# ARMY TM 9-2320-280-34
# AIR FORCE TO 36A12-1A-2092-3
# MARINE CORPS TM 2320-34/9B

(SUPERSEDES TM 9-2320-280-34, 20 AUGUST 1991)

# TECHNICAL MANUAL

# DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE

TRUCK, UTILITY: CARGO/TROOP CARRIER, 1-1/4 TON, 4X4, M998 (2320-01-107-7155) (EIC: BBD); M998A1 (2320-01-371-9577) (EIC: BBN);

TRUCK, UTILITY: CARGO/TROOP CARRIER, 1-1/4 TON, 4X4, W/WINCH, M1038 (2320-01-107-7156) (EIC: BBE); M1038A1 (2320-01-371-9578) (EIC: BBP);

TRUCK, UTILITY: HEAVY VARIANT, 4X4, M1097 (2320-01-346-9317) (EIC: BBM); M1097A1 (2320-01-371-9583) (EIC: BBU); M1097A2 (2320-01-380-8604) (EIC: BB6); M1123 (2320-01-455-9593) (EIC: B6G);

TRUCK, UTILITY: TOW CARRIER, ARMORED, 1-1/4 TON, 4X4, M966 (2320-01-107-7153) (EIC: BBC); M966A1 (2320-01-372-3932) (EIC: BBX); M1121 (2320-01-456-1282) (EIC: B6H);

TRUCK, UTILITY: TOW CARRIER, ARMORED, 1-1/4 TON, 4X4, W/WINCH, M1036 (2320-01-107-7154) (EIC: BBH);

TRUCK, UTILITY: TOW CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, M1045 (2320-01-146-7191); M1045A1 (2320-01-371-9580) (EIC: BBR); M1045A2 (2320-01-380-8229) (EIC: BB5);

TRUCK, UTILITY: TOW CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, W/WINCH, M1046 (2320-01-146-7188); M1046A1 (2320-01-371-9582) (EIC: BBT);

TRUCK, UTILITY: ARMAMENT CARRIER, ARMORED, 1-1/4 TON, 4X4, M1025 (2320-01-128-9551) (EIC: BBF); M1025A1 (2320-01-371-9584) (EIC: BBV); M1025A2 (2320-01-380-8233) (EIC: BB3);

TRUCK, UTILITY: ARMAMENT CARRIER, ARMORED, 1-1/4 TON, 4X4, W/WINCH, M1026 (2320-01-128-9552) (EIC: BBG); M1026A1 (2320-01-371-9579) (EIC: BBQ);

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TRUCK, UTILITY: ARMAMENT CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, W/WINCH, M1044 (2320-01-146-7189); M1044A1 (2320-01-371-9581) (EIC: BBS);

TRUCK, UTILITY: S250 SHELTER CARRIER, 4X4, M1037 (2320-01-146-7193) (EIC: BBK);

TRUCK, UTILITY: S250 SHELTER CARRIER, 4X4, W/WINCH, M1042 (2320-01-146-7187);

TRUCK, AMBULANCE, 2-LITTER, ARMORED, 4X4, M996 (2310-01-111-2275) (EIC: BBB); M996A1 (2310-01-372-3935) (EIC: BB2);

TRUCK, AMBULANCE, 4-LITTER, ARMORED, 4X4, M997 (2310-01-111-2274) (EIC: BBA); M997A1 (2310-01-372-3934) (EIC: BBZ) M997A2 (2310-01-380-8225) (EIC: BB8);

TRUCK, AMBULANCE, 2-LITTER, SOFT TOP, 4X4, M1035 (2310-01-146-7194); M1035A1 (2310-01-371-9585) (EIC: BBW); M1035A2 (2310-01-380-8290) (EIC: BB9).


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HEADQUARTERS, DEPARTMENTS OF THE ARMY,
THE AIR FORCE, AND MARINE CORPS

JANUARY 1996

# WARNING SUMMARY

## WARNING

## EXHAUST GASES CAN KILL

Brain damage or death can result from heavy exposure. Precautions must be followed to ensure personnel safety when the personnel heater or engine of any vehicle is operated for any purpose.

1. Do not operate your vehicle engine in enclosed areas.
2. Do not idle vehicle engine with vehicle windows closed.
3. Be alert at all times for exhaust odors.
4. Be alert for exhaust poisoning symptoms. They are:
    - Headache
    - Dizziness
    - Sleepiness
    - Loss of muscular control
5. If you see another person with exhaust poisoning symptoms:
    - Remove person from area
    - Expose to open air
    - Keep person warm
    - Do not permit physical exercise
    - Administer artificial respiration, if necessary*
    - Notify a medic

    * For artificial respiration, refer to FM 21-11.
6. BE AWARE, the field protective mask for nuclear-biological-chemical (NBC) protection will not protect you from exhaust poisoning.

    THE BEST DEFENSE AGAINST EXHAUST POISONING IS ADEQUATE VENTILATION.

- Improper cleaning methods and use of unauthorized cleaning solutions may cause injury to personnel or damage to equipment. See TM 9-247 for correct information.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).
- Do not use compressed air to dry bearings. Spinning a dry bearing with compressed air may cause injury to personnel or damage to equipment.
- Direct all personnel to stand clear during hoisting operations. Failure to do this may cause injury.

## WARNING SUMMARY (Cont'd)

- Do not touch hot exhaust system components with bare hands. Severe injury will result.
- Diesel fuel is highly flammable. Do not perform any procedure near fires, flames, or sparks. Severe injury or death may result.
- Ensure engine compartment is free of all tools and working material before starting engine. Failure to do this may cause injury to personnel or damage to equipment.
- Do not remove surge tank filler cap before depressurizing system when engine temperature is above 190°F (88°C). Steam or hot coolant under pressure will cause severe burns.
- Do not drain oil when engine is hot. Severe injury to personnel will result.
- Allow transmission/transfer case to cool before performing maintenance. Failure to do this may cause injury.
- When steam cleaning, protective clothing must be used. Failure to do this may cause injury.
- Air pressure must not exceed 50 psi (345 kPa) when air checking forward and direct clutch piston or injury to personnel or damage to equipment may result.
- Direct all personnel to stand clear of vehicle before starting engine. Transmission slipping into gear may cause injury to personnel or damage to equipment.
- When sanding fiberglass, personal protective equipment (respirator, goggles/shield, gloves, coveralls, etc.) must be used. Failure to do this may cause injury.
- Do not operate heater in enclosed areas. Exhaust gases can kill. Make sure work area is well ventilated and exhaust fumes are routed away from test area.
- Drycleaning solvent is flammable and will not be used near an open flame. A fire extinguisher will be kept nearby when solvent is used. Use only in well-ventilated places. Failure to do this may result in injury to personnel or damage to equipment.
- Always wear eye protection around air-conditioning refrigerant, or when servicing the air-conditioning system.
- Exercise extreme care when handling air-conditioning refrigerant, direct contact between air-conditioning refrigerant and skin may cause frostbite.
- Never smoke in areas where air-conditioning refrigerant is used or stored.
- Ensure adequate ventilation whenever air-conditioning refrigerant is being discharged. Personnel with a history of cardiac rhythm abnormalities should be made aware of potential aggravation as a result of exposure to air-conditioning refrigerant. Failure to do so may result in injury to personnel.
- Avoid breathing air-conditioning refrigerant. The gas will irritate the nose, throat, and lungs. In addition, because air-conditioning refrigerant is heavier than air, it can displace oxygen in a confined and a poorly ventilated area. Be sure the work area is properly ventilated in case of accidental release into the nearby atmosphere.
- Do not attempt to connect servicing equipment while engine is running. Injury to personnel or damage to equipment may result.
- Gaskets installed on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be removed with a scraper or putty knife then disposed of IAW current directives. Inhalation of asbestos fibers can cause respiratory ailments.
- Air-conditioning system must be discharged prior to replacing components. Failure to do this may result in injury to personnel or damage to equipment.

**CHANGE NO. 2**

**HEADQUARTERS,
DEPARTMENTS OF THE ARMY,
THE AIR FORCE, AND MARINE CORPS
WASHINGTON, D.C.,** 15 July ***2004***

# TECHNICAL MANUAL

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TRUCK, AMBULANCE, 2-LITTER, SOFT TOP, 4X4, M1035 (2310-01-146-7194);
M1035A1 (2310-01-371-9585) (EIC: BBW); M1035A2 (2310-01-380-8290) (EIC: BB9).**

TM 9-2320-280-34, 31 January 1996, is changed as follows:

1. Remove old pages and insert new pages as indicated below.
3. New or changed material is indicated by a vertical bar in the margin of the page.

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Peter J. Schoomaker
*General, United States Army*
*Chief of Staff*

JOEL B. HUDSON
*Administrative Assistant to*
*the Secretary of the Army*
0223407

By Order of the Secretary of the Air Force:

RONALD R. FOGLEMAN
*General, United States Air Force*
*Chief of Staff*

Official:

HENRY VICCELLIO, JR.
*General, United States Air Force*
*Commander, Air Force Materiel Command*

By Order of the Marine Corps:

R. P. SHOCKEY
*Director, Program Support*
*Marine Corps Systems Command*

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ARMY TM 9-2320-280-34
AIR FORCE TO 36A12-1A-2092-3
MARINE CORPS TM 2320-34/9B

**CHANGE**

**NO. 1**

**HEADQUARTERS,
DEPARTMENTS OF THE ARMY,
THE AIR FORCE, AND MARINE CORPS**

**Washington, D.C., *16 March 2001***

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TRUCK, UTILITY: S250 SHELTER CARRIER, 4X4, W/WINCH, M1042 (2320-01-146-7187);
TRUCK, AMBULANCE, 2-LITTER, ARMORED, 4X4, M996 (2310-01-111-2275) (EIC: BBB); M996A1 (2310-01-372-3935) (EIC: BB2);
TRUCK, AMBULANCE, 4-LITTER, ARMORED, 4X4, M997 (2310-01-111-2274) (EIC: BBA);
M997A1 (2310-01-372-3934) (EIC: BBZ); M997A2 (2310-01-380-8225) (EIC: BB8);
TRUCK, AMBULANCE, 2-LITTER, SOFT TOP, 4X4, M1035 (2310-01-146-7194);
M1035A1 (2310-01-371-9585) (EIC: BBW); M1035A2 (2310-01-380-8290) (EIC: BB9).**

TM 9-2320-280-34, 31 January 1996, is changed as follows:

1. Two new models have been added to the front cover. The new cover, located at the end of the change package, replaces the existing cover.
2. Remove old pages and insert new pages as indicated below.
3. New or changed material is indicated by a vertical bar in the margin of the page.

| Remove Page | Insert Page |
|---|---|
| a and b | a and b |
| None | A through C/(D blank) (after warning b) |
| i through iv | i through iv |
| 1-1 and 1-2 | 1-1 and 1-2 |
| 2-3 through 2-8 | 2-3 through 2-8 |
| 2-17 and 2-18 | 2-17 and 2-18 |
| 2-21 and 2-22 | 2-20.1/(2-20.2 blank) through 2-22 |
| 2-29 and 2-30 | 2-29 and 2-30 |
| 3-1 through 3-14 | 3-1 through 3-14.1/(3-14.2 blank) |
| 3-27 and 3-28 | 3-27 and 3-28 |
| 3-35 through 3-38 | 3-35 through 3-38 |

Approved for public release; distribution is unlimited.

| Remove Page | Insert Page |
|---|---|
| 3-41 and 3-42 | 3-41 and 3-42 |
| 3-45 and 3-46 | 3-44.1 through 3-46 |
| 3-81 and 3-82 | 3-81 and 3-82 |
| 3-113 and 3-114 | 3-113 and 3-114 |
| 3-121 through 3-130 | 3-121 through 3-130 |
| 3-133 and 3-134 | 3-133 and 3-134 |
| 3-145 and 3-146 | 3-145 and 3-146 |
| 3-155 through 3-162 | 3-155 through 3-162 |
| 3-165 through 3-168 | 3-165 through 3-168 |
| 3-173 and 3-174 | 3-173 and 3-174 |
| 3-179 and 3-180 | 3-179 and 3-180 |
| None | 3-182.1/(3-182.2 blank) |
| 3-183 through 3-186 | 3-183 through 3-186 |
| 3-193 and 3-194 | 3-193 through 3-194.1/(3-194.2 blank) |
| 4-5 through 4-14 | 4-5 through 4-14 |
| 5-1 through 5-5/(5-6 blank) | 5-1/(5-2 blank) (5-3 through 5-5/(5-6 blank) deleted) |
| 6-1 and 6-2 | 6-1 and 6-2 |
| 6-11 and 6-12 | 6-11 and 6-12 |
| 6-19 and 6-20 | 6-18.1 through 6-20 |
| 6-37 through 6-40 | 6-37 through 6-40 |
| 6-45 and 6-46 | 6-44.1 through 6-46 |
| 6-51 through 6-54 | 6-51 through 6-54 |
| 6-61 through 6-64 | 6-61 through 6-64 |
| 6-67 through 6-70 | 6-67 through 6-70 |
| 6-75 and 6-76 | 6-75 and 6-76 |
| 6-81 through 6-86 | 6-81 through 6-86 |
| 6-99 and 6-100 | 6-99 and 6-100 |
| 6-111/(6-112 blank) | 6-111 through 6-113/(6-114 blank) |
| 9-1 and 9-2 | 9-1 and 9-2 |
| 9-7 through 9-12 | 9-7 through 9-12 |
| 9-15 through 9-22 | 9-15 through 9-22 |
| 10-1 and 10-2 | 10-1 and 10-2 |
| 10-5 and 10-6 | 10-5 through 10-11/(10-12 blank) |
| 11-1 and 11-2 | 11-1 and 11-2 |
| None | 11-7/(blank) through 11-25/(11-26 blank) |
| 12-9 through 12-12 | 12-9 through 12-12 |
| 12-23 and 12-24 | 12-23 and 12-24 |
| 14-89 through 14-94 | 14-89 through 14-94 |
| 14-97 through 14-110 | 14-97 through 14-110 |
| 14-113 through 14-124 | 14-113 through 14-124 |
| 14-129 and 14-130 | 14-129 and 14-130 |
| 15-1 through 15-8 | 15-1 through 15-8 |
| 15-11 through 15-18 | 15-11 through 15-18 |
| 15-21 and 15-22 | 15-21 and 15-22 |
| 16-1 and 16-2 | 16-1 and 16-2 |
| 16-9 through 16-12 | 16-9/(16-10 and 16-11 deleted) and 16-12 |
| 16-15 through 16-43/(16-44 blank) | 16-15/(16-16 through 16-43/(16-44 blank) deleted) |
| 17-1 and 17-2 | 17-1 and 17-2 |
| 17-13 and 17-14 | 17-13 and 17-14 |
| 17-45 through 17-48 | 17-45 through 17-48 |
| 17-55 and 17-56 | 17-55 and 17-56 |
| 17-63 through 17-70 | 17-63 through 17-70 |
| 17-75 through 17-104 | 17-75 through 17-104 |
| 17-113 through 17-118 | 17-113 through 17-118 |
| 17-121 through 17-138 | 17-121 through 17-138 |
| 17-143 through 17-146 | 17-143 through 17-146 |

| Remove Page | Insert Page |
|---|---|
| 18-21 and 18-22 | 18-21 and 18-22 |
| 18-25 and 18-26 | 18-25 and 18-26 |
| 18-35 and 18-36 | 18-35 and 18-36 |
| 19-7 through 19-10 | 19-7 through 19-10 |
| 19-13 and 19-14 | 19-13 and 19-14 |
| 19-23 and 19-24 | 19-23 and 19-24 |
| 20-1 through 20-19/(20-20 blank) | 20-1/(20-2 through 20-19/(20-20 blank) deleted) |
| None | 20-21 through 20-23/(20-24 blank) |
| 21-3 through 21-6 | 21-3 through 21-6 |
| 21-9 and 21-10 | 21-9 and 21-10 |
| 22-3 and 22-4 | 22-3 and 22-4 |
| 22-17 and 22-18 | 22-16.1 through 22-18 |
| A-1 and A-2 | A-1 and A-2 |
| B-1 through B-6 | B-1 through B-6 |
| C-1 and C-2 | C-1 and C-2 |
| C-27/(C-28 blank) | C-27 through C-35/(C-36 blank) |
| D-3/(D-4 blank) | D-3/(D-4 blank) |
| E-1 through E-8 | E-1 through E-8 |
| G-1 through G7/(G-8 blank) | G-1 through G7/(G-8 blank) |
| Index 1 through Index 11/(Index 12 blank) | Index 1 through Index 12 |
| Cover | Cover |

4. File this change sheet in front of the publication for reference purposes.

By Order of the Secretary of the Army:

ERIC K. SHINSEKI
*General, United States Army*
*Chief of Staff*

JOEL B. HUDSON
*Administrative Assistant to the*
*Secretary of the Army*
05693

By Order of the Secretary of the Air Force:

RONALD R. FOGLEMAN
*General, United States Air Force*
*Chief of Staff*

Official:

HENRY VICCELLIO, JR.
*General, United States Air Force*
*Commander, Air Force Materiel Command*

By Order of the Marine Corps:

D.R. BLOOMER
*Colonel, USMC*
*Director, Program Support*
*Marine Corps Systems Command*

Distribution:

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## LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page.

Dates of issue for original and changed pages are:
Original . . . . . 0 . . . . . 31 January 1996
Change . . . . . 1 . . . . . 16 March 2001
Change . . . . . 2 . . . . . **15 July** 2004

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 1,281 CONSISTING OF THE FOLLOWING:

| Page No. | *Change No. |
|---|---|
| a | 0 |
| b | 2 |
| A - C | 2 |
| D Added | 2 |
| i | 2 |
| ii | 0 |
| iii | 1 |
| iv-viii | 0 |
| 1-1 | 1 |
| 1-2 | 2 |
| 1-3 - 1-6 | 0 |
| 2-1 - 2-2 | 0 |
| 2-3 | 1 |
| 2-4 | 0 |
| 2-5 - 2-7 | 1 |
| 2-8 - 2-12 | 0 |
| 2-12.1 - 2-12.2 | 0 |
| 2-13 - 2-17 | 0 |
| 2-18 | 1 |
| 2-19 | 0 |
| 2-20 | 2 |
| 2-20.1 - 2-20.2 Blank Deleted | 2 |
| 2-21 - 2-26 | 2 |
| 2-27 - 2-28 | 0 |
| 2-29 - 2-30 | 1 |
| 3-1 | 0 |
| 3-2 | 2 |
| 3-3 | 0 |
| 3-4 - 3-5 | 1 |
| 3-6 - 3-7 | 0 |
| 3-8 | 2 |
| 3-9 | 1 |
| 3-10 | 2 |
| 3-11 | 0 |
| 3-12 | 2 |
| 3-12.1 | 1 |
| 3-12.2 | 2 |
| 3-13 - 3-14 | 1 |
| 3-14.1 Added | 1 |
| 3-14.2 Blank | 1 |
| 3-15 - 3-19 | 0 |
| 3-20 | 2 |
| 3-21 | 0 |
| 3-22 | 2 |
| 3-23 | 0 |
| 3-24 | 2 |
| 3-25 | 0 |
| 3-26 | 2 |
| 3-27 | 1 |
| 3-28 - 3-30 | 2 |
| 3-31 - 3-32 | 0 |
| 3-33 | 2 |
| 3-34 - 3-35 | 0 |
| 3-36 - 3-39 | 2 |
| 3-40 - 3-41 | 0 |
| 3-42 | 1 |
| 3-43 - 3-44 | 0 |
| 3-44.1 - 3-44.2 | 2 |
| 3-45 | 1 |
| 3-46 - 3-113 | 2 |
| 3-114 | 1 |
| 3-115 - 3-116 | 0 |
| 3-117 | 2 |
| 3-118 - 3-121 | 0 |
| 3-122 | 1 |
| 3-123 | 2 |
| 3-124 - 3-125 | 1 |
| 3-126 | 2 |
| 3-127 | 1 |
| 3-128 | 2 |
| 3-129 | 1 |
| 3-130 | 2 |
| 3-131 | 0 |
| 3-132 | 2 |
| 3-133 | 0 |
| 3-134 | 1 |
| 3-135 | 2 |
| 3-136 - 3-140 | 0 |
| 3-141 | 2 |
| 3-142 - 3-145 | 0 |
| 3-146 - 3-147 | 2 |
| 3-148 | 0 |
| 3-149 - 3-150 | 2 |
| 3-151 - 3-153 | 0 |
| 3-154 | 2 |
| 3-155 | 0 |
| 3-156 | 1 |
| 3-157 - 3-158 | 2 |
| 3-159 | 1 |
| 3-160 | 2 |
| 3-161 - 3-162 | 1 |
| 3-163 - 3-164 | 0 |
| 3-165 - 3-166 | 2 |
| 3-167 | 1 |
| 3-168 - 3-169 | 0 |
| 3-170 | 2 |
| 3-171 - 3-173 | 0 |
| 3-174 | 2 |
| 3-175 | 0 |
| 3-176 - 3-177 | 2 |
| 3-178 - 3-179 | 0 |
| 3-180 | 2 |
| 3-181 - 3-182 | 0 |
| 3-182.1 Added | 1 |
| 3-182.2 Blank | 1 |
| 3-183 | 2 |
| 3-184 | 1 |
| 3-185 - 3-186 | 2 |
| 3-187 - 3-189 | 0 |
| 3-190 | 2 |
| 3-191 | 0 |
| 3-192 - 3-194 | 2 |
| 3-194.1 Added | 1 |
| 3-194.2 Blank | 1 |
| 3-195 - 3-196 | 0 |
| 3-197 | 2 |
| 3-198 | 0 |
| 3-199 - 3-200 | 2 |
| 3-201 | 0 |
| 3-202 Blank | 0 |
| 4-1 | 0 |
| 4-2 | 2 |
| 4-3 - 4-5 | 0 |
| 4-6 | 2 |
| 4-7 | 1 |
| 4-8 | 2 |

| Page No. | *Change No. |
|---|---|
| 4-9 - 4-10 | 1 |
| 4-11 | 0 |
| 4-12 - 4-13 | 1 |
| 4-14 | 2 |
| 4-15 | 0 |
| 4-16 | 2 |
| 4-17 | 0 |
| 4-18 | 2 |
| 4-19 - 4-21 | 0 |
| 4-22 Blank | 0 |
| 5-1 | 1 |
| 5-2 Blank | 1 |
| 5-3 - 5-5 Deleted | 1 |
| 5-6 Blank | 0 |
| 6-1/(6-2 - 6-18.1 Deleted) - 6-18.2 | 2 |
| 6-18.3 | 1 |
| 6-18.4 | 2 |
| 6-18.5 | 1 |
| 6-18.6 | 2 |
| 6-18.7 - 6-18.10 | 1 |
| 6-18.11 | 2 |
| 6-18.12 - 6-18.13 | 1 |
| 6-18.14 | 2 |
| 6-18.15 | 1 |
| 6-18.16 | 2 |
| 6-18.17 - 6-18.21 | 1 |
| 6-18.22 | 2 |
| 6-18.23 - 6-18.25 | 1 |
| 6-18.26 | 2 |
| 6-18.27 - 6-18.29 | 1 |
| 6-18.30 | 2 |
| 6-18.31 - 6-18.33 | 1 |
| 6-18.34 | 2 |
| 6-18.35 - 6-18.37 | 1 |
| 6-18.38 | 2 |
| 6-19 - 6-20 | 2 |
| 6-21 - 6-28 | 0 |
| 6-29 - 6-34 | 2 |
| 6-35 - 6-37 | 0 |
| 6-38 | 2 |
| 6-39 | 1 |
| 6-40 - 6-41 | 2 |
| 6-42 - 6-43 | 0 |
| 6-44 | 2 |
| 6-44.1 - 6-44.2 | 2 |
| 6-44.3 - 6-44.5 | 1 |
| 6-44.6 | 2 |
| 6-44.7 - 6-44.9 | 1 |
| 6-44.10 - 6-44.12 | 2 |
| 6-44.13 - 6-44.17 | 1 |
| 6-44.18 | 2 |
| 6-44.19 - 6-44.21 | 1 |
| 6-44.22 | 2 |
| 6-45 | 1 |
| 6-46 | 2 |
| 6-47 - 6-49 | 0 |
| 6-50 | 2 |
| 6-51 | 0 |
| 6-52 | 2 |
| 6-53 | 1 |
| 6-54 - 6-55 | 0 |
| 6-56 | 2 |
| 6-57 | 0 |
| 6-58 | 2 |
| 6-59 - 6-61 | 0 |
| 6-62 | 2 |
| 6-63 | 0 |
| 6-64 | 2 |
| 6-65 - 6-67 | 0 |
| 6-68 | 2 |
| 6-69 | 0 |
| 6-70 | 2 |
| 6-71 | 0 |
| 6-72 - 6-73 | 2 |
| 6-74 - 6-75 | 0 |
| 6-76 | 2 |
| 6-77 | 0 |
| 6-78 - 6-79 | 2 |
| 6-80 | 0 |
| 6-81 - 6-82 | 2 |
| 6-83 | 1 |
| 6-84 - 6-85 | 0 |
| 6-86 | 2 |
| 6-87 | 0 |
| 6-88 | 2 |
| 6-89 - 6-91 | 0 |
| 6-92 | 2 |
| 6-93 | 0 |
| 6-94 - 6-96 | 2 |
| 6-97 | 0 |
| 6-98 | 2 |
| 6-99 | 1 |
| 6-100 | 2 |
| 6-101 | 0 |
| 6-102 - 6-107 | 2 |
| 6-108 - 6-109 | 0 |
| 6-110 | 2 |
| 6-111 | 1 |
| 6-112 | 2 |
| 6-113 | 1 |
| 6-114 Blank | 1 |
| 7-1 | 0 |
| 7-2 | 2 |
| 7-3 - 7-6 | 0 |
| 7-7 | 2 |
| 7-8 - 7-9 | 0 |
| 7-10 | 2 |
| 7-11 | 0 |
| 7-12 - 7-13 | 2 |
| 7-14 | 0 |
| 7-15 - 7-16 | 2 |
| 7-17 | 0 |
| 7-18 | 2 |
| 7-19 - 7-20 | 0 |
| 7-21 | 2 |
| 7-22 | 0 |
| 7-23 | 2 |
| 7-24 | 0 |
| 7-25 - 7-26 | 2 |
| 7-27 | 0 |
| 7-28 | 2 |
| 7-29 | 0 |
| 7-30 Blank | 0 |
| 8-1 | 0 |
| 8-2 | 2 |
| 8-3 | 0 |
| 8-4 | 2 |
| 8-5 | 0 |
| 8-6 | 2 |
| 8-7 | 0 |
| 8-8 | 2 |
| 8-9 | 0 |
| 8-10 Blank | 0 |
| 9-1 | 1 |
| 9-2 - 9-4 | 2 |
| 9-5 | 0 |
| 9-6 - 9-7 | 2 |
| 9-8 | 1 |
| 9-9 - 9-11 | 2 |
| 9-12 - 9-15 | 0 |
| 9-16 | 2 |
| 9-16.1 Added | 1 |
| 9-16.2 Blank | 1 |
| 9-17 | 0 |
| 9-18 | 1 |
| 9-19 - 9-21 Deleted | 1 |
| 9-22 | 0 |
| 9-23 - 9-24 | 2 |
| 10-1 - 10-2 | 1 |
| 10-3 | 0 |
| 10-4 | 2 |
| 10-5 | 0 |
| 10-6 | 2 |
| 10-7 | 1 |
| 10-8 | 2 |
| 10-9 | 1 |
| 10-10 | 2 |
| 10-11 | 1 |
| 10-12 Blank | 1 |
| 11-1 | 2 |
| 11-2 - 11-5 Deleted | 2 |
| 11-6 | 2 |
| 11-7 Blank | 1 |
| 11-8 | 2 |

| Page No. | *Change No. |
|---|---|
| 11-9 | 1 |
| 11-10 - 11-11 | 2 |
| 11-12 - 11-20 | 1 |
| 11-21 | 2 |
| 11-22 - 11-25 | 1 |
| 11-26 Blank | 1 |
| 12-1 - 12-4 | 2 |
| 12-5 | 0 |
| 12-6 | 2 |
| 12-7 | 0 |
| 12-8 | 2 |
| 12-9 | 1 |
| 12-10 | 2 |
| 12-11 | 1 |
| 12-12 | 2 |
| 12-13 | 0 |
| 12-14 | 2 |
| 12-15 | 0 |
| 12-16 | 2 |
| 12-17 | 0 |
| 12-18 - 12-20 | 2 |
| 12-21 | 0 |
| 12-22 | 2 |
| 12-23 | 0 |
| 12-24 - 12-26 | 2 |
| 12-27 | 0 |
| 12-28 | 2 |
| 12-29 - 12-31 | 0 |
| 12-32 | 2 |
| 12-33 - 12-35 | 0 |
| 12-36 | 2 |
| 12-37 | 0 |
| 12-38 - 12-39 | 2 |
| 12-40 Blank | 2 |
| 12-41 - 12-42 Deleted | 2 |
| 13-1 | 0 |
| 13-2 Blank | 0 |
| 14-1 | 0 |
| 14-2 | 2 |
| 14-3 - 14-4 | 0 |
| 14-5 - 14-6 | 2 |
| 14-7 - 14-9 | 0 |
| 14-10 | 2 |
| 14-11 | 0 |
| 14-12 | 2 |
| 14-13 | 0 |
| 14-14 | 2 |
| 14-15 - 14-19 | 0 |
| 14-20 | 2 |
| 14-21 | 0 |
| 14-22 | 2 |
| 14-23 | 0 |
| 14-24 | 2 |
| 14-25 | 0 |
| 14-26 | 2 |
| 14-27 | 0 |
| 14-28 | 2 |
| 14-29 | 0 |
| 14-30 | 2 |
| 14-31 | 0 |
| 14-32 | 2 |
| 14-33 | 0 |
| 14-34 - 14-36 | 2 |
| 14-37 | 0 |
| 14-38 | 2 |
| 14-39 | 0 |
| 14-40 | 2 |
| 14-41 - 14-45 | 0 |
| 14-46 | 2 |
| 14-47 | 0 |
| 14-48 | 2 |
| 14-49 | 0 |
| 14-50 | 2 |
| 14-51 | 0 |
| 14-52 | 2 |
| 14-53 | 0 |
| 14-54 | 2 |
| 14-55 | 0 |
| 14-56 - 14-58 | 2 |
| 14-59 - 14-63 | 0 |
| 14-64 | 2 |
| 14-65 | 0 |
| 14-66 | 2 |
| 14-67 | 0 |
| 14-68 | 2 |
| 14-69 | 0 |
| 14-70 - 14-72 | 2 |
| 14-73 - 14-75 | 0 |
| 14-76 - 14-78 | 2 |
| 14-79 | 0 |
| 14-80 | 2 |
| 14-81 | 0 |
| 14-82 | 2 |
| 14-83 - 14-85 | 0 |
| 14-86 | 2 |
| 14-87 - 14-88 | 0 |
| 14-89 - 14-134 | 2 |
| 14-134.1 - 14-134.46 Added | 2 |
| 14-135 - 14-136 | 2 |
| 14-137 - 14-141 | 0 |
| 14-142 Blank | 0 |
| 15-1 - 15-24 | 2 |
| 15-25 Blank | 2 |
| 15-26 - 15-43 Added | 2 |
| 15-44 Blank Added | 2 |
| 16-1 | 1 |
| 16-2 | 2 |
| 16-3 | 0 |
| 16-4 - 16-8 | 2 |
| 16-9 | 1 |
| 16-10 - 16-11 Deleted | 1 |
| 16-12 - 16-13 | 2 |
| 16-14 | 0 |
| 16-15 | 1 |
| 16-16 - 16-43 Deleted | 1 |
| 16-44 Blank Deleted | 1 |
| 17-1 | 1 |
| 17-2 | 2 |
| 17-3 | 0 |
| 17-4 - 17-5 | 2 |
| 17-6 - 17-7 | 0 |
| 17-8 - 17-9 | 2 |
| 17-10 - 17-13 | 0 |
| 17-14 | 2 |
| 17-15 | 0 |
| 17-16 - 17-17 | 2 |
| 17-18 - 17-19 | 0 |
| 17-20 - 17-26 | 2 |
| 17-27 | 0 |
| 17-28 | 2 |
| 17-29 | 0 |
| 17-30 | 2 |
| 17-31 - 17-32 | 0 |
| 17-33 | 2 |
| 17-34 | 0 |
| 17-35 - 17-36 | 2 |
| 17-37 - 17-41 | 0 |
| 17-42 | 2 |
| 17-43 | 0 |
| 17-44 | 2 |
| 17-45 | 0 |
| 17-46 | 2 |
| 17-47 | 1 |
| 17-48 - 17-49 | 0 |
| 17-50 - 17-51 | 2 |
| 17-52 - 17-54 | 0 |
| 17-55 | 1 |
| 17-56 | 2 |
| 17-57 - 17-58 | 0 |
| 17-59 | 2 |
| 17-60 | 0 |
| 17-61 | 2 |
| 17-62 | 0 |
| 17-63 | 1 |
| 17-64 - 17-65 | 2 |
| 17-66 | 1 |
| 17-66.1 - 17-66.2 Added | 1 |
| 17-67 | 1 |
| 17-68 | 0 |
| 17-69 | 2 |
| 17-70 - 17-74 | 0 |
| 17-75 - 17-76 | 1 |

*Zero in this column indicates original page.

| Page No. | *Change No. |
|---|---|
| 17-77 | 0 |
| 17-78 | 1 |
| 17-79 | 0 |
| 17-80 | 1 |
| 17-81 | 0 |
| 17-82 - 17-84 | 1 |
| 17-84.1 - 17-84.2 Added | 1 |
| 17-85 - 17-86 | 1 |
| 17-87 | 0 |
| 17-88 | 1 |
| 17-88.1 - 17-88.2 Added | 1 |
| 17-89 | 1 |
| 17-90 | 2 |
| 17-91 - 17-92 | 1 |
| 17-93 | 2 |
| 17-94 | 1 |
| 17-95 - 17-96 | 2 |
| 17-97 | 1 |
| 17-98 | 2 |
| 17-99 | 1 |
| 17-100 | 2 |
| 17-101 | 1 |
| 17-102 | 2 |
| 17-103 | 1 |
| 17-104 | 2 |
| 17-105 | 0 |
| 17-106 | 2 |
| 17-107 - 17-113 | 0 |
| 17-114 - 17-116 | 1 |
| 17-116.1 | 2 |
| 17-116.2 Added | 1 |
| 17-117 | 1 |
| 17-118 | 2 |
| 17-119 | 0 |
| 17-120 - 17-122 | 2 |
| 17-123 | 0 |
| 17-124 - 17-125 | 2 |
| 17-126 - 17-127 | 0 |
| 17-128 - 17-131 | 2 |
| 17-132 | 0 |
| 17-133 - 17-134 | 1 |
| 17-135 | 0 |
| 17-136 | 1 |
| 17-137 | 2 |
| 17-138 - 17-140 | 0 |
| 17-141 | 2 |
| 17-142 - 17-143 | 0 |
| 17-144 | 1 |
| 17-144.1 - 17-144.2 Added | 1 |
| 17-145 | 1 |
| 17-146 | 2 |
| 17-147 | 0 |
| 17-148 Blank | 0 |
| 17-149 - 17-153 | 0 |
| 17-154 Blank | 0 |
| 18-1 | 0 |
| 18-2 | 2 |
| 18-3 - 18-4 | 0 |
| 18-5 | 2 |
| 18-6 | 0 |
| 18-7 | 2 |
| 18-8 | 0 |
| 18-9 | 2 |
| 18-10 - 18-15 | 0 |
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| 18-17 | 0 |
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| G-8 Blank | 1 |
| Index 1 - Index 12 | 2 |
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| Index 14 Blank Added | 2 |

*Zero in this column indicates original page.

TECHNICAL MANUAL
NO. 9-2320-280-34
NO. 2320-34/9B
TECHNICAL ORDER
NO. 36A12-1A-2092-3

HEADQUARTERS,
DEPARTMENTS OF THE ARMY,
THE AIR FORCE, AND MARINE CORPS
Washington, D.C., *31 January 1996*

# TECHNICAL MANUAL

## DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE

**TRUCK, UTILITY: CARGO/TROOP CARRIER, 1-1/4 TON, 4X4, M998 (2320-01-107-7155) (EIC: BBD); M998A1 (2320-01-371-9577) (EIC: BBN);
TRUCK, UTILITY: CARGO/TROOP CARRIER, 1-1/4 TON, 4X4, W/WINCH, M1038 (2320-01-107-7156) (EIC: BBE);
M1038A1 (2320-01-371-9578) (EIC: BBP);
TRUCK, UTILITY: HEAVY VARIANT, 4X4, M1097 (2320-01-346-9317) (EIC: BBM); M1097A1 (2320-01-371-9583) (EIC: BBU);
M1097A2 (2320-01-380-8604) (EIC: BB6); M1123 (2320-01-455-9593) (EIC: B6G);
TRUCK, UTILITY: TOW CARRIER, ARMORED, 1-1/4 TON, 4X4, M966 (2320-01-107-7153) (EIC: BBC);
M966A1 (2320-01-372-3932) (EIC: BBX); M1121 (2320-01-456-1282) (EIC: B6H);
TRUCK, UTILITY: TOW CARRIER, ARMORED, 1-1/4 TON, 4X4, W/WINCH, M1036 (2320-01-107-7154) (EIC: BBH);
TRUCK, UTILITY: TOW CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, M1045 (2320-01-146-7191);
M1045A1 (2320-01-371-9580) (EIC: BBR); M1045A2 (2320-01-380-8229) (EIC: BB5);
TRUCK, UTILITY: TOW CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, W/WINCH, M1046 (2320-01-146-7188);
M1046A1 (2320-01-371-9582) (EIC: BBT);
TRUCK, UTILITY: ARMAMENT CARRIER, ARMORED, 1-1/4 TON, 4X4, M1025 (2320-01-128-9551) (EIC: BBF);
M1025A1 (2320-01-371-9584) (EIC: BBV); M1025A2 (2320-01-380-8233) (EIC: BB3);
TRUCK, UTILITY: ARMAMENT CARRIER, ARMORED, 1-1/4 TON, 4X4, W/WINCH, M1026 (2320-01-128-9552) (EIC: BBG);
M1026A1 (2320-01-371-9579) (EIC: BBQ);
TRUCK, UTILITY: ARMAMENT CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, M1043 (2320-01-146-7190);
M1043A1 (2320-01-372-3933) (EIC: BBY); M1043A2 (2320-01-380-8213) (EIC: BB4);
TRUCK, UTILITY: ARMAMENT CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, W/WINCH, M1044 (2320-01-146-7189);
M1044A1 (2320-01-371-9581) (EIC: BBS);
TRUCK, UTILITY: S250 SHELTER CARRIER, 4X4, M1037 (2320-01-146-7193) (EIC: BBK);
TRUCK, UTILITY: S250 SHELTER CARRIER, 4X4, W/WINCH, M1042 (2320-01-146-7187);
TRUCK, AMBULANCE, 2-LITTER, ARMORED, 4X4, M996 (2310-01-111-2275) (EIC: BBB); M996A1 (2310-01-372-3935) (EIC: BB2);
TRUCK, AMBULANCE, 4-LITTER, ARMORED, 4X4, M997 (2310-01-111-2274) (EIC: BBA);
M997A1 (2310-01-372-3934) (EIC: BBZ); M997A2 (2310-01-380-8225) (EIC: BB8);
TRUCK, AMBULANCE, 2-LITTER, SOFT TOP, 4X4, M1035 (2310-01-146-7194);
M1035A1 (2310-01-371-9585) (EIC: BBW); M1035A2 (2310-01-380-8290) (EIC: BB9).**

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HOW TO USE THIS MANUAL

## ABOUT YOUR MANUAL

**a. New Features**. Spend some time looking through this manual. You'll find that it has a new look, different than most of the TMs you've been using. New features added to improve the convenience of this manual and increase your efficiency are:

1. **Accessing Information** - These include physical entry features such as the bleed-to-edge indicators on the cover and edge of the manual. Extensive troubleshooting guides for specific systems lead directly to step by step directions for problem solving and maintenance tasks.

2. **Illustrations** - A variety of methods are used to make locating and fixing components much easier. Locator illustrations with keyed text, exploded views, and cut-away diagrams make the information in this manual easier to understand.

3. **Keying Text With Illustrations** - Instructions are located together with figures that illustrate the specific task you are working on. In most cases, the tack steps and figures are located side by side making part identification and procedure sequence easier to follow.

**b. General Features.** The TM is the fundamental means by which the Army communicates to soldiers the requirements and procedures necessary to perform equipment operations and maintenance. This manual describes in detail the DS/GS Maintenance prescribed by the Maintenance Allocation Chart (TM 9-2320-280-20) and Source, Maintenance, and Recovery (SMR) Codes (TM 9-2320-280-24P). Your TM is the best source available for providing the following information and data critical to vehicle maintenance:

- General information, equipment descriptions, and data (chapter 1)
- Troubleshooting (chapter 2, section II)
- Detailed maintenance procedures
- General maintenance instructions (chapter 2, section IV)
- Expendable/durable supplies and materials list (appendix B)
- Illustrated list of manufactured items (appendix C)
- Torque limits (appendix D)
- Mandatory replacement parts (appendix E)
- Tool identification list (appendix G)
- Metric conversions (back cover)

A typical example of how to use this manual is provided on pages v, vi, and vii.

**TASK**: Unit maintenance has reported that an M998 has loss of coolant in the cooling system. The vehicle has been assigned to you for repair.

**TROUBLESHOOTING STEPS:**

**1.** Look at the cover of this manual. You'll see chapter titles listed from top to bottom on the right-hand side.

**2**. Look at the right edge of the manual. On some of the pages you'll see black bars (bleed-to-edge indicators) that are aligned with the chapter bars on the cover. These are the locations of the chapters in the text.

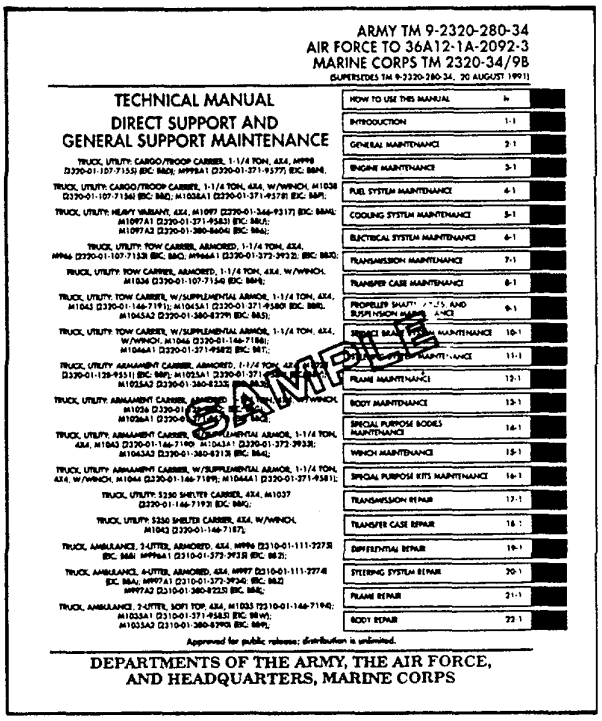
**3**. Look for "GENERAL MAINTENANCE" in the chapter list on the cover. This is where troubleshooting information is located.

**4**. Turn to those pages with the edge indicator matching the black bar for "GENERAL MAINTENANCE". Page numbers are also listed next to chapter titles.

**5**. One of the first pages having the "GENERAL MAINTENANCE" indicators is the "TROUBLESHOOTING SYMPTOM INDEX".

**6**. Look down the list until you find "Engine." Beneath that heading you will find the symptoms noted by unit maintenance: "Loss of coolant."

**7**. Turn to the page indicated: 2-7.



ARMY TM 9-2320-280-34
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TECHNICAL MANUAL
DIRECT SUPPORT AND
GENERAL SUPPORT MAINTENANCE

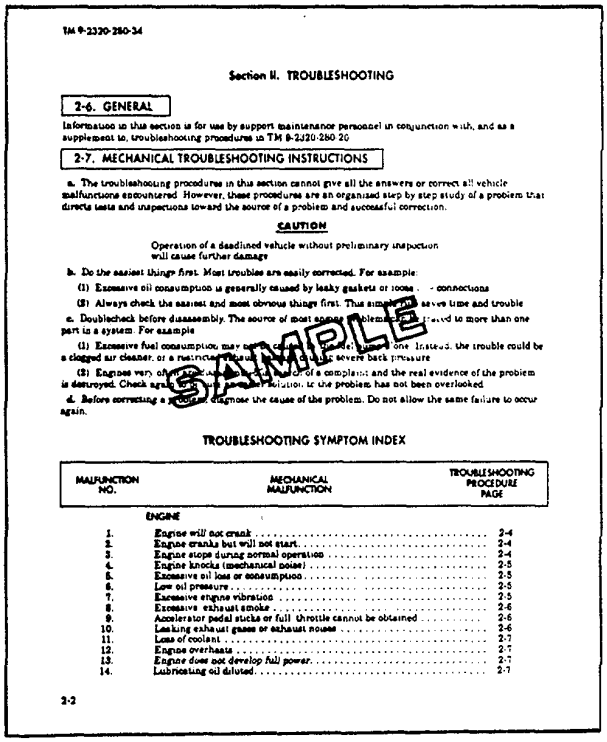
TRUCK, UTILITY: CARGO/TROOP CARRIER, 1-1/4 TON, 4X4, M998 (2320-01-107-7155) (EIC: B6D); M998A1 (2320-01-371-9377) (EIC: B6H);
TRUCK, UTILITY: CARGO/TROOP CARRIER, 1-1/4 TON, 4X4, W/WINCH, M1038 (2320-01-107-7156) (EIC: B6E); M1038A1 (2320-01-371-9378) (EIC: B6P);
TRUCK, UTILITY: HEAVY VARIANT, 4X4, M1097 (2320-01-366-9317) (EIC: B6M); M1097A1 (2320-01-371-9363) (EIC: B6L); M1097A2 (2320-01-380-8604) (EIC: B6L);
TRUCK, UTILITY: TOW CARRIER, ARMORED, 1-1/4 TON, 4X4, M966 (2320-01-107-7153) (EIC: B6C); M966A1 (2320-01-372-3922) (EIC: B6D);
TRUCK, UTILITY: TOW CARRIER, ARMORED, 1-1/4 TON, 4X4, W/WINCH, M1036 (2320-01-107-7154) (EIC: B6N);
TRUCK, UTILITY: TOW CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, M1043 (2320-01-146-7191); M1043A1 (2320-01-371-9380) (EIC: B6R); M1043A3 (2320-01-380-8729) (EIC: B6S);
TRUCK, UTILITY: TOW CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, W/WINCH, M1046 (2320-01-146-7188); M1046A1 (2320-01-371-9382) (EIC: B6T);
TRUCK, UTILITY: ARMAMENT CARRIER, ARMORED, 1-1/4 TON, 4X4, (2320-01-139-9551) (EIC: B6R); M1025A1 (2320-01-371-9[illegible]) (EIC: B6X); M1025A3 (2320-01-380-8233) (EIC: B6Y);
TRUCK, UTILITY: ARMAMENT CARRIER, ARMORED, W/WINCH, M1026 (2320-01-[illegible]); M1026A1 (2320-0[illegible]) (EIC: B6Z);
TRUCK, UTILITY: ARMAMENT CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, M1043 (2320-01-146-7189) M1043A1 (2320-01-372-3933); M1043A3 (2320-01-380-8213) (EIC: B6A);
TRUCK, UTILITY: ARMAMENT CARRIER, W/SUPPLEMENTAL ARMOR, 1-1/4 TON, 4X4, W/WINCH, M1044 (2320-01-146-7189); M1044A1 (2320-01-371-9381);
TRUCK, UTILITY: S250 SHELTER CARRIER, 4X4, M1037 (2320-01-146-7192) (EIC: B6K);
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TRUCK, AMBULANCE, 2-LITTER, ARMORED, 4X4, M996 (2310-01-111-7275) (EIC: B6M); M996A1 (2310-01-372-3935) (EIC: B6Z);
TRUCK, AMBULANCE, 4-LITTER, ARMORED, 4X4, M997 (2310-01-111-7274) (EIC: B6N); M997A1 (2310-01-372-3934) (EIC: B6Q); M997A2 (2310-01-380-8225) (EIC: B6K);
TRUCK, AMBULANCE, 2-LITTER, SOFT TOP, 4X4, M1035 (2310-01-146-7194); M1035A1 (2310-01-371-9383) (EIC: B6W); M1035A3 (2310-01-380-8790) (EIC: B6W);


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| [illegible] MAINTENANCE | 10-1 |
| [illegible] MAINTENANCE | 11-1 |
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DEPARTMENTS OF THE ARMY, THE AIR FORCE,
AND HEADQUARTERS, MARINE CORPS

SAMPLE



TM 9-2320-280-34

Section II. TROUBLESHOOTING

2-6. GENERAL

Information in this section is for use by support maintenance personnel in conjunction with, and as a supplement to, troubleshooting procedures in TM 9-2320-280-20.

2-7. MECHANICAL TROUBLESHOOTING INSTRUCTIONS

a. The troubleshooting procedures in this section cannot give all the answers or correct all vehicle malfunctions encountered. However, these procedures are an organized step by step study of a problem that directs tests and inspections toward the source of a problem and successful correction.

CAUTION

Operation of a deadlined vehicle without preliminary inspection will cause further damage.

b. Do the easiest things first. Most troubles are easily corrected. For example:

(1) Excessive oil consumption is generally caused by leaky gaskets or loose [illegible] connections.

(2) Always check the easiest and most obvious things first. This simple step may save time and trouble.

c. Doublecheck before disassembly. The source of most symptoms of problems is traced to more than one part in a system. For example:

(1) Excessive fuel consumption may be caused by [illegible] one. Instead, the trouble could be a clogged air cleaner, or a restricted exhaust system. Either of these could cause severe back pressure.

(2) Engines may vibrate excessively because of a complaint and the real evidence of the problem is destroyed. Check again to [illegible] problem solution to the problem has not been overlooked.

d. Before correcting a problem, diagnose the cause of the problem. Do not allow the same failure to occur again.

TROUBLESHOOTING SYMPTOM INDEX

| MALFUNCTION NO. | MECHANICAL MALFUNCTION | TROUBLESHOOTING PROCEDURE PAGE |
|---|---|---|
| | ENGINE | |
| 1. | Engine will not crank | 2-4 |
| 2. | Engine cranks but will not start | 2-4 |
| 3. | Engine stops during normal operation | 2-4 |
| 4. | Engine knocks (mechanical noise) | 2-5 |
| 5. | Excessive oil loss or consumption | 2-5 |
| 6. | Low oil pressure | 2-5 |
| 7. | Excessive engine vibration | 2-5 |
| 8. | Excessive exhaust smoke | 2-6 |
| 9. | Accelerator pedal sticks or full throttle cannot be obtained | 2-6 |
| 10. | Leaking exhaust gases or exhaust noises | 2-6 |
| 11. | Loss of coolant | 2-7 |
| 12. | Engine overheats | 2-7 |
| 13. | Engine does not develop full power | 2-7 |
| 14. | Lubricating oil diluted | 2-7 |

2-2

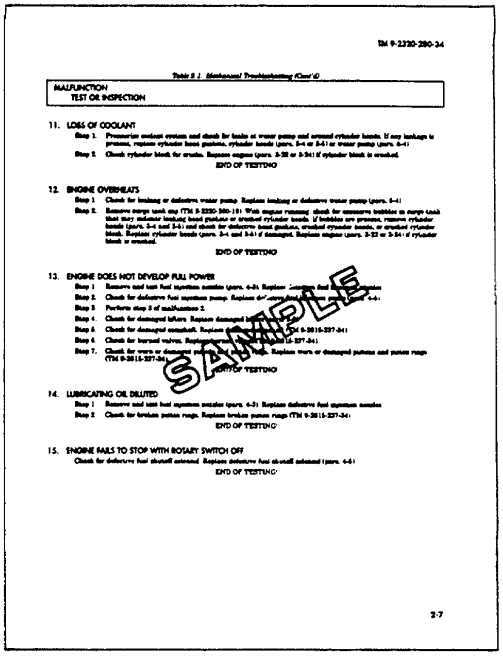
SAMPLE

**8.** On page 2-7, steps/tests relating to resolving the problem of loss of coolant are listed:

**Step 1**. Pressurize coolant system and check for leaks at water pump and around cylinder heads. If any leakage is present, replace cylinder head gaskets, cylinder heads (para. 3-4 or 3-5) or water pump (para. 5-4).

**Step 2.** Check cylinder block for cracks. Replace engine (para. 3-21) if cylinder block is cracked.

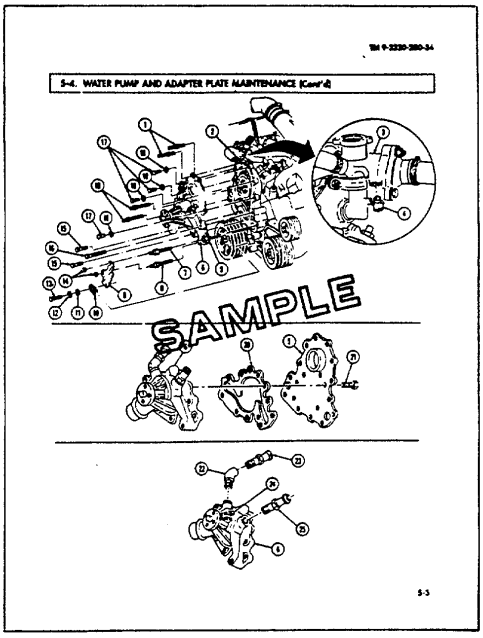
In both steps you are referred to a detailed procedure in another chapter. When actually performing this task, you should refer to these paragraphs and complete the task as necessary.

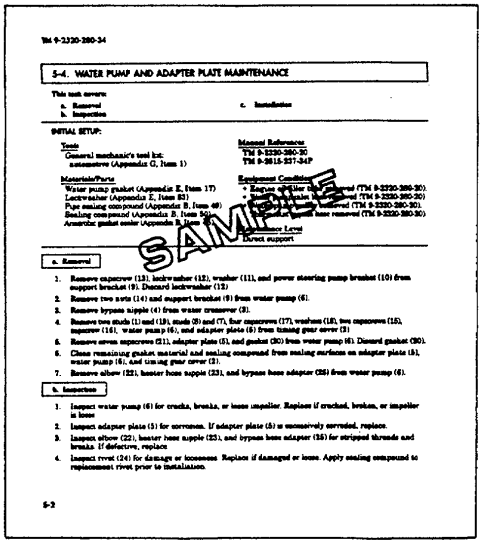


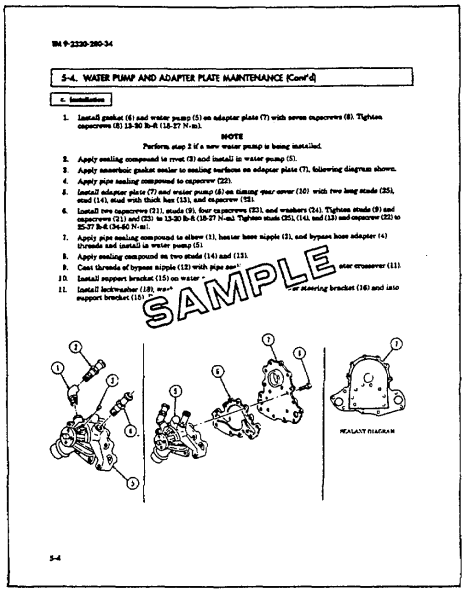

**9.** In step 1, you check for leaks at the water pump and around the cylinder heads. There is no leakage present around the cylinder heads. You note leakage at the water pump. The water pump must be replaced or repaired.

**10.** In step 2, you check cylinder block for cracks. You do not find any cracks.

**11.** At this point, you refer to para. 5-4, a detailed procedure containing step-by-step instructions for accomplishing a maintenance task. However, some malfunction tests or inspections refer you to an entire system (for example: cooling system). For these tasks you must use the table of contents to locate the system and task you need to solve the problem.




TM 9-2320-280-34

5-4. WATER PUMP AND ADAPTER PLATE MAINTENANCE (Cont'd)

c. Installation

1. Install gasket (6) and water pump (5) on adapter plate (7) with seven capscrews (8). Tighten capscrews (8) 13-30 lb-ft (18-37 N-m).

NOTE

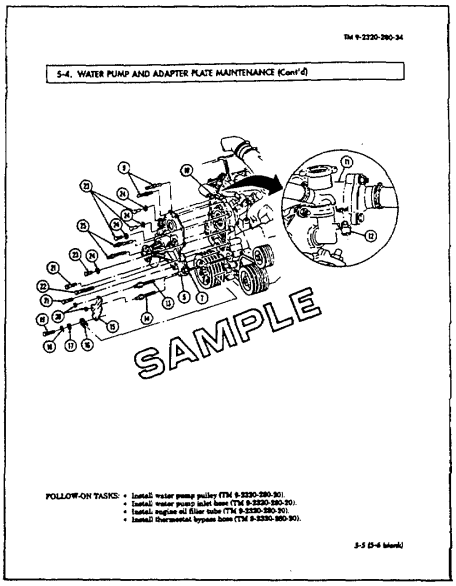
Perform step 2 if a new water pump is being installed.

2. Apply sealing compound to rivet (3) and install in water pump (5).
3. Apply anaerobic gasket sealer to sealing surfaces on adapter plate (7), following diagram shown.
4. Apply pipe sealing compound to capscrew (22).
5. Install adapter plate (7) and water pump (5) on timing gear cover (10) with two long studs (25), stud (14), stud with thick hex (13), and capscrew (22).
6. Install two capscrews (21), studs (9), four capscrews (23), and washers (24). Tighten studs (9) and capscrews (21) and (23) to 13-30 lb-ft (18-37 N-m). Tighten studs (25), (14), and (13) and capscrew (22) to 25-37 lb-ft (34-50 N-m).
7. Apply pipe sealing compound to elbow (1), heater hose nipple (3), and bypass hose adapter (4) threads and install in water pump (5).
8. Apply sealing compound on two studs (14) and (13).
9. Coat threads of bypass nipple (12) with pipe sealant and install in water crossover (11).
10. Install support bracket (15) on water pump (5).
11. Install lockwasher (18), nut (19), and washer (20) on stud (14) and install alternator (17) and adjusting strap (16) on alternator bracket (16) and into support bracket (15).

SAMPLE

SEALANT DIAGRAM

5-4


TM 9-2320-280-34

5-4. WATER PUMP AND ADAPTER PLATE MAINTENANCE (Cont'd)

SAMPLE

FOLLOW-ON TASKS:
- Install water pump pulley (TM 9-2320-280-30).
- Install water pump inlet hose (TM 9-2320-280-30).
- Install engine oil filler tube (TM 9-2320-280-30).
- Install thermostat bypass hose (TM 9-2320-280-30).

5-5 (5-6 blank)

**12**. After reporting the results of your troubleshooting efforts to your supervisor, he decides the most expedient means of returning the vehicle to service would be to replace the water pump. Turn to para. 5-4 as indicated in step 1 of your troubleshooting tests/steps.

**13**. In para. 5-4 (page 5-2) you find the detailed maintenance procedure for '"Water Pump and Adapter Plate Maintenance."

**DETAILED MAINTENANCE PROCEDURES:**

**14**. Detailed procedures include everything you must do to accomplish a basic maintenance task. The procedures are divided by chapter into Direct Support (DS) and General Support (GS) level maintenance tasks.

Before beginning the maintenance task, look through the procedure. You must familiarize yourself with the entire maintenance procedure of para 5-4, "Water Pump and Adapter Plate Maintenance." The task includes "a. Removal," "b. Inspection," and "c. Installation."

The eight basic headings listed under "INITIAL SETUP" outline task conditions, materials, special tools, manpower requirements, and special conditions. The headings are:

- **Applicable Models**: Any models that require a particular maintenance task. If a maintenance task covers all models, then this heading will not be used.

- **Test Equipment:** Test equipment needed to complete a task. If test equipment is not required, this heading will not be used.

- **Tools:** These are the tools and equipment needed to perform task.

- **Special Tools**: Those special tools needed to complete a maintenance task. The use of common tools is not explained. If no special tools are needed, this heading will not be used. If you don't have one of these special tools, requisition it (before starting the task) using the data supplied in this manual and TM 9-2320-280-24P, the repair parts and special tools list for this level of maintenance.

- **Materials/Parts**: This heading lists only mandatory replacement materials or parts (gaskets,O-rings sealant, etc.). To replace other unserviceable parts, refer to TM 9-2320-280-24P for requisition data. If no mandatory replacement materials/parts are required, this heading will not be used. For our task we need three lockwashers and a gasket.

**NOTE**

If you think that you need more help to adequately or safely complete a task, perhaps as the result of unusual conditions, etc., alert your supervisor and ask for help.

- **Personnel Required**: The number of personnel needed to perform a task. If only onemechanic is required, this heading will not be used.
- **Manual References**: Those TMs needed to complete the task.
- **Equipment Condition**: Notes the conditions that must exist before starting the task. For water pump replacement, the engine oil filler tube, inlet hose, water pump pulley and thermostat bypass hose have to be removed before you can start the task. If not already done, follow the procedures in TM 9-2320-280-20 before proceeding with this task.
- **General Safety Instructions**: Summarizes all safety warnings for the maintenance task. If none are required, this heading will not be used.
- **Maintenance Level**: Identifies maintenance level required to perform task.

**c.** A step-by-step maintenance procedure follows the "INITIAL SETUP" and gives detailed instructions for the procedure. These instructions give the part's general location and name and action performed. In the example for water pump - a. Removal, step 1 is: "Remove capscrew (13), lockwasher (12), and washer (11) and power steering pump bracket (10) from support bracket (9)."

**NOTE**

Warnings, cautions, and notes provide supplemental information:

- **Warnings** - Indicate conditions, practices, or procedures which must be observed to avoid personnel injury, loss of life, or long-term health hazard.
- **Cautions** - Indicate conditions, practices, or procedures which must be observed to avoid damage to equipment or destruction of equipment.
- **Notes** - Include essential information of special importance, interest, or aid in job performance which should be remembered and would be otherwise difficult to find or incorporate into the text.

**d**. At the end of a procedure, "FOLLOW-ON TASKS" will list those additional tasks that must be performed to complete the procedure. The Follow-On Tasks for water pump replacement are "Install water pump pulley (TM 9-2320-280-20), " "Install inlet hose (TM 9-2320-280-20)," "Install engine oil filter tube (TM 9-2320-280-20),"and "Install thermostat bypass hose (TM 9-2320-280-20)."

**15**. Refer to the example pages for para. 5-4, Water Pump and Adapter Plate Maintenance to review the following points:

**a. Modular Text**: Both pages of text and illustrations are to be used together. This manual was designed so that the two pages would be visible at once, making part identification and procedure sequence easy to follow.

**b**. **Initial Setup**: Outlines task conditions.

**c. Illustrations**: An exploded diagram of the component shows part locations, attachments, and relationships. Cutaway views (part of the vehicle is "erased") show the location and orientation of screws and attachments.

**16** . You can also use the Table of Contents (page ii) to find more information about the vehicle.

**17**. Refer to TM 9-2320-280-24P, Unit, Direct Support, and General Support Maintenance Repair Parts and Special Tools List for Truck, 1-1/4 ton, 4x4, M998 series when requisitioning parts, special tools, and equipment for maintenance.

**18** Your manual is easy to use once you understand its design. We hope it will encourage you to use your TM more often as an aid to maintenance support for M998 series vehicles.

# CHAPTER 1
# INTRODUCTION

## Section I. GENERAL INFORMATION

### 1-1. SCOPE

**a.** This technical manual contains instructions for direct support and general support maintenance for 1-1/4 ton, 4X4, M998 series vehicles.

**b.** Models included are:

**(1)** M998 and M998A1, Cargo/Troop Carrier

**(2)** M1038 and M1038A1, Cargo/Troop Carrier, W/W

**(3)** M1097, M1097A1, M1097A2, and M1123, Heavy Variant

**(4)** M966, M966A1, and M1121, TOW Carrier, Armored

**(5)** M1036, TOW Carrier, Armored, W/W

**(6)** M1045, M1045A1, and M1045A1 TOW Carrier, W/Supplemental Armor

**(7)** M1046 and M1046A1, TOW Carrier, W/Supplemental Armor, W/W

**(8)** M1025, M1025A1, and M1025A2, Armament Carrier, Armored

**(9)** M1026 and M1026A1, Armament Carrier, Armored, W/W

**(10)** M1043, and M1043A1, and M1043A2, Armament Carrier, W/Supplemental Armor

**(11)** M1044 and M1044A1, Armament Carrier, W/Supplemental Armor, W/W

**(12)** M1037, S250 Shelter Carrier

**(13)** M1042, S250 Shelter Carrier, W/W

**(14)** M996 and M996A1, 2-Litter, Armored Ambulance

**(15)** M997, M997A1, and M997A2, 4-Litter, Armored Ambulance

**(16)** M1035, M1035A1, and M1035A2, 2-Litter, Soft Top Ambulance

### 1-2. MAINTENANCE FORMS, RECORDS, AND REPORTS

(Army) Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, The Army Maintenance Management System (TAMMS). (Marine Corps) Refer to TM 4700-15/1 series.

## 1-3. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Refer to TM 750-244-6, Procedures for Destruction of Army Tank-Automotive Equipment to Prevent Enemy Use.

## 1-4. PREPARATION FOR SHIPMENT

(Army) Refer to TM 746-10, Marking, Packaging and Shipment of Supplies and Equipment: General Packaging Instructions for Field Use. (Marine Corps) Refer to MCO 4450-7.

## 1-5. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRs)

If your vehicle needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. The preferred method for submitting QDRs is through the Army Electronic Product Support (AEPS) website under the Electronic Deficiency Reporting System (EDRS). The web address is: https://aeps.ria.army.mil. This is a secured site requiring a password that can be applied for on the front page of the website. If the above method is not available to you, put it on an SF 368, Product Quality Deficiency Report (PQDR), and mail it to us at: Department of the Army, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/PQDR MS 267, 6501 E. 11 Mile Road, Warren, MI 48397-5000. We'll send you a reply. (Marine Corps) Submit QDR's in accordance with MCO 4855-10.

## 1-6. EQUIPMENT IMPROVEMENT REPORT AND MAINTENANCE DIGEST (EIR MD)

The quarterly Equipment Improvement Report and Maintenance Digest, TB 43-0001-62 series, contains valuable field information on the equipment covered in this manual. The information in the TB 43-0001-62 series is compiled from some of the Equipment Improvement Reports that you prepared on the vehicles covered in this manual. Many of these articles result from comments, suggestions, and improvement recommendations that you submitted to the EIR program. The TB 43-0001-62 series contains information on equipment improvements, minor alterations, proposed Modification Work Orders (MWOs), warranties (if applicable), actions taken on some of your DA Form 2028s (Recommended Changes to Publications and Blank Forms), and advance information on proposed changes that may affect this manual. The information will help you in doing your job better and will help in keeping you advised of the latest changes to this manual. Also refer to DA Pam 25-30, Consolidated Index of Army Publications and Blank Forms, and appendix A, References, of this manual. (Marine Corps) Submit QDR's in accordance with MCO 4855-10. For those with access to the World Wide Web (WWW), the EIR MD can be viewed through the Army Electronic Product Support. The site is http://aeps.ria.army.mil.

## 1-7. METRIC SYSTEM

The equipment described herein contains metric components and requires metric common and special tools; therefore, metric units in addition to standard units will be used throughout this publication. In addition, a metric conversion table is located on the inside back cover of this publication.

## 1-8. MANDATORY REPLACEMENT PARTS

The maintenance instructions contained herein make reference to removing and discarding piece parts such as: gaskets, lockwasher, cotter pins, O-ring seals, etc.; these items should be considered mandatory replacement items and replaced with new parts during assembly/installation.

## Section II. EQUIPMENT DESCRIPTION AND DATA

## 1-9. EQUIPMENT DESCRIPTION

Detailed descriptions covering the 1-1/4 ton, 4X4, M998 series vehicles are in TM 9-2320-280-10 and TM 9-2320-280-20.

## 1-10. TABULATED DATA

Tabulated data is listed in table 1-1. This information includes only that data applicable to direct support and general support maintenance. Information not covered can be found in TM 9-2815-237-34, TM 9-2320-280-20, TM 9-2320-280-10.

*Table 1-1. Tabulated Data*

**NOTE**

Standard and metric measurements will be used in this table and throughout the manual. A list of their abbreviations is provided below.

**TABULATED DATA ABBREVIATIONS**

| MEASUREMENT | ABBREVIATION | MEASUREMENT | ABBREVIATION |
|---|---|---|---|
| Pint | pt | Celsius | C |
| Quart | qt | Liter | 1 |
| Gallon | gal. | Centimeter | cm |
| Inch | in. | Kilometers Per Hour | kph |
| Pound | lb | KiloPascal | kPa |
| Miles Per Hour | mph | Maximum | max |
| Pound Per Square Inch | psi | Minimum | min |
| Revolutions Per Minute | rpm | Kilogram | kg |
| Pound-Feet | lb-ft | Newton Meter | N.m |
| Gallons Per Minute | gpm | Millimeter | mm |
| Volt | V | Ampere | A |
| Horsepower | hp | Liters Per Minute | lpm |
| Fahrenheit | F | KiloWatt | kW |

*Table 1-1. Tabulated Data (Cont'd)*

| | STANDARD | METRIC |
|---|---|---|
| 1. ENGINE | | |
| Refer to TM 9-2815-237-34 for tabulated data on the engine. | | |
| 2. ALTERNATOR | | |
| 60 Ampere: | | |
| Manufacturer | Prestolite | |
| Model | AMA-5104UT | |
| Output | 60 A @ 1300 rpm (engine) | |
| Rated Voltage | 28V | |
| 100 Ampere: | | |
| Manufacturer | Leece-Neville | |
| Model | A0013032AA | |
| Output | 100 A @ 1500 rpm (engine) | |
| Rated Voltage | 28V | |
| 100 Ampre: | | |
| Manufacturer | Neihoff | |
| Model | 12342944 | |
| Output | 100 A @ 1500 rpm (engine) | |
| Rated Voltage | 28V | |
| 200 Ampere: | | |
| Manufacturer | Leece-Neville | |
| Model | A0013036AA | |
| Output | 200 A @ 1600 rpm (engine) | |
| Rated Voltage | 28V | |
| 200 Ampere: | | |
| Manufacturer | Neihoff | |
| Model | 12338796-1 | |
| Output | 200 A @ 1600 rpm (engine) | |
| Rated Voltage | 28V | |
| 3. STARTER | | |
| Manufacturer | Prestolite | |
| Model | MFY | |
| Capacity | 9.5 hp | 7.1 kW |
| 4. TRANSMISSION | | |
| Manufacturer | Hydromatic | |
| Model | THM 400 (3L80) | |
| Torque Converter Ratio | 1.96:1 | |
| Gear Ratios: | | |
| Reverse | 2.08:1 | |
| Drive | 1:1 | |
| Second | 1.48:1 | |
| First | 2.48:1 | |
| 5. TRANSMISSION | | |
| Manufacturer | Hydromatic | |
| Model | 4L80-E | |
| Torque Converter Stall Ratio and Direct Drive w/Lock Up Clutch | 2.1 | |
| Gear Ratios: | | |
| First | 2.48:1 | |
| Second | 1.48:1 | |
| Third | 1.00:1 | |
| Fourth | 0.75:1 | |
| Reverse | 2.08:1 | |

*Table 1-1. Tabulated Data (Cont'd)*

| | STANDARD | METRIC |
|---|---|---|
| 6. TRANSFER CASE | | |
| Manufacturer | New Process Gear | |
| Model | 218 w/Intercooler | |
| Gear Ratios: | | |
| High and High Lock | 1:1 | |
| Low Lock | 2.61:1 | |
| Model | 242 w/Intercooler | |
| Gear Ratios: | | |
| High and High Lock | 1.0:1 | |
| Low Lock | 2.73:1 | |
| 7. DIFFERENTIAL | | |
| Manufacturer | AM General | |
| Type | Hypoid Gears | |
| Gear Ratio | 2.56:1 (2.73:1) | |
| 8. GEARED HUB | | |
| Manufacturer | AM General | |
| Type | Spur Gears | |
| Gear Ratio | 1.92:1 | |
| 9. SERVICE BRAKE CALIPER (FRONT) | | |
| Manufacturer | Kelsey-Hayes | |
| Piston Diameter | 2.6 in. | 66 mm |
| 10. SERVICE/PARKING BRAKE CALIPER (REAR) | | |
| Manufacturer | Kelsey-Hayes | |
| Piston Diameter | 2.6 in. | 66 mm |
| 11. SERVICE BRAKE ROTOR (FRONT) | | |
| Manufacturer | Kelsey-Hayes | |
| Diameter | 10.5 in. | 267 mm |
| Thickness | 0.87 in. | 22 mm |
| 12. SERVICE/PARKING BRAKE ROTOR (REAR) | | |
| Manufacturer | Kelsey-Hayes | |
| Diameter | 10.5 in. | 267 mm |
| Thickness | 0.87 in. | 22 mm |
| 13. STEERING GEAR | | |
| Manufacturer | Saginaw | |
| Type | Variable Ratio | |
| Ratio | 13/16:1 | |
| 14. POWER STEERING PUMP | | |
| Manufacturer | Saginaw | |
| Model | 125 | |
| Capacity (engine 1500 rpm) | 2.6 gpm | 9.8 lpm |
| 15. FRAME | | |
| Manufacturer | AM General | |
| Type | Box | |
| No. of Crossmembers | Five | |

*Table 1-1. Tabulated Data (Cont'd)*

| | STANDARD | METRIC |
|---|---|---|
| 16. WINCH | | |
| Manufacturer | Warn | |
| Capacity | 6,000 lb | 2.722 kg |
| Drive | Electric | |
| 17. WINCH | | |
| Model | MIL9000 | |
| Type | Electric Drive, Thermal Cutoff Switch | |
| Capacity | 9,000 lb | 4,086 kg |
| 18. AIR-CONDITIONING COMPRESSOR | | |
| Manufacturer | Sanden | |
| Model | 510 | |
| Field coil | 24V | |

# CHAPTER 2
# GENERAL MAINTENANCE

## Section I. REPAIR PARTS, SPECIAL TOOLS, TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE), AND SUPPORT EQUIPMENT

### 2-1. COMMON TOOLS AND EQUIPMENT

Refer to Modified Table of Organization and Equipment (MTOE) for authorized common tools and equipment applicable to your unit.

### 2-2. SPECIAL TOOLS AND SUPPORT EQUIPMENT

Special tools and support equipment are listed and illustrated in TM 9-2320-280-24P.

### 2-3. TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE)

Calibrate all measuring and test equipment used to determine equipment conformance in accordance with TB 43-1800.

### 2-4. FABRICATED TOOLS

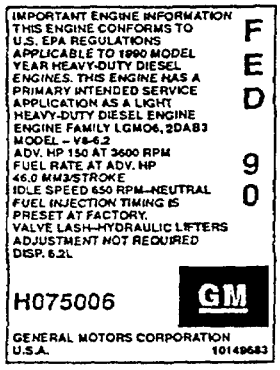
Fabricated tools needed to maintain the equipment in this manual can be found in appendix C. These tools are not available for issue, but must be fabricated and applied by direct and general support personnel only.

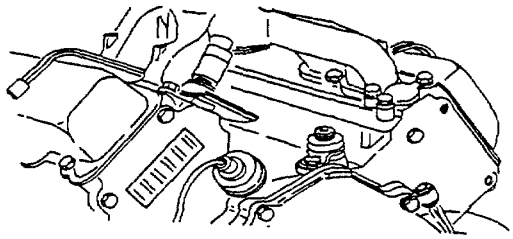
### 2-5. REPAIR PARTS

Repair parts are listed and illustrated in TM 9-2320-280-24P, except for engine assembly repair parts which are listed and illustrated in TM 9-2815-237-34P.

Pre-1990 and 1990 and above 6.2 L and 6.5 L engines have some new and revised parts which are not interchangeable. These part changes affect some of the maintenance procedures in chapters 3 and 4. Refer to engine decal on left rocker arm cover before performing maintenance procedures and ordering replacement parts.

The 6.2 L engine is identified by a decal which is adhered to the left rocker arm cover. The 6.5 L engine is identified by a serial number bar code.



## Section II. TROUBLESHOOTING

### 2-6. GENERAL

Information in this section is for use by support maintenance personnel in conjunction with, and as a supplement to, troubleshooting procedures in TM 9-2320-280-20.

### 2-7. MECHANICAL TROUBLESHOOTING INSTRUCTIONS

a. The troubleshooting procedures in this section cannot give all the answers or correct all vehicle malfunctions encountered. However, these procedures are an organized step by step study of a problem that directs tests and inspections toward the source of a problem and successful correction.

**CAUTION**

Operation of a deadlined vehicle without preliminary inspection will cause further damage.

b. Do the easiest things first. Most troubles are easily corrected. For example:
(1) Excessive oil consumption is generally caused by leaky gaskets or loose line connections.

(2) Always check the easiest and most obvious things first. This simple rule saves time and trouble.

c. Doublecheck before disassembly. The source of most engine problems can be traced to more than one part in a system. For example:

(1) Excessive fuel consumption may not be caused by the fuel pump alone. Instead, the trouble could be a clogged air cleaner, or a restricted exhaust passage causing severe back pressure.

(2) Engines very often are disassembled in search of a complaint and the real evidence of the problem is destroyed. Check again to be sure an easier solution to the problem has not been overlooked.

d. Before correcting a problem, diagnose the cause of the problem. Do not allow the same failure to occur again.

**TROUBLESHOOTING SYMPTOM INDEX**


| MALFUNCTION NO. | MECHANICAL MALFUNCTION | TROUBLESHOOTING PROCEDURE PAGE |
|---|---|---|
| | **ENGINE** | |
| 1. | Engine will not crank | 2-4 |
| 2. | Engine cranks but will not start | 2-4 |
| 3 | Engine stops during normal operation | 2-4 |
| 4. | Engine knocks (mechanical noise) | 2-5 |
| 5. | Excessive oil loss or consumption | 2-5 |
| 6. | Low oil pressure | 2-5 |
| 7. | Excessive engine vibration | 2-5 |
| 8. | Excessive exhaust smoke | 2-6 |
| 9 | Accelerator pedal sticks or full throttle cannot be obtained | 2-6 |
| 10. | Leaking exhaust gases or exhaust noises | 2-6 |
| 11. | Loss of coolant | 2-7 |
| 12. | Engine overheats | 2-7 |
| 13. | Engine does not develop full power | 2-7 |
| 14 | Lubricating oil diluted | 2-7 |

# TROUBLESHOOTING SYMPTOM INDEX


| MALFUNCTION NO. | MECHANICAL MALFUNCTION | TROUBLESHOOTING PROCEDURE PAGE |
|---|---|---|
| | **TRANSMISSION (3L80)** | |
| 16. | No 1-2 upshift or delayed upshift | 2-8 |
| 17. | 1-2 shift soft or slips | 2-8 |
| 18. | 1-2 shift firm or rough | 2-9 |
| 19. | No 2-3 upshift or delayed upshift | 2-9 |
| 20. | 2-3 shift soft or slips | 2-10 |
| 21. | 2-3 shift firm or rough | 2-10 |
| 22. | No engine braking – second gear | 2-10 |
| 23. | No engine braking – first gear | 2-10 |
| 24. | No detent downshift | 2-11 |
| 25. | No drive or slips in drive | 2-11 |
| 26. | No reverse or slips in reverse | 2-11 |
| 27. | Vehicle moves in neutral | 2-11 |
| 28. | Transmission noisy | 2-12 |
| | **TRANSMISSION (4L80-E)** | |
| 29. | Transmission control module (TCM) Codes are 59, 71, 75, 79, 81, 82, 83,. | 2-13 |
| 30. | No 1-2 upshift or delayed upshift | 2-14 |
| 31. | 1-2 shift soft or slips | 2-14 |
| 32. | 1-2 shift firm or rough | 2-15 |
| 33. | No 2-3 upshift or delayed upshift | 2-15 |
| 34. | 2-3 shift soft or slips | 2-15 |
| 35. | 2-3 shift firm or rough | 2-15 |
| 36. | No 3-4 upshift or delayed upshift | 2-16 |
| 37. | 3-4 shift soft or slips | 2-16 |
| 38. | 3-4 shift firm or rough | 2-16 |
| 39. | No engine braking-third gear | 2-16 |
| 40. | No engine braking-second gear | 2-16 |
| 41. | No engine braking-first gear | 2-17 |
| 42. | No drive or slips in drive | 2-17 |
| 43. | No reverse of slips in reverse | 2-17 |
| 44. | Vehicle moves in neutral | 2-17 |
| 45. | Vehicle moves in park | 2-17 |
| 46. | Transmission noisy | 2-18 |
| | **TRANSFER CASE** | |
| 47. | Transfer case will not shift | 2-18 |
| 48. | Transfer case noisy | 2-18 |
| | **DIFFERENTIAL** | |
| 49. | Differential noisy | 2-18 |
| | **BRAKES** | |
| 50. | Noisy brakes | 2-18 |
| 51. | Brake pedal pulsation | 2-19 |
| 52. | Erratic braking action | 2-19 |
| | **WHEELS, SUSPENSION, AND STEERING** | |
| 53. | Poor directional stability or uneven tire wear | 2-19 |
| 54. | Noisy suspension | 2-19 |
| 55. | Hard steering or excessive play in steering | 2-19 |

*Table 2-1. Mechanical Troubleshooting*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## ENGINE

**1. ENGINE WILL NOT CRANK**

Step 1. Remove all glow plugs (TM 9-2320-280-20). Using socket and breaker bar at crankshaft pulley, rotate crankshaft and check for mechanical or hydraulic seizure. If crankshaft will not turn, replace engine (para. 3-22 or 3-24). If crankshaft turns and liquid is discharged, determine if liquid is coolant for fuel. If coolant is discharged, remove cylinder heads (para. 3-4 and 3-5) and check for cracked cylinder heads or leaking head gaskets. Replace cracked cylinder heads. If fuel is discharged, remove and test fuel injection nozzles (para. 4-3). Replace defective fuel injection nozzles.

Step 2. Remove converter housing cover (TM 9-2320-280-20) and check for damaged flywheel. Replace flywheel (TM 9-2815-237-34) if damaged.

END OF TESTING!

**2. ENGINE CRANKS BUT WILL NOT START**

Step 1. Loosen fuel injection lines at injection nozzles and crank engine. If no fuel leaks from fuel injection lines while cranking engine, replace fuel injection pump (para 4-6).

Step 2. Remove and test fuel injection nozzles (para. 4-3). Replace defective fuel injection nozzles.

Step 3. Using compression tester J 6692, elbow NSN 4730-00-985-4804, coupling NSN 4730-01-042-5266, and adapter J 26999-30, check compression of each cylinder following steps a through f.

(a) Remove all glow plugs (TM 9-2320-280-20).

(b) Remove air cleaner element (TM 9-2320-280-20).

(c) Disconnect lead 54A from fuel injection pump.

(d) Install compression gauge adapter in glow plug hole of cylinder being tested and connect compression gauge.

**CAUTION**

Do not add oil to any cylinder when checking compression or damage to engine may result.

**NOTE**

Compression reading may exceed 450 psi (3103 kPa).

(e) Crank engine, allow engine to crank long enough to accumulate six compression pulses, and record highest reading.

(f) Repeat steps (d) and (e) for remaining cylinders.

(g) All cylinders should build up quickly and evenly to a minimum of 380 psi (2620 kPa) and lowest reading should not be less than 80% of highest cylinder reading.

Step 4. Check for warped or damaged cylinder heads. Replace warped or damaged cylinder heads (para. 3-4 and 3-5).

Step 5. Check for damaged valves. Replace damaged valves (TM 9-2815-237-34).

Step 6. Check for damaged or worn pistons and piston rings. Replace pistons or piston rings if worn or damaged (TM 9-2815-237-34).

END OF TESTING!

**3. ENGINE STOPS DURING NORMAL OPERATION**

Step 1. Perform step 1 of malfunction 1.

Step 2. Perform steps 1 and 2 of malfunction 2.

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## 4. ENGINE KNOCKS (MECHANICAL NOISE)

Step 1. Remove converter housing cover (TM 9-2320-280-20) and tighten torque converter capscrews to 32 lb-ft (43 N•m).

Step 2. Remove and test fuel injection nozzles (para. 4-3). Replace defective fuel injection nozzles.

Step 2.1. Check for defective fuel injection pump (TM 9-2815-237-34). Replace defective fuel injection pump (para. 4-6).

Step 3. Check for worn or damaged connecting rod bearings. Replace worn or damaged connecting rod bearings (TM 9-2815-237-34).

Step 4. Check for worn or damaged main bearings. Replace worn or damaged main bearings (TM 9-2815-237-34).

Step 5. Check for worn or damaged crankshaft. Replace worn or damaged crankshaft (TM 9-2815-237-34).

Step 6. Check for worn or damaged pistons and connecting rods. Replace worn or damaged pistons and connecting rods (TM 9-2815-237-34).

END OF TESTING!

## 5. EXCESSIVE OIL LOSS OR CONSUMPTION

Step 1. Check for oil leaks around oil pan, rocker arm covers, and timing gear cover oil seal. If any leakage is found, repair as necessary (chapter 3).

Step 2. Check for defective valve seals. Replace defective valve seals (TM 9-2815-237-34).

Step 3. Check for worn valve guides. Repair worn valve guides (TM 9-2815-237-34).

Step 4. Check for worn or damaged piston rings. Replace worn or damaged piston rings (TM 9-2815-237-34).

END OF TESTING!

## 6. LOW OIL PRESSURE

Step 1. Check for defective oil pump. Replace defective oil pump (para. 3-16).

Step 2. Check for worn or damaged rod bearings. Replace worn or damaged rod bearings (TM 9-2815-237-34).

Step 3. Check for worn or damaged main bearings. Replace worn or damaged main bearings (TM 9-2815-237-34).

Step 4. Check for worn or damaged crankshaft. Replace worn or damaged crankshaft (TM 9-2815-237-34).

END OF TESTING!

## 7. EXCESSIVE ENGINE VIBRATION

Step 1. Check for air in fuel lines. Bleed air from fuel lines (TM 9-2320-280-20).

Step 2. Remove and test fuel injection nozzles (para. 4-3). Replace defective fuel injection nozzles.

Step 2.1. Check for defective fuel injection pump (TM 9-2815-237-34). Replace defective fuel injection pump (para. 4-6).

Step 3. Check for broken engine mounts. Replace broken engine mounts (para. 3-3).

Step 4. Remove converter housing cover (TM 9-2320-280-20) and tighten torque converter capscrews to 32 lb-ft (43 N•m).

Step 5. Check for loose or damaged torsional damper. Replace if damaged (para. 3-7).

Step 6. Check for damaged flywheel and missing counterweight on flywheel. Replace flywheel (TM 9-2815-237-34) if damaged or counterweight is missing.

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## 8. EXCESSIVE EXHAUST SMOKE

a. Black Smoke

Step 1. Check for restricted exhaust pipe and intake manifold. Replace exhaust pipes (TM 9-2320-280-20) or intake manifold (para. 3-17) if restricted.

Step 2. Remove and test fuel injection nozzles (para. 4-3). Replace defective fuel injection nozzles.

Step 3. Check fuel injection pump timing (para. 3-20).

Step 4. Check for defective fuel injection pump (TM 9-2815-237-34). Replace defective fuel injection pump (para. 4-6).

END OF TESTING!

b. White Smoke

Step 1. Perform step 2 of malfunction 12.

Step 2. Remove and test glow plugs (TM 9-2815-237-34). Replace defective glow plugs.

Step 3. Remove and test fuel injection nozzles (para. 4-3). Replace defective fuel injection nozzles.

Step 4. Check for defective fuel injection pump (TM 9-2815-237-34). Replace defective fuel injection pump (para. 4-6).

END OF TESTING!

c. Blue Smoke

Step 1. Perform step 3 of malfunction 2.

Step 2. Check for defective valve seals. Replace defective valve seals (TM 9-2815-237-34).

Step 3. Check for worn valve guides. Repair worn valve guides (TM 9-2815-237-34).

Step 4. Check for worn or damaged pistons and piston rings. Replace worn or damaged pistons and piston rings (TM 9-2815-237-34).

Step 5. Check for worn or damaged cylinder block. Replace engine (para. 3-22 or 3-24) if cylinder block is worn or damaged.

END OF TESTING!

## 9. ACCELERATOR PEDAL STICKS OR FULL THROTTLE CANNOT BE OBTAINED

Step 1. Disconnect modulator cable from modulator link. Pull cable in and out to check for free operation. If modulator cable binds, replace modulator cable (TM 9-2320-280-20).

Step 2. Disconnect accelerator cable from fuel injection pump. Move throttle lever on injection pump to wide open throttle. If throttle lever does not move freely, replace injection pump (para. 4-6).

END OF TESTING!

## 10. LEAKING EXHAUST GASES OR EXHAUST NOISES

Check for leaking exhaust gases around exhaust manifolds. Replace any leaking exhaust manifold gaskets or exhaust manifolds (TM 9-2320-280-20).

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## 11. LOSS OF COOLANT

Step 1. Pressurize coolant system and check for leaks at water pump and around cylinder heads. If any leakage is present, replace cylinder head gaskets, cylinder heads (para. 3-4 or 3-5) or water pump (para. 5-4).

Step 2. Check cylinder block for cracks. Replace engine (para. 3-22 or 3-24) if cylinder block is cracked.

END OF TESTING!

## 12. ENGINE OVERHEATS

Step 1. Check for leaking or defective water pump. Replace leaking or defective water pump (para. 5-4).

Step 2. Remove surge tank cap (TM 9-2320-280-10). With engine running, check for excessive bubbles in surge tank that may indicate leaking head gaskets or cracked cylinder heads. If bubbles are present, remove cylinder heads (para. 3-4 and 3-5) and check for defective head gaskets, cracked cylinder heads, or cracked cylinder block. Replace cylinder heads (para. 3-4 and 3-5) if damaged. Replace engine (para. 3-22 or 3-24) if cylinder block is cracked.

END OF TESTING!

## 13. ENGINE DOES NOT DEVELOP FULL POWER

Step 1. Remove and test fuel injection nozzles (para. 4-3). Replace defective fuel injection nozzles.

Step 2. Check for defective fuel injection pump (TM 9-2815-237-34). Replace defective fuel injection pump (para. 4-6). ■

Step 3. Perform step 3 of malfunction 2.

Step 4. Check for damaged lifters. Replace damaged lifters (para. 3-9).

Step 5. Check for damaged camshaft. Replace damaged camshaft (TM 9-2815-237-34).

Step 6. Check for burned valves. Replace burned valves (TM 9-2815-237-34).

Step 7. Check for worn or damaged pistons and piston rings. Replace worn or damaged pistons and piston rings (TM 9-2815-237-34).

END OF TESTING!

## 14. LUBRICATING OIL DILUTED

Step 1. Remove and test fuel injection nozzles (para. 4-3). Replace defective fuel injection nozzles.

Step 2. Check for broken piston rings. Replace broken piston rings (TM 9-2815-237-34).

Step 3. Check for defective fuel injection pump (TM 9-2815-237-34). Replace defective fuel injection pump (para. 4-6). ■

END OF TESTING!

## 15. ENGINE FAILS TO STOP WITH ROTARY SWITCH OFF

Check for defective fuel shutoff solenoid. Replace defective fuel shutoff solenoid (para. 4-8).

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

**TRANSMISSION (3L80)**

**NOTE**

- In the event of a major transmission malfunction involving the torque converter or oil pump, replace filter, flush oil cooler and lines before replenishing fluid.
- Perform the oil pressure tests (para. 17-32) and record the readings for use during troubleshooting.
- Perform a road test (TM 9-2320-280-20).

**16. NO 1-2 UPSHIFT OR DELAYED UPSHIFT**

Step 1. If oil pressure in D )"(drive) at 1000 rpm is normal, proceed to step 2. If oil pressure is high, proceed to step 3.
Step 2. Check results of control valve and governor line pressure test (para. 17-32).
Step 3. If oil pressure in N' (neutral) at 1000 rpm was normal, proceed to step 4. If oil pressure was high, proceed to step 7.
Step 4. Check for damaged detent solenoid. Using multimeter, test solenoid coil resistance. Resistance should be 60-70 ohms. Replace solenoid (chapter 17) if damaged.
Step 5. Check control valve spacer plate for obstructions. Clean or replace spacer plate (chapter 17).
Step 6. Check detent valve train for stuck valves or incorrect assembly. Replace control valve (chapter 17) if necessary.
Step 7. Check modulator cable and linkage for damage or obstruction to movement. Cable core should move freely in its housing, replace modulator (TM 9-2320-280-20) or linkage (TM 9-2320-280-20) if damaged.
Step 8. Check adjustment of modulator cable. Adjust modulator cable (TM 9-2320-280-20).
Step 9. Remove modulator cable at transmission and measure depth of cable pin. Pin depth must be 0.590-0.700 in. (14.98-15.24 mm). Replace modulator (TM 9-2320-280-20) if pin depth is not within specifications.
Step 10. Check modulator valve for damage and freedom of movement in its bore. Replace modulator valve (chapter 17) if damaged.
Step 11. Check transmission case for damage or porosity at modulator valve. Replace transmission (para. 7-6) if case is damaged or porous.

END OF TESTING!

**17. 1-2 SHIFTS SOFT OR SUPS**

Step 1. Check transmission oil pressure response to varying throttle openings. Pressure should respond rapidly to quick changes in throttle opening. If oil pressure response is poor, proceed to step 2. If oil pressure response is normal, proceed to step 3.
Step 2. Perform steps 7 through 10 of malfunction 16.
Step 3. If oil pressure in ED" (drive) at 1000 rpm is low, proceed to step 4. If oil pressure is normal, proceed to step 10.
Step 4. Check oil pump for obstructed oil passages or damage. Repair oil pump (para. 17-6).
Step 5. Check forward clutch seals for damage. Replace damaged seals (para. 17-7).
Step 6. Check center support oil seal rings for damage. Replace damaged rings (par. 17-9).
Step 7. Check rear servo piston and oil seal rings for damage. Repair rear servo (para. 17-11) if damaged.
Step 8. Check front-accumulator piston and oil seal rings for damage. Replace control valve (chapter 17) if accumulator piston components are damaged.

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

Step 9. Check transmission case for internal damage or porosity. Replace transmission (para. 7-6) if case is damaged or porous.
Step 10. Inspect control valve for nicks on machined surfaces or voids in casting; check 1-2 accumulator valve train for stuck valves or incorrect assembly; check front accumulator piston and oil seal rings for damage. Replace control valve (chapter 17) if any damage is found.
Step 11. Check rear servo and rear accumulator pistons and oil seal rings for damage. Repair rear servo (para. 17-11) if damaged.
Step 12. Check center support bolt for looseness. Tighten to 20-25 lb-ft (27-34 N.m).

**WARNING**

Compressed air used for cleaning purpose will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personnel protective equipment (goggles, shield, gloves, etc.).

Step 13. Air check intermediate clutch piston for proper operation. If operation is normal, proceed to step 14. If piston exhibits excessive leakage, proceed to step 15.
Step 14. Check intermediate clutch piston, plates, and release springs for damage or incorrect assembly. Repair intermediate clutch piston (para. 17-18) if damaged.
Step 15. Check center support for missing orifice plug. Replace transmission (para. 76) if plug is missing.

END OF TESTING!

**18. 1-2 SHIFT FIRM OR ROUGH**

Step 1. Perform steps 7 through 10 of malfunction 16.
Step 2. If oil pressure in "D" (drive) at 1000 rpm is normal, proceed to step 3. If oil pressure is high, proceed to step 7.
Step 3. Check 1-2 accumulator valve train for stuck valves or incorrect assembly. Replace control valve (chapter 17) if any damage is found.
Step 4. Check rear accumulator piston and oil seal rings for damage. Repair rear servo (para. 17-11) if damaged.
Step 5. Check transmission case for restricted oil passages, damage, or porosity. Remove obstructions or replace transmission (para. 7-6) if case is damaged or porous.
Step 6. Check for missing or incorrectly installed check balls. Replace missing check balls (chapter 17).
Step 7. Check for damaged detent solenoid. Using multimeter, test solenoid coil resistance. Resistance should be 60-70 ohms. Replace solenoid (chapter 17) if damaged.
Step 8. Check control valve spacer plate for obstructions and damaged or misalined gasket. Clean or replace spacer plate (chapter 17).
Step 9. Check detent valve train for stuck valves or incorrect assembly. Replace control valve (chapter 17) if damaged.
Step 10. Check oil pump for obstructed oil passages or damage. Repair oil pump (para. 17-6) if damaged.

END OF TESTING!

**19. NO 2-3 UPSHIFT OR DELAYED UPSHIFT**

**NOTE**

If malfunction only occurs at or near full throttle, check engine timing for proper adjustment and check exhaust system for restrictions.

Step 1. Perform steps 7 through 10 of malfunction 16.
Step 2. Check control valve for a stuck 2-3 valve, and misaligned or damaged gaskets. Replace control valve (chapter 17) if damaged.
Step 3. Check direct clutch for damage or burned clutch plates. Repair direct clutch (para. 17-8) if damaged.

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

**20. 2-3 SHIFT SOFT OR SUPS**

Step 1. If oil pressure in 'D" (drive) at 1000 rpm is low, proceed to step 2. If oil pressure is normal, proceed to step 4.
Step 2. Perform steps 7 through 10 of malfunction 16.
Step 3. Perform steps 4 through 9 of malfunction 17.
Step 4. Perform steps 8 and 9 of malfunction 18.
Step 5. Check front servo for broken or missing spring and leak at servo pin. Repair front servo (chapter 17) if damaged.
Step 6. Air check direct clutch piston for proper operation. If piston exhibits excessive leakage, proceed to step 7. If operation is normal, proceed to step 8.
Step 7. Check direct clutch piston, plates, and release springs for damage or incorrect assembly. Repair intermediate clutch (para. 17-8) if damaged.
Step 8. Check transmission case passages for leaks. Replace transmission (para. 7-6) if case is damaged.

END OF TESTING!

**21. 2-3 SHIFT FIRM OR ROUGH**

Step 1. If oil pressure in "D' (drive) at 1000 rpm is normal, proceed to step 2. If oil pressure is high, proceed to step 5.
Step 2. Check front accumulator for damaged piston, rings, and broken or missing spring; check valve to accumulator feed for obstructions. Replace control valve (chapter 17) if damaged.
Step 3. Air check direct clutch piston for leak to outer area of clutch piston; check center piston seal for damage. Repair direct clutch (para. 17-8) if damaged.
Step 4. Check center support and second oil ring for damage. Repair center support (para. 17-9) if damaged.
Step 5. Perform steps 7 through 10 of malfunction 16.
Step 6. Perform steps 7 through 10 of malfunction 18.

END OF TESTING!

**22. NO ENGINE BRAKING - SECOND GEAR**

Step 1. Check front servo piston for leaking oil rings and damaged piston. Replace damaged components (chapter 17).
Step 2. Check front accumulator piston for leaking oil rings and damaged piston. Replace control valve (chapter 17) if damaged.
Step 3. Check front band for damage and proper installation. Replace front band (chapter 17) if damaged.

END OF TESTING!

**23. NO ENGINE BRAKING - FIRST GEAR**

Step 1. Check for missing or incorrectly installed check balls. Replace missing check balls (chapter 17).
Step 2. Check transmission case for damage at check ball locations. Replace transmission (para. 7-6) if damaged.
Step 3. Check rear servo for leaking oil seal rings and damaged piston. Repair rear servo (para. 17-11) if damaged.
Step 4. Check rear band apply pin for proper length. Replace pin (chapter 17) if length is not correct.
Step 5. Check rear band for damage and proper installation. Replace rear band (chapter 17) if damaged.

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

**24. NO DETENT DOWNSHIFTS**

Step 1. Check for damaged detent solenoid. Using multimeter, test solenoid coil resistance. Resistance should be 60-70 Ohms. Replace solenoid (chapter 17) if damaged.

Step 2. Check detent valve train for stuck valves and incorrect assembly. Replace control valve (chapter 17) if necessary.

END OF TESTING!

**25. NO DRIVE OR SUPS IN DRIVE**

Step 1. If oil pressure in 'D" (drive) at 1000 rpm is low, proceed to step 2. If oil pressure is normal, proceed to step 4.

Step 2. Perform steps 7 through 10 of malfunction 16.

Step 3. Perform steps 4, 5, and 9 of malfunction 17.

Step 4. Check forward clutch for damage and burned clutch plates. Repair forward clutch (para. 17-7) if damaged.

Step 5. Check roller clutch for damage and proper installation. Replace roller clutch (para. 17-8) if damaged.

END OF TESTING!

**26. NO REVERSE OR SUPS IN REVERSE**

Step 1. If oil pressure in 'D" (drive) at 1000 rpm is low, proceed to step 2. If oil pressure is normal, proceed to step 4.

Step 2. Perform steps 7 through 10 of malfunction 16.

Step 3. Perform step 4 and steps 6 through 9 of malfunction 17.

Step 4. Check control valve spacer plate for obstructions and misalined gasket. Clean or replace spacer plate (chapter 17) if damaged.

Step 5. Check control valve for damaged or leaky passages and stuck valves or incorrect assembly. Replace control valve (chapter 17) if damaged.

Step 6. Check rear servo and accumulator piston for damaged oil seal rings, pistons, and band apply pin. Check for correct length of ban apply pin. Repair rear servo and accumulator (para. 17-11) if damaged.

Step 7. Check center support and oil seal rings for damage and wear. Repair center support (para. 17-9) if damaged or worn.

Step 8. Check direct clutch for damage and burned clutch plates. Repair direct clutch (para. 17-8) if damaged.

Step 9. Check rear band for damage and proper installation. Replace band (chapter 17) if damaged.

Step 10. Check forward clutch for damage and binding (will not release). Repair forward clutch (para. 17-7) if damaged.

END OF TESTING!

**27. VEHICLE MOVES IN NEUTRAL**

Step 1. Check manual valve for damage and proper installation. Replace manual valve (chapter 17) if damaged.

Step 2. Check detent lever and pin for damage and proper installation. Replace lever of pin (chapter 17) if damaged.

Step 3. Check oil pump for leaking oil passages and damage. Repair oil pump (para. 17-6) if damaged.

Step 4. Check forward clutch for damage and burned clutch plates. Repair forward clutch (para. 17-7) if damaged.

END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Cont'd)

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

**28. TRANSMISSION NOISY**

**NOTE**

Check engine accessory drive components: water pump, power steering pump, alternator, and air conditioner compressor (if installed) for the source of "noise" before checking transmission.

a. Noise in Neutral and All Driving Ranges.

Step 1. Check torque converter for loose mounting capscrews and damage. Tighten capscrews or replace torque converter (para. 17-4) if damaged.
Step 2. Check flywheel for damage. Replace flywheel (TM 9-2815-237-34) if damaged.
Step 3. Check oil pump for obstructed oil passages, damage, and proper assembly. Repair oil pump (para. 17-6) if damaged.

b. Noise in First, Second, and Reverse.

Step 1. Check gear unit thrust bearings and races for damage. Replace bearing(s) and races if either is damaged (para. 17-10).
Step 2. Inspect gears for damage and wear. Replace damaged or worn components (para. 17-10).
Step 3. Inspect front internal gear ring for damage. Replace gear ring if damaged (para. 17-10).

c. Noise during Acceleration - Any Gear.

Check engine and transmission mounts for looseness or damage. Secure or replace mounts (para. 3-3 or TM 9-2320-280-20).

END OF TESTING!

**TRANSMISSION (4L80E)**

**NOTE**

- The 4L80-E Transmission is an electronically controlled four speed. The Transmission Control Module (TCM), an on board computer, receives and processes input signals from sensors on the vehicle and delivers output signals to the solenoids located on the control valve assembly. These solenoids control the transmission operating pressures, upshift and downshift patterns and torque converter clutch (TCC) operation. Unit Maintenance has recorded the Trouble Codes stored in the TCM. Refer to TM 9-2320-280-20 for definitions of trouble codes.
- In the event of a major transmission malfunction involving the torque converter or oil pump, replace filter, flush oil cooler and lines before replenishing fluid.
- Perform the oil pressure tests (para. 1732) and record the readings for use during troubleshooting.
- Perform a road test (TM 9-2320-280-20).
- Perform electrical check-out at transmission electrical connector of malfunction 29.

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

**ELECTRIC CHECK-OUT OF ELECTRONIC COMPONENTS IN 4L80-E TRANSMISSION AT TRANSMISSION ELECTRICAL CONNECTOR.**

SHIFT SOLENOID A (1-2)

With the transmission electrical connector disconnected, measure the resistance between pins A and E. Resistance should be between 18 to 24 ohms.

HIGH

Check for:
- High resistance of solenoid; replace.
- Bad connections and/or wires to the solenoid; repair or replace.

LOW

Check for:
- Low resistance of solenoid; replace.
- Shorts in wires or connectors; repair or replace.

SHIFT SOLENOID B (2-3)

With the transmission electrical connector disconnected, measure the resistance from pin B to pin E. Resistance should be between 18 to 24 ohms.

HIGH

Check for:
- High resistance of solenoid; replace.
- Bad connections and/or wires to the solenoid; repair or replace.

LOW

Check for:
- Low resistance of solenoid; replace.
- Shorts in wires or connectors; repair or replace.

FORCE MOTOR (PRESSURE CONTROL SOLENOID)

With the transmission electrical connector disconnected, measure the resistance between pins C and D. Resistance should be between 3.5 to 5.0 ohms.

HIGH

Check for:
- High resistance of solenoid; replace.
- Wires and connectors for bad connections and or breaks; repair or replace.

LOW

Check for:
- Low resistance of solenoid; replace.
- Short in wires or connectors; repair or replace.

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

TORQUE CONVERTER CLUTCH SOLENOID

With the transmission electrical connector disconnected, measure the resistance between pins S and E. Resistance should be between 10 to 14 ohms.

HIGH

Check for:
- High resistance of solenoid; replace.
- Wires and connectors for breaks or bad connections; repair or replace.

LOW

Check for:
- Low resistance of solenoid; replace.
- Short in wires or connectors; repair or replace.

TRANSMISSION FLUID TEMPERATURE SENSOR

With the transmission electrical connector disconnected, measure the resistance between pins M and L. The resistance should be high at low temperatures and low at high temperatures. At room temperature the resistance should be between 2500 and 5000 ohms.

HIGH

Check for:
- High resistance of solenoid; replace.
@ 0°C (32'F) > 11,000 ohms
@ 20°C (680F) > 4,100 ohms
@ 40°C (104°F) > 1,700 ohms
- Opens, breaks, and bad connections in the wires and connectors; repair or replace.

LOW

Check for:
- Low resistance of solenoid; replace.
O 00C (320F) > 7,800 ohms
@ 20°C (68°F) > 2,900 ohms
@ 40°C (104°F) > 1,200 ohms
- Shorts between wires or ground in the wires and connectors; repair or replace.

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

**29. TRANSMISSION CONTROL MODULE (TCM) CODES ARE 59, 71, 75, 79, 81, 82, 83**

a. Shift solenoid A (1-2) may not function properly (1st and 4th gear only, 2nd and 3rd gear only).
Step 1. Disconnect transmission electrical connector.
Step 2. Check resistance between pins A and E, resistance should be between 18 to 24 ohms.
Step 3. If resistance at connector is high or low proceed to step 4.
Step 4. Check wires to solenoid for open short circuit and check for bad connections replace internal harness (para. 17-14) if ok proceed to step 5.
Step 5. Replace solenoid (para. 17-28).

END OF TESTING!

b. Shift solenoid B (2-3) may not function properly (lst and 2nd only, 2nd gear only, 3rd and 4th gears only).
Step 1. Disconnect transmission electrical connector.
Step 2. Check resistance between pins B and E, resistance should be between 18 to 24 ohms.
Step 3. If resistance at connector is high or low proceed to step 4.
Step 4. Check wires to solenoid for open or short circuits and bad connections, or replace internal harness (para. 17-14) if ok proceed to step 5.
Step 5. Replace solenoid (para. 17-28).

END OF TESTING!

c. Force motor (pressure control solenoid) may not function properly (harsh shifting and soft shift).
Step 1. Disconnect transmission electrical connector.
Step 2. Check resistance between pins C and D resistance should be between 3.5 to 5.0 ohms.
Step 3. If resistance at connector is high or low proceed to step 4.
Step 4. Check wires to solenoid for open or short circuits and bad connections, or replace internal harness (para. 17-14) if ok proceed to step 5.
Step 5. Replace solenoid (para. 17-28).

END OF TESTING!

d. Torque converter clutch solenoid (no fourth gear, or clutch stuck on).
Step 1. Disconnect transmission electrical connector.
Step 2. Check resistance between pins S and E, resistance should be between 10 to 14 ohms.
Step 3. If resistance at connector is high or low proceed to step 4.
Step 4. Check wires from connector to solenoid for breaks or shorts, or replace internal harness (para. 17-14) if ok proceed to step 5.
Step 5. Replace solenoid (para. 17-28).

END OF TESTING!

e. Transmission fluid temperature sensor may not function properly (incorrect TCC apply and release).
Step 1. Disconnect transmission electrical connector.
Step 2. Using a multimeter check resistance between pins M and L (the resistance should be high at low temperatures and low at high temperatures).
(a) The resistance at connector at 0°C (320F) should be less than 11000 ohms and more than 7800 ohms.
(b) The resistance at connector, at 20°C (680F) should be less than 4100 ohms and more than 2900 ohms.
(c) The resistance at connector, at 40°C (104°F) should be less than 1700 ohms and 1200 ohms.
(d) The resistance at room temperature (72°F) should be between 2500 and 5000 ohms
If any of the above conditions are not met, replace transmission fluid temperature sensor (para. 17-28).
Step 3 Check wires from connector to sensor for breaks or shorts, or replace internal harness (para. 17-14).

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## 30. NO 1-2 UPSHIFT OR DELAYED UPSHIFT

Step 1. If oil pressure in "(D)"(overdrive) at 1000 rpm is normal, proceed to step 2. If oil pressure is high, proceed / to step 3.
Step 2. Check results of control valve and governor line pressure test (TM 9-2320-280-20).
Step 3. If oil pressure in N" (neutral) at 1000 rpm was normal, proceed to step 4. If oil pressure was high, proceed to step 4.
Step 4. Check control valve spacer plate for obstructions. Clean or replace spacer plate (chapter 17).

END OF TESTING!

## 31. 1-2 SHIFTS SOFT OR SLIPS

Step 1. Check transmission oil pressure response to varying throttle openings. Pressure should respond rapidly to quick changes in throttle opening. If oil pressure response is poor, proceed to step 2. If oil pressure response is normal, proceed to step 3.
Step 2. If oil pressure in "(D)" (overdrive) at 1000 rpm is low, proceed to step 3. If oil pressure is normal, proceed to step 9.
Step 3. Check oil pump for obstructed oil passages or damage. Repair oil pump (para. 17-29).
Step 4. Check forward clutch seals for damage. Replace damaged seals (para. 17-22).
Step 5. Check center support oil seal rings for damage. Replace damaged rings (para. 17-20).
Step 6. Check rear servo piston and oil seal rings for damage. Repair rear servo (para. 17-27) if damaged.
Step 7. Check front accumulator piston and oil seal rings for damage. Replace control valve (chapter 17) if accumulator piston components are damaged.
Step 8. Check transmission case for internal damage or porosity. Replace transmission (para. 7-8) if case is damaged or porous.
Step 9. Inspect control valve for nicks on machined surfaces or voids in casting, check 1-2 accumulator valve train for stuck valves or incorrect assembly; check front accumulator piston and oil seal rings for damage. Replace control valve (chapter 17) if any damage is found.
Step 10 Check rear servo and rear accumulator pistons and oil seal rings for damage. Repair rear servo (para. 17-11) if damaged.
Step 11. Check center support bolt for looseness. Tighten to 20-25 lb-ft (27-34 N-m).

**WARNING**

Compressed air used for cleaning purpose will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personnel protective equipment (goggles, shield, gloves, etc.).

Step 12. Air check intermediate clutch piston for proper operation. If operation is normal, proceed to step 13. If piston exhibits excessive leakage, proceed to step 14.
Step 13. Check intermediate clutch piston, plates, and release springs for damage or incorrect assembly. Repair intermediate clutch piston (para. 17-25) if damaged.
Step 14. Check center support for missing orifice plug. Replace transmission (para. 7-8) if plug is missing.

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## 32. 1-2 SHIFT FIRM OR ROUGH

Step 1. If oil pressure in "Ⓓ" (overdrive) at 1000 rpm is normal, proceed to step 2. If oil pressure is high, proceed to step 6.
Step 2. Check 1-2 accumulator valve train for stuck valves or incorrect assembly. Replace control valve (chapter 17) if any damage is found.
Step 3. Check rear accumulator piston and oil seal rings for damage. Repair rear servo (para. 17-27) if damaged.
Step 4. Check transmission case for restricted oil passages, damage, or porosity. Remove obstructions or replace transmission (para. 7-8) if case is damaged or porous.
Step 5. Check for missing or incorrectly installed check balls. Replace missing check balls (chapter 17).
Step 6. Check control valve spacer plate for obstructions and damaged or misalined gasket. Clean or replace spacer plate (chapter 17).
Step 7. Check oil pump for obstructed oil passages or damage. Repair oil pump (para. 17-29) if damaged.

END OF TESTING!

## 33. NO 2-3 UPSHIFT OR DELAYED UPSHIFT

**NOTE**

If malfunction only occurs at or near full throttle, check engine timing for proper adjustment and check exhaust system for restrictions.

Step 1. Check control valve for a stuck 2-3 valve, and misaligned or damaged gaskets. Replace control valve (chapter 17) if damaged.
Step 2. Check direct clutch for damage or burned clutch plates. Repair direct clutch (para. 17-21) if damaged.

END OF TESTING!

## 34. 2-3 SHIFT SOFT OR SUPS

Step 1. If oil pressure in "Ⓓ" (overdrive) at 1000 rpm is low, proceed to step 2. If oil pressure is normal, proceed to step 3.
Step 2. Perform steps 3 through 8 of malfunction 31.
Step 3. Perform steps 7 and 8 of malfunction 32.
Step 4. Check front servo for broken or missing spring and leak at servo pin. Repair front servo (chapter 17) if damaged.

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personnel protective equipment (goggles, shield, gloves, etc.).

Step 5. Air check direct clutch piston for proper operation. If piston exhibits excessive leakage, proceed to step 6. If operation is normal, proceed to step 7.
Step 6. Check direct clutch piston, plates, and release springs for damage or incorrect assembly. Repair intermediate clutch (para. 17-17) if damaged.
Step 7. Check transmission case passages for leaks. Replace transmission (para. 7-8) if case is damaged.

**END OF TESTING!**

## 35. 2-3 SHIFT FIRM OR ROUGH

Step 1. If oil pressure in "Ⓓ" (overdrive) at 1000 rpm is normal, proceed to step 2. If oil pressure is high, proceed to step 5.
Step 2. Check front accumulator for damaged piston, rings, and broken or missing spring; check valve to accumulator feed for obstructions. Replace control valve (chapter 17) if damaged.

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personnel protective equipment (goggles, shield, gloves, etc.).

Step 3. Air check direct clutch piston for leak to outer area of clutch piston; check center piston seal for damage. Repair direct clutch (para. 17-17) if damaged.
Step 4. Check center support and second oil ring for damage. Repair center support (para. 17-18) if damaged.
Step 5. Perform steps 6 and 7 of malfunction 32.

END OF TESTING!

## 36. NO 3-4 UPSHIFT OR DELAYED UPSHIFT

**NOTE**

If malfunction only occurs at or near full throttle, check engine timing for proper adjustment and check exhaust system for restrictions.

Step 1. Check control valve for a stuck 2-3 valve, and misaligned or damaged gaskets. Replace control valve (chapter 17) if damaged.
Step 2. Check direct clutch for damage or burned clutch plates. Repair direct clutch (para. 17-21) if damaged.

END OF TESTING!

## 37. 3-4 SHIFT SOFT OR SUPS

Step 1. If oil pressure in "D" (overdrive) at 1000 rpm is low, proceed to step 2. If oil pressure is normal, proceed to step 4.
Step 2. Perform steps 3 through 8 of malfunction 31.
Step 3. Perform steps 6 and 7 of malfunction 32.
Step 4. Check front servo for broken or missing spring and leak at servo pin. Repair front servo (chapter 17) if damaged.

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personnel protective equipment (goggles, shield, gloves, etc.).

Step 5. Air check direct clutch piston for proper operation. If piston exhibits excessive leakage, proceed to step 6. If operation is normal, proceed to step 7.
Step 6. Check direct clutch piston, plates, and release springs for damage or incorrect assembly. Repair intermediate clutch (para. 17-25) if damaged.
Step 7. Check transmission case passages for leaks. Replace transmission (para. 7-8) if case is damaged.

END OF TESTING

## 38. 3-4 SHIFT FIRM OR ROUGH

Step 1. If oil pressure in "D" (overdrive) at 1000 rpm is normal, proceed to step 2. If oil pressure is high, proceed to step 5.
Step 2. Check front accumulator for damaged piston, rings, and broken or missing spring; check valve accumulator feed for obstructions. Replace control valve (chapter 17) if damaged.

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personnel protective equipment (goggles, shield, gloves, etc.).

Step 3. Air check direct clutch piston for leak to outer area of clutch piston; check center piston seal for damage. Repair direct clutch (para. 17-21) if damaged.
Step 4. Check center support and second oil ring for damage. Repair center support (para. 17-20) if damaged.
Step 5. Perform steps 6 and 7 of malfunction 32.

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## 39. NO ENGINE BRAKING - THIRD GEAR

Step 1. Check front servo piston for leaking oil rings and damaged piston. Replace damaged components (chapter 17).
Step 2. Check front accumulator piston for leaking oil rings and damaged piston. Replace control valve (chapter 17) if damaged.
Step 3. Check front band for damage and proper installation. Replace front band (chapter 17) if damaged.

END OF TESTING!

## 40. NO ENGINE BRAKING - SECOND GEAR

Step 1. Check front servo piston for leaking oil rings and damaged piston. Replace damaged components (chapter 17).
Step 2. Check front accumulator piston for leaking oil rings and damaged piston. Replace control valve (chapter 17) if damaged.
Step 3. Check front band for damage and proper installation. Replace front band (chapter 17) if damaged.

END OF TESTING!

## 41. NO ENGINE BRAKING-FIRST GEAR

Step 1. Check for missing or incorrectly installed check balls. Replace missing check balls (chapter 17).
Step 2. Check transmission case for damage at check ball locations. Replace transmission (para. 7-8) if damaged.
Step 3. Check rear servo for leaking oil seal rings and damaged piston. Repair rear servo (para. 17-27) if damaged.
Step 4. Check rear band apply pin for proper length. Replace pin (character 17) if length is not correct.
Step 5. Check rear band for damage and proper installation. Replace rear band (chapter 17) if damaged.

END OF TESTING!

## 42. NO DRIVE OR SLIPS IN DRIVE

Step 1. If oil pressure in "(D)" (overdrive) at 1000 rpm is low, proceed to step 2. If oil pressure is normal, proceed to step 4.
Step 2. Perform steps 3, 4, and 8 of malfunction 31.
Step 3. Check forward clutch for damage and burned clutch plates. Repair forward clutch (para 17-22) if damaged.
Step 4. Check roller clutch for damage and proper installation. Replace roller clutch (para. 17-24) if damaged.

END OF TESTING!

## 43. NO REVERSE OR SUPS IN REVERSE

Step 1. If oil pressure in "(D)" (overdrive) at 1000 rpm is low, proceed to step 2. If oil pressure is normal, proceed to step 4.
Step 2. Perform step 4 and steps 6 through 9 of malfunction 31.
Step 3. Check control valve spacer plate for obstructions and misalined gasket. Clean or replace spacer plate (chapter 17) if damaged.
Step 4. Check control valve for damaged or leaky passages and stuck valves or incorrect assembly. Replace control valve (chapter 17) if damaged.
Step 5. Check rear servo and accumulator piston for damaged oil seal rings, pistons, and band apply pin. Check for correct length of ban apply pin. Repair rear servo and accumulator (para. 17-27) if damaged.
Step 6. Check center support and oil seal rings for damage and wear. Repair center support (para. 17-20) if damaged or worn.
Step 7. Check direct clutch for damage and burned clutch plates. Repair direct clutch (para. 17-21) if damaged.
Step 8. Check rear band for damage and proper installation. Replace band (chapter 17) if damaged.
Step 9. Check forward clutch for damage and binding (will not release). Repair forward clutch (para. 17-22) if damaged.

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

### 44. VEHICLE MOVES IN NEUTRAL

Step 1. Check manual valve for damage and proper installation. Replace manual valve (chapter 17) if damaged.

Step 2. Check oil pump for leaking oil passages and damage. Repair oil pump (para. 17-29) if damaged.

Step 3. Check forward clutch for damage and burned clutch plates. Repair forward clutch (para. 17-22) if damaged.

END OF TESTING!

### 45. VEHICLE MOVES IN PARK

Check parking lock pawl and actuator assembly for damage and proper installation. Replace (para 17-14) if damaged.

END OF TESTING!

### 46. TRANSMISSION NOISY

**NOTE**

Check engine accessory drive components: water pump, power steering pump, alternator, and air conditioner compressor (if installed) for the source of "noise" before checking transmission.

a. Noise in Neutral and All Driving Ranges.

Step 1. Check torque converter for loose mounting capscrews and damage. Tighten capscrews or replace torque converter (para. 17-15) if damaged.

Step 2. Check flywheel for damage. Replace flywheel (TM 9-2815-237-34) if damaged.

Step 3. Check oil pump for obstructed oil passages, damage, and proper assembly. Repair oil pump (para. 17-29) if damaged.

b. Noise in First, Second, Third, and Reverse.

Step 1. Check gear unit thrust bearings and races for damage. Replace bearing(s) and races if either is damaged (para. 17-19).

Step 2. Inspect gears for damage and wear. Replace damaged or worn components (para. 17-19).

Step 3. Inspect front internal gear ring for damage. Replace gear ring if damaged (para. 17-19).

c. Noise during Acceleration – Any Gear.

Check engine and transmission mounts for looseness or damage. Secure or replace mounts (para. 3-3 or TM 9-2320-280-20).

END OF TESTING!

## TRANSFER CASE

### 47. TRANSFER CASE WILL NOT SHIFT

**NOTE**

Perform the oil pressure diagnostic test (para. 17-32) and record the readings for use during troubleshooting.

Step 1. Check transfer case shift linkage for improper adjustment or damage which would interfere with operation. Adjust or replace shift rod (TM 9-2320-280-20).

Step 2. Check transfer case fluid level. Add fluid (TM 9-2320-280-20), if necessary.

Step 3. Repair or replace transfer case (para. 8-3).

END OF TESTING!

### 48. TRANSFER CASE NOISY

Step 1. Check transfer case fluid level. Add fluid (TM 9-2320-280-20), if necessary.

Step 2. Repair or replace transfer case (para. 8-3).

END OF TESTING!

*Table 2-1. Mechanical Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## DIFFERENTIAL

### 49. DIFFERENTIAL NOISY

Step 1. Check differential and axle free play tolerance (para. 9-11).

Step 2. Replace differential (para. 9-5).

END OF TESTING!

## BRAKES

### 50. NOISY BRAKES

Refinish brake rotors (para. 10-3)

### 51. BRAKE PEDAL PULSATION

Check brake rotor lateral runout (para. 10-3). Refinish any rotor not meeting specifications.

END OF TESTING!

### 52. ERRATIC BRAKING ACTION

Check for seized or binding brake caliper pistons. Repair any binding or seized caliper pistons (para. 10-4).

END OF TESTING!

## WHEELS, SUSPENSION, AND STEERING

### 53. POOR DIRECTIONAL STABILITY OR UNEVEN TIRE WEAR

Check front and rear wheel alignment (para. 9-8).

END OF TESTING!

### 54. NOISY SUSPENSION

Check for broken or cracked spring seats. Replace any damaged spring seats (para. 12-5).

END OF TESTING!

### 55. HARD STEERING OR EXCESSIVE PLAY IN STEERING

Check front wheel alignment (para. 9-8).

END OF TESTING!

## Section III. AIR-CONDITIONING TROUBLESHOOTING

### 2-8. GENERAL

Information in this section is used by support maintenance personnel to diagnose and correct air-conditioning system malfunctions.

### 2-9. AIR-CONDITIONING TROUBLESHOOTING INSTRUCTIONS

Before taking any action to correct a possible air-conditioning malfunction, perform the following:

**(1)** Question vehicle operator about nature of complaint and conditions under which problem occurs.

**(2)** Record symptoms and compare symptoms of listed malfunctions to help identify problem.

**(3)** Conduct visual inspection of system to identify obvious problems (loose belts or fittings, disconnected wires, dirty condensor, or evaporator surfaces, blown fuses, and massive leak).

### 2-10. INITIAL TEST CONDITIONS

**a.** Install manifold gauge set to compressor (para. 14-17 or 14-27.1).

**b.** Ensure a full charge of refrigerant is in system at start of test.

**(1)** Check sight glass reading for low refrigerant indication.

**(2)** Add refrigerant (para. 14-17 or 14-27.1), if necessary.

**NOTE**

Gauge readings taken at normal engine idle may not accurately reflect condition of system.

**c.** Set engine speed at 1500 rpm (TM 9-2320-280-20).

**d.** Set air-conditioner cooling and blower speed settings to maximum value (TM 9-2320-280-10).

**e.** Open vehicle doors to permit fresh flow of air through passenger/ambulance compartment.

**f.** Allow vehicle to run with air-conditioner on for at lease five minutes to allow temperature and pressure stabilization.

### 2-11. SYSTEM PERFORMANCE EVALUATION

**a.** Measure temperature of outlet duct in ambulance compartment by inserting end of thermometer to center air duct louver. Normal operation duct temperature is between 40°-50°F (4°-10°C), while ambient temperature is 70°F (231°C) and humidity is low.

**NOTE**

In a properly functioning system, duct temperature will increase as the ambient air temperature and humidity increases.

**b.** Low and high side gauge readings on manifold gauge set are used to identify and diagnose system problems. Refer to table 2-2 or 2-2.1 for normal low and high side pressure readings.

**c.** After troubleshooting repair, evacuation and recharging are complete, conduct performance test of system.

**d.** Perform pressure gauge and in-vehicle cold air duct readings to confirm system has been restored to peak operating condition.

**e.** Verify refrigerant level is correct before returning vehicle to service.

**NOTE**

Table 2-1.1 applies to air-conditioning systems serviced with FR-12 refrigerant only.

*Table 2-1.1. Normal Operating Temperatures and Pressures (FR-12).*

| Relative Humidity (percent) | Surrounding Air Temperature °F (°C) | Engine Speed (rpm) | Desirable Center Outlet Discharge Air Temperature °F (°C) | Low-Side Pressure ± 5 psi | High-Side Pressure ± 25 psi |
|---|---|---|---|---|---|
| 20 | 70 (21) | 1500 | 42 (6) | 9 | 157 |
| | 80 (26) | | 44 (7) | 15 | 188 |
| | 90 (32) | | 46 (8) | 20 | 206 |
| | 100 (37) | | 47 (8) | 23 | 235 |
| 30 | 70 (21) | 1500 | 44 (7) | 11 | 161 |
| | 80 (26) | | 45 (7) | 16 | 188 |
| | 90 (32) | | 47 (8) | 22 | 214 |
| | 100 (37) | | 48 (9) | 26 | 247 |
| 40 | 70 (21) | 1500 | 44 (7) | 12 | 165 |
| | 80 (26) | | 46 (8) | 18 | 200 |
| | 90 (32) | | 48 (9) | 24 | 223 |
| | 100 (37) | | 50 (10) | 28 | 258 |
| 50 | 70 (21) | 1500 | 46 (8) | 12 | 169 |
| | 80 (26) | | 48 (9) | 20 | 206 |
| | 90 (32) | | 52 (11) | 24 | 231 |
| | 100 (37) | | 54 (12) | 28 | 269 |
| 60 | 70 (21) | 1500 | 46 (8) | 14 | 173 |
| | 80 (26) | | 52 (11) | 22 | 213 |
| | 90 (32) | | 54 (12) | 26 | 239 |
| | 100 (37) | | 56 (13) | 30 | 280 |
| 70 | 70 (21) | 1500 | 48 (9) | 16 | 178 |
| | 80 (26) | | 52 (11) | 22 | 218 |
| | 90 (32) | | 56 (13) | 28 | 247 |
| | 100 (37) | | 60 (16) | 30 | 292 |
| 80 | 70 (21) | 1500 | 52 (11) | 20 | 182 |
| | 80 (26) | | 58 (14) | 24 | 222 |
| | 90 (32) | | 62 (17) | 30 | 257 |
| | 100 (37) | | N/A | N/A | N/A |
| 90 | 70 (21) | 1500 | 62 (17) | 22 | 186 |
| | 80 (26) | | 66 (19) | 32 | 230 |
| | 90 (32) | | 72 (22) | 42 | 264 |
| | 100 (37) | | N/A | N/A | N/A |

**NOTE**

Table 2-2 applies to air-conditioning systems serviced with R-12 refrigerant only.

*Table 2-2. Normal Operating Temperatures and Pressures (R-12).*

| Relative Humidity (percent) | Surrounding Air Temperature °F (°C) | Engine Speed (rpm) | Desirable Center Outlet Discharge Air Temperature °F (°C) | Low Side Pressure psi (kPa) ±5 psi (±34 kPa) | High Side Pressure psi (kPa) ±25 psi (±172 kPa) |
|---|---|---|---|---|---|
| | 70 (21) | | 40 ( 4) | 11 ( 76) | 177 (1220) |
| 20 | 80 (26) | 1500 | 42 ( 6) | 17 (117) | 208 (1434) |
| | 90 (32) | | 44 ( 7) | 22 (152) | 226 (1558) |
| | 100 (37) | | 45 ( 7) | 25 (172) | 255 (1758) |
| | 70 (21) | | 42 ( 6) | 13 ( 89) | 181 (1247) |
| 30 | 80 (26) | 1500 | 43 ( 6) | 18 (124) | 208 (1544) |
| | 90 (32) | | 45 ( 7) | 24 (165) | 234 (1613) |
| | 100 (37) | | 46 ( 9) | 28 (193) | 267 (1840) |
| | 70 (21) | | 42 ( 6) | 14 ( 96) | 185 (1275) |
| 40 | 80 (26) | 1500 | 44 ( 7) | 20 (138) | 220 (1517) |
| | 90 (32) | | 46 ( 8) | 26 (179) | 243 (1675) |
| | 100 (37) | | 48 ( 9) | 30 (207) | 278 (1917) |
| | 70 (21) | | 44 ( 7) | 14 ( 96) | 189 (1303) |
| 50 | 80 (26) | 1500 | 46 ( 8) | 22 (152) | 226 (1558) |
| | 90 (32) | | 50 (10) | 26 (179) | 251 (1730) |
| | 100 (37) | | 52 (11) | 30 (207) | 289 (1992) |
| | 70 (21) | | 44 ( 7) | 16 (110) | 193 (1331) |
| 60 | 80 (26) | 1500 | 50 (10) | 24 (165) | 233 (1606) |
| | 90 (32) | | 52 (11) | 28 (193) | 259 (1786) |
| | 100 (37) | | 54 (12) | 32 (221) | 300 (2068) |
| | 70 (21) | | 46 ( 8) | 18 (124) | 198 (1365) |
| 70 | 80 (26) | 1500 | 50 (10) | 24 (165) | 238 (1641) |
| | 90 (32) | | 54 (12) | 30 (207) | 267 (1840) |
| | 100 (37) | | 58 (14) | 32 (221) | 312 (2151) |
| | 70 (21) | | 50 (10) | 22 (152) | 202 (1393) |
| 80 | 80 (26) | 1500 | 56 (13) | 26 (179) | 244 (1682) |
| | 90 (32) | | 60 (16) | 32 (221) | 277 (1910) |
| | 100 (37) | | * | * | * |
| | 70 (21) | | 60 (16) | 24 (165) | 206 (1420) |
| 90 | 80 (27) | 1500 | 64 (18) | 34 (234) | 250 (1724) |
| | 90 (32) | | 70 (21) | 44 (303) | 284 (1958) |
| | 100 (38) | | * | * | * |

* Information not available

**NOTE**

Table 2-2.1 applies to air-conditioning systems serviced with R-134a refrigerant only.

*Table 2-2.1. Normal Operating Temperatures and Pressures (R-134a).*

| AMBIENT TEMPERATURE | | LOW SIDE PRESSURE RANGE** | | HIGH SIDE PRESSURE RANGE** | |
|---|---|---|---|---|---|
| F° | C° | PSI | kPa | PSI | kPa |
| 70 | 21 | 10-25 | 69-172 | 130-190 | 896-1310 |
| 80 | 27 | 13-27 | 90-186 | 170-230 | 1172-1586 |
| 90 | 32 | 18-32 | 124-221 | 210-270 | 1448-1862 |
| 100 | 38 | 23-37 | 159-255 | 250-310 | 1724-2137 |

**Low and high side pressures are affected by relative humidity. Greater humidity will cause higher pressures. Normal A/C test pressures at 1500 rpm.

# AIR-CONDITIONING
# TROUBLESHOOTING SYMPTOM INDEX


| MALFUNCTION NO. | AIR-CONDITIONING MALFUNCTION | TROUBLESHOOTING PROCEDURE PAGE |
|---|---|---|
| | **AIR-CONDITIONER** | |
| 1. | Insufficient cooling | 2-22 |
| 2. | Intermittent cooling | 2-23 |
| | **AIR-CONDITIONER COMPRESSOR** | |
| 3. | Insufficient cooling | 2-24 |
| 4. | Unusual noise with clutch engaged | 2-25 |
| 5. | Unusual noise with clutch disengaged | 2-26 |
| 6. | Incorrect oil level or leak | 2-26 |


## AIR-CONDITIONER

### 1. INSUFFICIENT COOLING

a. Check for Refrigerant Loss

Step 1. Connect manifold gauge to low and high service connectors (para. 14-17 or 14-27.1).

Step 2. Start vehicle engine and adjust speed to 1500 rpm (TM 9-2320-280-20).

Step 3. Set thermostat switch and fan switch to maximum position (TM 9-2320-280-10).

Step 4. Run vehicle with air-conditioner on for five minutes.

Step 5. Check low side of manifold gauge for normal to low reading and high side for low reading (table 2-2 or 2-2.1). If these conditions occur, perform leak test, repair leaks, evacuate, and recharge as necessary (para. 14-17 or 14-27.1).

b. Check for Air or Moisture in System

Step 1. Perform malfunction 1a, steps 1 through 4.

Step 2. Check low side of manifold gauge for normal to high reading (table 2-2 or 2-2.1). If sight glass has no bubbles, tiny bubbles, or occasional bubbles, discharge system, replace dryer bottle (para. 14-19 or 14-27.3), evacuate, and recharge system (para. 14-17 or 14-27.1).

c. Check Expansion Valve

Step 1. Perform malfunction 1a, steps 1 through 4.

Step 2. Check high side of manifold gauge for high reading and low side for low reading (possible vacuum) (table 2-2 or 2-2.1). If discharge (evaporator) air is cool, expansion valve sweating or frosted, or control tube loose, either reposition control tube or replace expansion valve (para. 14-21 or 14-27.5).

**NOTE**

If control tube must be repositioned, re-wrap bulb with insulating tape.

Step 3. Check high side of manifold gauge for high reading and low side for high reading (table 2-2 or 2-2.1). If discharge (evaporator) air is warm, replace expansion valve (para. 14-21 or 14-27.5).

d. Check Thermostatic Switch

Step 1. Perform malfunction 1a, steps 1 through 4.

Step 2. Check low and high side manifold gauge readings for normal reading (table 2-2 or 2-2.1). If system runs continuously, remains in on (evaporator freeze-up) or off (poor cooling) cycle, or is inoperative, but can be made operative by jumping battery to clutch power load wire, then relocate temperature sensor, perform electrical troubleshooting (TM 9-2320-280-20) or replace thermostat unit, as necessary (para. 14-15).

*Table 2-3. Air Conditioning Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

e. Check Clutch Cycling Pressure Switch

Step 1. Perform malfunction 1a, steps 1 through 4.

Step 2. Check low side of manifold gauge for low reading and high side for normal reading (table 2-2 or 2-2.1). If clutch cycling system runs continuously, then the switch is stuck closed. Replace pressure switch (para. 14-16).

Step 3. Check low and high side of manifold gauge for an approximate 70 psi (483 kPa) reading. If system is inoperative, but can be made operative by jumping battery to clutch power lead wire, then the switch is stuck open. Replace pressure switch (para. 14-16).

f. Check for High Side Restriction

Step 1. Perform malfunction 1a, steps 1 through 4.

Step 2. Check low side of manifold gauge for low reading and high side for normal to high reading (table 2-2 or 2-2.1). If discharge (evaporator) air is cool and high side refrigerant lines are cold, wet, or frosted, remove liquid line (para. 14-17 or 14-27.1), flush line (para. 14-17 or 14-27.1), and replace dryer bottle (para. 14-19 or 14-27.3).

**NOTE**

If blockage then occurs in liquid lines, condenser, receiver-drier, or expansion valve, frost may build up just beyond point of restriction.

g. Check Condenser

Step 1. Perform malfunction 1a, steps 1 through 4.

Step 2. Check low side of manifold gauge for normal or high reading and high side for high reading (table 2-2 or 2-2.1). If discharge (evaporator) air is warm, liquid line is hot, air flow through condenser is restricted, bubbles are seen in sight glass, then clean condenser exterior, if dirty. If condenser fans are inoperative, refer to electrical system troubleshooting (TM 9-2320-280-20) Flush condenser (para. 14-17 or 14-27.1) or replace condenser (para. 14-24 or 14-27.8), if damaged.

h. Check for Overcharged System

Step 1. Perform malfunction 1a, steps 1 through 4.

Step 2. Check low side of manifold gauge for normal to high reading and high side for high reading (table 2-2 or 2-2.1). If system runs continuously, compressor is noisy on start-up, discharge (evaporator) air is warm, a partial system discharge is required, continue to step 3.

Step 3. Insert center hose of manifold gauge set in a catch bottle or can.

**NOTE**

Do not allow refrigerant to escape too quickly. Lubricating oil will escape.

Step 4. Turn low pressure gauge valve and high pressure gauge valve counterclockwise slightly to permit refrigerant to slowly escape through center hose until correct pressure and high side pressure are obtained.

END OF TESTING!

## 2. INTERMITTENT COOLING

Check air-conditioner output for temperature variation. If air is intermittently warm and cold, perform the following:

Step 1. Check for air or moisture in system by performing malfunction 1b.

Step 2. Ensure temperature sensing probe is inserted properly in the evaporator fins near the outlet (para. 14-14).

Step 3. Perform mechanical troubleshooting malfunction 9.

Step 4. Check sight glass reading for oil streaks, indicating too much oil in system.

Step 5. If oil is found in system, flush system (para. 14-17 or 14-27.1), replace dryer bottle (para. 14-19 or 14-27.3), and change oil (para. 14-17 or 14-27.1).

END OF TESTING!

*Table 2-3. Air Conditioning Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## AIR-CONDITIONER COMPRESSOR

**NOTE**

Before beginning compressor troubleshooting or inspection procedures, always clean away oil, grease, dirt, and refrigerant residue.

### 3. INSUFFICIENT COOLING

a. If Air-Conditioner Compressor Runs Smoothly, Perform the Following:

Step 1. Connect manifold gauge set to low and high service connector ports (para. 14-17 or 14-27.1).

Step 2. Run compressor at idle speed (6.2 L at 650 rpm, 6.5 L at 700 rpm) for five minutes.

Step 3. If unusually high low pressure is observed in combination with unusually low high side pressure, stop compressor and measure elapsed time that high side pressure is equal to low side pressure. If less than two minutes, then the reed valve or head gasket may be defective. Disassemble and replace components (para. 14-27 or 14-27.11) as necessary.

**NOTE**

During disassembly, check for head gasket damage, a broken or deformed reed valve, dirt, or other foreign material stuck under reed valve or gasket, valve plate damage, cracks, etc.

Step 4. If unusually low side pressure and high side pressure are observed, check for low refrigerant charge or refrigerant leaks and replenish refrigerant as necessary (para. 14-17 or 14-27.1).

Step 5. Check compressor for oil leak under seal area between shaft and compressor. Replace shaft seal if defective (para. 14-27 or 14-27.11).

Step 6. Check for damaged front housing O-ring (missing or protruding sections). Replace O-ring, if damaged (para. 14-27 or 14-27.11).

Step 7. Check for oil around cylinder head. Inspect gasket, service port and fittings for looseness and damage. Tighten loose fittings and replace defective gaskets or other defective parts (para. 14-27 or 14-27.11).

Step 8. Check for oil seepage from filler hole. Inspect O-ring and plug for damage. Replace defective components (para. 14-27 or 14-27.11).

Step 9. Check for oil seepage from cracks in cylinder block. Replace compressor if cracks are found (para. 14-24 or 14-27.8).

b. If Air-Conditioner Compressor Runs Intermittently or is Inoperative, Perform the Following:

Step 1. Check belt tension. Restore belt tension (TM 9-2320-280-20).

Step 2. Check clutch air gap (space between pulley and front clutch plate) (para. 14-27 or 14-27.11) with feeler gauge. Gap must be within range of 0.016 - 0.031 in. (0.406 - 0.787 mm).

c. Check Clutch

Step 1. Inspect field clutch lead wire. If wire is broken or damaged, replace field coil (para. 14-27 or 14-27.11).

Step 2. Disconnect leads 436 and 798 from field coil leads.

Step 3. Connect positive lead of multimeter to circuit no. 436 on field coil. Connect negative lead of multimeter to circuit no. 798 on field coil. Field coil should read 12.0 to 15.0 ohms resistance at 73.4°F (23°C). If field resistance test is not within specifications, replace field coil (para. 14-27 or 14-27.11).

Step 4. Connect leads 436 and 798 to field oil leads.

Step 5. Check clutch air gap (space between pulley and front clutch plate) (para. 14-27 or 14-27.11) with feeler gauge. Gap must be within range of 0.016 - 0.031 in. (0.406 - 0.787 mm).

d. If Compressor Runs Roughly, Perform the Following:

Step 1. Discharge air-conditioning system (para. 14-17 or 14-27.1).

Step 2. Disconnect leads 436 and 798 from field coil and remove service valves (para. 14-25 or 14-27.9).

Step 3. Rotate compressor shaft clockwise (facing compressor) using 3/4 in. socket and wrench on shaft nut.

Step 4. Check for severe rough spots or catches while rotating shaft nut. If rough spots or catches are observed, replace compressor (para. 14-24 or 14-27.8).

END OF TESTING!

*Table 2-3. Air Conditioning Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

## 4. UNUSUAL NOISE WITH CLUTCH ENGAGED

a. Inspect Compressor Mounting Component

Step 1. Check for a loose belt. Restore tension (TM 9-2320-280-20).

Step 2. Check for broken bracket or compressor mounting gear. Replace damaged components (para. 14-26 or 14-24 for R-12. Para 14-27.10 or 14-27.8 for R-134a).

Step 3. Check for missing, broken, or loose bolts at compressor and engine mounting points. Replace damaged or missing components.

**NOTE**

Ensure correct torque has been applied to mounting bolts.

Step 4. Check for loose or wobbling compressor pulley, and for shaft nut torque and "bottoming". Repair or replace damaged components (para. 14-27 or 14-27.11).

b. Inspect Engine Compartment

Step 1. Disconnect belt (TM 9-2320-280-20) and operate engine at idle to isolate engine noise from air-conditioner compressor noise. If noise condition stops, continue to step 2. If noise condition still exists, refer to mechanical troubleshooting (table 2-1).

Step 2. Check for proper refrigerant charge (malfunction 1a). Low refrigerant charge can cause unusual noise.

Step 3. Check clutch air gap (space between pulley and front clutch plate) (para. 14-27 or 14-27.11) with feeler gauge. Gap must be within range of 0.016 - 0.031 in. (0.406 - 0.787 mm).

c. Check Clutch Bearing Operation

Step 1. Remove drivebelt (TM 9-2320-280-20).

Step 2. Rotate pulley by hand and listen for bearing noise while feeling for hard spots. If noise or hard spots are excessive, replace pulley and front clutch plate assembly or bearing (para. 14-27 or 14-27.11).

d. Check Oil Level

Insufficient amount of oil may cause compressor to be noisy. Restore oil to correct level (para. 14-17 or 14-27.1).

e. Check Internal Compressor

Perform malfunction 3d, steps 1 through 3, to determine an internal compressor failure. Replace compressor, if necessary (para. 14-24 or 14-27.8).

f. Inspect Valve Plate

Step 1. Remove and inspect valve plate. If compressor makes a "clacking" sound at idle speed, check the high side and low side valves for damage. Replace if necessary (para. 14-27 or 14-27.11).

Step 2. Perform malfunction 3a, steps 1 through 3, to determine pressure balance test. If high side pressure does not increase to a normal value at engine idle while the low side pressure remains high, the head gasket may be damaged. Replace if necessary (para. 14-27 or 14-27.11).

Step 3. Check for a broken discharge reed valve, retainer, or suction reed valve. Replace if necessary (para. 14-27 or 14-27.11).

END OF TESTING!

*Table 2-3. Air Conditioning Troubleshooting (Cont'd)*

| MALFUNCTION<br>TEST OR INSPECTION |
|---|

### 5. UNUSUAL NOISE WITH CLUTCH DISENGAGED

a. Check Clutch Air Gap (space between pulley and front clutch plate) (para. 14-27 or 14-27.11) with feeler gauge. Gap must be within range of 0.016 - 0.031 in. (0.406 - 0.787 mm). If air gap cannot be adjusted to specifications, add or remove shims (malfunction 3b, steps 1 and 2).

b. Check for defective clutch pulley or front plate. Replace as necessary (para. 14-27 or 14-27.11).

END OF TESTING!

### 6. INCORRECT OIL LEVEL OR LEAK

After a system component has been replaced or there is reason to suspect an incorrect oil level or leak, use the following procedure to check the oil level:

**NOTE**

Delete step 1 of this procedure if the compressor has been removed from vehicle.

Step 1. Run compressor for ten minutes at engine idle (6.2 L at 650 rpm, 6.5 L at 700 rpm).

Step 2. Check compressor oil level (para. 14-17 or 14-27.1).

END OF TESTING!

## SECTION IV. GENERAL MAINTENANCE INSTRUCTIONS

### 2-12. GENERAL MAINTENANCE INSTRUCTIONS TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 2-13. | Cleaning | 2-27 |
| 2-14. | Inspection | 2-28 |
| 2-15. | Repair | 2-29 |
| 2-16. | Assembly | 2-30 |


### 2-13. CLEANING

**a. General Instructions**. Cleaning procedures will be the same for the majority of parts and components which make up the vehicle subassemblies. General cleaning procedures are detailed in "b" through "h".
**b. The Importance of Cleaning**. Great care and effort are required in all cleaning operations. The presence of dirt and foreign material is a constant threat to satisfactory vehicle operation and maintenance. The following will apply to all cleaning operations:

**(1)** Hands must be kept free of any accumulation of grease which can collect dust and grit.
**(2)** Clean all parts before inspection, after repair, and before assembly.
**(3)** After cleaning, all parts must be covered or wrapped in plastic or paper to protect them from dust and/or dirt.
c. Disassembled Parts Cleaning. Place all disassembled parts in wire baskets for cleaning.

**(1)** Dry and cover all cleaned parts.
**(2)** Place on or in "racks" and hold for inspection or repair.
**(3)** All parts subject to rusting must be lightly oiled and wrapped.
**(4)** Keep all related parts and components together. Do not mix parts.

**WARNING**

Improper cleaning methods and use of unauthorized cleaning solutions will injure personnel and damage equipment. See TM 9-247 for correct information.
**d. Castings**.

**(1)** Clean inner and outer surfaces of castings and all areas subject to grease and oil with cleaning solvents. Refer to TM 9-247.
**(2)** Use a stiff brush to remove sludge and gum deposits.

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

**(3)** Use compressed air to blow out all tapped capscrew holes and dry castings after cleaning.

**e. Oil Passages**. Particular attention must be given to all oil passages in castings and machined parts. Oil passages must be clean and free of any obstructions.

**(1)** Clean passages with wire probes to break up any sludge or gum deposits.

**(2)** Wash passages by flushing with solvents. See TM 9-247.

**(3)** Dry passages with compressed air.

**CAUTION**

Do not allow solvents to come in contact with seals, cables, or flexible hoses. These cleaners cause leather, rubber, and synthetic materials to dry out, rot, and lose pliability making them unserviceable.

**f. Nonmetallic Parts**. Clean hoses and other nonmetallic parts with soap and water.

**g. Bearings**.

**WARNING**

Do not use compressed air to dry bearings. Spinning a dry bearing with compressed air may cause injury to personnel or damage to equipment.

**(1)** Bearings require special cleaning. After removing surface oil and gum deposits, place bearings in hot oil, 140°F (60°C), to loosen congealed oil and grease. Wipe bearings dry with a lint-free cloth; do not use compressed air.

**(2)** See TM 9-214 for information and care of bearings.

**h. Electrical Components**

**(1)** Clean electrical components with clean cloth dampened with drycleaning solvent. Care must be taken not to damage protective insulation.

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

**(2)** Use compressed air to dry electrical components.

## 2-14. INSPECTION

**a. General Instructions**. Procedures for inspections will be the same for many parts and components which make up the vehicle subassemblies. General procedures are detailed in "b" through "k". Dimensional standards for parts have been fixed at extremely close tolerances, so use specification tables. Use specified inspection equipment for inspection where cracks and other damage cannot be spotted visually. Exercise extreme care in all phases of inspection. Repair or replace all unserviceable components; refer to paragraph 2-15.

**b. Castings**.

**(1)** Inspect all ferrous and nonferrous castings for cracks. See MIL-STD-6866, Inspection, Penetrant Methods. Particularly check areas around studs, pipe plugs, threaded inserts, and sharp corners. Replace cracked castings.

**(2)** Inspect machined surfaces for nicks, burrs, and raised metal. Mark damaged areas for repair or replacement.

**(3)** Inspect all pipe plugs, pipe plug openings, capscrews, and capscrew openings for damage and stripped threads. Replace if damaged or threads are stripped.

**(4)** Check all gasket mating surfaces, flanges on housings, and supports for warpage with a straightedge or surface plate. Inspect mating flanges for discolorations which may indicate leakage. Replace if warped.

**(5)** Check all castings for conformance to applicable repair standards. Refer to TM 9-214.

**c. Bearings.** Check all bearings for conformance to applicable repair standards.

**d. Bushings and Bushing Type Bearings.**

**(1)** Check all bushings and bushing type bearings for secure fit, evidence of heating, wear, burrs, nicks, and out-of-round condition.

**(2)** Check for dirt in lubrication holes or grooves. Holes and grooves must be clean and free from damage.

**e. Machined Parts.**

**(1)** Check machined parts for cracks, distortion, and damage.

**(2)** Check all surfaces for nicks, burrs, and raised metal.

**f. Studs, Bolts, Capscrews, and Nuts.** Replace if bent, loose, stretched, or threads are damaged.

**g. Gears.**

**NOTE**

When gear teeth wear limits are not established, good judgment is required to determine if gear replacement is necessary.

**(1)** Inspect all gears for cracks and missing teeth. Replace if cracked or teeth are missing.

**(2)** Inspect gear teeth for wear, sharp fins, burrs, and galled or pitted surfaces.

**(3)** Inspect splines for wear, burrs, and galled or pitted surfaces.

**(4)** Check keyway slots for wear and/or damage.

**h. Oil Seals.** Oil seals are mandatory replacement items.

**i. Casting Plugs.** Inspect for leakage. Replace plugs when leakage is present.

**j. Springs.** Inspect for damaged, distorted, and collapsed coils.

**k. Snaprings, Retaining Rings, and Washers.** Many of these parts are mandatory replacement items. Inspect all others for obvious damage.

## 2-15. REPAIR

**a. General Instructions.** Repair of most parts and components is limited to general procedures outlined in applicable maintenance instructions and the following detailed procedures “b” through “h.”

**CAUTION**

Repaired items must be thoroughly cleaned to remove metal chips and abrasives to prevent them from entering working parts of vehicle components.

**b. Castings.**

**(1)** All cracked castings will be replaced.

**(2)** Only minor repairs to machined surfaces, flanges, and gasket mating surfaces are permitted. Remove minor nicks, burrs, and/or scratches by:

(a) Using fine mill file.

(b) Using abrasive cloth dipped in cleaning solvent.

(c) Lapping across a surface plate.

(d) Remachining of machined surfaces to repair damage, warpage, or uneven surfaces is not permitted. Replace castings.

**(3)** Repair damaged threaded pipe plug and/or capscrew holes with a thread tap or repair oversize holes with threaded inserts.

**c. Bearings.** See TM 9-214.

**d. Studs.** Replace all bent and stretched studs. Repair minor thread damage with a thread restorer file. Replace studs having stripped or damaged threads as outlined below:

**(1)** Remove, using a stud remover. Back studs out slowly to avoid heat buildup and seizure which can cause stud to break off.

**(2)** If studs break off too short to use a stud remover, use extractor to remove.

**(3)** Replacement studs have a special coating and must have a small amount of antiseize compound (appendix B, item 5) applied on threads before stud is installed. Install replacement stud slowly to prevent heat buildup and snapping off.

**e. Gears.**

**(1)** Remove gears using pullers, as required.

**(2)** Use the same methods described in paragraph 2-15.b (2) for castings to remove minor nicks, burrs, or scratches on gear teeth.

**(3)** If keyways are worn or enlarged, replace gear.

**f. Bushings and Bushing Type Bearings.** When bushings and bushing type bearings seize to a shaft and spin in the bore, the associated part must also be inspected and replaced, as required.

**g. Oil Seals.**

**(1)** Remove oil seals, being careful not to damage casting or adapter bore.

**(2)** Always install new seal in bore using proper seal replacing tool.

**h. Locking Threads.** When using thread sealing compound:

**(1)** Apply a liberal amount to both male and female threads on through-hole assemblies.

**(2)** Apply a liberal amount into the bottom of a blind hole (non-through hole assemblies). Installing the fastener pneumatically forces the adhesive onto the threads.

**(3)** Assemble parts shortly after applying thread sealing compound to allow adequate coating of threads.

## 2-16. ASSEMBLY

**a.** Cleanliness is essential in all component assembly operations. Dirt and dust, even in minute quantities, are abrasive. Parts must be cleaned as specified, and kept clean. Wrap or cover parts and components when assembly procedures are not immediately completed.

**b.** Coat all bearings and contact surfaces with operating oil (differential oil for differential parts, transmission oil for transmission parts, etc.) to ensure lubrication of parts during initial operation after repair.

# CHAPTER 3
# ENGINE MAINTENANCE

## Section I. GENERAL ENGINE MAINTENANCE

### 3-1. INTRODUCTION

This chapter contains instructions for replacement and repair of 6.2 L and 6.5 L engine components at the Direct Support maintenance level. Some subassemblies and parts must be removed before engine components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

### 3-2. GENERAL ENGINE MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 3-3. | Engine Mount and Insulator Maintenance | 3-2 |
| 3-4. | Left Cylinder Head Repair | 3-8 |
| 3-5. | Right Cylinder Head Replacement | 3-12 |
| 3-6. | Crankshaft Pulley Replacement | 3-14 |
| 3-7. | Torsional Damper Replacement | 3-15 |
| 3-8. | Rocker Arm Shafts and Pushrods Replacement | 3-17 |
| 3-9. | Hydraulic Valve Lifter Replacement | 3-18 |
| 3-10. | Timing Chain Cover, Timing Chain, and Drive Sprockets Maintenance | 3-20 |
| 3-11. | Left Rocker Arm Cover Maintenance | 3-24 |
| 3-12. | Right Rocker Arm Cover Maintenance | 3-26 |
| 3-13. | Front Cover Oil Seal Replacement | 3-28 |
| 3-14. | Oil Pump Drive Replacement | 3-29 |
| 3-15. | Rear Main Oil Seal Replacement | 3-30 |
| 3-16. | Oil Pump Maintenance | 3-34 |
| 3-17. | Intake Manifold Maintenance | 3-36 |
| 3-18. | Glow Plug Tip Removal (Damaged or Broken) | 3-38 |
| 3-19. | Engine Injection Pump Timing | 3-40 |
| 3-20. | Engine Run-In | 3-44 |

# 3-3. ENGINE MOUNT AND INSULATOR MAINTENANCE

**This task covers:**

**a. Removal**
**b. Disassembly**
**c. Assembly**
**d. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**
Crowfoot, 5/8 in. (Appendix G, Item 110)
Torque adapter, 9/16 in. (Appendix G, Item 106)
Torque adapter, 3/4 in. (Appendix G, Item 107)
Adapter, 3/8-1/2 in. (Appendix G, Item 108)
Engine lifting sling (Appendix G, Item 22)

**Materials/Parts**
Five lockwashers (Appendix E, Item 104)
Ten locknuts (Appendix E, Item 65)
Four locknuts (Appendix E, Item 63)
Antiseize compound (Appendix B, Item 7)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Fuel pump removed (right engine mount only) (TM 9-2320-280-20).
- Right engine splash shield removed (TM 9-2320-280-20).
- Engine access cover removed (TM 9-2320-280-20).
- Front propeller shaft removed (left engine mount only) (TM 9-2320-280-20).
- Glow plug controller removed (TM 9-2320-280-20).
- Air horn support and engine lift bracket removed (TM 9-2320-280-20).

**General Safety Instructions**
Direct all personnel to stand clear during hoisting operation.

**Maintenance Level**
Direct support

## a. Removal

**NOTE**

Left and right engine mounts are removed basically the same except right hand engine mounts have a starter support bracket.

1. Remove two locknuts (9) and washers (10) from insulator (11) on engine mount bracket (8). Discard locknuts (9).

**NOTE**

Perform steps 2 and 3 for right engine mount only.

2. Loosen nut (12) securing starter (13) to starter support bracket (1).

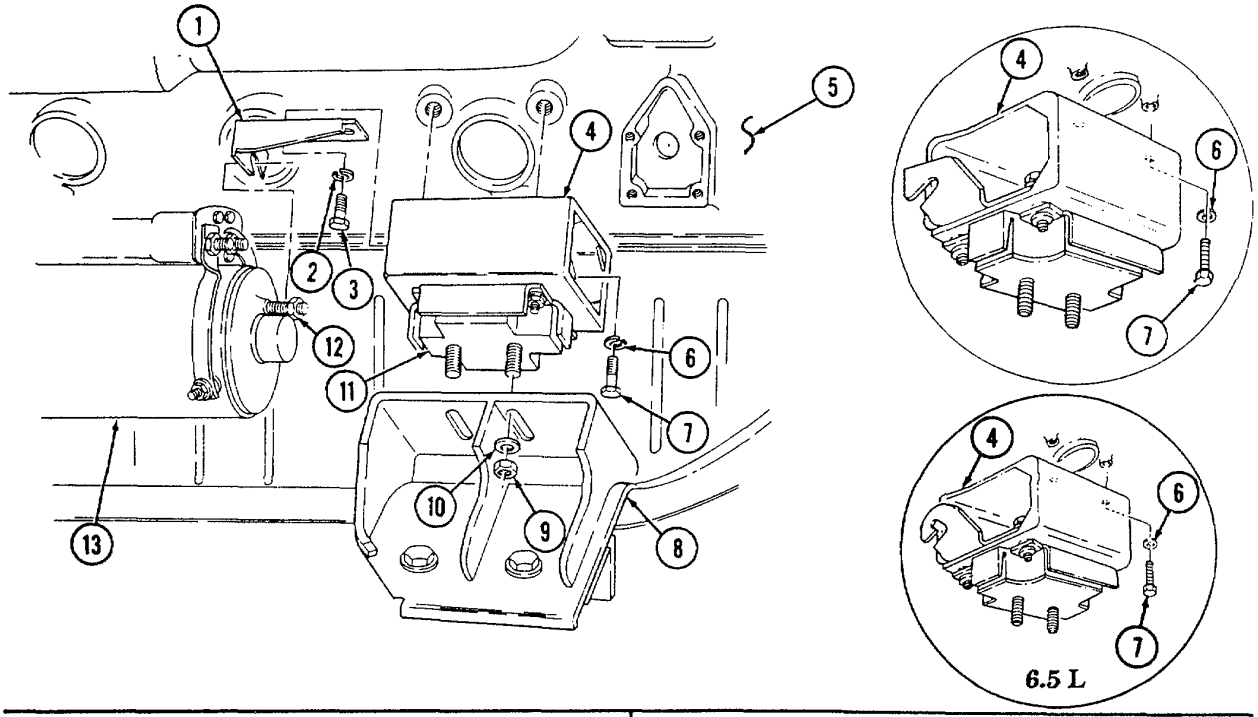
**NOTE**

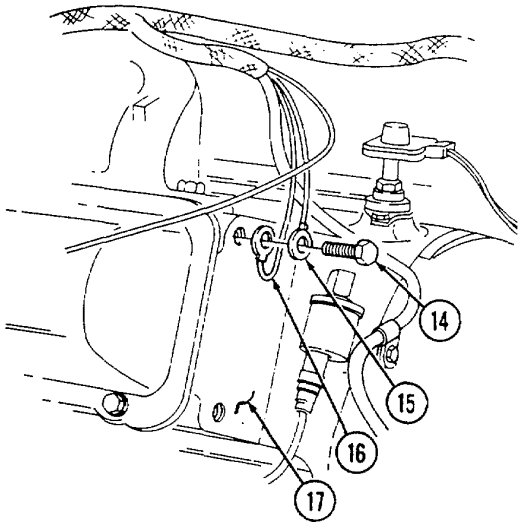
Proceed to step 4 for vehicles with new support bracket configuration.

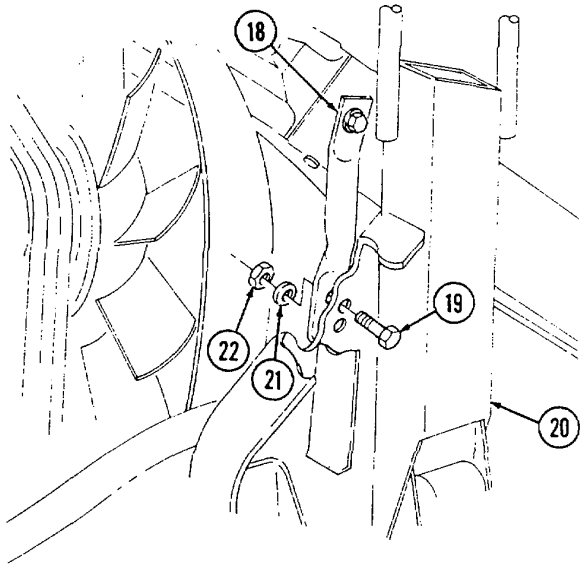
3. Remove two capscrews (3), lockwashers (2), and starter support bracket (1) from starter (13) and right engine mount (4). Discard lockwashers (2).
4. Remove three capscrews (7) and lockwashers (6) from right engine mount (4) and cylinder block (5). Discard lockwashers (6).
5. Remove capscrew (14) and grounds 3A (15) and 58A (16) from left cylinder head (17).
6. Remove four locknuts (22), washers (21), and capscrews (19) from radiator supports (18) and airlift brackets (20). Discard locknuts (22).

**3-3. ENGINE MOUNT AND INSULATOR MAINTENANCE (Cont'd)**

NEW 6.2L CONFIGURATION



## 3-3. ENGINE MOUNT AND INSULATOR MAINTENANCE (Cont'd)

7. Install engine lifting sling on engine (2) and to right cylinder head (7) with two bolts (6).
8. Install sling bracket (4) on left cylinder head (5) with two bolts (3). Tighten bolts (6) and (3) and install bracket (4) on engine lifting sling with pin (1).

**WARNING**

Direct all personnel to stand clear during hoisting operation. Failure to do this may cause injury.

9. Attach hoist to engine lifting sling. Slowly raise engine (2) enough to remove engine mount (8) and insulator (10) from engine mount bracket (9).
10. Remove engine mount (8) and insulator (10) from engine mount bracket (9).

**b. Disassembly**

**NOTE**

Perform step 1 for right engine mount. Perform step 2 for left engine mount.

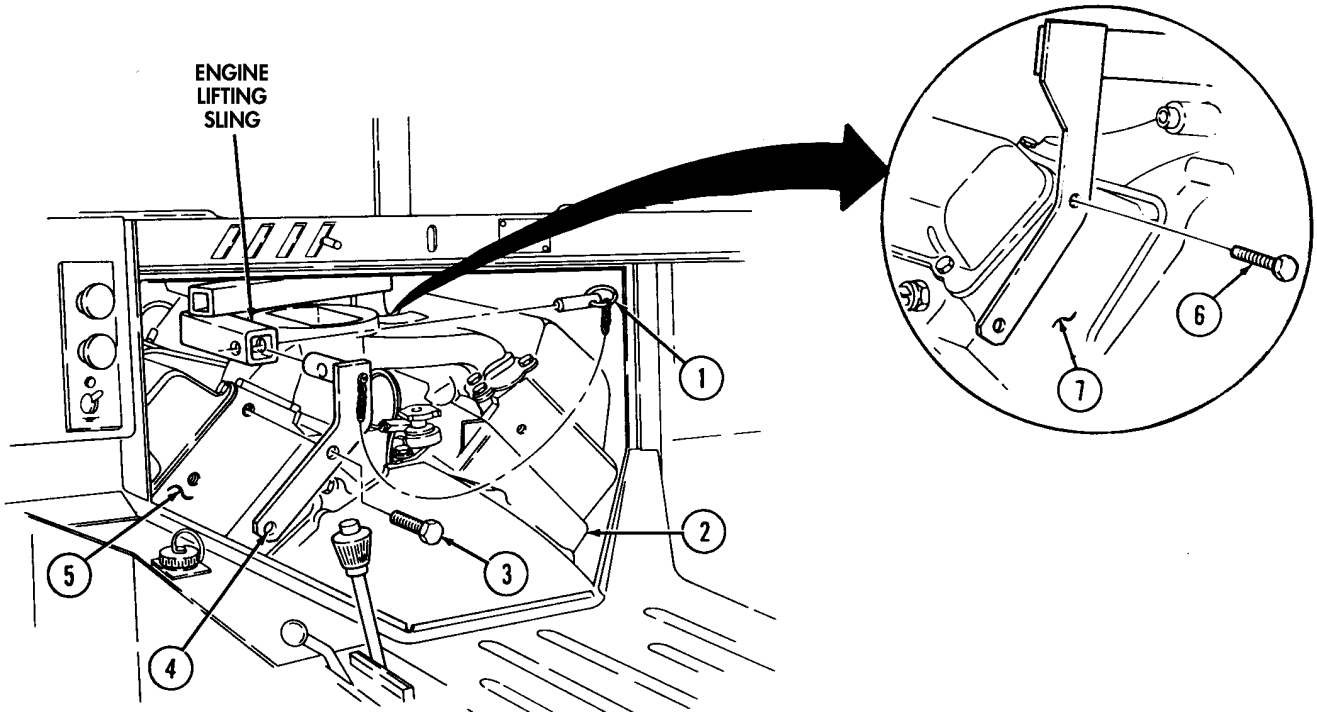
1. Remove four locknuts (13), washers (12), capscrews (11), washers (12), starter bracket (13.1), and insulator (10) from right engine mount (8). Discard locknuts (13)
2. Remove four locknuts (13), washers (12), capscrews (11), washers (12), and insulator (10) from left engine mount (14). Discard locknuts (13).

**c. Assembly**

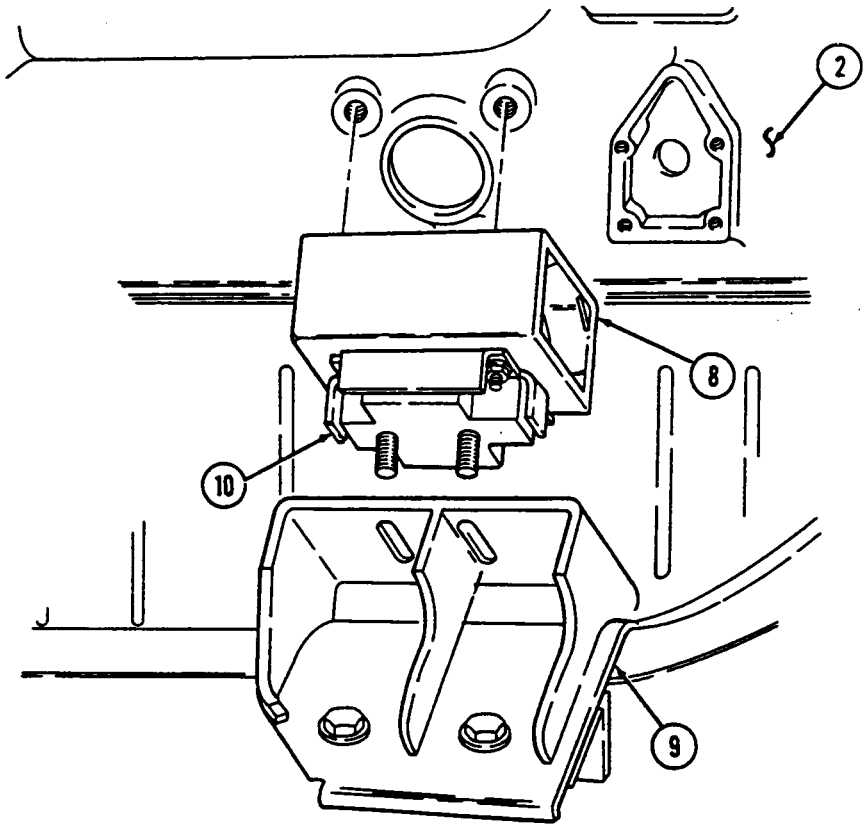
**NOTE**

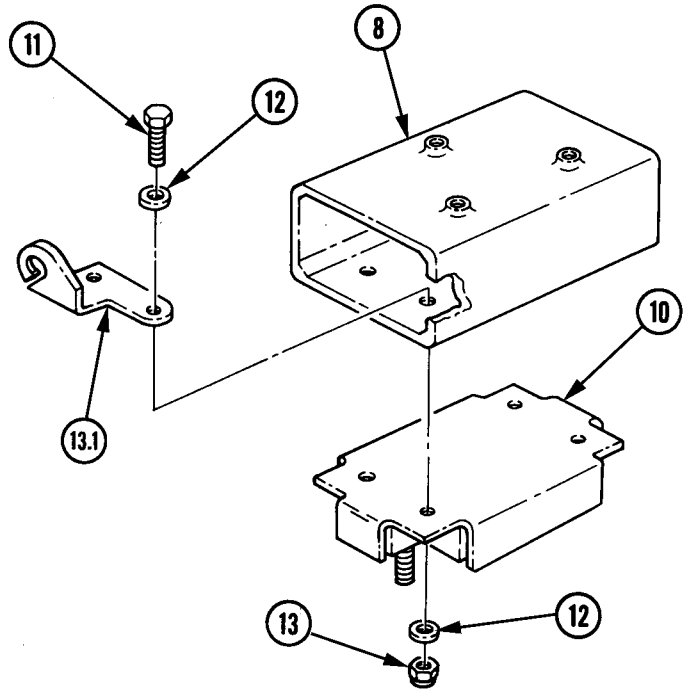
Perform step 1 for right engine mount. Perform step 2 for left engine mount.

1. Install insulator (10) and starter bracket (13.1) on right engine mount (8) with four washers (12), capscrews (11), washers (12), and locknuts (13). Tighten locknuts (13) to 37 lb-ft. (50 N•m).
2. Install insulator (10) on left engine mount (14) with four washers (12), capscrews (11), washers (12), and locknuts (13). Tighten locknuts (13) to 37 lb-ft. (50 N•m).

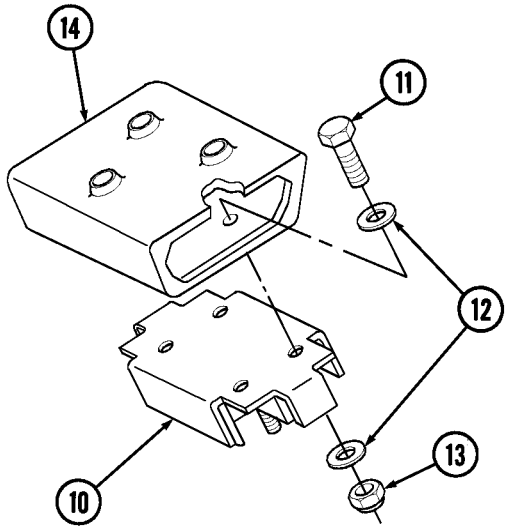


## 3-3. ENGINE MOUNT AND INSULATOR MAINTENANCE (Cont'd)




RIGHT ENGINE MOUNT




LEFT ENGINE MOUNT

## 3-3. ENGINE MOUNT AND INSULATOR MAINTENANCE (Cont'd)

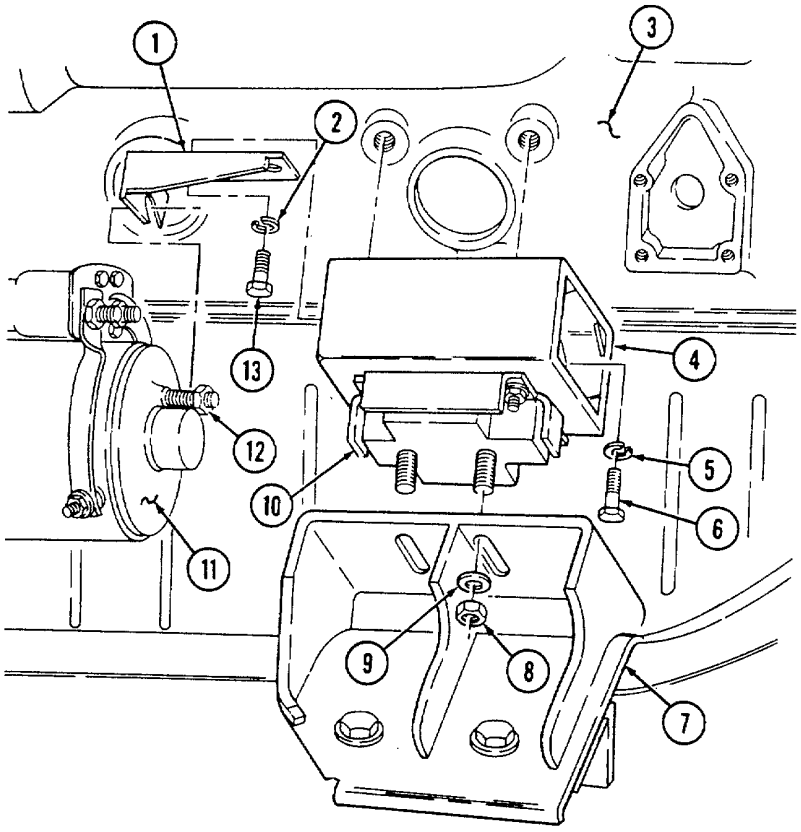
### d. Installation

1. Install engine mount (4) and insulator (10) on engine (3) with three lockwashers (5) and capscrews (6). Using 9/16 in. torque adapter, tighten capscrews (6) to 30-40 lb-ft (41-54 N•m).

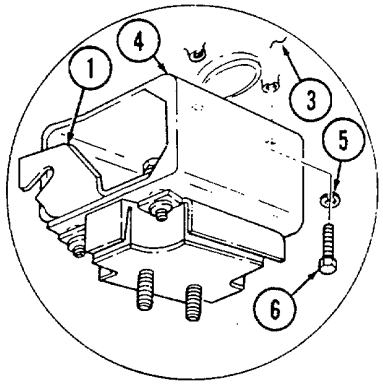
**NOTE**

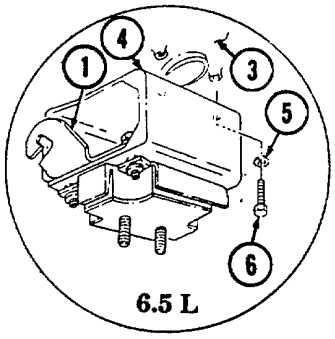
- Perform steps 2 and 3 for right engine mount only.
- Proceed to step 3 for vehicles with new support bracket configuration.

2. Install starter support bracket (1) on right engine mount (4) and starter (11) with two lockwashers (2) and capscrews (13). Using 9/16 in. torque adapter, tighten capscrews (13) to 30-40 lb-ft (41-54 N•m).
3. Using crowfoot and adapter, tighten nut (12) to 24 lb-ft (33 N•m).
4. Lower engine (3) until insulator (10) is aligned and resting on engine mount bracket (7). Install two washers (9) and locknuts (8) to insulator (10) and engine mount bracket (7). Using 3/4 in. torque adapter, tighten locknuts (8) to 90 lb-ft (122 N•m).
5. Remove pin (14) from sling bracket (16) and engine lifting sling.
6. Remove two bolts (15) and sling bracket (16) from left cylinder head (17).
7. Remove two bolts (19) and engine lift sling from right cylinder head (18).
8. Apply antiseize compound to grounds 3A (22) and 58A (20) and install on left cylinder head (17) with capscrew (21).
9. Install two radiator supports (24) on airlift brackets (26) with four capscrews (25), washers (27), and locknuts (23). Tighten capscrews (25) to 37 lb-ft (50 N•m).

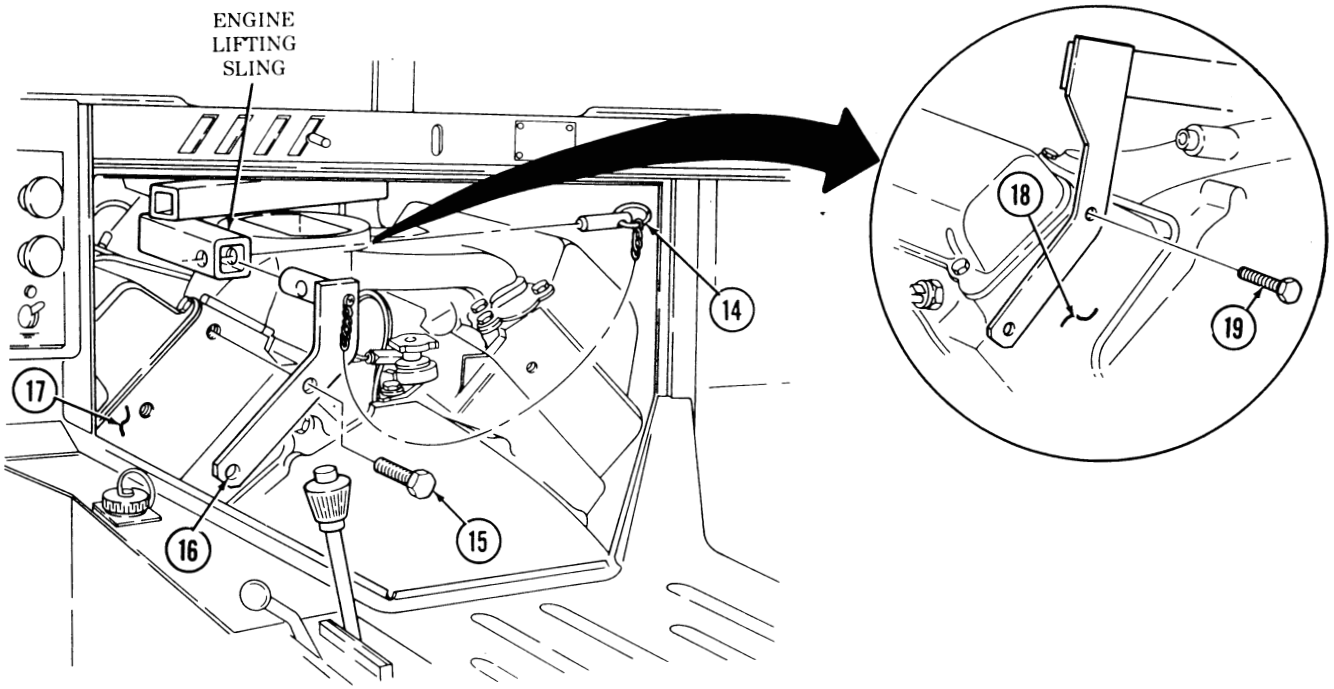


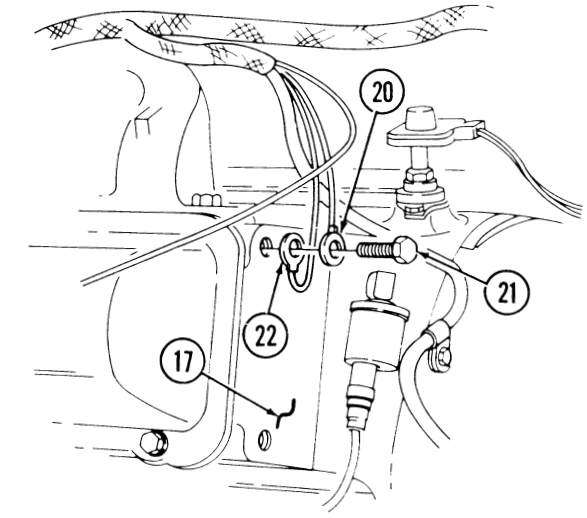

NEW 6.2L CONFIGURATION

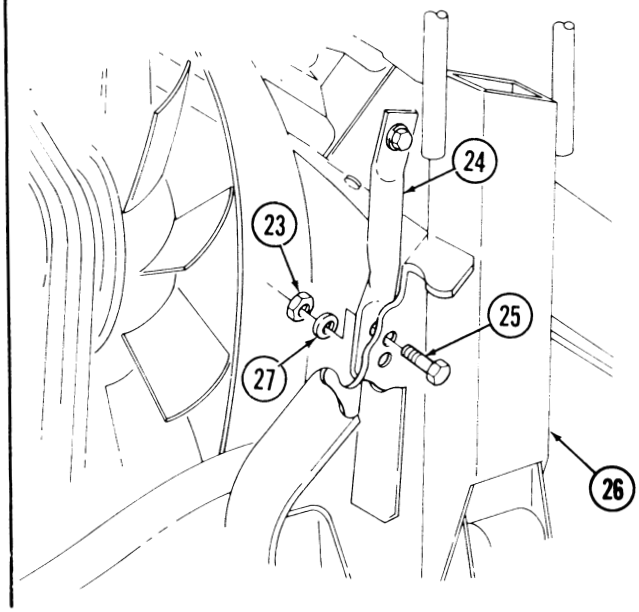


## 3-3. ENGINE MOUNT AND INSULATOR MAINTENANCE (Cont'd)




FOLLOW-ON TASKS:
- Install fuel pump (right engine mount only) (TM 9-2320-280-20).
- Install air horn support and engine lift bracket (TM 9-2320-280-20).
- Install right engine splash shield (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).
- Install front propeller shaft (left engine mount only) (TM 9-2320-280-20).
- Install glow plug controller (TM 9-2320-280-20).

## 3-4. LEFT CYLINDER HEAD REPAIR

**This task covers:**

a. **Removal**
b. **Repair**
c. **Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**

Gasket (Appendix E, Item 11)
Antiseize compound (Appendix B, Item 7)
Pipe sealing compound (Appendix B, Item 49)
Cylinder head lifting device (optional) (Appendix C, Figure C-48)

**Personnel Required**

One mechanic
One assistant

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P
TM 9-2815-237-34
TM 9-2815-237-34P

**Equipment Condition**

- Fuel drain back tube removed (TM 9-2320-280-20).
- Alternator brackets removed (TM 9-2320-280-20).
- Left exhaust manifold removed (TM 9-2320-280-20).
- Water crossover removed (TM 9-2320-280-20).
- Rocker arm shaft and pushrods removed (para. 3-8).
- Fuel injection return hoses removed (TM 9-2320-280-20).
- Fuel injection nozzles removed (para. 4-3).
- Glow plugs removed (TM 9-2320-280-20).
- Modulator linkage removed (TM 9-2320-280-20).

**General Safety Instructions**

- Cylinder head must be supported during removal and installation.
- Gaskets installed on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be disposed of IAW current directives.

**Maintenance Level**

Direct support

### a. Removal

1. Disconnect harness lead 33B (8) from engine temperature sending unit (7).
2. Remove capscrew (1) and two leads 58A (2) and 3A (3) from cylinder head (4).

**WARNING**

- Cylinder head must be supported during removal and installation. Failure to support cylinder head may cause injury to personnel or damage to equipment.
- Gaskets installed on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be removed with a scraper or putty knife and then disposed of IAW current directives. Inhalation of asbestos fibers can cause respiratory ailments

**CAUTION**

Cover or plug all hoses, ports, and/or fittings immediately after disconnection or component removal to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The left cylinder head replacement procedures for 1990 and above engines and previous model engines are the same. Refer to engine decal model number on left rocker arm cover before ordering replacement parts, since parts are not interchangeable.

## 3-4. LEFT CYLINDER HEAD REPAIR (Cont'd)

3. Remove seventeen capscrews (5) from cylinder head (4) and cylinder block (9).

**NOTE**

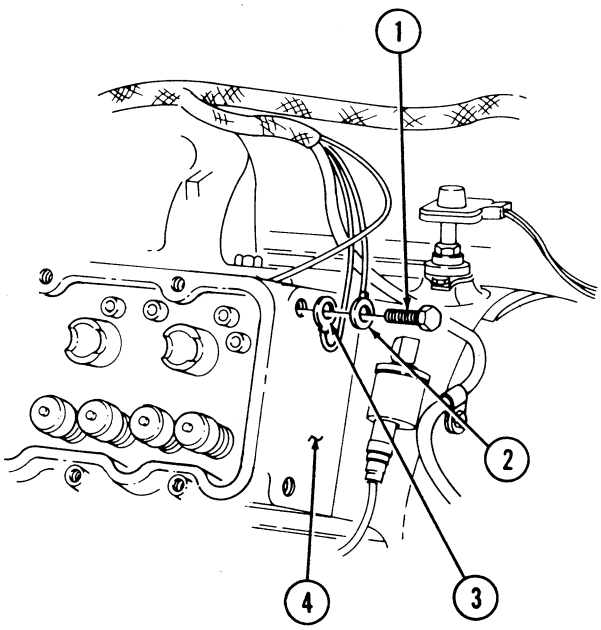
Use of cylinder head lifting device is optional.

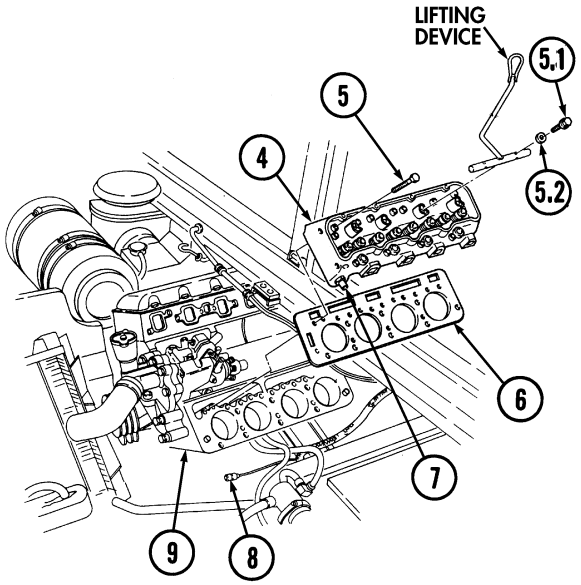
3.1. Install cylinder head lifting device on center of cylinder head (4) with two washers (5.2) and capscrews (5.1).

4. Using a hoist or other lifting device, remove cylinder head (4) and gasket (6) from cylinder block (9). Discard gasket (6).

4.1. Remove two capscrews (5.1), washers (5.2), and cylinder head lifting device from cylinder head (4), if installed.

5. For cylinder head (4) and valve repair procedures, refer to TM 9-2815-237-34.



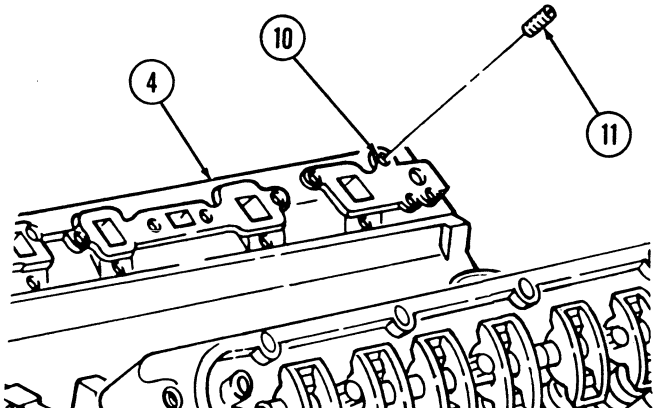

**b. Repair**

1. Extract broken portion of bolt (11) from cylinder head (4).

**NOTE**

If threaded hole cannot be repaired, the left cylinder head can be interchanged with the right cylinder head.

2. If threads are not serviceable, use threaded inserts to repair threaded hole (10) in cylinder head (4).



## 3-4. LEFT CYLINDER HEAD REPAIR (Cont'd)

**c. Installation**

**CAUTION**

Head gasket must be used without a sealer. Sealant may cause leaks or damage to engine.

1. Install head gasket (3) over dowel pins (5) on cylinder block (6).

**NOTE**

Use of cylinder head lifting device is optional.

1.1. Install cylinder head lifting device on center of cylinder head (1) with two washers (2.2) and capscrews (2.1).

2. Install cylinder head (1) on cylinder block (6), and remove two capscrews (2.1), washers (2.2), and cylinder head lifting device from center of cylinder head (1).

3. Apply pipe sealing compound to threads and under heads of seventeen capscrews (2).

**CAUTION**

Failure to tighten cylinder head capscrews in proper torque sequence may result in leaks or damage to cylinder head.

3.1 Install seventeen capscrews (2) and tighten to 20 lb-ft (27 N•m) following torque sequence.

**NOTE**

Perform step 4 for 6.2 L engine.
Perform steps 4.1 and 4.2 for 6.5 L engine.

4. Tighten seventeen capscrews (2) to 50 lb-ft (68 N•m) following torque sequence.

4.1 Tighten seventeen capscrews (2) to 55 lb-ft (75 N•m) following torque sequence.

4.2 Retighten seventeen capscrews (2) to 55 lb-ft (75 N•m) following torque sequence.

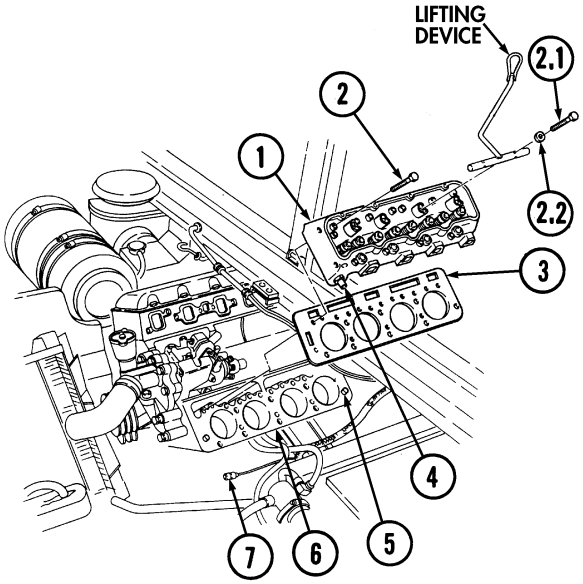
**NOTE**

Mark capscrews after 90-degree torque turn to prevent retightening.

5. Tighten seventeen capscrews (2) an additional 90 degrees following torque sequence and mark capscrews (2).

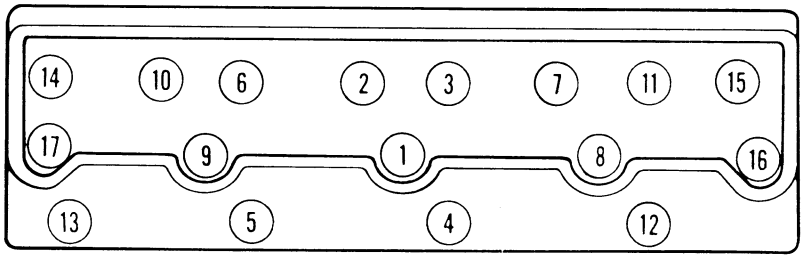
6. Apply antiseize compound to two leads 3A (10) and 58A (9) and install on cylinder head (1) with capscrew (8).

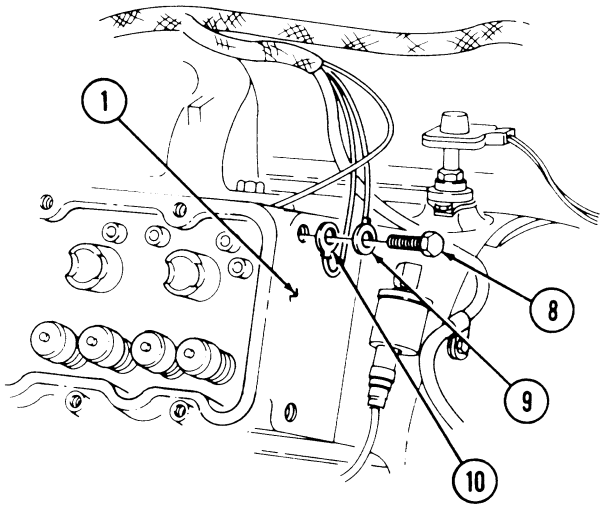
7. Connect harness lead 33B (7) to engine temperature sending unit (4).



## 3-4. LEFT CYLINDER HEAD REPAIR (Cont'd)

TORQUE SEQUENCE




FOLLOW-ON TASKS:
- Install glow plugs (TM 9-2320-280-20).
- Install fuel injection nozzles (para. 4-3).
- Install modulator linkages (TM 9-2320-280-20).
- Install fuel injection return hoses (TM 9-2320-280-20).
- Install rocker arm shaft and pushrods (para. 3-8).
- Install water crossover (TM 9-2320-280-20).
- Install left exhaust manifold (TM 9-2320-280-20).
- Install alternator brackets (TM 9-2320-280-20).
- Install fuel drain back tube (TM 9-2320-280-20).

# 3-5. RIGHT CYLINDER HEAD REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Gasket (Appendix E, Item 11)
Pipe sealing compound (Appendix B, Item 49)
Cylinder head lifting device (optional)
(Appendix C, Figure C-48)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2350-280-24P
TM 9-2815-237-34
TM 9-2815-237-34P

**Equipment Condition**
- Right exhaust manifold removed (TM 9-2320-280-20).
- Water crossover removed (TM 9-2320-280-20).
- Intake manifold removed (para. 3-17).
- Rocker arm shaft and pushrods removed (para. 3-8).
- Fuel injection return hoses removed (TM 9-2320-280-20).
- Fuel injection nozzles removed (para. 4-3).
- Glow plugs removed (TM 9-2320-280-20).

M997, M997A1, and M997A2 only:
- Air compressor bracket removed (para. 14-26).

**General Safety Instructions**
- Cylinder head must be supported during removal and installation.
- Gaskets installed on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be disposed of IAW current directives.

**Maintenance Level**
Direct support

**a. Removal**

**WARNING**

- Cylinder head must be supported during removal and installation. Failure to support cylinder head may cause injury to personnel or damage to equipment.
- Gaskets on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be removed with a scraper or putty knife then disposed of IAW current directives. Inhalation of asbestos fibers can cause respiratory ailments.

**CAUTION**

Cover or plug all hoses, ports, and/or fittings immediately after disconnection or component removal to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The right cylinder head replacement procedures for all model year engines are the same. Refer to engine decal model number on left rocker arm cover before ordering replacement parts, since parts are not interchangeable.

1. Remove cold advance switch (3) from cylinder head (4).
2. Remove capscrew (1) from transmission dipstick tube (2) and cylinder head (4).
3. Remove seventeen capscrews (5) from cylinder head (4) and cylinder block (6).

## 3-5. RIGHT CYLINDER HEAD REPLACEMENT (Cont'd)

**NOTE**

Use of cylinder head lifting device is optional.

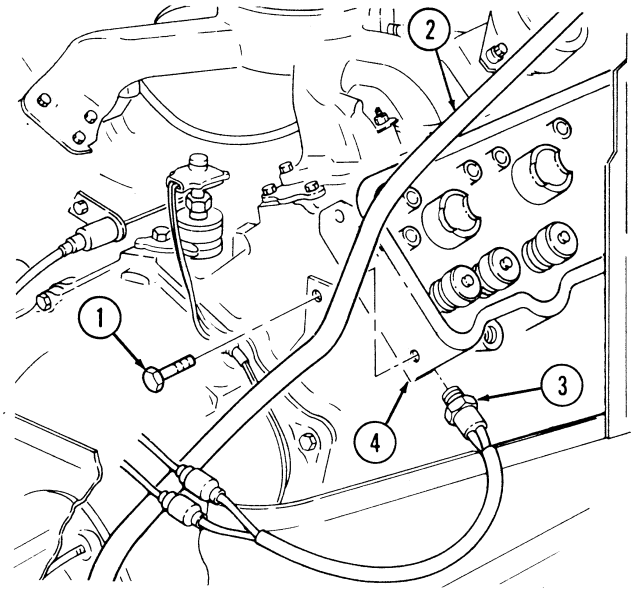
3.1. Install cylinder head lifting device on center of cylinder head (4) with two washers (4.2) and capscrews (4.1).

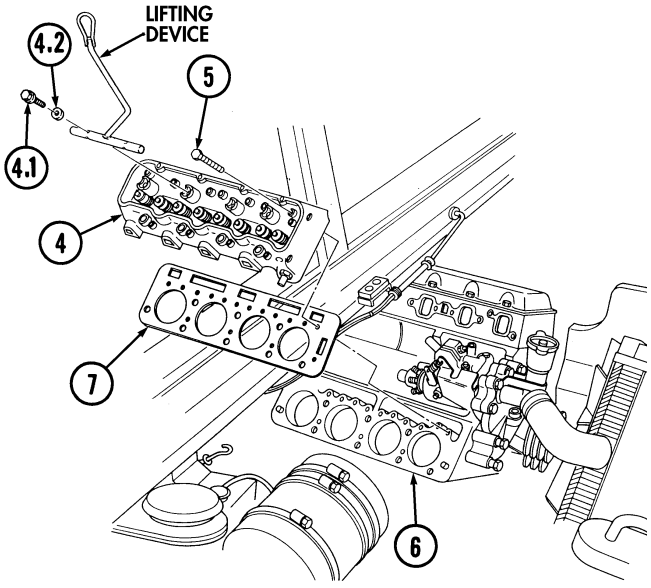
4. Using hoist or other lifting equipment, remove cylinder head (4).

4.1. Remove and discard gasket (7).

4.2. Remove two capscrews (4.1), washers (4.2), and cylinder head lifting device from cylinder head (4), if installed.

5. For cylinder head (4) and valve repair procedures, refer to TM 9-2815-237-34.



## 3-5. RIGHT CYLINDER HEAD REPLACEMENT (Cont'd)

**b. Installation**

**CAUTION**

Head gasket must be used without a sealer. Sealant may cause leaks or damage to engine.

1. Install head gasket (8) over dowel pins (6) on cylinder block (7).

**NOTE**

Use of cylinder head lifting device is optional.

1.1. Install cylinder head lifting device on center of cylinder head (4) with two washers (4.2) and capscrews (4.1).

2. Install cylinder head (4) on cylinder block (7), and remove two capscrews (4.1), washers (4.2), and cylinder head lifting device from center of cylinder head (4).

3. Apply pipe sealing compound to threads and under heads of seventeen capscrews (5).

**CAUTION**

Failure to tighten cylinder head capscrews in proper torque sequence may result in leaks or damage to cylinder head.

3.1 Install seventeen capscrews (5) and tighten to 20 lb-ft (27 N•m) following torque sequence.

**NOTE**

Perform step 4 for 6.2 L engine.

Perform steps 4.1 and 4.2 for 6.5 L engine.

4. Tighten seventeen capscrews (5) to 50 lb-ft (68 N·m) following torque sequence.

4.1 Tighten seventeen capscrews (5) to 55 lb-ft (75 N•m) following torque sequence.

4.2 Retighten seventeen capscrews (5) to 55 lb-ft (75 N•m) following torque sequence.

**NOTE**

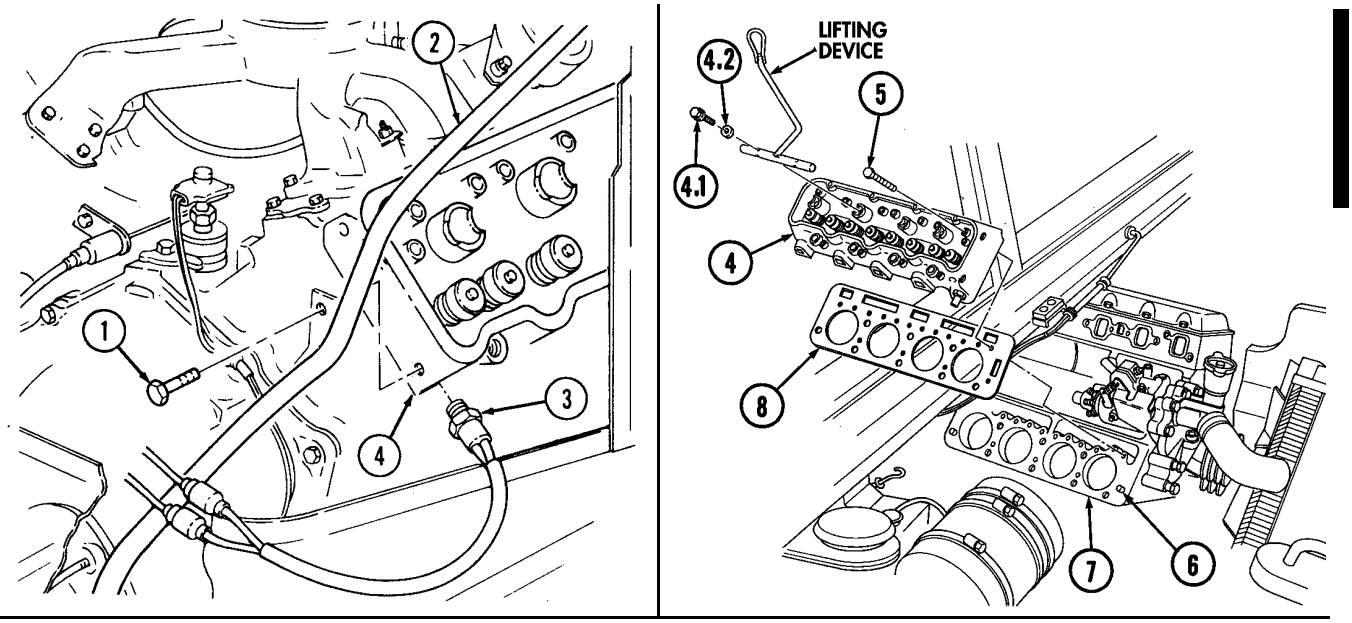
Mark capscrews after 90-degree torque turn to prevent retightening.

5. Tighten seventeen capscrews (5) an additional 90 degrees following torque sequence and mark capscrews (5).

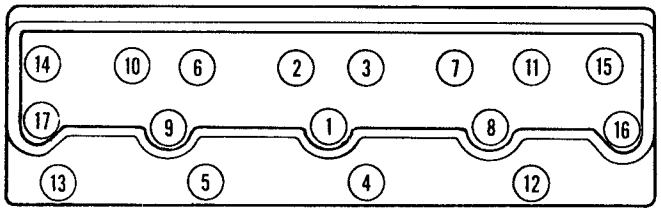
6. Install transmission dipstick tube (2) on cylinder head (4) with capscrew (1). Tighten capscrew (1) to 25-37 lb-ft (34-50 N•m).

7. Install cold advance switch (3) on cylinder head (4).

## 3-5. RIGHT CYLINDER HEAD REPLACEMENT (Cont'd)




TORQUE SEQUENCE




FOLLOW-ON TASKS:
- Install fuel injection return hoses (TM 9-2320-280-20).
- Install rocker arm shaft and pushrods (para. 3-7).
- Install intake manifold (para. 3-17).
- Install right exhaust manifold (TM 9-2320-280-20).
- Install water crossover (TM 9-2320-280-20).
- Install glow plugs (TM 9-2320-280-20).
- Install fuel injection nozzles (para. 4-3).

M997, M997A1, and M997A2 only:
- Install air compressor brackets (TM 9-2320-280-20).

# 3-6. CRANKSHAFT PULLEY REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Sealing compound (Appendix B, Item 53)

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P
TM 9-2815-237-34P

**Equipment Condition**
Hood raised and secured (TM 9-2320-280-10).

**Maintenance Level**
Direct support

## a. Removal

1. Loosen four capscrews (3) connecting crankshaft pulley (1) to torsional damper (2).

**NOTE**

- Perform steps 2 and 3 for vehicles with 6.2L engines only.
- Perform steps 4 and 5 for vehicles with 6.5L engines only.

2. Remove power steering belts (TM 9-2320-280-20).
3. Remove four capscrews (3) and crankshaft pulley (1) from torsional damper (2).
4. Remove serpentine belt (TM 9-2320-280-20).
5. Remove four capscrews (3), mud shield (4), crankshaft pulley (1), and spacer (5) from torsional damper (2).

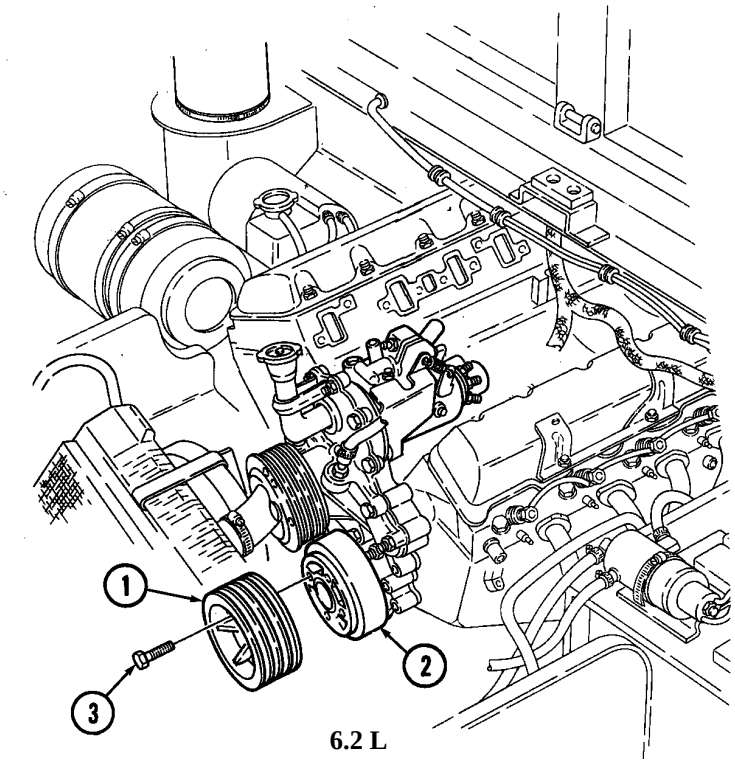
## b. Installation

**NOTE**

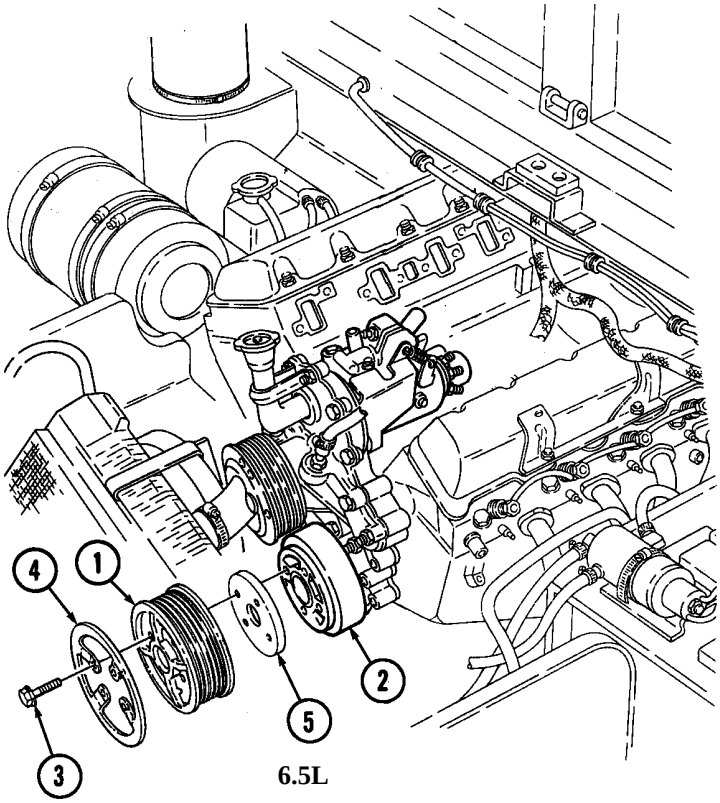
- Perform steps 1 through 4 for vehicles with 6.2L engines only.
- Perform steps 5 through 8 for vehicles with 6.5L engines only.

1. Apply sealing compound to four capscrews (3).
2. Install crankshaft pulley (1) on torsional damper (2) with four capscrews (3).
3. Install power steering belts (TM 9-2320-280-20).
4. Tighten four capscrews (3) to 48 lb-ft (65 N•m).
5. Apply sealing compound to four capscrews (3).
6. Install spacer (5), crankshaft pulley (1), and mud shield (4) on torsional damper (2) with four capscrews (3).
7. Install serpentine belt (TM 9-2320-280-20).
8. Tighten four capscrews (3) to 48 lb-ft (65 N•m).

## 3-6. CRANKSHAFT PULLEY REPLACEMENT (Cont'd)




6.2 L




6.5L

FOLLOW-ON TASK: Lower and secure hood (TM 9-2320-280-10).

## 3-7. TORSIONAL DAMPER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Lubricating oil (Appendix B, Item 31)
Sealing compound (Appendix B, Item 49)

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2815-237-34P

**Equipment Condition**
Hood raised and secured (TM 9-2320-280-10).

**General Safety Instructions**
Torsional damper must be supported during removal and installation.

**Maintenance Level**
Direct support

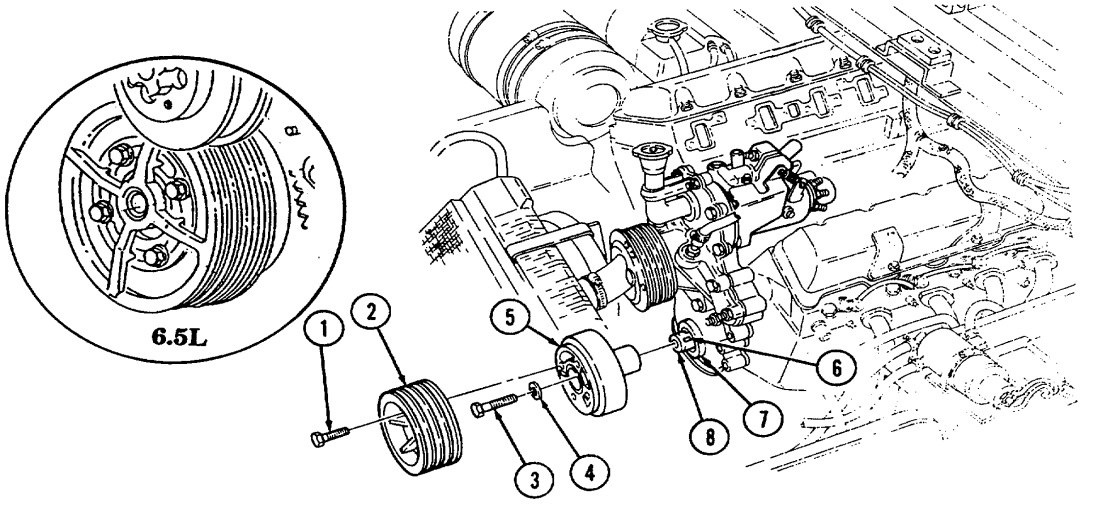
### a. Removal

1. Loosen four capscrews (1) connecting crankshaft pulley (2) to torsional damper (5). Loosen capscrew (3) connecting torsional damper (5) to crankshaft (8).
2. Remove power steering set or serpentine belt (TM 9-2320-280-20).
3. Remove four capscrew (1) and crankshaft pulley (2) from torsional damper (5). Remove capscrew (3) and washer (4) connecting torsional damper (5) to crankshaft (8).

**WARNING**

Torsional damper must be supported during removal and installation. Failure to do this may cause injury to personnel or damage to equipment.

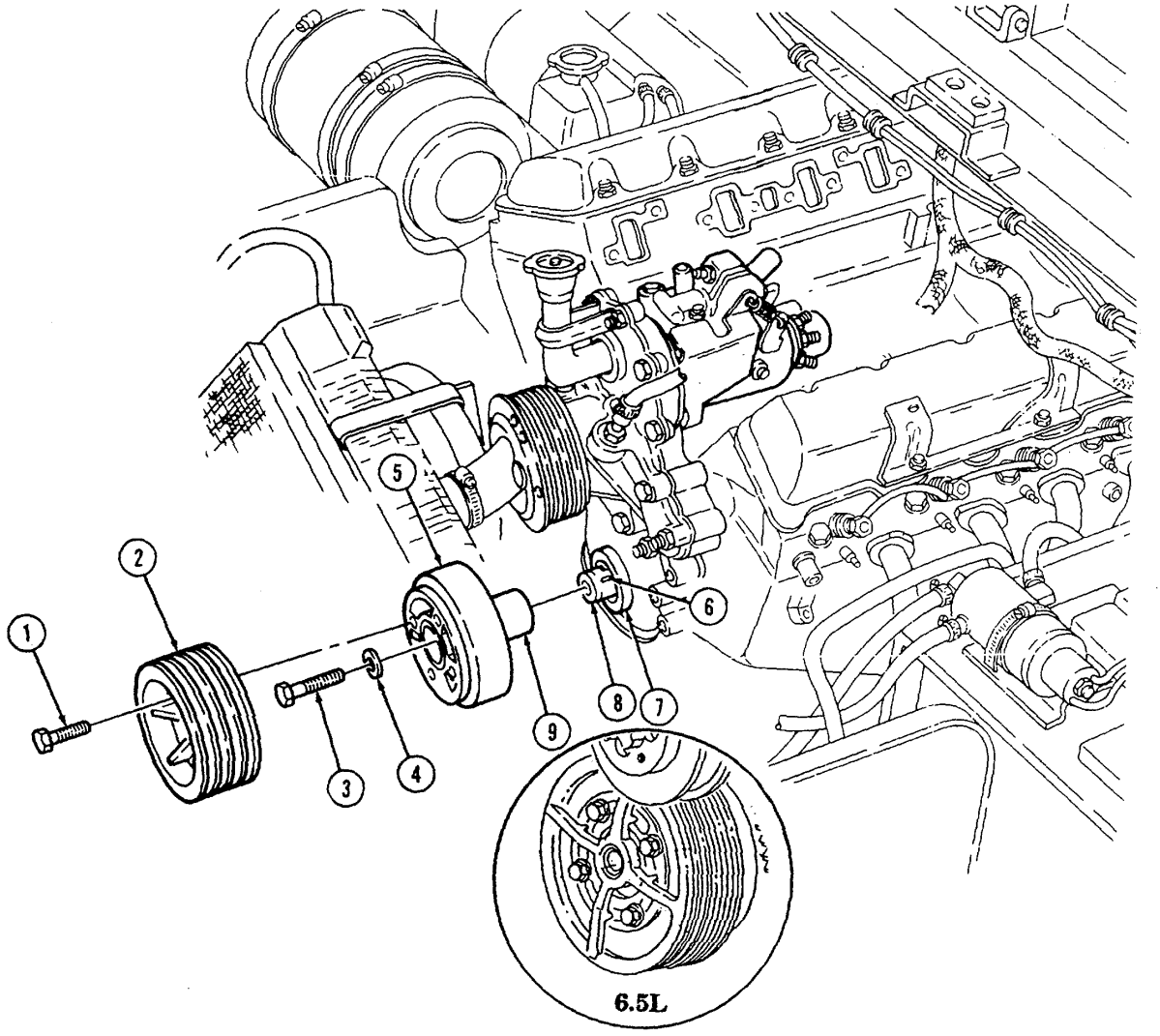
4. Reinstall capscrew (3) and remove torsional damper (5) from crankshaft (8) with puller.
5. Remove capscrew (3) from crankshaft (8).
6. Inspect woodruff key (6) and front cover seal (7) for damage. Replace woodruff key (6) or front cover seal (7) (para. 3-13) if damaged.



**3-7. TORSIONAL DAMPER REPLACEMENT (Cont'd)**

**b. Installation**

1. Apply lubricating oil to seal surface (9) on torsional damper (5).
2. Align torsional damper (5) with woodruff key (6) and install torsional damper (5) on crankshaft (8) far enough to install washer (4) and capscrew (3). Secure torsional damper (5) with capscrew (3).
3. Apply sealing compound to four capscrews (1). Install crankshaft pulley (2) on torsional damper (5) with four capscrews (1).
4. Install power steering set or serpentine belt (TM 9-2320-280-20).
5. Tighten capscrew (3) to 140-162 lb-ft (190-220 N·m). Tighten four capscrews (1) to 48 lb-ft (65 N·m).




FOLLOW-ON TASK: Lower and secure hood (TM 9-2320-280-10).

## 3-8. ROCKER ARM SHAFTS AND PUSHRODS REPLACEMENT

**This task covers:**
**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)
**Manual References**
TM 9-2815-237-34P
**Equipment Condition**
Left or right rocker arm cover removed (para. 3-11 or 3-12).
**Maintenance Level**
Direct support

### a. Removal

1. Remove four capscrews (2) and retainers (3) holding rocker arm and shaft assemblies (4) to cylinder head (5).

**NOTE**

Tag rocker arm and shaft assemblies for assembly.

2. Remove two rocker arm and shaft assemblies (4).

**NOTE**

Tops of pushrods are hardened and must be tagged for assembly.

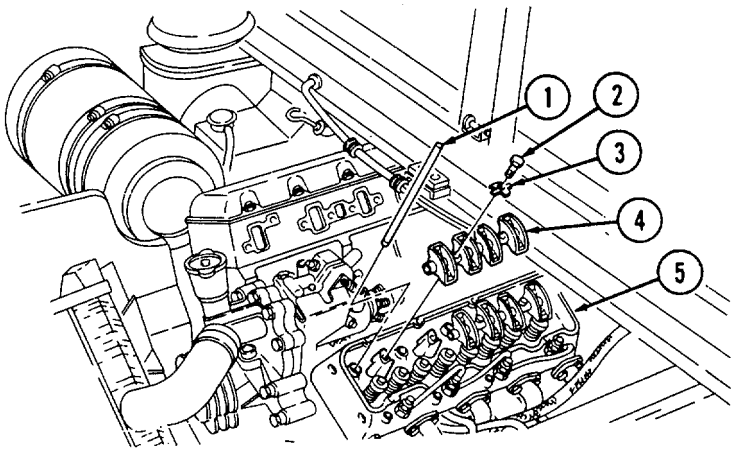
3. Remove eight pushrods (1).

### b. Installation

**CAUTION**

Marked ends of pushrods must point up when installed or engine damage may result.

1. Install eight pushrods (1) in proper location with marked ends of pushrods (1) up. Make sure pushrods (1) properly seat in lifters.
2. Install two rocker arm and shaft assemblies (4) on cylinder head (5). Make sure pushrods (1) properly seat in rocker arms (4).
3. Secure rocker arm and shaft assemblies (4) with four retainers (3) and capscrews (2).
4. Tighten capscrews (2) to 41 lb-ft (56 N·m).




FOLLOW-ON TASK: Install left or right rocker arm cover (para. 3-11 or 3-12).

## 3-9. HYDRAULIC VALVE LIFTER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)
**Special Tools**
Hydraulic valve lifter remover (Appendix G, Item 24)
**Materials/Parts**
Lubricating oil (Appendix B, Item 31)
**Manual References**
TM 9-2815-237-34P

**Equipment Condition**
Left or right cylinder heads removed (para. 3-4 or 3-5).
**General Safety Instructions**
Diesel fuel is flammable. Do not perform this procedure near fire, flames, or sparks.
**Maintenance Level**
Direct support

### a. Removal

1. Remove capscrew (1), guide plate clamp (2), and guide plate(s) (3) from cylinder block (5).

**NOTE**

Tag lifters for assembly if more than one lifter is being removed.

2. Using hydraulic valve lifter remover, remove valve lifter(s) (4) from cylinder block (5).

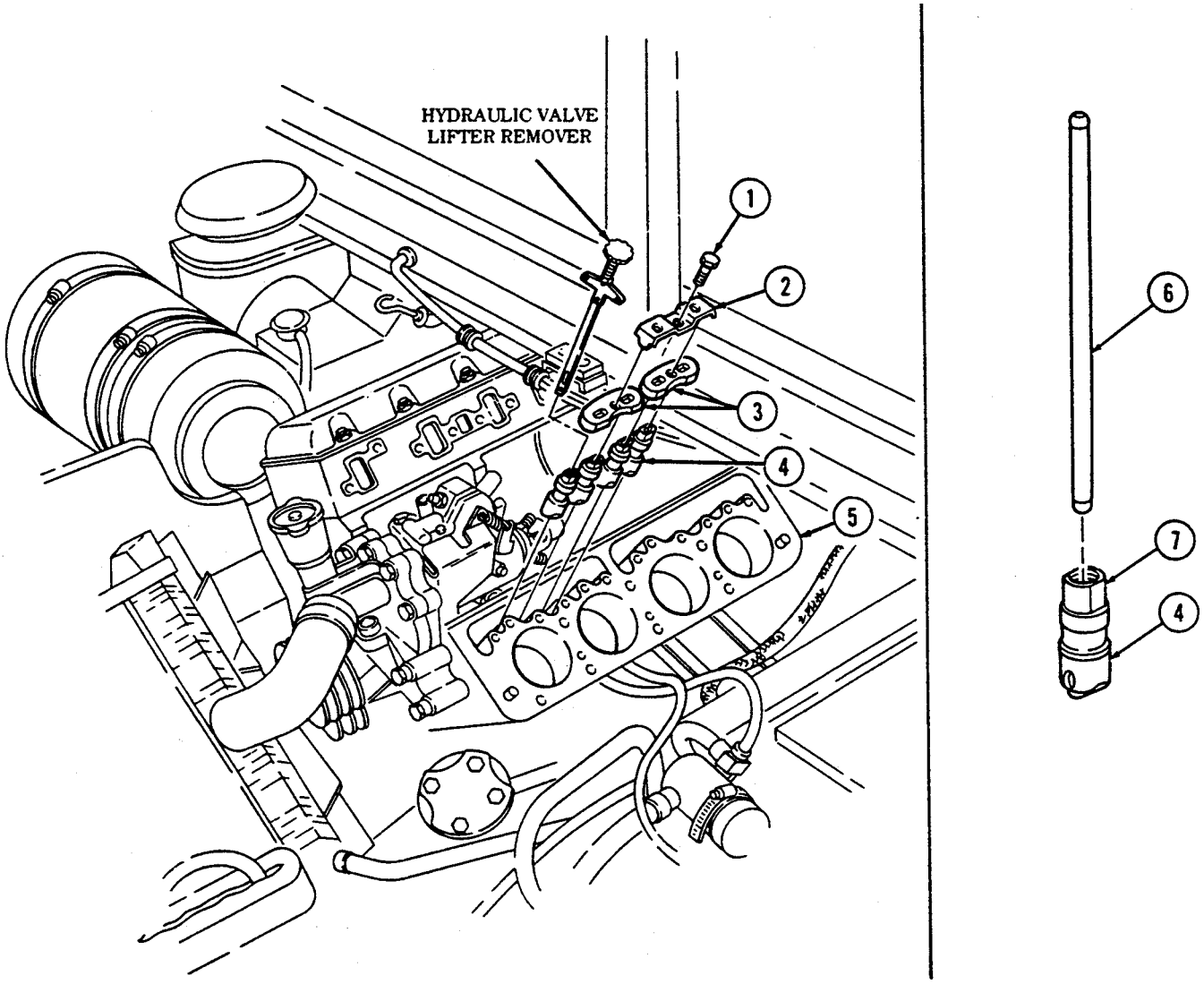
### b. Installation

**WARNING**

Diesel fuel is flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death may result.

1. Prime lifter(s) (4) by submerging in clean diesel fuel or kerosene and working plunger (7) up and down with pushrod (6).
2. Apply lubricating oil to lifter(s) (4).
3. Install lifter(s) (4) into cylinder block (5).
4. Install guide plate(s) (3) on lifter(s) (4).
5. Install guide plate clamp (2) with capscrew (1). Tighten capscrew (1) to 15-20 lb-ft (20-27 Nm).

## 3-9. HYDRAULIC VALVE LIFTER REPLACEMENT (Cont'd)




FOLLOW-ON TASK: Install left or right cylinder head (para. 3-4 or 3-5).

# 3-10. TIMING CHAIN COVER, TIMING CHAIN, AND DRIVE SPROCKETS MAINTENANCE

**This task covers:**

**a. Removal**
**b. Inspection**
**c. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Gasket (Appendix E, Item 9)
Three special keys (Appendix E, Item 45)
Sealing compound (Appendix B, Item 45)
Lubricating oil (Appendix B, Item 31)

**Manual References**
TM 9-2815-237-34P

**Equipment Condition**
- Torsional damper removed (para. 3-7).
- Water pump and adapter plate removed (para. 5-4).

**Maintenance Level**
Direct support

## a. Removal

**NOTE**

- When measuring timing chain deflection, slack should be removed from one side before measurement is taken on opposite side.
- In some cases, flanged head fasteners may be present instead of standard fasteners and washers. In all cases, washers should be used when replacing a flanged head fastener with a standard fastener.
- Perform step 1 for M997, M997A1, and M997A2 ambulance vehicles only.

1. Remove nut (5) and screw (7) from timing chain cover (6).
2. Remove three capscrews (1) and driven gear (2) from injection pump (9).
3. Remove two capscrews (18), nut (3), and baffle (4) from timing chain cover (6).
4. Remove three nuts (11) and washers (10) from injection pump (9) and timing chain cover (6).
5. Remove four capscrews (13) from timing chain cover (6) and oil pan (14).
6. Remove five capscrews (16), four washers (15), timing chain cover (6), and gasket (8) from cylinder block (12). Discard gasket (8).
7. Using dial indicator, check timing chain (23) deflection midway between camshaft sprocket (22) and crankshaft sprocket (29). Total deflection must not exceed 0.810 in. (20.6 mm). If deflection exceeds specification, timing chain (23) must be replaced.
8. Using dial indicator, check camshaft end play. Camshaft end play must not be more than 0.012 in. (0.3 mm). If end play exceeds specification, camshaft sprocket (22) and thrust plate (26) must be inspected for wear after removal.
9. Remove capscrew (19), washer (20), pump drive gear (21), and camshaft sprocket (22) from camshaft (24).
10. Remove crankshaft sprocket (29), camshaft sprocket (22), and timing chain (23) as an assembly.

**NOTE**

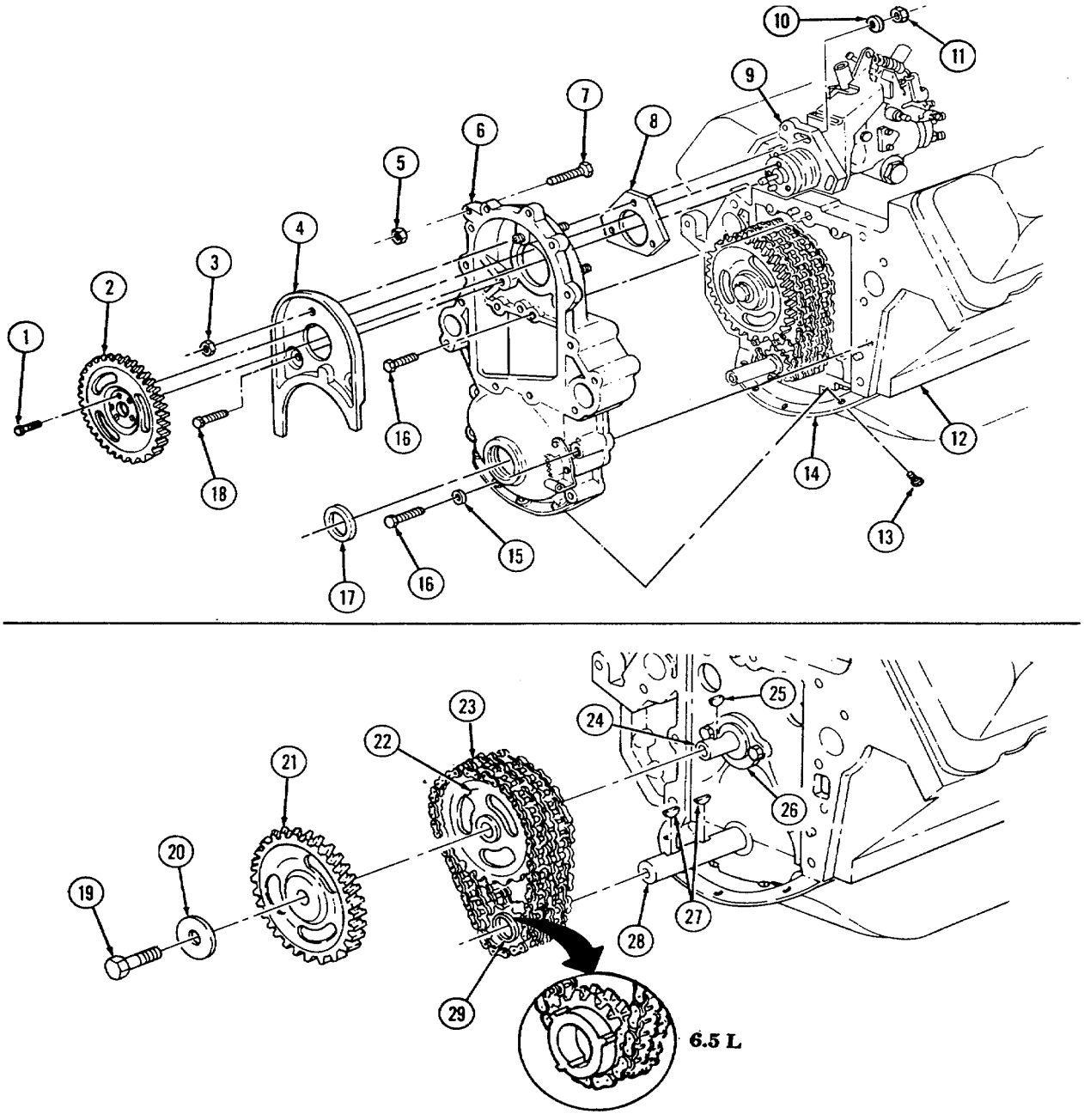
Cover oil pan opening to prevent special keys from falling into oil pan.

11. Remove two special keys (27) from crankshaft (28) and special key (25) from camshaft (24). Discard special keys (27) and (25).

## 3-10. TIMING CHAIN COVER, TIMING CHAIN, AND DRIVE SPROCKETS MAINTENANCE (Cont'd)

**b. Inspection**

Inspect front cover oil seal (17) for cracks, breaks, or deterioration. Replace front cover oil seal (17) (para. 3-13) if cracked, broken or deteriorated.



## 3-10. TIMING CHAIN COVER, TIMING CHAIN, AND DRIVE SPROCKETS MAINTENANCE (Cont'd)

**c. Installation**

1. Install special key (8) in camshaft (7) and two special keys (9) in crankshaft (10).
2. Install crankshaft sprocket (11) and camshaft sprocket (5) in timing chain (6) and align timing marks (12).
3. Rotate crankshaft (10) and camshaft (7) so special keys (8) and (9) align with keyway slots in crankshaft sprocket (11) and camshaft sprocket (5).

**CAUTION**

Timing marks on crankshaft sprocket and camshaft sprocket must remain aligned after installation, or engine damage may result.

4. Install crankshaft sprocket (11), camshaft sprocket (5), and timing chain (6) as an assembly onto camshaft (7) and crankshaft (10).
5. Install pump drive gear (3) on camshaft (7) with timing mark (4) at 0° with washer (2) and capscrew (1). Tighten capscrew (1) to 55-66 lb-ft (75-90 N•m).
6. Apply lubricating oil to timing chain (6).

**NOTE**

Perform step 7 only if timing chain was replaced.

7. Using dial indicator, check timing chain deflection midway between camshaft sprocket (5) and crankshaft sprocket (11). Total deflection must not exceed 0.5 in. (12.7 mm). If deflection exceeds specification, inspect camshaft sprocket (5) and crankshaft sprocket (11) for damage. Replace either if damaged and recheck deflection.
8. Apply a 0.094 in. (2.4 mm) bead of flange sealant to sealing surface on timing chain cover (18), following diagram shown.
9. Install gasket (21) and timing chain cover (18) on cylinder block (26) with four capscrews (30), washers (29), and short capscrew (31). Tighten four capscrews (30) and short capscrew (31) to 33 lb-ft (45 N•m).
10. Secure timing chain cover (18) to oil pan (28) with four capscrews (27). Tighten capscrews (27) to 4-10 lb-ft (5-14 N•m).

**CAUTION**

Maintain 0.040 in. (1.02 mm) minimum clearance between baffle plate and pump drive gear to avoid noise.

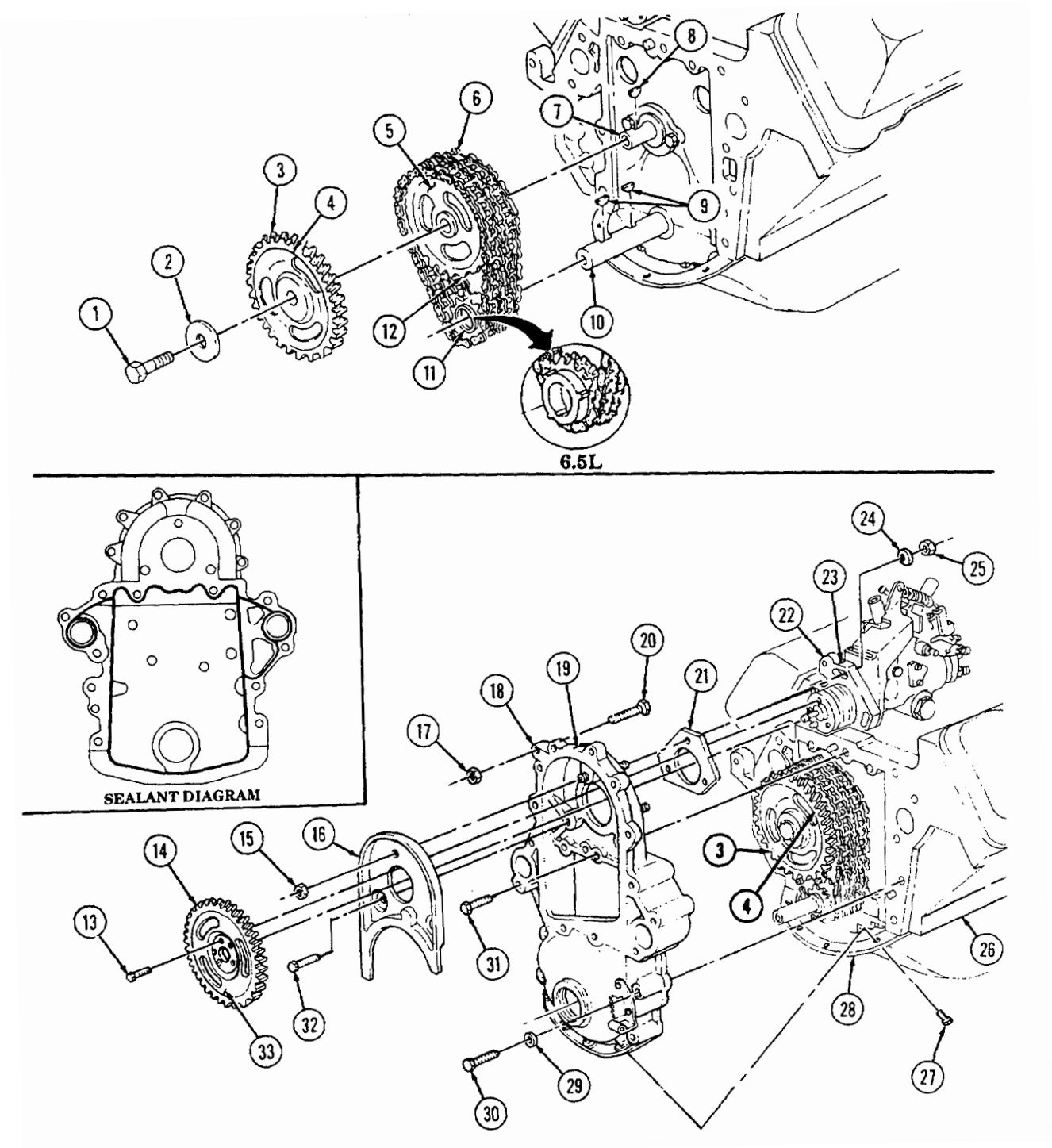
11. Install baffle plate (16) in timing chain cover (18) with two capscrews (32) and nut (15). Tighten capscrews (32) and nut (15) to 33 lb-ft (45 N•m).
12. Align timing mark (23) on injection pump (22) with timing mark (19) on timing chain cover (18) and install three washers (24) and nuts (25).
13. Align timing mark (33) on driven gear (14) with timing mark (4) on drive gear (3) and install three capscrews (13). Tighten capscrews (13) to 13-20 lb-ft (18-27 N•m).

**NOTE**

Perform step 14 for M997, M997A1, and M997A2 ambulance vehicles only.

14. Install capscrew (20) and nut (17) to timing chain cover (18).

## 3-10. TIMING CHAIN COVER, TIMING CHAIN, AND DRIVE SPROCKETS MAINTENANCE (Cont'd)




FOLLOW-ON TASKS:
- Install water pump and adapter plate (para. 5-4).
- Install torsional damper (para. 3-7).

## 3-11. LEFT ROCKER ARM COVER MAINTENANCE

**This task covers:**

**a. Removal**
**b. Repair**
**c. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
RTV sealant (Appendix B, Item 43)
Gasket (Appendix E, Item 29)

**Manual References**
TM 9-2320-280-20
TM 9-2815-237-34
TM 9-2815-237-34P

**Equipment Condition**
- Fuel injection lines removed (para. 4-4).
- Left fuel injection lines bracket removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

### a. Removal

**NOTE**

In some cases, flanged head fasteners may be present instead of standard fasteners and washers. In all cases, washers should be used when replacing a flanged head fastener with a standard fastener.

1. Remove nut (2), washer (1), clamp (8), and fuel drain back tube (9) from rocker arm cover stud (3).
2. Remove a combination of five capscrews (5), three studs (3), eight washers (6), and rocker arm cover (4) from cylinder head (7).

### b. Repair

For rocker arm cover repair procedures, refer to TM 9-2815-237-34.

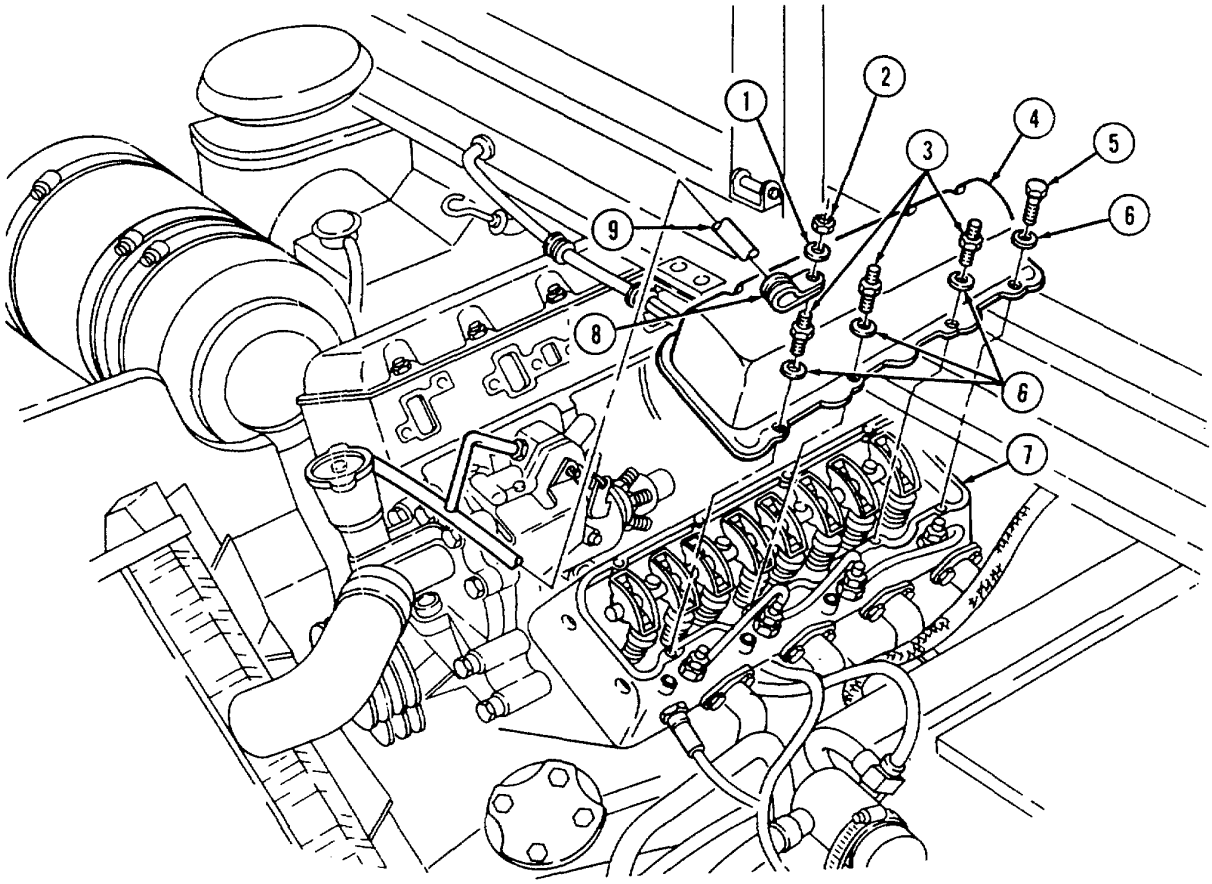
### c. Installation

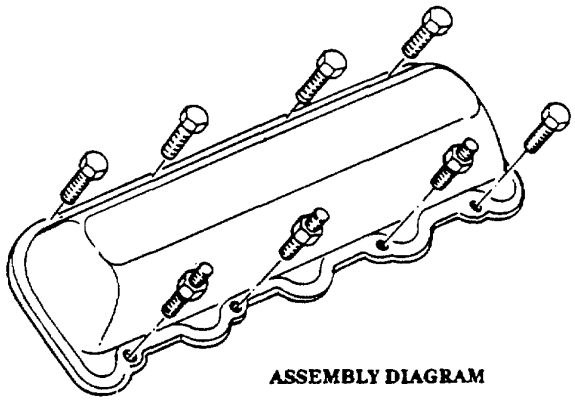
**NOTE**

- When applying RTV sealant, keep sealant out of capscrew holes.
- During installation, RTV sealant or new gasket is approved.
- If applying RTV sealant, perform step 1.
- If installing new gasket, RTV sealant may be applied with the gasket, but is not required.

1. Apply a .06 in. (1.5 mm) bead of RTV sealant around rocker arm cover (4) sealing surface.
2. Install rocker arm cover (4) on cylinder head (7) with eight washers (6), five capscrews (5), and three studs (3) following assembly diagram.
3. Tighten capscrews (5) and studs (3) to 13-25 lb-ft (18-34 N•m).
4. Install fuel drain back tube (9) and clamp (8) on stud (3) with washer (1) and nut (2).

## 3-11. LEFT ROCKER ARM COVER MAINTENANCE (Cont'd)



ASSEMBLY DIAGRAM

FOLLOW-ON TASK:
- Install left fuel injection lines bracket (TM 9-2320-280-20).
- Install fuel injection lines (para. 4-4).

## 3-12. RIGHT ROCKER ARM COVER MAINTENANCE

**This task covers:**

**a. Removal**
**b. Repair**
**c. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
RTV sealant (Appendix B, Item 43)
Gasket (Appendix E, Item 29)

**Manual References**
TM 9-2320-280-20
TM 9-2815-237-34
TM 9-2815-237-34P

**Equipment Condition**
- Engine access cover removed (TM 9-2320-280-20).
- Fuel injection lines removed (para. 4-4).
- Fuel injection lines bracket removed (TM 9-2320-280-20).
- CDR valve bracket removed (TM 9-2320-280-20).
- Heater outlet/inlet piping removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

### a. Removal

**NOTE**

In some cases, flanged head fasteners may be present instead of standard fasteners and washers. In all cases, washers should be used when replacing a flanged head fastener with a standard fastener.

1. Remove capscrew (6) and transmission oil dipstick tube (7) from cylinder head (5).
2. Remove a combination of two capscrews (3), six studs (2), four washers (1), and rocker arm cover (4) from cylinder head (5).

### b. Repair

For rocker arm cover repair procedures, refer to TM 9-2815-237-34.

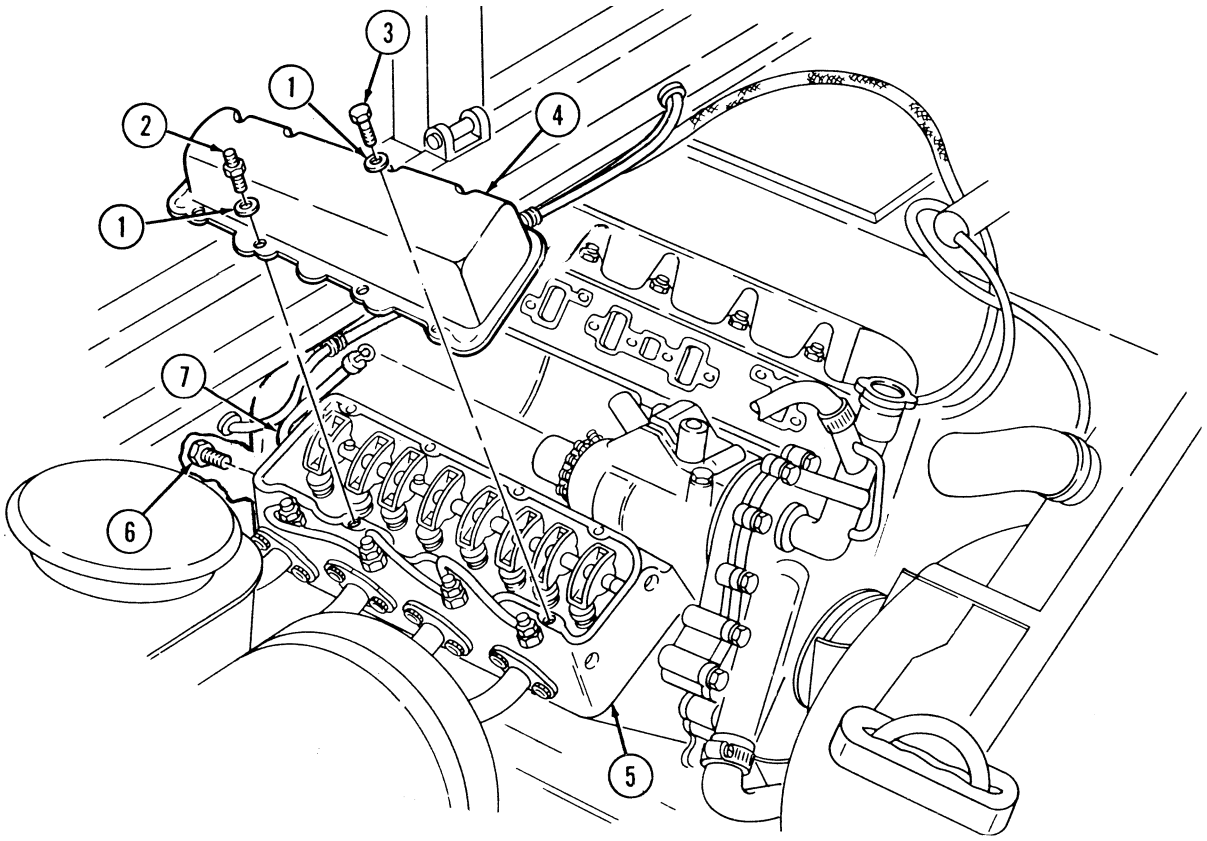
### c. Installation

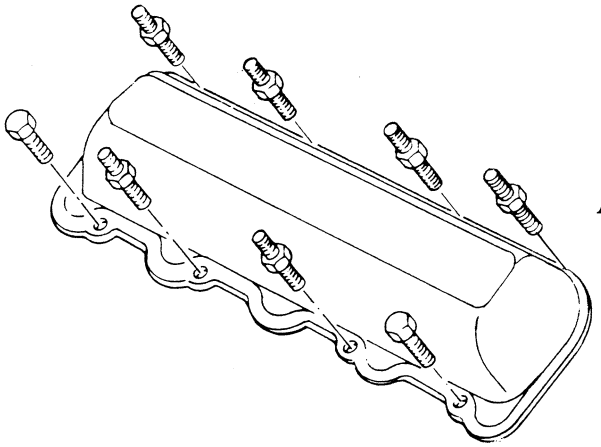
**NOTE**

- When applying RTV sealant, keep sealant out of capscrew holes.
- During installation, RTV sealant or new gasket is approved.
- If applying RTV sealant, perform step 1.
- If installing new gasket, RTV sealant may be applied with the gasket, but is not required.

1. Apply a .06 in. (1.5 mm) bead of RTV sealant around rocker arm cover (4) sealing surface.
2. Install rocker arm cover (4) on cylinder head (5) with eight washers (1), two capscrews (3), and six studs (2) following assembly diagram.
3. Tighten capscrews (3) and studs (2) to 13-25 lb-ft (18-34 N•m).
4. Install transmission oil dipstick tube (7) on cylinder head (5) with capscrew (6). Tighten capscrew (6) to 25-37 lb-ft (34-50 N•m).

## 3-12. RIGHT ROCKER ARM COVER MAINTENANCE (Cont'd)



**ASSEMBLY DIAGRAM**

FOLLOW-ON TASK:
- Install heater outlet/inlet piping (TM 9-2320-280-20).
- Install CDR valve bracket (TM 9-2320-280-20).
- Install left fuel injection lines bracket (TM 9-2320-280-20).
- Install fuel injection lines (para. 4-4).
- Install engine access cover (TM 9-2320-280-20).

## 3-13. FRONT COVER OIL SEAL REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Plain seal (Appendix E, Item 242)

**Manual References**
TM 9-2815-237-34P

**Equipment Condition**
Torsional damper removed (para. 3-7).

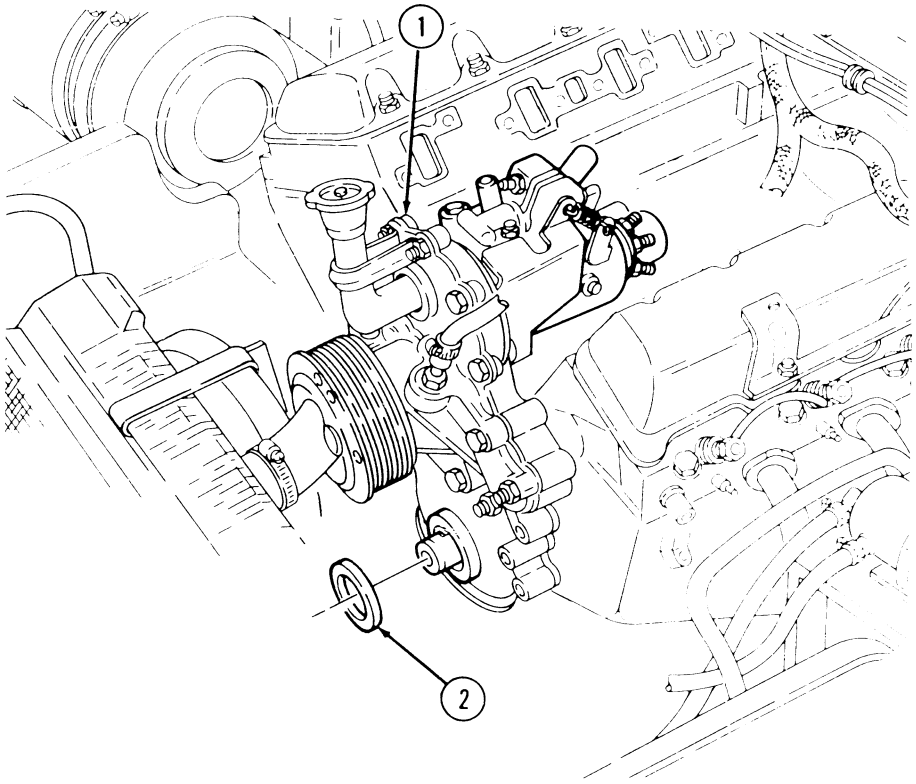
**Maintenance Level**
Direct support

**a. Removal**

Remove seal (2) from timing chain cover (1). Discard seal (2).

**b. Installation**

Install seal (2) on timing chain cover (1), ensuring lip of seal (2) faces inward.




FOLLOW-ON TASK: Install torsional damper (para. 3-7).

## 3-14. OIL PUMP DRIVE REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Gasket (Appendix E, Item 15)

**Manual References**
TM 9-2320-280-20
TM 9-2815-237-34P

**Equipment Condition**
- Engine access cover removed (TM 9-2320-280-20).
- Battery ground cable disconnected (TM 9-2320-280-20).

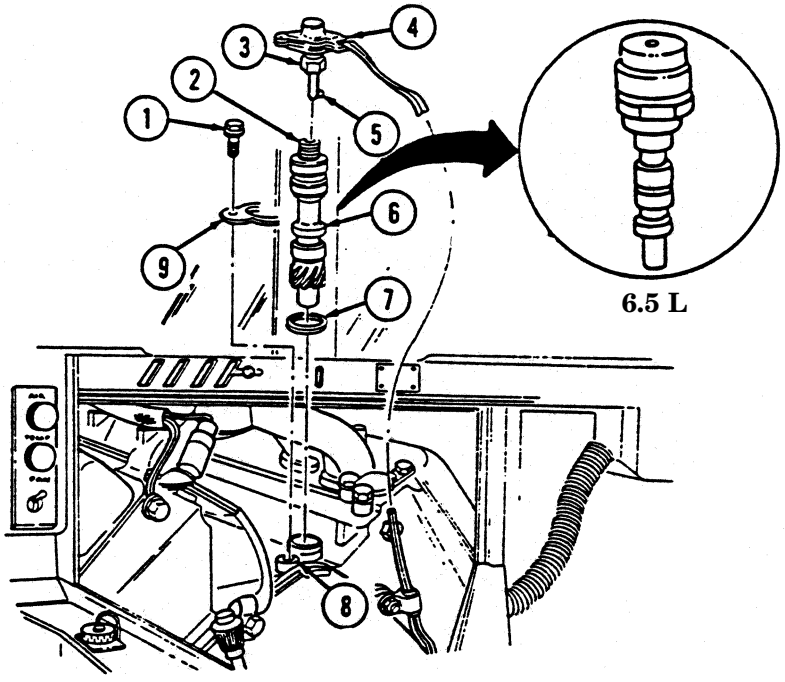
**Maintenance Level**
Direct support

### a. Removal

1. Loosen nut (3) connecting RPM sensor (4) to oil pump drive (6) and remove RPM sensor (4).
2. Remove capscrew (1) and clamp (9) from cylinder block (8).
3. Remove oil pump drive (6) and gasket (7) from cylinder block (8). Discard gasket (7).

### b. Installation

1. Install oil pump drive (6) and gasket (7) into cylinder block (8).
2. Secure oil pump drive (6) with clamp (9) and capscrew (1). Tighten capscrew (1) to 25-37 lb-ft (34-50 N•m).
3. Align tab (5) on RPM sensor (4) with slot (2) in oil pump drive (6). Install RPM sensor (4) on oil pump drive (6) with nut (3).




FOLLOW-ON TASKS:
- Connect battery ground cable (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).

## 3-15. REAR MAIN OIL SEAL REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
All except "A2" models

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Two plain seals (Appendix E, Item 228)
Anaerobic gasket sealer (Appendix B, Item 45)
Lubricating oil (Appendix B, Item 32)
Drycleaning solvent (Appendix B, Item 14)
Adhesive (Appendix B, Item 1)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2815-237-34P

**Equipment Condition**
- Oil pump removed (para. 3-16).
- Drivebelts loosened (TM 9-2320-280-20).

**General Safety Instructions**
Cleaning will be done in a well-ventilated area and a fire extinguisher will be kept nearby when solvent is used.

**Maintenance Level**
Direct support

### a. Removal

**NOTE**

- This task is for 6.2 L engine rear main oil seal replacement only. Disassembly of 6.5 L engine is necessary before replacing 6.5 L engine rear main oil seal. Refer to TM 9-2815-237-34 for 6.5 L engine rear main oil seal replacement.
- Before replacement of seal, thoroughly inspect engine crankcase ventilation system, tubes, rubber hoses, and CDR valve for blockage which may have caused pressure build-up in crankcase and seal failure. Correct as necessary.
- Gently tap rear main bearing cap from engine with rubber or brass mallet.

1. Remove two long capscrews (9), two short capscrews (10), and main bearing cap (6) from engine block (3).

**NOTE**

- The rear oil seal may be a nylon rope or a neoprene rubber. Perform step 2 for a nylon rope seal. Perform step 3 for a rubber seal.
- The crankshaft may need to be rotated by front crankshaft bolt to assist in seal removal.

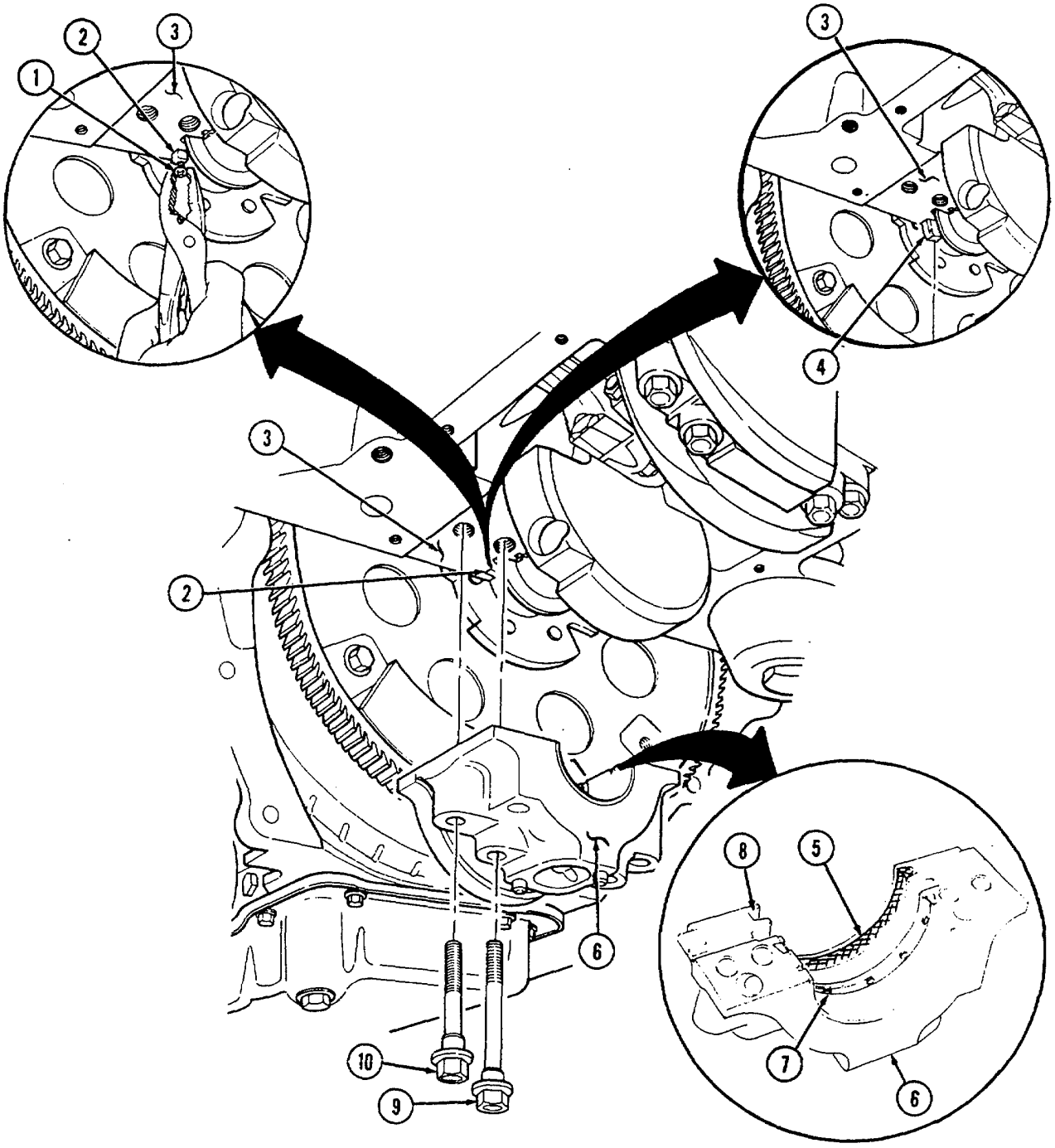
2. Screw a sheet metal screw (1) into nylon rope seal (2). Using pliers, pull nylon rope seal (2) from engine block (3) seal groove. Discard nylon rope seal (2).
3. Using pliers, pull seal (4) from engine block (3). Discard seal (4).
4. Remove seal (5) from rear main bearing cap (6). Discard seal (5).

**WARNING**

Drycleaning solvent is flammable and will not be used near an open flame. A fire extinguisher will be kept nearby when the solvent is used. Use only in well-ventilated places. Failure to do this may result in injury to personnel or damage to equipment.

5. Using drycleaning solvent, thoroughly clean the seal groove (8), oil relief slot (7), and engine block (3).

**3 - 15. REAR MAIN OIL SEAL REPLACEMENT (Cont'd)**



**3 - 15. REAR MAIN OIL SEAL REPLACEMENT (Cont'd)**

**b. Installation**

**NOTE**

- Each seal is marked "outside" on an edge. Install "outside" marking toward rear of engine for correct installation.
- If oil seal stops or binds during installation, tap into position with wood block and hammer.
- Seal shavings during installation are permitted. Large shavings, nicks, or gouges during installation are not permitted.

1. Lubricate seal (10) with lubricating oil. By hand, insert seal (10) into upper seal groove of engine block (1) until seal (10) stops.

**NOTE**

Seal must be pressed tightly against crankshaft, by assistant, to avoid rear side of seal being cut by block surface.

2. Press seal (10) against crankshaft (11) as shown, and lightly tap seal (10) with wood block and hammer into engine block (1) until one inch of seal (10) remains out of engine block (1).

3. Lubricate seal (2) with lubricating oil. Install seal (2) into opposite side of seal groove in engine block until seal halves (2) and (10) make contact.

**CAUTION**

Keep sealant off of bearing oil seal and bearing cap oil relief slot and non-shaded areas of bearing cap flange, or engine damage will result.

4. Apply lubricating oil to bearing (5).

5. Apply light coat of adhesive to main bearing cap seal groove (4).

**NOTE**

Immediately install rear main bearing cap after application of sealer.

6. Apply thin film of anerobic gasket sealer to rear main bearing cap mating surfaces (3) as shown by shaded areas. Keep sealer off bearing (5) and oil relief slot (7).

**CAUTION**

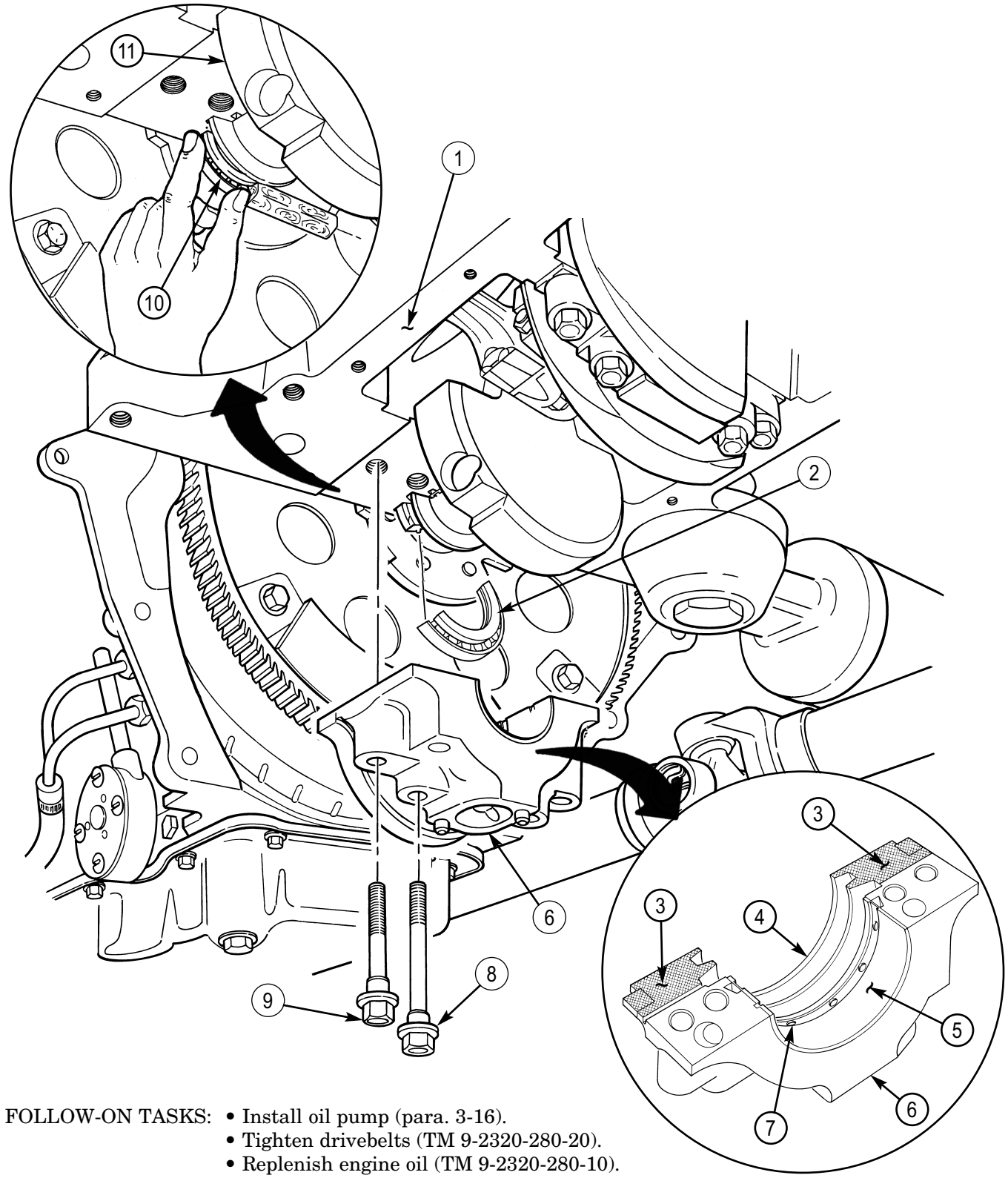
Do not use capscrews to pull main bearing cap into block cavity. Tap rear main bearing cap into cylinder block cavity using brass hammer or rubber mallet. Failure to do this may cause damage to equipment.

7. Install rear main bearing cap (6) with two long capscrews (8) and two short capscrews (9) and tighten to 40 lb-ft (54 N.m).

8. Evenly tighten two long capscrews (8) to 110 lb-ft (149 N.m).

9. Evenly tighten two short capscrews (9) to 100 lb-ft (136 N.m).

## 3-15. REAR MAIN OIL SEAL REPLACEMENT (Cont'd)




FOLLOW-ON TASKS:
- Install oil pump (para. 3-16).
- Tighten drivebelts (TM 9-2320-280-20).
- Replenish engine oil (TM 9-2320-280-10).
- Start engine (TM 9-2320-280-10) and check for leaks.

## 3-16. OIL PUMP MAINTENANCE

**This task covers:**

**a. Removal**
**b. Repair**
**c. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Manual References**
TM 9-2815-237-34
TM 9-2815-237-34P
TM 9-2320-280-20

**Equipment Condition**
Oil pan removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

### a. Removal

1. Remove nut (6) from pickup tube bracket (4) and stud (7).
2. Loosen capscrew (3) from bracket (4) and oil pickup tube (5) and slide bracket (4) off stud (7).
3. Remove stud (7) from oil pump (8) and rear main bearing cap (2).
4. Remove oil pump (8) and shaft (9) from cylinder block (1).
5. Remove capscrew (3) and bracket (4) from oil pickup tube (5).

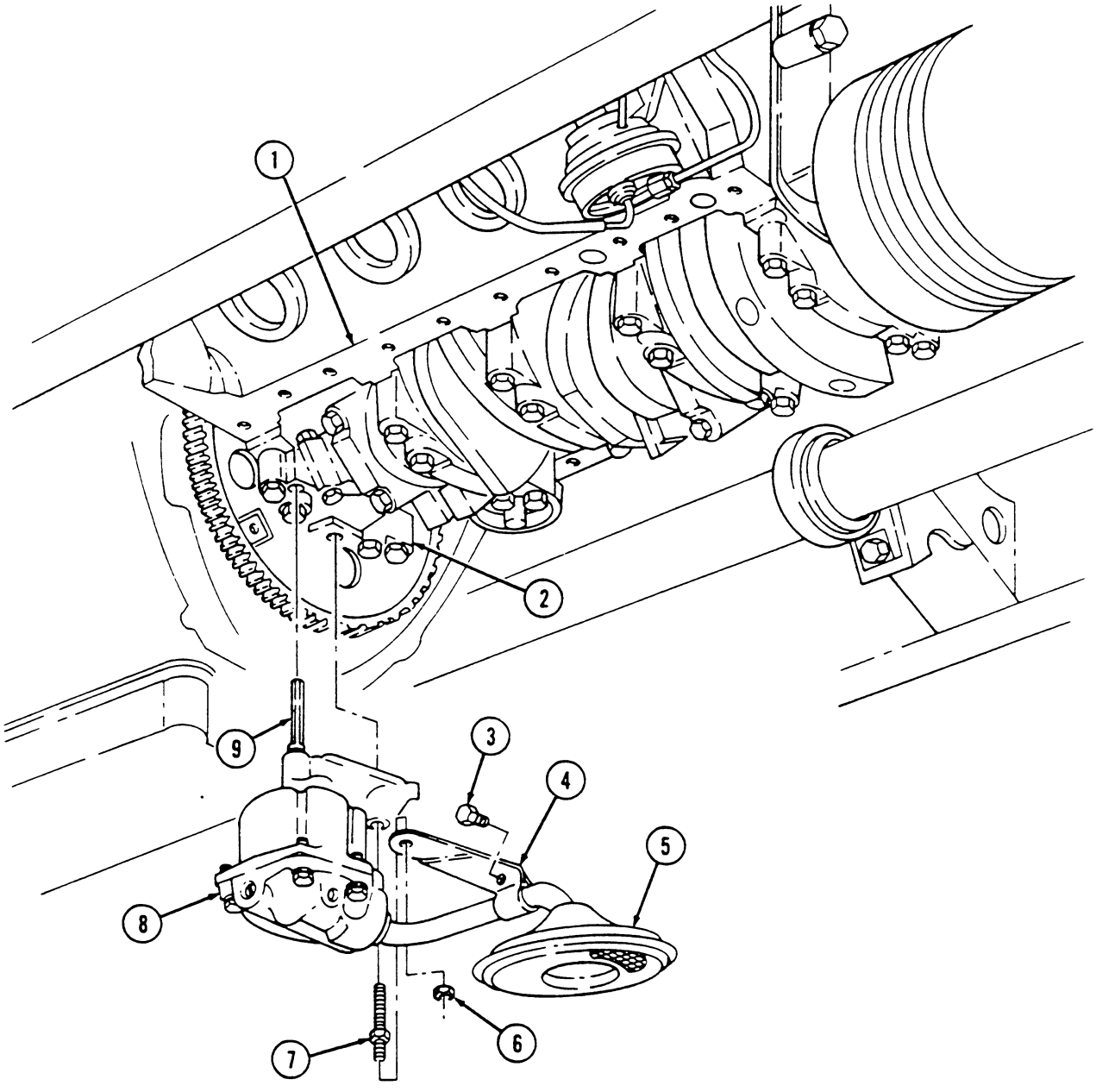
### b. Repair

For repair procedures for oil pump, refer to TM 9-2815-237-34.

### c. Installation

1. Install bracket (4) on oil pickup tube (5) with capscrew (3). Finger tighten capscrew (3).
2. Install oil pump (8) and shaft (9) on rear main bearing cap (2).
3. Install stud (7) on oil pump (8) and rear main bearing cap (2) and tighten to 59-74 lb-ft (80-100 N•m).
4. Secure bracket (4) on stud (7) with nut (6). Tighten nut (6) to 35 lb-ft (47 N•m).
5. Tighten capscrew (3) to 12 lb-ft (16 N•m).

## 3-16. OIL PUMP MAINTENANCE (Cont'd)




FOLLOW-ON TASK: Install oil pan (TM 9-2320-280-20).

# 3-17. INTAKE MANIFOLD MAINTENANCE

**This task covers:**

**a. Removal**
**b. Repair**
**c. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two gaskets (Appendix E, Item 17)

**Manual References**
TM 9-2320-280-20
TM 9-2815-237-34
TM 9-2815-237-34P

**Equipment Condition**
- Air horn removed (TM 9-2320-280-20).
- CDR valve bracket removed (TM 9-2320-280-20).

**General Safety Instructions**
Gaskets installed on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be disposed of IAW current directives.

**Maintenance Level**
Direct support

## a. Removal

**WARNING**

Gaskets installed on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be removed with a scraper or putty knife and then disposed of IAW current directives. Inhalation of asbestos fibers can cause respiratory ailments.

**NOTE**

In some cases, flanged head fasteners may be present instead of standard fasteners and washers. In all cases, washers should be used when replacing a flanged head fastener with a standard fastener.

1. Remove nut (12), washer (13), and fuel filter line clamp (14) from stud (15).
2. Remove nut (2), washer (3), and harness clamp (1) from stud (4).
3. Remove two nuts (9), washers (10), and wiring harness bracket (11) from studs (16).
4. Remove two nuts (7), washers (8), and harness brackets (6) and (17) from two studs (5).
5. Remove four long studs (22), long capscrew (24), six studs (23), five capscrews (20), and sixteen washers (19) from intake manifold (18).
6. Remove three injection line clamps (21), injection line clamp (25), and fuel supply clamp (26) from intake manifold (18).
7. Remove intake manifold (18) and two gaskets (27). Discard gaskets (27).
8. Cover cylinder head (28) ports.

## b. Repair

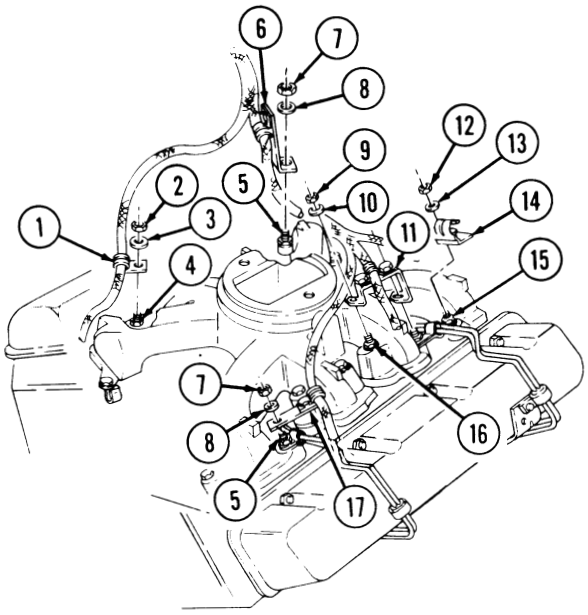
For intake manifold repair procedures, refer to TM 9-2815-237-34.

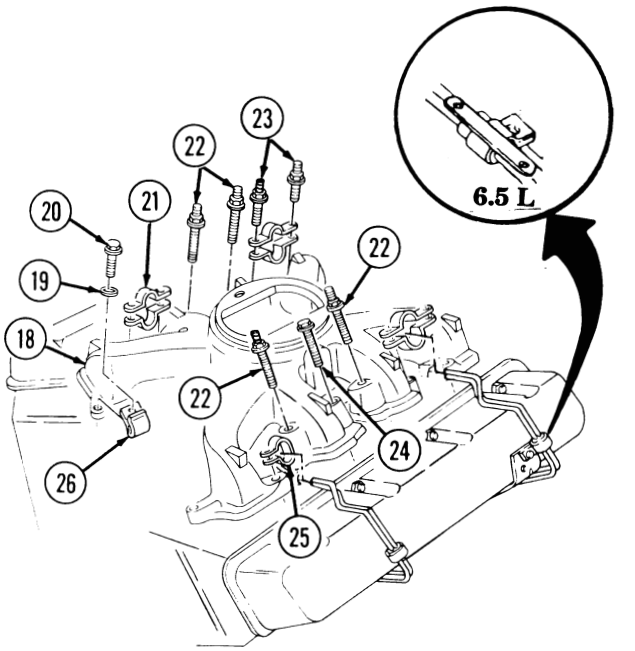
## c. Installation

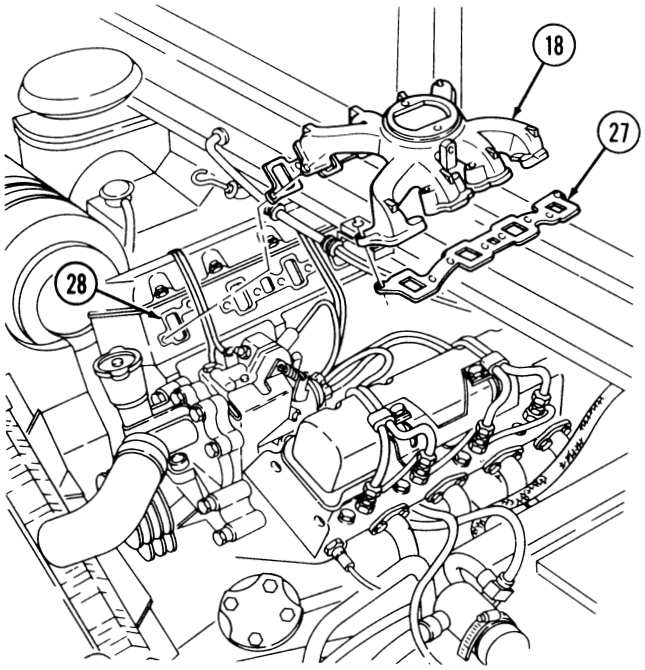
1. Install two intake manifold gaskets (27) and intake manifold (18) on cylinder heads (28).
2. Install injection line clamp (25), fuel supply clamp (26), and three injection line clamps (21) on fuel injection lines, and position on intake manifold (18).
3. Install four long studs (22), long capscrew (24), six studs (23), five capscrews (20), and sixteen washers (19) on intake manifold (18).

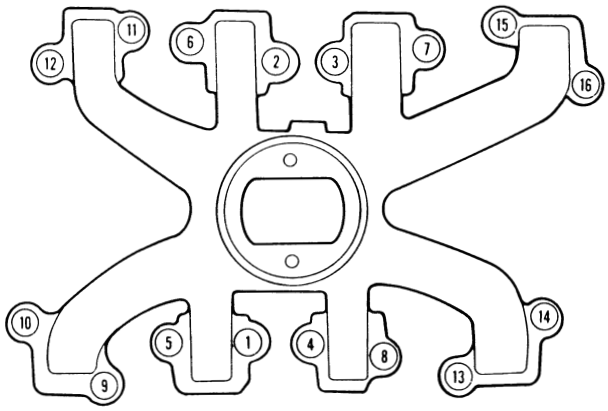
## 3-17. INTAKE MANIFOLD MAINTENANCE (Cont'd)

4. Tighten all studs (22) and (23) and capscrews (24) and (20) to 30 lb-ft (41 N•m), following torque sequence.
5. Install harness brackets (6) and (17) on two studs (5) with washers (8) and nuts (7).
6. Install harness bracket (11) on studs (16) with two washers (10) and nuts (9).
7. Install harness clamp (1) on stud (4) with washer (3) and nut (2).
8. Install fuel filter line clamp (14) on stud (15) with washer (13) and nut (12).




TORQUE SEQUENCE

FOLLOW-ON TASKS:
- Install CDR valve bracket (TM 9-2320-280-20).
- Install air horn (TM 9-2320-280-20).

## 3-18. GLOW PLUG TIP REMOVAL (DAMAGED OR BROKEN)

**This task covers:**

**Removal**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)
Needlenose pliers, 90 degree (Appendix G, Item 134)

**Special Tools**

Socket 3/8 in. (Appendix G, Item 114)

**Manual References**

TM 9-2320-280-20

**Personnel Required**

One mechanic
One assistant

**Equipment Condition**

- Fuel injector nozzle removed (para. 4-3).
- Drivebelts loosened (TM 9-2320-280-20).

**General Safety Instructions**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa).

**Maintenance Level**

Direct support

**Removal**

**NOTE**

Affected cylinder piston must be brought to (TDC) position to ensure intake and exhaust valves are closed.

1. Using socket wrench and breaker bar on torsion damper bolt (3), rotate crankshaft to bring piston (in affected cylinder) to top dead center (TDC) position.

**NOTE**

Perform steps 2 and 3 if failed glow plug is still installed in cylinder head. Perform step 4 if failed glow plug has been removed from the cylinder head and glow plug tip is broken off in cylinder head prechamber. Perform steps 5 and 6 if failed glow plug tip is swollen.

2. Inserting pliers through injector nozzel opening (1), grasp glow plug tip, break off expanded tip, and remove the piece from the prechamber.
3. Remove the glow plug (TM9-2320-280-20).

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personnel protective equipment (goggles, shield, gloves, etc.).

4. Direct compressed air into glow plug port (2) to expel broken tip from prechamber through injector nozzle opening (1).

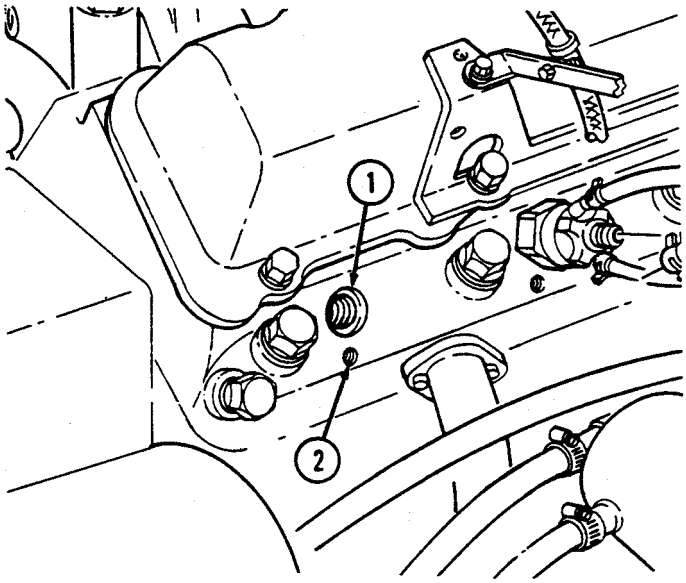
## 3-18. GLOW PLUG TIP REMOVAL (DAMAGED OR BROKEN) (Cont'd)

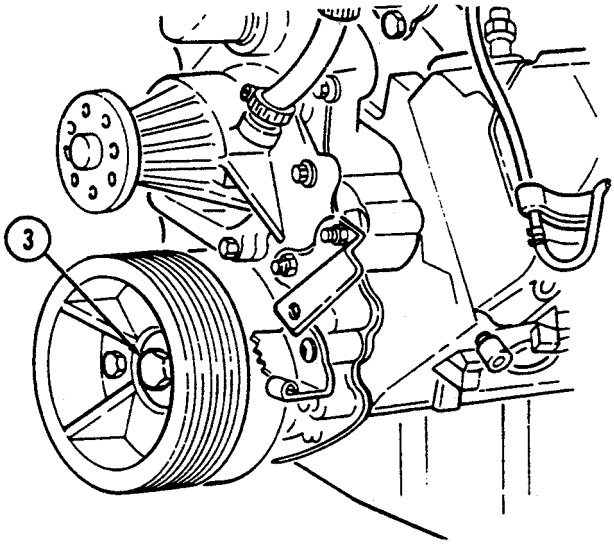
5. Coil one end of an 18 inch piece of tie wire the size of the injector nozzle opening (1). Place the flat coil end over the preheater to combustion chamber hole.

**NOTE**

In some cases it may be necessary to remove cylinder head to remove expanded glow plug tip.

6. Using long nose pliers with a 90 degree bend, insert pliers through injector nozzle opening (1), grasp glow plug tip, break off expanded tip, and remove the piece from the prechamber.
7. Install new glow plug (TM9-2320-280-20).




FOLLOW-ON TASKS:
- Install fuel injector nozzle (para. 4-3).
- Tighten drivebelts (TM 9-2320-280-20).

## 3-19. ENGINE INJECTION PUMP TIMING

**This task covers:**

**a. Timing Check** **b. Timing Adjustment**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**
Timing bracket gauge (Appendix G, Item 20)
Dynamic timing meter (Appendix G, Item 21)

**Materials/Parts**
Metallic wool (Appendix B, Item 60)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20

**Equipment Condition**
- Hood raised and secured (TM 9-2320-280-10).
- Engine access cover removed (TM 9-2320-280-20).
- Companion seat and battery box cover removed (TM 9-2320-280-20).

**General Safety Instructions**
Never adjust timing while engine is running.

**Maintenance Level**
Direct support

### a. Timing Check

**NOTE**

Magnetic pickup receptacle on timing bracket must be correctly positioned or timing meter will not register correctly.

1. Insert timing bracket gauge into magnetic pickup receptacle (8) on timing bracket (1).
2. Rotate timing bracket gauge so pointer on gauge fits into TDC notch (9) in timing bracket (1).
3. If pointer on gauge does not fit exactly into TDC notch (9), bend magnetic pickup receptacle (8) until pointer on gauge fits exactly into TDC notch (9).
4. Remove timing bracket gauge from pickup receptacle (8) on timing bracket (1).

**NOTE**

End of magnetic pickup must be .06 in. (1.5 mm) from torsional damper.

5. Install magnetic pickup (7) into magnetic pickup receptacle (8) and connect pickup lead (6) to timing meter.

**NOTE**

Clamp-on pickup must be used on a straight section of tube no further than 4 in. (10 cm) from injection nozzle.

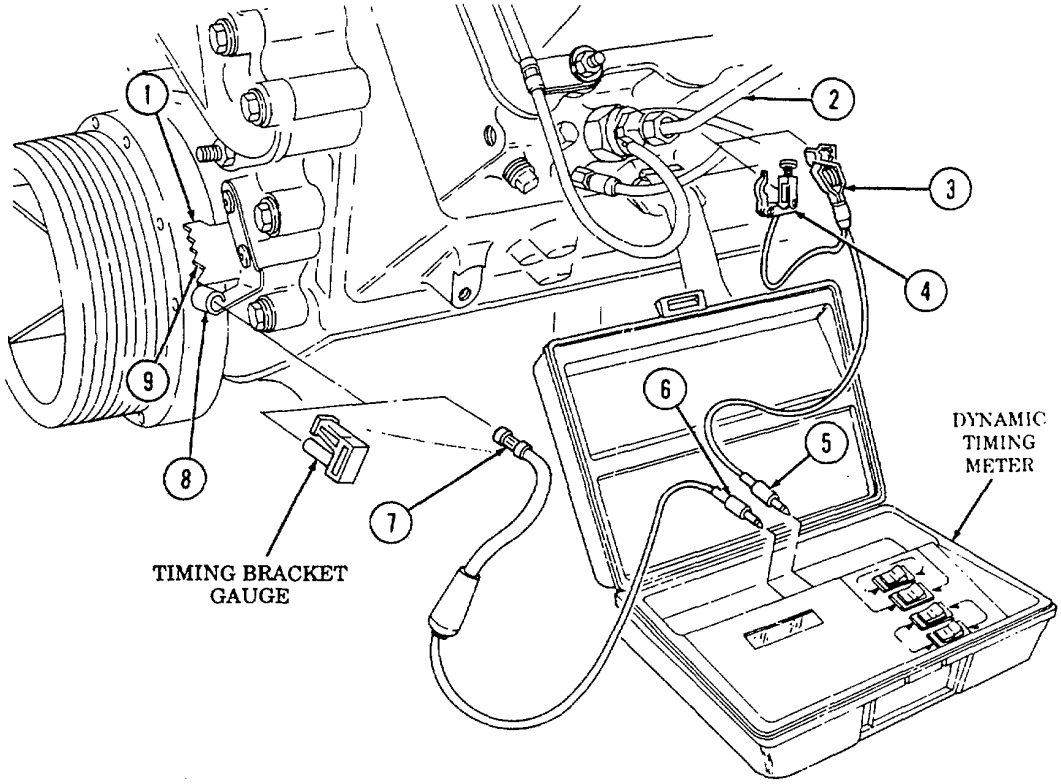
6. Clean cylinder number one injection line (2) with metallic wool.

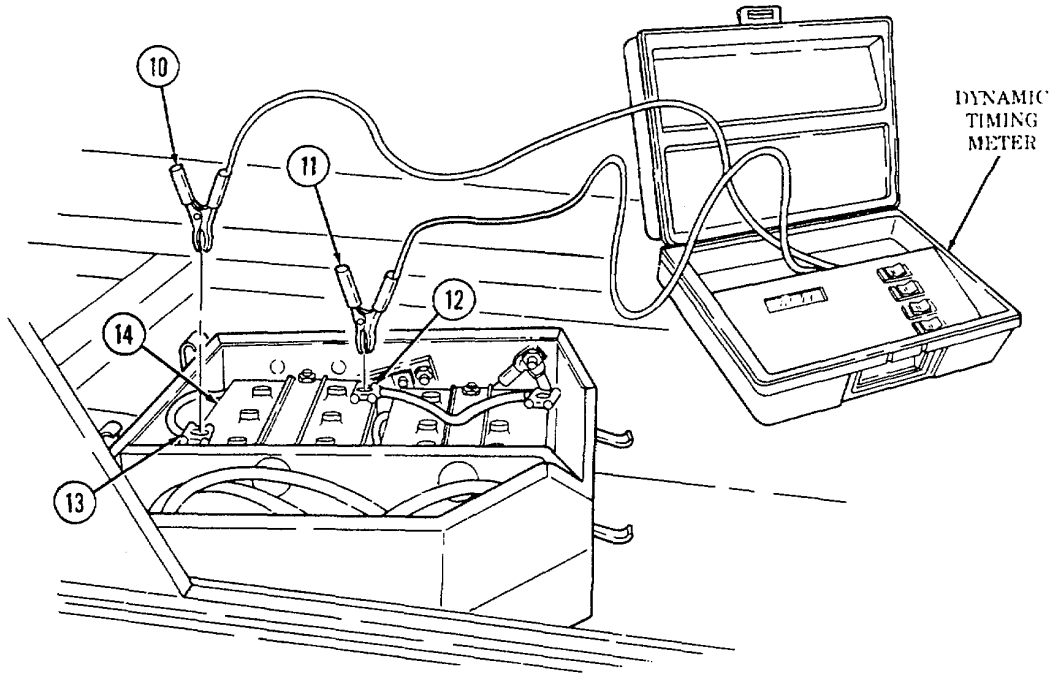
**CAUTION**

Do not overtighten clamp-on pickup or damage to pickup will result.

7. Install pickup (4) on injection line (2).
8. Connect ground clip (3) to fuel injection line (2) and connect pickup lead (5) to timing meter.
9. Route power leads of timing meter into battery compartment and connect red power lead (11) to positive battery terminal (12) on rear battery (14).
10. Connect black ground lead (10) to negative battery terminal (13) on rear battery (14). Display should light up and read: SE-1 20.0.

**3 - 19. ENGINE INJECTION PUMP TIMING (Cont'd)**



## 3-19. ENGINE INJECTION PUMP TIMING (Cont'd)

**CAUTION**

Ensure all cables and wires are clear from fan, belts, and exhaust manifolds before starting engine, or damage to equipment will result.

**NOTE**

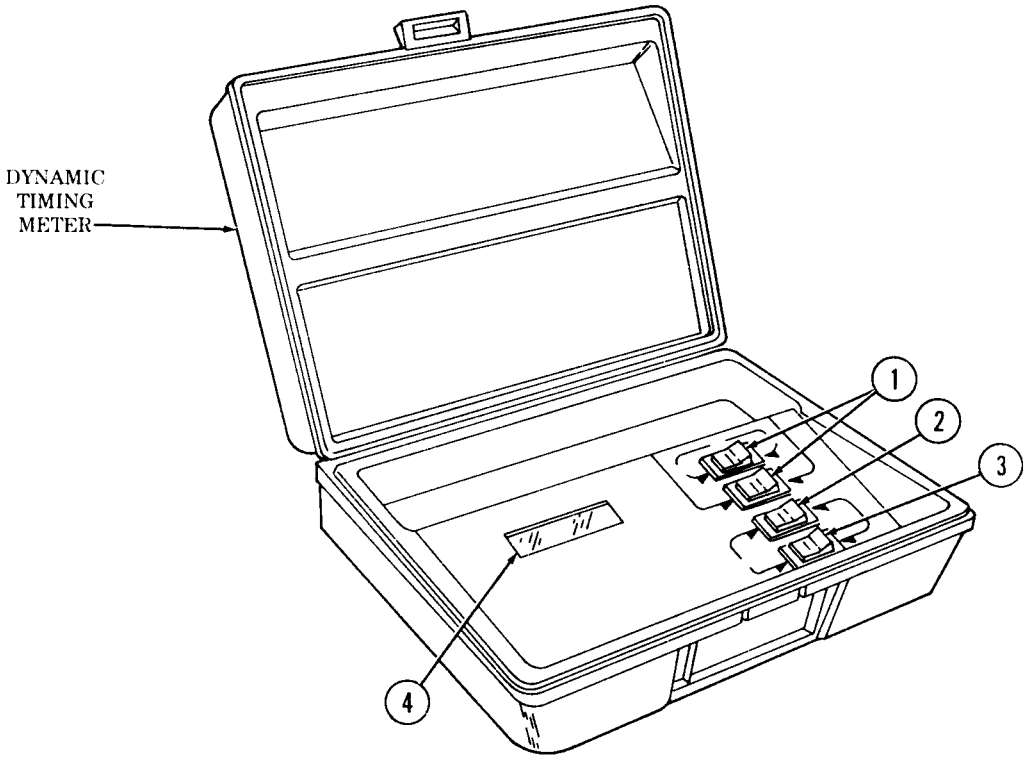
If sensor light is not blinking, check clamp-on pickup fuel injection line for proper installation.

11. Depress offset adjustment switch (3) and hold.
12. Operate increase/decrease switch (2) until offset adjustment reads 9.5 for 6.2L engines and 30.5 for 6.5L engines on display (4). Release offset adjustment switch (3). Display (4) should not read: 0000 ... 0.0.
13. Start engine (TM 9-2320-280-10) and warm up to operating temperature.
14. Position sensor switches (1) to clamp-on and magnetic pickup positions.

**NOTE**

For vehicles with 1990 engines and above, timing must be 5° before top dead center.

15. Raise engine speed to 1300 rpm and read injection pump timing on display (4). Timing must be 4° before top dead center. If timing is not 4° before top dead center, stop engine (TM 9-2320-280-10) and adjust timing (para. 3-19b).
16. Disconnect timing meter.



## 3 - 19. ENGINE INJECTION PUMP TIMING (Cont'd)

### b. Timing Adjustment

**WARNING**

Never adjust injection pump timing with engine running or injury to personnel and damage to equipment may result.

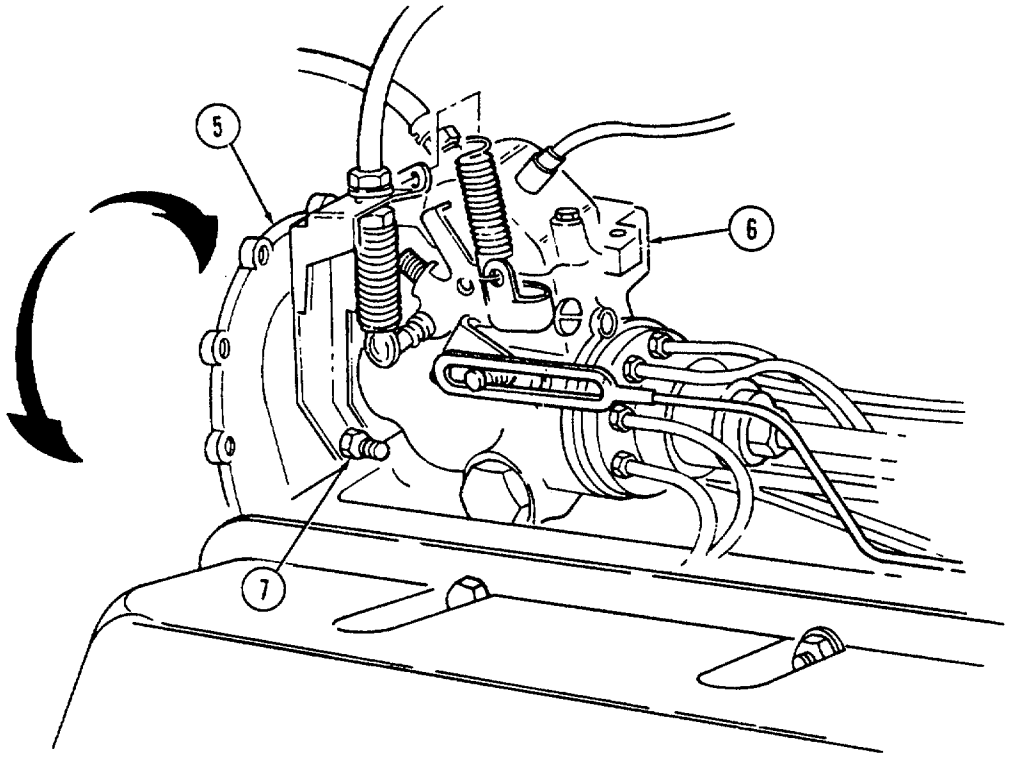
1. Loosen three nuts (7) securing injection pump (6) to timing chain cover (5).

**NOTE**

Moving injection pump .03 in. (.8 mm) is equal to approximately 1° of injection pump timing.

2. Move injection pump (6) clockwise to retard timing or counterclockwise to advance timing.

3. Tighten three nuts (7) securing injection pump (6) to timing chain cover (5) and recheck timing (para. 3-19a).




FOLLOW-ON TASKS:
- Install companion seat and battery box cover (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).
- Lower and secure hood (TM 9-2320-280-10).

## 3 - 20. ENGINE RUN-IN

This task covers:

In Chassis Run-In

INITIAL SETUP:

Tools
General mechanic's tool kit: automotive (Appendix G, Item 1)

Manual References
TM 9-2320-280-10
TM 9-2320-280-20

Equipment Condition
Engine installed in vehicle (para. 3-23 or 3-25).

General Safety Instructions
Ensure engine compartment is free of all tools and working material before starting engine.

Maintenance Level
Direct support

### In Chassis Run-In

**WARNING**

Ensure engine compartment is free of all tools and working material before starting engine. Failure to do this may cause injury to personnel or damage to equipment.

**CAUTION**

If any leaks or abnormal noise is noted, stop engine immediately and correct as necessary. Any abnormalities must be corrected before proceeding.

1. Start engine (TM 9-2320-280-10) and allow engine to idle for five to ten minutes.
2. Stop engine and inspect oil level and coolant level (TM 9-2320-280-10).
3. Check for leaks. If any leaks are found, correct as necessary.

**NOTE**

It may be necessary to block air flow to radiator.

4. Start engine (TM 9-2320-280-10) and run at 1/4 to 1/2 engine throttle until coolant temperature reaches 165°-195°F (74°-90°C).
5. Repeat steps 2 and 3.
6. Set engine idle speed (TM 9-2320-280-20).

FOLLOW-ON TASK: Follow break-in service (TM 9-2320-280-10).

## Section II. ENGINE REPLACEMENT

### 3-21. ENGINE REPLACEMENT TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 3-21.1. | Engine Replacement in Shipping/Storage Container | 3-44.2 |
| 3-22. | Engine Removal (6.2 L and 6.5 L [Detuned]) | 3-46 |
| 3-23. | Engine Installation (6.2 L and 6.5 L [Detuned]) | 3-82 |
| 3-24. | Engine Removal (6.5 L) | 3-114 |
| 3-25. | Engine Installation (6.5 L) | 3-146 |
| 3-26. | Engine Preparation (6.2 L and 6.5 L) | 3-174 |

# 3-21.1. ENGINE REPLACEMENT IN SHIPPING/STORAGE CONTAINER

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**
Engine lifting sling (Appendix G, Item 22)

**Materials/Parts**
Eight lockwashers (Appendix E, Item 104)

**Manual References**
TM 9-2320-280-24P
TM 9-2815-237-34

**Personnel Required**
One mechanic
One assistant

**General Safety Instructions**
Direct personnel to stand clear during hoisting operation.

**Maintenance Level**
Direct support

**a. Removal**

1. Press air-release button (1) located at center of breather valve (2) before opening engine container (5).
2. Remove twenty-six nuts (19), washers (18), capscrews (16), and upper container (4) from lower container (13).
3. Position engine lifting sling on engine (6) and install on right cylinder head (23) with two capscrews (24).
4. Install sling bracket on left cylinder head (20) with two capscrews (22). Tighten capscrews (22) and install sling bracket to engine lifting sling with pin (21).
5. Remove four capscrews (14), lockwashers (8), and washers (7) from two engine mounts (12). Discard lockwashers (8).
6. Remove four capscrews (9), lockwashers (8), and washers (7) from two rear engine mounts (11). Discard lockwashers (8).

**WARNING**

Direct personnel to stand clear during hoisting operation. Failure to do this may cause injury to personnel.

7. Attach hoist to engine lifting sling and remove engine (6) from lower container (13).
8. Prepare engine for assembly (TM 9-2815-237-34).

**b. Installation**

**WARNING**

Direct personnel to stand clear during hoisting operation. Failure to do this may cause injury to personnel.

1. Attach hoist to engine lifting sling.
2. Install engine assembly (6) in lower container (13).
3. Install engine assembly (6) on two rear engine mounts (11) with four washers (7), lockwashers (8), and capscrews (9).
4.. Install engine assembly (6) on two engine mounts (12) with four washers (7), lockwashers (8), and capscrews (14).
5. Remove pin (21) from sling bracket.

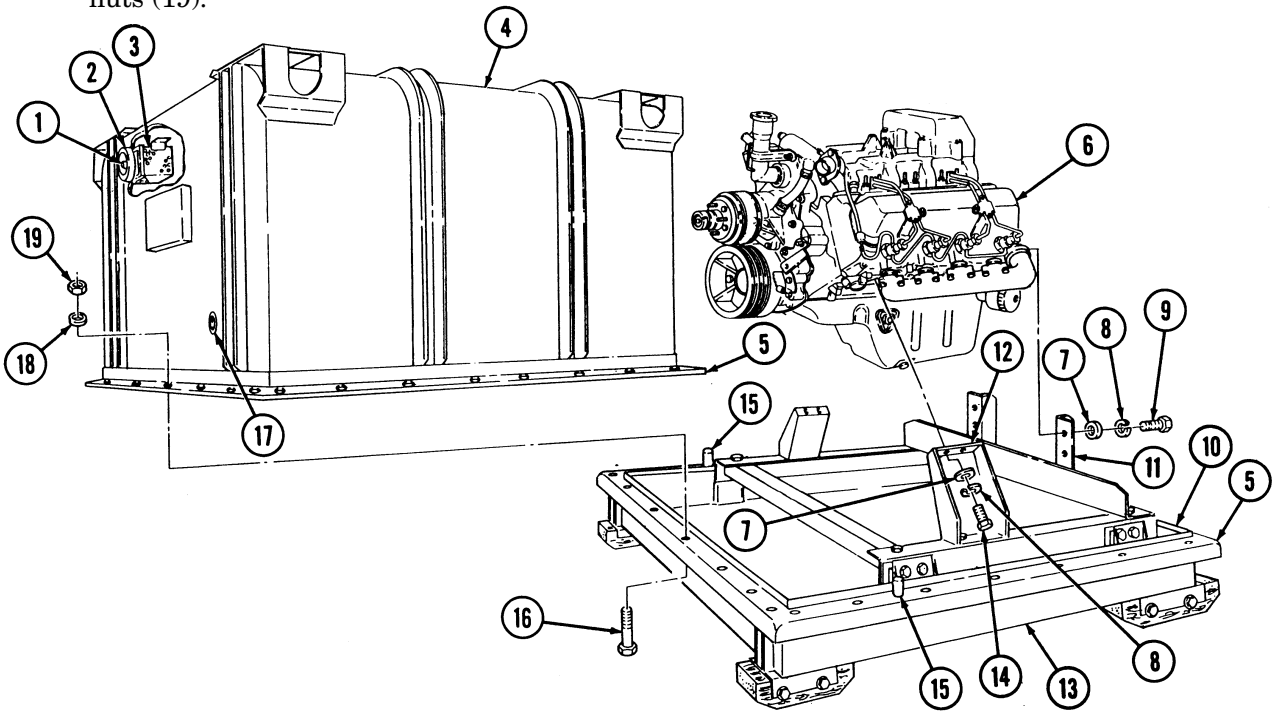
## 3-21.1. ENGINE REPLACEMENT IN SHIPPING/STORAGE CONTAINER (Cont'd)

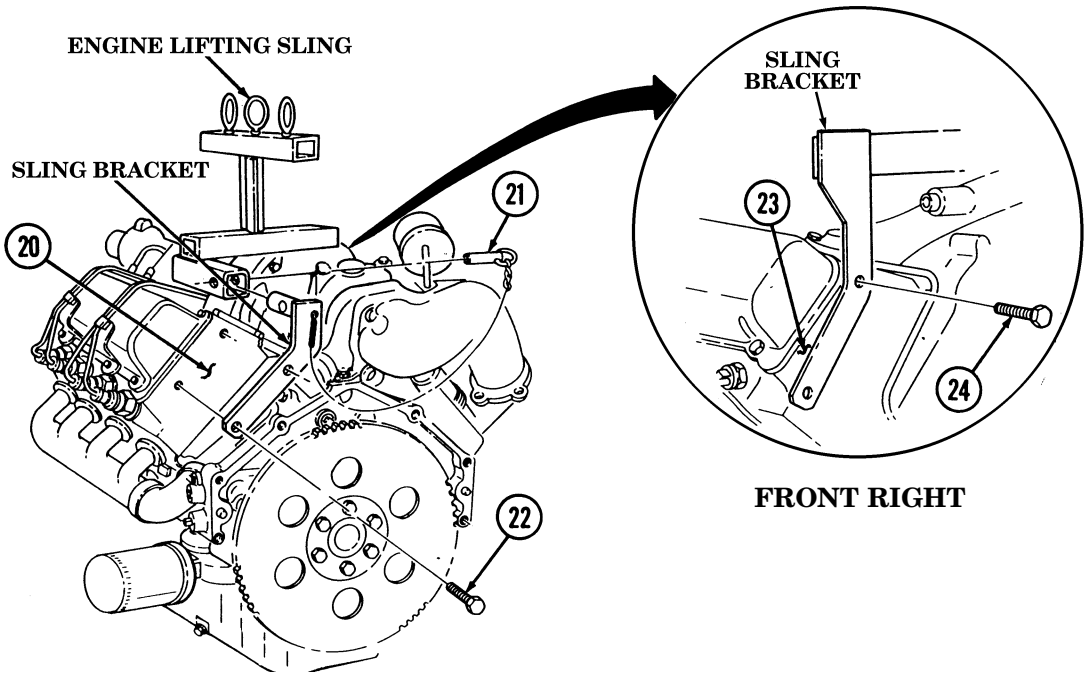
6. Remove two capscrews (24) and engine lifting sling from right cylinder head (23).
7. Remove two capscrews (22) and sling bracket from left cylinder head (20).
8. Visually check humidity indicator (17) for discolorization. If indicator (17) is dark purple, replace desiccant (3).

**NOTE**

Ensure gasket is seated properly.

9. Position upper container (4) using alignment pins (15) on gasket (10) and lower container (13).
10. Install upper container (4) on lower container (13) with twenty-six capscrews (16), washers (18), and nuts (19).




FRONT RIGHT

## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED])

**This task covers:**

**Removal**

**INITIAL SETUP:**

**Applicable Models**

All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**

Engine lifting sling (Appendix G, Item 22)
Hex head driver, 8 mm, (Appendix G, Item 115)

**Material/Parts**

Engine/Transmission support sling (Appendix C, Fig. 24 through 40) (Optional)

**Personnel Required**

One mechanic
One assistant

**Manual References**

TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Battery ground cable disconnected (TM 9-2320-280-20).
- Hood raised and secured (TM 9-2320-280-10).
- Engine access cover removed (TM 9-2320-280-20).

**General Safety Instructions**

- Hood must be supported during removal.
- Do not remove surge tank filler cap before releasing internal pressure.
- Do not drain oil when engine is hot.
- Alternator must be supported during removal.
- Do not touch hot exhaust system components with bare hands.
- Do not use diesel fuel near fires, flames, or sparks.
- Transmission must be supported during engine removal.
- Direct personnel to stand clear during hoisting operation.
- Do not use hands to free engine of hangups or snags.
- Parking brake to be applied throughout procedure.

**Maintenance Level**

Direct support

**NOTE**

- Replacement parts for 1990 and above engines and previous model engines are basically the same. Refer to engine decal model number on left rocker arm cover before ordering replacement parts.
- This procedure is for 6.2L and detuned 6.5L engines only. Refer to para. 3-24 for 6.5L engine removal.

**Removal**

**CAUTION**

Throughout engine removal procedure, cover or plug all hoses immediately after disconnecting to prevent contamination.

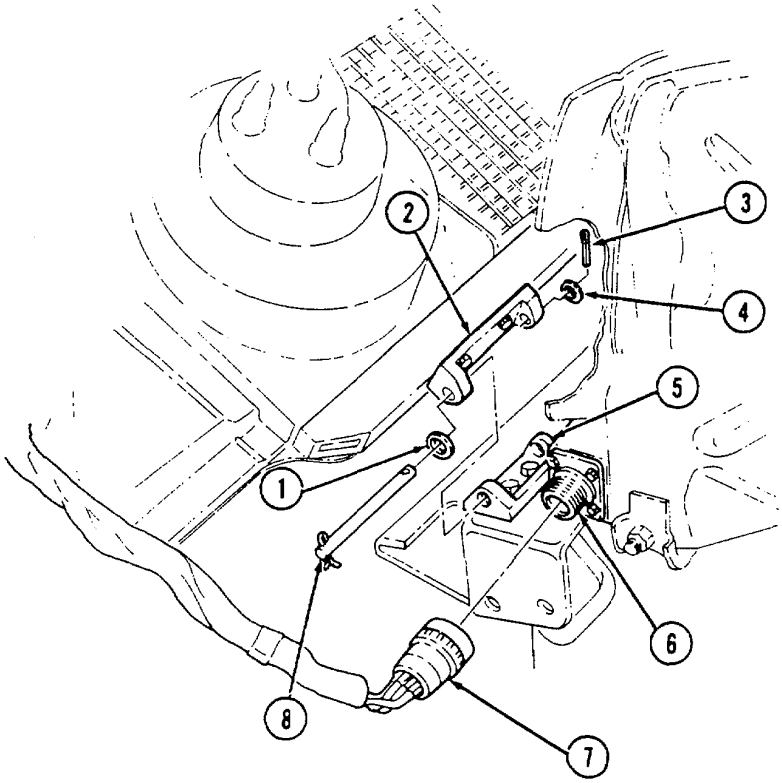
1. Disconnect connector plug (7) from connector to receptacle (6).

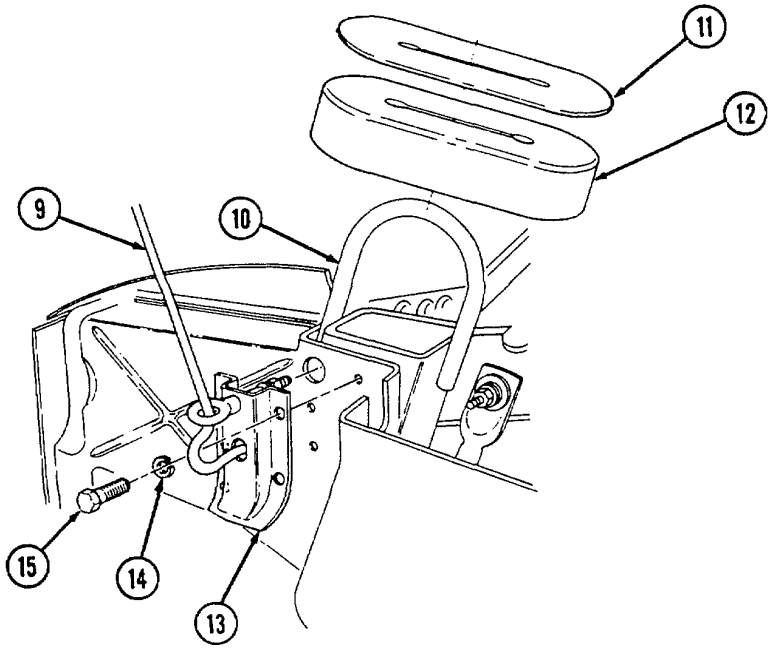
**WARNING**

Hood must be supported during removal. Failure to support hood may cause injury to personnel and damage to equipment.

2. Remove four screws (15), lockwashers (14), and bracket (13) from airlift bracket (10). Discard lockwashers (14).
3. Lower hood and remove two cotter pins (3), washers (4), hinge pins (8), washers (1), and two upper hinge halves (2) from lower hinge halves (5). Discard cotter pins (3).
4. Remove hood with prop rod (9) and bracket (13) attached.
5. Remove two cover plates (11) and seals (12) from airlift brackets (10).

**3 - 22. ENGINE REMOVAL (6.2L) (Cont'd)**



**3 - 22. ENGINE REMOVAL (6.2L) (Cont'd)**

**WARNING**

Do not remove surge tank filler cap before depressurizing system when engine temperature is above 190°F (88°C). Steam or hot coolant under pressure will cause severe burns.

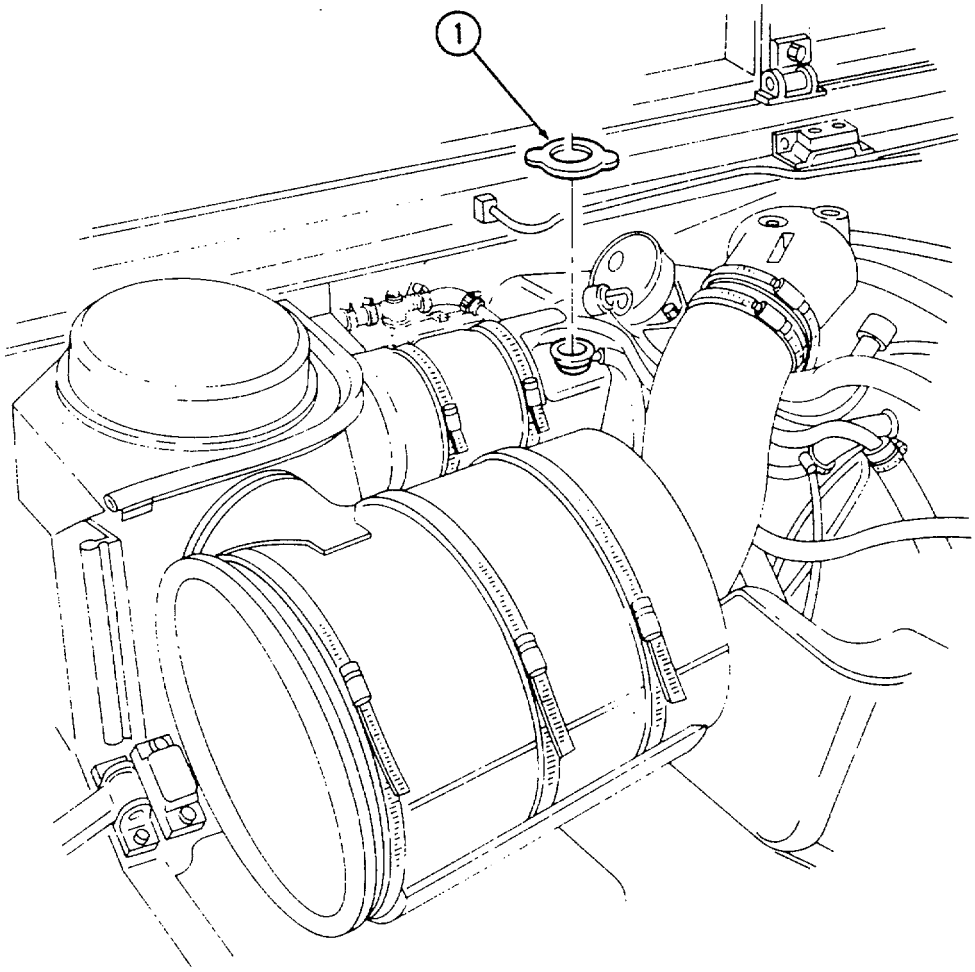
6. If engine is hot, remove surge tank filler cap (1) by placing a thick cloth over cap (1). Press down and turn counterclockwise to its first stop to release internal pressure.

7. After pressure has escaped, press down and turn cap (1) counterclockwise again and remove.

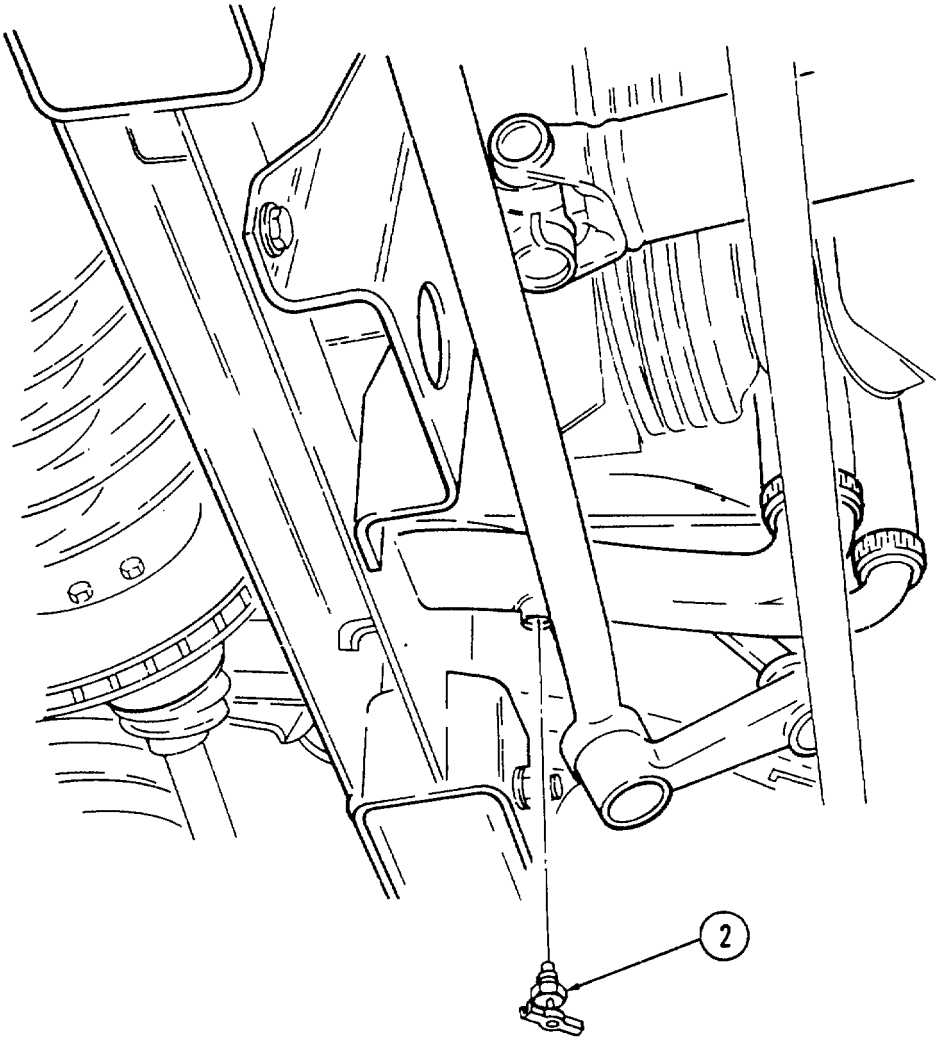
**NOTE**

Have drainage container ready to catch coolant.

8. Open and remove draincock (2) and allow system to drain.



**3 - 22. ENGINE REMOVAL (6.2L) (Cont'd)**



## 3 - 22. ENGINE REMOVAL (6.2L) (Cont'd)

9. Remove four screws (18) and connector receptacle (19) from bracket (17).

10. Loosen rear receptacle cover (20) and slide wires of receptacle (19) out through slot in bracket (17).

11. Remove nut and lockwasher assembly (24), screw (22), and harness and clamp (23) from left splash shield (7). Discard nut and lockwasher assembly (24).

12. Remove locknut (21), washer (14), capscrew (15), washer (14), and left splash shield (7) from support bracket (16). Discard locknut (21).

**NOTE**

Early production vehicles used studs to connect splash shields to airlift brackets.

13. Remove locknut (2), washer (3), washer (4), capscrew (11), and washer (3) from left splash shield (7) and airlift bracket (1). Discard locknut (2).

14. Remove capscrew (12), lockwasher (13), and left splash shield (7) from airlift bracket (1). Discard lockwasher (13).

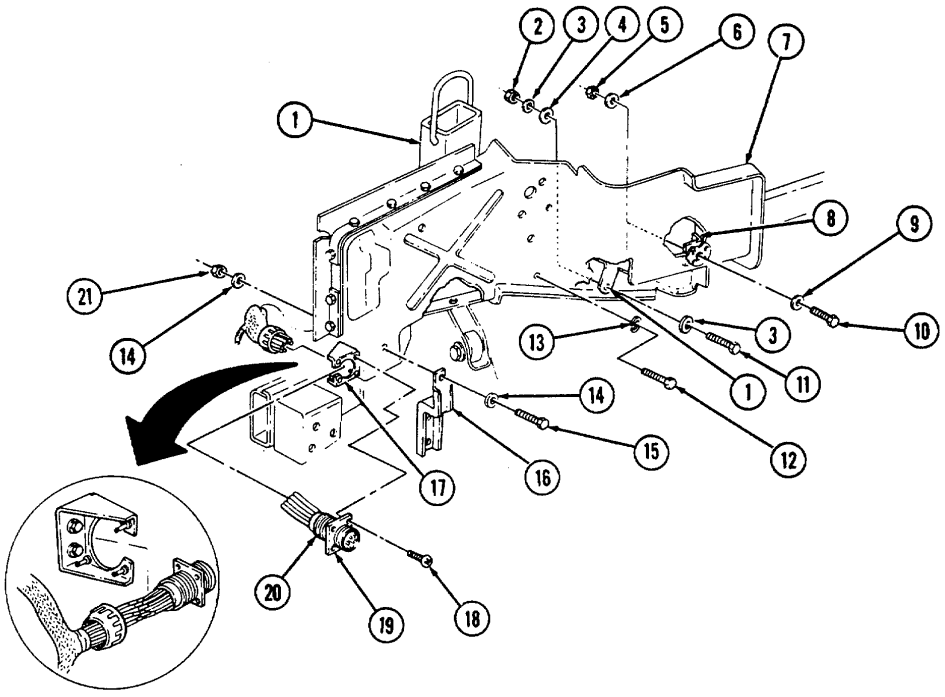
15. Remove locknut (5), washer (6), capscrew (10), washer (9), and left splash shield (7) from bracket (8). Discard locknut (5).

16. Remove locknut (30), two washers (29), capscrew (31), and right splash shield (39) from support bracket (28). Discard locknut (30).

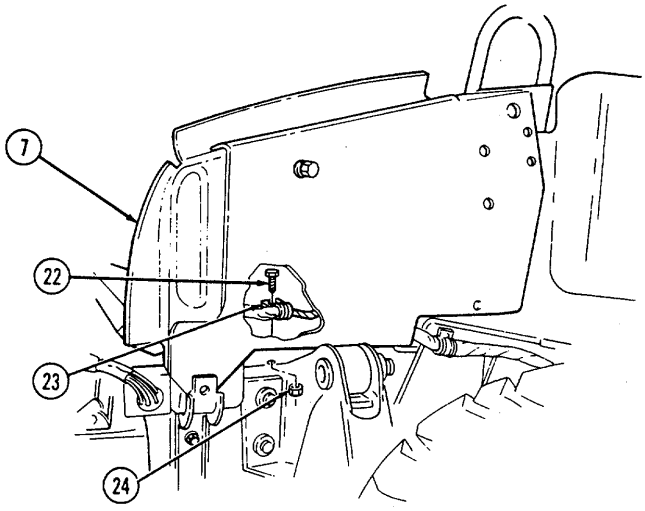
17. Remove locknut (32), washer (33), washer (34), capscrew (35), and washer (33) from right splash shield (39) and airlift bracket (1). Discard locknut (32).

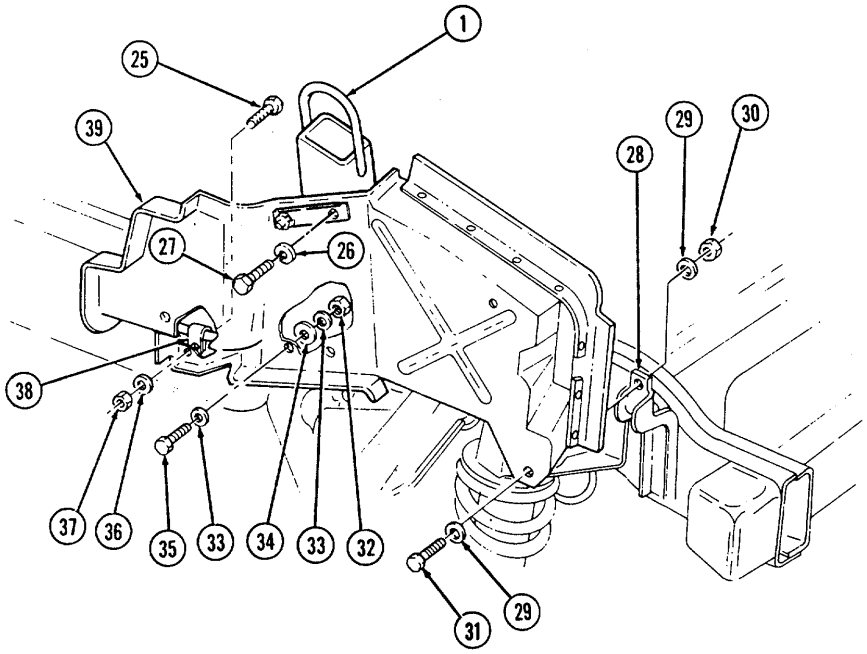
18. Remove locknut (37), washer (36), capscrew (25), and fuel line clamp (38) from right splash shield (39). Discard locknut (37).

19. Remove screw (27), lockwasher (26), and right splash shield (39) from airlift bracket (1). Discard lockwasher (26)



**3-22. ENGINE REMOVAL (6.2 L) (Cont'd)**



**3-22. ENGINE REMOVAL (6.2 L) (Cont'd)**

20. Loosen clamp (1) and disconnect radiator inlet hose (2) from engine.
21. Loosen clamp (5) and disconnect surge tank-to-radiator vent hose (4) from adapter (6).
22. Loosen clamp (15) and disconnect control valve hose (14) from bulkhead adapter (16).
23. Disconnect fan drive hose (17) from fan drive (18).
24. Loosen clamp (9) and disconnect lower radiator front hose (10) from radiator (3).
25. Remove locknut (25), washer (26), capscrew (31), washer (30), large washer (29), and lower mount (27), from frame bracket (28). Discard locknut (25).
26. Remove four locknuts (11), washers (12) capscrews (13), and two brackets (8) from airlift bracket (7). Discard locknuts (11).

**WARNING**

Do not drain engine oil when engine is hot. Severe injury to personnel will result.

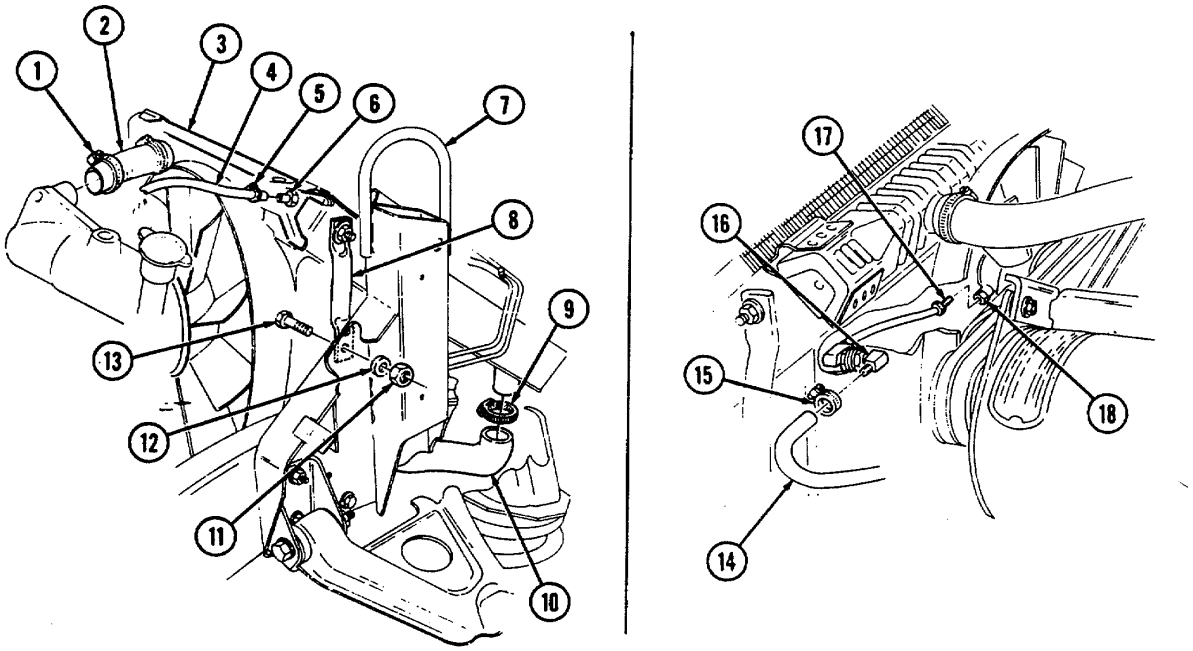
**CAUTION**

Cover or plug all hoses and immediately after disconnection to prevent contamination.

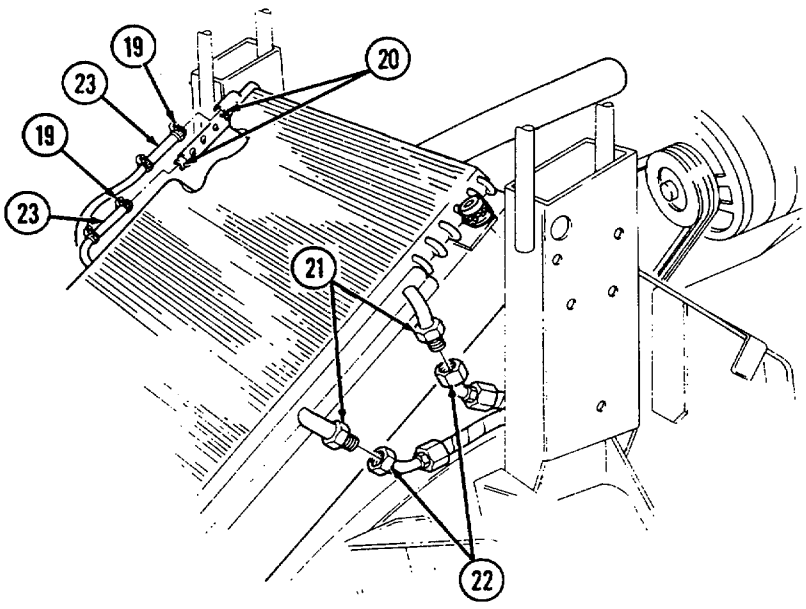
**NOTE**

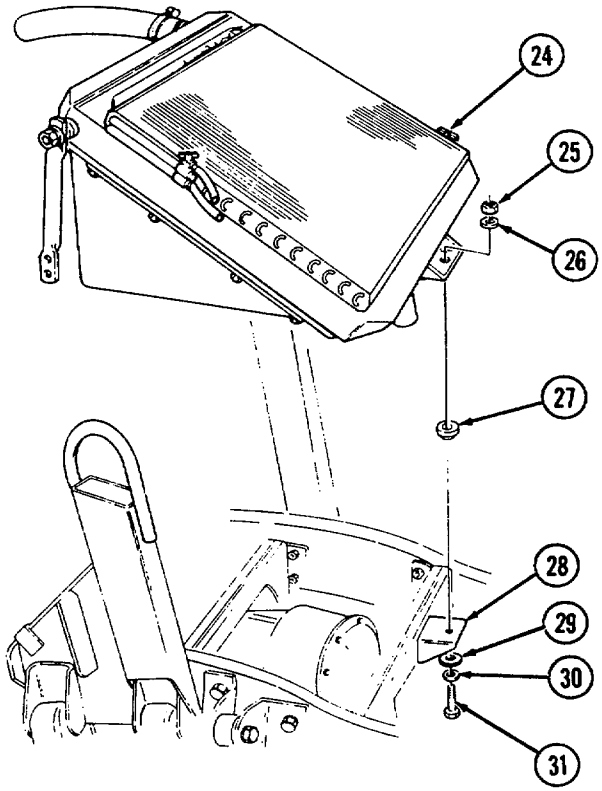
Have drainage container ready to catch oil.

27. Disconnect engine oil cooler supply and return lines (22) from engine oil cooler ports (21).
28. Loosen two hose clamps (19) and disconnect transmission oil cooler line connector hoses (23) from transmission oil cooler ports (20).
29. Lift up radiator (3) and shroud and oil cooler assembly (24) and remove from vehicle.



**3-22. ENGINE REMOVAL (6.2 L) (Cont'd)**



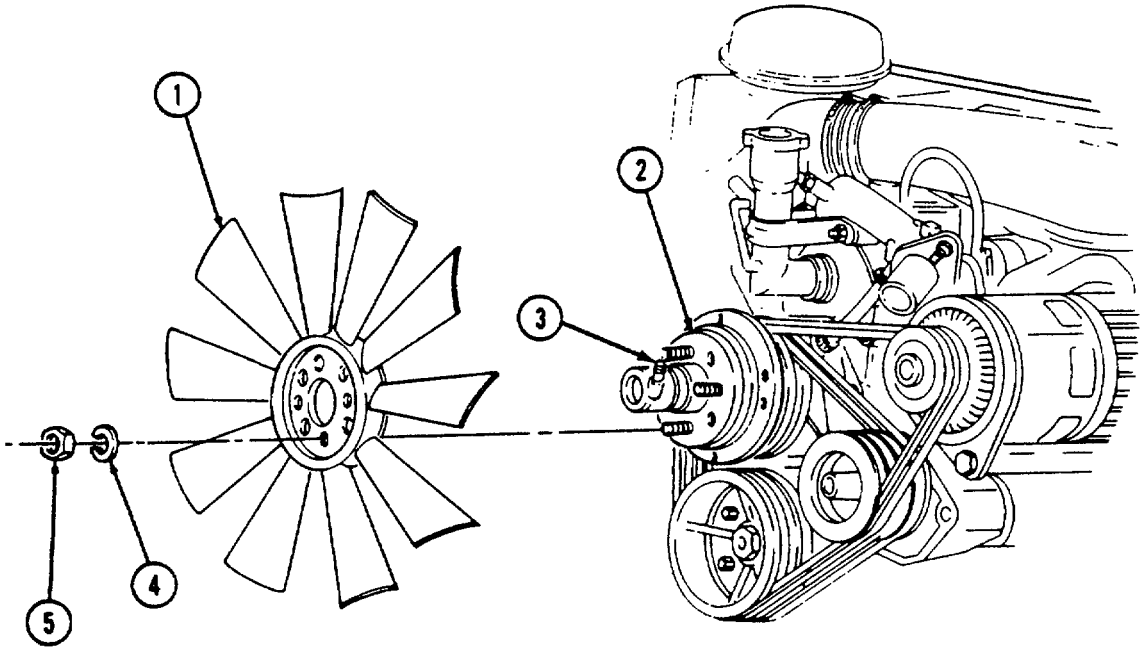



**3-22. ENGINE REMOVAL (6.2 L) (Cont'd)**

**NOTE**

- Mark front of fan blade for installation.
- Make sure the clutch adapter nipple is at the 6 o'clock position when removing fan blade.

30. Position clutch adapter fitting (3) at the 6 o'clock position.
31. Remove four nuts (5), lockwashers (4), and fan blade (1) from fan drive (2). Discard lockwashers (4).



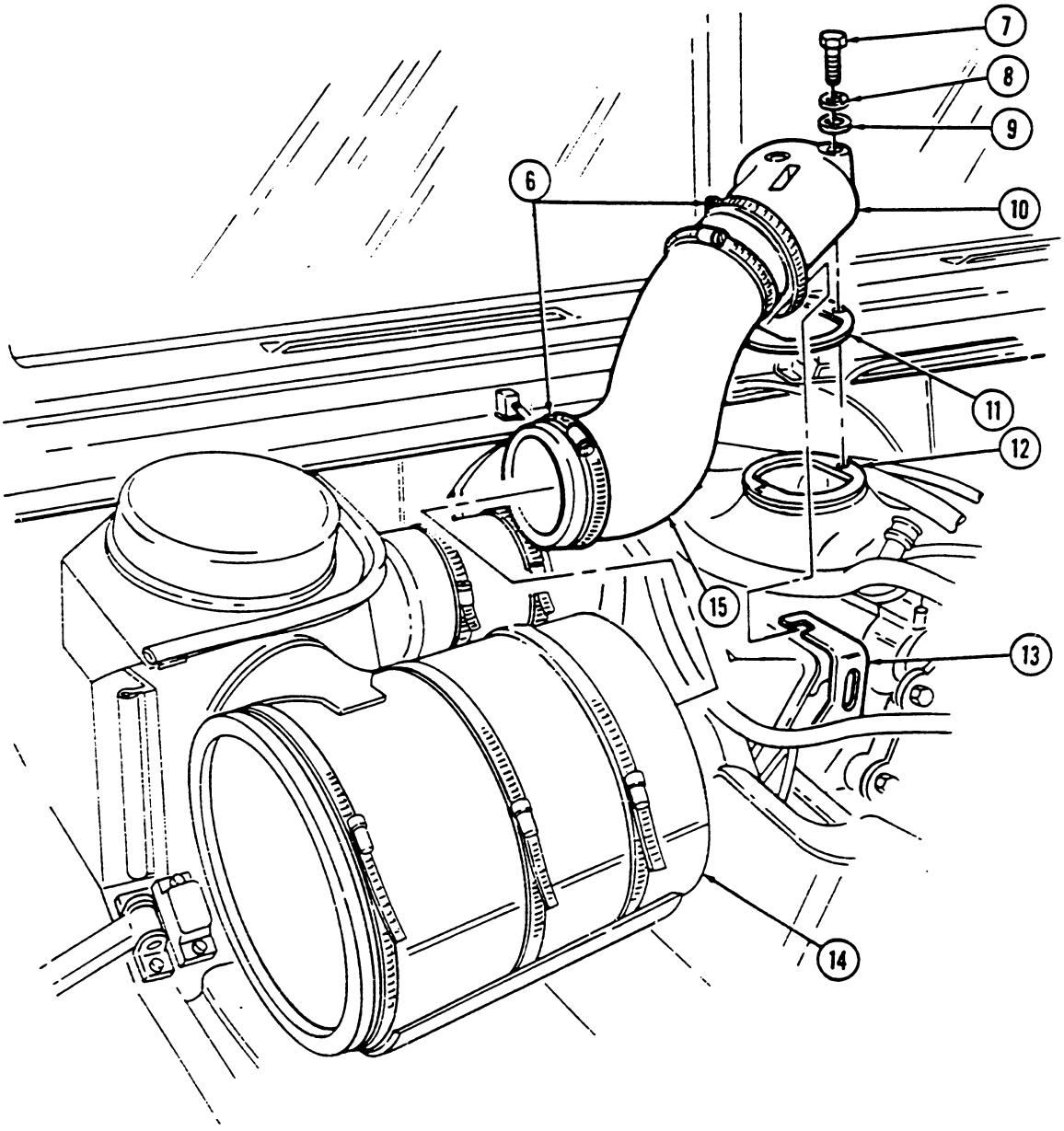
## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

32. Remove two screws (7), washers (8), and flat washers (9) from air horn (10) and intake manifold (12).

**CAUTION**

Cover opening of intake manifold to prevent foreign material from entering engine.

33. Loosen two clamps (6) and remove air horn (10) and air intake elbow (15) from air horn support bracket (13), intake manifold (12), and air cleaner (14).
34. Remove gasket (11) from intake manifold (12). Discard gasket (11).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

Perform steps 35 through 48 for M997 and M997A1 vehicles only.

35. Remove screw (10) and clamp (11) from adjusting bracket (5).

**NOTE**

Prior to removal, tag leads for installation.

36. Disconnect two compressor leads (23) from two harness leads (24).
37. Remove nut (9), lockwasher (8), and washer (7) from adjusting bracket (5) and stud (2) on engine front cover (1). Discard lockwasher (8).
38. Remove two nuts (14), lockwashers (13), washers (12), capscrews (3), washers (4), and clamp (21) from adjusting bracket (5) and compressor (20). Discard lockwashers (13).
39. Remove adjusting bracket (5) and washer (6) from stud (2) on engine front cover (1).
40. Loosen two capscrews (17) securing compressor (20) to support bracket (22) and remove drivebelt (16) from pulley (15).
41. Loosen hose clamp (26) and disconnect hose (27) from surge tank (25).

**NOTE**

Place surge tank hose clear of compressor.

42. Disconnect vent line (31) from air cleaner fitting (32).
43. Disconnect vent line (28) from fitting (29) on air cleaner (30).
44. Remove two capscrews (17), lockwashers (18), and washers (19) from compressor (20) and support bracket (22). Discard lockwashers (18).

**CAUTION**

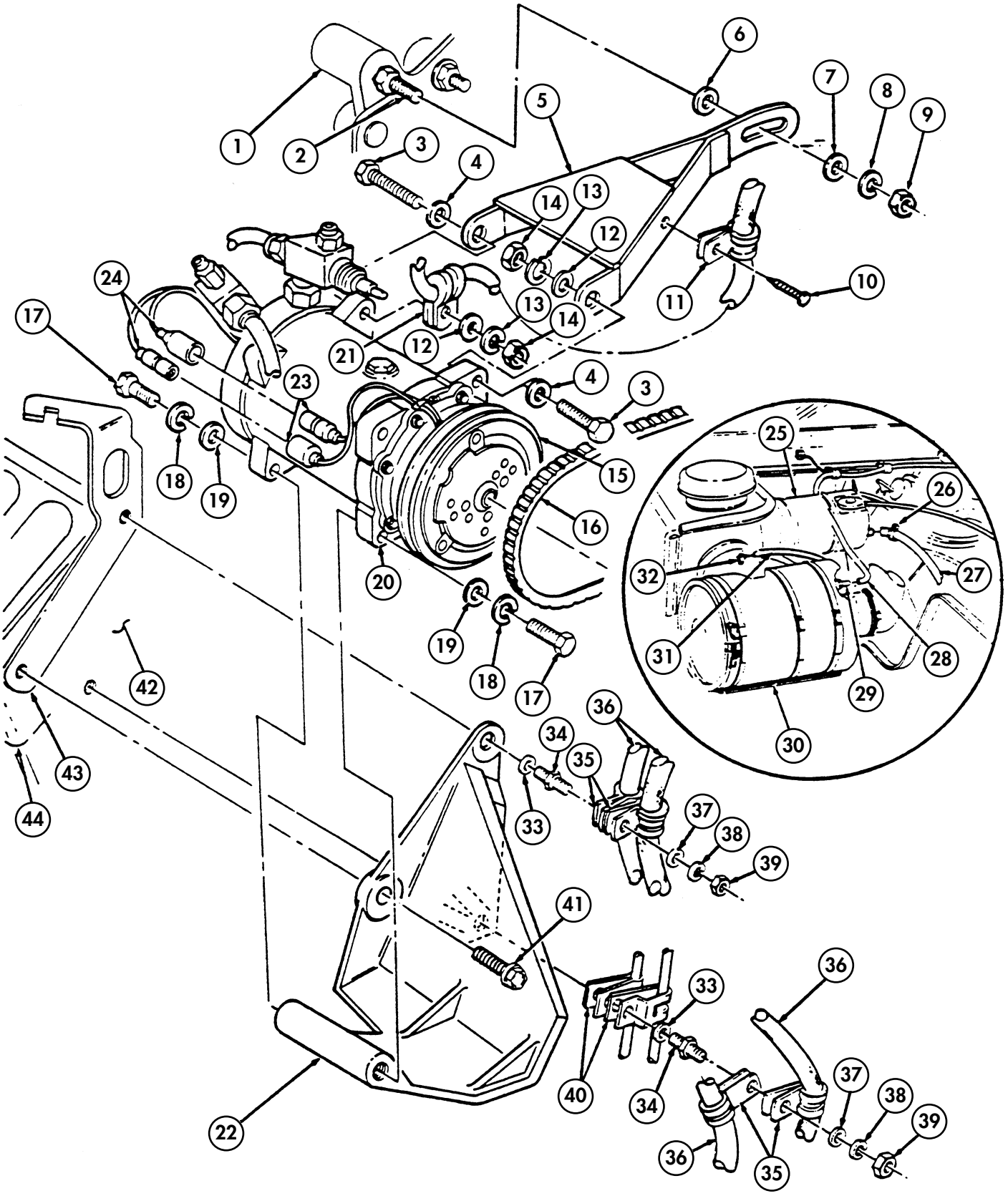
Be careful when removing compressor from support bracket, or damage to equipment may result.

**NOTE**

Place compressor and hoses on ground away from engine to prevent hang-ups during engine removal.

45. Remove compressor (20) from support bracket (22).
46. Remove capscrew (41) and brackets (22) and (43) from cylinder head (44).
47. Remove two nuts (39), lockwashers (38), washers (37), four clamps (35), and cables (36) from two studs (34). Discard lockwashers (38).
48. Remove two studs (34), washers (33), fuel line clamps (40), and brackets (22) and (43) from cylinder head (44) and engine block (42).

## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

Perform steps 49 through 63 for vehicles equipped with Prestolite 200 amp alternator only.

49. Remove four screws (21), lockwashers (1), cover (2) and gasket (3) from regulator (7). Discard lockwashers (1).

**NOTE**

Prior to removal, tag leads for installation.

50. Remove nut (16), washer (15), and lead 2A (14) from stud (13).
51. Remove nut (19), lockwasher (18), and lead 5A (17) from stud (8). Discard lockwasher (18).
52. Remove nut (4), lockwasher (5), and lead 568 (6) from stud (8). Discard lockwasher (5).
53. Remove rubber wedge (20) from opening in regulator (7).
54. Loosen capscrews (12) on alternator adjusting bracket (9) and two capscrews (41) on alternator (49), alternator mounting bracket (48), and support bracket (39).
55. Remove three drivebelts (10) from alternator pulley (11).
56. Slide back rubber boot (27) and remove nut (24), lockwasher (23), washer (25), fuse (26), insulator (22), alternator positive cable (28), and bushing (29) from positive stud (30). Discard lockwasher (23).
57. Remove nut (35), lockwasher (34), lead 3B (33), and ground strap (31) from ground stud (32). Discard lockwasher (34).

**WARNING**

Alternator must be supported during removal and installation. Failure to support alternator may cause injury to personnel or damage to equipment.

**NOTE**

- Perform step 59 for vehicles with old support bracket configuration.
- Perform steps 60 and 61 for vehicles with new support bracket configuration.

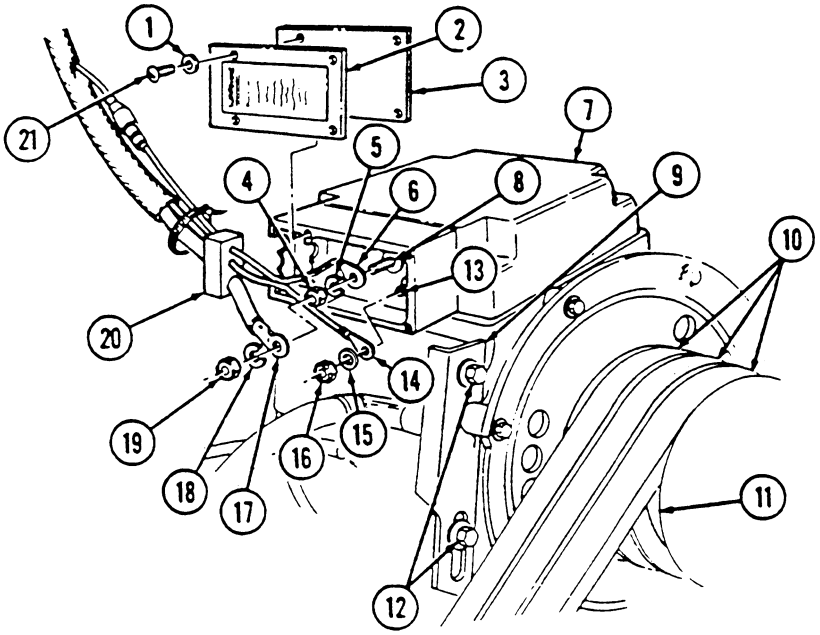
59. Remove locknut (44), washer (45), capscrew (38), spacer (47), power steering line clamps (46), and harness clamp (40) from alternator bracket (39). Discard locknut (44).
60. Remove locknut (57), washer (58), capscrew (53), washer (55), harness clamp (56), and power steering lines clamp (59) from bracket (61). Discard locknut (57).
61. Remove two capscrews (54), lockwashers (52), washers (51), and spacer (60) from alternator (50) and power steering lines bracket (61), alternator support bracket (62) and mounting bracket (63). Discard lockwashers (52).

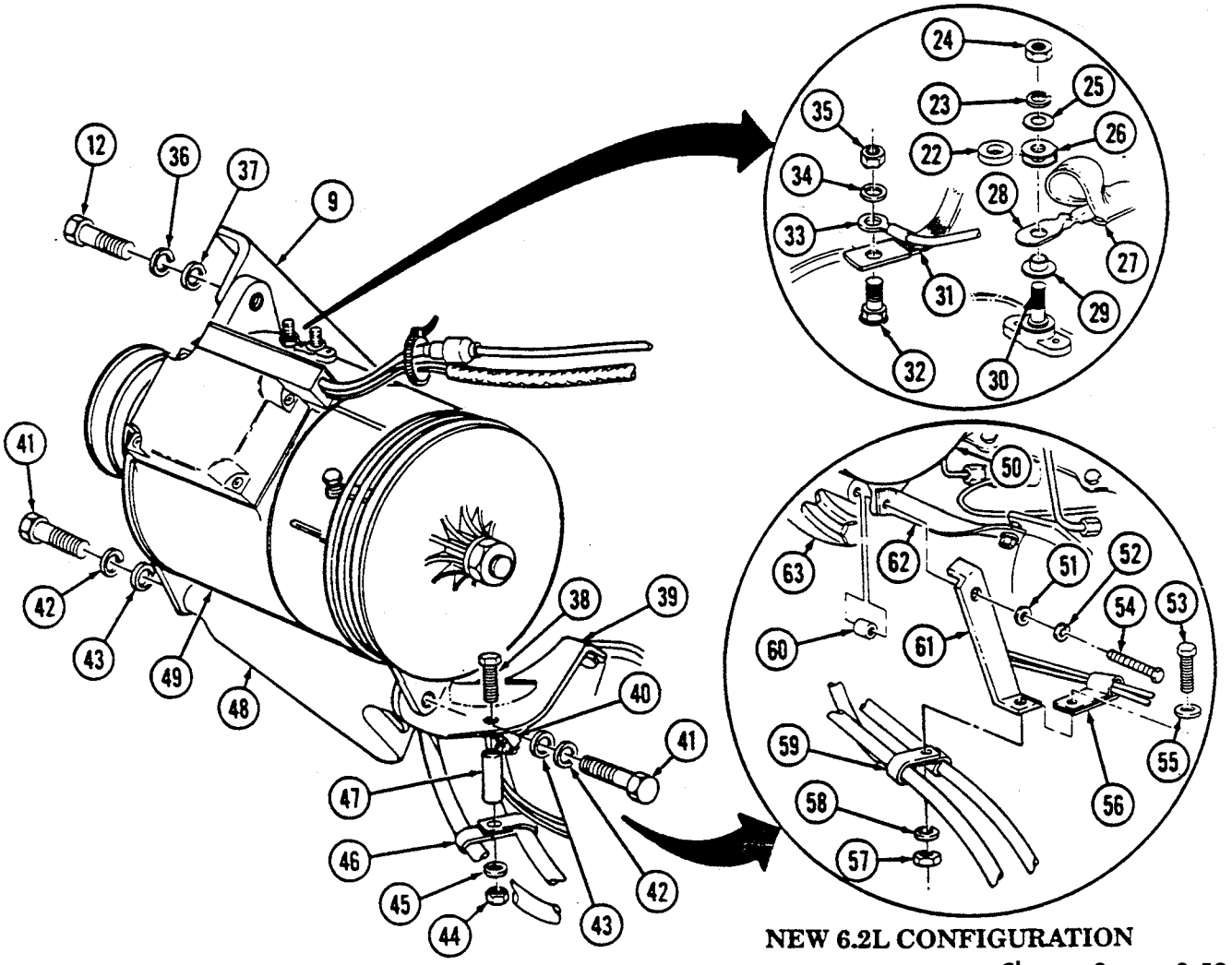
**NOTE**

In some cases, a thru-bolt and nut may be present on mounting bracket instead of standard capscrews and washers.

62. Remove two capscrews (41), lockwashers (42), and washers (43) from alternator (49), support bracket (39), and mounting bracket (48). Discard lockwashers (42).
63. Remove alternator (49) from mounting bracket (48).

## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)




NEW 6.2L CONFIGURATION

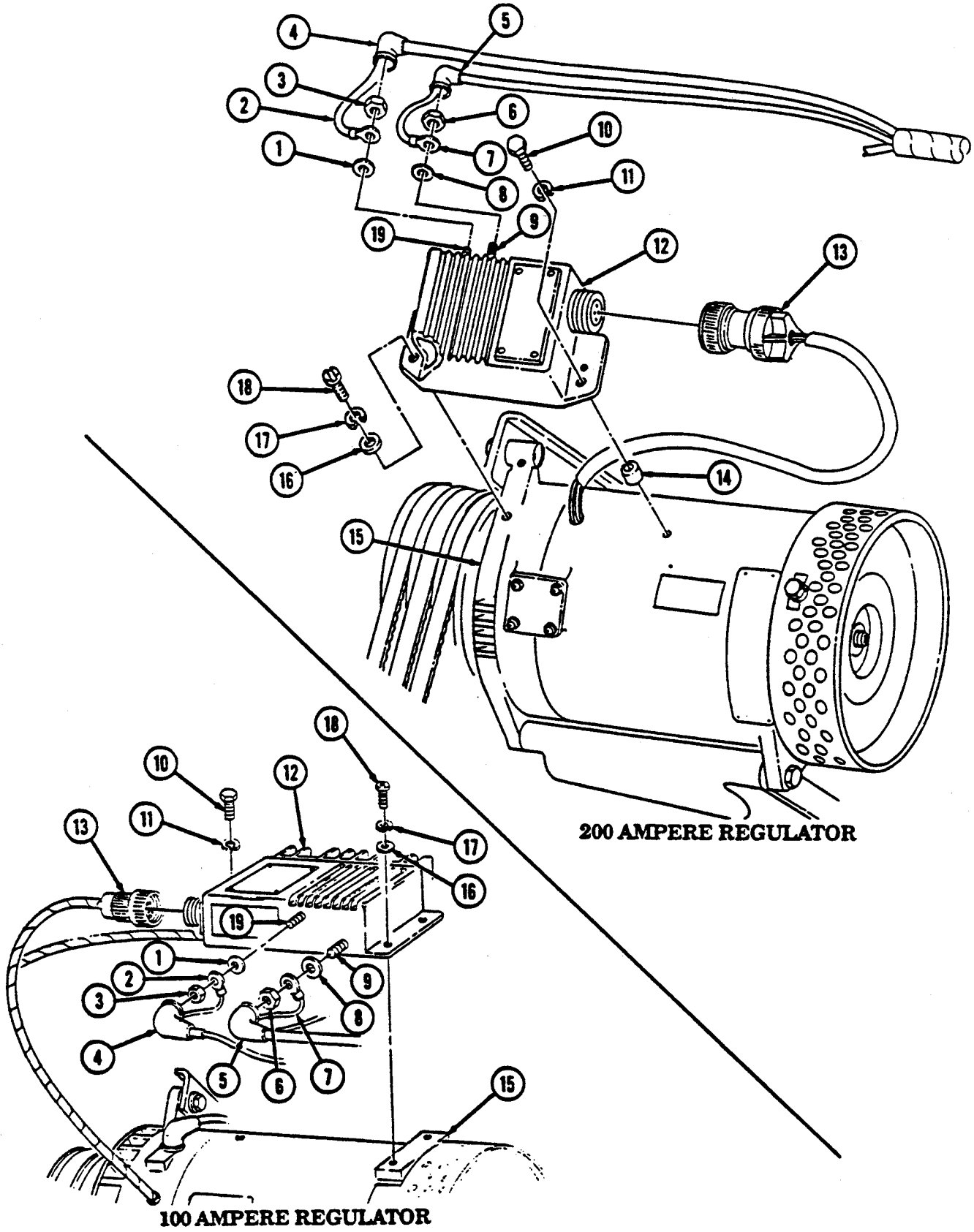
## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

- Disconnects for the 100 amp and 200 amp Neihoff regulators are basically the same. Differences are shown in the illustration.
- Perform steps 64 through 77 for vehicles equipped with Neihoff 200 amp alternator only.
- Prior to removal, tag leads for installation.

64. Disconnect regulator plug (13) from voltage regulator (12).
65. Slide back rubber boot (4) and remove nut (3), lead 5A (2), and washer (1) from red (energize) terminal (19).
66. Slide back rubber boot (5) and remove nut (6), lead 2A (7), and washer (8) from yellow (AC) terminal (9).
67. Remove two screws (18), spring tension washers (17), and washers (16) from voltage regulator (12) and alternator (15). Discard spring tension washers (17).
68. Remove capscrew (10), lockwasher (11), spacer (14), and voltage regulator (12) from alternator (15). Discard lockwasher (11).

## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

Prior to removal, tag leads for installation.

69. Remove nut (29), lockwasher (28), washer (27), lead 3B (26), and ground strap (25) from ground stud (24). Discard lockwasher (28).
70. Slide back rubber boot (30) and remove nut (1), lockwasher (2), washer (3), fuse link (4) insulator washer (31), alternator positive cable (5), and washer (6) from positive stud (7). Discard lockwasher (2).
71. Loosen capscrew (12) and (14) on alternator adjusting bracket (9) securing alternator (20) to alternator mounting bracket (19) and support bracket (18).
72. Remove three drivebelts (8) from alternator pulley (23).

**WARNING**

Alternator must be supported during removal and installation. Failure to support alternator may cause injury to personnel or damage to equipment.

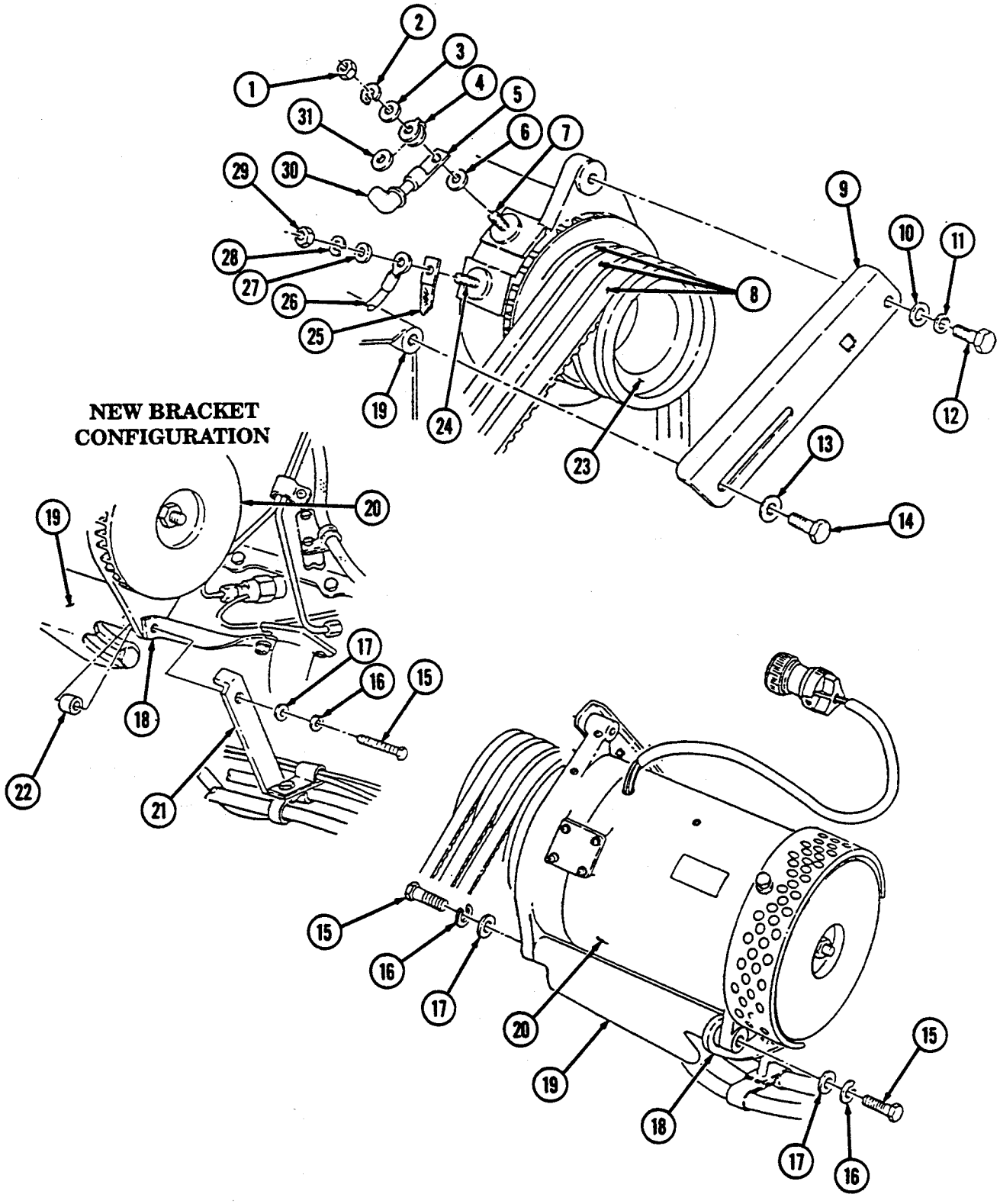
73. Remove capscrew (12), lockwasher (11), and washer (10) from alternator (20) and adjusting bracket (9). Discard lockwasher (11).
74. Remove capscrew (14), washer (13), and alternator adjusting bracket (9) from mounting bracket (19).

**NOTE**

- Perform step 76 for vehicles with new alternator support bracket configuration.
- In some cases, a thru-bolt and nut may be present on mounting bracket instead of standard capscrews and washers.

75. Remove two capscrews (15), lockwashers (16), and washers (17) from alternator (20) and support bracket (18) and mounting bracket (19). Discard lockwashers (16).
76. Remove two capscrews (15), lockwashers (16), washers (17), and spacer (22) securing alternator (20), power steering lines bracket (21), and support bracket (18) to mounting bracket (19). Discard lockwashers (16).
77. Remove alternator (20).

## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

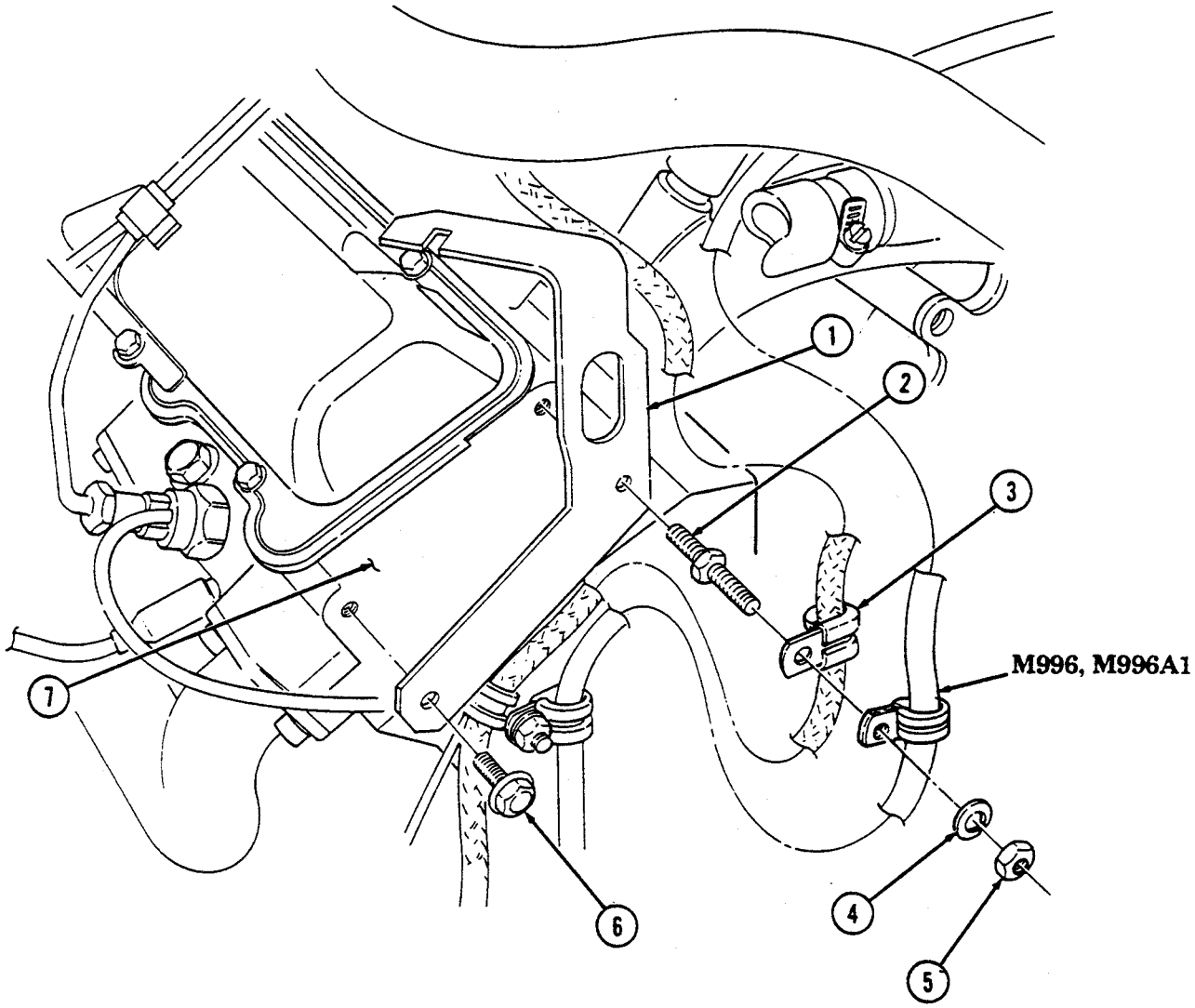


## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

- Steps 78 and 79 apply to all models except M997 and M997A1 vehicles.
- M996 and M996A1 vehicles have an additional wiring harness clamp secured to stud.

78. Remove nut (5), lockwasher (4) and clamp (3) from stud (2). Discard lockwasher (4).
79. Remove capscrew (6), stud (2), and support bracket (1) from cylinder head (7).

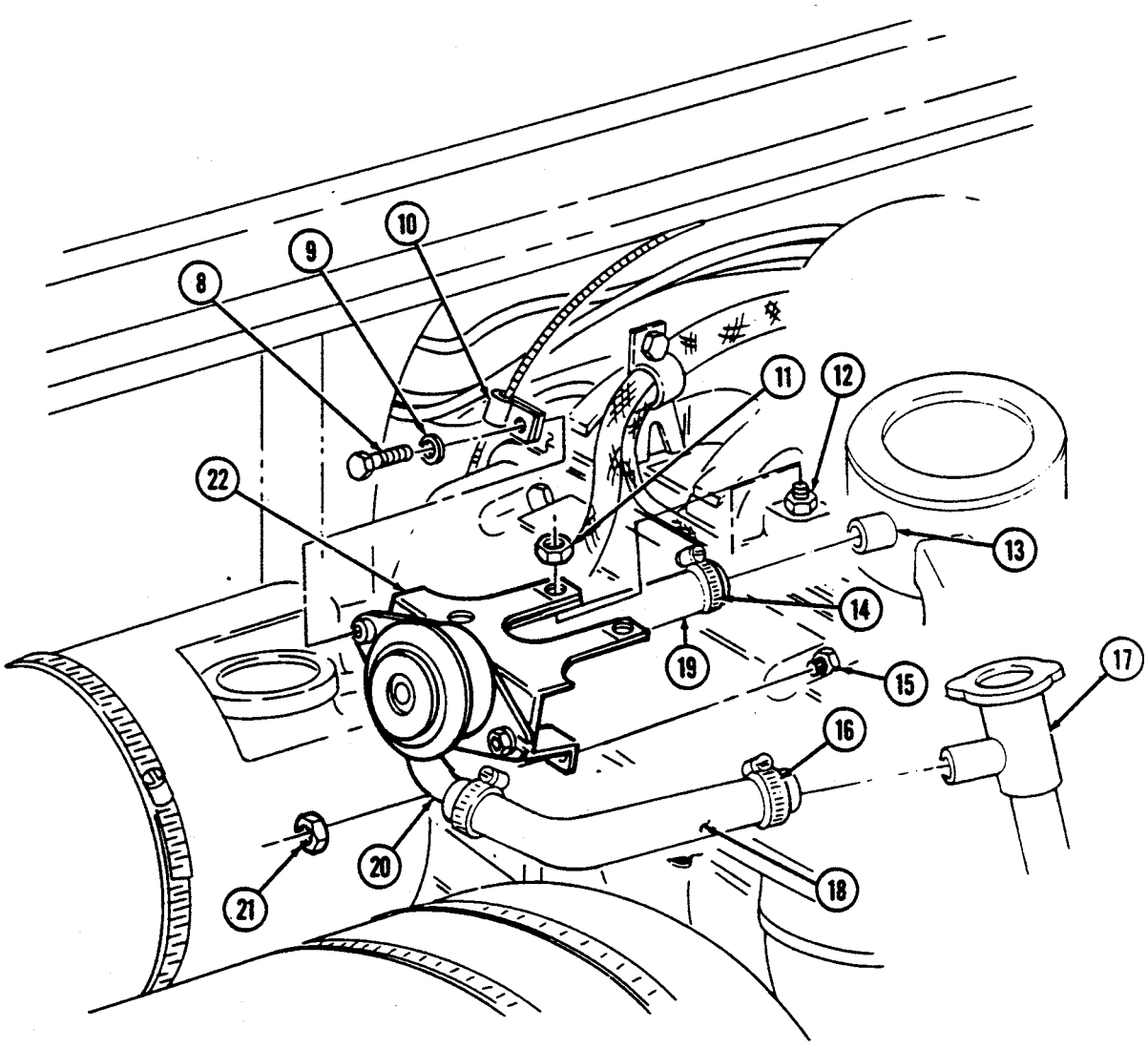


## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

- CDR valves on vehicles equipped with deep water fording kit contain two additional vent lines.
- Leave hoses connected to CDR valve.

80. Loosen clamp (16) and disconnect CDR valve oil fill tube hose (18) from oil fill tube (17).
81. Loosen clamp (14) and disconnect CDR intake manifold hose (19) from intake manifold (13).
82. Remove screw (8), washer (9) and controls cable clamp (10) from CDR valve (20) and bracket (22).
83. Remove two nuts (11) from two intake manifold studs (12).
84. Remove two nuts (21), CDR valve (20), and bracket (22) from two valve cover studs (15) and studs (12).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**WARNING**

Do not touch hot exhaust system components with bare hands.
Severe injury will result.

85. Remove nut (7), capscrew (2), washer (3), and clamp (1) from rear heat shield (9).
86. Remove capscrew (6) and rear heat shield (9) from heat shield (5).

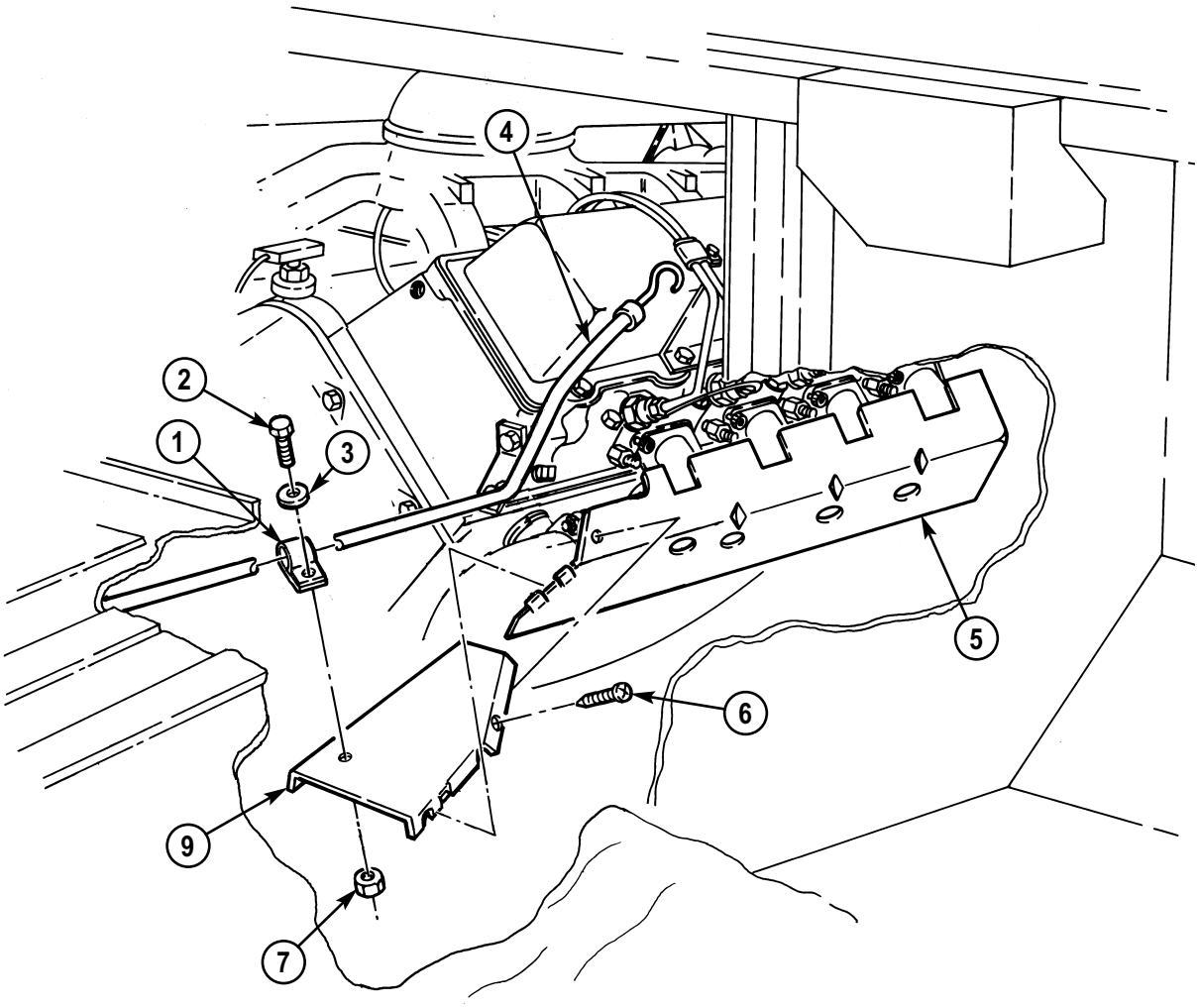
**CAUTION**

Plug open transmission port to prevent contamination.

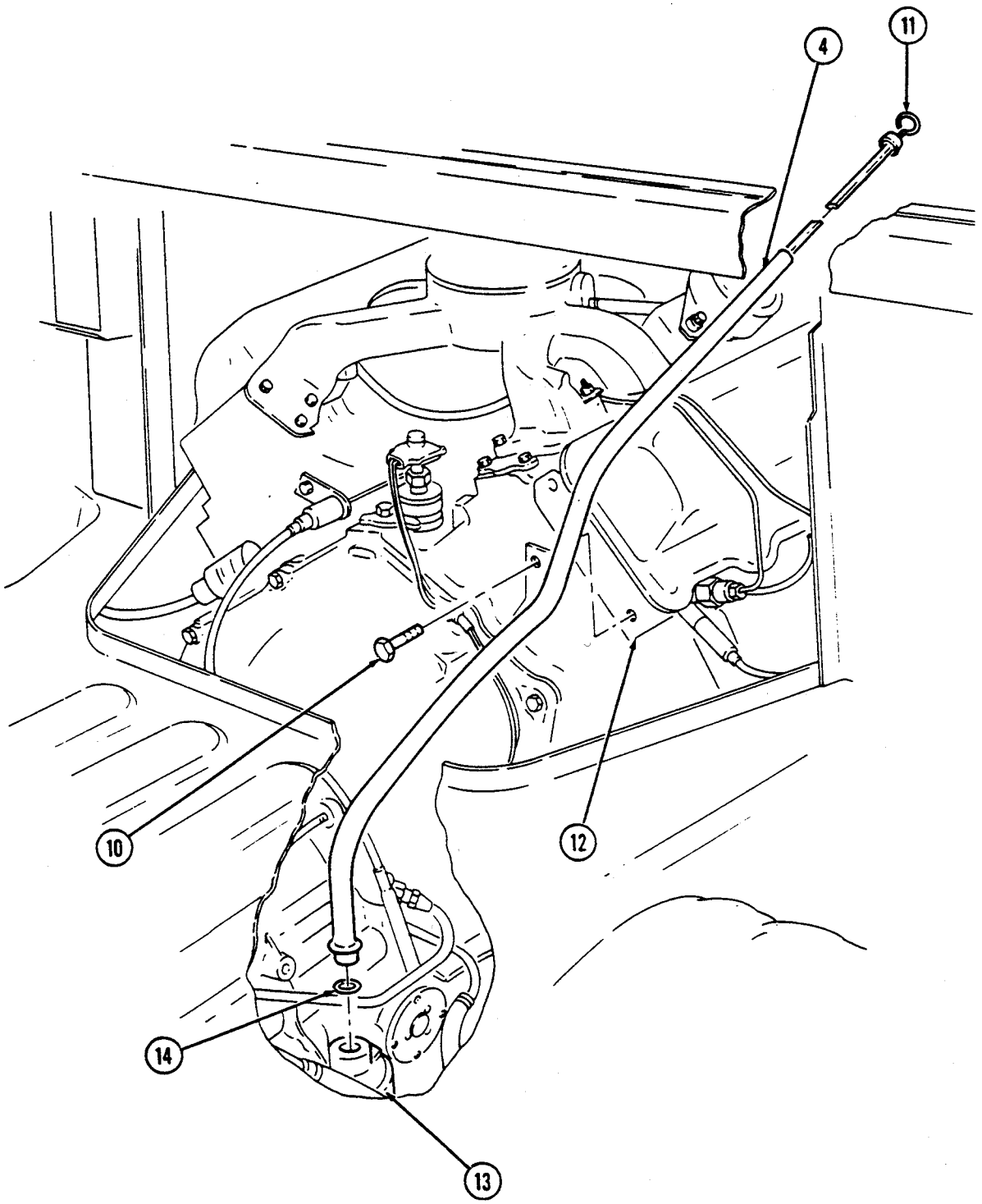
**NOTE**

Have drainage container ready to catch fluid.

87. Remove transmission oil dipstick (11) from dipstick tube (4).
88. Remove capscrew (10) from cylinder head (12).
89. Remove dipstick tube (4) from transmission (13).
90. Remove preformed packing (14) from dipstick tube (4). Discard preformed packing (14).

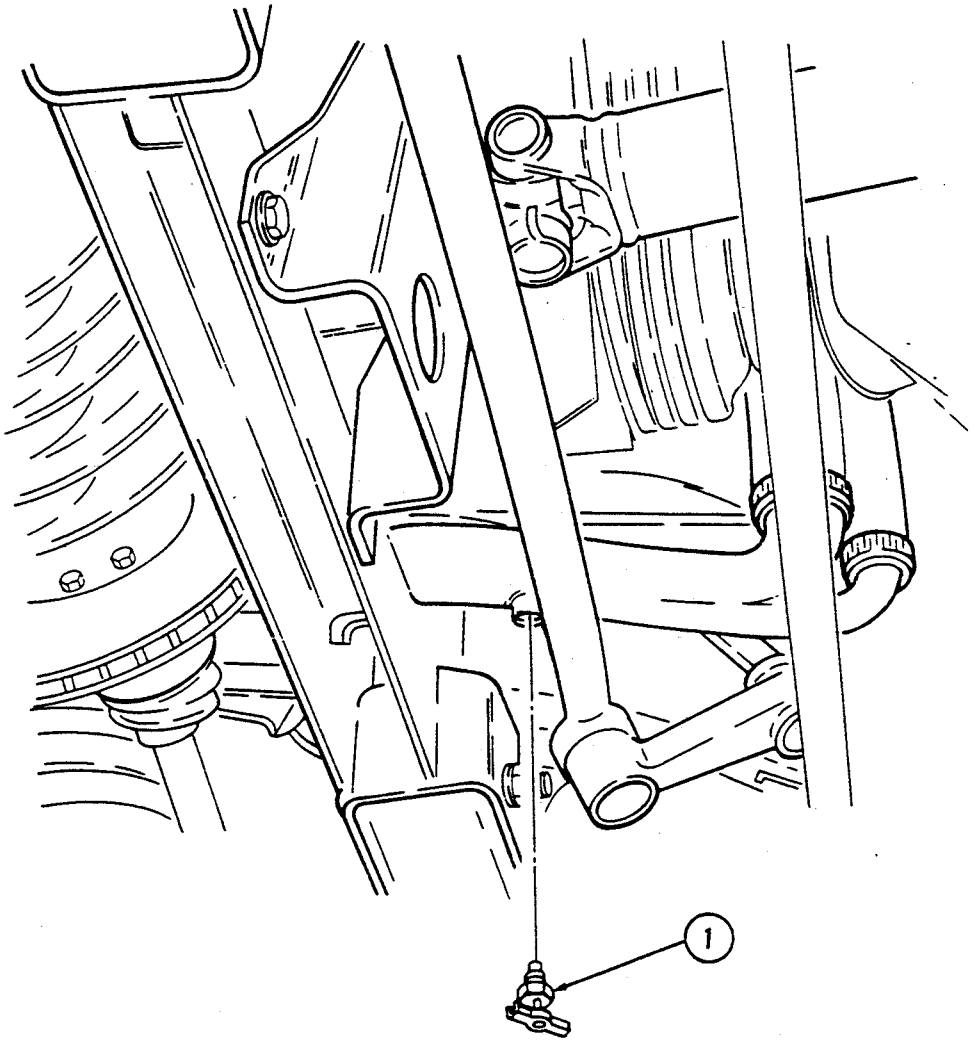


## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

91. Install and close draincock (1).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

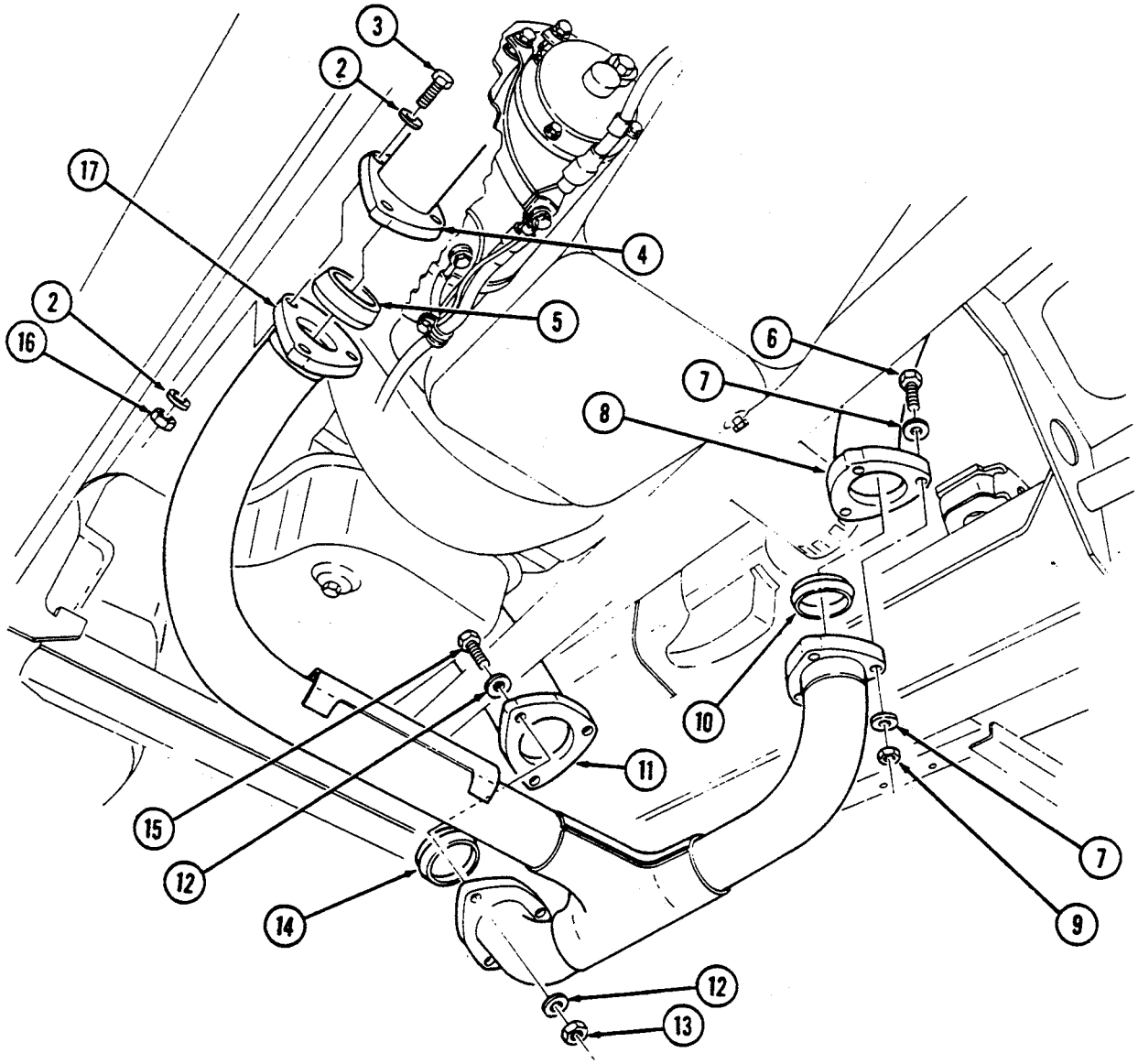
**WARNING**

Do not touch hot exhaust system components with bare hands. Severe injury will result.

**NOTE**

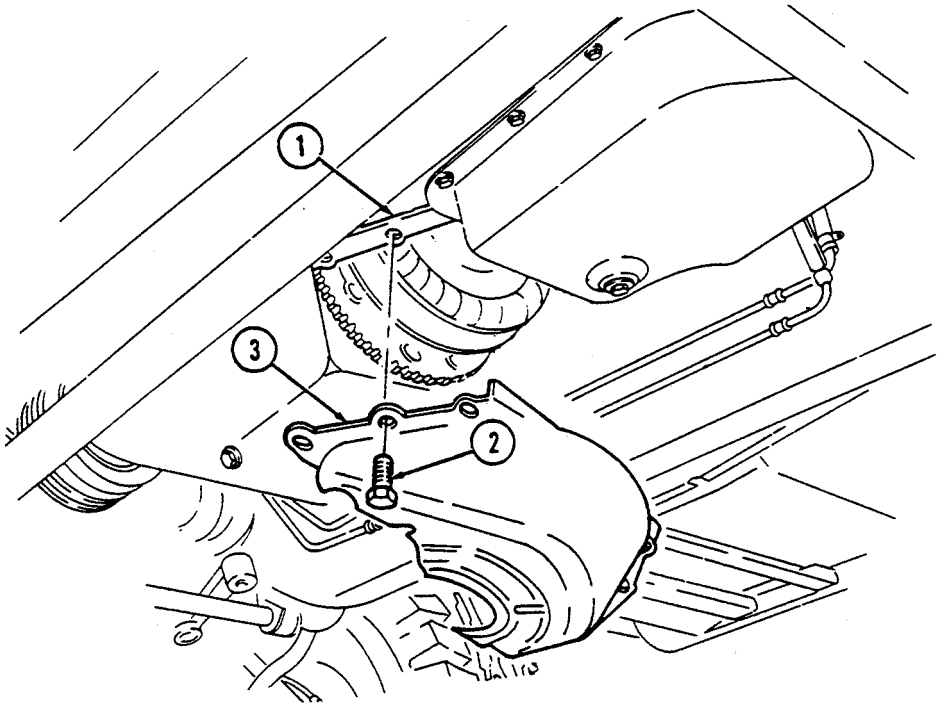
It will be necessary to use an additional .5 in. (13 mm) drive extension 12 in. (30 cm) to remove exhaust system mounting hardware.

92. Remove three locknuts (16), washers (2), capscrews (3), and washers (2) from crossover pipe (17) and right exhaust manifold (4). Discard locknuts (16).
93. Remove three locknuts (13), washers (12), capscrews (15), and washers (12) from crossover pipe (17) and muffler (11). Discard locknuts (13).
94. Remove three locknuts (9), washers (7), capscrews (6), washers (7), and crossover pipe (17) from left exhaust manifold (8). Discard locknuts (9).
95. Remove and discard gaskets (5), (10), and (14).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

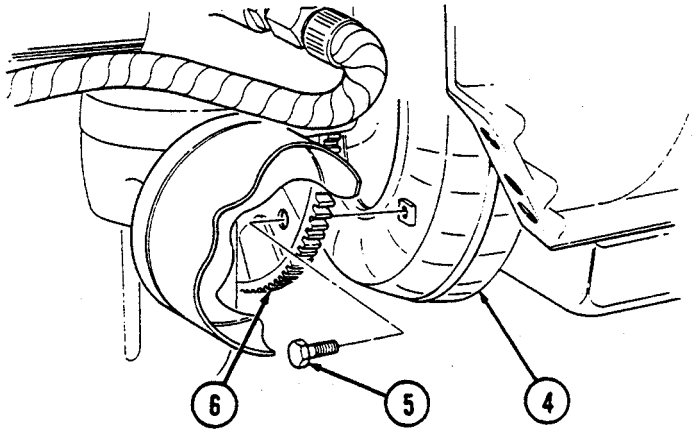
96. Remove six capscrews (2) and converter housing cover (3) from transmission (1).




**NOTE**

- It will be necessary to rotate flywheel clockwise from capscrew in front of crankshaft to gain access to capscrews securing torque converter.
- Have assistant hold crankshaft pulley in place when removing capscrews securing flywheel to torque converter.

97. Remove six capscrews (5) and torque converter (4) from flywheel (6) and slide torque converter (4) away from flywheel (6).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**CAUTION**

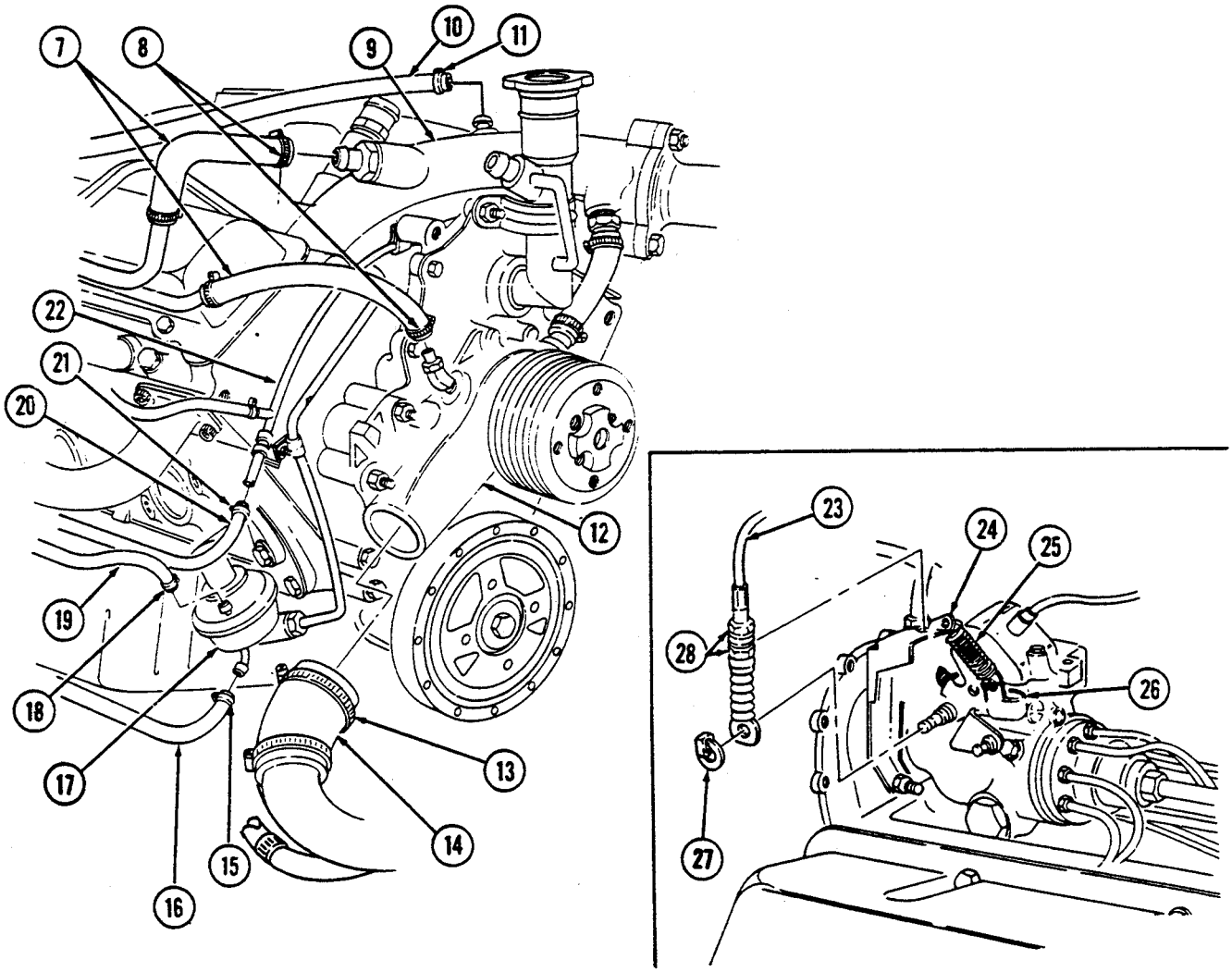
Cover or plug all hoses and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

98. Loosen clamp (11) and disconnect surge tank-to-water crossover hose (10) from water crossover (9).
99. Loosen two clamps (8) and disconnect heater hoses (7) at water crossover (9) and water pump (12).

**WARNING**

Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.

100. Loosen clamp (21) and disconnect fuel return hose (20) from fuel return line (22).
101. Loosen clamp (15) and disconnect fuel supply line (16) from fuel pump (17).
102. Loosen clamp (18) and disconnect vent line (19) from fuel pump (17).
103. Loosen clamp (13) and disconnect water pump inlet hose (14) from water pump (12).
104. Disconnect throttle return spring (25) from bracket (24).
105. Loosen two nuts (28) and disconnect cable assembly (23) from bracket (24).
106. Remove accelerator cable clip (27) and disconnect cable assembly (23) from throttle shaft lever (26). Retain clip (27) for installation.



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

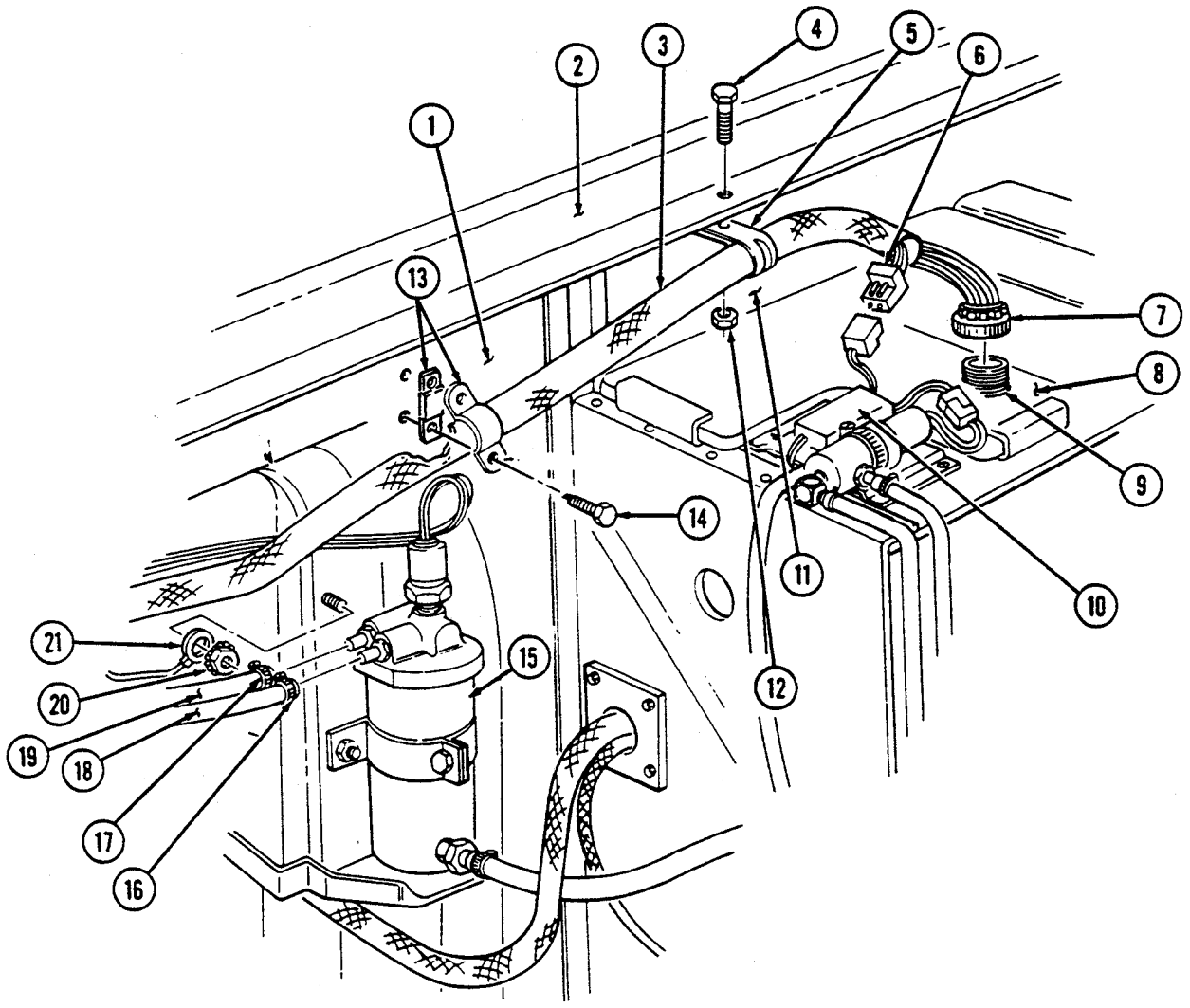
**WARNING**

Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.

**NOTE**

Tag fuel lines for installation.

107. Loosen clamps (16) and (17) and disconnect fuel inlet line (18) and fuel outlet line (19) from fuel filter (15).
108. Remove assembled locknut (20) securing engine harness ground 3C (21) to body (1). Discard assembled locknut (20).
109. Disconnect engine harness connector (6) from time delay module (10).
110. Remove rubber insulation (8) and disconnect engine harness connector plug (7) from protective control box (9).
111. Remove rubber insulation (11), nut (12), capscrew (4), clamp (5) and engine harness (3) from "A" beam (2).
112. Remove two screws (14), clamp (13), and engine harness (3) from body (1).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

113. Loosen two hose clamps (24) and (28) and disconnect control valve hose (23) from control valve (25) and hydro-boost hose (27) from hydro-boost (29).

114. Remove nut (26), washer (30), and capscrew (22) from two clamps (31).

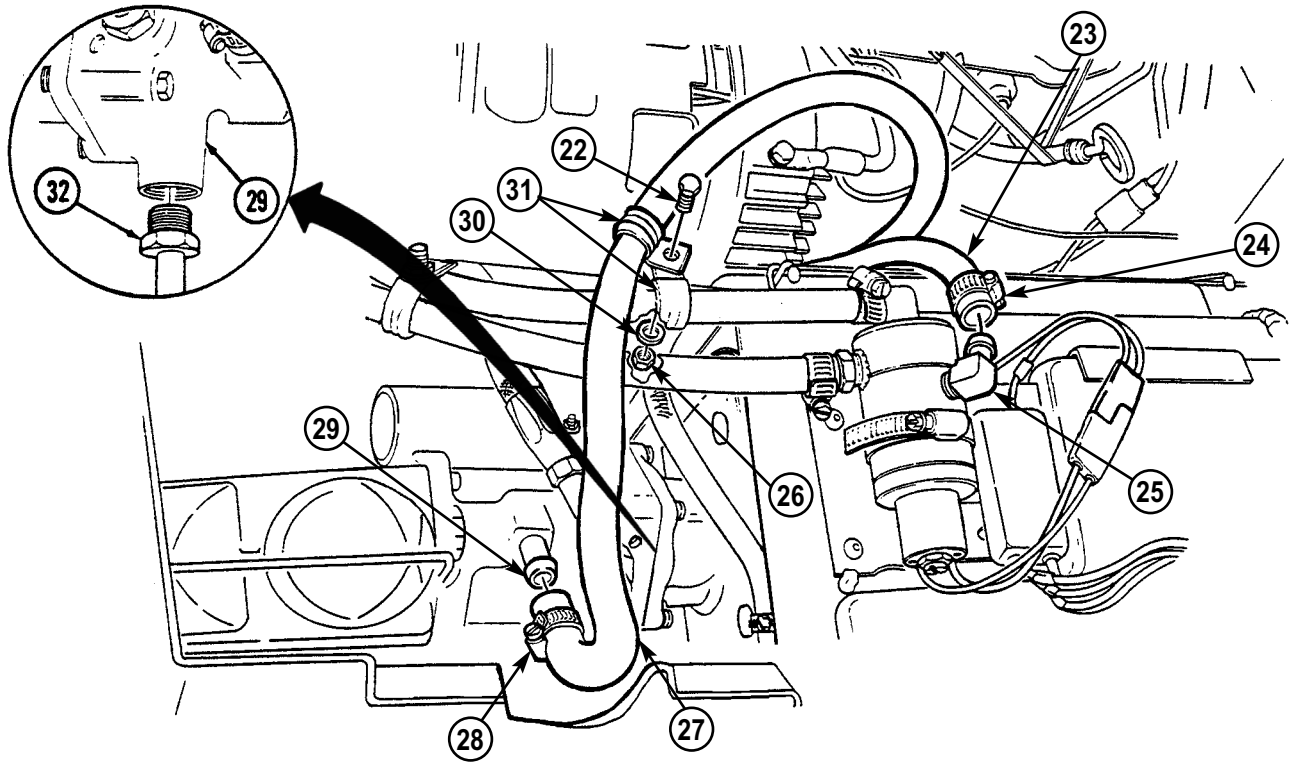
115. Disconnect high pressure line (32) from hydro-boost (29).

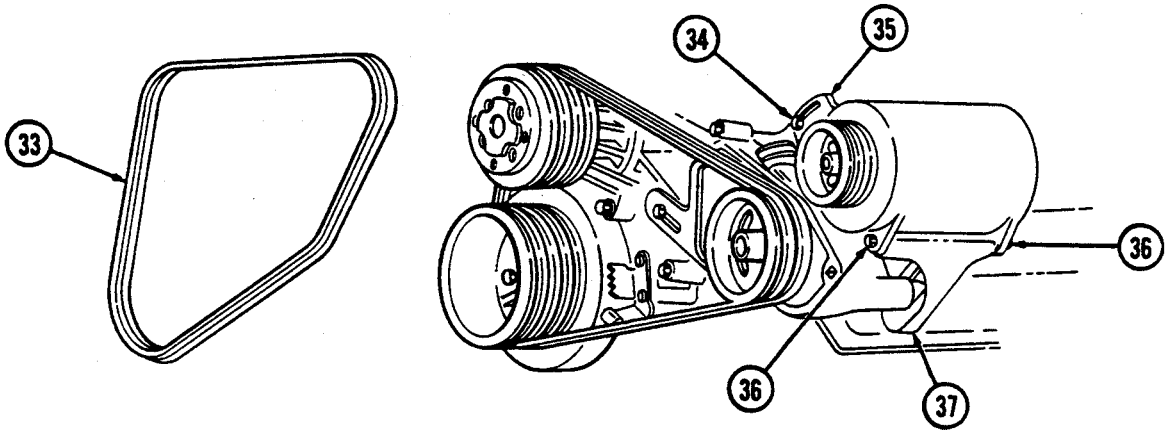
**NOTE**

Perform steps 116 and 117 for all models except M996, M996A1, M997, and M997A1 vehicles.

116. Loosen capscrew (34) on alternator adjusting bracket (35) and two capscrews (36) on alternator mounting bracket (37).

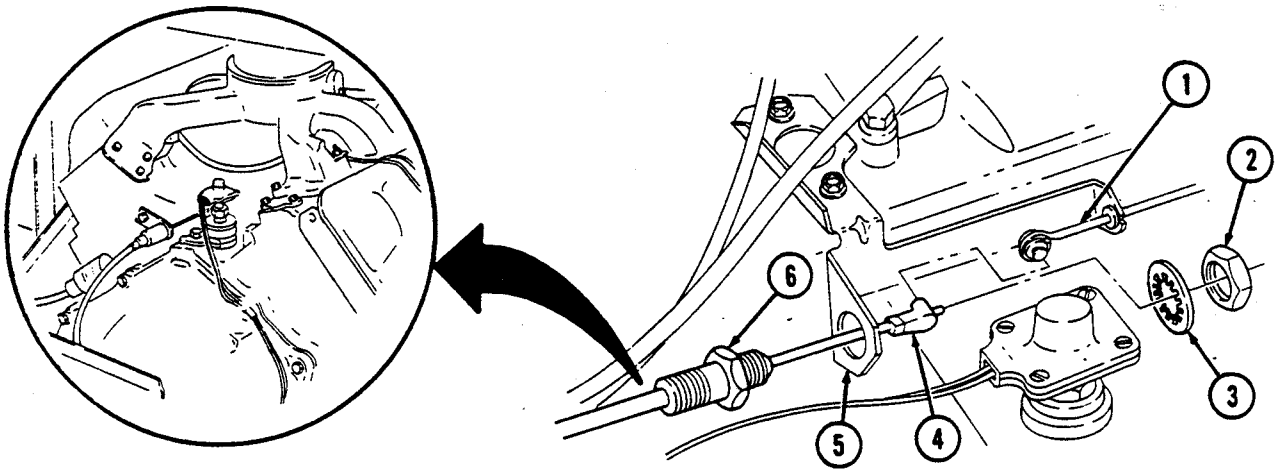
117. Remove two drivebelts (33). Tighten capscrew (34).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

118. Disconnect spring clip (4) from modulator linkage (1).
119. Remove front mounting nut (2), washer (3) and modulator cable (6) from cable bracket (5).




**NOTE**

Tag leads for installation.

120. Disconnect lead 36A (13) from oil pressure sending unit (8).
121. Disconnect engine harness lead 33B (9) from body harness lead 33A (12) and engine harness lead 58A (10) from body harness lead 58B (11).

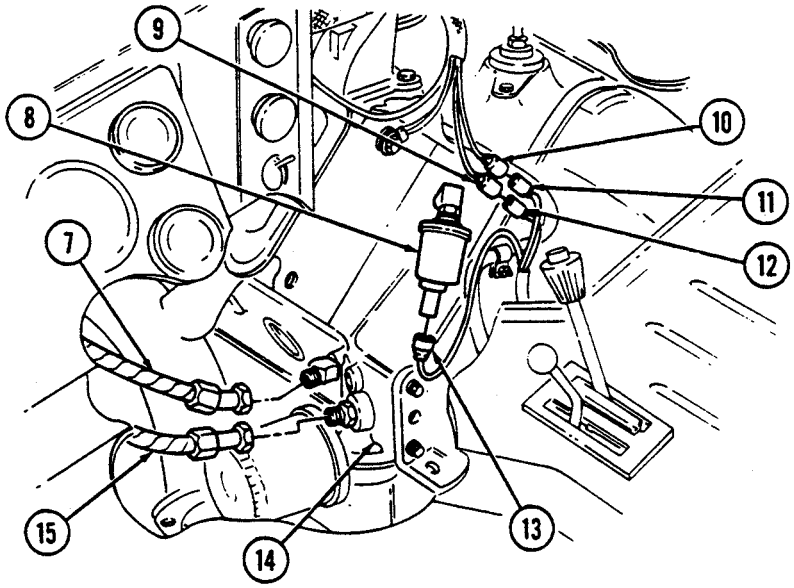
**CAUTION**

Cover or plug all hoses and connections immediately after disconnection to prevent contamination.

**NOTE**

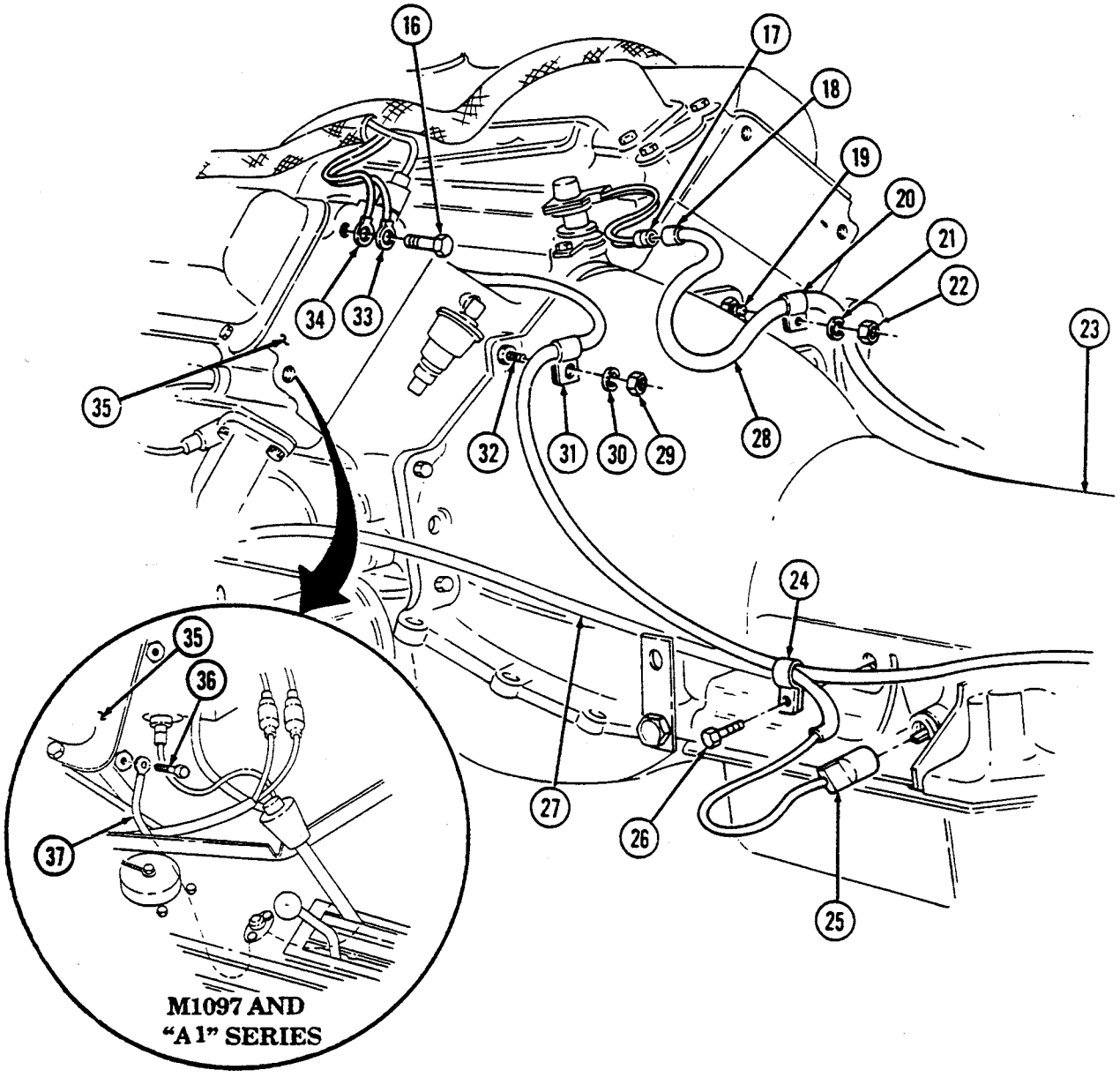
Have drainage container ready to catch oil.

122. Disconnect oil cooler supply line (15) and oil cooler return line (7) from engine (14).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

123. Remove nut (22), lockwasher (21), clamp (20) and STE/ICE-R leads harness (28) from stud (19) on transmission (23). Discard lockwasher (21).
124. Disconnect harness connector 7 (18) from rpm sensor (17).
125. Remove nut (29), lockwasher (30), clamp (31) and kick-down connector lead 315C (25) from stud (32) on transmission (23). Discard lockwasher (30).
126. Remove capscrew (16) and ground leads 3A (33) and 58A (34) from cylinder head (35).
127. Remove screw (26), clamp (24), kick-down connector lead 315C (25), and speedometer cable (27) from transmission (23).
128. Disconnect connector lead 315C (25) from transmission (23) and remove lead 315C (25) from clamp (24).
129. Remove screw (36) and transfer case indicator lamp ground leads (37) from cylinder head (35).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

- Perform steps 130 through 132 for M1026, M1026A1, M1036, M1038, M1038A1, M1042, M1044, M1044A1, M1046, and M1046A1 vehicles only.
- Prior to removal, tag leads for installation.

130. Remove nut (9), lockwasher (10) and lead 7 (11) from starter terminal (8). Discard lockwasher (10).
131. Remove nut (7), lockwasher (6) and lead 6 (4) from starter terminal (5). Discard lockwasher (6).
132. Remove assembled locknut (1) and clamp (3) from oil pan bracket screw (2). Discard assembled locknut (1).

**NOTE**

- Steps 133 through 135 apply to M996, M996A1, M997, and M997A1 vehicles only.
- Prior to removal, tag leads for installation.

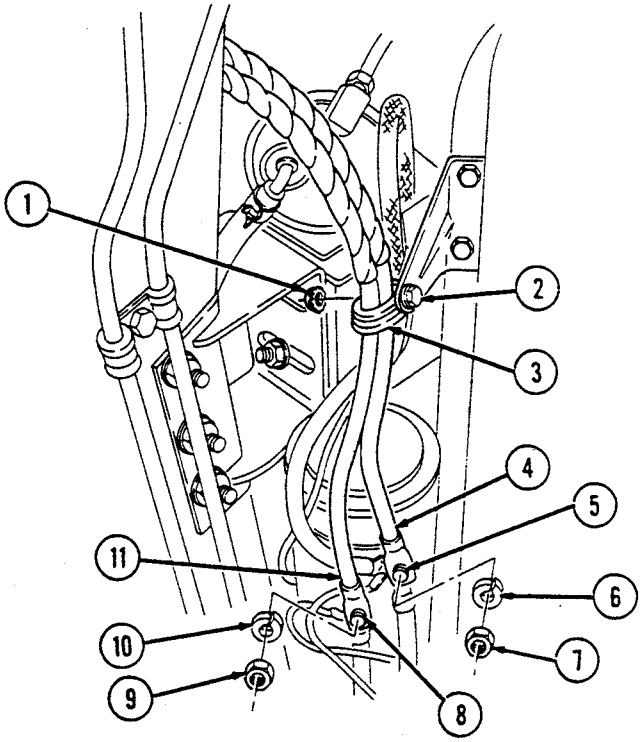
133. Remove tiedown strap (19), bolt (20), clamp (21), and 200 ampere cable (22) from starter (23). Discard tiedown strap (19).

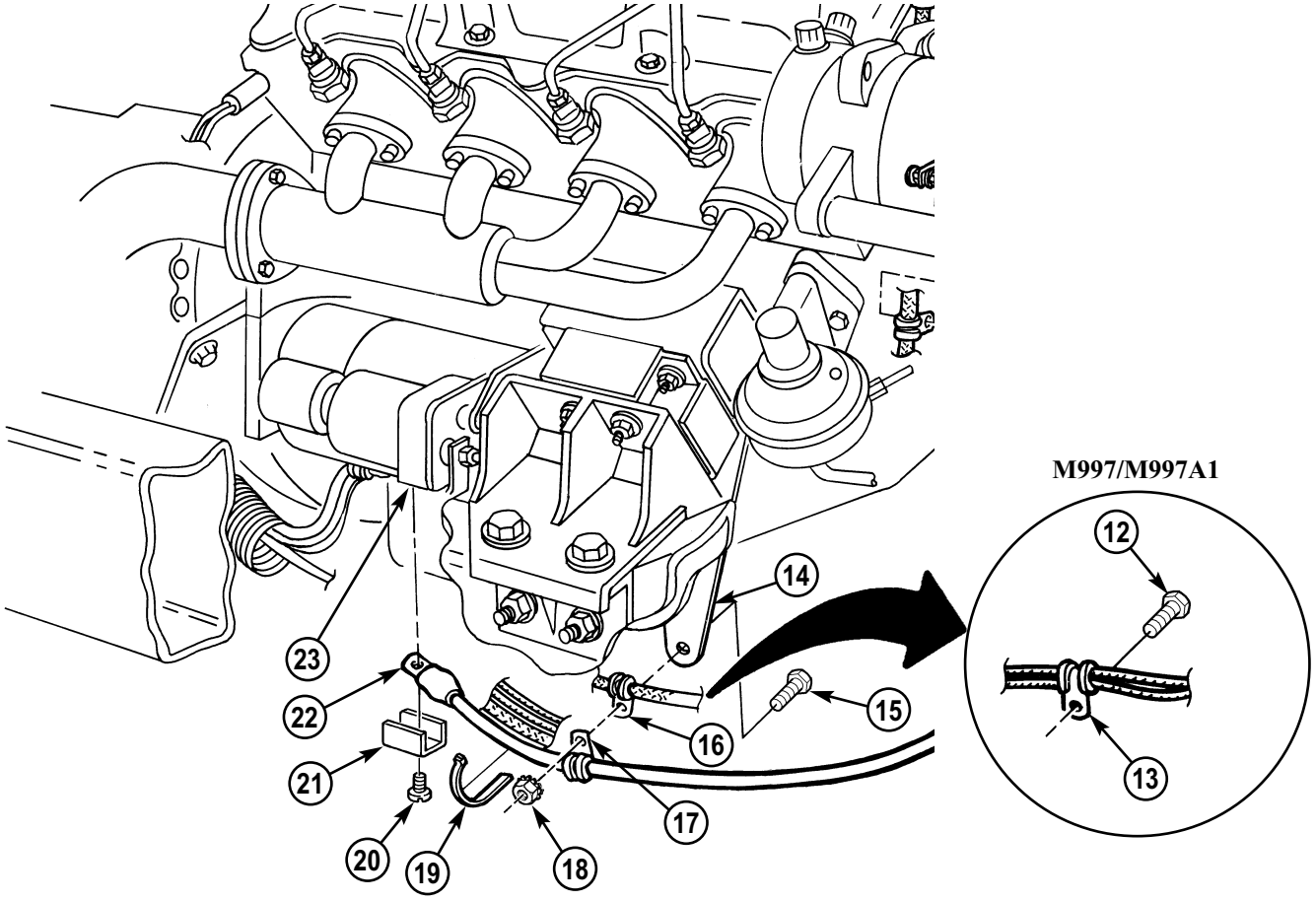
**NOTE**

Step 134 applies to M997 and M997A1 vehicles only. Step 135 applies to M996 and M996A1 vehicles only.

134. Remove assembled locknut (18), screw (15), cable (22), and clamps (16) and (17) from oil pan bracket (14).
135. Remove assembled locknut (18), screw (15), cable (22), and clamp (16) from oil pan bracket (14).

## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



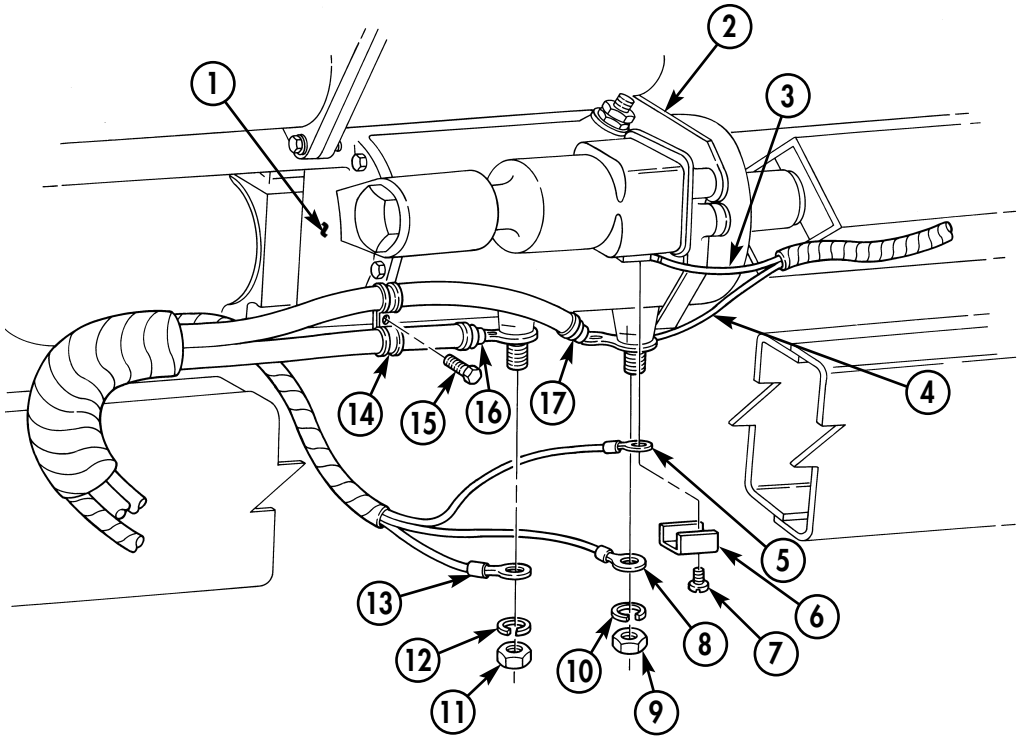



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

Hardware securing positive and negative starter cables to starter may have been removed previously depending upon vehicle configuration.

136. Remove nut (11), lockwasher (12), and lead 3D (13), from starter (1). Discard lockwasher (12).
137. Remove screw (15) and two clamps (14) from positive cable 6A (17), negative cable 7A (16), and starter (1).
138. Disconnect negative cable 7A (16) and lead 3D (13) from starter (1).
139. Remove nut (9), lockwasher (10), and positive cable 6A (17) and leads 81A (4) and 81B (8) from starter (1). Discard lockwasher (10).
140. Remove screw (7), clip (6), and leads 74A (3) and 74B (5) from solenoid (2).



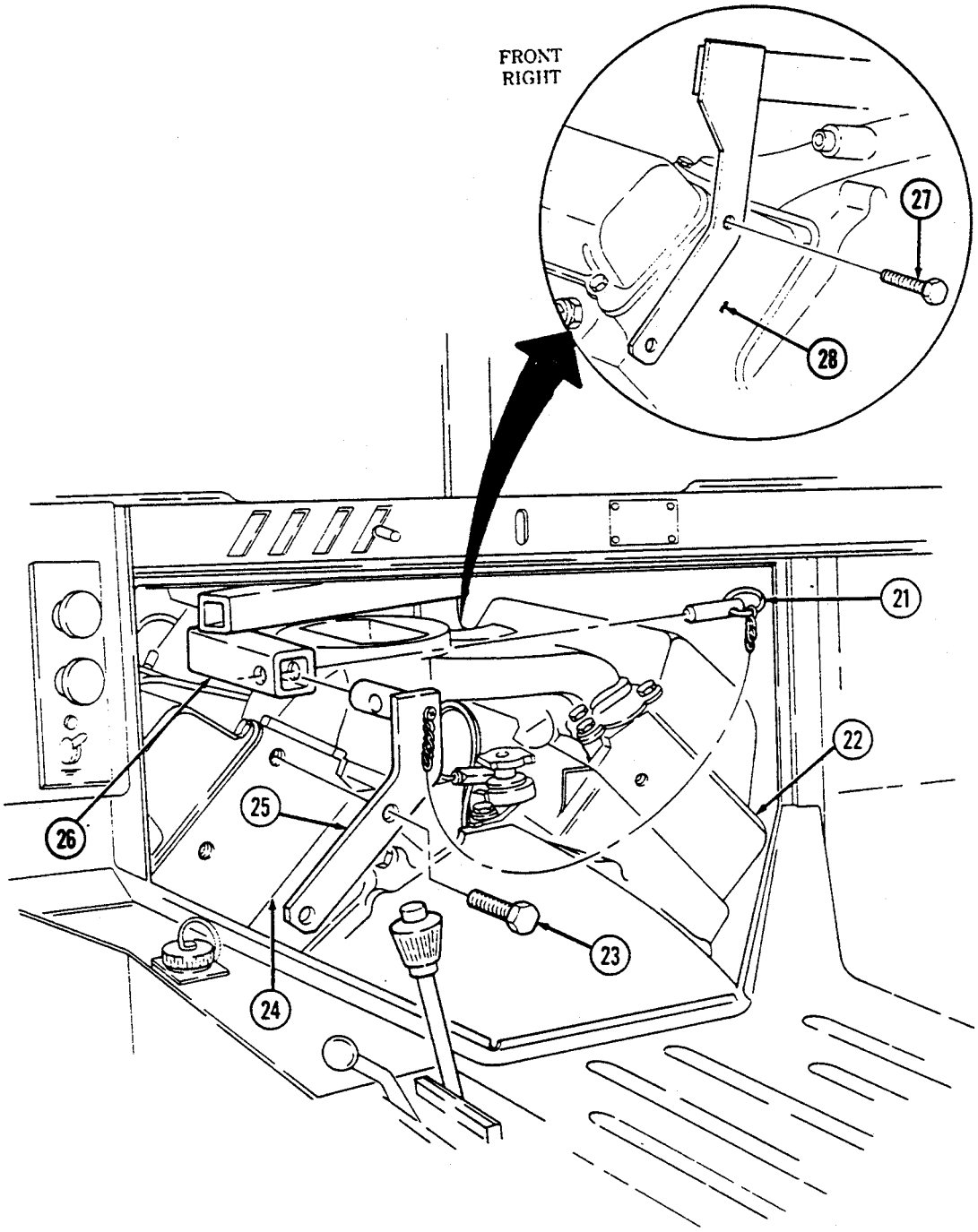
## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

- Install sling bracket on rear of engine first.
- Use four 15 x 25 mm capscrews to install lifting sling on engine.

141. Position engine lifting sling on engine (22) and install on right cylinder head (28) with two capscrews (27).

142. Install sling bracket (25) on left cylinder head (24) with two capscrews (23). Tighten capscrews (23) and (27) and install sling bracket (25) to engine lifting sling (26) with pin (21).



## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**CAUTION**

When using front eyelet on lifting sling engine oil pan must be supported during engine removal to prevent rear eyelet of lifting sling from damaging windshield

**NOTE**

Hoist must be attached to:

- Forward eyelet of lifting sling when lifting engine on M996, M996A1, M997, and M997A1.
- Intermediate eyelet when lifting engine on all other models.
- Rear eyelet when lifting engine and transmission together.

143. Raise engine (5) only enough to take pressure off mounting brackets.

144. Remove two locknuts (3), washers (4) and right engine mount insulator (1) from engine mount bracket (2). Discard locknuts (3). Repeat for left engine mount.

**WARNING**

Transmission must be supported during engine removal. Failure to do this may cause injury to personnel or damage to equipment.

**NOTE**

If vehicle is moved because of limited shop space or tactical movement, damage to the transmission and the vehicle may occur. To prevent damage, the engine/transmission support sling can be installed.

145. Support transmission (7) and remove four capscrews (8) and two studs (6) from transmission (7) and engine (5).

**WARNING**

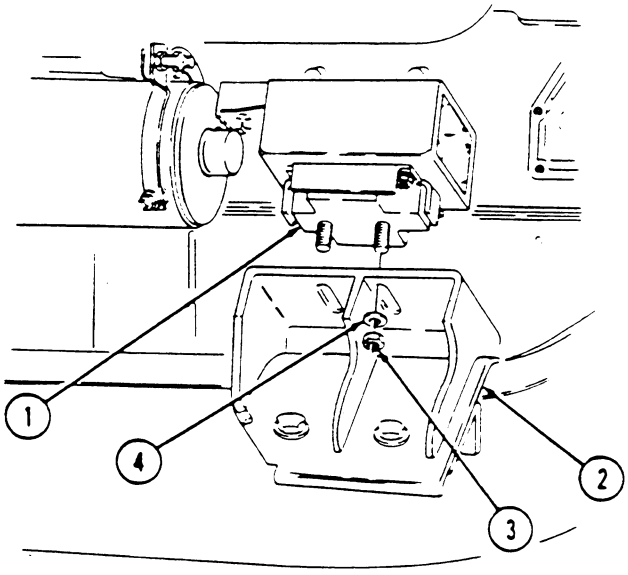
- Direct all personnel not participating in engine removal to stand clear during hoisting operation. Failure to do this may cause injury.
- Do not use hands to free engine of hang-ups or snags. Use prybars to avoid injury.

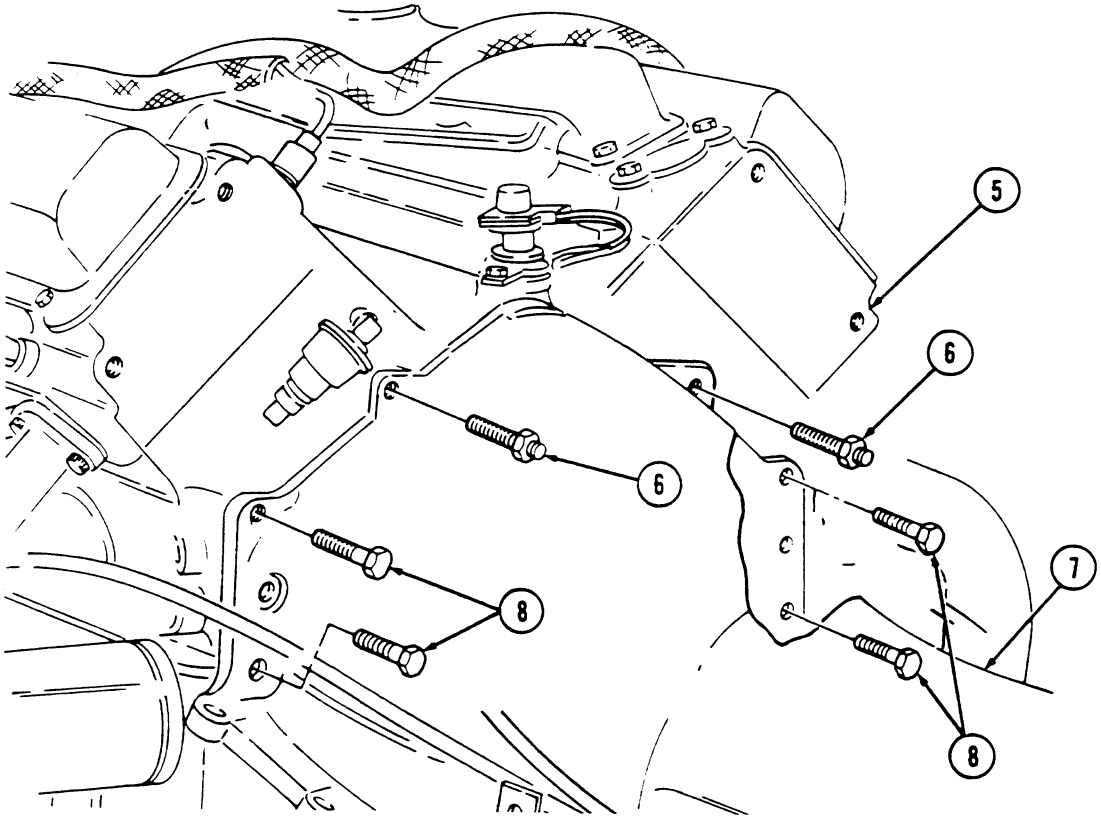
**CAUTION**

Always remove the engine slowly and watch for the following: engine binding or hard to move means that something may still be connected to engine that must be removed; ensure that wiring, lines, cables, and rods are not in the path of removal.

146. Hoist engine (5) slowly out of vehicle.

## 3-22. ENGINE REMOVAL (6.2 L AND 6.5 L [DETUNED]) (Cont'd)




FOLLOW-ON TASK: Prepare engine for disassembly (para. 3-26).

# 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED])

**This task covers:**

**Installation**

## INITIAL SETUP:

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Engine lifting sling (Appendix G, Item 22)
Torque adapter, 3/4 in. (Appendix G, Item 107)
Belt tension gauge (Appendix G, Item 27)

**Materials/Parts**
Two cotter pins (Appendix E, Item 168)
Gasket (Appendix E, Item 36)
Preformed packing (Appendix E, Item 179)
Three gaskets (Appendix E, Item 19)
Tiedown strap (Appendix E, Item 250)
Locknut (Appendix E, Item 54)
Locknut (Appendix E, Item 73)
Two locknuts (Appendix E, Item 65)
Fourteen locknuts (Appendix E, Item 63)
Four locknuts (Appendix E, Item 80)
Four assembled locknuts (Appendix E, Item 85)
Lockwasher (Appendix E, Item 106)
Two lockwashers (Appendix E, Item 114)
Two lockwashers (Appendix E, Item 95)
Two lockwashers (Appendix E, Item 109)
Two lockwashers (Appendix E, Item 110)
Two lockwashers (Appendix E, Item 103)
Eight lockwashers (Appendix E, Item 104)
Four lockwashers (Appendix E, Item 107)

**Material/Parts (cont'd)**
Four lockwashers (Appendix E, Item 117)
Two lockwashers (Appendix E, Item 108)
Three lockwashers (Appendix E, Item 100)
Four lockwashers (Appendix E, Item 120)
Two spring tension washers (Appendix E, Item 264)
Antiseize compound (Appendix B, Item 7)
Sealing compound (Appendix B, Item 50)
RTV sealant (Appendix B, Item 43)
Engine/Transmission support sling (Appendix C, Fig. 24, through 40) (Optional)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Engine prepared for installation (para. 3-26).

**General Safety Instructions**
- Direct personnel to stand clear during hoisting operation.
- Do not use hands to free engine if hangups or snags.
- Transmission must be supported during engine installation.

**Maintenance Level**
Direct support

**Installation**

**WARNING**

- Direct all personnel not participating in engine installation to stand clear during hoisting operation. Failure to do this may cause injury.
- Do not use hands to free engine of hangups or snags. Use prybars to avoid injury.

**CAUTION**

- Always install engine slowly. Lower into chassis carefully and closely observe all engine components to prevent engine damage.
- If transmission support sling was installed, remove prior to engine installation.

**NOTE**

- All plugs must be removed from hoses and connections prior to reconnection.
- Assistant will be needed for steps 1 through 7.
- This procedure is for 6.2L and detuned 6.5L engines only. Refer to para. 3-25 for 6.5L engine installation.

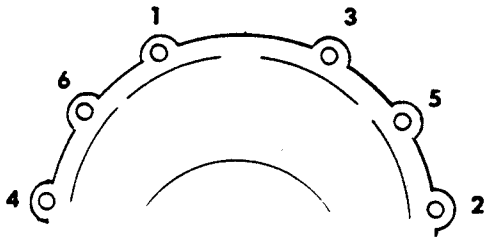
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

1. Lower engine (1) into vehicle.

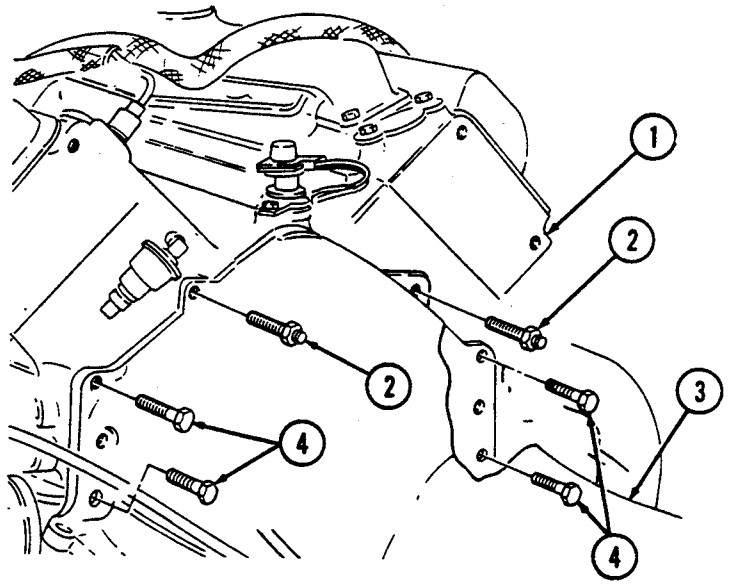
**WARNING**

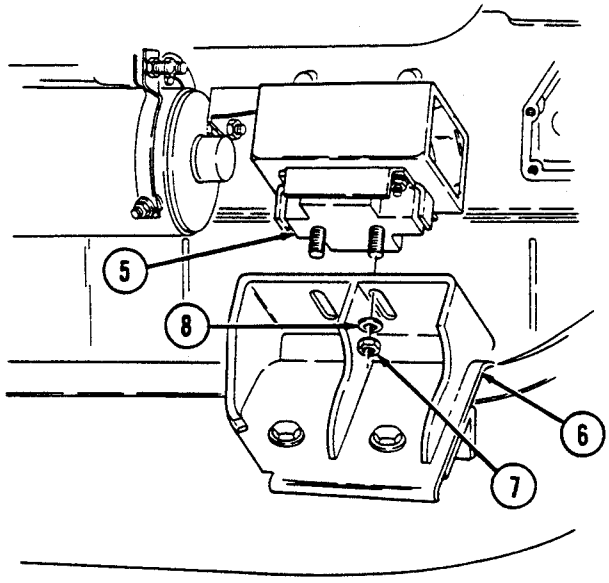
Transmission must be supported during engine installation. Failure to do this may cause injury to personnel or damage to equipment.

2. Raise and support transmission (3).
3. Install transmission (3) on engine (1) with four capscrews (4) and two studs (2). Using torque sequence tighten capscrews (4) and studs (2) to 35 lb-ft (48 N•m).
4. Align right engine mount insulator (5) to engine mount bracket (6) and install with two washers (8) and locknuts (7). Repeat for left engine mount. Using torque adapter, tighten locknuts (7) to 90 lb-ft (122 N·m).



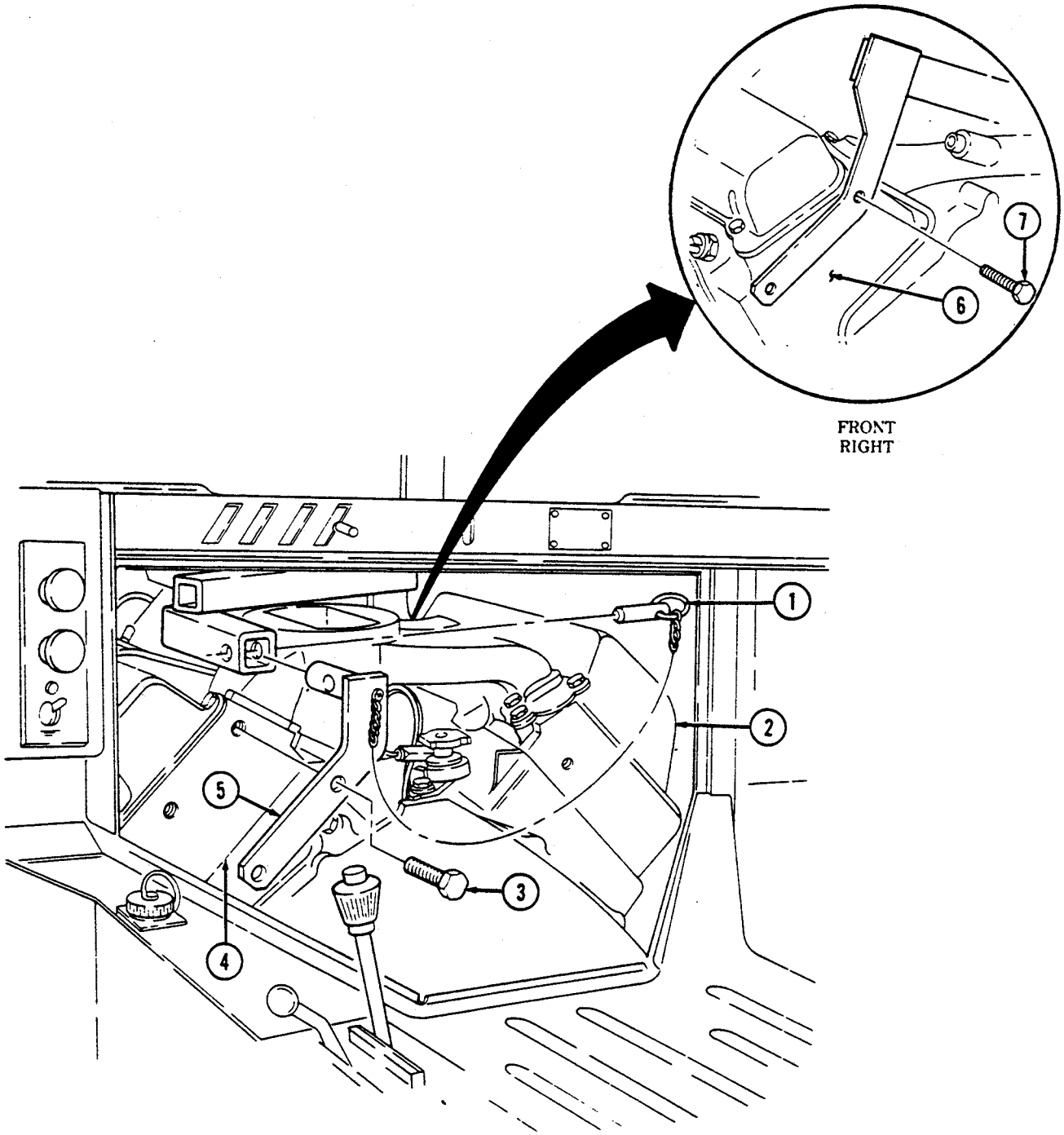

TRANSMISSION TORQUE SEQUENCE



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

5. Remove lifting device from engine lifting sling and lower transmission.
6. Remove two capscrews (3) and sling bracket (5) from left cylinder head (4).
7. Remove pin (1) and sling bracket (5) from engine lift sling.
8. Remove two capscrews (7) and engine lifting sling from right cylinder head (6) and remove engine lifting sling from engine (2).

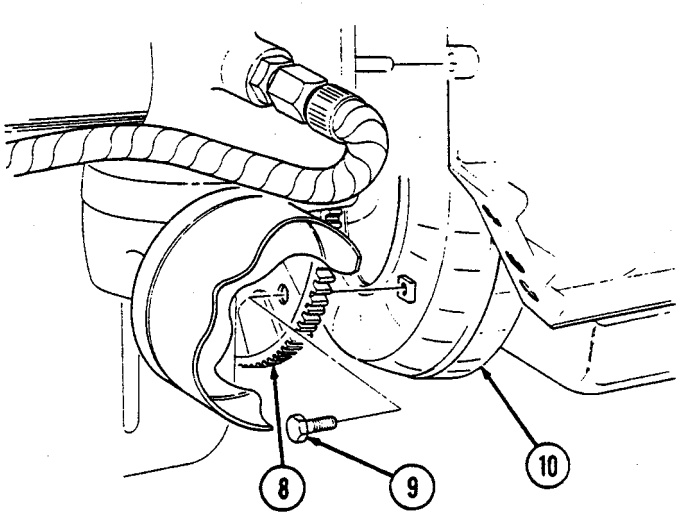


## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

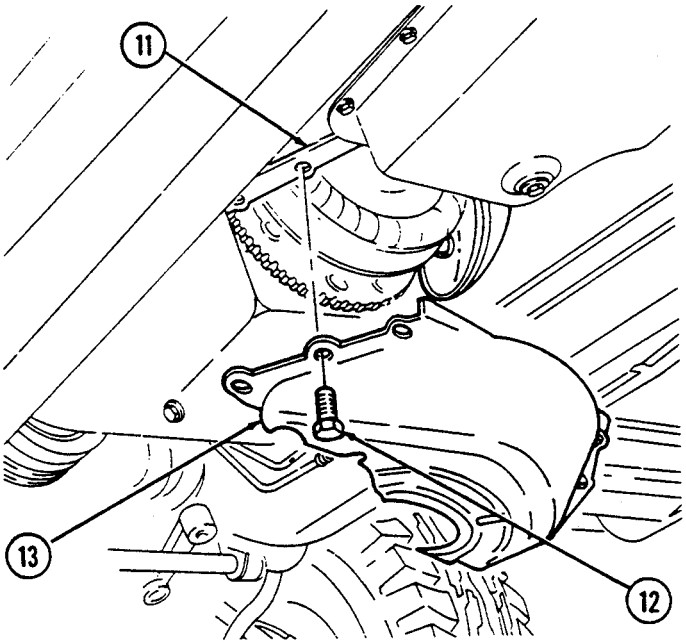
**NOTE**

- It will be necessary to rotate flywheel clockwise from capscrew in front of crankshaft to gain access to install capscrews to torque converter.
- Have assistant hold crankshaft pulley in place when installing flywheel to torque converter.

9. Align torque converter (10) to flywheel (8) with six capscrews (9).
10. Tighten capscrews (9) to 32 lb-ft (43 N·m).




11. Install converter housing cover (13) on transmission (11) with six capscrews (12).



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

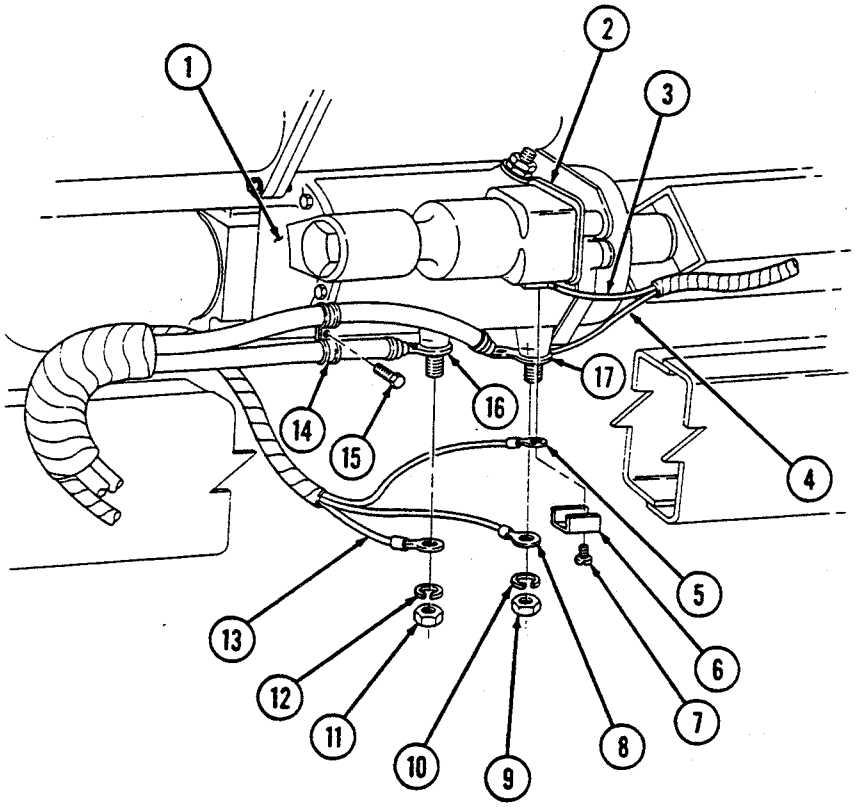
12. Install leads 74A (3) and 74B (5) on solenoid (2) with clip (6) and screw (7).

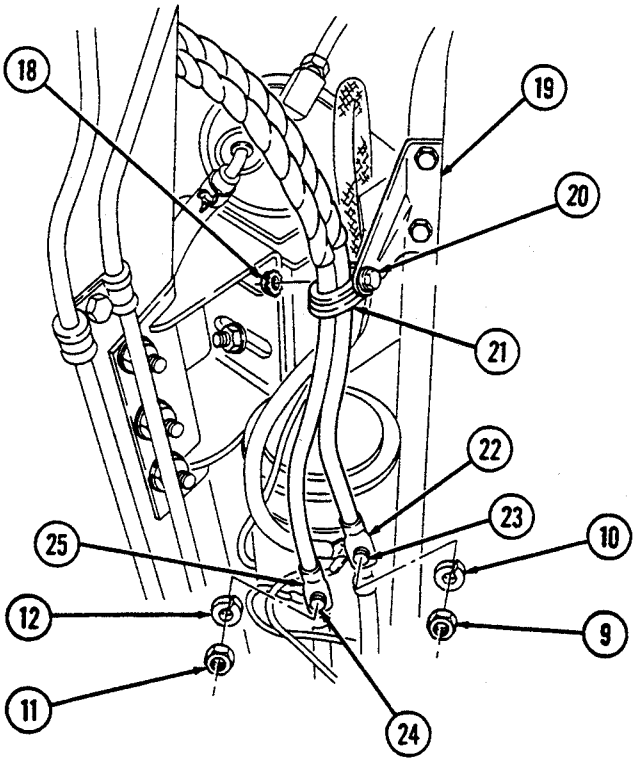
**NOTE**

Steps 13 through 16 apply to vehicle M1026, M1036, M1038, M1042, M1044, and M1046 only. Proceed to step 17 for all other vehicle models.

13. Install positive cable 6A (17), lead 81A (4), lead 81B (8), and lead 6 (22) on starter terminal (23) with lockwasher (10) and nut (9). Using torque adapter, tighten nut (9) to 25 lb-ft (34 N·m).
14. Install negative cable 7A (16), lead 3D (13), and lead 7 (25) on starter terminal (24) with lockwasher (12) and nut (11). Using torque adapter, tighten nut (11) to 15 lb-ft (20 N·m).
15. Install two clamps (14), positive cable 6A (17), and negative cable 7A (16) on starter (1) with screw (15).
16. Install clamp (21) and leads 6 (22) and 7 (25) on oil pan bracket (19) with capscrew (20) and assembled locknut (18).
17. Connect positive cable 6A (17), lead 81A (4), and lead 81B (8) to starter (1) with lockwasher (10) and nut (9).
18. Connect negative cable 7A (16) and lead 3D (13) to starter (1) with lockwasher (12) and nut (11).
19. Install two clamps (14), positive cable 6A (17), and negative cable 7A (16) on starter (1) with screw (15).
20. Using torque adapter, tighten nut (11) to 15-lb-ft (20 N·m) and nut (9) to 25 lb-ft (34 N·m).

## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



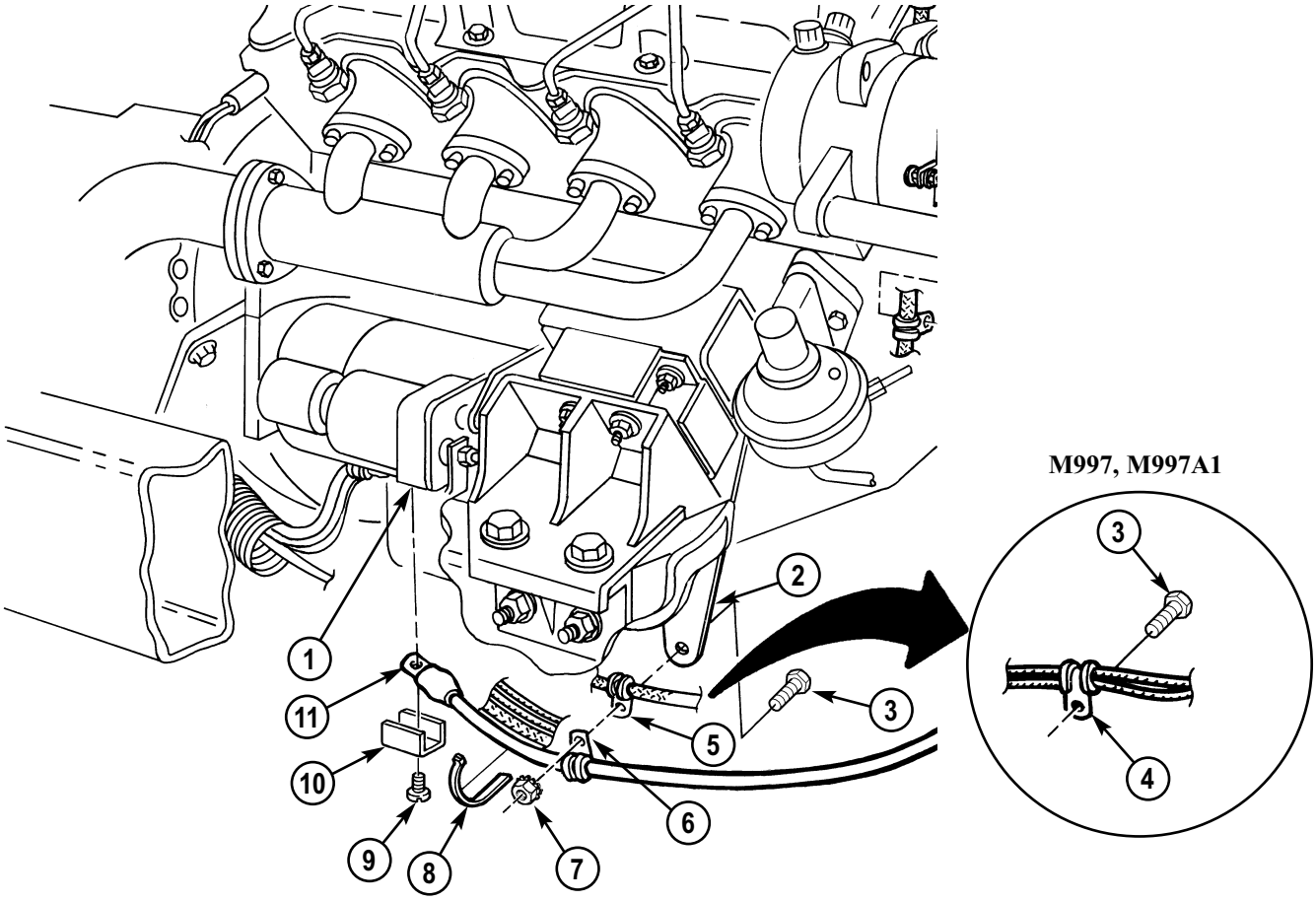



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

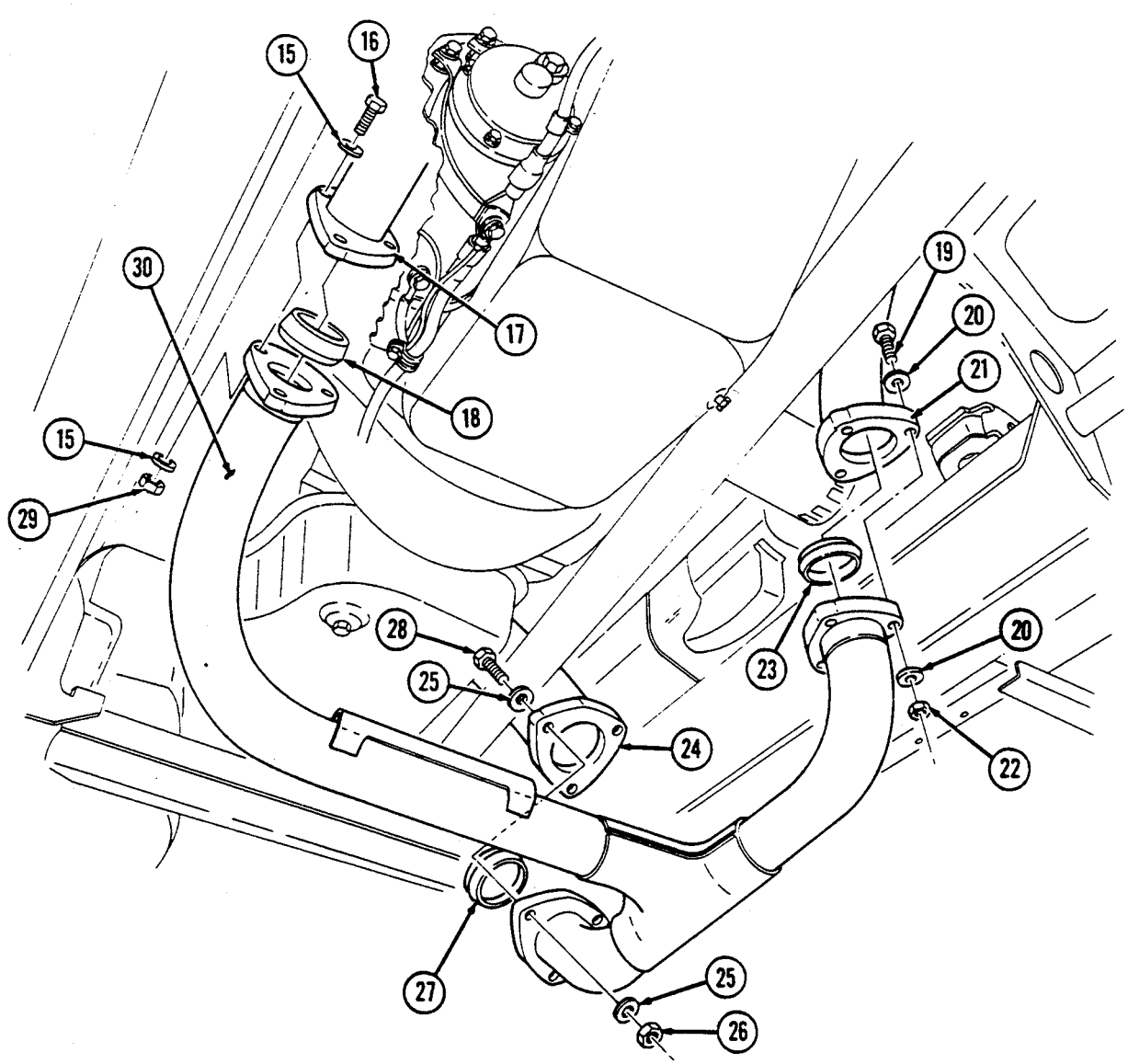
- Steps 21 and 22 apply to M996, M996A1, M997, and M997A1 vehicles only. Step 22 applies to M997 and M997A1 vehicles only.
- It may be necessary to remove lockwasher and nut from starter terminal in order to install 200 amp cable.

21. Install 200 amp cable (11) to starter (1) with clamp (10), bolt (9), and tiedown strap (8).
22. Install 200 amp cable clamp (6) and engine wiring harness clamp (5) to oil pan bracket (2) with screw (3) and assembled locknut (7).
23. Install air compressor harness clamp (4) to screw (3) on oil pan bracket (2) with assembled locknut (7).



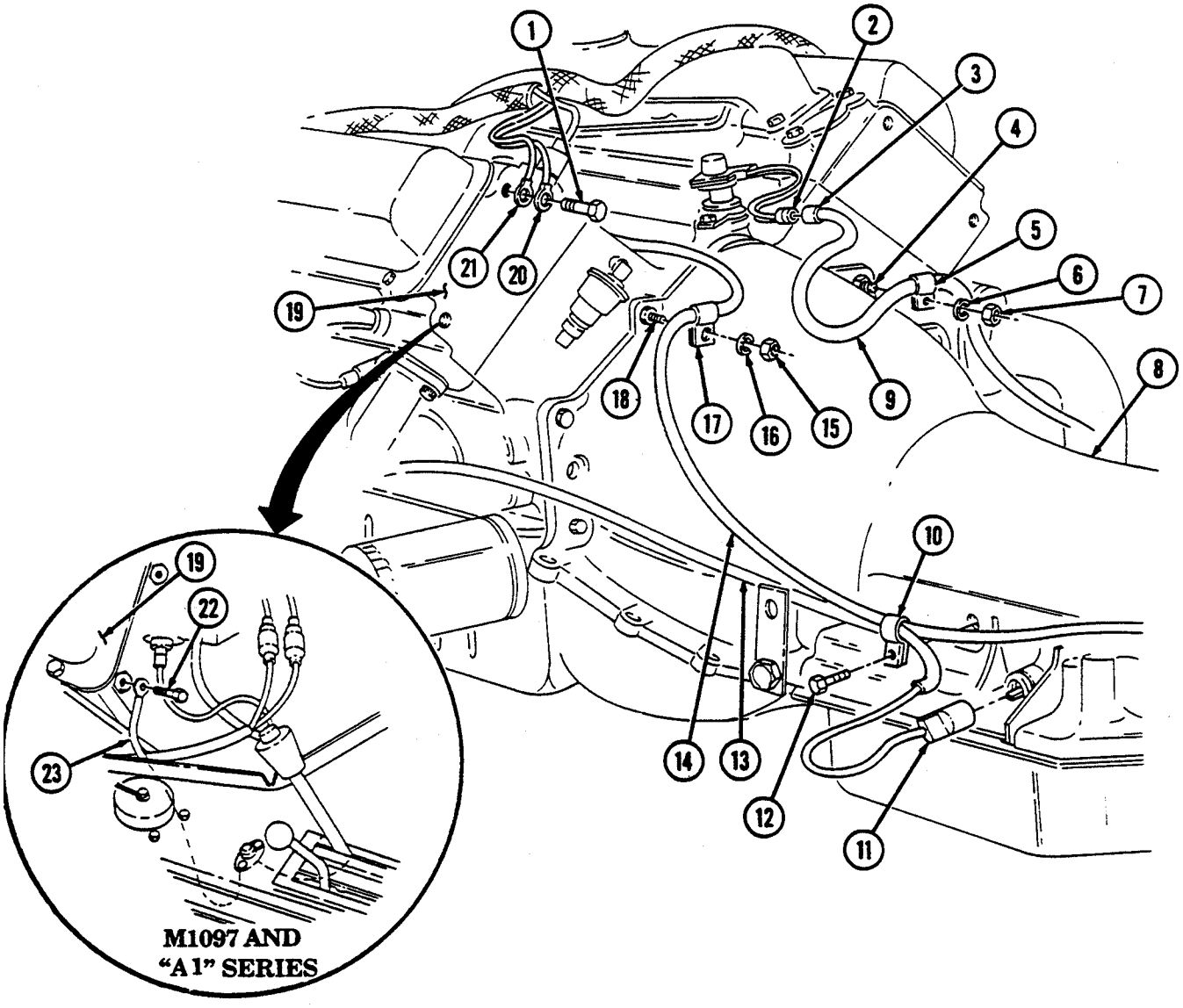
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

24. Install gasket (23) and crossover pipe (30) to left exhaust manifold (21) with three washers (20), capscrews (19), washers (20), and locknuts (22).
25. Install gasket (27) and crossover pipe (30) to muffler (24) with three washers (25), capscrews (28), washers (25), and locknuts (26).
26. Install gasket (18) and crossover pipe (30) to right exhaust manifold (17) with three washers (15), capscrews (16), washers (15), and locknuts (29).
27. Tighten locknuts (29), (22), and (26) to 26 lb-ft (35 N·m).



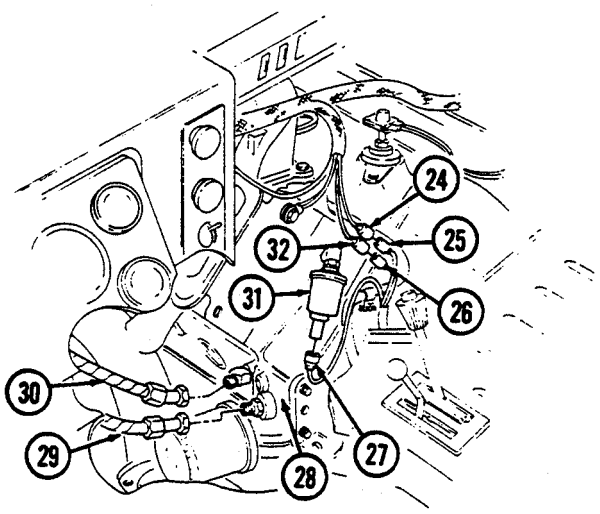
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

28. Connect kick-down connector lead 315C (11) to transmission (8).
29. Install connector lead 315C (14) and speedometer cable (13) on transmission (8) with clamp (10) and screw (12).
30. Install lead 315C (14) on stud (18) on transmission (8) with clamp (17), lockwasher (16), and nut (15).
31. Connect harness connector 7 (3) to rpm sensor (2).
32. Install STE/ICE-R harness leads (9) on stud (4) on transmission (8) with clamp (5), lockwasher (6), and nut (7).
33. Apply antiseize compound to ground leads 3A (20) and 58A (21) and install on left cylinder head (19) with capscrew (1).
34. Connect transfer case indicator lamp ground leads (23) on cylinder head (19) with screw (22).




35. Connect engine harness leads 33B (32) and 58A (24) to body harness leads 33A (26) and 58B (25).
36. Connect lead 36A (27) to oil pressure sending unit (31).
37. Connect oil cooler supply line (29) and oil cooler return line (30) to engine (28).

## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)




38. Position modulator cable (41) through cable bracket (34) and install washer (35) and start front mounting nut (36).

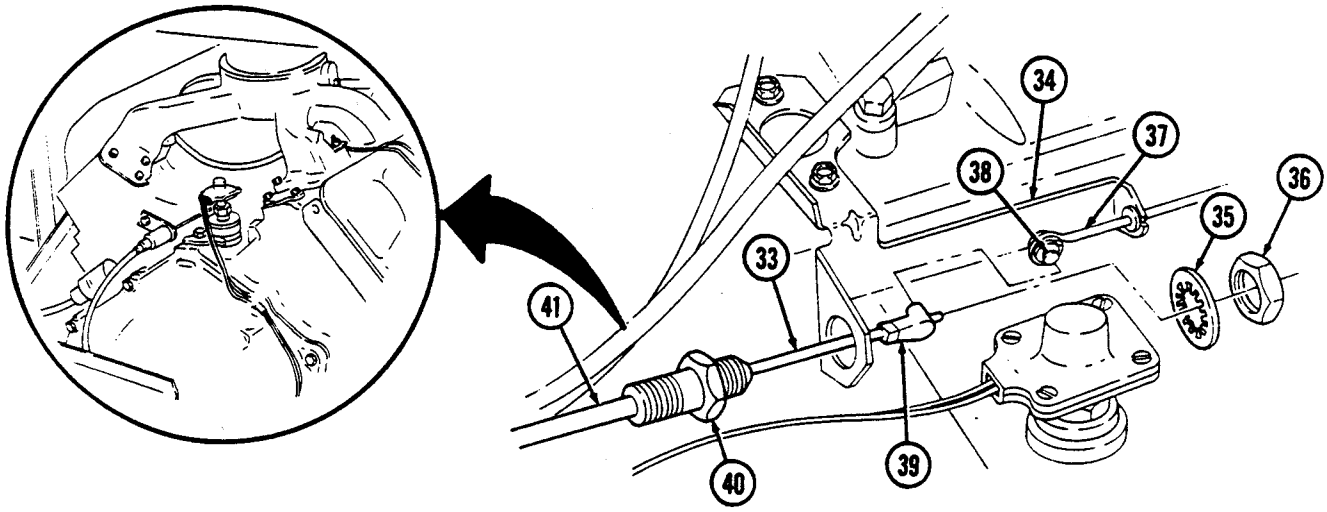
**CAUTION**

Ensure cable is clear of exhaust system or other sources of extreme heat to prevent damage to equipment.

**NOTE**

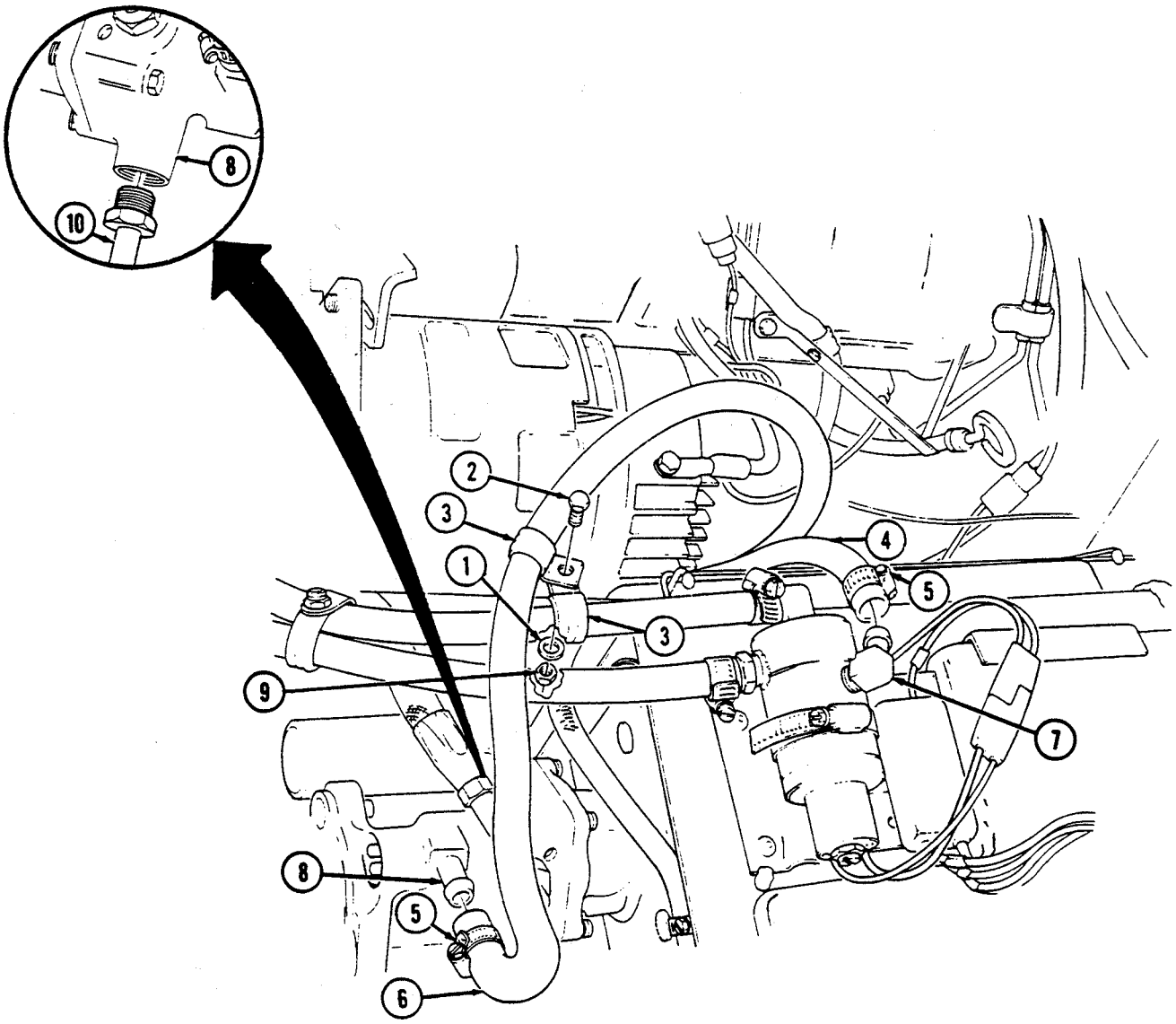
Do not tighten mounting nuts.

39. Pull modulator control rod (37) to the rear until stop is engaged and hold in position.
40. With modulator cable (41) in idle position (cable core is extended), adjust modulator mounting nuts (36) and (40) until modulator control rod head (38) and spring clip (39) align.
41. Tighten mounting nuts (36) and (40) and recheck alignment. Readjust if alignment has changed.
42. Pull modulator cable core (33) outward and connect spring clip (39) to modulator control rod head (38).
43. Check modulator cable (41) for ease and smoothness of operation and ensure cable returns to the idle position.



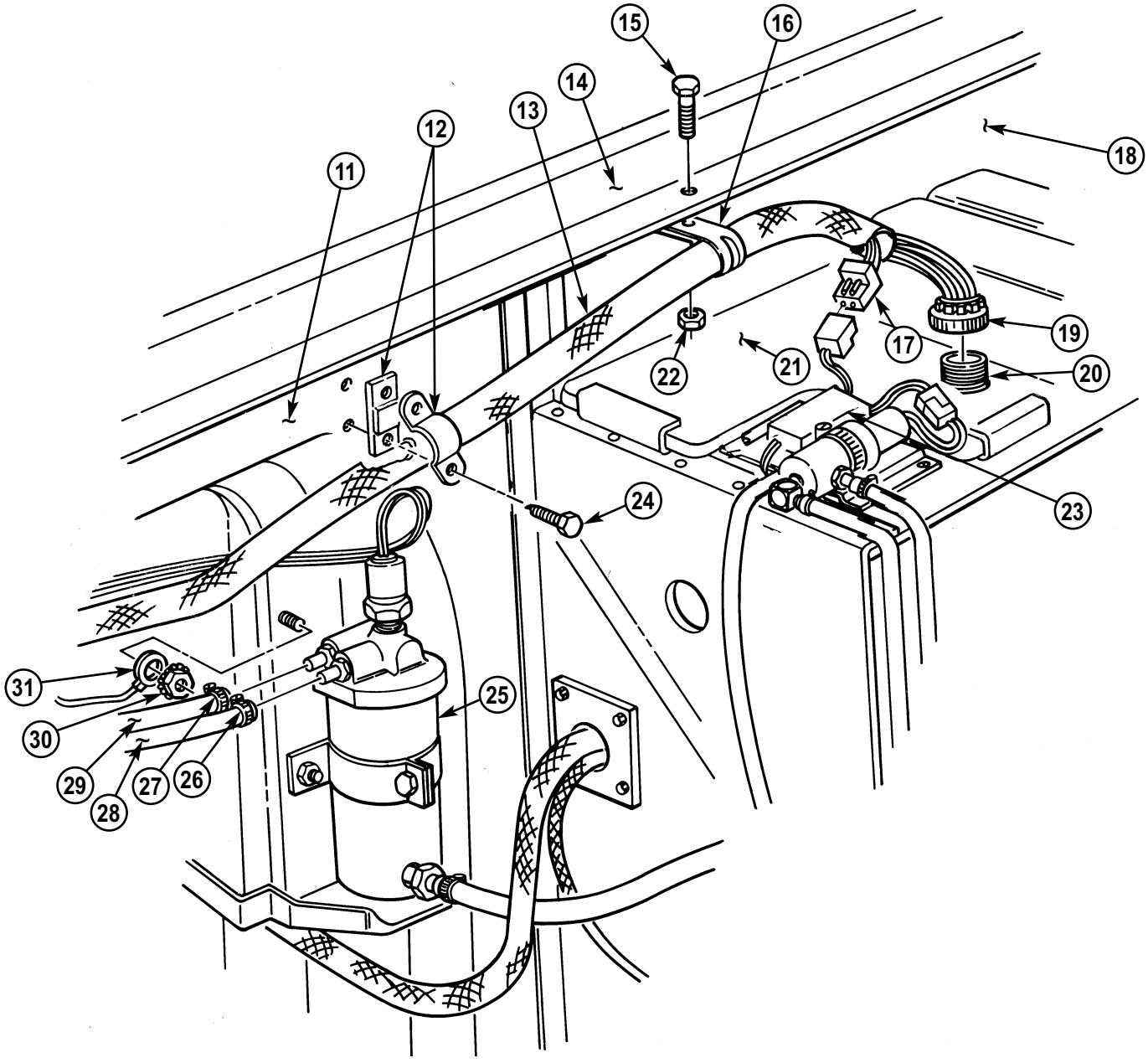
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

44. Connect control valve hose (4) to control valve (7) and hydro-boost hose (6) to hydro-boost (8) and tighten clamps (5) to 10-20 lb-in. (1-2 N•m).
45. Connect two clamps (3) with capscrew (2), washer (1), and nut (9).
46. Connect high pressure line (10) to hydro-boost (8).



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

47. Connect fuel inlet (28) and fuel outlet (29) lines to fuel filter (25) and tighten clamps (26) and (27).
48. Connect engine harness connector (17) to time delay module (23).
49. Connect harness connector plug (19) to protective control box (20).
50. Apply antiseize compound to engine harness ground 3C (31) and install on body (11) with assembled locknut (30).
51. Install engine harness (13) on body (11) with clamp (12) and two screws (24).
52. Install engine harness (13) on "A" beam (14) with clamp (16), capscrew (15), and nut (22).
53. Install two rubber insulation pads (18) and (21) to "A" beam (14) and protective control box (20).



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

54. Install cable assembly (1) on throttle shaft lever (4) with accelerator cable clip (7).
55. Install cable assembly (1) to cable bracket (2) with two nuts (8).
56. Connect throttle return spring (3) to cable bracket (2).

**NOTE**

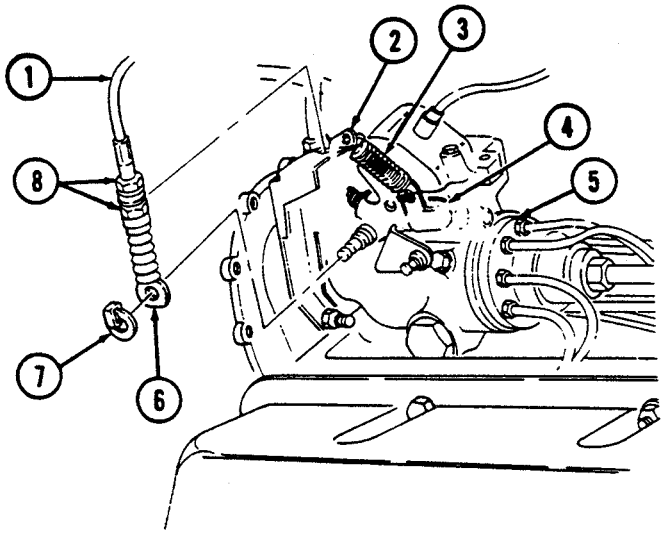
Steps 57 through 62 cover accelerator linkage adjustment.

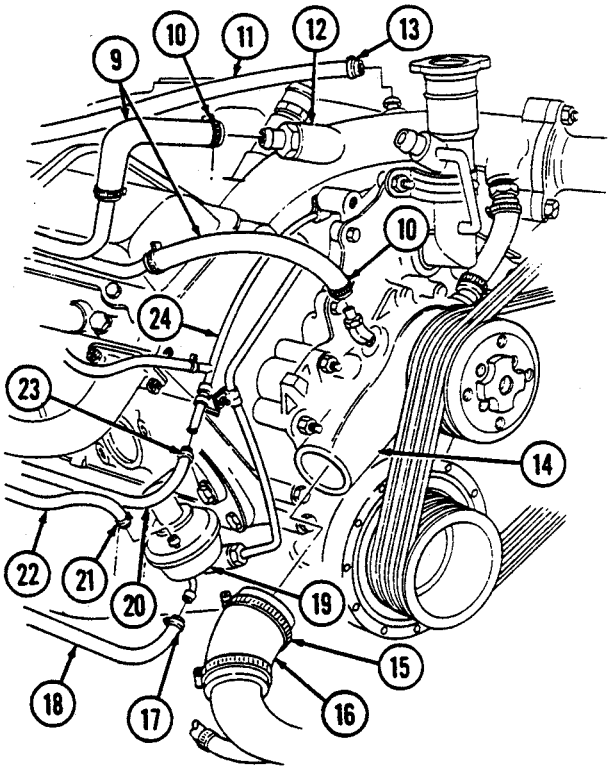
57. Loosen nuts (8) on cable bracket (2).
58. Fully depress accelerator pedal.
59. Hold throttle shaft lever (4) on injection pump (5) in full throttle position.
60. Adjust nuts (8) up or down so cable end (6) holds throttle shaft lever (4) in full throttle position.
61. Tighten nuts (8) on cable assembly (1) to cable bracket (2).
62. Release accelerator pedal and ensure throttle shaft lever (4) returns all the way to idle position.

**WARNING**

Ensure fuel pump vent line is properly attached to top vent line fitting of fuel pump. Improper vent line installation may cause injury to personnel or damage to equipment.

63. Connect vent line (22) to fuel pump (19) and tighten clamp (21).
64. Connect fuel supply line (18) to fuel pump (19) and tighten clamp (17) to 10-20 lb-in. (1-2 N•m).
65. Connect fuel return hose (20) to fuel return line (24) and tighten clamp (23) to 10-20 lb-in. (1-2 N•m).
66. Connect water hoses (9) to water crossover (12) and water pump (14) and tighten clamps (10).
67. Connect water pump inlet hose (16) to water pump (14) and tighten clamp (15).
68. Connect surge tank-to-water crossover hose (11) to crossover (12) and tighten clamp (13) to 10-20 lb-in. (1-2 N•m).



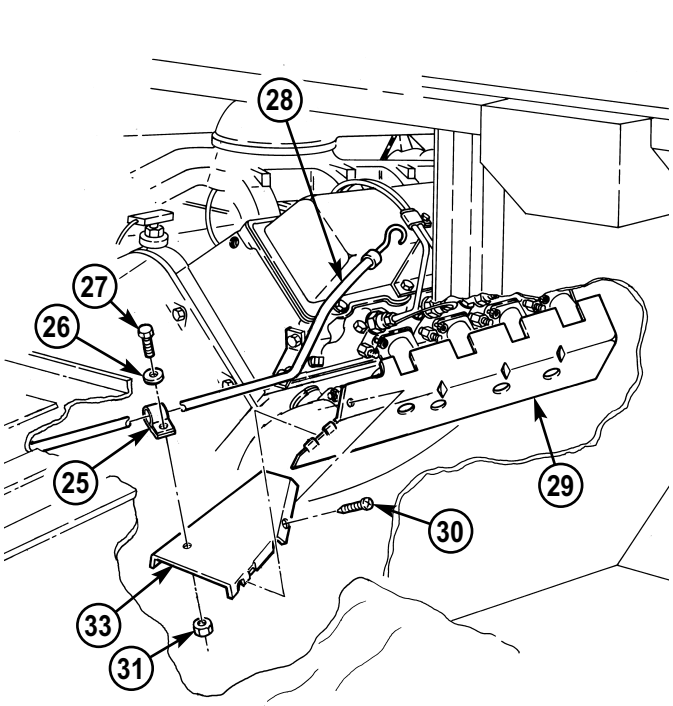
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

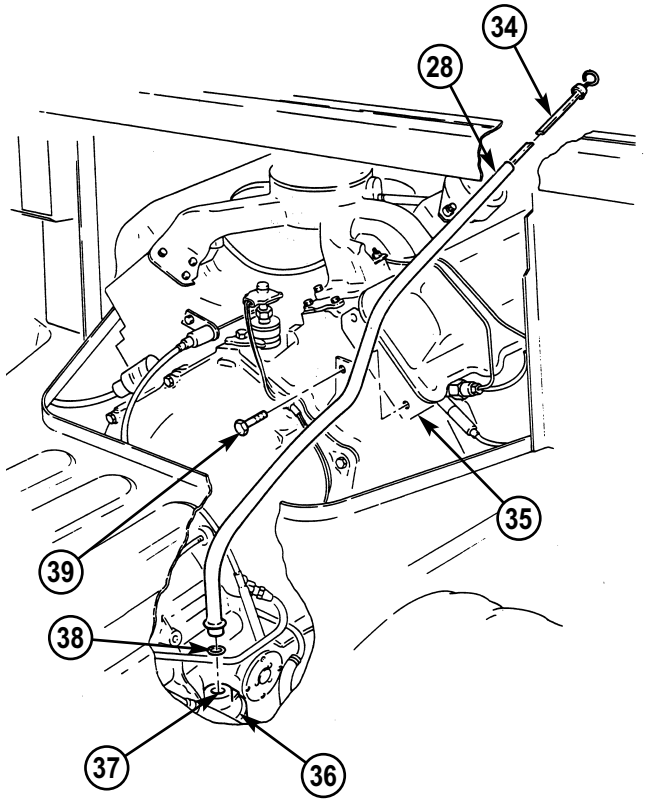
69. Install rear shield (33) to heat shield (29) with capscrew (30).

**NOTE**

Remove plug prior to installation of transmission oil dipstick tube.

70. Apply RTV sealant on preformed packing (38) and install preformed packing (38) on transmission oil dipstick tube (28).
71. Push dipstick tube (28) into opening (37) in transmission (36).
72. Install dipstick tube (28) to cylinder head (35) with capscrew (39). Tighten capscrew (39) to 25-37 lb-ft (34-50 N·m).
73. Install clamp (25) and rear heat shield (33) on transmission dipstick tube (28) with washer (26), capscrew (27), and nut (31).
74. Install transmission oil dipstick (34) in dipstick tube (28).



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

- Perform steps 75 through 90 for vehicles equipped with Prestolite 200 amp alternator only.
- Perform steps 75 through 77 for early production vehicles only.
- In some cases, a thru-bolt and nut may be present on mounting bracket instead of standard capscrews and washers.

75. Position alternator (16) on support bracket (6) with mounting bracket (15) between support bracket (6) and alternator (16) and install two washers (7), lockwashers (8), and capscrews (9). Do not tighten capscrews (9).
76. Align alternator (16) with adjusting bracket (4) and install washer (3), lockwasher (2), and capscrew (1). Do not tighten capscrew (1).
77. Install power steering lines clamps (12) and harness clamp (10) to alternator support bracket (6) with capscrew (5), spacer (11), washer (14), and locknut (13).

**NOTE**

Perform steps 78 through 81 for vehicles with new alternator support bracket configuration.

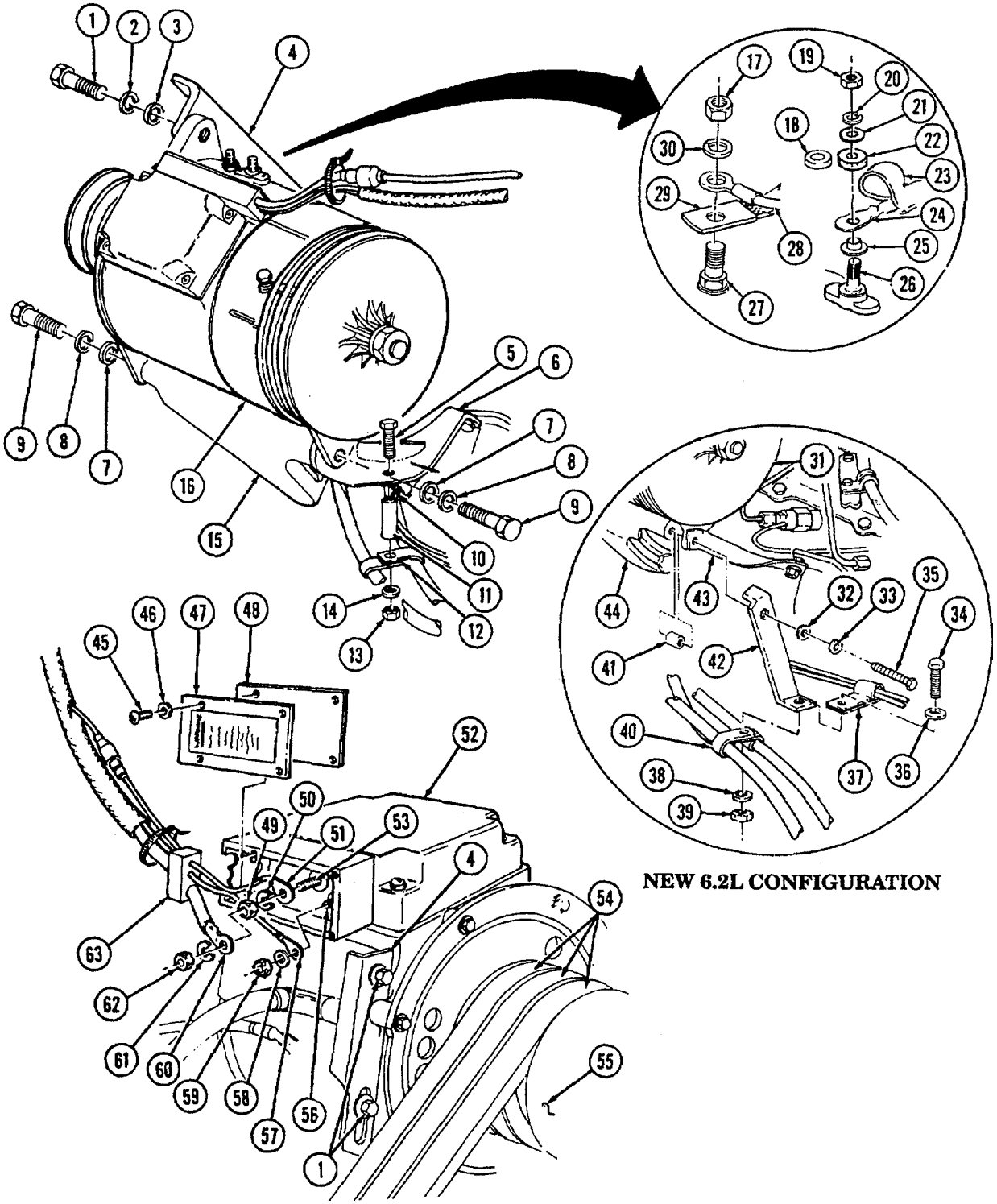
78. Position alternator (31) on mounting bracket (44) with power steering lines bracket (42) on the outside of alternator support bracket (43).
79. Position spacer (41) between alternator (31) and mounting bracket (44).
80. Secure alternator (31), spacer (41), power steering lines bracket (42), and support bracket (43) to mounting bracket (44) with two washers (32), lockwashers (33), and capscrews (35).
81. Install power steering lines clamps (40) and harness clamp (37) to bracket (42) with washer (36), capscrew (34), washer (38), and locknut (39).

**NOTE**

Ensure terminals are clean before connections are made.

82. Install ground strap (29) and lead 3B (28) to ground stud (27) with lockwasher (30) and nut (17). Tighten nut (17) to 8-12 lb-ft (11-16 N·m).
83. Install insulator (18) in fuse (22).
84. Install bushing (25), positive cable (24), fuse (22), and insulator (18) on positive stud (26) with washer (21), lockwasher (20), and nut (19). Tighten nut (19) to 10-15 lb-ft (14-20 N·m). Slide rubber boot (23) over nut (19).
85. Install three drivebelts (54) on alternator pulley (55).
86. Install lead 568 (51) to stud (53) with lockwasher (50) and nut (49).
87. Install lead 5A (60) to stud (53) with lockwasher (61) and nut (62).
88. Install lead 2A (57) to stud (56) with washer (58) and nut (59).
89. Install rubber wedge (63) in opening of regulator (52).
90. Install gasket (48) and cover (47) to regulator (52) with four lockwashers (46) and screws (45).

## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



NEW 6.2L CONFIGURATION

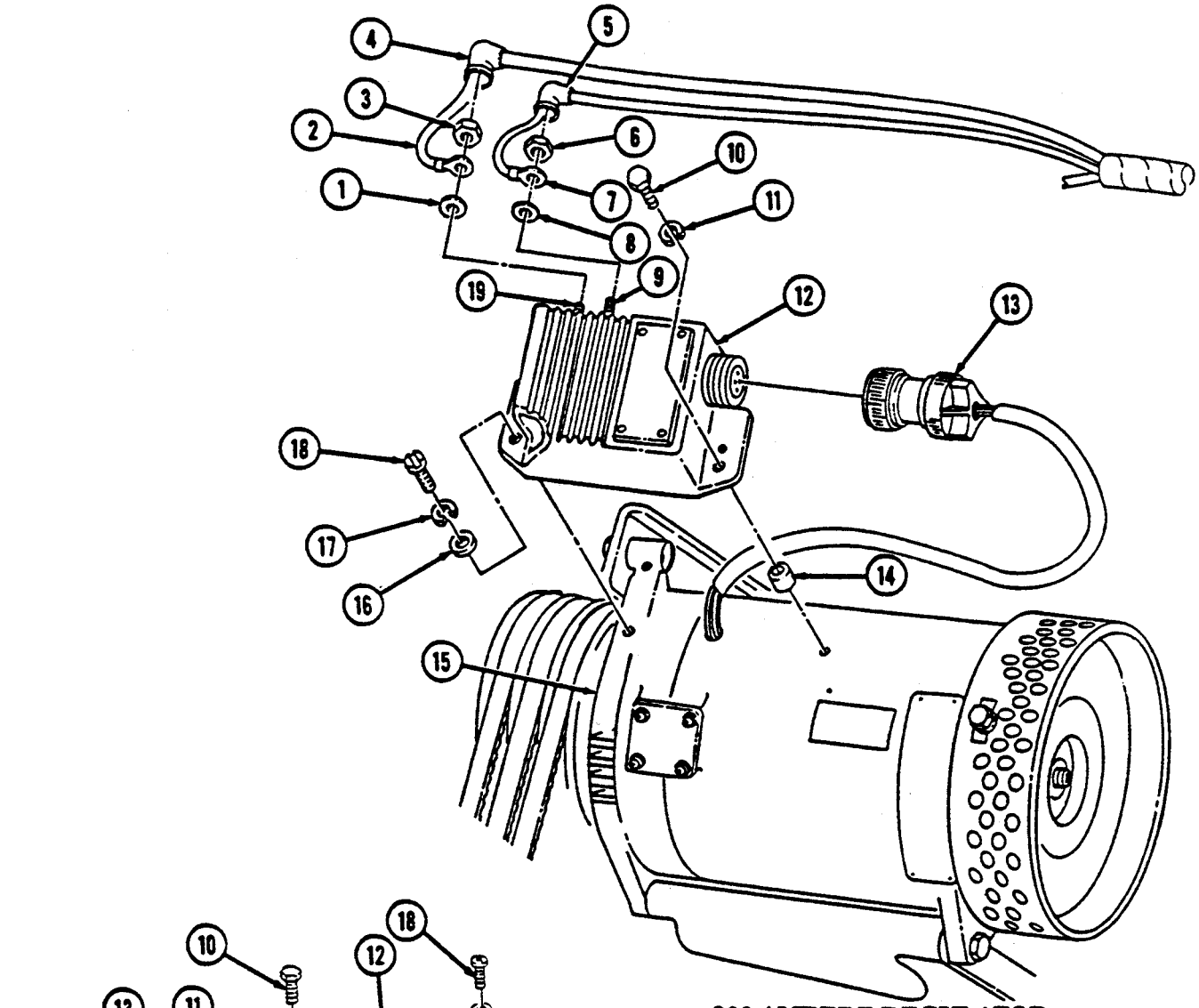
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

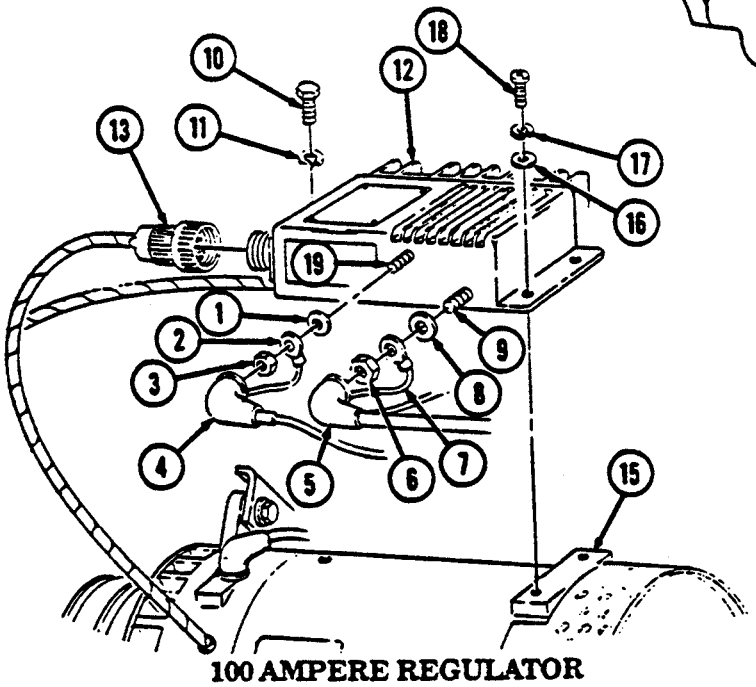
**NOTE**

Installation for the 100 amp and 200 amp Neihoff regulators are basically the same. Differences are shown in the illustration.

91. Apply sealing compound to threads of capscrew (10).
92. Install spacer (14) and voltage regulator (12) on alternator (15) with lockwasher (11) and capscrew (10). Tighten capscrews (10) to 88-94 lb-in. (10-11 N•m).
93. Install two washers (16), spring tension washers (17) and screws (18) on voltage regulator (12) and alternator (15). Tighten screws (18) to 30-34 lb-in (3-4 N•m).
94. Install washer (1), lead 5A (2), and nut (3) on red (energize) terminal (19). Tighten nut (3) to 23-27 lb-in. (2.6-3.0 N•m). Slide rubber boot (4) over terminal (19).
95. Install washer (8), lead 2A (7), and nut (6) on yellow (AC) terminal (9). Tighten nut (6) to 18-22 lb-in. (2.0-2.5 N•m). Slide rubber boot (5) over terminal (9).
96. Connect regulator plug (13) to voltage regulator (12).

## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

- Perform steps 97 through 105 for vehicles equipped with Neihoff 200 amp alternator.
- Perform step 98 for vehicles with new alternator support bracket configuration.
- In some cases, a thru-bolt and nut may be present on mounting bracket instead of standard capscrews and washers.

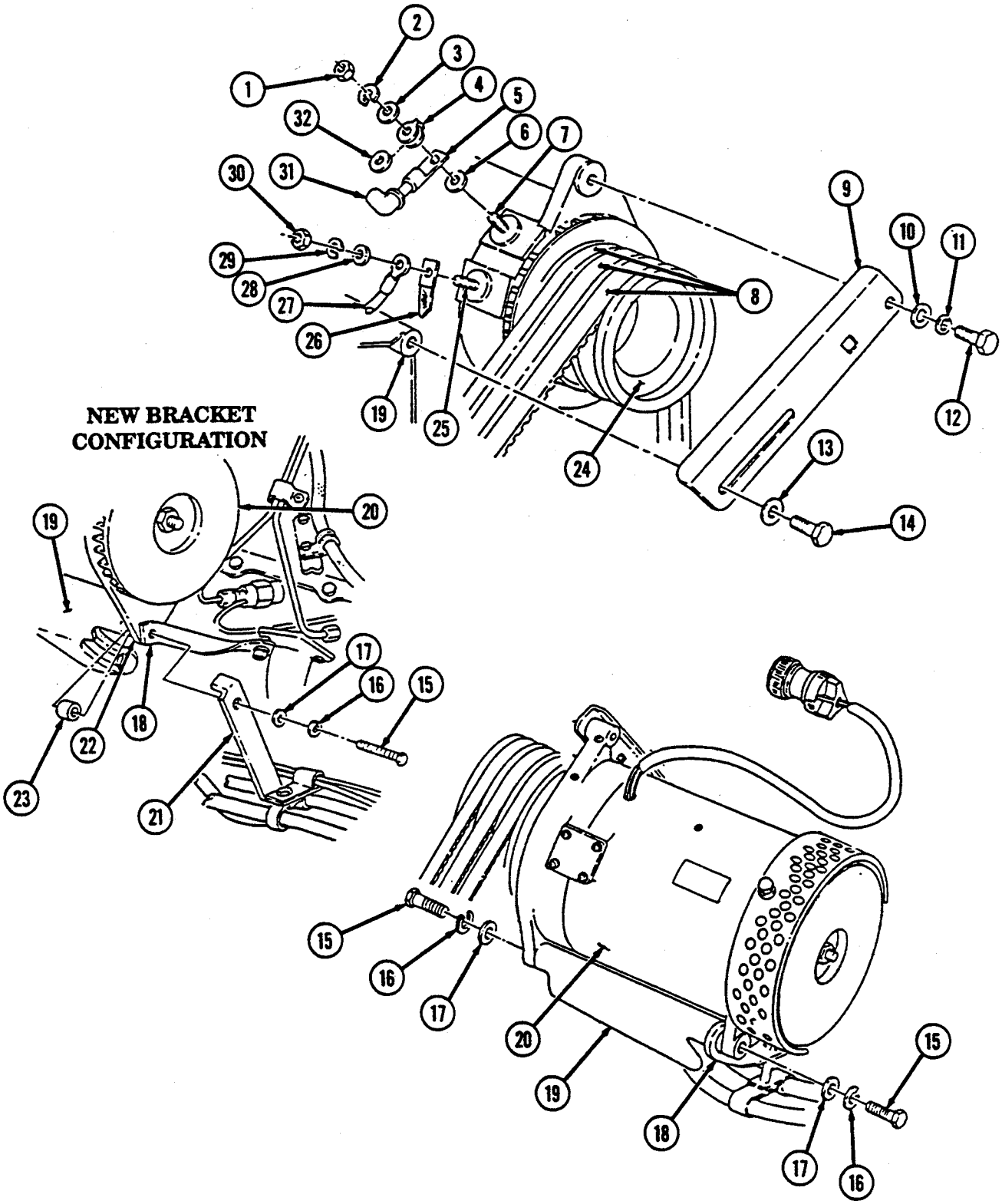
97. Position alternator (20) on mounting bracket (19) with support bracket (18) between mounting bracket (19) and alternator (20) and install two washers (17), lockwashers (16), and capscrews (15). Do no tighten capscrews (15).
98. Position alternator (20) on mounting bracket (19) with support bracket (18) and power steering lines bracket (21) on the outside of alternator mounting flange (22) and install spacer (23), two washers (17), lockwashers (16), and capscrew (15).
99. Position alternator adjusting bracket (9) and install washer (10), lockwasher (11), and capscrew (12). Do not tighten capscrew (12).
100. Align alternator (20) with adjusting bracket (9) and install washer (13) and capscrew (14). Do not tighten capscrew (14).

**NOTE**

Ensure terminals are clean before connections are made.

101. Install insulator washer (32) in fuse link (4).
102. Install washer (6), positive cable (5) fuse link (4) and insulator washer (32) on positive stud (7) with washer (3), lockwasher (2), and nut (1). Tighten nut (1) to 10-15 lb-ft (14-20 N•m)
103. Install ground strap (26) and lead 3B (27) to ground stud (25) with washer (28), lockwasher (29), and nut (30). Tighten nut (30) to 8-12 lb-ft (11-16 N•m)
104. Install three drivebelts (8) on alternator pulley (20).
105. Install rubber boot (31) over stud (7).

## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

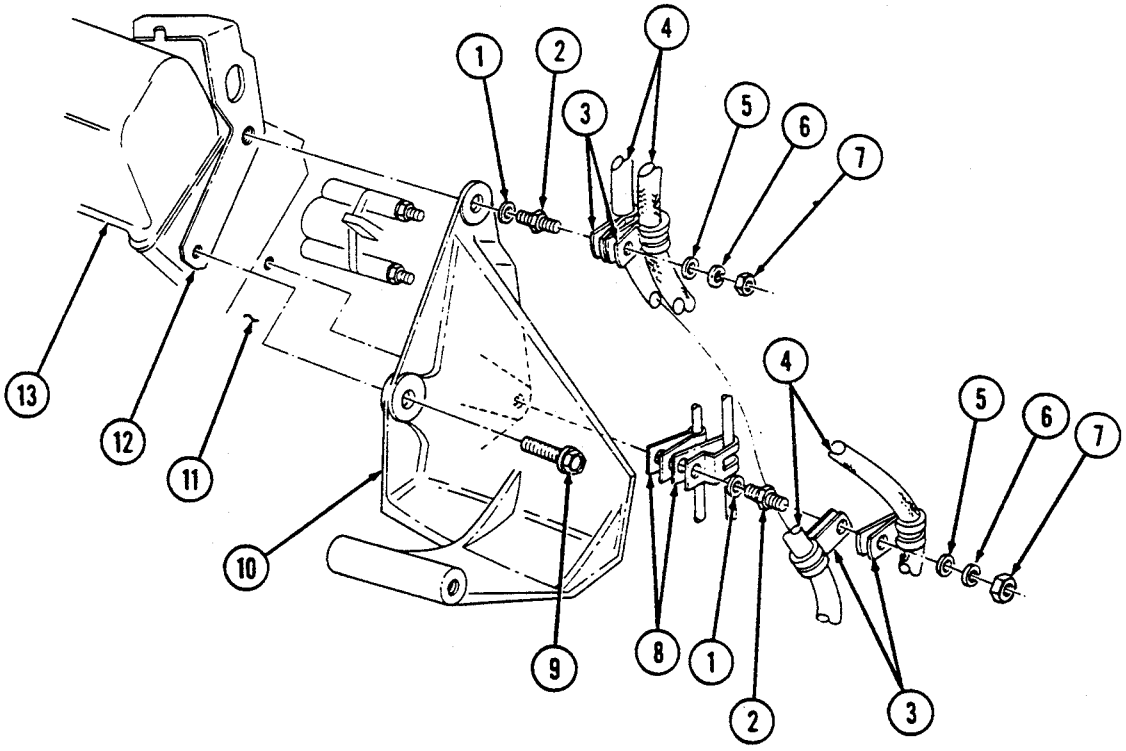


## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

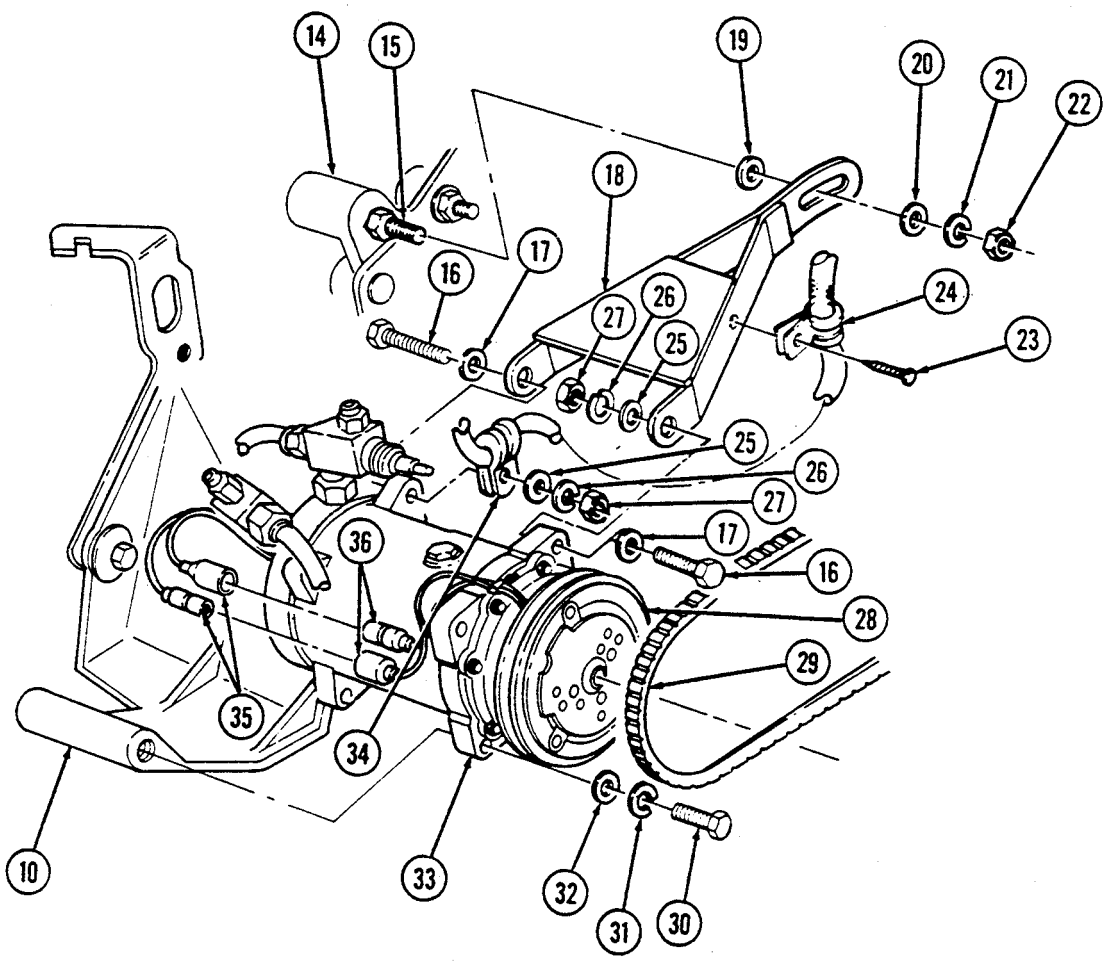
**NOTE**

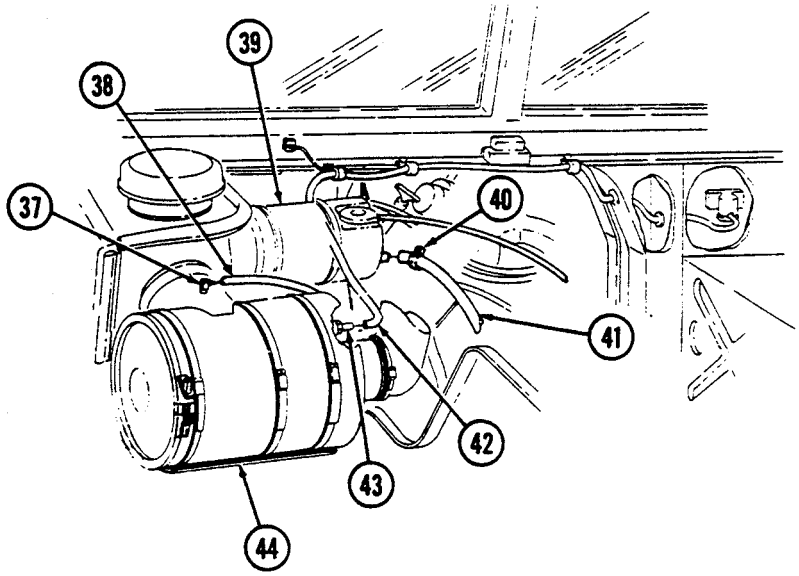
Perform steps 106 through 118 for M997 and M997A1 vehicles only.

106. Install brackets (12) and (10) and two fuel line clamps (8) on cylinder head (13) and engine block (11) with two washers (1) and studs (2). Tighten studs (2) to 40 lb-ft (54 N•m).
107. Install four clamps (3) and two cables (4) on studs (2) with two washers (5), lockwashers (6), and nuts (7). Tighten nuts (7) to 40 lb-ft (54 N•m).
108. Secure bracket (12) and (10) on cylinder head (13) with capscrew (9).
109. Tighten capscrew (9) to 40 lb-ft (54 N•m).
110. Install compressor (33) on support bracket (10) with two washers (32), lockwashers (31), and capscrew (30). Do not tighten.
111. Place drivebelt (29) on pulley (28).
112. Install washer (19) and adjusting bracket (18) to stud (15) on engine front cover (14) with washer (20), lockwasher (21), and nut (22). Install adjusting bracket (18) and harness clamp (34) on compressor (33) with two washers (17), capscrew (16), washers (25), lockwashers (26), and nuts (27).
113. Connect two harness leads (35) to two compressor leads (36).
114. Install clamp (24) on adjusting bracket (18) with screw (23).
115. Adjust belt (29) tension using belt tension gauge and tighten two capscrews (30).
116. Install hose (41) on surge tank (39) with clamp (40).
117. Connect vent line (38) to air cleaner fitting (37).
118. Connect vent line (42) to fitting (43) on air cleaner (44).



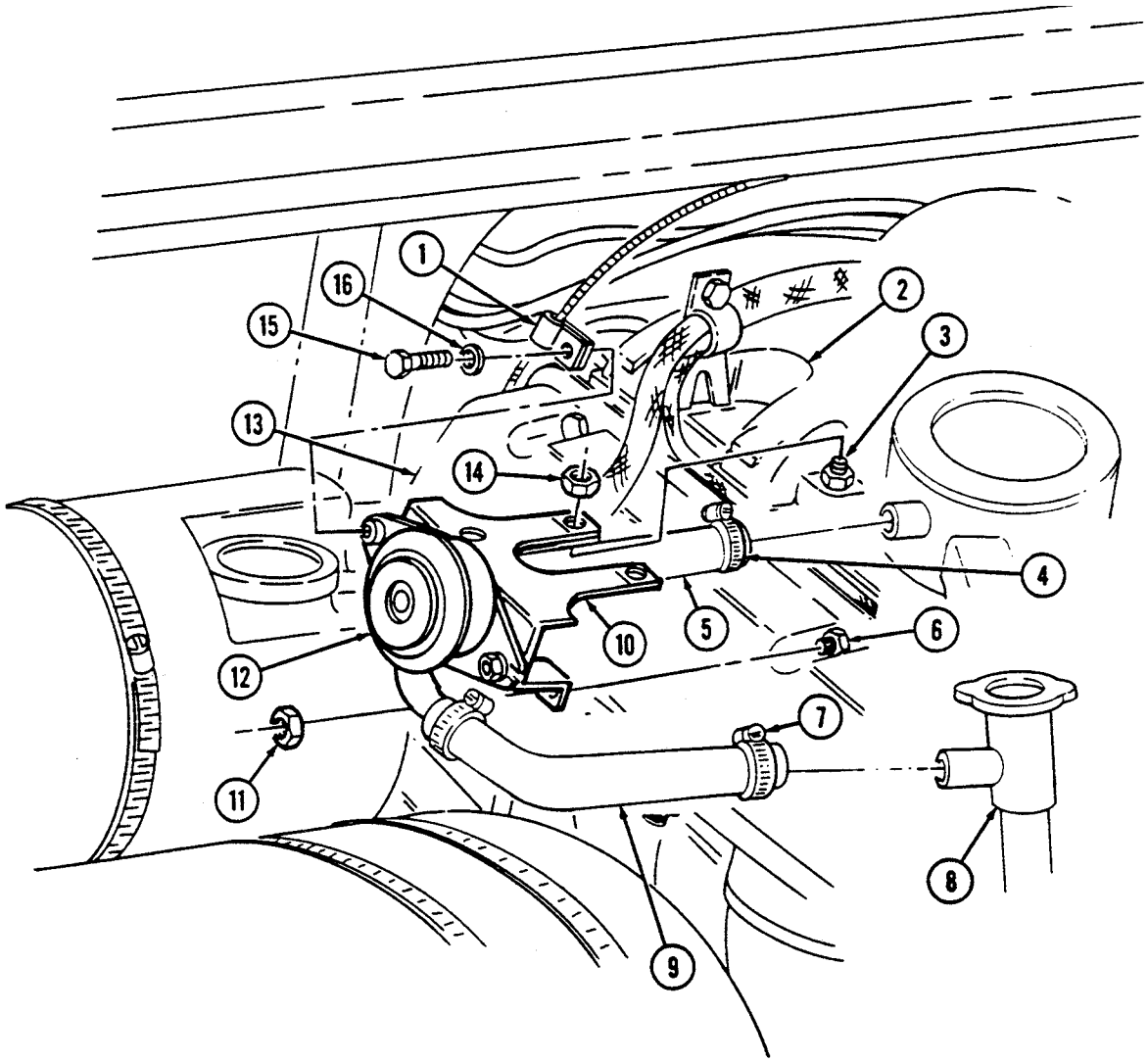
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

119. Position CDR valve (12) and bracket (10) over two intake manifold studs (3) and valve cover studs (6).
120. Secure bracket (10) on intake manifold (2) with two nuts (14). Tighten nuts (14) to 15 lb-ft (20 N•m).
121. Secure bracket (10) on valve cover (13) with two nuts (11). Tighten nuts (11) to 10 lb-ft (14 N•m).
122. Install heater control cable clamp (1) to CDR valve (12) and bracket (10) with washer (16) and screw (15). Tighten screw (15) to 15 lb-ft (20 N•m).
123. Connect CDR valve oil fill tube hose (9) to oil fill tube (8) with clamp (7).
124. Connect CDR valve intake manifold hose (5) to intake manifold (2) with clamp (4).



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

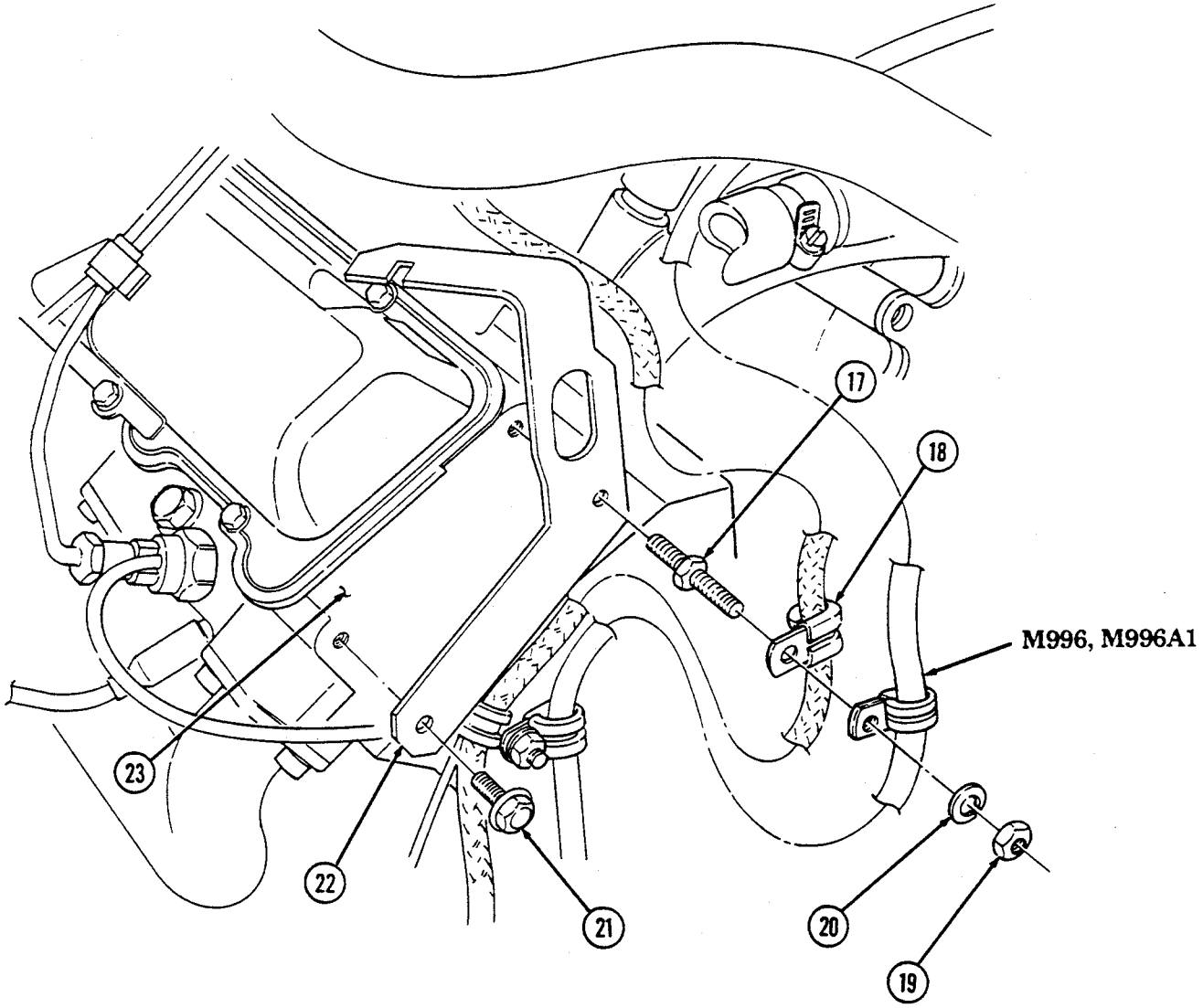
**NOTE**

- Steps 125 through 127 apply to all models except M997 and M997A1 vehicles.
- M996 and M996A1 vehicles have an additional clamp installed on stud.

125. Install air horn support bracket (22) on engine block (23) with stud (17).

126. Install lower end of air horn support bracket (22) on engine block (23) with capscrew (21). Tighten capscrew (21) and stud (17) to 40 lb-ft (54 N·m).

127. Install clamp (18) on stud (17) with lockwasher (20) and nut (19).



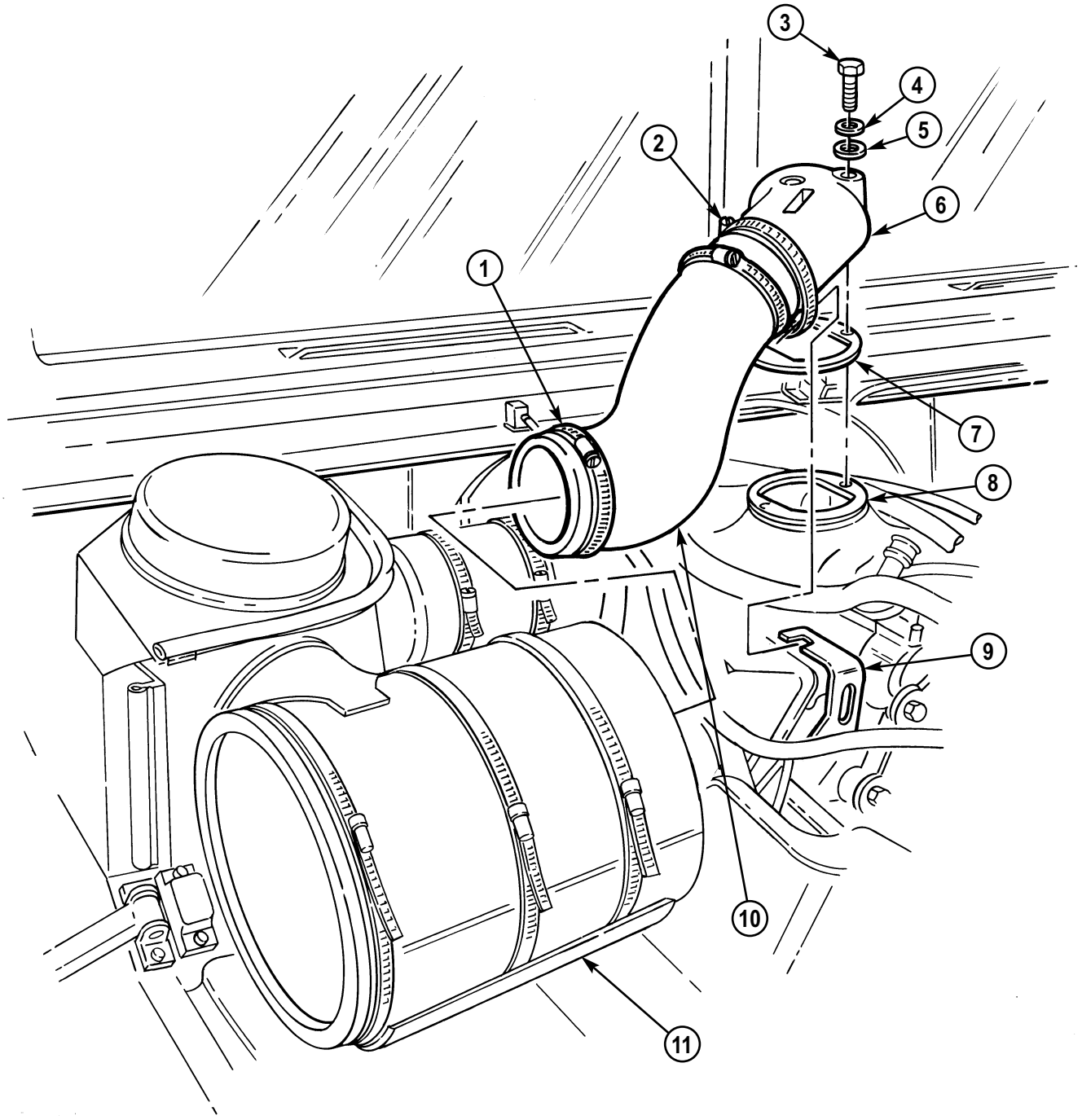
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

128. Install gasket (7) on intake manifold (8).

129. Coat threads of two screws (3) with sealing compound. Install air horn (6) and air intake elbow (10) on intake manifold (8) and install with two flat washers (5), washers (4), and screws (3). Tighten screws (3) to 40-45 lb-in. (54-61 N·m).

130. Install air intake elbow (10) on air cleaner (11) and tighten with clamp (1).

131. Slide clamp (2) to air horn support bracket (9) and install air horn (6) on air horn support bracket (9) with clamp (2).



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

**NOTE**

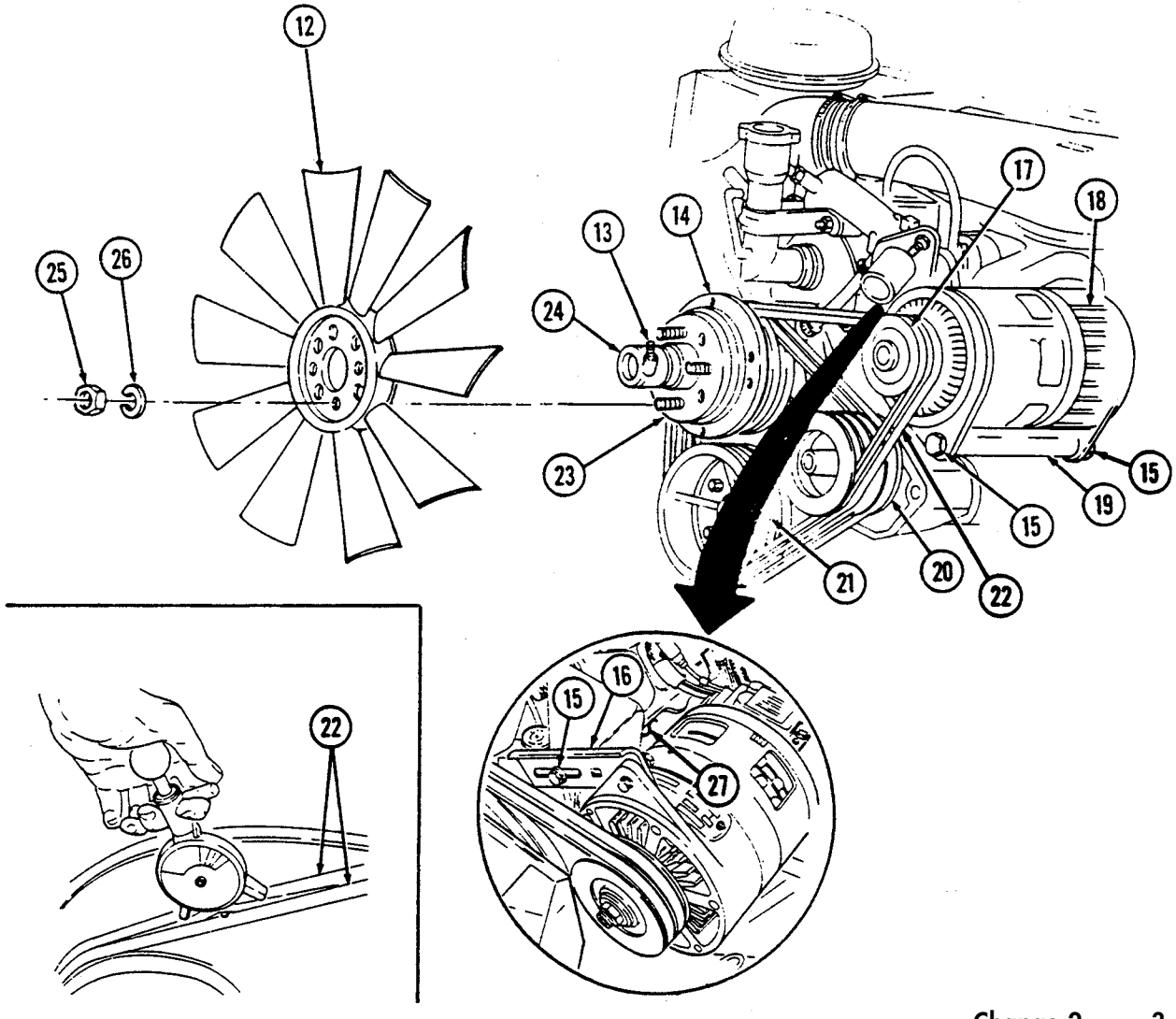
Perform steps 132 through 136 for all models except M996, M996A1, M997, and M997A1 vehicles.

132. Feed belt set (22) into grooves on crankshaft pulley (21), water pump pulley (14), alternator pulley (17), and power steering pump pulley (20).
133. Loosen three capscrews (15) from alternator (18) and alternator bracket (19).
134. Adjust alternator belt set (22) by inserting 1/2-inch drive ratchet and extension in square hole (27) of alternator bracket (16). Turn until belt set (22) appears tight, and tighten three capscrews (15) on alternator bracket (16).
135. Using belt tension gauge, check each belt of belt set (22) individually for proper tension.

**NOTE**

- New belt tension should read 105 ± 5 lbs (476 ± 22 N).
- Used belt tension should read 90 ± 5 lbs (400 ± 22 N).

136. If belt set (22) tension is correct, tighten three capscrews (15) on alternator (18) to 40 lb-ft (54 N·m). If not, repeat steps 133 through 135. If tension cannot be properly adjusted, replace belt set (22).
137. Position fitting (13) on clutch adapter (24) at 6 o'clock.
138. Align fan blade (12) onto fan drive (23) and install with four lockwashers (26) and nuts (25). Tighten nuts (25) to 45 lb-ft (61 N·m).



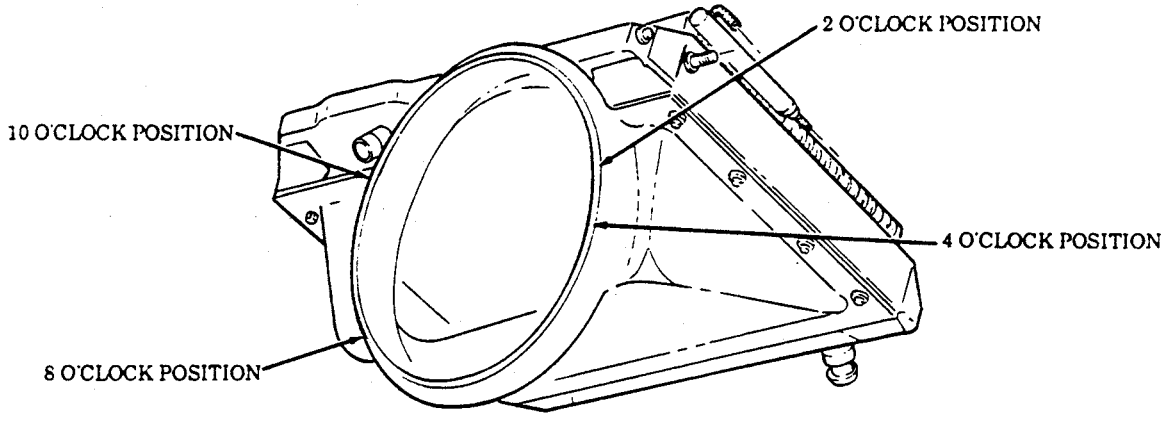
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

139. Align radiator assembly (3) on frame bracket (21), and rear support brackets (24) to airlift brackets (7).
140. Install rear support brackets (24) on airlift brackets (7) with four capscrews (12), washers (11), and locknuts (10). Do not tighten locknuts (10).
141. Install radiator assembly (3) and mount (20) on frame bracket (21) with large washer (22), washer (19), capscrew (23), washer (19), and locknut (18). Do not tighten capscrew (23).
142. Connect two transmission oil cooler line connector hoses (25) to transmission oil cooler ports (27) and tighten hose clamps (26) to 10-20 lb-in. (1-2 N•m).
143. Connect engine oil cooler supply and return lines (29) to engine oil cooler ports (28).

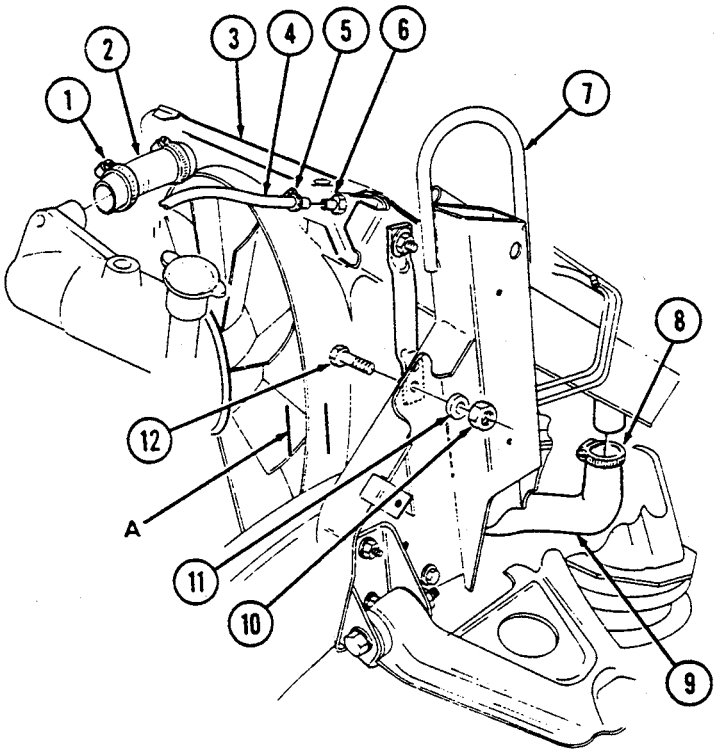
**NOTE**

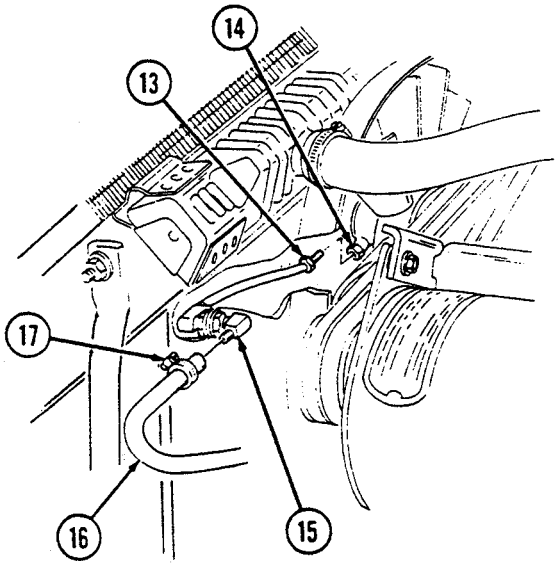
- Fan shroud should be aligned so the following dimensions are maintained. Adjustments may be made by tilting the radiator/shroud assembly. Distance "A" from the edge of shroud ring and rear edge of fan must be 1.5 ± .125 in. (38.1 ± 3 mm). Measure distance "A" at the 2, 4, 8, and 10 o'clock positions.
- Fan blade to fan shroud clearance, the distance between the top of the fan blade and fan shroud, must not be less than .25 in. (6 mm) at any position.

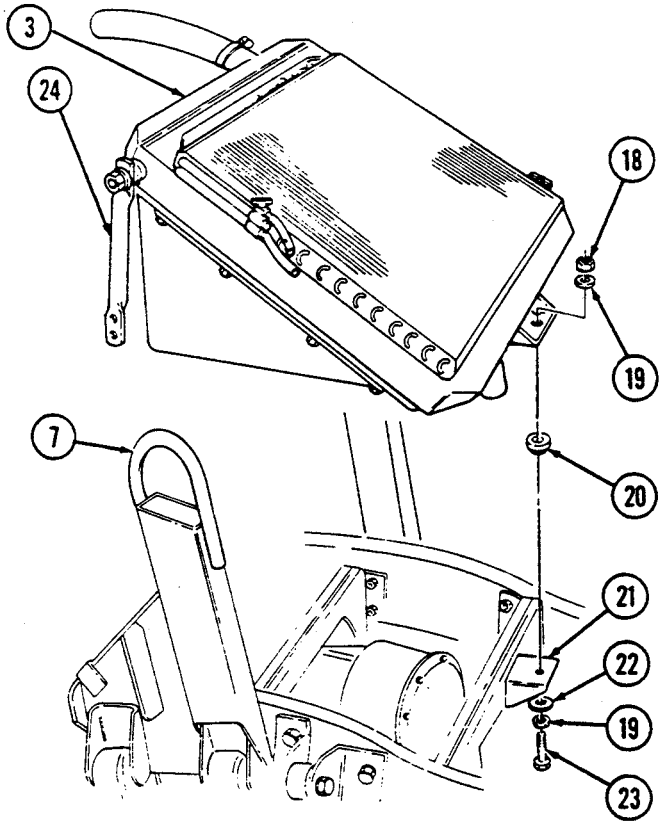
144. Tighten locknuts (10) to 26 lb-ft (35 N·m). Tighten capscrew (23) to 30 lb-ft (41 N·m).
145. Connect lower radiator front hose (9) to radiator (3) and tighten clamp (8).
146. Connect fan drive hose (13) to fan drive (14).
147. Connect control valve hose (16) to bulkhead adapter (15) and tighten clamp (17).
148. Connect radiator inlet hose (2) to engine and tighten clamp (1).
149. Connect surge tank-to-radiator vent hose (4) to adapter (6) and tighten clamp (5).

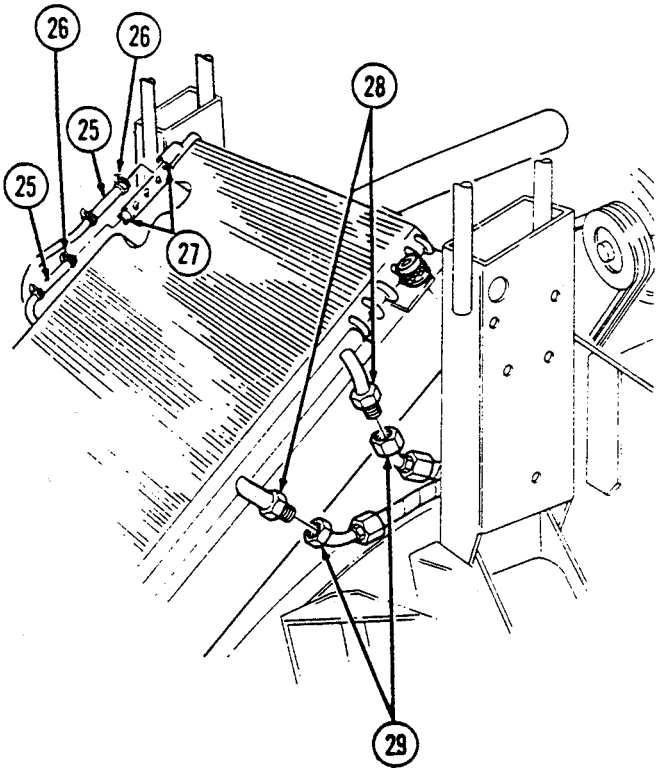


## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



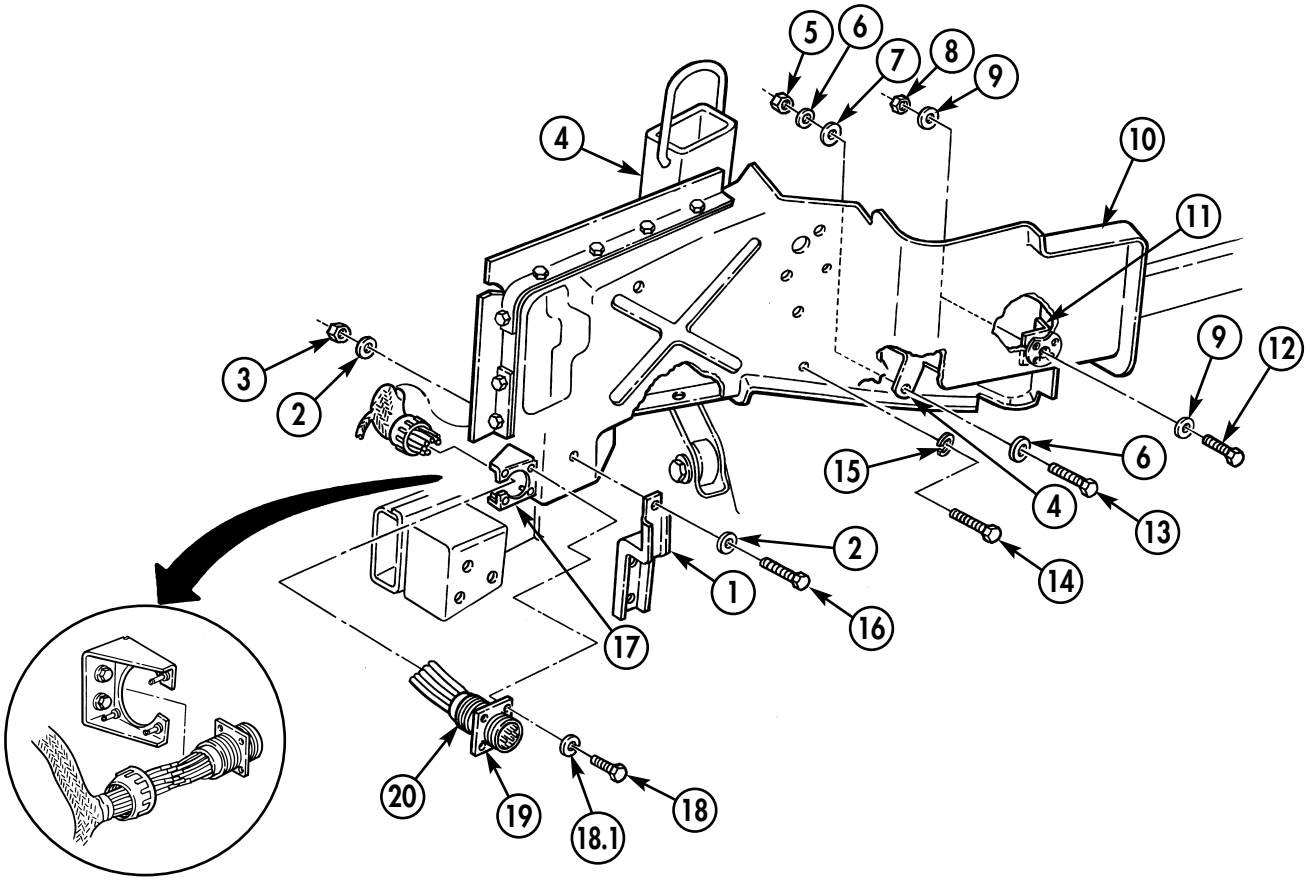



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

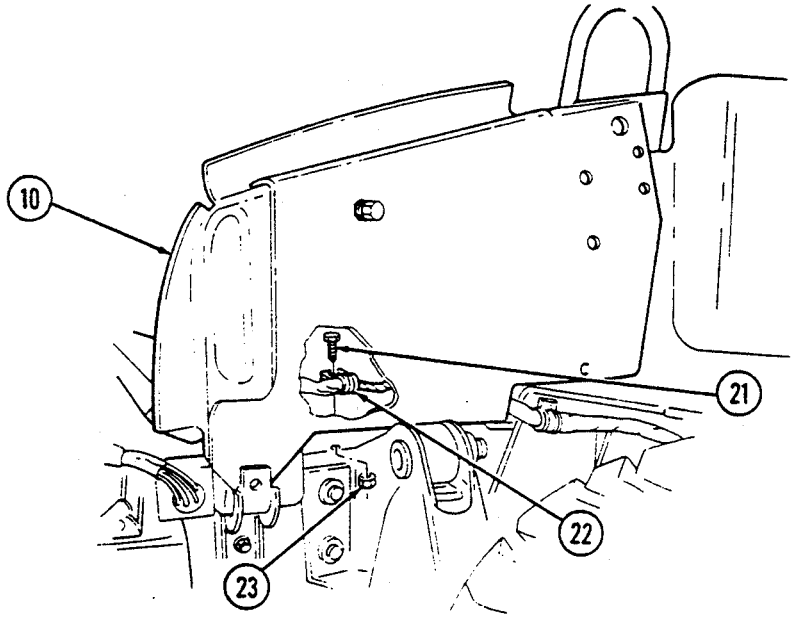
**NOTE**

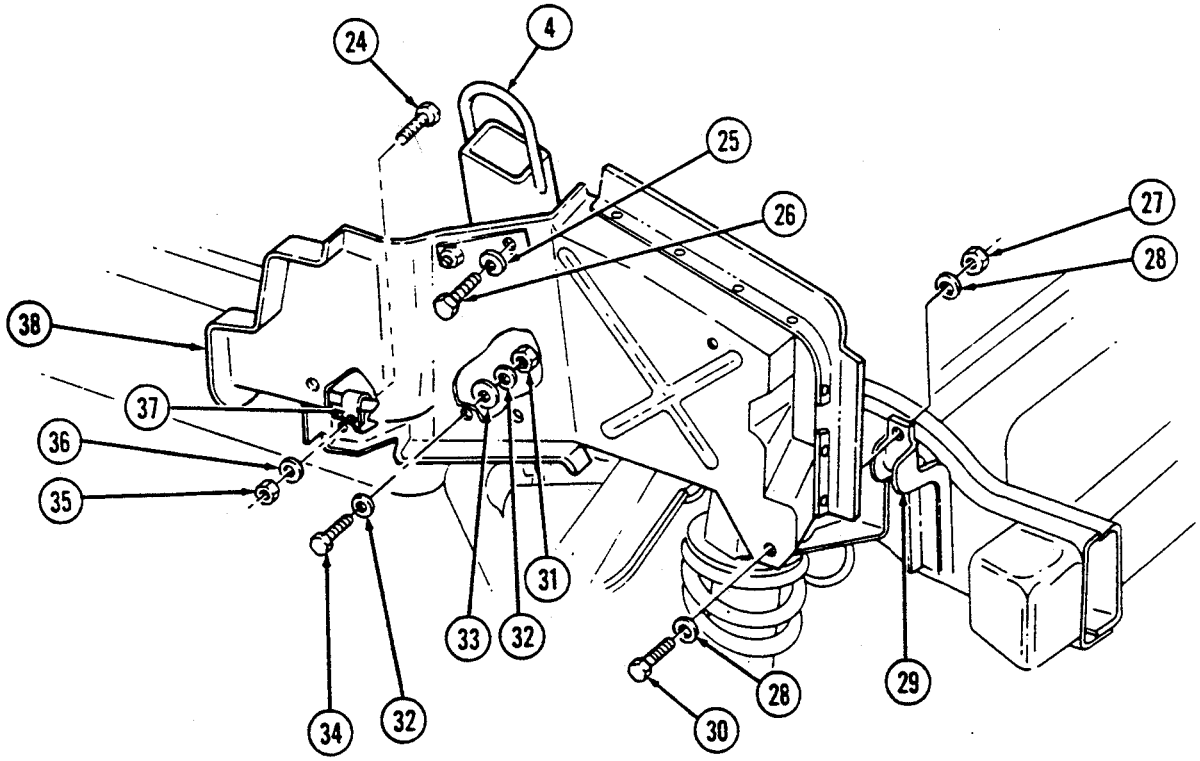
Early production vehicles used studs to secure splash shields to airlift brackets.

150. Install left splash shield (10) on bracket (11) with washer (9), capscrew (12), washer (9), and locknut (8).
151. Install harness and clamp (22) on splash shield (10) with screw (21) and assembled locknut (23).
152. Install connector receptacle (19) on bracket (17) with four screws (18) and lockwashers (18.1). Tighten receptacle cover (20).
153. Install left splash shield (10) on airlift bracket (4) with washer (15) and capscrew (14). Tighten capscrew (14) to 15 lb-ft (20 N·m).
154. Install left splash shield (10) on airlift bracket (4) with washer (6), capscrew (13), washer (7), washer (6), and locknut (5). Tighten capscrew (13) to 95-145 lb-in. (11-16 N·m).
155. Install left splash shield (10) on support bracket (1) with washer (2), capscrew (16), washer (2), and locknut (3). Tighten capscrew (16) to 6 lb-ft (8 N·m).
156. Install right splash shield (38) on airlift bracket (4) with lockwasher (25) and screw (26).
157. Install right splash shield (38) on airlift bracket (4) with washer (32), capscrew (34), washer (33), washer (32), and locknut (31). Tighten capscrew (34) to 15 lb-ft (20 N·m).
158. Install right splash shield (38) on support bracket (29) with washer (28), capscrew (30), washer (28), and locknut (27). Tighten capscrew (30) to 15 lb-ft (20 N·m).
159. Install fuel line clamp (37) on splash shield (38) with washer (36), capscrew (24), and locknut (35). Tighten capscrew (24) to 15 lb-ft (20 N·m).



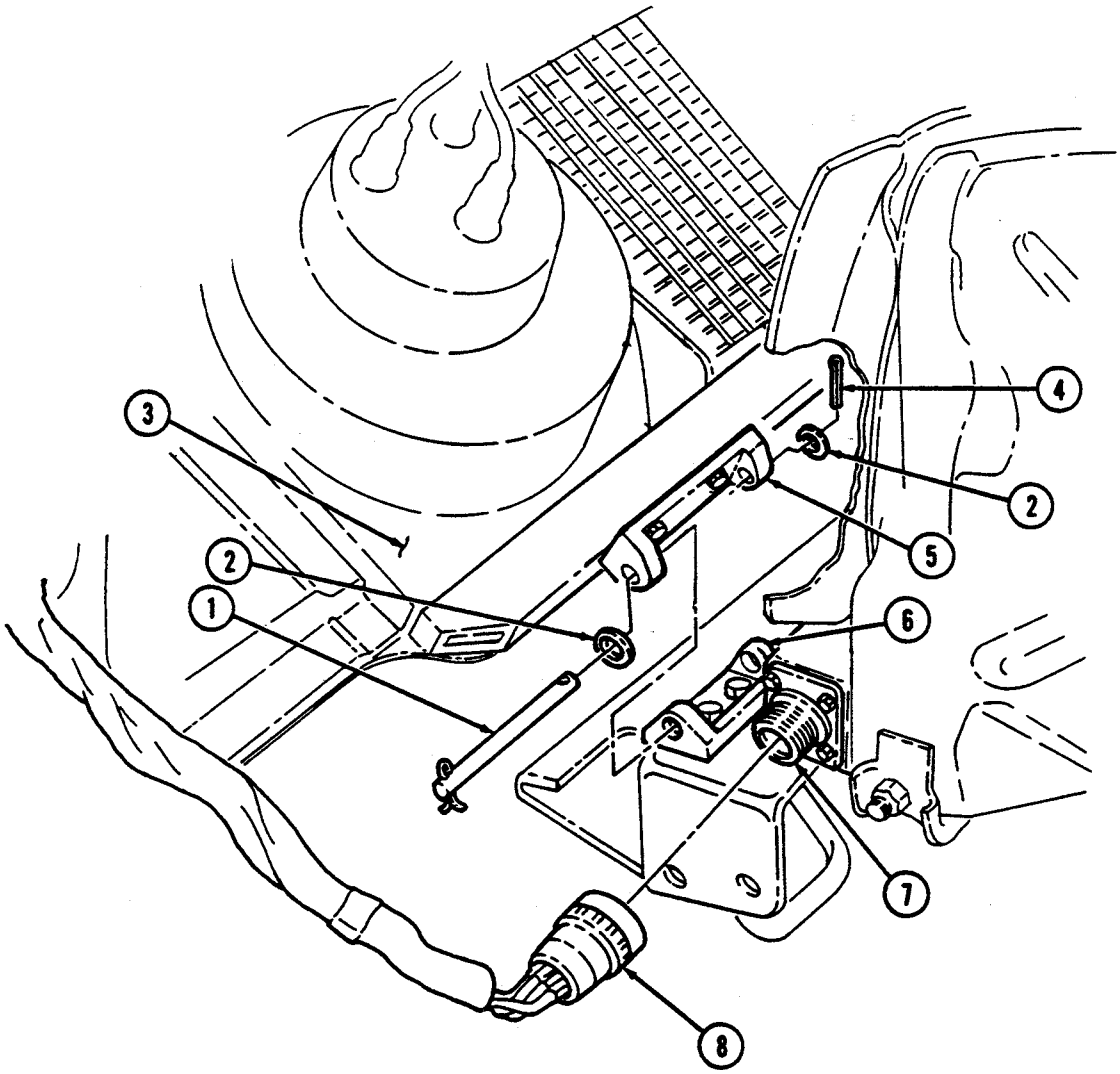
## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)



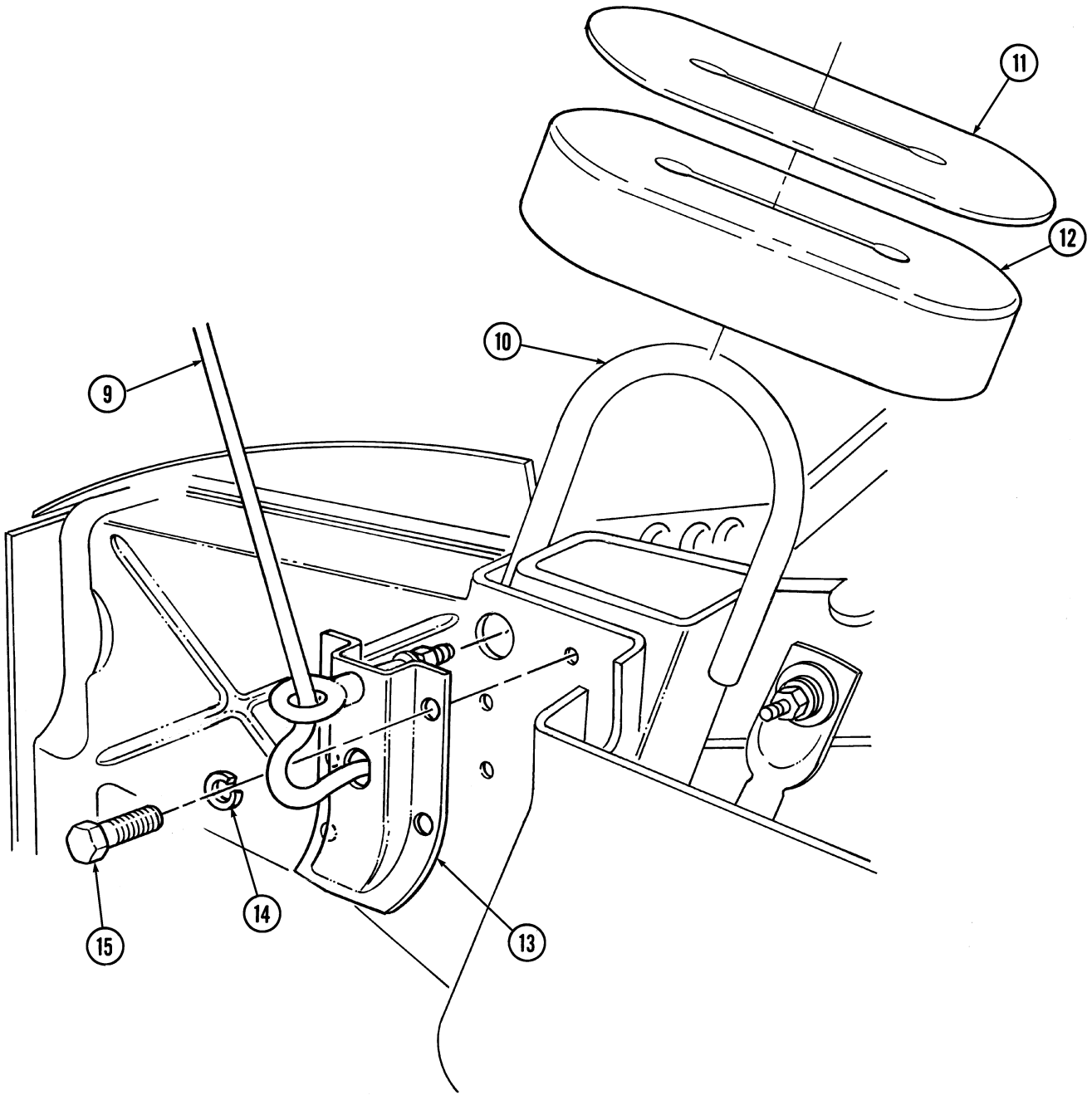



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)

160. Install hood (3) and align two upper hinge halves (5) with lower hinge halves (6).
161. Install two upper hinge halves (5) on lower hinge halves (6) with washers (2), hinge pins (1), washers (2), and cotter pins (4).
162. Install hood prop rod (9) and bracket (13) on airlift bracket (10) with four lockwashers (14) and screws (15). Tighten screws (15) to 6 lb-ft (8 N•m).
163. Connect plug (8) to receptacle (7).
164. Install two seals (12) and cover plates (11) on airlift brackets (10).



## 3-23. ENGINE INSTALLATION (6.2 L AND 6.5 L [DETUNED]) (Cont'd)




FOLLOW-ON TASKS:
- Fill engine oil, transmission oil, and power steering fluid to proper levels (TM 9-2320-280-10).
- Connect battery ground cable (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).
- Perform engine run-in (para. 3-20).

## 3-24. ENGINE REMOVAL (6.5 L)

**This task covers:**

**Removal**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)
Breaker bar, 3/8 in. (Appendix G, Item 2)

**Special Tools**
Engine lifting sling (Appendix G, Item 22)
Hex head driver, 8 mm (Appendix G, Item 115)

**Materials/Parts**
Engine/transmission support sling (Appendix C, Figs 24 through 40) (Optional)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Battery ground cables disconnected (TM 9-2320-280-20).
- Hood raised and secured (TM 9-2320-280-10).
- Engine access cover removed (TM 9-2320-280-20).

**General Safety Instructions**
- Hood must be supported during removal.
- Do not remove surge tank filler cap before releasing internal pressure.
- Do not drain oil when engine is hot.
- Alternator must be supported during removal.
- Do not touch hot exhaust system components with bare hands.
- Do not use diesel fuel near fires, flames, or sparks.
- Transmission must be supported during engine removal.
- Direct personnel to stand clear during hoisting operation.
- Do not use hands to free engine of hangups or snags.

**Maintenance Level**
Direct support

**NOTE**

This procedure is for 6.5L engine only. Refer to para. 3-22 for 6.2L engine and detuned 6.5L engine removal.

**Removal**

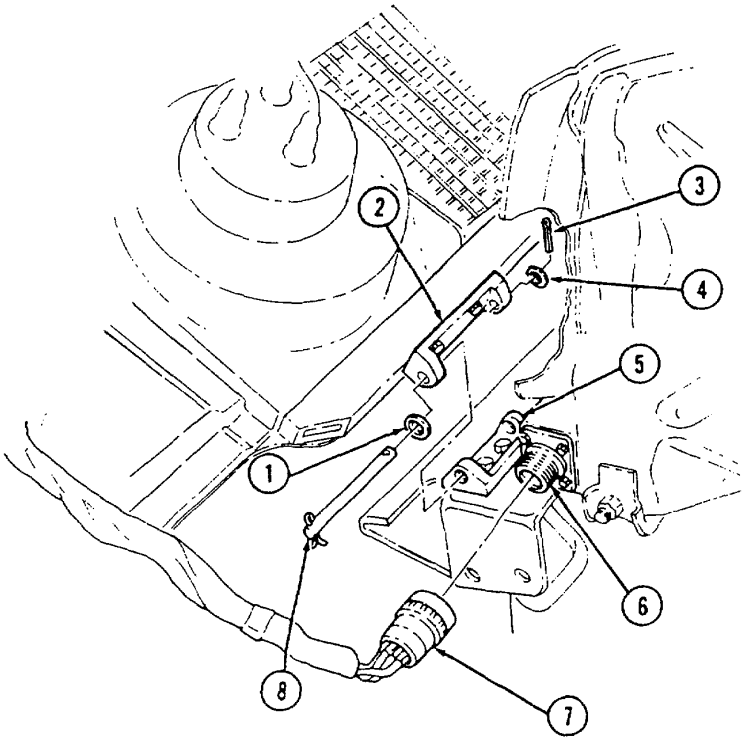
1. Disconnect connector plug (7) from receptacle (6).

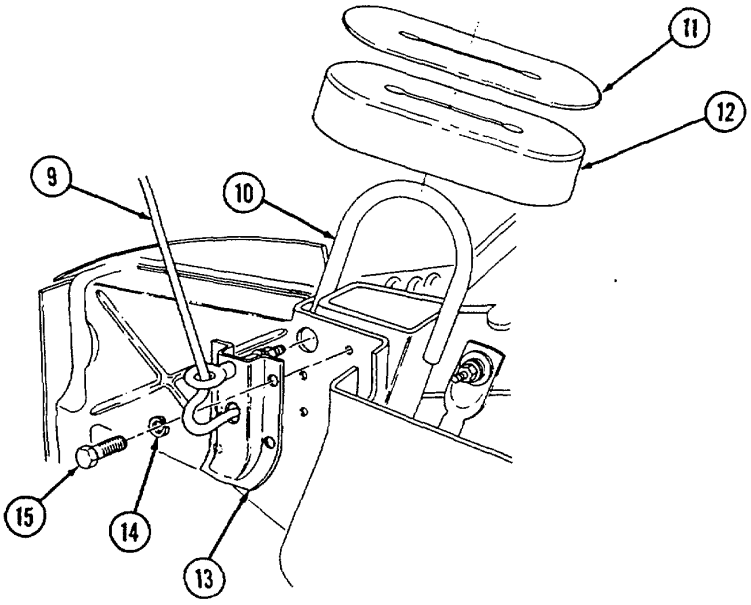
**WARNING**

Hood must be supported during removal. Failure to support hood may cause injury to personnel and damage to equipment.

2. Remove four screws (15), lockwashers (14) and bracket (13) from airlift bracket (10). Discard lockwashers (14).
3. Lower hood and remove two cotter pins (3), washers (4), hinge pins (8), washers (1), and two upper hinge halves (2) from lower hinge halves (5). Discard cotter pins (3).
4. Remove hood with prop rod (9) and bracket (13) attached.
5. Remove two cover plates (11) and seals (12) from airlift brackets (10).

**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**

**WARNING**

Do not remove surge tank filler cap before depressurizing system when engine temperature is above 190°F (88°C). Steam or hot coolant under pressure will cause severe burns.

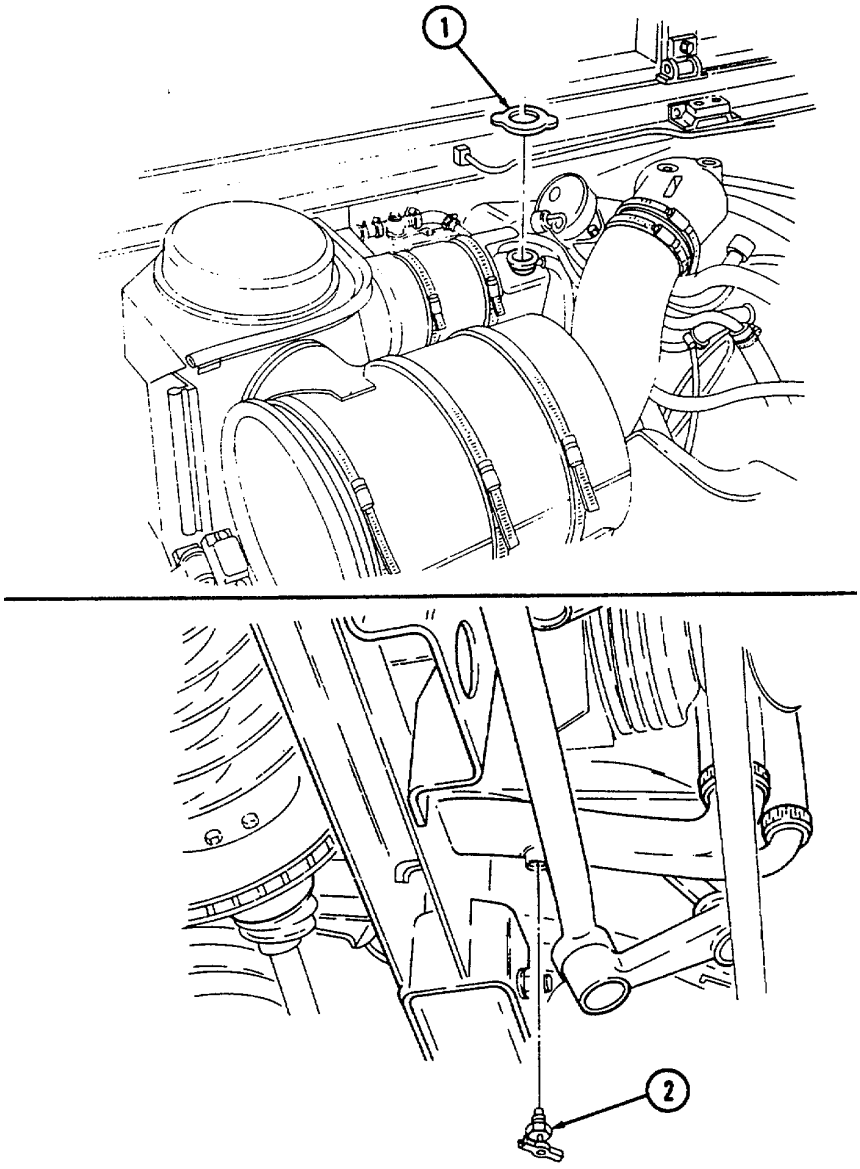
6. If engine is hot, remove surge tank filler cap (1) by placing a thick cloth over cap (1). Press down and turn counterclockwise to its first stop to release internal pressure.

7. After pressure has escaped, press down and turn cap (1) counterclockwise again and remove.

**NOTE**

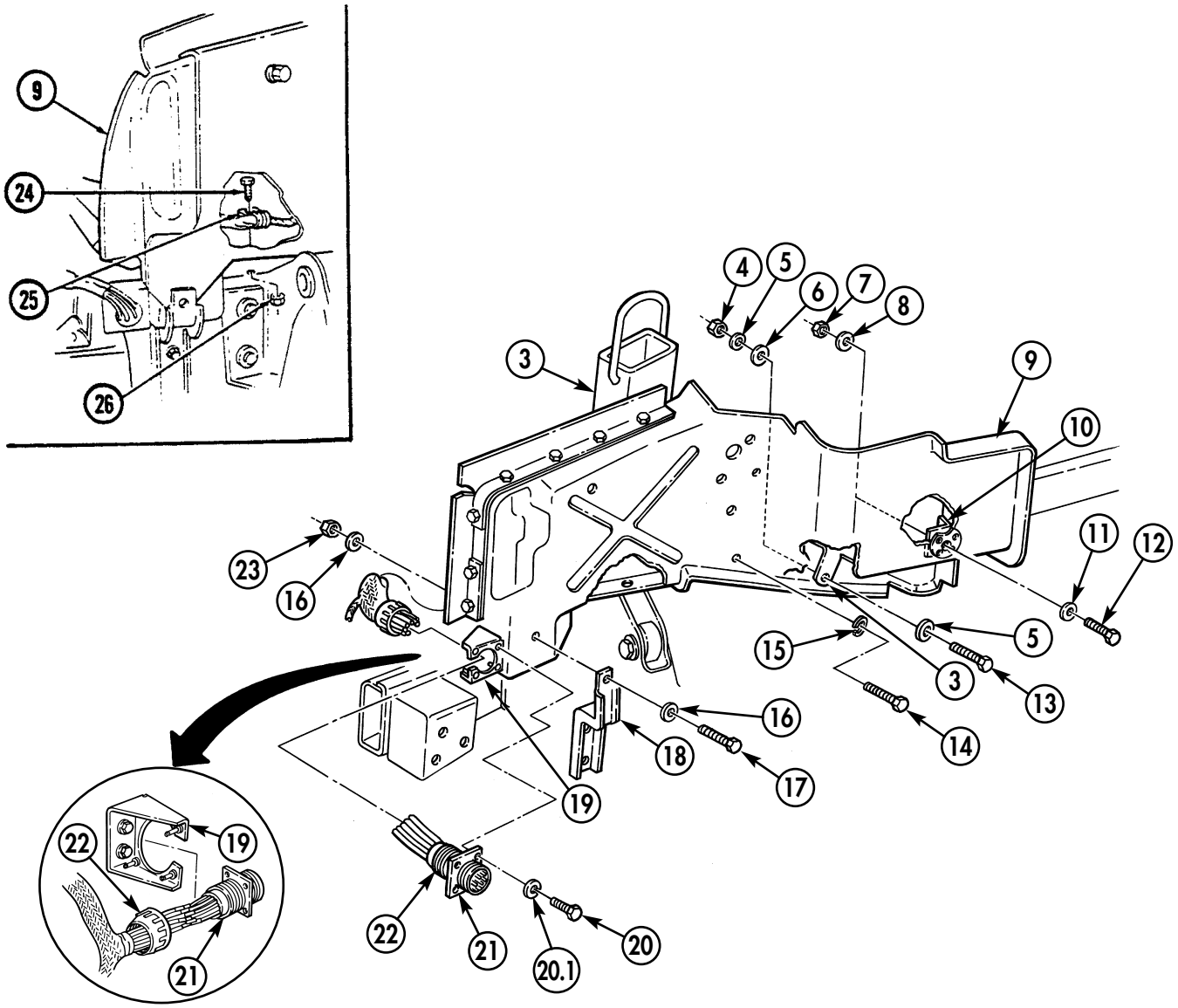
Have drainage container ready to catch coolant.

8. Open and remove draincock (2) and allow system to drain.



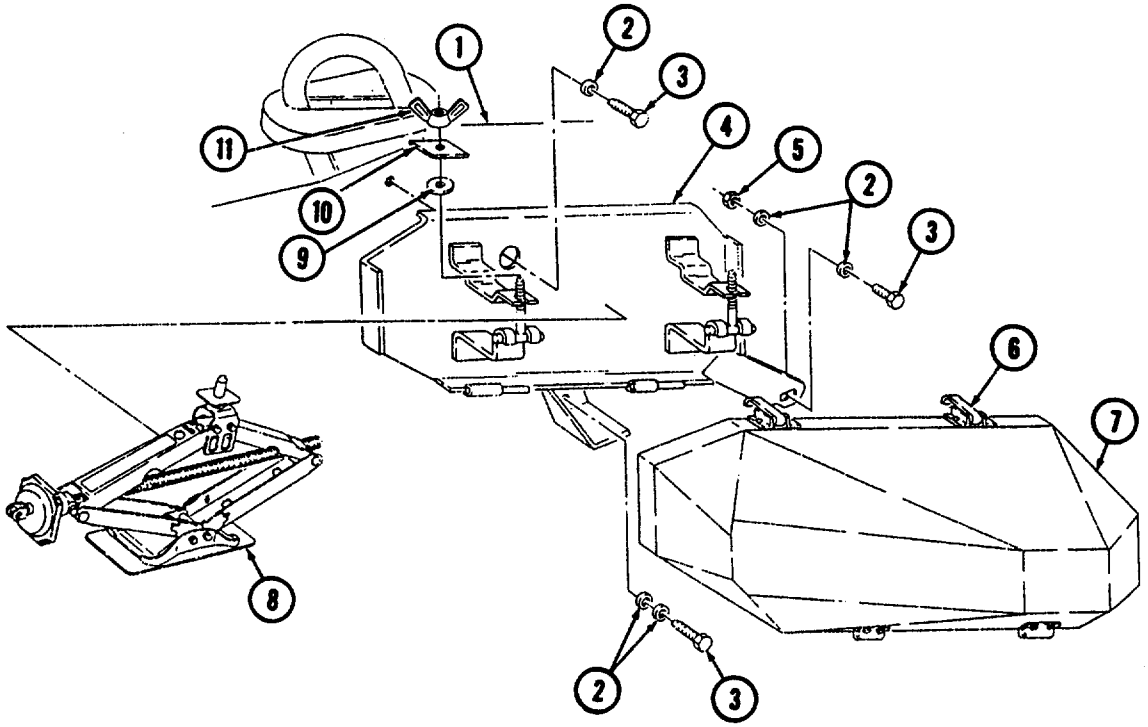
## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

9. Remove four screws (20) and lockwashers (20.1) connecting connector receptacle (21) to bracket (19).
10. Loosen rear receptacle cover (22) and slide wires of receptacle (21) out through slot in bracket (19).
11. Remove assembled locknut (26), screw (24), and harness and clamp (25) from left splash shield (9). Discard assembled locknut (26).
12. Remove locknut (23), washer (16), capscrew (17), washer (16), and left splash shield (9) from support bracket (18). Discard locknut (23).
13. Remove locknut (4), washer (5), washer (6), capscrew (13), and washer (5) from left splash shield (9) and airlift bracket (3). Discard locknut (4).
14. Remove capscrew (14), washer (15), and left splash shield (9) from airlift bracket (3).
15. Remove locknut (7), washer (8), capscrew (12), washer (11), and left splash shield (9) from bracket (10). Discard locknut (7).

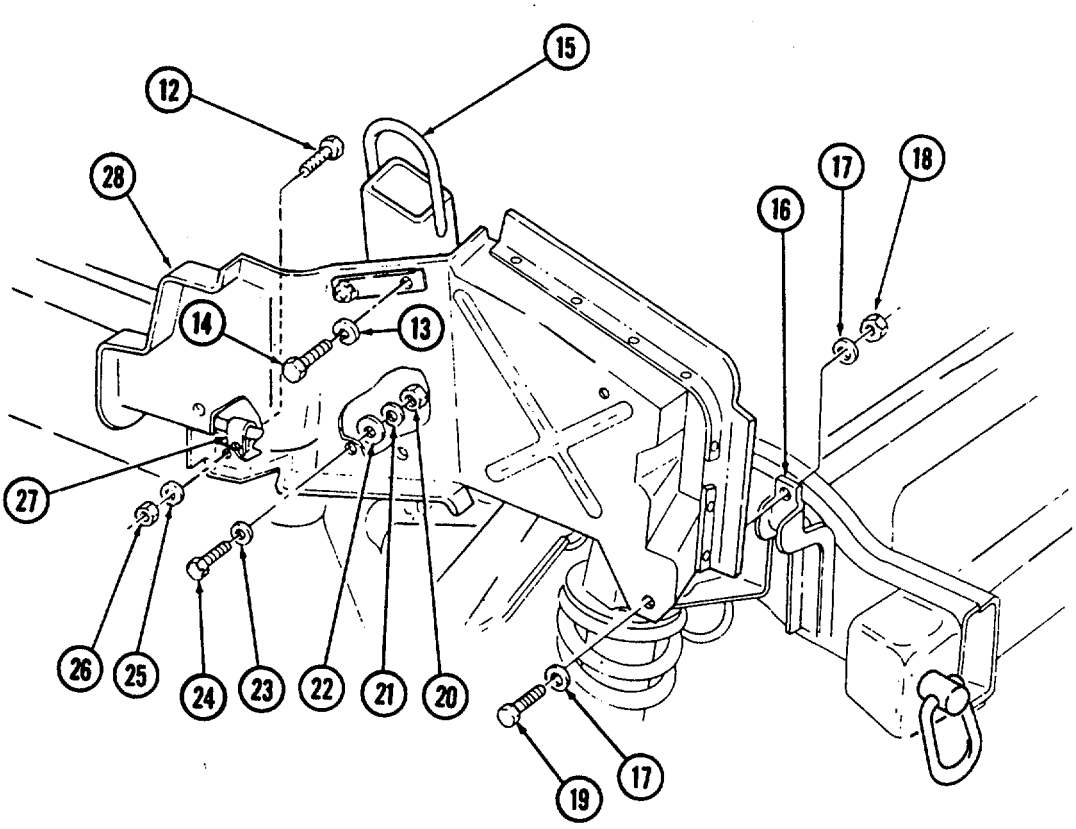


## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

16. Lift two latches (6) and remove cover (7) from bracket (4).
17. Remove two wing nuts (11), spacers (10), washers (9), and jack (8) from bracket (4).
18. Remove nut (5), washer (2), three capscrews (3), four washers (2), and bracket (4) front splash shield (1).
19. Remove locknut (18), washer (17), capscrew (19), washer (17), and right splash shield (28) from support bracket (16). Discard locknut (18).
20. Remove locknut (20), washer (21), washer (22), capscrew (24), and washer (23) from right splash shield (28) and airlift bracket (15). Discard locknut (20).
21. Remove locknut (26), washer (25), capscrew (12) and fuel line clamp (27) from right splash shield (28). Discard locknut (13).
22. Remove screw (14), lockwasher (13), and right splash shield (28) from airlift bracket (15). Discard lockwasher (13).



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**

23. Loosen clamp (1) and disconnect radiator inlet hose (2) from engine.
24. Loosen clamp (5) and disconnect surge tank-to-radiator vent hose (4) from adapter (6).
25. Loosen clamp (15) and disconnect control valve hose (14) from bulkhead adapter (16).
26. Disconnect fan drive hose quick disconnect (17) from fan drive (18).
27. Loosen clamp (9) and disconnect lower radiator front hose (10) from radiator (3).
28. Remove locknut (28), washer (29), capscrew (34), washer (33), large washer (32), and lower mount (30), from frame bracket (31). Discard locknut (28).
29. Remove four locknuts (11), washers (12), capscrews (13) and two brackets (8) from airlift bracket (7). Discard locknuts (11).

**WARNING**

Do not drain engine oil when engine is hot. Severe injury to personnel will result.

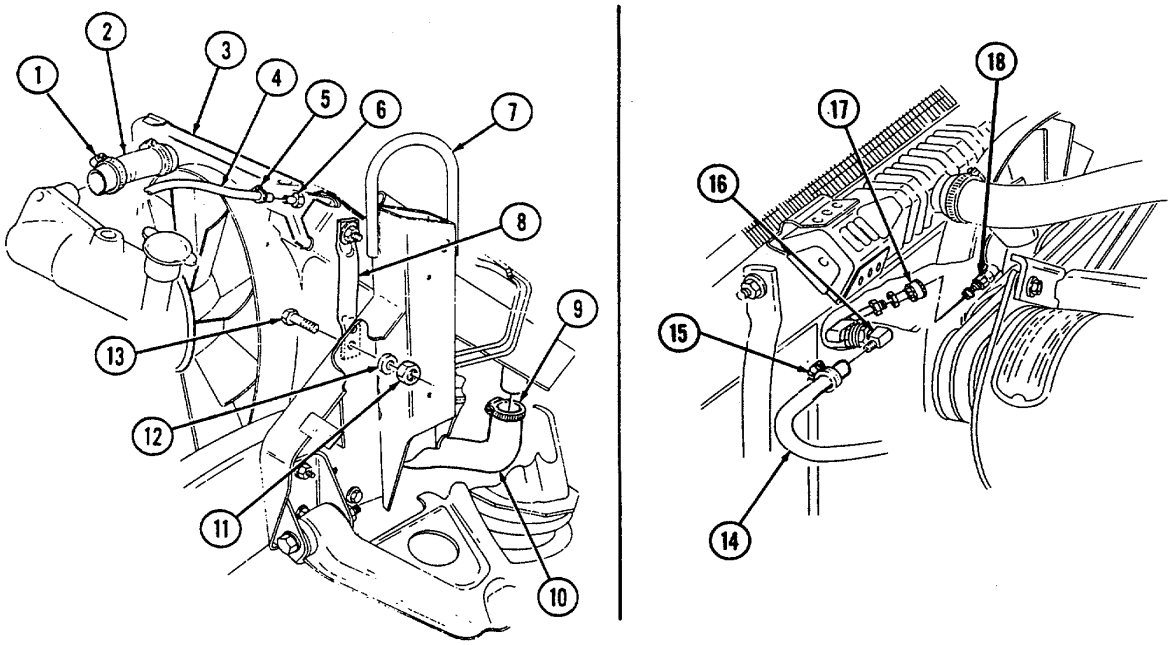
**CAUTION**

Cover or plug all hoses and connections immediately after disconnection to prevent contamination.

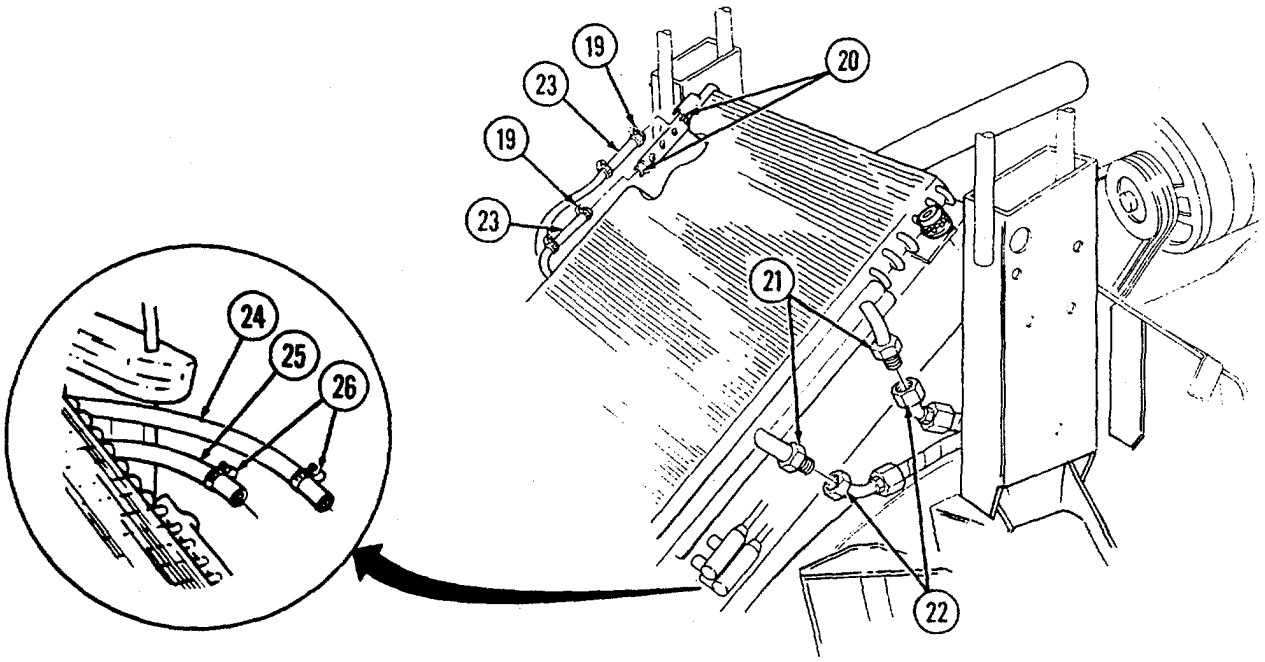
**NOTE**

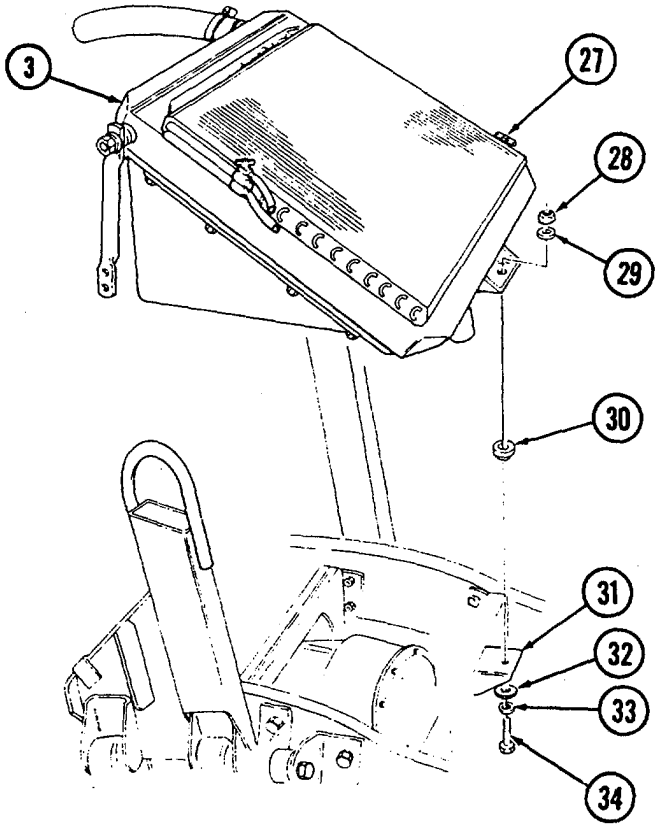
Have drainage container ready to catch oil.

30. Disconnect engine oil cooler supply and return lines (22) from engine oil cooler ports (21).
31. Loosen two clamps (26) and disconnect power steering hoses (24) and (25) from radiator (3).
32. Loosen hose clamps (19) and disconnect transmission oil cooler line connector hoses (23) from transmission oil cooler ports (20).
33. Lift up radiator (3) and fan shroud and oil cooler assembly (27) and remove from vehicle.



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**



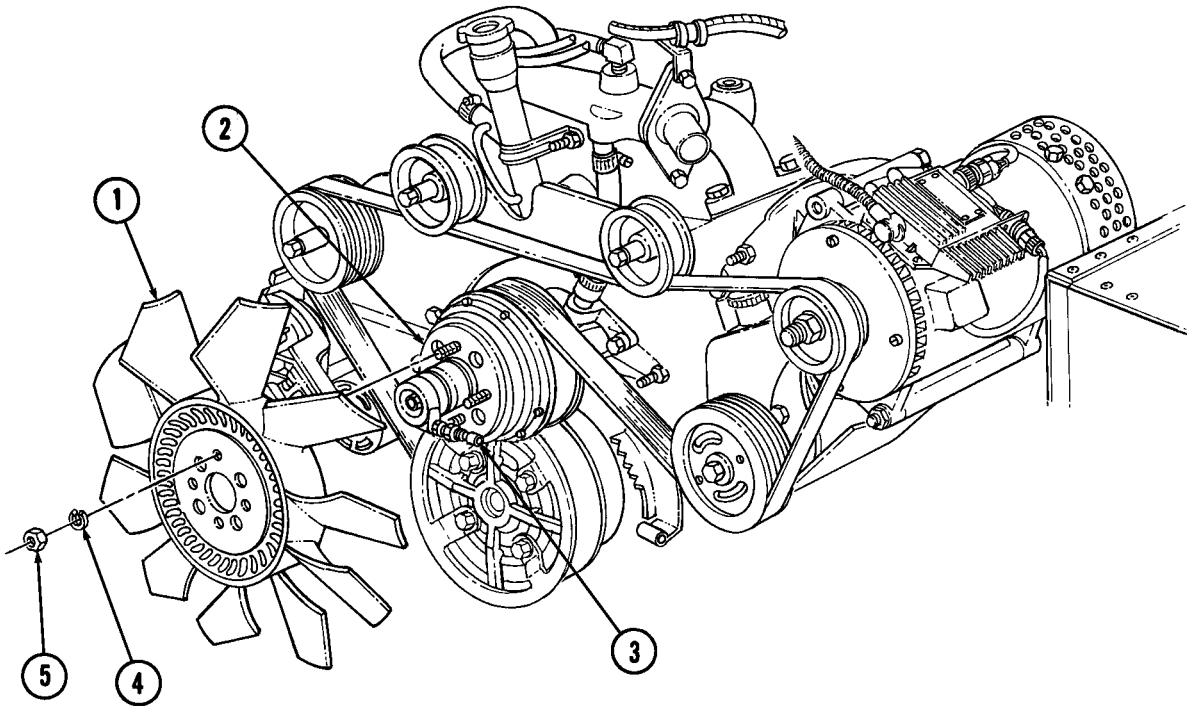
## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

34. Position clutch adapter fitting (3) at the 6 o'clock position.

**NOTE**

- Mark front of fan blade for installation.
- Ensure the clutch adapter fitting is at the 6 o'clock position when removing fan blade.

35. Remove four nuts (5), lockwashers (4), and fan blade (1) from fan drive (2). Discard lockwashers (4).



## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

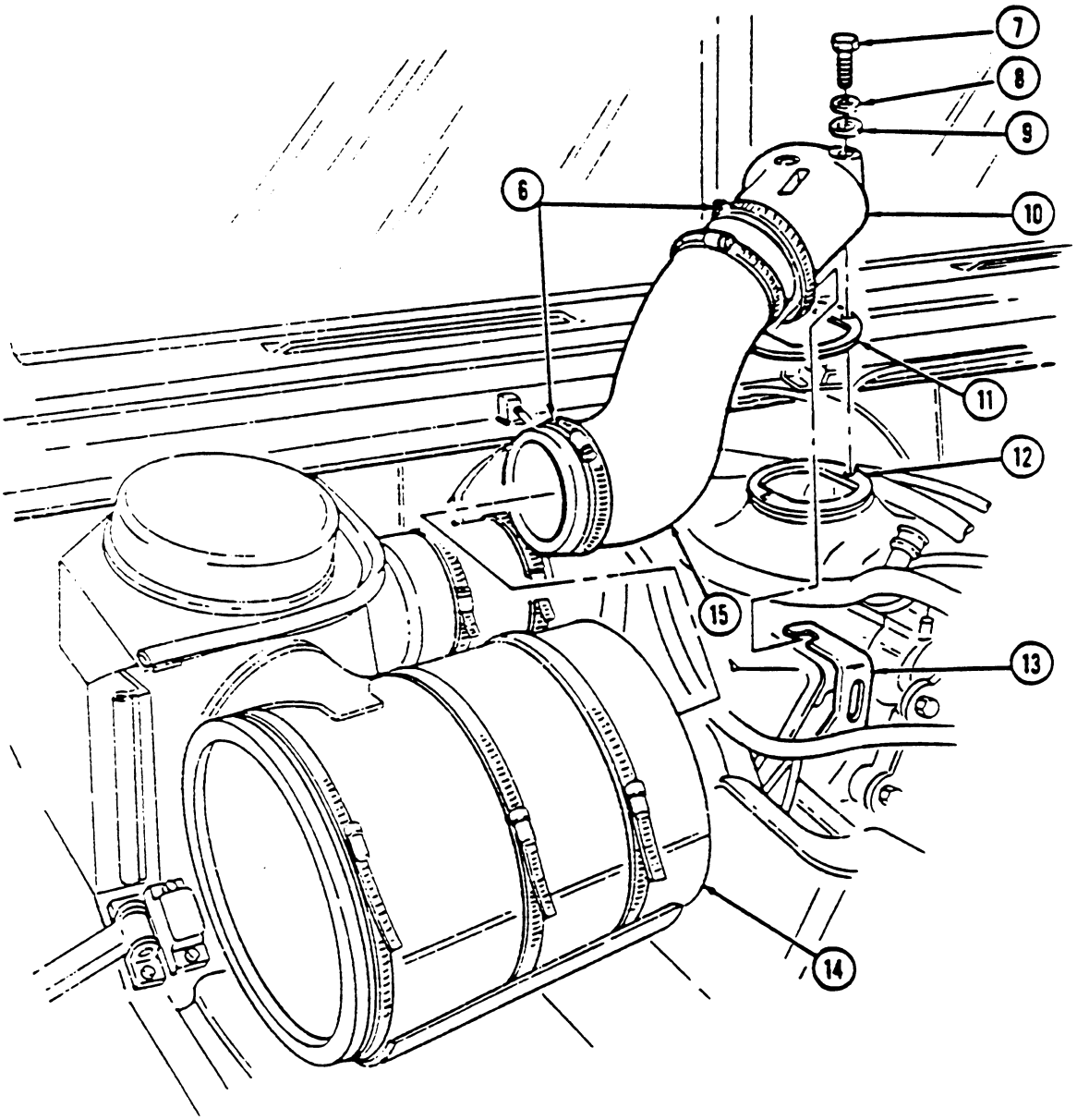
36. Remove two screws (7), washers (8), and flat washers (9) from air horn (10) and intake manifold (12).

**CAUTION**

Cover opening of intake manifold to prevent foreign material from entering engine.

37. Loosen two clamps (6) and remove air horn (10) and air intake elbow (15) from air horn support bracket (13), intake manifold (12), and air cleaner (14).

38. Remove gasket (11) from intake manifold (12). Discard gasket (11).



## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

**NOTE**

Perform steps 39 through 52 for M997A2 vehicles only.

39. Remove screw (10) and clamp (11) from adjusting bracket (5).

**NOTE**

Prior to removal, tag leads for installation.

40. Disconnect two compressor leads (23) from two harness leads (24).
41. Remove nut (9), lockwasher (8), and washer (7) from adjusting bracket (5) and stud (2) on engine front cover (1). Discard lockwasher (8).
42. Remove two nuts (14), lockwashers (13), washers (12), capscrews (3), washers (4), and clamp (21) from adjusting bracket (5) and compressor (20). Discard lockwashers (13).
43. Remove adjusting bracket (5) and washer (6) from stud (2) on engine front cover (1).
44. Position 3/8-inch breaker bar on belt tensioner (45), move tensioner (45) clockwise, and remove drivebelt (16) from pulley (15). Release belt tensioner (45).
45. Loosen hose clamp (26) and disconnect hose (27) from surge tank (25).

**NOTE**

Place surge tank hose clear of compressor.

46. Disconnect vent line (31) from elbow (32) on air cleaner (30).
47. Disconnect vent line (28) from fitting (29) on air cleaner (30).
48. Remove two capscrews (17), lockwashers (18), and washers (19) from compressor (20) and support bracket (22). Discard lockwashers (18).

**CAUTION**

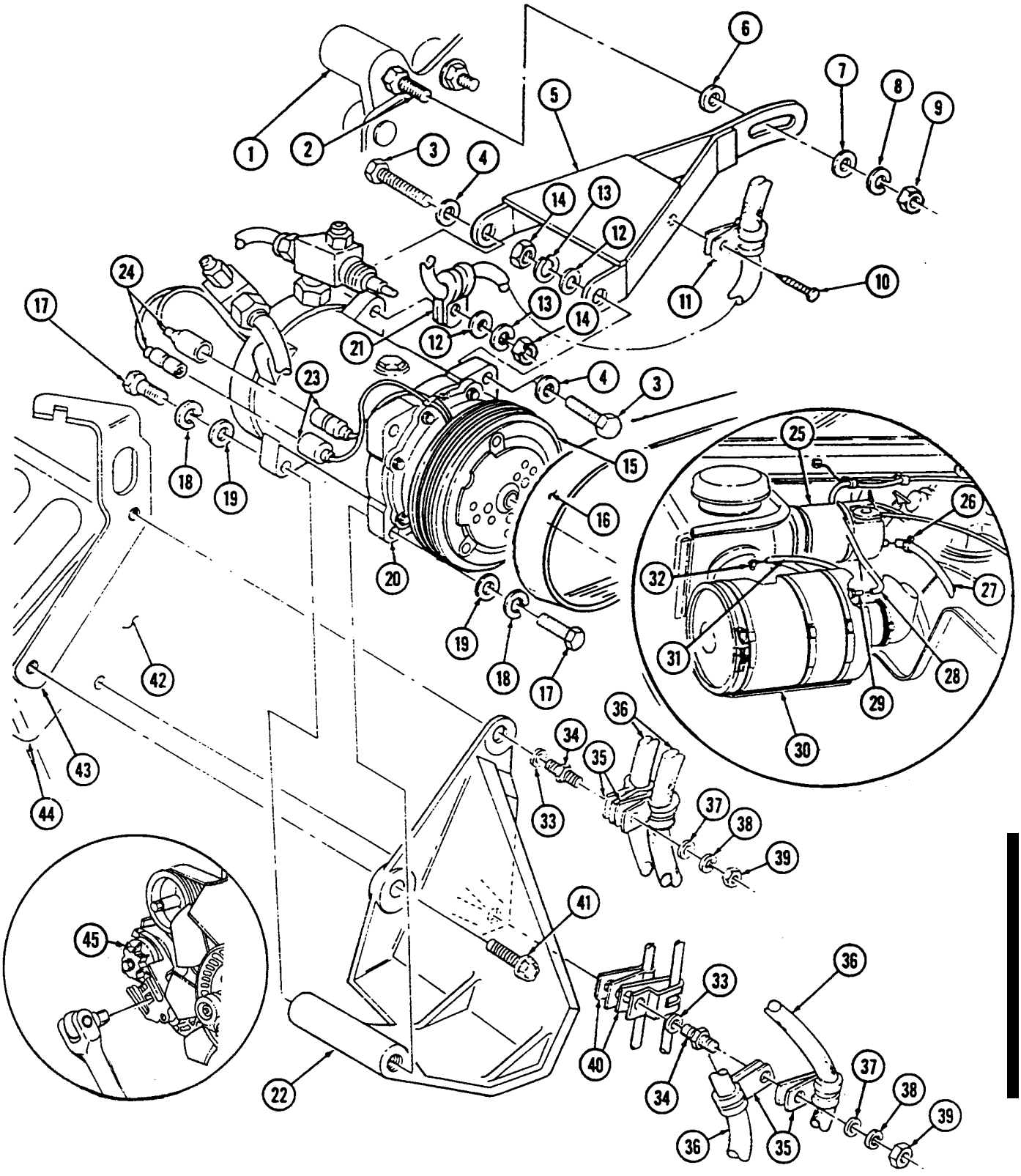
Be careful when removing compressor from support bracket, or damage to equipment may result.

**NOTE**

Place compressor and hoses on ground away from engine to prevent hang-ups during engine removal.

49. Remove compressor (20) from support bracket (22).
50. Remove capscrew (41) and brackets (22) and (43) from cylinder head (44).
51. Remove two nuts (39), lockwashers (38), washers (37), four clamps (35), and cables (36) from two studs (34). Discard lockwashers (38).
52. Remove two studs (34), washers (33), two fuel line clamps (40), and brackets (22) and (43) from cylinder head (44) and engine block (42).

## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)



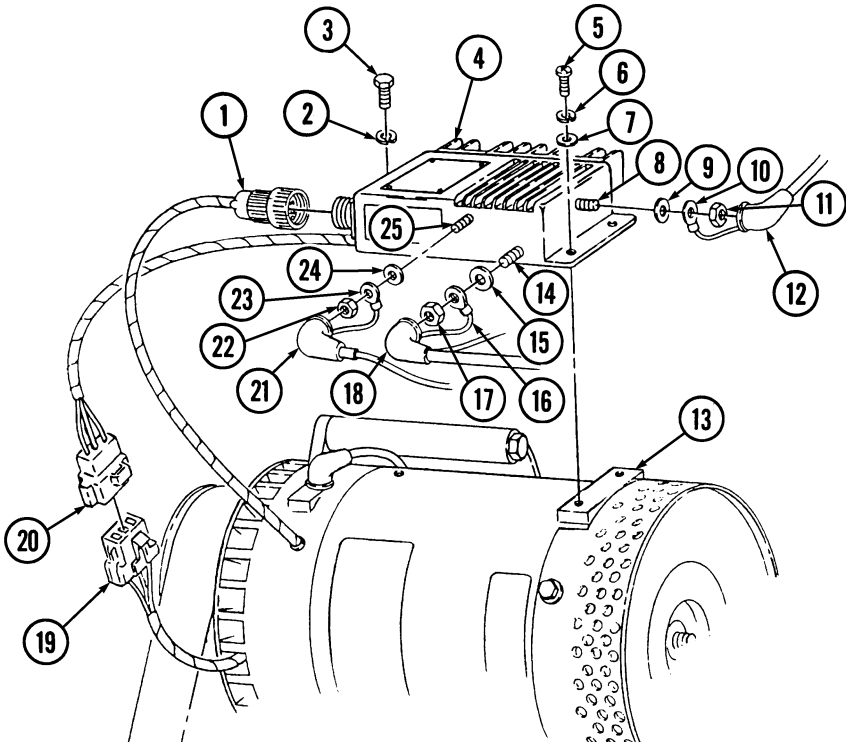
## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

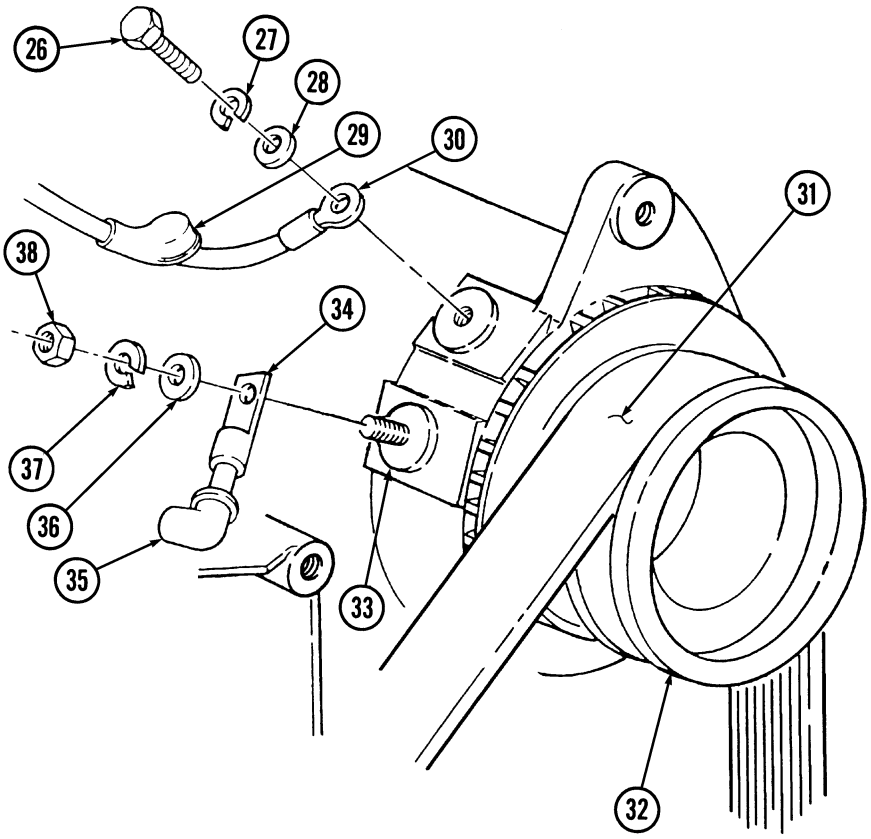
**NOTE**

- Perform steps 53 through 63 for vehicles equipped with Neihoff 100 amp alternator only.
- Prior to removal, tag leads for installation.

53. Disconnect regulator plug (1) from voltage regulator (4).
54. Slide back rubber boot (21) and remove nut (22), lead 5A (23), and washer (24) from red (energize) terminal (25).
55. Slide back rubber boot (18) and remove nut (17), lead 2A (16), and washer (15) from yellow (AC) terminal (14).
56. Slide back rubber boot (12) and remove nut (11), lead (10), and washer (9) from terminal (8).
57. Disconnect regulator connector (20) from alternator connector (19).
58. Remove two screws (5), lockwasher (6), washer (7), securing voltage regulator (4) to alternator (13). Discard lockwasher (6).
59. Remove capscrew (3), spring tension washer (2), and voltage regulator (4) from alternator (13). Discard spring tension washer (2).
60. Slide back rubber boot (29) and remove capscrew (26), lockwasher (27), washer (28), and ground cable (30) from alternator (13). Discard lockwasher (27).
61. Slide back rubber boot (35) and remove nut (38), lockwasher (37), washer (36), and alternator positive cable (34) from positive stud (33). Discard lockwasher (37).
62. Deleted.
63. Remove drivebelt (31) from alternator pulley (32).

## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)



## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

**NOTE**

- Perform steps 64 through 78 for vehicles equipped with Neihoff 200 amp alternator only.
- Prior to removal, tag leads for installation.

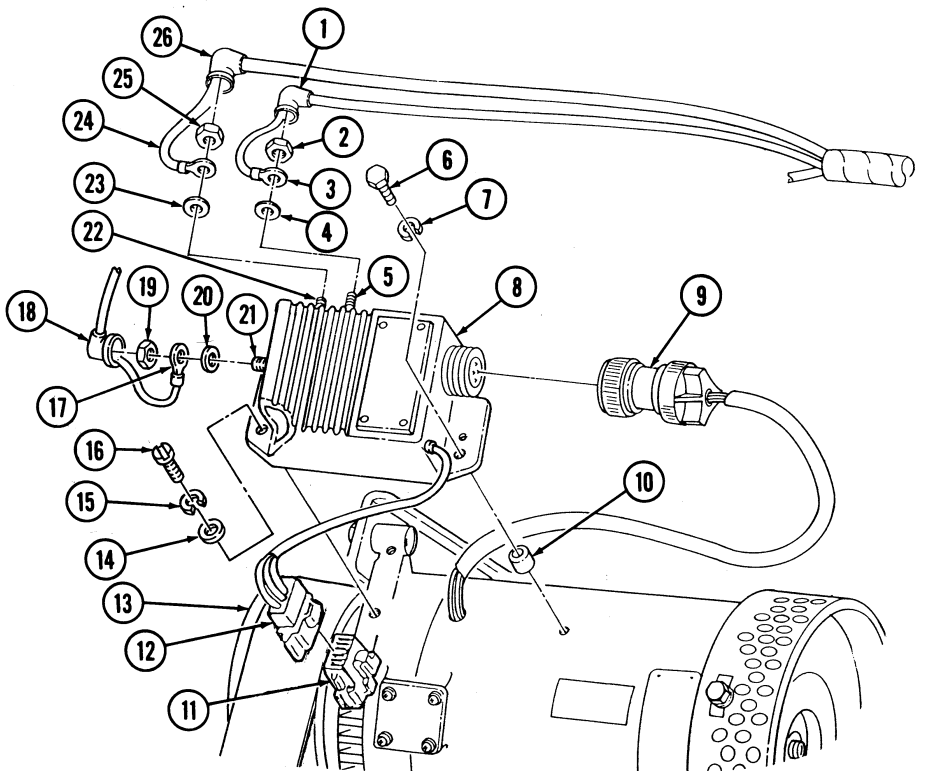
64. Disconnect regulator plug (9) from voltage regulator (8).
65. Slide back rubber boot (26) and remove nut (25), lead 5A (24), and washer (23) from red (energize) terminal (22).
66. Slide back rubber boot (1) and remove nut (2), lead 2A (3), and washer (4) from yellow (AC) terminal (5).
67. Slide back rubber boot (18) and remove nut (19), lead (17), and washer (20) from terminal (21).
68. Remove two screws (16), spring tension washers (15), and washers (14) connecting voltage regulator (8) to alternator (13). Discard spring tension washers (15).
69. Remove nut (41), lockwasher (40), washer (39), and lead 3B (38) from negative stud (36). Discard lockwasher (40).
70. Disconnect lead (12) from connector (11).
71. Slide back rubber boot (42) and remove nut (27), lockwasher (28), washer (29), fuse link (30), insulator washer (43), alternator positive cable (31), and washer (32) from positive stud (33). Discard lockwasher (28).
72. Remove drivebelt (34) from alternator pulley (35).
73. Loosen thru-bolt (46) securing alternator (13) to alternator mounting bracket (37) and support bracket (48).
74. Remove capscrew (6), lockwasher (7), spacer (10), and voltage regulator (8) from alternator (13). Discard lockwasher (7).
75. Deleted
76. Deleted

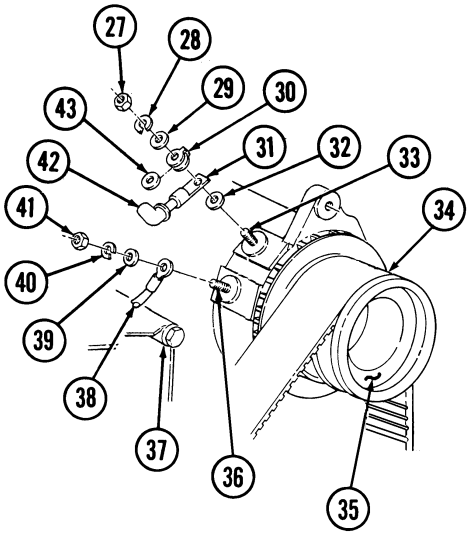
**WARNING**

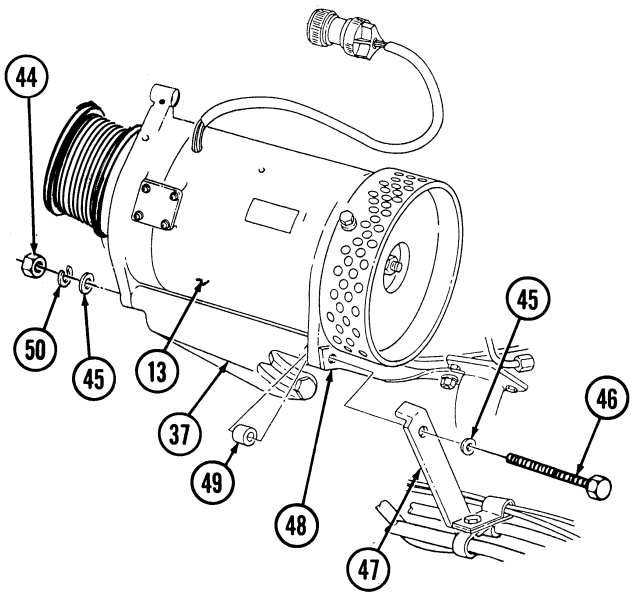
Alternator must be supported during removal and installation. Failure to support alternator may cause injury to personnel or damage to equipment.

77. Remove nut (44), lockwasher (50), washer (45), thru-bolt (46), washer (45), and spacer (49) from alternator (13), power steering lines bracket (47), support bracket (48), and mounting bracket (37). Discard lockwasher (50).
78. Remove alternator (13) from mounting bracket (37).

## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)



## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

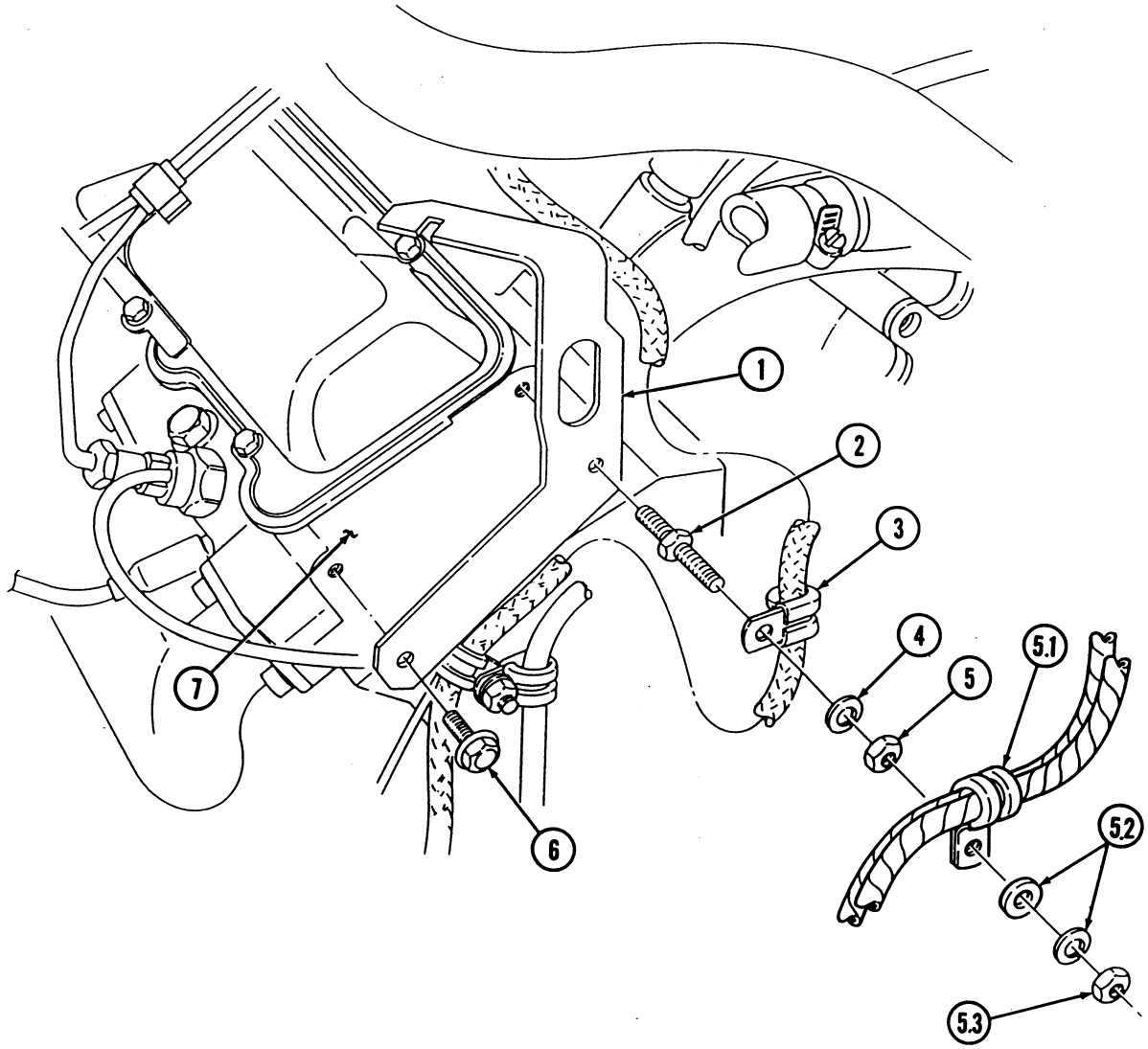
**NOTE**

Steps 78.1 through 80 apply to all models except M997A2 vehicles.

78.1. Remove nut (5.3), two washers (5.2), and clamp (5.1) from stud (2).

79. Remove nut (5), washer (4), and clamp (3) from stud (2).

80. Remove capscrew (6), stud (2), and support bracket (1) from cylinder head (7).

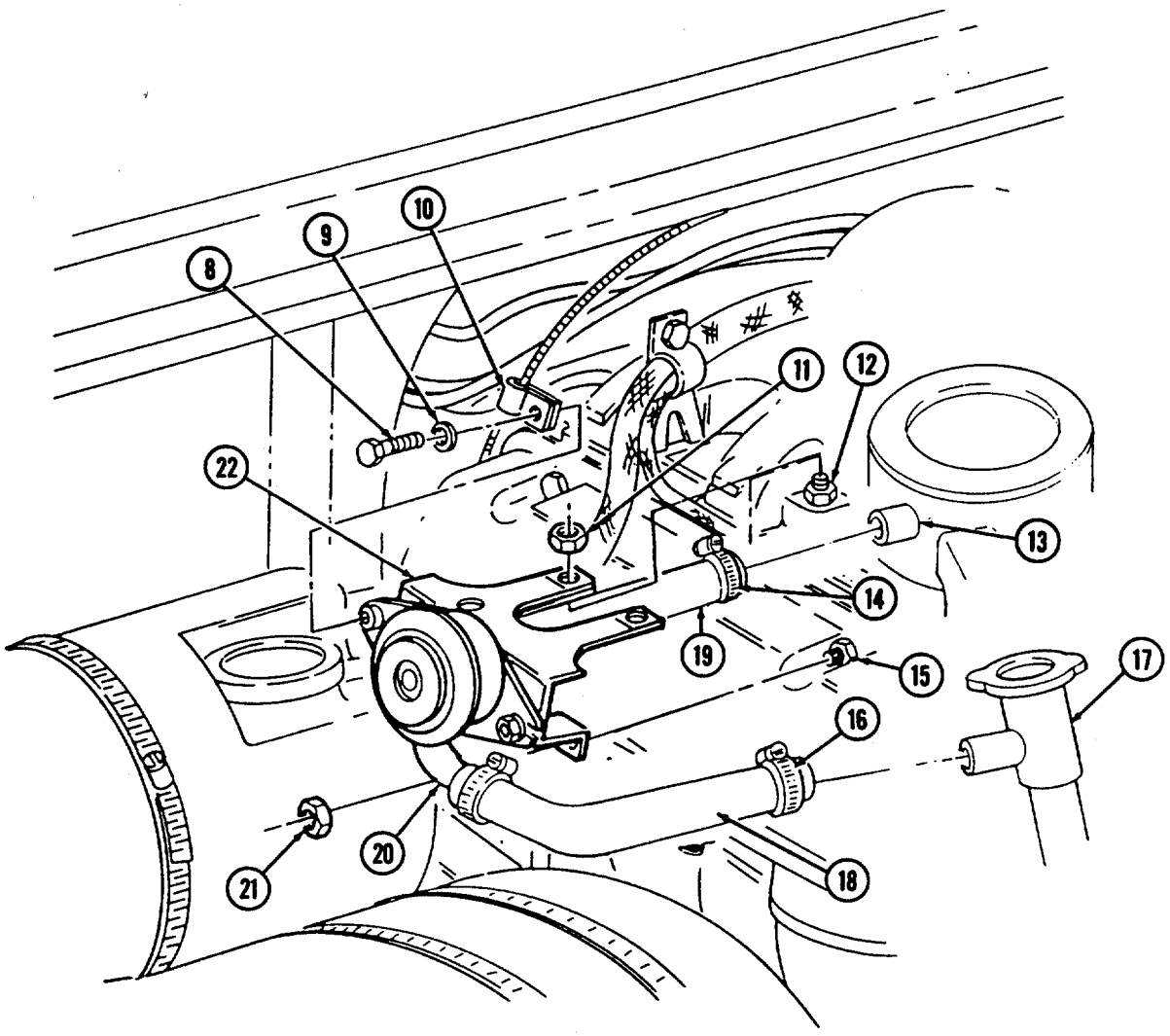


## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

**NOTE**

- CDR valves on vehicles equipped with deep water fording kit contain two additional vent lines.
- Leave hoses connected to CDR valve.

81. Loosen clamp (16) and disconnect CDR valve oil fill tube hose (18) from oil fill tube (17).
82. Loosen clamp (14) and disconnect CDR intake manifold hose (19) from intake manifold (13).
83. Remove screw (8) and washer (9) connecting controls cable clamp (10) to CDR valve (20) and bracket (22).
84. Remove two nuts (11) from two intake manifold studs (12).
85. Remove two nuts (21) and CDR valve (20) and bracket (22) from two valve cover studs (15) and manifold studs (12).



## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

86. Disconnect heater hose (16) from left transition (15), and right transition (17), and remove heater hose (16).

**WARNING**

Do not touch hot exhaust system components with bare hands. Severe injury will result.

87. Remove nut (7), capscrew (3), washer (2), and clamp (1) from rear heat shield (9).
88. Remove capscrew (6) and rear heat shield (9) from heat shield (5).

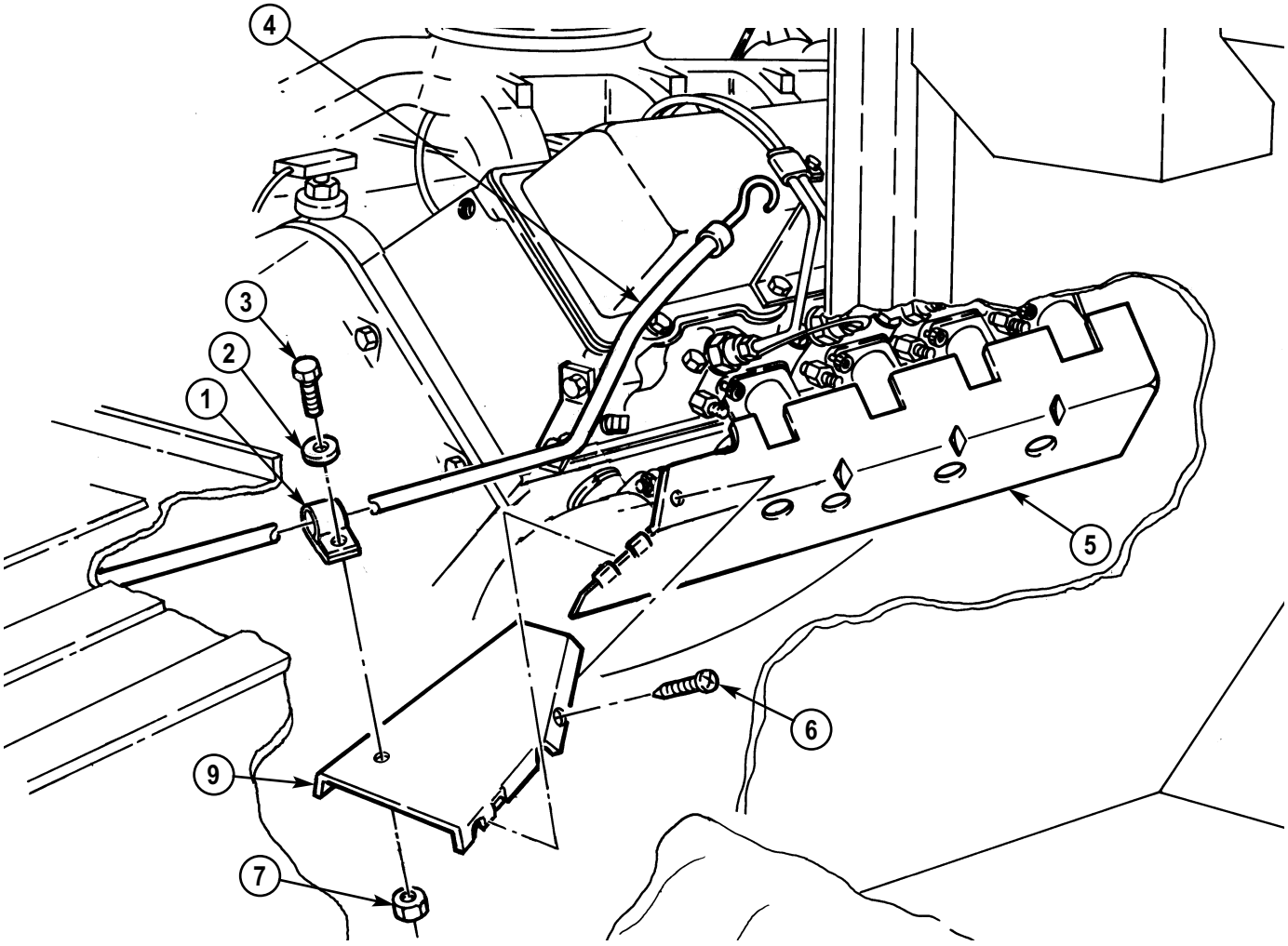
**CAUTION**

Plug open transmission port to prevent contamination parts.

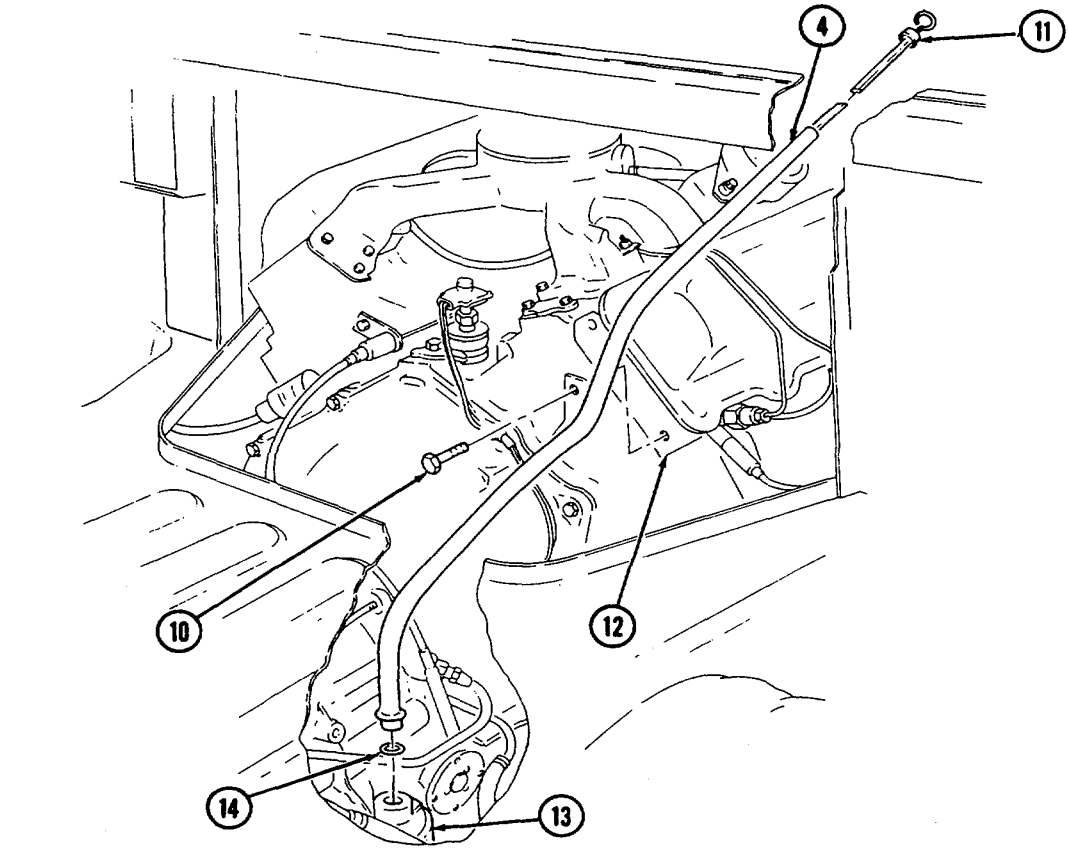
**NOTE**

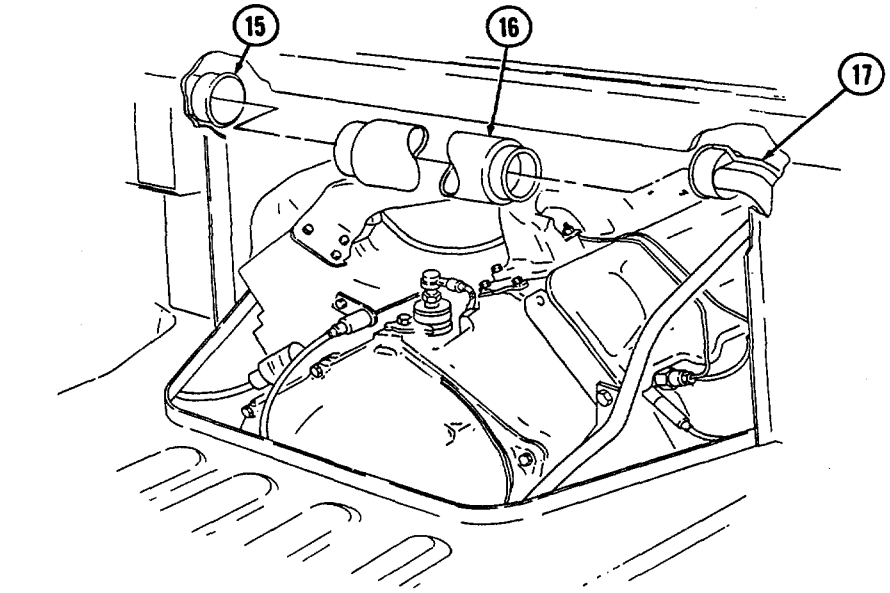
Have drainage container ready to catch fluid.

89. Remove transmission oil dipstick (11) from dipstick tube (4)
90. Remove capscrew (10) from cylinder head (12).
91. Remove dipstick tube (4) from transmission (13).
92. Remove preformed packing (14) from dipstick tube (4). Discard preformed packing (14).



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**



## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

**CAUTION**

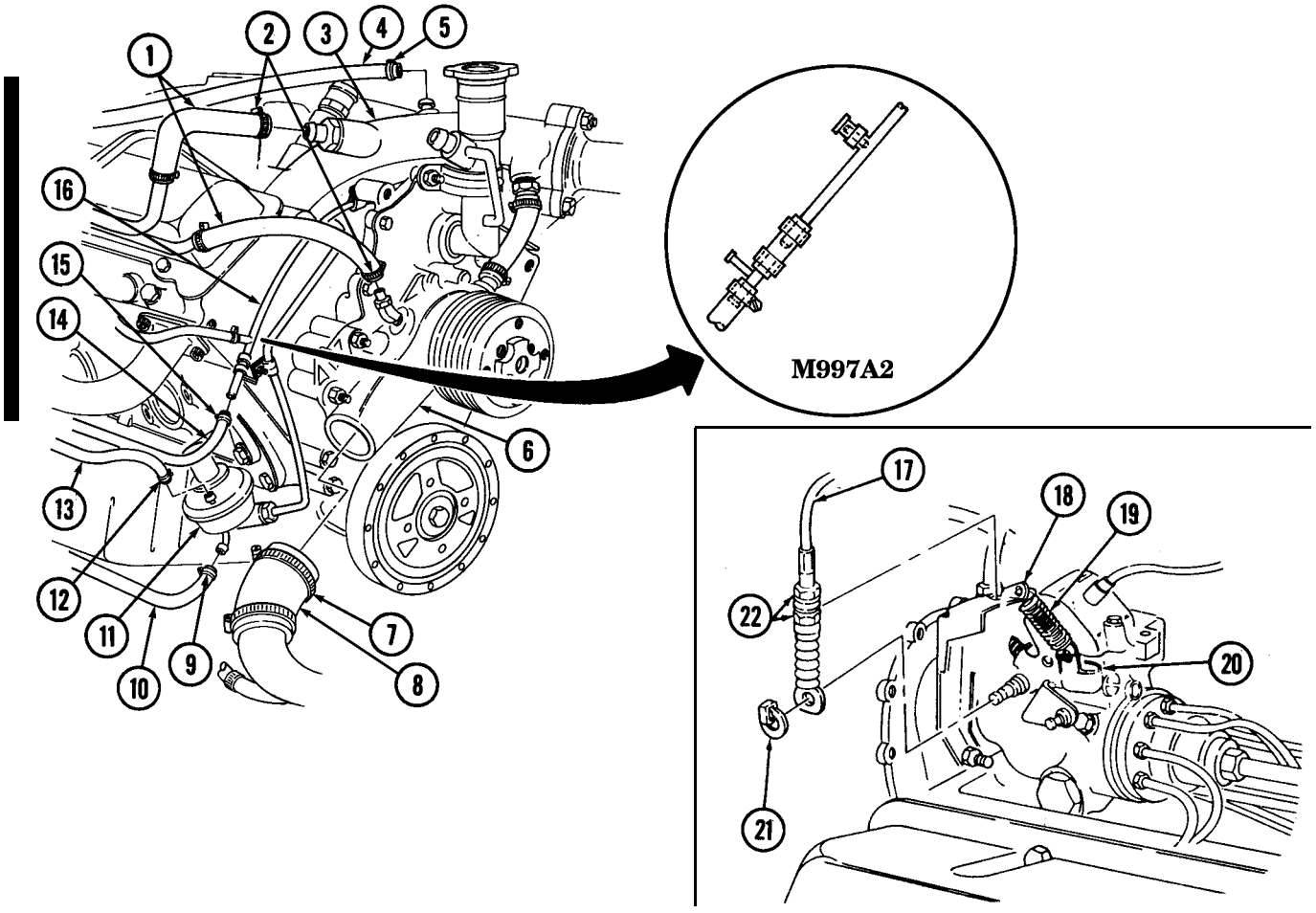
Cover or plug all hoses and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

93. Loosen clamp (5) and disconnect surge tank-to-water crossover hose (4) from water crossover (3).
94. Loosen clamps (2) and disconnect heater hoses (1) at water crossover (3) and water pump (6).

**WARNING**

Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.

95. Loosen clamp (15) and disconnect fuel return hose (14) from fuel return line (16)
96. Loosen clamp (9) and disconnect fuel supply line (10) from fuel pump (11).
97. Loosen clamp (12) and disconnect vent line (13) from fuel pump (11).
98. Loosen clamp (7) and disconnect water pump inlet hose (8) from water pump (6)
99. Disconnect throttle return spring (19) from bracket (18).
100. Loosen two nuts (22) and disconnect cable assembly (17) from bracket (18).
101. Remove accelerator cable clip (21) and disconnect cable assembly (17) from throttle shaft lever (20). Retain clip (21) for installation.



## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

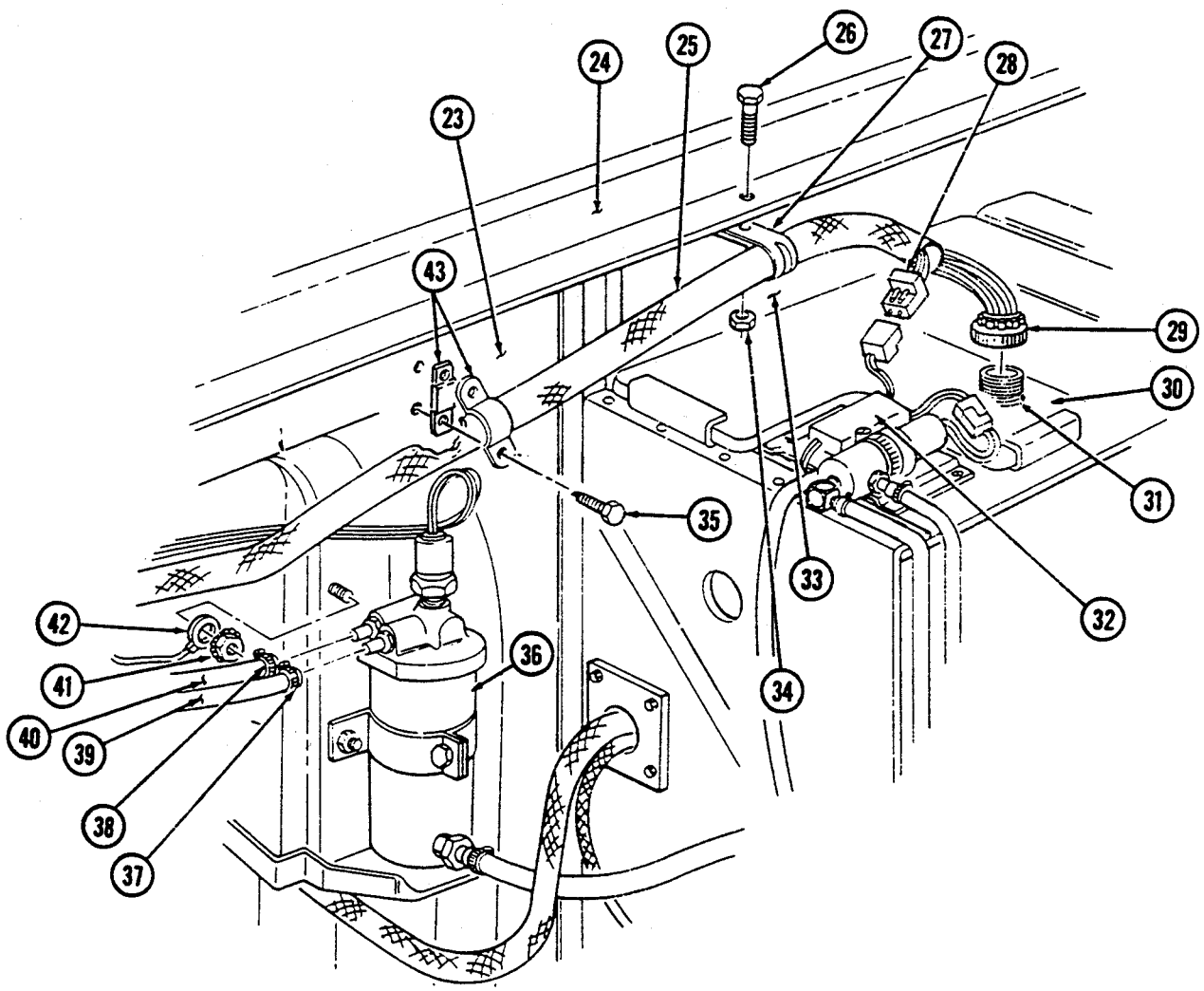
**WARNING**

Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.

**NOTE**

Tag fuel lines for installation.

102. Loosen clamps (37) and (38) and disconnect fuel inlet line (39) and fuel outlet line (40) from fuel filter (36).
103. Remove assembled locknut (41) securing engine harness ground 3C (42) to body (23). Discard assembled locknut (41).
104. Disconnect engine harness connector (28) from time delay module (32).
105. Remove rubber insulation (30) and disconnect engine harness connector plug (29) from protective control box (31).
106. Remove rubber insulation (33) and remove nut (34), capscrew (26), and clamp (27) and engine harness (25) from "A" beam (24).
107. Remove two screws (35) and clamp (43) and engine harness (25) from body (23).



## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

108. Loosen hose clamps (12) and (16) and disconnect control valve hose (11) from control valve (14) and hydro-boost hose (15) from hydro-boost (17).

**NOTE**

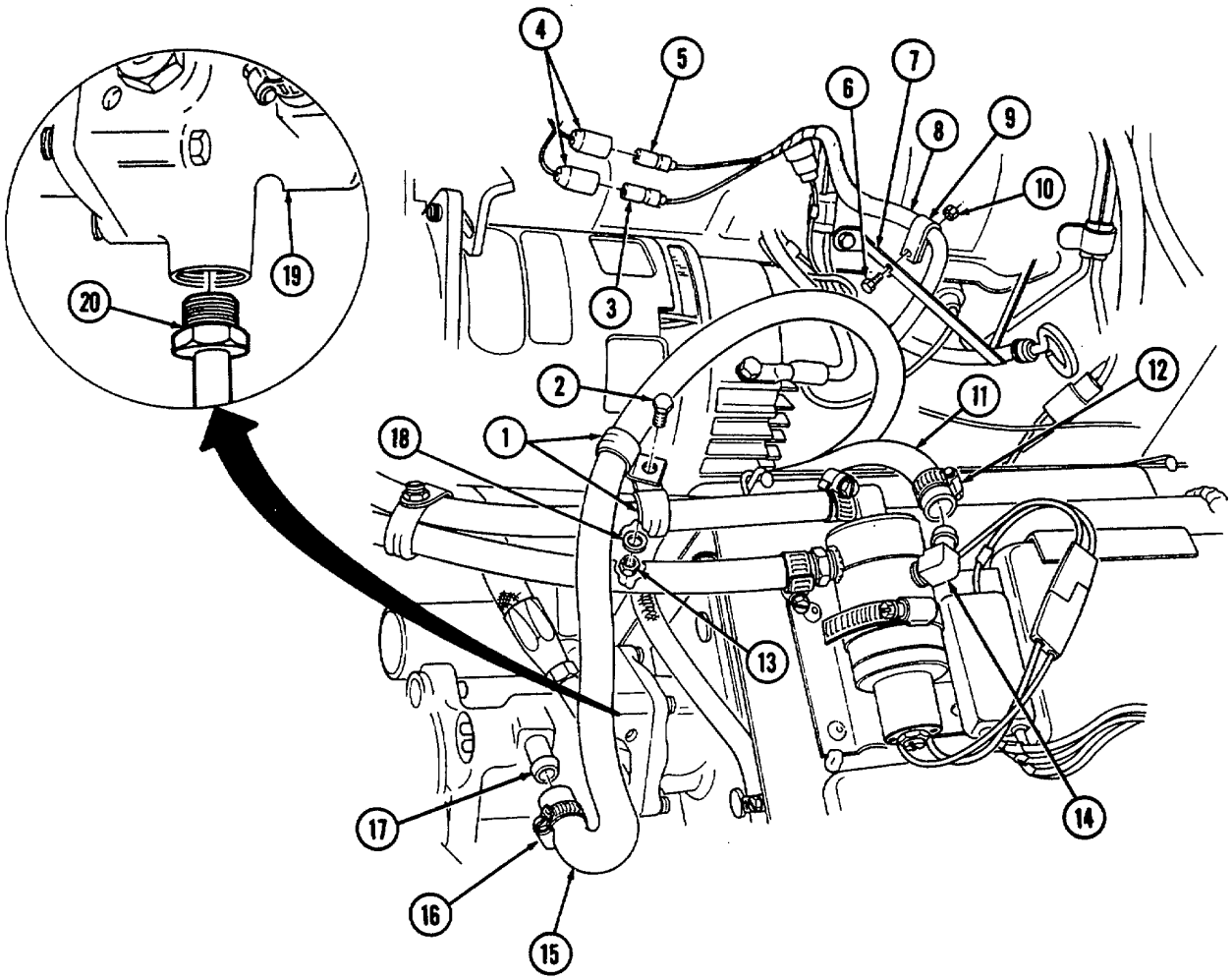
Perform steps 109 and 110 for all models except M997A2 vehicles.

109. Remove nut (13), washer (18), and capscrew (2) from two clamps (1).

110. Disconnect high pressure line (20) from hydro-boost (19).

111. Remove screw (6), clamp (9), washer (10), and body harness (8) from dipstick support bracket (7).

112. Disconnect two leads 458A (4) from leads 458C (3) and 458D (5).



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**

**NOTE**

Tag leads for installation.

113. Disconnect lead 36A (26) from oil pressure sending unit (17).
114. Disconnect engine harness lead 33A (18) from body harness lead 33A (25) and engine harness lead 58B (19) from body harness lead 58B (22).
115. Disconnect lead 349A (20) from leads 350B/359A/355A (21).

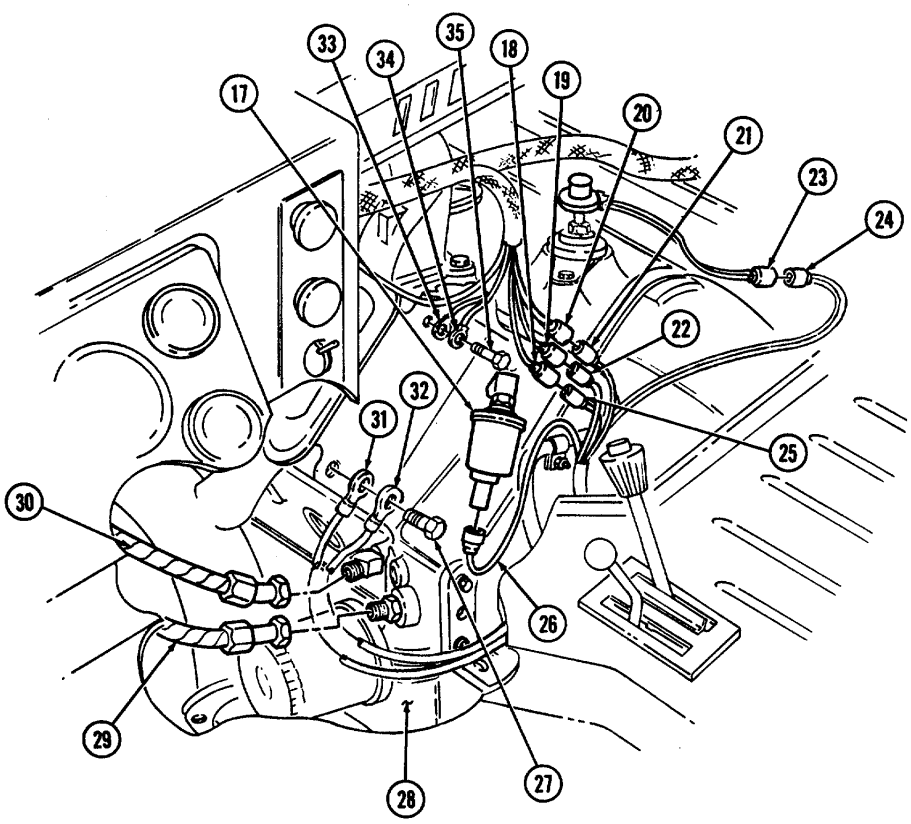
**CAUTION**

Cover or plug all hoses and connections immediately after disconnection to prevent contamination.

**NOTE**

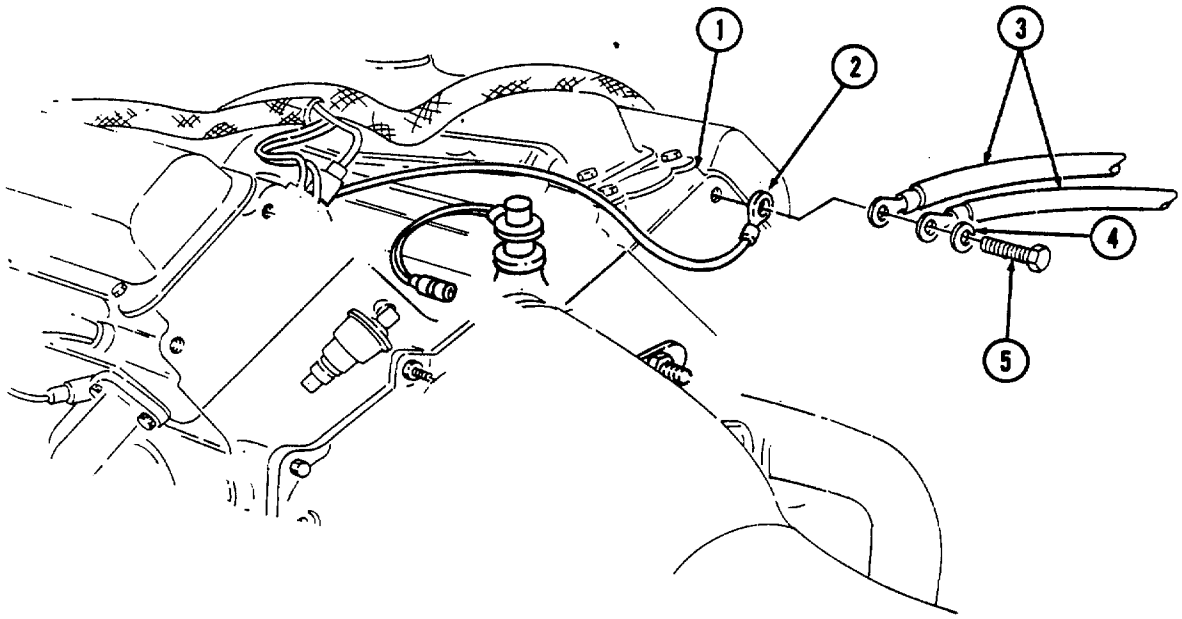
Have drainage container ready to catch oil.

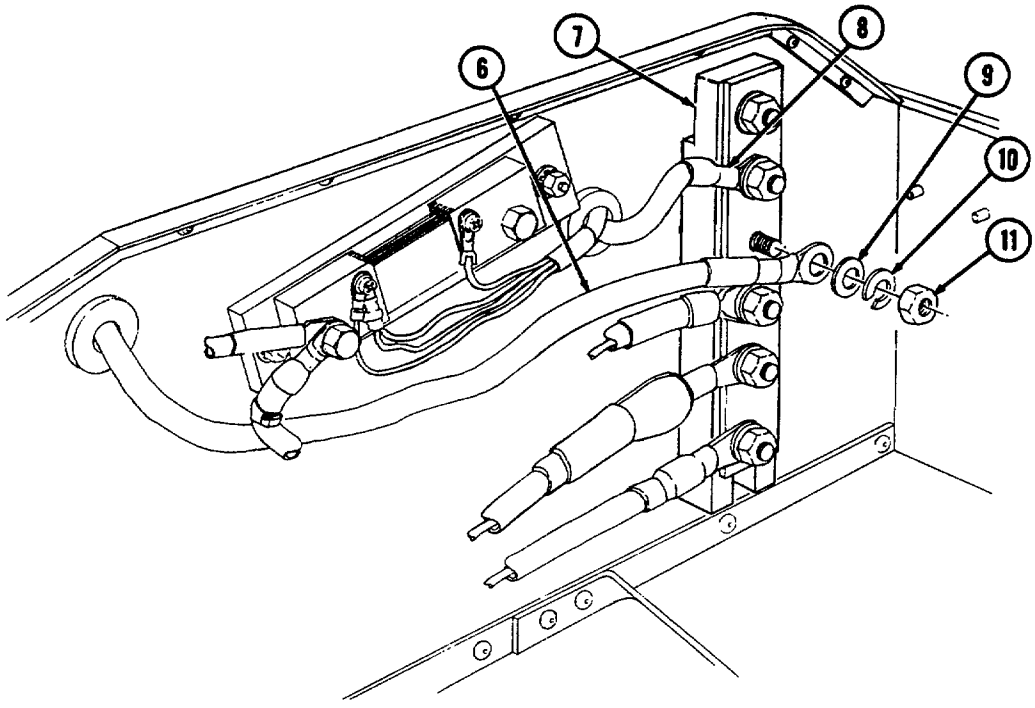
116. Disconnect oil cooler supply line (29) and oil cooler return line (30) from engine (28).
117. Remove screw (27), T-case indicator light ground (32), and transmission indicator light ground (31) from engine (28).
118. Remove capscrew (35) and ground leads 3A (34) and 58A (33) from engine (28).
119. Disconnect leads 359F/349A (24) from RPM sensor (23).



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**

120. Remove capscrew (5), lockwasher (4), two ground cables (3), and alternator ground (2) from cylinder head (1). Discard lockwasher (4).
121. Remove nut (11), lockwasher (10), washer (9), engine harness cable (8), and 200 amp alternator cable (6) (if installed) from buss bar (7). Discard lockwasher (10).



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**

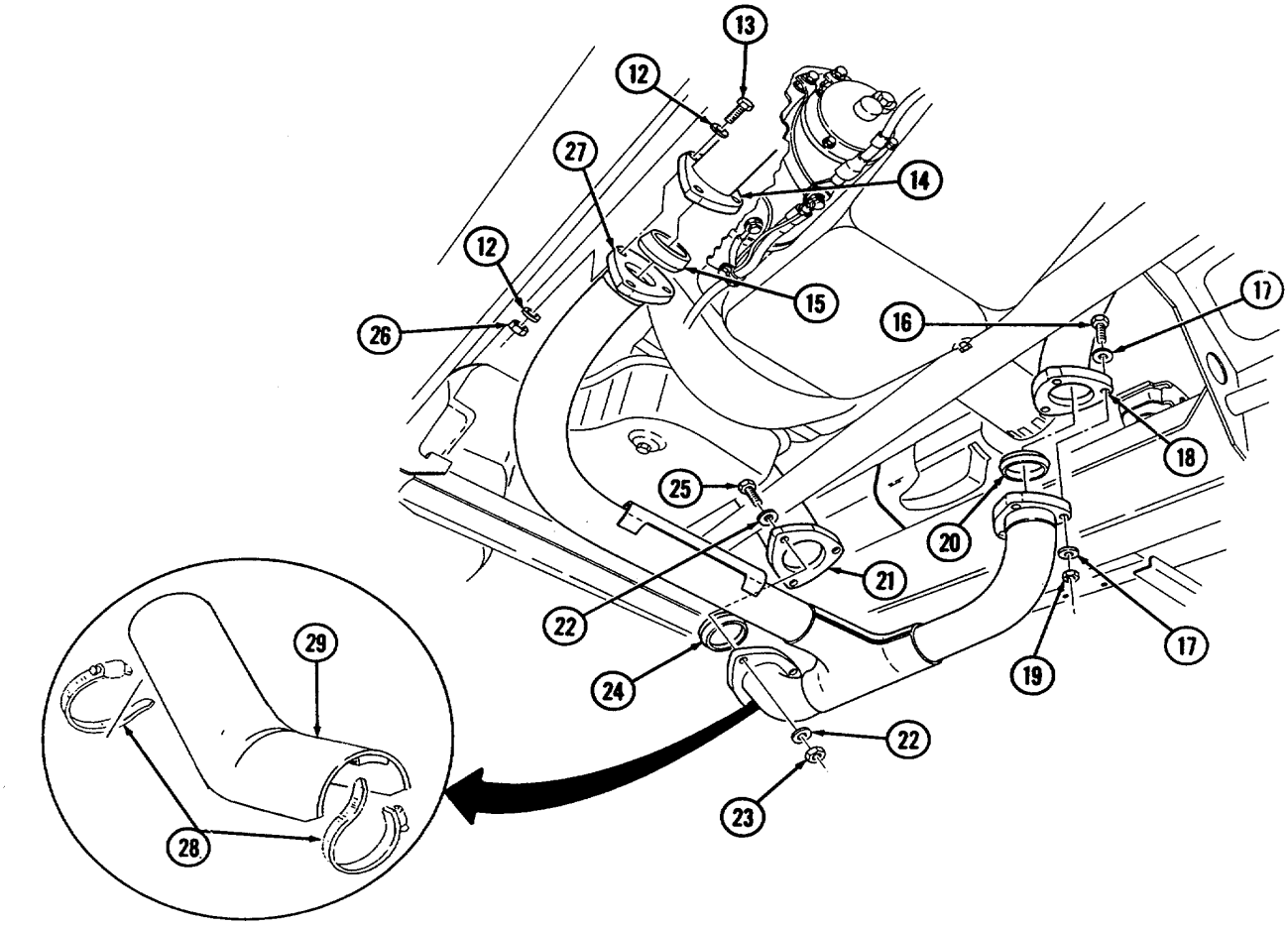
**WARNING**

Do not touch hot exhaust system components with bare hands.
Severe injury will result.

**NOTE**

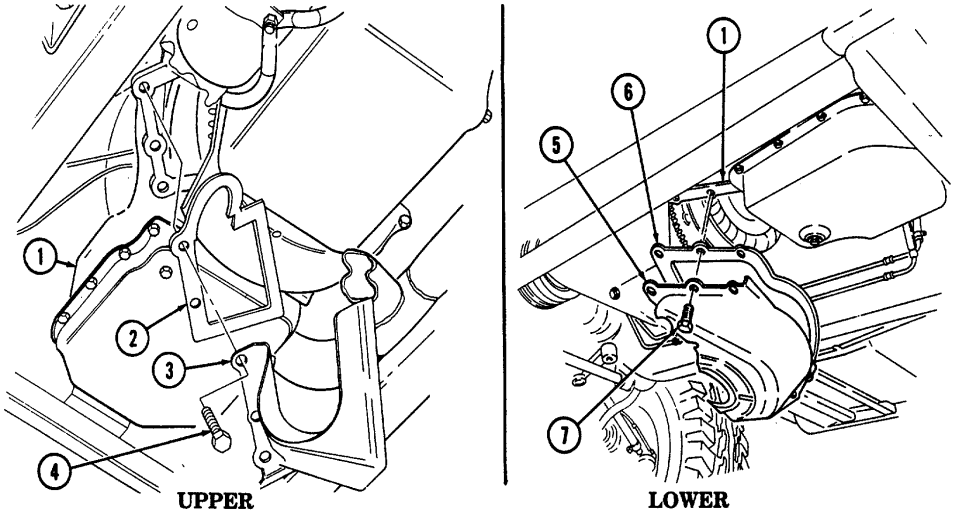
It will be necessary to use additional .5 in. (13 mm ) drive extension 12 in. (30 cm) to remove exhaust system mounting hardware.

122. Remove two clamps (28) and heat shield (29) from crossover pipe (27).
123. Remove three locknuts (26), washers (12), capscrews (13), and washers (12) from crossover pipe (27) and right exhaust manifold (14). Discard locknuts (26)
124. Remove three locknuts (23), washers (22), capscrews (25), and washers (22) from crossover pipe (27) and muffler (21). Discard locknuts (23).
125. Remove three locknuts (19), washers (17), capscrews (16), washers (17) and crossover pipe (27) from left exhaust manifold (18). Discard locknuts (19).
126. Remove and discard gaskets (15), (20), and (24).



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**

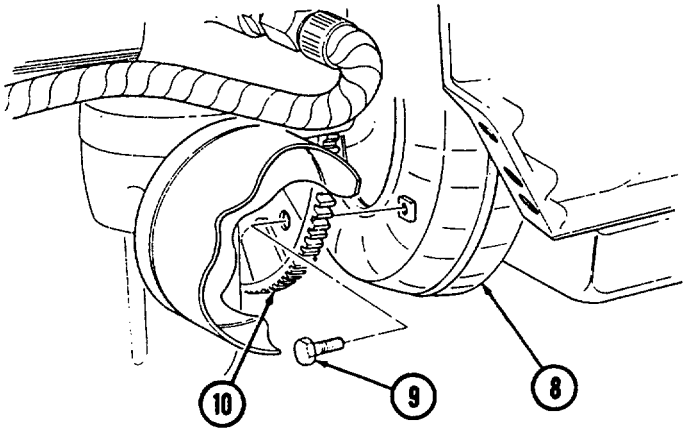
127. Remove two capscrews (4) and upper converter housing cover (3) from transmission (1).
128. Remove four capscrews (7) and lower converter housing cover (5) from transmission (1).
129. Remove gaskets (2) and (6) from converter housing cover (3 and 5). Discard gaskets (2) and (6).




**NOTE**

- It will be necessary to rotate flywheel clockwise from capscrew in front of crankshaft to gain access to capscrews securing torque converter.
- Have assistant hold crankshaft pulley in place when removing capscrews securing flywheel to torque converter.

130. Remove six capscrews (9) and torque converter (8) from flywheel (10) and slide torque converter (8) away from flywheel (10).



## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

131. Install and close draincock (1).

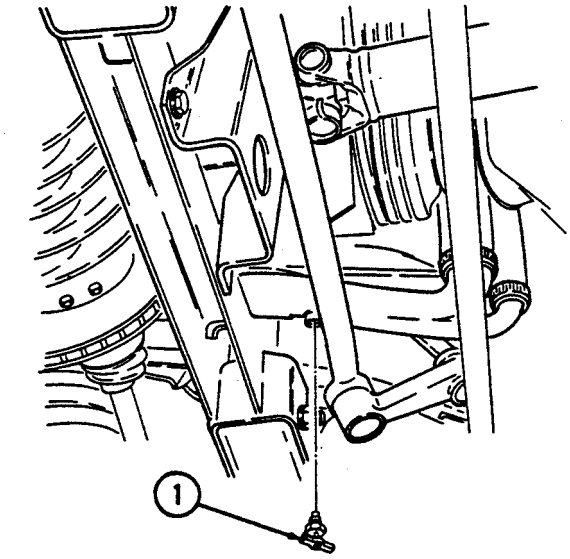
**NOTE**

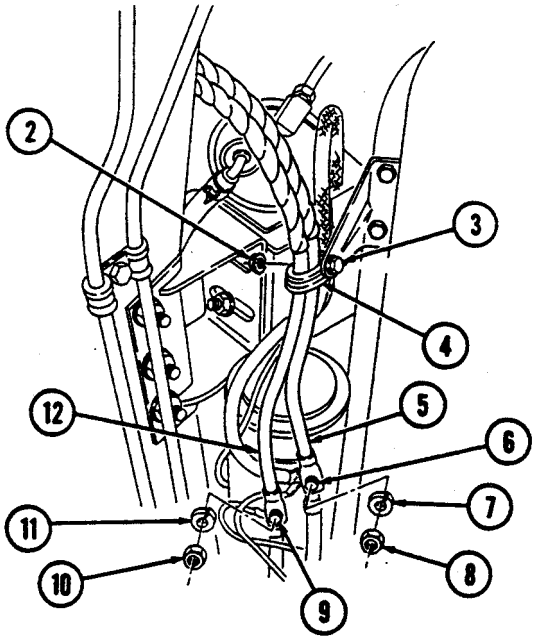
- Perform steps 132 through 134 for vehicles equipped with a winch.
- Prior to removal, tag leads for installation.

132. Remove nut (10), lockwasher (11), and lead 7 (12) from starter terminal (9). Discard lockwasher (11).

133. Remove nut (8), lockwasher (7), and lead 6 (5) from starter terminal (6). Discard lockwasher (7).

134. Remove assembled locknut (2) and clamp (4) from oil pan bracket screw (3). Discard assembled locknut (2).



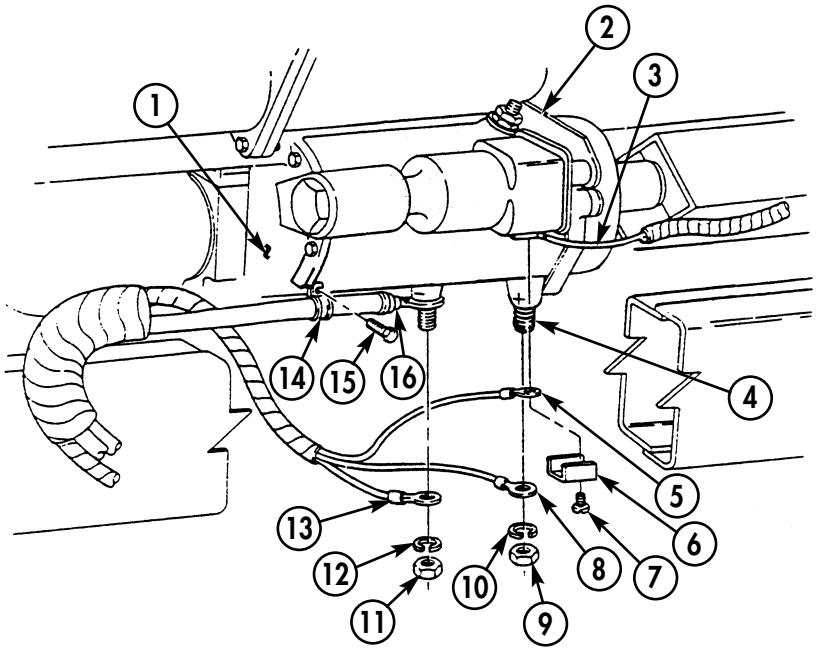



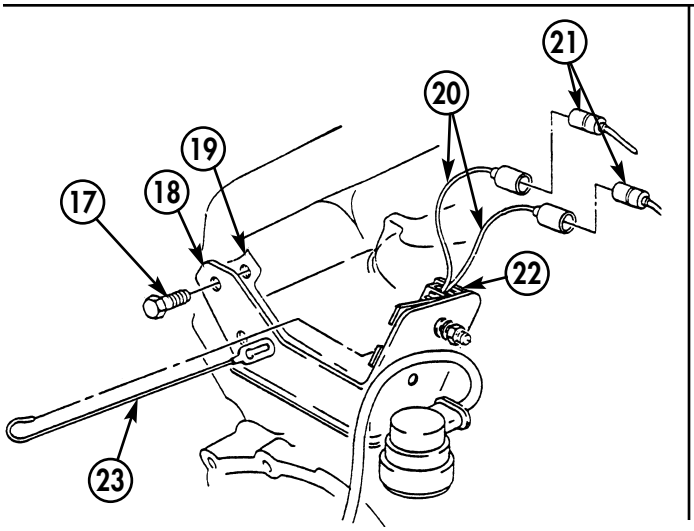
## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)

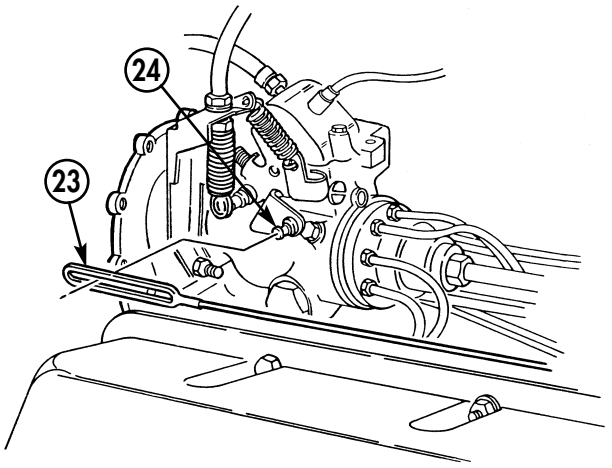
**NOTE**

Hardware securing positive and negative starter cables to starter may have been removed previously depending upon vehicle configuration.

135. Remove nut (11), lockwasher (12), and lead 3D (13) from starter (1). Discard lockwasher (12).
136. Remove screw (15), clamp (14), and negative cable 7A (16) from starter (1)
137. Remove nut (9), lockwasher (10) and lead 81B (8) from terminal (4). Discard lockwasher (10).
138. Remove screw (7), clip (6), and leads 74B (5) and 74A (3) from solenoid (2).
139. Slide rod (23) forward and disconnect from fuel injection pump (24).
140. Remove rod (23) from switch (22).
141. Disconnect two harness leads 315 (21) from switch leads 315A/315B (20).
142. Remove two capscrews (17) and bracket (18) from engine (19).



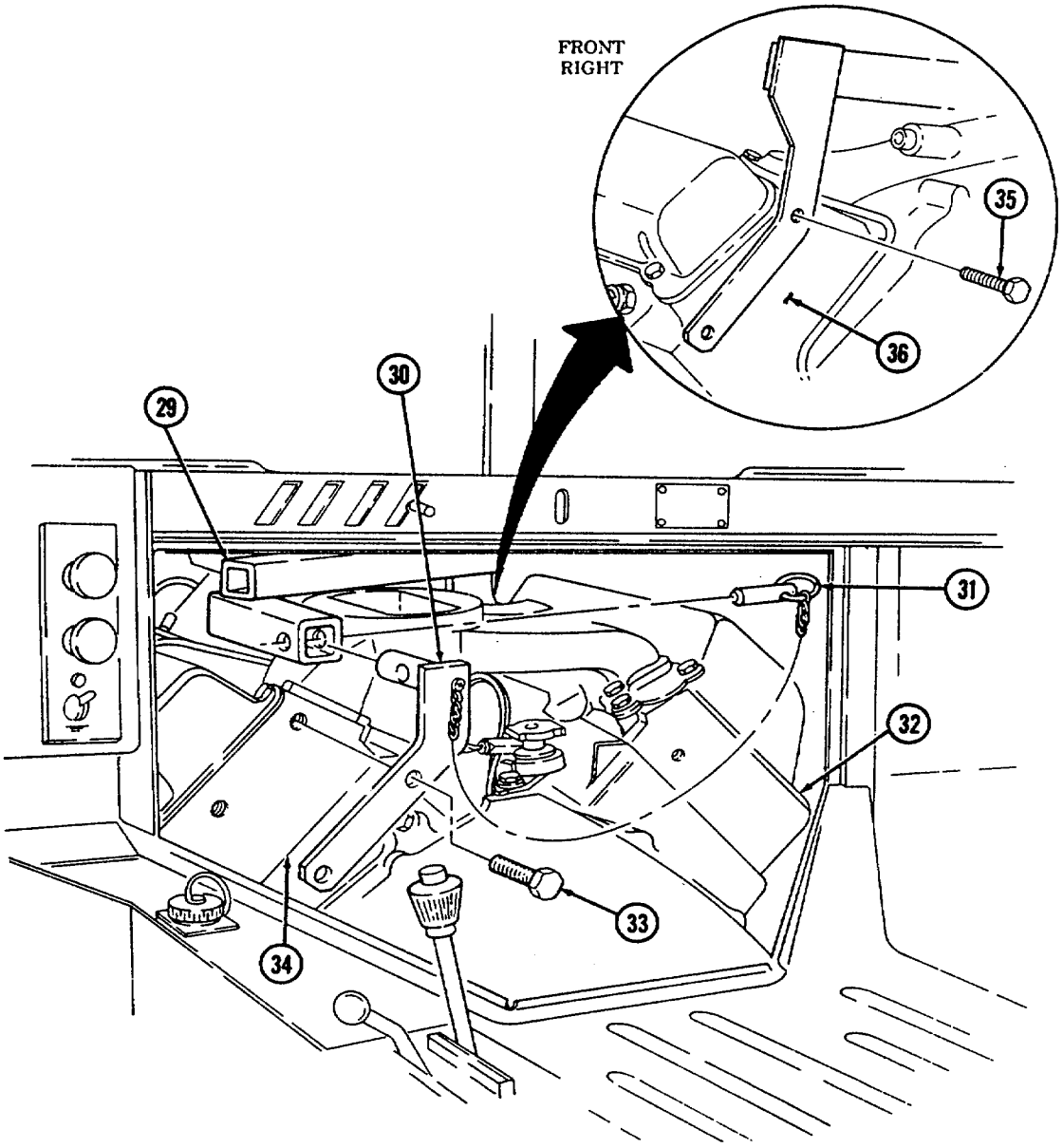



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**

**NOTE**

- Install sling bracket on rear of engine first.
- Use four 15 X 25 mm capscrews to install lifting sling on engine.

143. Position engine lifting sling (29) on engine (32) and install on right cylinder head (36) with two capscrews (35).
144. Install sling bracket (30) on left cylinder head (34) with two capscrews (33). Tighten capscrews (33) and (35). Install sling bracket (30) on engine lifting sling (29) with pin (31).



**3-24. ENGINE REMOVAL (6.5 L) (Cont'd)**

**CAUTION**

When using front eyelet on lifting sling, engine oil pan must be supported during engine removal to prevent rear eyelet of lifting sling from damaging windshield.

**NOTE**

Hoist must be attached to:

- Forward eyelet of lifting sling when lifting engine on M997A2.
- Intermediate eyelet when lifting engine on all other models.
- Rear eyelet when lifting engine and transmission together.

145. Raise engine (5) only enough to take pressure off mounting brackets (2).
146. Remove two locknuts (3) and washers (4) from right engine mount insulator (1) and engine mount bracket (2). Discard locknuts (3). Repeat for left engine mount.

**WARNING**

Transmission must be supported during engine removal. Failure to do this may cause injury to personnel or damage to equipment.

**NOTE**

If vehicle is moved because of limited shop space or tactical movement, damage to the transmission and the vehicle may occur. To prevent damage, the engine/transmission support sling can be installed.

147. Support transmission (7) and remove four capscrews (8) and two studs (6) from transmission (7) and engine (5).

**WARNING**

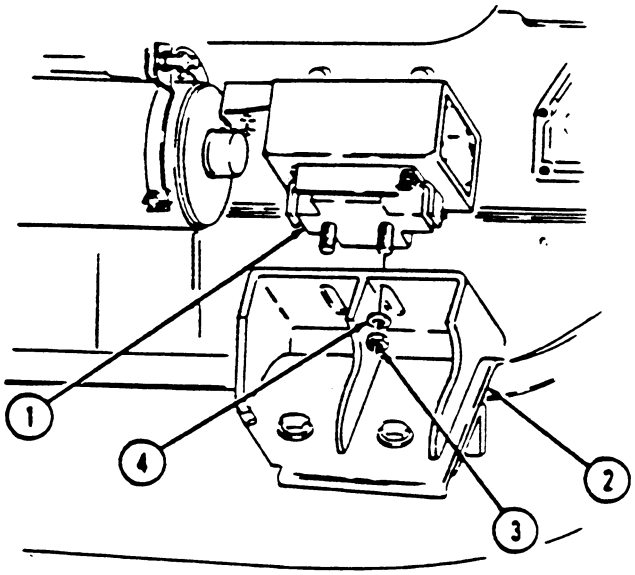
* Direct all personnel not participating in engine removal to stand clear during hoisting operation. Failure to do this may cause injury.
* Do not use hands to free engines of hangups or snags. Use prybars to avoid injury.

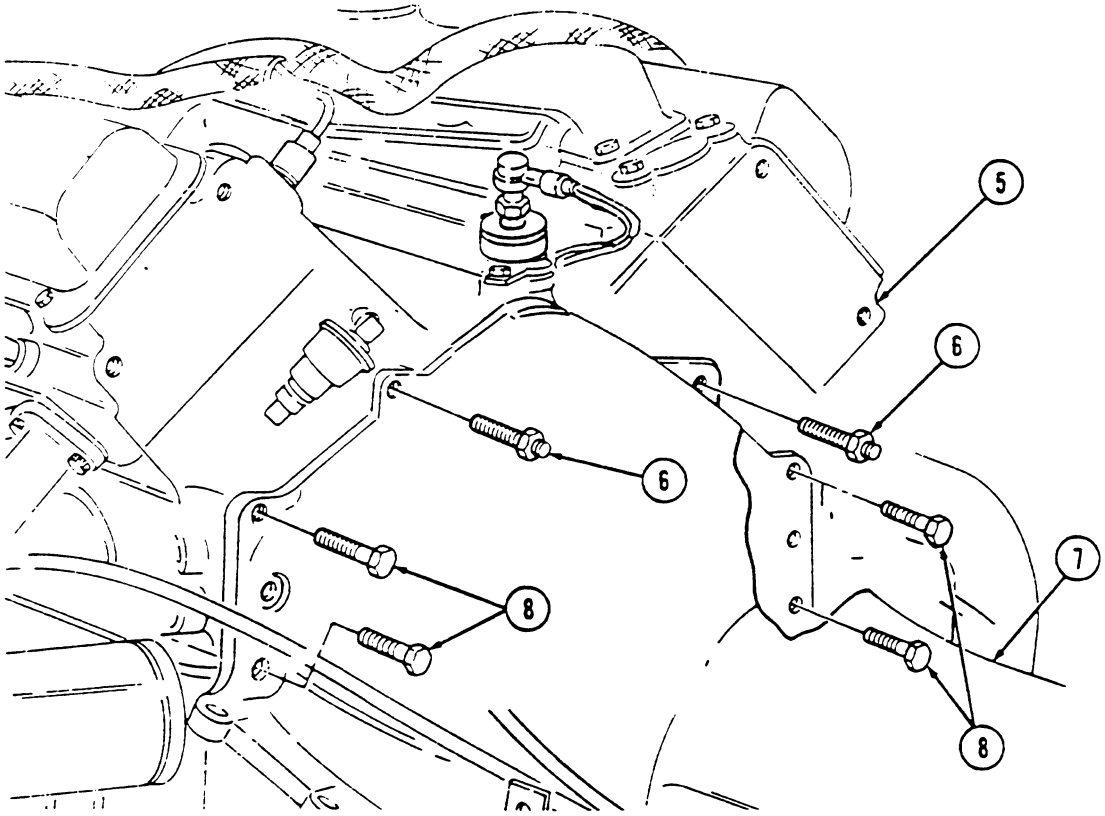
**CAUTION**

Always remove the engine slowly and watch for the following: engine binding or hard to move means that something may still be connected to engine that must be removed; ensure that wiring, lines, cables, and rods are not in the path of removal.

148. Hoist engine (5) slowly out of vehicle.

## 3-24. ENGINE REMOVAL (6.5 L) (Cont'd)




FOLLOW-ON TASK: Prepare engine for disassembly (para. 3-26).

## 3-25. ENGINE INSTALLATION (6.5 L)

**This task covers:**

**Installation**

**INITIAL SETUP:**

**Applicable Models**

M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)
Breaker bar, 3/8 in. (Appendix G, Item 2)

**Special Tools**

Engine lifting sling (Appendix G, Item 22)
Torque adapter, 3/4 in. (Appendix G, Item 107)
Belt tension gauge (Appendix G, Item 27)

**Materials/Parts**

Two cotter pins (Appendix E, Item 168)
Preformed packing (Appendix E, Item 179)
Three gaskets (Appendix E, Item 19)
Tiedown strap (Appendix E, Item 250)
Lockwasher (Appendix E, Item 106)
Lockwasher (Appendix E, Item 119)
Lockwasher (Appendix E, Item 110)
Lockwasher (Appendix E, Item 109)
Two spring tension washers (Appendix E, Item 264)
Two lockwashers (Appendix E, Item 108)
Two lockwashers (Appendix E, Item 103)
Two lockwashers (Appendix E, Item 120)
Three lockwashers (Appendix E, Item 100)
Two lockwashers (Appendix E, Item 107)
Seven lockwashers (Appendix E, Item 104)
Locknut (Appendix E, Item 73)
Four locknuts (Appendix E, Item 65)

**Materials/Parts (Cont'd)**

Three assembled locknuts (Appendix E, Item 85)
Fourteen locknuts (Appendix E, Item 63)
Four locknuts (Appendix E, Item 80)
Gasket (Appendix E, Item 20)
Silicone compound (Appendix B, Item 56.1)
Antiseize compound (Appendix B, Item 7)
Sealing compound (Appendix B, Item 50)
RTV sealant (Appendix B, Item 43)
Engine/transmission support sling (Appendix C, Figs. 24 through 40) (Optional)

**Personnel Required**

One mechanic
One assistant

**Manual References**

TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

Engine prepared for installation (para. 3-26).

**General Safety Instructions**

- Direct personnel to stand clear during hoisting operation.
- Do not use hands to free engine if hangups or snags.
- Transmission must be supported during engine installation.

**Maintenance Level**

Direct support

**WARNING**

- Direct all personnel not participating in engine installation to stand clear during hoisting operation. Failure to do this may cause injury.
- Do not use hands to free engine of hangups or snags. Use prybars to avoid injury.

**CAUTION**

- Always install engine slowly. Lower into chassis carefully and closely observe all engine components to prevent engine damage.
- If transmission support sling was installed, remove prior to engine installation.

**NOTE**

- All plugs must be removed from hoses and connections prior to reconnection.
- Assistant will be needed for steps 1 through 7.
- This procedure is for the 6.5 L engine only. Refer to para. 3-23 for 6.2 L engine and detuned 6.5L engine installation.

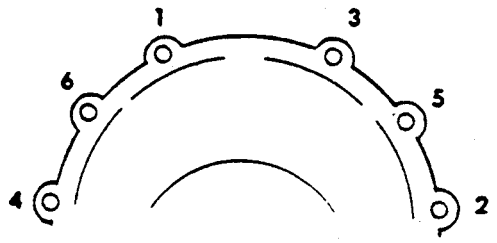
## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

1. Lower engine (1) into vehicle.

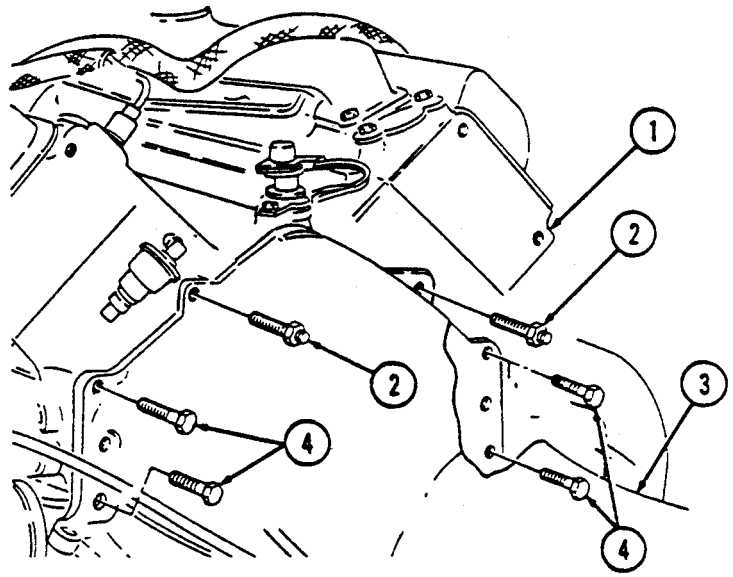
**WARNING**

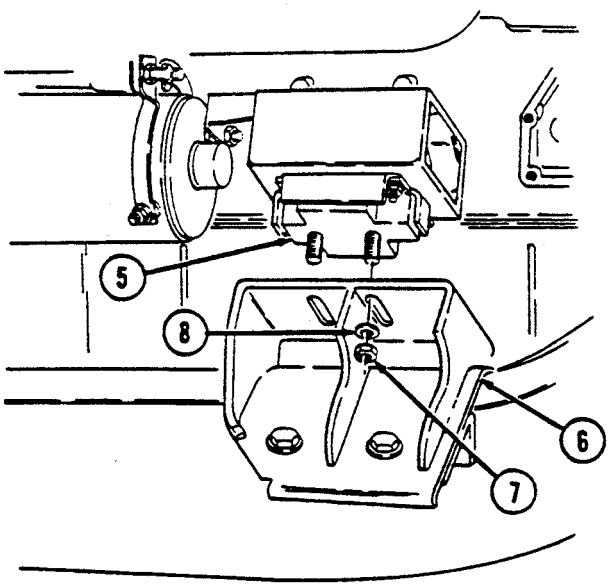
Transmission must be supported during engine installation. Failure to do this may cause injury to personnel or damage to equipment.

2. Raise and support transmission (3).
3. Install transmission (3) on engine (1) with four capscrews (4) and two studs (2). Using torque sequence tighten capscrews (4) and studs (2) to 35 lb-ft (48 N.m)
4. Align right engine mount insulator (5) on engine mount bracket (6) and install two washers (8) and locknuts (7). Repeat for left engine mount. Using torque adapter, tighten locknuts (7) to 90 lb-ft (122 N.m).



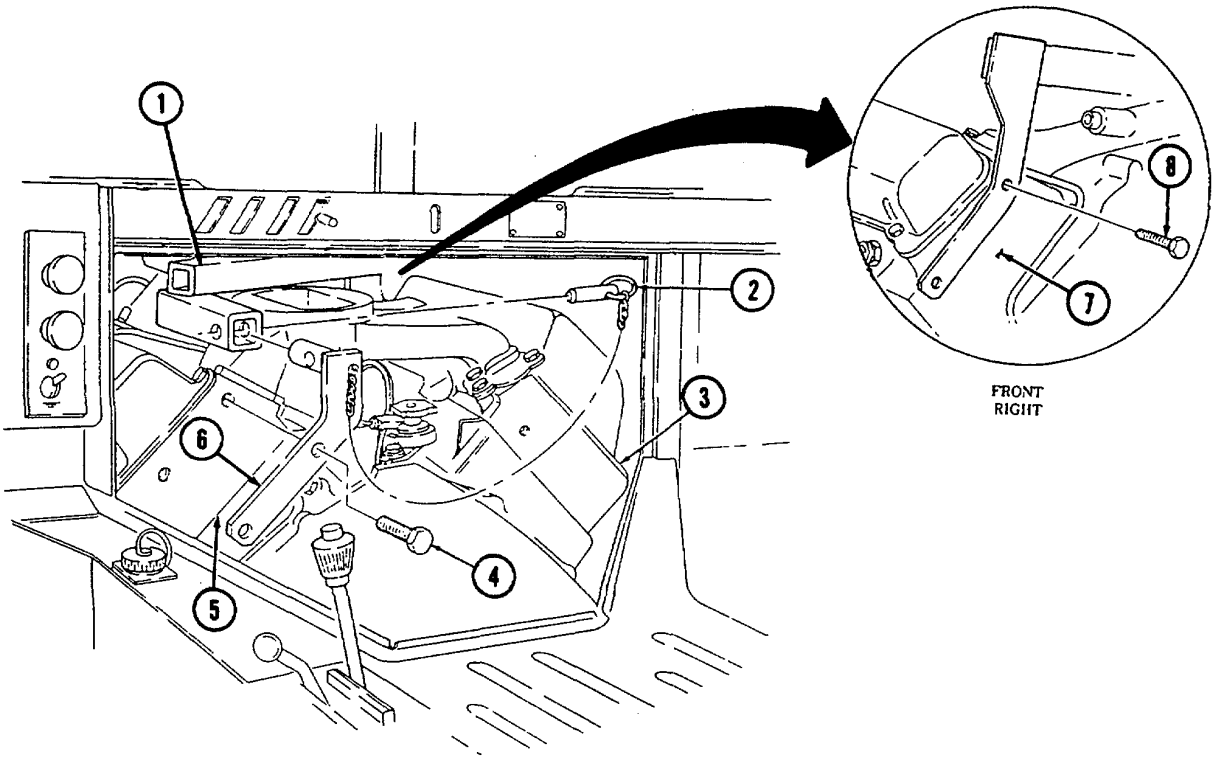

**TRANSMISSION TORQUE SEQUENCE**

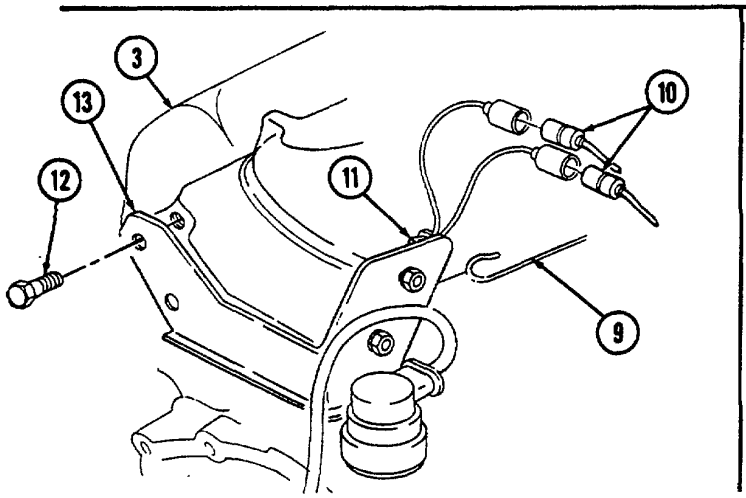


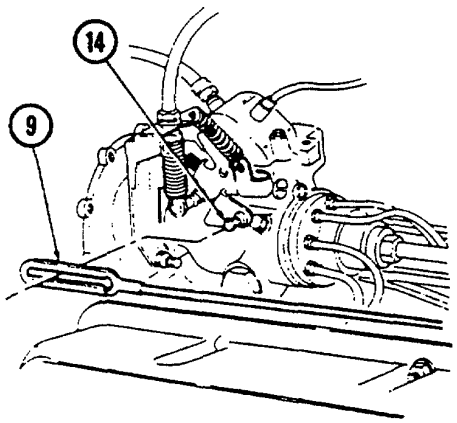



## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

5. Remove lifting device from engine lifting sling (1) and lower transmission.
6. Remove two capscrews (4) and sling bracket (6) from left cylinder head (5).
7. Remove pin (2) and sling bracket (6) from engine lifting sling.
8. Remove two capscrews (8) and engine lifting sling from right cylinder head (7) and engine (3).
9. Slide rod (9) forward and connect to fuel injection pump (14).
10. Install rod (9) on switch (11).
11. Install bracket (13) on engine (3) with two capscrews (12).
12. Position rod (9) at wide open throttle and adjust switch (11) to close (TM 9-2320-280-20).
13. Connect harness leads (10) to switch (11) leads.



## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

**NOTE**

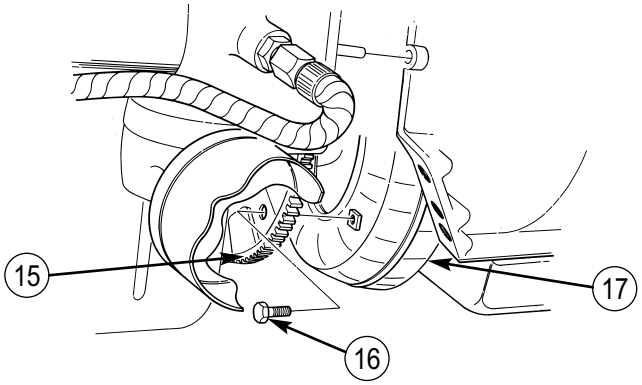
- It will be necessary to rotate flywheel clockwise from capscrew in front of crankshaft to gain access to install capscrews to torque converter.
- Have assistant hold crankshaft pulley in place when installing flywheel to torque converter.

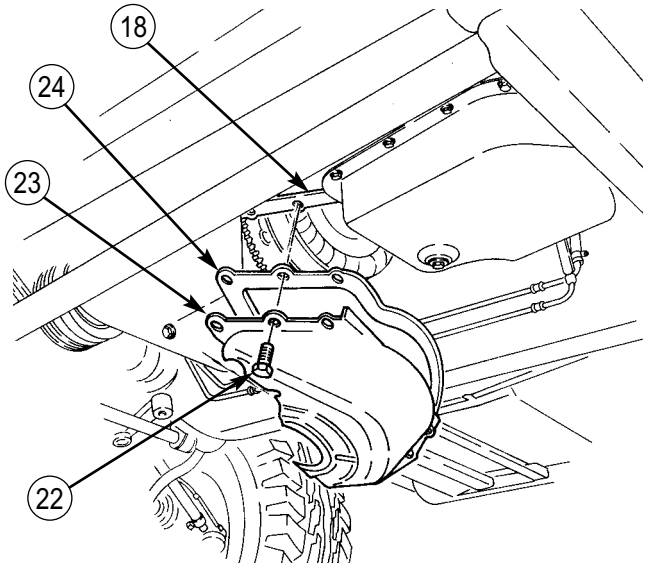
14. Align torque converter (17) to flywheel (15) with six capscrews (16).
15. Tighten capscrews (16) to 32 lb-ft (43 N·m).

**NOTE**

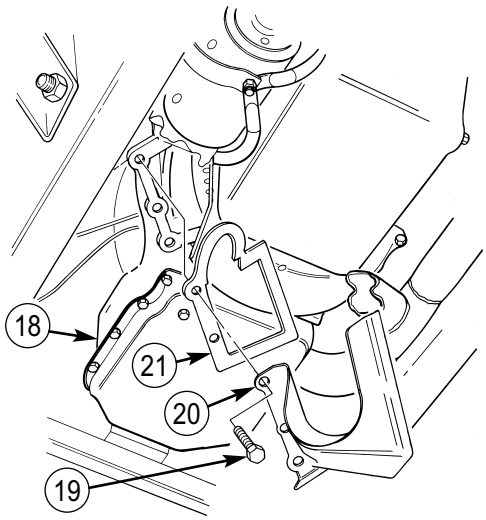
Gaskets may require bending over edge of converter housings cover to make gaskets seal properly.

16. Apply silicone compound to upper converter housing cover gasket (21). Install gasket (21) and upper converter housing (20) on transmission (18) with four capscrews (19).
17. Apply silicone compound to lower converter housing cover gasket (24). Install gasket (24) and lower converter housing (23) on transmission (18) with two capscrews (22).




LOWER




UPPER

## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

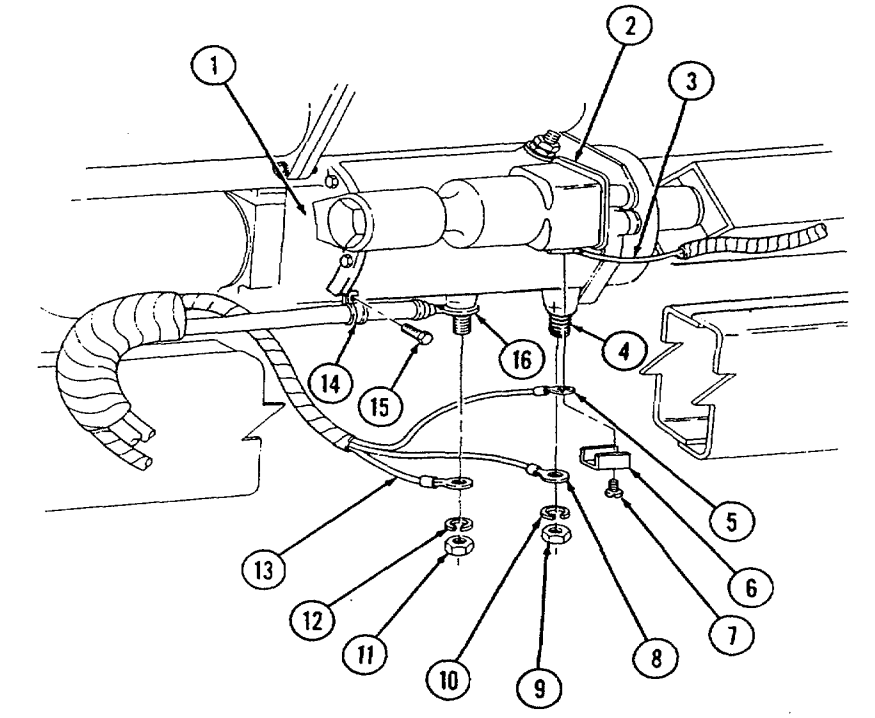
18. Install leads 74A (3) and 74B (5) on solenoid (2) with clip (6) and screw (7).
19. Install lead 81B (8) and lead 6 (22) on starter terminal (23) with lockwasher (10) and nut (9). Using torque adapter, tighten nut (9) to 25 lb-ft (34 N·m).
20. Install negative cable 7A (16), lead 3D (13), and lead 7 (25) on starter terminal (24) with lockwasher (12) and nut (11). Using torque adapter, tighten nut (11) to 15 lb-ft (20 N·m).
21. Install clamp (14) and negative cable 7A (16) on starter (1) with screw (15).

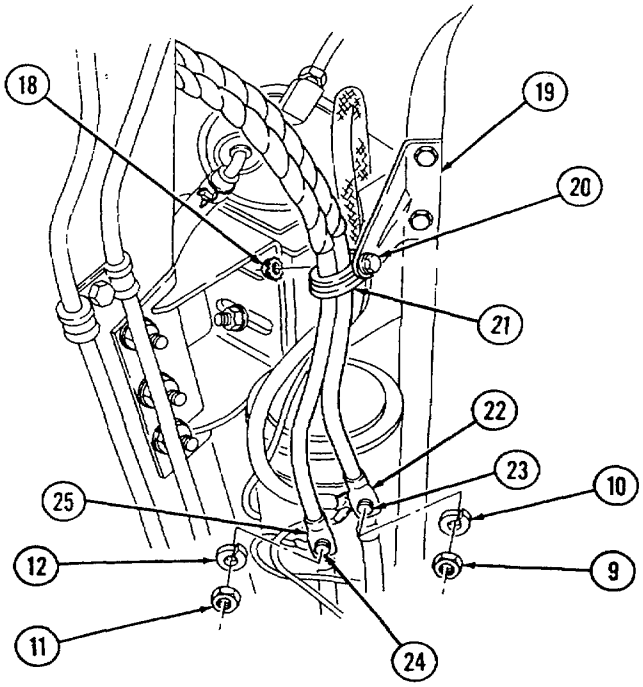
**NOTE**

Steps 22 through 25 apply to vehicles equipped with a winch.

22. Install clamp (21) and leads 6 (22) and 7 (25) on oil pan bracket (19) with capscrew (20) and assembled locknut (18).
23. Install lead 6 (22) on starter terminal (23) with lockwasher (10) and nut (9).
24. Install lead 7 (25) on starter terminal (24) with lockwasher (12) and nut (11).
25. Using torque adapter, tighten nut (11) to 15-lb-ft (20 N·m) and nut (9) to 25 lb-ft (34 N·m).
26. Deleted

**3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)**



**3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)**

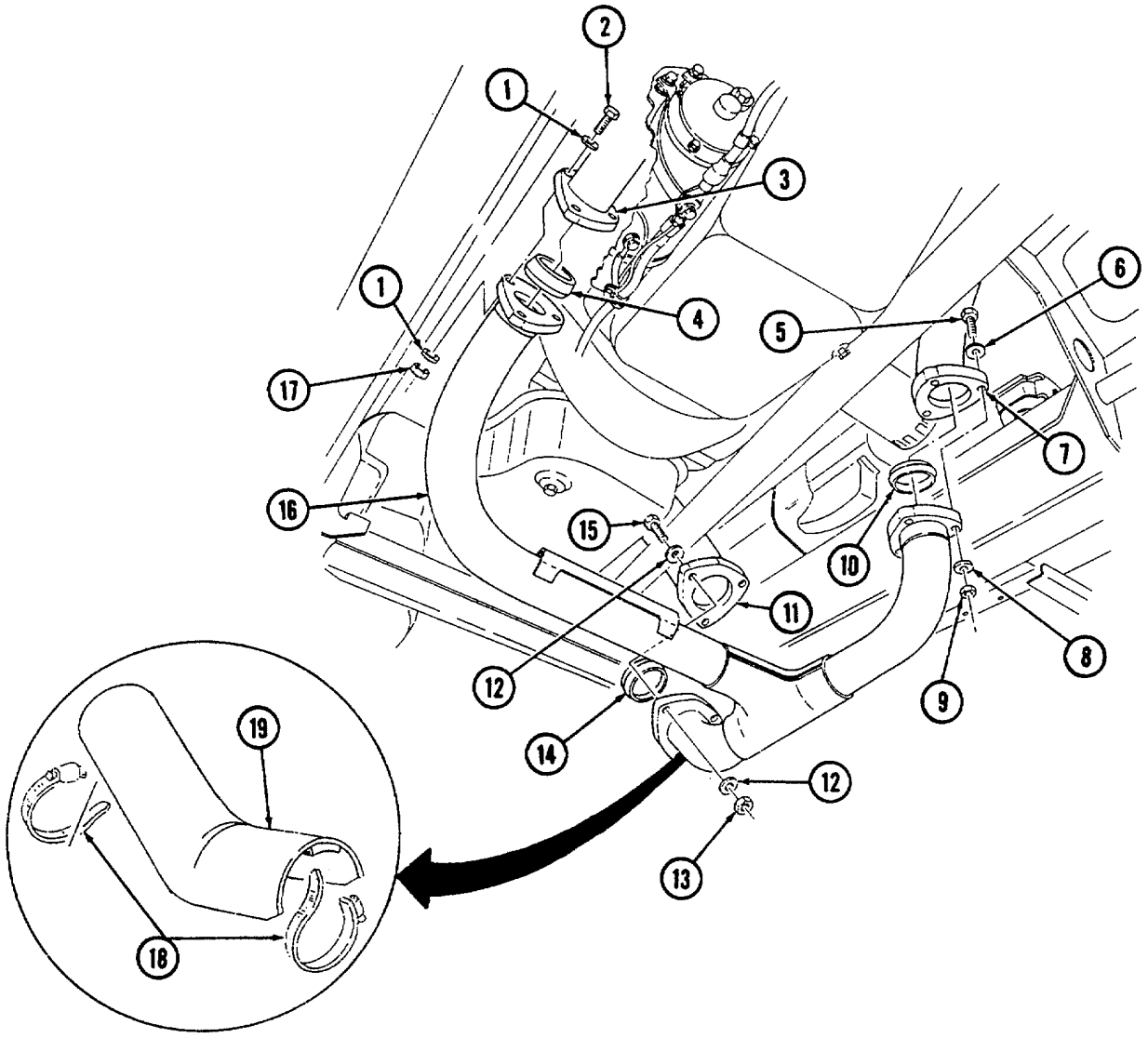
27. Install gasket (10) and crossover pipe (16) on left exhaust manifold (7) with three washers (6), capscrews (5), washers (8), and locknuts (9).

28. Install gasket (14) and crossover pipe (16) on muffler (11) with three washers (12), capscrews (15), washers (12), and locknuts (13).

29. Install gasket (4) and crossover pipe (16) on right exhaust manifold (3) with three washers (1), capscrews (2), washers (1), and locknuts (17).

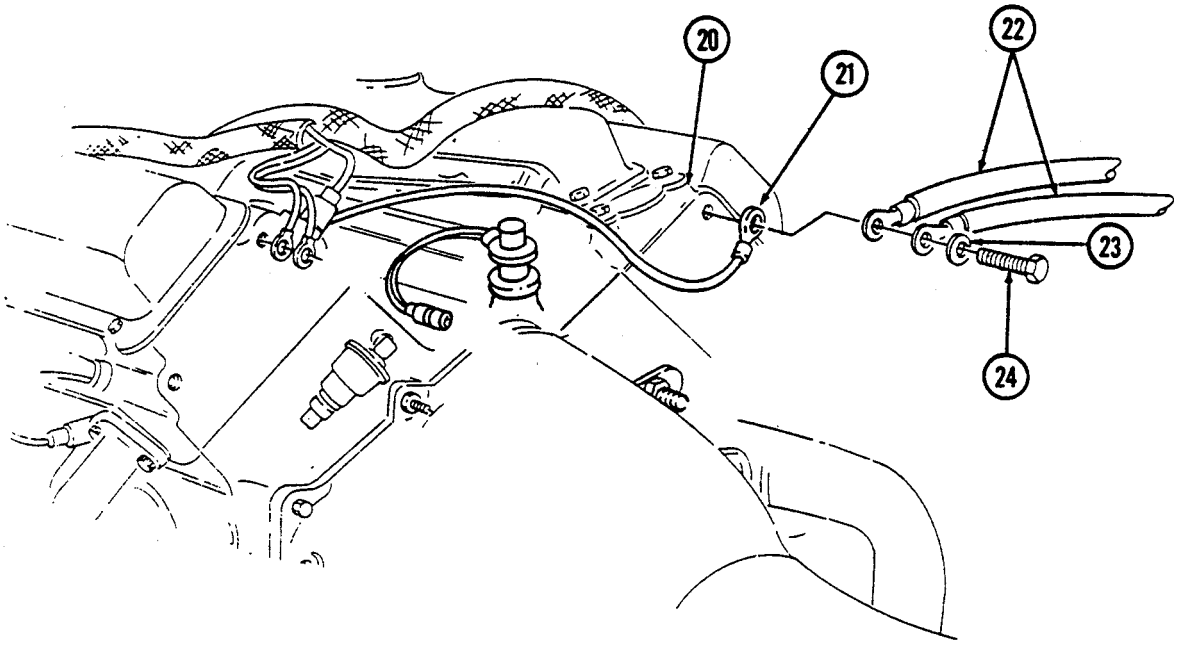
30. Install heat shield (19) and two clamps (18) on crossover pipe (16).

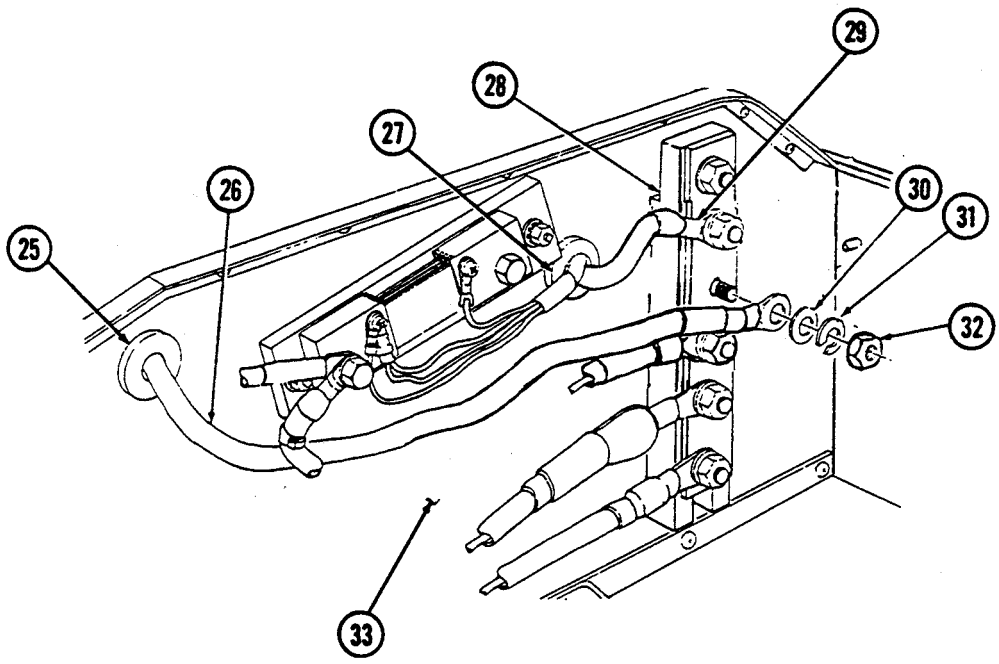
31. Tighten locknuts (17), (9), and (13) to 26 lb-ft (35 Nm).



## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

32. Install two ground cables (22) and alternator ground (21) on cylinder head (20) with washer (23) and capscrew (24).
33. Feed engine harness cable (29) and 200 amp alternator cable (26) (if removed) through grommets (25) and (27) in battery box (33) and install on buss bar (28) with washer (30), lockwasher (31), and nut (32).



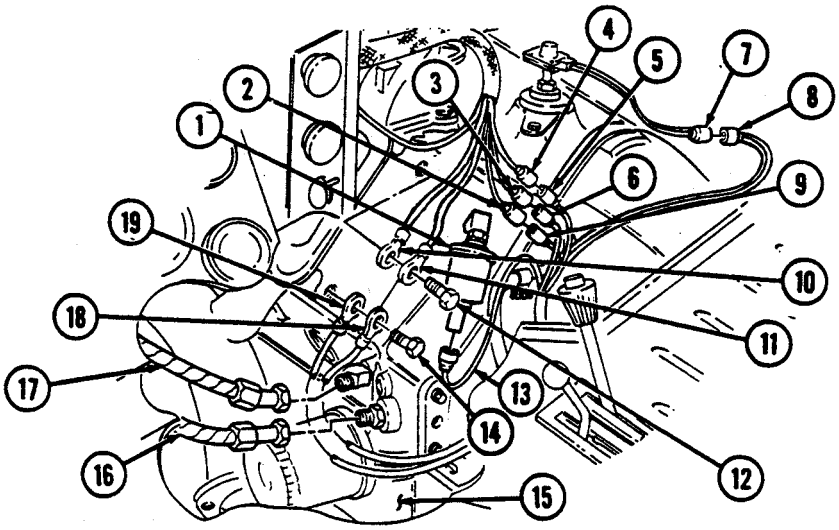
## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

34. Install harness leads 359F/349A (8) on RPM sensor (7).
35. Connect lead 349A (4) to leads 350B/359A/355A (5).
36. Connect engine harness leads 33A (2) and 58B (3) to body harness leads 33A (9) and 58B (6).
37. Connect lead 36A (13) to oil pressure sending unit (1).
38. Install T-case indicator light ground (19) and transmission indicator light ground (18) to engine (15) with screw (14).
39. Install ground leads 3A (10) and 58A (11) to engine (15) with capscrew (12).
40. Connect oil cooler supply line (16) and oil cooler return line (17) to engine (15).
41. Connect two leads 458A (22) to leads 458C (23) and 458D (24).
42. Install clamp (28) and body harness (27) to dipstick support bracket (25) with screw (26) and nut (29).
43. Connect control valve hose (30) to control valve (32) and hydro-boost (36) and tighten clamps (31) and (35) to 10-20 lb-in. (1-2 N•m).

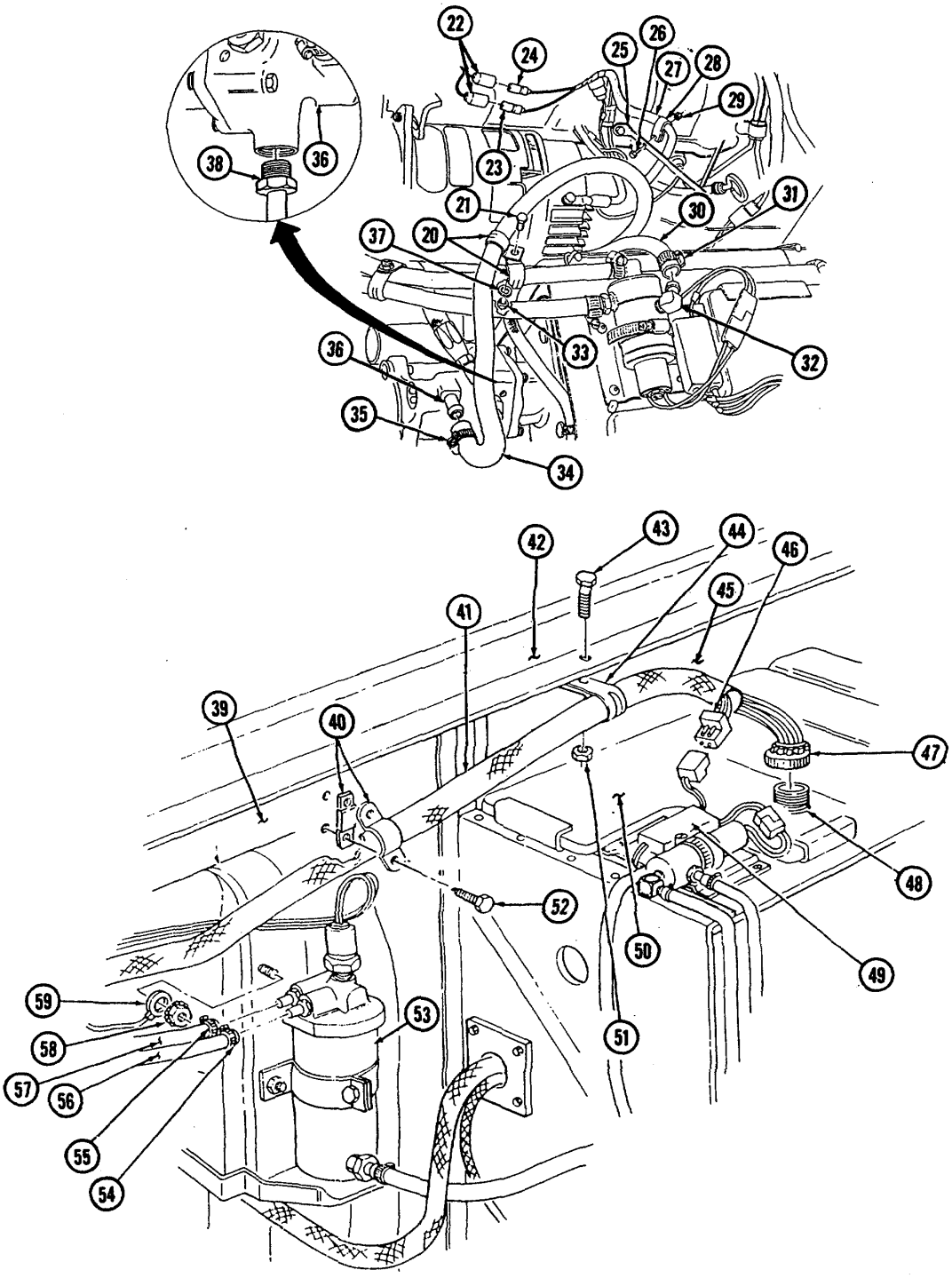
**NOTE**

Perform steps 44 and 45 for all models except M997A2 vehicles.

44. Connect two clamps (20) with capscrew (21), washer (37), and nut (33).
45. Connect high pressure line (38) to hydro-boost (36).
46. Connect fuel inlet (56) and fuel outlet (57) lines to fuel filter (53) and tighten clamps (54) and (55).
47. Connect engine harness connector (46) to time delay module (49).
48. Connect harness connector plug (47) to protective control box (48).
49. Apply antiseize compound to engine harness ground 3C (59) and install on body (39) with assembled locknut (58).
50. Install engine harness (41) on body (39) with clamp (40) and two screws (52).
51. Install engine harness (41) on "A" beam (42) with clamp (44), capscrew (43), and nut (57).
52. Install two rubber insulation pads (45) and (50) on "A" beam (42) and protective control box (48).



**3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)**



## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

53. Install cable assembly (1) on throttle shaft lever (4) with accelerator cable clip (7).
54. Install cable assembly (1) on cable bracket (2) with two nuts (8).
55. Connect throttle return spring (3) to cable bracket (2).

**NOTE**

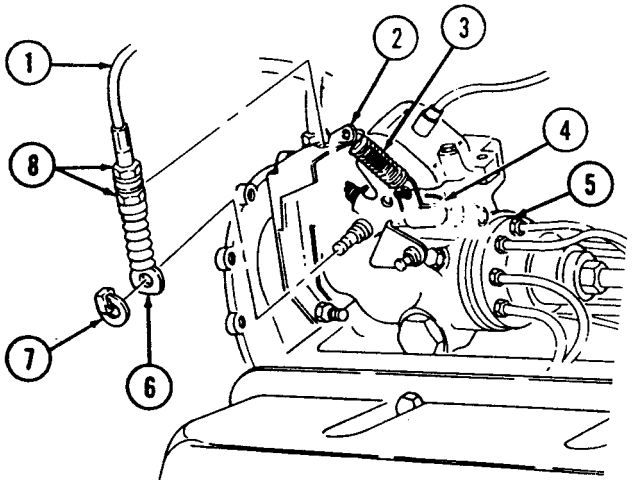
Steps 56 through 61 cover accelerator linkage adjustment.

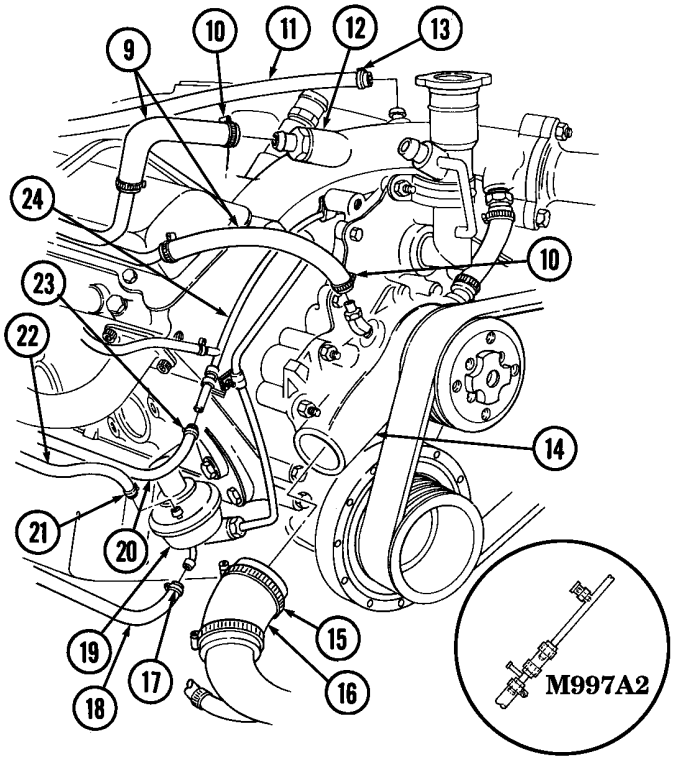
56. Loosen nuts (8) on cable bracket (2).
57. Fully depress accelerator pedal.
58. Hold throttle shaft lever (4) on injection pump (5) in full throttle position.
59. Adjust nuts (8) up or down so cable end (6) holds throttle shaft lever (4) in full throttle position.
60. Tighten nuts (8) connecting cable assembly (1) to cable bracket (2).
61. Release accelerator pedal and ensure throttle shaft lever (4) returns all the way to idle position.

**WARNING**

Ensure fuel pump vent line is properly attached to top vent line fitting of fuel pump. Improper vent line installation may cause injury to personnel or damage to equipment.

62. Connect vent line (22) to fuel pump (19) and tighten clamp (21).
63. Connect fuel supply line (18) to fuel pump (19) and tighten clamp (17) to 10-20 lb-in. (1-2 N•m).
64. Connect fuel return hose (20) to fuel return line (24) and tighten clamp (23) to 10-20 lb-in. (1-2 N•m).
65. Connect water hoses (9) to water crossover (12) and water pump (14) and tighten clamps (10).
66. Connect water pump inlet hose (16) to water pump (14) and tighten clamp (15).
67. Connect surge tank-to-water crossover hose (11) to crossover (12) and tighten clamp (13) to 10-20 lb-in. (1-2 N•m).



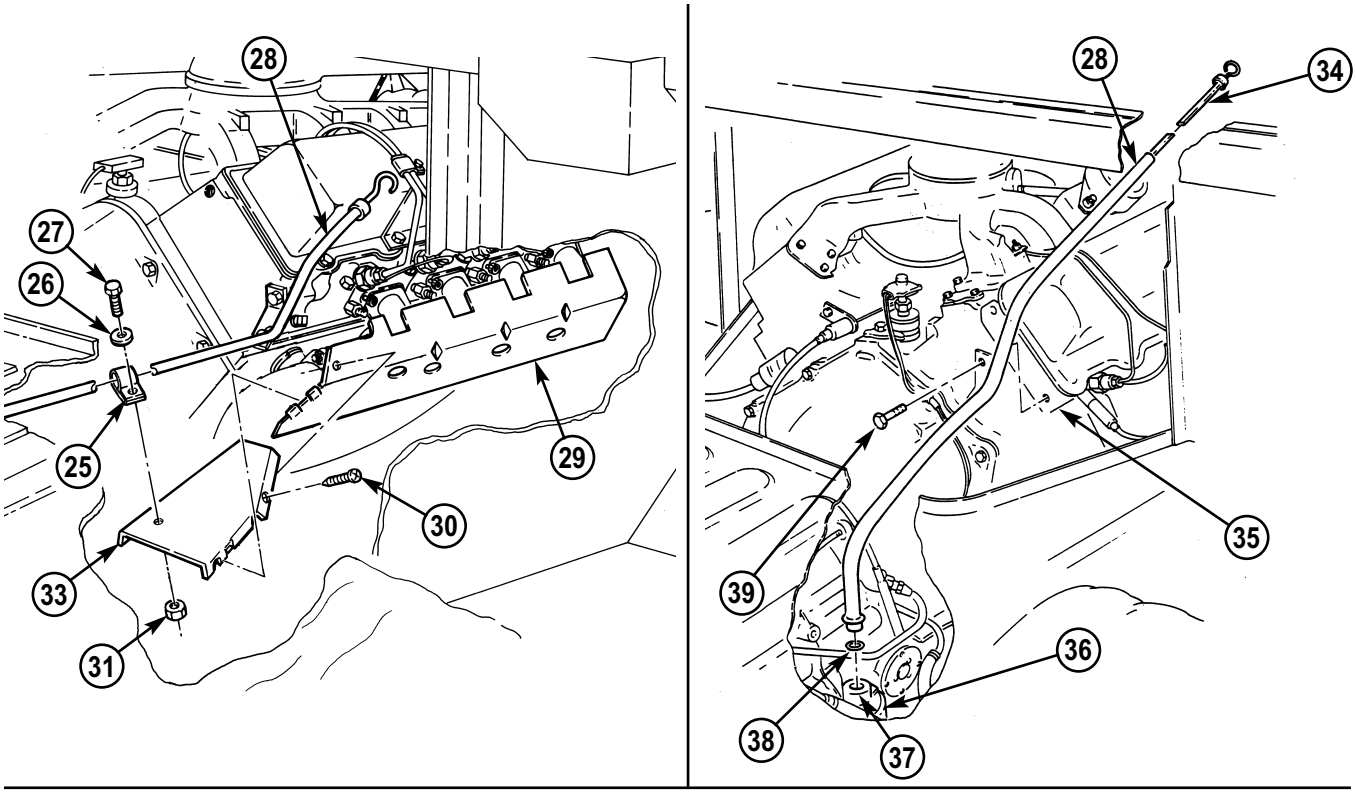
## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

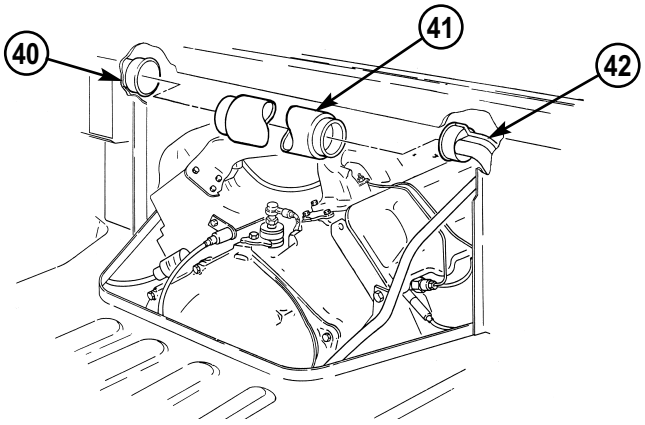
68. Install rear shield (33) on heat shield (29) with capscrew (30).

**NOTE**

Remove plug prior to installation of transmission oil dipstick tube.

69. Apply RTV sealant on O-ring (38) and install O-ring (38) on transmission oil dipstick tube (28).
70. Push dipstick tube (28) into opening (37) in transmission (36).
71. Install dipstick tube (28) on cylinder head (35) with capscrew (39). Tighten capscrew (39) to 25-37 lb-ft (34-50 N.m).
72. Connect heater hose (41) to left transition (40) and right transition (42), and installed heater hose (41).
73. Install clamp (25) and rear heat shield (33) to transmission dipstick tube (28) with washer (26), capscrew (27), and nut (31).
74. Install transmission oil dipstick (34) in dipstick tube (28).



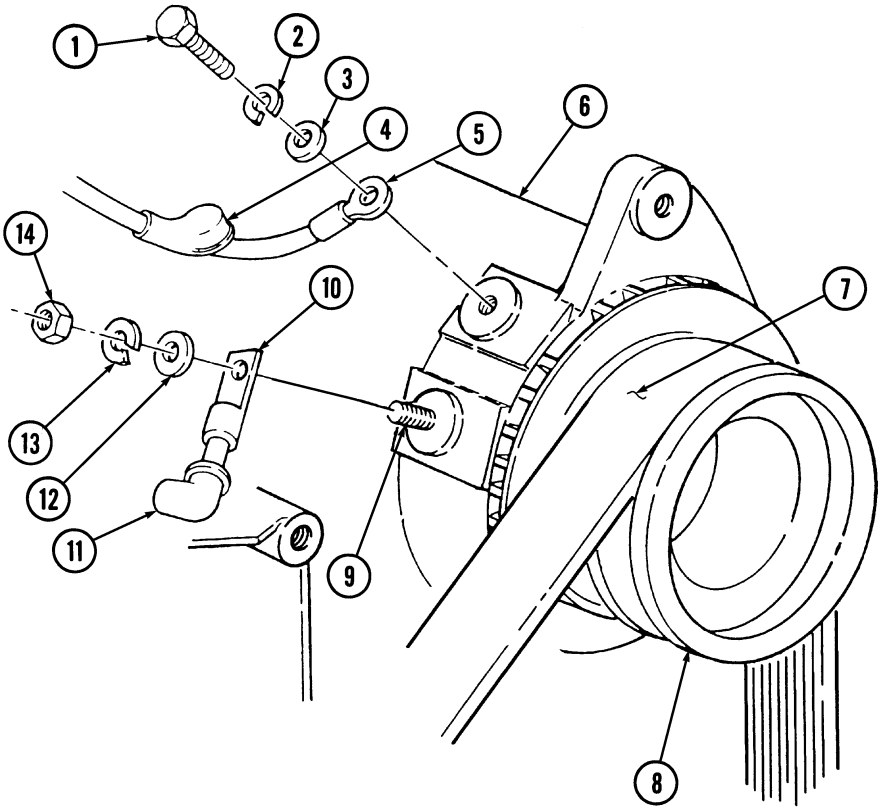
## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

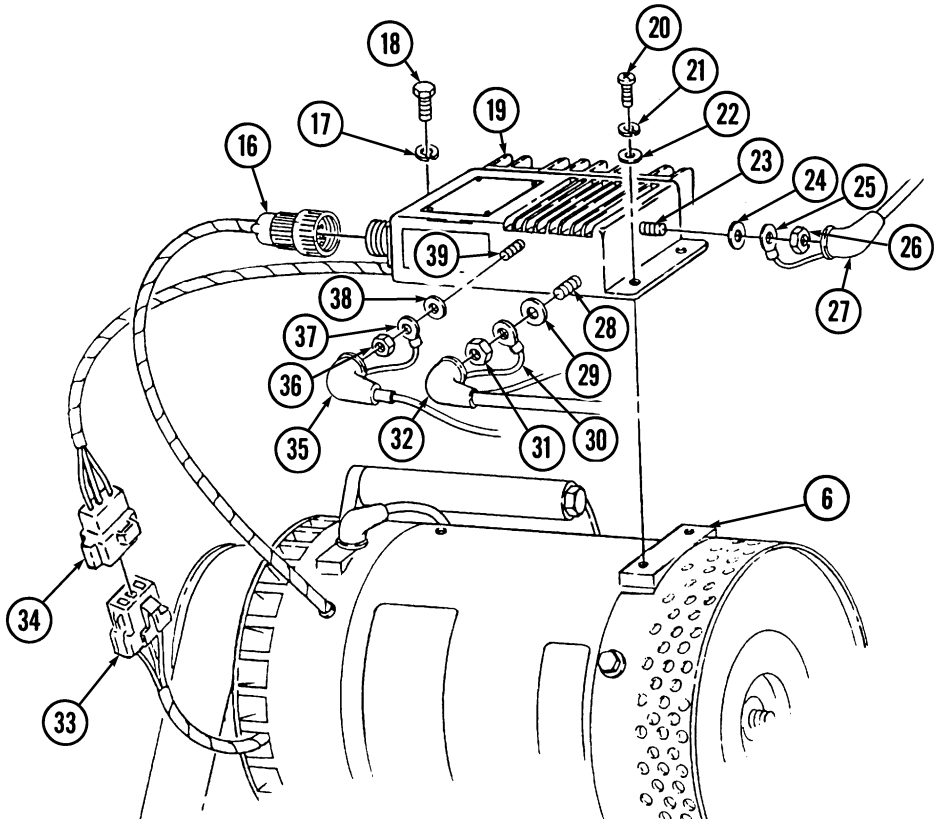
**NOTE**

- Perform steps 75 through 86 for vehicles equipped with Neihoff 100 amp alternator only.
- Ensure terminals are clean before connections are made.

75. Install positive cable (10) on positive stud (9) with washer (12), lockwasher (13), and nut (14). Tighten nut (14) to 10-15 lb-ft (14-20 N•m)
76. Install ground cable (5) on alternator (6) with washer (3), lockwasher (2), and capscrew (1). Tighten capscrew (1) to 8-12 lb-ft (11-16 N•m).
77. Position drivebelt (7) on pulley (8).
78. Install rubber boots (11) and (4) over cables (5) and (10).
79. Apply sealing compound to threads of capscrew (18).
80. Install voltage regulator (19) on alternator (6) with spring tension washer (17) and capscrew (18). Tighten capscrew (18) to 88-94 lb-in. (10-11 N•m)
81. Install two washers (22), lockwashers (21), and screws (20) on voltage regulator (19) and alternator (6). Tighten screws (20) to 30-34 lb-in. (3-4 N•m)
82. Install washer (24), lead (25), and nut (26) on terminal (23). Tighten nut (26) to 18-22 lb-in. (2.0-2.5 N•m). Slide rubber boot (27) over terminal (23).
83. Connect regulator connector (34) to alternator connector (33).
84. Install washer (38), lead 5A (37), and nut (36) on red (energize) terminal (39). Tighten nut (36) to 23-27 lb-in. (2.6-3.0 N•m). Slide rubber boot (35) over terminal (39).
85. Install washer (29), lead 2A (30), and nut (31) on yellow (AC) terminal (28). Tighten nut (31) to 18-22 lb-in (2.0-2.5 N•m). Slide rubber boot (32) over terminal (28).
86. Connect regulator plug (16) to voltage regulator (19).

## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)



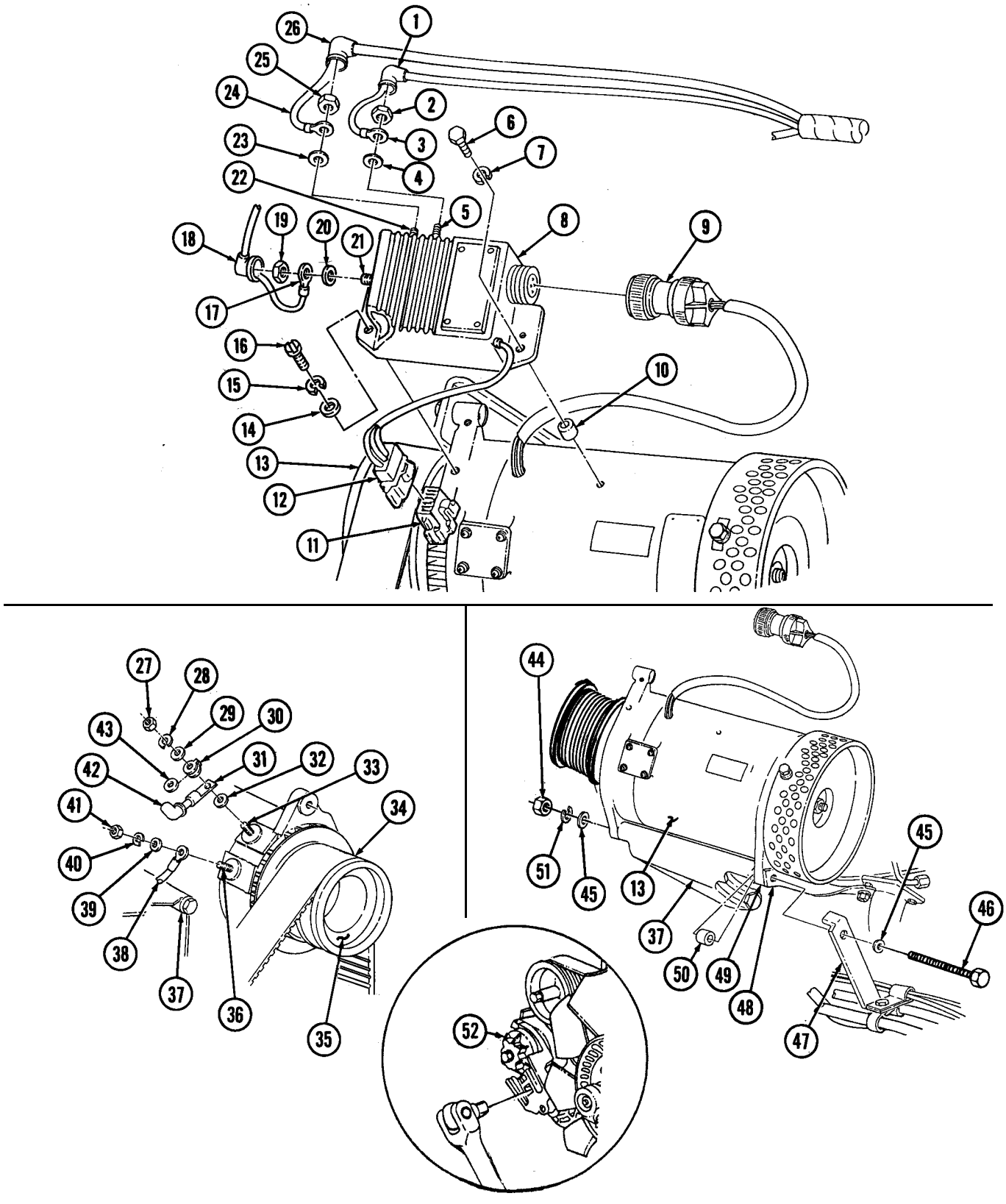
## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

**NOTE**

- Perform steps 87 through 101 for vehicles equipped with Neihoff 200 amp alternator only.
- Ensure terminals are clean before connections are made.

87. Position alternator (13) on mounting bracket (37) with support bracket (48) and power steering lines bracket (47) on outside of alternator mounting flange (49) and install spacer (50), washer (45), thru-bolt (46), washer (45), lockwasher (51), and nut (44).
88. Deleted
89. Deleted
90. Install insulator washer (43) in fuse link (30).
91. Install washer (32), positive cable (31), fuse link (30), and insulator washer (43) on positive stud (33) with washer (29), lockwasher (28), and nut (27). Tighten nut (27) to 10-15 lb-ft (14-20 N•m).
92. Install lead 3B (38) to negative stud (36) with washer (39), lockwasher (40), and nut (41). Tighten nut (41) to 8-12 lb-ft (11-16 N•m).
93. Position 3/8-inch breaker bar on belt tensioner (52), move tensioner (52) clockwise and install drivebelt (34) on pulley (35). Release belt tensioner (52).
94. Install rubber boot (42) over stud (33).
95. Apply sealing compound to threads of capscrew (6).
96. Install spacer (10) and voltage regulator (8) on alternator (13) with lockwasher (7) and capscrew (6). Tighten capscrew (6) to 88-94 lb-in. (10-11 N•m).
97. Install two washers (14), spring tension washers (15), and screws (16) connecting voltage regulator (8) to alternator (13). Tighten screws (16) to 30-34 lb-in. (3-4 N•m)
98. Install washer (20), lead (17), and nut (19) on terminal (21). Tighten nut (19) to 18-22 lb-in. (2.0-2.5 N•m). Slide rubber boot (18) over terminal (21).
99. Install washer (23), lead 5A (24), and nut (25) on red (energize) terminal (22). Tighten nut (25) to 23-27 lb-in. (2.6-3.0 N•m). Slide rubber boot (26) over terminal (22).
100. Install washer (4), lead 2A (3), and nut (2) on yellow (AC) terminal (5). Tighten nut (2) to 18-22 lb-in. (2.0-2.5 N•m). Slide rubber boot (1) over terminal (5).
101. Connect regulator plug (9) to voltage regulator (8).
102. Connect lead (12) to connector (11).

## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

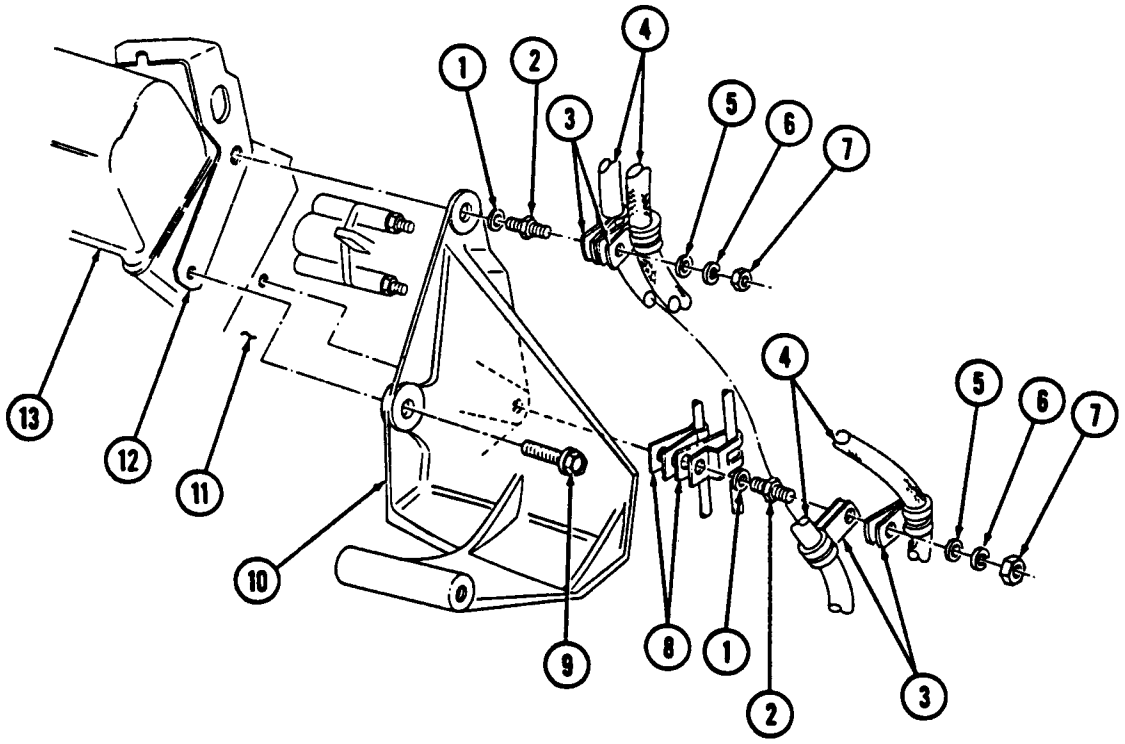


## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

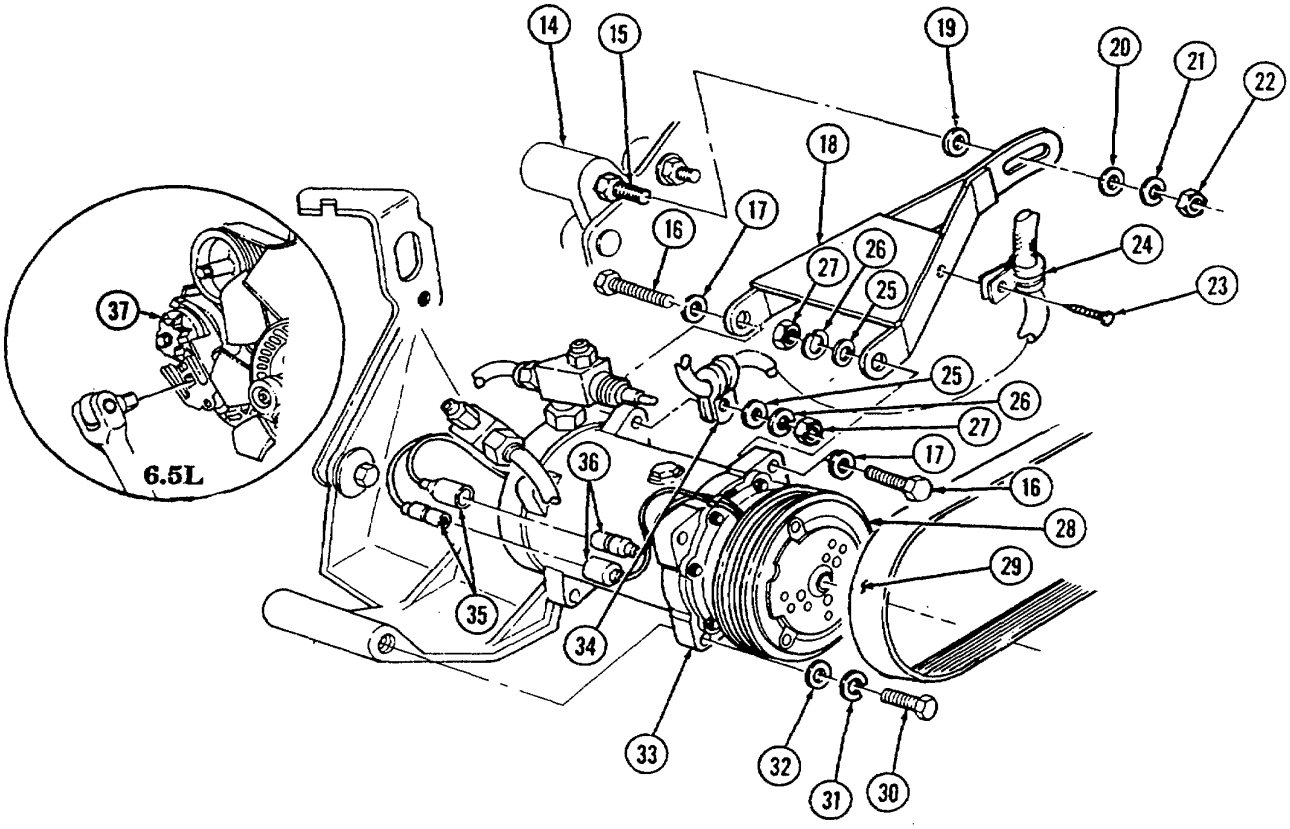
**NOTE**

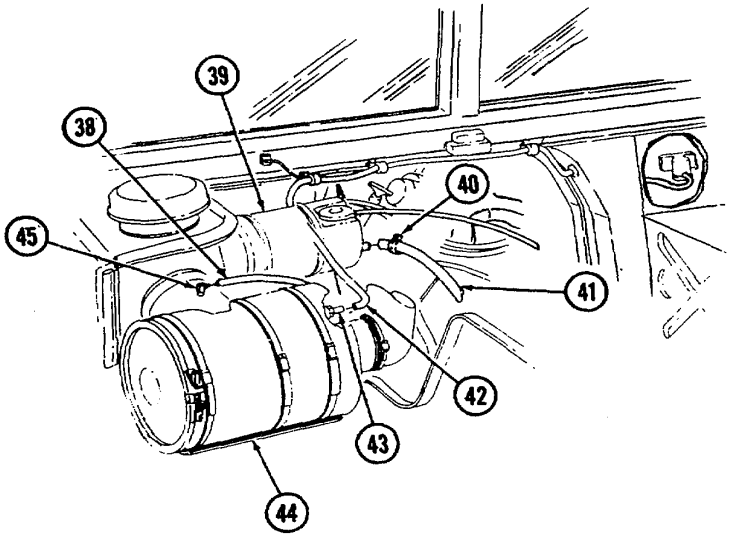
Perform steps 103 through 115 for M997A2 vehicles only.

103. Install brackets (12) and (10) and two fuel line clamps (8) on cylinder head (13) and engine block (11) with two washers (1) and studs (2). Tighten studs (2) to 40 lb-ft (54 N•m).
104. Install four clamps (3) and two cables (4) on studs (2) with two washers (5), lockwashers (6), and nuts (7). Tighten nuts (7) to 40 lb-ft (54 N•m).
105. Secure brackets (12) and (10) on cylinder head (13) with capscrew (9).
106. Tighten capscrew (9) to 40 lb-ft (54 N•m).
107. Install compressor (33) on support bracket (10) with two washers (32), lockwashers (31), and capscrews (30). Do not tighten capscrews (30).
108. Position 3/8-inch breaker bar on belt tensioner (37), move tensioner (37) clockwise, and install drivebelt (29) on pulley (28). Release belt tensioner (37).
109. Install washer (19) and adjusting bracket (18) onto stud (15) on engine front cover (14) with washer (20), lockwasher (21), and nut (22). Install adjusting bracket (18) and harness clamp (34) on compressor (33) with two washers (17), capscrews (16), washers (25), lockwashers (26), and nuts (27).
110. Connect two harness leads (35) to two compressor leads (36).
111. Install clamp (24) on adjusting bracket (18) with screw (23).
112. Tighten two capscrews (30) to 40 lb-ft (54 N•m).
113. Install hose (41) on surge tank (39) with clamp (40).
114. Connect vent line (38) to elbow (45) on air cleaner (44).
115. Connect vent line (42) to air cleaner fitting (43) on air cleaner (44).



**3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)**



**3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)**

116. Position CDR valve (12) and bracket (10) over two intake manifold studs (3) and valve cover studs (6).

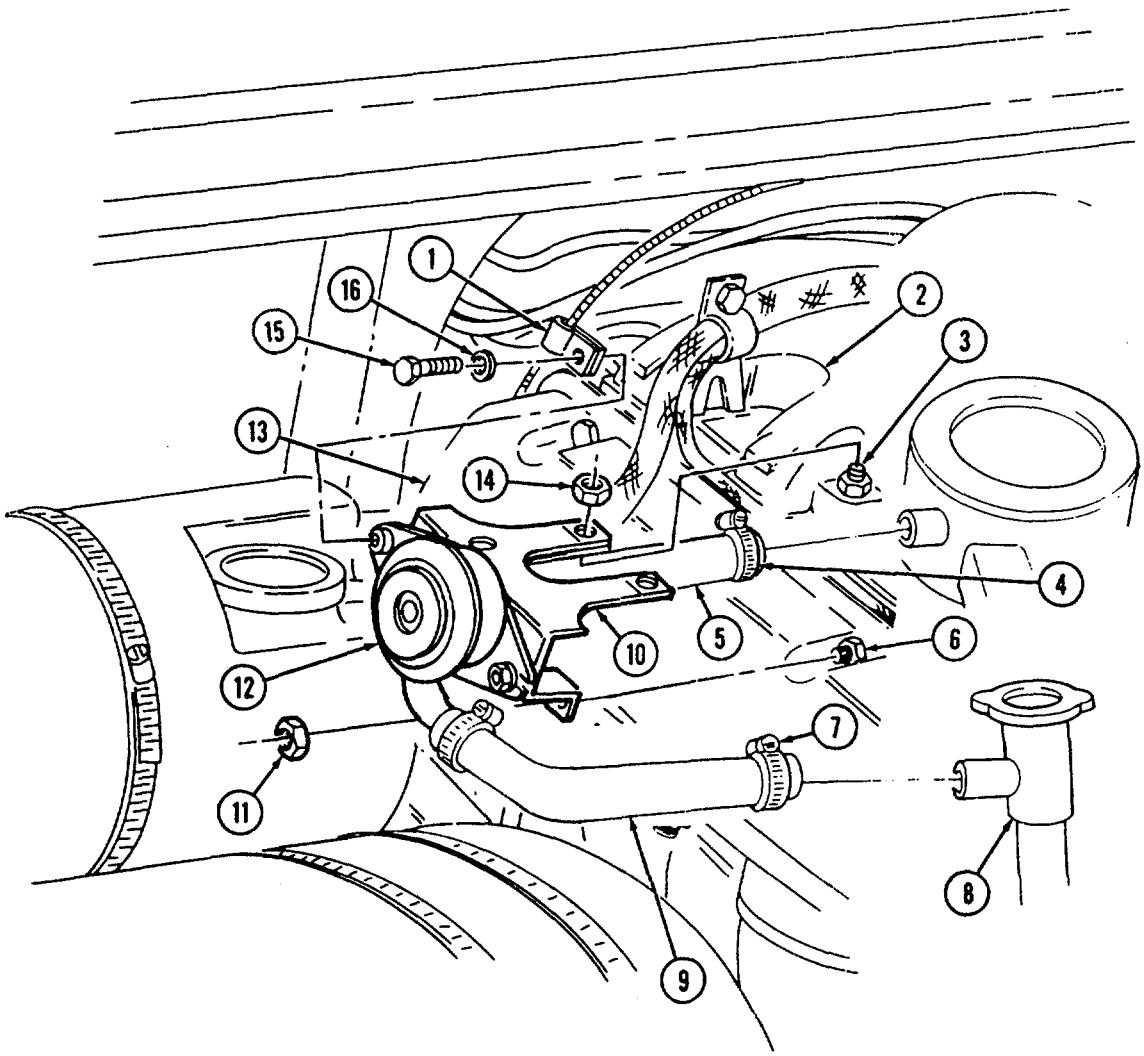
117. Secure CDR valve (12) and bracket (10) on intake manifold (2) with two nuts (14). Tighten nuts (14) to 15 lb-ft (20 N·m).

118. Secure CDR valve (12) and bracket (10) on valve cover (13) with two nuts (11). Tighten nuts (11) to 10 lb-ft (14 N·m).

119. Install heater control cable clamp (1) to CDR valve (12) and bracket (10) with washer (16) and screw (15). Tighten screw (15) to 15 lb-ft (20 N·m).

120. Connect CDR valve oil fill tube hose (9) to oil fill tube (8) and tighten clamp (7).

121. Connect CDR valve intake manifold hose (5) to intake manifold (2) and tighten clamp (4).



## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

**NOTE**

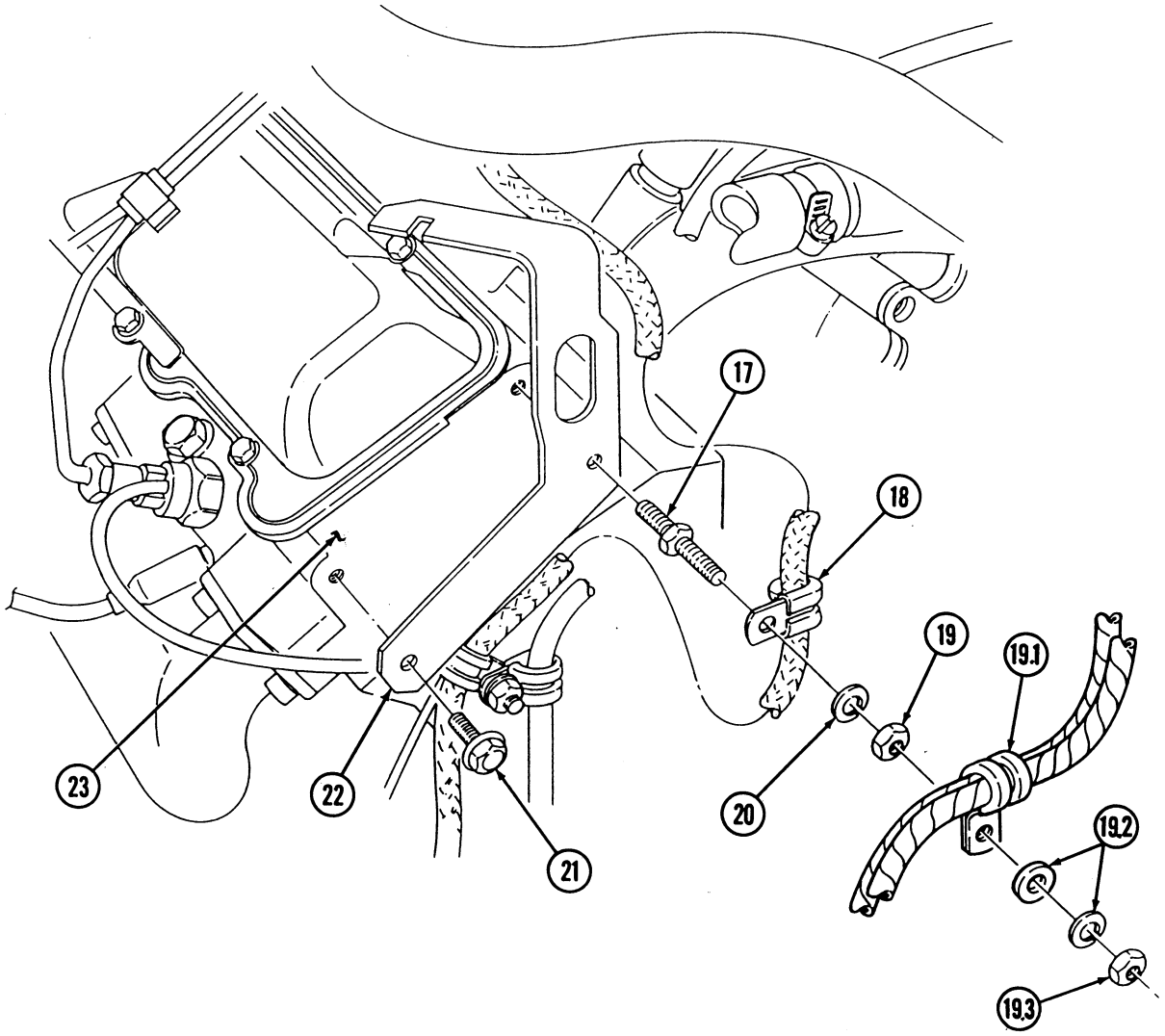
Steps 123 through 124.1 apply to all models except M997A2 vehicles.

122. Install air horn support bracket (22) on engine block (23) with stud (17).

123. Install lower end of air horn support bracket (22) on engine block (23) with capscrew (21). Tighten capscrew (21) and stud (17) to 40 lb-ft (54 N·m).

124. Install clamp (18) on stud (17) with washer (20) and nut (19).

124.1. Install clamp (19.1) on stud (17) with two washers (19.2) and nut (19.3).



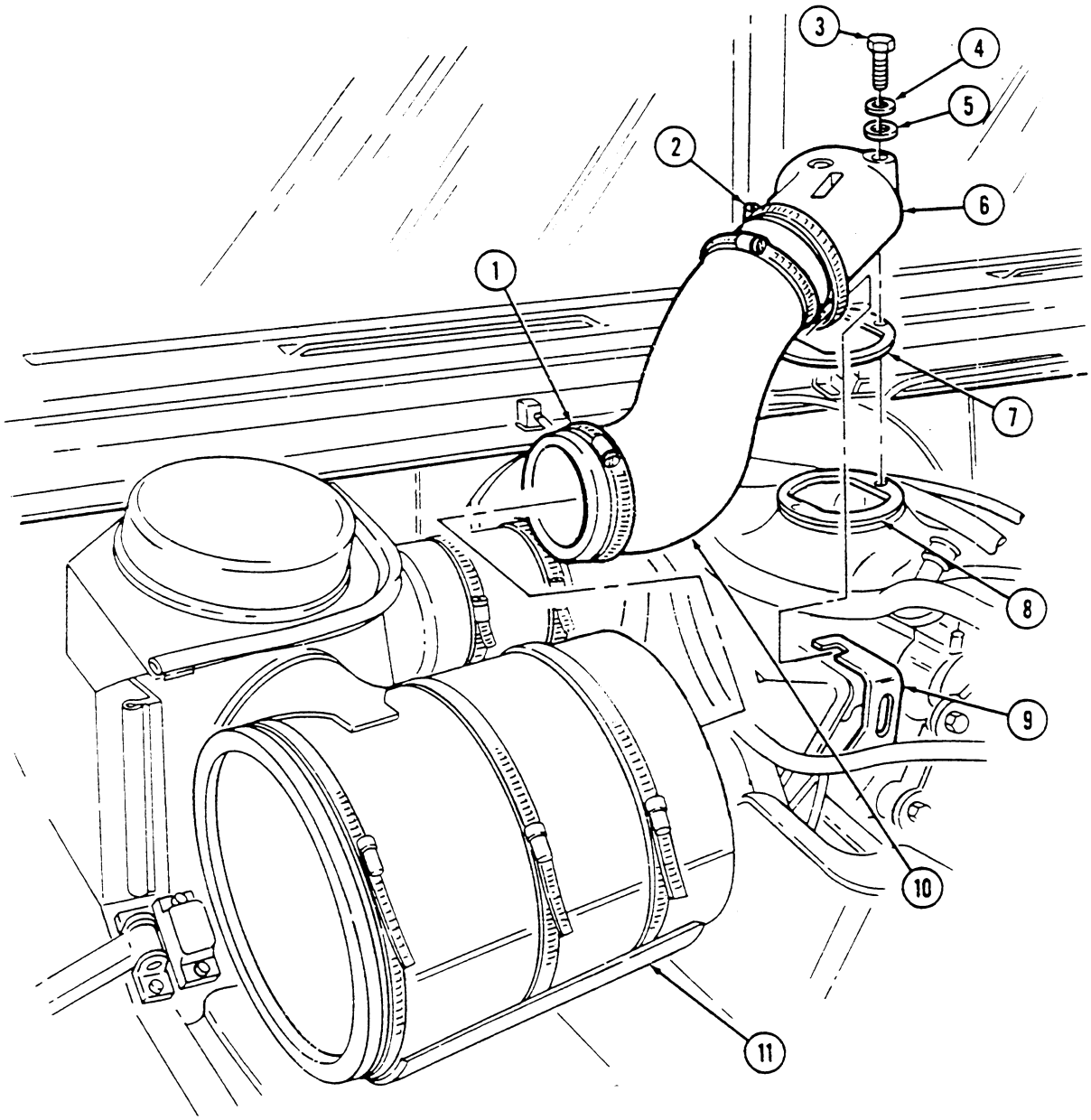
## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

125. Install gasket (7) on intake manifold (8).

126. Coat threads of two screws (3) with sealing compound. Install air horn (6) and air intake elbow (10) on intake manifold (8) with two flat washers (5), washers (4), and screws (3). Tighten screws (3) to 40-45 lb-in. (54-61 N·m).

127. Install air intake elbow (10) on air cleaner (11) and tighten clamp (1).

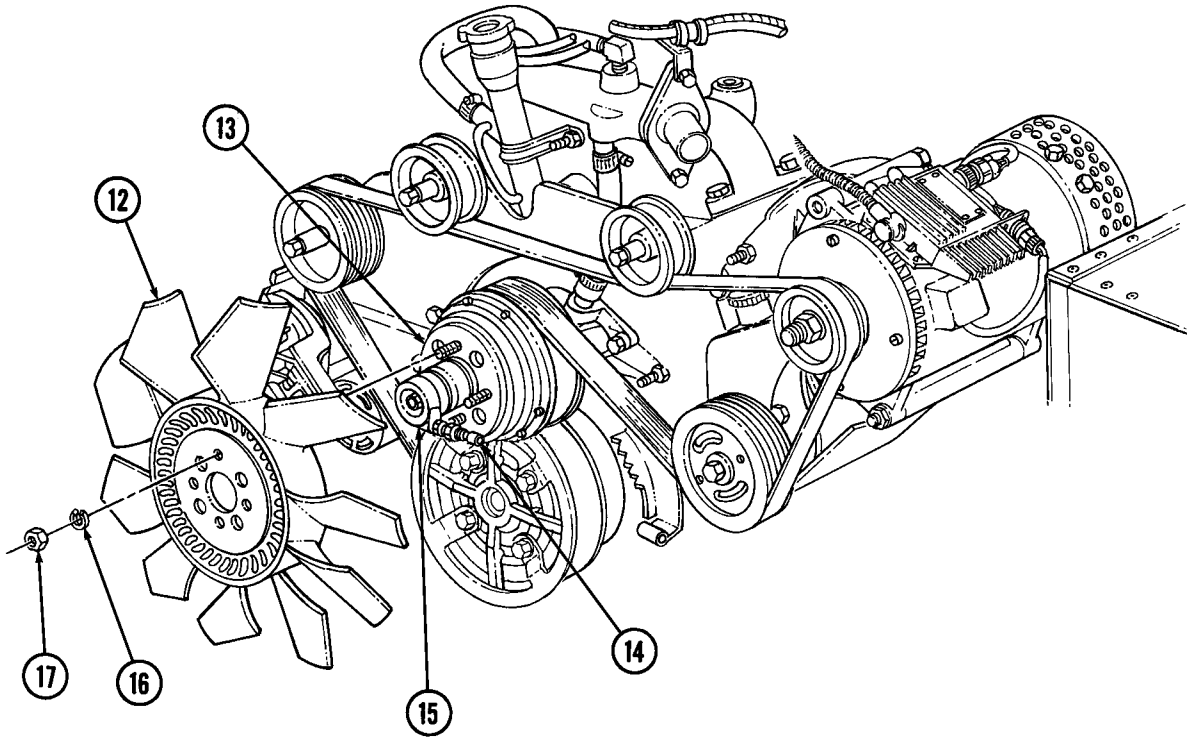
128. Slide clamp (2) to air horn support bracket (9). Install air horn (6) on air horn support bracket (9) and tighten clamp (2).



## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

129. Position fitting (14) on clutch adapter (15) at 6 o'clock.

130. Align fan blade (12) onto fan drive (13) and install with four lockwashers (16) and nuts (17). Tighten nuts (17) to 45 lb-ft (61 N·m).



**3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)**

131. Align radiator assembly (3) to frame bracket (21), and rear support brackets (24) to airlift brackets (7).

132. Install rear support brackets (24) on airlift brackets (7) with four capscrews (12), washers (11), and locknuts (10). Do not tighten locknuts (10).

133. Install radiator assembly (3) and mount (20) on frame bracket (21) with large washer (22), washer (19), capscrew (23), washer (19), and locknut (18). Do not tighten capscrew (23).

134. Connect two transmission oil cooler line connector hoses (25) to transmission oil cooler ports (27) and tighten hose clamps (26) to 10-20 lb-in. (1-2 N·m).

135. Connect engine oil cooler supply and return lines (29) to engine oil cooler ports (28).

136. Connect hoses (30) and (31) to radiator (3) and tighten clamp (32).

**NOTE**

- Fan shroud should be aligned so the following dimensions are maintained. Adjustments may be made by tilting the radiator/shroud assembly. Distance "A" from the edge of shroud ring and rear edge of fan must be 1.5 ± .125 in. (38.1 ± 3 mm). Measure distance "A" at the 2, 4, 8, and 10 o'clock positions.

- Fan blade to fan shroud clearance, the distance between the top of the fan blade and fan shroud, must not be less than .25 in. (6 mm) at any position.

137. Tighten locknuts (10) to 26 lb-ft (35 N·m). Tighten capscrew (23) to 30 lb-ft (41 N·m).

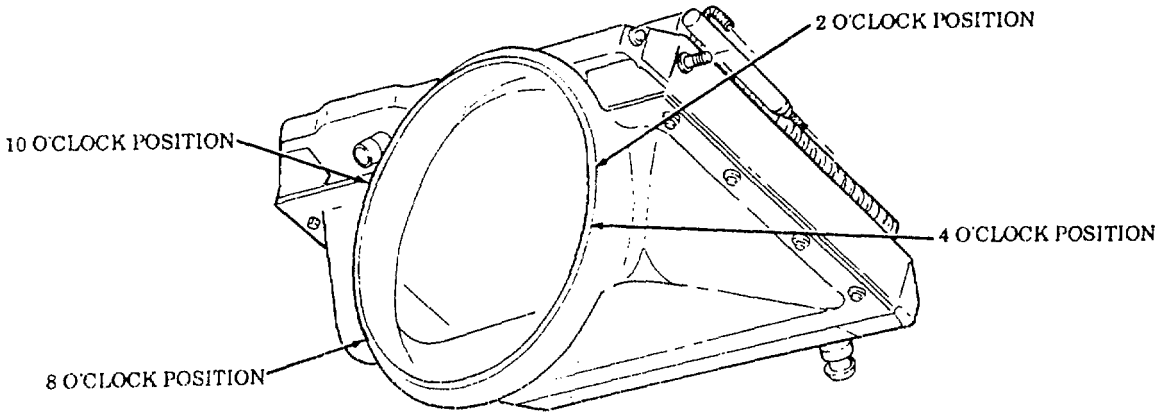
138. Connect lower radiator front hose (9) to radiator (3) and tighten clamp (8).

139. Connect fan drive hose quick disconnect (13) to fan drive disconnect (14).

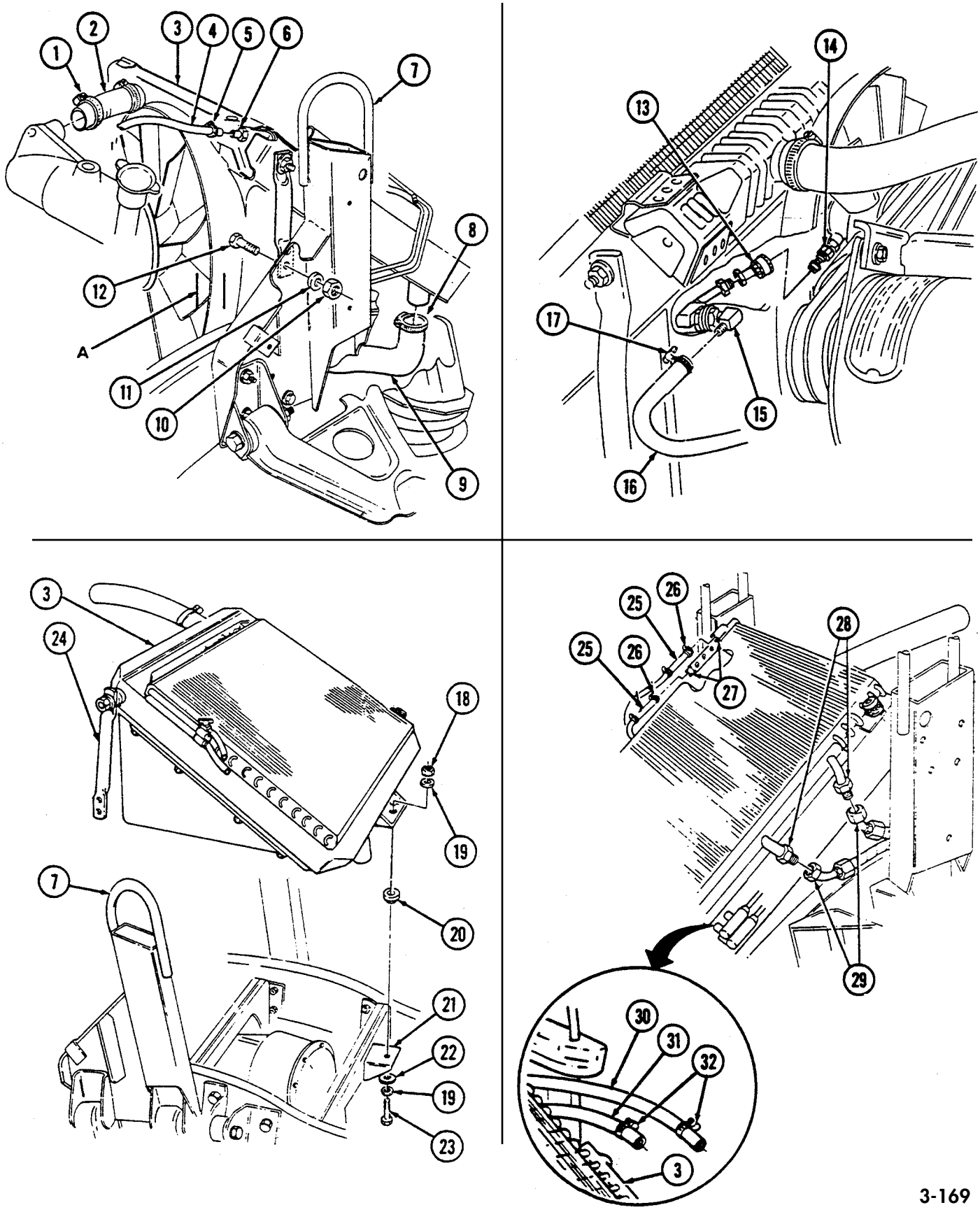
140. Connect control valve hose (16) to bulkhead adapter (15) and tighten clamp (17).

141. Connect radiator inlet hose (2) to engine and tighten clamp (1).

142. Connect surge tank-to-radiator vent hose (4) to adapter (6) and tighten clamp (5).

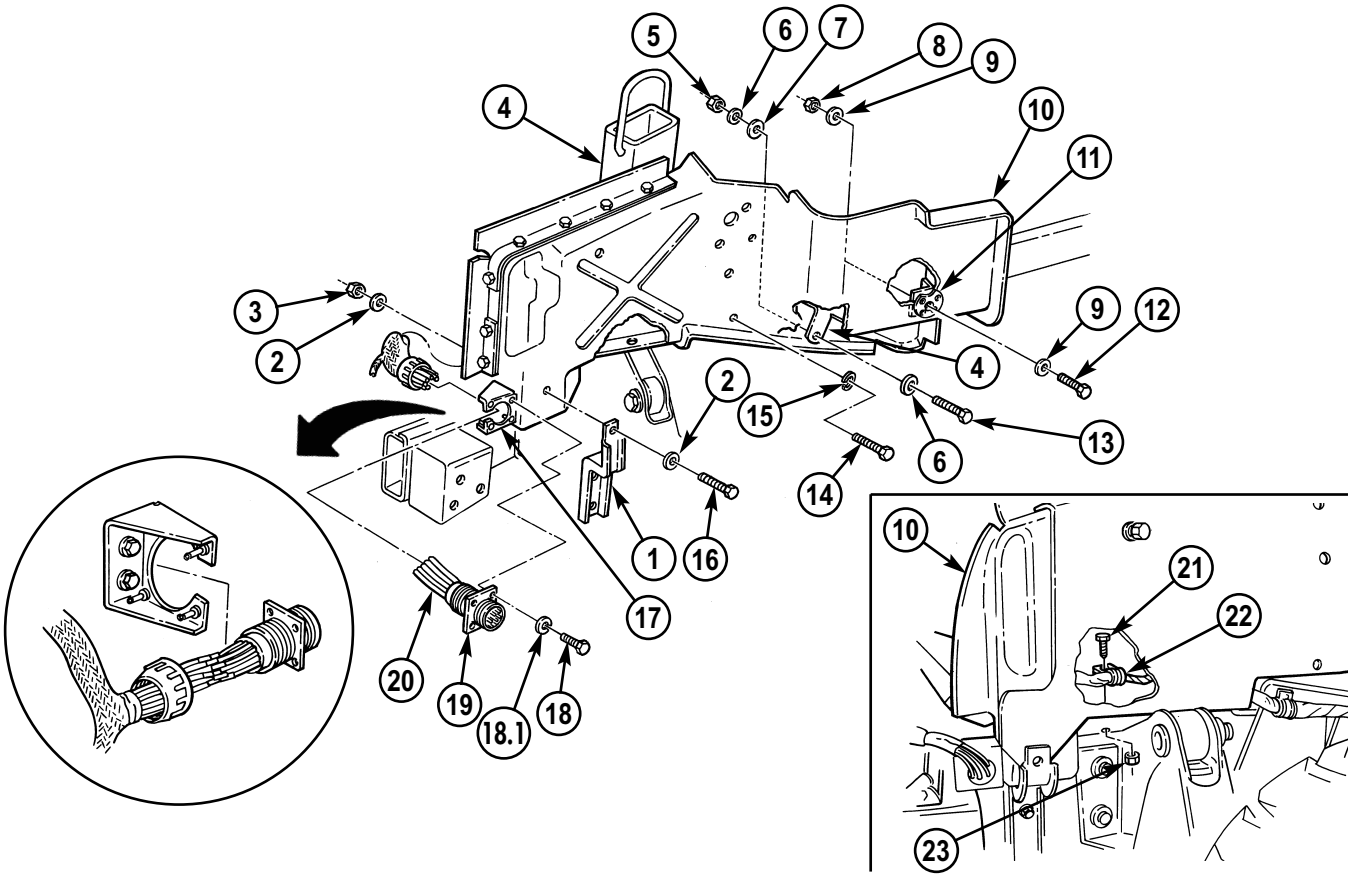


## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

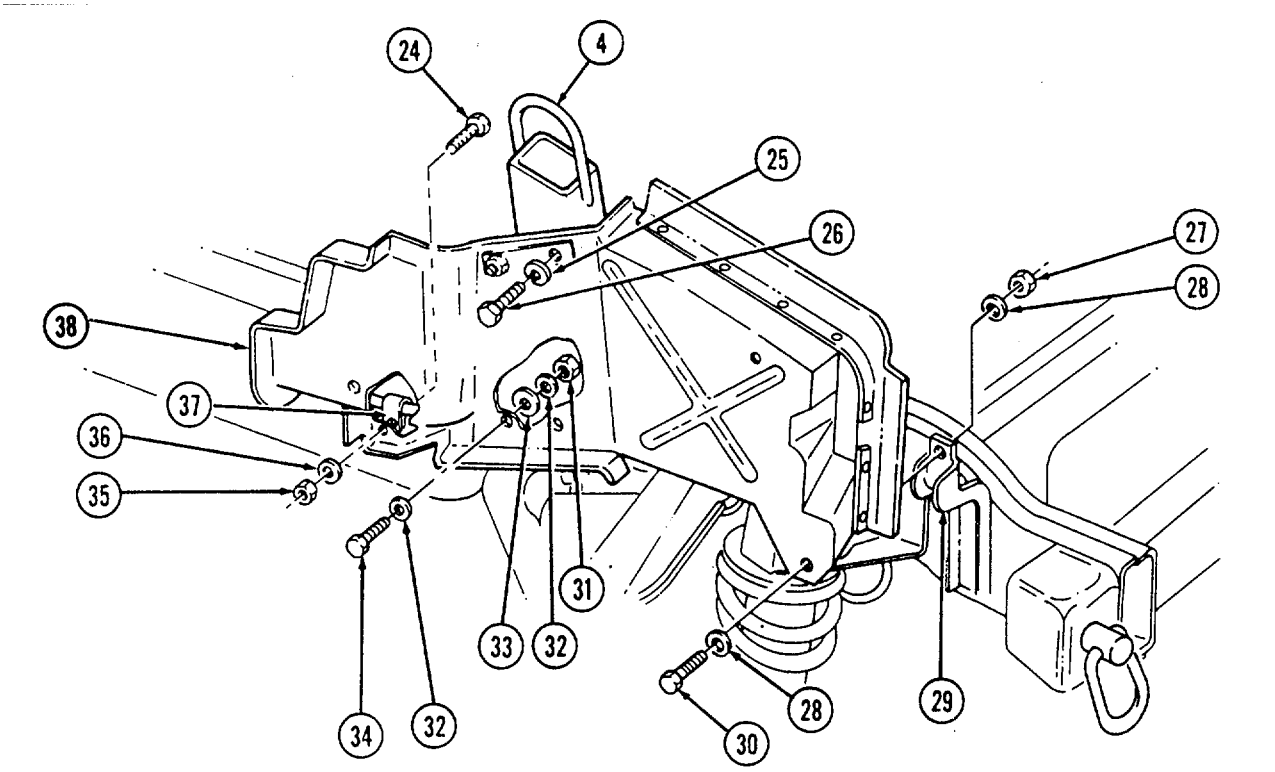


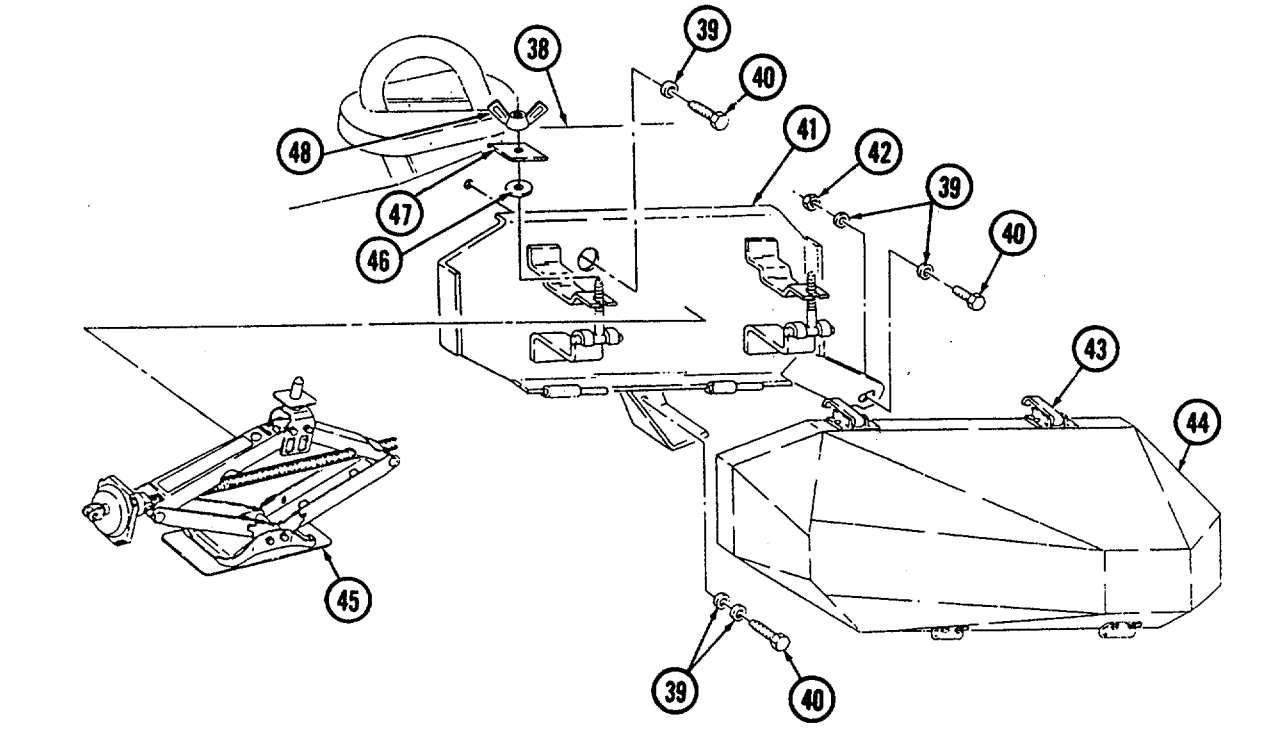
## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)

143. Install left splash shield (10) on bracket (11) with washer (9), capscrew (12), washer (9), and locknut (8).
144. Install harness and clamp (22) on splash shield (10) with screw (21) and assembled locknut (23).
145. Install connector receptacle (19) on bracket (17) with four screws (18) and lockwashers (18.1). Tighten receptacle cover (20).
146. Install left splash shield (10) on airlift bracket (4) with washer (15) and capscrew (14). Tighten capscrew (14) to 15 lb-ft (20 N·m).
147. Install left splash shield (10) on airlift bracket (4) with washer (6), capscrew (13), washer (7), washer (6), and locknut (5). Tighten capscrew (13) to 95-145 lb-in. (11-16 N·m).
148. Install left splash shield (10) on support bracket (1) with washer (2), capscrew (16), washer (2), and locknut (3). Tighten capscrew (16) to 6 lb-ft (8 N·m).
149. Install right splash shield (38) on airlift bracket (4) with lockwasher (25) and screw (26).
150. Install right splash shield (38) on airlift bracket (4) with washer (32), capscrew (34), washer (33), washer (32), and locknut (31). Tighten capscrews (34) to 15 lb-ft (20 N·m).
151. Install right splash shield (38) on support bracket (29) with washer (28), capscrew (30), washer (28), and locknut (27). Tighten capscrew (30) to 15 lb-ft (20 N·m).
152. Install fuel line clamp (37) on splash shield (38) with washer (36), capscrew (24), and locknut (35). Tighten capscrew (24) to 15 lb-ft (20 N·m).
153. Install bracket (41) on splash shield (38) with four washers (39), three capscrews (40), washer (39), and nut (42).
154. Install cover (44) on bracket (41).
155. Install jack (45) on bracket (41) with two washers (46), spacers (47), and wing nuts (48).
156. Install cover (44) on bracket (41) with two latches (43).



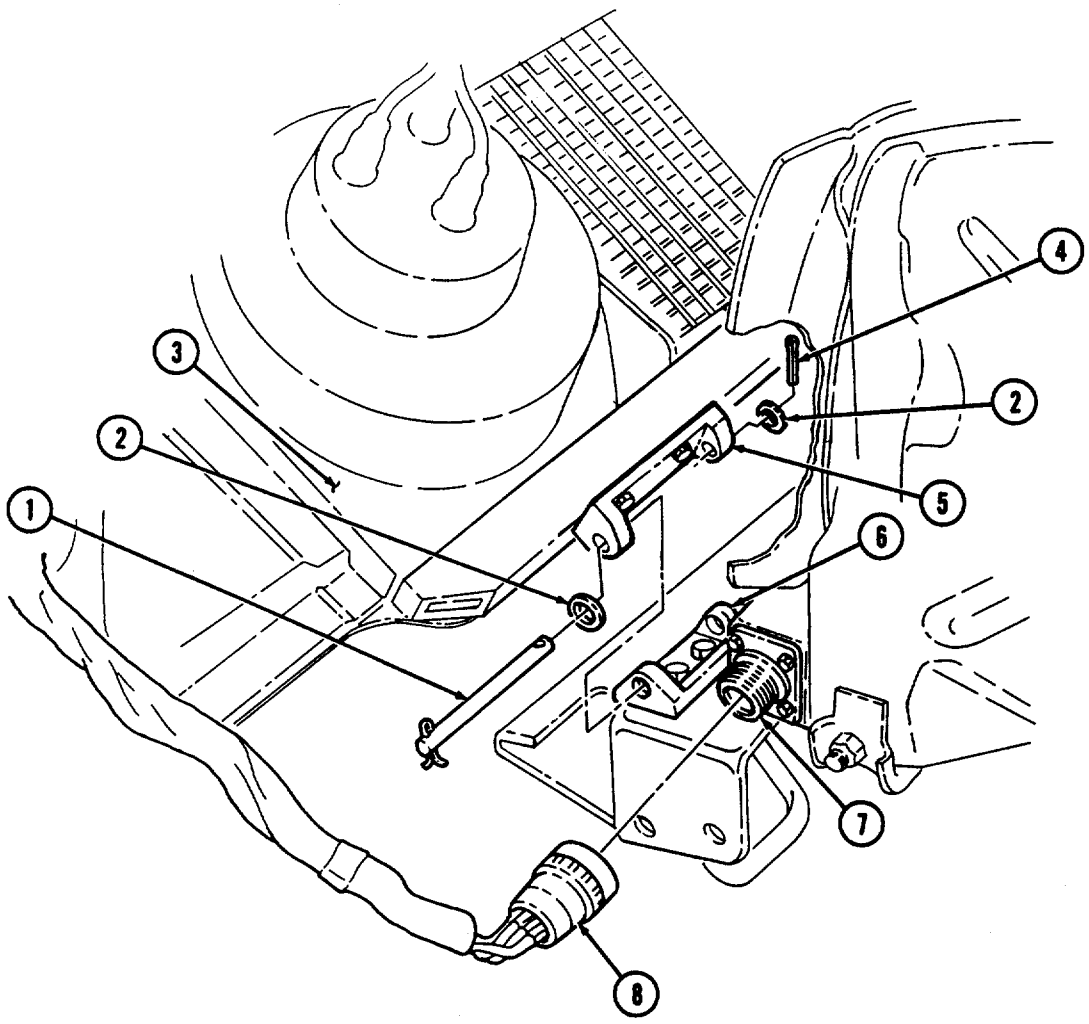
**3-25. ENGINE INSTALLATION (6.5L) (Cont'd)**



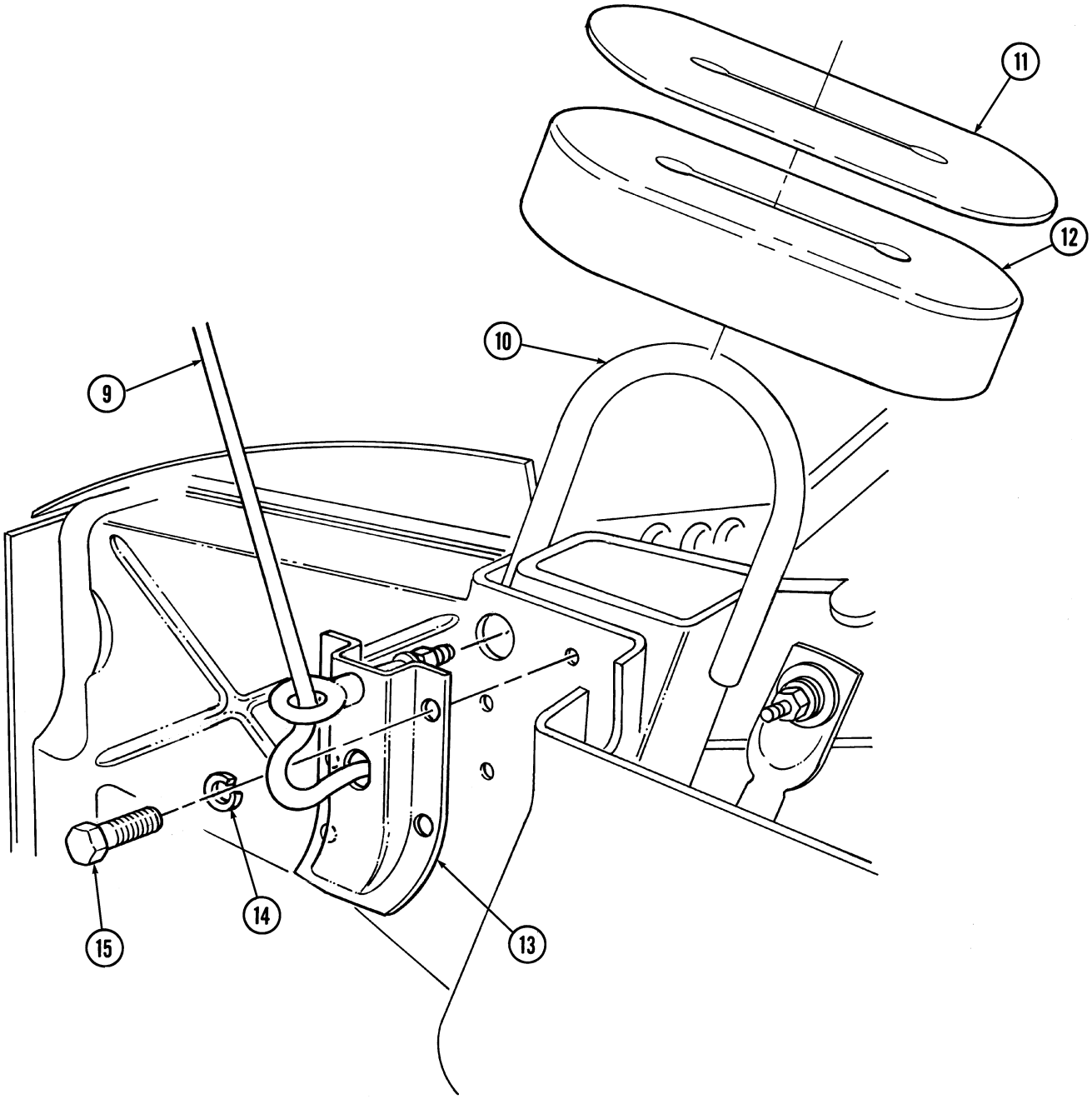



**3-25. ENGINE INSTALLATION (6.5L) (Cont'd)**

157. Install hood (3) and align two upper hinge halves (5) with lower hinge halves (6).
158. Install two upper hinge halves (5) on lower hinge halves (6) with washers (2), hinge pins (1), washers (2), and cotter pins (4).
159. Install hood prop rod (9) and bracket (13) on airlift bracket (10) with four lockwashers (14) and screws (15). Tighten screws (15) to 6 lb-ft (8 N m).
160. Connect plug (8) to receptacle (7).
161. Install two seals (12) and cover plates (11) on airlift brackets (10).



## 3-25. ENGINE INSTALLATION (6.5 L) (Cont'd)




FOLLOW-ON TASKS:
- Fill engine oil, transmission oil, and power steering fluid to proper levels (TM 9-2320-280-10).
- Connect battery ground cable (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).
- Perform engine run-in (para. 3-20).

# 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L)

**This task covers:**

**a. Disassembly** **b. Assembly**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**

Hex head driver, 8 mm, (Appendix G, Item 115)
Torque adapter, 9/16 in. (Appendix G, Item 109)
Crowfoot, 9/16 in. (Appendix G, Item 116)
Engine lifting sling (Appendix G, Item 22)
Engine stand (Appendix G, Item 23)
Belt tension gage (Appendix G, Item 27)

**Materials/Parts**

Two lockwashers (Appendix E, Item 120)
Nine lockwashers (Appendix E, Item 104)
Lockwasher (Appendix E, Item 103)
Ten lockwashers (Appendix E, Item 100)
Three lockwashers (Appendix E, Item 89)
Two lockwashers (Appendix E, Item 90)
Two lockwashers (Appendix E, Item 107)
Locknut (Appendix E, Item 54)
Plain assembled nut (Appendix E, Item 123)
Screw-assembled washer
(Appendix E, Item 199)
Screw-assembled washer
(Appendix E, Item 200)
O-ring (Appendix E, Items 128)

**Materials/Parts (Cont'd)**

Antiseize compound (Appendix B, Item 7)
Adhesive sealant (Appendix B, Item 2)
RTV sealant (Appendix B, Item 43)
Sealing compound (Appendix B, Item 49)
Sealing compound, thread-locking
(Appendix B, Item 50)

**Manual References**

TM 9-2320-280-24P

**Equipment Condition**

Engine removed (para. 3-22 or 3-24).

**General Safety Instructions**

- Direct personnel to stand clear during hoisting operation.
- Starter must be supported during removal and installation.
- Alternator must be supported during removal and installation.
- Power steering pump must be supported during removal and installation.

**Maintenance Level**

Direct support

**WARNING**

Direct personnel to stand clear during hoisting operation. Failure to do this may cause injury.

**a. Disassembly**

**NOTE**

Engine preparation for 6.2 L and 6.5 L engines is basically the same. Differences are noted.

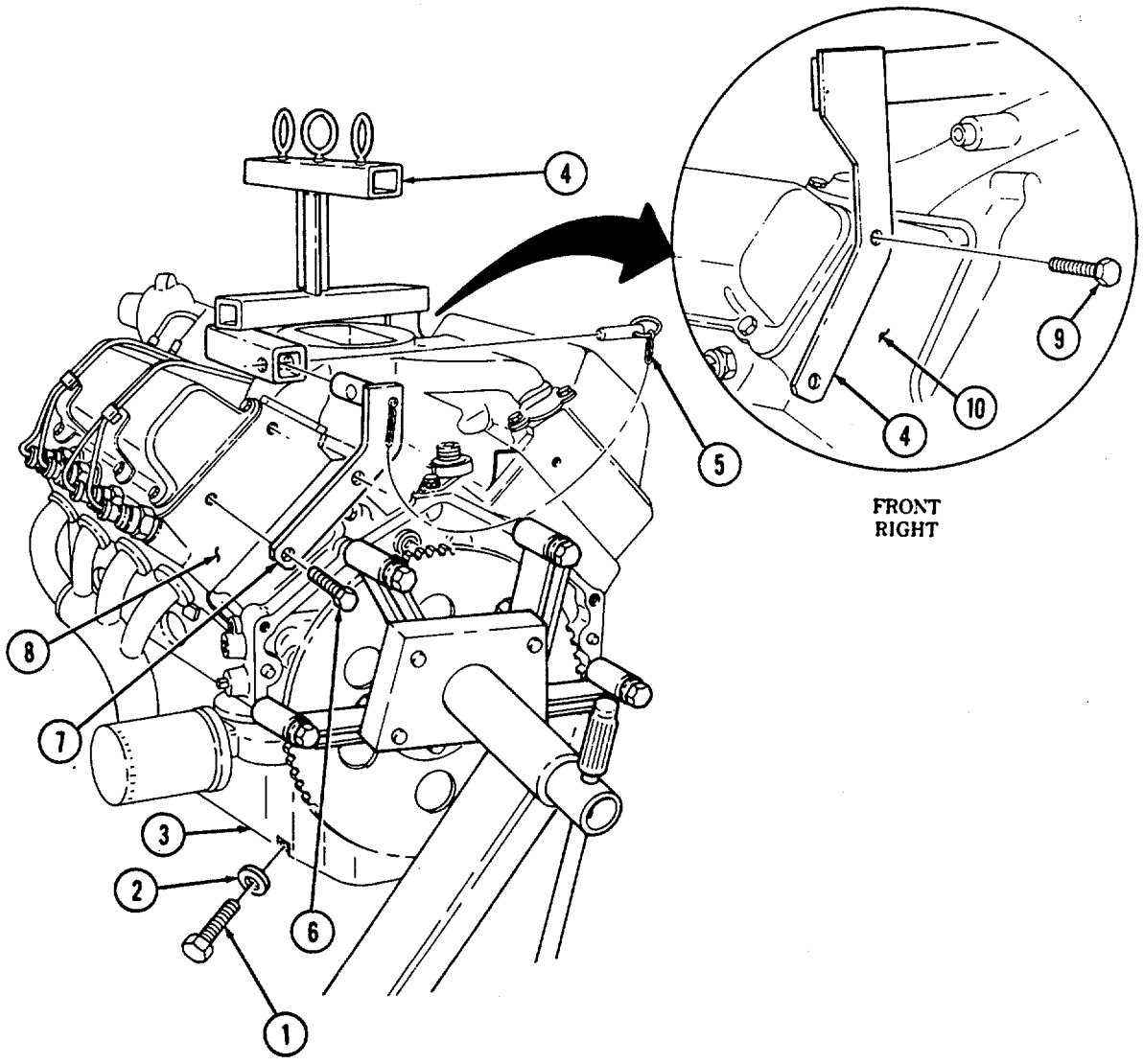
1. Place engine on stand and disconnect hoist.

**NOTE**

Have drainage container ready to catch oil.

2. Remove drainplug (1) and gasket (2) from oil pan (3). Allow oil to drain completely.
3. Install drainplug (1) and gasket (2). Tighten drainplug (1) to 20 lb-ft (27 N·m).
4. Remove two capscrews (9) from engine lifting sling (4) and right cylinder head (10).
5. Remove pin (5) from sling bracket (7) and engine lifting sling (4).
6. Remove two capscrews (6) and sling bracket (7) from cylinder head (8).

## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

**NOTE**

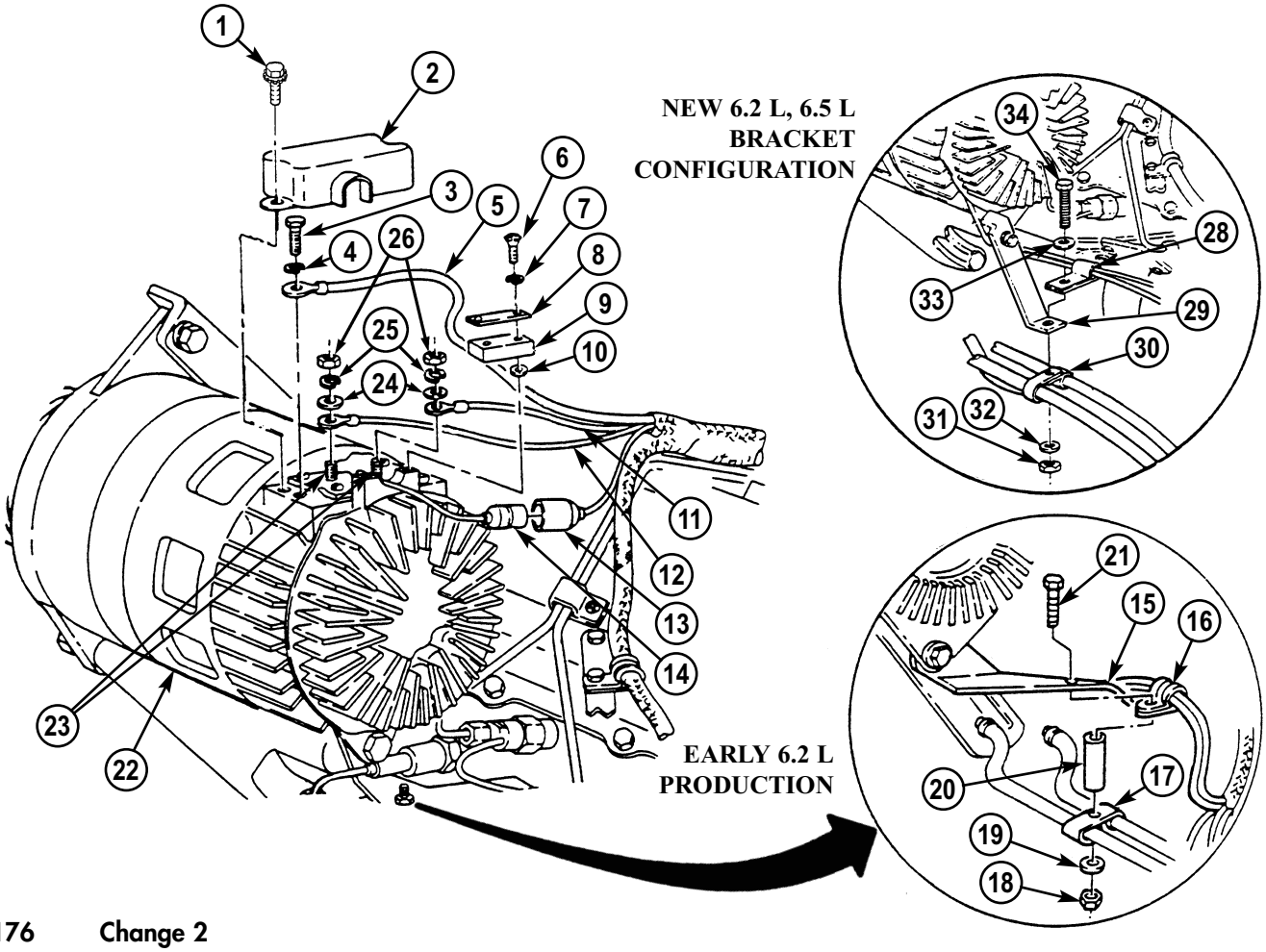
- Perform steps 7 through 13 for vehicles equipped with a 60 amp alternator.
- Prior to removal, tag all leads for installation.

7. Remove two screws (6), lockwashers (7), and wire retaining strap (8) from alternator (22) and remove wire retaining strap (8), spacer (9), and washer (10). Discard lockwashers (7).
8. Remove two screw-assembled washers (1) from terminal cover (2). Discard screw-assembled washers (1).
9. Pry cover (2) away from waterproofing adhesive and remove cover (2).
10. Remove waterproofing adhesive from around terminals (23).
11. Disconnect lead 568A (14) from engine wiring harness (13).
12. Remove capscrew (3), lockwasher (4), and ground 3B (5) from alternator (22). Discard lockwasher (4).
13. Remove two nuts (26), lockwashers (25), washers (24), and leads 5A (12) and 2A (11) from alternator (22). Discard lockwashers (25).

**NOTE**

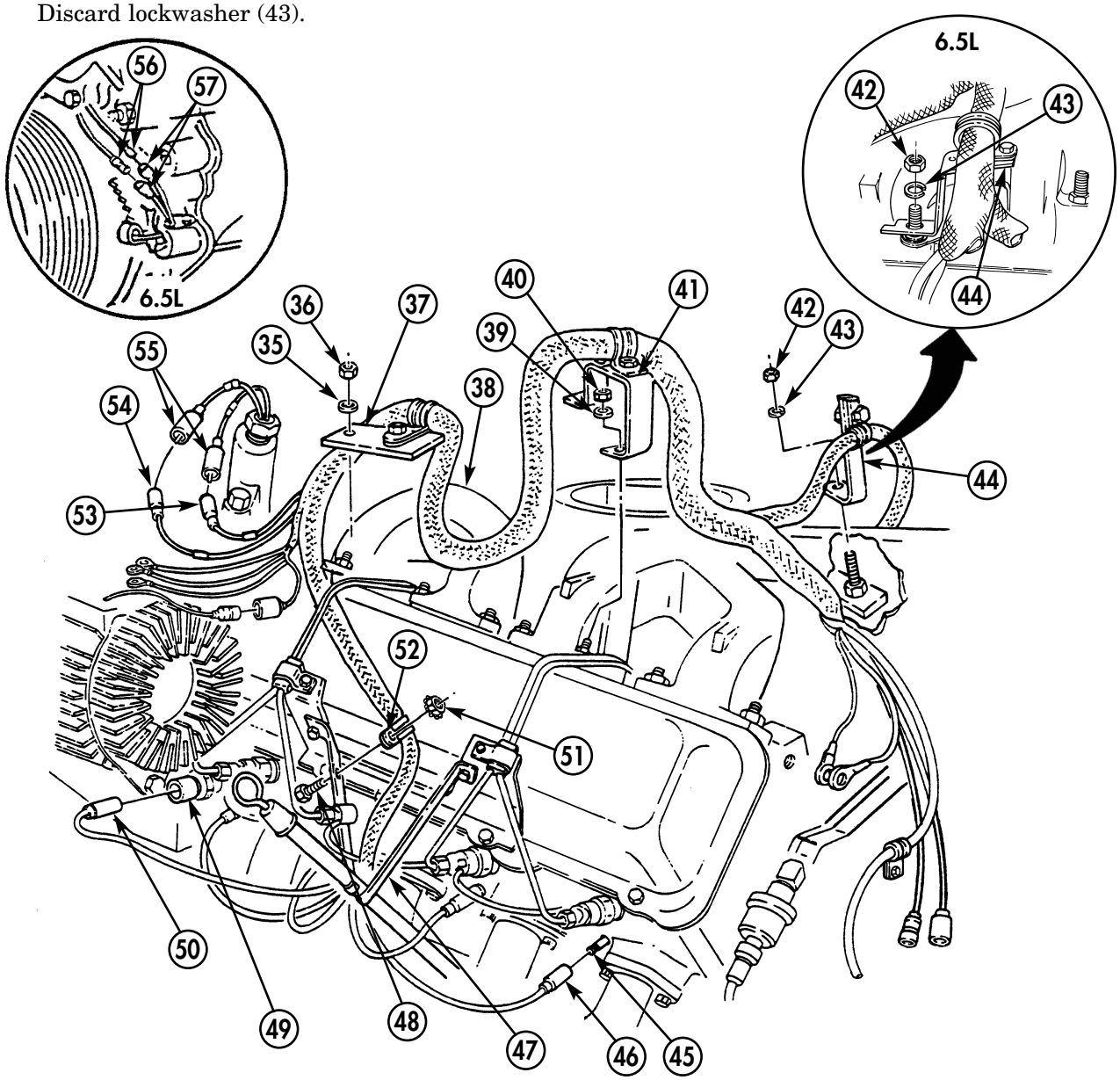
There has been a change to the power steering lines support bracket. Perform step 14 for vehicles with original configuration. Perform step 15 for vehicles with new support bracket configuration.

14. Remove locknut (18), washer (19), capscrew (21), spacer (20), harness clamp (16), and clamp (17) from support bracket (15). Discard locknut (18).
15. Remove locknut (31), washer (32), capscrew (34), washer (33), harness clamp (28), and clamp (30) from support bracket (29). Discard locknut (31).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

16. Disconnect leads 458A (53) and 458B (54) from fan clutch temperature switch leads (55).
17. Disconnect harness lead 33B (50) from engine temperature sending unit (49) and harness leads (56) from engine RPM sensor leads (57).
18. Disconnect four harness lead boots (46) from glow plugs (45).
19. Remove plain assembled nut (51), capscrew (48), and harness clamp (52) from upper dipstick tube bracket (47). Discard plain assembled nut (51).
20. Remove nut (36), lockwasher (35), and wiring harness bracket (37) from intake manifold (38). Discard lockwasher (35).
21. Remove two nuts (40), lockwashers (39), and wiring harness bracket (41) from intake manifold (38). Discard lockwashers (39).
22. Remove nut (42), lockwasher (43), and wiring harness bracket (44) from intake manifold (38). Discard lockwasher (43).



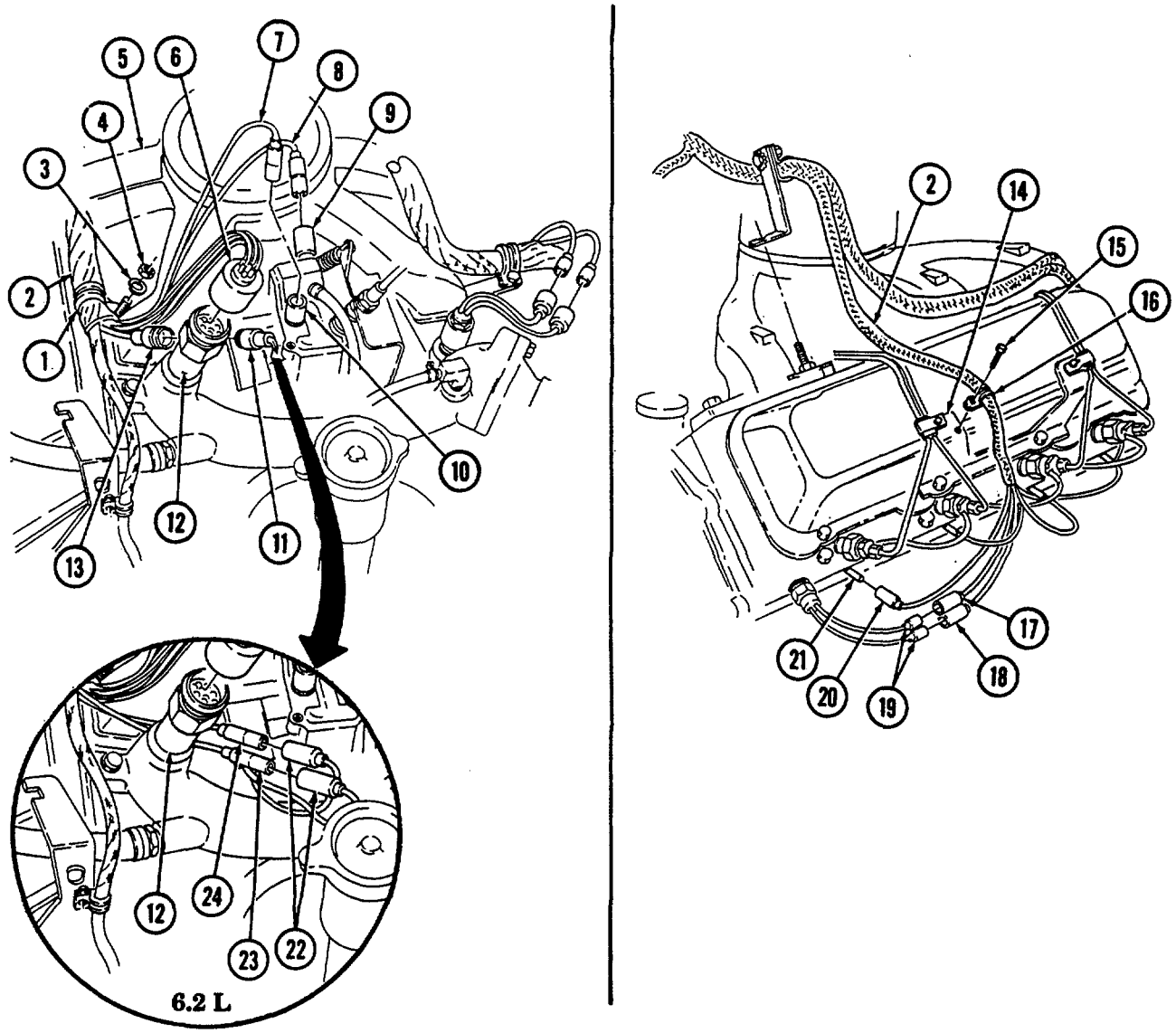
## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

23. Remove nut (4), lockwasher (3), clamp (1), and harness (2) from intake manifold (5). Discard lockwasher (3).
24. Disconnect harness connector (6) from glow plug controller (12).

**NOTE**

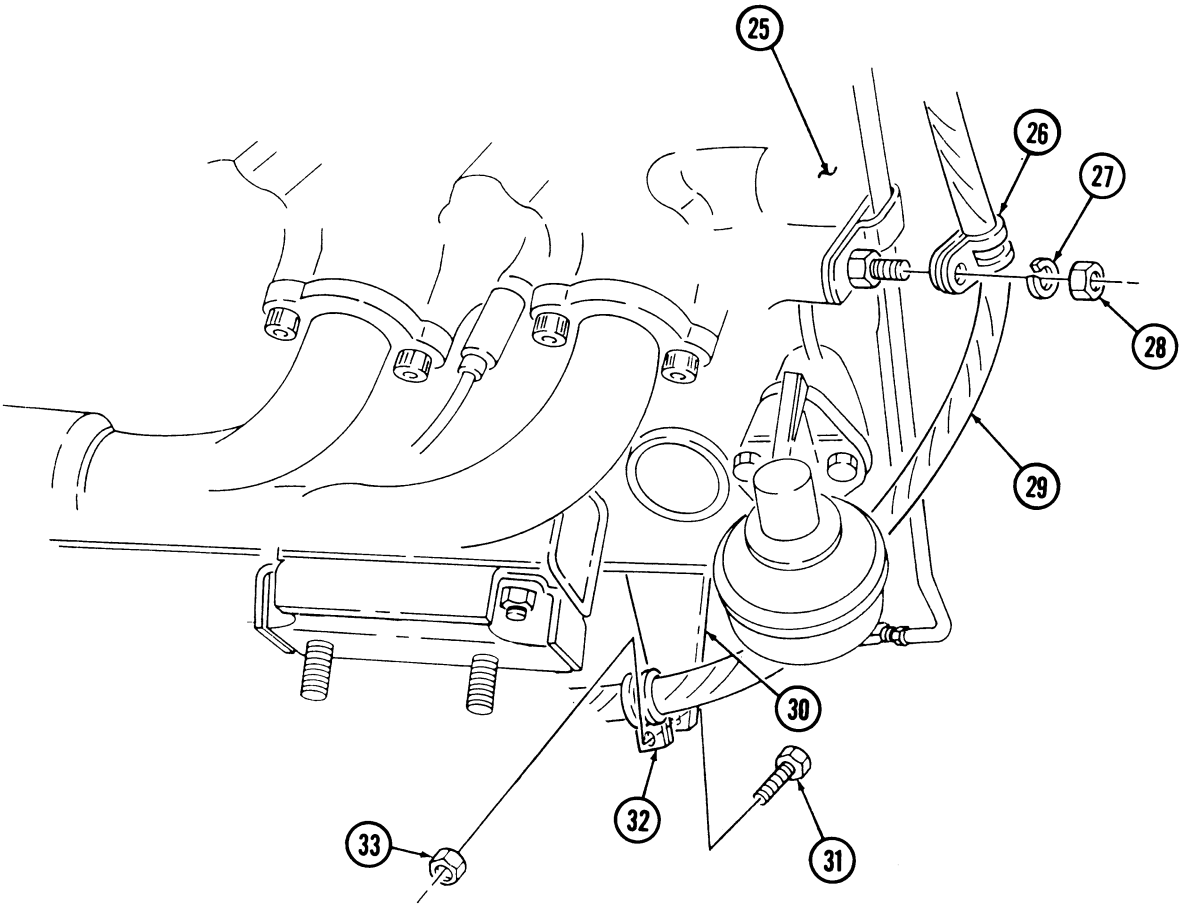
- Perform step 25 for 6.2 L only.
- Perform step 26 for 6.5 L only.

25. Disconnect leads 315A (24) and 315B (23) from transmission kickdown switch leads (22).
26. Disconnect lead 359E/355A/350B (13) from transmission TP sensor lead (11).
27. Disconnect leads 54A (7) and 569B (8) from fuel injection pump terminals (9) and (10).
28. Remove capscrew (15), clamp (16), and harness (2) from rocker arm cover bracket (14).
29. Disconnect leads 569A (17) and 569B (18) from cold advance switch leads (19).
30. Disconnect four harness boots (20) from glow plugs (21).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

31. Remove nut (28), lockwasher (27), clamp (26) and harness (29) from cylinder block (25). Discard lockwasher (27).
32. Remove capscrew (31), nut (33), clamp (32), and harness (29) from bracket (30).
33. Remove wiring harness (29) from engine.

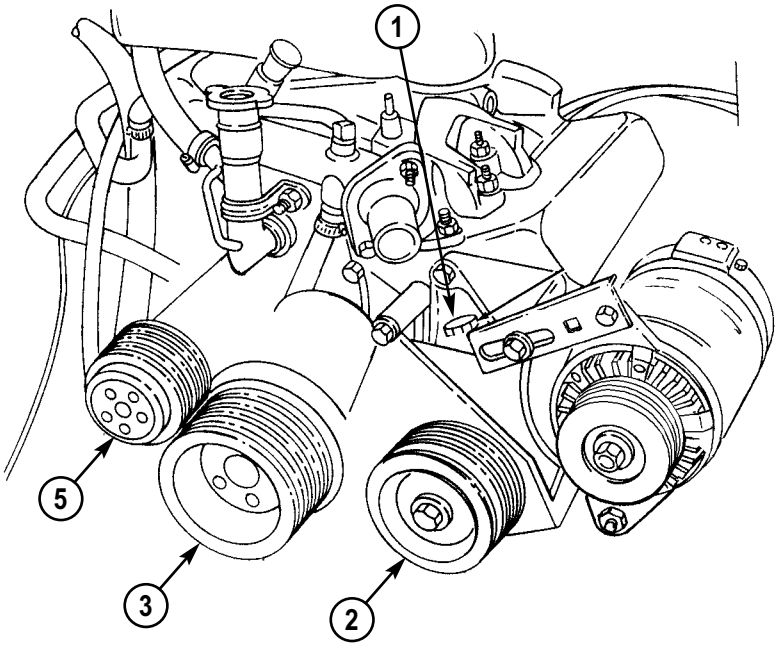


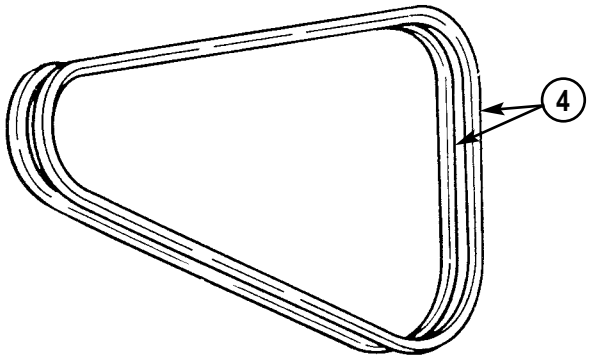
## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

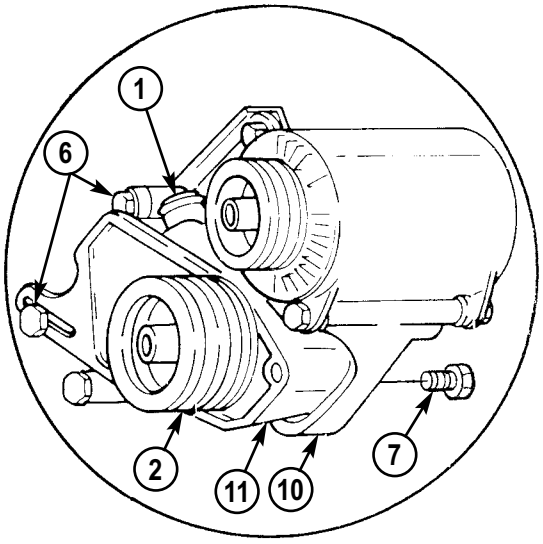
**NOTE**

- Perform steps 34 through 36 for 6.2 L engines only.
- Refer to para. 3-24 for 6.5 L serpentine belt removal.

34. Remove adjusting capscrew (7) and power steering pump mounting bracket (11) from alternator support bracket (10).
35. Loosen two capscrews (6) connecting power steering pump mounting bracket (11) to support bracket (10).
36. Push power steering pump and alternator assembly (1) towards engine and remove drivebelts (4) from power steering pump pulley (2), water pump pulley (5), and crankshaft pulley (3).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L)

**WARNING**

Alternator must be supported during removal. Failure to support alternator may cause injury to personnel or damage to equipment.

**NOTE**

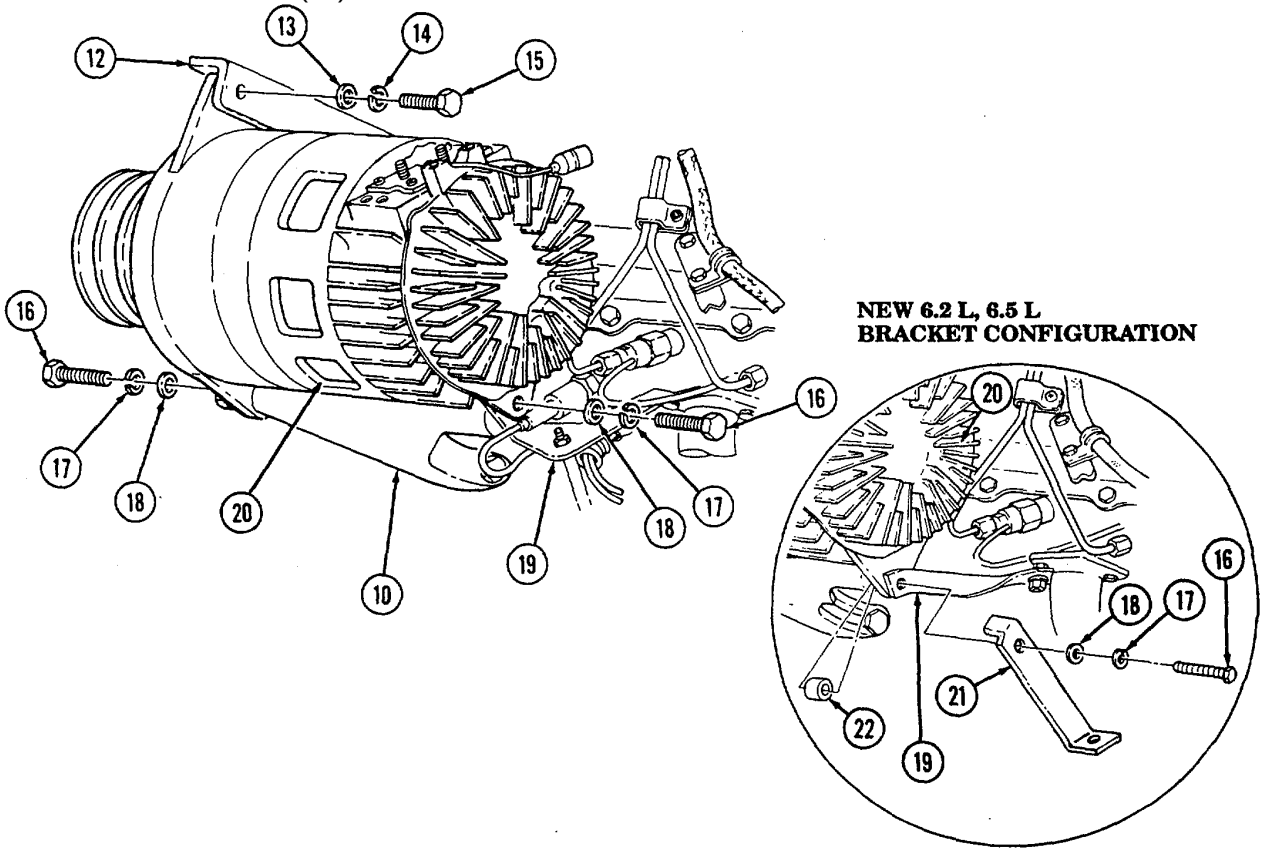
Perform steps 37 through 40 for vehicles equipped with 60 and 100 amp Prestolite alternators only.

37. Remove capscrew (15), lockwasher (14), and washer (13), from alternator (20) and adjusting bracket (12). Discard lockwasher (14).
38. Remove two capscrews (16), lockwashers (17), and washers (18) from alternator (20), support bracket (19) and mounting bracket (10). Discard lockwashers (17).

**NOTE**

- Perform step 39 for vehicles with new alternator support bracket configuration.
- In some cases, a thru-bolt and nut may be present on mounting bracket instead of standard capscrews and washers.

39. Remove two capscrews (16), lockwashers (17), washers (18), spacer (22), and power steering lines bracket (21) from support bracket (19) and mounting bracket (10). Discard lockwashers (17).
40. Remove alternator (20).

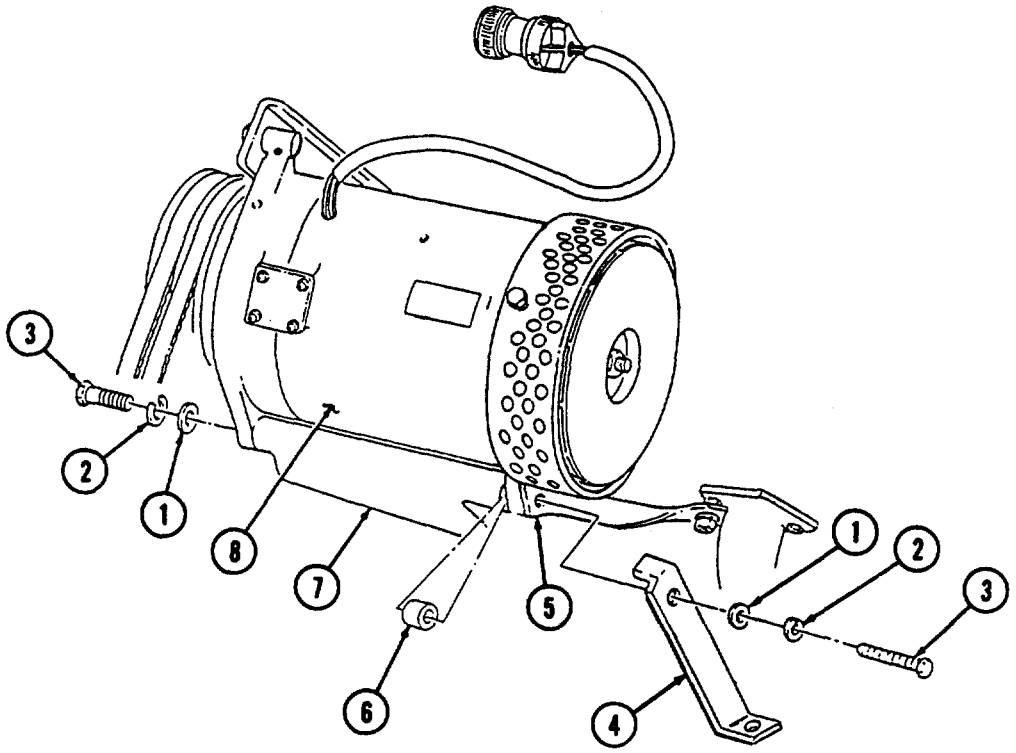


## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L)

**NOTE**

- Perform steps 41 and 42 for vehicles equipped with 100 amp Neihoff alternator only.
- In some cases, a thru-bolt and nut may be present on mounting bracket instead of standard capscrews and washers.

41. Remove two capscrews (3), lockwashers (2), washers (1), and spacer (6) from alternator (8), power steering lines bracket (4), support bracket (5), and mounting bracket (7). Discard lockwashers (2).
42. Remove alternator (8).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

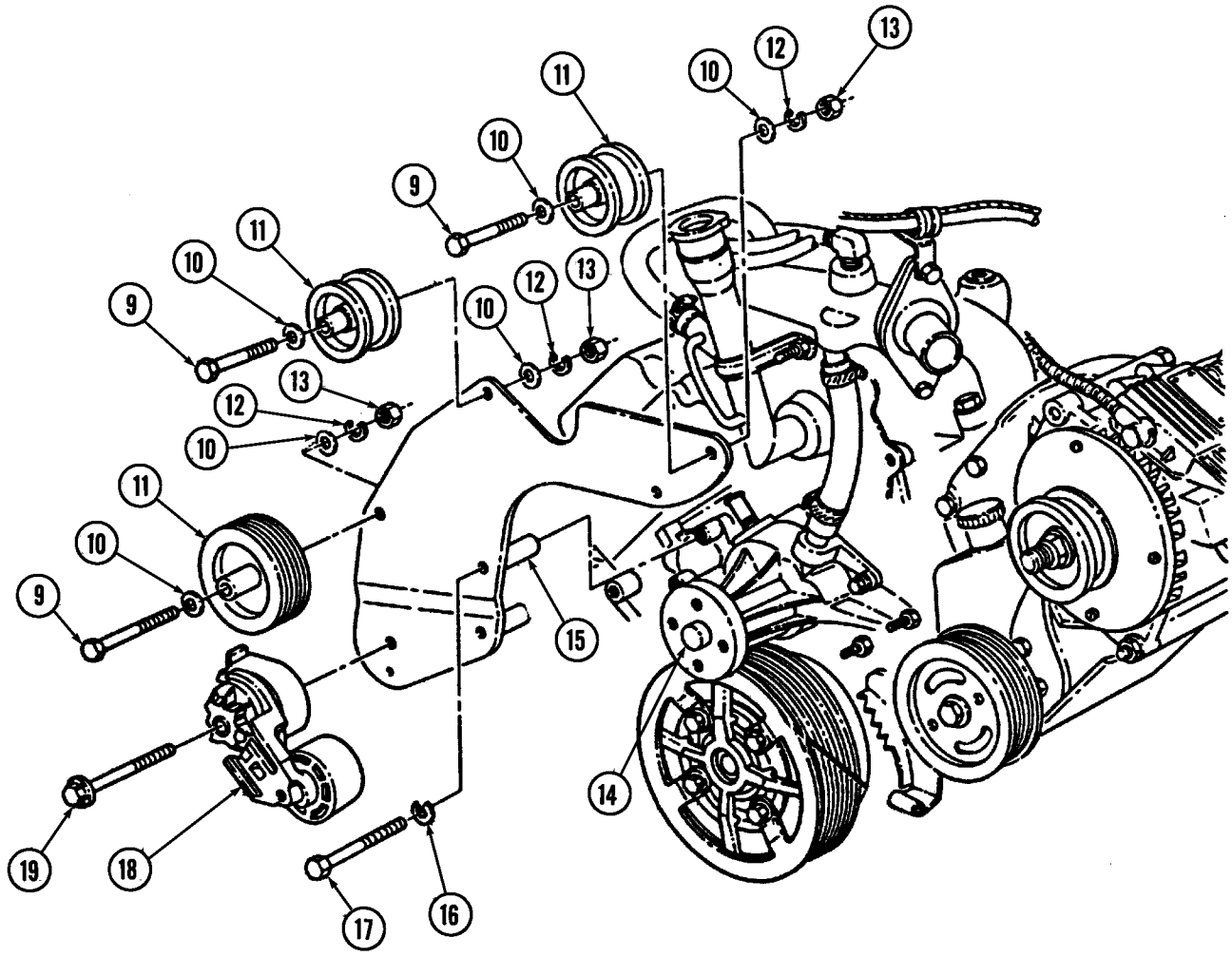
**NOTE**

Perform steps 42.1 through 42.3 for 6.5 L engines only.

42.1. Remove capscrew (19) and belt tensioner (18) from idler bracket (15).

42.2. Remove three nuts (13), lockwashers (12), washers (10), capscrews (9), washers (10), and idler pulleys (11) from idler bracket (15). Discard lockwashers (12).

42.3. Remove three capscrews (17), lockwashers (16), and idler bracket (15) from water pump (14). Discard lockwashers (16).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

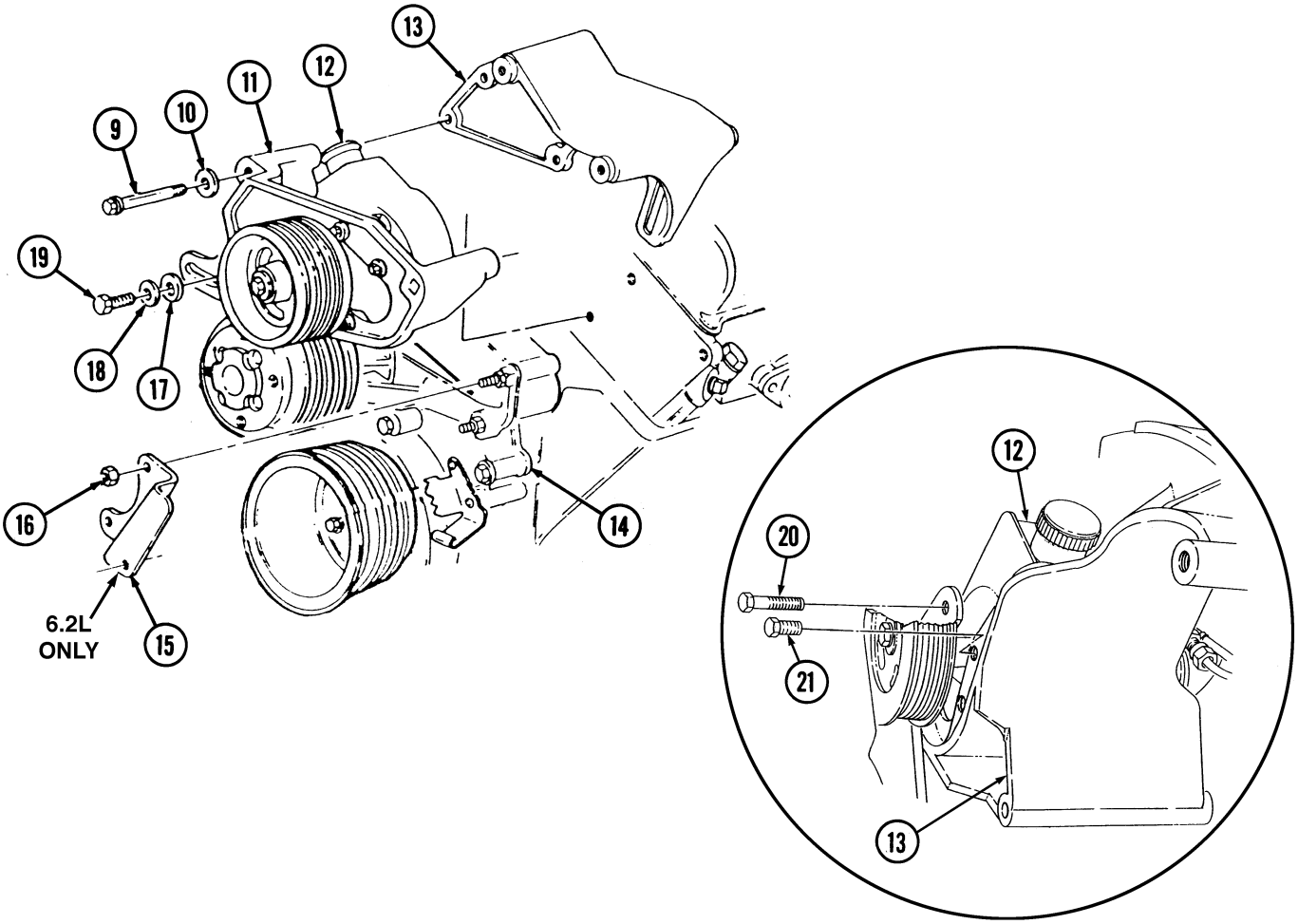
**WARNING**

Power steering pump must be supported during removal and installation. Failure to do this may cause injury to personnel.

**NOTE**

- Perform steps 43 through 46 for all vehicles except M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, and M1123 vehicles.
- Perform steps 46.1 and 46.2 for 6.5 L configuration.

43. Remove capscrew (9) and lockwasher (10) from power steering bracket (11) and alternator bracket (13). Discard lockwasher (10).
44. Remove adjusting capscrew (19), lockwasher (18), and washer (17) from power steering bracket (11). Discard lockwasher (18).
45. Remove power steering pump assembly (12).
46. Remove two nuts (16) and front support bracket (15) from water pump housing (14).
46.1. Remove capscrew (20) and two capscrews (21) from power steering pump (12) and alternator bracket (13).
46.2. Remove power steering pump (12) from alternator bracket (13).



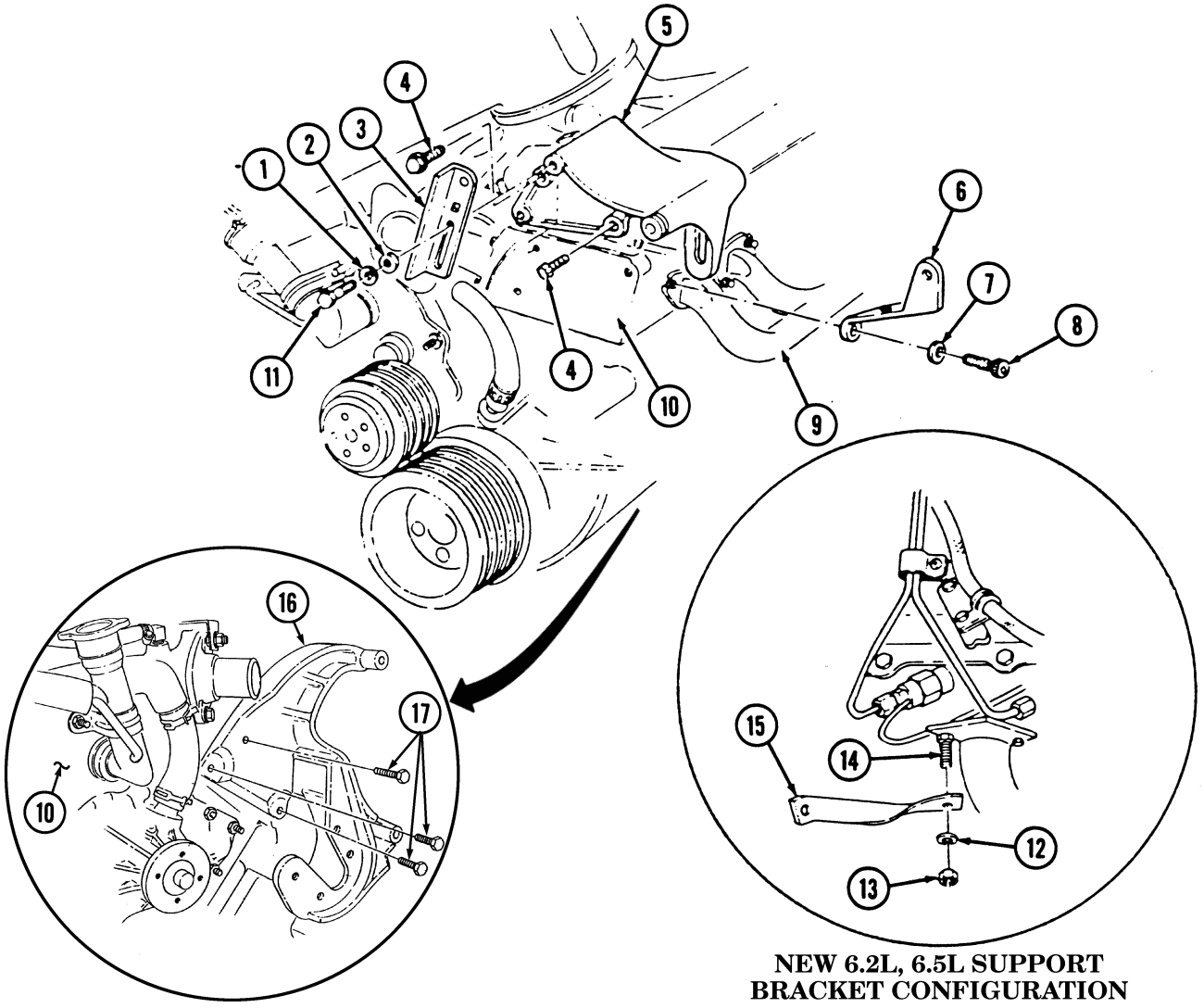

**6.5L CONFIGURATION**

## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

**NOTE**

- Perform steps 47 through 50 for vehicles equipped with 200 amp alternator only (except M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, and M1123 vehicles).
- Perform step 48.1 for 6.5 L alternator/power steering bracket configuration.

47. Remove capscrew (11), lockwasher (1), washer (2), and alternator adjusting bracket (3) from alternator mounting bracket (5). Discard lockwasher (1).
48. Remove two flanged head capscrews (4) and alternator mounting bracket (5) from engine (10).
48.1. Remove three capscrews (17) and alternator/power steering bracket (16) from engine (10).




**6.5L ALTERNATOR/POWER STEERING BRACKET CONFIGURATION**

**NEW 6.2L, 6.5L SUPPORT BRACKET CONFIGURATION**

## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

**NOTE**

Perform step 49 for 6.2 L model only.

49. Remove socket head screw (8), washer (7), and support bracket (6) from exhaust manifold (9).

**NOTE**

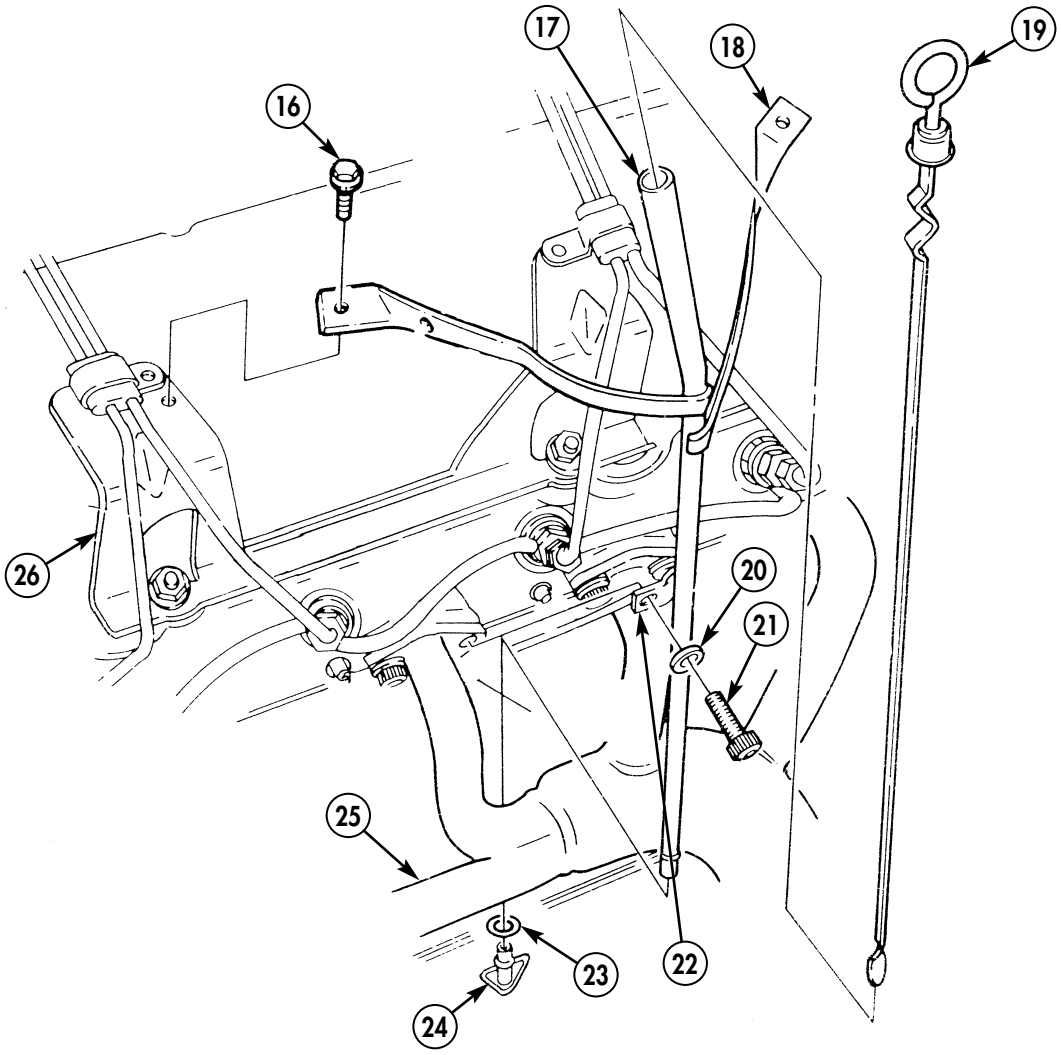
Perform step 50 for vehicles with new alternator support bracket configuration.

50. Remove nut (13), washer (12), and support bracket (15) from exhaust manifold stud (14).
51. Remove oil dipstick (19) from oil dipstick tube (17).
52. Remove socket head screw (21) and washer (20) securing lower dipstick tube bracket (22) to exhaust manifold (25).

**NOTE**

Perform step 53 for 6.2 L only.

53. Remove two screw-assembled washers (16) and upper dipstick tube bracket (18) from fuel line brackets (26).
54. Remove oil dipstick tube (17) from engine oil pan (24). Remove and discard O-ring (23).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

**NOTE**

Early production 6.2 L engines were equipped with a left engine heat shield. Removal is the same as right shield.

55. Loosen three socket head screws (1) and right heat shield (3) from exhaust manifold (2). Remove heat shield (3).
56. Loosen nut (8) and washer (7) from front of starter (6) and bracket (9).

**WARNING**

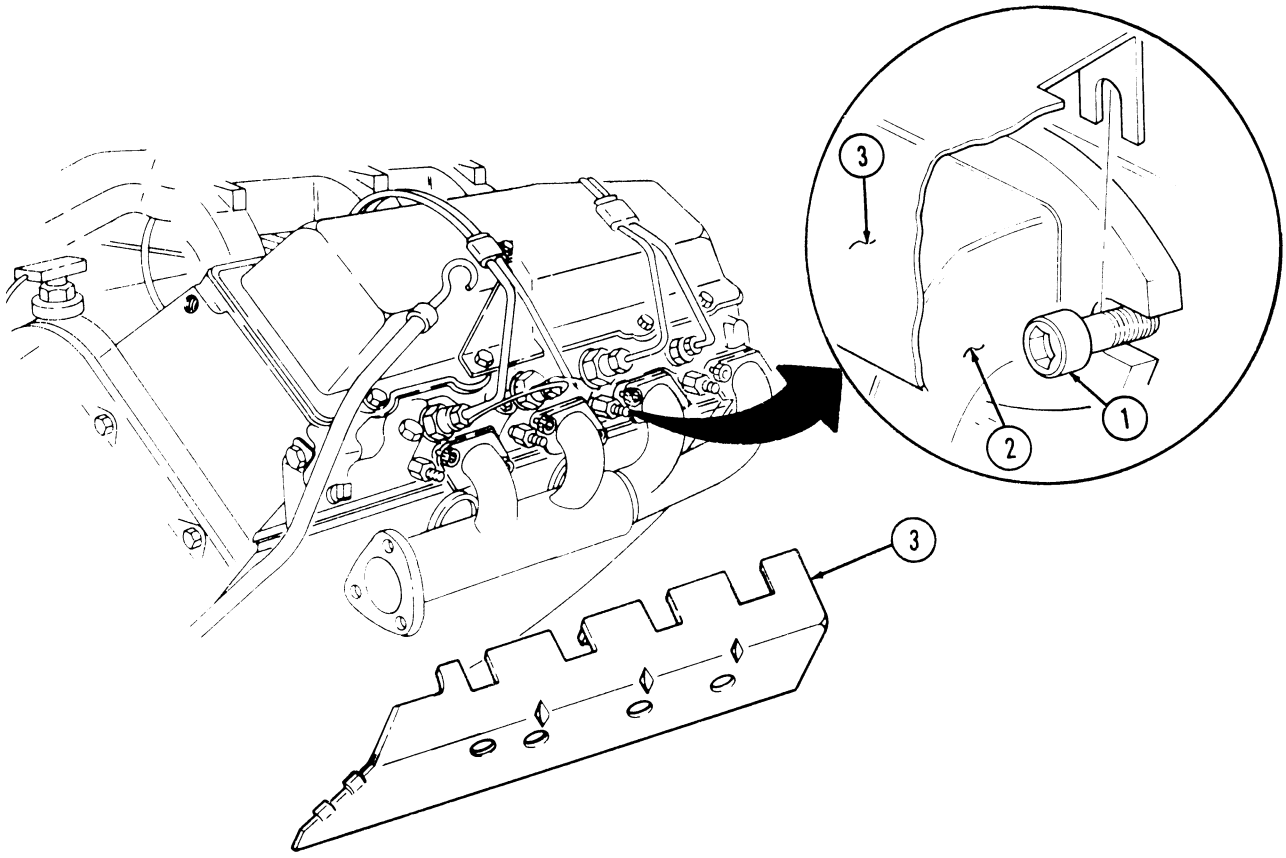
Starter must be supported during removal. Failure to support starter may cause injury to personnel or damage to equipment.

57. Remove two capscrews (10), washers (11), starter (6), and shim(s) (5), if present, from engine (4).

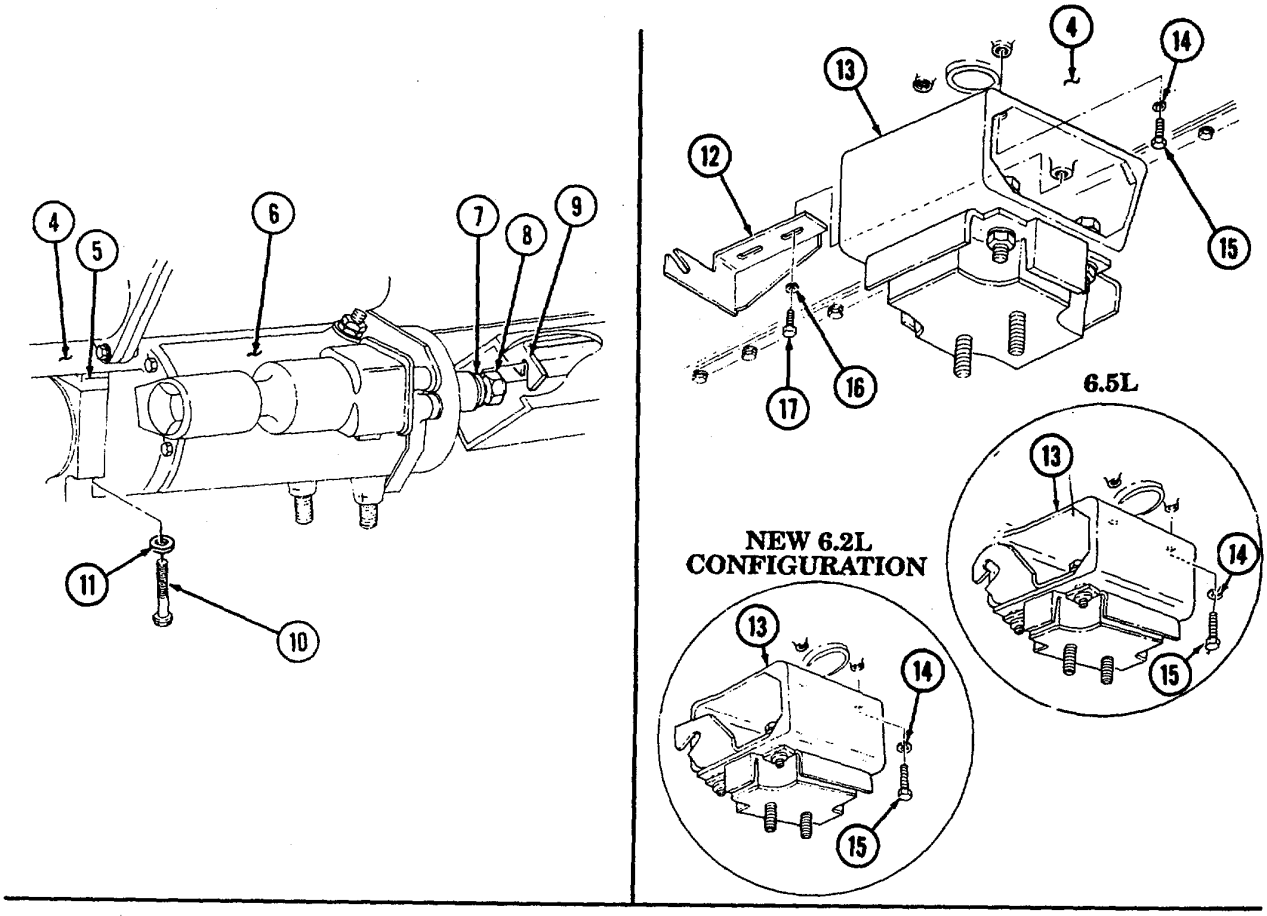
**NOTE**

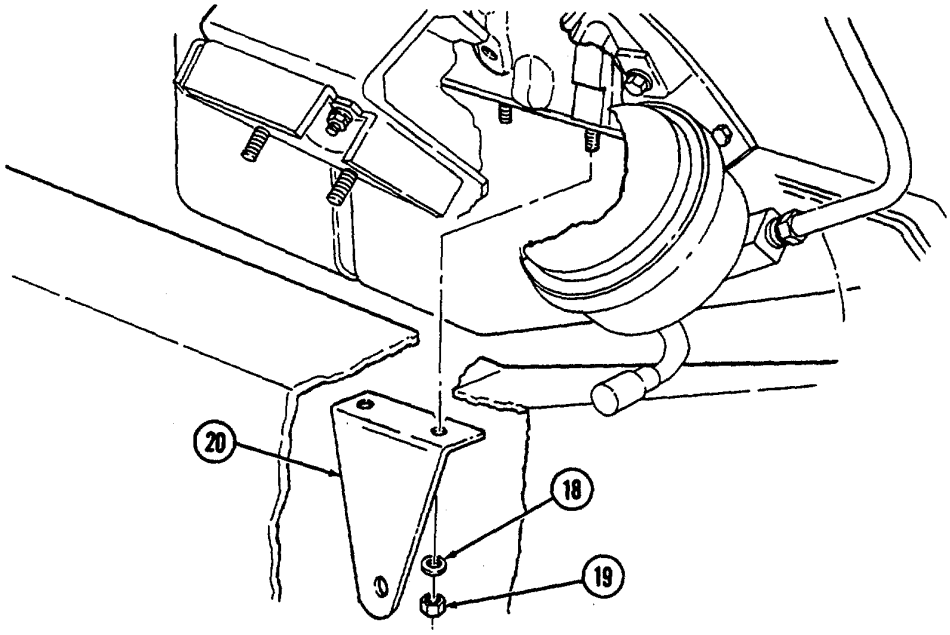
Perform step 58 for right engine mount on early production 6.2 L engines only.

58. Remove two capscrews (17), lockwashers (16), and starter support bracket (12) from right engine mount and insulator assembly (13). Discard lockwashers (16).
59. Remove three capscrews (15), lockwashers (14), and left and right engine mount and insulator assembly (13) from engine (4). Discard lockwashers (14).
60. Remove two nuts (19), lockwashers (18), and wiring harness bracket (20) from oil pan. Discard lockwashers (18).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L)



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L)

**NOTE**

Perform steps 61 and 62 for 6.2 L only.

61. Loosen nut (2) and remove RPM sensor (3) from oil pump drive (1).
62. Remove fitting (4) from clutch fan adapter (5).

**NOTE**

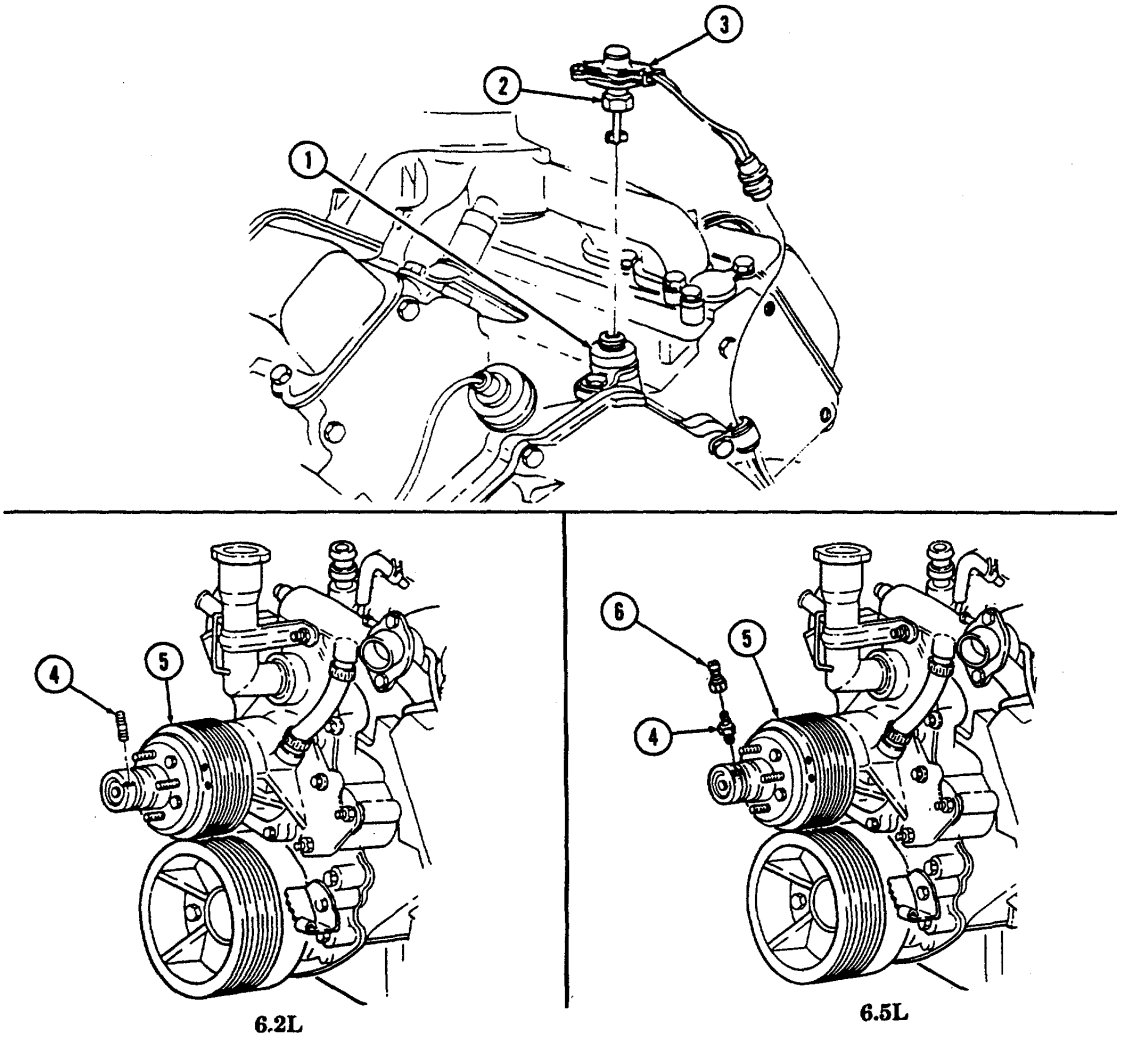
Perform step 63 for 6.5L only:

63. Remove fitting (4) from quick disconnect (6).

**NOTE**

Have drainage container ready to catch fluid.

64. Remove two plugs (7) and drain coolant from engine (8).




6.2L

6.5L

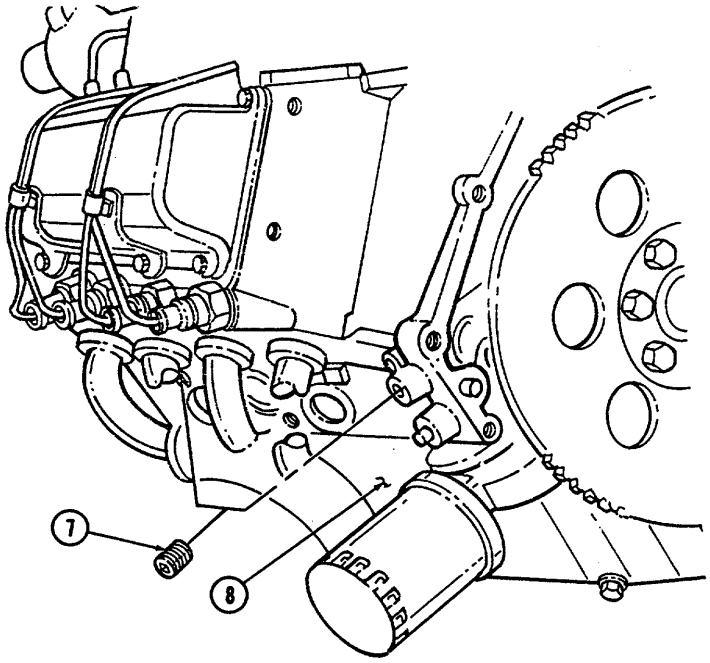
## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

**b. Assembly**

**NOTE**

Perform step 1 for 6.2 L only.

1. Align tab on RPM sensor (3) with oil pump drive (1) and install with nut (2).
2. Install fitting (4) in clutch fan adapter (5).
3. Install quick disconnect (6) on fitting (4).
4. Apply antiseize compound to two plugs (7) and install in engine (8).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

4. Install wiring harness bracket (1) on oil pan with two lockwashers (2) and nuts (3).
5. Position left and right engine mount and insulator assembly (5) to engine (6) with three lockwashers (7) and capscrews (8). Using 9/16 in. torque adapter, tighten capscrews (8) to 30-40 lb-ft (41-54 N•m).

**NOTE**

Perform step 6 for early production 6.2 L engine mount vehicles only.

6. Install starter support bracket (4) on right engine mount and insulator assembly (5) with two lockwashers (9) and capscrews (10). Using 9/16-in. torque adapter, tighten capscrews (10) to 30-40 lb-ft (41-54 N•m).

**WARNING**

Starter must be supported during installation. Failure to support starter may cause injury to personnel or damage to equipment

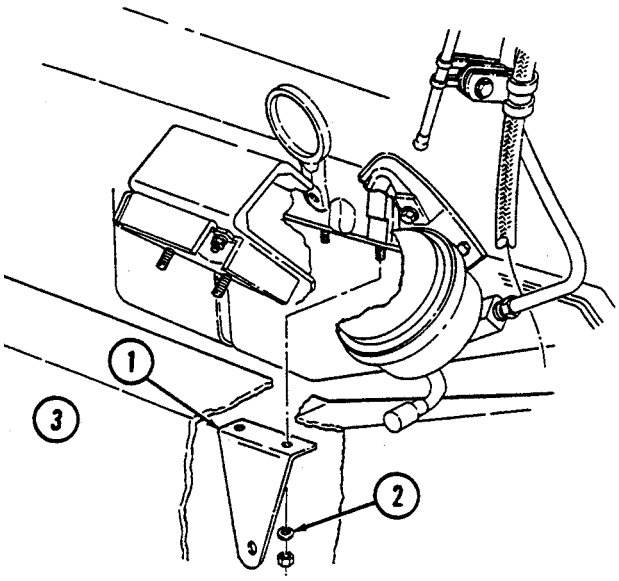
7. Position shim(s) (11), if removed, and starter (12) to flywheel housing with solenoid (13) facing outward.
8. Slide front stud on starter (12) in bracket (4), ensuring bracket (4) is between washer (14) and starter (12).
9. Apply thread locking sealing compound to capscrews (16). Install two washers (17) and capscrews (16) securing starter (12) to engine (6). Tighten capscrews (16) to 30-40 lb-ft (41-54 N•m).
10. Secure starter (12) to bracket (4) with nut (15) and washer (14). Using crowfoot, tighten locknut (15) to 15-19 lb-ft (20-26 N•m).

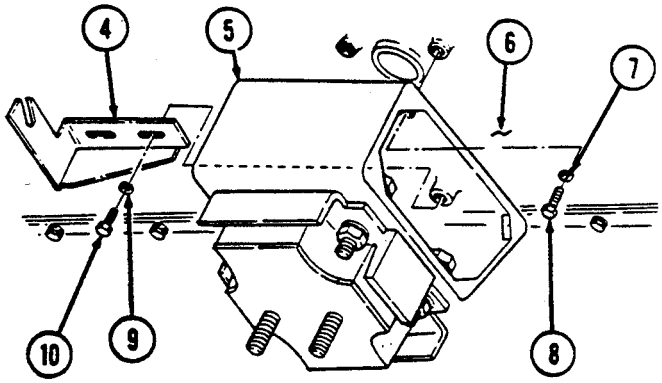
**NOTE**

Early production 6.2 L engines were equipped with a left heat shield. Installation is the same.

11. Install right heat shield (18) on exhaust manifold (20) with three socket head screws (19). Tighten socket head screws (19) to 25-33 lb-ft (34-45 N•m).

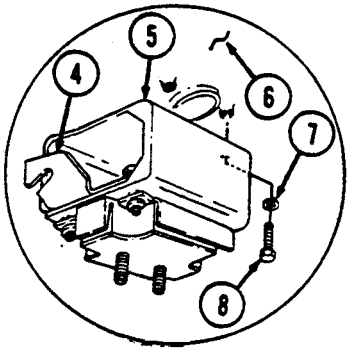
## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

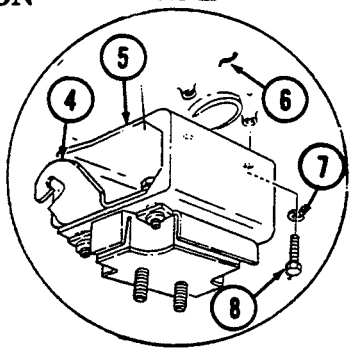


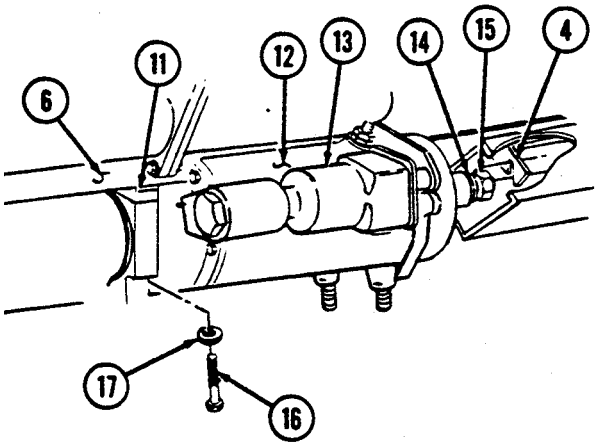



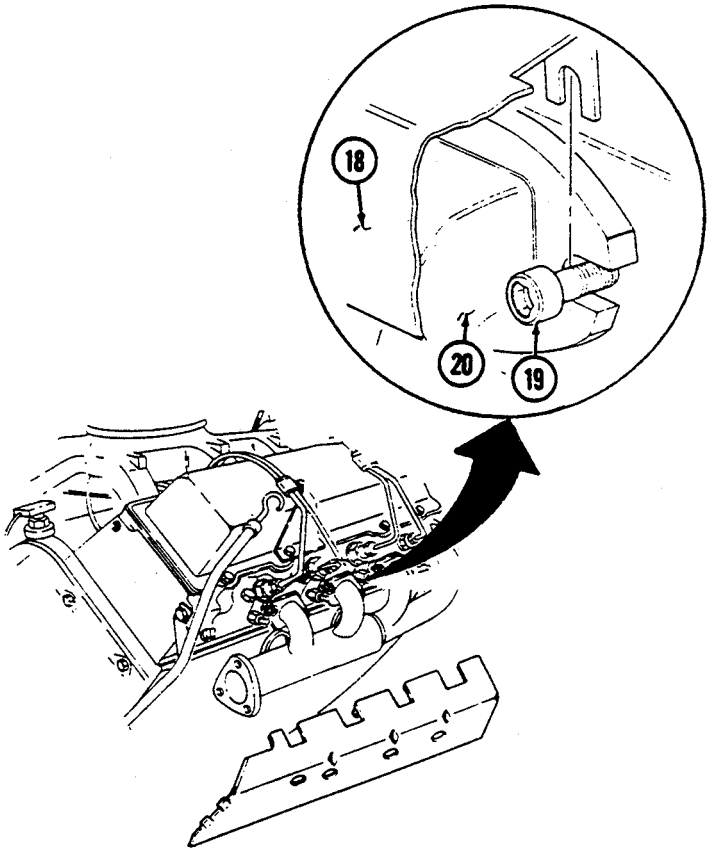

NEW 6.2L CONFIGURATION

6.5 L



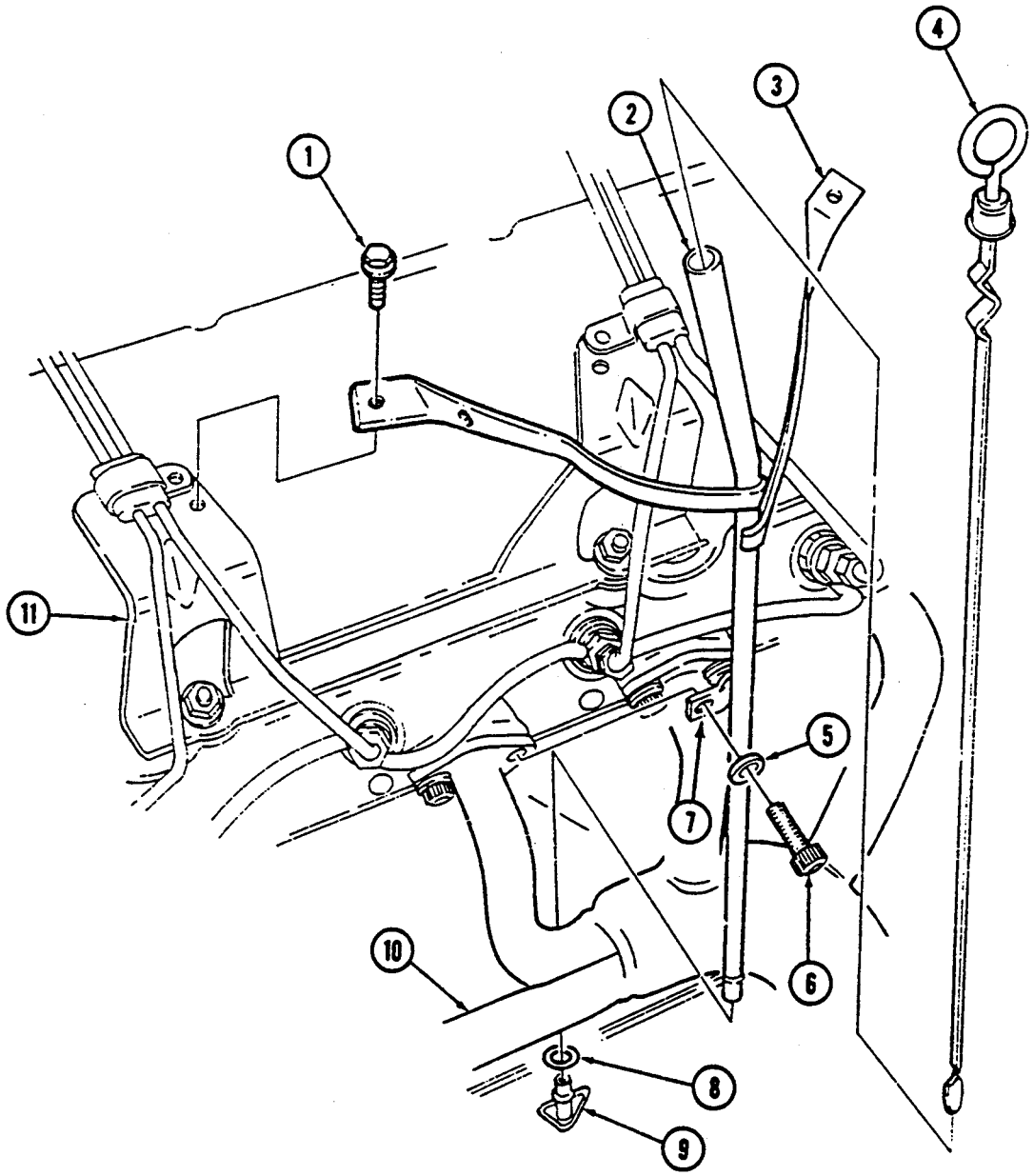
## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

12. Apply RTV sealant to O-ring (8) and install O-ring (8) on oil dipstick tube (2).
13. Insert oil dipstick tube (2) into engine oil pan (9).
14. Install lower dipstick tube bracket (7) on exhaust manifold (10) with washer (5) and socket head screw (6). Tighten socket head screw (6) to 25-33 lb-ft (34-45 N•m).

**NOTE**

Perform step 15 for 6.2 L only.

15. Install upper dipstick tube bracket (3) on fuel line brackets (11) with two screw-assembled washers (1).
16. Install oil dipstick (4) into oil dipstick tube (2).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

**NOTE**

Perform steps 17 through 21 for all vehicles except M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, and M1123.

17. Apply sealing compound to two flanged-head capscrews (13).
18. Install alternator mounting bracket (14) on engine (19) with two flanged-head capscrews (13). Tighten capscrews (13) to 48 lb-ft (65 N•m).
19. Install alternator adjusting bracket (12) on alternator mounting bracket (14) with washer (20), lockwasher (21), and capscrew (22).

**NOTE**

Perform step 19.1 for 6.5 L alternator/power steering bracket configuration.

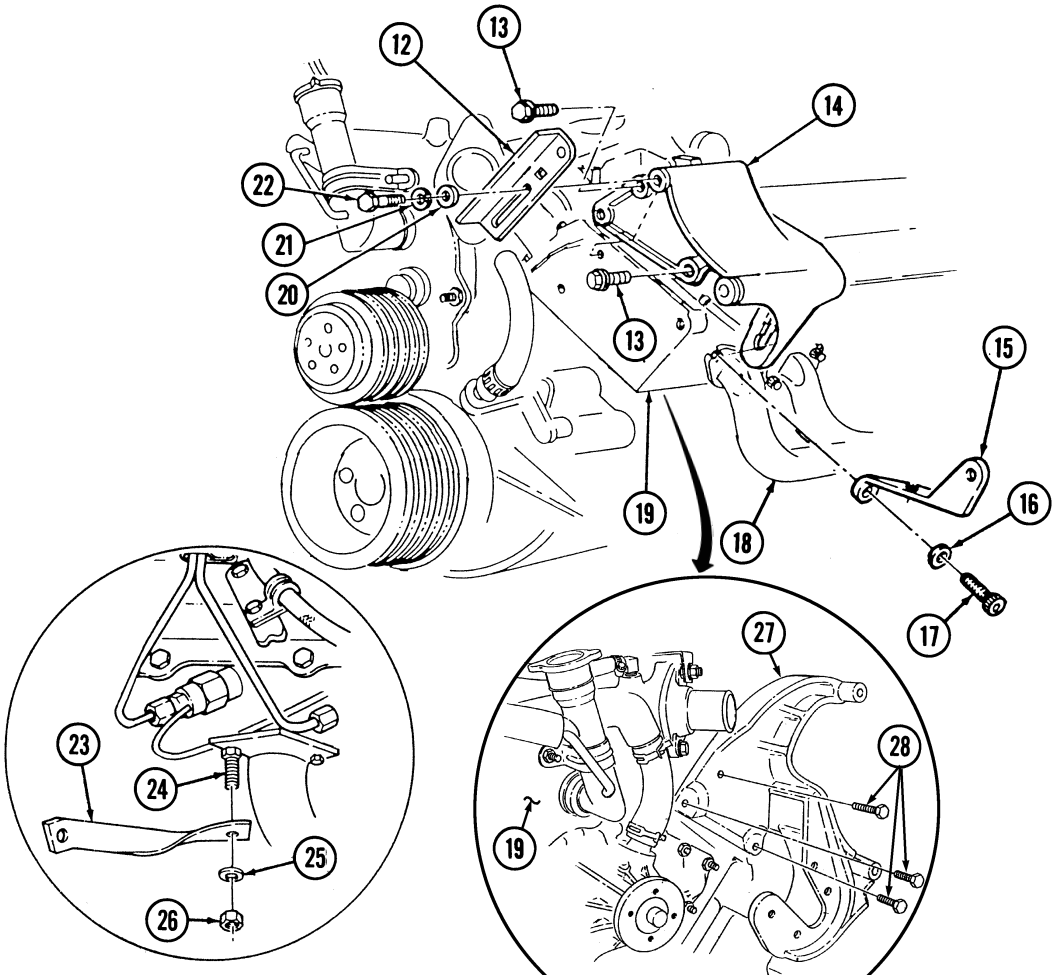
19.1. Install alternator/power steering bracket (27) on engine (19) with three capscrews (28). Tighten capscrews (28) to 48 lb-ft (65 N•m).

20. Install support bracket (15) to exhaust manifold (18) with washer (16) and socket head screw (17). Tighten socket head screw (17) to 25-33 lb-ft (34-45 N•m).

**NOTE**

Perform step 21 for vehicles with new support bracket configuration.

21. Install support bracket (23) on exhaust manifold stud (24) with washer (25) and nut (26). Tighten nut (26) to 25-33 lb-ft (34-45 N•m).




**NEW 6.2L, 6.5L SUPPORT BRACKET CONFIGURATION**

**6.5L ALTERNATOR/POWER STEERING BRACKET CONFIGURATION**

## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

**NOTE**

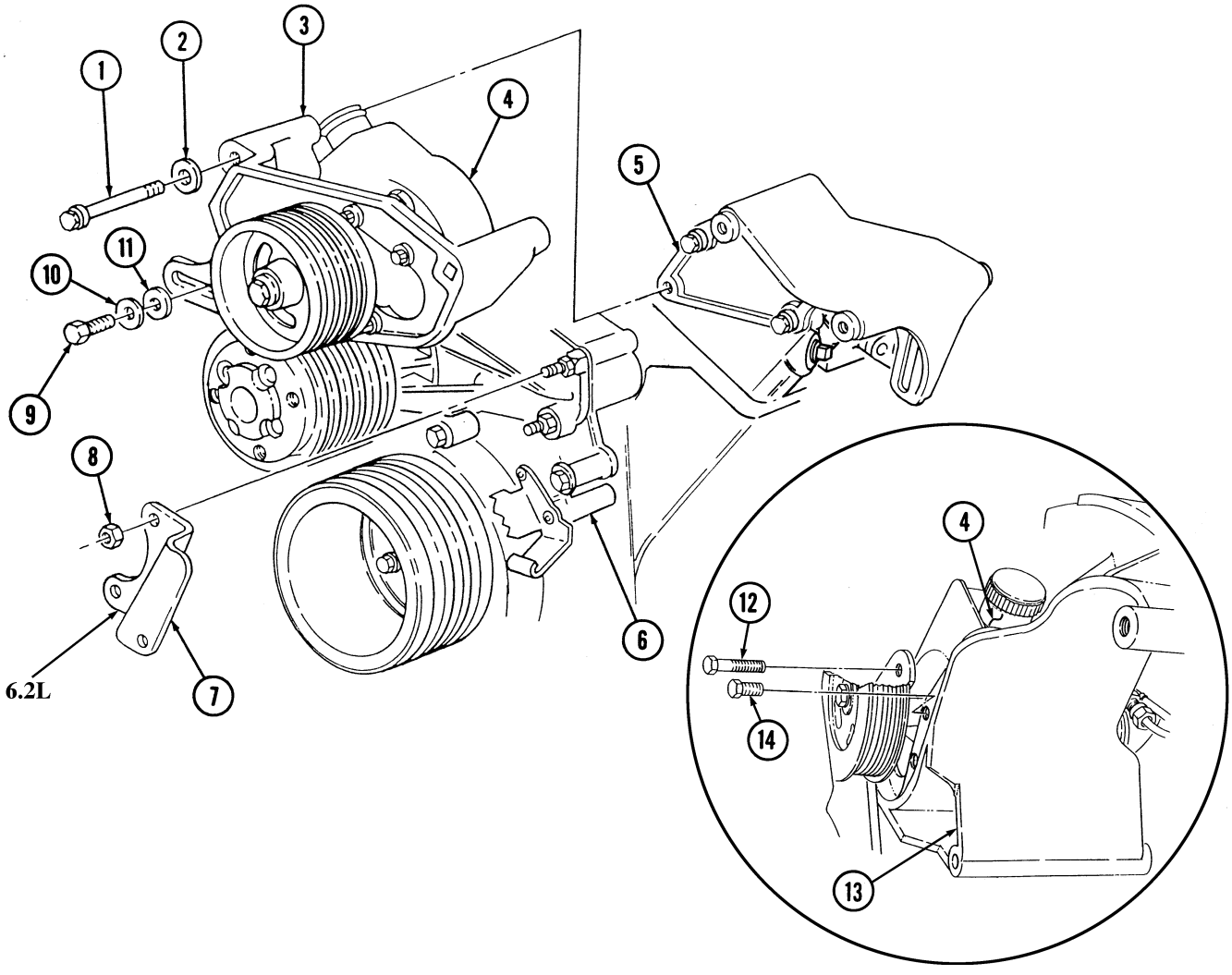
Perform steps 22 through 24 for all vehicles except A2 series and M1123.

22. Install front support bracket (7) on water pump housing (6) with two nuts (8). Tighten nuts (8) to 45 lb-ft (61 N.m).
23. Install power steering pump assembly (4) on alternator mounting bracket (5) with lockwasher (2) and capscrew (1). Do not tighten capscrew (1).
24. Secure power steering bracket (3) to support bracket (7) with washer (11), lockwasher (10), and capscrew (9). Do not tighten capscrew (9).

**NOTE**

Perform steps 24.1 through 24.4 for 6.5 L engines only.

24.1. Install power steering pump assembly (4) on alternator/power steering bracket (13) with capscrew (12) and two capscrews (14).



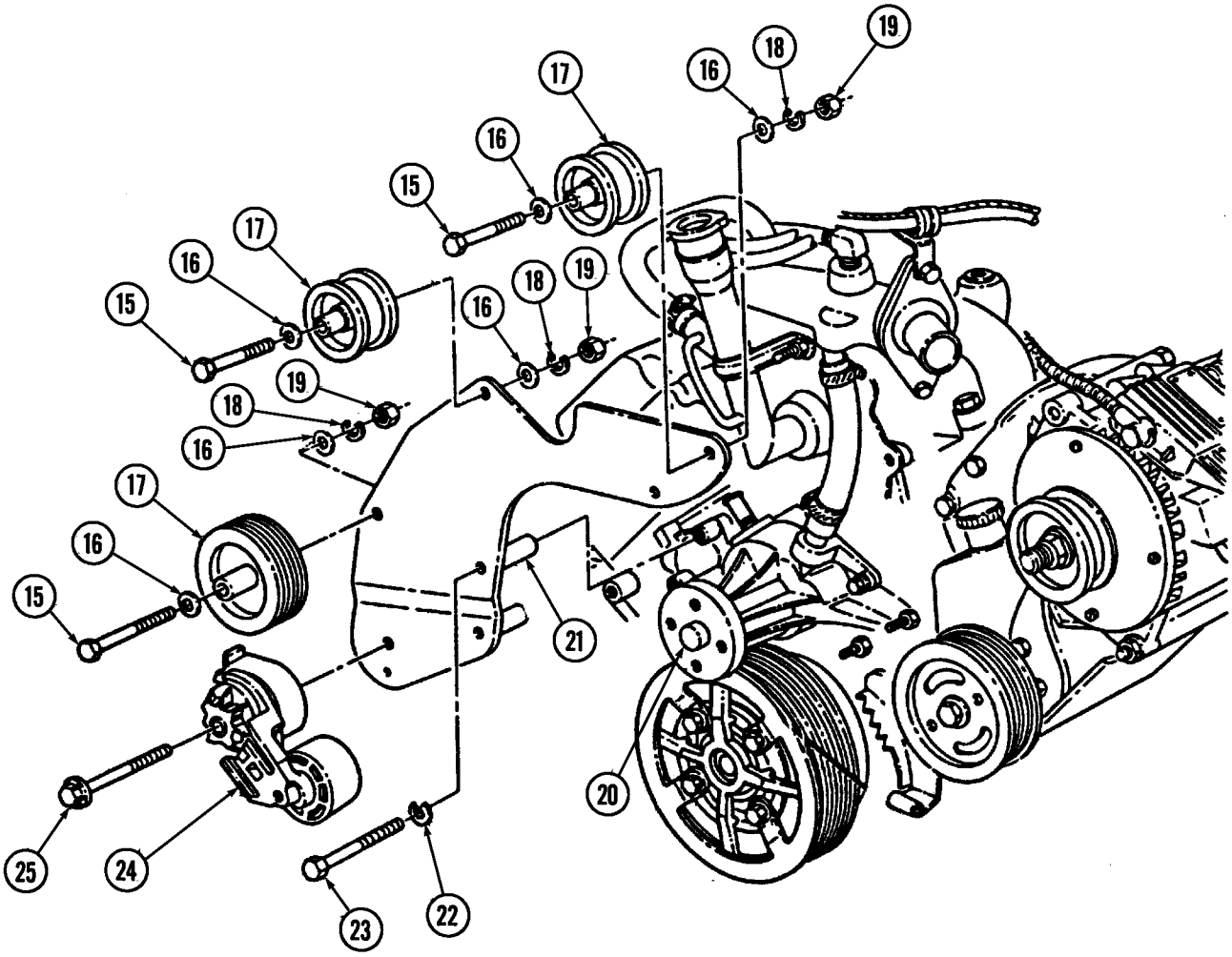

**6.5L CONFIGURATION**

## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

24.2. Install idler bracket (21) on water pump (20) with three lockwashers (22) and capscrews (23).

24.3. Install three idler pulleys (17) on idler bracket (21) with three washers (16), capscrews (15), washers (16), lockwashers (18), and nuts (19).

24.4. Install belt tensioner (24) on idler bracket (21) with capscrew (25).



**3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)**

WARNING

Alternator must be supported during installation. Failure to support alternator may cause injury to personnel or damage to equipment.

**NOTE**

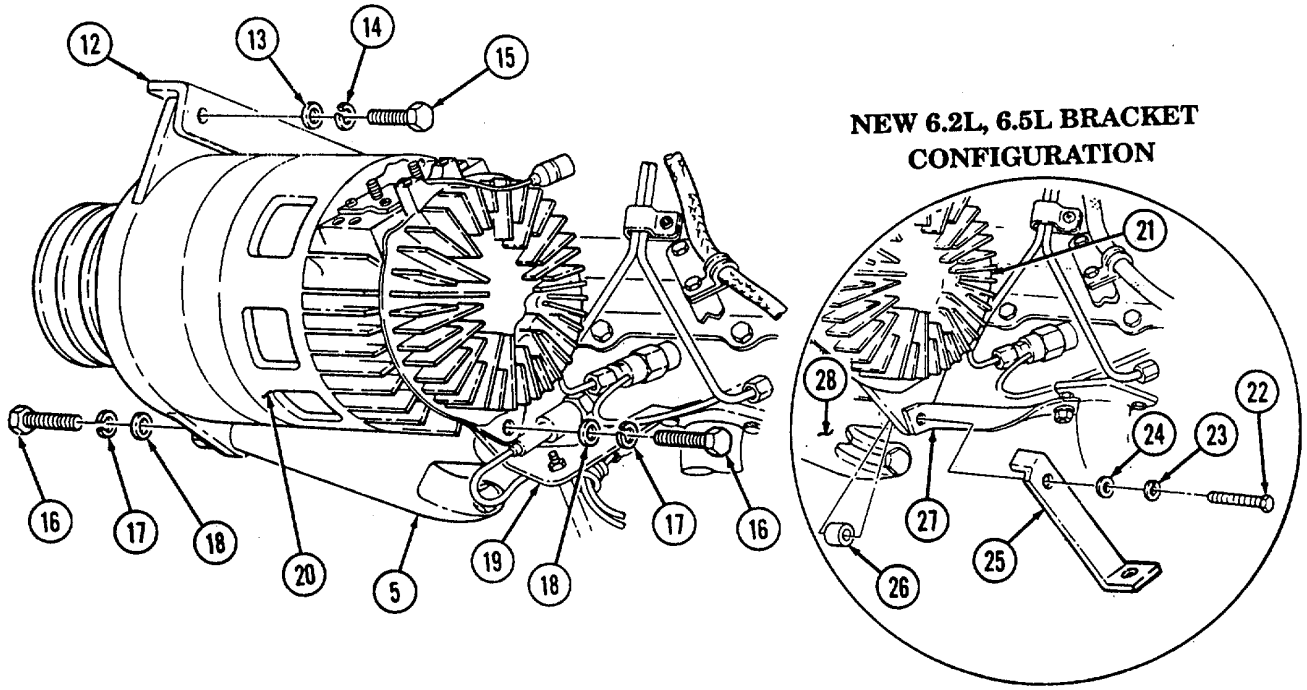
- Perform steps 25 through 29 for vehicles equipped with 60 and 100 amp Prestolite alternator only.
- In some cases, a thru-bolt and nut may be present on mounting bracket instead of standard capscrews and washers.

25. Install alternator (20) on mounting bracket (5) with support bracket (19) between mounting bracket and alternator (20) with two washers (18), lockwashers (17), and capscrews (16).
26. Align alternator (20), and adjusting bracket (12), and install washer (13), lockwasher (14), and capscrew (15).

**NOTE**

Perform steps 27 through 29 for vehicles with new alternator support bracket configuration.

27. Position alternator (21) on mounting bracket (28) with support bracket (27) on the outside of alternator (21) mounting flange.
28. Position spacer (26) between alternator (21) and mounting bracket (28).
29. Install alternator (21) and power steering lines bracket (25) on support bracket (21) and mounting bracket (28) with two washers (24), lockwashers (23), and capscrews (22).

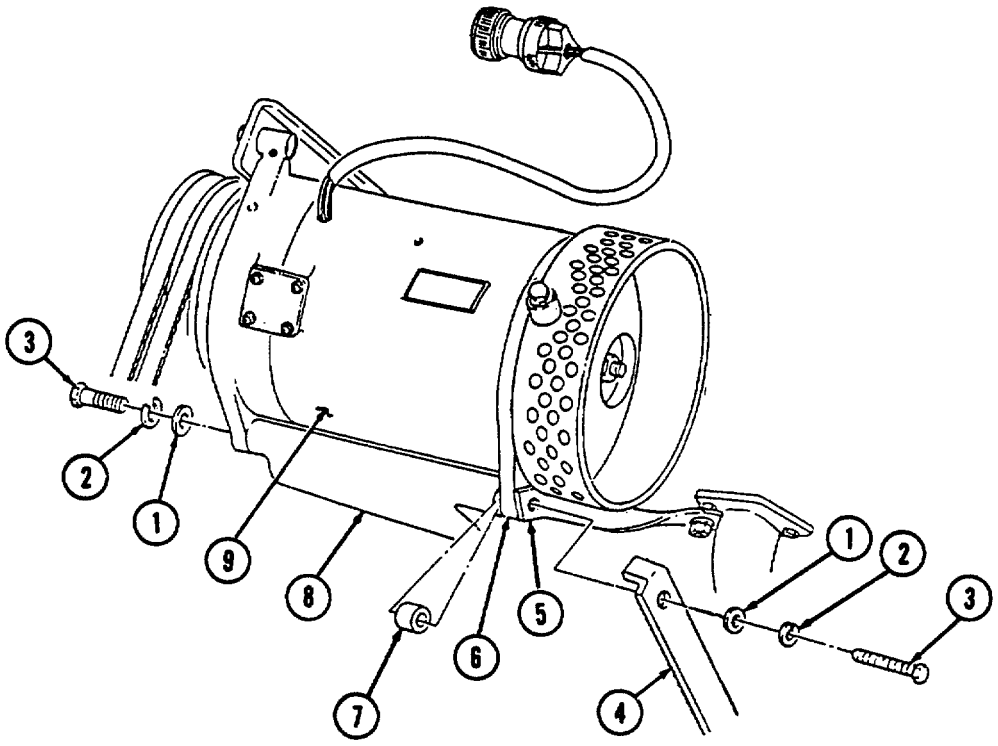


**3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)**

**NOTE**

- Perform step 30 for vehicles equipped with 100 amp Neihoff alternator only.
- In some cases, a thru-bolt and nut may be present on mounting bracket instead of standard capscrews and washers.

30. Position alternator (9) on mounting bracket (8) with support bracket (5) and power steering lines bracket (4) on the outside of alternator mounting flange (6) and install spacer (7), two washer (1), lockwashers (2), and capscrew (3).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

**NOTE**

- Perform steps 31 through 34 for 6.2 L engines only.
- Replace power steering drivebelts in matched sets only.

31. Feed belt set (14) into inner grooves on crankshaft pulley (12), water pump pulley (13), and power steering pump pulley (11).
32. Install adjusting capscrew (16) through adjusting slot in alternator support bracket (19). Do not tighten capscrew (16).

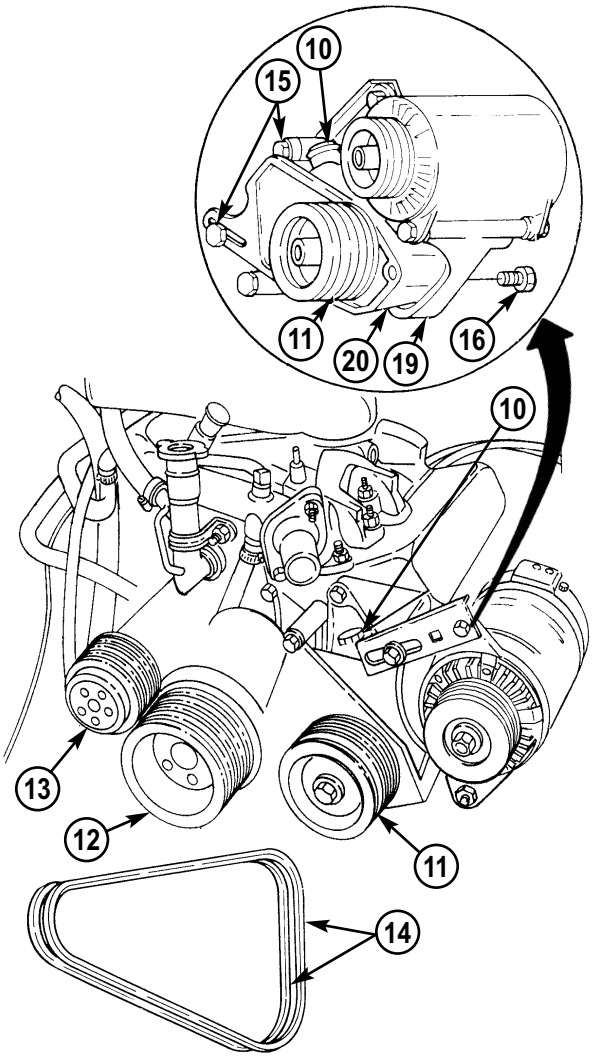
**CAUTION**

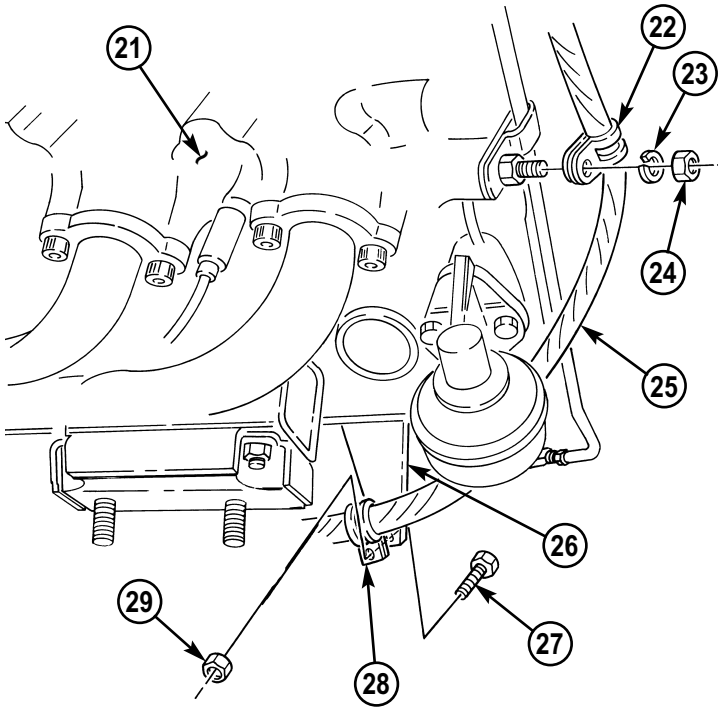
Do not pry against power steering pump housing with pry bar when adjusting belt tension. Damage to equipment may result.

**NOTE**

- New belt tension should read 105 + 5 lbs (476 + 22 N).
- Used belt tension should read 90 + 5 lbs (400 + 22 N).

33. Using belt tension gauge, check each belt for proper tension.
34. Tighten two capscrews (15) and adjusting capscrew (16) to 40 lb-ft (54 N•m) on power steering pump bracket (20), alternator bracket (19), and power steering pump (10).
35. Position wiring harness (25) in approximate mounting location.
36. Install wiring harness (25) on bracket (26) with capscrew (27), clamp (28), and nut (29).
37. Install wiring harness (25) on cylinder block (21) with clamp (22), lockwasher (23), and nut (24).



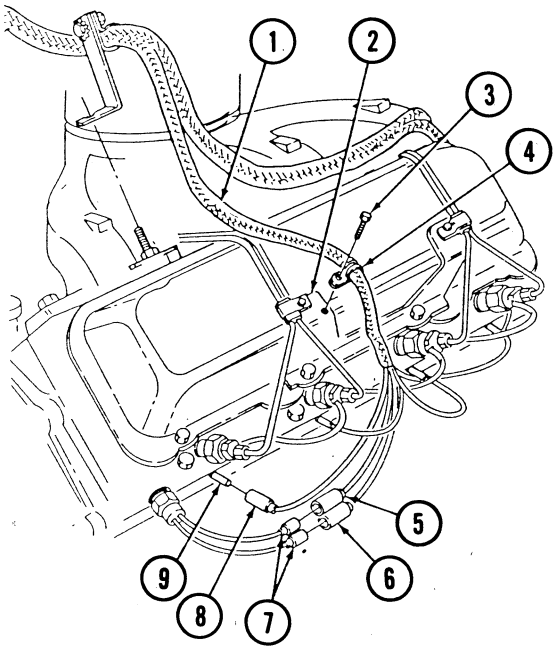
## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

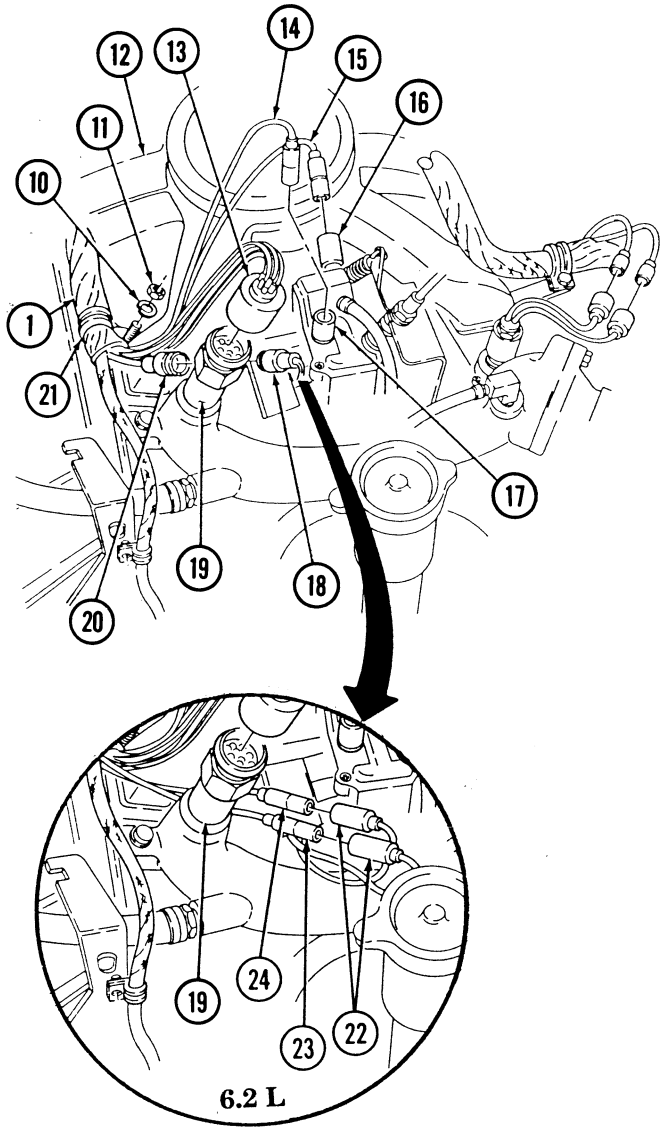
38. Connect four harness boots (8) to glow plugs (9).
39. Connect leads 569A (5) and 569B (6) to cold advance switch leads (7).
40. Install wiring harness (1) on rocker arm cover bracket (2) with clamp (4) and capscrew (3).

**NOTE**

- Perform step 42 for 6.2 L only.
- Perform step 43 for 6.5 L only.

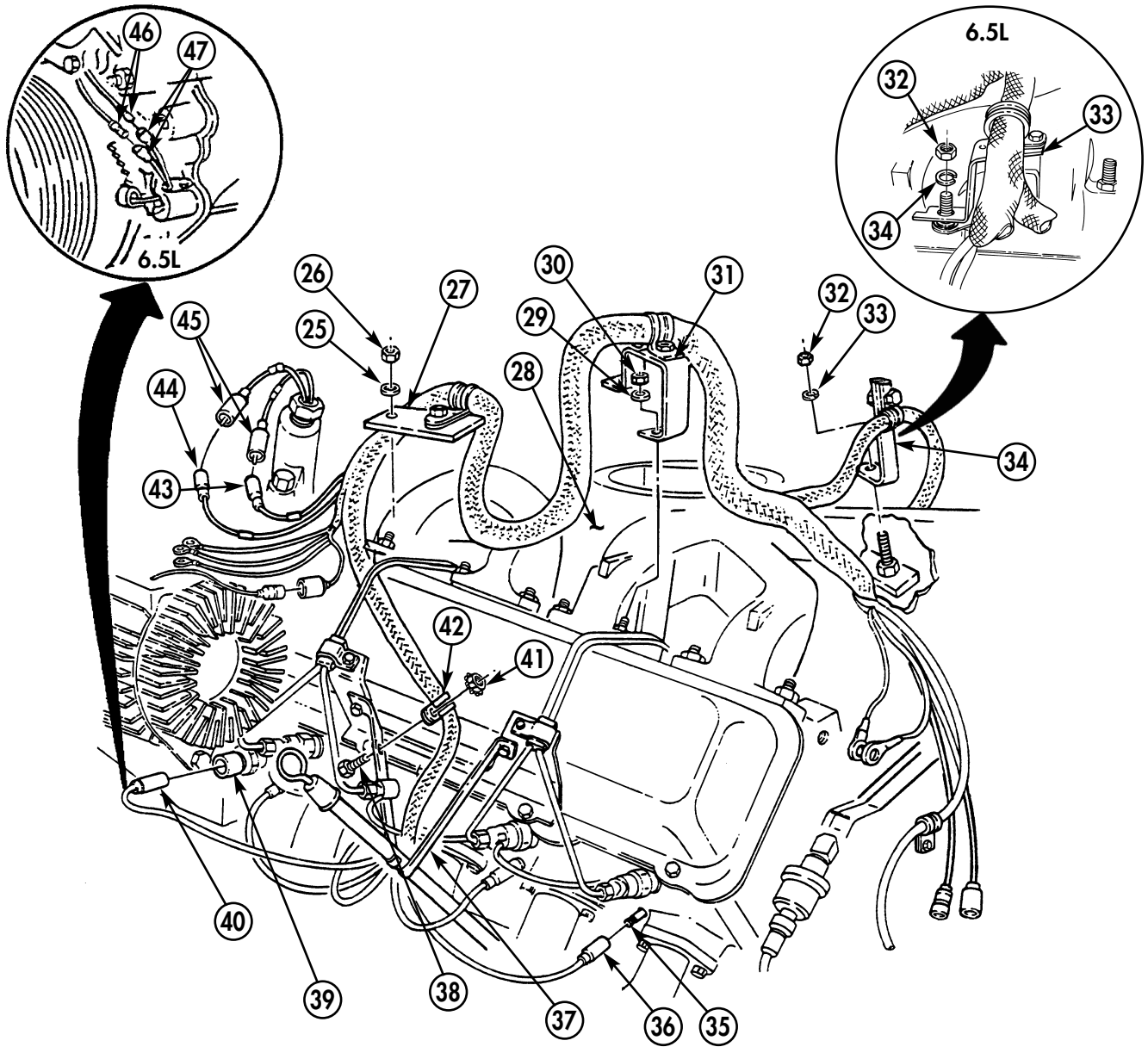
41. Connect leads 54A (14) and 569B (15) to fuel injection pump terminals (16) and (17).
42. Connect lead 315A (24) and 315B (23) to transmission kickdown switch leads (22).
43. Connect leads 359E/355A/350B (20) to transmission TP sensor lead (18).
44. Connect harness connector (13) to glow plug controller (19).
45. Install harness (1) on intake manifold (12) with clamp (21), lockwasher (10), and nut (11).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

46. Install wiring harness bracket (33) on intake manifold (28) with lockwasher (34) and nut (32).
47. Install wiring harness bracket (31) on intake manifold (28) with two lockwashers (29) and nuts (30).
48. Install wiring harness bracket (27) on intake manifold (28) with lockwasher (25) and nut (26).
49. Install harness clamp (42) on upper dipstick tube bracket (37) with plain assembled nut (41) and capscrew (38).
50. Connect four harness lead boots (36) to glow plugs (35).
51. Connect harness lead 33B (40) to engine temperature sending unit (39), and harness leads (46) to engine rpm sensor leads (47).
52. Connect leads 458A (43) and 458B (44) to fan clutch temperature switch leads (45).



## 3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)

**NOTE**

Perform step 53 for 6.2 L early production vehicles only.

53. Install spacer (23), clamps (26), and harness clamp (22) on support bracket (27) with capscrew (21), washer (25), and locknut (24).

**NOTE**

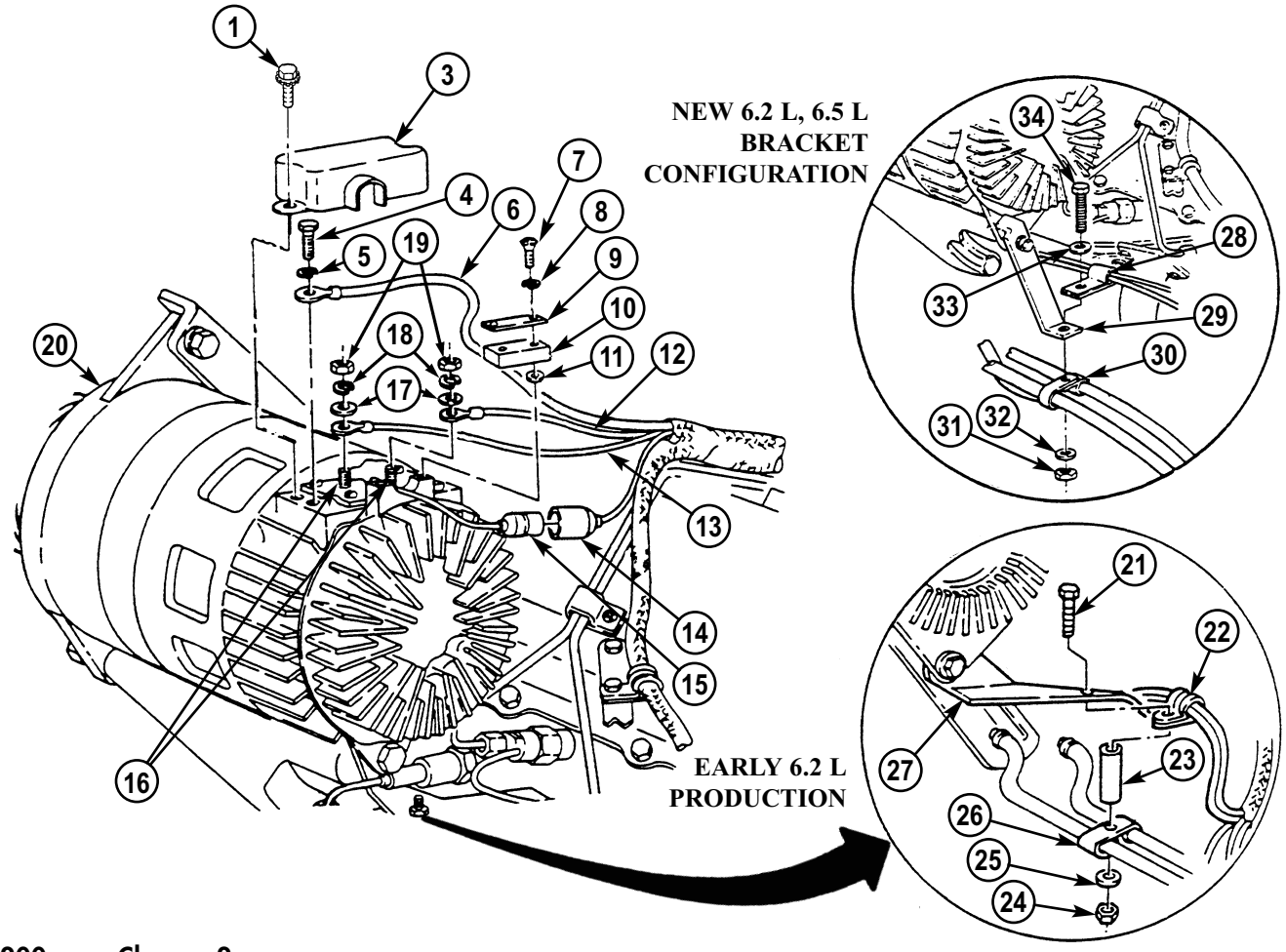
Perform step 54 for vehicles with new support bracket configuration.

54. Install power steering line clamps (30) and wiring harness clamp (28) on support bracket (29) with washer (33), capscrew (34), washer (32), and locknut (31).

**NOTE**

Perform steps 55 through 60 for vehicles equipped with a 60 amp alternator.

55. Install leads 2A (12) and 5A (13) to studs (16) with two washers (17), lockwashers (18), and nuts (19).
56. Install ground 3B (6) on alternator (20) with lockwasher (5), and capscrew (4).
57. Connect lead 568A (15) to engine wiring harness (14).
58. Seal terminal connections (16) using adhesive sealant.
59. Install terminal cover (3) on alternator (20) with two screw-assembled washers (1).
60. Install spacer (10), washer (11), and wire retaining strap (9) on alternator (20) with two lockwashers (8) and screws (7).



**3-26. ENGINE PREPARATION (6.2 L AND 6.5 L) (Cont'd)**

**CAUTION**

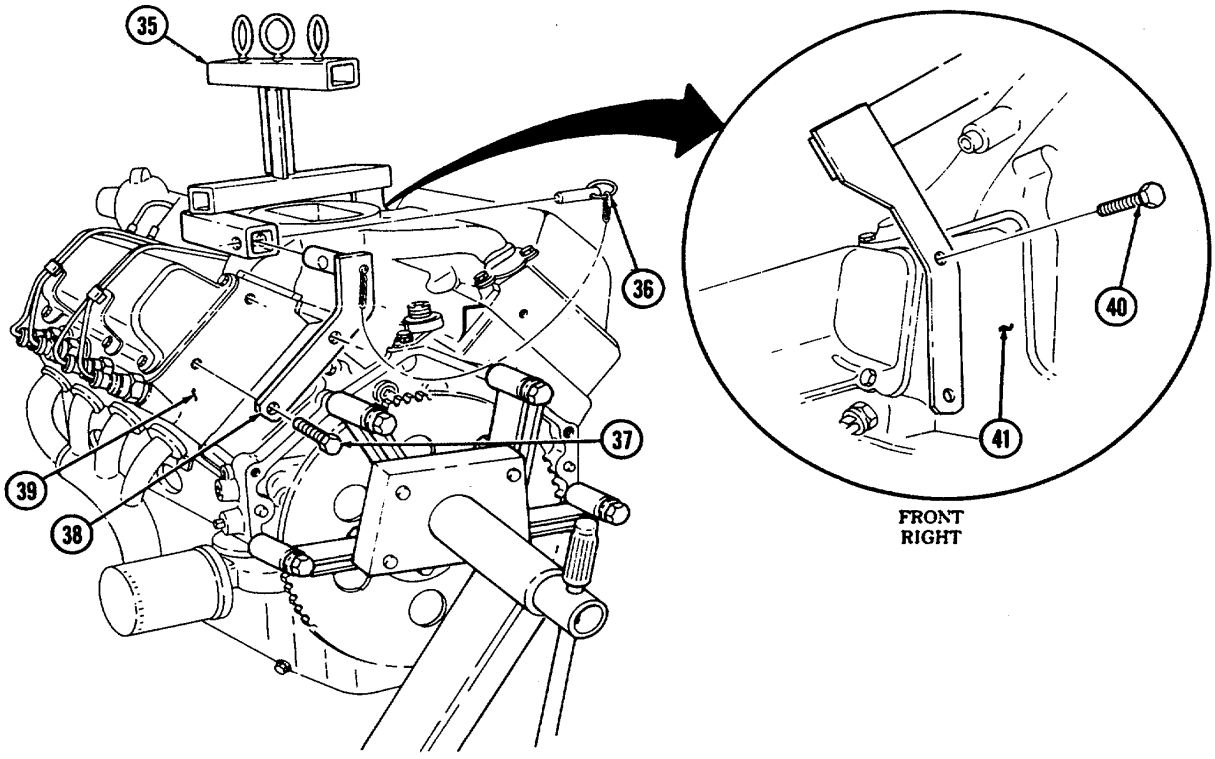
When using front eyelet on lifting sling, engine oil pan must be supported during engine installation to prevent rear eyelet of lifting sling from damaging windshield.

**NOTE**

Hoist must be attached to:
- Forward eyelet of lifting sling when lifting engine on M996, M996A1, M997, and M997A1 for 6.2 L.
- Forward eyelet of lifting sling when lifting engine on M997A2 for 6.5 L.
- Intermediate eyelet when lifting engine on all other models. Rear eyelet when lifting engine and transmission together.

Sling bracket must be installed on rear of engine.

61. Install sling bracket (38) on left cylinder head (39) with two capscrews (37).
62. Install engine lifting sling (35) on right cylinder head (41) with two capscrews (40).
63. Install pin (36) and sling bracket (38) on engine lifting sling (35)




FOLLOW-ON TASK: Install engine (para. 3-23 or 3-25).

# CHAPTER 4
# FUEL SYSTEM MAINTENANCE

## 4-1. INTRODUCTION

This chapter contains maintenance instructions for replacement of fuel system components at the Direct Support maintenance level. Some subassemblies and parts must be removed before fuel system components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## 4-2. FUEL SYSTEM MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 4-3. | Fuel Injection Nozzle Replacement | 4-2 |
| 4-4. | Fuel Injection Lines Maintenance | 4-4 |
| 4-5. | Servo Advance Seal Replacement | 4-6 |
| 4-6. | Fuel Injection Pump Maintenance | 4-8 |
| 4-7. | Fuel Injection Pump Cover Replacement | 4-14 |
| 4-8. | Fuel Injection Pump Shutoff Solenoid Maintenance | 4-16 |
| 4-9. | Fuel Injection Pump Cold Advance Solenoid Maintenance | 4-18 |
| 4-10. | Accelerator Cable Mounting Bracket Maintenance | 4-20 |

# 4-3. FUEL INJECTION NOZZLE REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**
Injection nozzle socket (Appendix G, Item 25)
Crowfoot, 19 mm (Appendix G, Item 111)
Crowfoot, 7/8 in. (Appendix G, Item 113)
(rear injection nozzle only)

**Materials/Parts**
Gasket (Appendix E, Item 16)

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Manual References (Cont'd)**
TM 9-2815-237-34P

**Equipment Condition**
- Hood raised and secured (TM 9-2320-280-10).
- Engine access cover removed (TM 9-2320-280-20) (rear injection nozzles only).
- Battery ground cable disconnected (TM 9-2320-280-20).

**General Safety Instructions**
Do not perform this procedure near fire, flames, or sparks.

**Maintenance Level**
Direct support

**WARNING**

Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.

**CAUTION**

Cover or plug all hoses, connections, and openings immediately after disconnection or component removal to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The fuel injection nozzle replacement procedures for pre-1990, 1990 and above 6.2 L engines and 6.5 L engines are the same. Refer to engine decal model number on left rocker arm cover before ordering replacement parts, since parts are not interchangeable.

**a. Removal**

**NOTE**

- Removal and installation procedures for all eight injection nozzles are basically the same. This procedure covers one injection nozzle.
- Have drainage container available to catch fuel.
- Perform step 1 if replacing rear injection nozzles.

1. Loosen clamps (6) and remove fuel return hose (2) and cap (10) from fuel injection nozzle (7).
2. Loosen clamps (6) and disconnect fuel return hoses (2) from fuel injection nozzle (7) .
3. Remove screw-assembled washer (4) from clamp (3) and support bracket (1).
4. Loosen and disconnect two fuel injection line nuts (5) from fuel injection nozzles (7).
5. Using injection nozzle socket, remove fuel injection nozzle (7) and gasket (8) from cylinder head (9). Discard gasket (8).

**4-3. FUEL INJECTION NOZZLE REPLACEMENT (Cont'd)**

b. Installation

**NOTE**

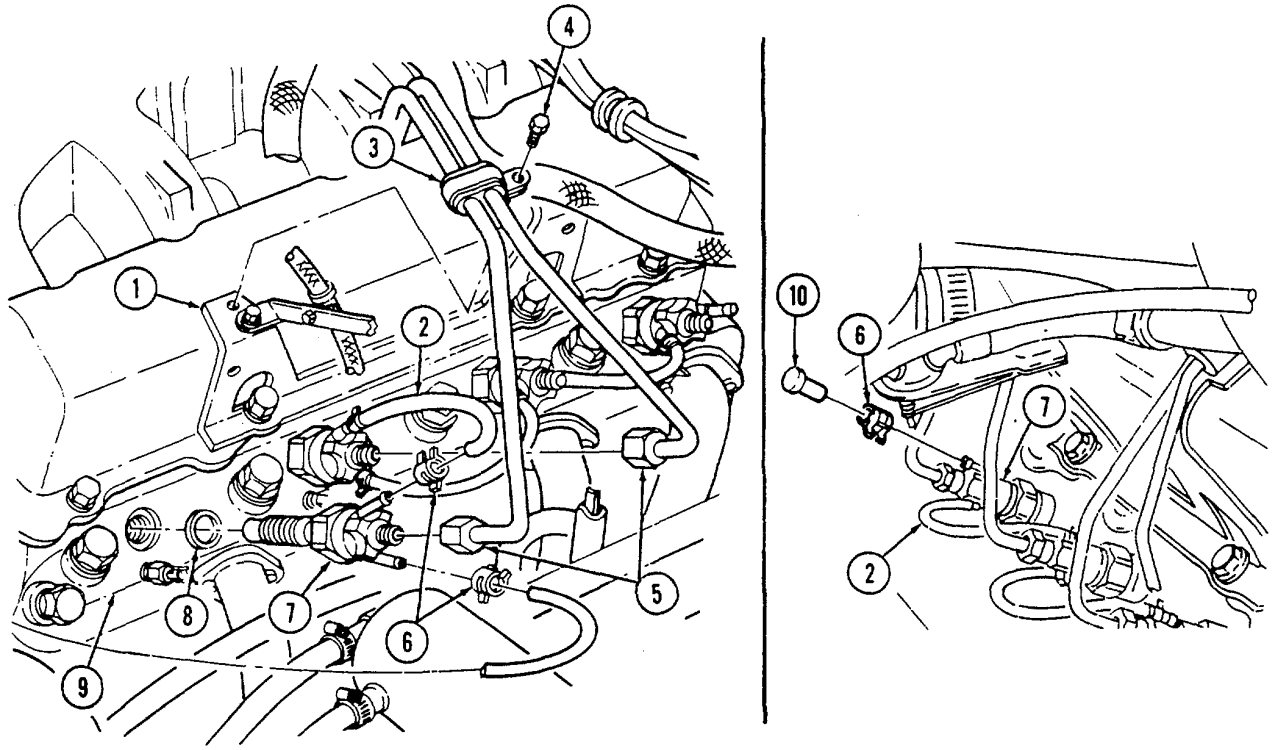
If replacing rear injection nozzles, tighten nozzles in accordance with step 2. Tighten fuel injection line nuts in accordance with step 4.

1. Install gasket (8) and fuel injection nozzle (7) into cylinder head (9). Using injection nozzle socket, tighten fuel injection nozzle (7) to 44-60 lb-ft (60-81 N m).
2. Using injection nozzle socket and 7/8 in. crowfoot, tighten fuel injection nozzle (7) to 44-60 lb-ft (60-81 N m).
3. Secure fuel injection line nuts (5) to fuel injection nozzles (7).
4. Using 19 mm crowfoot, tighten fuel injection line nuts (5) to 20 lb-ft (27 Nm).
5. Install clamp (3) on support bracket (1) with screw-assembled washer (4).

**NOTE**

Perform step 6 if replacing rear injection nozzles.

6. Install fuel return hose (2) and cap (10) on fuel injection nozzle (7) with clamp (6).
7. Install fuel return hoses (2) on fuel injection nozzle (7) with clamps (6).
8. Bleed lines (para. 4-4.d).




FOLLOW-ON TASKS:
- Connect battery ground cable (TM 9-2320-280-20).
- Start engine (TM 9-2320-280-10) and check for fuel leakage.
- Install engine access cover (TM 9-2320-280-20), rear injection nozzles only.
- Lower and secure hood (TM 9-2320-280-10).

## 4-4. FUEL INJECTION LINES MAINTENANCE

This task covers:
a. Removal
b. Inspection
c. Installation
d. Bleeding

INITIAL SETUP:

Tools
General mechanic's tool kit:
automotive (Appendix G, Item 1)

Special Tool
Crowfoot, 16 mm (Appendix G, Item 135)
Crowfoot, 19 mm (Appendix G, Item 111)

Manual References
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2815-237-34P

Equipment Condition
- Intake manifold removed (para. 3-17).
- Fuel injection pump boot removed (TM 9-2320-280-20).

General Safety Instructions
Do not perform this procedure near fire, flames, or sparks.

Maintenance Level
Direct support

**WARNING**

Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.

**CAUTION**

Cover or plug all hoses, connections, and openings immediately after disconnection or component removal to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The fuel injection pump replacement procedures for pre-1990, 1990 and above 6.2 L and 6.5 L engines, are basically the same. Refer to engine decal model number on left rocker arm cover before ordering replacement parts, since replacement parts are not interchangeable.

### a. Removal

**NOTE**

Have drainage container available to catch fuel.

1. Loosen two fuel injection line nuts (2) and disconnect fuel injection lines (3) from fuel injection nozzles (7).
2. Remove screw-assembled washer (4) and clamp (5) from support bracket (8).

**NOTE**

Tag fuel injection lines by cylinder number for assembly.

3. Loosen two fuel injection line nuts (2) and remove fuel injection lines (3) from fuel injection pump (1).
4. Remove clamp (5) and two grommets (6) from fuel injection lines (3).

### b. Inspection

1. Inspect fuel injection lines (3) for cracks, bends, or damage. Replace if cracked, bent, or damaged.
2. Inspect grommets (6) for damage. Replace if damaged.

## 4-4. FUEL INJECTION LINES MAINTENANCE (Cont'd)

**c. Installation**

1. Install two grommets (6) on fuel injection lines (3).
2. Connect fuel injection lines (3) to fuel injection pump (1) and fuel injection nozzles (7).
3. Using 16 mm crowfoot, tighten two fuel injection line nuts (2) on fuel injection lines (3) and fuel injection pump (1) to 20 lb-ft (27 N•m).
4. Install clamp (5) and fuel injection lines (3) to support bracket (8) with screw-assembled washer (4). Tighten screw-assembled washer (4) to 3-4 lb-ft (4-5 N•m).

**d. Bleeding**

1. Loosen eight fuel injection line nut (2) at eight injection nozzles (7).

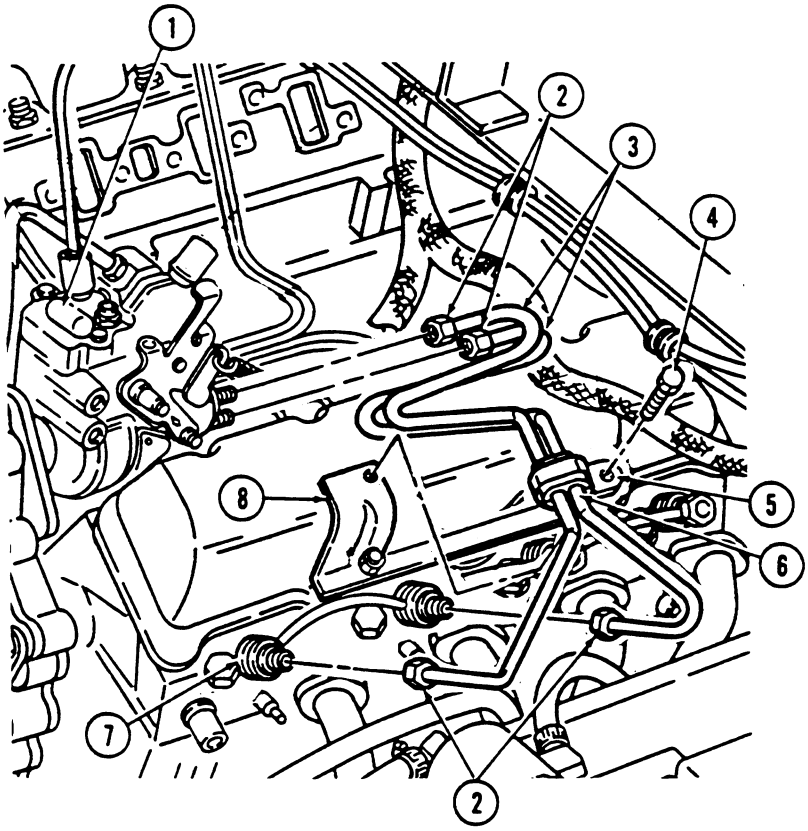
**CAUTION**

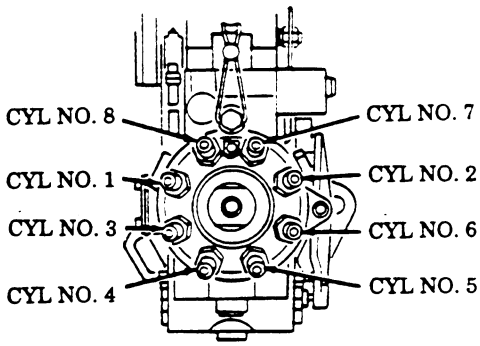
Do not operate starter continuously for more than 20 seconds, wait 10 to 15 seconds between periods of operation. Failure to do so will result in damage to the starter.

**NOTE**

Have drainage container available to catch fuel.

2. Crank engine until fuel exits from all fuel injection lines (3).
3. Using 19 mm crowfoot, tighten fuel injection line nuts (2) to 20 lb-ft (27 N•m).




FOLLOW-ON TASKS:
- Install fuel injection pump boot (TM 9-2320-280-20).
- Install intake manifold (para. 3-17).
- Start engine (TM 9-2320-280-10) and check for fuel leaks.

# 4-5. SERVO ADVANCE SEAL REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)
Modified box wrench (Appendix C, Fig. 18)

**Materials/Parts**
Drain plug seal (Appendix E, Item 212)
Seal (Appendix E, Item 202)

**Manual References**
TM 9-2320-280-20
TM 9-2815-237-34P

**Equipment Condition**
Kick-down switch removed (TM 9-2320-280-20).

**Maintenance Level**
Direct Support

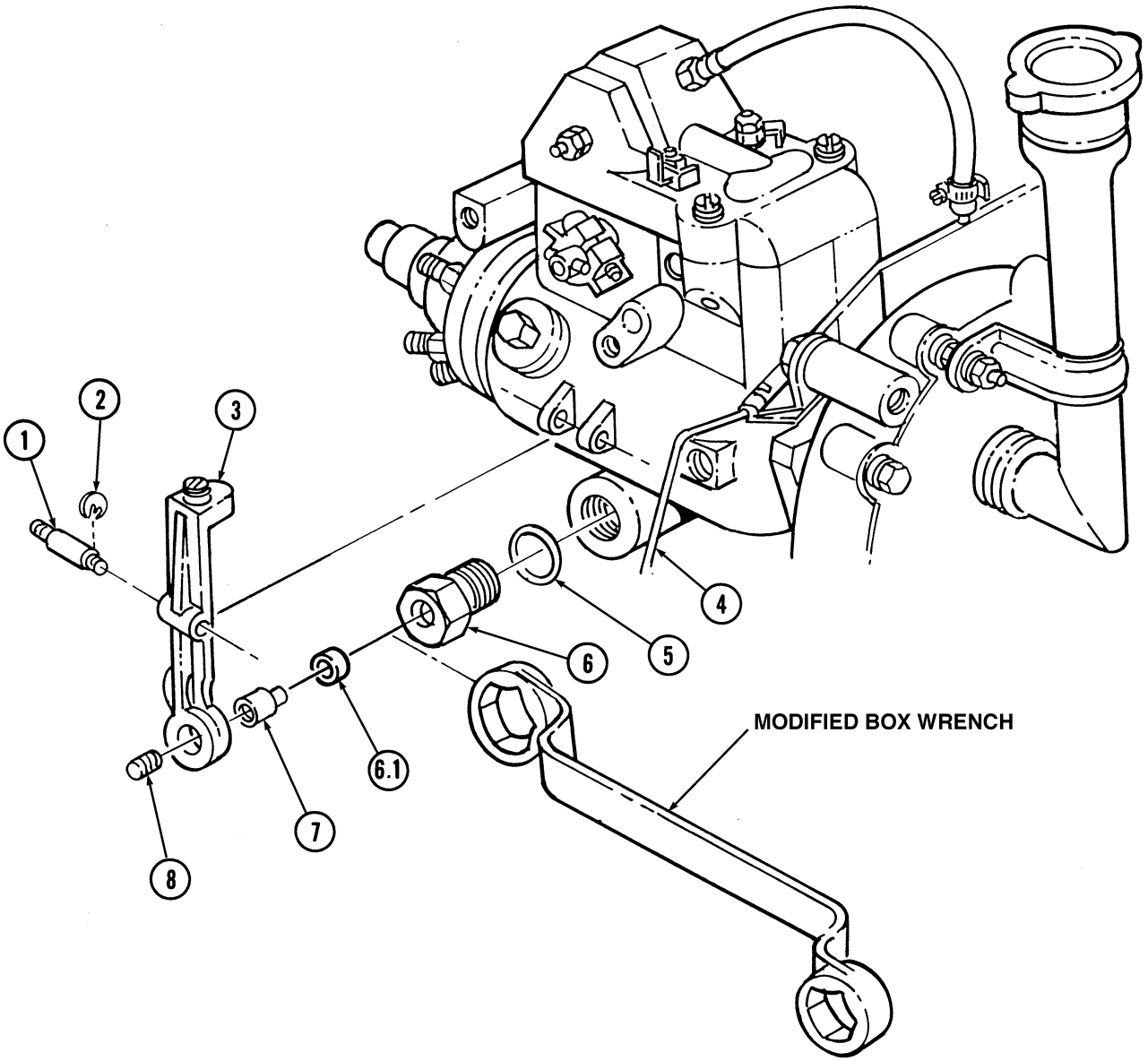
## a. Removal

1. Remove two retaining rings (2) and pin (1) from rocker lever (3) and injection pump (4).
2. Remove setscrew (8), rocker lever (3), plunger (7), and seal (6.1) from piston plug nut (6). Discard seal (6.1).
3. Using a modified box wrench, remove piston plug nut (6) from fuel injection pump (4).
4. Remove drain plug seal (5) from piston plug nut (6). Discard seal (5).

## b. Installation

1. Install drain plug seal (5) on piston plug nut (6).
2. Install piston plug nut (6) on fuel injection pump (4) with modified box wrench.
3. Install seal (6.1), plunger (7), and rocker lever (3) on piston plug nut (6) with setscrew (8).
4. Install rocker lever (3) on fuel injection pump (4) with pin (1) and two retaining rings (2).

## 4-5. SERVO ADVANCE SEAL REPLACEMENT (Cont'd)




FOLLOW-ON TASK: Install kick-down switch (TM 9-2320-280-20).

## 4-6. FUEL INJECTION PUMP MAINTENANCE

**This task covers:**

**a. Removal**
**b. Repair**
**c. Installation**

### INITIAL SETUP

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Gasket (Appendix E, Item 9)
Tiedown strap (Appendix E, Item 250)

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2815-237-34P
TM 9-2815-237-34

**Equipment Condition**
- Engine oil filler tube removed (TM 9-2320-280-20).
- Kick-down switch removed (TM 9-2320-280-20).
- Fuel injection lines removed (para. 4-4).
- Accelerator cable mounting bracket removed (para. 4-10).
- Remove TP sensor (TM 9-2320-280-20).

**General Safety Instructions**
- Do not perform this procedure near fire, flames, or sparks.
- Gaskets installed on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be disposed of IAW current directives.

**Maintenance Level**
Direct support

**WARNING**

- Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.
- Gaskets installed on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be removed with a scraper or putty knife then disposed of IAW current directives. Inhalation of asbestos fibers can cause respiratory ailments

**CAUTION**

Cover or plug all hoses, connections, and openings immediately after disconnection or component removal to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The fuel injection pump replacement procedures for 6.2L and 6.5L engine models prior to, and later than 1990 are basically the same. Refer to engine decal model number on left rocker arm cover before ordering replacement parts, since replacement parts are not interchangeable.

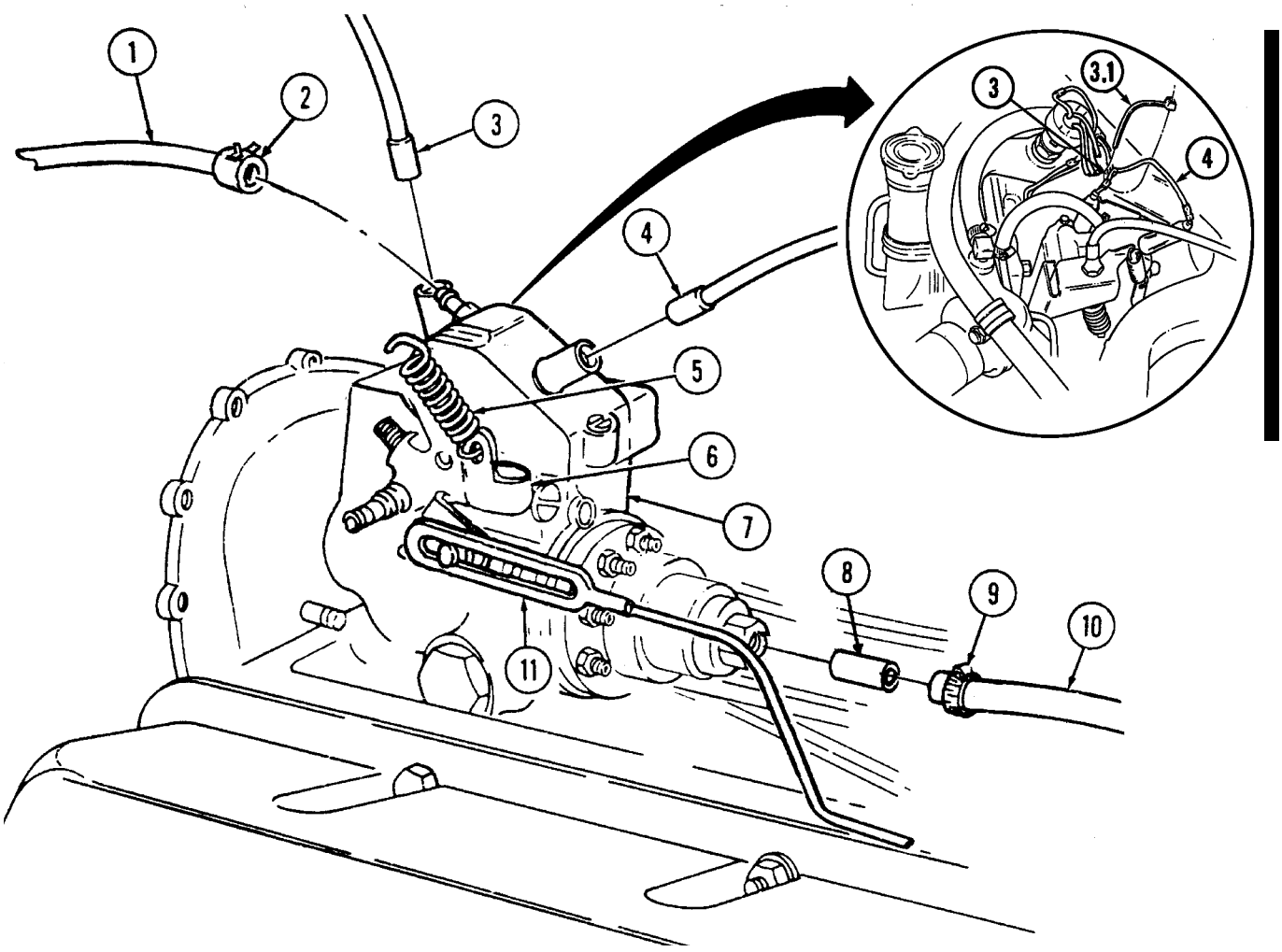
**a. Removal**

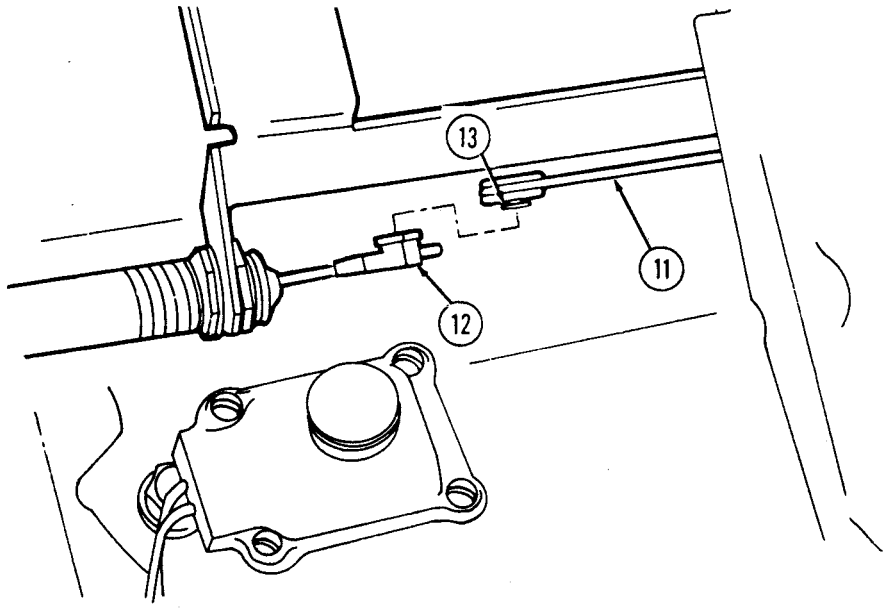
**NOTE**

- In some cases, flanged head fasteners may be present instead of standard fasteners and washers. In all cases, washers should be used when replacing a flanged head fastener with a standard fastener.
- Prior to removal, tag leads for installation.
- Have drainage container available to catch fuel.

1. Disconnect leads 54A (3) and 569B (4) at fuel injection pump (7).
1.1. Remove tiedown strap (3.1) from leads 54A (3) and 569B (4). Discard tiedown strap (3.1).
2. Loosen clamp (2) and disconnect fuel drain back hose (1) from fuel injection pump (7).
3. Loosen clamp (9) and disconnect outlet hose (10) from hose adapter (8).
4. Remove return spring (5) from throttle shaft lever (6).
5. Pull off cable clip (12) from modulator link pin (13).
6. Slide modulator link (11) forward and disconnect from fuel injection pump (7).
7. Remove hose adapter (8) from fuel injection pump (7).

## 4-6. FUEL INJECTION PUMP MAINTENANCE (Cont'd)



## 4-6. FUEL INJECTION PUMP MAINTENANCE (Cont'd)

**NOTE**

Rotate engine in order to gain access to driven gear and injection pump retaining capscrews.

8. Remove three capscrews (9) from pump driven gear and fuel injection pump (4).

**WARNING**

Gaskets installed on some 6.2L engines assembled prior to 1991 may contain asbestos. Gaskets should be removed with a scraper or putty knife and then be disposed of IAW current directives. Inhalation of asbestos fibers can cause respiratory ailments.

9. Remove three nuts (5), washers (6), fuel injection pump (4), and gasket (1) from timing gear cover (7). Discard gasket (1).
10. Clean gasket surface of timing gear cover (7) and fuel injection pump (4).

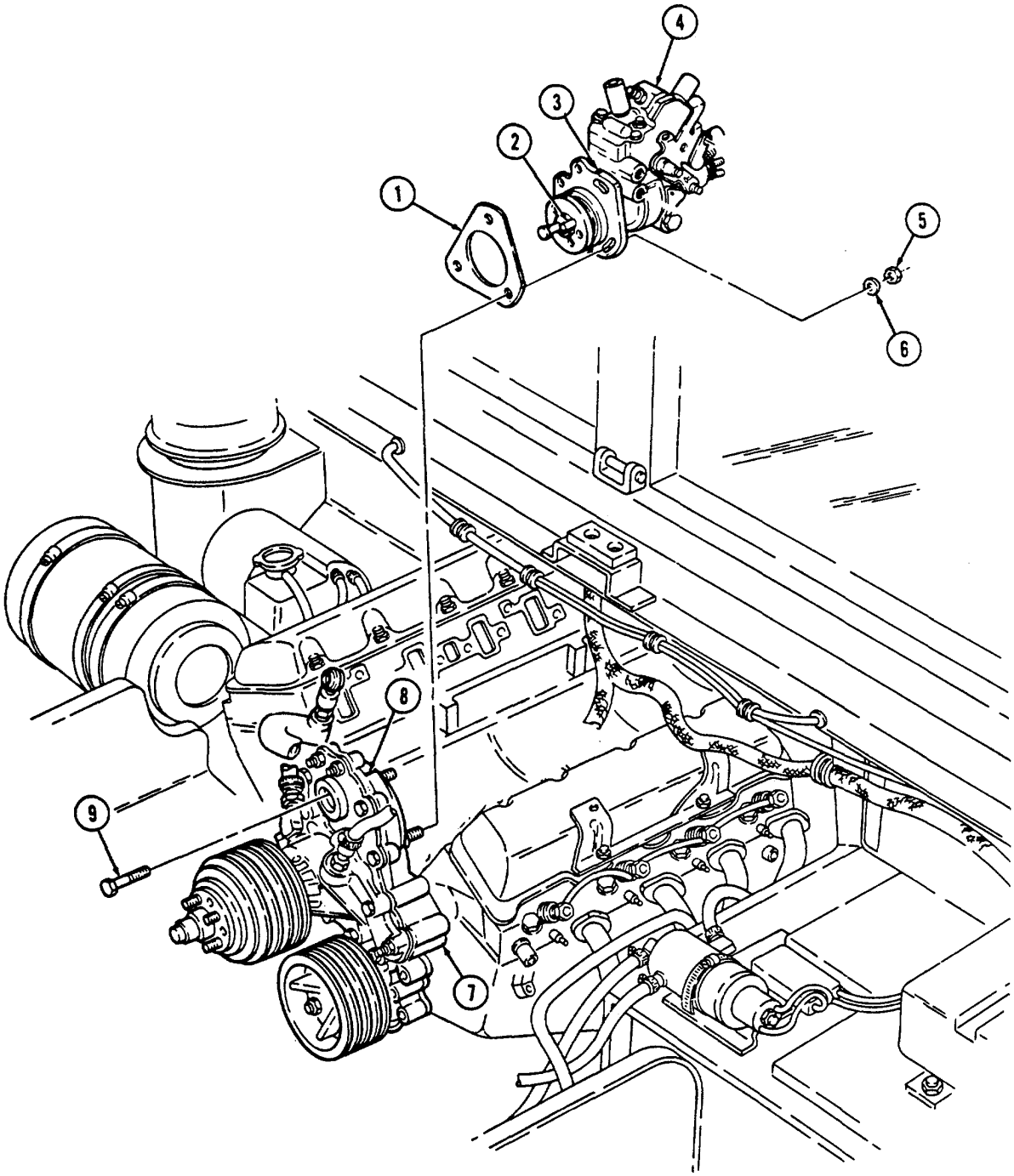
### b. Repair

For fuel injection pump repair procedures, refer to TM 9-2815-237-34.

### c. Installation

1. Align pin (2) on pump drive with elongated hole in pump driven gear.
2. Install gasket (1) and fuel injection pump (4) on timing gear cover (7).
3. Align fuel injection pump timing marks (3) and gear cover timing marks (8).
4. Install fuel injection pump (4) on timing gear cover (7) with three washers (6) and nuts (5).
5. Secure pump driven gear on fuel injection pump (4) with three capscrews (9). Tighten capscrews (9) to 13-20 lb-ft (18-27 N·m).

## 4-6. FUEL INJECTION PUMP MAINTENANCE (Cont'd)



## 4-6. FUEL INJECTION PUMP MAINTENANCE (Cont'd)

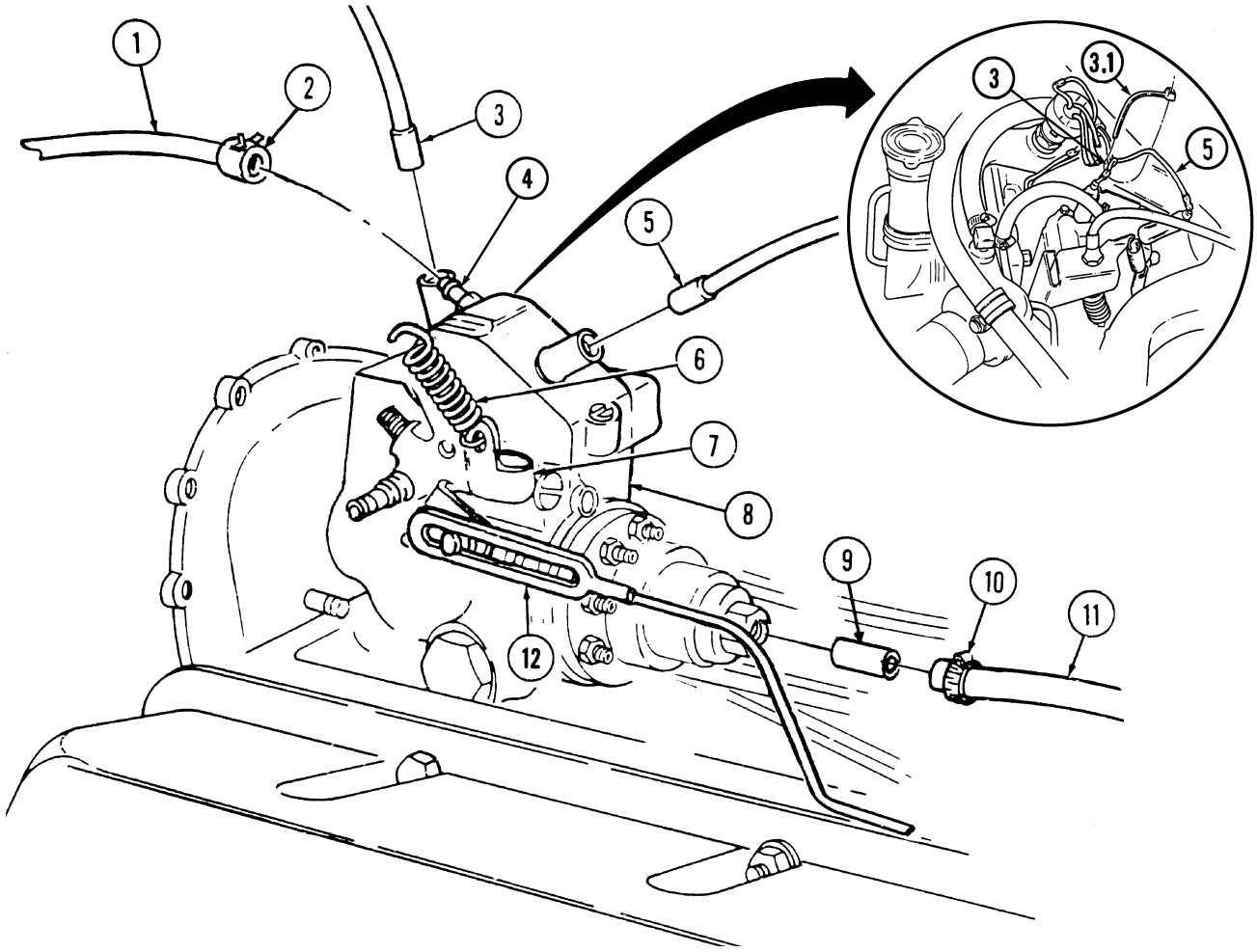
6. Install hose adapter (9) to fuel injection pump (8).
7. Slide modulator link (12) forward and connect to fuel injection pump (8).
8. Connect cable clip (13) to modulator link pin (14).
9. Install accelerator cable mounting bracket (para. 4-10).
10. Connect throttle return spring (6) to throttle shaft lever (7).
11. Connect fuel filter outlet hose (11) to hose adapter (9) with clamp (10).
12. Install kick-down switch (TM 9-2320-280-20).
13. Install engine oil filler tube (TM 9-2320-280-20).
14. Install fuel injection lines (para. 4-4), but do not bleed air from lines.
15. Adjust accelerator linkage (TM 9-2320-280-20).

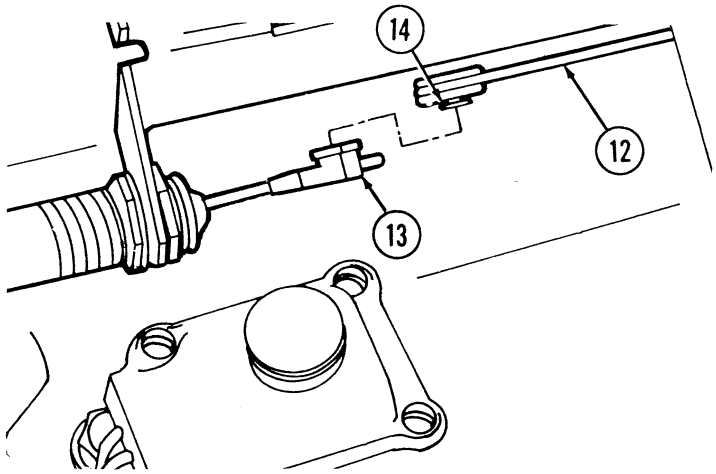
**CAUTION**

Do not operate starter continuously for more than 20 seconds, wait 10 to 15 seconds between periods of operation. Failure to do so will result in damage to the starter.

16. Crank engine until fuel exits from check valve (4) on fuel injection pump (8).
17. Connect fuel drain back hose (1) to check valve (4) with clamp (2).
18. Connect leads 54A (3) and 569B (5) to fuel injection pump (8).
19. Secure leads 54A (3) and 569B (5) with tiedown strap (3.1).

## 4-6. FUEL INJECTION PUMP MAINTENANCE (Cont'd)




FOLLOW-ON TASKS:
- Bleed fuel system (para. 4-4).
- Install TP sensor (TM 9-2320-280-20).
- Start engine (TM 9-2320-280-10) and check for fuel leaks.
- Time engine injection pump with dynamic timing meter (para. 3-19).

# 4-7. FUEL INJECTION PUMP COVER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)
Retaining tool (Appendix G, Item 26)

**Materials/Parts**

Gasket (Appendix E, Item 18)
O-ring (Appendix E, Item 126)
Three lockwashers (Appendix E, Item 86)

**Manual References**

TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2815-237-34P

**Equipment Condition**

- Hood raised and secured (TM 9-2320-280-10).
- Battery ground cable disconnected (TM 9-2320-280-20).

**General Safety Instructions**

Do not perform this procedure near fire, flames, or sparks.

**Maintenance Level**

Direct support

**WARNING**

Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.

**CAUTION**

Cover or plug all hoses, connections, and openings immediately after disconnection or component removal to prevent contamination. Remove all plugs prior to connection.

**NOTE**

Prior to removal, tag leads for installation.

**a. Removal**

**CAUTION**

Fuel pump body must be thoroughly cleaned before disconnecting any attaching components to prevent foreign particles from entering pump.

**NOTE**

Working area should be clean, well ventilated, and free from blowing dirt and dust.

1. Loosen clamp (2) and disconnect fuel drain back hose (1) from fuel injection pump (6).
2. Disconnect leads 54A (3) and 569B (5) at fuel injection pump (6).
3. Clean exterior of fuel injection pump (6) in accordance with para. 2-13.
4. Remove three screws (9), lockwashers (10), four washers (11), and ground strap (12) from fuel injection pump cover (4). Discard lockwashers (10).
5. Remove cover (4) and gasket (13) from fuel injection pump housing (14). Discard gasket (13).

**NOTE**

Perform step 6 only if fuel injection pump cover is being replaced.

6. Remove fuel return line check valve (7) and O-ring (8) from cover (4). Discard O-ring (8).
7. Inspect fuel return line check valve (7) for damage. Replace if damaged.

**b. Installation**

**NOTE**

Perform step 1 only if check valve was removed.

1. Install O-ring (8) and fuel return line check valve (7) in cover (4).

## 4-7. FUEL INJECTION PUMP COVER REPLACEMENT (Cont'd)

2. Install washer (11) between ground strap (12) and cover (4).
3. Install gasket (13) on fuel injection pump housing (14).

**CAUTION**

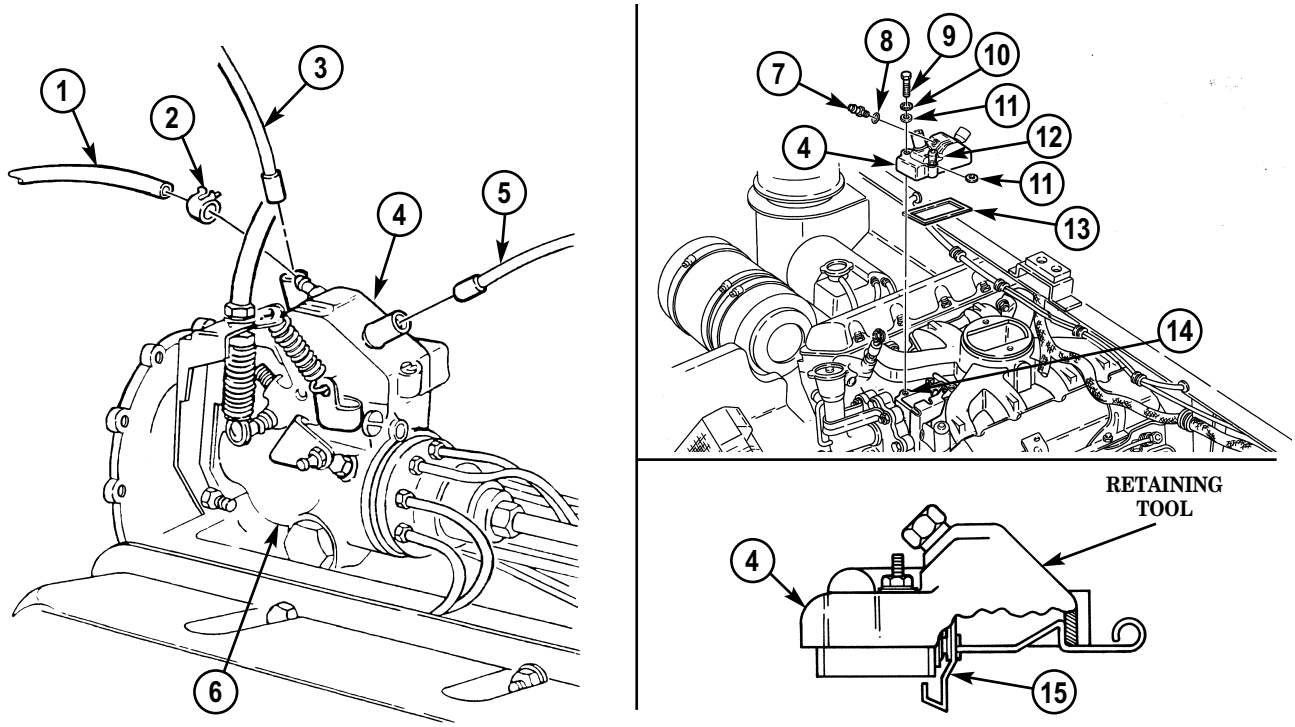
Incorrect installation of cover may cause damage to cover gasket or pump to malfunction.

4. Install retaining tool on cover (4) to restrict shutoff solenoid linkage (15).
5. Position cover (4) over fuel injection pump housing (14) ahead of threaded holes in housing and slide rearward and downward to align holes in cover (4) with threaded holes in housing (14).
6. Twist retaining tool to release solenoid linkage (15) and slide tool out from between cover (4) and fuel injection pump housing (14). Take care not to damage gasket (13).
7. Secure cover (4) with three screws (9), lockwashers (10), and washers (11). Tighten screws (9) to 34-45 lb-in. (4-5 N•m).
8. Connect fuel drain back hose (1) to fuel injection pump (6) with clamp (2).
9. Connect battery ground cable (TM 9-2320-280-20).

**CAUTION**

Do not attempt to start engine until all the following steps are completed. If no clicking noise is present in the cover of the fuel injection pump, the linkage may possibly be jammed in the wide open throttle position. If engine is started with linkage in wide open throttle position, engine runaway will occur and engine damage will result.

10. Place rotary switch to "RUN" position. Listen for a clicking noise when connecting and disconnecting lead 54A (3) to fuel injection pump (6). If no clicking noise is present, remove and reinstall cover (4). If clicking noise is present, connect harness leads 54A (3) and 569B (5) to fuel injection pump (6).




FOLLOW-ON TASKS:
- Start engine (TM 9-2320-280-10) and check for fuel leaks.
- Lower and secure hood (TM 9-2320-280-10).

## 4-8. FUEL INJECTION PUMP SHUTOFF SOLENOID MAINTENANCE

**This task covers:**

**a. Removal**
**b. Inspection**
**c. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Three lockwashers (Appendix E, Item 101)
Locknut (Appendix E, Item 52)
Two shouldered washers (Appendix E, Item 263)

**Equipment Condition**
Fuel injection pump cover removed (para. 4-7).

**Manual References**
TM 9-2320-280-20
TM 9-2815-237-34P

**Maintenance Level**
Direct support

**NOTE**

Working area should be clean, well ventilated, and free from blowing dirt and dust.

### a. Removal

1. Remove terminal (5), washer (6), and shell (7) from stud (12).
2. Remove nut (8), lockwasher (9), washer (10), and shouldered washer (11) from stud (12). Discard lockwasher (9) and shouldered washer (11).
3. Remove locknut (4), ground strap (3), lockwasher (2), nut (8), lockwasher (9), washer (10), and shouldered washer (11) from stud (14). Discard locknut (4), lockwashers (2) and (9), and shouldered washer (11).
4. Remove electrical shutoff solenoid (13) from cover (1).

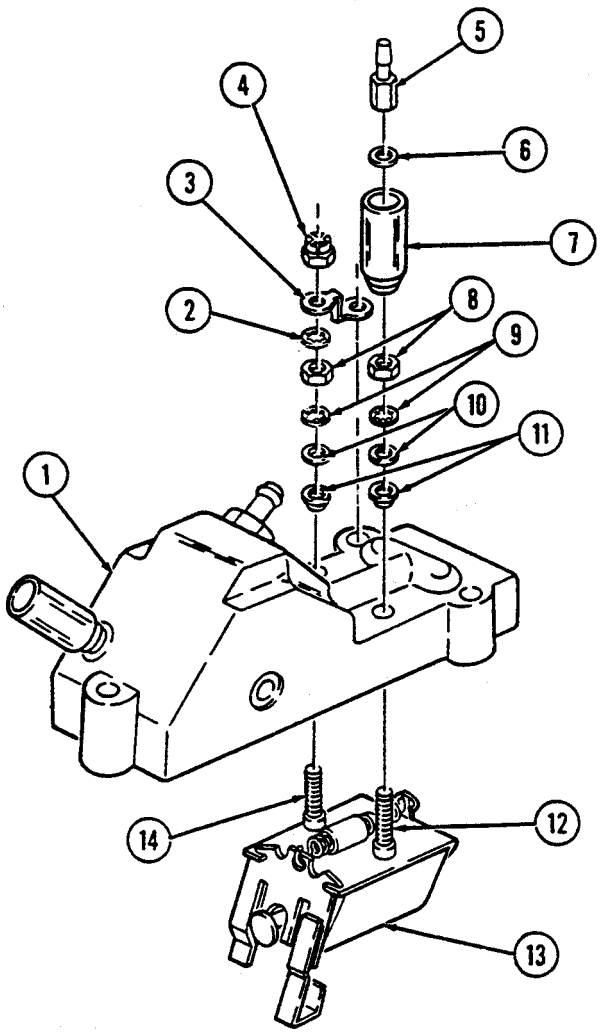
### b. Inspection

Inspect shell (7) for deterioration, cracks, or damage. Replace if cracked, deteriorated, or damaged.

### c. Installation

1. Install electrical shutoff solenoid (13) in cover (1).
2. Install shouldered washer (11), washer (10), lockwasher (9), nut (8), lockwasher (2), ground strap (3), and locknut (4) on stud (14).
3. Install shouldered washer (11), washer (10), lockwasher (9), and nut (8) on stud (12).
4. Install shell (7), washer (6), and terminal (5) on stud (12).

## 4-8. FUEL INJECTION PUMP SHUTOFF SOLENOID MAINTENANCE (Cont'd)




FOLLOW-ON TASK: Install fuel injection pump cover (para. 4-7).

# 4-9. FUEL INJECTION PUMP COLD ADVANCE SOLENOID MAINTENANCE

**This task covers:**

**a. Removal**
**b. Inspection**
**c. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two lockwashers (Appendix E, Item 101)
Locknut (Appendix E, Item 52)
O-ring (Appendix E, Item 126)
Two shouldered washers (Appendix E, Item 263)

**Manual References**
TM 9-2815-237-34P

**Equipment Condition**
Fuel injection pump shutoff solenoid removed (para. 4-8).

**Maintenance Level**
Direct support

**NOTE**

Working area should be clean, well-ventilated, and free from blowing dirt and dust.

## a. Removal

1. Remove terminal (1), washer (2), and ribbed shell (3) from stud (15).
2. Remove nut (4), lockwasher (5), washer (6), and shouldered washer (7) from stud (15). Discard lockwasher (5) and shouldered washer (7).
3. Remove locknut (11), nut (4), lockwasher (5), washer (6), and shouldered washer (7) from stud (12). Discard lockwasher (5), locknut (11), and shouldered washer (7).
4. Remove check valve (9) and O-ring (8) from cover (10). Discard O-ring (8).
5. Remove cold advance solenoid (13) and plunger (14) from cover (10).
6. Remove plunger (14) from cold advance solenoid (13).

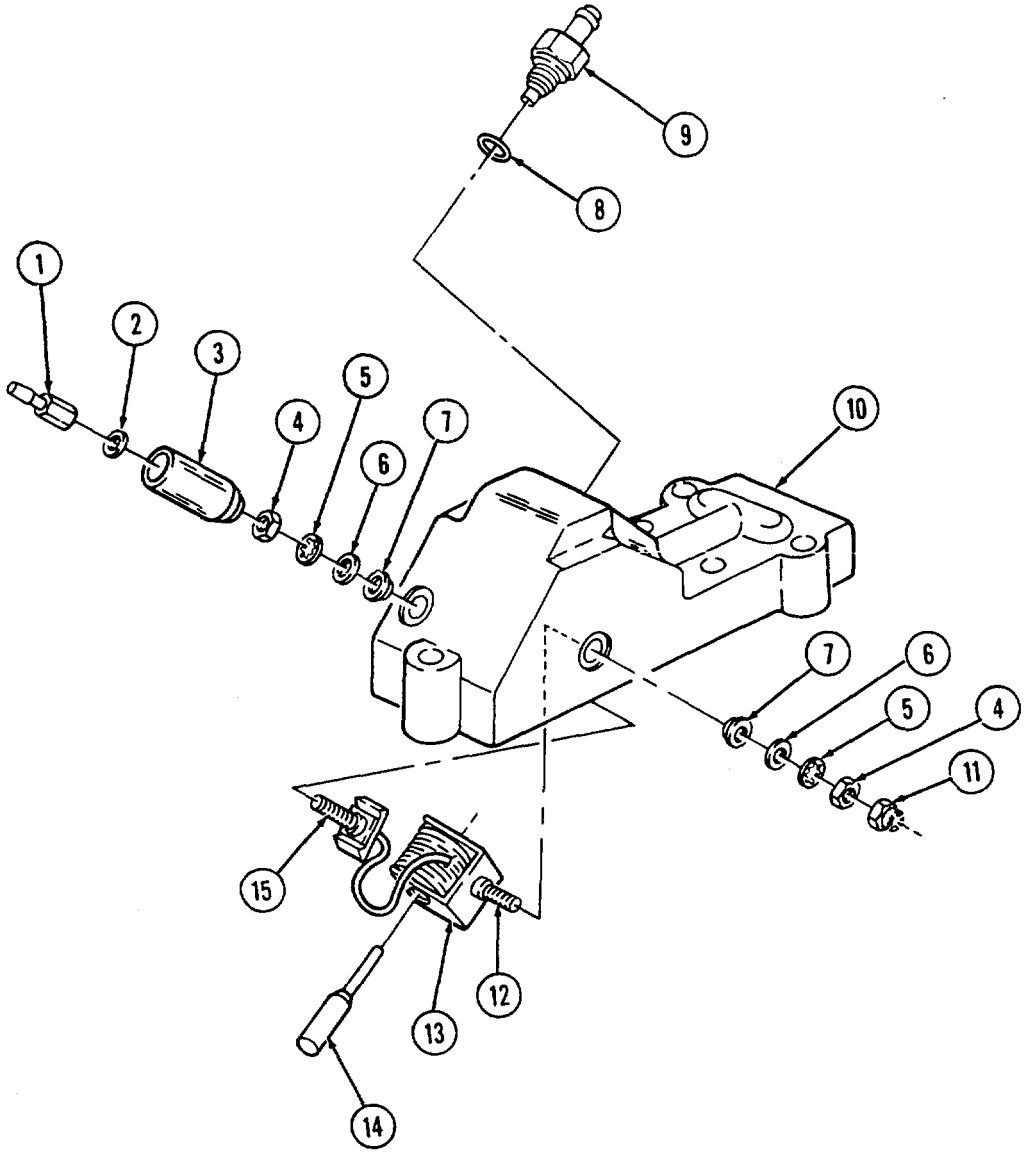
## b. Inspection

Inspect ribbed shell (3) for deterioration, cracks, or damage. Replace if cracked, deteriorated, or damaged.

## c. Installation

1. Install plunger (14) in cold start advance solenoid (13). Install stud (15) in hole in rear of cover (10).
2. Install O-ring (8) and check valve (9) in cover (10).
3. Install cold start advance solenoid (13) in cover (10) so small tip of plunger (14) fits in port of check valve (9) and stud (12) fits through hole in side of cover (10).
4. Install shouldered washer (7), washer (6), lockwasher (5), nut (4), and locknut (11) on stud (12).
5. Install shouldered washer (7), washer (6), lockwasher (5), and nut (4) on stud (15).
6. Install ribbed shell (3), washer (2), and terminal (1) on stud (15).

**4-9. FUEL INJECTION PUMP COLD ADVANCE SOLENOID MAINTENANCE (Cont'd)**




FOLLOW-ON TASK: • Install fuel injection pump shutoff solenoid (para. 4-8).

## 4-10. ACCELERATOR CABLE MOUNTING BRACKET MAINTENANCE

**This task covers:**

**a. Removal**
**b. Inspection**
**c. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2815-237-34P

**Equipment Condition**
Hood raised and secured (TM 9-2320-280-10).

**Maintenance Level**
Direct support

### a. Removal

1. Loosen two nuts (7) and disconnect cable assembly (1) from accelerator bracket (5).
2. Disconnect throttle return spring (2) from bracket (5).
3. Remove stop collar (6) and disconnect cable assembly (1) from fuel injection pump (4).
4. Remove nut (8) and washer (9) from fuel injection pump (4) and stud (11).
5. Remove two capscrews (10) and bracket (5) from fuel injection pump (4).

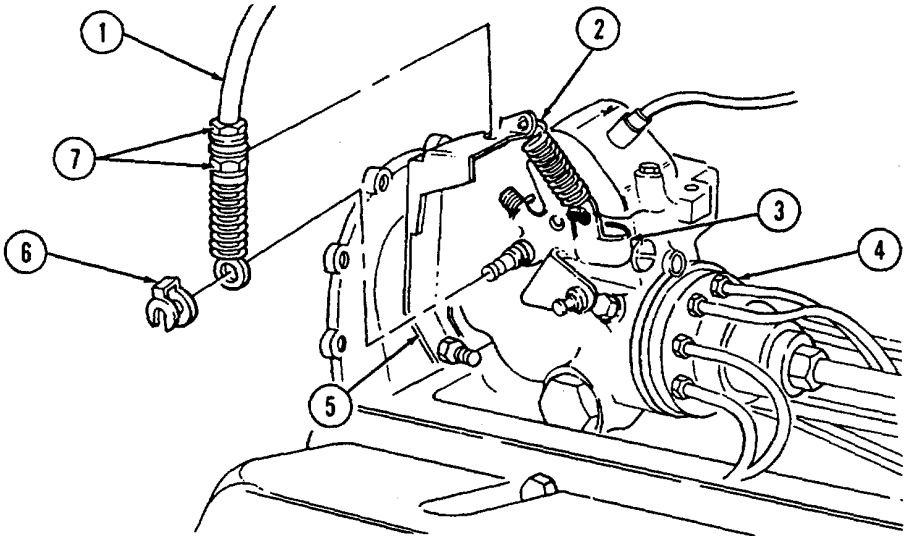
### b. Inspection

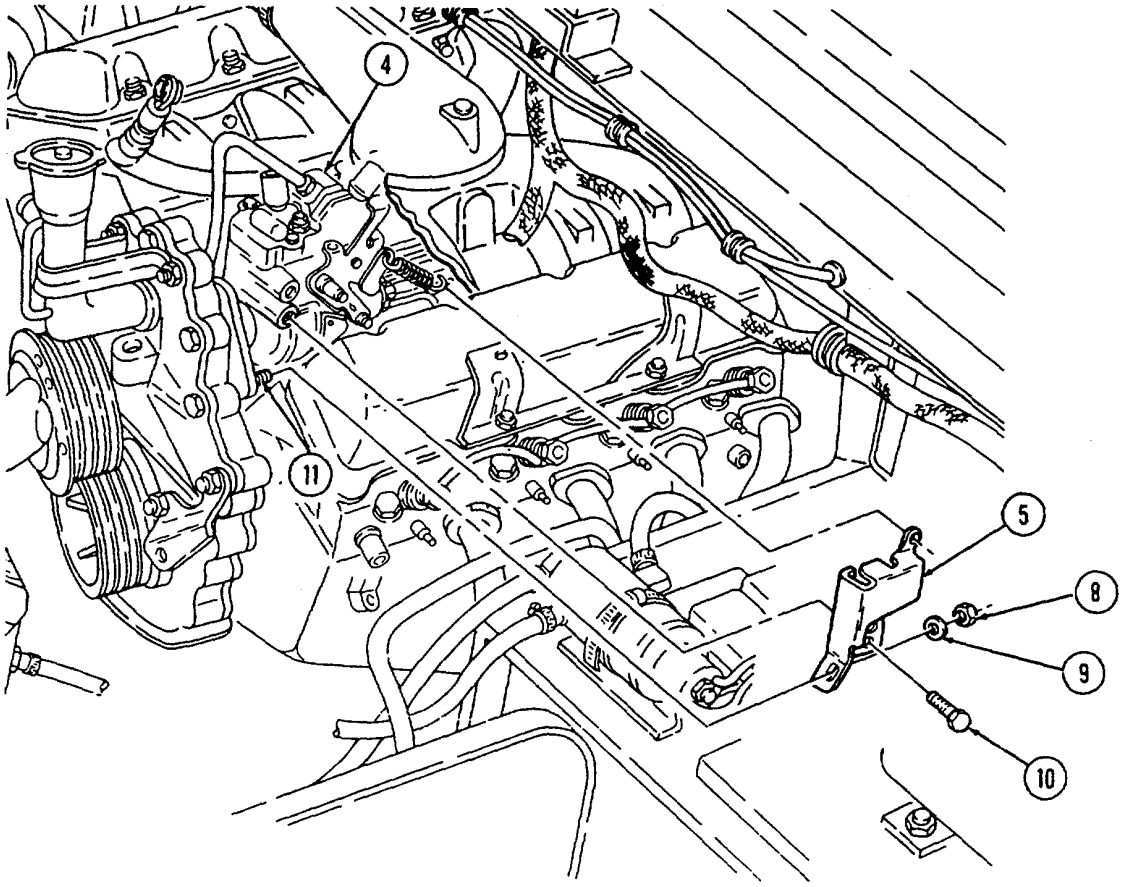
Inspect throttle return spring (2) for damage. Replace if defective.

### c. Installation

1. Install bracket (5) on fuel injection pump (4) and stud (11) with washer (9) and nut (8).
2. Install bracket (5) on fuel injection pump (4) with two capscrews (10). Tighten capscrews (10) to 13 lb-ft (18 N·m).
3. Position throttle shaft lever (3) to full throttle position and secure cable assembly (1) to throttle shaft lever (3) with stop collar (6).
4. Connect throttle return spring (2) to bracket (5).
5. Install cable assembly (1) to bracket (5) with two nuts (7).

**4-10. ACCELERATOR CABLE MOUNTING BRACKET MAINTENANCE (Cont'd)**




FOLLOW-ON TASK: • Adjust accelerator linkage (TM 9-2320-280-20).

# CHAPTER 5
# COOLING SYSTEM MAINTENANCE

## 5-1. INTRODUCTION

This chapter contains maintenance instructions for replacement of cooling system components at the Direct Support maintenance level. Some subassemblies and parts must be removed before cooling system components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## 5-2. COOLING SYSTEM MAINTENANCE TASK SUMMARY


| TASK PARA | PROCEDURES | PAGE NO. |
|---|---|---|
| 5-3. | Radiator and Oil Cooler Maintenance | 5-1 |
| 5-4. | Deleted | |


## 5-3. RADIATOR AND OIL COOLER MAINTENANCE

For authorized cleaning, inspection, troubleshooting, preventive maintenance, and repair of the radiator and oil cooler, refer to TM 750-254. When splicing radiator water tubes, the splices must be between the funneled ends of each tube. If the tube ends are damaged and cannot be repaired, the tube must be blocked (refer to TM 750-254) or the radiator should be declared unserviceable.

# CHAPTER 6
# ELECTRICAL SYSTEM MAINTENANCE

## 6-1. INTRODUCTION

This chapter contains maintenance instructions for replacement and repair of electrical system components at the Direct Support maintenance level. Some subassemblies and parts must be removed before electrical system components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## 6-2. GENERAL ENGINE MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 6.3 | Deleted | |
| 6-3.1. | 100 Ampere Alternator (12340912) Repair | 6-18.2 |
| 6-3.2. | 100 Ampere Alternator (12342944) Testing and Repair | 6-18.16 |
| 6-3.3. | 100 Ampere Dual Voltage Alternator (12447110) Testing and Repair | 6-18.30 |
| 6-4. | 200 Ampere Alternator (A0013036AA) Testing and Repair | 6-20 |
| 6-5. | 200 Ampere Alternator (12338796-1) Testing and Repair | 6-38 |
| 6-5.1. | 200 Ampere Dual Voltage Alternator (12447109) Testing and Repair | 6-44.2 |
| 6-5.2. | 400 Ampere Dual Voltage Alternator (12469057) Testing and Repair | 6-44.12 |
| 6-6. | Starter Repair | 6-46 |
| 6-7. | STE/ICE-R Wiring Harness Replacement | 6-62 |
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| 6-10. | 60/100 Ampere Alternator Bracket Modification | 6-112 |

## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
All except M996, M996A1, M997, M997A1, M997A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Test Equipment**
Multimeter (Appendix G, Item 120)

**Materials/Parts**
Engine parts kit (Appendix E, Item 156)
Two lockwashers (Appendix E, Item 114)
Four lockwashers (Appendix E, Item 96)
Adhesive sealant (Appendix B, Item 2)
Cord (Appendix B, Item 12)
Grease (Appendix B, Item 19)
Seal sleeve tool (Appendix C, Fig. 5)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-214
TM 9-2320-280-20
TM 9-2320-280-24P

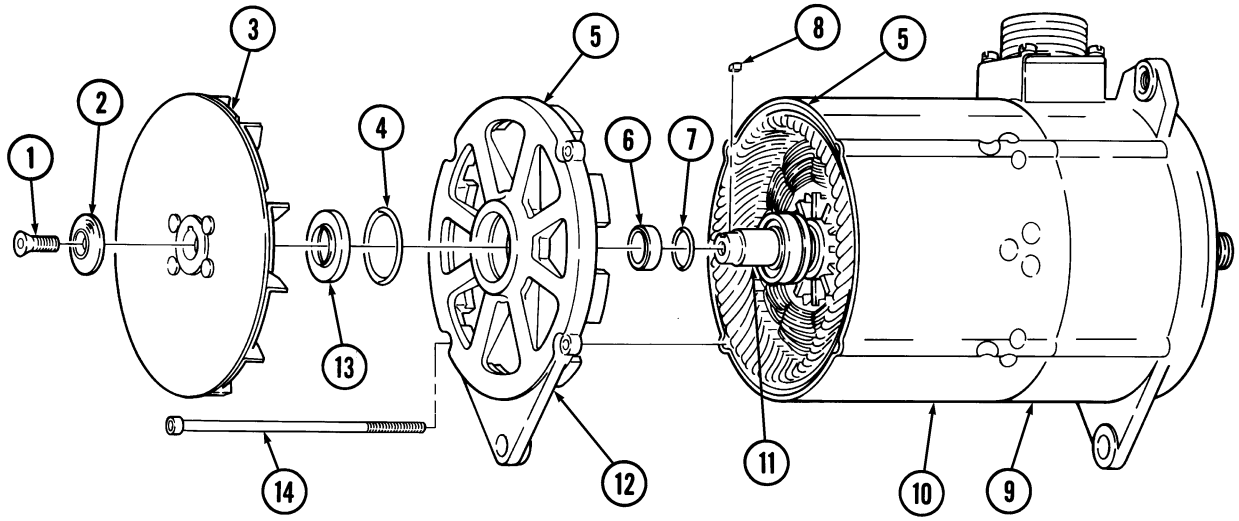
**General Safety Instructions**
- Alternator removed (TM 9-2320-280-20).
- Alternator pulley removed (TM 9-2320-280-20).

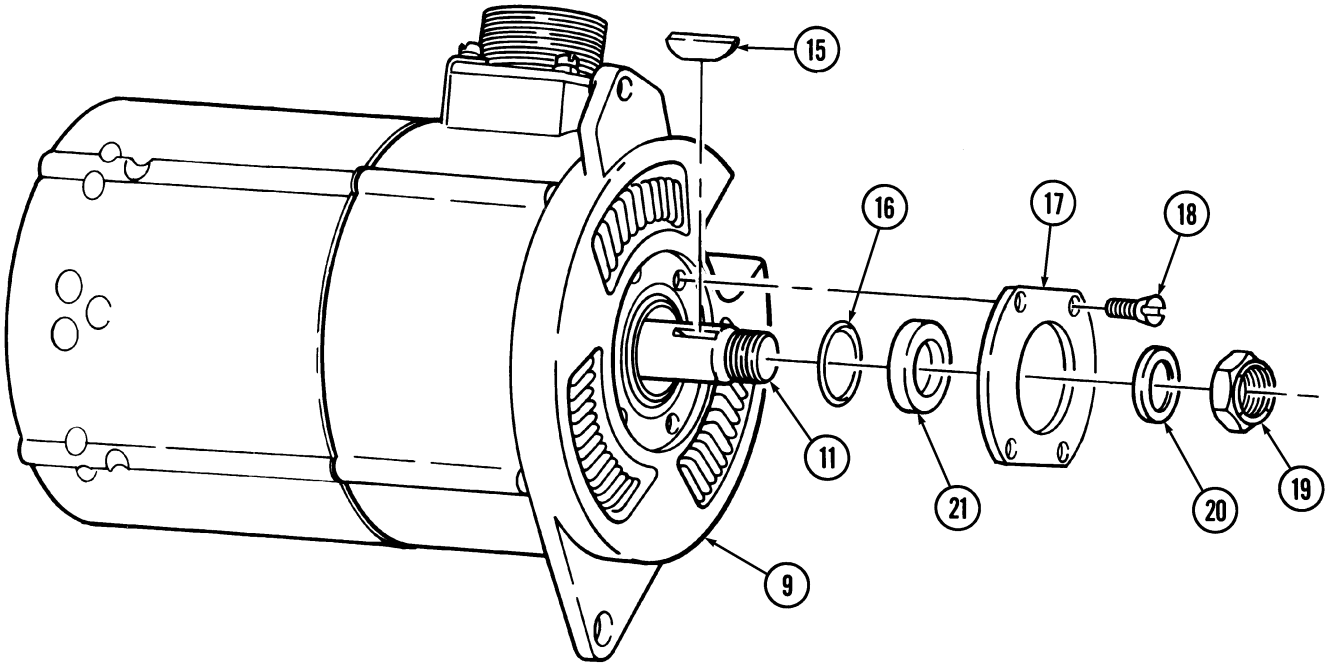
**Maintenance Level**
Direct support

### a. Disassembly

1. Remove screw (1), washer (2), and fan assembly (3) from rotor shaft (11).
2. Remove end housing woodruff key (8) from rotor shaft (11).
3. Scribe alignment marks (5) on end housing (12) and stator (10).
4. Remove four screws (14) and end housing (12) from stator (10) and rotor shaft (11).
5. Remove seal (13) and O-ring (4) from end housing (12). Discard seal (13) and O-ring (4).
6. Remove end housing spacer (6) and preformed packing (7) from rotor shaft (11). Discard preformed packing (7).
7. Remove drive end shaft nut (19) and washer (20) from drive end of rotor shaft (11).
8. Remove four screws (18) and bearing retainer (17) from drive end housing (9).
9. Remove woodruff key (15) from drive end of rotor shaft (11).
10. Remove drive end housing spacer (21) and preformed packing (16) from drive end of rotor shaft (11). Discard preformed packing (16).

## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)



## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)

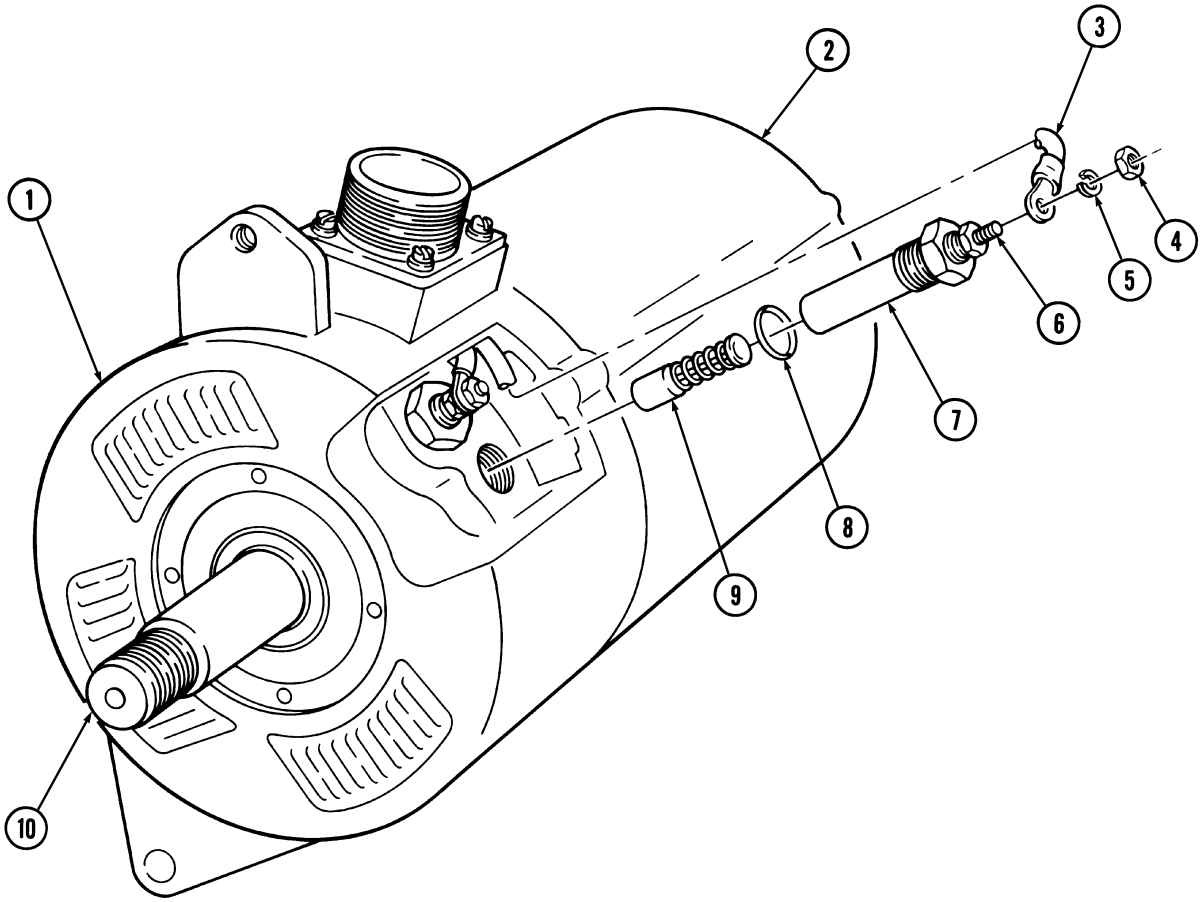
11. Remove sealer from two brush holder terminal nuts (4).

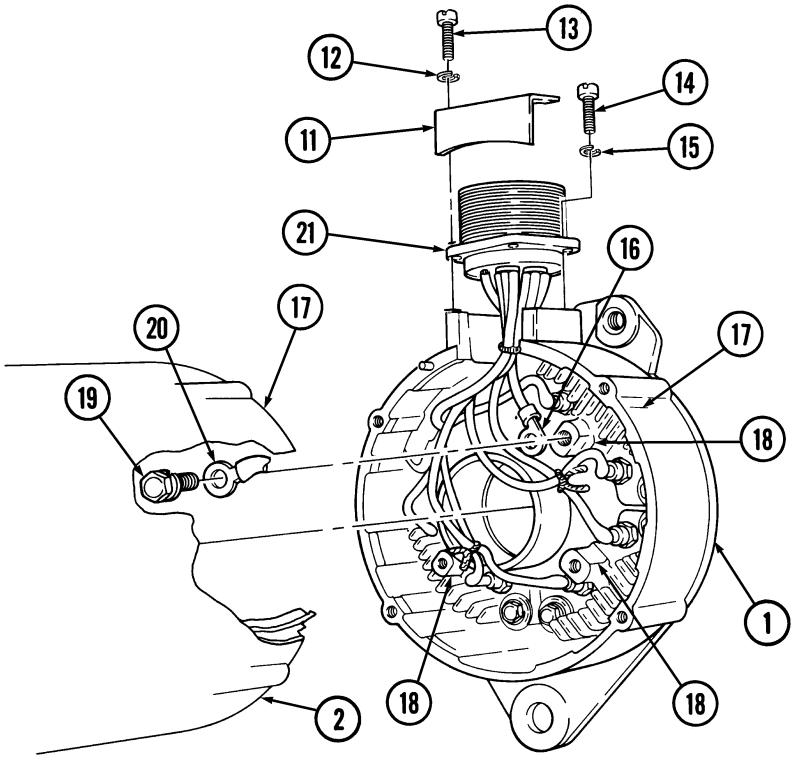
**NOTE**

Prior to removal, tag leads for installation.

12. Remove two terminal nuts (4), lockwashers (5), and disconnect two leads (3) from two brush holder terminals (6). Discard lockwashers (5).
13. Remove sealer from two brush holders (7). Remove two brush holders (7), brushes (9), and preformed packings (8) from drive end housing (1). Discard preformed packings (8).
14. Using puller, push drive end of rotor shaft (10) out of drive end housing (1) and stator (2).
15. Remove sealer from three stator lead terminal screws (19). Remove three stator lead terminal screws (19) from three stator leads (20), electrical connector lead (16), and three rectifier mounts (18).
16. Scribe alignment marks (17) on drive end housing (1) and stator (2). Separate drive end housing (1) and stator (2).
17. Remove two screws (13), lockwashers (12), and terminal cover (11) from drive end housing (1). Discard lockwashers (12).
18. Remove two screws (14), lockwashers (15), and electrical connector (21) from drive end housing (1). Discard lockwashers (15).

## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)



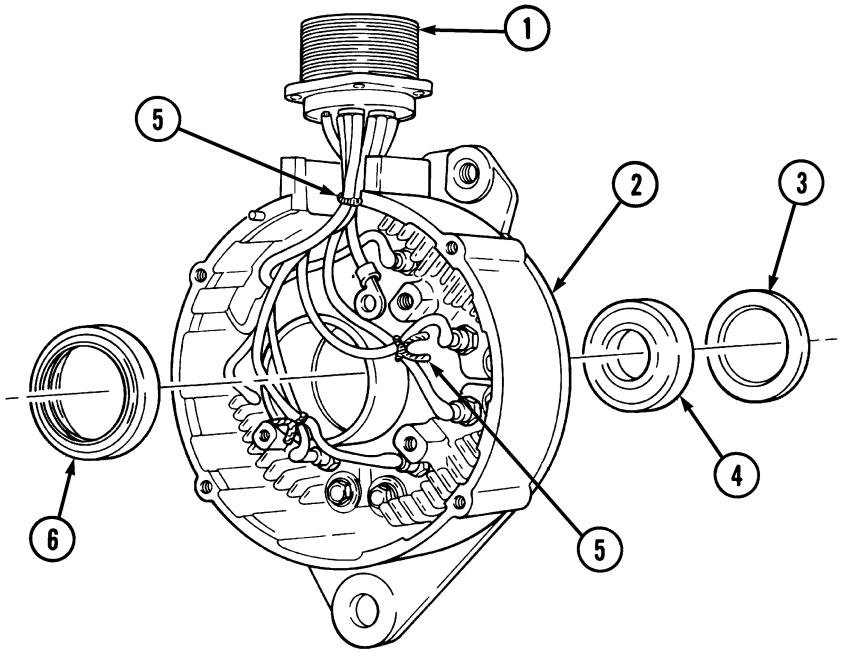
## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)

19. Remove seal (3) and bearing (4) from drive end housing (2). Discard seal (3).
20. Remove seal (6) from drive end housing (2). Discard seal (6).
21. Remove all cords (5) from rectifier leads (8). Discard cords (5).

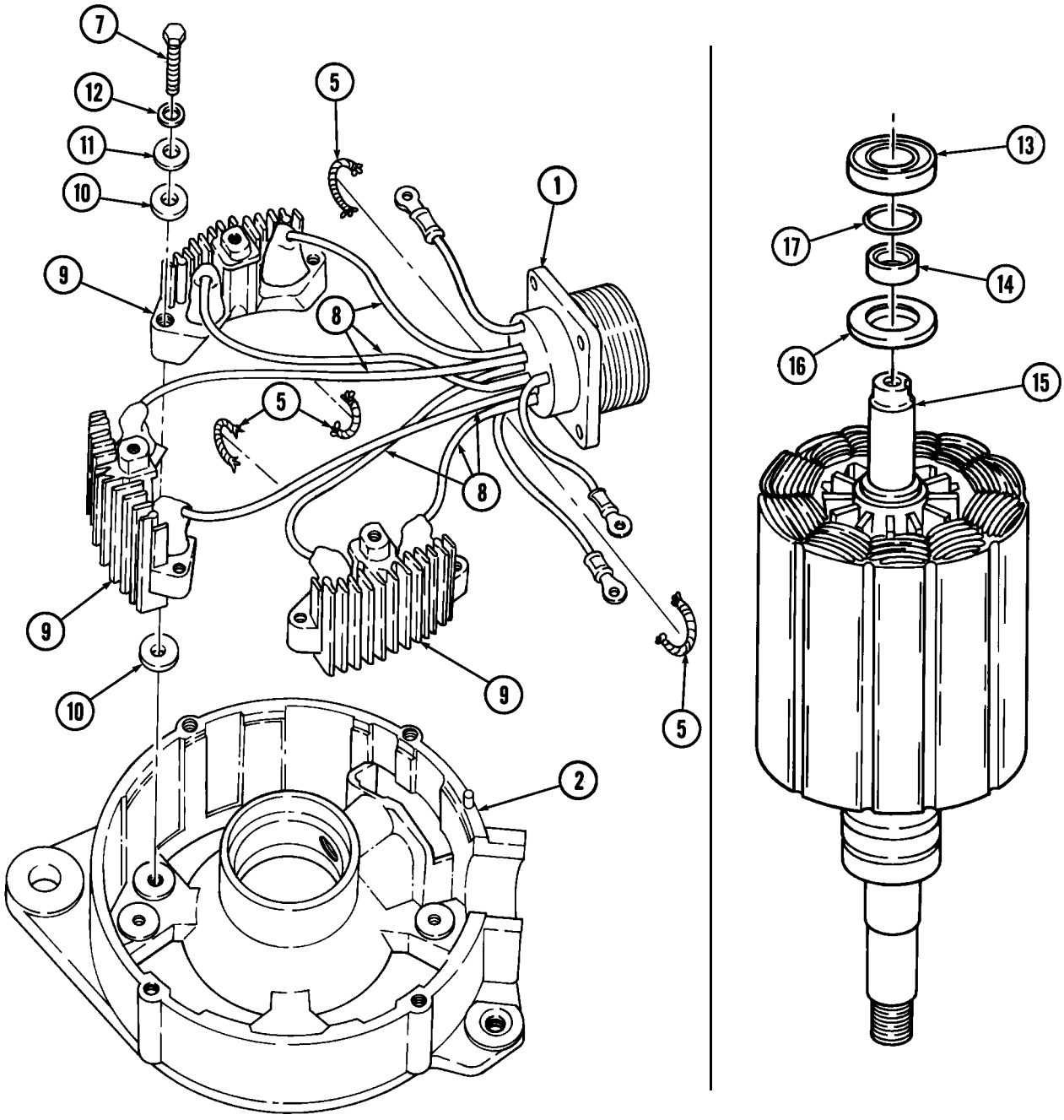
**NOTE**

Prior to removal, tag rectifier mounts and note position of rectifiers for installation.

22. Remove six screws (7), guard washers (12), tension washers (11), insulation washers (10), three rectifier mounts (9), and electrical mount (1) from drive end housing (2).
23. Remove six insulation washers (10) from drive end housing (2) and retain for installation.
24. Use a press or bearing puller to remove bearing (13) from rotor shaft (15).
25. Remove preformed packing (17), flat washer (16), and end housing spacer (14) from rotor shaft (15). Discard preformed packing (17).



## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)



## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)

**b. Cleaning**

Clean all alternator components in accordance with para. 2-13.

**c. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect drive end housing (1) for cracks, breaks, and stripped threads. Replace alternator if defective.
2. Inspect end housing (5) for cracks and breaks. Replace alternator if defective.
3. Check rotor (7) and stator (3) for shorts, grounds, and open circuits. Replace alternator if defective.
4. Inspect fan (4) for cracks and breaks. Replace fan (4) if defective.
5. Inspect roller bearings (2) and (6). Refer to TM 9-214. Replace bearings (2) or (6) if defective.
6. Inspect electrical connector (12) for stripped threads, loose pins, broken, or frayed wiring. If damaged, perform steps 7 through 9. If not, go to step 10.
7. Remove sealer from rear of electrical connector (12).

**NOTE**

Prior to removal, tag rectifier leads and terminal pins for installation.

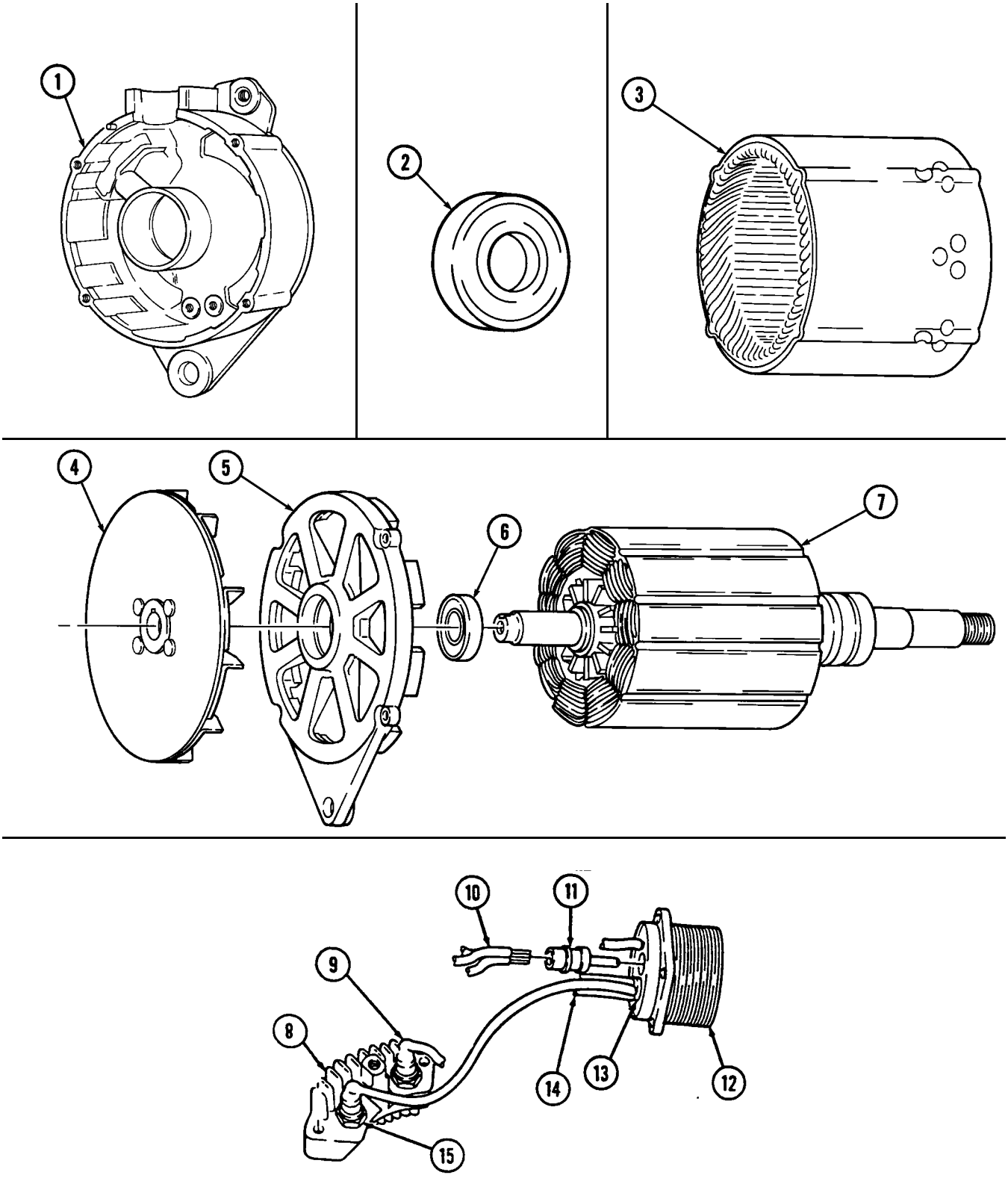
8. Pull two rectifier terminal pins (11) and (13) out of electrical connector (12).
9. Unsolder and pull six rectifier leads (10) and (14) out of two rectifier terminal pins (11) and (13).

**NOTE**

Electrical connector must not be reassembled until rectifiers have been tested.

10. Check rectifiers (9) and (15) for continuity in one direction and infinite resistance in opposite direction. Check for shorts from rectifiers (9) and (15) to rectifier mounts (8). If rectifiers (9) or (15) are defective, perform steps 11 through 17. If not, go to step 18.

## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)



## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)

**NOTE**

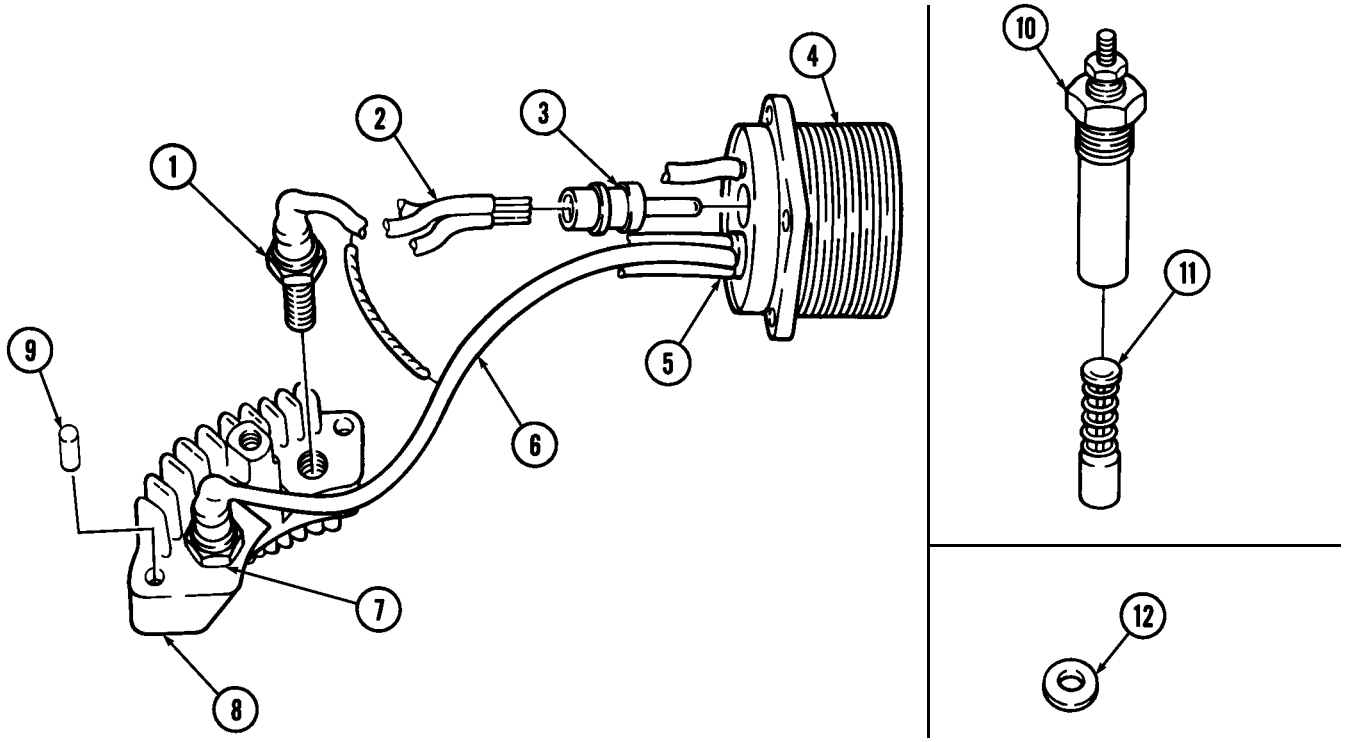
- Prior to removal, tag rectifiers, rectifier leads and terminal pins for installation.
- Proceed to step 14 if rectifier leads are removed.

11. Remove sealer from rear of electrical connector (4).
12. Pull two rectifier terminal pins (3) and (5) out of electrical connector (4).
13. Unsolder and pull three rectifier leads (2) or (6) out of two rectifier terminal pins (3) or (5).
14. Remove sealer from rectifier(s) (1) or (7). Remove positive rectifier(s) (1) or negative rectifier(s) (7) from rectifier mount(s) (8). Replace defective rectifier(s) (1) or (7).
15. Inspect rectifier mounts (8) for breaks or cracks. Replace rectifier mount(s) (8) if defective.
16. Inspect insulating sleeves (9) for breaks or cracks. Replace sleeves (9) if defective.
17. Install rectifier(s) (1) or (7) in rectifier mount(s) (8).

**NOTE**

- Proceed to step 23 if rectifier leads and terminal pins are installed.
- Pin A is blank.

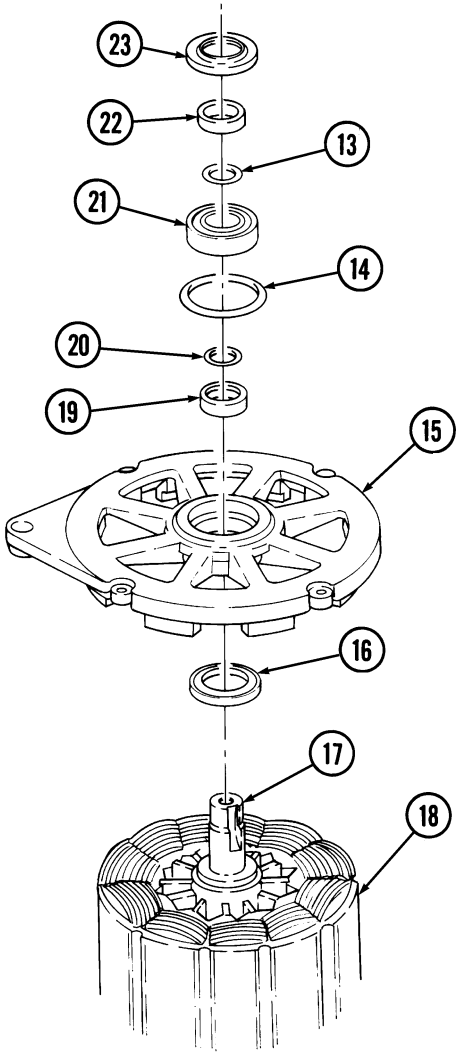
18. Solder three negative rectifier leads (2) (white) in terminal pin B (3).
19. Solder three positive rectifier leads (6) (black) in terminal pin C (5).
20. Install rectifier terminal pins (3) and (5) in electrical connector (4).
21. Apply adhesive sealant to rectifier(s) (1) or (7) and rectifier mounts (8).
22. Apply adhesive sealant to rear of electrical connector (4).
23. Inspect brushes (11) for roughness, galling, wear, and broken brush leads. Replace brushes (11) if brush length is less than 0.187 in. (4.8 mm).
24. Inspect brush holders (10) and six insulation washers (12) for cracks and breaks. Replace brush holders (10) or insulation washers (12) if defective.



## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)

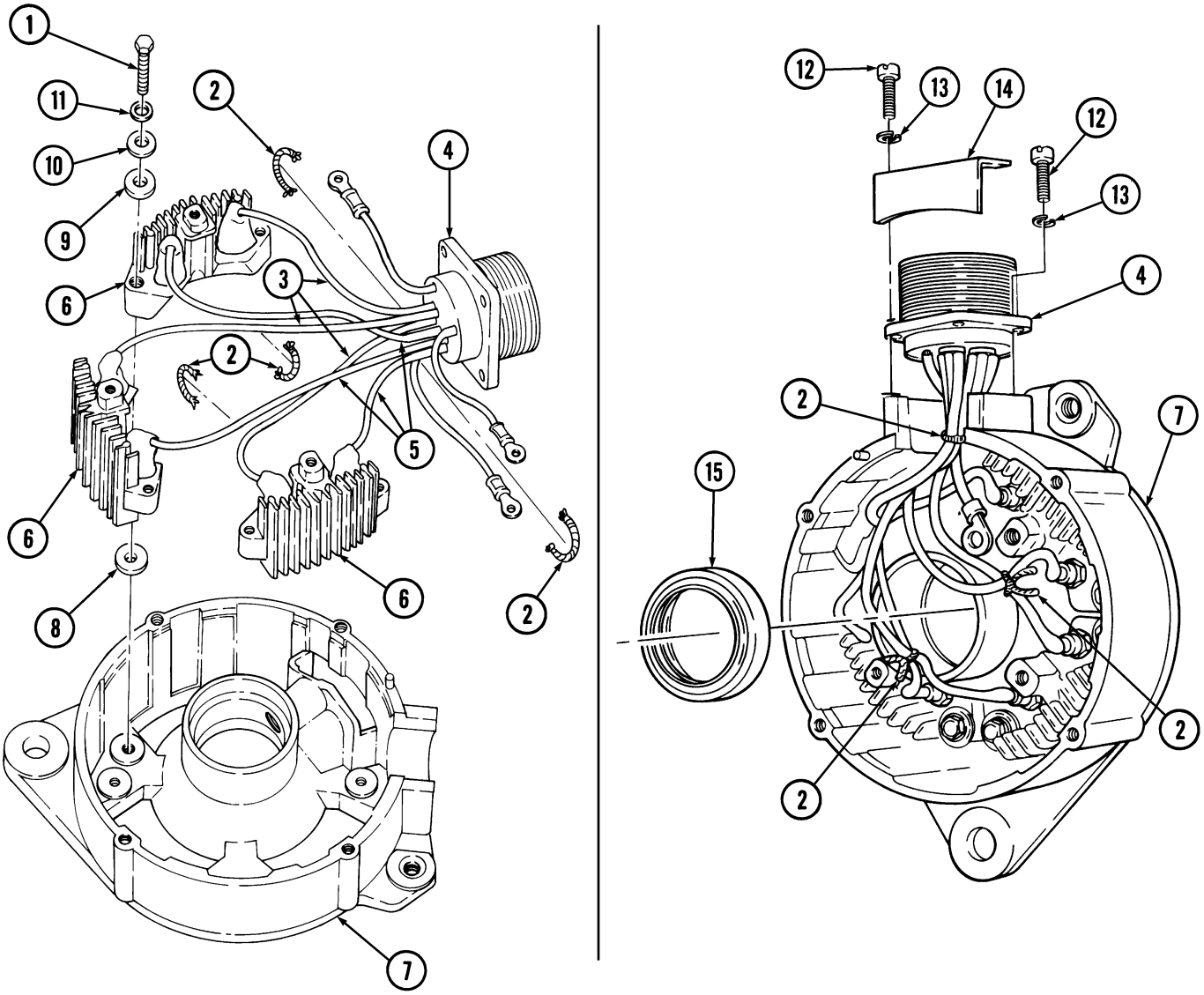
**d. Assembly**

1. Install O-ring (14) in end housing (15).
2. Install seal (16) flush in end housing (15) with lip facing away from end housing (15).
3. Install end housing (15) on rotor shaft (17).
4. Slide spacer (19) on rotor shaft (17) and into seal (16) with tapered end of spacer (19) facing away from rotor (18).
5. Apply a small amount of grease around spacer (19) and seal (16).
6. Install preformed packing (20) on rotor shaft (17) and into taper of spacer (19).
7. Press bearing (21) onto shaft (17) and into end housing (15).
8. Place a small amount of grease in end housing (15) and on rotor shaft (17).
9. Slide preformed packing (13) on rotor shaft (17).
10. Slide spacer (22) on rotor shaft (17) with tapered end of spacer (22) toward preformed packing (13).
11. Install flat washer (23) flush in end housing (15).



## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)

12. Install three rectifier mounts (6) with six insulation washers (8) under rectifier mounts (6) in drive end housing (7) with six insulation washers (9), tension washers (10), guard washers (11), and screws (1).
13. Install cords (2) on rectifier leads (3) and (5).
14. Apply a small amount of grease in seal (15).
15. Install seal (15) in drive end housing (7) with lip facing away from drive end housing (7).
16. Install electrical connector (4) and terminal cover (14) on drive end housing (7) with four lockwashers

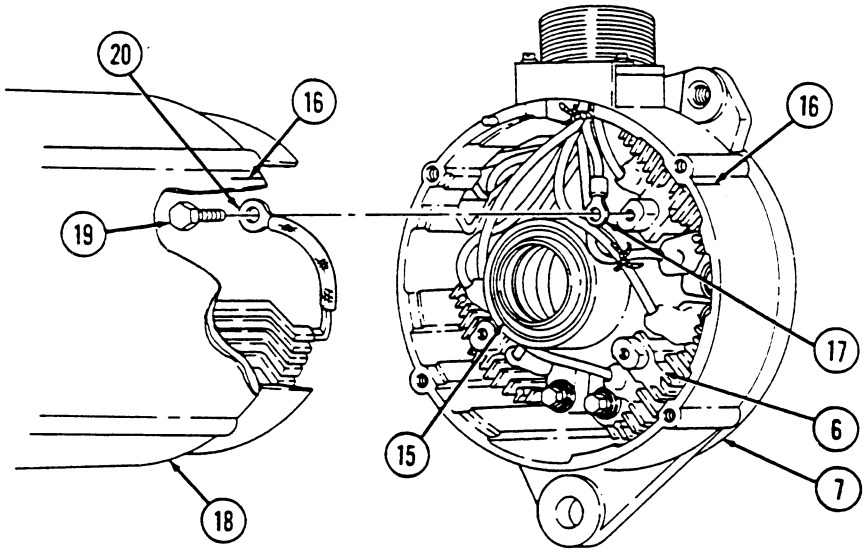


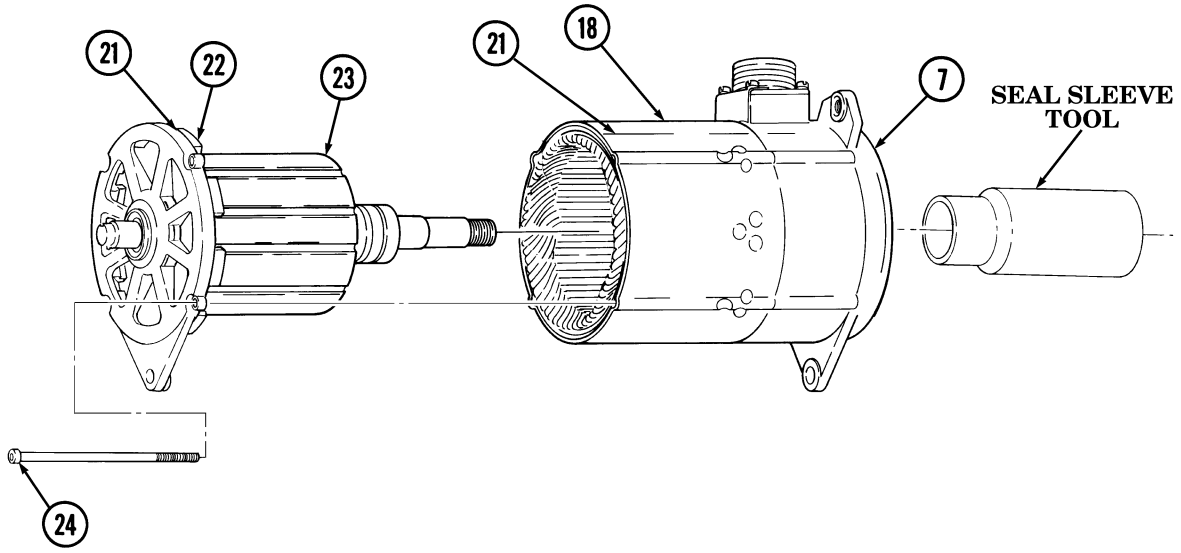
## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)

**CAUTION**

During assembly of stator and drive end housing, do not rest stator on winding end turns.

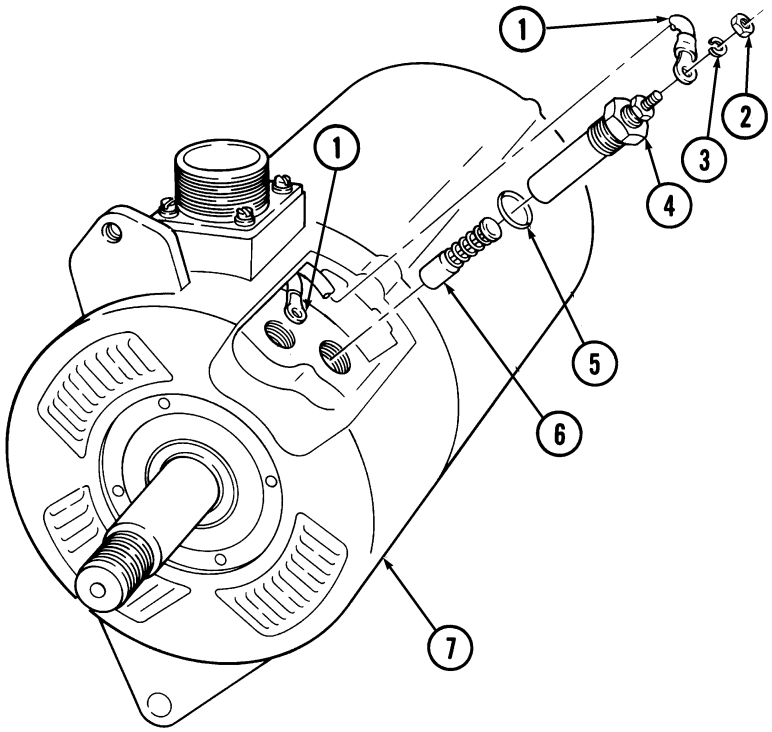
17. Align scribe marks (16) on drive end housing (7) and stator (18) and install stator (18) on drive end housing (7).
18. Connect large electrical connector lead (17) and three stator leads (20) to three rectifier mounts (6) with three screws (19).
19. Apply sealant to three screws (19), connections of stator leads (20) and rectifier mounts (6).
20. Install seal sleeve tool into seal (15).
21. Align scribe marks (21) on end housing (22) and stator (18).
22. Install rotor (23) and end housing (22) into stator (18) and drive end housing (7) until seal sleeve tool is forced out of seal (15).
23. Secure end housing (22) and stator (18) on drive end housing (7) with four screws (24).



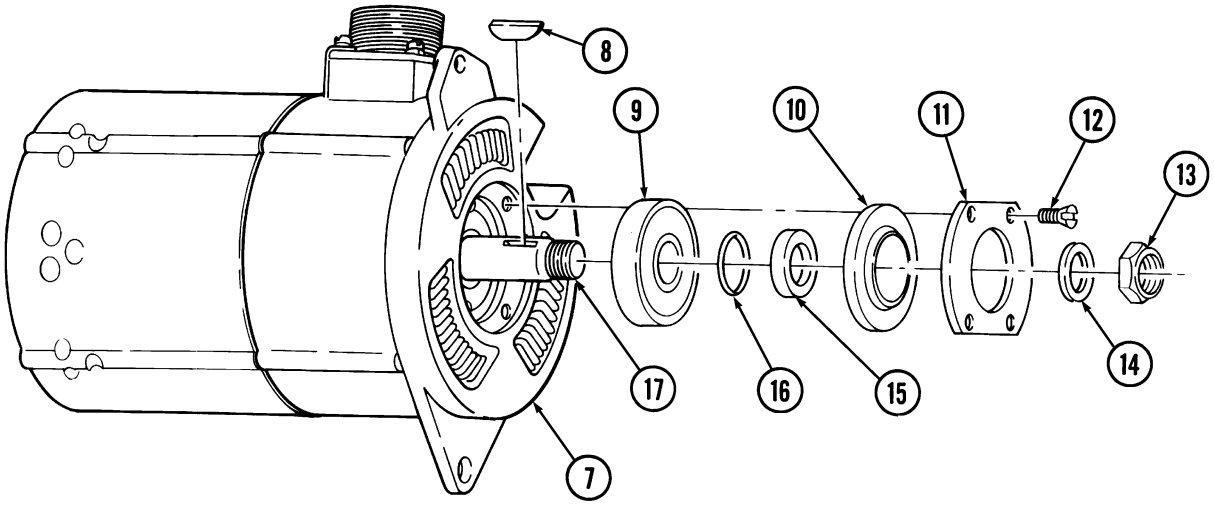



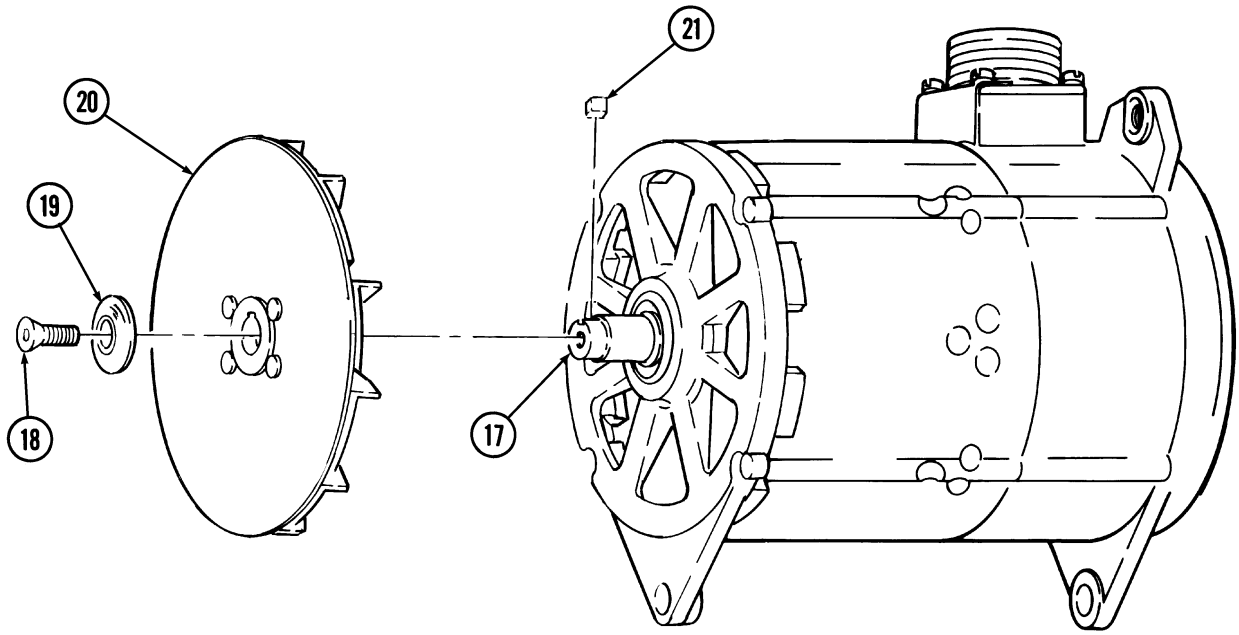
## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)

24. Press bearing (9) on rotor shaft (17) and into drive end housing (7).
25. Install two brushes (6), preformed packings (5), and brush holders (4) in drive end housing (7). Do not overtighten brush holder (4).
26. Connect two leads (1) to two brush holders (4) with two lockwashers (3) and terminal nuts (2).
27. Apply sealant to two terminal nuts (2) and brush holders (4).
28. Install preformed packing (16) and drive housing spacer (15) on rotor shaft (17) with tapered end of spacer (15) facing toward preformed packing (16).
29. Apply a small amount of grease on spacer (15).
30. Install seal (10) in drive end housing (7) with lip facing away from drive end housing (7).
31. Install bearing retainer (11) on drive end housing (7) with four screws (12).
32. Install woodruff key (8), washer (14), and nut (13) on rotor shaft (17).
33. Install woodruff key (21) on rotor shaft (17).
34. Install fan (20) on rotor shaft (17) over woodruff key (21) with washer (19) and screw (18).



## 6-3.1. 100 AMPERE ALTERNATOR (12340912) REPAIR (Cont'd)




FOLLOW-ON TASKS: • Install alternator pulley (TM 9-2320-280-20).
• Install alternator (TM 9-2320-280-20).

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR

**This task covers:**

**a. Alternator Output Testing**
**b. Disassembly**
**c. Static Testing**
**d. Cleaning**
**e. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M996, M996A1, M997, M997A1

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)
Puller (Appendix G, Item 136)

**Test Equipment**
Multimeter (Appendix G, Item 120)
Test stand (Appendix G, Item 94)

**Materials/Parts**
Nine locknuts (Appendix E, Item 76)
Locknut (Appendix E, Item 66)
Six lockwashers (Appendix E, Item 90)
Nine locknuts (Appendix E, Item 68)
Four lockwashers (Appendix E, Item 109)
Sealing compound (Appendix B, Item 51)
Sealing compound (Appendix B, Item 54)
Sealing compound (Appendix B, Item 55)
Sealant (Appendix B, Item 43)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P
TM 9-4910-663-12
TM 9-4910-485-12

**Equipment Condition**
Alternator removed (TM 9-2320-280-20).

**General Safety Instructions**
Always support alternator core and shaft assembly during removal and installation.

**Maintenance Level**
Direct support

### a. Alternator Output Testing

1. Mount pivot arm of 500 amp test stand to high-speed side and screw mounting flange adapter to pivot arm, and connect pulley drive shaft to high-speed head. Screw pulley drive shaft to mounting flange adapter.
2. Mount alternator to starter/alternator mounting bracket on 500 amp test stand, and connect V-belt from 500 amp test stand pulley to alternator pulley. Adjust belt tension.
3. Connect cable from alternator ground terminal to 500 amp test stand G- terminal. Connect cable from alternator "Bat" terminal to 500 amp test stand G+ terminal. Connect cable from alternator regulator IGN to 500 amp test stand F terminal.
4. Make a jumper wire with a ring terminal at both ends. Connect jumper wire on 500 amp test stand from IGN SWITCH terminal to F-B terminal.

**NOTE**

Prior to operation of the test stand, ensure all switches and controls are in the "initial" positions as referenced in Operator and Maintenance Manual, TM 9-4910-663-12 (UMC Model GSAR-500), or Operator and Maintenance Manual, TM 9-4910-485-12 (Sun Model AGT-99A).

5. Set 500 amp test stand as follows:

| | Model GSAR-500 | Model AGT-99A |
|---|---|---|
| (a) DC ammeter load and starter selector | X10 | 500 amp |
| (b) DC ammeter field and battery charge selector | X1 | 5 amp |
| (c) Field circuit switch | Regulator | Regulator |
| (d) DC voltmeter circuit selector | RECT/GEN | RECT/GEN |

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)

6. Perform no-load test. Set test stand battery circuit selector to 24 VDC, IGN switch to ON, and start varidrive. Observing the DC voltmeter output voltage and tachometer rpm, increase speed until tachometer reads 5000 rpm. Record voltmeter reading and refer to table 6-A for diagnosis.

*Table 6-A. No-Load Test.*

| AMPS | VOLTS | DIAGNOSIS |
|---|---|---|
| High | Low | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| High | Normal | Give time to stabilize while monitoring VOLTS. If VOLTS rise above normal range (26-30 volts), regulator and/or tube assembly must be replaced. If AMPS fall, charging system is OK. |
| High | High | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to Static Testing. |
| Low | Low | Alternator and/or regulator must be repaired or replaced. Refer to table 6-A.2. |
| Low | Normal | Regulator OK. Refer to table 6-A.1. |
| Low | High | STOP TEST. Bench malfunction or wiring error. |

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)

7. Perform full-load test. Set test battery stand circuit selector to 24 VDC, IGN switch to ON, start varidrive, and set the 100A load bank switch to ON. Snap the load bank master switch to the ON position and adjust variable load control to 91±10 percent amp load. Observe the DC output readings. Refer to table 6-A.1 for diagnosis.

*Table 6-A.1. Full-Load Test.*

| AMPS | VOLTS | DIAGNOSIS |
|---|---|---|
| High | Low | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| High | Normal | Charging system OK. |
| High | High | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to Static Testing. |
| Low | Low | Alternator and/or regulator must be repaired or replaced. Refer to table 6-A.2. |
| Low | Normal | Increase load. |
| Low | High | STOP TEST. Test bench malfunction or wiring error. |

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)

8. Regulator Bypass Test.

**NOTE**

Perform this test only when instructed from tables 6-A and 6-A.1.

(a) Prepare alternator as in Full-Load Test.

**NOTE**

Use jumper wire rated for 15 amps.

(b) Disconnect alternator connector from regulator. With alternator spinning, use jumper wire and short pin A of connector to ground momentarily. Record results.

(c) Amperage should rise within ± 10% of rated output with jumper wire connected and fall with jumper disconnected. Refer to table 6-A.2 for diagnosis.

9. Turn test stand master power switch and load switch to OFF.
10. Disconnect jumper wires from terminals on test stand and alternator.
11. Remove V-belt from test stand pulley and alternator pulley. Remove alternator from test stand.

*Table 6-A.2. Regulator Bypass Test.*

| CONNECT | DISCONNECT | DIAGNOSIS |
|---|---|---|
| AMPS RISE | AMPS FALL | Alternator OK. See note. Replace regulator only if low AMPS/low VOLTS are indicated in table 6-A and/or table 6-A.1. |
| NO CHANGE | NO CHANGE | Alternator must be repaired. Refer to Static Testing. |

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)

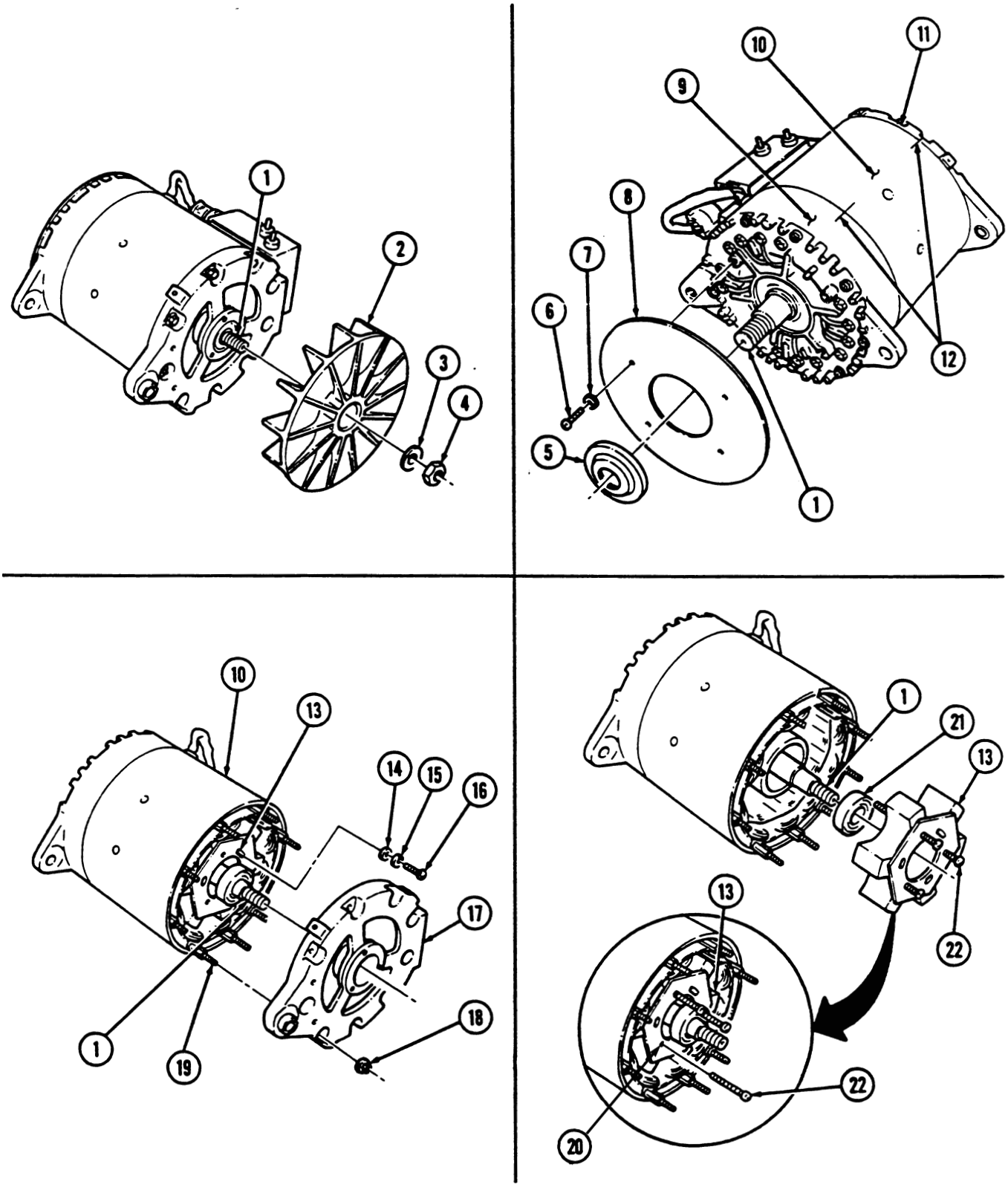
**b. Disassembly**

**NOTE**

Complete alternator disassembly is not required for static testing.

1. Insert core and shaft assembly (1) in soft-jawed vise and remove locknut (4), washer (3), and fan (2). Discard locknut (4).
2. Remove bearing bushing (5) from core and shaft assembly (1).
3. Remove four screws (6), lockwashers (7), and plate cover (8) from front housing (9). Discard lockwashers (7).
4. Scribe alignment marks (12) on front housing (9), stator/field core assembly (10), and end housing assembly (11).
5. Remove nine locknuts (18) from studs (19) and end housing assembly (17) Discard locknuts (18).
6. Use a puller to remove end housing assembly (17) from stator/field coil assembly (10).
7. Remove three screws (16), lockwashers (15), and washers (14) from rotor assembly (13) and core and shaft assembly (1). Discard lockwashers (15).
8. Use three 10-32 x 2-in. long machine screws (22) as jacks in threaded holes (20) on end plate of rotor assembly (13). Gradually tighten screws (22) to remove rotor assembly (13) from core and shaft assembly (1). Remove rotor assembly (13) and screws (22).
9. Use a press or bearing puller to remove rear bearing (21) from core and shaft assembly (1).

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)



## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)

**NOTE**

Prior to removal, tag leads for installation.

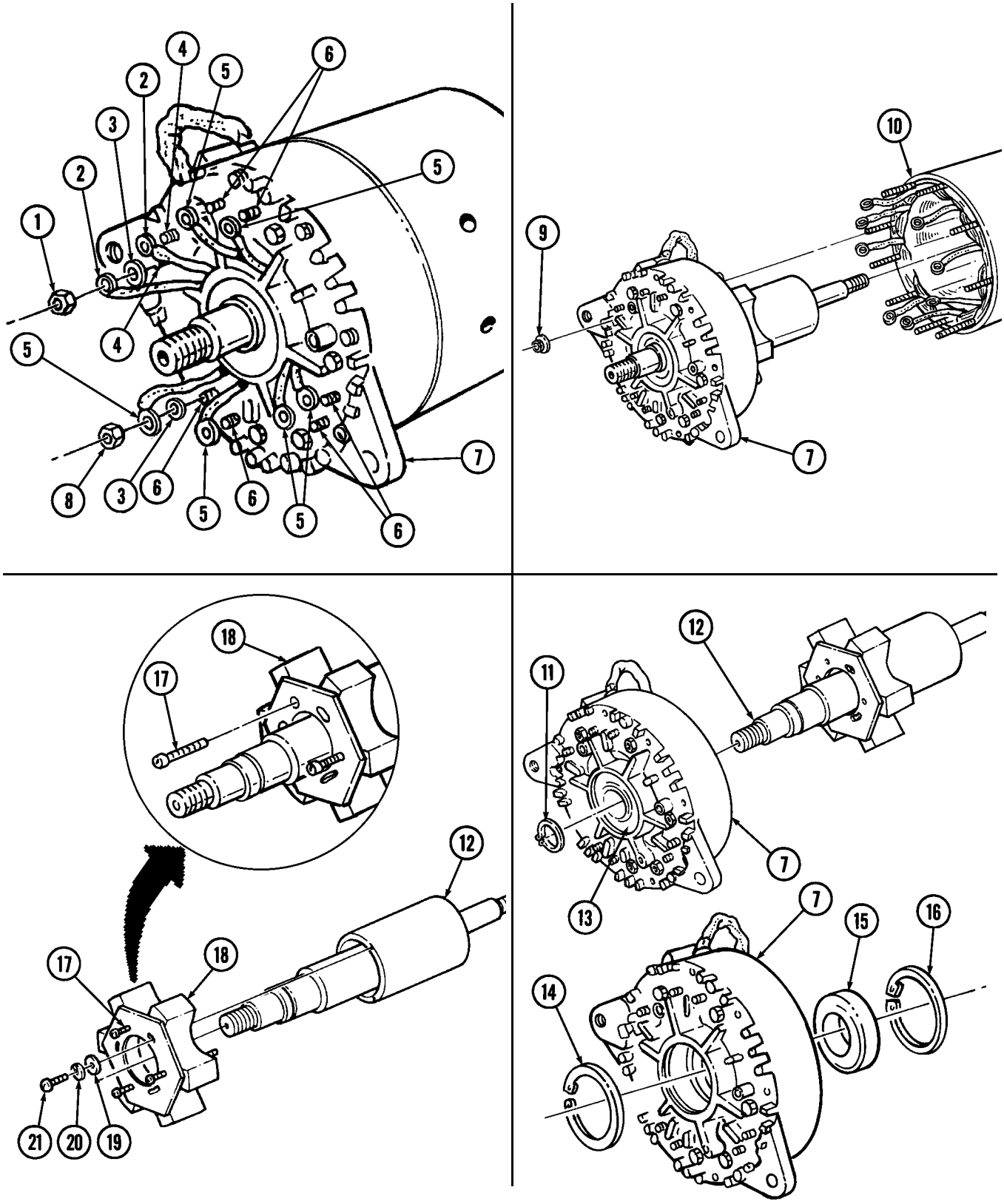
10. Remove six nuts (1), field leads (2), and washers (3) from studs (4) on front housing assembly (7).
11. Remove six nuts (8), phase leads (5), and washers (3) from diodes (6) on front housing assembly (7).
12. Remove nine locknuts (9) from front housing (7) and stator (10). Discard locknuts (9).
13. Remove front housing (7) from stator shell (10) by tapping lightly with a soft-faced mallet.
14. Remove shaft retaining ring (11) from core and shaft assembly (12).

**WARNING**

Always support alternator core and shaft assembly during removal.
Failure to do so may cause injury to personnel or equipment damage.

15. Use press to remove core and shaft assembly (12) from front bearing (13) and front housing (7).
16. Remove front (14) and rear (16) retaining rings from front housing (7).
17. Use press to remove front bearing (15) from front housing (7).
18. Remove three screws (21), lockwashers (20), and washers (19) from front rotor assembly (18) and core and shaft assembly (12). Discard lockwashers (20).
19. Use three 10-32 x 2-in. long machine screws (17) as jacks in threaded holes on end plate of front rotor assembly (18). Gradually tighten screws to remove front rotor assembly (18) from core and shaft assembly (12).

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)



## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)

### c. Static Testing

**NOTE**

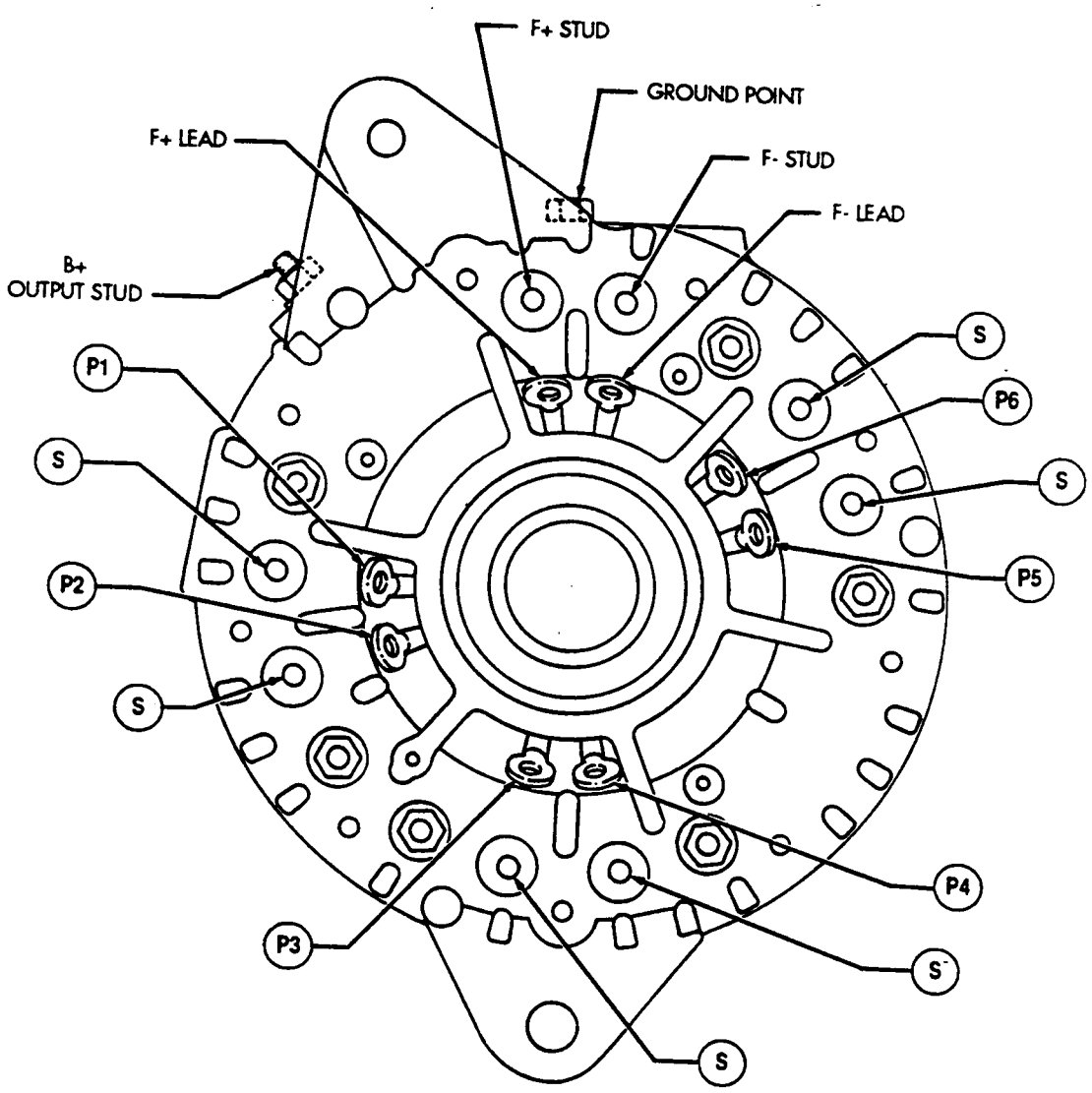
Refer to disassembly for component removal, if necessary.

1. Perform Stator Test.
   (a) Remove six nuts and phase leads from diodes in front housing.
   (b) Set ohmmeter to XI scale and zero ohmmeter.
   (c) Connect ohmmeter leads between each successive pair of stator phase leads P1-P2, P2-P3, and P1-P3. Ohmmeter should read less than 1 ohm. If ohmmeter reads infinity (∞), the stator is open, replace alternator.
   (d) Set ohmmeter to X10 scale and zero ohmmeter.
   (e) Connect ohmmeter leads between each phase lead, P1, P2, and P3 and the ground terminal on outside of front housing. Ohmmeter should read infinity (∞). If ohmmeter reads zero the stator is grounded, replace alternator.
   (f) Repeat step (e) to check phase lead P4, P5, and P6.
2. Perform Field Coil Test.
   (a) Remove two nuts and field coil leads (F+, F-) from diodes in front housing.
   (b) Set ohmmeter to XI scale and zero ohmmeter.
   (c) Connect ohmmeter leads to the two field leads (F+, F-). Ohmmeter should read less than 3 ohms. If ohmmeter reads more than 3 ohms, the field coil is open, replace alternator.
   (d) Set ohmmeter to X10 scale and zero ohmmeter.
   (e) Connect one ohmmeter lead to a field lead and the other to the ground stud on the front housing. Ohmmeter should read infinity (∞). If ohmmeter reads less than 100K ohms, the field coil is grounded, replace alternator.
3. Perform Positive Diode Test.
   (a) Set ohmmeter to X100 scale and zero ohmmeter.
   (b) Connect one ohmmeter lead to the B+ output stud and the other lead to each of the six diode terminals S. Ohmmeter should read nearly alike for all six, either less than 600 ohms or infinity (∞). Reverse ohmmeter leads, ohmmeter should read nearly alike for all six but opposite the first set of readings. If readings are not opposite, the diode rectifier assembly is BAD, replace alternator.
4. Perform Negative Diode Test.
   (a) Set ohmmeter to X100 scale and zero ohmmeter.
   (b) Connect one ohmmeter lead to the ground terminal and the other lead to each of the six diode terminals S. Ohmmeter should read nearly alike for all six, either less than 600 ohms or infinity (∞). Reverse ohmmeter leads, ohmmeter should read nearly alike for all six but opposite the first set of readings. If readings are not opposite, the diode rectifier assembly is open, replace alternator.

### d. Cleaning

Clean all alternator components in accordance with paragraph 2-13.

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)



## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)

**e. Assembly**

**WARNING**

Always support alternator core and shaft assembly during installation. Failure to do so may cause injury to personnel or equipment damage.

1. Install front rotor assembly (2) on core and shaft assembly (3).
2. Apply sealing compound to three screws (6).
3. Align slots (1) in front rotor assembly (2) to mount holes on core and shaft assembly (3) and install with three screws (6), lockwashers (5), and washers (4). Tighten screws (6) to 45 lb-in. (5 N•m).
4. Coat outer race of front bearing (9) with a thin coat of sealing compound.
5. Use a press to install front bearing (9) in front housing assembly (8).
6. Install front (7) and rear (10) retaining rings on front housing (8).

**WARNING**

Always support alternator core and shaft assembly during installation. Failure to do so may cause injury to personnel or equipment damage.

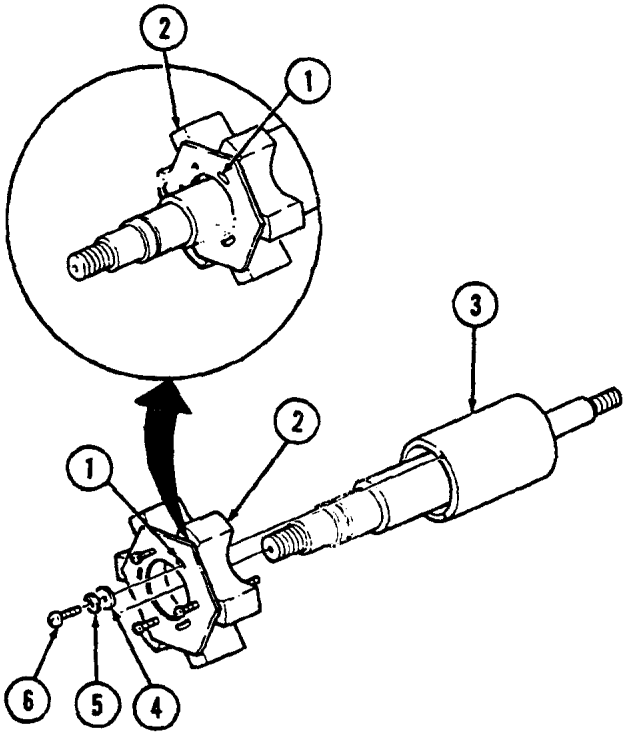
7. Use a press to install front bearing (11) and housing assembly (8) on core and shaft assembly (3).
8. Install shaft retaining ring (12) on core and shaft assembly (3).
9. Insert core and shaft assembly (3) and front housing assembly (8) into stator/field coil assembly (14).

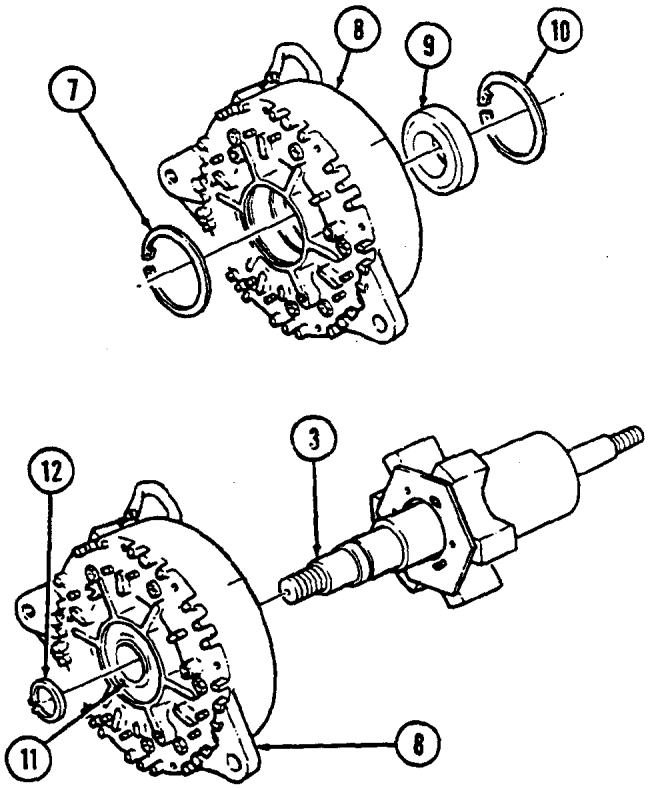
**NOTE**

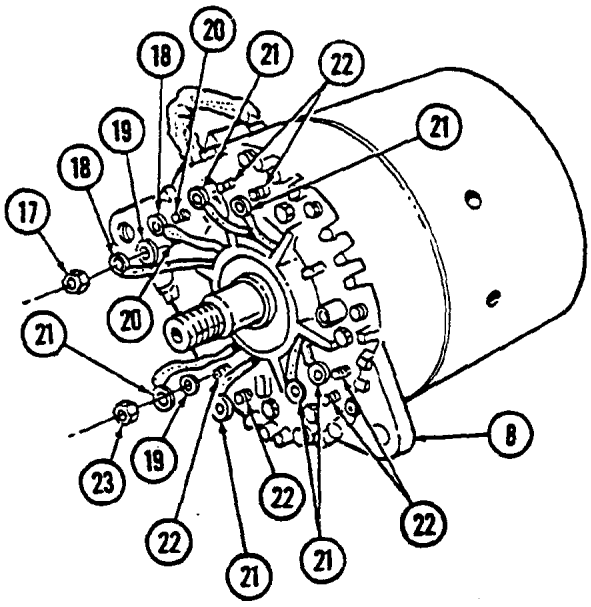
Align scribe marks on front housing and stator shell.

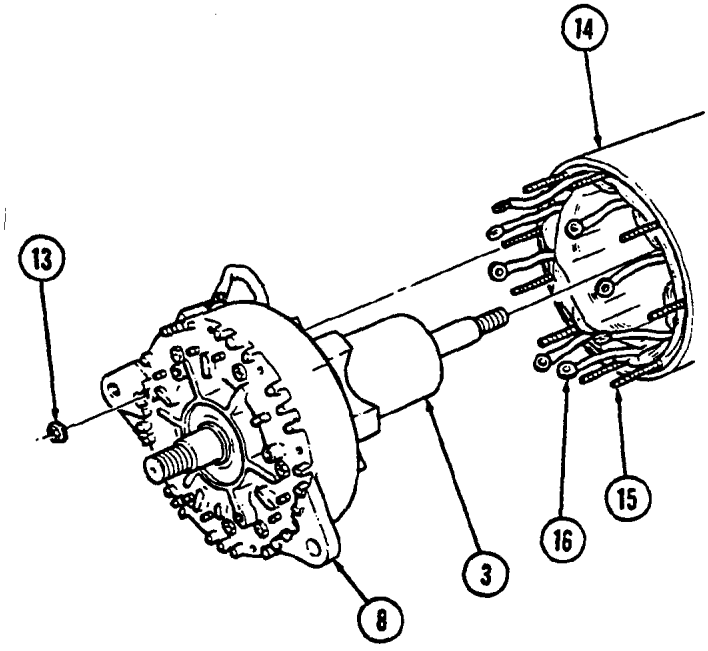
10. Feed leads (16) from stator (14) through front housing assembly (8).
12. Apply sealing compound to studs (15) on stator/coil field assembly (14).
13. Install front housing (8) on studs (15) and shell/stator/coil field assembly (14) with nine locknuts (13). Tighten locknuts (13) to 18 lb-in. (2 N•m).
14. Install six washers (19), phase leads (21), and nuts (23) to diodes (22) on front housing assembly (8). Tighten nuts (23) to 18 lb-in. (2 N•m).
15. Install six washers (19), field leads (18), and nuts (17) to studs (20) on front housing assembly (8). Tighten nuts (17) to 18 lb-in. (2 N•m).
16. Apply a thin coat of sealant to leads (18) and (21) on studs (20) and diodes (22) and front housing assembly (8).

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)



## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)

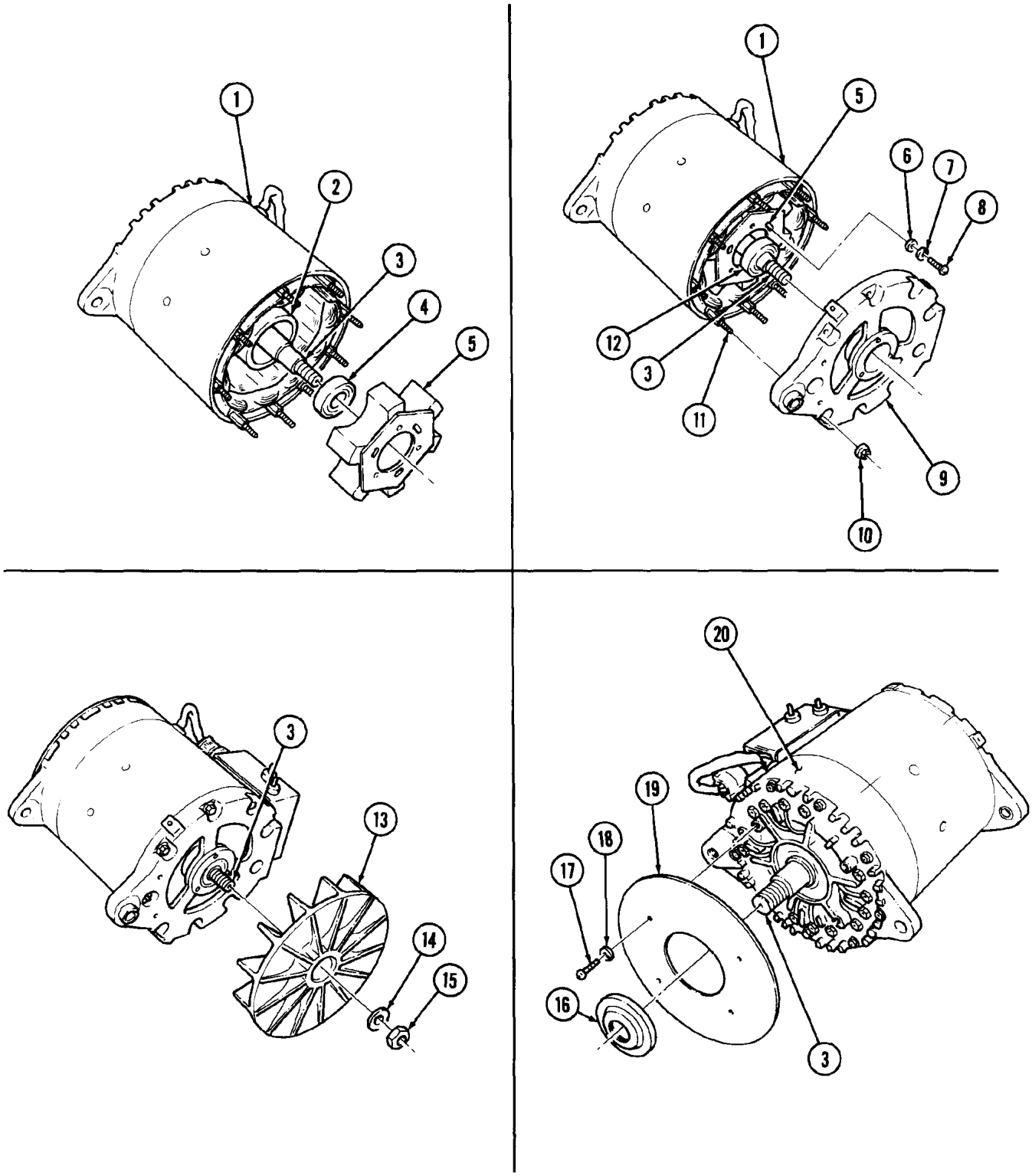
17. Use a press to install rear bearing (4) on core and shaft assembly (3) and stator/field coil assembly (1).
18. Install rear rotor assembly (5) on core and shaft assembly (3).
19. Apply sealing compound to three screws (8).
20. Align slots in rear rotor assembly (5) to mount holes on core and shaft assembly (3) and install with three screws (8), lockwashers (7), and washers (6). Tighten screws (8) to 45 lb-in. (5 N•m).

**NOTE**

Align scribe marks on end housing and stator shell.

21. Install end housing (9) on core and shaft asembly (3) and rear bearing (12). Tap lightly with a soft-faced mallet.
22. Apply sealing compound to studs (11) on stator/field coil assembly (1).
23. Install end housing (9) on stator/field coil assembly (1) with nine locknuts (10). Tighten locknuts (10) to 18 lb-in. (2 N•m).
24. Install fan (13) on core and shaft assembly (3) with washer (14) and locknut (15).
25. Install core and shaft assembly (3) on soft-jawed vise. Tighten locknut (15) to 50 lb-ft (68 N•m).
26. Install cover plate (19) on front housing assembly (20) with four lockwashers (18) and screws (17).
27. Install bearing bushing (16) on core and shaft assembly (3).

## 6-3.2. 100 AMPERE ALTERNATOR (12342944) TESTING AND REPAIR (Cont'd)




FOLLOW-ON TASK: Install alternator on vehicle (TM 9-2320-280-20).

## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447110) TESTING AND REPAIR

**This task covers:**

**a. Alternator Output Testing**
**b. Disassembly**
**c. Static Testing**
**d. Cleaning**
**e. Assembly**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)
Puller (Appendix G, Item 136)

**Test Equipment**

Multimeter (Appendix G, Item 120)
Test stand (Appendix G, Item 94)

**Materials/Parts**

Silicone compound (Appendix B, Item 57)
RTV sealant (Appendix B, Item 43)
Locknut (Appendix E, Item 81)
Three lockwashers (Appendix E, Item 111)
Eighteen locknuts (Appendix E, Item 68)

**Personnel Required**

One mechanic
One assistant

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P
TM 9-4910-663-12
TM 9-4910-485-12

**Equipment Condition**

Alternator removed (TM 9-2320-280-20).

**General Safety Instructions**

Always support alternator core and shaft assembly during removal and installation.

**Maintenance Level**

Direct support

### a. Alternator Output Testing

1. Mount pivot arm of 500 amp test stand to high-speed side and install mounting flange adapter on pivot arm. Connect pulley driveshaft to high-speed head. Install pulley driveshaft on mounting flange adapter.
2. Mount alternator to starter/alternator mounting bracket on 500 amp test stand. Connect belt from test stand pulley to alternator pulley. Adjust belt tension.
3. Connect cable from alternator ground terminal to test stand G- terminal. Connect cable from alternator battery terminal to test stand G+ terminal. Connect cable from alternator regulator IGN to test stand F terminal.
4. Connect 28 VDC output and 14 VDC output to test stand. Auxiliary voltage and current meters may be required to measure 14 VDC output.
5. Fabricate a jumper wire with a ring terminal at both ends. Connect jumper wire on test stand from IGNITION SWITCH terminal to F-B terminal.

## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447110) TESTING AND REPAIR (Cont'd)

**CAUTION**

Ensure auxiliary measuring equipment is properly grounded to test stand. Failure to do so may lead to erroneous readings or damage to equipment.

**NOTE**

Prior to operation of test stand, ensure all switches and controls are in initial positions as referenced in Operator and Maintenance Manual, TM 9-4910-663-12 (UMC Model GSAR-500), or Operator and Maintenance Manual, TM 9-4910-485-12 (Sun Model AGT-9/9A).

6. Set test stand as follows:

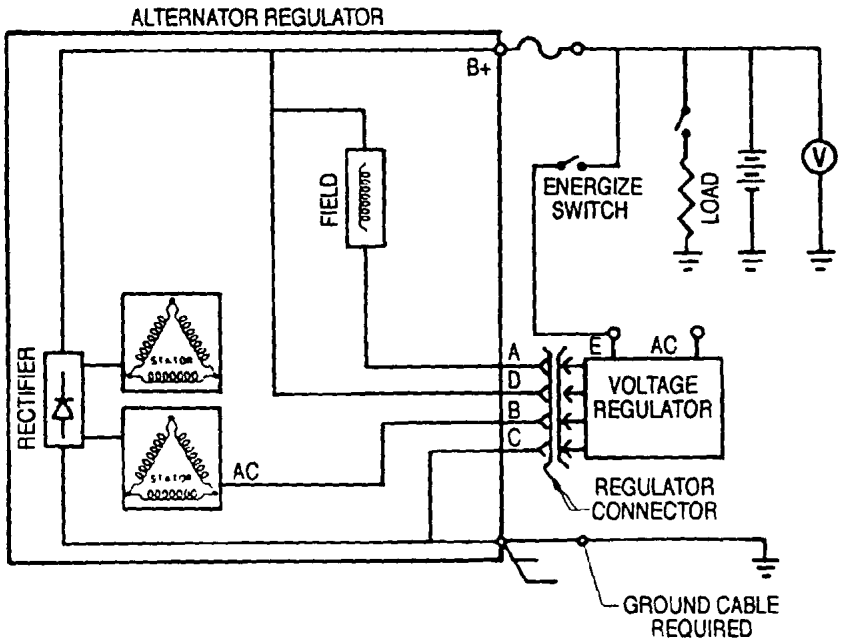
| | Model GSAR-500 | Model AGT-9/9A |
|---|---|---|
| (a) DC ammeter load and starter selector | X10 | 500 amp |
| (b) DC ammeter field and battery charge selector | X1 | 5 amp |
| (c) Field circuit switch | Regulator | Regulator |
| (d) DC voltmeter circuit selector | RECT/GEN | RECT/GEN |

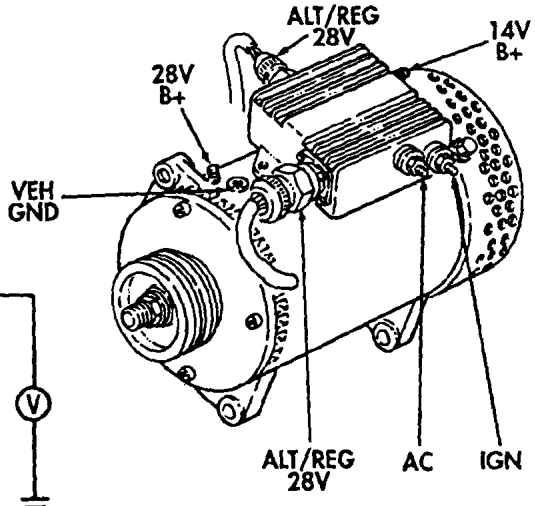
(e) Connect DC voltmeter (0-50 VDC) from point between regulator 14 VDC output and load in 14-volt circuit (or 14-volt battery).

(f) Connect ammeter (0-75 ADC) in load line from 14 V regulator to 14 V load.

7. Turn test stand master power switch and master load switch to ON, and turn battery switch to 24 VDC. Green lamp on test stand must illuminate.

8. Perform no-load test. Set test stand battery circuit selector to 24 VDC, IGN switch to ON, and start varidrive. Observing the DC voltmeter output voltage and tachometer rpm, increase speed until tachometer reads 5000 rpm. Record voltmeter reading and refer to table 6-A.3, No-Load Test, for diagnosis.



## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447110) TESTING AND REPAIR (Cont'd)

**NOTE**

- When tachometer reaches 3000 rpm, green lamp should go off indicating proper charging from alternator.
- Normal voltage range is 26-30 VDC. High amperage is +10 percent over the rated alternator output of 81 amps at 5000 rpm.

9. Perform full-load test. Ensure all load switches are in ON position on 500-amp test stand, and increase alternator speed to 5000 rpm. Set load to 81 amps/min; record results. Refer to table 6-A.4, Full-Load Test, for diagnosis.

*Table 6-A.3. No-Load Test.*

| AMPS | 28 VDC | 14 VDC | DIAGNOSIS |
|---|---|---|---|
| 81-100 | 21-25 | 10.5-12.5 | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| 81-100 | 26-30 | 13-15 | Give time to stabilize while monitoring VOLTS. If VOLTS rise above normal range (26-30 volts), regulator and/or tube assembly must be replaced. If AMPS fall, charging system is OK. |
| 81-100 | 31-35 | 15.5-17.5 | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to static testing, task c. |
| 40-59 | 21-25 | 10.5-12.5 | Alternator and/or regulator must be repaired or replaced. Refer to table 6-A.6. |
| 40-59 | 26-30 | 13-15 | Regulator OK. Refer to table 6-A.4. |
| 40-59 | 31-35 | 15.5-17.5 | STOP TEST. Test bench malfunction or wiring error. |

*Table 6-A.4. Full-Load Test.*

| AMPS | 28 VDC | 14 VDC | DIAGNOSIS |
|---|---|---|---|
| 81-100 | 21-25 | 10.5-12.5 | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| 81-100 | 26-30 | 13-15 | Charging system OK. |
| 81-100 | 31-35 | 15.5-17.5 | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to static testing, task c. |
| 40-59 | 21-25 | 10.5-12.5 | Alternator and/or regulator must be replaced. Refer to table 6-A.6. |
| 40-59 | 26-30 | 13-15 | Increase load. |
| 40-59 | 31-35 | 15.5-17.5 | STOP TEST. Test bench malfunction or wiring error. |

## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447110) TESTING AND REPAIR (Cont'd)

10. Alternator speed and current output tracking values. Refer to table 6-A.5.

*Table 6-A.5. Alternator Speed and Current Tracking.*

| ALTERNATOR SPEED (RPM) | 28 VDC OUTPUT CURRENT ±5 AMP | 14 VDC OUTPUT CURRENT MINIMUM AMP | ALTERNATOR SPEED (RPM) | 28 VDC OUTPUT CURRENT ±5 AMP | 14 VDC OUTPUT CURRENT MINIMUM AMP |
|---|---|---|---|---|---|
| 1,200 | *0 | 26 | 2000 | 25 | 36 |
| | 10 | 31 | | 38 | 43 |
| | 25 | 23 | | 52 | 33 |
| | 35 | 13 | | 65 | 20 |
| | 48 | 0 | | **85 | 0 |
| 1,500 | *0 | 23 | 4000 to 8000 | *0 | 8 |
| | 15 | 34 | | 25 | 32 |
| | 32 | 37 | | 48 | 52 |
| | 55 | 14 | | 70 | 30 |
| | 69 | 0 | | 87 | 13 |
| 2,000 | *0 | 20 | | **100 | 0 |

* Dependent on ammeter location in test circuit.
** Minimum acceptable current with no load on 28 VDC system.

11. Perform regulator bypass test. Prepare alternator as in full-load test.

**NOTE**

- Perform this test only when instructed from tables 6-A.3 and 6-A.4.
- Use jumper wire rated for 15 amps.

12. Disconnect alternator connector from regulator. With alternator spinning, use jumper wire and short pin A to ground momentarily. Record results.
13. Amperage should rise within ± 10 percent of rated value with jumper wire connected, and fall with jumper disconnected. Refer to table 6-A.6, Regulator Bypass Test, for diagnosis.
14. Turn test stand master power switch and load switch to OFF.
15. Disconnect jumper wires from terminals on test stand and alternator.
16. Remove belt from test stand pulley and alternator pulley. Remove alternator from test stand.

*Table 6-A.6. Regulator Bypass Test.*

| CONNECT | DISCONNECT | DIAGNOSIS |
|---|---|---|
| AMPS RISE | AMPS FALL | Alternator OK. See note. Replace regulator only if low AMPS (40-59)/low VOLTS (21-25) are indicated in table 6-A.3 and/or table 6-A.4. |
| NO CHANGE | NO CHANGE | Alternator must be repaired. Refer to static testing, task c. |

## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447110) TESTING AND REPAIR (Cont'd)

**b. Disassembly**

**NOTE**

Complete alternator disassembly is not required for static testing.

1. Remove voltage regulator (TM 9-2320-280-20).
2. Remove locknut (6), washer (5), fan (4), and bearing bushing (3) from core and shaft assembly (11). Discard locknut (6).
3. Remove three screws (21), lockwashers (22), and plate cover (20) from front housing (17). Discard lockwashers (22).
4. Scribe alignment marks on front housing (17), stator (9), and end housing (2).
5. Remove nine locknuts (7) from end housing (2) and studs of stator (9). Discard locknuts (7).
6. Using puller, remove end housing (2) from stator (9).
7. Remove six nuts (1) from rear rotor (24) and studs of core and shaft assembly (11).
8. Using three 10-32 x 2-in. long machine screws as jacks in threaded holes on end plate of rear rotor (24), gradually tighten screws and remove rear rotor (24) from core and shaft assembly (11). Remove machine screws.

**NOTE**

Prior to removal, tag leads for installation.

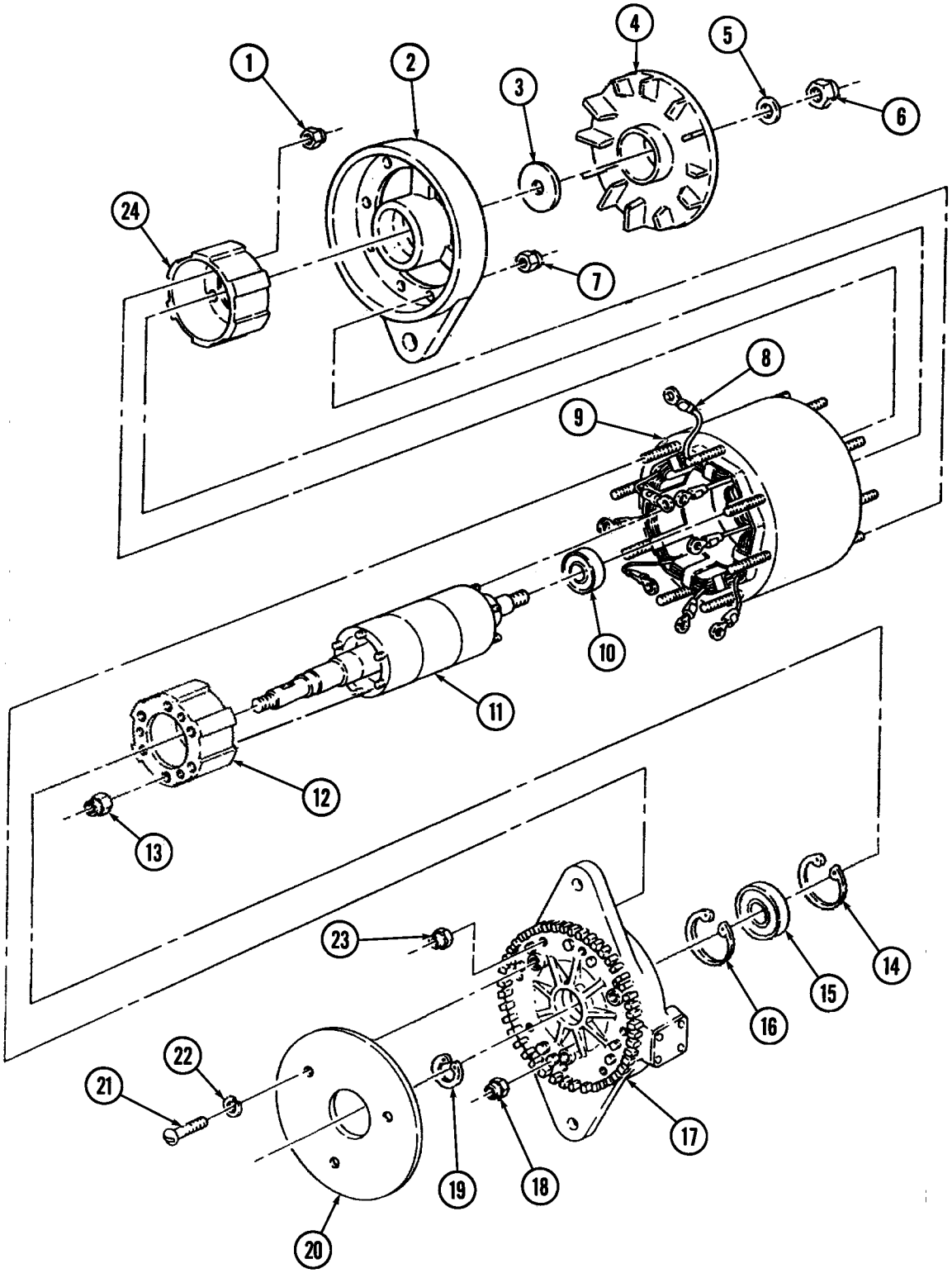
9. Remove eight nuts (18) and disconnect two field and six phase leads (8) from diodes in front housing (17).
10. Remove nine locknuts (23) from front housing (17) and studs of stator (9). Discard locknuts (23).
11. Remove shaft retaining ring (19) from core and shaft assembly (11).
12. Remove front housing (17) from stator (9) by tapping lightly with a soft-faced mallet.

**WARNING**

Always support alternator core and shaft assembly during removal. Failure to do so may cause injury to personnel or equipment damage.

13. Using press, remove core and shaft assembly (11) from front bearing (15) and front housing (17).
14. Remove front (16) and rear (14) retaining rings from front housing (17).
15. Using press, remove front bearing (15) from front housing (17).
16. Remove six nuts (13) from front rotor (12) and studs of core and shaft assembly (11).
17. Using three 10-32 x 2-in. long machine screws as jacks in threaded holes on end plate of front rotor (12), gradually tighten screws and remove front rotor (12) from core and shaft assembly (11). Remove machine screws.
18. Using press, remove rear bearing (10) from core and shaft assembly (11).

## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447110) TESTING AND REPAIR (Cont'd)



## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)

**c. Static Testing**

**NOTE**

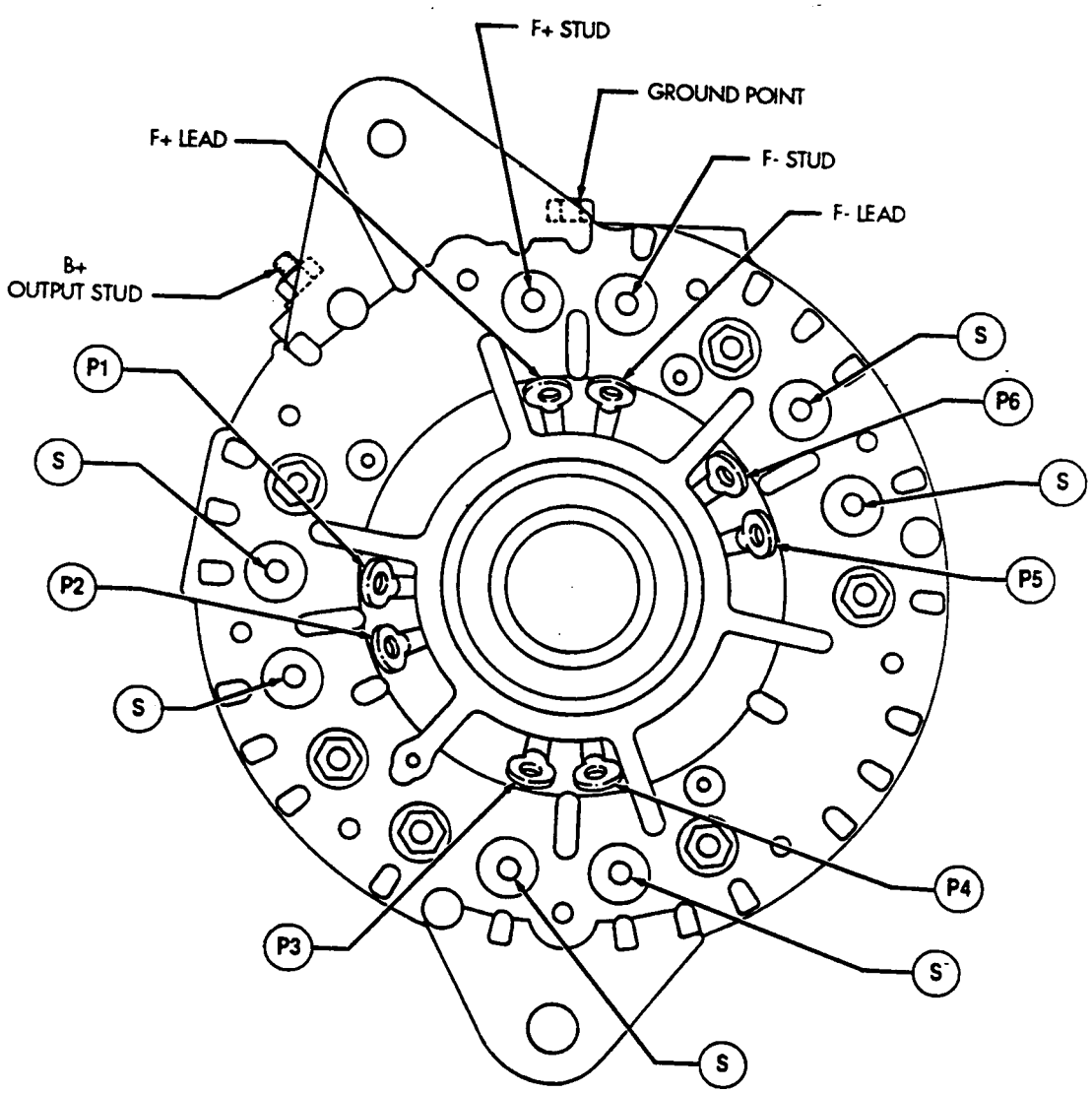
Refer to disassembly for component removal, if necessary.

1. Perform Stator Test:
   (a) Remove six nuts and phase leads from diodes in front housing.
   (b) Set multimeter to XI scale and zero multimeter.
   (c) Connect multimeter leads between each successive pair of stator phase leads P1-P2, P2-P3, and P1-P3. Multimeter should read less than 1 ohm. If multimeter reads infinity (∞), the stator is open; replace alternator.
   (d) Set multimeter to X10 scale and zero multimeter.
   (e) Connect multimeter leads between each phase lead, P1, P2, and P3 and the ground terminal on outside of front housing. Multimeter should read infinity (∞). If multimeter reads zero, the stator is grounded; replace alternator.
   (f) Repeat step (e) to check phase leads P4, P5, and P6.
2. Perform Field Coil Test:
   (a) Remove two nuts and field coil leads (F+, F-) from diodes in front housing.
   (b) Set multimeter to XI scale and zero multimeter.
   (c) Connect multimeter leads to the two field leads and measure the resistance. Multimeter should read less than 3 ohms. If multimeter reads more than 3 ohms, the field coil is open; replace alternator.
   (d) Set multimeter to X10K scale and zero multimeter.
   (e) Connect one multimeter lead to a field lead and the other to the ground stud on front housing. Multimeter should read infinity (∞). If multimeter reads less than 100K ohms, the field coil is grounded. Replace alternator.
3. Perform Positive Diode Test:
   (a) Set multimeter to X100 scale and zero multimeter.
   (b) Connect one ohmmeter lead to the B+ output stud and the other lead to each of the six diode terminals S. Multimeter should read either less than 600 ohms or infinity (∞) for all six diode terminals. Reverse multimeter leads. Multimeter should read nearly alike for all six, but opposite the first set of readings. If readings are not opposite, the diode rectifier assembly is open. Replace alternator.
4. Perform Negative Diode Test:
   (a) Set multimeter to X100 scale and zero multimeter.
   (b) Connect one multimeter lead to the ground terminal and the other lead to each of the six diode terminals S. Multimeter should read either less than 600 ohms or infinity (∞) for all six diode terminals. Reverse multimeter leads. Multimeter should read nearly alike for all six, but opposite the first set of readings. If readings are not opposite, the diode rectifier assembly is open. Replace alternator.

**d. Cleaning**

Clean all alternator components in accordance with para. 2-13.

## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447110) TESTING AND REPAIR (Cont'd)



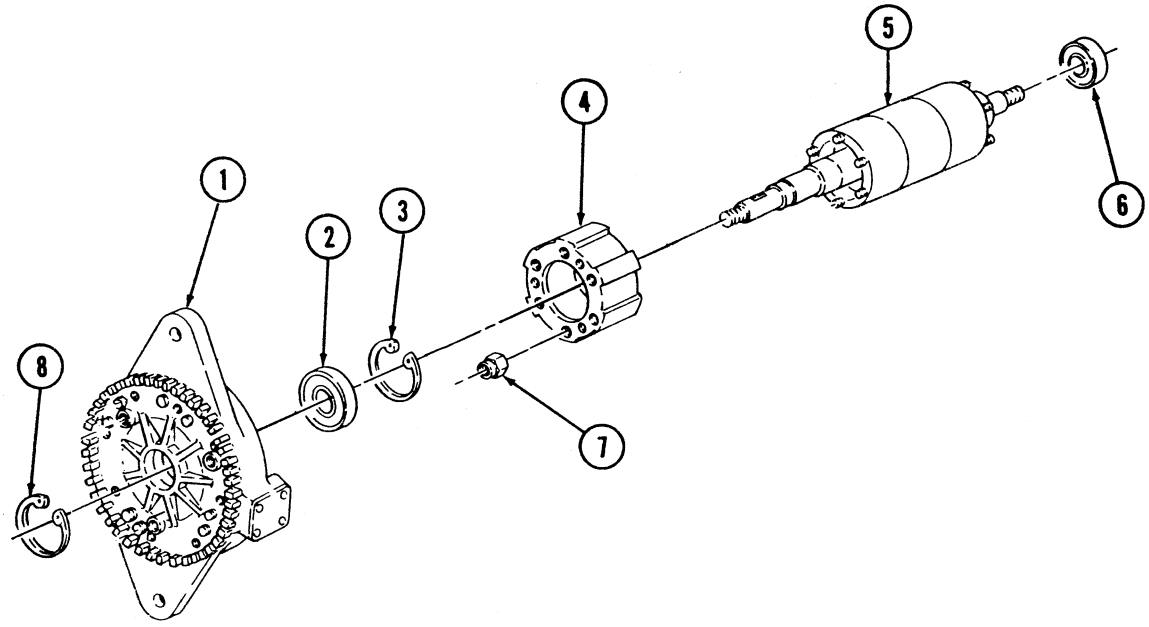
## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447110) TESTING AND REPAIR (Cont'd)

**e. Assembly**

**WARNING**

Always support alternator core and shaft assembly during installation. Failure to do so may cause injury to personnel or equipment damage.

1. Using press, install rear bearing (6) on core and shaft assembly (5).
2. Position front rotor (4) on core and shaft assembly (5).
3. Apply silicone compound to studs of core and shaft assembly (5).
4. Install core and shaft assembly (5) on front rotor (4) with six nuts (7). Tighten nuts (7) to 45 lb-in. (5 N•m).
5. Coat outer race of front bearing (2) with a thin coat of silicone compound.
6. Using press, install front bearing (2) on front housing (1).
7. Install front retaining ring (8) and rear retaining ring (3) on front housing (1).
8. Using press, install front bearing (2) with housing (1) on core and shaft assembly (5).




9. Install shaft retaining ring (19) on core and shaft assembly (5).
10. Insert core and shaft assembly (5) and front housing (1) into stator (15).

**NOTE**

Align scribe marks on front housing and stator shell.

11. Feed leads (17) from stator (15) through front housing (1).
12. Apply silicone compound to studs (16) on stator (15).
13. Install front housing (1) on stator (15) with nine locknuts (23). Tighten locknuts (23) to 18 lb-in. (2 N•m).
14. Install six phase leads and two field leads (17) on diodes on front housing (1) with eight nuts (18).
15. Apply thin coat of RTV sealant on leads (17) and diodes on front housing (1).
16. Install rear rotor (24) on core and shaft assembly (5).
17. Apply silicone compound to studs on core and shaft assembly (5).

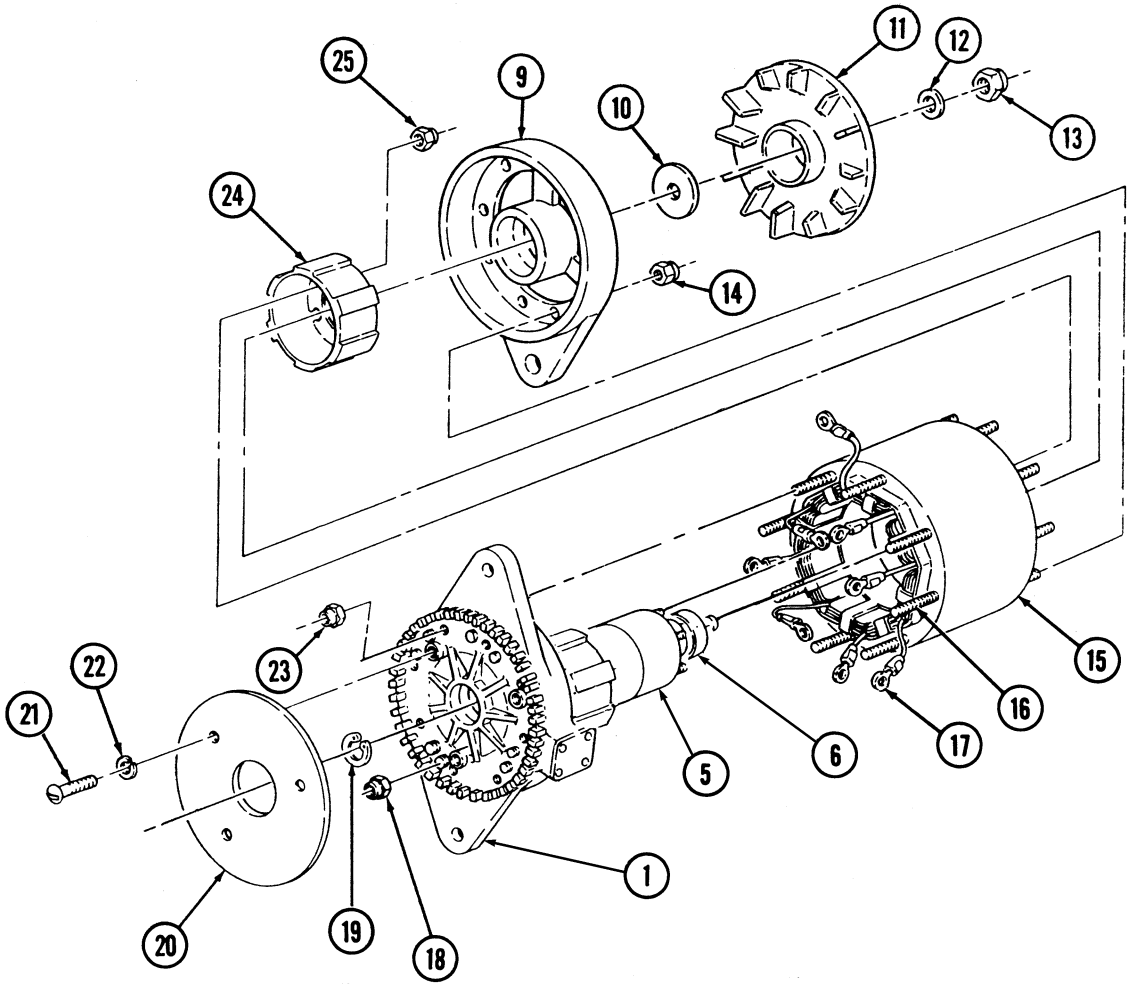
## 6-3.3. 100 AMPERE DUAL VOLTAGE ALTERNATOR (12447110) TESTING AND REPAIR (Cont'd)

18. Install core and shaft assembly (5) on rear rotor (24) with six nuts (25). Tighten nuts (25) to 45 lb-in. (5 N•m).

**NOTE**

Align scribe marks on end housing and stator shell.

19. Install end housing (9) on core and shaft assembly (5) and rear bearing (6). Tap lightly with a soft-faced mallet.
20. Apply silicone compound to studs (16) on stator (15).
21. Install end housing (9) on stator (15) with nine locknuts (14). Tighten locknuts (14) to 18 lb-in. (2 N•m).
22. Install cover plate (20) on front housing (1) with three lockwashers (22) and screws (21).
23. Install bearing bushing (10) on core and shaft assembly (5).
24. Install fan (11) on core and shaft assembly (5) with washer (12) and locknut (13). Tighten locknut (13) to 50 lb-ft (68 N•m).




FOLLOW-ON TASKS:
- Install voltage regulator (TM 9-2320-280-20).
- Install alternator (TM 9-2320-280-20).

## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR

**This task covers:**

**a. Alternator Output Testing**
**b. Disassembly/Testing**
**c. Cleaning**
**d. Assembly**

### INITIAL SETUP:

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 6)

**Test Equipment**

Multimeter (Appendix G, Item 30)
Test stand (Appendix G, Item 94)

**Materials/Parts**

Two electrical brushes (Appendix E, Item 5)
Gasket (Appendix E, Item 30)
Preformed packing (Appendix E, Item 178)
Four lockwashers (Appendix E, Item 97)
Four lockwashers (Appendix E, Item 115)
Seven lockwashers (Appendix E, Item 116)
Lockwasher (Appendix E, Item 114)
Seal (Appendix E, Item 205)
Two plain seals (Appendix E, Item 225)
Plain seal (Appendix E, Item 226)
Gasket (Appendix E, Item 33)
Locknut (Appendix E, Item 74)
Machine key (Appendix E, Item 44)
Grease (Appendix B, Item 20)

**Personnel Required**

One mechanic
One assistant

**Manual References**

TM 9-214
TM 9-2320-280-20
TM 9-2320-280-24P
TM 9-4910-485-12
TM 9-4910-663-12

**Equipment Condition**

- Alternator removed (TM 9-2320-280-20).
- Regulator removed (TM 9-2320-280-20).

**General Safety Instructions**

Always support alternator rotor during removal and installation.

**Maintenance Level**

Direct support

### a. Alternator Output Testing

1. Mount pivot arm of 500 amp test stand to high speed side and attach mounting flange adapter to pivot arm. Connect pulley drive shaft to high speed head. Attach pulley drive shaft to mounting flange adapter.
2. Mount alternator to starter/generator mounting bracket on 500 amp test stand. Connect V-belt from 500 amp test stand pulley to pulley. Adjust belt tension.
3. Connect cable from alternator ground terminal to 500 amp test stand G terminal. Connect cable from alternator “Bat” terminal to 500 amp test stand G+ terminal. Connect cable from alternator regulator IGN to 500 amp test stand F terminal.
4. Make a jumper wire with a ring terminal at both ends. Connect jumper wire on 500 amp test stand from IGN SWITCH terminal to F-B terminal.

**NOTE**

Prior to operation of the test stand, make certain that all switches and controls are in the “initial” positions as referenced in: Operator and Maintenance Manual, TM 9-4910-663-12 (UMC Model GSAR-500), or Operator and Maintenance Manual, TM 9-4910-485-12 (Sun Model AGT-99A).

**6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)**

5. Set 500 amp test stand as follows:

| | | Model GSAR-500 | Model AGT-99A |
|---|---|---|---|
| (a) | DC ammeter load and starter selector | X10 | 500 amp |
| (b) | DC ammeter field and battery charge selector | X1 | 5 amp |
| (c) | Field circuit switch | Regulator | Regulator |
| (d) | DC voltmeter circuit selector | RECT/GEN | RECT/GEN |

6. Turn 500 amp test stand master power switch and master load switch to "ON." Green lamp on 500 amp test stand must illuminate. Start the varidrive by actuating the start button. Set 500 amp battery circuit selector to 24V DC, and the "IGN" switch to "ON".

**NOTE**

When tachometer reaches 3000 rpm, test light should go out to indicate proper charging from alternator.

7. Observing DC output and tachometer rpm, set the 200 A switch of the load bank switches to "ON". and raise speed until tachometer reads 5000 rpm.

8. Snap the load bank master load switch in the "ON" position, and use the variable load control to apply the load.

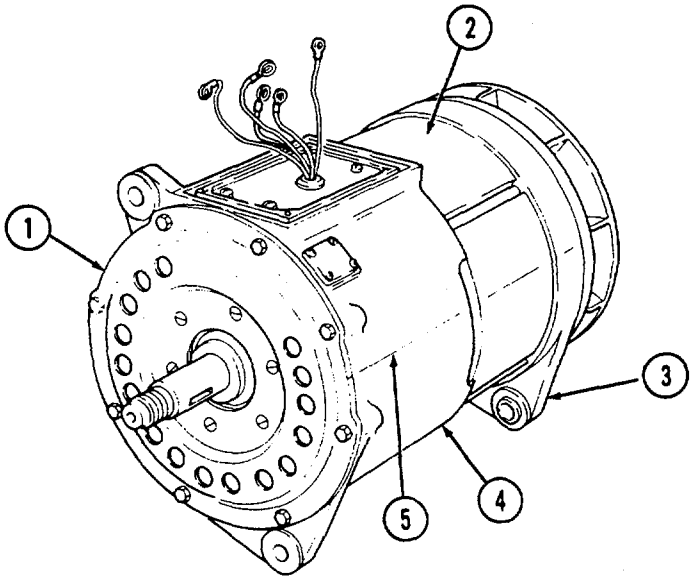
9. Readings should be 28.0 volts and 100-160 amps. If readings are not correct, repair alternator.

**NOTE**

Prior to removal, tag leads for installation.

b. Disassembly/Testing

1. Scribe alignment marks (5) on cover plate (1), drive end housing (4), stator (2) and end housing (3).



**6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)**

2. Remove four screws (4), lockwashers (5), and baffle plate (2) from drive end housing (7). Discard lockwashers (5).

3. Slide five leads through grommet (3) and remove baffle plate (2) from drive end housing (7).

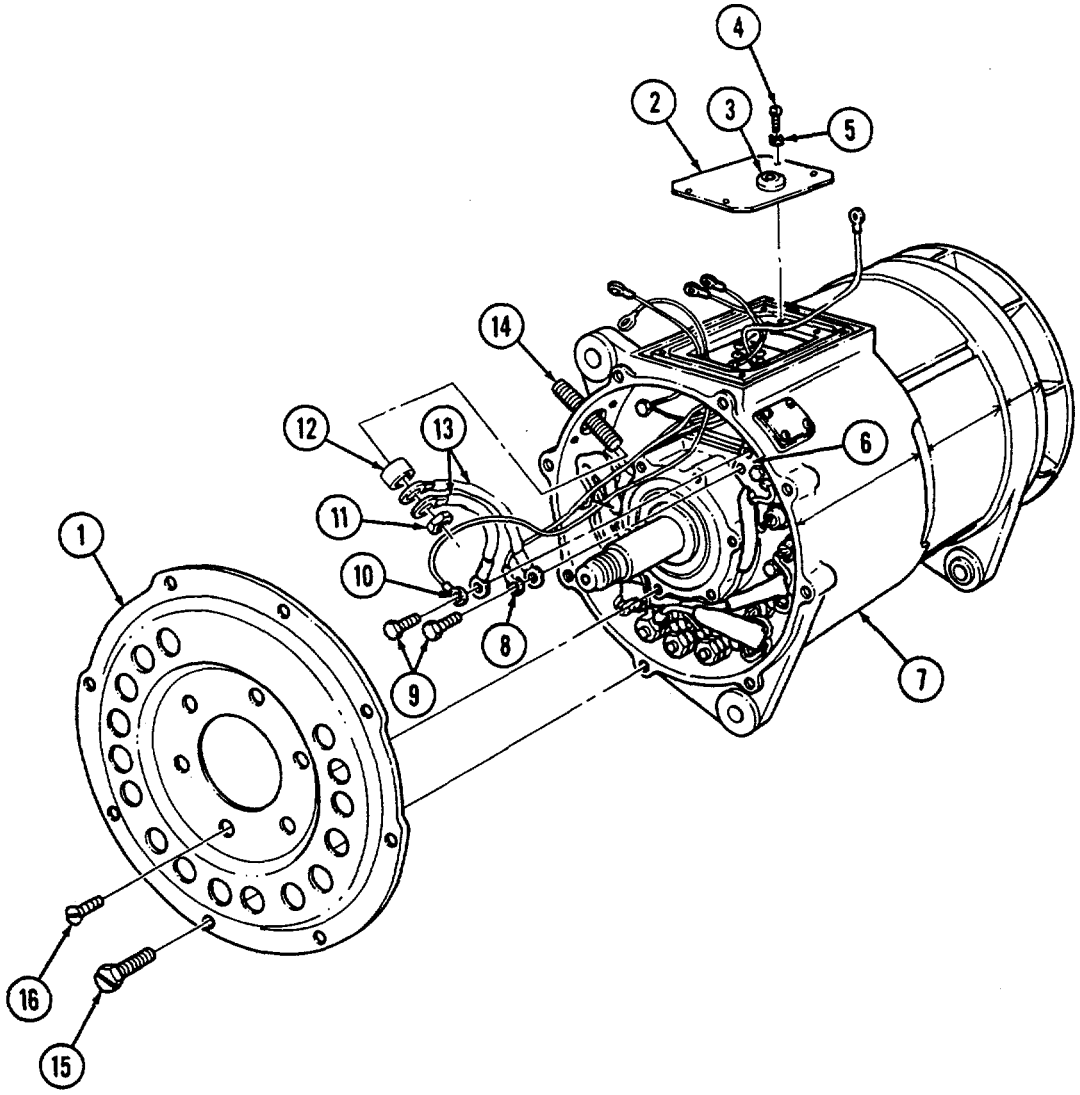
4. Remove eight screws (15), six screws (16), and cover plate (1) from drive end housing (7).

**NOTE**

Lead 7 will fall free when hardware is removed.

5. Remove two capscrews (9), positive leads (13), lead 7 (10), and an additional lead 4 (8) from rectifier bridge (6).

6. Remove nut (11), two positive leads (13), and spacer (12) from fuse holder (14).



**6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)**

7. Remove two screws (20) and fuse holder (21) from drive end housing (7).

**NOTE**

Lead 6 will fall free when hardware is removed.

8. Remove screw (17), lead 6 (18), and lead 1 (19) from drive end housing (7).

9. Remove nut (39), and positive rectifier leads (37) and (38) from each of three stator studs (34).

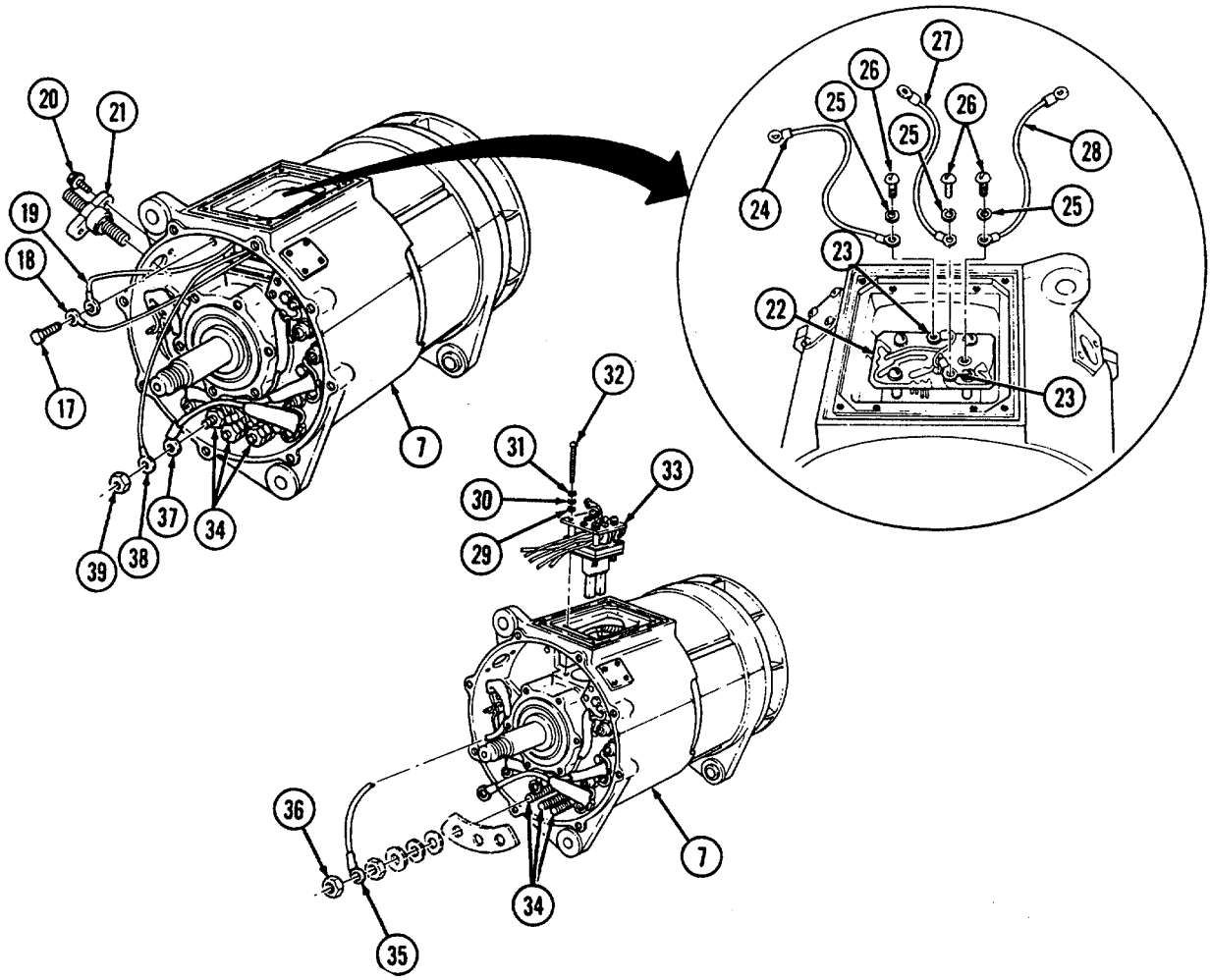
10. Remove nut (36) and negative rectifier lead (35) from each of three stator studs (34).

**NOTE**

- Spacers will fall free when diode trio is removed from drive end housing.
- Note position of diode trio for installation.

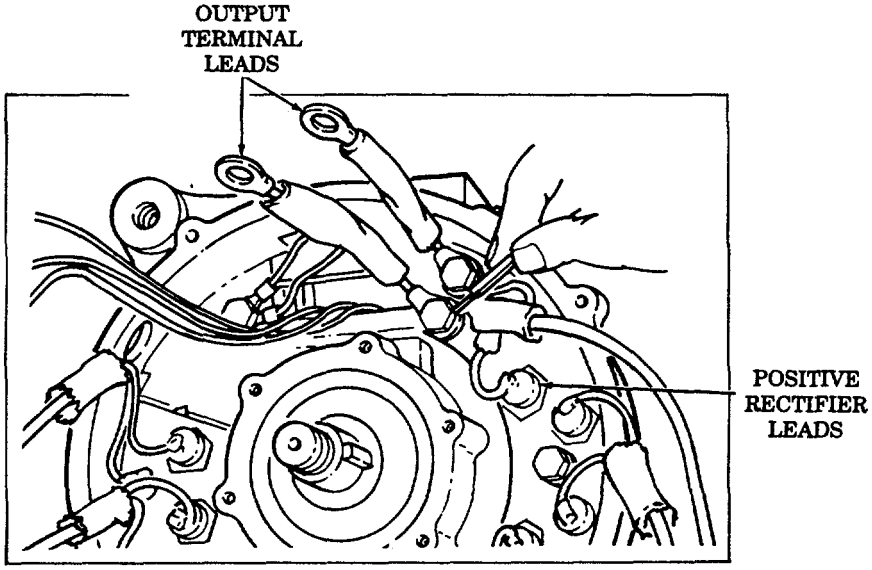
11. Remove three screws (26), lockwashers (25), leads 10 (24), 8 (27), 11 (28), and two brush leads (23) from diode trio assembly (22).

12. Remove four screws (32), lockwashers (31), washers (30), insulation washers (29), and diode trio assembly (33) from drive end housing (7).

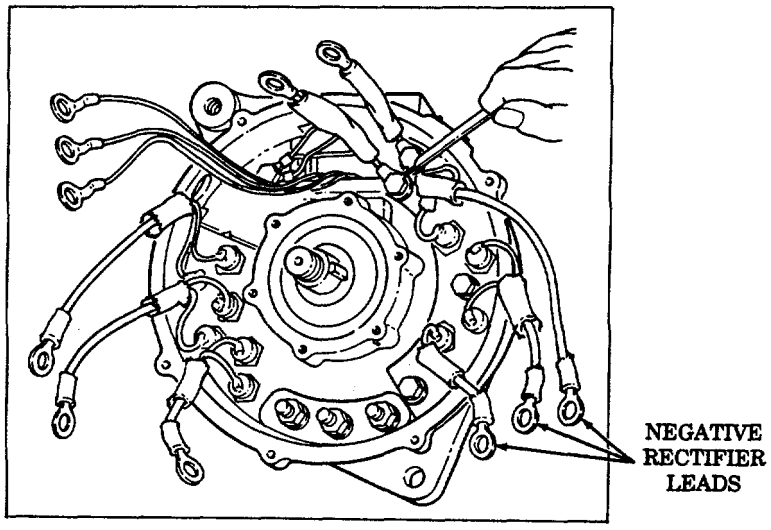


## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)

13. Perform positive rectifier ground test as follows:
    (a) Set ohmmeter to X1OK scale. Connect one test probe to a bare metal surface on the housing.
    (b) Connect the second ohmmeter test lead to the positive rectifier mount. An infinity (∞) reading indicates a high resistance. A LESS THAN infinity reading indicates a grounded rectifier mount. The housing must be replaced.




14. Perform rectifier tests as follows:
    (a) Set an ohmmeter to X1OK scale and connect the NEGATIVE probe to the positive rectifier mount.
    (b) Connect the POSITIVE probe to each of the three positive rectifier leads. An infinity (∞) reading for any of the three leads indicates a HIGH resistance. The rectifier(s) is defective and the mount must be replaced.



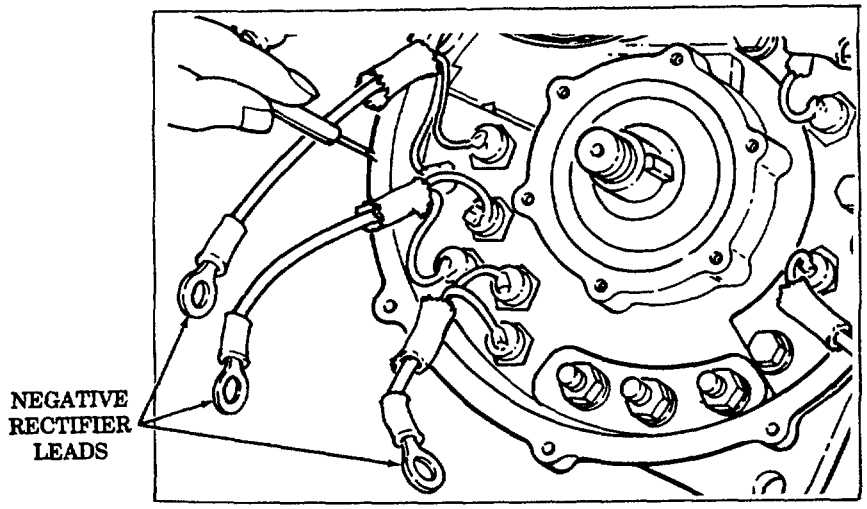
**6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)**

(c) Reverse ohmmeter leads so the POSITIVE probe contacts the positive rectifier mount and the NEGATIVE probe contacts each of the three rectifier leads. LOW resistance (zero or close to zero) reading indicates defective rectifiers. Mount must be replaced.

**NOTE**

Positive rectifiers are acceptacle if a LOW resistance reading is noted in step 14.(b) and a HIGH resistance reading is noted in step 14.(c) for each of the three rectifier leads.

(d) Connect ohmmeter POSITIVE probe to a bare metal surface on the housing, and the NEGATIVE probe to each of the three negative rectifier leads. HIGH resistance for any of the three rectifier leads indicates defective rectifiers. Replace alternator.




(e) Reverse test probes so NEGATIVE probe contacts the housing and the POSITIVE probe is connected to each of the three rectifier leads. LOW resistance indicates defective rectifiers. Replace alternator.

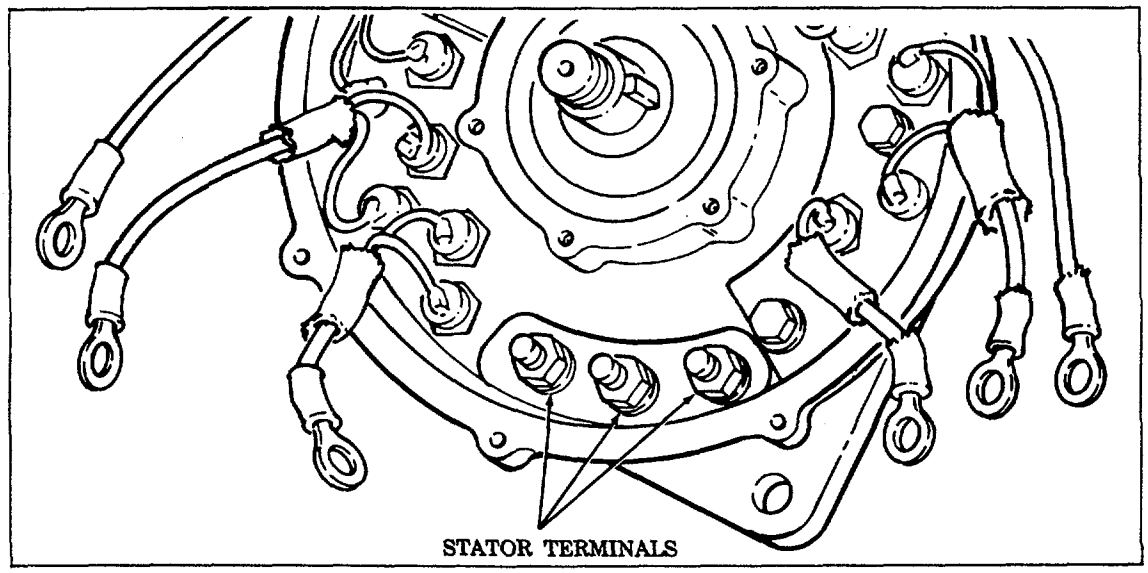
**NOTE**

Negative rectifiers are acceptable if a LOW resistance reading is noted for each rectifier lead in step 14.(d) and a HIGH resistance reading is noted for each rectifier lead in step 14.(e).

15. Perform stator ground test as follows:
    (a) Set ohmmeter to X10K scale and connect one probe to a bare metal surface on the housing and the other probe to each of the three stator terminals.

**6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)**

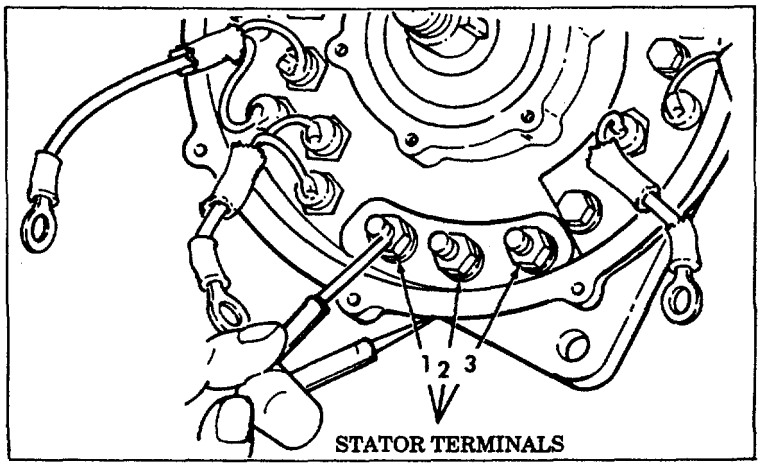
(b) An infinity (∞) reading indicates HIGH resistance. If a LOW resistance is noted, then stator is grounded. Replace alternator.




16. Perform stator phase resistance test as follows:

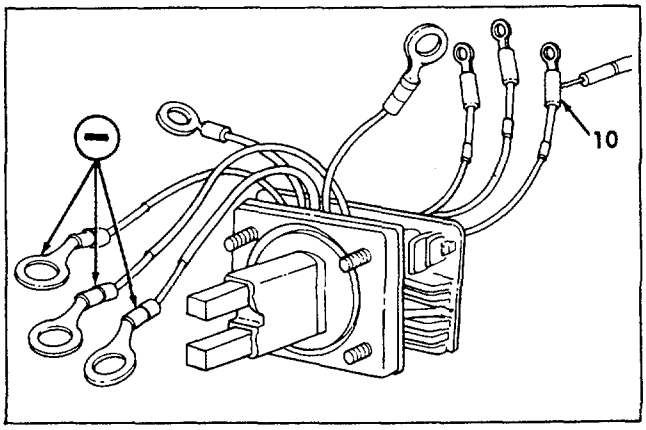
**NOTE**

To perform this test, use an ohmmeter capable of reading 1/1000 of an ohm (mΩ). Connect ohmmeter probes across stator terminals 1 & 2, 1 & 3 and 2 & 3. If the resistance reading across any of the three sets of terminals (phases) is greater or smaller than 0.017-0.021 ohms, then the stator is defective and the alternator must be replaced.



**6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)**

17. Perform diode trio panel assembly tests as follows:
    (a) Set ohmmeter to RX1 scale and connect POSITIVE probe to the field POSITIVE lead (#10) and the NEGATIVE probe to the three long leads. A LOW resistance (zero or close to zero) indicates a defective diode. Replace diode trio/brush holder assembly. If a HIGH resistance reading is noted, then continue with step 17.(b).

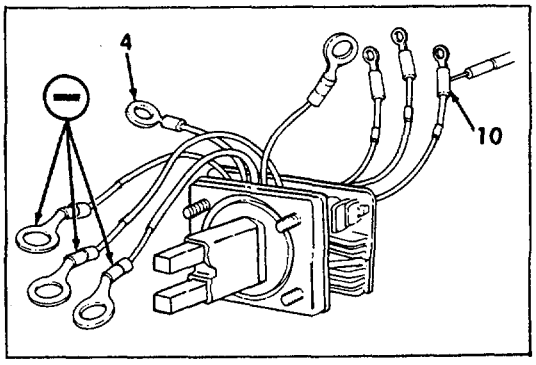



    (b) Reverse ohmmeter probes and connect them to the same test points as in step 17.(a). A HIGH resistance indicates a defective diode. Replace diode trio/brush holder assembly. A LOW resistance reading for each of the three leads indicates that diode trio is acceptacle.

**NOTE**

The diode trio is acceptacle when a HIGH resistance reading is noted for each of the three leads in step 17.(a) and a LOW resistance reading is noted in step 17.(b).

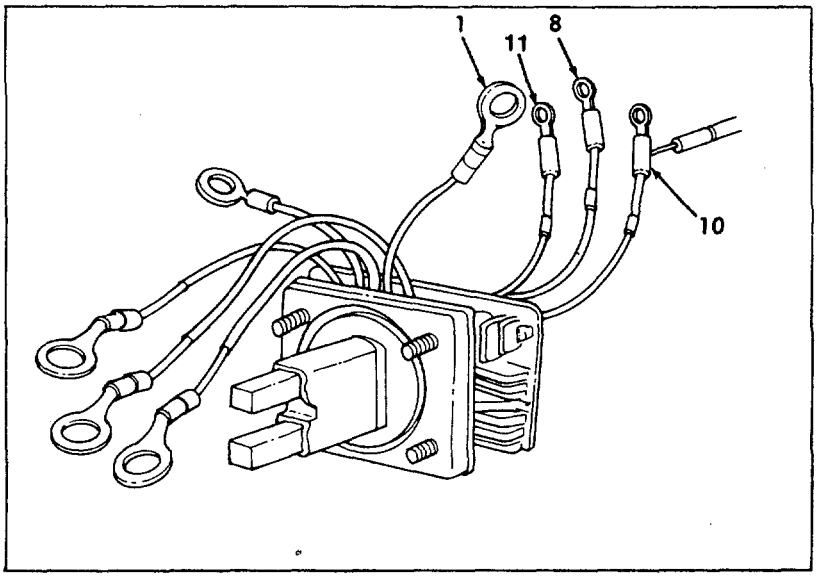
    (c) Connect ohmmeter test probes to diode trio panel lead #10 and #4. If ohmmeter needle deflects and then climbs to HIGH resistance (100,000 ohms or higher), then capacitor is acceptacle. If needle does not deflect, then reverse test probes.




If needle deflects and then climbs to HIGH resistance, capacitor is acceptable. If needle does not deflect, or if it shows LOW resistance (less than 100,000 ohms), then capacitor is defective and diode trio/brush holder must be replaced.

**6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)**

(d) Connect ohmmeter probes to diode trio panel leads #8 and #1. If ohmmeter needle deflects and then climbs to HIGH resistance (100,000 ohms or higher), then capacitor is acceptable. If needle does not deflect, then reverse test probes. If needle defects and then climbs to HIGH resistance then capacitor is acceptable. If needle does not deflect, or if it shows LOW resistance (less than 100,000 ohms), then capacitor is defective and diode trio/brush holder assembly must be replaced.




(e) Connect ohmmeter probes to diode trio panel leads #8 and #1. If ohmmeter needle deflects and then climbs to HIGH resistance (100,000 ohms or higher), then capacitor is acceptable. If needle does not deflect, then reverse test probes. If needle deflects and then climbs to HIGH resistance then capacitor is acceptable. If needle does not deflect, or if it shows LOW resistance (less than 100,000 ohms), then capacitor is defective and diode trio/brush holder assembly must be replaced.

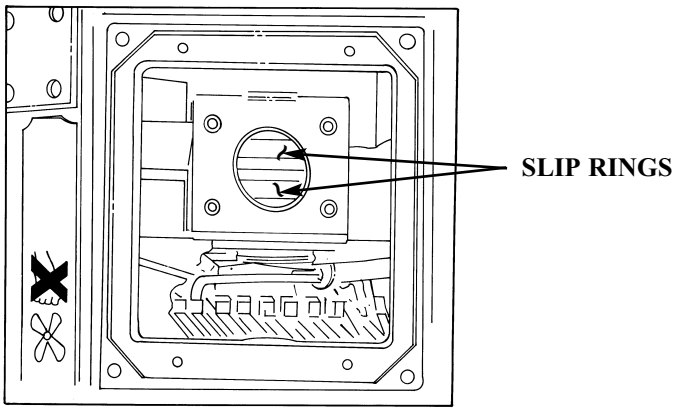
(f) Inspect leads #8, #10, and #11. Replace defective leads.

18. Inspect brushes. If brushes are burned, cracked, or broken or if they are less than 3/16" long, then diode trio/brush holder assembly must be replaced.
    (a) Inspect brush holder. If it appears damaged, replace diode trio/brush holder assembly.
    (b) Press each of the two brushes all the way into the brush holder, then allow them to return to their original position. Replace diode trio/brush holder assembly if any of the following conditions exist:
        (1) either brush does not move freely in and out of brush holder
        (2) little or no spring tension is noted

## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)

19. Perform rotor coil ground test as follows:

    Set ohmmeter to X10K scale. Connect one probe to a bare metal surface on the rotor shaft. Insert the second test lead in the housing and contact probe to each of the two slip rings. If a LOW resistance is noted (less than 50,000 ohms) then the rotor coil is grounded and the alternator must be replaced.



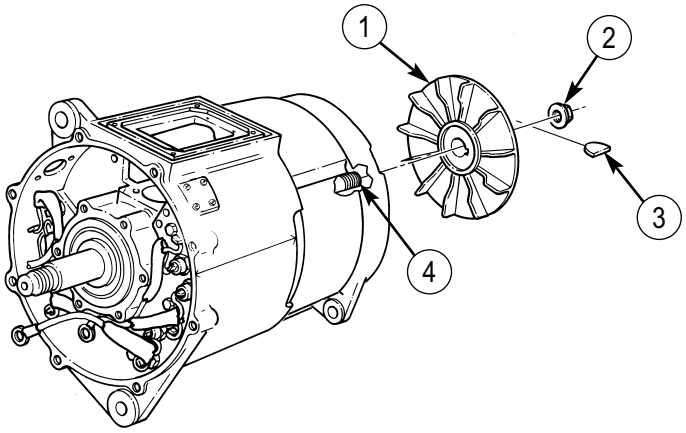

20. Perform rotor coil resistance test as follows:

    Set ohmmeter to X1 scale and insert the two probes in brush holder opening in the housing. Connect a probe to each of the two slip rings. Correct resistance is 5.0-6.0 ohms. If resistance falls outside values shown, then the rotor coil is defective and alternator must be replaced.

**NOTE**

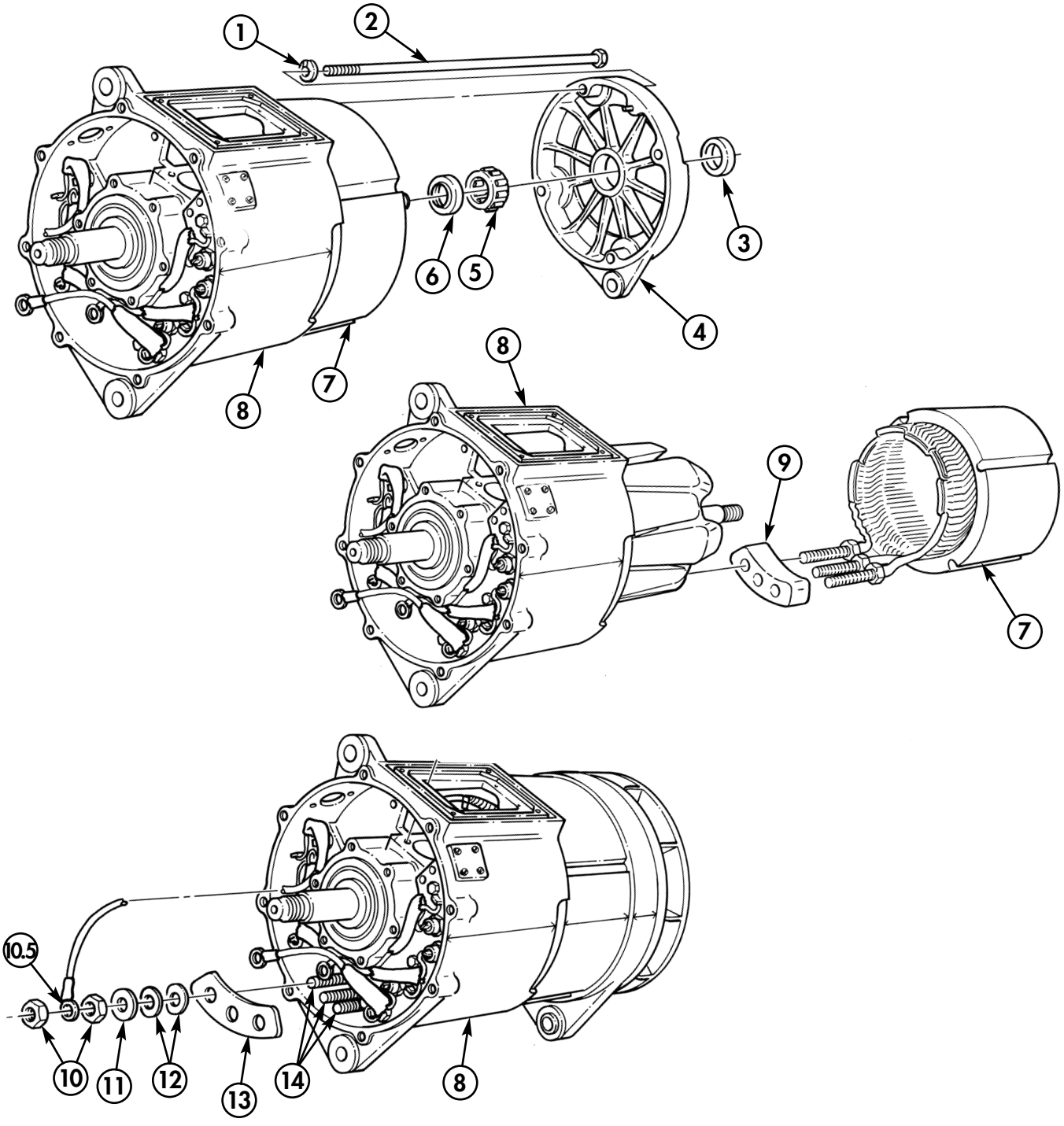
- The stator is the most difficult component to test. If all components are acceptable, then the stator should be replaced, as it is most likely to be misdiagnosed as being serviceable.
- Perform steps 21 through 28 when disassembling the complete alternator.

21. Remove locknut (2), machine key (3), and fan (1) from rotor shaft (4). Discard machine key (3) and locknut (2). ■



## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)

22. Remove four screws (2), lockwashers (1), and end housing (4) from stator (7) and drive end housing (8). Discard lockwashers (1).
23. Remove seals (6) and (3) and bearing (5) from end housing (4). Discard seals (6) and (3).
24. Remove nut (10), negative rectifier lead (10.5), nut (10), washer (11), and two spring washers (12) from insulator (13) and each of three stator studs (14). Remove insulator (13) from stator studs (14).
25. Remove stator (7) and insulator (9) from drive end housing (8). Remove insulator (9) from stator (7).



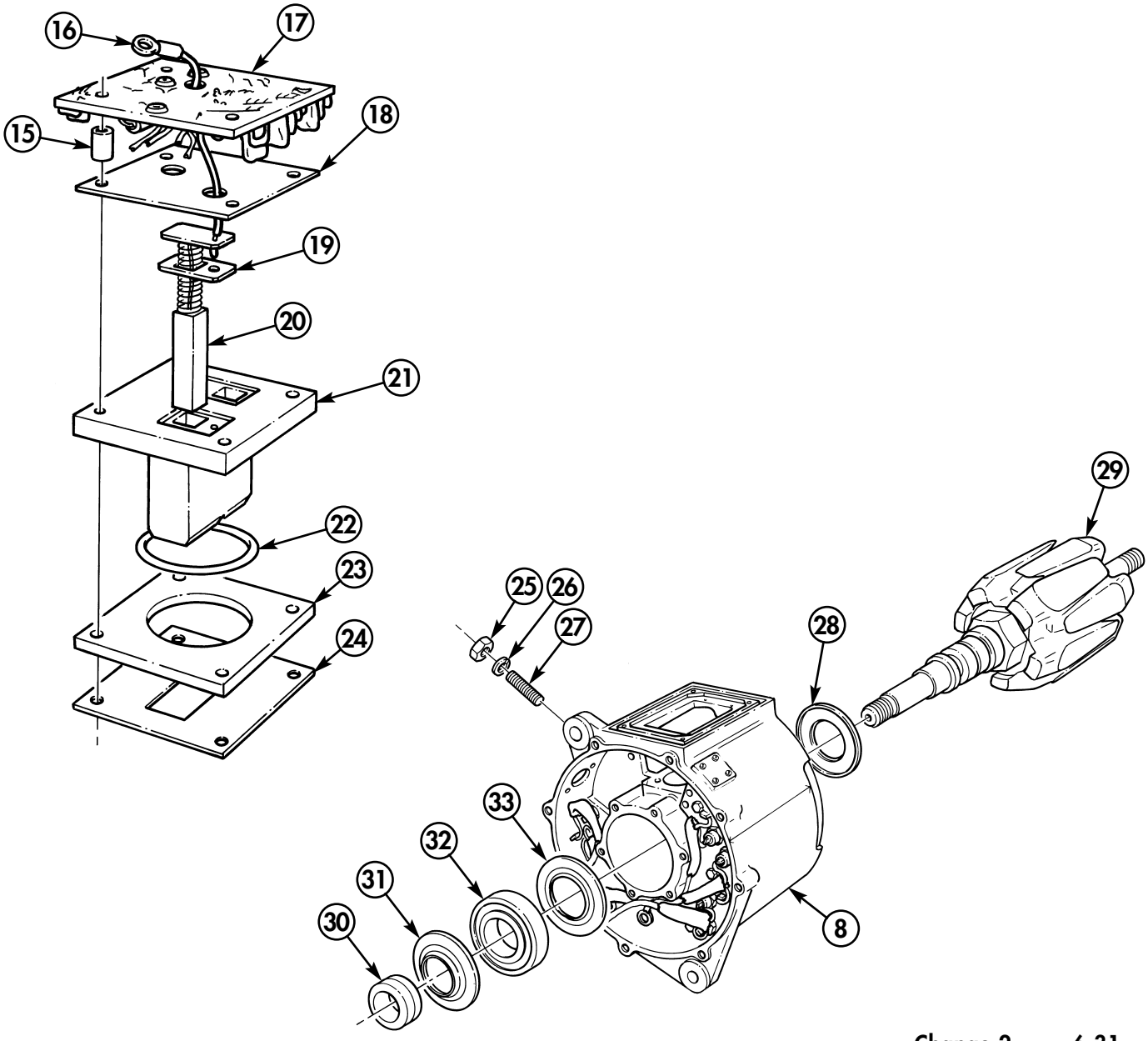
## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)

26. Remove two brush leads (16) from diode trio panel (17) and remove four spacers (15), brush cover (18), two brushes (20), and two electrical brushes (19) from brush holder (21). Remove preformed packing (22), plate (23), and gasket (24) from brush holder (21). Discard preformed packing (22) and gasket (24).
27. Remove two electrical brushes (19) from two brushes (20). Discard electrical brushes (19).

**WARNING**

Always support alternator rotor during removal. Failure to do so may cause personnel injury or equipment damage.

28. Remove rotor (29) and spacer (30) from drive end housing (8).
29. Remove gasket (28) from drive end housing (8). Discard gasket (28).
30. Remove seal (31), bearing (32), and seal (33) from drive end housing (8). Discard seals (31) and (33).
31. Remove nut (25), lockwasher (26), and ground stud (27) from drive end housing (8). Discard lockwasher (26).



## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)

**c. Cleaning**

Clean all alternator components in accordance with paragraph 2-13.

**d. Assembly**

**NOTE**

Perform steps 1 through 13 when assembling the complete alternator.

1. Install ground stud (3) on drive end housing (8) with lockwasher (2) and nut (1).
2. Install gasket (4) in drive end housing (8) with inner lip facing toward stator (6). Apply thin film of grease to lip of gasket (4).
3. Install seal (9) in drive end housing (8) with inner lip facing out from front of drive end housing (8). Apply thin film of grease to lip of seal (9).
4. Install insulator (5) on stator (6).
5. Align scribe marks (7) on stator (6) and drive end housing (8) and install stator (6) in drive end housing (8).
6. Install bearing (11) into drive end housing (8). Ensure at least 0.156 in. (3.96 mm) clearance between bearing (11) and drive end housing (8).

**WARNING**

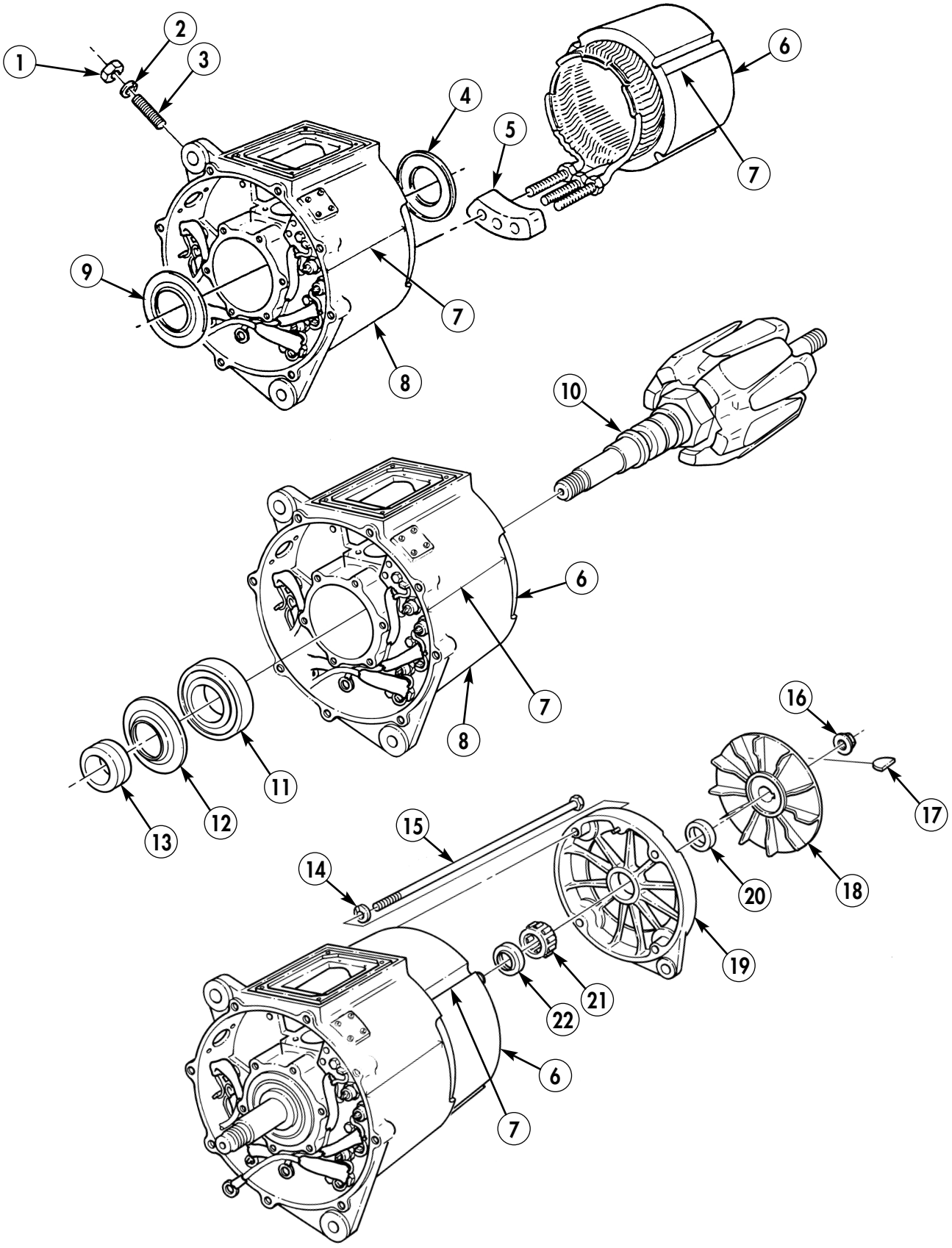
Always support alternator rotor during installation. Failure to do so may cause injury to personnel or equipment damage.

**CAUTION**

When installing rotor shaft use caution not to damage seal.

7. Install rotor (10) into drive end housing (8) until shoulder is against bearing (11).
8. Install seal (20) flush with end housing (19) with lip facing out, away from end housing (19).
9. Install bearing (21) into end housing (19). Install inside seal (22) into end housing (19) with lip facing in, toward stator (6).
10. Align scribe marks (7) on end housing (19) and stator (6) and install end housing (19) on stator (6) with four bolts (15) and lockwashers (14). Tighten bolts (15) to 12-14 lb-ft (16-19 N.m).
11. Install fan (18) and machine key (17) on rotor (10) with locknut (16).
12. Install spacer (13) on rotor (10).
13. Install seal (12) on drive end housing (8) with lip facing out, away from drive end housing (8). Apply thin film of grease to lip of seal (12).

## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)

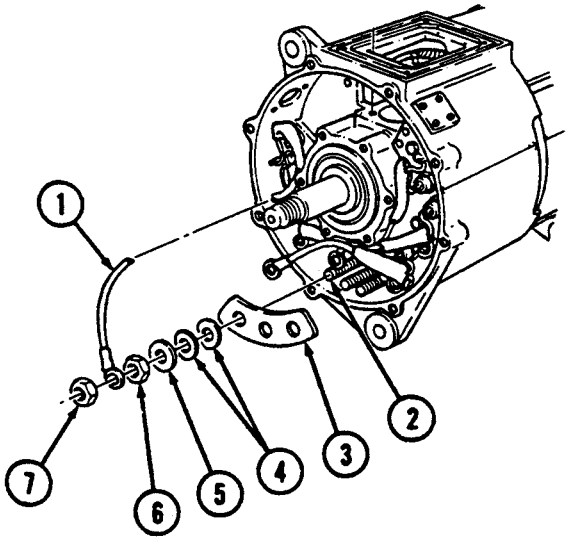


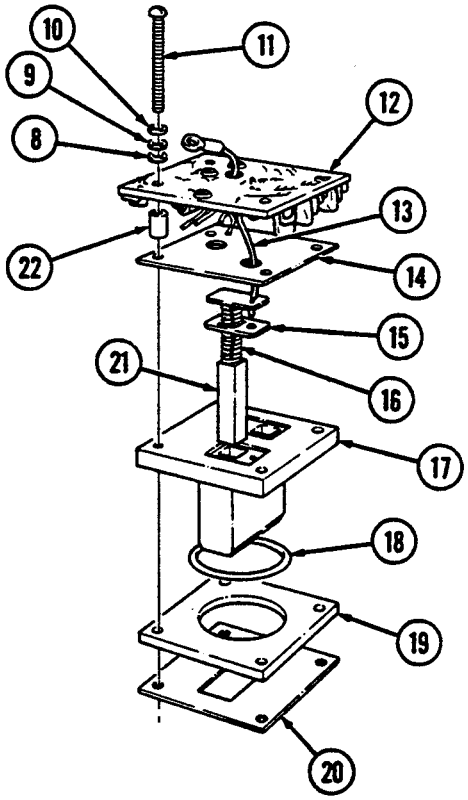
## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)

14. Install insulator (3) over three stator studs (2) with six spring washers (4), three washers (5) and three nuts (6). Tighten nuts (6) to 16-18 lb-ft (22-24 N·m).
15. Install two electrical brushes (15) over two brush springs (16).
16. Install two brush leads (13) through brush cover (14) and diode trio panel (12) and install two brushes (21) into brush holder (17).
17. Connect two brush leads (13), lead 10 (24), lead 8 (27), and lead 11 (28) to diode trio panel (12) with three lockwashers (25) and screws (26).
18. Connect three negative rectifier leads (1) to three stator studs (2) with three nuts (7). Tighten nuts (7) to 12-14 lb-ft (16-19 N·m).
19. Install preformed packing (18), plate (19), and gasket (20) on brush holder (17).
20. Position spacer (22) between diode trio panel (12) and brush cover (14) and retain in place by installing insulation washer (8), washer (9), lockwasher (10), and screw (11) through diode trio panel (12), spacer (22), brush cover (14) and brush holder (17). Repeat step for three remaining spacers (22).

**NOTE**

Leads #1, #2, #3, #4 and #5 should be routed through opening provided into the rectifier cavity of housing. Leads #8, #10 and #11 will be attached to the regulator and should be routed toward the outside of housing.



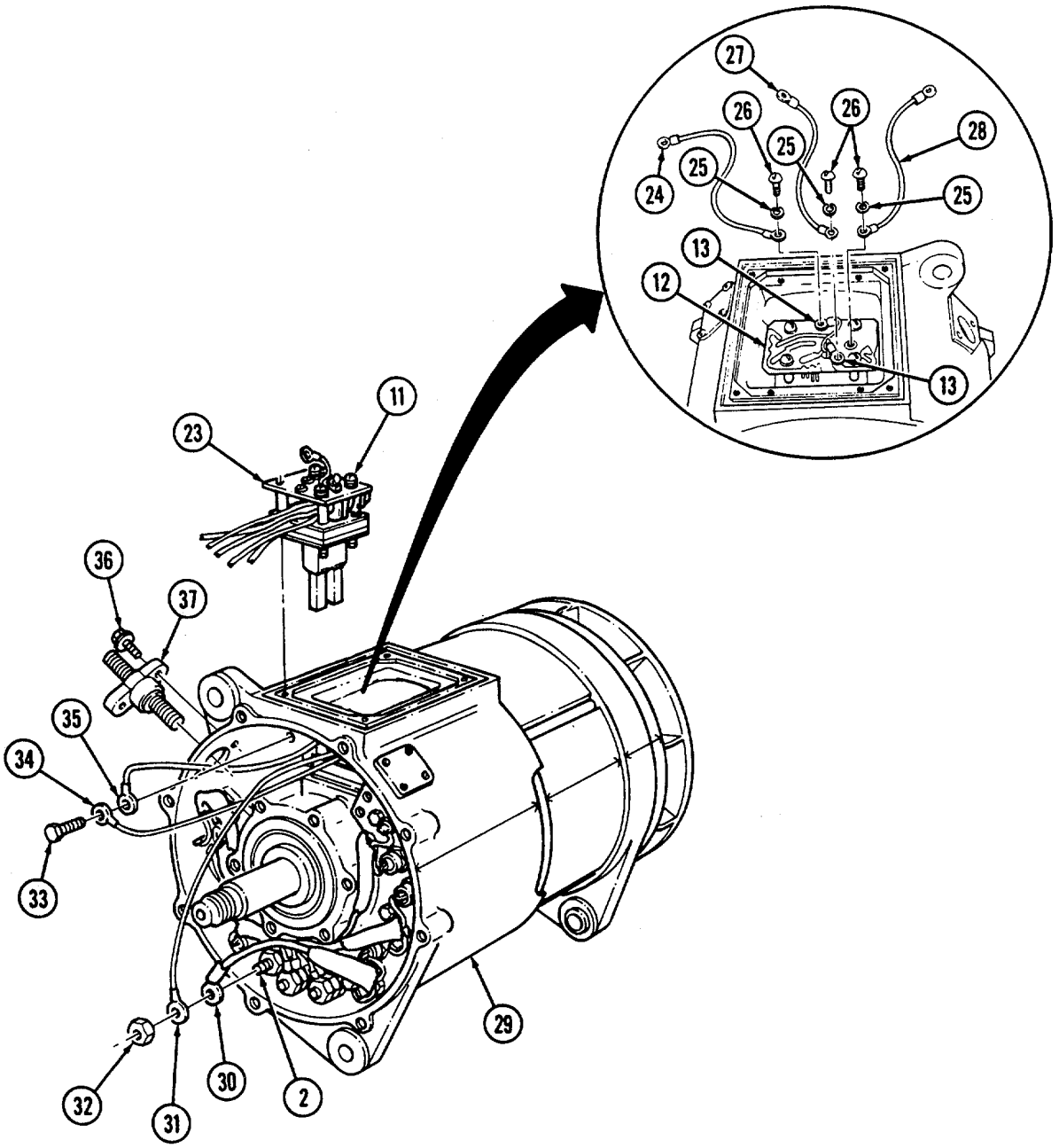
## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)

21. Install diode trio assembly (23) into drive end housing (29) and tighten screws (11).

22. Connect three positive rectifier leads (30) and diode leads (31) to stator studs (2) with nuts (32). Tighten nuts (32) to 12-14 lb-ft (16-19 N·m).

23. Connect lead 6 (34) and lead 1 (35) to drive end housing (29) with capscrew (33). Tighten cap-screw (33) to 8-10 lb-ft (11-14 N·m).

24. Install fuse holder (37) on drive end housing (29) with two screws (36).



**6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)**

25. Install spacer (18) and two positive leads (19) on fuse holder (3) with nut (17).

26. Connect positive lead (19) and lead 4 (14) to inner positive rectifier bridge hole (12) with capscrew (15). Tighten capscrews (15) to 8-10 lb-ft (11-14 N·m).

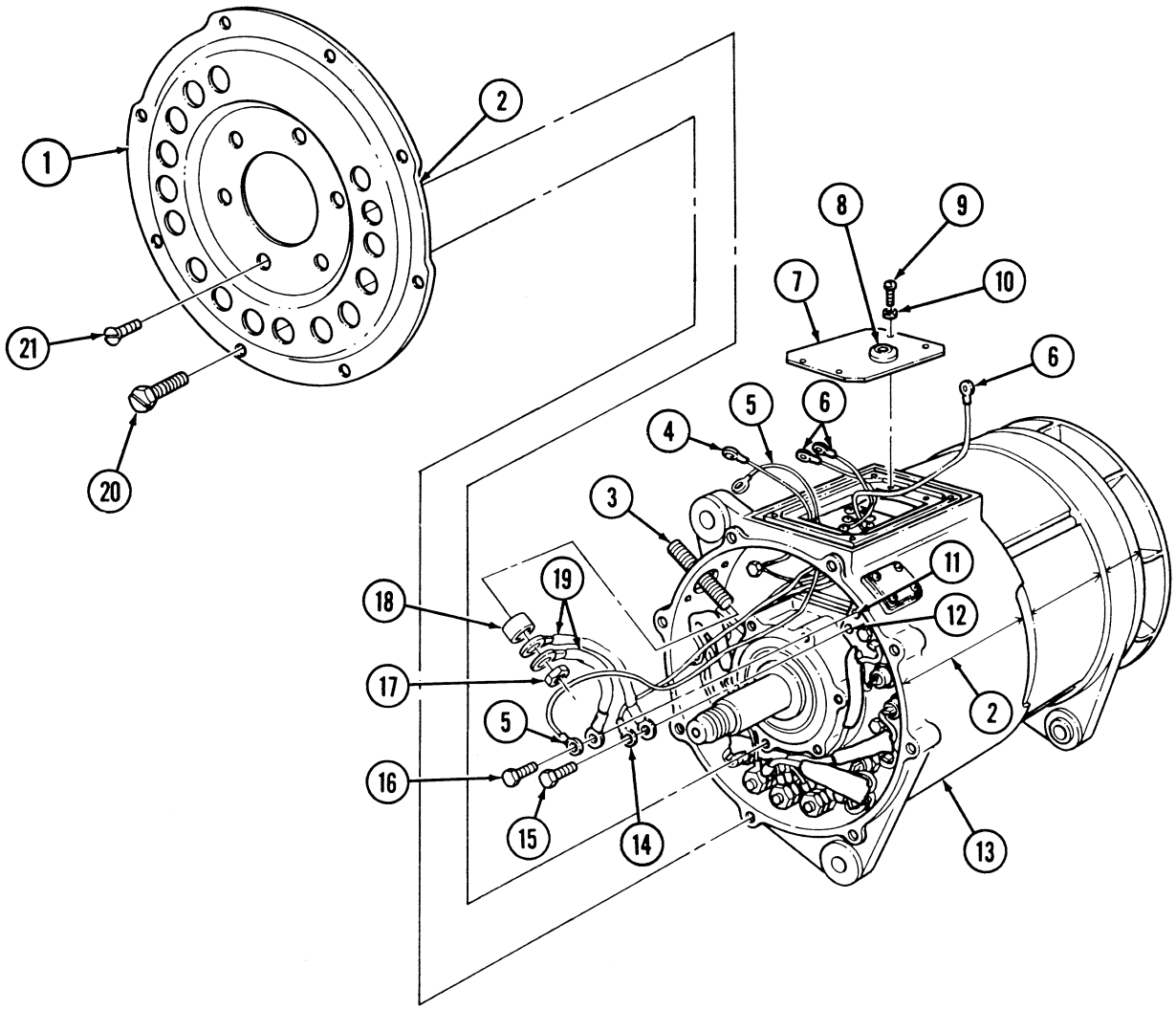
27. Connect positive lead (19) and lead 7 (5) to outer bridge hole (11) with capscrew (16).

28. Route three leads (6), lead 6 (4), and lead 7 (5) through grommet (8) in panel (7).

29. Install panel (7) on drive end housing (13) with four lockwashers (10) and screws (9).

30. Align scribe marks (2) on drive end housing (13) and cover plate (1) and install cover plate (1) on housing (13) with six screws (21) and eight screws (20).

## 6-4. 200 AMPERE ALTERNATOR (A0013036AA) TESTING AND REPAIR (Cont'd)




FOLLOW-ON TASKS:
- Install alternator (TM 9-2320-280-20).
- Install alternator safety guard assembly (TM 9-2320-280-20).
- Install regulator (TM 9-2320-280-20).

# 6-5. 200 AMPERE ALTERNATOR (12338796-1) TESTING AND REPAIR

**This task covers:**

**a. Alternator Output Testing**
**b. Disassembly**
**c. Static Testing**
**d. Cleaning**
**e. Assembly**

## INITIAL SETUP:

**Applicable Models**
M996, M996A1, M997, M997A1, M997A2

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)
Puller (Appendix G, Item 136)

**Test Equipment**
Multimeter (Appendix G, Item 120)
Test stand (Appendix G, Item 94)

**Materials/Parts**
Sealing Compound (Appendix B, Item 57)
Sealant (Appendix B, Item 43)
Locknut (Appendix E, Item 81)
Three lockwashers (Appendix E, Item 111)
Eighteen locknuts (Appendix E, Item 68)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P
TM 9-4910-663-12
TM 9-4910-485-12

**Equipment Condition**
Alternator removed (TM 9-2320-280-20).

**General Safety Instructions**
Always support alternator core and shaft assembly during removal and installation.

**Maintenance Level**
Direct support

### a. Alternator Output Testing

1. Mount pivot arm of 500 amp test stand to high speed side and screw mounting flange adapter to pivot arm. Connect pulley drive shaft to high speed head. Screw pulley drive shaft to mounting flange adapter.
2. Mount alternator to starter/alternator mounting bracket on 500 amp test stand. Connect “V” belt from 500 amp test stand pulley to alternator pulley. Adjust belt tension.
3. Connect cable from alternator ground terminal to 500 amp test stand “G-” terminal. Connect cable from alternator “Bat” terminal to 500 amp test stand “G+” terminal. Connect cable from alternator regulator “IGN” to 500 amp test stand “F” terminal.
4. Make a jumper wire with a ring terminal at both ends. Connect jumper wire on 500 amp test stand from IGN SWITCH terminal to “F-B” terminal.

**NOTE**

Prior to operation of the test stand, make certain that all switches and controls are in the “initial” positions as referenced in: Operator and Maintenance Manual, TM 9-4910-663-12 (UMC Model GSAR-500), or Operator and Maintenance Manual, TM 9-4910-485-12 (Sun Model AGT-99A).

5. Set 500 amp test stand as follows:

| | Model GSAR-500 | Model AGT-99A |
|---|---|---|
| (a) DC ammeter load and starter selector | X10 | 500 amp |
| (b) DC ammeter field and battery charge selector | X1 | 5 amp |
| (c) Field circuit switch | Regulator | Regulator |
| (d) DC voltmeter circuit selector | RECT/GEN | RECT/GEN |

6. Turn 500 amp test stand master power switch and master load switch to “ON” and battery switch to 24V DC. Green lamp on 500 amp test stand must illuminate.

## 6-5. 200 AMPERE ALTERNATOR (12338796-1) TESTING AND REPAIR (Cont'd)

**NOTE**

- When tachometer reaches 3000 rpm, green lamp should go off indicating proper charging from alternator.
- "Normal" voltage range is 26-30 VDC. "High" amperage is ±10% over the rated alternator output of 182 amps (@ 5000 rpm).

7. Perform no-load test. Increase alternator speed to 5000 rpm; record results. Refer to table 6-A.7, No-Load Test, for diagnosis.
8. Perform full-load test. Set all load switches on 500 amp test stand to "ON" and increase alternator speed to 5000 rpm. Set load to 182 amps min.; record results. Refer to table 6-B, Full-Load Test, for diagnosis.

*Table 6-A.7. No-Load Test.*

| AMPS | VOLTS | DIAGNOSIS |
|---|---|---|
| 161-200 | 21-25 | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| 161-200 | 26-30 | Give time to stabilize while monitoring VOLTS. If VOLTS rise above normal range (26-30 volts), regulator and/or tube assembly must be replaced. If AMPS fall, charging systems OK. |
| 161-200 | 31-35 | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to Static Testing. |
| 80-119 | 21-25 | Alternator and/or regulator must be repaired or replaced. Refer to table 6-C. |
| 80-119 | 26-30 | Regulator OK. Refer to table 6-B. |
| 80-119 | 31-35 | STOP TEST. Bench malfunction or wiring error. |

*Table 6-B. Full-Load Test.*

| AMPS | VOLTS | DIAGNOSIS |
|---|---|---|
| 161-200 | 21-25 | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| 161-200 | 26-30 | Charging system OK. |
| 161-200 | 31-35 | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to Static Testing. |
| 80-119 | 21-25 | Alternator and/or regulator must be replaced. Refer to table 6-C. |
| 80-119 | 26-30 | Increase load. |
| 80-119 | 31-35 | STOP TEST. Test bench malfunction or wiring error. |

## 6-5. 200 AMPERE ALTERNATOR (12338796-1) TESTING AND REPAIR (Cont'd)

9. Regulator Bypass Test.

**NOTE**

Perform this test only when instructed from tables 6-A.7 and 6-B.

(a) Prepare alternator as in full load test.

**NOTE**

Use jumper wire rated for 15 amps.

(b) Disconnect alternator connector from regulator. With alternator spinning, use jumper wire and short pin A of connector to ground momentarily. Record results.

(c) Amperage should rise within ± 10% of rated output with jumper wire connected and fall with jumper disconnected. Refer to Table 6-C, Regulator Bypass Test, for diagnosis.

10. Turn test stand master power switch and load switch to OFF.
11. Disconnect jumper wires from terminals on test stand and alternator.
12. Remove "V" belt from test stand pulley and alternator pulley. Remove alternator from test stand.

*Table 6-C. Regulator Bypass Test.*

| CONNECT | DISCONNECT | DIAGNOSIS |
|---|---|---|
| AMPS RISE | AMPS FALL | Alternator OK. See note. Replace regulator only if low AMPS (80-119)/low VOLTS (21-25) are indicated in table 6-A.7 and/or table 6-B. |
| NO CHANGE | NO CHANGE | Alternator must be repaired. Refer to Static Testing. |

**b. Disassembly**

**NOTE**

Complete alternator disassembly is not required for static testing.

1. Remove voltage regulator (TM 9-2320-280-20).

1.1. Install core and shaft assembly (11) in soft-jawed vise and remove locknut (6), washer (5), and fan (4) from core and shaft assembly (11). Discard locknut (6).

2. Remove bearing bushing (3) from core and shaft assembly (11).
3. Remove three screws (20), lockwashers (21), and plate cover (19) from front housing (17). Discard lockwashers (21).
4. Scribe alignment marks on front housing (17), stator (9), and end housing (2).
5. Remove nine locknuts (7) from end housing (2) and stator (9). Discard locknuts (7).
6. Use puller to remove end housing (2) from stator (9).
7. Remove six nuts (1) from rear rotor (24) on core and shaft assembly (11).
8. Use three 10-32 x 2-in. long machine screws as jacks in threaded holes on end plate of rear rotor (24). Gradually tighten screws to remove rear rotor (24) from core and shaft assembly (11). Remove rear rotor (24) and screws.

**NOTE**

Prior to removal, tag leads for installation.

9. Remove eight nuts (18) and disconnect two field and six phase leads (8) from diodes in front housing (17).
10. Remove nine locknuts (22) from front housing (17) and stator (9). Discard locknuts (22).
11. Remove front housing (17) from stator (9) by tapping lightly with a soft-faced mallet.

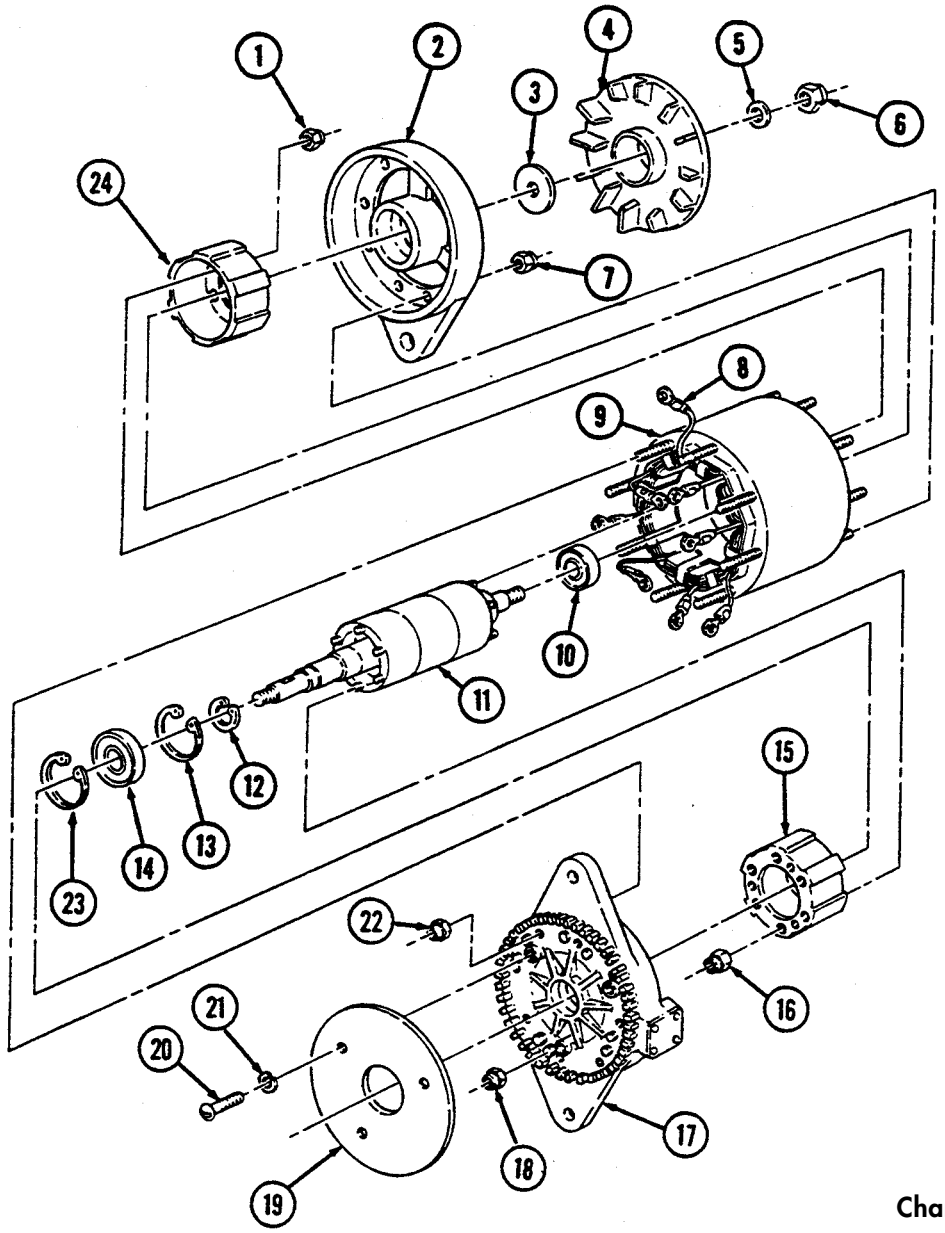
## 6-5. 200 AMPERE ALTERNATOR (12338796-1) TESTING AND REPAIR (Cont'd)

12. Remove shaft retaining ring (12) from core and shaft assembly (11).

**WARNING**

Always support alternator core and shaft assembly during removal. Failure to do so may cause injury to personnel or equipment damage.

13. Use press to remove core and shaft assembly (11) from front bearing (14) and front housing (17).
14. Remove front (23) and rear (13) retaining rings from front housing (17).
15. Use press to remove front bearing (14) from front housing (17).
16. Remove six nuts (16) from front rotor (15) and core and shaft assembly (11).
17. Use three 10-32 X 2-in. long machine screws as jacks in threaded holes on end plate of front rotor (15). Gradually tighten screws to remove front rotor (15) from core and shaft assembly (11). Remove front rotor (15) and screws.
18. Use press to remove rear bearing (10) from core and shaft assembly (11).



## 6-5. 200 AMPERE ALTERNATOR (12338796-1) TESTING AND REPAIR (Cont'd)

**c. Static Testing**

**NOTE**

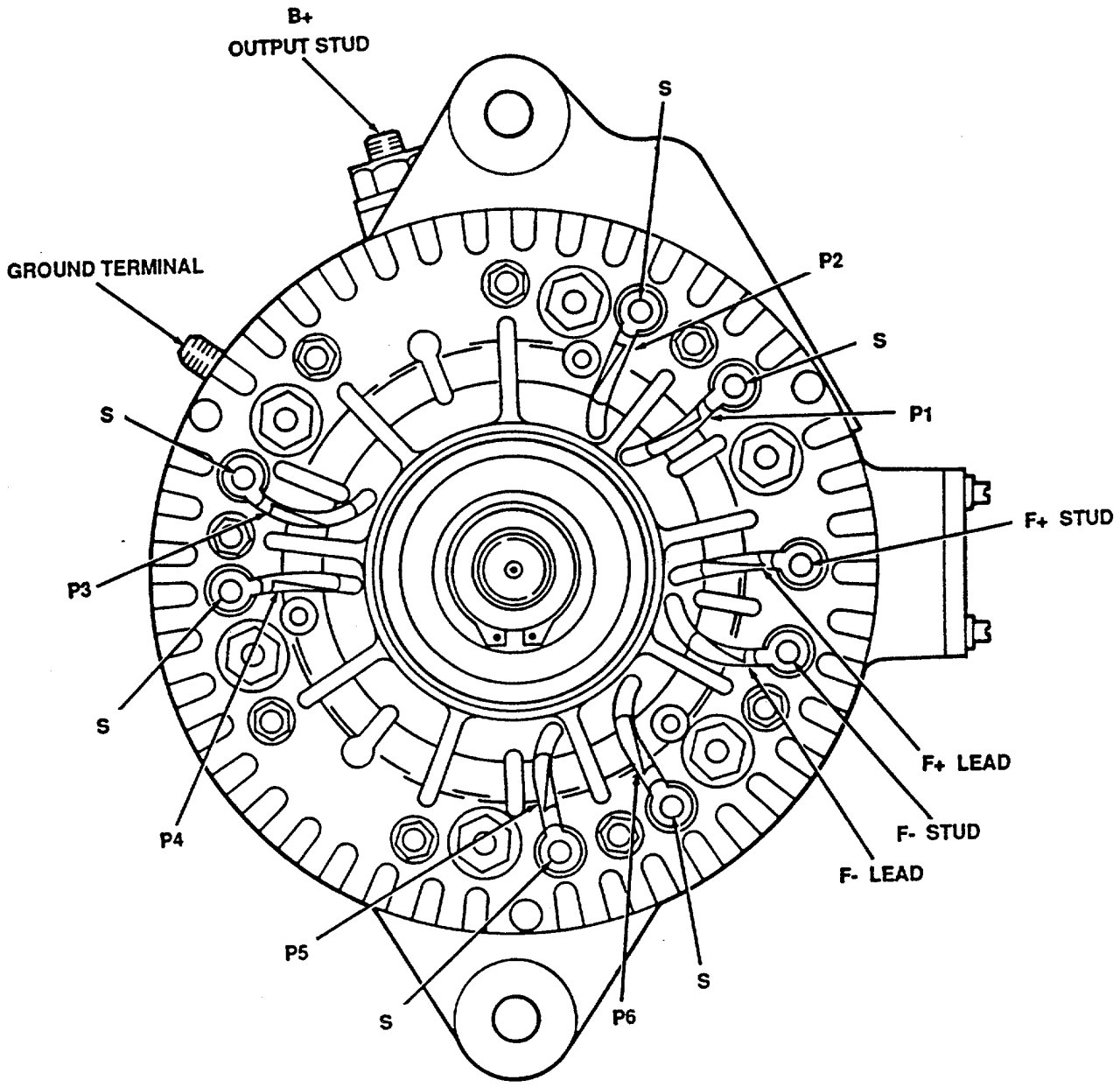
Refer to disassembly for component removal, if necessary.

1. Perform Stator Test.
   (a) Remove six nuts and phase leads from diodes in front housing.
   (b) Set ohmmeter to XI scale and zero ohmmeter.
   (c) Connect ohmmeter leads between each successive pair of stator phase leads “P1” - “P2”, “P2” - “P3”, and “P1” - “P3”. Ohmmeter should read less than 1 ohm. If ohmmeter reads infinity (»), the stator is open, replace alternator.
   (d) Set ohmmeter to X10 scale and zero ohmmeter.
   (e) Connect ohmmeter leads between each phase lead, “P1”, “P2”, and “P3” and the ground terminal on outside of front housing. Ohmmeter should read infinity (»). If ohmmeter reads zero the stator is grounded, replace alternator.
   (f) Repeat step (e) to check phase lead “P4”, “P5”, and “P6”.
2. Perform Field Coil Test.
   (a) Remove two nuts and field coil leads (F+, F-) from diodes in front housing.
   (b) Set ohmmeter to XI scale and zero ohmmeter.
   (c) Connect ohmmeter leads to the two field leads and measure the resistance. Ohmmeter should read less than 3 ohms. If ohmmeter reads more than 3 ohms, the field coil is open, replace alternator.
   (d) Set ohmmeter to X10K scale and zero ohmmeter.
   (e) Connect one ohmmeter lead to a field lead and the other to the ground stud on the front housing. Ohmmeter should read infinity (»). If ohmmeter reads less than 100K ohms, the field coil is grounded, replace alternator.
3. Perform Positive Diode Test.
   (a) Set ohmmeter to X100 scale and zero ohmmeter.
   (b) Connect one ohmmeter lead to the “B+” output stud and the other lead to each of the six diode terminals “S”. Ohmmeter should read nearly alike for all six, either less than 600 ohms or infinity (»). Reverse ohmmeter leads, ohmmeter should read nearly alike for all six but opposite the first set of readings. If readings are not opposite, the diode rectifier assembly is BAD, replace alternator.
4. Perform Negative Diode Test.
   (a) Set ohmmeter to X100 scale and zero ohmmeter.
   (b) Connect one ohmmeter lead to the ground terminal and the other lead to each of the six diode terminals “S”. Ohmmeter should read nearly alike for all six, either less than 600 ohms or infinity (»). Reverse ohmmeter leads, ohmmeter should read nearly alike for all six but opposite the first set of readings. If readings are not opposite, the diode rectifier assembly is BAD, replace alternator.

**d. Cleaning**

Clean all alternator components in accordance with paragraph 2-13.

## 6-5. 200 AMPERE ALTERNATOR (12338796-1) TESTING AND REPAIR (Cont'd)



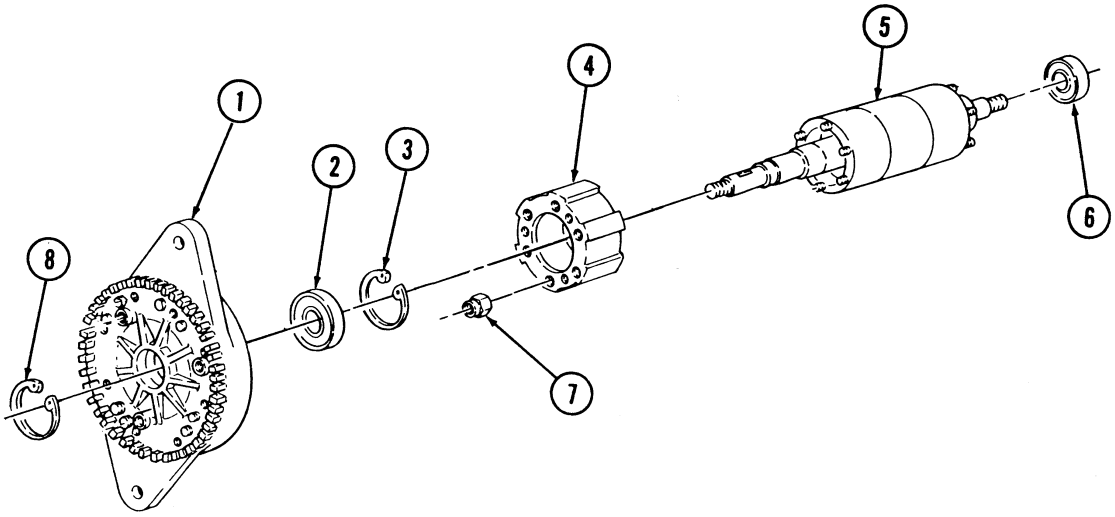
## 6-5. 200 AMPERE ALTERNATOR (12338796-1) TESTING AND REPAIR (Cont'd)

**e. Assembly**

**WARNING**

Always support alternator core and shaft assembly during installation. Failure to do so may cause injury to personnel or equipment damage.

1. Use press to install rear bearing (6) on core and shaft assembly (5).
2. Install front rotor (4) on core and shaft assembly (5).
3. Apply sealing compound to studs on core and shaft assembly (5).
4. Center core and shaft assembly (5) studs in the center of slots on front rotor (4) with six nuts (7). Tighten nuts (7) to 45 lb-in. (5 N•m).
5. Coat outer race of front bearing (2) with a thin coat of sealing compound.
6. Use press to install front bearing (2) in front housing (1).
7. Install front (8) and rear (3) retaining rings on front housing (1).




**WARNING**

Always support alternator core and shaft assembly during installation. Failure to do so may cause injury to personnel or equipment damage.

8. Use press to install front bearing (2) and housing assembly (1) on core and shaft assembly (5).
9. Install shaft retaining ring (18) on core and shaft assembly (5).
10. Insert core and shaft assembly (5) and front housing (1) into stator shell (16).

**NOTE**

Align scribe marks on front housing and stator shell.

11. Feed leads (15) from stator shell (16) through front housing (1).
12. Apply sealing compound to studs on stator shell (16).
13. Install front housing (1) on stator shell (16) with nine locknuts (22). Tighten locknuts (22) to 18 lb-in. (2 N•m).
14. Install six phase leads and two field leads (15) on diodes on front housing (1) with eight nuts (17).
15. Apply thin coat of sealant on leads (15) and diodes on front housing (1).
16. Install rear rotor (23) on core and shaft assembly (5).

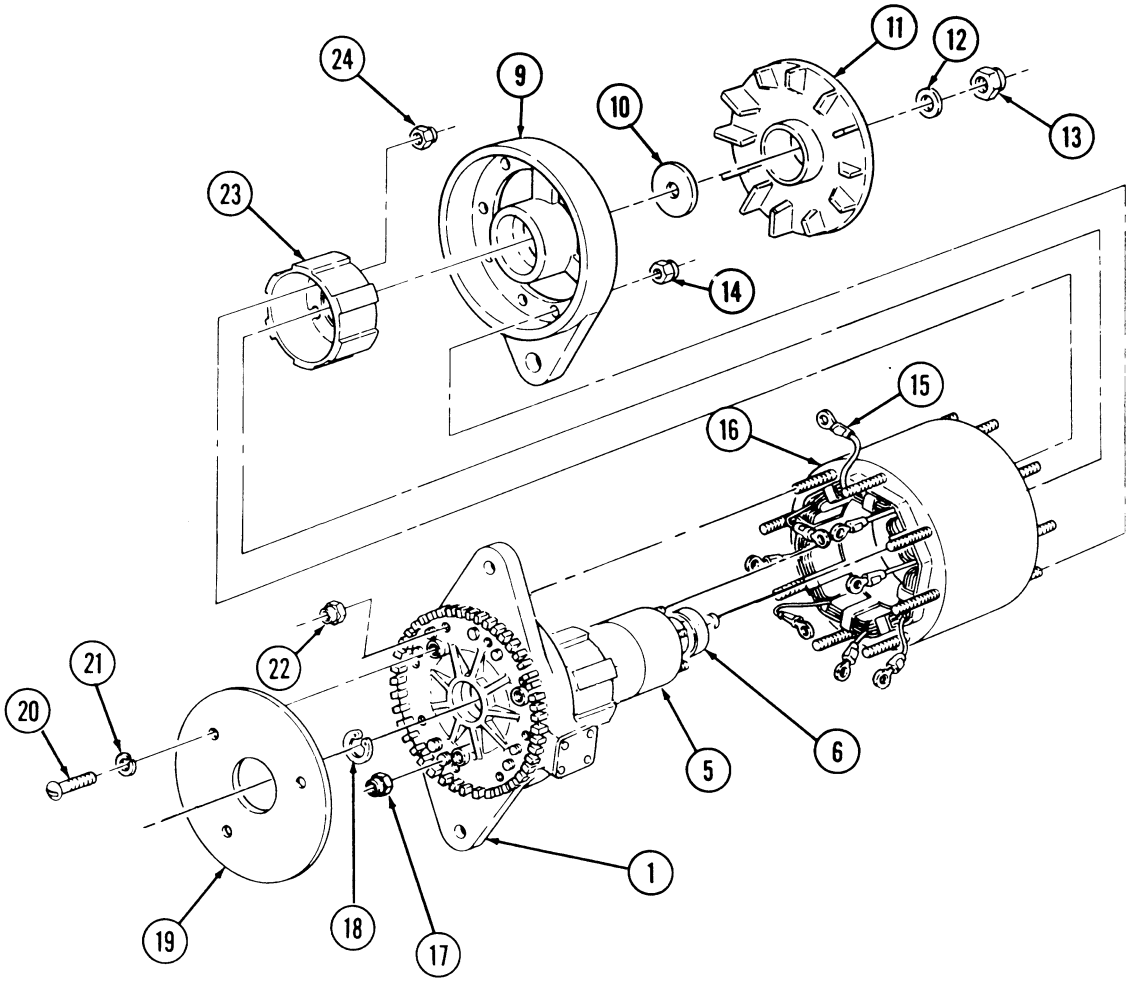
## 6-5. 200 AMPERE ALTERNATOR (12338796-1) TESTING AND REPAIR (Cont'd)

17. Apply sealing compound to studs on core and shaft assembly (5).
18. Center core and shaft assembly studs in the center of slots on rear rotor (23) with six nuts (24). Tighten nuts (24) to 45 lb-in. (5 N•m).

**NOTE**

Align scribe marks on end housing and stator.

19. Install end housing (9) on core and shaft assembly (5) and rear bearing (6). Tap lightly with a soft-faced mallet.
20. Apply sealing compound to studs on stator (16).
21. Install end housing (9) on stator shell (16) with nine locknuts (14). Tighten locknuts (14) to 18 lb-in. (2 N•m).
22. Install cover plate (19) on front housing (1) with three lockwashers (21) and screws (20).
23. Install bearing bushing (10) on core and shaft assembly (5).
24. Install fan (11) on core and shaft assembly (5) with washer (12) and locknut (13).
25. Install core and shaft assembly (5) on soft-jawed vise and tighten locknut (13) to 50 lb-ft (68 N•m).




FOLLOW-ON TASKS:
- Install voltage regulator (TM 9-2320-280-20).
- Install alternator on vehicle (TM 9-2320-280-20).

# 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR

**This task covers:**

**a. Alternator Output Testing**
**b. Disassembly**
**c. Static Testing**
**d. Cleaning**
**e. Assembly**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)
Puller (Appendix G, Item 136)

**Test Equipment**

Multimeter (Appendix G, Item 120)
Test stand (Appendix G, Item 94)

**Materials/Parts**

Silicone compound (Appendix B, Item 57)
RTV sealant (Appendix B, Item 43)
Locknut (Appendix E, Item 81)
Three lockwashers (Appendix E, Item 111)
Eighteen locknuts (Appendix E, Item 68)

**Personnel Required**

One mechanic
One assistant

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P
TM 9-4910-663-12
TM 9-4910-485-12

**Equipment Condition**

Alternator removed (TM 9-2320-280-20).

**General Safety Instructions**

Always support alternator core and shaft assembly during removal and installation.

**Maintenance Level**

Direct support

## a. Alternator Output Testing

1. Mount pivot arm of test stand to high-speed side and install mounting flange adapter on pivot arm. Connect pulley driveshaft to high-speed head. Install pulley driveshaft on mounting flange adapter.
2. Mount alternator to starter/alternator mounting bracket on 500 amp test stand. Connect belt from test stand pulley to alternator pulley. Adjust belt tension.
3. Connect cable from alternator ground terminal to test stand G- terminal. Connect cable from alternator battery terminal to test stand G+ terminal. Connect cable from alternator regulator IGN to test stand F terminal.
4. Connect 28 VDC output and 14 VDC output to test stand. Auxiliary voltage and current meters may be required to measure 14 VDC output.
5. Fabricate a jumper wire with a ring terminal at both ends. Connect jumper wire on test stand from IGNITION SWITCH terminal to F-B terminal.

## 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)

**CAUTION**

Ensure auxiliary measuring equipment is properly grounded to test stand. Failure to do so may lead to erroneous readings or damage to equipment.

**NOTE**

Prior to operation of test stand, ensure all switches and controls are in "initial" positions as referenced in Operator and Maintenance Manual, TM 9-4910-663-12 (UMC Model GSAR-500), or Operator and Maintenance Manual, TM 9-4910-485-12 (Sun Model AGT-9/9A).

6. Set test stand as follows:

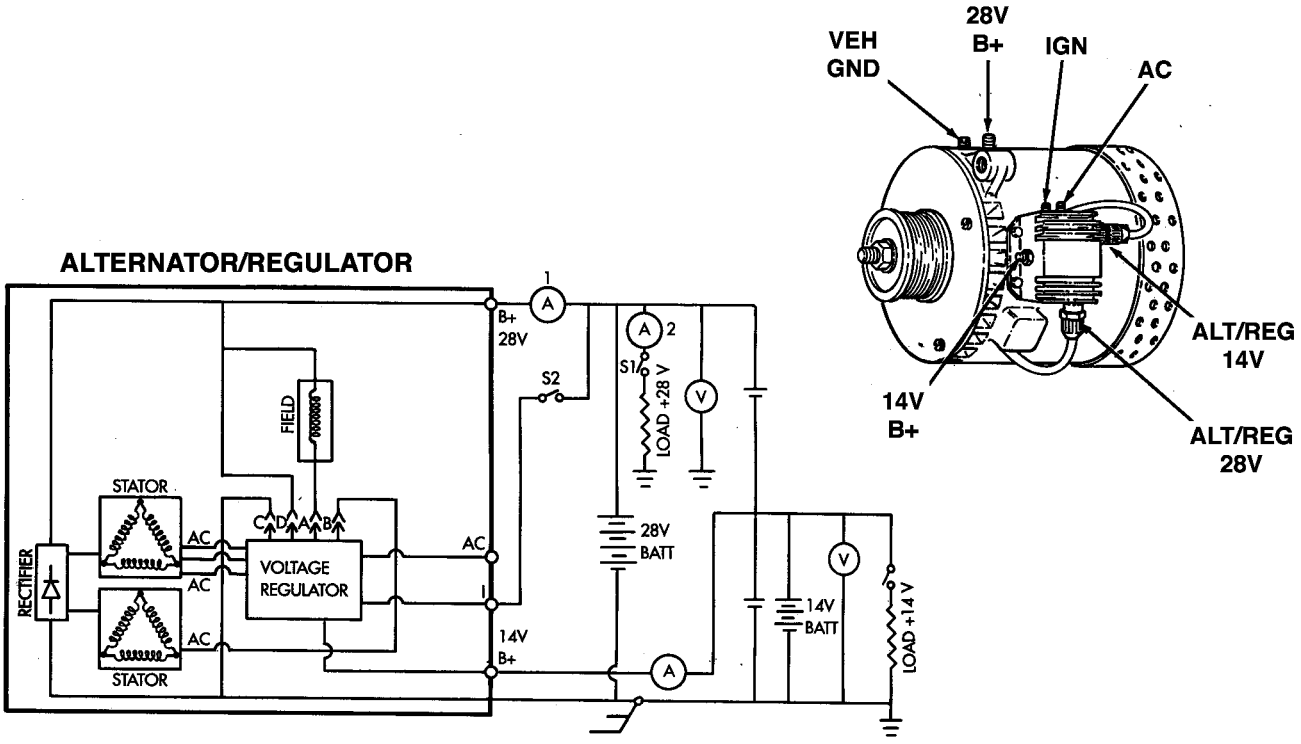
| | Model GSAR-500 | Model AGT-9/9A |
|---|---|---|
| (a) DC ammeter load and starter selector | X10 | 500 amp |
| (b) DC ammeter field and battery charge selector | X1 | 5 amp |
| (c) Field circuit switch | Regulator | Regulator |
| (d) DC voltmeter circuit selector | RECT/GEN | RECT/GEN |

(e) Connect DC voltmeter (0-50 VDC) from point between regulator 14 VDC output and load in 14-volt circuit (or 14 volt battery).

(f) Connect ammeter (0-75 ADC) in load line from 14 V regulator to 14 V load.

7. Turn test stand master power switch and master load switch to ON, and turn battery switch to 24 VDC. Green lamp on test stand must illuminate.

8. Perform No-Load Test. Set test stand battery circuit selector to 24 VDC, IGN switch to ON, and start varidrive. Observing DC voltmeter output voltage and tachometer rpm, increase speed until tachometer reads 5000 rpm. Record voltmeter reading and refer to table 6-D, No-Load Test, for diagnosis.



## 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)

**NOTE**

- When tachometer reaches 3000 rpm, green lamp should go off, indicating proper charging from alternator.
- Normal voltage range is 26-30 VDC. High amperage is +10 percent over the rated alternator output of 162 amps at 5000 rpm.

9. Perform full-load test. Ensure all load switches are in ON position on 500 amp test stand, and increase alternator speed to 5000 rpm. Set load to 81 amps/min; record results. Refer to table 6-E, Full-Load Test, for diagnosis.
10. For alternator speed and current output tracking values, refer to table 6-F.
11. Perform regulator bypass test. Prepare alternator as in full-load test.

*Table 6-D. No-Load Test.*

| AMPS | 28VDC | 14VDC | DIAGNOSIS |
|---|---|---|---|
| 162-200 | 21-25 | 10.5-12.5 | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| 162-200 | 26-30 | 13-15 | Give time to stabilize while monitoring VOLTS. If VOLTS rise above normal range (26-30 volts), regulator and/or tube assembly must be replaced. If AMPS fall, charging system is OK. |
| 162-200 | 31-35 | 15.5-17.5 | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to static testing, task c. |
| 80-118 | 21-25 | 10.5-12.5 | Alternator and/or regulator must be repaired or replaced. Refer to table 6-F. |
| 80-118 | 26-30 | 13-15 | Regulator OK. Refer to table 6-E. |
| 80-118 | 31-35 | 15.5-17.5 | STOP TEST. Test bench malfunction or wiring error. |

*Table 6-E. Full-Load Test.*

| AMPS | 28VDC | 14VDC | DIAGNOSIS |
|---|---|---|---|
| 162-200 | 21-25 | 10.5-12.5 | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| 162-200 | 26-30 | 13-15 | Charging system OK. |
| 162-200 | 31-35 | 15.5-17.5 | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to static testing, task c. |
| 80-118 | 21-25 | 10.5-12.5 | Alternator and/or regulator must be replaced. Refer to table 6-G. |
| 80-118 | 26-30 | 13-15 | Increase load. |
| 80-118 | 31-35 | 15.5-17.5 | STOP TEST. Test bench malfunction or wiring error. |

## 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)

*Table 6-F. Alternator Speed and Current Tracking.*

| ALTERNATOR SPEED (RPM) | 28 VDC OUTPUT CURRENT ±5 AMP | 14 VDC OUTPUT CURRENT MINIMUM AMP |
|---|---|---|
| 1,200 | *0 | 26 |
| | 4 | 33 |
| | 20 | 17 |
| | 30 | 7 |
| | **37 | 0 |
| 1,500 | *6 | 40 |
| | 50 | 40 |
| | 60 | 30 |
| | 74 | 16 |
| | **90 | 0 |
| 2,000 | *0 | 20 |
| | 8 | 40 |
| | 90 | 42 |
| | 105 | 27 |
| 2000 | 120 | 12 |
| | 132 | 0 |
| 3000 | 8 | 23 |
| | 110 | 50 |
| | 130 | 30 |
| | 150 | 10 |
| | 160 | 8q |
| 5000 to 8000 | *0 | 8 |
| | 8 | 10 |
| | 140 | 40 |
| | 165 | 25 |
| | 180 | 10 |
| | 190 | 0 |

*Dependent on ammeter location in test circuit.
**Minimum acceptable current with no load on 28 VDC system.

11. Perform regulator bypass test. Prepare alternator as in full-load test.

**NOTE**

- Perform this test only when instructed from tables 6-D and 6-E.
- Use jumper wire rated for 15 amps.

12. Disconnect alternator connector from regulator. With alternator spinning, use jumper wire and short pin A to ground momentarily. Record results.
13. Amperage should rise within ± 10 percent of rated value with jumper wire connected, and fall with jumper disconnected. Refer to table 6-G for diagnosis.
14. Turn test stand master power switch and load switch to OFF.
15. Disconnect jumper wires from terminals on test stand and alternator.
16. Remove belt from test stand pulley and alternator pulley. Remove alternator from test stand.

*Table 6-G. Regulator Bypass Test.*

| CONNECT | DISCONNECT | DIAGNOSIS |
|---|---|---|
| AMPS RISE | AMPS FALL | Alternator OK. See note. Replace regulator only if low AMPS (40-59)/low VOLTS (21-25) are indicated in table 6-D and/or table 6-E. |
| NO CHANGE | NO CHANGE | Alternator must be repaired. Refer to static testing, task c. |

## 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)

**b. Disassembly**

**NOTE**

Complete alternator disassembly is not required for static testing.

1. Remove voltage regulator and alternator pulley (TM 9-2320-280-20).
2. Remove locknut (6), washer (5), fan (4), and bearing bushing (3) from core and shaft assembly (11). Discard locknut (6).
3. Remove three screws (21), lockwashers (22), and plate cover (20) from front housing (17). Discard lockwashers (22).
4. Scribe alignment marks on front housing (17), stator (9), and end housing (2).
5. Remove nine locknuts (7) from end housing (2) and studs of stator (9). Discard locknuts (7).
6. Using puller, remove end housing (2) from stator (9).
7. Remove six nuts (1) from rear rotor (24) and studs of core and shaft assembly (11).
8. Using three 10-32 x 2-in. long machine screws as jacks in threaded holes on end plate of rear rotor (24), gradually tighten screws and remove rear rotor (24) from core and shaft assembly (11). Remove machine screws.

**NOTE**

Prior to removal, tag leads for installation.

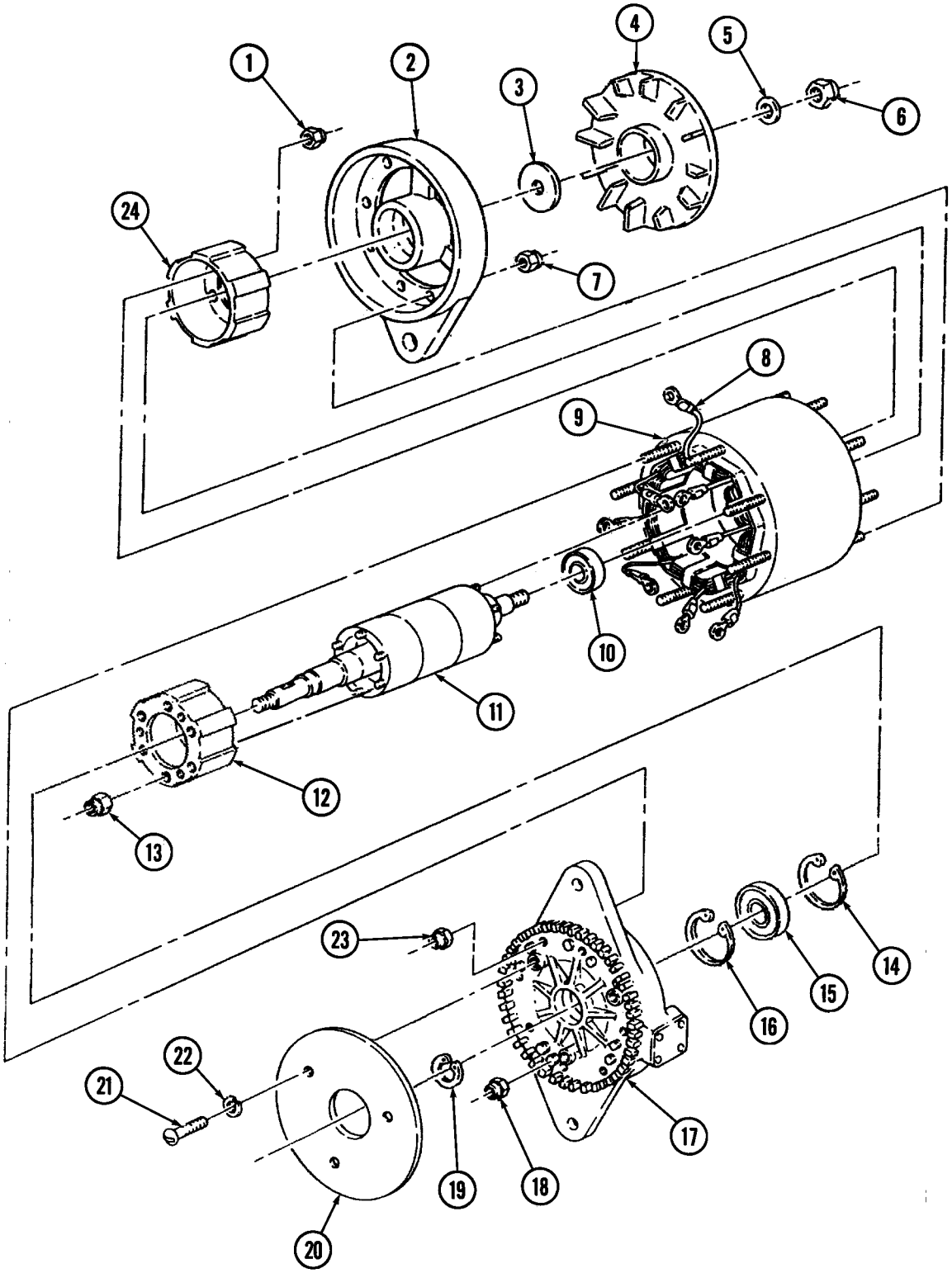
9. Remove eight nuts (18) and disconnect two field and six phase leads (8) from diodes in front housing (17).
10. Remove nine locknuts (23) from front housing (17) and studs of stator (9). Discard locknuts (23).
11. Remove shaft retaining ring (19) from core and shaft assembly (11).
12. Remove front housing (17) from stator (9) by tapping lightly with a soft-faced mallet.

**WARNING**

Always support alternator core and shaft assembly during removal. Failure to do so may cause injury to personnel or equipment damage.

13. Using press, remove core and shaft assembly (11) from front bearing (15) and front housing (17).
14. Remove front (16) and rear (14) retaining rings from front housing (17).
15. Using press, remove front bearing (15) from front housing (17).
16. Remove six nuts (13) from front rotor (12) and studs of core and shaft assembly (11).
17. Using three 10-32 x 2-in. long machine screws as jacks in threaded holes on end plate of front rotor (12), gradually tighten screws and remove front rotor (12) from core and shaft assembly (11). Remove machine screws.
18. Using press, remove rear bearing (10) from core and shaft assembly (11).

## 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)



## 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)

### c. Static Testing

**NOTE**

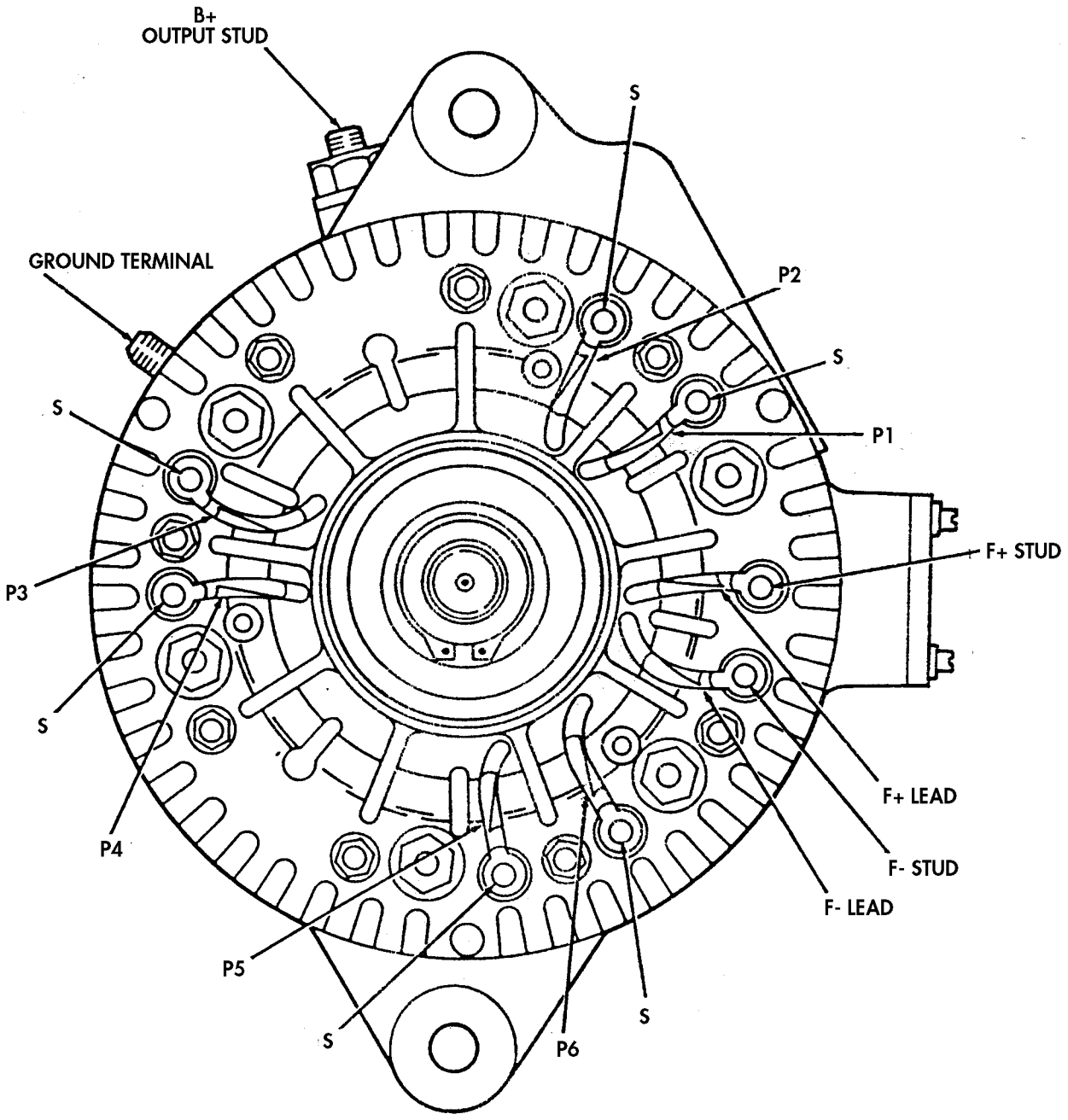
Refer to disassembly for component removal, if necessary.

1. Perform Stator Test:
   (a) Remove six nuts and phase leads from diodes in front housing.
   (b) Set multimeter to XI scale and zero multimeter.
   (c) Connect multimeter leads between each successive pair of stator phase leads P1-P2, P2-P3, and P1-P3. Multimeter should read less than 1 ohm. If multimeter reads infinity (∞), the stator is open; replace alternator.
   (d) Set multimeter to X10 scale and zero multimeter.
   (e) Connect multimeter leads between each phase lead, P1, P2, and P3 and the ground terminal on outside of front housing. Multimeter should read infinity (∞). If multimeter reads zero, the stator is grounded; replace alternator.
   (f) Repeat step (e) to check phase leads P4, P5, and P6.
2. Perform Field Coil Test:
   (a) Remove two nuts and field coil leads (F+, F-) from diodes in front housing.
   (b) Set multimeter to XI scale and zero multimeter.
   (c) Connect multimeter leads to the two field leads and measure the resistance. Multimeter should read less than 3 ohms. If multimeter reads more than 3 ohms, the field coil is open; replace alternator.
   (d) Set multimeter to X10K scale and zero multimeter.
   (e) Connect one multimeter lead to a field lead and the other to the ground stud on front housing. Multimeter should read infinity (∞). If multimeter reads less than 100K ohms, the field coil is grounded. Replace alternator.
3. Perform Positive Diode Test:
   (a) Set multimeter to X100 scale and zero multimeter.
   (b) Connect one ohmmeter lead to the B+ output stud and the other lead to each of the six diode terminals S. Multimeter should read either less than 600 ohms or infinity (∞) for all six diode terminals. Reverse multimeter leads. Multimeter should read nearly alike for all six, but opposite the first set of readings. If readings are not opposite, the diode rectifier assembly is open. Replace alternator.
4. Perform Negative Diode Test:
   (a) Set multimeter to X100 scale and zero multimeter.
   (b) Connect one multimeter lead to the ground terminal and the other lead to each of the six diode terminals S. Multimeter should read either less than 600 ohms or infinity (∞) for all six diode terminals. Reverse multimeter leads. Multimeter should read nearly alike for all six, but opposite the first set of readings. If readings are not opposite, the diode rectifier assembly is open. Replace alternator.

### d. Cleaning

Clean all alternator components in accordance with para. 2-13.

## 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)



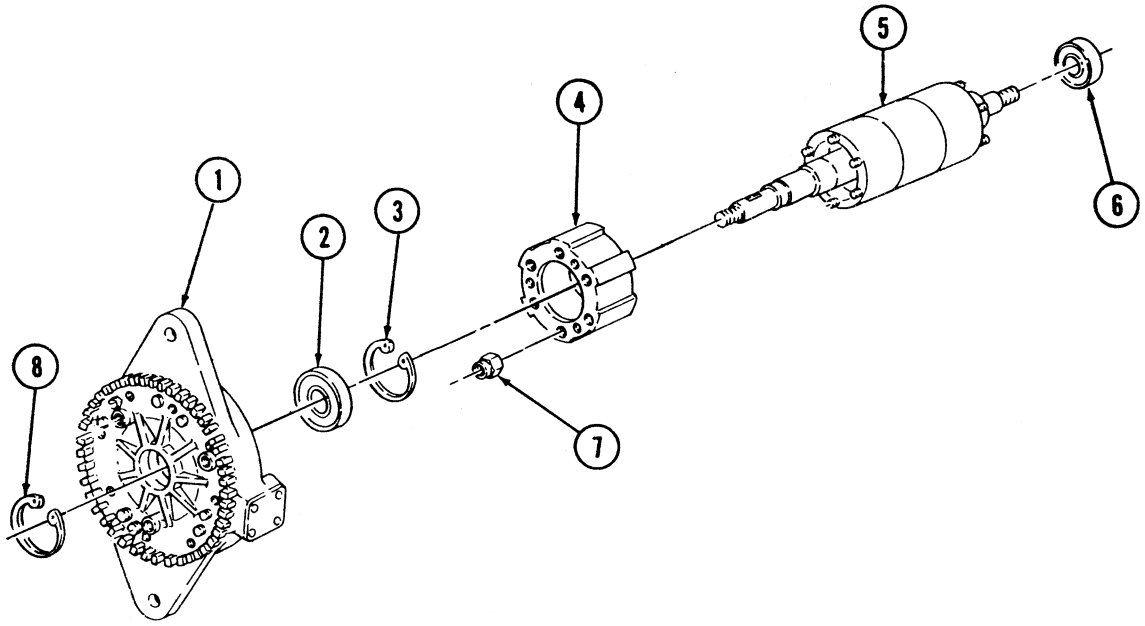
## 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)

**e. Assembly**

**WARNING**

Always support alternator core and shaft assembly during installation. Failure to do so may cause injury to personnel or equipment damage.

1. Using press, install rear bearing (6) on core and shaft assembly (5).
2. Position front rotor (4) on core and shaft assembly (5).
3. Apply silicone compound to studs of core and shaft assembly (5).
4. Install core and shaft assembly (5) on front rotor (4) with six nuts (7). Tighten nuts (7) to 45 lb-in. (5 N•m).
5. Coat outer race of front bearing (2) with a thin coat of silicone compound.
6. Using press, install front bearing (2) on front housing (1).




7. Install front retaining ring (8) and rear retaining ring (3) on front housing (1).
8. Using press, install front bearing (2) with housing (1) on core and shaft assembly (5).
9. Install shaft retaining ring (19) on core and shaft assembly (5).
10. Insert core and shaft assembly (5) and front housing (1) into stator (15).

**NOTE**

Align scribe marks on front housing and stator.

11. Feed leads (17) from stator shell (15) through front housing (1).
12. Apply silicone compound to studs (16) on stator (15).
13. Install front housing (1) on stator (15) with nine locknuts (23). Tighten locknuts (23) to 18 lb-in. (2 N•m).
14. Install six phase leads and two field leads (17) on diodes on front housing (1) with eight nuts (18).
15. Apply thin coat of RTV sealant on leads (17) and diodes on front housing (1).

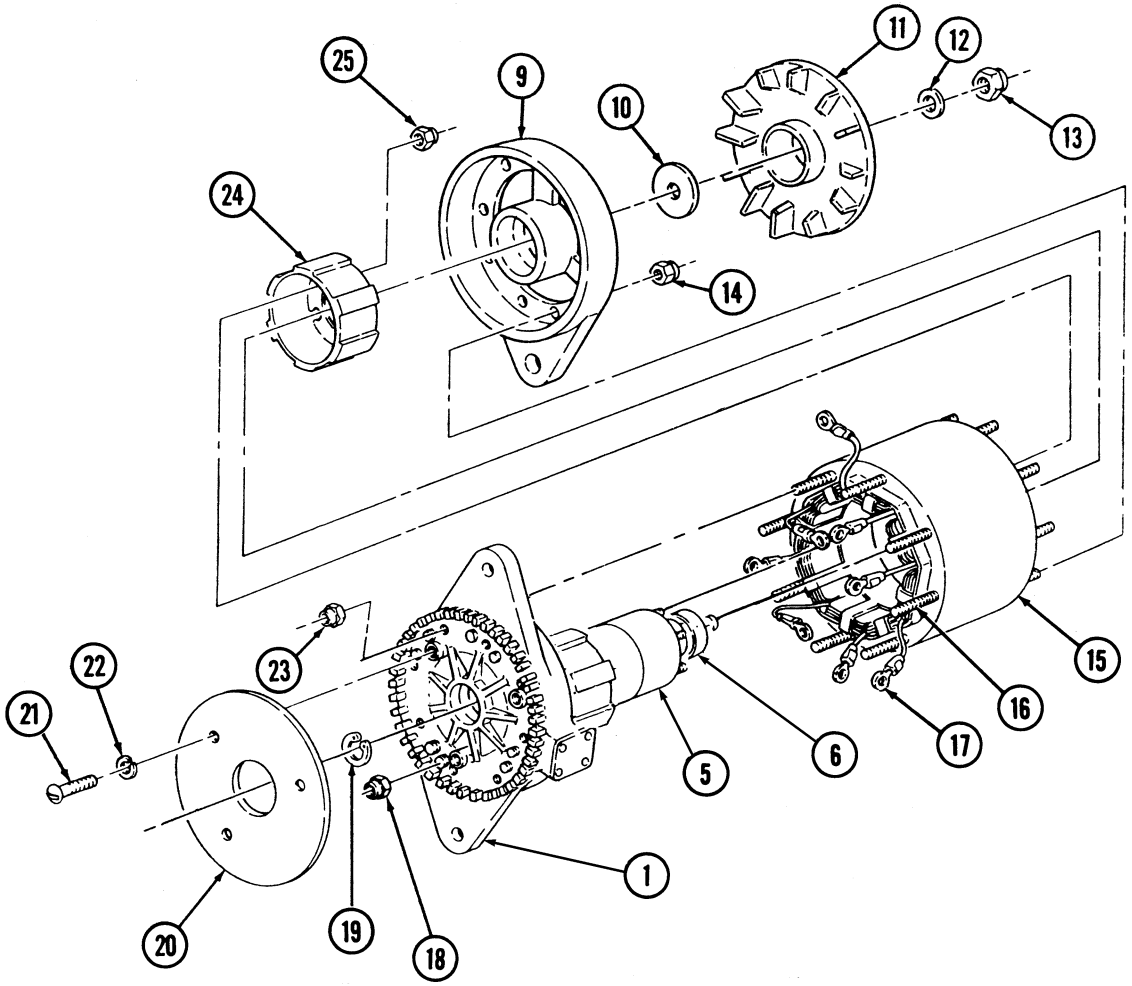
## 6-5.1. 200 AMPERE DUAL VOLTAGE ALTERNATOR (12447109) TESTING AND REPAIR (Cont'd)

16. Position rear rotor (24) on core and shaft assembly (5).
17. Apply silicone compound to studs on core and shaft assembly (5).
18. Install core and shaft assembly (5) on rear rotor (24) with six nuts (25). Tighten nuts (25) to 45 lb-in. (5 N•m).

**NOTE**

Align scribe marks on end housing and stator.

19. Apply silicone compound to studs (16) on stator (15).
20. Install end housing (9) on core and shaft assembly (5) and rear bearing (6). Tap lightly with a soft-faced mallet.
21. Install end housing (9) on stator shell (15) with nine locknuts (14). Tighten locknuts (14) to 18 lb-in. (2 N•m).
22. Install cover plate (20) on front housing (1) with three lockwashers (22) and screws (21).
23. Install bearing bushing (10) on core and shaft assembly (5).
24. Install fan (11) on core and shaft assembly (5) with washer (12) and locknut (13). Do not tighten locknut (13).
25. Install core and shaft assembly (5) on soft-jawed vise and tighten locknut (13) to 50 lb-in. (68 N•m).




FOLLOW-ON TASKS:
- Install alternator pulley (TM 9-2320-280-20).
- Install voltage regulator (TM 9-2320-280-20).
- Install alternator (TM 9-2320-280-20).

# 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR

**This task covers:**

**a. Alternator Output Testing**
**b. Disassembly**
**c. Static Testing**
**d. Cleaning**
**e. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M996, M996A1, M997, M997A1, M997A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)
Puller (Appendix G, Item 136)

**Test Equipment**
Multimeter (Appendix G, Item 120)
Test stand (Appendix G, Item 94)

**Materials/Parts**
RTV sealant (Appendix B, Item 43)
Silicone compound (Appendix B, Item 57)
Locknut (Appendix E, Item 70)
Locknut (Appendix E, Item 67)
Eighteen locknuts (Appendix E, Item 69)
Twelve locknuts (Appendix E, Item 68)
Twelve lockwashers (Appendix E, Item 111)
Two spring tension washers (Appendix E, Item 264)
Two seals (Appendix E, Item 203)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P
TM 9-4910-663-12
TM 9-4910-485-12

**Equipment Condition**
Alternator removed (TM 9-2320-280-20).

**General Safety Instructions**
Always support alternator core and shaft assembly during removal and installation.

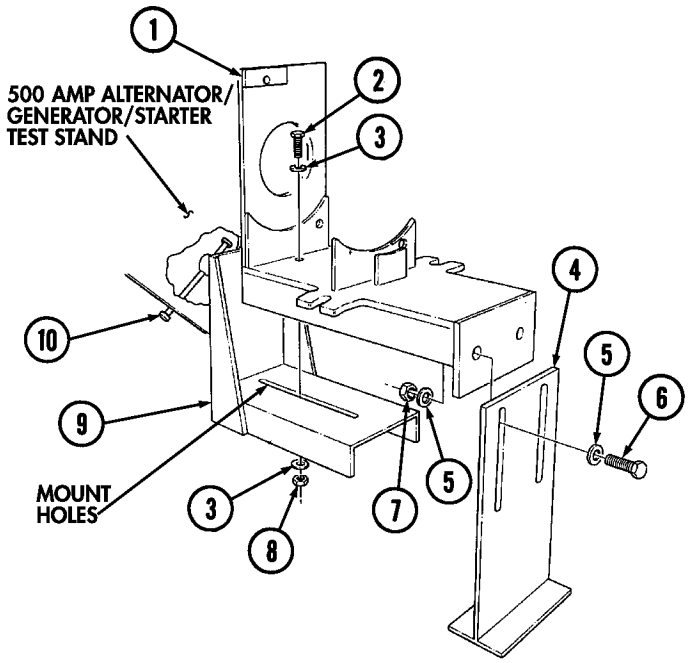
**Maintenance Level**
Direct support

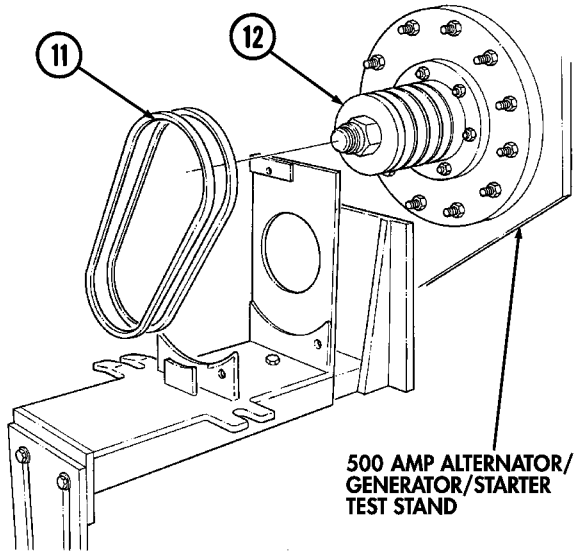
## a. Alternator Output Testing

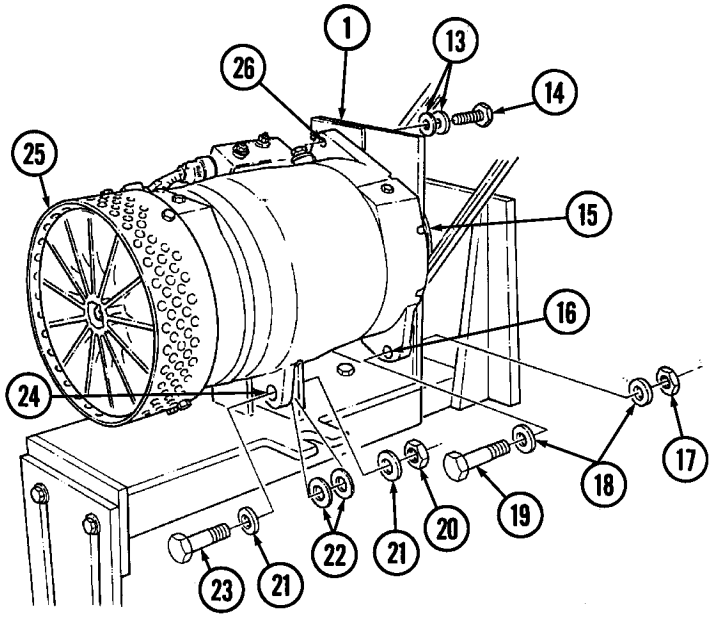
1. Mount 500-amp test stand pivot arm to high-speed side and install mounting flange adapter on pivot arm. Connect pulley driveshaft to high-speed head. Install pulley driveshaft on mounting flange adapter.
2. Position adapter mount (1) to bracket (9) on test stand.
3. Install adapter mount (1) on bracket (9) with washer (3), screw (2), washer (3), and nut (8). Do not tighten screw (2).
4. Loosen locking handle (10) on bracket (9), raise bracket (9) to highest point, and tighten locking handle (10).
5. Install support plate (4) on adapter mount (1) with two washers (5), screws (6), washers (5), and nuts (7). Do not tighten nuts (7).
6. Install two V-belts (11) on driver pulley (12) on alternator/generator/starter test stand.
7. Position alternator (25) on adapter mount (1) and install two V-belts (11) on pulley (15).
8. Position two washers (22) between rear lower mount (24) on alternator (25) and adapter mount (1), and install washer (21), screw (23), washer (21), and nut (20). Do not tighten nut (20).
9. Align front lower mount holes (16) on alternator (25) and adapter mount (1) and install washer (18), screw (19), washer (18), and nut (17). Do not tighten nut (17).
10. Align top mount hole (26) on alternator (25) and adapter mount (1) and install two washers (13) and screw (14).
11. Tighten nuts (20) and (17) to 40 lb-ft (54 N•m).

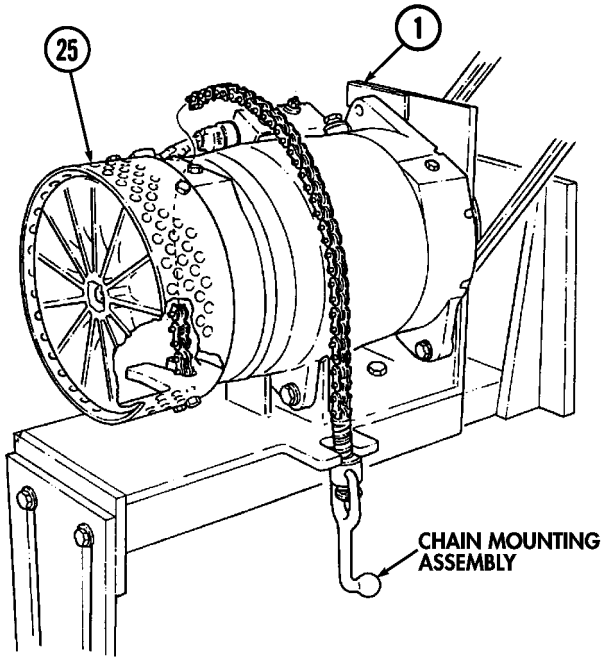
## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)

12. Position chain mounting assembly over alternator (25) and secure to adapter mount (1).
13. Loosen locking handle (10) on bracket (9), lower bracket (9) to obtain tension on V-belts (11), and tighten locking handle (10).
14. Adjust support plate (4) on adapter mount (1) until support plate (4) contacts floor surface and tighten screws (2) and (6) and nuts (7) and (8).





## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)

**NOTE**

- Ensure a jumper cable is attached to both alternator ground points when attaching cables from test stand G- terminals.
- Ensure a jumper cable is attached to both alternator 28V B+ terminals when attaching cables from test stand G+ terminals.

15. Connect cables from both alternator ground terminals to test stand G- terminal.
16. Connect cables from both alternator positive terminals to test stand G+ terminal.
17. Connect cable from alternator regulator IGN to test stand F terminal.
18. Connect 28 VDC output and 14 VDC output to test stand.

**NOTE**

Auxiliary voltage and current meters may be required to measure 14 VDC output.

19. Fabricate a jumper wire with a ring terminal at both ends. Connect test stand wire from IGNITION SWITCH terminal to F-B terminal.

**CAUTION**

Ensure auxiliary measuring equipment is properly grounded to test stand. Failure to do so may lead to erroneous readings or damage to equipment.

**NOTE**

Prior to operation of test stand, ensure all switches and controls are in "initial" positions as referenced in Operator and Maintenance Manual, TM 9-4910-663-12 (UMC Model GSAR-500), or Operator and Maintenance Manual, TM 9-4910-485-12 (Sun Model AGT-9/9A).

20. Set test stand as follows:

| | Model GSAR-500 | Model AGT-9/9A |
|---|---|---|
| (a) DC ammeter load and starter selector | X10 | 500 amp |
| (b) DC ammeter field and battery charge selector | X1 | 5 amp |
| (c) Field circuit switch | Regulator | Regulator |
| (d) DC voltmeter circuit selector | RECT/GEN | RECT/GEN |

(e) Connect DC voltmeter (0-50 VDC) from point between regulator 14 VDC output and load in 14 volt circuit (or 14 volt battery).

(f) Connect ammeter (0-75 ADC) in load line from 14 V regulator to 14 V load.

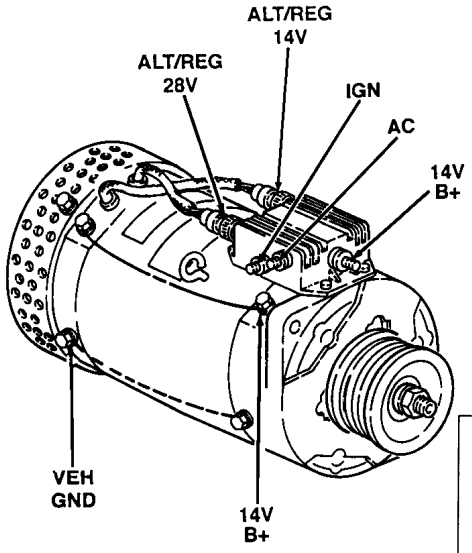
21. Turn test stand master power switch and master load switch to ON, and turn battery switch to 24 VDC. Green lamp on test stand must illuminate.
22. Perform no-load test. Set test stand battery circuit selector to 24 VDC, IGN switch to ON, and start varidrive. Observing the DC voltmeter output voltage and tachometer rpm, increase speed until tachometer reads 5000 rpm. Record voltmeter reading and refer to table 6-H, No-Load Test, for diagnosis.

**NOTE**

- When tachometer reaches 3000 rpm, green lamp should go off indicating proper charging from alternator.
- Normal voltage range is 26-30 VDC. High amperage is +10 percent over the rated alternator output of 364 amps at 5000 rpm.

23. Perform no-load test. Increase alternator speed to 5000 rpm; record results. Refer to table 6-H, No-Load Test, for diagnosis.

## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)



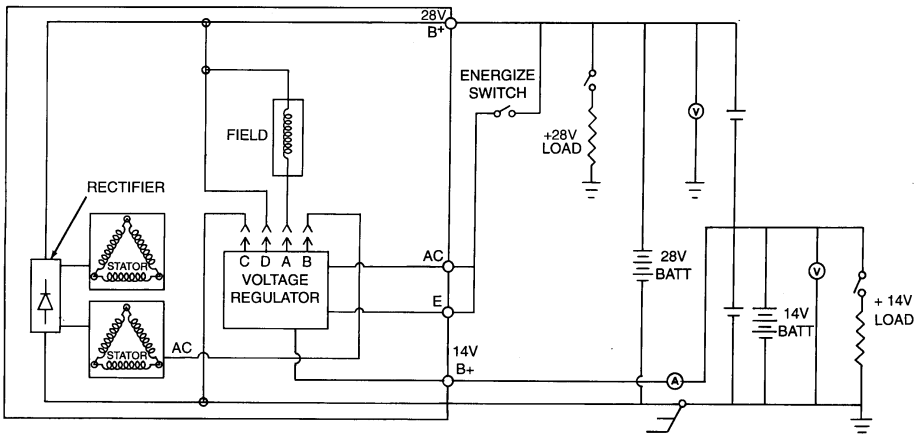




*Table 6-H. No-Load Test.*

| AMPS | 28VDC | 14VDC | DIAGNOSIS |
|---|---|---|---|
| 322-400 | 21-25 | 10.5-12.5 | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| 322-400 | 26-30 | 13-15 | Give time to stabilize while monitoring VOLTS. If VOLTS rise above normal range (26-30 volts), regulator and/or tube assembly must be replaced. If AMPS fall, charging system is OK. |
| 322-400 | 31-35 | 15.5-17.5 | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to static testing, task c. |
| 160-238 | 21-25 | 10.5-12.5 | Alternator and/or regulator must be repaired or replaced. Refer to table 6-K. |
| 160-238 | 26-30 | 13-15 | Regulator OK. Refer to table 6-I. |
| 160-238 | 31-35 | 15.5-17.5 | STOP TEST. Bench malfunction or wiring error. |

## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)

24. Perform full-load test. Ensure all load switches are in ON position on test stand, and increase alternator speed to 5000 rpm. Set load to 364 amps/min; record results. Refer to table 6-I, Full-Load Test, for diagnosis.
25. Alternator speed and current output tracking values. Refer to table 6-J.

*Table 6-I. Full-Load Test.*

| AMPS | 28VDC | 14VDC | DIAGNOSIS |
|---|---|---|---|
| 322-400 | 21-25 | 10.5-12.5 | Test bench battery is discharged (or defective). Allow to charge (or replace). |
| 322-400 | 26-30 | 13-15 | Charging system OK. |
| 322-400 | 31-35 | 15.5-17.5 | STOP TEST. Regulator and/or tube assembly must be replaced. Refer to static testing, task c. |
| 160-238 | 21-25 | 10.5-12.5 | Alternator and/or regulator must be replaced. Refer to table 6-K. |
| 160-238 | 26-30 | 13-15 | Increase load. |
| 160-238 | 31-35 | 15.5-17.5 | STOP TEST. Test bench malfunction or wiring error. |

*Table 6-J. Alternator Speed and Current Tracking.*

| ALTERNATOR SPEED (RPM) | 28VDC OUTPUT CURRENT ±5 AMP | 14VDC OUTPUT CURRENT MINIMUM AMP | ALTERNATOR SPEED (RPM) | 28VDC OUTPUT CURRENT ±5 AMP | 14VDC OUTPUT CURRENT MINIMUM AMP |
|---|---|---|---|---|---|
| 1200 | *3 | 45 | 2000 | 255 | 50 |
| | 10 | 38 | | 275 | 30 |
| | 20 | 28 | | **302 | 3 |
| | 30 | 18 | 3500 | *5 | 10 |
| | **44 | 4 | | 70 | 20 |
| 1500 | *5 | 20 | | 200 | 50 |
| | 10 | 30 | | 350 | 50 |
| | 50 | 50 | | 380 | 20 |
| | 100 | 50 | | **397 | 3 |
| | 140 | 50 | 5000 TO 8000 | *5 | 10 |
| | 160 | 30 | | 70 | 20 |
| | *187 | 3 | | 200 | 25 |
| 2000 | *5 | 16 | | 350 | 40 |
| | 60 | 30 | | 380 | 20 |
| | 97 | 50 | | **397 | 3 |
| | 120 | 50 | | | |

* Dependent on ammeter location in test circuit.
**Minimum acceptable current with no load on 28 VDC system.

## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)

24. Perform full-load test. Ensure all load switches are in ON position on test stand, and increase alternator speed to 5000 rpm. Set load to 364 amps/min; record results. Refer to table 6-I, Full-Load Test, for diagnosis.
25. Alternator speed and current output tracking values. Refer to table 6-J.
26. Perform regulator bypass test. Prepare alternator as in full-load test.

**NOTE**

- Perform this test only when instructed from tables 6-H and 6-I.
- Use jumper wire rated for 15 amps.

*Table 6-K. Regulator Bypass Test.*

| CONNECT | DISCONNECT | DIAGNOSIS |
|---|---|---|
| AMPS RISE | AMPS FALL | Alternator OK. Replace regulator only if low AMPS (160-238)/low VOLTS (21-25) are indicated in table 6-H and/or table 6-I. |
| NO CHANGE | NO CHANGE | Alternator must be repaired. Refer to static testing, task c. |

27. Disconnect alternator connector from regulator. With alternator spinning, use jumper wire and short pin A to ground momentarily. Record results.
28. Amperage should rise within ±10 percent of rated value with jumper wire connected, and fall with jumper disconnected. Refer to table 6-K, Regulator Bypass Test, for diagnosis.
29. Turn test stand master power switch and load switch to OFF.
30. Disconnect jumper wires from terminals on test stand and alternator.
31. Remove belt from test stand pulley and alternator pulley. Remove alternator from test stand.

## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)

**b. Disassembly**

**NOTE**

Complete disassembly is not required for static testing.

1. Disconnect two cannon plugs (2) from voltage regulator (39).
2. Remove three screws (37), two spring tension washers (38), three washers (40), and voltage regulator (39) from front housing (27). Discard spring tension washers (38).
3. Remove locknut (31), washer (32), pulley (30), and pulley bushing (33) from core and shaft assembly (24). Discard locknut (31).
4. Remove four screws (8), washers (9), and fan guard (10) from stator (20).
5. Remove locknut (11), washer (12), fan (13), and spring ring (14) from core and shaft assembly (24). Discard locknut (11).
6. Scribe alignment marks on front housing (27), stator (20), and end housing (1).
7. Remove six screws (7), lockwashers (6), and plate cover (15) from end housing (1). Discard lockwashers (6).

**NOTE**

Prior to removal, tag leads for installation.

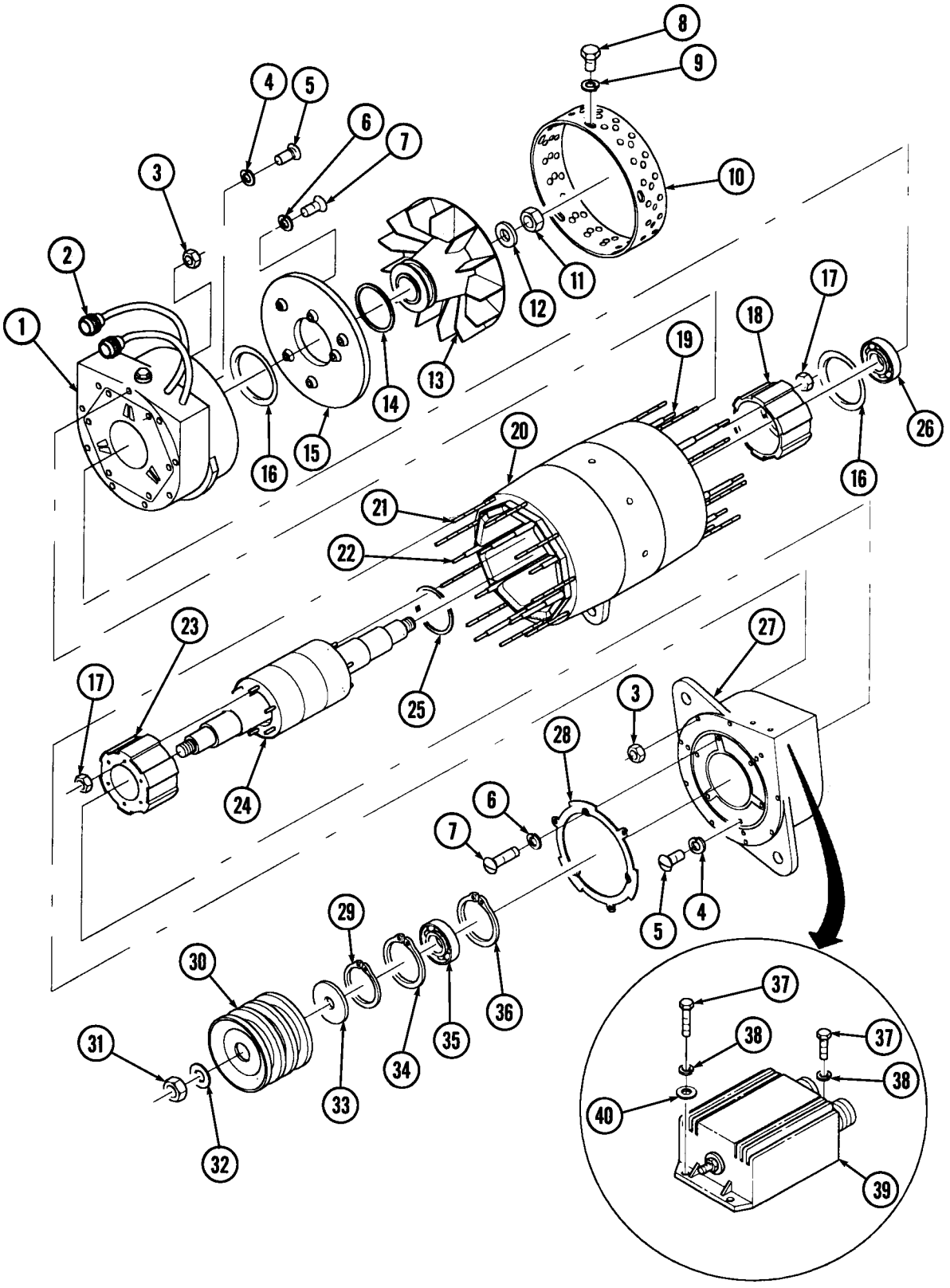
8. Remove eight screws (5) and washers (4), and disconnect two field leads (19) and six phase leads (22) from diodes in end housing (1).
9. Remove nine locknuts (3) from front housing (27) and studs (21) of stator (20). Discard locknuts (3).
10. Using a soft-faced mallet, tap from side-to-side to remove end housing (1) from stator (20).
11. Remove six locknuts (17) from studs of core and shaft assembly (24). Discard locknuts (17).
12. Using a gear puller, remove rotor (18) from core and shaft assembly (24).
13. Using a gear puller, remove rear bearing (26), two seals (16), and spring ring (25) from core and shaft assembly (24). Discard two seals (16).
14. Remove six screws (7), lockwashers (6), and plate cover (28) from front housing (27). Discard lockwashers (6).

**NOTE**

Prior to removal, tag leads for installation.

15. Remove five screws (5) and washers (4), and disconnect two field leads (19) and three phase leads (22) from diodes in front housing (27).
16. Remove nine locknuts (3) from front housing (27) and studs (21) from stator (20). Discard locknuts (3).
17. Using a soft-faced mallet, tap from side-to-side to remove front housing (27) from stator (20).
18. Remove shaft retaining ring (29) from core and shaft assembly (24).
19. Using an arbor press, remove core and shaft assembly (24) from front housing (27).
20. Remove front (34) and rear (36) retaining rings from front housing (27).
21. Using an arbor press, remove bearing (35) from front housing (27).
22. Remove six locknuts (17) from studs on core and shaft assembly (24). Discard locknuts (17).
23. Using a gear puller, remove rotor (23) from core and shaft assembly (24).

## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)



## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)

**c. Static Testing**

**NOTE**

Refer to disassembly for component removal, if necessary.

1. Perform Stator Test:

**NOTE**

- Steps (a) through (f) apply to test procedure for end housing.
- Steps (a) through (e) apply to test procedure for front housing.

(a) Remove six nuts and phase leads from diodes in end housing.

(b) Set multimeter to X1 scale and zero multimeter.

(c) Connect multimeter leads between each phase leads P1-P2, P2-P3, and P1-P3. Multimeter should read less than 1 ohm. If multimeter reads infinity (∞), the stator is open; replace alternator.

(d) Set multimeter to X1 scale and zero multimeter.

(e) Connect multimeter leads between each phase lead, P1, P2, and P3 and ground terminal on outside of front housing. Multimeter should read infinity (∞). If multimeter reads zero, the stator is grounded; replace alternator.,

(f) Repeat step (e) to check phase lead P4, P5, and P6.

2. Perform Field Coil Test for End Housing Only:

(a) Remove two nuts and field coil leads (F+, F-) from diodes in end housing.

(b) Set multimeter to XI scale and zero multimeter.

(c) Connect multimeter leads to the two field leads and measure the resistance. Multimeter should read less than 3 ohms. If multimeter reads more than 3 ohms, field coil is open; replace alternator.

(d) Set multimeter to X10K scale and zero multimeter.

(e) Connect one multimeter lead to a field lead and other to ground stud on front housing. Multimeter should read infinity (∞). If multimeter reads less than 100K ohms, field coil is grounded. Replace alternator.

3. Perform Positive Diode Test:

(a) Set multimeter to X100 scale and zero multimeter.

(b) Connect one ohmmeter lead to B+ output stud and other lead to each of six diode terminals S. Multimeter should read either less than 600 ohms or infinity (∞) for all six diode terminals. Reverse multimeter leads. Multimeter should read nearly alike for all six, but opposite first set of readings. If readings are not opposite, diode rectifier assembly is open. Replace alternator.

4. Perform Negative Diode Test:

(a) Set multimeter to X100 scale and zero multimeter.

(b) Connect one multimeter lead to ground terminal and other lead to each of six diode terminals S. Multimeter should read either less than 600 ohms or infinity (∞) for all six diode terminals. Reverse multimeter leads. Multimeter should read nearly alike for all six, but opposite first set of readings. If readings are not opposite, diode rectifier assembly is open. Replace alternator.

## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)

**d. Cleaning**

Clean all alternator components in accordance with para. 2-13.

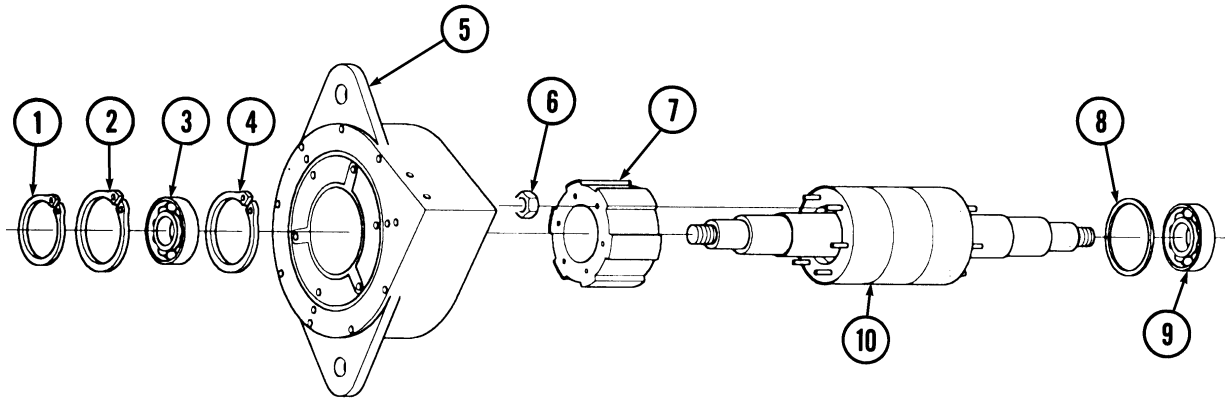
xx. Format line.

**e. Assembly**

**WARNING**

Always support alternator core and shaft assembly during installation. Failure to do so may cause injury to personnel or equipment damage

1. Using press, install spring ring (8) and rear bearing (9) on core and shaft assembly (10).
2. Position front rotor (7) on core and shaft assembly (10).
3. Apply silicone compound to studs of core and shaft assembly (10).
4. Install core and shaft assembly (10) on front rotor (7) with six locknuts (6). Tighten locknuts (6) to 45 lb-in. (5 N•m).
5. Coat outer race of front bearing (3) with a thin coat of silicone compound.
6. Install retaining ring (4) on front housing (5).
7. Using a press, install front bearing (3) on front housing (5) and secure with retaining ring (2).
8. Using press, install front bearing (3) with housing assembly (5) on core and shaft assembly (10).
9. Install shaft retaining ring (1) on core and shaft assembly (10).



## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)

10. Insert core and shaft assembly (9) and front housing (10) in stator (24).

**NOTE**

Align scribe marks on front housing and stator.

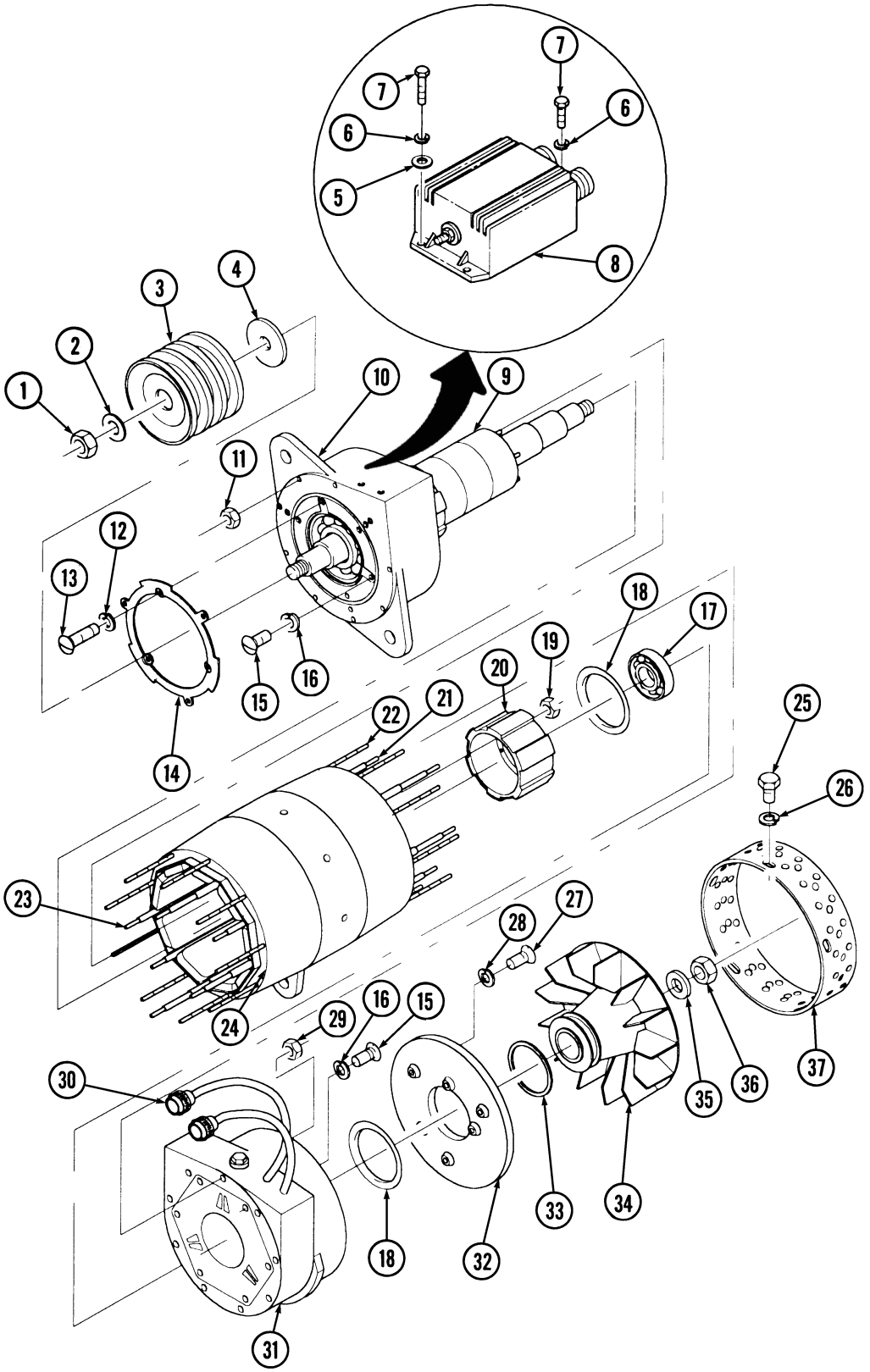
11. Feed leads (23) and (21) from stator (24) through front housing (10).
12. Apply silicone compound to studs (22) on stator (24).
13. Install three phase leads (23) and two field leads (21) on diodes of front housing (10) with eight washers (16) and screws (15).
14. Apply a thin coat of RTV sealant on leads (23) and (21) and diodes of front housing (10).
15. Using a soft-faced mallet, tap from side to side to install front housing (10) on stator (24).
16. Secure front housing (10) to studs (22) on stator (24) with nine locknuts (11). Tighten locknuts (11) to 18 lb-in. (2 N•m).
17. Install rear rotor (20) on core and shaft assembly (9) with six locknuts (19). Tighten locknuts (19) to 45 lb-in. (5 N•m).
18. Apply silicone compound to studs on core and shaft assembly (9).
19. Using an arbor press, install ring bearing (17) and two seals (18) on core and shaft assembly (9).
20. Insert end housing (31) on stator (24).

**NOTE**

Align scribe marks on end housing and stator.

21. Feed leads (23) and (21) from stator (24) through end housing (31).
22. Apply silicone compound to studs (22) on stator (24).
23. Install six phase leads (23) and two field leads (21) on diodes of end housing (31) with eight washers (16) and screws (15).
24. Apply thin coat of RTV sealant on leads (23) and (21) and diodes of end housing (31).
25. Using a soft-faced mallet, tap from side to side to install end housing (31) on stator (24).
26. Secure end housing (31) to studs (22) on stator (24) with nine locknuts (29). Tighten locknuts (29) to 18 lb-in. (2 N•m)
27. Install plate cover (32) on end housing (31) with six lockwashers (28) and screws (27).
28. Install plate cover (14) on front housing (10) with six lockwashers (12) and screws (13).
29. Install spring ring (33) on fan (34).
30. Install fan (34) on core and shaft assembly (9) with washer (35) and locknut (36). Tighten locknut (36) to 50 lb-ft (68 N•m).
31. Install fan guard (37) on stator (24) with four washers (26) and screws (25).
32. Install pulley bushing (4), pulley (3), washer (2), and locknut (1) on core and shaft assembly (9). Tighten locknut (1) to 120 lb-ft (163 N•m).
33. Install voltage regulator (8) on stator (24) with two spring tension washers (6), three washers (5), and screws (7).
34. Connect two cannon plugs (30) to voltage regulator (8).

## 6-5.2. 400 AMPERE DUAL VOLTAGE ALTERNATOR (12469057) TESTING AND REPAIR (Cont'd)



FOLLOW-ON TASK: Install alternator (TM 9-2320-280-20).

## 6-6. STARTER REPAIR

**This task covers:**

a. **Disassembly**
b. **Cleaning**
c. **Inspection**
d. **Assembly**
e. **Bench Testing and Adjusting**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Test Equipment**

Switch (Appendix G, Item 91)
Multimeter (Appendix G, Item 120)
Carbon pile (Appendix G, Item 92)
Armature test set (Appendix G, Item 93)

**Materials/Parts**

Pinion stop and snapring kit (Appendix E, Item 47)
Thrust washer and spacer kit (Appendix E, Item 51)
Gasket set (Appendix E, Item 42)
Gasket set (Appendix E, Item 43)
Solenoid parts kit (Appendix E, Item 161)
Gasket kit, commutator end head (Appendix E, Item 41)

**Materials/Parts (Cont'd)**

Pinion O-ring (Appendix E, Item 152)
Engine parts kit (Appendix E, Item 157)
Adhesive-sealant (Appendix B, Item 2)
Aircraft grease (Appendix B, Item 20)
Lithium grease (Appendix B, Item 22)
Lubricating oil (Appendix B, Item 32)
Core shaft nut tool (Appendix C, Fig. 3)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

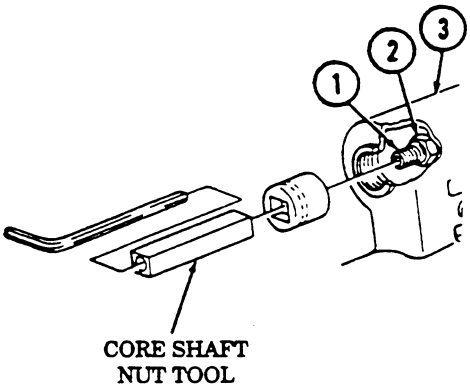
Starter removed (TM 9-2320-280-20).

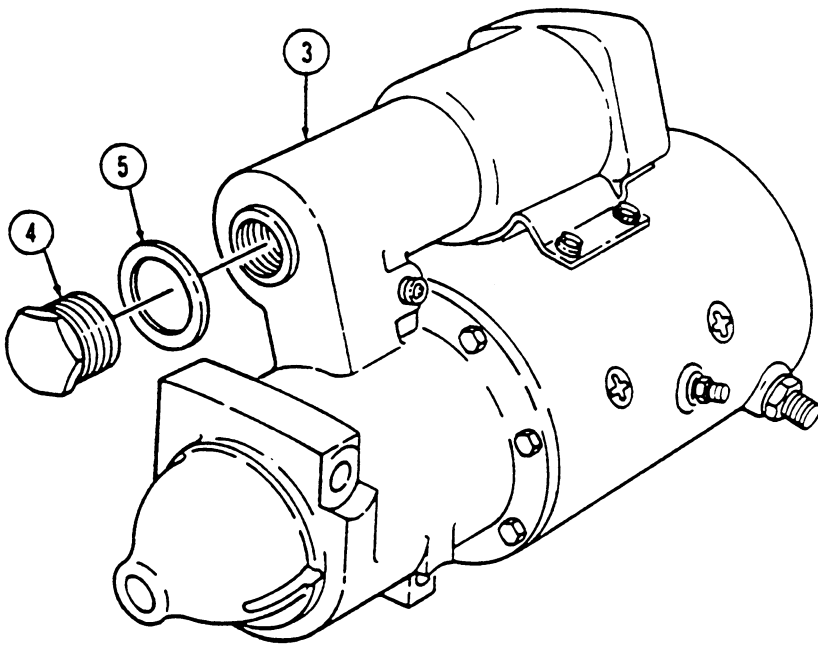
**Maintenance Level**

Direct support

### a. Disassembly

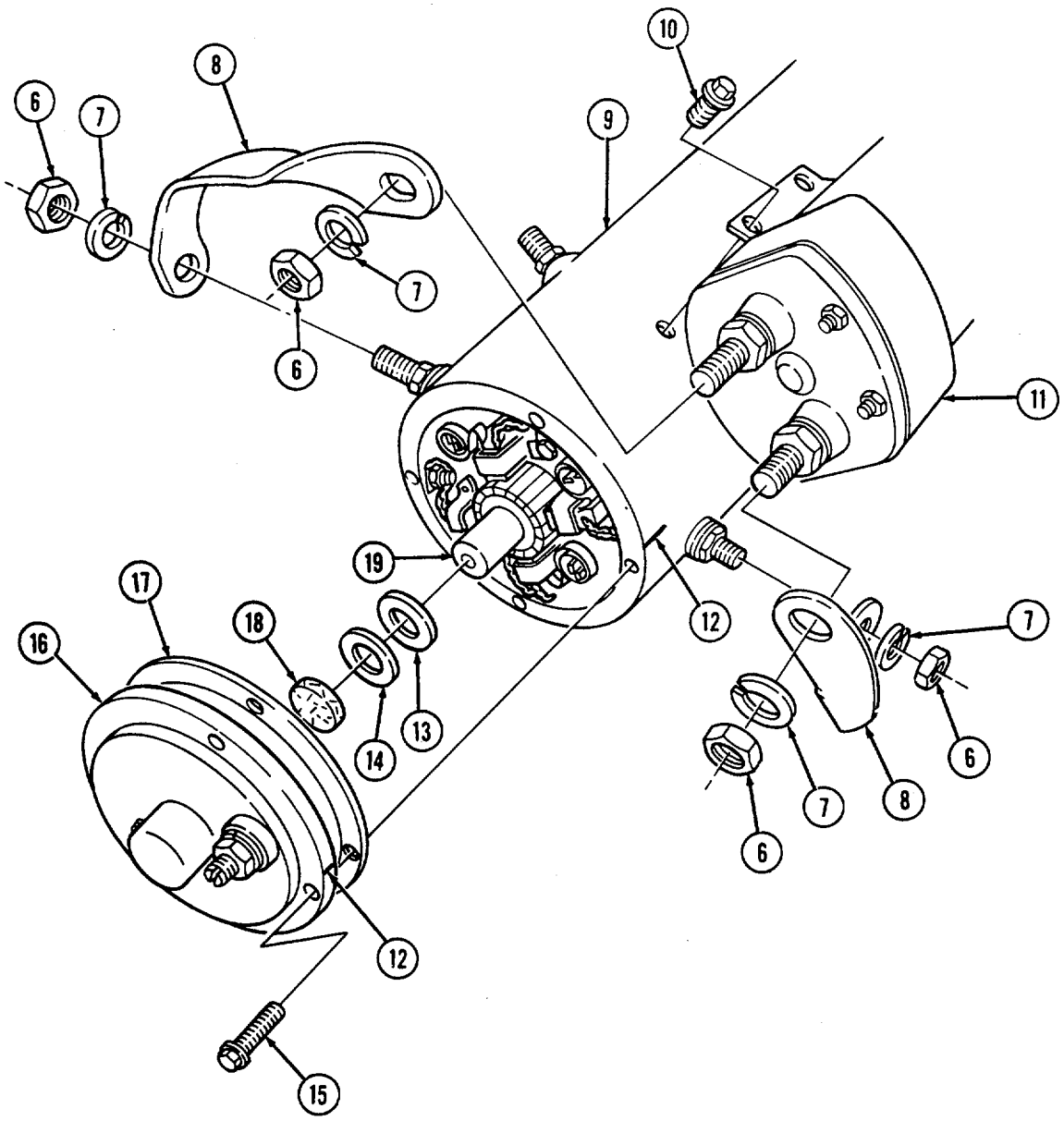
1. Remove plug (4) and gasket (5) from pinion housing (3). Discard gasket (5).
2. Using core shaft nut tool, remove nut (2) from end of core shaft (1) located inside pinion housing (3).



**6-6. STARTER REPAIR (Cont'd)**

3. Remove four nuts (6), lockwashers (7), and two solenoid lead connectors (8) from frame and field assembly (9) and solenoid (11). Discard lockwashers (7).
4. Remove four capscrews (10) and solenoid (11) from frame and field assembly (9).
5. Scribe a locating mark (12) on commutator end head (16) and frame and field assembly (9).
6. Remove four capscrews (15), commutator end head (16), and gasket (17) from frame and field assembly (9). Discard gasket (17).
7. Remove thrust washer(s) (14) and spacer (13) from armature shaft (19). Discard spacer (13) and thrust washer(s) (14).
8. Remove oil felt washer (18) from commutator end head (16). Discard felt washer (18).



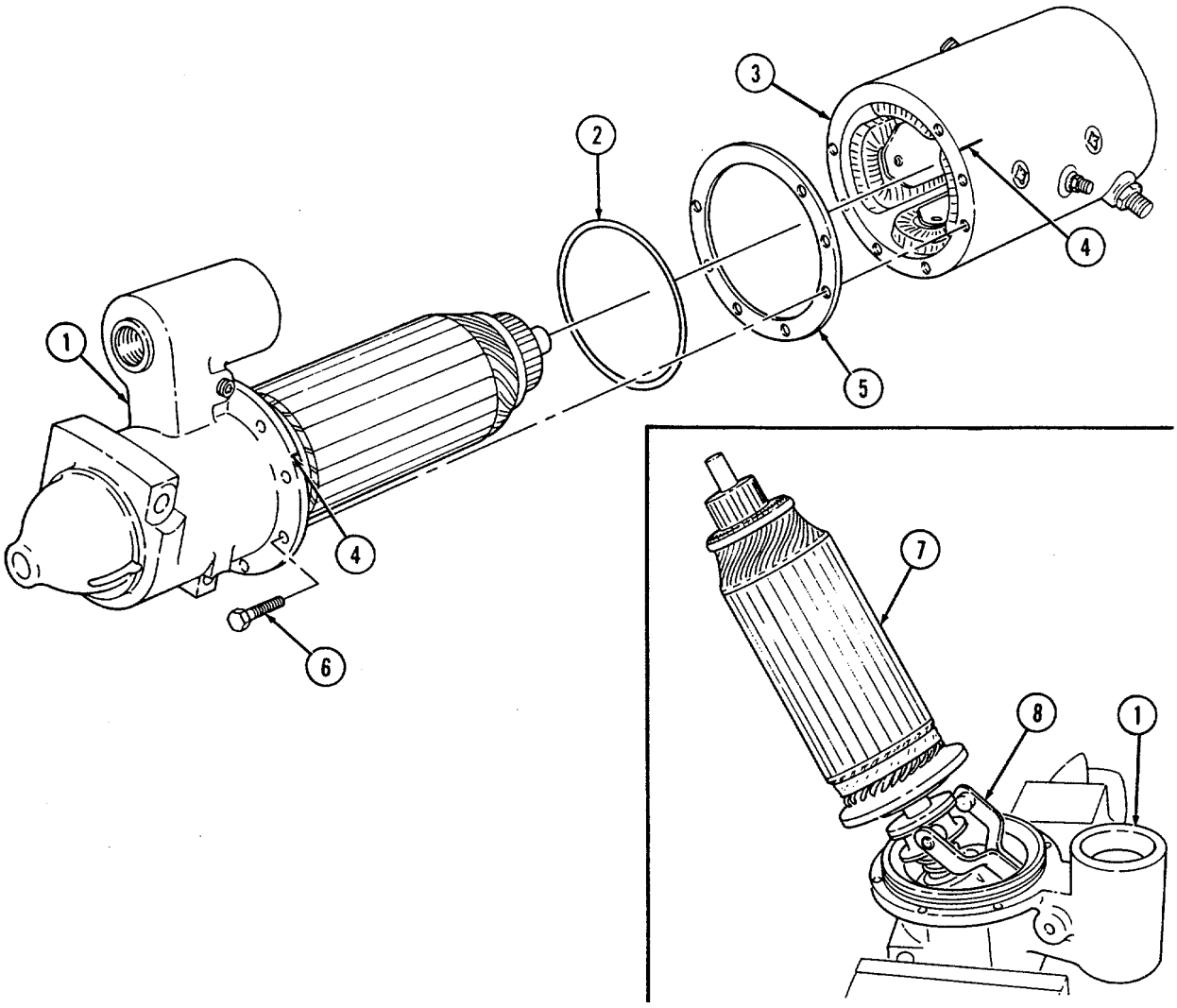
**6-6. STARTER REPAIR (Cont'd)**

9. Scribe a locating mark (4) on pinion housing (1) and starter motor frame (3).
10. Remove seven capscrews (6), starter motor frame (3), gasket (5), and O-ring (2) from pinion housing (1). Discard gasket (5) and O-ring (2).
11. Remove two plugs (9) and pin (10) from shift lever (8) and pinion housing (1).

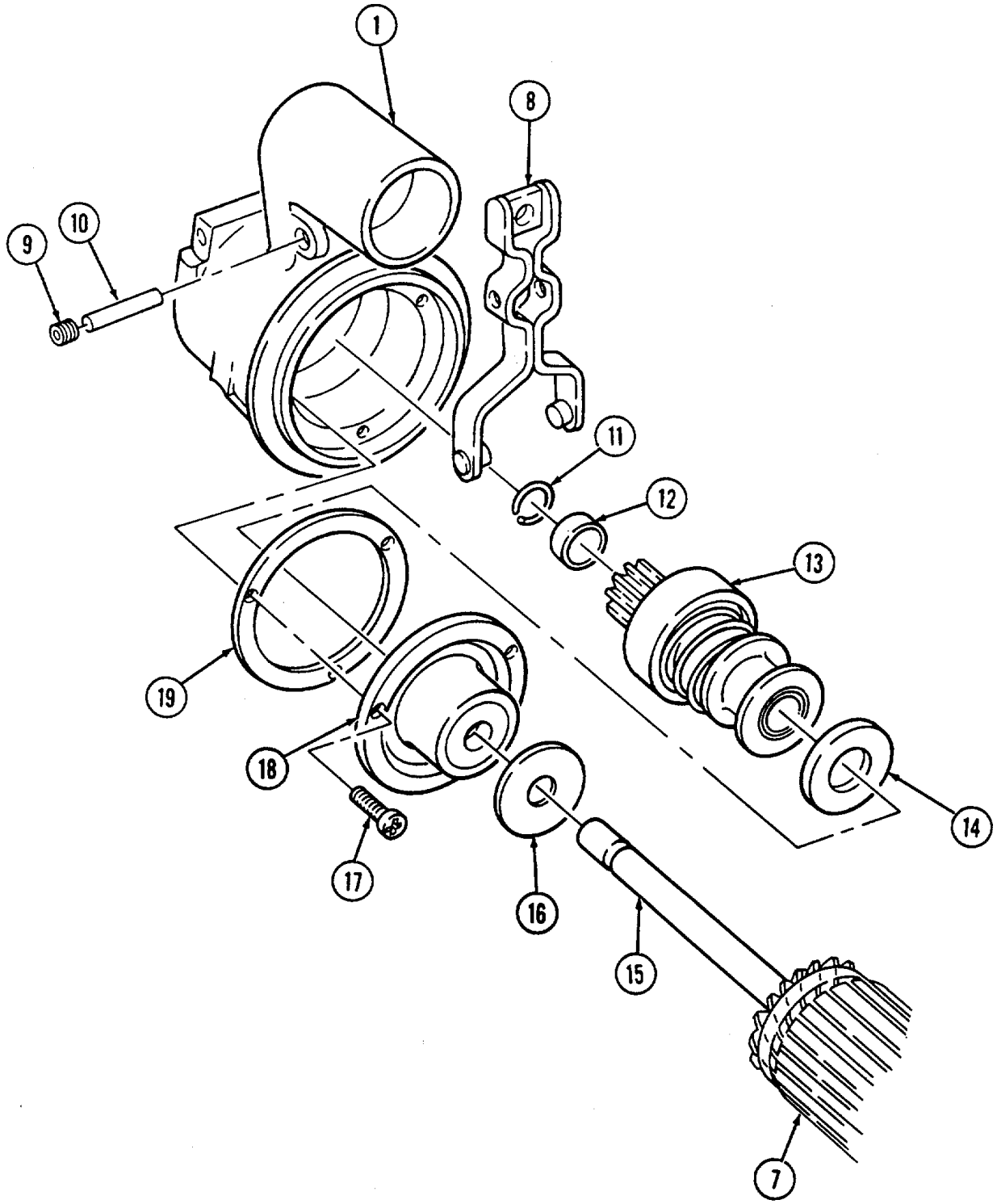
**NOTE**

Armature and shift lever must be positioned as shown for removal from pinion housing.

12. Clamp pinion housing (1) in vise and remove three screws (17) from pinion housing (1). Slide armature (7) and shift lever (8) out from pinion housing (1).
13. Remove snapring (11) and pinion stop (12) from armature shaft (15) and slide clutch (13) off armature shaft (15). Discard snapring (11) and pinion stop (12).
14. Remove washer (14), pinion housing end plate (18), and washer (16) from armature shaft (16). Discard washers (14) and (16).
15. Remove gasket (19) from pinion housing end plate (18) and discard gasket (19).

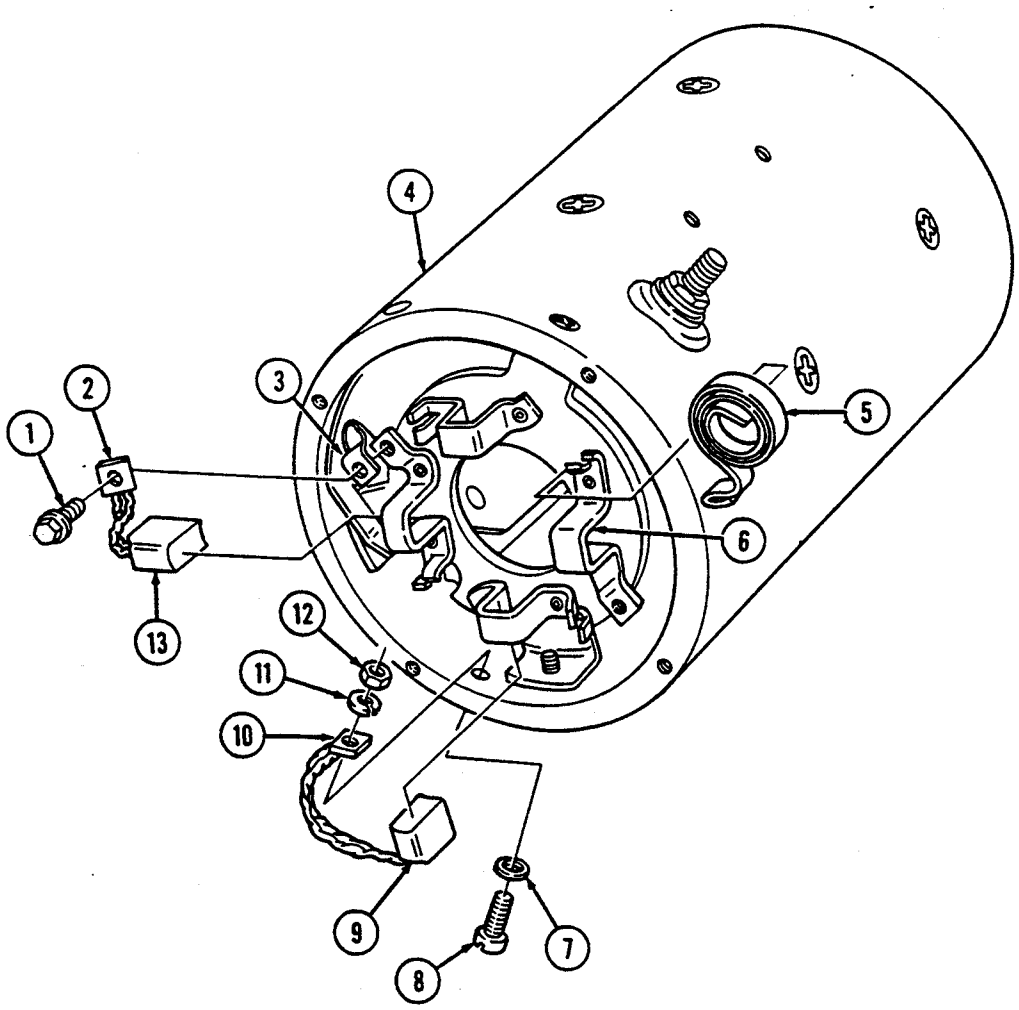


## 6-6. STARTER REPAIR (Cont'd)

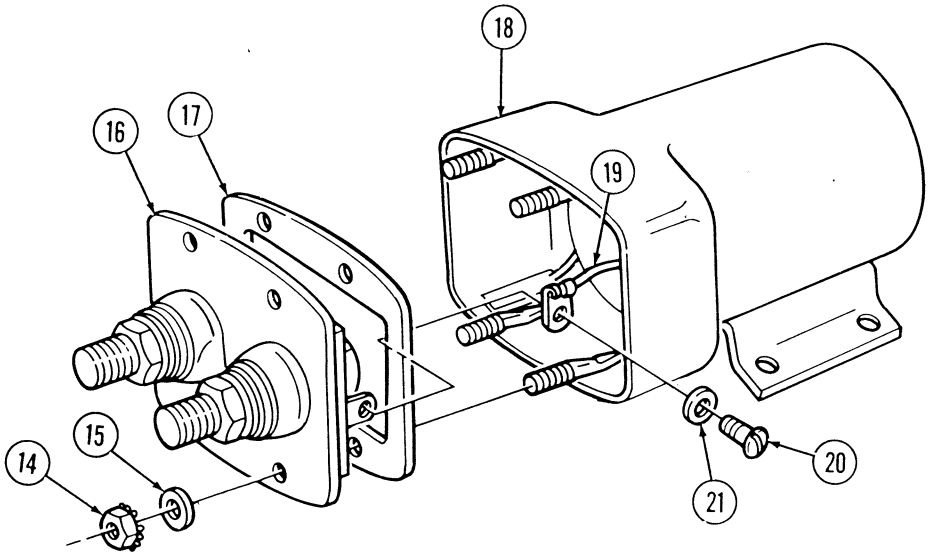


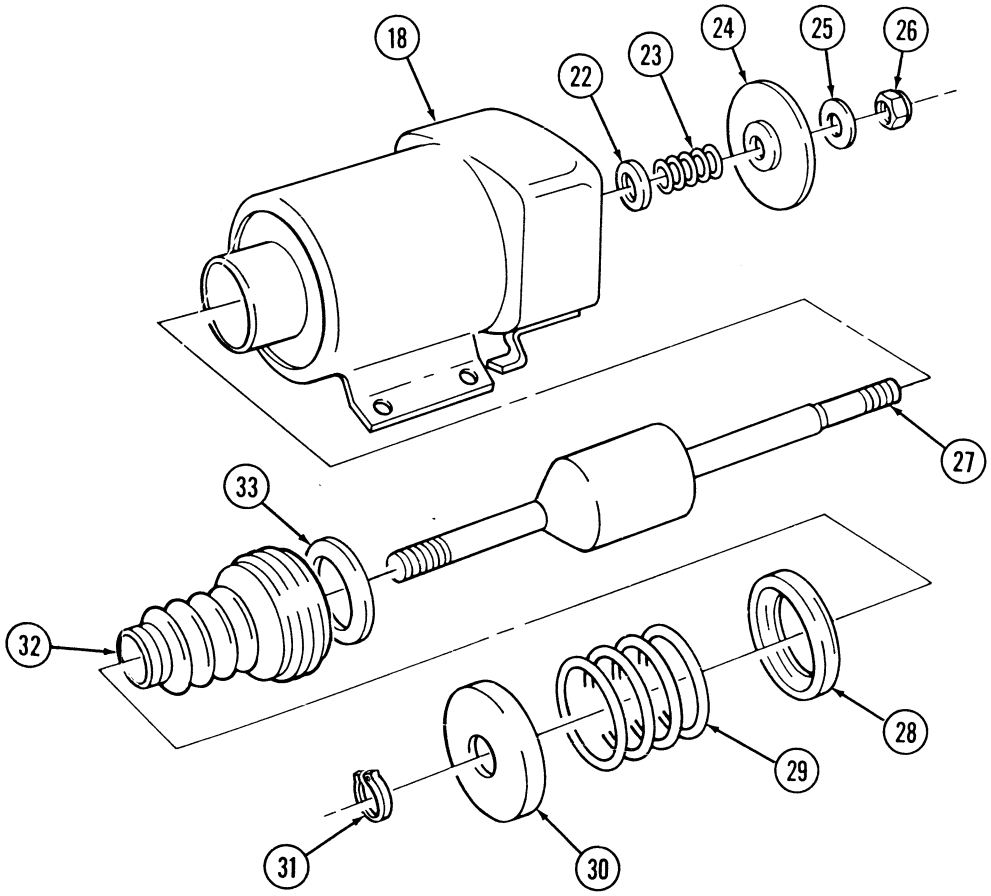
## 6-6. STARTER REPAIR (Cont'd)

16. Remove two nuts (12), lockwashers (11), screws (8), copper washers (7) and two negative brush leads (10) from starter motor frame (4). Disconnect two negative brush leads (10) and remove two brushes (9). Discard two lockwashers (11).
17. Remove two screws (1) and two positive brush leads (2) from field coil (3).
18. Remove four springs (5) from brush holders (6).
19. Remove four nut and lockwasher assemblies (14), rubber washers (15), and cover (16) from solenoid housing (18). Pull cover (16) away from solenoid housing (18) far enough to allow access to series winding connection (19) and screw (20). Discard rubber washers (15) and nut and lockwasher assemblies (14).
20. Remove screw (20) and washer (21) from series winding connection (19) on cover (16). Remove cover (16) and gasket (17) from solenoid housing (18). Discard gasket (17).
21. Hold core shaft (27) and remove nut (26), washer (25), and contact (24) from core shaft (27). Remove core shaft (27), washer (22), and spring (23) from solenoid housing (18).
22. Remove snapring (31), spring retainer (30), spring (29), spring retainer (28), rubber boot (32), and washer (33) from core shaft (27). Discard snapring (31).



## 6-6. STARTER REPAIR (Cont'd)



## 6-6. STARTER REPAIR (Cont'd)

**b. Cleaning**

Clean all starter motor components in accordance with para. 2-13.

**c. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect clutch (7) for damage, roughness, or damaged gear. Replace clutch (7) if defective.
2. Check the brushes (4) for roughness, galling, and wear. Replace brushes (4) if defective. Replace any brushes (4) if brush length is less than 0.375 in. (9.52 mm).
3. Check the brush springs (5) for damage. Replace brush springs (5) if damaged.
4. Inspect end head bearing (1) for roughness, galling, or damage. Replace end head bearing (1) if defective.
5. Inspect pinion housing (6) for pitting, cracks, or damage. Inspect inside diameter of bearing (6.1) for pitting, cracks, or visual evidence of elongation. If pinion housing (6) or bearing (6.1) is damaged, replace both pinion housing (6) and bearing (6.1).
6. Check the commutator (10) for damage or evidence of excessive arcing. Inspect the armature shaft (11) for rough bearing surfaces and rough or damaged splines (8). Replace starter motor if defective.
7. The armature (9), field coils (3), and brush holder (2) should be checked for shorts, grounds, and open circuits with armature test set. Replace starter motor if armature (9), field coils (3), or brush holder (2) is defective.
8. Inspect core spring (20) and rubber boot (23) for damage. Replace if damaged.
9. Inspect contact (15) for burns or damage. Replace if burned or damaged.

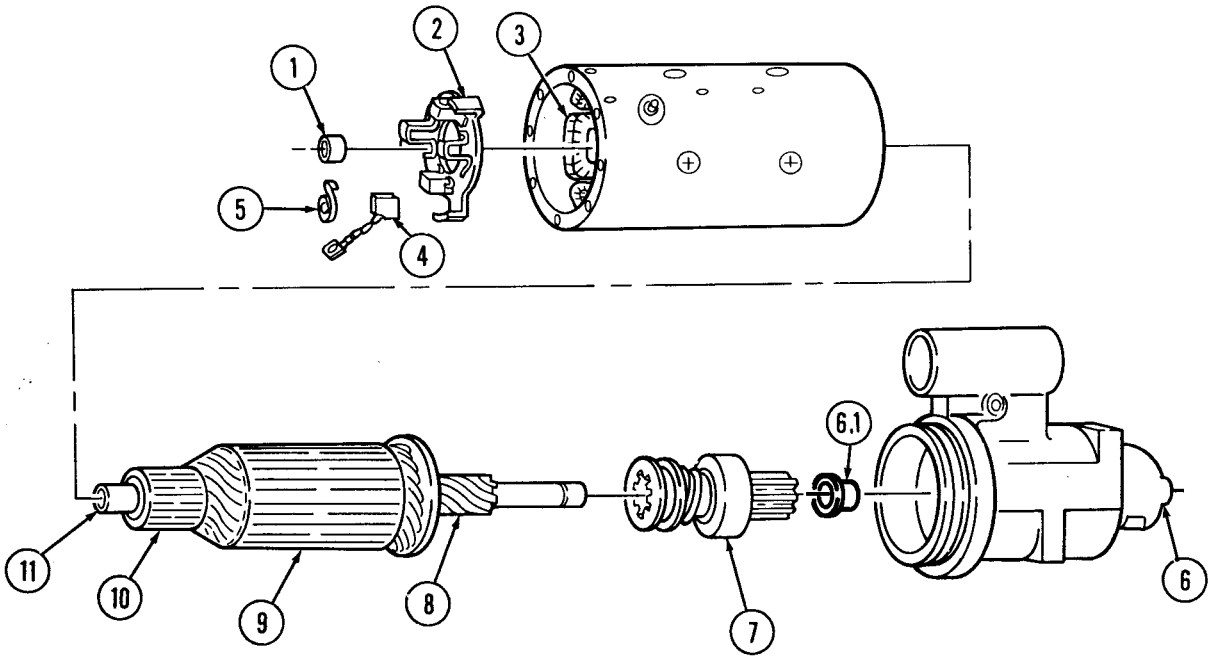
**d. Assembly**

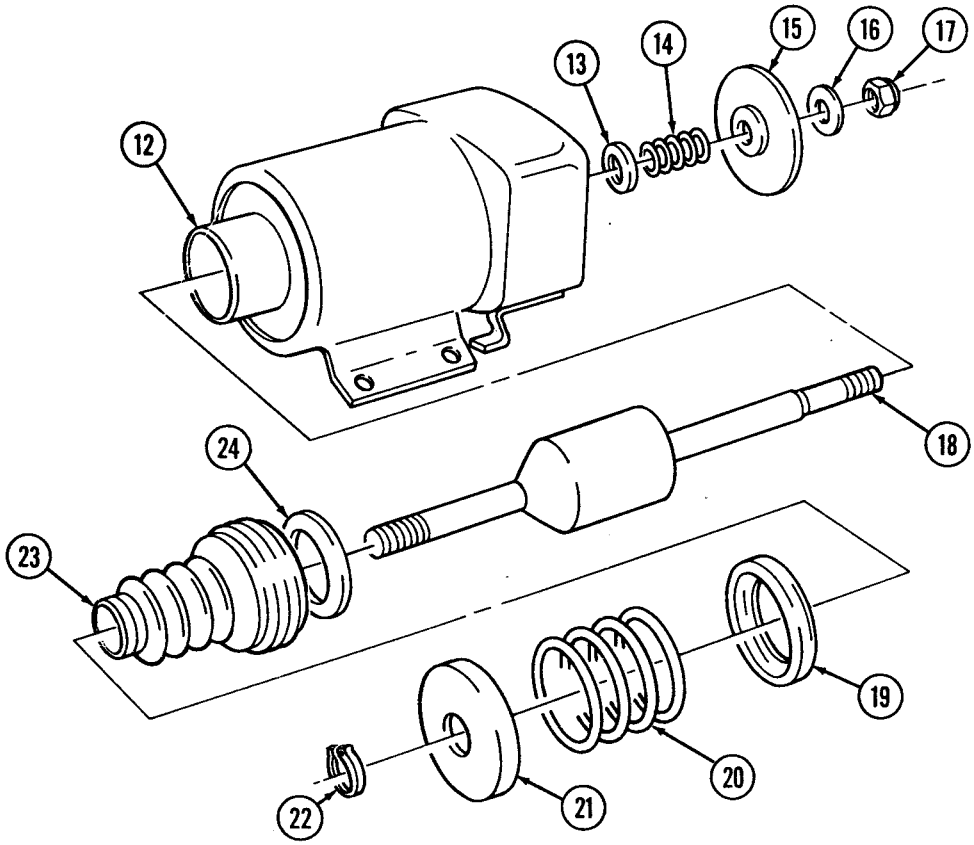
**NOTE**

For general assembly instructions, refer to para. 2-16.

1. Install washer (24), rubber boot (23), spring retainer (19), spring (20), and spring retainer (21) on core shaft (18) with retaining ring (22).
2. Install core shaft (18), washer (13), spring (14), contact (15), and washer (16) into solenoid housing (12). Hold core shaft (18) and install nut (17).

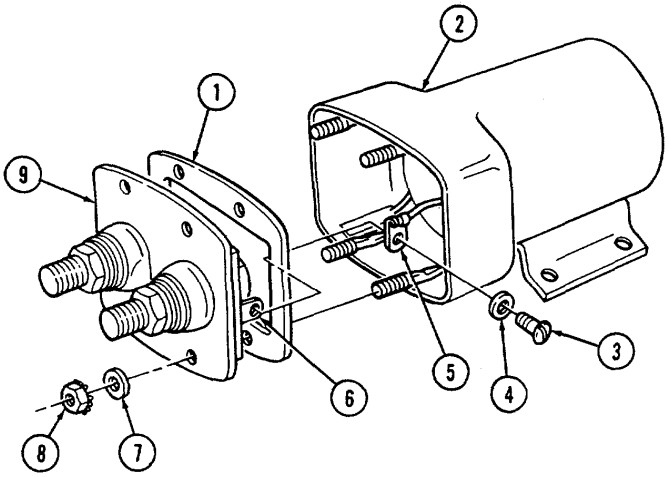
## 6-6. STARTER REPAIR (Cont'd)



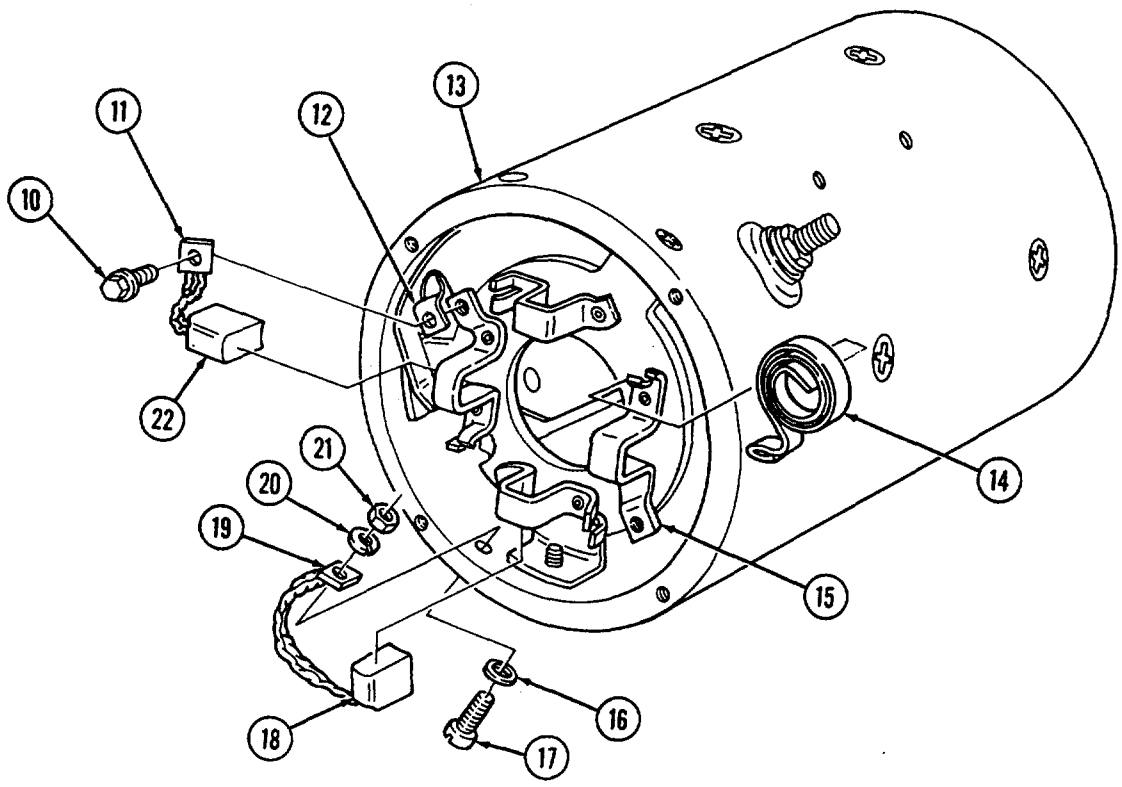



**6-6. STARTER REPAIR (Cont'd)**

3. Install gasket (1) on solenoid housing (2) and connect series winding connection (6) in cover (9) with series winding connection (5) in solenoid housing (2) with washer (4) and screw (3).
4. Install cover (9) on solenoid housing (2) with four rubber washers (7) and nut and lockwasher assemblies (8).




5. Install two negative brushes (18) and two positive brushes (22) on four brush holders (15) with springs (14).
6. Connect two positive brush leads (11) to field coil (12) with two screws (10).
7. Connect two negative brush leads (19) to frame and field assembly (13) with two screws (17), copper washers (16), lockwashers (20), and nuts (21). Cover heads of screws (17) with adhesive-sealant.



## 6-6. STARTER REPAIR (Cont'd)

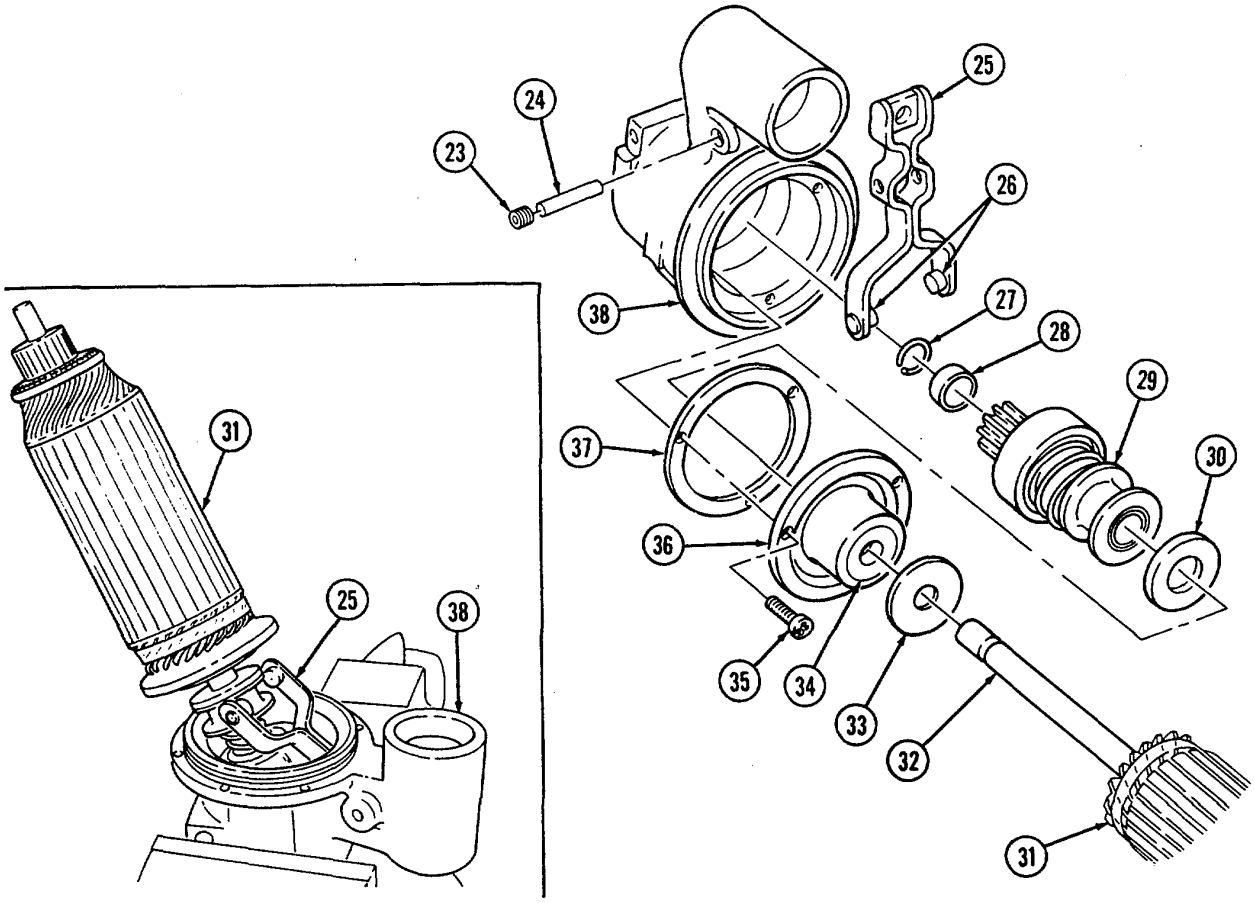
8. Apply aircraft grease to armature shaft (32), shift lever studs (26), and the inside diameter of end plate seal (34).
9. Install washer (33), pinion housing end plate (36), gasket (37), and washer (30) on armature shaft (32).
10. Install clutch (29) on armature shaft (32) with pinion stop (28) and snapring (27).

**NOTE**

Armature and shift lever must be positioned as shown for installation into pinion housing.

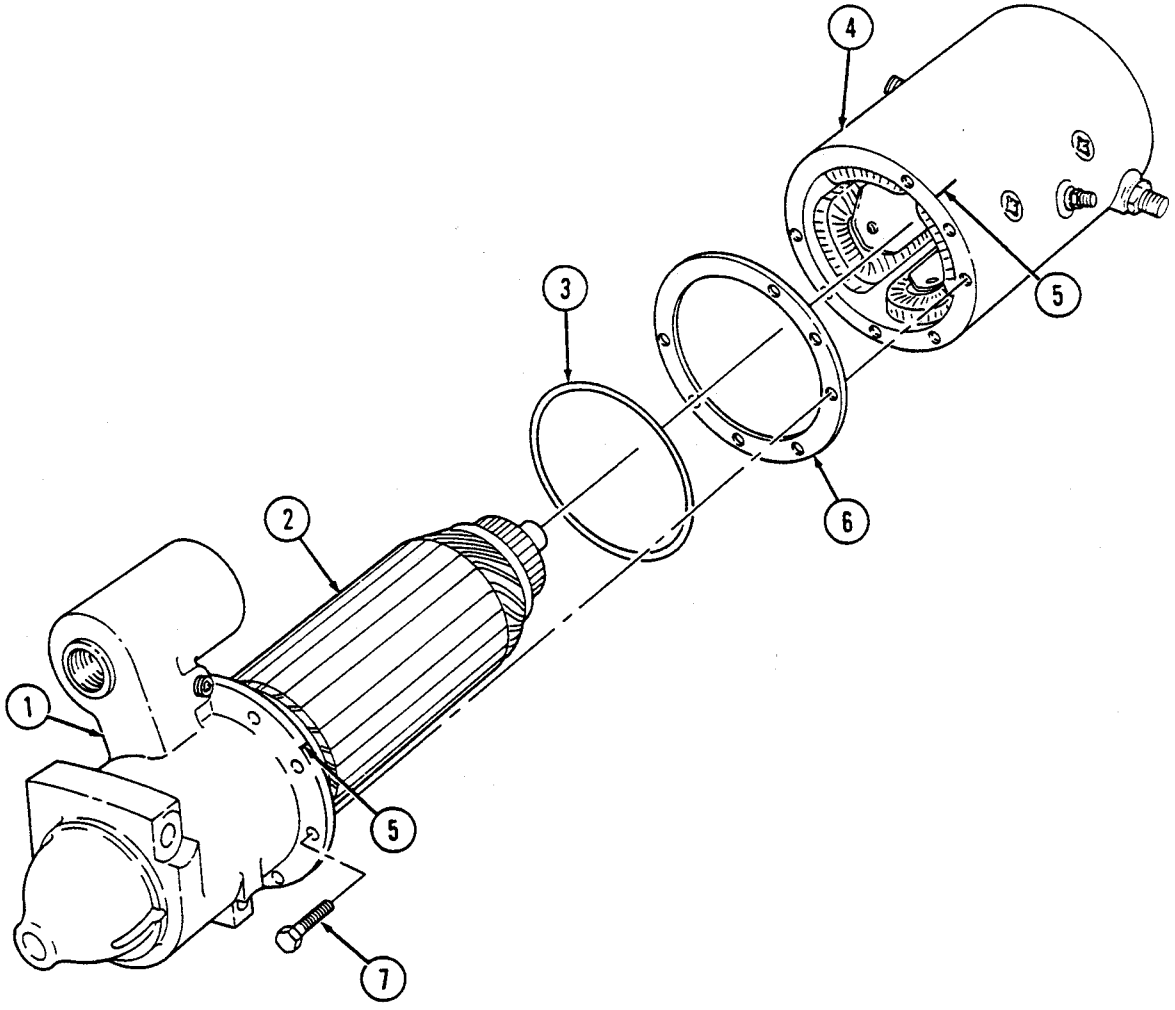
11. Install shift lever (25) and armature (31) into pinion housing (38). Install pinion housing end plate (36) on pinion housing (38) with three screws (35). Tighten screws (35) to 40 lb-in. (5 N·m).
12. Install shift lever (25) on pinion housing (38) with pin (24) and two plugs (23).

12. Install shift lever (25) on pinion housing (38) with pin (24) and two plugs (23).

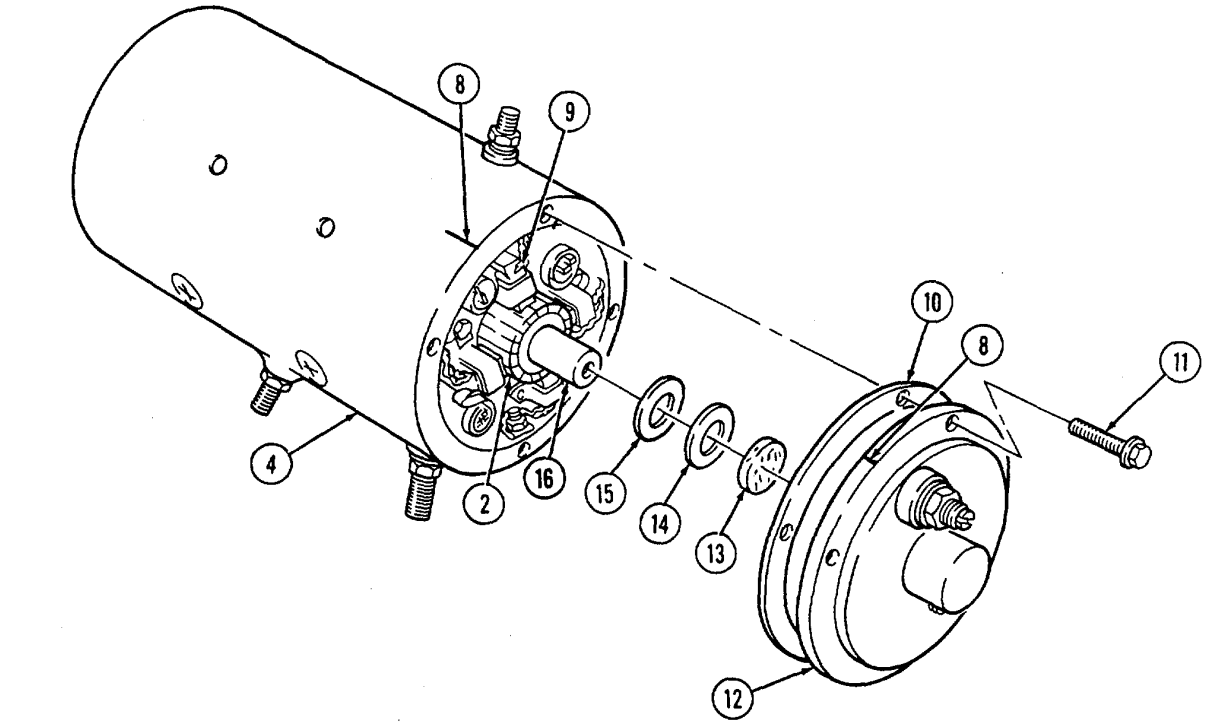


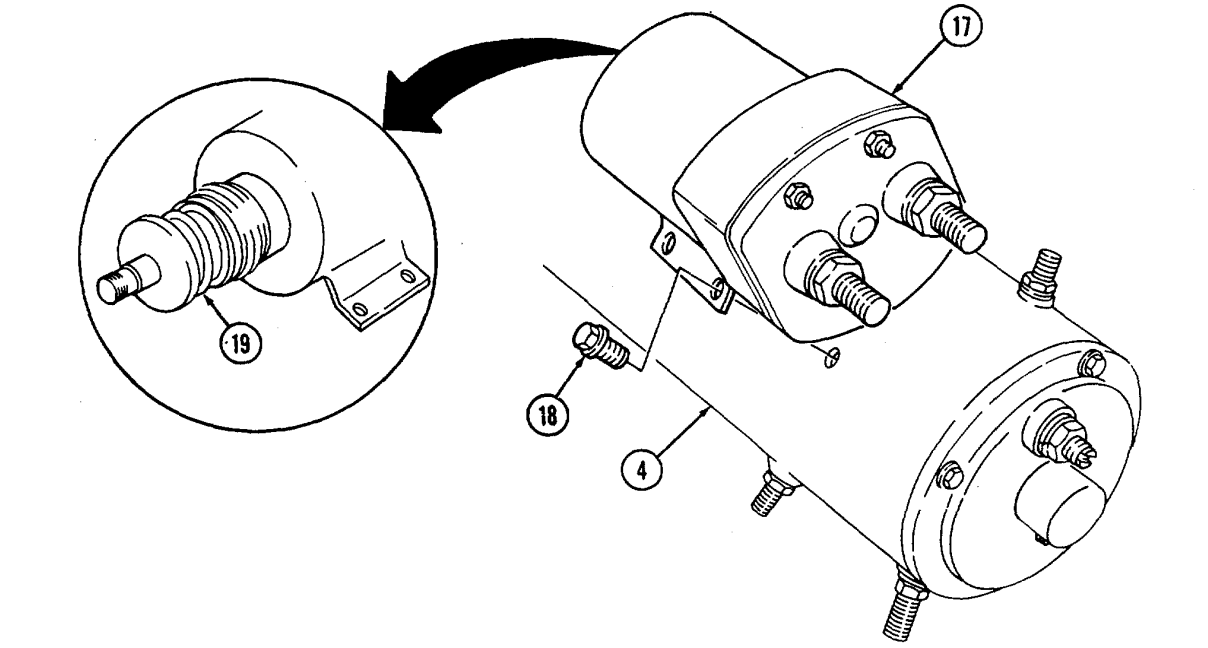
## 6-6. STARTER REPAIR (Cont'd)

13. Install gasket (6) and O-ring (3) on pinion housing (1) and align locating scribe marks (5) on pinion housing (1) and frame and field assembly (4).
14. Coat threads of capscrews (7) with adhesive-sealant.
15. Install armature (2) into frame and field assembly (4) and position brushes (9) on armature (2). Secure pinion housing (1) to frame and field assembly (4) with seven capscrews (7). Tighten capscrews (7) to 50 lb-in. (6 N·m).
16. Saturate felt washer (13) with lubricating oil and install into commutator end head (12).
17. Install spacer (15) and thrust washer(s) (14) on armature shaft (16).
18. Align locating marks (8) on commutator end head (12) and frame and field assembly (4).
19. Coat threads of capscrews (11) with adhesive-sealant.
20. Install commutator end head (12) and gasket (10) on frame and field assembly (4) with four capscrews (11). Tighten capscrews (11) to 25 lb-in. (3 N·m).
21. Coat threads of capscrews (18) with adhesive-sealant. Coat ribbed area of boot (19) with lithium grease.
22. Install solenoid (17) on frame and field assembly (4) with four capscrews (18). Tighten capscrews (18) to 50 lb-in. (6 N·m).



## 6-6. STARTER REPAIR (Cont'd)



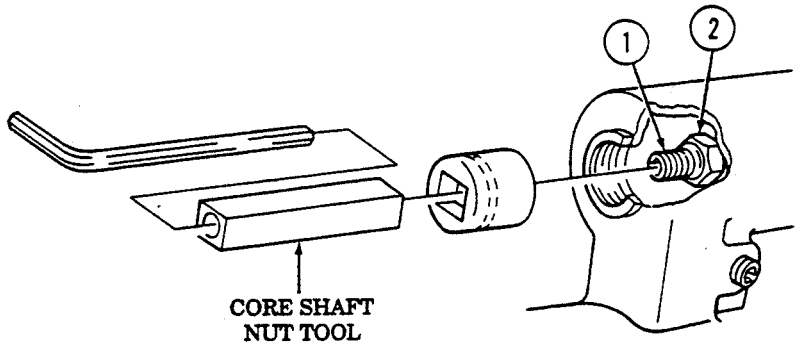



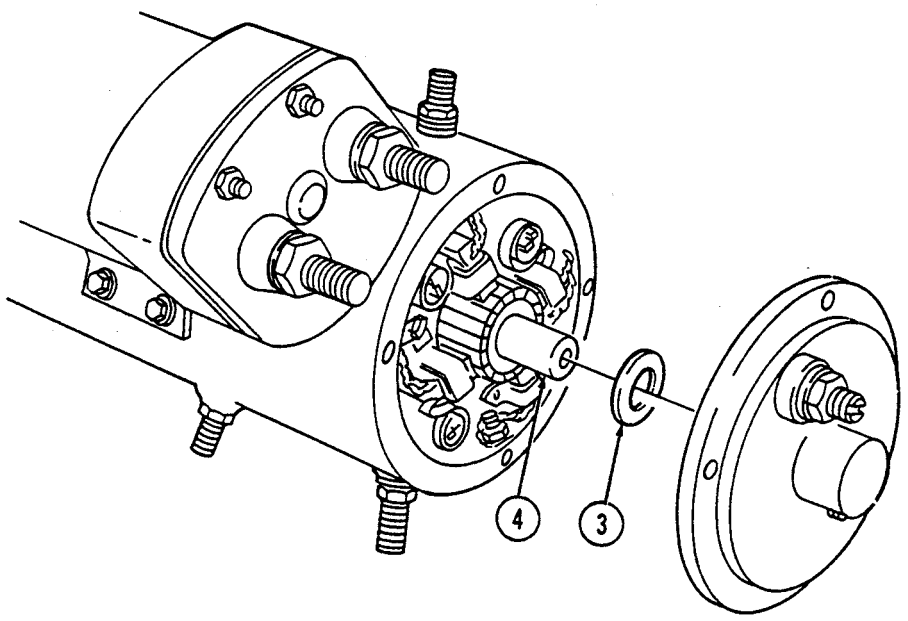
## 6-6. STARTER REPAIR (Cont'd)

23. Using core shaft nut tool, install nut (2) on core shaft (1).

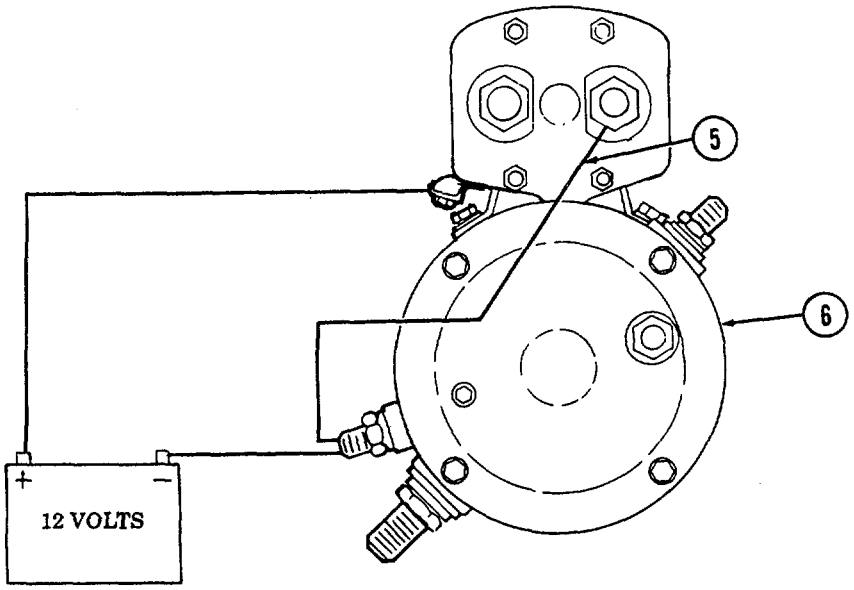
### e. Bench Testing and Adjustment

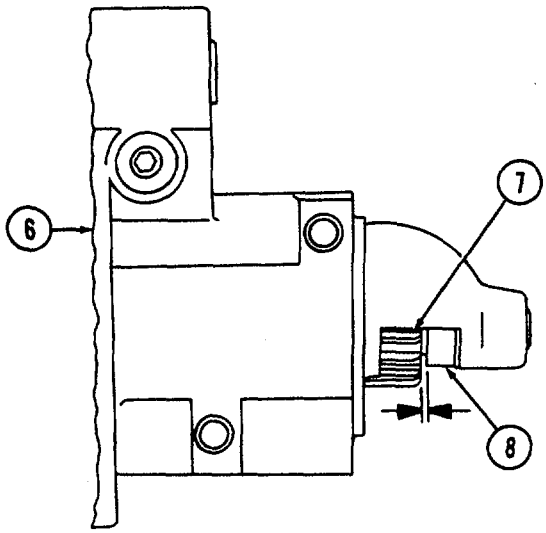
1. Adjust armature end play 0.005-0.030 in. (0.127-0.762 mm) by adding or removing thrust washer(s) (3) on commutator end of armature shaft (4).
2. Connect 24-volt supply to starter motor (6). Momentarily connect jumper lead (5) as shown. This will shift clutch (7) into cranking position until battery is disconnected.
3. Push clutch (7) towards commutator end of starter motor (6) to eliminate slack. Measure distance between outside edge of clutch (7) and pinion stop (8). End play must be 0.020-0.050 in. (0.508-1.27 mm). Adjust end play by turning core shaft nut (2) in or out.



**6 - 6. STARTER REPAIR (Cont'd)**

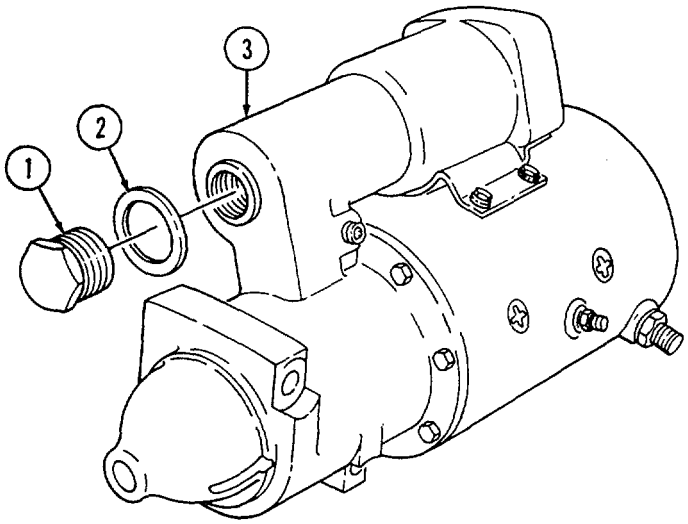


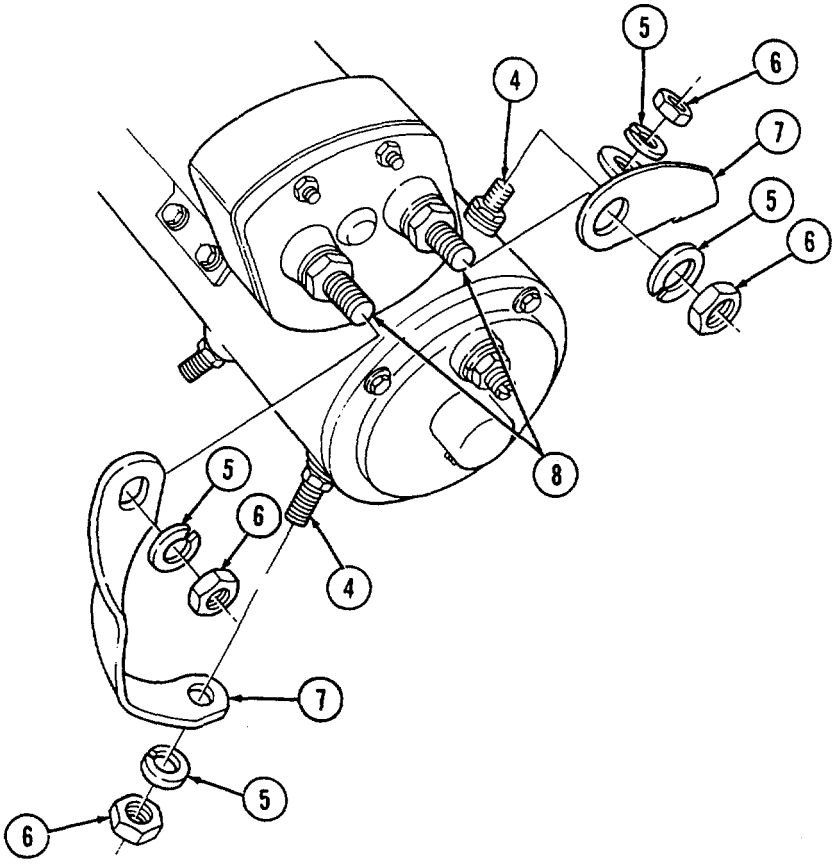



**6 - 6. STARTER REPAIR (Cont'd)**

4. Install gasket (2) and plug (1) on pinion housing (3).

5. Install two solenoid lead connectors (7) on solenoid terminals (8) and starter motor terminals (4) with four lockwashers (5) and nuts (6).



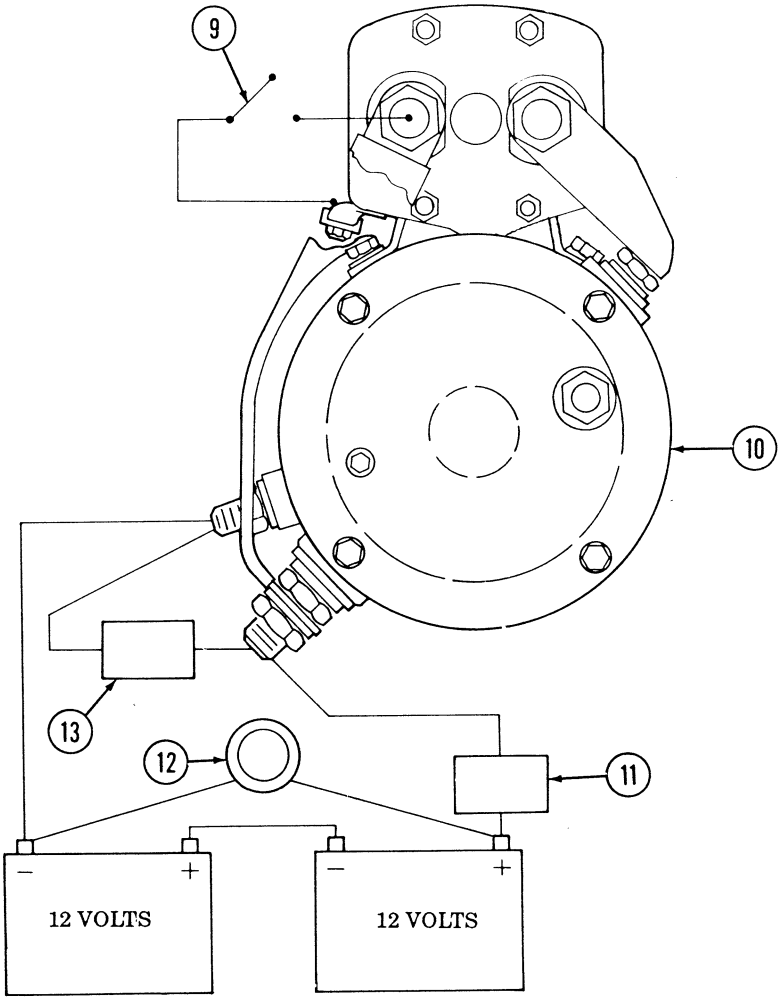
## 6-6. STARTER REPAIR (Cont'd)

6. Connect 24-volt supply to starter motor (10).

**CAUTION**

Do not operate starter motor for more than 30 seconds at a time. Allow starter motor to cool at least 2 minutes between tests or damage to starter motor may result.

7. Close switch (9), adjust voltage to 20 volts on voltmeter (13) using carbon pile (12), and check rotating speed of armature with tachometer. Check current draw on ammeter (11).
8. Maximum current draw should be 65 amperes with a minimum armature speed of 5,000 rpm. If low speed, high current draw condition exists, check bearing alignment or inspect armature for shorts or grounds. If low speed, low current draw exists, inspect start motor for faulty connections or poor brush contact.




FOLLOW-ON TASK: Install starter (TM 9-2320-280-20).

## 6-7. STE/ICE-R WIRING HARNESS REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Torque adapter, 3/4 in. (Appendix G, Item 107)

**Materials/Parts**
Three lockwashers (Appendix E, Item 91)
Lockwasher (Appendix E, Item 104)
Lockwasher (Appendix E, Item 106)
Lockwasher (Appendix E, Item 107)
Antiseize compound (Appendix B, Item 7)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Battery holddown removed (TM 9-2320-280-20).
- Engine access cover removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**a. Removal**

**NOTE**

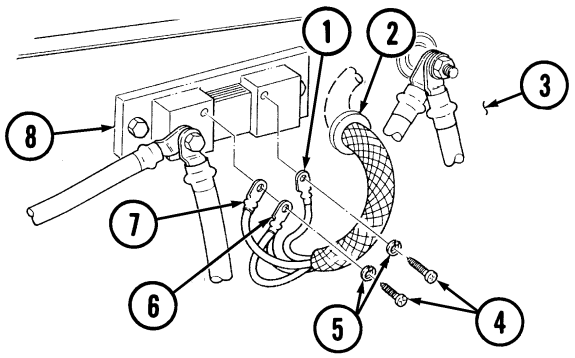
- Prior to removal tag leads for installation.
- Refer to TM 9-2320-280-20 for repair of wiring harness connections.

1. Remove two screws (4), lockwashers (5), and STE/ICE-R harness leads 7B-7D (6), 8A (1), and 9A (7) from shunt (8). Discard lockwashers (5).
2. Remove boot (9) from power stud (11). Remove nut (29) and lockwasher (30) from leads 6B-6C (12) and 6A (10) and power stud (11), and disconnect lead 6B-6C (12). Discard lockwasher (30).
3. Remove nut (27) and lockwasher (28) from leads 3D (23) and 7A (26) on starter (18) and disconnect lead 3D (23). Discard lockwasher (28).
4. Remove nut (22) and lockwasher (21) from leads 6A (10), 81A (19), and 81B (20) on starter (18) and disconnect lead 81B (20). Discard lockwasher (21).
5. Remove screw (13) and retainer (14) from leads 74A (16) and 74B (15) on starter solenoid (17) and disconnect lead 74B (15).
6. Remove screw (25) and clamp (24) from leads 3D (23), 6A (10), 74B (15), and 81B (20) on starter (18).

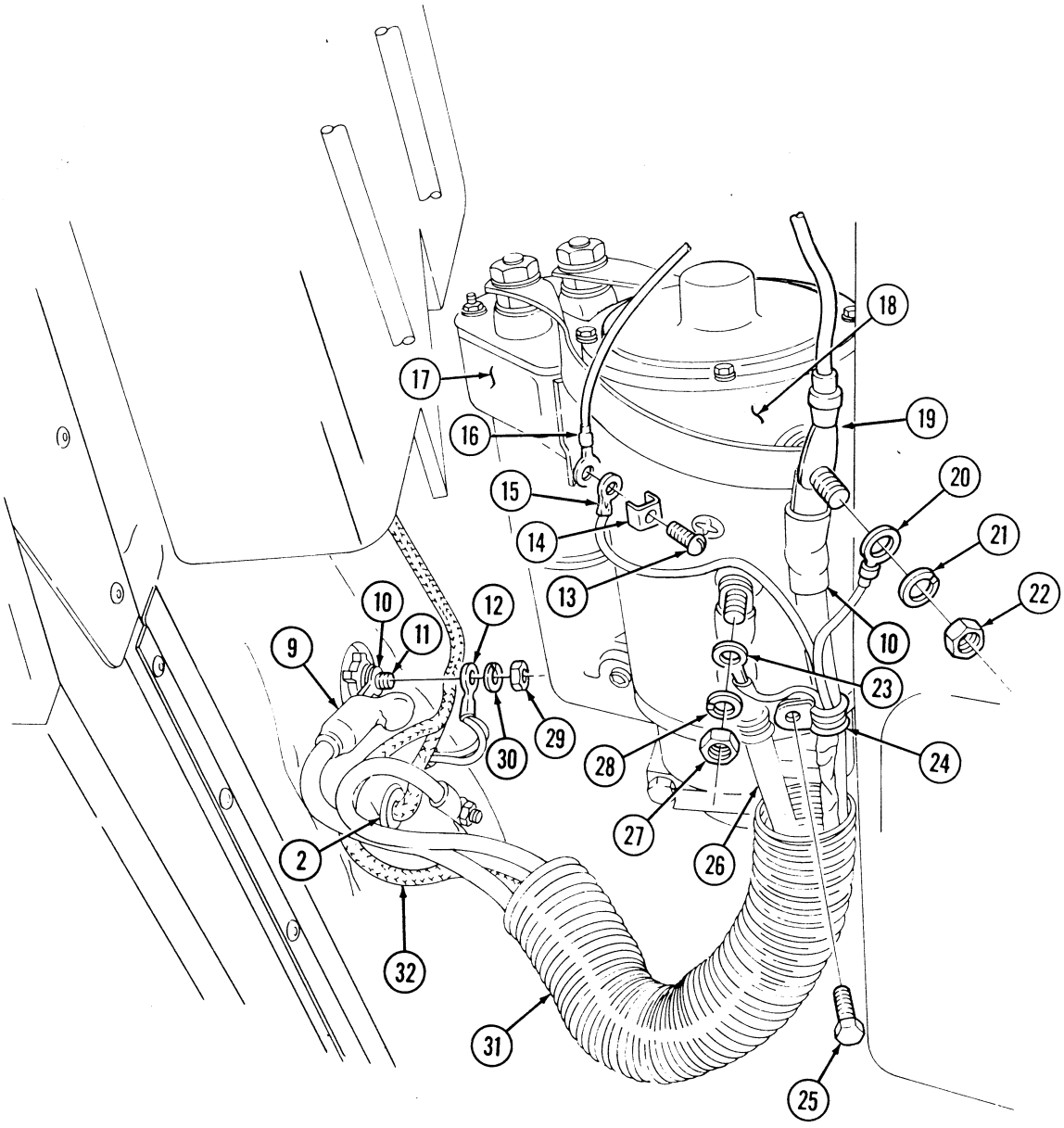
**CAUTION**

Use care when removing harness. Snagging or pulling may cause damage to harness.

7. Remove harness (32) and grommet (2) from battery compartment (3).
8. Slide harness (32) out of protective shield (31).



## 6-7. STE/ICE-R WIRING HARNESS REPLACEMENT (Cont'd)



## 6-7. STE/ICE-R WIRING HARNESS REPLACEMENT (Cont'd)

9. Remove three screws (2) and clamps (16) from harness (9) and body (1).
10. Remove two screws (10) and clamps (12) from body harness (11), harness (9) and body (1).
11. Disconnect harness connector (18) from rpm sensor connector (22).
12. Disconnect harness connector (8) from fuel pressure transducer connector (7).
13. Remove nut (20), lockwasher (21), and clamp (19) from harness (9) and transmission (17). Discard lockwasher (21).
14. Remove cover (5) from STE/ICE-R DCA assembly (6).
15. Remove screw (4), washer (14), nut (13), harness ground 7C (15), and cover retainer (3) from body (1) and assembly (6).
16. Remove remaining three screws (4), washers (14), and nuts (13) from DCA assembly (6) and body (1).
17. Remove DCA assembly (6) and harness (9).

**b. Installation**

**NOTE**

Refer to TM 9-2320-280-20 for repair of wiring harness connectors.

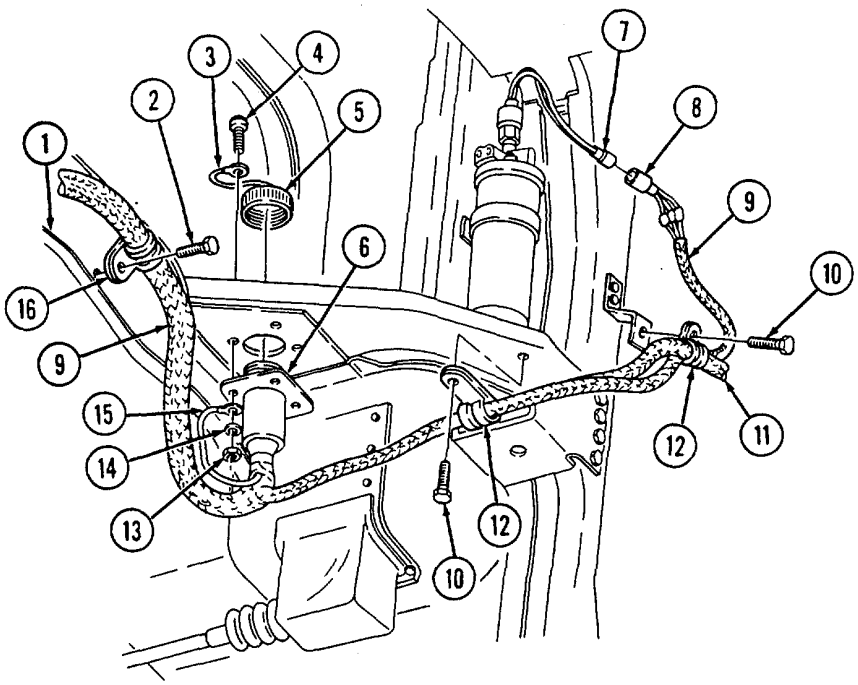
1. Install STE/ICE-R harness (9) on body (1) in approximate mounting location.

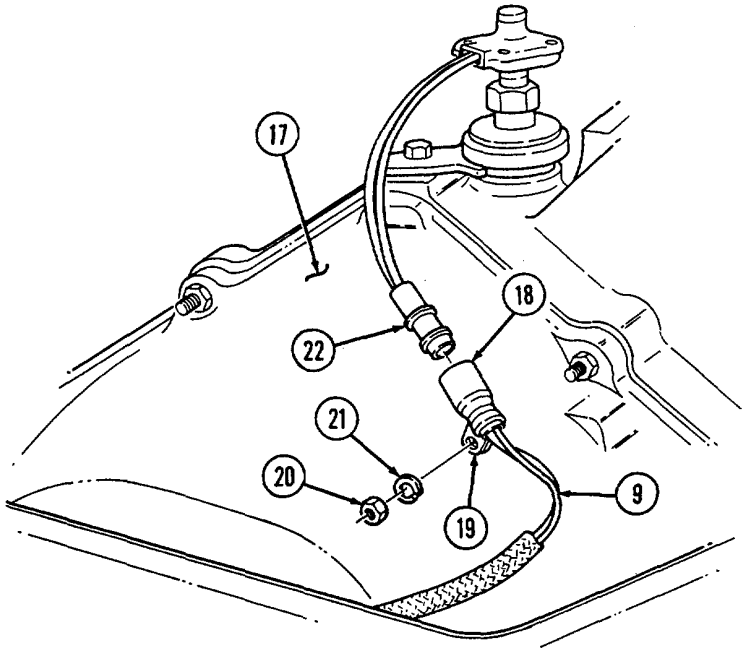
**CAUTION**

Use care when routing harness. Snagging or pulling may cause damage to harness.

2. Connect harness connector (8) to fuel pressure transducer connector (7).
3. Connect harness connector (18) to rpm sensor connector (22).
4. Install harness (9) on transmission (17) with clamp (19), lockwasher (21), and nut (20).
5. Install harness (9) and body harness (11) on body (1) with two clamps (12) and screws (10). Finger tighten screws (10).
6. Install DCA assembly (6) on body (1) with three screws (4), washers (14), and nuts (13).
7. Apply antiseize compound to harness ground 7C (15). Install cover retainer (3) and harness ground 7C (15) on body (1) and assembly (6) with screw (4), washer (14), and nut (13).
8. Install cover (5) on DCA assembly (6).
9. Install harness (9) on body (1) with three clamps (16) and screws (2). Finger tighten screws (2).

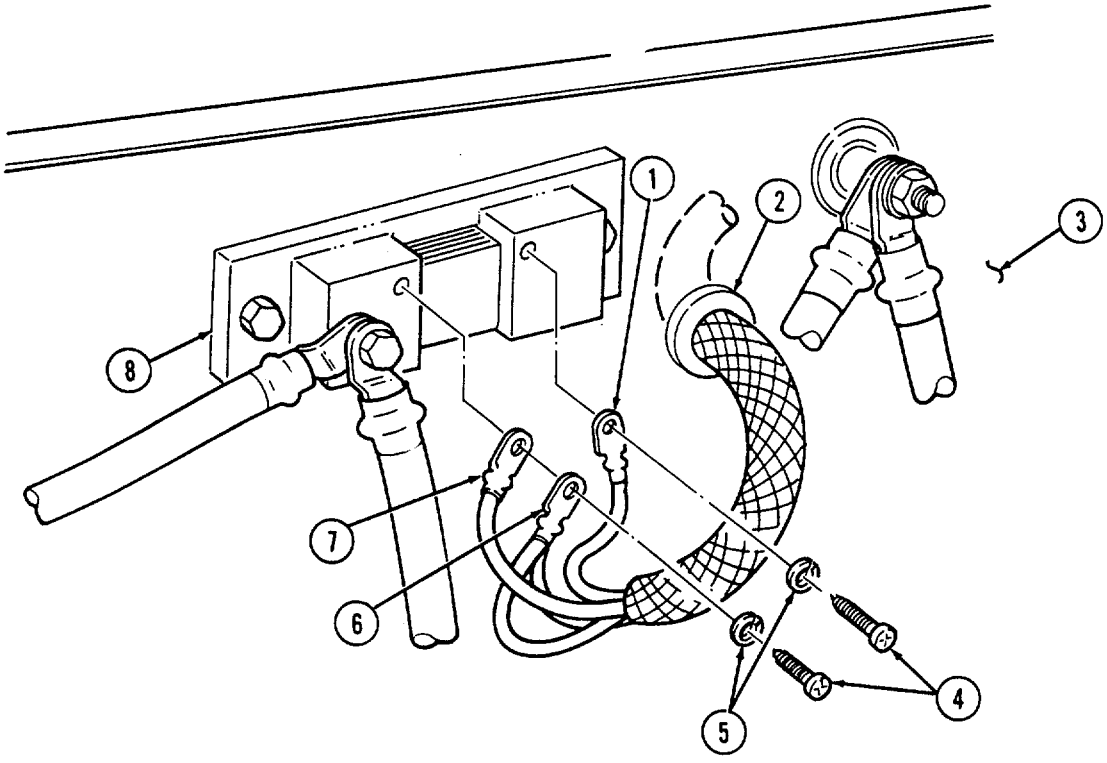
**6 - 7. STE/ICE-R WIRING HARNESS REPLACEMENT (Cont'd)**



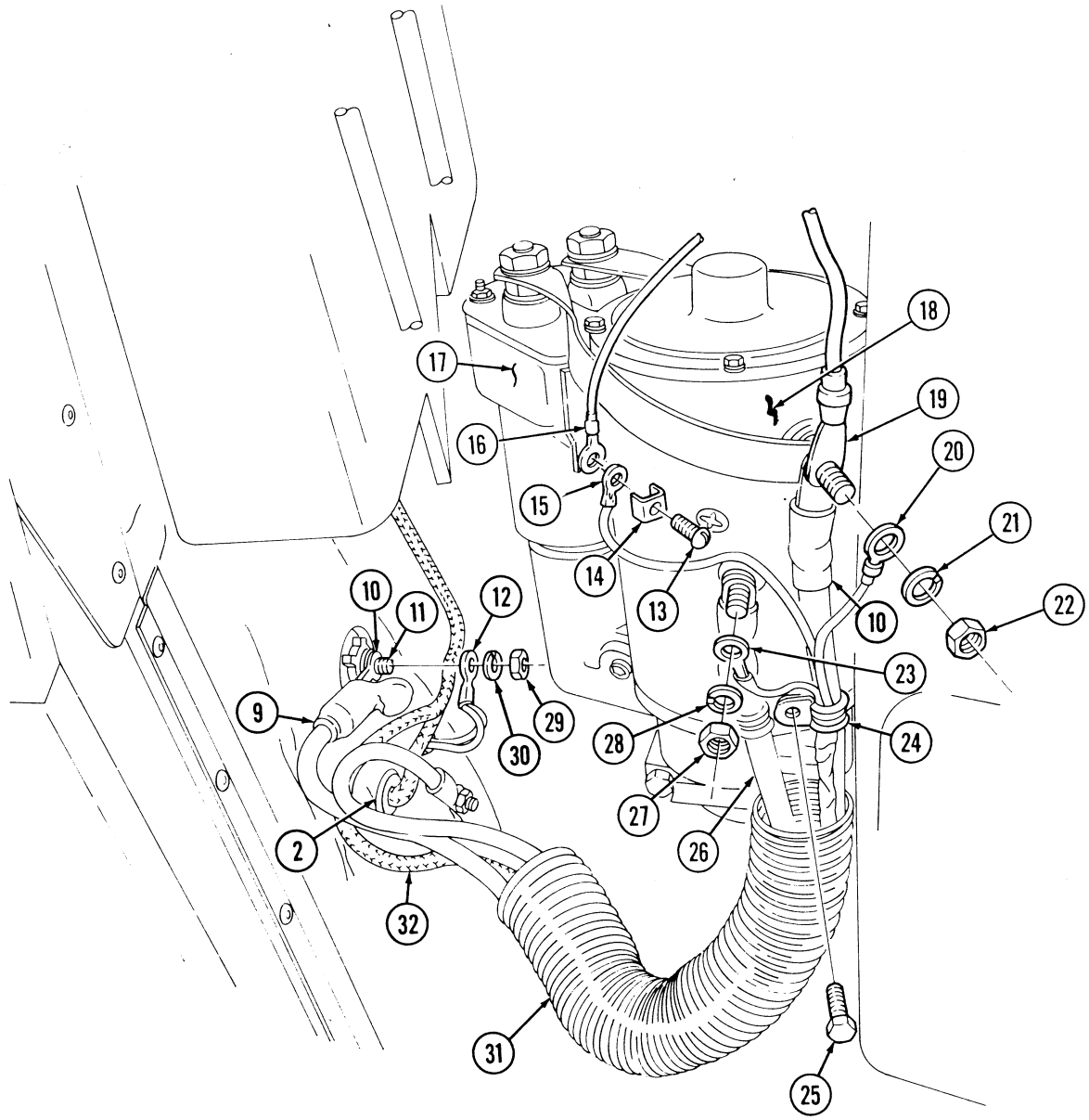



**6 - 7. STE/ICE-R WIRING HARNESS REPLACEMENT (Cont'd)**

10. Slide harness (32) through protective shield (31).
11. Insert harness (32) and grommet (2) into battery compartment (3).
12. Connect harness lead 6B-6C (12) to stud (11) and install lead 6A (10) and 6B-6C (12) with lockwasher (30) and nut (29). Install boot (9) over stud (11).
13. Install harness lead 8A (1) on right side of shunt (8) with lockwasher (5) and screw (4).
14. Install harness leads 7B-7D (6) and 9A (7) on left side of shunt (8) with lockwasher (5) and screw (4).
15. Install leads 74B (15) and 74A (16) on starter solenoid (17) with retainer (14) and screw (13).
16. Connect harness lead 3D (23) to starter (18) and install leads 7A (26) and 3D (23) on starter (18) with lockwasher (28) and nut (27).
17. Connect harness lead 81B (20) to starter (18) and install leads 6A (10), 81B (20), and 81A (19) on starter (18) with lockwasher (21) and nut (22).
18. Install leads 3D (23), 6A (10), 74B (15), and 81B (20) on starter (18) with clamp (24) and screw (25).
19. Tighten nut (27) to 15-20 lb-ft (20-27 N.m). Using torque adapter, tighten nut (22) to 25-30 lb-ft (34-41 N.m).
20. Tighten all clamps securing harness (32).



## 6-7. STE/ICE-R WIRING HARNESS REPLACEMENT (Cont'd)




FOLLOW-ON TASKS:
- Install engine access cover (TM 9-2320-280-20).
- Install battery holddown (TM 9-2320-280-20).
- Perform STE/ICE-R G01, VTM connections and checkout test (TM 9-2320-280-20).

# 6-8. ENGINE WIRING HARNESS REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**

Torque adapter, 3/4 in. (Appendix G, Item 107)

**Materials/Parts**

Nine lockwashers (Appendix E, Item 104)
Lockwasher (Appendix E, Item 100)
Two lockwashers (Appendix E, Item 90)
Lockwasher (Appendix E, Item 103)
Four lockwashers (Appendix E, Item 117)
Two lockwashers (Appendix E, Item 95)
Four lockwashers (Appendix E, Item 118)
Assembled locknut (Appendix E, Item 85)
Two assembled-washer screws
(Appendix E, Item 201)
Adhesive sealant (Appendix B, Item 2)
Silicone compound (Appendix B, Item 57)

**Manual References**

TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Hood raised and secured (TM 9-2320-280-10).
- Battery ground cable disconnected (TM 9-2320-280-20).
- Engine access cover removed (TM 9-2320-280-20).
- Air horn removed (TM 9-2320-280-20).

**Maintenance Level**

Direct support

## a. Removal

**NOTE**

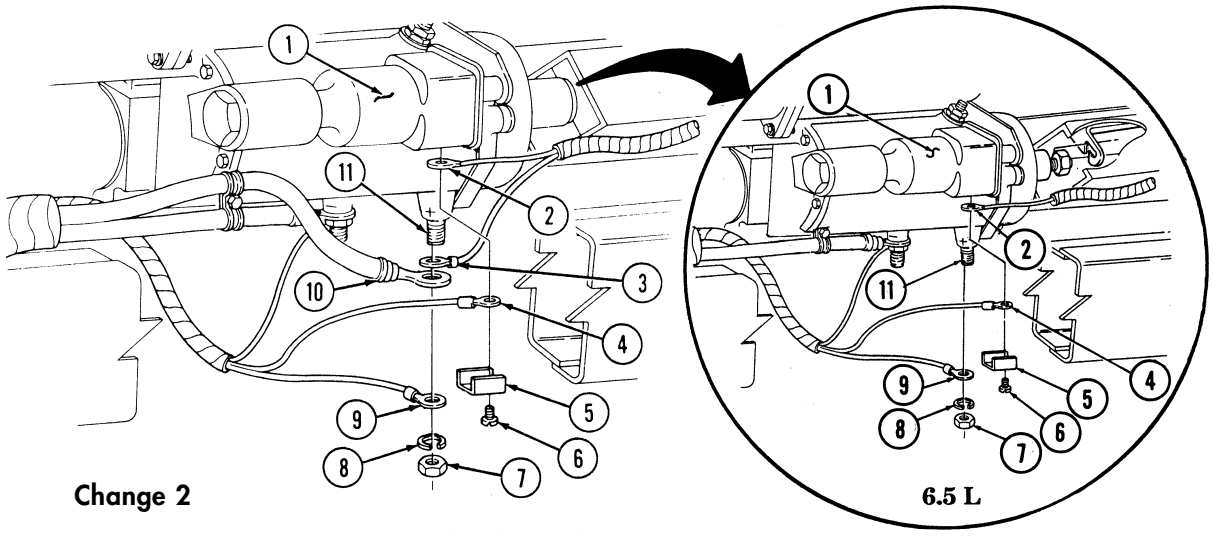
- Prior to removal, tag leads for installation.
- Engine wiring harness replacement for 6.2 L and 6.5 L engines is basically the same. Differences are noted.
- Refer to TM 9-2320-280-20 for repair of wiring harness connectors.

1. Remove nut (7), lockwasher (8), and lead 81B (9) from starter positive terminal (11). Discard lockwasher (8).

**NOTE**

Perform step 2 for 6.2 L only.

2. Disconnect leads 81A (3) and 6A (10) from terminal (11).
3. Remove screw (6), clip (5), and leads 74A (4) and 74B (2) from starter solenoid (1).



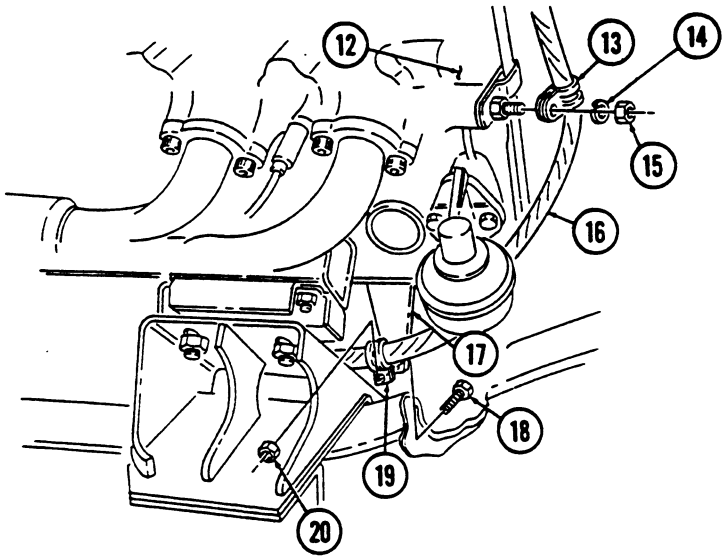
## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

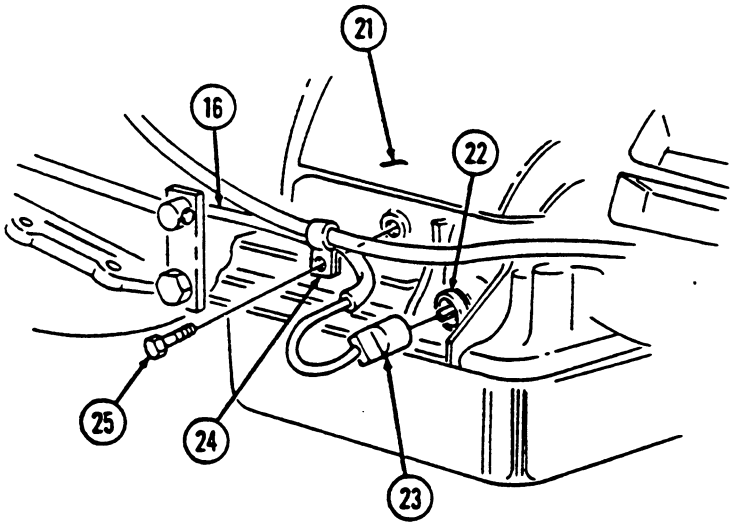
4. Remove capscrew (18), nut (20), clamp (19), and harness (16) from bracket (17).
5. Remove nut (15), lockwasher (14), clamp (13), and harness (16) from cylinder block (12). Discard lockwasher (14).

**NOTE**

Perform steps 6 and 7 for 6.2 L only.

6. Disconnect harness connector 315C (23) from transmission connector (22).
7. Remove screw (25), clamp (24), and harness (16) from transmission (21).



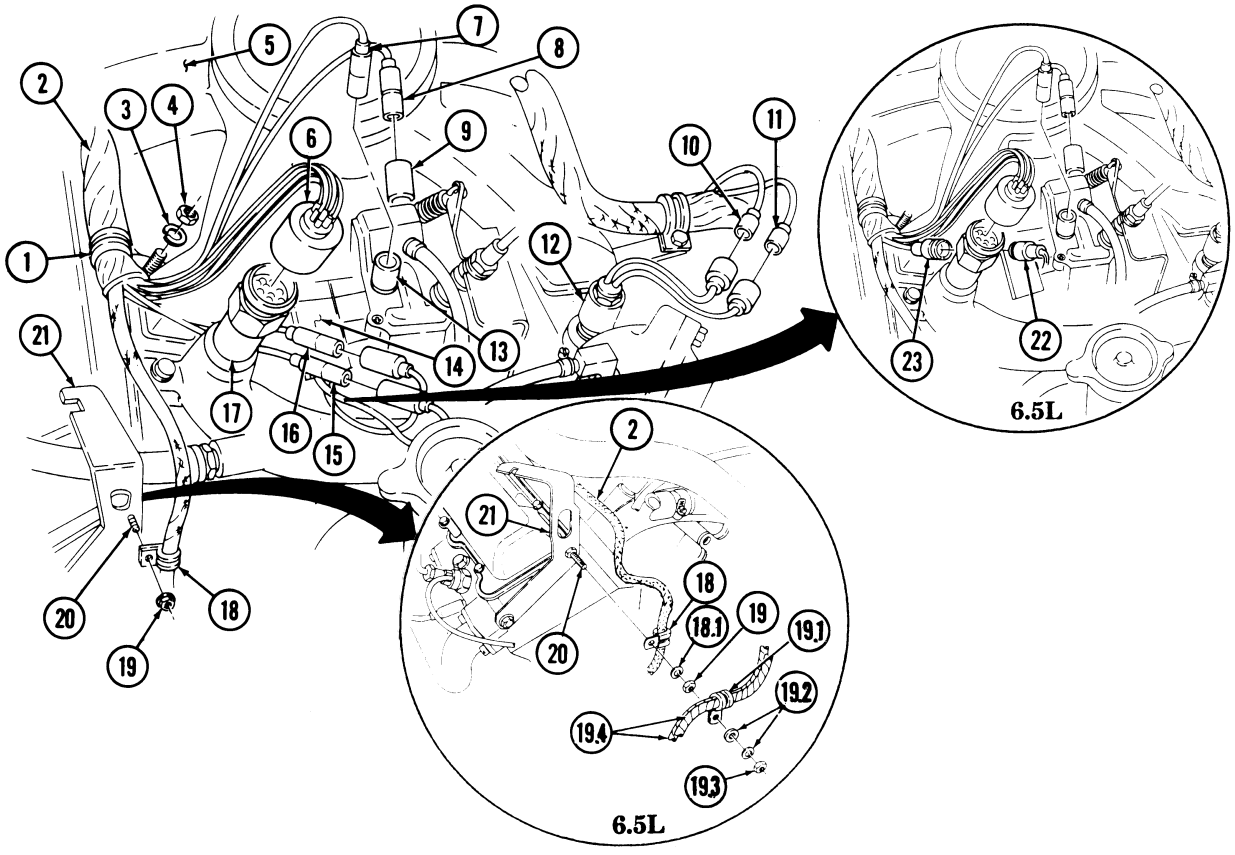
## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

**NOTE**
Perform steps 8.1 and 8.2 for 6.5 L only.

8. Remove nut (19), clamp (18), and harness (2) from stud (20) on support bracket (21).
8.1. Remove nut (19.3), two washers (19.2), clamp (19.1), and two harnesses (19.4) from stud (20) on support bracket (21).
8.2. Remove nut (19), lockwasher (18.1), clamp (18), and harness (2) from stud (20) on support bracket (21). Discard lockwasher (18.1).
9. Remove nut (4), lockwasher (3), clamp (1), and harness (2) from intake manifold (5). Discard lockwasher (3).
10. Disconnect harness connector (6) from glow plug controller (17).

**NOTE**
Perform step 11 for 6.2 L and step 12 for 6.5 L.

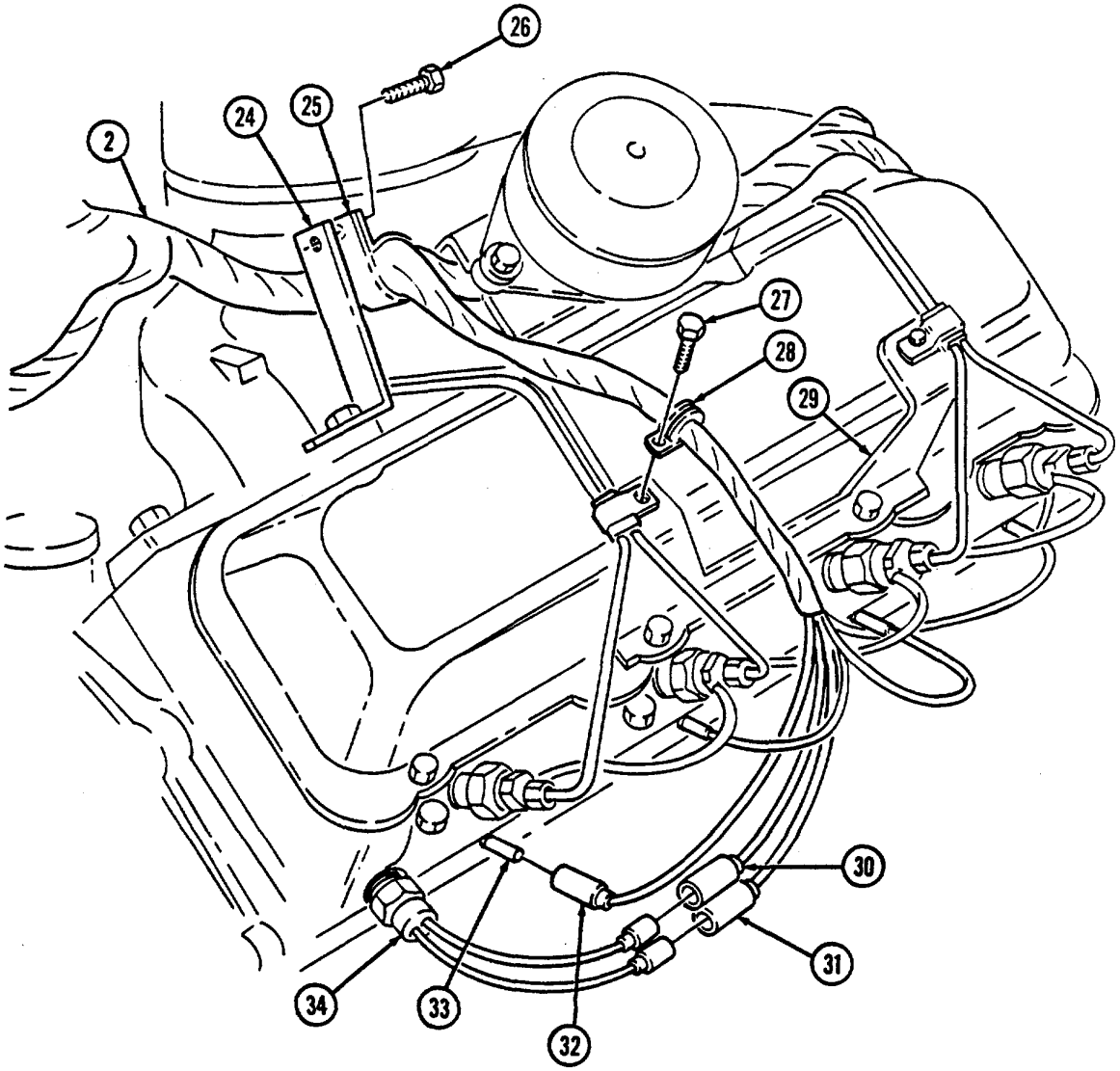
11. Disconnect leads 315A (16) and 315B (15) from transmission kickdown switch (14).
12. Disconnect lead 359E/355A/350B (23) from transmission TP sensor lead (22).
13. Disconnect leads 54A (7) and 569B (8) from fuel injection pump terminals (9) and (13).
14. Disconnect leads 458A (10) and 458B (11) from fan clutch temperature switch (12).
15. Disconnect leads 569A (30) and 569B (31) from cold advance switch (34).
16. Disconnect four harness boots (32) from glow plugs (33).
17. Remove capscrew (27), clamp (28), and harness (2) from rocker arm cover bracket (29).
18. Remove screw (26), clamp (25), and harness (2) from intake manifold bracket (24).



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

TM 9-2320-280-34

6 - 8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

19. Remove capscrew (5), clamp (6), and harness (8) from intake manifold bracket (7).
20. Remove two capscrews (10), clamp (9), and harness (8) from intake manifold bracket (11).
21. Remove capscrew (3), clamp (4), and harness (8) from rocker arm cover bracket (14).
22. Disconnect four harness lead boots (13) at glow plugs (12).
23. Disconnect harness lead 33B (1) at engine temperature sending unit (2).

**NOTE**

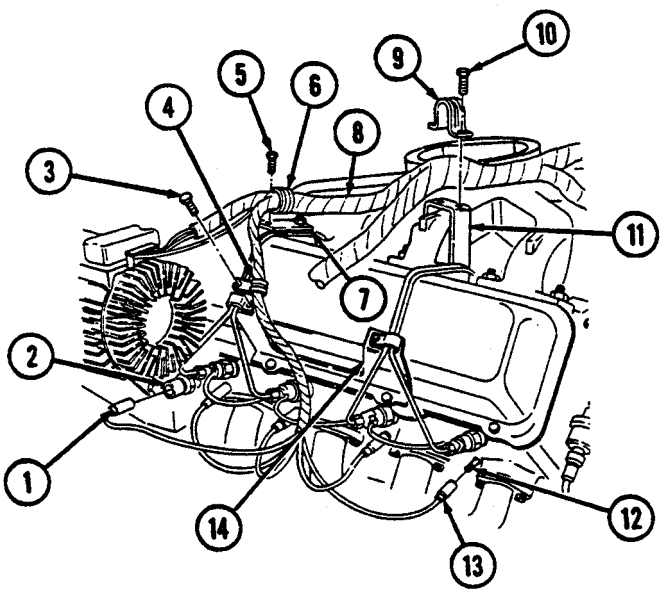
Proceed to steps 30 through 34 for M996, M996A1, M997, and M997A1 only. Perform steps 24 through 29 for all other vehicles.

24. Disconnect lead 568A (32) at alternator (15).
25. Remove two assembled-washer screws (21) and cover (20) from alternator (15). Discard assembled-washer screws (21).
26. Remove sealant from terminals.
27. Remove two screws (26), lockwashers (27), washers (28), retaining strap (29) spacer (30) and washer (31) from alternator (15). Discard lockwashers (27).
28. Remove capscrew (19), lockwasher (18), and lead 3B (17) from alternator (15). Discard lockwasher (18).
29. Remove two nuts (22), lockwashers (23), washers (24), and leads 2A (25) and 5A (16) from alternator (15). Discard lockwashers (23).
30. Remove four screws (48), lockwashers (33), cover (34), and gasket (35) from regulator (39). Discard lockwashers (33).

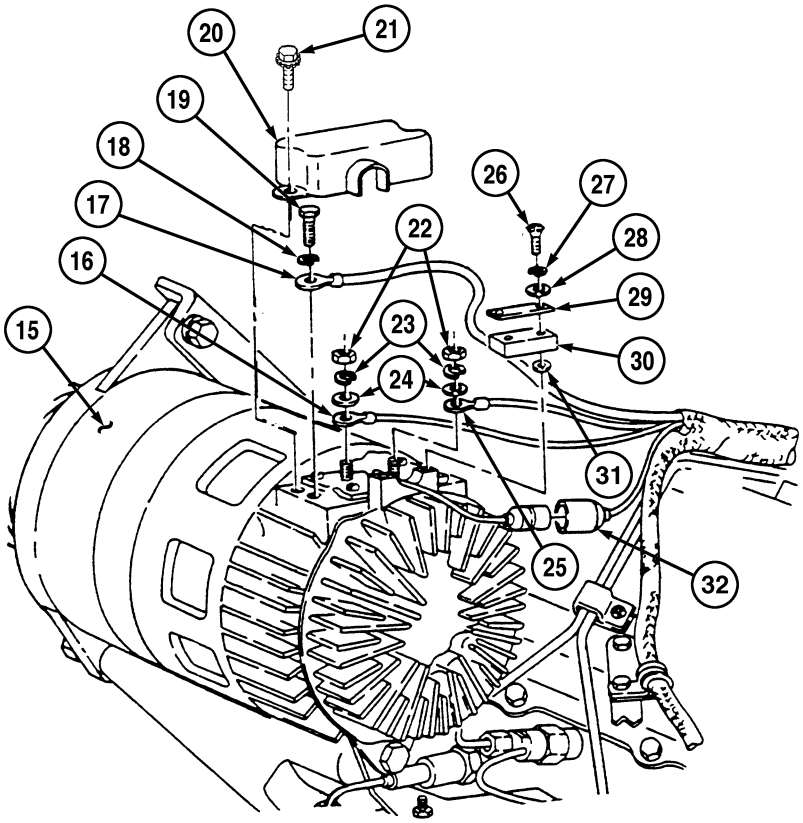
**NOTE**

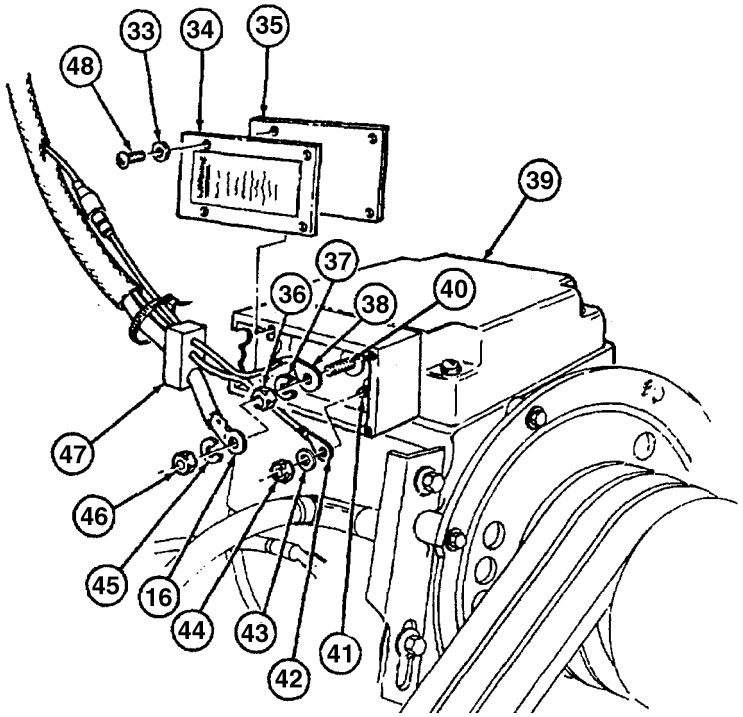
Prior to removal, tag leads for installation.

31. Remove nut (44), washer (43), and lead 2A (42) from stud (41).
32. Remove nut (46), lockwasher (45), and lead 5A (16) from stud (40). Discard lockwasher (45).
33. Remove nut (36), lockwasher (37), and lead 568 (38) from stud (40). Discard lockwasher (37).
34. Remove rubber wedge (47) from opening in regulator (39).



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)



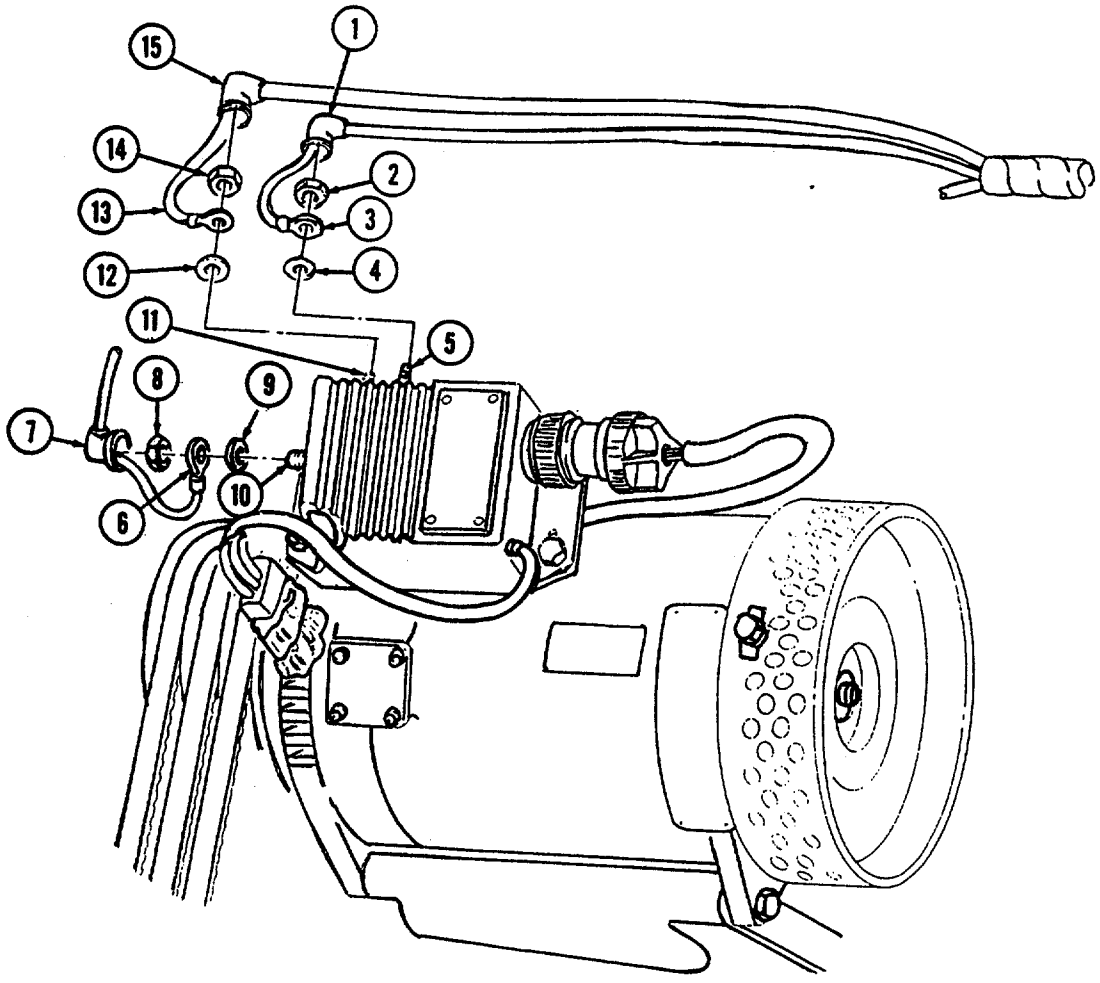



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

**NOTE**

- Perform steps 35 through 37 for 200 amp regulator only.
- Prior to removal, tag leads for installation.

35. Slide back rubber boot (15) and remove nut (14), lead 5A (13), and washer (12) from red (energize) terminal (11).
36. Slide back rubber boot (1) and remove nut (2), lead 2A (3), and washer (4) from yellow (AC) terminal (5).
37. Slide back rubber boot (7) and remove nut (8), lead (6), and washer (9) from terminal (10).



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

**NOTE**

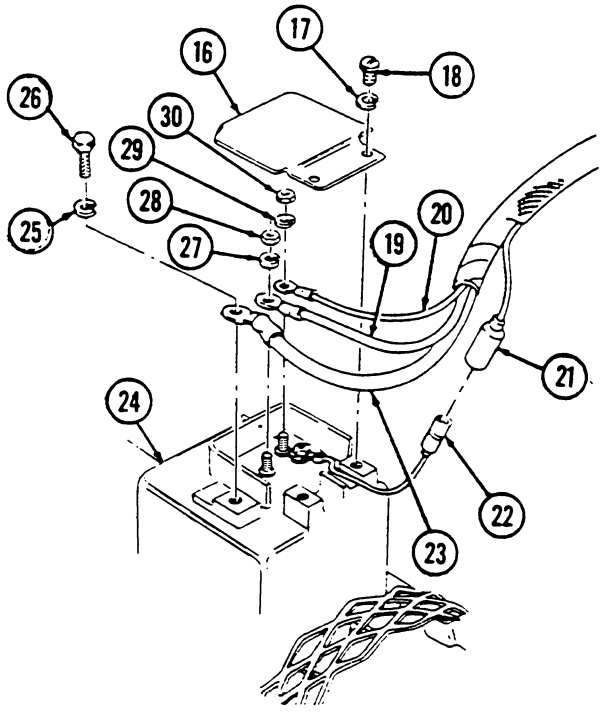
- Perform steps 39 through 46 for 100 amp regulator only.
- Prior to removal, tag leads for installation.
- Older model regulators have two screws connecting regulator cover and terminals sealed with sealant. Newer model regulators have four screws connecting regulator cover and no sealant. Identify which type is on vehicle and follow particular model steps as noted.

38. Remove capscrew (26), lockwasher (25), and lead 3B (23) from regulator (24). Discard lockwasher (25).

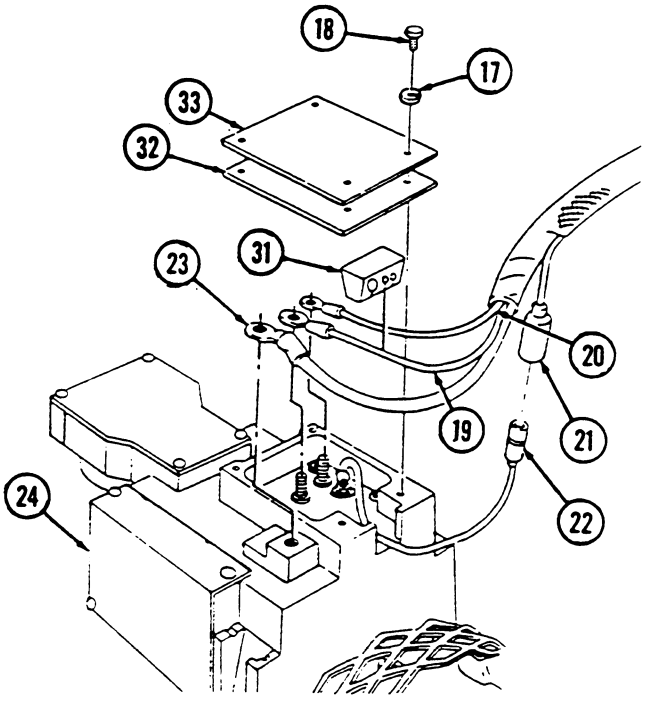
**NOTE**

Perform steps 39 and 40 for older model regulators and step 41 for newer models.

39. Remove two screws (18), lockwashers (17), and cover (16) from regulator (24). Discard lockwashers (17).
40. Remove sealant from cover (16), leads (19), (20), (22), and regulator (24).
41. Remove four screws (18), lockwashers (17), cover (33), and gasket (32) from regulator (24). Remove sealing wedge (31) from leads. Discard lockwashers (17).
42. Remove nut (28), lockwasher (27), and lead 5A (19) from regulator (24). Discard lockwasher (27).
43. Remove nut (30), lockwasher (29), and lead 2A (20) from regulator (24). Discard lockwasher (29).
44. Disconnect lead 568 (21) from regulator lead (22).




NEWER MODEL REGULATORS



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

**NOTE**

Perform step 45 for 6.5 L only.

45. Disconnect fan cut-off switch leads 315 (1) from harness leads 315A/315B (2).
46. Remove capscrew (6) and leads 58A (5) and 3A (4) from cylinder head (3).
47. Disconnect harness leads 33A (10) and 58B (13) from body harness leads 33A (11) and 58B (12).

**NOTE**

Perform step 48 for 6.2 L only.

48. Remove nut (8), lockwasher (9), clamp (7), and harness (15) from transmission (14). Discard lockwasher (9).

**NOTE**

To gain access to nut it may be necessary to disconnect arctic heater hose.

49. Remove assembled locknut (26) and lead 3C (27) from body (25). Discard assembled locknut (26).
50. Remove two screws (24), clamp (16), and harness (15) from body (25).
51. Remove capscrew (19), nut (18), clamp (20), and harness (15) from body (25).
52. Disconnect harness connector (21) from fan clutch time delay (17).
53. Disconnect harness connector plug (22) from protective control box connector (23).
54. Remove harness (15) from engine.

**b. Installation**

**NOTE**

Refer to TM 9-2320-280-20 for repair of wiring harness connectors.

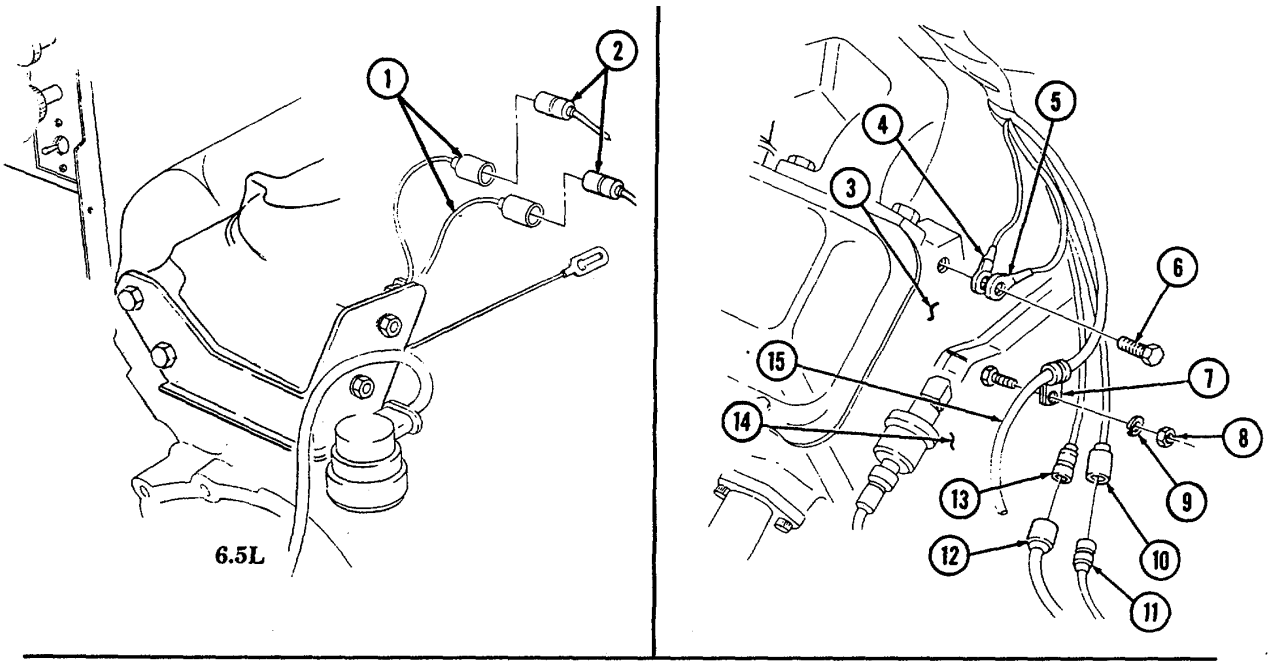
1. Position harness (15) in approximate mounting location.
2. Connect harness connector plug (22) on protective control box connector (23).
3. Connect harness connector (21) on fan clutch time delay (17).
4. Install harness (15) on body (25) with clamp (16) and two screws (24).
5. Install harness (15) on body (25) with clamp (20), capscrew (19), and nut (18).
6. Apply antiseize compound to lead 3C (27) and install lead 3C (27) on body (25) with assembled locknut (26).
7. Connect harness leads 33A (10) and 58B (13) to body harness leads 33A (11) and 58B (12).
8. Install harness (15) on transmission (14) with clamp (7), lockwasher (9), and nut (8).
9. Apply antiseize compound to leads 3A (4) and 58A (5) and install on cylinder head (3) with capscrew (6).

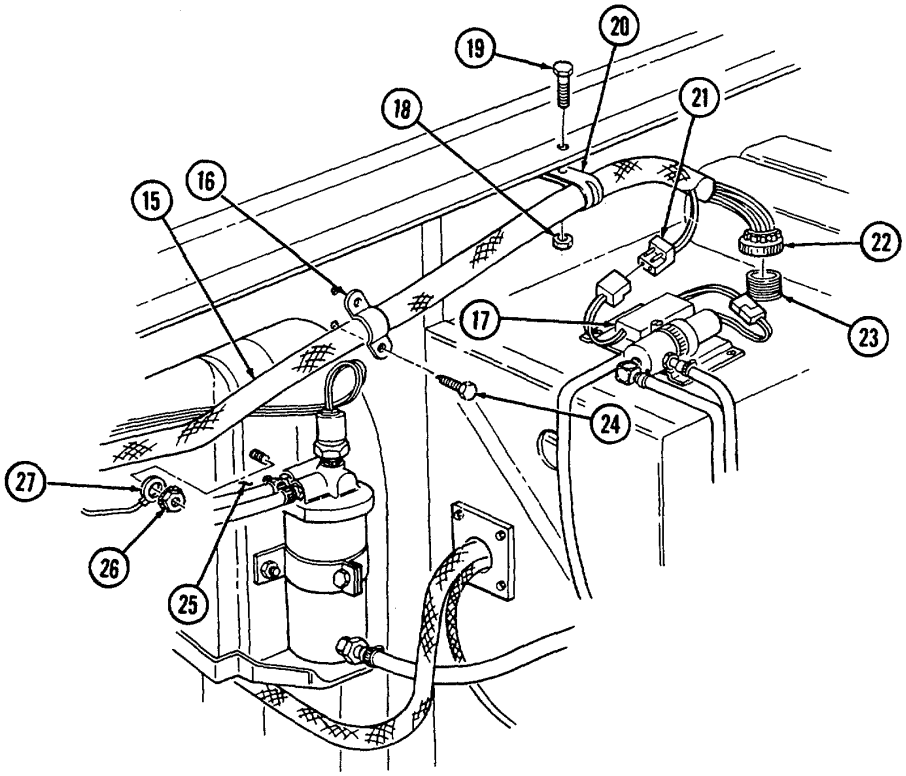
**NOTE**

Perform step 10 for 6.5 L only.

10. Connect fan cut-off switch leads 315 (1) to harness 315A/315B leads (2).

## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)



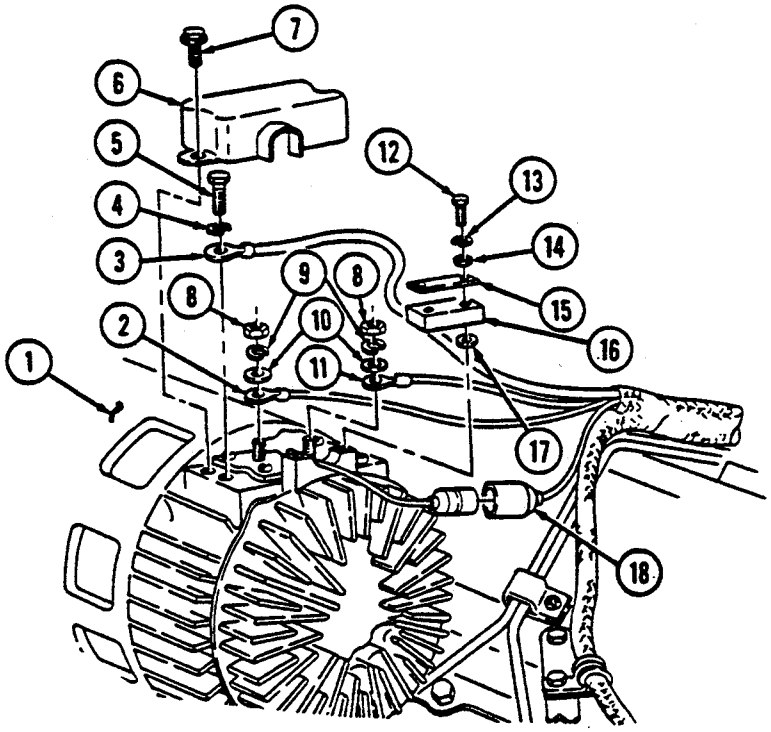



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

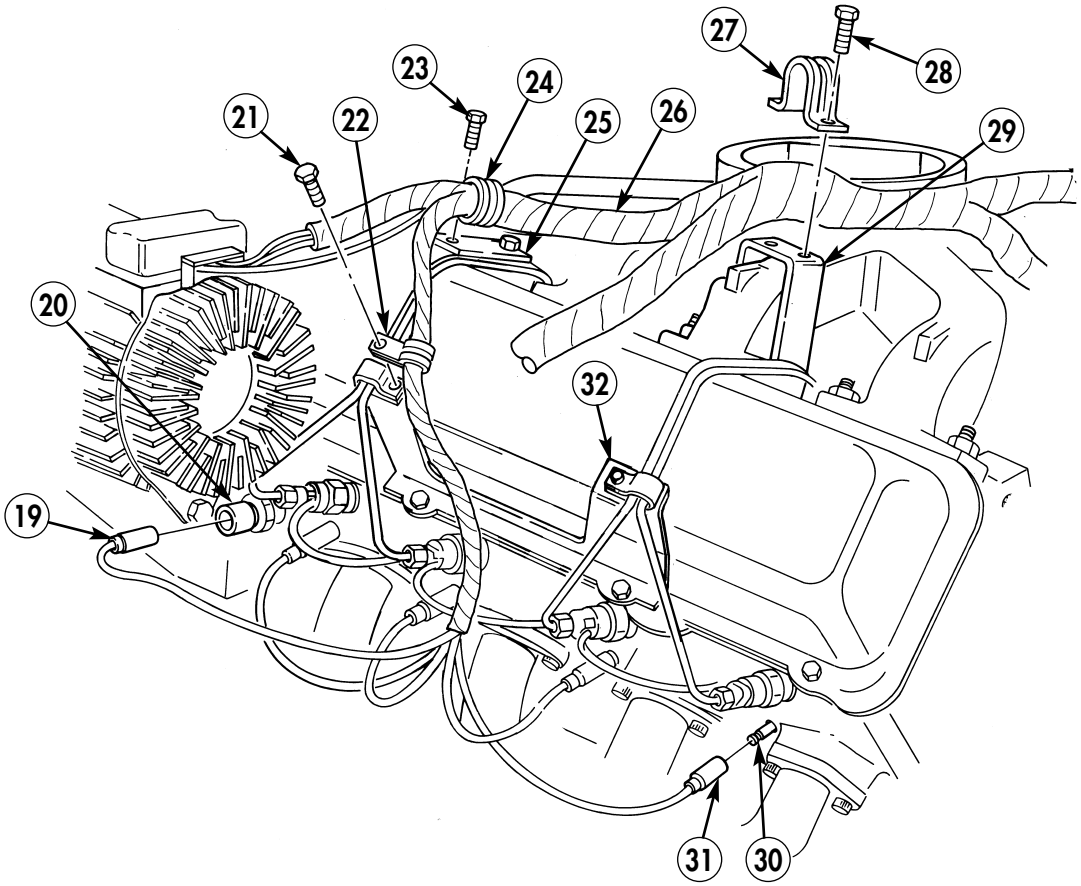
**NOTE**

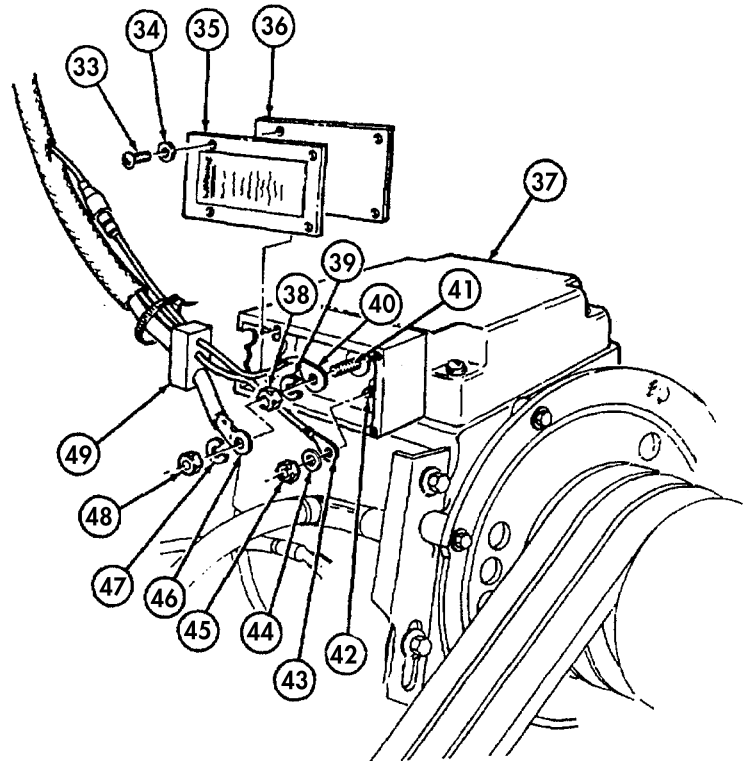
Proceed to steps 17 through 21 for M996, M996A1, M997, and M997A1 only. Perform steps 11 through 16 for all other vehicles.

11. Connect harness lead 568A (18) to alternator (1).
12. Connect harness leads 2A (11) and 5A (2) to alternator (1) with two washers (10), lockwashers (9), and nuts (8).
13. Install washer (17), spacer (16), and retaining strap (15) on alternator (1) with two washers (14), lockwashers (13), and screws (12).
14. Apply adhesive-sealant to alternator terminals.
15. Install cover (6) on alternator (1) with two assembled-washer screws (7).
16. Apply antiseize compound to harness lead 3B (3) and secure to alternator (1) with lockwasher (4) and capscrew (5).
17. Install lead 568 (40) on stud (41) with lockwasher (39) and nut (38).
18. Install lead 5A (46) on stud (41) with lockwasher (47) and nut (48).
19. Install lead 2A (43) on stud (42) with washer (44) and nut (45).
20. Install rubber wedge (49) in opening of regulator (37).
21. Install gasket (36) and cover (35) on regulator (37) with four lockwashers (34) and screws (33).
22. Connect four harness boots (31) to glow plugs (30).
23. Connect harness lead 33B (19) to engine temperature sending unit (20).
24. Install harness (26) on rocker arm cover bracket (32) with clamp (22) and screw (21).
25. Install harness (26) on intake manifold bracket (25) with clamp (24) and capscrew (23).
26. Install harness (26) on intake manifold bracket (29) with clamp (27) and two capscrews (28).



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)



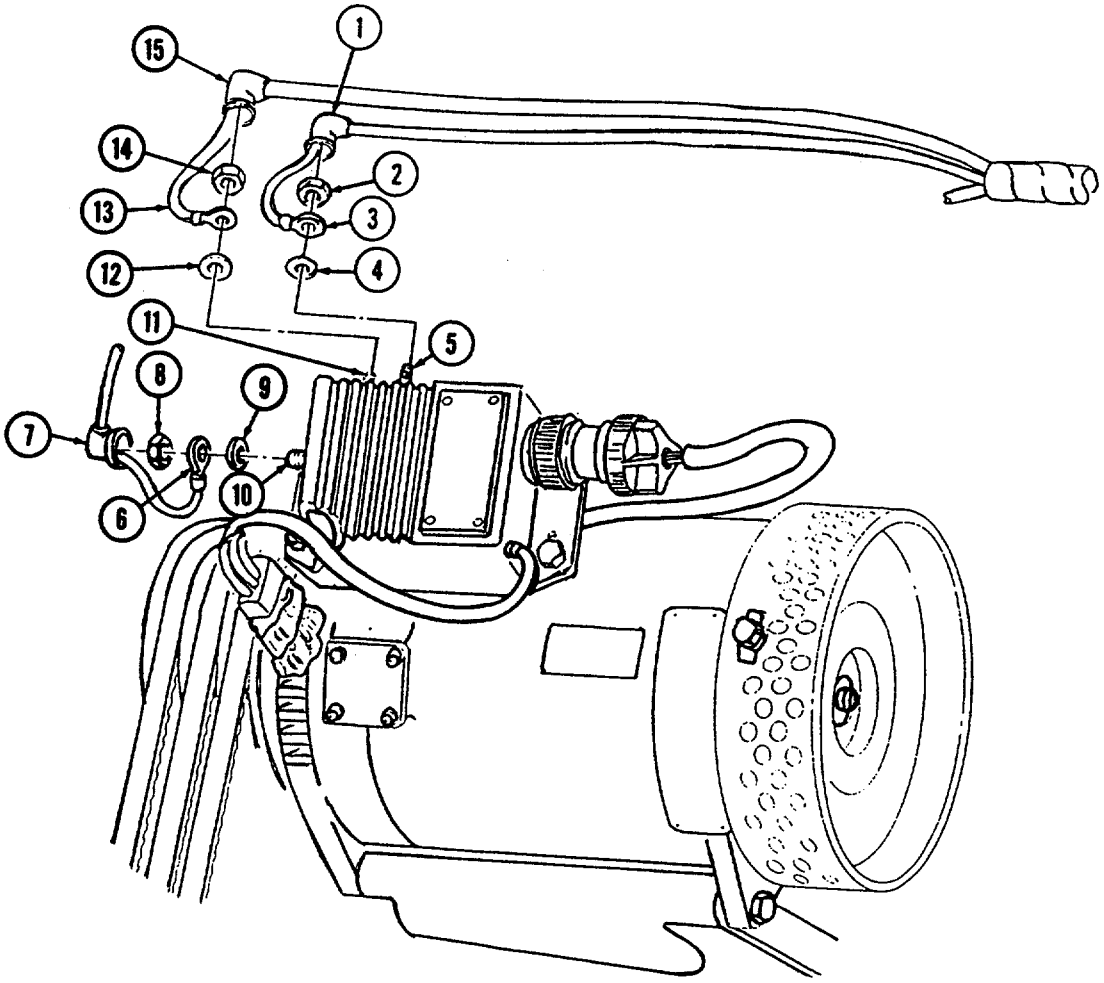



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

**NOTE**

Perform steps 27 through 29 for 200 amp regulator only.

27. Install washer (9), lead (6), and nut (8) on terminal (10). Tighten nut (8) to 18-22 lb-in. (2.0-2.5 N•m). Slide rubber boot (7) over terminal (10).
28. Install washer (12), lead 5A (13), and nut (14) on red (energize) terminal (11). Tighten nut (14) to 23-27 lb-in. (2.6-3.0 N•m). Slide rubber boot (15) over terminal (11).
29. Install washer (4), lead 2A (3), and nut (2) on yellow (AC) terminal (5). Tighten nut (2) to 18-22 lb-in. (2.0-2.5 N•m). Slide rubber boot (1) over terminal (5).



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

**NOTE**

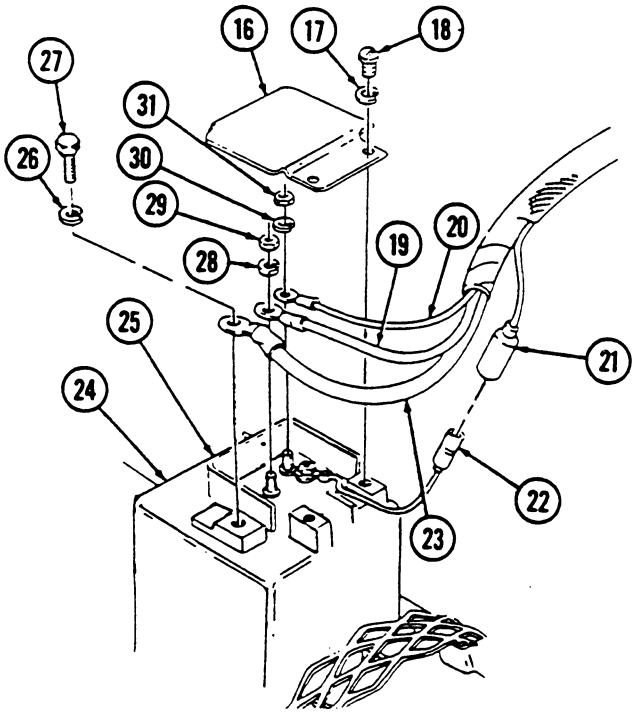
- Perform steps 30 through 37 for 100 amp regulator only.
- Ensure terminals are clean before connections are made.

30. Connect lead 568A (21) to regulator lead (22).
31. Connect lead 2A (20) to regulator (24) with lockwasher (30) and nut (31). Tighten nut (31) to 20 lb-in. (2.3 N•m).
32. Connect lead 5A (19) to regulator (24) with lockwasher (28) and nut (29). Tighten nut (29) to 50 lb-in. (5.6 N•m).

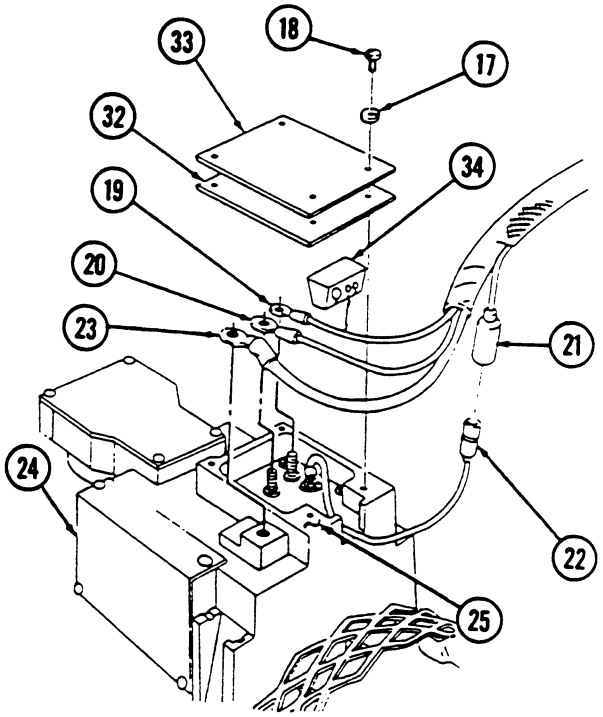
**NOTE**

Perform steps 33 and 34 for older model regulators, and steps 35 and 36 for newer model regulators.

33. Completely fill regulator cavity (25) with sealant to form a water tight seal. Sealant should extrude from side of cover (16) when installed.
34. Install cover (16) on regulator (24) with two lockwashers (17) and screws (13).
35. Insert leads (19), (20), and (23) into sealing wedge (34) and install sealing wedge (34) in regulator cavity (25).
36. Install gasket (32) and cover (33) on regulator (24) with four lockwashers (17) and screws (18).
37. Apply antiseize compound to contact surface of lead 3B (23). Install lead 3B (23) on regulator (24) with lockwasher (26) and capscrew (27). Tighten capscrew (27) to 90 lb-in. (10 N•m).




NEWER MODEL REGULATORS



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)

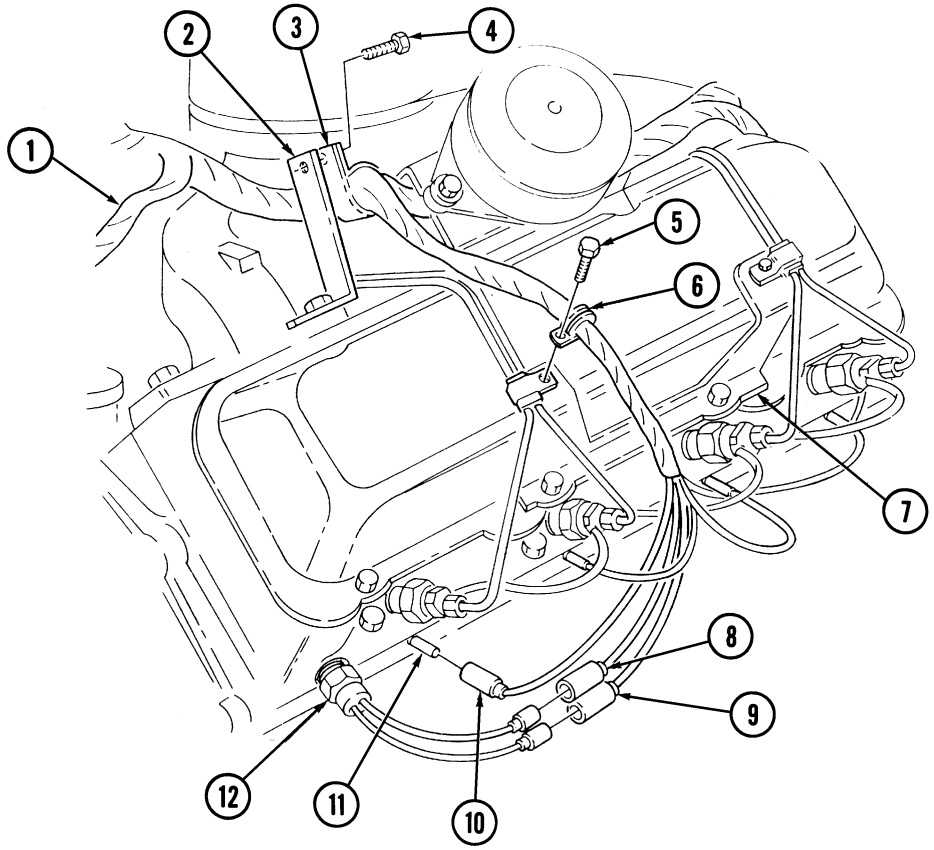
38. Connect four harness boots (10) to glow plugs (11).
39. Connect harness leads 569A (8) and 569B (9) to cold advance switch (12).
40. Install harness (1) on rocker arm cover bracket (7) with clamp (6) and capscrew (5).
41. Install harness (1) on intake manifold bracket (2) with clamp (3) and capscrew (4).
42. Connect harness connector (17) to glow plug controller (28).

**NOTE**
Perform step 43 for 6.5 L, and step 44 for 6.2 L.

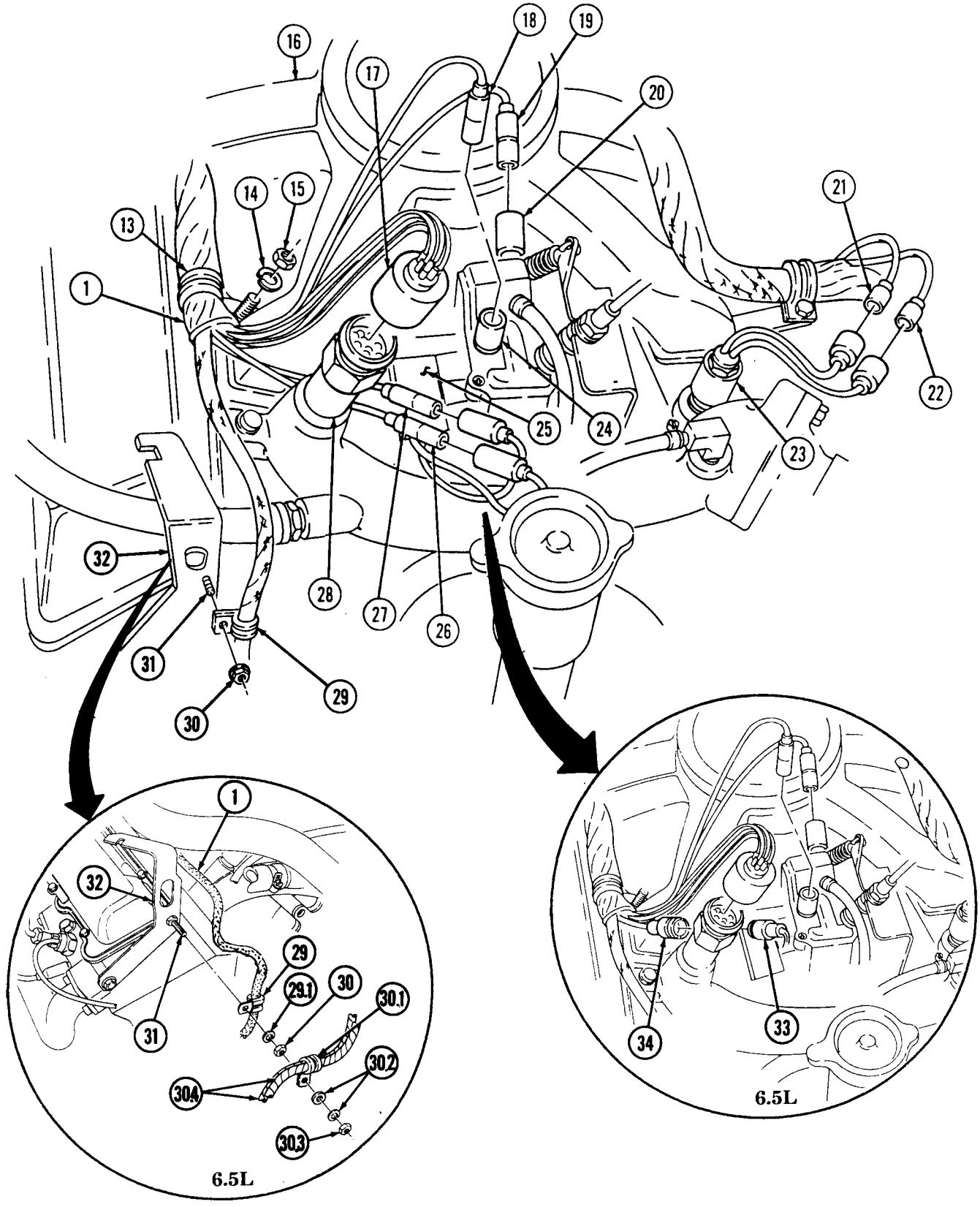
43. Connect harness lead 359E/355A/350B (34) to transmission TP sensor (33).
44. Connect harness leads 315A (27) and 315B (26) to transmission kickdown switch (25).
45. Connect harness leads 54A (18) and 569B (19) to fuel injection pump terminals (20) and (24).
46. Connect harness leads 458A (21) and 458B (22) to fan clutch temperature switch (23).
47. Install harness (1) with clamp (29) on stud (31) on support bracket (32) with nut (30).

**NOTE**
Perform steps 47.1 and 47.2 for 6.5 L only.

47.1. Install harness (1) to stud (31) on support bracket (32) with clamp (29), lockwasher (29.1), and nut (30).
47.2. Install two harnesses (30.4) to stud (31) on support bracket (32) with clamp (30.1), two washers (30.2), and nut (30.3).
48. Install harness (1) on intake manifold (16) with clamp (13), lockwasher (14), and nut (15).



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)



**6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)**

49. Install leads 74A (4) and 74B (2) on starter solenoid (1) with clip (5) and screw (6).

**NOTE**
Only harness lead 81B is connected to positive terminal for 6.5 L.

50. Connect harness leads 81A (3), 81B (9), and 6A (10) to positive terminal (11) with lockwasher (8) and nut (7). Using torque adapter, tighten nut (7) to 39 lb-ft (53 N•m).

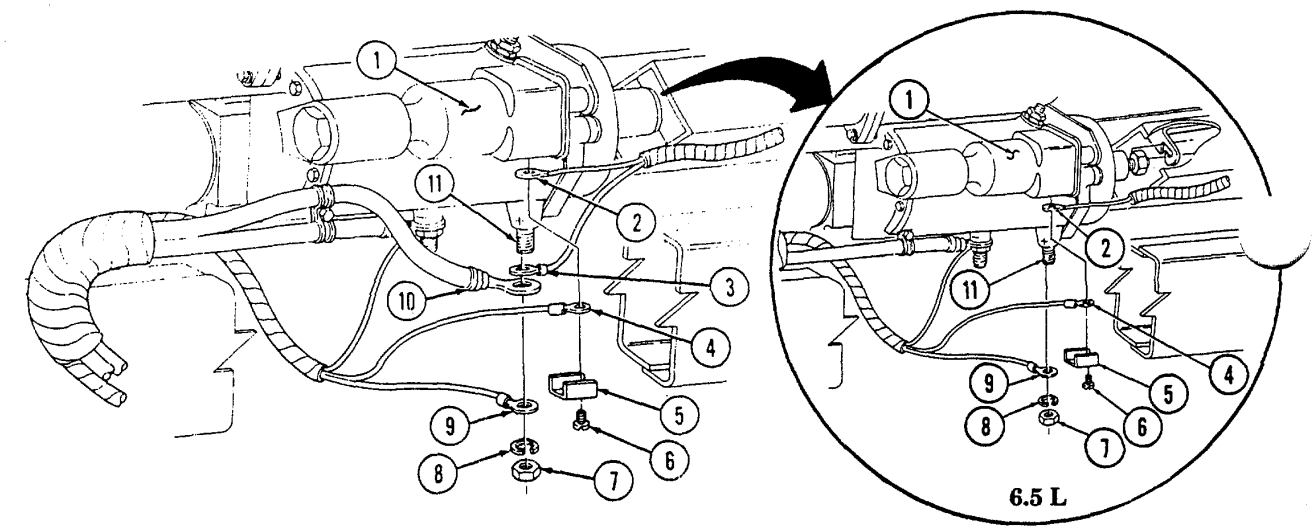
51. Install harness (16) on cylinder block (12) with clamp (13), lockwasher (14), and nut (15).

52. Install harness (16) on bracket (17) with clamp (19), capscrew (18), and nut (20).

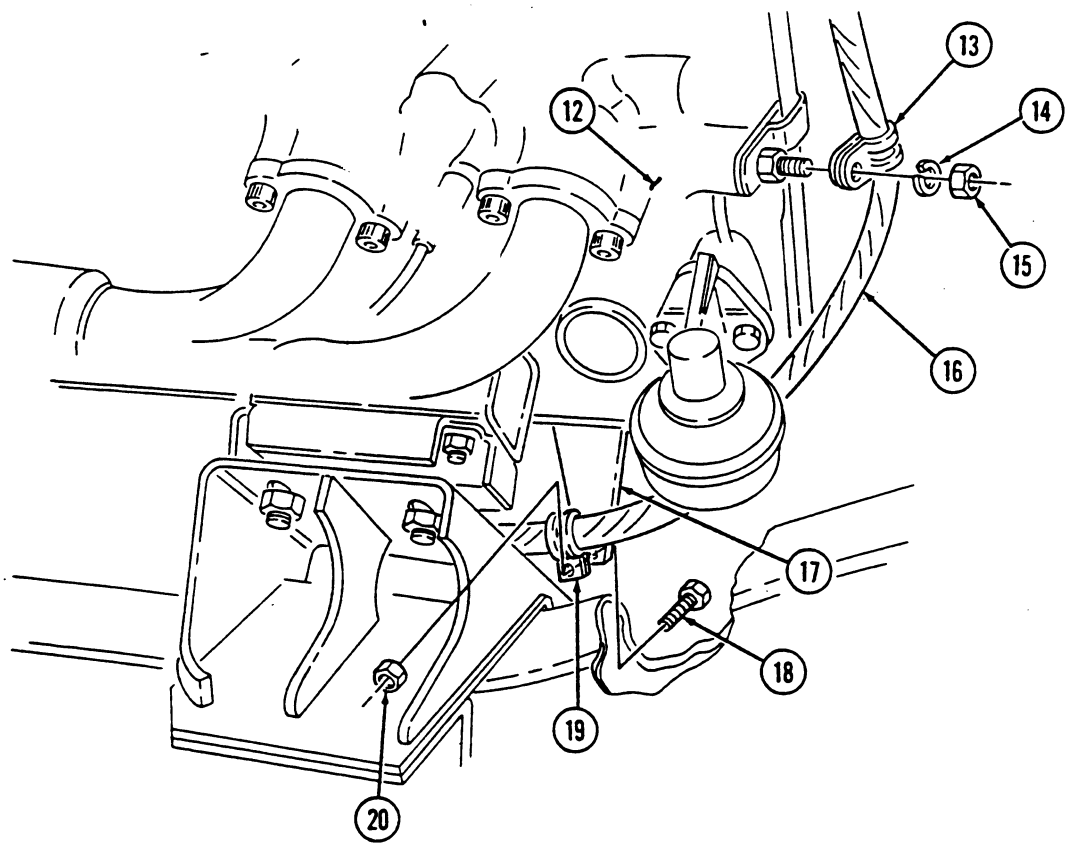
**NOTE**
Do not perform steps 53 and 54 if engine is removed from vehicle.

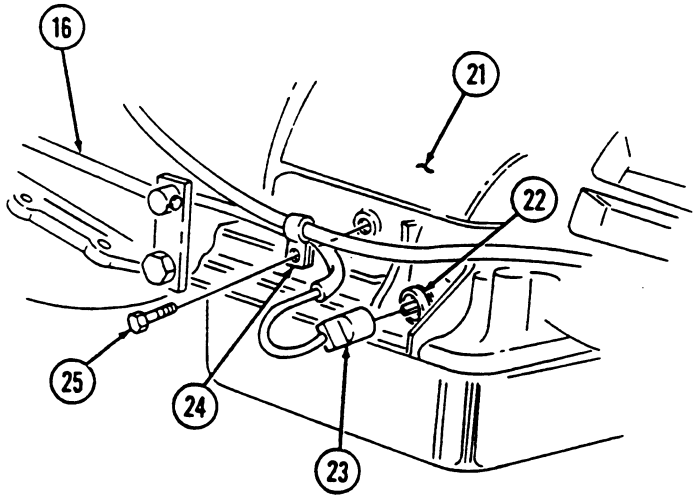
53. Connect harness connector 315C (23) to transmission connector (22).

54 Install harness (16) on transmission (21) with clamp (24) and screw (25).



## 6-8. ENGINE WIRING HARNESS REPLACEMENT (Cont'd)




FOLLOW-ON TASKS:
- Install air horn (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).
- Connect battery ground cable (TM 9-2320-280-20).
- Lower and secure hood (TM 9-2320-280-10).
- Start engine (TM 9-2320-280-10) and check for proper operation.

# 6-9. BODY WIRING HARNESS REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**

Three plain assembled nuts
(Appendix E, Item 123)
Eight assembled locknuts
(Appendix E, Item 85)
Eight locknuts (Appendix E, Item 83)
Eight locknuts (Appendix E, Item 80)
Eight lockwashers (Appendix E, Item 120)
Four tiedown straps (Appendix E, Item 250)
Three assembled-washer screws
(Appendix E, Item 200)
Antiseize compound (Appendix B, Item 7)
Lubricating oil (Appendix B, Item 31)
Silicone compound (Appendix B, Item 56)

**Personnel Required**

One mechanic
One assistant

**Manual References**

TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Engine access cover removed (TM 9-2320-280-20).
- Left splash shield removed (TM 9-2320-280-20).
- Muffler removed (TM 9-2320-280-20).
- Heater ducting removed (TM 9-2320-280-20).
- Left defroster nozzle removed (TM 9-2320-280-20).
- Instrument cluster removed (TM 9-2320-280-20).
- Rear side marker light lenses removed (TM 9-2320-280-20).

**Maintenance Level**

Direct support

**a. Removal**

**CAUTION**

Use care when removing harness. Snagging or pulling may cause damage to harness.

**NOTE**

- Prior to removal, tag leads for installation.
- Body wiring harness replacement for 6.2 L and 6.5 L engines is basically the same. Differences are noted.
- Refer to TM 9-2320-280-20 for repair of wiring harness connectors.

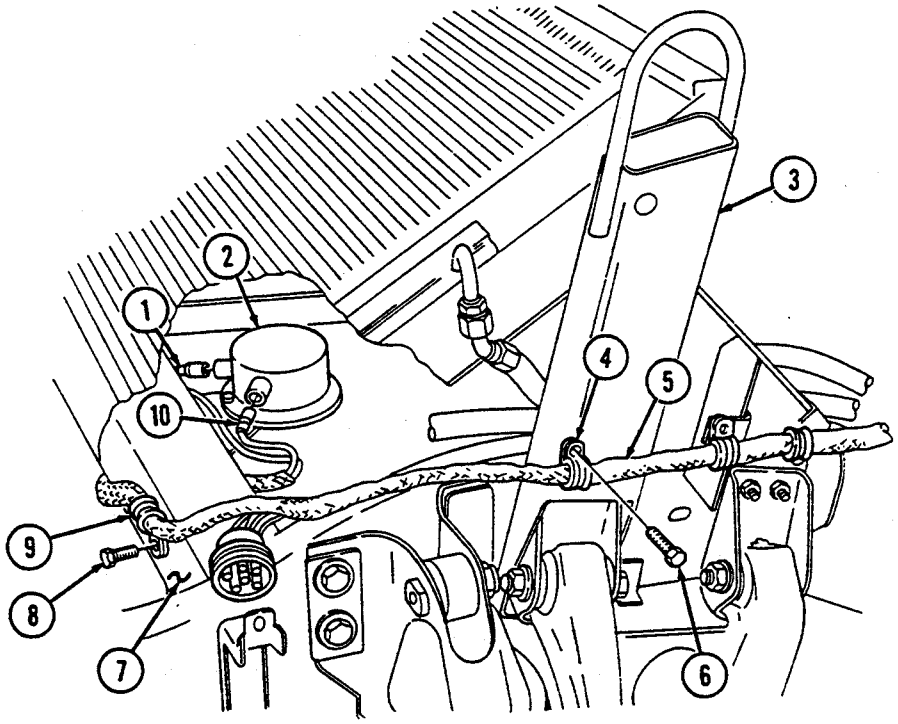
1. Remove three screws (6), clamps (4), and harness (5) from left airlift bracket (3).
2. Disconnect harness leads 25A (10) and 26A (1) from horn (2).
3. Remove screw (8), clamp (9), and harness (5) from crossmember (7).
4. Disconnect harness connector (16) from brake warning lamp switch (17).
5. Remove three capscrews (20), plain assembled nuts (18), clamps (19), and harness (5) from cowl (14). Discard plain assembled nuts (18).
6. Remove assembled locknut (22), clamp (21), and harness (5) from cowl (14). Discard assembled locknut (22).

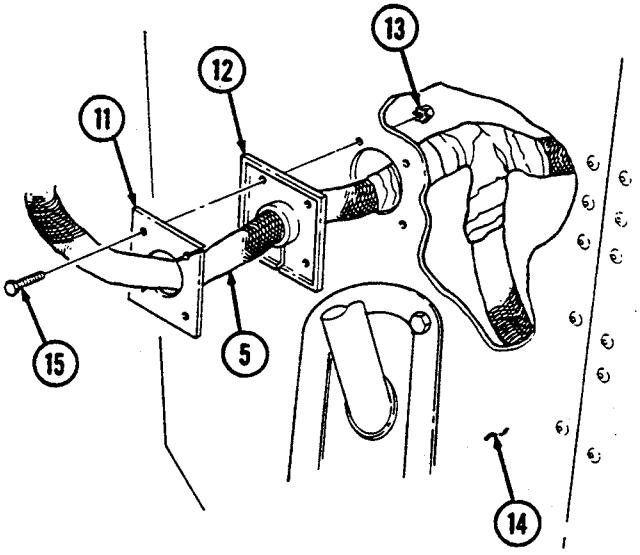
**NOTE**

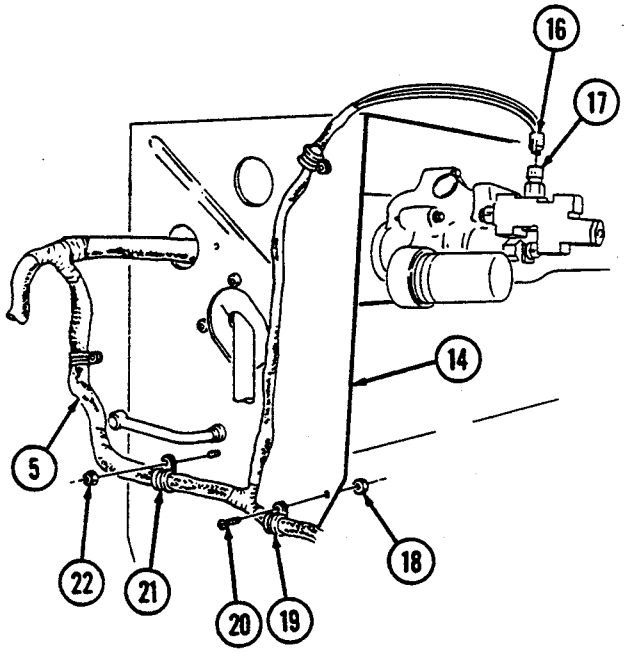
The top screws connecting the closeout plate may be longer than the rest, if the fuel filter drain tube is routed to the top of the closeout plate.

7. Remove four nuts (13), screws (15), closeout plate (11), and grommet (12) from cowl (14).
8. Remove closeout plate (11) and grommet (12) from harness (5).

## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

9. Disconnect harness leads 67C (30) and 67E (31) from parking brake switch (25).
10. Disconnect harness leads 14A (1), 14B (2), and 40F (34) from shift controls housing (35).

**NOTE**

Perform step 11 for M1035, M1035A1 and M1035A2 only.

11. Disconnect harness leads 467C (32) and 457D (33) from shift controls housing (35).
12. Remove screws (11) and (8), clamps (7) and (9), and harnesses (6) and (10) from body (21).

**NOTE**

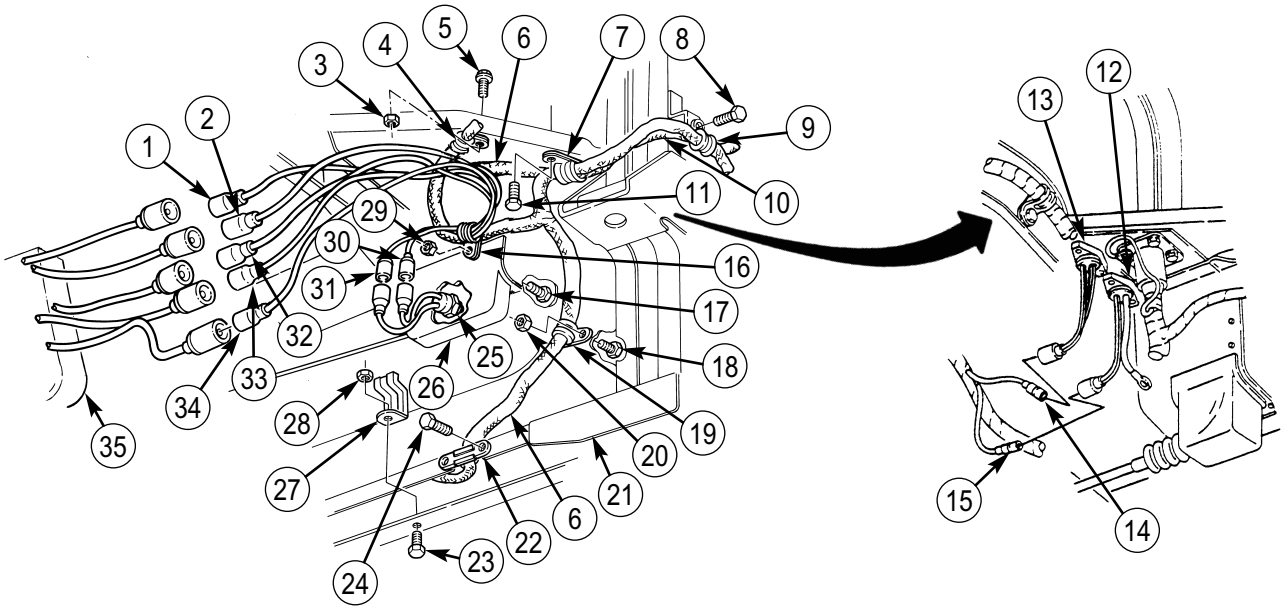
Perform step 13 for 6.5 L only.

13. Disconnect harness leads (14) and (15) from transmission and transfer case indicator lights (12) and (13).
14. Remove two screws (24), clamp (22), and harness (6) from body (21).
15. Remove capscrew (18), nut (20), clamp (19), and harness (6) from body (21).
16. Remove assembled locknut (29), capscrew (17), clamp (16), and harness (6) from parking brake boot (26). Discard assembled locknut (29).
17. Remove capscrew (5), nut (3), clamp (4), and harness (6) from body (21).
18. Remove four capscrews (23), locknuts (28), clamps (27), and harness (6) from body (21). Discard locknuts (28).
19. Disconnect harness lead 36A (36) from engine oil pressure sending unit (37).
20. Disconnect harness leads 33A (40) and 58B (41) from engine harness leads 33A (39) and 58B (38).

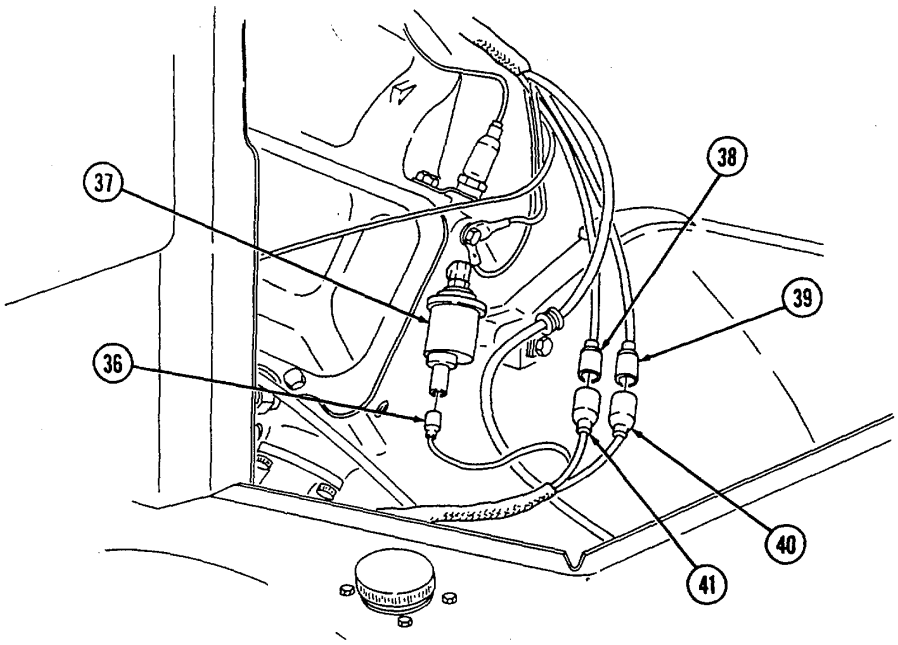
**NOTE**

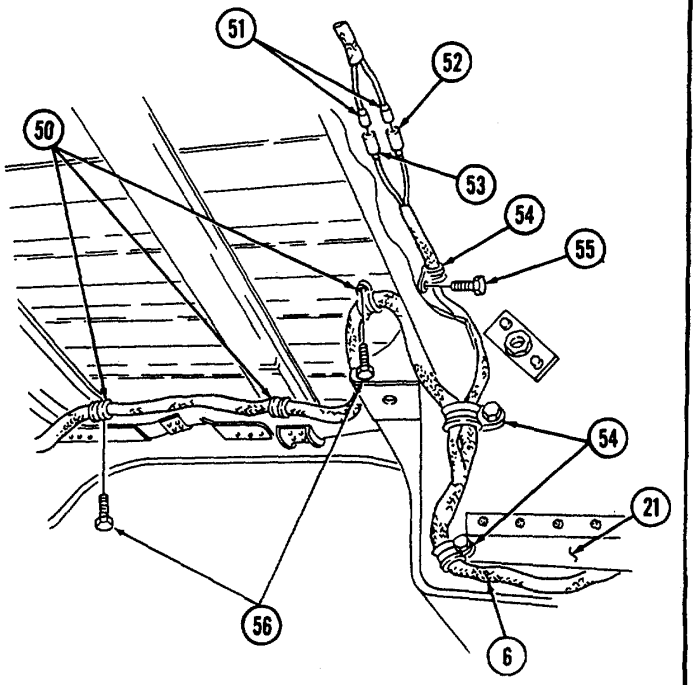
Perform steps 21 and 22 for 6.5 L only.

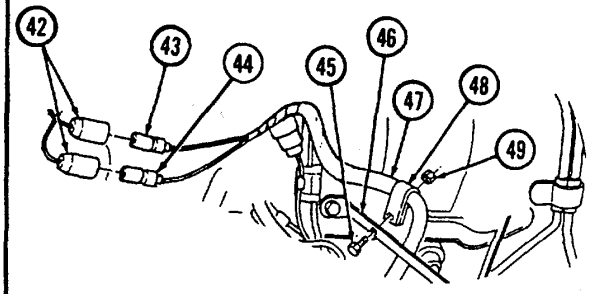
21. Remove screw (45), clamp (48), nut (49), and body harness (47) from dipstick support bracket (46).
22. Disconnect two leads 458A (42) from leads 458c (44) and 458d (43).
23. Disconnect harness leads 28A (52) and 58C (53) from fuel tank jumper harness (51).
24. Remove three screws (55), clamps (54), and harness (6) from body (21).
25. Remove three screws (56), clamps (50), and harness (6) from body (21).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)




6.5 L

**6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)**

**NOTE**

Perform steps 26 through 36 for 6.5 L only.

26. Disconnect harness connector (2) from RPM sensor (1).

27. Disconnect wiring harness connector (9) from transmission (8).

28. Disconnect connectors 497/498 (6) and 495/496 (10) from output and input speed sensors (7) and (11).

29. Remove two capscrews (3), washers (4) and clamps (5) from sensors (7) and (11).

30. Disconnect two leads (17) from transfer case switch leads (16) on transfer case (15).

31 Remove four tiedown straps (13) and harness (12) from speedometer cable (14). Discard tiedown straps (13).

32. Disconnect harness connector (18) from TCM (19).

**NOTE**

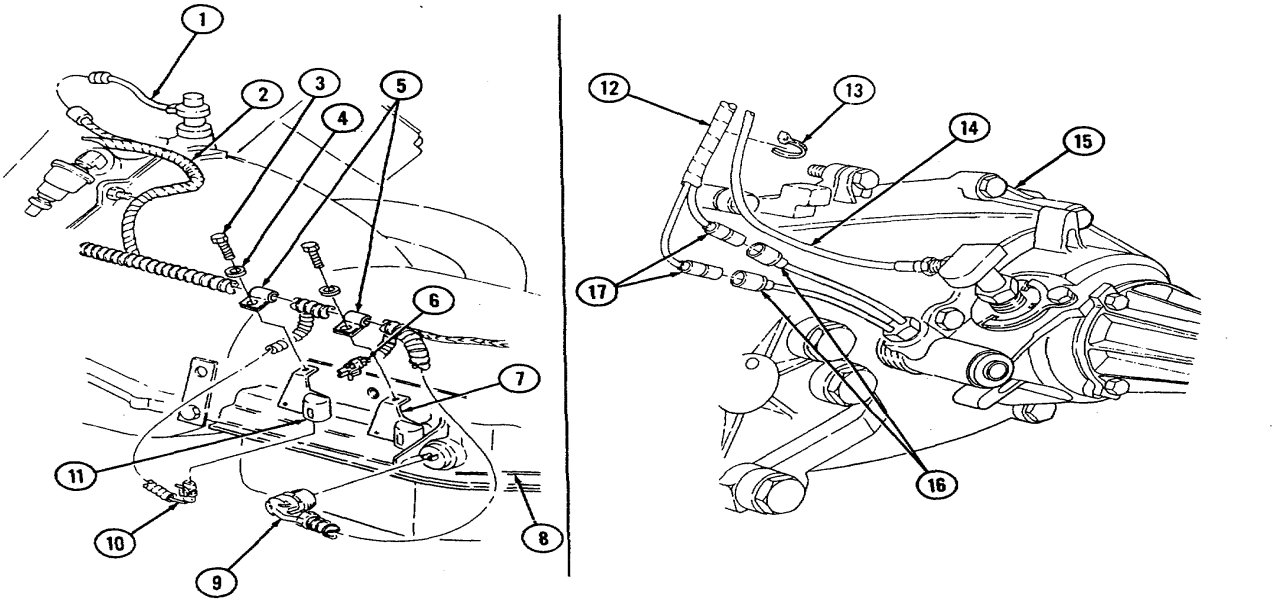
M1025A2 and M1043A2 are equipped with four capscrews.

33. Remove five capscrews (21), two washers (23) and coverplate (20) from "B" beam (22).

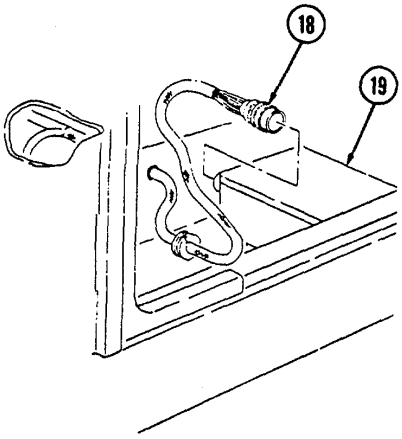
34. Disconnect two harness leads (24) from transmission relay 290A/291A leads (25).

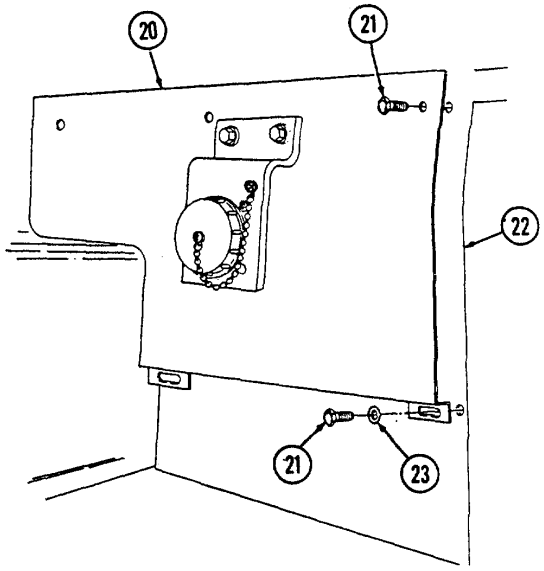
35. Remove screw (27) and lead (31) from circuit breaker (26).

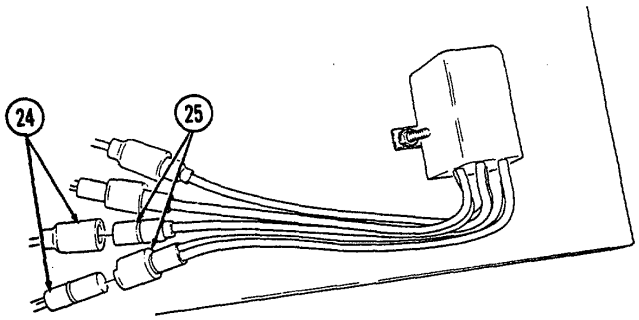
36. Push three leads 11C, 290A/291A (24) and lead (31) through rear grommet (28) and lead 537 (31) thr ough grommet(29) in battery box (30).

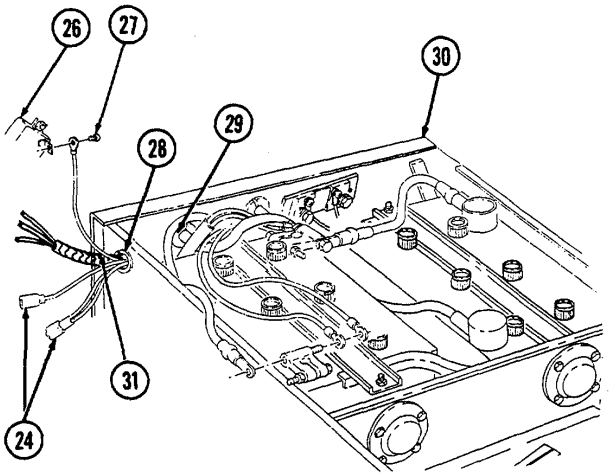


## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)



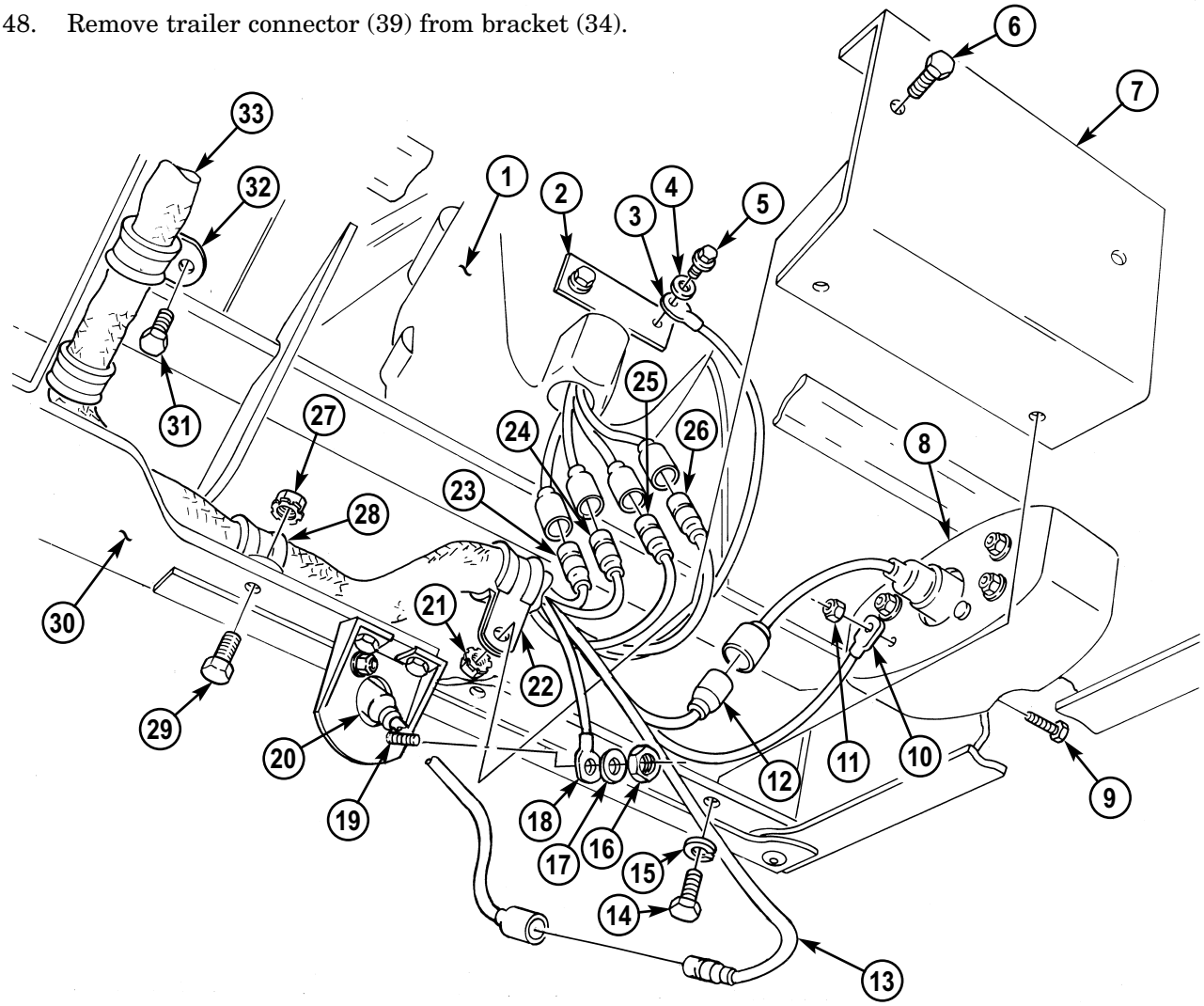
## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

37. Remove two screws (31), clamps (32), and harness (33) from body (30).
38. Remove capscrew (29), assembled locknut (27), clamp (28), and harness (33) from body (30). Discard assembled locknut (27).
39. Remove two screws (14), lockwashers (15), and shield (7) from body (30). Discard lockwashers (15).
40. Remove two capscrews (6), assembled locknuts (21), clamps (22), and harness (33) from shield (7). Discard assembled locknuts (21).
41. Disconnect harness lead 489A (12) at left rear side marker light (8).
42. Disconnect harness leads 21C (23), 22-461B (24), 23B (25), and 24B (26) at left rear composite light (1).

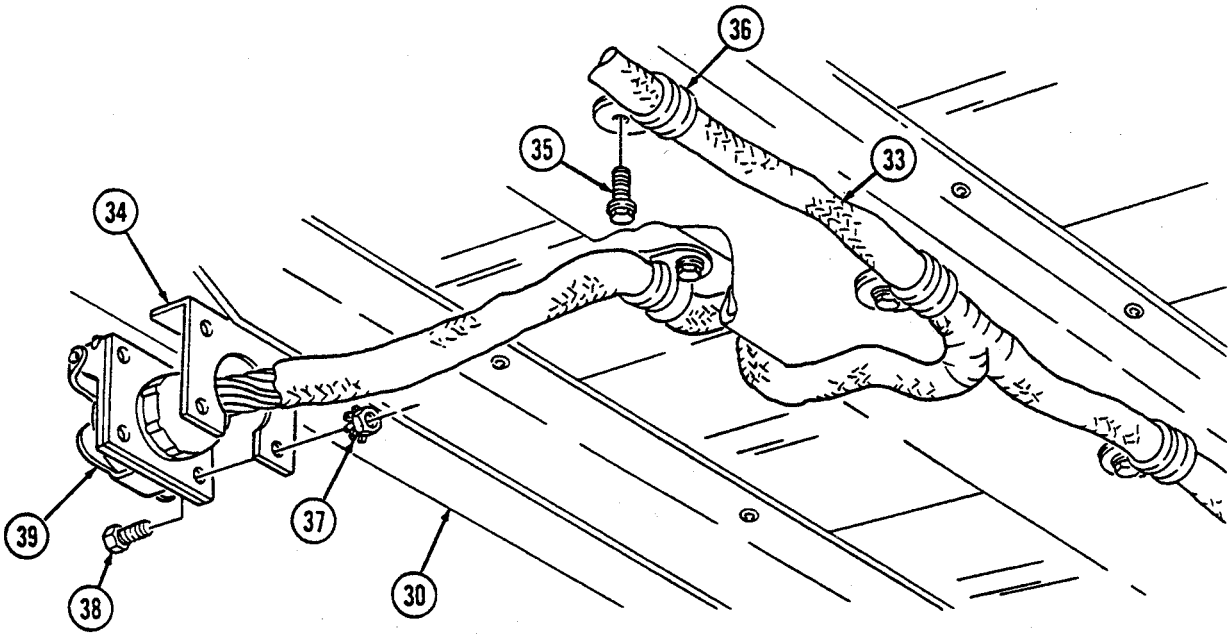
**NOTE**

Perform step 43 for M1035, M1035A1 and M1035A2 only.

43. Disconnect harness lead 467E (13) from backup light (20). Remove nut (16), lockwasher (17), and ground lead 95D (18) from stud (19). Discard lockwasher (17).
44. Remove nut (11), screw (9), and harness ground lead 95C (10) from left rear side marker light (8).
45. Remove capscrew (5), washer (4), and harness ground lead 95B (3) from buss bar (2).
46. Remove five screws (35), clamps (36), and harness (33) from body (30).
47. Remove four capscrews (38), locknuts (37), and trailer connector (39) from bracket (34). Discard locknut (37).
48. Remove trailer connector (39) from bracket (34).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)



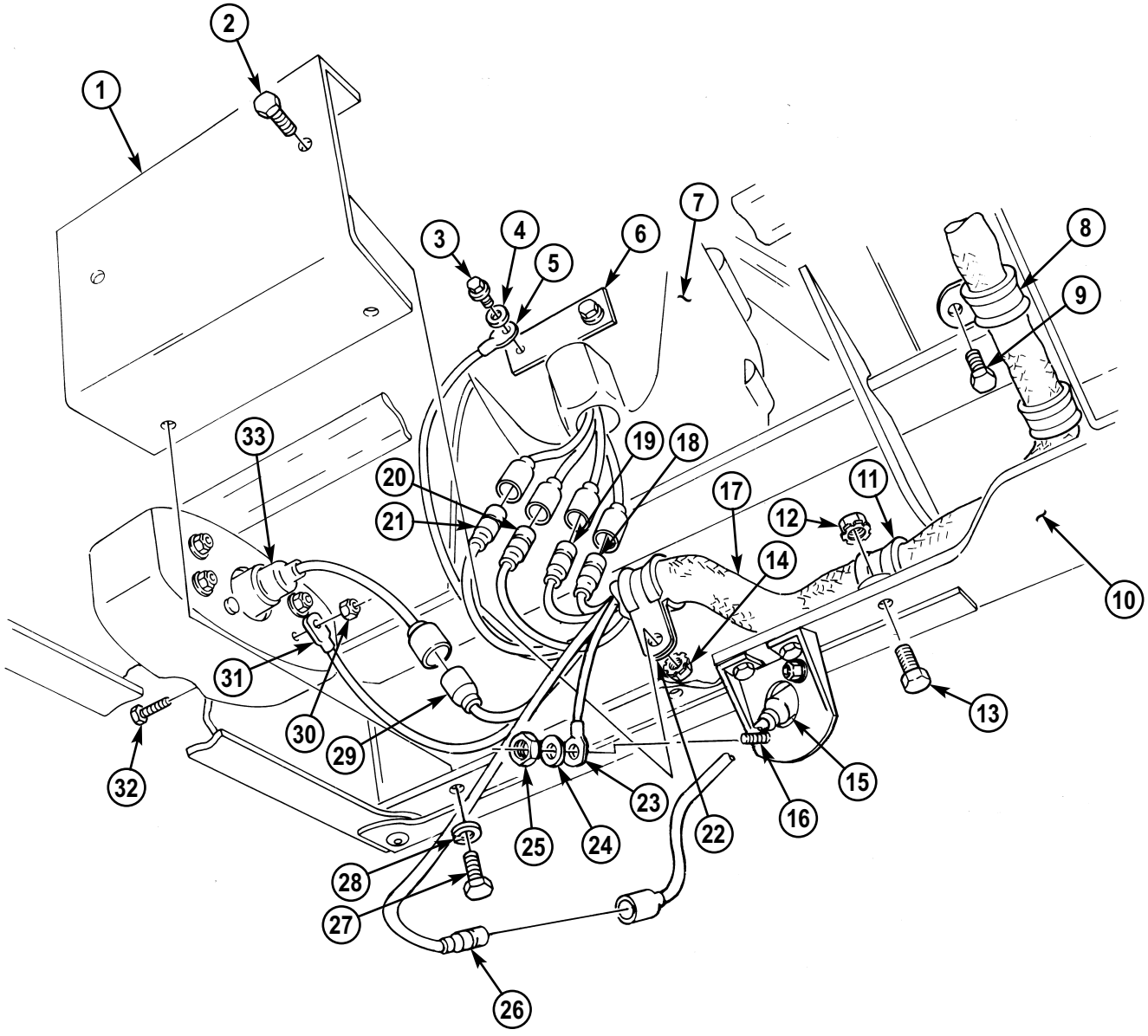
## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

49. Remove two screws (9), clamps (8), and harness (17) from body (10).
50. Remove capscrew (13), assembled locknut (12), clamp (11), and harness (17) from body (10). Discard assembled locknut (12).
51. Remove two screws (27), lockwashers (28), and shield (1) from body (10). Discard lockwashers (28).
52. Remove two capscrews (2), assembled locknuts (14), clamps (22), and harness (17) from shield (1). Discard assembled locknuts (14).
53. Disconnect harness lead 489B (29) at right rear side marker light (33).
54. Disconnect harness leads 21E (18), 22-460C (19), 23D (20), and 24C (21) from right rear composite light (7).

**NOTE**

Perform step 55 for M1035, M1035A1, and M1035A2 only.

55. Disconnect harness lead 467F (26) from backup light (15), remove nut (25), lockwasher (24), and ground lead 95H (23) from stud (16). Discard lockwasher (24).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

**NOTE**

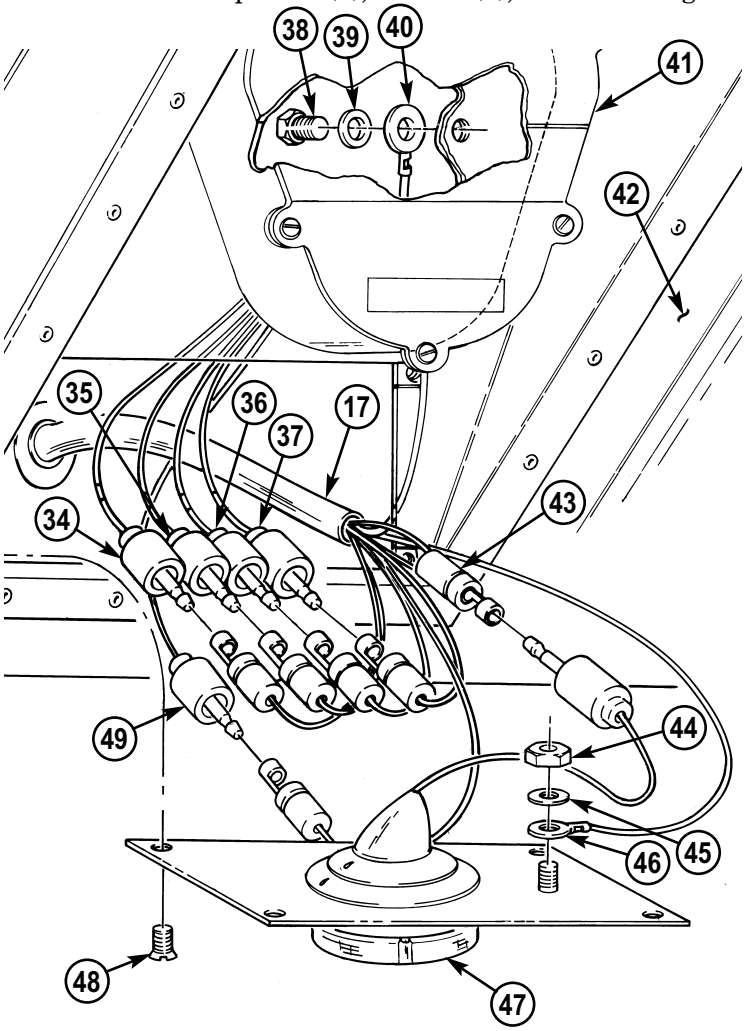
Perform steps 56 through 61 for M996, M996A1, M997, M997A1 and M997A2 only.

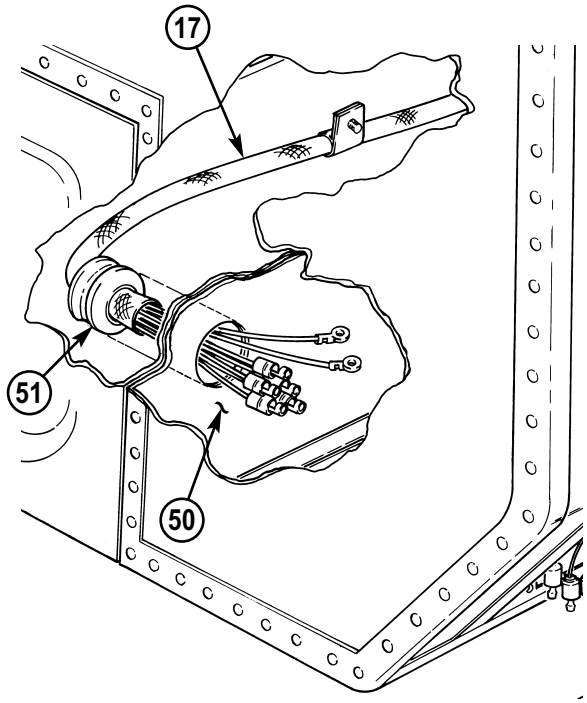
56. Remove eight screws (48) and backup lamp assemblies (47) from ambulance body (42).
57. Pull backup lamp assemblies (47) away from ambulance body (42) to allow access to backup and composite lamp leads.

**NOTE**

- Before removal, tag leads for installation.
- Lead 21H is only for right side of vehicle.

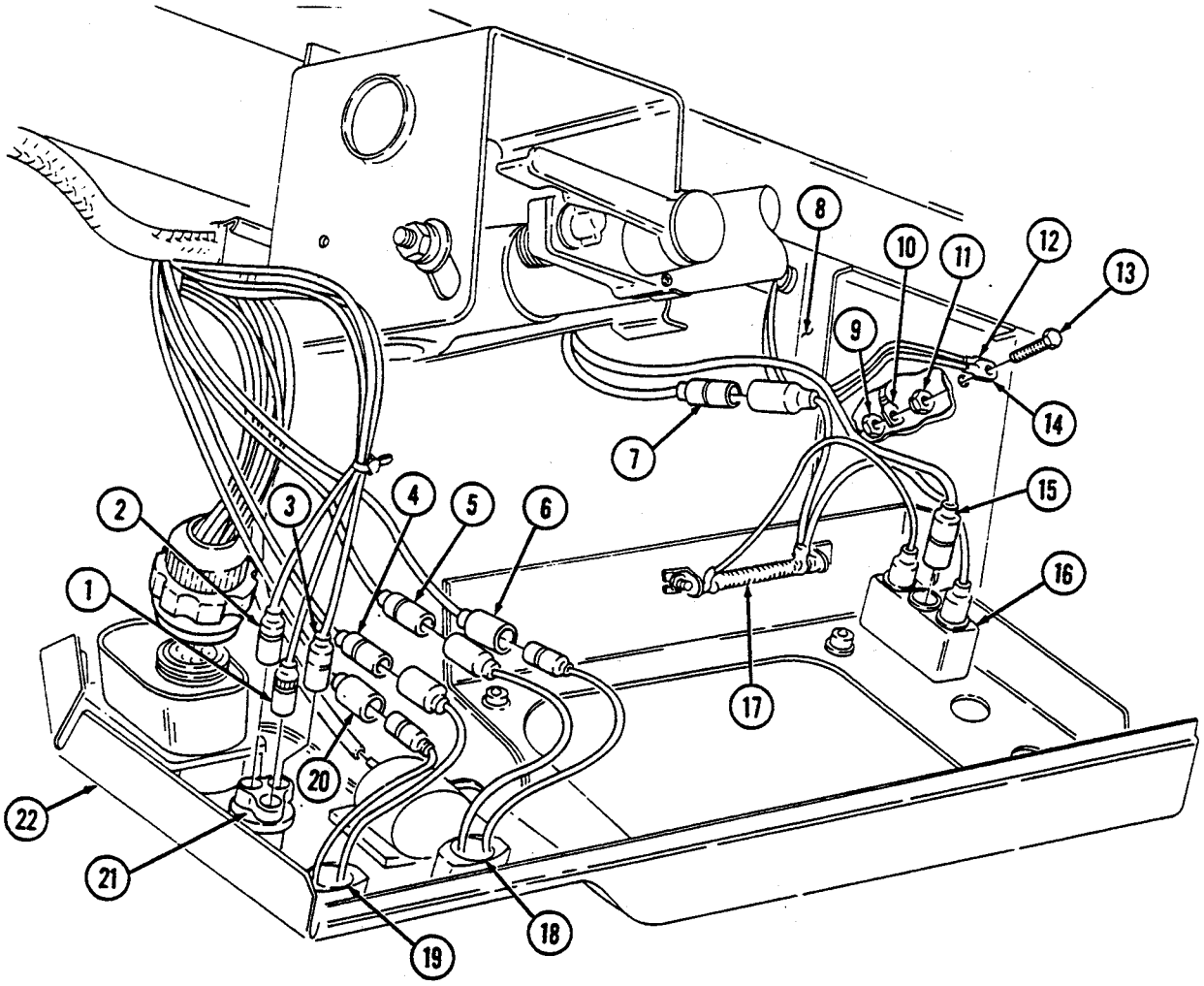
58. Disconnect leads 24 (34), 23 (35), 21 (36), 22 (37), 21H (49), and 467 (43) from body harness (17).
59. Remove two nuts (44), washers (45), and backup lamp ground leads (46) from backup lamp assemblies (47). Disconnect ground leads (46).
60. Remove two capscrews (38), lockwashers (39), and composite lamp ground leads (40) from composite lamps (41). Disconnect ground leads (40) and discard lockwashers (39).
61. Pull harness (17) through grommets (51) and vehicle rear walls (50). Remove harness (17) from vehicle rear walls (50).
62. Remove nut (30), screw (32), and harness ground lead 95G (31) from right rear side marker light (33).
63. Remove capscrew (3), washer (4), and harness ground lead 95F (5) from buss bar (6).



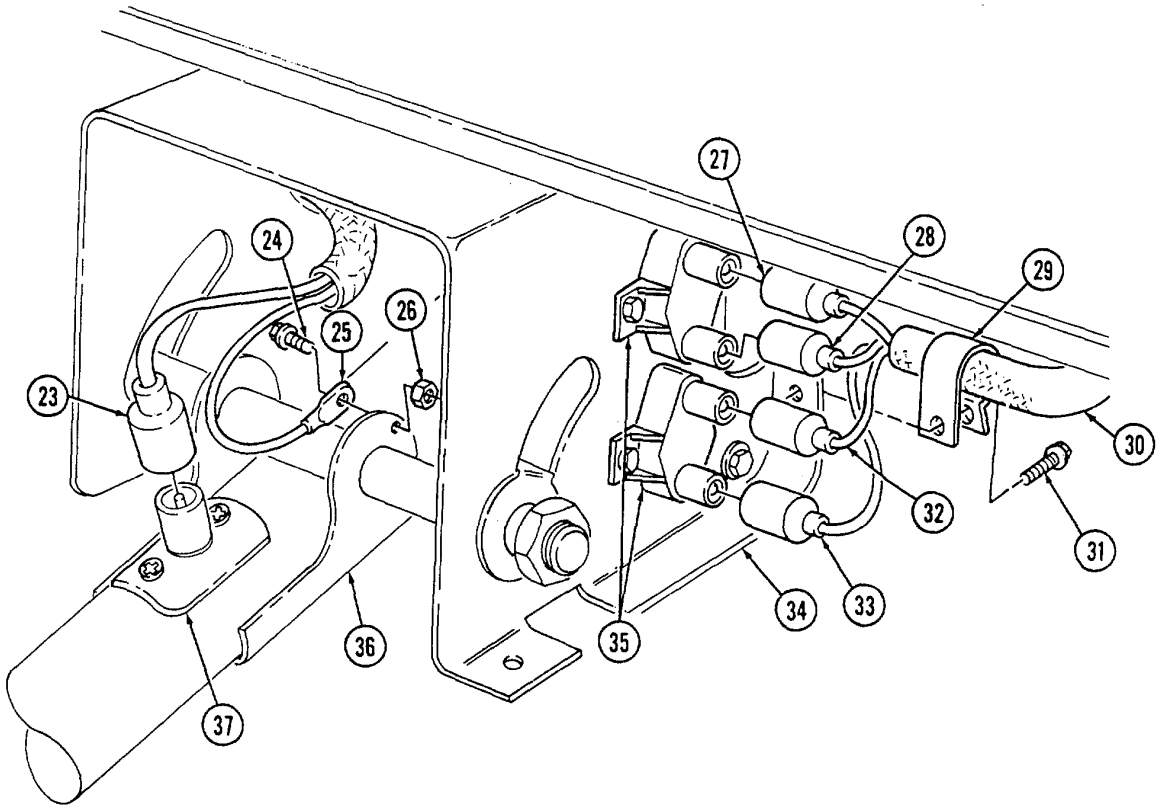
## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

64. Disconnect harness leads 11A (1), 14A (2), and 29A (3) from run-start switch (21) behind dash panel (22).
65. Disconnect harness leads 27F (4) and 571A (20) at wait-to-start indicator light (19).
66. Disconnect harness leads 27L (5) and 67D (6) at parking brake warning indicator light (18).
67. Disconnect harness lead 400D (7) from resistor (17).
68. Disconnect harness lead 27D (15) from blower switch (16).
69. Remove locknut (9), engine harness ground lead 3C (10), locknut (11), capscrew (13), and harness ground leads 57A (12) and 79A (14) from body (8). Discard locknuts (9) and (11).



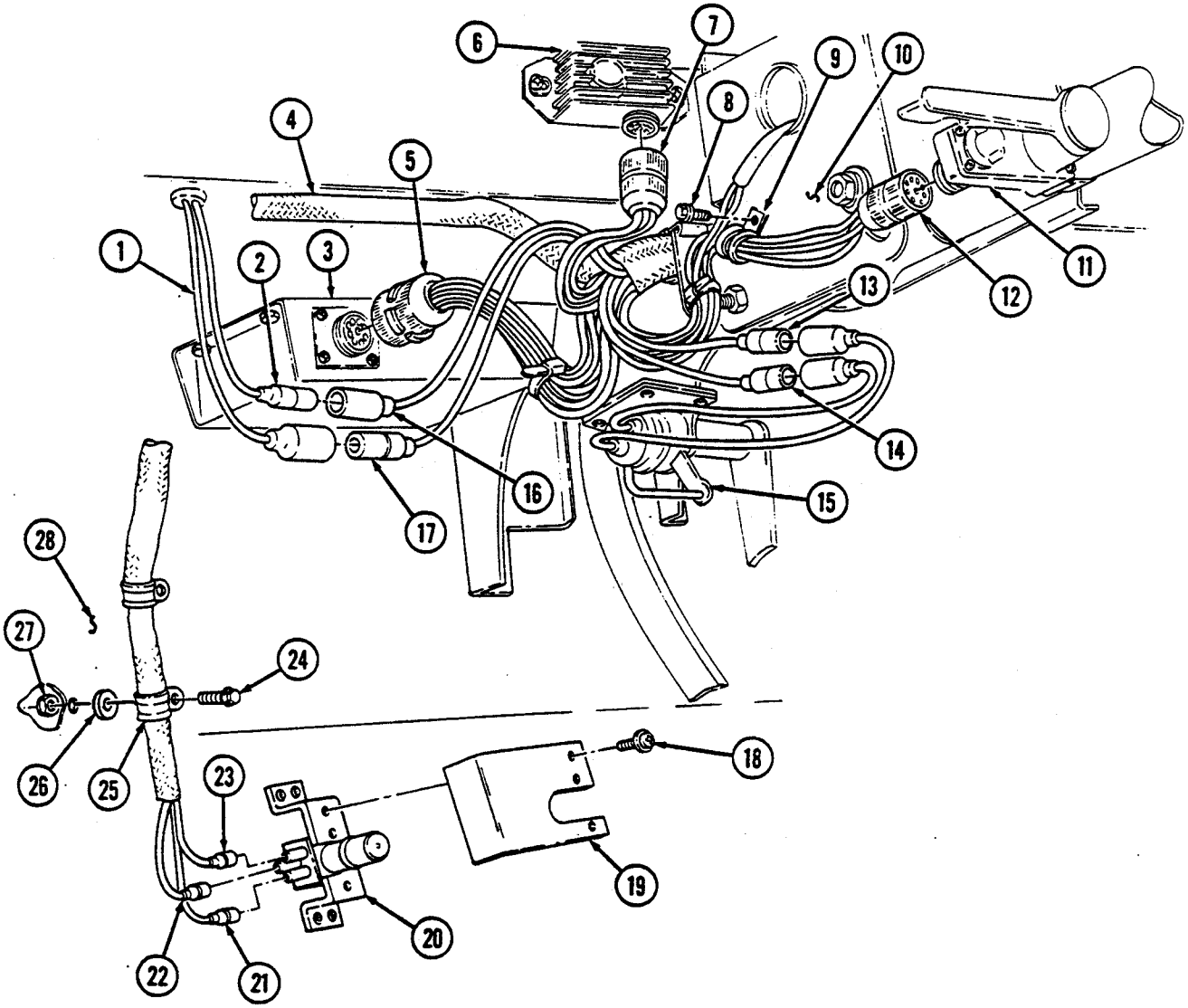
## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

70. Disconnect harness leads 27C (27), 27D (28), 27K (32), and 71A (33) from two circuit breakers (35).
71. Remove two screws (31), clamps (29), and harness (30) from steering column support (34).
72. Disconnect harness lead 25A (23) from horn switch (37).
73. Remove capscrew (24), locknut (26), and harness ground lead 57C (25) from steering column (36). Discard locknut (26).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

74. Disconnect harness connector (12) from turn signal control (11).
75. Disconnect harness connector (7) from turn signal flasher module (6).
76. Disconnect harness leads 75A (14) and 75B (13) from stoplight switch (15).
77. Disconnect harness leads 57D (17) and 71C (16) from windshield washer motor leads 57 (1) and 71 (2).
78. Disconnect harness connector (5) from protective control box (3).
79. Remove screw (8), clamp (9), and harness (4) from steering column support (10).
80. Remove three assembled-washer screws (18) and shield (19) from dimmer switch (20). Discard assembled-washer screws (18).
81. Disconnect harness leads 16A (23), 17A (21), and 18A (22) from dimmer switch (20).
82. Remove three capscrews (24), locknuts (27), washers (26), clamps (25), and harness (4) from body (28). Discard locknuts (27).



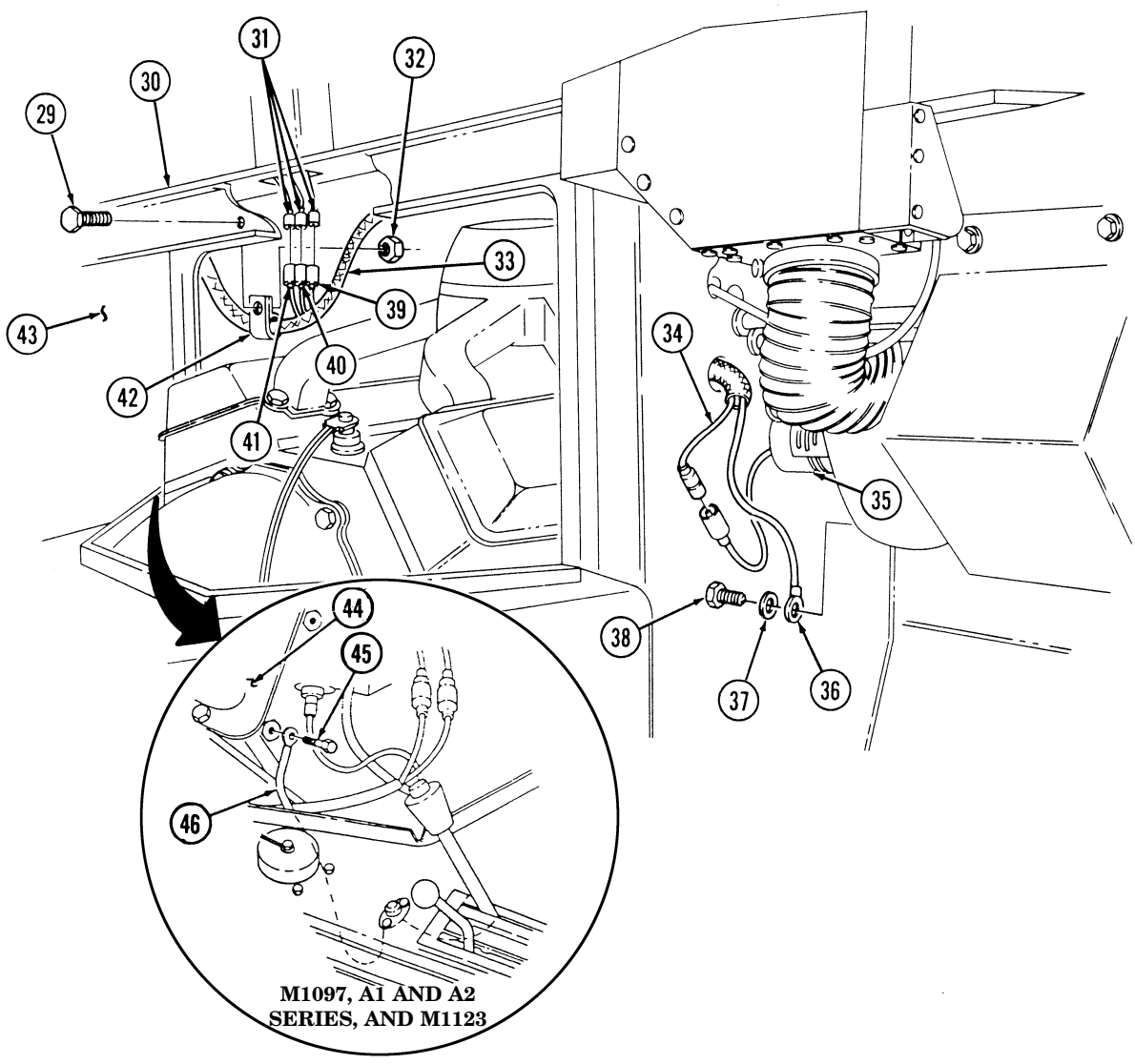
## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

83. Disconnect harness lead 400D (34) from heater motor (35).
84. Remove screw (38), washer (37), and harness ground lead 57E (36) from heater motor (35).
85. Remove two capscrews (29), locknuts (32), clamps (42), and harness (33) from "A" beam (30). Discard locknuts (32).
86. Disconnect harness connectors 27K (40), 57F (41), and 71C (39) from windshield wiper motor jumper harness (31).
87. Remove harness (33) from "A" beam (30) and guide into instrument panel area.
88. Remove left body mounts (para. 13-2).
89. Guide harness (33) out through hole in body (43) and remove harness (33) from vehicle.

**NOTE**

Perform step 90 for M1097, A1 and A2 series, and M1123.

90. Remove screw (45) and transfer case indicator lamp ground lead (46) from cylinder head (44).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

**b. Installation**

**CAUTION**

Use care when installing harness. Snagging or pulling may damage harness.

**NOTE**

Refer to TM 9-2320-280-20 for repair of wiring harness connectors.

1. Position harness (5) in approximate mounting position. Feed forward branch of harness (5) through hole (20).
2. Install left body mounts (para. 13-3).
3. Install grommet (19) over yellow locator tape (22) and position closeout plate (18) on grommet (19).

**NOTE**

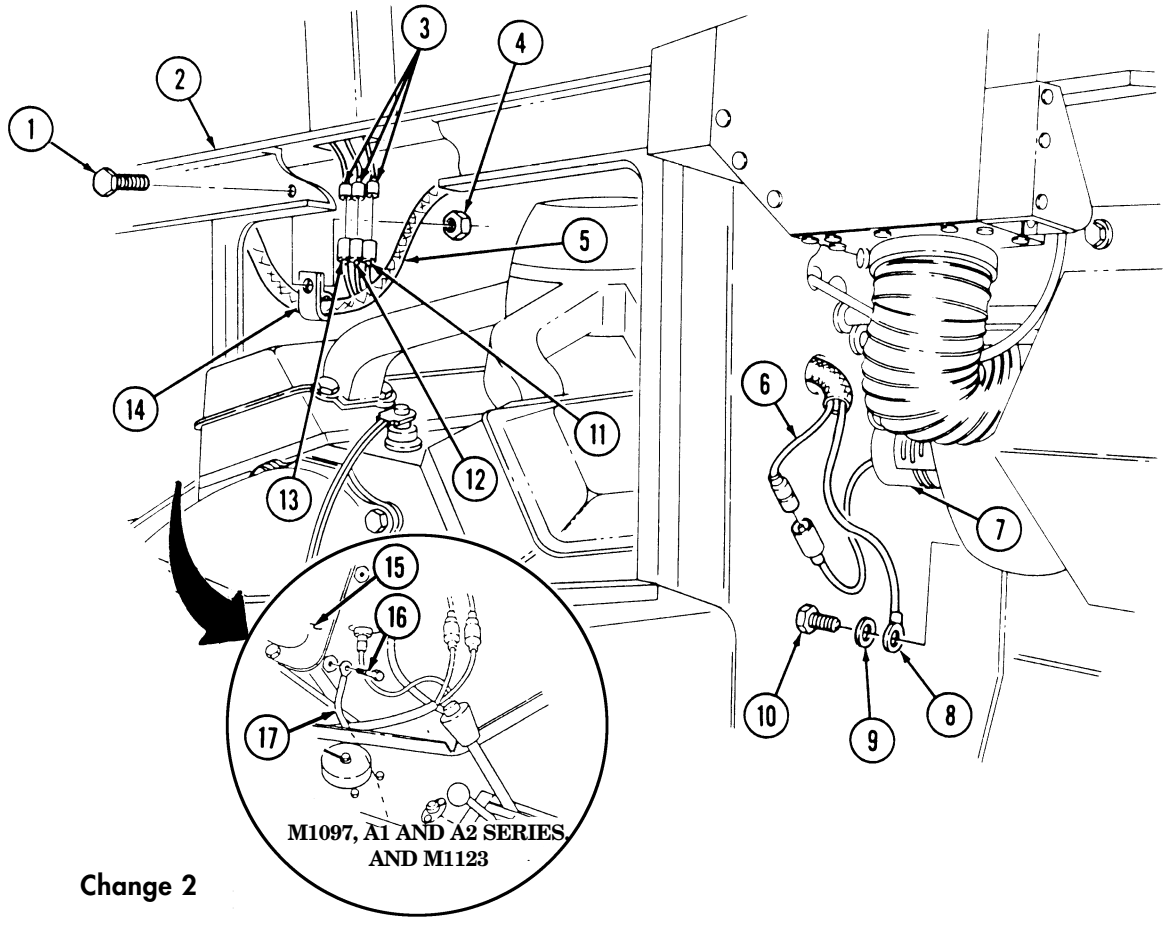
The top screws connecting the closeout plate may be longer than the rest, if the fuel filter drain tube is routed to the top of the closeout plate.

4. Install grommet (19) and closeout plate (18) on cowl (23) with four screws (24) and nuts (21).
5. Install harness ground lead 57E (8) on heater motor (7) with washer (9) and screw (10).
6. Connect harness lead 400D (6) to heater motor (7).
7. Connect harness leads 27K (12), 57F (13), and 71C (11) to windshield wiper motor jumper harness (3).
8. Install harness (5) on "A" beam (2) with two clamps (14), capscrews (1), and locknuts (4).

**NOTE**

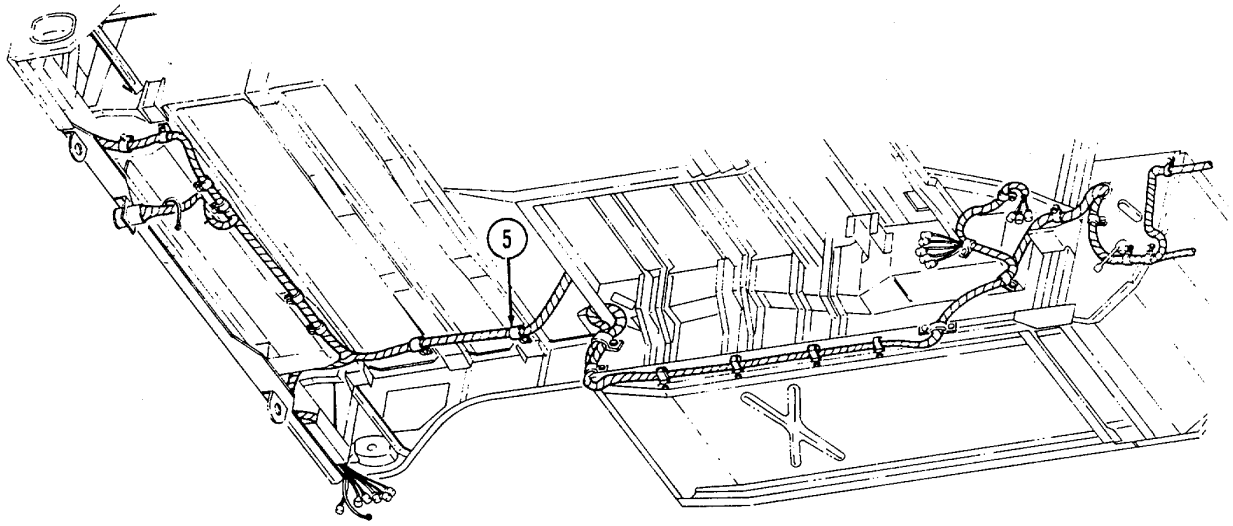
Perform step 9 for M1097, A1 and A2 series, and M1123.

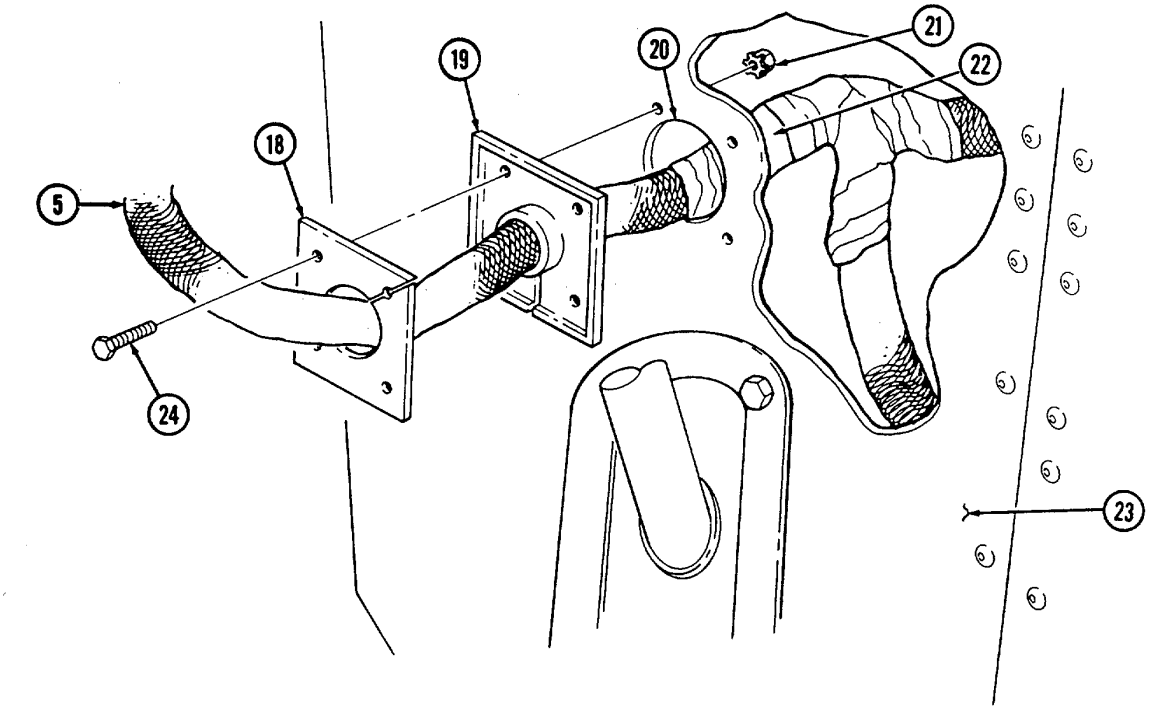
9. Install screw (16) and transfer case indicator lamp ground lead (17) on cylinder head (15).




**M1097, A1 AND A2 SERIES, AND M1123**

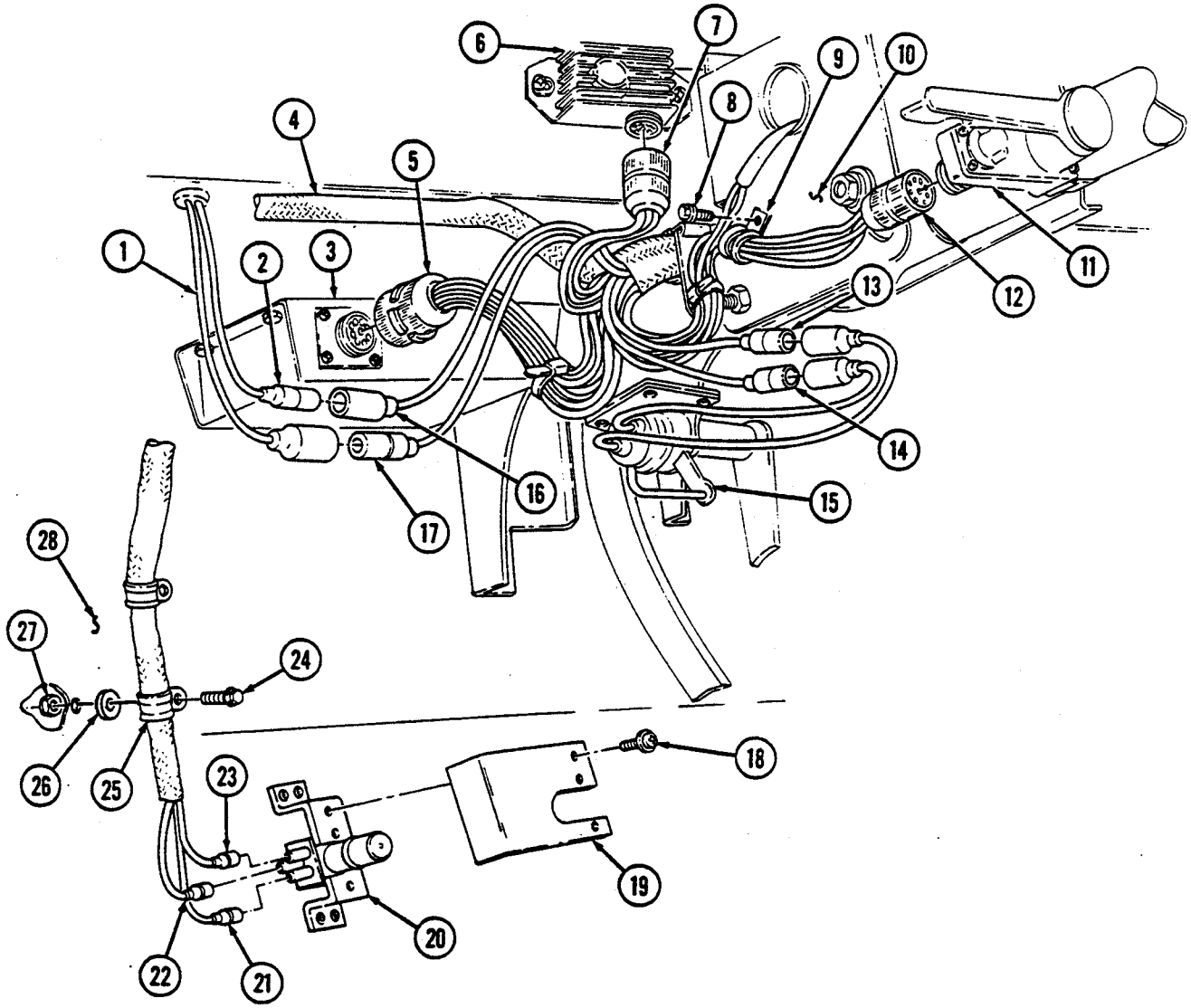
## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)



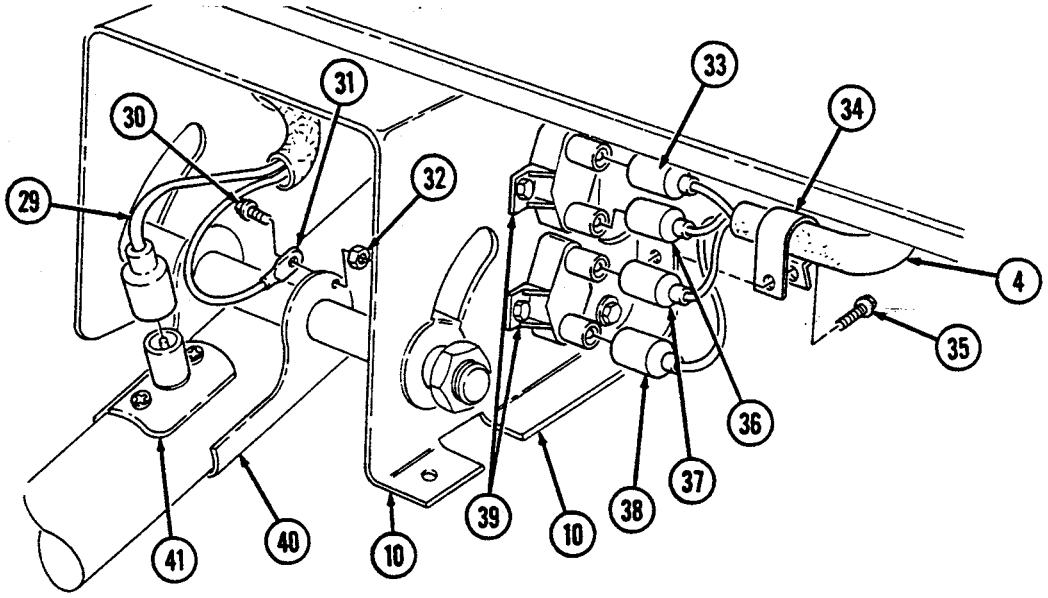



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

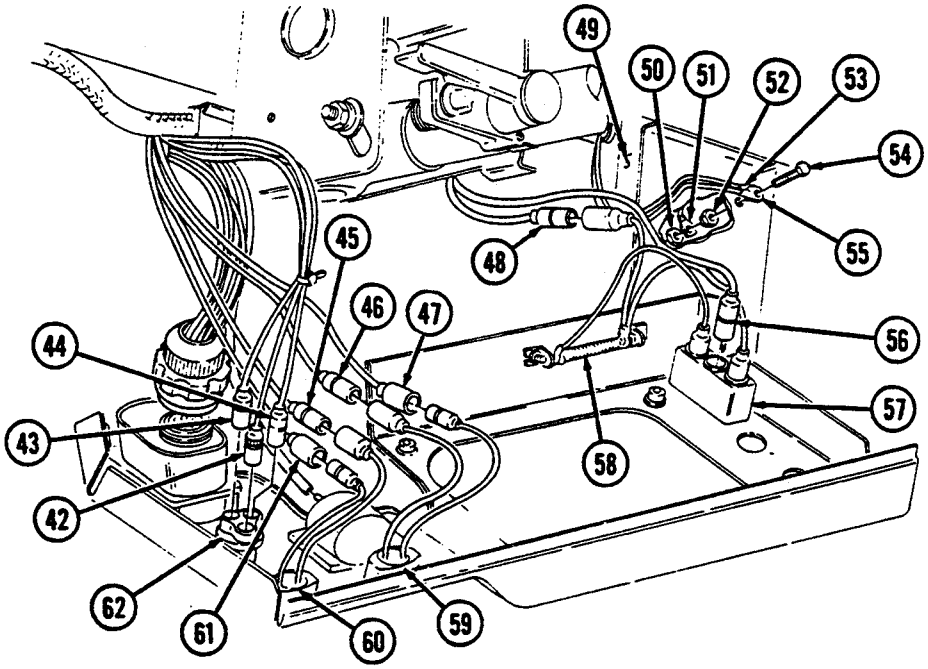
10. Connect harness connector (5) to protective control box (3).
11. Connect harness connector (7) to turn signal flasher module (6).
12. Connect harness connector (12) to turn signal control (11).
13. Connect harness leads 75A (13) and 75B (14) to stoplight switch (15).
14. Connect harness leads 57D (17) and 71C (16) to windshield washer motor leads 71 (2) and 57 (1).
15. Install harness (4) on steering column support (10) with clamp (9) and screw (8).
16. Connect harness leads 17A (21), 18A (22), and 16A (23) to dimmer switch (20).
17. Install shield (19) on dimmer switch (20) with three assembled-washer screws (18).
18. Install harness (4) on body (28) with three clamps (25), capscrews (24), washers (26), and locknuts (27).
19. Connect harness leads 27C (33), 27D (36), 27K (37), and 71A (38) to two circuit breakers (39).
20. Connect harness lead 25A (29) to horn switch (41).
21. Apply antiseize compound to harness ground lead 57C (31) and install on steering column (40) with capscrew (30) and locknut (32).
22. Install harness (4) on steering column support (10) with two clamps (34) and screws (35).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)




23. Apply antiseize compound to harness leads 57A (53) and 79A (55) and install on body (49) with capscrew (54) and locknut (52). Apply antiseize compound to engine harness ground lead 3C (51) and install on body (49) with locknut (50).
24. Connect harness lead 27D (56) to blower switch (57).
25. Connect harness lead 400D (48) to resistor (58).
26. Connect harness leads 27L (46) and 67D (47) to parking brake warning indicator light (59).
27. Connect harness leads 27F (45) and 571A (61) to wait-to-start indicator light (60).
28. Connect harness leads 11A (42), 14A (43), and 29A (44) to run-start switch (62).



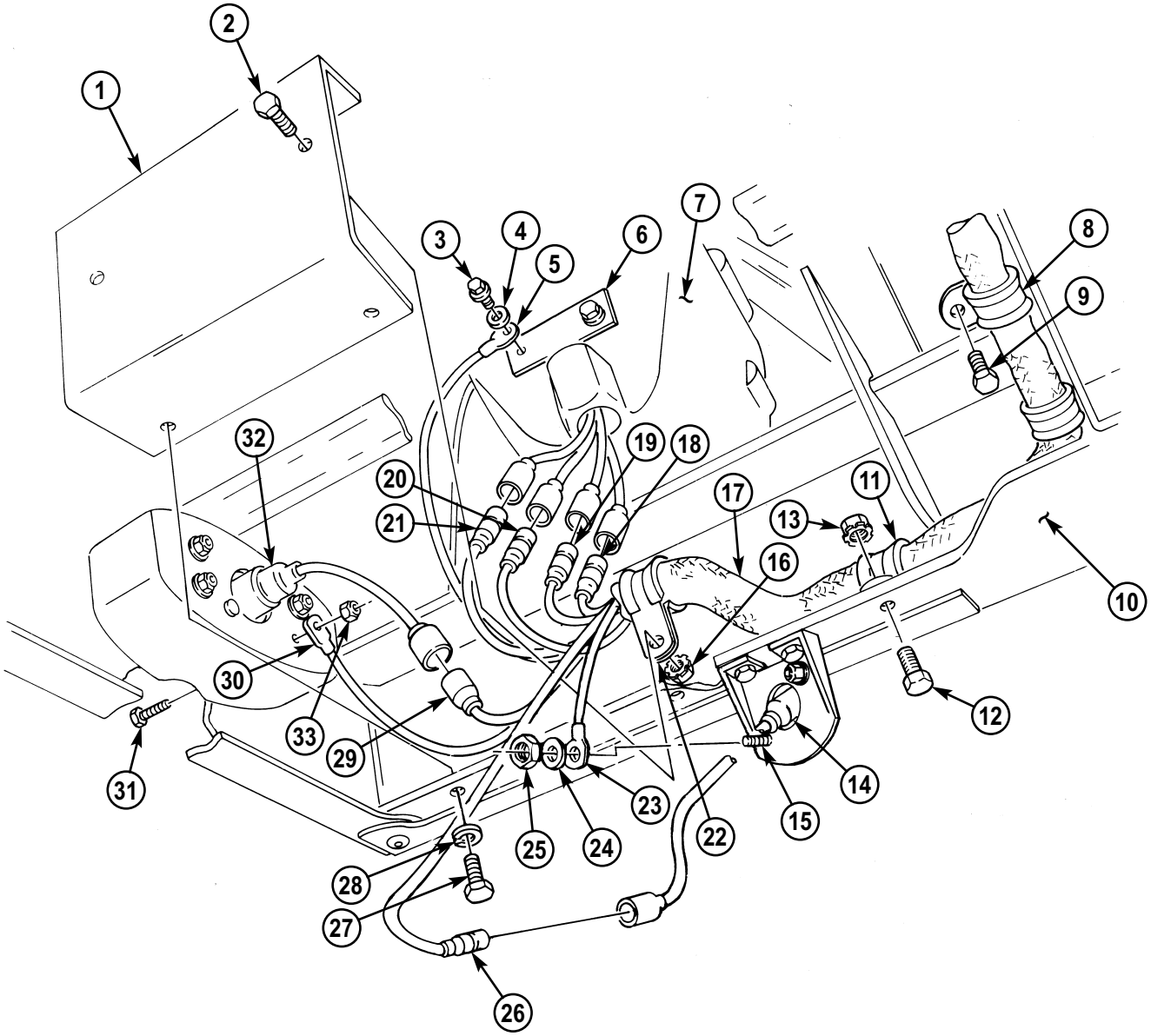
## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

29. Apply antiseize compound to harness ground lead 95F (5) and install on buss bar (6) with washer (4) and capscrew (3).
30. Apply antiseize compound to harness ground lead 95G (30) and install on right rear side marker light (32) with nut (33) and screw (31).
31. Connect harness leads 21E (18), 22-460C (19), 23D (20), and 24C (21) to right rear composite light (7).

**NOTE**

Perform step 32 for M1035, M1035A1 and M1035A2 only.

32. Connect harness lead 467F (26) to backup light (14). Install ground lead 95H (23) to stud (15) with lockwasher (24) and nut (25).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

**NOTE**

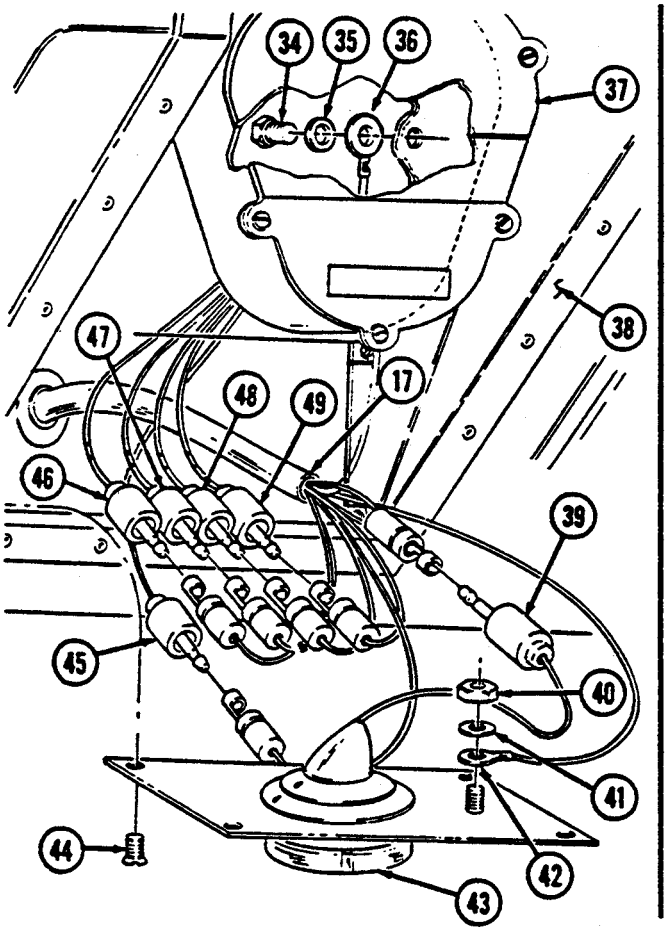
Perform steps 33 through 36 for M996, M996A1, M997, M997A1, and M997A2 only.

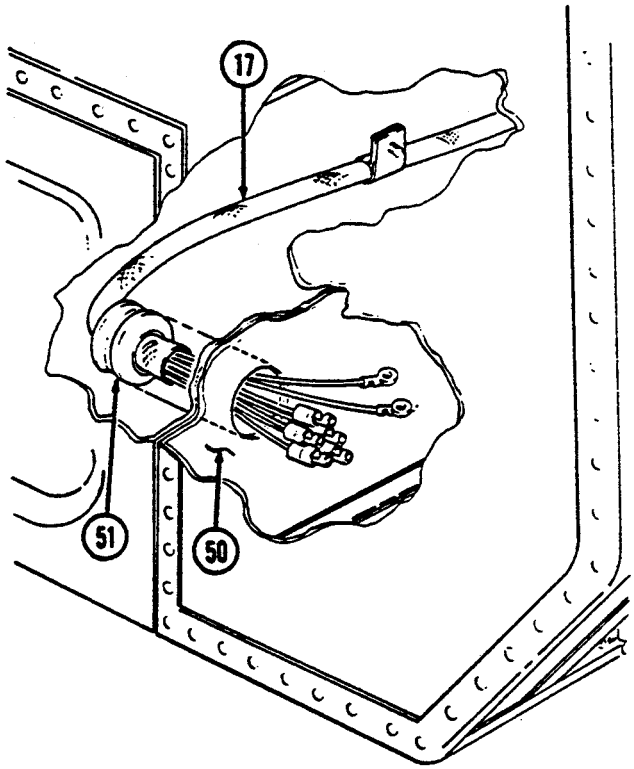
33. Route harness (17) in ambulance body compartments (50) by pulling harness (17) through grommet (51) and vehicle rear wall (50).
34. Install two ground leads (36) on composite lamps (37) with two lockwashers (35) and capscrews (34).
35. Install ground leads (42) on backup lamps (43) with two washers (41) and nuts (40).

**NOTE**

Lead 21H is only on right side of vehicle.

36. Connect leads 24 (46), 23 (47), 21 (48), 22 (49), 21H (39), and 467 (45) of composite lamps (37) and backup lamps (43) to body harness (17).
37. Install backup lamp assemblies (43) on ambulance body (38) with eight screws (44).
38. Connect harness lead 489B (29) to right rear side marker light (32).
39. Install harness (17) on shield (1) with two clamps (22), capscrews (2), and assembled locknuts (16).
40. Install shield (1) on body (10) with two lockwashers (28) and screws (27).
41. Install harness (17) on body (10) with clamp (11), capscrew (12), and assembled locknut (13).
42. Install harness (17) on body (10) with two clamps (8) and screws (9).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

43. Install trailer connector (1) in bracket (2) with four capscrews (8) and locknuts (7).
44. Install harness (3) on body (6) with five clamps (5) and screws (4).
45. Apply antiseize compound to harness ground lead 95B (11) and install on buss bar (10) with washer (12) and capscrew (13).
46. Apply antiseize compound to harness ground lead 95C (22) and install on left rear side marker light (19) with nut (21) and screw (20).
47. Connect harness leads 21C (38), 22-461B (37), 23B (36), and 24B (35) to left rear composite light (9).

**NOTE**

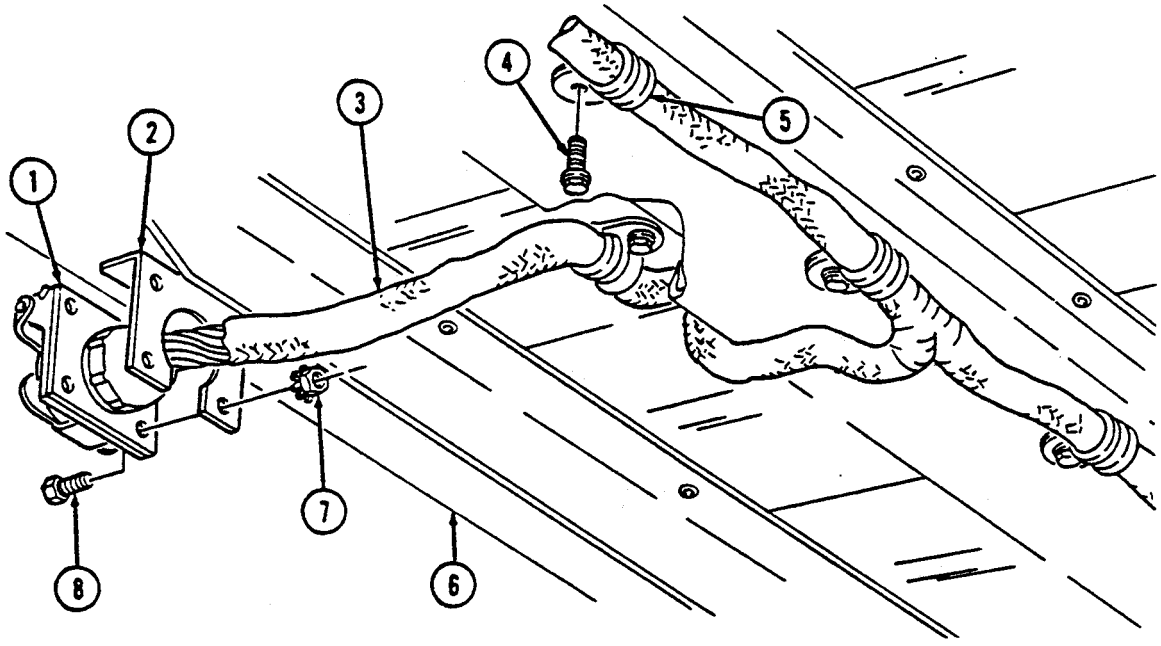
Perform step 48 for M1035, M1035A1 and M1035A2 only.

48. Connect harness lead 467E (32) to backup light (39). Install ground lead 95D (18) to stud (31) with lockwasher (17) and nut (16).
49. Connect harness lead 489A (23) to left rear side marker light (19).
50. Install harness (3) on shield (15) with two clamps (27), capscrews (14), and assembled locknuts (26).
51. Install shield (15) on body (6) with two lockwashers (25) and screws (24).
52. Install harness (3) on body (6) with clamp (28), capscrew (29), and assembled locknut (30).
53. Install harness (3) on body (6) with two clamps (34) and screws (33).

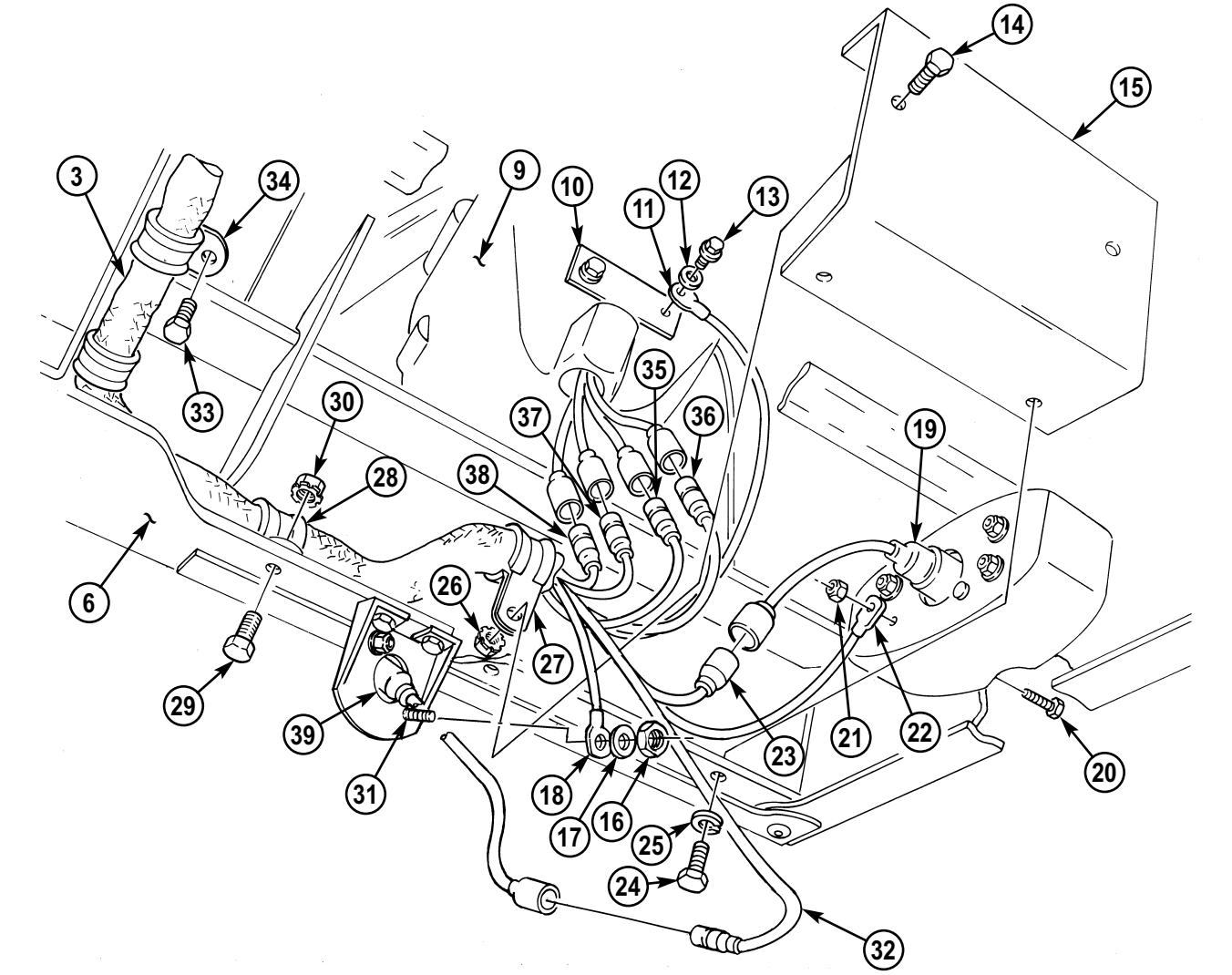
**NOTE**

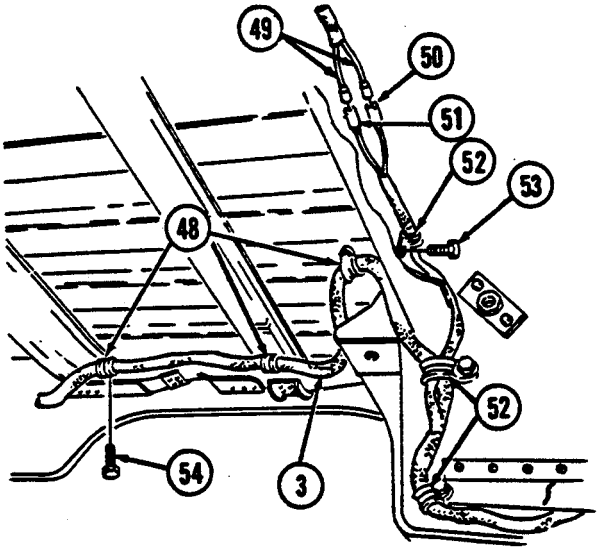
Perform steps 54 and 55 for 6.5 L only.

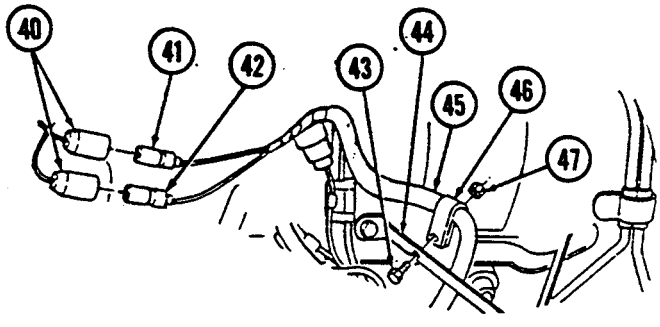
54. Install body harness (45) on dipstick support bracket (44) with screw (43), clamp (46), and nut (47).
55. Connect two leads 458A (40) to leads 458c (42) and 458d (41).
56. Install harness (3) on body (6) with three clamps (48) and screws (54).
57. Install harness (3) on body (6) with three clamps (52) and screws (53).
58. Connect harness leads 28A (51) and 58C (50) to fuel tank jumper harness (49).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)




**6.5 L**

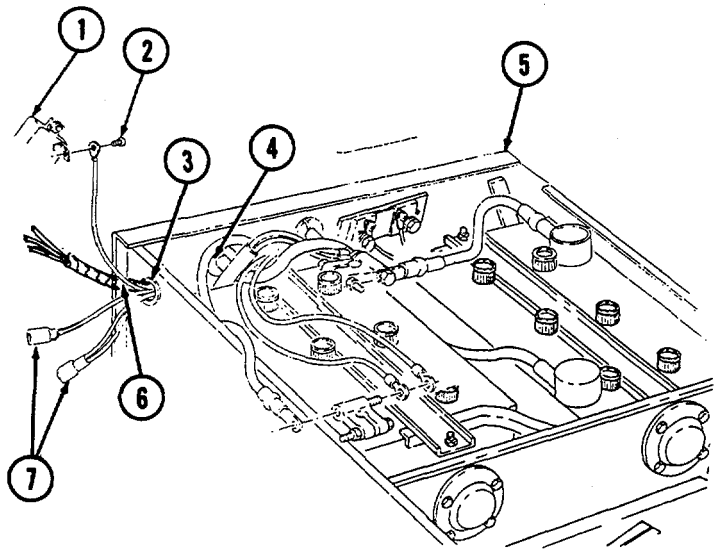
## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

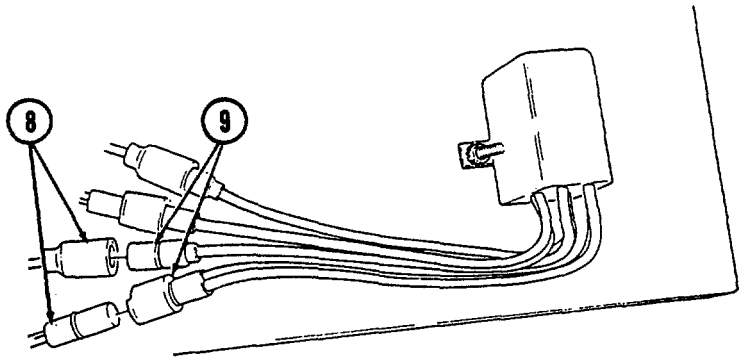
59. Install lead (6) on circuit breaker (1) with screw (2).
60. Feed lead (6) through grommet (4) in battery box (5).
61. Route three leads (7) and lead (6) through rear grommet (3) and connect to transmission relay 290A/291A leads (9) to leads (8).

**NOTE**

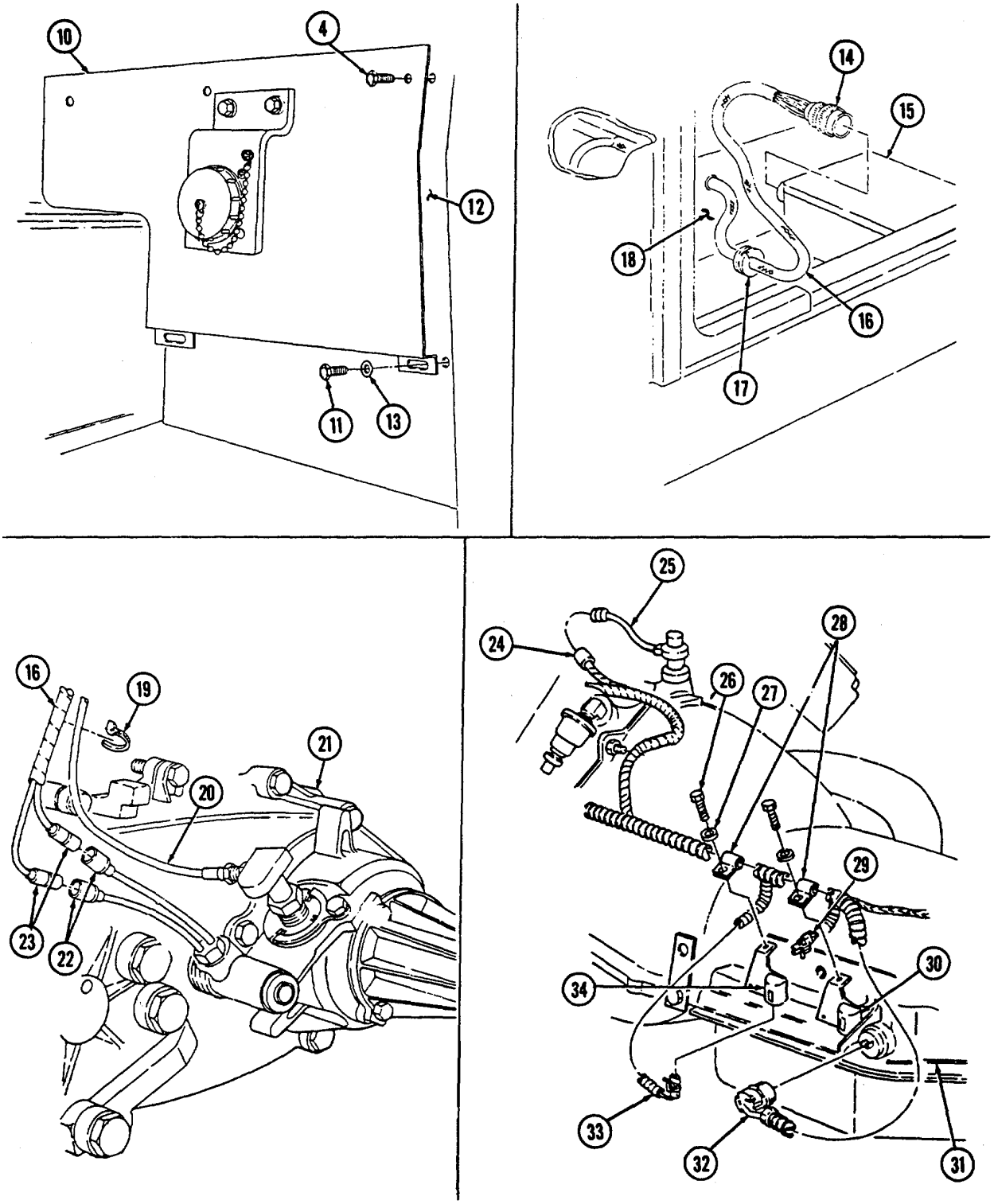
M1025A2 and M1043A2 are equipped with four capscrews.

62. Install coverplate (10) to "B" beam (12) with two washers (13) and five capscrews (11).
63. Feed harness (16) through body (18) and grommet (17) and connect harness connector (14) to TCM (15).
64. Connect two leads (23) to transfer case switch leads (22) on transfer case (21).
65. Connect connectors 495/496 (33) and 497/498 (29) to input and output speed sensors (34) and (30).
66. Connect wiring harness connector (32) to transmission (31).
67. Install harness (16) on sensors (30) and (34) with two clamps (28), washers (27), and capscrews (26), and to speedometer cable (20) with four tiedown straps (19).
68. Connect harness connector (24) to RPM sensor (25).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)

69. Install harness (6) on body (33) with four clamps (26), capscrews (25), and locknuts (27).
70. Connect harness leads 67C (29) and 67E (30) on parking brake switch (21).
71. Connect harness leads 14A (1), 14B (2), and 40F (34) on shift controls housing (35).

**NOTE**

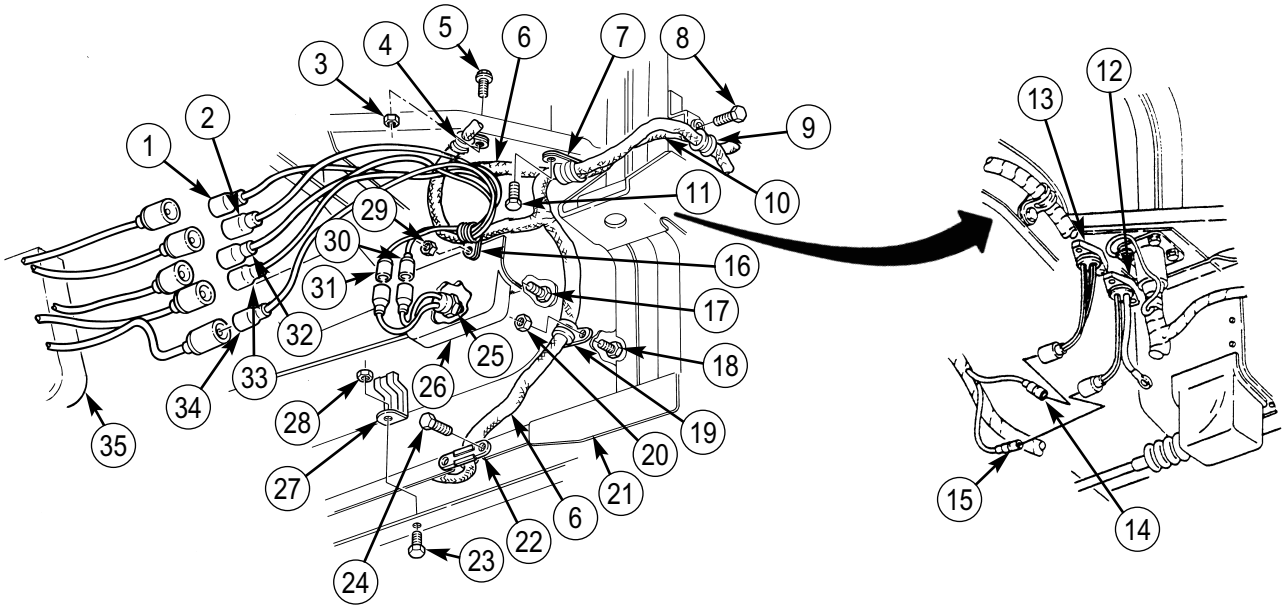
Perform step 72 for M1035, M1035A1 and M1035A2 only.

72. Connect harness leads 467C (31) and 457D (32) to shift controls housing (35).
73. Install harness (6) on body (33) with clamp (24) and two screws (23).
74. Install harness (6) and harness (10) on body (33) with clamps (7) and (9) and screws (8) and (11).

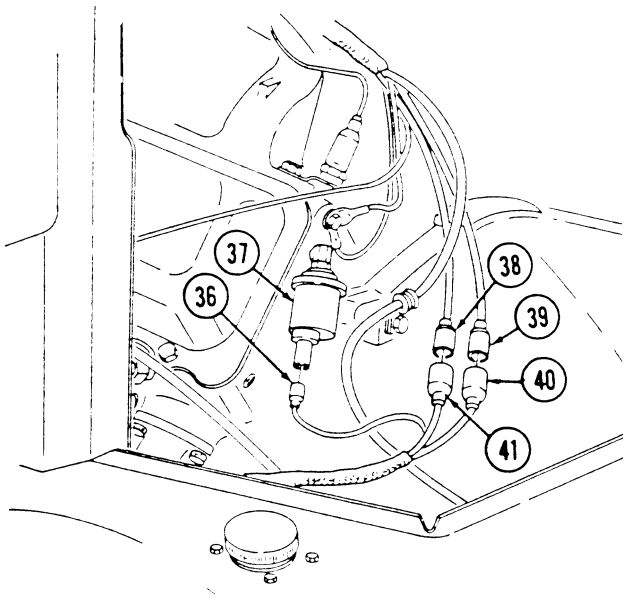
**NOTE**

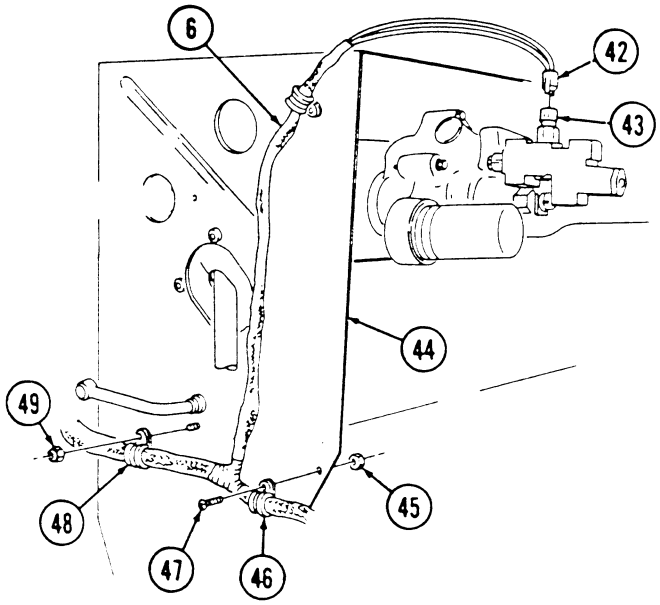
Perform step 75 for 6.5 L only.

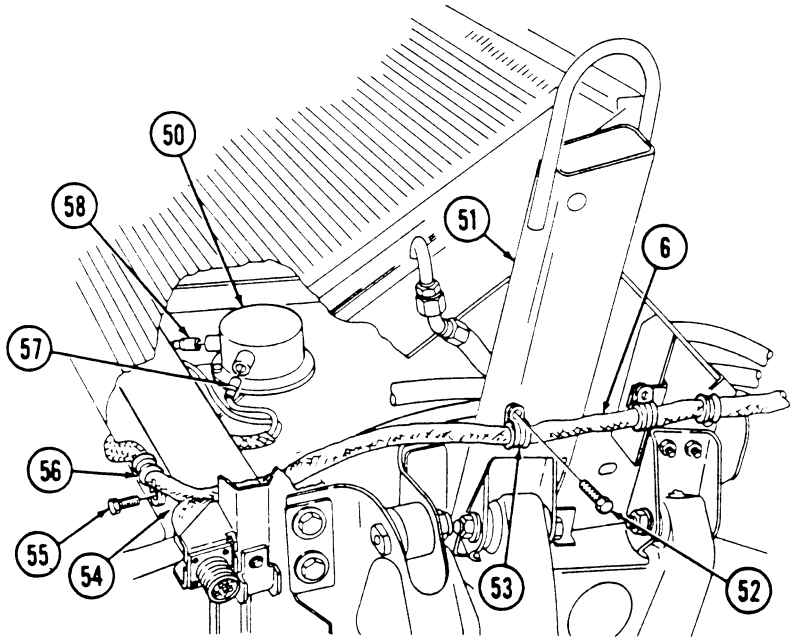
75. Connect harness leads (14) and (15) to transmission and transfer case indicator lights (12) and (13).
76. Install harness (6) on body (33) with clamp (19), capscrew (18), and nut (20).
77. Install harness (6) on parking brake boot (22) with clamp (16), capscrew (17), and assembled locknut (28).
78. Install harness (6) on body (33) with clamp (5), capscrew (4), and nut (3).
79. Connect harness lead 36A (36) to engine oil pressure sending unit (37).
80. Connect harness leads 33A (40) and 58B (41) to engine harness leads 33A (39) and 58B (38).
81. Install harness (6) on cowl (44) with three clamps (46), capscrews (47), and plain assembled nuts (45).
82. Install harness (6) on cowl (44) with clamp (48) and assembled locknut (49).
83. Apply lubricating oil to harness connector (42) and to brake warning lamp switch (43).
84. Connect harness connector (42) to brake warning lamp switch (43).
85. Connect harness leads 25A (57) and 26A (58) to horn (50).
86. Install harness (6) on crossmember (54) with clamp (56) and screw (55).
87. Install harness (6) on left airlift bracket (51) with three clamps (53) and screws (52).



## 6-9. BODY WIRING HARNESS REPLACEMENT (Cont'd)




FOLLOW-ON TASKS:
- Install instrument cluster (TM 9-2320-280-20).
- Install rear side marker light lenses (TM 9-2320-280-20).
- Install heater ducting (TM 9-2320-280-20).
- Install left defroster nozzle (TM 9-2320-280-20).
- Install muffler (TM 9-2320-280-20).
- Install left splash shield (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).
- Start engine (TM 9-2320-280-10) and check operation of vehicle electrical systems.

# 6-10. 60/100 AMPERE ALTERNATOR BRACKET MODIFICATION

**This task covers:**

**Modification**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)
Maintenance and repair shop equipment:
automotive (Appendix G, Item 2)

**Materials/Parts**
Aluminum spacer (Appendix C, Fig. 45)
Drill fixture (Appendix C, Fig. 46)

**Manual References**
TC 9-237
TM 9-2320-280-20

**Equipment Condition**
Alternator bracket removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

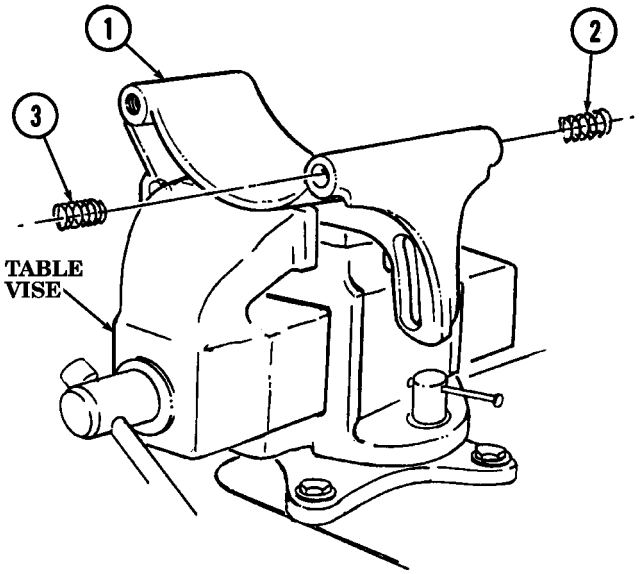
**Modification**

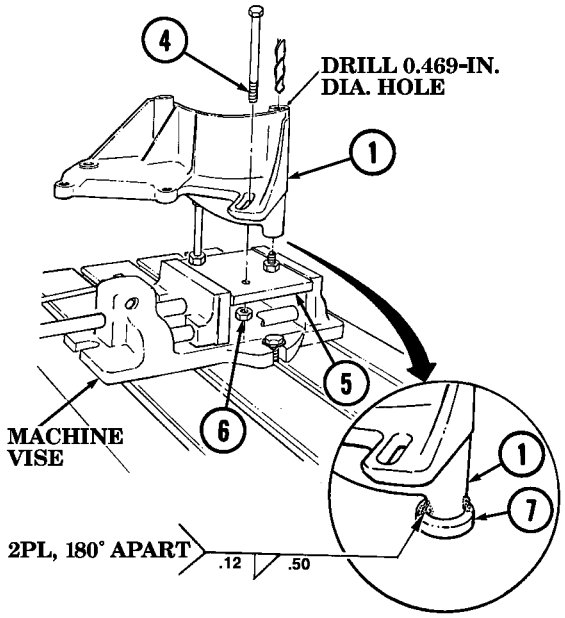
**NOTE**

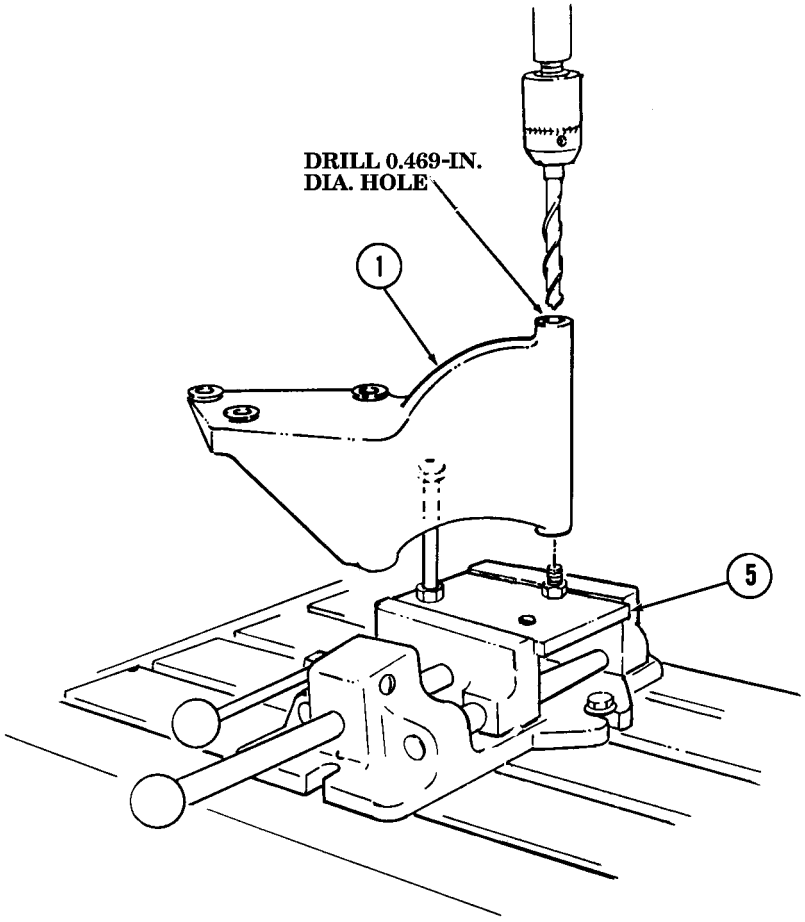
This procedure will provide for more overall stability by drilling one hole to accommodate a thru-bolt.

1. Secure alternator bracket (1) in table vise, and remove helicals (2) and (3) from alternator bracket (1).
2. Remove alternator bracket (1) from table vise.
3. Position fabricated drill fixture (5) in machine vise.
4. Position alternator bracket (1) above drill fixture (5) and secure alternator bracket (1) with screw (4) and nut (6).
5. Weld aluminum spacer (7) to alternator bracket (1) (refer to TC 9-237).
6. Drill 0.469-in. diameter hole in alternator bracket (1). Drill hole to maximum depth.
7. Remove nut (6), screw (4), and alternator bracket (1) from drill fixture (5) and turn alternator bracket (1) over.
8. Position alternator bracket (1) above drill fixture (5) and secure with screw (4) and nut (6).
9. Drill 0.469-in. diameter hole in alternator bracket (1). Drill hole to maximum depth.
10. Remove nut (6), screw (4), and alternator bracket (1) from drill fixture (5).

## 6-10. 60/100 AMPERE ALTERNATOR BRACKET MODIFICATION (Cont'd)




FOLLOW-ON TASK: Install alternator bracket (TM 9-2320-280-20).

# CHAPTER 7
# TRANSMISSION MAINTENANCE

## Section I. GENERAL TRANSMISSION MAINTENANCE

### 7-1. INTRODUCTION

This chapter contains maintenance instructions for replacement of transmission components at the Direct Support maintenance level. Some subassemblies and parts must be removed before transmission system components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

### 7-2. GENERAL TRANSMISSION MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 7-3. | Governor Maintenance (3L80) | 7-2 |
| 7-4. | Transmission Oil Pump Seal Replacement (3L80) | 7-4 |

## 7-3. GOVERNOR MAINTENANCE (3L80)

**This task covers:**

**a. Removal**
**b. Inspection**
**c. Installation**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Gasket (Appendix E, Item 25)

**Manual References**
TM 9-2320-280-24P

**Maintenance Level**
Direct support

**CAUTION**

Area around governor must be thoroughly cleaned prior to removal to prevent contamination.

### a. Removal

1. Remove four capscrews (5), vent line clamp (4), governor cover (3), and gasket (2) from transmission (1). Discard gasket (2).
2. Remove governor (6) from transmission (1).

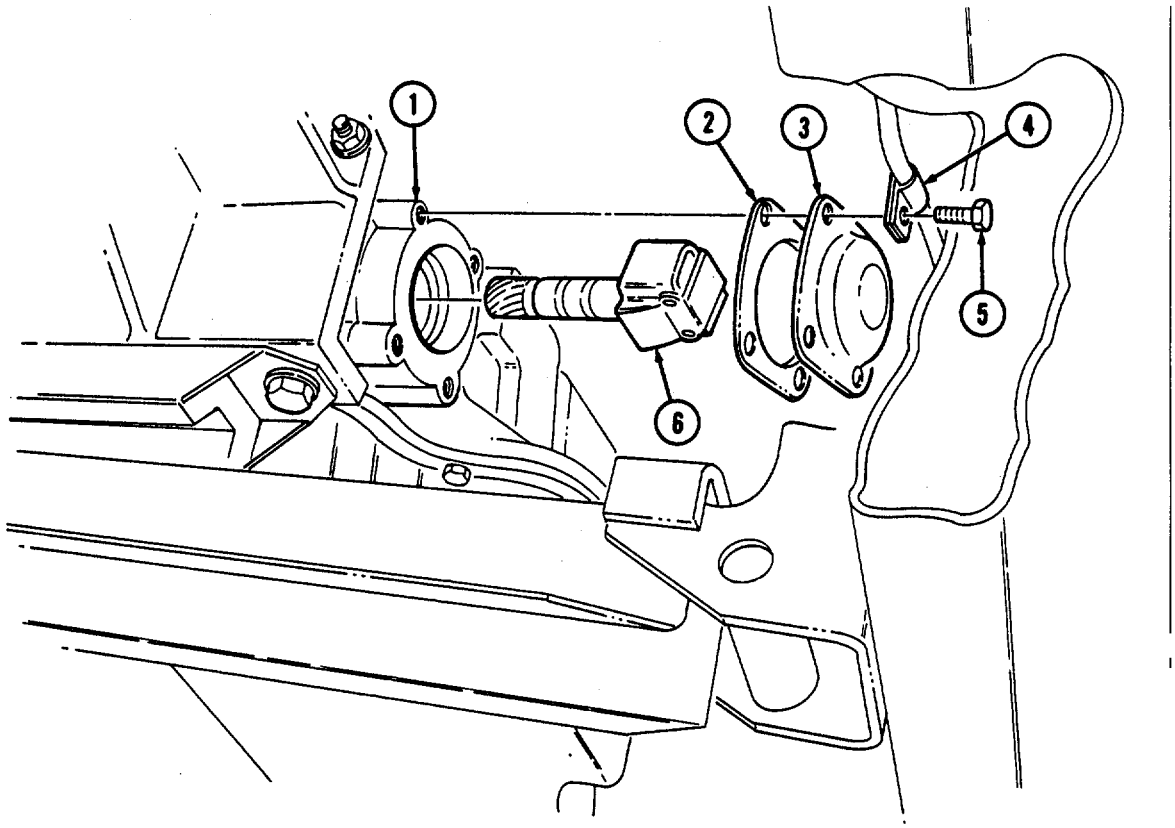
### b. Inspection

Inspect governor (para. 17-12).

### c. Installation

1. Install govenor (6) into transmission(1).
2. Install gasket (2), governor cover (3), and vent line clamp (4) on transmission (1) with four capscrews (5). Tighten capscrews (5) to 17 lb-ft (23 N•m).

## 7-3. GOVERNOR MAINTENANCE (3L80)



## 7-4. TRANSMISSION OIL PUMP SEAL REPLACEMENT (3L80)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

Applicable Models
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2

Manual References
TM 9-2320-280-10
TM 9-2320-280-24P

Tools
General mechanic's tool kit: automotive (Appendix G, Item 1)

Equipment Condition
Transmission/transfer case assembly removed (para. 7-6).

Special Tools
Oil pump seal installer (Appendix G, Item 39)

General Safety Instructions
Torque converter must be supported during removal and installation.

Materials/Parts
Sealing compound (Appendix B, Item 47)

Maintenance Level
Direct support

**WARNING**

Torque converter must be supported during removal and installation. Failure to do this may cause injury to personnel or damage to equipment.

**NOTE**

This procedure is for the 3L80 transmission oil pump seal replacement only. Refer to para. 17-29 for 4L80-E oil pump seal replacement.

### a. Removal

**NOTE**

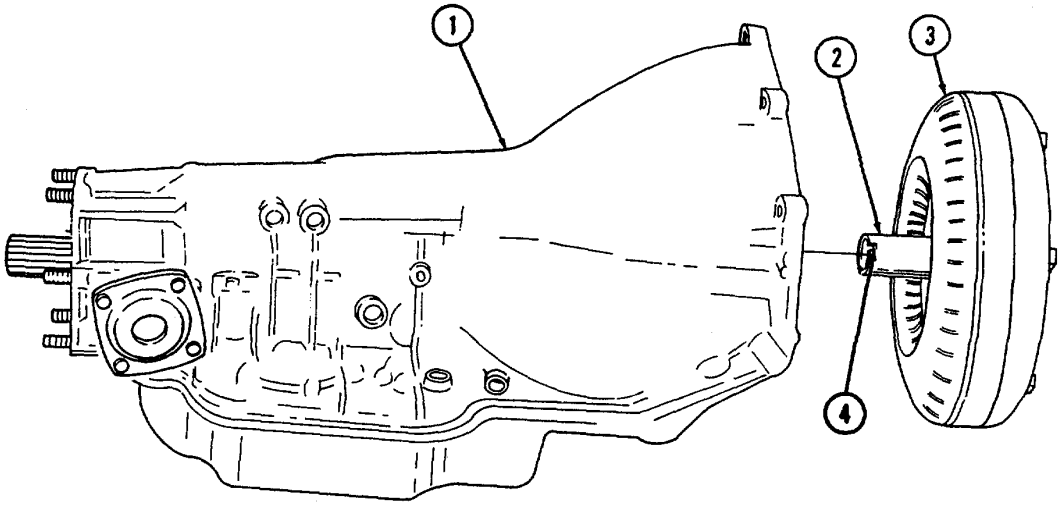
Have drainage container ready to catch fluid.

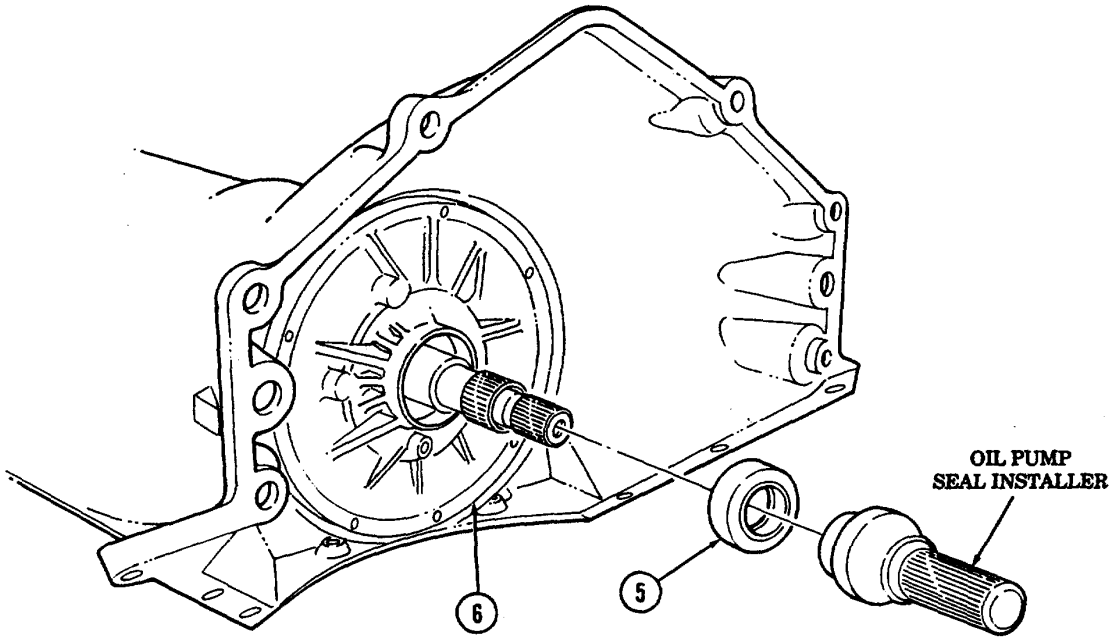
1. Remove torque converter (3) from transmission (1).
2. Remove oil seal (5) from oil pump (6).

### b. Installation

1. Apply sealing compound to outside diameter of oil seal (5).
2. Using seal installer, install oil seal (5) in oil pump (6).
3. Install torque converter (3) in transmission (1). Ensure drive lugs of inner pump rotor in oil pump (6) are properly engaged with drive slots (4) of torque converter hub (2).

**7-4. TRANSMISSION OIL PUMP SEAL REPLACEMENT (3L80) (Cont'd)**




FOLLOW-ON TASKS:
- Install transmission/transfer case assembly (para. 7-7).
- Fill transmission to proper fluid level (TM 9-2320-280-10).

## Section II. TRANSMISSION REPLACEMENT

## 7-5. TRANSMISSION REPLACEMENT TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 7-6. | Transmission/Transfer Case Assembly Removal (3L80) | 7-6 |
| 7-7. | Transmission/Transfer Case Assembly Installation (3L80) | 7-12 |
| 7-8. | Transmission/Transfer Case Assembly Removal (4L80-E) | 7-16 |
| 7-9. | Transmission/Transfer Case Assembly Installation (4L80-E) | 7-21 |
| 7-10. | Transmission Preparation | 7-28 |


## 7-6. TRANSMISSION/TRANSFER CASE ASSEMBLY REMOVAL (3L80)

**This task covers:**

**Removal**

### INITIAL SETUP:

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Engine lifting sling (Appendix G, Item 22)

**Material/Parts**
Engine/Transmission support sling (Appendix: C, Fig. 24 through 40) (Optional)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Engine access cover removed (TM 9-2320-280-20).
- Transmission shift rod removed (TM 9-2320-280-20).
- Muffler support bracket removed (TM 9-2320-280-20).
- Rear propeller shaft removed (TM 9-2320-280-20).
- Converter housing cover removed (TM 9-2320-280-20).
- Transmission oil dipstick removed (TM 9-2320-280-20).
- Drain transmission fluid (TM 9-2320-280-20).
- Front propeller shaft removed (TM 9-2320-280-20).

**General Safety Instructions**
- Converter must be removed with transmission as an assembly and transmission must be level.
- Do not use hands to free transmission/transfer case assembly of hang-ups or snags.
- Allow transmission/transfer case to cool before performing this task.

**Maintenance Level**
Direct support

## 7-6. TRANSMISSION/TRANSFER CASE ASSEMBLY REMOVAL (3L80) (Cont'd)

**NOTE**

The following maintenance procedure applies to vehicles with 3L80 transmissions. Refer to para. 7-8 for 4L80-E transmission removal.

**Removal**

**WARNING**

Allow transmission/transfer case to cool before performing this task. Failure to do this may cause injury.

**CAUTION**

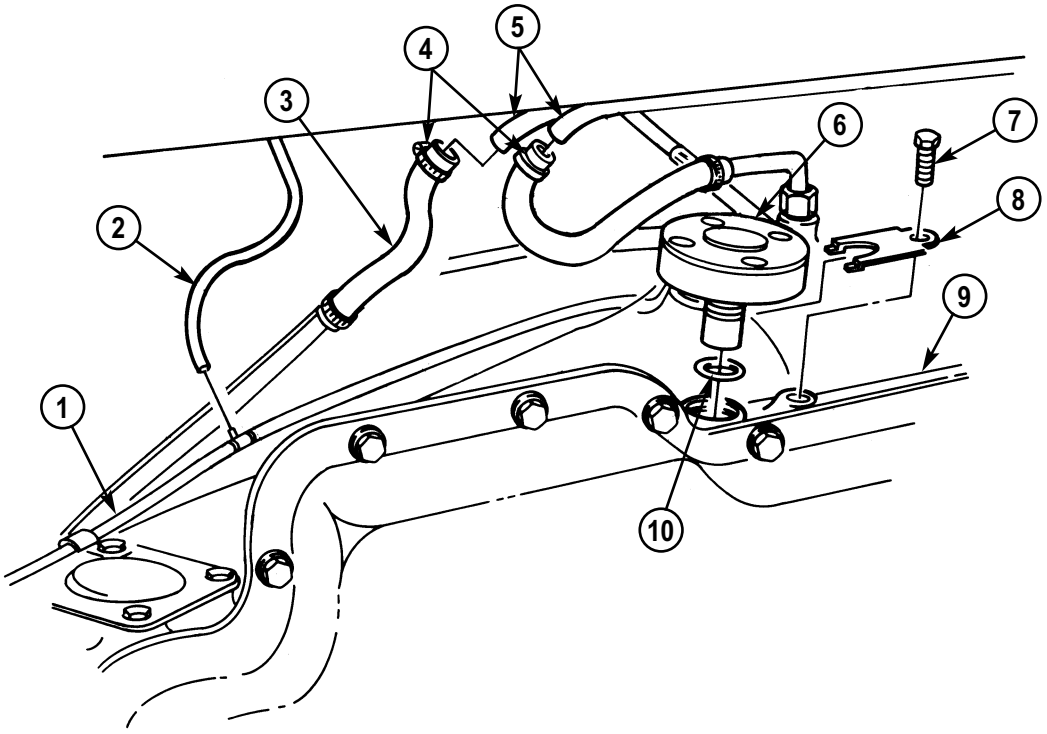
Cover or plug all open lines and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

1. Raise and support rear of vehicle.

**NOTE**

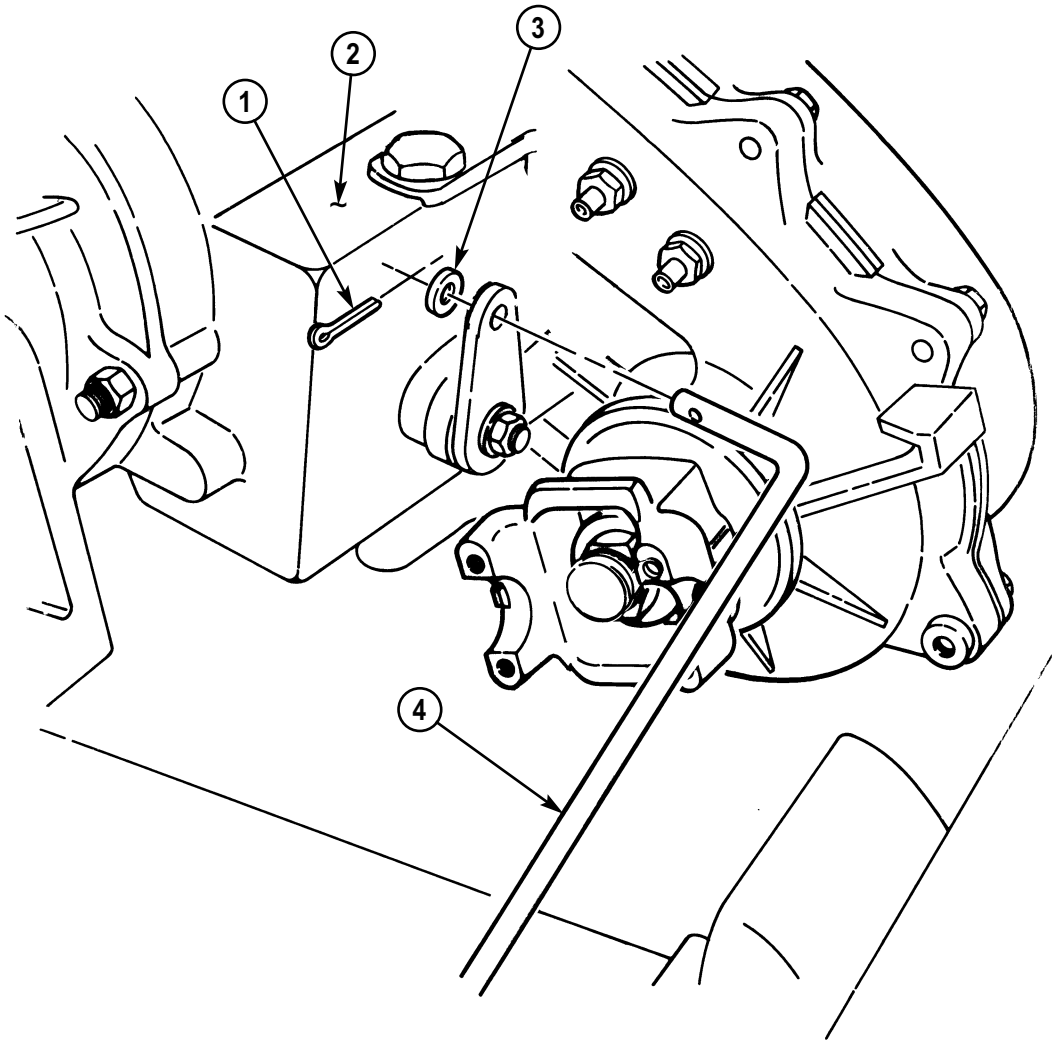
- Have drainage container ready to catch fluid.
- Tag hoses for aid in installation.

2. Loosen two hose clamps (4) and disconnect hoses (3) from cooler lines (5).
3. Disconnect main vent line (2) from transmission/transfer case vent line (1).
4. Remove capscrew (7), clip (8), modulator (6), and packing retainer (10) from transmission (9). Discard packing retainer (10).

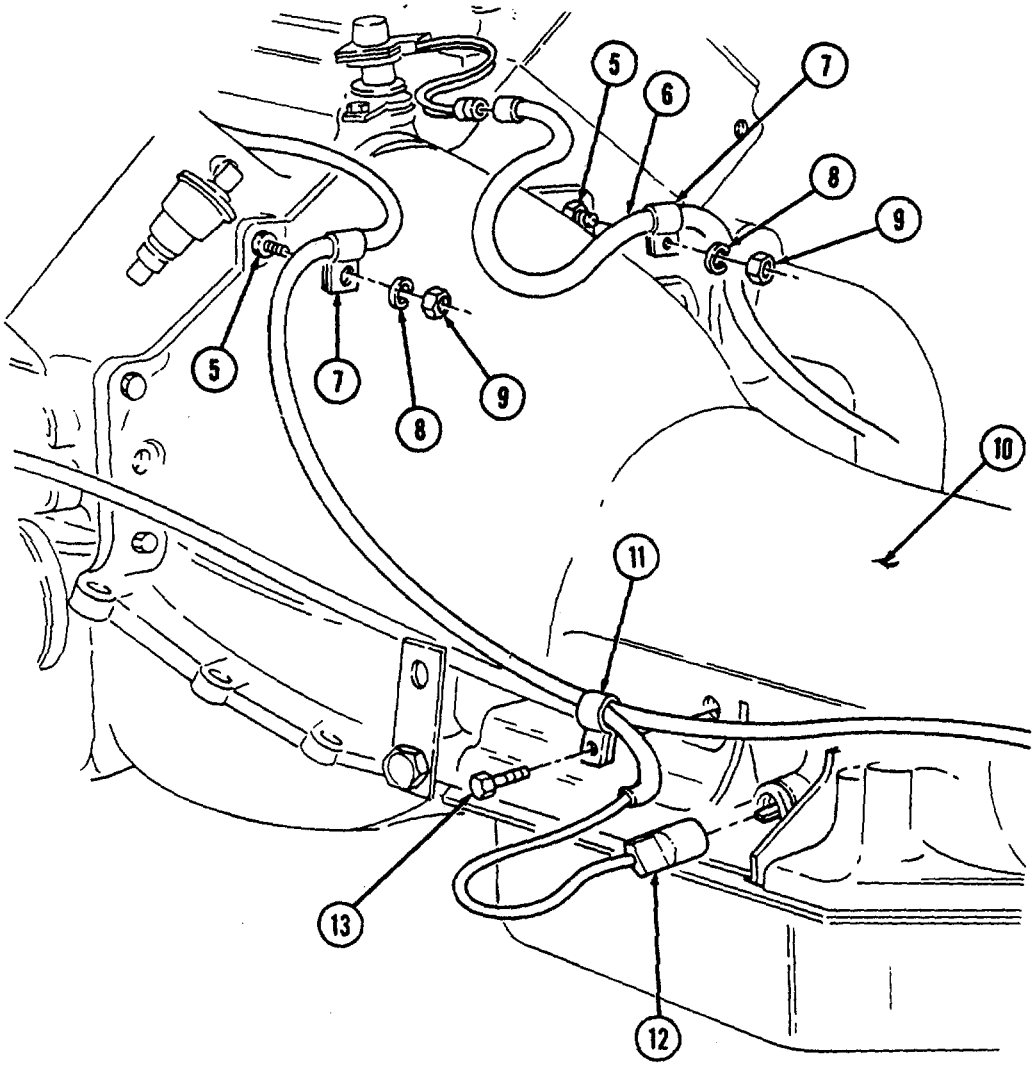


## 7-6. TRANSMISSION/TRANSFER CASE ASSEMBLY REMOVAL (3L80) (Cont'd)

5. Remove cotter pin (1) and washer (3) from transfer case shift rod (4). Disconnect shift rod (4) and remove from tranfer case (2). Discard cotter pin (1).
6. Remove screw (13) and clamp (11) from left side of transmission (10). Disconnect circuit 315C (12) from transmission (10).
7. Remove two nuts (9), lockwashers (8), clamps (7), STE/ICE-R wiring harness (6), and lead 315C (12) from studs (5). Discard lockwashers (8).



## 7-6. TRANSMISSION/TRANSFER CASE ASSEMBLY REMOVAL (3L80) (Cont'd)



## 7-6. TRANSMISSION/TRANSFER CASE ASSEMBLY REMOVAL (3L80) (Cont'd)

**NOTE**

It will be necessary to rotate flywheel clockwise from capscrew in front of crankshaft to gain access to capscrews connecting torque converter.

8. Remove six capscrews (8) and torque converter (9) from flywheel (7) and slide torque converter (9) away from flywheel (7).

**CAUTION**

Safety chain must be routed under transmission oil cooler lines and speedometer cable or damage may result.

9. Support transmission (3) with transmission jack and secure with safety chain.
10. Remove transmission mount crossmember (TM 9-2320-280-20).

**CAUTION**

- If transmission is lowered too far, cooling fan damage will result.
- Wood block must completely cover bottom of engine oil pan or oil pan damage will result.

11. Lower transmission (3) slightly and support engine under oil pan (6) with wood block and stand.
12. Remove 90 degree speedometer adapter (10) from transfer case (4) and disconnect speedometer cable (11) from bracket (12). Secure 90 degree speedometer adapter (10) and speedometer cable (11) away from transfer case (4).
13. Remove four capscrews (5) and two studs (2) from transmission (3) and engine (1).

**WARNING**

- Torque converter must be removed with the transmission as an assembly. Keep transmission level. The converter may slide off front of transmission and cause injury to personnel or damage to converter.
- Do not use hands to free transmission/transfer case assembly of hangups or snags. Use prybar to avoid injury.

**CAUTION**

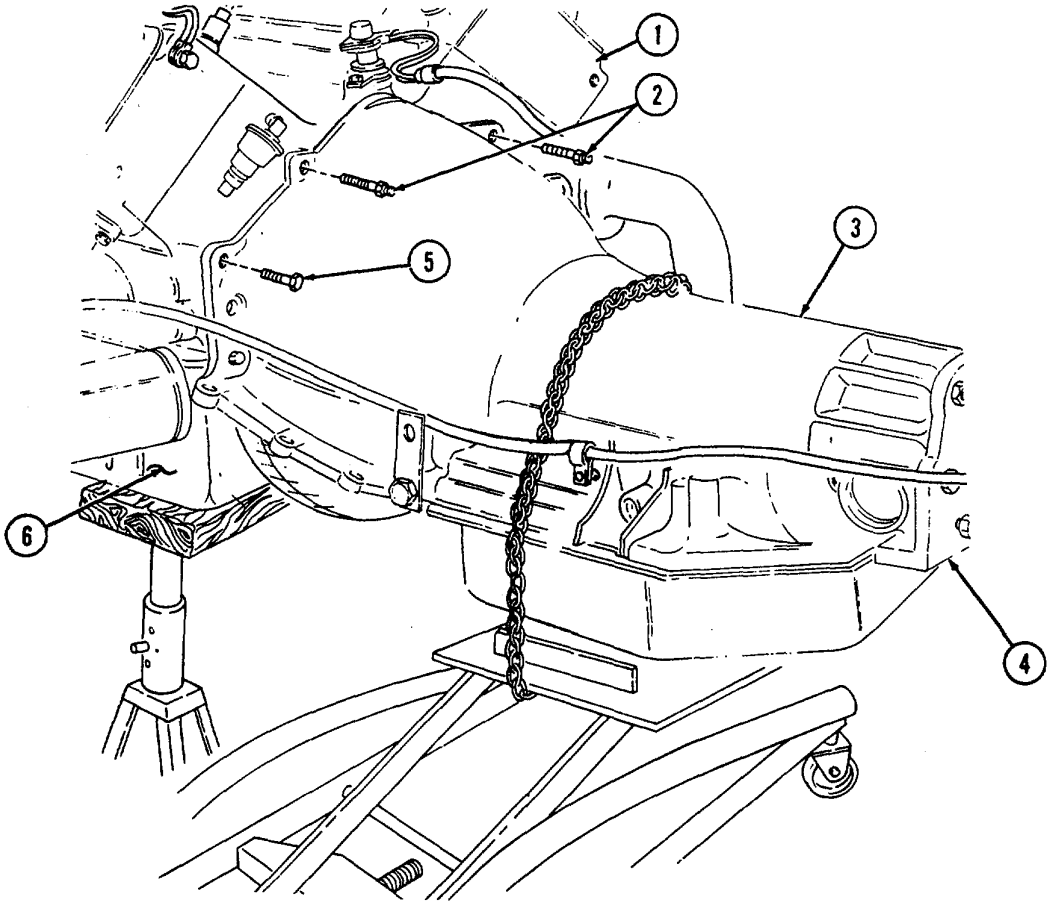
Always remove the transmission/transfer case assembly slowly and watch for the following: binding or hard to move means that something may still be connected that must be removed; ensure that wiring, lines, cables, and rods are not in the path of the removal.

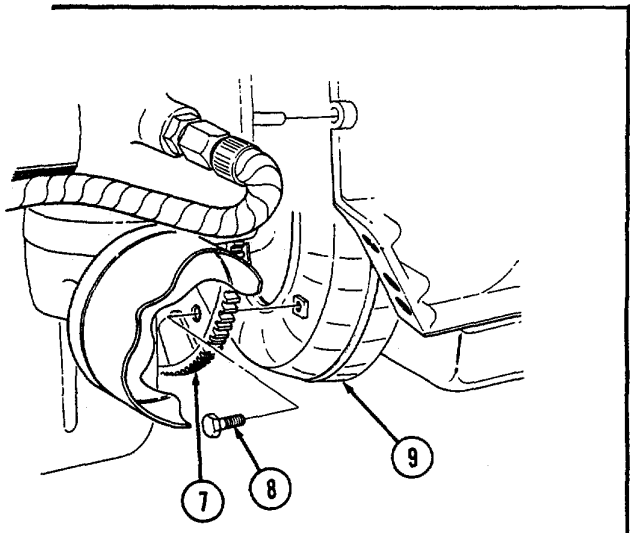
14. Move transmission (3) and transfer case (4) rearward to clear engine (1).
15. Lower transmission (3) and transfer case (4) slowly.
16. Remove transmission (3) and transfer case (4) from under vehicle.

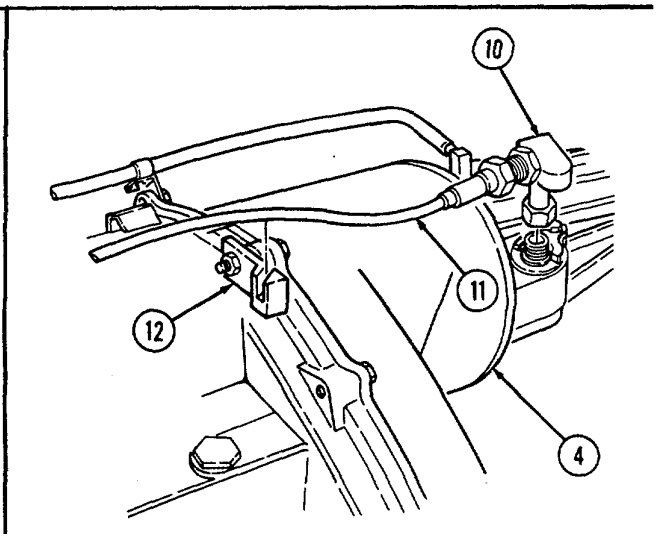
**NOTE**

If vehicle is moved because of limited shop space or tactical movement, damage to the engine and the vehicle may occur. To prevent damage, an engine/transmission support sling can be installed.

## 7-6. TRANSMISSION/TRANSFER CASE ASSEMBLY REMOVAL (3L80) (Cont'd)




FOLLOW-ON TASK: Prepare transmission for disassembly (para.7-10).

## 7-7. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (3L80)

**This task covers:**

**Installation**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two lockwashers (Appendix E, Item 100)
Packing retainer (Appendix E, Item 187)
Cotter pin (Appendix E, Item 169)
Sealing compound (Appendix B, Item 55)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Transmission/transfer case assembly prepared for installation (para. 7-10).

**General Safety Instructions**
- Torque converter must be installed with transmission as an assembly. Transmission must be level.
- Do not use hand to free transmission/ transfer case assembly hang-ups or snags.

**Maintenance Level**
Direct support

**NOTE**

The following maintenance procedure applies to vehicles with 3L80 transmissions. Refer to para. 7-9 for 4L80-E transmission installation.

**Installation**

**WARNING**

Torque converter must be installed with transmission as an assembly. Keep transmission level. The torque converter may slide off front of transmission and cause injury to personnel or damage to converter.

**CAUTION**

- Torque converter must be properly installed in transmission or transmission damage will result.
- Safety chain must be routed under transmission oil cooler lines or damage to cooler lines will result.
- Remove engine support sling prior to transmission/transfer case installation if installed.

1. Place transmission (3) and transfer case (4) on transmission jack and secure with safety chain.

**WARNING**

Do not use hands to free transmission/transfer case assembly of hang-ups or snags. Use prybar to avoid injury.

**CAUTION**

Always install transmission/transfer case assembly slowly. Raise into chassis carefully and closely observe all components to prevent damage.

2. Position transmission (3) and transfer case (4) under vehicle and raise into place, aligning converter housing pilot holes (7) with engine dowels (6).

## 7-7. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (3L80) (Cont'd)

**NOTE**

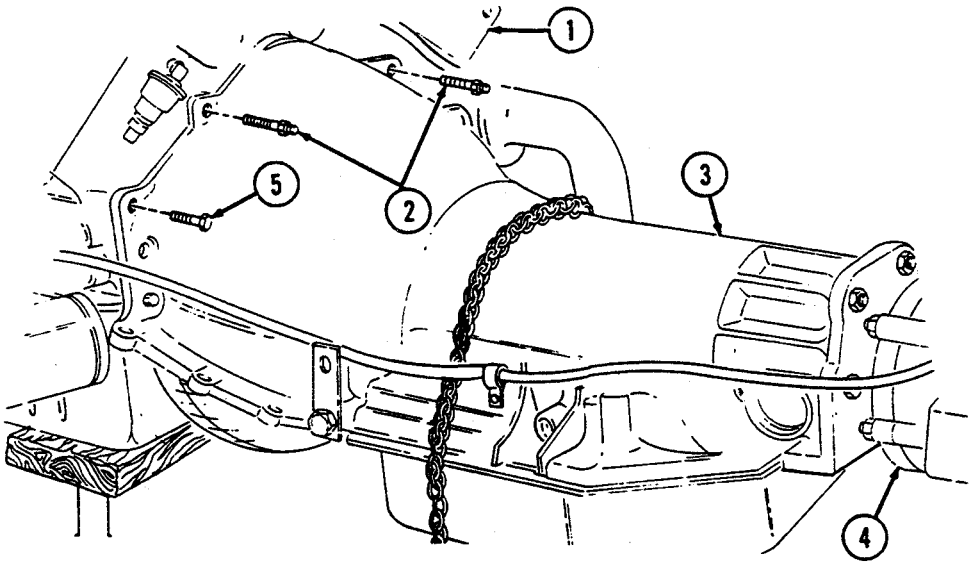
Be certain torque converter rotates freely

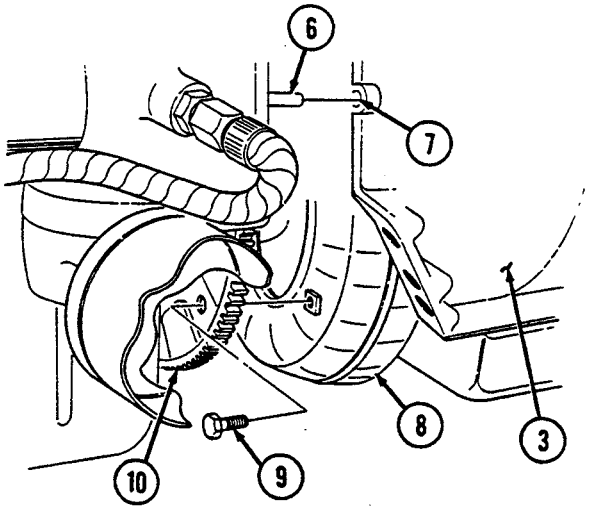
3. Apply sealing compound to capscrews (5) and studs (2).
4. Move transmission (3) forward onto engine dowels (6). Install four capscrews (5) and two studs (2) on transmission (3) and engine (1). Tighten capscrews (5) and studs (2) to 35 lb-ft (48 N•m).
5. Install speedometer cable (12) in bracket (13) and install 90 degree adapter (11) to transfer case (4).
6. Raise transmission (3) and transfer case (4) and remove stand supporting engine (1). Install transmission mount crossmember (TM 9-2320-280-20).
7. Remove safety chain and lower transmission jack.

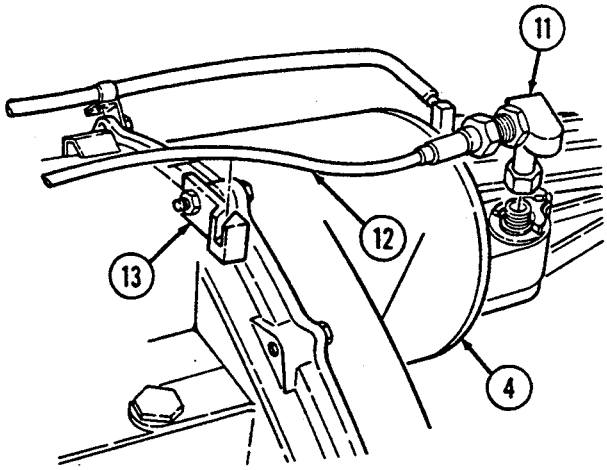
**NOTE**

It will be necessary to rotate flywheel clockwise from capscrew in front of crankshaft to gain access to capscrews securing torque converter.

8. Align torque converter (8) with holes in flywheel (10). Install six capscrews (9) and torque converter (8) on flywheel (10).
9. Tighten capscrews (9) to 32 lb-ft (43 N•m).

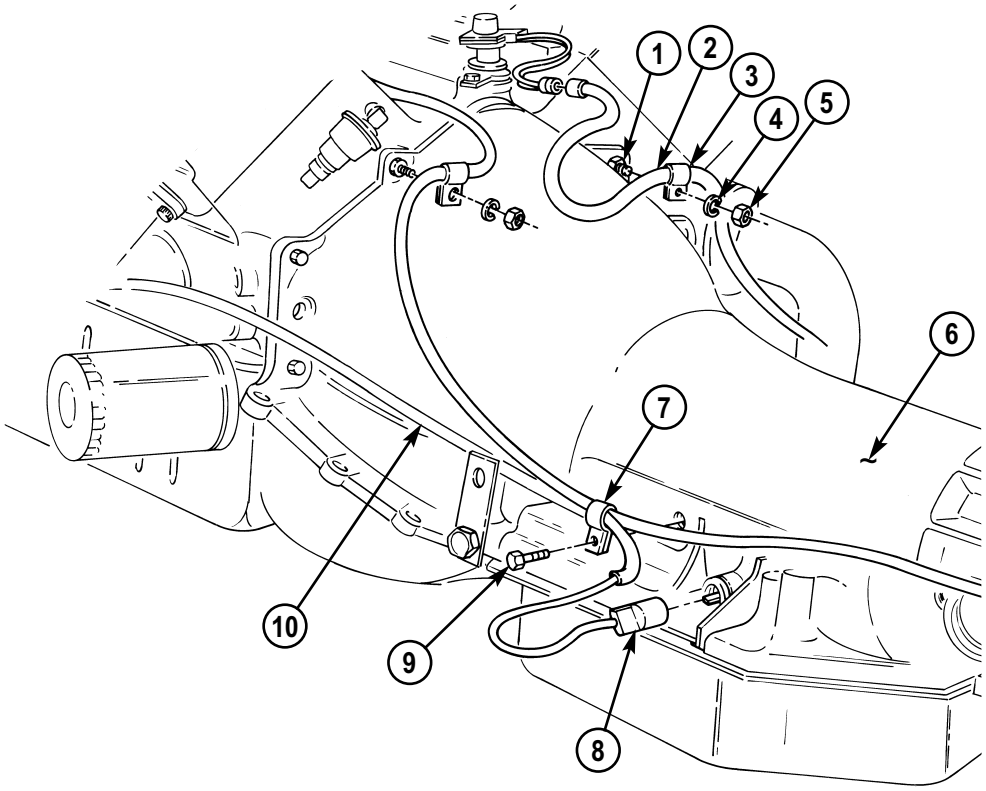


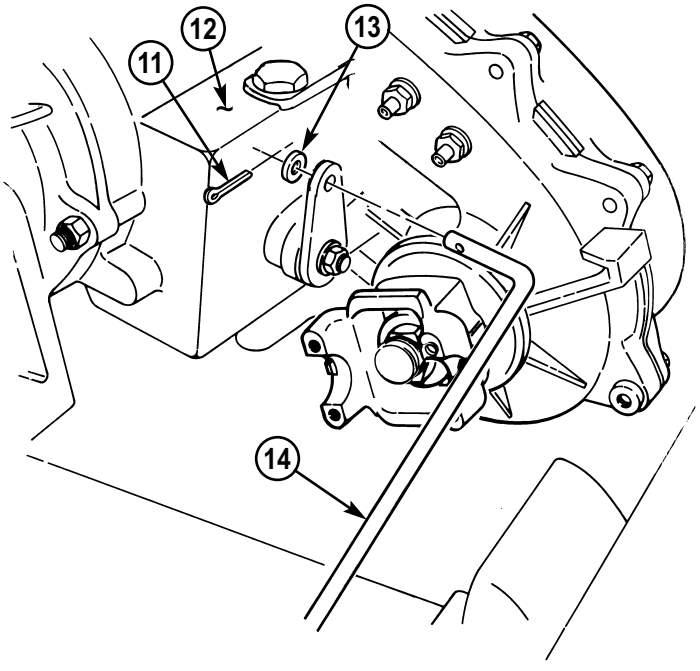



## 7-7. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (3L80) (Cont'd)

10. Install lead 315C (8) and STE/ICE-R wiring harness (2) on studs (1) with two clamps (3), lockwashers (4), and nuts (5).
11. Connect lead 315C (8) to transmission (6). Install lead 315C (8) and speedometer cable (10) on transmission (6) with screw (9) and clamp (7).

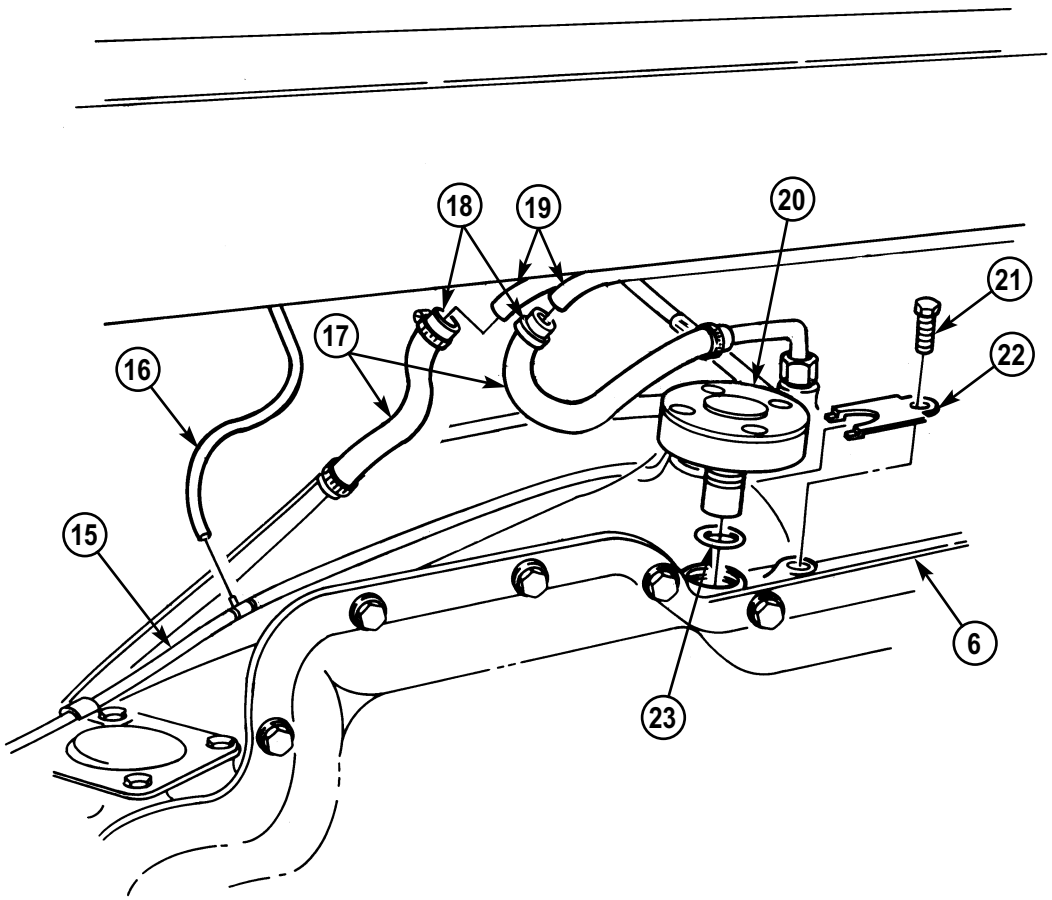



12. Connect transfer case shift rod (14) to transfer case (12) with washer (13) and cotter pin (11).



## 7-7. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (3L80) (Cont'd)

13. Install packing retainer (23) on modulator (20). Install modulator (20) into transmission (6) with clip (22) and capscrew (21). Tighten capscrew (21) to 18 lb-ft (24 N•m).
14. Connect hoses (17) to transmission/transfer case cooler lines (19) with two hose clamps (18).
15. Connect main vent line (16) to transmission/transfer case vent line (15).
16. Lower rear of vehicle.




FOLLOW-ON TASKS:
- Install front propeller shaft (TM 9-2320-280-20).
- Install muffler support bracket (TM 9-2320-280-20).
- Install converter housing cover (TM 9-2320-280-20).
- Install transmission oil dipstick (TM 9-2320-280-20).
- Install rear propeller shaft (TM 9-2320-280-20).
- Install transmission shift rod (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).
- Fill transmission to proper fluid level (TM 9-2320-280-10).
- Start engine (TM 9-2320-280-10) and inspect for leaks.
- Lower and secure hood (TM 9-2320-280-10).
- Road test vehicle (TM 9-2320-280-20) and check for proper transmission/transfer case operation.

## 7-8. TRANSMISSION/TRANSFER CASE ASSEMBLY REMOVAL (4L80-E)

**This task covers:**

**Removal**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Engine/Transmission support sling (Appendix C. Fig. 24 through 40) (Optional)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-380-24P

**Equipment Condition**
- Engine access cover removed (TM 9-2320-280-20).
- Muffler support bracket removed (TM 9-2320-280-20).
- Rear propeller shaft removed (TM 9-2320-280-20).
- Converter housing cover removed (TM 9-2320-280-20).
- Transmission oil dipstick removed (TM 9-2320-280-20).
- Drain transmission fluid (TM 9-2320-280-20).
- Front propeller shaft removed (TM 9-2320-280-20).

**General Safety Instructions**
- Converter must be removed with transmission as an assembly and transmission must be level.
- Do not use hands to free transmission/transfer case assembly of hang-ups or snags.
- Allow transmission/transfer case to cool before performing this task.

**Maintenance Level**
Direct support

**NOTE**

The following maintenance procedure applies to vehicles with 4L80-E transmissions. Refer to para. 7-6 for 3L80 transmission removal.

**Removal**

**WARNING**

Allow transmission/transfer case to cool before performing this task. Failure to do this may cause injury.

**CAUTION**

Cover or plug all open lines and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

1. Raise and support rear of vehicle.

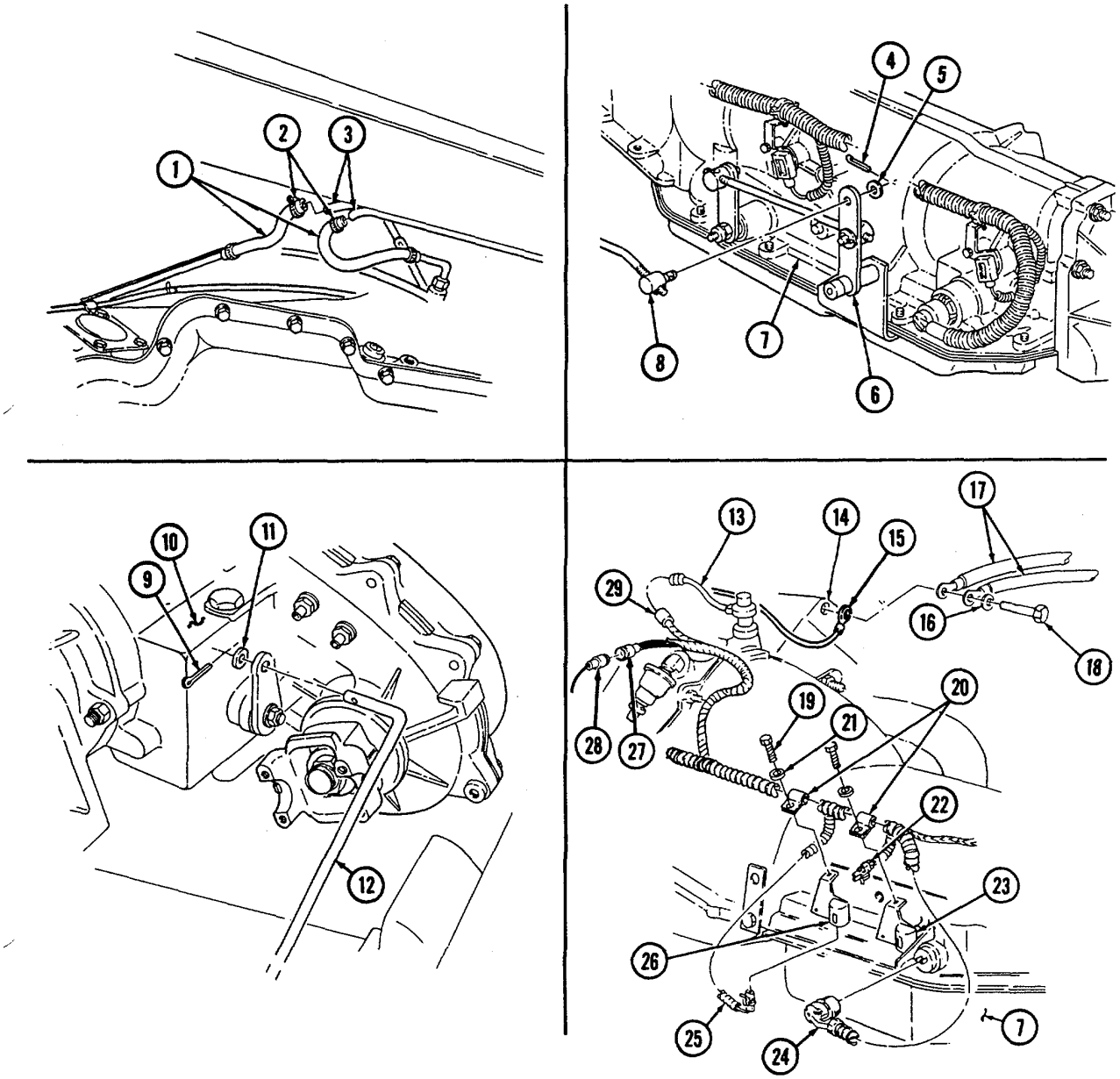
**NOTE**

- Have drainage container ready to catch fluid.
- Tag hoses for aid in installation.

2. Loosen two hose clamps (2) and disconnect hoses (1) from cooler lines (3).
3. Remove cotter pin (4), washer (5), and shift rod and trunnion (8) from relay lever (6). Discard cotter pin (4).
4. Remove lock pin (9) and washer (11) from transfer case shift rod (12). Disconnect shift rod (12) from transfer case (10). Discard lock pin (9).

## 7-8. TRANSMISSION/TRANSFER CASE ASSEMBLY REMOVAL (4L80-E) (Cont'd)

5. Disconnect wiring harness connector (24) from transmission (7).
6. Disconnect connectors 495/496 (25) and 497/498 (22) from input speed sensor (26) and output speed sensor (23).
7. Remove two capscrews (19), washers (21), and clamps (20) from sensors (23) and (26).
8. Disconnect harness leads 359F/349A (29) from RPM sensor (13) and lead 349A (28) from leads 350B/359A/355A (27).
9. Remove capscrew (18), lockwasher (16), and two ground cables 3A and 55A (17) and alternator ground (15) from cylinder head (14). Discard lockwasher (16).



## 7-8. TRANSMISSION/TRANSFER CASE ASSEMBLY REMOVAL (4L80-E) (Cont'd)

**NOTE**

It will be necessary to rotate flywheel clockwise from capscrew in front of crankshaft to gain access to capscrews securing torque converter.

10. Remove six capscrews (26) from torque converter (27) and flywheel (25) and slide torque converter (27) away from flywheel (25).

**CAUTION**

Safety chain must be routed under transmission oil cooler lines and speedometer cable or damage may result.

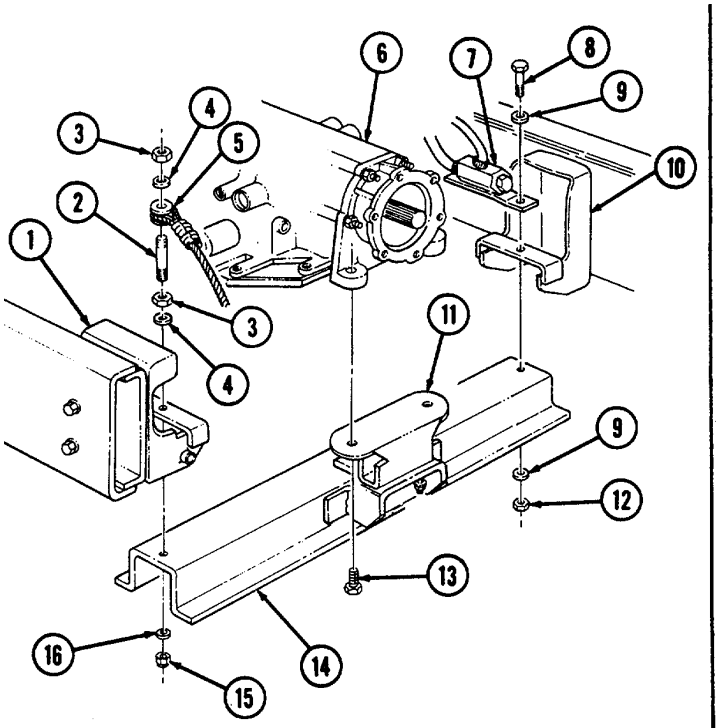
11. Support transmission (19) with transmission jack and secure with safety chain.
12. Remove two capscrews (13) from transmission adapter (6) and bracket (11).
13. Remove locknut (12), two washers (9), bypass valve (7), and capscrew (8) from right side of crossmember (14) and support bracket (10). Discard locknut (12).
14. Remove locknut (15), washer (16), crossmember (14), and two washers (4), stud (2), cable (5), and two nuts (3) from support bracket (1). Discard locknut (15).

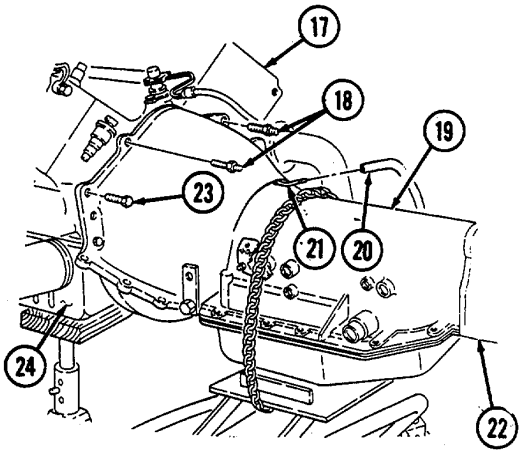
**CAUTION**

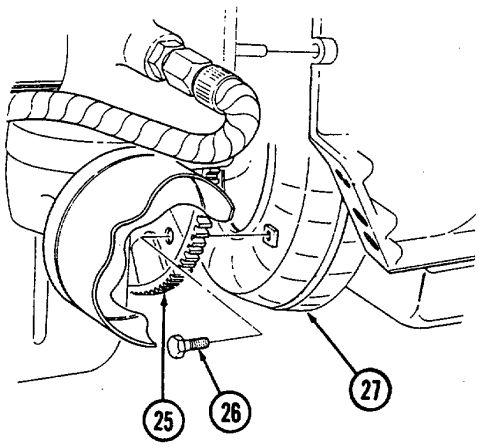
- If transmission is lowered too far, cooling fan damage will result.
- Wood block must completely cover bottom of engine oil pan or oil pan damage will result.

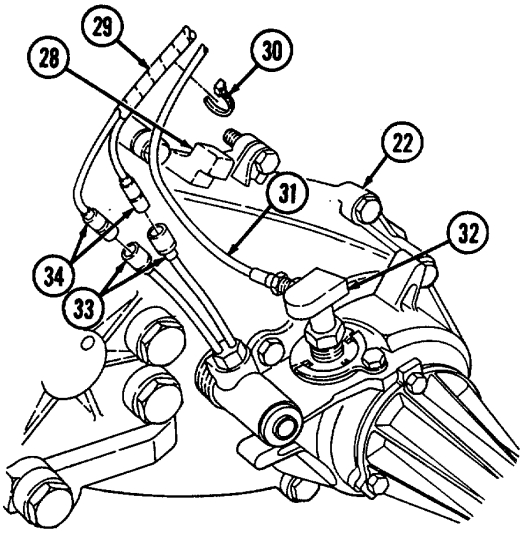
15. Lower transmission (19) slightly and support engine under oil pan (24) with wood block and stand.
16. Disconnect main vent line (20) from transmission/transfer case vent line (21).
17. Remove 90 degree speedometer adapter (32) from transfer case (22) and disconnect speedometer cable (31) from bracket (28). Secure 90 degree speedometer adapter (32) and speedometer cable (31) away from transfer case (22).
18. Disconnect two leads (34) from transfer case switch leads (33) on transfer case (22).
19. Remove four tiedown straps (30) and harness (29) from speedometer cable (31). Discard tiedown straps (30).
20. Remove four capscrews (23) and two studs (18) from transmission (19) and engine (17).

**7-8. TRANSMISSION/TRANSFER CASE REMOVAL (4L80E) (Cont'd)**



## 7-8. TRANSMISSION/TRANSFER CASE REMOVAL (4L80E) (Cont'd)

**WARNING**

- Torque converter must be removed with the transmission as an assembly. Keep transmission level. The converter may slide off front of transmission and cause injury to personnel or damage to converter.
- Do not use hands to free transmission/transfer case assembly of hangups or snags. Use prybar to avoid injury.

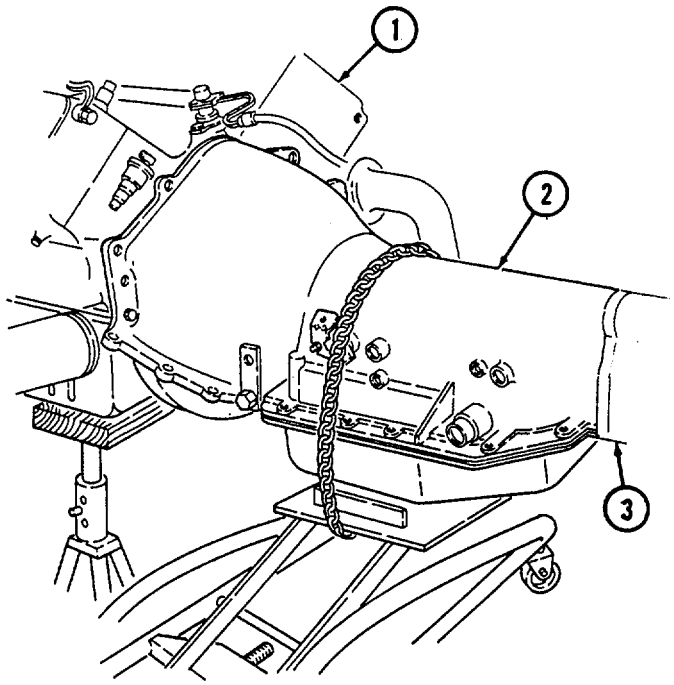
**CAUTION**

Always remove the transmission/transfer case assembly slowly and watch for the following: binding or hard to move means that something may still be connected that must be removed; ensure that wiring, lines, cables, and rods are not in the path of the removal.

21. Move transmission (2) and transfer case (3) rearward to clear engine (1).
22. Lower transmission (2) and transfer case (3) slowly.
23. Remove transmission (2) and transfer case (3) from under vehicle.

**NOTE**

If vehicle is moved because of limited shop space or tactical movement, damage to the engine and vehicle may occur. To prevent damage, an engine/transmission support sling can be installed.




FOLLOW-ON TASKS: Prepare transmission for disassembly (para. 7-10).

# 7-9. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (4L80-E)

**This task covers:**

**Installation**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Lockwasher (Appendix E, Item 104)
Lock pin (Appendix E, Item 170)
Cotter pin (Appendix E, Item 168)
Four tiedown straps (Appendix E, Item 250)
Locknut (Appendix E, Item 79)
Locknut (Appendix E, Item 66)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM-9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Transmission/transfer case assembly prepared for installation (para. 7-10).

**General Safety Instructions**
- Torque converter must be installed with transmission as an assembly. Transmission must be level.
- Do not use hand to free transmission/transfer case assembly of hang-ups or snags.

**Maintenance Level**
Direct support

**NOTE**

The following maintenance procedure applies to vehicles with 4L80-E transmissions. Refer to para. 7-7 for 3L80 transmission installation.

**Installation**

**WARNING**

Torque converter must be installed with transmission as an assembly. Keep transmission level. The torque converter may slide off front of transmission and cause injury to personnel or damage to converter.

**CAUTION**

- Torque converter must be properly installed in transmission or transmission damage will result.
- Safety chain must be routed under transmission oil cooler lines or damage to cooler lines will result.

## 7-9. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (4L80-E) (Cont'd)

1. Place transmission (3) and transfer case (4) on transmission jack and secure with safety chain.

**WARNING**

Do not use hands to free transmission/transfer case assembly of hangups or snags. Use prybar to avoid injury.

**CAUTION**

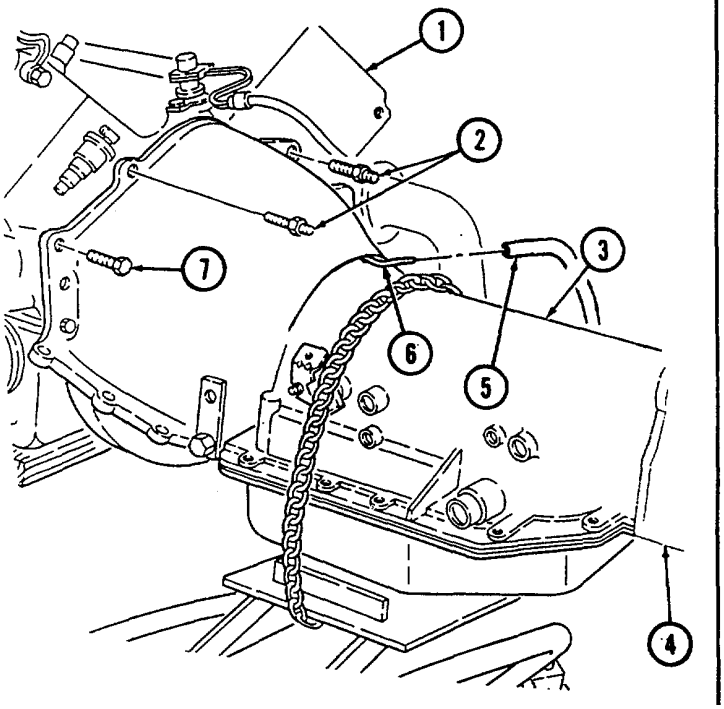
Always install transmission/transfer case assembly slowly. Raise into chassis carefully and closely observe all components to prevent damage.

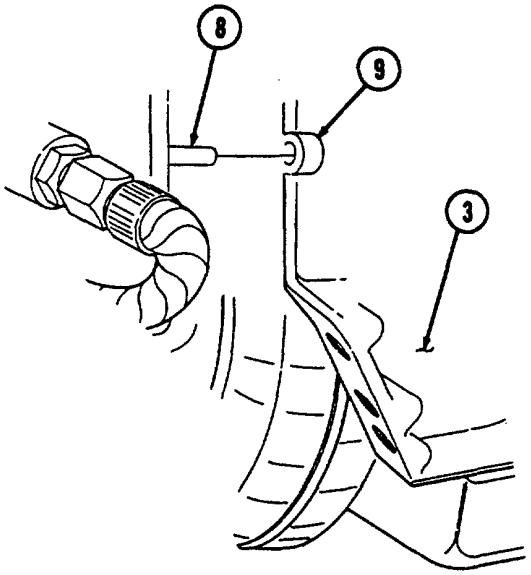
2. Position transmission (3) and transfer case (4) under vehicle and raise into place, aligning converter housing pilot holes (9) with engine dowels (8).

**NOTE**

Be certain torque converter rotates freely.

3. Move transmission (3) forward onto engine dowels (8). Install four capscrews (7), two studs (2), and transmission (3) on engine (1). Tighten capscrews (7) and studs (2) to 35 lb-ft (47 N•m).
4. Connect main vent (5) to transmission/transfer case vent line (6).
5. Raise transmission (3) and transfer case (4) and remove stand supporting engine (1).



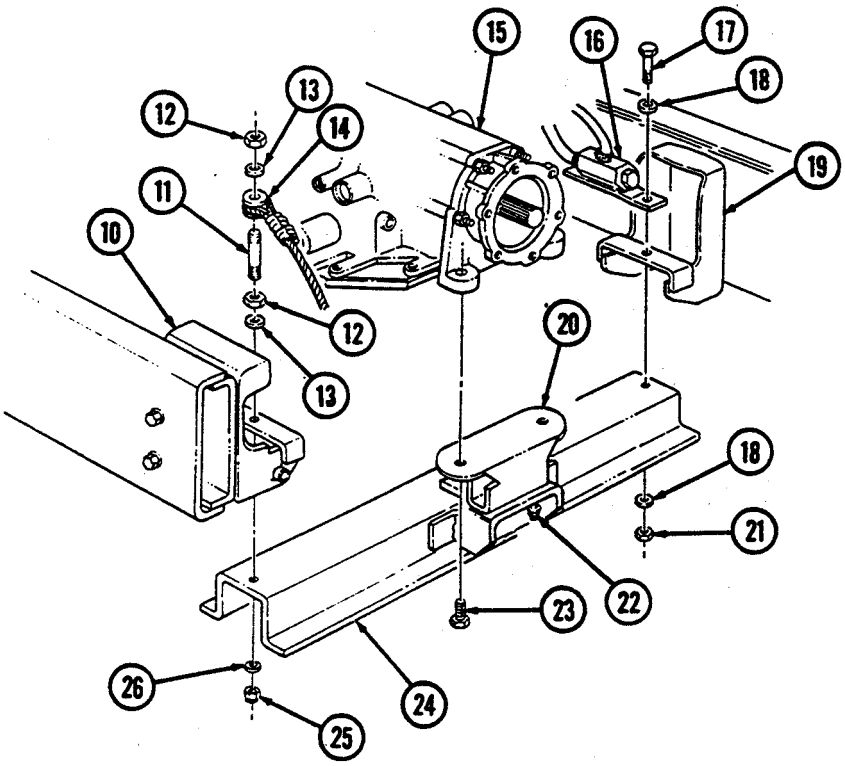



## 7-9. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (4L80-E) (Cont'd)

**NOTE**

Bracket nuts must be loosened prior to installation of crossmember on vehicle for proper alignment.

6. Loosen two nuts (22) on bracket (20) and crossmember (24).
7. Install bracket (20) and crossmember (24) on transmission adapter (15) with two capscrews (23). Tighten capscrews (23) to 65 lb-ft (88 N•m).
8. Install two nuts (12), washers (13), cable (14), washer (26), and locknut (25) on crossmember (24) and support bracket (10). Tighten locknut (25) to 90 lb-ft (122 N•m).
9. Install capscrew (17), two washers (18), bypass valve (16), and locknut (21) on crossmember (24) and support bracket (19). Tighten locknut (21) to 65 lb-ft (88 N•m).
10. Tighten two nuts (22) to 65 lb-ft (88 N•m).



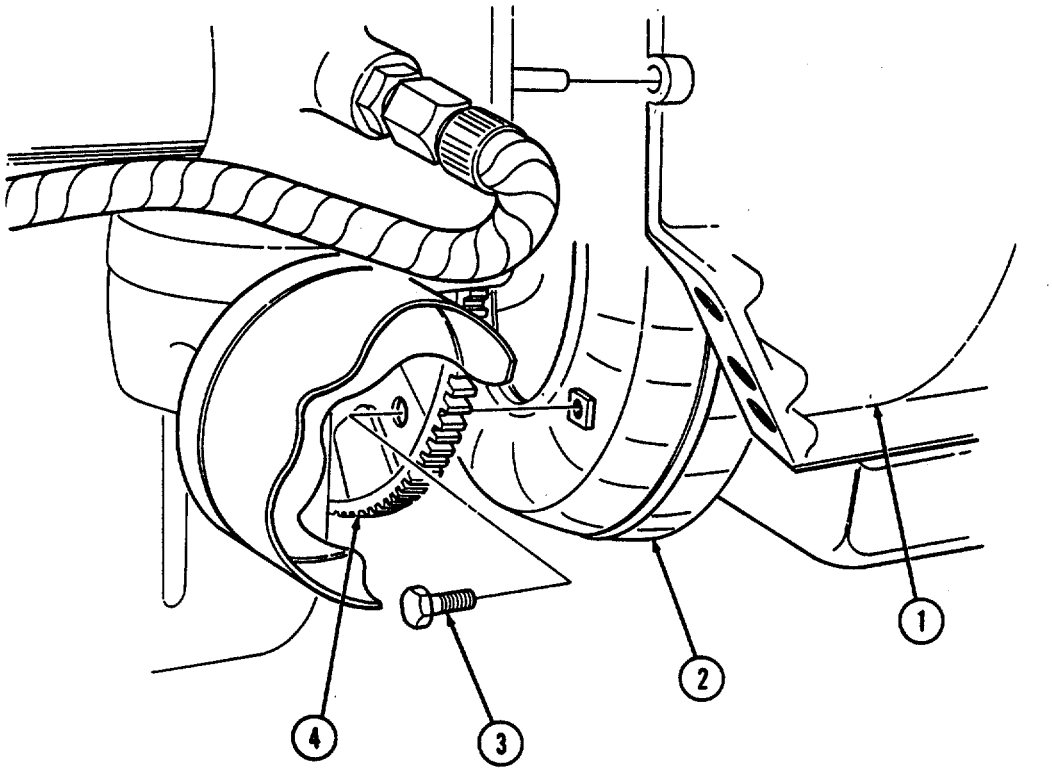
## 7-9. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (4L80-E) (Cont'd)

11. Remove safety chain and lower transmission jack.

**NOTE**

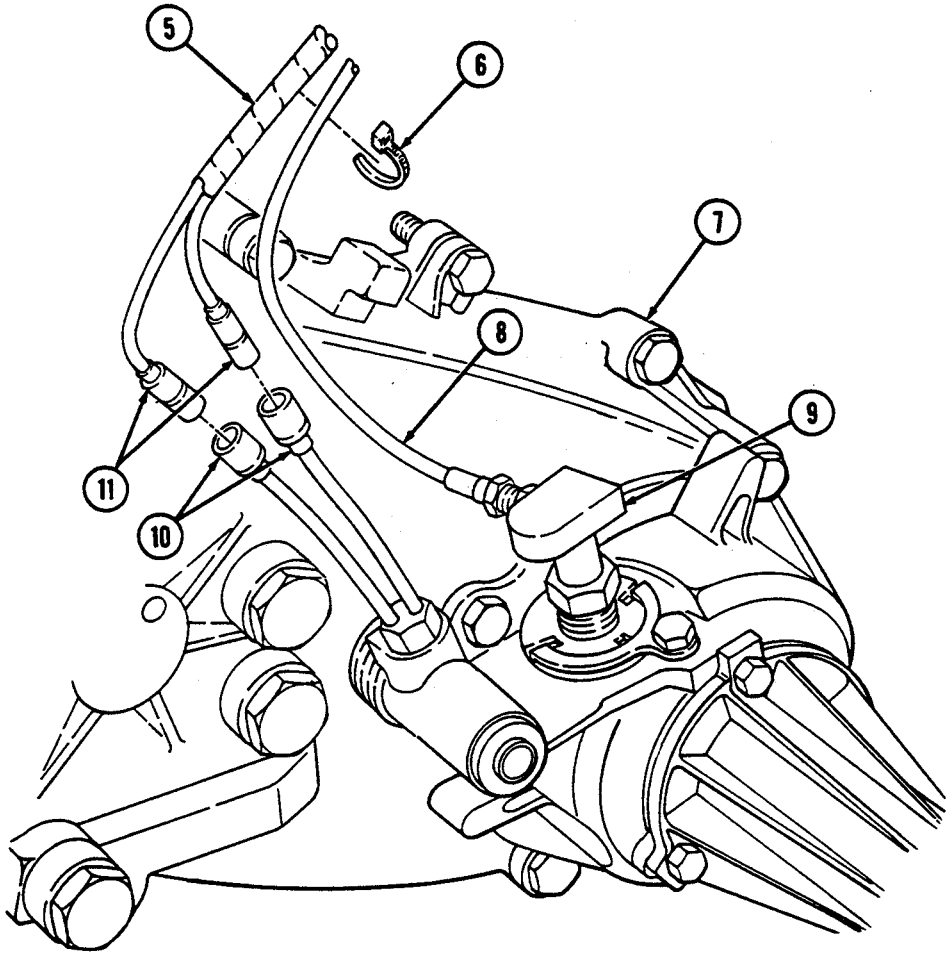
It will be necessary to rotate flywheel clockwise from capscrew in front of crankshaft to gain access to capscrews securing torque converter.

12. Align torque converter (1) with holes in flywheel (4). Install six capscrews (3) and torque converter (2) on flywheel (4).
13. Tighten capscrews (3) to 32 lb-ft (43 N•m).



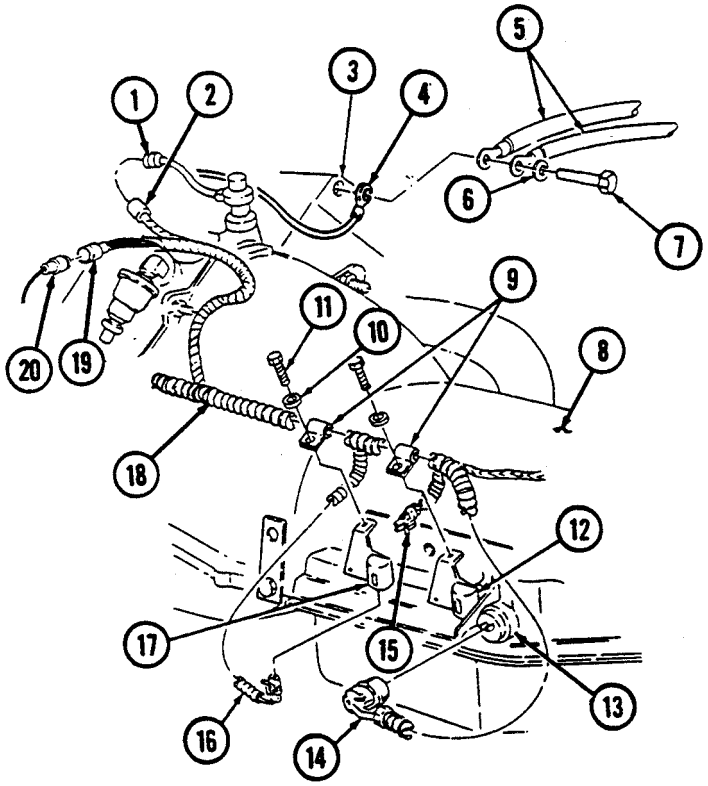
## 7-9. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (4L80-E) (Cont'd)

14. Install 90 degree speedometer cable (8) to speedometer adapter (9) and secure to transfer case (7). ■
15. Connect two leads 511A and 511B (11) to transfer case switch leads 511 (10).
16. Install harness (5) on speedometer cable (8) with four tiedown straps (6).

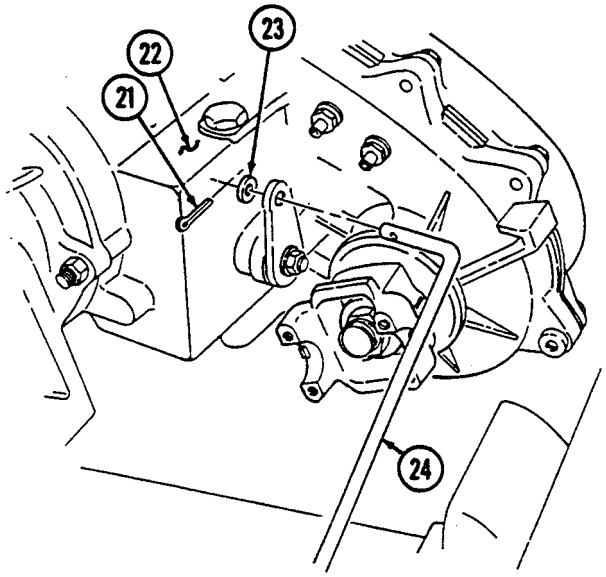


## 7-9. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (4L80-E) (Cont'd)

17. Connect harness leads 359F/349A (2) to RPM sensor (1) and lead 349A (20) to leads 350B/359A/355A (19).
18. Install two ground cables 3A and 55A (5) and alternator ground (4) on cylinder head (3) with lockwasher (6) and capscrew (7).
19. Connect wiring harness connector (14) to transmission case connector (13).
20. Connect connnectors 497/498 (15) and 495/496 (16) to output and input speed sensors (12) and (17) on transmission (8).
21. Install wiring harness (18) to sensors (17) and (12) with two clamps (9), washers (10), and capscrews (11).

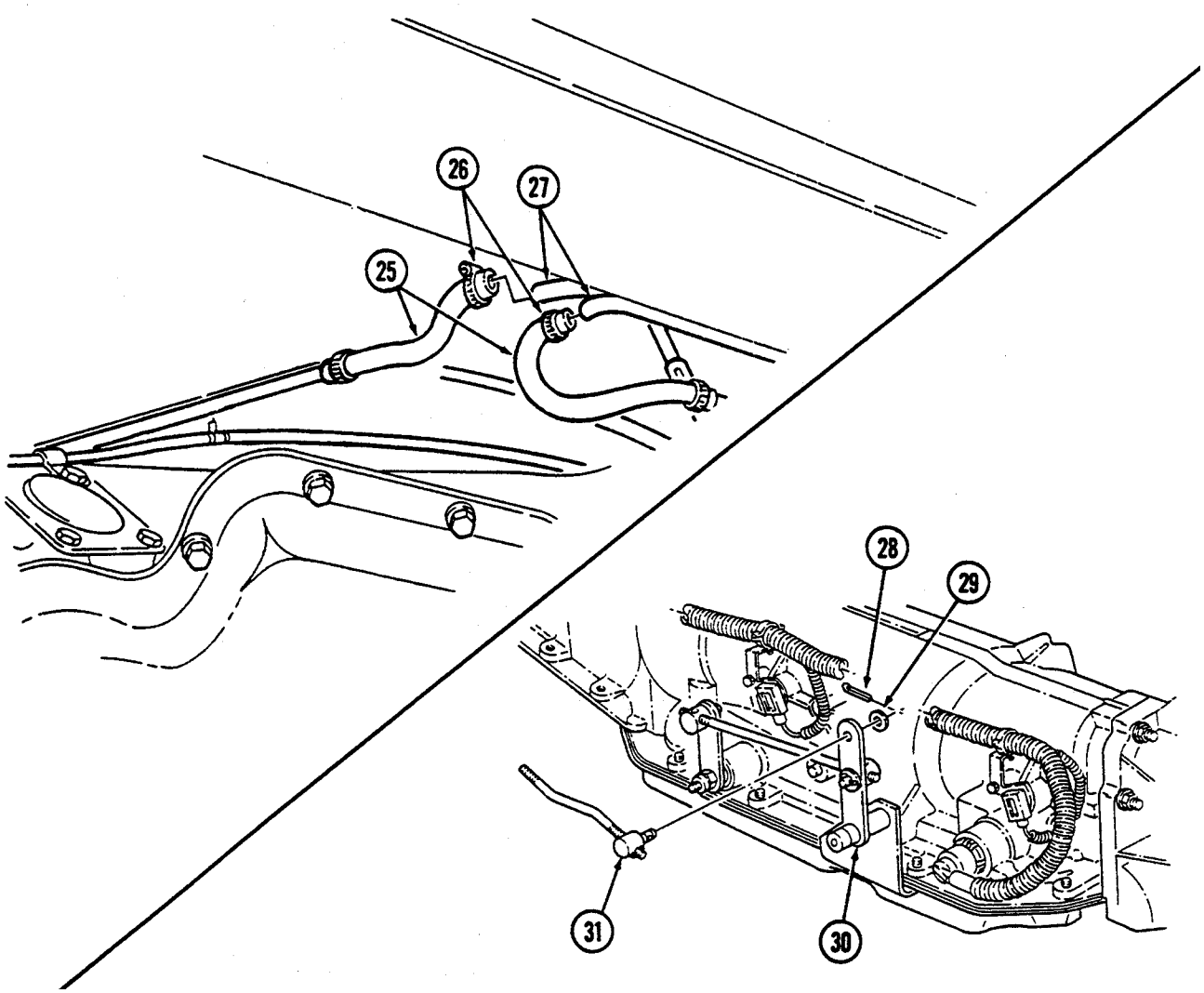



22. Connect transfer case shift rod (24) to transfer case (22) with washer (23) and lock pin (21).



## 7-9. TRANSMISSION/TRANSFER CASE ASSEMBLY INSTALLATION (4L80-E) (Cont'd)

23. Connect two hoses (25) to transmission/transfer case cooler lines (27) and tighten hose clamps (26).
24. Install shift rod and trunnion (31) on relay lever (30) with washer (29) and cotter pin (28).
25. Lower rear of vehicle.




FOLLOW-ON TASKS:
- Install front propeller shaft (TM 9-2320-280-20).
- Install muffler support bracket (TM 9-2320-280-20).
- Install converter housing cover (TM 9-2320-280-20).
- Install transmission oil dipstick (TM 9-2320-280-20).
- Install rear propeller shaft (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).
- Fill transmission to proper fluid level (TM 9-2320-280-10).
- Start engine (TM 9-2320-280-10) and inspect for leaks.
- Lower and secure hood (TM 9-2320-280-10).
- Road test vehicle (TM 9-2320-280-20) and check for proper transmission/transfer case operation.

## 7-10. TRANSMISSION PREPARATION

**This task covers:**

**a. Disassembly** **b. Assembly**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**

Torque adapter, 9/16 in. (Appendix G, Item 106)

**Materials/Parts**

Six locknuts (Appendix E, Item 64)
Anaerobic gasket sealer (Appendix B, Item 45)

**Equipment Condition**

Transmission/transfer case assembly removed (para. 7-6 or 7-8).

**Maintenance Level**

Direct support

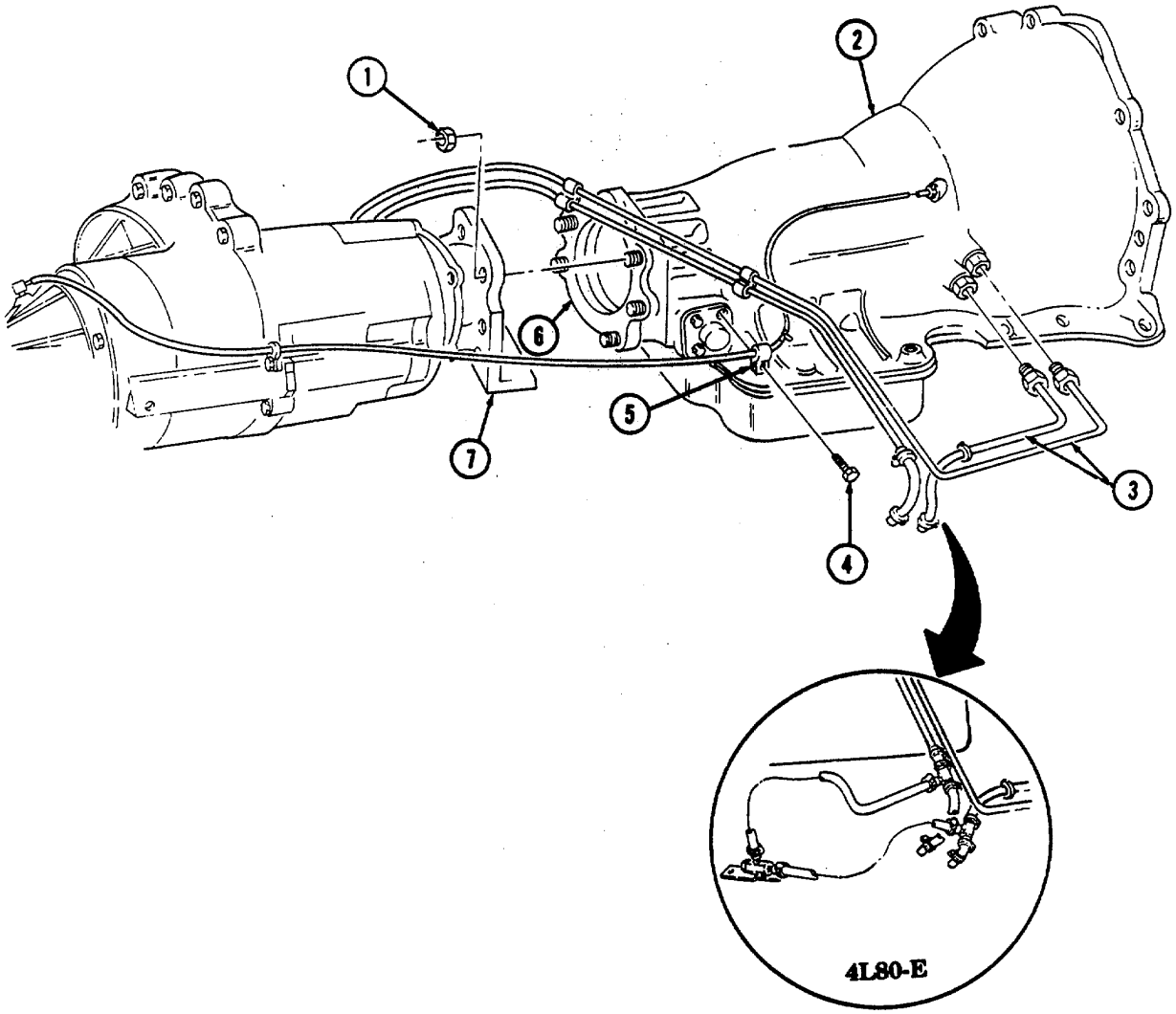
### a. Disassembly

1. Disconnect transmission/transfer case cooler lines (3) from transmission (2).
2. Remove capscrew (4) and transmission/transfer case vent line clamp (5) from transmission (2).
3. Remove six locknuts (1) and transmission (2) from transfer case adapter (7). Discard locknuts (1).
4. Clean old sealer from transfer case adapter (7).

### b. Assembly

1. Apply anaerobic gasket sealer to transmission mounting surface (6).
2. Install transmission (2) on transfer case adapter (7) with six locknuts (1). Using torque adapter, tighten locknuts to 26 lb-ft (35 N•m).
3. Install transmission/transfer case vent line clamp (5) to transmission (2) with capscrew (2). Tighten capscrew (4) to 11 lb-ft (15 N•m).
4. Connect transmission/transfer case cooler lines (3) to transmission (2).

**7 - 10. TRANSMISSION PREPARATION (Cont'd)**




FOLLOW-ON TASK: Install transmission/transfer case assembly (para. 7-7 or 7-9).

# CHAPTER 8
# TRANSFER CASE MAINTENANCE

## 8-1. INTRODUCTION

This chapter contains maintenance instructions for replacement of the transfer case at the Direct Support maintenance level. Some subassemblies and parts must be removed before the transfer case can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## 8-2. TRANSFER CASE MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 8-3. | Transfer Case Replacement | 8-2 |
| 8-4. | Transfer Case Guide Cable Replacement | 8-8 |

# 8-3. TRANSFER CASE REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**
Torque adapter 9/16 in.
(Appendix G, Item 106)

**Materials/Parts**
Six locknuts (Appendix E, Item 64)
Four lockwashers (Appendix E, Item 103)
Lock pin (Appendix E, Item 170)
Anaerobic gasket sealer (Appendix B, Item 45)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Muffler removed (TM 9-2320-280-20).
- Muffler support bracket removed (TM 9-2320-280-20).

**General Safety Instructions**
- Allow transfer case to cool before performing this task.
- Transfer case must be supported during removal and installation.

**Maintenance Level**
Direct support

**a. Removal**

**WARNING**

Allow transfer case to cool before performing this task. Failure to do this may cause injury.

**CAUTION**

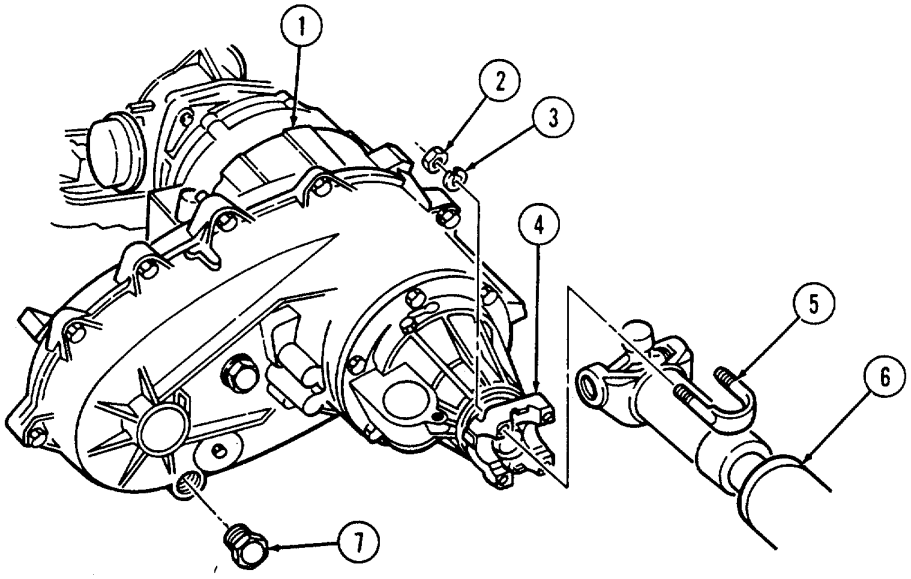
Cover or plug all open lines and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

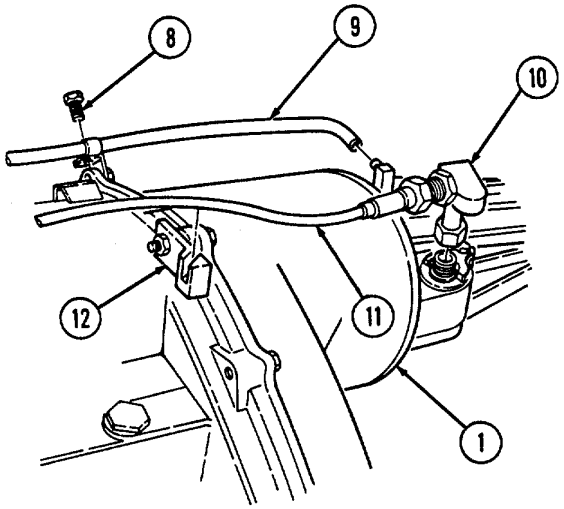
**NOTE**

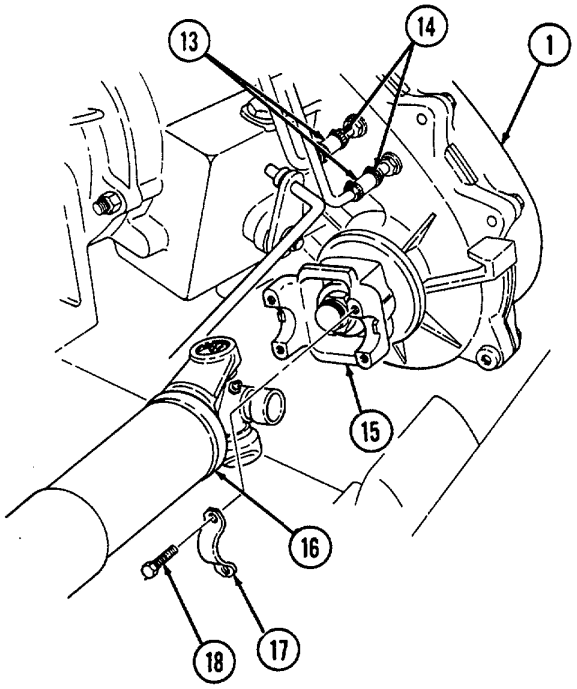
- Transfer case replacement procedure for the M1097, "A1" and "A2" vehicles is basically the same except the rear propeller shaft is attached to the transfer case extension instead of the output yoke. Refer to the vehicle data plate before ordering replacement parts.
- Have drainage container ready to catch fluid.

1. Remove drainplug (7) from transfer case (1). Allow to drain, and install drainplug (7). Tighten drainplug (7) to 35 lb-ft (47 N.m).
2. Remove four nuts (2), lockwashers (3), two U-bolts (5), and rear propeller shaft (6) from transfer case yoke (4) and disconnect shaft (6) from yoke (4). Discard lockwashers (3).
3. Disconnect 90 degree speedometer cable adapter (10) from transfer case (1) and remove speedometer cable (11) from bracket (12).
4. Remove capscrews (8) and disconnect vent line (9) from transfer case (1).
5. Remove four capscrews (18), two straps (17), and front propeller shaft (16) from transfer case yoke (15).
6. Loosen two hose clamps (14) and disconnect rubber cooling lines (13) from transfer case (1).

## 8-3. TRANSFER CASE REPLACEMENT (Cont'd)



## 8-3. TRANSFER CASE REPLACEMENT (Cont'd)

7. Remove lock pin (1) and washer (3) from shift linkage (4) and transfer case (2) and disconnect shift linkage (4). Discard lock pin (1).

**WARNING**

Transfer case must be supported during removal and installation. Failure to do this may cause injury to personnel or damage to equipment.

8. Place transmission jack under transfer case (2) for support.
9. Remove six locknuts (5) from transfer case (2) and transfer case adapter (6). Discard locknuts (5).
10. Slide transfer case (2) away from transfer case adapter (6). Lower transfer case (2) to clear vehicle and remove transfer case (2).
11. Clean old sealant from transfer case adapter (6) and transfer case (2).

**NOTE**

Perform steps 12 and 13 while holding bolt securely to prevent changing torque or damaging transfer case seal.

12. Remove nut (7), washer (8), and vent line bracket (9) from transfer case (2).
13. Remove nut (11) and cable bracket (10) from transfer case (2).

**b. Installation**

**NOTE**

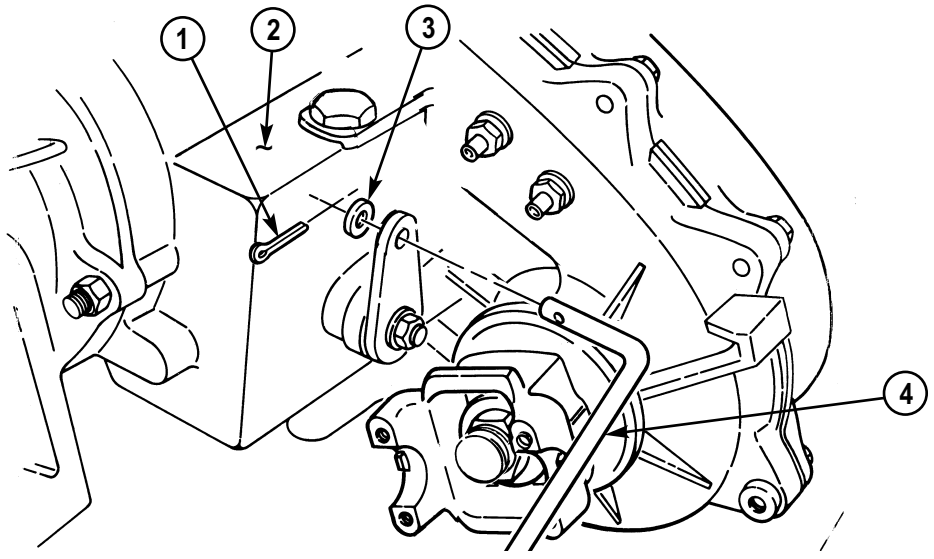
Perform steps 1 and 2 while holding bolt securely to prevent changing torque or damaging transfer case seal.

1. Install vent line bracket (9) on transfer case (2) with washer (8) and nut (7). Tighten nut (7) to 37 lb-ft (50 N•m).
2. Install cable bracket (10) on transfer case (2) with nut (11). Tighten nut (11) to 25 lb-ft (34 N•m).
3. Place transfer case (2) on transmission jack.

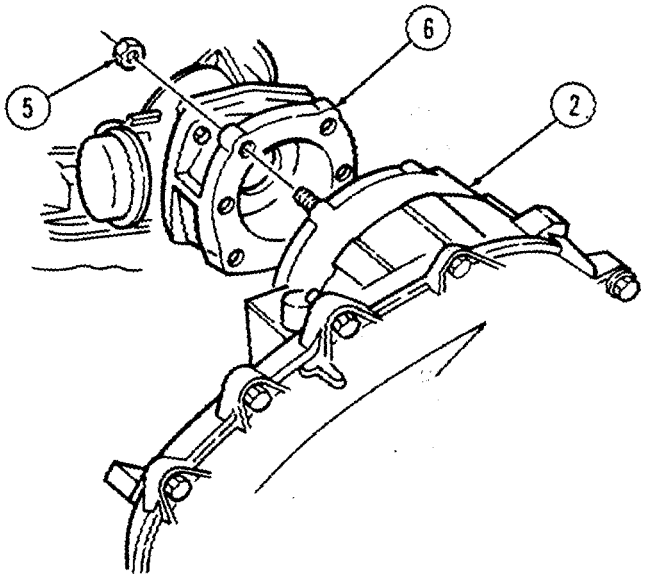
**NOTE**

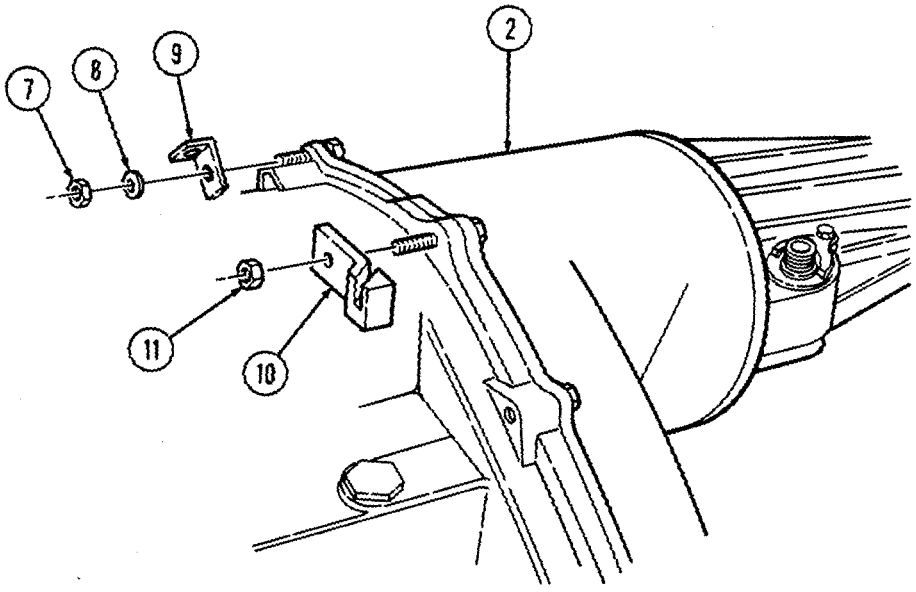
Immediately install transfer case after application of sealer.

4. Apply anaerobic gasket sealer to transfer case (2) mounting surface.
5. Raise transfer case (2) and slide into transfer case adapter (6).
6. Install transfer case (2) on transfer case adapter (6) with six locknuts (5). Tighten locknuts (5) to 26 lb-ft (35 N•m).
7. Remove transmission jack.
8. Connect transfer case shift linkage (4) to transfer case (2) with washer (3) and lock pin (1).



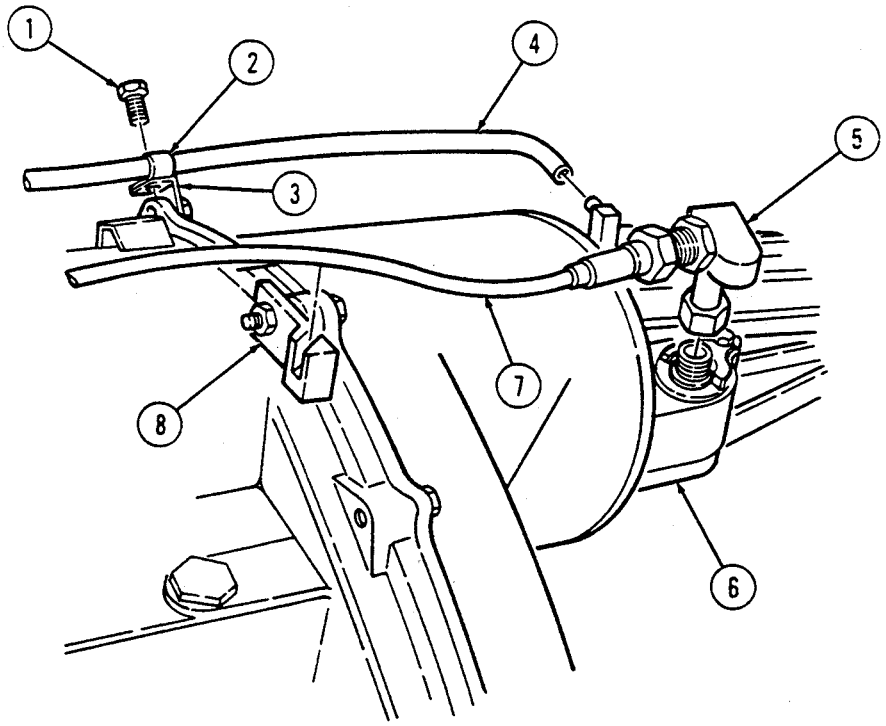
## 8-3. TRANSFER CASE REPLACEMENT (Cont'd)



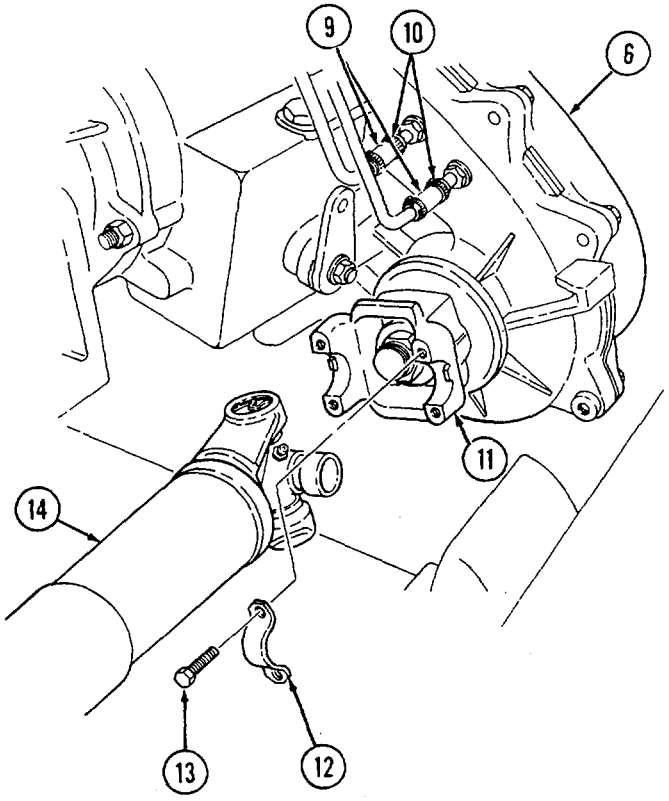



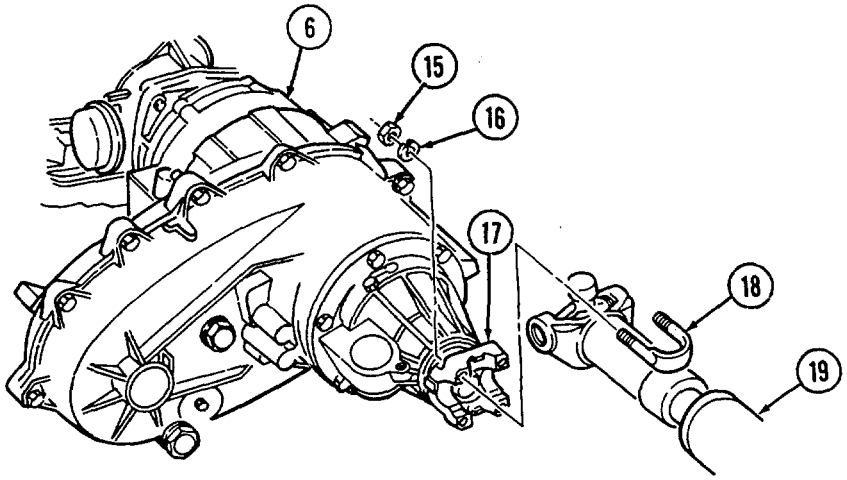
## 8-3. TRANSFER CASE REPLACEMENT (Cont'd)

9. Connect vent line (4) to transfer case (6) and bracket (3) with vent line clamp (2) and capscrew (1).
10. Install speedometer cable (7) in bracket (8) and connect 90 degree speedometer adapter (5) to transfer case (6).
11. Connect cooler lines (9) to transfer case (6) with two hose clamps (10).
12. Connect front propeller shaft (14) on transfer case yoke (11) with two straps (12) and four capscrews (13). Tighten capscrews (13) to 13-18 lb-ft (18-24 N•m).
13. Connect rear propeller shaft (19) on transfer case yoke (17) with two U-bolts (18), four lockwashers (16), and nuts (15). Tighten nuts (15) to 21 lb-ft (28 N•m).



## 8-3. TRANSFER CASE REPLACEMENT (Cont'd)




FOLLOW-ON TASKS:
- Fill fluid to proper level (TM 9-2320-280-20).
- Install muffler support bracket (TM 9-2320-280-20).
- Install muffler (TM 9-2320-280-20).
- Adjust shift linkage (TM 9-2320-280-20).

# 8-4. TRANSFER CASE GUIDE CABLE REPLACEMENT

**This task covers:**

**a. Removal** **b Installation**

**INITIAL SETUP:**

**Applicable Models**
M1097, "A1" and "A2" series

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Lockwasher (Appendix E, Item 119)

**Manual References**
TM 9-2320-280-24P

**Maintenance Level**
Direct support

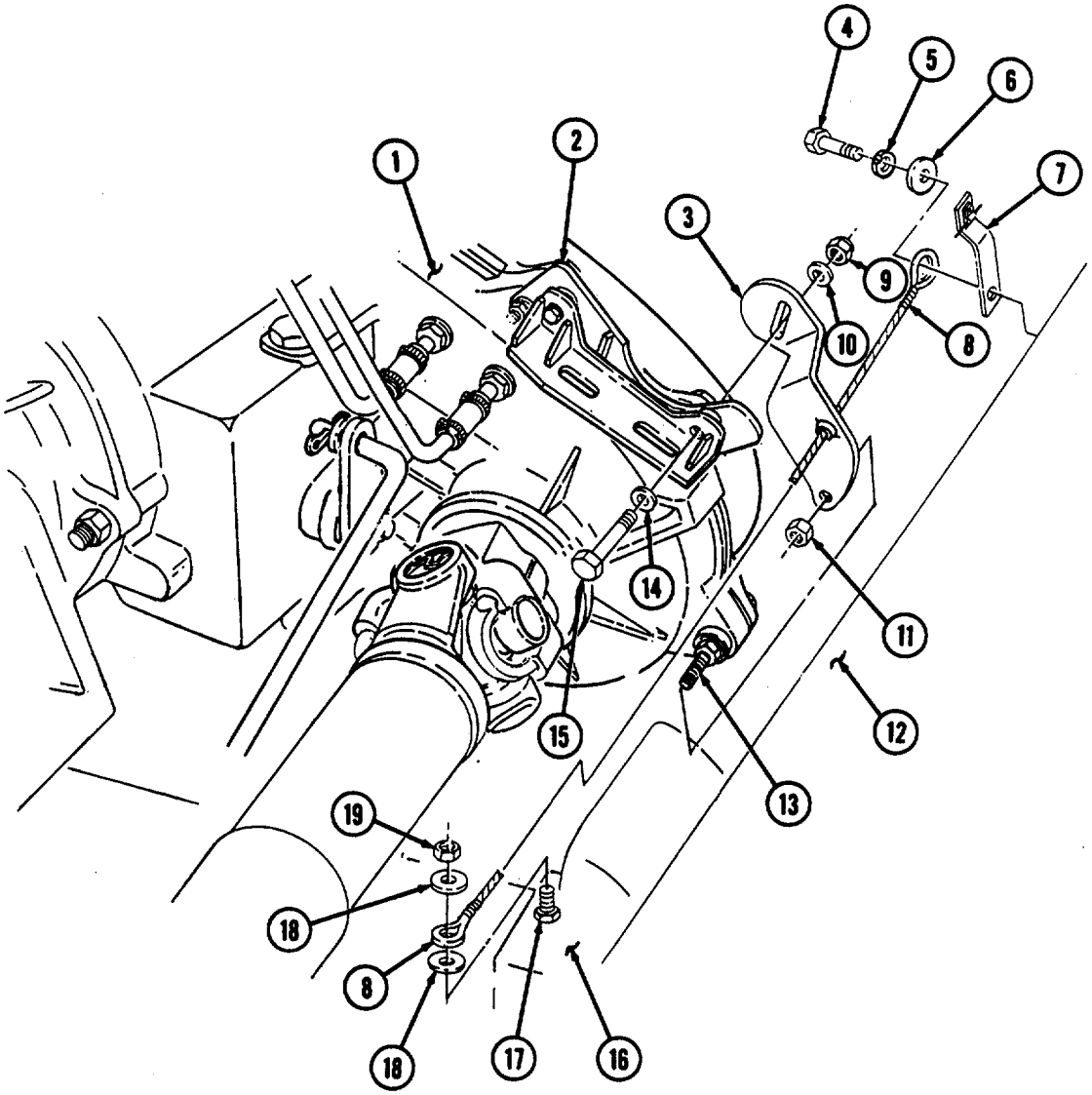
## a. Removal

1. Remove nut (9), washer (10), capscrew (15), and washer (14) from muffler mounting bracket (2) and guide cable bracket (3).
2. Remove nut (11) and guide cable bracket (3) from capscrew (13) on transfer case (1).
3. Remove capscrew (4), lockwasher (5), washer (6), guide cable (8), and support bracket (7) from frame (12). Discard lockwasher (5).
4. Remove nut (19), washer (18), guide cable (8), and washer (18) from stud (17) on crossmember (16).

## b. Installation

1. Install guide cable bracket (3) on muffler mounting bracket (2) with capscrew (15), washer (14), washer (10), and nut (9).
2. Install guide cable bracket (3) on capscrew (13) with nut (11). Tighten nut (11) to 16-18 lb-ft (22-24 N•m).
3. Install guide cable (8) and support bracket (7) on left hand frame (12) with washer (6), lockwasher (5), and capscrew (4). Tighten screw (4) to 30 lb-ft (41 N•m).
4. Install washer (18) and guide cable (8) on stud (17) and crossmember (16) with washer (18) and nut (19). Tighten nut (19) to 60 lb-ft (81 N•m).

## 8-4. TRANSFER CASE GUIDE CABLE REPLACEMENT (Cont'd)



# CHAPTER 9
# PROPELLER SHAFTS, AXLES, AND SUSPENSION MAINTENANCE

## 9-1. INTRODUCTION

This chapter contains maintenance instructions for replacement and repair of propeller shafts, axles, and suspension system components at the Direct Support maintenance level. Some subassemblies and parts must be removed before propeller shafts, axles, and suspension system components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## 9-2. PROPELLER SHAFTS, AXLES, AND SUSPENSION MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 9-3. | Differential Output Shaft Seal Replacement | 9-2 |
| 9-4. | Pinion Seal Replacement | 9-4 |
| 9-5. | Differential Replacement | 9-6 |
| 9-6. | Geared Hub Repair | 9-10 |
| 9-7. | Control Arm Bushing Replacement | 9-18 |
| 9-8. | Deleted | |
| 9-9. | Front Propeller Shaft Repair | 9-22 |
| 9-10. | Rear Differential and Parking Brake Mounting Bracket Replacement | 9-23<br>9-24 |
| 9-11. | Differential and Axle Free Play Tolerance Inspection | 9-24 |

# 9-3. DIFFERENTIAL OUTPUT SHAFT SEAL REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Axle shaft and seal installer (Appendix G, Item 79)

**Materials/Parts**
O-ring (Appendix E, Item 149)
Locknut (Appendix E, Item 53)
Sealing compound (Appendix B, Item 50)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Service brake rotors removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**a. Removal**

**NOTE**

New configuration side mounting bracket allows for output shaft seal replacement without bracket removal. Inspect bracket to determine output shaft seal clearance. If clearance exists, perform steps 2 through 4. If clearance does not exist, perform steps 1 through 4.

1. Remove old configuration side mounting bracket (9) (para. 12-16).
2. Remove locknut (5), O-ring (4), and output flange (3) from output shaft (2). Discard O-ring (4) and locknut (5).
3. Remove two capscrews (7) and brake adapter (6) from differential (1).
4. Remove output shaft seal (8) from differential (1).

**b. Installation**

**NOTE**

New configuration side mounting bracket allows for output shaft seal replacement without bracket removal. If side mounting bracket was not removed, perform steps 2 through 4. If bracket was removed, perform steps 1 through 4.

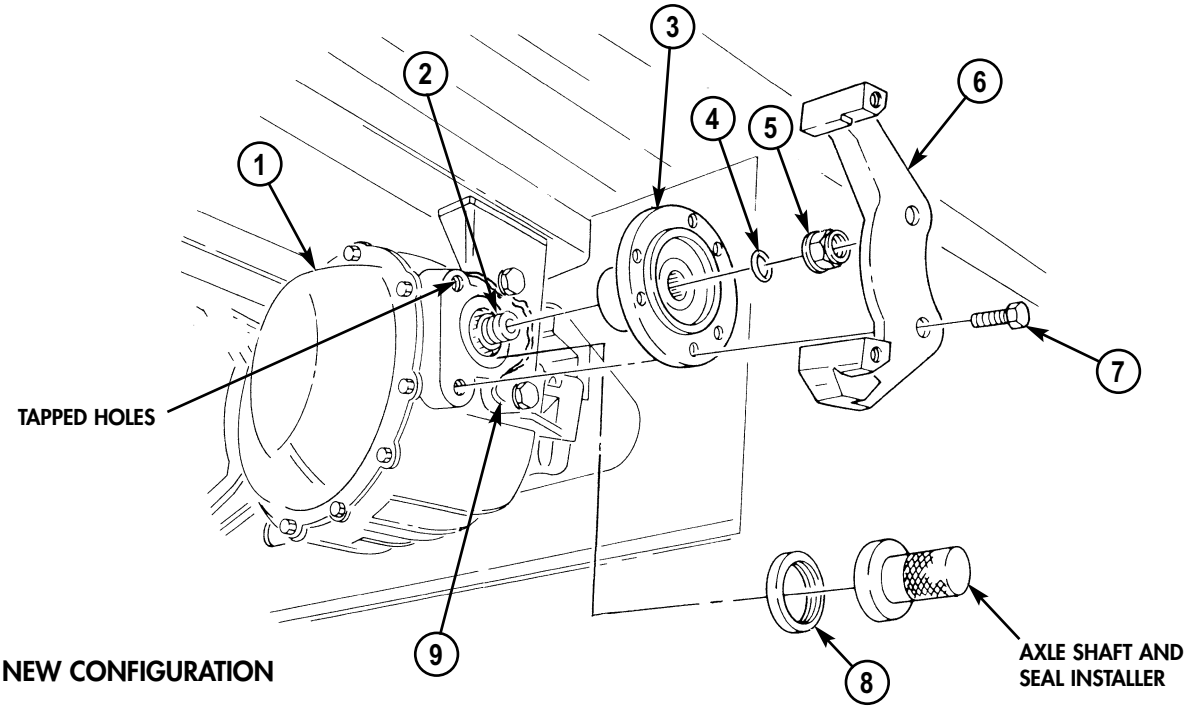
1. Install new configuration side mounting bracket (9) (para. 12-16).
2. Using axle shaft and seal installer, install output shaft seal (8) in differential (1).

**CAUTION**

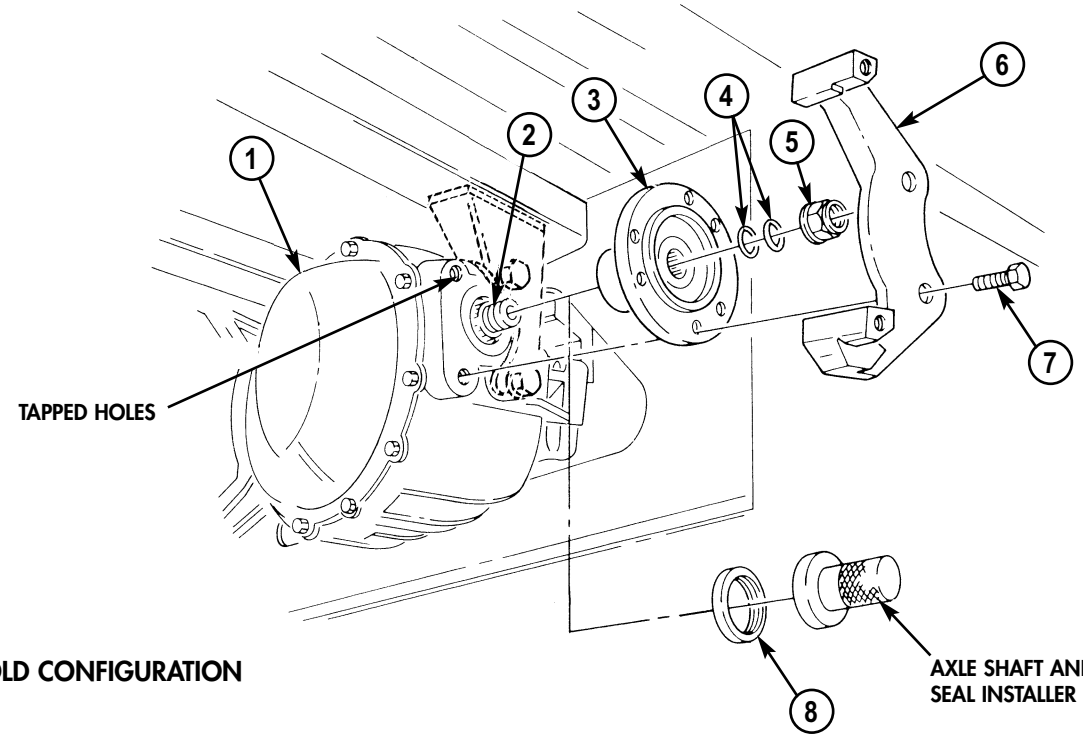
Apply a liberal amount of thread sealing compound to the tapped holes of differential. To allow adequate coating of threads, install capscrews shortly after applying thread sealing compound. Failure to do this could allow capscrews to loosen and cause damage to differential.

3. Apply sealing compound to tapped holes of differential (1) and install brake adapter (6) on differential (1) with two capscrews (7). Tighten capscrews (7) to 110-140 lb-ft (149-190 N•m).
4. Install output flange (3), O-ring (4), and locknut (5) on output shaft (2). Tighten locknut (5) to 170 lb-ft (231 N•m).

## 9-3. DIFFERENTIAL OUTPUT SHAFT SEAL REPLACEMENT (Cont'd)




NEW CONFIGURATION




OLD CONFIGURATION

FOLLOW-ON TASK: Install service brake rotors (TM 9-2320-280-20).

## 9-4. PINION SEAL REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**
Yoke seal installer (Appendix G, Item 83)

**Materials/Parts**
Four lockwashers (Appendix E, Item 93)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Service brake rotors removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**NOTE**

Removal and installation procedures for pinion seals are basically the same for front and rear differentials. This procedure covers the rear differential pinion seal.

### a. Removal

1. Remove four capscrews (8), lockwashers (7), and rear propeller shaft (1) from pinion flange (4). Discard lockwashers (7).
2. Remove parking brake rotor (2) from pinion flange (4).
3. Using a lb-in. torque wrench, measure torque required to rotate pinion (5) and record measurement.
4. Count and record number of exposed threads on end of pinion (5) and mark locknut (3) and pinion (5) for assembly.
5. Remove locknut (3) and pinion flange (4) from pinion (5).
6. Remove pinion seal (6) from pinion (5).

### b. Installation

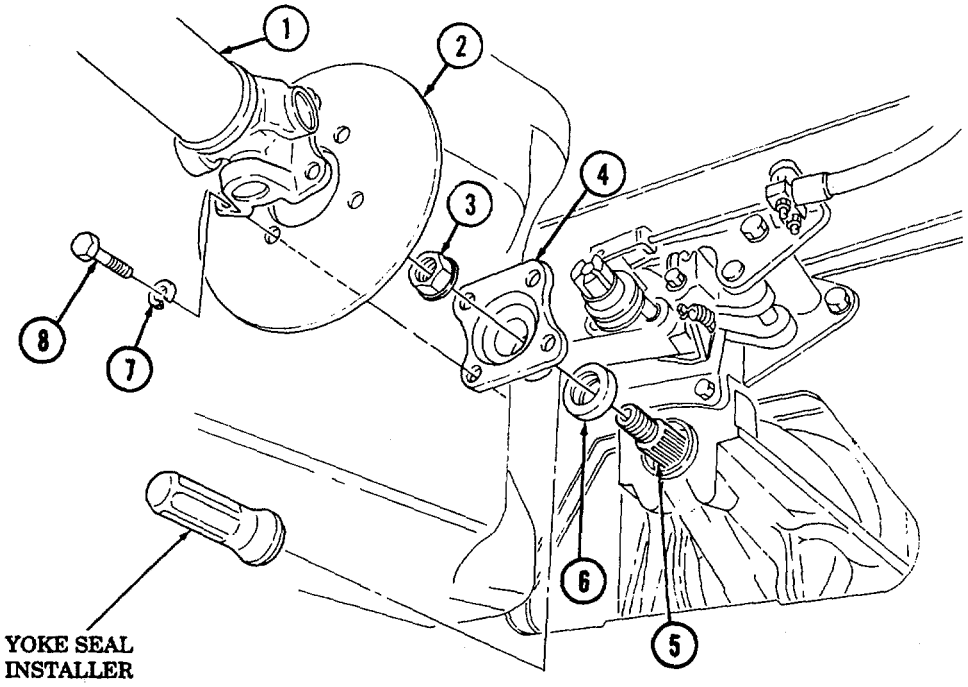
1. Using yoke seal installer, install pinion seal (6) on pinion (5).
2. Install pinion flange (4) and locknut (3) on pinion (5).
3. Tighten locknut (3) to original position.
4. Tighten locknut (3) in small increments, until torque required to rotate pinion (5) exceeds original measurement by 2 lb-in. (0.2 N•m).

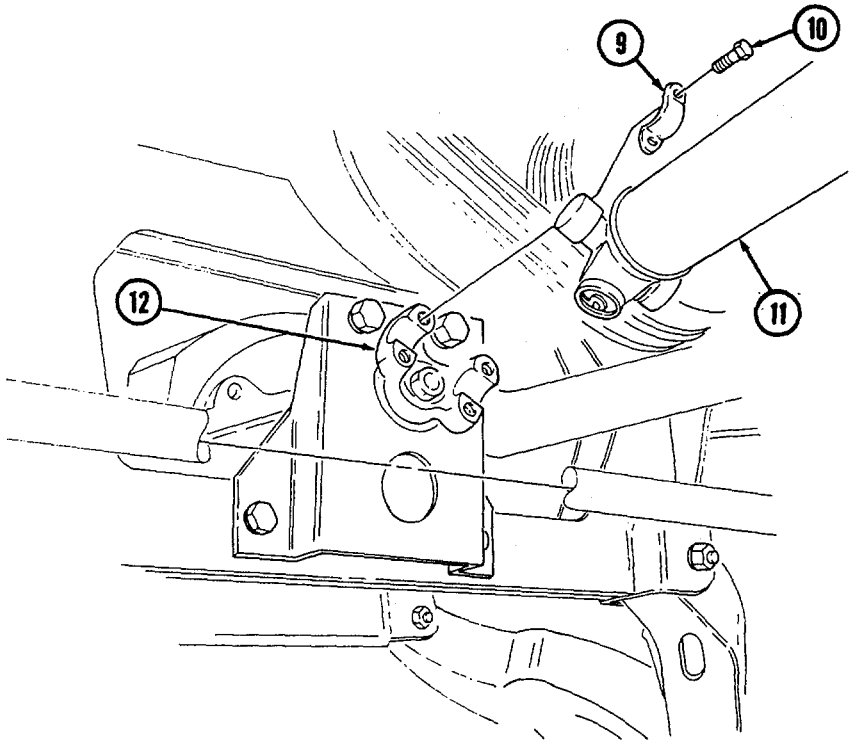
**NOTE**

Perform step 5 if replacing front pinion seal.

5. Connect front propeller shaft (11) to pinion yoke (12) with two straps (9) and four capscrews (10). Tighten capscrews (10) to 13-18 lb-ft (18-24 N•m).
6. Install parking brake rotor (2) and propeller shaft (1) on pinion flange (4) with four lockwashers (8) and capscrews (8). Tighten capscrews (8) to 60 lb-ft (81 N•m).

## 9-4. PINION SEAL REPLACEMENT (Cont'd)




FOLLOW-ON TASK: Install service brake rotors (TM 9-2320-280-20).

## 9-5. DIFFERENTIAL REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Four lockwashers (Appendix E, Item 103)
Four O-rings (Appendix E, Item 149)
Four locknuts (Appendix E, Item 53)
Sealing compound (Appendix B, Item 50)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-24P
TM 9-2320-280-20

**Equipment Condition**
Service brake rotors removed
(TM 9-2320-280-20).

**General Safety Instructions**
Differential must be supported during removal and installation.

**Maintenance Level**
Direct support

**a. Removal**

**NOTE**

Have drainage container ready to catch oil.

1. Remove drainplug (26) from differential (6). Allow oil to drain and install drainplug (26).

**NOTE**

Perform step 2 if replacing front or rear differential on vehicles with serial numbers USBL Eff. 44825 and above.

2. Remove four capscrews (11), two straps (10), and propeller shaft (12) from pinion yoke (7).
3. Remove four capscrews (5), lockwashers (4), and rear propeller shaft (1) from differential flange (3). Discard lockwashers (4).
4. Remove parking brake rotor (2).

**NOTE**

Washers are not required when securing front differential to mounting bracket.

5. Remove two capscrews (9) and washers (20) from differential (6) and mounting bracket (8).

**NOTE**

Perform step 6 if replacing front differential.

6. Remove two locknuts (16), washers (13), capscrews (14), washers (13), and mounting bracket (8) from frame crossmember (15). Discard locknuts (16).
7. Remove two locknuts (21), four O-rings (22), and two output flanges (23) from differential (6). Discard locknuts (21) and O-rings (22).

**WARNING**

Differential must be supported during removal and installation. Failure to do this may cause injury to personnel or damage to equipment.

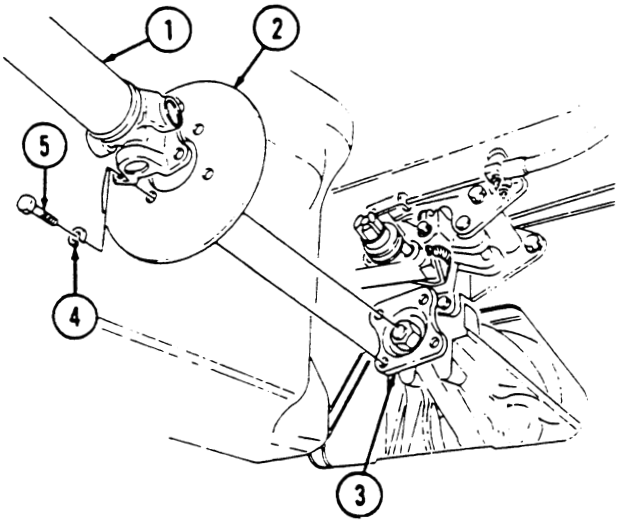
8. Support differential (6).
9. Remove four capscrews (19) and washers (18) from differential (6) and side mounting brackets (17).
10. Lower differential slightly and disconnect vent line (27).

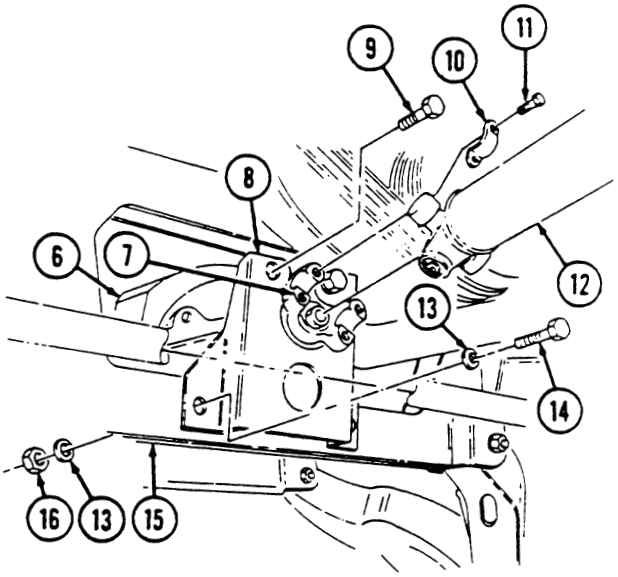
## 9-5. DIFFERENTIAL REPLACEMENT (Cont'd)

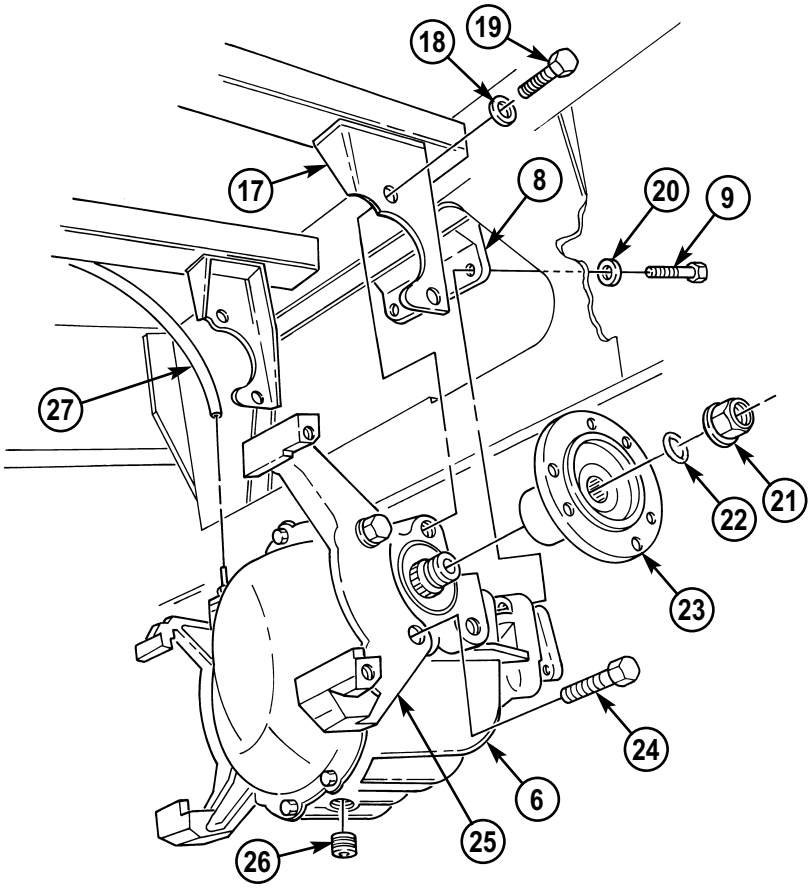
**NOTE**

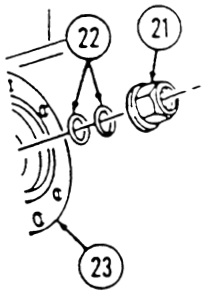
New configuration side mounting bracket allows for output shaft seal replacement without bracket removal. Inspect bracket to determine output shaft seal clearance. If no clearance exists, replacement of side mounting bracket with new configuration bracket is recommended.

11. Remove differential (6).
12. Remove four capscrews (24) and two brake caliper adapters (25) from differential (6).
13. If necessary, remove both old configuration side mounting brackets (17) (para. 12-16).




**OLD CONFIGURATION**

## 9-5. DIFFERENTIAL REPLACEMENT (Cont'd)

**b. Installation**

**NOTE**

- New configuration (P/N 12338415-3) differentials are provided with a pinion yoke and slinger installed. Four O-rings and three locknuts are also provided, but not installed. Output flanges are not provided.
- No modification to service differential is required when replacing rear differential on vehicles with serial numbers USBL Eff. 44825 and above.
- If service differential is replacing a front differential, the service yoke must be replaced and the slinger removed.
- If service differential is replacing a rear differential on vehicles with serial numbers USBL Eff. 44825 and below, the service yoke must be replaced with a flange.
- Perform step 1 for front and rear differential installation.

1. Measure torque required to rotate pinion yoke (3) on service differential (1) and record.

**NOTE**

Perform steps 2 through 5 for front differential only.

2. If necessary, remove locknut (4) and pinion yoke (3) from old differential (1). Discard locknut (4).
3. Remove locknut (4) and pinion yoke (3) from service differential (1). Remove slinger (2). Discard locknut (4).
4. Install new pinion yoke (3) and locknut (4) on service differential (1).
5. Tighten locknut (4) in small increments, until torque required to rotate pinion yoke (3) exceeds original measurement (step 1) by 2 lb-in. (0.2 N•m).
6. For rear differentials, apply sealing compound to differential (1) tapped holes. Install two brake caliper adapters (16) on differential (1) with four capscrews (15). Tighten capscrews (15) to 110-140 lb-ft (149-190 N•m).
7. If removed, installation of new configuration side mounting brackets (6) is recommended, refer to (para. 12-16).
8. Raise differential (1) into place and connect vent line (17).

**CAUTION**

Apply a liberal amount of thread sealing compound to the tapped holes of differential. To allow adequate coating of threads, install capscrews shortly after applying thread sealing compound. Failure to do this could allow capscrews to loosen and cause damage to differential.

9. Apply sealing compound to differential (1) tapped holes. Install capscrews (8), washers (7), and differential (1) on side mounting brackets (6).

**NOTE**

Perform step 10 if replacing front differential.

10. Install mounting bracket (9) on frame crossmember (24) with two washers (23), capscrews (22), washers (23), and locknuts (25). Tighten locknuts (25) to 90 lb-ft (122 N•m).

**NOTE**

Washers are not required when securing front differential to mounting bracket.

11. Apply sealing compound to capscrews (11). Install two capscrews (11), washers (10), and differ-

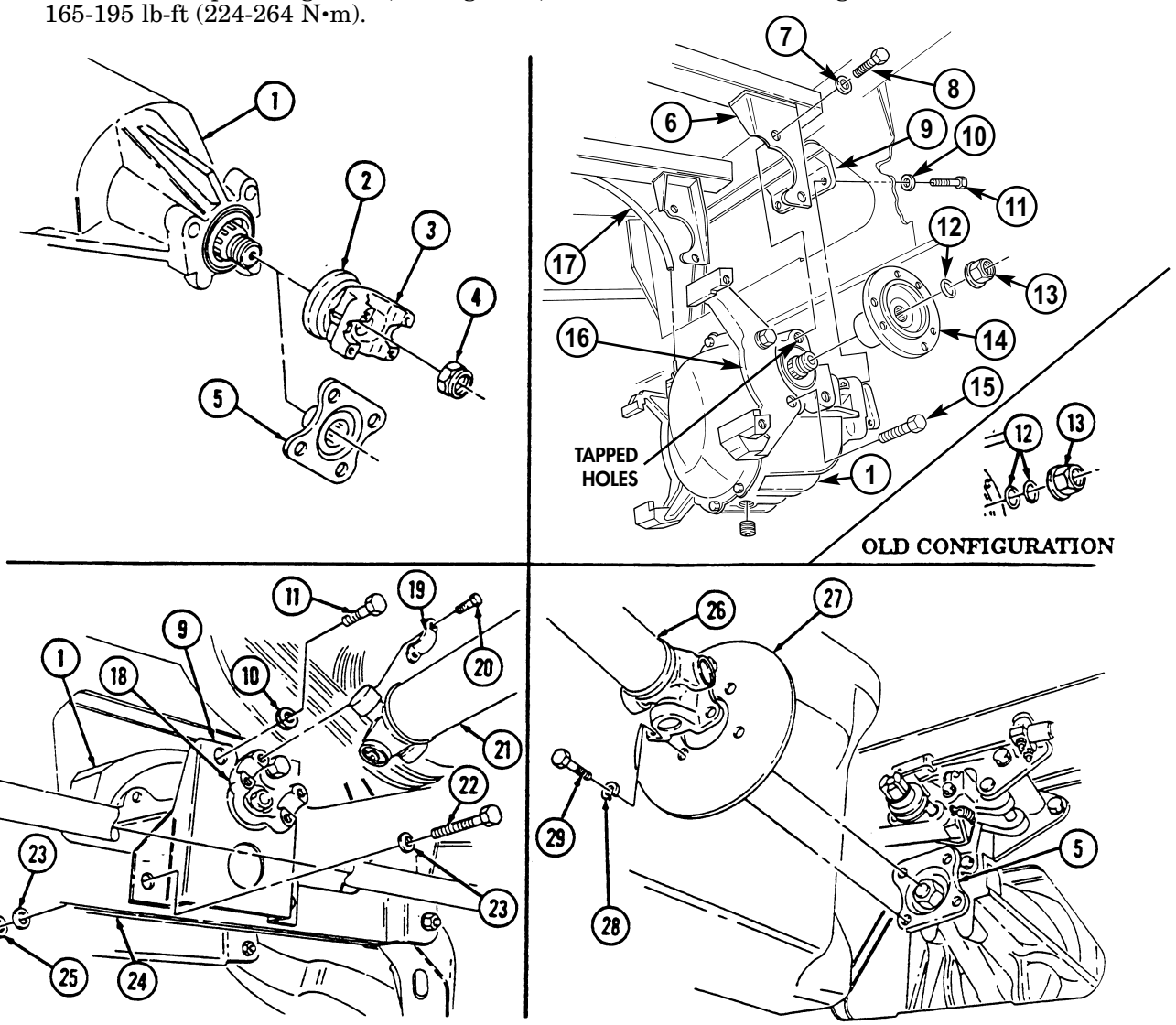
## 9-5. DIFFERENTIAL REPLACEMENT (Cont'd)

12. Tighten capscrews (8) and (11) to 110-140 lb-ft (149-190 N•m).

**NOTE**

- Perform steps 13 and 18 if replacing front or rear differential on vehicles with serial numbers USBL Eff. 44825 and above.
- Perform steps 14 through 18 if replacing rear differential on vehicles with serial numbers USBL Eff. 44825 and below.

13. Connect propeller shaft (21) to pinion yoke (18) with two straps (19) and four capscrews (20). Tighten capscrews (20) to 13-18 lb-ft (18-24 N•m).
14. Remove locknut (4) and pinion yoke (3) from service differential (1).
15. Install pinion flange (5) and locknut (4) on service differential (1).
16. Tighten locknut (4) in small increments, until torque required to rotate pinion flange (5) exceeds original measurement (step 1) by 2 lb-in. (0.2 N•m).
17. Install parking brake rotor (27) and connect propeller shaft (26) to pinion flange (5) with four capscrews (29), and lockwashers (28). Tighten capscrews (29) to 60 lb-ft (81 N•m).
18. Install two output flanges (14), O-rings (12), and two locknuts (13). Tighten locknuts (13) to 165-195 lb-ft (224-264 N•m).




FOLLOW-ON TASKS:
- Install service brake rotors (TM 9-2320-280-20).
- Fill differential to proper level (TM 9-2320-280-20).

## 9-6. GEARED HUB REPAIR

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)
Dial indicator (Appendix G, Item 95)
Blind hole puller set
(Appendix G, Item 138) optional

**Special Tools**
Input seal installer (Appendix G, Item 88)
Spindle seal installer (Appendix G, Item 90)
Driver handle (Appendix G, Item 66)
Geared hub locknut wrench
(Appendix G, Item 89)

**Materials/Parts**
Input seal (Appendix E, Item 232)
Spindle seal (Appendix E, Item 241)
Key washer (Appendix E, Item 260)
Anaerobic sealer (Appendix B, Item 45)
Sealing compound (Appendix B, Item 49)
Grease (Appendix B, Item 20)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Geared hub removed (TM 9-2320-280-20).

**General Safety Instructions**
Ensure locktab on lockwasher is bent completely into slot on retaining nut. Eight-slotted retaining nut provides additional security by enabling two locktabs to be bent into slots on retaining nut.

**Maintenance Level**
Direct support

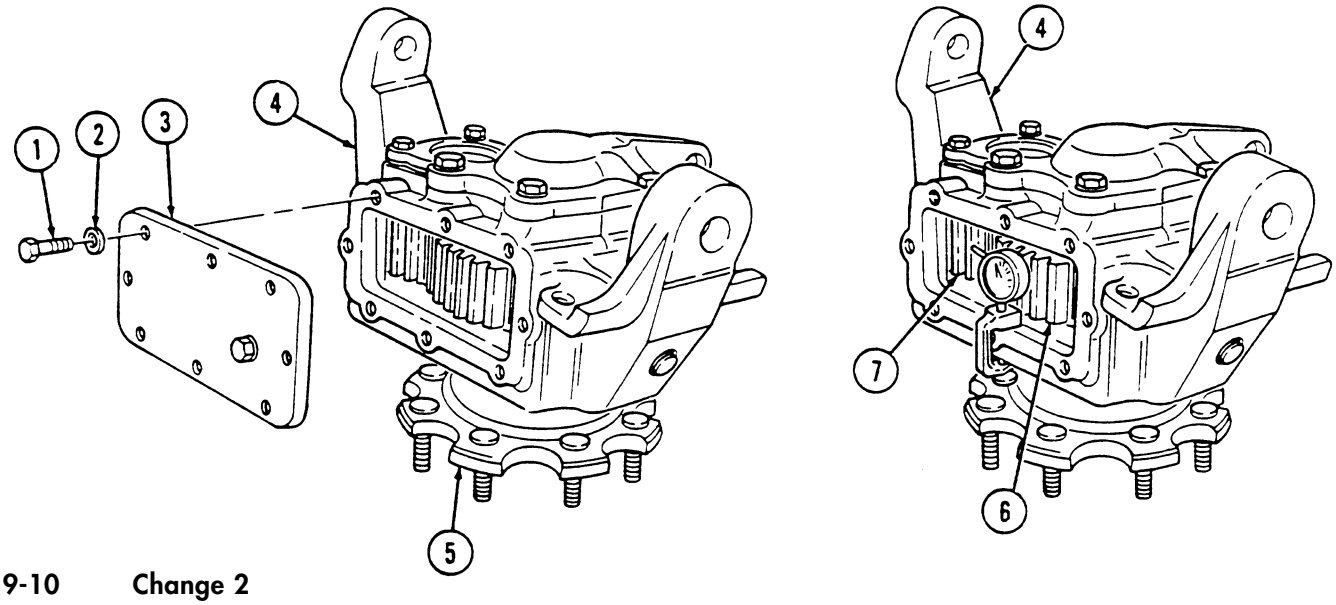
### a. Disassembly

1. Position geared hub (4) with spindle (5) supporting geared hub (4).
2. Remove eight capscrews (1), washers (2), and side cover (3) from geared hub (4).

**NOTE**

If backlash between drive and driven gears is more than 0.018 in. (0.46 mm) both gears must be replaced.

3. Mount dial indicator on geared hub (4) and index indicator to register from one drive gear (7) tooth. Move drive gear (7) back and forth while holding driven gear (6) stationary to read backlash.



## 9-6. GEARED HUB REPAIR (Cont'd)

4. Remove four capscrews (8), washers (9), and steering arm cover (10) from geared hub (4).

**NOTE**

Perform steps 4.1 and 4.2 for A2 and M1123 vehicles only.

4.1. Remove retaining ring (10.4) and seal (10.3) from steering arm cover (10.2).

4.2. Remove spindle extension (10.1) from spindle (17).

**NOTE**

For new configuration, two locktabs on lockwasher must be bent away from retaining nut for removal.

5. Bend tab on key washer (12) away from retaining nut (11).

**NOTE**

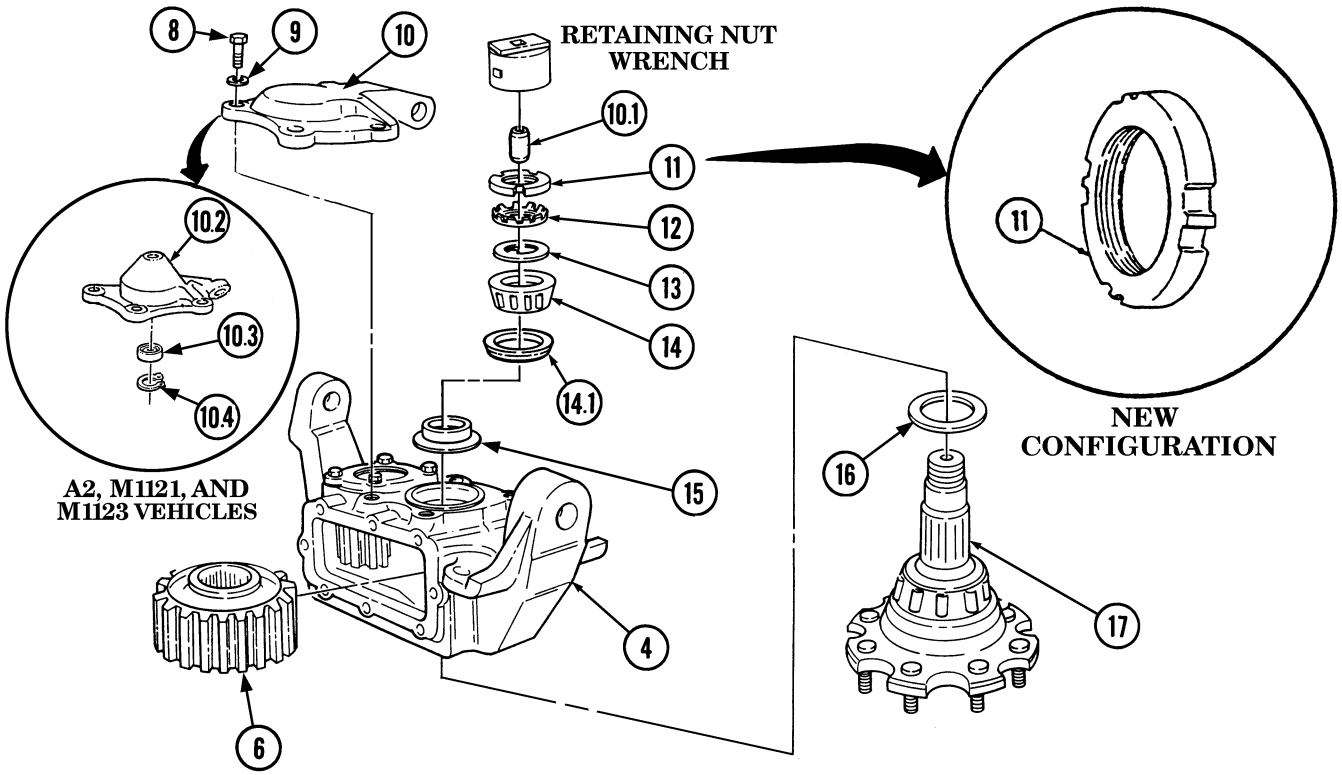
If four-slotted retaining nut TN-07 is present, replacement with eight-sided retaining nut 12342680 is recommended.

6. Using retaining nut wrench, remove retaining nut (11), key washer (12), and washer (13) from spindle (17). Discard key washer (12).

**NOTE**

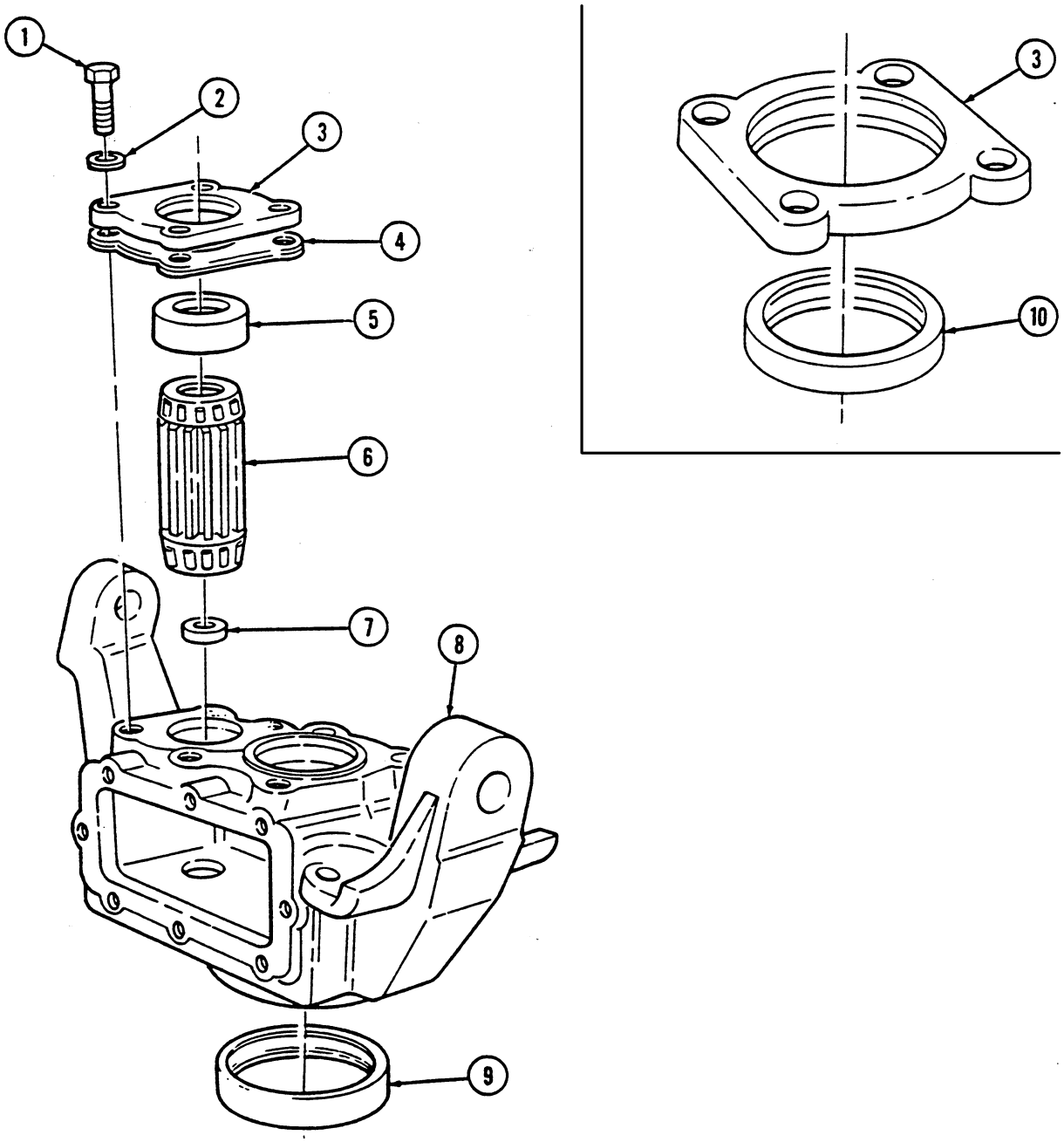
It may be necessary to lightly tap threaded end of spindle to release it from the inner spindle bearing.

7. Lift geared hub (4) off spindle (17).
8. Remove inner bearing (14), inner bearing spacer (14.1) (A2 and M1123 vehicles only), inner bearing spindle spacer (15), and driven gear (6) from geared hub (4).
9. Remove outer bearing spacer (16) from spindle (17).



## 9-6. GEARED HUB REPAIR (Cont'd)

10. Remove four capscrews (1), washers (2), drive gear retainer (3), shim gaskets (4), bearing cup (5), and drive gear (6) from geared hub (8).
11. Remove retaining washer (7) from inside drive gear (6) or geared hub (8).
12. Remove spindle seal (9) from geared hub (8). Discard spindle seal (9).
13. Remove input seal (10) from drive gear retainer (3). Discard input seal (10).



## 9-6. GEARED HUB REPAIR (Cont'd)

### b. Cleaning

Clean all geared hub components in accordance with para. 2-13.

### c. Inspection

**NOTE**

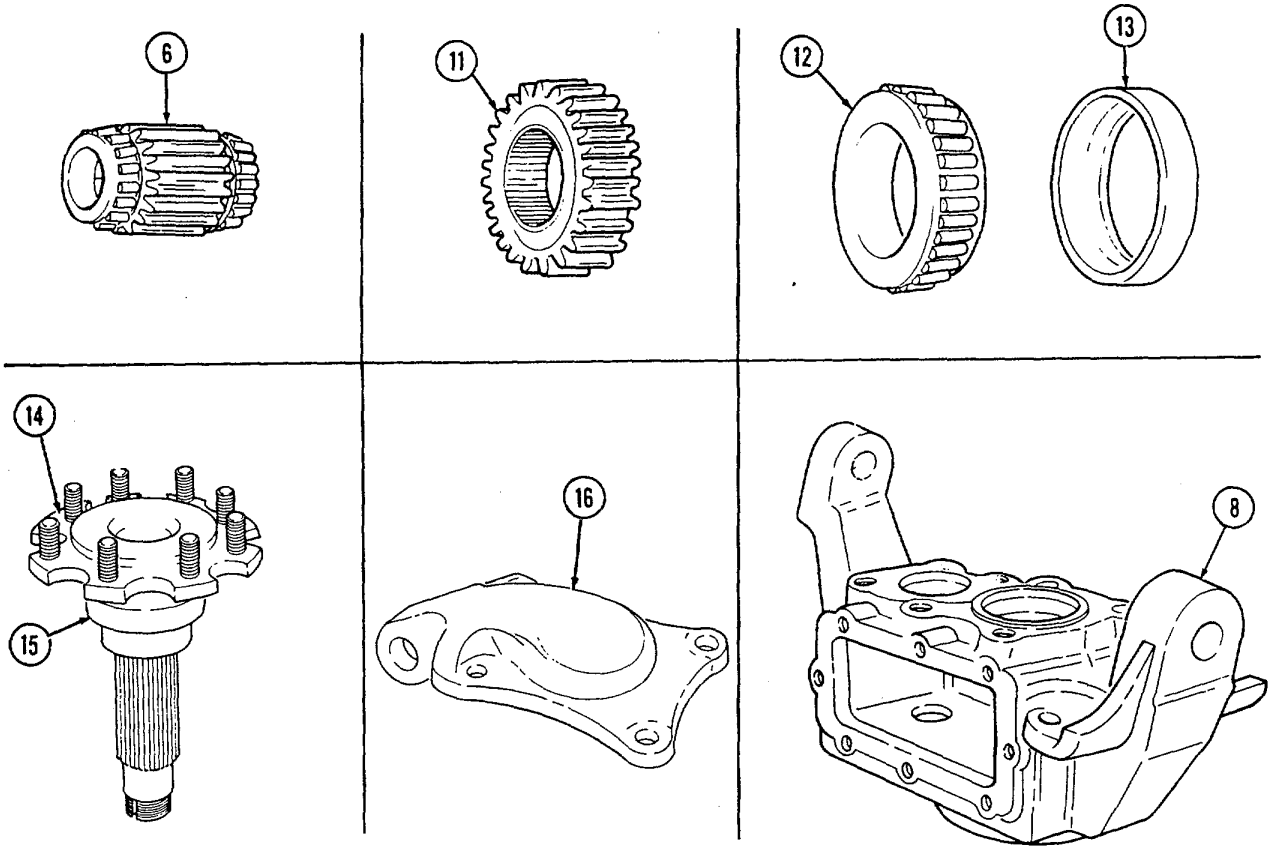
- For general inspection instructions, refer to para. 2-14.
- Drive and driven gears must be replaced as matched set.

1. Inspect splines and gear teeth on drive gear (6) and driven gear (11) for damage. Replace either if damaged.
2. Inspect spindle (14) for damage and rough or corroded sealing surface (15). Replace spindle (14), if damaged, or if sealing surface (15) is rough or corroded.

**NOTE**

A blind hole puller can be used to remove bearing and bearing race.

3. Inspect all bearings (12) and bearing races (13) for damage. Replace if damaged.
4. Inspect steering arm cover (16) for damage. Replace if damaged.
5. Inspect geared hub (8) and all threaded holes for damage. Repair any damaged holes using thread repair inserts. Replace geared hub assembly if geared hub (8) is damaged.

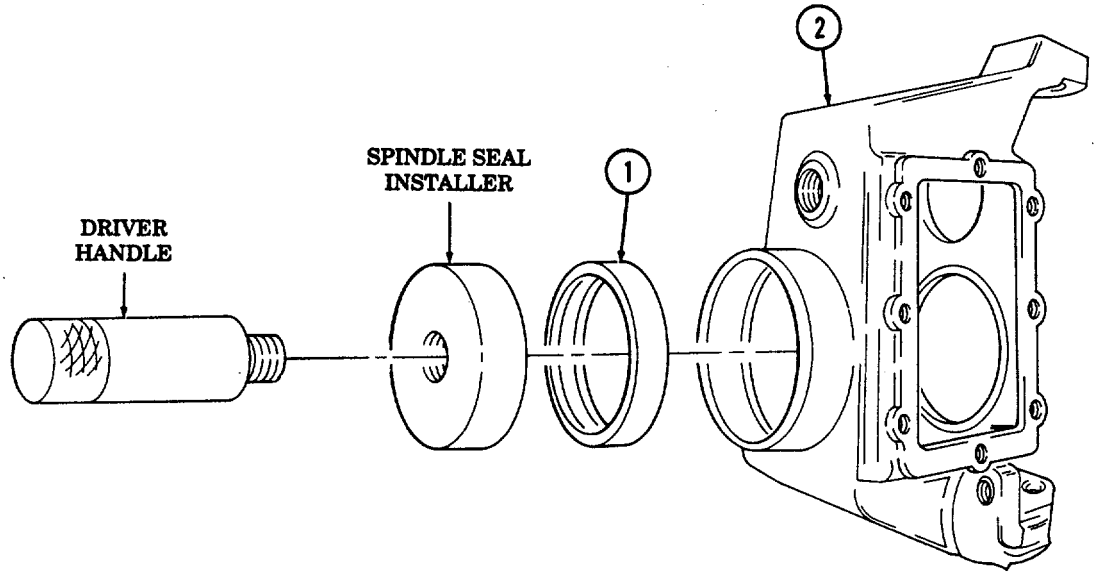


## 9-6. GEARED HUB REPAIR (Cont'd)

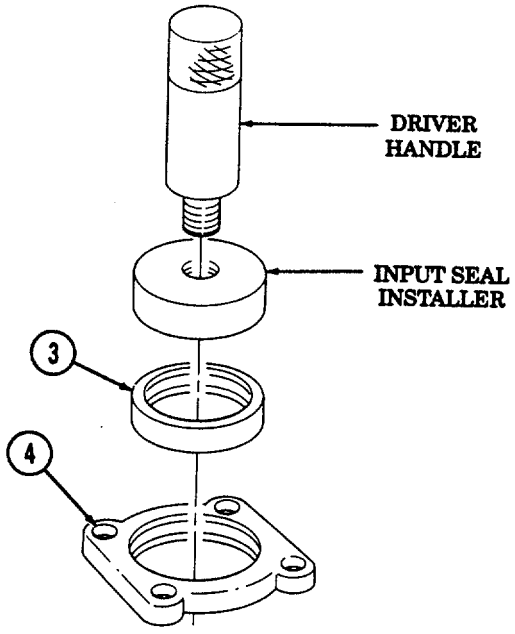
### d. Assembly

**NOTE**

For general assembly instructions, refer to para. 2-16.

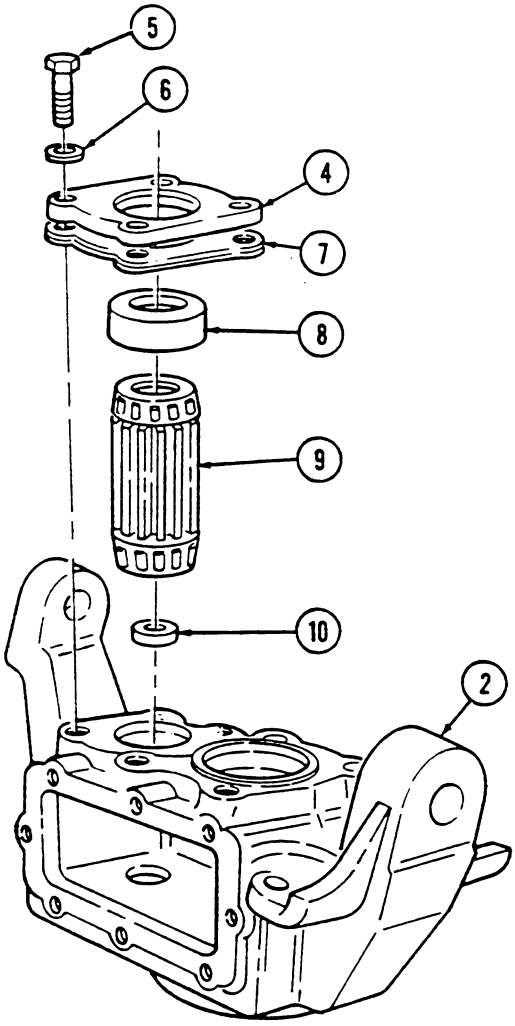


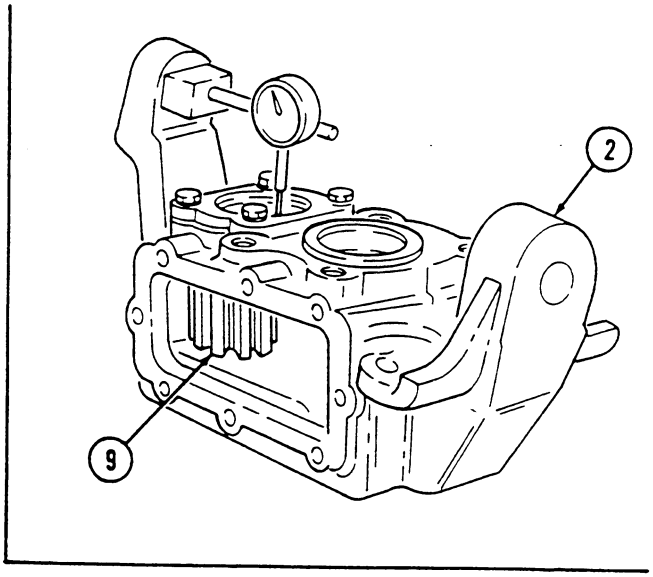

1. Using driver handle and spindle seal installer, install spindle seal (1) in geared hub (2).
2. Ensure radius on outer diameter of input seal (3) faces inside drive gear retainer (4). Using input seal installer and driver handle, install input seal (3) in drive gear retainer (4).



## 9-6. GEARED HUB REPAIR (Cont'd)

3. Install retaining washer (10) in shallow end of drive gear (9).
4. Install drive gear (9) and inboard bearing cup (8) in geared hub (2).
5. Apply sealing compound to capscrews (5). Install shim gaskets (7) and drive gear retainer (4) on geared hub (2) with four washers (6) and capscrews (5). Tighten capscrews (5) to 25-35 lb-ft (34-48 N•m).
6. Mount dial indicator on geared hub (2) and index indicator to register on end of drive gear (9).
7. Move drive gear (9) up and down to read end play. End play should be 0.001-0.006 in. (0.03-0.15 mm). If end play is incorrect, add or subtract shim gaskets (7) and recheck end play.



## 9-6. GEARED HUB REPAIR (Cont'd)

8. Install driven gear (13), inner bearing spindle spacer (8), and bearing spacer (7.1) (A2 and M1123 vehicles only) in geared hub (9).
9. Install outer bearing spacer (10) on spindle (11).
10. Lower geared hub (9) onto spindle (11) and align splines on driven gear (13) with splines on spindle (11). Make sure outer spindle bearing (12) seats in bearing cup.

**NOTE**

Steps 10.1 and 10.2 apply to A2 and M1123 vehicles only.

10.1. Install spindle extension (3.1) on spindle (11).

10.2. Install seal (3.3) and retaining ring (3.4) on steering arm cover (3.2).

11. Apply grease to face of retaining nut (4).
12. Install inner bearing (7), washer (6), key washer (5), and retaining nut (4) on spindle (11).
13. Using retaining nut wrench, tighten retaining nut (4) to 40 lb-ft (54 N•m) while rotating geared hub (9) back and forth to seat bearings (7) and (12).
14. Loosen and retighten retaining nut (4) to 23-27 lb-ft (31-37 N•m).

**WARNING**

Ensure locktab on key washer is bent completely into slot on retaining nut. Failure to do this may cause injury to personnel or damage to equipment.

**NOTE**

For new configuration, two locktabs on key washer must be bent into slots on retaining nut.

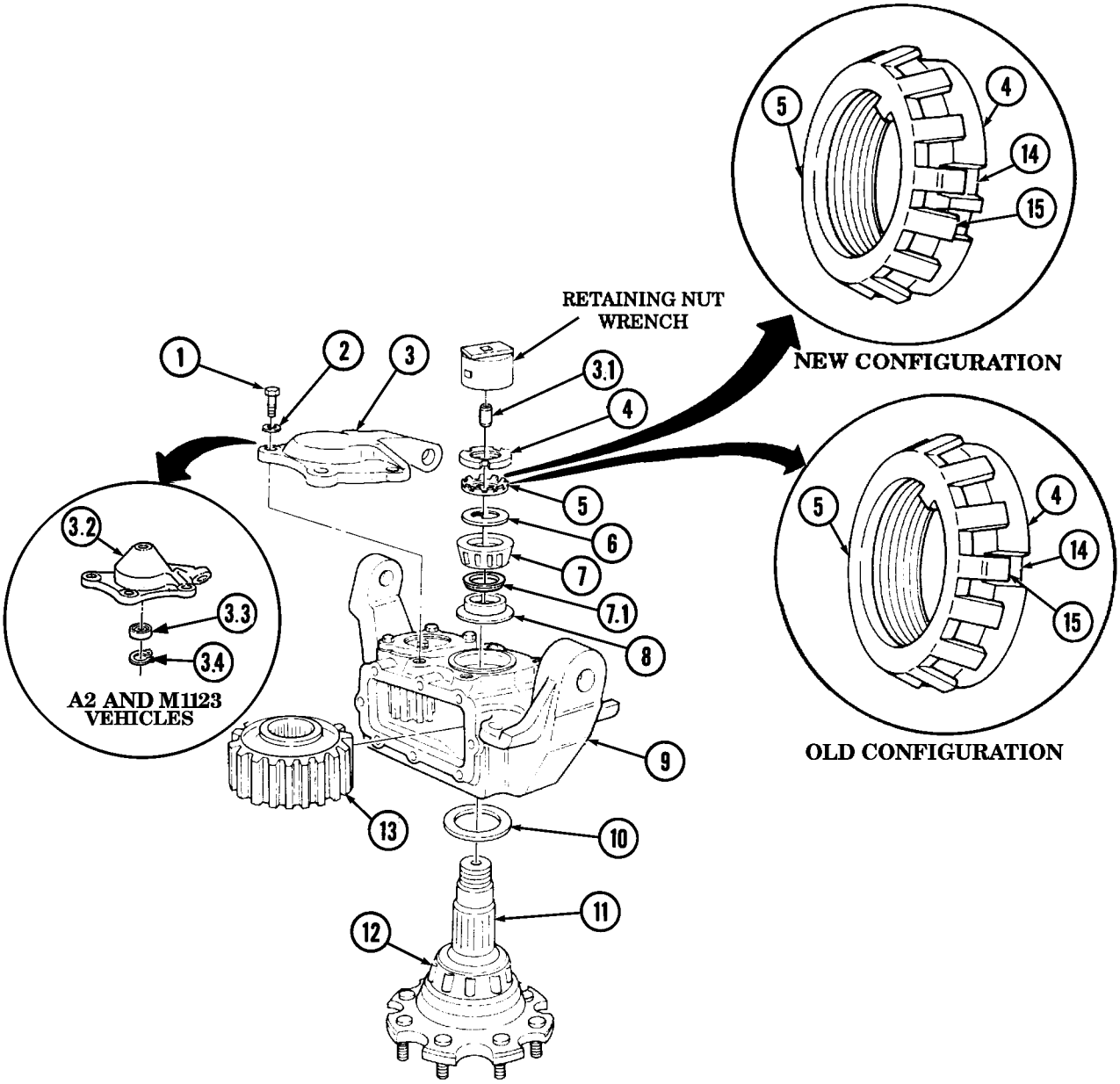
15. Determine which locktab (15) on key washer (5) aligns with slot (14) in retaining nut (4). Bend locktab (15) into slot (14) on retaining nut (4).

**NOTE**

Immediately install steering arm cover after application of sealer.

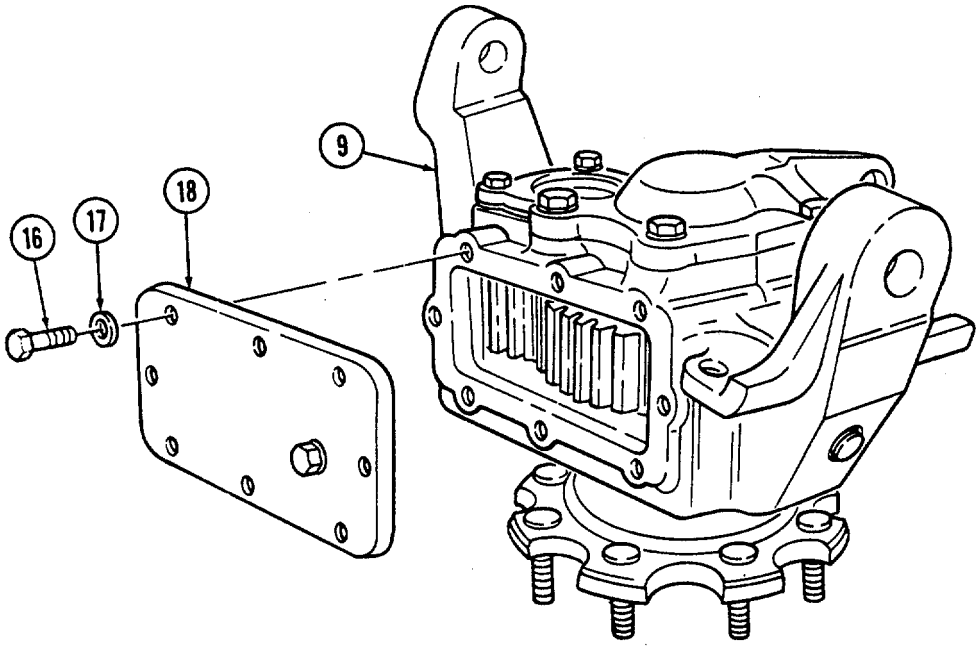
16. Apply anaerobic sealer to steering arm cover (3) and install steering arm cover (3) on geared hub (9).
17. Apply sealing compound to capscrews (1). Install steering arm cover (3) on geared hub (9) with four washers (2) and capscrews (1). Tighten capscrews (1) to 65 lb-ft (88 N•m).

## 9-6. GEARED HUB REPAIR (Cont'd)



**9-6. GEARED HUB REPAIR (Cont'd)**

18. Apply anaerobic sealer to side cover (18) mating surface and install side cover (18) on geared hub (9).
19. Apply sealing compound to capscrews (16). Install side cover (18) on geared hub (9) with eight washers (17) and capscrews (16). Tighten capscrews (16) to 8-13 lb-ft (11-18 N.m).




FOLLOW-ON TASK: Install geared hub (TM 9-2320-280-20).

## 9-7. CONTROL ARM BUSHING REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Grease (Appendix B, Item 21)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Control arm removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**NOTE**

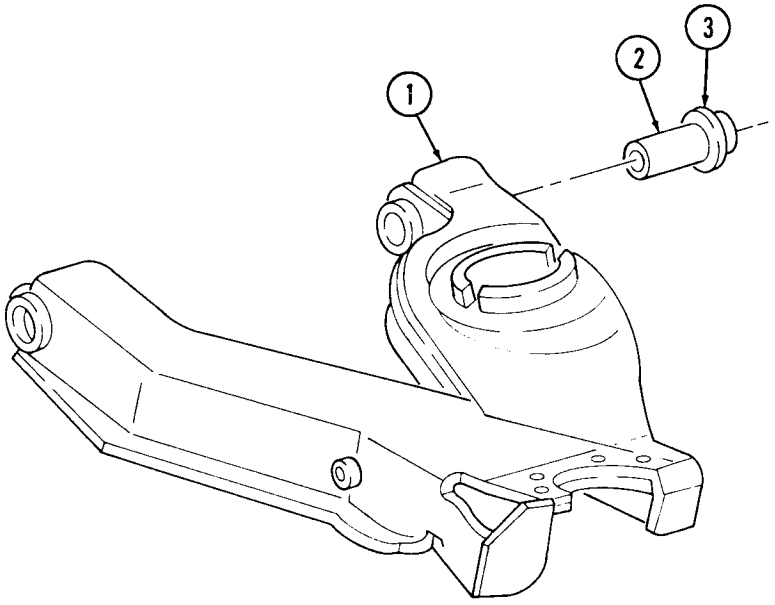
Control arm bushings must be replaced as a set.

**a. Removal**

Support control arm (1) and press bushing (2) out of control arm (1).

**b. Installation**

1. Lubricate O.D. of bushing (2) with grease.
2. Insert bushing (2) in control arm (1).
3. Support control arm (1) and press bushing (2) into control arm (1) until flange (3) on bushing (2) seats on control arm (1).




FOLLOW-ON TASK: Install control arm (TM 9-2320-280-20).

## 9-9. FRONT PROPELLER SHAFT REPAIR

**This task covers:**

**a. Disassembly** **b. Assembly**

**INITIAL SETUP:**

Tools
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Equipment Condition**
Front propeller shaft disassembled (TM 9-2320-280-20).

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-34

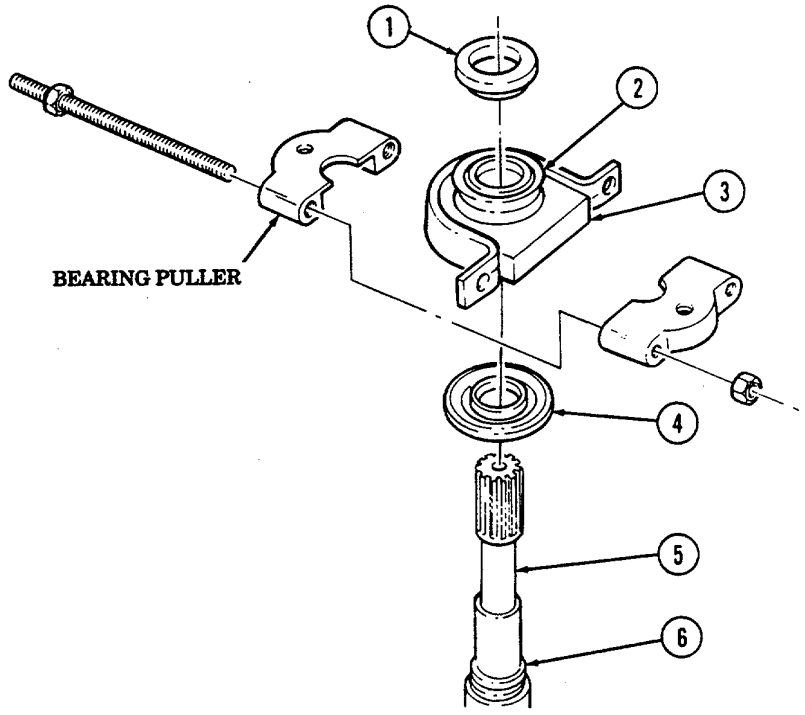
**Maintenance Level**
Direct support

### a. Disassembly

1. Install bearing puller between center bearing (3) and shield (4).
2. Remove center bearing (3) and retainer (1) from coupling shaft (5).
3. Remove shield (4) from coupling shaft (5).

### b. Assembly

1. Install shield (4) on coupling shaft (5).
2. Press center bearing (3) on coupling shaft (5) until seated against shoulder (6). Ensure flange (2) on center bearing (3) faces up.
3. Press bearing retainer (1) on coupling shaft (5).




FOLLOW-ON TASK: Assemble front propeller shaft (TM 9-2320-280-20).

# 9-10. REAR DIFFERENTIAL AND PARKING BRAKE MOUNTING BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**

Two locknuts (Appendix E, Item 65)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Parking brake caliper and rotor removed (TM 9-2320-280-20).
- Parking brake heat shield removed (TM 9-2320-280-20).

**Maintenance Level**

Direct support

**a. Removal**

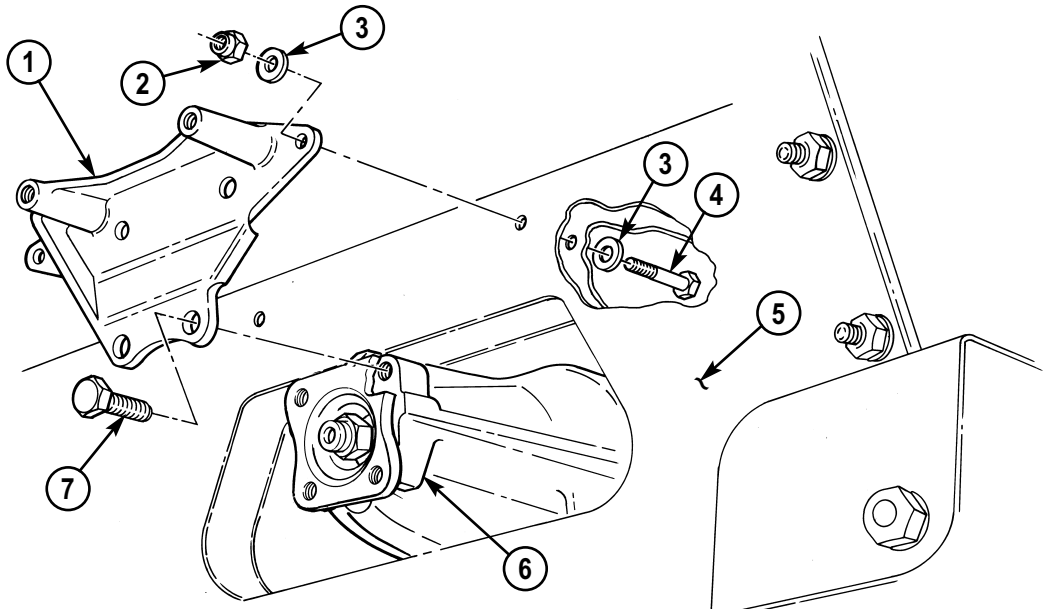
**NOTE**

It may be necessary to lift vehicle and turn rear wheels to rotate flange for access to capscrews.

1. Remove two capscrews (7) from mounting bracket (1) and rear differential (6).
2. Remove two capscrews (4), washers (3), locknuts (2), washers (3), and mounting bracket (1) from frame crossmember (5). Discard locknuts (2).

**b. Installation**

1. Install mounting bracket (1) on frame crossmember (5) with two capscrews (4), washers (3), locknuts (2), and washers (3). Tighten locknuts (2) to 90 lb-ft (122 N•m).
2. Install mounting bracket (1) on differential (6) with two capscrews (7). Tighten capscrews (7) to 110 lb-ft (149 N•m).




FOLLOW-ON TASKS:
- Install parking brake caliper and rotor (TM 9-2320-280-20).
- Install parking brake heat shield (TM 9-2320-280-20).

## 9-11. DIFFERENTIAL AND AXLE FREE PLAY TOLERANCE INSPECTION

**This task covers:**

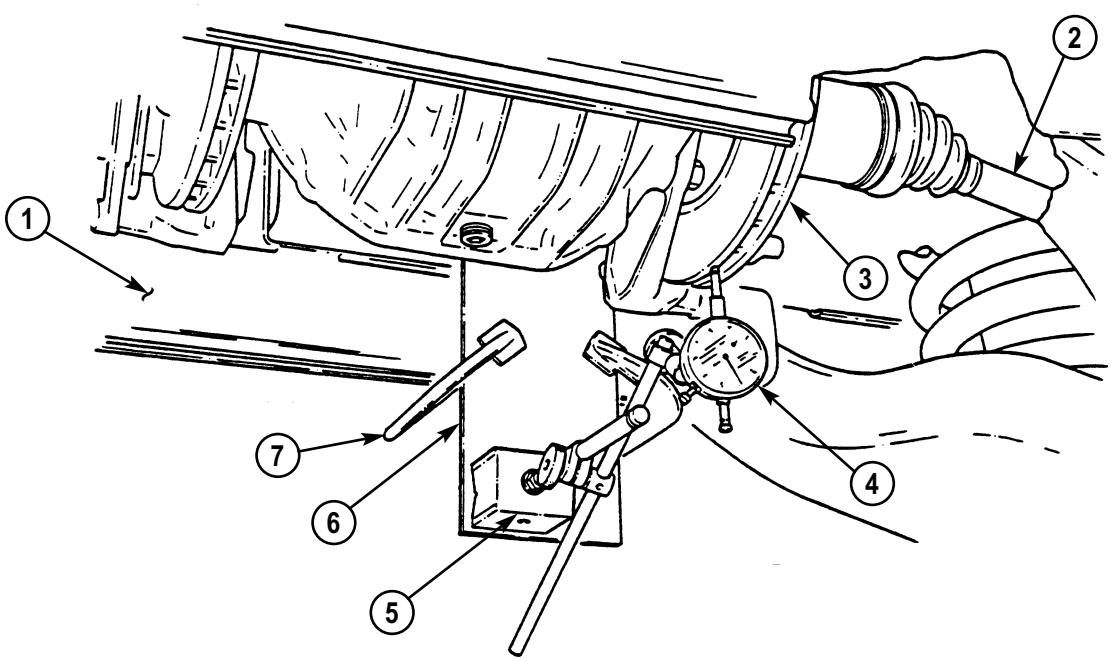
**Inspection**

**INITIAL SETUP:**

| Tools | Maintenance Level |
|---|---|
| General mechanic's tool kit: automotive (Appendix G, Item 1)<br>Dial indicator (Appendix G, Item 95)<br>Clamp (Appendix G, Item 119) | Direct support |

**Inspection**

1. Park vehicle on a flat surface.
2. Chock front and rear wheels, and release parking brake.
3. Use a flat steel plate or scrap metal (6) and clamps (7), to position dial indicator mount assembly (5) on crossmember suspension (1).
4. Position dial indicator (4) on disc assembly (3).
5. Manually move axle shaft (2) up and down vertically as far as possible. Note dial indicator reading in each direction, and record combined readings.
6. If sum of up and down vertical movement exceeds 0.0236 in. (0.5994 mm), notify General Support to disassemble differential, inspect for excessive wear, and replace worn components (para. 19-3).
7. Repeat steps 1 through 6 for remaining axles.



# CHAPTER 10
# SERVICE BRAKE SYSTEM MAINTENANCE

## 10-1. INTRODUCTION

This chapter contains maintenance instructions for repair of service brake system components at the Direct Support maintenance level. Some subassemblies and parts must be removed before service brake system components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## 10-2. SERVICE BRAKE SYSTEM MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 10-3. | Brake Rotor Repair | 10-2 |
| 10-4. | Disc Brake Caliper Repair | 10-4 |
| 10-5. | Rear Parking Brake Caliper Repair | 10-8 |

## 10-3. BRAKE ROTOR REPAIR

**This task covers:**

**a. Inspection**
**b. Checking Lateral Runout**
**c. Checking Thickness Variation**
**d. Refinishing**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)
Dial indicator (Appendix G, Item 95)
Micrometer (Appendix G, Item 96)

**Materials/Parts**
Abrasive crocus cloth (Appendix B, Item 10)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Brake rotor removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

### a. Inspection

**NOTE**

If rotor braking surfaces are rusted or scaled, they must be cleaned before attempting inspection or measurement.

1. Mount rotor (1) in brake lathe and turn while cleaning surfaces with abrasive crocus cloth.
2. Inspect rotor (1) for heat cracks, nicks, broken cooling fins (2), scoring, discoloration, and pitting. Replace if damaged.

### b. Checking Lateral Runout

1. Mount dial indicator with stylus contacting rotor (1) surface 1 in. (25 mm) in from outer edge.
2. Turn rotor (1) 360° and note indicator reading.
3. If lateral runout exceeds 0.004 in. (0.10 mm) total, replace or refinish rotor.

### c. Checking Thickness Variation

1. Measure thickness variation of rotor (1) with a micrometer at four equally-spaced points around rotor (1). Measure 1 in. (25 mm) in from outer edge.

**NOTE**

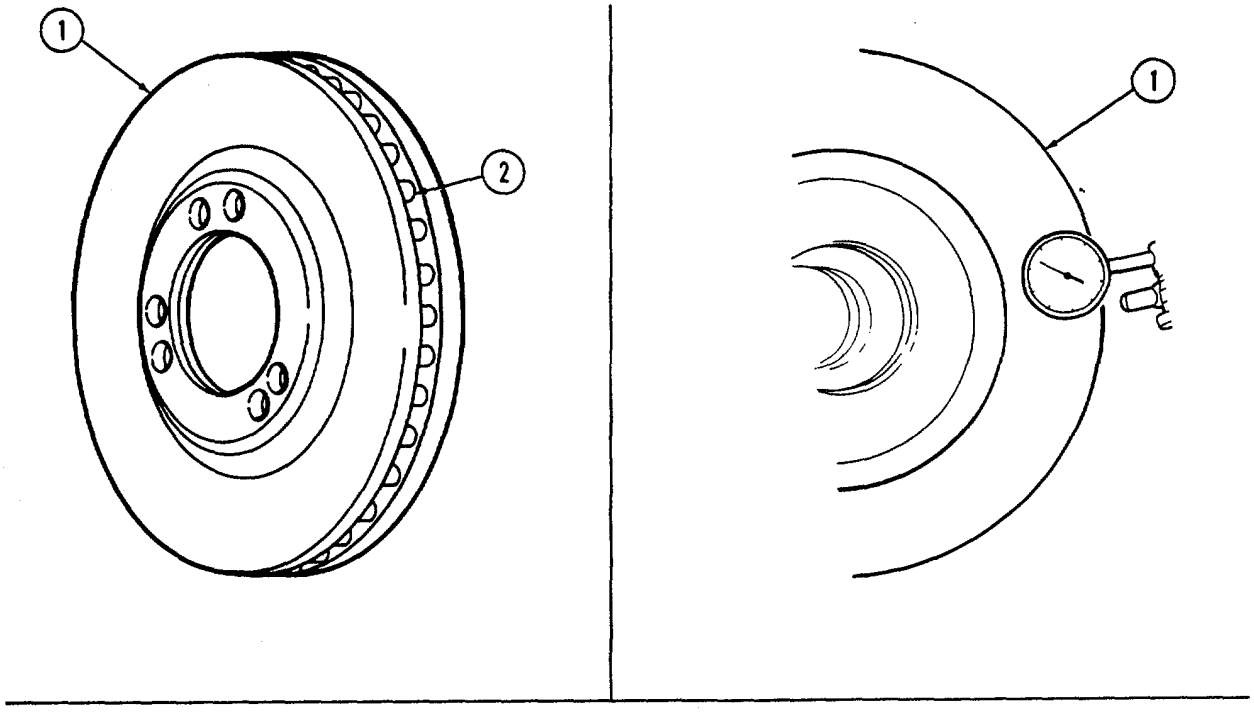
Rotor must be replaced if minimum thickness falls below 0.81 in. (20.6 mm). For the A2 and M1123 vehicles, rotor must be replaced if minimum thickness falls below 0.97 in. (24.6 mm).

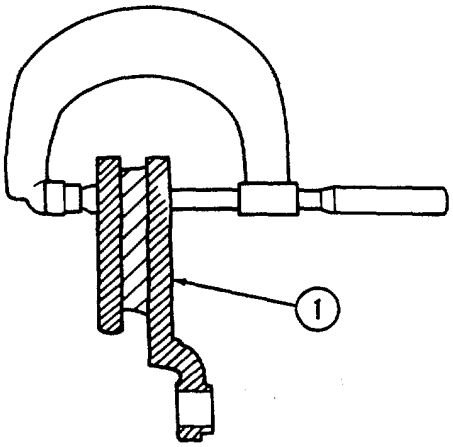
2. If thickness variation exceeds 0.005 in. (0.13 mm), replace or refinish rotor (1).

### d. Refinishing

1. Mount rotor (1) on brake lathe and refinish surface.
2. Replace rotor (1) if refinishing causes rotor (1) to fall below minimum thickness, 0.81 in. (20.6 mm) or 0.97 in. (24.6 mm) for A2 and M1123 vehicles.

## 10-3. BRAKE ROTOR REPAIR (Cont'd)




FOLLOW-ON TASK: Install brake rotor (TM 9-2320-280-20).

## 10-4. DISC BRAKE CALIPER REPAIR

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Service brake caliper kit (Appendix E, Item 50)
Abrasive crocus cloth (Appendix B, Item 10)
Brake fluid, silicone (Appendix B, Item 9)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Disc brake caliper removed (TM 9-2320-280-20).

**General Safety Instructions**
- Hold caliper so piston is facing away from your body. Keep fingers out of space between piston and wood block.
- Compressed air will not exceed 30 psi (207 kPa). Eyeshield must be worn.

**Maintenance Level**
Direct support

### a. Disassembly

**WARNING**

- Hold caliper so piston is facing away from your body. Keep fingers out of space between piston and wood block. Failure to do this may cause injury.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

1. Insert wood block between jaw of caliper (3) and piston (1).
2. Remove piston (1) from caliper (3) by applying air pressure to hose inlet (2) of caliper (3).

**CAUTION**

Do not use metal tools to remove dust boot and gasket. It could damage caliper bore.

3. Remove piston dust boot (4) and gasket (5) from caliper bore (6). Discard dust boot (4) and gasket (5).
4. Remove bleeder screw (7) from caliper (3).

### b. Cleaning

Clean disc brake caliper components in accordance with para. 2-13.

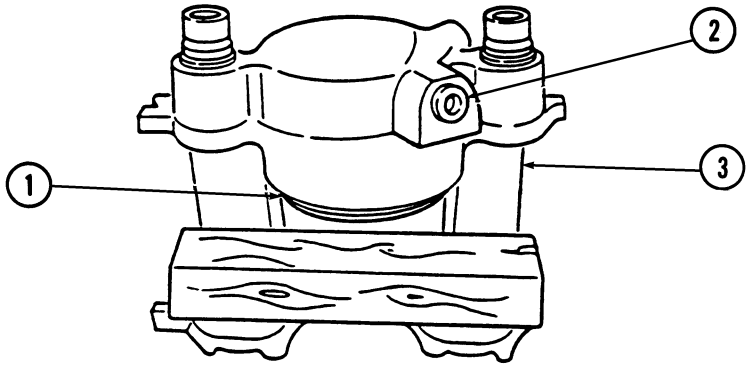
## 10-4. DISC BRAKE CALIPER REPAIR (Cont'd)

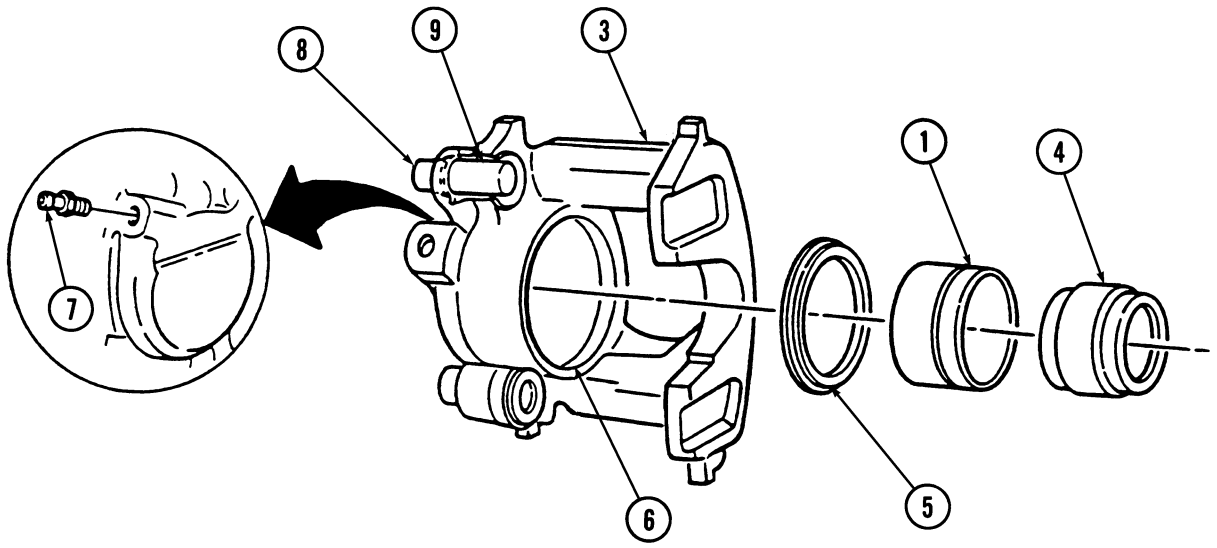
**c. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect caliper bore (6) for scoring, nicks, or corrosion. Bore (6) is not plated and minor corrosion can be polished with abrasive crocus cloth. Replace caliper (3) if bore (6) is not repairable.
2. Inspect piston (1) O.D. for scoring, nicks, corrosion, and worn or damaged chrome plating. Replace piston (1) if there are any surface defects.
3. Inspect bleeder screw (7) for damage or stripped threads. Replace if damaged.
4. Inspect seal (8) and bushing (9) for damage. Replace both if either is damaged.



## 10-4. DISC BRAKE CALIPER REPAIR (Cont'd)

**d. Assembly**

**CAUTION**

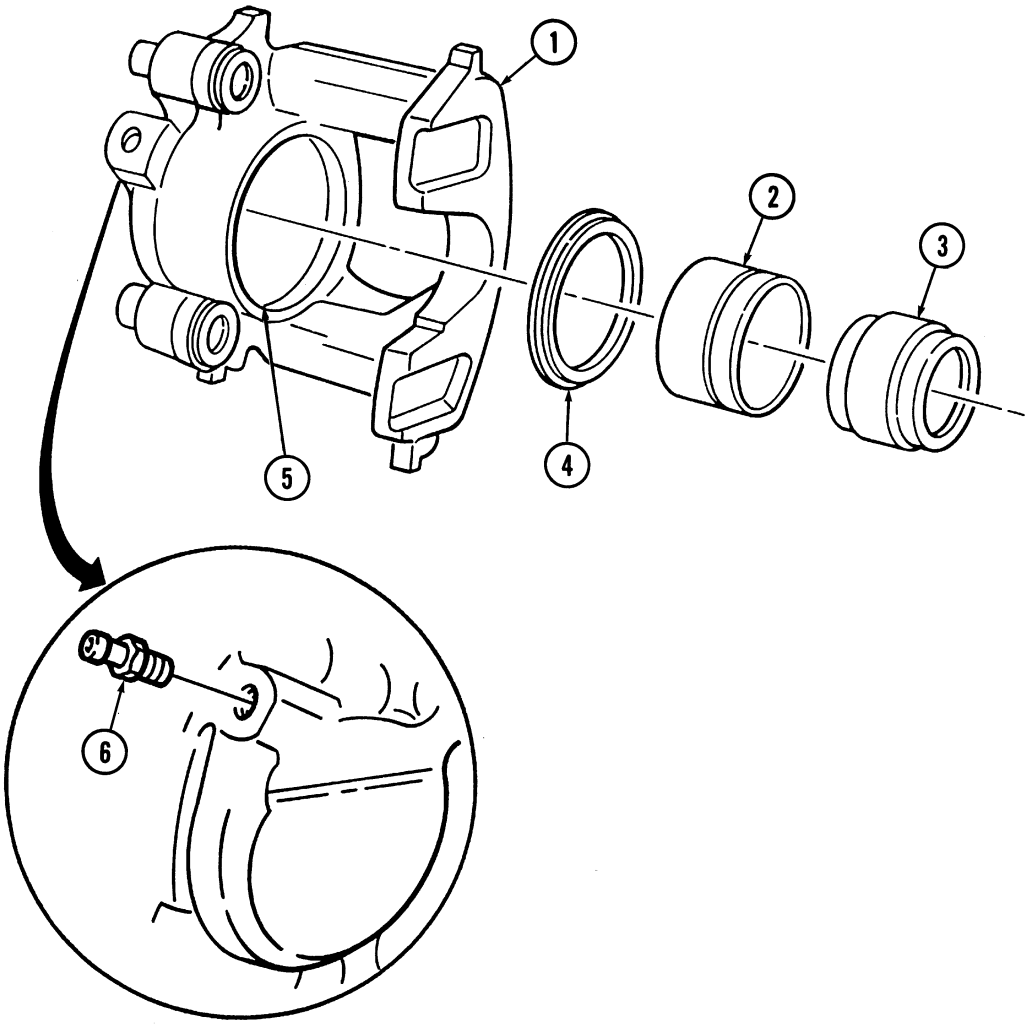
Use Silicone Brake Fluid only, MIL-B-46176. Failure to use BFS will cause damage to brake system.

**NOTE**

For general assembly instructions, refer to para. 2-16.

1. Lubricate caliper bore (5) and gasket (4) with brake fluid.
2. Install gasket (4) in groove of caliper bore (5).
3. Lubricate piston (2) with brake fluid and install dust boot (3) on piston (2).
4. Work piston (2) and dust boot (3) into caliper bore (5).
5. Seat dust boot (3) in caliper (1).
6. Install bleeder screw (6) in caliper (1) finger tight.

## 10-4. DISC BRAKE CALIPER REPAIR (Cont'd)




FOLLOW-ON TASK: Install disc brake caliper (TM 9-2320-280-20).

## 10-5. REAR PARKING BRAKE CALIPER REPAIR

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Caliper parts kit (Appendix E, Item 155)
Brake fluid, silicone (Appendix B, Item 9)
Hex wrench (Appendix C, Fig. 41) (optional)
Open-end wrench (Appendix C, Fig. 42) (optional)
Parking brake spring tool (Appendix C, Fig. 43) (optional)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Rear parking brake caliper removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**a. Disassembly**

**NOTE**

Refer to instructions for parking brake spring tool (Appendix C, Fig. 44) (optional).

1. Remove parking brake spring (10) from parking brake lever (9) and caliper housing (1).
2. Remove screw (11) and parking brake lever (9) from actuator shaft (12).
3. Remove piston cap (26) from piston (22).
4. Remove piston retaining screw (24) from piston (22).
5. Turn piston (22) counterclockwise and remove from caliper housing (1).
6. Remove piston boot (25) and piston seal (21) from caliper housing (1).
7. Remove thrust screw retaining ring (20) and thrust screw spring shield (27) from caliper housing (1).
8. Remove thrust screw spring (28) and thrust screw (29) from caliper housing (1).
9. Remove three actuator shaft bearings (19), bearing plate (18), and actuator shaft assembly parts (17), (16), and (15) from caliper housing (1).
10. Remove actuator shaft seal (13) from caliper housing (1). Discard actuator shaft seal (13).
11. Remove pin retaining plug assembly (5), antirotation pin spacer (6), and antirotation pin (7) from caliper housing (1).
12. Remove bleeder screw cap (3) and bleeder screw (2) from caliper housing (1).
13. Remove O-rings (4) and (8) from retaining plug assembly (5) and antirotation pin (7). Remove O-rings (23) and (14) from piston retaining screw (24) and actuator shaft (17). Discard O-rings (4), (8), (23), and (14).

## 10-5. REAR PARKING BRAKE CALIPER REPAIR (Cont'd)

**b. Cleaning**

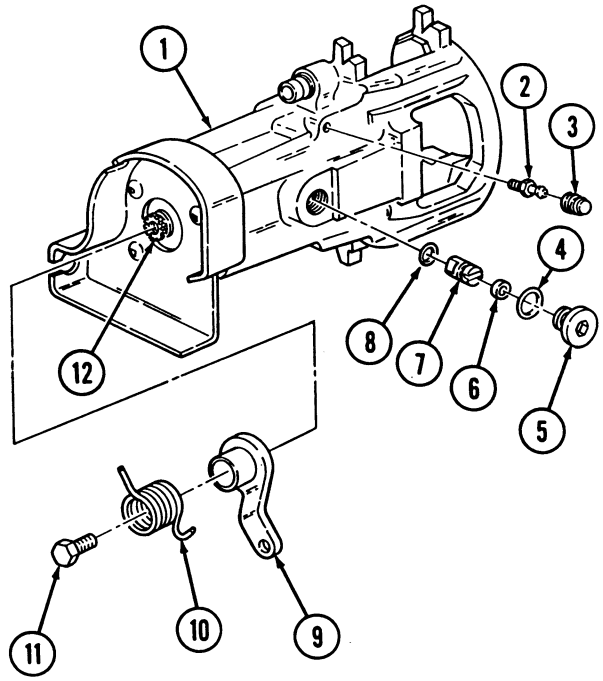
Clean rear brake caliper components in accordance with para. 2-13.

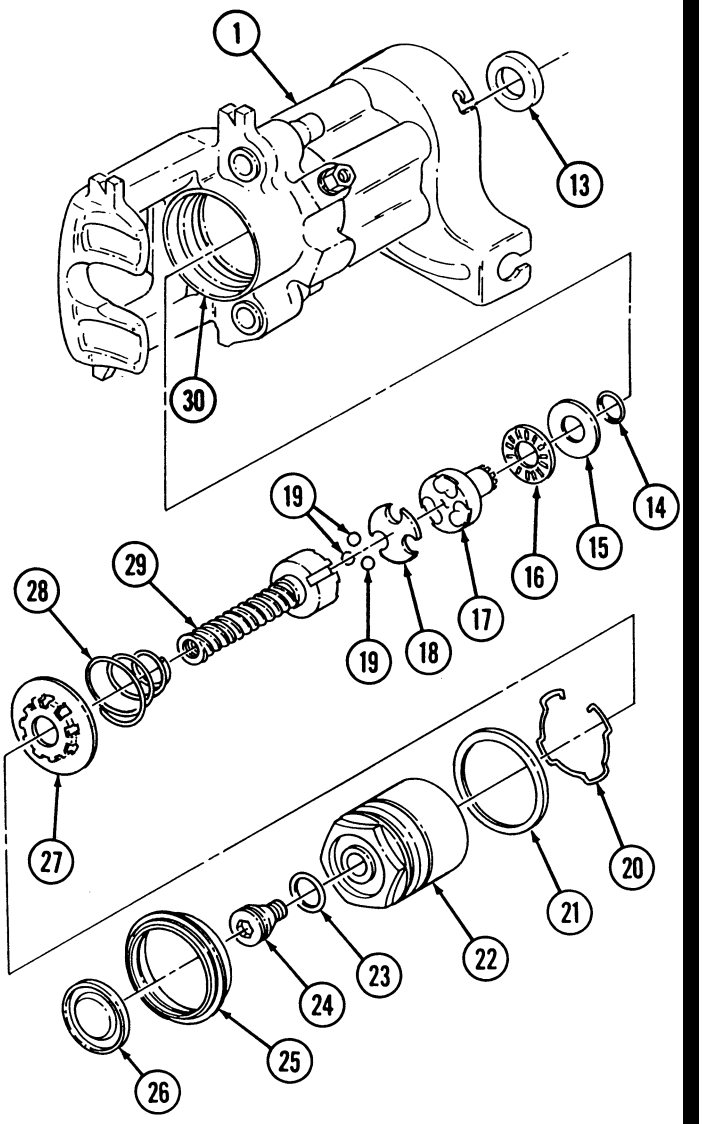
**c. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect caliper bore (30) for scoring, nicks, or corrosion. Replace if damaged.
2. Inspect piston (22) O.D. for scoring, nicks, corrosion, and worn or damaged plating. Replace piston (22) if there are any surface defects.
3. Inspect bleeder screw (2) for damage or stripped threads. Replace if damaged.
4. Inspect piston seal (21) and actuator shaft dust shield (13) for damage. Replace if damaged.



## 10-5. REAR PARKING BRAKE CALIPER REPAIR (Cont'd)

**d. Assembly**

**CAUTION**

Use silicone brake fluid only, MIL-B-46176. Failure to use SBF will cause damage to brake system.

**NOTE**

- For general assembly instructions, refer to para. 2-16.
- Lubricate caliper bore, piston, and piston seal with brake fluid.

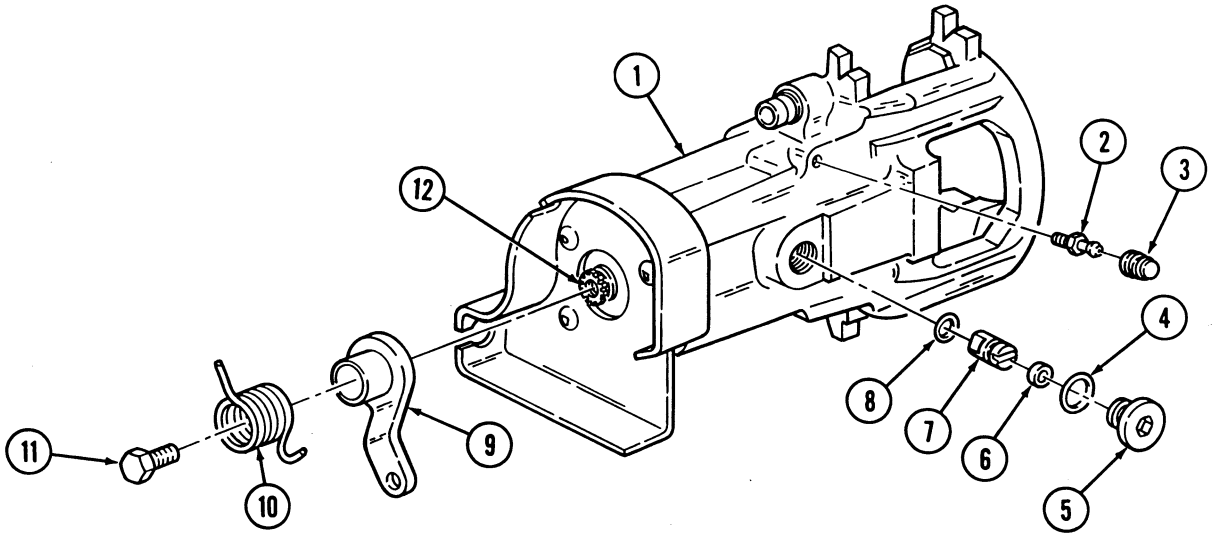
1. Install O-rings (23) and (14) on piston retaining screw (24) and actuator shaft (17).
2. Install O-rings (4) and (8) on pin retaining plug assembly (5) and antirotation pin (7).
3. Install actuator shaft seal (13) in caliper housing (1).
4. Install actuator shaft assembly parts (15), (16), and (17) in caliper housing (1).
5. Install bearing plate (18) and three actuator shaft bearings (19) in caliper housing (1).
6. Install thrust screw (29) in caliper housing (1).

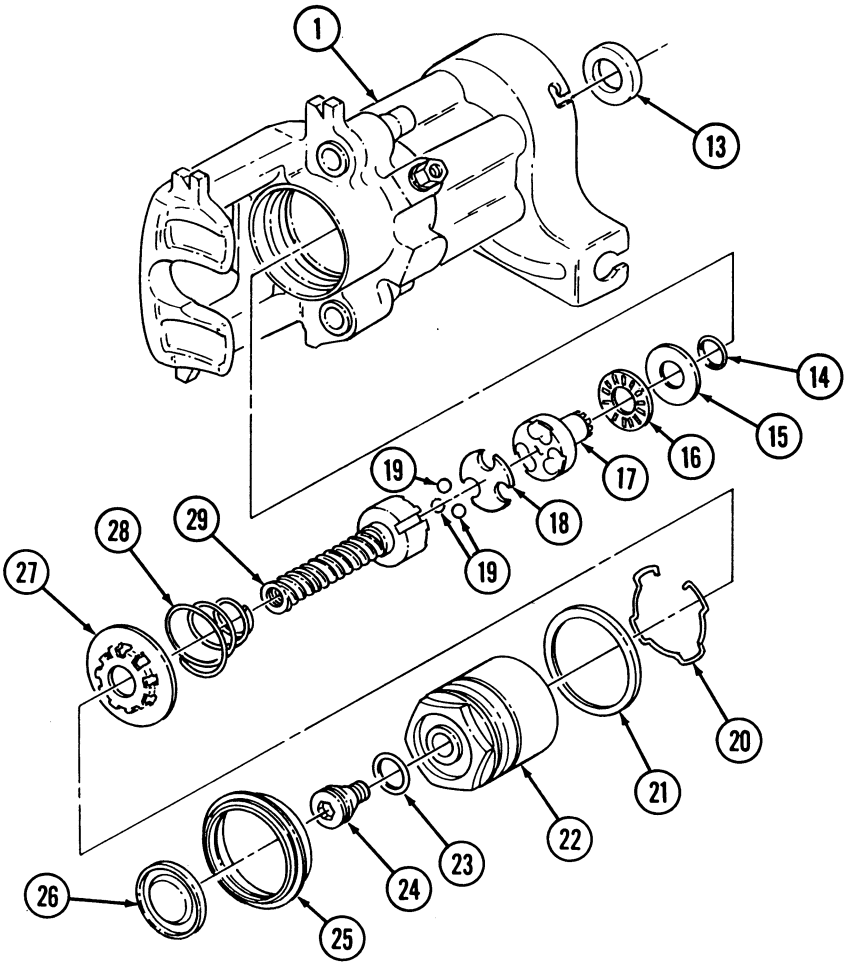
**NOTE**

Ensure slot in thrust screw is aligned with hole in caliper housing for antirotation pin.

7. Install antirotation pin (7), antirotation pin spacer (6), and pin retaining plug assembly (5) in caliper housing (1). Tighten plug (5) to 8-12 lb-ft (11-16 N•m).
8. Install screw spring (28) and thrust screw spring shield (27) and secure with thrust screw retaining ring (20).
9. Install piston seal (21) in caliper housing (1).
10. Install piston (22) in caliper housing (1) by turning piston (22) clockwise and pushing in on piston (22).
11. Install piston boot (25) on caliper housing (1) and piston (22).
12. Install piston retaining screw (24) in piston (22). Tighten screw (24) to 15-22 lb-ft (20-30 N•m).
13. Install piston cap (26) in piston (22).
14. Install parking brake lever (9) on actuator shaft (12) with screw (11). Tighten screw (11) to 15-25 lb-ft (20-34 N•m).
15. Install parking brake spring (10) on caliper housing (1) and parking brake lever (9).
16. Install bleeder screw (2) in caliper housing (1). Tighten screw (2) to 6-15 lb-ft (8-20 N•m).
17. Install bleeder screw cap (3) on bleeder screw (2).

## 10-5. REAR PARKING BRAKE CALIPER REPAIR (Cont'd)




FOLLOW-ON TASK: Install rear parking brake caliper (TM 9-2320-280-20).

# CHAPTER 11
# STEERING SYSTEM MAINTENANCE

## 11-1. INTRODUCTION

This chapter contains maintenance instructions for repair and testing of steering system components at the Direct Support maintenance level. Some subassemblies and parts must be removed before steering system components can be accessed. They are referenced to other paragraphs in this manual or TM 9-2320-280-20.

## 11-2. STEERING SYSTEM MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 11-3. | Deleted | |
| 11-4. | Power Steering Pump and Steering Gear Leak Test | 11-6 |
| 11-5. | Steering Gear Repair | 11-8 |

## 11-4. POWER STEERING PUMP AND STEERING GEAR LEAK TEST

**This task covers:**

**Leak Test**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)
Power steering analyzer (Appendix, G, Item 129)
Power steering pump and gear test stand (Appendix C, Fig. C-19)

**Equipment Condition**

- Power steering pump and steering gear installed properly on test stand.
- Power steering fluid at proper level (TM 9-2320-280-20).

**Maintenance Level**

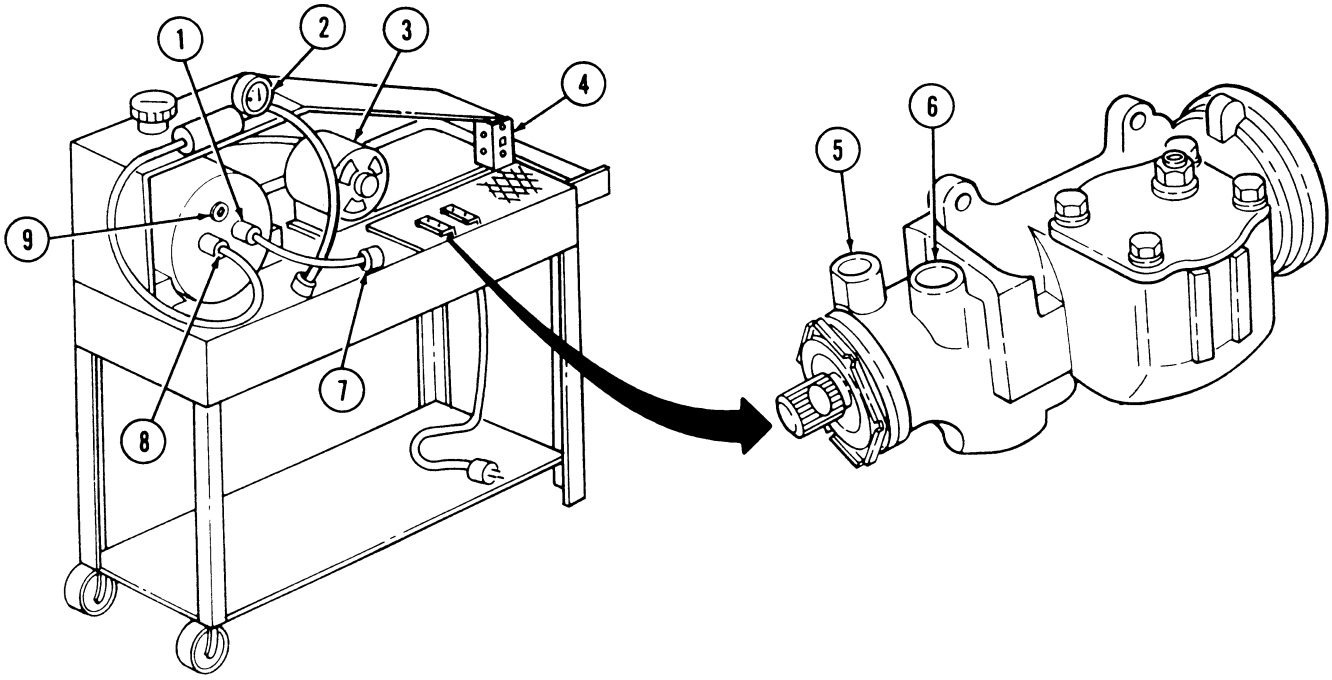
Direct support

**Leak Test**

**NOTE**

Mounting of components to stand is left to discretion of user.

1. Connect power steering analyzer (2) between power steering pump high pressure (output) side (8) and steering gear inlet (6).
2. Connect a pressure hose (7) between power steering return port (1) and steering gear outlet (5).
3. Plug unused power steering pump return port (9).
4. Start electric motor (3) using on/off switch (4).
5. Power steering pump should be operated at 455-1475 rpm.
6. Adjust power steering analyzer pressure to 140-170 psi (965-1172 kPa).
7. Check power steering pump and steering gear for leaks.



## 11-5. STEERING GEAR REPAIR

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Housing Group Inspection and Repair**
**d. Pitman Shaft Inspection and Repair**
**e. Rack Piston Group Inspection and Repair**
**f. Valve and Adjuster Group Inspection and Repair**
**g. Assembly**
**h. Adjustment**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Adjuster plug bearing remover/installer (Appendix G, Item 97)
Pitman shaft bearing remover/installer (Appendix G, Item 98)
Spanner wrench (Appendix G, Item 99)
Rack piston arbor (Appendix G, Item 100)

**Materials/Parts**
Steering parts kit (Appendix E, Item 162)
Steering parts kit (Appendix E, Item 164)
Linear AC parts kit (Appendix E, Item 160)
Pitman shaft seal (Appendix E, Item 244)
Seal kit (Appendix E, Item 49)
Steering parts kit (Appendix E, Item 163)

**Materials/Parts (Cont'd)**
Crocus cloth (Appendix B, Item 10)
Grease (Appendix B, Item 22)
Hydraulic fluid (Appendix B, Item 24)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P
TM 9-214

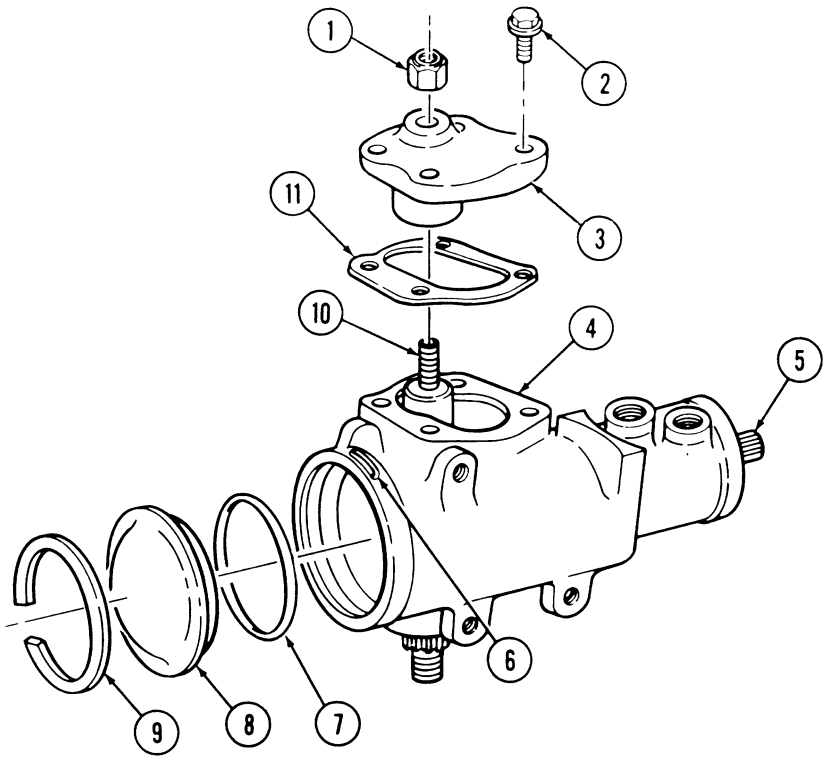
**Equipment Condition**
Steering gear removed (TM 9-2320-280-20).

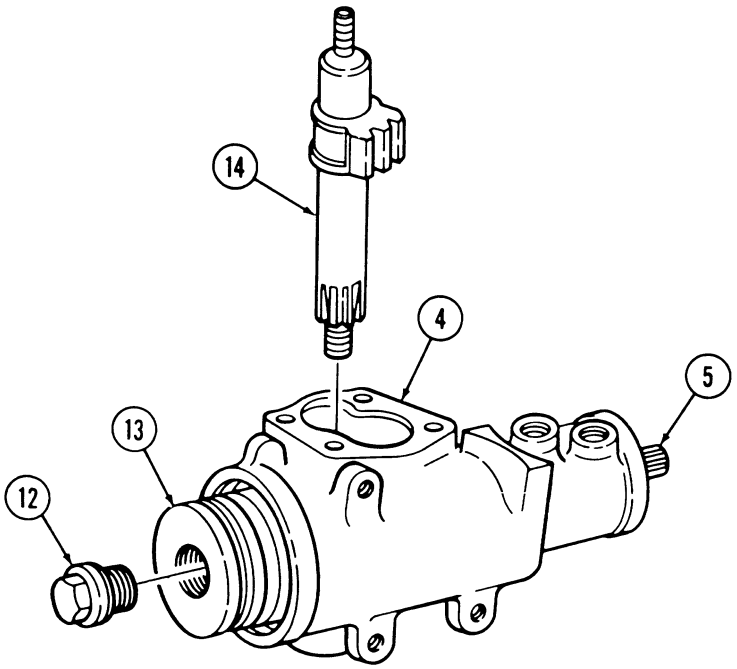
**Maintenance Level**
Direct support

### a. Disassembly

1. Hold adjuster screw (10) and remove lash adjuster nut (1).
2. Remove four capscrews (2) from side cover (3) and housing (4).
3. Unscrew side cover (3) from adjuster screw (10).
4. Remove gasket (11) from side cover (3). Discard gasket (11).
5. Insert punch through access hole (6) and force retaining ring (9) out. Discard retaining ring (9).
6. Rotate stub shaft (5) counterclockwise to force end plug (8) from housing (4).
7. Rotate stub shaft (5) clockwise and remove O-ring (7). Discard O-ring (7).
8. Remove plug (12) from rack piston (13).
9. Rotate stub shaft (5) to center and remove pitman shaft (14) from housing (4).

## 11-5. STEERING GEAR REPAIR (Cont'd)



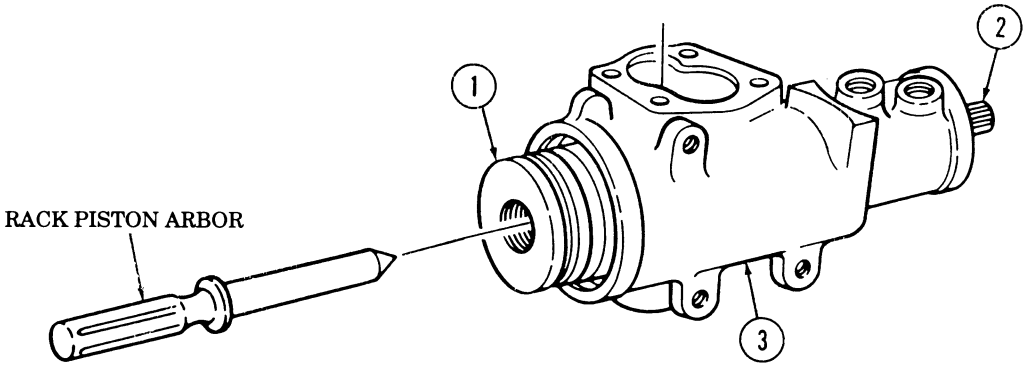
## 11-5. STEERING GEAR REPAIR (Cont'd)

10. Insert rack piston arbor in rack piston (1) and hold tightly while turning stub shaft (2) counterclockwise.
11. Remove rack piston (1) and rack piston arbor from gear housing (3) together.
12. Remove locknut (4) from adjuster plug (5).

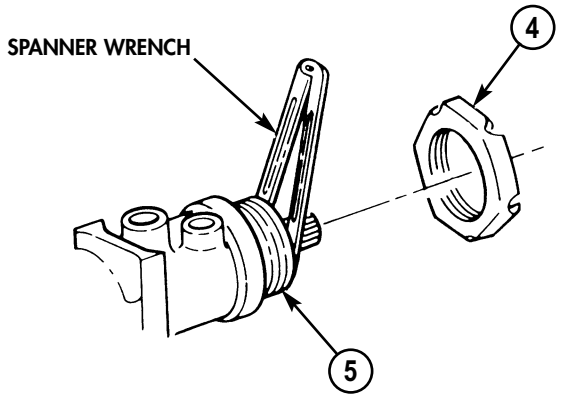
**NOTE**

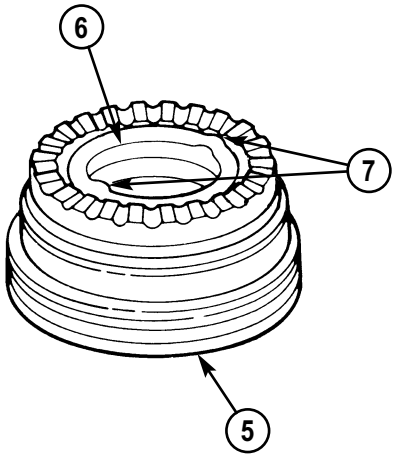
Worm and valve may come out with adjuster plug. If so, separate adjuster from worm and valve.

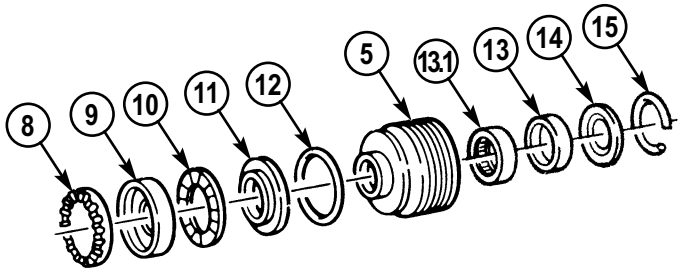
13. Using spanner wrench, remove adjuster plug (5) from housing (3).
14. Pry off bearing retainer (6) at raised area (7).
15. Remove thrust bearing spacer (8), small bearing race (9), upper thrust bearing (10), and large bearing race (11) from plug (5).
16. Remove O-ring seal (12) from plug (5). Discard O-ring seal (12).
17. Remove retaining ring (15) from opposite side of adjuster plug (5). Discard retaining ring (15).
18. Remove stub shaft dust seal (14), stub shaft oil seal (13), and bearing (13.1) from plug (5). Discard seals (14) and (13).
19. Hold stub shaft (2) and remove valve (21) and worm shaft (19) together from housing (3).
20. Remove bearing race (16), lower thrust bearing (17), and bearing race (18) from worm shaft (19).
21. Clamp worm shaft (19) in soft-jawed vise and pull valve (21) from worm shaft (19).
22. Remove and discard three valve body teflon rings (23) and O-ring seals (22) from valve body (21).
23. Remove stub shaft O-ring seal (20) from valve body (21). Discard O-ring seal (20).

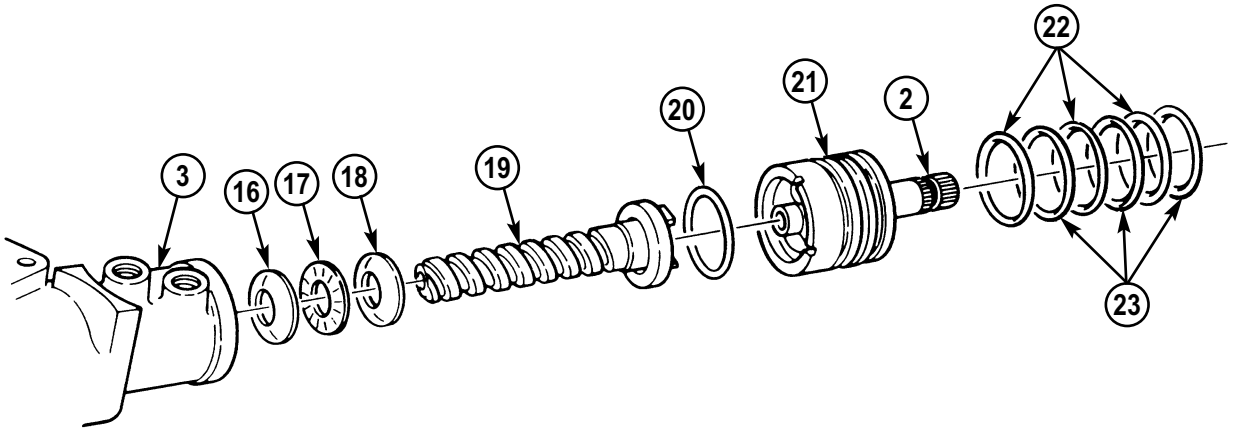


## 11-5. STEERING GEAR REPAIR (Cont'd)



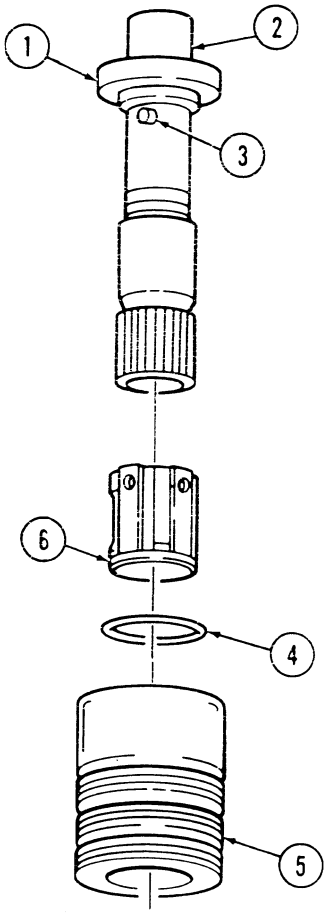
## 11-5. STEERING GEAR REPAIR (Cont'd)

24. Tap splined end of stub shaft (2) lightly on wood block until shaft cap (1) is free of valve body (5).
25. Pull shaft (2) outward 0.25 in. (6 mm).
26. Press spool valve locating pin (3) inward and remove stub shaft (2) from valve body (5).

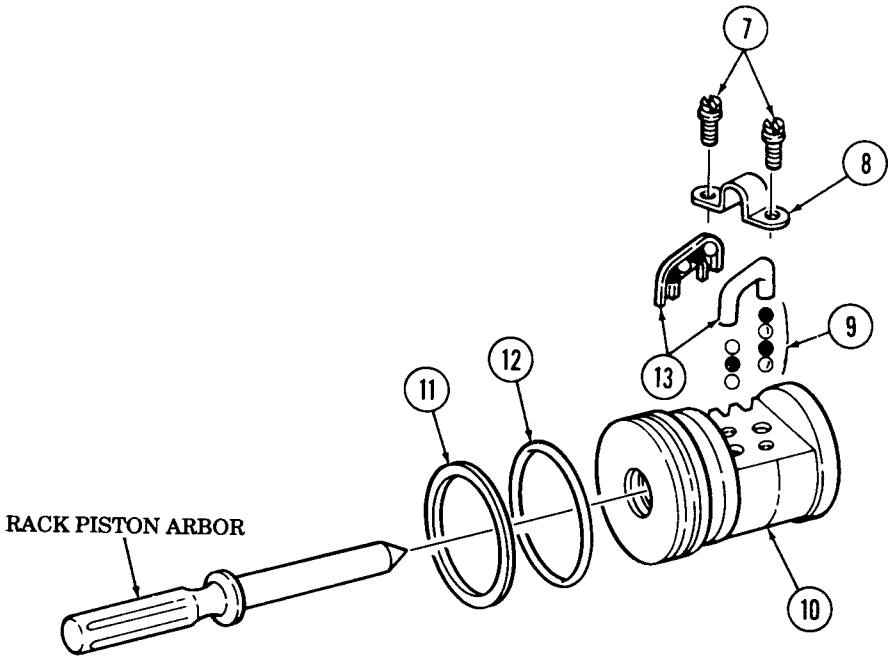
**NOTE**

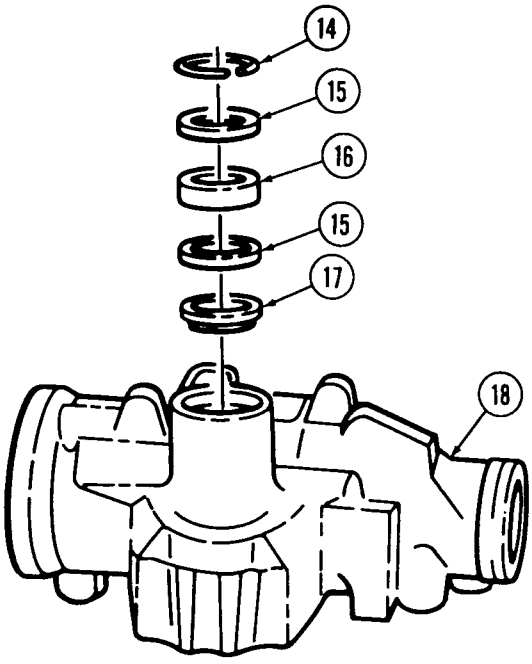
Rotate spool to remove from valve.

27. Remove valve (6) from valve body (5).
28. Remove O-ring (4) from spool (6). Discard O-ring (4).
29. Remove two screw-assembled washers (7) and clamp (8) from rack piston (10).
30. Remove and separate two halves of guide (13).
31. Remove black and chrome bearing balls (9) from two halves of guide (13).
32. Tip rack piston (10) so remaining bearing balls (9) fall out. The total number of bearing balls (9) should be twenty-four, twelve black and twelve chrome colored.
33. Remove rack piston arbor from rack piston (10).
34. Remove teflon ring (11) and O-ring seal (12) from rack piston (10). Discard teflon ring (11) and O-ring seal (12).
35. Remove pitman shaft retaining ring (14) from housing (18). Discard retaining ring (14).
36. Remove washer (15), double-lip seal (16), washer (15), and single-lip seal (17) from housing (18). Discard seals (16) and (17) and washers (15).



## 11-5. STEERING GEAR REPAIR (Cont'd)



## 11-5. STEERING GEAR REPAIR (Cont'd)

### b. Cleaning

Clean all parts (para. 2-13).

### c. Housing Group Inspection and Repair

1. Inspect housing (4) for breaks, cracks, chipped or broken retaining ring grooves (5) and (22), and damaged sealing surfaces. Replace steering gear if housing (4) is damaged.
2. Inspect housing (4) for crossed or stripped threads. Refer to paragraph 2-15 for thread repair. Replace steering gear if housing (4) threads cannot be repaired.

**NOTE**

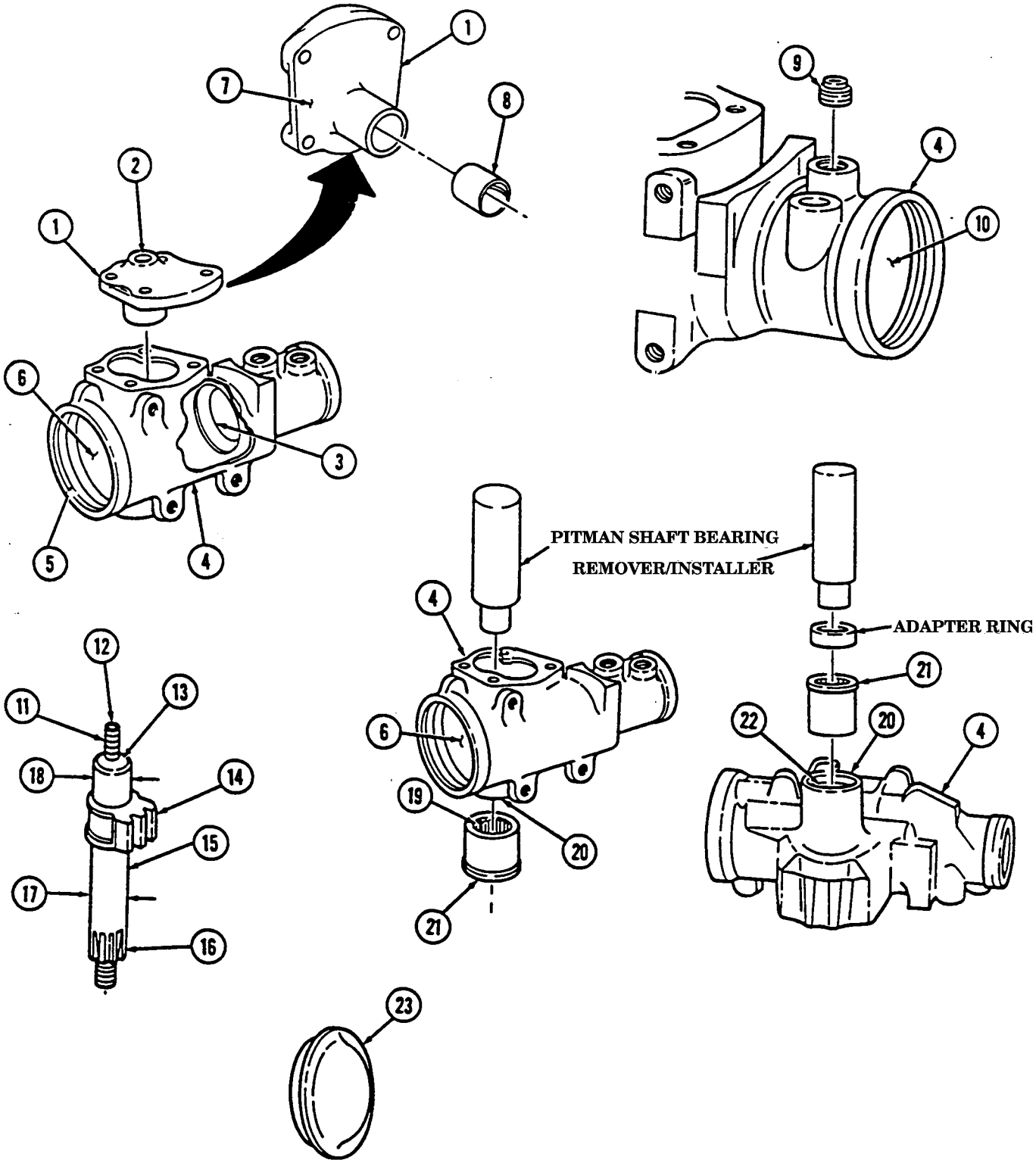
- Rack piston bore has laser hardened tracks on side of piston bore opposite pitman shaft cavity. These are not wear or scoring indicators.
- Inspect pitman shaft bearing bore only if pitman shaft bearing is replaced. (Refer to steps 3 and 4.)

3. Inspect pitman shaft needle bearing (21) for damage or wear (TM 9-214). Replace needle bearing (21) if damaged or inside diameter (I.D.) (19) is worn below 1.2510 in. (31.750 mm). If damaged or worn, replace needle bearing (21) as follows:
   a. Using pitman shaft bearing remover/installer, remove bearing (21) from housing (4).
   b. Lubricate bearing bore (20) and bearing (21) with hydraulic fluid.
   c. Using pitman shaft bearing remover/installer and adapter ring, install bearing (21) until seated in housing (4).
4. Inspect valve bore (10), rack piston bore (5), worm shaft support bore (3), and pitman shaft bearing bore (20) for rust, pitting, scoring, galling, and wear. Wear limits for bore I.D. are: valve bore (10) 2.034 in. (51.64 mm), rack piston bore (6) 3.128 in. (79.45 mm), worm support bore (3) 1.040 in. (26.42 mm), and pitman shaft bearing bore (20) 1.766 in. (44.80 mm). Remove minor rust, pitting, and scoring with crocus cloth. If bore(s) do not meet specifications, or if there is other unrepairable damage, replace steering gear.
5. Inspect check valve (9) for freedom of movement. If damaged, replace check valve (9) as follows:
   a. Pry check valve (9) out of housing (4) with a small screwdriver.
   b. Lubricate housing (4) and check valve (9) with hydraulic fluid.
   c. Install check valve (9), using 3/8 in. (9.52 mm) outside diameter (O.D.) tubing, 4 in. (10.16 cm) long.
6. Inspect side cover (1) for breaks, cracks, stripped or crossed threads (2), warped or damaged sealing surface (7), and scored or worn bushing (8). Repair minor scoring and thread (2) damage. Replace side cover (1) if bushing (8) is worn through or loose in bore. Replace bushing (8) if I.D. is worn over 1.248 in. (31.70 mm).
7. Inspect housing end plug (23) for breaks, cracks, and chipped edges. Replace housing end plug (23) if damaged.

### d. Pitman Shaft Inspection and Repair

1. Inspect pitman shaft (15) for bends, breaks, chipped, cracked, or broken gear teeth (14), wear on bushing journal (18) or bearing journal (17), crossed or stripped threads, and bent or twisted splines (16). Bushing journal (18) minimum O.D. is 1.2468 in. (31.699 mm) and bearing journal (17) minimum O.D. is 1.2500 in. (31.750 mm). Repair minor thread damage. Replace pitman shaft (15) if worn or unrepairable.
2. Inspect lash adjuster screw (11) for free rotation in shaft (15), tight retainer plug (13), crossed or stripped threads, and rounded hex socket hole (12). Repair minor thread damage. Replace pitman shaft (15) if damaged.

## 11-5. STEERING GEAR REPAIR (Cont'd)



## 11-5. STEERING GEAR REPAIR (Cont'd)

### e. Rack Piston Group Inspection and Repair

**NOTE**

If rack piston internal worm thread, worm thread, or ball bearings are broken, chipped, or moderately or badly scored, replace all three parts.

1. Inspect rack piston (7) for breaks, burrs, chipped seal grooves (8), crossed or stripped threads, cracked or broken gear teeth (3), and broken, chipped or scored internal worm thread. Repair minor burrs and scoring with fine mill file or crocus cloth. Repair minor thread damage. Replace rack piston (7) if gear teeth (3) are cracked or broken or other damage is unrepairable.
2. Inspect twenty-four ball bearings (6) for breaks, chipped surface, flats, and scoring. Minor scoring on ball bearings (6) is acceptable. Replace ball bearings (6) as a set if any one or more fails inspection. (Refer to note above.)
3. Inspect ball bearing guides (2) for bends, dents, and breaks and clamp (5) for bends and breaks. Replace damaged parts.
4. Inspect screw-assembled washers (4) for crossed or stripped threads. Replace screw-assembled washers (4) if damaged.
5. Inspect rack piston plug (1) for burred or rounded hex flats and stripped or crossed threads. Replace rack piston plug (1) if damaged.

### f. Valve and Adjuster Group Inspection and Repair

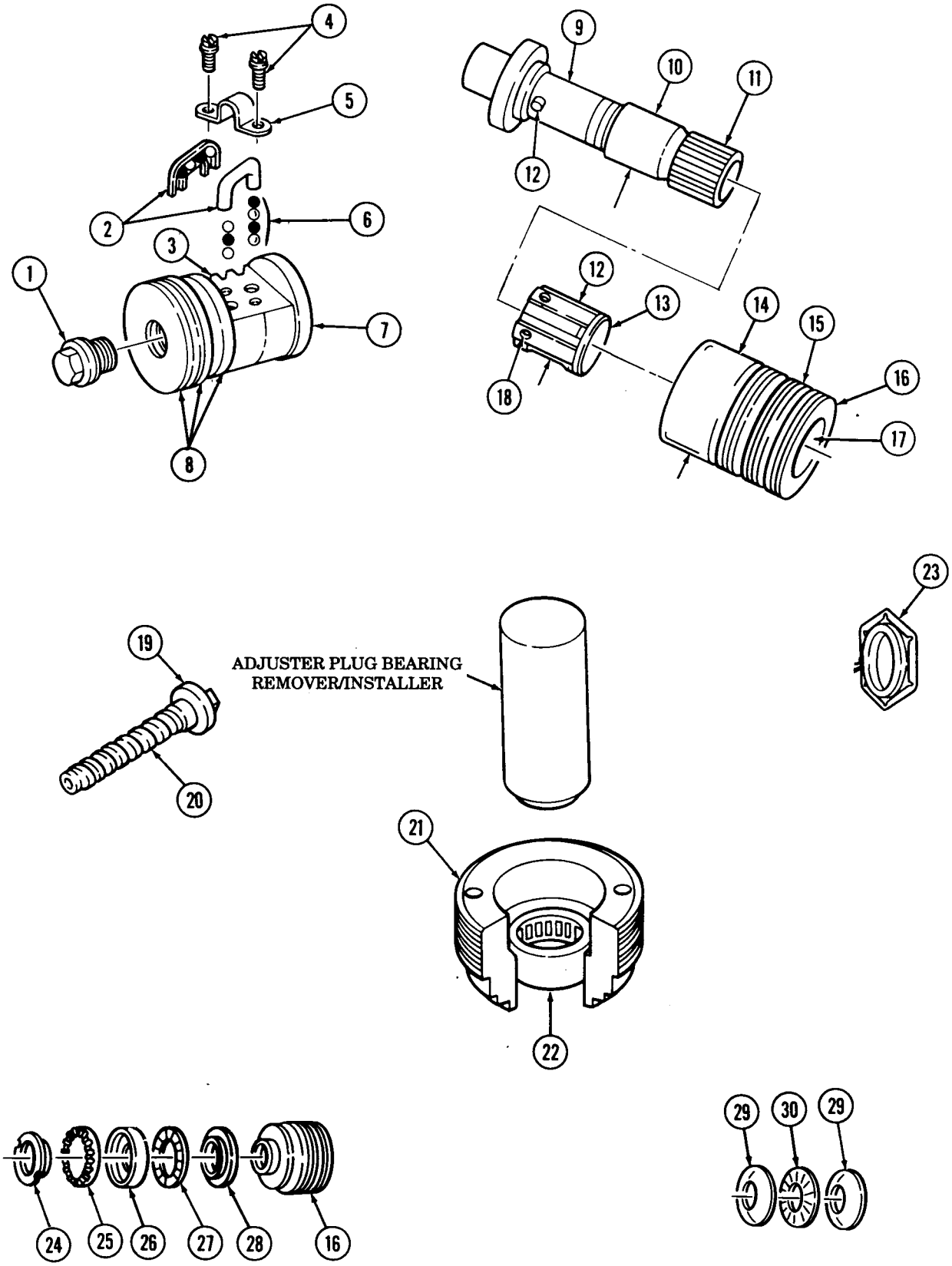
1. Inspect valve body (16) for burrs, chipped or broken seal ring grooves (15), scoring on inner bore (17), and wear. Repair minor burrs and scoring with crocus cloth. Valve body (16) bore (17) maximum I.D. is 1.1557 in. (29.355 mm) and valve body (16) minimum O.D. (14) is 2.0150 in. (51.181 mm). Replace valve body (16) if worn or unrepairable.
2. Inspect valve (13) for burrs, cracks, blocked oil passages (18), chipped or cracked seal ring groove, scoring, and wear. Spool valve (13) minimum O.D. (12) is 1.152 in. (29.26 mm). Remove minor burrs and scoring with crocus cloth and clear blocked oil passages (18). Replace valve (13) if worn or unrepairable.
3. Inspect stub shaft (9) for bends, cracks, breaks, damaged pin (12), bent or twisted splines (11), and worn bearing journal (10). Bearing journal (10) minimum O.D. is 1.25 in. (31.75 mm). Replace stub shaft (9) if worn or damaged.
4. Inspect worm (19) for bends, breaks, burrs, chipped thread (20), and scoring. Remove minor burrs and scoring with fine mill file or crocus cloth. Replace worm (19) if damage is unrepairable. (Refer to note before step e.1.)
5. Inspect adjuster plug (21) for cracks, breaks, crossed or stripped threads, chipped retainer grooves, and seal ring surface. Replace plug (21) if damaged.
6. Inspect adjuster plug needle bearing (22) for damage (TM 9-214) and wear. Replace needle bearing (22) if damaged or I.D. worn over 1.25 in. (31.75 mm). If damaged or worn, replace needle bearing (22) as follows.
   a. Using adjuster plug bearing remover/installer, remove bearing (22) from adjuster plug (21).
   b. Lubricate adjuster plug (21) and bearing (22) with hydraulic fluid.
   c. Using adjuster plug bearing remover/installer, install bearing (22) 0.625 in.(16 mm) deep in adjuster plug (21).
7. Inspect adjuster plug locknut (23) for cracks, burred flats or notches, and stripped or crossed threads. Replace locknut (23) if damaged.

**NOTE**

Outer edge of bearing is marked with identification number.

8. Inspect bearing retainer (24), thrust bearing spacer (25), small race (26), upper thrust bearing (27), and large race (28) for damage (TM 9-214). Replace all items if one item is damaged.
9. Inspect lower thrust bearing (30) and two races (29) for damage (TM 9-214). Replace all items if any one is damaged.

## 11-5. STEERING GEAR REPAIR (Cont'd)



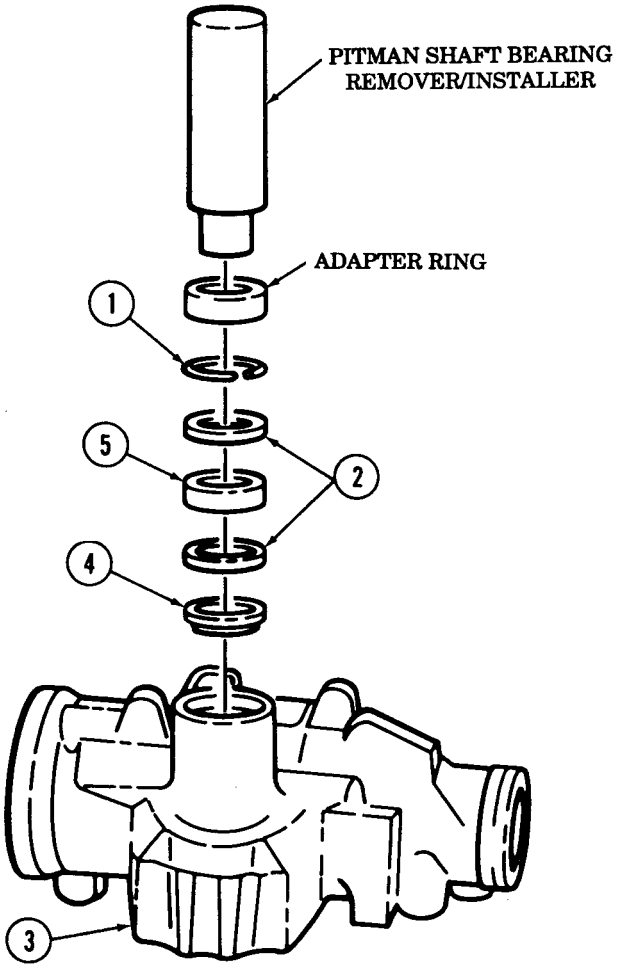
## 11-5. STEERING GEAR REPAIR (Cont'd)

**g. Assembly**

**NOTE**

For general assembly instructions, refer to para. 2-16.

1. Using pitman shaft bearing remover/installer and adapter ring, install single-lip seal (4) and one washer (2) in housing (3) only far enough to provide clearance for next seal (5) and washer (2).
2. Using pitman shaft bearing remover/installer and adapter ring, install double-lip seal (5) and second washer (2) in housing (3) only far enough to provide clearance for retaining ring (1).
3. Install retaining ring (1) in housing (3).




**NOTE**

Soak teflon ring in warm water to ease assembly.

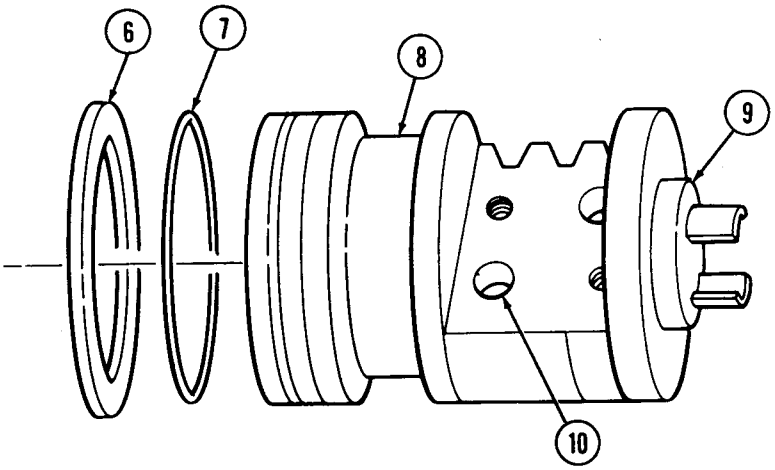
4. Install O-ring seal (7) and teflon ring (6) on rack piston (8).
5. Install worm shaft (9) in rack piston (8).
6. Align lower ball return guide hole (10) with worm shaft groove.
7. Alternately install eight each black and chrome bearing balls (11) into lower guide hole (10) while rotating worm shaft (9) counterclockwise.

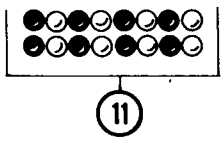
## 11-5. STEERING GEAR REPAIR (Cont'd)

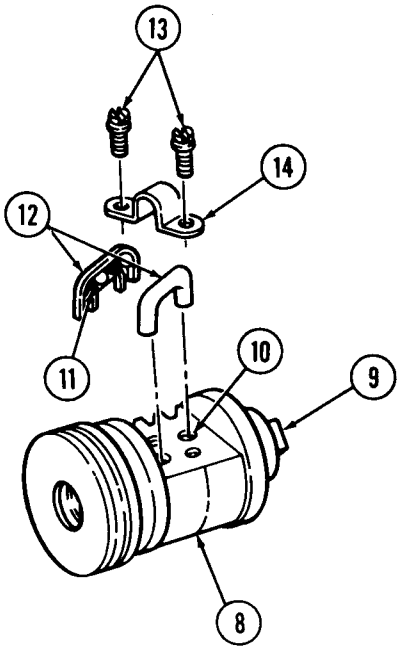
**NOTE**

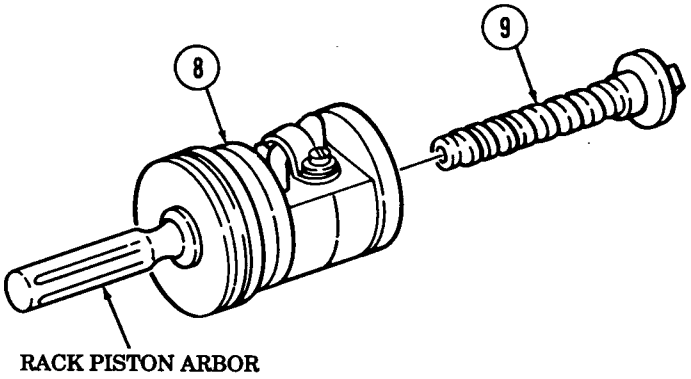
Keep bearing balls in alternating sequence when installing guide in rack piston. Ensure a total of 24 bearing balls are used.

8. Install eight remaining bearing balls (11) in guide (12) half and retain with grease.
9. Assemble both guide (12) halves together and install guide (12) in guide holes (10).
10. Install clamp (14) over guide (12) with two screw-assembled washers (13). Tighten screw-assembled washers (13) to 4 lb-ft (5 N•m).
11. Rotate worm shaft (9) clockwise until flush with rack piston (8).
12. Install rack piston arbor into rack piston (8) and hold firmly against worm shaft (9). Remove worm shaft (9).



## 11-5. STEERING GEAR REPAIR (Cont'd)

**NOTE**

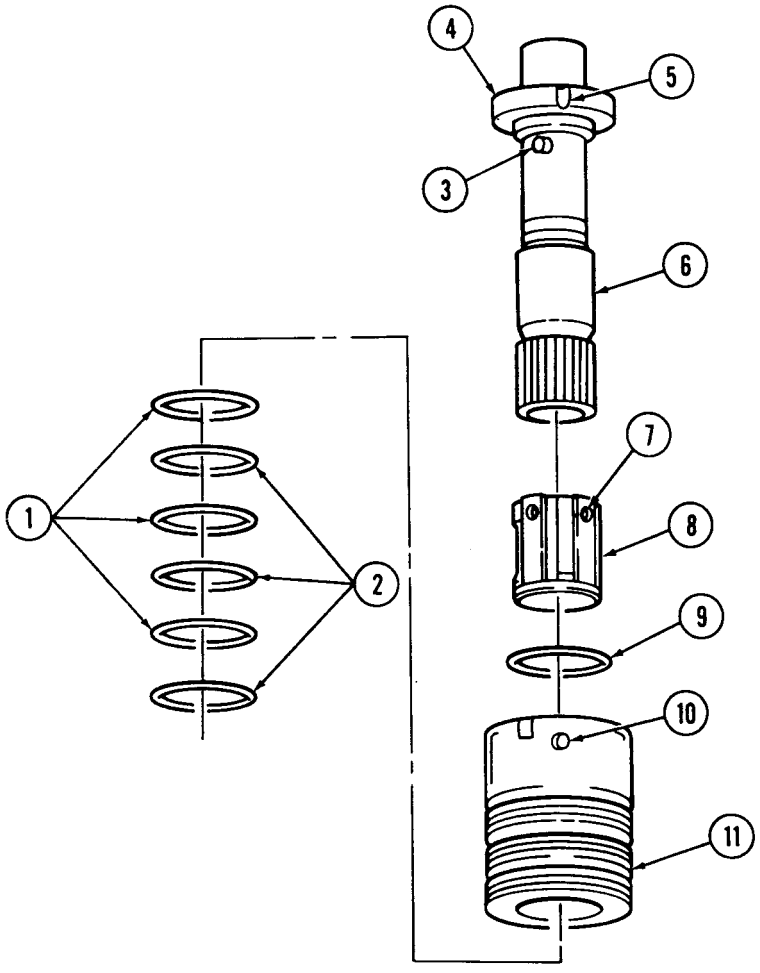
Soak teflon rings in warm water to ease assembly.

13. Starting on inner seal ring groove, install O-ring seal (2) and a backup teflon ring (1) on valve body (11).
14. Repeat step 13 in order from innermost seal ring groove and install two remaining O-rings (2) and teflon rings (1) on valve body (11).

**NOTE**

Rotate valve spool to install in valve.

15. Install O-ring (9) on valve spool (8) and install valve (8) into valve body (11) until flush with notched end of valve body (11).
16. Install stub shaft (6) in valve spool (8) so pin (3) on stub shaft (6) engages hole (7) in valve spool (8).
17. Align notch (5) in stub shaft cap (4) with pin (10) in valve body (11) and press stub shaft (6) and valve spool (8) into valve body (11).



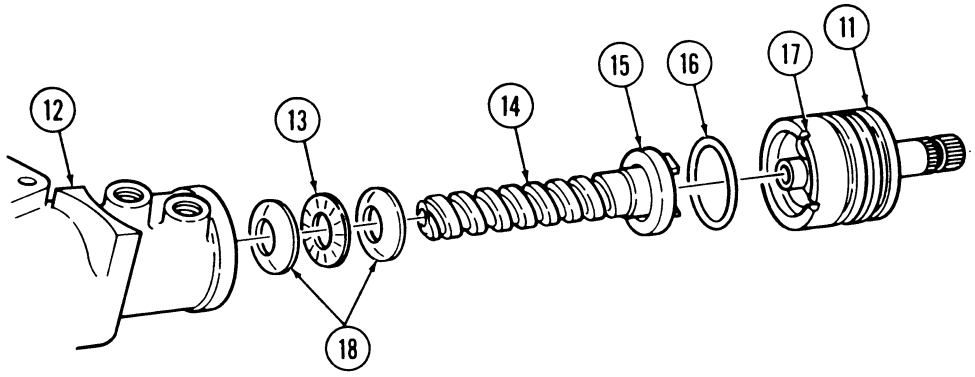
## 11-5. STEERING GEAR REPAIR (Cont'd)

18. Install O-ring (16) in valve body (11).
19. Insert worm shaft (14) into valve body (11).
20. Engage locating pin (15) on worm shaft (14) with slot (17) in valve body (11).

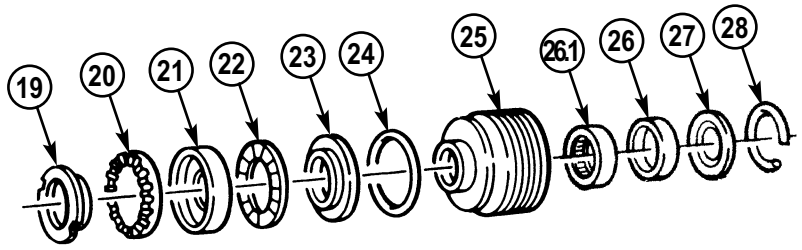
**NOTE**

Coned surface of races face toward housing.

21. Install lower thrust bearing race (18), lower thrust bearing (13), and lower thrust bearing race (18) on worm shaft (14).
22. Install assembled valve body (11) and worm shaft (14) into housing (12).

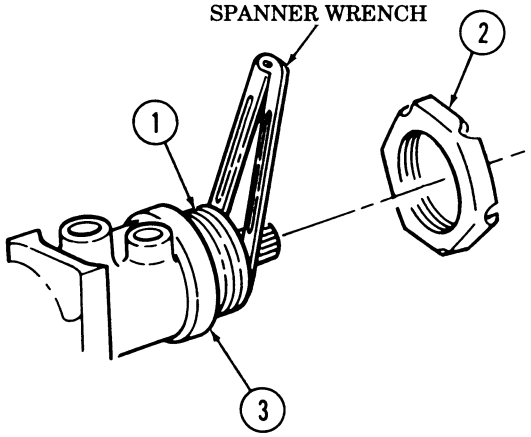


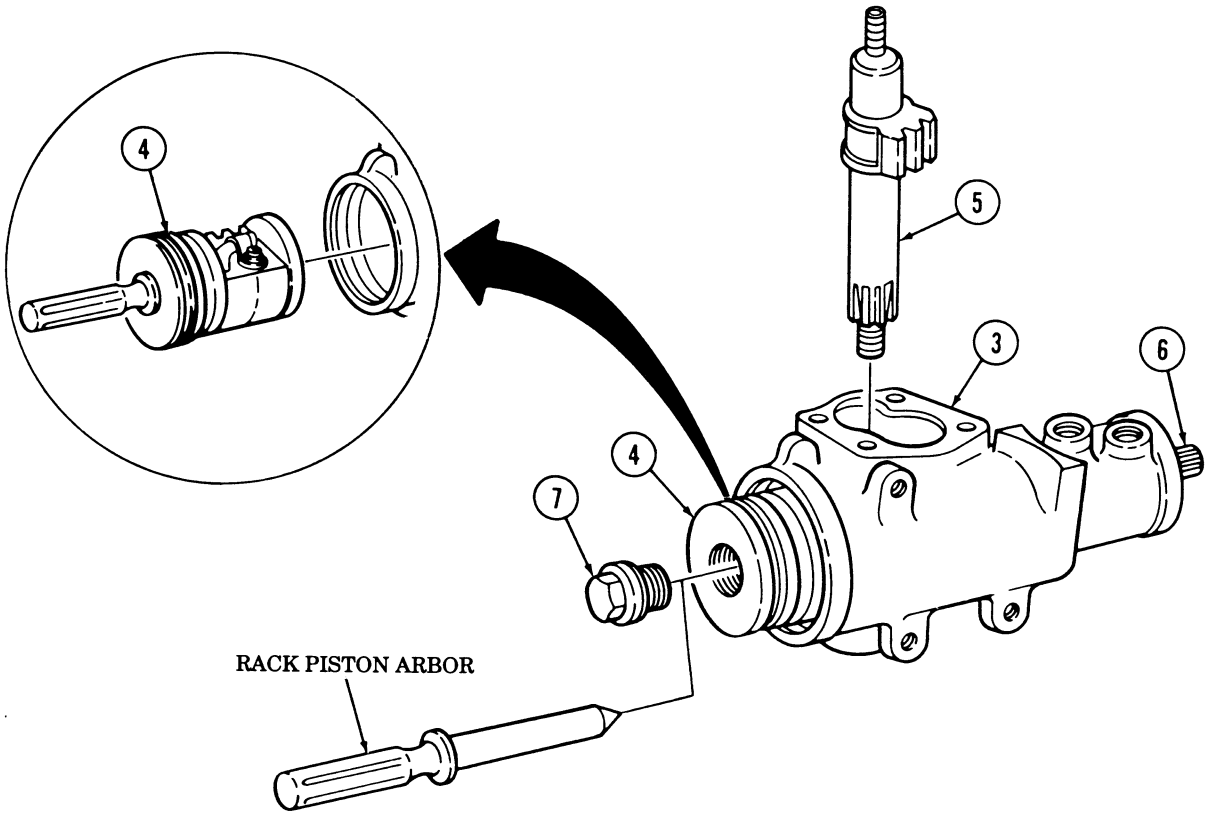

23. Install O-ring seal (24), large upper bearing race (23), upper thrust bearing (22), small upper bearing race (21), thrust bearing spacer (20), and bearing retainer (19) on adjuster plug (25). Press retainer (19) onto adjuster plug (25) with a brass drift.
24. Install bearing (26.1) and stub shaft oil seal (26) in adjuster plug (25). Install far enough to provide clearance for dust seal (27) and retaining ring (28).
25. Install stub shaft dust seal (27) and retaining ring (28) in adjuster plug (25).



## 11-5. STEERING GEAR REPAIR (Cont'd)

26. Using spanner wrench, install adjuster plug (1) in housing (3). Do not tighten.
27. Install locknut (2) over adjuster plug (1). Do not tighten.
28. Install rack piston (4) and rack piston arbor into gear housing (3) so gear teeth on rack piston (4) align with gear teeth on pitman shaft (5).
29. Hold rack piston arbor tightly against rack piston (4) while turning stub shaft (6) clockwise. Remove rack piston arbor.
30. Install rack piston plug (7) into rack piston (4). Do not tighten.
31. Center rack piston (4) and install pitman shaft (5) in housing (3).
32. Tighten rack piston plug (7) to 75 lb-ft (102 N•m).



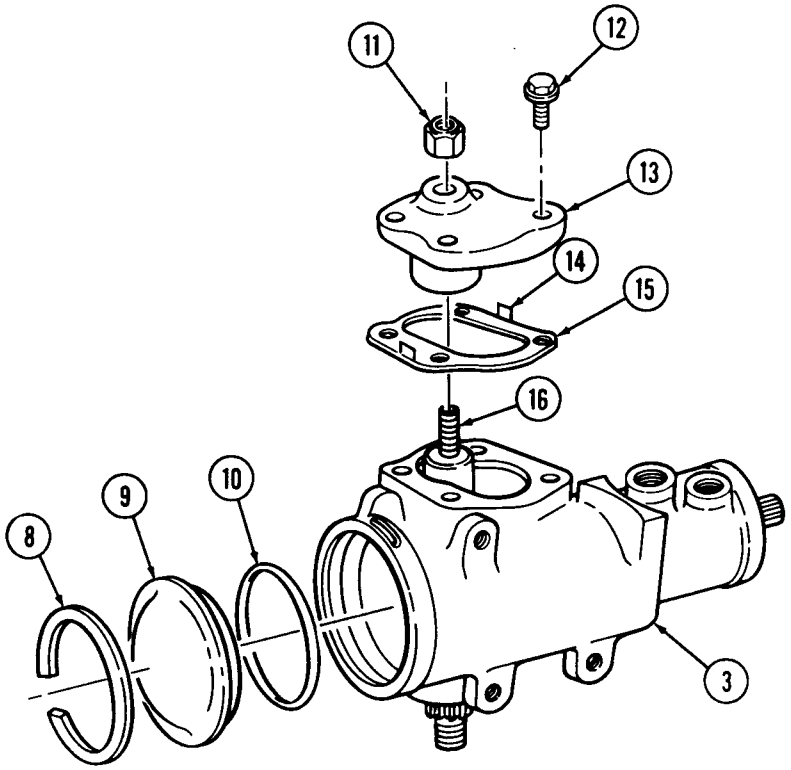
## 11-5. STEERING GEAR REPAIR (Cont'd)

33. Install housing end plug O-ring seal (10) and housing end plug (9) in housing (3).

**NOTE**

Opening in retaining ring should be located approximately 1 in. (25 mm) from access hole.

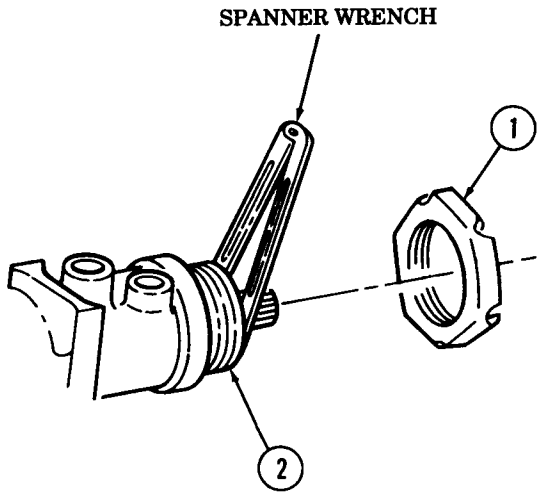
34. Install retaining ring (8) in housing (3).
35. Install side cover gasket (15) on side cover (13) by bending tabs (14) around side cover (13) edge.
36. Screw side cover (13) onto adjuster screw (16).
37. Install four capscrews (12) on side cover (13). Tighten capscrews (12) to 40 lb-ft (54 N•m).
38. Install lash adjuster nut (11) on pitman shaft adjuster screw (16).

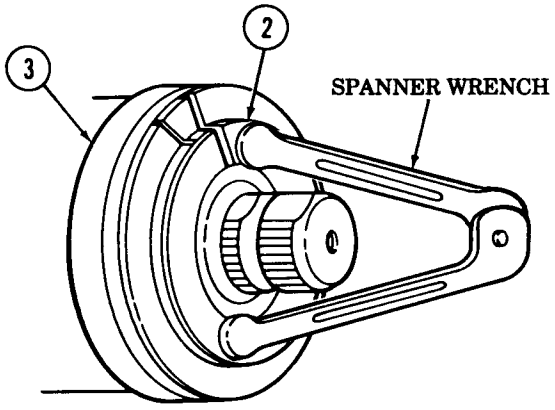


## 11-5. STEERING GEAR REPAIR (Cont'd)

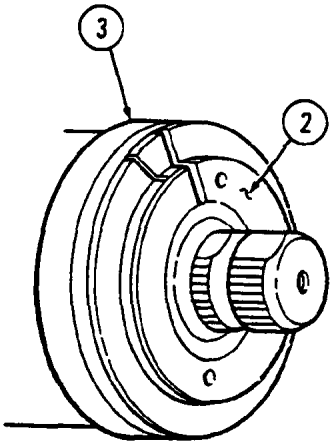
**h. Adjustment**

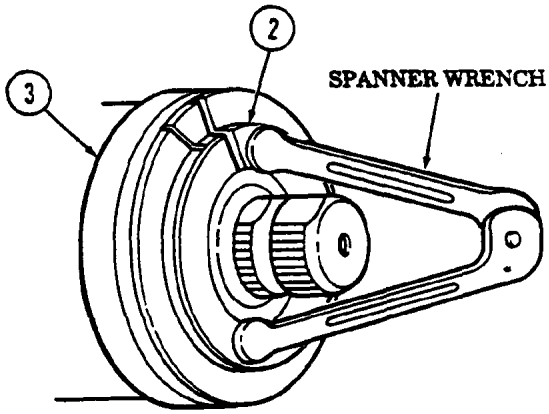
1. For worm shaft bearing preload adjustment, remove locknut (1).
2. Using spanner wrench, tighten adjuster plug (2) clockwise until thrust bearing is firmly bottomed.
3. Match mark housing (3) and adjuster plug (2) face.
4. Measure back counterclockwise 0.5 in. (13 mm) and place second mark on housing (3).
5. Turn adjuster plug (2) counterclockwise until mark on face of adjuster plug (2) aligns with second mark on housing (3).
6. Install locknut (1) on adjuster plug (2).
7. Hold adjuster plug (2) using spanner wrench and tighten locknut (1).
8. Turn stub shaft (7) clockwise to stop, then back one-quarter turn.
9. Check torque required to turn stub shaft (7). Reading should be 4-10 lb-in. (0.5-1 N•m).
10. If reading is not correct turn adjuster plug (2) in or out and repeat steps 7 through 9 until torque required to turn stub shaft (7) is 4-10 lb-in. (0.5-1 N•m).
11. For pitman shaft-over-center adjustment, loosen adjuster screw locknut (5).
12. Turn adjuster screw (4) counterclockwise until fully extended, then turn clockwise one full turn.
13. Rotate stub shaft (7) from stop to stop and count number of turns.
14. Back off stub shaft (7) one-half number of turns counted.
15. With gear centered, flat on stub shaft (7) will face upward and block tooth (6) should be in line with adjuster screw (4).
16. With gear at center of travel, check torque to turn stub shaft (7).
17. Turn adjuster screw (4) clockwise until torque to turn stub shaft (7) is 6-10 lb-in. (0.7-1 N•m) more than the reading obtained in step 16.
18. Hold adjuster screw (4) and tighten locknut (5) to 20 lb-ft (27 N•m).

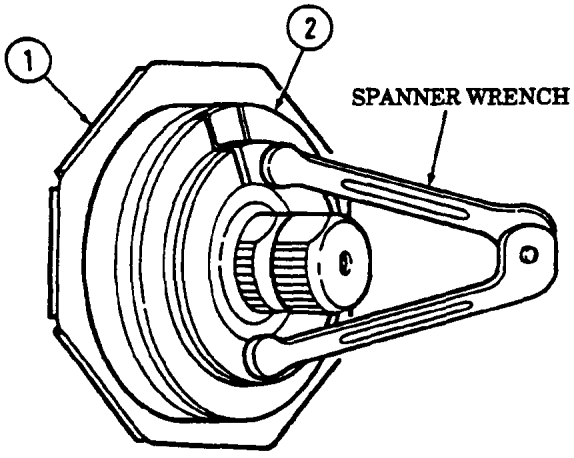


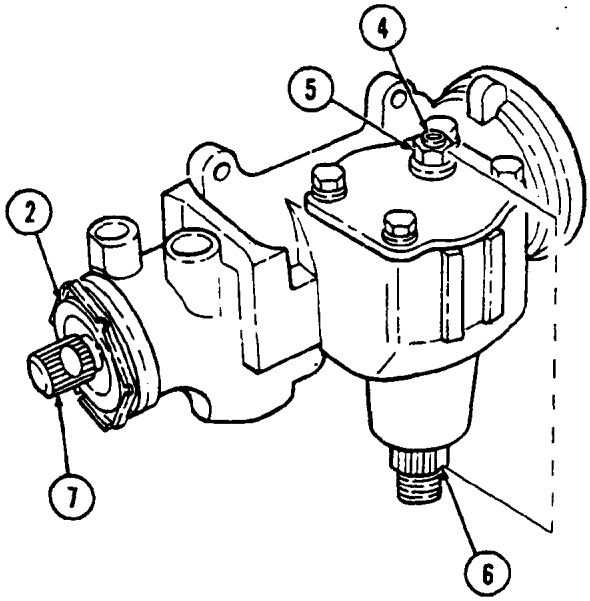



## 11-5. STEERING GEAR REPAIR (Cont'd)




FOLLOW-ON TASKS:
- Perform leak test (para. 11-4).
- Install steering gear (TM 9-2320-280-20).

# CHAPTER 12
# FRAME MAINTENANCE

## 12-1. INTRODUCTION

This chapter contains maintenance instructions for replacement and repair of frame components at the Direct Support maintenance level. Some subassemblies and parts must be removed before frame components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## 12-2. GENERAL

Refer to technical bulletin (TB 9-2300-247-40) for repairs on frames used on the M998 series vehicles. Refer to TM 9-2320-280-24P for authorized replacement parts used in frame repair.

## 12-3. FRAME MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 12-4. | Splash Shield Support Bracket Replacement | 12-2 |
| 12-5. | Spring Seat Replacement | 12-3 |
| 12-6. | Front Suspension Brace Replacement | 12-4 |
| 12-7. | Front Suspension Brace Replacement (Serial Numbers 100,000 and Above) | 12-6 |
| 12-8. | Left Airlift Bracket and Front Upper Control Arm Brackets Replacement | 12-8 |
| 12-9. | Right Airlift Bracket and Front Upper Control Arm Brackets Replacement | 12-10 |
| 12-10. | Right Engine Mount Bracket Replacement | 12-12 |
| 12-11. | Left Engine Mount Bracket Replacement | 12-14 |
| 12-12. | Rear Upper Control Arm Bracket Replacement | 12-16 |
| 12-13. | Rear-Rear Tiedown Bracket Replacement | 12-18 |
| 12-14 . | Transmission Crossmember Support Bracket Replacement | 12-19 |
| 12-15. | Rear-Front Tiedown Bracket Replacement | 12-20 |
| 12-16. | Differential Support Bracket and Side Mounting Bracket Replacement | 12-22 |
| 12-17. | Front Suspension Front Crossmember Replacement | 12-26 |
| 12-18. | Front Suspension Rear Crossmember Replacement | 12-28 |
| 12-19. | Rear Suspension Front Crossmember Replacement | 12-32 |
| 12-20. | Rear Suspension Rear Crossmember Replacement | 12-36 |
| 12-21. | Suspension Crossmember Repair | 12-38 |
| 12-22. | Deleted | |
| 12-23. | Deleted | |
| 12-24. | Deleted | |

# 12-4. SPLASH SHIELD SUPPORT BRACKET REPLACEMENT

**This task covers:**
**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Three locknuts (Appendix E, Item 65)

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-24P

**Equipment Condition**
Hood raised and secured (TM 9-2320-280-10).

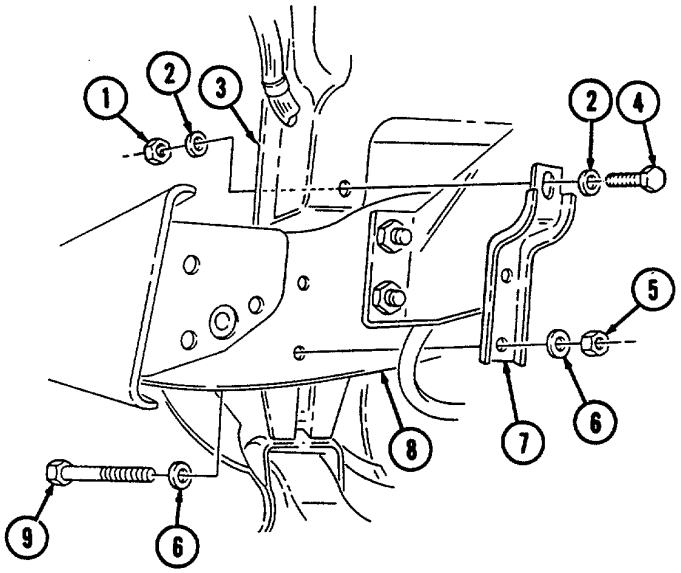
**Maintenance Level**
Direct support

## a. Removal

1. Remove locknut (1), washer (2), capscrew (4), and washer (2) securing splash shield (3) to bracket (7). Discard locknut (1).
2. Remove two locknuts (5), washers (6), capscrews (9), washers (6), and bracket (7) from frame rail (8). Discard locknuts (5).

## b. Installation

1. Install bracket (7) on frame rail (8) with two washers (6), capscrews (9), washers (6), and locknuts (5). Tighten locknuts (5) to 90 lb-ft (122 N•m).
2. Install splash shield (3) on bracket (7) with washer (2), capscrew (4), washer (2), and locknut (1). Tighten capscrew (4) to 15 lb-ft (20 N•m).




FOLLOW-ON TASK: Lower and secure hood (TM 9-2320-280-10).

## 12-5. SPRING SEAT REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**

Four locknuts (Appendix E, Item 66)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

Coil spring removed (TM 9-2320-280-20).

**Maintenance Level**

Direct support

### a. Removal

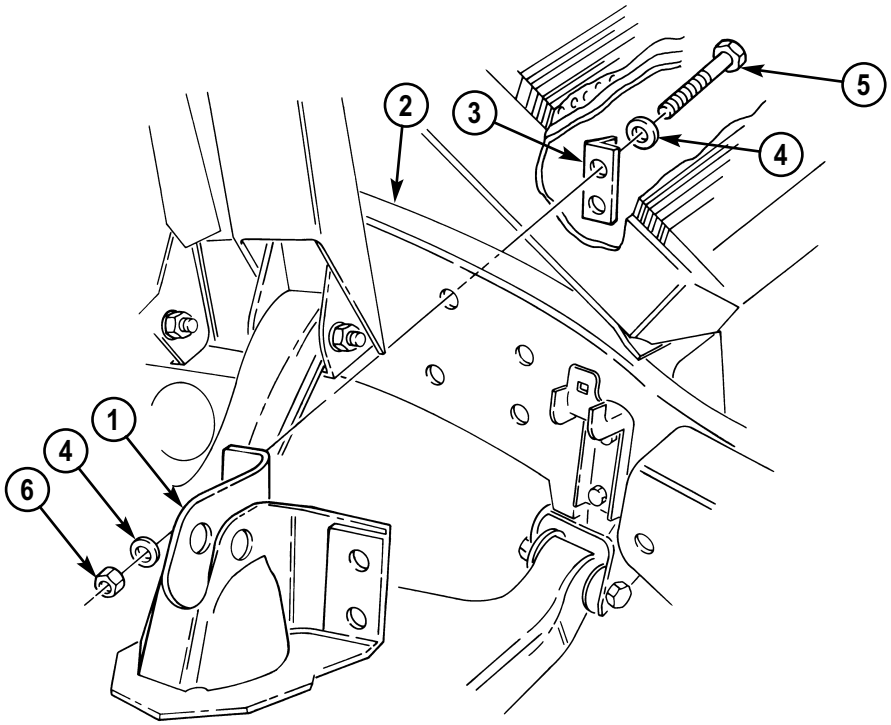
**NOTE**

The procedures for removing and installing the four spring seats are basically the same. This procedure covers the right front spring seat.

Remove four locknuts (6), washers (4), capscrews (5), washers (4), two spring brackets (3), and spring seat (1) from frame rail (2). Discard locknuts (6).

### b. Installation

Install two spring brackets (3) and spring seat (1) on frame rail (2) with four washers (4), capscrews (5), washers (4), and locknuts (6). Tighten locknuts (6) to 260 lb-ft (353 N•m).




FOLLOW-ON TASK: Install coil spring (TM 9-2320-280-20).

## 12-6. FRONT SUSPENSION BRACE REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
All models except M1026, M1026A1, M1036, M1038, M1038A1, M1042, M1044, M1044A1, M1046, M1046A1 (serial numbers 100,000 and above)

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two locknuts (Appendix E, Item 65)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Winch removed (TM 9-2320-280-20).

**General Safety Instructions**
Lower control arm must be supported during removal and installation.

**Maintenance Level**
Direct support

**WARNING**

Lower control arm must be supported during removal and installation. Failure to support lower control arm may cause injury to personnel or damage to equipment.

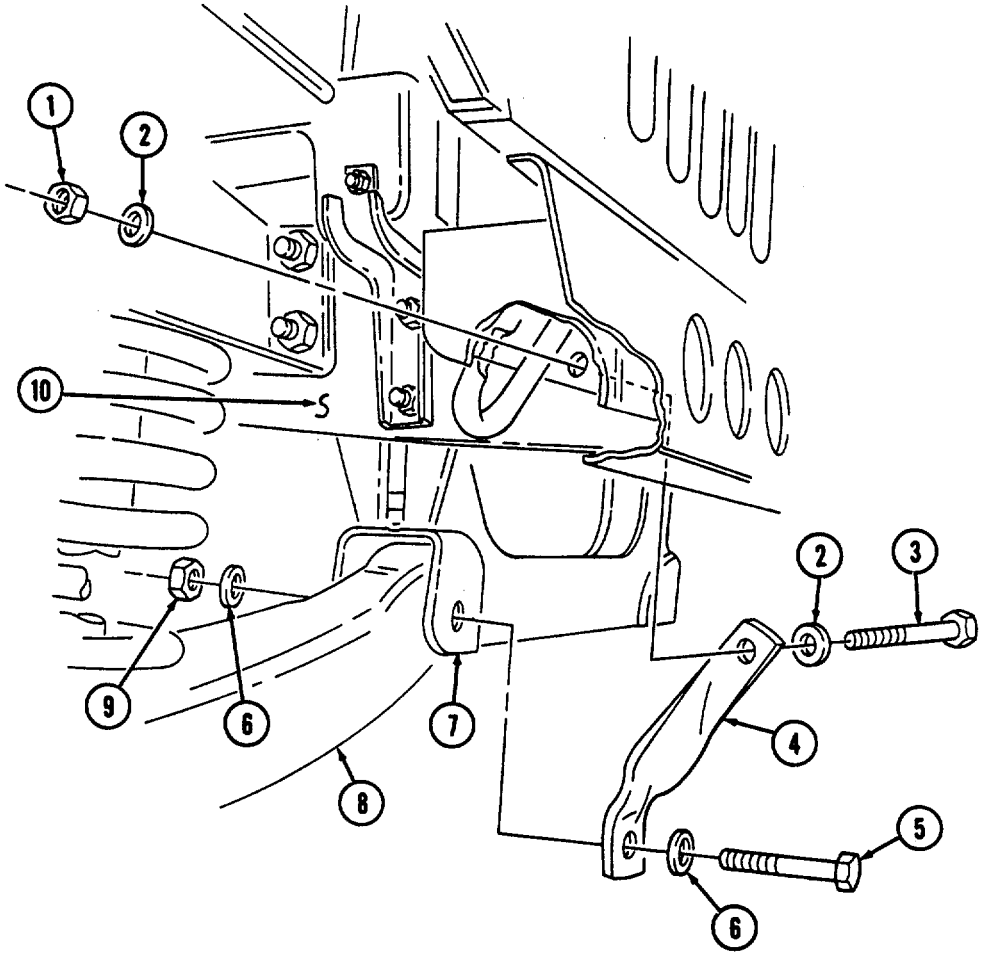
### a. Removal

1. Remove locknut (1), washer (2), capscrew (3), and washer (2) from brace (4) and frame rail (10). Discard locknut (1).
2. Remove locknut (9), washer (6), capscrew (5), washer (6), and brace (4) from lower control arm (8) and crossmember (7). Discard locknut (9).

### b. Installation

1. Install brace (4) on crossmember (7) and lower control arm (8) with washer (6), capscrew (5), washer (6), and locknut (9).
2. Install brace (4) on frame rail (10) with washer (2), capscrew (3), washer (2), and locknut (1).
3. Tighten locknut (9) to 260 lb-ft (353 N•m) and locknut (1) to 178 lb-ft (241 N•m).

## 12-6. FRONT SUSPENSION BRACE REPLACEMENT (Cont'd)




FOLLOW-ON TASK: Install winch (TM 9-2320-280-20).

## 12-7. FRONT SUSPENSION BRACE REPLACEMENT (SERIAL NUMBERS 100,000 AND ABOVE)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M1026, M1026A1, M1036, M1038, M1038A1, M1042, M1044, M1044A1, M1046, M1046A1 (serial numbers 100,000 and above)

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Three locknuts (Appendix E, Item 63)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Winch removed (TM 9-2320-280-20).

**General Safety Instructions**
Lower control arm must be supported during removal and installation.

**Maintenance Level**
Direct support

**WARNING**

Lower control arm must be supported during removal and installation. Failure to support lower control arm may cause injury to personnel or damage to equipment.

**NOTE**

The procedures for removing and installing the left and right front suspension braces are the same. This procedure covers the left front suspension brace.

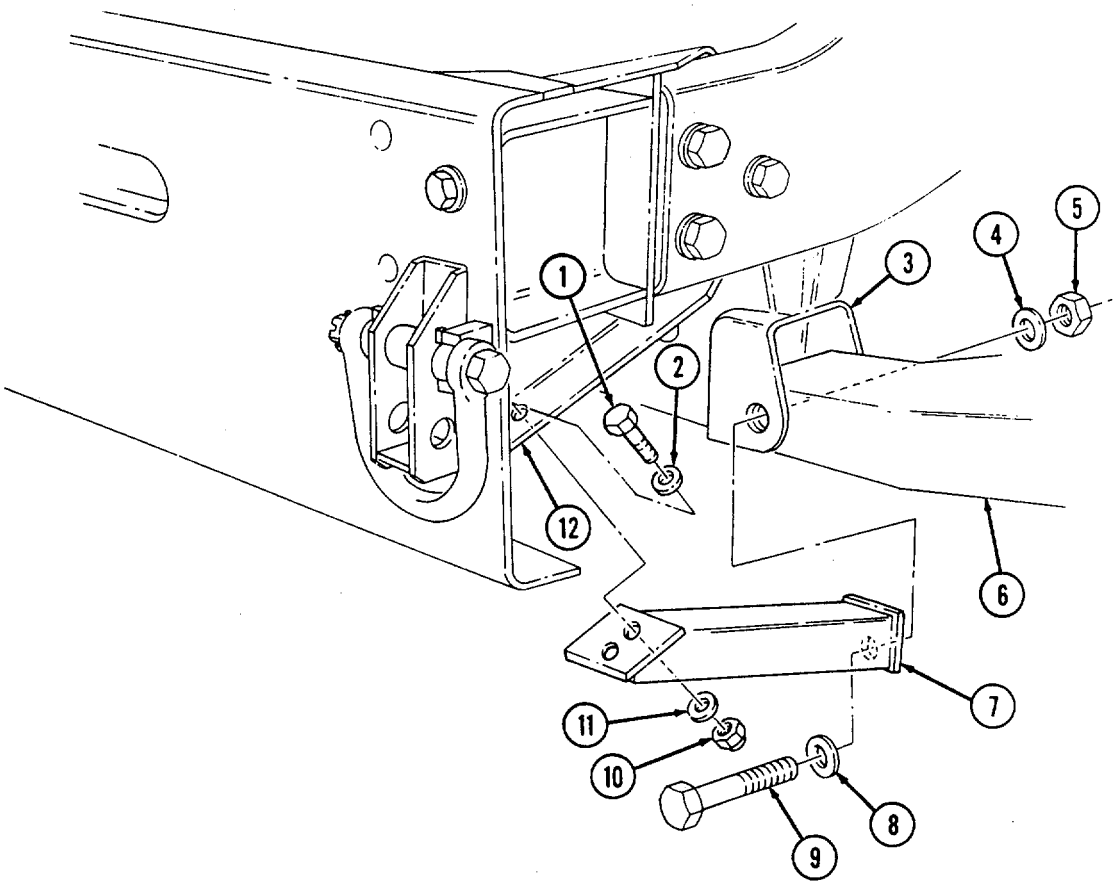
### a. Removal

1. Remove two locknuts (10), washers (11), capscrews (1), and washers (2) from brace (7) and frame extension (12). Discard locknuts (10).
2. Remove locknut (5), washer (4), capscrew (9), washer (8), and brace (7) from lower control arm (6) and crossmember (3). Discard locknut (5).

### b. Installation

1. Install brace (7) on crossmember (3) and lower control arm (6) with washer (8), capscrew (9), washer (4), and locknut (5). Do not tighten locknut (5).
2. Install brace (7) on frame extension (12) with two washers (2), capscrews (1), washers (11), and locknuts (10). Do not tighten locknuts (10).
3. Tighten locknut (5) to 260 lb-ft (353 N•m) and two locknuts (10) to 178 lb-ft (241 N•m).

## 12-7. FRONT SUSPENSION BRACE REPLACEMENT (SERIAL NUMBERS 100,000 AND ABOVE) (Cont'd)




FOLLOW-ON TASK: Install winch (TM 9-2320-280-20).

## 12-8. LEFT AIRLIFT BRACKET AND FRONT UPPER CONTROL ARM BRACKETS REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Two locknuts (Appendix E, Item 63)
Eight locknuts (Appendix E, Item 65)
Two locknuts (Appendix E, Item 66)
Sealing compound (Appendix B, Item 50)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Left engine splash shield removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**NOTE**

Vehicles with serial numbers 100,000 and above have new, reinforced airlift brackets. Previous model airlift brackets will be used on vehicles with serial numbers 99,999 and below only. Refer to vehicle serial number before ordering replacement parts.

### a. Removal

1. Raise and support front of vehicle.
2. Remove three screws (9), clamps (7), and harness (8) from airlift bracket (5).
3. Remove two locknuts (2), washers (3), and capscrews (6) from radiator support (4) and airlift bracket (5). Discard locknuts (2).
4. Remove two locknuts (12), washers (13), capscrews (18), washers (13), and disconnect upper control arm (15) from two control arm brackets (16). Discard locknuts (12).

**NOTE**

Note direction of capscrews for installation.

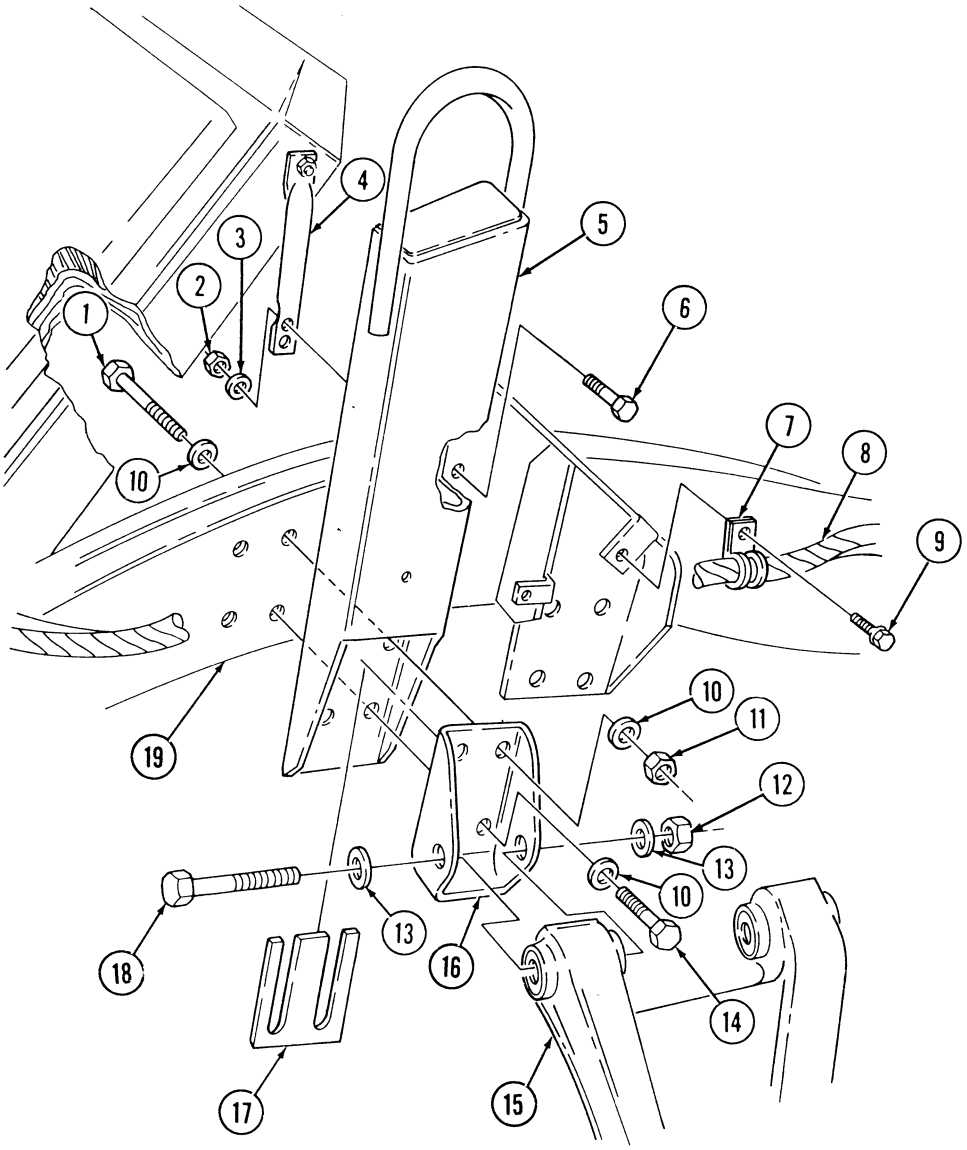
5. Remove eight locknuts (11), washers (10), capscrews (1), and washers (10) from two control arm brackets (16), airlift bracket (5), and frame rail (19). Discard locknuts (11).
6. Remove four capscrews (14), washers (10), control arm brackets (16), shims(s) (17) if present, and airlift bracket (5) from frame rail (19).

### b. Installation

1. Install airlift bracket (5), shim(s) (17) if removed, and two control arm brackets (16) on frame rail (19) with eight washers (10), capscrews (1), washers (10), and locknuts (11). Tighten locknuts (11) to 90 lb-ft (122 N•m).
2. Apply sealing compound to threads of two capscrews (14).
3. Secure airlift bracket (5) and two control arm brackets (16) on frame rail (19) with four washers (10) and capscrews (14). Tighten capscrews (14) to 90 lb-ft (122 N•m).
4. Install upper control arm (15) on two control arm brackets (16) with two washers (13), capscrews (18), washers (13), and locknuts (12). Tighten locknuts (12) to 260 lb-ft (353 N•m).

## 12-8. LEFT AIRLIFT BRACKET AND FRONT UPPER CONTROL ARM BRACKETS REPLACEMENT (Cont'd)

5. Install radiator support (4) on airlift bracket (5) with two capscrews (6), washers (3), and locknuts (2). Tighten locknuts (2) to 37 lb-ft (50 N•m).
6. Install harness (8) on airlift bracket (5) with three clamps (7) and screws (9).
7. Lower front of vehicle.




FOLLOW-ON TASKS: • Check alignment (TM 9-2320-280-20).
• Install left engine splash shield (TM 9-2320-280-20).

# 12-9. RIGHT AIRLIFT BRACKET AND FRONT UPPER CONTROL ARM BRACKETS REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Equipment Condition**
Right engine splash shield removed (TM 9-2320-280-20).

**Materials/Parts**
Two locknuts (Appendix E, Item 63)
Eight locknuts (Appendix E, Item 65)
Two locknuts (Appendix E, Item 66)

**Maintenance Level**
Direct support

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**NOTE**

Vehicles with serial numbers 100,000 and above have new, reinforced airlift brackets. Previous model airlift brackets will be used on vehicles with serial numbers 99,999 and below only. Refer to vehicle serial number before ordering replacement parts.

**a. Removal**

1. Raise and support front of vehicle.
2. Remove two locknuts (9), washers (10), and capscrews (4), from radiator support (8) and airlift bracket (5). Discard locknuts (9).
3. Remove two locknuts (16), washers (14), capscrews (12), washers (14), and disconnect upper control arm (15) from two control arm brackets (3). Discard locknuts (16).

**NOTE**

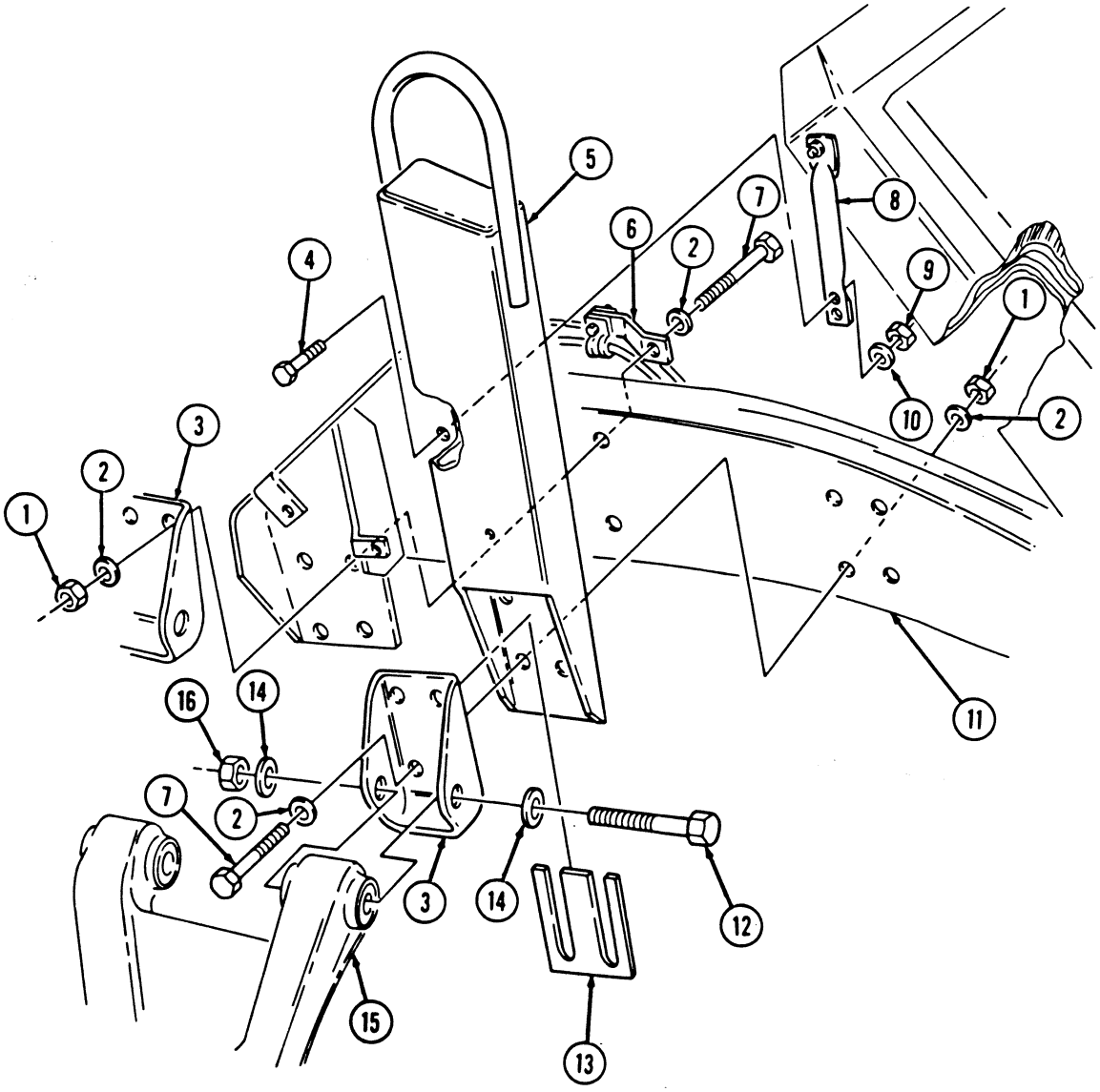
Note direction of capscrews for installation.

4. Remove eight locknuts (1), washers (2), capscrews (7), washers (2), control arm brackets (3), shim(s) (13) if present, cooler line bracket (6), and airlift bracket (5) from frame rail (11). Discard locknuts (1).

**b. Installation**

1. Install airlift bracket (5), shim(s) (13) if removed, two control arm brackets (3), and cooler line bracket (6) on frame rail (11) with eight washers (2), capscrews (7), washers (2), and locknuts (1). Tighten locknuts (1) to 90 lb-ft (122 N•m).
2. Install upper control arm (15) on two control arm brackets (3) with two washers (14), capscrews (12), washers (14), and locknuts (16). Tighten locknuts (16) to 260 lb-ft (353 N•m).
3. Install radiator support (8) on airlift bracket (5) with two capscrews (4), washers (10), and locknuts (9). Tighten locknuts (9) to 37 lb-ft (50 N•m).
4. Lower front of vehicle.

## 12-9. RIGHT AIRLIFT BRACKET AND FRONT UPPER CONTROL ARM BRACKETS REPLACEMENT (Cont'd)




FOLLOW-ON TASKS:
- Check alignment (TM 9-2320-280-20).
- Install right engine splash shield (TM 9-2320-280-20).

## 12-10. RIGHT ENGINE MOUNT BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Five locknuts (Appendix E, Item 65)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Engine right mount and insulator removed (para. 3-3).

**Maintenance Level**
Direct support

### a. Removal

**NOTE**

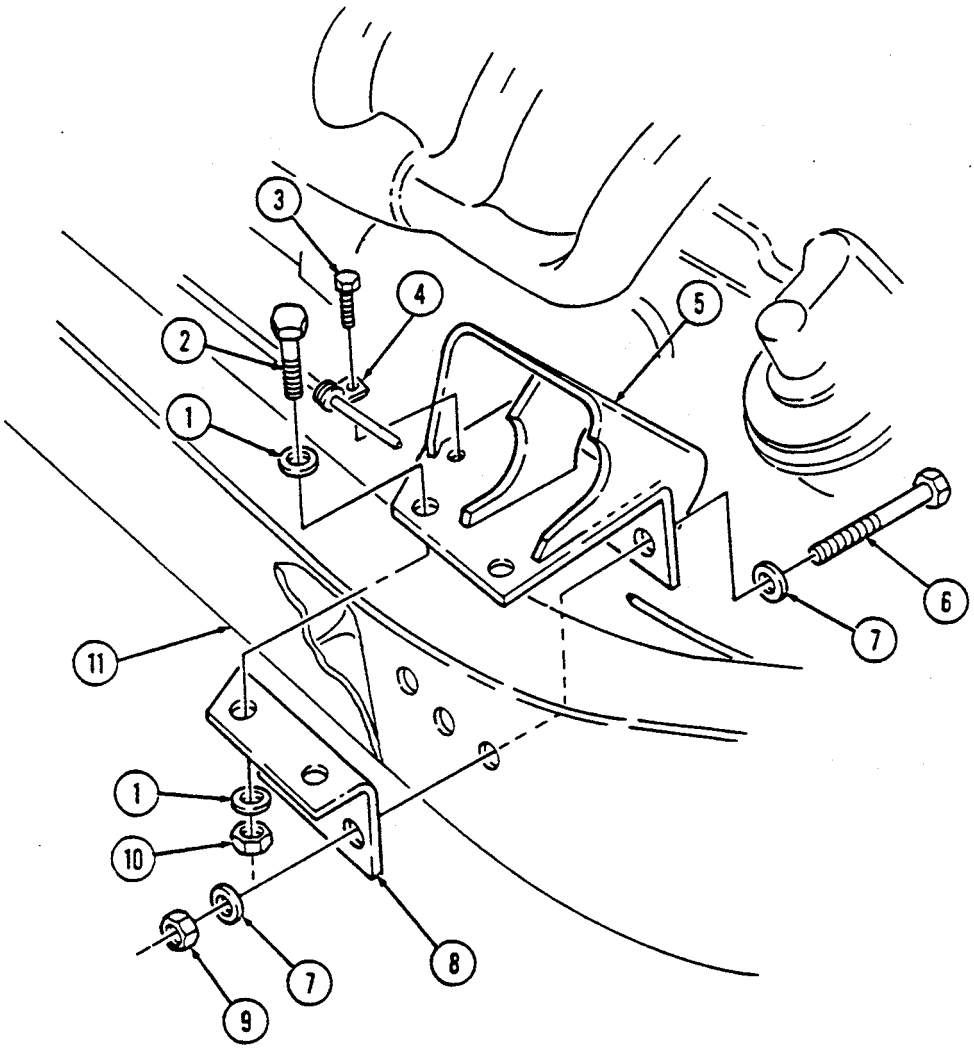
Tag engine mounts for assembly. The left and right engine mounts are not interchangeable with each other.

1. Remove two locknuts (10), washers (1), capscrews (2), and washers (1) from support bracket (8) and engine mount bracket (5). Discard locknuts (10).
2. Remove capscrew (3) and vent tube clamp (4) from engine mount bracket (5).
3. Remove three locknuts (9), washers (7), capscrews (6), washers (7), support bracket (8), and engine mount bracket (5) from frame rail (11). Discard locknuts (9).

### b. Installation

1. Install support bracket (8) and engine mount bracket (5) on frame rail (11) with three washers (7), capscrews (6), washers (7), and locknuts (9).
2. Secure support bracket (8) on engine mount bracket (5) with two washers (1), capscrews (2), washers (1), and locknuts (10). Tighten locknuts (10) and (9) to 90 lb-ft (122 N•m).
3. Install vent tube clamp (4) on engine mount bracket (5) with capscrew (3).

## 12-10. RIGHT ENGINE MOUNT BRACKET REPLACEMENT (Cont'd)




FOLLOW-ON TASK: Install engine right mount and insulator (para. 3-3).

## 12-11. LEFT ENGINE MOUNT BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Six locknuts (Appendix E, Item 65)

**Manual References**
TM 9-2320-280-24P

**Maintenance Level**
Direct support

### a. Removal

**NOTE**

Tag engine mounts for assembly. The left and right engine mounts are not interchangeable with each other.

1. Remove two capscrews (2), brake line clamp (1), and oil line clamp (3) from engine mount bracket (4).
2. Remove two locknuts (7) and washers (6) from insulator (5) and engine mount bracket (4). Discard locknuts (7).

**CAUTION**

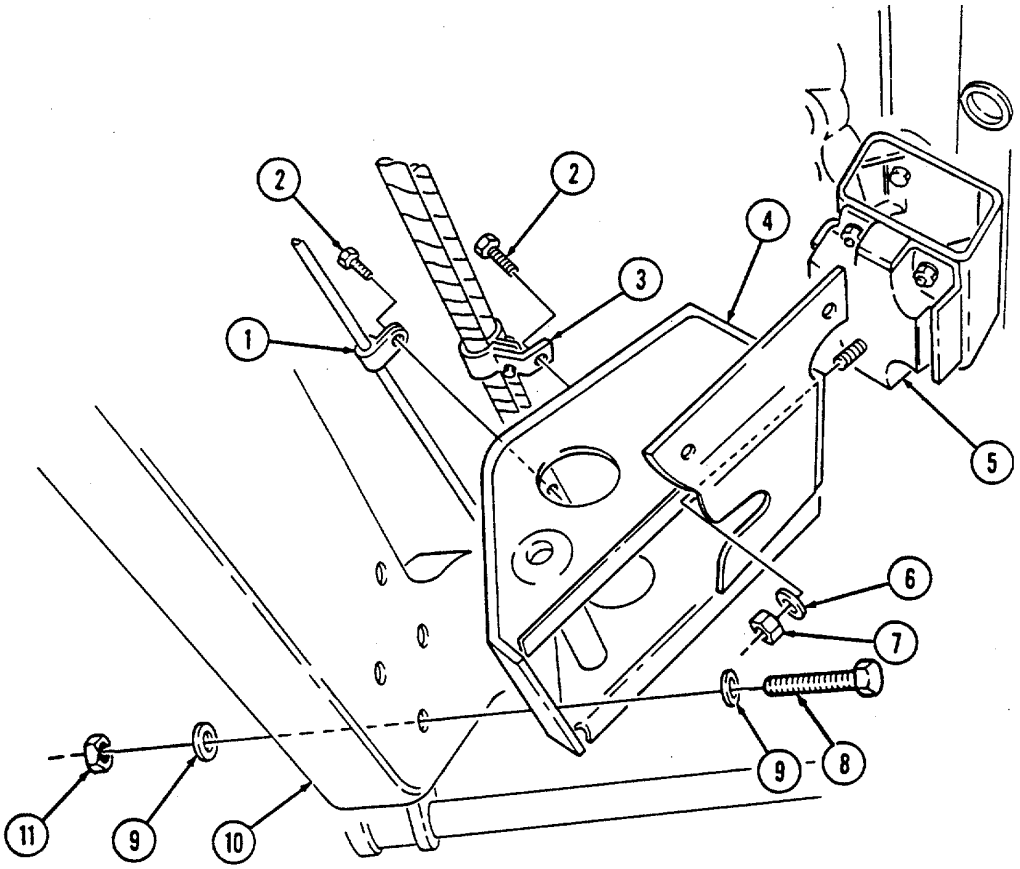
Wood block must completely cover bottom of engine oil pan or damage to oil pan may result.

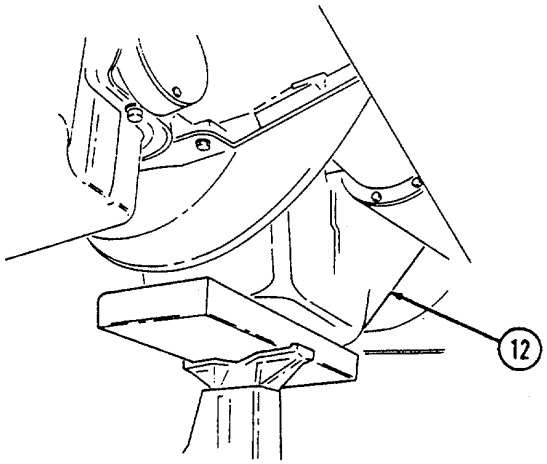
3. Support engine under engine oil pan (12) with wood block and jack.
4. Remove four locknuts (11), washers (9), capscrews (8), washers (9), and engine mount bracket (4) from frame rail (10). Discard locknuts (11).

### b. Installation

1. Install engine mount bracket (4) on frame rail (10) with four washers (9), capscrews (8), washers (9), and locknuts (11). Tighten locknuts (11) to 90 lb-ft (122 N•m).
2. Remove support from engine oil pan (12).
3. Install engine mount bracket (4) on insulator (5) with two washers (6) and locknuts (7). Tighten locknuts (7) to 90 lb-ft (122 N•m).
4. Install brake line clamp (1) and oil line clamp (3) on engine mount bracket (4) with two capscrews (2).

## 12-11. LEFT ENGINE MOUNT BRACKET REPLACEMENT (Cont'd)



## 12-12. REAR UPPER CONTROL ARM BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Two locknuts (Appendix E, Item 66)
Four locknuts (Appendix E, Item 65)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Wheel removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**NOTE**

The procedures for removing and installing the four rear upper control arm brackets are basically the same. This procedure covers the right rear upper control arm front bracket.

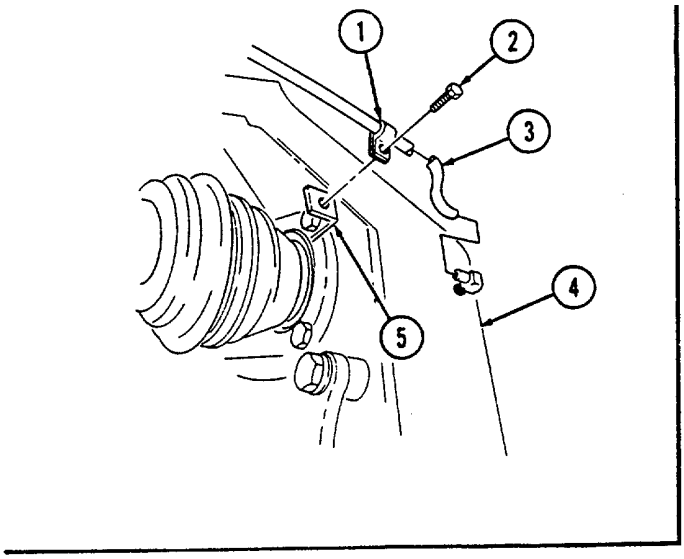
### a. Removal

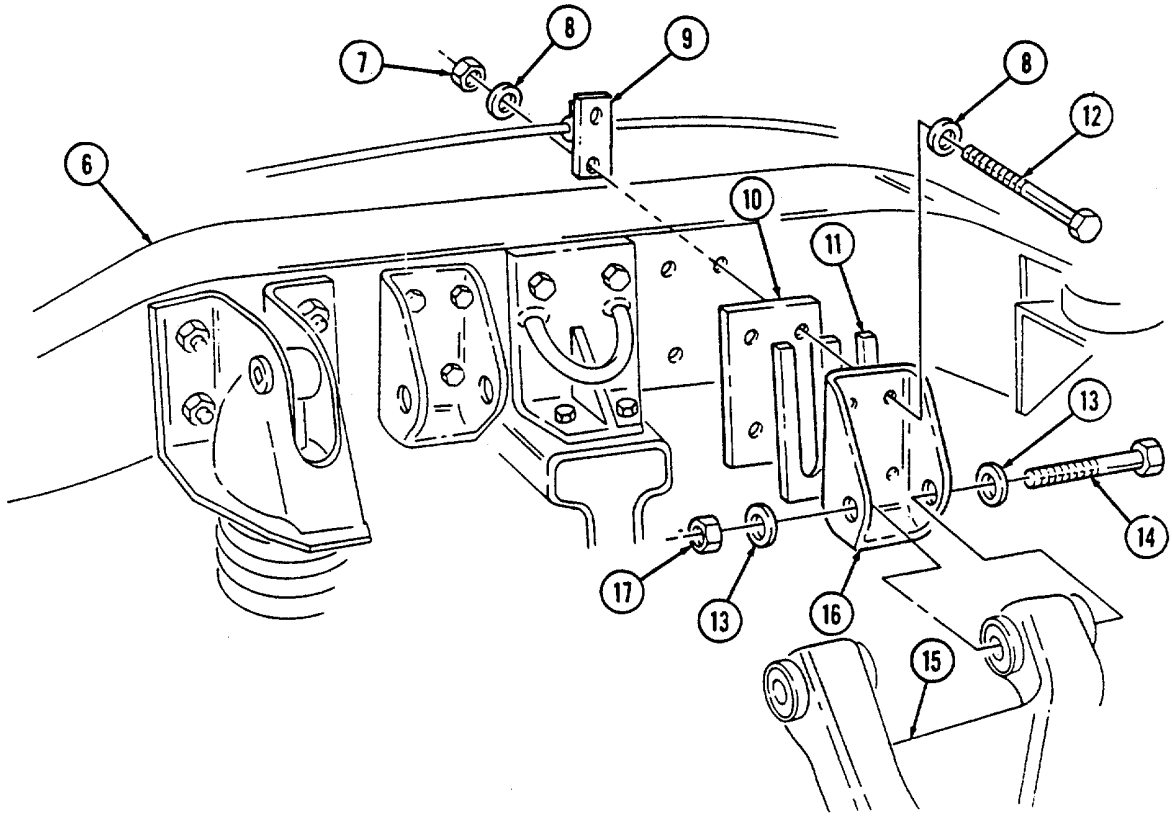
1. Remove capscrew (2) and clamp (1) from bracket (5) and disconnect vent line (3) from geared hub (4).
2. Remove two locknuts (17), washers (13), capscrews (14), washers (13), and upper control arm (15) from two control arm brackets (16). Discard locknuts (17).
3. Remove four locknuts (7), washers (8), capscrews (12), washers (8), spacer (10), shim(s) (11) if present, vent line mounting bracket (9), and control arm bracket (16) from frame rail (6). Discard locknuts (7).

### b. Installation

1. Install shim(s) (11) if removed, spacer (10), vent line bracket (9), and control arm bracket (16) on frame rail (6) with four washers (8), capscrews (12), washers (8), and locknuts (7). Tighten locknuts (7) to 90 lb-ft (122 N•m).
2. Install upper control arm (15) on two upper control arm brackets (16) with two washers (13), capscrews (14), washers (13), and locknuts (17). Tighten locknuts (17) to 260 lb-ft (353 N•m).
3. Connect vent line (3) to geared hub (4) and install clamp (1) on bracket (5) with capscrew (2).

## 12-12. REAR UPPER CONTROL ARM BRACKET REPLACEMENT (Cont'd)




FOLLOW-ON TASK: Install wheel (TM 9-2320-280-20).

## 12-13. REAR-REAR TIEDOWN BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Maintenance Level**
Direct support

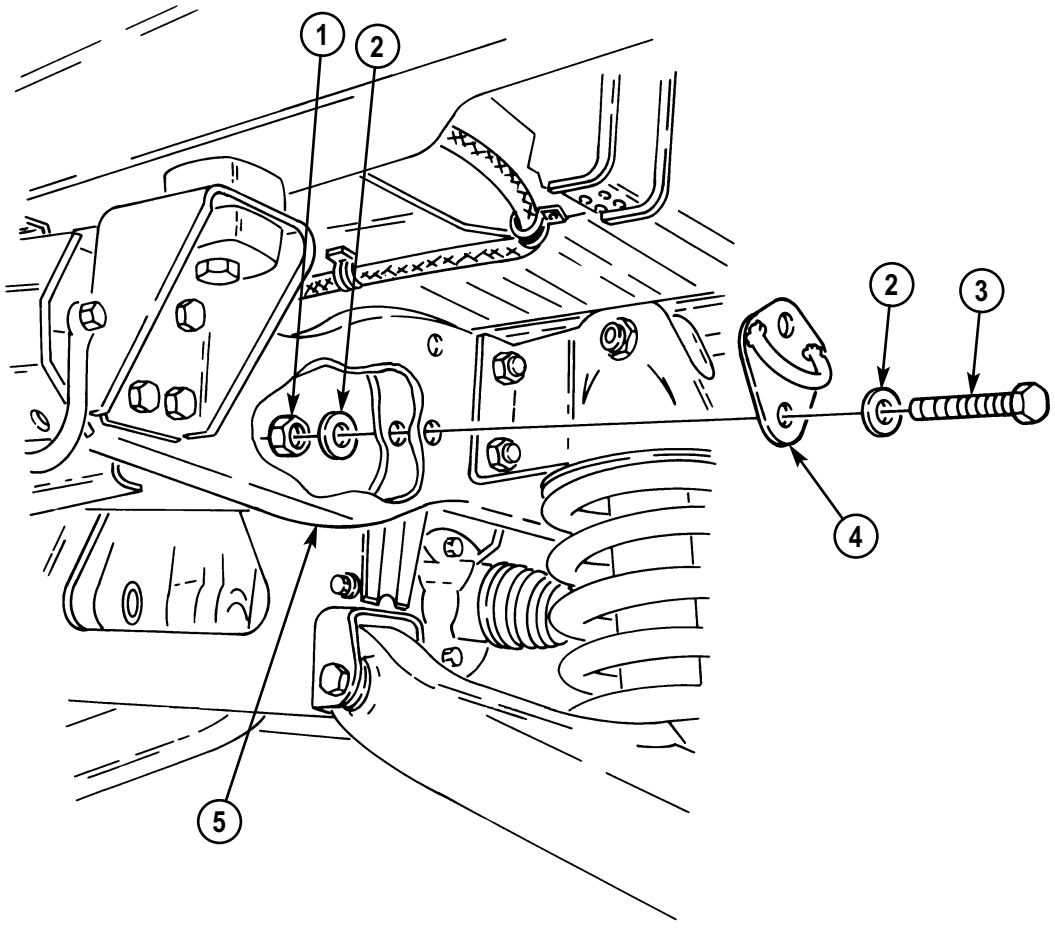
**Manual References**
TM 9-2320-280-24P

**a. Removal**

Remove two nuts (1), washers (2), capscrews (3), washers (2), and rear-rear tiedown bracket (4) from frame rail (5).

**b. Installation**

Install rear-rear tiedown bracket (4) on frame rail (5) with two washers (2), capscrews (3), washers (2), and nuts (1). Tighten nuts (1) to 260 lb-ft (353 N•m).



## 12-14. TRANSMISSION CROSSMEMBER SUPPORT BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two locknuts (Appendix E, Item 65)

**Manual References**
TM 9-2320-280-20P

**Equipment Condition**
Transmission mount crossmember removed (TM 9-2320-280-20).

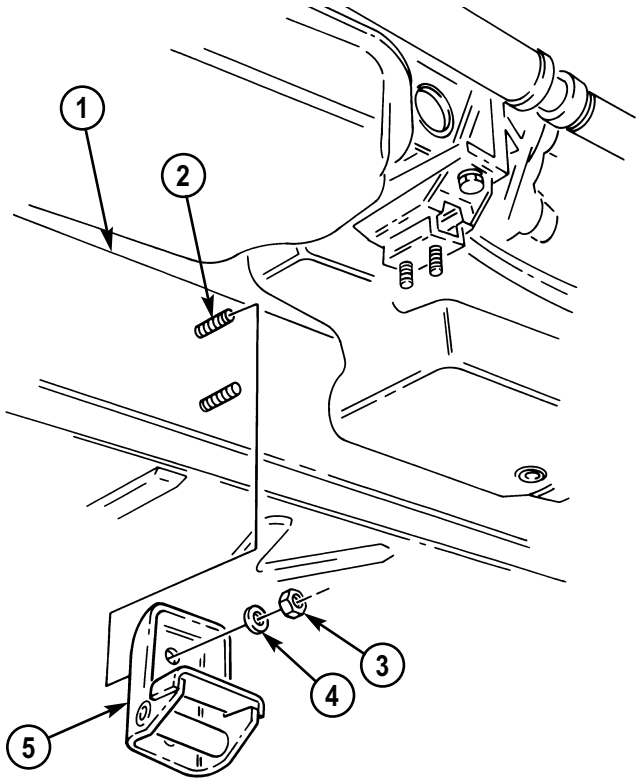
**Maintenance Level**
Direct support

### a. Removal

Remove two locknuts (3), washers (4), and transmission support bracket (5) from frame rail (1) and two capscrews (2). Discard locknuts (3).

### b. Installation

Install transmission support bracket (5) on frame rail (1) and two capscrews (2) with washers (4) and locknuts (3). Tighten locknuts (3) to 90 lb-ft (122 N•m).




FOLLOW-ON TASK: Install transmission mount crossmember (TM 9-2320-280-20).

## 12-15. REAR-FRONT TIEDOWN BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Wheel removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

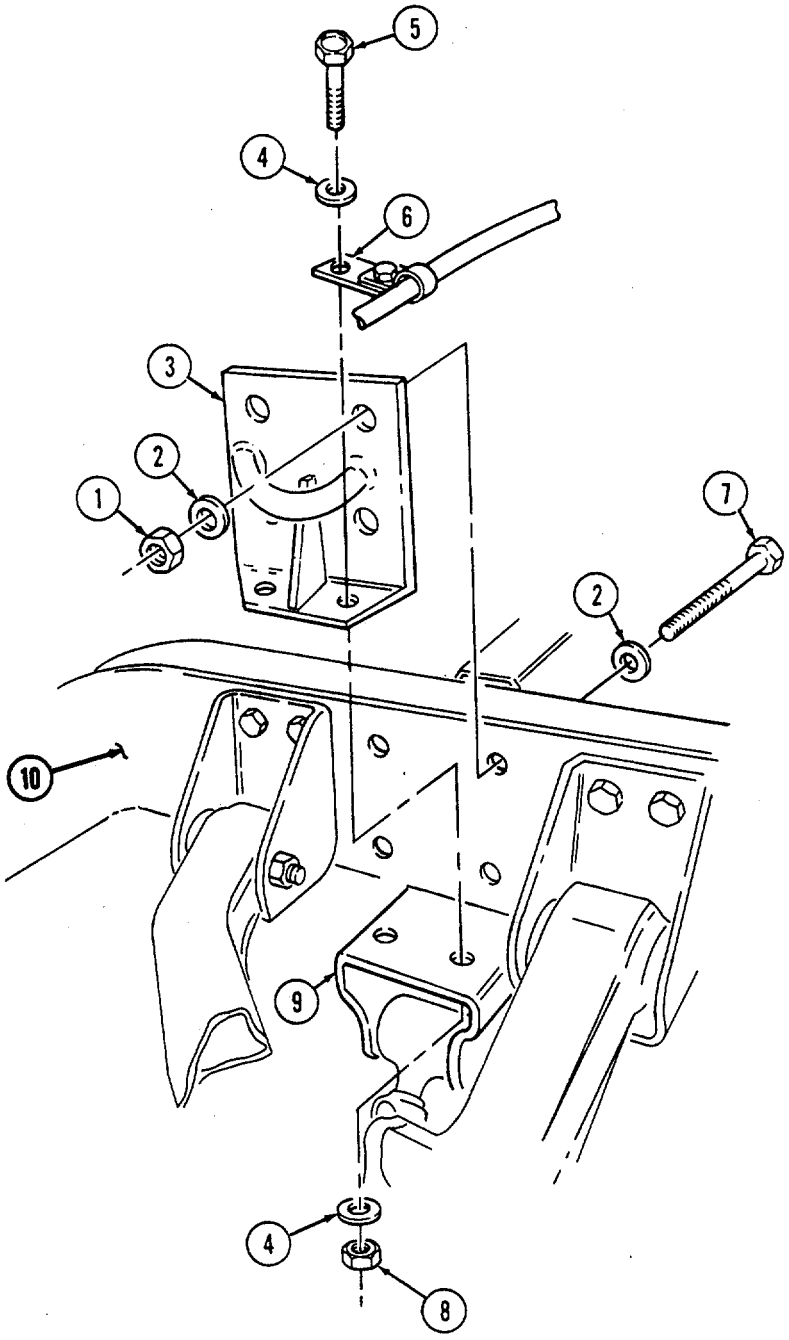
### a. Removal

1. Remove four nuts (1), washers (2), capscrews (7), and washers (2), from tiedown bracket (3) and frame rail (10).
2. Remove two nuts (8), washers (4), capscrews (5), washers (4), vent tube mounting bracket (6), and tiedown bracket (3) from rear suspension front crossmember mounting bracket (9).

### b. Installation

1. Install tiedown bracket (3) on frame rail (10) with four washers (2), capscrews (7), washers (2), and nuts (1). Tighten nuts (1) to 260 lb-ft (353 N•m).
2. Install tiedown bracket (3) and vent tube mounting bracket (6) on rear suspension front crossmember mounting bracket (9) with two washers (4), capscrews (5), washers (4), and nuts (8). Tighten nuts (8) to 90 lb-ft (122 N•m).

## 12-15. REAR-FRONT TIEDOWN BRACKET REPLACEMENT (Cont'd)




FOLLOW-ON TASK: Install wheel (TM 9-2320-280-20).

## 12-16. DIFFERENTIAL SUPPORT BRACKET AND SIDE MOUNTING BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Two O-rings (Appendix E, Item 149)
Four locknuts (Appendix E, Item 65)
Locknut (Appendix E, Item 53)
Sealing compound (Appendix B, Item 50)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Service brake rotor removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

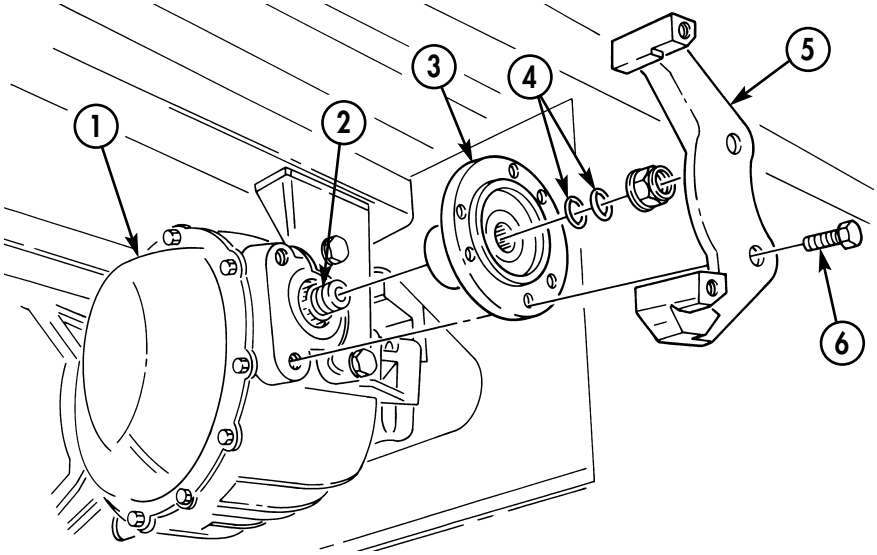
**a. Removal**

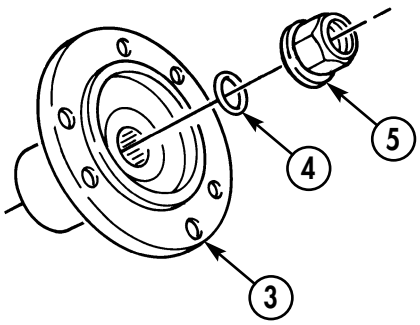
1. Remove locknut (5), two O-rings (4), and output flange (3) from output shaft (2). Discard O-rings (4) and locknut (5).
2. Remove two capscrews (7) and brake adapter (6) from differential (1).

**NOTE**

New configuration side mounting bracket allows for output shaft seal replacement without bracket removal. Inspect bracket to determine output shaft seal clearance. If no clearance exists, replacement of side mounting bracket with new configuration is recommended.

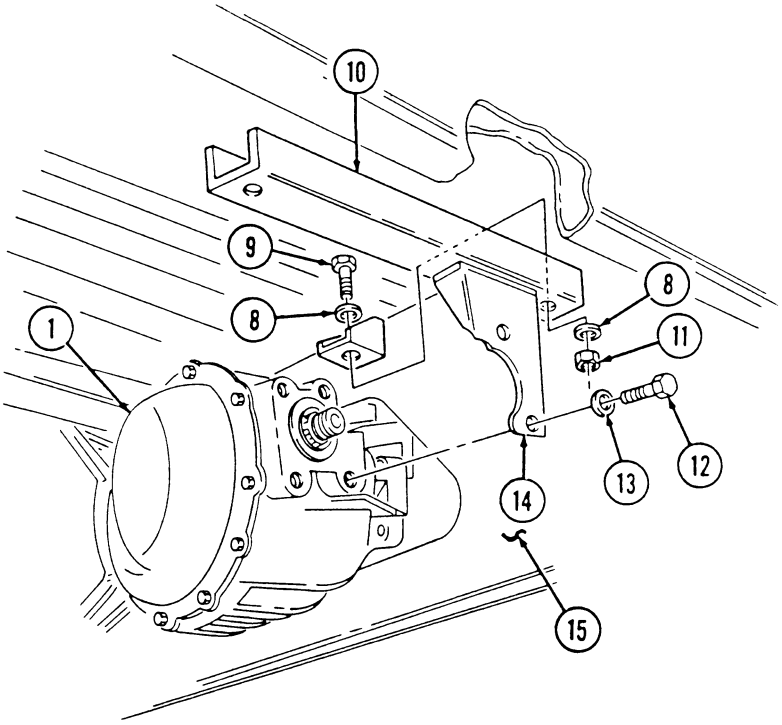
3. Remove two capscrews (12) and washers (13) from differential (1) and differential side mounting bracket (14).
4. Remove two locknuts (11), washers (8), capscrews (9), washers (8), differential support bracket (10), and side mounting bracket (14) from suspension crossmember (15). discard locknuts (11).
5. Remove two locknuts (16), washers (17), capscrews (18), washers (17), and side mounting bracket (14) from support bracket (10). Discard locknuts (16).

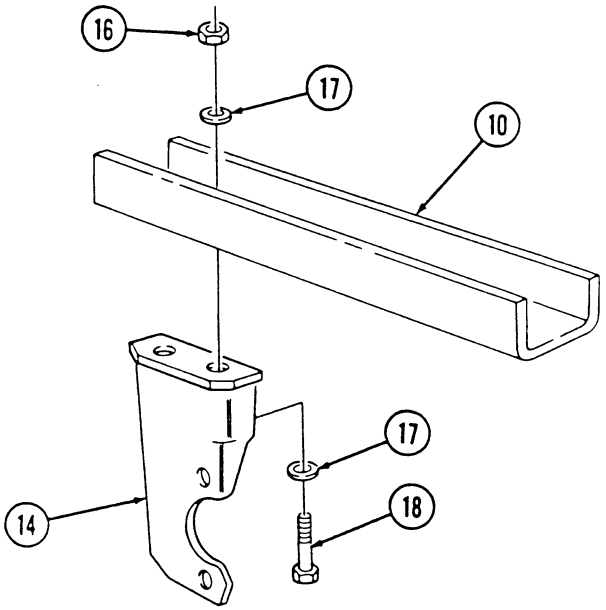



NEW CONFIGURATION

## 12-16. DIFFERENTIAL SUPPORT BRACKET AND SIDE MOUNTING BRACKET REPLACEMENT (Cont'd)



## 12-16. DIFFERENTIAL SUPPORT BRACKET AND SIDE MOUNTING BRACKET REPLACEMENT (Cont'd)

**b. Installation**

**NOTE**

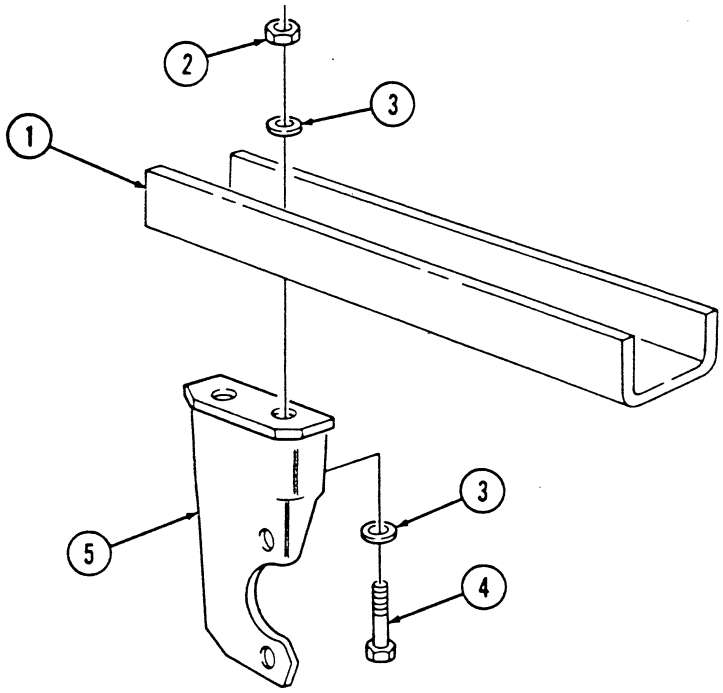
New configuration side mounting bracket allows for output shaft seal replacement without bracket removal. If old configuration mounts were removed, installation of new configuration side mounting bracket is recommended.

1. Install side mounting bracket (5) on support bracket (1) with two washers (3), capscrews (4), washers (3), and locknuts (2).
2. Install differential support bracket (1) and differential side mounting bracket (5) on suspension crossmember (12) with two washers (7), capscrews (8), washers (7), and locknuts (9).
3. Align holes inside mounting bracket (5) with threaded holes in differential (6).
4. Remove two locknuts (9), washers (7), capscrews (8), washers (7), side mounting bracket (5) and support bracket (1) from crossmembers (12).
5. Tighten capscrews (4) to 90 lb-ft (122 N•m).
6. Install support bracket (1) and side mounting bracket (5) on crossmembers (12) with two washers (7), capscrews (8), washers (7), and locknuts (9).

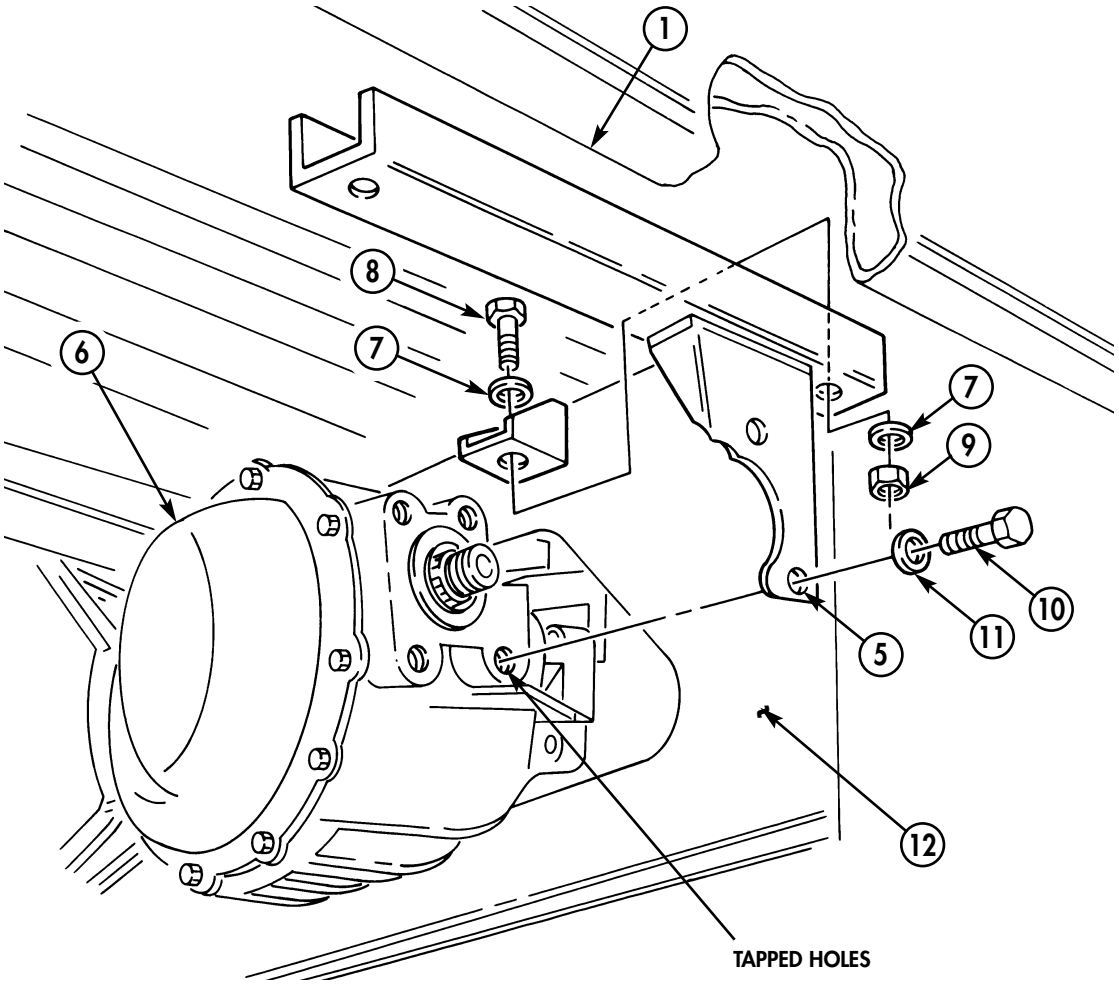
**CAUTION**

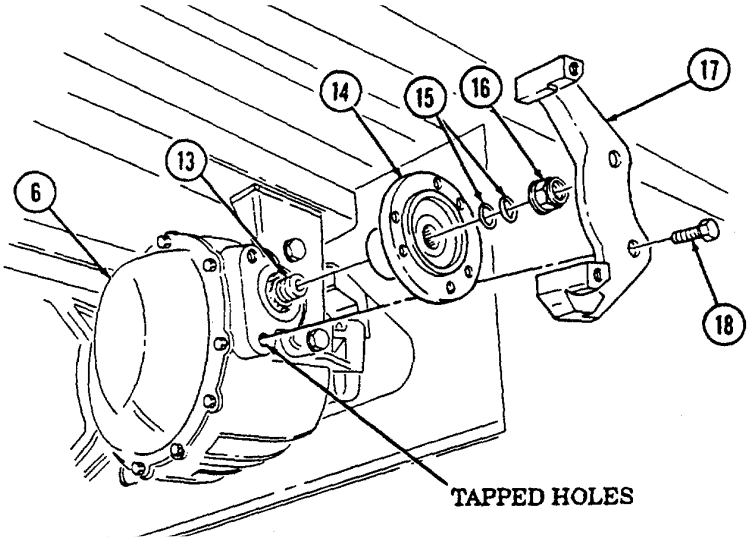
Apply a liberal amount of thread sealing compound to the tapped holes of differential. To allow adequate coating of threads, install capscrews shortly after applying thread sealing compound. Failure to do this could allow capscrews to loosen and cause damage to differential.

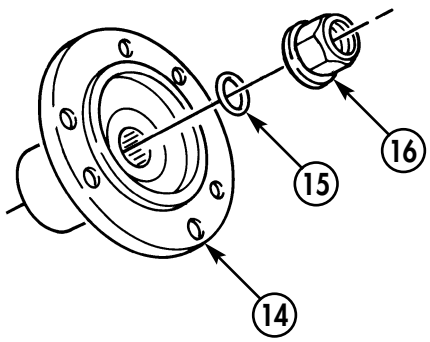
7. Apply sealing compound to tapped holes of differential (6). Install two short capscrews (10) and washers (11) securing side mounting bracket (5) to differential (6). Tighten capscrews (10) to 110-140 lb-ft (149-190 N•m) and capscrews (8) to 90 lb-ft (122 N•m).
8. Apply sealing compound to tapped holes of differential (6) and install brake adapter (17) on differential (6) with two capscrews (18). Tighten capscrews (18) to 110-140 lb-ft (149-190 N•m).
9. Install output flange (14), two O-rings (15), and locknut (16) on output shaft (13). Tighten locknut (16) to 170 lb-ft (231 N•m).



## 12-16. DIFFERENTIAL SUPPORT BRACKET AND SIDE MOUNTING BRACKET REPLACEMENT (Cont'd)




NEW CONFIGURATION

FOLLOW-ON TASK: Install service brake rotor (TM 9-2320-280-20).

# 12-17. FRONT SUSPENSION FRONT CROSSMEMBER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**

Four locknuts (Appendix E, Item 66)
Ten locknuts (Appendix E, Item 65)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Front lower control arms removed (TM 9-2320-280-20).
- Lower radiator hose removed (TM 9-2320-280-20).
- Horn removed (TM 9-2320-280-20).
- Radiator front mounting bracket removed (TM 9-2320-280-20).
- Differential removed (para. 9-5).
- Differential support brackets and side mounting brackets removed (para. 12-16).

**Maintenance Level**

Direct support

## a. Removal

**NOTE**

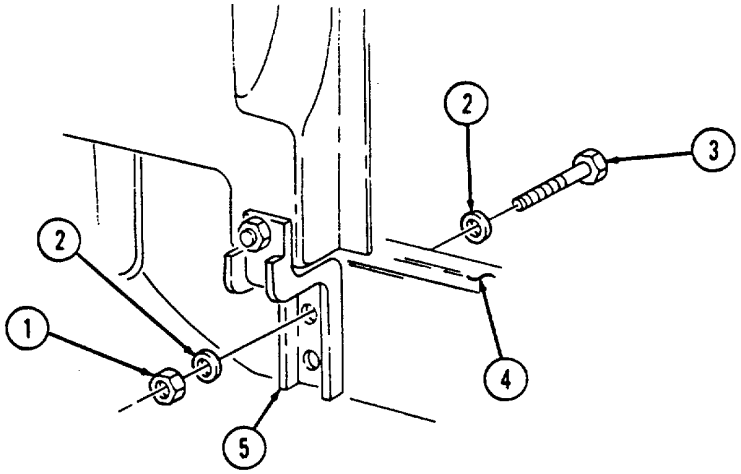
Note direction of capscrews for installation.

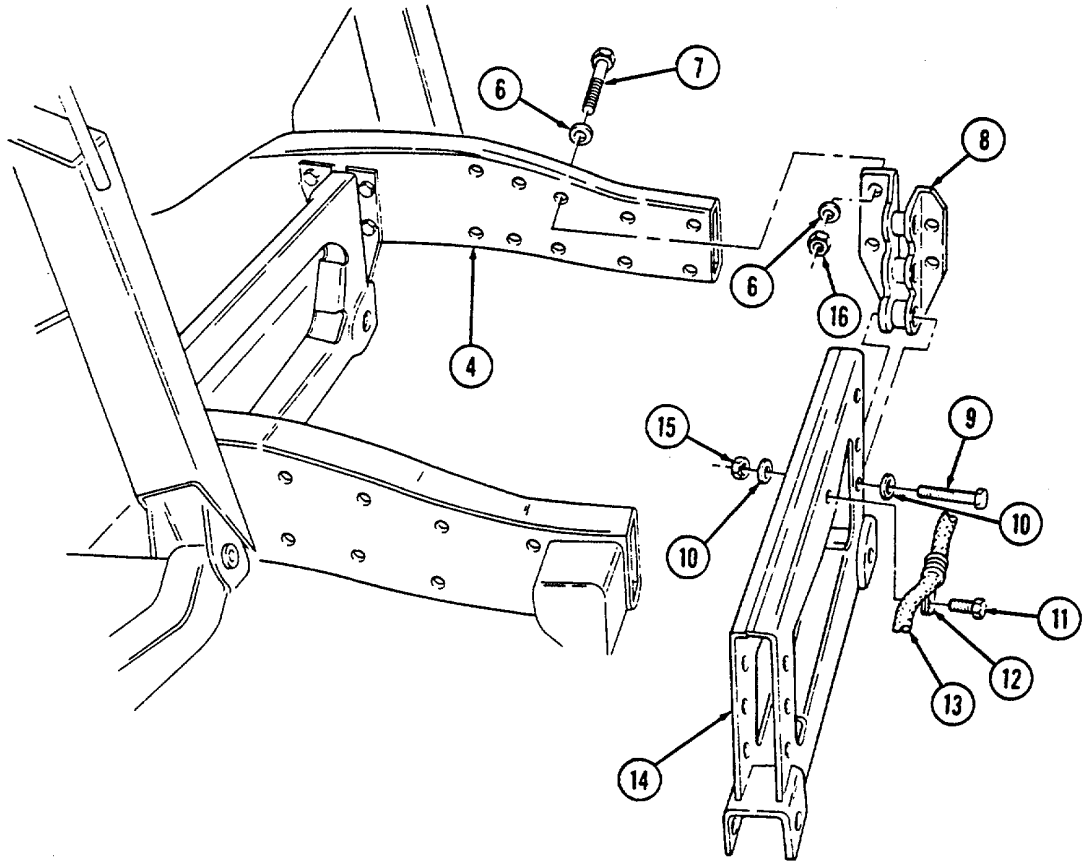
1. Remove four locknuts (1), washers (2), capscrews (3), washers (2), and two splash shield brackets (5) from frame rails (4). Discard locknuts (1).
2. Remove screw (11), clamp (12), and harness (13) from front crossmember (14).
3. Remove four locknuts (16), washers (6), capscrews (7), and washers (6) from front crossmember (14) and frame rails (4). Discard locknuts (16).
4. Remove six locknuts (15), washers (10), capscrews (9), and washers (10) from front crossmember (14) and left and right front crossmember mounting brackets (8). Discard locknuts (15).
5. Slide front crossmember (14) and mounting brackets (8) down and out from under vehicle.
6. Remove left and right mounting brackets (8) from crossmember (14).

## b. Installation

1. Install left and right crossmember mounting brackets (8) in front crossmember (14).
2. Install front crossmember (14) and mounting brackets (8) on frame rails (4) with four washers (6), capscrews (7), washers (6), and locknuts (16).
3. Install six washers (10), capscrews (9), washers (10), and locknuts (15) on left and right mounting brackets (8) and front crossmember (14).
4. Install four washers (2), capscrews (3), washers (2), and locknuts (1) on two splash shield brackets (5) and frame rails (4).
5. Tighten four locknuts (16) to 260 lb-ft (353 N•m).
6. Tighten four locknuts (1) and six locknuts (15) to 90 lb-ft (122 N•m).
7. Install harness (13) on front crossmember (14) with clamp (12) and screw (11).

## 12-17. FRONT SUSPENSION FRONT CROSSMEMBER REPLACEMENT (Cont'd)




FOLLOW-ON TASKS:
- Install horn (TM 9-2320-280-20).
- Install lower radiator hose (TM 9-2320-280-20).
- Install radiator front mounting bracket (TM 9-2320-280-20).
- Install differential support brackets and side mounting brackets (para. 12-16).
- Install differential (para. 9-5).
- Install front lower control arms (TM 9-2320-280-20).

## 12-18. FRONT SUSPENSION REAR CROSSMEMBER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**

Three lockwashers (Appendix E, Item 107)
Eight locknuts (Appendix E, Item 65)
Five locknuts (Appendix E, Item 66)
Sealing compound (Appendix B, Item 53)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Radiator removed (TM 9-2320-280-20).
- Right front upper control arm removed (TM 9-2320-280-20).
- Lower radiator tube removed (TM 9-2320-280-20).
- Right front caliper to tee brake line removed (TM 9-2320-280-20).
- Lower control arms removed (TM 9-2320-280-20).
- Differential removed (para. 9-5).
- Differential support brackets and side mounting brackets removed (para. 12-16).

**Maintenance Level**

Direct support

**a. Removal**

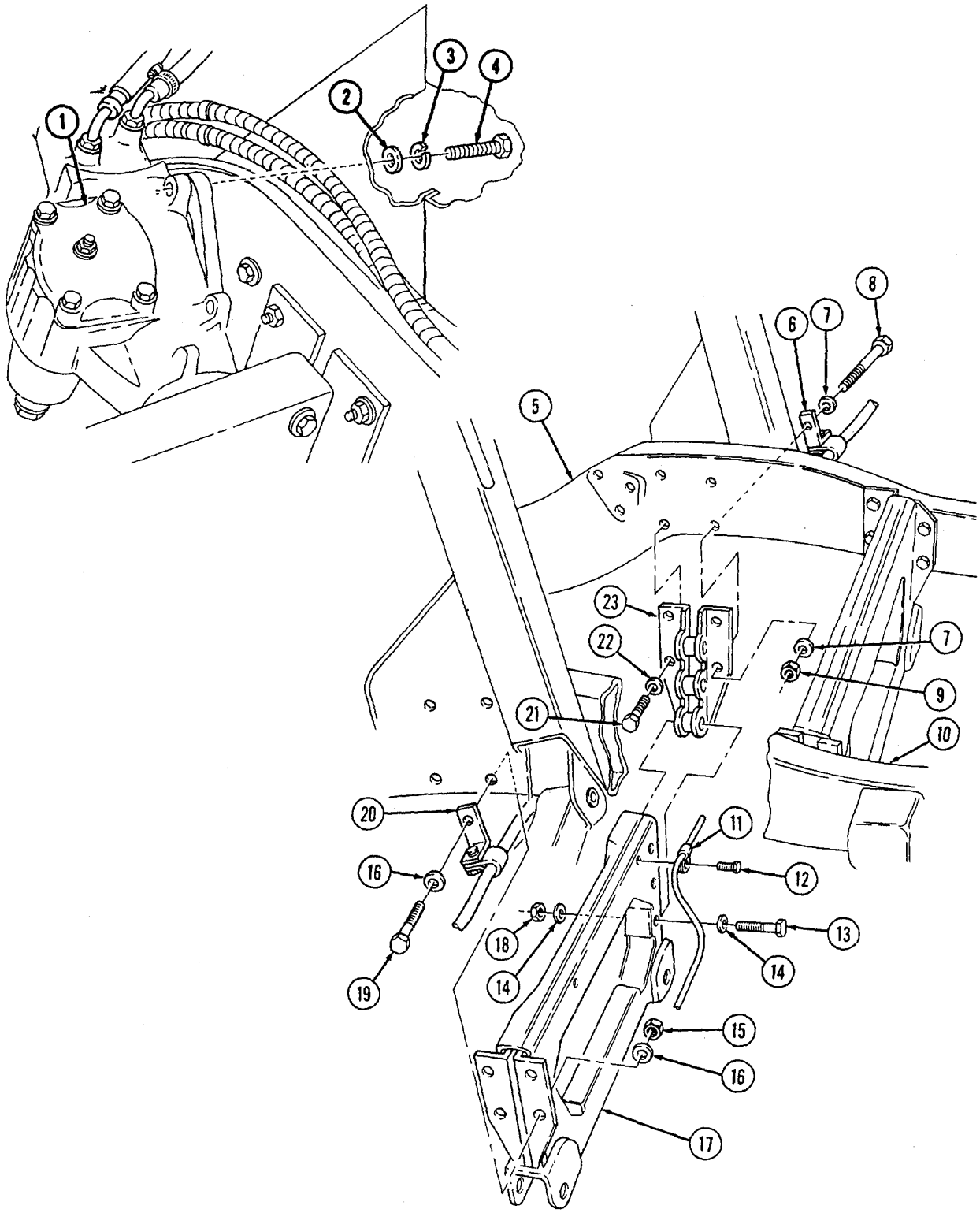
1. Remove three capscrews (4), lockwashers (3), washers (2), and pull steering gear (1) away from left frame rail (5). Discard lockwashers (3).
2. Remove three capscrews (12) and vent line clamps (11) from rear crossmember (17).

**NOTE**

Note direction of capscrews for installation.

3. Remove four locknuts (15), washers (16), capscrews (19), washers (16), and vent line bracket (20) from rear crossmember (17) and right frame rail (10). Discard locknuts (15).
4. Remove three locknuts (9), washers (7), capscrews (8), washers (7), and vent line bracket (6) from rear crossmember (17) and frame rail (5). Discard locknuts (9).
5. Remove capscrew (21) and washer (22) from rear crossmember (17) and frame rail (5).
6. Remove six locknuts (18), washers (14), capscrews (13), and washers (14) from rear crossmember (17) and left and right rear crossmember mounting brackets (23). Discard locknuts (18).
7. Slide rear crossmember (17) and left and right crossmember mounting brackets (23) down and out from under vehicle.
8. Remove left and right crossmember mounting brackets (23) from rear crossmember (17).

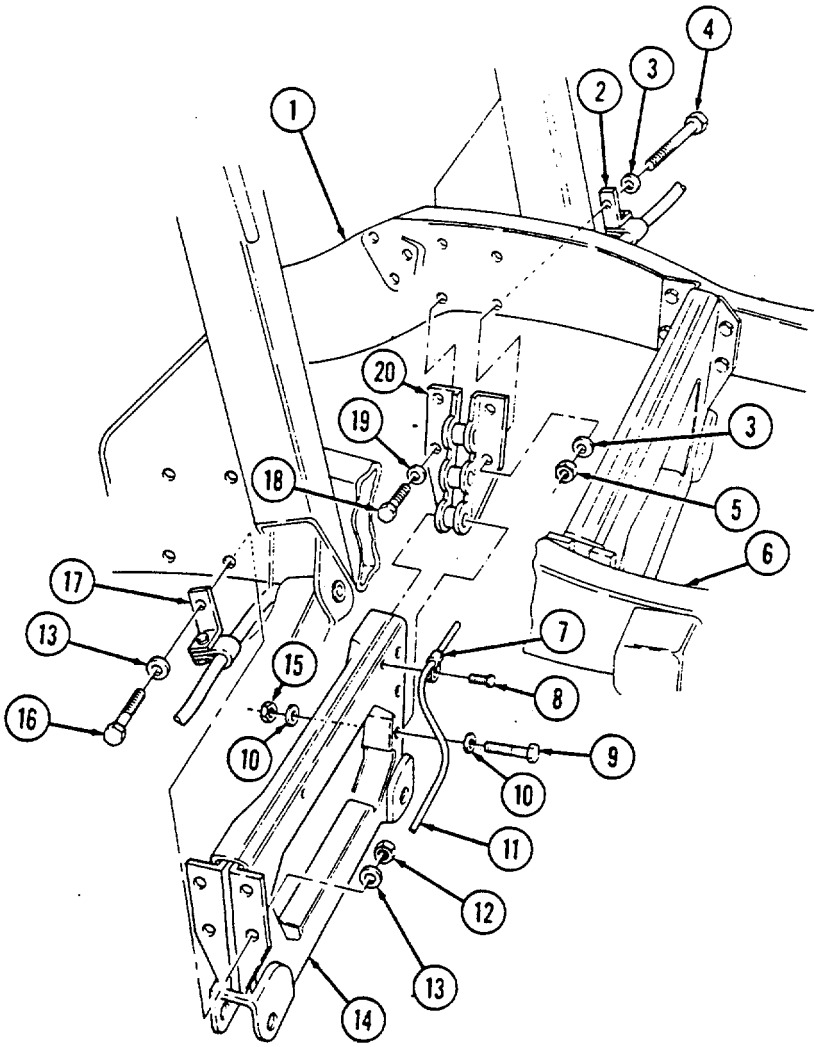
## 12-18. FRONT SUSPENSION FRONT CROSSMEMBER REPLACEMENT (Cont'd)



## 12-18. FRONT SUSPENSION FRONT CROSSMEMBER REPLACEMENT

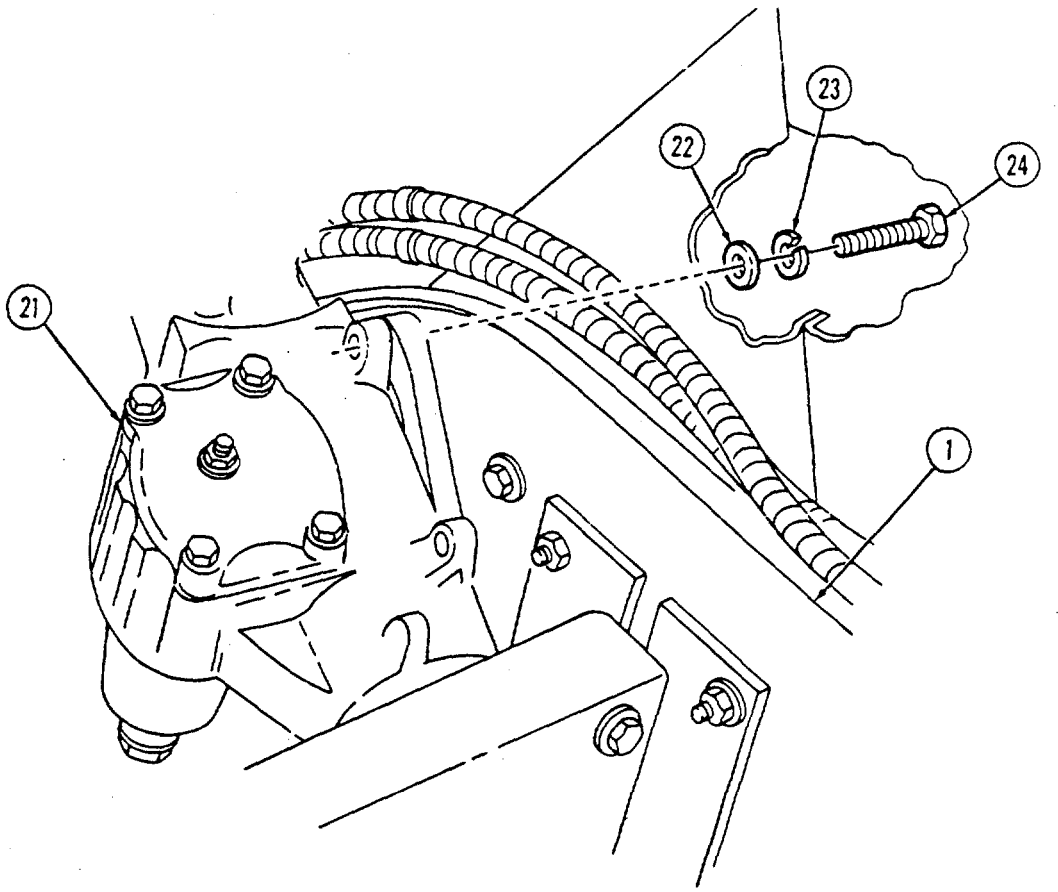
### b. Installation

1. Install left and right rear crossmember mounting brackets (20) on rear crossmember (14).
2. Install rear crossmember (14) on frame rails (1) and (6).
3. Apply sealing compound to capscrew (18) and secure rear crossmember (14) on frame rail (1) with washer (19) and capscrew (18).
4. Secure rear crossmember (14) on frame rail (1) with vent line bracket (2), three washers (3), capscrews (4), washers (3), and locknuts (5).
5. Install rear crossmember (14) and vent line bracket (17) on frame rail (6) with four washers (13), capscrews (16), washers (13), and locknuts (12).
6. Install six washers (10), capscrews (9), washers (10), and locknuts (15) on rear crossmember (14) and left and right mounting brackets (20).



## 12-18. FRONT SUSPENSION REAR CROSSMEMBER REPLACEMENT (Cont'd)

7. Tighten capscrew (18) to 65-78 lb-ft (88-106 N•m).
8. Tighten three capscrews (4) to 90 lb-ft (122 N•m).
9. Tighten four capscrews (16) to 90 lb-ft (122 N•m).
10. Tighten six capscrews (9) to 90 lb-ft (122 N•m).
11. Install vent line (11) on rear crossmember (14) with three clamps (7) and capscrews (8).
12. Install steering gear (21) on frame rail (1) with three washers (22), lockwashers (23), and capscrews (24). Tighten capscrews (24) to 60 lb-ft (81 N•m).




FOLLOW-ON TASKS:
- Install differential support brackets and side mounting brackets (para. 12-16).
- Install differential (para. 9-5).
- Install lower control arms (TM 9-2320-280-20).
- Install right front caliper to tee brake line (TM 9-2320-280-20).
- Install right front upper control arm (TM 9-2320-280-20).
- Install lower radiator tube (TM 9-2320-280-20).
- Install radiator (TM 9-2320-280-20).

# 12-19. REAR SUSPENSION FRONT CROSSMEMBER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**

Eight locknuts (Appendix E, Item 65)
Two locknuts (Appendix E, Item 66)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Rear-front tiedown brackets removed (para. 12-15).
- Differential removed (para. 9-5).
- Differential support brackets and side mounting brackets removed (para. 12-16).
- Rear lower control arms removed (TM 9-2320-280-20).

**General Safety Instructions**

Crossmember must be supported during removal.

**Maintenance Level**

Direct support

**a. Removal**

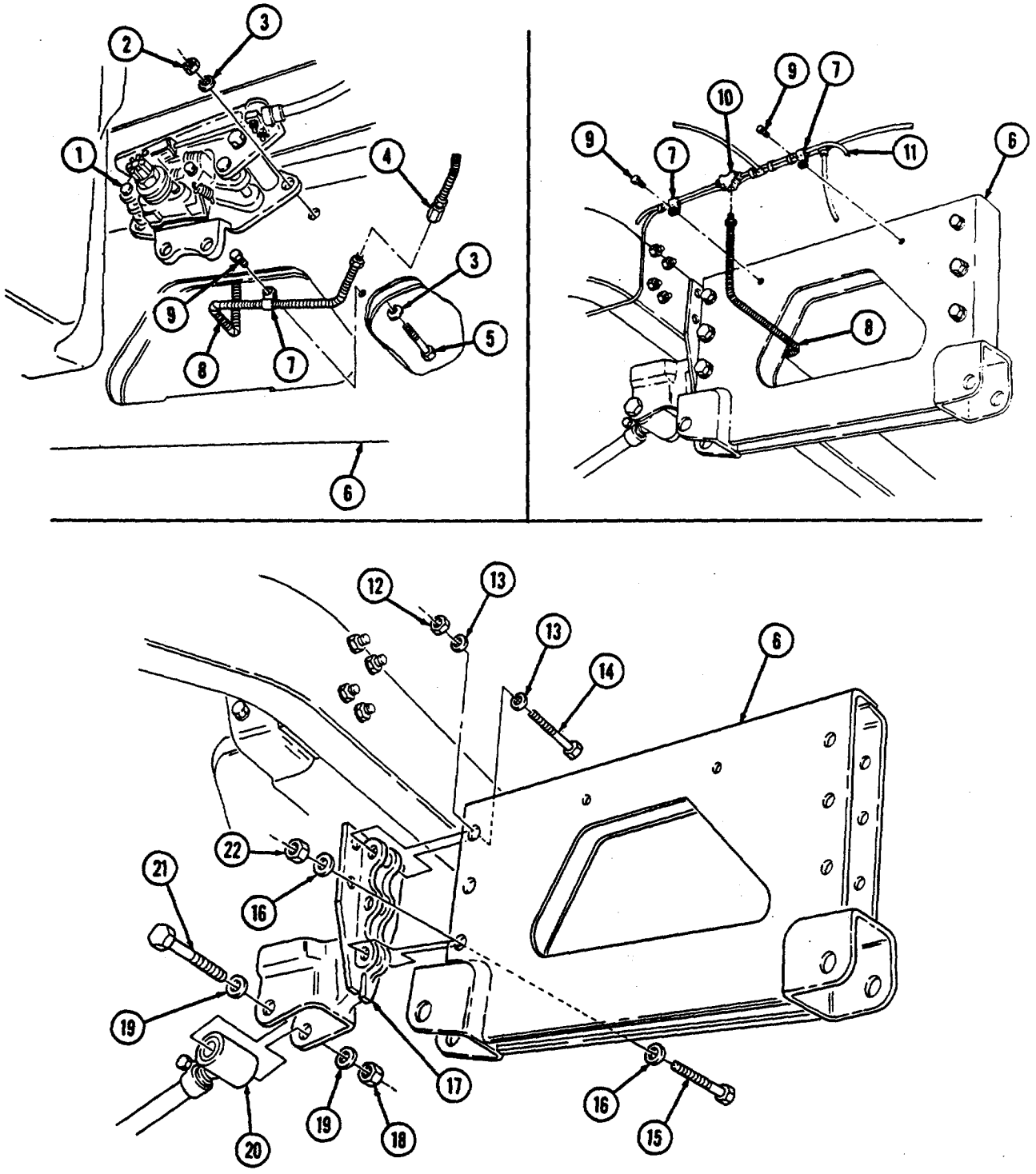
1. Remove two locknuts (2), washers (3), and capscrews (5), washers (3), and parking brake caliper and mounting bracket (1) from front crossmember (6). Move caliper and mounting bracket (1) away from front crossmember (6). Discard locknuts (2).
2. Remove three capscrews (9), clamps (7), brake line (8), and vent line (11) from front crossmember (6).
3. Disconnect brake line (8) from tee (10) and tube coupling (4). Remove brake line (8).
4. Remove two locknuts (18), washers (19), capscrews (21), washers (19), and radius rods (20) from crossmember mounting brackets (17). Discard locknuts (18).

**WARNING**

Crossmember must be supported during removal. Failure to support crossmember during removal may cause injury to personnel or damage to equipment.

5. Loosen two nuts (12) and four locknuts (22) on front crossmember (6) and crossmember mounting brackets (17).
6. Slide front crossmember (6) down and out from under vehicle.
7. Remove two locknuts (12), washers (13), capscrews (14), and washers (13) from crossmember mounting brackets (17) and front crossmember (6). Discard locknuts (12).
8. Remove four locknuts (22), washers (16), capscrews (15), washers (16), and two crossmember mounting brackets (17) from front crossmember (6). Discard locknuts (22).

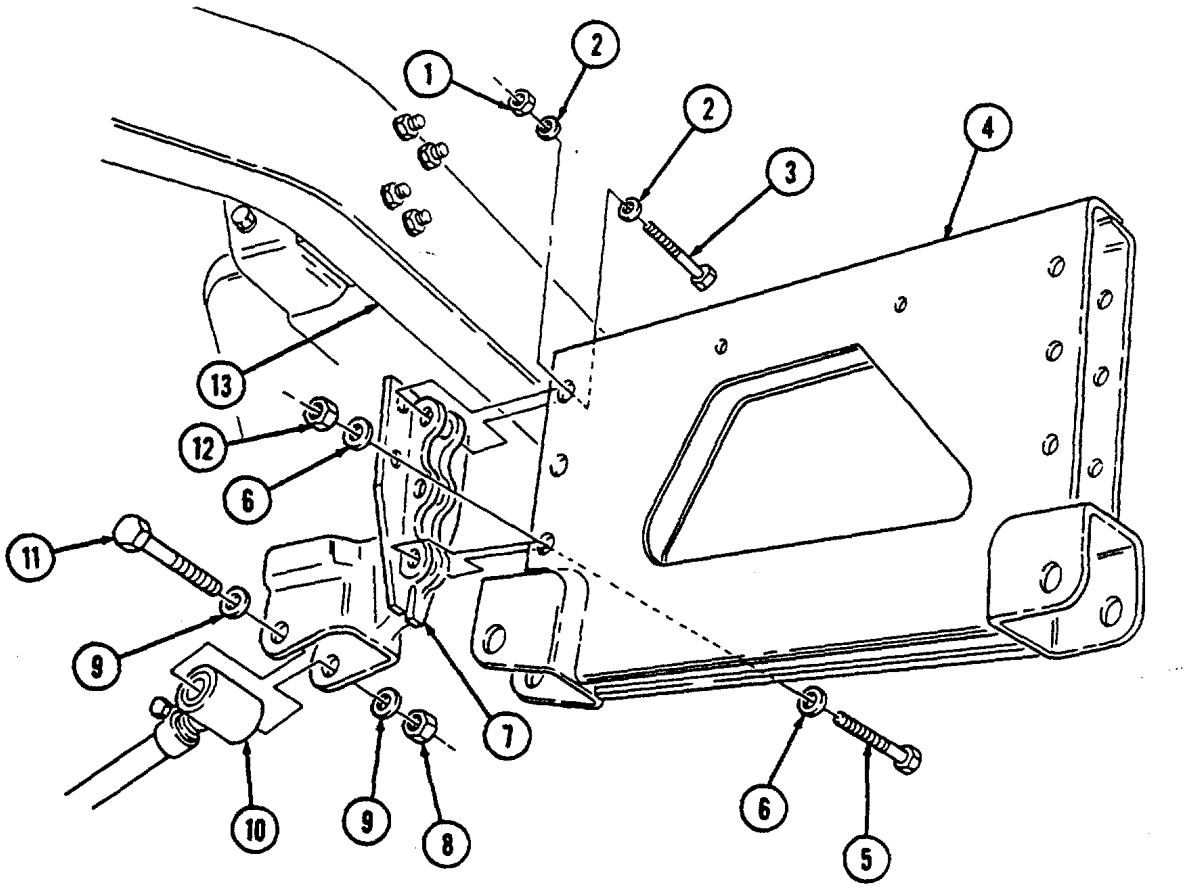
**12-19. REAR SUSPENSION FRONT CROSSMEMBER REPLACEMENT (Cont'd)**



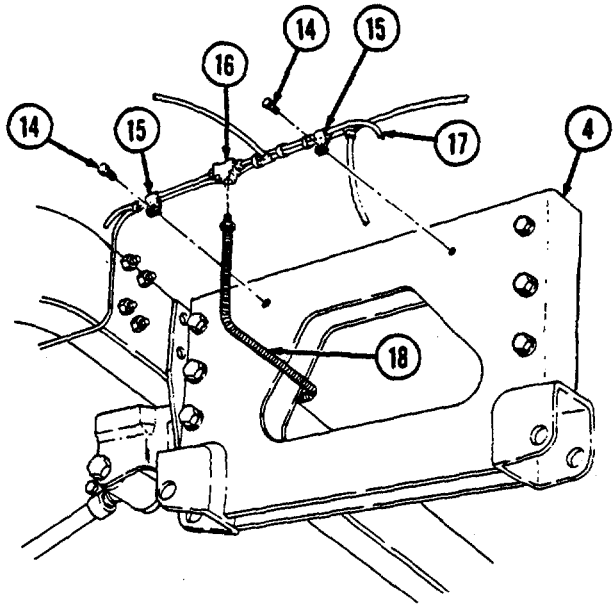
**12-19. REAR SUSPENSION FRONT CROSSMEMBER REPLACEMENT (Cont'd)**

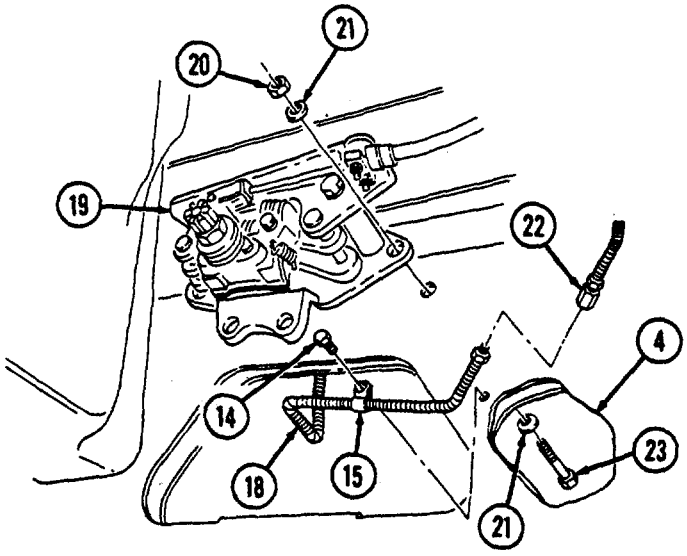
b. Installation

1. Install two crossmember mounting brackets (7) on front crossmember (4) with two washers (2), capscrews (3), washers (2), and bcknuts (1).
2. Install four washers (6), capscrews (5), washers (6), and locknuts (12) on crossmember mounting brackets (7) and front crossmember (4).
3. Install front crossmember (4) on frame rails (13).
4. Install rear-front tiedown brackets (para. 12-15).
5. Tighten four locknuts (12) to 260 lb-ft (353 N.m) and two locknuts (1) to 90 ft-lb (122 N.m).
6. Install two radius rods (10) on crossmember mounting brackets (7) with washers (9), capscrews (11), washers (9), and locknuts (8). Tighten locknuts (8) to 260 lb-ft (353 N.m).
7. Install brake line (18) and connect to tee (16) and tube coupling (22).
8. Install brake line (18) and vent line (17) on front crossmember (4) with three clamps (15) and capscrews (14).
9. Install parking brake caliper and mounting bracket (19) on front crossmember (4) with two washers (21), capscrews (23), washers (21), and locknuts (20). Tighten locknuts (20) to 90 lb-ft (122 N.m).



## 12-19. REAR SUSPENSION FRONT CROSSMEMBER REPLACEMENT (Cont'd)




FOLLOW-ON TASKS:
- Install differential support brackets and side mounting brackets (para. 12-16).
- Install differential (para. 9-5).
- Install rear lower control arms (TM 9-2320-280-20).
- Bleed rear brakes (TM 9-2320-280-20).

## 12-20. REAR SUSPENSION REAR CROSSMEMBER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**

Four locknuts (Appendix E, Item 66)
Six locknuts (Appendix E, Item 65)

**Manual References**

TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Differential support brackets and side mounting brackets removed (para. 12-16).
- Rear-rear tiedown brackets removed (para. 12-13).
- Rear lower control arms removed (TM 9-2320-280-20).
- Pioneer tool tray removed (TM 9-2320-280-10).

**General Safety Instructions**

Crossmember must be supported during removal.

**Maintenance Level**

Direct support

### a. Removal

**WARNING**

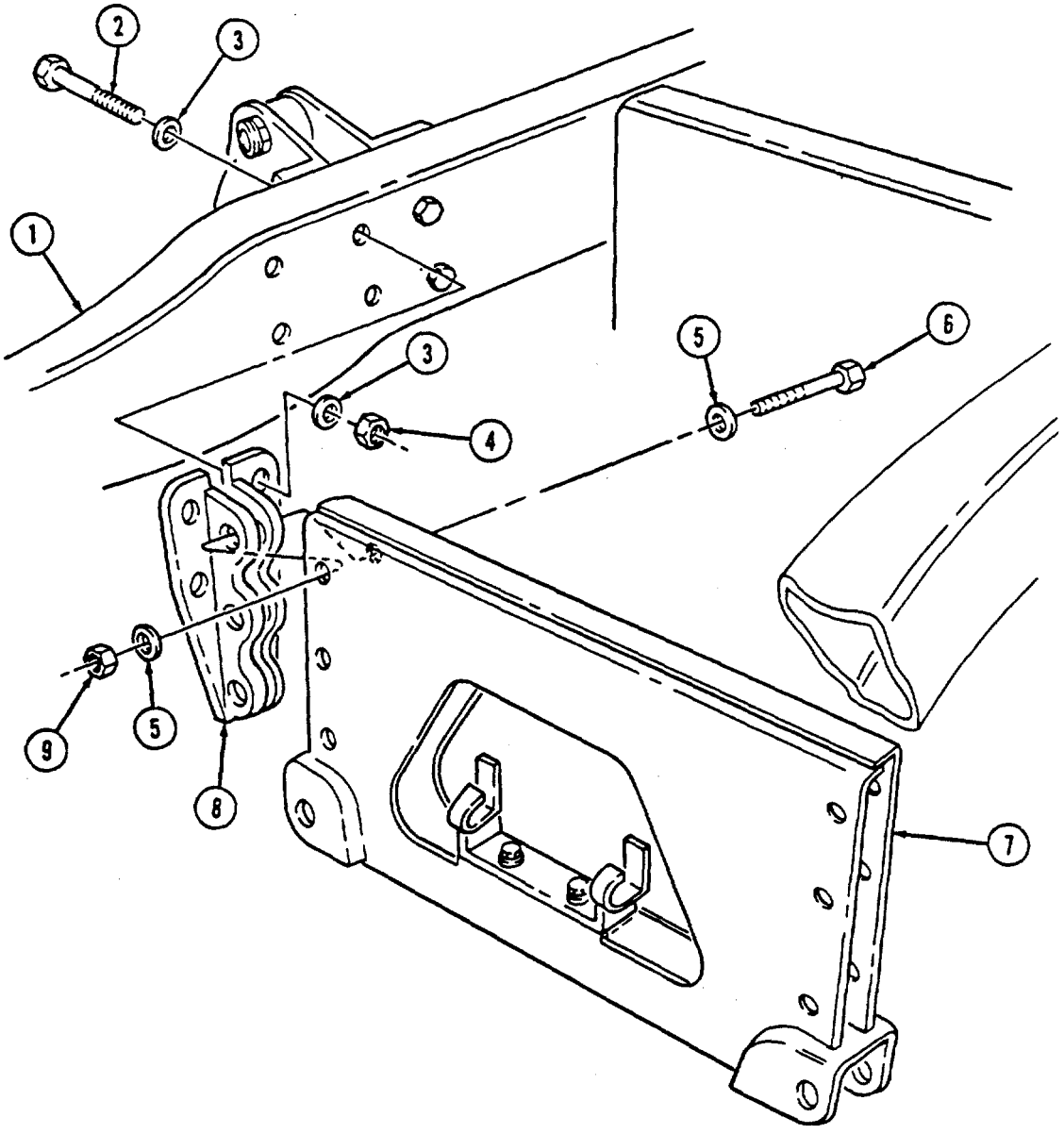
Crossmember must be supported during removal. Failure to support crossmember during removal may cause injury to personnel or damage to equipment.

1. Remove four locknuts (4), washers (3), capscrews (2), and washers (3) from rear crossmember (7) and frame rails (1). Discard locknuts (4).
2. Loosen six locknuts (9) on rear crossmember mounting brackets (8) and rear crossmember (7).
3. Slide rear crossmember (7) down and out from under vehicle.
4. Remove six locknuts (9), washers (5), capscrews (6), washers (5), and two rear crossmember mounting brackets (8) from rear crossmember (7). Discard locknuts (9).
5. Remove tool tray mounting bracket (TM 9-2320-280-20).

### b. Installation

1. Install tool tray mounting bracket (TM 9-2320-280-20).
2. Install two crossmember mounting brackets (8) on rear crossmember (7) with six washers (5), capscrews (6), washers (5), and locknuts (9).
3. Install rear crossmember (7) on frame rails (1) with four washers (3), capscrews (2), washers (3), and locknuts (4). Tighten locknuts (4) to 260 lb-ft (353 N•m).
4. Tighten six locknuts (9) to 90 lb-ft (122 N•m).

**12-20. REAR SUSPENSION FRONT CROSSMEMBER REPLACEMENT (Cont'd)**




FOLLOW-ON TASKS:
- Install rear-rear tiedown brackets (para. 12-13).
- Install differential support brackets and side mounting brackets (para. 12-16).
- Install rear lower control arms (TM 9-2320-280-20).
- Install pioneer tool tray (TM 9-2320-280-10).

## 12-21. SUSPENSION CROSSMEMBER REPAIR

**This task covers:**

**a. Inspection** **b. Repair**

**INITIAL SETUP:**

**Materials/Parts**
Metal strip (Appendix B, Item 36)

**Maintenance Level**
Direct support

**Manual References**
TC 9-237
TM 43-0139

**a. Inspection**

1. Visually inspect the main frame rails for damage or distortion. Vehicles with damaged frame rails should be sent to GS maintenance for repair.

**NOTE**

Crossmember with end bracket weld breaks of more than 1 in. (2.54 cm) must be replaced. Any crack or tear in the crossmember longer than 1-3/4 in. (4.4 cm) requires replacement of the crossmember.

2. Inspect the crossmember (1) for bends, cracks, or broken end bracket welds. Bent crossmembers (1) should be straightened. Small cracks or tears should be stop-drilled and welded.

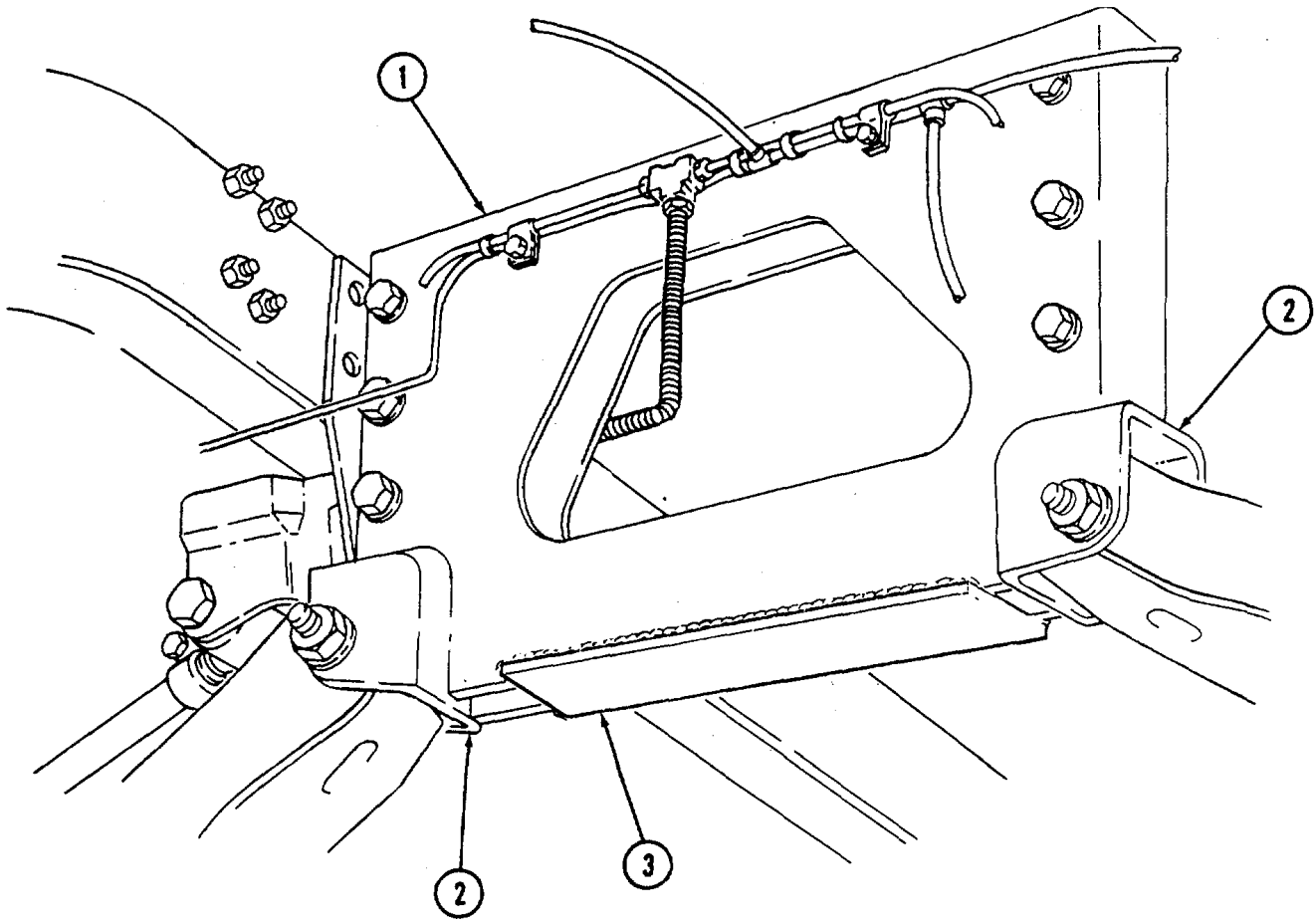
**b. Repair**

**NOTE**

- Heli-Arc, MIG, or TIG welding equipment may be used, provided the electrode used has a 70,000 (482,650 kPa) psi tensile strength.
- Avoid heat buildup in the rubber bushing areas toward the outer edges of the crossmember.
- For welding instruction refer to TC 9-237.

1. Center a 15-1/2-in. (39.4 cm) metal strip (3) between the end brackets (2), flat against bottom edges of the crossmember (1). Weld the metal strip (3) to the crossmember (1).
2. Spot paint welded area. (Refer to TM 43-0139).

## 12-21. SUSPENSION CROSSMEMBER REPAIR (Cont'd)



# CHAPTER 13
# BODY MAINTENANCE

## 13-1. INTRODUCTION

No body maintenance is authorized at the Direct Support Maintenance level. Refer to Chapter 22 for body repair authorized at Direct Support.

# CHAPTER 14

# SPECIAL PURPOSE BODIES MAINTENANCE

## 14-1. INTRODUCTION

This chapter contains maintenance instructions for replacement and repair of special purpose bodies components at the Direct Support maintenance level. Some subassemblies and parts must be removed before body components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## Section I. TOW AND ARMAMENT CARRIER MAINTENANCE

### 14-2. TOW AND ARMAMENT CARRIER MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 14-3. | Roof Replacement | 14-2 |
| 14-4. | Support Ring Maintenance | 14-6 |
| 14-5. | Windshield Maintenance | 14-12 |
| 14-6. | Cargo Shell Replacement | 14-22 |
| 14-7. | Blast Shield Replacement | 14-30 |
| 14-8. | Cargo Shell Repair | 14-32 |

## 14-3. ROOF REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
All except M996, M996A1, M997, M997A1, M997A2, M998, M998A1, M1035, M1035A1, M1035A2, M1037, M1038, M1038A1, M1042, M1097, M1097A1, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Sixteen locknuts (Appendix E, Item 63)
Plain assembled nut (Appendix E, Item 124)
Sealing compound (Appendix B, Item 49)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Personnel Required**
One mechanic
One assistant

**Equipment Condition**
Weapon station tray removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**NOTE**

It may not be necessary to perform the following procedure if damage is isolated to blast shield. Refer to (para. 14-7) for replacement of blast shield.

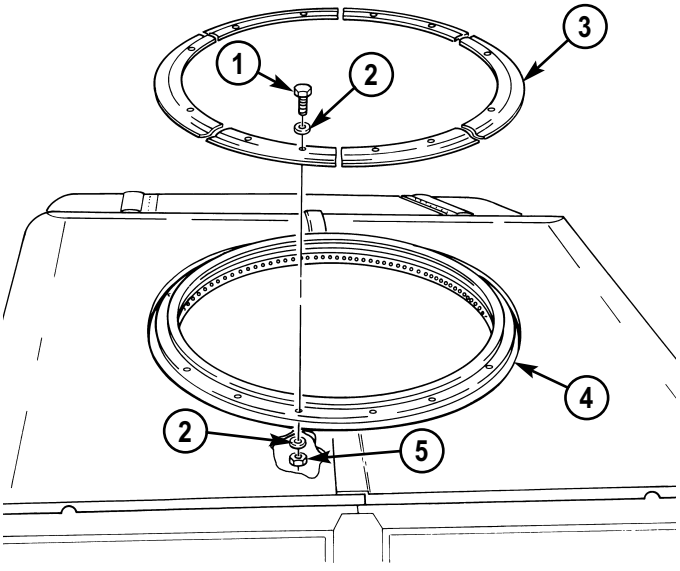
**a. Removal**

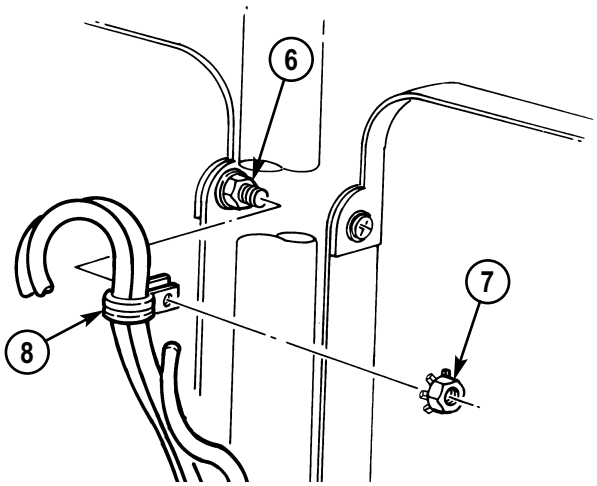
1. Remove twelve locknuts (5), washers (2), capscrews (1), washers (2), and six roof retainers (3) from bearing (4). Discard locknuts (5).

**NOTE**

Perform step 2 for M966, M966A1, M1036, M1045, M1045A1, M1045A2, M1046, and M1046A1 TOW vehicles only.

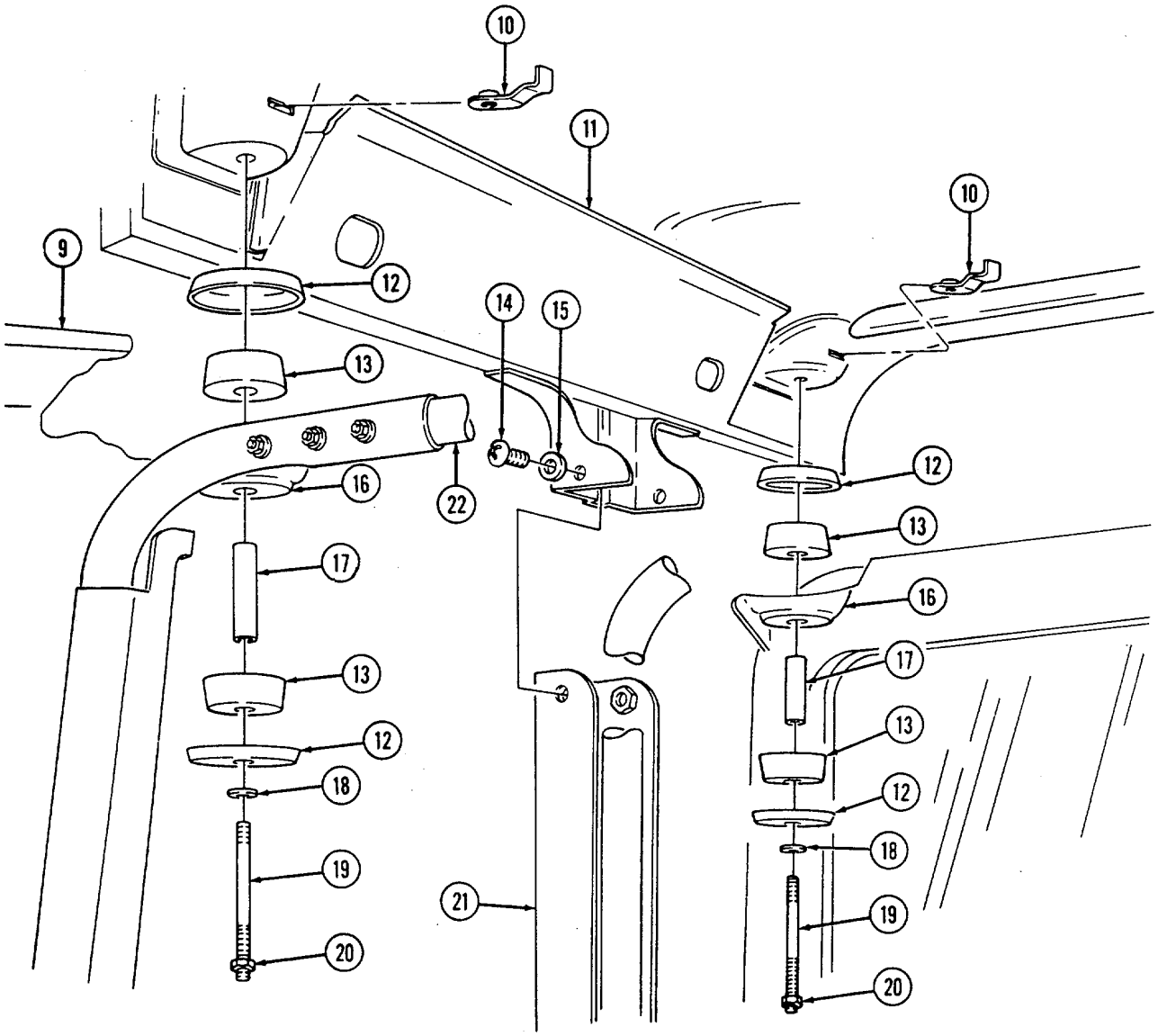
2. Remove plain assembled nut (7) from screw (6) to free TOW wiring harness clamp (8) (at right front "B" pillar cover screw (6) only). Discard plain assembled nut (7).



## 14-3. ROOF REPLACEMENT

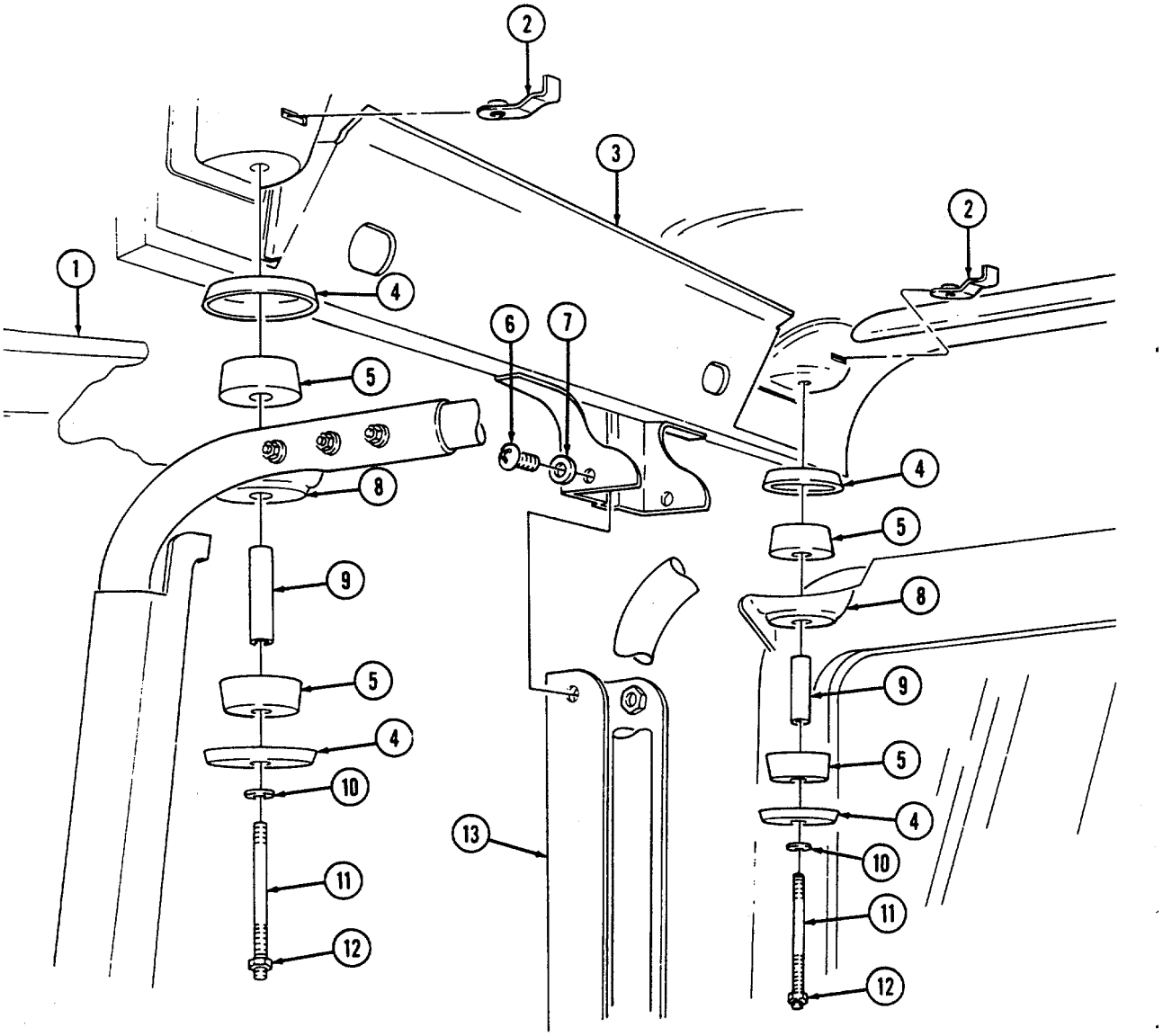
3. Remove four screws (14) and washers (15) securing roof (11) to "B" pillar covers (21).
4. Remove four locknuts (20) with studs (19) and washers (18) from roof mounting plates (10). Remove four snubber plates (12), roof mounts (13), and bushings (17) from ring mount supports (16).
5. Remove four roof mounting plates (10) from roof (11).
6. Remove roof (11) from vehicle.
7. Remove four snubber plates (12) and roof mounts (13) from ring mount supports (16).
8. Clean sealant from roof (11), support ring (22), and roof mounting ledges (9) on body sides.



## 14-3. ROOF REPLACEMENT

b. Installation

1. Apply sealing compound on roof mounting ledges (1) at body sides.
2. Install four roof mounts (5) and snubber plates (4) on ring mount supports (8).
3. Install roof (3) on ring mount supports (8).
4. Install four bushings (9), roof mounts (5), and snubber plates (4) on ring mount supports (8).
5. Install four roof mounting plates (2) in roof (3), and secure roof (3) to ring mount supports (8) with washers (10), studs (11), and locknuts (12).
6. Install roof (3) to "B" pillar covers (13) with four washers (7) and screws (6).
7. Tighten four locknuts (12) to 37 lb-ft (50 N.m).

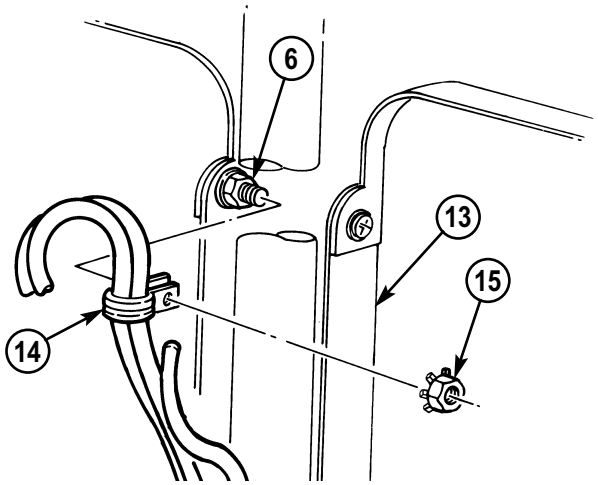


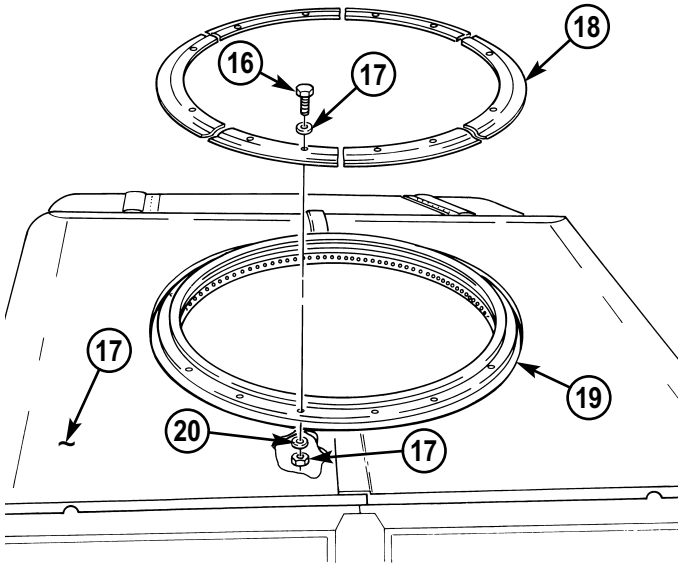
## 14-3. ROOF REPLACEMENT (Cont'd)

**NOTE**

Perform step 8 for M966, M966A1, M1036, M1045, M1045A1, M1045A2, M1046, and M1046A1 TOW vehicles only.

8. Install TOW wiring harness clamp (14) to top front screw (6), on right "B" pillar cover (13) with plain assembled nut (15).
9. Install turret bearing (19) (TM 9-2320-280-20), if removed.
10. Install six roof retainers (18) to turret bearing (19) with twelve washers (17), capscrews (16), washers (17), and locknuts (20). Tighten locknuts (20) to 37 lb-ft (50 N•m).




FOLLOW-ON TASK: Install weapon station tray (TM 9-2320-280-20).

## 14-4. SUPPORT RING MAINTENANCE

**This task covers:**

**a. Removal**
**b. Disassembly**
**c. Assembly**
**d. Installation**

**INITIAL SETUP:**

**Applicable Models**
All except M996, M996A1, M997, M997A1, M997A2, M998, M998A1, M1035, M1035A1, M1035A2, M1037, M1038, M1038A1, M1042, M1097, M1097A1, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Six spring pins (Appendix E, Item 172)
Eight locknuts (Appendix E, Items 63)
Eight locknuts (Appendix E, Item 57)
Assembled locknut (Appendix E, Item 85)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Turret bearing removed (TM 9-2320-280-20).
- Roof removed (para. 14-3).

**Maintenance Level**
Direct support

### a. Removal

**NOTE**

Note location of attaching hardware for installation.

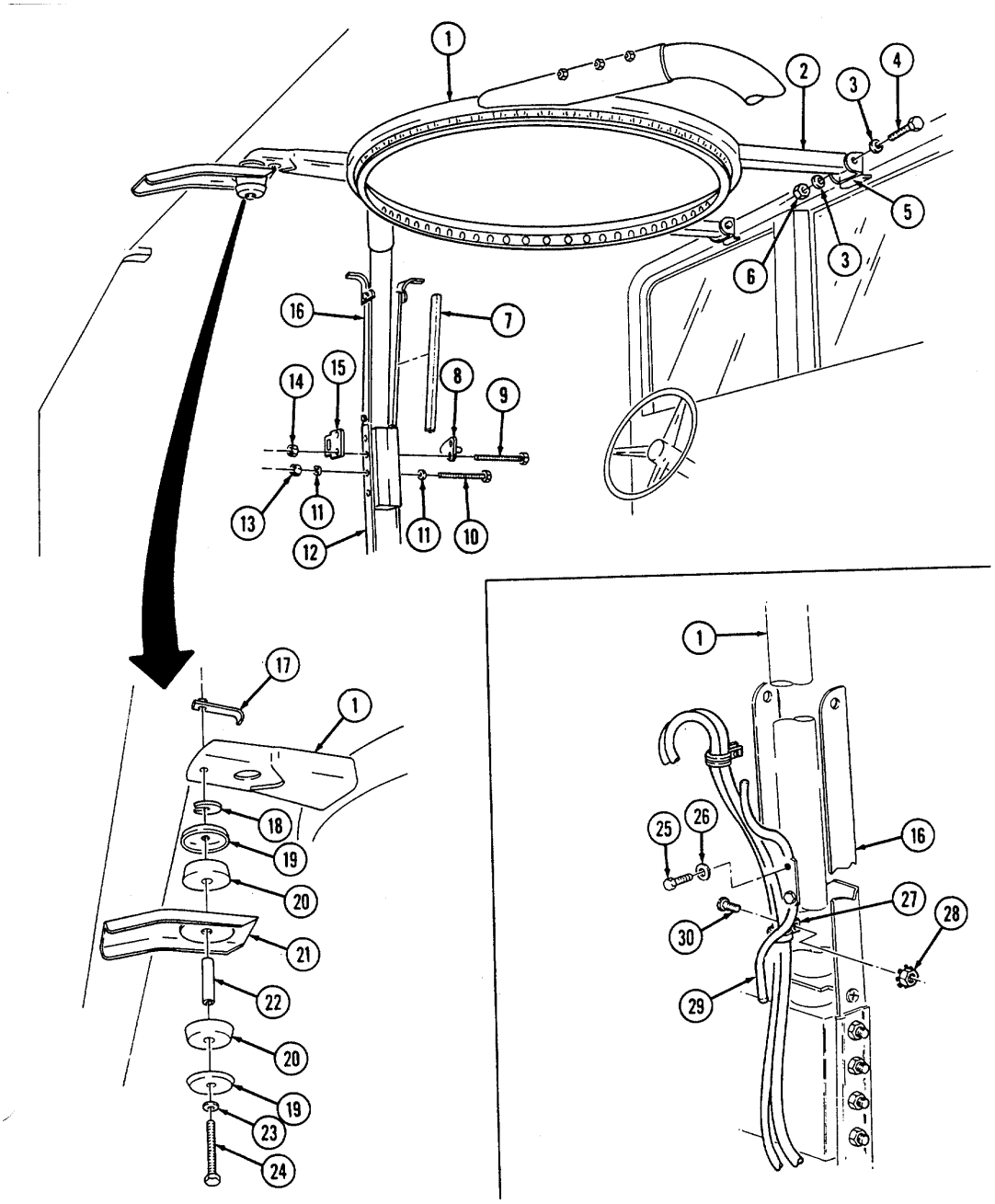
1. Remove two locknuts (6), washers (3), capscrews (4), washers (3), and front supports (2) from front mounting clevises (5). Discard locknuts (6).
2. Remove four locknuts (14), capscrews (9), two striker plates (8), and strap brackets (15) from "B" pillars (12). Discard locknuts (14).
3. Remove four locknuts (13), washers (11), capscrews (10), washers (11), and support ring (1) from two "B" pillars (12). Discard locknuts (13).
4. Remove four edge trim strips (7) from "B" pillar covers (16).

**NOTE**

Perform steps 5 and 6 for M966, M966A1, M1045, M1045A1, M1045A2, M1046, M1046A1, and M1036 TOW vehicles only.

5. Remove assembled locknut (28) and screw (30) from right "B" pillar cover (16) to free TOW wiring harness clamp (27) from right "B" pillar cover (16). Discard assembled locknut (28).
6. Remove two capscrews (25), washers (26), and cable stowage cleat (29) from support ring (1).
7. Remove capscrew (24), washer (23), snubber (19), mount (20), bushing (22), mount (20), snubber (19), shim(s) (18) if present, and plate (17) from support ring (1) and "C" pillar support bracket (21).
8. Remove support ring (1) from vehicle.

**14-4. SUPPORT RING MAINTENANCE (Cont'd)**



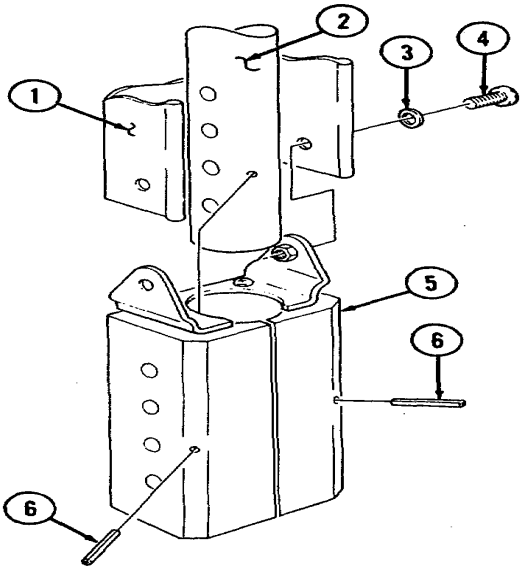
## 14-4. SUPPORT RING MAINTENANCE (Cont'd)

### b. Disassembly

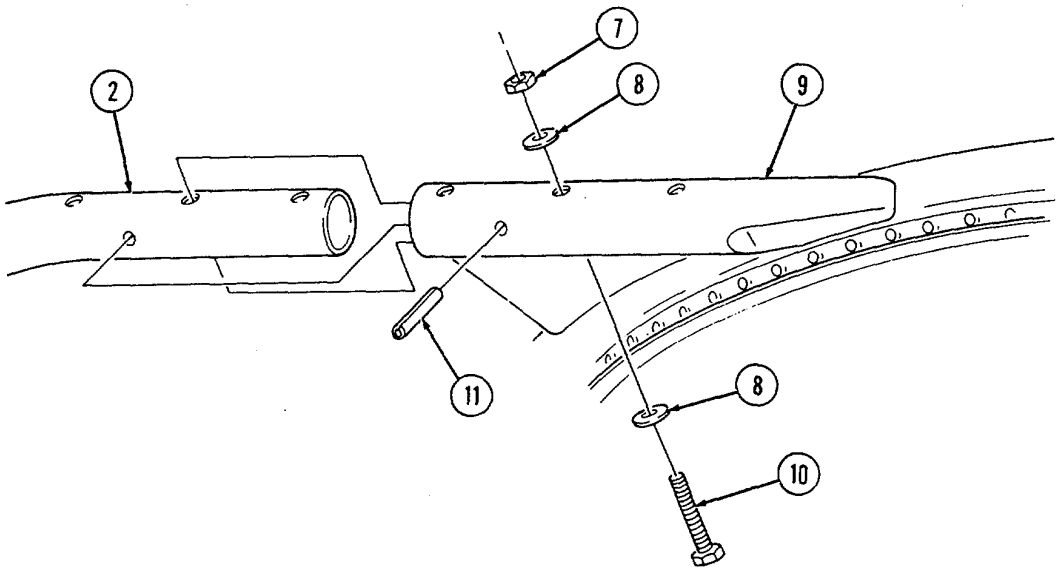
1. Remove four screws (4), washers (3), and two 'B" pillar support covers (1) from connecting blocks (5).
2. Remove four spring pins (6) and two connecting blocks (5) from two upper supports (2). Discard spring pins (6).
3. Remove six locknuts (7), washers (8), capscrews (10) and washers (8) from two upper supports (2) and support ring (9). Discard locknuts (7).
4. Remove two spring pins (11) and two upper supports (2) from support ring (9). Discard spring pins (11).
5. Remove eighteen capscrews (14), washers (15), and three turret lockrings (13) from support ring (9).
6. Remove four bushings (12) from support ring (9). Inspect bushings (12) for damage. Replace if damaged.

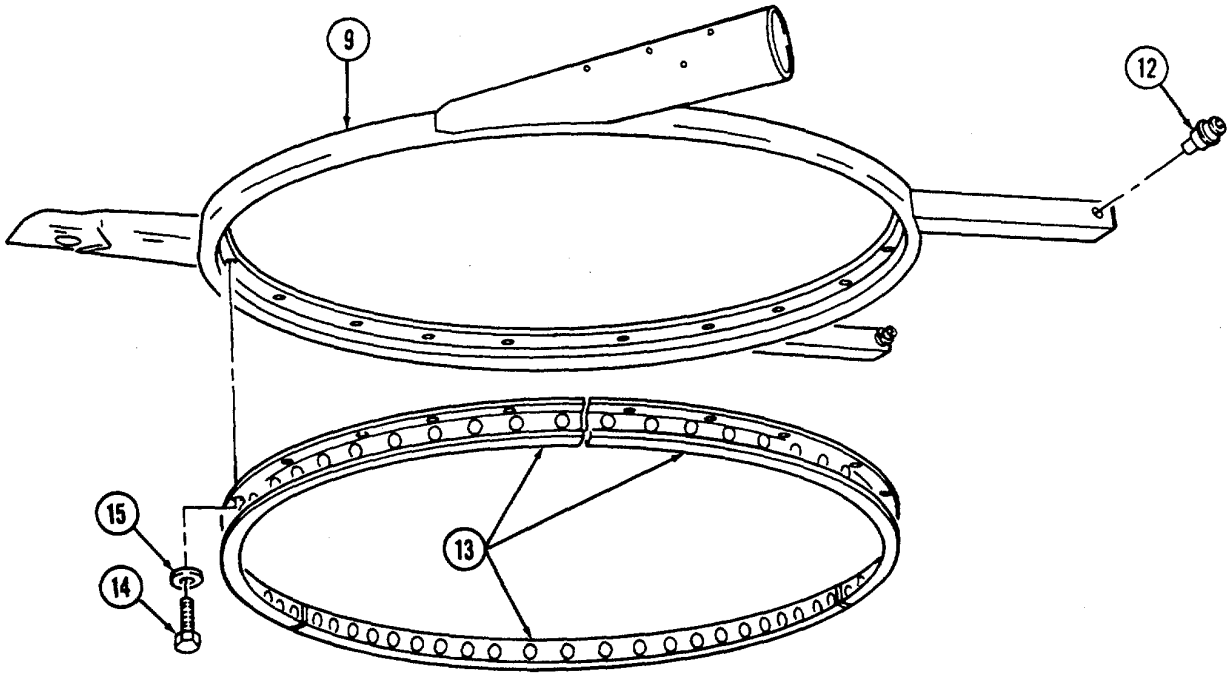
### c. Assembly

1. Install four bushings (12) on support ring (9).
2. Install three turret lockrings (13) on support ring (9) with eighteen washers (15) and capscrews (14). Tighten capscrews (14) to 37 lb-ft (50 N.m).
3. Install two upper supports (2) on support ring (9) with six washers (8), capscrews (10), washers (8), and locknuts (7). Finger tighten locknuts (7).
4. Install two connecting blocks (5) on upper supports (2).
5. Install two 'B" pillar support covers (1) on connecting blocks (5) with four washers (3) and screws (4). Finger tighten screws (4).



**14-4. SUPPORT RING MAINTENANCE (Cont'd)**



## 14-4. SUPPORT RING MAINTENANCE (Cont'd)

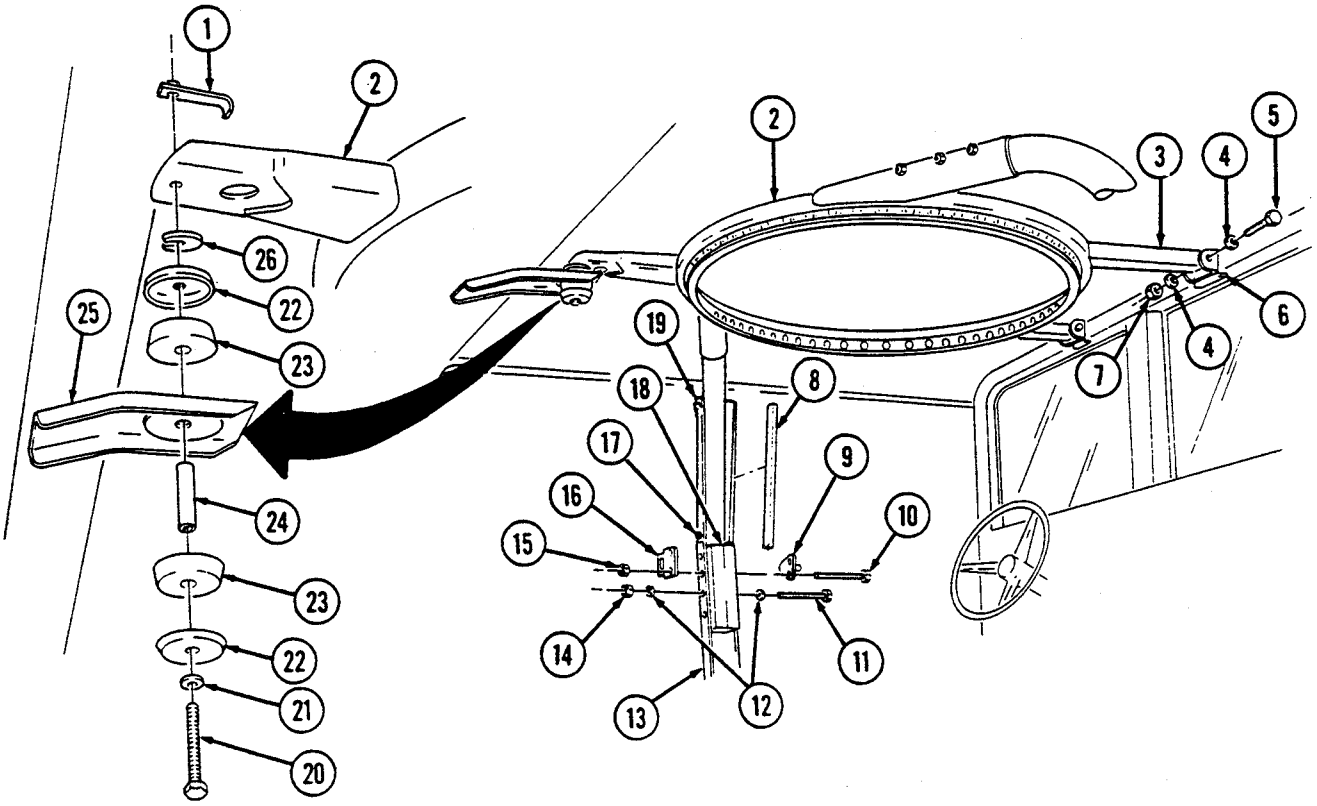
**d. Installation**

1. Install support ring (2) on vehicle.
2. Install support ring (2) on “C” pillar support bracket (25) with plate (1), shim(s) (26) if removed, snubber (22), mount (23), bushing (24), mount (23), snubber (22), washer (21), and capscrew (20). Finger tighten capscrew (20).
3. Install two front supports (3) on front mounting clevises (6) with two washers (4), capscrews (5), washers (4), and locknuts (7).
4. Install roof (para. 14-3).
5. Tighten two locknuts (7) to 26 lb-ft (35 N•m).
6. Install two connecting blocks (18) to “B” pillars (13) with four washers (12), capscrews (11), washers (12), and locknuts (14). Tighten locknuts (14) to 21 lb-ft (29 N•m).
7. Tighten four screws (17) securing “B” pillar covers (19) to 15 lb-ft (20 N•m).
8. Install two striker plates (9) and two strap brackets (16) to “B” pillars (13) with four capscrews (10) and locknuts (15). Tighten locknuts (15) to 21 lb-ft (29 N•m).
9. Install four edge trim strips (8) on “B” pillar covers (19).

**NOTE**

Perform steps 10 and 11 for M966, M966A1, M1036, M1045, M1045A1, M1045A2, M1046, and M1046A1 TOW vehicles only.

10. Install TOW wiring harness clamp (29) to right “B” pillar cover (19) with screw (32) and assembled locknut (30).
11. Install cable stowage cleat (31) to support ring (2) with two washers (28) and capscrews (27). Tighten capscrews (27) to 6 lb-ft (8 N•m).



**14-4. SUPPORT RING MAINTENANCE (Cont'd)**

12. Tighten six locknuts (34) on support ring (2) and upper supports (33) to 37 lb-ft (50 N.m).

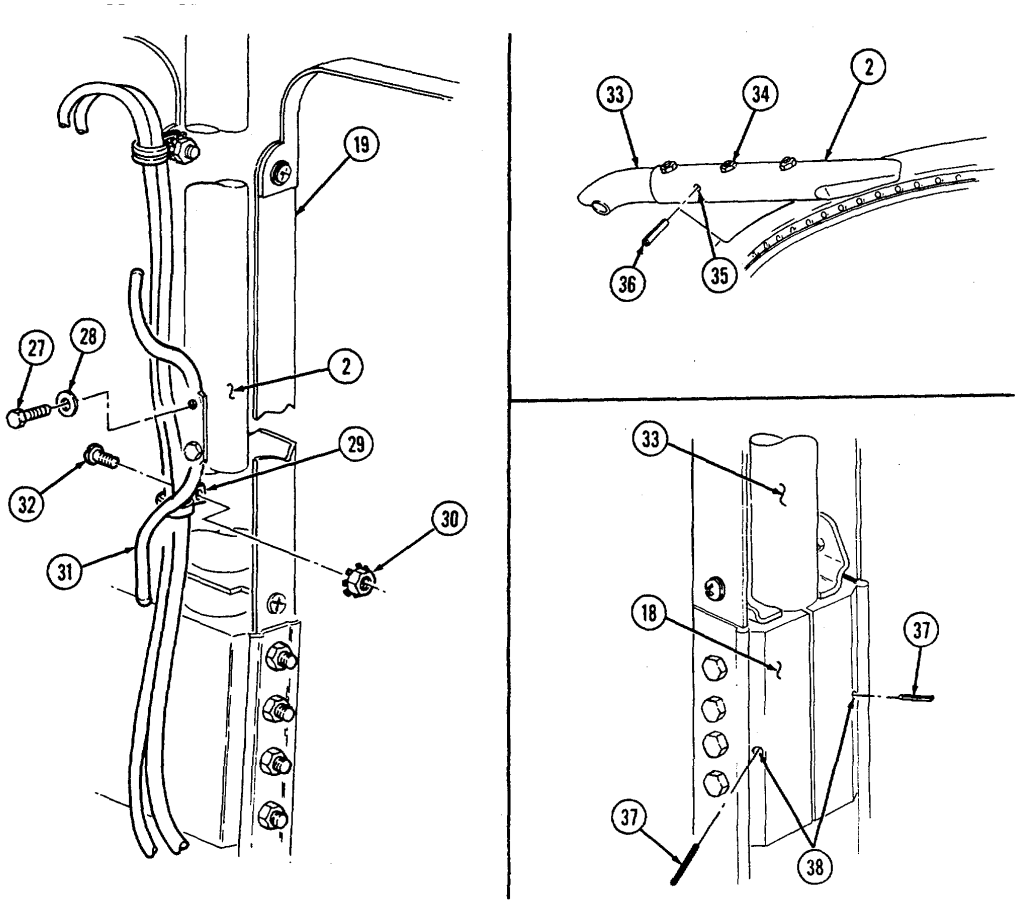
13. Tighten capscrew (20) on support ring (2) and "C" pillar support bracket (25) to 37 lb-ft (50 N.m).

**NOTE**

It may be necessary to drill new holes into upper supports to allow spring pins to be inserted.

14. Insert four spring pins (37) through spring pin holes (38) in two connecting blocks (18). Drive ends of spring pins (37) into upper supports (33). Ensure ends of spring pins (37) are even with surface of connecting blocks (18).

15. Insert two spring pins (36) through spring pin holes (35) in support ring (2). Drive spring pins (36) into upper supports (33). Ensure ends of spring pins (36) are even with surface of support ring (2).




FOLLOW-ON TASKS: Install turret bearing (TM 9-2320-280-20).
Adjust striker plates (TM 9-2320-280-20).

## 14-5. WINDSHIELD MAINTENANCE

**This task covers:**

**a. Removal**
**b. Disassembly**
**c. Assembly**
**d. Installation**

**INITIAL SETUP:**

**Applicable Models**
All except M996, M996A1, M997, M997A1, M997A2, M998, M998A1, M1035, M1035A1, M1035A2, M1037, M1038, M1038A1, M1042, M1097, M1097A1, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Four locknuts (Appendix E, Item 63)
Assembled locknut (Appendix E, Item 85)
Six lockwashers (Appendix E, Item 88)
Twenty-seven blind rivets (Appendix E, Item 197)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

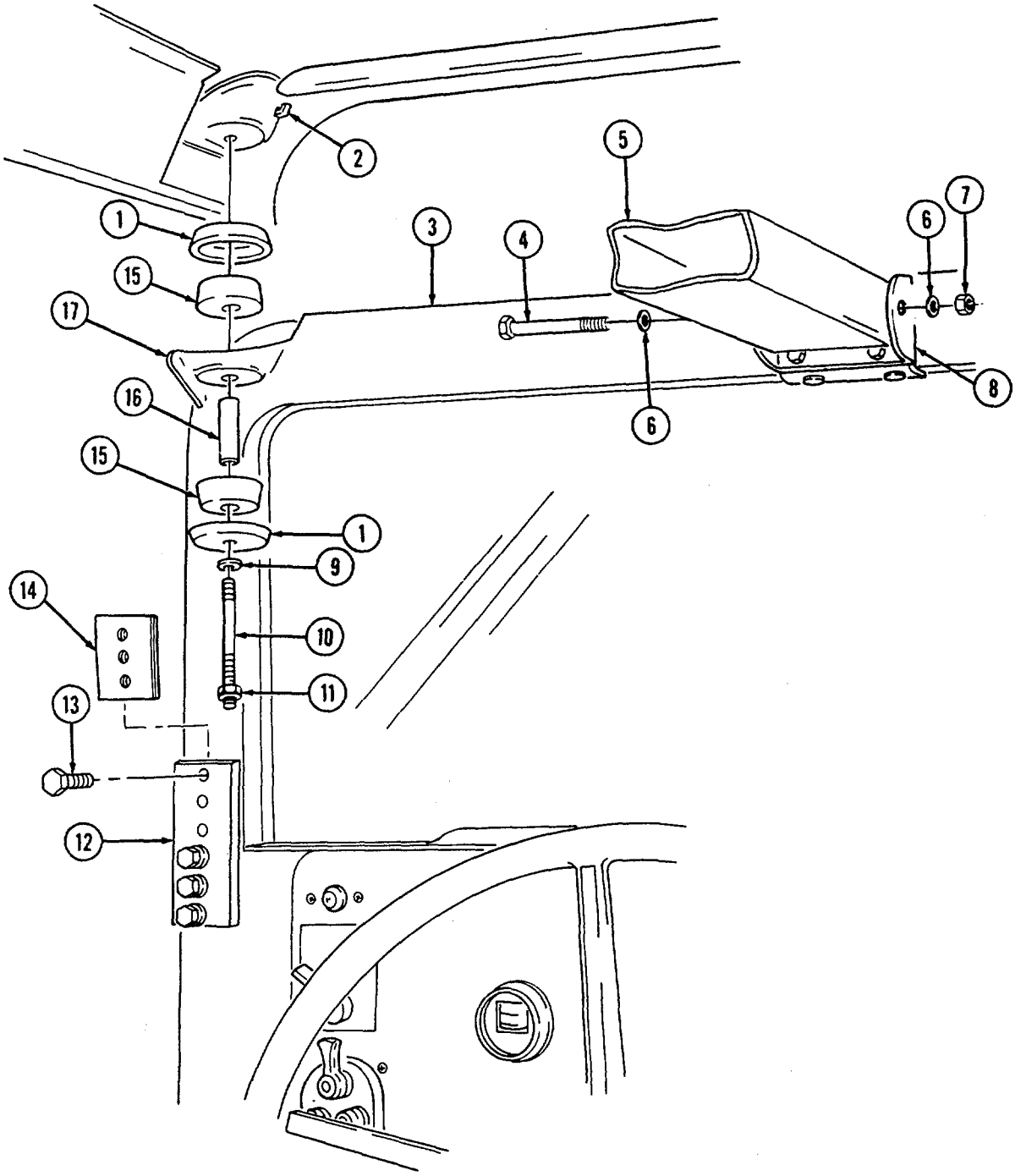
**Equipment Condition**
- Wiper arms removed (TM 9-2320-280-20).
- Left defroster nozzle removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

### a. Removal

1. Remove six capscrews (13) from two rear windshield mounting brackets (12) and windshield (3). Remove shims (14) from behind mounting brackets (12), if present.
2. Remove two locknuts (7), washers (6), capscrews (4), washers (6), and ring front supports (5) from windshield clevises (8). Discard locknuts (7).
3. Remove two locknuts (11), studs (10), washers (9), snubber plates (1), mounts (15), bushings (16), mounts (15), snubber plates (1), and front roof mount plates (2) from windshield support mounts (17). Discard locknuts (11).

**14-5. WINDSHIELD MAINTENANCE (Cont'd)**

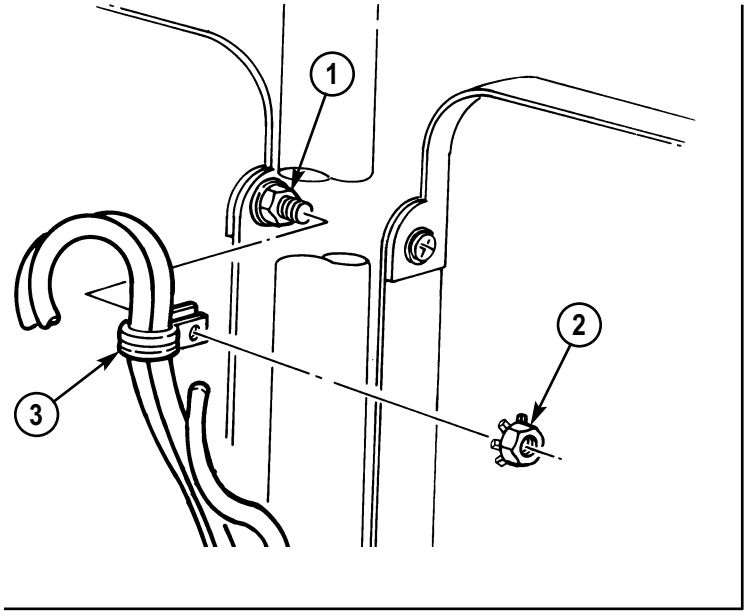


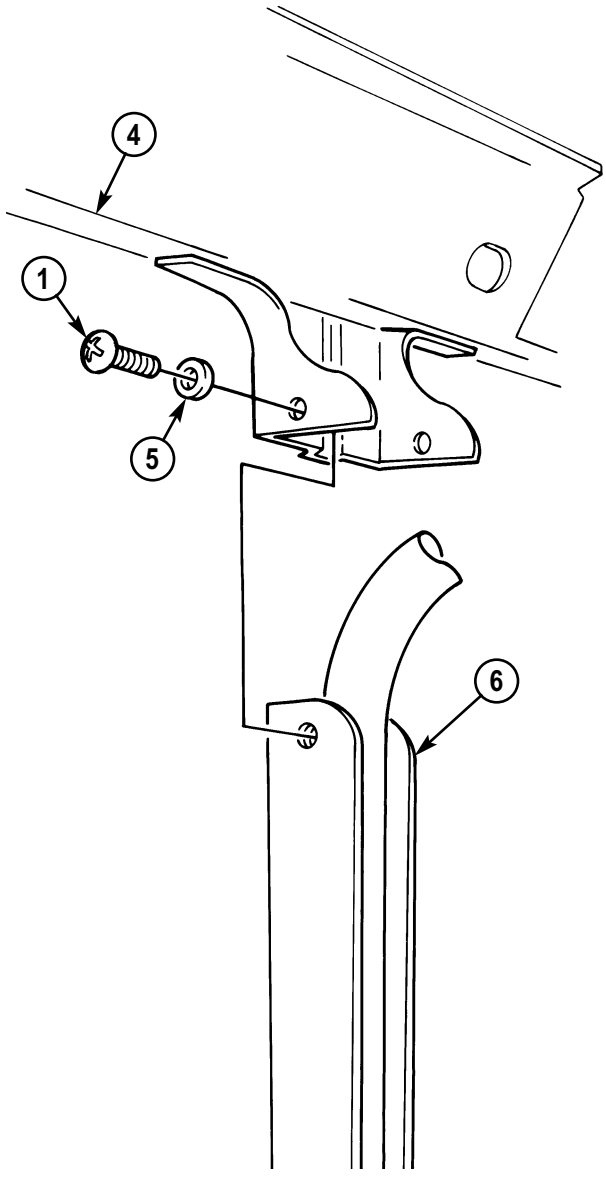
## 14-5. WINDSHIELD MAINTENANCE (Cont'd)

**NOTE**

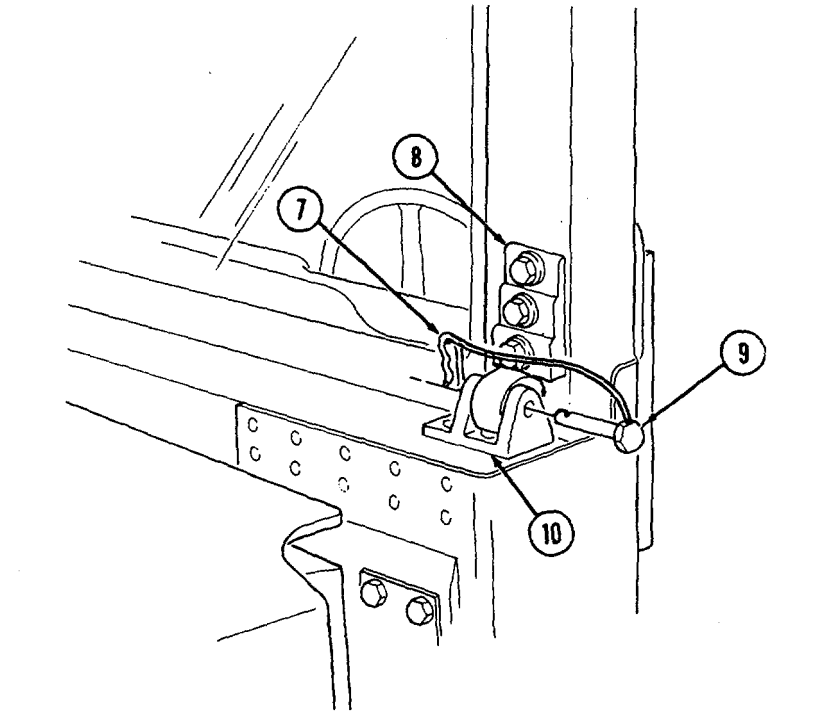
Perform step 4 for M966, M966A1, M1036, M1045, M1045A1, M1045A2, M1046, and M1046A1 TOW vehicles only.

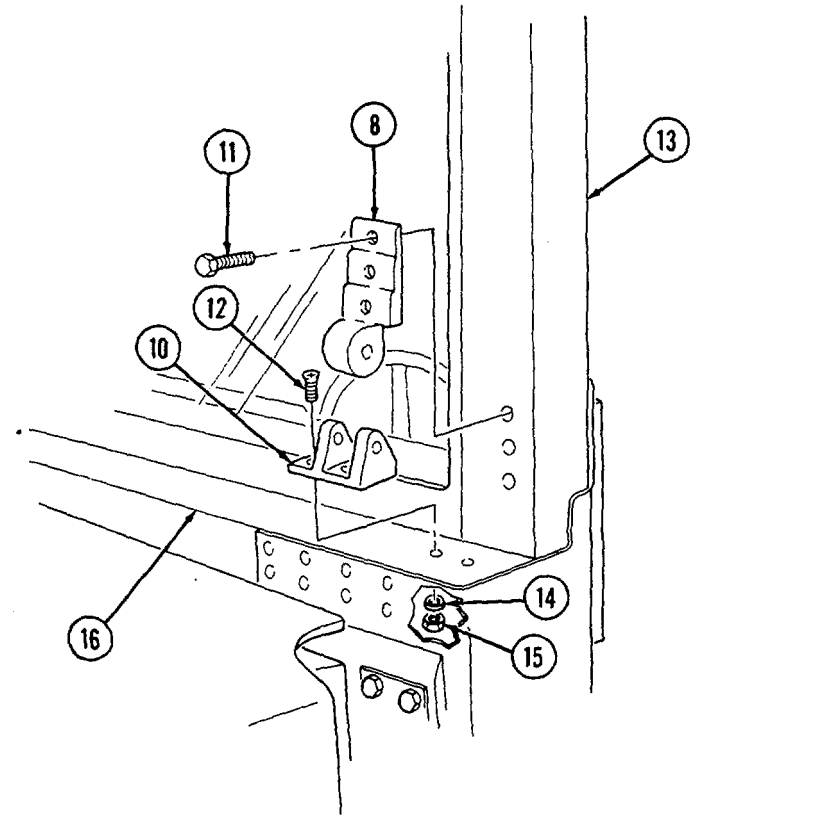
4. Remove assembled locknut (2) and TOW wiring harness clamp (3) from screw (1) (right side only). Discard assembled locknut (2).
5. Remove four screws (1), washers (5), and roof (4) from two "B" pillar support covers (6).
6. Remove three hitch pins (7) and windshield hinge pins (9) from front hinges (8) and lower hinges (10).
7. Remove nine capscrews (11) and three windshield frame front hinges (8) from windshield frame (13).
8. Remove six nuts (15), lockwashers (14), flat head screws (12), and three windshield lower hinges (10) from "A" beam (16). Discard lockwashers (14).



**14-5. WINDSHIELD MAINTENANCE (Cont'd)**



**14-5. WINDSHIELD MAINTENANCE (Cont'd)**

8. Raise and support front of roof (2) to allow removal of windshield (1).

9. Pull windshield (1) forward. Remove grommet (3) from "A" beam (9) and disconnect leads 71 (4), 71B (5), and 57F (7) from body harness (6).

10. Remove windshield (1).

b. Disassembly

1. Remove eight capscrews (13), washers (12), two clevises (11) and shim(s) (10) if present, from windshield (1)
2. Remove windshield wiper arm pivots (TM 9-2320-280-20).
3. Remove grommet (3) and jumper harness (8) from windshield (1).
4. Remove seals (17) and (18) from windshield (1).

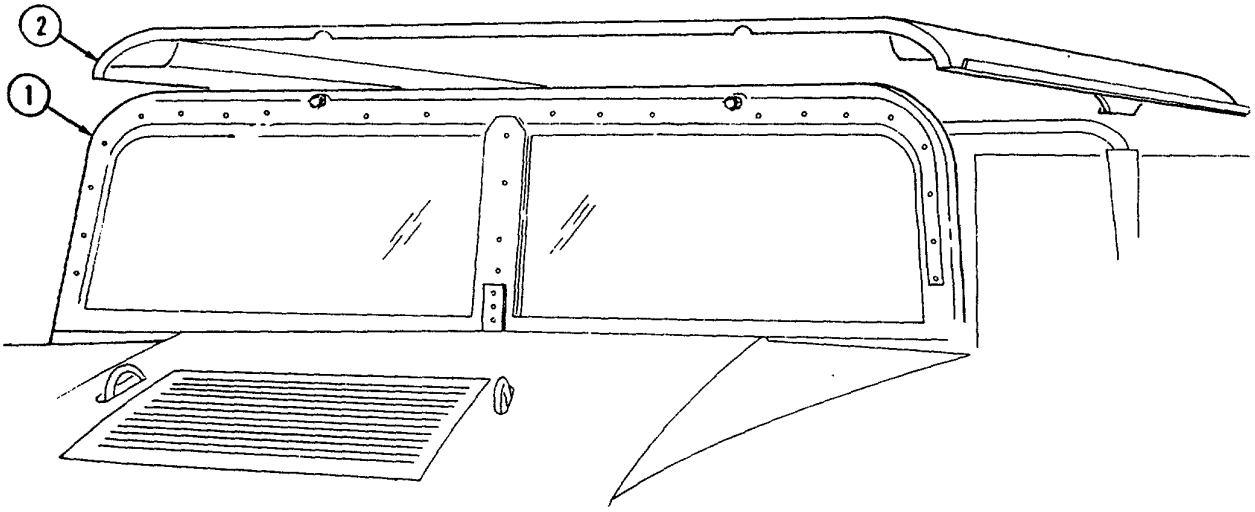
**NOTE**

For instructions on replacement of rivets, refer to para. 22-7.

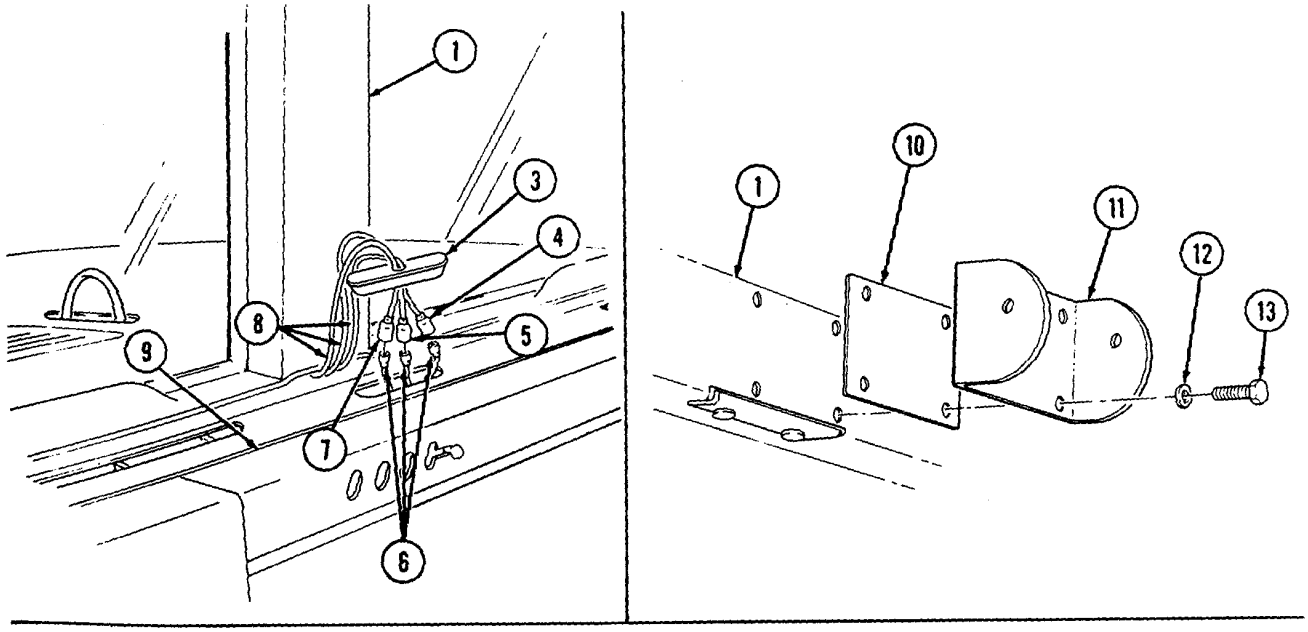
5. Remove twenty-seven rivets (16), retainer (15), and seal (14) from windshield (1).

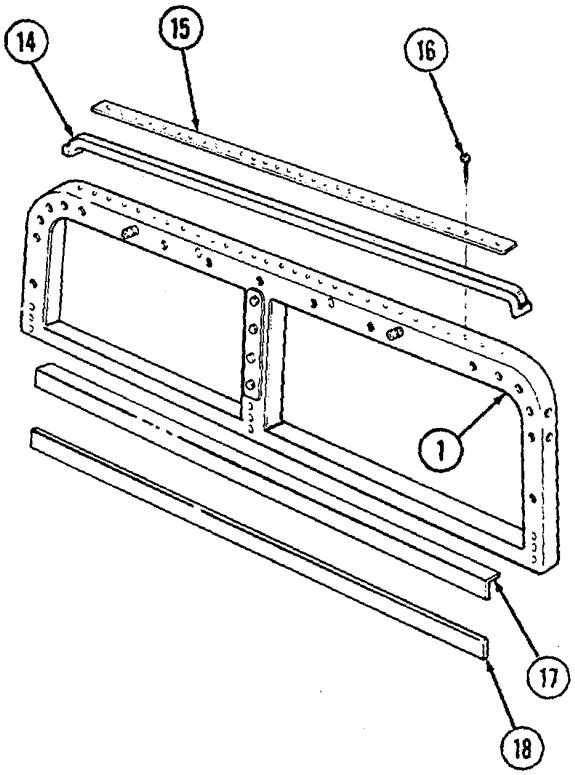
c. Assembly

1. Install seal (14) and retainer (15) on windshield (1) with twenty-seven rivets (16).
2. Apply seals (17) and (18) to bottom of windshield (1).
3. Install jumper harness (8) and grommet (3) in windshield (1).
4. Install windshield wiper arm pivots (TM 9-2320-280-20), but do not install wiper arms.
5. Install shim(s) (10), ifremoved, and two devises (11) on windshield (1) with eight washers (12) and capscrews (13). Tighten capscrews (13) to 15 lb-ft (20 N-m).



**14-5. WINDSHIELD MAINTENANCE (Cont'd)**



**14-5. WINDSHIELD MAINTENANCE (Cont'd)**

d. Installation

1. Position windshield (1) on vehicle hood (8). Connect leads 71 (4), 71B (5), and 57F (2) to body harness (6) and install grommet (3) in "A" beam (7).

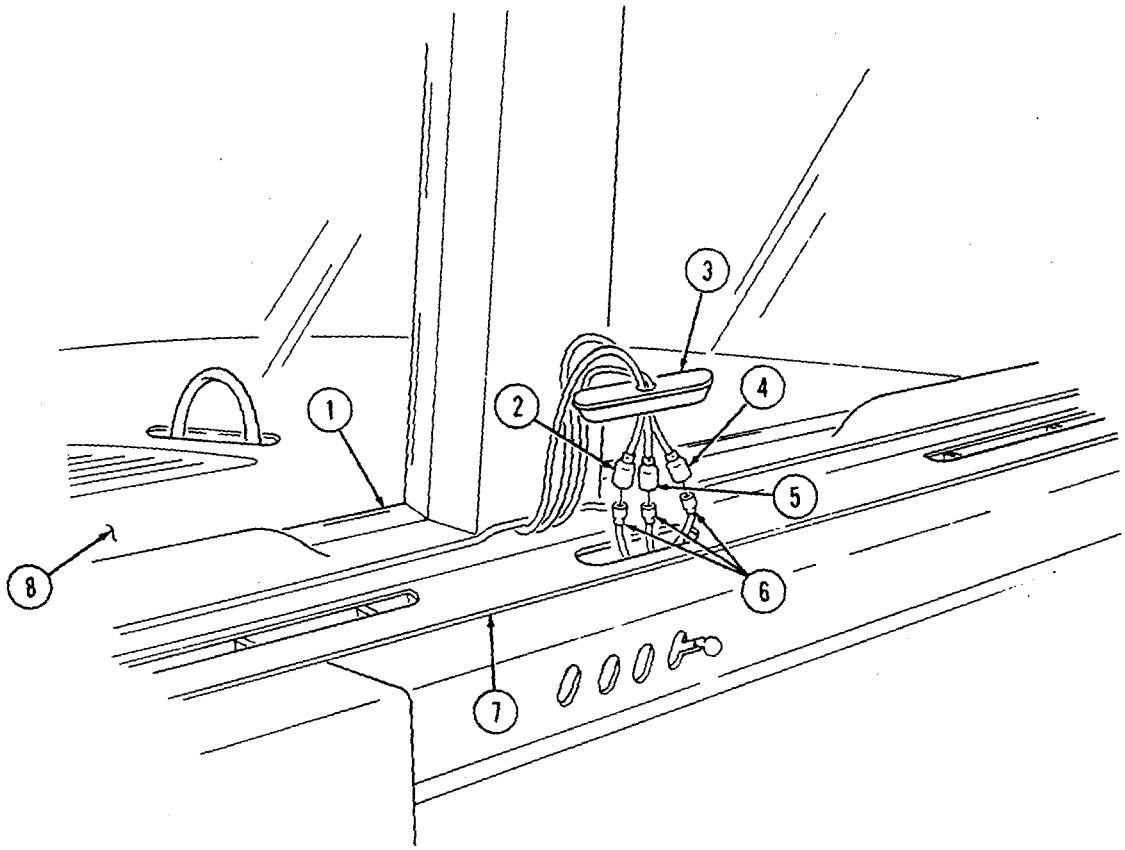
2. Raise and support front of roof (9) to allow installation of windshield (1).

3. Slide windshield (1) into mounting position between roof (9) and "A" beam (7).

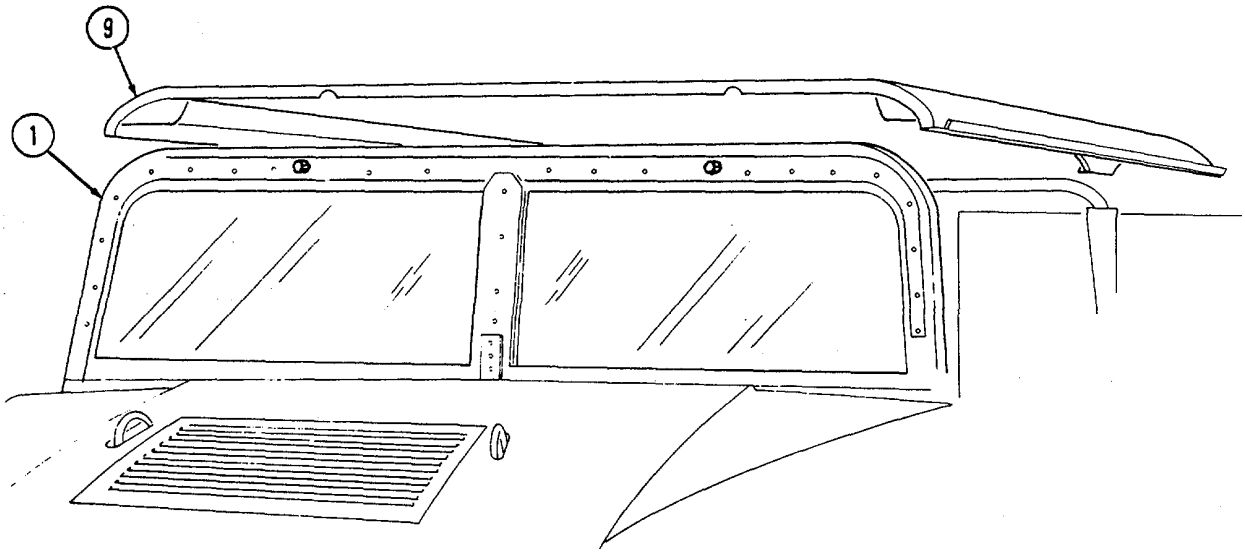
4. Lower front of roof (9) and install two windshield levises (14) on two ring front supports (11) with two washers (12), capscrews (10), washers (12), and locknuts (13).

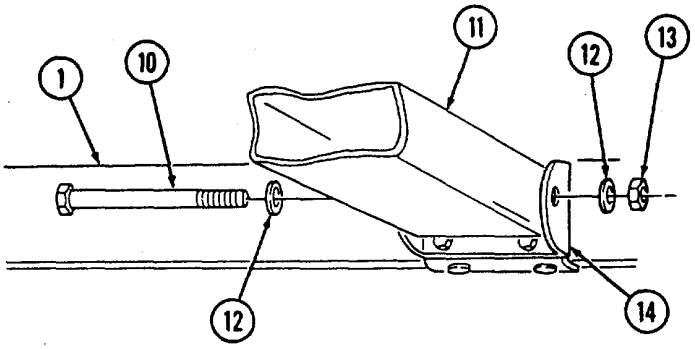
5. Install three lower hinges (19) to "A" beam (7) with six flat head screws (20), lockwashers (17), and nuts (18). Tighten flat head screws (20) to 8 lb-ft (11 N.m).

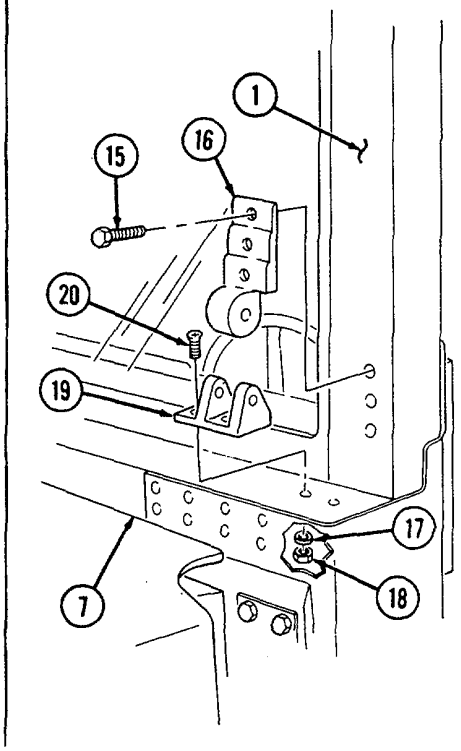
6. Install three front hinges (16) to windshield (1) with nine capscrews (15). Tighten capscrews (15) to 15 lb-ft (20 N.m).



**14-5. WINDSHIELD MAINTENANCE (Cont'd)**



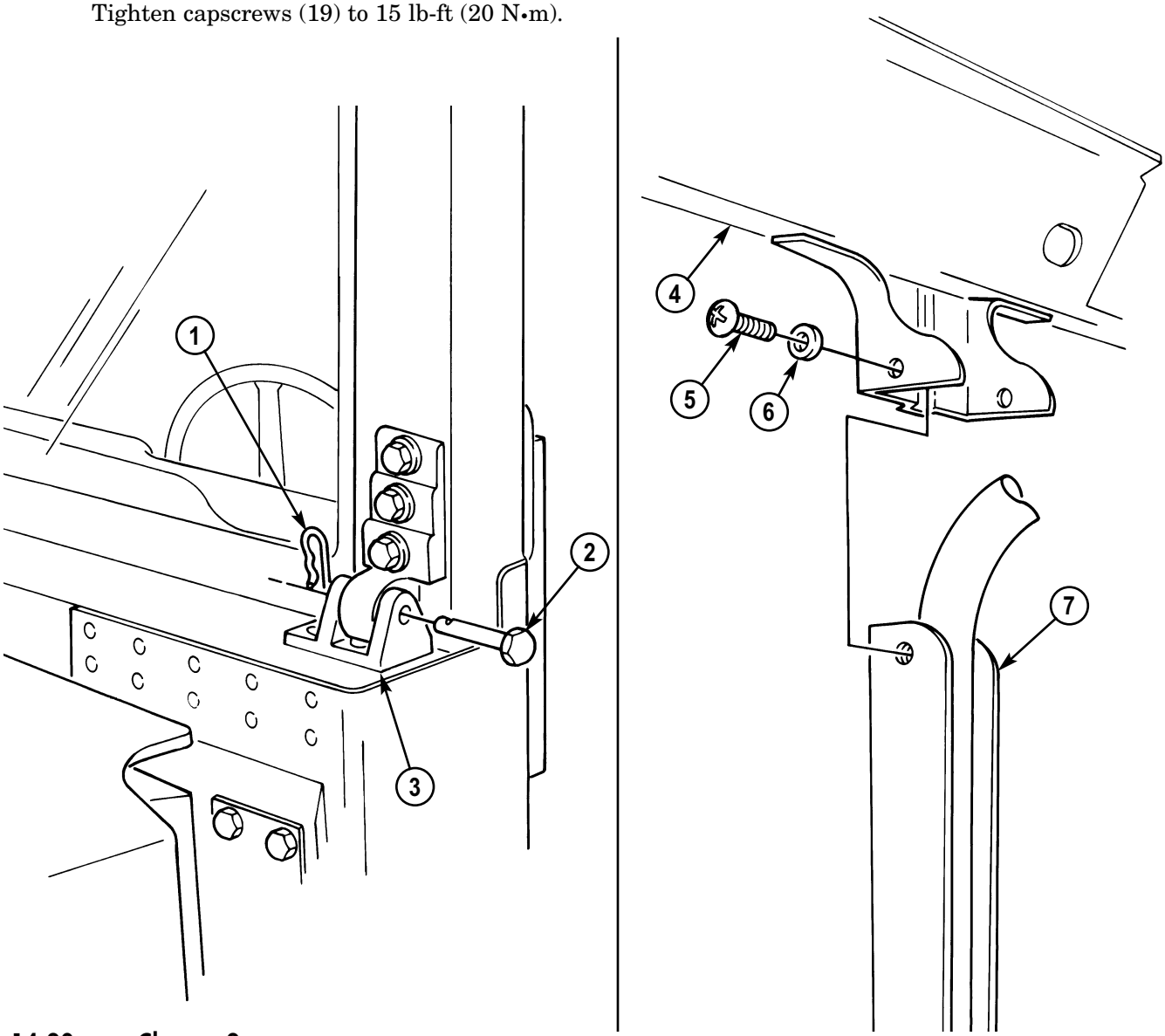
## 14-5. WINDSHIELD MAINTENANCE (Cont'd)

7. Install three hinge pins (2) in lower hinges (3) with three hitch pins (1).
8. Install two “B” pillar covers (7) on roof (4) with four washers (6) and screws (5). Tighten screws (5) to 15 lb-ft (20 N•m).

**NOTE**

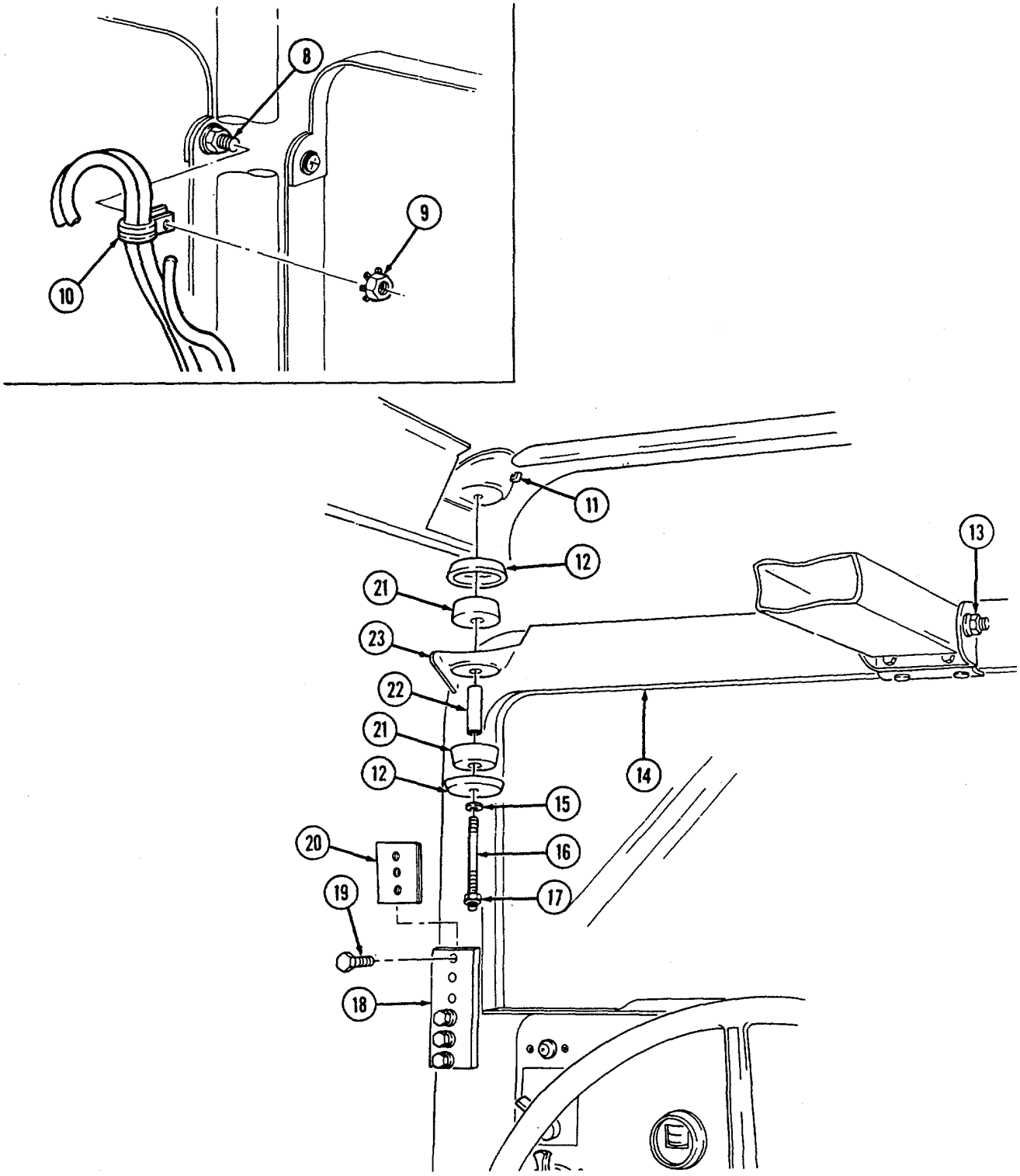
Perform step 9 for M966, M966A1, M1036, M1045, M1045A1, M1045A2, M1046,and M1046A1 TOW vehicles.

9. Install TOW wiring harness clamp (10) on right side front “B” pillar cover screw (8) with assembled locknut (9).
10. Install two bushings (22) four mounts (21) and snubber plates (12) on windshield support mounts (23) and roof mounting plates (11) with two washers (15), studs (16), and locknuts (17). Tighten locknuts (17) to 37 lb-ft (50 N•m).
11. Tighten two locknuts (13) to 26 lb-ft (35 N•m).
12. Place shims (20) between rear windshield mounting brackets (18) and windshield (14) as required to fill gap.
13. Install two rear windshield mounting brackets (18) on windshield (14) with six capscrws (19). Tighten capscrews (19) to 15 lb-ft (20 N•m).



**14-5. WINDSHIELD MAINTENANCE (Cont'd)**

FOLLOW-ON TASKS: Install wiper arms (Install wiper arms (TM 9-2320-280-20).
Install left defroster nozzle (TM 9-2320-280-20).



# 14-6. CARGO SHELL REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
All except M996, M996A1, M997, M997A1, M997A2, M998, M998A1, M1035, M1035A1, M1035A2, M1037, M1038, M1038A1, M1042, M1097, M1097A1, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Eight locknuts (Appendix E, Item 63)
Nine locknuts (Appendix E, Item 55)
Four locknuts (Appendix E, Item 57)
Seven blind rivets (Appendix E, Item 191)
Assembled locknut (Appendix E, Item 85)
Grease (Appendix B, Item 21)
Adhesive tape (Appendix B, Item 58)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Cargo shell door removed (TM 9-2320-280-20).
- Front and rear strikers removed (TM 9-2320-280-20).
- Antenna removed (TM 9-2320-280-20), if present.
- Dovetail spring removed (TM 9-2320-280-20).

M966, M966A1, M1036, M1045, M1045A1, M1045A2, M1046, and M1046A1 only:
- M16 ammo rack removed, left cargo shell only (TM 9-2320-280-20).

M1043, M1043A1, M1043A2, M1044, and M1044A1 only:
- Ammo box tray removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

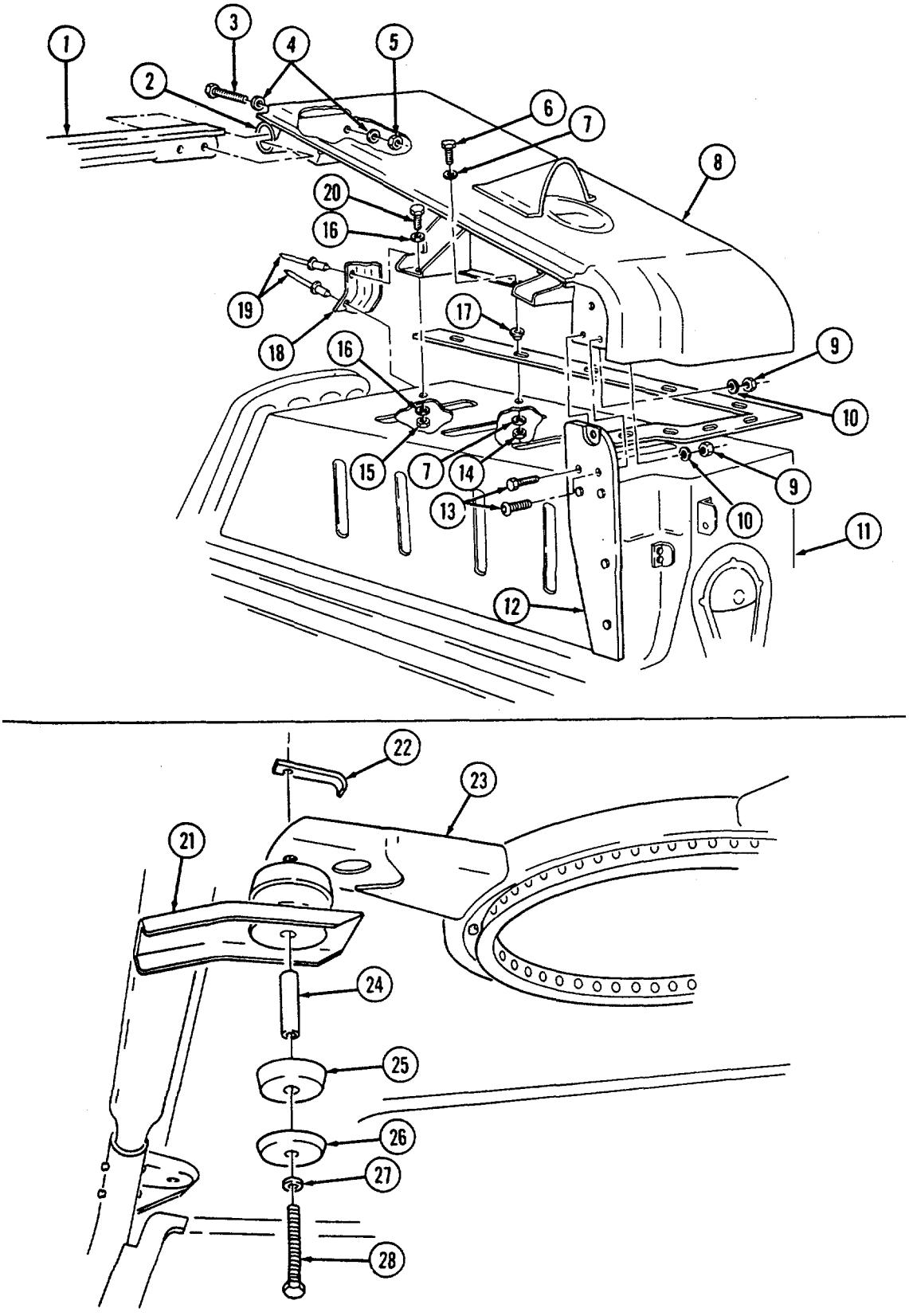
**NOTE**

- The procedures for removing and installing the right cargo shell and left cargo shell are basically the same. This procedure covers the right cargo shell.
- For instructions on replacement of rivets, refer to para. 22-7.

**a. Removal**

1. Remove seven rivets (19) and panel (18) from cargo shell (8) and wheelhouse (11).
2. Remove two locknuts (9), washers (10), and screws (13) from cargo shell (8) and striker mounting plate (12). Discard locknuts (9).
3. Remove nine locknuts (14), washers (7), capscrews (6), washers (7), and spacers (17) from cargo shell (8) and wheelhouse (11). Discard locknuts (14).
4. Remove two locknuts (15), washers (16), capscrews (20), and washers (16) from cargo shell support tube (2) and wheelhouse (11). Discard locknuts (15).
5. Remove two locknuts (5), washers (4), capscrews (3), and washers (4) from cargo shell support tube (2) and “C” pillar (1). Discard locknuts (5).
6. Remove capscrew (28), washer (27), snubber (26), mount (25), bushing (24), and plate (22) from rear ring support (23) and “C” pillar support bracket (21).

**14-6. CARGO SHELL REPLACEMENT (Cont'd)**



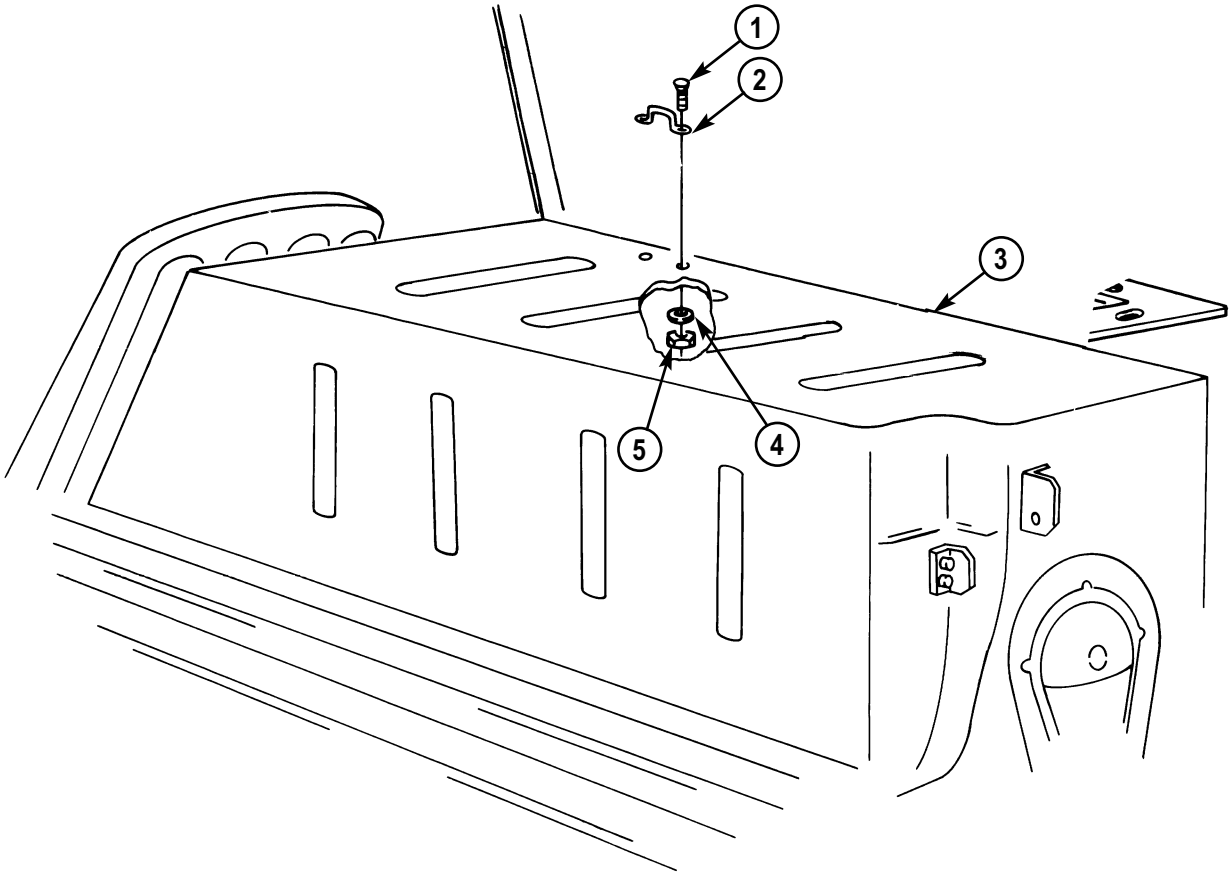
## 14-6. CARGO SHELL REPLACEMENT (Cont'd)

7. Remove two nuts (5), washers (4), screws (1), and footman loop (2) from wheelhouse (3).
8. Remove two locknuts (16), studs (15), washers (14), snubber plates (13), mounts (12), and bushings (11) from support tubes (10) to roof (9). Discard locknuts (16).

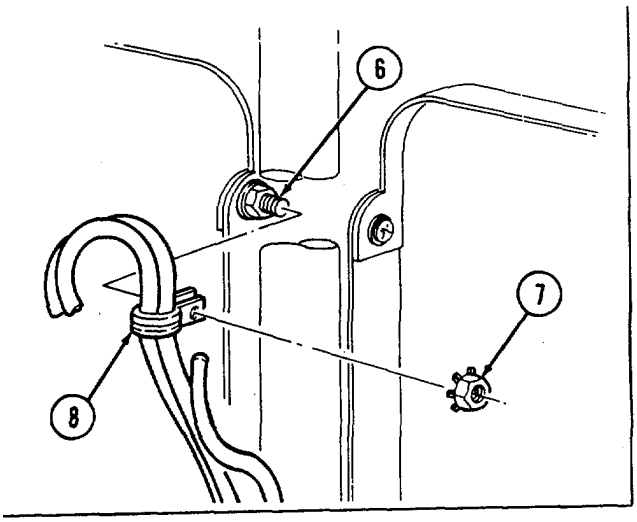
**NOTE**

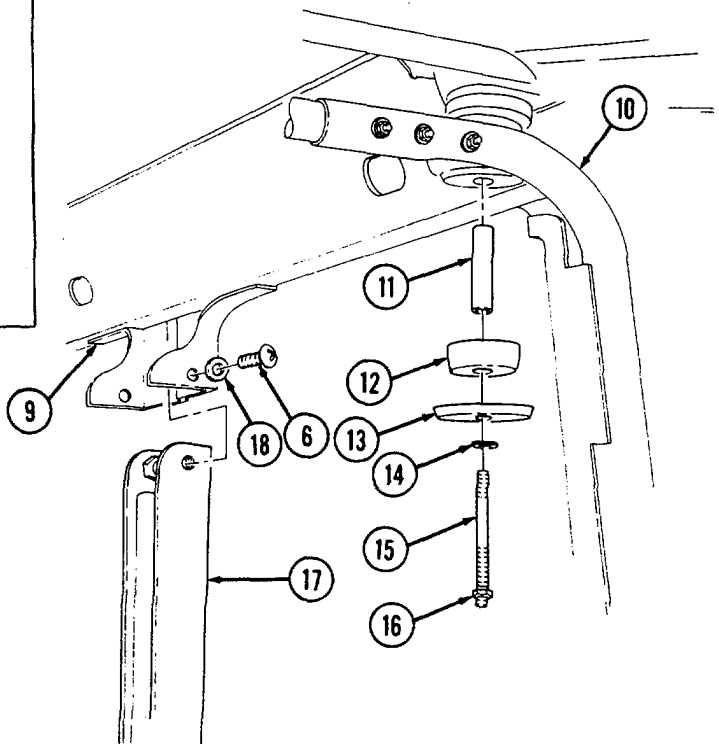
Perform step 9 for M966, M966A1, M1036, M1045, M1045A1, M1045A2, M1046, and M1046A1 TOW vehicles only.

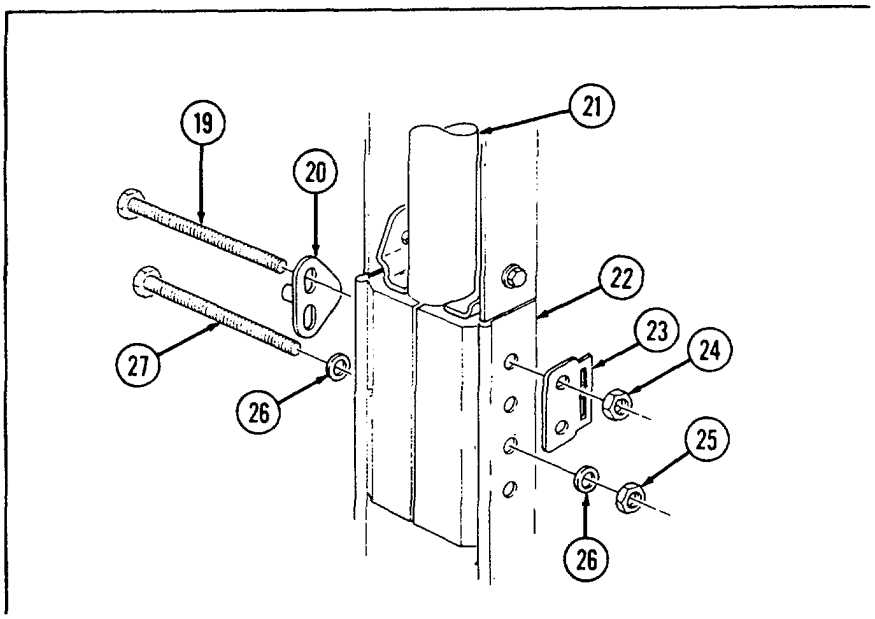
9. Remove assembled locknut (7) and TOW wiring harness clamp (8) from "B" pillar cover screw (6). Discard assembled locknut (7).
10. Remove four screws (6), washers (18), and roof (9) from "B"pillar covers (17).
11. Remove two locknuts (25), washers (26), capscrews (27), washers (26), and support tube (21) from right "B" pillar (22). Discard locknuts (25).
12. Remove two locknuts (24), capscrews (19), striker plate (20), and strap bracket (23) from right "B" pillar (22). Discard locknuts (24).



**14-6. CARGO SHELL REPLACEMENT (Cont'd)**



## 14-6. CARGO SHELL REPLACEMENT (Cont'd)

13. Remove mount (4), snubber (3), and shim(s) (2) if present, from between rear ring support (1) and "C" pillar support bracket (5).
14. Remove two mounts (11) and snubbers (10) from between right and left rear roof mounts (7) and cargo shell support tubes (12).

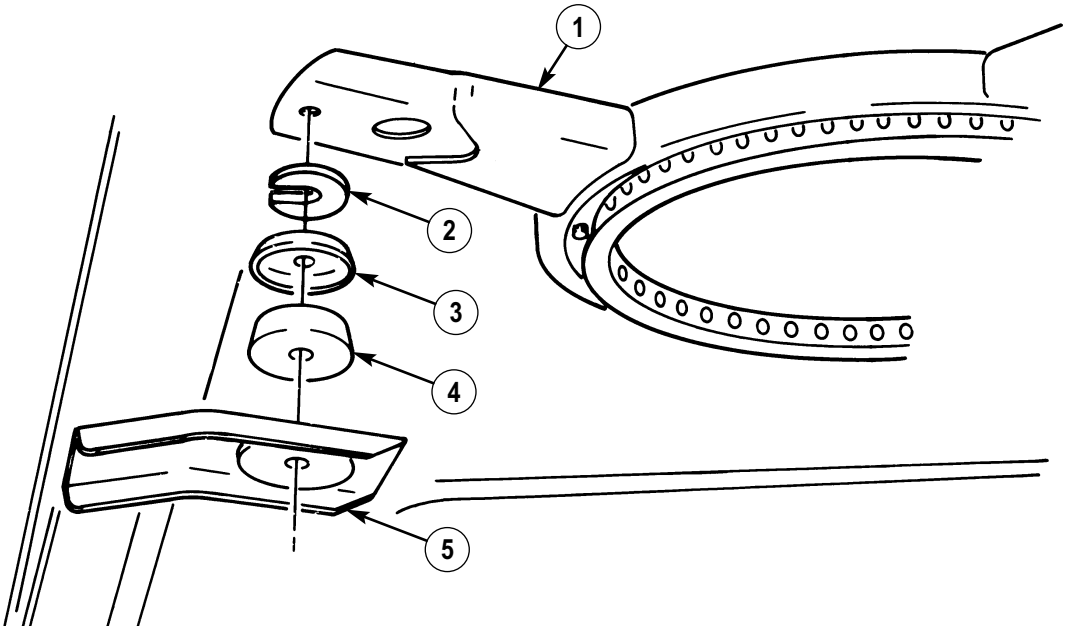
**CAUTION**

Do not lift cargo shell further than limits specified in step 16.
Raising cargo shell too far may cause damage to "C"pillar.

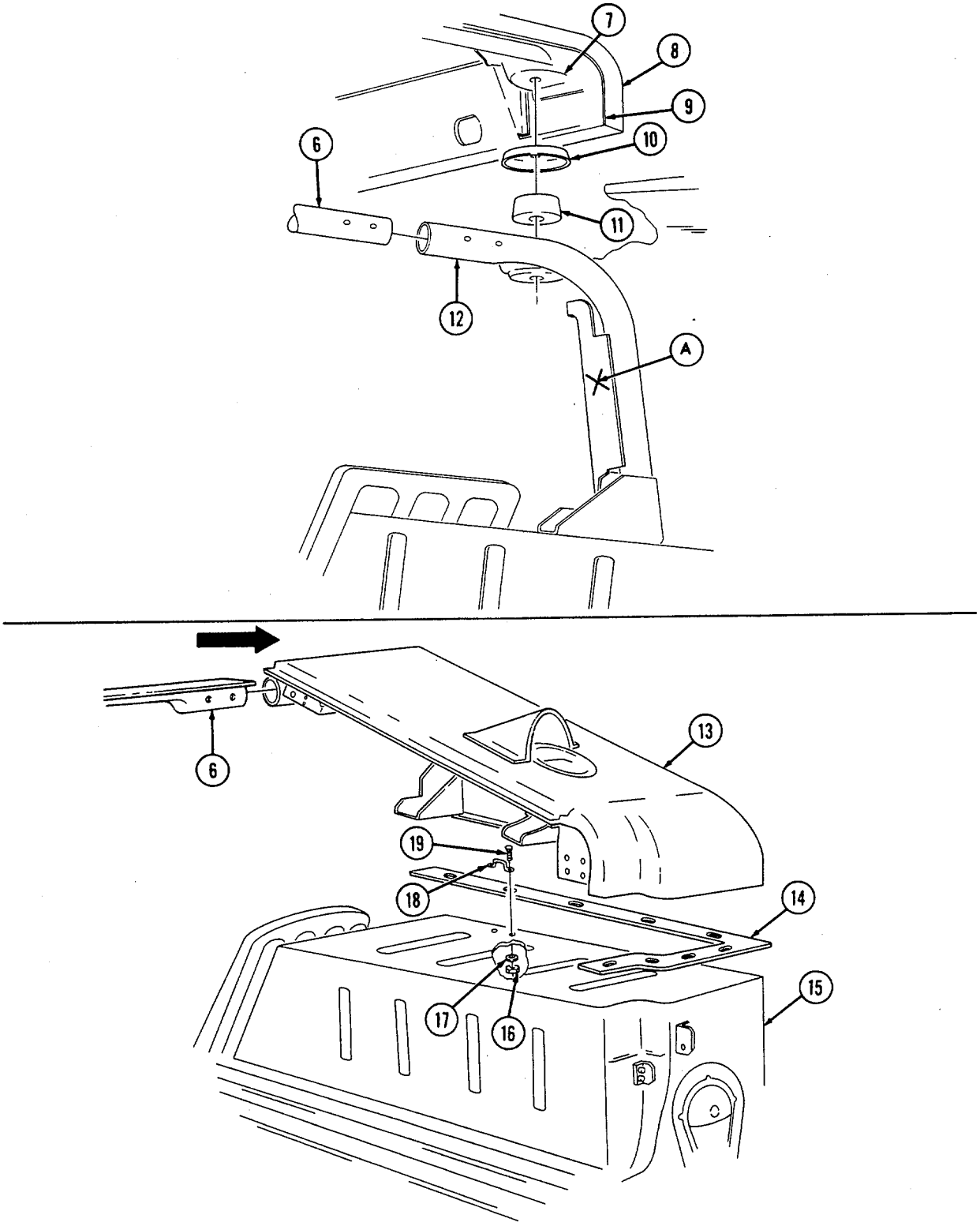
15. Lift roof (8) far enough to allow cargo shell (13) to clear lip (9).
16. Raise cargo shell (13) approximately 1 in. (2.5 cm) and rap cargo shell support tube (12) at point "A" with a mallet to loosen cargo shell (13), taking care not to bend "C" pillar (6). Remove cargo shell (13).
17. Remove cargo shell seal (14) and inspect for damage. Replace if damaged.
18. Remove adhesive tape from cargo shell (13). Discard tape.

**b. Installation**

1. Apply adhesive tape to cargo shell (13) and wheelhouse (15) mounting surface.
2. Coat inside surface of support tube (12) that makes contact with outside surface of "C" pillar (6) with grease.
3. Raise and support roof (8).
4. Lift rear of cargo shell (13) slightly while installing cargo shell support tube (12) over "C" pillar (6).
5. Align cargo shell seal (14) between cargo shell (13) and wheelhouse (15).
6. When cargo shell support tube (12) is installed over "C" pillar (6) and cargo shell (13) is aligned with wheelhouse (15) lower cargo shell (13) ensuring cargo shell (13) is inside of lip (9) at roof (8).
7. Install snubber (3), mount (4), and shim(s) (2) if removed, between rear ring support (1) and "C" pillar support bracket (5).
8. Install two snubbers (10) and mounts (11) between right and left rear roof mounts (7) and cargo shell support tube (12).
9. Install footman loop (18) to wheelhouse (15) with two screws (19), washers (17), and nuts (16).



**3 - 4. LEFT CYLINDER HEAD REPAIR (Cont'd)**



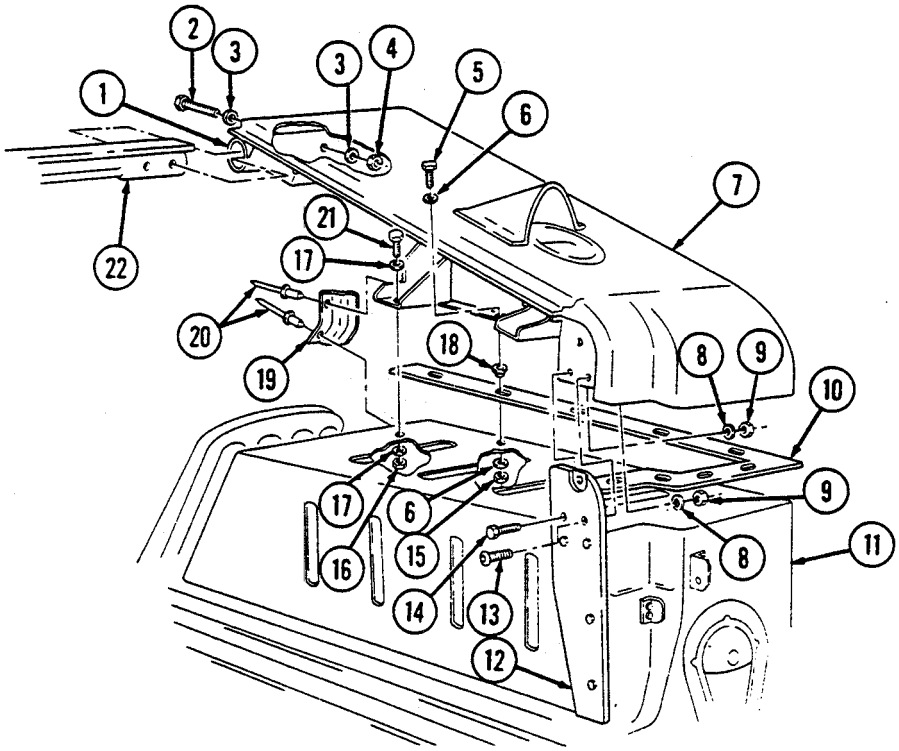
## 14-6. CARGO SHELL REPLACEMENT (Cont'd)

10. Install support tube (1) to “C” pillar (22) with two washers (3), capscrews (2), washers (3), and locknuts (4).
11. Install cargo shell support tube (1) to wheelhouse (11) with two washers (17), capscrews (21), washers (17), and locknuts (16).
12. Install seal (10) and cargo shell (7) to wheelhouse (11) with nine washers (6), capscrews (5), spacers (18), washers (6), and locknuts (15). Tighten locknuts (15) to 85-110 lb-in. (10-12 N·m).
13. Install support tube (45) to right “B” pillar (46) with two washers (50), capscrews (51), washers (50), and locknuts (49).
14. Install striker plate (44) and strap bracket (47) to right “B” pillar (46) with two capscrews (43) and locknuts (48). Tighten locknuts (48) and (49) to 21 lb-ft (29 N·m).
15. Install roof (23) to “B” pillar cover (30) with four washers (31) and screws (32). Tighten screws (32) to 15 lb-ft (20 N·m).

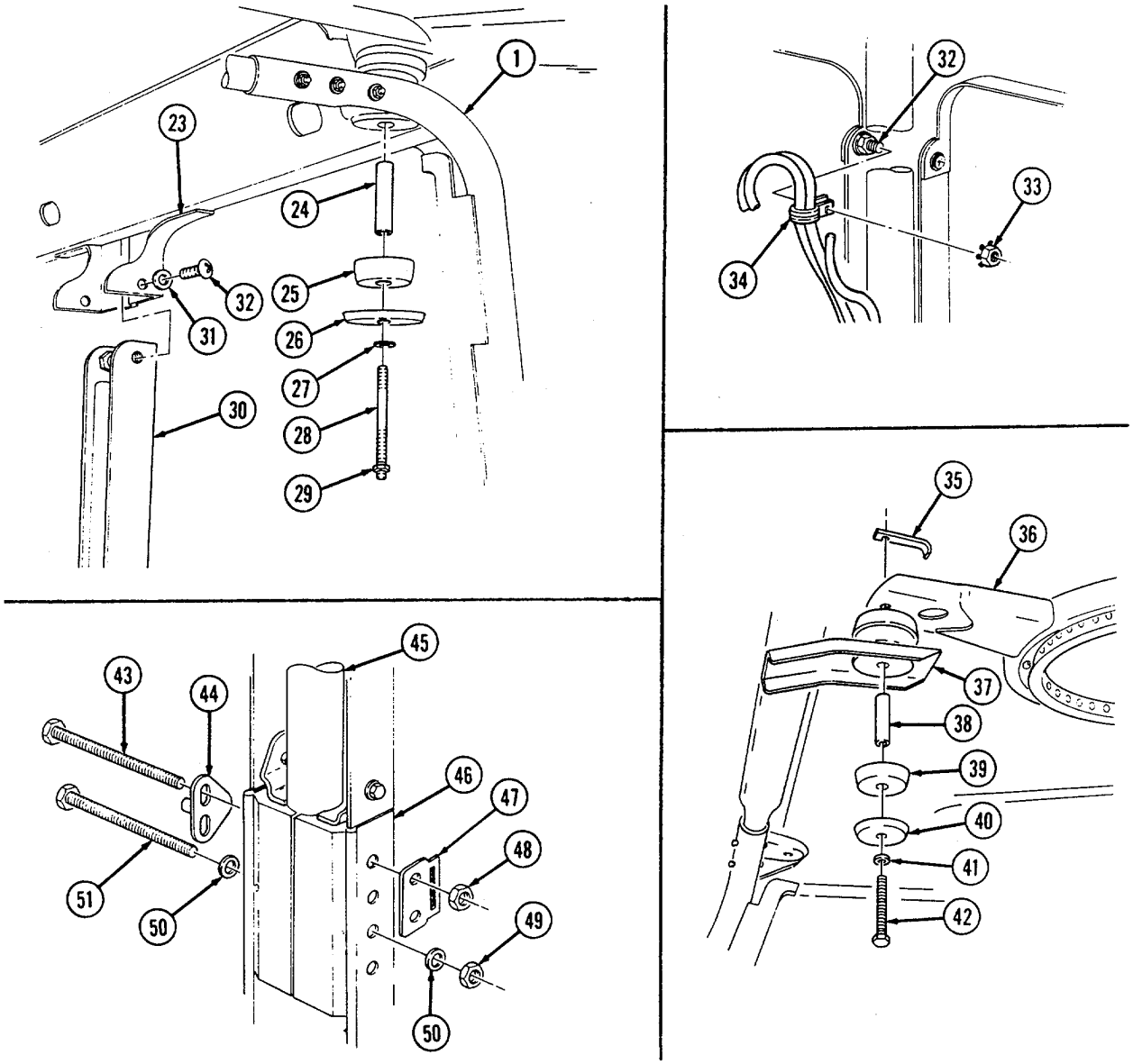
**NOTE**

Perform step 16 for M966, M966A1, M1036, M1045, M1045A1, M1045A2, M1046, and M1046A1 TOW vehicles only.

16. Install TOW wiring harness clamp (34) on screw (32) (right front “B” pillar cover screw (32) only) with assembled locknut (33).
17. Install rear ring support (36) to "C" pillar support bracket (37) with plate (35), bushing (38), mount (39), snubber (40), washer (41), and capscrew (42). Tighten capscrew (42) to 37 lb-ft (50 N·m).
18. Install roof (23) to cargo shell support tube (1) with two bushings (24), mounts (25), snubbers (26), washers (27), studs (28), and locknuts (29). Tighten locknuts (29) to 37 lb-ft (50 N·m).
19. Install striker mounting plate (12) on cargo shell (7) with socket head screw (13), capscrew (14), two washers (8), and locknuts (9). Tighten locknuts (9) to 31 lb-ft (42 N·m).
20. Install panel (19) to cargo shell (7) with four rivets (20) and to wheelhouse (11) with three rivets (20).



**14-6 CARGO SHELL REPLACEMENT (Cont'd)**




FOLLOW-ON TASKS:

- Install dovetail spring (TM 9-2320-280-20).
- Install antenna (TM 9-2320-280-20), if present.
- Adjust striker plate (TM 9-2320-280-20).
- Install front and rear strikers (TM 9-2320-280-20).
- Install cargo shell door (TM 9-2320-280-20).
- M966, M966A1, M1036, M1045, M1045A1, M1045A2, M1046, and M1046A1 only:
- Install M16 ammo rack (TM 9-2320-280-20), left cargo shell only.
- M1043, M1043A1, M1043A2, M1044, and M1044A1 only:
- Install ammo box tray (TM 9-2320-280-20).

## 14-7. BLAST SHIELD REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M966, M996A1, M1036, M1045, M1045A1, M1045A2, M1046, M1046A1

**Materials/Parts**
Twenty-eight blind rivets (Appendix E, Item 192)
Adhesive sealant (Appendix B, Item 3)

**Manual References**
TM 9-2320-280-24P

**Maintenance Level**
Direct Support

**NOTE**

- If blast shield is secured with spot welds, replace with kit 57K0223. Installation instructions are included with kit.
- If it is riveted, proceed with task.
- For instructions on replacement of rivets, refer to para. 22-7.

**a. Removal**

Remove twenty-eight rivets (1) and blast shield (2) from roof (3). Discard rivets (1).

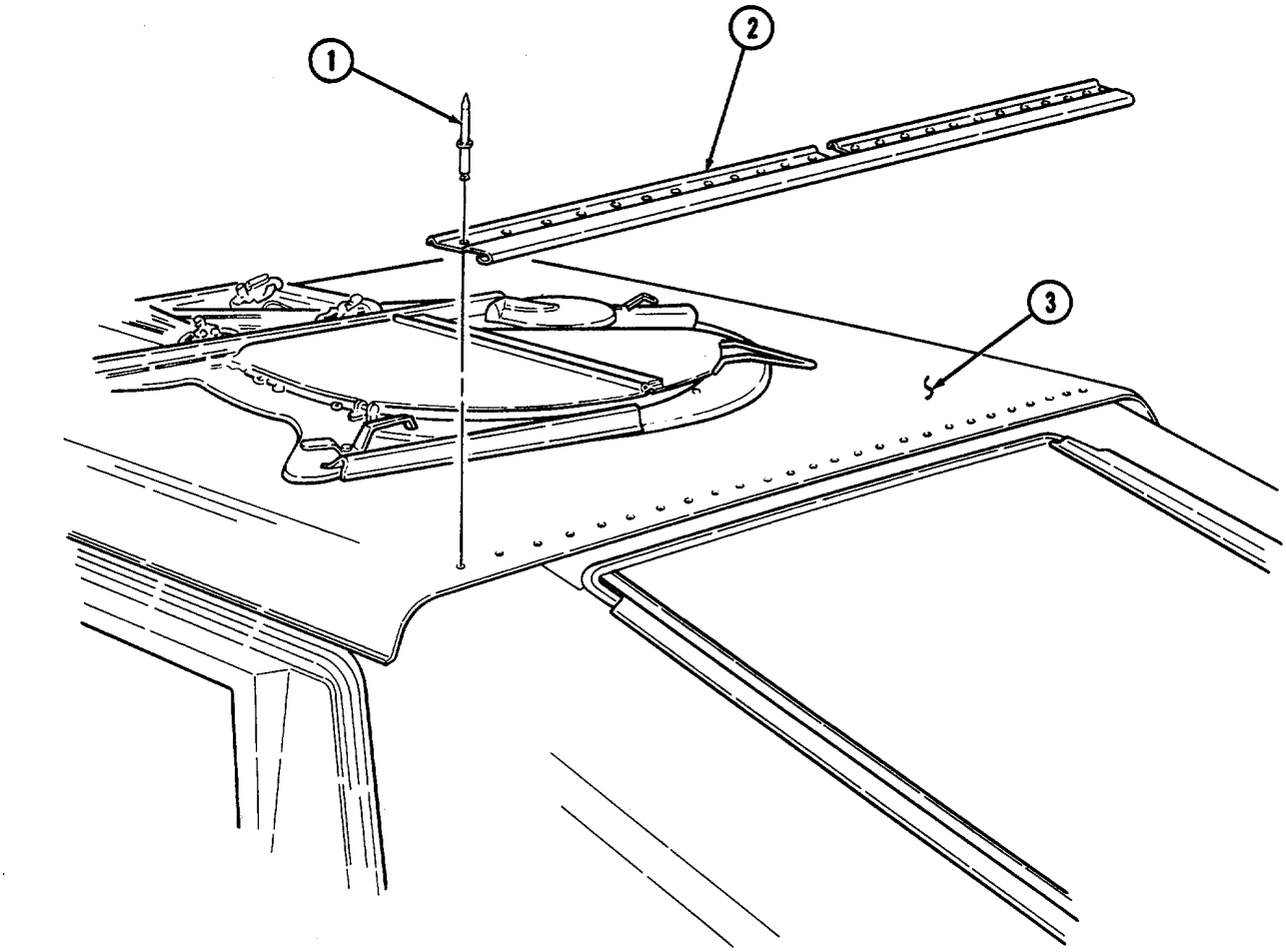
**b. Installation**

**NOTE**

Use old blast shield as a template for drilling holes in new blast shield before installing on vehicle.

1. Using old blast shield as a template, locate, mark, and drill twenty-eight .194-in. (4.93 mm) diameter holes in new blast shield.
2. Apply adhesive sealant to blast shield (2) and install blast shield (2) on roof (3) with twenty-eight rivets (1).

## 14-7 BLAST SHIELD REPLACEMENT



## 14-8. CARGO SHELL REPAIR

**This task covers:**

**Repair**

**INITIAL SETUP:**

**Applicable Models**
All except M966, M996A1, M997, M997A1, M997A2, M998, M998A1, M1035, M1035A1, M1035A2, M1037, M1038, M1038A1, M1042, M1097, M1097A1, M1097A2

**Materials/Parts**
Sealing compound (Appendix B, Item 53)
Primer, weld-through (Appendix B, Item 40)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P
TM 43-0139
TC 9-237

**Equipment Condition**
Cargo shell door dovetail spring removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**Repair**

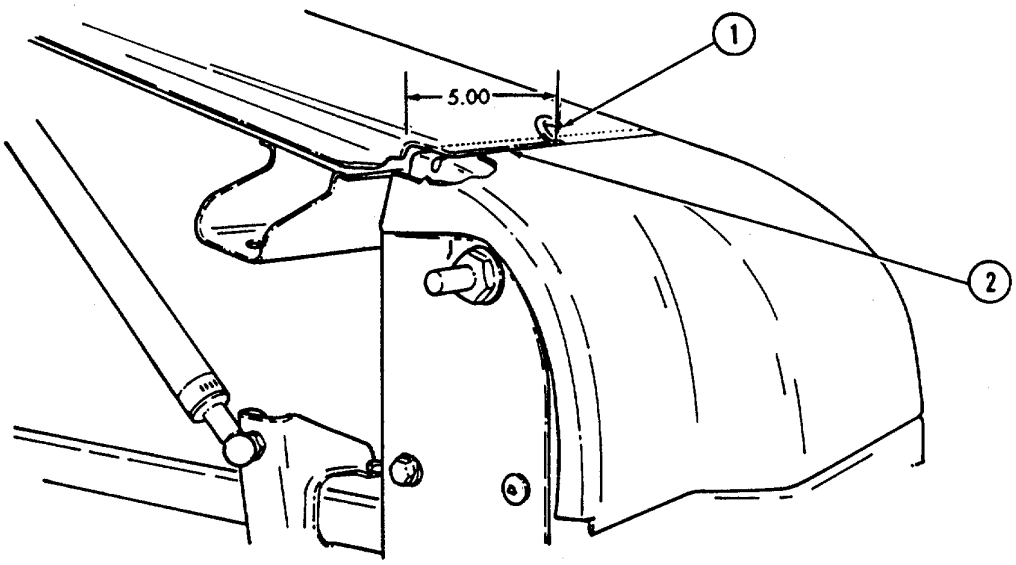
1. Remove sealing compound (1) from cargo shell seam (2).
2. Remove paint from surface area to be welded. (Refer to TM 43-0139).
3. Prime surface area to be welded with weld-through primer. (Refer to TM 43-0139).

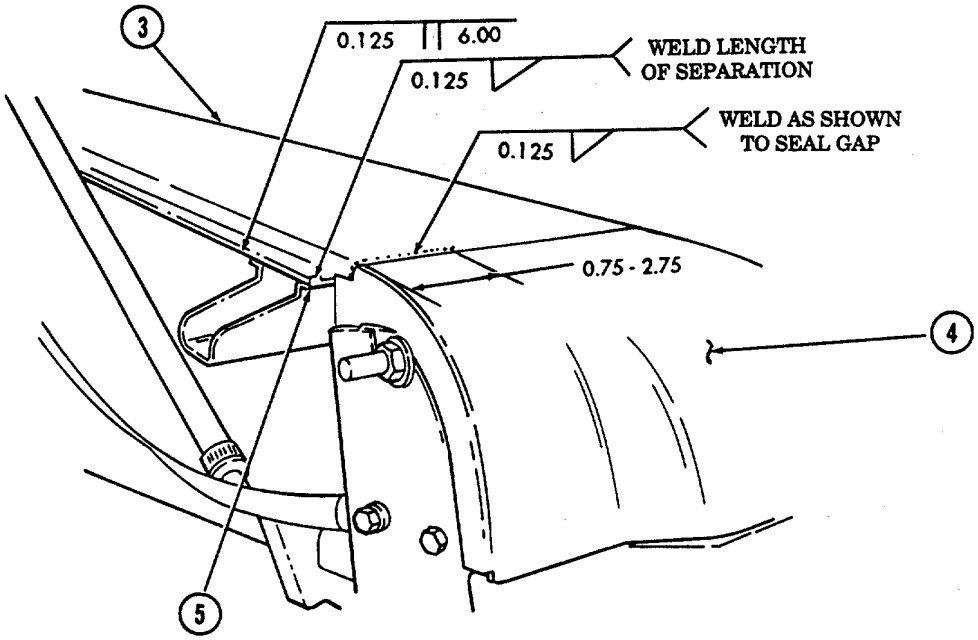
**NOTE**

Clamping devices are recommended to hold cargo shell reinforcement to cargo shell during positioning.

4. Position cargo shell reinforcement (5), cargo shell (3), and corner cap (4).
5. Weld cargo shell reinforcement (5), cargo shell (3), and corner cap (4). (Refer to TC 9-237).
6. Apply sealing compound (1) to cargo shell seam (2).
7. Spot paint welded area. (Refer to TM 43-0139).

**14-8 CARGO SHELL REPAIR (Cont'd)**




FOLLOW-ON TASK: Install cargo shell door dovetail spring (TM 9-2320-280-20).

## Section II. AMBULANCE MAINTENANCE

## 14-9. AMBULANCE MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 14-10. | Ambulance Heater Repair (Model 10530A) | 14-35 |
| 14-11. | Ambulance Heater Repair (Model 10530B) (Ambulance and Arctic) | 14-52 |
| 14-12. | Ambulance Heater Fuel Control Valve Testing and Adjustment (Model 10530A) | 14-70 |
| 14-13. | Ambulance Heater Fuel Control Valve Testing and Adjustment (Model 10530B) | 14-76 |
| 14-14. | Heater/Air-Conditioning Control Box Replacement | 14-80 |
| 14-15. | Thermostat Switch Replacement | 14-86 |
| 14-16. | Pressure Switch Replacement | 14-88 |
| 14-17. | Air-Conditioning System Servicing (R-12) | 14-89 |
| 14-18. | Air-Conditioning Pressure Lines Replacement (R-12) | 14-102 |
| 14-19. | Dryer Bottle Replacement (R-12) | 14-106 |
| 14-20. | Air-Conditioning Evaporator Maintenance (R-12) | 14-108 |
| 14-21. | Expansion Valve Replacement (R-12) | 14-114 |
| 14-22. | Evaporator Duct Replacement (R-12) | 14-116 |
| 14-23. | Condenser Assembly Replacement (R-12) | 14-118 |
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| 14-26. | Compressor Mounting and Air Horn Bracket Replacement (R-12) | 14-123 |
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| 14-27.1. | Air-Conditioning System Servicing (R-134a) | 14-134.2 |
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| 14-27.7. | Condenser Assembly Replacement (R-134a) | 14-134.26 |
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| 14-28. | Ambulance Windshield Replacement | 14-136 |

# 14-10. AMBULANCE HEATER REPAIR (MODEL 10530A)

**This task covers:**

**a. Disassembly**
**b. Cleaning and Inspection**
**c. Assembly**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Twenty-eight assembled-washer screws (Appendix E, Item 199)
Three lockwashers (Appendix E, Item 98)
Two tiedown straps (Appendix E, Item 250)
Gasket (Appendix E, Item 21)
O-ring (Appendix E, Item 125)
Insulation varnish (Appendix B, Item 27)
Drycleaning solvent (Appendix B, Item 14)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Ambulance heater removed (TM 9-2320-280-20).

**General Safety Instructions**
- Drycleaning solvent is flammable and will not be used near an open flame.
- Compressed air source will not exceed 30 psi (207 kPa).

**Maintenance Level**
Direct support

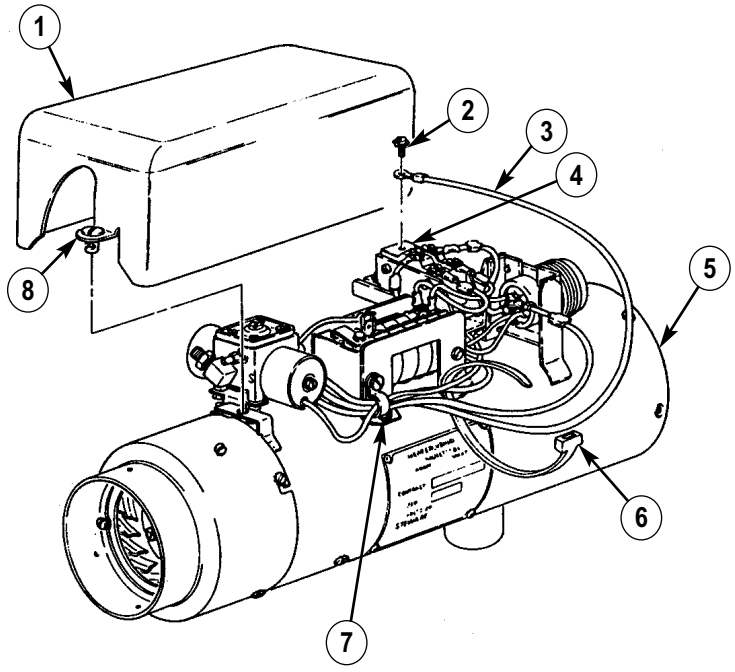
## a. Disassembly

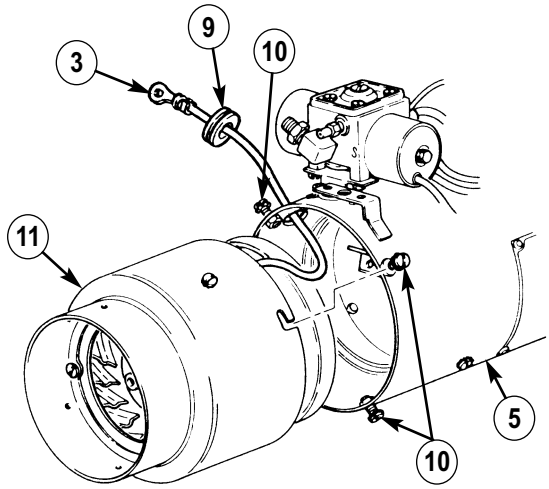
1. Turn two dzus fasteners (8) and remove guard (1) from housing (5).

**NOTE**

Prior to removal, tag leads for installation.

2. Remove assembled-washer screw (2) and blower motor lead (3) from flame detector switch (4). Remove two tiedown straps (6) from leads and pull blower motor lead (3) through clamp (7). Discard tiedown straps (6) and assembled-washer screw (2).
3. Loosen four assembled-washer screws (10) from blower assembly (11) and housing (5), turn blower assembly (11) counterclockwise, and remove from housing (5). Discard assembled-washer screws (10).
4. Remove grommet (9) and blower motor lead (3) from housing (5).



## 14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)

5. Remove assembled-washer screw (1) and fuel control valve lead "B" (2) from receptacle (3). Discard assembled-washer screw (1).
6. Remove nut (7), lead (5), lockwasher (13), receptacle lead 9 (12), lockwasher (11), and ignition control lead 9 (9) from number 9 stud (8) on overheat switch (10). Discard lockwashers (11) and (13).
7. Remove nut (14) and fuel control valve lead 30 (4) from number 30 stud (15) on overheat switch (10).

**CAUTION**

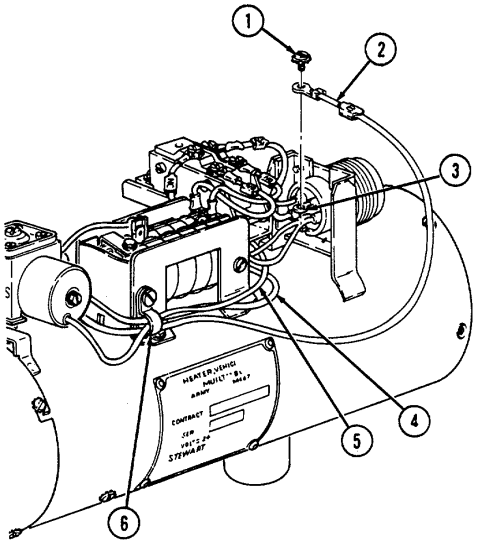
Cover or plug all hoses and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

8. Disconnect fuel tube (20) from fuel control valve outlet (16).
9. Pull control valve leads "B" (2), 30 (4), and 9 (5) through clamp (6). Remove four assembled-washer screws (18) and fuel control valve (17) from housing (19). Discard assembled-washer screws (18).
10. Remove nut (21), receptacle ground lead (29), lockwasher (22), and igniter ground strap (23) from ignition control base stud (28). Discard lockwasher (22).

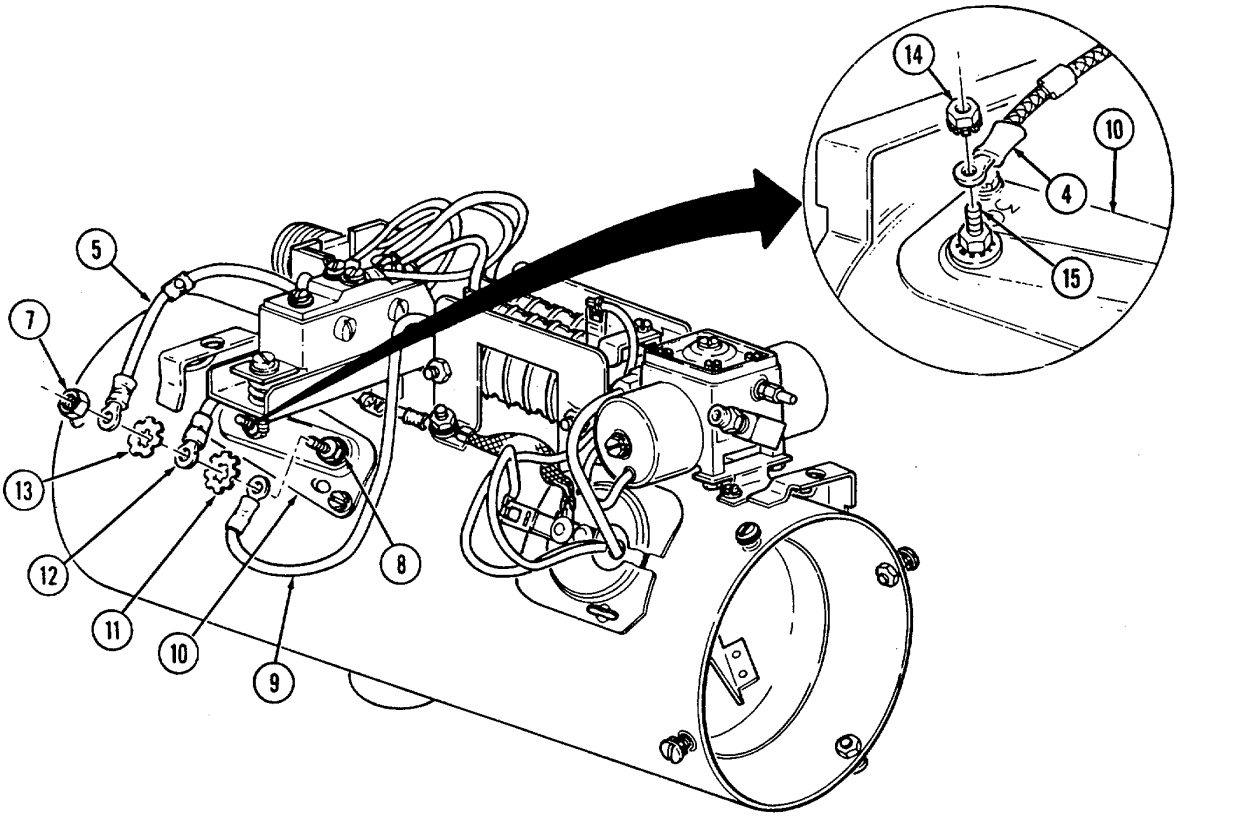
**CAUTION**

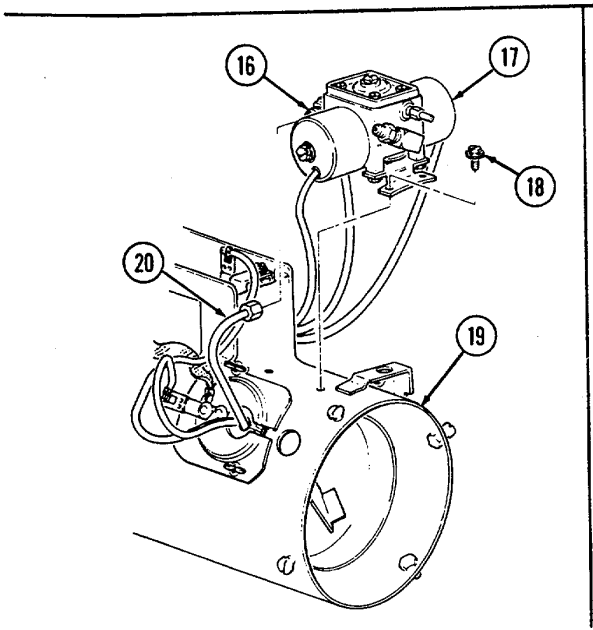
When disconnecting leads, do not break leads loose from the igniter assembly.

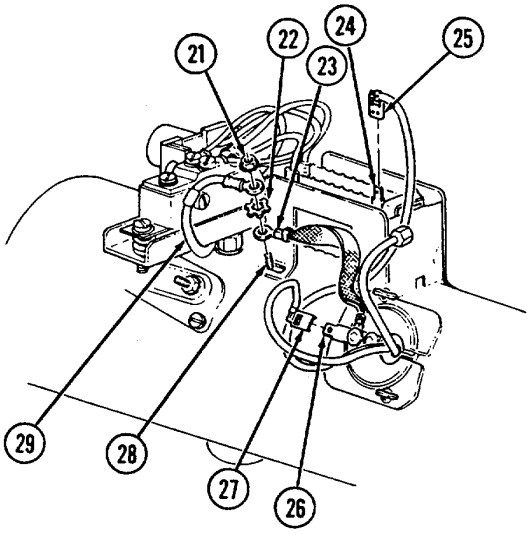
11. Disconnect igniter lead (25) from ignition control terminal (24) and igniter lead (27) from igniter ground terminal (26).



**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**



**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**

12. Loosen two wing screws (1) and remove igniter cover (7) from housing (3).

13. Remove igniter (6) from tube (2) by pushing down and twisting counterclockwise to disengage from slots in tube (2).

14. Remove screw-assembled lockwasher (4) and igniter tube (2 ) from housing (3). Discard screw-assembled lockwasher (4).

15. Loosen nut (10) and disconnect fuel tube (11) from burner fuel inlet (8).

16. Remove secondary blower housing (5) from heat exchanger (9) and housing (3).

17. Remove two screw-assembled lockwashers (13) and ignition control leads (12) from flame detector switch (16). Discard screw-assembled lockwashers (13).

18. Remove three screw-assembled lockwashers (15) and ignition control unit (14) from housing (3). Discard screw-assembled lockwashers (15).

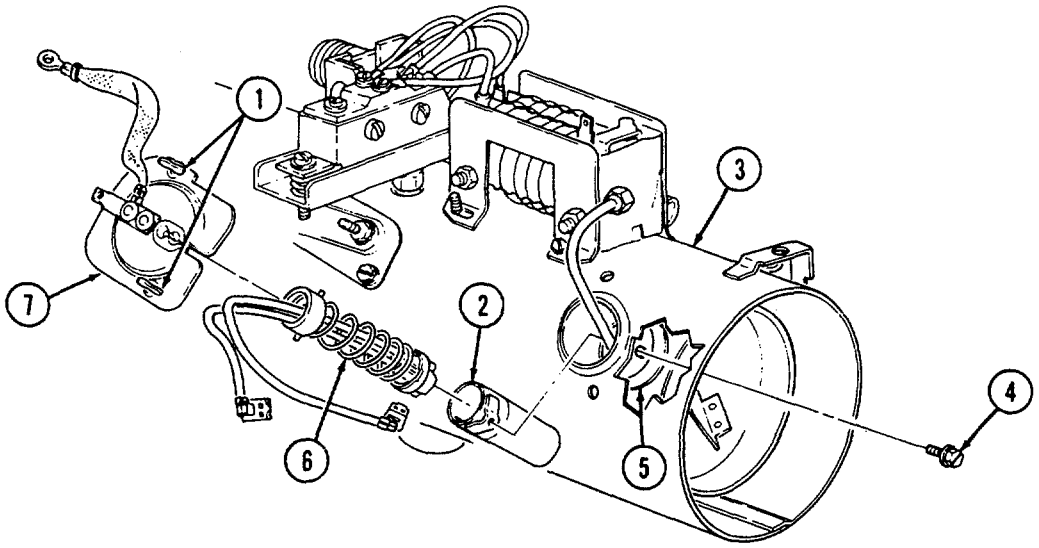
19. Remove two screw-assembled lockwashers (17) and leads (18) from flame detector switch (16). Discard screw-assembled lockwashers (17).

20. Loosen nut (19) and remove flame detector switch (16) from heat exchanger fitting (20).

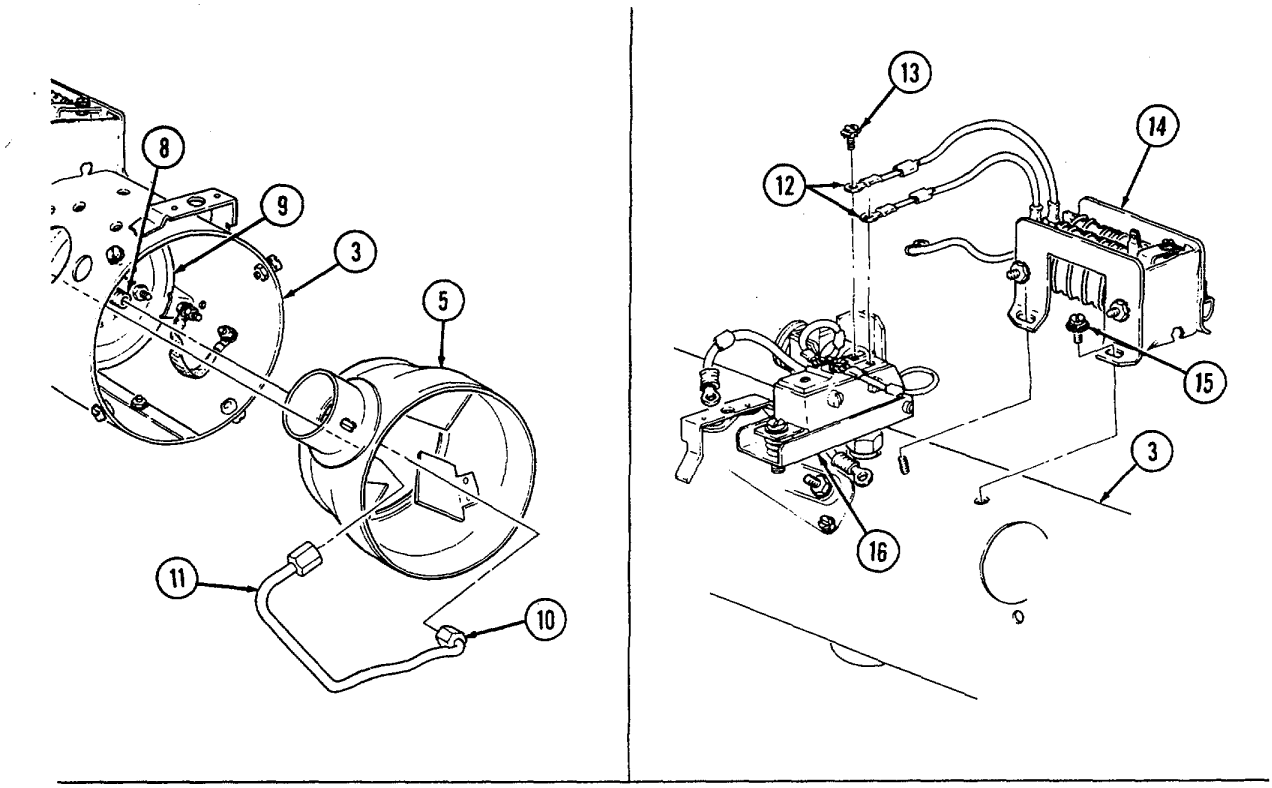
**CAUTION**

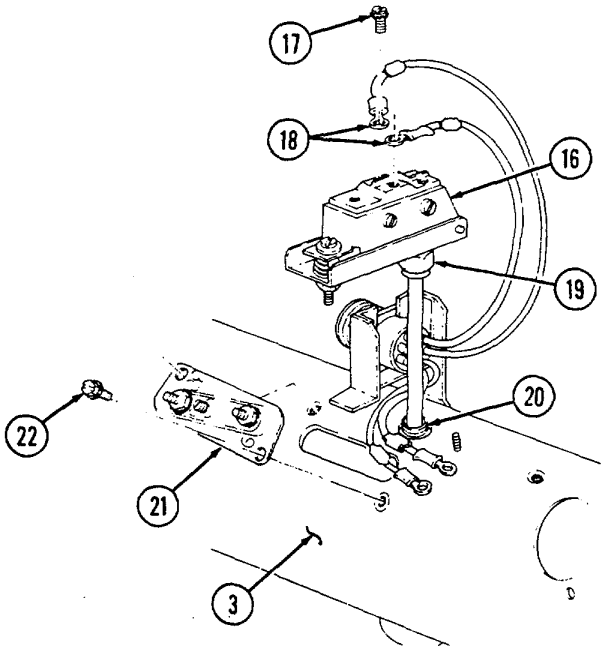
The overheat switch is adjusted and sealed at the factory. To prevent damage, do not bend or twist the switch or change the setting of the adjustment screw.

21. Remove two screw-assembled lockwashers (22) and overheat switch (21) from housing (3). Discard screw-assembled lockwashers (22).



**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**



**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**

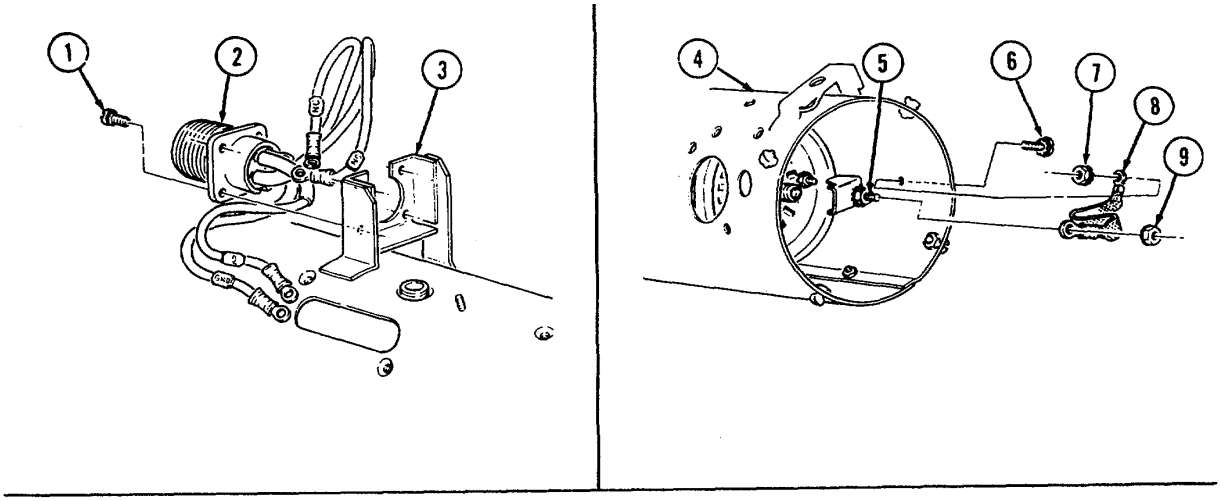
22. Remove four screw-assembled lockwashers (1) and receptacle (2) from mounting bracket (3). Discard screw-assembled lockwashers (1).

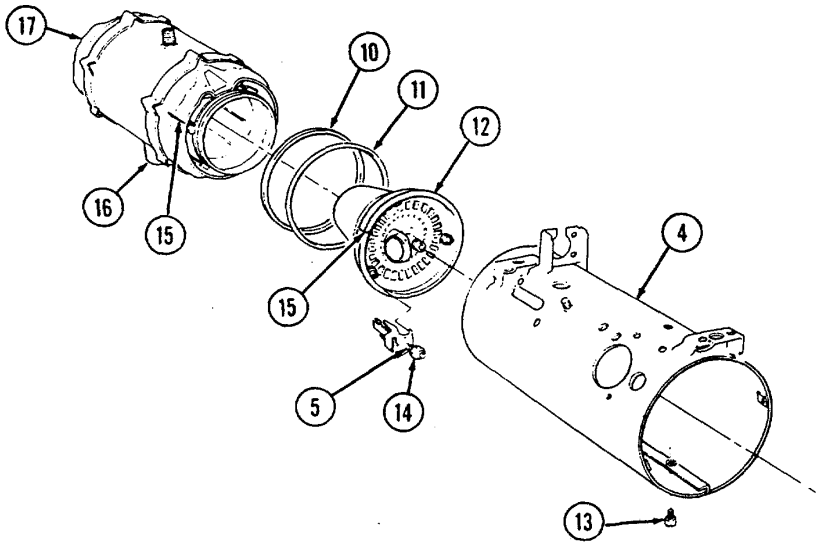
23. Remove nut and lockwasher assemblies (7) and (9), screw-assembled lockwasher (6), and ground strap (8) from housing (4) and hook bolt (5). Discard nut and lockwasher assemblies (7) and (9) and screw-assembled lockwasher (6).

24. Remove three screw-assembled lockwashers (13) and heat exchanger (17) from housing (4). Spread housing (4) just enough to clear exhaust tube (16) on heat exchanger (17). Discard screw-assembled lockwashers (13).

25. Scribe alignment marks (15) on burner assembly (12) and heat exchanger (17) to ensure proper alignment of burner assembly (12) to heat exchanger (17) during assembly.

26. Remove four nut and lockwasher assemblies (14), hookbolts (5), burner assembly (12), O-ring (11), and gasket (10) from heat exchanger (17). Discard nut and lockwasher assemblies (14), O-ring (11), and gasket (10).



## 14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)

b. Cleaning and Inspection

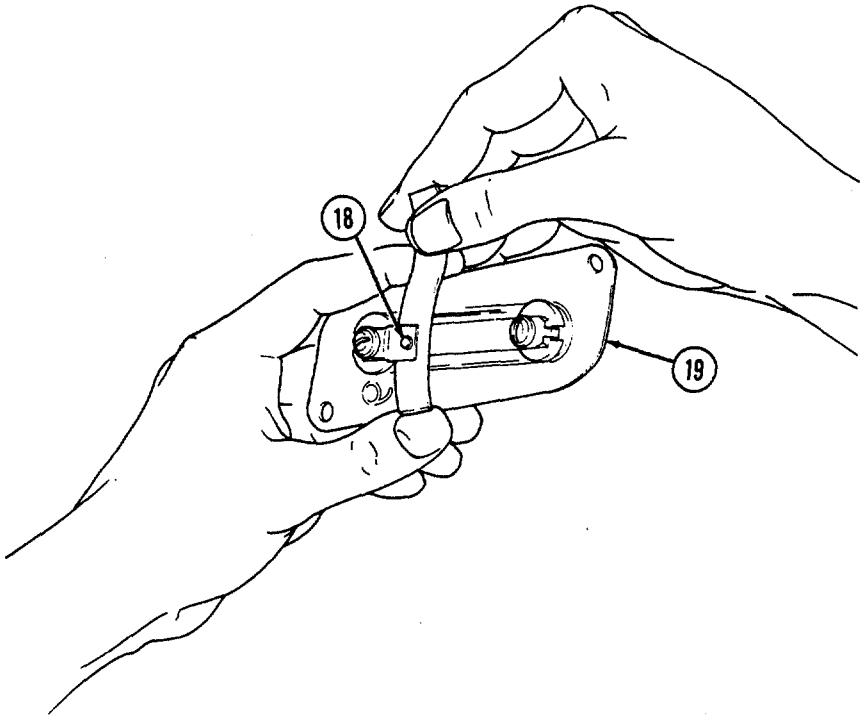
1. Overheat switch (19):

**CAUTION**

The overheat switch is adjusted and sealed at the factory. Do not bend or twist the switch. Do not change the setting of the adjustment screw.

(a) Slide a clean strip of bond paper between contact points (18) on switch to clean points (18). Do not use abrasive paper.

(b) Inspect switch (19) for burned, bent, damaged, or defective parts. Replace switch (19) if any parts are burned, bent, damaged, or defective.



**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**

**WARNING**

- Drycleaning solvent is flammable and will not be used near an open flame. A fire extinguisher will be kept nearby when the solvent is used. Use only in well-ventilated places. Failure to do this will result in injury to personnel and/or damage to equipment.
- Compressed air source will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc).

2. Blower assembly (1):
   (a) Clean blower assembly (1) fan and surrounding areas with drycleaning solvent. Dry with compressed air.
   (b) Inspect blower assembly (1) for damage. Replace if damaged.

3. Fuel control valve (2):
   (a) Clean fuel control valve (2) with compressed air.
   (b) Inspect control valve (2) and leads (3) for damage. Replace control valve (2) if any part is damaged.

4. Burner assembly (12):
   (a) Remove three nuts (13), lockwashers (14), and burner plate (16) from bowl (25). Discard lockwashers (14).
   (b) Clean residue and carbon from bowl (25) and burner plate (16). Clean burner plate (16) with compressed air.
   (c) Inspect burner plate (16) and bowl (25) for damage, replace burner plate (16) or burner assembly if bowl (25) is damaged.
   (d) Remove screw (24), vaporizer shield (23), washer (22), washer (21), fuel vaporizer (20), retaining washer (19), two notched fiber washers (18), and wick (17) from burner plate (16). Discard screw (24), fuel vaporizer shield (23), washer (22), washer (21), fuel vaporizer (20), retaining washer (19), notched fiber washers (18), and wick (17).
   (e) Assemble two notched fiber washers (18) to burner plate (16) making sure to align notches with igniter pocket.
   (f) Press retaining washer (19) over fuel feed bushing (15) with flange facing away from burner plate (16).

**NOTE**

A new fuel vaporizer is supplied with ignition wick already inserted in hole of vaporizer with excess length for assembly.

   (g) Position wick (17) and fuel vaporizer shield (23) over fuel feed bushing (15) so the wick (17) will lie in the slot. Use a piece of thin wire to pull looped end of wick through igniter pocket. Remove wire from wick (17).

   (h) Hold fuel vaporizer shield (23) firmly against retaining washers (19) and pull wick (17) back through vaporizer until wick (17) is taut. Cut off excess wick (17) close to small end of fuel vaporizer shield (23).

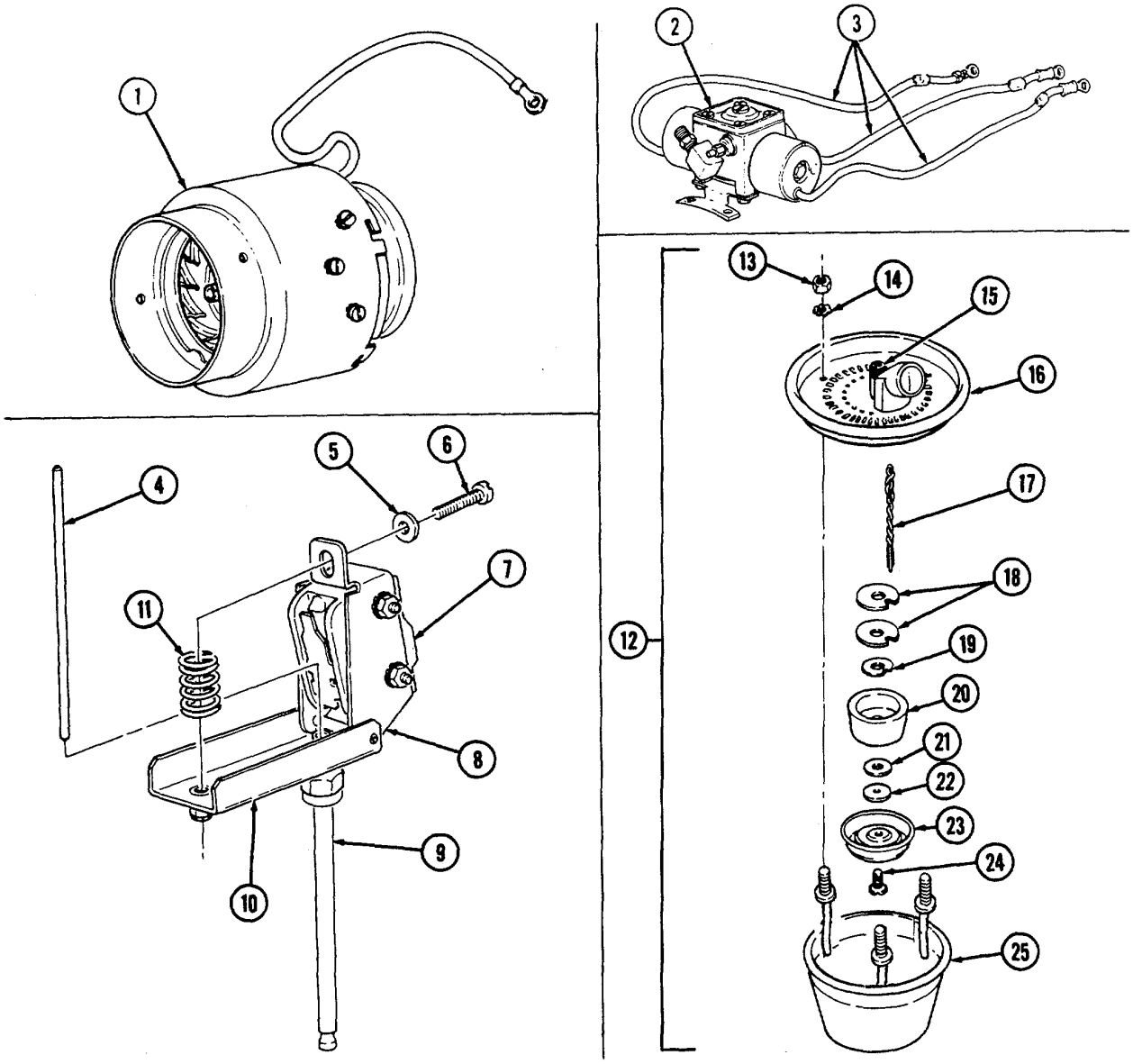
   (i) Install fuel vaporizer (20), washer (21), washer (22), and screw (24) on burner plate (16).

   (j) Install burner plate (16) on bowl (25) studs with three lockwashers (14) and nuts (13).

**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**

5. Flame detector switch (8):

(a) Remove adjusting screw (6), washer (5), and spring (11) from flame detector switch (8).
(b) Remove ceramic rod (4) from tube (9). Inspect ceramic rod (4) for cracks, chips, or breakage. Replace flame detector switch (8) if ceramic rod (4) is cracked, chipped, or broken.
(c) Clean flame detector switch (8) with compressed air.
(d) Inspect flame detector switch (8) for damaged or defective parts. Replace flame detector switch (8) if any part is damaged or defective.
(e) Carefully insert ceramic rod (4) into tube (9). Install spring (11) on channel (10), tip microswitch (7) down, and install washer (5) and adjusting screw (6).
(f) Turn adjusting screw (6) clockwise until microswitch (7) just "clicks". Turn adjusting screw (6) an additional 3/4 turn clockwise, and seal screw (6) in place with insulating varnish.



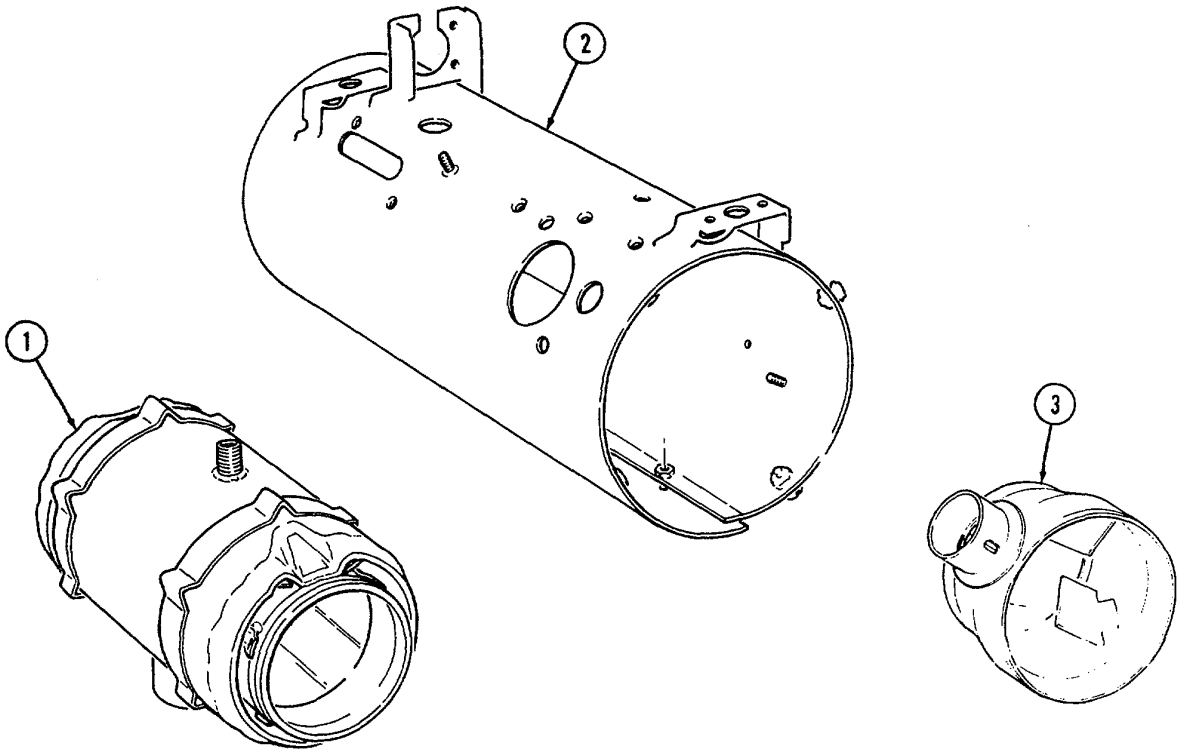
**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**

6. Clean heat exchanger (1), secondary blower housing (3), housing (2), and guard (4) with drycleaning solvent. Remove all traces of solvent and allow to air dry before assembly.

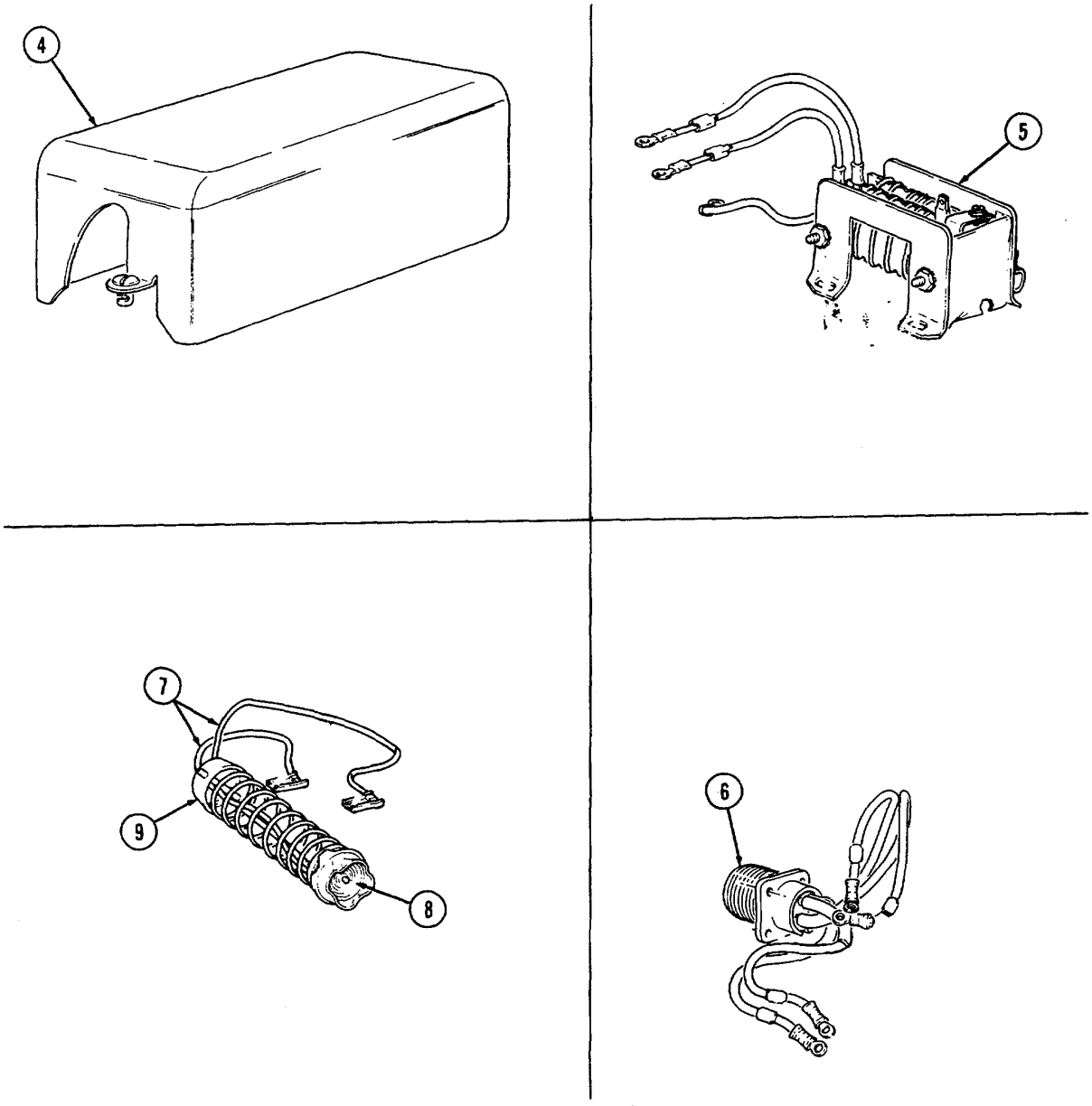
7. Inspect ignition control unit (5) and receptacle (6) for broken connections or damage. Replace either if damage or broken connections are evident.

8. Inspect igniter assembly (9) for loose or broken leads (7) or damaged element (8). Replace igniter assembly (9) if leads (7) are broken or loose, or element (8) is damaged.

9. Connect multimeter to leads (7) to check igniter assembly (9) for proper resistance. Resistance should be 2.2 Ohms. If resistance is not 2.2 Ohms, replace igniter assembly (9).



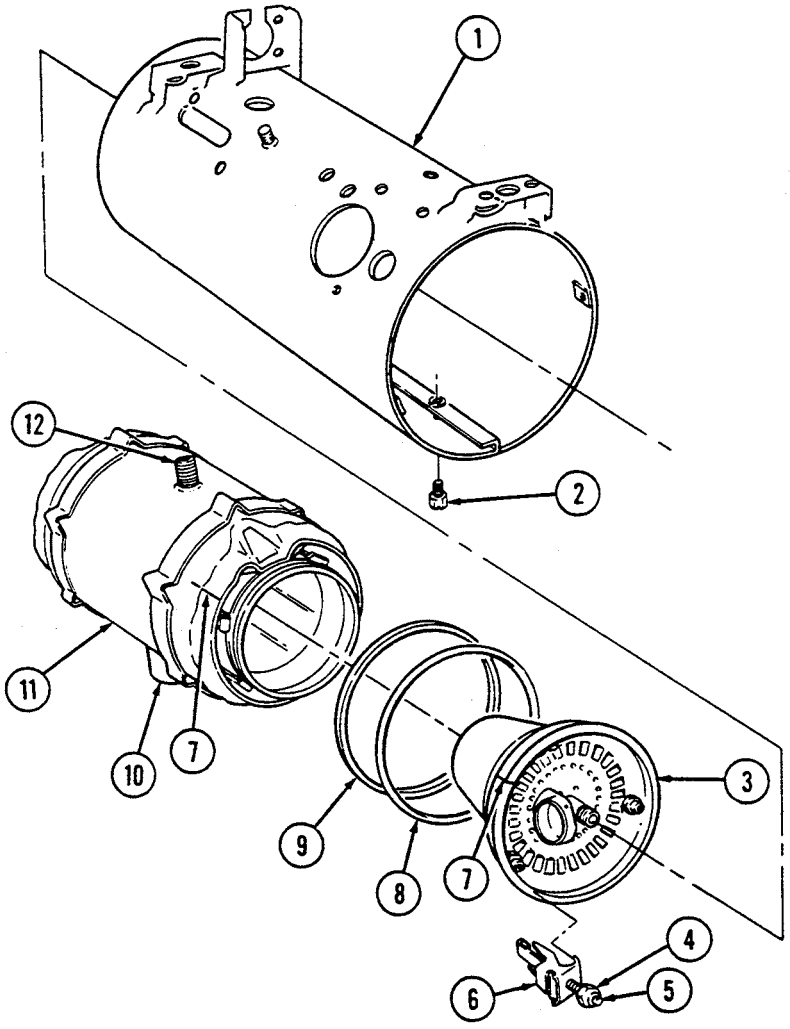
**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**



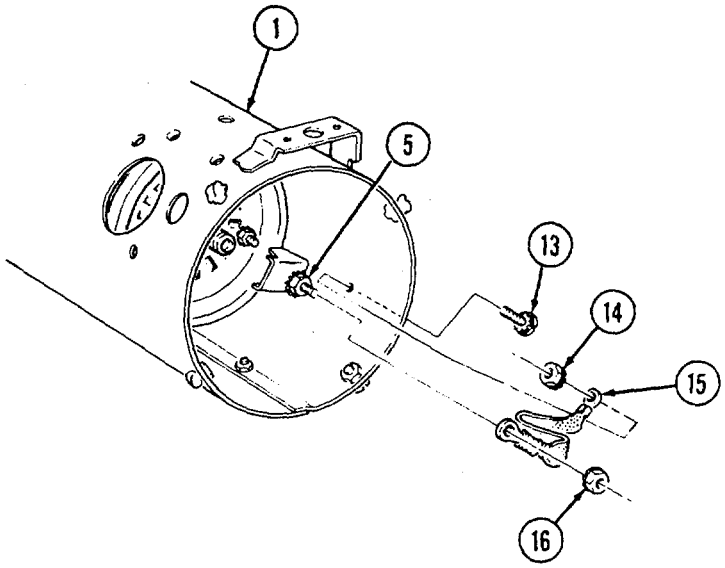
## 14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)

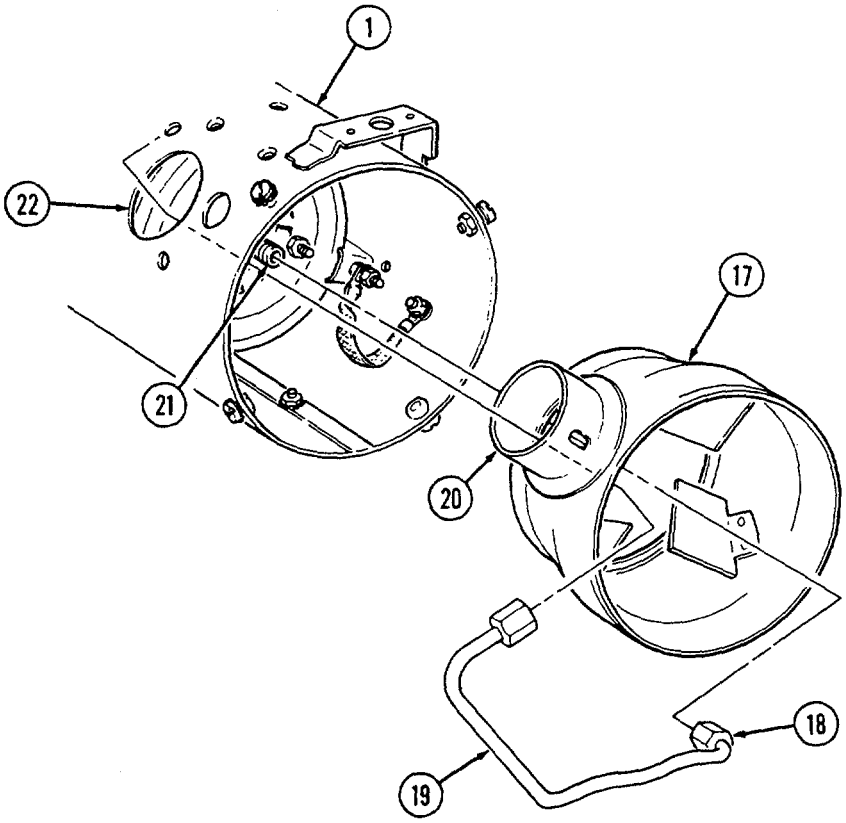
**c. Assembly**

1. Place O-ring (8) and gasket (9) on burner assembly (3) and install burner assembly (3) on heat exchanger (11).
2. Align scribe marks (7) on burner assembly (3) and heat exchanger (11) and install burner assembly (3) on heat exchanger (11) with four hookbolts (5), clamps (6), and nuts (4).
3. Spread housing (1) just enough to clear heat exchanger exhaust tube (10) and install heat exchanger (11) on housing (1) so exhaust tube (10) and flame detector fitting (12) extend through housing (1).
4. Install housing (1) together with three assembled-washer screws (2).
5. Install ground strap (15) to hookbolt (5) with nut (16). Install ground strap (15) to housing (1) with nut (14) and assembled-washer screw (13).
6. Install secondary blower housing (17) in housing (1) and align the access opening (20) with the large igniter hole (22) in housing (1). Make sure secondary blower housing (17) is fully seated in housing (1).
7. Install fuel tube (19) through housing (1) and secondary blower housing (17) and connect to burner fuel inlet (21) with nut (18).



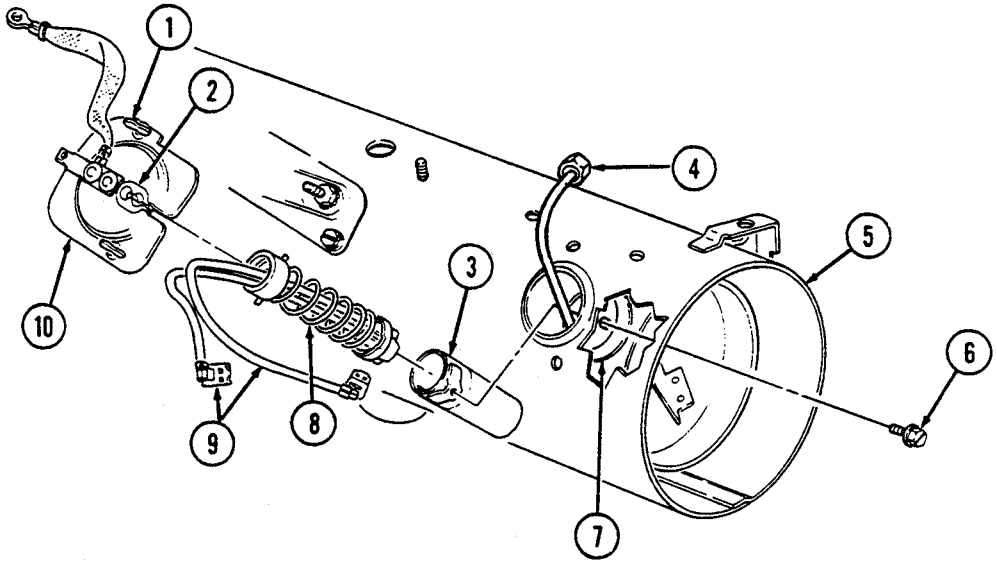
**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**



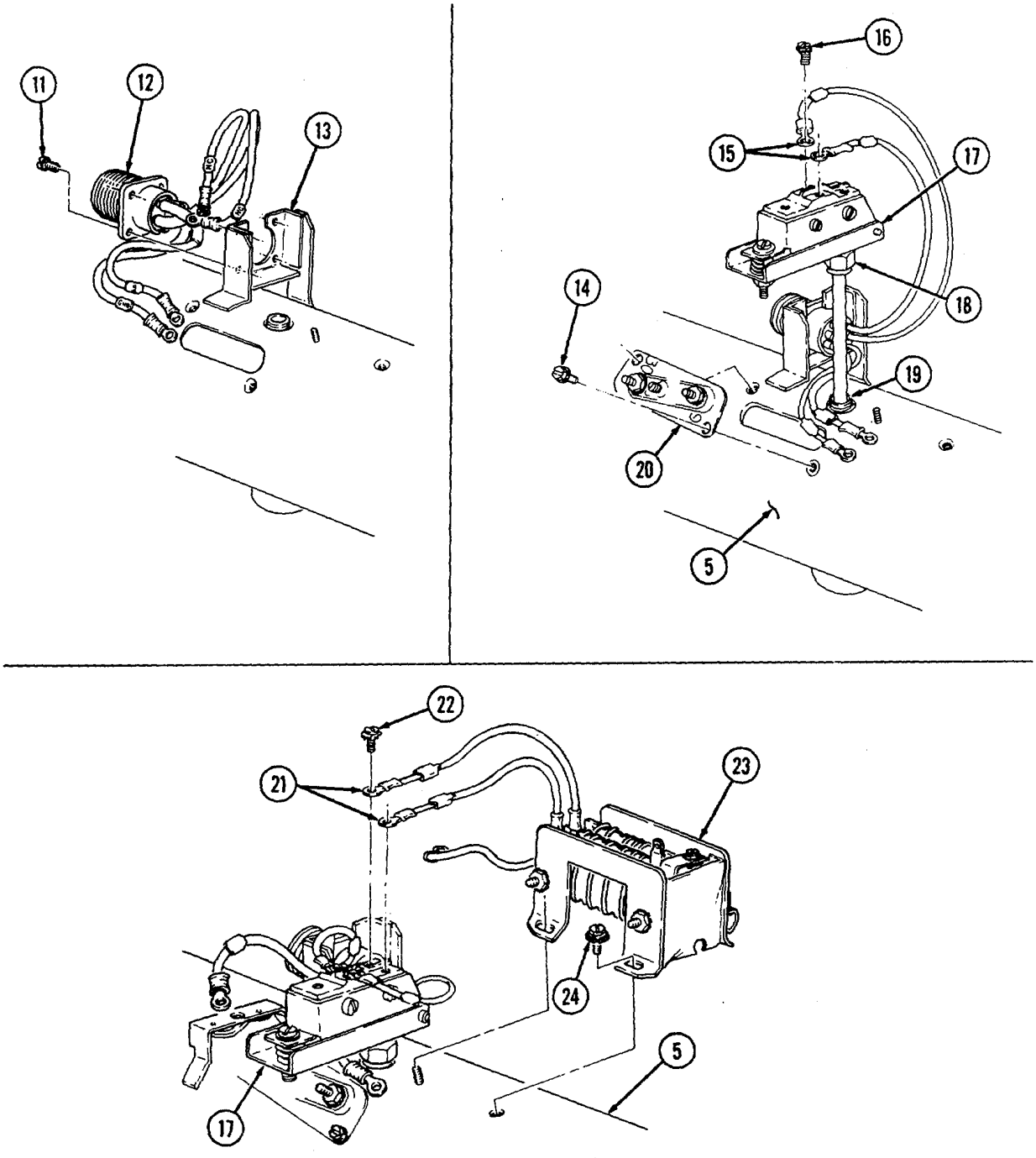



## 14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)

8. Install igniter tube (3) on secondary blower housing (7) with assembled-washer screw (6).
9. Install igniter assembly (8) into igniter tube (3). Press igniter assembly (8) down and turn clockwise to lock in place.
10. Install igniter cover (10) on housing (5), placing igniter leads (9) and fuel tube (4) in igniter cover grommet (2) on housing (5) and tighten two wing screws (1).
11. Install receptacle (12) on bracket (13) with four assembled-washer screws (11).
12. Install flame detector switch (17) on heat exchanger fitting (19) with nut (18).
13. Install overheat switch (20) on housing (5) with two assembled-washer screws (14).
14. Install ignition control unit (23) on housing (5) with three assembled-washer screws (24).
15. Connect two leads (15) from receptacle (12) on flame detector switch (17) with two assembled-washer screws (16).
16. Connect two leads (21) from ignition control unit (23) on flame detector switch (17) with two assembled-washer screws (22).

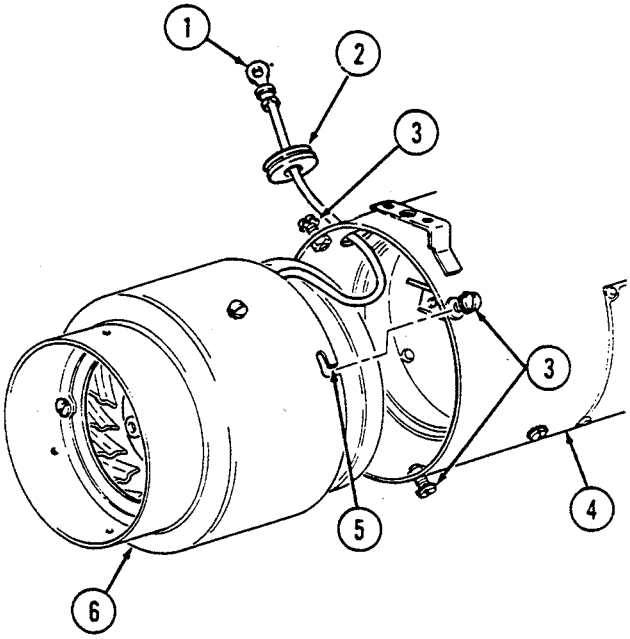


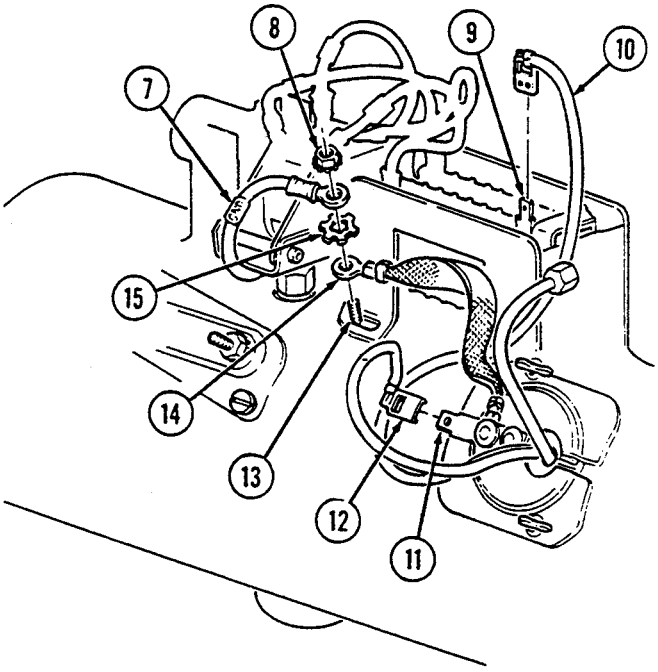
**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**



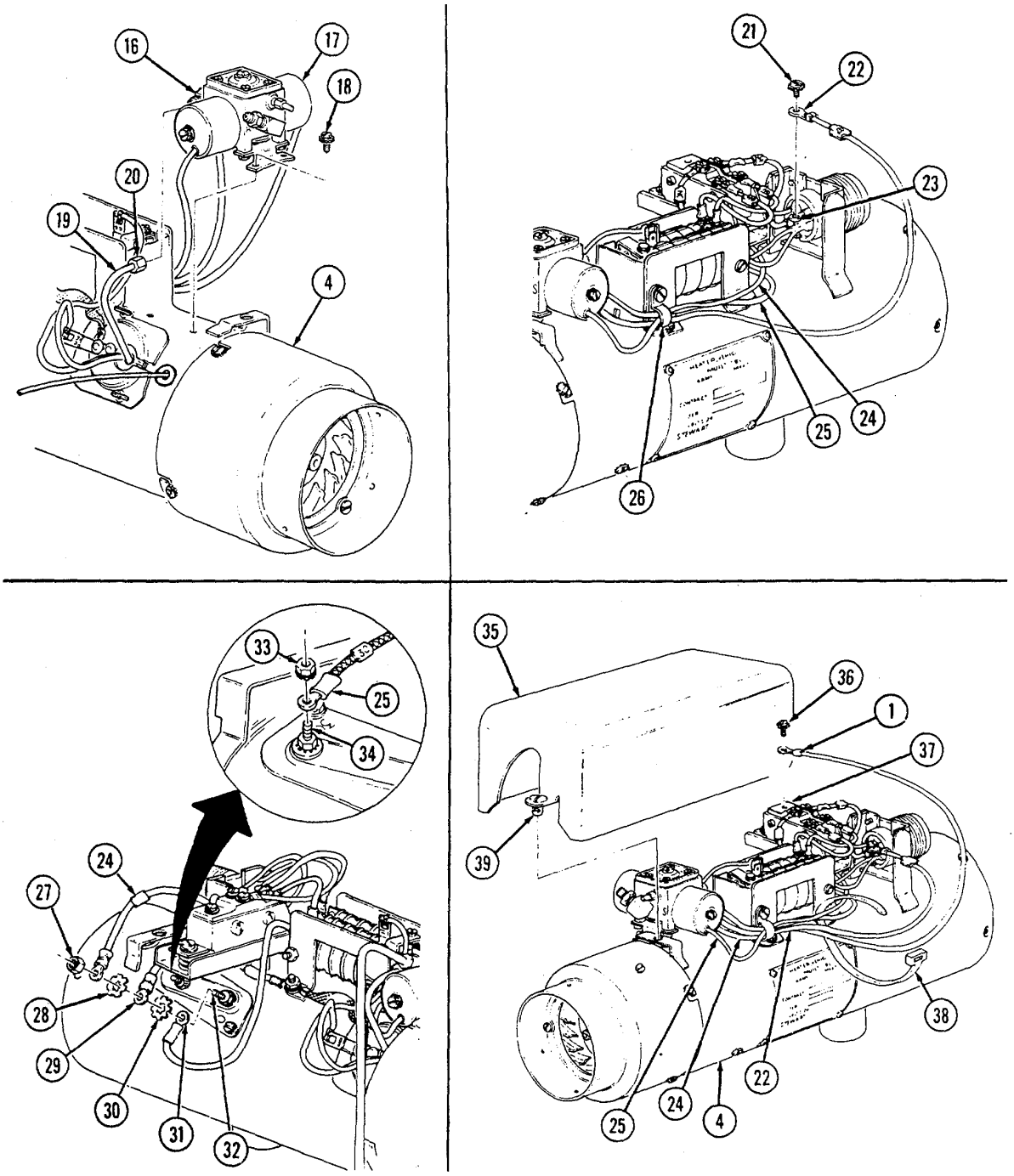
## 14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)

17. Route blower assembly lead (1) through hole in housing (4) and install with grommet (2) on housing (4).
18. Align slots (5) in blower assembly (6) with four assembled-washer screws (3) on housing (4), engage blower assembly (6) on assembled-washer screws (3), and turn clockwise to lock in blower assembly slots (5). Tighten four assembled-washer screws (3).
19. Install igniter cover ground strap (14), lockwasher (15), and receptacle ground lead (7) on ignition control base stud (13) with nut (8).
20. Connect short igniter lead (12) to igniter cover terminal (11) and long igniter lead (10) to ignition control unit terminal (9).
21. Install fuel control valve (17) on housing (4) with four assembled-washer screws (18).
22. Connect fuel tube (19) on fuel control valve inlet (16) with nut (20).
23. Route blower motor lead (1), and fuel control valve leads (22), (24), and (25) through clamp (26).
24. Connect fuel control valve lead B (22) on receptacle (23) with assembled-washer screw (21).
25. Connect fuel control valve lead 30 (25) on overheat switch stud (34) with nut (33).
26. Install ignition control lead wire 9 (31), lockwasher (30), receptacle lead wire 9 (29), lockwasher (28), and fuel control valve thermostat lead wire 9 (24) on overheat switch stud (32) with nut (27).
27. Connect blower motor lead (1) on flame detector switch (37) with assembled-washer screw (36).
28. Group fuel control valve leads (22), (24), and (25), and blower motor lead (1) together with two tiedown straps (38).
29. Install guard (35) on housing (4) with two dzus fasteners (39).



**14-10. AMBULANCE HEATER REPAIR (MODEL 10530A) (Cont'd)**




FOLLOW-ON TASK: Bench test ambulance heater (para. 14-12)

## 14-11. AMBULANCE HEATER REPAIR (MODEL 10530B)

**This task covers:**

**a. Disassembly**
**b. Cleaning and Inspection**
**c. Assembly**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Seventeen assembled-washer screws (Appendix E, Item 199)
Four tiedown straps (Appendix E, Item 254)
Five locknuts (Appendix E, Item 56)
Three lockwashers (Appendix E, Item 98)
Gasket (Appendix E, Item 21)
O-ring (Appendix E, Item 125)
Insulation varnish (Appendix B, Item 27)
Drycleaning solvent (Appendix B, Item 14)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Ambulance or arctic heater removed (TM 9-2320-280-20).

**General Safety Instructions**
- Drycleaning solvent is flammable and will not be used near an open flame.
- Compressed air source will not exceed 30 psi (207 kPa).

**Maintenance Level**
Direct support

### a. Disassembly

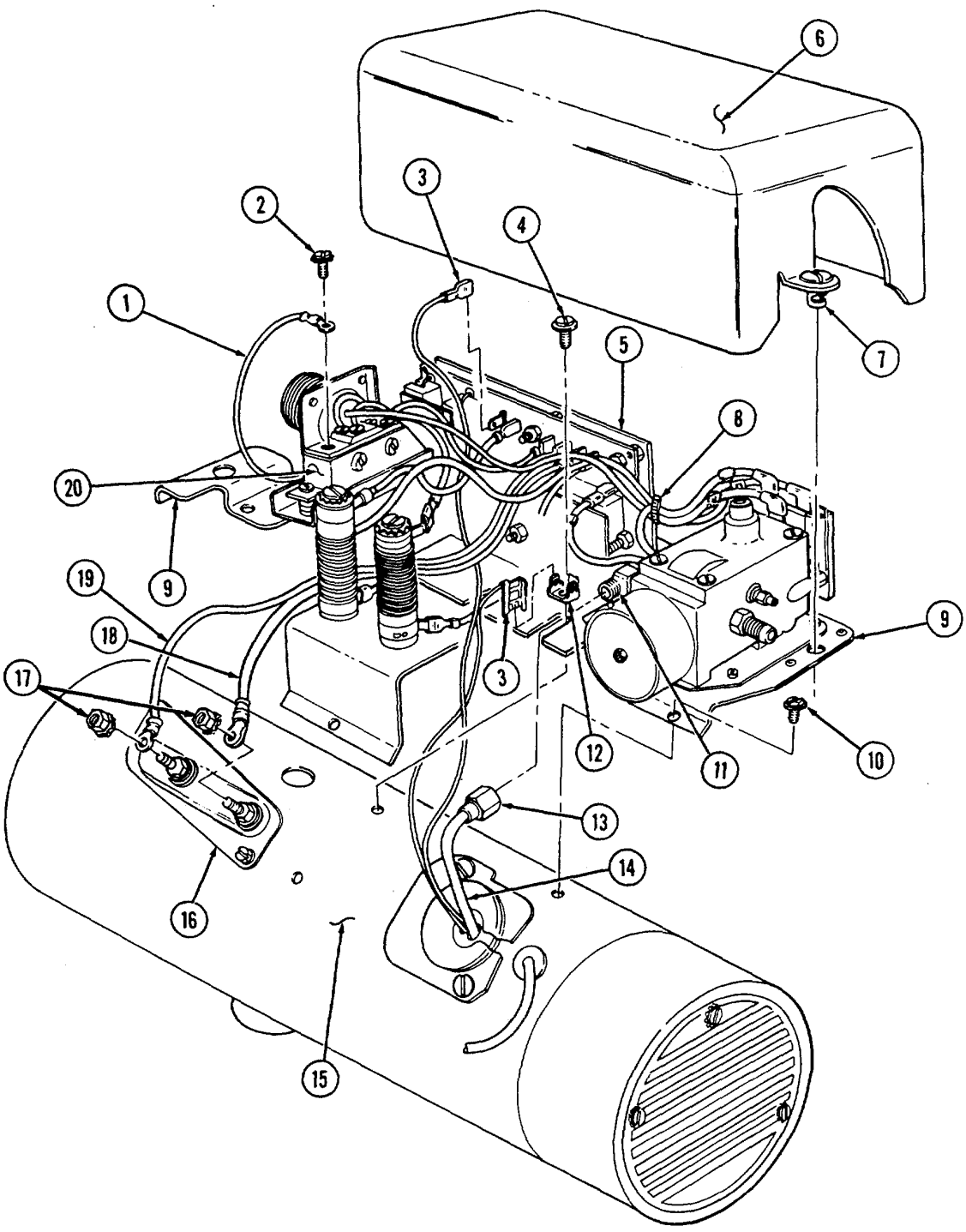
1. Turn two dzus fasteners (7) and remove guard (6) from control bracket (9).

**NOTE**

Prior to removal, tag leads for installation.

2. Remove two nuts (17) and leads 30 (19) and 9 (18) from overheat switch (16).
3. Remove four tiedown straps (8) securing leads together. Discard tiedown straps (8).
4. Remove five assembled-washer screws (2) and leads (1) from flame detector switch (20). Discard assembled-washer screws (2).
5. Disconnect two igniter leads (3) from ground terminal (12) and circuit board (5).
6. Loosen line nut (13) and disconnect fuel outlet line (14) from fuel valve fitting (11).
7. Remove six screws (10) from control bracket (9) and heater body (15).
8. Remove two screws (4), control bracket (9), and ground terminal (12) from heater body (15).

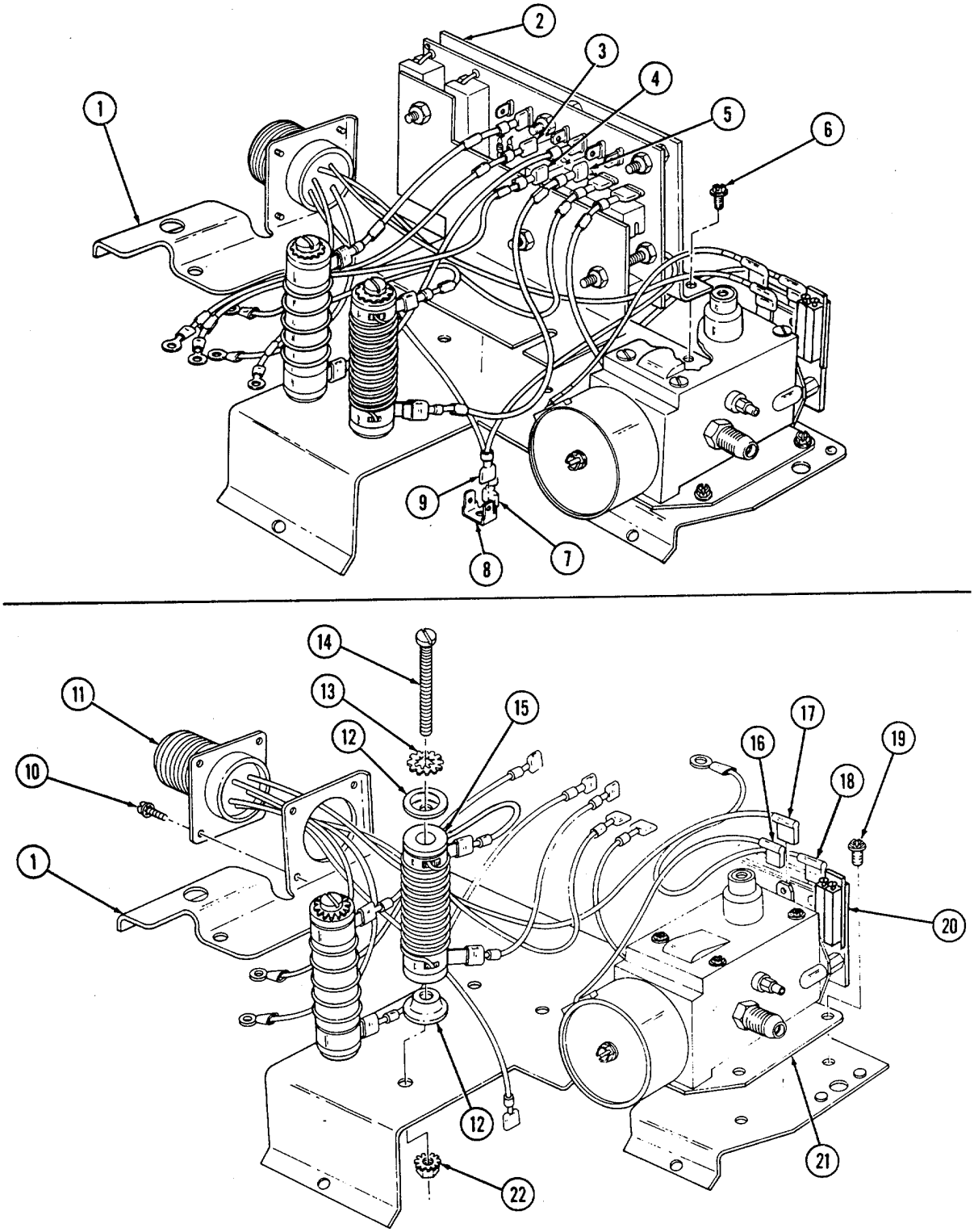
**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**



## 14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)

9. Disconnect circuit board ground lead (7) and receptacle ground lead (9) from ground terminal (8) and remove ground terminal (8).
10. Disconnect overheat switch lead 3 (4) and flame detector switch lead 4 (3) from circuit board (2).
11. Disconnect five leads (5) from circuit board (2).
12. Remove three screws (6) and circuit board (2) from control bracket (1).
13. Remove two nuts (22), screws (14), lockwashers (13), four capwashers (12), and two resistors (15) from control bracket (1). Discard lockwashers (13).
14. Disconnect leads 15 (18), 16 (16), and 17 (17) from fuel valve circuit board (20) and remove lead 15 (18).
15. Remove four screws (19) and fuel control valve assembly (21) from control bracket (1).
16. Remove four assembled-washer screws (10) and plug receptacle (11) from control bracket (1). Discard assembled-washer screws (10).

**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**

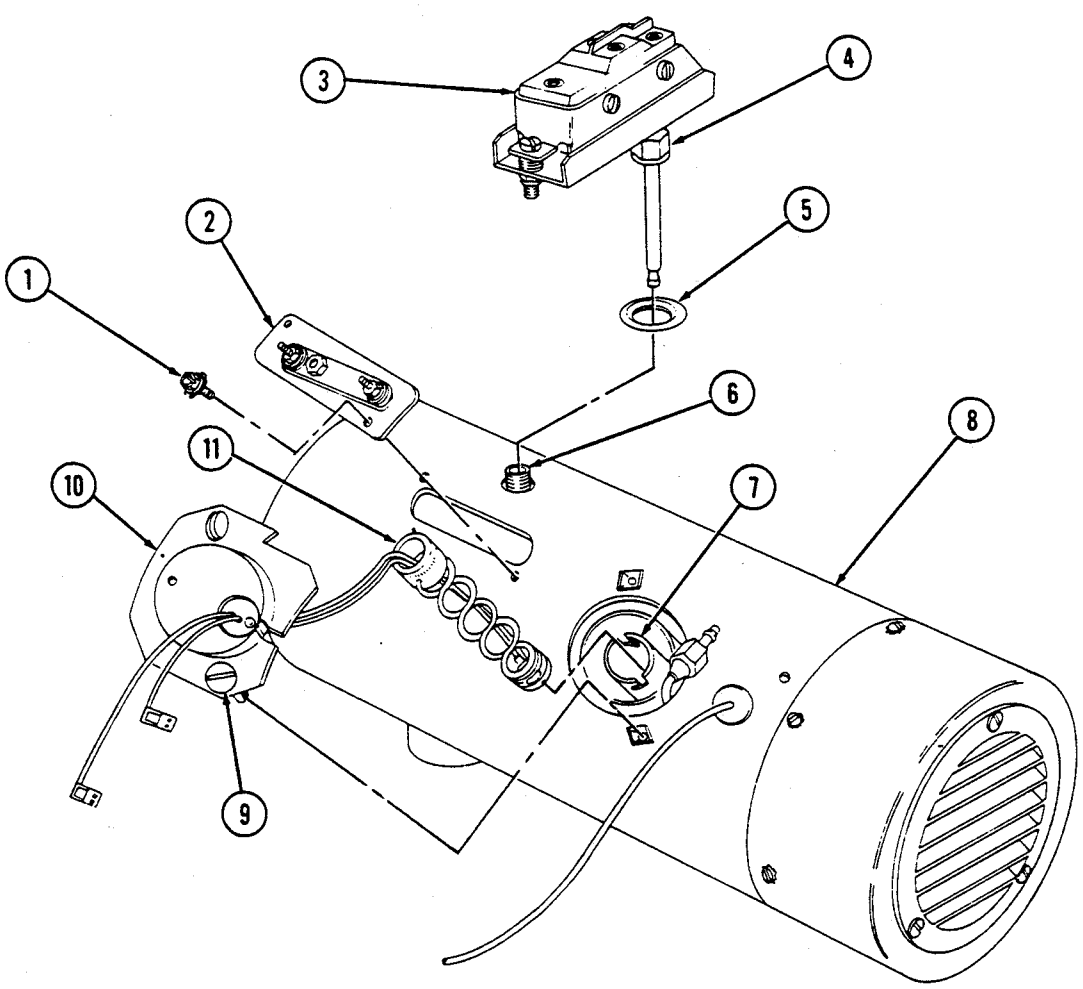


## 14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)

**CAUTION**

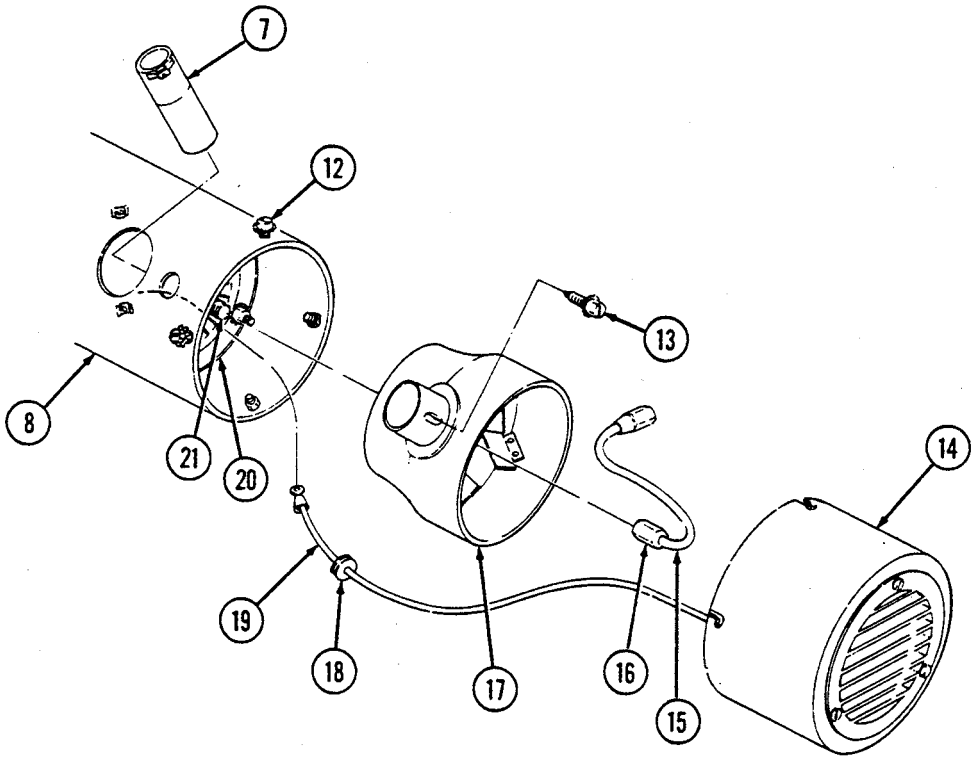
The overheat switch is adjusted and sealed at the factory. To prevent damage, do not bend or twist the switch or change the setting of the adjustment screw.

17. Remove two assembled-washer screws (1) and overheat switch (2) from heater body (8). Discard assembled-washer screws (1).
18. Loosen nut (4) and remove flame detector switch (3) and washer (5) from heat exchanger fitting (6).
19. Turn two dzus fasteners (9) and remove cover plate (10) from heater body (8).
20. Turn igniter (11) counterclockwise and remove from igniter tube (7).



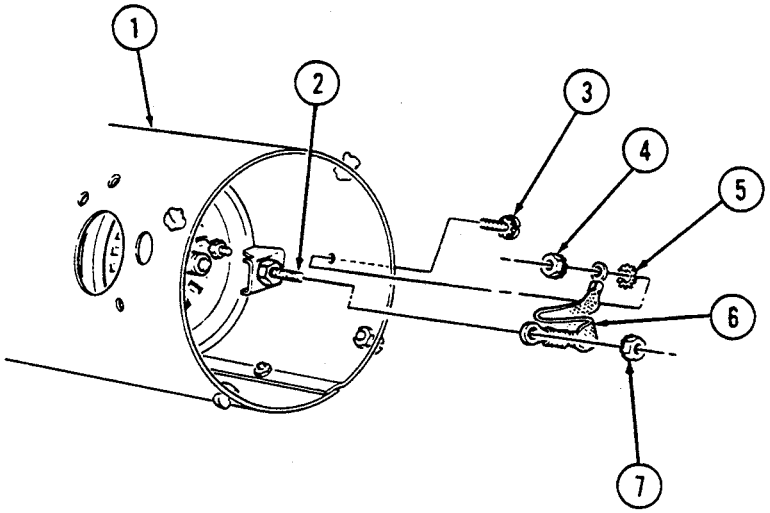
## 14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)

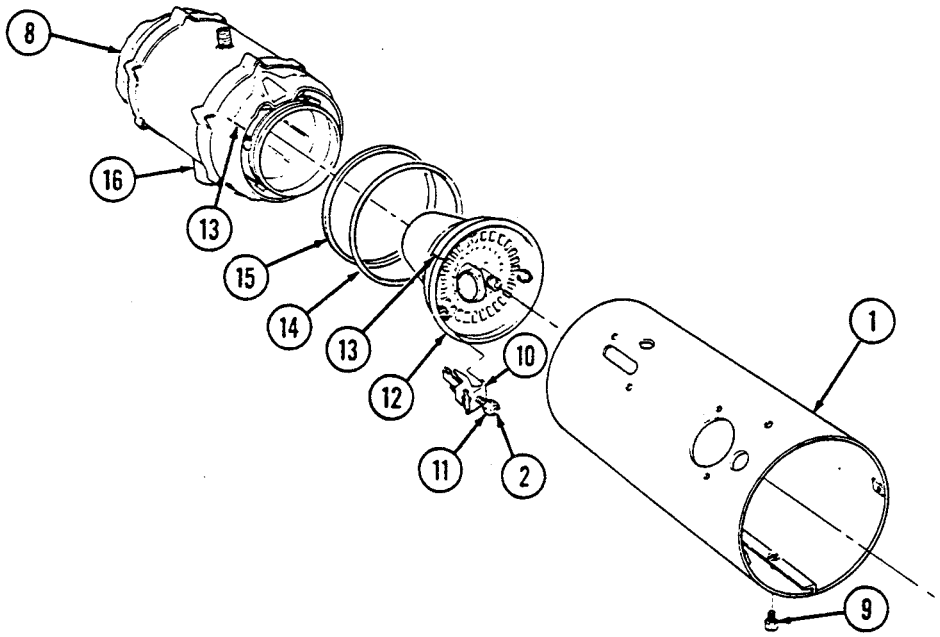
21. Loosen four assembled-washer screws (12), turn blower assembly (14) counterclockwise and remove blower assembly (14), blower lead (19), and grommet (18) from heater body (8).
22. Remove assembled-washer screw (13) and igniter tube (7) from secondary blower housing (17). Discard assembled-washer screw (13).
23. Loosen line nut (16) and remove fuel line (15) from burner inlet (21).
24. Remove secondary blower housing (17) from burner (20).



## 14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)

25. Remove nut (4), assembled-washer screw (3), ground strap (6), and lockwasher (5) from heater body (1). Discard lockwasher (5) and assembled-washer screw (3).
26. Remove locknut (7) and ground strap (6) from hookbolt (2). Discard locknut (7).
27. Scribe alignment marks (13) on burner assembly (12) and heat exchanger (8) to ensure proper alignment of burner assembly (12) and heat exchanger (8) during assembly.
28. Remove screw (9) securing heater body (1) together, spread heater body (1) just enough to clear exhaust outlet (16), and remove heat exchanger (8) and burner assembly (12) from heater body (1).
29. Remove four locknuts (11), clamps (10), hookbolts (2), and burner assembly (12) from heat exchanger (8). Discard locknuts (11).
30. Remove gasket (15) and O-ring (14) from burner assembly (12). Discard gasket (15) and O-ring (14).



**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**

**b. Cleaning and Inspection**

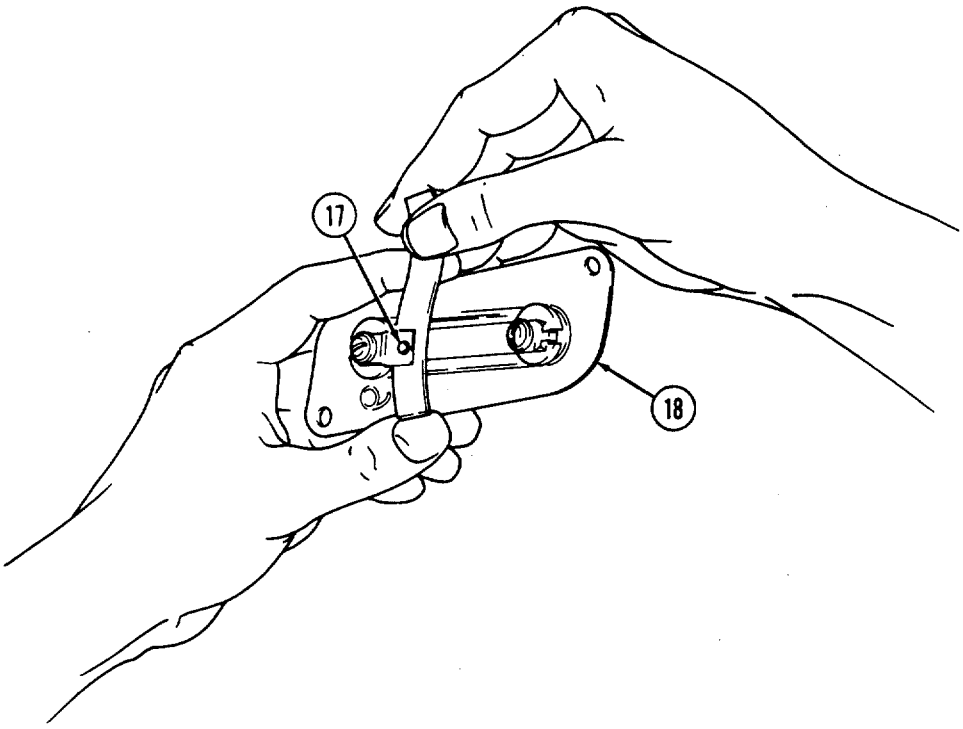
1. Overheat switch (18):

**CAUTION**

The overheat switch is adjusted and sealed at the factory. Do not bend or twist the switch. Do not change the setting of the adjustment screw.

(a) Slide a clean strip of bond paper between contact points (17) on switch (18) to clean points. Do not use abrasive paper.

(b) Inspect switch (18) for burned, bent, damaged, or defective parts. Replace switch (18) if any parts are burned, bent, damaged, or defective.



**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**

**WARNING**

- Drycleaning solvent is flammable and will not be used near an open flame. A fire extinguisher will be kept nearby when the solvent is used. Use only in well-ventilated places. Failure to do this will result in injury to personnel and/or damage to equipment.
- Compressed air source will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc).

2. Blower assembly (1):
   (a) Clean blower assembly (1) fan and surrounding areas with drycleaning solvent. Dry with compressed air.
   (b) Inspect blower assembly (1) for damage. Replace if damaged.
3. Fuel control valve (2):
   (a) Clean fuel control valve (2) with compressed air.
   (b) Inspect control valve (2) and leads (3) for damage. Replace control valve (2) if any part is damaged.
4. Burner assembly (4):
   (a) Remove three nuts (5), screws (16), and burner plate (6) from bowl (15) and remove burner plate (6).
   (b) Clean residue and carbon from bowl (15) and burner plate (6). Clean burner plate (6) with compressed air.
   (c) Inspect burner plate (6) and bowl (15) for damage, replace burner plate (6) or burner assembly (4) if bowl (15) is damaged.
   (d) Remove screw (14), fuel vaporizer shield (13), washer (12), washer (11), fuel vaporizer (10), retaining washer (9), two notched fiber washers (8), and wick (7) from burner plate (6). Discard screw (14), fuel vaporizer shield (13), washer (12), washer (11), fuel vaporizer (10), retaining washer (9), notched fiber washers (8), and wick (7).
   (e) Assemble two notched fiber washers (8) to burner plate (6) making sure to align notches with igniter pocket.
   (f) Press retaining washer (9) over fuel feed bushing (17) with flange facing away from burner plate (5).

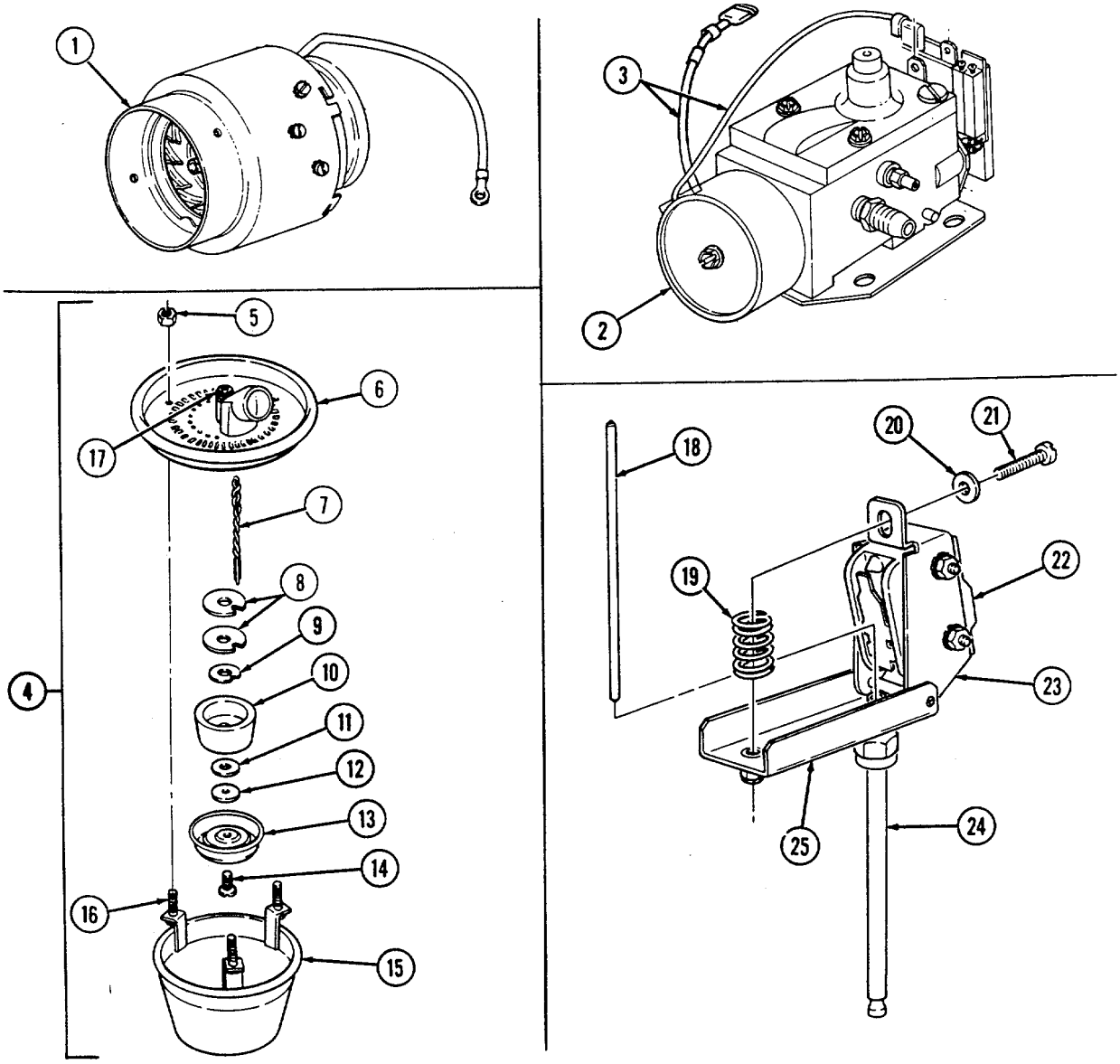
**NOTE**

A new fuel vaporizer is supplied with ignition wick already inserted in hole of vaporizer with excess length for assembly.

   (g) Position wick (7) and fuel vaporizer shield (13) over fuel feed bushing (17) so the wick (7) will lie in the slot. Use a piece of thin wire to pull looped end of wick through igniter pocket. Remove wire from wick (7).
   (h) Hold fuel vaporizer shield (13) firmly against retaining washers (9) and pull wick (7) back through vaporizer until wick (7) is taut. Cut off excess wick (7) close to small end of fuel vaporizer shield (13).
   (i) Install fuel vaporizer (10), washer (11), washer (12), and screw (14) on burner plate (6).
   (j) Install burner plate (6) on bowl (15) with three screws (16) and nuts (5).

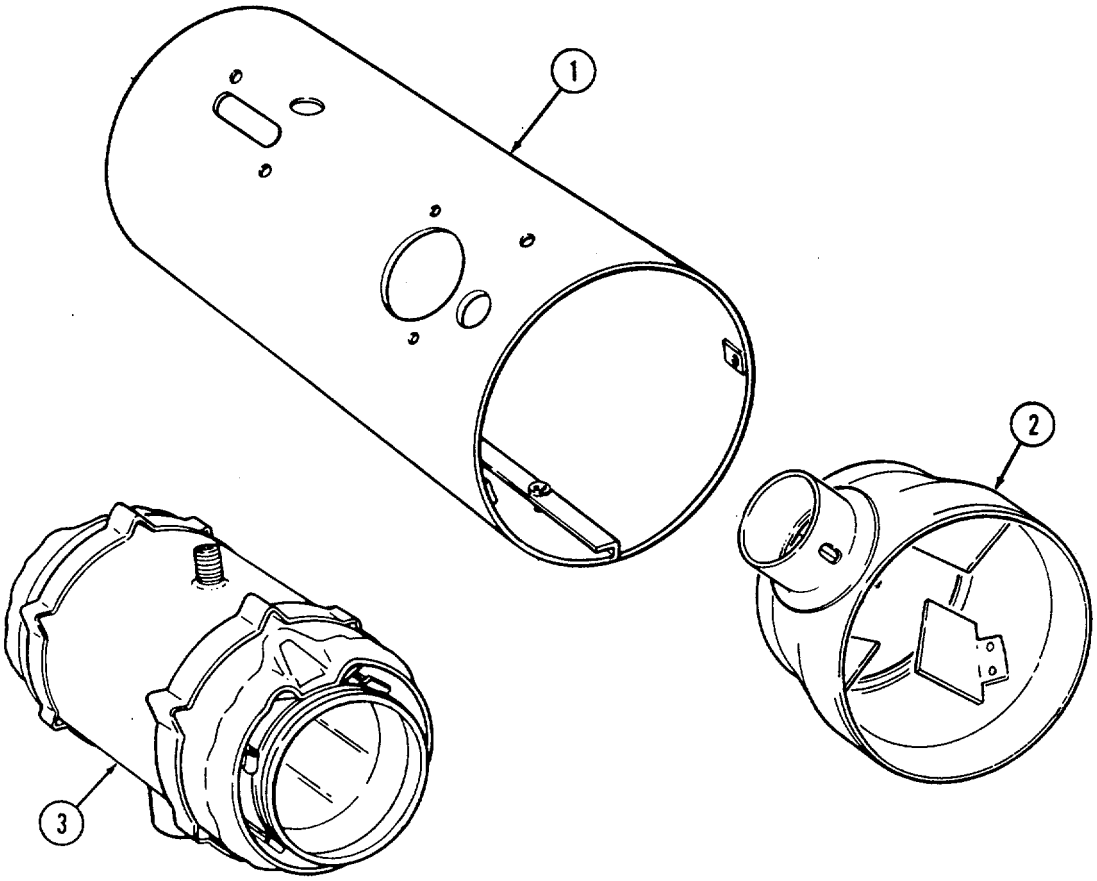
**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**

5. Flame detector switch (23):
   (a) Remove adjusting screw (21), washer (20), and spring (19) from flame detector switch (23).
   (b) Remove ceramic rod (18) from tube (24). Inspect ceramic rod (18) for cracks, chips, or breakage. Replace flame detector switch (23) if ceramic rod (18) is cracked, chipped, or broken.
   (c) Clean flame detector switch (23) with compressed air.
   (d) Inspect flame detector switch (23) for damaged or defective parts. Replace flame detector switch (23) if any part is damaged or defective.
   (e) Carefully insert ceramic rod (18) into tube (24). Install spring (19) on channel (25), tip microswitch (22) down, and install washer (20) and adjusting screw (21).
   (f) Turn adjusting screw (21) clockwise until microswitch (22) just 'clicks", and stop turning screw (21). Turn adjusting screw (21) an additional 3/4 turn clockwise, and seal screw (21) in place with insulating varnish.

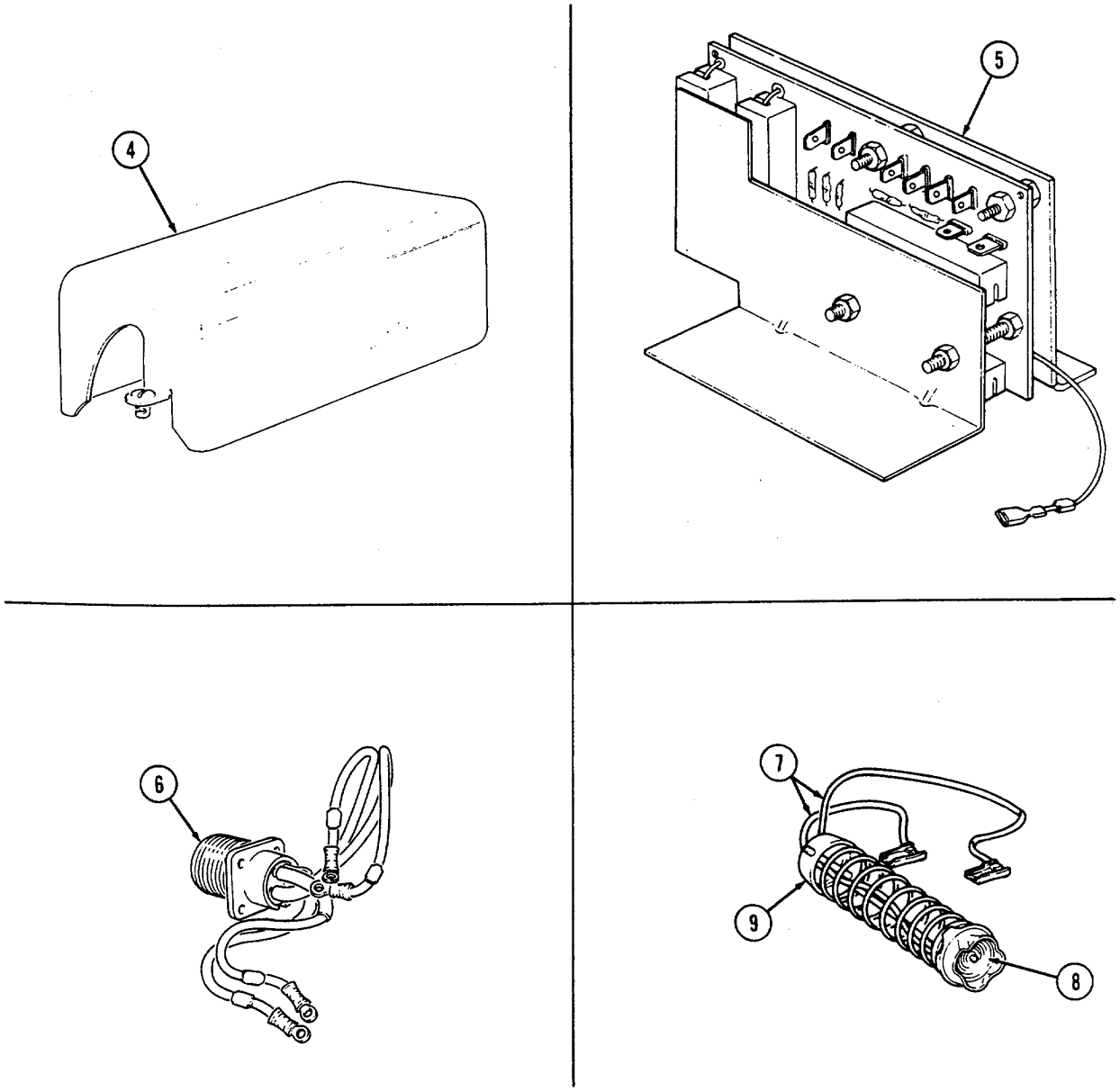


**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**

6. Clean heat exchanger (3), secondary blower housing (2), housing (1), and guard (4) with drycleaning solvent. Remove all traces of solvent and allow to air dry before assembly.
7. Inspect circuit board (5) and receptacle (6) for broken connections and damage. Replace either if damage or broken connections are evident.
8. Inspect igniter assembly (9) for loose or broken leads (7) or damaged element (8). Replace igniter assembly (9) if leads (7) are broken or loose, or element (8) is damaged.
9. Connect multimeter to leads (7) to check igniter assembly (9) for proper resistance. Resistance should be 2.2 Ohms. If resistance is not 2.2 Ohms, replace igniter assembly (9).



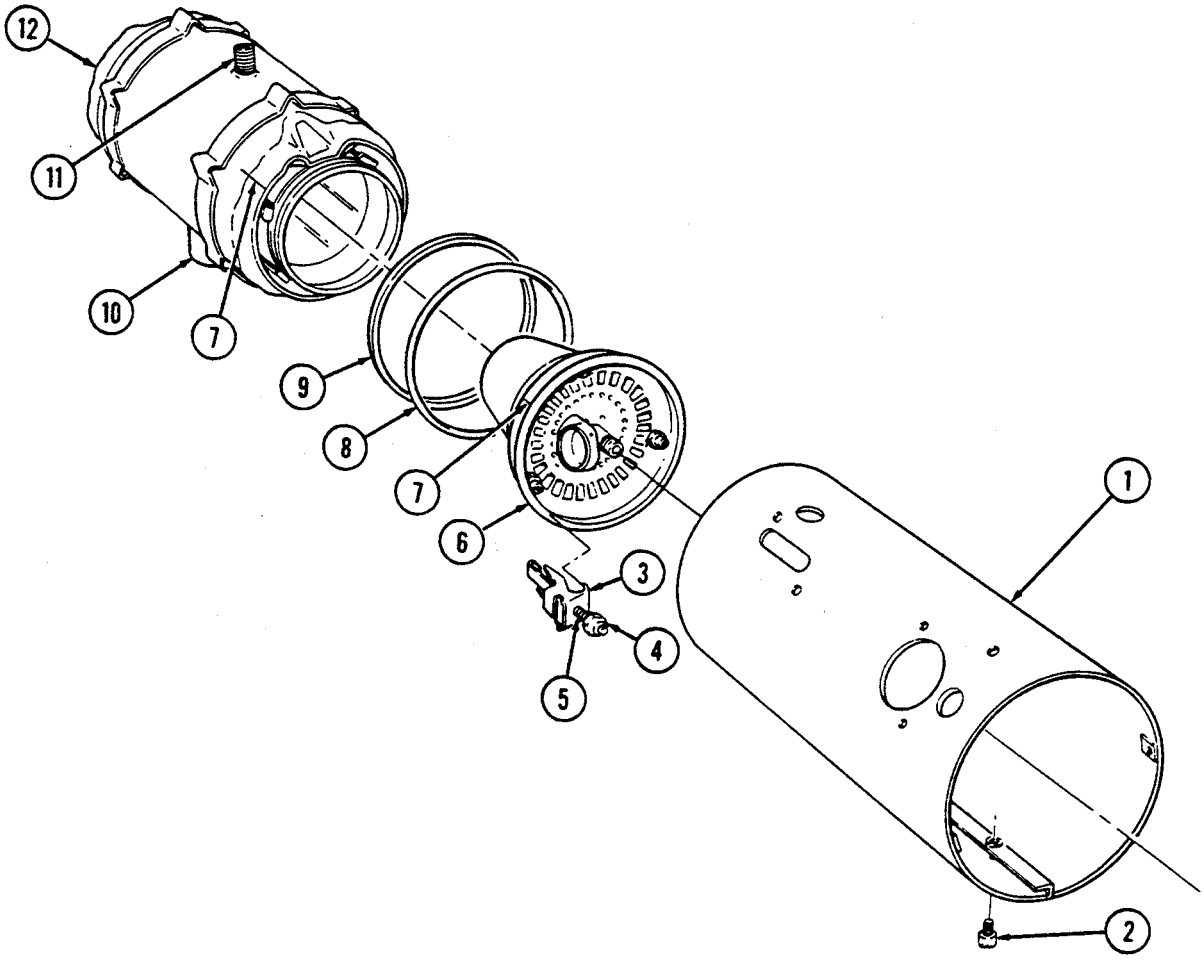
**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**



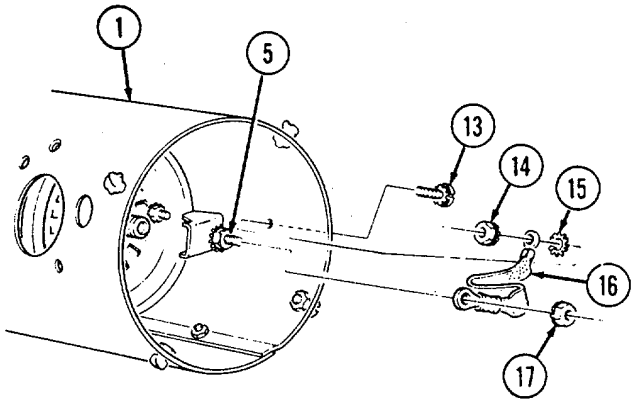
## 14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)

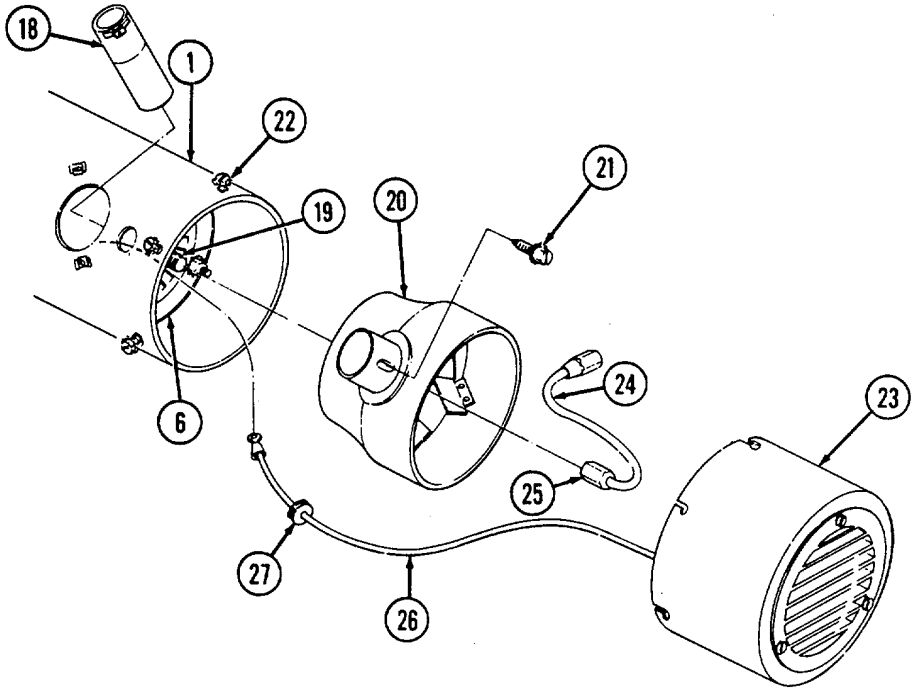
**c. Assembly**

1. Install O-ring (8) and gasket (9) on burner assembly (6).
2. Install burner assembly (6) on heat exchanger (12) ensuring alignment marks (7) align, and secure with four hookbolts (5), clamps (3), and locknuts (4).
3. Spread heater body (1) just enough to clear exhaust outlet (10) and install heat exchanger (12) and burner assembly (6) in heater body (1). Ensure exhaust outlet (10) and flame detector switch fitting (11) extend through heater body (1) holes.
4. Secure heater body (1) together with screw (2).
5. Install ground strap (16) on hookbolt (5) with locknut (17).
6. Install lockwasher (15) and ground strap (16) on heater body (1) with assembled-washer screw (13) and nut (14).
7. Install secondary blower housing (20) in heater body (1) onto burner assembly (6).
8. Position fuel line (24) through heater body (1) and secondary blower housing (20) and install on burner fuel inlet (19) with line nut (25).
9. Install igniter tube (18) on secondary blower housing (20) with assembled-washer screw (21).
10. Route blower lead (26) through heater body (1) and install grommet (27).
11. Install blower assembly (23) to heater body (1) and tighten four assembled-washer screws (22). Remove slack from blower lead (26) by pulling up through grommet (27).



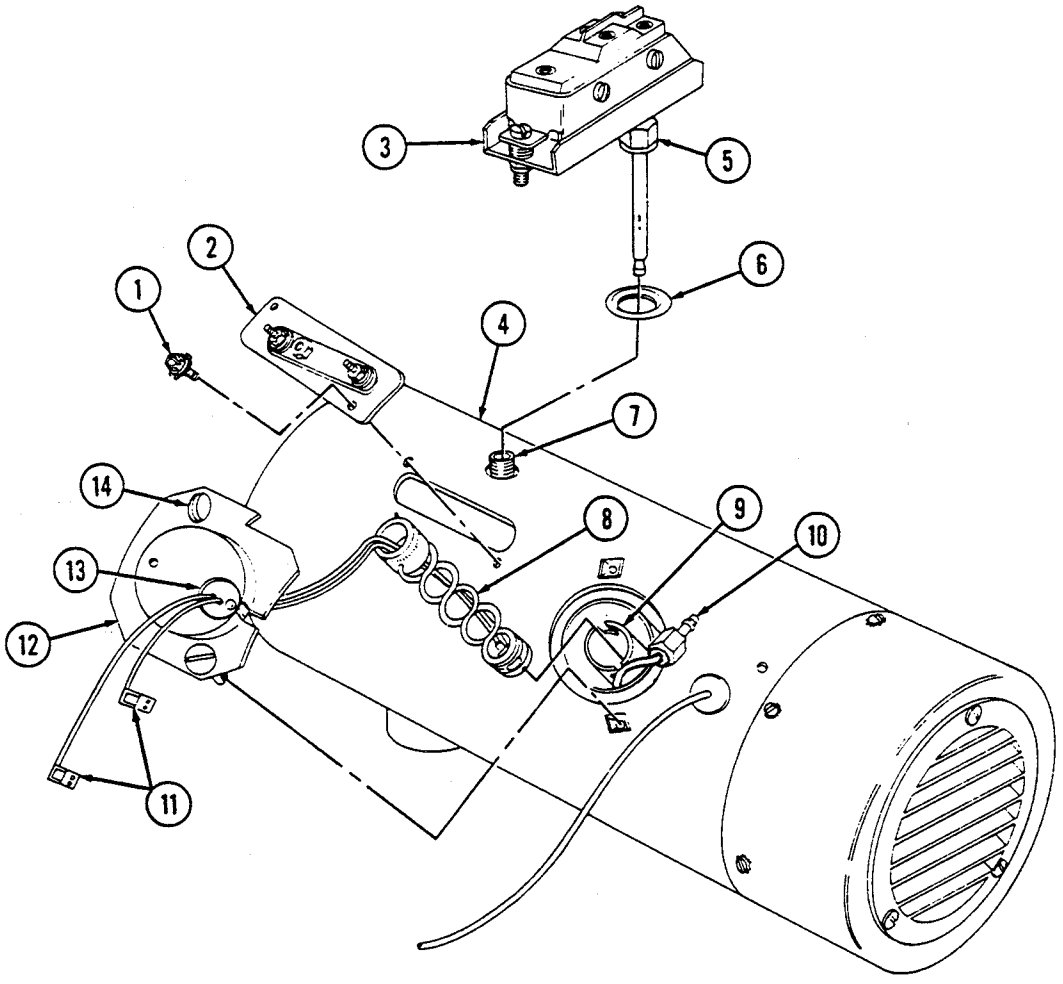
**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**



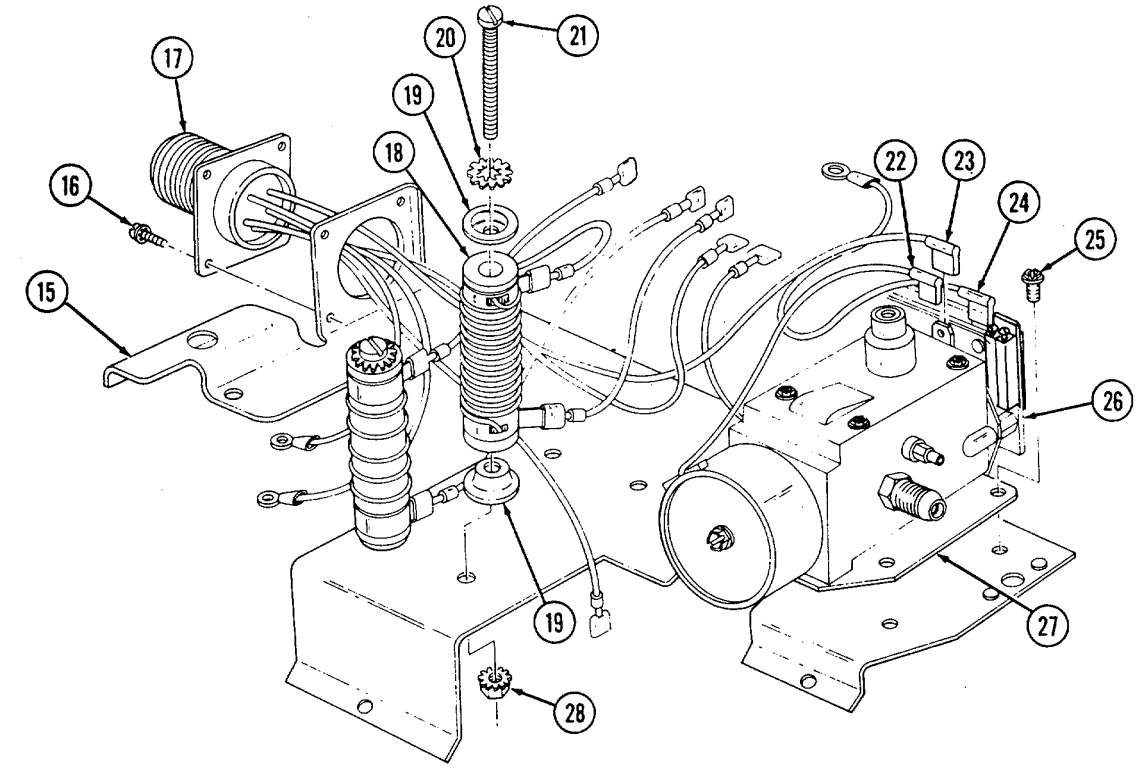



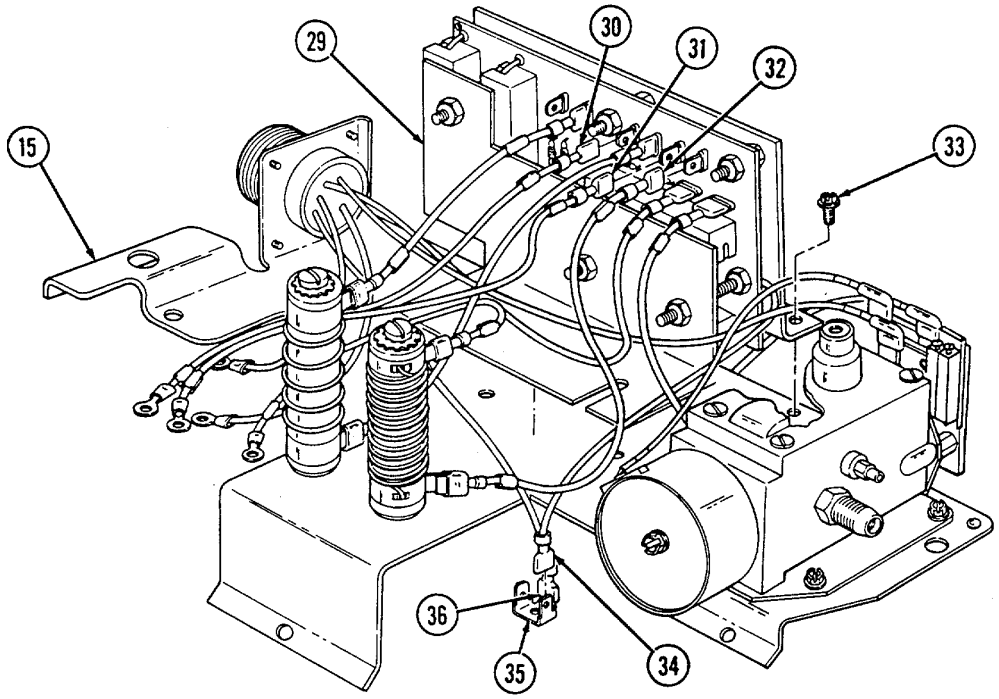
## 14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)

12. Install igniter (8) into igniter tube (9). Push igniter (8) down and turn clockwise to install in tube (9).
13. Place igniter leads (11) and fuel line (10) in cover plate grommet (13) and install cover plate (12) on heater body (4) with two dzus fasteners (14).
14. Install washer (6) and flame detector switch (3) on heat exchanger fitting (7) with tube nut (5).
15. Install overheat switch (2) on heater body (4) with two assembled-washer screws (1).
16. Install plug receptacle (17) on control bracket (15) with four assembled-washer screws (16).
17. Install fuel control valve assembly (27) on control bracket (15) with four screws (25).
18. Connect leads 15 (24), 16 (22), and 17 (23) to fuel valve circuit board (26).
19. Install two resistors (18) on control bracket (15) with four capwashers (19), two lockwashers (20), screws (21), and nuts (28).
20. Install circuit board (29) on control bracket (15) with three screws (33).
21. Connect overheat switch lead 3 (31) and flame detector switch lead 4 (30) on circuit board (29).
22. Connect five leads (32) to circuit board (29).
23. Connect circuit board ground lead (34) and receptacle ground lead (36) on ground terminal (35).



**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**

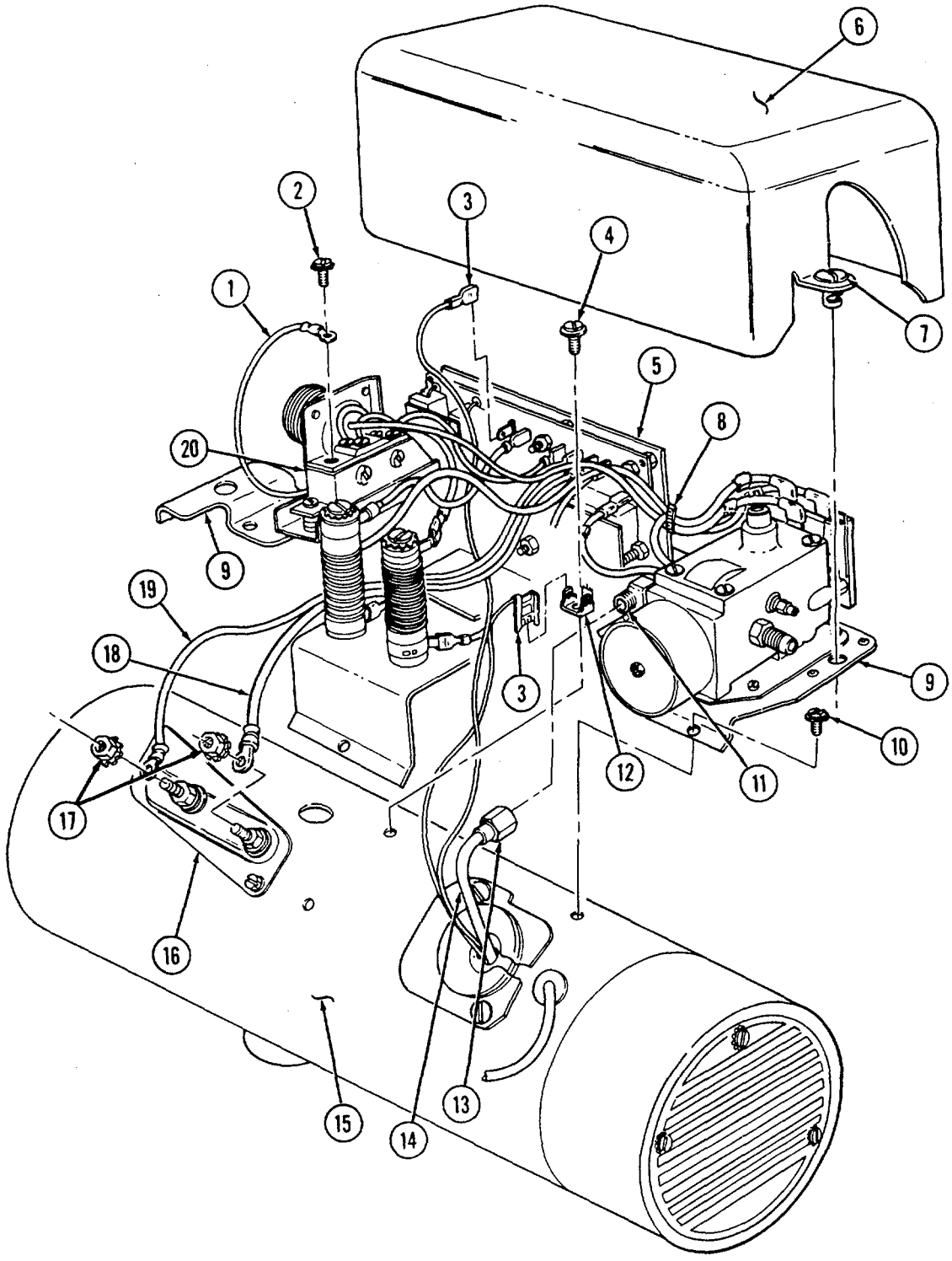


## 14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)

24. Install control bracket (9) and ground terminal (12) on heater body (15) with two screws (4).
25. Install control bracket (9) on heater body (15) with six screws (10).
26. Connect fuel line (14) to fuel control valve fitting (11) with line nut (13).
27. Connect two igniter leads (3) to ground terminal (12) and circuit board (5).
28. Install five leads (1) on flame detector switch (20) with five assembled-washer screws (2).
29. Install leads 30 (19) and 9 (18) on overheat switch (16) with two nuts (17).
30. Group leads together with four tiedown straps (8).
31. Install guard (6) on control bracket (9) with two dzus fasteners (7).

**14-11. AMBULANCE HEATER REPAIR (MODEL 10530B) (Cont'd)**




FOLLOW-ON TASK: Bench test ambulance heater (para. 14-13).

# 14-12. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT (MODEL 10530A)

**This task covers:**

**Testing and Adjustment**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Test Equipment**

24 volt DC power source (Appendix G, Item 130)
Graduated beaker, 1.7 oz (50 cc) (Appendix G, Item 131)
Fuel container, 1 gal (3.785 L) (Appendix G, Item 132)
Ammeter (50 ampere) (Appendix G, Item 133)

**Materials/Parts**

Nonmetallic tubing, .187 in. (4.7 mm) diameter (Appendix E, Item 258)
Fuel oil (Appendix B, Item 16)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

Ambulance heater removed (TM 9-2320-280-20).

**General Safety Instructions**

- Do not perform this procedure near fire, flames, or sparks.
- Do not operate heater in enclosed areas. Exhaust gases can kill.

**Maintenance Level**

Direct support

**Testing and Adjustment**

**WARNING**

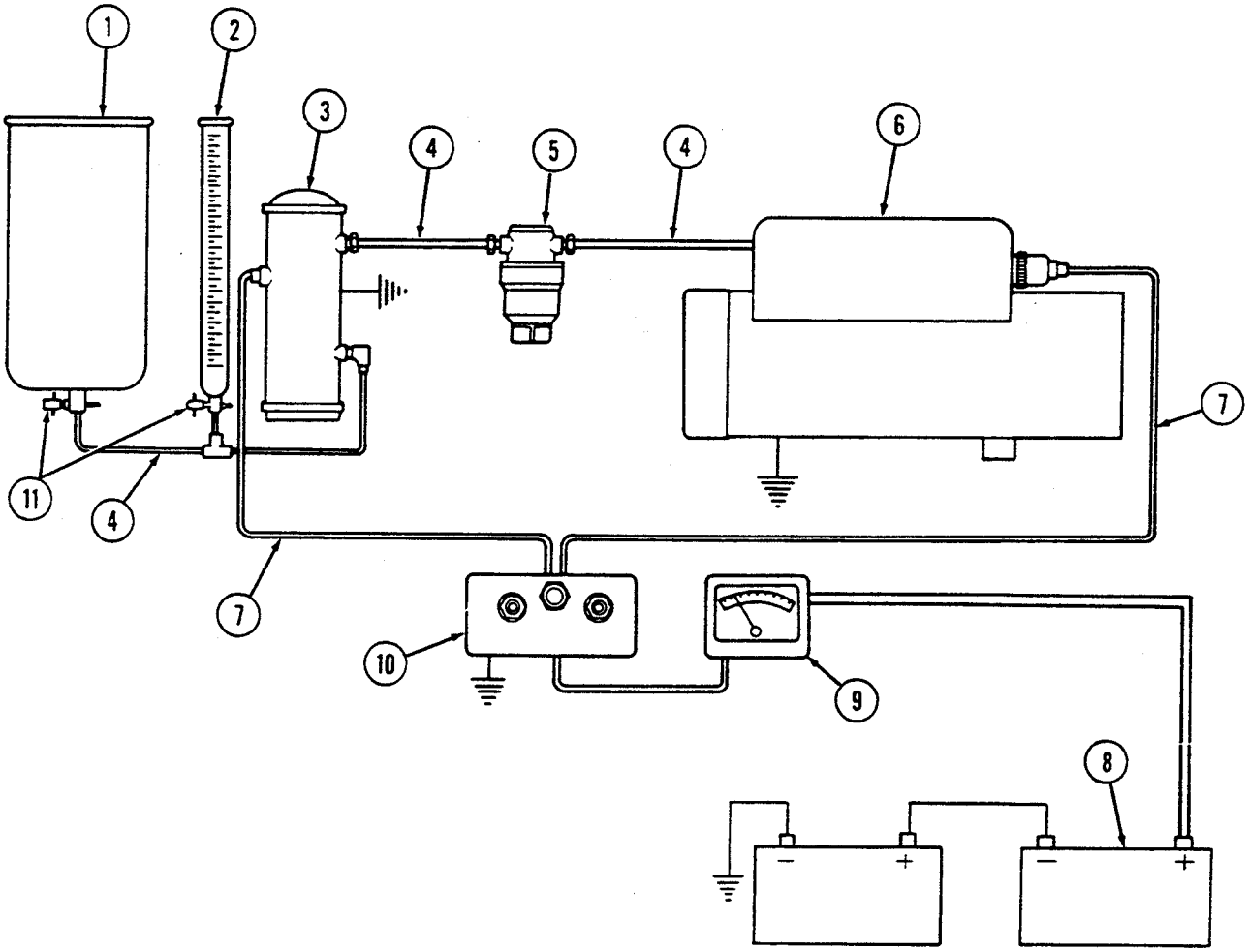
- Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.
- Do not operate heater in enclosed areas. Exhaust gases can kill. Make sure work area is well-ventilated and exhaust fumes are routed away from test area.

**NOTE**

- Make sure heater is placed in its normal operating position in holding fixture.
- Use DF-2 grade diesel fuel for bench testing.
- Testing is to be performed in an area of surrounding temperature of 50°F (10°C) or higher.

## 14-12. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT (MODEL 10530A) (Cont'd)

1. Connect heater to test equipment following diagram below.




1 One Gallon (3.785 liter) Fuel Container
2 50 Cubic Centimeter (1.7 Fluid Ounce) Graduated Beaker
3 Electric Fuel Pump*
4 Nonmetallic Tubing*
5 Fuel Filter*
6 Heater Assembly*
7 Wiring Harness*
8 24 Volt DC Power Source
9 Ammeter (50 Ampere)
10 Control Box*
11 Shutoff Valves

* Fuel pump, fuel filter, heater, wiring harness, nonmetallic tubing, and control box must be the same type installed in vehicle.

## 14-12. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT (MODEL 10530A) (Cont'd)

2. Make sure power source is disconnected. Turn two dzus fasteners (3) securing guard (2) to housing (1) and remove guard (2).
3. Loosen nut (4) securing fuel tube (10) to valve outlet port (6) and disconnect fuel tube (10). Connect .187 in. (4.7 mm) diameter nonmetallic tubing to control valve outlet port (6).
4. Disconnect long igniter lead (5) from ignition control unit (11).
5. Close graduated beaker shutoff valve (17) and open fuel container shutoff valve (18). Connect power source.

**NOTE**

Have drainage container ready to catch fuel.

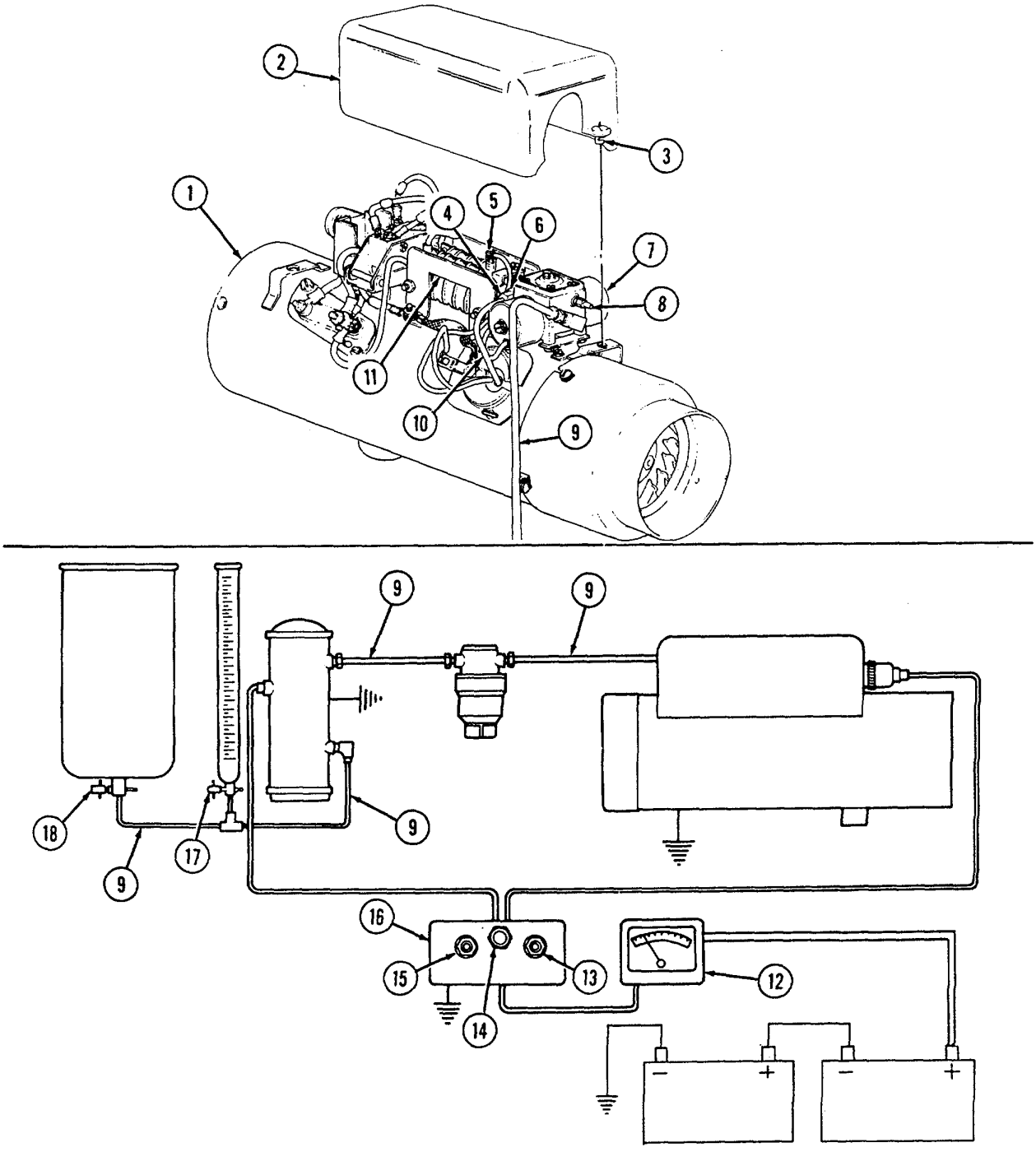
6. Position toggle switch (13) on control box (16) to START position. Open bleed valve (8) on control valve (7) to remove air from fuel lines (9). Close bleed valve (8) when fuel from outlet port (6) runs free and clear of air bubbles. Position toggle switch (13) to OFF position.
7. Remove nonmetallic tubing from outlet port (6) and connect fuel tube (10) on outlet port (6) with nut (4).
8. Disconnect power source, and connect long igniter lead (5) to ignition control unit (11).
9. Connect power source and place HI-LO switch (15) on control box (16) in LO position.

**NOTE**

Ignition time is the interval from activating toggle switch until indicator lamp illuminates.

10. Place and hold toggle switch (13) in START position and record ignition time. During ignition period, check ignition amperage on ammeter (12).
11. If ignition time exceeds three minutes, or if ignition amperage exceeds 15 amperes, repair heater assembly (para. 14-10).
12. When indicator lamp (14) illuminates, place toggle switch (13) to RUN position.

**14-12. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT (MODEL 10530A) (Cont'd)**



## 14-12. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT MODEL 10530A) (Cont'd)

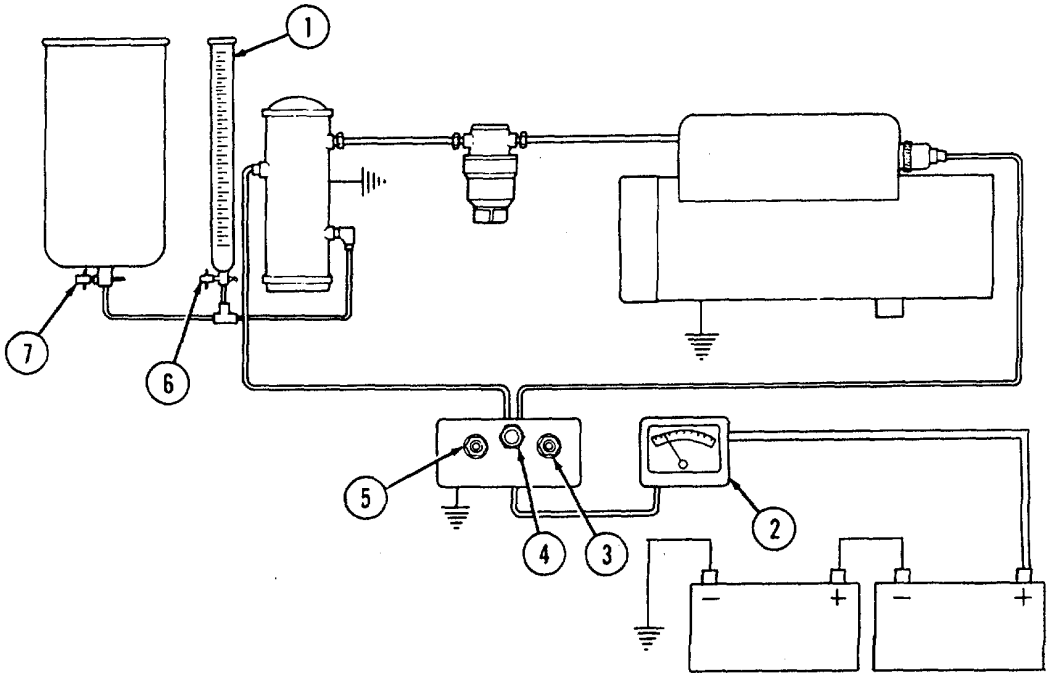
13. Fill graduated beaker (1) with fuel to 50 cubic centimeter level. Close fuel container shutoff valve (7) and open graduated beaker shutoff valve (6). Allow heater to operate for thirty seconds.
14. Check fuel consumption rate at graduated beaker (1) for exactly one minute. Fuel consumption rate should be 10-13 cc per minute. If fuel consumption rate is not 10-13 cc per minute, adjust fuel control valve (11) by turning screw (10) clockwise to increase flow or counterclockwise to decrease flow. If not adjustable, replace fuel control valve (11) (para. 14-10).
15. Place HI-LO switch (5) in HI position.
16. Observe exhaust outlet (13) for smoke. Visible smoke up to three minutes after switch (5) is positioned to HI is normal. If smoke continues to be visible at exhaust outlet (13) after three minutes, repair heater assembly (para. 14-10).
17. Fill graduated beaker (1) with fuel. Check fuel consumption rate at graduated beaker (1) for exactly one minute. Fuel consumption rate should be 19-23 cc per minute. If fuel consumption rate is not 19-23 cc per minute, replace fuel control valve (para. 14-10).
18. Close graduated beaker shutoff valve (6) and open fuel container shutoff valve (7).
19. Check operating amperage on ammeter (2). If operating amperage exceeds 10 amperes, repair heater assembly (para. 14-10).

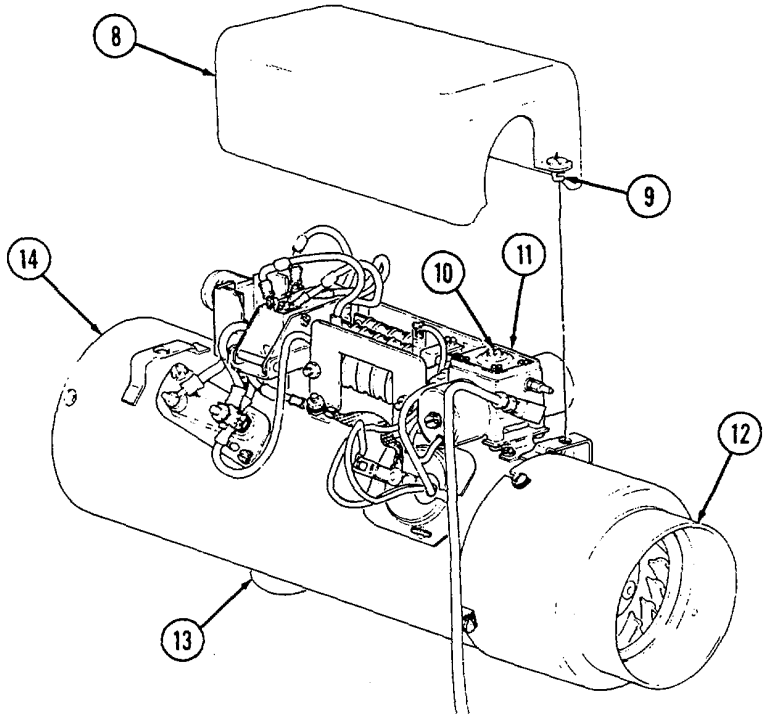
**NOTE**

Purge time is the interval from turning toggle switch to OFF position until indicator lamp goes out.

20. Place toggle switch (3) to OFF position and record purge time. Purge time should not exceed four minutes. If purge time exceeds four minutes, replace or adjust flame detector switch (para. 14-10).
21. Start heater and allow to operate for thirty seconds.
22. Partially restrict fresh air inlet (12) with a sheet or cardboard or sheet metal. Overheat switch on heater should actuate and shut down heater in less than five minutes. If heater does not shut down after five minutes, replace overheat switch (para. 14-10). Make sure indicator lamp (4) extinguishes.
23. Disconnect test equipment from heater assembly.
24. Install guard (8) on housing (14) with two dzus fasteners (9).

**14-12. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT MODEL 10530A) (Cont'd)**




FOLLOW-ON TASK: Install ambulance heater (TM 9-2320-280-20).

# 14-13. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT (MODEL 10530B)

**This task covers:**

**Testing and Adjustment**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Test Equipment**

24 volt DC power source (Appendix G, Item 130)
Graduated beaker, 1.7 oz (50 cc) (Appendix G, Item 131)
Fuel container, 1 gal (3.785 L) (Appendix G, Item 132)
Ammeter (50 ampere) (Appendix G, Item 133)

**Materials/Parts**

Nonmetallic tubing, .187 in. (4.7 mm) diameter (Appendix E, Item 258)
Insulation varnish (Appendix B, Item 27)
Fuel oil (Appendix B, Item 16)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

Ambulance or arctic heater removed (TM 9-2320-280-20).

**General Safety Instructions**

- Do not perform this procedure near fire, flames, or sparks.
- Do not operate heater in enclosed areas. Exhaust gases can kill.

**Maintenance Level**

Direct support

**Testing and Adjustment**

**WARNING**

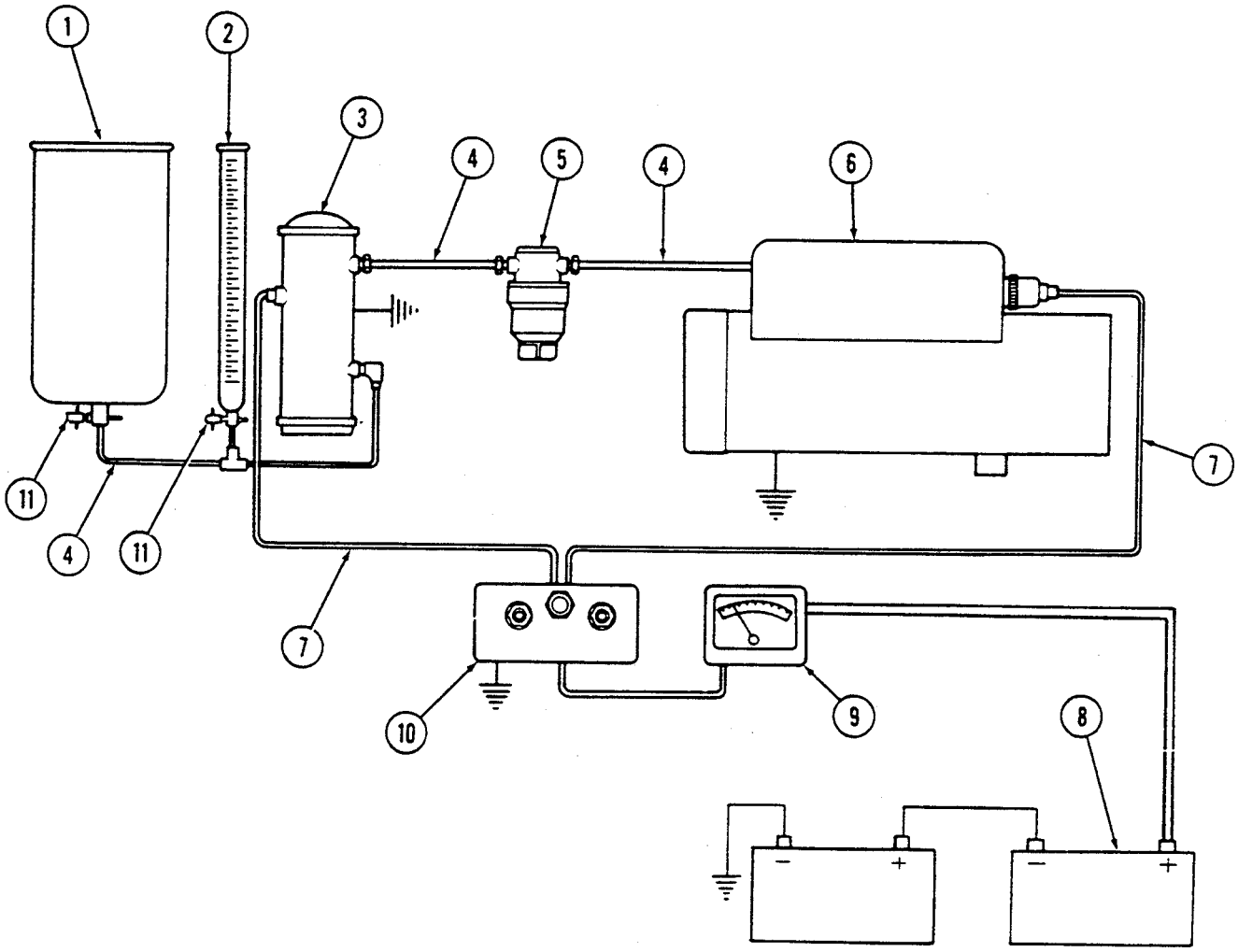
- Diesel fuel is highly flammable. Do no perform this procedure near fire, flames, or sparks. Severe injury or death will result.
- Do not operate heater in enclosed areas. Exhaust gases can kill. Make sure work area is well-ventilated and exhaust fumes are routed away from test area.

**NOTE**

- Make sure heater is placed in its normal operating position in holding fixture.
- Use DF-2 grade diesel fuel for bench testing.
- Testing is to be performed in an area of surrounding temperature of 50ÞF (10ÞC) or higher.

## 14-13. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT (MODEL 10530B) (Cont'd)

1. Connect heater to test equipment following diagram below.




1 One Gallon (3.785 liter) Fuel Container
2 50 Cubic Centimeter (1.7 Fluid Ounce) Graduated Beaker
3 Electric Fuel Pump*
4 Nonmetallic Tubing*
5 Fuel Filter*
6 Heater Assembly*
7 Wiring Harness*
8 24 Volt DC Power Source
9 Ammeter (50 Ampere)
10 Control Box*
11 Shutoff Valves

* Fuel pump, fuel filter, heater, wiring harness, nonmetallic tubing, and control box must be the same type installed in vehicle.

## 14-13. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT (MODEL 10530B) (Cont'd)

2. Make sure power source is disconnected. Turn two dzus fasteners (2) and remove guard (1) from control bracket (3)
3. Loosen nut (4) and disconnect fuel tube (5) from control valve outlet (7).
4. Connect one end of nonmetallic tubing (6) on control valve outlet (7) and place other end in graduated beaker or similar container.
5. Disconnect lead 3 (16) from shunt resistor (17) to disable the motor and igniter.
6. Disconnect lead 15 (12) from fuel valve (14) to disable fuel valve (14).
7. Connect power source and place HI-LO switch to LO position.

**NOTE**

Have drainage container ready to catch fuel.

8. Open bleed valve (15) on fuel valve (14) to remove air from fuel flow. Close bleed valve (14) when fuel flow is free of air bubbles.
9. Connect lead 15 (12) to fuel valve (14).
10. Disconnect lead 17 (11) from fuel valve (14).
11. Partially raise lead (12) and place switch in start position.
12. Connect jumper lead (13) to lead 17 (11) terminal and lead 15 (12) terminal. A clicking sound should increase in rate.
13. Connect 50 in. (127 cm) long, and .187 in. (4.7 mm) diameter clear nonmetallic tubing to bleed valve (15) and position the open end of nonmetallic tube (18) at least 45 in. (114 cm) higher than bleed valve. Open bleed valve (15) and allow fuel to flow up the nonmetallic tube (18) until it stabilizes.
14. From bleed valve (15) measure vertically the height of fuel. Fuel should be between 36 to 40 in. (91 to 102 cm) from bleed valve (15). If adjustment is necessary, proceed to step 15. If not, proceed to step 16.
15. Adjust height (regulated pressure) by turning the regulated pressure adjustment screw (10). If height will not adjust or stabilize, then replace valve (para. 14-11). Close bleed valve (15).
16. Disconnect nonmetallic tube (18) from bleed valve (15). Turn fuel pump off.
17. Disconnect jumper lead (13) from terminals (11) and (12).

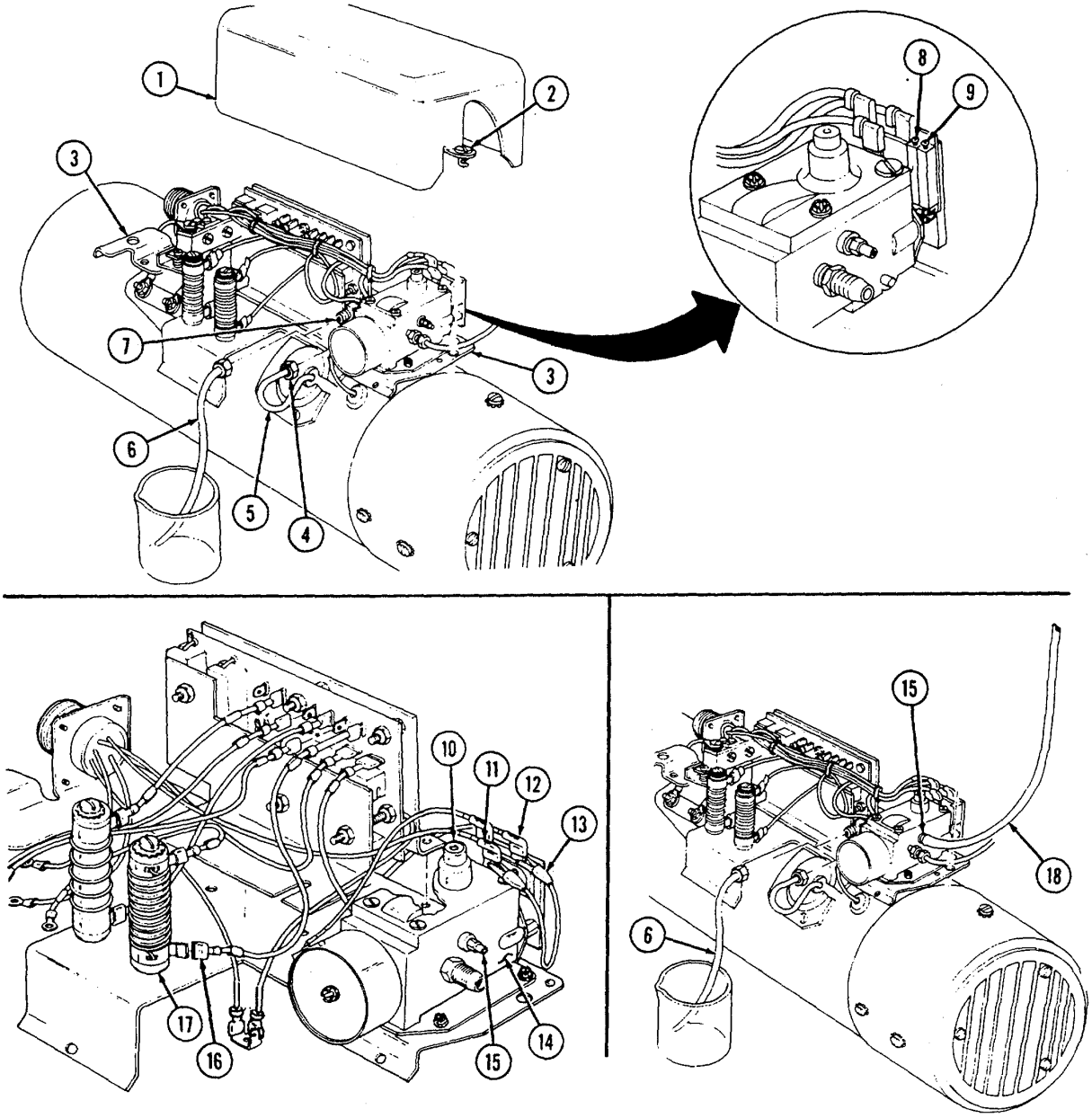
**NOTE**

Low fuel flow rate must be set before high fuel flow can be set.

18. Operate fuel pump for one minute and stop.
19. Repeat step 13.
20. Disconnect jumper lead (13) from terminals (11) and (12).
21. Record amount of fuel accumulated in graduated beaker. The fuel flow rate must be 0 to 10cc per minute.
22. If flow rate is not within limits, turn adjusting screw (9) clockwise to lower flow rate or counterclockwise to raise flow rate. If flow rate is not obtainable, replace fuel valve (para. 14-11).
23. Place HI-LO switch in HI position.
24. Operate fuel pump for one minute and stop.
25. Repeat step 13.
26. Disconnect jumper lead (13) from terminals (11) and (12).
27. Record amount of fuel accumulated in graduated beaker. High fuel flow rate should be 20 cc per minute.
28. If flow rate is not within limits, turn adjusting screw (8) clockwise to lower flow rate or counter-clockwise to raise flow rate. If flow rate is not obtainable, replace fuel valve (para. 14-11).
29. Apply insulating varnish to adjusting screws (8), (9), and (10).
30. Connect lead 17 (12) to fuel valve (14).
31. Connect lead 3 (16) to shunt resistor (17).
32. Remove fuel tubing (6) from control valve outlet (7).

## 14-13. AMBULANCE HEATER FUEL CONTROL VALVE TESTING AND ADJUSTMENT (MODEL 10530B) (Cont'd)

33. Install fuel tube (5) on control valve outlet (7) with nut (4).
34. Disconnect test equipment from heater assembly.
35. Install guard (1) on bracket (3) with two dzus fasteners (2).




FOLLOW-ON TASK: Install ambulance or arctic heater (TM 9-2320-280-20).

# 14-14. HEATER/AIR-CONDITIONING CONTROL BOX REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1, M997A2

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Twenty lockwashers (Appendix E, Item 96)
Assembled locknut (Appendix E, Item 85)
Three push-on nuts (Appendix E, Item 122)
Tape (Appendix B, Item 58)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Battery ground cable disconnected (TM 9-2320-280-20).
- Evaporator blower housing opened (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**a. Removal**

**NOTE**

Prior to removal, tag all leads for installation.

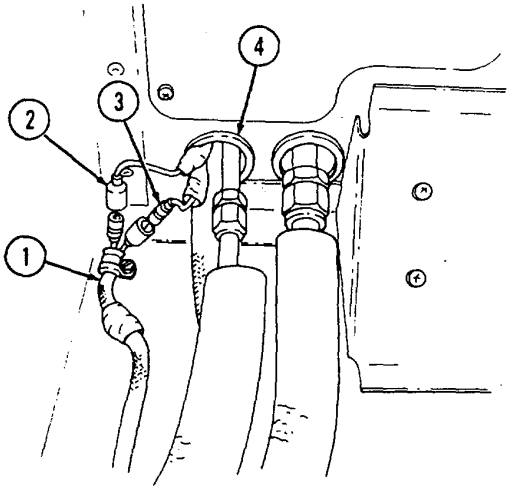
1. Disconnect fuel pump lead (2) and compressor lead (3) from fuel pump and compressor jumper harness (1).
2. Disconnect four control box leads (28) from condenser fan leads (27).
3. Disconnect four blower harness leads (16) from fan blower motor leads (15).
4. Remove capscrew (18), lockwasher (17), clamp (19), and control box blower harness (20) from blower housing (14). Discard lockwasher (17).
5. Pull insulation (22) back to allow access to capscrew (21).
6. Remove nut (11), lockwasher (12), washer (13), capscrew (21), washer (13), clamp (24), and harness (20) from body (23). Discard lockwasher (12).
7. Disconnect control box connector plug (6) from heater (5).

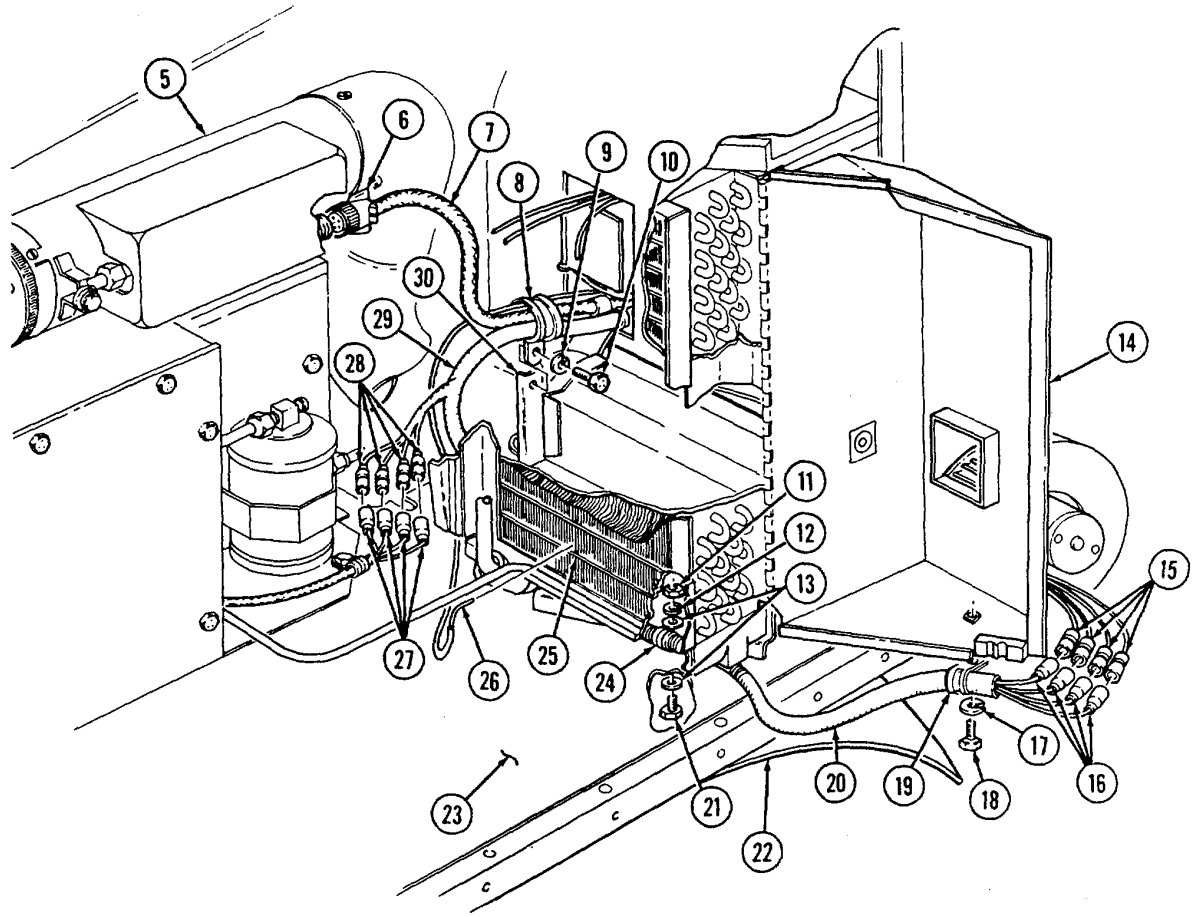
**CAUTION**

Handle cold control probe carefully to prevent damage to probe or evaporator.

8. Remove cold control probe (26) from evaporator coils (25).
9. Remove screw (10), lockwasher (9), clamp (8), heater cable (7), fan harness (29), and cold control probe (26) from heater outlet duct bracket (30). Discard lockwasher (9).
10. Pull fuel pump lead (2) and compressor lead (3) up through grommet (4).

## 14-14. HEATER/AIR-CONDITIONING CONTROL BOX REPLACEMENT (Cont'd)



## 14-14. HEATER/AIR-CONDITIONING CONTROL BOX REPLACEMENT (Cont'd)

**NOTE**

Prior to removal, tag control cables and corresponding duct door arms for installation.

11. Remove two screws (6), lockwashers (5), and control cables (4) from air inlet duct (1). Discard lockwashers (5).
12. Remove two push-on nuts (2) and control cables (4) from duct door arms (3). Discard push-on nuts (2).
13. Remove two capscrews (14) and lockwashers (13) from plate (8) and evaporator duct (7). Discard lockwashers (13).
14. Remove two screws (10), lockwashers (9), and plate (8) from evaporator duct (7). Discard lockwashers (9).
15. Remove screw (12), lockwasher (15), and control cable (16) from evaporator duct (7). Discard lockwasher (15).
16. Remove push-on nut (11) and control cable (16) from evaporator duct door (17) and disconnect control cable (16) and pull through grommet (18). Discard push-on nut (11).
17. Remove four screws (24), lockwashers (25), and cover (23) from circuit box (33). Discard lockwashers (25).
18. Remove four screws (28) and control box leads (27) from terminal block (19).
19. Remove assembled locknut (31), clamp (30), and control box harness (29) from screw (32). Discard assembled locknut (31).
20. Remove six screws (21), lockwashers (20), and control box (22) from body (26). Discard lockwashers (20).

**CAUTION**

Use care when removing control box. Snagging or pulling may damage harness.

21. Slowly remove control box (22), being careful not to snag any cables or leads.

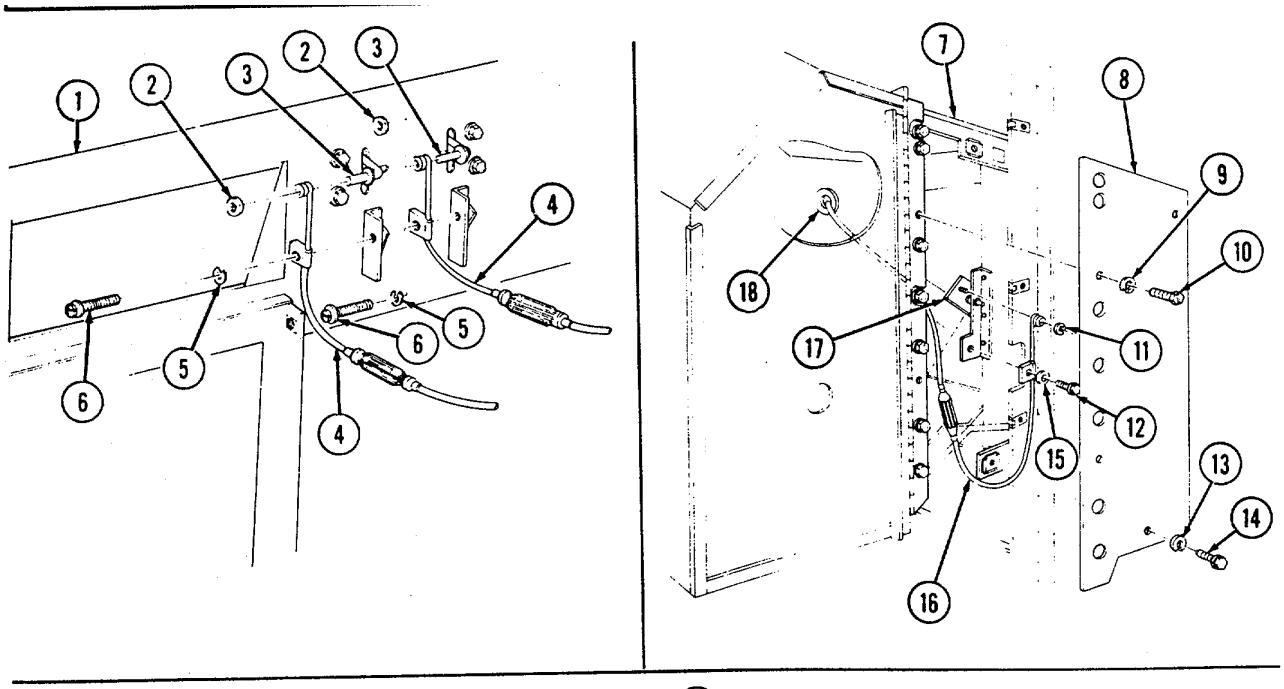
**b. Installation**

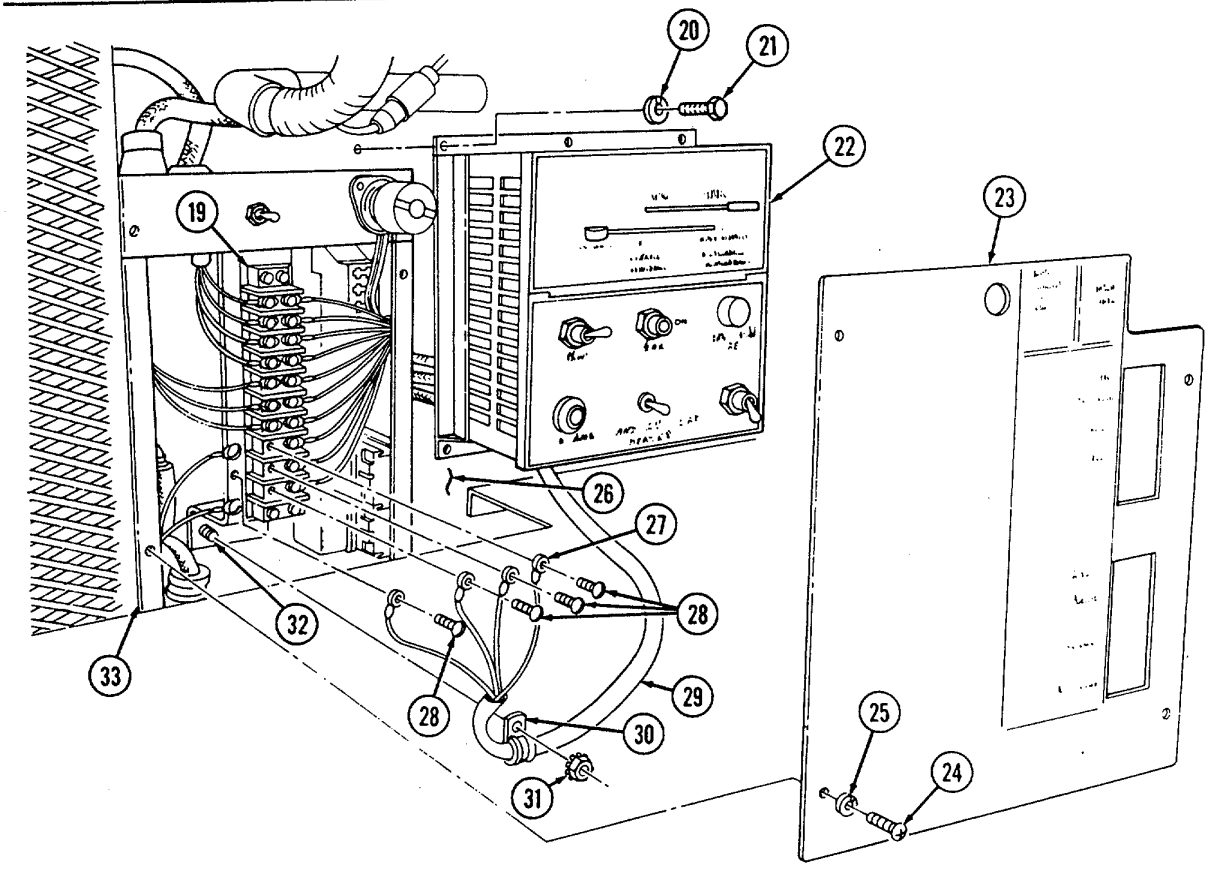
**CAUTION**

Use care when installing harness. Snagging or pulling may damage harness.

1. Install control box (22) on body (26) while routing cables and leads to approximate mounting positions.
2. Install control box (22) on body (26) with six lockwashers (20) and screws (21).
3. Install clamp (30) on control box harness (29) and circuit box screw (32) with assembled locknut (31).
4. Install control box leads (27) on terminal block (19) with four screws (28).
5. Install cover (23) on circuit box (33) with four lockwashers (25) and screws (24).
6. Route control cable (16) through grommet (18) in evaporator duct (7).
7. Install control cable (16) on evaporator duct door (17) with push-on nut (11).
8. Install control cable (16) on evaporator duct (7) with lockwasher (15) and screw (12).
9. Install plate (8) on evaporator duct (7) with two lockwashers (9), screws (10), lockwashers (13), and capscrews (14).
10. Connect two control cables (4) on duct door arms (3) with two push-on nuts (2).
11. Install control cables (4) on air inlet duct (1) with two lockwashers (5) and screws (6).

## 14-14. HEATER/AIR-CONDITIONING CONTROL BOX REPLACEMENT (Cont'd)



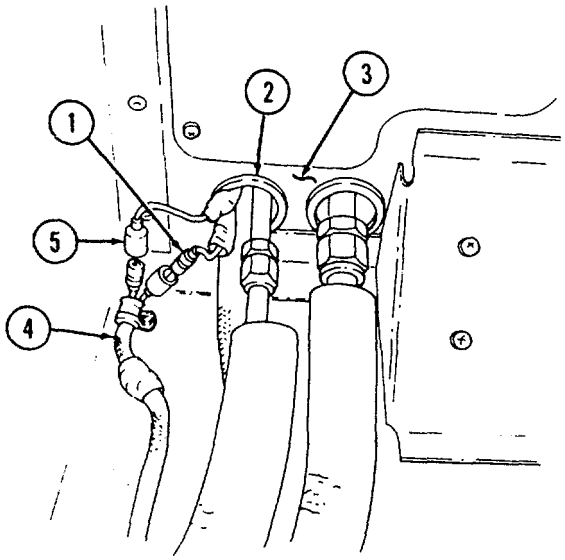
**14-14. HEATER/AIR-CONDITIONING CONTROL BOX REPLACEMENT (Cont'd)**

12. Route fuel pump lead (5) and compressor lead (1) through outboard grommet (2) in body (3).
13. Connect fuel pump lead (5) and compressor lead (1) to jumper harness leads (4).
14. Install clamp (9) on harness (29), heater cable (8), and cold control probe (26) on heater outlet duct bracket (30) with lockwasher (10) and screw (11).

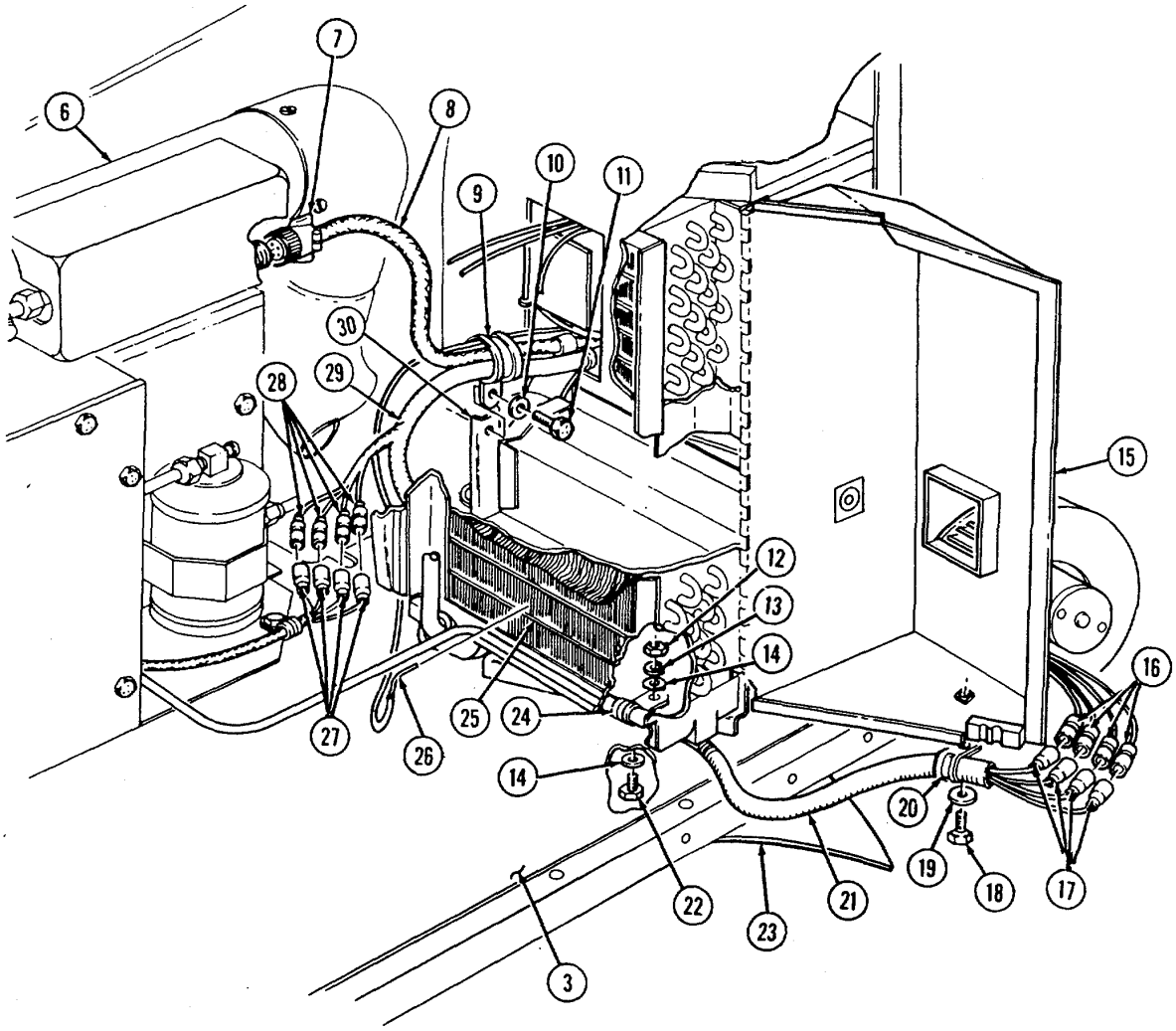
**CAUTION**

Handle cold control probe carefully to prevent damage to evaporator or probe.

15. Install cold control probe (26) into evaporator coils (25) to a minimum depth of 3 in. (7.62 cm).
16. Connect control box connector plug (7) to heater (6).
17. Install clamp (24) and harness (21) on body (3) with washer (14), capscrew (22), washer (14), lockwasher (13), and nut (12).
18. Apply tape to insulation (23) and install to cab roof.
19. Install clamp (20) and harness (21) to blower housing (15) with lockwasher (19) and capscrew (18).
20. Connect four control box leads (17) to fan blower motor leads (16).
21. Connect four control box leads (28) to condenser fan harness leads (27).



**14-14. HEATER/AIR-CONDITIONING CONTROL BOX REPLACEMENT (Cont'd)**




FOLLOW-ON TASKS:
- Adjust duct door control cables (TM 9-2320-280-20).
- Connect battery ground cable (TM 9-2320-280-20).

## 14-15. THERMOSTAT SWITCH REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1, M997A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Lockwasher (Appendix E, Item 102)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Heater/air-conditioning control box removed (para. 14-14).

**Maintenance Level**
Direct support

### a. Removal

1. Remove two screws (11) securing panel (12) to bracket (16).
2. Remove four corner screws (13) securing panel (12) to control box (1) and pull panel (12) away for access to leads (5) and (9).
3. Remove capscrew (3), lockwasher (2), clamp (4), heater cable (14), probe (10), and harness (15) from bracket (16). Discard lockwasher (2).
4. Remove knob (7), nut (8), and switch (6) from panel (12).

**NOTE**

Prior to removal, tag leads for installation.

5. Disconnect leads 720D (5) and 436 (9) from switch (6) and remove switch (6).

### b. Installation

**CAUTION**

Handle cold control probe carefully to prevent damage to probe.

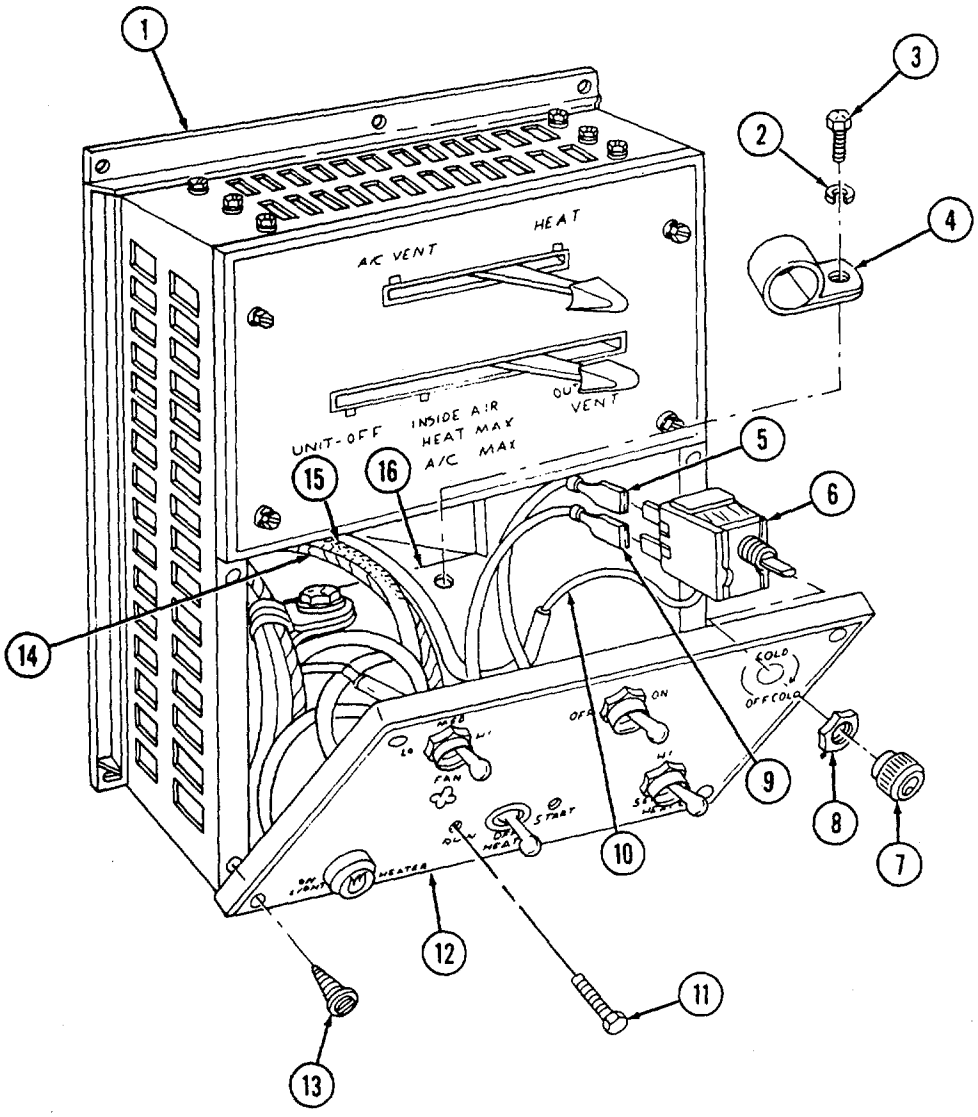
1. Install switch (6) on panel (12) with nut (8) and knob (7).
2. Connect leads 720D (5) and 436 (9) to switch (6).
3. Install heater cable (14), probe (10), and harness (15) on bracket (16) with clamp (4), lockwasher (2), and screw (3).

**NOTE**

Check for loose or disconnected wires before installing panel.

4. Install panel (12) on control box (1) and bracket (16) with four screws (13) and two screws (11).

**14-15. THERMOSTAT SWITCH REPLACEMENT (Cont'd)**




FOLLOW-ON TASK: Install heater/air-conditioning control box (para. 14-13).

## 14-16. PRESSURE SWITCH REPLACEMENT

**This task covers:**
**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1
(TM 9-2320-280-20).

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Evaporator blower housing opened

**Maintenance Level**
Direct support

### a. Removal

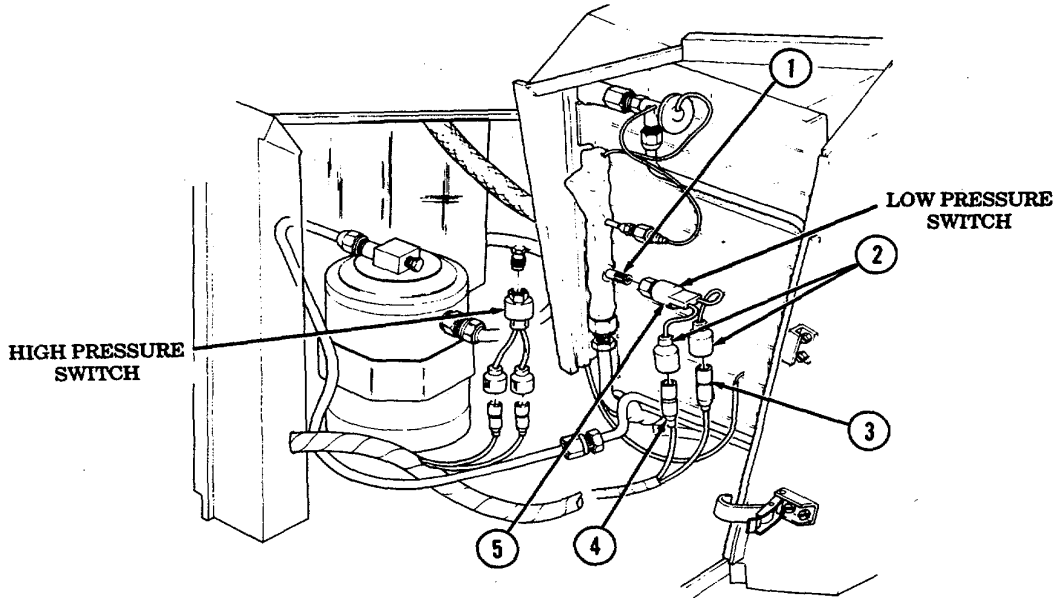
**NOTE**

- Lower pressure switch and high pressure switch are replaced basically the same.
- Prior to removal, tag leads for installation.

1. Disconnect leads (4) and (3) from pressure switch leads (2).
2. Remove pressure switch (5) from valve (1).

### b. Installation

1. Install pressure switch (5) to valve (1).
2. Connect leads (4) and (3) to pressure switch leads (2).




FOLLOW-ON TASK: Close evaporator blower housing (TM 9-2320-280-20).

## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12)

**This task covers:**

a. **Manifold Gauge Set Installation**
b. **Manifold Gauge Set Removal**
c. **Discharging System**
d. **Flushing System**
e. **Evacuating System**
f. **Charging System**
g. **Checking/Adding Lubricating Oil**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)
Flushing cylinder (Appendix G, Item 103)
Flush gun (Appendix G, Item 104)
Vacuum pump (Appendix G, Item 105)

**Special Tools**
Compressor tool kit (Appendix G, Item 101)

**Test Equipment**
Manifold gauge set (Appendix G, Item 137)

**Materials/Parts**
O-ring (Appendix E, Item 133)
Lubricating oil (Appendix B, Item 35)
Refrigerant R-12 (Appendix B, Item 42)
Nitrogen (Appendix B, Item 37)
Flushing agent (Appendix B, Item 15)

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**General Safety Instructions**
- Always wear eye protection when around R-12.
- Exercise extreme care when handling R-12.
- Never smoke where R-12 is used or stored.
- Ensure adequate ventilation whenever R-12 is discharged.
- Exposure to R-12 may be hazardous for individuals with cardiac rhythm abnormalities.
- Do not attempt to connect servicing equipment while engine is running, and hoses must be clear of any moving engine parts.
- Make sure hand valves on manifold gauge set are closed during connection.
- Do not disconnect hoses before back-seating service valves.
- Eye protection must be worn when using compressed air.
- Make sure high side service valve on manifold gauge set is in OFF/CLOSED position during charging.
- Avoid breathing R-12. Be sure the work area is properly ventilated in case of accidental release into the nearby atmosphere.

**Maintenance Level**
Direct support

**WARNING**

- Always wear eye protection around R-12, or when servicing the air-conditioning system. Injury will result if R-12 comes in contact with eyes.
- Exercise extreme care when handling R-12; direct skin contact between R-12 may cause frostbite.
- Never smoke in areas where R-12 is used or stored. Injury to personnel may result.
- Avoid breathing R-12. Ensure adequate ventilation whenever R-12 is being discharged. Injury to personnel may result if used in a confined area.
- Personnel with a history of cardiac rhythm abnormalities should be made aware of potential aggravation as a result of exposure to R-12. Failure to do so may result in injury to personnel.
- Do not attempt to connect servicing equipment while engine is running. Injury to personnel or damage to equipment may result.

## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

**CAUTION**

Never mix R-134a and R-12 refrigerants. They are incompatible and will cause severe damage to system components if mixed.

**NOTE**

- Whenever any air-conditioning vapor system component needs replacement, the system must be discharged, flushed, and a new dryer bottle installed (para. 14-19).
- The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.1 for vehicles with R-134a refrigerant.

**a. Manifold Gauge Set Installation**

1. Turn high pressure gauge valve (2) and low pressure gauge valve (1) on gauge set (3) clockwise to their front-seated (closed) positions.
2. Remove two dust caps (9) from service valves (6) and (7).
3. Ensure both service valve shafts (11) are moved fully counterclockwise until in back-seated position.
4. Remove two cap nuts (8) from service valve ports (10) and (12).

**WARNING**

Make sure hand valves on manifold gauge set are in closed position during connection, and hoses are clear of any moving parts in engine compartment. Injury to personnel or damage to equipment may result.

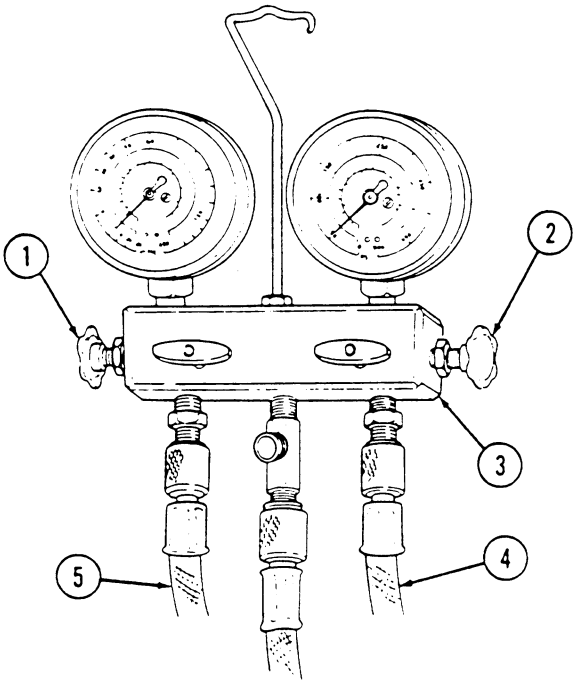
5. Connect low pressure gauge hose (5) on manifold gauge set (3) to suction (low side) service valve port (10).
6. Connect high pressure gauge hose (4) on manifold gauge set (3) to discharge (high side) service valve (6).
7. Hang manifold gauge set (3) so that hoses (5) and (4) are well away from moving engine parts.

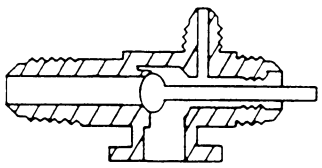
**NOTE**

- Service valve mid-seated position is used for discharging, flushing, evacuating, charging, and testing.
- Do not perform step 9 if system is already evacuated. High and low pressure hoses must be purged with R-12 for charging purposes (refer to task f.)

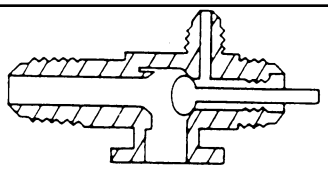
8. Turn both service valve shafts (11) to mid-seated position.
9. Loosen low pressure gauge hose (5) and high pressure gauge hose (4) at manifold gauge set slightly for a second to purge air from hoses, and then tighten.

## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

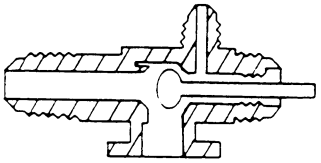


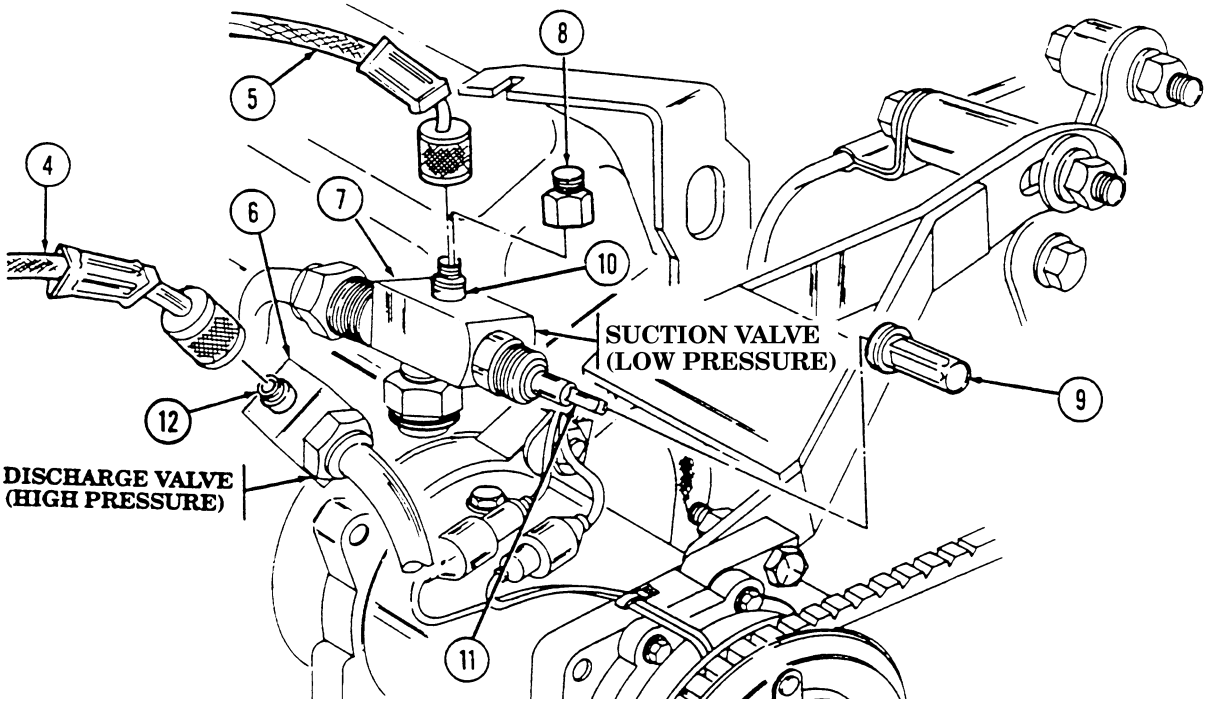
SERVICE VALVE IN FRONT-SEATED POSITION



SERVICE VALVE IN BACK-SEATED POSITION



SERVICE VALVE IN MID-SEATED POSITION



## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

### b. Manifold Gauge Set Removal

**WARNING**

Before attempting to disconnect manifold gauge set hoses, service valve shafts must be returned to their "back-seated" position. Failure to do so may result in injury to personnel.

**CAUTION**

Never operate A/C system with service valves "front-seated" Damage to compressor will result.

1. Turn each service valve shaft (11) counterclockwise to "back-seated" position.
2. Loosen low pressure gauge valve (1) and high pressure gauge valve (2) slowly, allowing refrigerant to escape from hoses (4) and (6) through hose (5).
3. Disconnect low pressure gauge hose (6) and high pressure gauge hose (4) from service valves (7) and (8).
4. Install two capnuts (9) on two service valve ports (10).
5. Install two dust caps (12) on service valves (7) and (8).

### c. Discharging System

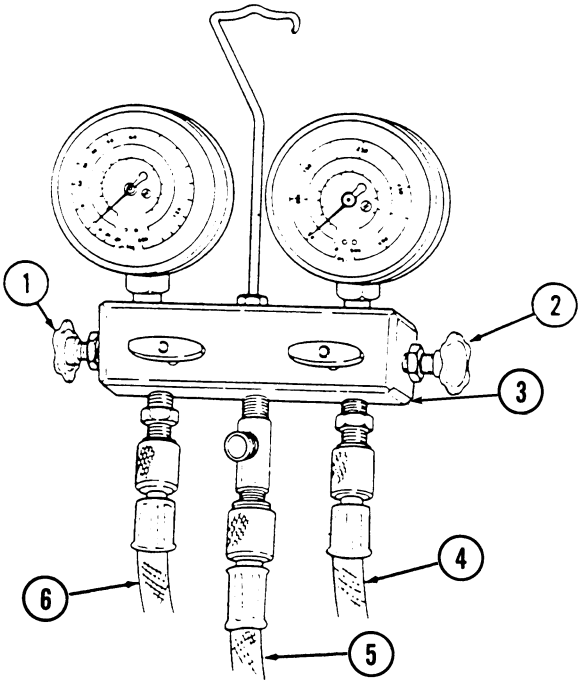
1. Disconnect battery ground cable (TM 9-2320-280-20).
2. Install manifold gauge set (refer to task a.).
3. Insert center hose (5) of manifold gauge set (3) in a catch bottle or can.

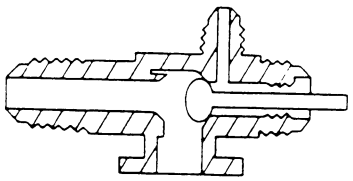
**NOTE**

- Do not allow refrigerant R-12 to escape too quickly. Lubricating oil will escape.
- When high pressure gauge and low pressure gauge read "zero", the discharging procedure is complete.

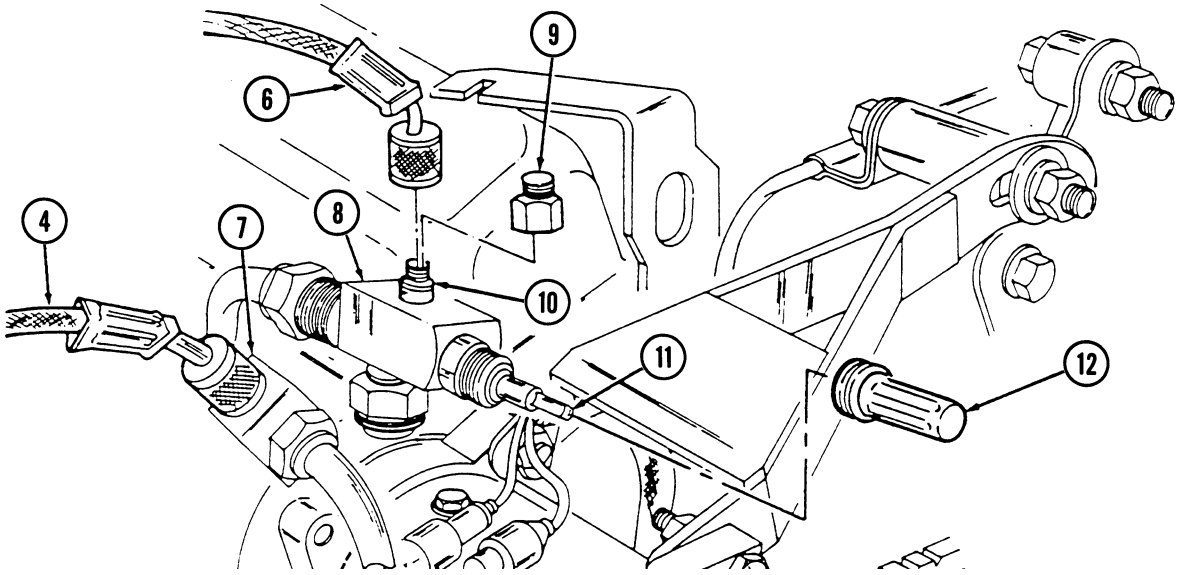
4. Turn low pressure gauge valve (1) and high pressure gauge valve (2) counterclockwise slightly to permit refrigerant to slowly escape through center hose (5) until gauges read "zero".
5. Turn service valve shafts (11) to "back-seated" position to prevent air and moisture from entering system.
6. Measure any significant accumulation of oil in discharge bottle and record for oil charging purposes.
7. Disconnect manifold gauge set (refer to task b.).

## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)



SERVICE VALVE IN BACK-SEATED POSITION



## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

### d. Flushing System

**CAUTION**

- Never flush air compressor. Flushing removes oil. Damage to compressor will result if compressor is flushed.
- Air-conditioning system flushing is essential when replacing failed compressors. Failure to flush A/C system will result in damage to new compressor.

**NOTE**

- Do not attempt to use R-12 as a flushing agent. R-12 will not remain a liquid at ambient temperatures. Use R-111 or R-113 for flushing purposes.
- Flushing is done to remove solid materials such as oil, sludge, and metal particles from failed components.
- For a complete system flush, tools must be installed at A/C lines at compressor.

1. Discharge A/C system (refer to task c.).
2. Fill flushing cylinder with flushing agent.

**WARNING**

Eye protection must be worn when using nitrogen. Failure to do so may result in injury to personnel.

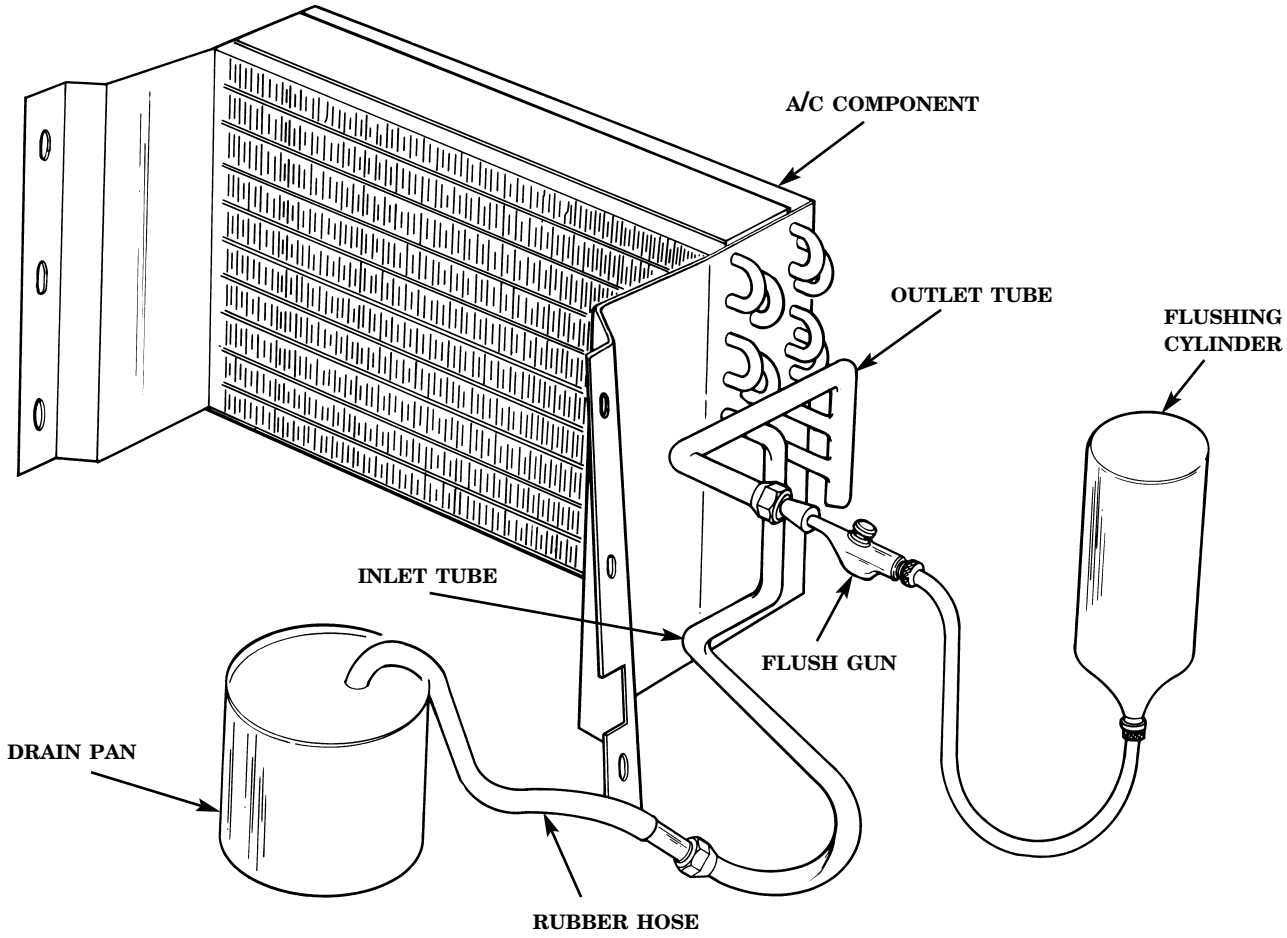
3. Pressurize cylinder with nitrogen to 100 psi (689.5 kPa).
4. Connect flushing gun to flushing cylinder.

**NOTE**

Perform steps 5 through 7 on condenser, evaporator, and refrigerant lines. Continue flushing until there is no evidence of oil or contaminants.

5. Insert flush gun into refrigerant outlet tube of components to be flushed.
6. Connect a rubber hose over inlet of component to be flushed, and place other end of hose in a drain pan.
7. Open flush gun to blow cleaning agent through component.
8. Remove rubber hose from component and plug line.
9. Remove flush gun from component and plug line.

## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)



## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

**e. Evacuating System**

**CAUTION**

Never attempt to evacuate A/C system if system has not been completely discharged.

1. Discharge A/C system (refer to task c.) and flush A/C system if necessary (refer to task d.).
2. Connect manifold gauge set (refer to task a.).
3. Turn each service valve shaft (5) clockwise to mid-seated position.
4. Connect vacuum pump to center hose (4) on manifold gauge set (3).
5. Turn vacuum pump on and open low pressure gauge valve (1) and high pressure gauge valve (2) on manifold gauge set (3).

**NOTE**

- High side gauge should drop to "zero" or below. If not, a blockage in A/C system is indicated.
- 29-30 pounds of vacuum should be sustained on low pressure gauge for at least ten minutes. If not, a leak in A/C system is indicated. Identify source of leak and repair as necessary.

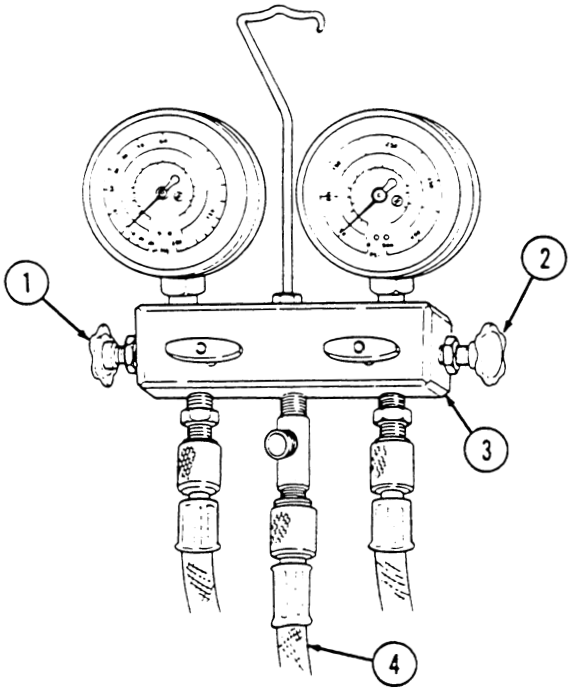
6. Evacuate unit until low pressure gauge reads 29-30 pounds vacuum.
7. Continue evacuation for forty-five minutes after correct gauge reading of 29-30 pounds vacuum has been achieved.
8. Turn low pressure gauge valve (1) and high pressure gauge valve (2) on manifold gauge set (3) to closed position after evacuation is complete.
9. Turn off vacuum pump and disconnect center hose (4) from vacuum pump.
10. Turn service valve shafts (5) to "back-seated" position.

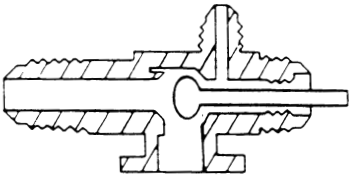
**NOTE**

Manifold gauge set can remain connected and service valves left in mid-position. If charging A/C system will follow immediately.

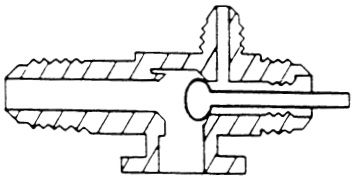
11. Disconnect manifold gauge set (refer to task b.).

## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

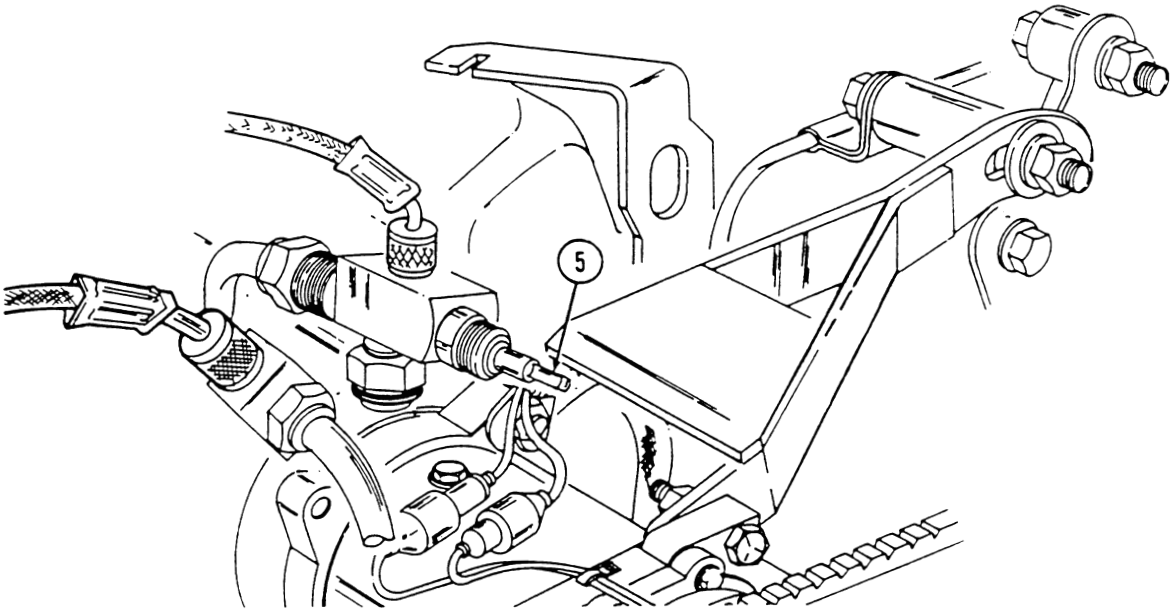


SERVICE VALVE IN MID-SEATED POSITION



SERVICE VALVE IN BACK-SEATED POSITION



## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

**f. Charging System**

**NOTE**

If A/C system requires replacement of a major component or has been flushed, lubricating oil must be added to system to compensate loss (refer to task g.).

1. Evacuate A/C system (refer to task e.).
2. Connect refrigerant R-12 source to center hose (5) of manifold gauge set (3).
3. Open refrigerant R-12 source to allow refrigerant to flow into center hose (5).
4. Purge center hose (5), low pressure hose (6), and high pressure hose (4) as follows:

   (a) Loosen center hose (5) at manifold gauge set center port (7) slightly until refrigerant escapes, then tighten hose (5).

   (b) Open high pressure gauge valve (2) and low pressure gauge valve (1) to allow refrigerant to flow into high pressure hose (4) and low pressure hose (6).

   (c) Purge high pressure hose (4) and low pressure hose (6) at service valve ports at compressor.

   (d) Turn high pressure gauge valve (2) and low pressure gauge valve (1) clockwise to off position.
5. Turn service valve shafts (8) clockwise to mid-seated position.
6. Connect STE/ICE-R (TM 9-2320-280-20) to obtain engine RPM reading.

**WARNING**

Make sure high pressure gauge valve is in closed position on manifold gauge set during charging. Failure to do so will cause compressor to build pressure in refrigerant container, causing injury to personnel or damage to equipment.

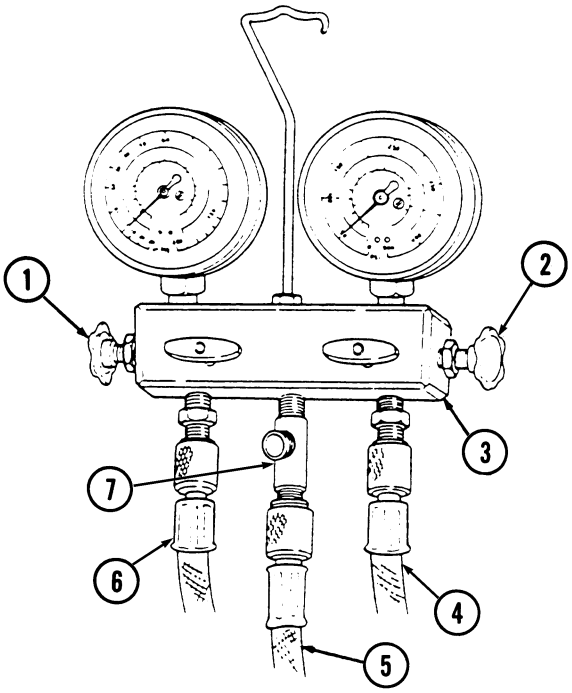
7. Start engine and set engine speed to 1500 rpm with hand throttle (TM 9-2320-280-10).
8. Turn on A/C system (TM 9-2320-280-10) and blower fans on high speed.

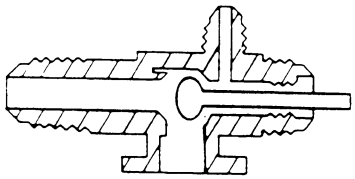
**NOTE**

- Keep refrigerant container upright at all times so refrigerant enters system as a gas.
- The A/C system has a 1-3/4 lb (0.794 kg) capacity.

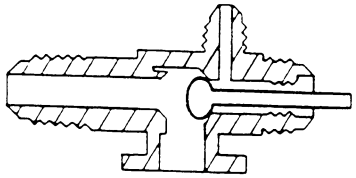
9. Open low pressure gauge valve (1) on manifold gauge set (3) until system is fully charged (table 2-2).
10. Close low pressure gauge valve (1) on manifold gauge set (3).
11. Return hand throttle to normal idle (TM 9-2320-280-10).
12. Stop engine (TM 9-2320-280-10).
13. Remove refrigerant R-12 source from center hose (5) of manifold gauge set (3).
14. Perform task g.

## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

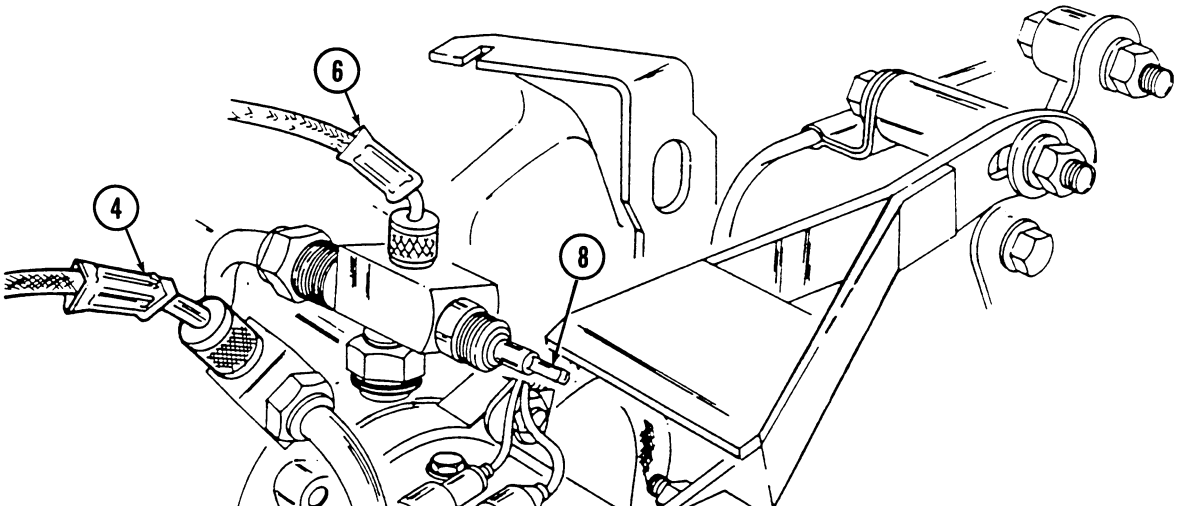


SERVICE VALVE IN MID-SEATED POSITION



SERVICE VALVE IN BACK-SEATED POSITION



## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

**g. Checking/Adding Lubricating Oil**

**NOTE**

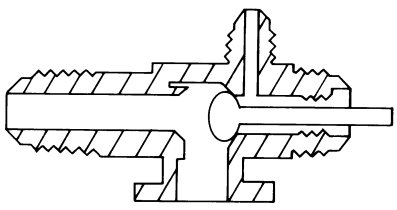
- It is not necessary to check or add oil as routine maintenance. It is necessary to check oil when the evaporator, condenser, compressor, or receiver/dryer has been replaced, or there was an obvious oil leak. When a system is discharged, it is also necessary to replace any oil carried out with the refrigerant.
- Vehicle must be on level ground.

1. Charge A/C system (refer to task f.).
2. Make sure low pressure gauge valve (1) and high pressure gauge valve (2) on manifold gauge set (3) are turned clockwise to off position.
3. Turn two service valve shafts (6) counterclockwise to back-seated position.
4. Start engine and turn on A/C system (refer to TM 9-2320-280-10). Allow engine to idle for approximately ten to fifteen minutes. Stop engine.
5. Turn two service valve shafts (6) clockwise to front-seated position.

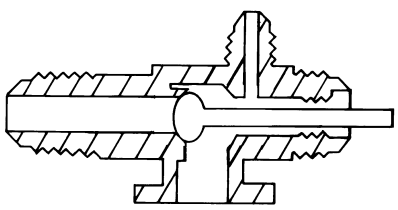
**NOTE**

- Do not allow refrigerant R-12 to escape too quickly. Lubricating oil will escape.
- When high pressure gauge and low pressure gauge read "zero", the compressor is discharged.

6. Turn low pressure gauge valve (1) and high pressure gauge valve (2) counterclockwise slightly to permit refrigerant in the compressor (5) to slowly escape through center hose (4) until gauges read "zero".
7. Close low pressure gauge valve (1) and high pressure gauge valve (2).
8. Remove fill plug (7) and O-ring (8) from compressor (5). Discard O-ring (8).
9. Look through fill plug (7) hole in compressor (5) and rotate front clutch plate (9) with ratchet and socket to position internal compressor parts, as shown. Planet plate should be positioned so that dipstick can be inserted to full depth.
10. Insert the dipstick to its stop position, as shown. The stop is the angle near the top of the dipstick. The point of the angle must be to the right, and the bottom surface of the angle must be flush with the surface of the filler hole.
11. Remove dipstick from compressor (5) and count number of increments oil level is up to on dipstick.
12. Oil level should be between six and eight increments on dipstick. Add or subtract oil as necessary to attain proper level.
13. Lubricate O-ring (8) with lubricating oil and install O-ring (8) and fill plug (7) on compressor (5). Tighten fill plug (7) to 6-9 lb-ft (8-12 N•m).
14. Remove manifold gauge set (refer to task b.).

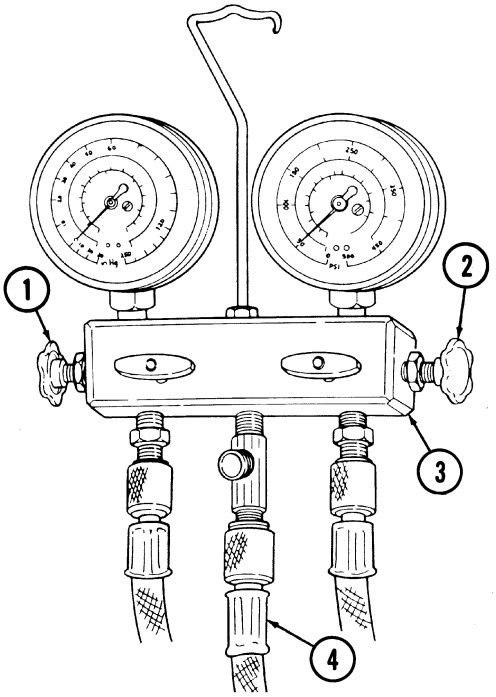


**SERVICE VALVE IN BACK-SEATED POSITION**

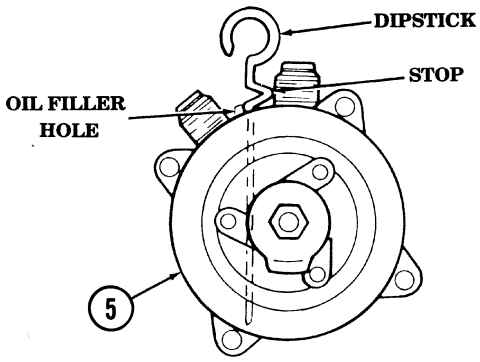


**SERVICE VALVE IN FRONT-SEATED POSITION**

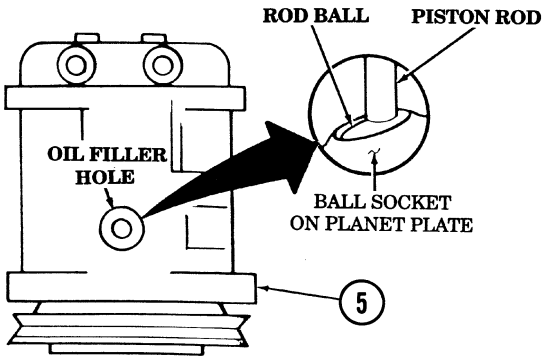
## 14-17. AIR-CONDITIONING SYSTEM SERVICING (R-12) (Cont'd)

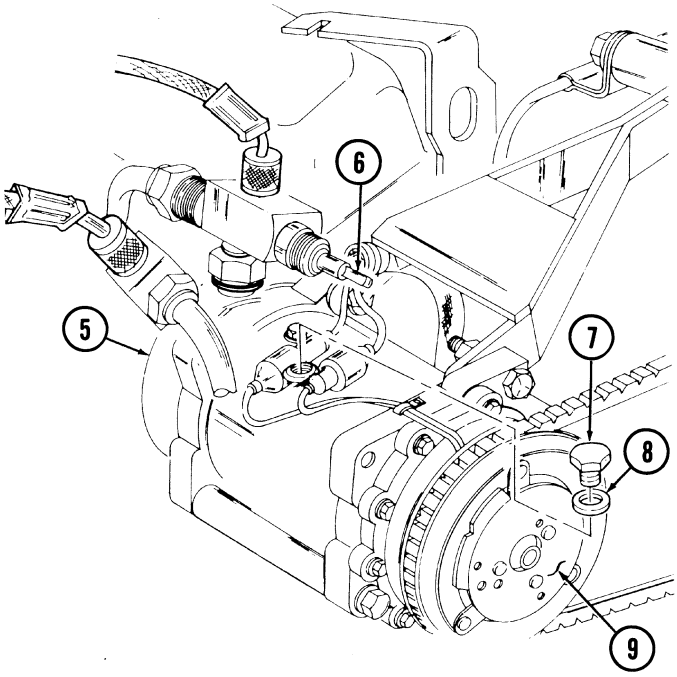



MOUNTING ANGLE
LEFT
(AS FACING CLUTCH)




VIEW WHEN
COMPRESSOR ANGLE LEFT
(TOP VIEW)



## 14-18. AIR-CONDITIONING PRESSURE LINES REPLACEMENT (R-12)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Four O-rings (Appendix E, Item 144)
Three tiedown straps (Appendix E, Item 252)
Two tiedown straps (Appendix E, Item 255)
Three lockwashers (Appendix E, Item 120)
Insulation (Appendix B, Item 26)
Lubricating oil (Appendix B, Item 35)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-17).
- Companion seat removed (TM 9-2320-280-20).
- Air horn hose removed (TM 9-2320-280-20).

**General Safety Instructions**
Air conditioner system must be discharged, prior to replacing components.

**Maintenance Level**
Direct support

**WARNING**

Air conditioner system must be discharged prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Cover or plug all open hoses and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

**NOTE**

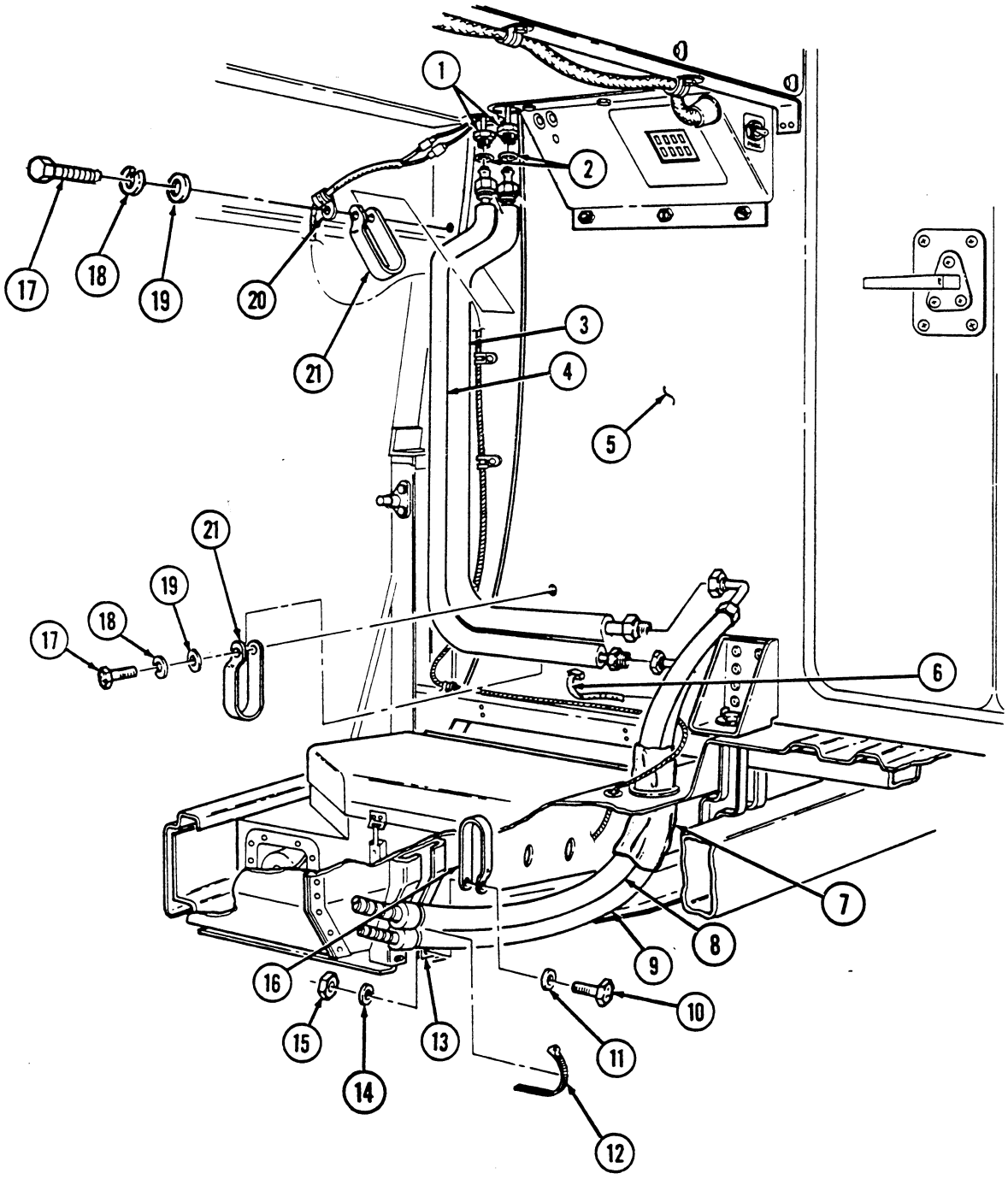
- All air-conditioning pressure lines are replaced basically the same. This procedure covers the A/C compartment to compressor lines.
- Suction line has a larger diameter than the discharge line, fittings will not interconnect.
- The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.2 for vehicles with R-134a refrigerant.

**a. Removal**

1. Remove two capscrews (17), lockwashers (18), washers (19), harness bracket (20), clamps (21), suction line (3), and discharge line (4) from body (5). Remove clamps (21) from suction line (3) and discharge line (4). Discard lockwashers (18).
2. Disconnect suction line (3) and discharge line (4) from fittings (1). Remove and discard two O-rings (2).
3. Remove three tiedown straps (6) and slide insulation (7) on suction line (3) and discharge line (4) away from suction hose (8) and discharge hose (9). Disconnect and remove suction line (3) and discharge line (4) from suction hose (8) and discharge hose (9). Discard tiedown straps (6).

## 14-18. AIR-CONDITIONING PRESSURE LINES REPLACEMENT (R-12) (Cont'd)

4. Remove nut (15), lockwasher (14), washer (11), capscrew (10), clamp (16), suction hose (8), and discharge hose (9) from underside of body (13). Remove two tiedown straps (12) securing suction hose (8) and discharge hose (9) together. Remove clamp (16) from suction hose (8) and discharge hose (9). Discard lockwasher (14) and tiedown straps (12).
5. Remove and discard insulation (7) from suction hose (8) and discharge hose (9).

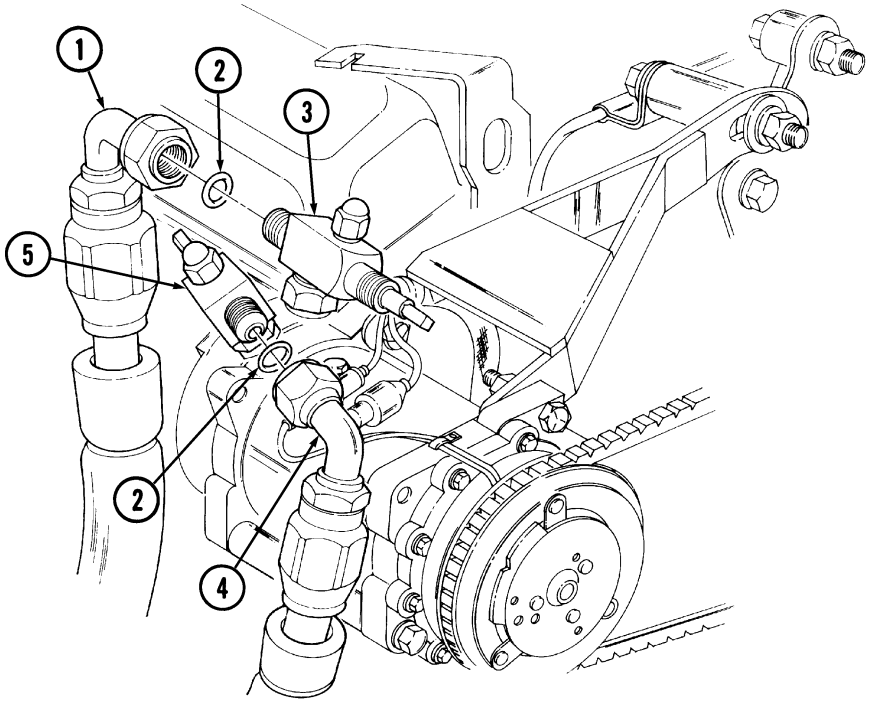


## 14-18. AIR-CONDITIONING PRESSURE LINES REPLACEMENT (R-12) (Cont'd)

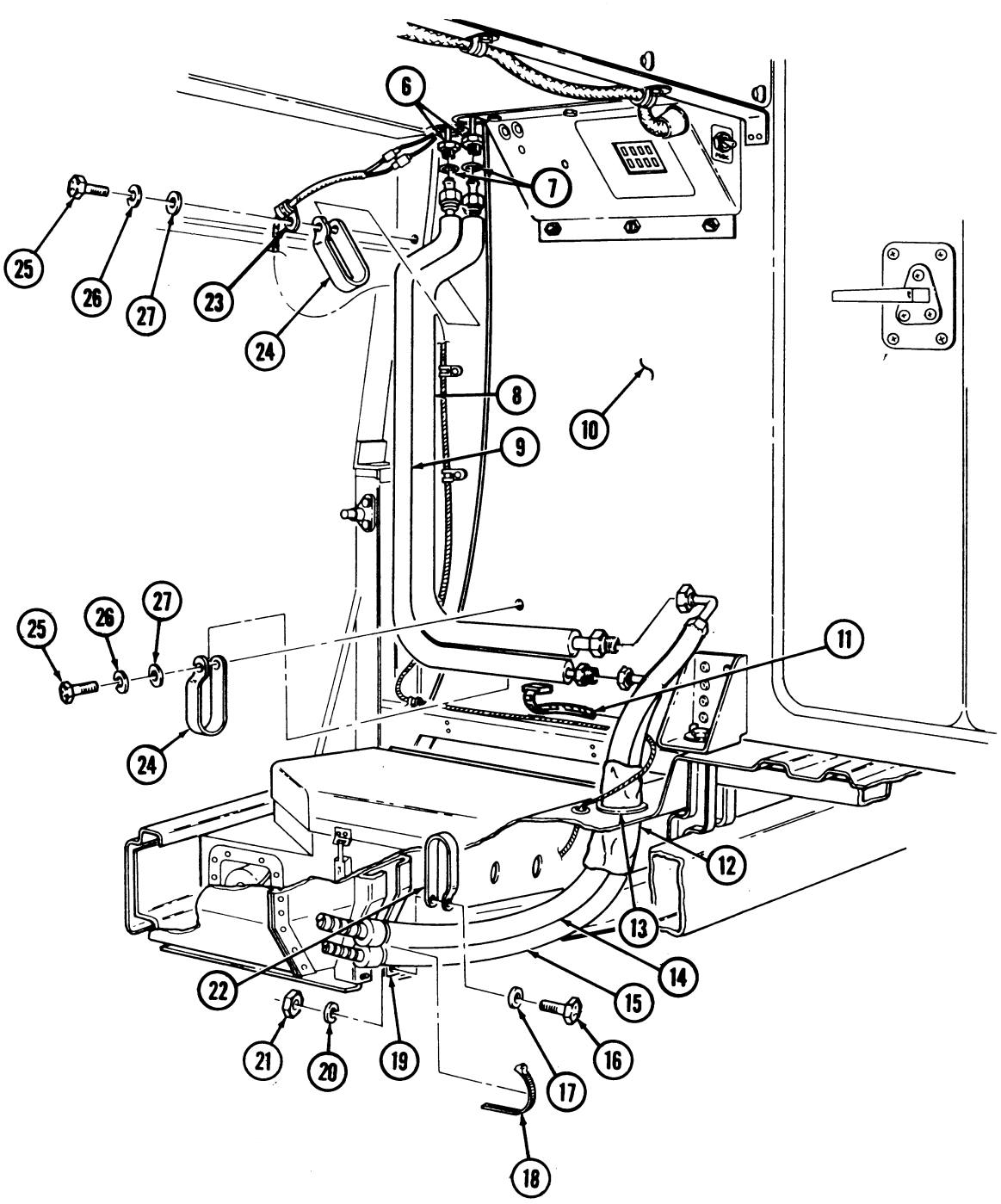
6. Disconnect suction hose (1) and discharge hose (4) from compressor service valve (3) and service valve (5) and remove suction hose (1) and discharge hose (4). Remove and discard two O-rings (2).

**b. Installation**

1. Using the old pressure lines as a positioning template, install insulation (12) to suction hose (14) and discharge hose (15).
2. Install suction hose (14) and discharge hose (15) through grommet (13) and into crew compartment ensuring that insulation (12) is positioned to prevent chafing of hoses against grommet (13).
3. Lubricate two O-rings (2) with lubricating oil and install O-rings (2) on suction hose (1) and discharge hose (4) and connect to compression service valve (3) and service valve (5).
4. Lubricate two O-rings (7) with lubricating oil and install O-rings (7) on fittings (6). Install and tighten suction line (8) on fitting (6) to 33 lb-ft (45 N•m). Install and tighten discharge line (9) on fitting (6) to 20 lb-ft (27 N•m).
5. Connect discharge line (9) to discharge hose (15) and tighten to 30 lb-ft (41 N•m). Connect suction line (8) to suction hose (14) and tighten to 45 lb-ft (61 N•m).
6. Slide insulation (12) on discharge line (9) towards discharge hose (15) and install three tiedown straps (11).
7. Install clamp (22) on suction hose (14) and discharge hose (15) on underside of body (19) with capscrew (16), washer (17), lockwasher (20), and nut (21). Secure suction hose (14) and discharge hose (15) together with two tiedown straps (18).
8. Install two clamps (24) harness clamp (23) on suction line (8) and discharge line (9) to body (10) with washers (27), lockwashers (26), and capscrews (25).



## 14-18. AIR-CONDITIONING PRESSURE LINES REPLACEMENT (R-12) (Cont'd)




FOLLOW-ON TASKS:
- Install companion seat (TM 9-2320-280-20).
- Install air horn (TM 9-2320-280-20).
- Charge air-conditioning system (para. 14-17).

## 14-19. DRYER BOTTLE REPLACEMENT (R-12)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two O-rings (Appendix E, Item 132)
Lubricating oil (Appendix B, Item 35)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-17).
- Evaporator blower housing opened (TM 9-2320-280-20).

**General Safety Instructions**
Air conditioner system must be discharged prior to replacing components.

**Maintenance Level**
Direct support

**WARNING**

Air conditioner system must be discharged prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Cover or plug all open lines and connections immediately after removal to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.3 for vehicles with R-134a refrigerant.

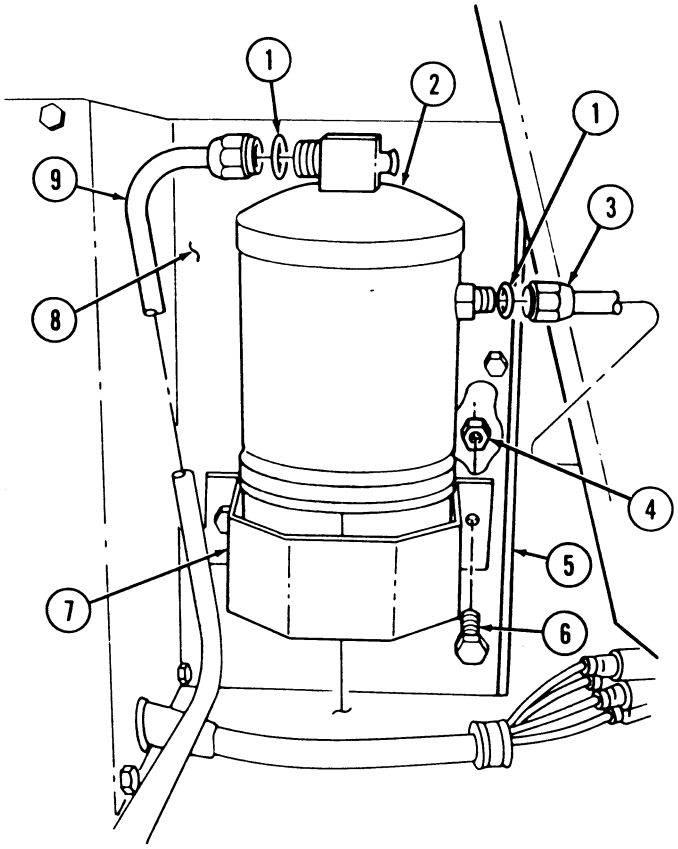
### a. Removal

1. Peel away insulation (5) from panel (8) to allow access to nut (4).
2. Disconnect lines (9) and (3) from dryer bottle (2). Remove and discard two O-rings (1).
3. Loosen nut (4) and capscrew (6) on right side of bracket (7).
4. Remove dryer bottle (2) from bracket (7).

### b. Installation

1. Lubricate two O-rings (1) with lubricating oil and install O-rings (1) on lines (3) and (9).
2. Install dryer bottle (2) in bracket (7) and connect lines (3) and (9) to dryer bottle (2).
3. Tighten nut (4) and screw (6) securing bracket (7) and dryer bottle (2) to panel (8).
4. Install insulation (5) to panel (8).

## 14-19. DRYER BOTTLE REPLACEMENT (R-12) (Cont'd)




FOLLOW-ON TASKS:
- Close evaporator blower housing (TM 9-2320-280-20).
- Evacuate and charge air-conditioning system (para. 14-17).

## 14-20. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-12)

**This task covers:**

**a. Removal**
**b. Disassembly**
**c. Assembly**
**d. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Seven O-rings (Appendix E, Item 133)
Nonmetallic seal (Appendix E, Item 215)
Lubricating oil (Appendix B, Item 35)

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-17).
- Evaporator blower motor housing removed (TM 9-2320-280-20).

**General Safety Instructions**
Air-conditioner system must be discharged, prior to replacing components.

**Maintenance Level**
Direct support

**WARNING**

Air conditioner system must be discharged, prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Cover or plug all open hoses and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.4 for vehicles with R-134a refrigerant.

### a. Removal

1. Disconnect tube assembley (10) from sight glass line (8). Remove and discard O-ring (9).
2. Disconnect low-pressure line (12) from evaporator outlet line (15). Remove and discard O-ring (13).

**NOTE**

Prior to removal, tag leads for installation.

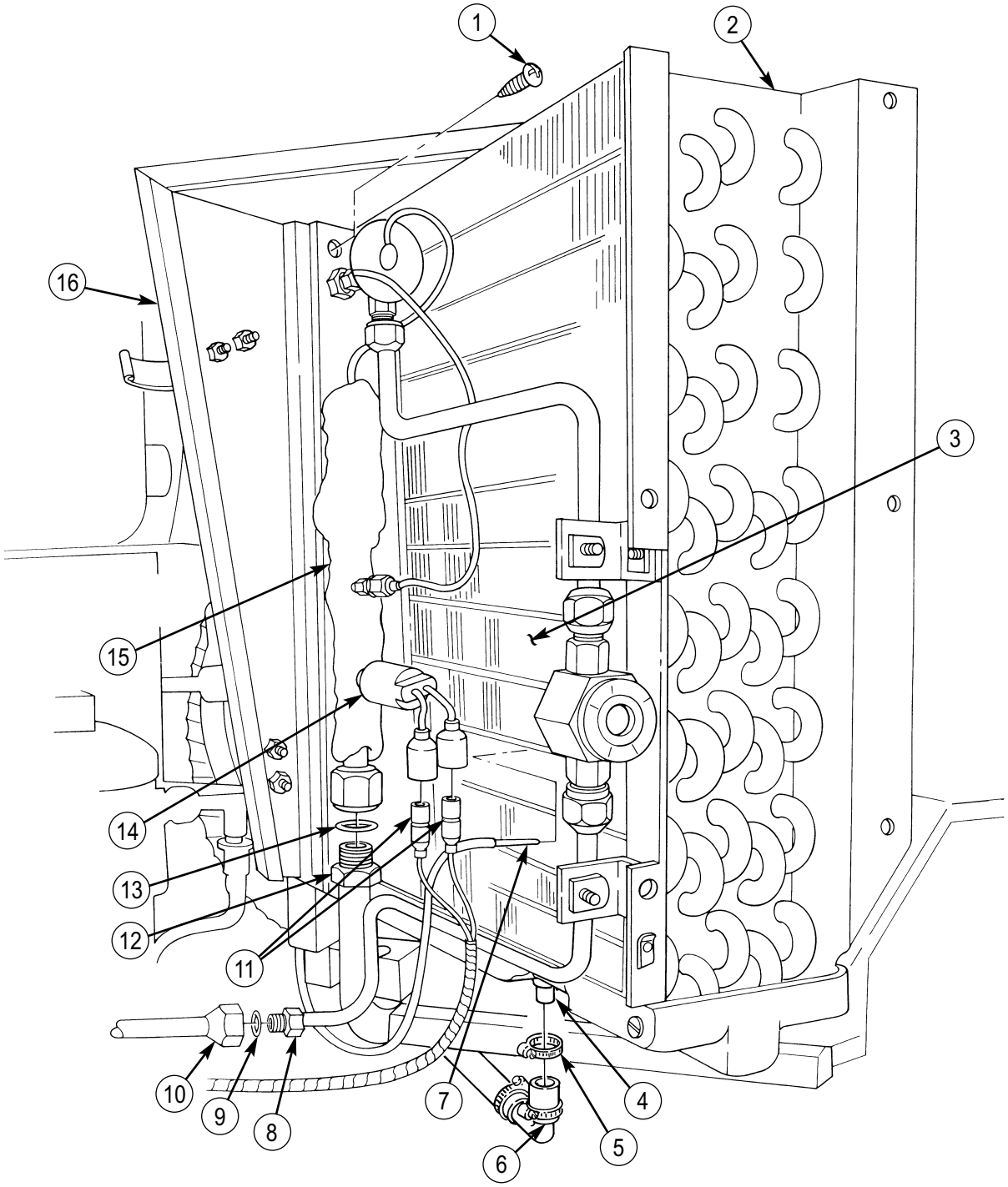
3. Disconnect two wires (11) from low-pressure switch (14).

**CAUTION**

- Avoid kinking or excessive bending of cold control probe during removal.
- Evaporator coil and evaporator duct clearances are tight, avoid forcing or twisting during removal.

4. Remove cold control probe (7) from coils (3) and position probe (7) away from evaporator (2).
5. Loosen clamp (5) and disconnect drain tube (6) from drain pan (4).
6. Remove five screws (1) and evaporator (2) from evaporator duct (16).

## 14-20. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-12) (Cont'd)



## 14-20. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-12) (Cont'd)

**b. Disassembly**

1. Remove low pressure switch (23) from outlet line (25).
2. Remove two capscrews (8), nuts (11), clamps (9), and pressure lines (7) and (14) from brackets (12).
3. Disconnect pressure lines (14) and (7) from sight glass (16) and remove sight glass (16), pressure line (14) and two O-rings (15). Discard O-rings (15).
4. Disconnect pressure line (7) from expansion valve (4). Remove and discard O-ring (6).
5. Remove two capscrews (20), nuts (13), brackets (12), and spacers (10) from evaporator (2).
6. Disconnect expansion valve line (5) from outlet line (25). Remove and discard O-ring (19).
7. Remove nonmetallic seal (24) from evaporator outlet line (25) and expansion valve control tube (18). Discard nonmetallic seal (24).
8. Loosen clamp (17) securing control tube (18) to evaporator outlet line (25).
9. Disconnect expansion valve (4) from evaporator inlet line (1) and remove expansion valve (4) and O-ring (3). Discard O-ring (3).
10. Remove two screws (22) and drain pan (21) from evaporator (2) .
11. Inspect evaporator (2), expansion valve (4), pressure lines (7), (14), and (5), sight glass (16), and low pressure switch (23) for stripped threads, cracks, evidence of leakage, and damage. Replace sight glass (16) and any other component if cracked, damaged, threads are stripped, or leakage is evident.

**c. Assembly**

1. Install drain pan (21) on evaporator (2) with two screws (22).

**CAUTION**

- To prevent damage to control line tube during installation of expansion valve, avoid excessive bending or kinking of expansion valve control tube.
- Avoid over tightening of expansion valve control tube retaining clamp.

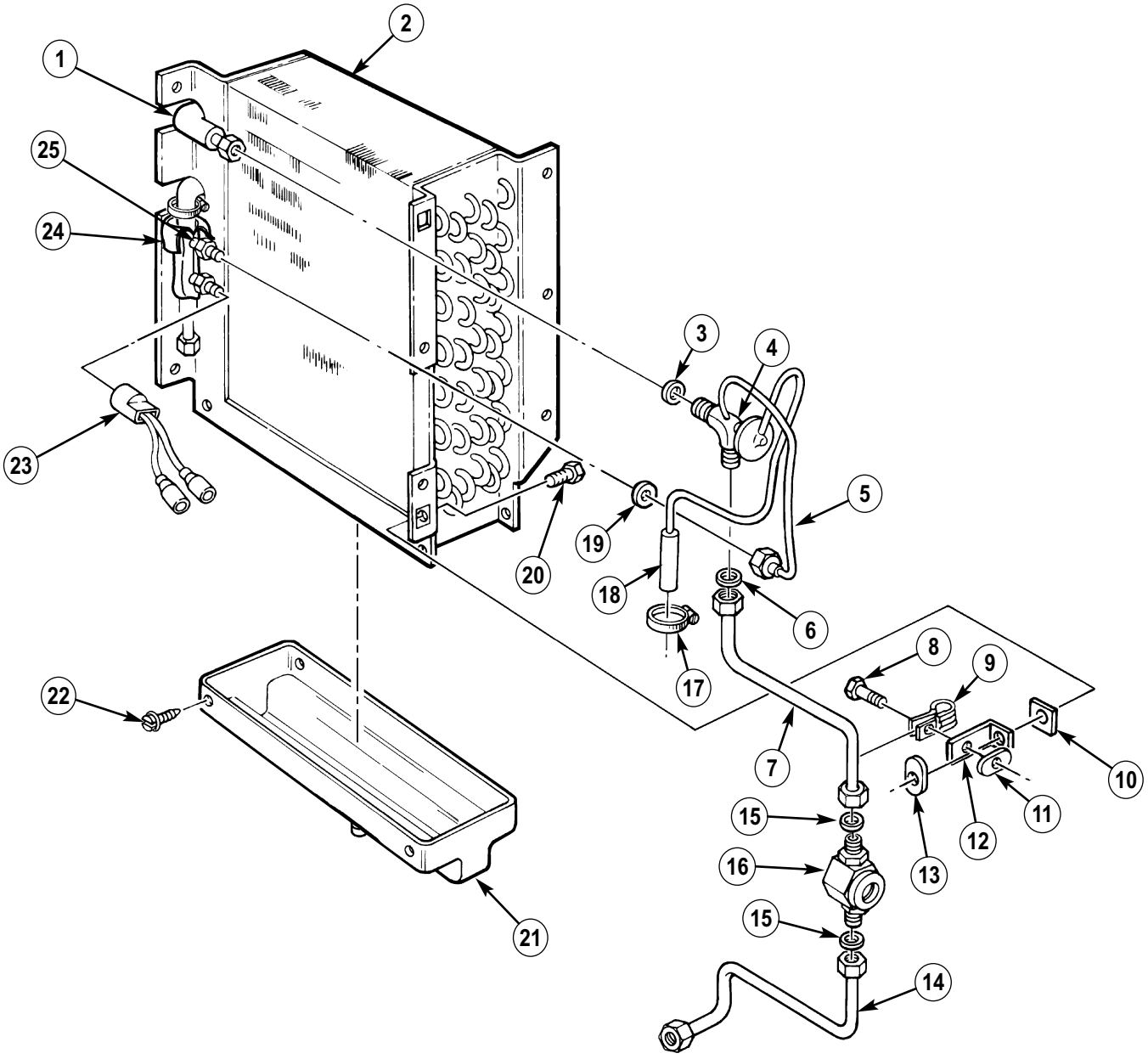
2. Lubricate O-ring (3) with lubricating oil, install O-ring (3) and connect expansion valve (4) on evaporator inlet line (1).
3. Lubricate O-ring (19) with lubricating oil, install O-ring (19) and connect expansion valve line (5) on outlet line (25).
4. Install control tube (18) on outlet line (25) with clamp (17). Do not overtighten.
5. Install low pressure switch (23) on outlet line (25).
6. Insulate control tube (18), evaporator inlet line (1), and outlet line (25) with nonmetallic seal (24).
7. Install two brackets (12) and spacers (10) on evaporator (2) with two capscrews (20) and nuts (13).
8. Lubricate O-ring (6) with lubricating oil, install O-ring (6) and connect pressure line (7) on expansion valve (4).

**NOTE**

Sight glass must face away from outlet line.

9. Lubricate two O-rings (15) with lubricating oil, install two O-rings (15), and connect pressure lines (7) and (14) on sight glass (16).
10. Install two clamps (9) and pressure lines (7) and (14) on bracket (12) with two capscrews (8) and nuts (11).

## 14-20. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-12) (Cont'd)



## 14-20. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-12) (Cont'd)

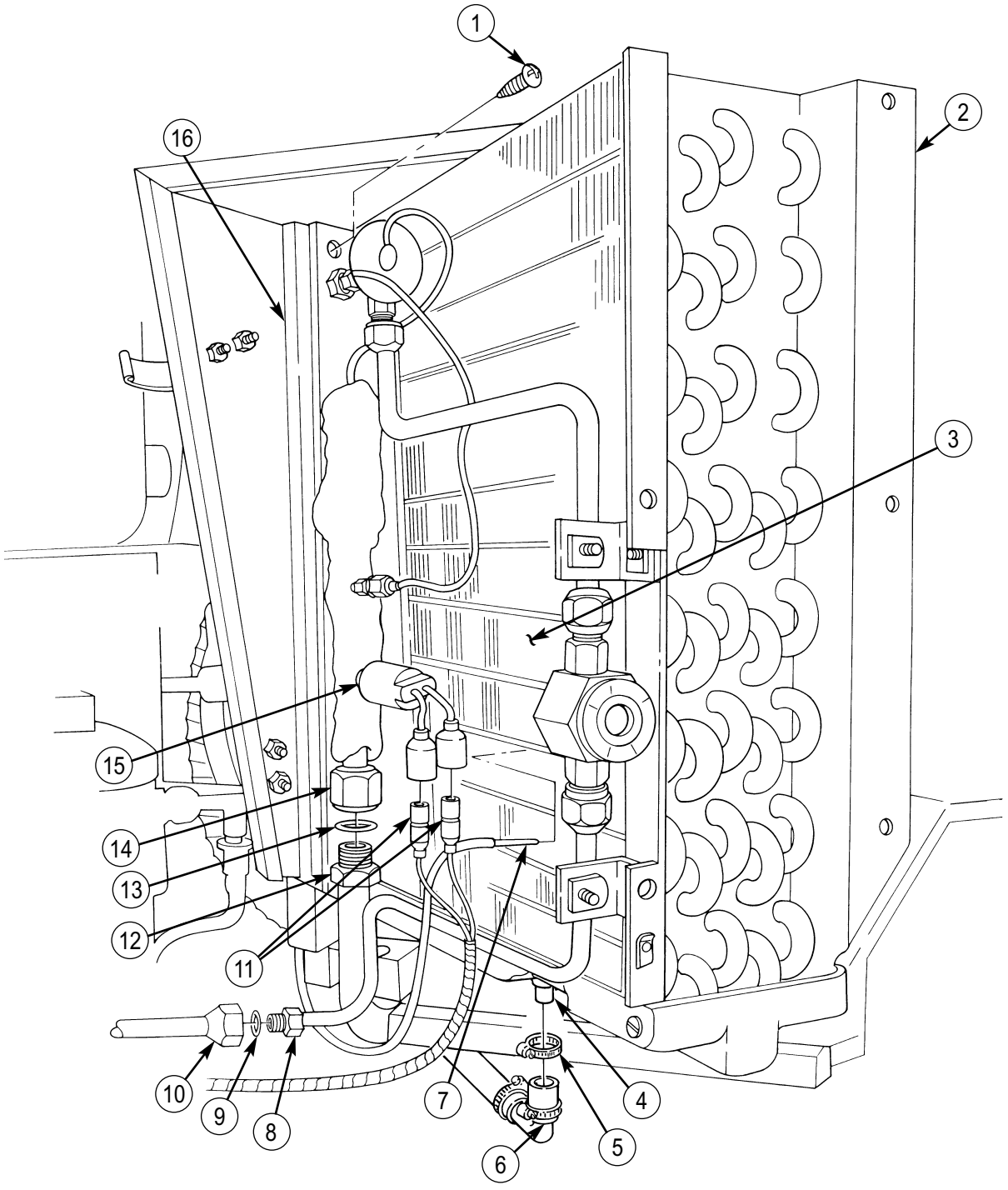
**d. Installation**

**CAUTION**

- Evaporator and evaporator duct clearances are tight, avoid forcing or twisting evaporator during installation.
- Avoid kinking or excessive bending of cold control probe during installation.

1. Install evaporator (2) on evaporator duct (16) with five screws (1).
2. Connect drain tube (6) to drain pan (4) with clamp (5).
3. Install cold control probe (7) into coils (3) a minimum depth of 3 in. (7.62 cm).
4. Connect two wires (11) to low-pressure switch (15).
5. Lubricate O-ring (13) with lubricating oil, install O-ring (13) and connect low pressure line (12) to outlet line (14).
6. Lubricate O-ring (9) with lubricating oil, install O-ring (9), and connect tube assembly (10) to sight glass line (8).

## 14-20. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-12) (Cont'd)




FOLLOW-ON TASKS:
- Evacuate and charge air-conditioning system (para. 14-17).
- Install evaporator blower motor housing (TM 9-2320-280-20).
- Check operation of air conditioning system (TM 9-2320-280-10).

## 14-21. EXPANSION VALVE REPLACEMENT (R-12)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Three O-rings (Appendix E, Item 132)
Nonmetallic seal (Appendix E, Item 215)
Lubricating oil (Appendix B, Item 35)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-17).
- Evaporator blower housing opened (TM 9-2320-280-20).

**General Safety Instructions**
Air conditioner system must be discharged prior to replacing components.

**Maintenance Level**
Direct support

**a. Removal**

**WARNING**

Air conditioner system must be discharged prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Cover or plug all open hoses and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.5 for vehicles with R-134a refrigerant.

1. Remove nonmetallic seal (2) from evaporator outlet tube (1). Discard nonmetallic seal (2).
2. Loosen clamp (3) and slide control tube (10) from clamp (3).
3. Disconnect expansion valve pressure tube (8) from evaporator outlet tube (1) and remove O-ring (11). Discard O-ring (11).
4. Deleted.
5. Deleted.
6. Disconnect expansion valve (7) from sight glass line (5) and remove O-ring (9). Discard O-ring (9).
7. Disconnect and remove expansion valve (7) from inlet tube (4) and remove O-ring (6). Discard O-ring (6).

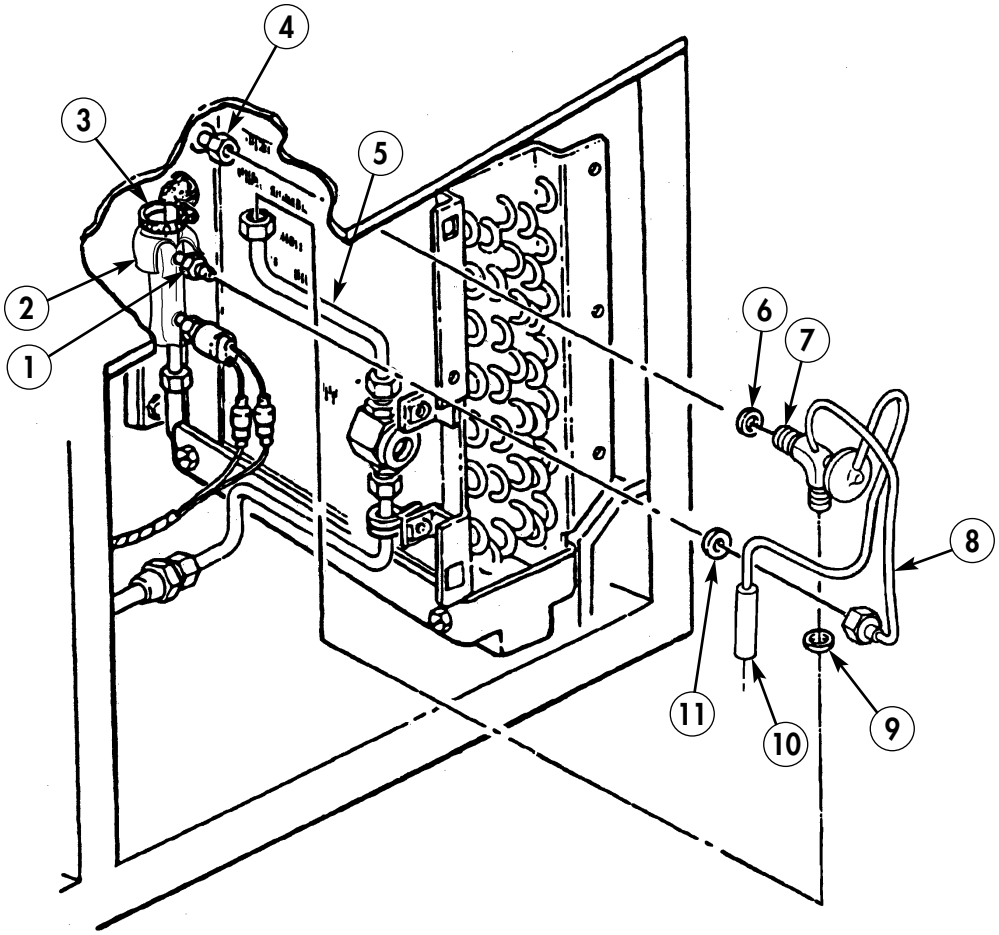
## 14-21. EXPANSION VALVE REPLACEMENT (R-12) (Cont'd)

**b. Installation**

**CAUTION**

- During installation of expansion valve, avoid excessive bending or kinking of control tube and pressure tube.
- Avoid overtightening of clamp securing expansion valve control tube to outlet tube.

1. Lubricate O-rings (6), (9), and (11) with lubricating oil and install on inlet tube (4), sight glass line (5), and pressure tube (8).
2. Connect expansion valve (7) to sight glass line (5) and inlet tube (4).
3. Connect pressure tube (8) to evaporator outlet tube (1).
4. Deleted.
5. Deleted.
6. Deleted.
7. Install control tube (10) on evaporator outlet tube (1) with clamp (2).
8. Wrap evaporator outlet tube (1) and control tube (10) with nonmetallic seal (2) to form tight seal.
9. Deleted.




FOLLOW-ON TASKS:
- Close evaporator blower housing (TM 9-2320-280-20).
- Evacuate and charge air-conditioning system (para. 14-17).

## 14-22. EVAPORATOR DUCT REPLACEMENT (R-12)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Push-on nut (Appendix E, Item 122)
Four locknuts (Appendix E, Item 65)
Seven lockwashers (Appendix E, Item 94)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Air conditioning evaporator removed (para. 14-20).

**Maintenance Level**
Direct support

**NOTE**

The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.6 for vehicles with R-134a refrigerant.

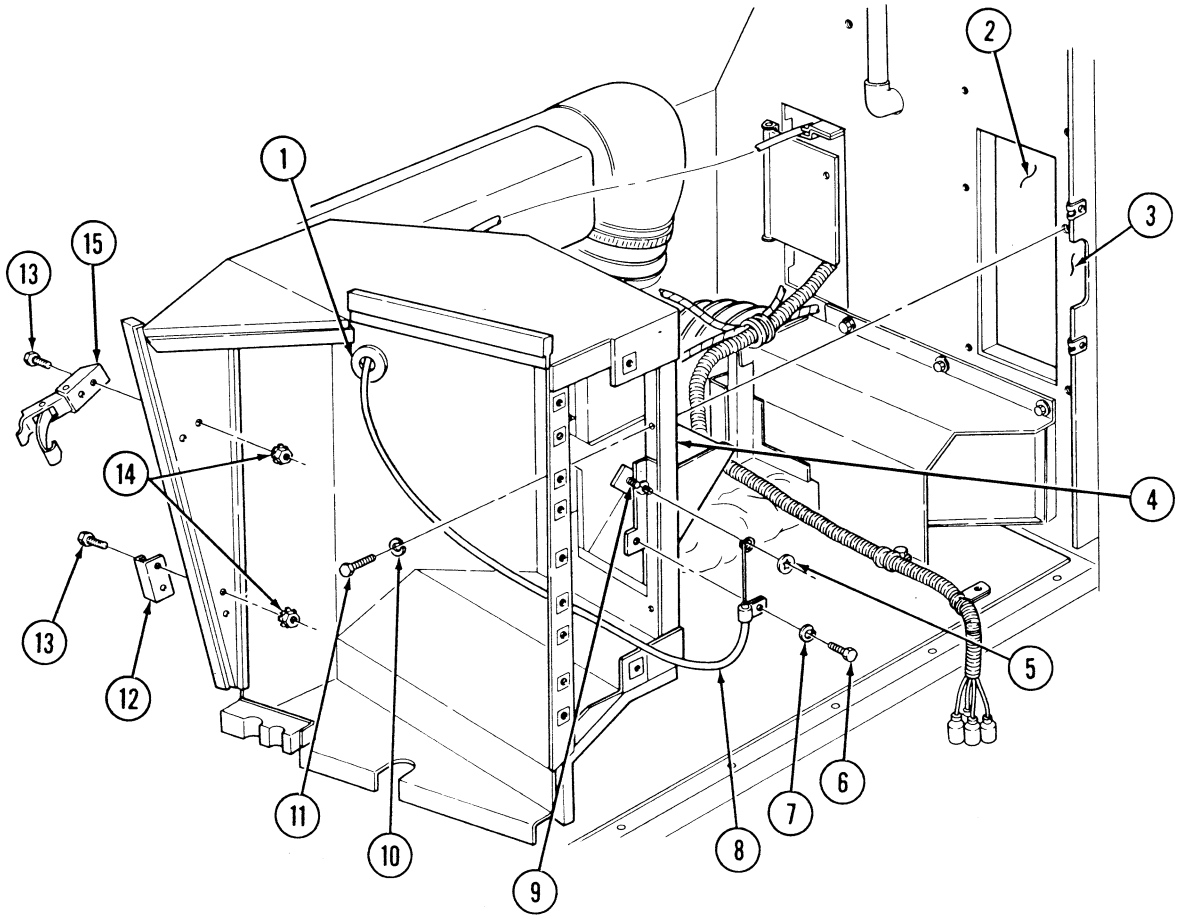
### a. Removal

1. Remove screw (6), lockwasher (7), and control cable (8) from evaporator duct (4). Discard lockwasher (7).
2. Remove push-on nut (5) and control cable (8) from duct door pin (9). Discard push-on nut (5).
3. Remove six capscrews (11), lockwashers (10), and duct (4) from body (3). Discard lockwashers (10).
4. Pull evaporator duct (4) and insulation away from heater duct (2) and slide control cable (8) through grommet (1).
5. Remove four screws (13), locknuts (14), latch catch (12), and latch (15) from evaporator duct (4). Discard locknuts (14).
6. Inspect insulation for damage. Replace insulation (TM 9-2320-280-20) only if damaged.

### b. Installation

1. Install latch (15) and latch catch (12) on evaporator duct (4) with four screws (13) and locknuts (14).
2. Install control cable (8) through grommet (1) in evaporator duct (4).
3. Install evaporator duct (4) on body (3) with six lockwashers (10) and capscrews (11).
4. Connect control cable (8) on duct door pin (9) with push-on nut (5).
5. Install control cable (8) on evaporator duct (4) with lockwasher (7) and screw (6).

## 14-22. EVAPORATOR DUCT REPLACEMENT (R-12) (Cont'd)




FOLLOW-ON TASKS:
- Install air-conditioning evaporator (para. 14-20).
- Adjust heater/air-conditioning outlet cable (TM 9-2320-280-20).

## 14-23. CONDENSER ASSEMBLY REPLACEMENT (R-12)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
O-ring (Appendix E, Item 132)
Ten lockwashers (Appendix E, Item 94)
Lubricating oil (Appendix B, Item 35)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Intake and exhaust grilles removed (TM 9-2320-280-20).
- Condenser fans removed (TM 9-2320-280-20).
- Dryer bottle removed (para. 14-19).

**Maintenance Level**
Direct support

**NOTE**

The following procedure applies to vehicles with R-12 refrigerant only.
Refer to para. 14-27.7 for vehicles with R-134a refrigerant.

### a. Removal

1. Remove eight screws (1) securing dryer bottle mounting panel (2) to fan support bracket (13) and condenser housing (3).
2. Remove eight capscrews (10) and lockwashers (11) securing dryer bottle mounting panel (2) and fan bracket (13) to body (12). Discard lockwashers (11).
3. Remove two nuts (7), lockwashers (8), and capscrews (9). Discard lockwashers (8).
4. Remove nut (14), washer (15), and clamp (16) from screw (17) and slide wiring harness (18) to side.
5. Turn fan support bracket (13) to allow removal through front intake grille opening. Remove fan bracket (13).
6. Disconnect compressor line (6) from condenser (4). Remove and discard O-ring (5).
7. Remove six screws (19) and condenser (4) from condenser housing (3).

**CAUTION**

Slowly remove condenser to avoid damage to the cooling fins.
Failure to do this will result in damage to equipment.

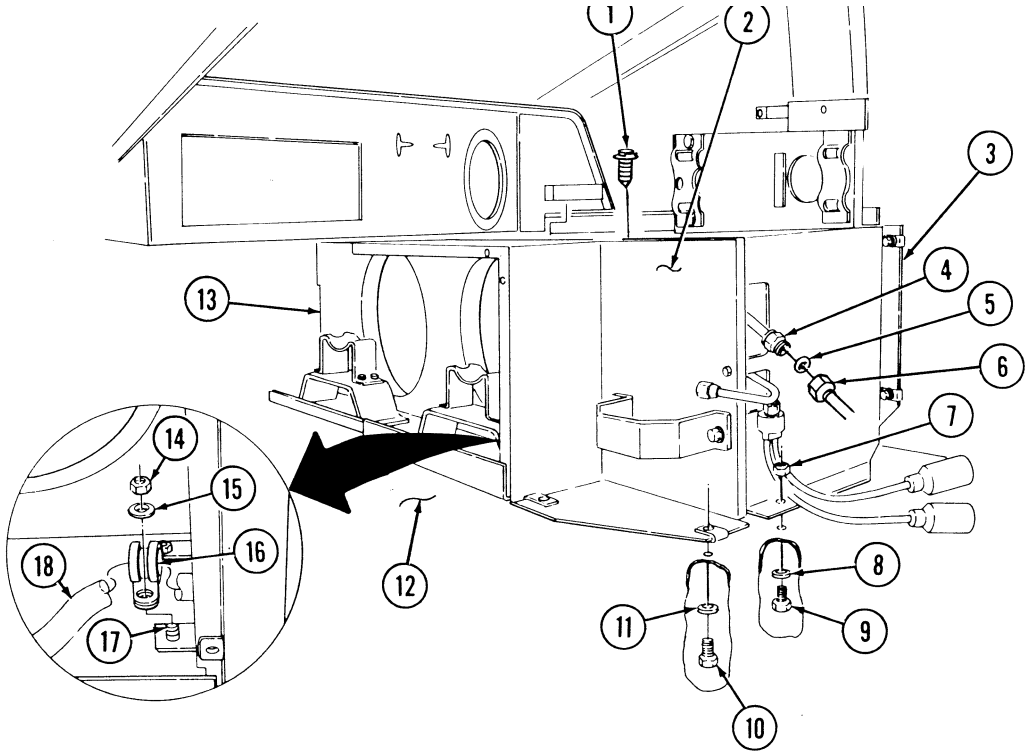
8. Remove condenser (4) through condenser blower housing opening into driver's compartment.

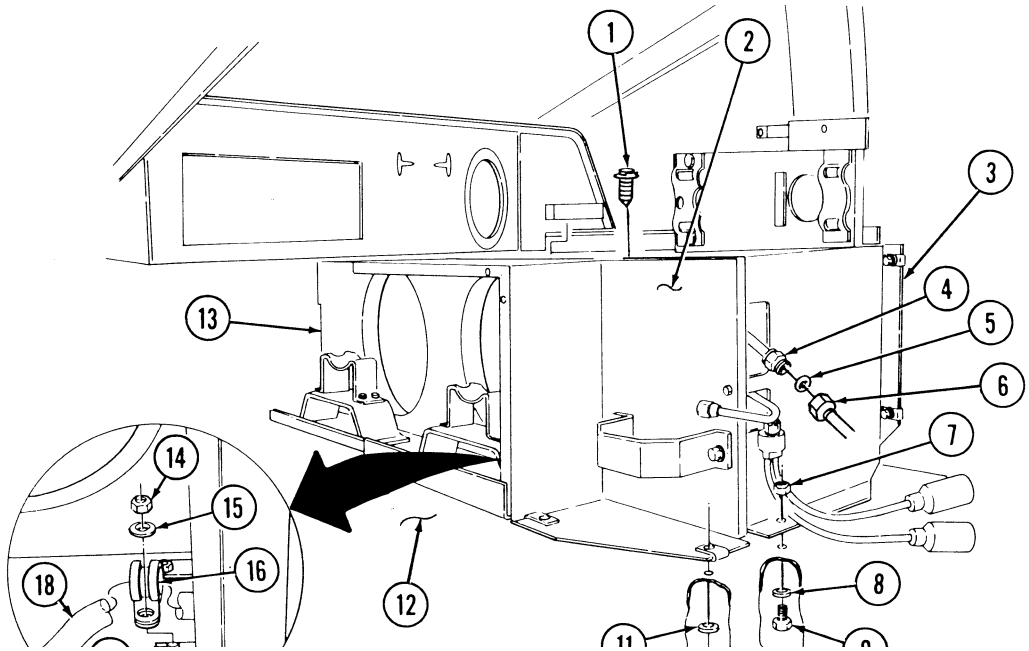
### b. Installation

1. Install condenser (4) on condenser housing (3) with six screws (19).
2. Lubricate O-ring (5) and install O-ring (5) in compressor line (6). Connect compressor line (6) to condenser (4).
3. Install fan support bracket (13) on body (12) with two capscrews (9), lockwashers (8), and nuts (7).
4. Install eight lockwashers (11) and capscrews (10) securing fan support bracket (13) and dryer panel mounting panel (2) to body (12).

## 14-23. CONDENSER ASSEMBLY REPLACEMENT (R-12) (Cont'd)

5. Install body wiring harness (18) and clamp (16) on screw (17) with washer (15) and nut (14).
6. Install dryer panel mounting bottle panel (2) on condenser housing (3) and support bracket (13) with eight screws (1).




FOLLOW-ON TASKS:
- Install dryer bottle (para. 14-19).
- Install condenser fans (TM 9-2320-280-20).
- Install intake and exhaust grilles (TM 9-2320-280-20).

## 14-24. AIR-CONDITIONING COMPRESSOR REPLACEMENT (R-12)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Lockwasher (Appendix E, Item 100)
Four lockwashers (Appendix E, Item 104)
Two O-rings (Appendix E, Item 144)
Lubricating oil (Appendix B, Item 35)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-17) (compressor replacement only).
- Right splash shield removed (TM 9-2320-280-20).
- Air filter to air horn hose removed (TM 9-2320-280-20).
- Disconnect battery ground cable (TM 9-2320-280-20).

**General Safety Instructions**
Air-conditioning system must be discharged, prior to replacing components.

**Maintenance Level**
Direct support

**NOTE**

The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.8 for vehicles with R-134a refrigerant.

### a. Removal

**WARNING**

Air conditioning system must be discharged, prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Ensure valve holes in compressor and service valves are immediately capped after service valve removal. Failure to do so may cause damage to compressor.

**NOTE**

- Perform steps 1 and 2 if compressor is being removed to service other than the A/C system components.
- Tag service valves “front-seated” for installation.

1. Turn both service valves (3) fully clockwise until front-seated.
2. Loosen two nuts (2) on service valves (3) slowly to allow refrigerant to escape from compressor (20).
3. Remove two service valves (3) and O-rings (1) from compressor (20) slowly. Discard O-rings (1).
4. Remove screw (10) and clamp (11) from adjusting bracket (6).

**NOTE**

Prior to removal, tag leads for installation.

5. Disconnect two compressor leads (23) from two harness leads (24).
6. Remove nut (9), lockwasher (8), and washer (7) from adjusting bracket (6) and timing chain cover bolt. Discard lockwasher (8).
7. Remove two nuts (14), lockwashers (13), washers (12), capscrews (4), washers (5), adjusting bracket (6), and clamp (21) and washers (7), from compressor (20). Discard lockwashers (13).
8. Remove drive belt (16) from pulley (15).
9. Remove adjusting bracket (6) and washer (7) from compressor (20) and timing chain cover bolt.

## 14-24. AIR-CONDITIONING COMPRESSOR REPLACEMENT (R-12) (Cont'd)

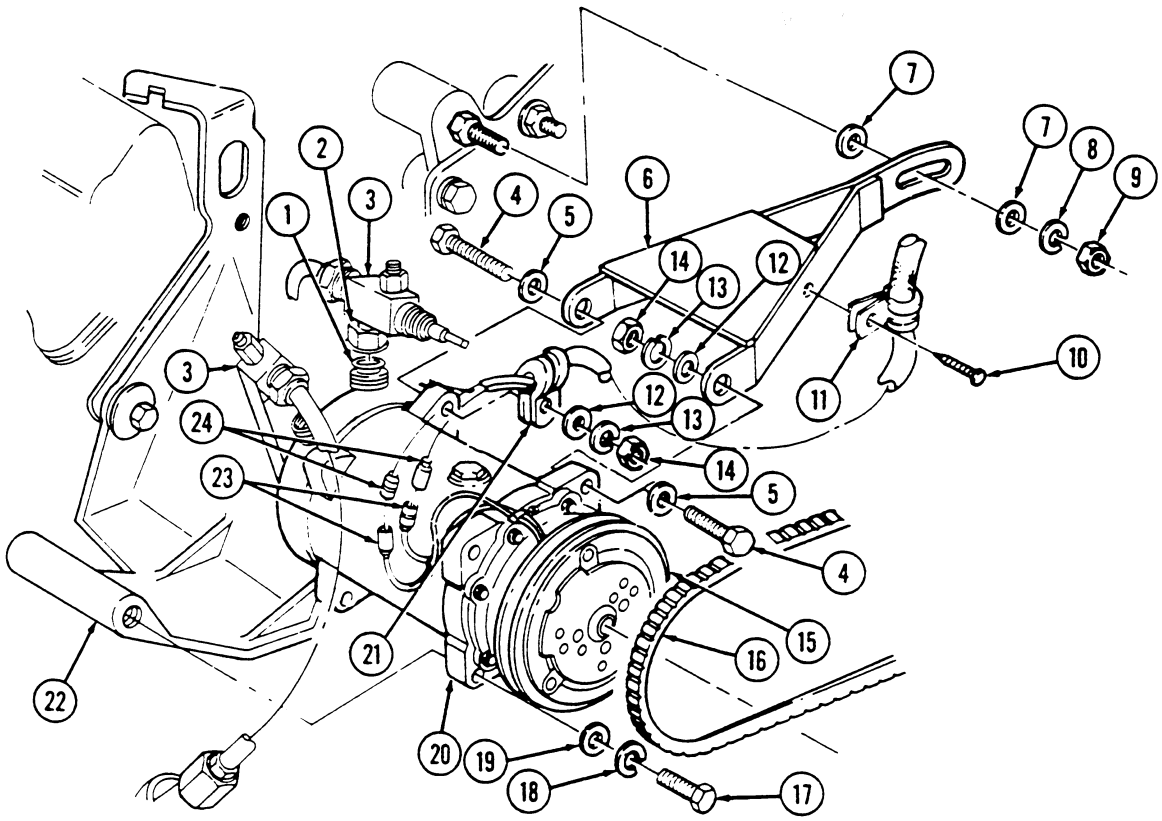
10. Remove two capscrews (17), lockwashers (18), washers (19), and compressor (20) from support bracket (22). Discard lockwashers (18).
11. Remove compressor (20) from support bracket (22).

**b. Installation**

**NOTE**

- When installing a new compressor, it is necessary to add an additional 3.0 oz (89 ml) of lubricating oil to the compressor prior to installation.

1. Install compressor (20) on support bracket (22) with two washers (19), lockwashers (18), and capscrews (17).
2. Place drive belt (16) on pulley (15).
3. Install washer (7) and adjusting bracket (6) on timing chain cover bolt and air compressor (20) with washer (7), lockwasher (8), and nut (9).
4. Install adjusting bracket (6) and clamp (21) on compressor (20) with two washers (5), capscrews (4), washers (12), lockwasher (13), and nuts (14).
5. Connect two harness leads (24) to two compressor leads (23).
6. Install clamp (11) on adjusting bracket (6) with screw (10).
7. Lubricate two O-rings (1) with lubricating oil and install on service valves (3). Connect two service valves (3) to compressor (20).




FOLLOW-ON TASKS:
- Install air filter to air horn hose (TM 9-2320-280-20).
- Adjust compressor drive belt (TM 9-2320-280-20).
- Connect battery ground cable (TM 9-2320-280-20).
- Evacuate and charge air-conditioning system (para. 14-17).
- Install right splash shield (TM 9-2320-280-20).

## 14-25. AIR-CONDITIONING SERVICE VALVE REPLACEMENT (R-12)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two O-rings (Appendix E, Item 144)
Lubricating oil (Appendix B, Item 35)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-17).
- Air horn to air cleaner hose removed (TM 9-2320-280-20).

**General Safety Instructions**
Air conditioner system must be discharged, prior to replacing components.

**Maintenance Level**
Direct support

**WARNING**

Air conditioner system must be discharged, prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**NOTE**

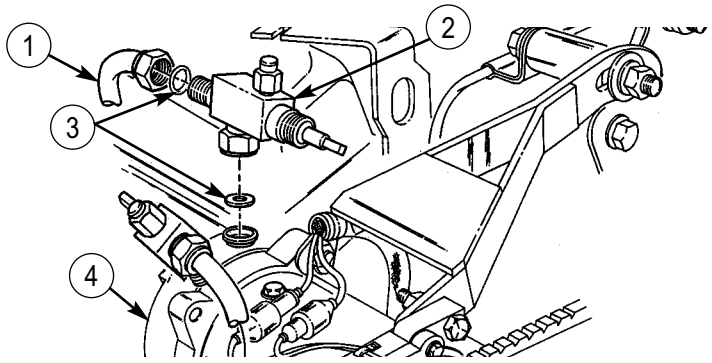
- Suction (low pressure) and discharge (high pressure) service valves are replaced basically the same. This procedure covers the suction service valve.
- The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.9 for vehicles with R-134a refrigerant.

### a. Removal

1. Disconnect suction line (1) from service valve (2).
2. Remove suction service valve (2) and two O-rings (3) from compressor (4). Discard O-rings (3).

### b. Installation

1. Lubricate two O-rings (3) with lubricating oil and install on suction service valve (2).
2. Install suction service valve (2) on compressor (4).
3. Connect suction line (1) to suction service valve (2).




FOLLOW-ON TASKS:
- Evacuate and charge air-conditioning system (para. 14-17).
- Install air horn to air cleaner hose (TM 9-2320-280-20).

# 14-26. COMPRESSOR MOUNTING AND AIR HORN BRACKET REPLACEMENT (R-12)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Two lockwashers (Appendix E, Item 100)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Compressor removed (para. 14-24).
- Air horn removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**NOTE**

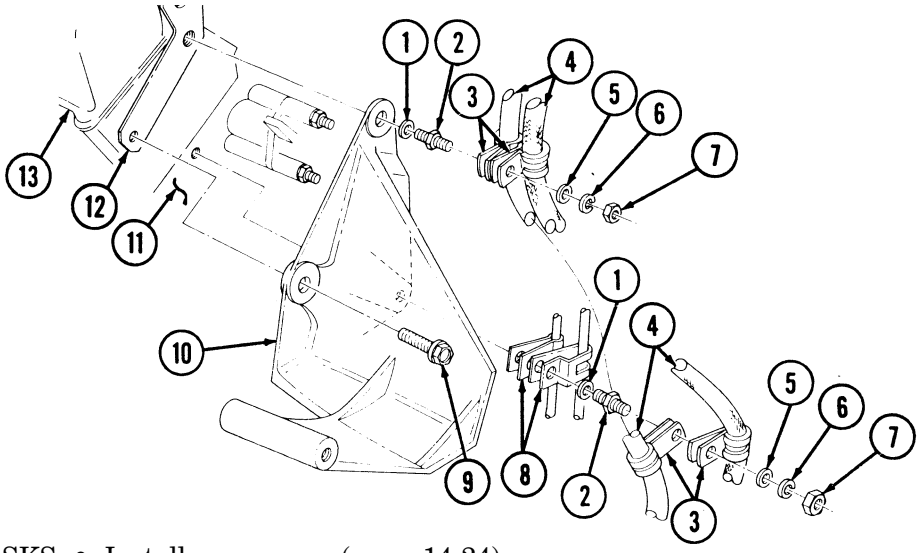
The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.10 for vehicles with R-134a refrigerant.

## a. Removal

1. Remove capscrew (9) from brackets (10) and (12) and cylinder head (13).
2. Remove two nuts (7), lockwashers (6), washers (5), four clamps (3), and cables (4) from two studs (2). Discard lockwashers (6).
3. Remove two studs (2), washers (1), fuel line clamps (8), and brackets (10) and (12) from cylinder head (13) and engine block (11).

## b. Installation

1. Install brackets (10) and (12) and two fuel line clamps (8) on cylinder head (13) and engine block (11) with two washers (1) and studs (2).
2. Secure brackets (10) and (12) on cylinder head (13) with capscrew (9).
3. Tighten capscrew (9) and two studs (2) to 40 lb-ft (54 N•m).
4. Install four clamps (3) and cables (4) on two studs (2) with washers (5), lockwashers (6), and nuts (7). Tighten nuts (7) to 40 lb-ft (54 N•m).




FOLLOW-ON TASKS:
- Install compressor (para. 14-24).
- Install air horn (TM 9-2320-280-20).

## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12)

**This task covers:**

**a. Preliminary Inspection and Cleaning**
**b. Disassembly**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Test Equipment**
Multimeter (Appendix G, Item 120)

**Special Tools**
Compressor tool kit (Appendix G, Item 102)

**Materials/Parts**
O-ring (Appendix E, Item 130)
Seal kit (Appendix E, Item 48)
Gasket kit (Appendix E, Item 39)
Direct clutch parts kit (Appendix E, Item 154)
Lubricating oil (Appendix B, Item 35)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Air-conditioning compressor removed (para. 14-24).

**General Safety Instructions**
- Compressed air for cleaning purposes will not exceed 30 psi (207 kPa).
- Compressor cylinder block may be pressurized.

**Maintenance Level**
Direct support

**NOTE**

The following procedure applies to vehicles with R-12 refrigerant only. Refer to para. 14-27.1 for vehicles with R-134a refrigerant.

### a. Preliminary Inspection and Cleaning

1. Inspect front of compressor shaft (6) for oil leakage. If oil leakage is evident, replace compressor shaft seal.

**WARNING**

Compressed air for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

2. Clean compressor assembly with lubricating oil and dry with compressed air.

**WARNING**

Compressor cylinder block may be pressurized. Loosen oil filler plug slowly. If sound of escaping gas is heard, do not continue loosening plug until all pressure is released.

3. Loosen oil fill plug (3) to relieve any pressure buildup in compressor cylinder block (1).
4. Rotate compressor shaft (6) with ratchet and socket on compressor shaft nut (5). If severe rough spots or catches are felt while rotating shaft (6), replace compressor assembly.
5. Remove oil fill plug (3) and O-ring (4) from compressor cylinder block (1) and drain oil from cylinder block (1) into measuring container. Discard O-ring (4). Record amount of oil in measuring container.
6. Install O-ring (4) and fill plug (3) in cylinder block (1) and tighten fill plug (3) finger tight.
7. Inspect oil for chips, metal shavings, and metal particles. Replace compressor assembly if chips, metal shavings, or metal particles are present in oil.

### b. Disassembly

**CAUTION**

Do not clamp compressor body in vise. Clamp or support only at mounting ears, with blocks of wood, to prevent damage to compressor body.

## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)

**NOTE**

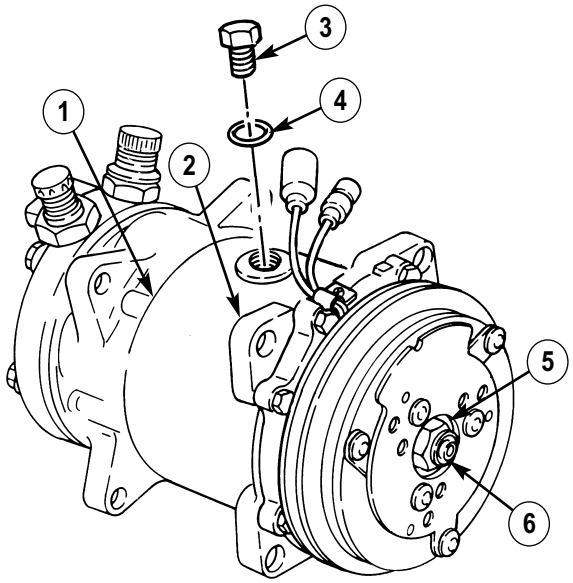
Perform steps 1 through 18 if replacing compressor shaft oil seal or clutch assembly. Perform steps 19 through 22 only if replacing cylinder head or valve plate assembly.

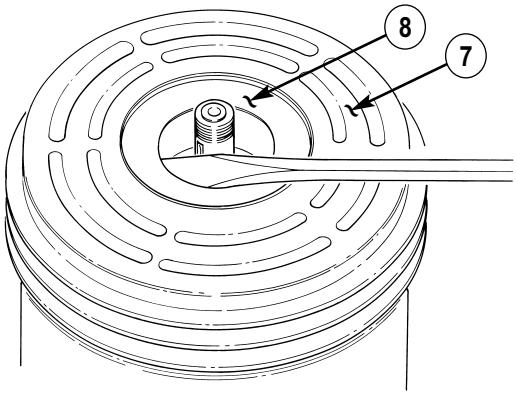
1. Clamp compressor mounting ears (2) in vise with blocks of wood on mounting ears (2).
2. Using front plate spanner to hold front clutch plate (9), remove nut (5) from compressor shaft (6). Discard nut (5).
3. Using clutch plate puller, remove front clutch plate (9) from compressor shaft (6).
4. Remove woodruff key (13) from compressor shaft (6). Discard woodruff key (13).
5. Using screwdriver, remove dust shield (8) from pulley (7) by lightly prying up on dust shield (8) while turning pulley (7).

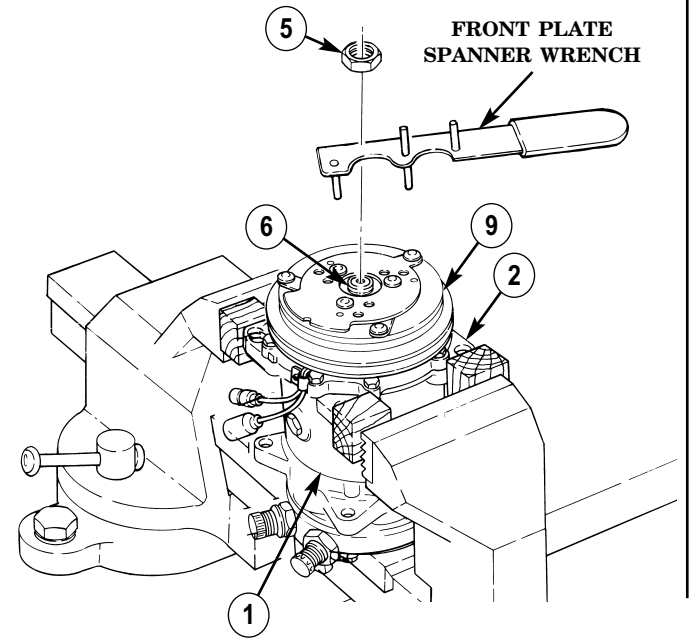
**NOTE**

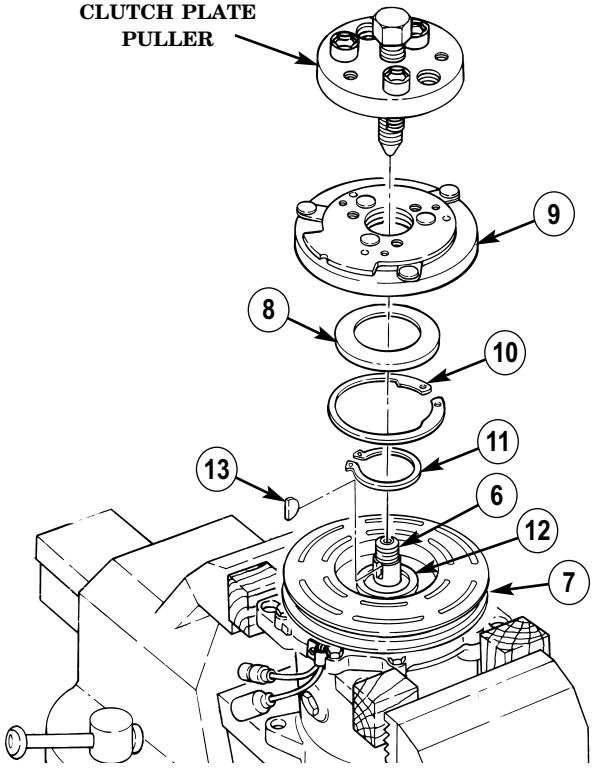
Offset snaprings 180 degrees prior to removal.

6. Using internal snapring pliers, remove internal bearing snapring (10) from rotor pulley (7).
7. Using external snapring pliers, remove external snapring (11) from seal housing (12). Discard snapring (11).



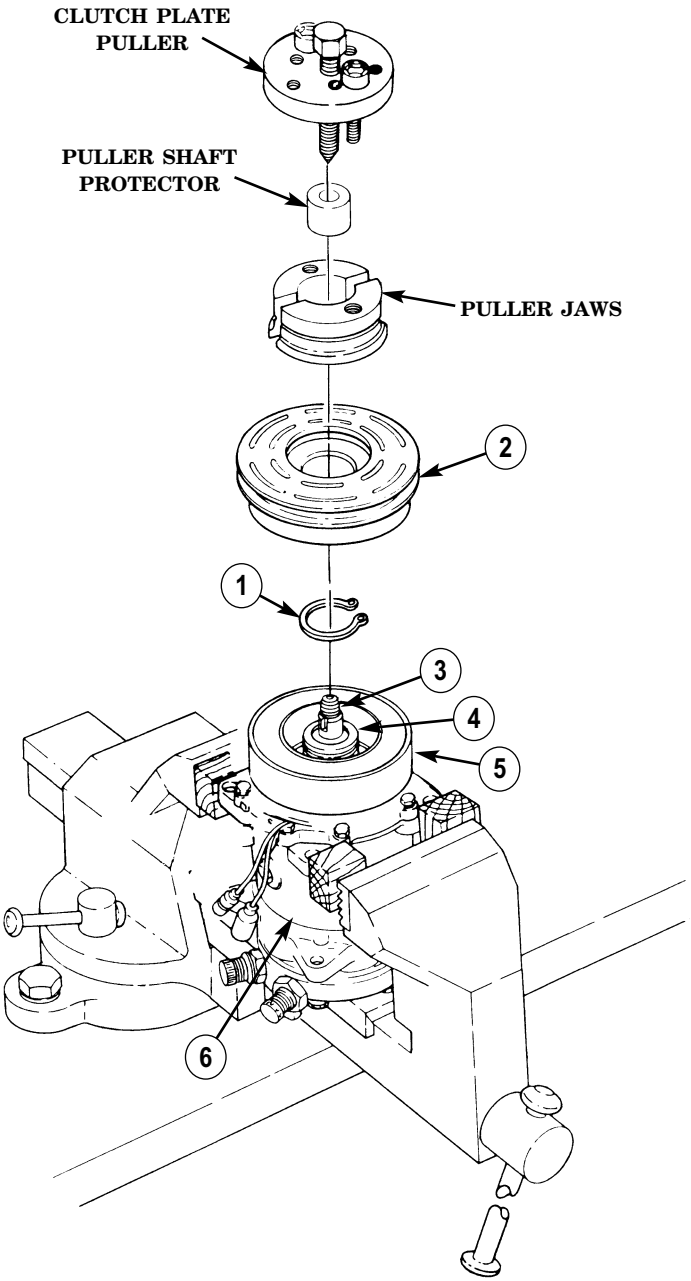



## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)

8. Place puller jaws into rotor pulley (2) around shaft (3).
9. Insert the bottom lips of the jaws into the internal bearing snapring groove on rotor pulley (2). Place puller shaft protector between jaws, and seat on shaft (3). Install clutch plate puller on puller jaws and tighten capscrews finger tight.
10. Remove rotor pulley (2) from shaft (3).
11. Using external snapring pliers, remove snapring (1) from seal housing (4) and remove field coil (5). Discard snapring (1).



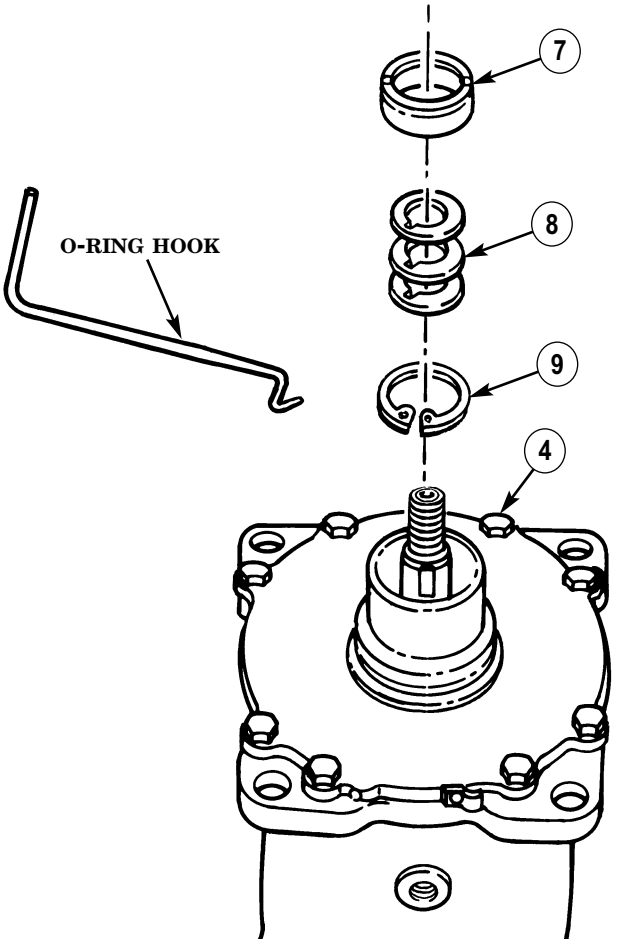
## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)

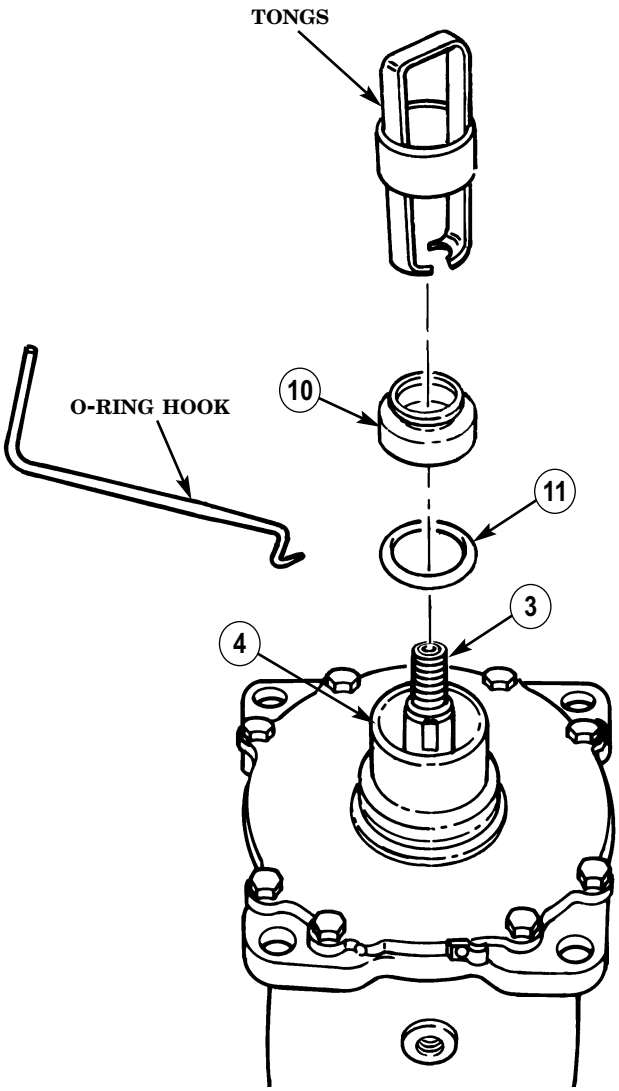
12. Using snapring pliers, remove felt ring assembly (7) from seal housing (4). Discard felt ring assembly (7).
13. Using O-ring hook and small screwdriver, remove shims (8) from seal housing (4).
14. Using internal snapring pliers, remove snapring (9) from seal housing (4). Discard snapring (9).
15. Using tongs, remove seal retainer (10) from shaft (3). Discard seal retainer (10).

**CAUTION**

Be careful not to scratch O-ring groove when removing O-ring from seal housing.

16. Using O-ring hook, remove seal (11) from groove in seal housing (4). Discard seal (11).



## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)

17. Insert seal remover and installer in seal housing (2) on seal assembly (1). Press seal remover and installer down against seal assembly (1) and twist clockwise to engage slots on seal assembly (1). Remove seal assembly (1) from seal housing (2). Discard seal assembly (1).
18. Remove compressor cylinder block (8) from vise.
19. Remove five capscrews (3) and cylinder head (5) from compressor cylinder block (8).
20. Using small plastic mallet, tap around outer edge of the cylinder head (5) to free it from valve plate assembly (7). Remove cylinder head (5) from valve plate assembly (7).

**NOTE**

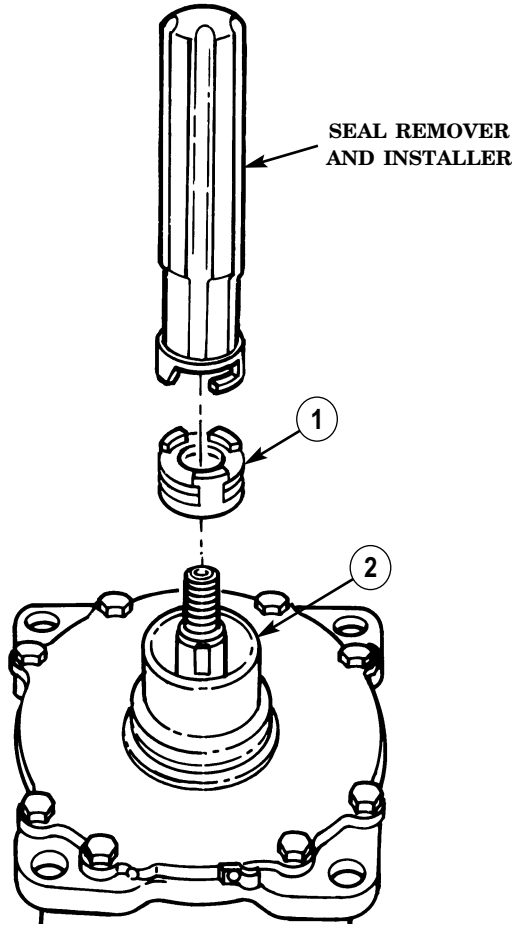
Do not remove screw, nut, and lockwasher from center of valve plate assembly.

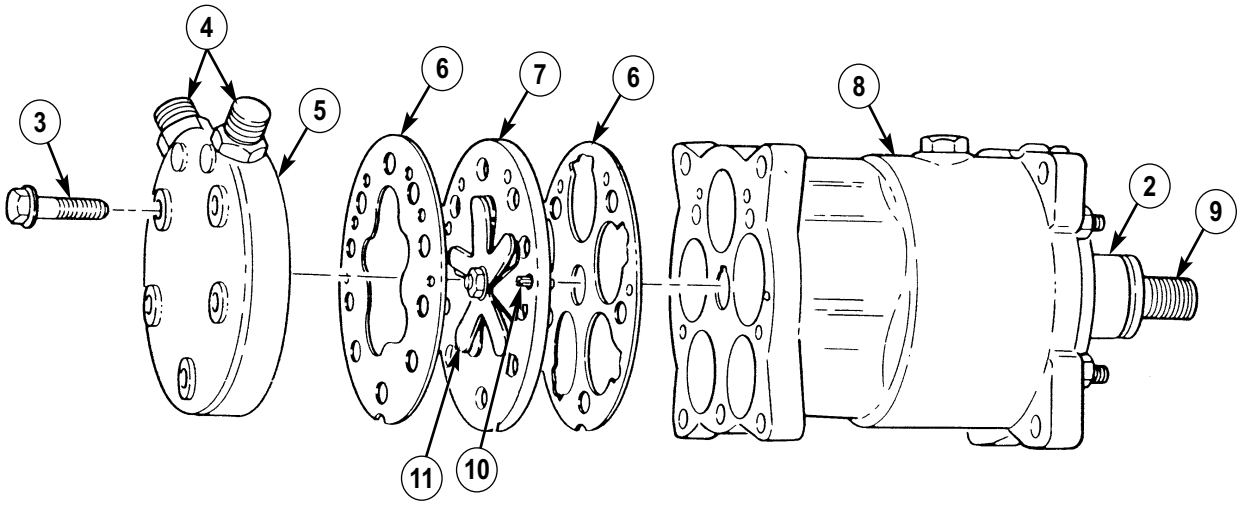
21. Position gasket scraper between valve plate assembly (7) and compressor cylinder block (8), and lightly tap around edge to remove valve plate assembly (7). Remove two gaskets (6) from valve plate assembly (7). Discard gaskets (6).
22. Using gasket scraper, carefully remove any gasket (6) remains on cylinder head (5) and compressor cylinder block (8).

### c. Inspection

1. Inspect compressor shaft (9) and seal housing (2) for nicks, gouges, scrapes, or damage. Replace compressor assembly if shaft (9) or seal housing (2) is nicked, gouged, scraped, or damaged.
2. Inspect compressor cylinder block (8) for cracks, stripped threads, and cracks or gouges in cylinder walls. Replace compressor assembly if cracked, threads are stripped, or cylinder walls are gouged or cracked.
3. Inspect cylinder head (5) for cracks, gouges, and damaged fittings (4). Replace cylinder head (5) if cracked, gouged, or fittings (4) are damaged.
4. Inspect valve plate assembly (7) for damaged or worn reed valves (11) and presence and condition of alignment pins (10). Replace valve plate assembly (7) if damaged or worn.

## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)



## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)

5. Inspect front clutch plate (6) for warping, distortion, and damage. Replace clutch assembly if damaged.
6. Inspect pulley (4) and bearing (5) for cracks, scoring, or damage. Replace clutch assembly if rotor pulley (4) or bearing (5) is damaged.
7. Inspect field coil (3) for broken or damaged lead wires (1) and (2), gouges, and damage. Replace field coil (3) if leads (1) and (2) are damaged.
8. Connect positive lead of multimeter to lead 433 (1) on field coil (3). Connect negative lead of multimeter to lead 798 (2) on field coil. Field coil (3) should read 2.0 to 15.0 ohms of resistance. If field coil resistance test is not within specifications, replace field coil (3).

**d. Assembly**

**NOTE**

- Perform steps 1 through 5 if cylinder head or valve plate assembly was removed. Perform steps 6 through 29 if compressor shaft oil seal or clutch assembly was removed.

1. Coat valve plate assembly (10) with lubricating oil. Install cylinder head gaskets (9) and (11) on valve plate assembly (10), making sure gaskets (9) and (11) do not restrict oil holes in valve plate assembly (10).
2. Align valve plate assembly (10) with compressor cylinder block (12) cylinders, and install valve plate assembly (10) on compressor cylinder block (12).

**NOTE**

Make sure valve plate assembly alignment pins are engaged, and all bolt holes and oil holes are unrestricted by gaskets before installing cylinder head.

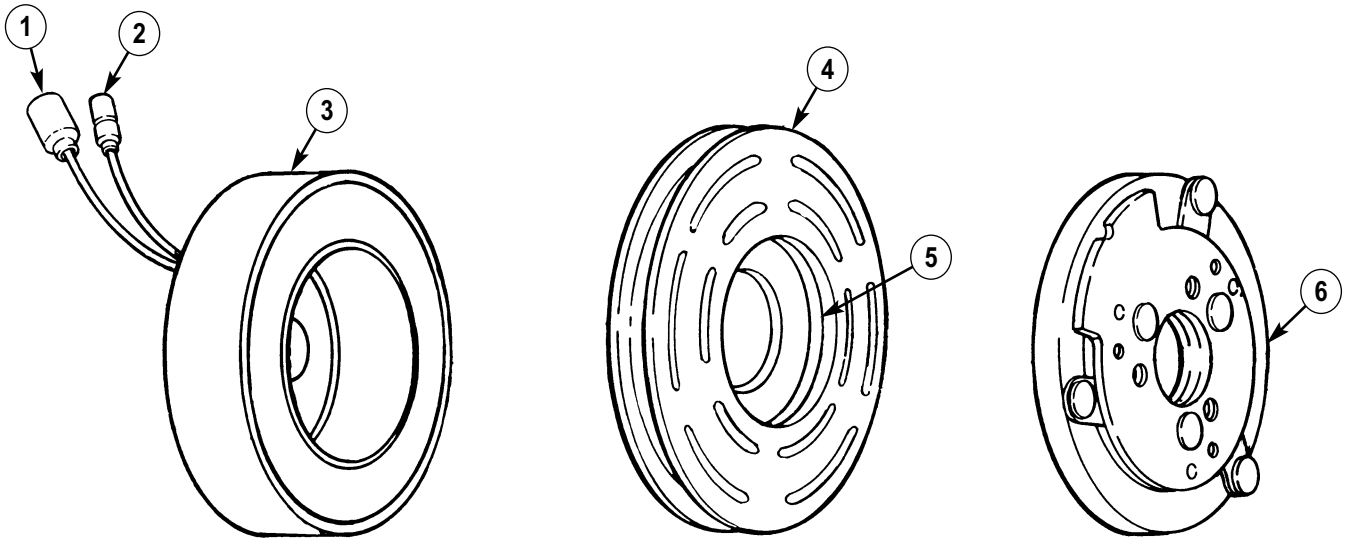
3. Position cylinder head (8), with fittings on same side of compressor cylinder block (12) as oil fill hole, and install cylinder head (8) on valve plate assembly (10) without misaligning gasket (9).
4. Install five capscrews (7) into cylinder head (8) and tighten capscrews (7) finger tight.
5. Tighten five capscrews (7) to 10-15 lb-ft (14-20 N•m) in tightening sequence shown. Then retighten to 22-25 lb-ft (30-34 N•m) in tightening sequence shown.

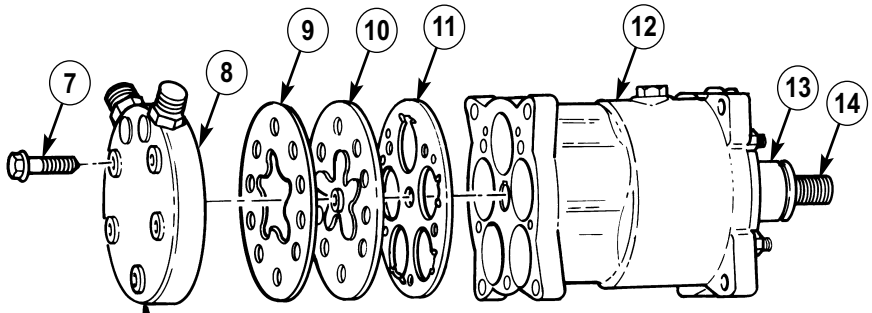
**WARNING**

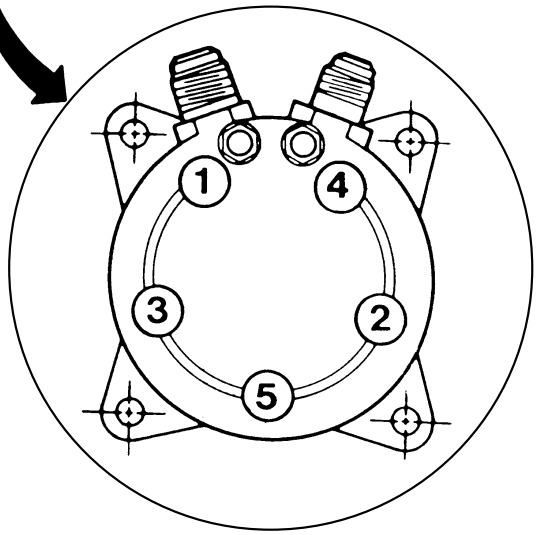
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

6. Clean seal housing (13) and shaft (14) thoroughly with lubricating oil, a clean lint free cloth, and dry with compressed air. Make sure all foreign substances are removed from seal housing (13) and shaft (14).
7. Insert seal sleeve protector over shaft (14). Dip mating surfaces of seal (15) in lubricating oil and slide seal (15) over seal sleeve protector and into seal housing (13).
8. Place seal (15) in slots of seal remover and installer and install seal (15) into seal housing (13), making sure seal (15) is fully seated in seal housing (13). Twist seal remover and installer counterclockwise to disengage from seal (15) and remove seal remover and installer.

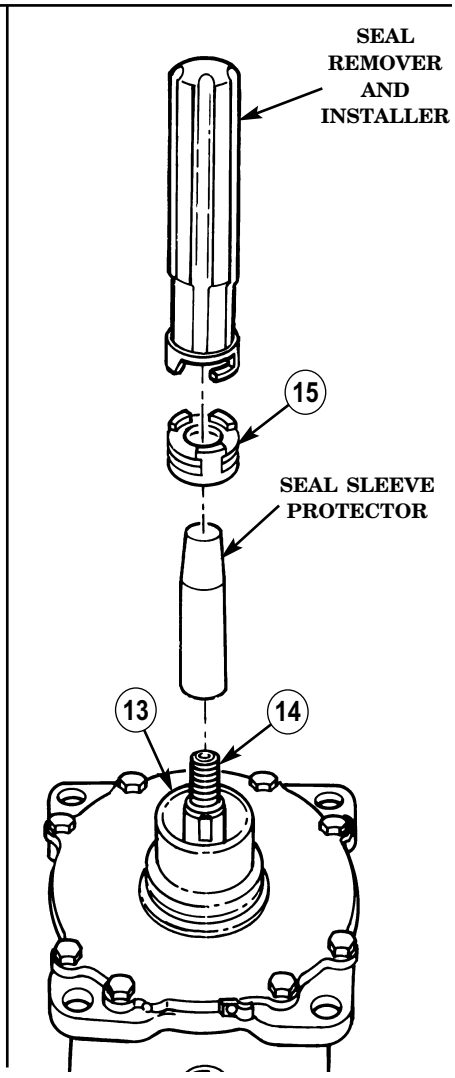
## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)




TIGHTENING SEQUENCE



## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)

**CAUTION**

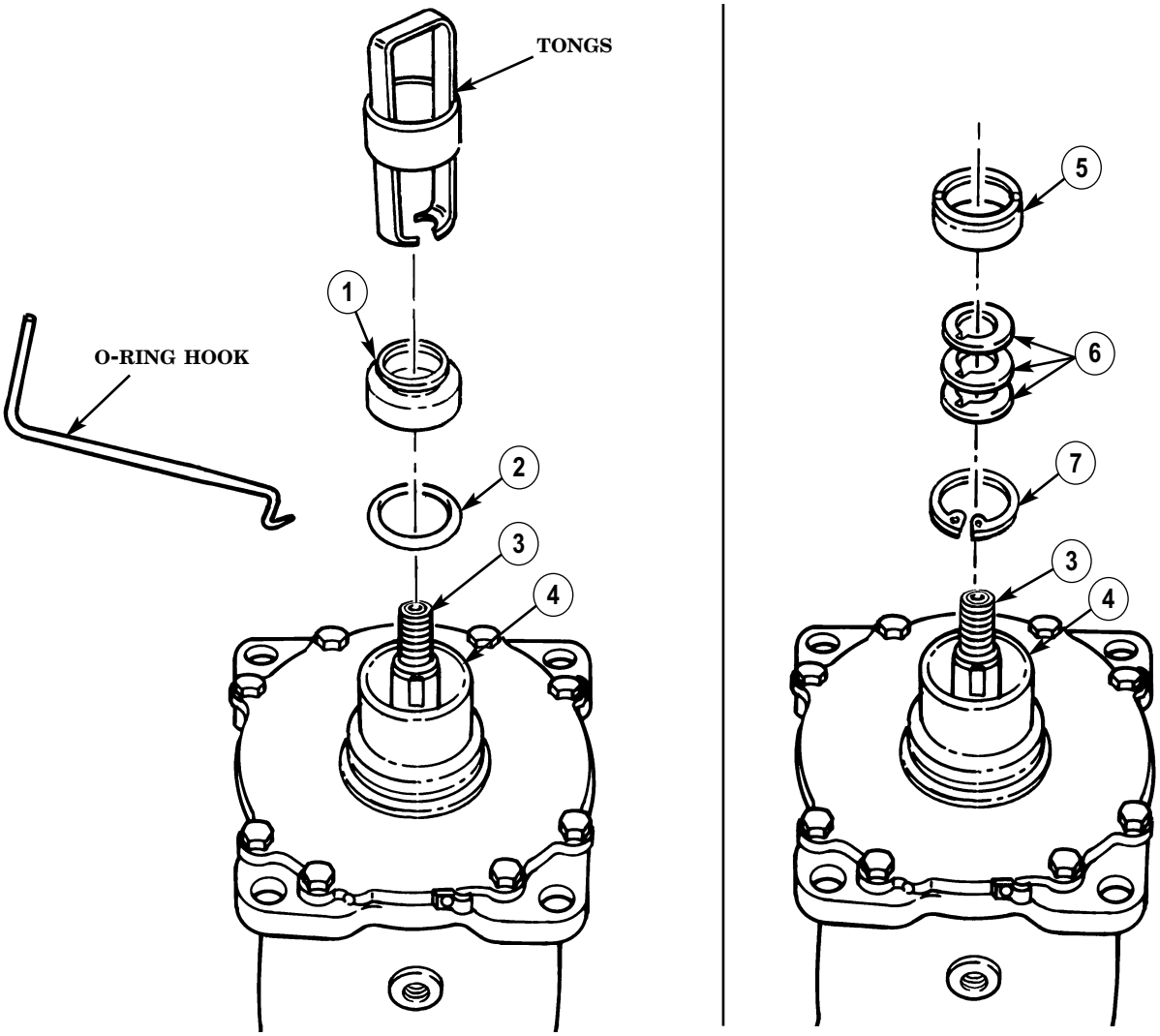
Do not scratch seal housing with O-ring hook.

9. Coat seal (2) with lubricating oil. Using O-ring hook, install seal (2) into seal housing (4) groove. Do not scratch seal housing (4) surface with O-ring hook.
10. Coat seal retainer (1) with lubricating oil. Using tongs, install seal retainer (1) in seal housing (4) and press lightly against seal.
11. Using snapring pliers, install snapring (7) in seal housing (4) with beveled edge of snapring (7) facing away from seal retainer (1).

**NOTE**

The air gap is determined by the spacer shims. When installing the original or a new clutch assembly, try the original shims first. When installing a clutch on a new compressor assembly, use 0.040 (1 mm), 0.020 (.51 mm), and 0.005 in. (.13 mm) shims from clutch accessory kit.

12. Install clutch spacer shims (6) on shaft (3).
13. Install felt ring assembly (5) into seal housing (4) and tap in place with plastic-faced hammer.



## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)

14. Install field coil (13) onto seal housing (4), making sure bump on field coil (13) fits in locating depression on compressor housing (14). Using snapring pliers, install snapring (12) on seal housing (4) to secure field coil (13).

**CAUTION**

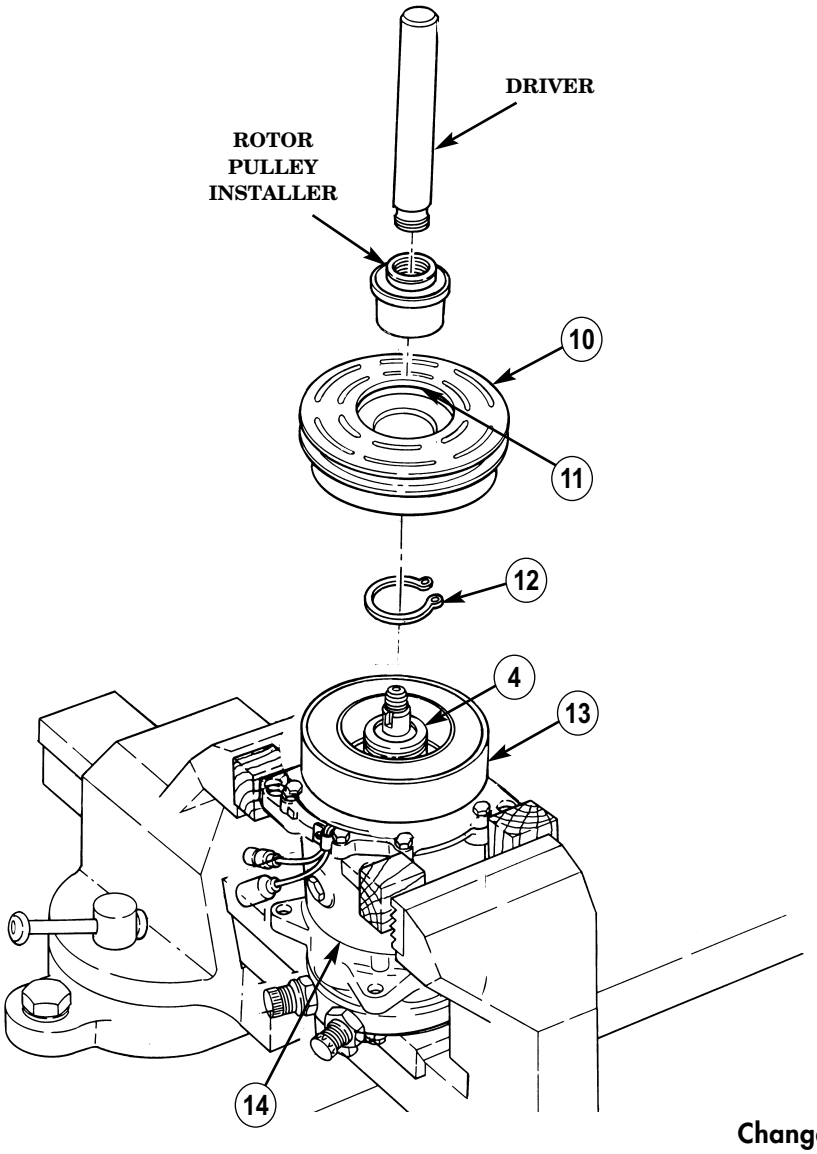
Do not clamp compressor body in vise. Clamp or support only at mounting ears, with blocks of wood, to prevent damage to compressor body.

15. Clamp compressor housing (14) in vise with blocks of wood on mounting ears.
16. Place rotor pulley (10) on seal housing (4), making sure it is not misaligned or crooked.
17. Place rotor pulley installer into bearing cavity of rotor pulley (10), making sure the outer edge of the installer rests on the bearing outer race (11).

**CAUTION**

Make sure all slack is taken out of field coil lead wires (with clamp) before installing rotor pulley to prevent damage to lead wires.

18. Place driver on rotor pulley installer, and tap driver with hammer until rotor pulley (10) fully seats on seal housing (4).



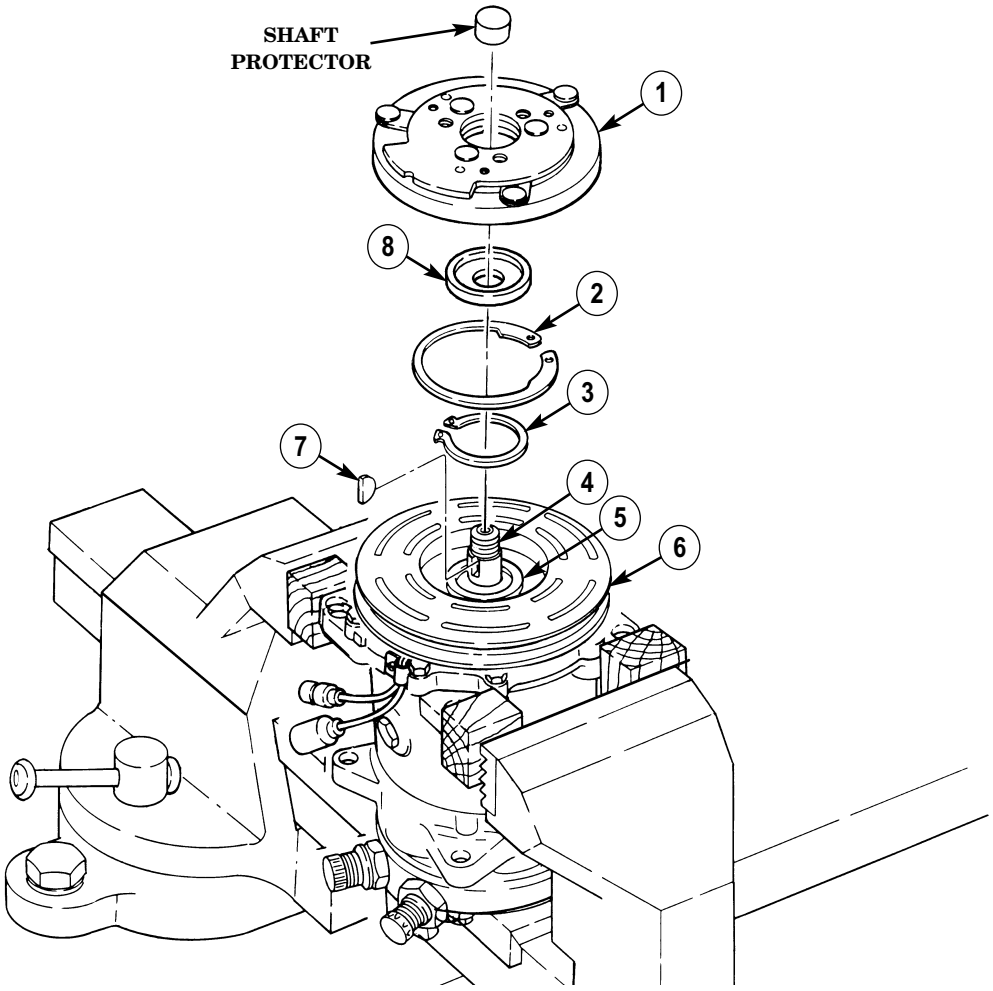
## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)

19. Using external snapring pliers, install snapring (3) on seal housing (5).
20. Using internal snapring pliers, install internal bearing snapring (2) in pulley (6).
21. Using bearing installer and plastic mallet, install bearing dust cover (8) on pulley (6).
22. Install woodruff key (7) in compressor shaft (4).
23. Align front clutch plate (1) with woodruff key (7) and install on rotor pulley (6).
24. Using shaft protector, tap front clutch plate (1) onto shaft (4) until it seats on clutch shims.
25. Install nut (9) on compressor shaft (4). Using front plate spanner to hold front clutch plate (1), tighten nut (9) to 25-30 lb-ft (34-41 N·m).

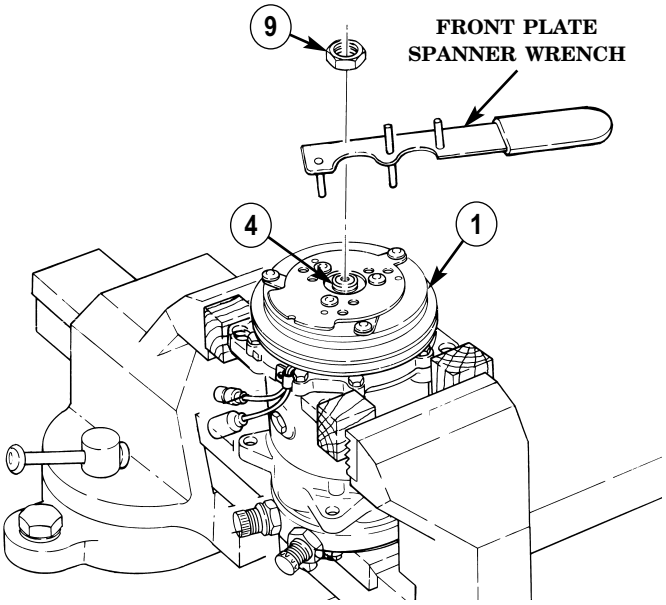
**NOTE**

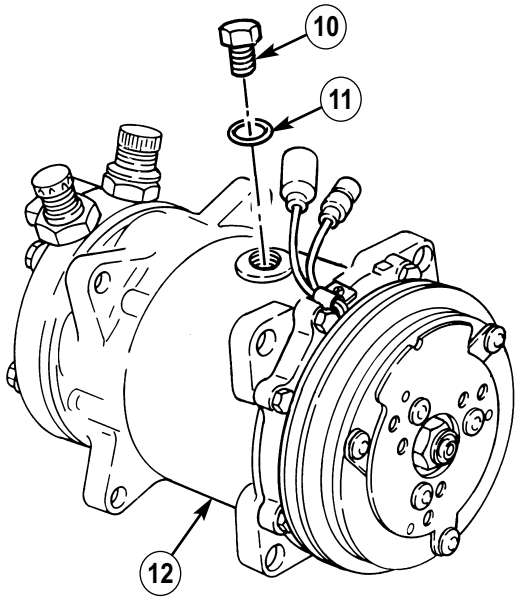
Air gap is the space between front clutch plate and rotor pulley.

26. Check air gap of front clutch plate (1) with feeler gauge. Air gap should be 0.016-0.031 in. (0.04-0.079 cm). If air gap is not consistent around the circumference of the front clutch plate (1), lightly pry up or tap down edge to make gap consistent. If air gap is not within specifications, remove rotor pulley (6) (steps b.1 through b.13), add or subtract shims as required, and replace rotor pulley (6) and front clutch plate (1) (steps d.11 through d.25).
27. Remove compressor assembly (12) from vise, and place on flat surface.
28. Remove oil fill plug (10) and O-ring (11). Discard O-ring (11).
29. Perform steps 9 through 13 in para. 14-17g.



## 14-27. AIR-CONDITIONING COMPRESSOR REPAIR (R-12) (Cont'd)




FOLLOW-ON TASK: Install air-conditioner compressor (para. 14-24).

## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a)

**This task covers:**

**a. Manifold Gauge Set Installation**
**b. Manifold Gauge Set Removal**
**c. Discharging System**
**d. Flushing System**
**e. Evacuating System**
**f. Charging System**
**g. Adding lubricating oil**

**INITIAL SETUP:**

**Applicable Models**

M997A2

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)
Flushing cylinder (Appendix G, Item 103)
Flush gun (Appendix G, Item 104)
Service refrigeration unit tool kit (Appendix G, Item 19)
Vacuum pump (Appendix G, Item 105)

**Test Equipment**

Manifold gauge set (Appendix G, Item 137)
Reusable cylinder (Appendix G, Item 103.1)

**Materials/Parts**

PAG lubricating oil (Appendix B, Item 35.2)
Refrigerant R-134a (Appendix B, Item 42.2)
Nitrogen (Appendix B, Item 37)
Flushing agent (Appendix B, Item 15)

**Manual References**

TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

Hood raised and secured (TM 9-2320-387-10).

**General Safety Instructions**

- Always wear eye protection when around R-134a.
- Avoid breathing R-134a. Be sure the work area is properly ventilated in case of accidental release into the nearby atmosphere.
- Exercise extreme care when handling R-134a.
- Ensure adequate ventilation whenever R-134a is discharged.
- Do not attempt to connect servicing equipment while engine is running, and hoses must be clear of any moving engine parts.
- Ensure hand valves on manifold gauge set are closed during connection.
- Do not disconnect hoses before back-seating service valves.
- Eye protection must be worn when using compressed air.
- Ensure high side service valve on manifold gauge set is in OFF/CLOSED position during charging.
- Do not vent R-134a into the atmosphere. Recover all refrigerant in a reusable cylinder (RR-C-910-1-4).
- Never smoke where R-134a is used or stored.
- Exposure to R-134a may be hazardous for individuals with cardiac rhythm abnormalities.

**Maintenance Level**

Direct support

**WARNING**

- Avoid breathing R-134a. The gas will irritate the nose, throat, and lungs. In addition, because R-134a is heavier than air, it can displace oxygen in a confined and a poorly ventilated area. Be sure the work area is properly ventilated in case of accidental release into the nearby atmosphere.
- Always wear eye protection when using R-134a or when servicing the air conditioning system. Injury will result if R-134a comes in contact with eyes.
- Exercise extreme care when handling R-134a. Direct contact between R-134a and skin may cause frostbite.
- Ensure adequate ventilation whenever R-134a is being discharged. Injury to personnel may result if used in a confined area.
- Do not attempt to connect servicing equipment while engine is running. Injury to personnel or damage to equipment may result.
- Personnel with a history of cardiac rhythm abnormalities should be made aware of potential aggravation as a result of exposure to R-134a. Failure to do so may result in injury to personnel.
- Never smoke in areas where R-134a is used or stored. Injury to personnel may result.

## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a) (Cont'd)

**CAUTION**

Never mix R-134a and R-12 refrigerants. They are incompatible and will cause severe damage to system components if mixed.

**NOTE**

- Whenever any air-conditioning vapor system component needs replacement, the system must be discharged, flushed, and a new dryer bottle installed (para. 14-27.3).
- The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-17 for vehicles with R-12 refrigerant.

### a. Manifold Gauge Set Installation

1. Turn high-pressure gauge valve (2) and low-pressure gauge valve (1) on manifold gauge set (3) clockwise to seated (closed) positions.
2. Remove two caps (10) from service valves (11) and turn service valve shafts (9) counterclockwise to back-seated position.
3. Remove two caps (6) from service ports (7) and (8).

**WARNING**

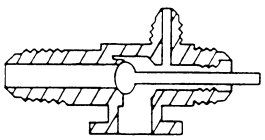
Ensure hand valves on manifold gauge are in closed position during connection and hoses are clear of any moving parts in engine compartment. Injury to personnel or damage to equipment may result.

4. Connect low-pressure gauge hose (5) on manifold gauge set (3) to suction (low side) service port (7).
5. Connect high-pressure gauge hose (4) on manifold gauge set (3) to discharge (high side) service port (8).
6. Hang manifold gauge set (3) so hoses (4) and (5) are well away from moving engine parts.
7. Turn service valve shafts (9) to mid-seated position.

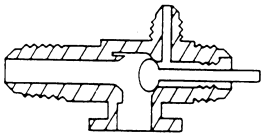
**NOTE**

Do not perform step 8 if system is already evacuated. High- and low-pressure hoses must be purged with R-134a for charging purposes (refer to task f.).

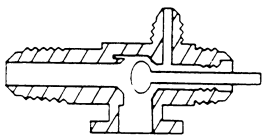
8. Slightly loosen low-pressure gauge hose (5) and high-pressure gauge hose (4) at manifold gauge set (3) to purge air from hoses, then tighten.



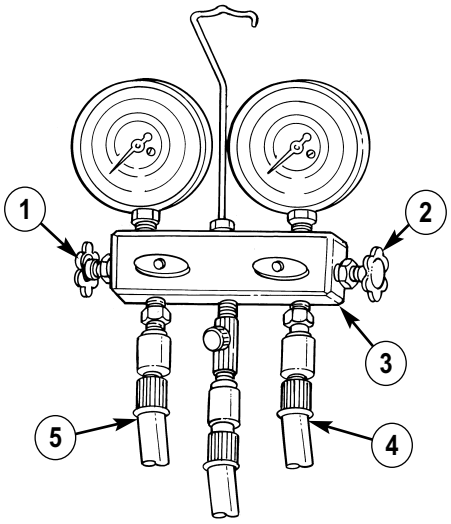
SERVICE VALVE IN FRONT-SEATED POSITION

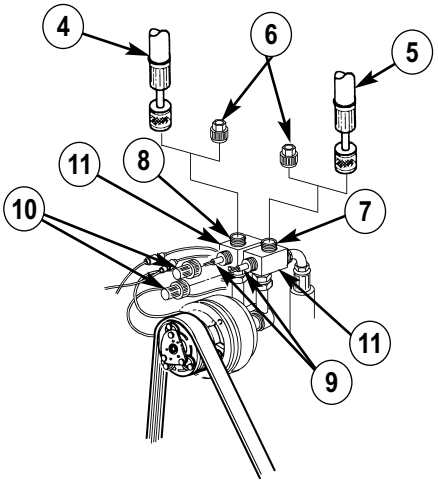


SERVICE VALVE IN BACK-SEATED POSITION



SERVICE VALVE IN MID-SEATED POSITION



## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a) (Cont'd)

### b. Manifold Gauge Set Removal

1. Turn service valve shafts (10) counterclockwise to back-seated position.
2. Ensure high-pressure gauge valve (2) and low-pressure gauge valve (1) on manifold gauge set (3) are in (seated, clockwise) OFF position.
3. If system was charged with refrigerant, wait several minutes after turning engine off for high and low sides to stabilize before performing next step.

**CAUTION**

A charged A/C system is always pressurized at 70-80 psi (483-552 kPa). Hose connectors must be held firmly to avoid ends whipping back and damaging equipment.

4. Disconnect low-pressure gauge hose (6) and high-pressure gauge hose (4) from service ports (8) and (9).
5. Install two caps (7) on service ports (8) and (9).

### c. Discharging System

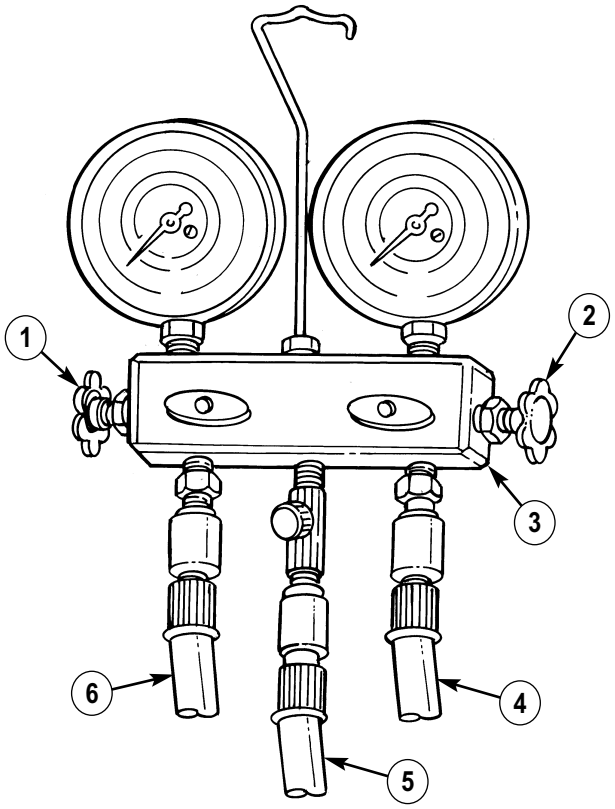
1. Turn service valve shafts (10) counterclockwise to back-seated position.
2. Install manifold gauge set (refer to task a.).
3. Connect center hose (5) of manifold gauge set (3) to an approved recovery machine.

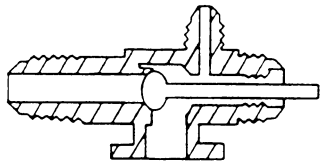
**NOTE**

- Do not allow refrigerant R-134a to escape too quickly. Lubricating oil will escape.
- When high- and low-pressure gauges read zero, the discharging procedure is complete. Allow machine to run for 5 minutes after gauges read zero.

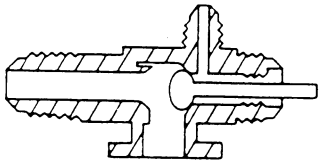
4. Slightly turn high-pressure gauge valve (2) and low-pressure gauge valve (1) counterclockwise to permit refrigerant to slowly escape through center hose (5) until both gauges read zero.
5. Measure any significant accumulation of oil in discharge bottle and record for oil charging purposes.
6. Turn service valve shafts (10) counterclockwise to back-seated position.
7. Disconnect manifold gauge set (3) (refer to task b.).
8. Turn service valve shafts (10) counterclockwise to mid-seated position.

## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a) (Cont'd)

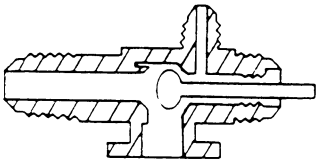


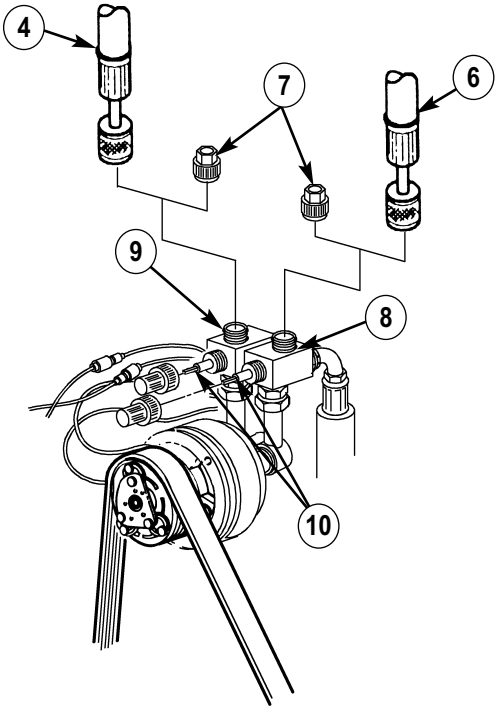
SERVICE VALVE IN
FRONT-SEATED POSITION



SERVICE VALVE IN
BACK-SEATED POSITION



SERVICE VALVE IN
MID-SEATED POSITION



## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a) (Cont'd)

**d. Flushing System**

**CAUTION**

- Never flush compressor. Flushing removes oil. Damage to compressor will result if compressor is flushed.
- Air conditioning system flushing is essential when replacing failed compressors. Failure to flush A/C system will result in damage to new compressor.

**NOTE**

- Do not attempt to use R-134a as a flushing agent. R-134a will not remain a liquid at ambient air temperatures. Use R-111 or R-113 for flushing purposes.
- Flushing is done to remove solid materials such as oil, sludge, and metal particles from failed components.
- For a complete system flush, tools must be installed at A/C lines at compressor.

1. Discharge A/C system (refer to task c.).
2. Fill flushing cylinder (2) with flushing agent.

**WARNING**

Eye protection must be worn when using compressed nitrogen. Failure to do so may result in injury to personnel.

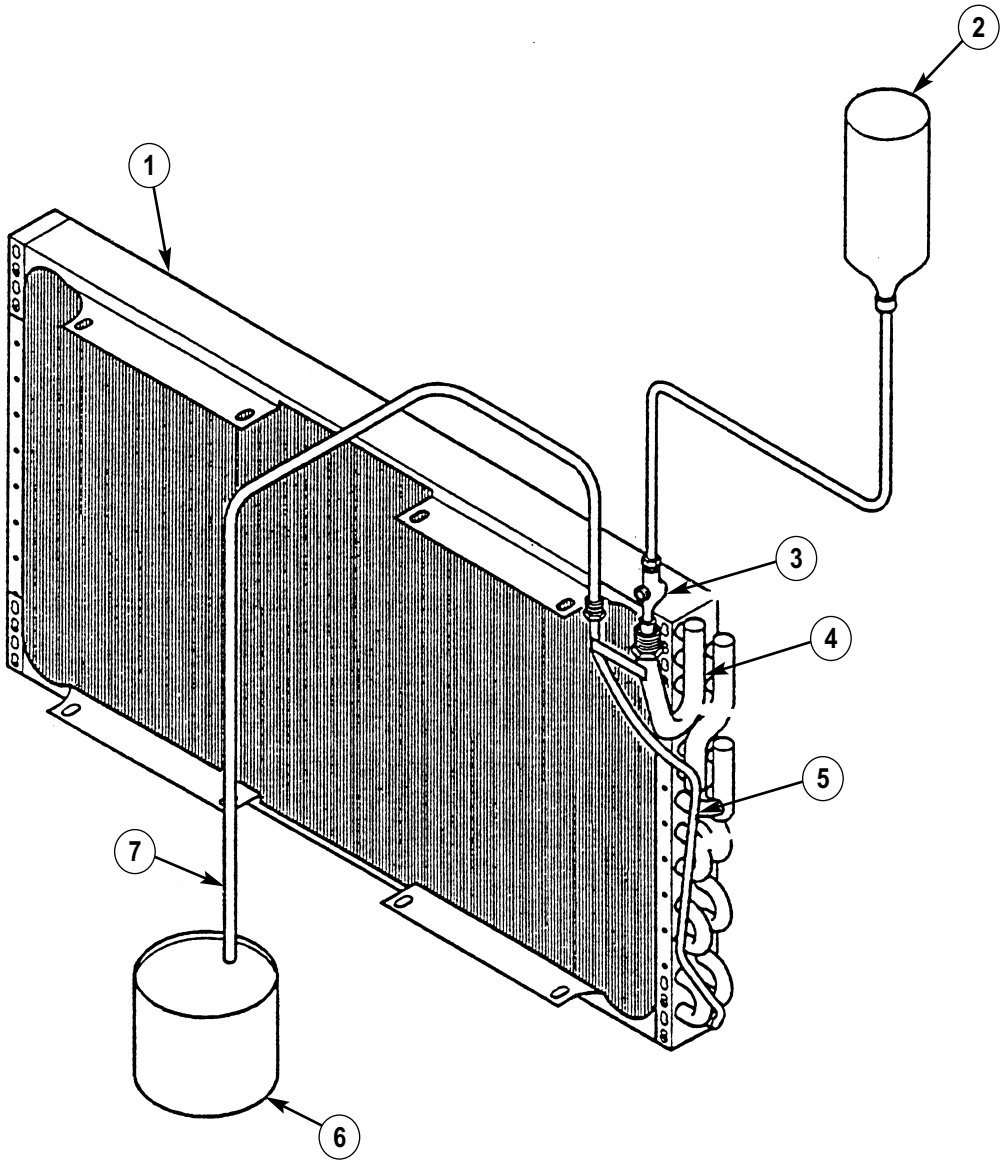
3. Pressurize flushing cylinder (2) with compressed nitrogen to 100 psi (690 kPa).
4. Connect flushing gun (3) to flushing cylinder (2).

**NOTE**

- Perform steps 5 through 7 on condenser, evaporator, and refrigerant lines. Continue flushing until there is no evidence of oil or contaminants.
- Illustration shows flushing of condenser. Procedure is similar for flushing of other components.

5. Insert flushing gun (3) into refrigerant outlet tube (4) of component to be flushed.
6. Connect a rubber hose (7) over inlet (5) of component to be flushed, and place other end of hose (7) in a drain pan (6).
7. Open flushing gun (3) to blow cleaning agent through component.
8. Remove rubber hose (7) from component and plug refrigerant line.
9. Remove flushing gun (3) from component and plug refrigerant line.

## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a) (Cont'd)



## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a) (Cont'd)

**e. Evacuating System**

**CAUTION**

Never attempt to evacuate A/C system if system has not been completely discharged.

1. Discharge A/C system (refer to task c.) and flush A/C system if necessary (refer to task d.).
2. Connect manifold gauge set (3) to service ports (refer to task a.).
3. Connect vacuum pump to center hose (4) on manifold gauge set (3).
4. Turn vacuum pump on and open high-pressure gauge valve (2) and low-pressure gauge valve (1) on manifold gauge set (3).

**NOTE**

High-pressure side gauge should drop to zero or below. If not, a blockage in A/C system is indicated.

5. Evacuate unit until low-pressure gauge reads 29 in. Hg of vacuum.
6. Continue evacuation for forty-five minutes after correct gauge reading of 29 in. Hg of vacuum has been achieved.
7. Turn high-pressure gauge valve (2) and low-pressure gauge valve (1) on manifold gauge set (3) to closed position after evacuation is complete.
8. Turn off vacuum pump and disconnect center hose (4) from vacuum pump.

**NOTE**

Vacuum of 29 in. Hg should be sustained on low-pressure gauge for at least ten minutes. If not, a leak in A/C system is indicated. Identify source of leak and repair as necessary.

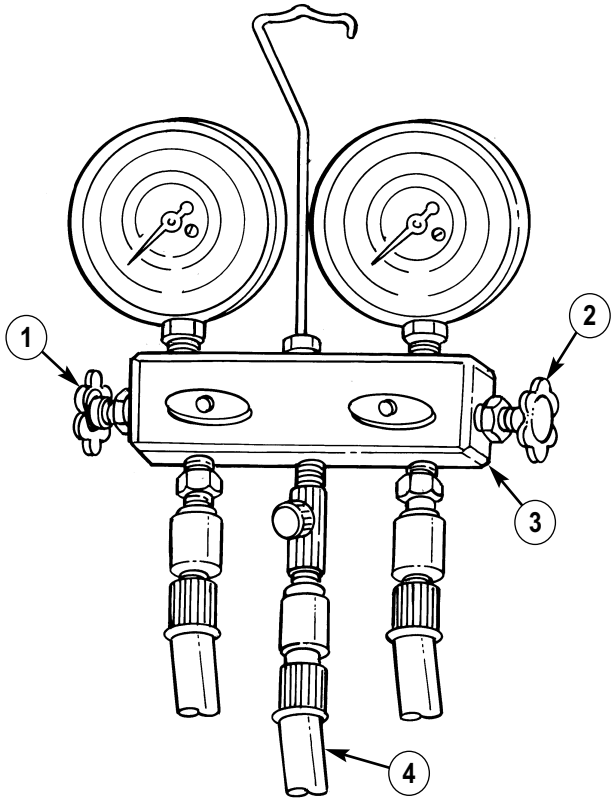
9. Check for leaks ten minutes after gauge valves are turned off.

**NOTE**

Manifold gauge set can remain connected and service valves left in mid-position if charging A/C system will follow immediately.

10. Disconnect manifold gauge set (3) (refer to task b.).

## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a) (Cont'd)



## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a) (Cont'd)

**f. Charging System**

**NOTE**

If A/C system requires replacement of a major component or has been flushed, PAG lubricating oil must be added to system to compensate loss (refer to task g.).

1. Evacuate A/C system (refer to task e.).
2. Connect refrigerant R-134a source to center hose (5) of manifold gauge set (3) or recover and recycle unit.
3. Open refrigerant R-134a source to allow refrigerant to flow into center hose (5).
4. Purge center hose (5), low-pressure hose (6), and high-pressure hose (4) as follows:
   a. Slightly loosen center hose (5) at center port (7) of manifold gauge set (3) until refrigerant escapes, then tighten hose (5).
   b. Open high-pressure gauge valve (2) and low-pressure gauge valve (1) to allow refrigerant to flow into high-pressure hose (4) and low-pressure hose (6).
   c. Purge high-pressure hose (4) and low-pressure hose (6) at service ports on compressor.
   d. Turn high-pressure gauge valve (2) and low-pressure gauge valve (1) clockwise to OFF position.
5. Connect STE/ICE-R (TM 9-2320-280-20) to obtain engine rpm reading.

**WARNING**

Ensure high-pressure gauge valve is in closed position on manifold gauge set during charging. Failure to do so will cause compressor to build pressure in refrigerant container, causing injury to personnel or damage to equipment.

6. Start engine and set engine speed to 1,500 rpm with hand throttle (TM 9-2320-280-10).
7. Turn on A/C system (TM 9-2320-280-10) and set blower fans on high speed.

**NOTE**

Keep refrigerant container upright at all times so refrigerant enters system as a gas.

8. Open low-pressure gauge valve (1) on manifold gauge set (3) until system is fully charged with 2 lb 10 oz of R-134a refrigerant (refer to table 2-2.1).
9. Close low-pressure gauge valve (1) on manifold gauge set (3).
10. Return hand throttle to normal idle (TM 9-2320-280-10).
11. Stop engine (TM 9-2320-280-10).
12. Remove refrigerant R-134a source from center hose (5) of manifold gauge set (3).
13. If no lubricating oil is needed, turn service valve shafts (10) counterclockwise to back-seated position and disconnect manifold gauge hoses (4), (5), and (6) from A/C system service ports (7), (8), and (9). Install caps (11) on service ports. If lubricating oil is needed, perform task g.
14. Turn service valve shafts (10) clockwise to mid-seated position.

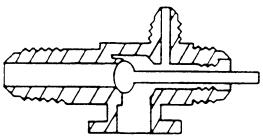
## 14-27.1. AIR-CONDITIONING SYSTEM SERVICING (R-134a) (Cont'd)

### g. Adding Lubricating Oil

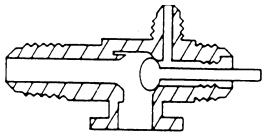
**NOTE**

- It is not necessary to check or add oil as routine maintenance. It is necessary to add oil when the evaporator, condenser, compressor, or receiver/dryer has been replaced or there was an obvious oil leak. When a system is discharged, it is also necessary to replace any oil carried out with the refrigerant.
- Vehicle must be on level ground.
- A new compressor is charged with 6 oz of lubricating oil.

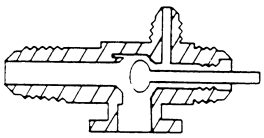
1. If only the compressor is being replaced, drain and measure oil from compressor being replaced. Drain new compressor and add the same amount of PAG lubricating oil as was drained from old compressor.
2. If there is a loss of refrigerant over a period of time and a component is being replaced to correct leak, add lubricating oil to the component being replaced as follows:
   - Condenser - 0.5 oz
   - Receiver/Dryer - 0.5 oz
   - Evaporator - 1.5 oz
3. When the system oil level is unknown, or system performance and efficiency are marginal, drain and flush system and add a new 8-oz charge of PAG lubricating oil to the system.



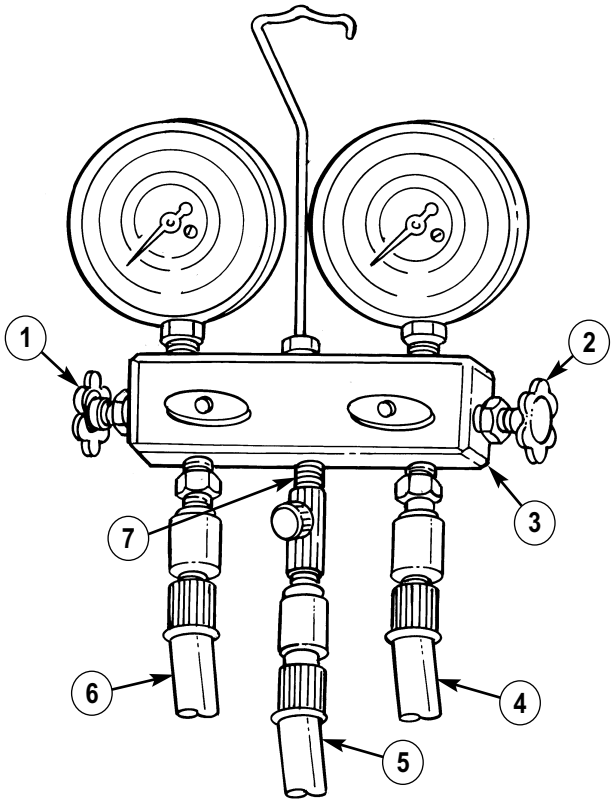
SERVICE VALVE IN FRONT-SEATED POSITION

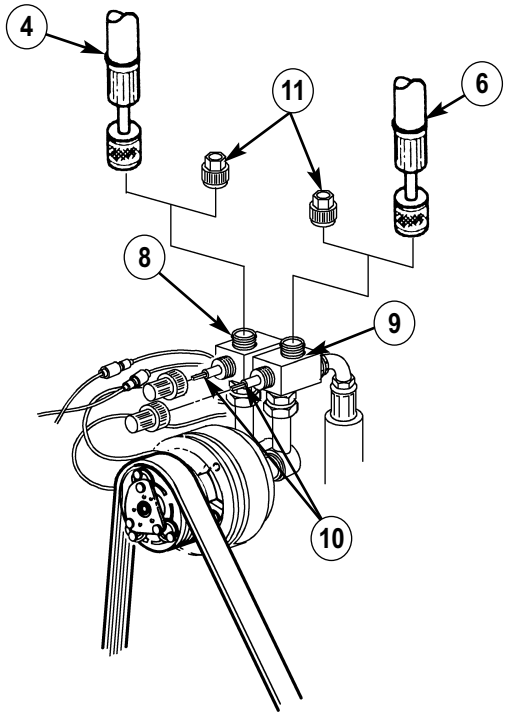


SERVICE VALVE IN BACK-SEATED POSITION



SERVICE VALVE IN MID-SEATED POSITION




FOLLOW-ON TASK: Lower and secure hood (TM 9-2320-280-10).

## 14-27.2. AIR-CONDITIONING PRESSURE LINES REPLACEMENT (R-134a)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Four O-rings (Appendix E, Item 144)
Three tiedown straps (Appendix E, Item 252)
Two tiedown straps (Appendix E, Item 255)
Three lockwashers (Appendix E, Item 120)
Insulation (Appendix B, Item 26)
Lubricating oil (Appendix B, Item 35.2)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-27.1).
- Companion seat removed (TM 9-2320-280-20).
- Air horn hose removed (TM 9-2320-280-20).

**General Safety Instructions**
Air conditioner system must be discharged, prior to replacing components.

**Maintenance Level**
Direct support

**WARNING**

Air conditioner system must be discharged prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Cover or plug all open hoses and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

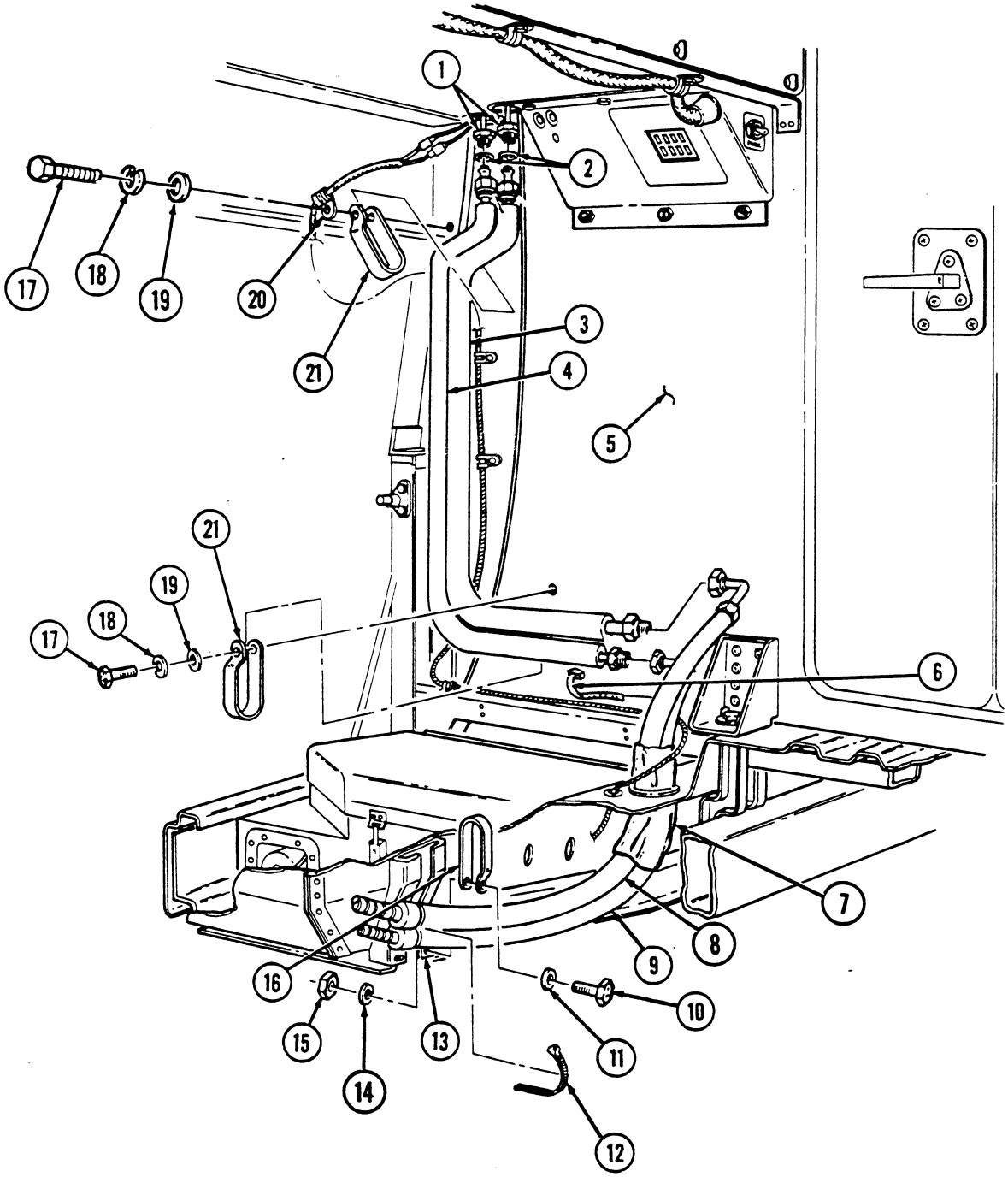
**NOTE**

- All air-conditioning pressure lines are replaced basically the same. This procedure covers the A/C compartment to compressor lines.
- Suction line has a larger diameter than the discharge line, fittings will not interconnect.
- The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-18 for vehicles with R-12 refrigerant.

**a. Removal**

1. Remove two capscrews (17), lockwashers (18), washers (19), harness bracket (20), clamps (21), suction line (3), and discharge line (4) from body (5). Remove clamps (21) from suction line (3) and discharge line (4). Discard lockwashers (18).
2. Disconnect suction line (3) and discharge line (4) from fittings (1). Remove and discard two O-rings (2).
3. Remove three tiedown straps (6) and slide insulation (7) on suction line (3) and discharge line (4) away from suction hose (8) and discharge hose (9). Disconnect and remove suction line (3) and discharge line (4) from suction hose (8) and discharge hose (9). Discard tiedown straps (6).
4. Remove nut (15), lockwasher (14), washer (11), capscrew (10), clamp (16), suction hose (8), and discharge hose (9) from underside of body (13). Remove two tiedown straps (12) securing suction hose (8) and discharge hose (9) together. Remove clamp (16) from suction hose (8) and discharge hose (9). Discard lockwasher (14) and tiedown straps (12).
5. Remove and discard insulation (7) from suction hose (8) and discharge hose (9).

## 14-27.2. AIR-CONDITIONING PRESSURE LINES REPLACEMENT (R-134a) (Cont'd)

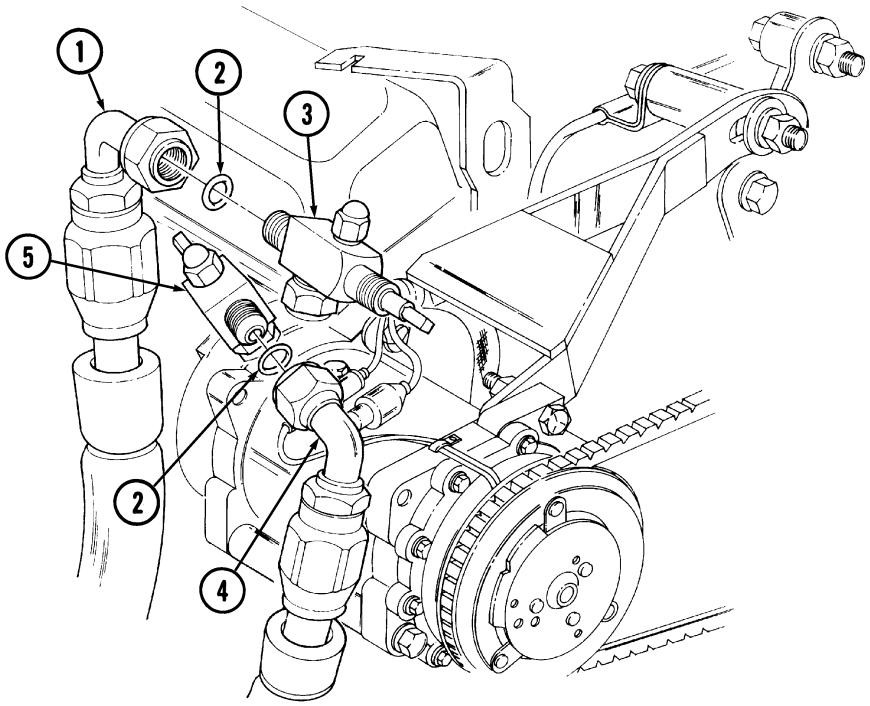


## 14-27.2. AIR-CONDITIONING PRESSURE LINES REPLACEMENT (R-134a) (Cont'd)

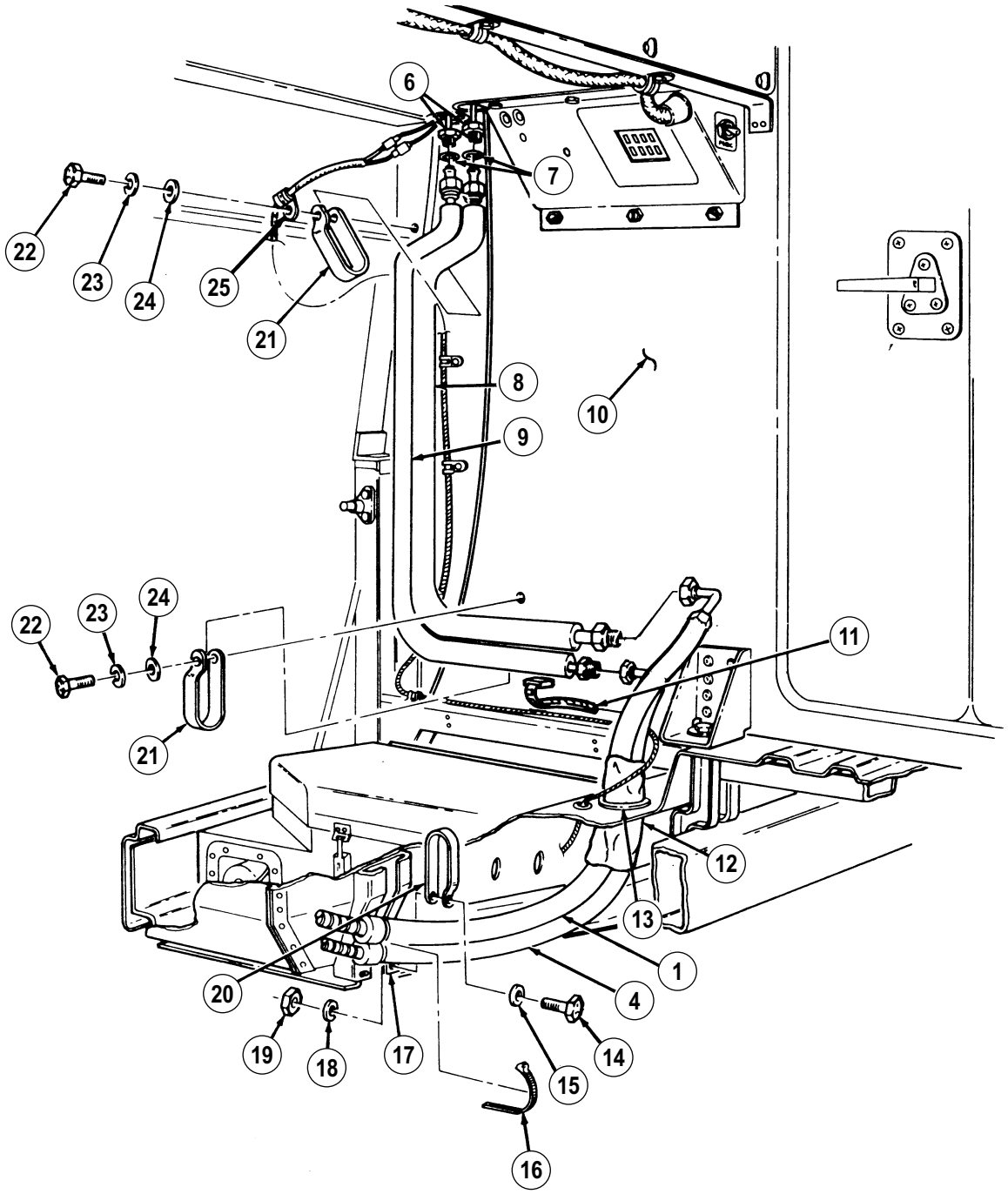
6. Disconnect suction hose (1) and discharge hose (4) from compressor service valve (3) and service valve (5) and remove suction hose (1) and discharge hose (4) from vehicle. Remove and discard two O-rings (2).

**b. Installation**

1. Using old pressure lines as a positioning template, install insulation (12) to suction hose (1) and discharge hose (4).
2. Install suction hose (1) and discharge hose (4) through grommet (13) and into crew compartment ensuring that insulation (12) is positioned to prevent chafing of hoses against grommet (13).
3. Lubricate two O-rings (2) with lubricating oil and install O-rings (2) on suction hose (1) and discharge hose (4) and connect to compression service valve (3) and service valve (5).
4. Lubricate two O-rings (7) with lubricating oil and install O-rings (7) on fittings (6). Install and tighten suction line (8) on fitting (6) to 33 lb-ft (45 N•m). Install and tighten discharge line (9) on fitting (6) to 20 lb-ft (27 N•m).
5. Connect discharge line (9) to discharge hose (4) and tighten to 30 lb-ft (41 N•m). Connect suction line (8) to suction hose (1) and tighten to 45 lb-ft (61 N•m).
6. Slide insulation (12) on discharge line (9) towards discharge hose (4) and install three tiedown straps (11).
7. Install clamp (20) on suction hose (1) and discharge hose (4) on underside of body (17) with capscrew (14), washer (15), lockwasher (18), and nut (19). Secure suction hose (1) and discharge hose (4) together with two tiedown straps (16).
8. Install two clamps (21) and harness clamp (25) on suction line (8) and discharge line (9) on body (10) with washers (24), lockwashers (23), and capscrews (22).



## 14-27.2. AIR-CONDITIONING PRESSURE LINES REPLACEMENT (R-134a) (Cont'd)




FOLLOW-ON TASKS:
- Install companion seat (TM 9-2320-280-20).
- Install air horn (TM 9-2320-280-20).
- Evacuate and charge air-conditioning system (para. 14-27.1).

## 14-27.3. DRYER BOTTLE REPLACEMENT (R-134a)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two O-rings (Appendix E, Item 132)
Lubricating oil (Appendix B, Item 35.2)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-27.1).
- Evaporator blower housing opened (TM 9-2320-280-20).

**General Safety Instructions**
Air conditioner system must be discharged prior to replacing components.

**Maintenance Level**
Direct support

**WARNING**

Air conditioner system must be discharged prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Cover or plug all open lines and connections immediately after removal to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-19 for vehicles with R-12 refrigerant.

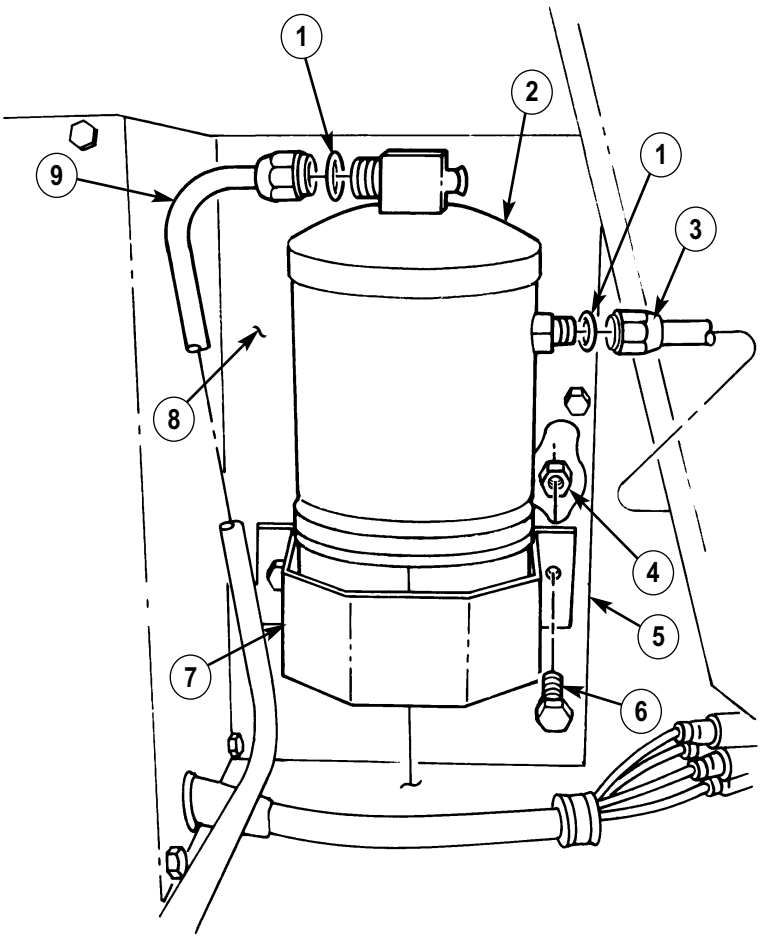
### a. Removal

1. Remove lines (9) and (3) and two O-rings (1) from dryer bottle (2). Discard O-rings (1).
2. Peel away insulation (5) from panel (8) and loosen nut (4) and capscrew (6) on right side of bracket (7).
3. Remove dryer bottle (2) from bracket (7).

### b. Installation

1. Install dryer bottle (2) in bracket (7).
2. Lubricate two O-rings (1) with lubricating oil and install O-rings (1) and lines (9) and (3) on dryer bottle (2).
3. Tighten nut (4) and capscrew (6) on dryer bottle bracket (7).
4. Install insulation (5) on panel (8).

## 14-27.3. DRYER BOTTLE REPLACEMENT (R-134a) (Cont'd)




FOLLOW-ON TASKS:
- Close evaporator blower housing (TM 9-2320-280-20).
- Evacuate and charge air-conditioning system (para. 14-17.1).

## 14-27.4. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-134a)

**This task covers:**

**a. Removal**
**b. Disassembly**
**c. Assembly**
**d. Installation**

### INITIAL SETUP

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Two O-rings (Appendix E, Item 133)
O-ring (Appendix E, Item 132)
O-ring (Appendix E, Item 131)
O-ring (Appendix E, Item 143)
Nonmetallic seal (Appendix E, Item 215)
Lubricating oil (Appendix B, Item 35.2)

**Manual References**
TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-27.1).
- Evaporator blower motor housing removed (TM 9-2320-280-20).

**General Safety Instructions**
Air-conditioner system must be discharged, prior to replacing components.

**Maintenance Level**
Direct support

**WARNING**

Air conditioner system must be discharged, prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Cover or plug all open hoses and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-20 for vehicles with R-12 refrigerant.

### a. Removal

1. Disconnect tube assembly (10) from sight glass line (8). Remove and discard O-ring (9).
2. Disconnect low-pressure line (12) from evaporator outlet line (15). Remove and discard O-ring (13).

**NOTE**

Prior to removal, tag leads for installation.

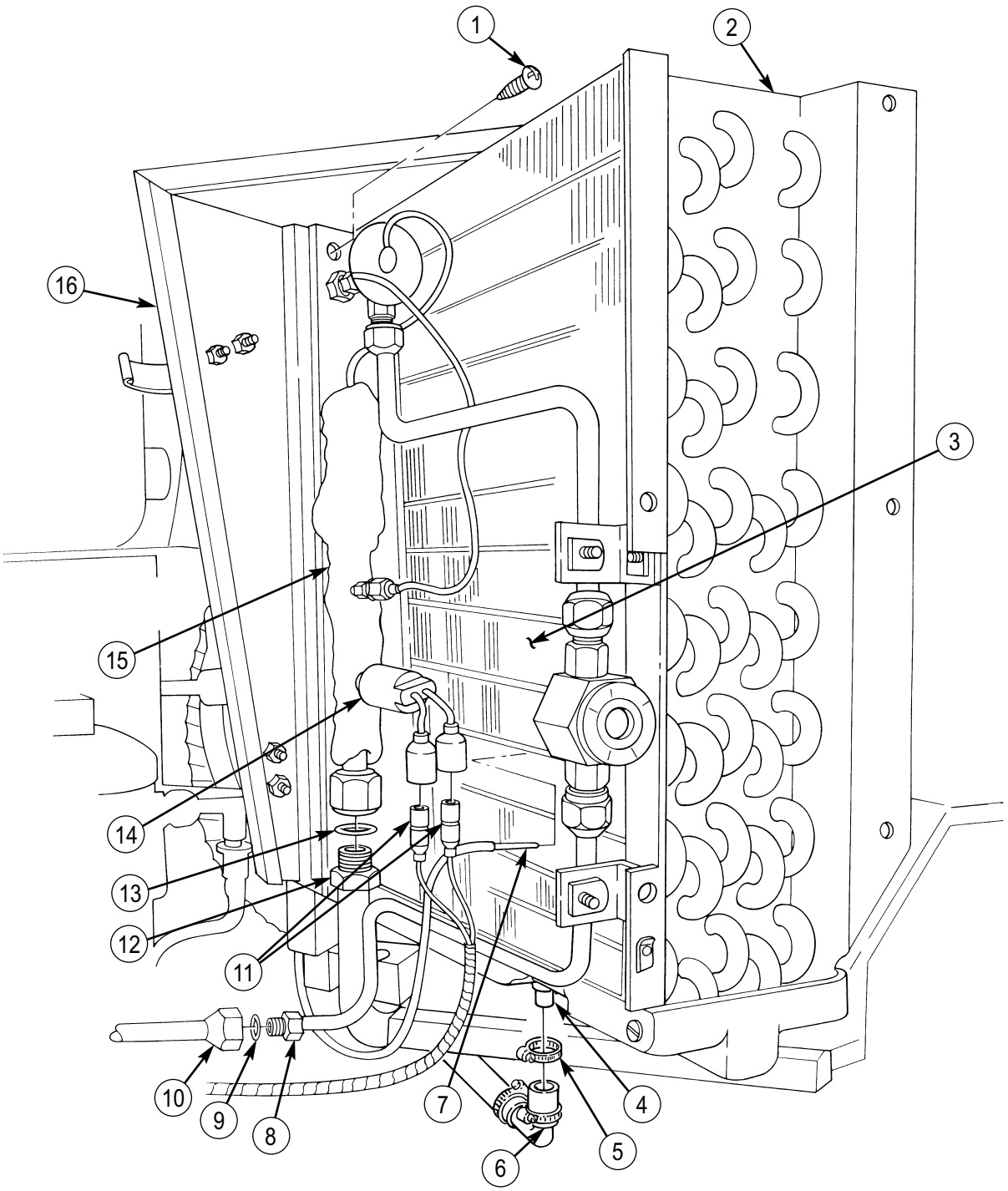
3. Disconnect two wires (11) from low-pressure switch (14).

**CAUTION**

- Avoid kinking or excessive bending of cold control probe during removal.
- Evaporator coil and evaporator duct clearances are tight, avoid forcing or twisting during removal.

4. Remove cold control probe (7) from coils (3) and position probe (7) away from evaporator (2).
5. Loosen clamp (5) and disconnect drain tube (6) from drain pan (4).
6. Remove five screws (1) and evaporator (2) from evaporator duct (16).

## 14-27.4. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-134a) (Cont'd)



## 14-27.4. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-134a) (Cont'd)

### b. Disassembly

1. Remove low-pressure switch (23) from outlet line (25).
2. Remove two capscrews (8), nuts (11), clamps (9), and pressure lines (7) and (14) from brackets (12).
3. Disconnect pressure lines (14) and (7) from sight glass (16) and remove sight glass (16), pressure line (14), and two O-rings (15). Discard O-rings (15).
4. Disconnect pressure line (7) from expansion valve (4). Remove and discard O-ring (6).
5. Remove two capscrews (20), nuts (13), brackets (12), and spacers (10) from evaporator (2).
6. Disconnect expansion valve line (5) from outlet line (25). Remove and discard O-ring (19).
7. Remove nonmetallic seal (24) from evaporator outlet line (25) and expansion valve control tube (18). Discard nonmetallic seal (24).
8. Loosen clamp (17) securing control tube (18) to evaporator outlet line (25).
9. Disconnect expansion valve (4) from evaporator inlet line (1) and remove expansion valve (4) and O-ring (3). Discard O-ring (3).
10. Remove two screws (22) and drain pan (21) from evaporator (2) .
11. Inspect evaporator (2), expansion valve (4), pressure lines (7), (14), and (5), sight glass (16), and low-pressure switch (23) for stripped threads, cracks, evidence of leakage, and damage. Replace sight glass (16) and any other component if cracked, damaged, threads are stripped, or leakage is evident.

### c. Assembly

1. Install drain pan (21) on evaporator (2) with two screws (22).

**CAUTION**

- To prevent damage to control line tube during installation of expansion valve, avoid excessive bending or kinking of expansion valve control tube.
- Avoid over tightening of expansion valve control tube retaining clamp.

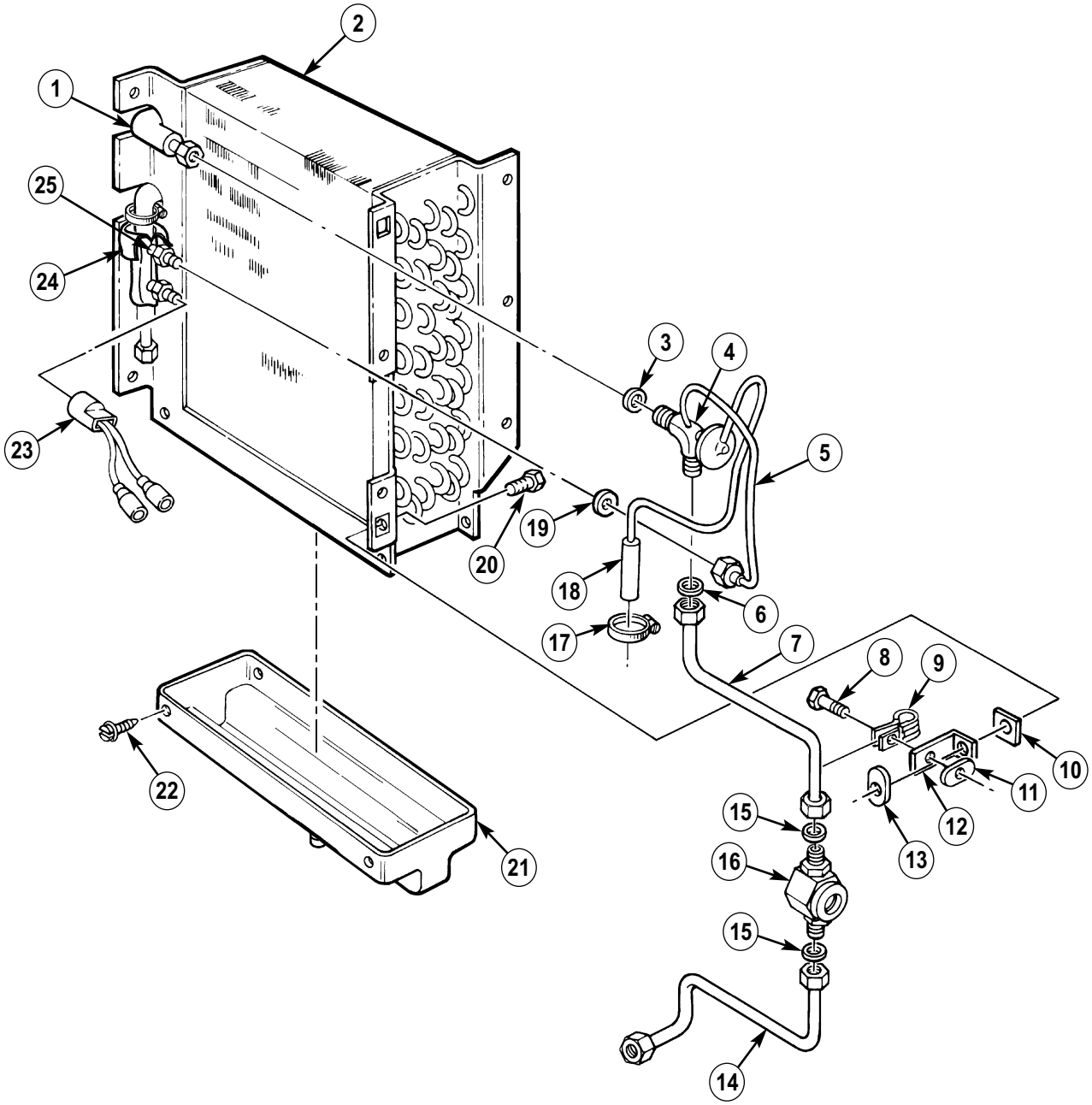
2. Lubricate O-ring (3) with lubricating oil, install O-ring (3) and connect expansion valve (4) on evaporator inlet line (1).
3. Lubricate O-ring (19) with lubricating oil, install O-ring (19) and connect expansion valve line (5) on outlet line (25).
4. Install control tube (18) on outlet line (25) with clamp (17). Do not overtighten.
5. Install low pressure switch (23) on outlet line (25).
6. Insulate control tube (18), evaporator inlet line (1), and outlet line (25) with nonmetallic seal (24).
7. Install two brackets (12) and spacers (10) on evaporator (2) with two capscrews (20) and nuts (13).
8. Lubricate O-ring (6) with lubricating oil, install O-ring (6) and connect pressure line (7) on expansion valve (4).

**NOTE**

Sight glass must face away from outlet line.

9. Lubricate two O-rings (15) with lubricating oil, install two O-rings (15) and connect pressure lines (7) and (14) on sight glass (16).
10. Install two clamps (9) and pressure lines (7) and (14) on bracket (12) with two capscrews (8) and nuts (11).

## 14-27.4. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-134a) (Cont'd)



## 14-27.4. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-134a) (Cont'd)

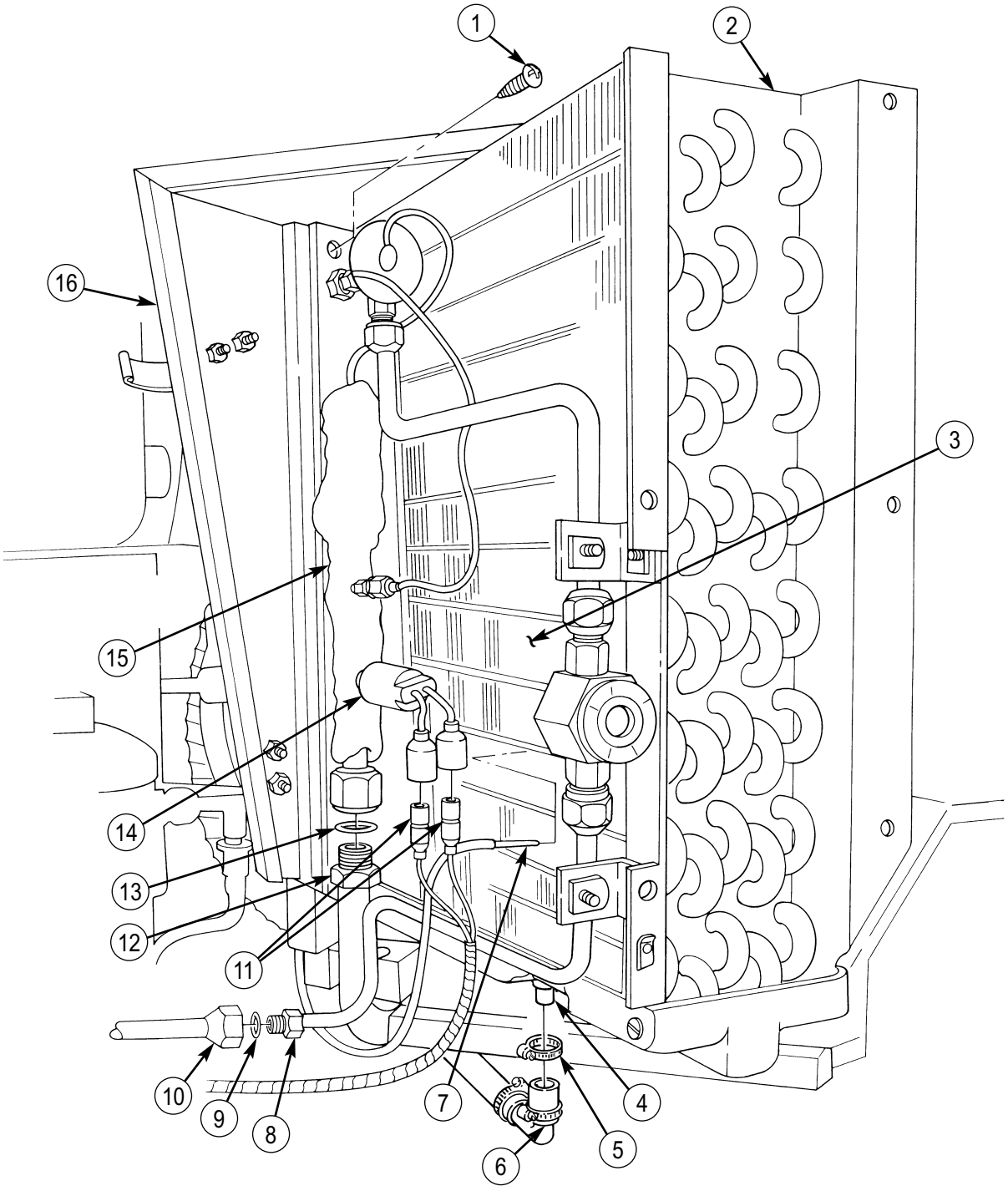
**d. Installation**

**CAUTION**

- Evaporator and evaporator duct clearances are tight, avoid forcing or twisting evaporator during installation.
- Avoid kinking or excessive bending of cold control probe during installation.

1. Install evaporator (2) on evaporator duct (16) with five screws (1).
2. Connect drain tube (6) to drain pan (4) with clamp (5).
3. Install cold control probe (7) into coils (3) a minimum depth of 3 in. (7.62 cm).
4. Connect two wires (11) to low-pressure switch (14).
5. Lubricate O-ring (13) with lubricating oil, install O-ring (13) and connect low pressure line (12) to outlet line (15).
6. Lubricate O-ring (9) with lubricating oil, install O-ring (9) and connect high pressure line (10) to sight glass line (8).

## 14-27.4. AIR-CONDITIONING EVAPORATOR MAINTENANCE (R-134a) (Cont'd)




FOLLOW-ON TASKS:
- Install evaporator blower motor housing (TM 9-2320-280-20).
- Evacuate and charge air-conditioning system (para. 14-27.1).
- Check operation of air conditioning system (TM 9-2320-280-10).

## 14-27.5. EXPANSION VALVE REPLACEMENT (R-134a)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Nonmetallic seal (Appendix E, Item 215)
O-ring (Appendix E, Item 133)
O-ring (Appendix E, Item 131)
O-ring (Appendix E, Item 132)
Lubricating oil (Appendix B, Item 35.2)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-27.1).
- Evaporator blower housing opened (TM 9-2320-280-20).

**General Safety Instructions**
Air conditioner system must be discharged, prior to replacing components.

**Maintenance Level**
Direct support

### a. Removal

**WARNING**

Air conditioner system must be discharged, prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Cover or plug all open hoses and connections immediately after disconnection to prevent contamination. Remove all plugs prior to connection.

**NOTE**

The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-21 for vehicles with R-12 refrigerant.

1. Remove moisture seal (9) from evaporator outlet tube (11) and control tube (12).
2. Loosen clamp (10) and slide control tube (12) from clamp (10).
3. Remove expansion valve pressure tube (6) and O-ring (7) from outlet tube (8). Discard O-ring (7).
4. Remove expansion valve (3) and O-ring (4) from lower tube (5). Discard O-ring (4).
5. Remove expansion valve (3) and O-ring (2) from inlet tube (1). Discard O-ring (2).

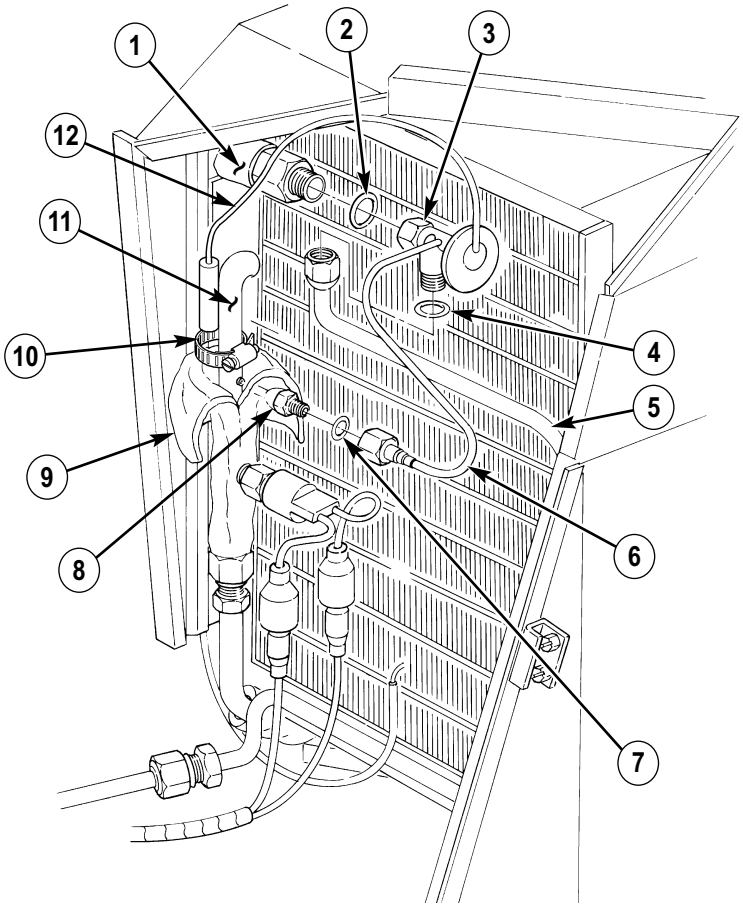
## 14-27.5. EXPANSION VALVE REPLACEMENT (R-134a) (Cont'd)

**b. Installation**

**CAUTION**

- During installation of expansion valve, avoid excessive bending or kinking of control tube and pressure tube.
- Avoid overtightening of clamp securing expansion valve control tube to outlet tube.

1. Lubricate all O-rings with lubricating oil at installation.
2. Install O-ring (2) and expansion valve (3) on inlet tube (1).
3. Install O-ring (4) and lower tube (5) on expansion valve (3).
4. Install O-ring (7) and expansion valve pressure tube (6) on outlet tube (8).
5. Slide control tube (12) in clamp (10) and tighten clamp (10).
6. Install moisture seal (9) around evaporator outlet tube (11) and control tube (12).




FOLLOW-ON TASKS:
- Close evaporator blower housing (TM 9-2320-280-20).
- Evacuate and charge air-conditioning system (para. 14-27.1).

## 14-27.6. EVAPORATOR DUCT REPLACEMENT (R-134a)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Push-on nut (Appendix E, Item 122)
Four locknuts (Appendix E, Item 65)
Seven lockwashers (Appendix E, Item 94)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Air-conditioning evaporator removed (para. 14-27.4).

**Maintenance Level**
Direct support

**NOTE**

The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-22 for vehicles with R-12 refrigerant.

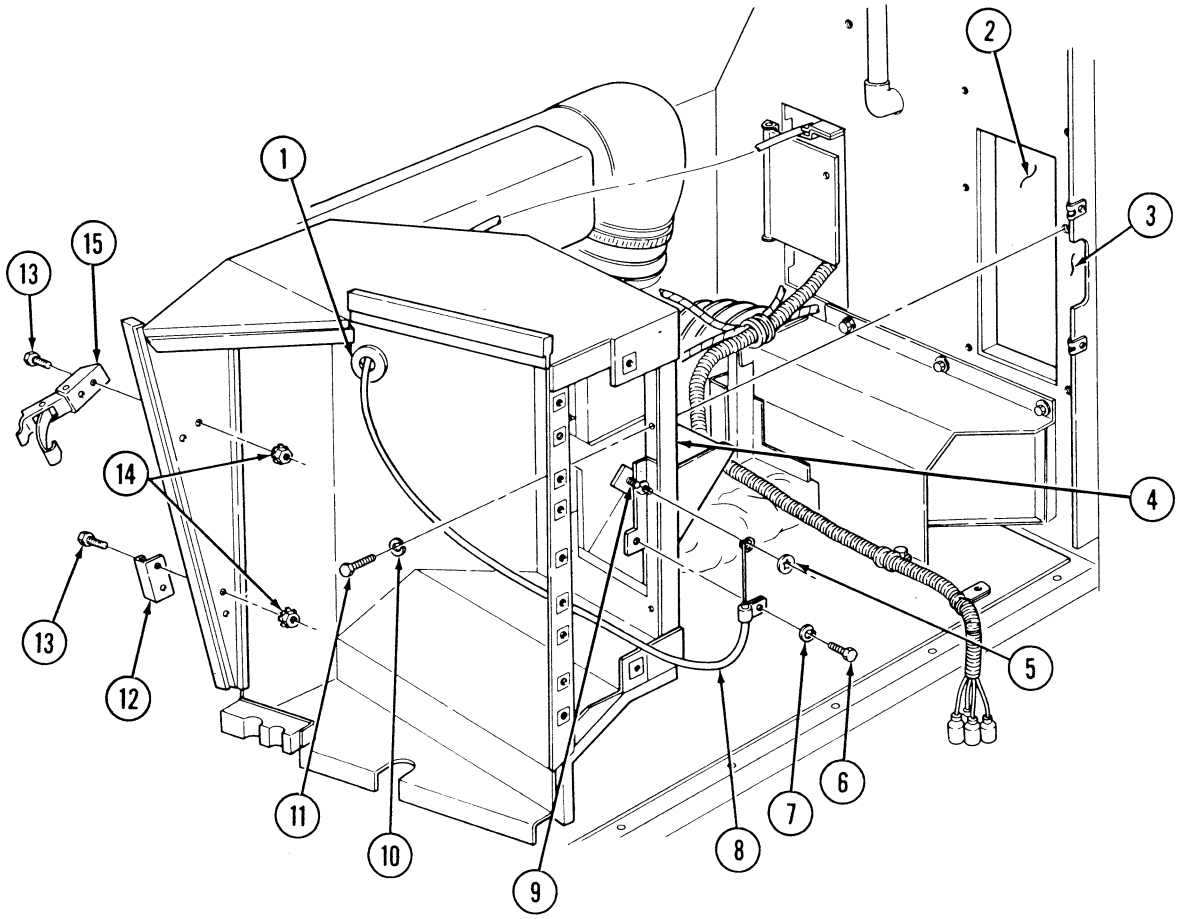
### a. Removal

1. Remove screw (6), lockwasher (7), and control cable (8) from evaporator duct (4). Discard lockwasher (7).
2. Remove push-on nut (5) and control cable (8) from duct door pin (9). Discard push-on nut (5).
3. Remove six capscrews (11), lockwashers (10), and duct (4) from body (3). Discard lockwashers (10).
4. Pull evaporator duct (4) and insulation away from heater duct (2) and slide control cable (8) through grommet (1).
5. Remove four locknuts (14), screws (13), latch catch (12), and latch (15) from evaporator duct (4). Discard locknuts (14).
6. Inspect insulation for damage. Replace insulation (TM 9-2320-280-20) only if damaged.

### b. Installation

1. Install latch (15) and latch catch (12) on evaporator duct (4) with four screws (13) and locknuts (14).
2. Install control cable (8) through grommet (1) in evaporator duct (4).
3. Install evaporator duct (4) on body (3) with six lockwashers (10) and capscrews (11).
4. Connect control cable (8) on duct door pin (9) with push-on nut (5).
5. Install control cable (8) on evaporator duct (4) with lockwasher (7) and screw (6).

## 14-27.6. EVAPORATOR DUCT REPLACEMENT (R-134a) (Cont'd)




FOLLOW-ON TASKS: • Install air-conditioning evaporator (para. 14-27.4).
• Adjust heater/air-conditioning outlet cable (TM 9-2320-280-20).

## 14-27.7. CONDENSER ASSEMBLY REPLACEMENT (R-134a)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
O-ring (Appendix E, Item 132)
Ten lockwashers (Appendix E, Item 94)
Lubricating oil (Appendix B, Item 35.2)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Intake and exhaust grilles removed (TM 9-2320-280-20).
- Condenser fans removed (TM 9-2320-280-20).
- Dryer bottle removed (para. 14-27.3).

**Maintenance Level**
Direct support

**NOTE**

The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-23 for vehicles with R-12 refrigerant.

### a. Removal

1. Remove eight screws (1) securing dryer bottle mounting panel (2) to fan support bracket (13) and condenser housing (3).
2. Remove eight capscrews (10) and lockwashers (11) securing dryer bottle mounting panel (2) and fan bracket (13) to body (12). Discard lockwashers (11).
3. Remove two nuts (7), lockwashers (8), and capscrews (9). Discard lockwashers (8).
4. Remove nut (14), washer (15), and clamp (16) from screw (17) and slide wiring harness (18) to side.
5. Turn fan support bracket (13) to allow removal through front intake grille opening. Remove fan bracket (13).
6. Disconnect compressor line (6) from condenser (4). Remove and discard O-ring (5).
7. Remove six screws (19) and condenser (4) from condenser housing (3).

**CAUTION**

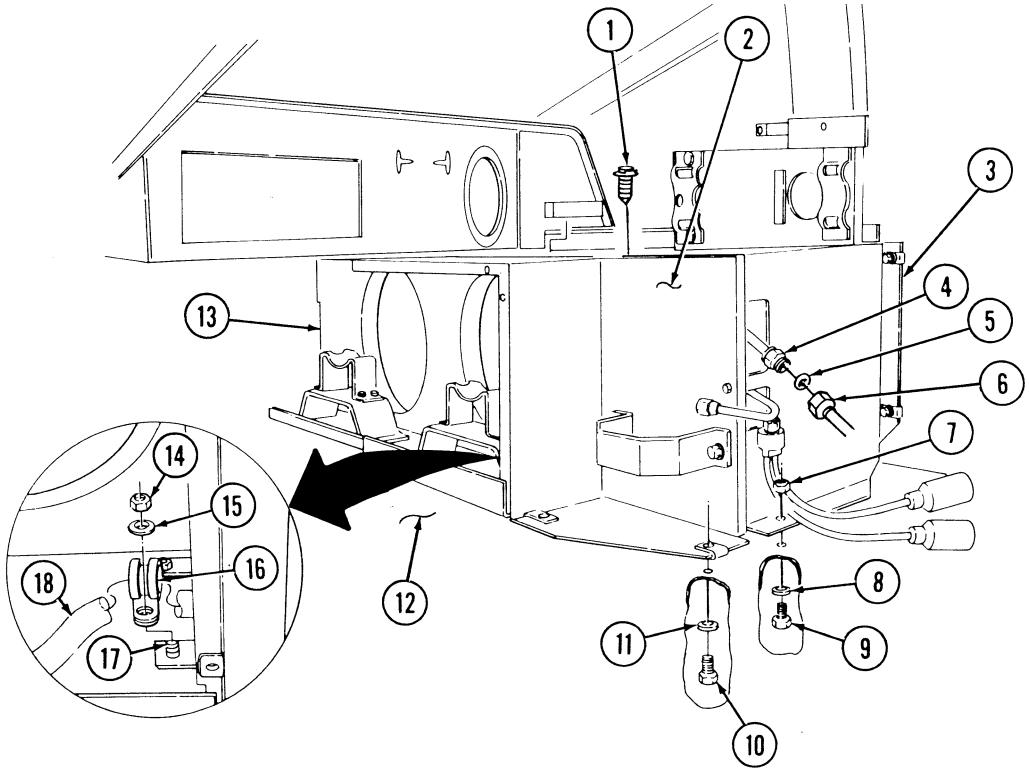
Slowly remove condenser to avoid damage to the cooling fins.
Failure to do this will result in damage to equipment.

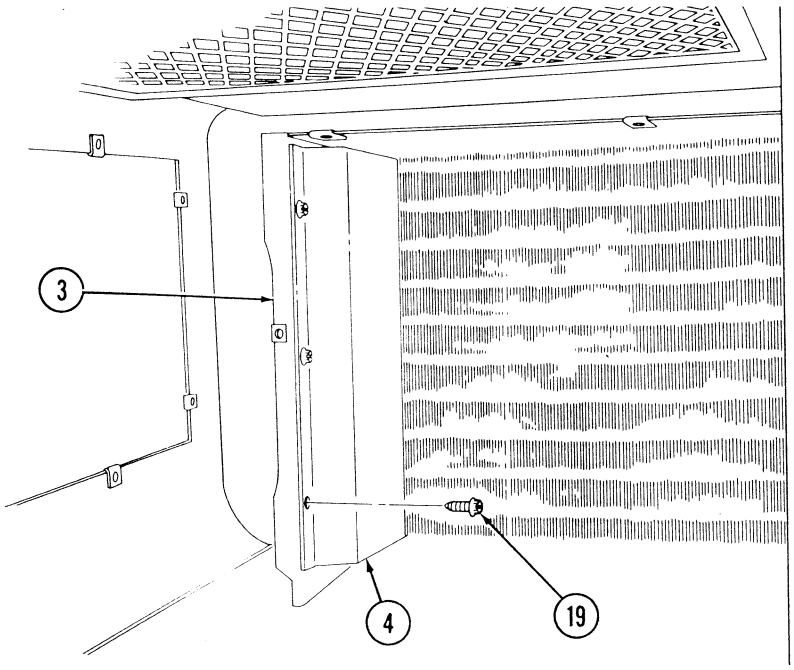
8. Remove condenser (4) through condenser blower housing opening into driver's compartment.

### b. Installation

1. Install condenser (4) on condenser housing (3) with six screws (19).
2. Lubricate O-ring (5) with lubricating oil and install O-ring (5) in compressor line (6). Connect compressor line (6) to condenser (4).
3. Install fan support bracket (13) on body (12) with two capscrews (9), lockwashers (8), and nuts (7).
4. Install eight lockwashers (11) and capscrews (10) securing fan support bracket (13) and dryer panel mounting panel (2) to body (12).
5. Install body wiring harness (18) and clamp (16) on screw (17) with washer (15) and nut (14).
6. Install dryer bottle mounting panel (2) on condenser housing (3) and support bracket (13) with eight screws (1).

## 14-27.7. CONDENSER ASSEMBLY REPLACEMENT (R-134a) (Cont'd)




FOLLOW-ON TASKS:
- Install dryer bottle (para. 14-27.3).
- Install condenser fans (TM 9-2320-280-20).
- Install intake and exhaust grilles (TM 9-2320-280-20).

## 14-27.8. AIR-CONDITIONING COMPRESSOR REPLACEMENT (R-134a)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Three lockwashers (Appendix E, Item 92)
Two lockwashers (Appendix E, Item 91)
Two O-rings (Appendix E, Item 144)
Lubricating oil (Appendix B, Item 35.2)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-27.1) (compressor replacement only).
- Right splash shield removed (TM 9-2320-280-20).
- Air filter to air horn hose removed (TM 9-2320-280-20).
- Disconnect battery ground cable (TM 9-2320-280-20).

**General Safety Instructions**
Air-conditioning system must be discharged, prior to replacing components.

**Maintenance Level**
Direct support

### a. Removal

**WARNING**

Air conditioning system must be discharged, prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**CAUTION**

Ensure valve holes in compressor and service valves are immediately capped after service valve removal. Failure to do so may cause damage to compressor.

**NOTE**

The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-24 for vehicles with R-12 refrigerant.

1. Remove two caps (15) from service valves (2) and turn service valve shafts (3) clockwise to front-seated position.
2. Disconnect two A/C clutch leads (1) from harness leads (16).

**CAUTION**

Cover or plug all open lines and connections immediately after removal to prevent contamination. Remove all plugs prior to connection.

3. Remove service valves (2) and O-rings (4) from compressor manifold (7). Discard O-rings (4).
4. Remove serpentine belt (TM 9-2320-280-20).
5. Remove screw (13), lockwasher (9), washer (14), and spacer (5) from A/C compressor (10) and rear mounting bracket (6). Discard lockwasher (9).
6. Remove two nuts (8), lockwashers (9), screws (12), and A/C compressor (10) from idler pulley bracket (11). Discard lockwashers (9).

**NOTE**

Perform step 7 to remove idler pulley bracket.

7. Remove remaining three screws (12), two lockwashers (9), and idler pulley bracket (11). Discard lockwashers (9).

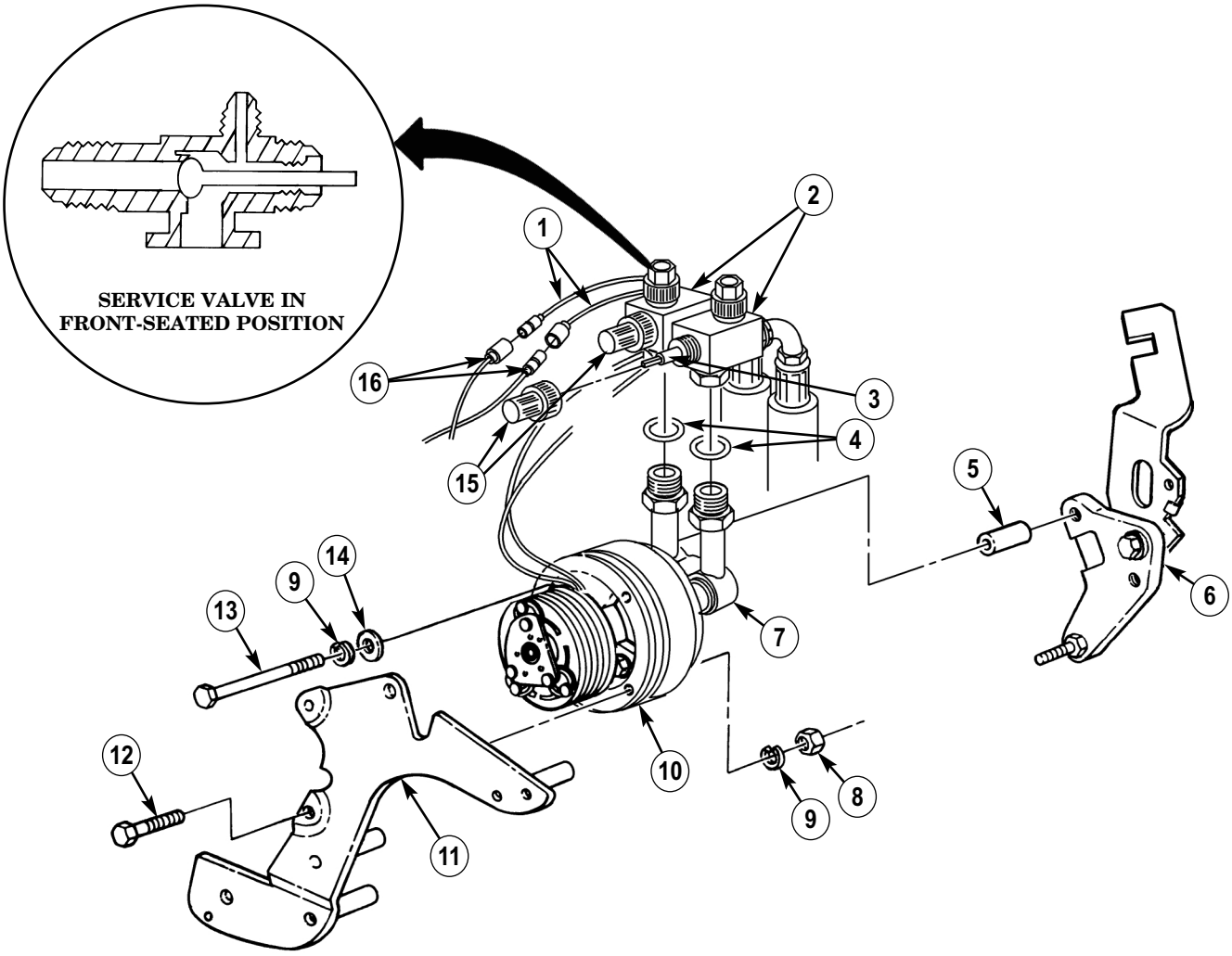
## 14-27.8. AIR-CONDITIONING COMPRESSOR REPLACEMENT (R-134a) (Cont'd)

**b. Installation**

**NOTE**

Perform step 1 to install idler pulley bracket only.

1. Install idler pulley bracket (11) on engine with two lockwashers (9) and three screws (12).
2. Install A/C compressor (10) on idler pulley bracket (11) with two screws (12), lockwashers (9), and nuts (8).
3. Install spacer (5) between rear mounting bracket (6) and A/C compressor (10) with washer (14), lockwasher (9), and screw (13).
4. Install serpentine belt (TM 9-2320-280-20).
5. Lubricate two O-rings (4) with lubricating oil and install service valves (2) on compressor manifold (7).
6. Connect two harness leads (16) to A/C clutch leads (1).
7. Install two caps (15) on service valves (2) and return to original position.




FOLLOW-ON TASKS:
- Install air filter to air horn hose (TM 9-2320-280-20).
- Connect battery ground cable (TM 9-2320-280-20).
- Evacuate and charge air-conditioning system (para. 14-27.1).
- Install right splash shield (TM 9-2320-280-20).

## 14-27.9. AIR-CONDITIONING SERVICE VALVE REPLACEMENT (R-134a)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Four O-rings (Appendix E, Item 144)
Lubricating oil (Appendix B, Item 35.2)
Tiedown strap (Appendix E, Item 252)
Seal washer (Appendix E, Item 261)
Seal washer (Appendix E, Item 262)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning system discharged (para. 14-27.1).
- Air horn to air cleaner hose removed (TM 9-2320-280-20).

**General Safety Instructions**
Air conditioner system must be discharged, prior to replacing components.

**Maintenance Level**
Direct support

**WARNING**

Air conditioner system must be discharged, prior to replacing components in vapor system. Failure to do this may result in injury to personnel or damage to equipment.

**NOTE**

- Suction (low pressure) and discharge (high pressure) service valves are replaced basically the same. This procedure covers the suction service valve.
- The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-25 for vehicles with R-12 refrigerant.

### a. Removal

1. Remove tiedown strap (12) from harness leads (10) and high-pressure line (13). Disconnect compressor clutch leads (11) from harness leads (10). Discard tiedown strap (12).

**CAUTION**

Cover or plug all open lines and connections immediately after removal to prevent contamination. Remove all plugs prior to connection.

2. Remove high-pressure line (13) and low-pressure line (1) from service valves (3). Remove and discard two O-rings (2).
3. Loosen two nuts (4) on service valves (3) and remove service valves (3) and O-rings (6) from compressor manifold (7). Discard O-rings (6).
4. Remove screw (5), compressor manifold (7), and two seal washers (9) from A/C compressor (8). Discard seal washers (9).

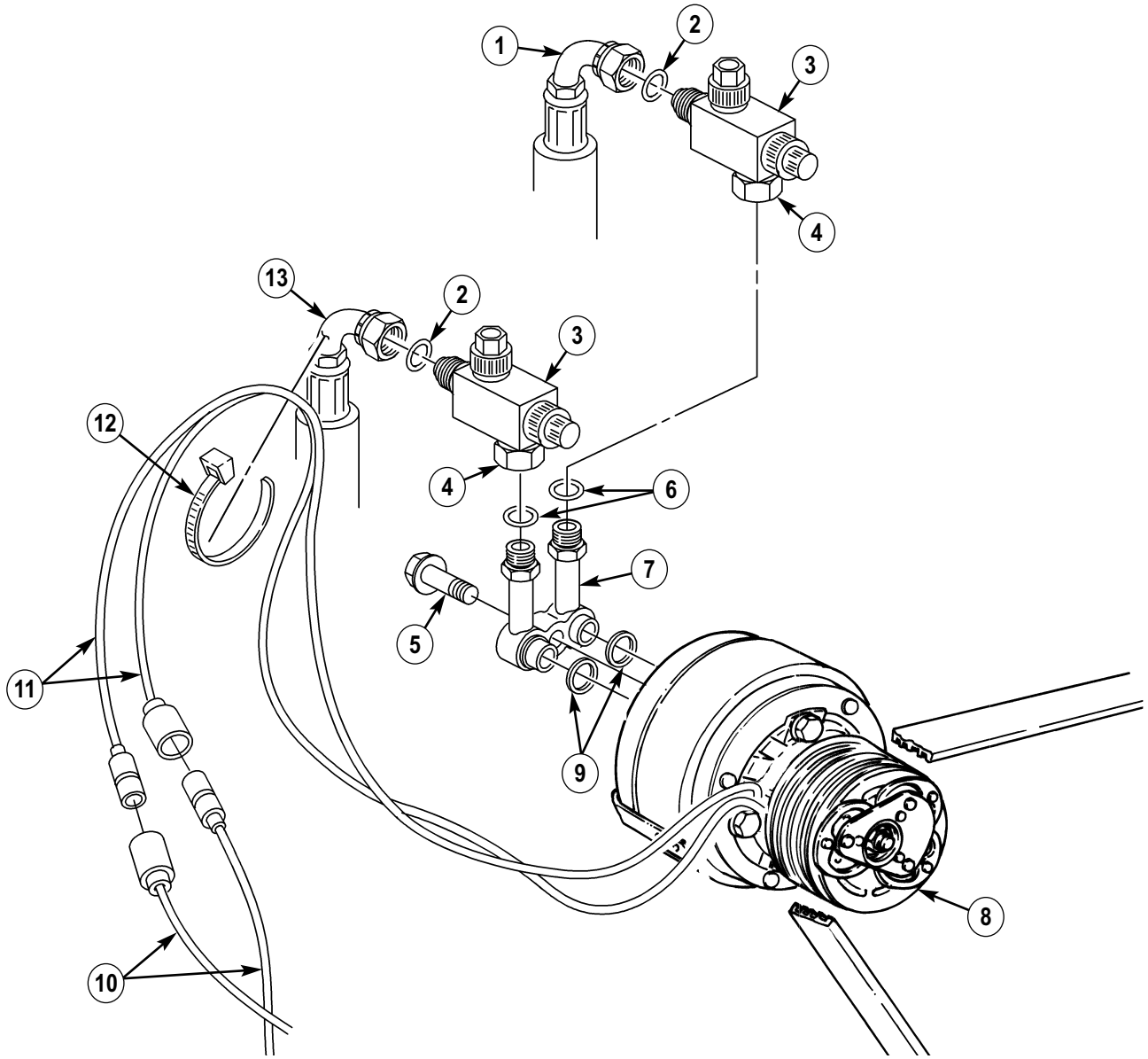
## 14-27.9. AIR-CONDITIONING SERVICE VALVE REPLACEMENT (R-134a) (Cont'd)

**b. Installation**

**NOTE**

Apply lubricating oil to O-rings and seal washers before installation.

1. Install compressor manifold (7) on A/C compressor (8) with two seal washers (9) and screw (5).
2. Install two O-rings (6) and service valves (3) on compressor manifold (7) and tighten nuts (4).
3. Install two O-rings (2), low-pressure line (1), and high-pressure line (13) on service valves (3).
4. Connect harness leads (10) to A/C compressor clutch leads (11) and install harness leads (10) on high-pressure line (13) with tiedown strap (12).




FOLLOW-ON TASKS:
- Install air horn to air cleaner hose (TM 9-2320-280-20).
- Evacuate and charge air-conditioning system (para. 14-27.1).

# 14-27.10. COMPRESSOR MOUNTING AND AIR HORN BRACKET REPLACEMENT (R-134a)

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Air-conditioning compressor removed (para. 14-27.8).
- Air horn removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**NOTE**

The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-26 for vehicles with R-12 refrigerant.

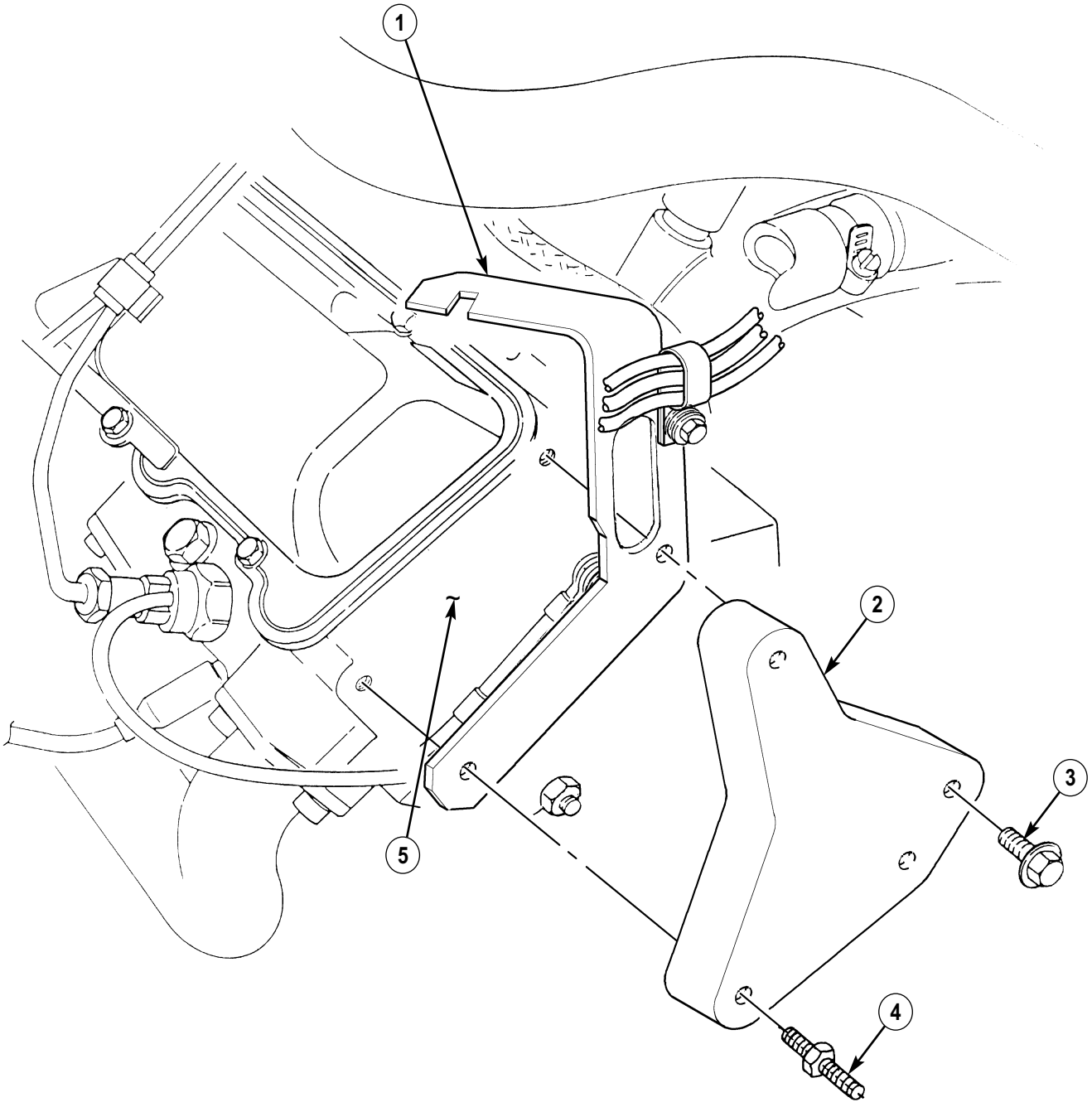
## a. Removal

Remove capscrew (3), stud (4), and rear mounting bracket (2) from air horn support bracket (1) and cylinder head (5).

## b. Installation

Install rear mounting bracket (2) on air horn support bracket (1) and cylinder head (5) with stud (4) and capscrew (3).

## 14-27.10. COMPRESSOR MOUNTING AND AIR HORN BRACKET REPLACEMENT (R-134a) (Cont'd)




FOLLOW-ON TASKS:
- Install air-conditioning compressor (para. 14-27.8).
- Install air horn (TM 9-2320-280-20).

## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a)

**This task covers:**

**a. Preliminary Inspection and Cleaning**
**b. Disassembly**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Test Equipment**
Multimeter (Appendix G, Item 120)

**Special Tools**
Compressor tool kit (Appendix G, Item 102)

**Materials/Parts**
O-ring (Appendix E, Item 130)
Seal kit (Appendix E, Item 48)
Gasket kit (Appendix E, Item 39)
Direct clutch parts kit (Appendix E, Item 154)
Lubricating oil (Appendix B, Item 35.2)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Air-conditioning compressor removed (para. 14-27.8).

**General Safety Instructions**
- Compressed air for cleaning purposes will not exceed 30 psi (207 kPa).
- Compressor cylinder block may be pressurized.

**Maintenance Level**
Direct support

**NOTE**

The following procedure applies to vehicles with R-134a refrigerant only. Refer to Paragraph 14-27 for vehicles with R-12 refrigerant.

### a. Preliminary Inspection and Cleaning

1. Inspect front of compressor shaft (6) for oil leakage. If oil leakage is evident, replace compressor shaft seal.

**WARNING**

Compressed air for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

2. Clean compressor assembly with lubricating oil and dry with compressed air.

**WARNING**

Compressor cylinder block may be pressurized. Loosen oil filler plug slowly. If sound of escaping gas is heard, do not continue loosening plug until all pressure is released.

3. Loosen oil fill plug (3) to relieve any pressure buildup in compressor cylinder block (1).
4. Rotate compressor shaft (6) with ratchet and socket on compressor shaft nut (5). If severe rough spots or catches are felt while rotating shaft (6), replace compressor assembly.
5. Remove oil fill plug (3) and O-ring (4) from compressor cylinder block (1) and drain oil from cylinder block (1) into measuring container. Discard O-ring (4). Record amount of oil in measuring container.
6. Install O-ring (4) and fill plug (3) in cylinder block (1) and tighten fill plug (3) finger tight.
7. Inspect oil for chips, metal shavings, and metal particles. Replace compressor assembly if chips, metal shavings, or metal particles are present in oil.

### b. Disassembly

**CAUTION**

Do not clamp compressor body in vise. Clamp or support only at mounting ears, with blocks of wood, to prevent damage to compressor body.

**NOTE**

Perform steps 1 through 18 if replacing compressor shaft oil seal or clutch assembly. Perform steps 19 through 22 only if replacing cylinder head or valve plate assembly.

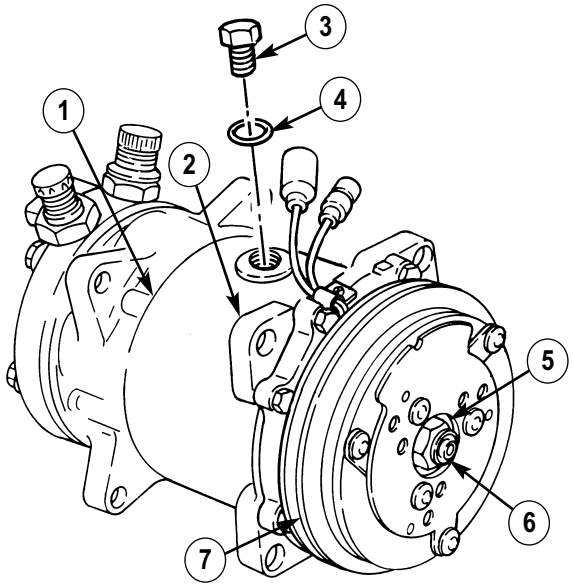
## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)

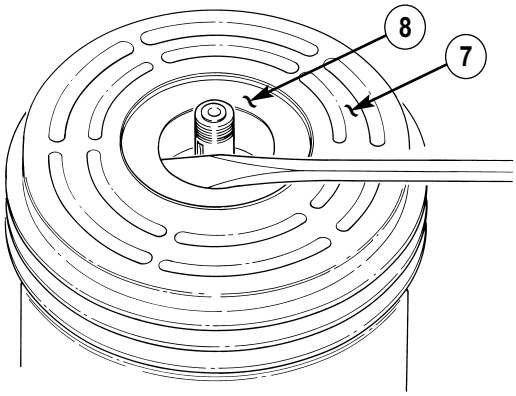
1. Clamp compressor mounting ears (2) in vise with blocks of wood on mounting ears (2).
2. Using front plate spanner to hold front clutch plate (9), remove nut (5) from compressor shaft (6). Discard nut (5).
3. Using clutch plate puller, remove front clutch plate (9) from compressor shaft (6).
4. Remove woodruff key (13) from compressor shaft (6). Discard woodruff key (13).
5. Using screwdriver, remove dust shield (8) from pulley (7) by lightly prying up on dust shield (8) while turning pulley (7).

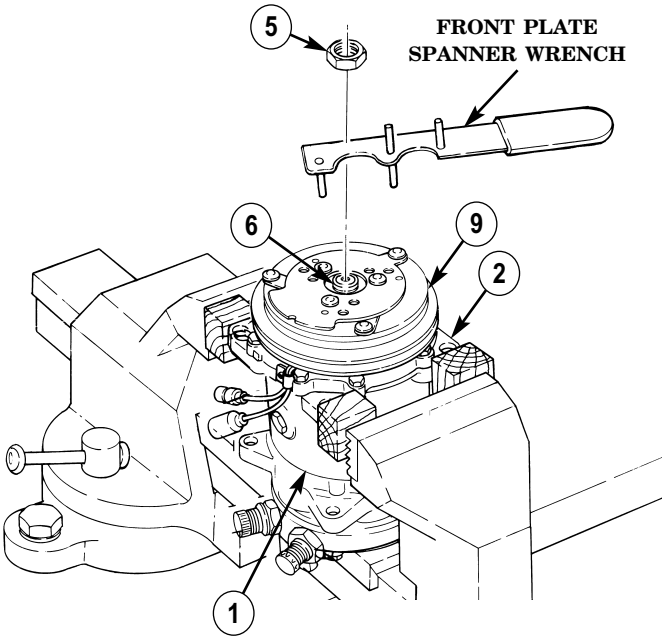
**NOTE**

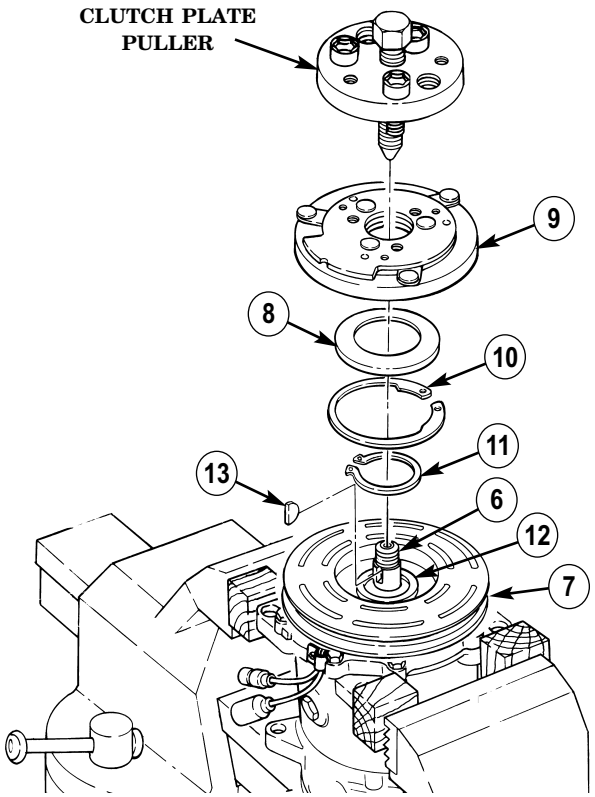
Offset snaprings 180 degrees prior to removal.

6. Using internal snapring pliers, remove internal bearing snapring (10) from rotor pulley (7).
7. Using external snapring pliers, remove external snapring (11) from seal housing (12). Discard snapring (11).



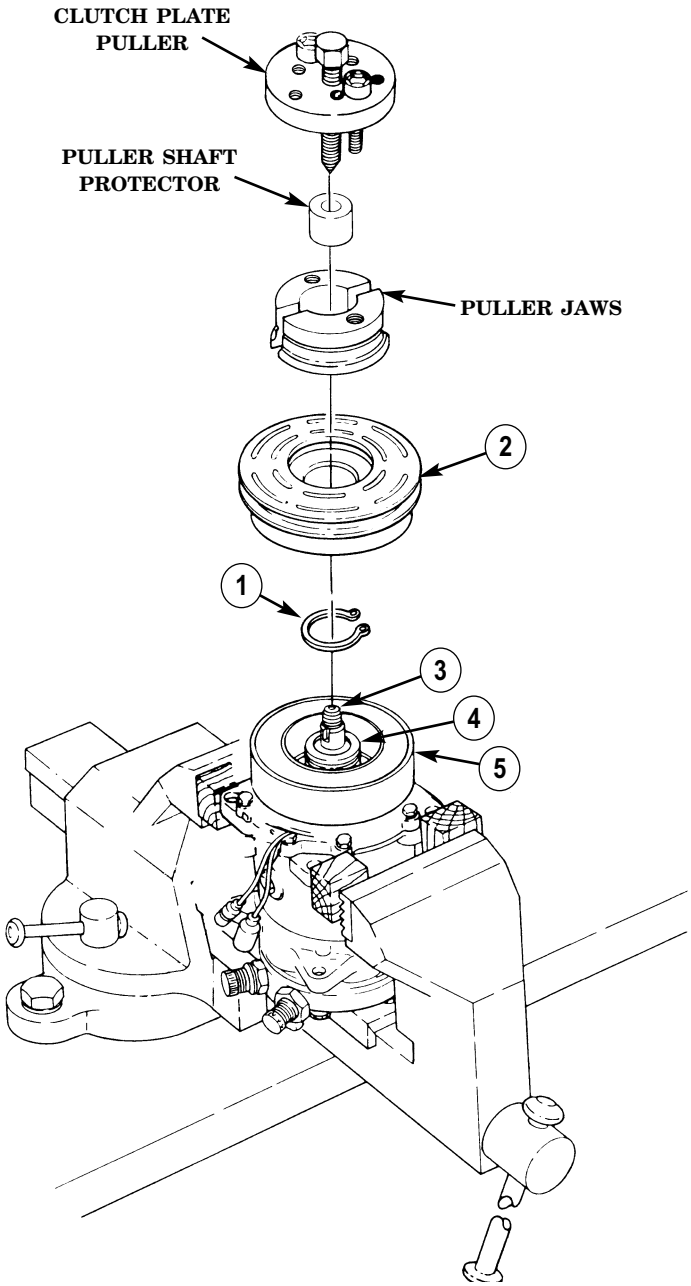



## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)

8. Place puller jaws into rotor pulley (2) around shaft (3).
9. Insert the bottom lips of the jaws into the internal bearing snapring groove on rotor pulley (2). Place puller shaft protector between jaws, and seat on shaft (3). Install clutch plate puller on puller jaws and tighten capscrews finger tight.
10. Remove rotor pulley (2) from shaft (3).
11. Using external snapring pliers, remove snapring (1) from seal housing (4) and remove field coil (5). Discard snapring (1).



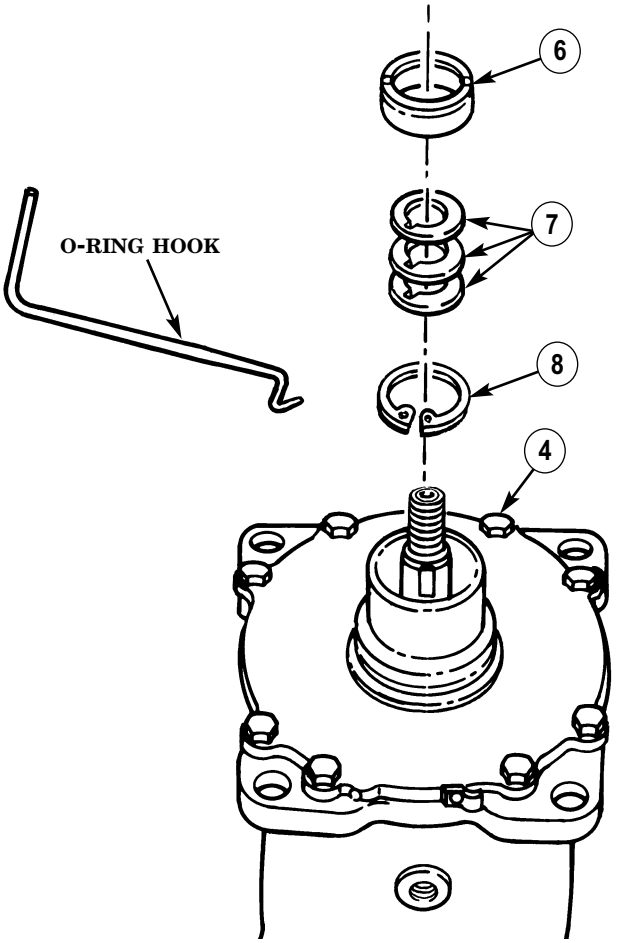
## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)

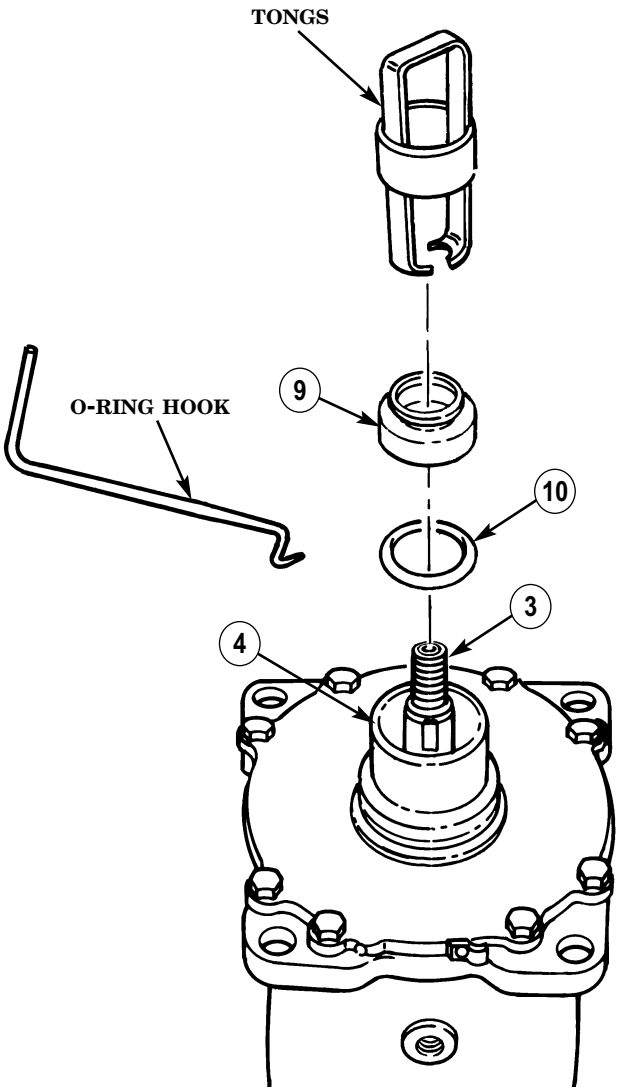
12. Using snapring pliers, remove felt ring assembly (6) from seal housing (4). Discard felt ring assembly (6).
13. Using O-ring hook and small screwdriver, remove shims (7) from seal housing (4).
14. Using internal snapring pliers, remove snapring (8) from seal housing (4). Discard snapring (8).
15. Using tongs, remove seal retainer (9) from shaft (3). Discard seal retainer (9).

**CAUTION**

Be careful not to scratch O-ring groove when removing O-ring from seal housing.

16. Using O-ring hook, remove O-ring (10) from groove in seal housing (4). Discard O-ring (10).



## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)

17. Insert seal remover and installer in seal housing (2) on seal assembly (1). Press seal remover and installer down against seal assembly (1) and twist clockwise to engage slots on seal assembly (1). Remove seal assembly (1) from seal housing (2). Discard seal assembly (1).
18. Remove compressor cylinder block (8) from vise.
19. Remove five capscrews (3) and cylinder head (5) from compressor cylinder block (8).
20. Using small plastic mallet, tap around outer edge of cylinder head (5) to free it from valve plate assembly (7). Remove cylinder head (5) from valve plate assembly (7).

**NOTE**

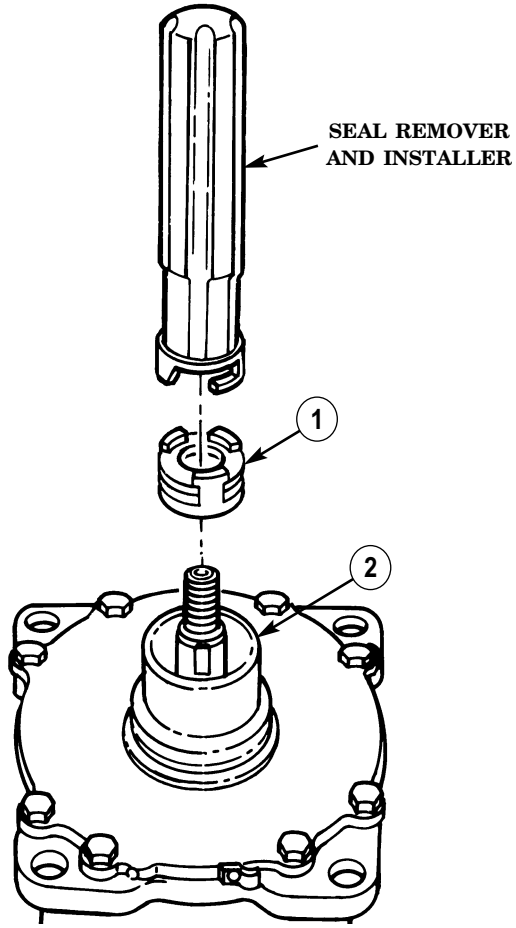
Do not remove screw, nut, and lockwasher from center of valve plate assembly.

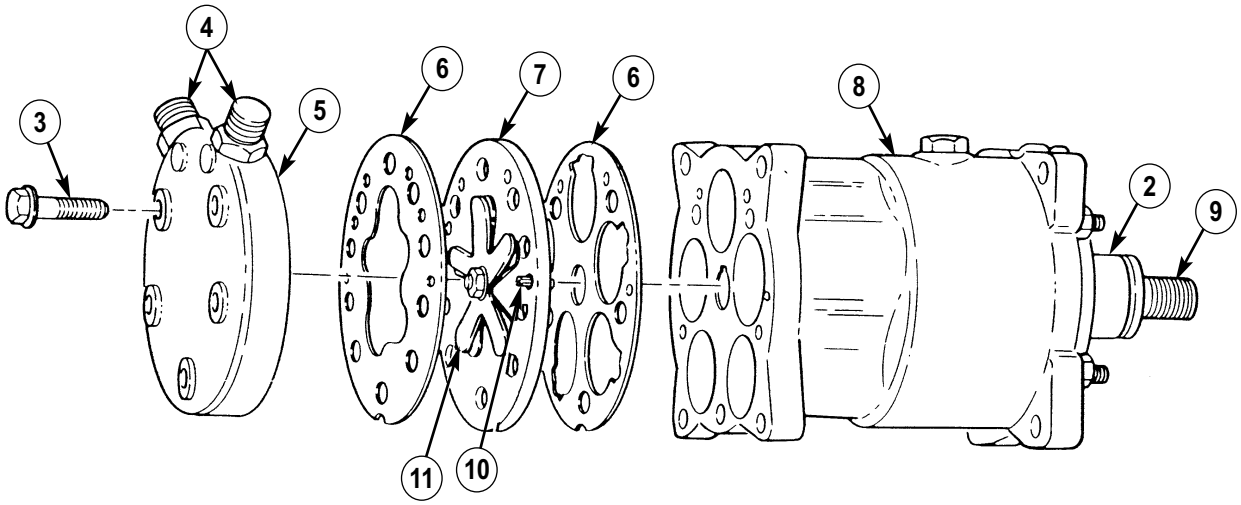
21. Position gasket scraper between valve plate assembly (7) and compressor cylinder block (8), and lightly tap around edge to remove valve plate assembly (7). Remove two gaskets (6) from valve plate assembly (7). Discard gaskets (6).
22. Using gasket scraper, carefully remove any gasket (6) remains on cylinder head (5) and compressor cylinder block (8).

### c. Inspection

1. Inspect compressor shaft (9) and seal housing (2) for nicks, gouges, scrapes, or damage. Replace compressor assembly if shaft (9) or seal housing (2) is nicked, gouged, scraped, or damaged.
2. Inspect compressor cylinder block (8) for cracks, stripped threads, and cracks or gouges in cylinder walls. Replace compressor assembly if cylinder block (8) is cracked, threads are stripped, or cylinder walls are gouged or cracked.
3. Inspect cylinder head (5) for cracks, gouges, and damaged fittings (4). Replace cylinder head (5) if cracked, gouged, or fittings (4) are damaged.
4. Inspect valve plate assembly (7) for damaged or worn reed valves (11) and presence and condition of alignment pins (10). Replace valve plate assembly (7) if damaged or worn.

## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)



## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)

5. Inspect front clutch plate (6) for warping, distortion, and damage. Replace clutch assembly if plate (6) is damaged.
6. Inspect pulley (4) and bearing (5) for cracks, scoring, or damage. Replace clutch assembly if rotor pulley (4) or bearing (5) is damaged.
7. Inspect field coil (3) for broken or damaged lead wires (1) and (2), gouges, and damage. Replace field coil (3) if leads (1) and (2) are damaged.
8. Connect positive lead of multimeter to lead 433 (1) on field coil (3). Connect negative lead of multimeter to lead 798 (2) on field coil. Field coil (3) should read 2.0 to 15.0 ohms of resistance. If field coil resistance test is not within specifications, replace field coil (3).

**d. Assembly**

**NOTE**

Perform steps 1 through 5 if cylinder head or valve plate assembly was removed. Perform steps 6 through 29 if compressor shaft oil seal or clutch assembly was removed.

1. Coat valve plate assembly (10) with lubricating oil. Install cylinder head gaskets (9) and (11) on valve plate assembly (10), making sure gaskets (9) and (11) do not restrict oil holes in valve plate assembly (10).
2. Align valve plate assembly (10) with compressor cylinder block (12) cylinders, and install valve plate assembly (10) on compressor cylinder block (12).

**NOTE**

Make sure valve plate assembly alignment pins are engaged, and all bolt holes and oil holes are unrestricted by gaskets before installing cylinder head.

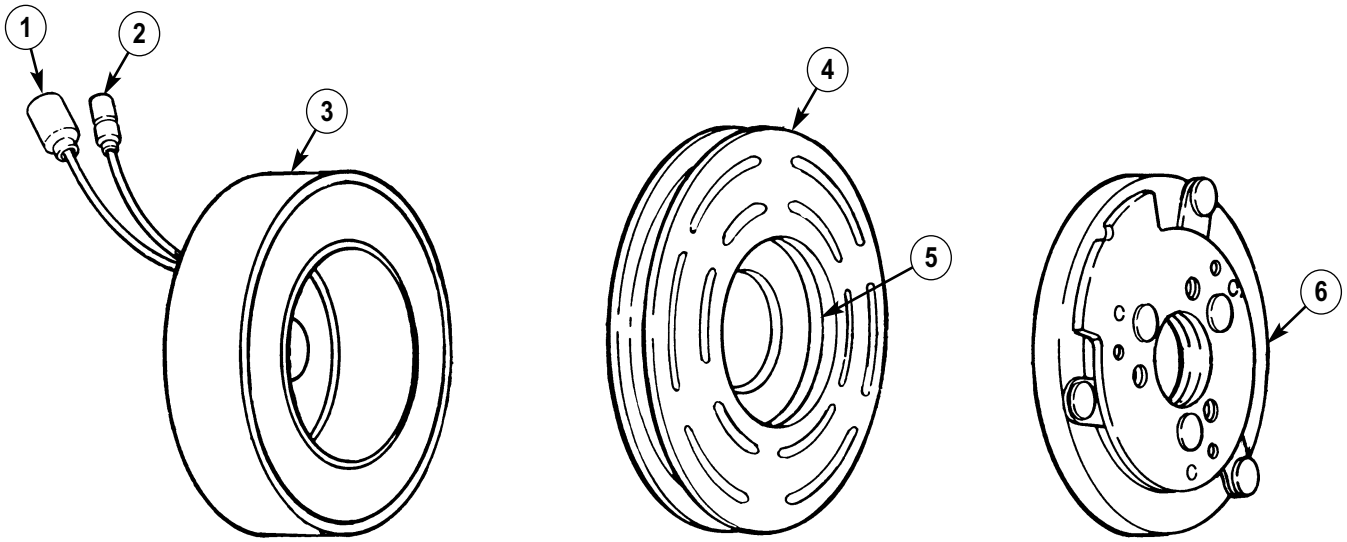
3. Position cylinder head (8), with fittings on same side of compressor cylinder block (12) as oil fill hole, and install cylinder head (8) on valve plate assembly (10) without misaligning gasket (9).
4. Install five capscrews (7) into cylinder head (8) and tighten capscrews (7) finger tight.
5. Tighten five capscrews (7) to 10-15 lb-ft (14-20 N•m) in tightening sequence shown. Then retighten to 22-25 lb-ft (30-34 N•m) in tightening sequence shown.

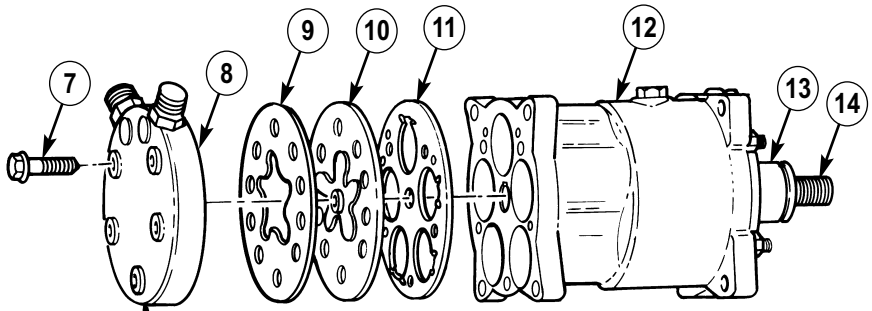
**WARNING**

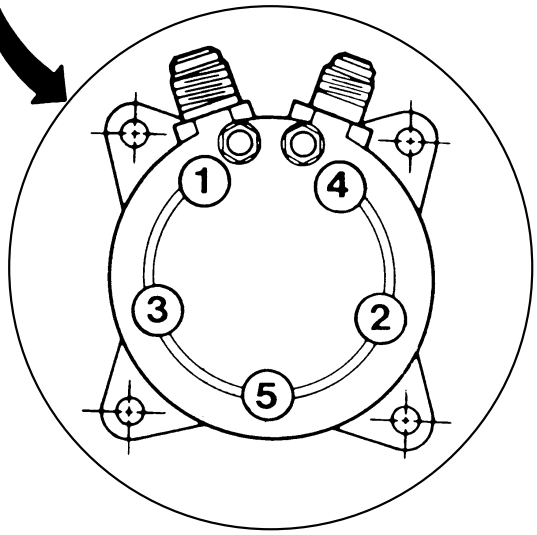
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

6. Clean seal housing (13) and shaft (14) thoroughly with lubricating oil, a clean lint free cloth, and dry with compressed air. Make sure all foreign substances are removed from seal housing (13) and shaft (14).
7. Insert seal sleeve protector over shaft (14). Dip mating surfaces of seal (15) in lubricating oil and slide seal (15) over seal sleeve protector and into seal housing (13).
8. Place seal (15) in slots of seal remover and installer and install seal (15) into seal housing (13), making sure seal (15) is fully seated in seal housing (13). Twist seal remover and installer counterclockwise to disengage from seal (15) and remove seal remover and installer.

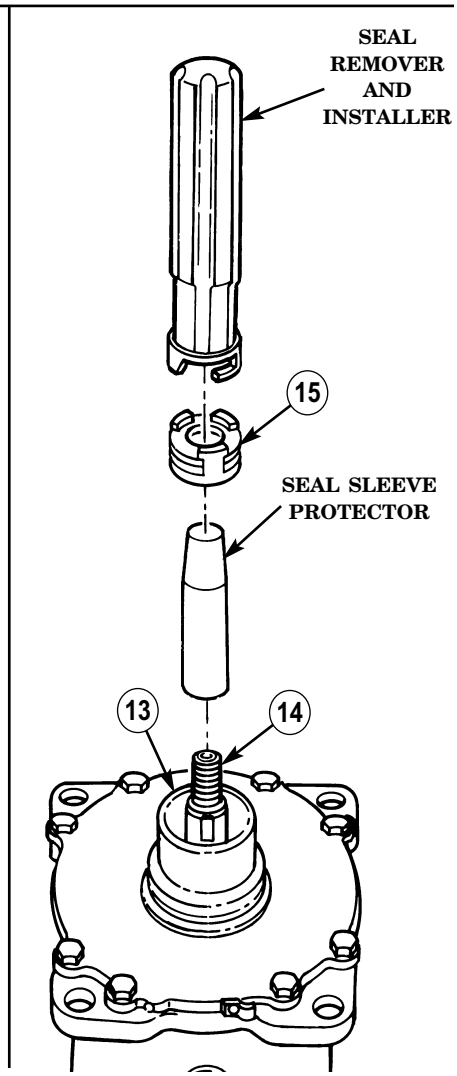
## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)




TIGHTENING SEQUENCE



## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)

**CAUTION**

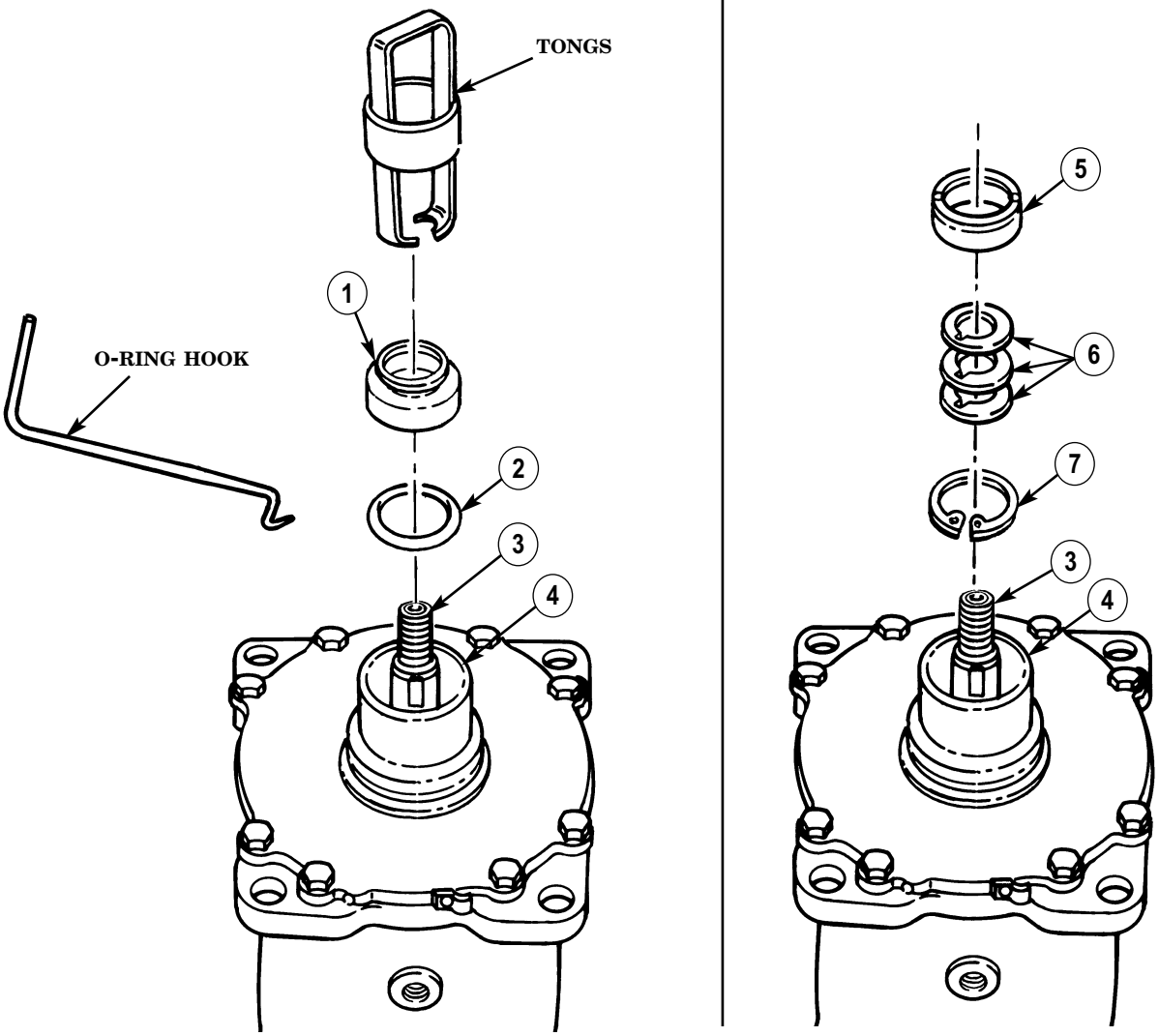
Do not scratch seal housing with O-ring hook.

9. Coat O-ring (2) with lubricating oil. Using O-ring hook, install O-ring (2) into seal housing (4) groove. Do not scratch seal housing (4) surface with O-ring hook.
10. Coat seal retainer (1) with lubricating oil. Using tongs, install seal retainer (1) in seal housing (4) and press lightly against seal.
11. Using snapring pliers, install snapring (7) in seal housing (4) with beveled edge of snapring (7) facing away from seal retainer (1).

**NOTE**

The air gap is determined by the spacer shims. When installing the original or a new clutch assembly, try the original shims first. When installing a clutch on a new compressor assembly, use 0.040 (1 mm), 0.020 (.51 mm), and 0.005 in. (.13 mm) shims from clutch accessory kit.

12. Install clutch spacer shims (6) on shaft (3).
13. Install felt ring assembly (5) into seal housing (4) and tap in place with plastic-faced hammer.



## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)

14. Install field coil (11) onto seal housing (4), making sure bump on field coil (11) fits in locating depression on compressor housing (12). Using snapring pliers, install snapring (10) on seal housing (4) to secure field coil (11).

**CAUTION**

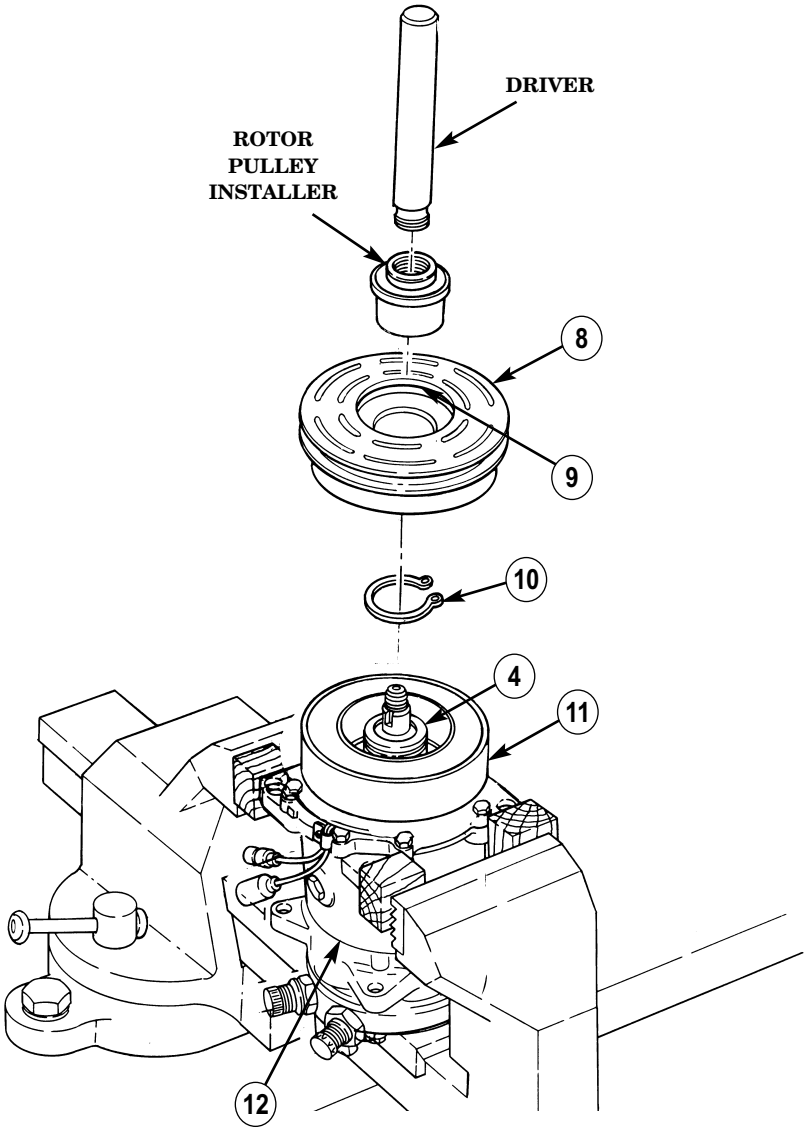
Do not clamp compressor body in vise. Clamp or support only at mounting ears, with blocks of wood, to prevent damage to compressor body.

15. Clamp compressor housing (12) in vise with blocks of wood on mounting ears.
16. Place rotor pulley (8) on seal housing (4), making sure it is not misaligned or crooked.
17. Place rotor pulley installer into bearing cavity of rotor pulley (8), making sure outer edge of installer rests on bearing outer race (9).

**CAUTION**

Make sure all slack is taken out of field coil lead wires (with clamp) before installing rotor pulley to prevent damage to lead wires.

18. Place driver on rotor pulley installer, and tap driver with hammer until rotor pulley (8) fully seats on seal housing (4).



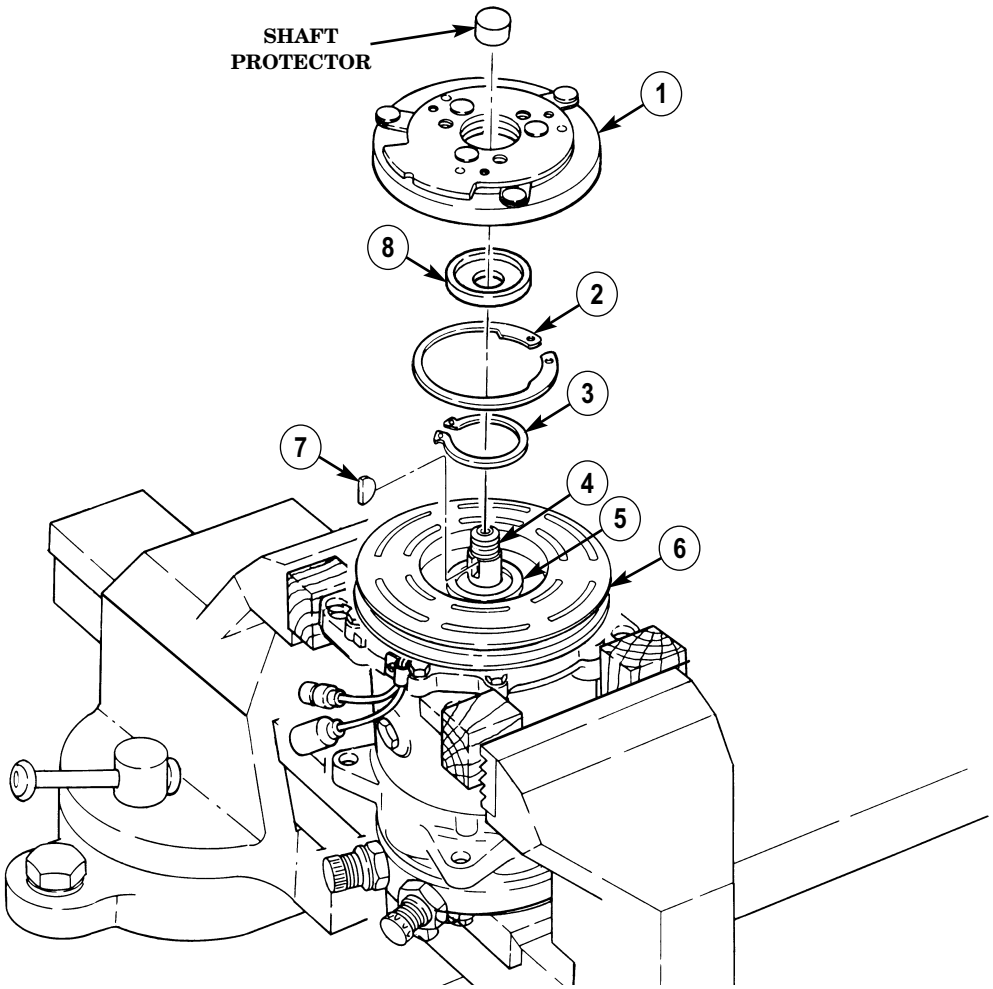
## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)

19. Using external snapring pliers, install snapring (3) on seal housing (5).
20. Using internal snapring pliers, install internal bearing snapring (2) in pulley (6).
21. Using bearing installer and plastic mallet, install bearing dust cover (8) on pulley (6).
22. Install woodruff key (7) in compressor shaft (4).
23. Align front clutch plate (1) with woodruff key (7) and install on rotor pulley (6).
24. Using shaft protector, tap front clutch plate (1) onto shaft (4) until it seats on clutch shims.
25. Install nut (9) on compressor shaft (4). Using front plate spanner to hold front clutch plate (1), tighten nut (9) to 25-30 lb-ft (34-41 N·m).

**NOTE**

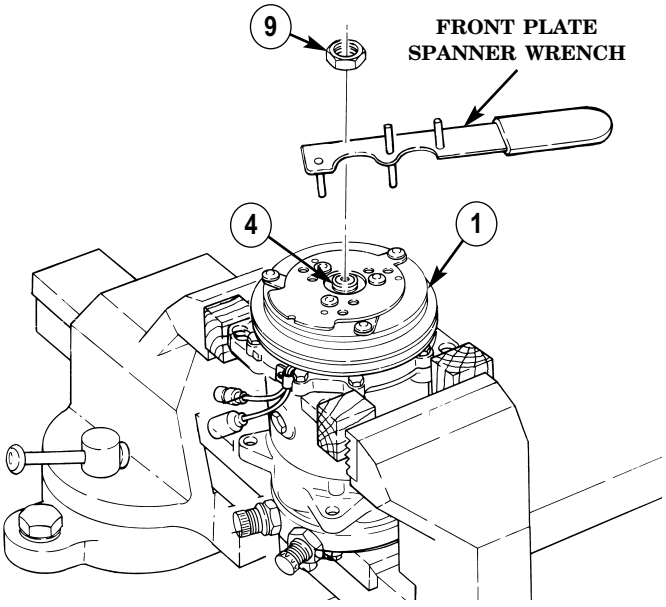
Air gap is the space between front clutch plate and rotor pulley.

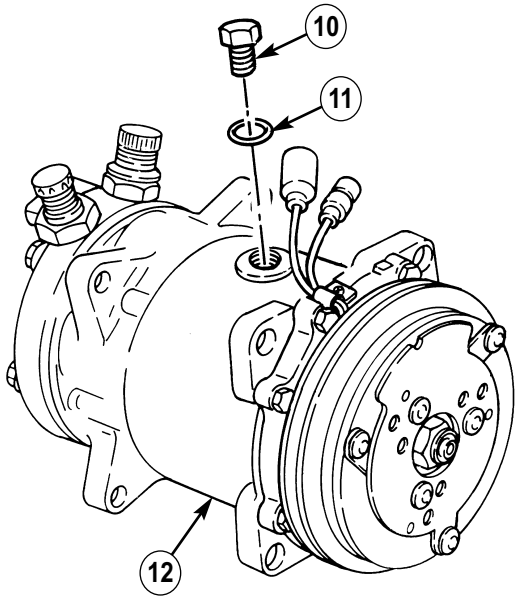
26. Check air gap of front clutch plate (1) with feeler gauge. Air gap should be 0.016-0.031 in. (0.04-0.079 cm). If air gap is not consistent around the circumference of the front clutch plate (1), lightly pry up or tap down edge to make gap consistent. If air gap is not within specifications, remove rotor pulley (6) (steps b.1 through b.13), add or subtract shims as required, and replace rotor pulley (6) and front clutch plate (1) (steps d.11 through d.25).
27. Remove compressor assembly (12) from vise, and place on flat surface.
28. Remove oil fill plug (10) and O-ring (11). Discard O-ring (11).



## 14-27.11. AIR-CONDITIONING COMPRESSOR REPAIR (R-134a) (Cont'd)

29. Look through fill plug (10) hole in compressor (12) and rotate front clutch plate (1) with ratchet and socket to position internal compressor parts, as shown. Planet plate should be positioned so that dipstick can be inserted to full depth.
30. Insert the dipstick to its stop position, as shown. The stop is the angle near the top of the dipstick. The point of the angle must be to the right, and the bottom surface of the angle must be flush with the surface of the filler hole.
31. Remove dipstick from compressor (12) and count number of increments oil level is up to on dipstick.
32. Oil level should be between six and eight increments on dipstick. Add or subtract oil as necessary to attain proper level.
33. Lubricate O-ring (11) with lubricating oil and install O-ring (11) and fill plug (10) on compressor (12). Tighten fill plug (10) to 6-9 lb-ft (8-12 N•m).




FOLLOW-ON TASK: Install air-conditioner compressor (para. 14-27.8).

## 14-28. AMBULANCE WINDSHIELD REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M996, M996A1, M997, M997A1, M997A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Wood block, 4 in. x 4 in., 40 in. (1016 mm) long
Wood block, 4 in. x 4 in., 24 in. (610 mm) long
Twelve blind rivets (Appendix E, Item 194)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Windshield wiper arm pivots removed (TM 9-2320-280-20).

**General Safety Instructions**
Do not perform this procedure near fire, flames, or sparks.

**Maintenance Level**
Direct support

### a. Removal

1. Remove six capscrews (1) and washers (2) from two rear windshield mounting brackets (5) and windshield (4). Remove shims (3) from behind mounting brackets (5), if present.
2. Remove three screws (7), clamps (6), antenna cables (8), and intercom cable (9) from windshield (4).
3. Remove three hitch pins (10) and windshield hinge pins (12) from front hinges (11) and lower hinges (13).

**NOTE**

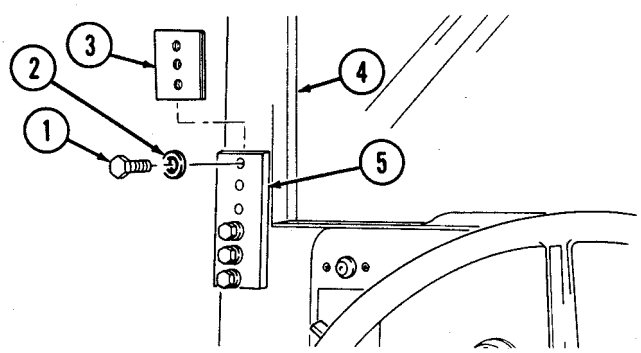
- Perform steps 4, 5, and 7 for M996 and M996A1 vehicles only.
- Have drainage container ready to catch fuel.

4. Close heater fuel shutoff valve (14) at heater fuel line (15).

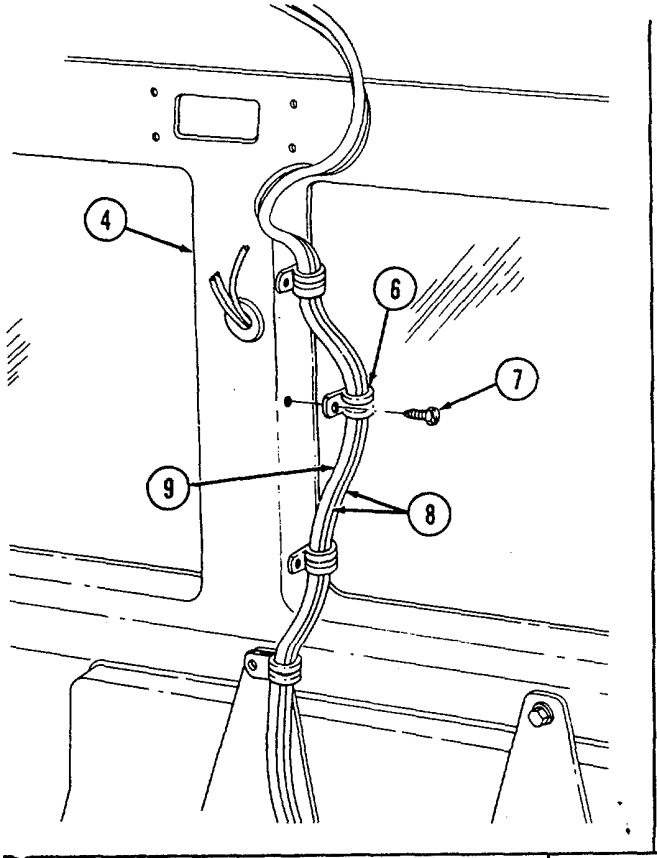
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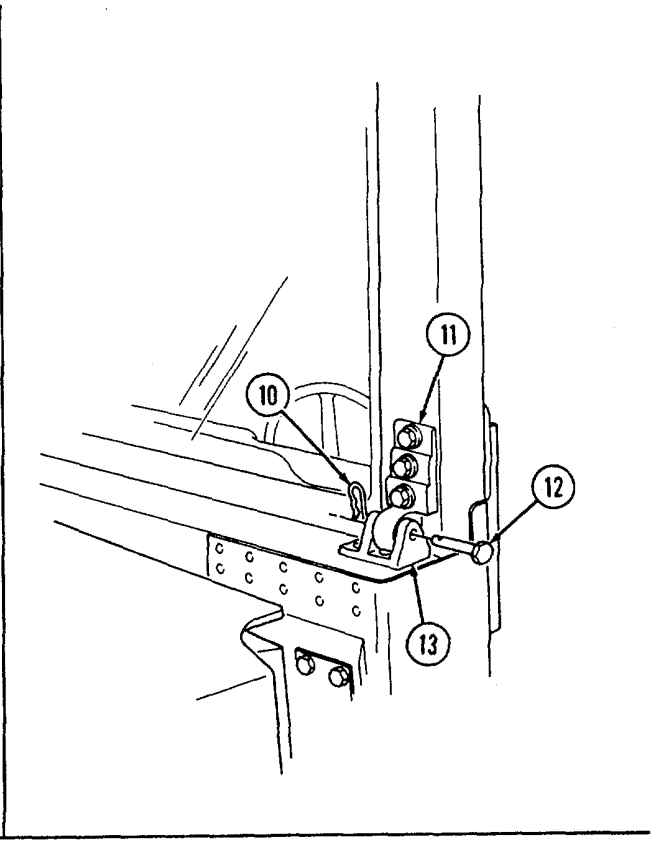
Diesel fuel is highly flammable. Do not perform this procedure near fire, flames, or sparks. Severe injury or death will result.

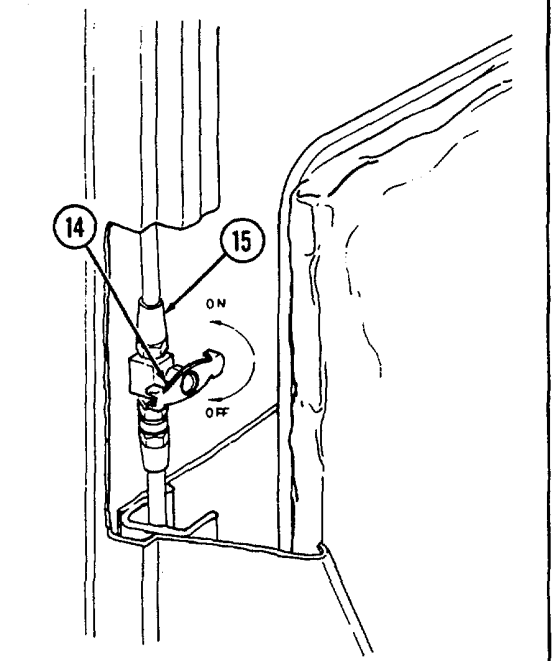
5. Disconnect heater fuel line (15) above shutoff valve (14).
6. Remove two capscrews (17) and washers (16) from front of ambulance body (18) and cargo floor (19).

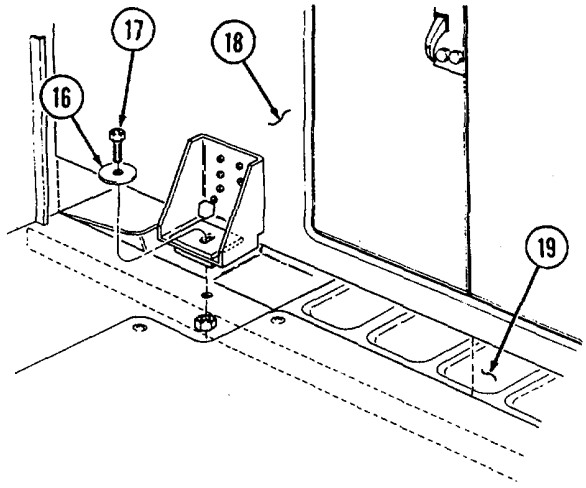


**14 - 28 . AMBULANCE WINDSHIELD REPLACEMENT (Cont'd)**



**14 - 28 . AMBULANCE WINDSHIELD REPLACEMENT (Cont'd)**

7. Loosen two jamnuts (2) from snubber (3) and bracket (1) and turn snubber (3) away from windshield (4).

**CAUTION**

Ensure 4 in. by 4 in. wood block, 40 in. (1016 mm) long, is positioned between jack and across top of body. Damage to equipment will result, if wood block is not used.

8. Using jack and wood blocks as shown, lift front end of ambulance body (6) approximately .75 in. (19 to provide clearance to remove windshield (4).
9. Pull windshield (4) forward and lay across hood (7).
10. Lower jack and wood block.
11. Remove grommet (8) from 'A" beam (11).

**NOTE**

Prior to removal, tag leads for installation.

12. Disconnect three windshield harness leads (9) from body harness leads (10) at bottom of windshield (4). Remove windshield (4). Inspect seal (5) for damage. Replace if damaged.
13. Remove two seals (13) and clean remains of seals (13) from extension (12).

**NOTE**

For instructions on replacement of rivets, refer to para. 22-7.

14. Remove twelve rivets (14) and two extensions (12) from windshield (4) and remove extensions (12).
15. Remove two seals (15) and clean remains of seals (15) from windshield (4).
16. Remove nine capscrews (18) and three windshield frame front hinges (17) from windshield (4).
17. Remove two seals (16) and clean remains of seals (16) from windshield (4).

b. Installation

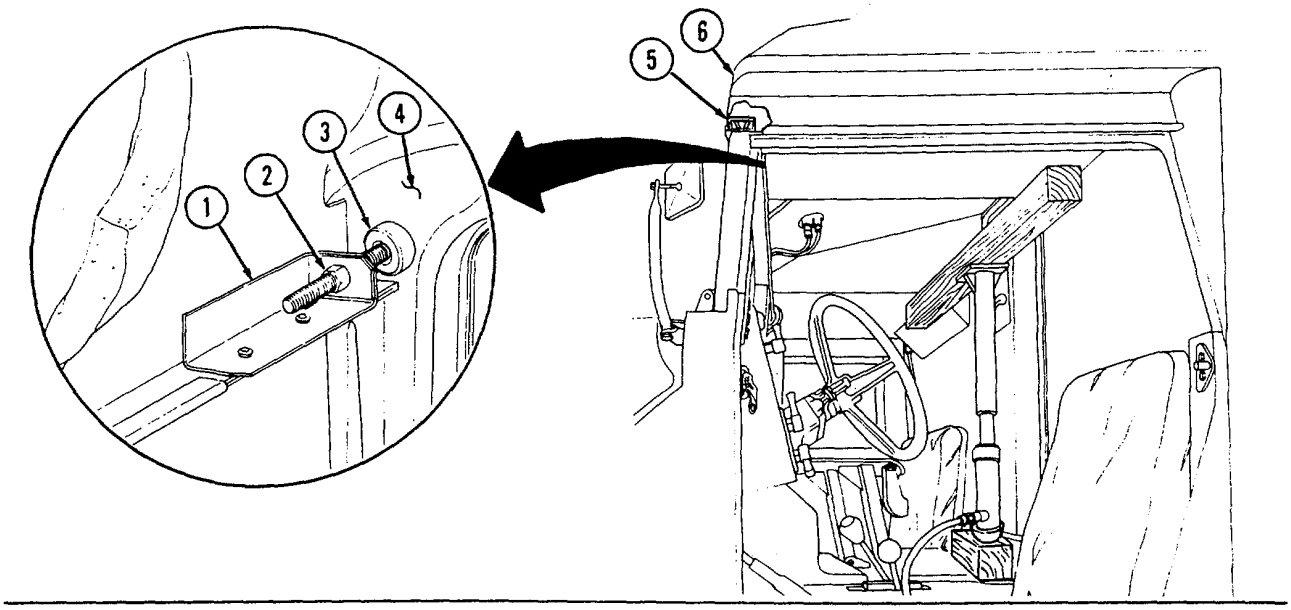
1. Peel paper backing from two seals (16) and install seals (16) on windshield (4).
2. Install three front hinges (17) on windshield (4) with nine capscrews (18). Tighten capscrews (18) to 15 lb-ft (20 N.m).
3. Peel paper backing from two seals (15) and install seals (15) to windshield (4).
4. Install two extensions (12) on windshield (4) with twelve rivets (14).
5. Peel paper backing from two seals (13) and install seals (13) to extensions (12).
6. Position windshield on vehicle hood (7). Connect three body harness leads (10) to windshield harness leads (9) at bottom of windshield (4).
7. Install grommet (8) on "A" beam (11).
8. Raise and support ambulance body (6) approximately .75 in, (19 mm).
9. Slide windshield (4) into mounting position between ambulance body (6) and 'A" beam (11).
10. Lower ambulance body (6) onto windshield (4).

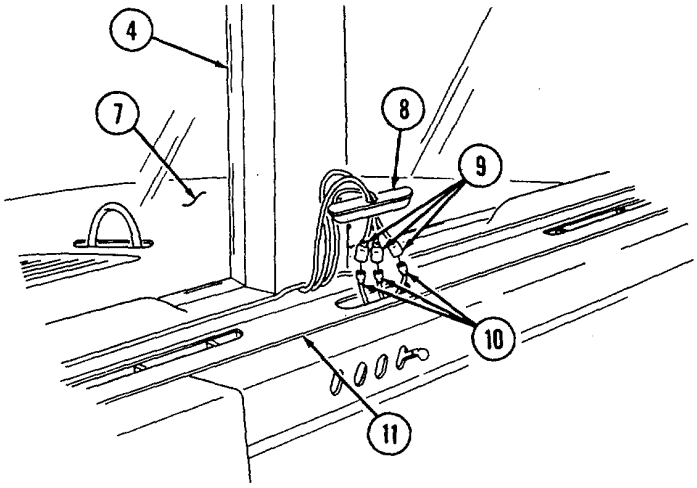
**NOTE**

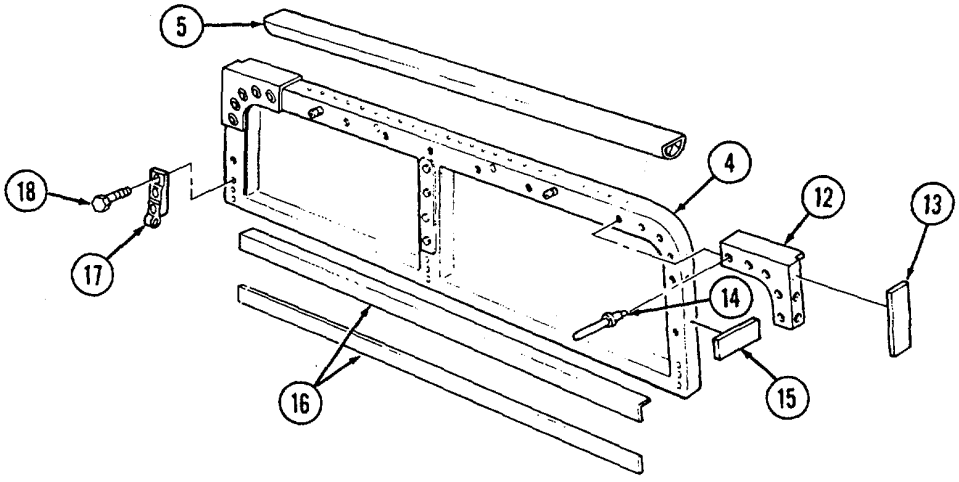
Perform step 11 for M996 and M996A1 only.

11. Turn snubber (3) toward windshield (4) to prevent windshield (4) from contacting body drip rails. Tighten two jamnuts (2) securing snubber (3) to bracket (1) when snubber (3) contacts windshield (4).

**14 - 28 . AMBULANCE WINDSHIELD REPLACEMENT (Cont'd)**



**14 - 28 . AMBULANCE WINDSHIELD REPLACEMENT (Cont'd)**

12. Install three hinge pins (3) in lower hinges (4) and front hinges (2) with three hitch pins (1).

13. Install two washers (6) and capscrews (5) securing front of body (7) to cargo floor (8). Tighten capscrews (5) to 60 lb-ft (81 N.m).

**NOTE**

Perform steps 14 and 15 for M996 and M996A1 only.

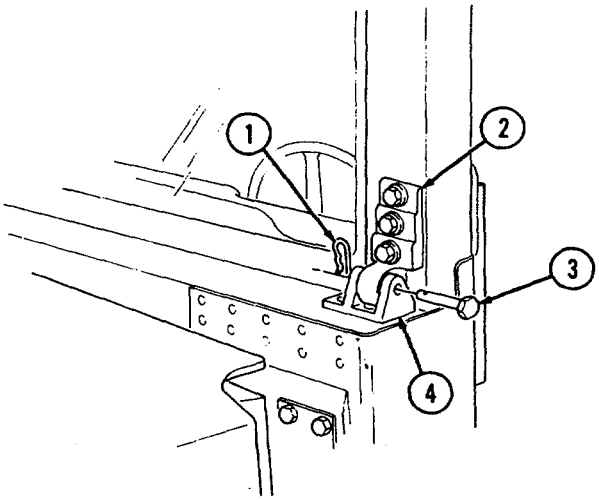
14. Connect heater fuel line (10) to shut-off valve (9).

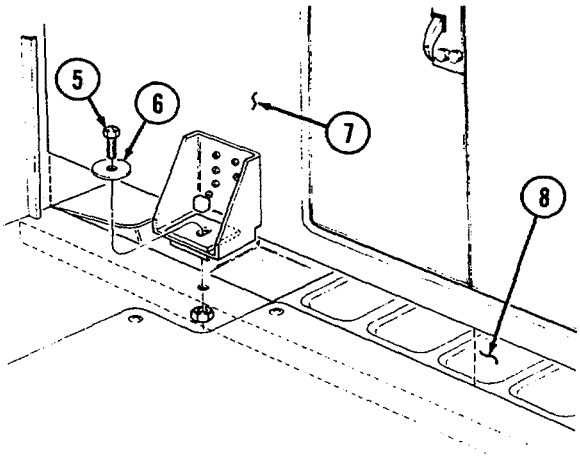
15. Open heater fuel shut-off valve (9) at heater fuel line (10).

16. Install three clamps (14) on intercom cable (17), and antenna cables (16) on windshield (13) with three screws (15).

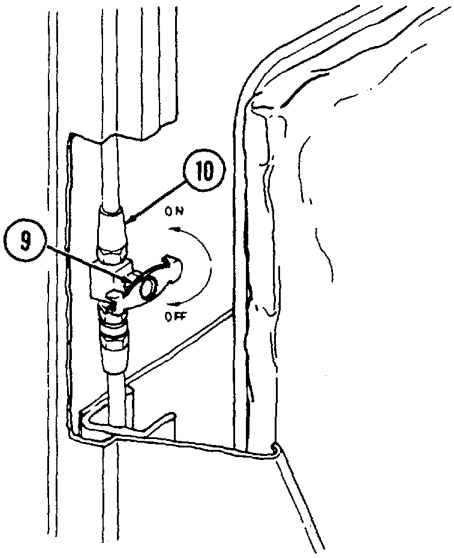
17. Install shims (18) between rear windshield mounting brackets (19) and windshield (13) as required to fill gap.

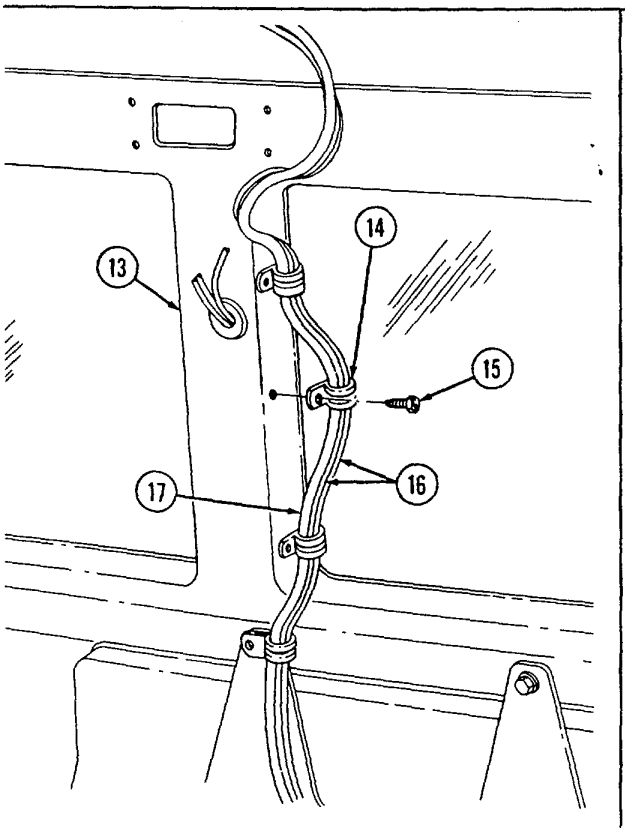
18. Secure two rear windshield mounting brackets (19) on windshield (13) with six washers (20) and capscrews (21). Tighten capscrews (21) to 15 lb-ft (20 N.m).

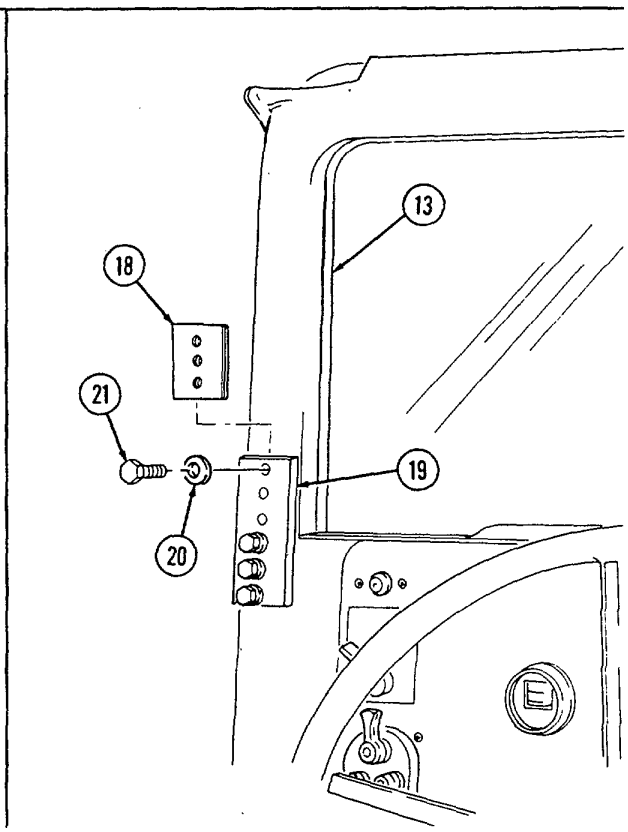


**14 - 28 . AMBULANCE WINDSHIELD REPLACEMENT (Cont'd)**



# CHAPTER 15
# WINCH MAINTENANCE

## 15-1. INTRODUCTION

This chapter contains maintenance instructions for disassembly and repair of winch components at the Direct Support maintenance level. Some subassemblies and parts must be removed before winch components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## 15-2. WINCH MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 15-3. | 6,000 Lb. Electric Winch Repair | 15-2 |
| 15-4. | 9,000 Lb. Electric Winch Repair | 15-16 |
| 15-5. | 10,500 Lb. Hydraulic Winch Repair | 15-26 |

## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
All models equipped with 6,000 lb. winch.

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**
Hex head driver, 5/32 in. (Appendix G, Item 117)

**Materials/Parts**
O-ring (Appendix E, Item 127)
Three gaskets (Appendix E, Item 13)
Six locknuts (Appendix E, Item 55)
Thrust washer bearing (Appendix E, Item 1)

**Materials/Parts (Cont'd)**
Coating compound (Appendix B, Item 11)
Aircraft grease (Appendix B, Item 20)
Bushing grease (Appendix B, Item 22)
Anaerobic pipe sealant (Appendix B, Item 49)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Winch removed (TM 9-2320-280-20).

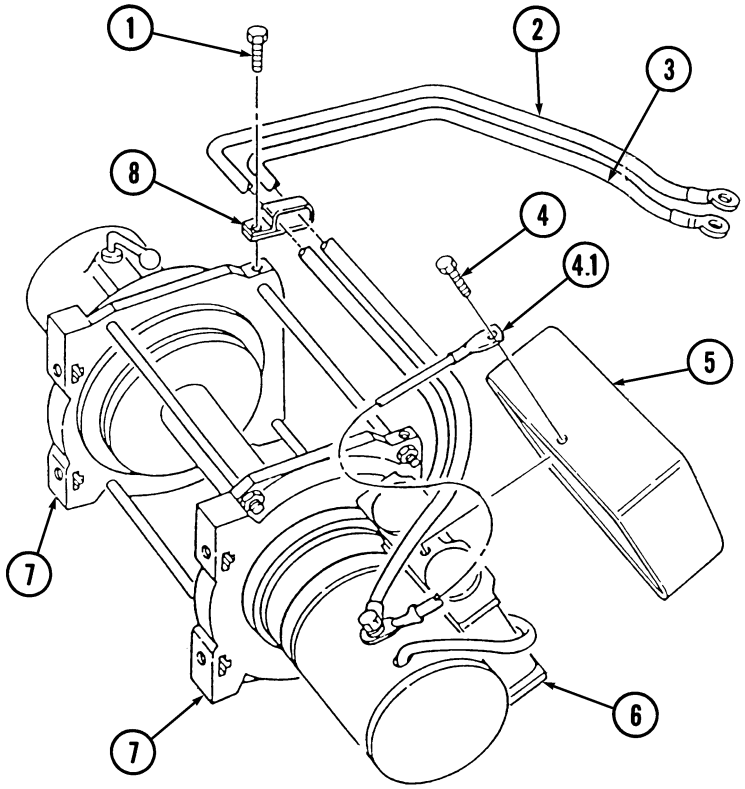
**Maintenance Level**
Direct support

### a. Disassembly

**NOTE**

Tag leads for assembly.

1. Remove two screws (1) and clamps (8) securing leads 6C (2) and 7C (3) to drum supports (7).
2. Remove screw (4), ground wire (4.1), and cover (5) from control (6).

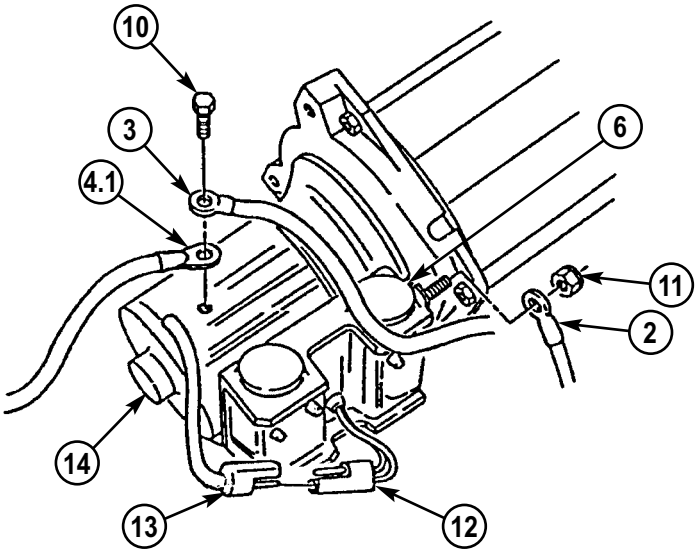


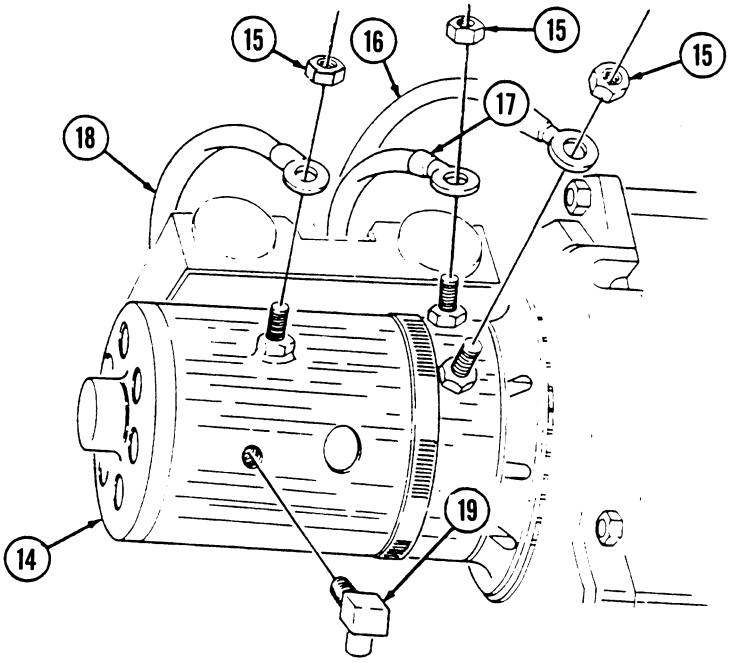
## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

**NOTE**

In order to perform steps 3 through 11, it may be necessary to remove plastic coating from winch.

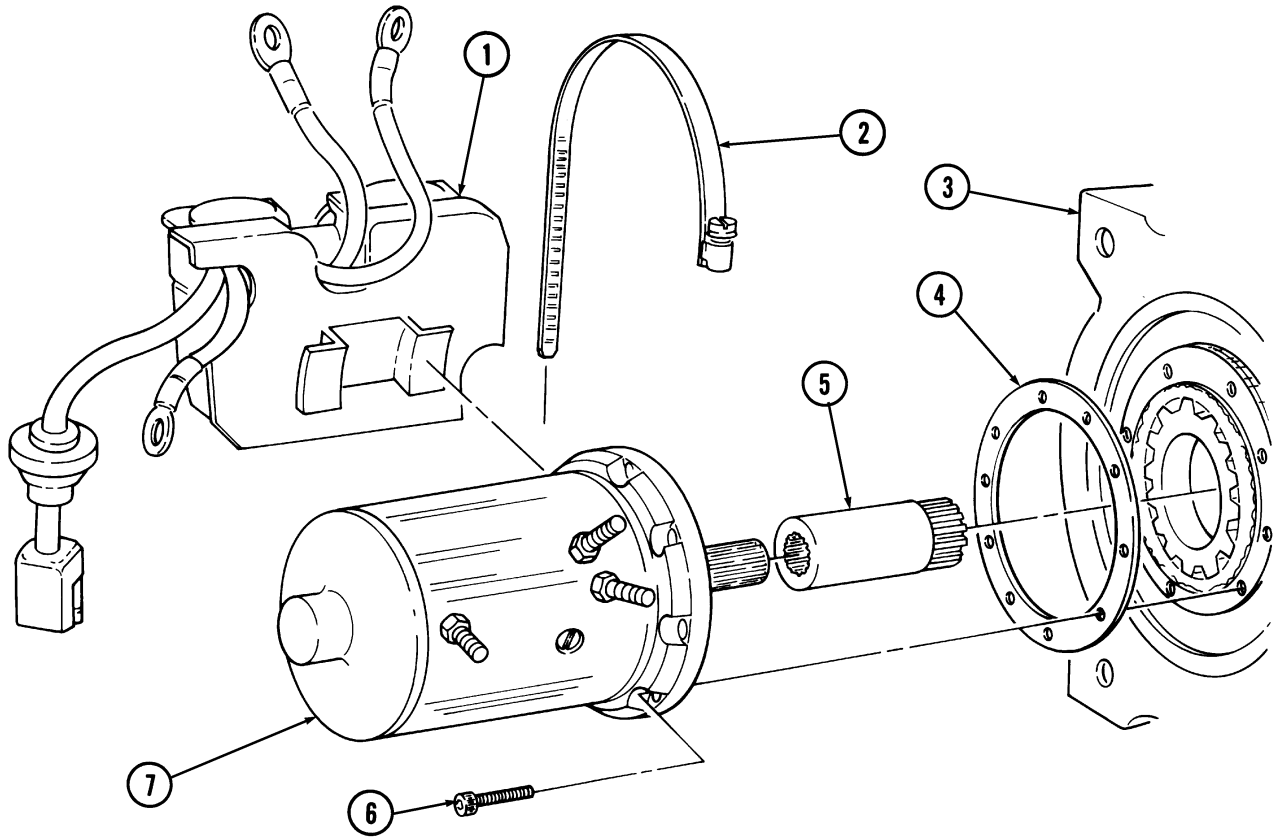
3. Remove nut (11) and lead 6C (2) from control (6).
4. Remove capscrew (10), lead 7C (3), and ground wire (4.1) from motor (14).
5. Disconnect motor connector (13) from control connector (12).
6. Remove three nuts (15) and control leads (16), (17), and (18) from motor (14).
7. Remove vent tube fitting (19) from motor (14).



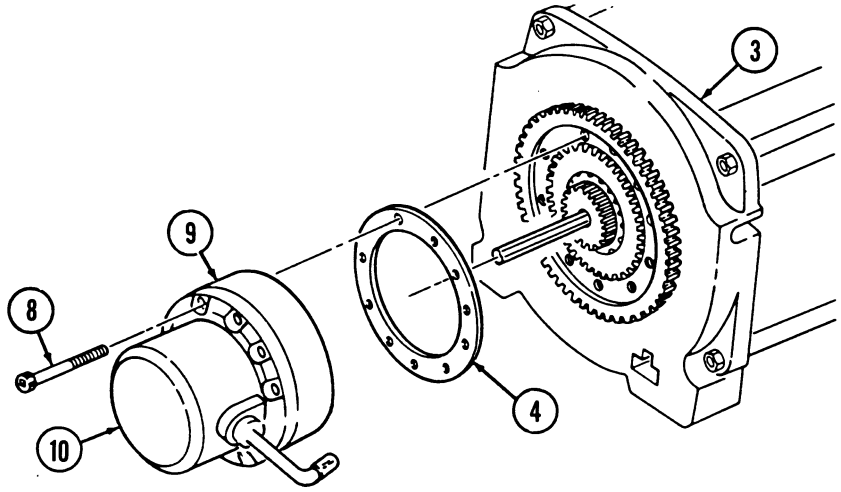
## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

8. Loosen clamp (2) and remove control (1) from motor (7).
9. Remove clamp (2) from motor (7).
10. Mark drum support (3) and motor (7) for assembly.
11. Remove ten socket head screws (6), motor (7), gasket (4), and coupling (5) from drum support (3). Discard gasket (4).

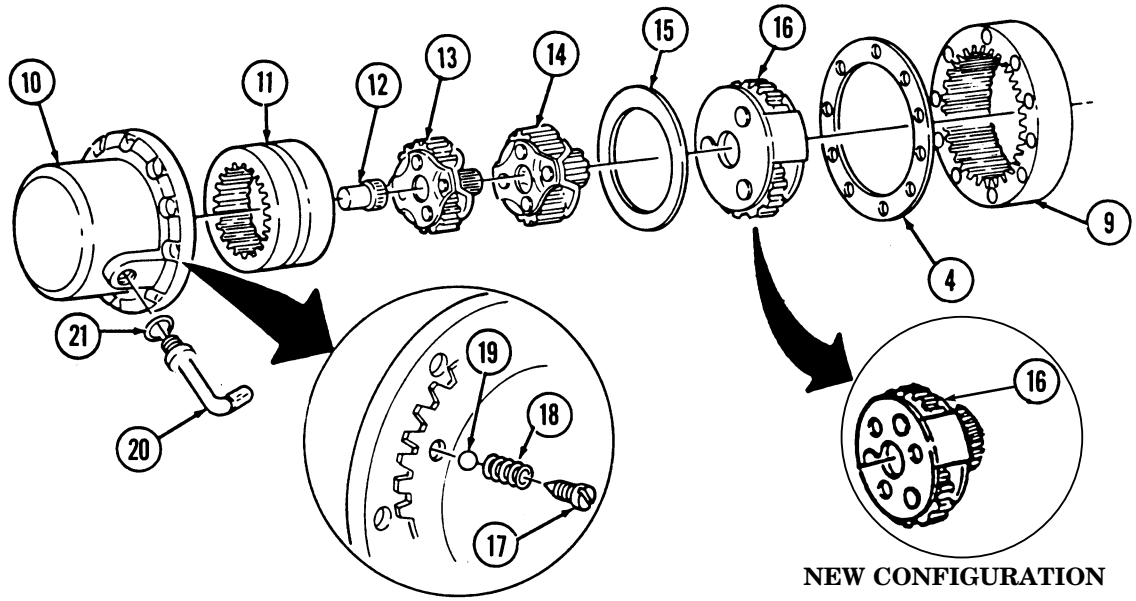


## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

12. Mark drum support (3), ring gear (9), and end housing (10) for assembly.
13. Remove ten socket head screws (8), end housing (10), ring gear (9), and gasket (4) from drum support (3). Discard gasket (4).




14. Remove ring gear (9) and gasket (4) from end housing (10). Discard gasket (4).
15. Remove stage three gear carrier (16) and thrust washer bearing (15) from end housing (10). Discard thrust washer bearing (15).
16. Remove set screw (17), spring (18), and ball (19) from end housing (10).
17. Remove clutch lever (20) and O-ring (21) from end housing (10). Discard O-ring (21).
18. Remove stage two gear carrier (14), stage one gear carrier (13), stage one sun gear (12), and clutch ring gear (11) from end housing (10).



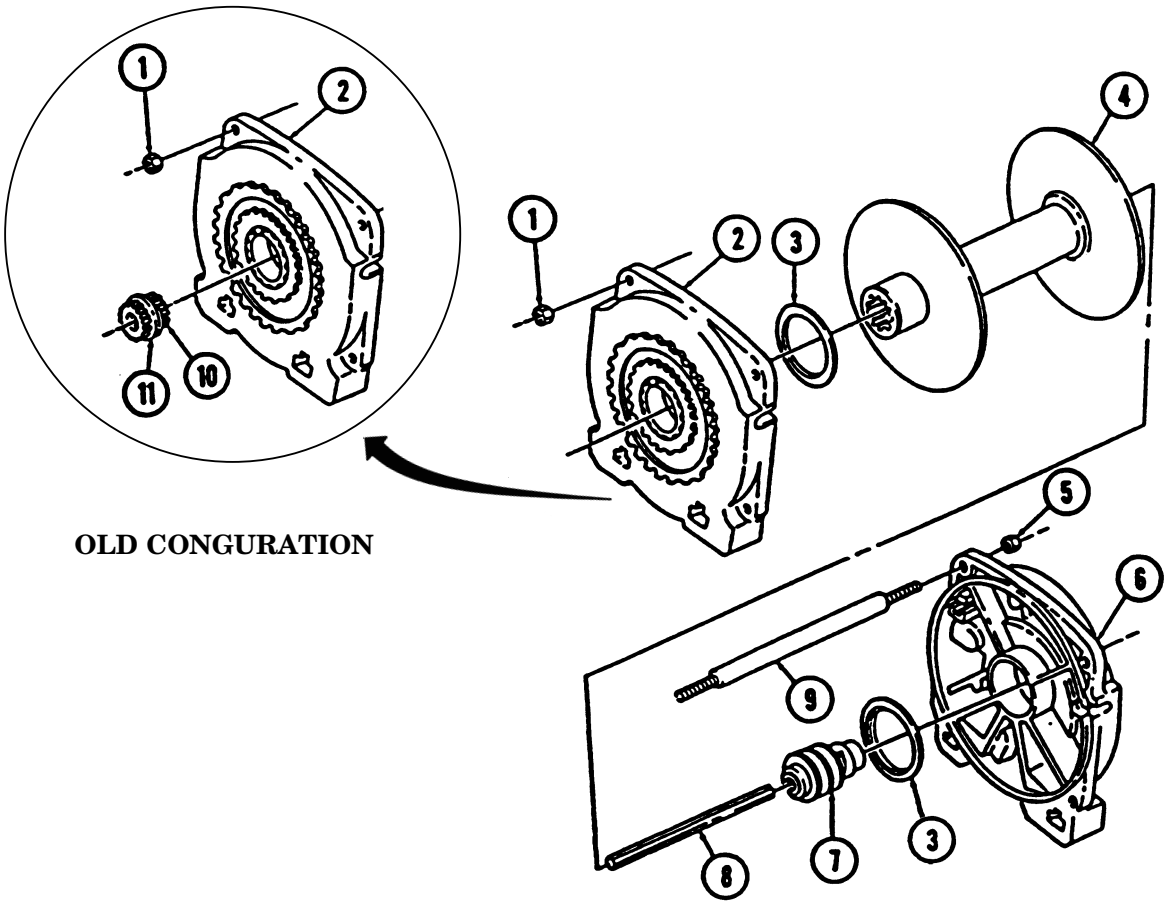

NEW CONFIGURATION

## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

**NOTE**

Perform step 19 for vehicles with old configuration only.

19. Remove splined drive (10) and retaining ring (11) from drive shaft (8). Remove retaining ring (11) from splined drive (10).
20. Remove three locknuts (1) and drum support (2) from tie rods (9). Remove thrust bushing (3) from drum (4). Discard locknuts (1).
21. Remove drum (4) and thrust bushing (3) from drum support (6).
22. Push drive shaft (8) and brake assembly (7) out of drum (4).
23. Remove three locknuts (5) and tie rods (9) from drum support (6). Discard locknuts.




**OLD CONGURATION**

## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

**b. Cleaning**

**CAUTION**

Do not clean brake assembly or damage to equipment may result.

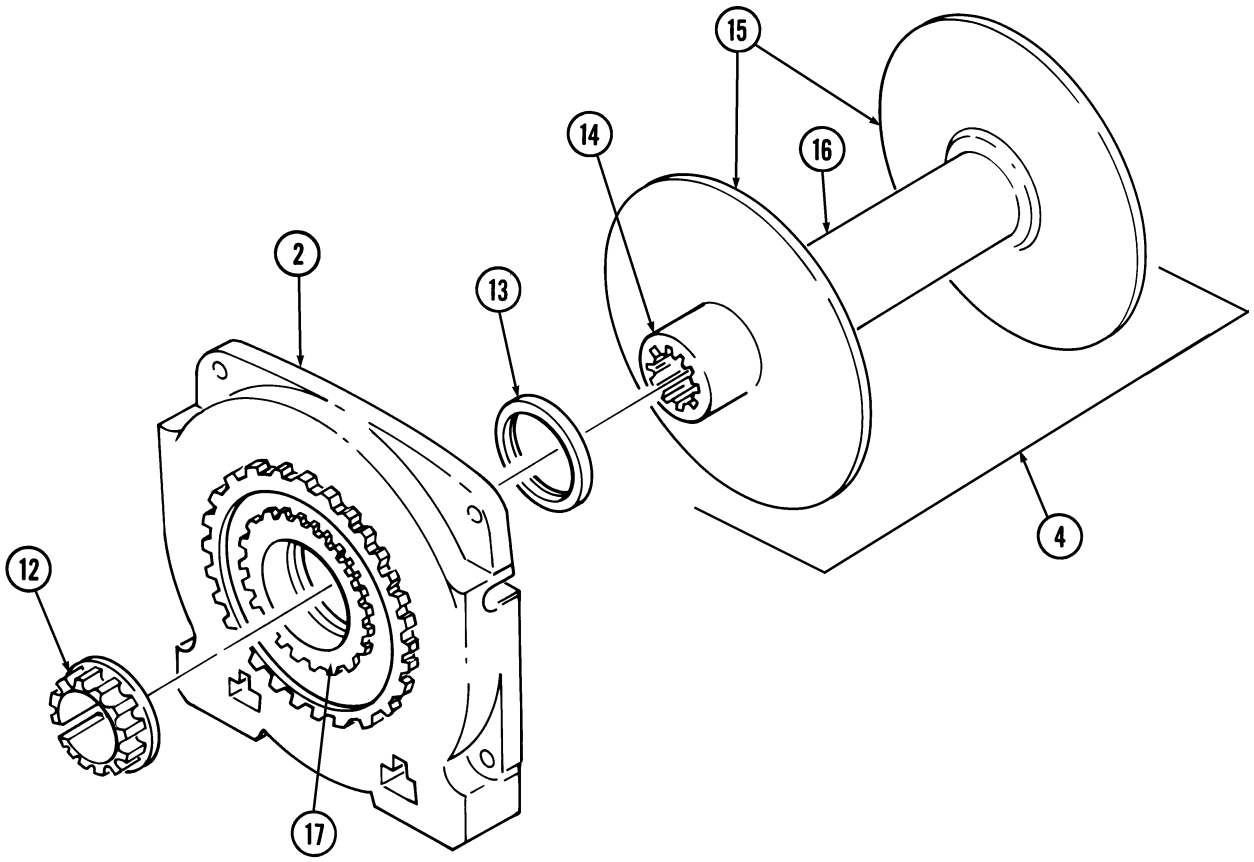
Clean all winch components except brake assembly (7) in accordance with para. 2-13.

**c. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect drum (4) for damage to splined end (14), flanges (15), and tube (16). Replace winch if damaged.
2. Inspect drum supports (2) for damage. Replace winch if damaged.
3. Remove bushing (12) from drum support (2).
4. Inspect oil seal (13) for damage. Perform steps 5 through 7 if seal (13) is damaged, if not, go to step 8.
5. Remove seal (13) from drum support (2).
6. Inspect sealing surface (17) of drum support (2) for damage. Replace winch if damaged.
7. Install seal (13) into drum support (2).
8. Inspect bushing (12) for damage. Replace if damaged. Install bushing (12) in drum support (2).
9. Repeat steps 3 through 8 for other drum support.



## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

10. Inspect end housing (1) for damage. Replace if damaged.

**NOTE**

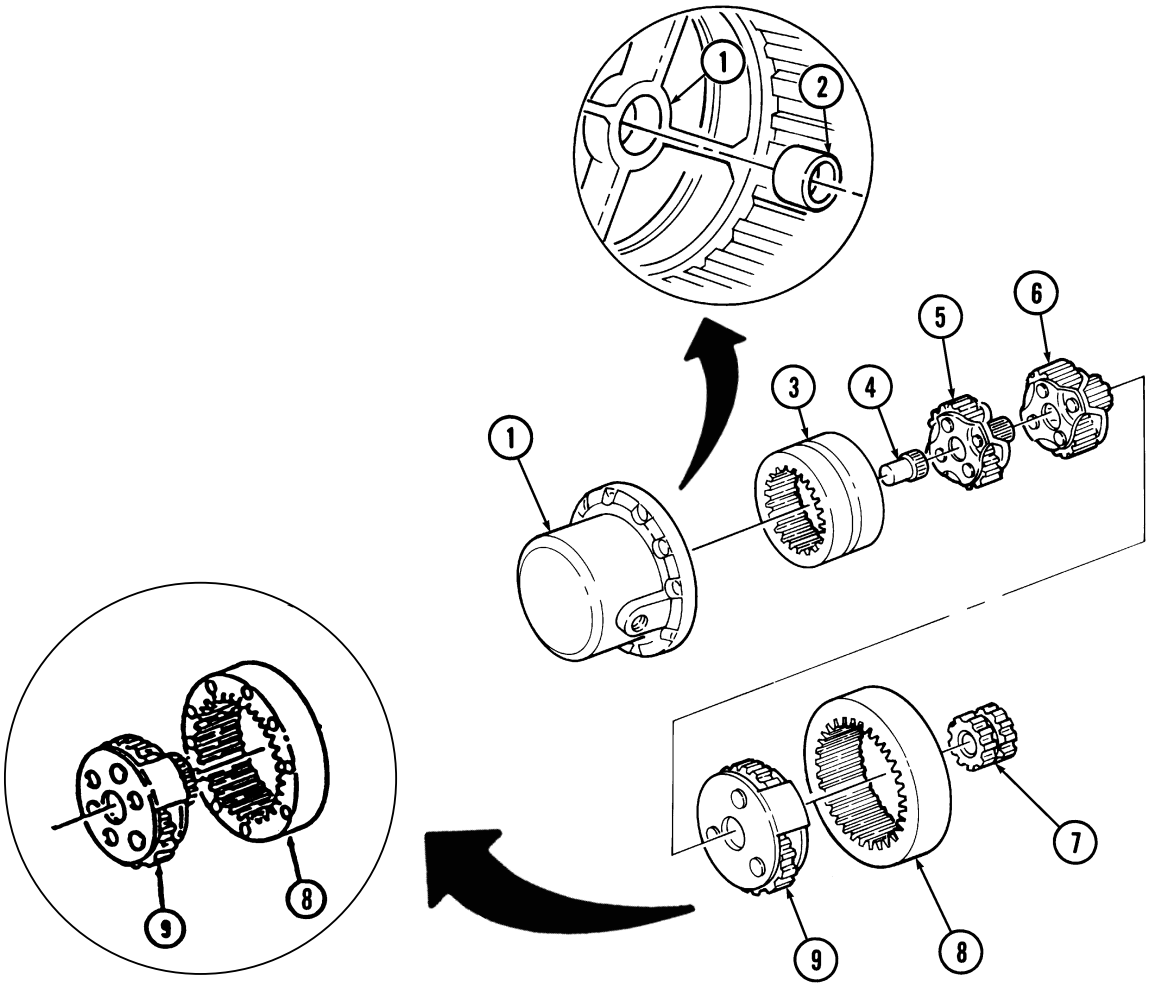
Perform steps 11 and 12 for vehicles with old configuration only.

11. Inspect end housing bushing (2) for damage or wear. Replace with new configuration end housing (1) if damaged or worn. If bushing (2) is to be reused, lubricate with bushing grease.
12. Inspect gear teeth, splines, and machined surfaces of clutch ring gear (3), stage one sun gear (4), stage one gear carrier (5), stage two gear carrier (6), stage three gear carrier (9), ring gear (8), and splined drive (7) for damage. Replace with new configuration parts if damaged.

**NOTE**

Perform step 12.1 for vehicles with new configuration only.

12.1. Inspect gear teeth, splines, and machined surfaces of clutch ring gear (3), stage one sun gear (4), stage one gear carrier (5), stage two gear carrier (6), stage three gear carrier (9), and ring gear (8) for damage. Replace any damaged parts.

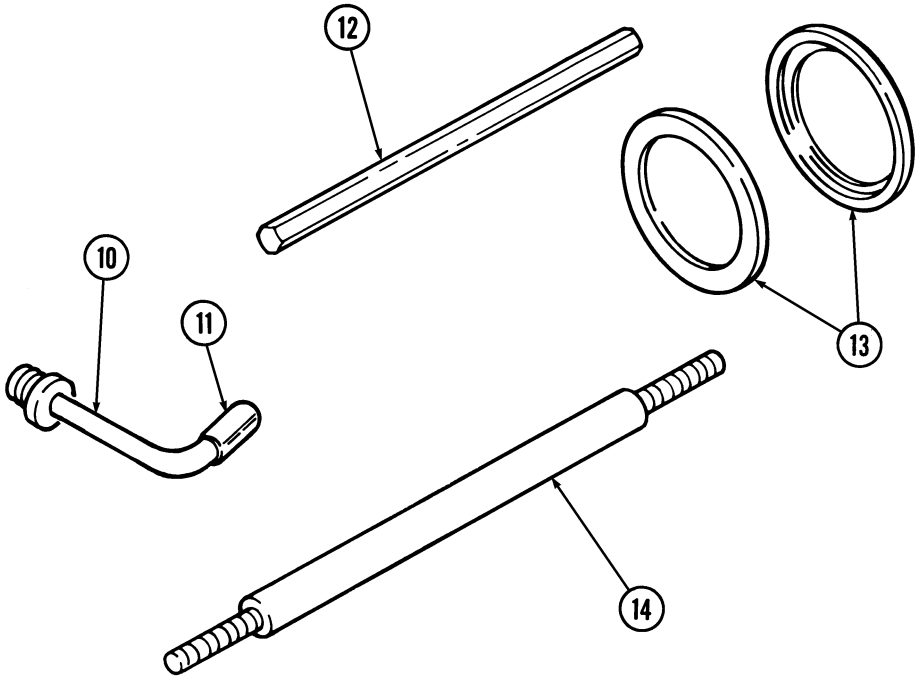



NEW CONFIGURATION

OLD CONFIGURATION

## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

13. Inspect drive shaft (12) for damage. Replace if damaged.
14. Inspect tie rods (14) for damage. Replace if damaged.
15. Inspect clutch lever (10) and plastic cap (11) for damage. Replace either if damaged.
16. Inspect thrust bushings (13) for damage. Replace if damaged.

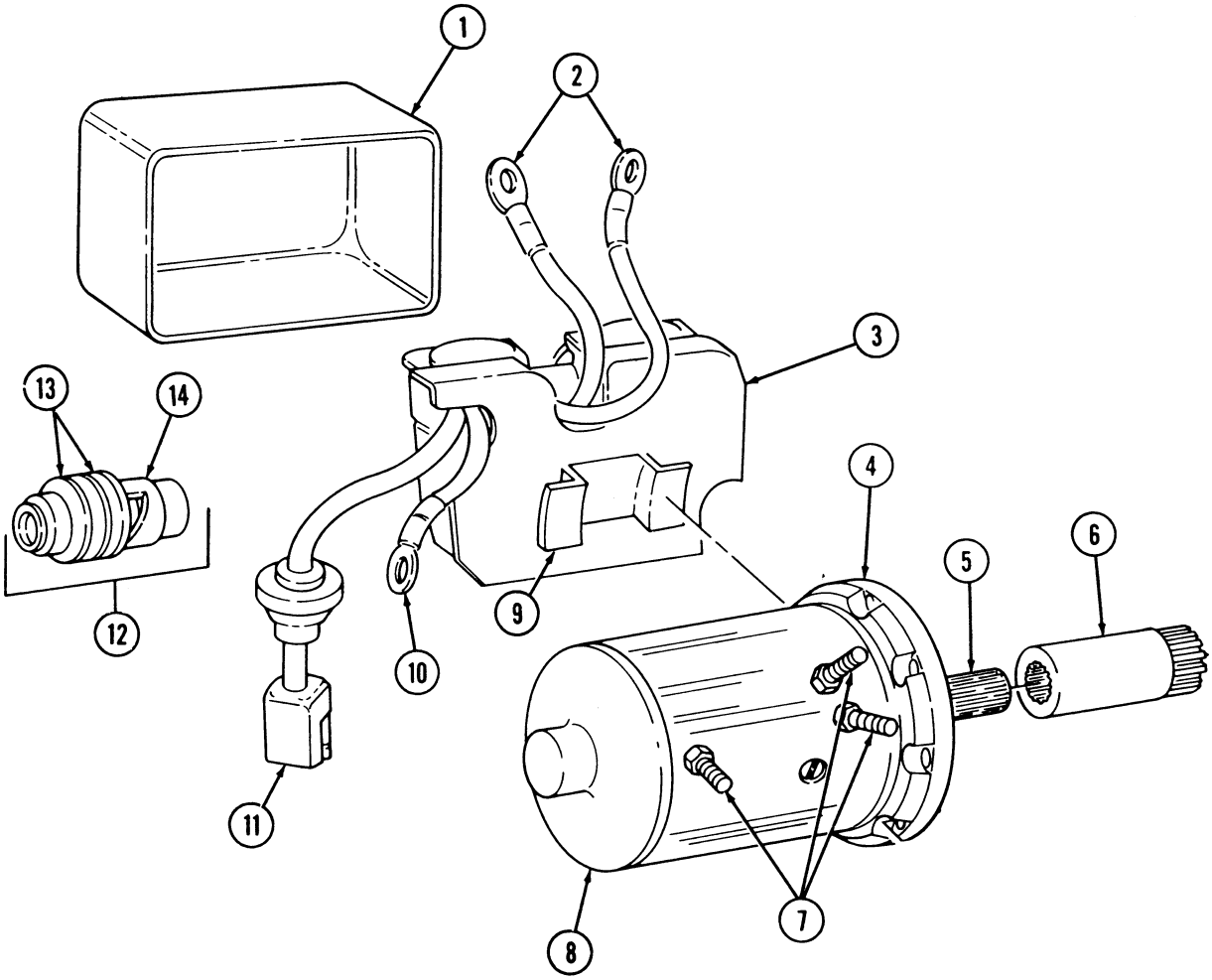


## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

**CAUTION**

The gaps of both friction rings must be aligned or winch may malfunction causing damage to equipment.

17. Inspect friction rings (13) and drive cam (14) on brake assembly (12) for damage. Replace brake assembly (12) if damaged.
18. Inspect brake assembly (12) for other damage. Replace if damaged.
19. Inspect motor (8), splines (5), mating surface (4) and terminals (7) for damage. Replace motor (8) if damaged.
20. Inspect coupling (6) for damage. Replace if damaged.
21. Inspect cover (1) for damage. Replace if damaged.
22. Inspect control (3) for damaged leads (2), (10), and (11), breaks in plastic coating, and damaged mounting base (9). Replace control (3) if damaged or repair plastic coating.
23. Inspect all other items in accordance with para. 2-14.



## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

**d. Assembly**

**NOTE**

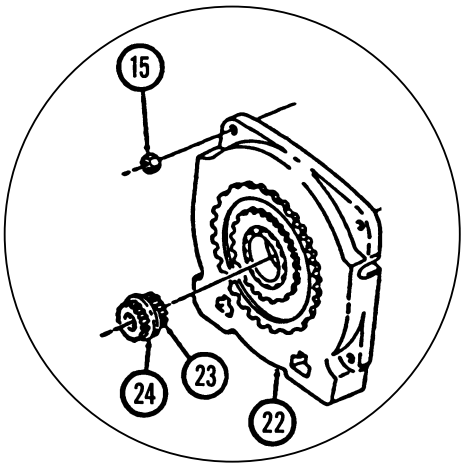
For general inspection instructions, refer to para. 2-16.

1. Install three tie rods (21) into drum support (19) with three locknuts (18).
2. Install drive shaft (20) in brake assembly (12) and apply aircraft grease to brake assembly (12).
3. While holding driveshaft (20), rotate brake assembly (12) to compress for installation, and install in drum (17).
4. Apply aircraft grease to thrust bushing (16) and install thrust bushing (16) and drum (17) on drum support (19).

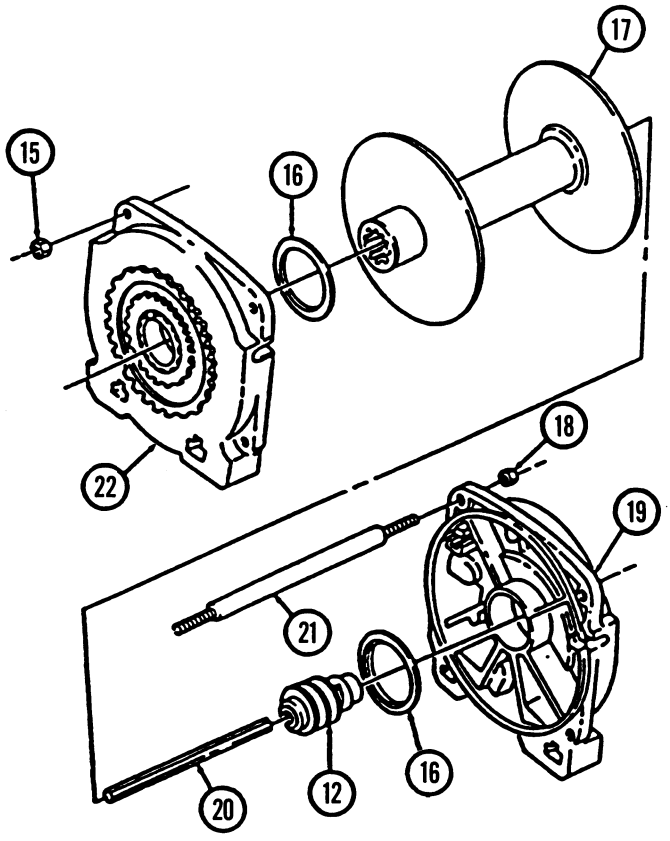
**NOTE**

Perform step 5 for vehicles with old configuration only.

5. Install retaining ring (23) on spline drive (24) and install both in drum (17).
6. Apply aircraft grease to thrust bushing (16). Install thrust bushing (16) and drum support (22) on drum (17) and tie rods (21) with three locknuts (15). Tighten locknuts (15) and (18) to 18 lb-ft (25 N•m).




**OLD CONFIGURATION**



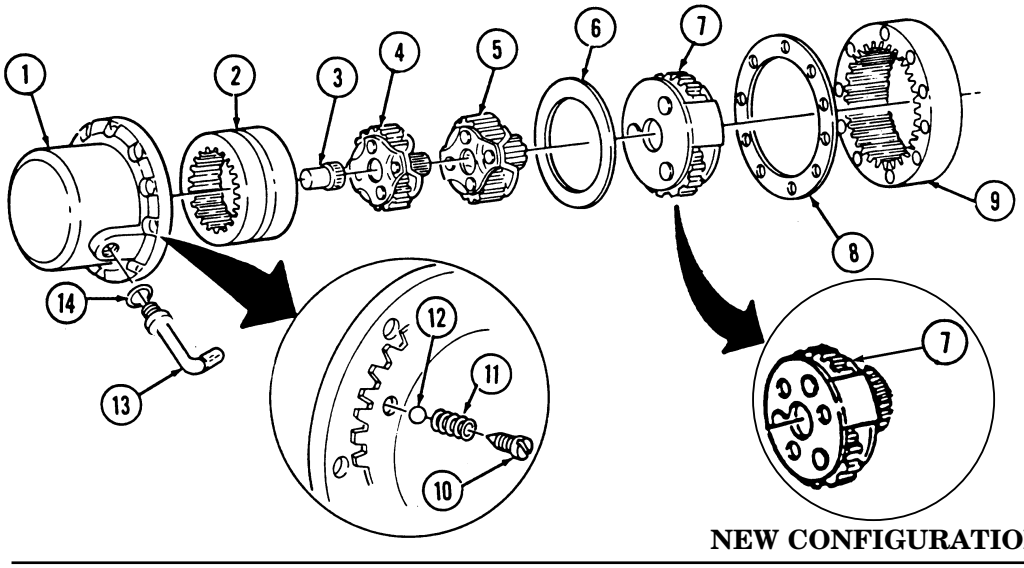
## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

7. Install clutch ring gear (2) into end housing (1) with pointed ends of gear teeth facing in.
8. Install O-ring seal (14) on clutch lever (13) and apply aircraft grease to unpainted surfaces of clutch lever (13).
9. Align groove in clutch ring gear (2) with hole in end housing (1) and install clutch lever (13) in end housing (1).

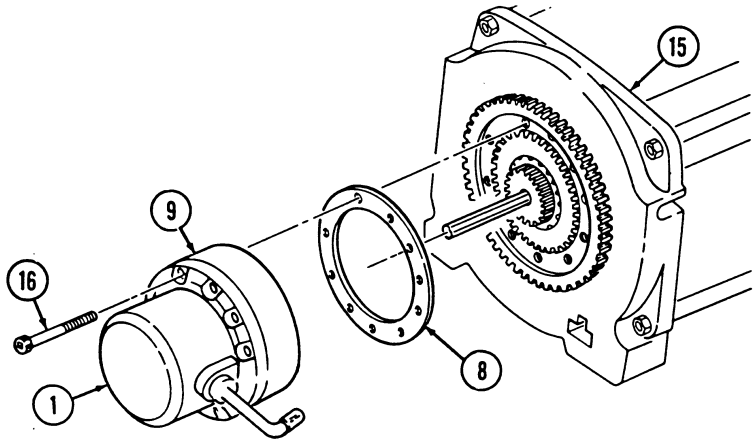
**CAUTION**

Do not tighten setscrew past flush with housing, or damage to winch may result.

10. Install ball (12), spring (11), and setscrew (10) in end housing (1).
11. Apply aircraft grease to stage one sun gear (3), stage one gear carrier (4), and stage two gear carrier (5) and install in end housing (1).
12. Apply aircraft grease to thrust washer bearing (6) and stage three gear carrier (7) and install in end housing (1).
13. Install gasket (8) and ring gear (9) on end housing (1).
14. Install end housing (1), ring gear (9), and gasket (8) on drum support (15), ensure to align reference marks and secure with ten socket-head screws (16). Using hex-head driver, tighten screws (16) to 35 lb-in. (4 N•m).




**NEW CONFIGURATION**



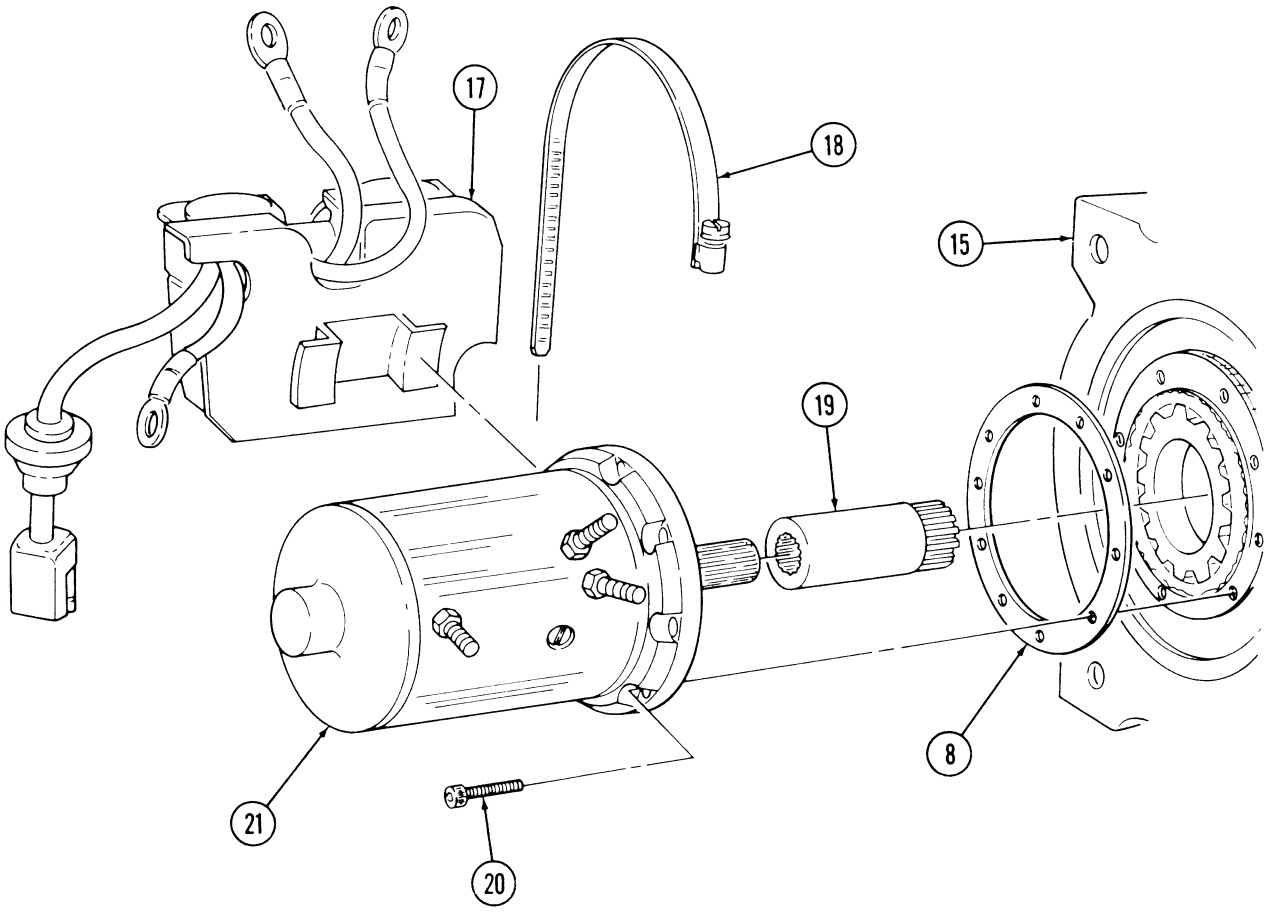
## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

15. Assemble gasket (8) and coupling (19) on motor (21) and install on drum support (15), ensuring to align reference marks.
16. Install motor (21) on drum support (15) with ten socket head screws (20). Using hex head driver, tighten screws (20) to 35 lb-in. (4 N•m).

**NOTE**

If motor or control have been pre-coated with sealing compound, remove compound from between motor case and control mounting gear contact area. Failure to do so may cause improper grounding of control.

17. Install clamp (18) on motor (21).
18. Install control (17) on motor (21).



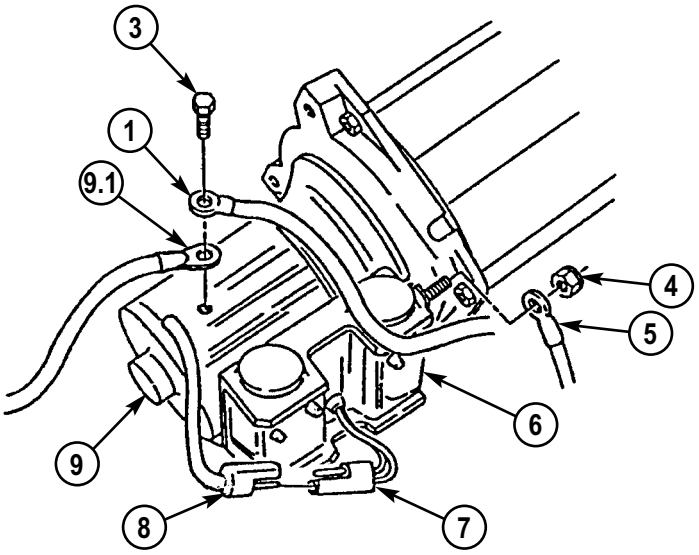
## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

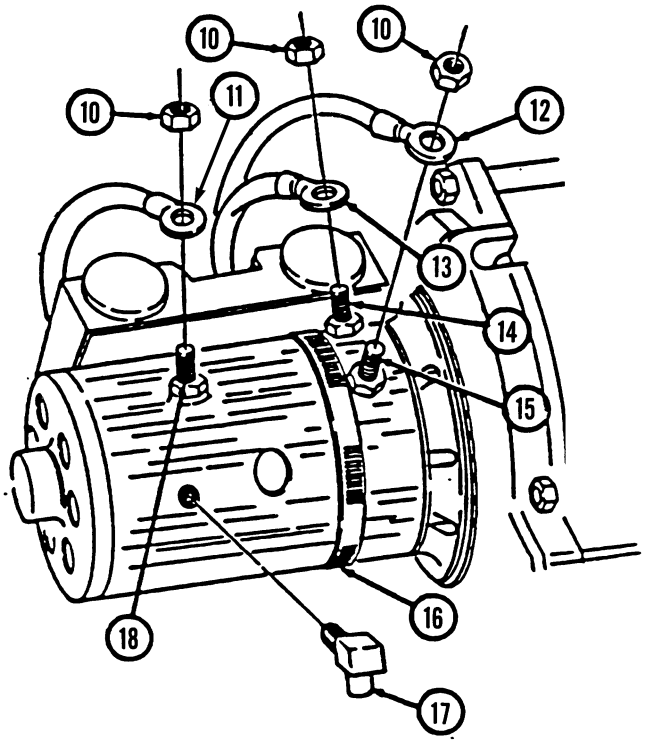
19. lnstall leads (11), (12), and (13) on terminals (18), (15), and (14) with three nuts (10).
20. Apply pipe sealant to threads of vent tube fitting (17).
21. Install vent tube fitting (17).
22. Install control (6) on motor (9) with clamp (16).
23. Connect control connector (7) to motor connector (8).

**NOTE**

Lead 6C must be positioned to align with opening in cover.

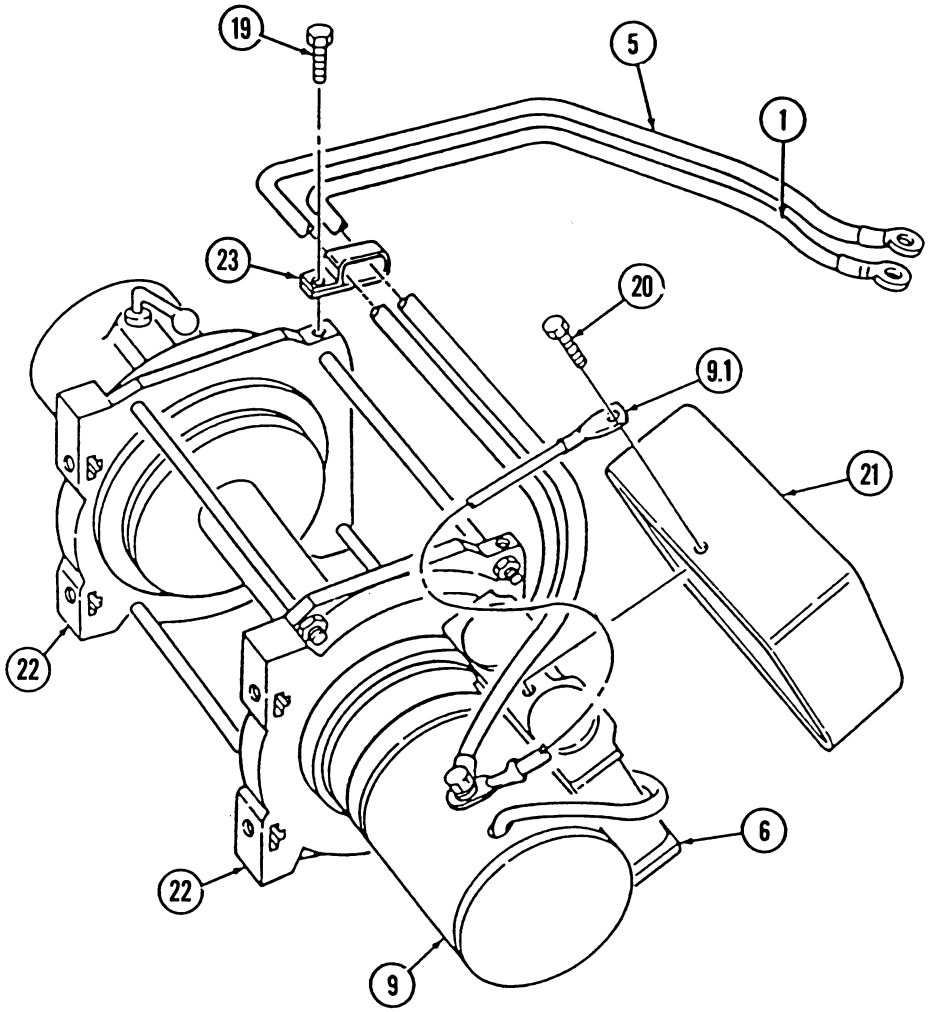
24. Install lead 6C (5) on control (6) with nut (4).
25. Install ground wire (9.1) and lead 7C (1) on motor (9) with capscrew (3).



## 15-3. 6,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

26. Coat motor (9) end of winch up to drum support (22) with coating compound.
27. Secure leads 6C (5) and 7C (1) to drum supports (22) with two clamps (23) and screws (19).
28. Install cover (21) and ground wire (9.1) on control (6) with screw (20).




FOLLOW-ON TASK: Install winch (TM 9-2320-280-20).

## 15-4. 9,000 LB. ELECTRIC WINCH REPAIR

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2
M1045A2, M1097A2

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Special Tools**
Hex head driver, 5/32 in. (Appendix G, Item 117)

**Materials/Parts**
O-ring (Appendix E, Item 125)
Three gaskets (Appendix E, Item 13)
Coating compound (Appendix B, Item 11)
Lubricating oil (Appendix B, Item 28)

**Materials/Parts (Cont'd)**
Aircraft grease (Appendix B, Item 20)
Bushing grease (Appendix B, Item 22)
Anaerobic pipe sealant (Appendix B, Item 49)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Winch removed (TM 9-2320-280-20).

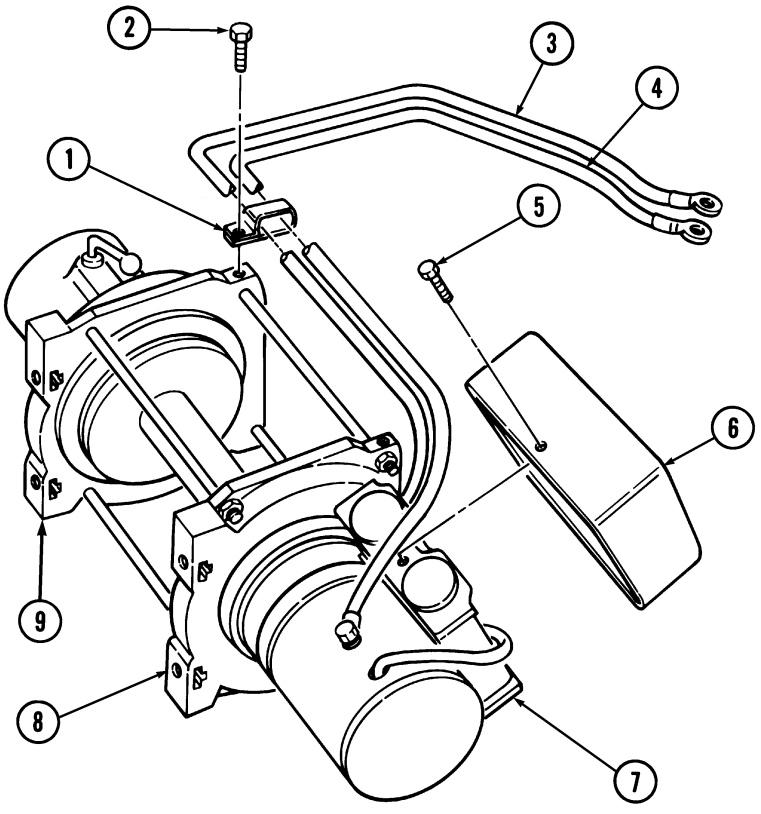
**Maintenance Level**
Direct support

### a. Disassembly

**NOTE**

Tag leads for assembly.

1. Remove two screws (2), clamps (1), and leads 6C (3) and 7C (4) from motor end drum support (8) and gear end drum support (9).
2. Remove three screws (5) and motor control cover (6) from control (7).

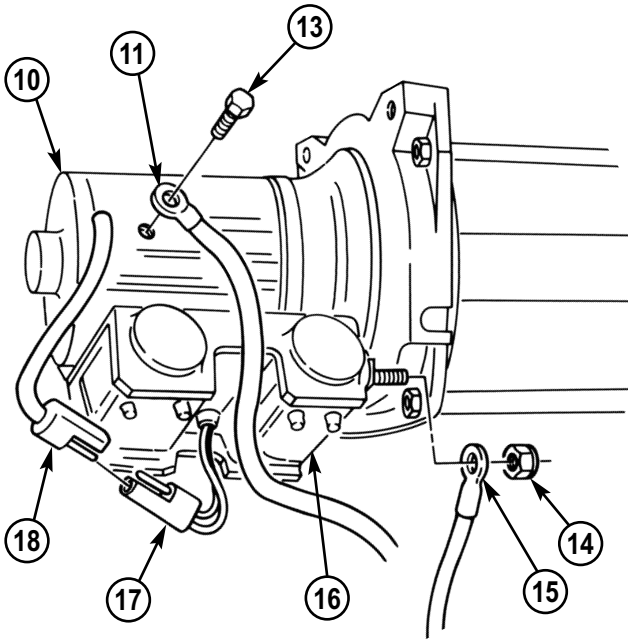


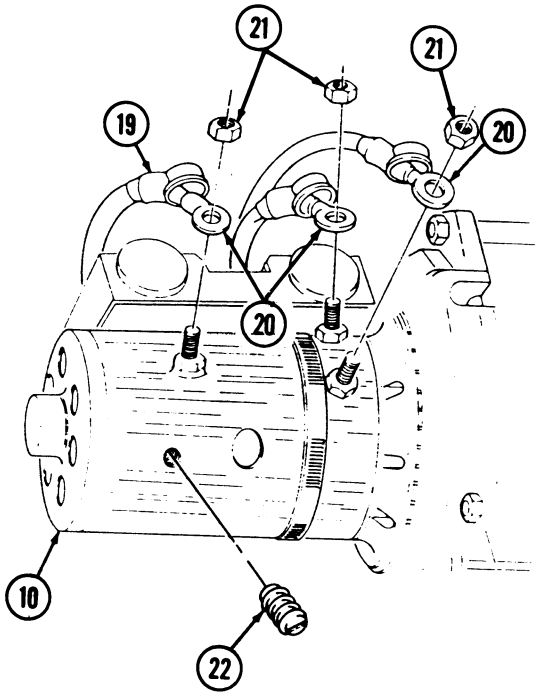
## 15-4. 9,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

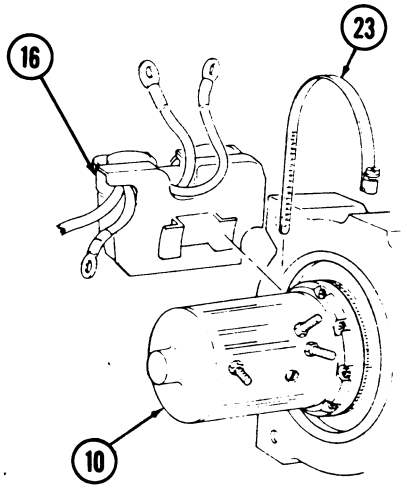
**NOTE**

In order to perform steps 3 through 9, it may be necessary to remove plastic coating from winch.

3. Remove nut (14) and lead 6 (15) from control (16).
4. Remove capscrew (13) and lead 7 (11) from motor (10).
5. Disconnect motor connector (18) from control connector (17).
6. Slide back three rubber boots (19) and remove nuts (21) and control leads (20) from motor (10).
7. Remove set screw (22) from motor (10).
8. Loosen two clamps (23) and remove control (16) from motor (10).
9. Remove clamps (23) from motor (10).

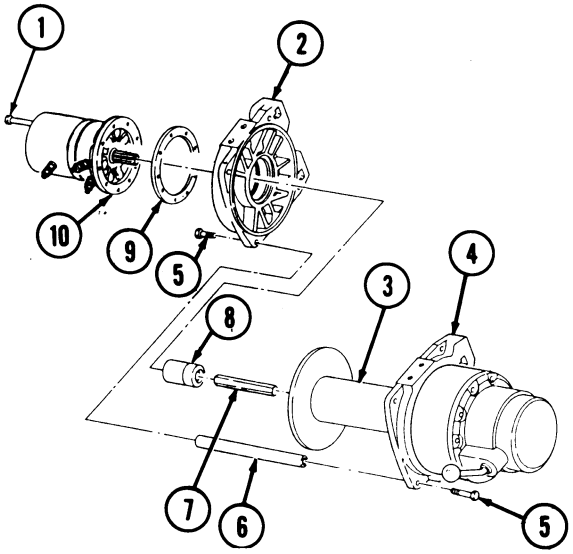


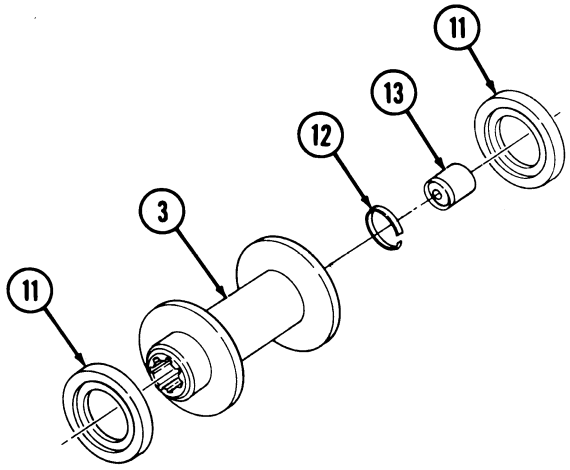



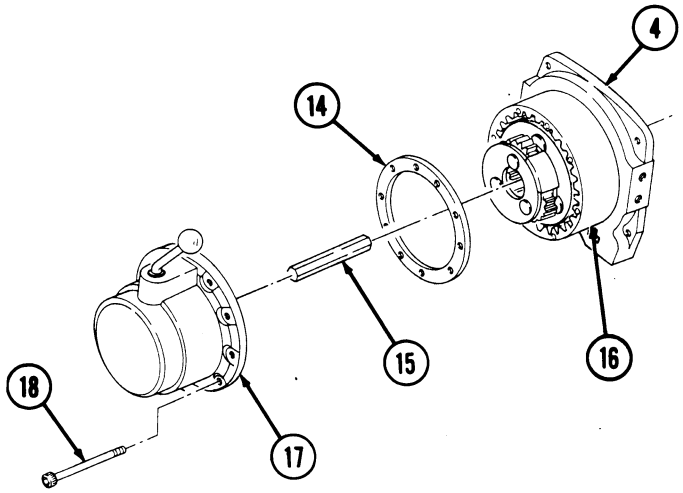



## 15-4. 9,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

10. Mark motor end drum support (2) and gear end drum support (4) for assembly.
11. Remove six capscrews (5) and three tie rods (6) from motor end drum support (2) and gear end drum support (4).
12. Place winch on end with motor end up and remove two hex head screws (1) and motor (10) from motor end drum support (2).
13. Remove gasket (9) and motor end drum support (2) from drum assembly (3). Discard gasket (9).
14. Remove motor shaft coupling (8) and input shaft (7) from drum assembly (3).
15. Remove drum assembly (3) from gear end drum support (4).
16. Remove two nylon thrust washers (11) from drum assembly (3).
17. Push brake (13) through open end of drum assembly (3) and remove thrust washer (12).
18. Remove drive shaft (15) from gear housing (17).
19. Turn gear housing (17) over with gear end drum support (4) down and remove ten hex head screws (18) and gear housing (17) from output ring gear (16).
20. Remove gasket (14) from output ring gear (16). Discard gasket (14).



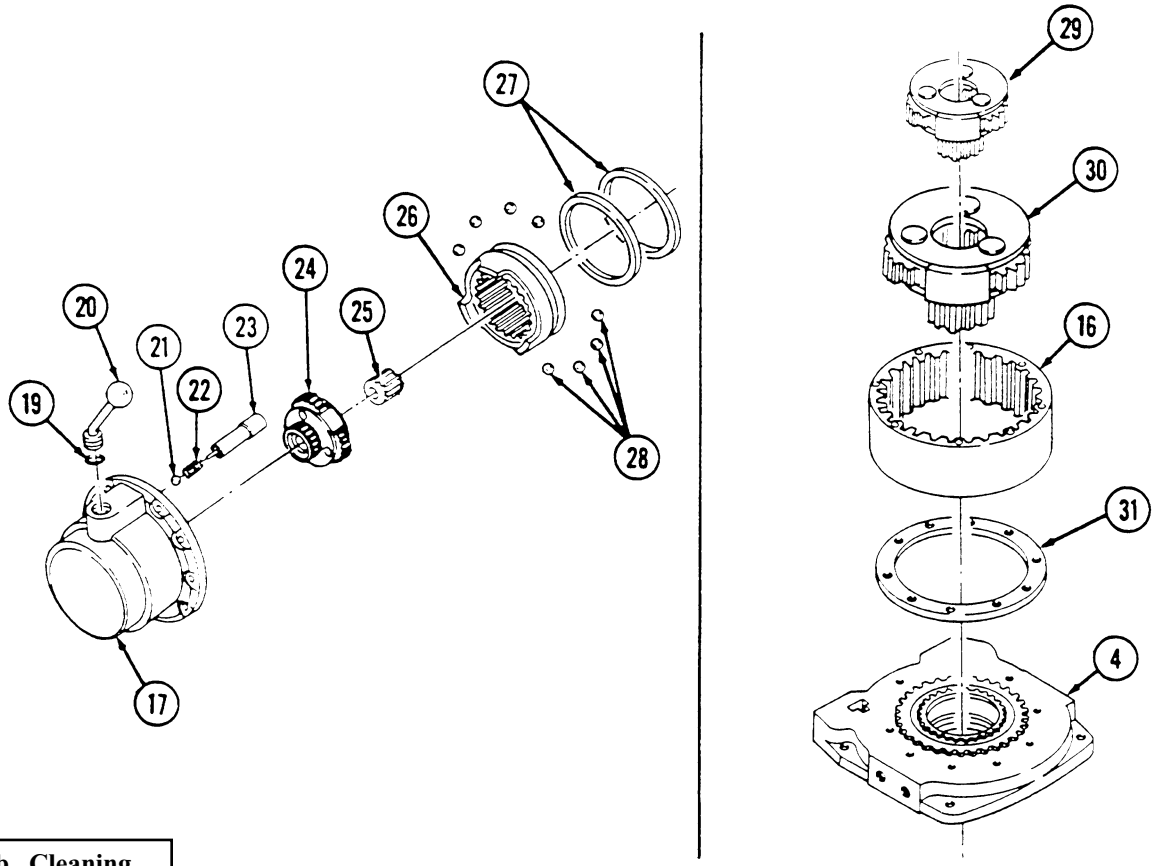
## 15-4. 9,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

21. Remove detent spacer (23), spring (22), and detent ball (21) from gear housing (17).
22. Remove clutch lever (20) and O-ring (19) from gear housing (17). Discard O-ring (19).
23. Remove two retaining rings (27) from gear housing (17).

**NOTE**

Intermediate ring gear will come out with 85-87 steel balls. Be careful to catch all 85-87 steel balls.

24. Remove intermediate ring gear (26) and 85-87 steel balls (28) from gear housing (17).
25. Remove input sun gear (25) and input gear carrier (24) from gear housing (17).
26. Remove intermediate gear carrier (29), output gear carrier (30), and output ring gear (16) from gear end drum support (4).
27. Remove gasket (31) from gear end drum support (4). Discard gasket (31).




**b. Cleaning**

**CAUTION**

Do not clean brake assembly or damage to equipment may result.

Clean all winch components in accordance with para. 2-13.

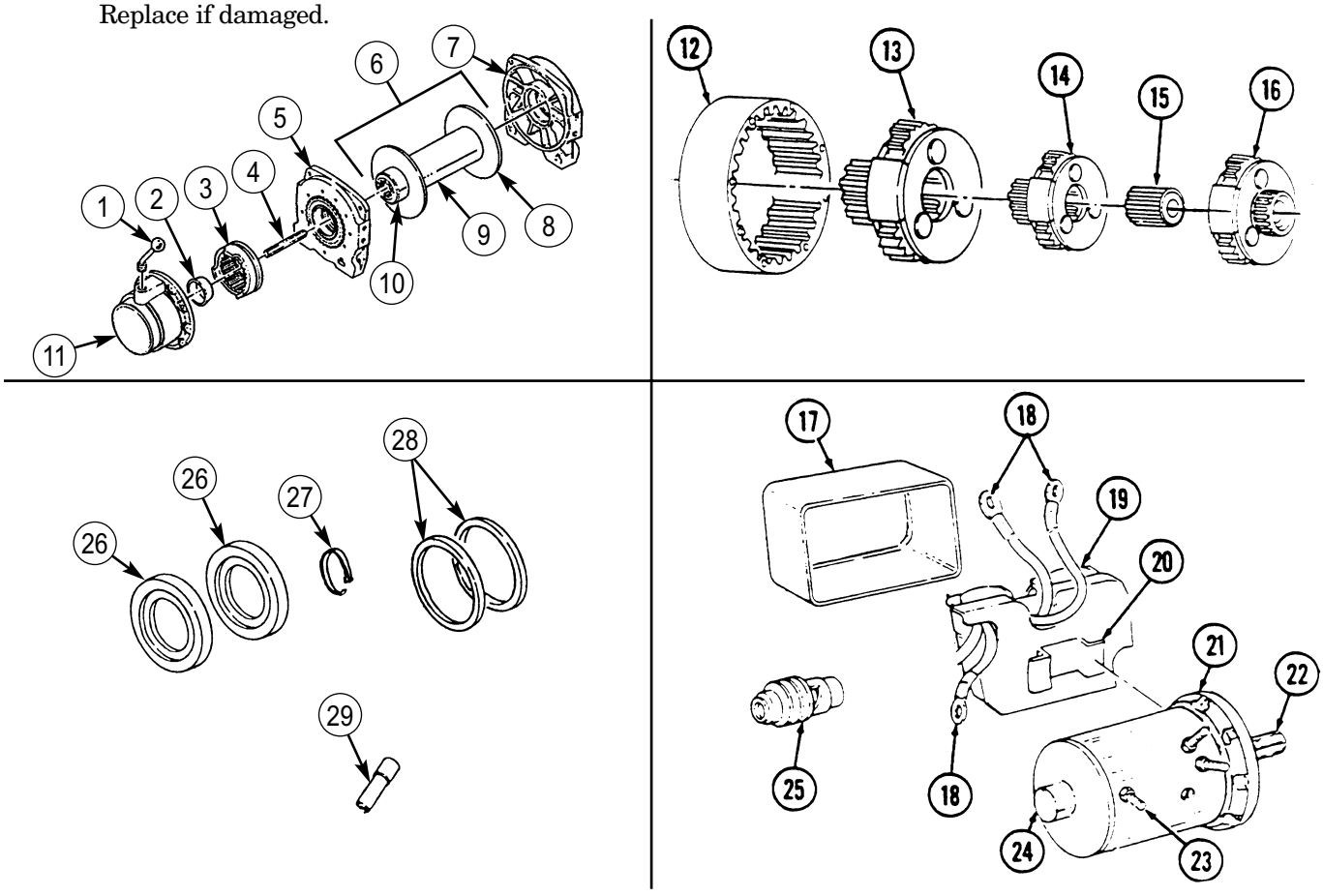
## 15-4. 9,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

**c. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect drum (6) for damage to splined end (10), flanges (8), and tube (9). Replace if damaged.
2. Inspect gear end drum support (5) and motor end drum support (7) for damage. Replace if damaged.
3. Inspect gear housing (11) for damage. Replace if damaged.
4. Inspect thrust plate (2) for damage or wear. Replace if damaged or worn. Apply grease on thrust plate (2) for assembly.
5. Inspect gear teeth and machined surfaces of intermediate ring gear (3) for damage. Replace if damaged.
6. Inspect clutch lever (1) and drive shaft (4) for damage. Replace if damaged.
7. Inspect gear teeth, splines, and machined surfaces of output ring gear (12), output gear carrier (13), intermediate gear carrier (14), input gear carrier (16), and input sun gear (15) for damage. Replace any damaged parts.
8. Inspect brake assembly (25) for damage. Replace if damaged.
9. Inspect motor (24), spline (22), mating surface (21), and terminals (23) for damage. Replace if damaged.
10. Inspect cover (17) for damage. Replace if damaged.
11. Inspect control (19) for damaged leads (18), breaks in plastic coating, and damaged mounting base (20). Replace control (19) if damaged or repair plastic coating.
12. Inspect three thrust washers (26) and (27), two retaining rings (28) and detent spacer (29) for damage. Replace if damaged.



## 15-4. 9,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

**d. Assembly**

1. Position 85-87 steel balls (34) in groove of intermediate ring gear (3) and install intermediate ring gear (3) in gear housing (11).

**NOTE**

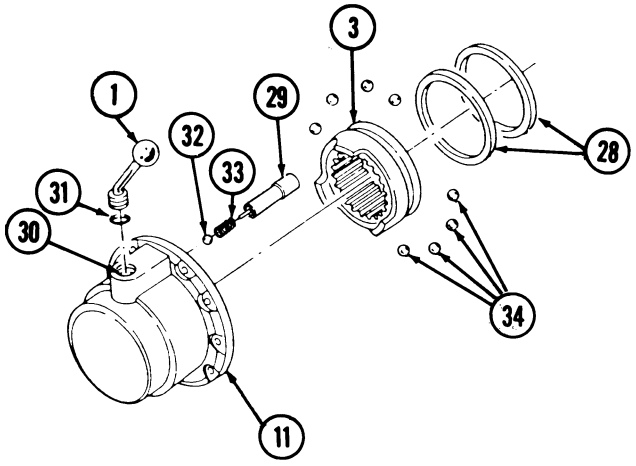
Openings in retaining rings should be opposite of each other and 90 degrees from clutch lever.

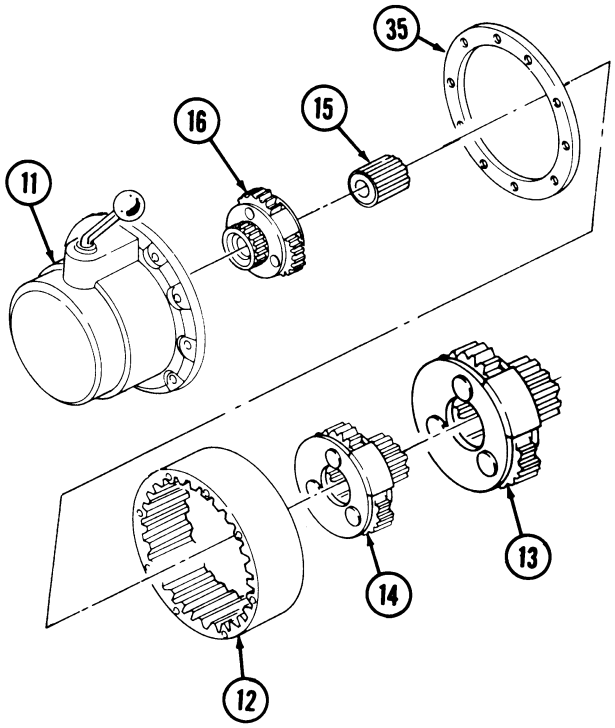
2. Install two retaining rings (28) in gear housing (11).
3. Apply light oil to steel balls (34) through the clutch lever hole (30).
4. Apply grease to clutch lever hole (30) and install O-ring (31) and clutch lever (1) in gear housing (11).
5. Install detent ball (32), spring (33), and detent spacer (29) in gear housing (11).
6. Apply aircraft grease to output ring gear (12), intermediate gear carrier (14), and output gear carrier (13) and input gear carrier (16).
7. Install input sun gear (15) and input gear carrier (16) in gear housing (11).

**NOTE**

Be sure ring gear engages in gear housing.

8. Install gasket (35) and output ring gear (12) on gear housing (11).
9. Install intermediate gear carrier (14) on gear housing (1).
10. Install output gear carrier (13) on input gear carrier (16).



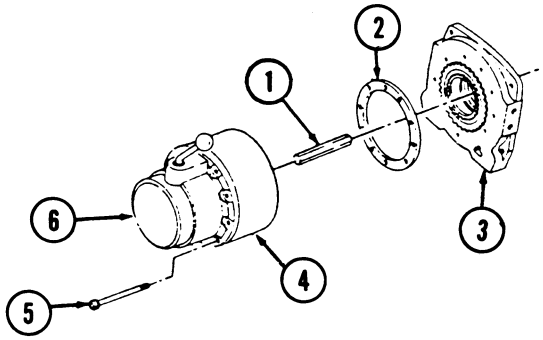
## 15-4. 9,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

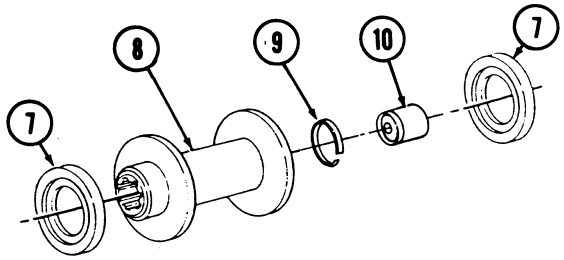
11. Install gasket (2) on output ring gear (4).

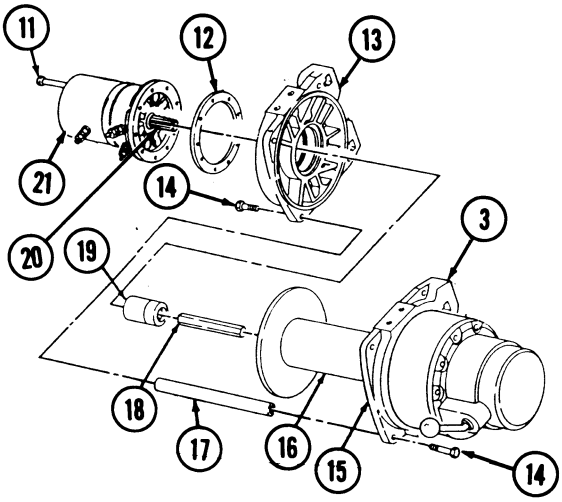
**NOTE**

Ensure spline on drum support engages in output ring gear.

12. Install gear end drum support (3) on output ring gear (4).
13. Install gear housing (6) on gear end drum support (3) with ten hex head screws (5). Tighten hex head screws (5) to 100 lb-in. (11.3 N•m).
14. Turn gear housing (6) over with gear end drum support (3) facing up.
15. Install drive shaft (1) in output ring gear (4).
16. Apply grease to drum (8) and brake (10) and install thrust washer (9).
17. With drum horizontal, install brake (10) into drum (8).
18. Install two nylon thrust washers (7) on drum (8).
19. Install drum assembly (16) on gear end drum support (3). Rotate drum assembly (16) as needed to engage drive shaft (1) and brake (10).
20. Install input shaft (18) and motor shaft coupling (19) in drum assembly (16).
21. Install motor end drum support (13) on drum assembly (16).
22. Install gasket (12) on motor (21) and motor end drum support (13) ensuring to engage motor shaft (20) into motor shaft coupling (19).
23. Install two hex head screws (11) on motor (21) and motor end drum support (13). Tighten hex head screws (11) to 35 lb-in. (47 N•m).
24. Install three tie rods (17) between motor end drum supports (13) and gear end drum support (3) with six capscrews (14). Tighten capscrews (14) to 18 lb-ft (24 N•m).



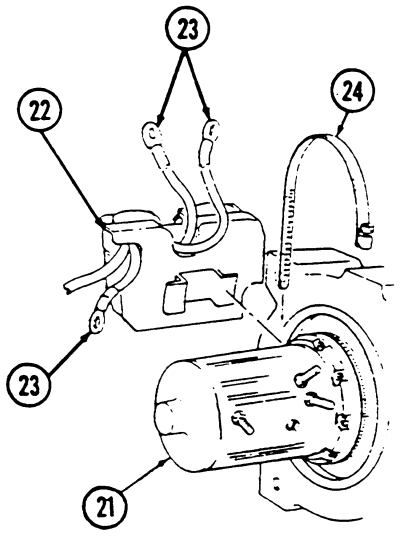



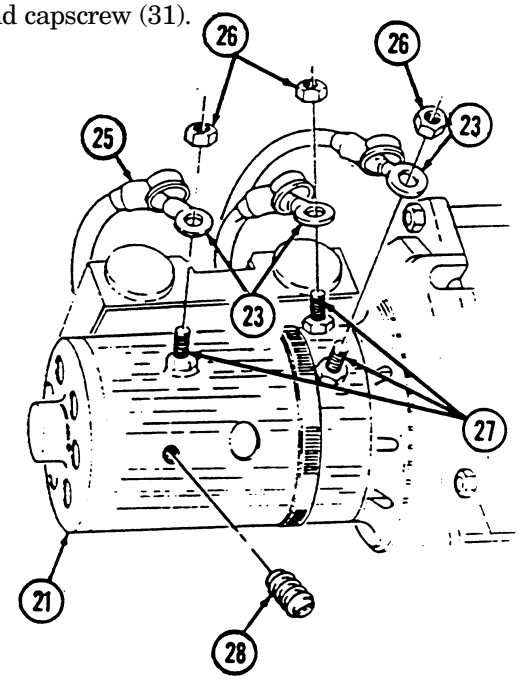
## 15-4. 9,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

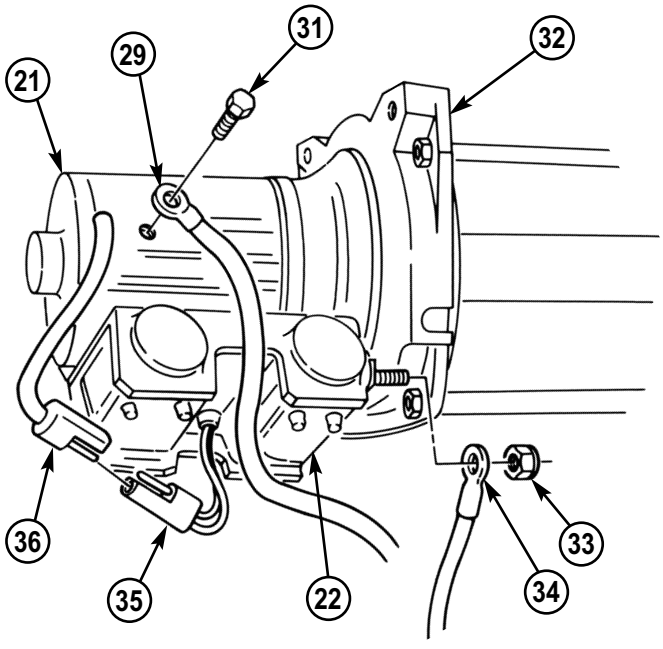
**NOTE**

If motor or control have been pre-coated with sealing compound, remove compound from between motor case and control mounting gear contact area. Failure to do so may cause improper grounding of control.

25. Install two clamps (24) on motor (21).
26. Install control (22) on motor (21) and tighten two clamps (24).
27. Connect three leads (23) to terminals (27) with nuts (26) and slide rubber boots (25) over nuts (26).
28. Apply pipe sealant to threads of set screw (28) and install on motor (21).
29. Connect control connector (35) to motor connector (36).
30. Connect lead 6 (34) to control (22) with nut (33).
31. Connect lead 7 (29) to motor (21) with lockwasher (30) and capscrew (31).

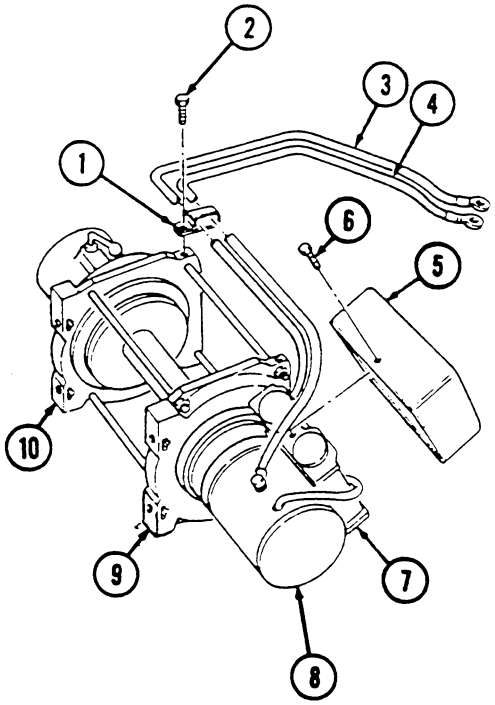


## 15-4. 9,000 LB. ELECTRIC WINCH REPAIR (Cont'd)

32. Coat motor end of winch (8) up to motor end drum support (9) with coating compound.
33. Install leads 6 (3) and 7 (4) on motor end drum support (9) and gear end drum support (10) with two clamps (1) and screws (2).
34. Install motor control cover (5) on control (7) with three screws (6).




FOLLOW-ON TASK: Install winch (TM 9-2320-280-20).

## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Tools**
General mechanics tool kit: automotive (Appendix G, Item 1)
Maintenance and repair shop equipment: automotive (Appendix G, Item 2)

**Materials/Parts**
Four copper washers (Appendix E, Item 259)
Two square cut O-rings (Appendix E, Item 153)
O-ring (Appendix E, Item 139)
Two drum end O-rings (Appendix E, Item 152)
O-ring (Appendix E, Item 140)
Two O-rings (Appendix E, Item 141)
Grease (Appendix B, Item 20)
Sealing compound (Appendix B, Item 51)
Hydraulic fluid (Appendix B, Item 24)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Winch removed (TM 9-2320-280-20)

**Maintenance Level**
Direct Support

### a. Disassembly

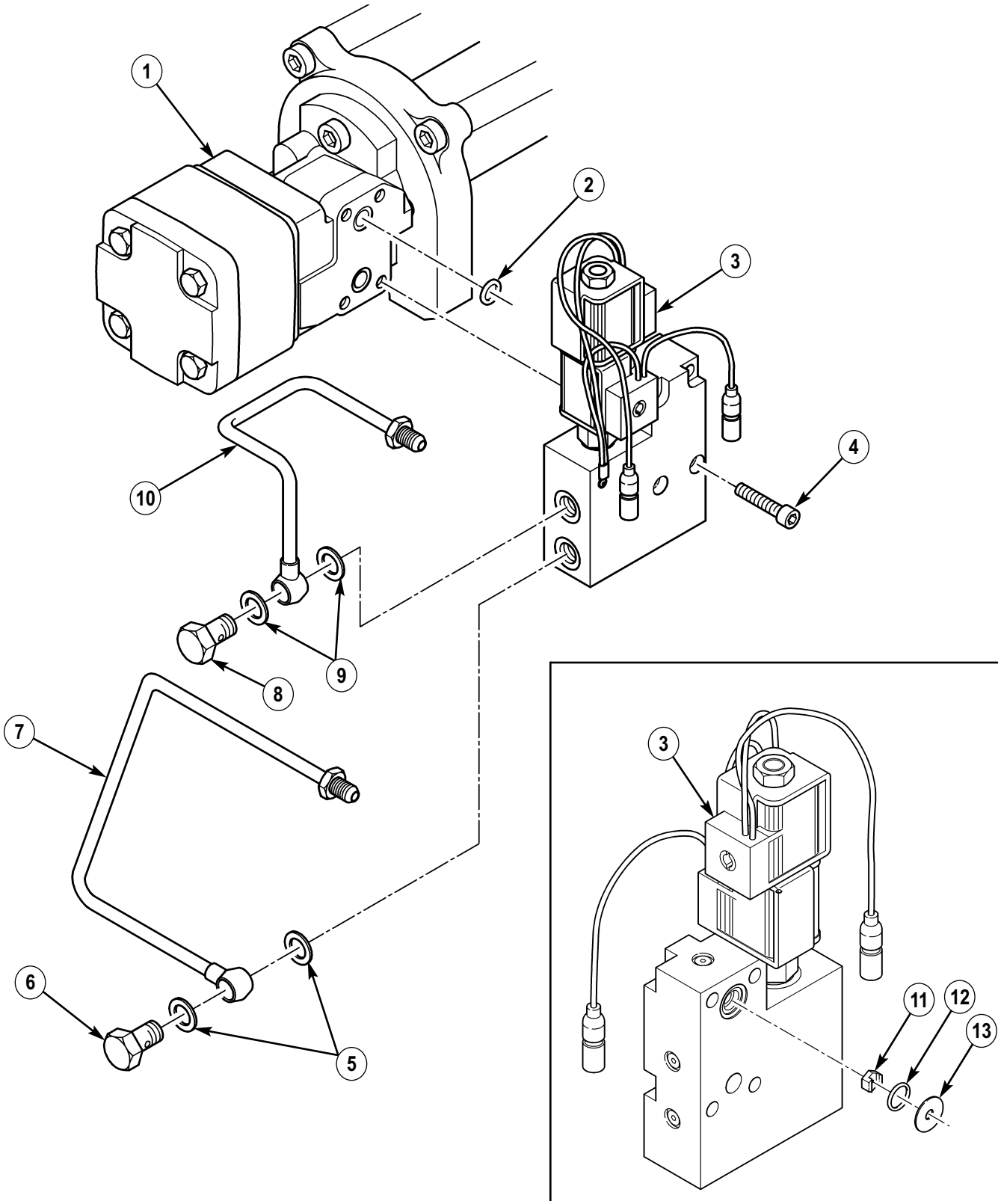
**NOTE**
Tag hydraulic lines for assembly

1. Remove banjo screw (8), two copper washers (9), and inlet banjo tube (10) from valve and solenoid assembly (3). Discard copper washers (9).
2. Remove banjo screw (6), two copper washers (5), and outlet banjo tube (7) from valve and solenoid assembly (3). Discard copper washers (5).

**NOTE**
Restrictor, restrictor washer, and O-ring may come out of valve and solenoid assembly during removal. Be careful to catch parts during disassembly.

3. Remove four socket-head screws (4) and valve and solenoid assembly (3) from motor (1).
4. Remove two O-rings (2) from motor (1). Discard O-rings (2).
5. Remove restrictor (11), restrictor washer (13), and O-ring (12) from valve and solenoid assembly (3).

## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

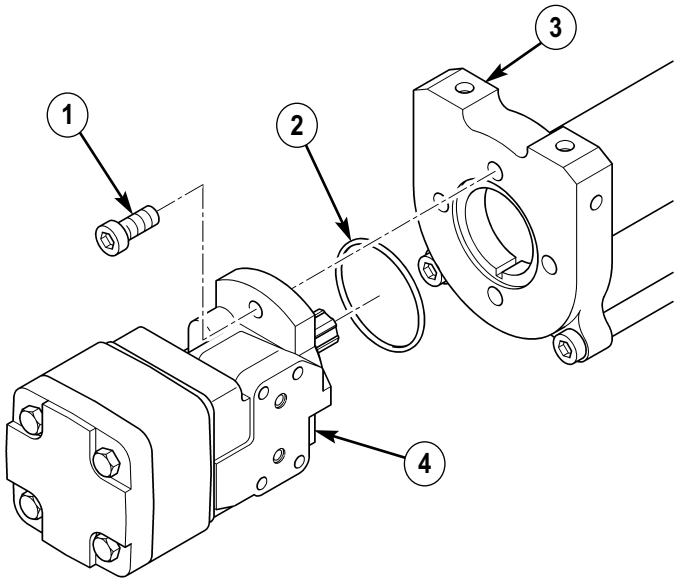


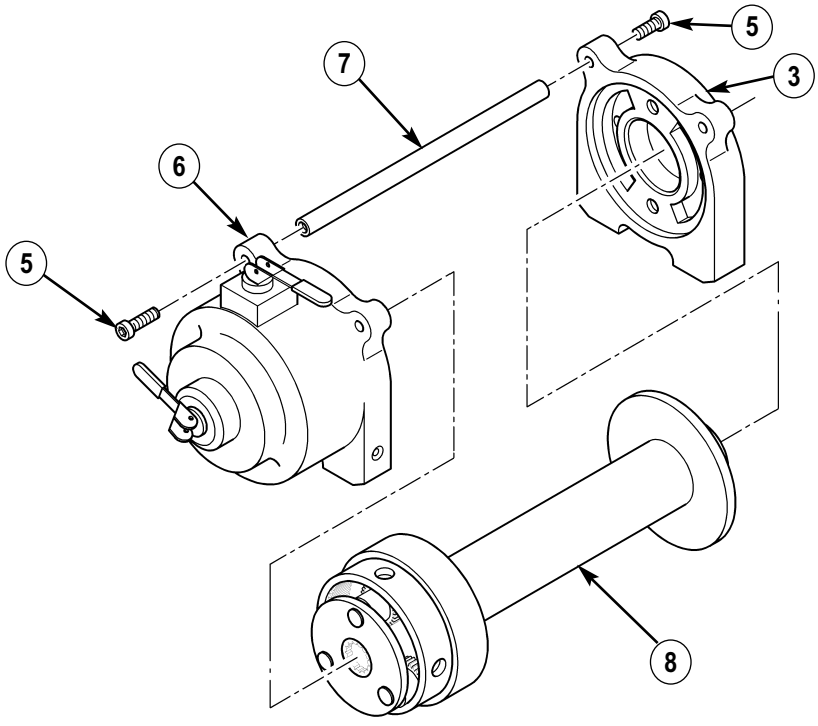
## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

**NOTE**

Scribe motor and motor end/drum support for assembly.

6. Remove two socket-head screws (1), motor (4), and O-ring (2) from motor end/drum support (3). Discard O-ring (2).
7. Remove four socket-head screws (5) and two tie bars (7) from motor end/drum support (3) and gear box/drum support (6).



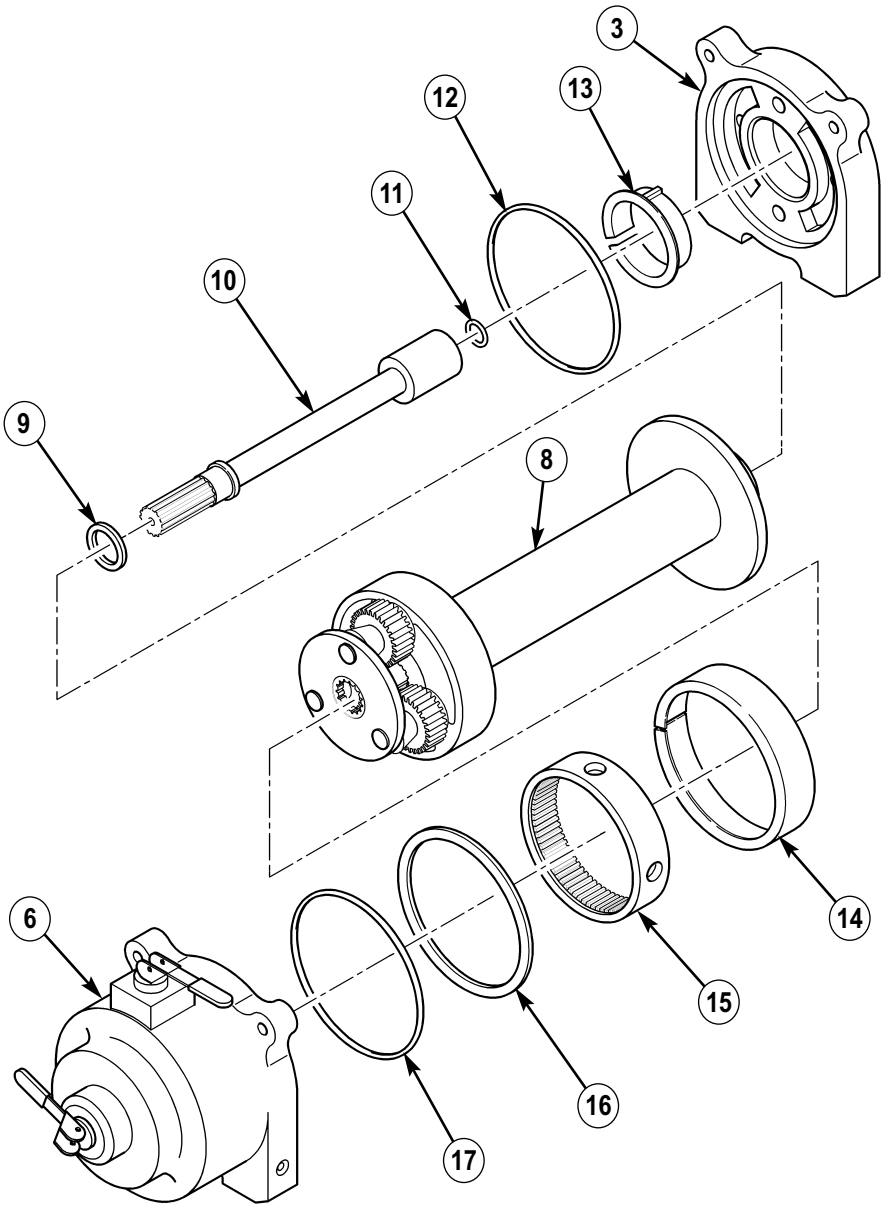
## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

8. Remove motor end/drum support (3), drum bushing (13), and O-ring (12) from drum assembly (8). Discard O-ring (12).

**NOTE**

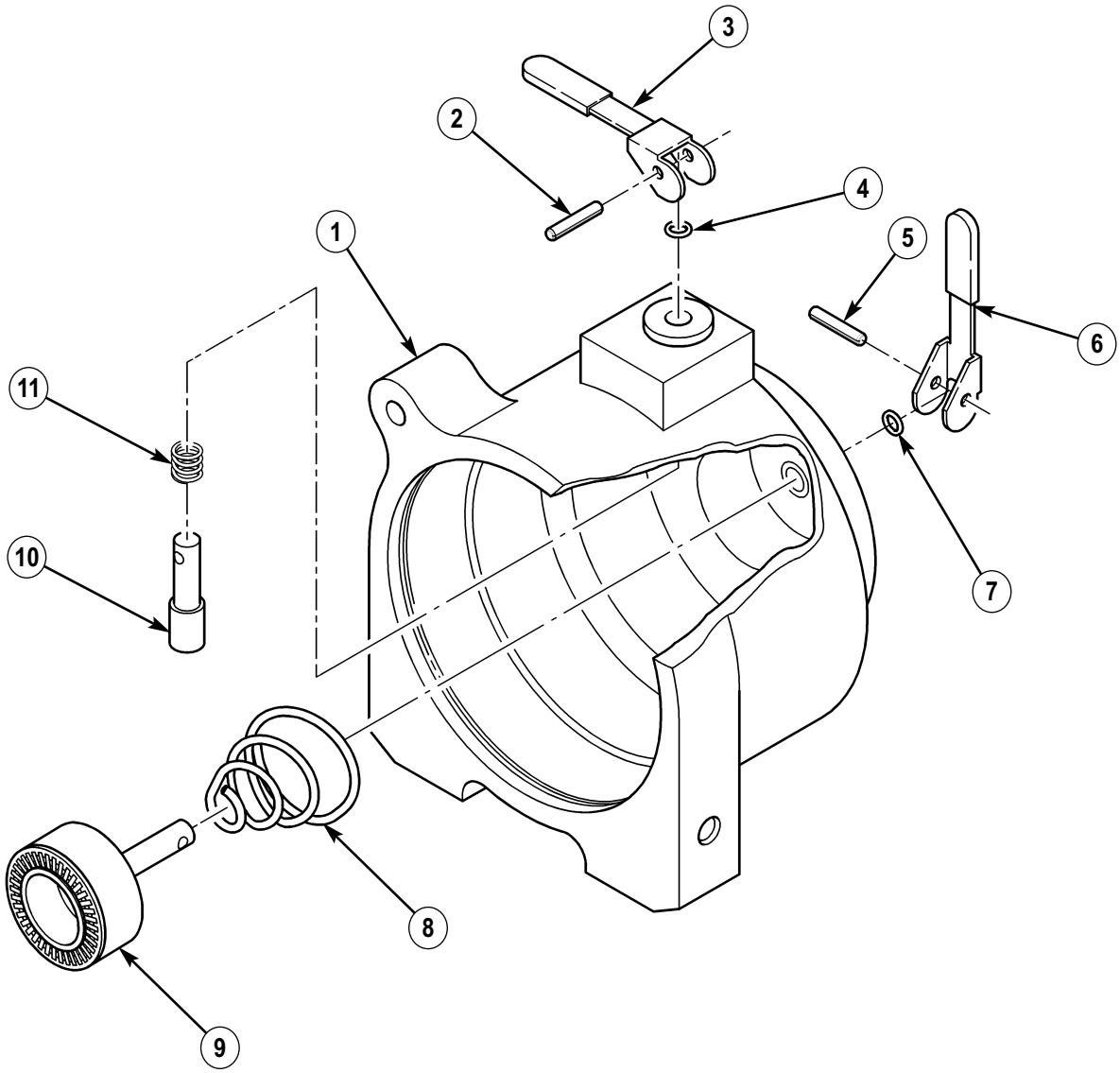
Make sure high lever and low lever are both in FREE position.

9. Remove gear box/drum support (6) and O-ring (17) from drum assembly (8). Discard O-ring (17).
10. Remove drive shaft assembly (10) from drum assembly (8). Remove drive shaft thrust washer (9) and O-ring (11) from drive shaft assembly (10). Discard O-ring (11).
11. Remove drum drive bushing (14), ring gear (15), and ring gear thrust washer (16) from gear box/drum support (6).



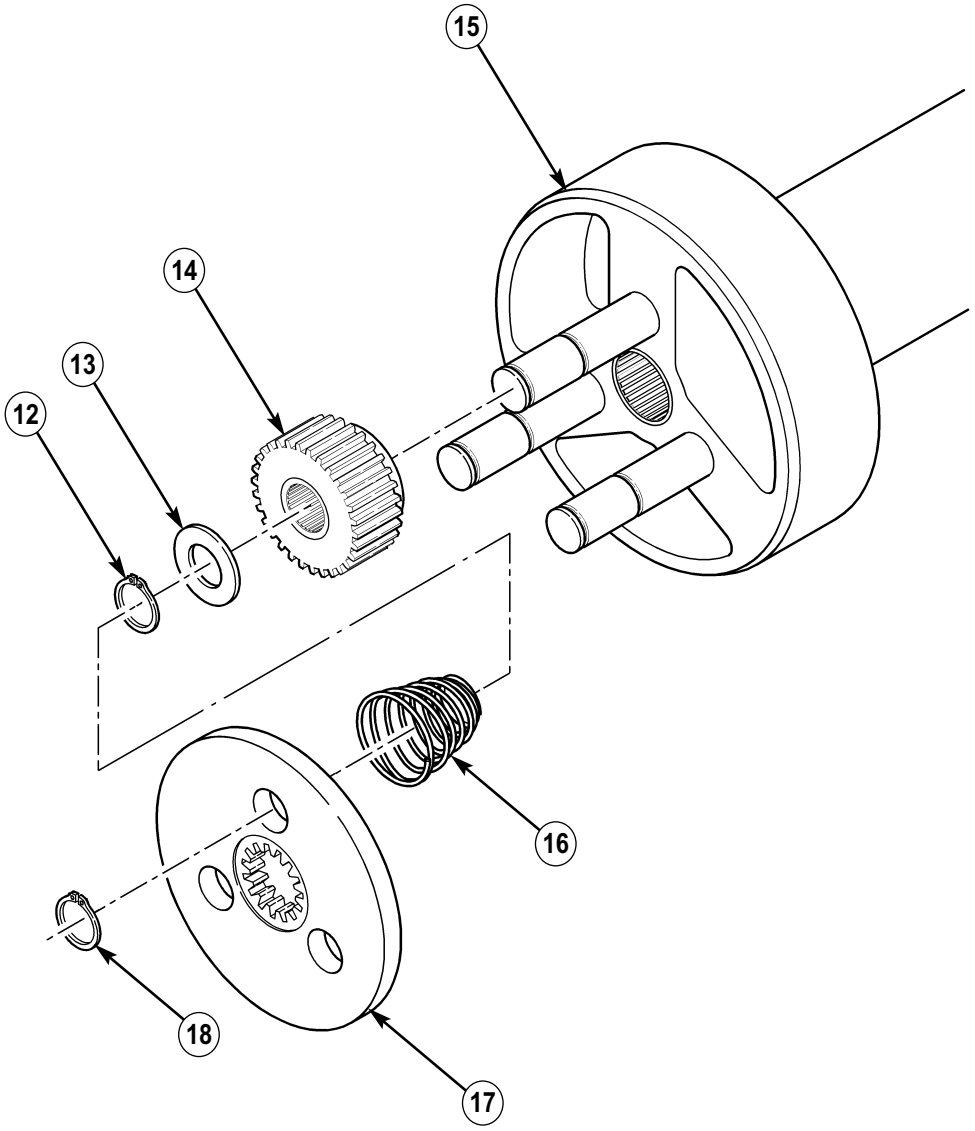
## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

12. Remove lever pin (5), high lever (6), drive shaft plunger (9), drive shaft plunger spring (8), and O-ring (7) from gear box/drum support (1). Discard O-ring (7).
13. Remove lever pin (2), low lever (3), low lever plunger (10), low lever spring (11), and O-ring (4) from gear box/drum support (1). Discard O-ring (4).



## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

14. Remove three snaprings (18), shaft plunger plate (17), and three planetary springs (16) from drum assembly (15).
15. Remove three snaprings (12), planetary washers (13), and planetary gears (14) from drum assembly (15)



## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

**b. Cleaning**

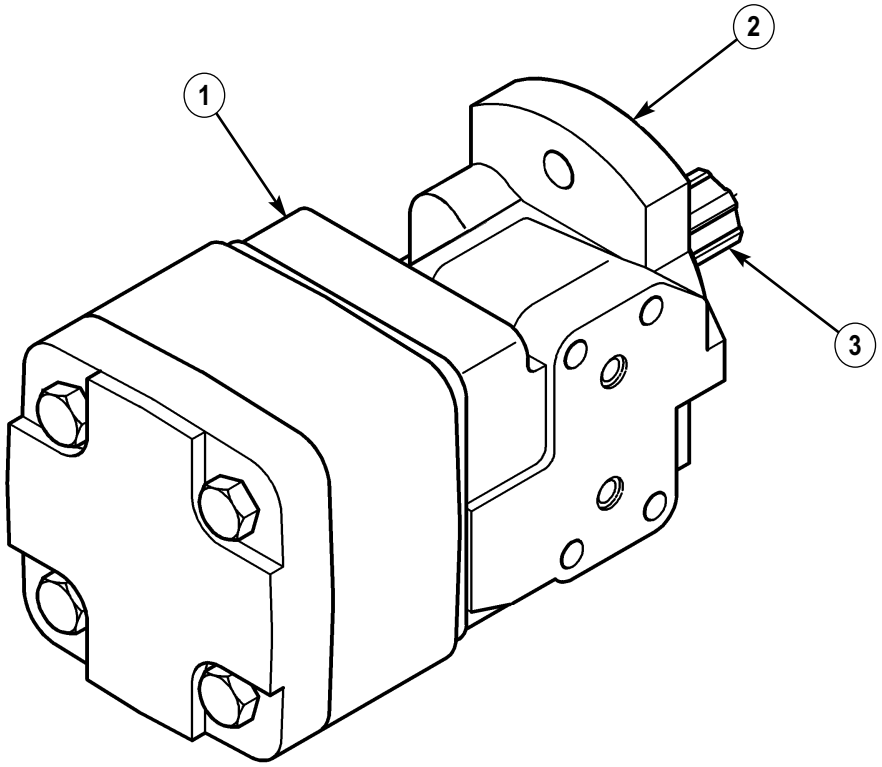
Clean all winch components in accordance with para. 2-13.

**c. Inspection**

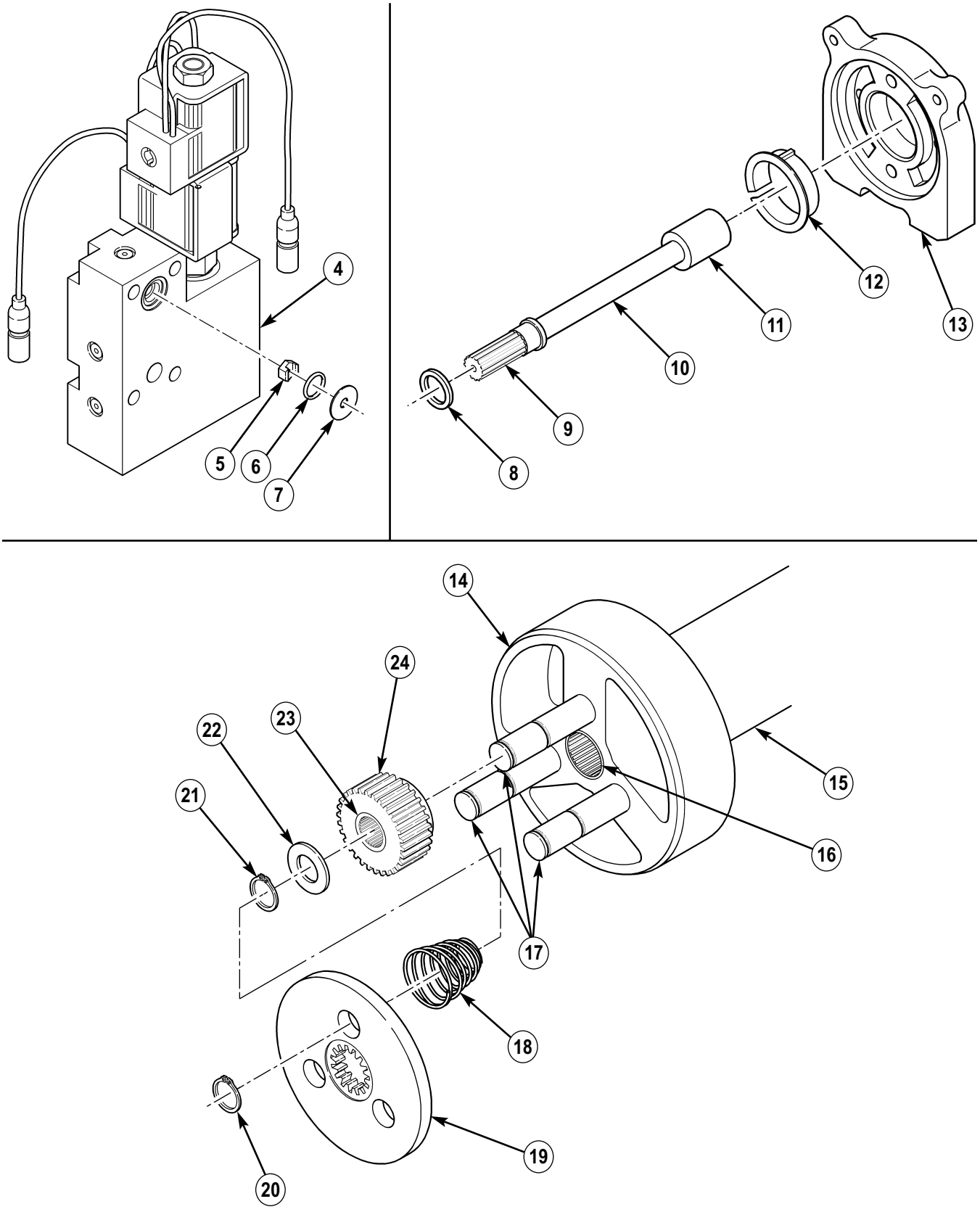
**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect motor (1), splines (3), and mating surface (2) for damage or wear. Replace if damaged or worn.
2. Inspect valve and solenoid assembly (4) and restrictor (5), O-ring (6), and restrictor washer (7) for damage or wear. Replace valve and solenoid assembly (4) if any parts are damaged or worn.
3. Inspect motor end/drum support (13) and drum bushing (12) for damage or wear. Replace any damaged or worn parts.
4. Inspect drive shaft thrust washer (8), splines (9), and machine surfaces (11) of drive shaft assembly (10) for damage or wear. Replace any damaged or worn parts.
5. Inspect drum assembly (14) for damage to roller bearing (16), planetary gear shafts (17), and tube (15). Replace drum assembly (14) if any parts are damaged or worn.
6. Inspect shaft plunger plate (19), three planetary gears (24) and bearings (23), planetary springs (18), planetary washers (22), snaprings (20), and snaprings (21) for damage or wear. Replace drum assembly (14) if any parts are damaged or worn.

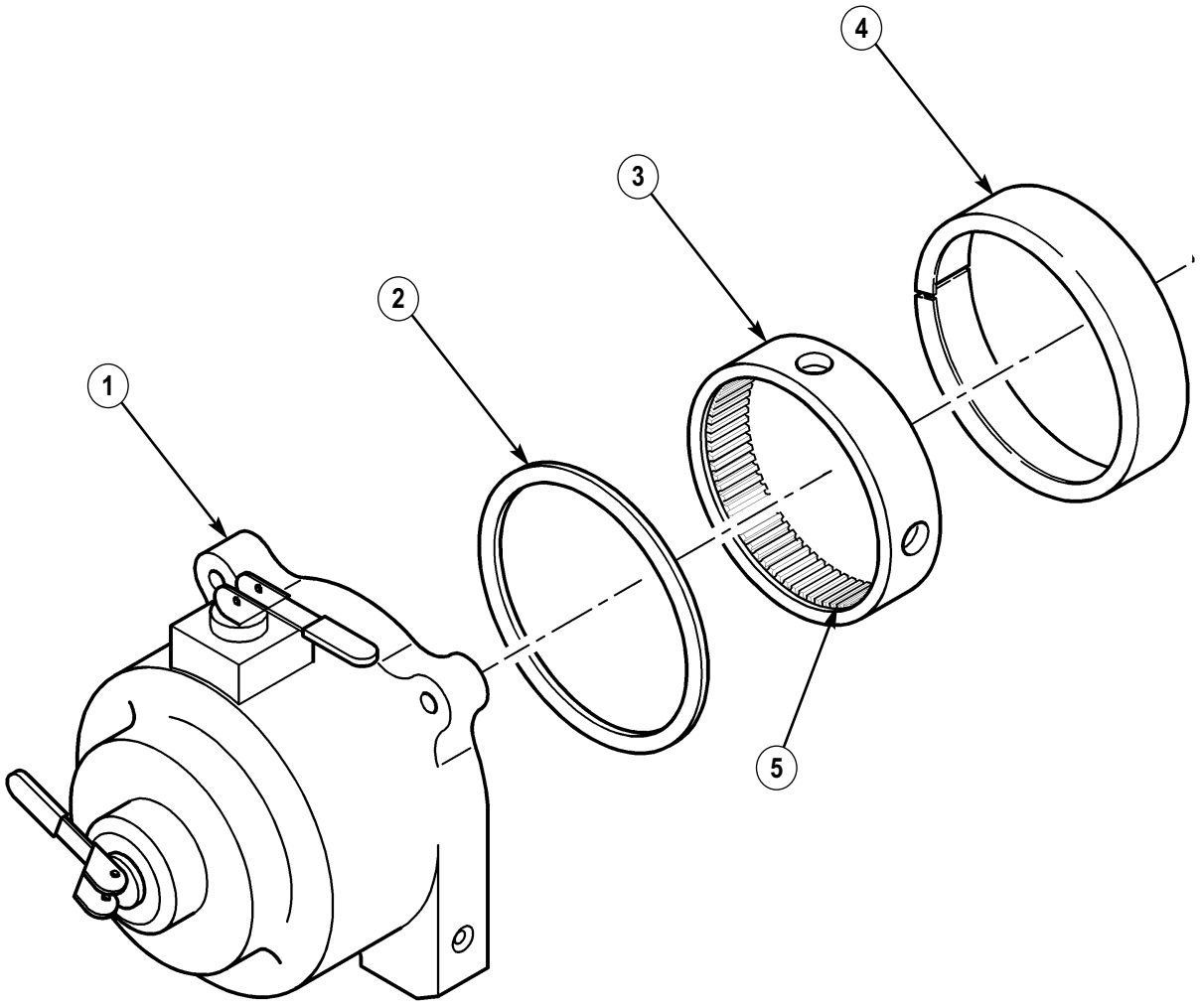


## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)



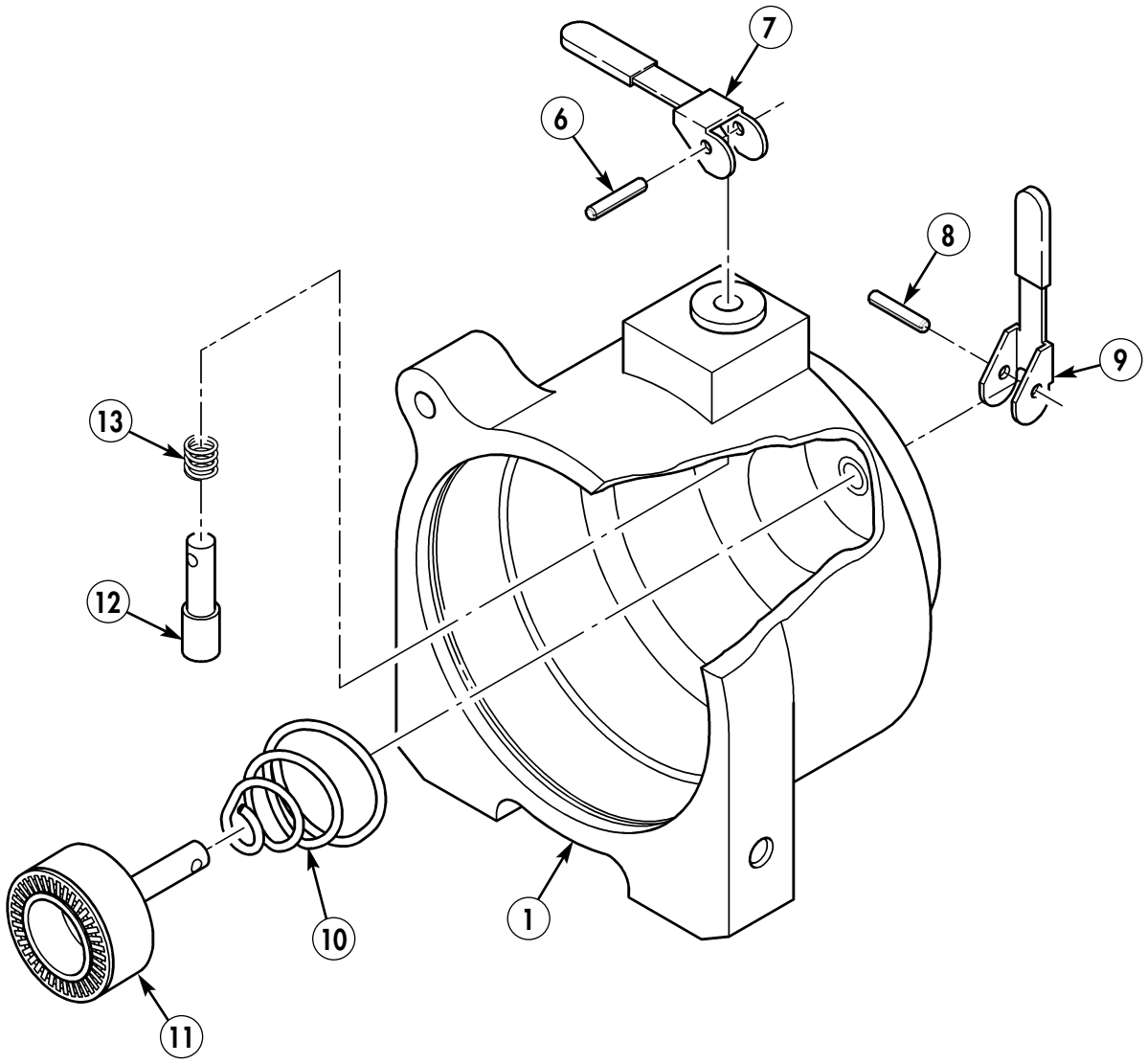
## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

7. Inspect ring gear thrust bushing (2) and drum drive bushing (4) for damaged or wear. Replace any damaged or worn parts.
8. Inspect gear teeth (5) and machined surfaces of ring gear (3) for damage or wear. Replace any damaged or worn parts.



## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

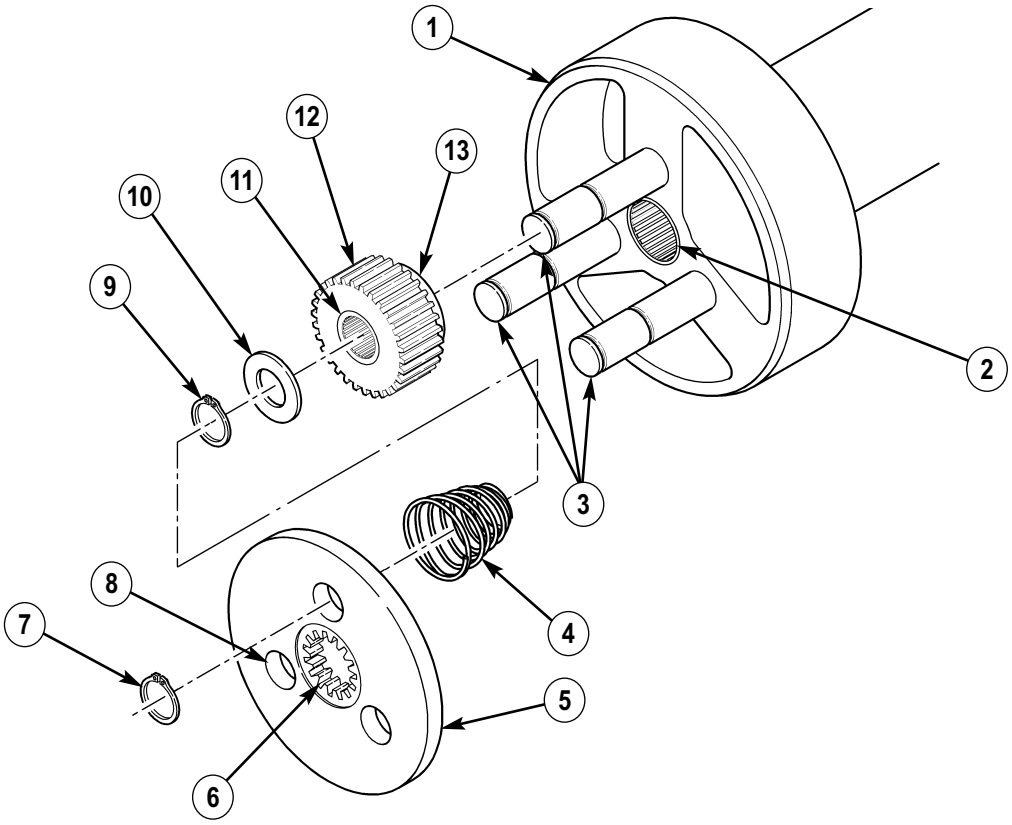
9. Inspect gear housing/drum support (1) for damage or wear. Replace if damaged or worn.
10. Inspect low lever (7), lever pin (6), low lever plunger (12), and low lever spring (13) for damage or wear. Replaced any damaged or worn parts.
11. Inspect high lever (9), lever pin (8), drive shaft plunger (11), and drive shaft plunger spring (10) for damage or wear. Replace any damaged or worn parts.



## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

**d. Assembly**

1. Apply grease to roller bearings (2) of drum assembly (1).
2. Apply grease to three planetary gear shafts (3) of drum assembly (1), roller bearings (11), and gear teeth (12) of three planetary gears (13), and washers (10).
3. Install three planetary gears (13), planetary washers (10), and snaprings (9) on planetary shafts (3) of drum assembly (1).
4. Apply grease to splines (6) and planetary shaft holes (8) of plunger plate assembly (5).
5. Install three planetary gear springs (4) (with smaller diameter of spring towards planetary gears (13)), plunger plate assembly (5), and three snaprings (7) on shafts (3) of drum assembly (1).



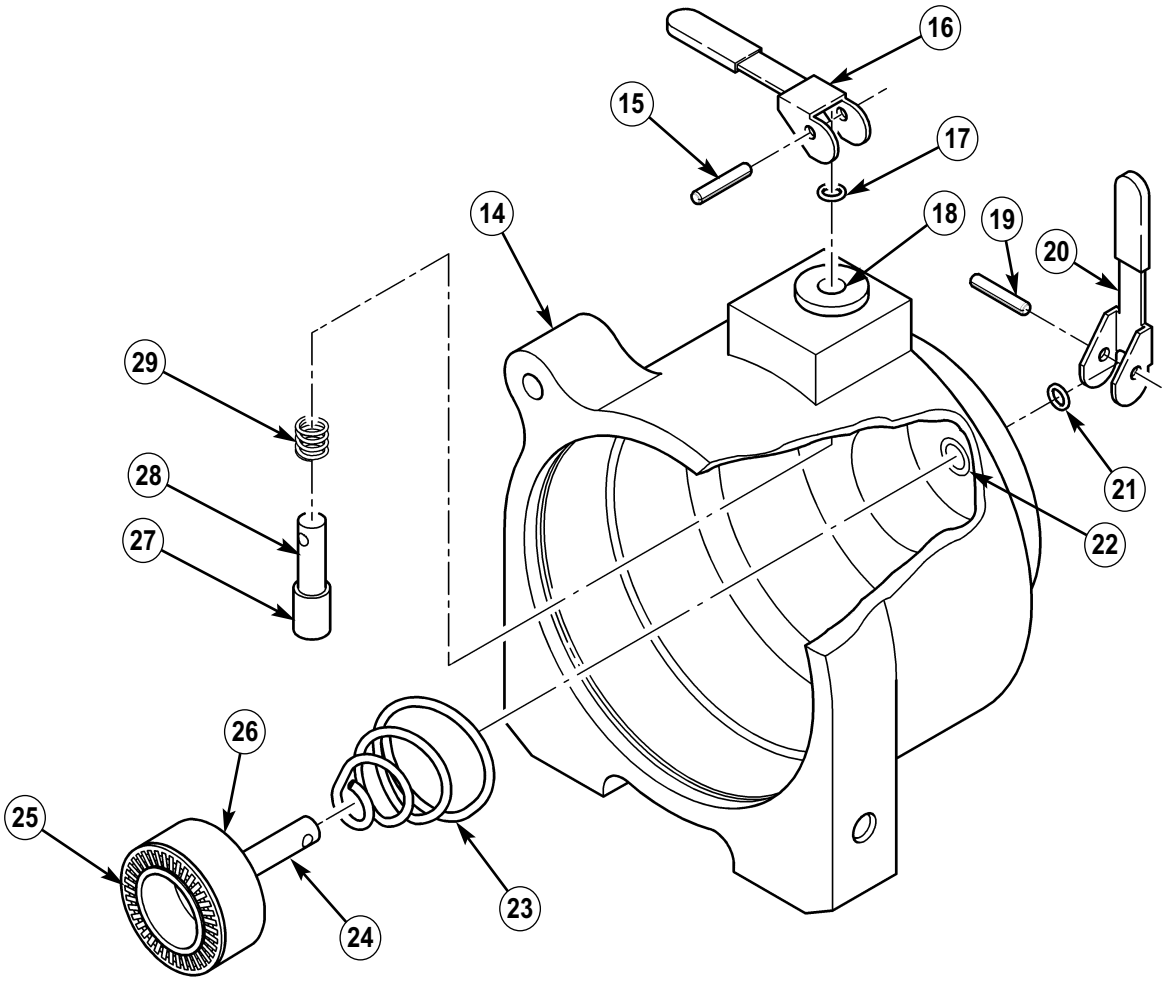
## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

6. Apply hydraulic fluid to O-ring (17) and install in hole (18) of gear box/drum support (14).
7. Apply hydraulic fluid to O-ring (21) and install in hole (22) of gear box/drum support (14).
8. Apply grease to needle bearings (25) and shaft (24) of drive shaft plunger (26).

**NOTE**

The drive shaft assembly may be used to depress drive shaft plunger and drive shaft plunger spring to aid assembly.

9. Place drive shaft plunger spring (23) onto drive shaft plunger (26) (with smaller diameter of spring towards drive shaft plunger) and install in hole (22) of gear box/drum support (14). Depress drive shaft plunger (26) and drive shaft plunger spring (23) and install high lever (20) and lever pin (19).
10. Apply grease to shaft (28) of low lever plunger (27).
11. Place low lever spring (29) on low lever plunger (27) and install in hole (18) of gear box/drum support (14). Depress low lever plunger (27) and low lever spring (29) and install low lever (16) and lever pin (15).



## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

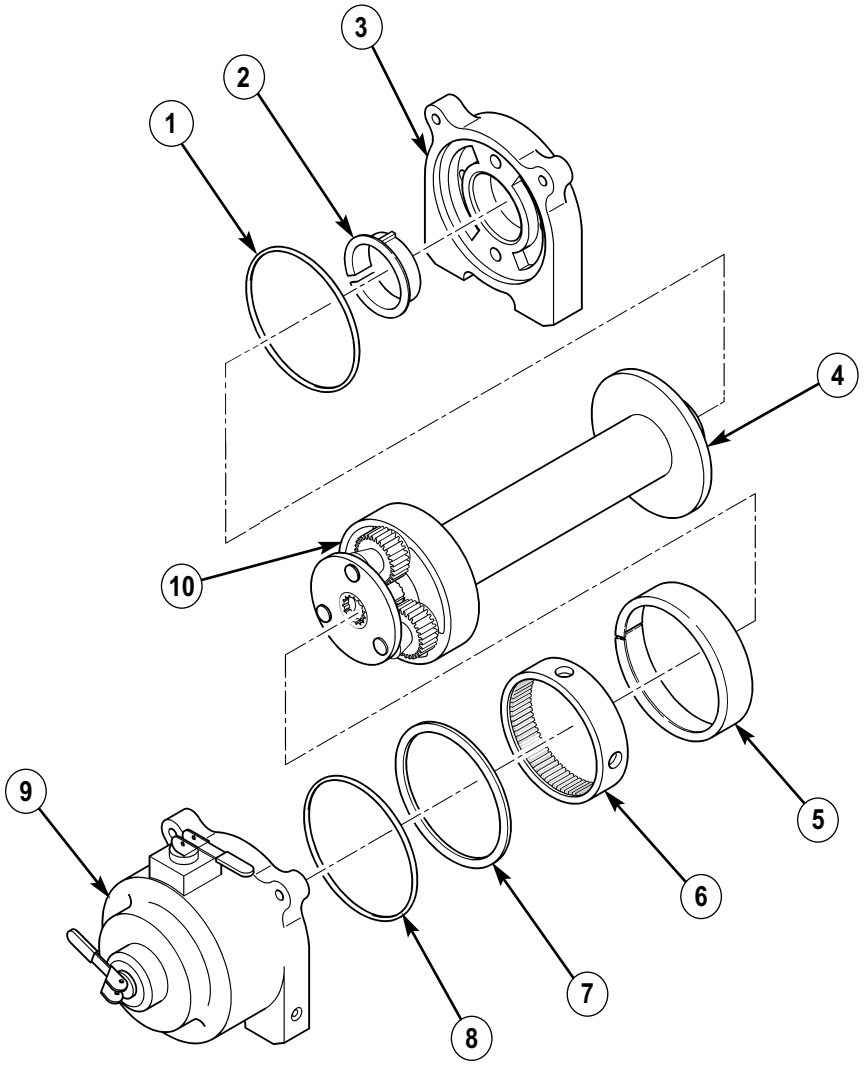
12. Apply grease to ring gear thrust bushing (7) and install in gear box/drum support (9).
13. Apply hydraulic fluid to O-ring (8) and install in gear box/drum support (9).
14. Apply grease to drum drive bushing (5). Install drum drive bushing (5) on planetary gear end (10) of drum assembly (4).
15. Apply grease to gear teeth and machined surfaces of ring gear (6). Install ring gear (6) on planetary gear end (10) of drum assembly (4) with wider machined edge of ring gear (6) towards drum assembly (4).

**NOTE**

Make sure high lever and low lever are both in FREE position.

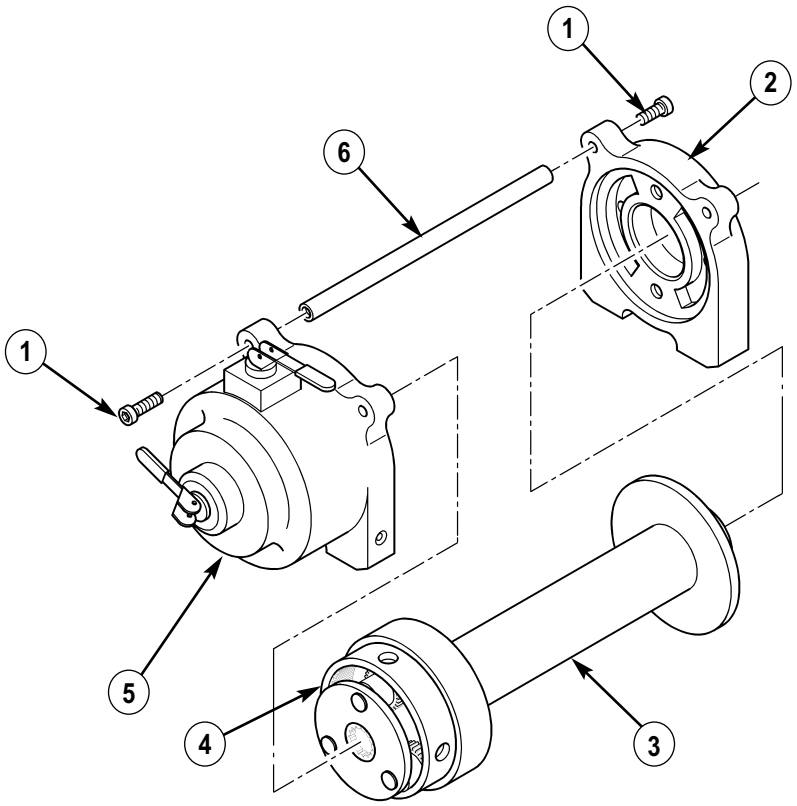
16. Install drum assembly (4) in gear box/drum support (9).
17. Apply grease to drum bushing (2). Align tab on drum bushing (2) with slot on motor end/drum support (3) and install in motor end/drum support (3).
18. Apply hydraulic fluid to O-ring (1) and install in motor end/drum support (3).
19. Install motor end/drum support (3) on drum assembly (4).

## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

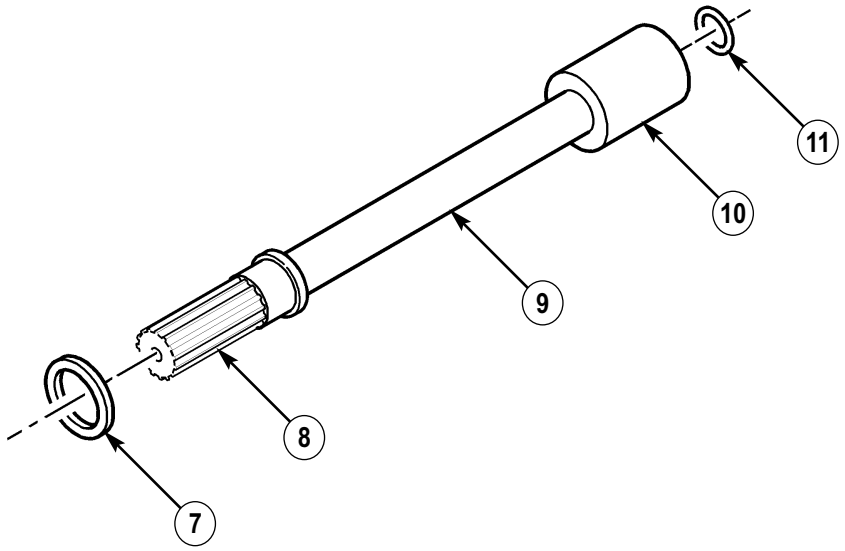


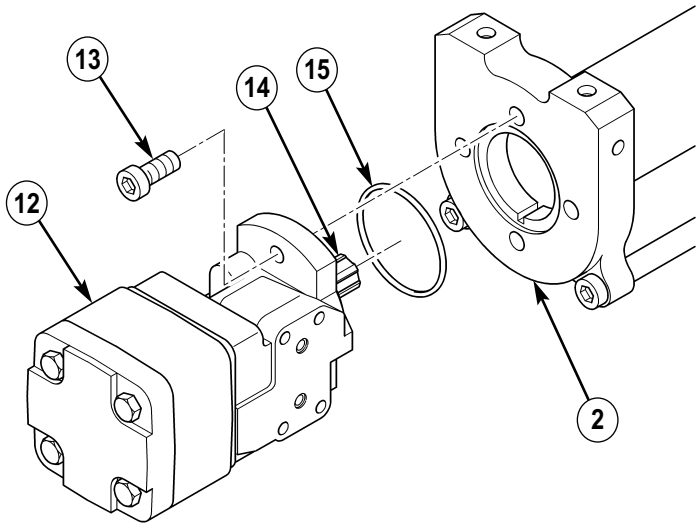
## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

20. Apply sealing compound to threads of four socket-head screws (1). With drum assembly (3) in place, install four socket-head screws (1) and two tie bars (6) on motor end/drum support (2) and gear box/drum support (5). Tighten socket-head screws (1) to 18 lb-ft (24 N·m).
21. Apply hydraulic fluid to O-ring (11) and install into motor end (10) of drive shaft assembly (9). Apply grease to internal splines in motor end (10) and external (8) splines of drive shaft assembly (9).
22. Apply grease to drive shaft thrust washer (7) and install onto drive shaft assembly (9).
23. Install drive shaft assembly (9) through motor end/drum support (2) through drum assembly (3) until splines (8) engage planetary gear assembly (4).
24. Apply hydraulic fluid to O-ring (15) and install onto motor (12). Apply grease onto splines (14) of motor (12).
25. Apply adhesive to threads of two socket-head screws (13). Align scribe marks and install motor (12) on motor end/drum support (2) with two socket-head screws (13). Tighten socket-head screws (13) to 45 lb-ft (61 N·m).



## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)



## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)

26. Apply hydraulic fluid to two O-rings (8) and install in ports (16) of motor (7).

**CAUTION**

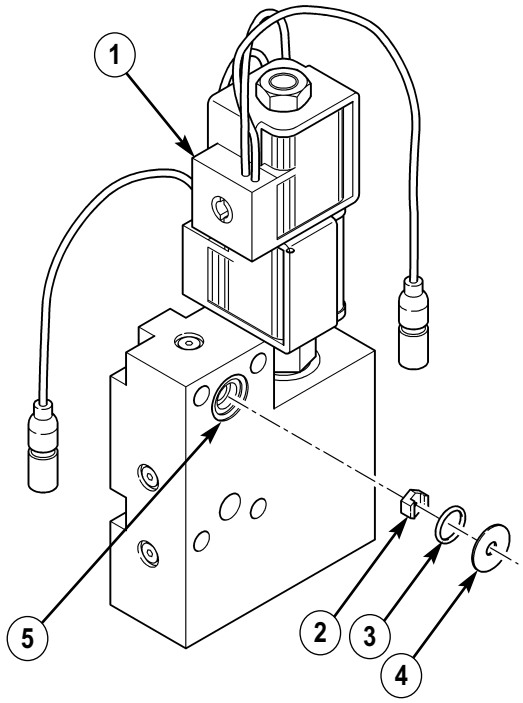
Do not allow restrictor valve assembly to separate from valve and solenoid assembly during installation. Damage to parts may result.

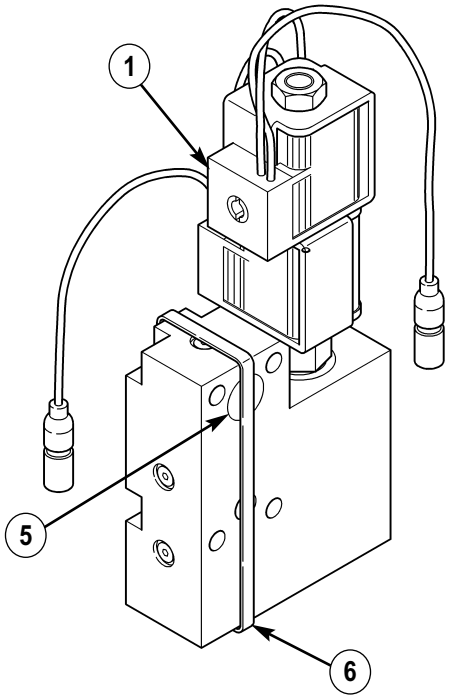
27. Install restrictor (2), O-ring (3), and restrictor washer (4) into port (5) of valve and solenoid assembly (1). Secure restrictor (2), O-ring (3), and restrictor washer (4) with rubber band (6) on valve and solenoid assembly (1).
28. Apply adhesive to threads of four socket-head screws (9) loosely install two socket-head screws (9) then remove rubber band (6) being careful not to allow restrictor valve assembly (2), (3), and (4) to fall out of position in valve and solenoid assembly (1).
29. Install two remaining socket-head screws (9). Tighten socket-head screws (9) to 18 lb-ft (24 N·m).

**NOTE**

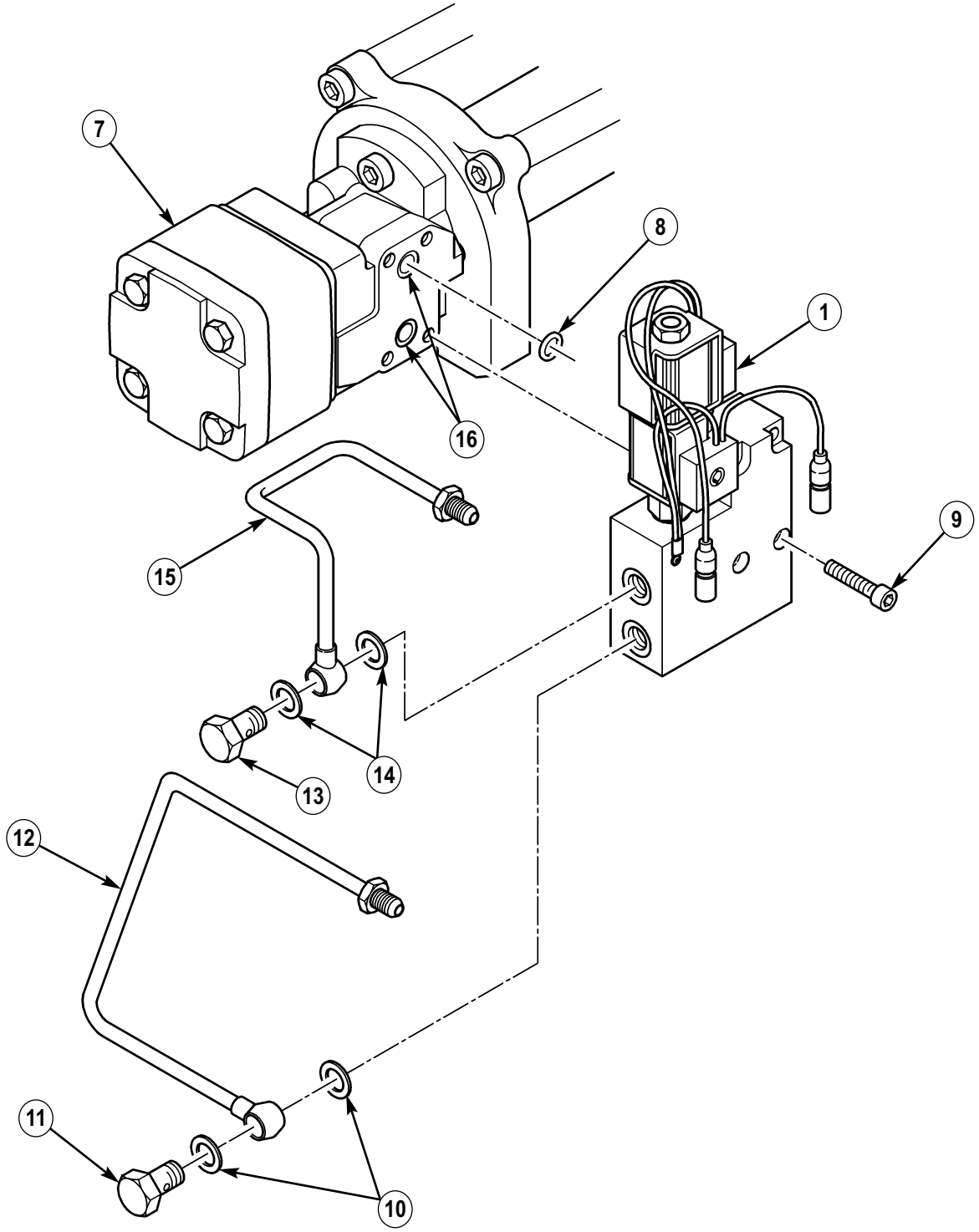
Valve and solenoid assembly is stamped with letter "P" at inlet port and with letter "T" at outlet port.

30. Using two copper washers (14) and banjo screw (13) install inlet banjo tube (15) to port "P" on valve and solenoid assembly (1).
31. Using two copper washers (10) and banjo screw (11) install outlet banjo tube (12) to port "T" on valve and solenoid assembly (1).
32. Tighten banjo screws (11) and (13) to 33-40 lb-ft (45-54 N·m).



## 15-5. 10,500 LB HYDRAULIC WINCH REPAIR (Cont'd)




FOLLOW-ON TASKS: Install winch (TM 9-2320-280-20)

# CHAPTER 16
# SPECIAL PURPOSE KITS MAINTENANCE

## Section I. ARCTIC WINTERIZATION KIT

### 16-1. INFORMATION

This chapter contains maintenance instructions for replacement and repair of special purpose kit components at the Direct Support maintenance level. Some subassemblies and parts must be removed before special purpose kit components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

### 16-2. ARCTIC WINTERIZATION KIT MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 16-3. | Arctic Heater Cowl Cover Replacement | 16-2 |
| 16-4. | Arctic Heater Exhaust Diverter to Oil Pan Shroud Tube Replacement | 16-4 |
| 16-5. | Arctic Heater Exhaust Pipe Replacement | 16-5 |
| 16-6. | Arctic Heater Elbow to Exhaust Diverter Elbow Replacement | 16-6 |
| 16-7. | Arctic Heater Exhaust Diverter to Flex Tube Elbow Replacement | 16-7 |
| 16-8. | Arctic Heater Exhaust Diverter Replacement | 16-8 |
| 16-9. | Deleted | |
| 16-10. | Arctic Heater Battery Box to Plenum Bracket Replacement | 16-12 |
| 16-11. | Arctic Heater Electric Fuel Pump Mounting Bracket Replacement | 16-13 |
| | Arctic Heater Repair (Model 10530B) | Refer to para. 14-11 |
| 16-12. | Air Ventilator and Light Diverter Replacement | 16-14 |

# 16-3. ARCTIC HEATER COWL COVER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M966, M966A1, M996, M996A1, M997, M997A1, M997A2, M998, M998A1, M1025, M1025A1, M1025A2, M1037, M1038, M1038A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Eight blind rivets (Appendix E, Item 192)
Four locknuts (Appendix E, Item 56)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Conditions**
- Plenum assembly removed (TM 9-2320-280-20).
- Exhaust diverter assembly removed (para. 16-8).

**Maintenance Level**
Direct support

**NOTE**

For instructions on removal and installation of rivets, refer to para. 22-7.

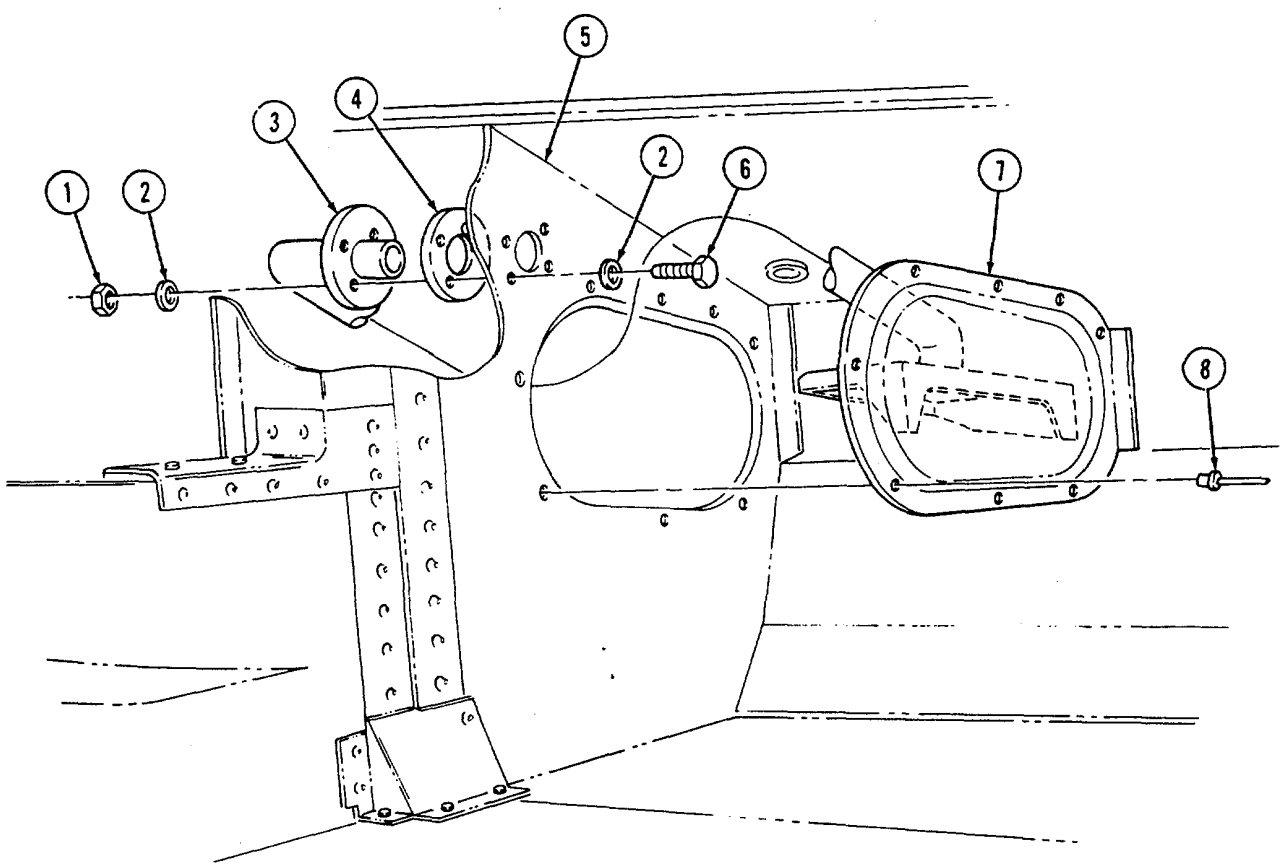
**a. Removal**

1. Remove eight rivets (8) and cowl cover (7) from cowl (5).
2. Remove four locknuts (1), washers (2), capscrews (6), washers (2), insulator (4), and cowl cover exhaust pipe flange (3) from cowl (5). Discard four locknuts (1).
3. Inspect insulator (4), replace if defective.

**b. Installation**

1. Install insulator (4) and cowl cover exhaust pipe flange (3) to cowl (5) with four washers (2), capscrews (6), washers (2), and locknuts (1). Tighten locknuts (1) to 6 lb-ft (8 N•m).
2. Install cowl cover (7) on cowl (5) with eight rivets (8).

## 16-3. ARCTIC HEATER COWL COVER REPLACEMENT




FOLLOW-ON TASKS:
- Install exhaust diverter assembly (para. 16-8).
- Install plenum assembly (TM 9-2320-280-20).

# 16-4. ARCTIC HEATER EXHAUST DIVERTER TO OIL PAN SHROUD TUBE REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two cotter pins (Appendix E, Item 166)
Locknut (Appendix E, Item 77)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Conditions**
Engine right splash shield removed (TM 9-2320-280-20).

**General Safety Instructions**
Do not touch hot exhaust system with bare hands.

**Maintenance Level**
Direct Support

**WARNING**

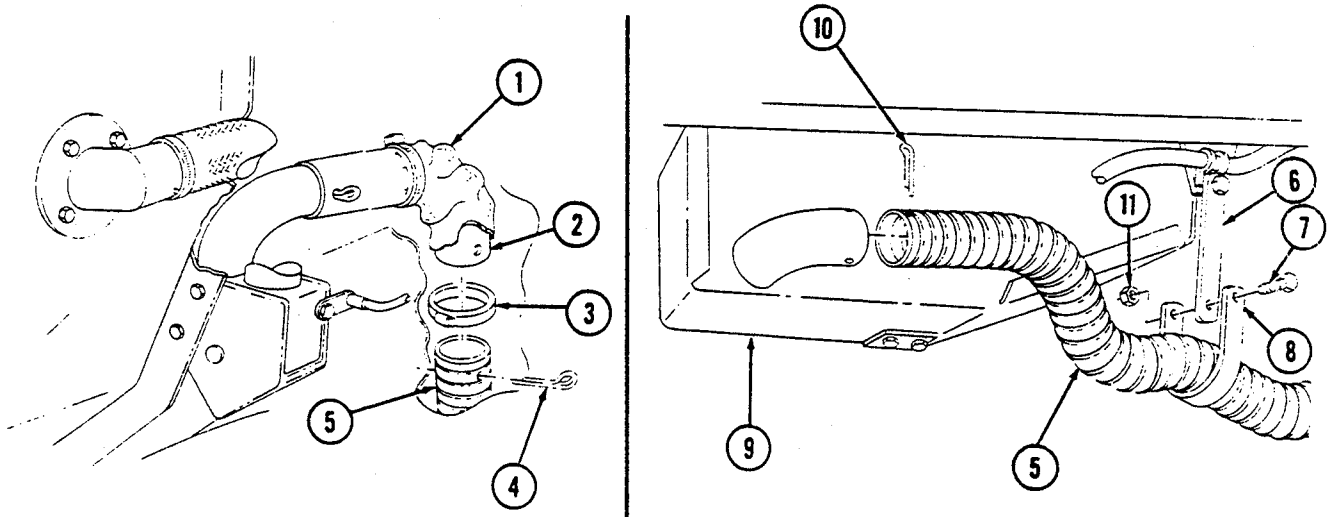
Do not touch hot exhaust system components with bare hands. Severe injury will result.

**a. Removal**

1. Loosen clamp (3) securing insulator sleeve (1) to flex tube (5).
2. Slide insulator sleeve (1) above cotter pin (4) and remove cotter pin (4) and flex tube (5) from exhaust pipe elbow (2). Discard cotter pin (4).
3. Remove locknut (11), capscrew (7), clamp (8), and flex tube (5) from strap (6). Discard locknut (11).
4. Remove cotter pin (10) and flex tube (5) from oil pan shroud (9). Discard cotter pin (10).

**b. Installation**

1. Install flex tube (5) on oil pan shroud (9) with cotter pin (10).
2. Connect flex tube (5) to exhaust pipe elbow (2) with cotter pin (4).
3. Install flex tube (5) on strap (6) with clamp (8), capscrew (7), and locknut (11).
4. Slide insulator sleeve (1) down over cotter pin (4) with clamp (3).




FOLLOW-ON TASKS: Install engine right splash shield (TM 9-2320-280-20).

# 16-5. ARCTIC HEATER EXHAUST PIPE REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**

Cotter pin (Appendix E, Item 168)
Four blind rivets (Appendix E, Item 193)

**Manual References**

TM 9-2320-280-24P

**General Safety Instructions**

Do not touch hot exhaust system with bare hands.

**Maintenance Level**

Direct support

**WARNING**

Do not touch hot exhaust system components with bare hands. Severe injury will result.

**a. Removal**

1. Remove cotter pin (2) and exhaust pipe (3) from exhaust diverter box (1). Discard cotter pin (2).

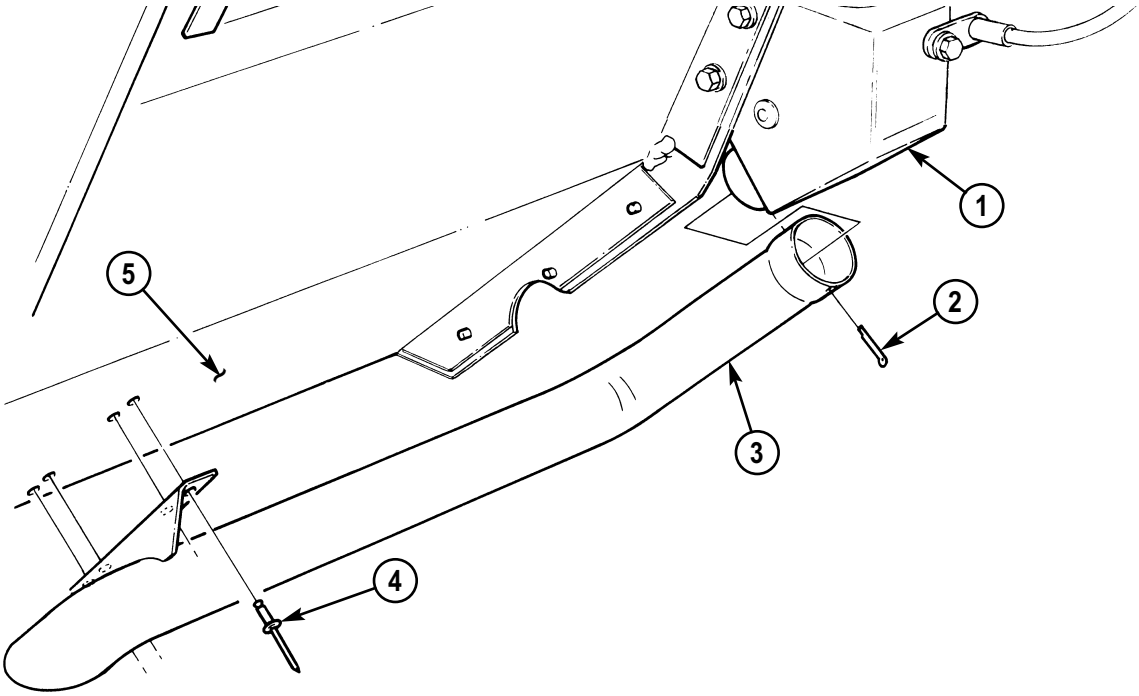
**NOTE**

For instructions on the replacement of rivets, refer to para. 22-7.

2. Remove four rivets (4) and exhaust pipe (3) from cowl (5). Discard rivets (4).

**b. Installation**

1. Install exhaust pipe (3) on exhaust diverter box (1) with cotter pin (2).
2. Install exhaust pipe (3) on cowl (5) with four rivets (4).



# 16-6. ARCTIC HEATER ELBOW TO EXHAUST DIVERTER ELBOW REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two cotter pins (Appendix E, Item 166)
Four locknuts (Appendix E, Item 61)
Heater thermaseal (Appendix E, Item 256)

**Manual References**
TM 9-2320-280-24P

**General Safety Instructions**
Do not touch hot exhaust system with bare hands.

**Maintenance Level**
Direct support

**WARNING**

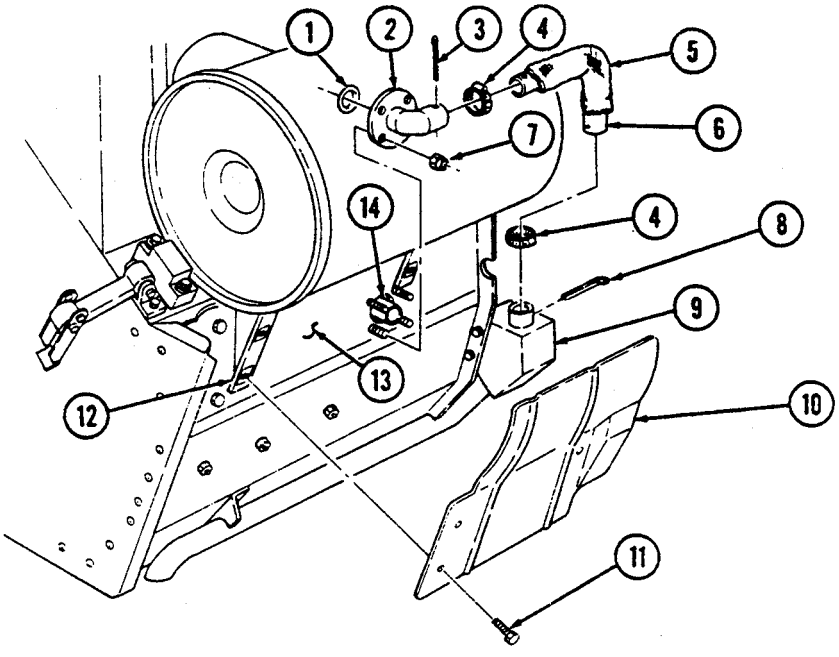
Do not touch hot exhaust system components with bare hands. Severe injury will result.

**a. Removal**

1. Remove three capscrews (11) and dust unloader cover plate (10) from air cleaner bracket (12).
2. Remove four locknuts (7), heater elbow (2), and heater thermaseal (1) from cowl (13). Discard locknuts (7) and heater thermaseal (1).
3. Remove cotter pin (3) and heater elbow (2) from exhaust pipe elbow (6). Discard cotter pin (3).
4. Remove cotter pin (8) and exhaust pipe elbow (6) from exhaust diverter box (9). Discard cotter pin (8).
5. Remove two clamps (4) and insulator sleeve (5) from exhaust pipe elbow (6).

**b. Installation**

1. Install insulator sleeve (5) on exhaust pipe elbow (6) with two clamps (4).
2. Install exhaust pipe elbow (6) on exhaust diverter box (9) with cotter pin (8).
3. Connect exhaust pipe elbow (6) to heater elbow (2) with cotter pin (3).
4. Install heater thermaseal (1) on exhaust pipe (14) and secure heater elbow (2) on cowl (13) with four locknuts (7).
5. Install dust unloader cover plate (10) on air cleaner bracket (12) with three capscrews (11).



# 16-7. ARCTIC HEATER EXHAUST DIVERTER TO FLEX TUBE ELBOW REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Two cotter pins (Appendix E, Item 166)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Conditions**
Engine right splash shield removed (TM 9-2320-280-20).

**General Safety Instructions**
Do not touch hot exhaust system with bare hands.

**Maintenance Level**
Direct support

**WARNING**

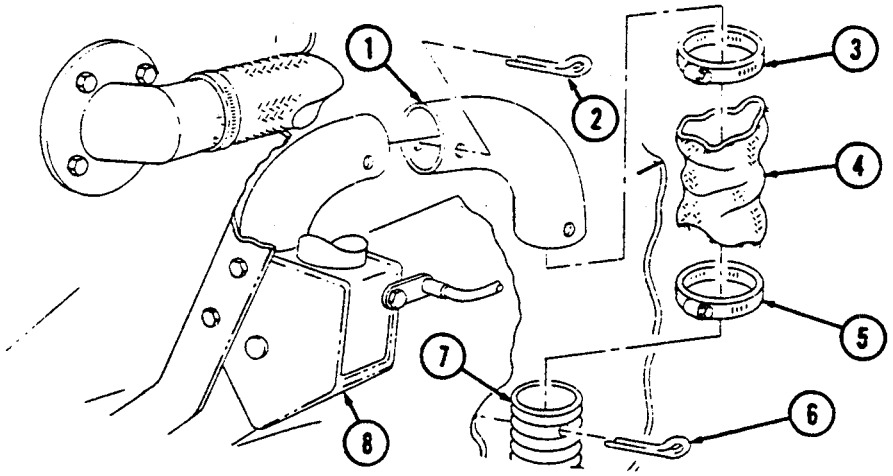
Do not touch hot exhaust system components with bare hands.
Severe injury will result.

**a. Removal**

1. Remove cotter pin (2) and exhaust pipe elbow (1) from exhaust diverter box (8). Discard cotter pin (2).
2. Loosen clamp (5) securing insulator sleeve (4) to flex tube (7).
3. Slide insulator sleeve (4) above cotter pin (6) and remove cotter pin (6) and exhaust pipe elbow (1) from flex tube (7). Discard cotter pin (6).
4. Remove clamps (3) and (5) and insulator sleeve (4) from exhaust pipe elbow (1).

**b. Installation**

1. Install insulator sleeve (4) and clamps (3) and (5) on exhaust pipe elbow (1) and secure with clamp (3).
2. Install exhaust pipe elbow (1) on exhaust diverter box (8) with cotter pin (2).
3. Connect exhaust pipe elbow (1) on flex tube (7) with cotter pin (6).
4. Slide insulator sleeve (4) down over cotter pin (6) on flex tube (7) with clamp (5).




FOLLOW-ON TASK: Install engine right splash shield (TM 9-2320-280-20).

## 16-8. ARCTIC HEATER EXHAUST DIVERTER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**

Two cotter pins (Appendix E, Item 166)
Three lockwashers (Appendix E, Item 120)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Engine right splash shield removed (TM 9-2320-280-20).
- Arctic heater exhaust pipe removed (para. 16-5).
- Arctic heater elbow to exhaust diverter elbow removed (para. 16-6).

**General Safety Instructions**

Do not touch hot exhaust system with bare hands.

**Maintenance Level**

Direct support

**WARNING**

Do not touch hot exhaust system components with bare hands. Severe injury will result.

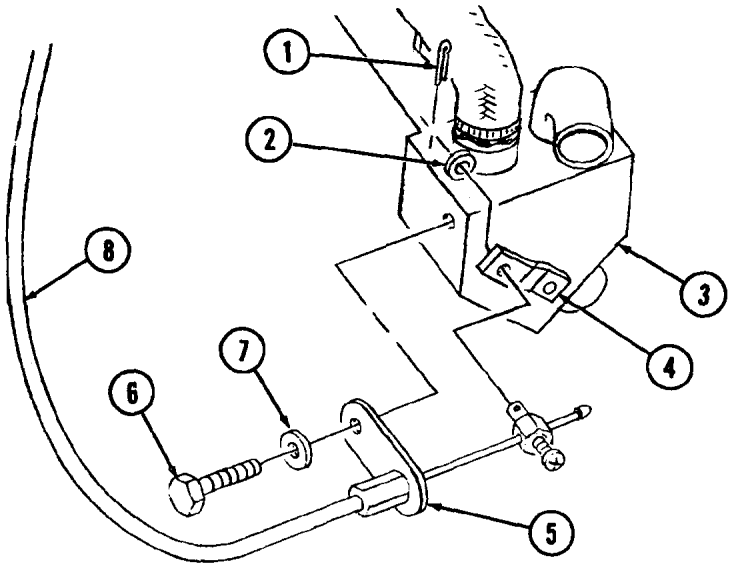
### a. Removal

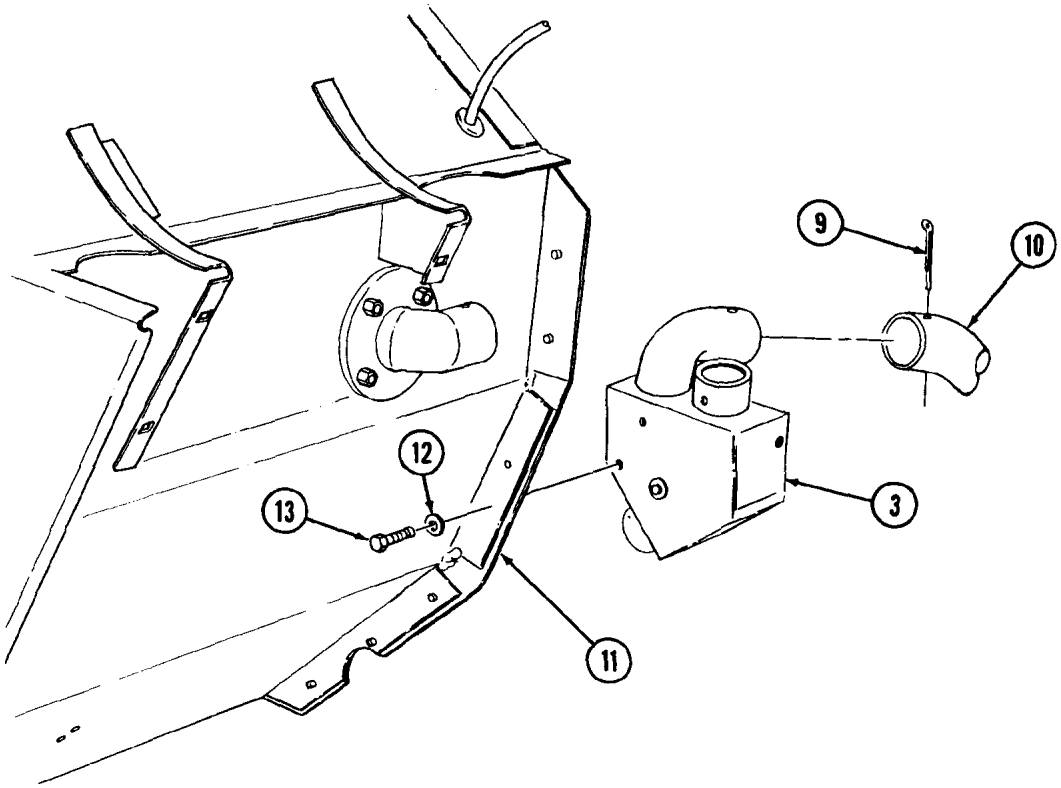
1. Remove capscrew (6), lockwasher (7), and exhaust control cable bracket (5) from exhaust diverter box (3). Discard lockwasher (7).
2. Remove cotter pin (1), washer (2), and exhaust control cable (8) from exhaust diverter lever (4). Discard cotter pin (1).
3. Remove cotter pin (9) and exhaust pipe elbow (10) from exhaust diverter box (3). Discard cotter pin (9).
4. Remove two capscrews (13), lockwashers (12), and exhaust diverter box (3) from body flange (11). Discard lockwashers (12).

### b. Installation

1. Install exhaust diverter box (3) on body flange (11) with two lockwashers (12) and capscrews (13).
2. Connect exhaust pipe elbow (10) on exhaust diverter box (3) with cotter pin (9).
3. Install exhaust control cable (8) on exhaust diverter lever (4) with washer (2) and cotter pin (1).
4. Install exhaust control cable bracket (5) on exhaust diverter box (3) with lockwasher (7) and capscrew (6).

## 16-8. ARCTIC HEATER EXHAUST DIVERTER REPLACEMENT(Cont'd)




FOLLOW-ON TASKS:
- Install heater elbow to exhaust diverter elbow (para. 16-6).
- Install heater exhaust pipe (para. 16-5).
- Install engine right splash shield (TM 9-2320-280-20).

# 16-10. ARCTIC HEATER BATTERY BOX TO PLENUM BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M966, M966A1, M996, M996A1, M997, M997A1, M997A2, M998, M998A1, M1025, M1025A1, M1025A2, M1037, M1038, M1038A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Four blind rivets (Appendix E, Item 192)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
Batteries removed (TM 9-2320-280-20).
Arctic heater plenum assembly removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**NOTE**

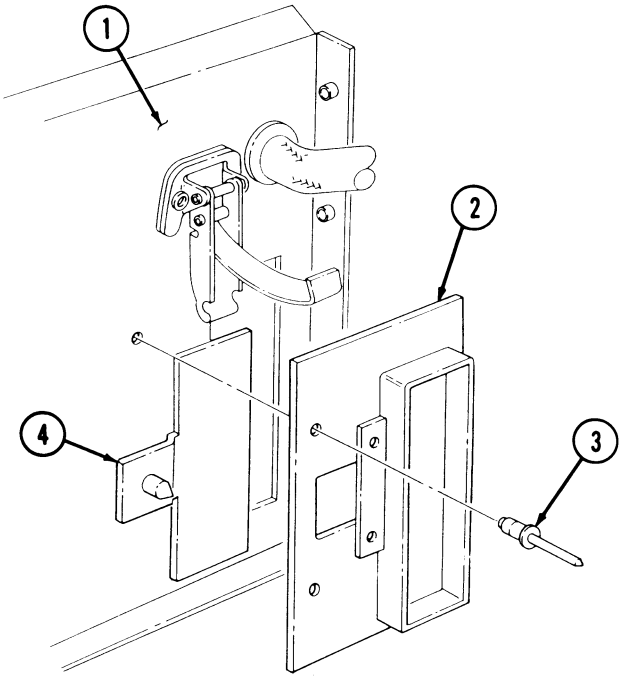
For instructions on removal and installation of rivets, refer to para. 22-7.

**a. Removal**

Remove four rivets (3), plenum bracket (2), and door assembly (4) from battery box (1). Discard rivets (3).

**b. Installation**

Install door assembly (4) and plenum bracket (2) to battery box (1) with four rivets (3).




FOLLOW-ON TASKS:
- Install arctic heater plenum assembly (TM 9-2320-280-20).
- Install batteries (TM 9-2320-280-20).

# 16-11. ARCTIC HEATER ELECTRIC FUEL PUMP MOUNTING BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M966, M966A1, M996, M996A1, M997, M997A1, M997A2, M998, M998A1, M1025, M1025A1, M1025A2, M1037, M1038, M1038A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Four blind rivets (Appendix E, Item 192)

**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**
- Engine access cover removed (TM 9-2320-280-20).
- Electric fuel pump removed (TM 9-2320-280-20).

**Maintenance Level**
Direct support

**NOTE**

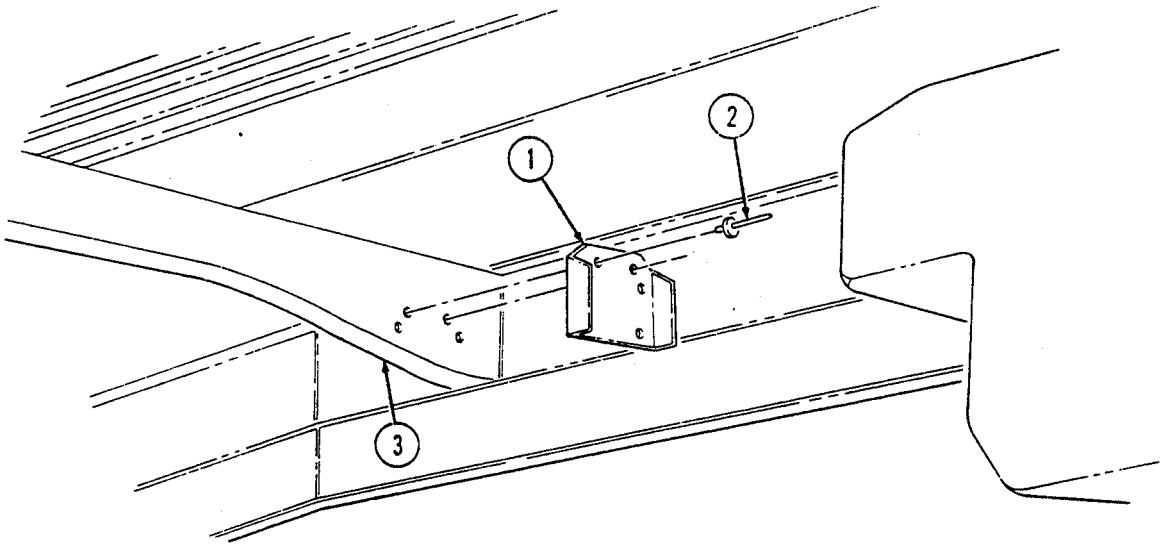
For instructions on removal and installation of rivets, refer to para. 22-7.

**a. Removal**

Remove four rivets (2) and fuel pump mounting bracket (1) from body crossmember (3).

**b. Installation**

Install bracket (1) to body crossmember (3) with four rivets (2).




FOLLOW-ON TASKS:
- Install electric fuel pump (TM 9-2320-280-20).
- Install engine access cover (TM 9-2320-280-20).

## 16-12. AIR VENTILATOR AND LIGHT DIVERTER REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M998, M998A1, M1038, M1038A1

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Silicone sealant (Appendix B, Item 43)
Light diverter fabricate (Appendix C, Fig. 20)

**Maintenance Level**
Direct support

**NOTE**

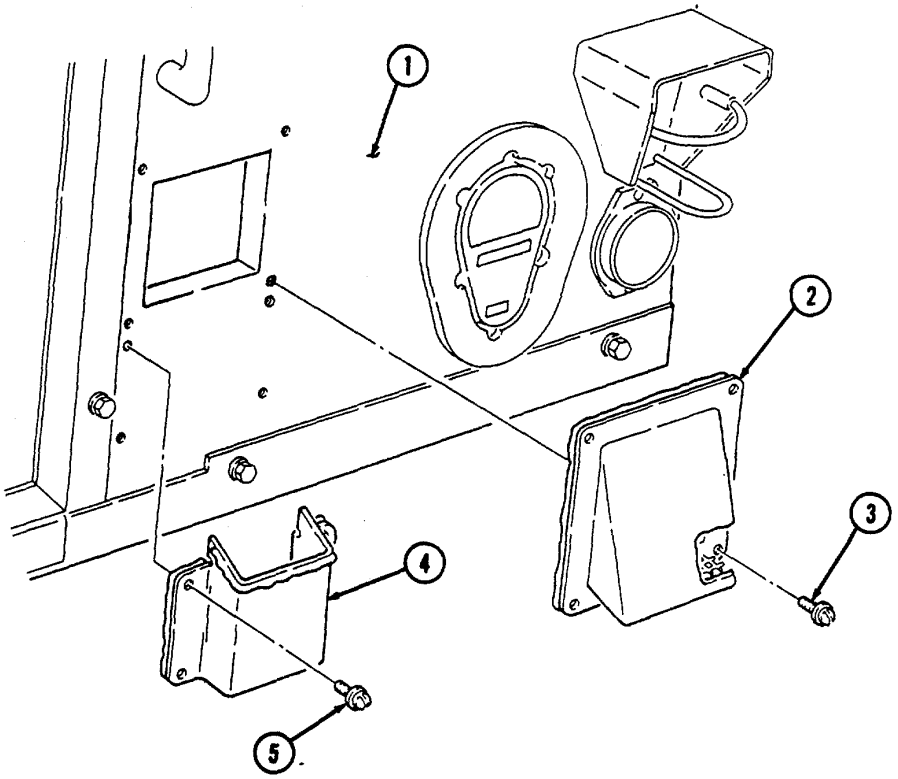
To prevent the heater from being starved of air, the diverter assembly can be modified. Modification can be accomplished at unit commanders discretion.

### a. Removal

1. Remove four screws (3) and ventilator (2) from body (1).
2. Remove four screws (5) and diverter (4) from body (1).

### b. Installation

1. Install diverter (4) on body (1) with four screws (5).
2. Apply a light bead of silicone sealant on ventilator (2). Install ventilator (2) on body (1) with four screws (3).



## SECTION II. DELETED

# CHAPTER 17
# TRANSMISSION REPAIR

## 17-1. INTRODUCTION

This chapter contains maintenance instructions for disassembly and repair of transmission components at the General Support maintenance level. Some subassemblies and parts must be removed before transmission system components can be accessed. They are referenced to other paragraphs of this manual.

## Section I. TRANSMISSION DISASSEMBLY, REPAIR, AND ASSEMBLY

## 17-2. TRANSMISSION DISASSEMBLY, REPAIR, AND ASSEMBLY TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 17-3. | Transmission Disassembly Into Subassemblies (3L80) | 17-2 |
| 17-4. | Torque Converter Maintenance (3L80) | 17-12 |
| 17-5. | Transmission Case Repair (3L80) | 17-14 |
| 17-6. | Oil Pump Repair (3L80) | 17-16 |
| 17-7. | Forward Clutch and Turbine Shaft Repair (3L80) | 17-22 |
| 17-8. | Direct Clutch and Intermediate Sprag Repair (3L80) | 17-26 |
| 17-9. | Center Support Repair (3L80) | 17-30 |
| 17-10. | Gear Unit Repair (3L80) | 17-36 |
| 17-11. | Rear Servo Repair (3L80) | 17-42 |
| 17-12. | Governor Repair (3L80) | 17-44 |
| 17-13. | Transmission Assembly From Subassemblies (3L80) | 17-46 |
| 17-14. | Transmission Disassembly Into Subassemblies (4L80-E) | 17-63 |
| 17-15. | Torque Converter Maintenance (4L80-E) | 17-78 |
| 17-16. | Transmission Case Repair (4L80-E) | 17-80 |
| 17-17. | Parking Lock Pawl and Activator Assembly Repair (4L80-E) | 17-82 |
| 17-18. | Rear Band and Selective Thrust Washer Repair (4L80-E) | 17-83 |
| 17-19. | Gear Unit and Output Assemblies Repair (4L80-E) | 17-84 |
| 17-20. | Center Support Repair (4L80-E) | 17-90 |
| 17-21. | Direct Clutch Assembly Repair (4L80-E) | 17-96 |
| 17-22. | Forward Clutch Assembly Repair (4L80-E) | 17-100 |
| 17-23. | Fourth Clutch Assembly Repair (4L80-E) | 17-104 |
| 17-24. | Turbine Shaft and Overdrive Carrier Assembly Repair (4L80-E) | 17-106 |
| 17-25. | Intermediate Clutch Assembly and Front Band Repair (4L80-E) | 17-114 |
| 17-26. | Front Servo Repair (4L80-E) | 17-115 |
| 17-27. | Rear Servo Repair (1995 - 4L80-E) | 17-116 |
| 17-27.1. | Rear Servo Repair (1996-1998 - 4L80-E) | 17-116.2 |
| 17-28. | Control Valve and Accumulator Housing Repair (4L80-E) | 17-118 |
| 17-29. | Oil Pump Assembly Repair (4L80-E) | 17-124 |
| 17-30. | Transmission Assembly From Subassemblies (4L80-E) | 17-130 |

# 17-3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (3L80)

**This task covers:**

**a. Torque Converter**
**b. Holding Fixture**
**c. Oil Pan**
**d. Oil Filter**
**e. Governor**
**f. Control Valve**
**g. Detent Solenoid**
**h. Front Servo**
**i. Rear Servo**
**j. Oil Pump**
**k. Forward Clutch and Turbine Shaft**
**l. Direct Clutch**
**m. Manual Linkage**
**n. Front Band**
**o. Intermediate Clutch**
**p. Gear Unit**
**q. Center Support**
**r. Rear Band**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Transmission holding fixture (Appendix G, Item 29)
Transmission holding fixture base (Appendix G, Item 30)
Two slide hammer adapters (Appendix G, Item 32)
Gear unit holding tool (Appendix G, Item 31)

**Personnel Required**
One mechanic
One assistant

**Equipment Condition**
Transmission prepared for disassembly (para. 7-10).

**General Safety Instructions**
Torque converter must be supported during removal.

**Maintenance Level**
General support

**a. Torque Converter**

**WARNING**

Torque converter must be supported during removal and installation. Failure to do this may cause injury to personnel or damage to equipment.

**NOTE**

Ensure torque converter turns freely. Record any abnormal looseness or noises.

Remove torque converter (2) from transmission (1).

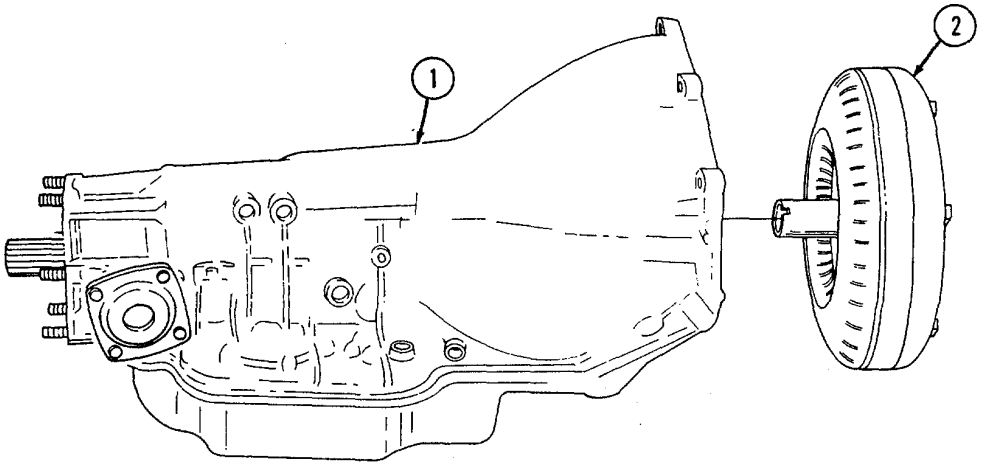
**b. Holding Fixture**

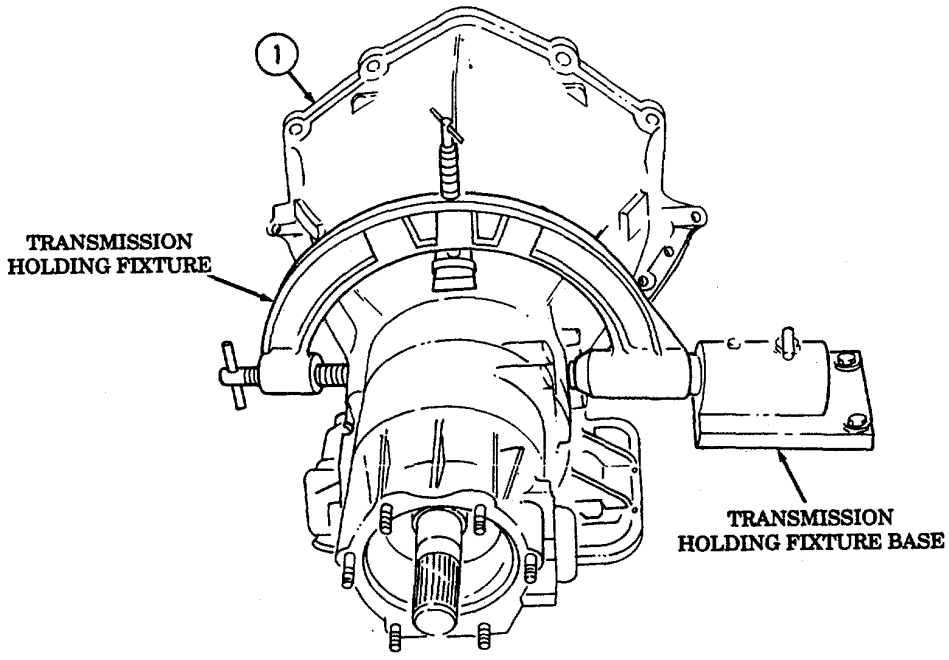
**CAUTION**

Do not overtighten screws. This will bind center support.

1. Install transmission holding fixture into locating holes on side of transmission (1).
2. Install transmission holding fixture and transmission (1) into transmission holding fixture base.
3. Position front of transmission (1) up and allow to drain.

## 17 - 3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (Cont'd)



## 17-3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (3L80) (Cont'd)

**c. Oil Pan**

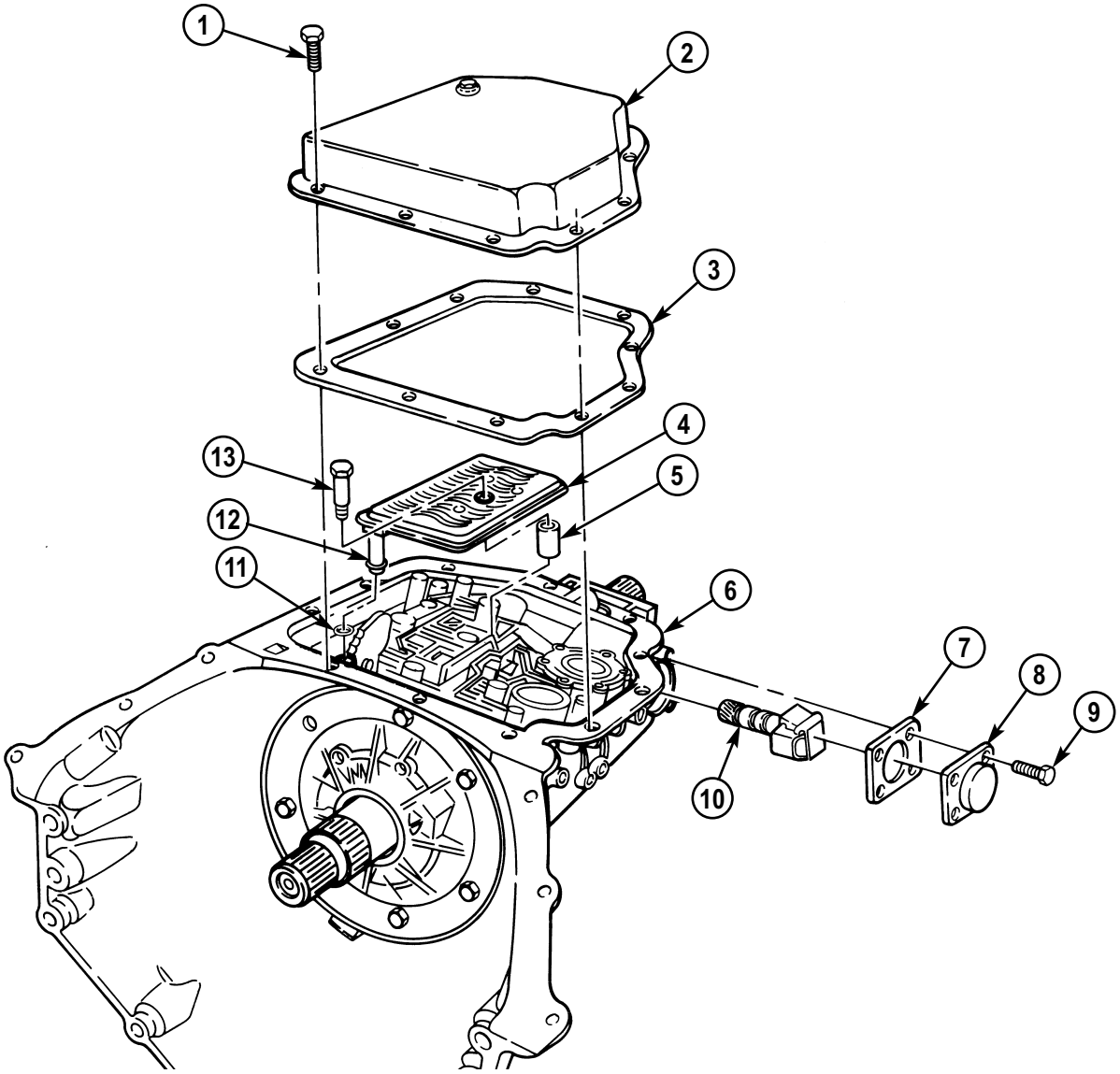
1. Position transmission case (6) so oil pan (2) faces upward.
2. Remove thirteen capscrews (1), oil pan (2), and gasket (3) from case (6). Discard gasket (3).
3. Clean mating surfaces of case (6) and oil pan (2).

**d. Oil Filter**

1. Remove shoulder bolt (13), fluid parts kit (4), intake pipe (12), and spacer (5) from case (6). Discard fluid parts kit (4).
2. Remove intake pipe seal (11) from case (6). Discard seal (11).

**e. Governor**

1. Remove four capscrews (9), governor cover (8), and gasket (7) from case (6). Discard gasket (7).
2. Remove governor (10) from case (6).
3. Clean mating surfaces of governor cover (8) and case (6).



## 17-3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (3L80) (Cont'd)

### f. Control Valve

1. Remove eight capscrews (19), detent roller and spring (18), and three capscrews (20) from control valve (21) and case (6).
2. Remove control valve (21), gasket (22), and governor pipes (17) from case (6).
3. Remove governor screen (16) from governor feed pipe (17) or feed pipe hole (28).
4. Remove modulator valve (25) from case (6).

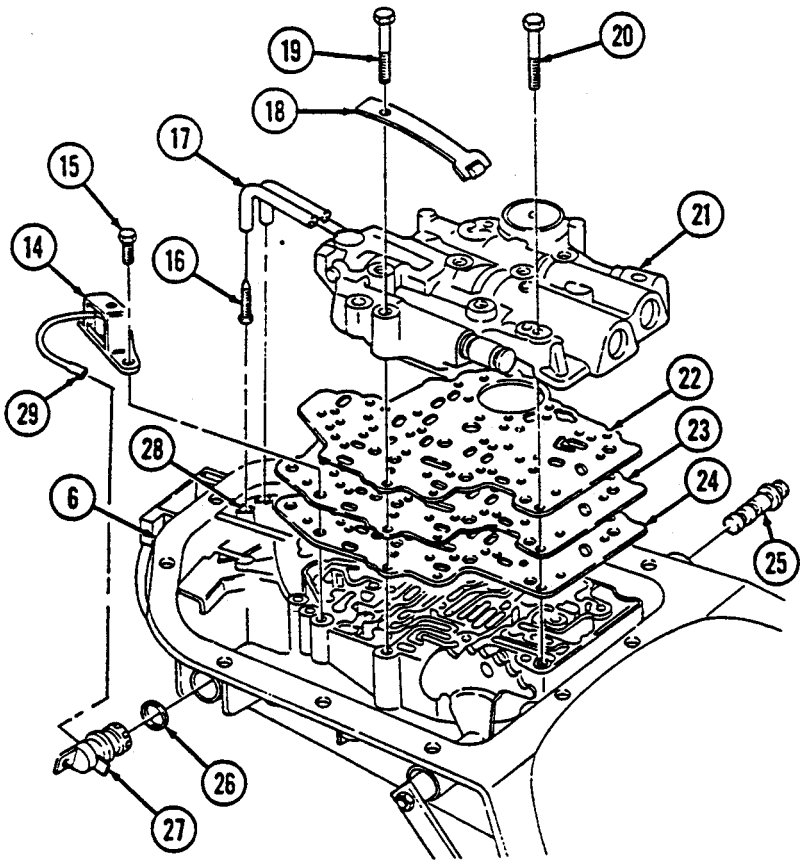
### g. Detent Solenoid

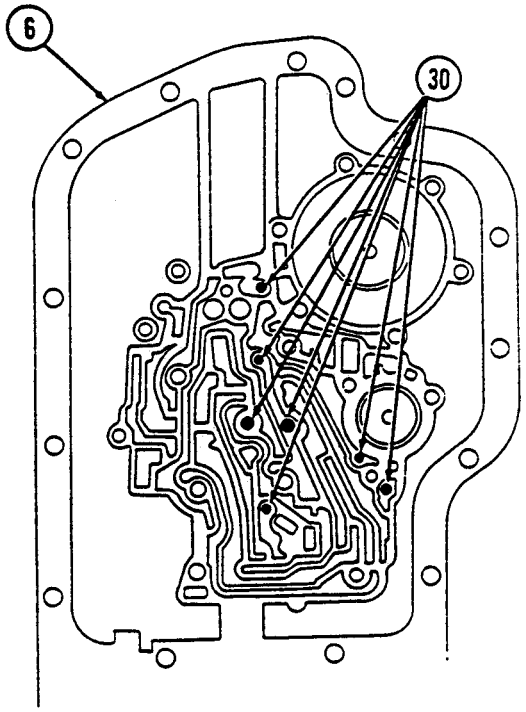
1. Disconnect detent solenoid wire (29) from electrical connector (27).
2. Remove two capscrews (15) and detent solenoid (14) from case (6).
3. Remove control valve spacer plate (23) and gasket (24) from case (6). Discard gasket (24).
4. If necessary, compress three tabs on electrical connector (27) and remove electrical connector (27) and packing retainer (26) from case (6). Discard packing retainer (26).

**NOTE**

- Do not scratch marks on any machined surface of transmission case.
- There may only be six check balls.

5. Note location of seven check balls (30) in passages in case (6) for assembly.
6. Remove seven check balls (30) from case (6).



## 17 - 3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (Cont'd)

### h. Front Servo

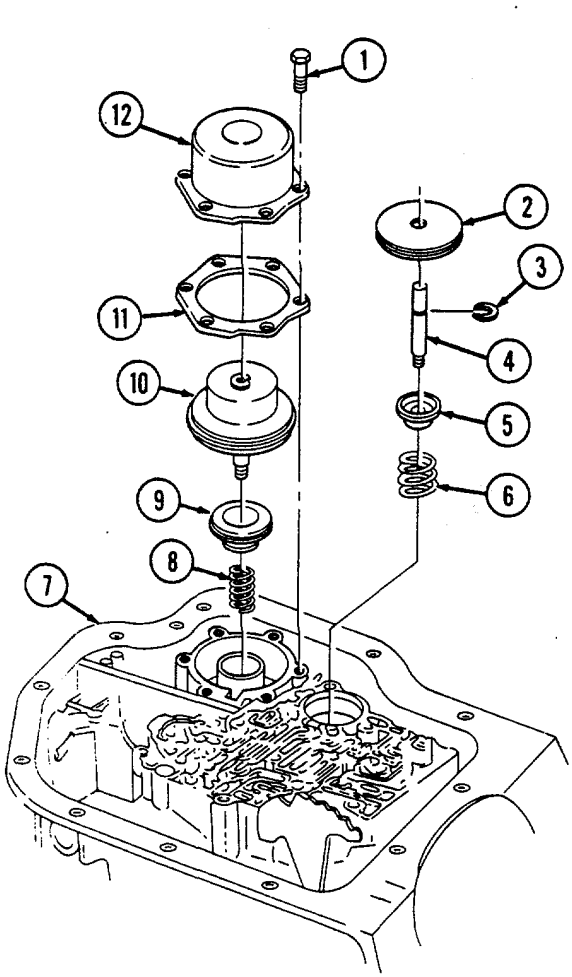
Remove front servo pin (4), piston (2), retaining ring (3), spring retainer (5), and spring (6) from case (7).

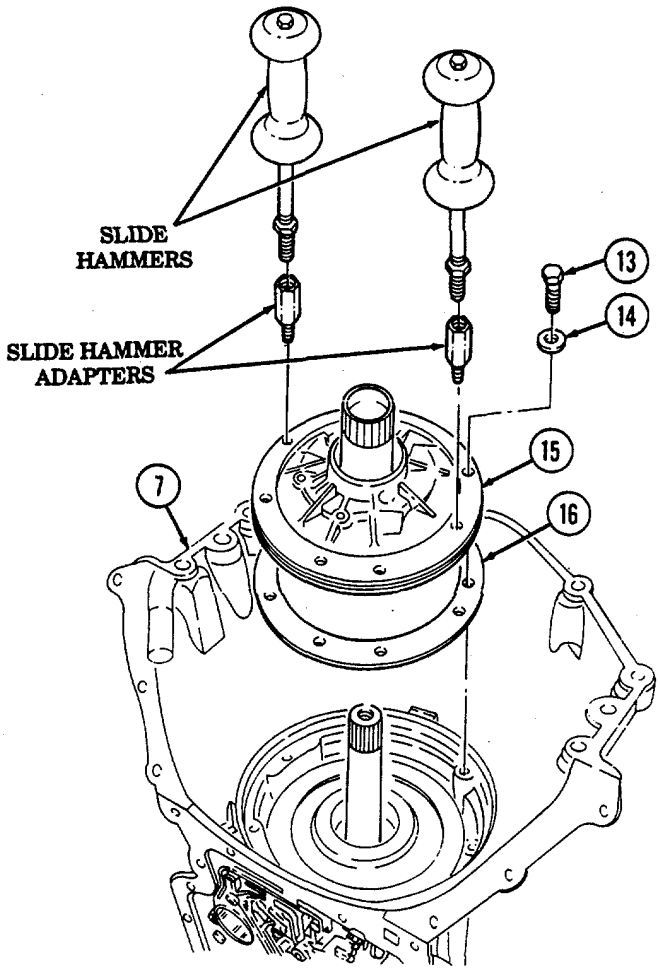
### i Rear Servo

1. Remove six capscrews (1), servo cover (12), and gasket (11) from case (7). Discard gasket (11).
2. Remove rear servo piston (10), accumulator piston (9), and spring (8) from case (7).

### j. Oil Pump

1. Position transmission case (7) so oil pump (15) faces up.
2. Remove six capscrews (13), seal washers (14), and oil pump (15) from case (7). Discard seal washers (14).
3. Install slide hammer adapters into threaded holes in oil pump (15).
4. Using slide hammer and adapters, remove oil pump (15) and gasket (16) from case (7). Discard gasket (16).



**17 - 3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (Cont'd)**

k. Forward Clutch and Turbine Shaft

1. Remove forward clutch and turbine shaft (17) from case (7).

2. Remove forward clutch hub thrust washer (23) from forward clutch and turbine shaft (17) and tag for assembly.

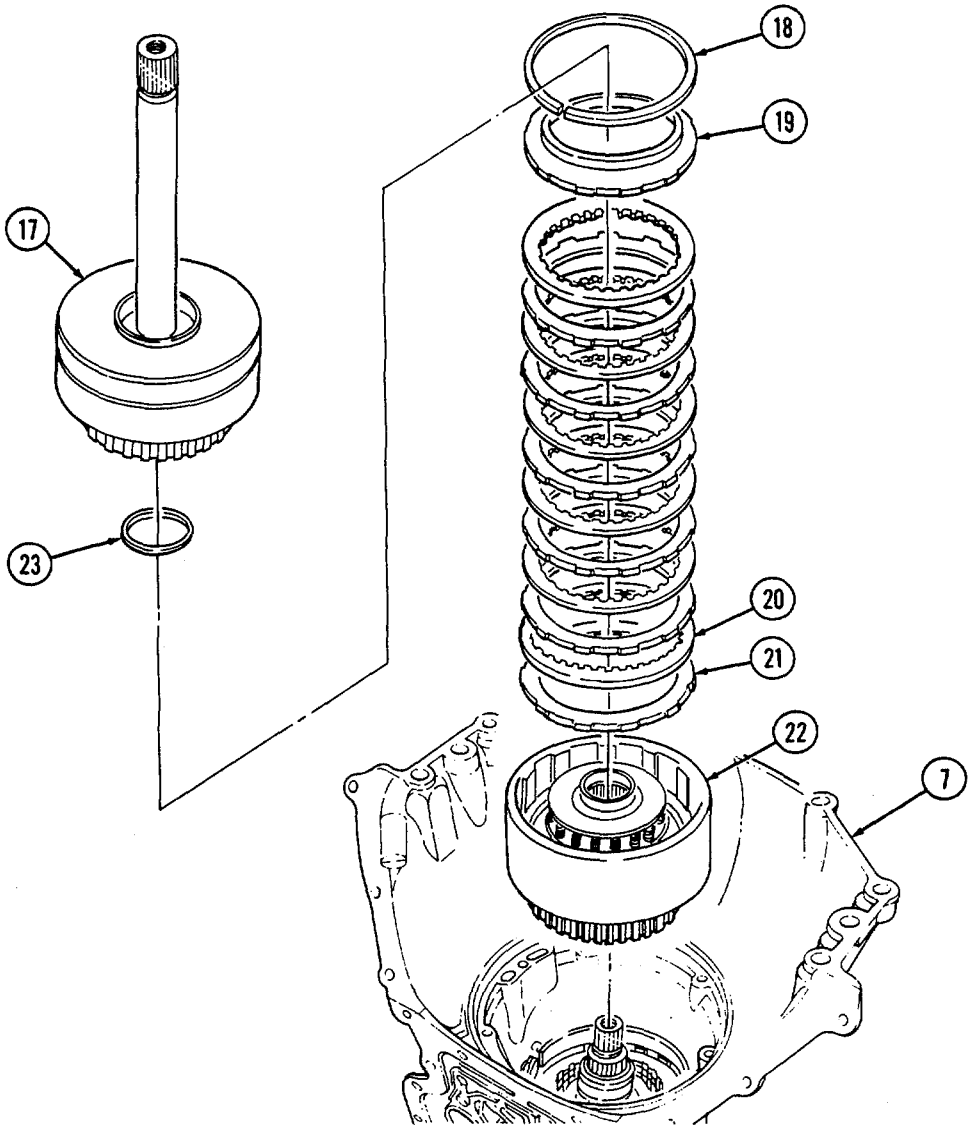
l. Direct Clutch

1. Remove snapring (18) securing direct clutch backing plate (19) to direct clutch housing (22).

2. Remove direct clutch housing plate (19), six composition clutch plates (20), and six steel clutch plates (21) from direct clutch housing (22).

3. Remove direct clutch housing (22) from case (7).

4. Install clutch plates (21) and (20) and backing plate (19) in direct clutchhousing (22) with snapring (18).



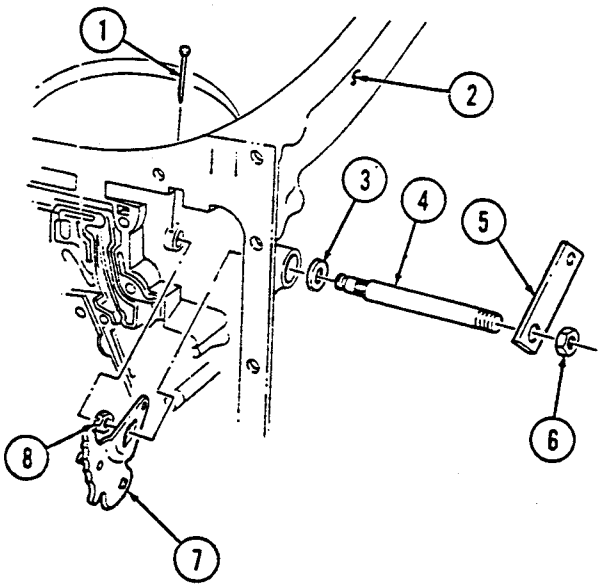
## 17-3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (3L80) (Cont'd)

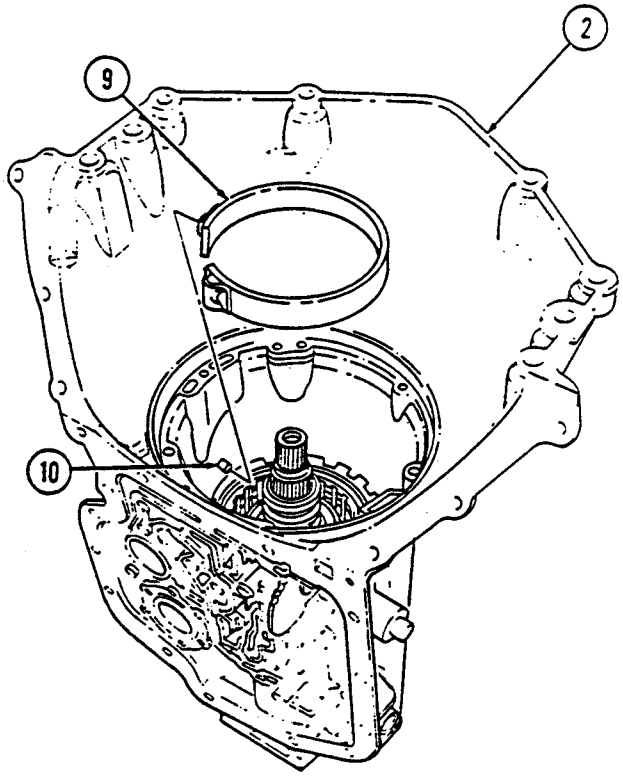
**m. Manual Linkage**

1. Remove nut (6) securing shift lever (5) to manual shaft (4) and remove shift lever (5).
2. Loosen jam nut (8) from manual shaft (4).
3. Remove manual shaft retaining pin (1) from case (2).
4. Remove manual shaft (4), jam nut (8), and detent lever (7) from case (2).
5. Remove gasket (3) from case (2). Discard gasket (3).

**n. Front Band**

Lift front band (9) away from anchor pin (10) and remove band (9) from case (2).



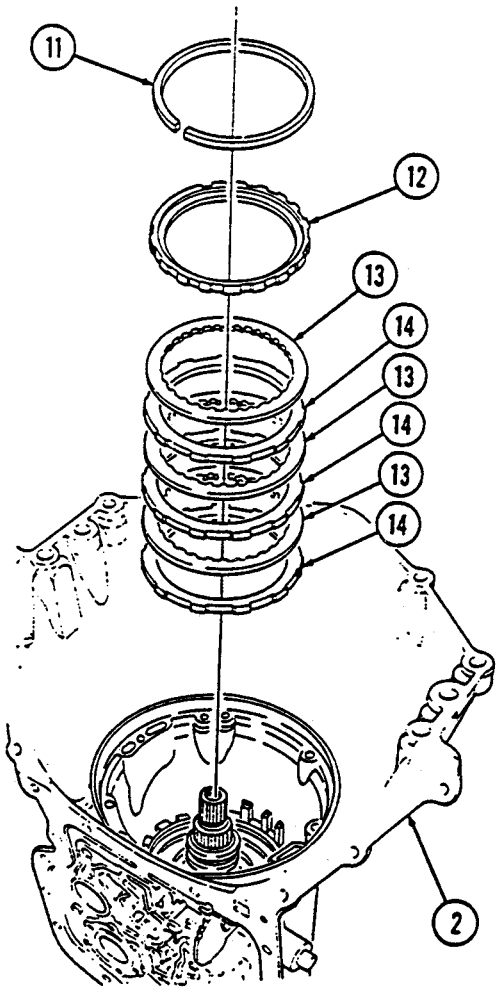
## 17-3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (3L80) (Cont'd)

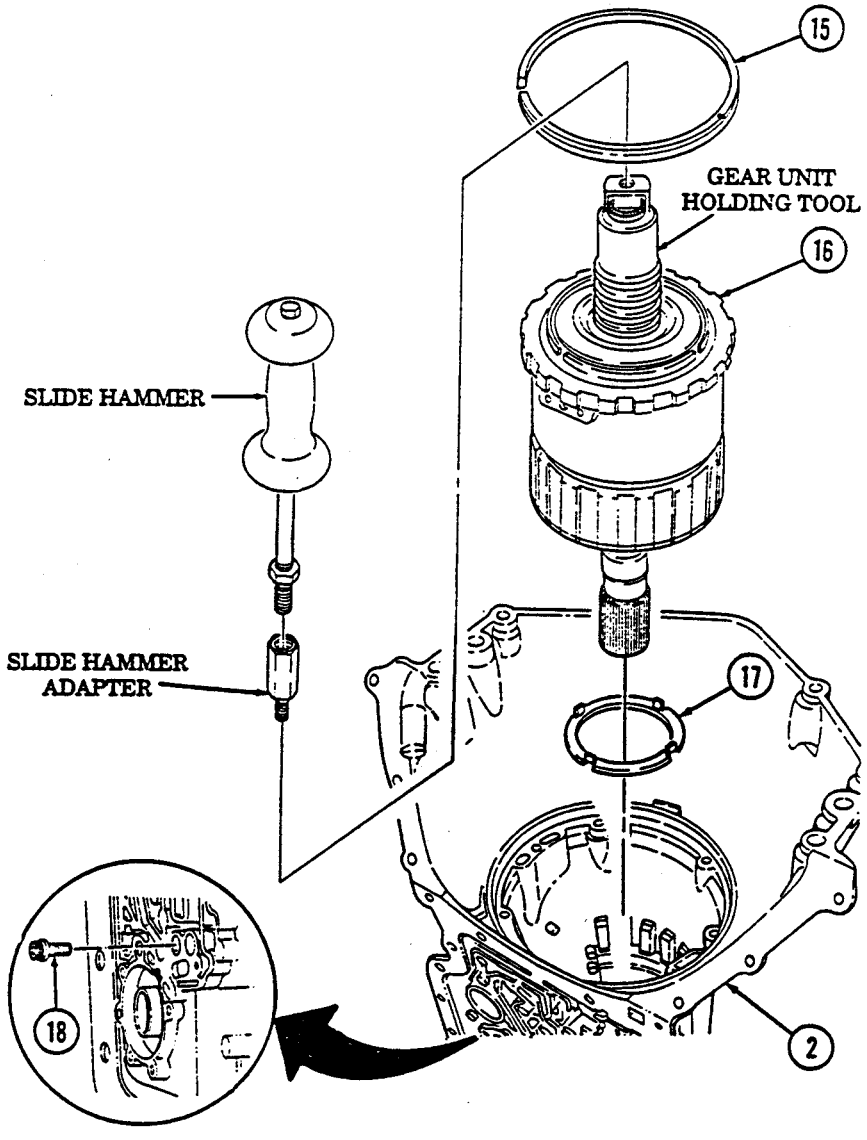
### o. Intermediate Clutch

1. Remove snapring (11) from intermediate clutch backing plate (12) and case (2).
2. Remove backing plate (12), three clutch disks (13), and three steel clutch plates (14) from case (2). Discard clutch disks (13).

### p. Gear Unit

1. Using 3/8 in. 12-point socket, remove center support-to-case aligning bolt (18) from case (2).
2. Remove center support-to-case snapring (15) from case (2).
3. Using gear unit holding tool, slide hammer adapter, and slide hammer, remove center support and gear unit assembly (16) and rear case thrust washer (17) from case (2). Install thrust washer (17) on center support and gear unit assembly (16).

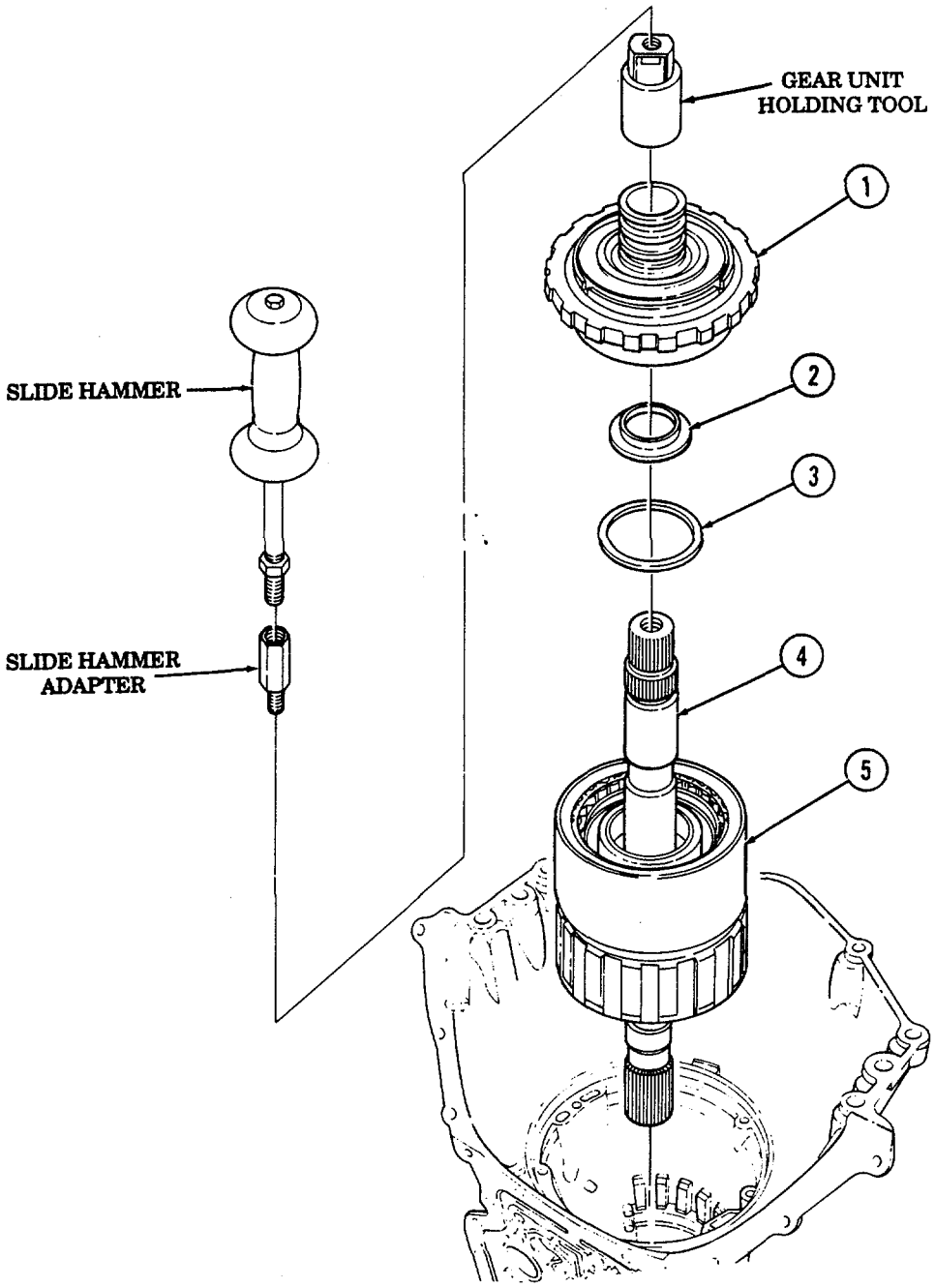


## 17 - 3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (Cont'd)

q. Center Support

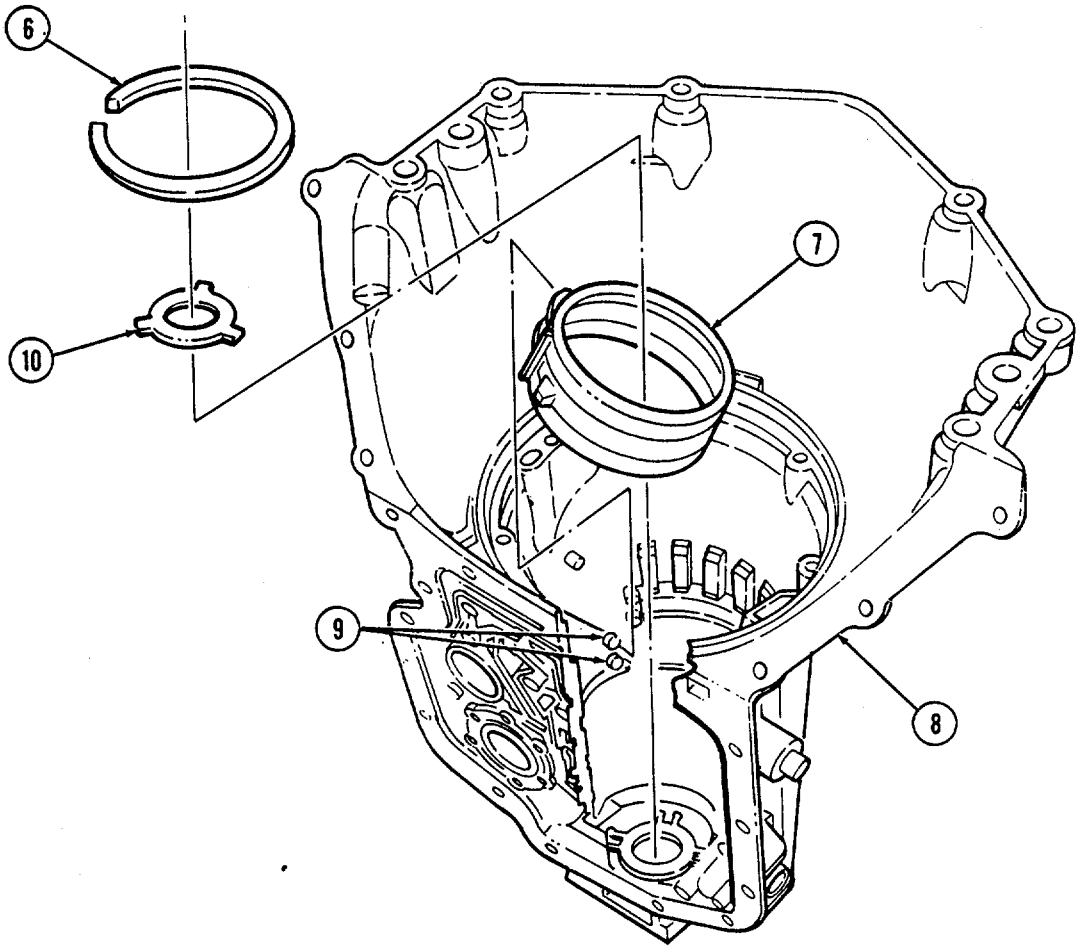
1. Remove slide hammer, slide hammer adapter, and gear unit holding tool from gear unit (5).
2. Remove center support (1) from gear unit (5).
3. Remove center support thrust washer (3) from center support (1) and tag for assembly.
4. Remove outer sun gear thrust bearing race (2) from center support (1) and place over sun gear shaft (4).



## 17 - 3. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (Cont'd)

r. Rear Band

1. Remove rear selective washer (10) from case (8).
2. Remove center support-to-case spacer (6) from case (8).
3. Lift rear band (7) away from anchor pins (9) and remove rear band (7) from case (8).



## 17-4. TORQUE CONVERTER MAINTENANCE (3L80)

**This task covers:**

**a. Cleaning** **b. Inspection**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-3).

**Maintenance Level**
General support

**a. Cleaning**

**NOTE**

Have drainage container ready to catch fluid.

1. Drain fluid from torque converter (1). Replace torque converter (1) if fluid is contaminated.
2. Clean exterior of torque converter (1) in accordance with para. 2-13.

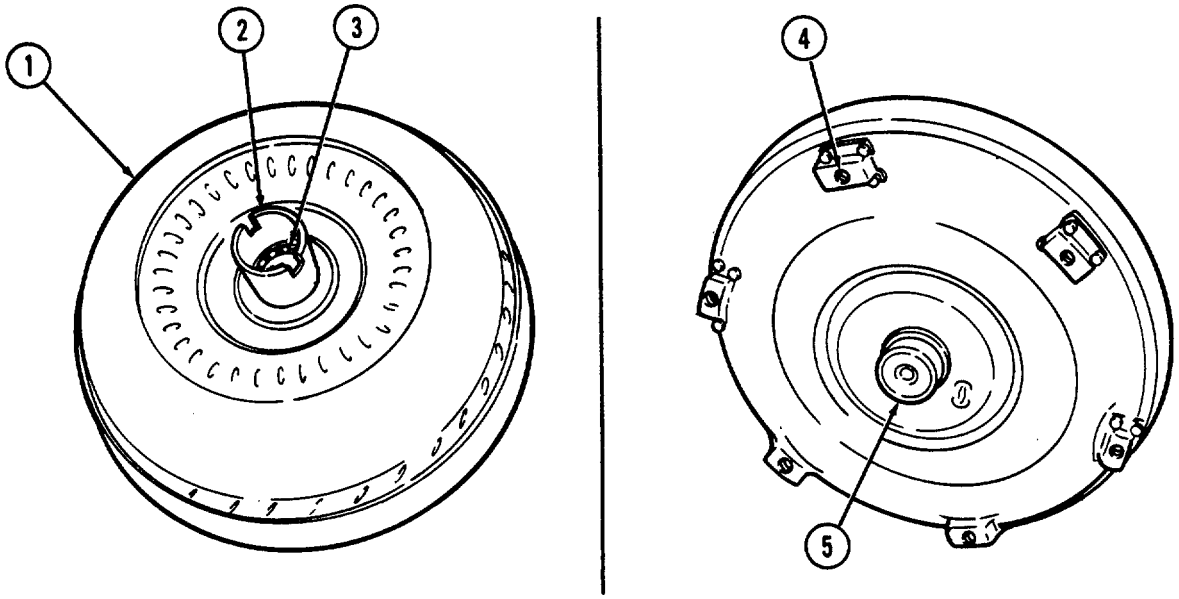
**b. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect torque converter hub (2) for damage. Replace torque converter (1) if hub (2) is damaged or abnormal looseness or noises were recorded at torque converter removal (para. 17-3a).
2. Inspect torque converter (1) for proper operation by manually rotating splined inner race (3) in both directions. The splined inner race (3) should turn freely in clockwise direction, but not turn or be very difficult to turn, in counterclockwise direction. Replace torque converter (1) if it does not operate properly.
3. Inspect torque converter (1) for damaged or leaking seams and welds. Replace torque converter (1) if damaged.
4. Inspect torque converter pilot (5) for damage. Replace torque converter (1) if damaged.
5. Inspect threaded holes (4) for damage. Repair with thread repair inserts. If unable to repair threaded holes (4), replace torque converter (1).

## 17 - 4. TORQUE CONVERTER MAINTENANCE (3L80) (Cont'd)



## 17-5. TRANSMISSION CASE REPAIR (3L80)

**This task covers:**

**a. Cleaning** **b. Inspection**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Bushing service set (Appendix G, Item 33)
Driver handle (Appendix G, Item 34)

**Materials/Parts**
Bushing (Appendix E, Item 7)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-3).

**General Safety Instructions**
- Compressed air for cleaning purposes will not exceed 30 psi (207 kPa).
- Protective clothing must be used when steam cleaning.

**Maintenance Level**
General support

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

**a. Cleaning**

1. Remove transmission case (3) from transmission holding fixture.

**WARNING**

When steam cleaning, protective clothing must be used. Failure to do this may cause serious injury.

2. Thoroughly steam clean transmission case (3).

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc).

3. Blow all dirt and cleaning solution from transmission case (3) with compressed air.

**b. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect all surfaces and general overall condition of transmission case (3).
2. Inspect front and rear band anchor pins (2) for looseness. Replace transmission case (3) if anchor pins (2) are loose or missing.
3. Inspect intermediate clutch plate lugs (5) for damage. Replace transmission case (3) if lugs (5) are damaged.
4. Inspect governor bore (1) for scoring, pitting, or damage. Replace transmission case (3) if scored, pitted, or damaged.

**NOTE**

If transmission was manufactured before March 1, 1990 and a new transmission case is to be used, install a new center support assembly.

5. Inspect all threaded holes in transmission case (3) for damage. Repair any damaged threaded hole with thread repair inserts. If unable to repair threaded hole, replace transmission.

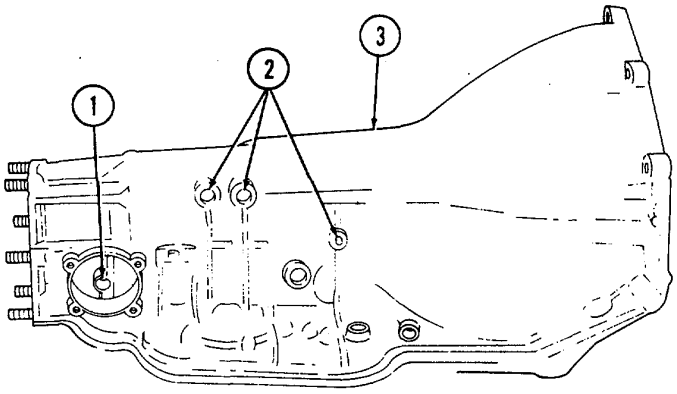
## 17 - 5. TRANSMISSION CASE REPAIR (Cont'd)

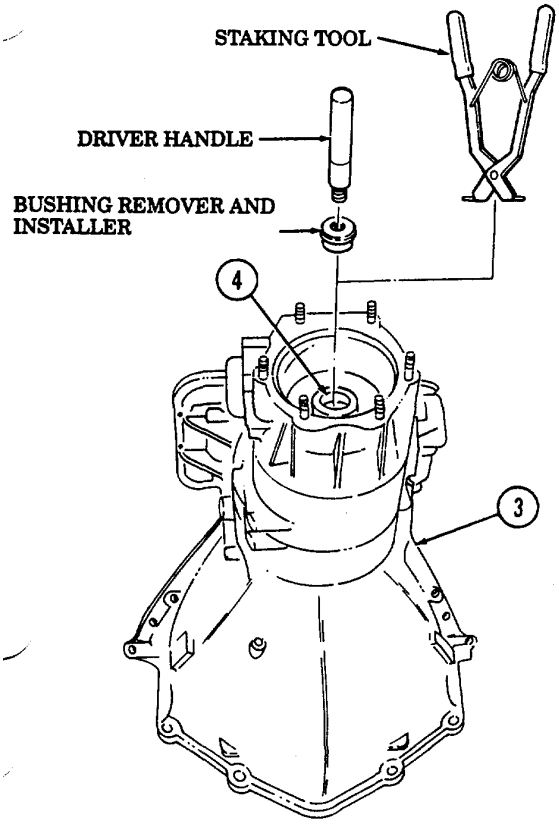
6. Inspect rear case bushing (4) for damage. If damaged, perform steps 7 through 9.

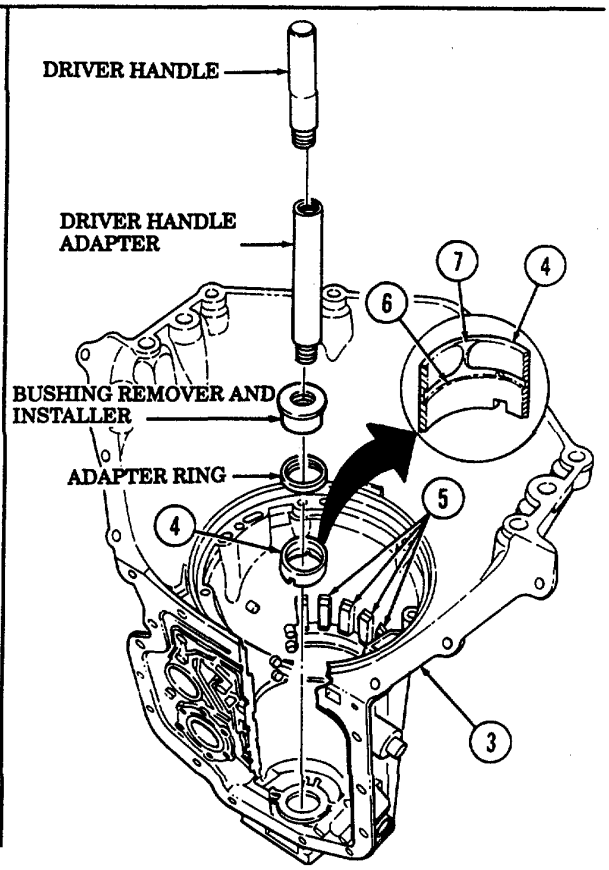
7. Working from rear of transmission case (3), use bushing remover and installer J21465-8 and driver handle to remove bushing (4) from transmission case (3). Discard bushing (4).

8. Working from front of transmission case (3), use driver handle, driver handle adapter J21465-13, bushing remover and installer J21465-8, and adapter ring J21465-9 to install bushing (4). Place bushing (4) on remover and installer with lube passage (7) on bushing (4) facing adapter ring. Install bushing (4) on transmission case (3) until adapter ring bottoms.

9. Working from rear of transmission case (3), use staking tool to stake bushing (4). Stake marks must be in bushing groove (6).



## 17-6. OIL PUMP REPAIR (3L80)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Slide hammer adapter (Appendix G, Item 32)
Bushing service set (Appendix G, Item 33)
Driver handle (Appendix G, Item 34)
Oil pump seal installer (Appendix G, Item 39)

**Materials/Parts**
Packing retainer (Appendix E, Item 188)
Thrust washer bearing (Appendix E, Item 2)
Seal (Appendix E, Item 208)
Plain seal (Appendix E, Item 234)
Gasket (Appendix E, Item 26)
Sealing compound (Appendix B, Item 47)
Transmission fluid (Appendix B, Item 23)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-3).

**Maintenance Level**
General support

**NOTE**

Work area should be well ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

**CAUTION**

Pressure regulator is spring loaded.

1. Remove pin (10.1), snapring (11), boost valve bushing (12), boost valve (13), pressure regulator spring (14), regulator valve (17), spring retainer (15), and spacer(s) (16) from pump cover (4).
2. Remove disk (18.1) from pump cover (4).

2.1. Remove gasket (1) from pump cover (4). Discard gasket (1).

3. Remove thrust washer bearing (2.1), packing retainer (2), and selective washer (3) from pump cover (4). Discard thrust washer bearing (2.1) and packing retainer (2).
4. Remove five capscrews (18) and pump cover (4) from pump body (7).
5. Mark drive gear (5) and driven gear (6) for assembly.
6. Remove drive gear (5), driven gear (6), and seal (9) from pump body (7). Discard seal (9).
7. Remove oil pump oil seal (6.1) from pump cover (4). Discard oil seal (6.1).

### b. Cleaning

Clean all oil pump components in accordance with para. 2-13.

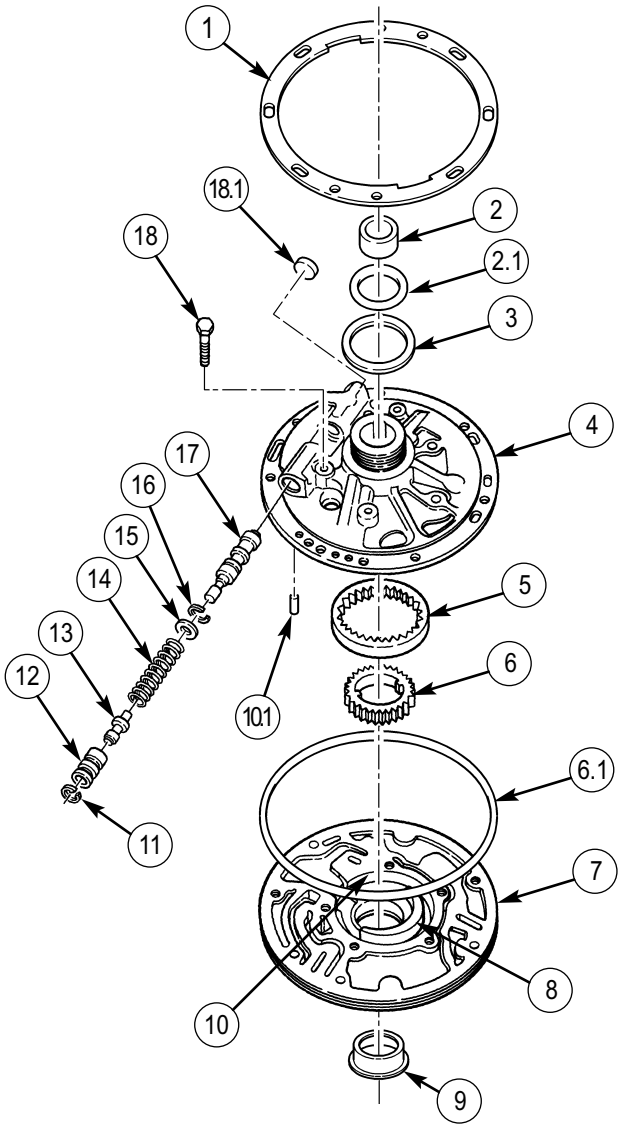
## 17-6. OIL PUMP REPAIR (3L80) (Cont'd)

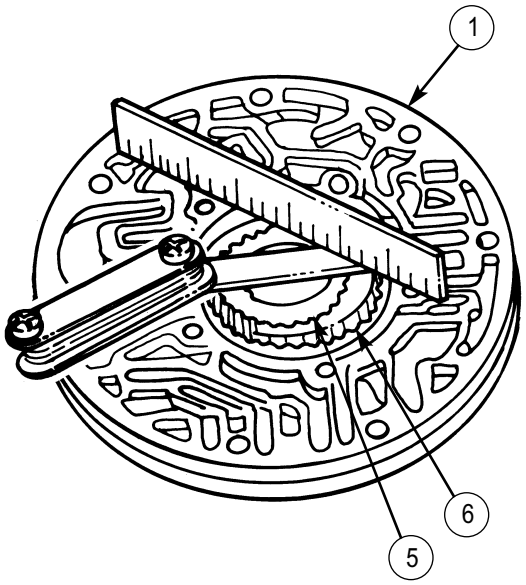
**c. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect gear pockets (10), crescent (8), drive gear (5), driven gear (6), and pump body (7) for scoring, galling, or damage. Replace oil pump if any parts are scored, galled, or damaged.
2. Place drive gear (5) and driven gear (6) in pump body (7).
3. Check pump body (7) to drive gear (5) face and driven gear (6) face clearance using a straight edge and feeler gauge. Clearance should be 0.0008-0.0035 inch (0.02-0.09 mm). If clearance does not meet specifications, replace oil pump.
4. Inspect snapring (11), boost valve bushing (12), and boost valve (13) for damage. Replace all items if one item is damaged.
5. Inspect pressure regulator spring (14), spring retainer (15), spacer(s) (16), and regulator valve (17) for damage. Replace any damaged items.



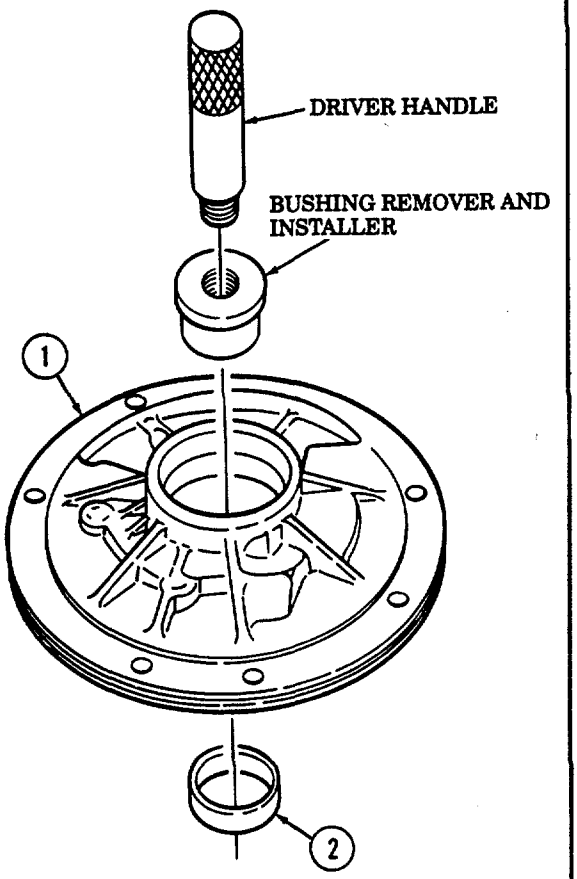



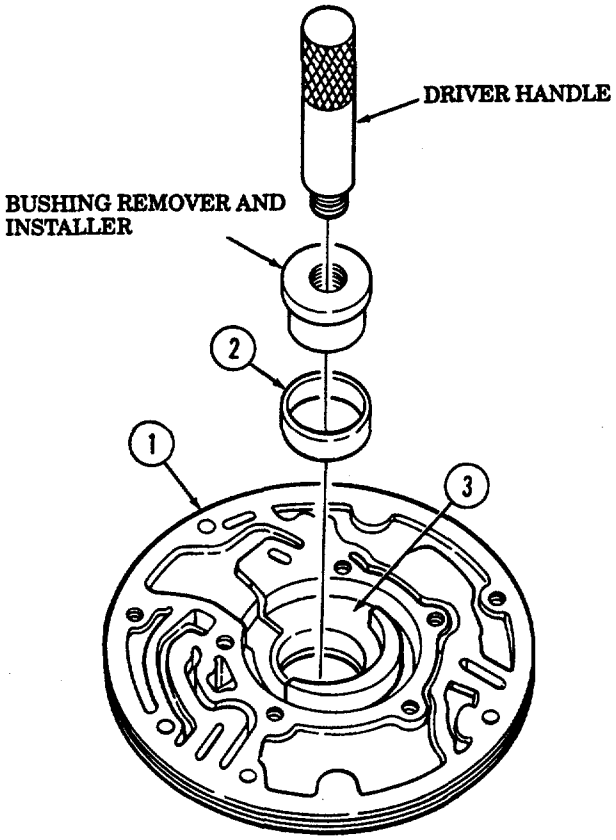
## 17- 6 OIL PUMP REPAIR (3L80) (Cont'd)

6. Inspect pump bushing (2) for damage. If damaged, perform steps 7 and 8. If not, go to step 9.

7. Using driver handle and bushing remover and installer J21465-17, remove bushing (2) from pump body (1).

8. Using driver handle and bushing remover and installer J21465-17, install bushing (2) in pump body (1) until bushing (2) is 0.010 in. (0.25 mm) below gear pocket face (3).



**17-6. OIL PUMP REPAIR (3L80) (Cont'd)**

9. Inspect pump cover (7) for galling or scoring. Replace oil pump if cover (7) is damaged.
10. Inspect stator shaft splines (5) for damage. Replace oil pump if splines (5) are damaged.
11. Inspect oil ring grooves (8) for damage. Replace oil pump if grooves (8) are damaged.
12. Inspect front and rear stator shaft bushings (4) for damage. If damaged, perform steps 13 through 15. If not, go to d. assembly.

**NOTE**

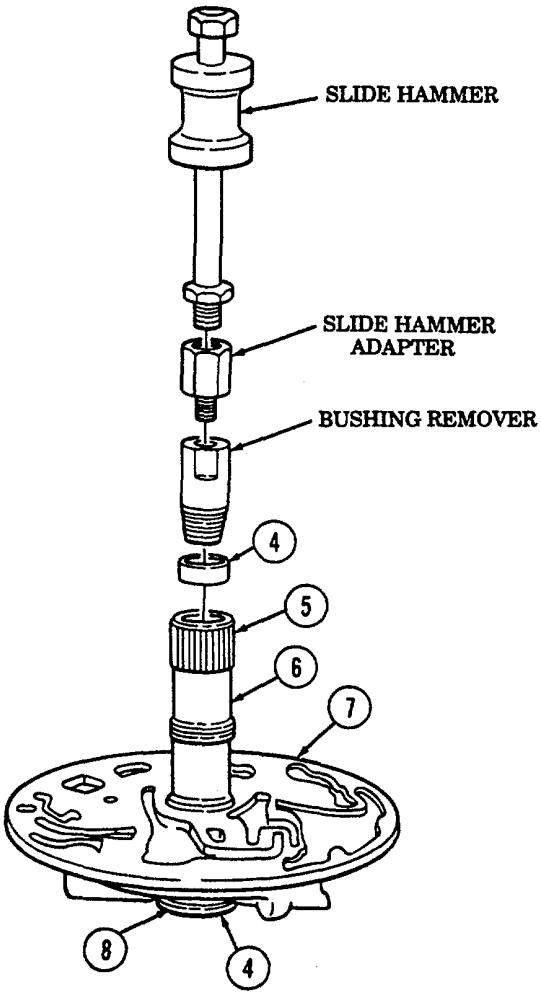
Replacement procedures for front or rear stator shaft bushings are basically the same. Steps 13 through 15 cover the front stator shaft bushing.

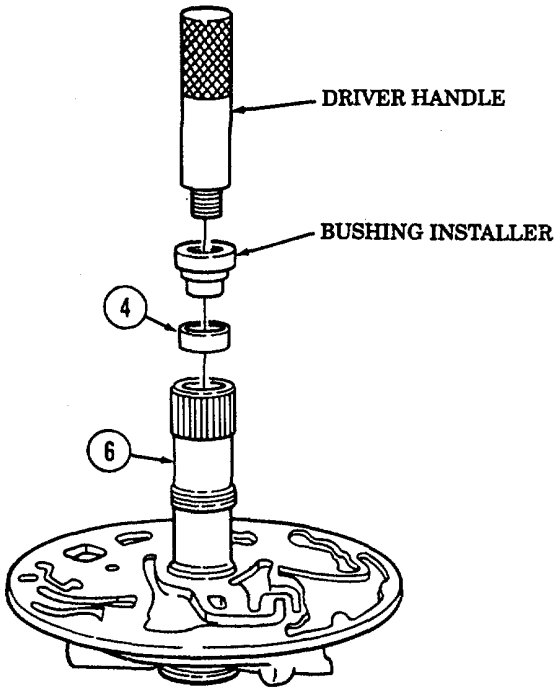
13. Mount pump cover (7) in soft-jawed vise.
14. Using bushing remover J21465-15, slide hammer adapter, and slide hammer, remove stator shaft bushing (4) from stator shaft (6). Discard bushing (4).

**NOTE**

Use bushing installer J21465-2 if replacing rear stator shaft bushing.

15. Using driver handle and bushing installer J21465-3, install bushing (4) in stator shaft (6).



## 17-6. OIL PUMP REPAIR (3L80) (Cont'd)

**d. Assembly**

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid before assembly. Foreign material will cause transmission damage.

**NOTE**

For general assembly instructions, refer to para. 2-16.

1. Install oil seal (7.1) on pump cover (4).

1.1. Install drive gear (6) and driven gear (5) in pump body (8) with reference marks and tangs (7) on drive gear (6) aligned face up.

2. Install pump cover (4) on pump body (8).

2.1. Install disk (15.1) in pump cover (4).

2.2. Install gasket (1) in pump cover (4).

**NOTE**

See table 17-1 for proper location of capscrews.

3. Align pump cover (4) and pump body (8) and install five capscrews (17).

*Table 17-1. Capscrew location.*

| | |
|---|---|
| **Capscrew A** | 5/16 X 18 X 1 |
| **Capscrew B** | 5/16 X 18 X 1-1/2 |
| **Capscrew C** | 5/16 X 18 X 1-3/4 |

4. Install oil pump (18) into transmission case (16) and tighten five capscrews (17) to 18 lb-ft (24 N•m).

5. Remove oil pump (18) from transmission case (16).

6. Install regulator valve (15), spacer(s) (14), spring retainer (13), spring (12), boost valve (11), boost valve bushing (10), snapring (9), and pin (8.1) in pump cover (4).

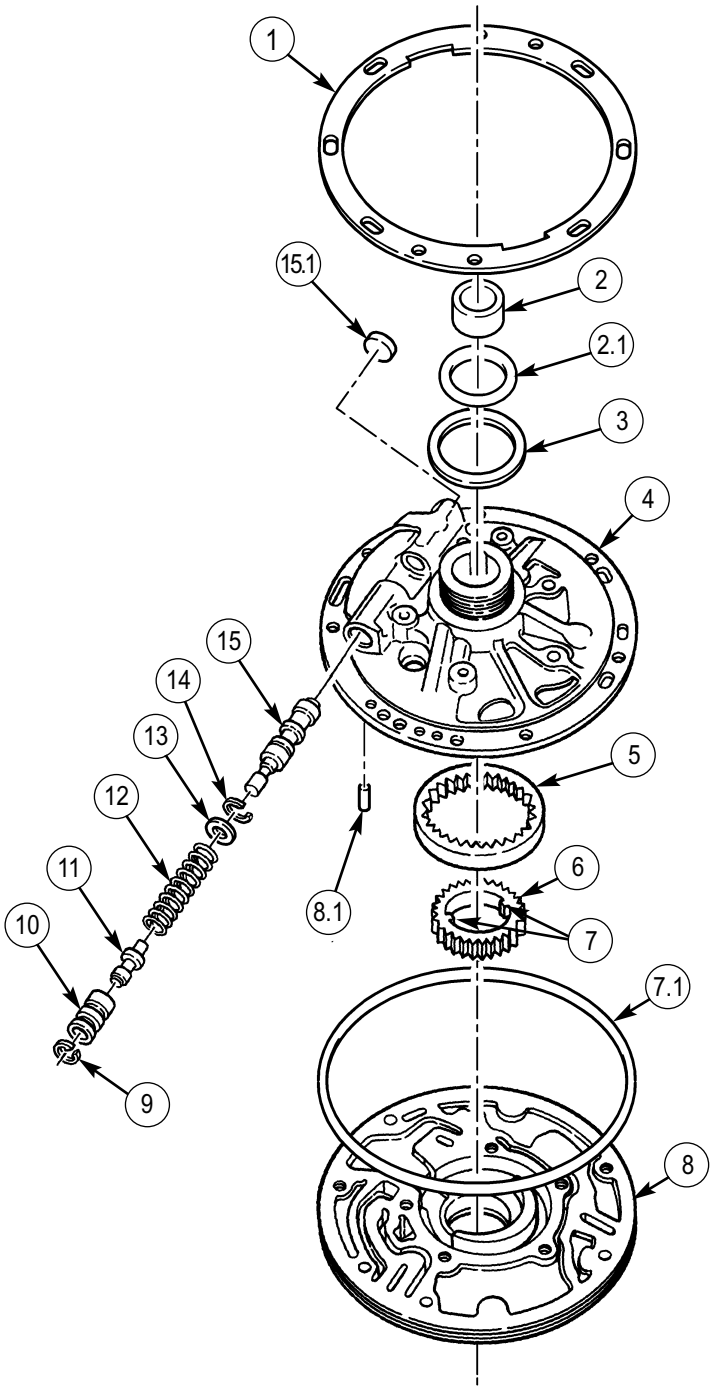
7. Install selective washer (3), thrust washer bearing (2.1), and packing retainer (2) on pump cover (4). Ensure lap joints on packing retainer (2) and thrust washer bearing (2.1) are properly joined.

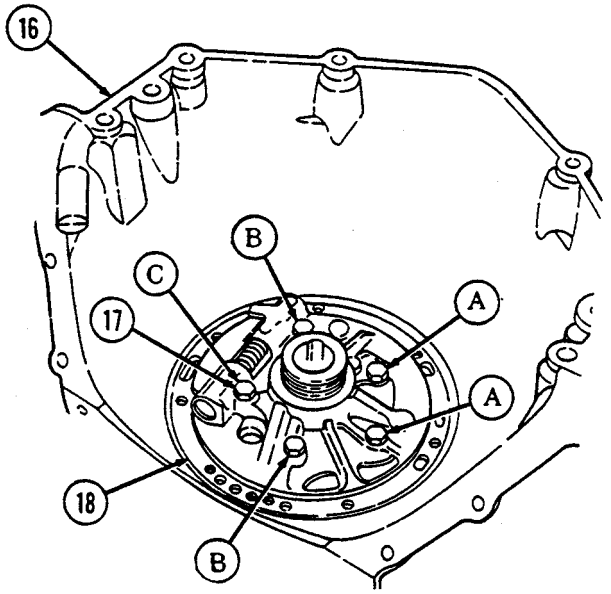
8. Deleted.

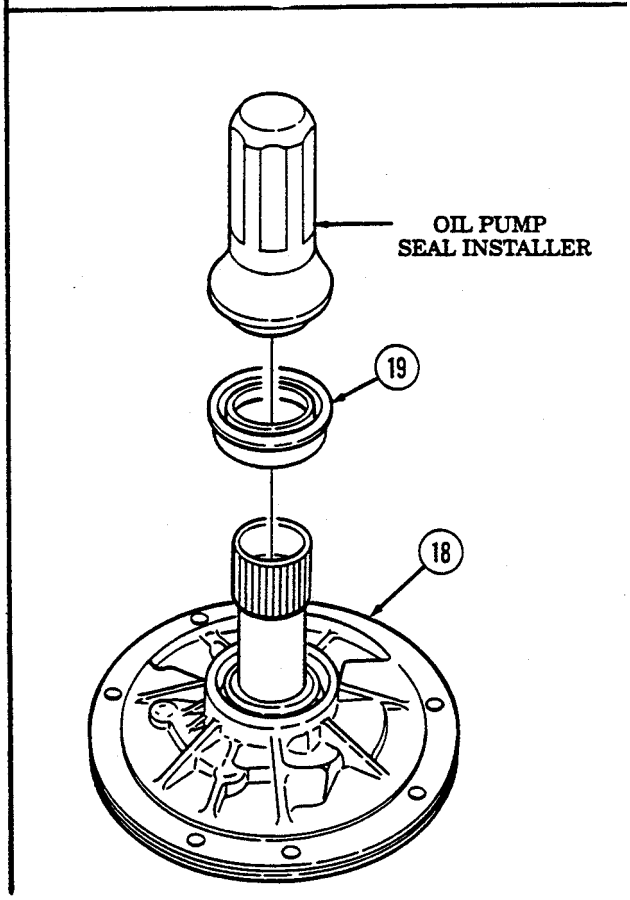
9. Apply sealing compound to outside diameter of seal (19).

10. Using oil pump seal installer, install seal (19) in oil pump (18).

## 17-6. OIL PUMP REPAIR (3L80) (Cont'd)



## 17-7. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (3L80)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Clutch spring compressor (Appendix G, Item 35)
Clutch spring compressor adapter (Appendix G, Item 36)

**Materials/Parts**
Five clutch disks (Appendix E, Item 8)
Plain seal (Appendix E, Item 222)
Outer seal (Appendix E, Item 219)
Air seal (Appendix E, Item 210)

**Materials/Parts (Cont'd)**
Petrolatum (Appendix B, Item 38)
Transmission fluid (Appendix B, Item 23)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-3).

**General Safety Instructions**
Air pressure must not exceed 50 psi (345 kPa) when air checking clutch piston.

**Maintenance Level**
General support

**NOTE**

Work area should be well ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

1. Remove snapring (1), direct clutch hub (2), forward clutch hub (3), thrust washer (4), five clutch disks (7), and steel clutch plates (5) from forward clutch housing (6). Discard clutch disks (7).
2. Place clutch housing (6) in press. Using clutch spring compressor and clutch spring compressor adapter, compress spring retainer (9) and remove snapring (8) and spring retainer (9) from clutch housing (6).

**NOTE**

Keep forward clutch release springs separate from direct clutch release springs.

3. Remove spring retainer (9), sixteen release springs (10), and clutch piston (12) from clutch housing (6).
4. Remove plain seal (13) and outer seal (14) from clutch piston (6). Discard seals (13) and (14).

4.1. Remove air seal (14.1) from clutch housing (6). Discard air seal (14.1).

5. Remove clutch piston apply ring (11) from clutch piston (12).

### b. Cleaning

Clean all forward clutch and turbine shaft components in accordance with para. 2-13.

### c. Inspection

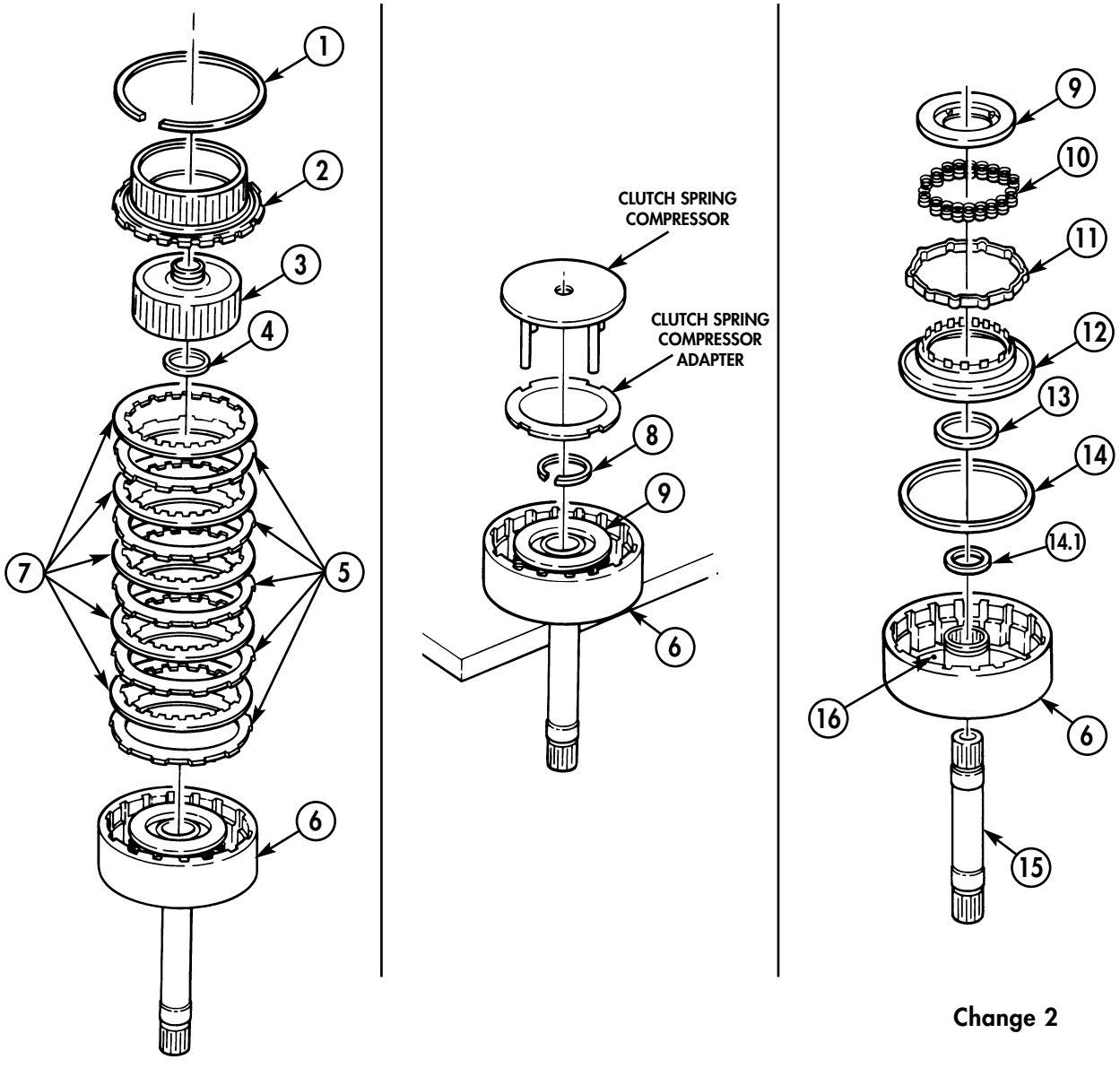
**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect five steel clutch plates (5) for signs of burning, scoring, or cracks. Replace any that are burnt, scored, or cracked.

## 17-7. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (3L80) (Cont'd)

2. Inspect thrust washer (4), spring retainer (9), and snapring (8) for distortion or damage. Replace any if distorted or damaged.
3. Inspect forward clutch hub (3) and direct clutch hub (2) for damage. Replace either if damaged.
4. Inspect clutch piston (12) for distortion or damage. Replace if distorted or damaged.
5. Inspect clutch release springs (10) for collapsed coils or distortion. Replace all release springs (10) if any are damaged.
6. Inspect clutch housing (6) and turbine shaft (15) for damage. If either are damaged, perform steps 7 through 10. If not, go to d. assembly.
7. Using press, remove turbine shaft (15) from clutch housing (6).
8. Check for freeness of check ball (16) in clutch housing (6), and that all oil passages are open. Replace
forward clutch assembly if check ball (16) is not free or if oil passages are blocked.
9. Inspect turbine shaft (15) for blocked oil passages. Replace turbine shaft (15) if oil passages are blocked.
10. Using press, install turbine shaft (15) in clutch housing (6).



## 17-7. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (3L80) (Cont'd)

**d. Assembly**

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid before assembly. Foreign material will cause transmission damage.

**NOTE**

For general assembly instructions, refer to para. 2-16.

1. Install clutch piston apply ring (3) in clutch piston (5).

1.1. Install air seal (7.1) on clutch housing (8). Be sure lip on air seal (7.1) faces up.

2. Install plain seal (6) and outer seal (7) on clutch piston (5). Ensure lips on seals (6) and (7) face away from spring guides (4).

**NOTE**

It may be necessary to use 0.015 in. (0.381 mm) feeler gauge to start inner and outer clutch piston seals into clutch housing.

3. Install clutch piston (5) in clutch housing (8).
4. Install sixteen release springs (2) and spring retainer (1) on clutch piston (5).
5. Place clutch housing (8) in press.
6. Using clutch spring compressor and clutch spring compressor adapter, compress spring retainer (1).
7. Install snapring (9) securing spring retainer (1) to clutch housing (8).
8. Install forward clutch hub thrust washer (13) on forward clutch hub (12) and retain with petrolatum.
9. Install clutch hub (12) in clutch housing (8).
10. Install five steel clutch plates (14) and five clutch disks (15) in clutch housing (8). Start with steel clutch plate (14) then alternate clutch disks (15) and steel clutch plates (14).
11. Install direct clutch hub (11) in clutch housing (8) with snapring (10).
12. Install forward clutch housing (8) on oil pump (17).

**WARNING**

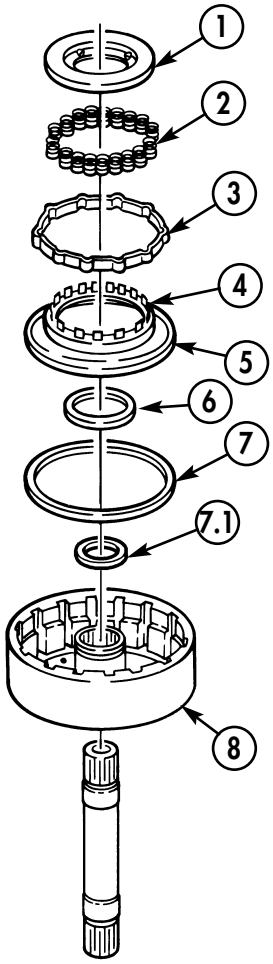
Air pressure must not exceed 50 psi (345 kPa) when air checking clutch piston, or injury to personnel or damage to equipment may result.

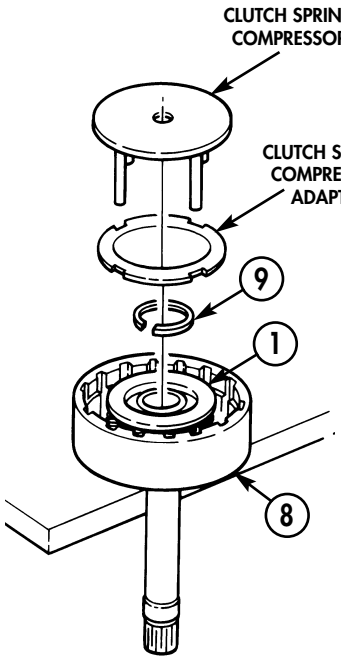
**NOTE**

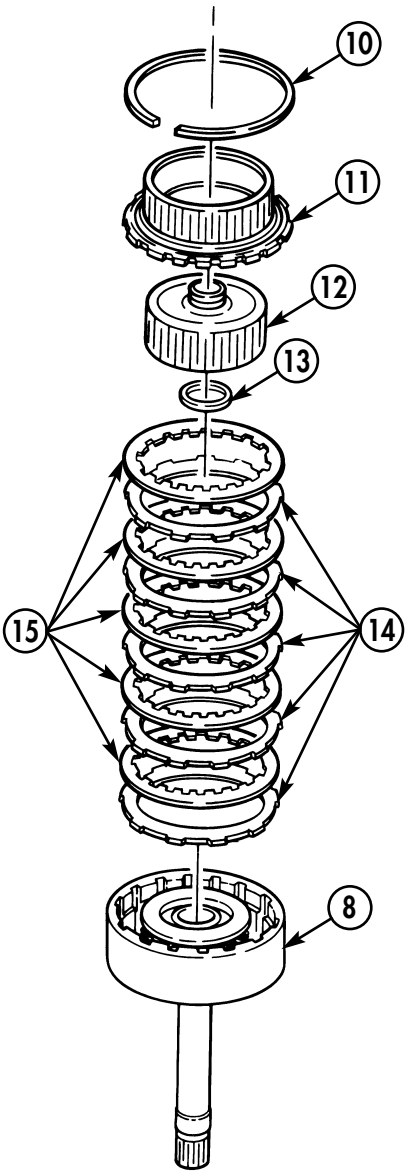
Direct clutch hub must move up and down freely when air pressure is applied.

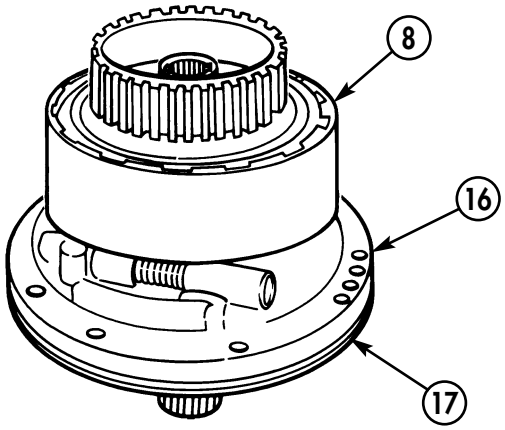
13. Apply air pressure to forward clutch oil passage (16) to check operation of clutch piston.

## 17-7. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (3L80) (Cont'd)



## 17-8. DIRECT CLUTCH AND INTERMEDIATE SPRAG REPAIR (3L80)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Clutch spring compressor (Appendix G, Item 35)
Clutch spring compressor adapter (Appendix G, Item 36)

**Materials/Parts**
Six clutch disks (Appendix E, Item 8)
Air seal (Appendix E, Item 210)

**Materials/Parts (Cont'd)**
Outer seal (Appendix E, Item 207)
Center seal (Appendix E, Item 206)
Transmission fluid (Appendix B, Item 23)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-3).

**General Safety Instructions**
Air pressure must not exceed 50 psi (345 kPa) when air checking clutch piston.

**Maintenance Level**
General support

**NOTE**

Work area should be well ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

1. Remove snapring (1), sprag retainer (2), outer race (3), bushing (4), sprag (5), and bushing (4) from direct clutch housing (6).
2. Remove snapring (7), backing plate (8), six clutch disks (10), and steel clutch plates (9) from clutch housing (6). Discard clutch disks (10).
3. Using press, clutch spring compressor, and clutch spring compressor adapter, compress spring retainer (12).
4. Remove snapring (11) securing spring retainer (12) to clutch housing (6).

**NOTE**

Keep direct clutch release springs separate from forward clutch release springs.

5. Remove spring retainer (12), fourteen release springs (13), and clutch piston (15) from clutch housing (6).
6. Remove air seal (16) and center seal (17) from clutch piston (15). Discard seals (16) and (17).
7. Remove outer seal (18) from clutch housing (6). Discard seal (18).
8. Remove clutch piston apply ring (14) from clutch piston (15).

### b. Cleaning

Clean all direct clutch and intermediate sprag components in accordance with para. 2-13.

### c. Inspection

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect clutch backing plate (8) and six steel clutch plates (9) for signs of burning, scoring, or cracks. Replace any plate if burnt, scored, or cracked.

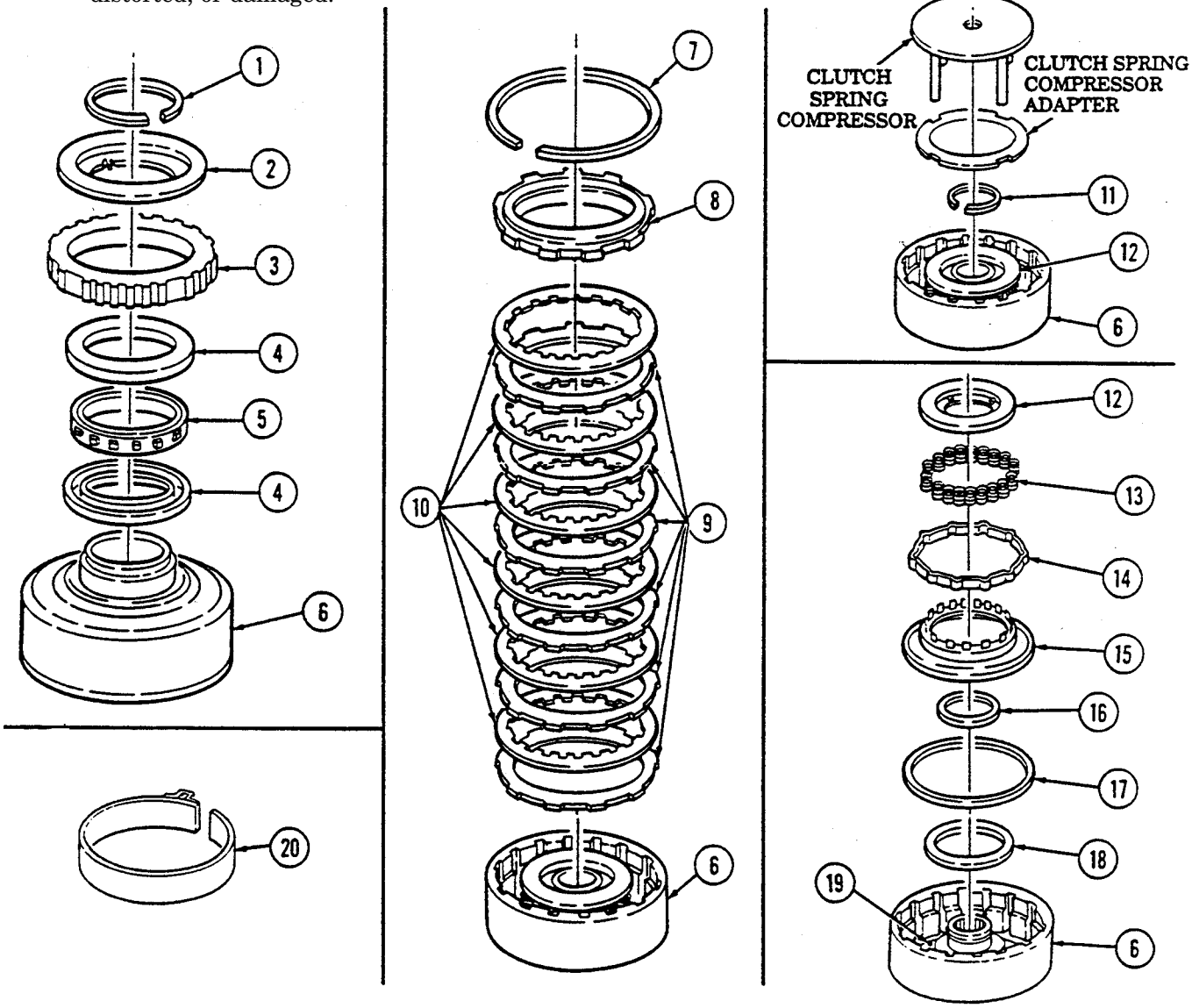
## 17-8. DIRECT CLUTCH AND INTERMEDIATE SPRAG REPAIR (3L80) (Cont'd)

2. Inspect sprag retainer snapring (1), backing plate snapring (7), spring retainer (12), and sprag retainer (2) for distortion or damage. Replace any if distorted or damaged.
3. Inspect sprag (5), sprag bushings (4), and outer sprag race (3) for scoring, galling, or damage. Replace any if scored, galled, or damaged.
4. Inspect clutch piston (15) for distortion or damage. Replace if distorted or damaged.
5. Inspect clutch release springs (13) for collapsed coils or distortion. Replace all if any are collapsed or distorted.
6. Inspect direct clutch housing (6) for damage. Replace if damaged.
7. Check for freeness of check ball (19) and ensure all oil passages in clutch housing (6) are open. Replace direct clutch assembly if check ball (19) is not free or oil passages are blocked.

**NOTE**

Front band was removed during transmission disassembly (para. 17-3).

8. Inspect front band (20) for burning, scoring, distortion, or damage. Replace if burnt, scored, distorted, or damaged.



## 17-8. DIRECT CLUTCH AND INTERMEDIATE SPRAG REPAIR (3L80) (Cont'd)

**d. Assembly**

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid before assembly. Foreign material will cause transmission damage.

**NOTE**

For general assembly instructions, refer to para. 2-16.

1. Install clutch piston apply ring (3) in clutch piston (5).
2. Install air seal (6) and center seal (7) on clutch piston (5). Ensure lips on seals (6) and (7) face away from spring guides.
3. Install outer seal (8) on clutch housing (9). Be sure lip on air seal (8) faces up.

**NOTE**

It may be necessary to use 0.015 in. (0.381 mm) feeler gauge to start seals into clutch housing.

4. Install clutch piston (5) in clutch housing (9).
5. Install fourteen release springs (2) and spring retainer (1) on clutch piston (5).
6. Using press, clutch spring compressor and clutch spring compressor adapter, compress spring retainer (1).
7. Install snapring (10) securing spring retainer (1) to clutch housing (9).
8. Remove clutch spring compressor and clutch spring compressor adapter from clutch housing (9).
9. Install six steel clutch plates (13) and six clutch disks (14) in clutch housing (9). Start with steel clutch plate (13) then alternate clutch disks (14) and steel clutch plates (13).
10. Install clutch backing plate (12) on clutch housing (9) with snapring (11).
11. Install sprag bushing (20) cup side up over inner sprag race (21).
12. Install sprag (19) into outer sprag race (17).

**CAUTION**

Outer sprag race should not turn counterclockwise after installa-tion or transmission damage will result.

**NOTE**

If outer sprag race turns counterclockswise, sprag is installed upside down.

13. Install sprag (19) and outer sprag race (17) over inner sprag race (21) with shoulder on inner cage of sprag (19) facing down and rotate until seated on lower sprag bushing (20).
14. Install upper sprag bushing (18) cup side down into outer sprag race (17).
15. Install sprag retainer (16) on clutch housing (9) with snapring (15).
16. Place clutch housing (9) on center support (23).

## 17-8. DIRECT CLUTCH AND INTERMEDIATE SPRAG REPAIR (3L80) (Cont'd)

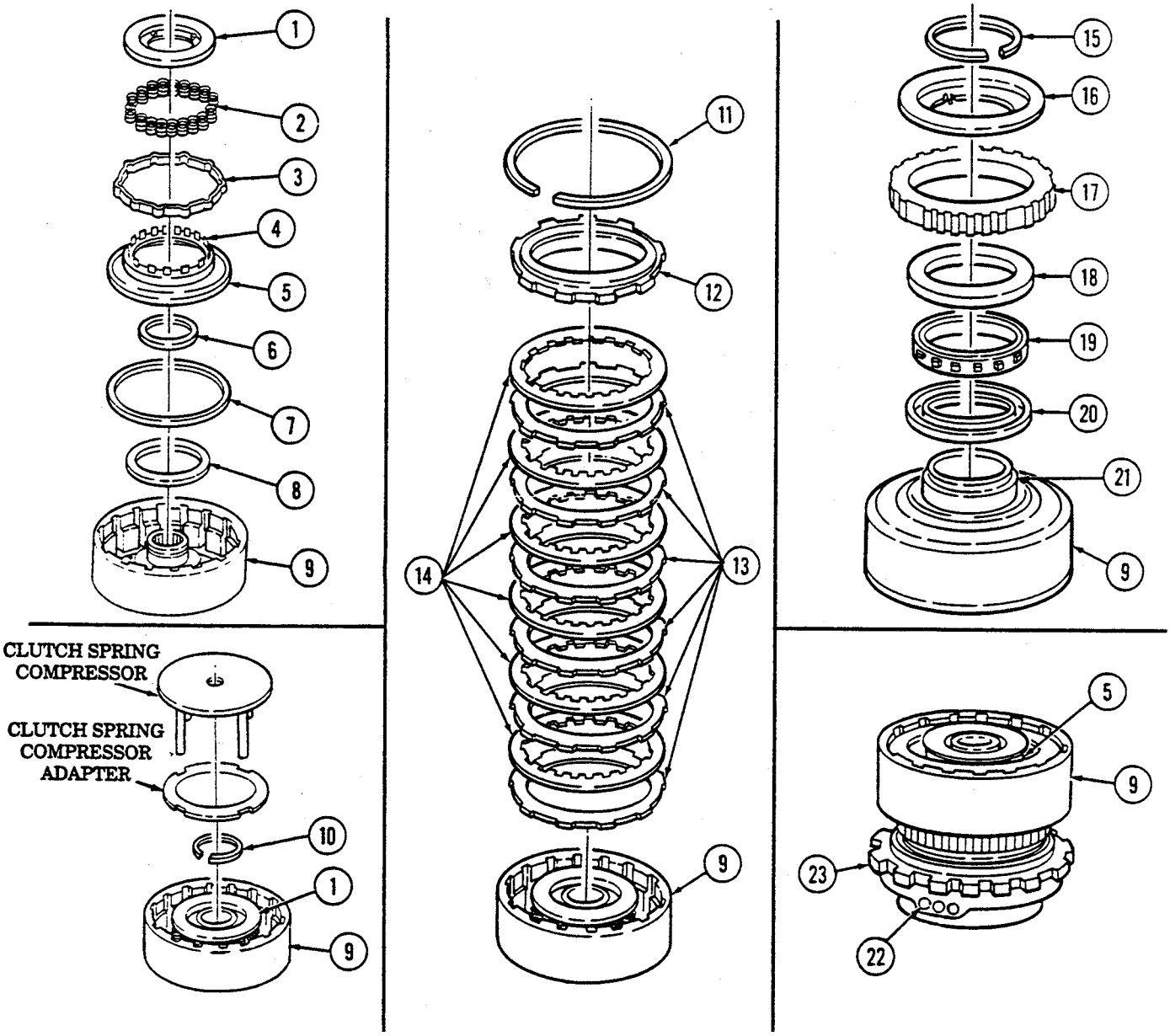
**WARNING**

Air pressure must not exceed 50 psi (345 kPa) when air checking clutch piston, or injury to personnel or damage to equipment may result.

**NOTE**

- If air is applied through reverse passage (right oil feed hole), it will escape from direct clutch passage (left oil feed hole). This is considered normal.
- Clutch piston must move up and down freely when air pressure is applied.

17. Apply air pressure through left oil feed hole (22) to check operation of clutch piston (5).



## 17-9. CENTER SUPPORT REPAIR (3L80)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Driver handle (Appendix G, Item 34)
Bushing service set (Appendix G, Item 33)

**Materials/Parts**
Preformed packing (Appendix E, Item 180)
Preformed packing (Appendix E, Item 182)
Four packing retainers (Appendix E, Item 188)
Transmission fluid (Appendix B, Item 23)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-3).

**General Safety Instructions**
Air pressure must not exceed 15 psi (103 kPa) when air check clutch piston.

**Maintenance Level**
General support

**NOTE**

Work area should be well ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

1. Remove four packing retainers (1) from center support (2). Discard packing retainers (1).
2. Compress spring retainer (11), and remove snapring (5) and spring retainer (11) from center support (2).
3. Remove three release springs (10), spring guide (9), and clutch piston (6) from center support (2).
4. Remove preformed packings (7) and (8) from clutch piston (6). Discard preformed packings (7) and (8).

### b. Cleaning

Clean all center support components in accordance with para. 2-13.

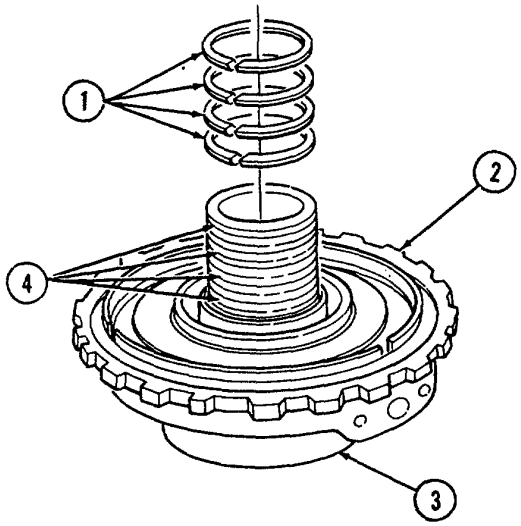
### c. Inspection

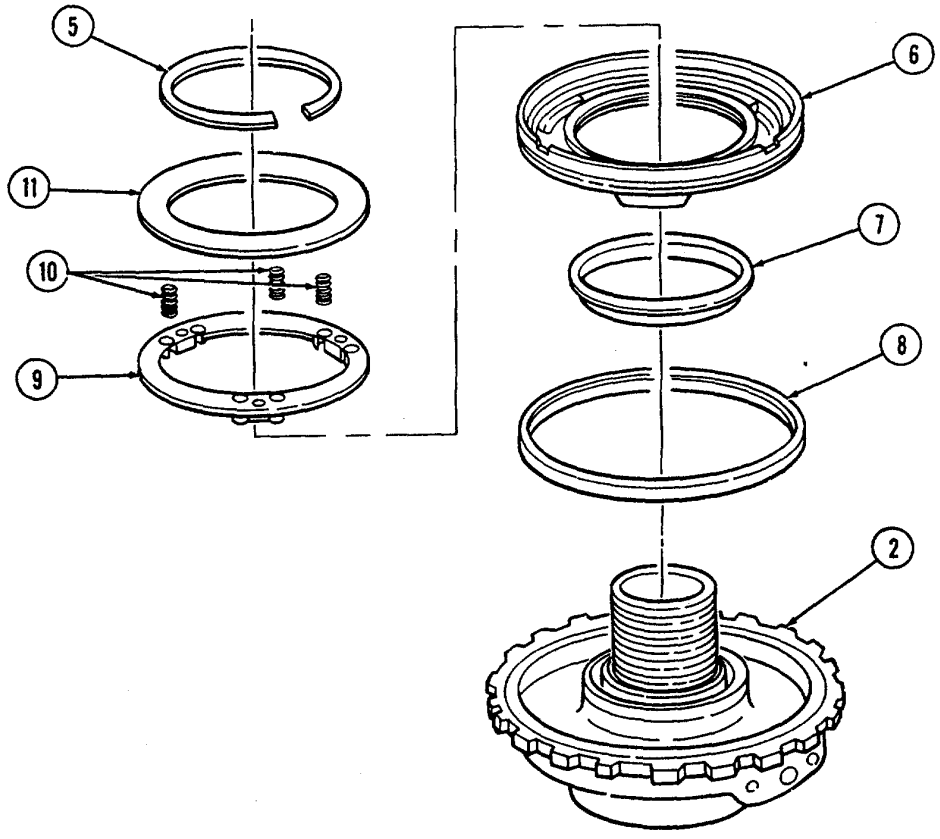
**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect roller clutch inner race (3) for damage. Replace center support (2) if damaged.
2. Inspect oil ring grooves (4) in center support (2) for roughness or damage. Replace center support (2) if damaged.
3. Inspect center support (2) for damage. Replace if damaged.
4. Check all oil passages in center support (2) for blockage.
5. Inspect release springs (10) for signs of distortion or collapsed coils. Replace all springs (10) if any have distorted or collapsed coils.
6. Inspect clutch piston (6), spring guide (9), spring retainer (11), and snapring (5) for damage or distortion. Replace any part if damaged or distorted.

## 17-9. CENTER SUPPORT REPAIR (3L80) (Cont'd)



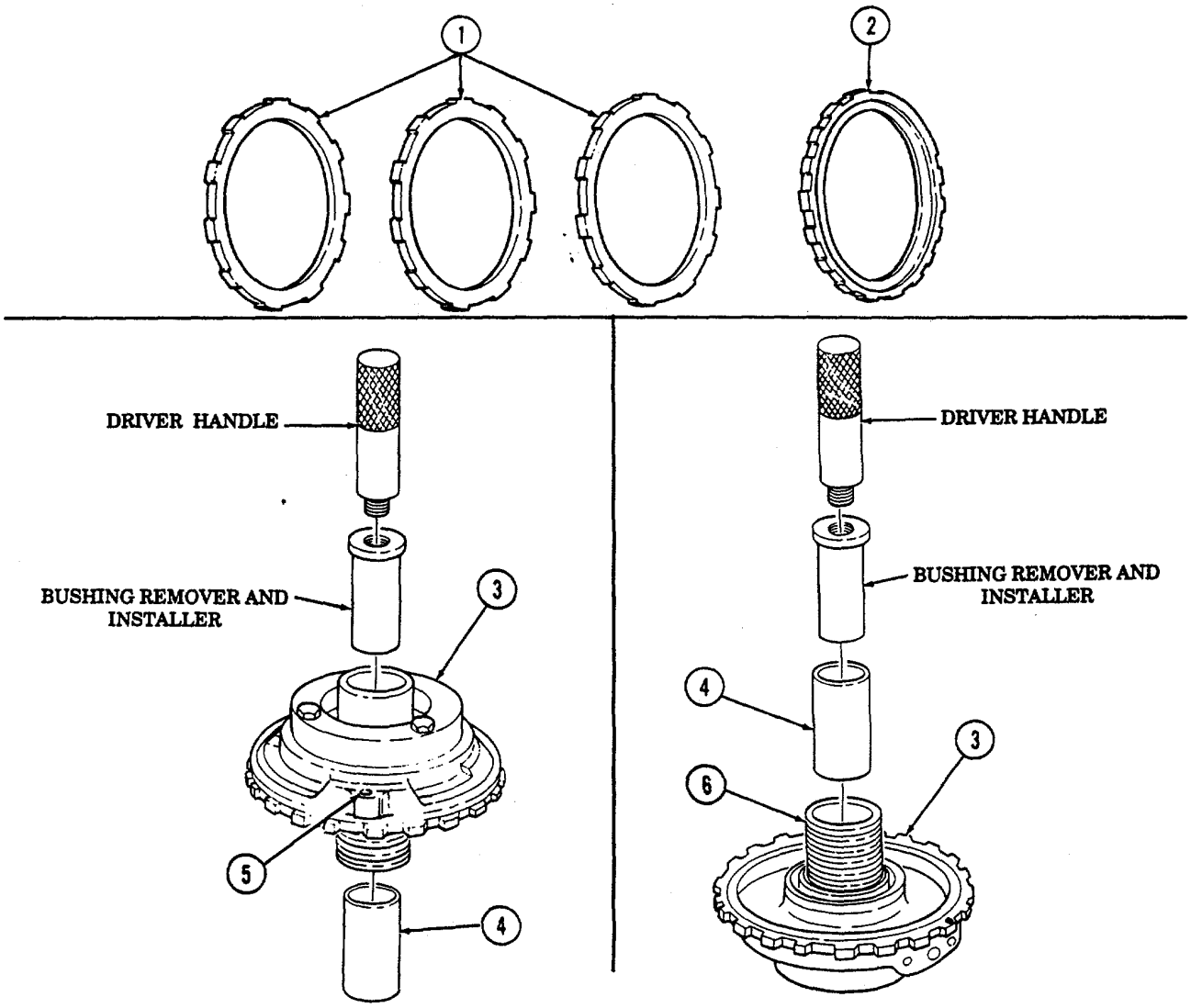



## 17-9. CENTER SUPPORT REPAIR (3L80) (Cont'd)

**NOTE**

Intermediate clutch plates and backing plate were removed during transmission disassembly (para 17-3).

7. Inspect steel clutch plates (1) and backing plate (2) for signs of burning, scoring, or cracks. Replace any that are burned, scored, or cracked.
8. Inspect bushing (4) in center support (3) for damage. If damaged, perform steps 9 through 11. If not, go to step 12.
9. Using driver handle and bushing remover and installer J21465-6, remove bushing (4) from center support (3).
10. Align elongated slot in bushing (4) with drilled hole in oil delivery sleeve (6) closest to piston cavity in center support (3).
11. Using driver handle and bushing remover and installer J21465-6, install bushing (4) into center support (3) until bushing (4) is flush to 0.010 in. (0.254 mm) below top of oil delivery sleeve (6).
12. Check center support (3) for obstructions in orifice plug (5). Remove obstructions with a piece of wire. Replace center support if plug (5) is missing or obstructions cannot be removed.



## 17-9. CENTER SUPPORT REPAIR (3L80) (Cont'd)

**d. Assembly**

**CAUTION**

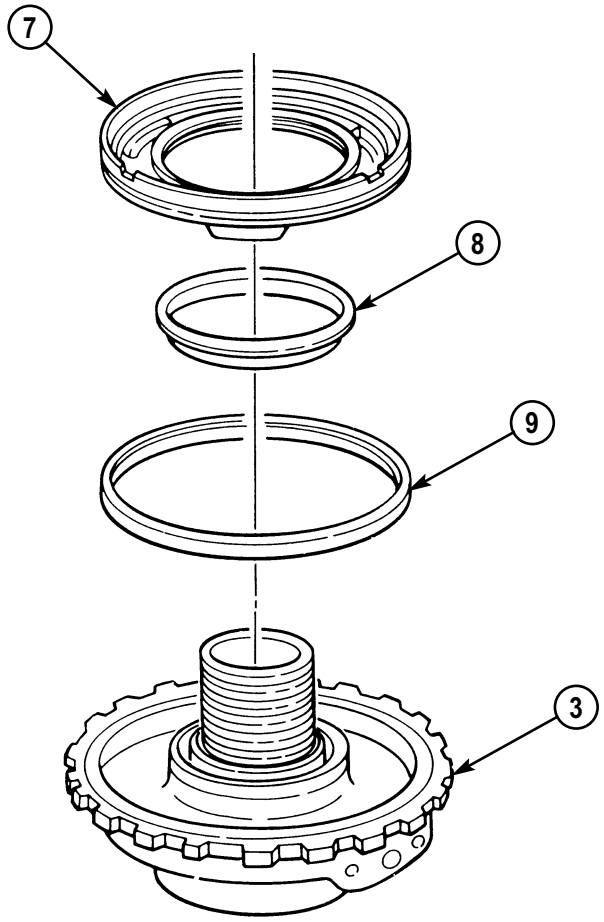
All transmission parts must be lubricated with clean transmission fluid before assembly. Foreign material will cause transmission damage.

**NOTE**

- For general assembly instructions, refer to para. 2-16.
- It may be necessary to use a 0.015 in. (0.381 mm) feeler gauge to start outer and inner piston seals into center support.

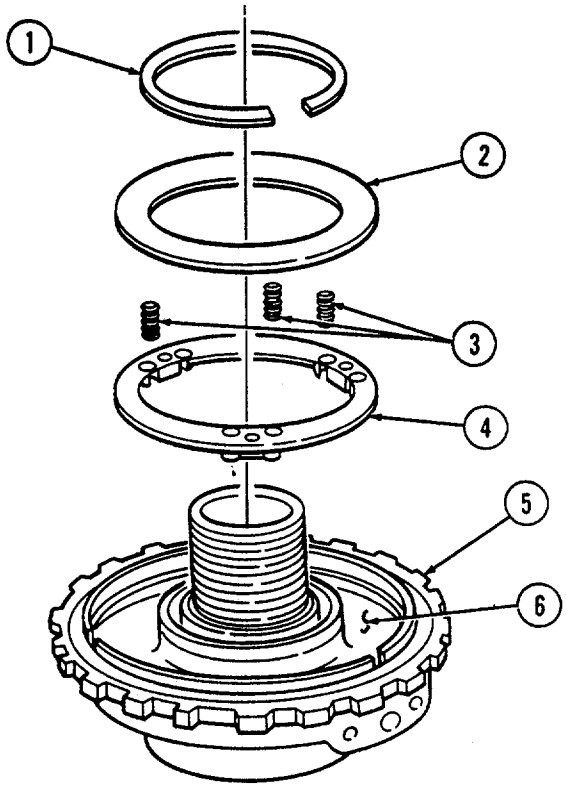
1. Install preformed packings (8) and (9) on clutch piston (7). Ensure lips on preformed packings (8) and (9) face away from spring pockets in clutch piston (7).

2. Install clutch piston (7) in center support (3), indexing spring pockets in clutch piston (7) with cored areas in center support (3).



## 17-9. CENTER SUPPORT REPAIR (3L80) (Cont'd)

3. Install spring guide (4) and three release springs (3) evenly spaced in clutch piston (6).
4. Place spring retainer (2) on release springs (3).
5. Compress release springs (3) and install snapring (1) securing spring retainer (2) to center support (5).



## 17-9. CENTER SUPPORT REPAIR (3L80) (Cont'd)

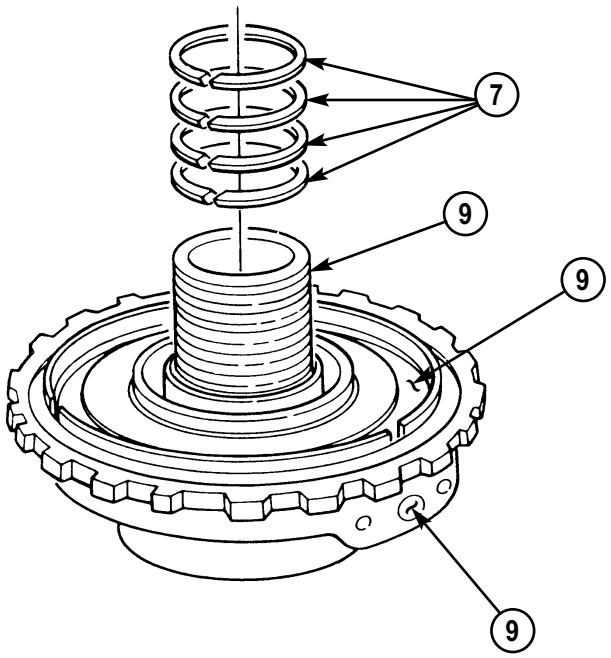
**WARNING**

Air pressure must not exceed 15 psi (103 kPa) when air checking clutch piston, or injury to personnel or damage to equipment may result.

**NOTE**

Clutch piston must move up and down freely when air pressure is applied.

6. Apply compressed air through center support bolt hole (9) to check operation of clutch piston (6).
7. Install four packing retainers (7) on oil delivery sleeve (8). Ensure lap joints on packing retainers (7) are properly joined.



## 17-10. GEAR UNIT REPAIR (3L80)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Driver handle (Appendix G, Item 34)
Bushing service set (Appendix G, Item 33)
Slide hammer adapter (Appendix G, Item 32)
Gear unit holding tool (Appendix G, Item 31)

**Materials/Parts**
Petrolatum (Appendix B, Item 38)
Transmission fluid (Appendix B, Item 23)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-3).

**Maintenance Level**
General support

**NOTE**
Work area should be well ventilated, clean, and free from blowing dirt and dust.

**a. Disassembly**

1. Remove roller clutch (1) from reaction carrier (2).
2. Remove reaction carrier (2) from output carrier (8).

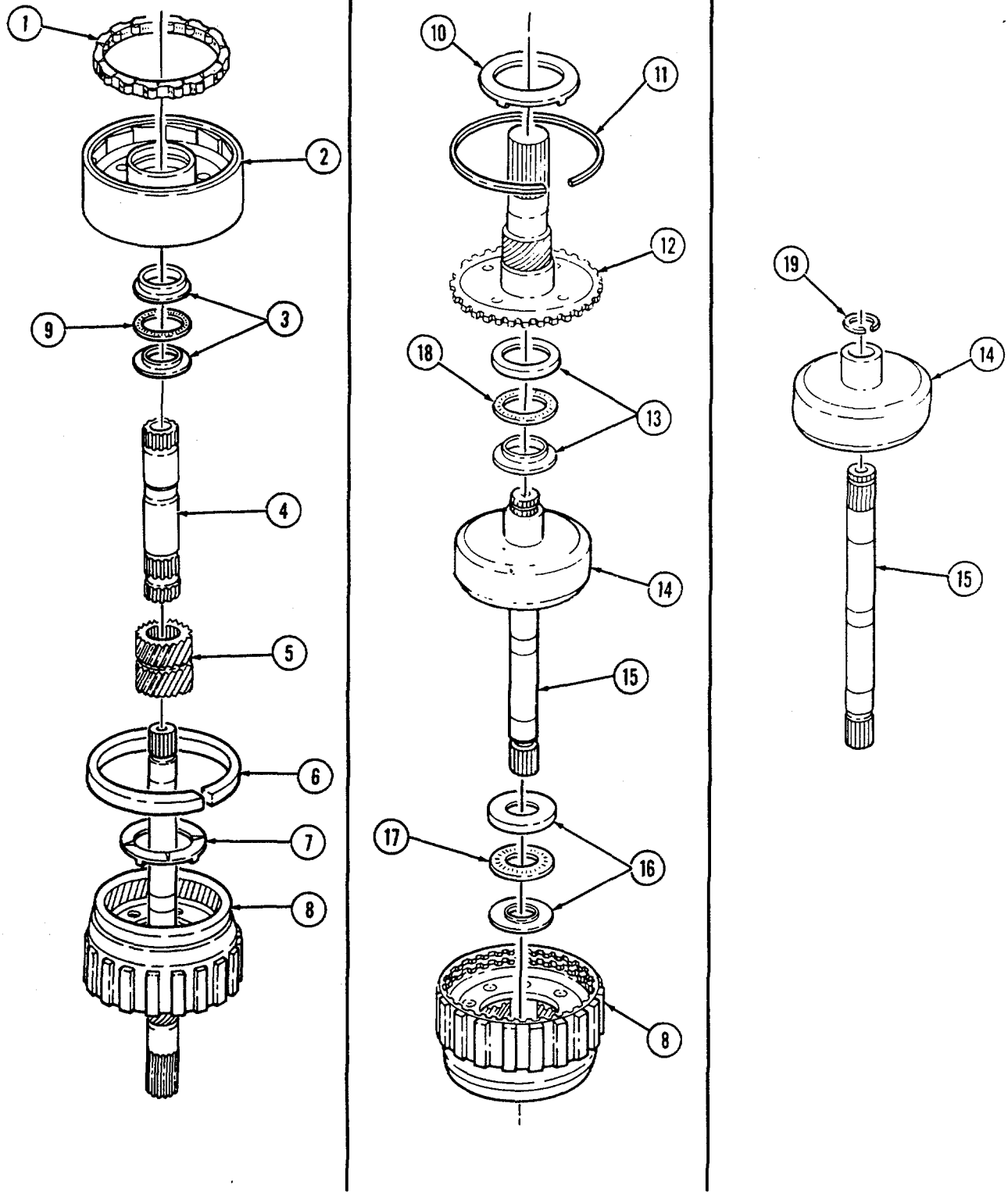
**NOTE**
Keep all thrust bearings and races together as sets.

3. Remove race (3), sun gear thrust bearing (9), and race (3) from sun gear shaft (4). Tag thrust bearing (9) and races (3) for assembly.
4. Remove sun gear shaft (4), sun gear (5), front internal gear ring (6), and reaction carrier thrust washer (7) from output carrier (8).
5. Turn output carrier (8) over.
6. Remove snapring (11) from output shaft (12) and output carrier (8).
7. Remove case thrust washer (10) and output shaft (12) from output carrier (8).
8. Remove two races (13) and output shaft thrust bearing (18) from rear internal gear (14). Tag thrust bearing (18) and races (13) for assembly.
9. Remove rear internal gear (14) and mainshaft (15) from output carrier (8).
10. Remove two races (16) and rear internal gear thrust bearing (17) from output carrier (8). Tag thrust bearing (17) and races (16) for assembly.
11. Remove snapring (19) and mainshaft (15) from rear internal gear (14).

**b. Cleaning**

Clean all gear unit components in accordance with para. 2-13.

## 17-10. GEAR UNIT REPARI (3L80) (Cont'd)



## 17-10. GEAR UNIT REPAIR (3L80) (Cont'd)

### c. Inspection

**NOTE**

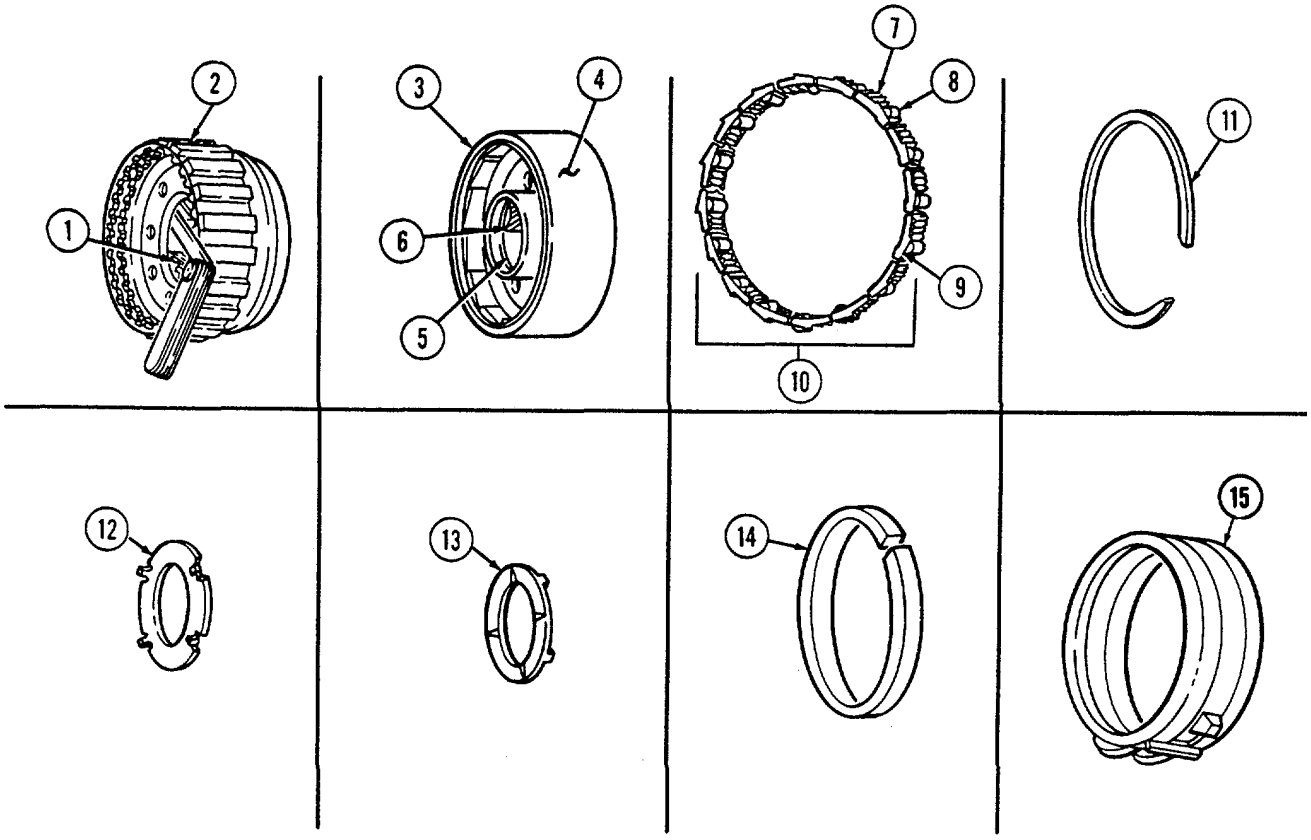
For general inspection instructions, refer to para. 2-14. '

1. Inspect output carrier (2) for damage. Replace if damaged.
2. Inspect output carrier pinion gears (1) for damage, rough bearings, or excessive end play. Using feeler gauge, measure pinion gear end play; end play should not exceed 0.024 in. (0.61 mm). If any of these conditions exist, replace output carrier (2).
3. Inspect band surface (4) on reaction carrier (3) for burning, scoring, or galling. Replace if burnt, scored, or galled.
4. Inspect reaction carrier bushing (5). Replace reaction carrier (3) if bushing (5) is damaged.
5. Inspect reaction carrier pinion gear (6) for damage, rough bearings, or excessive end play. Using feeler gauge, measure pinion gear end play; end play should not exceed 0.024 in. (0.61 mm). If any of these conditions exist, replace reaction carrier (3).
6. Inspect roller clutch (10) for damaged rollers (8), springs (7), or cage (9). Replace roller clutch (10) if any parts are damaged.
7. Inspect snapring (11), case thrust washer (12), reaction carrier thrust washer (13), and front internal gear ring (14) for distortion or damage. Replace any part distorted or damaged.

**NOTE**

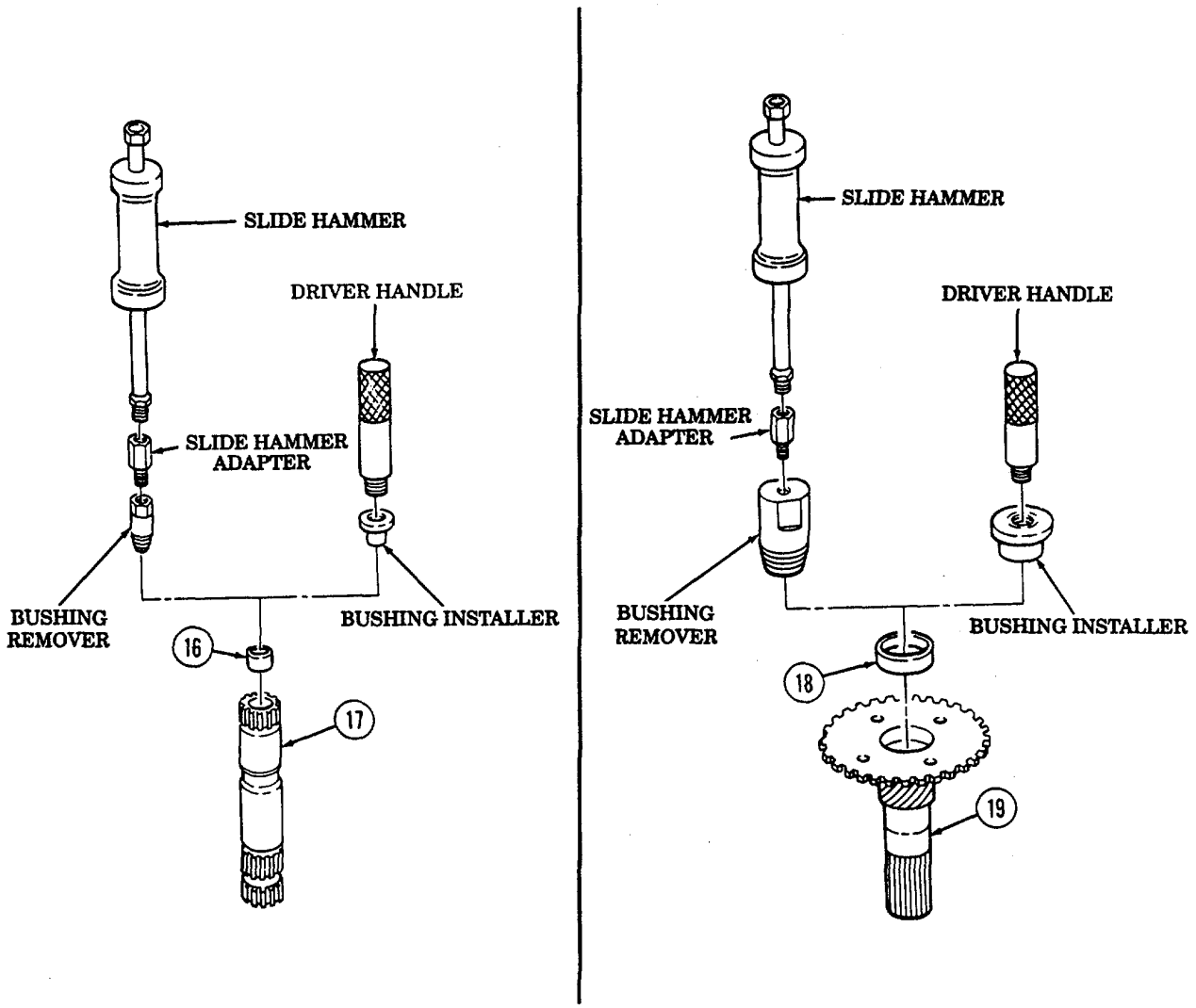
Rear band was removed during transmission disassembly (para. 17-3).

8. Inspect rear band (15) for burning, scoring, distortion, or other damage. Replace if burnt, scored, distorted, or otherwise damaged.



## 17-10. GEAR UNIT REPAIR (3L80) (Cont' d)

9. Inspect sun gear shaft bushings (16) for damage. If damaged, perform steps 10 and 11, if not, go to step 12.
10. Using bushing remover J21465-15, slide hammer adapter and slide hammer, remove bushing (16) from sun gear shaft (17). Discard bushing (16).
11. Using driver handle and bushing installer J21465-5, install bushing (16) in sun gear shaft (17).
12. Inspect output shaft bushing (18) for damage. If damaged, perform steps 13 and 14, if not, go to step 15.
13. Using bushing remover J21465-16, slide hammer adapter and slide hammer, remove bushing (18) from output shaft (19). Discard bushing (18).
14. Using driver handle and bushing installer J21465-1, install bushing (18)in output shaft (19).
15. Refer to para. 2-14 for general inspection instructions for all other gear unit parts.



## 17-10. GEAR UNIT REPAIR (3L80) (Cont' d)

### d. Assembly

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid before assembly. Foreign material will cause transmission damage.

**NOTE**

- For general assembly instructions, refer to para. 2-16.
- If replacing mainshaft, make sure orifice cup plug in service mainshaft is removed.

1. Install mainshaft (1) in rear internal gear (2) and secure with snapring (3).
2. Install large bearing race (7), thrust bearing (6), and small bearing race (5) (with inside diameter flange facing thrust bearing (6)) on mainshaft (1).
3. Install output carrier (4) on mainshaft (1) and rotate carrier (4) until seated.
4. Install small diameter bearing race (13) (with inside diameter flange facing up), thrust bearing (12), and large bearing race (11) (with outside diameter flange facing thrust bearing (12)) on rear internal gear (2).
5. Install output shaft (10) on output carrier (4) and secure with snapring (9).
6. Install case thrust washer (8) on output shaft (10) and retain with petrolatum.
7. Turn gear unit over.
8. Install reaction carrier thrust washer (23) on output carrier (4) with tabs on thrust washer (23) fitting in pockets in output carrier (4).
9. Install sun gear (21) on mainshaft (1), with bevel on inside diameter splines (20) facing down, and - into output carrier (4).

**NOTE**

When a new output carrier and/or reaction carrier is being installed and front internal gear ring prevents assembly of carriers, replace front gear ring with replacement gear ring.

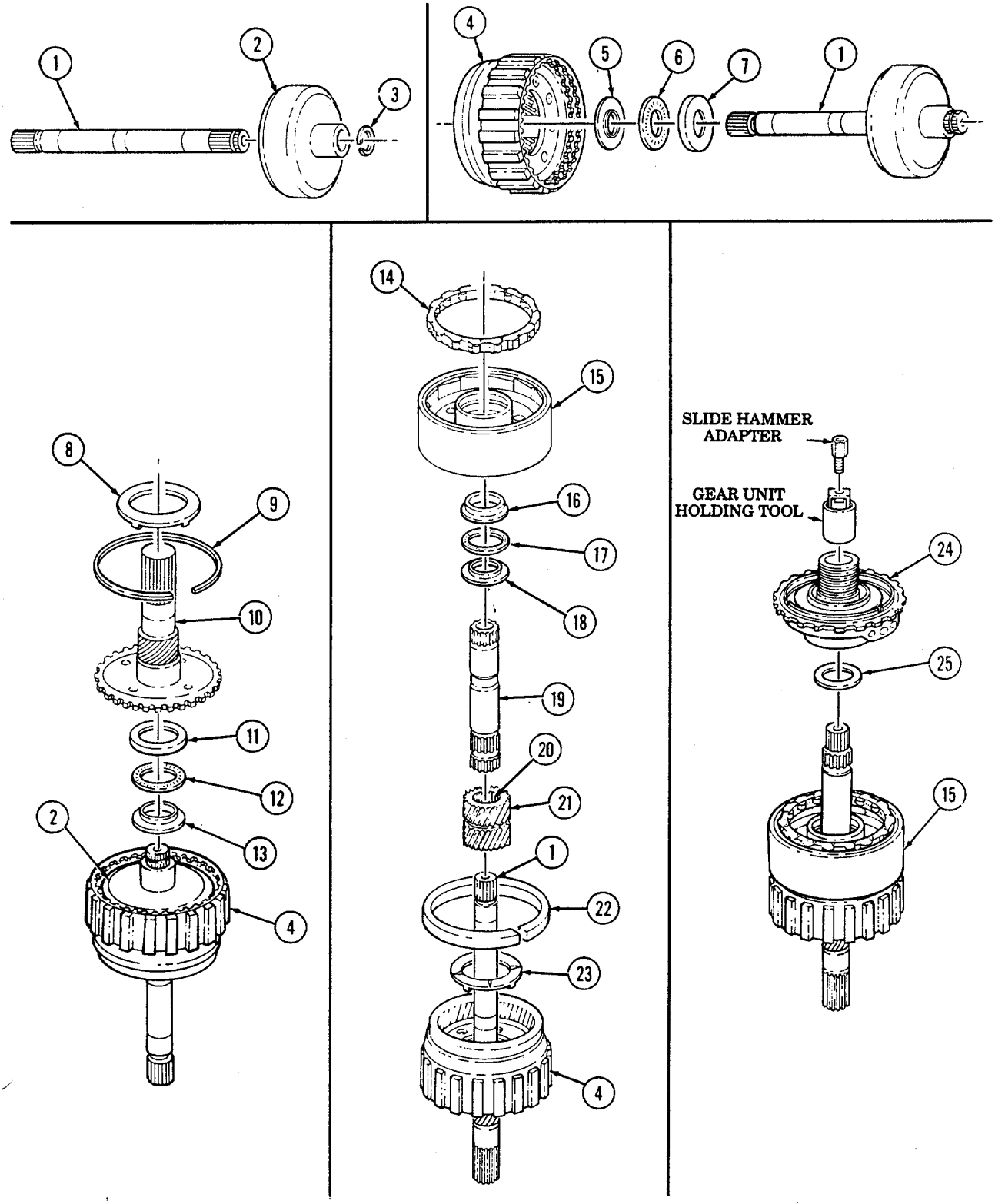
10. Install front internal gear ring (22) and reaction carrier (15) on output carrier (4) so pinion gears mesh with sun gear (21).
11. Install sun gear shaft (19) into sun gear (21) with long splines fitting into sun gear (21).
12. Install large bearing race (18) (with inside diameter flange facing up), thrust bearing (17), and small bearing race (16) (with inside diameter facing up) on sun gear shaft (19).
13. Install roller clutch (14) in reaction carrier (15).
14. Install center support thrust washer (25) in recess of center support (24). Retain thrust washer (25) with petrolatum.

**NOTE**

With reaction carrier held, center support should only turn counter-clockwise.

15. Install center support (24) in reaction carrier (15).
16. Install gear unit holding tool and slide hammer adapter to hold assembly together.

## 17-10. GEAR UNIT REPAIR (3L80) (Cont'd)



## 17-11. REAR SERVO REPAIR (3L80)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-3).

**Maintenance Level**
General support

**NOTE**

Work area should be well ventilated, clean, and free from blowing dirt and dust.

**a. Disassembly**

1. Remove rear accumulator piston (6) from rear servo piston (9).

**CAUTION**

Band apply pin is spring loaded.

2. Remove E-ring (10) from band apply pin (1) and remove band apply pin (1), washer (4), spring (3), and spring retainer (2) from rear servo piston (9).

**b. Cleaning**

Clean all gear unit components in accordance with para. 2-13.

**c. Inspection**

**NOTE**

- For general inspection instructions, refer to para. 2-14.
- Do not remove oil seal rings from accumulator piston or servo piston unless oil seals require replacement.

1. Inspect accumulator piston oil seal rings (7) and (5) for damage. Replace rings (7) or (5) if damaged.
2. Inspect servo piston oil seal (8) for nicks, cuts, or damage. Replace seal (8) if nicked, cut, or damaged.
3. Inspect accumulator piston (6) and servo piston (9) for damage. Replace either if damaged.
4. Inspect band apply pin (1) for scoring or damage. Replace pin (1) if scored or otherwise damaged.

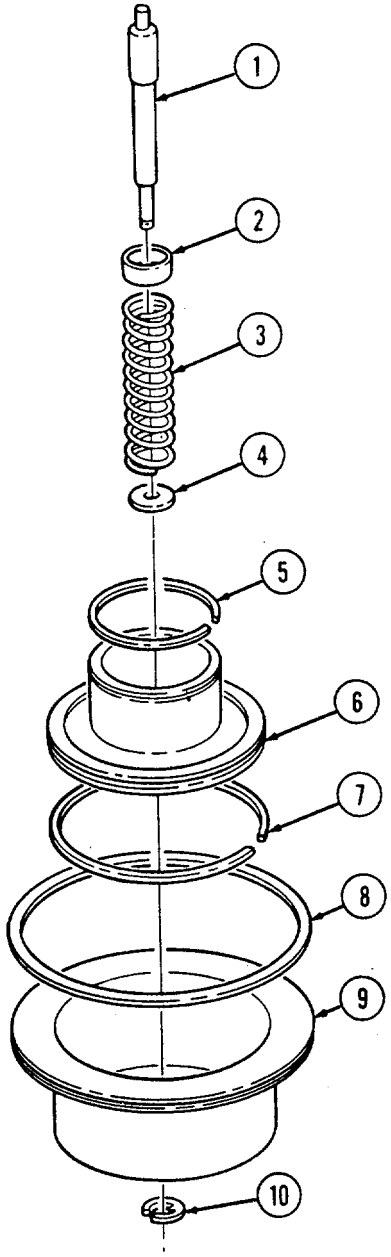
**d. Assembly**

**NOTE**

For general assembly instructions, refer to para. 2-16.

1. Install spring retainer (2), spring (3), and washer (4) on band apply pin (1).
2. Install band apply pin (1) into rear servo piston (9) and secure with E-ring (10).
3. Install accumulator piston (6) into rear servo piston (9).

## 17-11. REAR SERVO REPAIR (3L80) (Cont'd)




17-43

## 17-12. GOVERNOR REPAIR (3L80)

**This task covers:**

**a. Cleaning** **b. Inspection**

**INITIAL SETUP:**

**Applicable Models**
All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Governor removed (para. 17-3)

**Maintenance Level**
General support

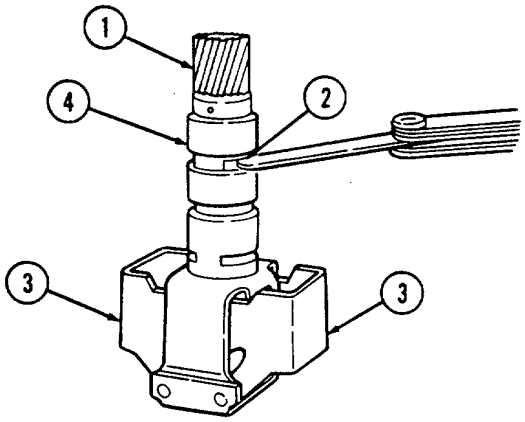
### a. Cleaning

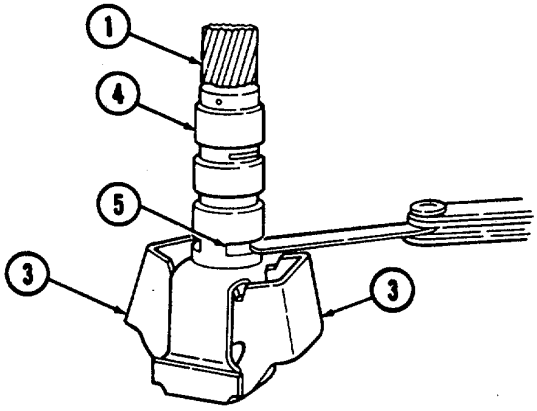
Clean governor (4) in accordance with para. 2-13.

### b. Inspection

1. Inspect governor (4) for scoring or damage. Replace if scored or damaged.
2. Inspect gear (1) for damage. Replace governor (4) if gear (1) is damaged.
3. Check governor weights (3) for free operation. Replace governor (4) if weights (3) are binding.
4. Allow governor weights (3) to hang in their outward position. Using feeler gauge, measure valve opening at governor intake (2). Minimum valve opening is 0.020 in. (0.50 mm). Replace governor (4) if opening does not meet specifications.
5. Hold governor weights (3) inward. Using feeler gauge, measure valve opening at governor exhaust (5). Minimum valve opening is 0.020 in. (0.50 mm). Replace governor (4) if valve opening does not meet specifications.

## 17-12. GOVERONOR REPAIR (3L80) (Cont'd)



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80)

**This task covers:**

**a. Rear Band**
**b. Gear Unit and Center Support**
**c. Establish Rear End Play**
**d. Intermediate Clutch**
**e. Front Band**
**f. Manual Linkage**
**g. Direct Clutch**
**h. Forward Clutch and Turbine Shaft**
**i. Oil Pump**
**j. Establish Front End Play**
**k. Detent Solenoid**
**l. Front Servo**
**m. Rear Servo**
**n. Control Valve**
**o. Governor**
**p. Oil Filter**
**q. Oil Pan**
**r. Holding Fixture**
**s. Torque Converter**

**INITIAL SETUP:**

**Applicable Models**

All vehicles except: M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)
Dial indicator (Appendix G, Item 95)

**Special Tools**

Band apply pin selector gauge (Appendix G, Item 37)
Slide hammer adapter (Appendix G, Item 32)
Gear unit holding tool (Appendix G, Item 31)
Intermediate clutch alignment tool (Appendix G, Item 38)
Torque adapter, 9/16 in. (Appendix G, Item 109)

**Materials/Parts**

Gasket (Appendix E, Item 28)
Gasket (Appendix E, Item 38)
Gasket (Appendix E, Item 24)
Gasket (Appendix E, Item 25)
Fluid parts kit (Appendix E, Item 158)
Nonmetallic seal (Appendix E, Item 214)
Gasket (Appendix E, Item 22)
Packing retainer (Appendix E, Item 187)
Gasket (Appendix E, Item 34)
Three clutch disks (Appendix E, Item 8)
Transmission fluid (Appendix B, Item 23)
Petrolatum (Appendix B, Item 38)
Two guide pins (Appendix C, Fig. 2)

**Personnel Required**

One mechanic
One assistant

**Manual References**

TM 9-2320-280-24P

**Maintenance Level**

General support

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid before assembly. Foreign material will cause transmission damage.

**NOTE**

- During assembly operations, it is important to closely inspect each unit to make sure nothing has been overlooked during inspection and repair. Plugs should be checked for tightness, parts kept clean, openings covered, and machined surfaces protected. Application of lubricant should be performed from covered containers.
- For general assembly instructions, refer to para. 2-16.
- Install transmission holding fixture (para. 17-3.b.).
- If using new transmission case, discard blue plug and copper plug that are packaged with transmission case. These plugs are not required on M998 and M998A1 vehicles.
- The speedometer drive opening must be plugged with seal plug P/N 8623463 on new transmission case.

## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

**a. Rear Band**

1. Position front of transmission case (4) up.
2. Install rear band (2) so two lugs on rear band (2) index with anchor pins (6) in case (4). Ensure rear band (2) is seated on anchor pins (6).

**b. Gear Unit and Center Support**

**NOTE**

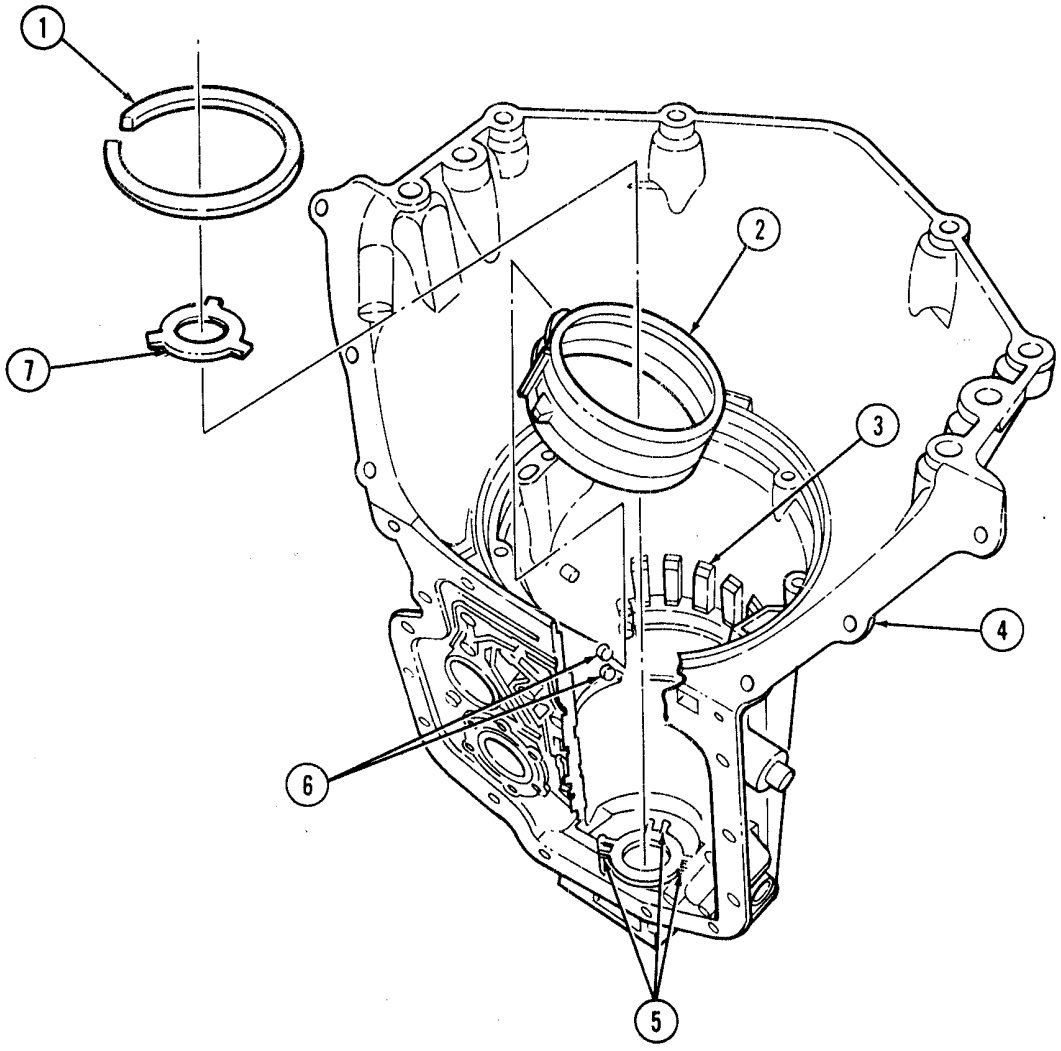
If transmission was manufactured before March 1, 1990 and a new transmission case is to be used, install a new center support assembly.

1. Install rear selective washer (7) in slots (5) inside rear of case (4).

**NOTE**

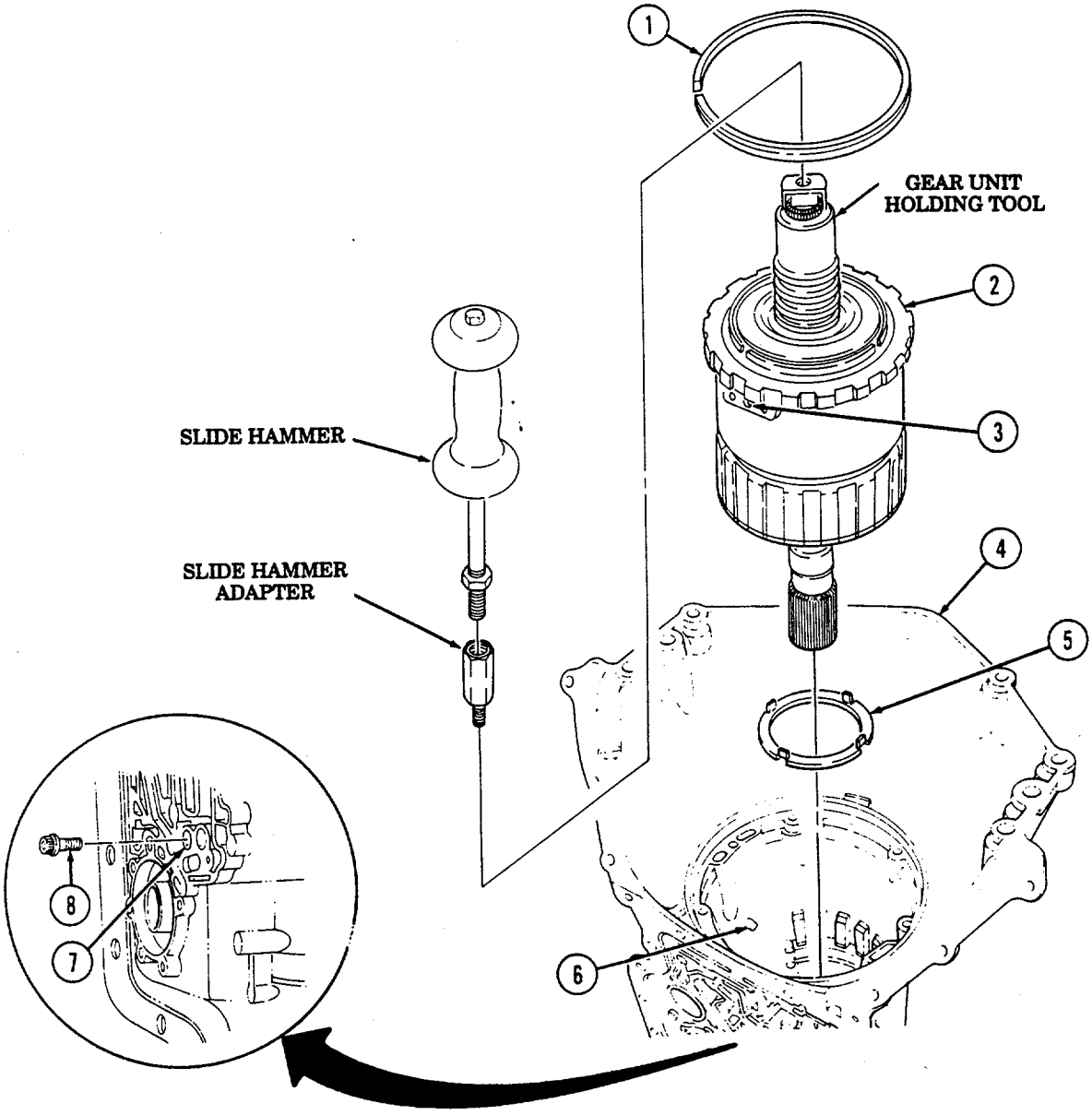
Do not confuse center support spacer (0.040 in. (1.016 mm) thick and both sides flat) with either center support snapring (beveled on one side) or intermediate clutch backing plate snapring (0.093 in. (2.362 mm) thick and both sides flat).

2. Install center support to case spacer (1) against shoulder at bottom of case splines (3), and locate gap in spacer (1) adjacent to anchor pins (6).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

3. Using gear unit holding tool, slide hammer adapter, and slide hammer, install complete gear unit and center support (2) into case (4). Ensure case thrust washer (5) is properly installed on gear unit and center support (2), and center support bolt hole (3) is properly aligned with bolt hole (7) in case (4). Remove installation tools.
4. Lubricate and install center support snapring (1) with beveled side up (flat side against center support) and locate gap in snapring (1) adjacent to front band anchor pin (6). Ensure snapring (1) is properly seated.
5. Install center support alignment bolt (8) through bolt hole (7) in case (4) and into gear unit and center support (2). Using a 3/8 in. 12 point socket, tighten alignment bolt (8) to20-25 lb-ft (27-34 N.m).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

### c. Establish Rear End Play

1. Position transmission (4) so that output shaft (9) faces upward.
2. Mount dial indicator on transmission stud (10) and index dial indicator with end of output shaft (9).
3. Move output shaft (9) in and out to rear end play. End play should be 0.007-0.019 in. (0.177-0.482 mm). The selective washer controlling this end play is the steel washer having three lugs and located between the rear thrust washer and the rear face of the transmission case (4).

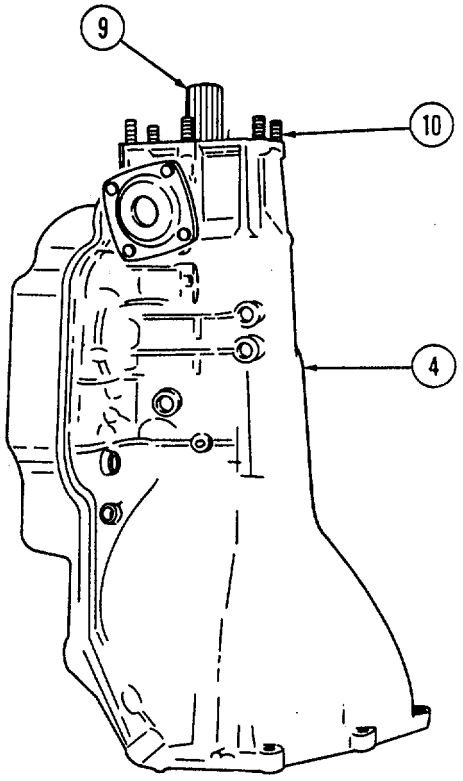
**NOTE**

If a difference in washer thickness is required to bring end play within specifications, it can be selected from the following table.

*Table 17-2. Rear Selective Washer Thickness*

| | IDENTIFICATION | |
|---|---|---|
| **THICKNESS** | **NOTCHES** | **NUMERAL** |
| 0.078-0.082 in. (1.98-2.08 mm) | None. | 1 |
| 0.086-0.090 in. (2.18-2.28 mm) | 1 tab side | 2 |
| 0.094-0.098 in. (2.38-2.48 mm) | 2 tabs side | 3 |
| 0.102-0.106 in. (2.59-2.69 mm) | 1 tab outer | 4 |
| 0.110-0.114 in. (2.79-2.89 mm) | 2 tabs outer diameter | 5 |
| 0.118-0.122 in. (2.99-3.09 mm) | 3 tabs outer diameter | 6 |

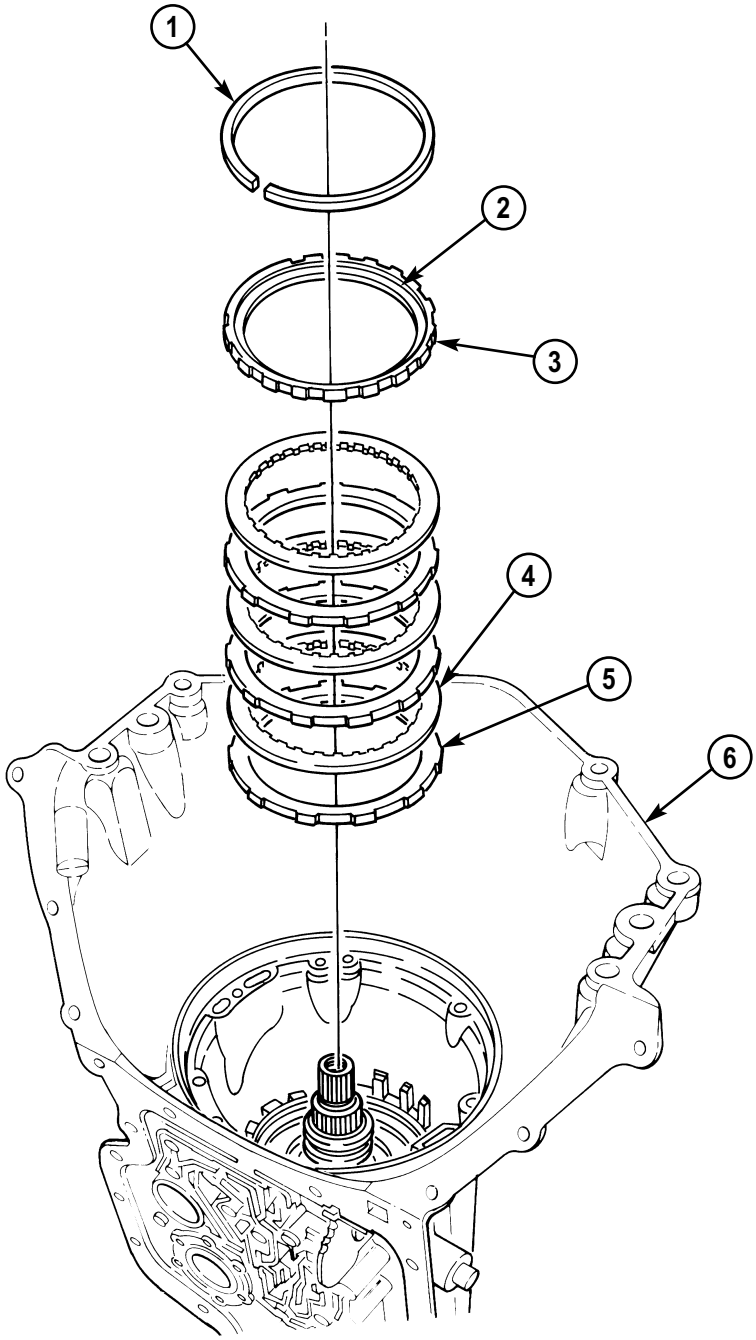
4. If end play is not within specifications, remove selective washer and install a new selective washer of proper thickness.



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

**d. Intermediate Clutch**

1. Position front of case (6) up.
2. Soak three clutch disks (4) in transmission fluid.
3. Install three steel clutch plates (5) and clutch disks (4) in case (6). Start with steel clutch plate (5) then alternate between clutch disks (4) and steel clutch plates (5).
4. Install intermediate clutch backing plate (3), with ridge (2) facing up, and snapring (1). Locate gap in snapring (1) opposite front band anchor pin (7).



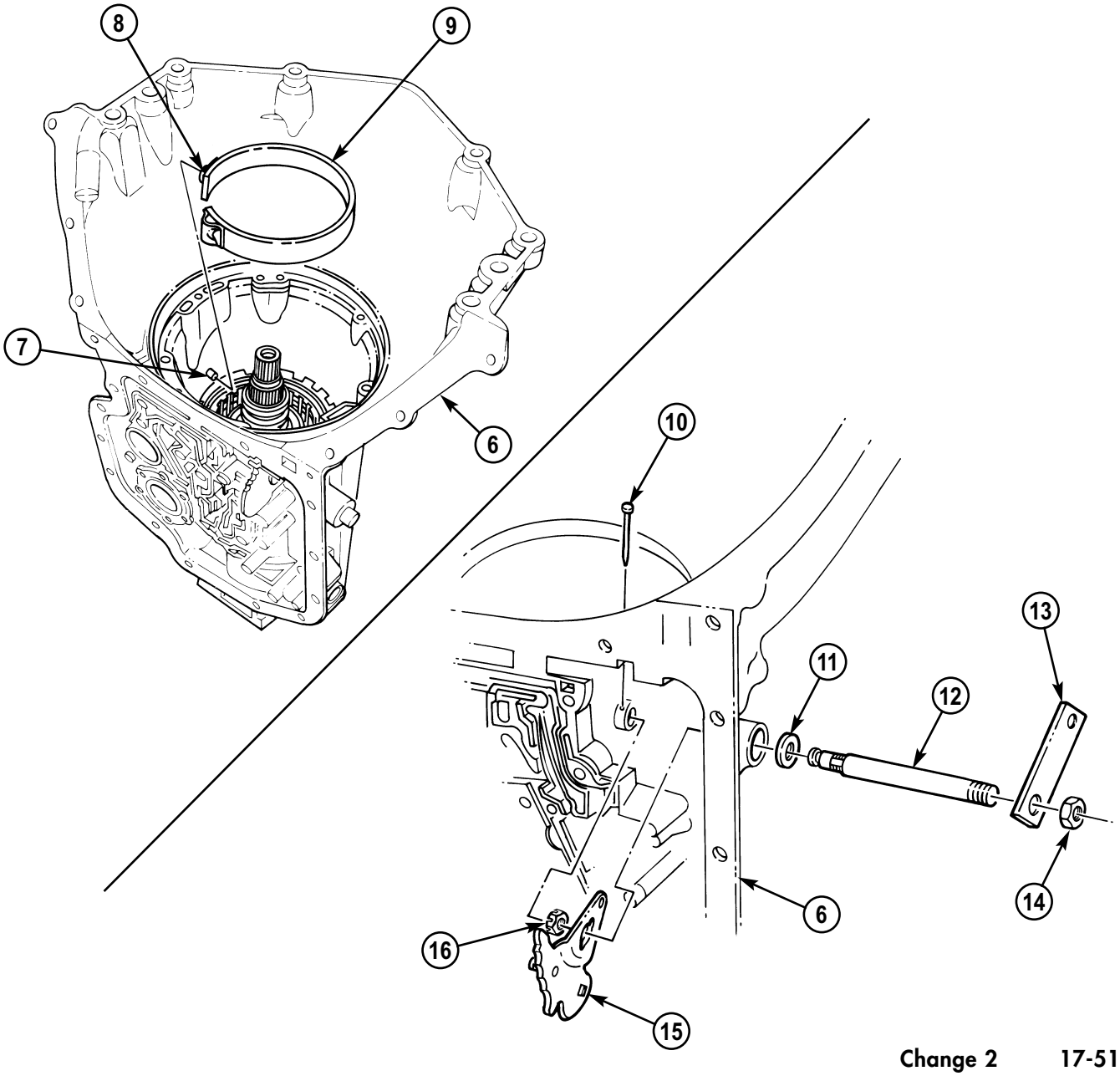
## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

**e. Front Band**

Install front band (9) in case (6) and position band anchor hole (8) on band anchor pin (7).

**f. Manual Linkage**

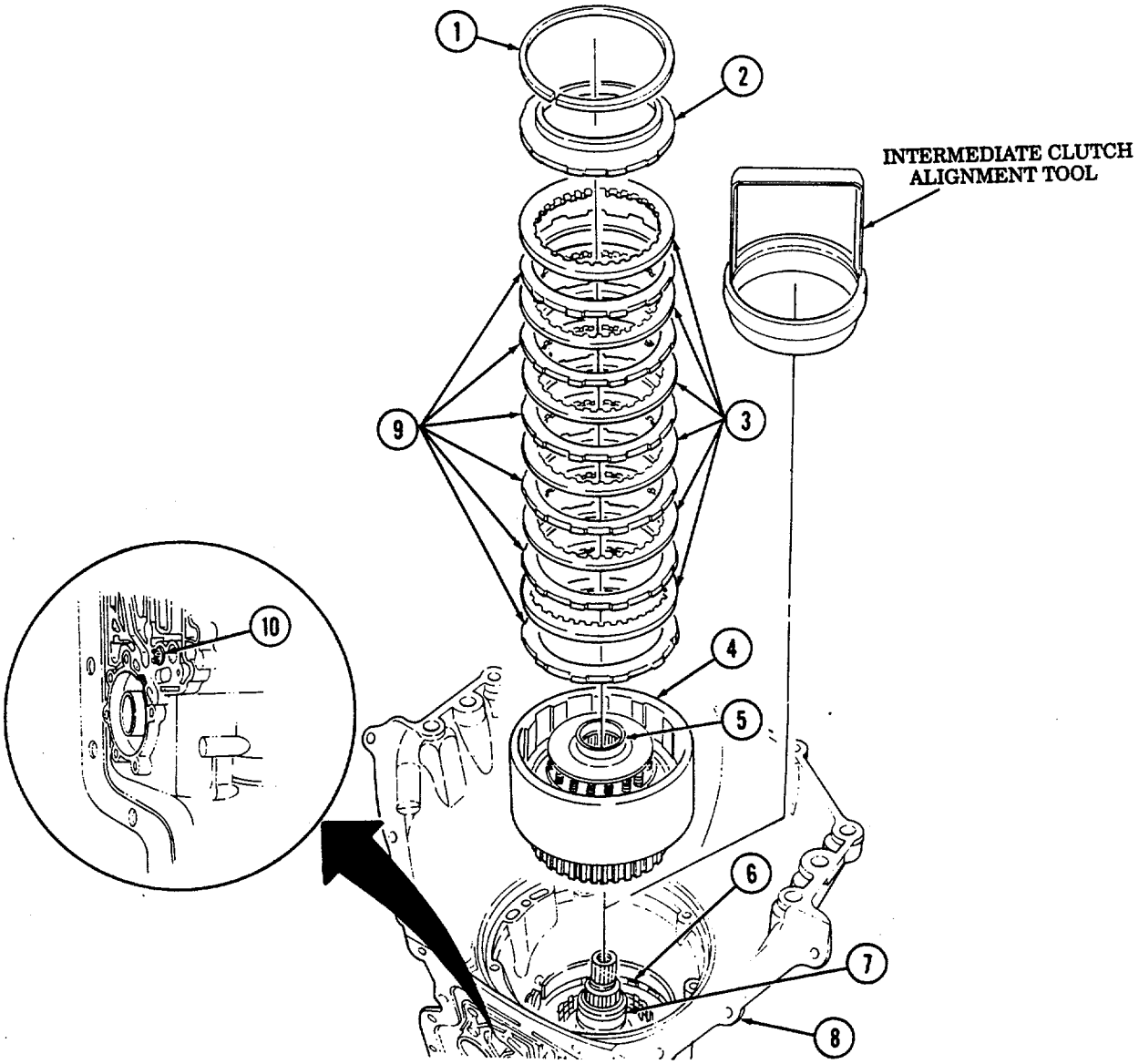
1. Install gasket (11) in case (6).
2. Install manual shaft (12) in case (6).
3. Install detent lever (15) and jam nut (16) on manual shaft (12). Using 9/16 in. torque adapter, tighten jam nut (16) to 15-18 lb-ft (20-24 N•m).
4. Install retaining pin (10) securing manual shaft (12) into case (6).
5. Install shift lever (13) on manual shaft (12) with nut (14). Tighten nut (14) to 15-25 lb-ft (20-34 N•m).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

**g. Direct Clutch**

1. Remove snapring (1), direct clutch backing plate (2), six composition clutch plates (3), and steel clutch plates (9) from direct clutch housing (4).
2. Using intermediate clutch alignment tool, align intermediate clutches (6). Apply air pressure through center support bolt (10) to hold clutch plates (6) in place. Remove alignment tool and install direct clutch housing (4) into case (8).
3. Remove air pressure and ensure that direct clutch housing hub (5) bottoms on sun gear shaft (7).
4. Install clutch plates (9) and (3) into direct clutch housing (4) starting with a steel clutch plate (9), then alternating composition clutch plates (3) and steel clutch plates (9).
5. Install direct clutch backing plate (2) in direct clutch housing (4) with snapring (1).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3LB80) (Cont'd)

### h. Forward Clutch and Turbine Shaft

1. Install forward clutch hub thrust washer (13) on forward clutch housing (12). Retain thrust washer (13) with petrolatum.

**NOTE**

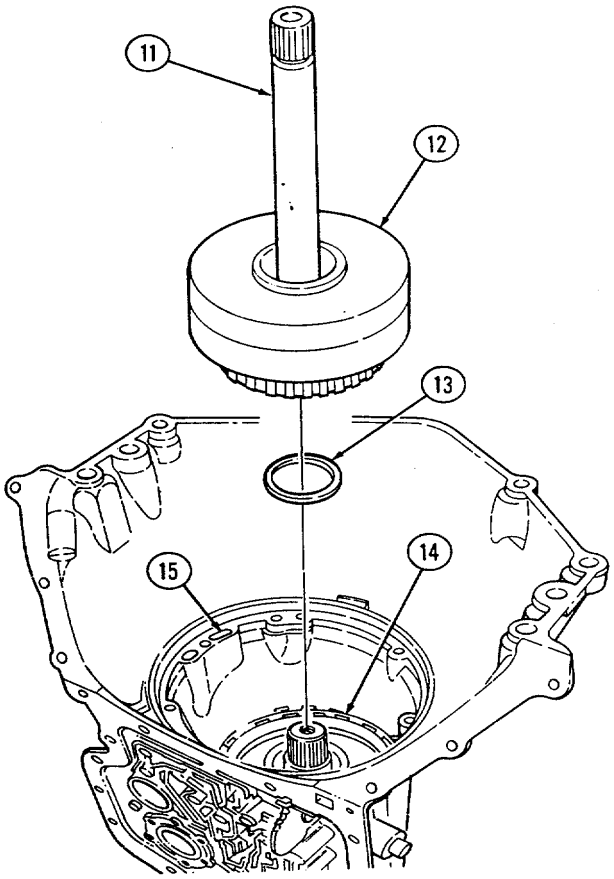
When installing forward clutch and turbine shaft, it may be necessary to rotate and shake forward clutch and turbine shaft assembly to align direct clutch plates with forward clutch housing.

2. Install forward clutch (12) and turbine shaft (11) into direct clutch (14).

**CAUTION**

The top of the forward clutch housing must be 1-1/4 in. (31.7 mm) from oil pump mounting surface or transmission damage will result.

3. Measure the distance from top of forward clutch housing (12) to oil pump mounting surface (15) to determine if forward clutch (12) is fully engaged with direct clutch (14).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3LB80) (Cont'd)

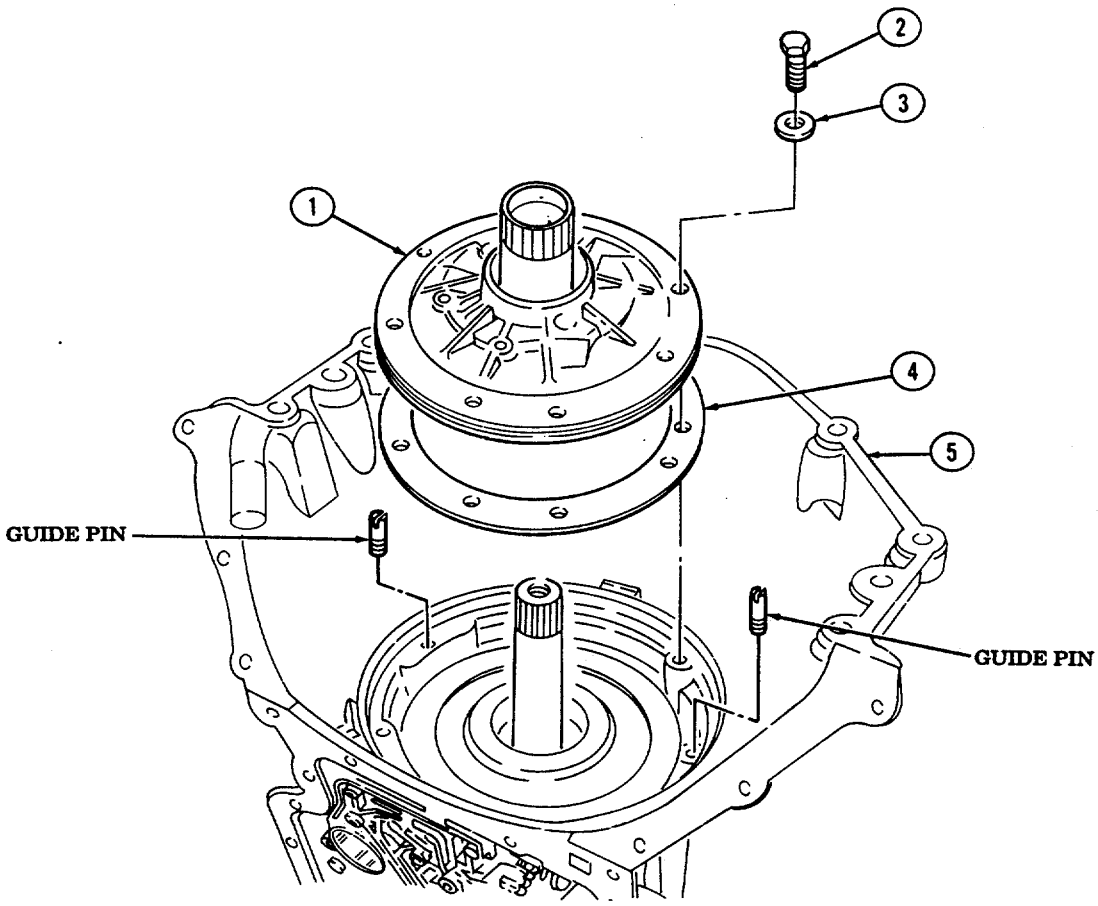
### i Oil Pump

1. Install two guide pins in case (5).
2. Coat oil sealing rings on oil pump (1) with petrolatum.
3. Install oil pump gasket (4) over guide pins.
4. Install oil pump (1) over guide pins and into case (5).
5. Using wooden handle, lightly tap oil pump (1) into case (5) far enough to start capscrews (2).
6. Remove guide pins and install five seal washers (3) and capscrews (2). Leave one threaded capscrew hole in oil pump (1) open.

**CAUTION**

If turbine shaft cannot be rotated as pump is being pulled in place, forward or direct clutch housing has not been properly installed. This condition must be corrected before oil pump is pulled fully in place or transmission damage will result.

7. Evenly tighten capscrews (2) securing oil pump (1) to case (5) to 16-20 lb-ft (22-27 N•m).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

**j. Establish Front End Play**

1. Position case (5) so that oil pan sealing surface (7) faces upward.
2. Install slide hammer bolt (6) into capscrew hole in oil pump (1).
3. Mount dial indicator on bolt (6) and index indicator to register with end of turbine shaft (9).
4. Push turbine shaft (9) rearward.
5. Push output shaft (8) forward, and "zero" dial indicator.
6. Pull turbine shaft (9) forward, and read dial indicator.

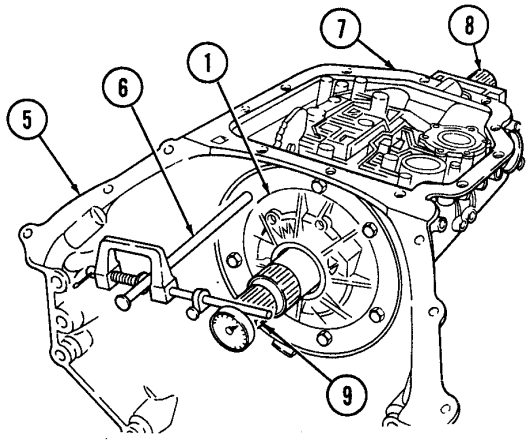
**NOTE**

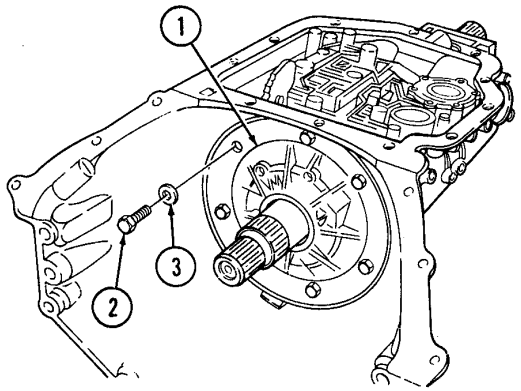
- Selective washer controlling end play is located between pump cover and forward clutch housing, refer to para. 17-6. If more or less washer thickness is required to bring end play within specifications, select proper washer from table 17-3.
- An oil soaked washer may tend to discolor. It will be necessary to measure washer for its actual thickness.

*Table 17-3. Front Selective Washer Thickness*

| THICKNESS | COLOR |
|---|---|
| 0.060-0.064 in. (1.52-1.63 mm) | Yellow |
| 0.071-0.075 in. (1.80-1.90 mm) | Blue |
| 0.082-0.086 in. (2.08-2.18 mm) | Red |
| 0.093-0.097 in. (2.36-2.46 mm) | Brown |
| 0.104-0.108 in. (2.64-2.74 mm) | Green |
| 0.115-0.119 in. (2.92-3.02 mm) | Black |
| 0.126-0.130 in. (3.20-3.30 mm) | Purple |

7. Resulting travel or end play should be 0.003-0.024 in. (0.076-0.610 mm). If end play is not within specifications, remove selective washer and install new selective washer of proper thickness.
8. Remove dial indicator and bolt (6). Install remaining oil pump seal washer (3) and capscrew (2) in oil pump (1). Tighten capscrew (2) to 16-20 lb-ft (22-27 N•m).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

**NOTE**

Install six check balls only; the seventh check ball is not required.

**k. Detent Solenoid**

1. Install six check balls (2) in ballseat pockets in case (1).
2. Install two guide pins in case (1).

**NOTE**

Spacer plate gasket is marked “C”.

3. Install gasket (13) over guide pins.
4. Install spacer plate (12) over guide pins.
5. Install detent solenoid (4) on spacer plate (12) with two capscrews (5). Do not tighten capscrews (5) at this time.
6. Install packing retainer (16) on electrical connector (15). Align tab (14) on electrical connector (15) with notch in side of case (1) and install electrical connector (15) into case (1).
7. Connect detent solenoid lead (3) to electrical connector (15).

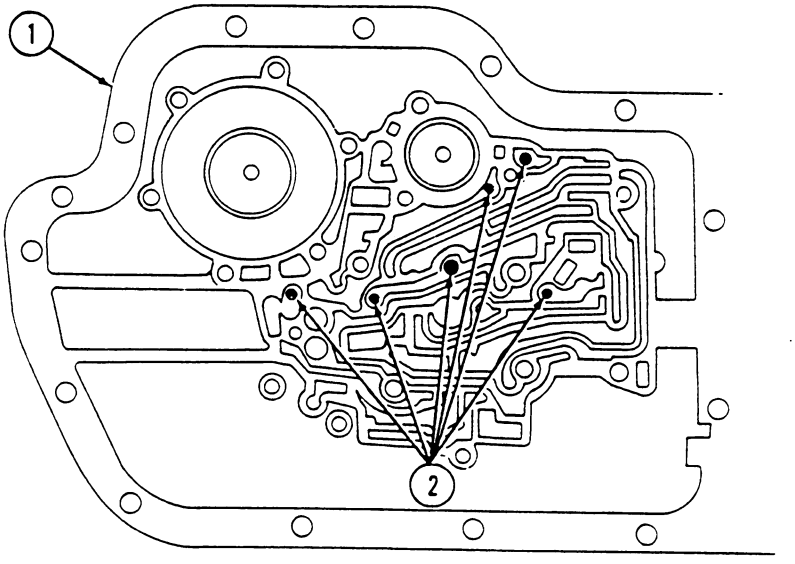
**l. Front Servo**

1. Install front servo spring (11) and spring retainer (10) into front servo piston bore in case (1).
2. Install retaining ring (8) in front servo pin (9) and install servo pin (9) in case (1) so that tapered end of servo pin (9) contacts front band.

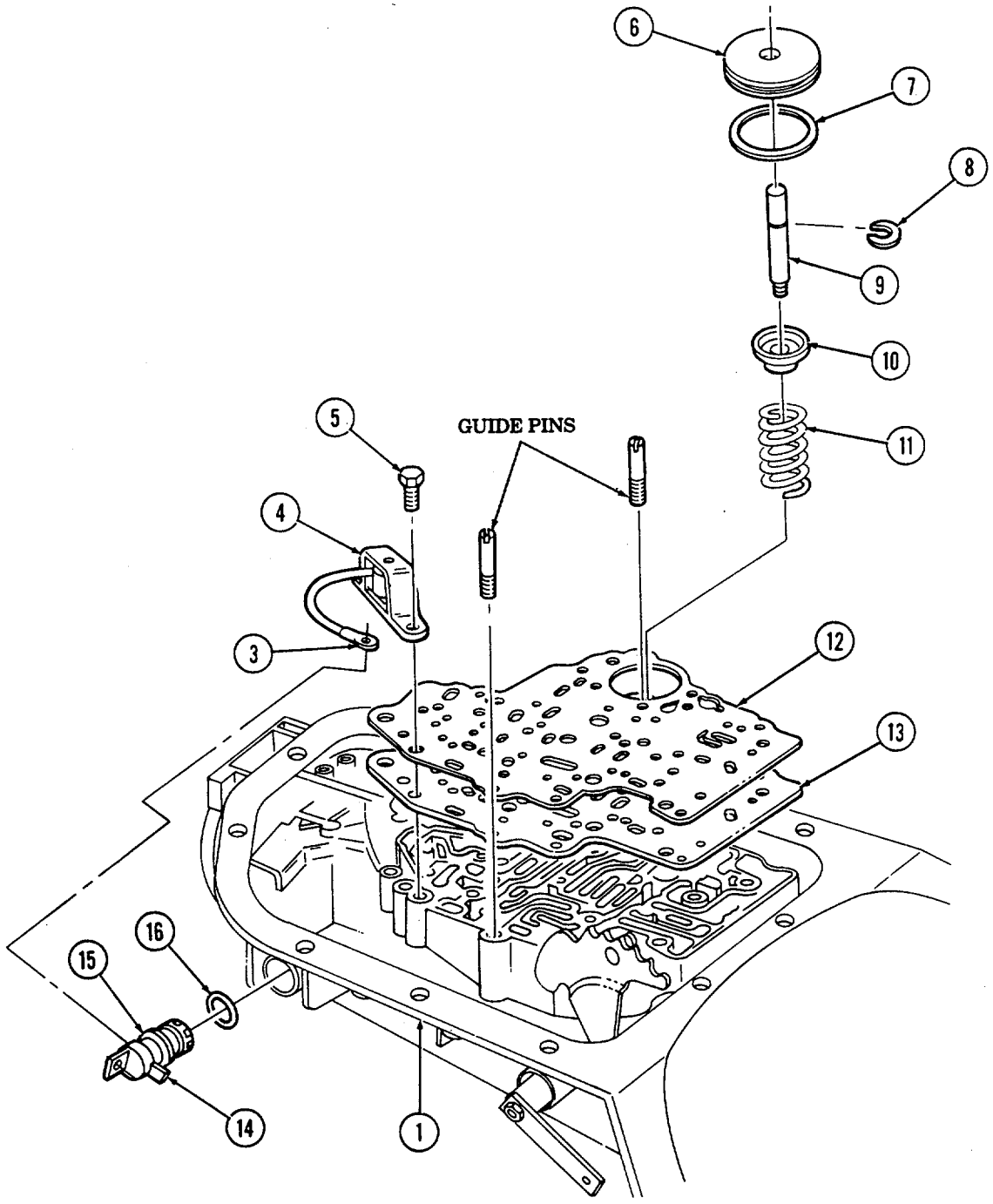
**NOTE**

The teflon ring allows the front servo piston to slide very freely in case. The free fit of teflon ring is normal and does not indicate leakage. The teflon ring should only be replaced if it shows damage or evidence of leakage.

3. Install seal ring (7) on piston (6) if removed. Install servo piston (6), with flat side of servo piston (6) facing up, on servo pin (9).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

### m. Rear Servo

**NOTE**

Before installing rear servo, check for correct band apply pin, using band apply pin selector gauge. This is equivalent to adjusting band.

1. Attach band apply pin selector gauge to case (3) using two rear servo cover capscrews (1). Do not tighten capscrews (1) at this time.

2. Install gauge pin into band apply pin selector gauge and into case (3). Check for freeness of gauge pin and tighten capscrews (1) to 15 lb-ft (20 N•m).

3. Apply 25 lb-ft (34 N•m) torque to lever on band apply pin selector gauge. Selection of proper rear band apply pin is determined by relation of flats on gauge pin to machined area (2) around hole on band apply pin selector gauge base.

4. Determine correct apply pin to be used from table below.

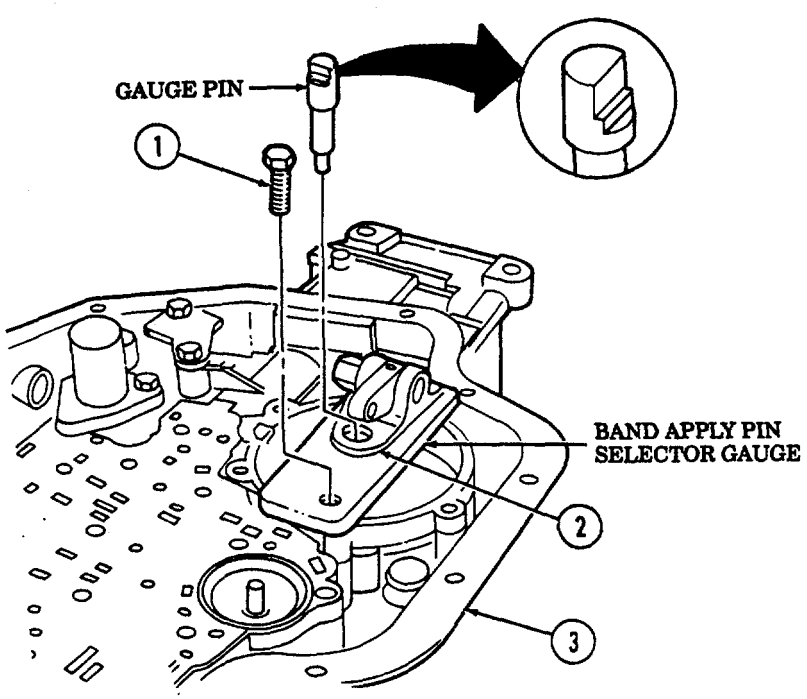
**NOTE**

- Apply pins are identified by the number of rings around small end of apply pins.
- If necessary to change apply pin, refer to rear servo repair para. 17-11.

Table 17-4. Apply Pin Selection

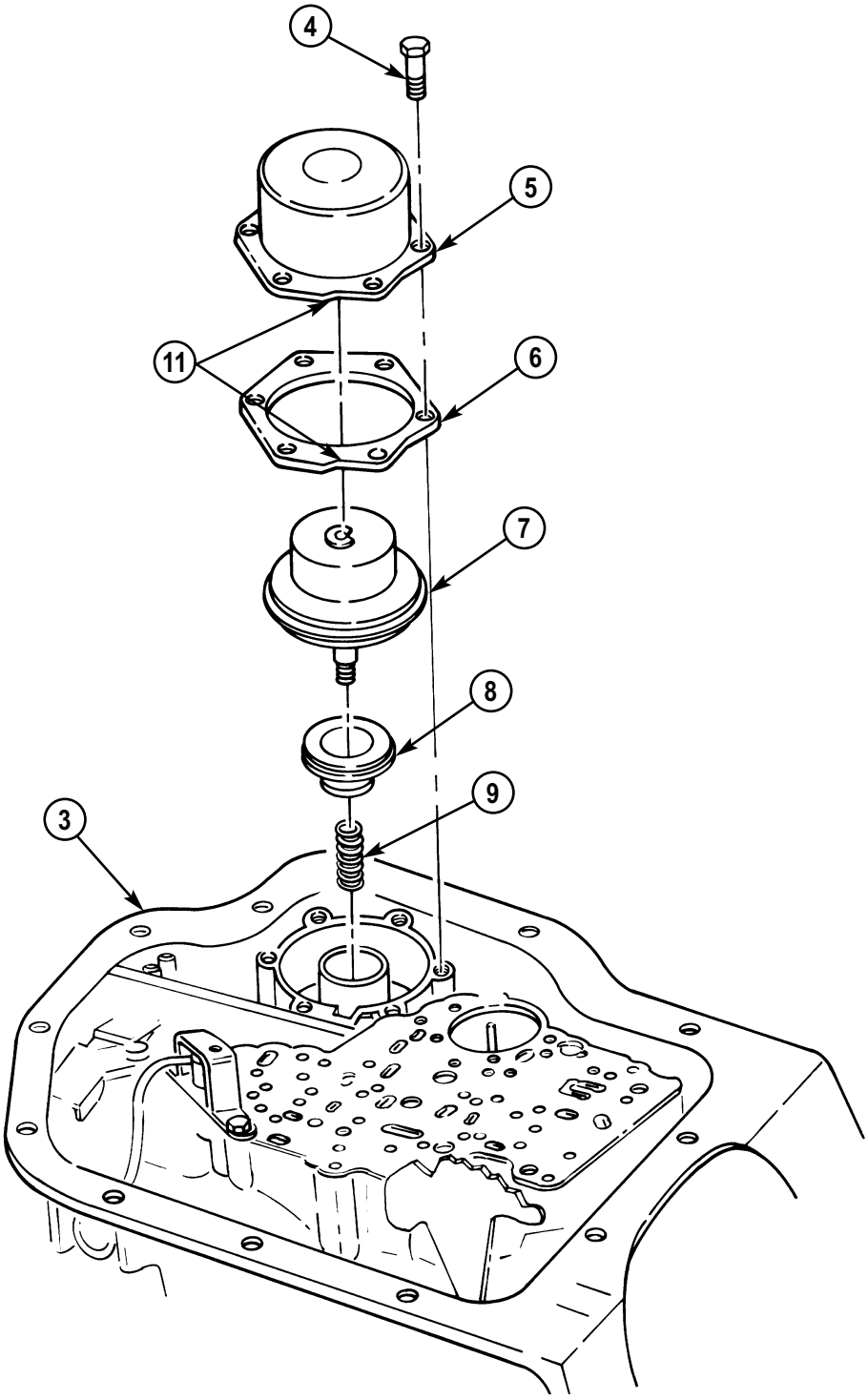
| |
|---|
| a. If both flats are below gauge surface, install long servo pin identified by 3 rings. |
| b. If 1 flat is above gauge surface, install medium servo pin identified by 2 rings. |
| c. If both flats are above gauge surface, install short servo pin identified by 1 ring. |

5. Remove band apply pin selector gauge from case (3).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

6. Install rear accumulator spring (9) in case (3).
7. Install accumulator piston (8) and rear servo piston (7) in case (3).
8. Align notch (11) on gasket (6) and rear servo cover (5) with oil feed hole (10) in transmission case (3).
9. Install gasket (6) and rear servo cover (5) on case (3) with six capscrews (4). Tighten capscrews (4) to 16-20 lb-ft (22-27 N•m).



**17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)**

**n. Control Valve**

**NOTE**

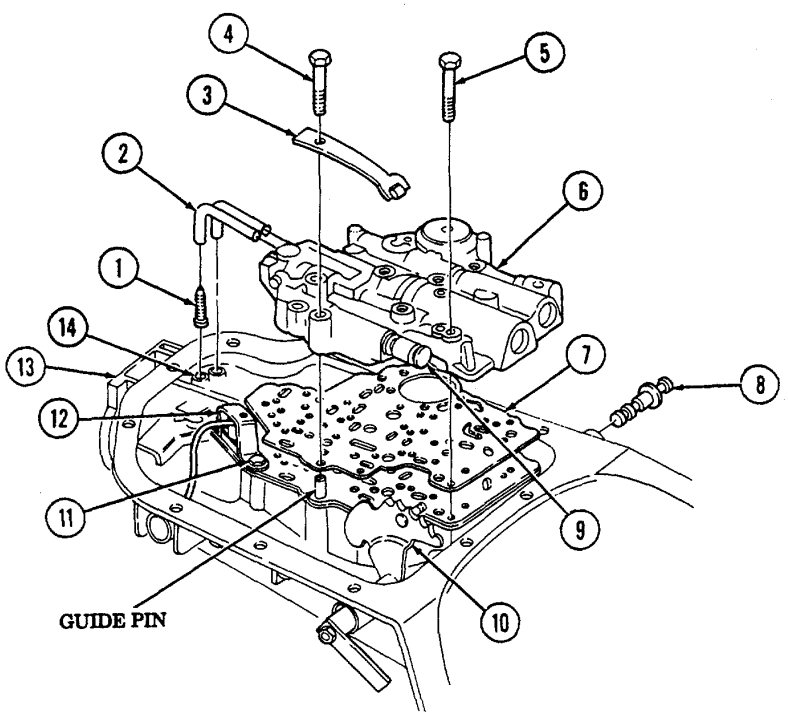
Control valve gasket is marked "VB".

1. Install control valve gasket (7) over guide pins.
2. Install governor pipes (2) into control valve (6).
3. Install governor screen (1) open end first into governor feed pipe hole (14) (hole nearest center of transmission).
4. Install control valve (6) and governor pipes (2) over guide pins and onto case (13). Carefully align governor feed pipe (2) over governor screen (1) and index manual valve (9) with pin on detent lever (10).
5. Using wooden handle, lightly tap governor feed pipes (2) into case (13) until seated.

**NOTE**

Control valve is secured with eight 5/16-18 and three 1/4-20 capscrews.

6. Install six capscrews (4) and three capscrews (5) securing control valve (6) to case (13).
7. Remove two guide pins from case (13).
8. Install detent roller and spring assembly (3) with two remaining capscrews (4).
9. Tighten eleven capscrews (4) and (5) on control valve (6), and two capscrews (11) on detent solenoid (12) to 8 lb-ft (11 N·m).
10. Install modulator valve (8) into case (13).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

### o. Governor

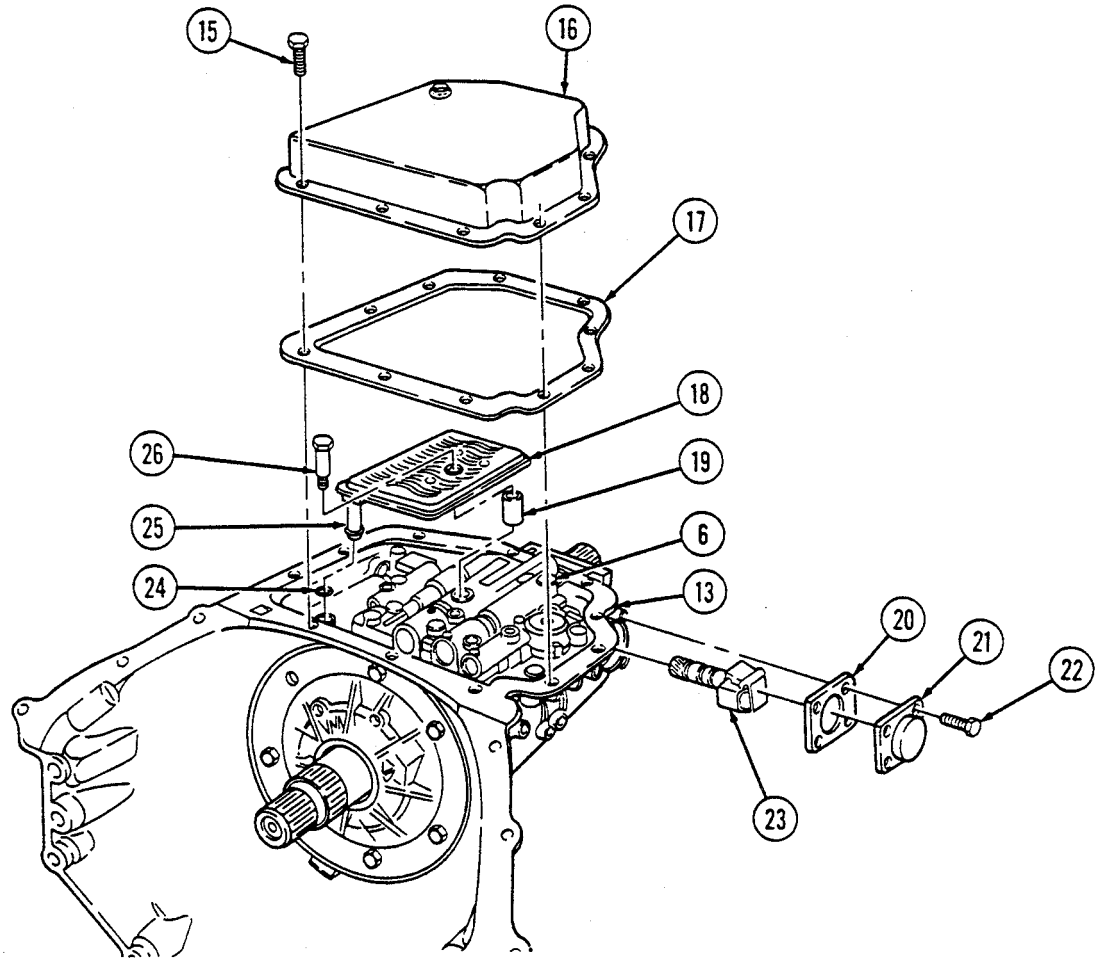
1. Install governor (23) into case (13).
2. Install gasket (20) and governor cover (21) on case (13) with four capscrews (22). Tighten capscrews (22) to 16-20 lb-ft (22-27 N•m).

### p. Oil Filter

1. Install seal (24) on end of intake pipe (25) marked “case”. Assemble end of intake pipe (25) marked “filter” into fluid parts kit (18).
2. Install fluid parts kit (18) and intake pipe (25) into case (13).
3. Install filter spacer (19) between control valve (6) and fluid parts kit (18) with shoulder bolt (26). Tighten shoulder bolt (26) to 11 lb-ft (15 N•m).

### q. Oil Pan

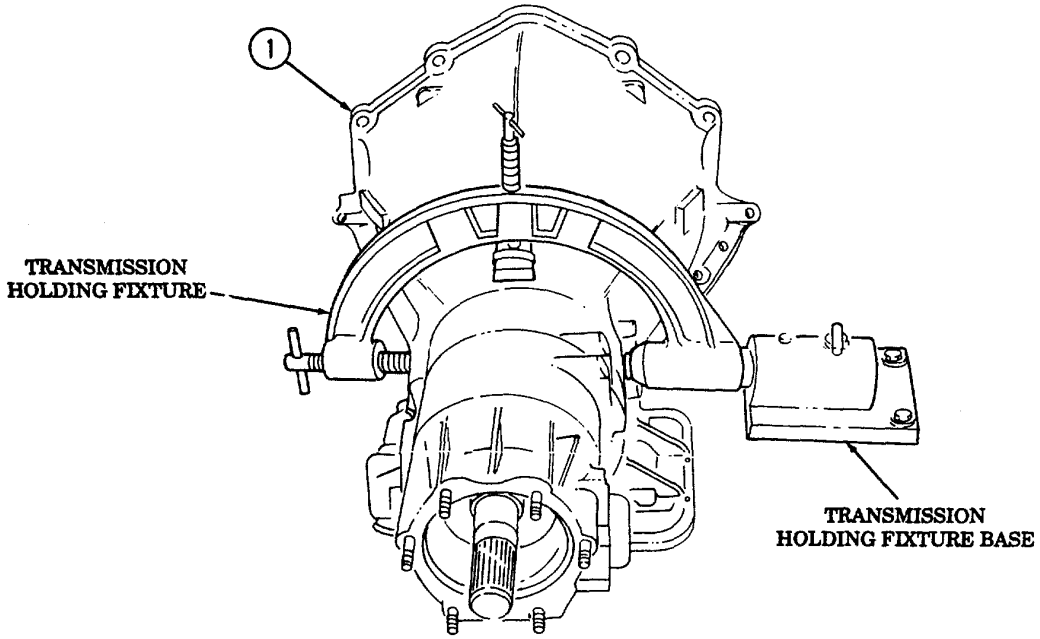
1. Clean oil pan (16) in accordance with para. 2-13.
2. Install gasket (17) and oil pan (16) on case (13) with thirteen capscrews (15). Tighten capscrews (15) to 11-13 lb-ft (15-18 N•m).



## 17-13. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (3L80) (Cont'd)

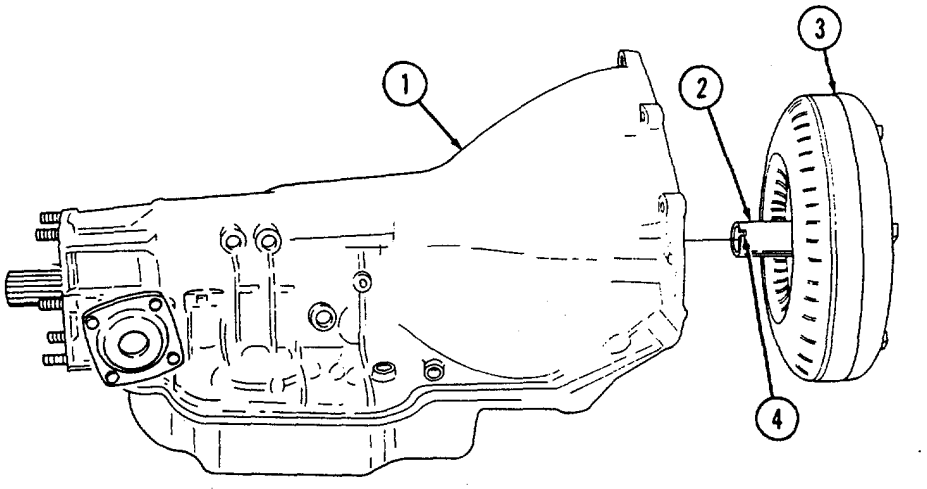
### r. Holding Fixture

1. Remove transmission (1) and transmission holding fixture from transmission holding fixture base.
2. Remove transmission holding fixture from transmission (1).




### s. Torque Converter

Install torque converter (3) into transmission (1). Be sure drive lugs of inner pump rotor are properly engaged with drive slots (4) of torque converter hub (2).




FOLLOW-ON TASK: Prepare transmission for installation (para. 7-10).

# 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E)

**This task covers:**

- **a. Torque Converter**
- **b. Holding Fixture**
- **c. Speed Sensors**
- **d. Oil Pan and Filter Assembly**
- **e. Control Valve Assembly (1995 - 1996)**
- **e.1. Control Valve Assembly (1997 - 1998)**
- **f. Front Servo**
- **g. Rear Servo**
- **h. Parking Lock Pawl and Actuator Assembly**
- **i. Front End Play Check (Measured)**
- **j. Rear Unit End Play Check (Measured)**
- **k. Pump Assembly**
- **l. Turbine Shaft and Overdrive Carrier Assembly**
- **m. Forward Clutch Assembly**
- **n. Direct Clutch Assembly**
- **o. Intermediate Clutch Assembly**
- **p. Gear Unit Assembly and Rear Band**
- **q. Center Support Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)
Dial indicator (Appendix G, Item 95)

**Special Tools**
Transmission holding fixture (Appendix G, Item 29)
Transmission holding fixture base (Appendix G, Item 30)
Adapter (Appendix G, Item 41)
Slide hammer adapter (Appendix G, Item 32)
Oil pump remover/installer (Appendix G, Item 43)

**Special Tools (Cont'd)**
Torx adapter (Appendix G, Item 28)
Gear unit remover/installer Appendix G, Item 44)

**Personnel Required**
One mechanic
One assistant

**Equipment Condition**
Transmission prepared for disassembly (para. 7-10).

**General Safety Instructions**
Torque converter must be supported during removal.

**Maintenance Level**
General support

## a. Torque Converter

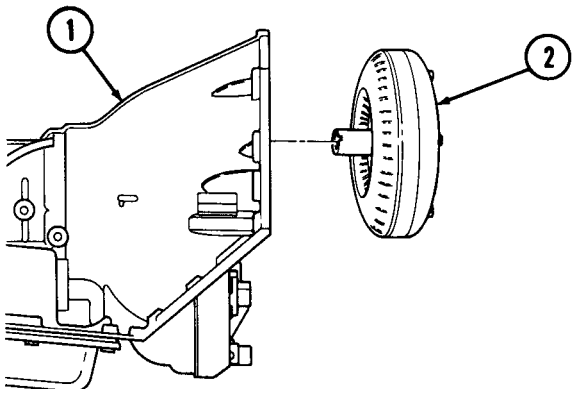
**WARNING**

Torque converter must be supported during removal and installation. Failure to do this may cause injury to personnel or damage to equipment.

**NOTE**

Be certain torque converter turns freely. Record any abnormal looseness or noises.

Remove torque converter (2) from transmission (1).



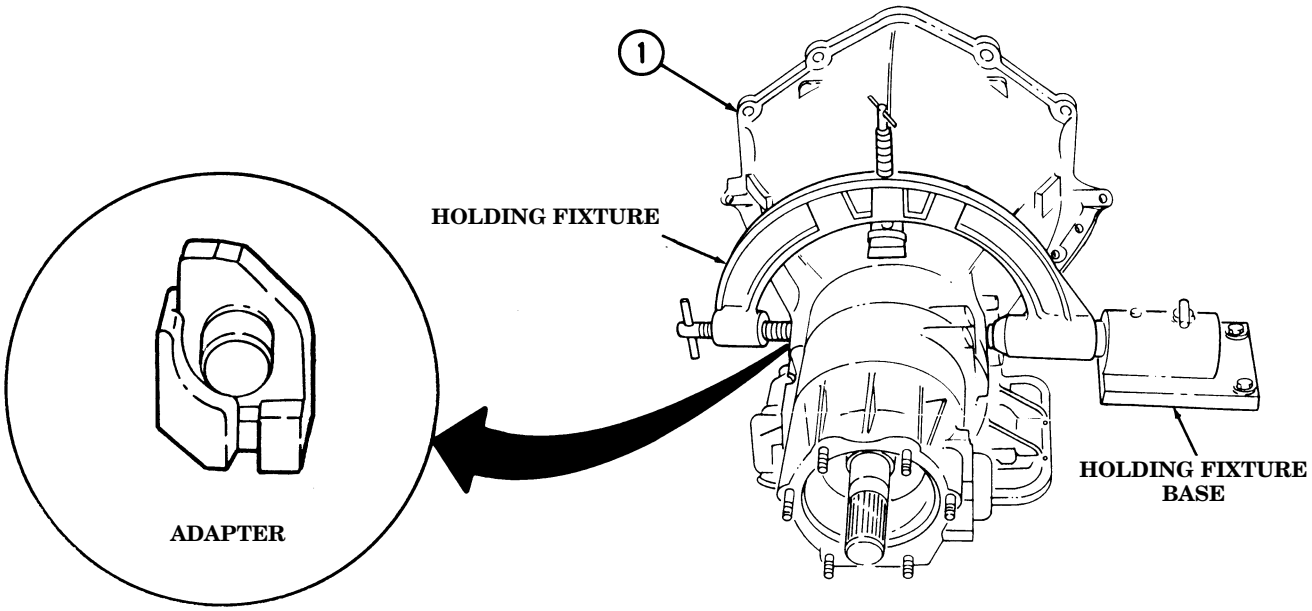
## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

**b. Holding Fixture**

**CAUTION**

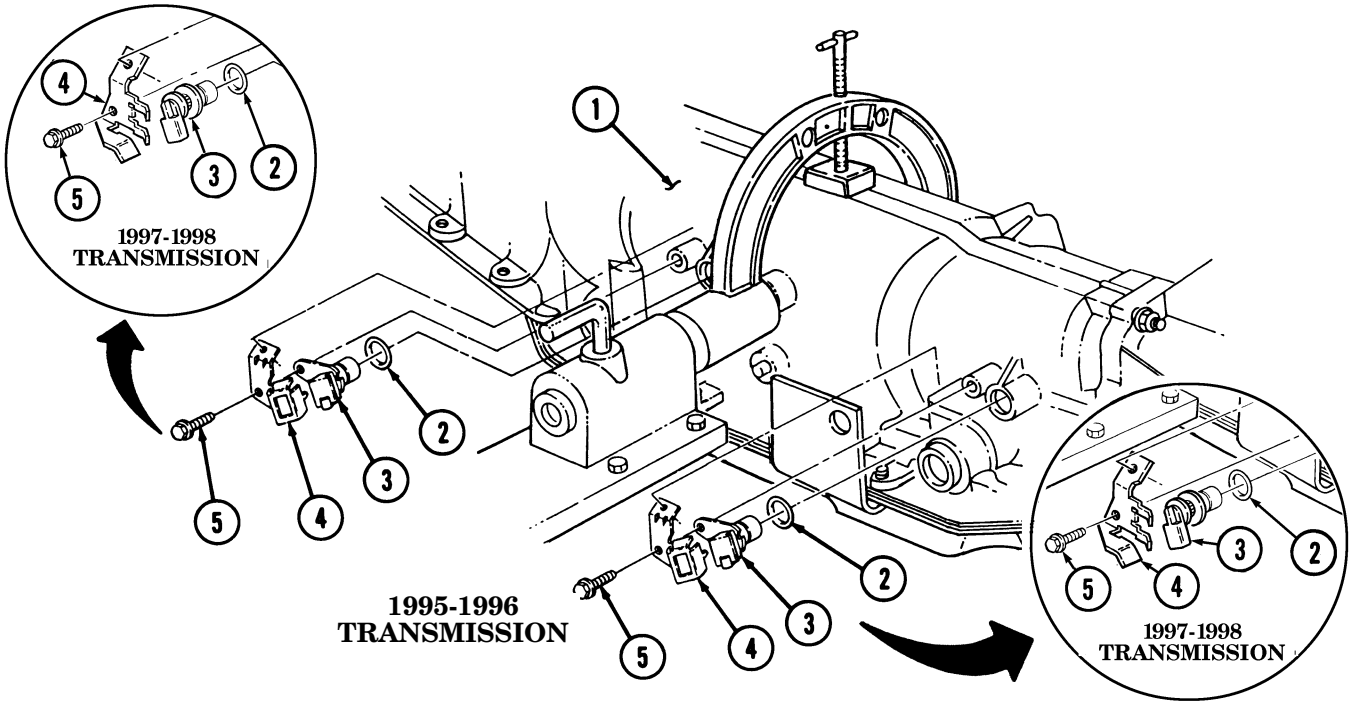
Do not overtighten screws. This will bind center support.

1. Install transmission holding fixture and adapter into locating holes on side of transmission case (1).
2. Install transmission holding fixture and transmission (1) into transmission holding fixture base.




**c. Speed Sensors**

Remove two capscrews (5), brackets (4), speed sensors (3), and packing retainers (2) from transmission (1). Discard packing retainers (2).



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

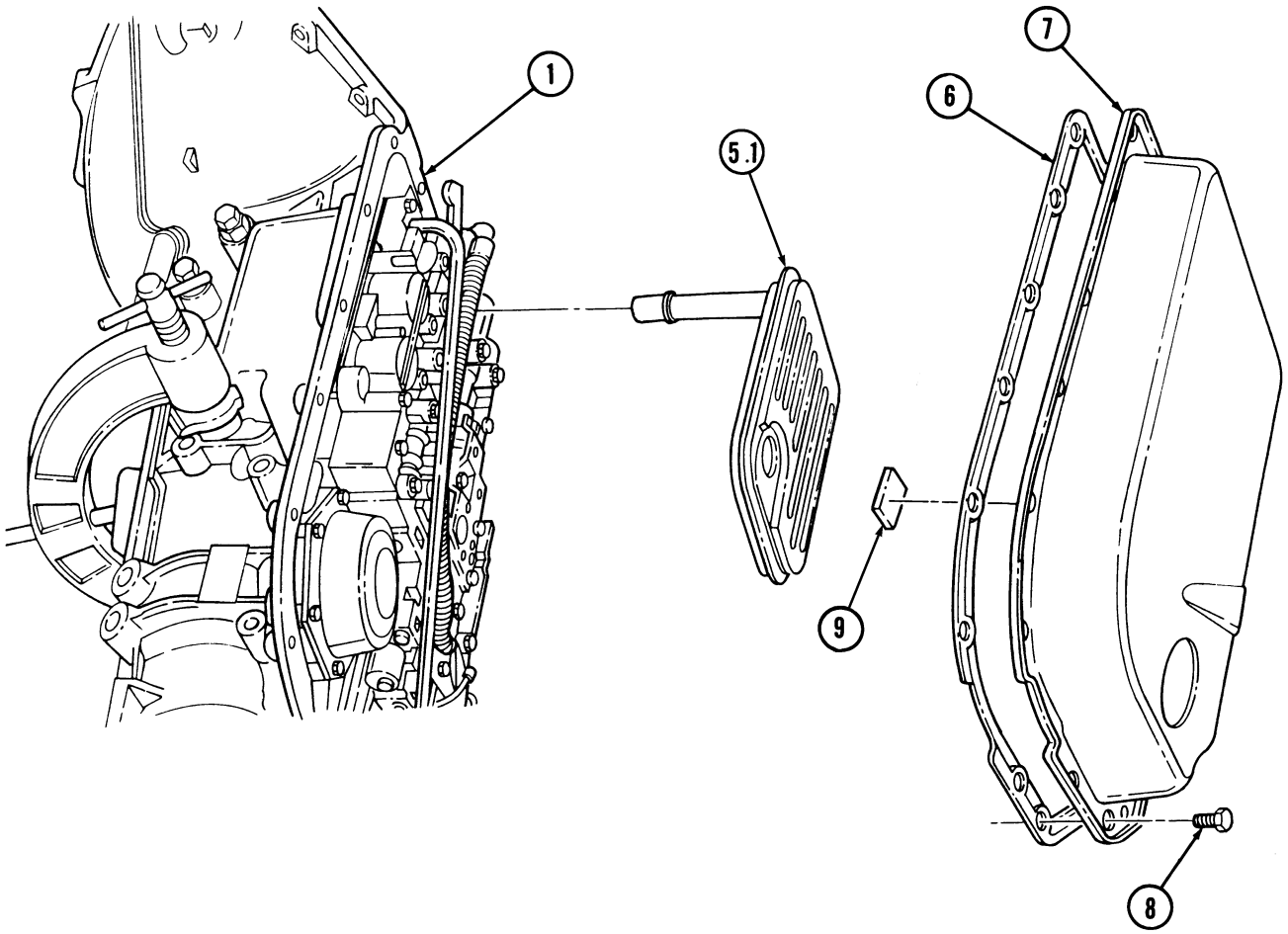
**d. Oil Pan and Filter Assembly**

1. Rotate transmission (1) to a vertical left side position and lock in place. This position will prevent any remaining contaminated fluid from reentering transmission.
2. Remove seventeen capscrews (8) and oil pan (7).

**NOTE**

Oil pan gasket seal is reusable. Discard only if damaged.

3. Remove gasket (6) and magnet (9) from transmission (1).
4. Remove hydraulic parts kit (5.1) from transmission (1).



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

### e. Control Valve Assembly (1995-1996)

1. Disconnect wiring harness (6) from PWM solenoid (7), pressure control solenoid (8), transmission fluid pressure switch (2), 2-3 shift solenoid (5), 1-2 shift solenoid (4), and connector (3).

**NOTE**

Capscrews are different lengths. Record location of each capscrew for installation.

2. Remove three capscrews (9), clips (10), and harness (6) from control valve assembly (12).
3. Remove six capscrews (18) and transmission fluid pressure switch (19) from control valve assembly (12).
4. Remove capscrew (14), clip (13), and lube pipe (11) from transmission (1) and control valve assembly (12).
5. Remove two capscrews (15) and spring and roller assembly (20) from control valve assembly (12).
6. Remove two capscrews (15), fluid lever indicator stop (17), and lube pipe retainer (16) from control valve assembly (12).
7. Remove eight capscrews (23) (1995 transmission) or fourteen capscrews (23) (1996 transmission) and control valve body assembly (12) from transmission (1).

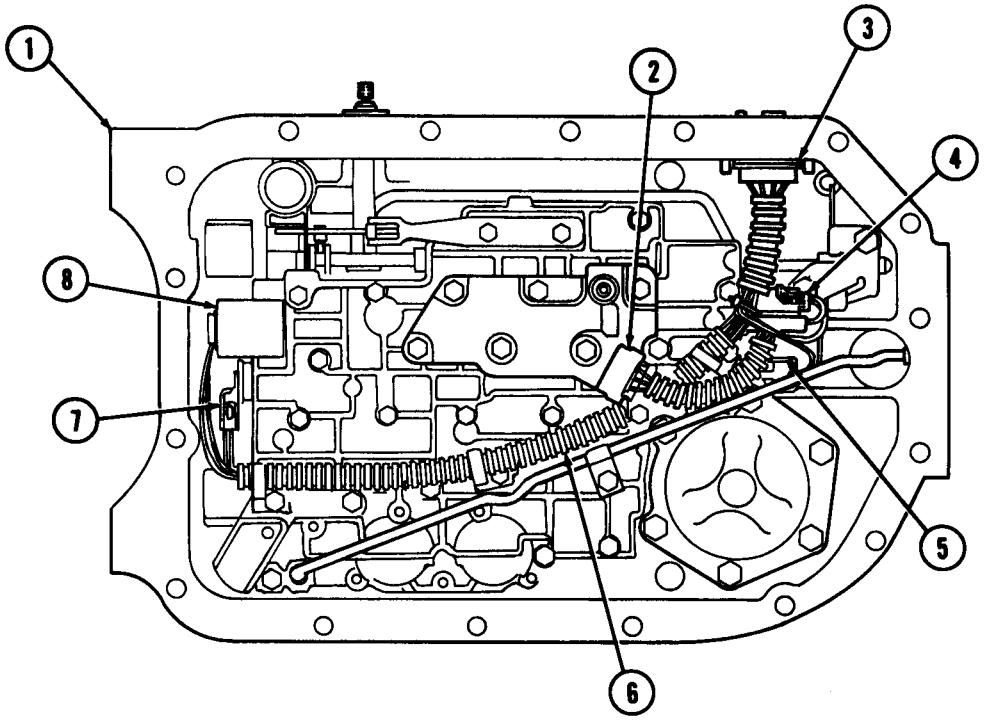
**CAUTION**

Do not use magnets or any magnetized tools to remove checkballs. Some checkballs are metal, and if magnetized, will pick up debris from oil and cause malfunction of transmission.

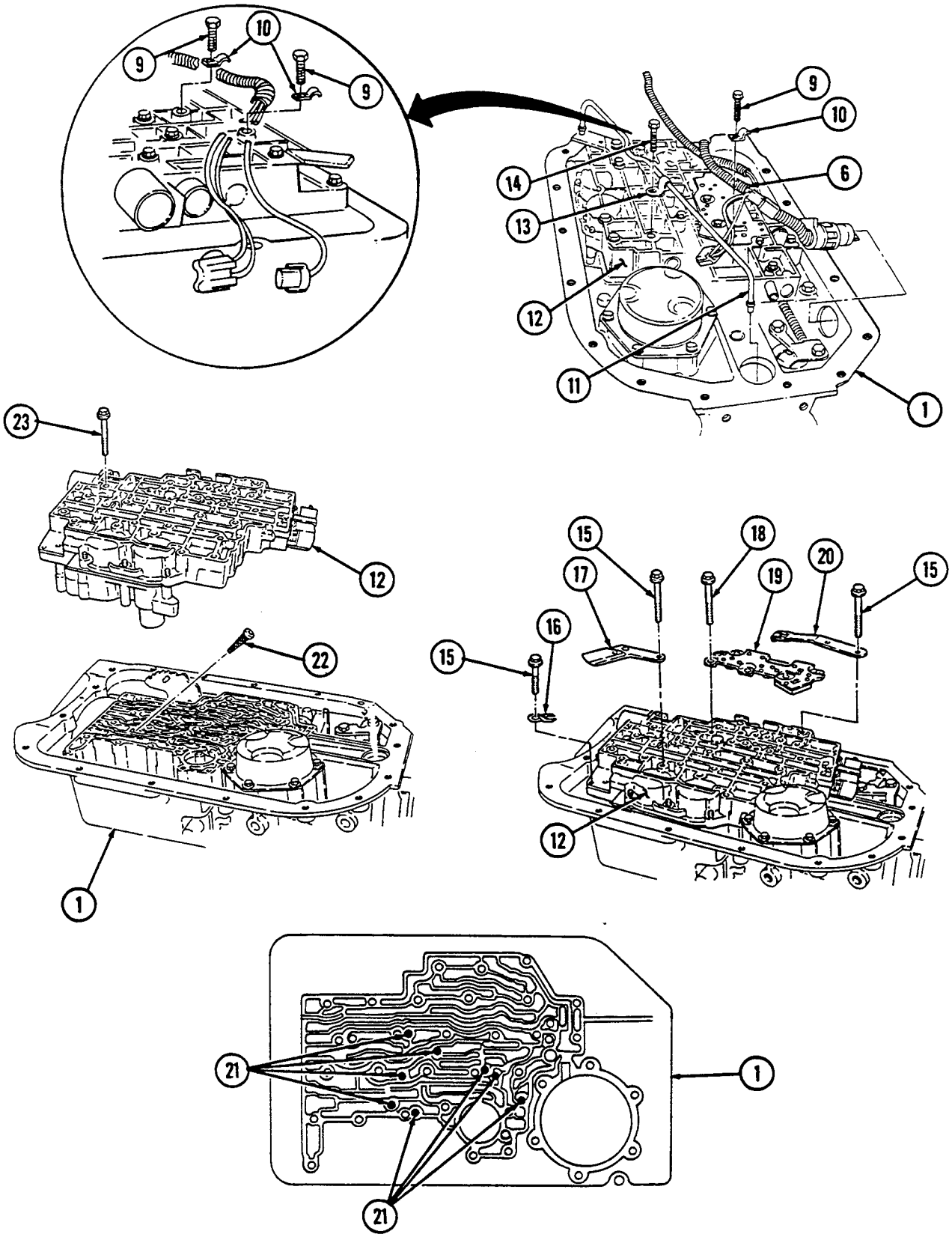
**NOTE**

Record locations of checkballs for assembly.

8. Remove eight checkballs (21) from transmission (1).
9. Remove screen (22) from transmission (1).



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

### e.1. Control Valve Assembly (1997-1998)

1. Disconnect wiring harness (6) from PWM solenoid (7), pressure control solenoid (8), transmission fluid pressure switch (2), 2-3 shift solenoid (5), 1-2 shift solenoid (4), and connector (3).

**NOTE**

Capscrews are different lengths. Record location of each capscrew for installation.

2. Remove two capscrews (9), clips (10), and harness (6) from control valve assembly (12).
3. Remove six capscrews (13) and transmission fluid pressure switch (14) from control valve assembly (12).
4. Remove capscrew (16) and spring and roller assembly (15) from control valve assembly (12).
5. Remove lube pipe (11) from control valve assembly (12).
6. Remove sixteen capscrews (19) and control valve body assembly (12) from transmission (1).

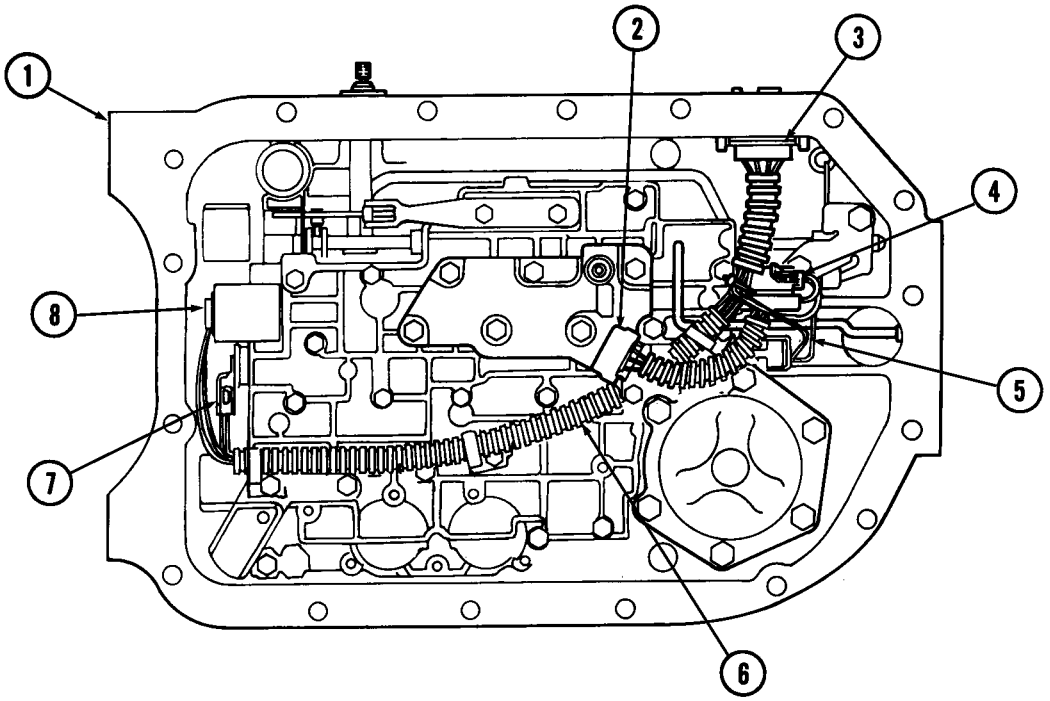
**CAUTION**

Do not use magnets or any magnetized tools to remove checkballs. Some checkballs are metal, and if magnetized, will pick up debris from oil and cause malfunction of transmission.

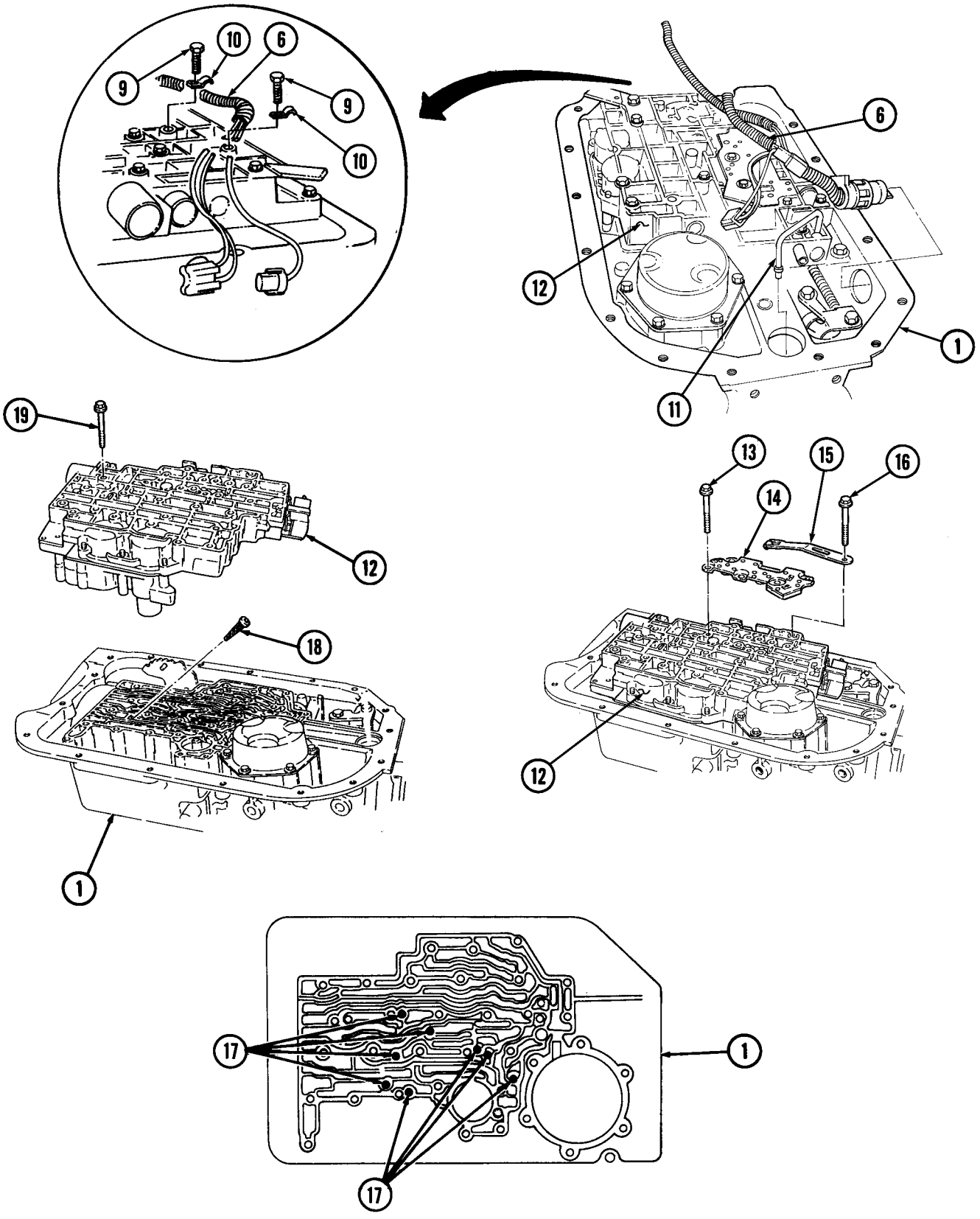
**NOTE**

Record locations of checkballs for assembly.

7. Remove eight checkballs (17) from transmission (1).
8. Remove screen (18) from transmission (1).



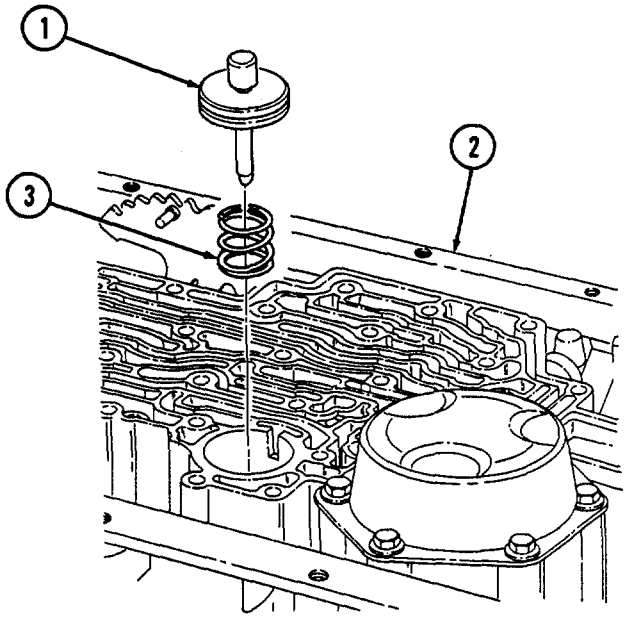
## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

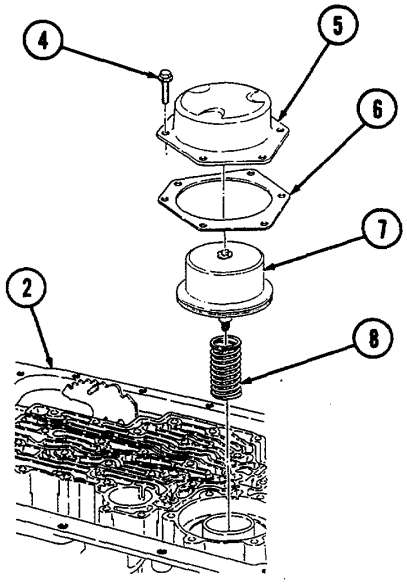
### f. Front Servo

Remove servo piston assembly (1) and piston spring (3) from transmission case (2).




### g. Rear Servo

1. Remove six capscrews (4), cover (5), and gasket (6) from transmission case (2).
2. Remove servo piston assembly (7) and piston spring (8) from transmission case (2).



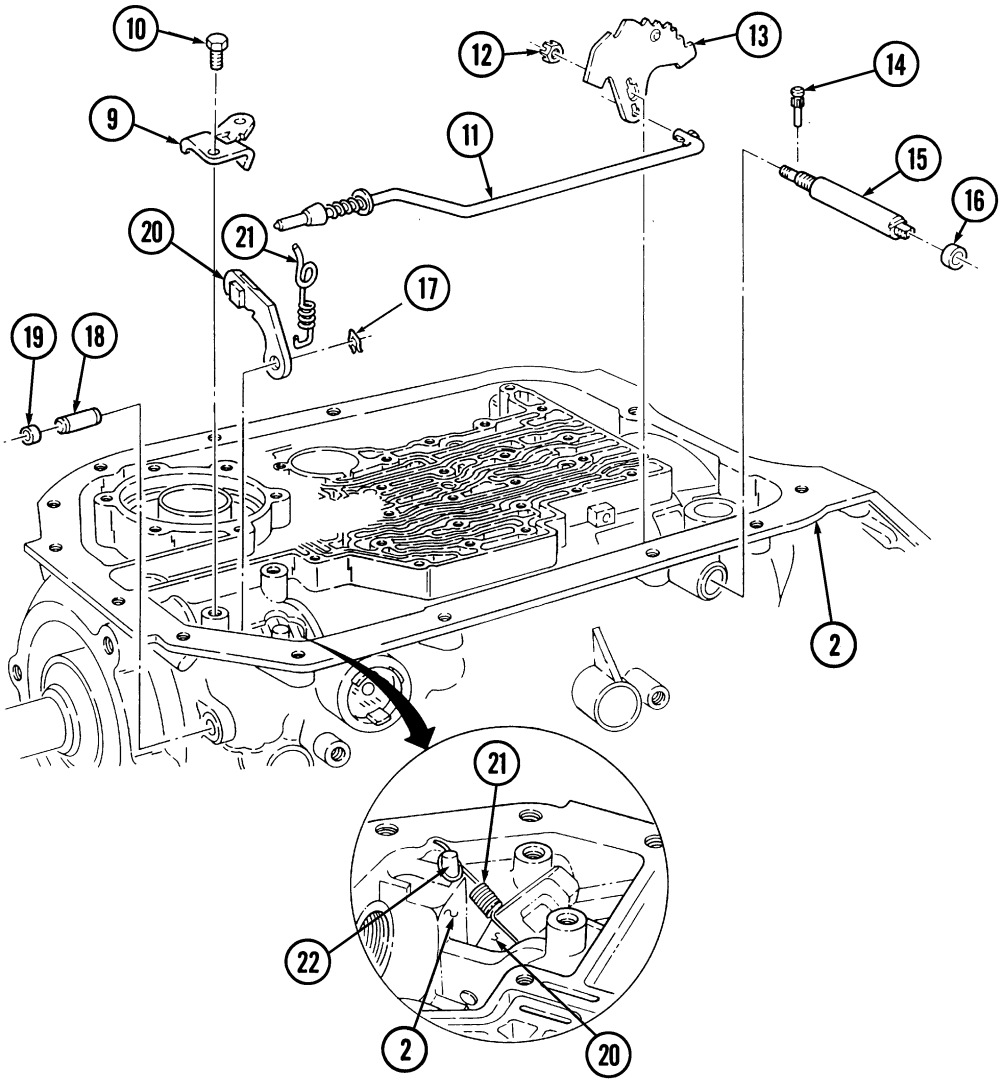
## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

**h. Parking Lock Pawl and Actuator Assembly**

**CAUTION**

Do not apply excessive force, prying, or hammering to any parking mechanism parts. Doing so may cause parking system failure.

1. Remove shaft retaining pin (14) from manual shaft (15).
2. Loosen nut (12), slide manual shaft (15) from detent lever (13), and remove nut (12) and detent lever (13).
3. Turn detent lever (13) to free it from parking lock actuator (11).
4. Remove two screws (10) and bracket (9) from transmission case (2).
5. Remove parking lock actuator (11) from pawl (20).
6. Disconnect and remove return spring (21) from pawl (20), retainer (17), and round end on stud (22) in transmission case (2).
7. Remove expansion plug (19) from transmission case (2). Discard plug (19). ■
8. Remove retainer (17), shaft (18), and pawl (20) from transmission case (2).
9. Remove manual shaft (15) and gasket (16) from transmission case (2). Discard gasket (16). ■



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

### i. Front End Play Check (Measured)

**CAUTION**

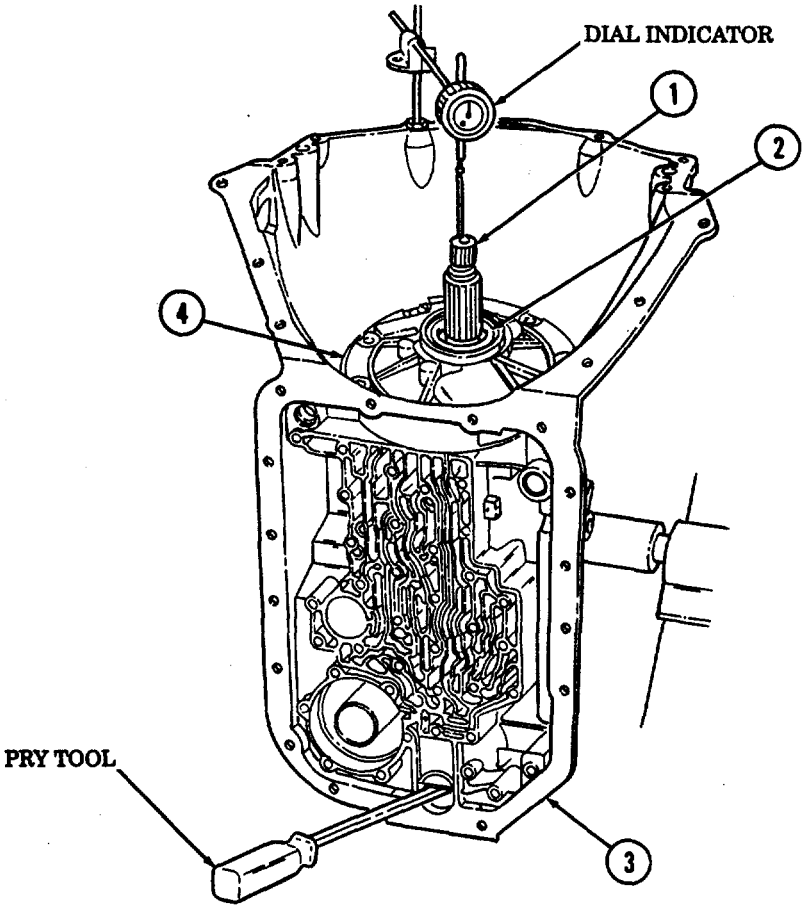
If end play procedures are not closely adhered to, incorrect shim thickness will be selected, which may result in severe damage to internal transmission components.

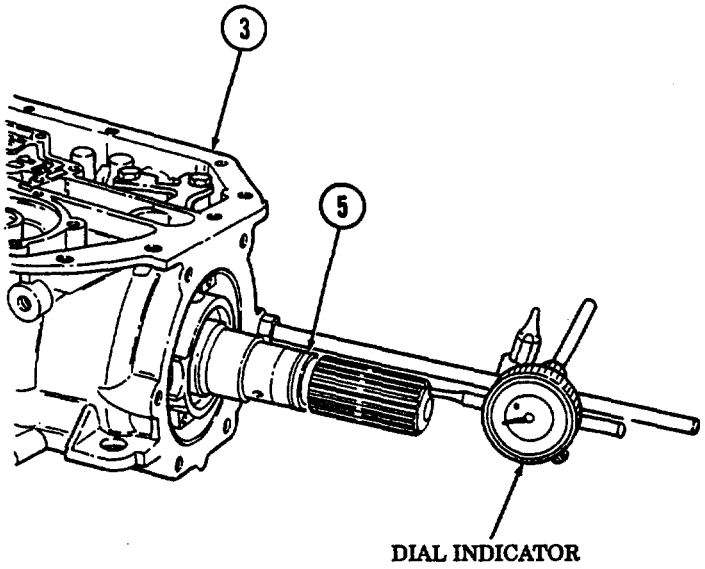
1. Turn transmission case (3) with turbine shaft (1) vertical.
2. Set dial indicator to read turbine shaft (1) vertical movement.
3. Press down turbine shaft (1) and pry up output carrier to remove rear end play.
4. Lift turbine shaft (1) with light force to remove slack between snapring (2) on turbine shaft (1) and overdrive carrier (4).
5. Index dial indicator to read "zero."
6. Pull up turbine shaft (1) and hold up overdrive carrier (4). Use enough force (at least 20 lb (9.1 kg)) to lift front parts. Read amount of movement on dial indicator.
7. Record this value for use in reassembly. Proper end play is 0.004-0.022 in. (0.102-0.559 mm).
8. Remove dial indicator and pry tool.

### j. Rear Unit End Play Check (Measured)

1. Turn transmission case (3) with output shaft (5) horizontal.
2. Set dial indicator to read end movement of output shaft (5).
3. Push output shaft (5) into transmission case (3) and "zero" dial indicator.
4. Pull output shaft (5) out of transmission case (3) and read amount of movement on dial indicator.
5. Record this value for use in reassembly. Proper end play is 0.005-0.025 in. (0.127-0.635 mm).
6. Remove dial indicator.

**17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)**

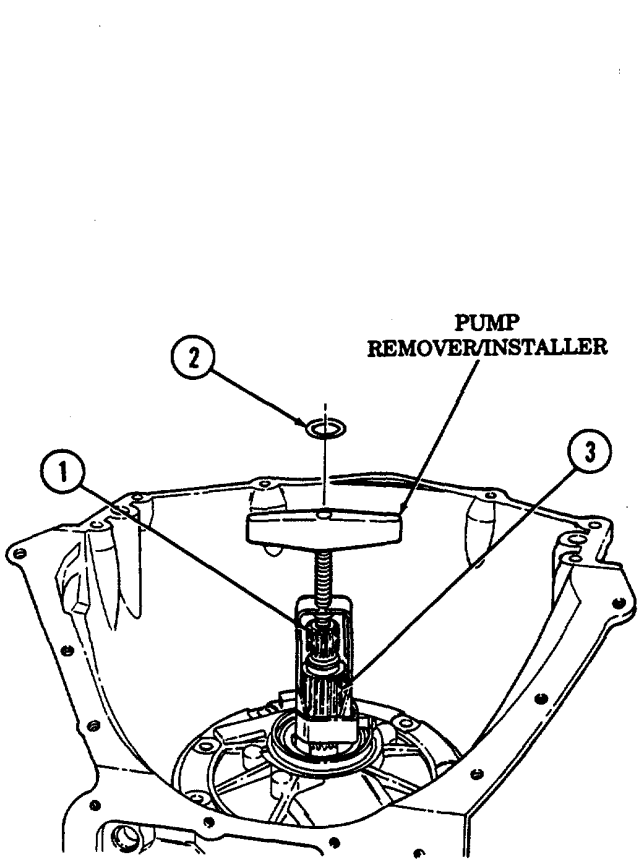


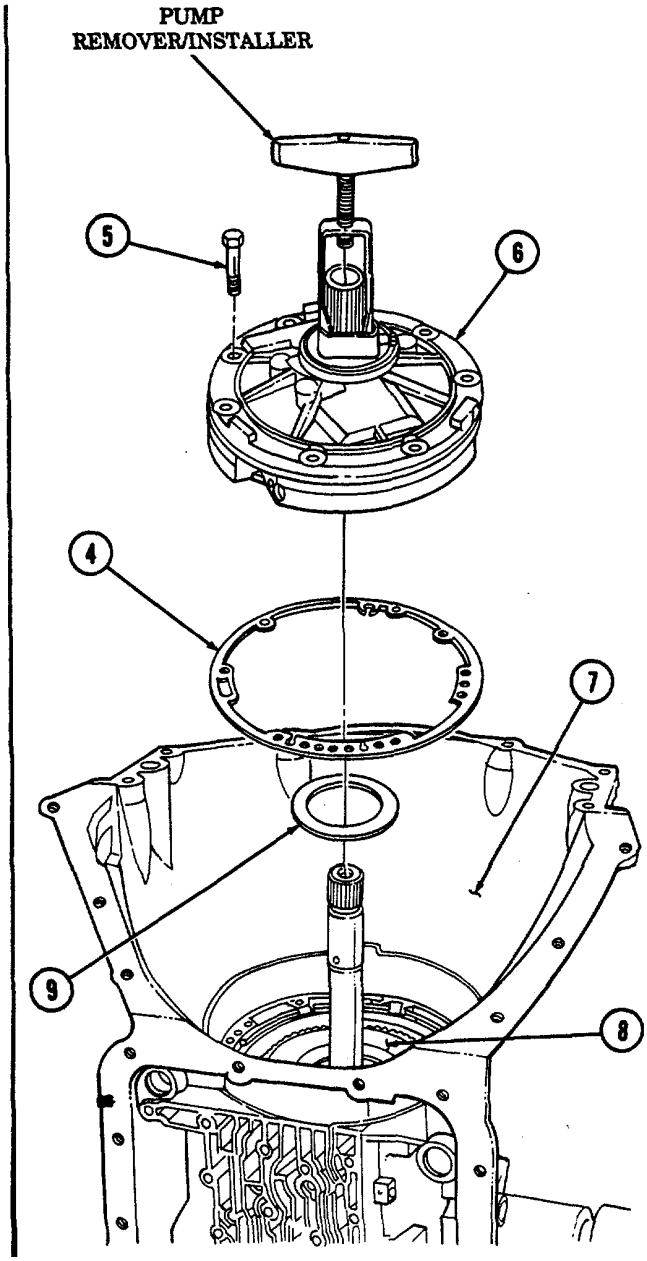



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

### k. Pump Assembly

1. Remove O-ring (2) from turbine shaft (1). Discard 0-ring (2).
2. Install pump remover/installer J37789-A on stator shaft (3).
3. Remove seven screws (5) from pump (6) and transmission case (7).
4. Remove pump (6) and gasket (4) from transmission case (7). Discard gasket (4).
5. Remove thrust washer (9) from overdrive carrier (8).



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

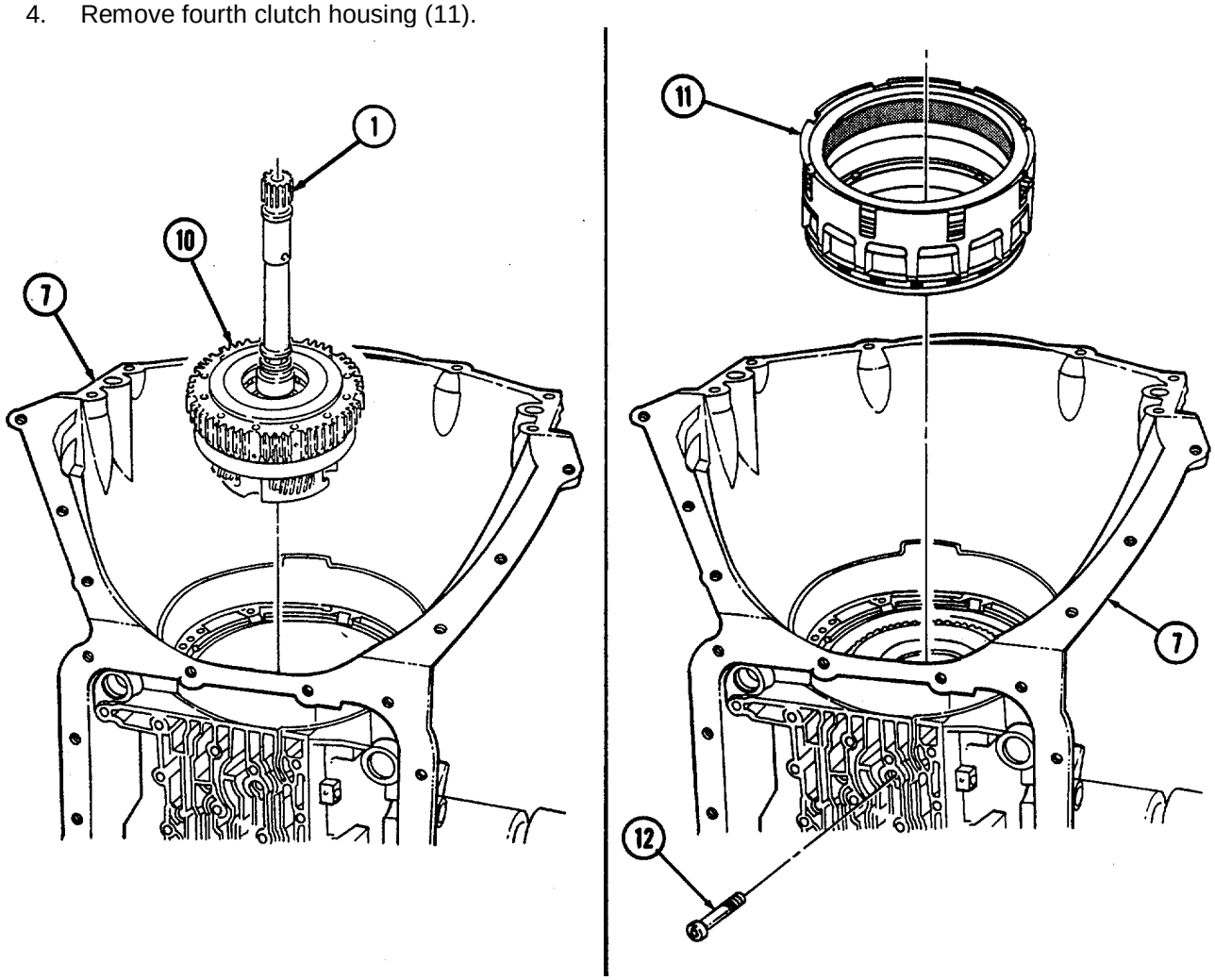
### I. Turbine Shaft and Overdrive Carrier Assembly

1. Lift turbine shaft (1) and remove overrun clutch housing assembly (10) from transmission case (7).

**CAUTION**

Correct torque for installed fourth clutch bolt should be 133 lb-in. (15 N·m). If not tightened to minimum torque, check case for cracks and damaged threads. Replace case if damaged.

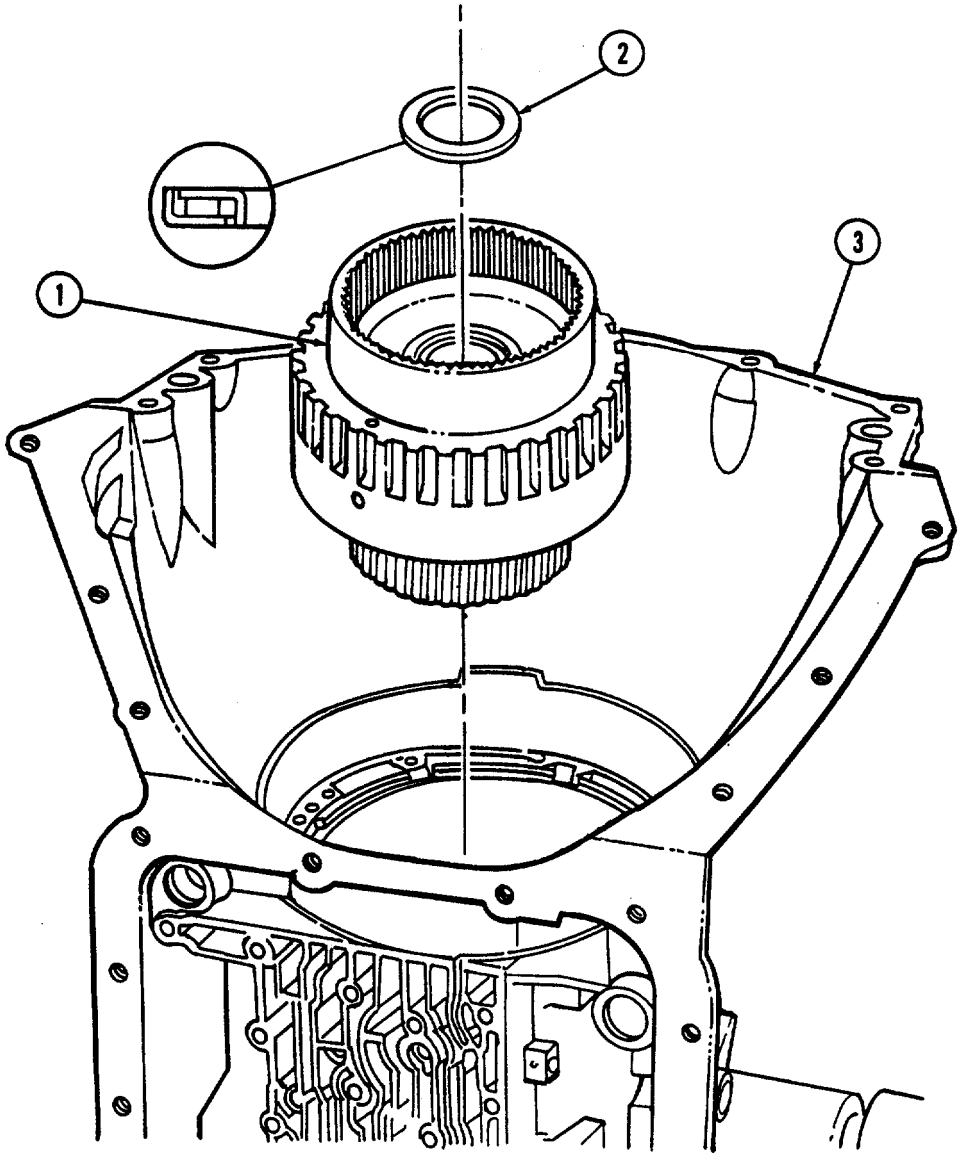
2. Check fourth clutch bolt (12) torque for a minimum of 133 lb-in. (15 N·m).
3. Remove bolt (12) from fourth clutch housing (11) with torx adapter. Discard bolt (12).
4. Remove fourth clutch housing (11).



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

### m. Forward Clutch Assembly

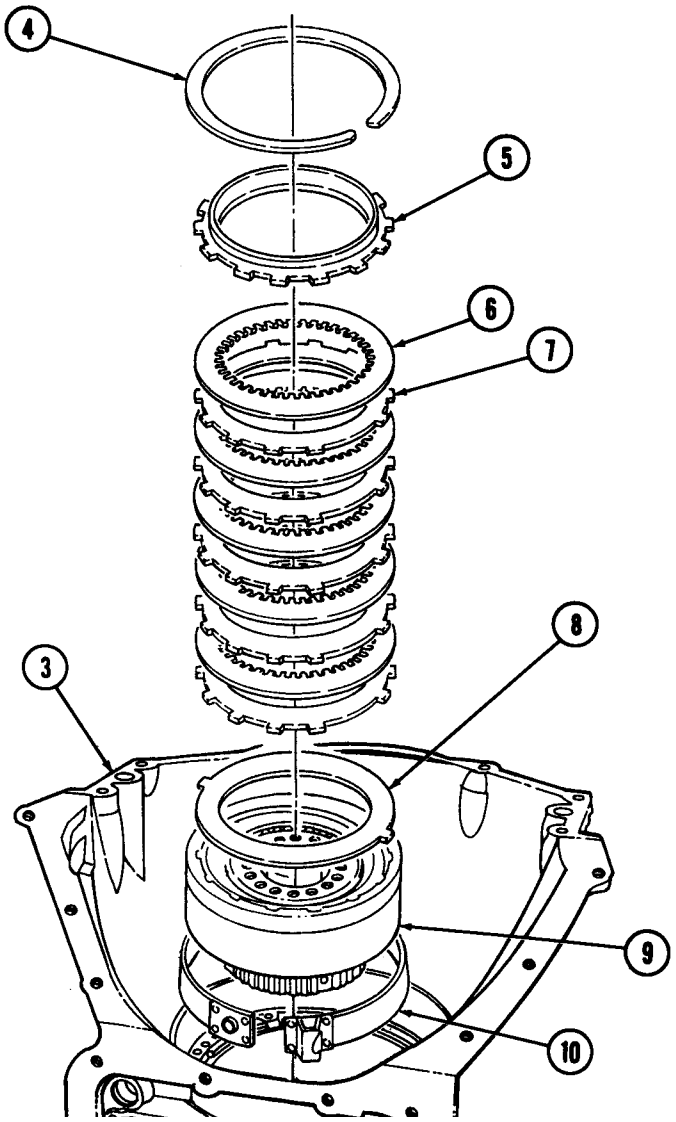
1. Remove flat bearing assembly (2) from top of forward clutch assembly (1).
2. Remove forward clutch assembly (1) from transmission case (3).



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)

**n. Direct Clutch Assembly**

1. Remove snapring (4), direct clutch backing plate (5), five composition clutch plate assemblies (6), clutch plates (7), and dished plate (8) (1995-1996 transmissions only) from direct clutch housing (9).
2. Remove direct clutch housing (9) from transmission case (3).
3. Install dished plate (8) (1995-1996 transmissions only), five clutch plates (7), composition clutch plate assemblies (6), and backing plate (5) in direct clutch housing (9) with snapring (4).
4. Remove front band (10) from transmission case (3).



## 17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E)(Cont'd)

**o. Intermediate Clutch Assembly**

**NOTE**

Wave plate is used on 1997 and 1998 transmissions only.

Remove snapring (3), backing plate (2), four clutch plate assemblies (4), clutch plates (1), and wave plate (5.1) from transmission case (5).

**p. Gear Unit Assembly and Rear Band**

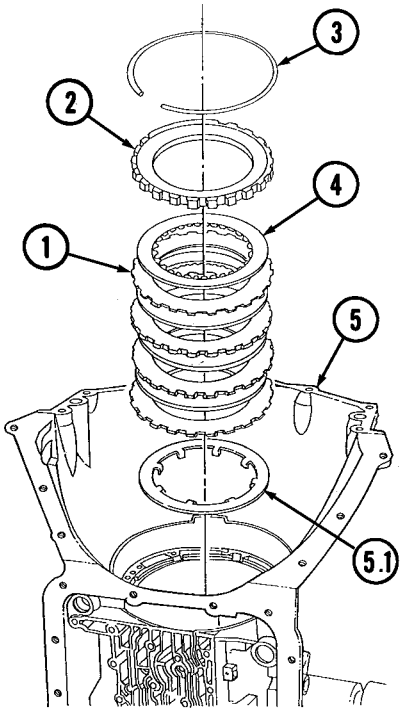
**CAUTION**

Correct torque for installed center support bolt should be 29 lb-ft (39 N•m). If not tightened to minimum torque, case could be damaged. If center support bolt is not tightened to minimum torque, a new center support and bolt should be installed during reassembly to avoid component damage.

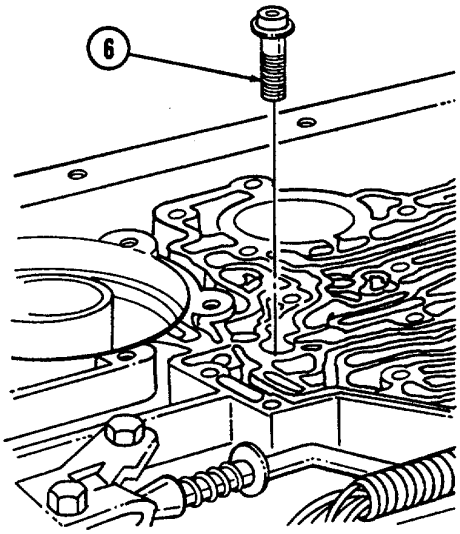
1. Check center support bolt (6) for torque.
2. Remove and discard center support bolt (6).
3. Remove snapring (7) from transmission case (5).
4. Attach gear unit installer/remover tool and slide hammer to main shaft (8).
5. Lift gear unit (9) out of transmission case (5).
6. Remove thrust washer (10) from gear unit (9).
7. Remove spacer (11), rear band (12), and thrust washer (13) from transmission case (5).

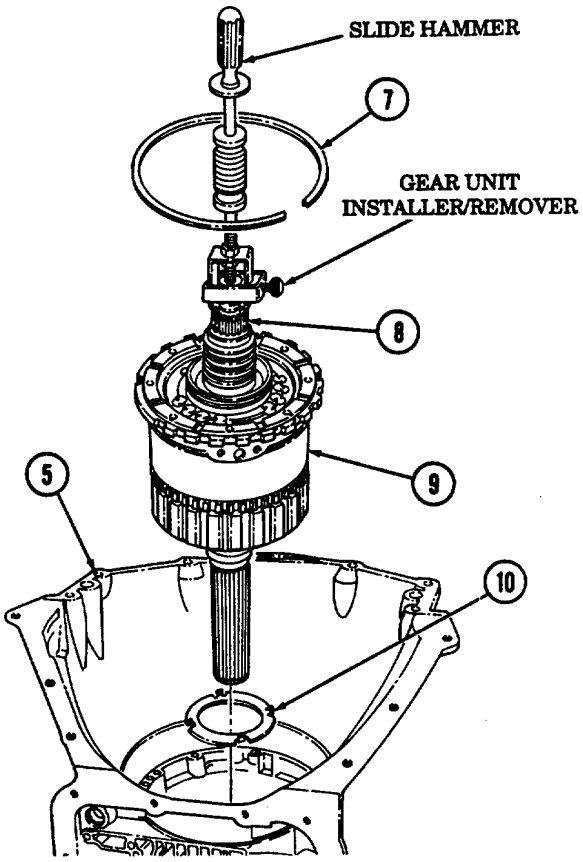
**q. Center Support Assembly**

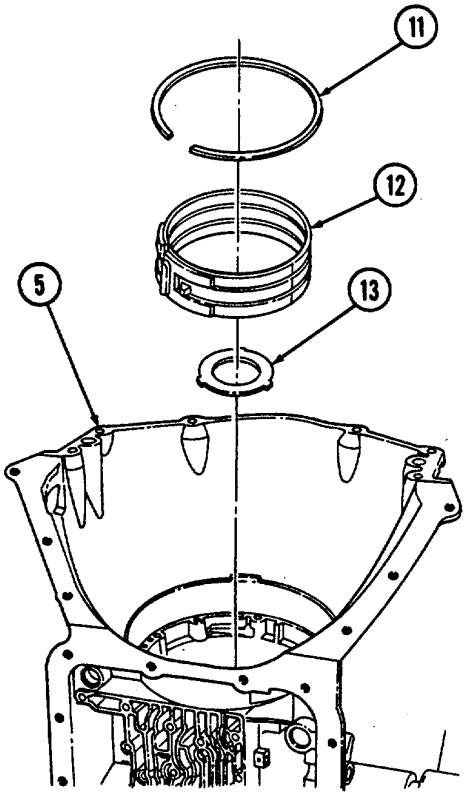
Remove center support (14) and thrust washer (15) from gear unit (9).

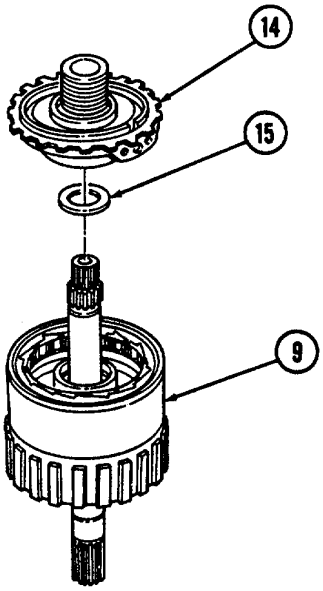


**17-14. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (4L80-E) (Cont'd)**



# 17-15. TORQUE CONVERTER MAINTENANCE (4L80-E)

**This task covers:**

**a. Cleaning** **b. Inspection**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Manual References**
TM 9-2320-280-24P

**Maintenance Level**
General support

**a. Cleaning**

**NOTE**

Have drainage container ready to catch fluid.

1. Drain fluid from torque converter (1). Replace torque converter (1) if fluid is contaminated or abnormal looseness or noises were recorded at torque converter removal (para. 17-14a).
2. Clean exterior of torque converter (1) in accordance with para. 2-13.

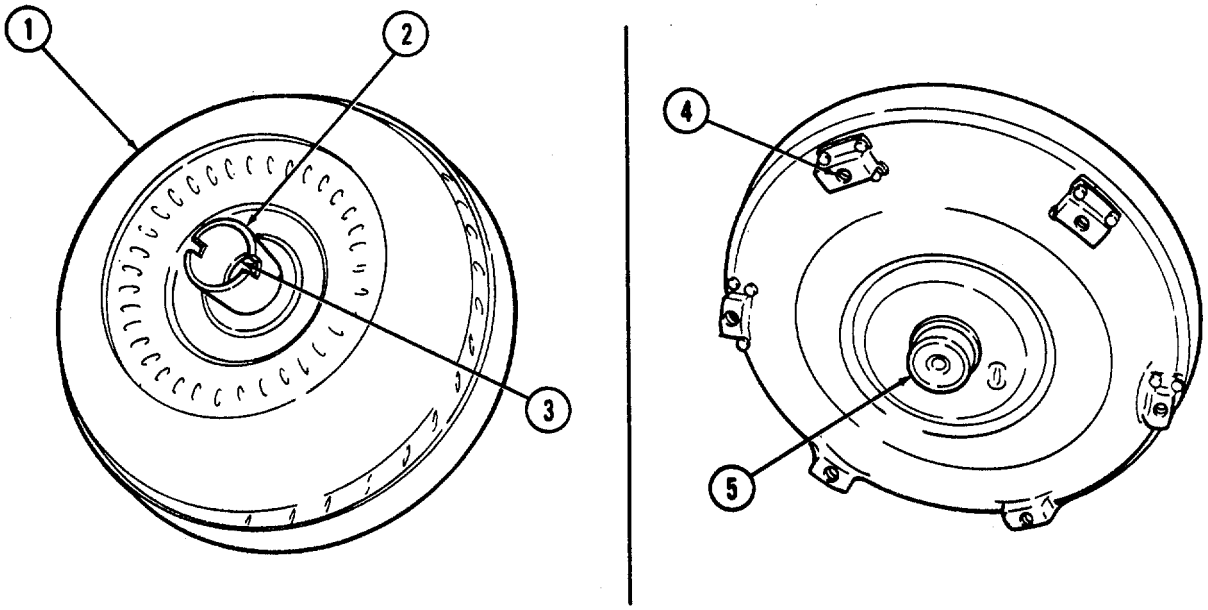
**b. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect torque converter hub (2) for damage. Replace torque converter (1) if hub (2) is damaged.
2. Inspect torque converter (1) for proper operation by manually rotating splined inner race (3) in both directions. The splined inner race (3) should turn freely in clockwise direction, but not turn or be very difficult to turn, in counterclockwise direction. Replace torque converter (1) if it does not operate properly.
3. Inspect torque converter (1) for damaged or leaking seams and welds. Replace torque converter (1) if damaged.
4. Inspect torque converter pilot (5) for damage. Replace torque converter (1) if damaged.
5. Inspect threaded holes (4) for damage. Repair with thread repair inserts. If unable to repair threaded holes (4), replace torque converter (1).

**17-15. TORQUE CONVERTER MAINTENANCE (4L80-E) (Cont'd)**



# 17-16. TRANSMISSION CASE REPAIR (4L80-E)

**This task covers:**

**a. Cleaning** **b. Inspection**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Seal installer (Appendix G, Item 39)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**General Safety Instructions**
- Protective clothing must be used when steam cleaning.
- Compressed air for cleaning purposes will not exceed 30 psi (207 kPa).

**Maintenance Level**
General support

## a. Cleaning

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

1. Remove transmission case (1) from transmission holding fixture.

**WARNING**

When steam cleaning, protective clothing must be used. Failure to do this may cause serious injury.

2. Thoroughly steam clean transmission case (1).

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

3. Blow all dirt and cleaning solution from transmission case (1) with compressed air.

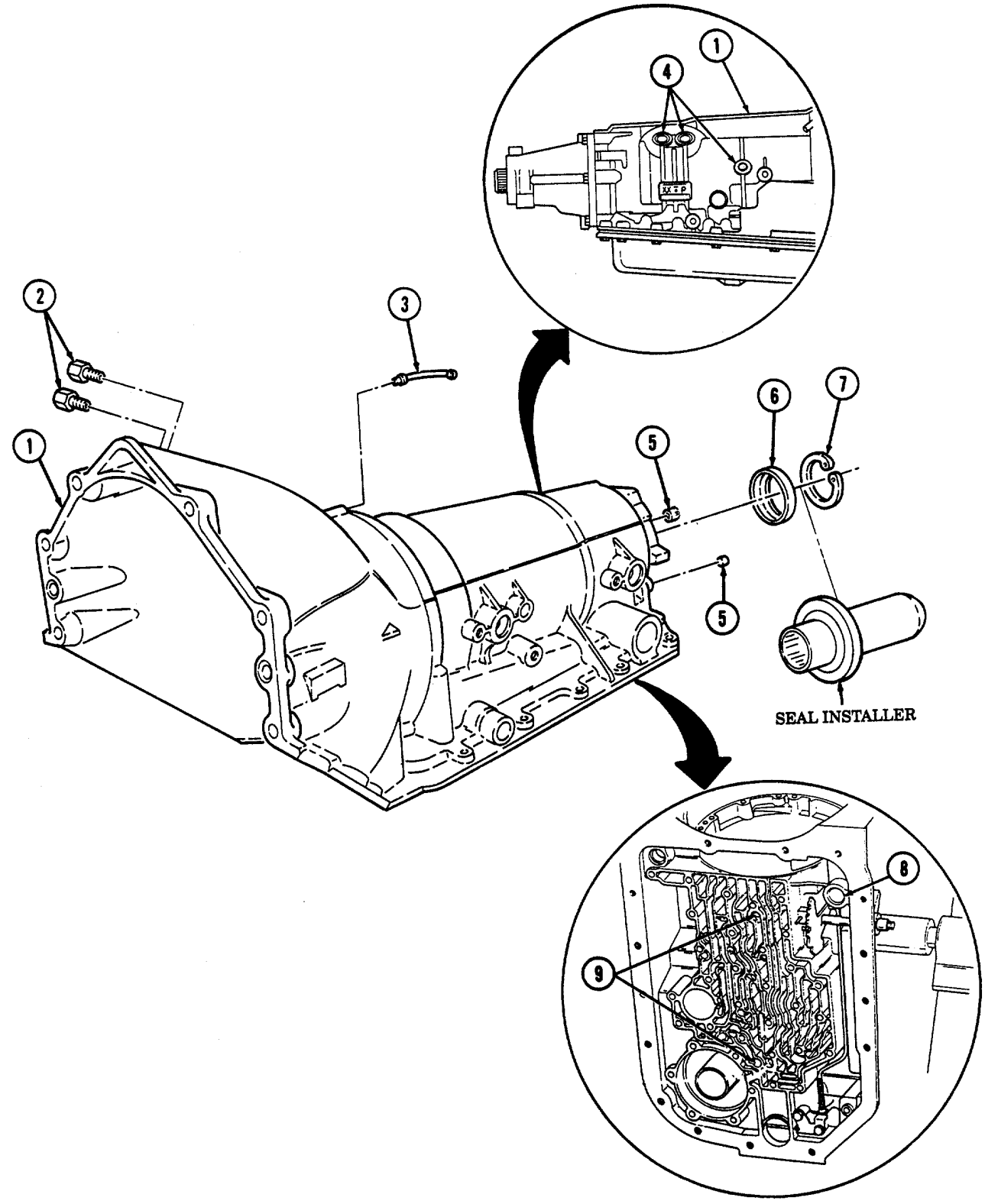
## b. Inspection

**NOTE**

For general inspection procedures, refer to para. 2-14.

1. Inspect all oil passages and bores for cracks, leaks, holes, and burrs. Use soft stone or crocus cloth to remove burrs.
2. Use helicoils to repair damaged threads.
3. Inspect bores for holes or pits as leakage paths. Replace transmission case (1) if holes or pits are present.
4. Inspect anchor pins (4) for looseness. Replace anchor pins (4) if damaged or loose.
5. Inspect internal splines, lugs, and snapring grooves for cracks, breaks, and burrs. Repair minor burrs. Replace damaged transmission case (1).
6. Remove retaining ring (7) and replace seal assembly (6) using seal installer.
7. Inspect plugs (5), cooler fittings (2), and vent pipe (3). Replace damaged parts.
8. Inspect oil multilip seal (8) for damage. Replace if damaged.
9. Inspect bolt holes (9) for damage. Replace transmission case (1) if holes (9) are damaged.

## 17-16. TRANSMISSION CASE REPAIR (4L80-E) (Cont'd)



# 17-17. PARKING LOCK PAWL AND ACTUATOR ASSEMBLY REPAIR (4L80-E)

**This task covers:**

**Inspection**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Manual References**
TM 9-2320-280-24P

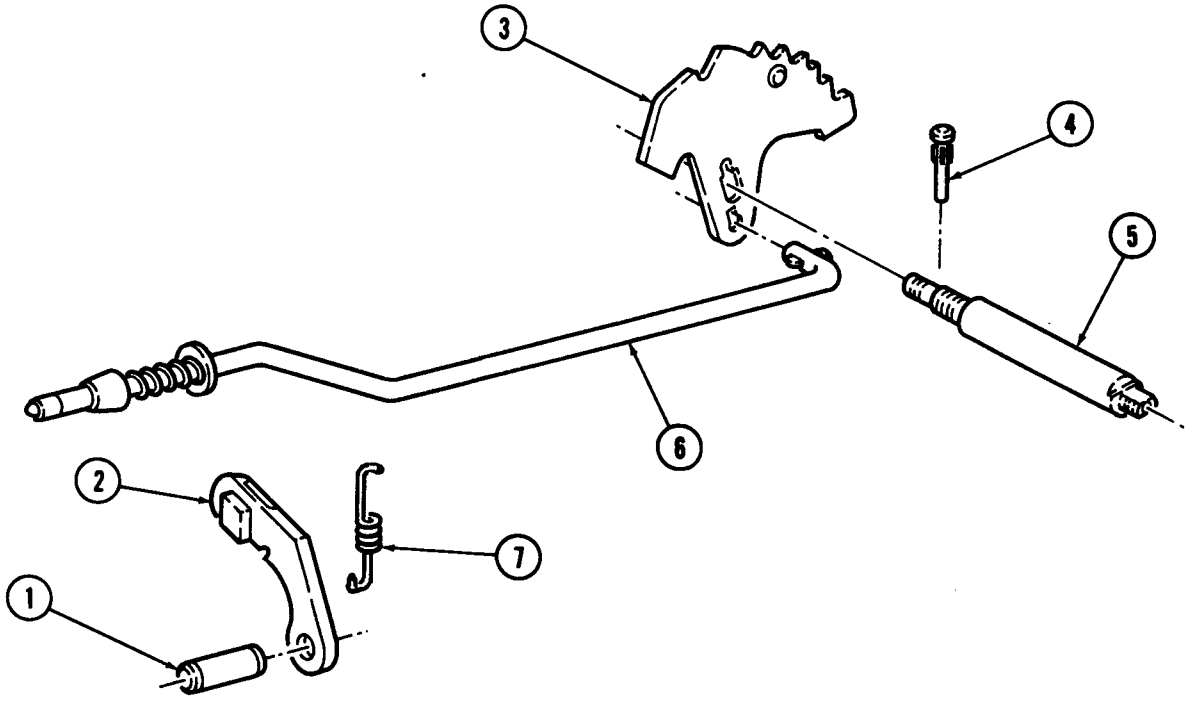
**Maintenance Level**
General support

**Inspection**

**NOTE**

Return spring is part of transmission.

1. Inspect parking lock pawl (2) for cracks and burrs. Replace if cracked and remove any minor burrs.
2. Inspect pawl shaft (1) for cracks, burrs, and damaged flats. Remove minor burrs. Replace if damaged.
3. Inspect detent lever (3) and manual shaft (5) for cracks, burrs, and damaged threads. Replace if damaged.
4. Inspect actuator assembly (6) for cracks, burrs, free movement, and damaged spring. Replace if damaged.
5. Inspect return spring (7) for breaks and distortion. Replace if damaged.
6. Inspect retaining pin (4) for tightness. Replace if damaged.



# 17-18. REAR BAND AND SELECTIVE THRUST WASHER REPAIR (4L80-E)

**This task covers:**

**Inspection**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

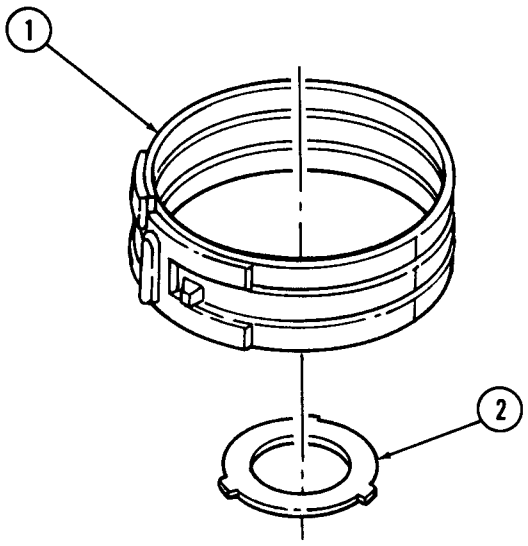
**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Manual References**
TM 9-2320-280-24P

**Maintenance Level**
General support

**Inspection**

1. Inspect rear band (1) for burning, scoring, distortion, or other damage. Replace rear band (1) if damaged.
2. Inspect rear selective thrust washer (2) for wear, scoring, breaks, cracks, or heat discoloration. Replace thrust washer (2) if damaged.



# 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E)

**This task covers:**

**a. Disassembly (1995-1996)**
**a.1. Disassembly (1997-1998)**
**b. Cleaning**
**c. Inspection**
**d. Assembly (1995-1996)**
**d.1. Assembly (1997-1998)**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Petrolatum (Appendix B, Item 38)
Transmission fluid (Appendix B, Item 24)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Maintenance Level**
General support

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

**a. Disassembly (1995-1996)**

1. Remove sun gear shaft (6) from sun gear (7) and main shaft (9).
2. Remove reaction drum (3) from output carrier assembly (11).

**NOTE**

Keep all bearing and races together as sets.

3. Remove bearing and two races (5), sun gear (7), and bearing and two races (8) from output carrier assembly (11).

**NOTE**

Place output carrier assembly on its side for ease of disassembly.

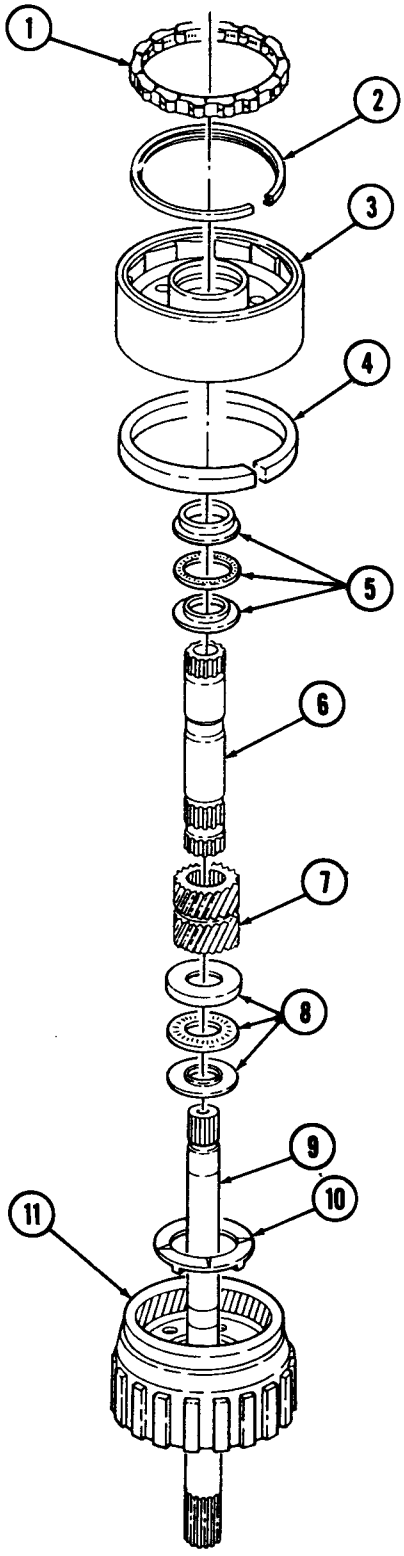
4. Remove thrust washer (10) from output carrier assembly (11).
5. Remove thrust washer (12), snapring (13), output shaft (14), and bearing and two races (15) from internal gear (16).
6. Remove internal gear (16) and main shaft (9) from output carrier assembly (11).
7. Remove snapring (17) and internal gear (16) from main shaft (9).

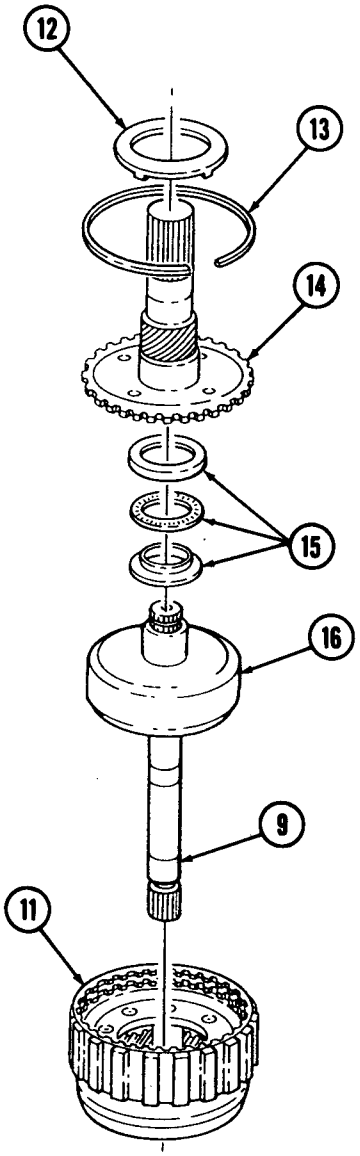
**NOTE**

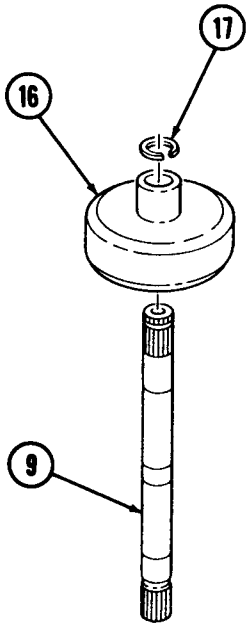
Internal ring and spacer ring are used on 1995 transmission only.

8. Remove roller clutch (1), spacer ring (2), and internal ring (4) from reaction drum (3).

## 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E)(Cont'd)



## 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E)(Cont'd)

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

**a.1. Disassembly (1997-1998)**

1. Remove sun gear shaft (4) from sun gear (5) and main shaft (6).
2. Remove reaction drum (2) from output carrier assembly (8).

**NOTE**

Keep all bearing and races together as sets.

3. Remove bearing and two races (3) and sun gear (5) from output carrier assembly (8).

**NOTE**

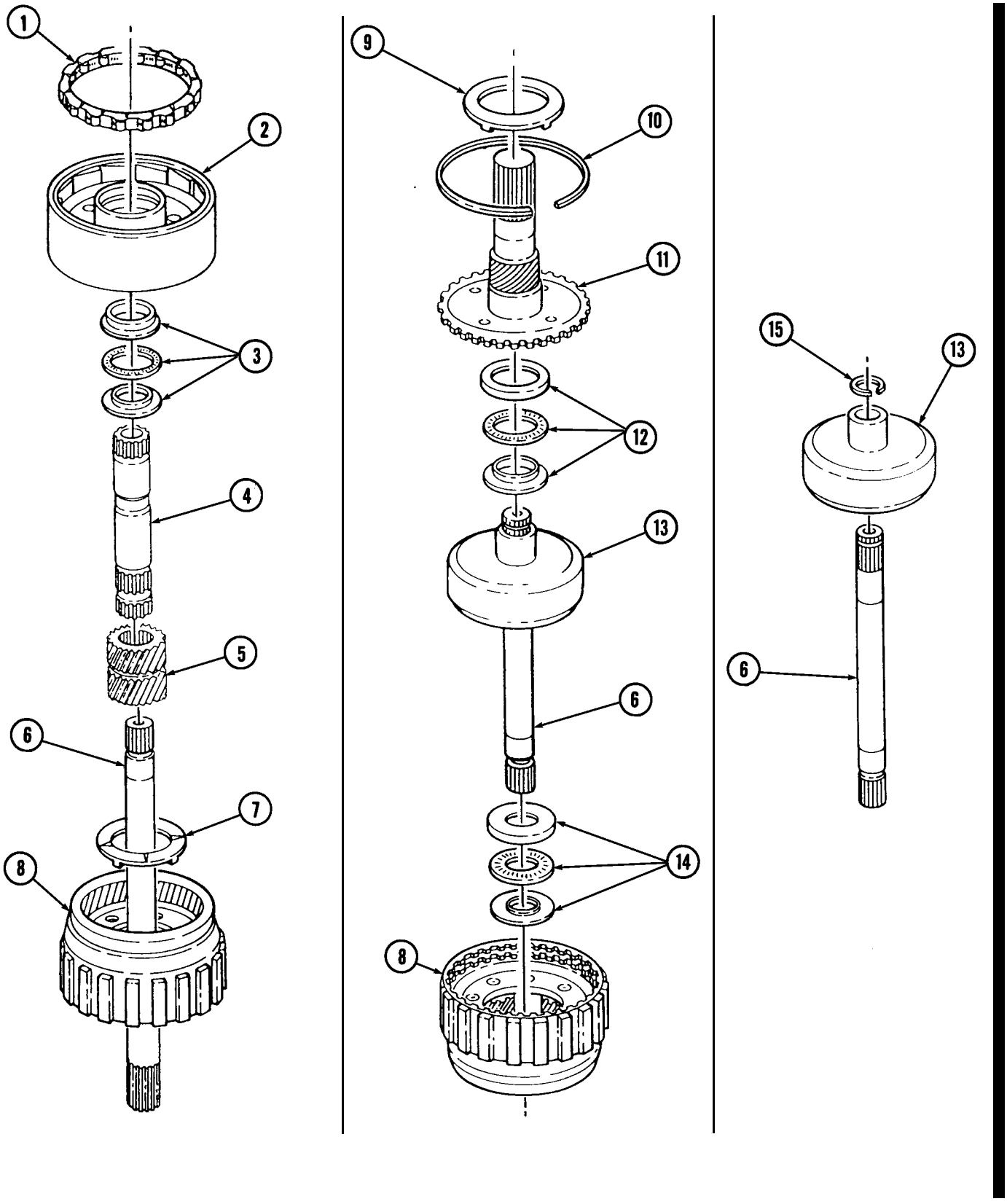
Place output carrier assembly on its side for ease of disassembly.

4. Remove thrust washer (7) from output carrier assembly (8).
5. Remove thrust washer (9), snapring (10), output shaft (11), and bearing and two races (12) from internal gear (13).
6. Remove internal gear (13), main shaft (6), and bearing and two races (14) from output carrier assembly (8).
7. Remove snapring (15) and internal gear (13) from main shaft (6).
8. Remove roller clutch (1) from reaction drum (2).

**b. Cleaning**

Clean all components in accordance with para. 2-13.

## 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E)(Cont'd)



## 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E)(Cont'd)

**c. Inspection**

**NOTE**

For general inspection instructions, refer to para. 2-14.

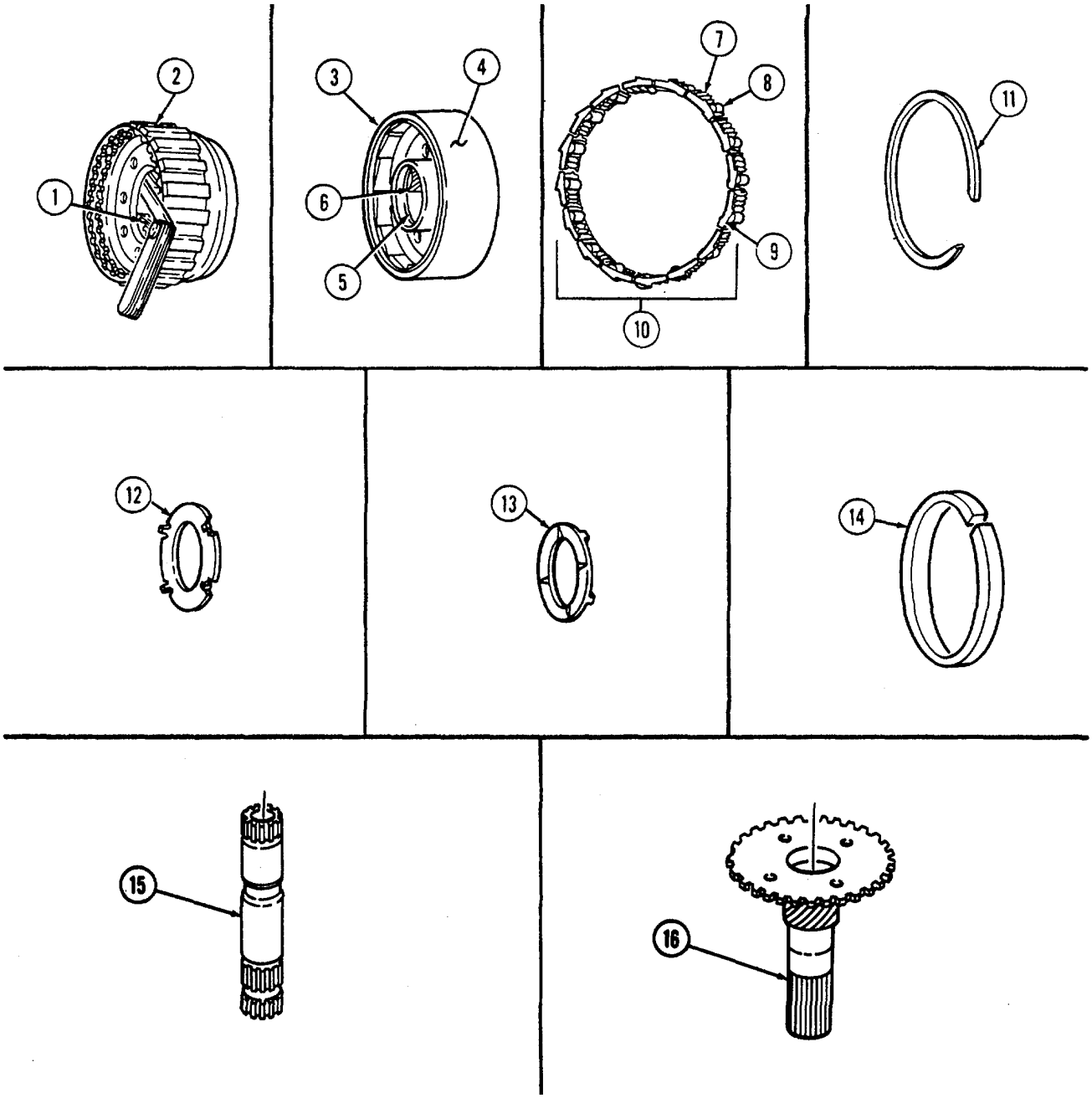
1. Inspect output carrier (2) for damage. Replace if damaged.
2. Inspect output carrier pinion gears (1) for damage, rough bearings, or excessive end play. Using feeler gauge, measure pinion gear end play; end play should not exceed 0.024 in. (0.61 mm). If any of these conditions exist, replace output carrier (2).
3. Inspect band surface (4) on reaction drum (3) for burning, scoring, or galling. Replace if burnt, scored, or pitted.
4. Inspect reaction carrier bushing (5). Replace reaction drum (3) if bushing (5) is damaged.
5. Inspect reaction carrier pinion gear (6) for damage, rough bearings, or excessive end play. Using feeler gauge, measure pinion gear end play; end play should not exceed 0.024 in. (0.61 mm). If any of these conditions exist, replace reaction drum (3).
6. Inspect roller clutch (10) for damaged rollers (8), springs (7), or cage (9). Replace roller clutch (10) if any parts are damaged.

**NOTE**

Internal ring is used on 1995 transmission only.

7. Inspect snapring (11), case thrust washer (12), reaction carrier thrust washer (13), and internal ring (14) for distortion or damage. Replace any part distorted or damaged.
8. Inspect sun gear shaft (15) for damage. Replace if damaged.
9. Inspect output shaft (16) for damage. Replace if damaged.
10. Refer to para. 2-14 for general inspection instructions for all other gear unit parts.

## 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E) (Cont'd)



## 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E)(Cont'd)

**d. Assembly (1995-1996)**

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid (Dexron® III) before assembly. Foreign material will cause transmission damage.

**NOTE**

- For general assembly instructions, refer to para. 2-16.
- Internal ring and spacer ring are used on 1995 transmissions only.

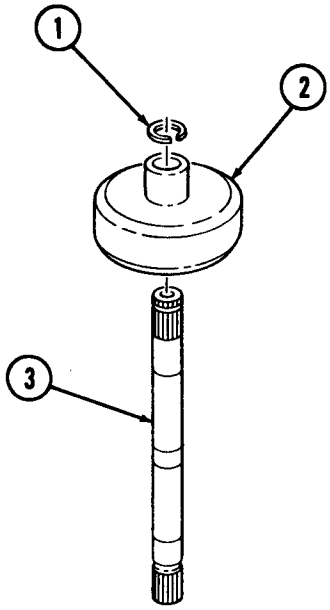
1. Install internal ring (12), spacer ring (10), and roller clutch (9) in reaction drum (11).
2. Install main shaft (3) into rear internal gear (2) with snapring (1).
3. Install bearing and two races (7) on rear journal of rear internal gear (2). Retain races (7) with petrolatum.
4. Install output carrier assembly (8) and output shaft (6) on internal gear (2). Secure with snapring (5).

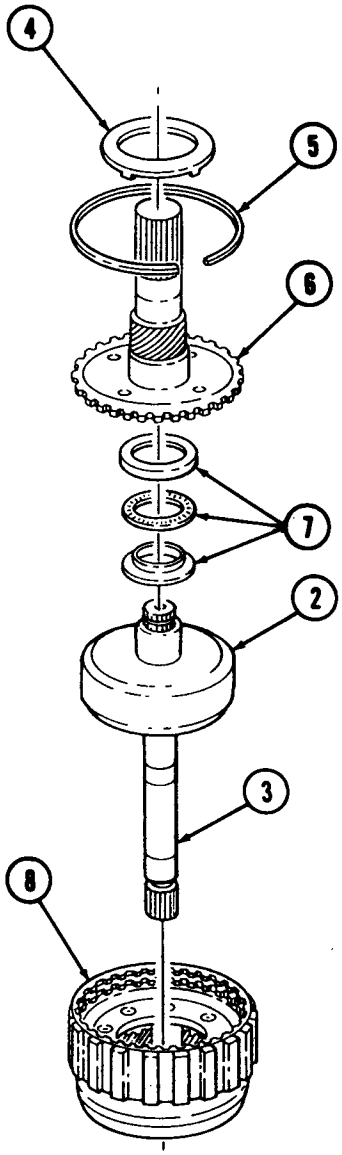
**NOTE**

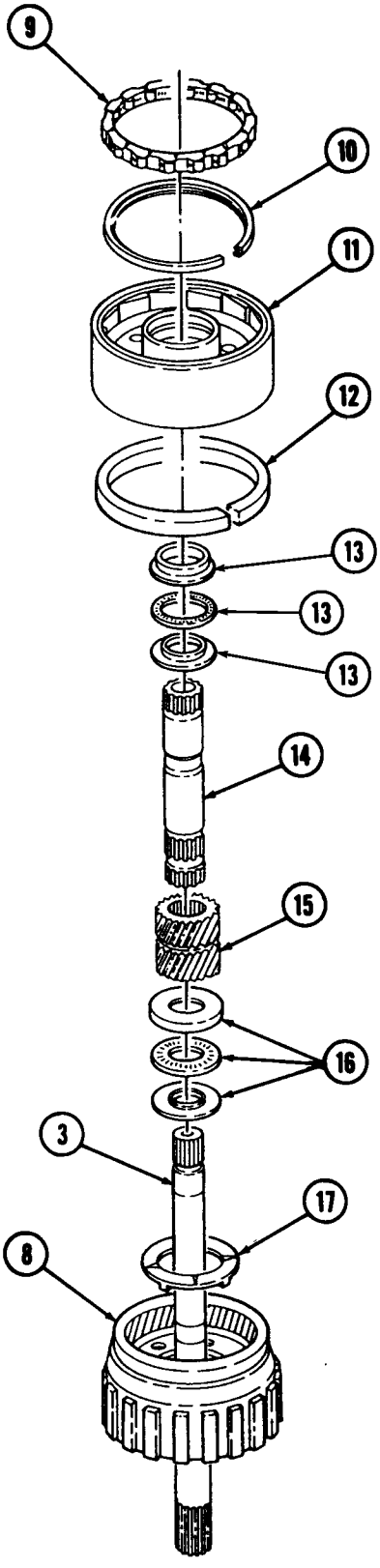
The metal thrust washer is installed on output shaft. The plastic thrust washer is installed in output carrier.

5. Install thrust washer (4) on output shaft (6) and retain with petrolatum. Seat tabs in pockets of output shaft (6).
6. Turn partially assembled gear unit over with main shaft (3) facing up.
7. Install plastic thrust washer (17) and reaction drum (11) on output carrier assembly (8). Mesh gears.
8. Install bearing and two races (16) and sun gear (15), chamfered edge first, into reaction drum (11) and output carrier (8).
9. Install long, splined end of sun gear shaft (14) in sun gear (15).
10. Install bearing and two races (13) with longer lip race on reaction drum (11). Retain races (13) with petrolatum.

## 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E)(Cont'd)



## 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E)(Cont'd)

**d.1. Assembly (1997-1998)**

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid (Dexron® III) before assembly. Foreign material will cause transmission damage.

**NOTE**

For general assembly instructions, refer to para. 2-16.

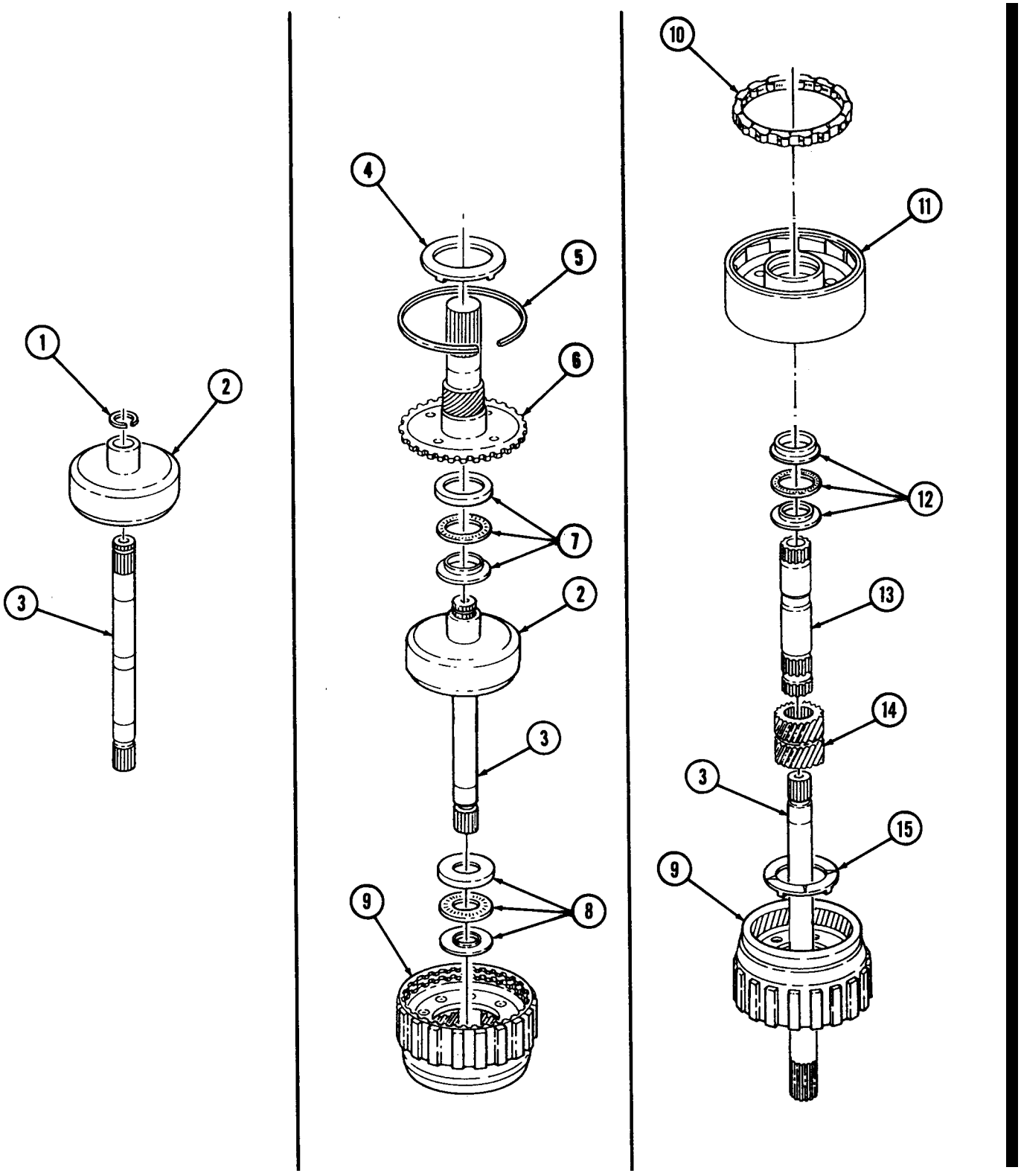
1. Install roller clutch (10) in reaction drum (11).
2. Install main shaft (3) into rear internal gear (2) with snapring (1).
3. Install bearing and two races (7) on rear journal of rear internal gear (2). Retain races (7) with petrolatum.
4. Install output carrier assembly (9) and output shaft (6) on internal gear (2). Secure with snapring (5).

**NOTE**

The metal thrust washer is installed on output shaft. The plastic thrust washer is installed in output carrier.

5. Install thrust washer (4) on output shaft (6) and retain with petrolatum. Seat tabs in pockets of output shaft (6).
6. Turn partially assembled gear unit over with main shaft (3) facing up.
7. Install bearing and two races (8) on main shaft (3).
8. Install plastic thrust washer (15) and reaction drum (11) on output carrier assembly (9). Mesh gears.
9. Install sun gear (14), chamfered edge first, into reaction drum (11) and output carrier (9).
10. Install long, splined end of sun gear shaft (13) in sun gear (14).
11. Install bearing and two races (12) with longer lip race on reaction drum (11). Retain races (12) with petrolatum.

## 17-19. GEAR UNIT AND OUTPUT ASSEMBLIES REPAIR (4L80-E)(Cont'd)



## 17-20. CENTER SUPPORT REPAIR (4L80-E)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Driver handle (Appendix G, Item 34)
Bushing service set (Appendix G, Item 33)
Adapter (Appendix G, Item 45)
Clutch spring compressor (Appendix G, Item 47)
Center support thread reamer (Appendix G, Item 143)

**Materials/Parts**
Preformed packing (Appendix E, Item 181)
Preformed packing (Appendix E, Item 183)
Four packing retainers (Appendix E, Item 189)
Transmission fluid (Appendix B, Item 24)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**General Safety Instructions**
Air pressure must not exceed 15 psi (103 kPa) when air checking clutch piston.

**Maintenance Level**
General support

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

1. Remove four packing retainers (1) from center support (2). Discard packing retainers (1).
2. Using adapter and clutch spring compressor J23327-1, compress spring and retainer (9) and remove snapring (5) from center support (2).
3. Remove spring and retainer (9) and clutch piston (6) from center support (2).
4. Remove preformed packings (7) and (8) from clutch piston (6). Discard preformed packings (7) and (8).

**NOTE**

Perform step 5 for 1997-1998 transmissions only.

5. Remove oil cooler pipe fitting seal (8.1) from center support (2).

### b. Cleaning

Clean all center support components in accordance with para. 2-13.

### c. Inspection

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect roller clutch inner race (3) for damage. Replace center support (2) if damaged.
2. Inspect oil ring grooves (4) in center support (2) for roughness or damage. Replace center support (2) if damaged.
3. Inspect center support (2) for damage. Replace if damaged.

## 17-20. CENTER SUPPORT REPAIR (4L80-E) (Cont'd)

**NOTE**

- The center support bolt hole can be reconditioned ONE TIME ONLY using a reamer and a new service bolt. This is an optional procedure.
- 1997-1998 transmission center supports are shown. The 1995-1996 transmissions are similar.

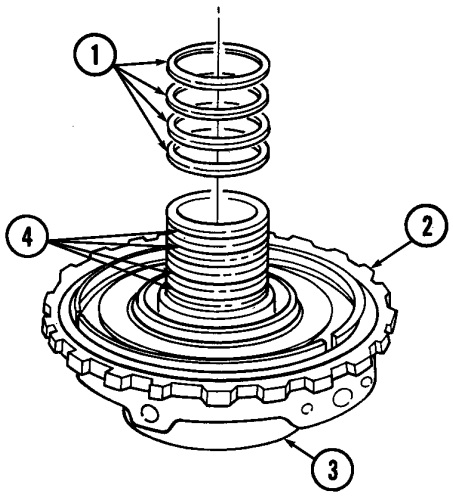
3.1. Insert, do not force, gauge pin with chamfer end towards hole in bolt hole (4.1). If gauge pin fits in hole at least half way, go to step 3.2. If half way or more, replace center support (2).

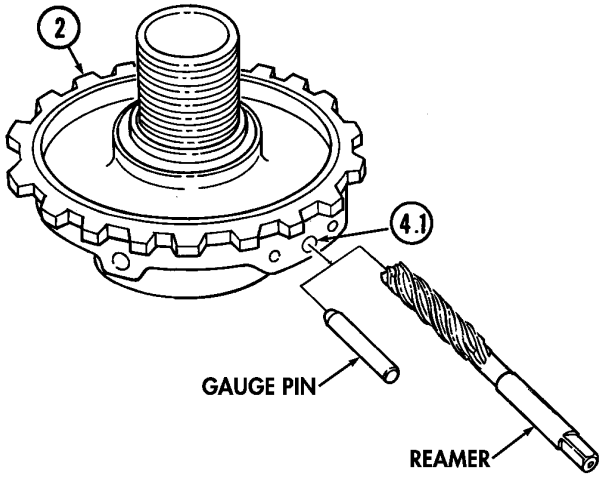
3.2. Position reamer in bolt hole (4.1) and using light pressure, turn clockwise approximately 4-6 times or until reamer bottoms out. Remove reamer and clean center support (2).

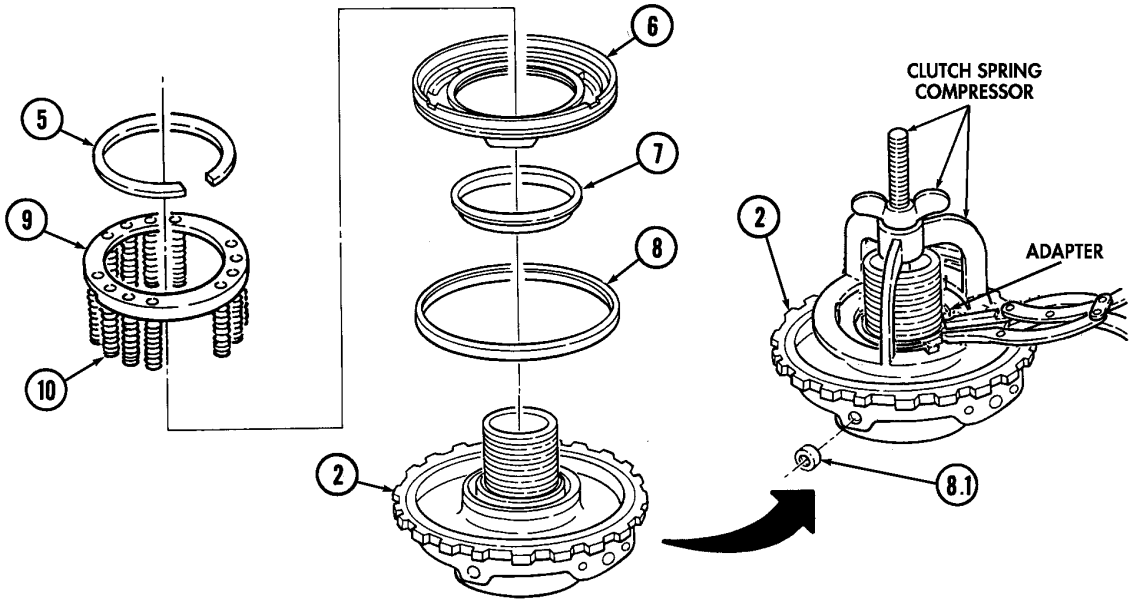
4. Check all oil passages in center support (2) for blockage.

5. Inspect release springs (10) for signs of distortion or collapsed coils. Replace all springs (10) if any have distorted or collapsed coils.

6. Inspect clutch piston (6), spring and retainer (9), and snapring (5) for damage or distortion. Replace any part if damaged or distorted.



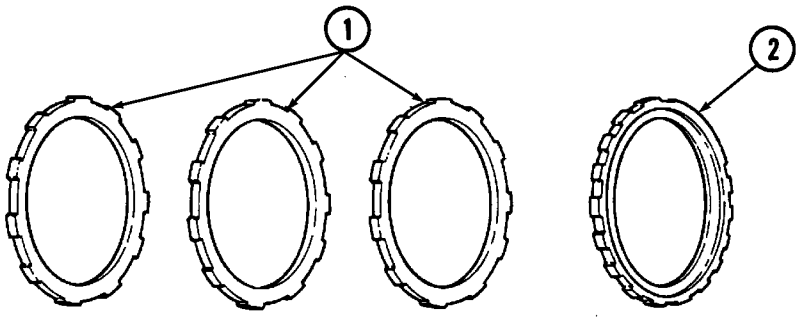



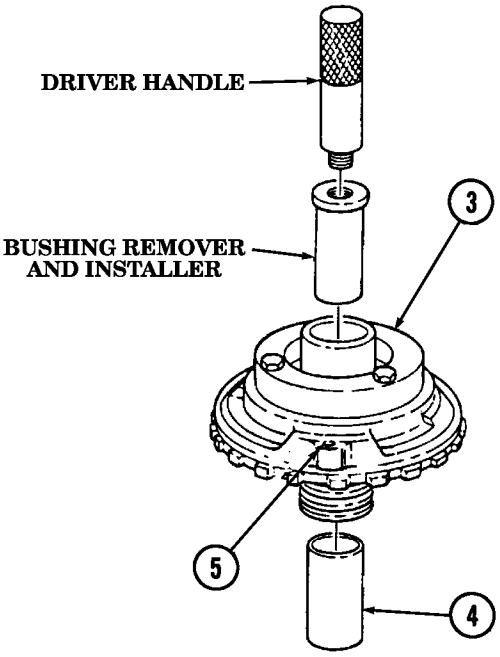
## 17-20. CENTER SUPPORT REPAIR (4L80-E) (Cont'd)

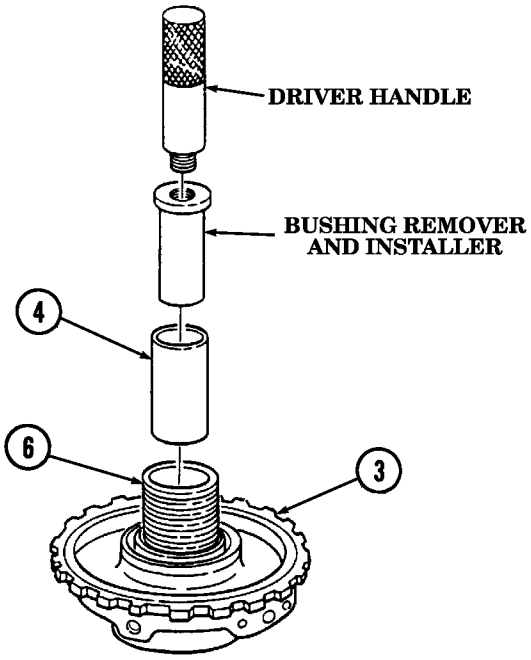
**NOTE**

Intermediate clutch plates and backing plate were removed during transmission disassembly (para. 17-14).

7. Inspect steel clutch plates (1) and backing plate (2) for signs of burning, scoring, or cracks. Replace any that are burned, scored, or cracked.
8. Inspect bushing (4) in center support (3) for damage. If damaged, perform steps 9 through 11. If not, go to step 12.
9. Using driver handle and bushing remover and installer J 21465-6, remove bushing (4) from center support (3).
10. Align elongated slot in bushing (4) with drilled hole in oil delivery sleeve (6) closest to piston cavity in center support (3).
11. Using driver handle and bushing remover and installer, install bushing (4) into center support (3) until bushing (4) is flush to 0.010 in. (0.254 mm) below top of oil delivery sleeve (6).
12. Check center support (3) for obstructions in orifice plug (5). Remove obstructions with a piece of wire. Replace center support if plug (5) is missing or obstructions cannot be removed.



## 17-20. CENTER SUPPORT REPAIR (4L80-E) (Cont'd)

**d. Assembly**

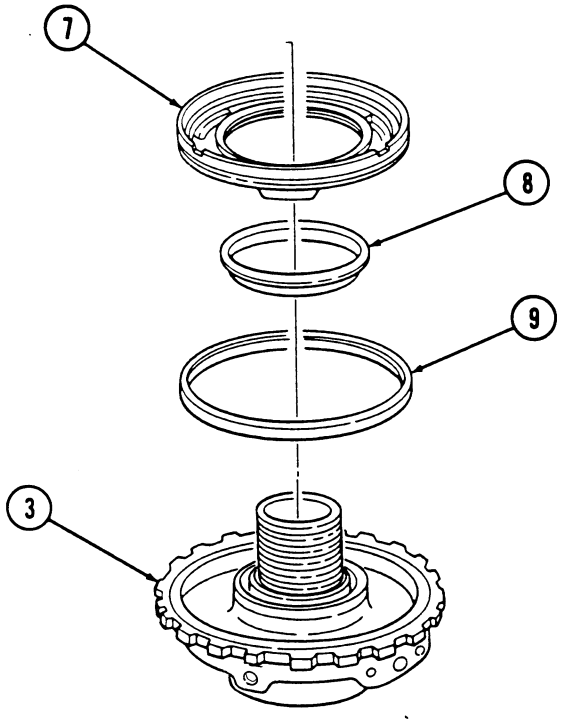
**CAUTION**

All transmission parts must be lubricated with clean transmission fluid (Dexron® III) before assembly. Foreign material will cause transmission damage.

**NOTE**

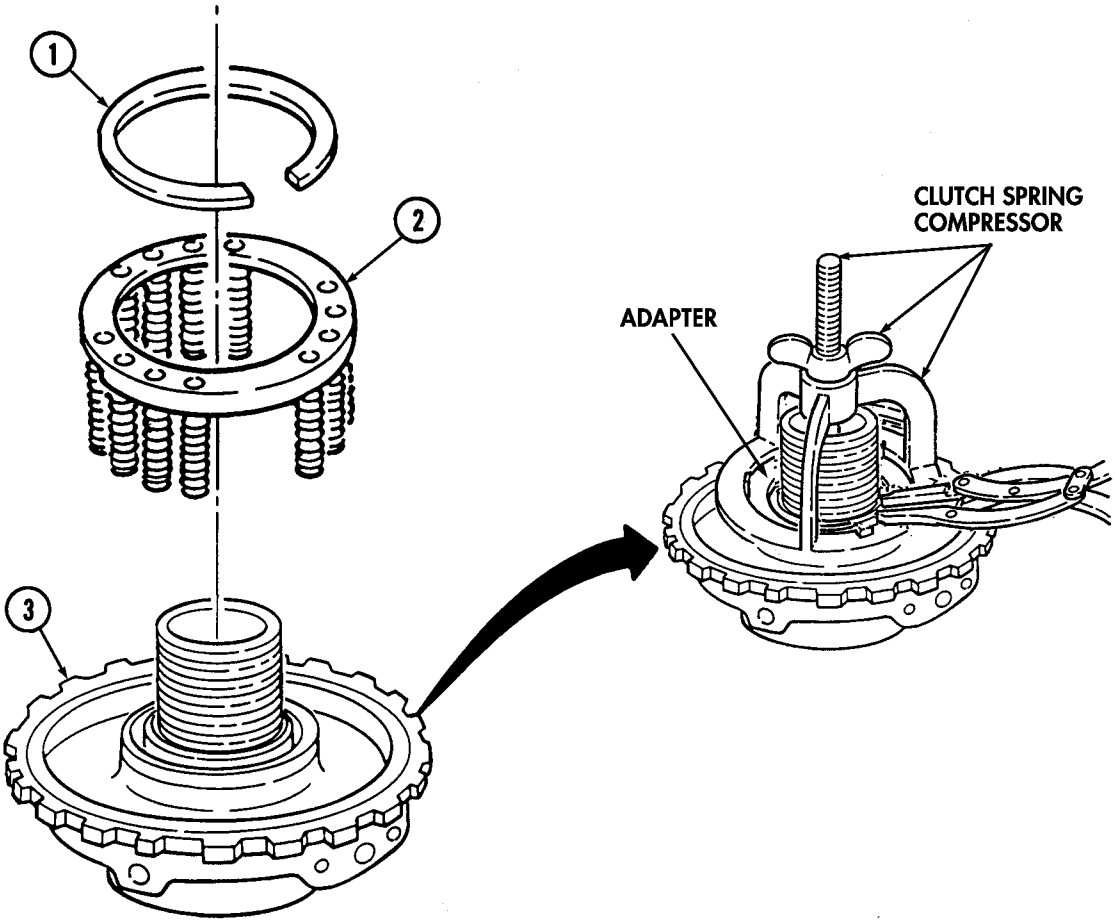
- For general assembly instructions, refer to para. 2-16.
- It may be necessary to use a 0.015 in. (0.381 mm) feeler gauge to start outer and inner piston seals into center support.

1. Install preformed packings (8) and (9) on clutch piston (7). Ensure lips on preformed packings (8) and (9) face away from spring pockets in clutch piston (7).
2. Install clutch piston (7) in center support (3) indexing spring pockets in clutch piston (7) with cored areas in center support (3).



## 17-20. CENTER SUPPORT REPAIR (4L80-E) (Cont'd)

3. Place spring and retainer (2) on center support (3).
4. Using adapter and spring compressor J23327-1, compress spring and retainer (2) on center support (3) and install snapring (1).



## 17-20. CENTER SUPPORT REPAIR (4L80-E) (Cont'd)

**WARNING**

Air pressure must not exceed 15 psi (103 kPa) when air checking clutch piston, or injury to personnel or damage to equipment may result.

**NOTE**

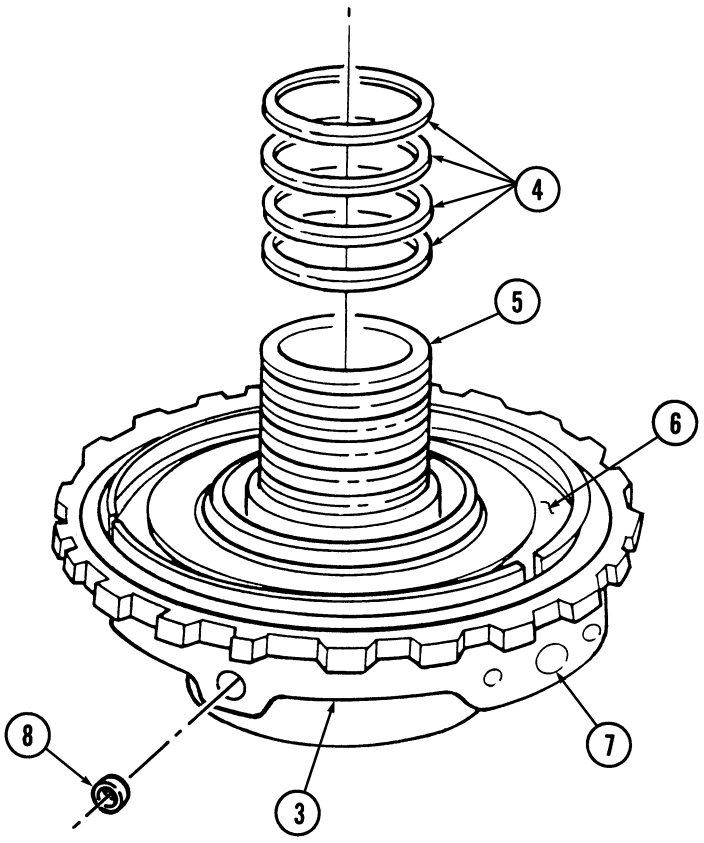
Clutch piston must move up and down freely when air pressure is applied.

5. Apply compressed air through center support bolt hole (7) to check operation of clutch piston (6).
6. Install four packing retainers (4) on oil delivery sleeve (5).

**NOTE**

Perform step 7 for 1997-1998 transmissions only.

7. Install oil cooler pipe fitting seal (8) in center support (3).



# 17-21. DIRECT CLUTCH ASSEMBLY REPAIR (4L80-E)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**
**e. Direct Clutch Piston Movement Measurement**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Clutch spring compressor (Appendix G, Item 47)
Adapter (Appendix G, Item 48)
Adapter (Appendix G, Item 45)
Seal protectors (Appendix G, Item 46)

**Manual References**
TM 9-2320-280-24P

**Materials/Parts**
Direct clutch seal (Appendix E, Item 211)
Inner piston seal (Appendix E, Item 216)
Outer piston seal (Appendix E, Item 217)
Transmission fluid (Appendix B, Item 24)

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**General Safety Instructions**
Air pressure must not exceed 80 psi (552 kPa) when air checking clutch piston.

**Maintenance Level**
General support

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

## a. Disassembly

1. Remove snapring (1), clutch retainer (2), and outer race (3) from direct clutch housing (5).
2. Remove sprag assembly (4) from direct clutch housing (5).
3. Remove snapring (6), backing plate (7), five clutch plate assemblies (8), clutch plates (10), and dished plate (9) (1995-1996 transmission only) from direct clutch housing (5).

**NOTE**

Piston removed in step 4 is for 1995-1996 transmissions only.

4. Using spring compressor, adapter, and clutch spring adapter, remove snapring (11), spring and retainer assembly (12), and piston (13) from clutch housing (5).

**NOTE**

Perform step 5 for 1995-1996 transmissions only.

5. Remove inner seal (14), outer seal (15), and direct clutch seal (16) from clutch housing (5). Discard seals (14), (15), and (16).

## b. Cleaning

Clean all direct clutch components in accordance with para. 2-13.

## c. Inspection

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect backing plate (7), five clutch plates (10), and dished plate (9) (1995-1996 transmission only) for signs of burning, scoring, or cracks. Replace any plate if burned, scored, or cracked.

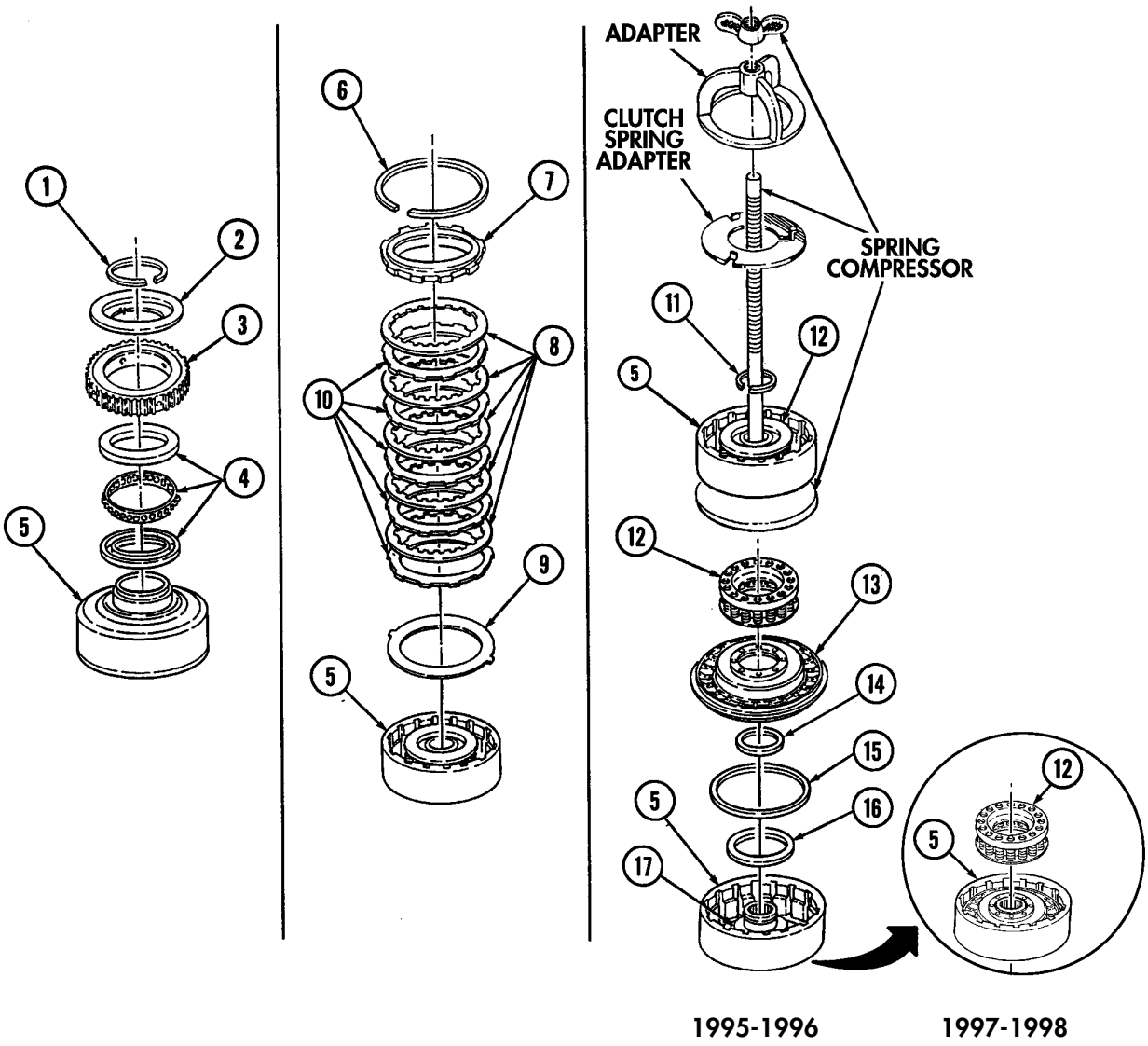
## 17-21. DIRECT CLUTCH ASSEMBLY REPAIR (4L80-E) (Cont'd)

2. Inspect snapring (1), backing plate snapring (6), spring and retainer assembly (12), and clutch retainer (2) for distortion or damage. Replace any if distorted or damaged.
3. Inspect sprag assembly (4) and outer race (3) for scoring, pitting, or damage. Replace any if scored, pitted, or damaged.

**NOTE**

Perform step 4 for 1995-1996 transmissions only.

4. Inspect piston (13) for distortion or damage. Replace if distorted or damaged.
5. Inspect spring and retainer assembly (12) for collapsed coils or distortion. Replace all if any are collapsed or distorted.
6. Inspect direct clutch housing (5) for damage. Replace if damaged.
7. Check for freeness of check ball (17) and ensure all oil passages in clutch housing (5) are open. Replace direct clutch housing (5) if check ball (17) is not free or oil passages are blocked.



## 17-21. DIRECT CLUTCH ASSEMBLY REPAIR (4L80-E) (Cont'd)

**d. Assembly**

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid (Dexron® III) before assembly. Foreign material will cause transmission damage.

**NOTE**

- For general assembly instructions, refer to para 2-16.
- Perform step 1 for 1995-1996 transmissions only.

1. With piston (2) facing up, install inner seal (3), outer seal (4), lip side down, and direct clutch seal (5), lip side up, into clutch housing (6).
2. Position seal protectors J38732-1 and J21362-1 on direct clutch housing (6).

**NOTE**

Perform step 2.1 for 1995-1996 transmissions only.

2.1. Install piston (2) using twisting motion until seated.

3. Using spring compressor and adapter, install spring and retainer assembly (1) on piston (2) with snapring (7).
4. Install sprag assembly (11) over rear hub of direct clutch housing (6).
5. Install outer race (10), groove side up, and clutch retainer (9) over sprag assembly (11) with snapring (8).
6. Check sprag assembly (11) to ensure it only turns clockwise and locks on housing (6) when turned counterclockwise.
7. Install dished plate (15) (1995-1996 transmission only), cupped surface toward piston (2), on direct clutch housing (6).
8. Install five clutch plates (16) and clutch plate assemblies (14) on clutch housing (6). Alternate plates, starting with a clutch plate (16).
9. Install backing plate (13) on housing (6) with snapring (12).

**e. Direct Clutch Piston Movement Measurement**

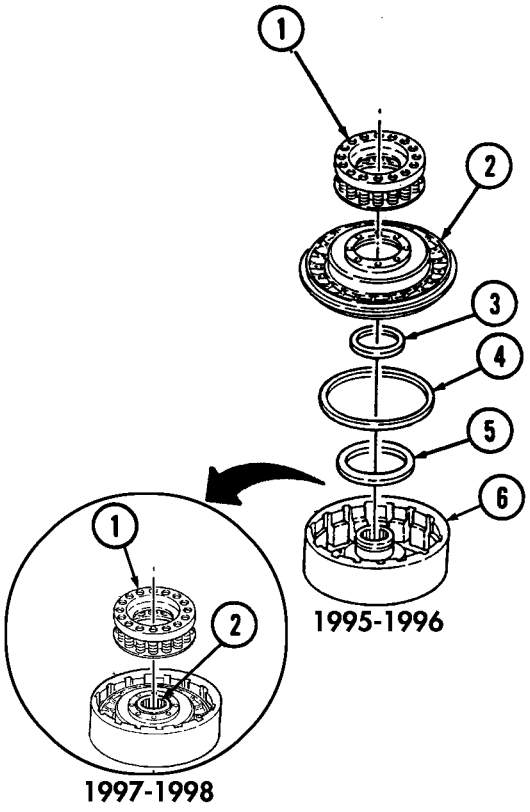
1. Set direct clutch assembly (17) on center support (18).
2. Set dial indicator to seat on direct clutch assembly (17).

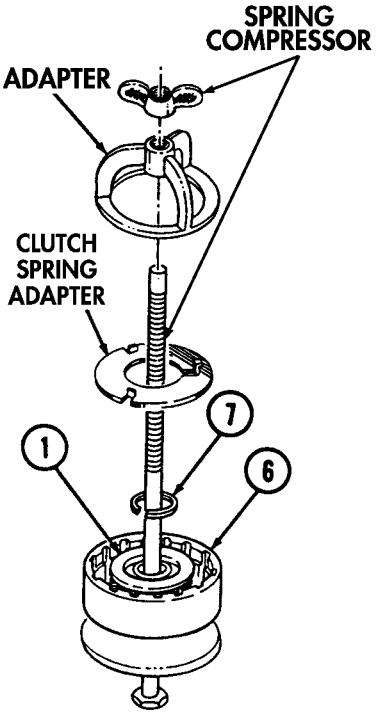
**WARNING**

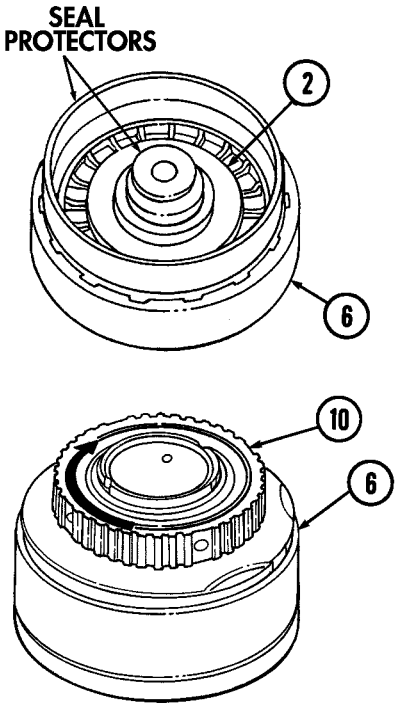
Air pressure must not exceed 80 psi (552 kPa) when air checking clutch piston.

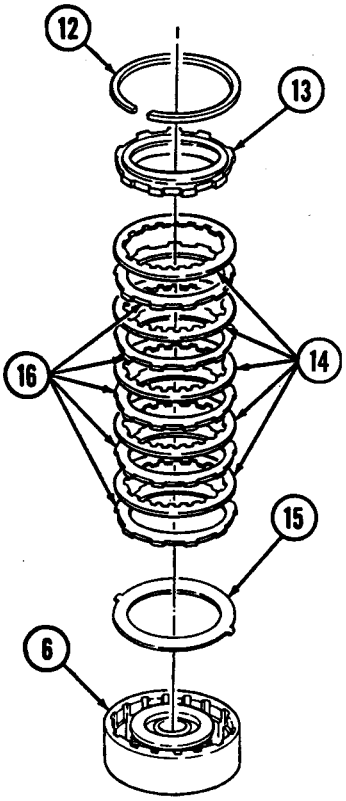
3. Apply 80 psi (552 kPa) of air pressure to direct clutch fluid passage (20) in center support (18) only. Do not apply air pressure to reverse passage (19), air will vent out normally.
4. Piston should move to compress clutch plates. Travel should be 0.121-0.186 in. (3.07-4.72 mm).
5. If correct measurement is read, remove direct clutch assembly (17) from center support (18).
6. If incorrect measurement is read, check clutch plates (16) and (14) for proper installation. Replace all clutch plates if damaged.

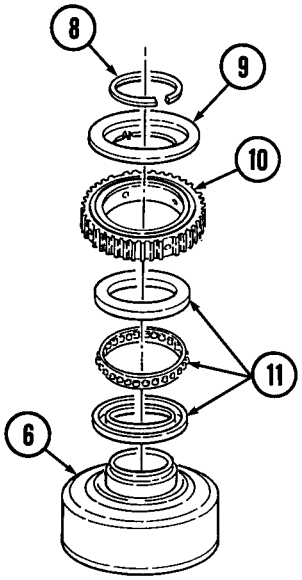
## 17-21. DIRECT CLUTCH ASSEMBLY REPAIR (4L80-E) (Cont'd)

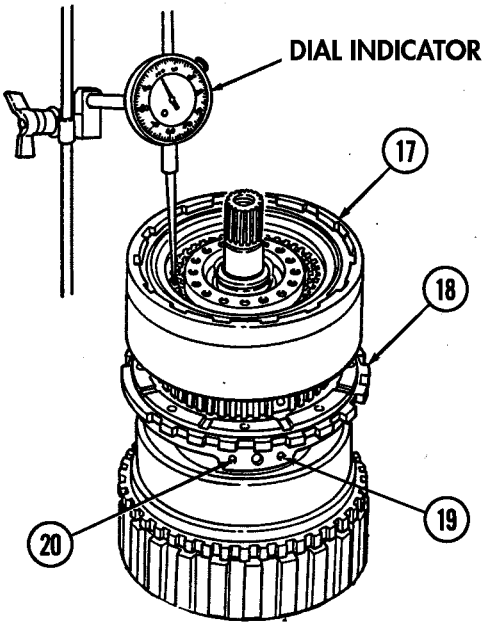


## 17-22. FORWARD CLUTCH ASSEMBLY REPAIR (4L80-E)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Clutch compressor (Appendix G, Item 47)
Adapter (Appendix G, Item 48)
Seal protectors (Appendix G, Item 46)

**Materials/Parts**
Inner seal (Appendix E, Item 213)
Outer seal (Appendix E, Item 220)
Seal (Appendix E, Item 204)

**Materials/Parts (Cont'd)**
Petrolatum (Appendix B, Item 38)
Transmission fluid (Appendix B, Item 24)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**General Safety Instructions**
Air pressure must not exceed 80 psi (552 kPa) when air checking clutch piston.

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

1. Remove snapring (1) and direct clutch driving hub (2) from forward clutch housing (7).
2. Remove forward clutch hub (4), thrust washer (3), and bearing washer (4.1) from direct clutch driving hub (2).
3. Remove five clutch plates (8), clutch plate assemblies (5), and dished clutch plate (6) (1995-1996 transmission only) from forward clutch housing (7).
4. Using spring compressor, adapter, and clutch spring adapter, compress spring and retainer assembly (10) and remove snapring (9) from forward clutch housing (7).
5. Remove spring and retainer assembly (10) from forward clutch housing (7).

**NOTE**

Perform steps 6, 7, and 8 for 1995-1996 transmissions only.

6. Remove piston (11) from forward clutch housing (7).
7. Remove inner and outer seals (12) and (13) from piston (11). Discard seals (12) and (13).
8. Remove seal (14) from clutch housing (7). Discard seal (14).

### b. Cleaning

Clean all forward clutch components in accordance with para. 2-13.

### c. Inspection

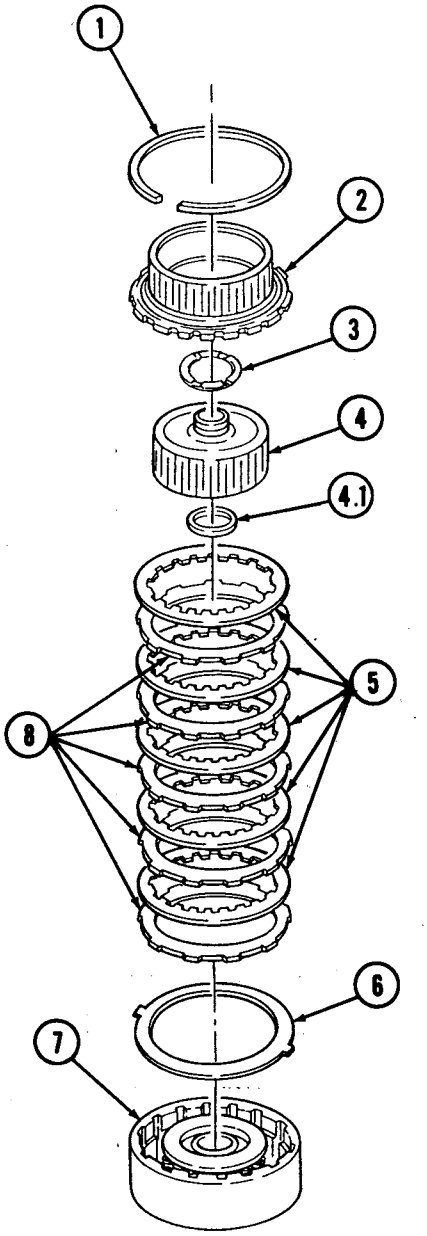
**NOTE**

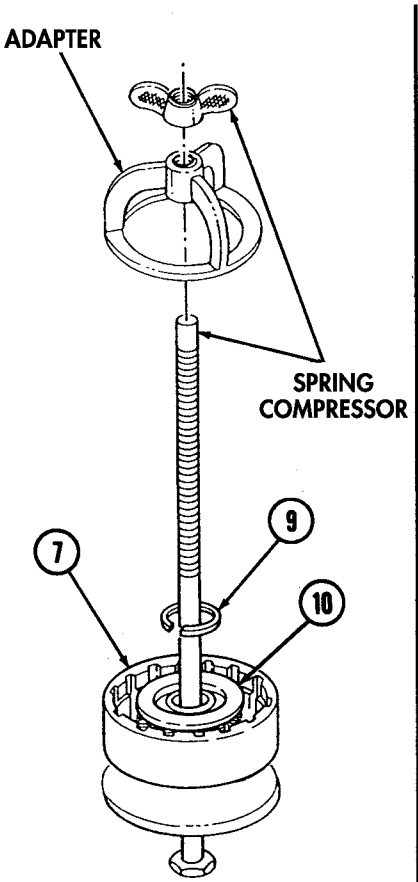
For general inspection instructions, refer to para. 2-14.

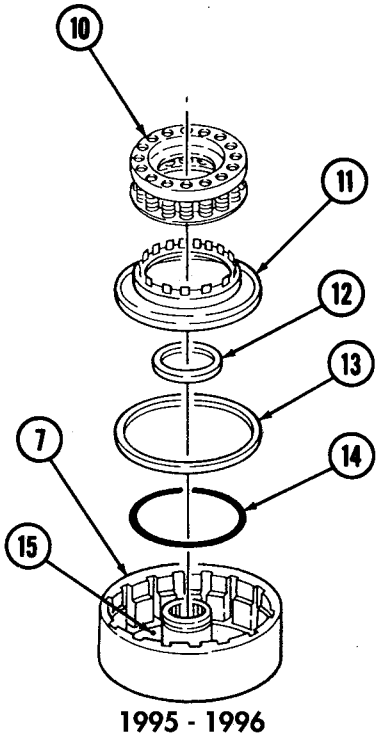
1. Inspect five clutch plates (8) for signs of burning, scoring, or cracks. Replace any that are burned, scored, or cracked.

## 17-22. FORWARD CLUTCH ASSEMBLY REPAIR (4L80-E)(Cont'd)

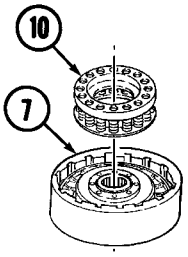
2. Inspect thrust washer (3), bearing washer (4.1), spring and retainer assembly (10), and snapring (9) for distortion or damage. Replace any if distorted or damaged.
3. Inspect forward clutch hub (4) and direct clutch hub (2) for damage. Replace either if damaged.
4. Inspect piston (11) for distortion or damage. Replace if distorted or damaged.
5. Inspect spring and retainer assembly (10) for collapsed coils or distortion. Replace if distorted or damaged.
6. Inspect clutch housing (7) for damage. Replace if damaged.
7. Check for freeness of check ball (15) in clutch housing (7), and that all oil passages are open. Replace forward clutch assembly if check ball (15) is not free or if oil passages are blocked.




1995 - 1996




1997 - 1998

## 17-22. FORWARD CLUTCH ASSEMBLY REPAIR (4L80-E) (Cont'd)

**d. Assembly**

**CAUTION**

- All transmission parts must be lubricated with clean transmission fluid (Dexron® III) before assembly. Foreign material will cause transmission damage.
- Perform steps 1 and 2 for 1995-1996 transmissions only.

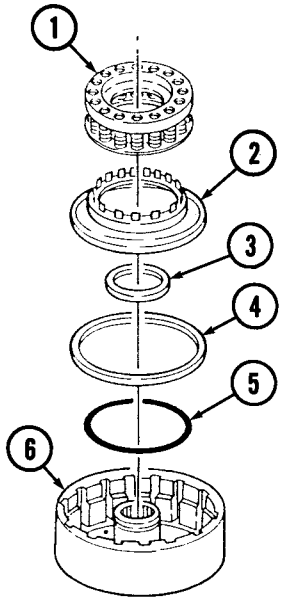
1. Install inner seal (3) and outer seal (4) on piston (2), with lips of seals facing down toward housing (6).
2. Install seal (5) on forward clutch housing (6), with lip of seal facing up.
3. Install seal protectors over clutch housing (6).
4. Install piston (2) on forward clutch housing (6). Twist slightly to ensure piston (2) seats on housing (6).
5. Using spring compressor and adapter, install spring and retainer assembly (1) on piston (2) and forward clutch housing (6) and secure with snapring (7).
6. Install dished clutch plate (13) (1995-1996 transmissions only), concave side toward piston, on forward clutch housing (6).
7. Starting with a clutch plate (14), install five clutch plates (14) and clutch plate assemblies (12) on clutch housing (6).
8. Install direct clutch driving hub (9) in forward clutch housing (6) with snapring (8).
9. Install forward clutch housing (6) on turbine shaft (15).
10. Set up dial indicator to measure piston (2) movement with direct clutch driving hub (9).

**WARNING**

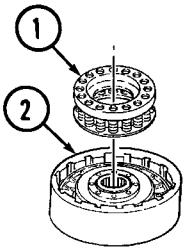
Air pressure must not exceed 80 psi (552 kPa) when air checking clutch piston.

11. Apply 80 psi (552 kPa) of air pressure to hole "A" on forward clutch assembly (6). Piston (2) should move 0.121-0.186 in. (3.07-4.27 mm).
12. Remove turbine shaft (15), snapring (8), and direct clutch driving hub (9) from forward clutch housing (6).
13. Install thrust washer (10) inside forward clutch hub (11) and bearing washer (11.1) outside forward clutch hub (11) and retain with petrolatum.
14. Install clutch hub (11) on forward clutch housing (6).
15. Install direct clutch driving hub (9) on forward clutch housing (6) with snapring (8).

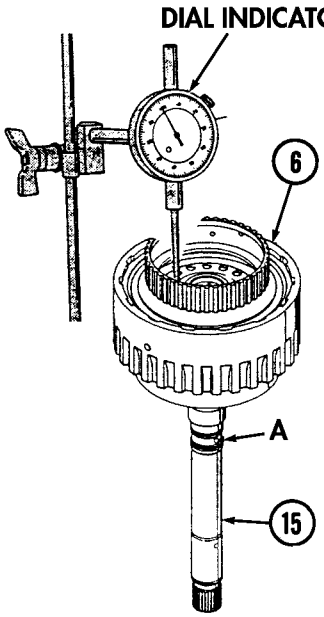
## 17-22. FORWARD CLUTCH ASSEMBLY REPAIR (4L80-E)(Cont'd)

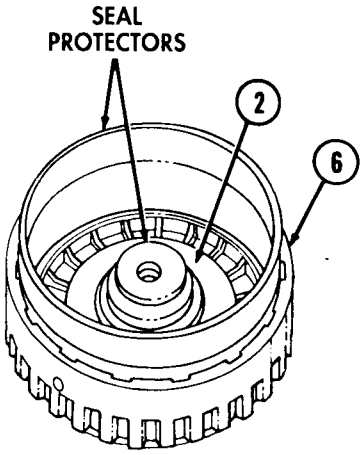


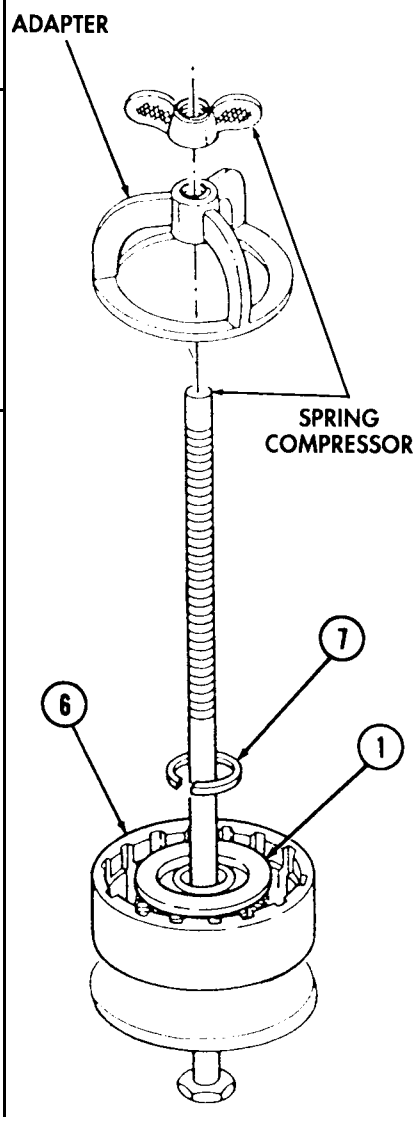

1995 - 1996

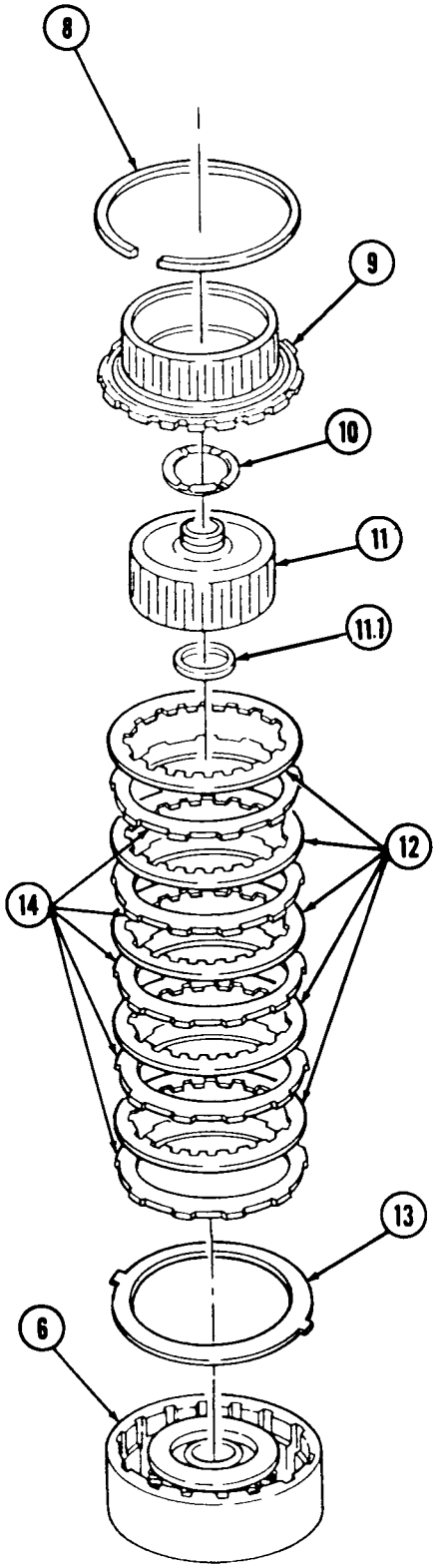



1997 - 1998



## 17-23. FOURTH CLUTCH ASSEMBLY REPAIR (4L80-E)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**
**e. End Play Measurement**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Seal protectors (Appendix G, Item 46)

**Materials/Parts**
O-ring (Appendix E, Item 142)
O-ring (Appendix E, Item 145)

**Materials/Parts (Cont'd)**
Petrolatum (Appendix B, Item 38)
Transmission fluid (Appendix B, Item 24)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Maintenance Level**
General support

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

1. Remove snapring (1), backing plate (11), four clutch plates (9), and clutch plate assemblies (10) from clutch housing (4).
2. Remove snapring (8) and spring and retainer assembly (7) from clutch housing (4).
3. Remove piston (3) from clutch housing (4).
4. Remove O-ring (2) from piston (3) and O-ring (6) from housing (4). Discard O-rings (2) and (6).

### b. Cleaning

Clean all components in accordance with para. 2-13.

### c. Inspection

1. Inspect piston (3), backing plate (11), and clutch housing (4) for cracks, breaks, and damaged seal ring grooves. Replace any that are cracked, broken, or damaged.
2. Inspect plug (5). If missing, replace clutch housing (4).

### d. Assembly

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid (Dexron® III) before assembly. Foreign material will cause transmission damage.

1. Install O-ring (2) on piston (3), with lip facing toward spring and retainer assembly (7) side.
2. Install O-ring (6) on housing (4), with lip facing away from spring and retainer assembly (7) side.
3. Place inner seal protector J38731-1 on clutch housing (4).
4. Place outer seal protector J38731-2 on piston (3).
5. Position piston (3) on base J38731-3 with snapring groove of piston (3) up.
6. Place housing (4) over piston (3) while holding inner seal protector in position.

**17-23. FOURTH CLUTCH ASSEMBLY REPAIR (4L80-E) (Cont'd)**

7. With both hands and a firm grip on the outside of housing (4), push down on housing (4) until the inner piston (3) protrudes through the center.
8. Place spring and retainer assembly (7) and snapring (8) over piston (3) keeping the housing (4) on base J38731-3.
9. Compress spring and retainer assembly (7) and install snapring (8).

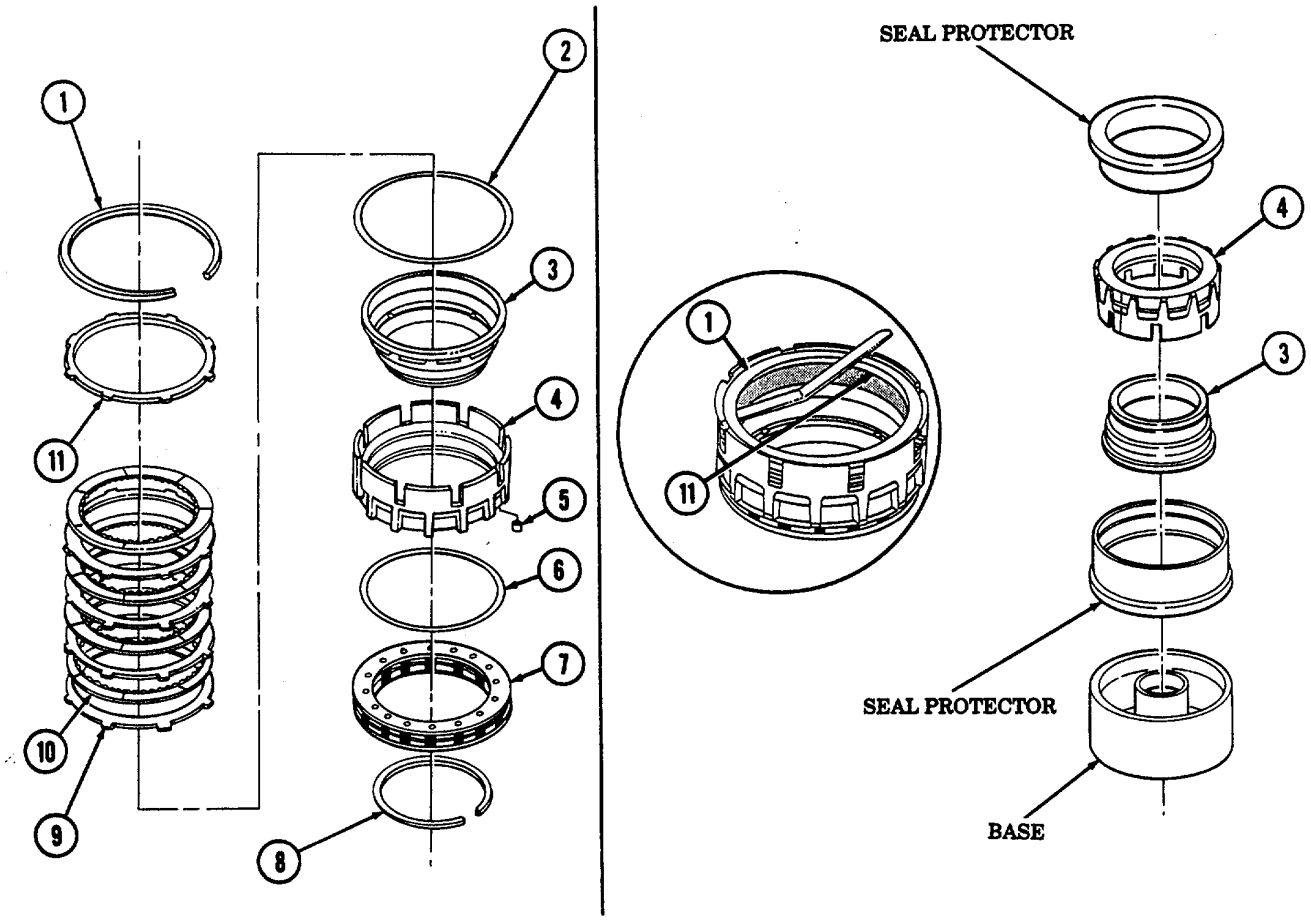
**NOTE**

Clutch plate index notch is opposite fourth clutch assembly bolt hole in housing.

10. Turn housing (4) over and install four clutch plates (9), clutch plate assemblies (10), and backing plate (11). Start with clutch plate (9). Backing plate (11) must have flat side down.
11. Secure backing plate (11), clutch plates (9), and clutch plate assemblies (10) to housing (4) with snapring (1).

**e. End Play Measurement**

1. Place fourth clutch assembly (4) on bench with spring and retainer assembly.(7) facing down.
2. Press lightly on backing plate (11) and measure gap between snapring (1) and backing plate (11). Measurement should be 0.040-0.100 in. (1.016-2.540 mm). If not, check for correct clutch plate pack or replace worn clutch plate pack.



## 17-24. TURBINE SHAFT AND OVERDRIVE CARRIER ASSEMBLY REPAIR (4L80-E)

**This task covers:**

**a. Overdrive Unit Disasssembly**
**b. Overrun Clutch Disassembly**
**c. Overrun Clutch Cleaning**
**d. Overrun Clutch Inspection**
**e. Overrun Clutch Assembly**
**f. Overdrive Carrier Measurement**
**g. Overdrive Carrier Cleaning**
**h. Overdrive Carrier Inspection**
**i. Turbine Shaft Inspection**
**j. Overdrive Unit Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)
Dial indicator (Appendix G, Item 95)

**Special Tools**
Spring compressor (Appendix G, Item 47)
Adapter (Appendix G, Item 45)
Seal installer (Appendix G, Item 50)

**Materials/Parts**
Two plain seals (Appendix E, Item 223)
Two plain seals (Appendix E, Item 224)
Transmission fluid (Appendix B, Item 24)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Maintenance Level**
General support

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

### a. Overdrive Unit Disassembly

1. Remove snapring (1) and turbine shaft (4) from overdrive carrier assembly (2).
2. Remove four seals (5) from shaft (4). Discard seals (5).
3. Separate overdrive carrier assembly (2) from overrun clutch housing assembly (3).

### b. Overrun Clutch Disassembly

1. Remove snapring (6), backing plate (7), three clutch plates (12), and clutch plate assemblies (8) from clutch housing (3).
2. Using spring compressor and adapter, compress spring and retainer assembly (10) and remove snapring (9).
3. Remove spring compressor and adapter, spring and retainer assembly (10), and piston (11) from housing (3).

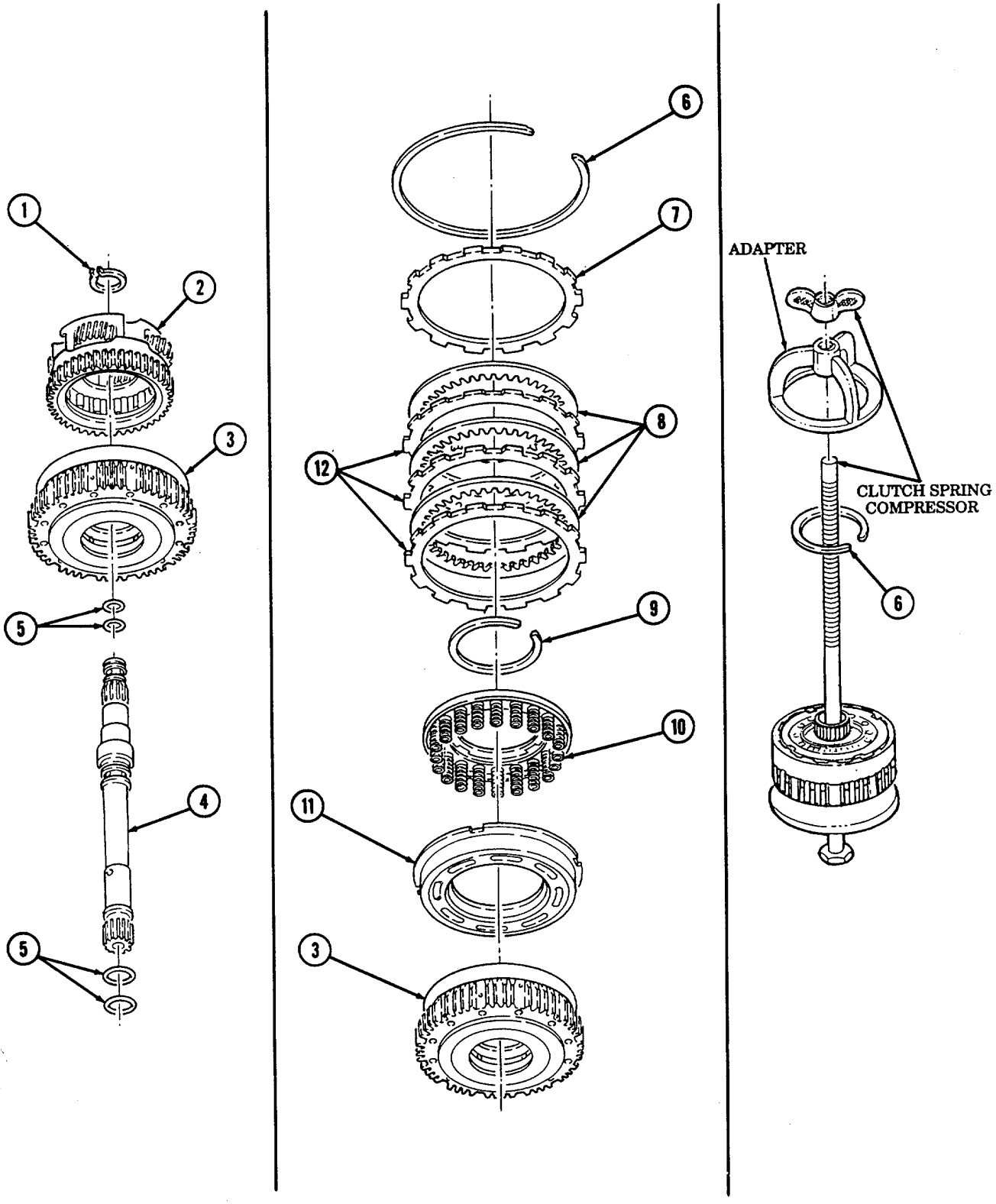
### c. Overrun Clutch Cleaning

Clean all overrun clutch components, except piston (11), in accordance with para. 2-13.

### d. Overrun Clutch Inspection

1. Inspect all clutch plates (12) and (8) for cracks, breaks, scoring, pitting, and evidence of overheating or composition wear. Replace clutch plates (12) and clutch plate asssemblies (8) as a set if any are damaged.
2. Inspect backing plate (7) for cracks, warpage, and scoring. Remove minor scoring. Replace plate (7) if damaged.
3. Inspect spring and retainer assembly (10) for cracks, breaks, and uneven or damaged springs. Replace spring if damaged.
4. Inspect piston (11) for crack or damage. Replace piston (11) if damaged.
5. Inspect housing (3) for cracks, chips, scored or burned thrust faces, and plugged holes. Unplug holes. Replace if damaged.

## 17-24. TURBINE SHAFT AND OVERDRIVE CARRIER ASSEMBLY REPAIR (4L80-E) (Cont'd)



## 17-24. TURBINE SHAFT AND OVERDRIVE CARRIER ASSEMBLY REPAIR (4L80-E) (Cont'd)

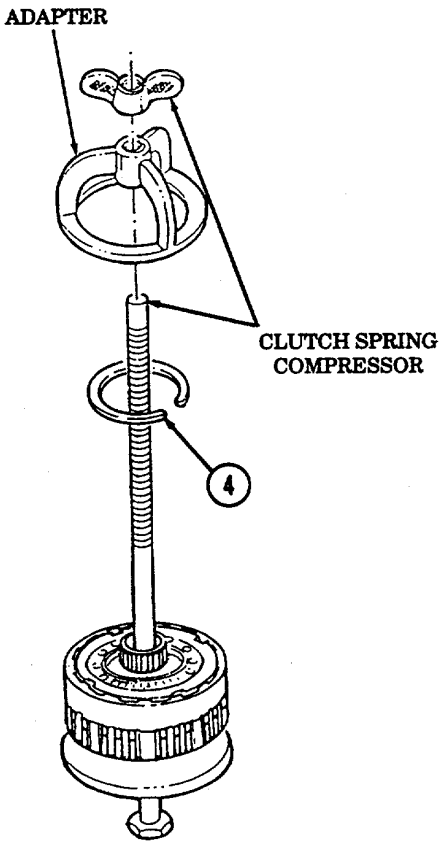
### e. Overrun Clutch Assembly

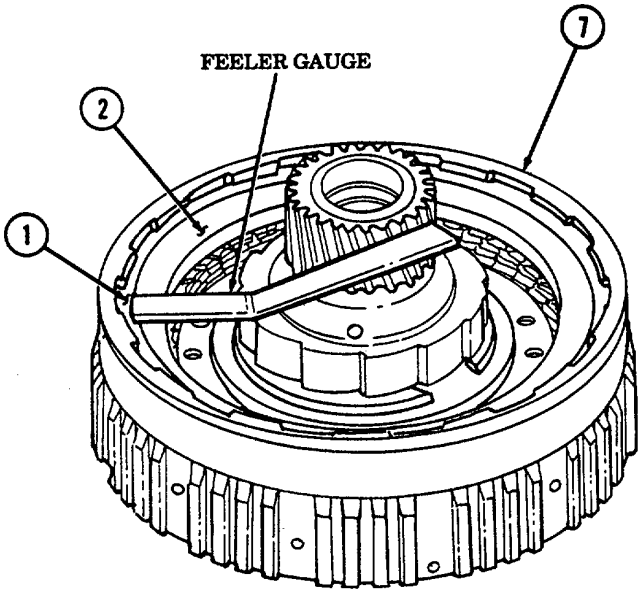
**CAUTION**

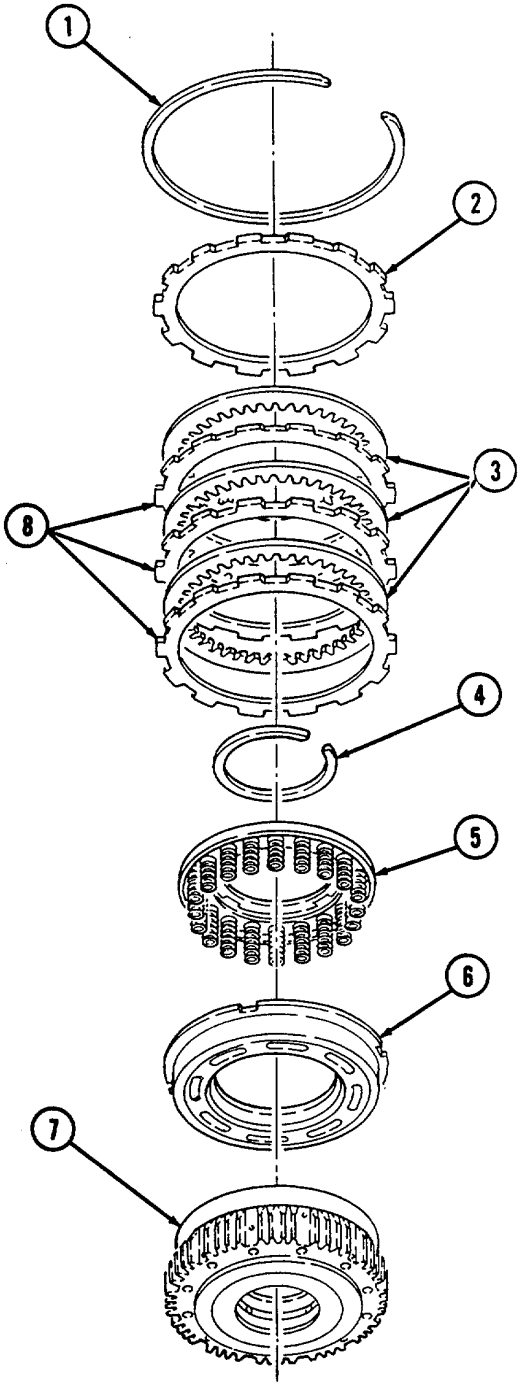
All transmission parts must be lubricated with clean transmission fluid (Dexron III) before assembly. Foreign material will cause transmission damage.

1. Install piston (6) on clutch housing (7) and rotate piston (6) while seating in housing (7).
2. Using spring compressor and adapter, install spring and retainer assembly (5) on housing (7) and secure with snapring (4).
3. Starting with clutch plate (8), install three clutch plates (8) alternately with clutch plate assemblies (3) in housing (7).
4. Install backing plate (2) over clutch plate assembly (3) and secure with snapring (1).
5. Measure gap between snapring (1) and backing plate (2). Gap should be 0.033-0.094 in. (0.838-2.388 mm). If not, check assembly of clutch plate pack (8) or replace clutch plate pack (8).

## 17-24. TURBINE SHAFT AND OVERDRIVE CARRIER ASSEMBLY REPAIR (4L80-E) (Cont'd)



## 17-24. TURBINE SHAFT AND OVERDRIVE CARRIER ASSEMBLY REPAIR (4L80-E) (Cont'd)

### f. Overdrive Carrier Measurement

1. Set dial indicator to read pinion gear (1) end play.
2. Lift pinion gear (1) and read movement from dial indicator. Normal end freeplay is 0.009-0.024 in. (0.229-0.610 mm). If not, replace overdrive carrier assembly (6).

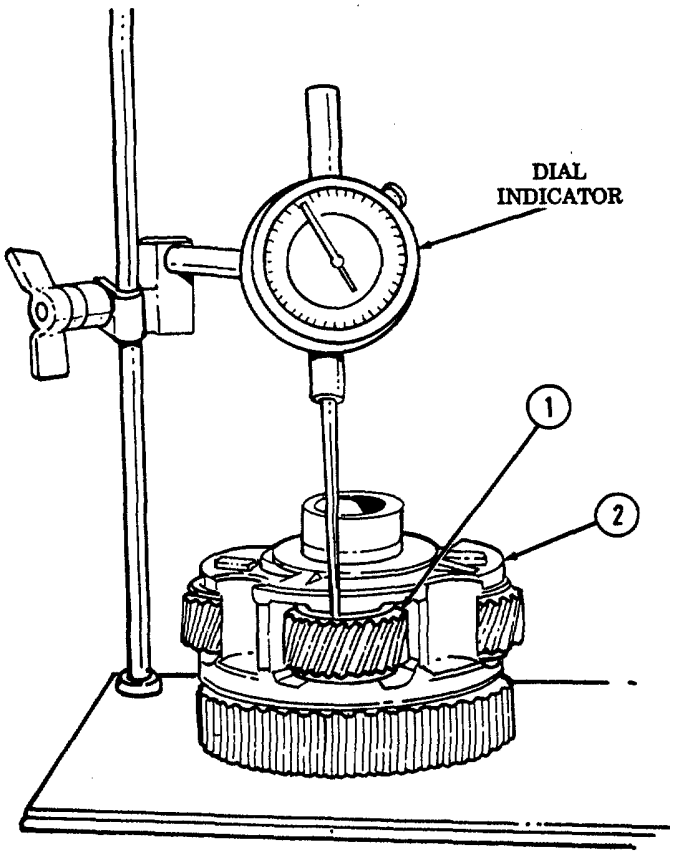
### g. Overdrive Carrier Cleaning

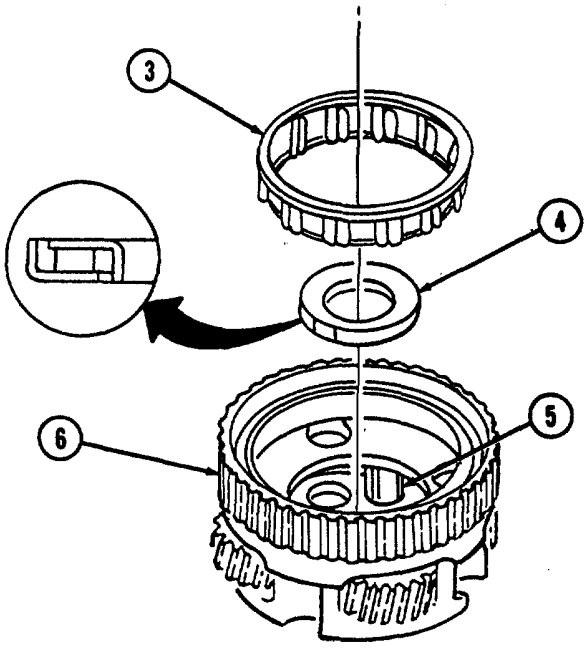
Clean all components in accordance with para. 2-13.

### h. Overdrive Carrier Inspection

1. Inspect pinion gears (1) surfaces for scoring or burrs. Remove minor burrs. Replace overdrive carrier assembly (6) if damaged.
2. Inspect pinion gears (1) for damaged teeth and scored or damaged bearing bore. Replace overdrive carrier assembly (6) if damaged.
3. Inspect roller clutch assembly (3) for cracked, or broken rollers or cage, and scoring. Replace roller clutch assembly (3) if damaged.
4. Inspect bearing assembly (4) for damage. Replace if damaged.
5. Inspect carrier (6) for cracks, breaks, or scoring on finished thrust surfaces. Remove minor scoring. Replace overdrive carrier assembly (6) if damaged.
6. Inspect pinion pins (5) and pinion pin retainer (2) for looseness and drainage. Replace overdrive carrier assembly (6) if loose or damaged.

**17-24. TURBINE SHAFT AND OVERDRIVE CARRIER ASSEMBLY REPAIR (4L80-E) (Cont'd)**



## 17-24. TURBINE SHAFT AND OVERDRIVE CARRIER ASSEMBLY REPAIR (4L80-E) (Cont'd)

### i. Turbine Shaft Inspection

1. Ensure that checkball (3) on end of shaft (2) is present. Replace shaft (2) if checkball (3) is missing.
2. Inspect shaft (2) for broken or twisted splines, cracks, and plugged oil passages. Clear oil passages. Replace shaft (2) if damaged.

### j. Overdrive Unit Assembly

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid (Dexron III) before assembly. Foreign material will cause transmission damage.

**NOTE**

- Steps 1 through 4 apply to one end of shaft. Repeat these steps using different size tools for opposite end of shaft.
- Use small chamfer end of sizer to do the lower seal. Use larger chamfered end to size all other seals.
- Install the inner seal ring first, then the outer ring.

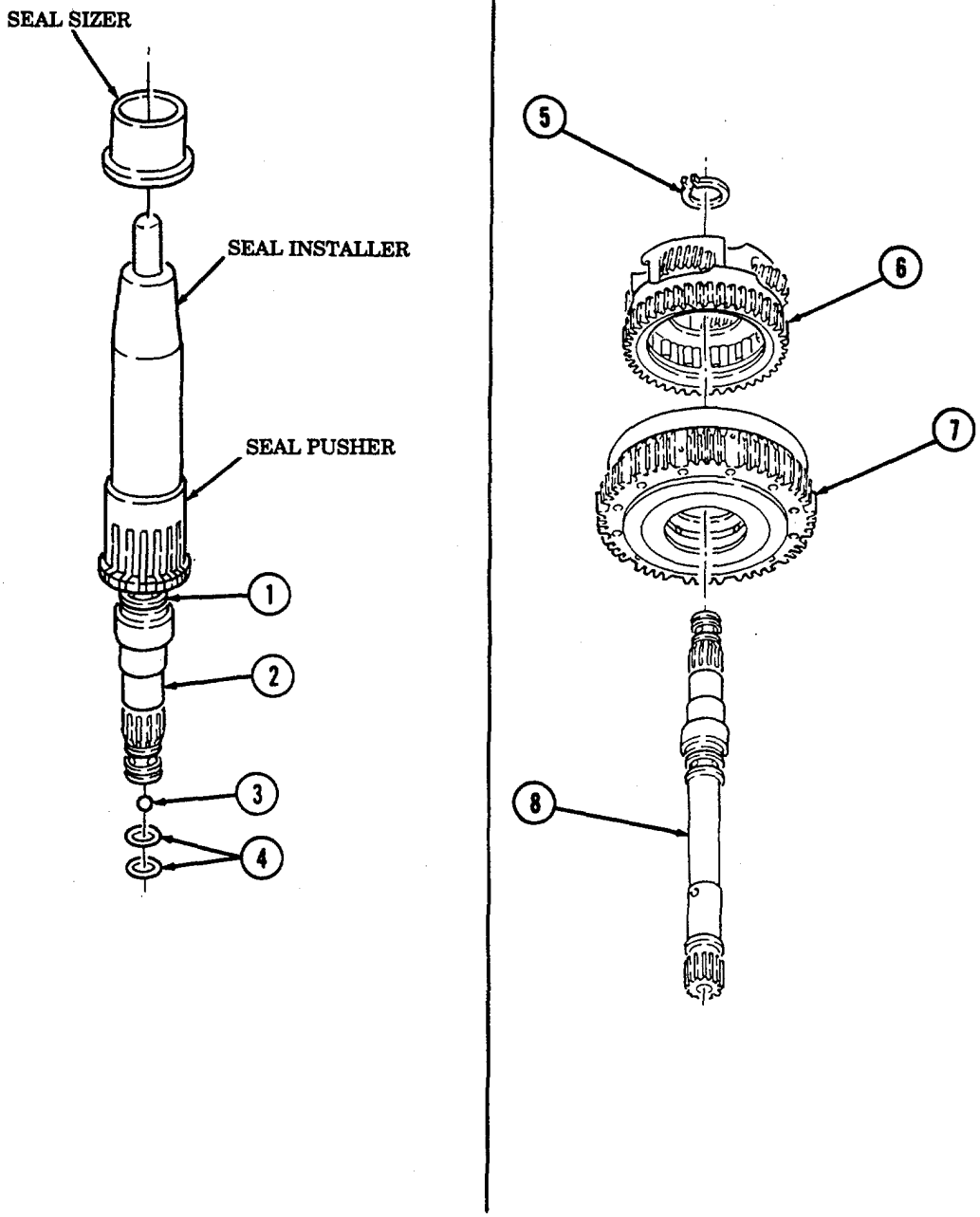
1. Place seal installer J38736-1 on shaft (2).
2. Using seal pusher J38736-5, push inner seal ring (1) over and down the installer until in place. Repeat step for outer ring (1).
3. Remove seal pusher and installer.

**NOTE**

Sizer must remain on seal for 5 minutes.

4. Place seal sizer J38736-3 over shaft (2) and size seal rings (1) in place.
5. Repeat steps 1 through 4 for inner and outer seal rings (4).
6. Place carrier assembly (6) in overrun clutch housing (7). Rotate carrier (6) during assembly to align clutch plate assembly teeth.
7. Install turbine shaft (8) through housing (7) and overdrive carrier assembly (6), and secure with snapring (5).

## 17-24. TURBINE SHAFT AND OVERDRIVE CARRIER ASSEMBLY REPAIR (4L80-E) (Cont'd)



# 17-25. INTERMEDIATE CLUTCH ASSEMBLY AND FRONT BAND REPAIR (4L80-E)

**This task covers:**

**Inspection**

**INITIAL SETUP:**

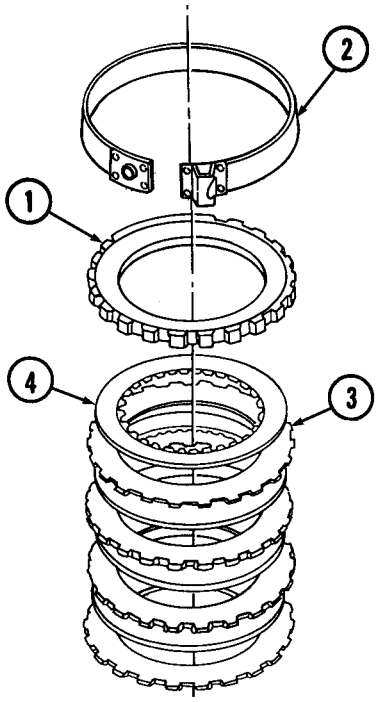
| Applicable Models | Equipment Condition |
|---|---|
| M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123 | Transmission disassembled into subassemblies (para. 17-14). |
| **Manual References** | **Maintenance Level** |
| TM 9-2320-280-24P | General support |

**Inspection**

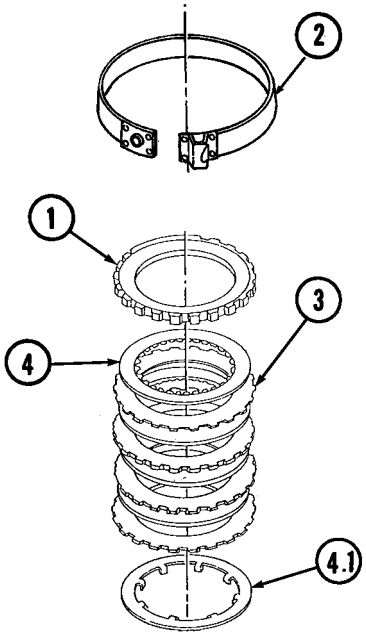
**NOTE**

- Intermediate clutch plates, backing plate, and front band were removed during disassembly. Inspect clutch plates only if they will be reused.
- Work area should be well-ventilated, clean, and free from blowing dirt and dust.
- Replaced damaged plates as a set.
- Wave plate is used on 1997-1998 transmissions only.

1. Inspect wave plate (4.1), four clutch plates (3), and clutch plate assemblies (4) for cracks, wear, evidence of overheating and scoring.
2. Inspect backing plate (1) for cracks, breaks, scoring, and evidence of overheating. Replace if damaged.
3. Inspect front band (2) for cracks, loose or damaged anchor or pin ends, and worn or burned composition material. Replace if damaged.




1995 - 1996




1997 - 1998

## 17-26. FRONT SERVO REPAIR (4L80-E)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Appblicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Maintenance Level**
General support

**NOTE**

Work area should be well ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

1. Remove spring retainer (4) and piston (3) from pin (1).
2. Remove seal (2) from piston (3).

### b. Cleaning

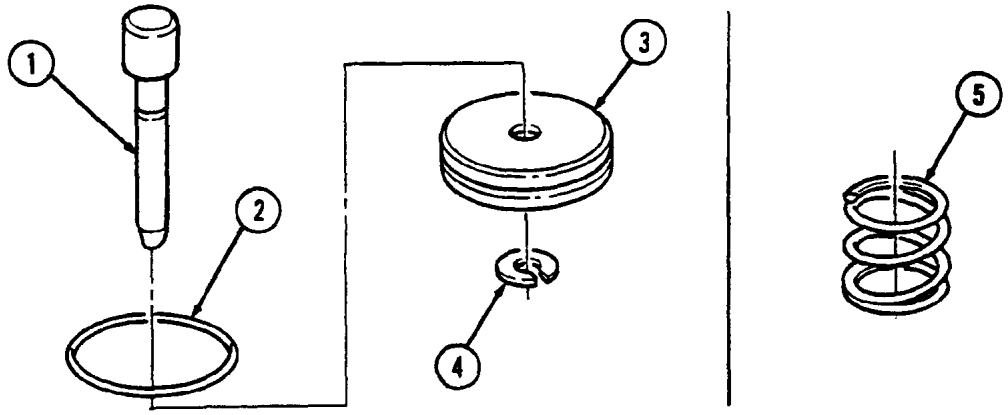
Clean all components in accordance with para. 2-13.

### c. Inspection

1. Inspect front servo piston (3) for cracks and broken seal groove. Replace if damaged.
2. Inspect piston pin (1) for cracks, bends, and damaged snapring groove. Replace if damaged.
3. Inspect spring (5) for breaks and distortion. Replace if damaged.

### d. Assembly

1. Coat seal (2) with oil soluble grease and install seal (2) on piston (3).
2. Install pin (1) on piston (3) and secure with spring retainer (4).



## 17-27. REAR SERVO REPAIR (1995 - 4L80-E)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2
M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Transmission fluid (Appendix B, Item 24)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Maintenance Level**
General support

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

1. Remove retainer clip (1) from pin (8) in servo piston (10).
2. Remove accumulator piston (3), spacer (5), servo spring (6), and spring retainer (7) from pin (8).

### b. Cleaning

Clean all parts in accordance with para. 2-13.

### c. Inspection

1. Inspect pistons (3) and (10) for cracks, porosity, and damaged seal grooves. Remove minor burrs and scoring. Replace if damaged.
2. Inspect spring (6) for breaks and distortion. Replace if damaged.
3. Inspect pin (8) for cracks, burrs, bends, and chipped or damaged retainer groove. Replace if damaged.
4. Inspect outer oil seal (9) for nicks, cuts, or damage. Replace seal (9) if nicked, cut, or damaged.

**NOTE**

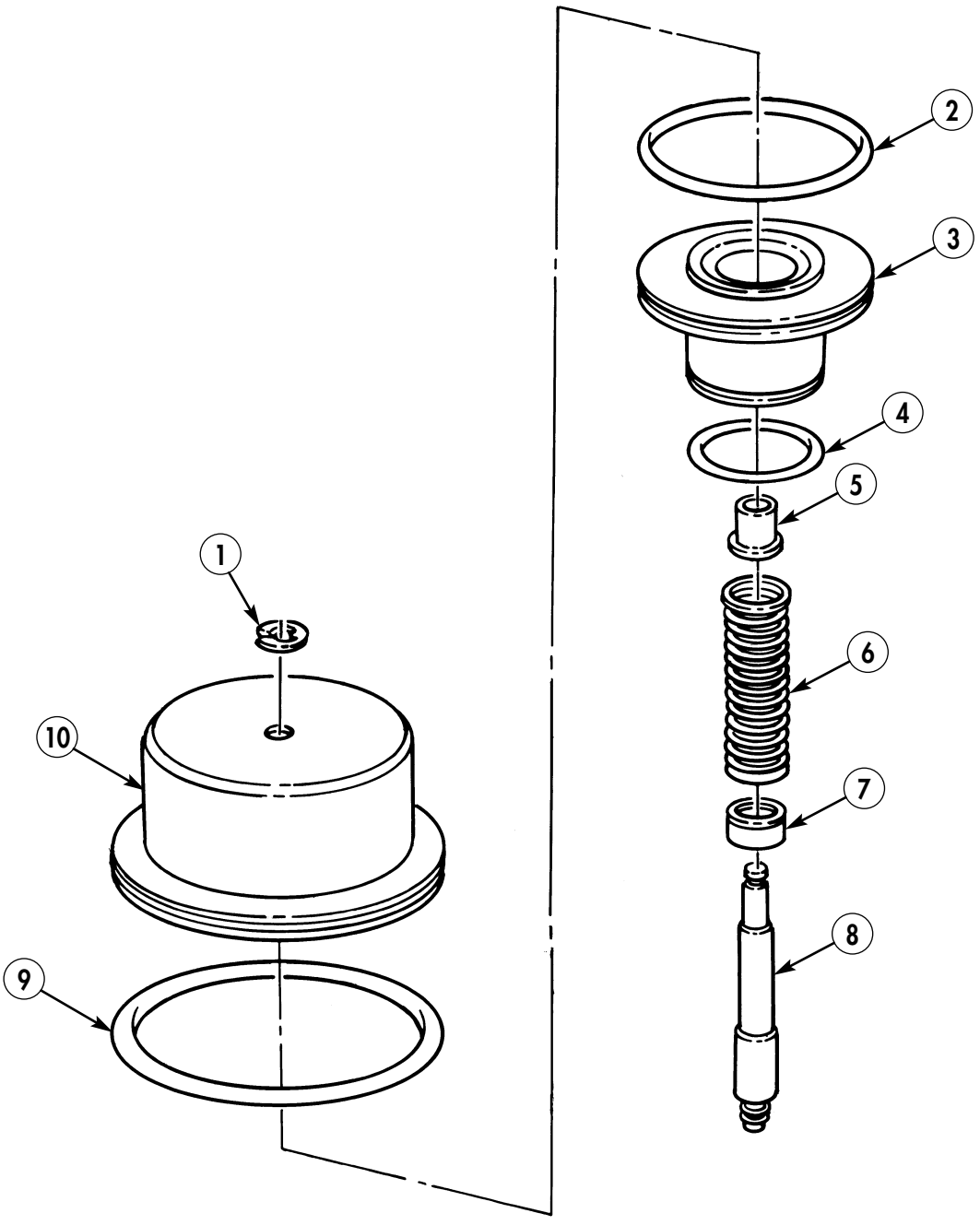
If replacing any seal, coat seal with transmission fluid (Dexron® III).

5. Inspect inner seal (2) and piston seal (4) for nicks, cuts, or damage. Replace inner seal (2) and piston seal (4) if nicked, cut, or damaged.

### d. Assembly

1. Install spring retainer (7), rear servo spring (6), spacer (5), and pin (8) on servo piston (10) and accumulator piston (3) with retaining clip (1).
2. Install accumulator piston (3) in servo piston (10).

## 17-27. REAR SERVO REPAIR (1995 - 4L80-E) (Cont'd)



## 17-27.1. REAR SERVO REPAIR (1996-1998 - 4L80-E)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2
M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Materials/Parts**
Transmission fluid (Appendix B, Item 24)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Maintenance Level**
General support

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

**a. Disassembly**

1. Remove retainer clip (12) from pin (9) in servo piston (11).
2. Remove assist spring (2), accumulator piston (4), spacer (6), rear servo spring (7), and spring retainer (8) from pin (9).

**b. Cleaning**

Clean all parts in accordance with para. 2-13.

**c. Inspection**

1. Inspect pistons (4) and (11) for cracks, porosity, and damaged seal grooves. Remove minor burrs and scoring. Replace if damaged.
2. Inspect rear servo spring (7) and assist spring (2) for breaks and distortion. Replace if damaged.
3. Inspect pin (9) for cracks, burrs, bends, and chipped or damaged retainer groove. Replace if damaged.
4. Inspect outer oil seal (10) for nicks, cuts, or damage. Replace seal (10) if nicked, cut, or damaged.

**NOTE**

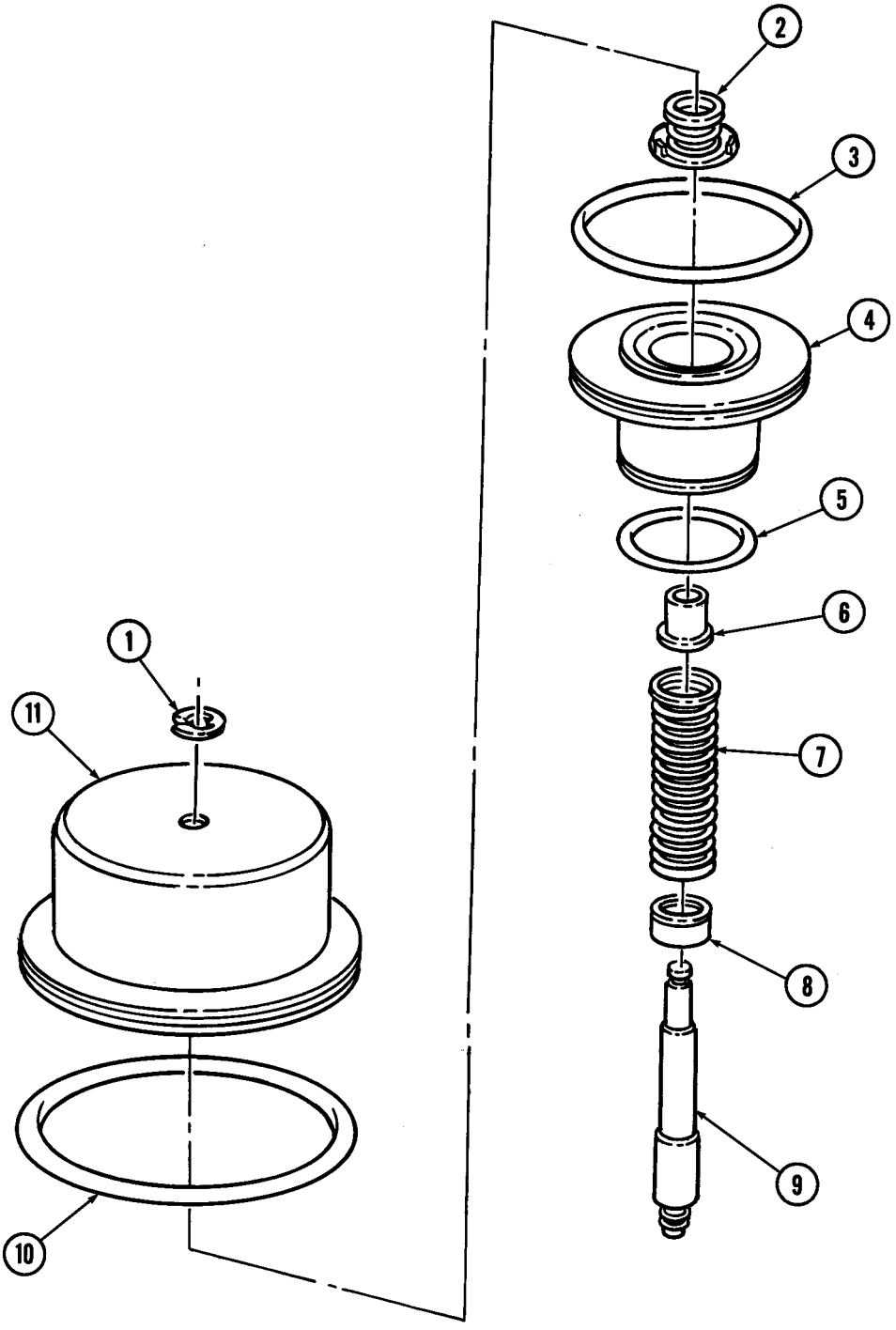
If replacing any seal, coat seal with transmission fluid (Dexron® III).

5. Inspect inner seal (3) and piston seal (5) for nicks, cuts, or damage. Replace inner seal (3) and piston seal (5) if nicked, cut, or damaged.

**d. Assembly**

1. Install spring retainer (8), rear servo spring (7), spacer (6), and accumulator piston (4) on pin (9).
2. Install accumulator piston (4) and assist spring (2) into servo piston (11) and install retaining clip (1) on pin (9).

## 17-27.1. REAR SERVO REPAIR (1996-1998 - 4L80-E) (Cont'd)



# 17-28. CONTROL VALVE AND ACCUMULATOR HOUSING REPAIR (4L80-E)

**This task covers:**

**a. Accumulator Housing Cleaning**
**b. Accumulator Housing Disassembly**
**c. Control Valve Disassembly**
**d. Control Valve Cleaning**
**e. Control Valve Inspection**
**f. Control Valve Assembly**
**g. Accumulator Housing Inspection**
**h. Accumulator Housing Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Gasket kit (Appendix E, Item 40)
Preformed packing (Appendix E, Item 184)
Two preformed packings (Appendix E, Item 185)
Preformed packing (Appendix E, Item 186)
Petrolatum (Appendix B, Item 38)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Maintenance Level**
General support

**CAUTION**

Do not use a honing stone, fine sandpaper, or crocus cloth to clean a valve. Use micro fine lapping compound 900 grit (J384-59).

**NOTE**

Work area should be well-ventilated, clean, and free from blowing dirt and dust.

## a. Accumulator Housing Cleaning

1. Clean control valve assembly (8) and accumulator housing (2) thoroughly in solvent.
2. Air dry control valve assembly (8).

## b. Accumulator Housing Disassembly

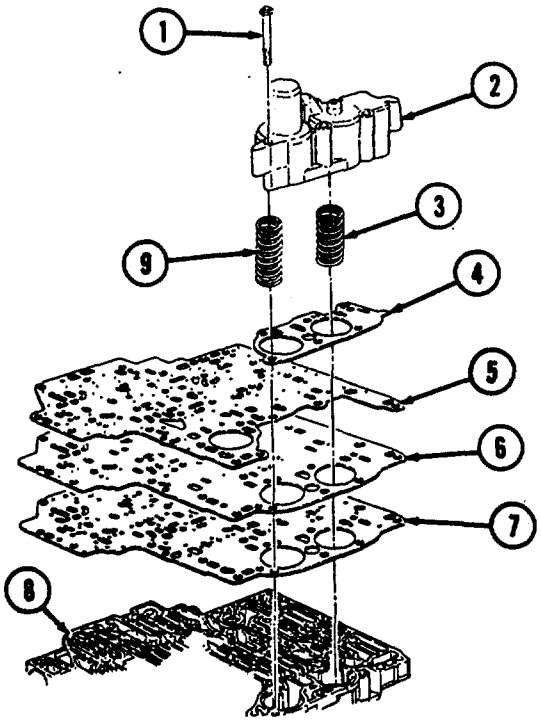
1. Remove six capscrews (1) from accumulator housing (2) and control valve assembly (8).
2. Remove accumulator housing (2), gasket (4), and springs (3) and (9) from control valve assembly (8). Discard gasket (4).
3. Remove gasket (5), spacer plate (6), and gasket (7) from control valve assembly (8). Discard gaskets (7) and (5).
4. Remove snapring (10) from pin (16) on the outside housing, and remove fourth clutch piston assembly (15) from housing (2).

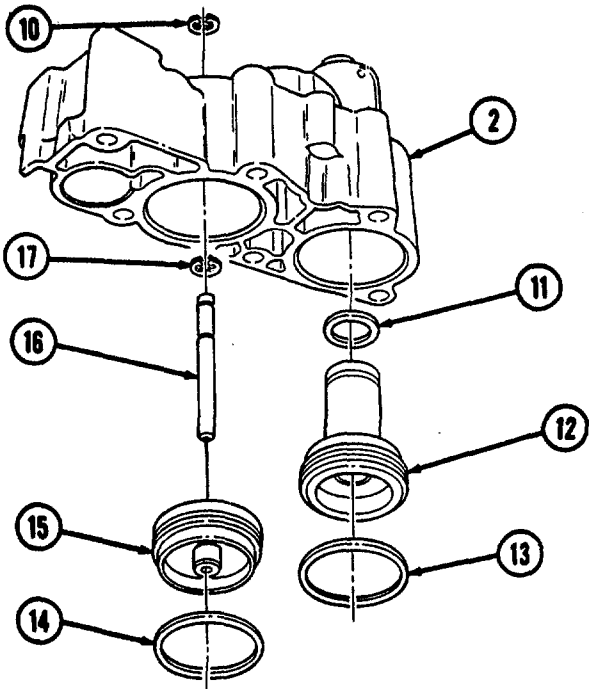
**NOTE**

Perform step 5 for 1995-1996 transmissions only.

5. Remove snapring (17) and pin (16) from fourth clutch piston (15).
6. Remove preformed packing (14) from fourth clutch piston (15). Discard preformed packing (14).
7. Remove third clutch piston (12) from housing (2).
8. Remove preformed packings (11) and (13) from third clutch piston (12). Discard preformed packings (11) and (13).

## 17-28. CONTROL VALVE AND ACCUMULATOR HOUSING REPAIR (4L80-E) (Cont'd)



## 17-28. CONTROL VALVE AND ACCUMULATOR HOUSING REPAIR (4L80-E) (Cont'd)

### c. Control Valve Disassembly

1. Remove manual valve (30) from body (2).
2. Remove screen filter (1) from body (2).

**NOTE**

A 5/64-in. (1.984-mm) drill bit may be used to remove spring pins. While rotating drill bit lift and remove spring pins.

3. Remove spring pin (9), plug (8), ball (7), bushing (6), preformed packing (5), 3-4 shift valve (4), and spring (3) from body (2). Discard preformed packing (5).
4. Remove capscrew (10), 2-3 shift solenoid (11), spring pin (12), 2-3 shift valve (13), and spring (14) from body (2).
5. Remove capscrew (18), 1-2 shift solenoid (19), spring pin (17), 1-2 shift valve (16), and spring (15) from body (2).
6. Remove spring pin (20), plug (21), and filter (22) from body (2).
7. Remove sleeve (25), plug (24), and ball (23) from body (2).
8. Remove capscrew (31), clamp (32), and pressure control solenoid (33) from body (2).
9. Remove clip (37), PWM solenoid (38), spring pin (36), TCC valve (35), and spring (34) from body (2).
10. Remove retainer plate (39), spring (40), and feed limit valve (41) from body (2).
11. Remove spring pin (26), plug (27), spring (28), and accumulator valve (29) from body (2).

### d. Control Valve Cleaning

Clean all parts in accordance with para. 2-13.

### e. Control Valve Inspection

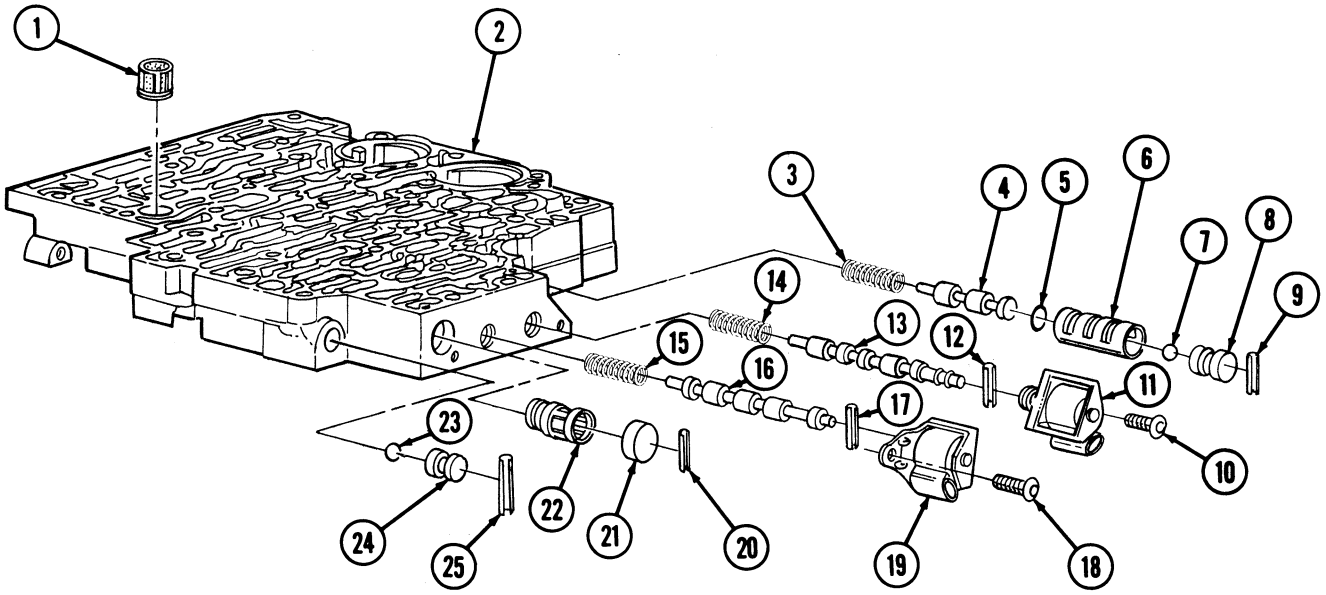
1. Inspect valves (4), (13), (16), (29), (30), (35), (41), and bushing (6) for scoring, nicks and scratches. Replace control valve assembly if damaged.
2. Inspect shift solenoids (11) and (19) for O-ring damage. Replace if damaged.
3. Inspect springs (3), (14), (15), (28), (34), and (40) for damage or distorted coils. Replace if damaged.
4. Inspect body (2) for cracks, interconnected passages, and damaged machined surfaces. Replace control valve if damaged.
5. Inspect screen filter (1) for damage. Replace if damaged.

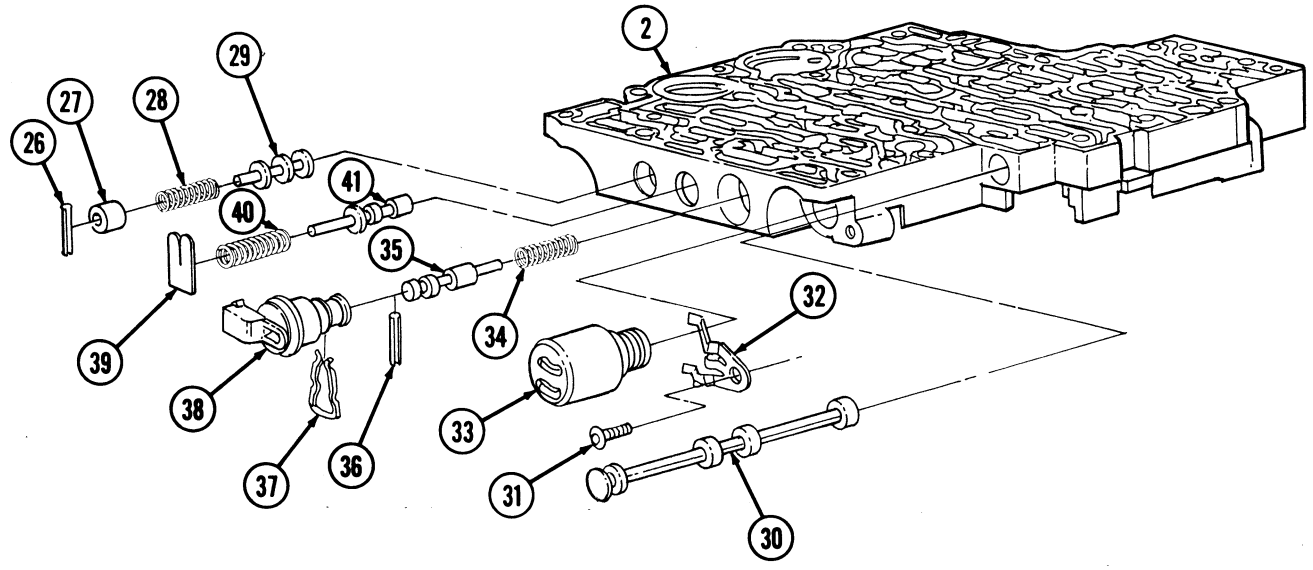
### f. Control Valve Assembly

1. Install accumulator valve (29), spring (28), and plug (27) in body (2) with spring pin (26).
2. Install feed limit valve (41) and spring (40) in body (2) with retainer plate (39).
3. Install spring (34) and TCC valve (35) in body (2) with spring pin (36). Install PWM solenoid (38) with clip (37).

## 17-28. CONTROL VALVE AND ACCUMULATOR HOUSING REPAIR (4L80-E) (Cont'd)

4. Install clamp (32) and pressure control solenoid (33) in body (2) with capscrew (31).
5. Install ball (23) and plug (24) in body (2) with sleeve (25).
6. Install filter (22) and plug (21) in body (2) with spring pin (20).
7. Install spring (15) and 1-2 shift valve (16) in body (2) with spring pin (17). Install 1-2 shift solenoid (19) with capscrew (18).
8. Install spring (14) and 2-3 shift valve (13) in body (2) with spring pin (12). Install 2-3 shift solenoid (11) with capscrew (10).
9. Install spring (3), 3-4 shift valve (4), preformed packing (5), bushing (6), ball (7), and plug (8) in body (2) with spring pin (9).
10. Install manual valve (30) in body (2).
11. Install screen filter (1) in body (2).



## 17-28. CONTROL VALVE AND ACCUMULATOR HOUSING REPAIR (4L80-E) (Cont'd)

### g. Accumulator Housing Inspection

1. Inspect accumulator housing (2) for cracks, breaks, and scoring on bores and sealing surfaces. Remove minor scoring. Replace if damaged.
2. Inspect springs (11) and (17) for breaks and distortion. Replace if damaged.
3. Inspect pistons (4) and (7) for cracks, breaks, and chipped or damaged seal grooves. Replace if damaged.
4. Inspect pin (8) for cracks, bends, and damaged grooves. Replace if damaged.

### h. Accumulator Housing Assembly

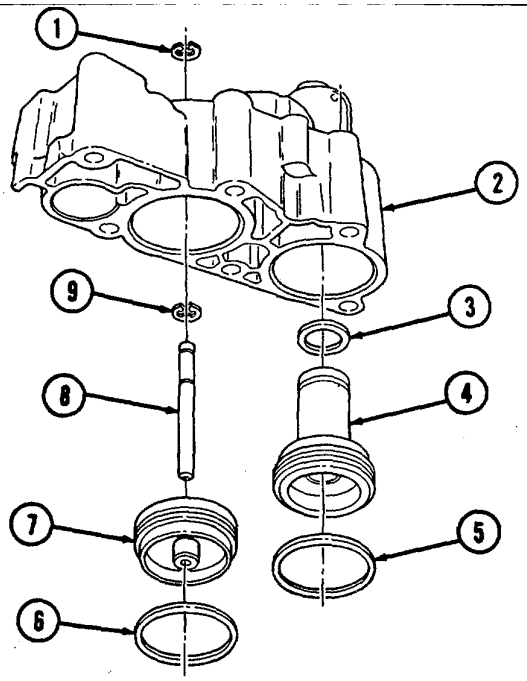
1. Coat preformed packings (3) and (5) with petrolatum and install on third clutch piston (4).
2. Install third clutch piston (4) on housing (2).
3. Coat preformed packing (6) with petrolatum and install on fourth clutch piston (7).

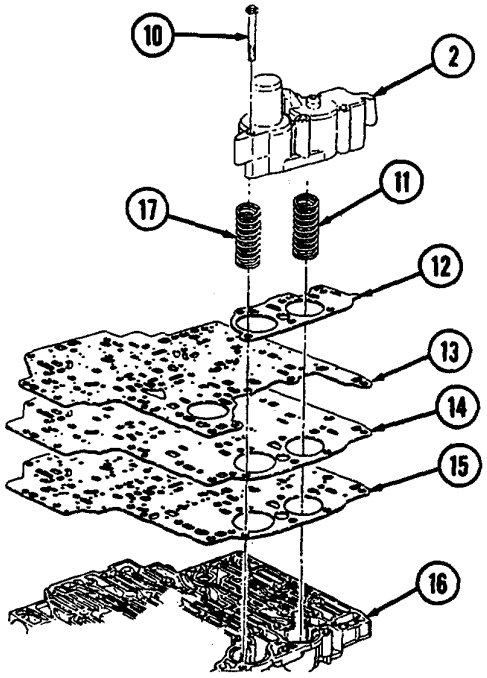
**NOTE**

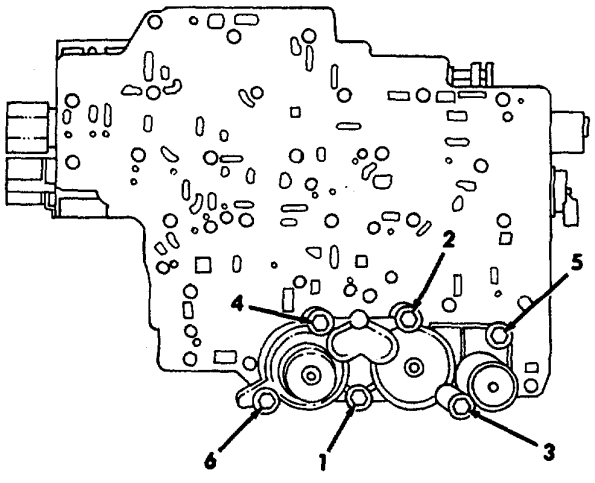
Perform step 4 for 1995-1996 transmissions only.

4. Install fourth clutch piston (7) on pin (8) and install snapring (9) in lower snapring groove.
5. Install fourth clutch piston (7) and pin (8) in housing (2) and secure with snapring (1) on the outside housing.
6. Install springs (17) and (11) on control valve assembly (16).
7. Install gasket (15), spacer plate (14), and gasket (13) on control valve assembly (16).
8. Install gasket (12) and accumulator housing (2) on control valve assembly (16) with six capscrews (10). Tighten capscrews (10) in sequence shown to 97 lb-in (11 N•m).

## 17-28 CONTROL VALVE AND ACCUMULATOR HOUSING REPAIR (4L80-E) (Cont'd)




TORQUE SEQUENCE

## 17-29. OIL PUMP ASSEMBLY REPAIR (4L80-E)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Special Tools**
Seal installer/pusher/sizer (Appendix G, Item 51)
Oil pump seal installer (Appendix G, Item 39)

**Manual References**
TM 9-2320-280-24P

**Materials/Parts**
Plain seal (Appendix E, Item 221)
Gasket (Appendix E, Item 27)
Two O-rings (Appendix E, Item 147)
Seal (Appendix E, Item 208)
Plain seal (Appendix E, Item 236)
Petrolatum (Appendix B, Item 38)
Transmission fluid (Appendix B, Item 24)

**Equipment Condition**
Transmission disassembled into subassemblies (para. 17-14).

**Maintenance Level**
General support

**NOTE**

Work area should be well ventilated, clean, and free from blowing dirt and dust.

### a. Disassembly

1. Remove seal (29.1) from pump body (1). Discard seal (29.1).
1.1. Remove seven screws (6.1) from pump body (1).
1.2. Remove seal (30) from pump body (1). Discard seal (30).

**NOTE**

- Before removal, mark pump body and cover for assembly.
- Vent shield is used on 1997-1998 transmissions only.

2. Remove five screws (5) and vent shield (4.1) from cover (4) and pump body (1). Separate pump body (1) and cover (4).
3. Remove seal (2) and gasket (2.1) from pump body (1). Discard seal (2) and gasket (2.1).

**NOTE**

Before removal, mark gear faces for assembly.

4. Remove drive gear (3) and driven gear (6) from pump body (1).

**CAUTION**

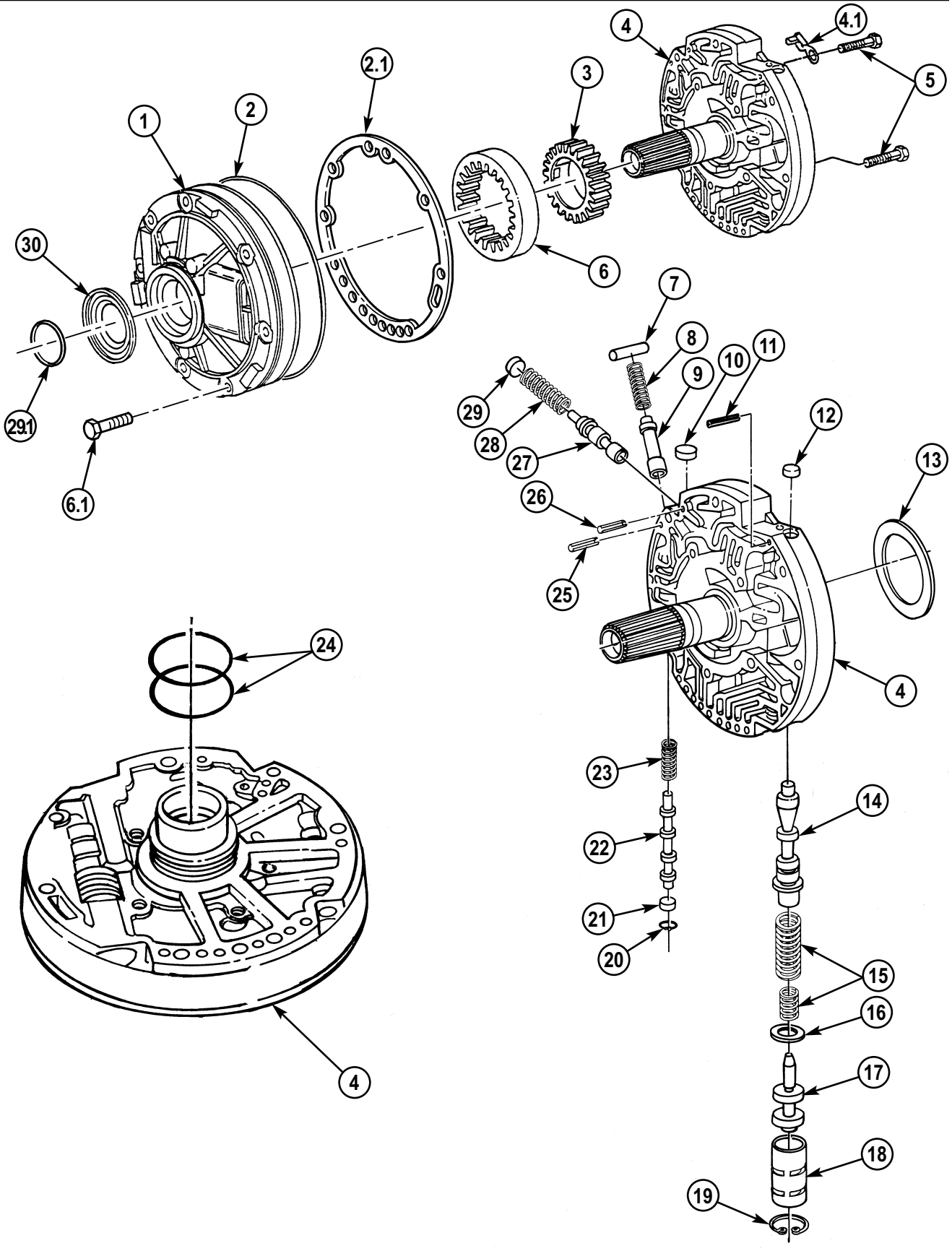
Pressure regulator valve is spring-loaded.

5. Remove snapring (19) from cover (4) and release tension.
6. Remove bushing (18), reverse boost valve (17), spring retainer (16), two springs (15), pressure regulator valve (14), spring pin (11), and plug (12) from cover (4).
7. Remove spring pin (26), plug (29), spring (28), and converter limit valve (27) from cover (4).
8. Remove spring retainer (7), spring (8), and converter enable valve (9) from cover (4).
9. Remove snapring (20), plug (21), converter clutch valve (22), spring (23), spring pin (25), and plug (10) from cover (4).
10. Remove two O-rings (24) from cover (4). Discard O-rings (24).
11. Remove front selective thrust washer (13) from cover (4).

### b. Cleaning

Clean all components in accordance with para. 2-13.

## 17-29. OIL PUMP ASSEMBLY REPAIR (4L80-E) (Cont'd)



## 17-29. OIL PUMP ASSEMBLY REPAIR (4L80-E) (Cont'd)

**c Inspection**

1. Inspect pump body (1) for cracks, breaks, burrs, damaged threads, and chipped seal or snap ring grooves. Remove minor burrs. If damaged, replace oil pump.

2. Inspect pump body (1) gear pockets, crescent, bushings, and gear face for nicks, scoring, and wear. Repair minor nicks and scoring. If damaged, replace oil pump.

3. Inspect pump body (1) for blocked oil passages and ports and cross-channel leakage paths. Clear oil passages. If damaged, replace oil pump.

4. Install drive gear (3) and driven gear (2) in pump body (1) with chamfered edges down. Measure clearance of gears (3) and (2) to pump body (1) using a straight-edge and feeler gauge. Clearance should be 0.0007-0.0028 in. (0.017-0.071 mm). If clearance does not meet specifications, replace oil pump.

5. Inspect pump cover (6) for cracks, breaks, burrs, and chipped seal or snapring grooves. Remove minor burrs. If damaged, replace oil pump.

6. Inspect stator shaft (9) splines. Replace oil pump if damaged.

7. Inspect pump cover (6) for scored, discolored, or worn bushings. If damaged, replace oil pump.

8. Inspect pump cover (6) for chipped or broken oil seal ring grooves on hub. If damaged, replace oil pump.

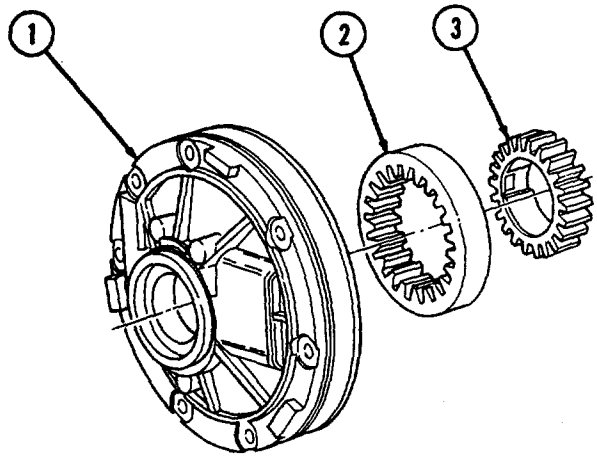
9. Inspect pump cover (6) for blocked oil passages and ports, and cross-channel leakage paths. Clear oil passages. If damaged, replace oil pump.

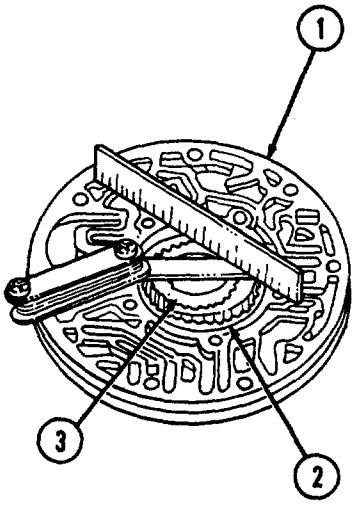
10. Inspect pump cover (6) for blocked breather hole. Unblock hole if plugged.

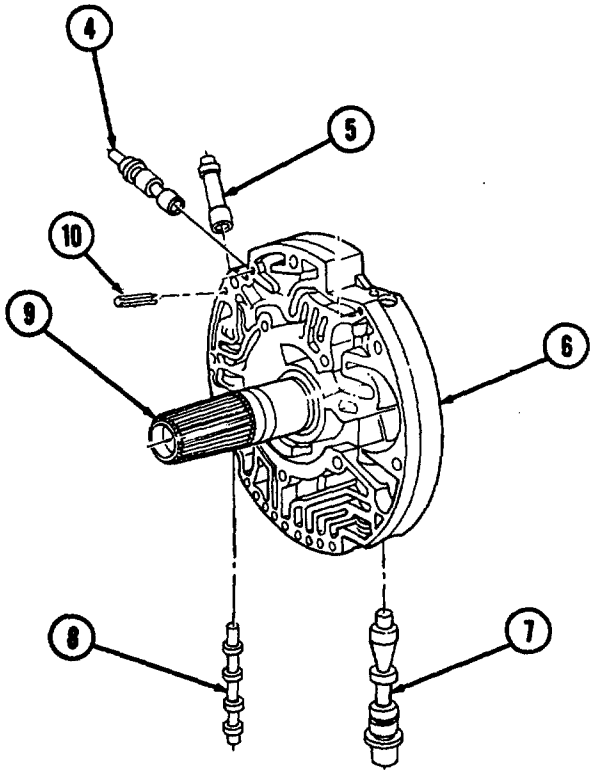
11. Inspect that pressure regulator (7), converter limit (4), converter clutch (8), and converter enable valves (5) are not broken, burred, or chipped, and can move freely (dry) in cover (6). Replace any damaged items.

12 Inspect spring pins (10) for breaks, burrs, or chips. If damaged, replace oil pump.

**17-29. OIL PUMP ASSEMBLY REPAIR (4L80-E) (Cont'd)**



## 17-29. OIL PUMP ASSEMBLY REPAIR (4L80-E) (Cont'd)

**d. Assembly**

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid (Dexron III) before assembly. Foreign material will cause transmission damage.

1. Install plug (8), spring pin (7), regulator valve (11), two springs (12), spring retainer (13), reverse boost valve (14), and bushing (15) in cover (10) with snapring (16).
2. Install converter limit valve (23), spring (2), and plug (1) in cover (10) with spring pin (22).
3. Install converter enable valve (5) and spring (4) in cover (10). Compress spring (4) and install spring retainer (3).
4. Install plug (6), spring pin (21), spring (20), converter clutch valve (19), and plug (18) in cover (10) with snapring (17).
5. Install drive gear (25) and driven gear (24), with marked surfaces facing up, in oil pump body (26).

**NOTE**

- Align reference marks on cover and pump body.
- Vent shield is used on 1997-1998 transmissions only.

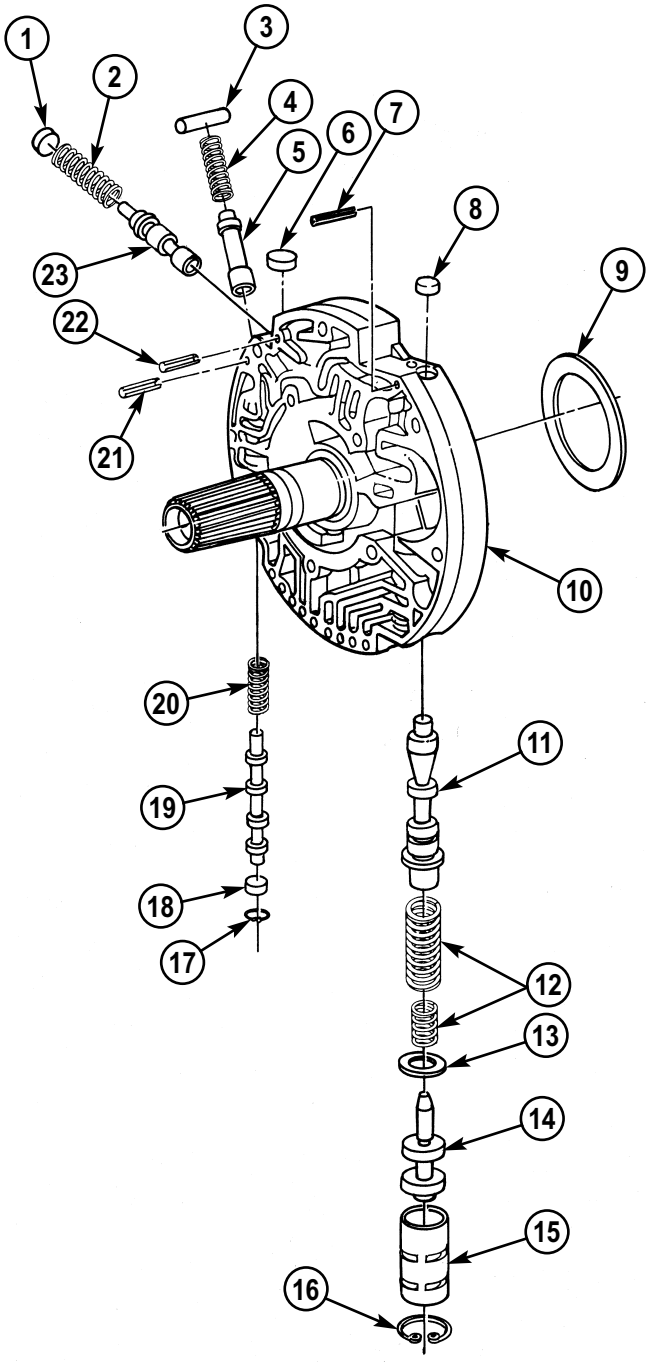
6. Install cover (10) and vent shield (29.1) on pump body (26) with five capscrews (29). Tighten capscrews (29) to 18 lb-ft (24 N•m).
7. Coat seal (27) with petrolatum and install on pump body (26).
8. Coat selective thrust washer (9) with petrolatum and install on cover (10).

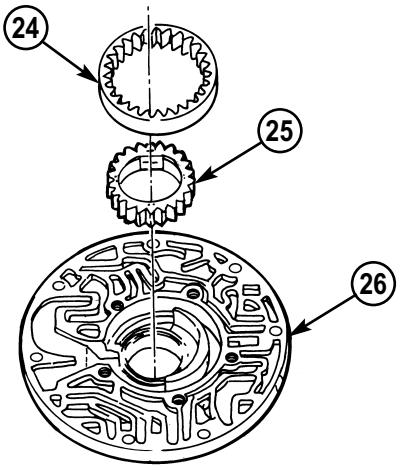
**NOTE**

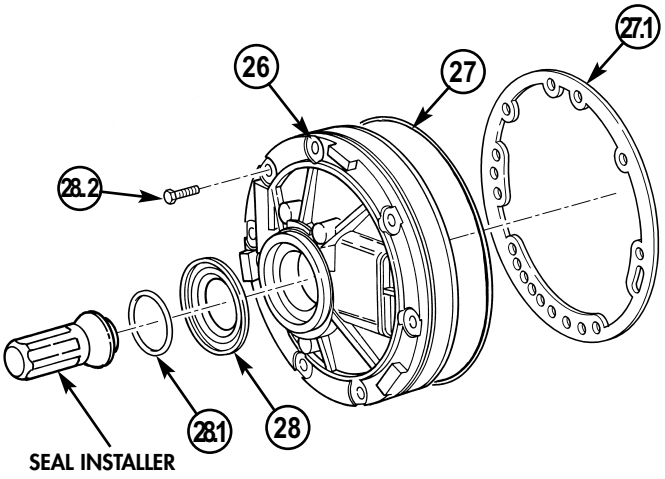
Use small chamfer end of seal installer to install inner seal ring.

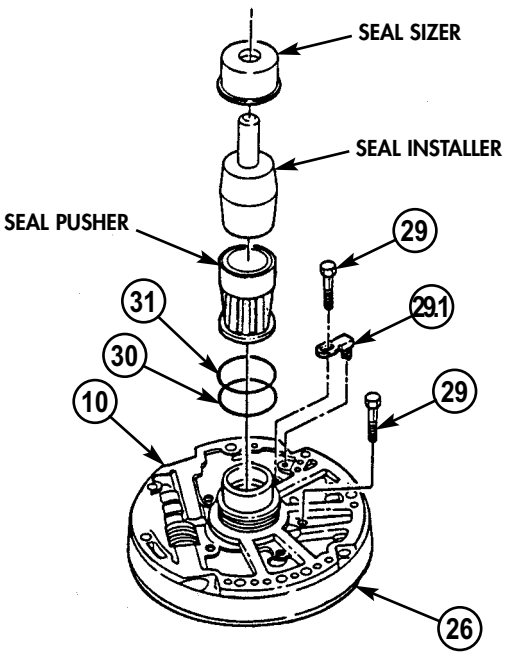
9. Using seal installer, pusher, and sizer, install O-ring (30) in pump cover (10) groove.
10. Using seal installer, pusher, and sizer, install O-ring (31) in pump cover (10) groove.
11. Using oil pump seal installer, install plain seal (28) on pump body (26).
12. Install seal (28.1) on pump body (26).
13. Install gasket (27.1) on pump body (26).
14. Install seven screws (28.2) in pump body (26).

## 17-29. OIL PUMP ASSEMBLY REPAIR (4L80-E) (Cont'd)



## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-E)

**This task covers:**

**a. Parking Lock Pawl and Actuator Assembly**
**b. Center Support Assembly**
**c. Gear Unit Assembly**
**d. Rear Unit End Play Check**
**e. Intermediate Clutch Assembly**
**f. Direct Clutch Assembly**
**g. Forward Clutch Assembly**
**h. Fourth Clutch, Turbine Shaft, and Overdrive Carrier Assembly**
**i. Pump Assembly**
**j. Front Unit End Play Check**
**k. Front Servo**
**l. Band Apply Pin Check**
**m. Rear Servo**
**n. Control Valve Assembly (1995-1996)**
**n.1. Control Valve Assembly (1997-1998)**
**o. Oil Pan and Filter Assembly**
**p. Speed Sensors**
**q. Holding Fixture**
**r. Torque Converter**

**INITIAL SETUP:**

**Applicable Models**
M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2, M1123

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)
Dial indicator (Appendix G, Item 95)

**Special Tools**
Transmission holding fixture (Appendix G, Item 29)
Transmission holding fixture base (Appendix G, Item 30)
Adapter (Appendix G, Item 41)
Gear unit installer/remover (Appendix G, Item 44)
Band apply pin checking tool (Appendix G, Item 53)
Pump remover/installer (Appendix G, Item 43)
Clutch alignment tool (Appendix G, Item 38)

**Materials/Parts**
Expansion plug (Appendix E, Item 175)
Gasket (Appendix E, Item 28)
Plain seal (Appendix E, Item 221)
Gasket (Appendix E, Item 32)
Gasket (Appendix E, Item 27)
Two packing retainers (Appendix E, Item 187)
Hydraulic parts kit (Appendix E, Item 159)
Gasket (Appendix E, Item 23)
Transmission fluid (Appendix B, Item 24)
Petrolatum (Appendix B, Item 38)
Two guide pins (Appendix C, Fig. 2)
Sealant (Appendix B, Item 43)

**Personnel Required**
One mechanic
One assistant

**Manual References**
TM 9-23320-280-24P

**Maintenance Level**
General support

### a. Parking Lock Pawl Actuator Assembly

**CAUTION**

All transmission parts must be lubricated with clean transmission fluid (Dexron® III) before assembly. Foreign material will cause transmission damage.

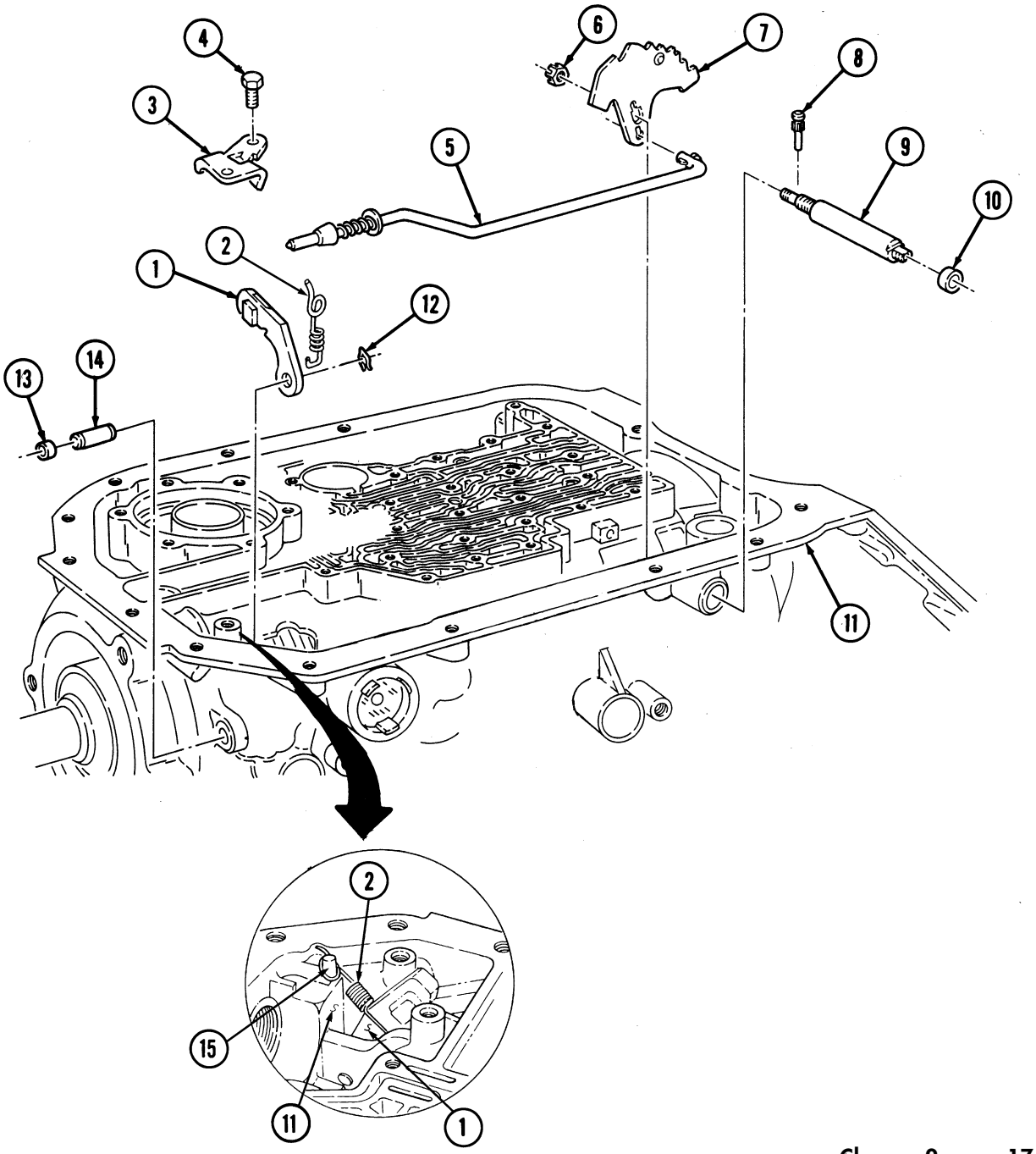
**NOTE**

- During assembly operations, it is important to closely inspect each unit to ensure nothing has been overlooked during inspection and repair. Plugs should be checked for tightness, parts kept clean, openings covered, and machined surfaces protected. Application of lubricant should be performed from covered containers.
- Install transmission case in holding fixture (para. 17-14).
- For general assembly instructions, refer to para. 2-16.

1. Install shaft (14) and pawl (1) in transmission case (11) and secure with retainer (12).
2. Using sealant, install expansion plug (13) in transmission case (11).

## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-E) (Cont'd)

3. Install return spring (2) with square hook end under pawl (1) and round end on stud (15) in transmission case (11).
4. Position actuator (5) in detent lever (7) over pawl (1) in transmission case (11).
5. Install gasket (10) in transmission case (11).
6. Coat manual shaft (9) with transmission fluid and install shaft (9) on transmission case (11) through seal (10) and detent lever (7).
7. Secure manual shaft (9) to detent lever (7) with nut (6).
8. Adjust position of manual shaft (9) in transmission case (11) and secure manual shaft (9) with retaining pin (8). Tighten nut (6) to 18 lb-ft (24 N•m).
9. Install slide bracket (3) over actuator (5) and transmission case (11) with two capscrews (4).



## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-E) (Cont'd)

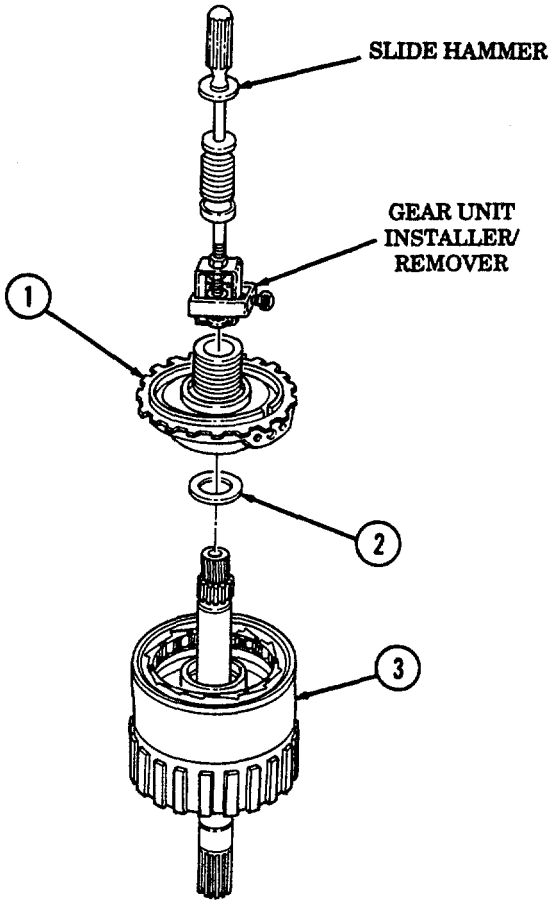
### b. Center Support Assembly

1. Install thrust washer (2) and center support (1) in gear unit (3).

2. Install gear unit installer/remover and slide hammer to hold assembly together.

### c. Gear Unit Assembly

1. Install selective thrust washer (5) in transmission case (6), with smooth side of thrust washer (5) facing up.
2. Position rear band (4) on transmission case (6) with flat end in notch and tab aligned with servo pin hole.




**NOTE**

Do not confuse center support spacer (0.040 in. (1.016 mm) thick and both sides flat) with either center support snapring (beveled on one side) or intermediate clutch backing plate snapring (0.093 in. (2.362 mm) thick and both sides flat).

3. Install center support spacer (11) on fourth snapring groove (12) in transmission case (6) and position spacer gap at nine o'clock position.

4. Coat thrust washer (10) with petrolatum and install over output shaft (9) onto gear unit (3) ensuring four tabs align with holes on gear unit (3).

5. Align bolt hole (8) in center support (1) with bolt hole in transmission case (6).

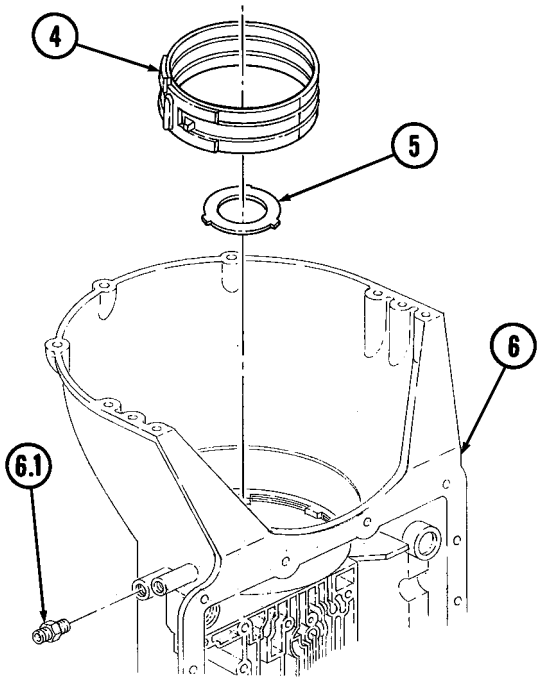
## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES(4L80-E) (Cont'd)

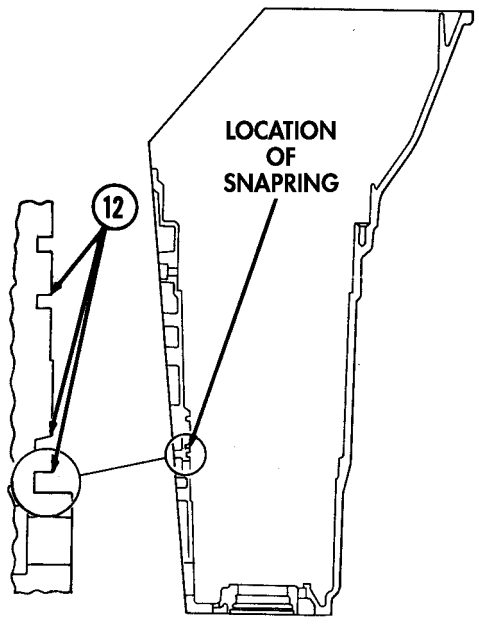
6. Lower gear unit (3) into transmission case (6). Remove gear unit remover/installer.
7. Install center support snapring (7) against center support (1) in second snapring groove. Beveled side of snapring (7) must be in an upward position, and snapring gap at nine o'clock position.

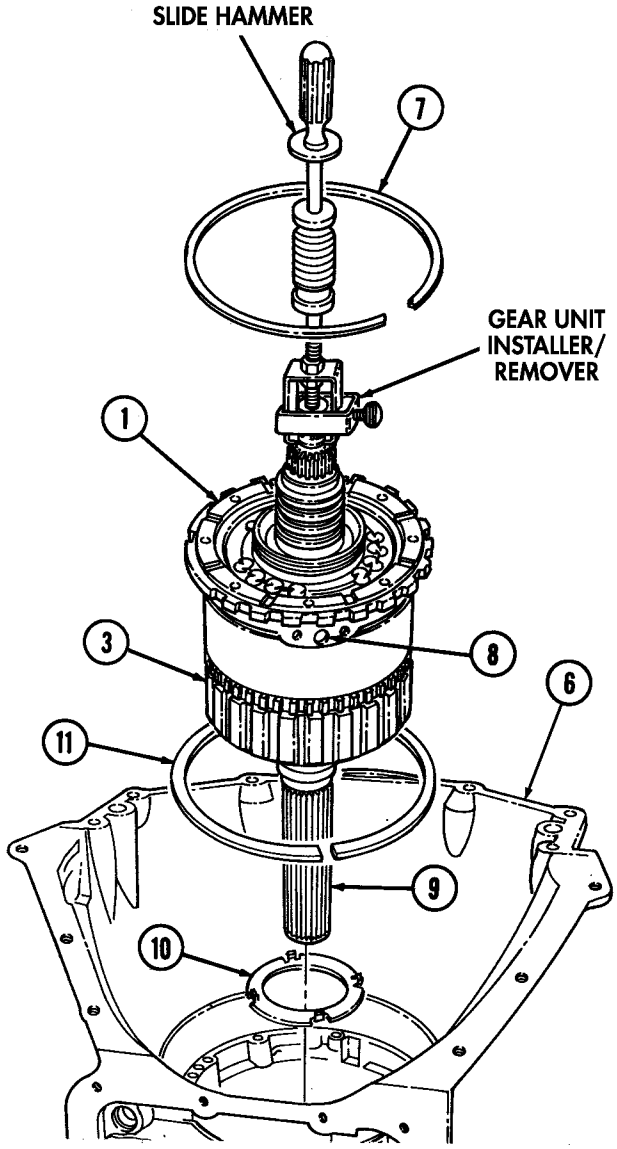
**NOTE**

Perform step 8 for 1997-1998 transmissions only.

8. Install oil cooler pipe fitting (6.1).



## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES(4L80-E) (Cont'd)

**d. Rear Unit End Play Check**

1. Turn transmission case (1) horizontal, and install dial indicator on case (1) with probe against end of output shaft (2).
2. Push output shaft (2) into case (1) and "zero" dial indicator.
3. Pull output shaft (2) out and read movement from dial indicator. Repeat twice to check value. Movement should be 0.005-0.025 in. (0.127-0.635 mm). The selective washer controlling this end play is the steel washer having three lugs and located between the rear thrust washer and the rear face of the transmission case (1).

**NOTE**

If a difference in washer thickness is required to bring end play within specifications, it can be selected from the following table.

*Table 17-5. Rear Selective Washer Thickness*

| | IDENTIFICATION | |
|---|---|---|
| THICKNESS | NOTCHES | NUMERAL |
| 0.074-0.078 in. (1.88-1.98 mm) | None | 1 |
| 0.082-0.086 in. (2.08-2.18 mm) | 1 tab side | 2 |
| 0.090-0.094 in. (2.28-2.38 mm) | 2 tabs side | 3 |
| 0.980-0.102 in. (2.48-2.59 mm) | 1 tab outer diameter | 4 |
| 0.106-0.110 in. (2.69-2.79 mm) | 2 tabs outer diameter | 5 |
| 0.114-0.118 in. (2.89-2.99 mm) | 3 tabs outer diameter | 6 |

4. If end play is not within specifications, remove selective washer, and install a new selective washer of proper thickness.

**CAUTION**

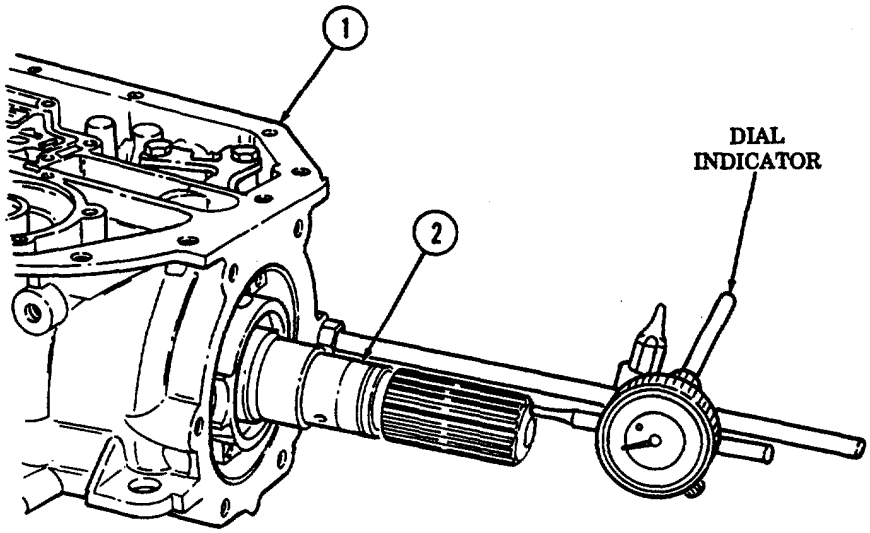
Do not overtorque bolt. Damage to case or bolt could result in transmission malfunction.

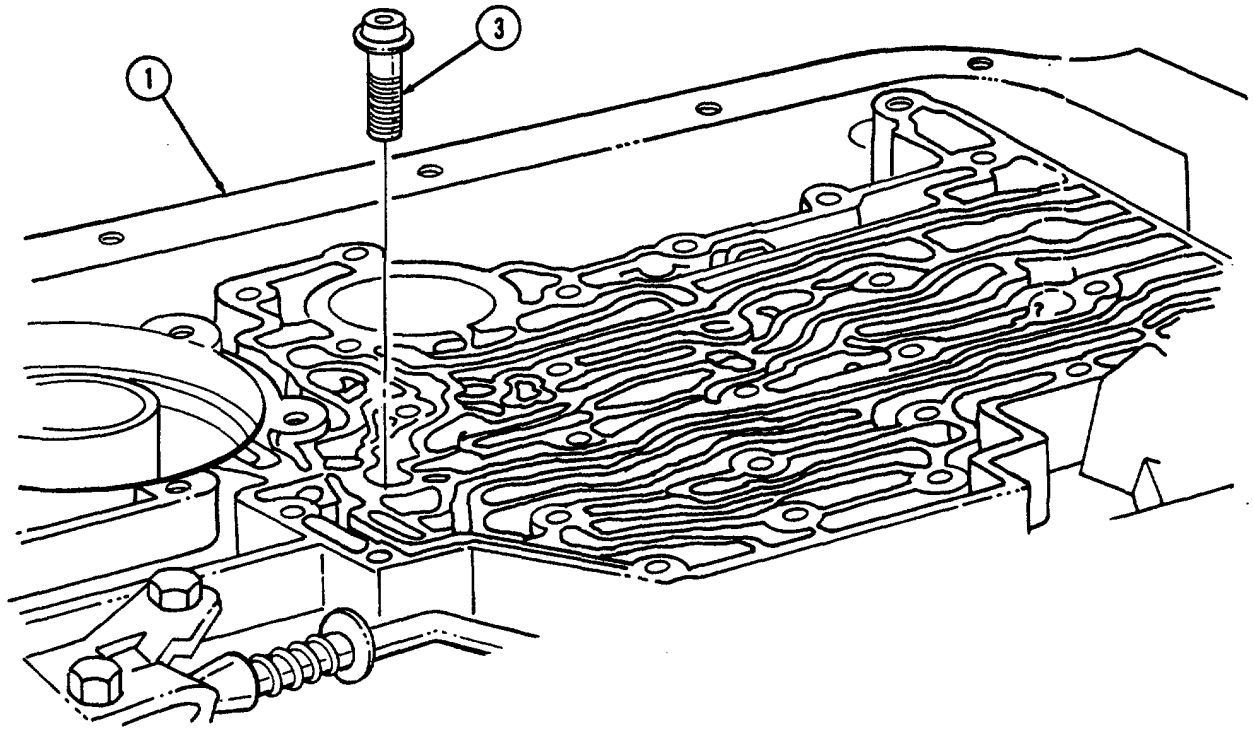
**NOTE**

If center support was reconditioned, bolt will be coated with zinc chromate and will be yellow in color.

5. Install bolt (3). Tighten bolt (3) to 32 lb-ft (43 N•m).

**17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-E) (Cont'd)**



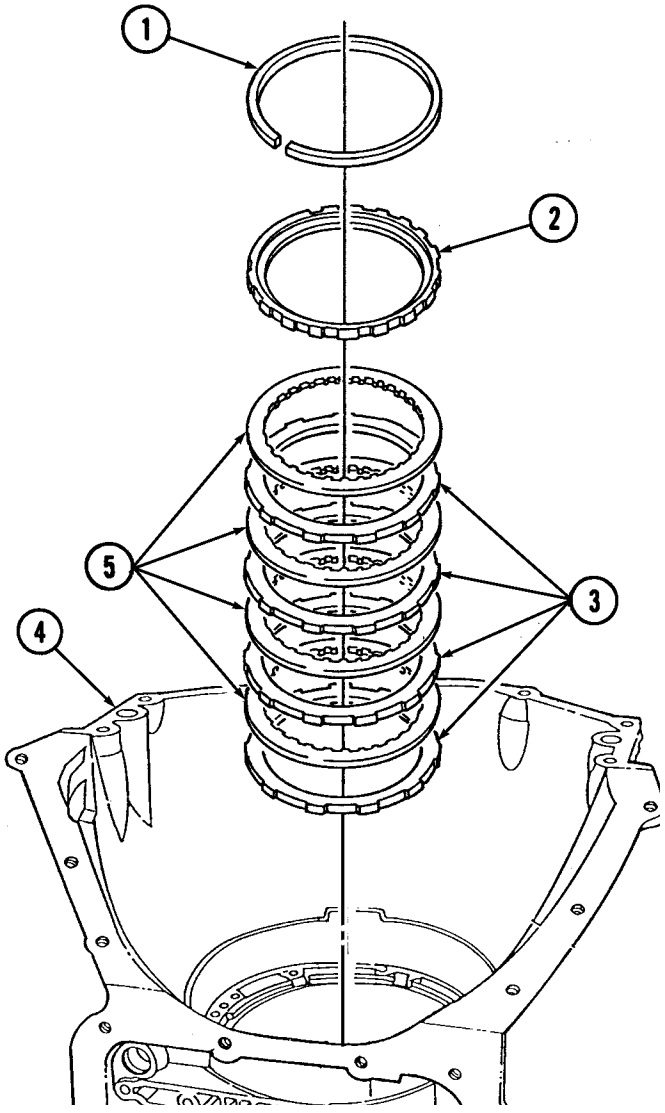
## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES(4L80-E) (Cont'd)

**e. Intermediate Clutch Assembly**

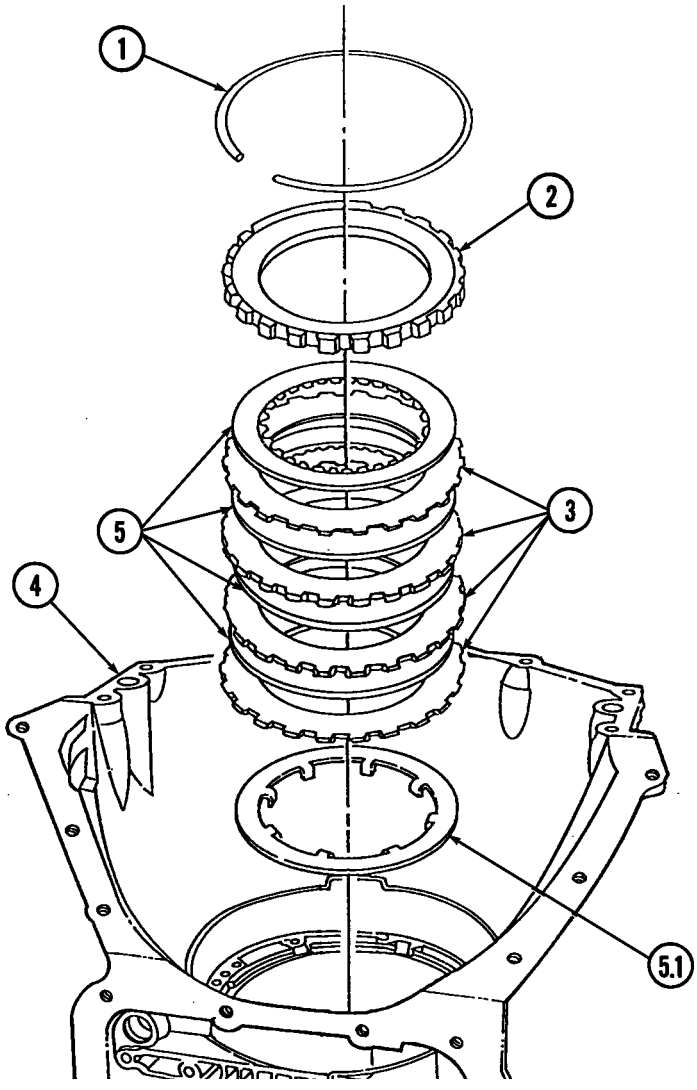
**NOTE**

- Soak all clutch plates in transmission fluid for at least three minutes before assembly.
- Wave plate is used on 1997-1998 transmissions only.

1. Install wave plate (5.1), four clutch plates (3), plate assemblies (5), and backing plate (2) on transmission case (4) starting with a clutch plate (3), then alternating plate assemblies (5) with clutch plates (3) and ending with flat side of backing plate (2) facing down.
2. Secure backing plate (2) to transmission case (4) with snapring (1). Position snapring gap at nine o'clock position.
3. Measure gap between snapring (1) and backing plate (2). Gap should be 0.040-0.107 in. (1.02-2.72 mm).




1995-1996




1997-1998

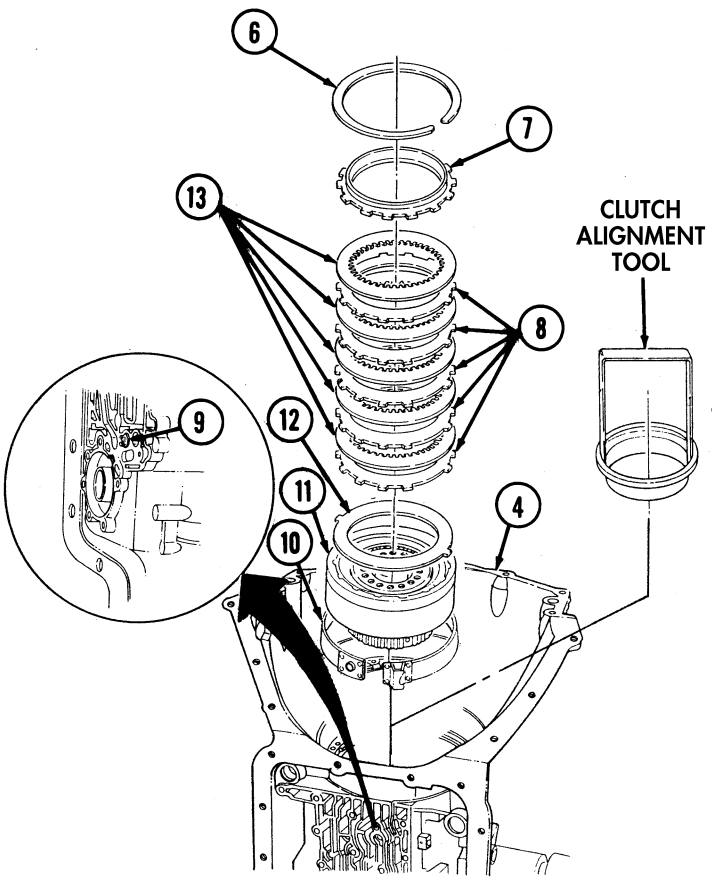
## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-E) (Cont'd)

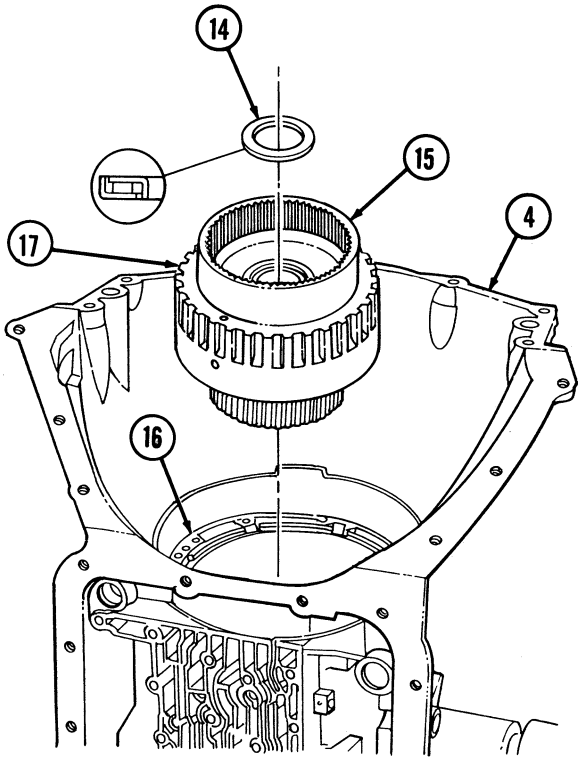
### f. Direct Clutch Assembly

1. Install front band (10) on transmission case (4). Ensure pin socket on band is over servo pin hole, and tab end can move freely.
2. Remove snapring (6), backing plate (7), five clutch plate assemblies (13), clutch plates (8), and dished plate (12) (1995-1996 transmissions only) from direct clutch housing (11).
3. Using clutch alignment tool, align intermediate clutch plates (3). Do not remove tool.
4. Apply air pressure to intermediate clutch plates (3) through hole (9) in center support bolt. Remove alignment tool and maintain air pressure.
5. Install direct clutch assembly (11) into transmission case (4) and remove air pressure.
6. Install dished clutch plate (12) (1995-1996 transmissions only) on direct clutch housing (11).
7. Install five clutch plates (8) and clutch plate assemblies (13) on clutch housing (11). Alternate plates, starting with a clutch plate (8).
8. Install backing plate (7) on housing (11) with snapring (6).

### g. Forward Clutch Assembly

1. Install forward clutch assembly (15) onto direct clutch (11).
2. Ensure that forward clutch assembly (15) is fully seated, and that top of speed sensor ring (17) is 3.85-3.89 in. (98-99 mm) below gasket surface (16).
3. Install flat bearing (14) on forward clutch (15).



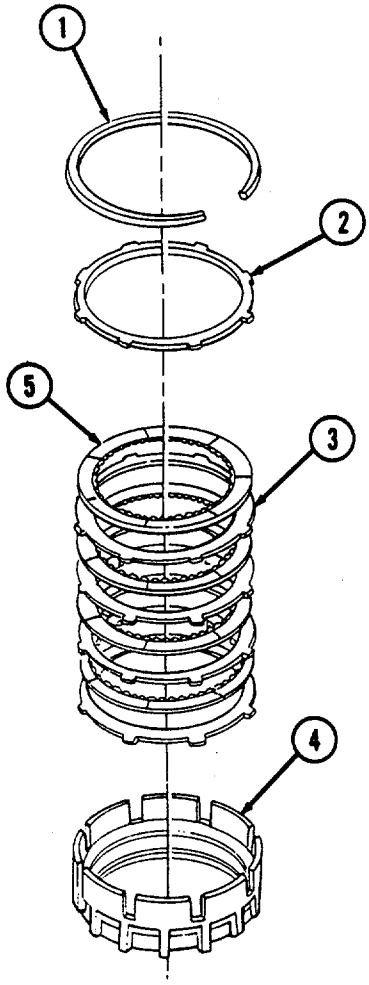
## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-E) (Cont'd)

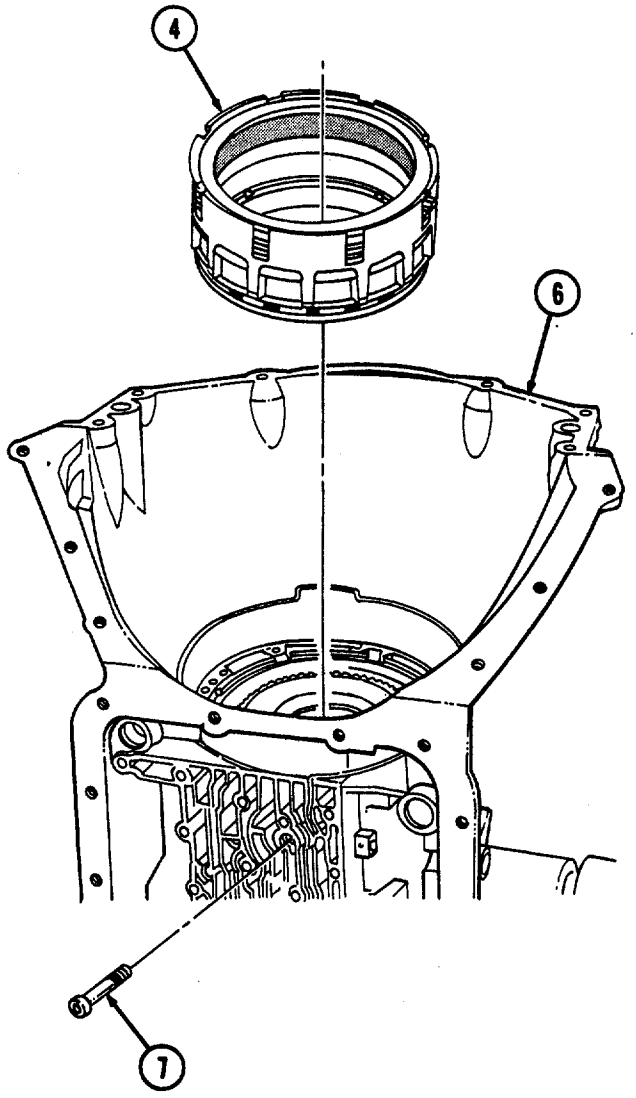
### h. Fourth Clutch, Turbine Shaft, and Overdrive Carrier Assembly

1. Remove snapring (1), backing plate (2), four clutch plate assemblies (5), and clutch plates (3) from fourth clutch housing (4).

2. Install fourth clutch housing (4) on transmission case (6), aligning bolt hole in housing (4) with bolt hole in case (6).

3. Install bolt (7) on fourth clutch housing (4). Tighten bolt (7) to 13-17 lb-ft (18-23 Nam).



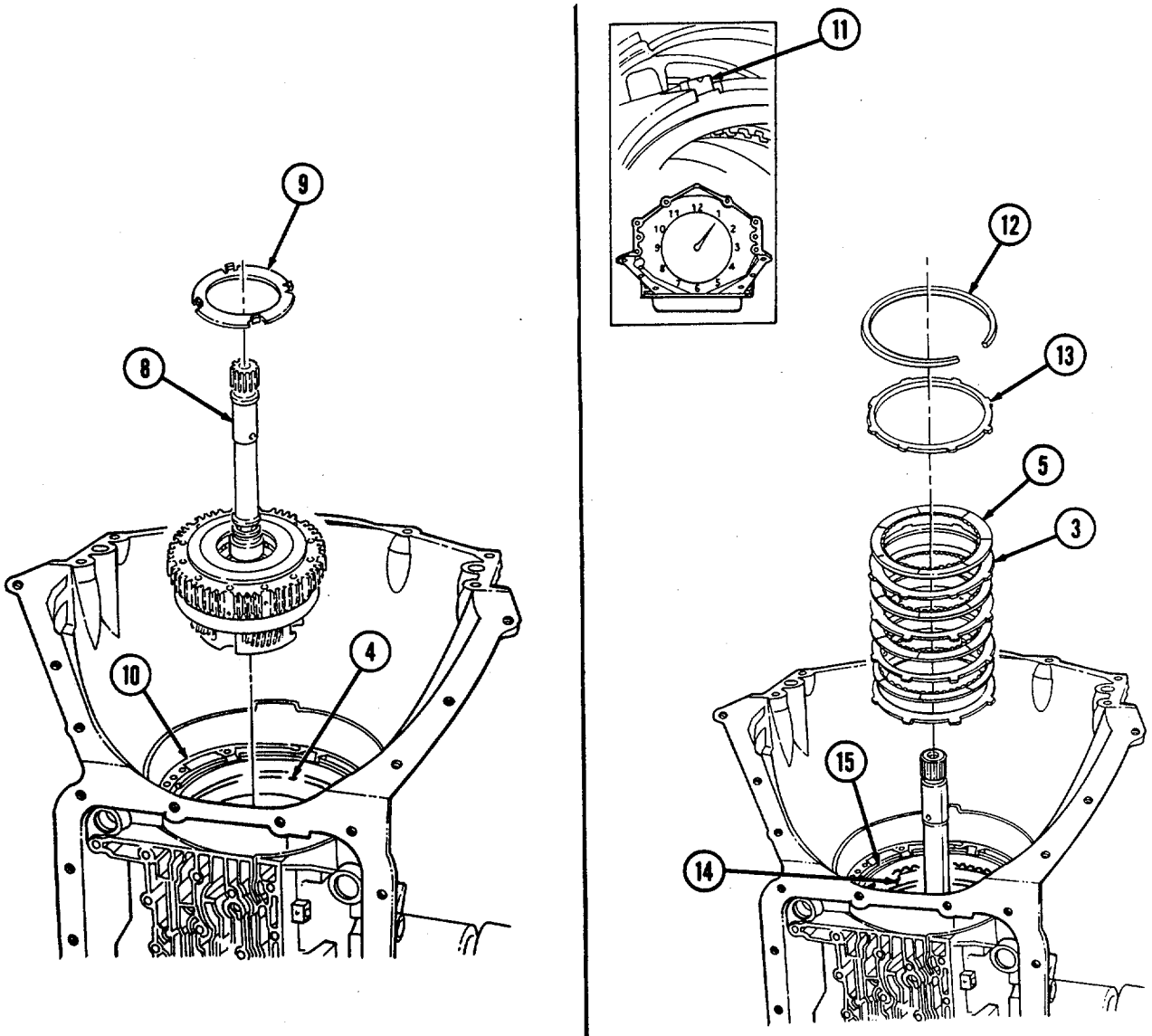
## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-e) (Cont'd)

4. Install turbine shaft and overrun clutch housing assembly (8) on fourth clutch assembly (4). Mesh pinion gears in teeth of forward clutch assembly (4).
5. Install selective thrust washer (9) on overrun clutch housing assembly (8).
6. Use a straight-edge on pump-t-case surface (10) and over thrust washer (9). The two surfaces should be flush.

**NOTE**

Ensure clutch plates are saturated with transmission fluid before installation.

7. Install four clutch plates (3) and clutch plate assemblies (5) on fourth clutch housing (15) and overrun carrier assembly (14). Start with clutch plate (3), with the '" notch (11) at the one o'clock position, then alternate with clutch assemblies (5).
8. Install backing plate (13), flat side facing down, on clutch plate assemblies (5) and secure with snapring (12). Position snapring (12) with gap at one o'clock position.



## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-e) (Cont'd)

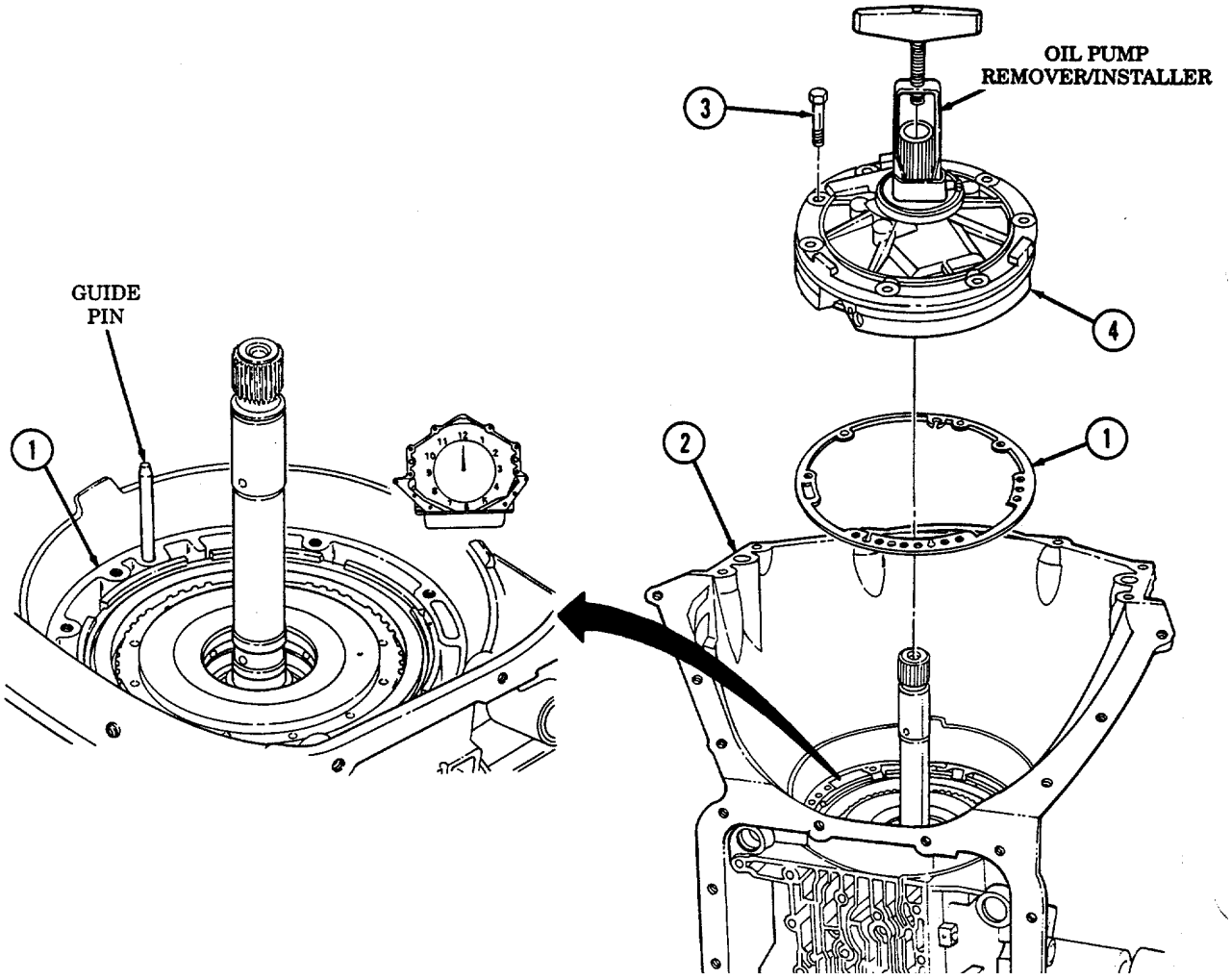
**i. Pump Assembly**

1. Install two guide pins at 12 and 5 o'clock positions on transmission case (2).
2. Install gasket (1) over guide pins, ensuring it matches holes in transmission case (2).
3. Using pump remover/installer, align pump assembly (4) over guide pins in transmission case (2).

**CAUTION**

If turbine shaft cannot be rotated as pump assembly is being pulled into place, the overrun, 4th, forward and/or direct clutch housings have not been properly installed. This condition must be corrected before pump assembly is fully installed.

4. Install pump (4) with seven capscrews (3) and tighten evenly to 18 lb-ft (24 N.m).



## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-E) (Cont'd)

**j. Front Unit End Play Check**

**CAUTION**

If end play procedures are not closely followed, incorrect shim thickness will be selected, resulting in severe damage to internal transmission components.

1. Install dial indicator on transmission case (2) to read vertical movement on turbine shaft (5).
2. Press down turbine shaft (5) and pry up on output carrier (7) to eliminate slack between end of turbine shaft (5) and stator shaft (6).
3. Pull up turbine shaft (5) to eliminate slack between snapring on turbine shaft (5) and overdrive carrier.
4. Zero dial indicator.
5. Pull turbine shaft (5) forward, and read dial indicator.

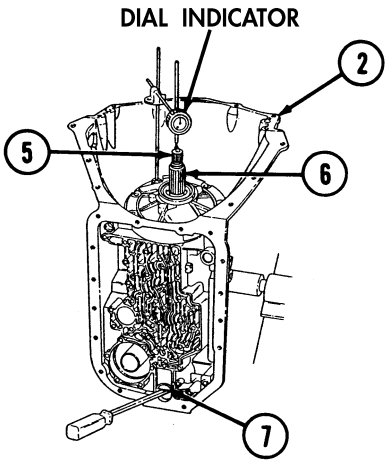
**NOTE**

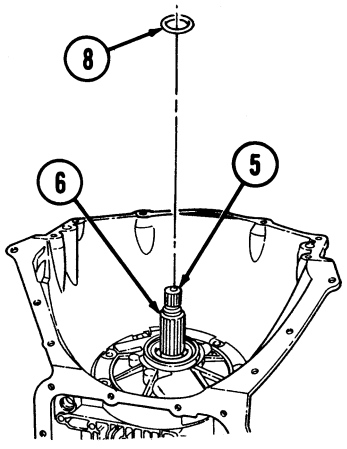
- Selective washer controlling end play is located between pump cover and forward clutch housing, refer to para. 17-22. If more or less washer thickness is required to bring end play within specifications, select proper washer from table 17-6.
- An oil-soaked washer may tend to discolor.
- It will be necessary to measure washer for its actual thickness.

*Table 17-6. Front Selective Washer Thickness*

| THICKNESS | COLOR |
|---|---|
| 0.057-0.061 in. (1.45-1.55 mm) | Blue |
| 0.073-0.077 in. (1.85-1.96 mm) | Red |
| 0.089-0.093 in. (2.26-2.36 mm) | Brown |
| 0.105-0.109 in. (2.67-2.77 mm) | Green |
| 0.121-0.125 in. (3.07-3.18 mm) | Plain |

6. Resulting travel or end play should be 0.004-0.022 in. (0.102-0.559 mm). If end play is not within specifications, remove selective washer and install new selective washer of proper thickness.
7. Install seal (8) on turbine shaft (5). ■

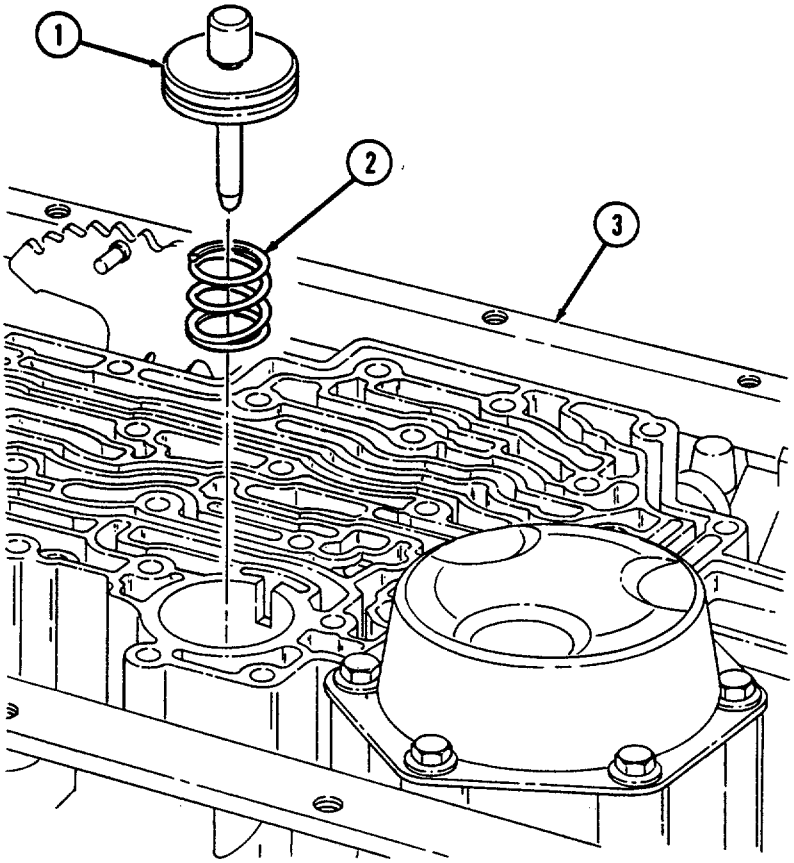


## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-e) (Cont'd)

**k. Front Servo**

Install spring (2) and piston assembly (1) in transmission case (3) ensuring piston assembly (1) is firmly seated on spring (2).




**l. Band Apply Pin Check**

1. Place gauge pin in rear servo bore of transmission case (3) and rotate to side "A".
2. Place checking tool on servo bore with hex nut (5) facing parking pawl side of transmission case (3).
3. Secure checking tool to transmission case (3) with two servo cover screws (4). Tighten screws (4) to 18 lb-ft ( 24 N-m).
4. Ensure gauge pin can move freely in checking tool.
5. Apply 25 lb-ft (34 N.m) of torque to hex nut (5).
6. Read edge of gauge pin that is even with checking tool edge at pin gauge. Record number and letter.

## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-e) (Cont'd)

7. Determine correct apply pin to be used from table below:

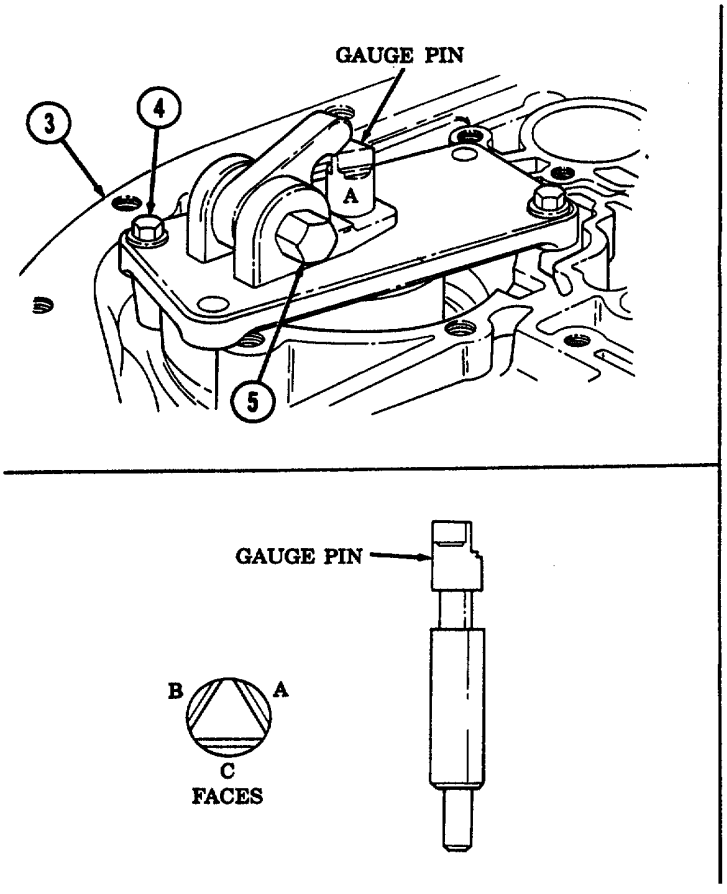
**NOTE**

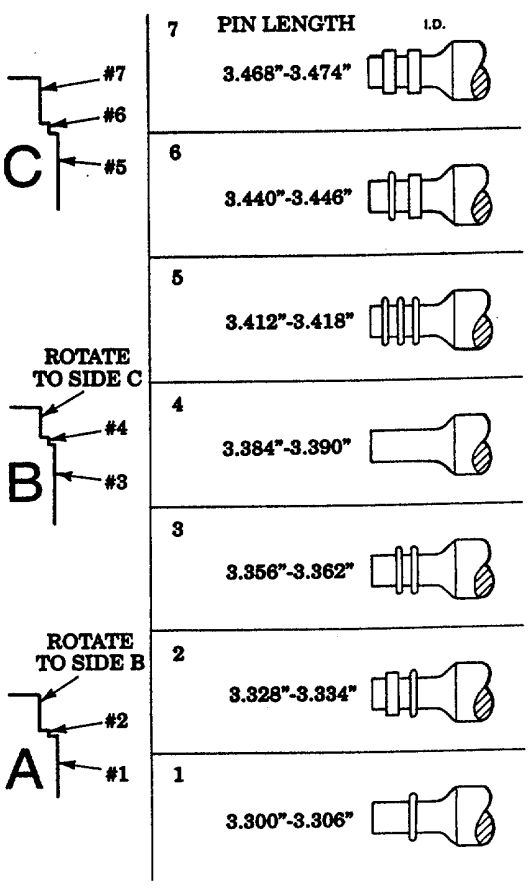
* Apply pins are identified by the number of rings around small end of apply pins.
* If necessary to change apply pin, refer to rear servo repair para. 17-27.

Table 17-7. Apply Pin Selection

| |
|---|
| a. If both flats are above gauge surface, use pin length #1. |
| b. If one flat is above gauge surface, use pin length #2. |
| c. If both flats are below gauge surface, rotate to side B. |
| d. If both flats are above gauge surface, use pin length #3. |
| e. If one flat is above gauge surface, use pin length #4. |
| f. If both flats are below gauge surface, rotate to side C. |
| g. If both flats are above gauge surface, use pin length #5. |
| h. If one flat is above gauge surface, use pin length #6. |
| i. If both flats are below gauge surface, use pin length #7. |

8. Remove checking tool and gauge pin.

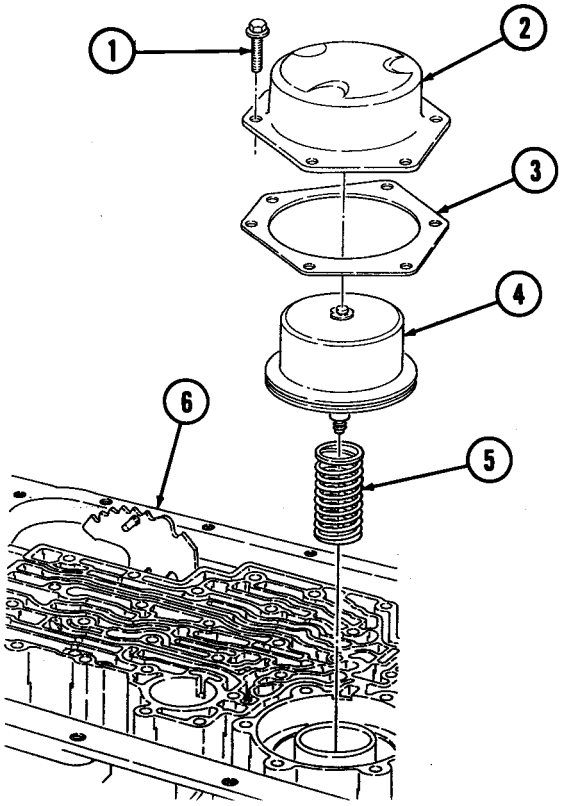


## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES(4L80-E) (Cont'd)

**m. Rear Servo**

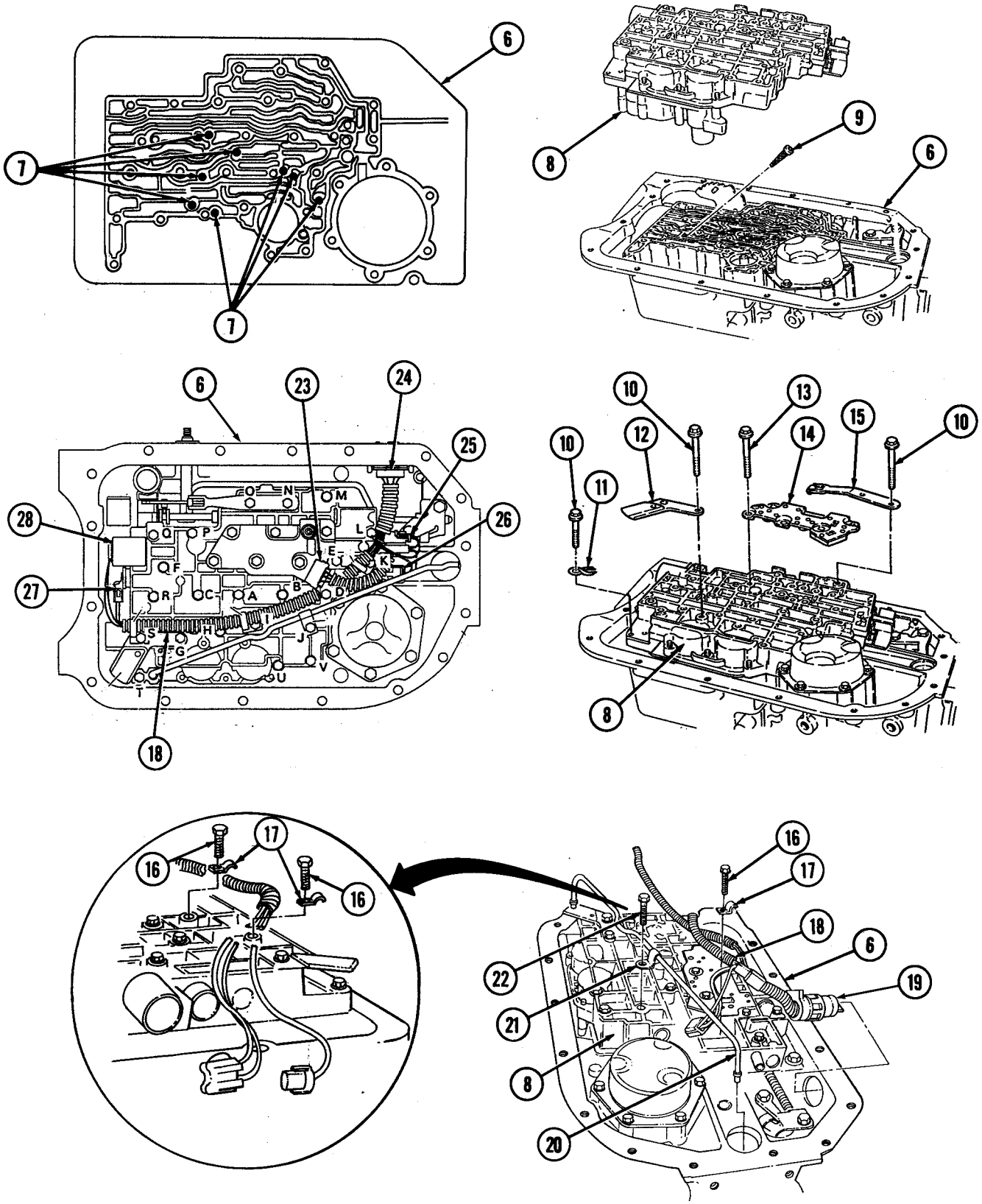
Install spring (5), servo piston (4), gasket (3), and servo cover (2) in transmission case (6) with six capscrews (1). Tighten capscrews (1) to 18 lb-ft (24 N•m).




**n. Control Valve Assembly (1995-1996)**

1. Install eight checkballs (7) in passages of transmission case (6).
2. Install screen (9) in transmission case (6).
3. Position control valve assembly (8) on transmission case (6).
4. Install fluid pressure switch assembly (14) on control valve assembly (8) with six capscrews (13) finger tight.
5. Install spring and roller assembly (15) on control valve assembly (8) with two capscrews (10) finger tight.
6. Install three wiring harness clips (17), fluid indicator stop (12), and lube pipe retainer (11) on valve assembly (8) with ten capscrews (10) (1995 transmission) or sixteen capscrews (10) (1996 transmission) and three capscrews (16) finger tight.
7. Install lube pipe (19) on transmission case (6) and valve assembly (8) with clip (20) and capscrew (21).
8. Position wiring harness (18) over control valve assembly with electrical connector going through transmission case (6).
9. Connect wiring harness (18) to pressure control solenoid (27), PWM solenoid assembly (26), 2-3 shift solenoid (25), 1-2 shift solenoid (24), connector (23), and transmission fluid pressure switch assembly (22).
10. Tighten twenty-two capscrews (10) and (13) (1995 transmission) or twenty-eight capscrews (10) and (13) (1996 transmission) to 97 lb-in. (11 N•m) in sequence shown, A through V.

## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES(4L80-E) (Cont'd)

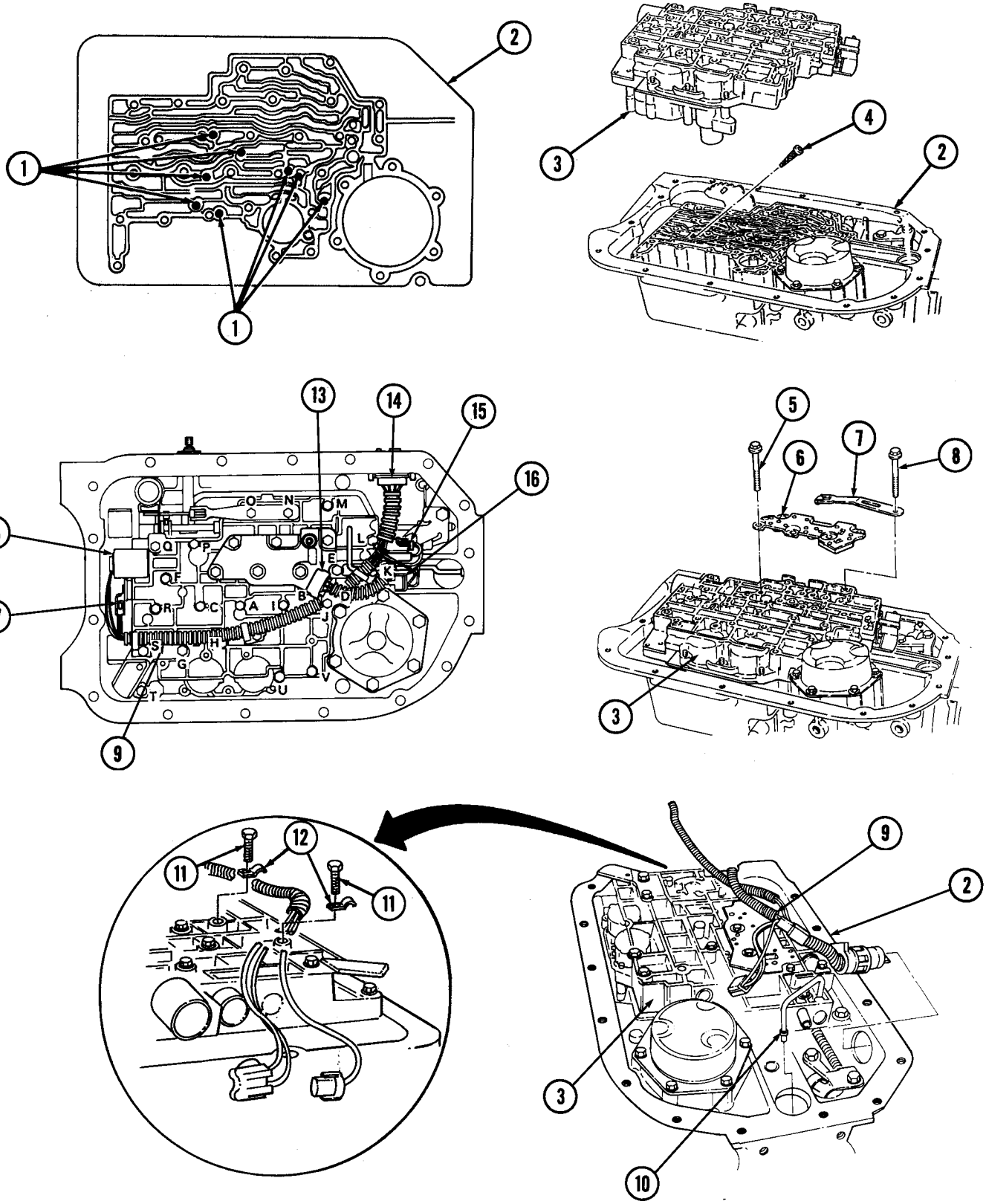


## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES(4L80-E) (Cont'd)

**n.1. Control Valve Assembly (1997-1998)**

1. Install eight checkballs (1) in passages of transmission case (2).
2. Install screen (4) in transmission case (2).
3. Position control valve assembly (3) on transmission case (2).
4. Install spring and roller assembly (7) on control valve assembly (3) with capscrew (8).
5. Install lube pipe (10) on transmission case (2) and control valve assembly (3).
6. Install fluid pressure switch assembly (6) on control valve assembly (3) with six capscrews (5) finger tight.
7. Install wiring harness (9) on control valve assembly (3) with two clips (12) and capscrews (11).
8. Position wiring harness (9) over control valve assembly (3), with electrical connector going through transmission case (2).
9. Connect wiring harness (9) to pressure control solenoid (18), PWM solenoid assembly (17), 2-3 shift solenoid (16), 1-2 shift solenoid (15), connector (14), and transmission fluid pressure switch assembly (13).
10. Install remaining sixteen capscrews (8) and tighten seventeen capscrews (8), six capscrews (5), and two capscrews (11) to 97 lb-in. (11 N•m) in sequence shown, A through V.

## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES(4L80-E) (Cont'd)



## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-E) (Cont'd)

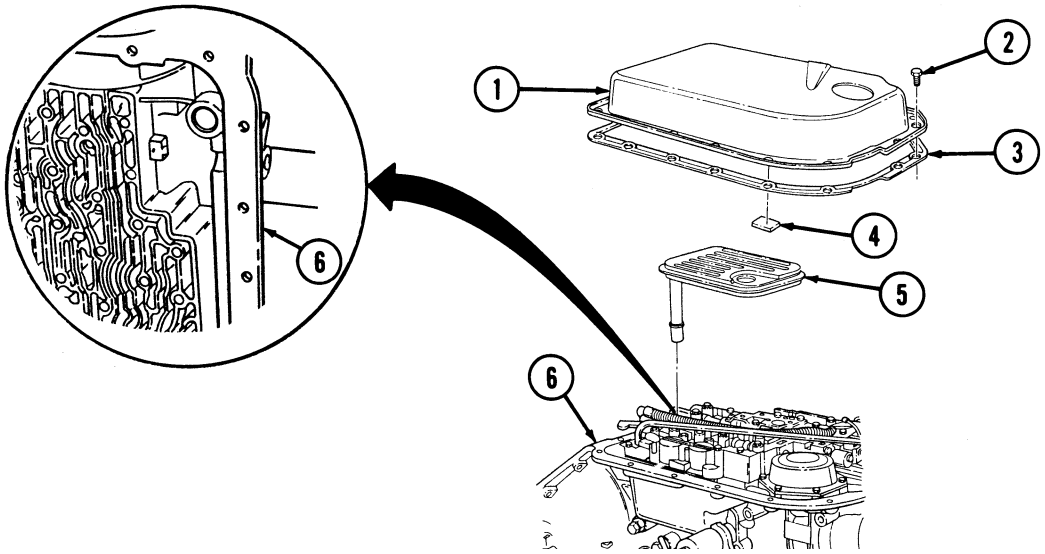
### o. Oil Pan and Filter Assembly

1. Install hydraulic parts kit (5) on transmission case (6).
2. Install magnet (4) in oil pan (1).

**NOTE**

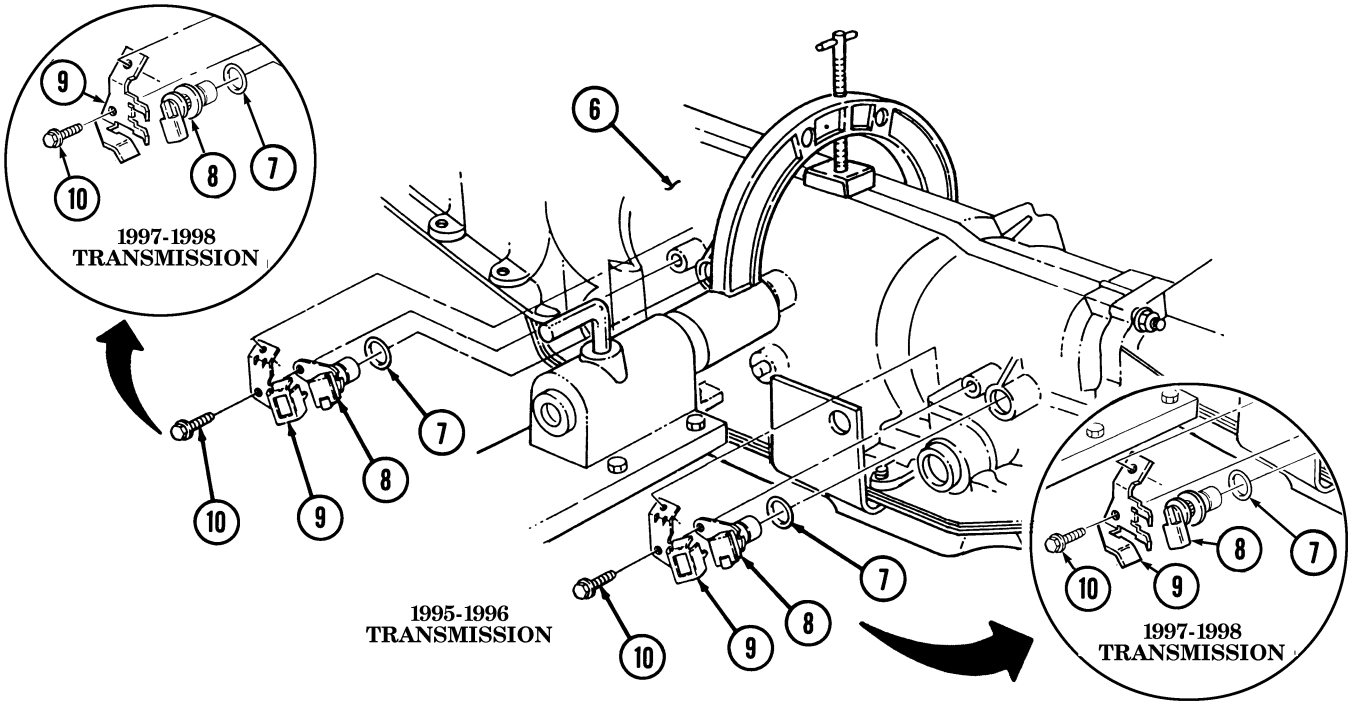
Do not use a sealer or adhesive on oil pan seal, oil pan, or transmission case surface.

3. Install gasket (3) and oil pan (1) on transmission case (6) with seventeen capscrews (2). Tighten capscrews (2) to 18 lb-ft (24 N•m).




### p. Speed Sensors

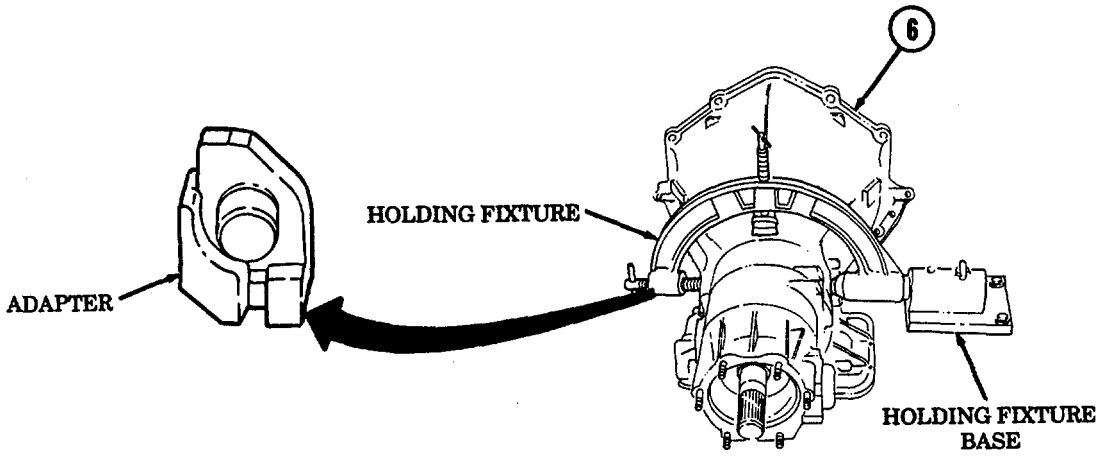
Install two packing retainers (7), speed sensors (8), and bracket (9) on transmission case (6) with capscrews (10).



## 17-30. TRANSMISSION ASSEMBLY FROM SUBASSEMBLIES (4L80-e) (Cont'd)

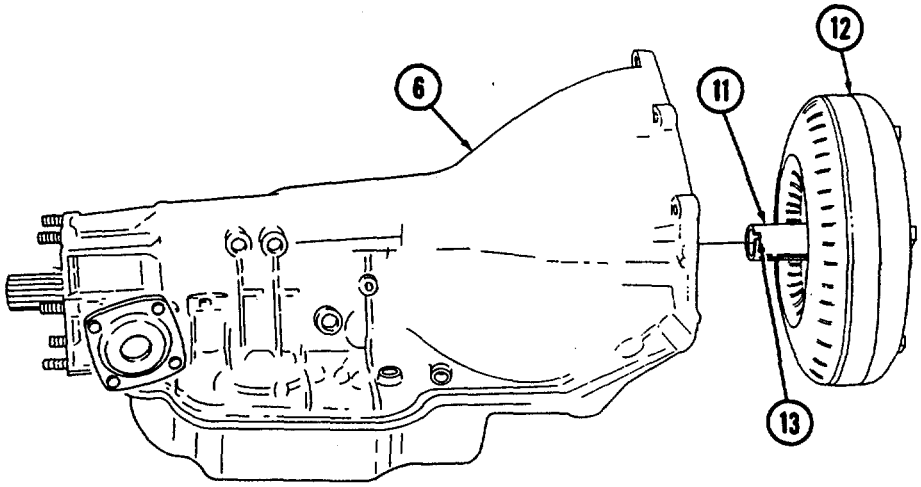
**q. Holding Fixture**

Remove transmission (6) and adapter from transmission holding fixture.




**r. Torque Converter**

Install torque converter (12) into transmission (6). Be sure drive lugs of inner pump rotor are properly engaged with drive slots (13) of torque converter hub (11).




FOLLOW-ON TASK: Prepare transmission for installation (para. 7-10).

## Section II. TRANSMISSION TESTING

### 17-31. TRANSMISSION TESTING TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 17-32 | Transmission Oil Pressure Tests (3L80) | 17-150 |

## 17-32. TRANSMISSION OIL PRESSURE TESTS (3I80)

**This task covers:**

**a. Oil Pressure Diagnostic Test** **b. Control Valve and Governor Line Pressure Test**

**INITIAL SETUP:**

Tools
General mechanic's tool kit: automotive (Appendix G, Item 1)

Test Equipment
Pressure gauge 0-300 psi (Appendix G, Item 40)

Manual References
TM 9-2320-280-10
TM 9-2320-280-20

Equipment Condition
* Transmission fluid at proper level (TM 9-2320-280-20).
* Adjust manual shift linkage (TM 9-2320-280-20).
* Adjust modulator cable (TM 9-2320-280-20).

General Safety Instructions
Direct all personnel to stand clear of vehicle when conducting pressure test.

Maintenance Level
Direct Support

**NOTE**

* The testing procedures are for use in conjunction with troubleshooting instructions in chapter 2. Table 7-5, Oil Pressure Diagnosis, shows possible causes of transmission malfunctions directly related to oil pressure. Note if any reading is normal, low, or high.
* The testing procedures in this paragraph applies to vehicles with 3L80 transmissions. Refer to TM 9-2320-280-20 for 4L80-E transmission oil pressure testing.

### a. Oil Pressure Diagnostic Test

1. Remove pipe plug (3) from line pressure port (2) on left side of transmission (1).
2. Connect oil pressure gauge to line pressure port (2).

**WARNING**

Direct all personnel to stand clear of vehicle before starting engine. Transmission slipping into gear may cause injury.

3. Start engine (TM 9-2320-280-10) and check for leaks at connections.
4. Bring engine to operating temperature.
5. Place transmission shift lever in "N" (neutral) and operate engine at 1,000 rpm, note pressure reading. Pressure should be 55-70 psi (379-483 kPa).

**CAUTION**

Total running time for next five tests should not exceed two minutes.

6. Apply service brakes and place transmission shift lever in "D" (drive), and allow engine to idle, note pressure reading. Pressure should be 60-85 psi (414-586 kPa).
7. Apply service brakes and place transmission shift lever in "D" (drive) and operate engine at 1,000 rpm, note pressure reading. Pressure should be 60-90 psi (414-621 kPa).
8. Apply service brakes and place transmission shift lever in "2" (low 2) and operate engine at 1,000 rpm, note pressure reading. Pressure should be 135-160 psi (931-1103 kPa).

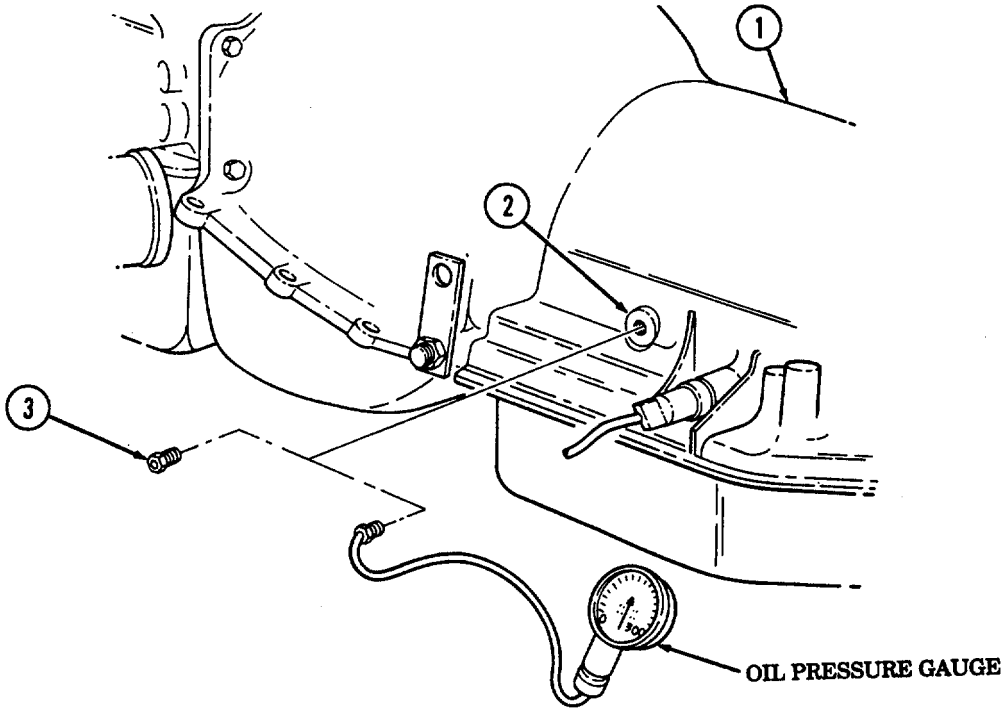
## 17-32. TRANSMISSION OIL PRESSURE TESTS (3L80) (Cont'd)

9. Apply service brakes and place transmission shift lever in "1" (low 1) and operate engine at 1,000 rpm, note pressure reading. Pressure should be 135-160 psi (931-1103 kPa).
10. Apply service brakes and place transmission shift lever in "R" (reverse) and operate engine at 1,000 rpm, note pressure reading. Pressure should be 95-150 psi (655-1034 kPa).
11. Activate kickdown switch manually or through the use of an electrical jumper lead. Apply service brakes and place transmission shift lever in "D" (drive) and operate engine at 1,000 rpm, note pressure reading. Pressure should be 90-110 psi (621-758 kPa).

**NOTE**

Next pressure test must be performed during a road test or with vehicle raised and tires off the ground. Pressure must be recorded at rpm specified with closed throttle.

12. Place transmission shift lever in "D" (drive) and take foot off brake. Operate engine at 2,000 rpm, close throttle (foot off accelerator), and take pressure reading when engine rpm is between 2,000-1,200. Pressure should be 55-70 psi (379-483 kPa).




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## 17-32. TRANSMISSION OIL PRESSURE TESTS (3L80) (Cont'd)

13. Compare oil pressure test results to information in table 17-9. If malfunction is still unknown, consult troubleshooting, table 2-1.

*Table 17-9. Oil Pressure Diagnosis*

| | **Test Conditions** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Neutral 1,000 rpm | Drive idle | Drive 1,000 rpm | Low 2 1,000 rpm | Low 1 1,000 rpm | Reverse 1,000 rpm | Drive 1,000 rpm Kick-down switch activated | Drive* 2,000 rpm closed throttle | Check Transmission for Malfunctions in |
| **Test Results** | Normal | High | High | Normal | Normal | Normal | Normal | High | Detent System |
| | High | High | High | Normal | Normal | High | ** | ** | Modulator System |
| | Normal | Normal | Normal | Normal | Normal | Low | Normal | Normal | Direct Clutch Oil Feed |
| | Normal | Low to Normal | Low to Normal | Low to Normal | Low to Normal | Normal | Low to Normal | Low to Normal | Forward Clutch Oil Feed |
| | Normal | Normal | Normal | Normal | Normal | Normal | Low | Normal | Detent System |

* Modulator cable and linkage held in full throttle position.
** Oil pressure not important under test condition indicated.

14. Remove oil pressure gauge from transmission (1) and install pipe plug (3) in line pressure port (2).

## 17-32. TRANSMISSION OIL PRESSURE TESTS (3L80) (Cont'd)

### b. Control Valve and Governor Line Pressure Test

1. Remove pipe plug (3) from line pressure port (2) on left side of transmission (1).
2. Connect oil pressure gauge to line pressure port (2).

**WARNING**

Direct all personnel to stand clear of vehicle before starting engine. Transmission slipping into gear may cause injury.

**NOTE**

This test must be performed with vehicle raised and tires off the ground.

3. Start engine (TM 9-2320-280-10) and check for leaks at connections.
4. Bring engine to operating temperature.
5. Hold modulator linkage in the full extended position during testing.
6. Activate kickdown switch manually or through the use of an electrical jumper lead. Apply service brakes, place transmission shift lever in "D" (drive) and take foot off brake. Operate engine at 1,000 rpm and note pressure reading. Pressure should be 90-110 psi (621-758 kPa).
7. Slowly increase engine speed to 3,000 rpm and determine if line pressure drops below the reading recorded in step 6.
8. If line pressure drops more than 10 psi (69 kPa), remove control valve and inspect for damage. Replace control valve if damaged.
9. If line pressure drops less than 10 psi (69 kPa):
   a. Remove governor and inspect for damage (para. 7-3), replace governor if damaged.
   b. Check governor pipes, screen, and transmission case for obstructions to fluid flow. Replace damaged components.
10. Remove oil pressure gauge from transmission (1) and install pipe plug (3) in line pressure port (2).
11. Remove electrical jumper lead from kick-down switch if attached.

# CHAPTER 18

# TRANSFER CASE REPAIR

## 18-1. INTRODUCTION

This chapter contains maintenance instructions for disassembly and repair of transfer case components at the General Support maintenance level. Some subassemblies and parts must be removed before the transfer case components can be accessed. They are referenced to other paragraphs of this manual.

## 18-2. TRANSFER CASE REPAIR TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 18-3. | Transfer Case Repair (Model 218) | 18-2 |
| 18-4. | Transfer Case Repair (Model 242) | 18-26 |

# 18-3. TRANSFER CASE REPAIR (Model 218)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)
Dial indicator (Appendix G, Item 95)

**Special Tools**

Rear output shaft bearing installer (Appendix G, Item 57)
Rear retainer bearing installer (Appendix G, Item 62)
Front output shaft front bearing installer (Appendix G, Item 58)
Front output shaft front bearing remover (Appendix G, Item 59)
Front output shaft rear bearing installer (Appendix G, Item 56)
Bearing remover set (Appendix G, Item 73)
Input gear bearing remover (Appendix G, Item 60)
Input gear bearing installer (Appendix G, Item 61)
Slide hammer adapter (Appendix G, Item 55)
Yoke seal installer (Appendix G, Item 54)
Annulus gear bushing remover (Appendix G, Item 64)
Annulus gear bushing installer (Appendix G, Item 65)
Driver handle (Appendix G, Item 34)
Mainshaft bearing installer (Appendix G, Item 63)

**Materials/Parts**

Two O-rings (Appendix E, Item 138)
Plain seal (Appendix E, Item 230)
Plain seal (Appendix E, Item 233)
Plain seal (Appendix E, Item 243)
Two lockwashers (Appendix E, Item 112)
Locknut (Appendix E, Item 59)
Plain seal (Appendix E, Item 229)
O-ring (Appendix E, Item 136)
O-ring (Appendix E, Item 134)
O-ring (Appendix E, Item 135)
Anaerobic gasket sealer (Appendix B, Item 49)
Petrolatum (Appendix B, Item 38)
Silicone sealant (Appendix B, Item 43)
Sealing compound (Appendix B, Item 50)
Transfer case support stand (Appendix C, Fig. 4)

**Manual References**

TM 9-2320-280-24P

**Equipment Condition**

Transfer case removed (para. 8-3).

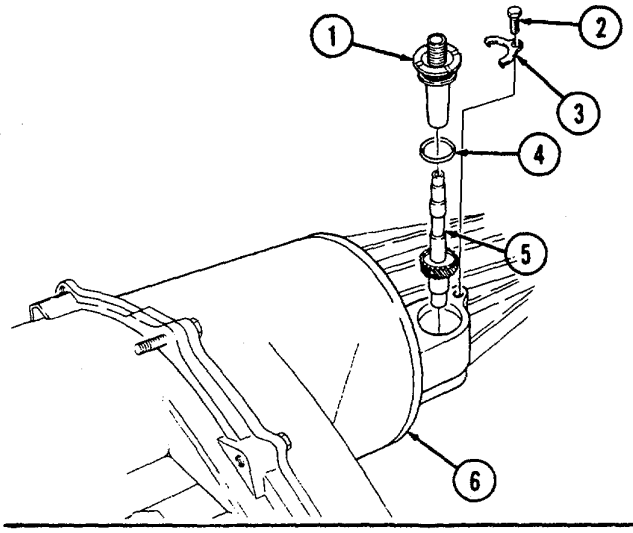
**Maintenance Level**

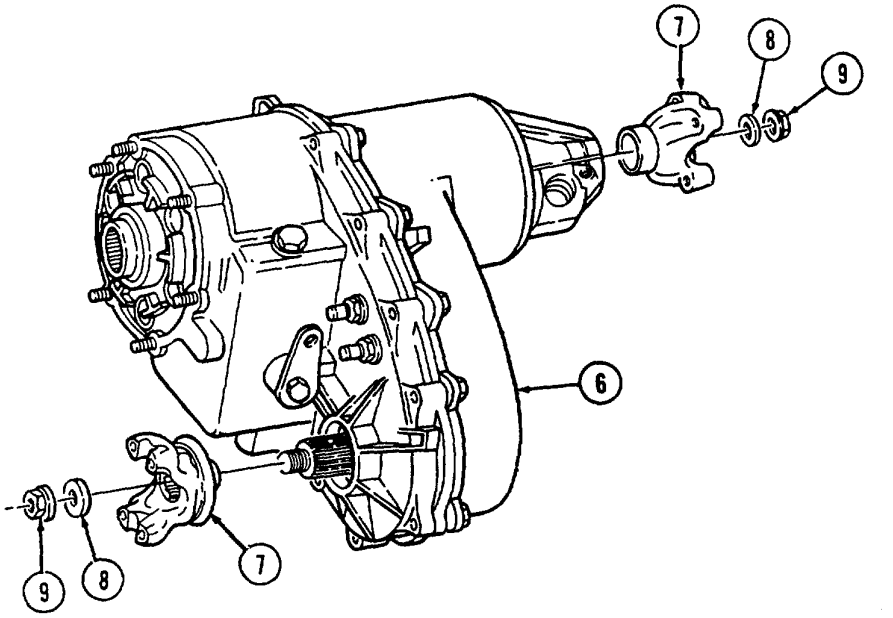
General support

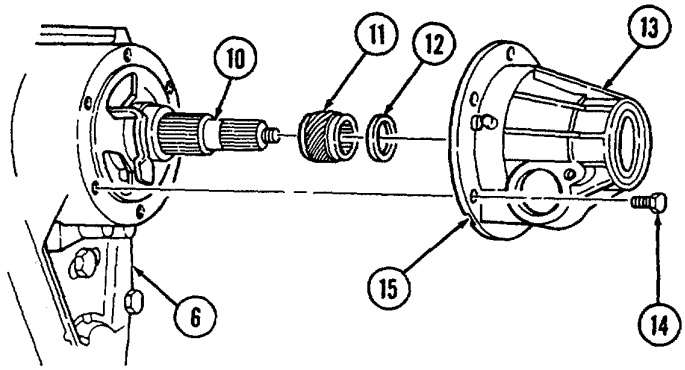
## a. Disassembly

1. Remove capscrew (2), clamp (3), pinion adapter (1), and driven gear (5) from transfer case (6).
2. Remove O-ring (4) from pinion adapter (1). Discard O-ring (4).
3. Remove two nuts (9), lockwashers (8), and output yokes (7) from transfer case (6). Discard lockwashers (8).
4. Mark rear retainer (13) and transfer case (6) for assembly.
5. Remove six capscrews (14) and rear retainer (13) from transfer case (6).
6. Insert screwdrivers in two notches (15) in rear retainer (13) and remove rear retainer (13) from transfer case (6).
7. Remove differential shim(s) (12) and speedometer drive gear (11) from rear output shaft (10). Tag shim(s) (12) for assembly.

**18-3. TRANSFER REPAIR CASE REPAIR (Model 218) (Cont'd)**

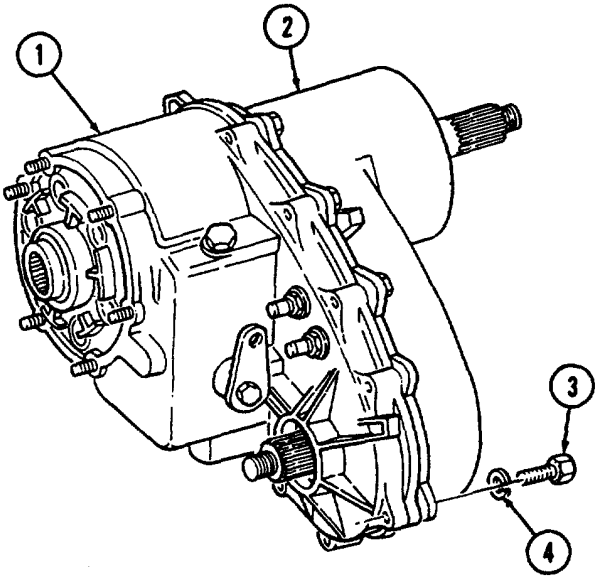


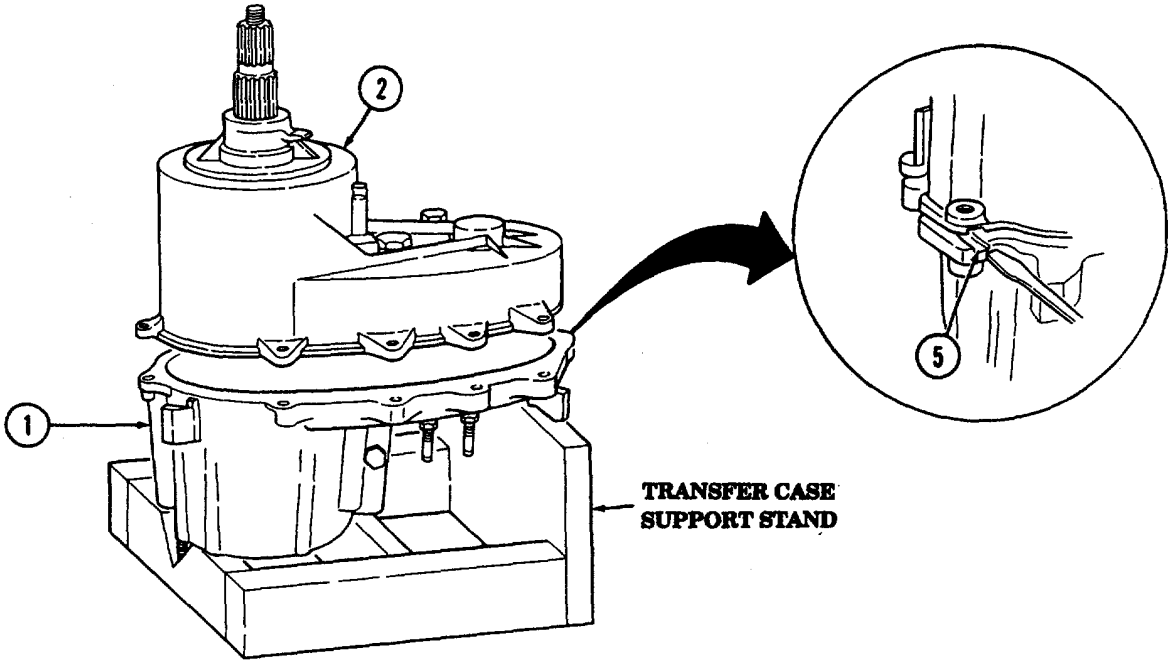



**18-3. TRANSFER REPAIR CASE REPAIR (Model 218) (Cont'd)**

8. Remove ten capscrews (3) and two washers (4) from rear case (2) and front case (1).
9. Position transfer case on transfer case support stand.
10. Insert screwdrivers in two notches (5) at case ends and pry cases apart. Remove rear case (2) from front case (1).



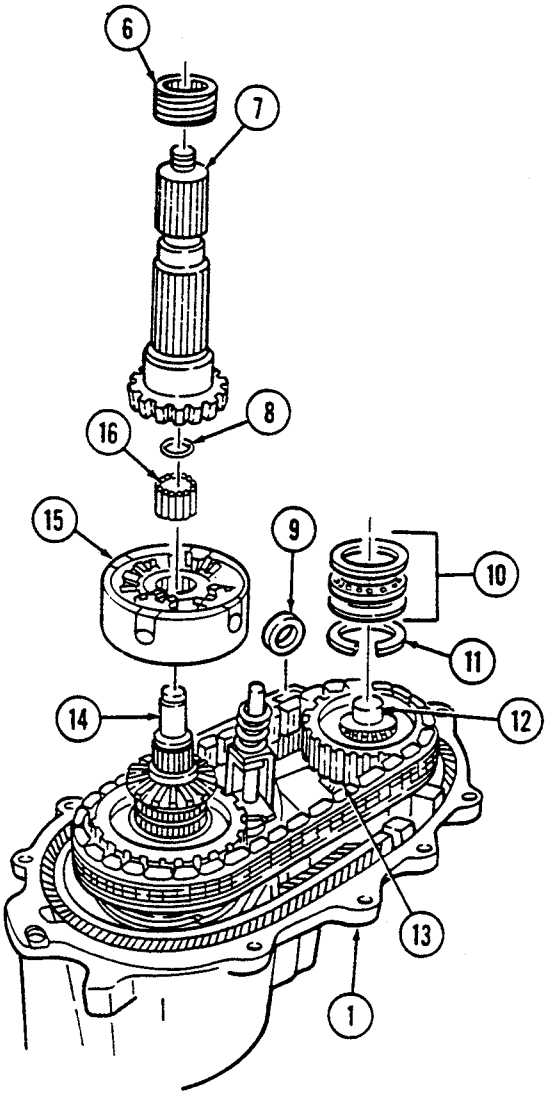



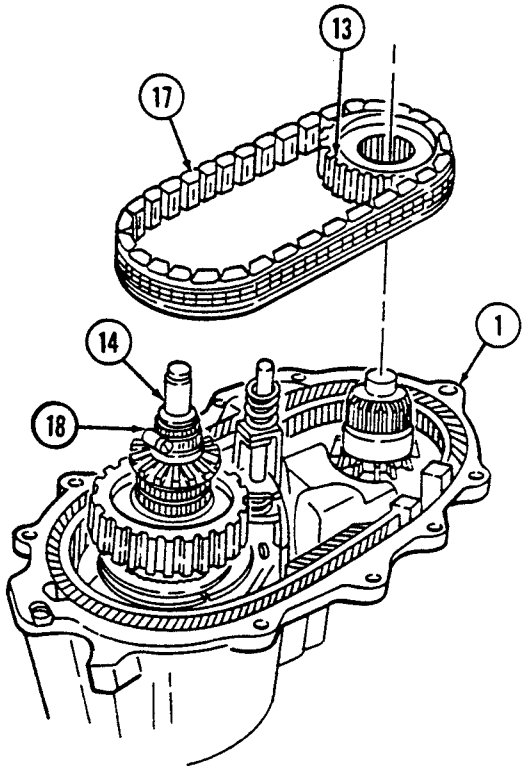
## 18-3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

**NOTE**

Pilot roller bearings will fall free when removing output shaft.

11. Remove oil pump (6), rear output shaft (7), and fifteen pilot roller bearings (16). Remove O-ring (8) from groove on mainshaft (14). Discard O-ring (8).
12. Remove differential (15) and magnet (9) from front case (1).
13. Remove front output shaft rear thrust bearing assembly (10) from front output shaft (12). Tag thrust bearing assembly (10) for assembly.
14. Remove snapring (11) from driven sprocket (13) and front output shaft (12).
15. Place hose clamp (18) around mainshaft (14) to hold assembly together.
16. Lift mainshaft (14) slightly, and remove driven sprocket (13) and drive chain (17) from front case (1).



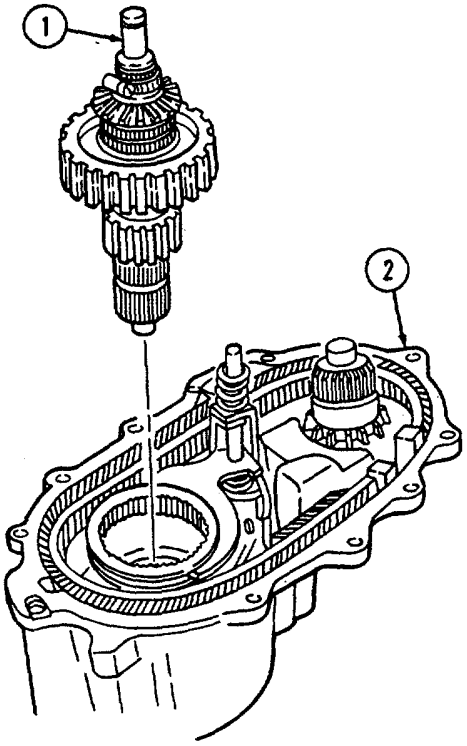
## 18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

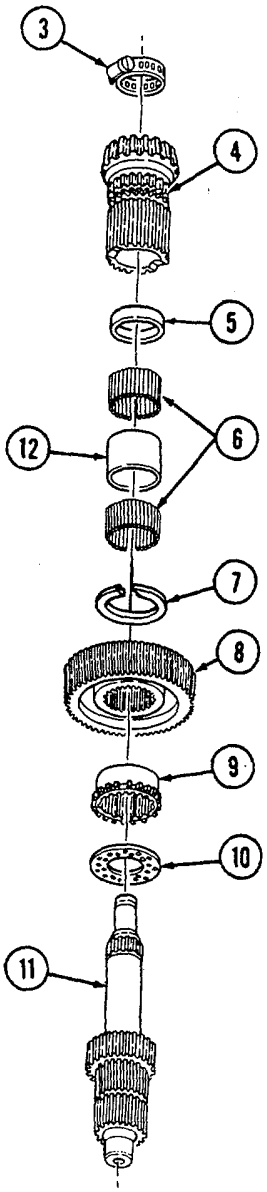
17. Remove mainshaft assembly (1) from front case (2).

**NOTE**

Needle bearings will fall free when removing side gear.

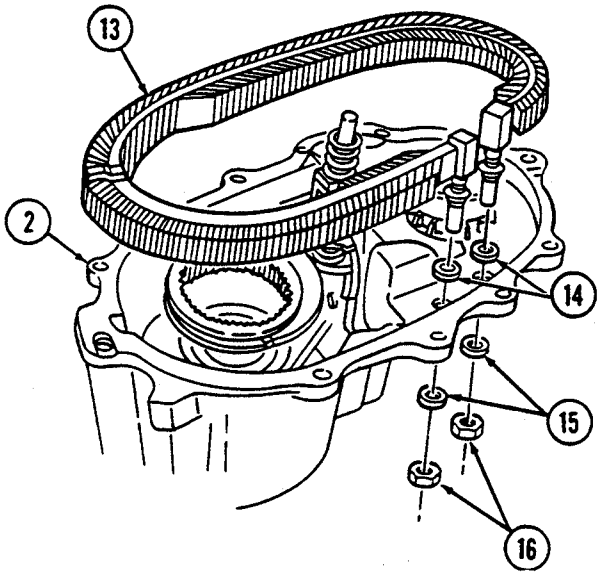
18. Remove hose clamp (3), side gear (4), drive gear (8), spacer ring (5), spacer sleeve (12), eighty-two needle bearings (6), side gear clutch (9), and mainshaft thrust washer (10) from mainshaft (11).
19. Remove snapring (7) from side gear (4).

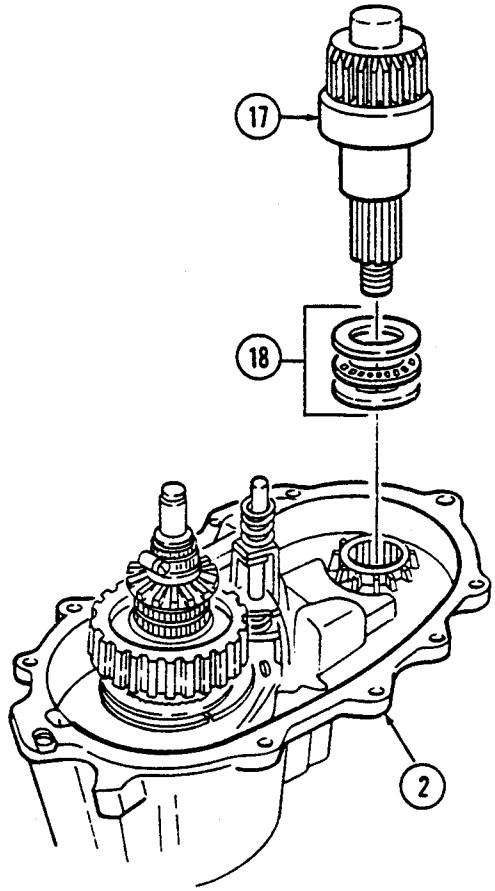


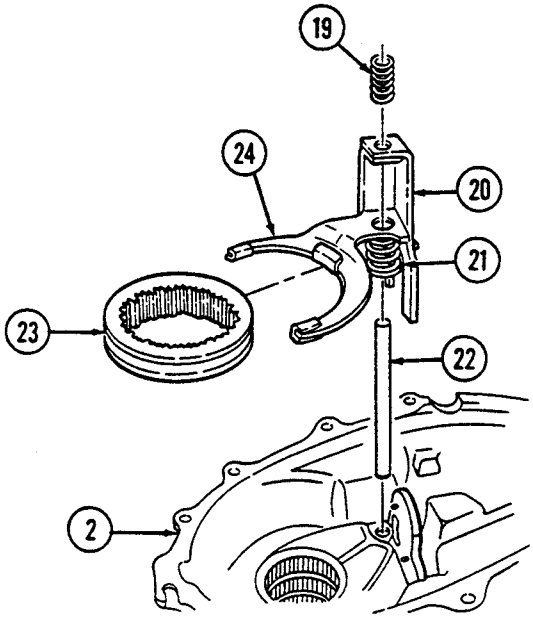



## 18-3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

20. Remove two nuts (16), washers (15), and oil cooler (13) from front case (2).
21. Remove two O-rings (14) from oil cooler (13). Discard O-rings (14).
22. Remove front output shaft (17) and front thrust bearing assembly (18) from front case (2). Tag thrust bearing assembly (18) for assembly.
23. Remove shift rail spring (19), clutch sleeve (23), mode selector fork (24), mode selector fork bracket (20), mode selector fork spring (21), and shift rail (22) from front case (2).

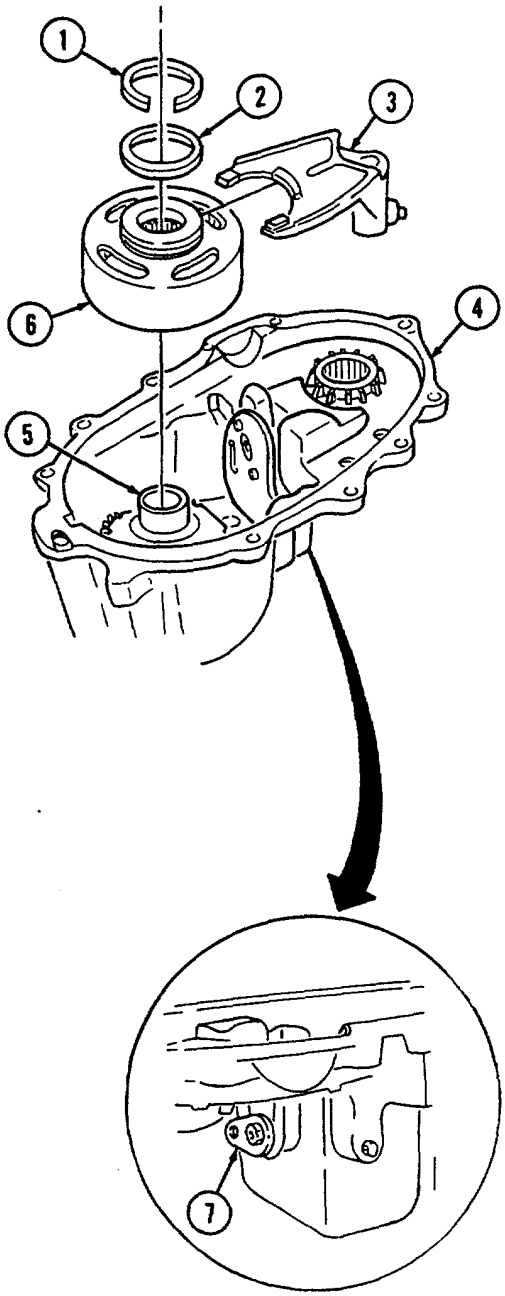


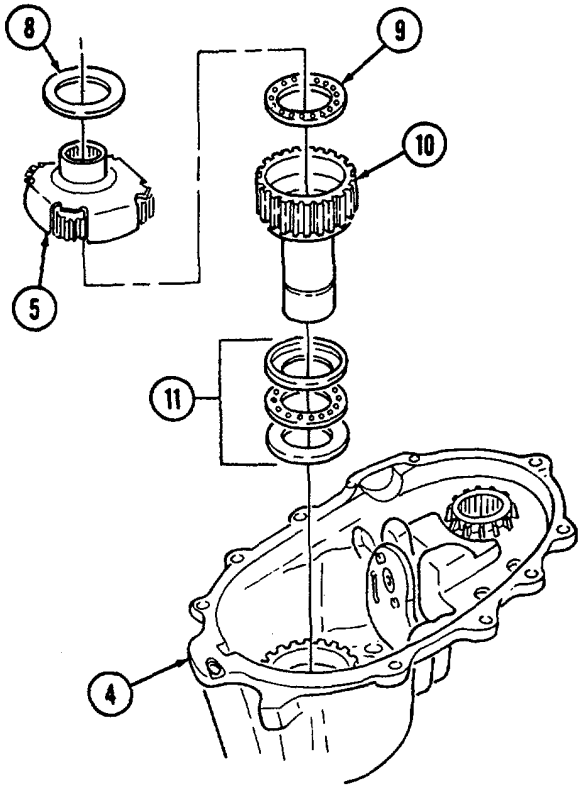



**18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)**

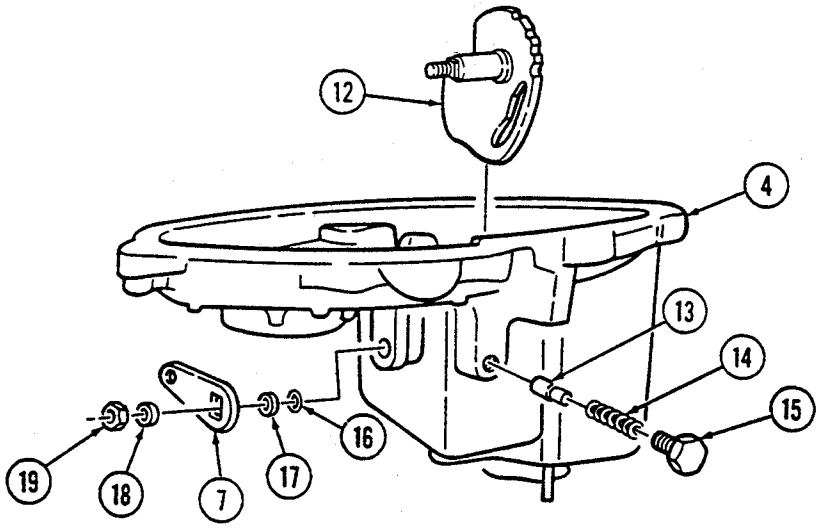
24. Move range operating lever (7) downward to last detent.
25. Remove snapring (1) from annulus gear (6) and planetary assembly (5).
26. Remove annulus gear thrust washer (2), annulus gear (6), and range fork (3) from front case (4).
27. Remove planetary thrust washer (8) and planetary assembly (5) from front case (4
28. Remove mainshaft thrust bearing (9), input gear (10), and input gear thrust bearing assembly (11) from front case (4). Tag thrust bearing (9) and thrust bearing assembly (11) for assembly.

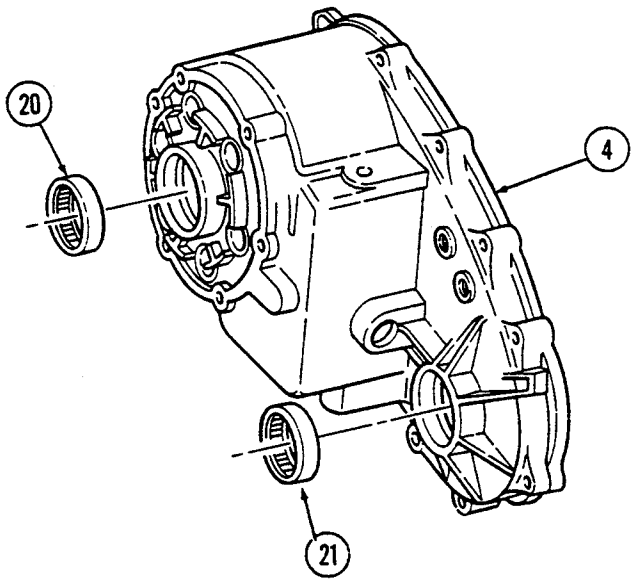


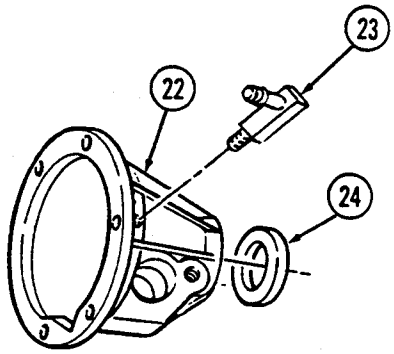



## 18-3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

29. Remove spring retainer bolt (15), spring (14), and detent poppet (13) from front case (4).
30. Remove locknut (19), washer (18), operating lever (7), range sector (12), O-ring seal retainer (17), and O-ring (16) from front case (4). Discard O-ring (16) and locknut (19).
31. Remove seals (20) and (21) from front case (4). Discard seals (20) and (21).
32. Remove seal (24) from rear retainer (22). Discard seal (24).
33. Remove elbow (23) from rear retainer (22).



## 18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

b. Cleaning

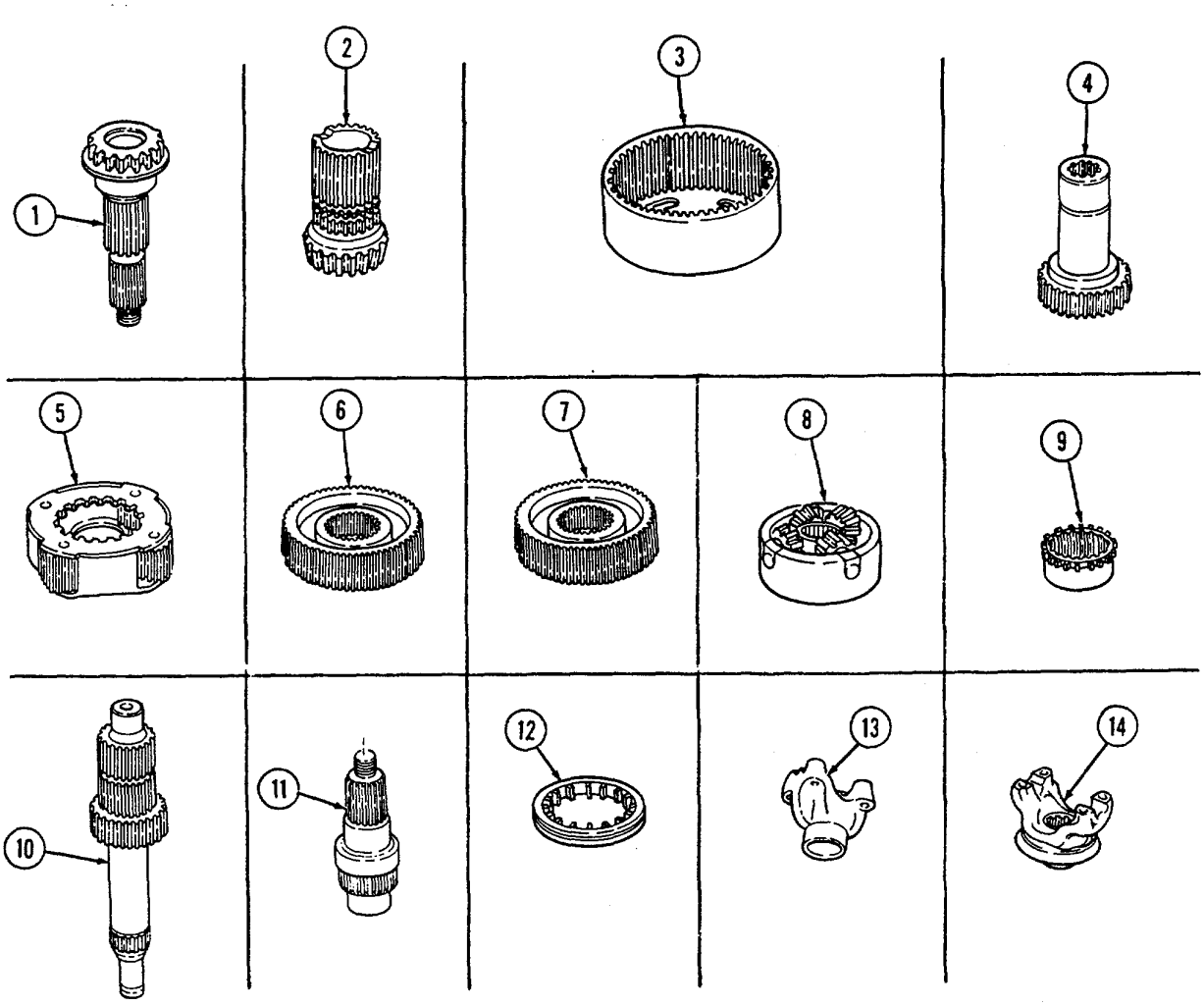
Clean all transfer case components in accordance with para. 2-13.

c. Inspection

**NOTE**

For general inspection instructions, refer to para. 2-14.

1. Inspect splines and gear teeth on rear output shaft (1), side gear (2), annulus gear (3), input gear (4), planetary assembly (5), drive gear (6), and driven gear (7) for damage. Replace any if damaged.
2. Inspect gear teeth and splines on differential assembly (8), side gear clutch (9), mainshaft (10), front output shaft (11), clutch ring (12), rear output shaft yoke (13) and front output shaft yoke (14) for damage. Replace any if damaged.



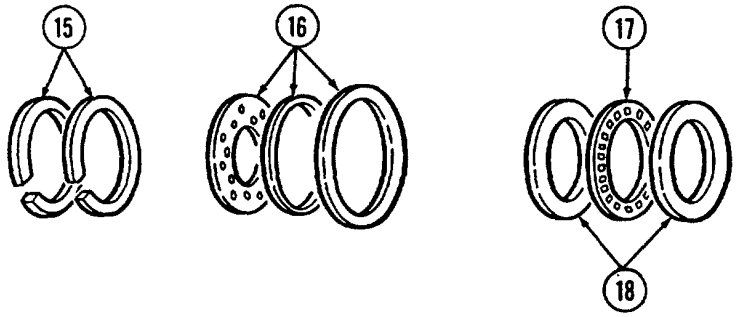
## 18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

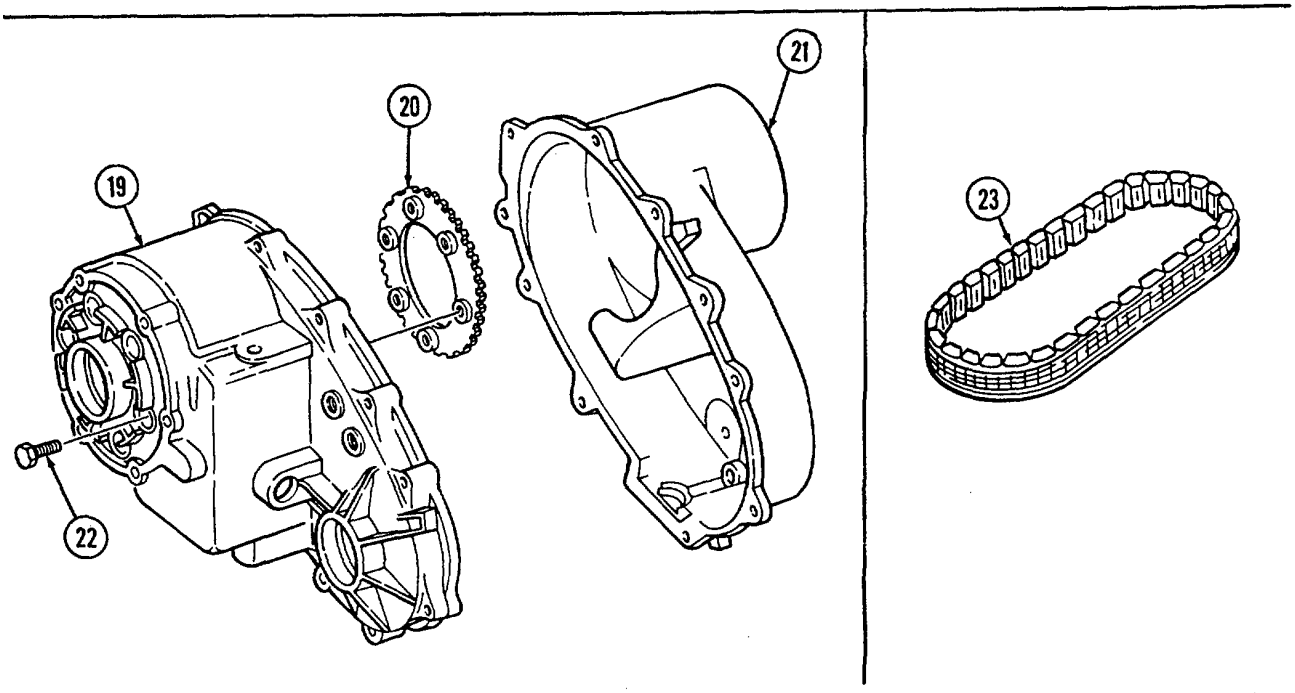
3. Inspect thrust washers (16), snaprings (15), thrust bearings (17), and inner and outer thrust bearing races (18) for damage. Replace any if damaged.
4. Inspect rear case (21) and front case (19) for damage. Replace transfer case assembly if either are damaged.
5. Inspect lockplate (20) for damage. If damaged, perform steps 6 through 8, if not, go to step 9.
6. Remove six capscrews (22) from lockplate (20) and remove from front case (19).
7. Apply anaerobic gasket sealer to lockplate (20) mounting surface and install in front case (19).
8. Coat six lockplate capscrews (22) with anaerobic gasket sealer and install capscrews (22) in lockplate (20). Tighten capscrews (22) to 30 lb-ft (41 N•m).

**NOTE**

If there has been any contamination which requires bearing replacement, the drive chain should be replaced. The same contaminants which wear out bearings will wear out the drive chain.

9. Inspect drive chain (23) for binding or damage. Replace drive chain (23) if binding or damaged.



**18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)**

**CAUTION**

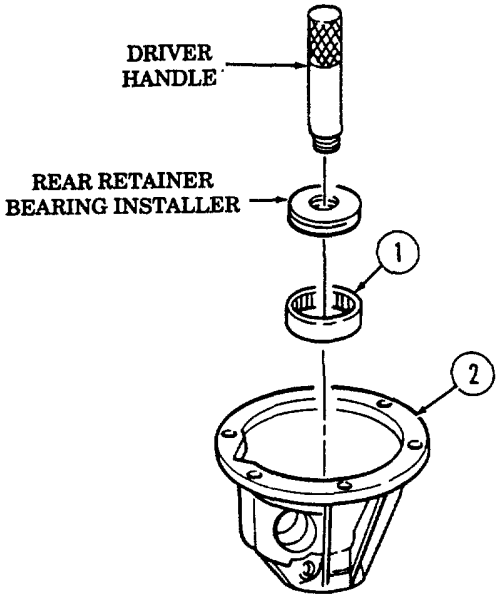
All bearings used in the transfer case must be correctly positioned to avoid covering the bearing oil feed holes. After replacing any bearing, check bearing position to be sure oil feed hole is not blocked. Incorrect bearing installation will lead to failure of transfer case.

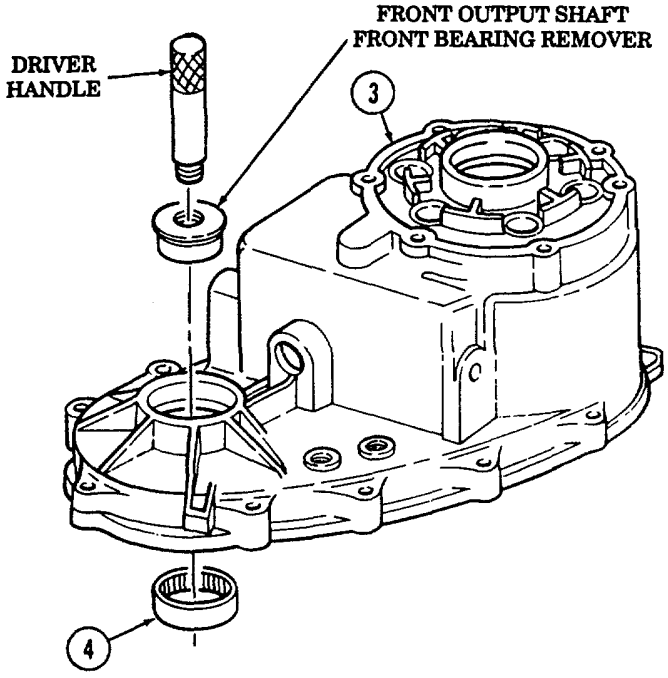
10. Inspect rear retainer output shaft bearing (1) for damage. If damaged, perform steps 11 and 12. If not, go to step 13.
11. Remove bearing (1) from rear retainer (2).

**NOTE**

Be sure shielded side of bearing faces interior of transfer case after installation.

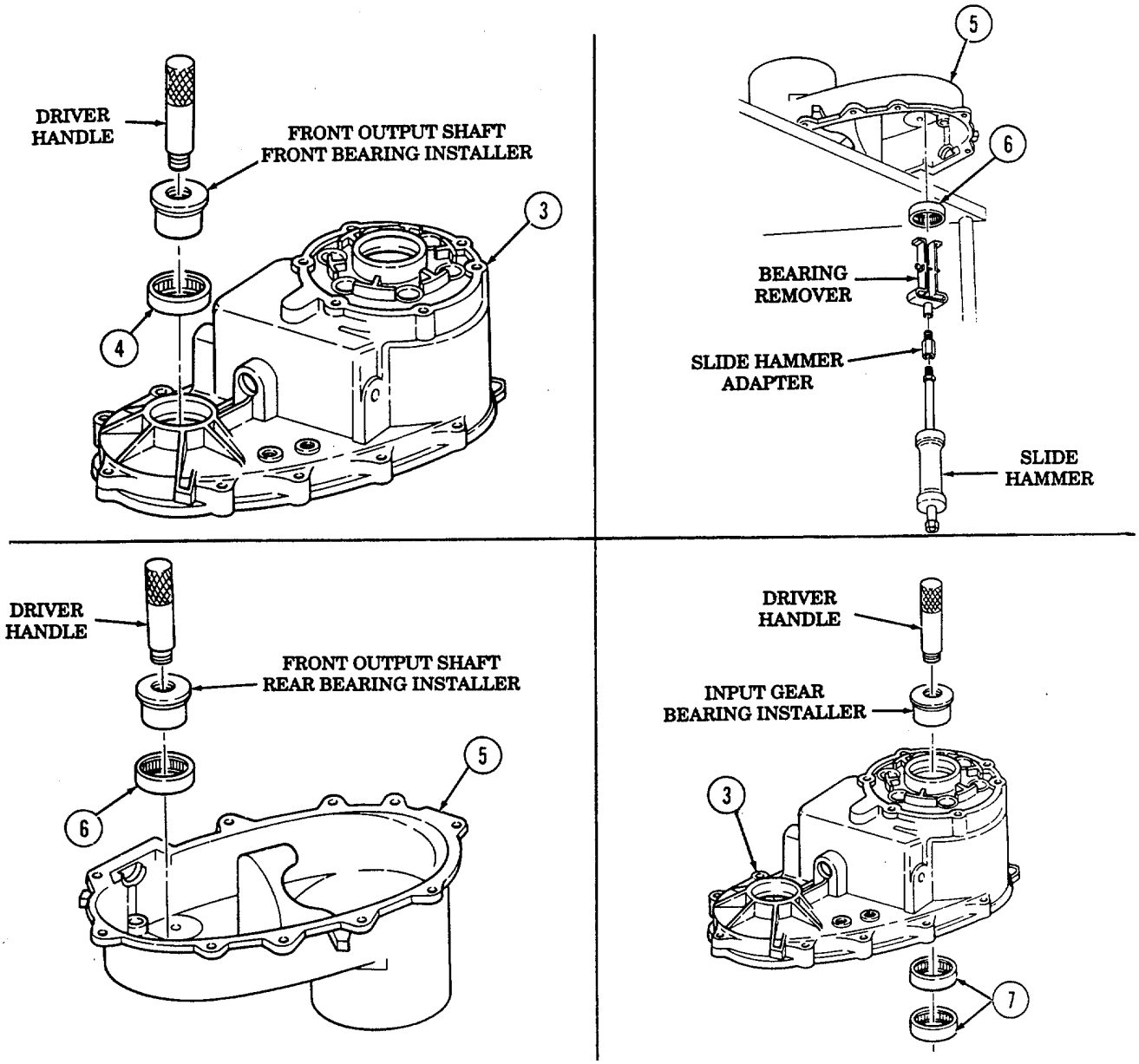
12. Using driver handle and rear retainer bearing installer, install bearing (1) in rear retainer (2).
13. Inspect front output shaft front bearing (4) for damage. If damaged, perform steps 14 and 15. If not, go to step 16.
14. Using driver handle and front output shaft front bearing remover, remove bearing (4) from front case (3).



## 18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

15. Using driver handle and front output shaft front bearing installer, install bearing (4) in front case (3).
16. Inspect front output shaft rear bearing (6). If damaged, perform steps 17 and 18. If not, go to step 19.
17. Using slide hammer, slide hammer adapter, and bearing remover, remove bearing (6) from rear case (5).
18. Using driver handle and front output shaft rear bearing installer, install bearing (6) in rear case (5).
19. Inspect input gear front and rear bearings (7). If damaged, perform steps 20 through 22. If not, go to step 23.
20. Using driver handle and input gear bearing remover, remove both bearings (7) from front case (3) at the same time.



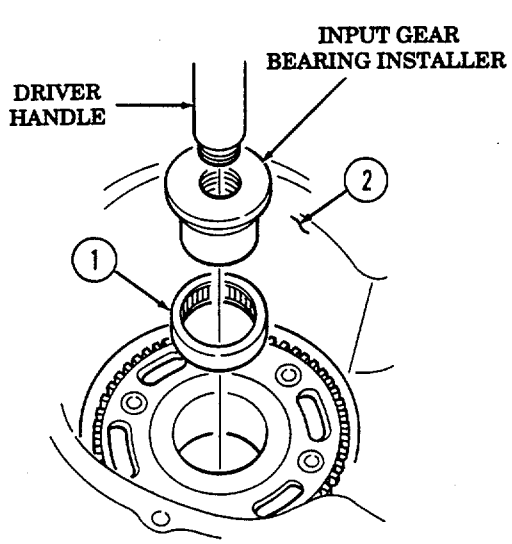
18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

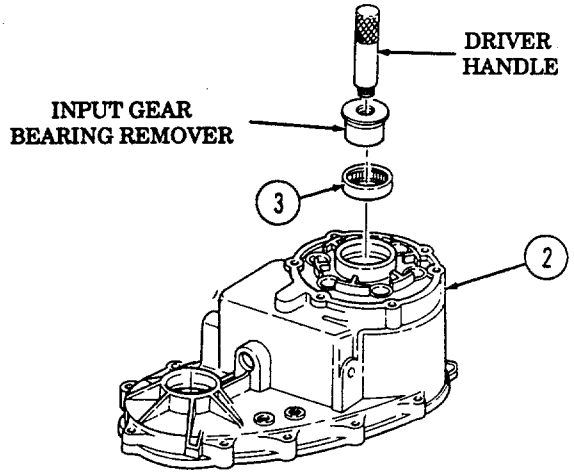
21. Using driver handle and input gear bearing installer, install rear bearing (1) in front case (2).
22. Using driver handle and input gear bearing installer, install front bearing (3) in front case (2).
23. Inspect mainshaft pilot bearing (4) for damage. If damaged, perform steps 24 through 26. If not, go to step 27.
24. Using slide hammer, slide hammer adapter, and bearing remover, remove bearing (4) from input gear (5).

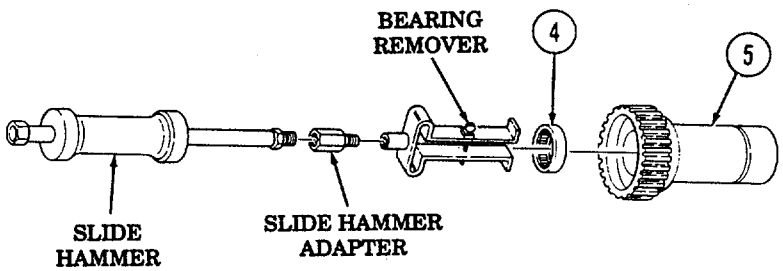
**CAUTION**

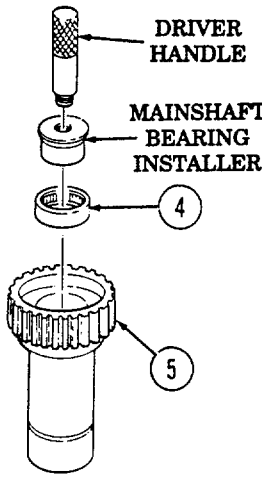
Correctly position mainshaft pilot bearing to avoid covering the bearing oil feed hole. Incorrect bearing installation will lead to failure of transfer case.

25. Using driver handle and mainshaft bearing installer, install bearing (4) in input gear (5).
26. Remove installation tools and check bearing (4) position to be sure bottom of bearing (4) is flush with top of oil feed hole.



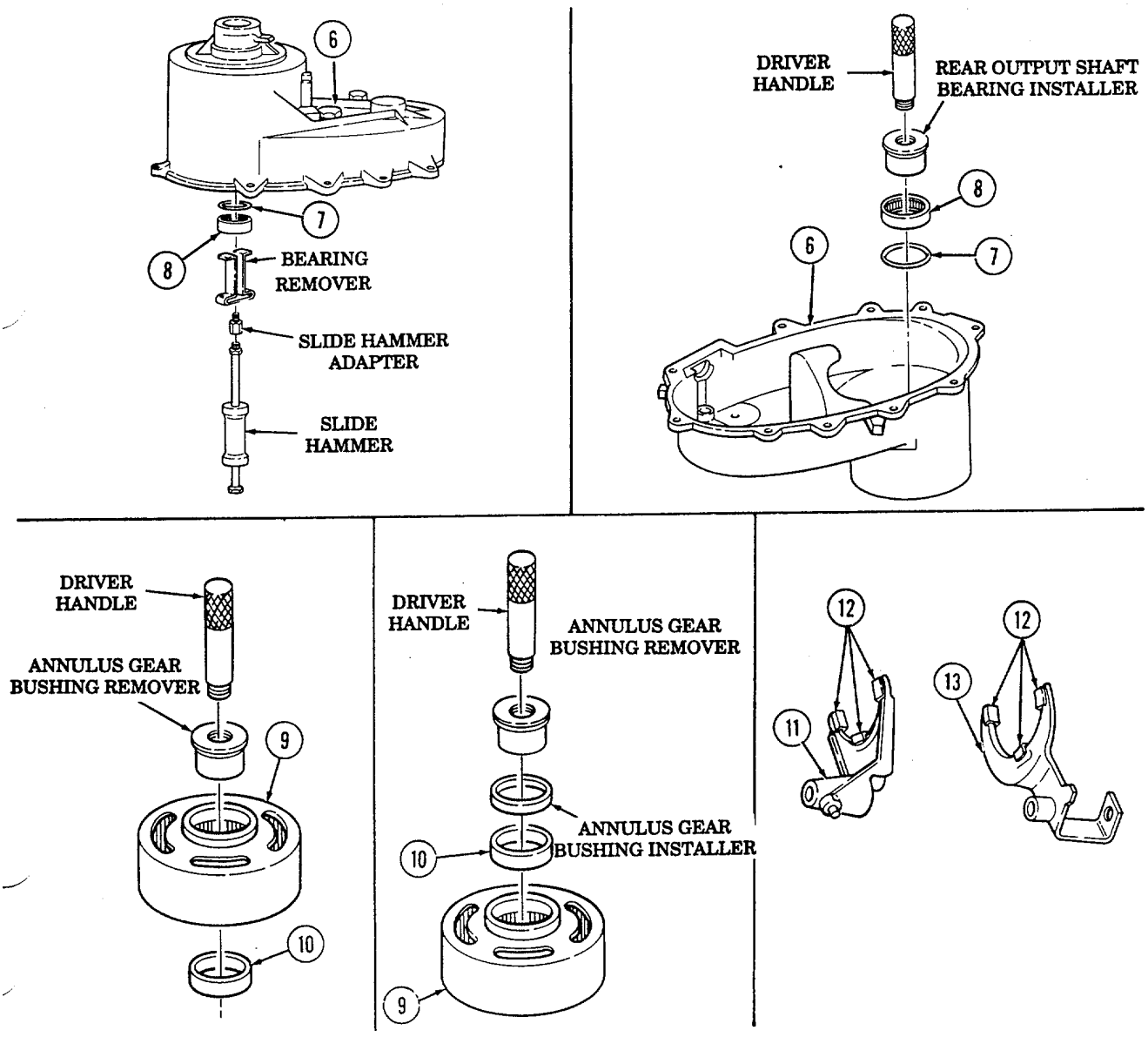



18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

27. Inspect rear case output shaft bearing (8). If damaged, perform steps 28 and 29. If not, go to step 30.
28. Using bearing remover, slide hammer adapter, and slide hammer, remove bearing (8) and seal (7) from rear case (6). Discard seal (7).
29. Using driver handle and rear output shaft bearing installer, install seal (7) and bearing (8) in rear case (6).
30. Inspect annulus gear bushing (10). If damaged, perform steps 31 and 32. If not, go to step 33.
31. Using driver handle and annulus gear bushing remover, remove bushing (10) from annulus gear (9)
32. Using driver handle, annulus gear bushing remover and annulus gear bushing installer, install bushing (10) in annulus gear (9).
33. Inspect range fork (11), mode selector fork (13), and pads (12) for damage. Replace any if damaged.
34. Refer to para. 2-14 for general inspection instructions for all other transfer case parts.



## 18-3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

**d. Assembly**

**NOTE**

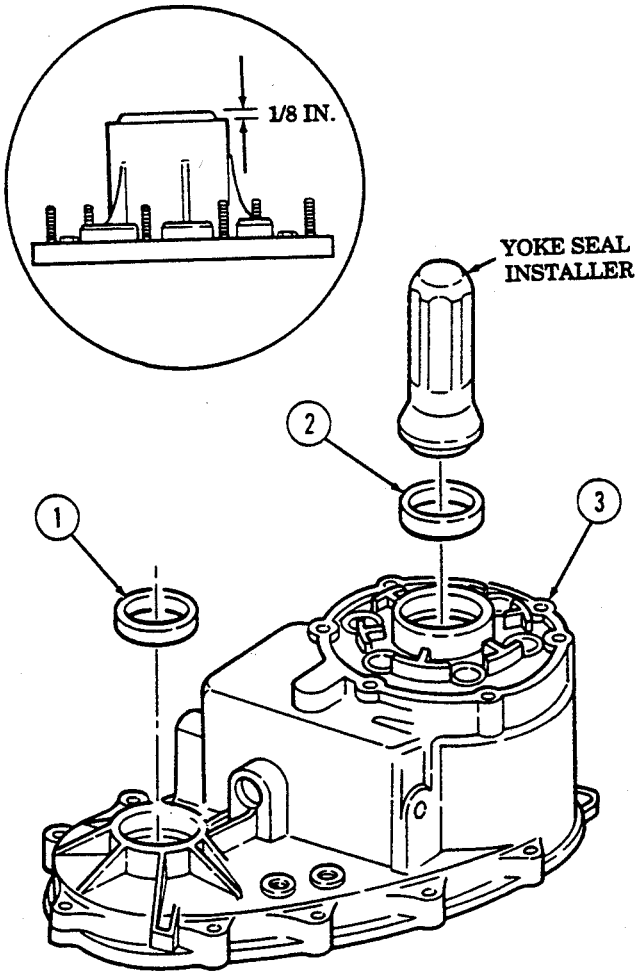
- For general assembly instructions, refer to para. 2-16.
- Ensure rubber surface of seal faces yoke seal installer.

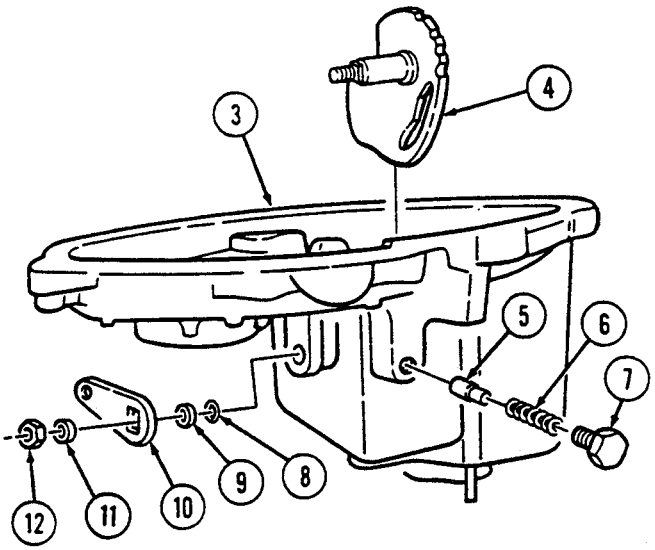
1. Using yoke seal installer, install seals (1) and (2) in front case (3).

**NOTE**

- Ensure input gear oil seal is installed with 0.125 in. (3.17 mm) of seal out of front end housing as shown.
- Ensure rubber surface of seal faces yoke seal installer.

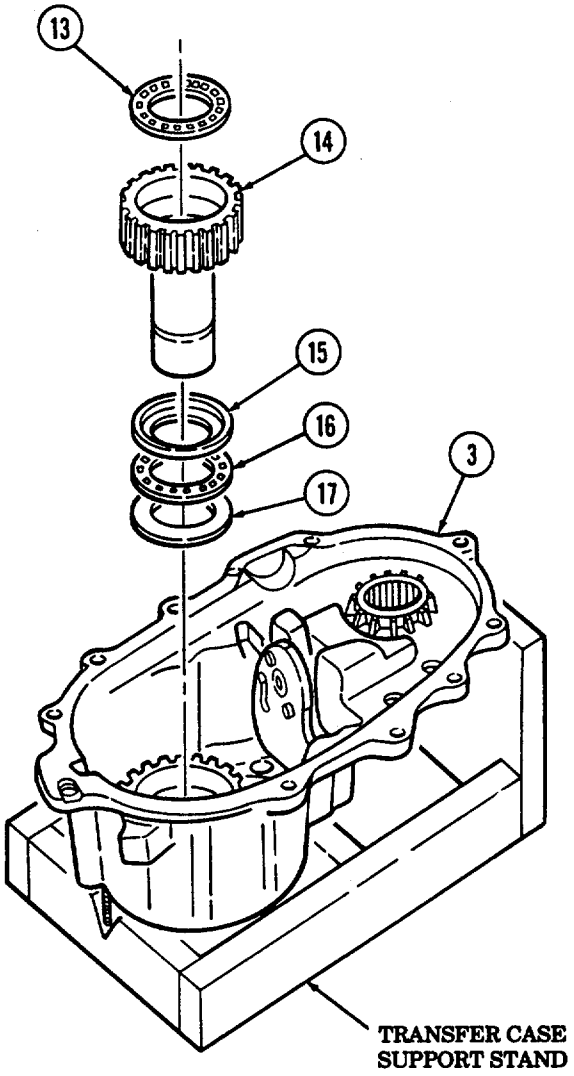
2. Using yoke seal installer, install seal (2) in front case (3).
3. Install sector shaft O-ring (8) and retainer (9) in front case (3).
4. Install range sector (4) and operating lever (10) in front case (3) with washer (11) and locknut (12). Tighten locknut (12) to 28 lb-ft (38 N·m).
5. Install poppet (5), spring (6), and retaining bolt (7) in detent bore in front case (3). Tighten retaining bolt (7) to 22 lb-ft (30 N·m).
6. Move operating lever (10) down to last detent.

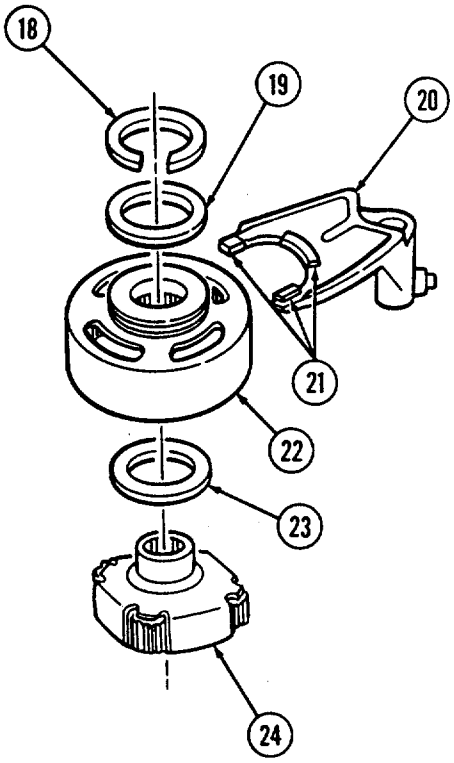


## 18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

7. Place front case (3) on transfer case support stand.
8. Install input gear flat bearing race (17) and thrust bearing (16) in counterbore in front case (3).
9. Install flanged O.D. bearing race (15) on input gear (14) and install input gear (14) in front case (3).
10. Install mainshaft thrust bearing (13) in recess in inputgear (14).
11. Assemble planetary assembly (24), thrust washer (23), annulus gear (22), and annulus gear thrust washer (19), and install snapring (18).
12. Ensuring that three plastic pads (21) are in place on range fork (20), install range fork (20) in annulus gear (22).



## 18-3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

13. Install planetary assembly (1) until seated on input gear (4), and position range fork lug (2) into detent slot in range sector (3).
14. Install two O-rings (7) on oil cooler manifolds (6) and position oil cooler (5) in front case (10).

**CAUTION**

Do not over-torque retaining nuts, or internal damage to the transfer case oil cooler may result.

15. Install two washers (8) and nuts (9) securing oil cooler (5) to front case (10), ensuring narrow side of washers (8) is next to nuts (9). Hold the end of the oil cooler stationary and use a pound-inch torque wrench to tighten nuts (9) to 192-216 lb-in. (22-24 N•m).

**NOTE**

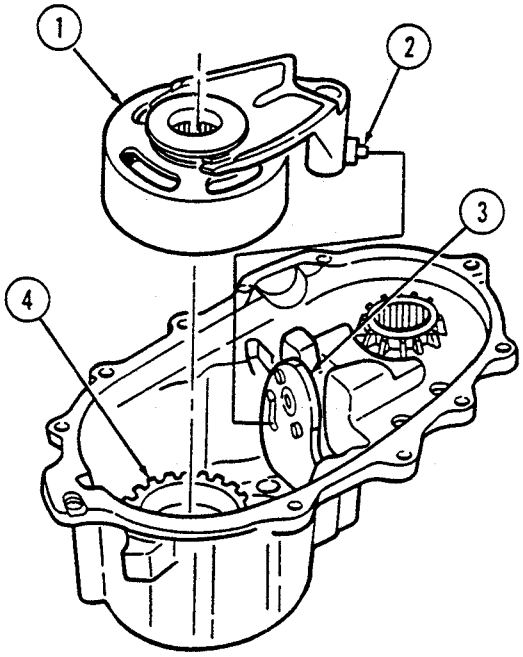
Oil in case bore may prevent shift rail from seating completely and prevent rear case installation.

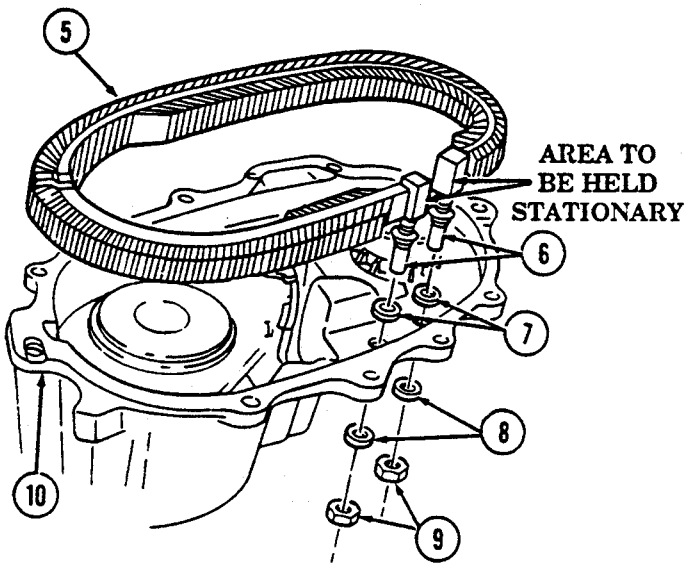
16. Remove all traces of oil from shift rail bore in front case (10).

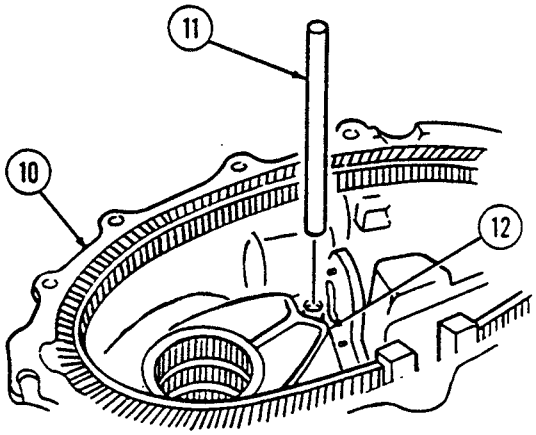
**NOTE**

Tapered end of shift rail must point up.

17. Install shift rail (11) through range fork (12) and into shift rail bore in front case (10). Be sure shift rail (11) is seated.

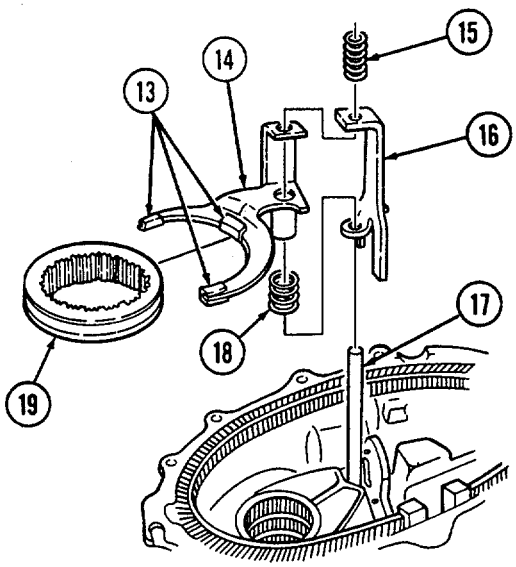


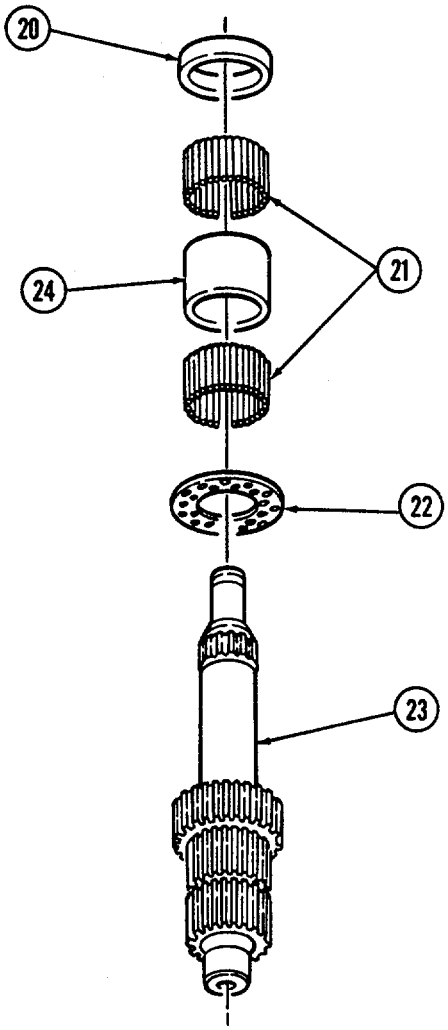



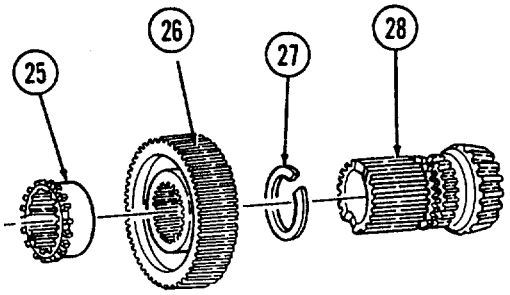



18 - 3. TRANSFER CASE REPAIR ) (Model 218) (Cont'd)

18. Assemble mode selector fork (14), mode selector fork spring (18), and mode selector fork bracket (16).
19. Ensuring that three plastic pads (13) are in place on mode selector fork (14), install mode selector fork (14) in groove in clutch sleeve (19).
20. Install mode selector fork (14), mode fork spring (18), mode selector fork bracket (16), clutch sleeve (19), and shift rail spring (15) on shift rail (17).
21. Install mainshaft thrust washer (22) on mainshaft (23).
22. Apply petrolatum to surface of mainshaft (23) to hold needle bearings (21) in place.
23. Assemble forty-one needle bearings (21) on mainshaft (23). Install spacer sleeve (24) on mainshaft (23).
24. Assembly forty-one needle bearings (21) on mainshaft (23). Install spacer ring (20) on mainshaft (23).
25. Install snapring (27) in slot closest to center on side gear (28).
26. Install drive gear (26) and side gear clutch (25) on side gear (28).



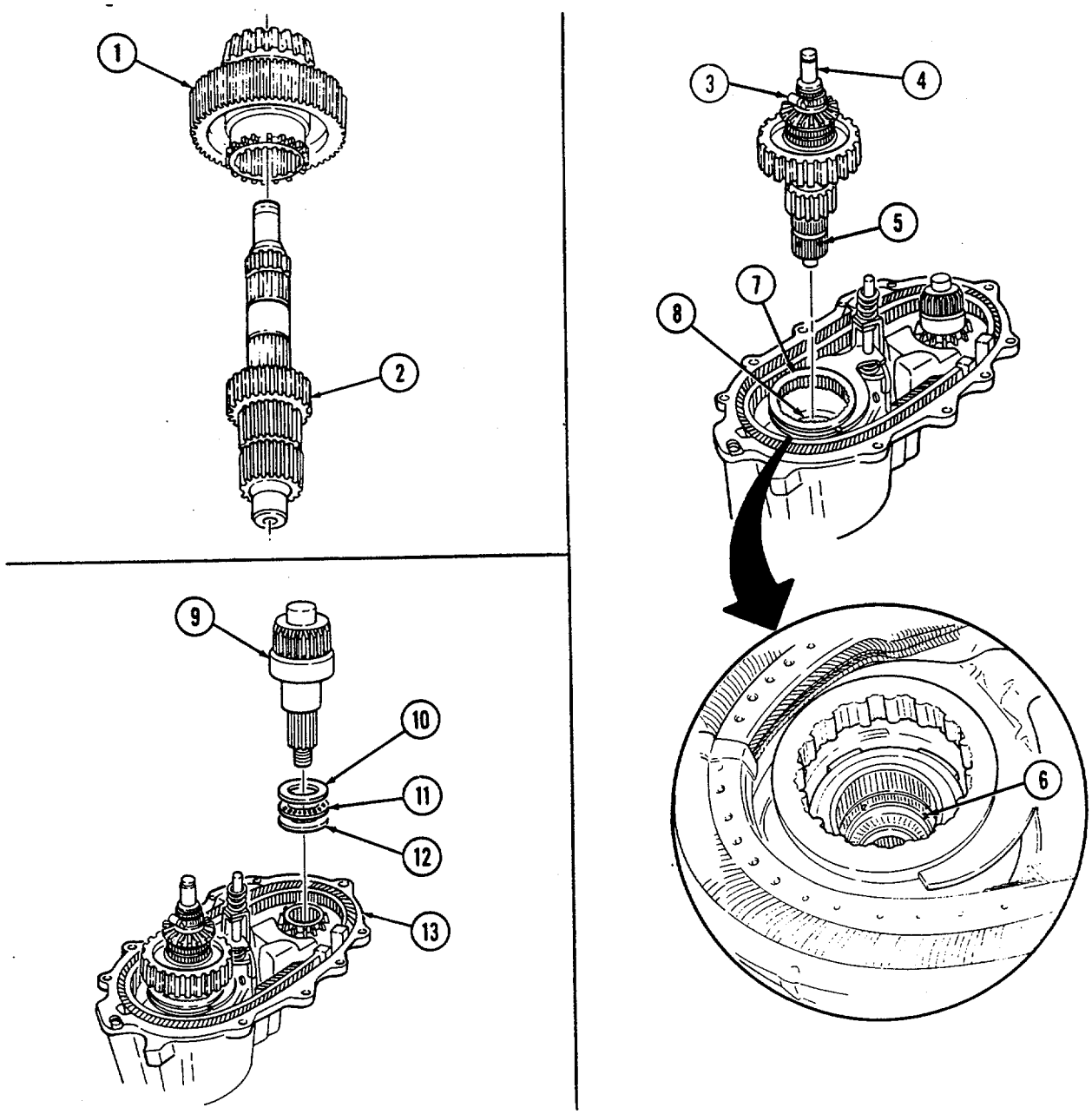



18 - 34. TRANSFER CASE REPAIR) (Model 218) Cont'd)

**CAUTION**

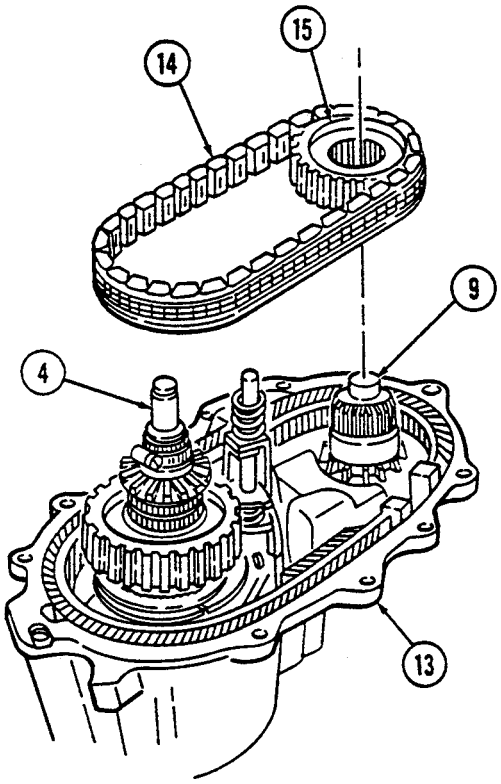
Care must be taken when assembling gears on mainshaft to avoid displacing bearings.

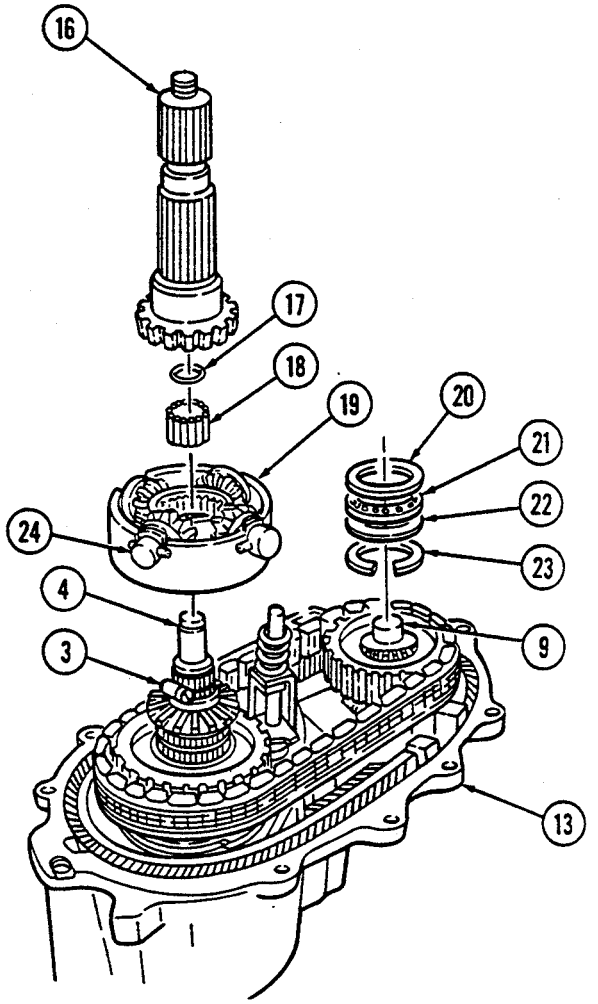
27. Install assembled gears (1) on mainshaft (2).
28. Install hose clamp (3) on end of mainshaft assembly (4) to hold assembled components together.
29. Install mainshaft assembly (4) through clutch sleeve (7) and into annulus gear (8), ensuring mainshaft oil holes (5) align with planetary oil holes (6).
30. Install front output shaft thick bearing race (12), bearing (11), thin bearing race (10), and front output shaft (9) in front case (13).



## 18-3. TRANSFER CASE REPAIR (Model 218) Cont'd)

31. Position driven sprocket (15) in drive chain (14) and align driven sprocket (15) with front output shaft (9).
32. Pull up on mainshaft assembly (4) slightly and install drive chain (14) and driven sprocket (15) in front case (13).
33. Install snapring (23), thin bearing race (22), bearing (21), and thick bearing race (20) on front output shaft (9).
34. Remove hose clamp (3) from mainshaft assembly (4).
35. Apply petrolatum to end of rear output shaft (16) to hold pilot roller bearings (18) in place. Assemble fifteen pilot roller bearings (18) into end of rear output shaft (16).
36. Install O-ring (17) in groove on end of mainshaft assembly (4). ■
37. Install differential (19) over mainshaft assembly (4) with thrust blocks (24) facing up. Be sure differential (19) seats on mainshaft assembly (4).
38. Install rear output shaft (16) on differential (19). Push output shaft (16) over O-ring (17). ■



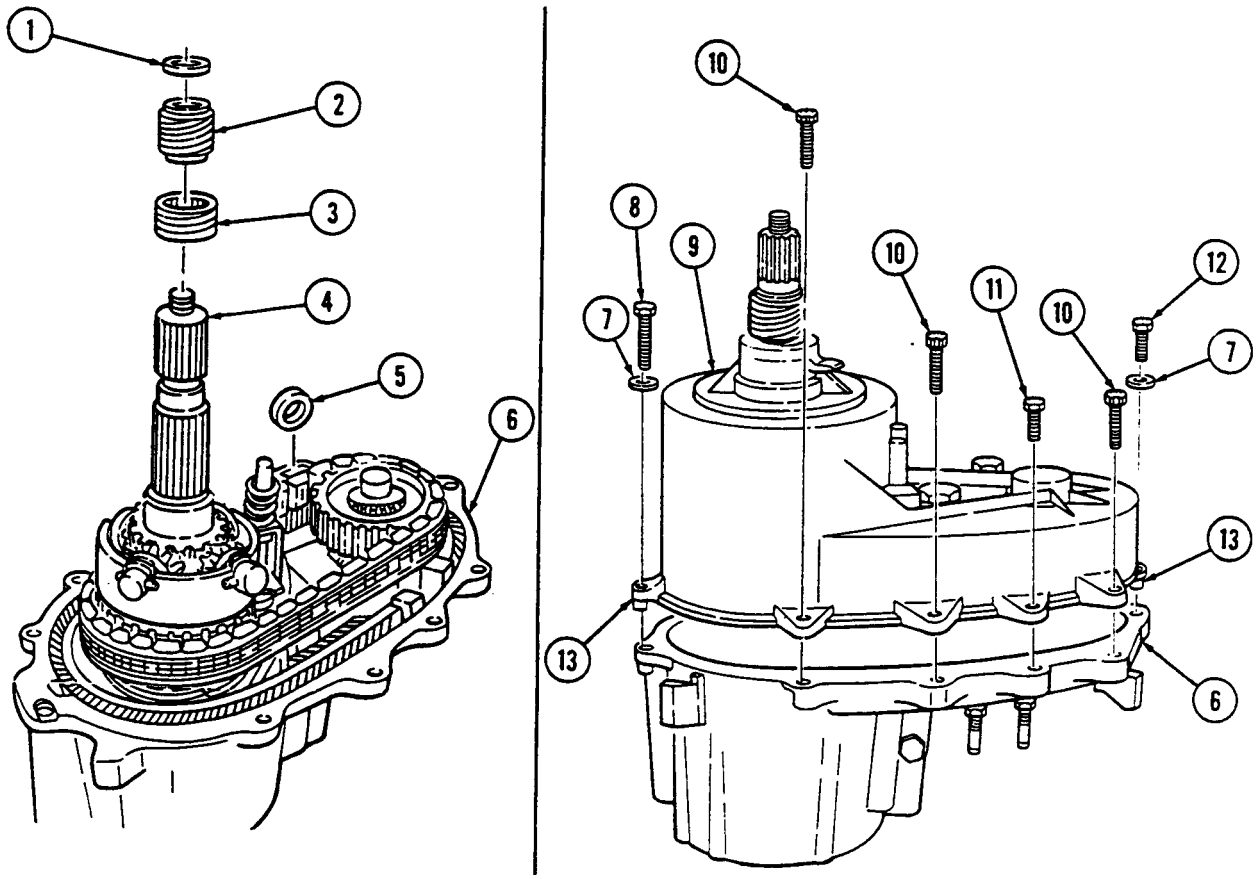
## 18-3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

39. Install oil pump (3) on rear output shaft (4) with recess on inside diameter of oil pump (3) facing down, and snap in place.
40. Install magnet (5) in front case (6).

**CAUTION**

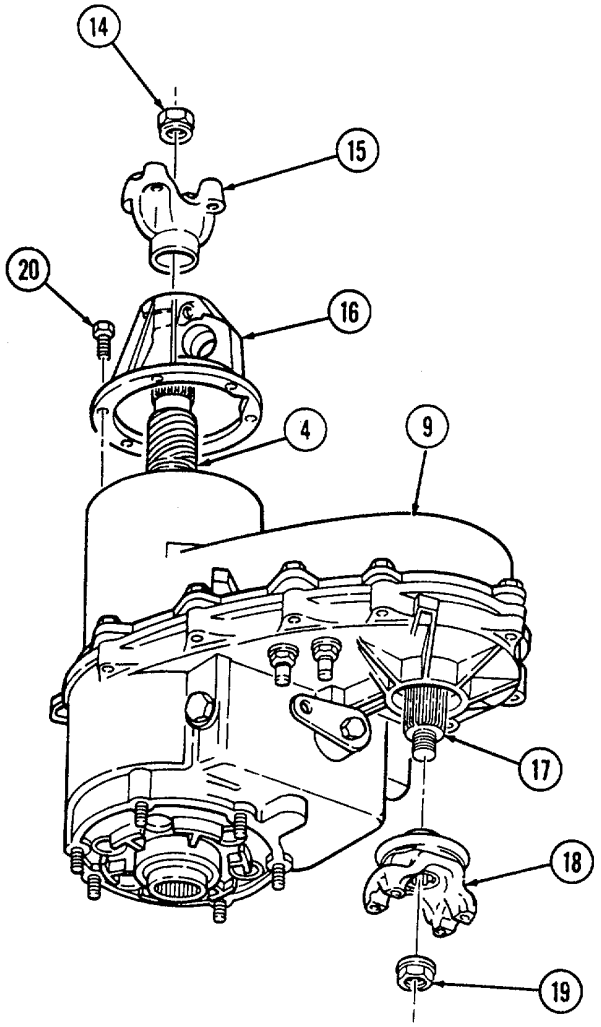
- Both front and rear case contact surfaces must be clean, dry, and free of oil prior to application of silicone sealant (RTV). Oil spills may be wiped from transfer case with a non-petroleum base cleaner. For proper bonding, case halves should be attached within five minutes and all capscrews tightened within one hour after application of silicone sealant (RTV).
- Make sure that the oil cooler is clear of transfer case housing during installation.

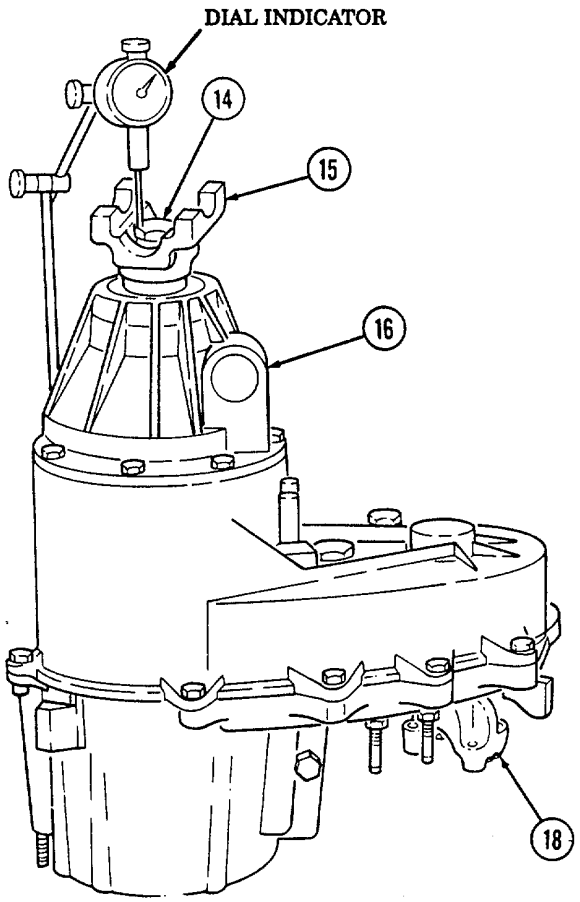
41. Apply silicone sealant to mating surface of front case (6).
42. Align dowels (13) and install rear case (9) on front case (6) with two washers (7), long capscrew (8), and capscrew (12).
43. Install three capscrews (10), five capscrews (11), and rear case (9) on front case (6).
44. Tighten capscrews (8), (10), (12), and (11) to 22 lb-ft (30 N•m).
45. Install speedometer gear (2) on rear output shaft (4).
46. Install differential shims (1) on rear output shaft (4) with thickest shim (1) against rear output shaft (4).



## 18 - 3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

47. Align and install rear retainer (16) to rear case (9) with two capscrews (20) opposite each other. Tighten capscrews (20) to 22 l-ft (30 N.m).
48. Install front output yoke (18) and seal washer and nut (19) on front output shaft (17). Install rear output yoke (15) and seal washer and nut (14) on rear output shaft (4). Finger tighten only.
49. Mount dial indicator on rear retainer (16), index dial indicator so it contacts top of yoke nut (14).
50. Rotate front output yoke (18) ten complete revolutions and zero dial indicator at the highest point.
51. Lift up on rear output yoke (15) and note end play reading on dial indicator. End play should be 0.008-0.020 in. (0.20-0.51 mm). If end play is correct, go to next step. If end play must be adjusted, remove rear retainer and add or subtract shims as necessary and recheck end play.



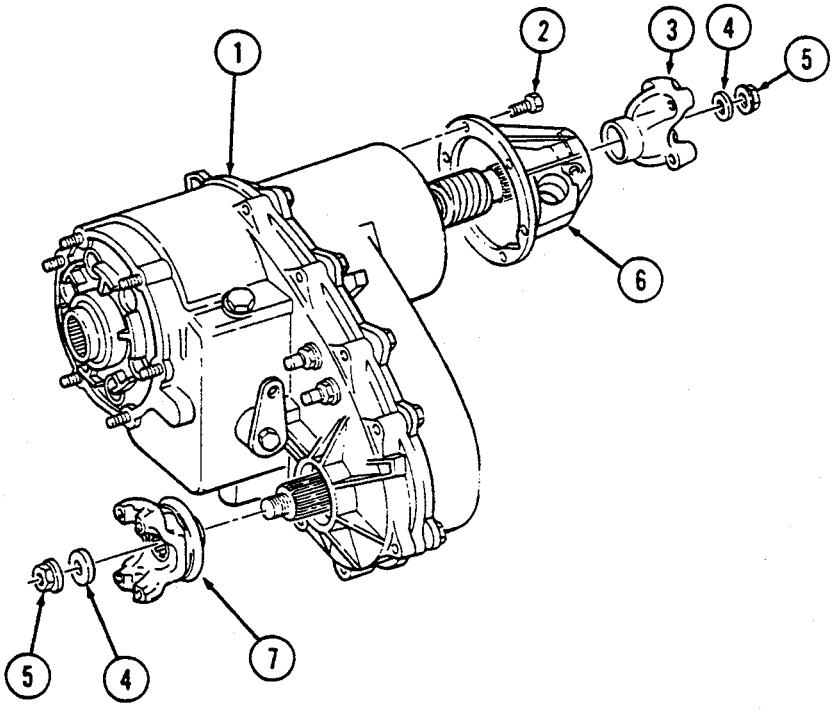
## 18-3. TRANSFER CASE REPAIR (Model 218) (Cont'd)

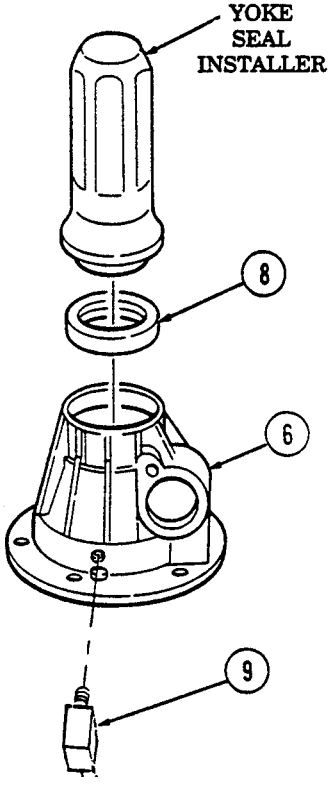
52. Remove two nuts (5), lockwashers (4) and output yokes (7) and (3) from transfer case (1).
53. Remove two capscrews (2) and rear retainer (6) from transfer case (1).

**NOTE**

Ensure that the word “outside,” molded on the seal, is facing the yoke seal installer.

54. Using yoke seal installer, install seal (8) in rear retainer (6).
55. Apply sealing compound to threads of elbow (9).
56. Install elbow (9) into rear retainer (6).
57. Apply silicone sealant to rear retainer (6) mating surface. Align and install rear retainer (6) on transfer case (1) with six capscrews (2). Tighten capscrews (2) to 22 lb-ft (30 N·m).
58. Install front output yoke (7) and rear output yoke (3) on transfer case (1) with two lockwashers (4) and nuts (5). Tighten nuts (5) to 110 lb-ft (149 N·m).



## 18-3. TRANSFER CASE REPAIR (MODEL 218) (Cont'd)

59. Install O-ring (13) on pinion adapter (10).

**NOTE**

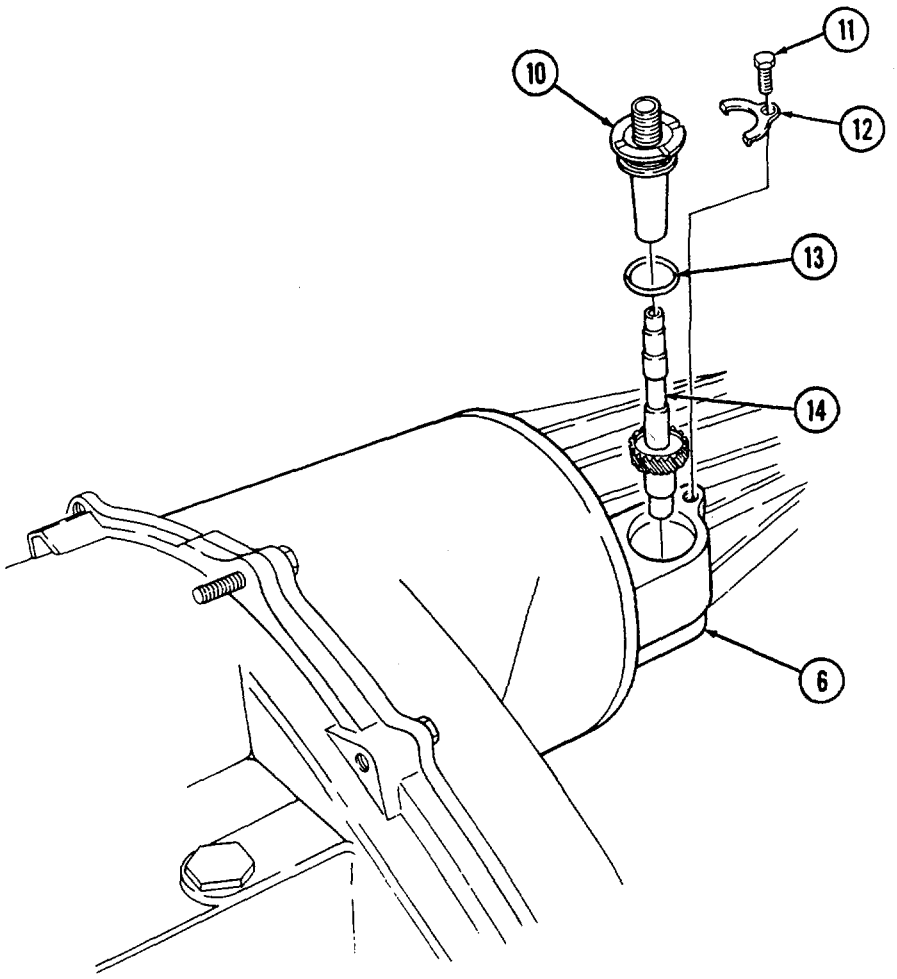
Note number stamped on driven gear.

60. Install driven gear (14) into pinion adapter (10).

**NOTE**

Numbers on pinion adapter represent number stamped on driven gear. When installing adapter, numbers on adapter must match with numbers on transfer case housing.

61. Install and align pinion adapter (10) into rear retainer (6) with clamp (12) and capscrew (11). Tighten capscrew (11) to 15 lb-ft (20 N.m).




FOLLOW-ON TASK: Install transfer case (para. 8-3).

## 18-4. TRANSFER CASE REPAIR (MODEL 242)

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection and Repair**
**d. Assembly**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)
Screw extractor set (Appendix G, Item 78)
Arbor press (Appendix G, Item 77)

**Special Tools**

Slide hammer adapter (Appendix G, Item 55)
Driver handle (Appendix G, Item 34)
input gear seal installer
(Appendix G, Item 69)
Bearing remover set (Appendix G, Item 73)
Input gear bearing installer
(Appendix G, Item 61)
Output shaft front bearing remover/installer
(Appendix G, Item 70)
Extension bushing remover
(Appendix G, Item 72)
Bushing remover/bearing installer
(Appendix G, Item 67)
Extension housing seal installer
(Appendix G, Item 75)
Output shaft seal installer
(Appendix G, Item 71)
Bearing tool (Appendix G, Item 74)
Mainshaft pilot bearing installer
(Appendix G, Item 68)
Seal installer (Appendix G, Item 139)
Seal installer (Appendix G, Item 140)
Drive handle (Appendix G, Item 141)

**Materials/Parts**

O-ring (Appendix E, Item 136)
Two O-rings (Appendix E, Item 138)
Lockwasher (Appendix E, Item 113)
Oil tube seal (Appendix E, Item 239)
O-ring (Appendix E, Item 148)
Input gear seal (Appendix E, Item 229)
Front output shaft seal (Appendix E, Item 233)
Rear output drive seal (Appendix E, Item 240)
Straight pin (Appendix E, Item 174)
Spacer ring (Appendix E, Item 246)
Petrolatum (Appendix B, Item 38)
Silicone compound (Appendix B, Item 56.1)
Transmission fluid (Appendix B, Item 23)
Transfer case support stand
(Appendix C, Fig. 4)

**Manual References**

TM 9-2320-280-24P

**Equipment Condition**

Transfer case removed (para. 8-3).

**Maintenance Level**

General support

### a. Disassembly

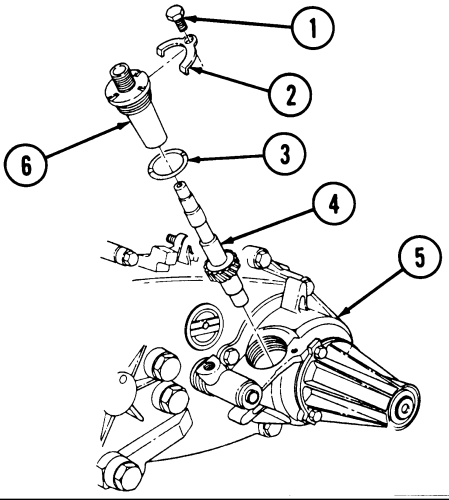
1. Remove capscrew (1), clamp (2), pinion adapter (6), and driven gear (4) from rear retainer (5).
2. Remove O-ring (3) from pinion adapter (6). Discard O-ring (3).
3. Remove nut (7), front output yoke (8), and lockwasher (9) from transfer case (11) Discard lockwasher (9).
4. Move shift range lever (10) to most rear position.
5. Remove three capscrews (13) from rear extension (14) and rear retainer (5).

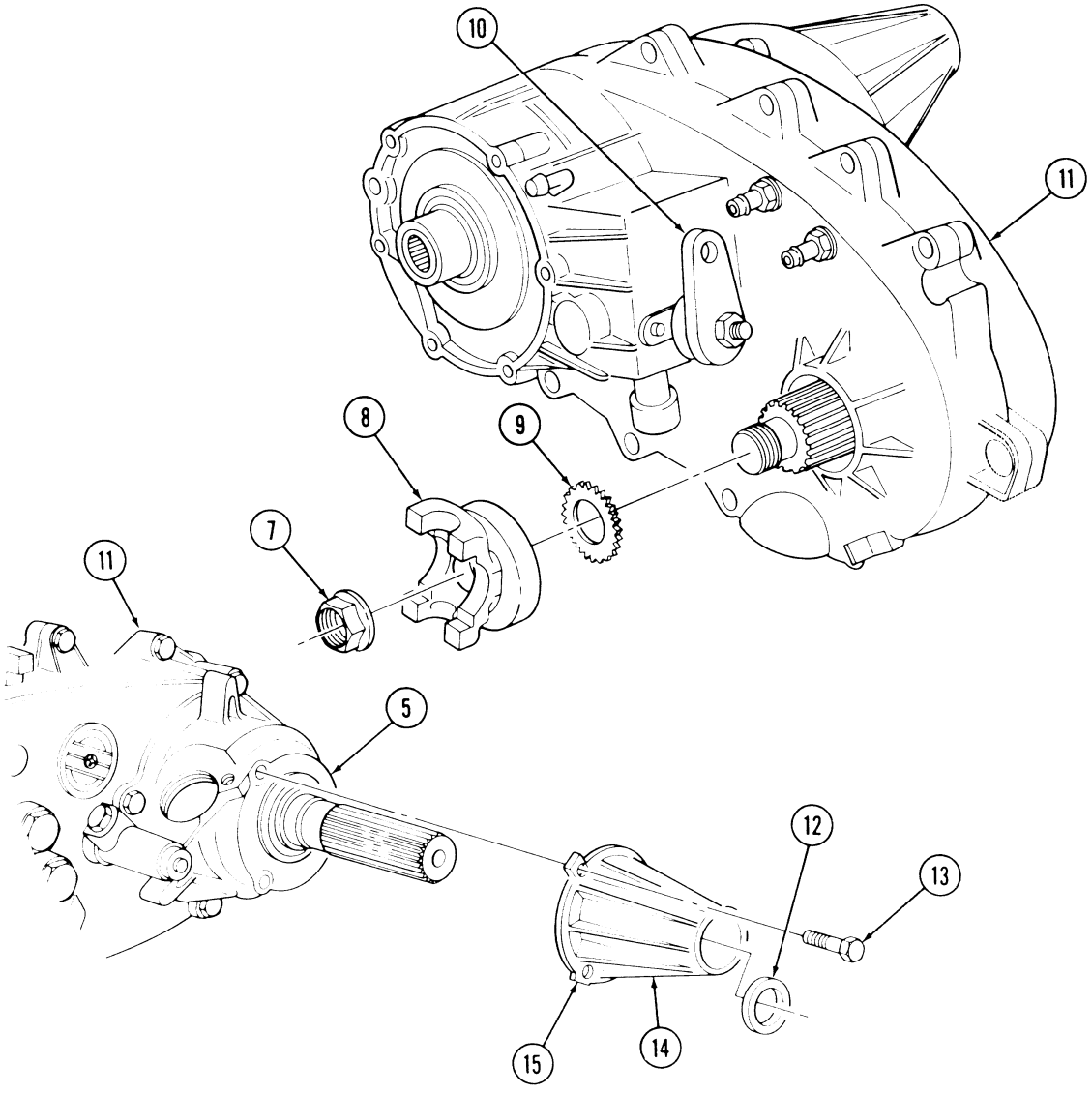
**CAUTION**

Do not pry or wedge rear extension from rear retainer. Sealing surfaces could be damaged.

6. Use a soft nosed hammer or mallet on screw hole bosses (15) of rear extension (14) to break sealing bead and remove rear extension (14) from rear retainer (5).
7. Remove rear output drive seal (12) from rear extension (14). Discard rear output drive seal (12).

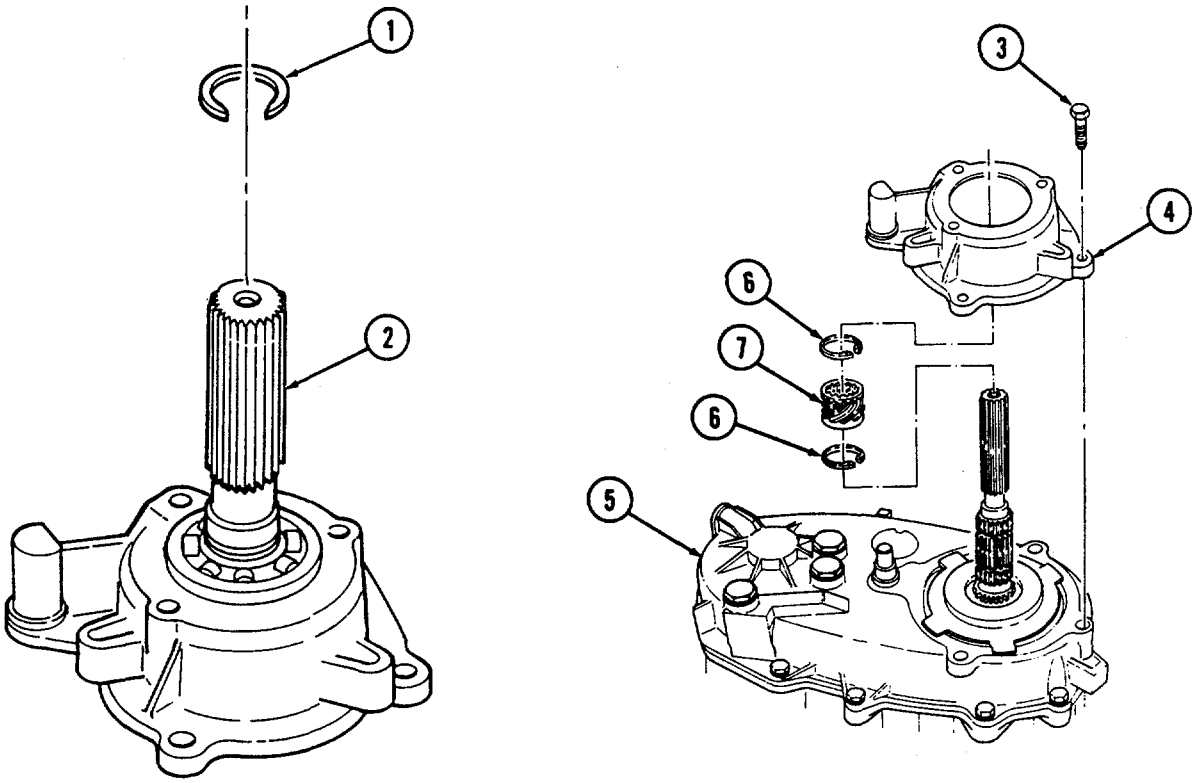
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

8. Remove snapring (1) from mainshaft assembly (2).
9. Remove four capscrews (3) from rear retainer (4) and rear half-case (5).
10. Prying on tabs of rear retainer (4), remove rear retainer (4) from rear half-case (5) and mainshaft (2).
11. Remove two snaprings (6) and speedometer drive gear (7) from mainshaft assembly (2).




12. Remove two capscrews (10) and washers (11) from rear half-case (5).

**NOTE**

Mark positions of long screws for installation.

13. Remove two long screws (9) from front output end of rear half-case (5).

14. Remove seven screws (8) from rear half-case (5).

**NOTE**

Use slots in half-cases when separating half-cases.

15. Pry and remove rear half-case (5) from front half-case (17). Lay rear half-case (5) on bench with oil pump (15) up.

**CAUTION**

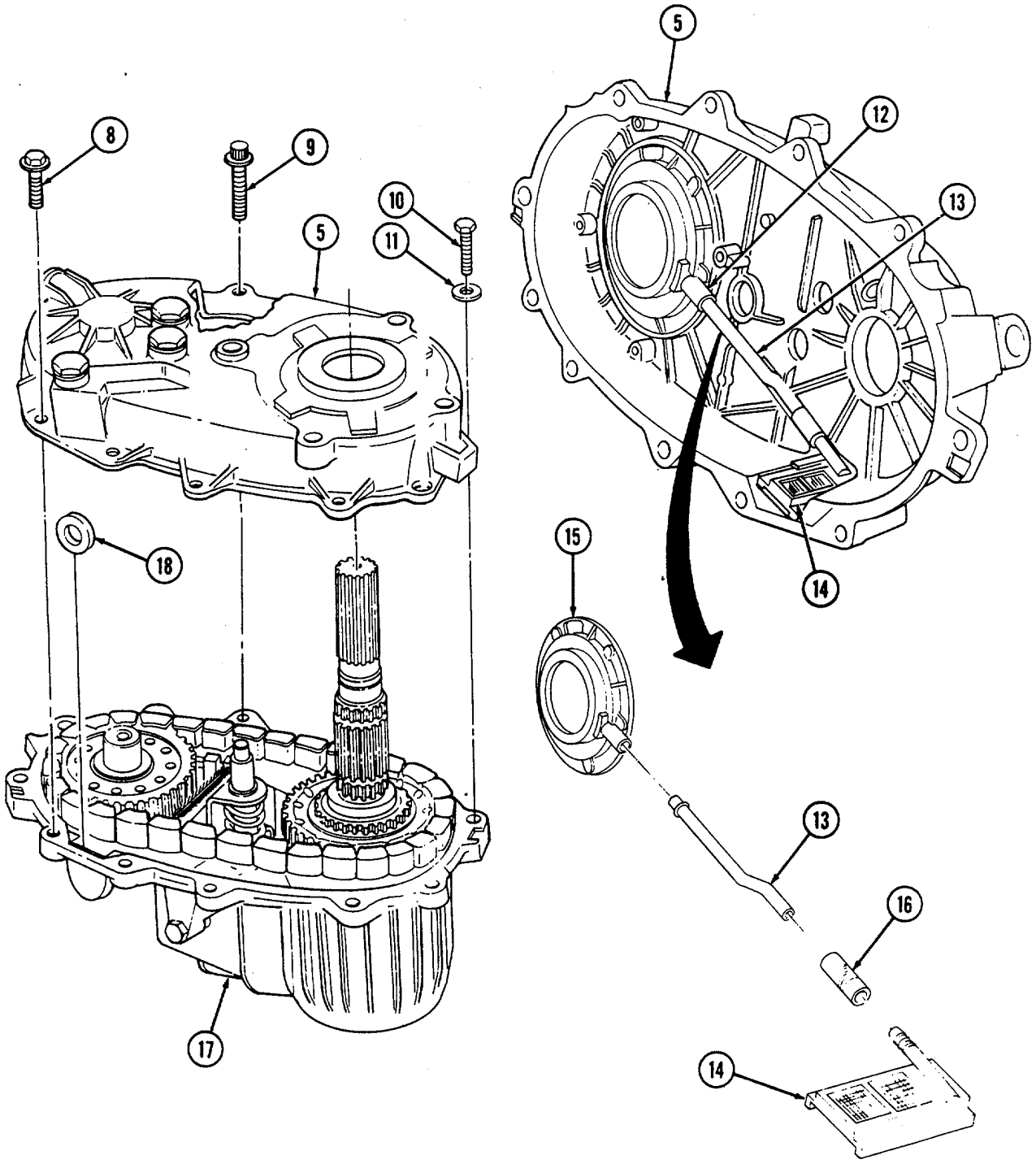
Mark position of oil pump to rear half-case before removal. Failure to do so will cause damage to equipment.

16. Rotate oil pickup tube (13) and oil screen (14) out of rear half-case (5) and pull pickup tube (13) out of oil pump inlet port (12).

17. Remove oil pump (15) from rear half-case (5).

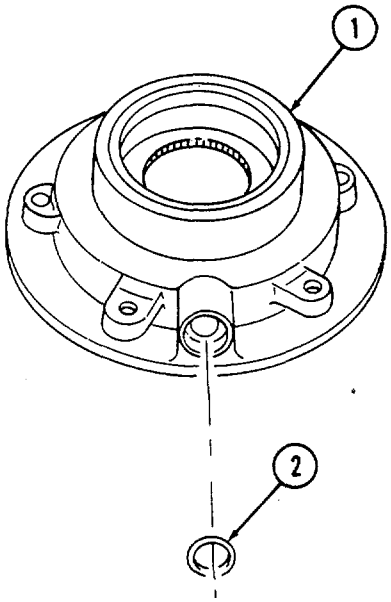
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

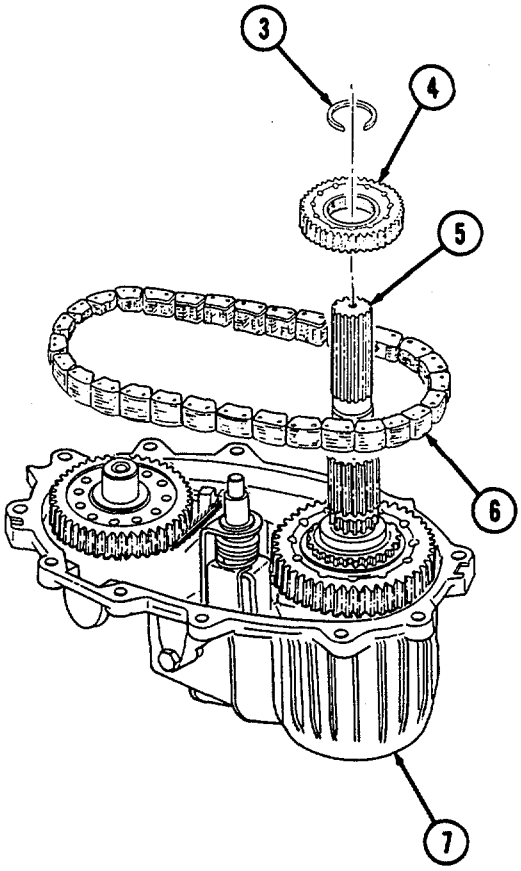
18. Remove oil screen (14) and pickup tube (13) from hose (16).
19. Remove magnetic pickup (18) from pocket in front half-case (17).



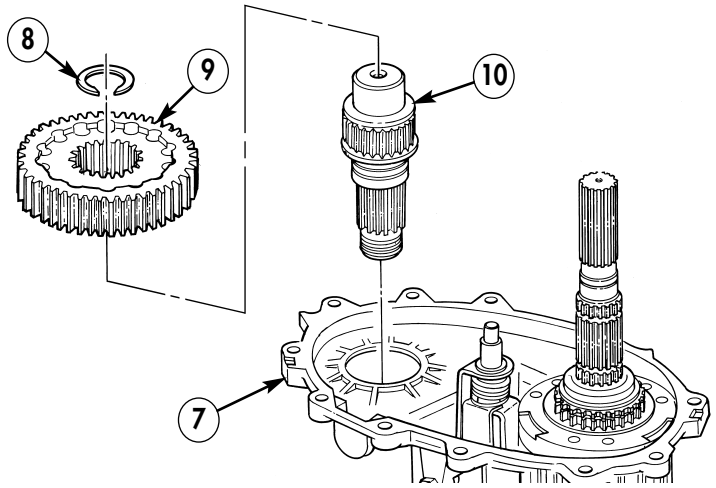
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

20. Remove oil tube seal (2) from oil pump (1). Discard oil tube seal (2).
21. Remove snapring (3) securing drive sprocket (4) on mainshaft assembly (5).
22. Remove drive sprocket (4) and drive chain (6) from front half-case (7).
23. Remove front output shaft (10) and driven gear (9) from front half-case (7).
24. Remove snapring (8) and driven gear (9) from front output shaft (10).

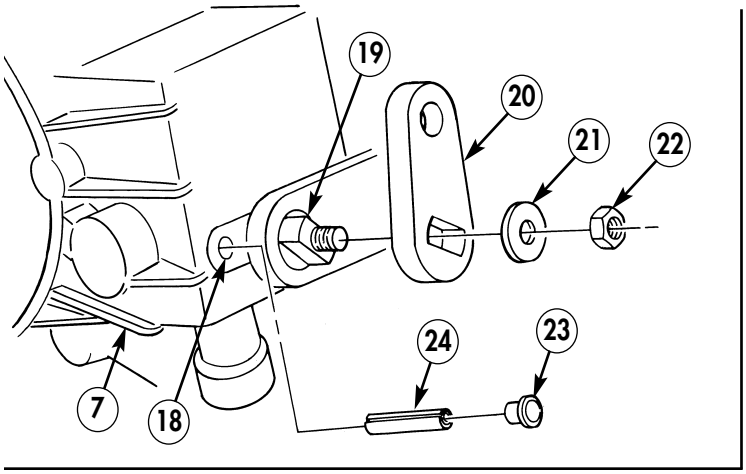


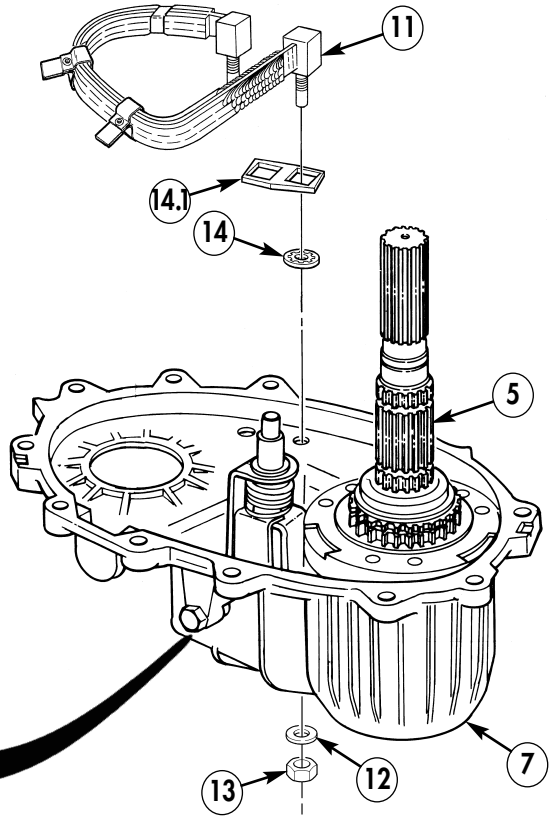



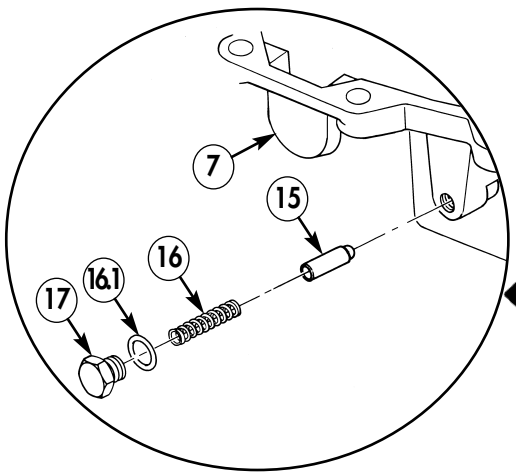
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)




25. Remove nut (22), washer (21), and shift lever (20) from sector shaft (19).
26. Remove plug (23) from low range fork access hole (18).
27. Using screw extractor in straight pin (24), turn counterclockwise and withdraw straight pin (24) from low range fork access hole (18). Discard straight pin (24).
28. Remove shifter detent plug (17), O-ring (16.1), spring (16), and poppet (15) from front half-case (7). Discard O-ring (16.1).
29. Remove two nuts (13), washers (12), and oil cooler (11) from front half-case (7).
30. Remove two O-rings (14) and cooler support (14.1) from oil cooler (11). Discard O-rings (14).

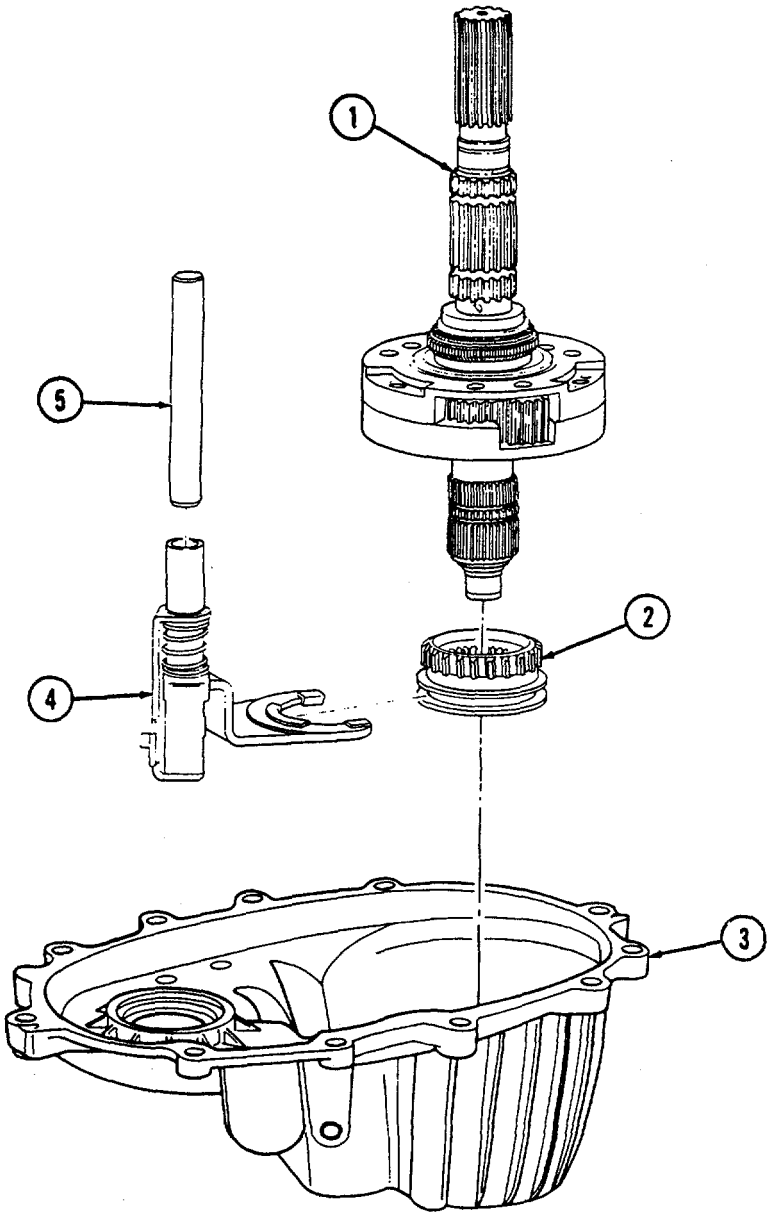


## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

31. Pull shift rail (5) out of mode shift fork assembly (4).
32. Remove mode shift fork assembly (4) and mainshaft assembly (1) out of front half-case (3) as a unit.
33. Remove mode shift fork assembly (4) from mode shift sleeve (2) on mainshaft assembly (1).
34. Remove mode shift sleeve (2) from mainshaft assembly (1).



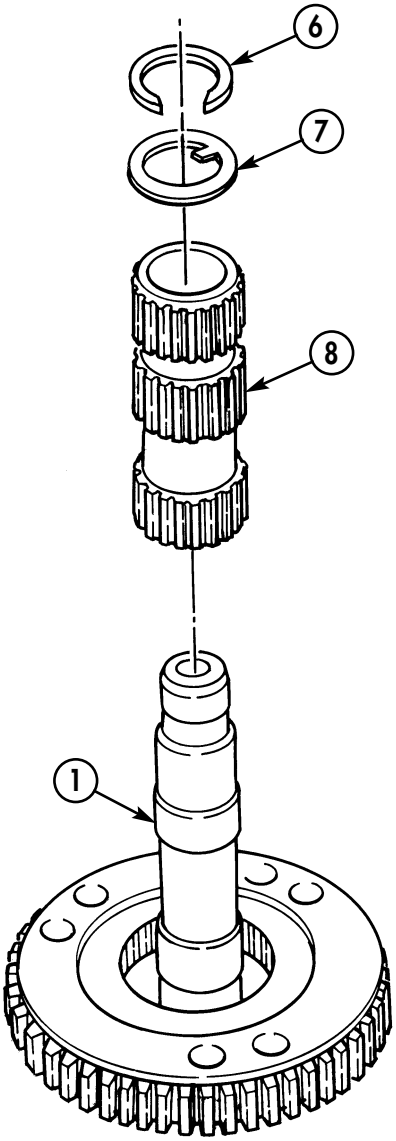
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

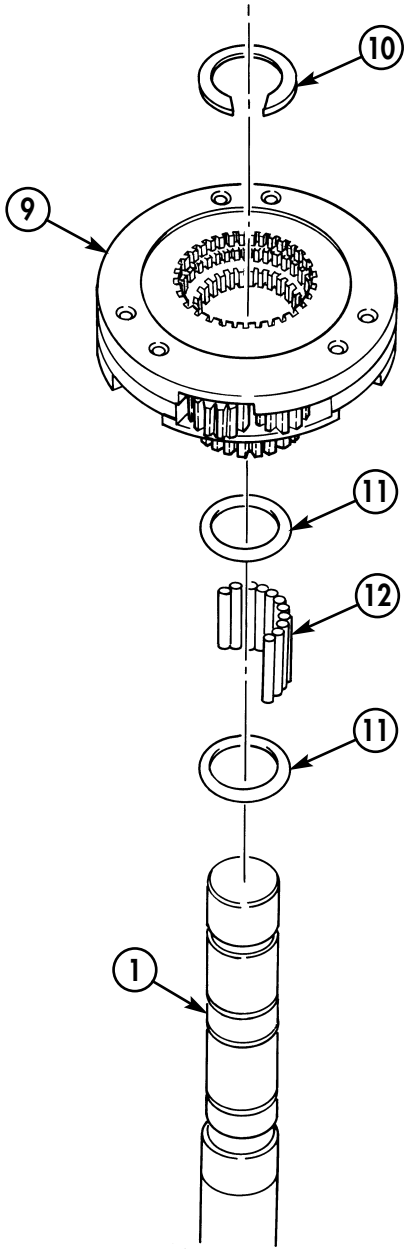
35. Remove snapring (6) and keyed thrust washer (7) from mainshaft (1).
36. Slide intermediate clutch shaft (8) off mainshaft (1).
37. Remove differential snapring (10) from mainshaft (1).

**NOTE**

Needle bearings will fall free when differential is removed from mainshaft.

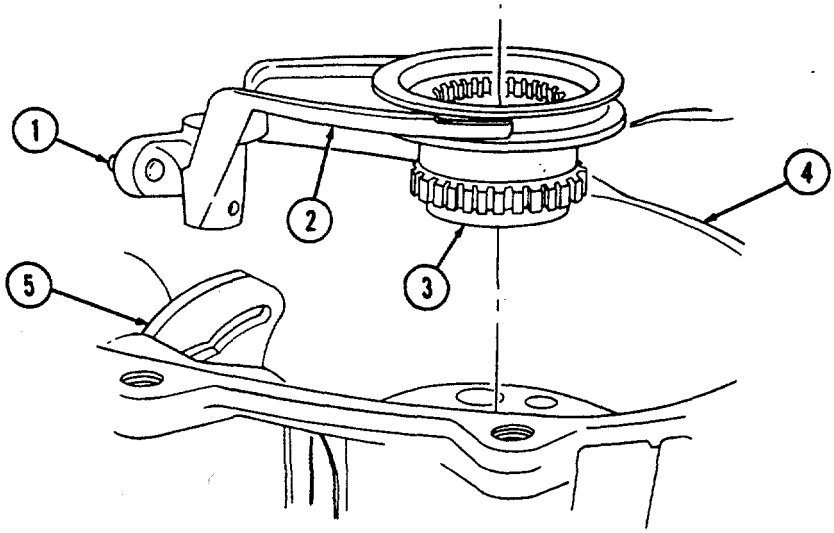
38. Remove differential assembly (9) from mainshaft (1).
39. Remove two thrust washers (11) and fifty-three needle bearings (12) from mainshaft (1).



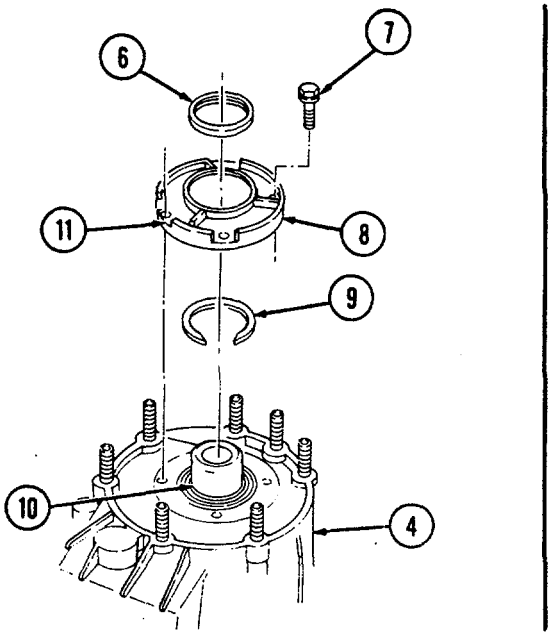



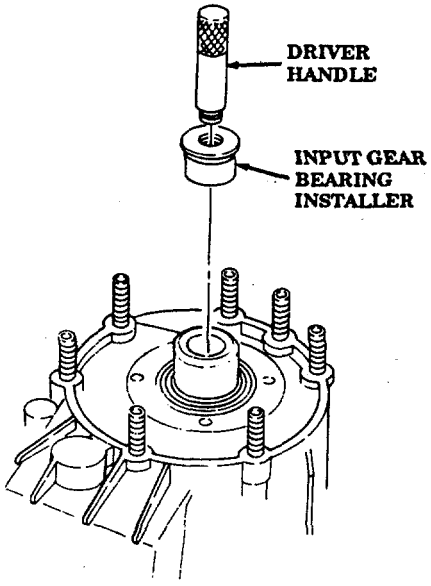
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

40. Twist range shift fork (2) and range clutch sleeve (3) to disengage pin (1) from shift sector (5) and remove range shift fork (2) and range clutch sleeve (3) from front half-case (4).
41. Remove shift sector (5) from front half-case (4).



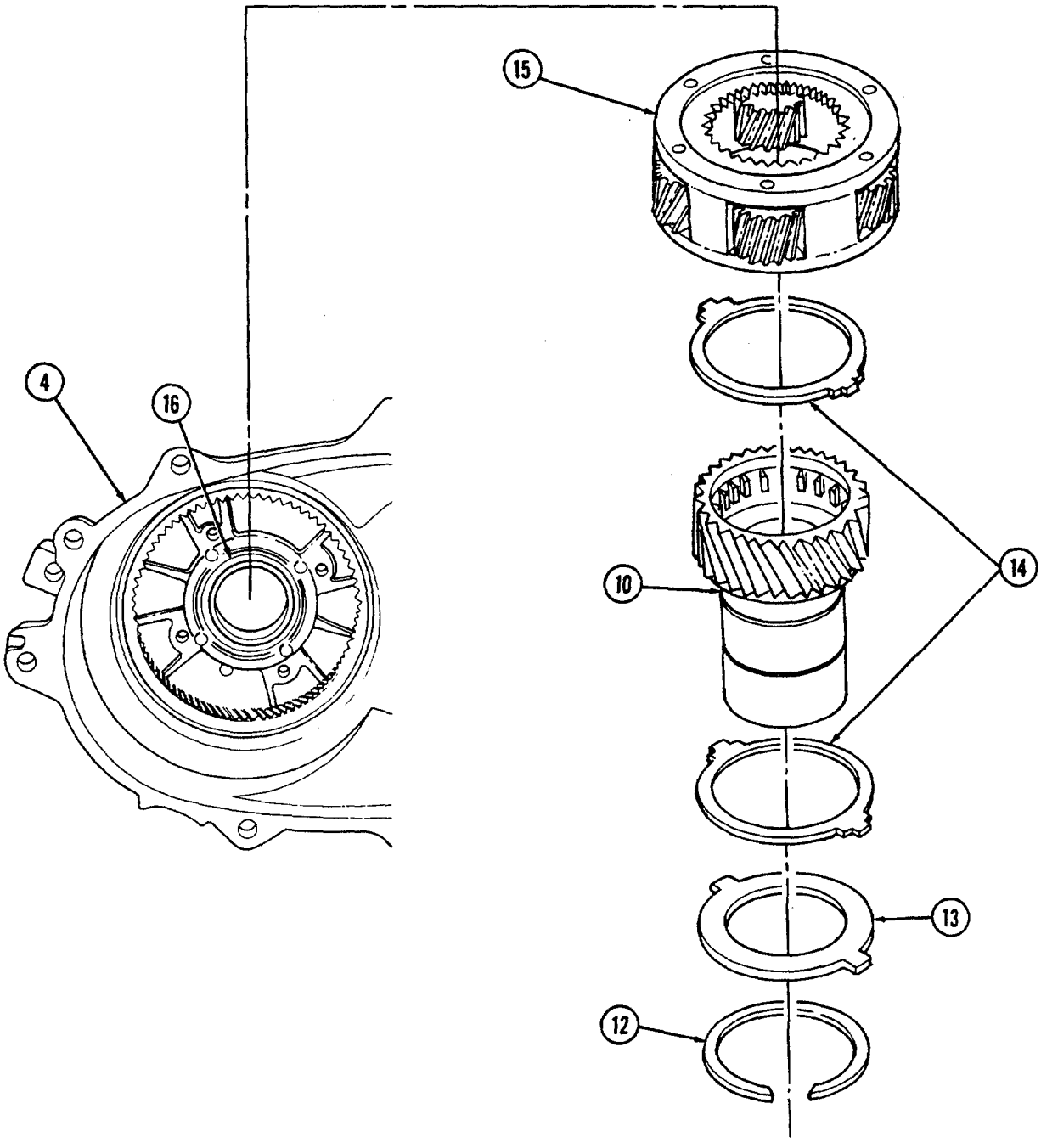

42. Remove four screws (7) and bearing retainer (8) from front half-case (4). Pry on bearing retainer (8) at slots (11).
43. Remove input gear seal (6) from bearing retainer (8). Discard input gear seal (6).
44. Remove snapring (9) from input gear shaft (10).



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

45. Supporting front half-case (4), use driver handle and input gear bearing installer to press on input gear shaft (10) and remove input gear shaft (10) and low range gear (15) from input bearing (16).
46. Remove snapring (12) from low range gear (15).
47. Turn and remove retainer (13) from housing of low range gear (15).
48. Remove two thrust washers (14) and input gear (10) from low range gear (15).



## 18-4. TRANSFER CASE REPAIR (Model 242) (Cont'd)

**b. Cleaning**

Clean all parts in accordance with para. 2-13.

**c. Inspection and Repair**

1. Inspect all parts in accordance with para. 2-14.
2. Repair all parts in accordance with para. 2-15.
3. Inspect front half-case (1) for cracks, nicks, burrs, blocked oil passages, and broken, missing, or damaged studs (7). Also check front input ball bearing (5) and front output ball bearing (4). Repair or replace damaged studs (7). Remove burrs and clear blocked oil passages. Replace front half-case (1) if cracked or broken at any machined surface. Remove and discard front output shaft seal (10). Replace front half-case (1) if annulus gear (2) is loose or damaged. Replace defective ball bearings as follows:

   (a)Front output ball bearing (4).

   (1) Remove snapring (3) from front half-case (1). (Use bearing remover tool for A2 vehicles.)

   (2) Using driver handle, output shaft front bearing remover, and bearing tool, remove and install ball bearing (4) in front half-case (1).

   (3) Install output shaft seal (10) in front half-case (1) with output shaft seal installer.

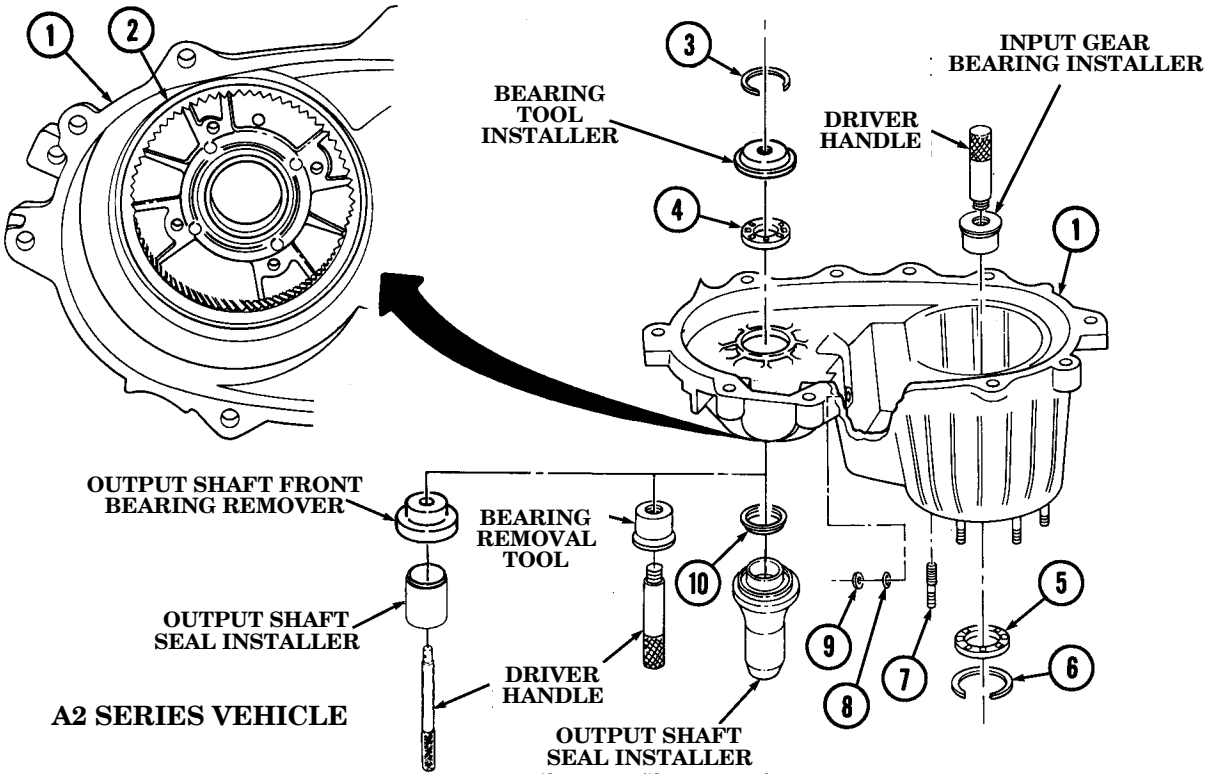
   (b)Front input ball bearing (5).

   (1) Using driver handle, input gear bearing installer, and arbor press, press ball bearing (5) out of front half-case (1).

   (2) Remove snapring (6) from ball bearing (5).

   (3) Install snapring (6) in ball bearing (5). (Use bearing installer tool for A2 vehicles.)

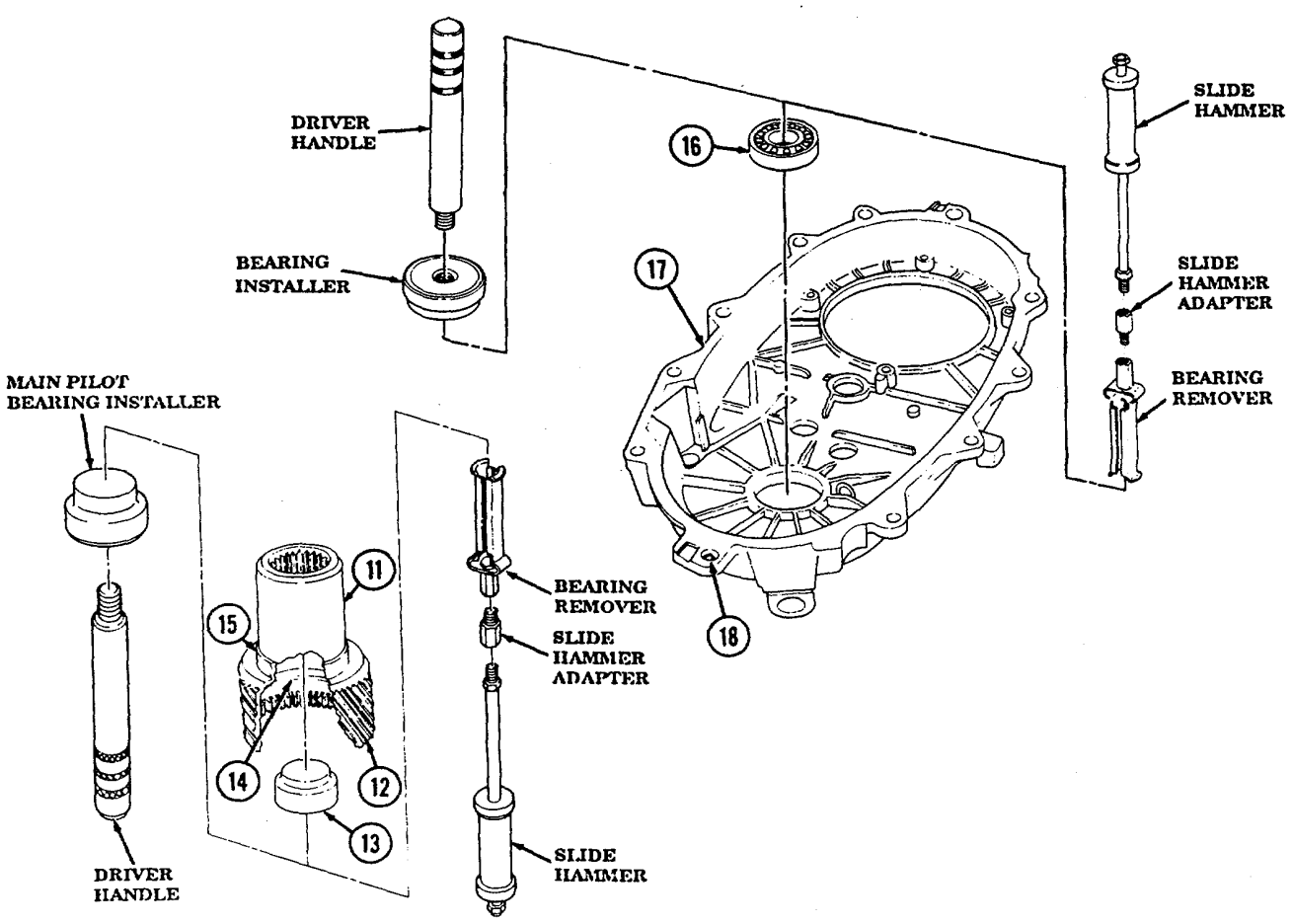
   (4) Using wooden block, seat ball bearing (5) in front half-case (1). Seat ball bearing (5) until snapring (6) is against front half-case (1).
4. Inspect retainer (9) and O-ring (8) for damage. Replace if damaged.




A2 SERIES VEHICLE

## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

5. Inspect input gear (11) for breaks, cracks, broken or chipped gear teeth (12), scoring on sealing area (15), and damaged snapring groove (14). Inspect bearing (13). Replace input gear (11) if damaged. Replace bearing (13) as follows:
   (a) Mount input gear (11) in soft-jawed vise, gear end up.
   (b) Install bearing remover to remove bearing (13).
   (c) Use slide hammer and slide hammer adapter to remove bearing (13) from input gear (11).
   (d) Coat bearing (13) with transmission oil and install in input gear (11) with driver handle and main pilot bearing installer.
6. Inspect rear half-case (17) for cracks, breaks, burrs, and plugged oil passages. Remove burrs. Replace rear half-case if cracked or broken. Inspect front output shaft rear bearing (16). Replace loose or damaged alignment retaining dowel (18). Replace front output shaft rear bearing (16) as follows:
   (a) Using bearing remover, slide hammer and slide hammer adapter, remove bearing (16).
   (b) Coat bearing (16) with transmission oil.
   (c) Using driver handle and bearing installer, install bearing (16) in rear half-case (17).



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

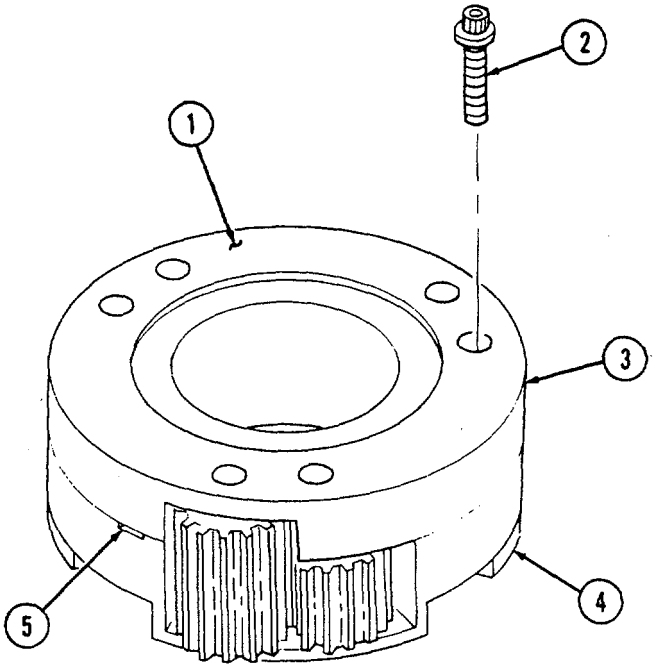
7. Inspect rear differential assembly (1).
   (a) Mark front carrier (4) and rear carrier (3) cases for assembly.
   (b) Remove six screws (2) from rear carrier (3) and turn rear carrier (3) over.
   (c) Using slots (5), pry rear carrier (3) off front carrier (4).

**NOTE**
Needle bearing will fall free when removing short pinion gears.

   (d) Remove six pinion washers (6), three long pinion gears (7), six thrust washers (12), three short pinion gears (8), and fifty-four needle bearings (13) from pins (10) on front carrier (4).

**NOTE**
Record position of mainshaft gear, sprocket gear, and front carrier for assembly.

   (e) Remove mainshaft gear (9) and sprocket gear (11) from front carrier (4). Separate mainshaft gear (9) and sprocket gear (11).
   (f) Inspect front carrier (4) for cracks, damaged threads, broken or chipped gear teeth, and loose or damaged pins (10). Replace front carrier (4) if damaged.
   (g) Inspect rear carrier (3) for cracks and breaks. Replace rear carrier (3) if damaged.
   (h) Inspect short pinions (8) and long pinions (7) for cracks, chipped or broken gear teeth, and ridged or scored gear teeth. Replace three short pinions (8) and three long pinions (7), if any one is damaged.
   (i) Inspect thrust washers (12) and pinion washers (6) for breaks, cupping, and scoring. Replace all thrust and pinion washers (12) and (6) if any one is damaged.
   (j) Inspect mainshaft gear (9) and sprocket gear (11) for cracks, broken or chipped gear teeth, and cracks, gouges, or deep scoring on brass ring on bottom of mainshaft gear. Replace gear (9) or (11) if damaged.



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

**CAUTION**

All transfer case parts must be lubricated with clean transmission oil before assembly. Foreign material will cause transfer case damage.

(k) Lay front carrier (4) on flat work table and place mainshaft gear (9) in rear carrier (3) with cone surface up.

(l) Install sprocket gear (11) on mainshaft gear (9). Splined hub of mainshaft gear (9) must be up.

**NOTE**

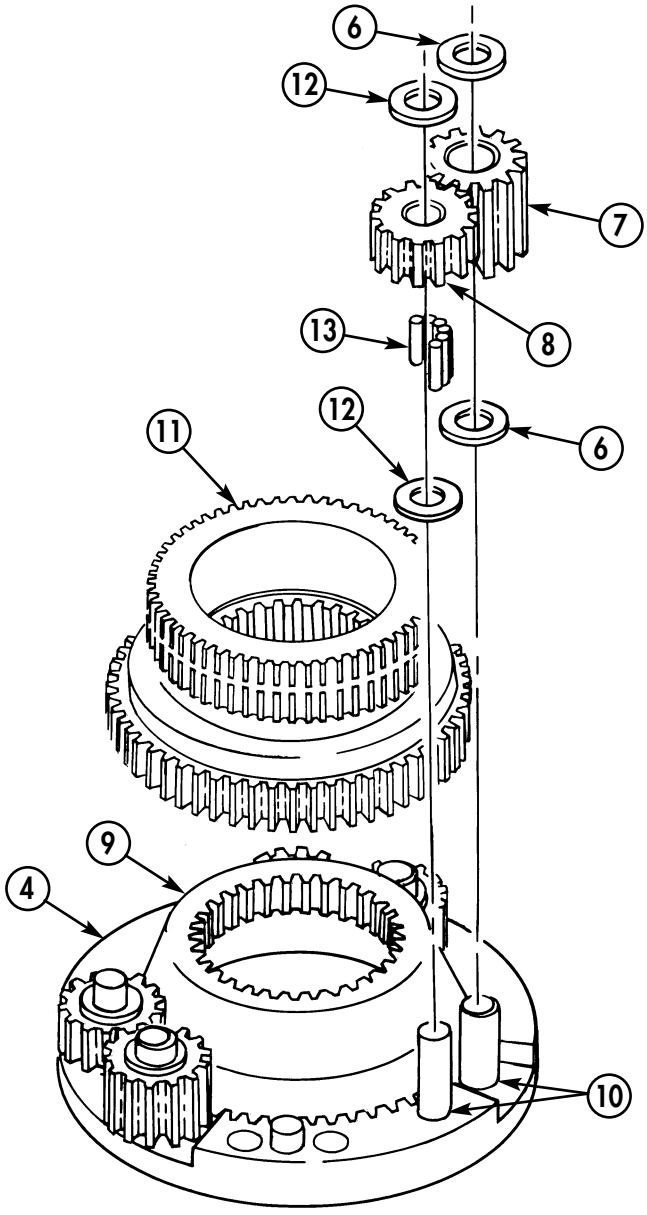
Use petrolatum to hold needle bearings in place on pins.

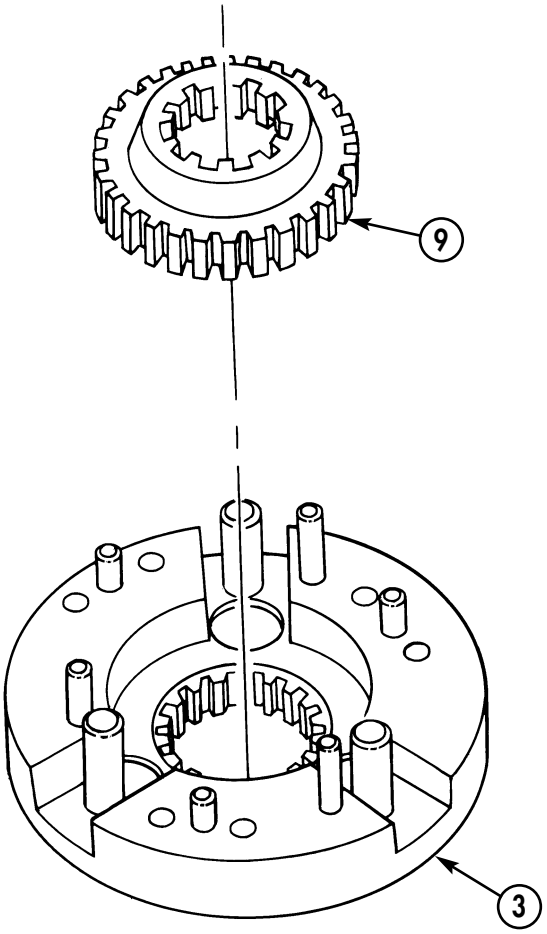
(m) Install three thrust washers (12), fifty-four needle bearings (13), three short pinion gears (8), and thrust washers (12) on pins (10).

(n) Install three pinion washers (6), long pinion gears (7), and pinion washers (6) on pins (10).

(o) Align index marks on front carrier (4) and rear carrier (3) and set rear carrier (3) over pins (10).

(p) Install front and rear carriers (4) and (3) with six screws (2).



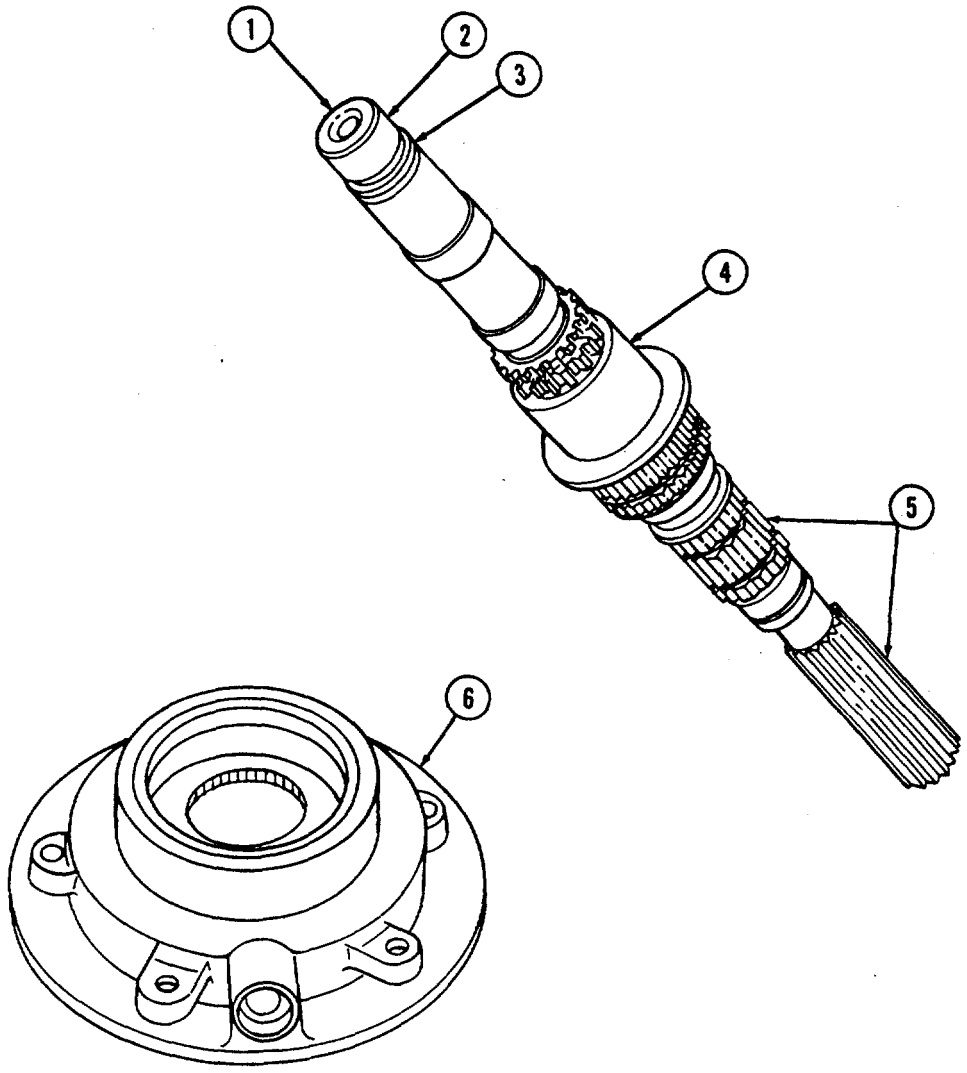
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

8. Inspect mainshaft (1) for cracks, breaks, scored bearing surfaces (2), chipped or broken splines (5), damaged lockring groove (3), and damaged gear teeth. Clean oil passages (4). Repair minor scoring and remove burrs on mainshaft (1). Replace mainshaft (1) if damaged.

**NOTE**

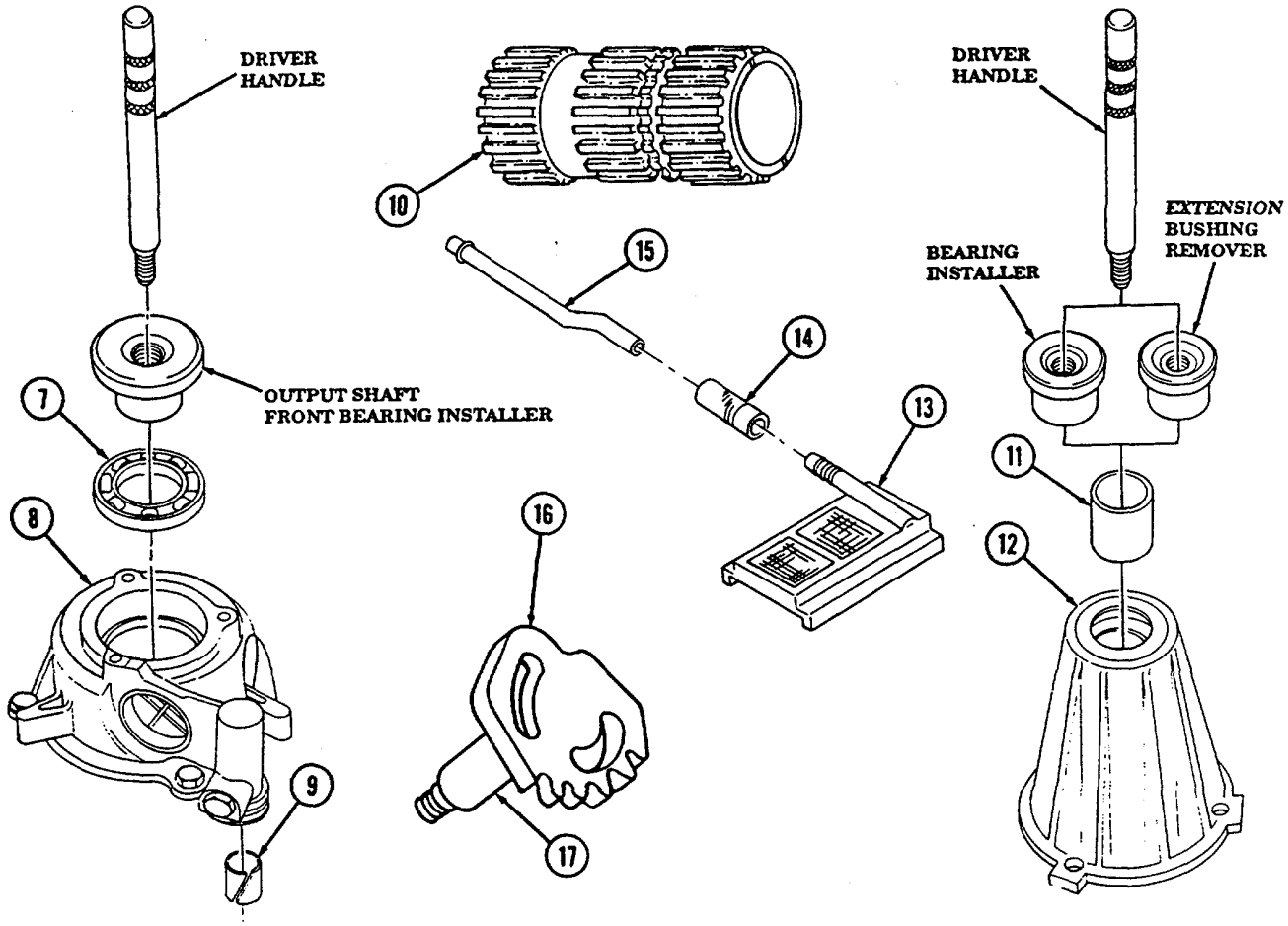
If any parts of oil pump fail inspection and cannot be repaired, replace oil pump.

9. Inspect oil pump (6) for cracks, breaks, scoring, and damaged bushing and threads. Replace oil pump if any parts are damaged.



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

10. Inspect rear retainer (8) for cracks, breaks, damaged threads, and worn or damaged ball bearing (7). Repair damaged threads. Replace rear retainer (8) if cracked, broken, or threads unreparable. Replace worn or damaged ball bearing (7). Replace loose or damaged alignment retainer dowel (9) if damaged.
    (a) Use hammer and soft drift punch to remove ball bearing (7) from rear retainer (8).
    (b) Seat ball bearing (7) in rear retainer (8) using driver handle and output shaft front bearing installer.
11. Inspect rear extension (12) for cracks, breaks, and worn or damaged bushing (11). Replace rear extension (12) if cracked or broken. Replace worn or damaged bushing (11) as follows:
    (a) Remove defective bushing (11) using driver handle and extention bushing remover.
    (b) Install bushing (11) in rear extension (12) using driver handle and bearing installer.
12. Inspect intermediate clutch shaft (10) for cracks, breaks, and bent or twisted splines. Replace intermediate clutch shaft (10) if damaged.
13. Inspect shift sector (16) for burrs, cracks, breaks, loose shaft (17), and damaged threads. Remove minor burrs and repair minor thread damage. Replace shift sector (16) if cracked, broken, or loose or damaged shaft (17).
14. Inspect oil screen (13), hose (14), and pickup tube (15). Clean oil screen (13) and inspect for holes. Replace oil screen (13) if damaged. Inspect tube (15), hose (14), and oil screen (13) for bends or cracks that would prevent sealing. Replace damaged parts.



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

15. Inspect range shift fork (16) for burrs, bends, and breaks. Remove burrs. Replace pads (6) if there is any wear. Replace range shift fork (16) if broken, cracked, loose pin (15) or damaged.
16. Inspect range clutch sleeve (17) and mode shift sleeve (7) for burrs, cracks, breaks, and damaged splines or gear teeth. Remove minor burrs. Replace range clutch sleeve (17) or mode shift sleeve (7) if damaged.
17. Inspect mode shift fork assembly (8) for cracks, breaks, bent brackets (2) and (14), and broken or deformed springs (4) and (10). If pads (6) are worn, replace pads (6). Replace bracket (14) if pin (1) is damaged. Mode shift fork assembly (8) must slide freely on shift rail (18) without excessive side free play. Remove spacer ring (5) and discard. If free play is excessive, replace mode shift fork assembly (8). Disassemble mode shift fork assembly (8) as follows:

    (a) Position mode shift fork assembly (8) in vise with bracket (14) secured in vise.

    **NOTE**

    Mode shift fork assembly is under spring tension. Use care when compressing fork to release bracket.

    (b) Press mode shift fork (8) down and tilt to free and remove mode shift fork assembly (8) from bracket (14).

    (c) Remove bushing sleeve (11), spring (10), and thrust washer (9) from mode shift fork (8).

    (d) Remove bracket (2), cup (3), and spring (4) from mode shift fork (8).

    (e) Remove bracket (14) from vise.

    Assemble mode shift fork assembly (8) as follows:

    (a) Install bracket (14) in vise.

    (b) Install spacer ring (5), spring (4), cup (3), and bracket (2) on short end of mode shift fork (8). Ensure open end of bracket (2) is positioned under mode shift fork lip (12).

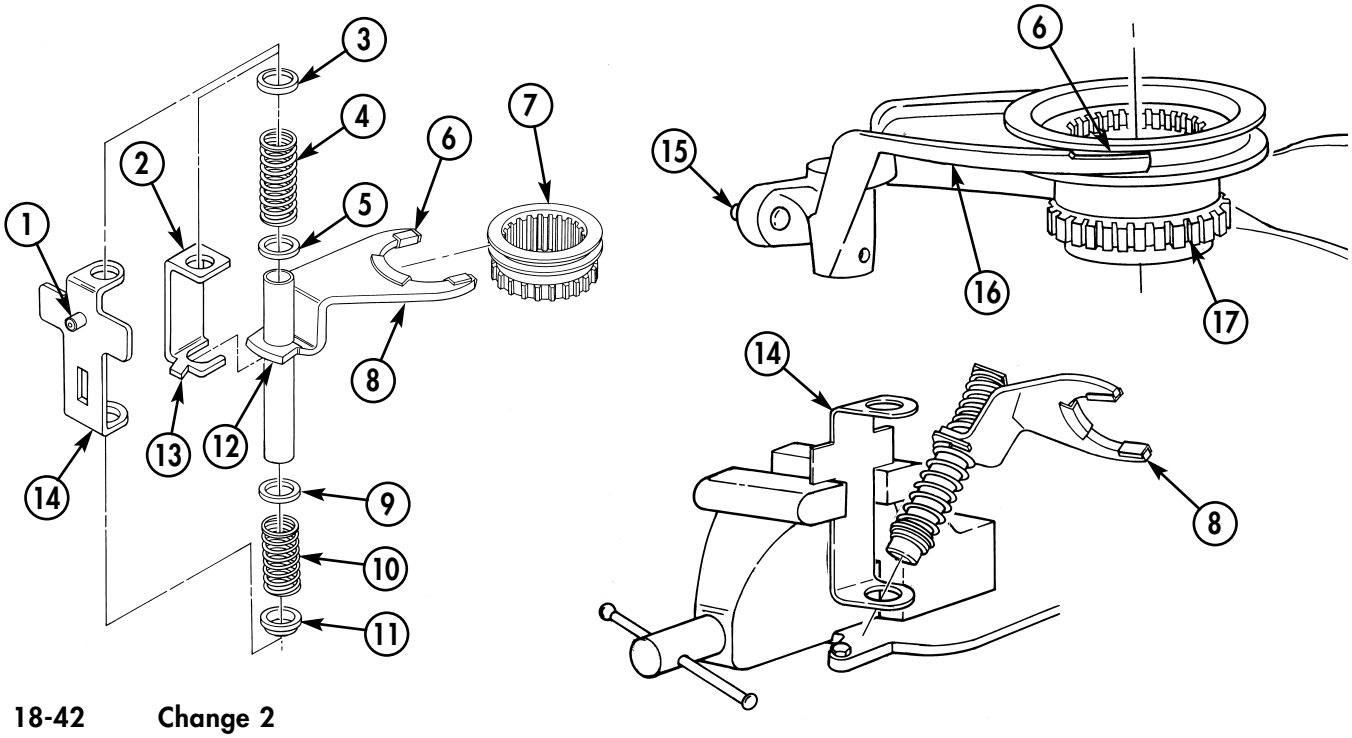
    (c) Install thrust washer (9), spring (10), and bushing sleeve (11) on mode shift fork (8).

    (d) Position mode shift fork assembly (8) on bracket (14).

    (e) Press mode shift fork (8) down and forward until tab (13) on bracket (2) is seated in bracket (14).

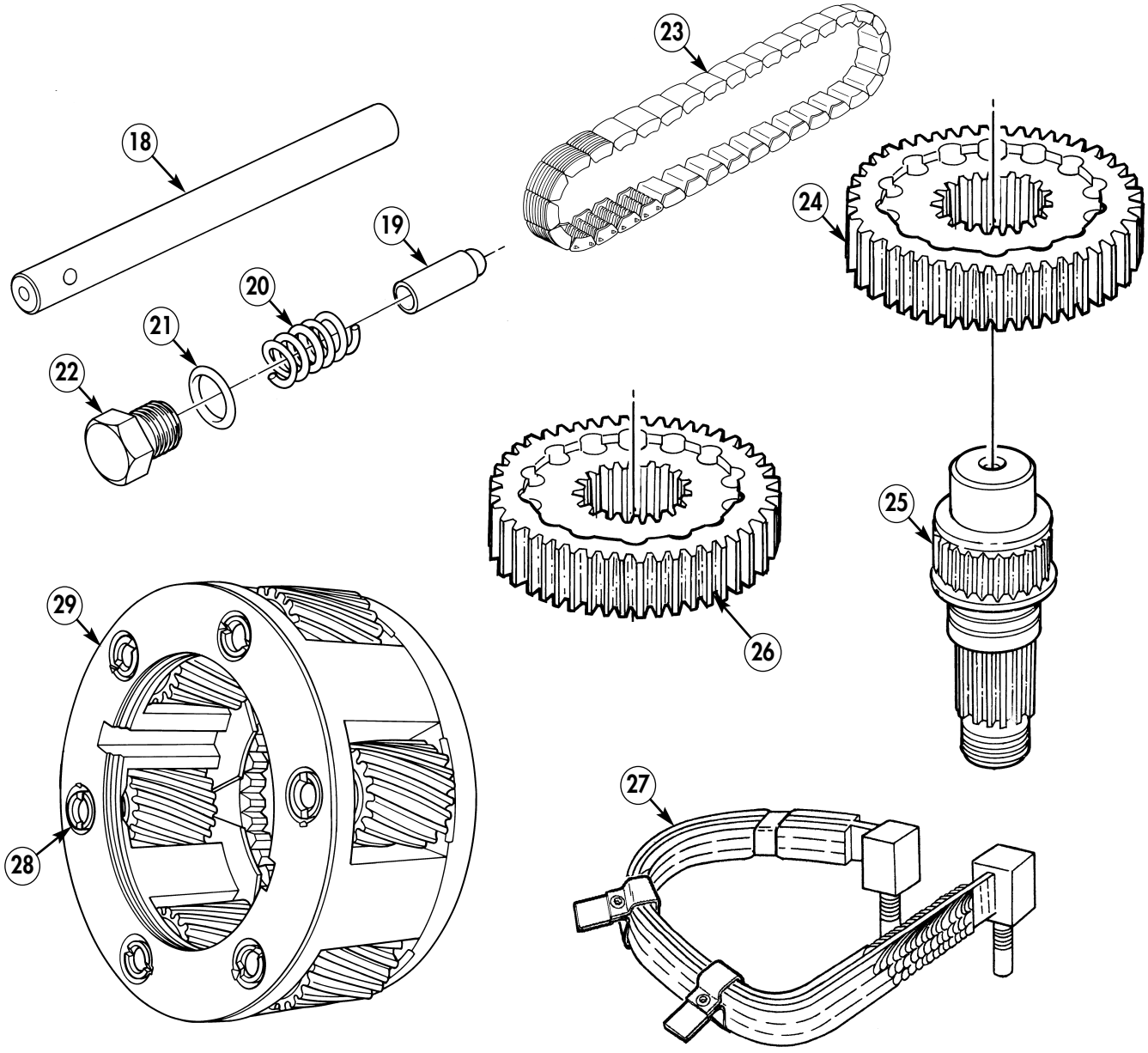
    (f) Remove mode shift fork assembly (8) from vise.

18. Inspect shift rail (18) for bends, cracks, and grooving. Replace shift rail (18) if damaged.
19. Inspect detent assembly for broken or kinked spring (20), broken or burred poppet (19), or damaged plug (22). Replace O-ring (21) on plug (22). Replace plug (22), spring (20), or poppet (19) if damaged.



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

20. Inspect drive chain (23) for breaks, missing parts, kinks, and evidence of scratching on contact surfaces. Replace drive chain (23) if damaged.
21. Inspect drive sprocket (24) and driven gear (26) for cracks, breaks, bent or twisted splines, and broken or chipped gear teeth. Replace gears (24) or (26) if damaged.
22. Inspect front output shaft (25) for cracks, bent or twisted splines, damaged threads, and scored bearing and sealing surfaces. Minor scoring and thread damage is reparable. Replace front output shaft (25) if damaged.
23. Inspect low range gear (29) for cracks, breaks, chipped or broken gear teeth, pinion side free play and smooth rotation. If front and rear carriers are loose, tighten screws (28); if still loose, replace low range gear (29). For all other damage, replace low range gear (29).
24. Inspect oil cooler (27) for bends, breaks, and leaks. Repair by straightening bent fins. Replace oil cooler (27) if damaged.



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

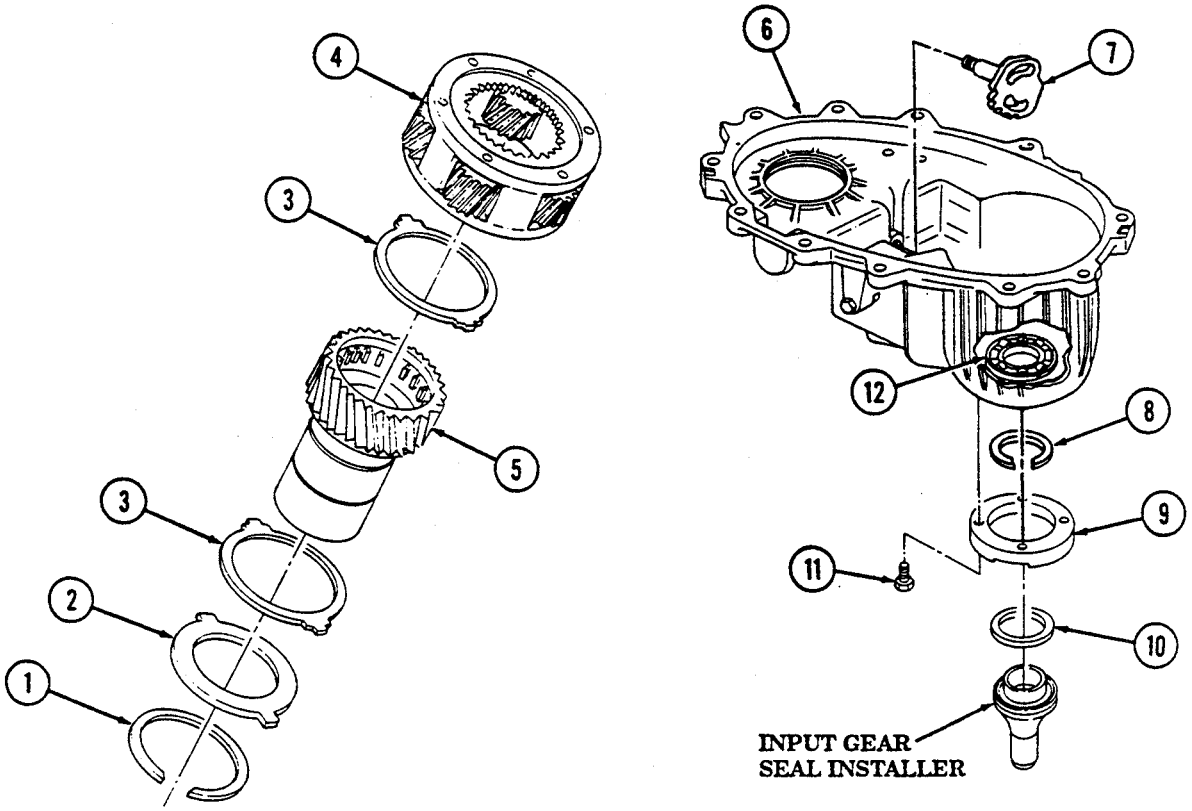
**d. Assembly**

1. For general assembly instructions, refer to para. 2-16.
2. Place thrust washer (3), input gear (5), thrust washer (3), and retainer (2) into low range gear (4) with snapring (1). Make sure snapring (1) is fully seated in groove of low range gear (4).

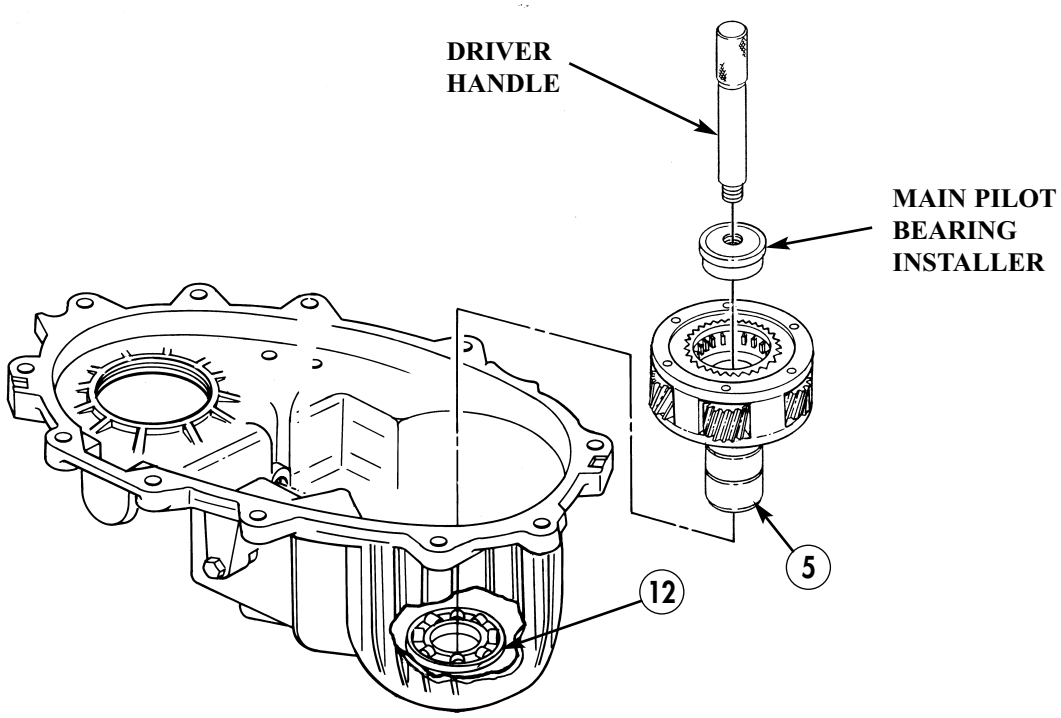
**CAUTION**

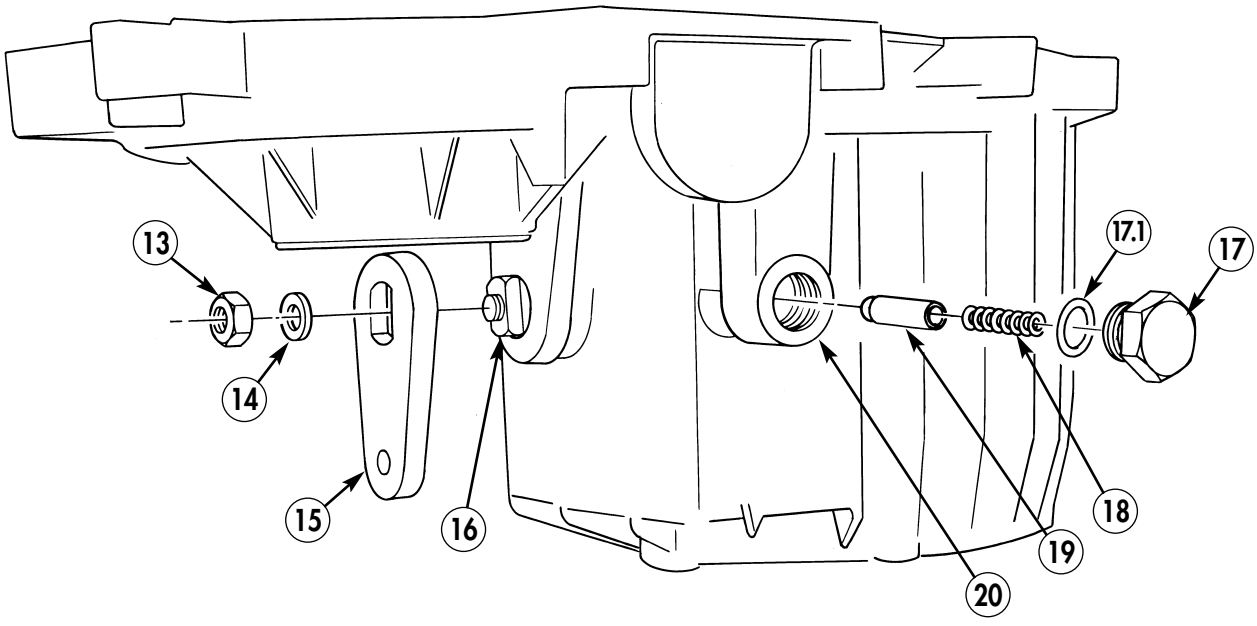
Use correct tool to press input gear into ball bearing. Pilot bearing could be moved out of position causing damage to equipment.

3. Using driver handle and main pilot bearing installer and supporting ball bearing (12), press input gear shaft (5) into ball bearing (12). Snapring groove must be exposed beyond ball bearing (12).
4. Install snapring (8) in input gear shaft (5).
5. Using input gear seal installer, install input gear seal (10) in bearing retainer (9).
6. Run a bead of silicone compound on contact surface of bearing retainer (9).
7. Install bearing retainer (9) on front half-case (6) with four screws (11). Tighten screws (11) to 12-20 lb-ft (16-27 N•m).
8. Install shift sector (7) in front half-case (6).
9. Install shift lever (15) on shift sector (16) with washer (14) and nut (13). Tighten nut (13) to 20-25 lb-ft (27-34 N•m).
10. Install poppet (19), spring (18), O-ring (17.1), and shift detent plug (17) in bore (20). Tighten plug to 12-18 lb-ft (16-24 N•m). Turn shift lever (15) so poppet (19) fits in teeth of shift sector (7).



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)



## 18-4. TRANSFER CASE REPAIR (Model 242) (Cont'd)

11. Position range shift fork (1) in range clutch sleeve (2).

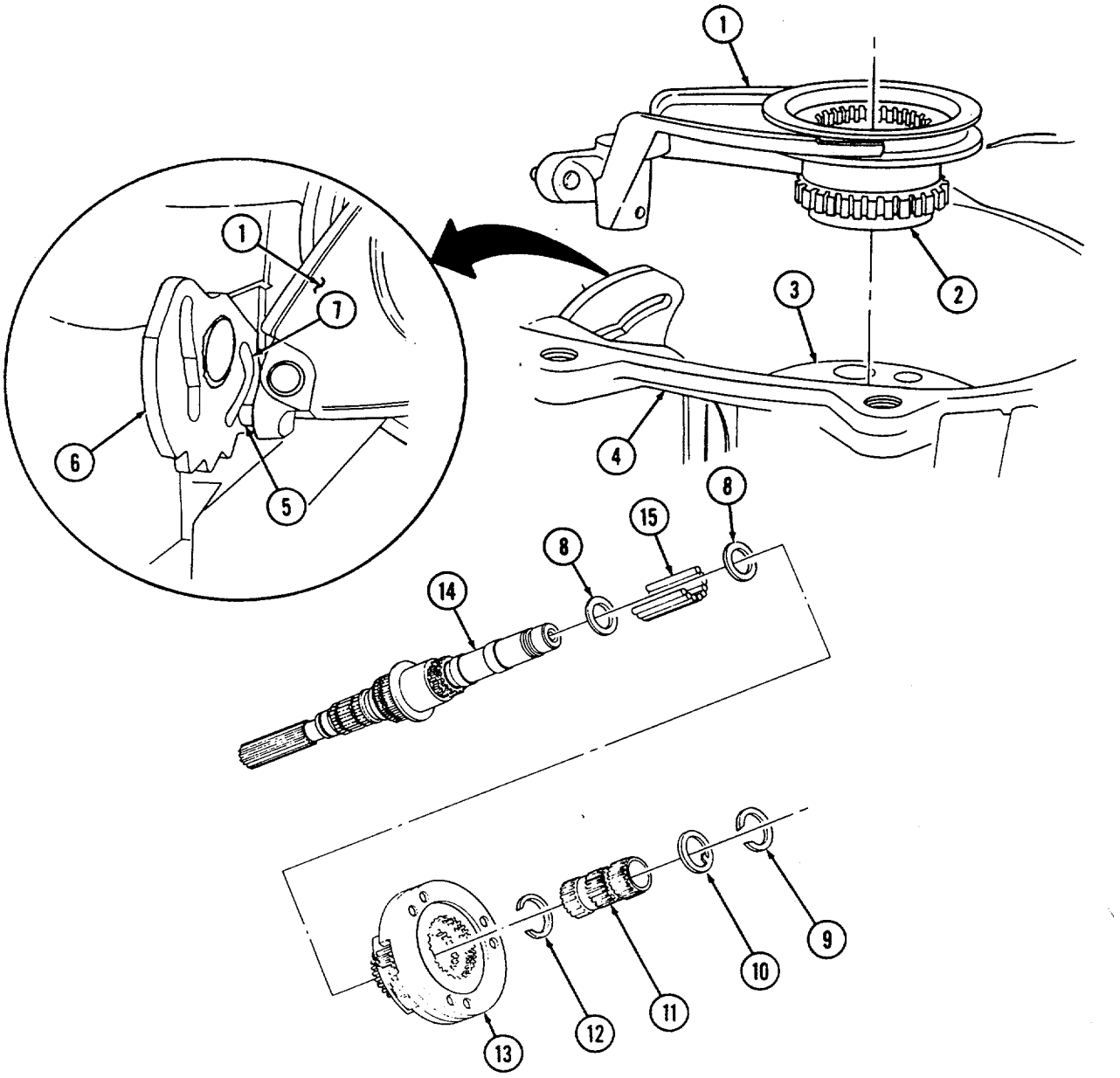
12. Holding range shift fork (1) and range clutch sleeve (2) together, install range clutch sleeve (2) in input gear shaft (3) and pin (5) in angle slot (7) of shift sector (6). Move shift sector (6) as necessary to align fork (1).

13. Place thrust washer (8), fifty-three needle bearings (15), and thrustwasher (8) on mainshaft (14). Ij Use petrolatum to hold needle bearings (15) in place on mainshaft journal (14).

14. Carefully slide differential assembly (13) over mainshaft (14) and needle bearings (15) with snapring (12). Make sure that, no needle bearings (15) are displaced.

15. Place intermediate clutch shaft (11) over mainshaft (14).

16. Position keyed thrust washer (10) over mainshaft (14) on intermediate clutch shaft (11) with snapring (9). Snapring (9) seats in groove in mainshaft (14).



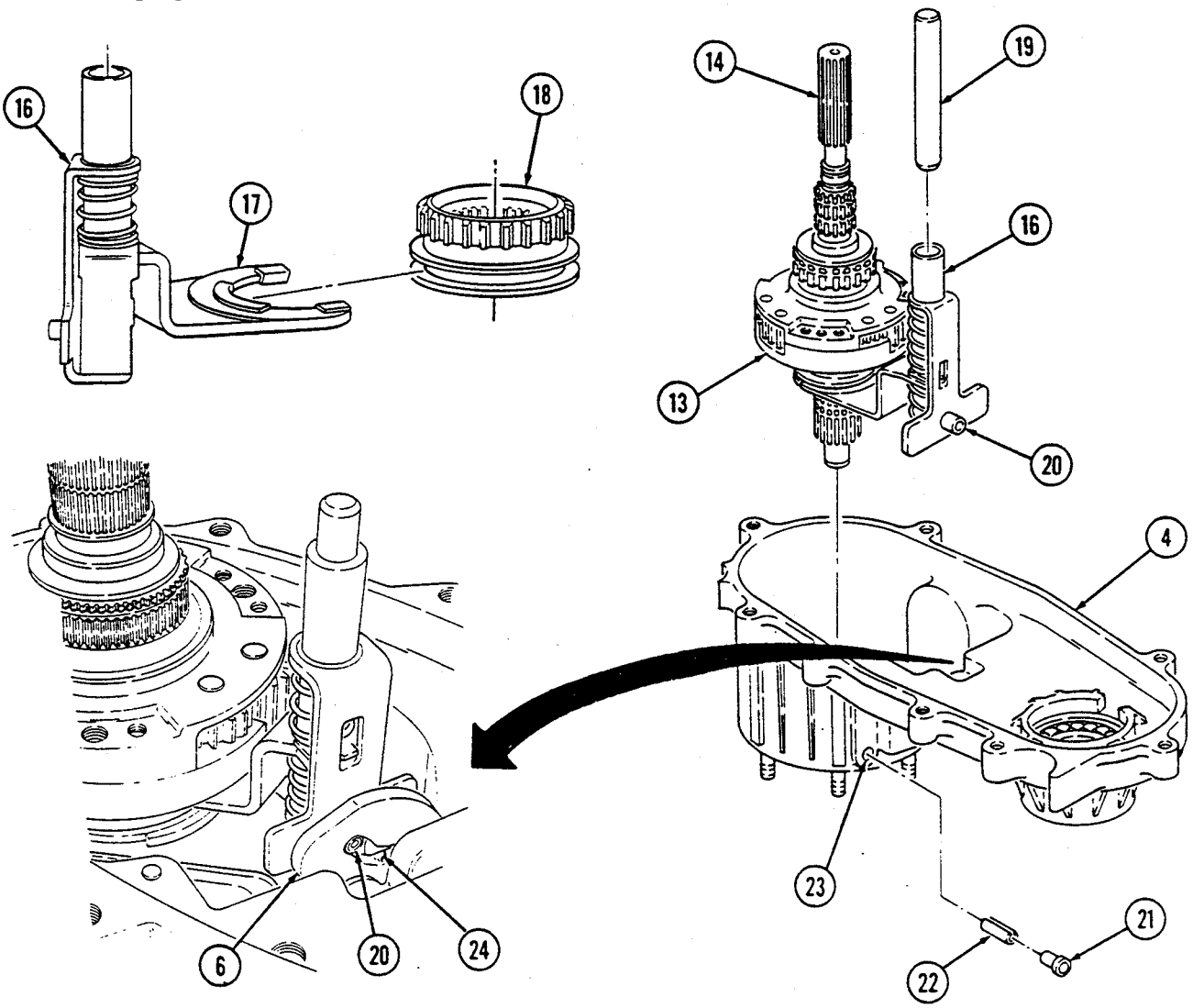
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

17. Slide mode shift sleeve (18) onto mode shift fork (17).
18. Slide mode shift fork assembly (16) over mainshaft assembly (14) and align with differential assembly (13).
19. Lifting on end of mainshaft assembly (14), holding mode shift fork assembly (16) in place, set end of mainshaft assembly (14) into input gear in front half-case (4).
20. Carefully align pin (20) of mode fork (16) in long slot (24) of shift sector (6).
21. Align mode shift fork (16), and range shift fork (1) in front half-case (4) and insert shift rail (19) and seat in front half-case (4).

**NOTE**

- It may be necessary to use screw extractor to start straight pin in range shift fork.
- It may be necessary to remove shift lever to install straight pin.

22. Align pin hole in range shift fork (1) and shift rail (19) with hole (23) in front half-case (4) and install straight pin (22) in shift rail (19).
23. Install plug (21) in front half-case (4).



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

24. Install cooler support (2) and two O-rings (6) on oil cooler (1).

24.1. Position oil cooler (1) into front half-case (3) and install two washers (5) and nuts (4). Do not tighten nuts (4).

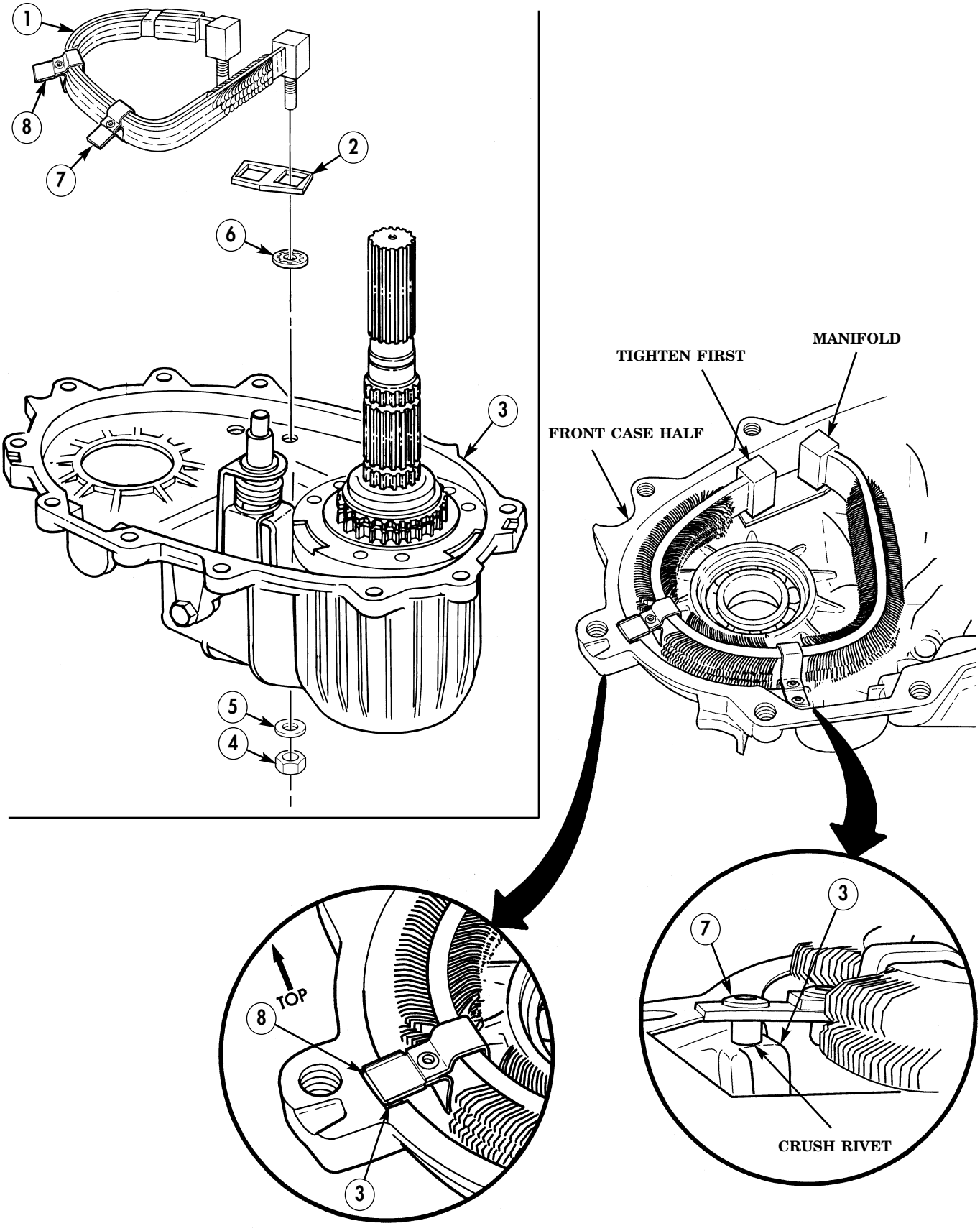
24.2. Align cooler upper support tab (8) in recess on mounting face of front half-case (3) and lower tab (7) on recess in front half-case (3).

**NOTE**

- Lower tab is designed so that the crush rivet compresses between recessed casting areas of the front and rear halves of the transfer case when they are bolted together.
- To prevent damage to tube while tightening tube nuts, tube manifold should be held in place with 3/4-inch wrench.

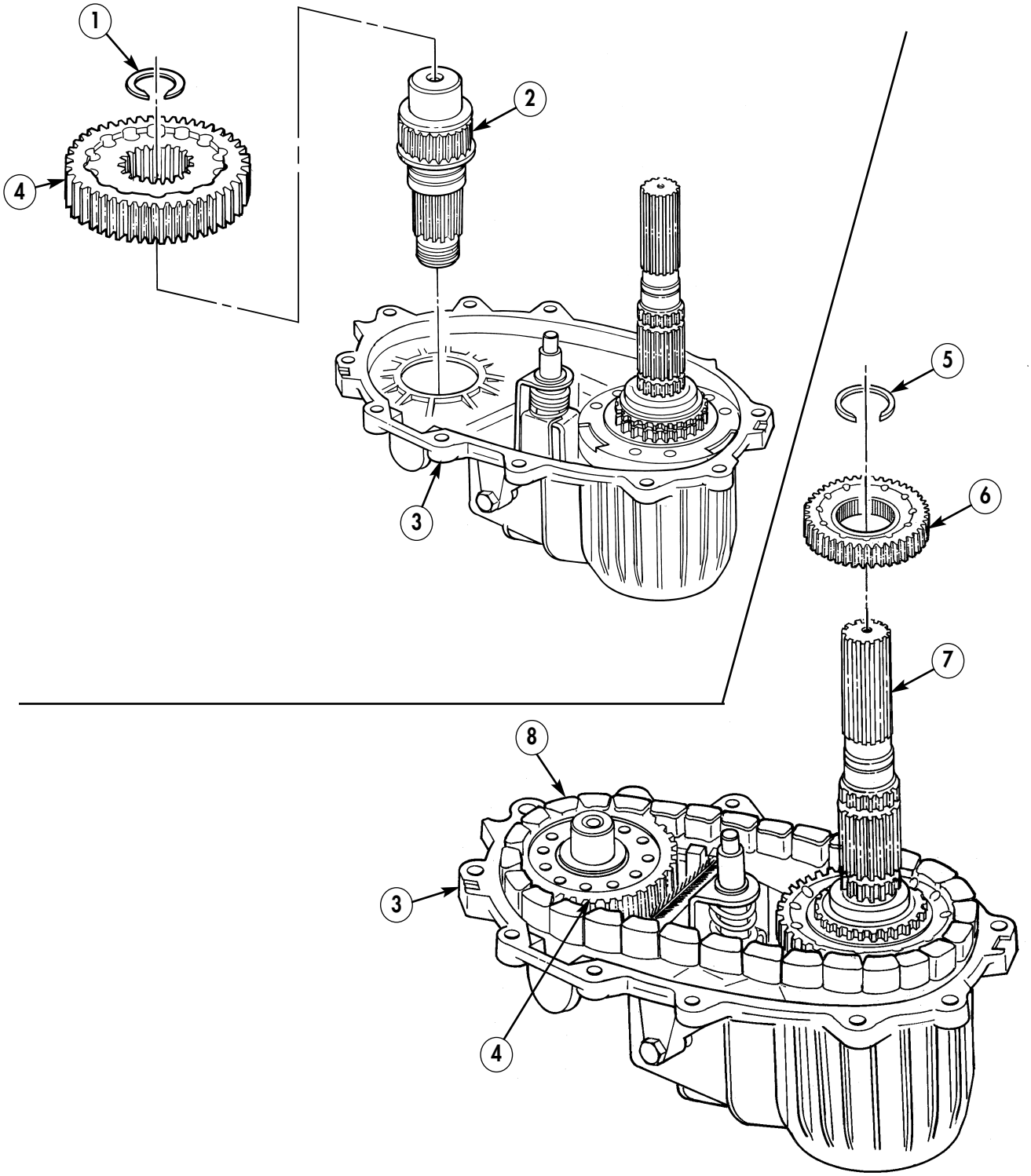
24.3. Tighten nut (4) closest to support tab (8) to 15 lb-ft (20 N•m), and then tighten second nut (4) to 15 lb-ft (20 N•m).

## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)



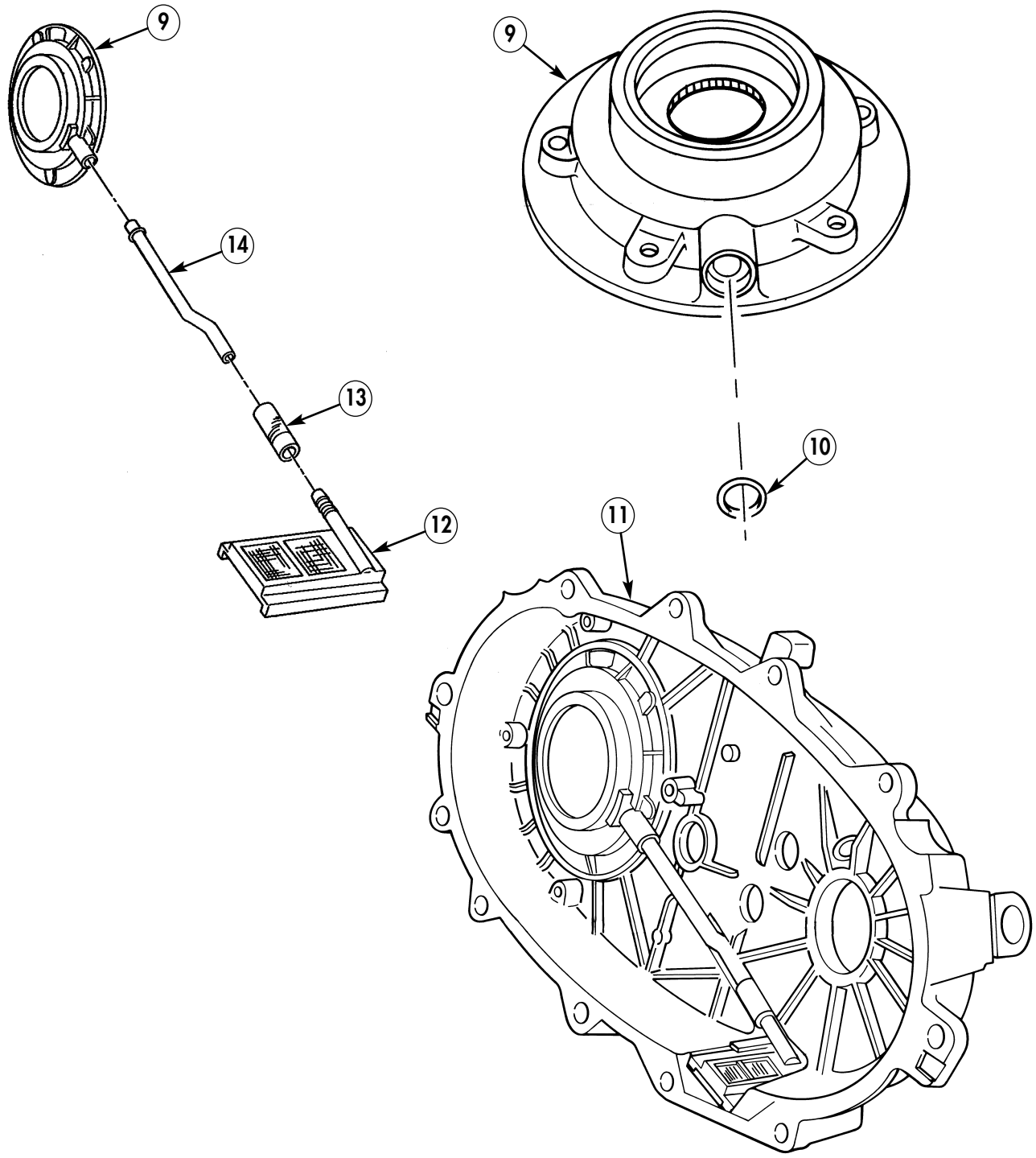
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

25. Install driven gear (4) on front output shaft (2) with snapring (1).
26. Install front output shaft (2) and driven gear (4) on front half-case (3).
27. Position drive chain (8) over mainshaft assembly (7) and driven gear (4).
28. Work drive sprocket (6) onto mainshaft assembly (7) and into drive chain (8) and mainshaft (7) with snapring (5).



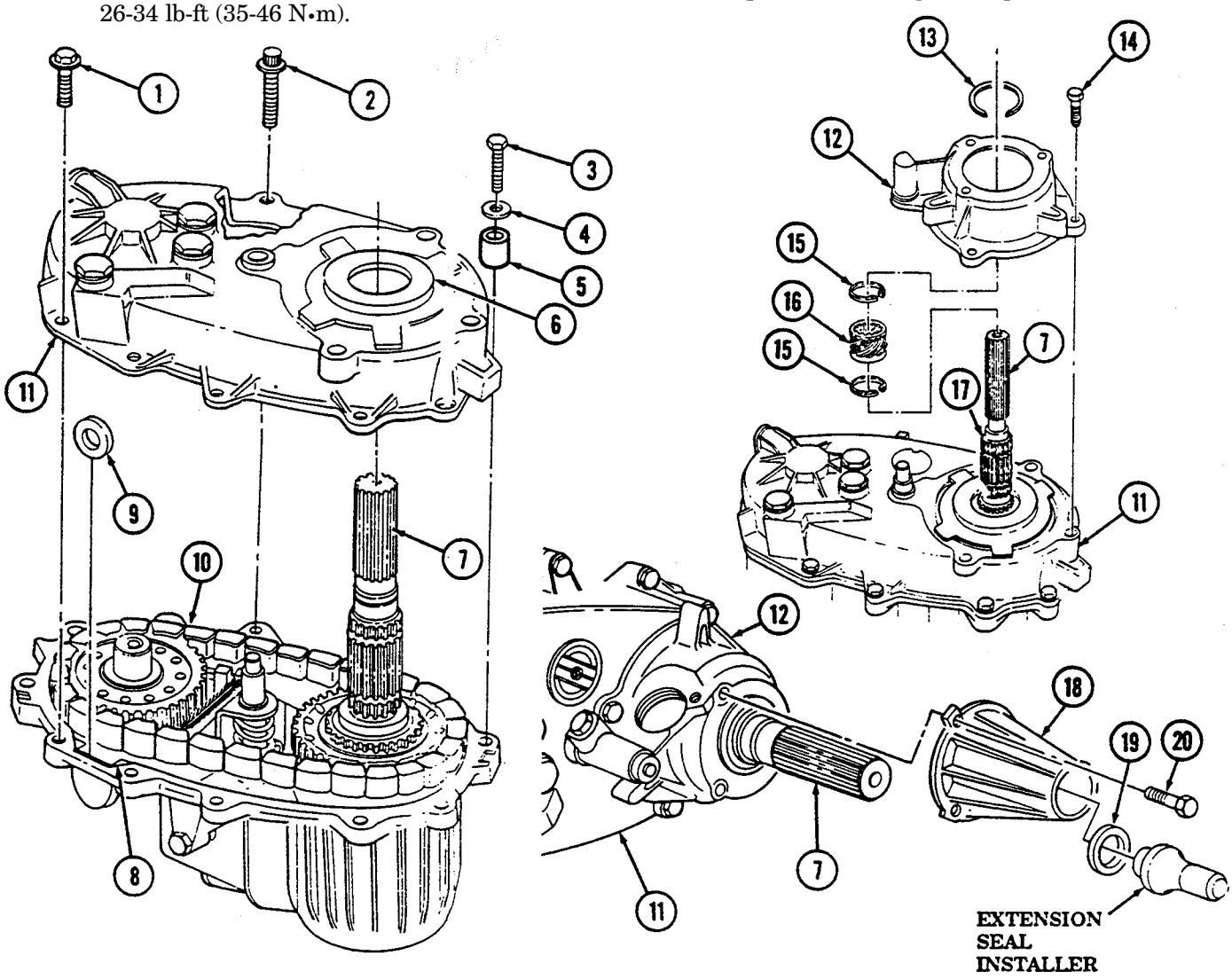
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

29. Install oil tube seal (10) in pickup bore of front housing of oil pump (9).
30. Assemble oil screen (12), hose (13), and oil pickup tube (14).
31. Place oil pump (9) on rear half-case (11), insert pickup tube (14) into oil pump (9), and install oil screen (12) in rear half-case (11).



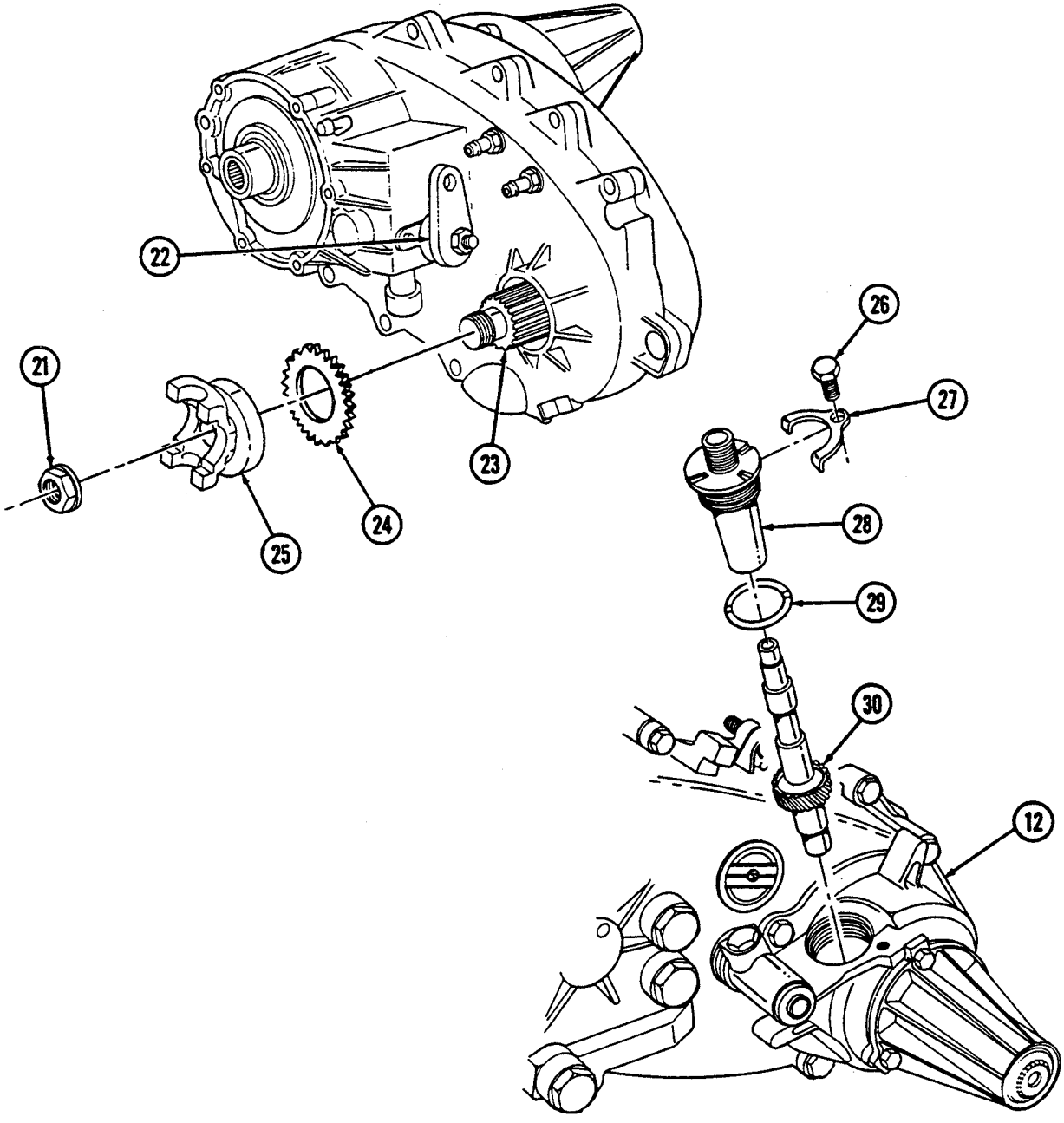
## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

32. Install magnet pickup (9) in socket (8) in front half-case (10).
33. Install two alignment dowels (5) in rear half-case (11) if they were removed.
34. Run a 1/8 in. (3 mm) bead of silicone compound on mating flange surface of the front half-case (10).
35. Position rear half-case (11) on front half-case (10) and install two washers (4) and capscrews (3) through alignment dowels (5) into front half-case (10). Turn mainshaft assembly (7) to align oil pump (6) gears.
36. Install two long screws (2) at front output shaft area and seven screws (1) in remaining holes in rear half-case (11). Tighten screws (3), (2), and (1) to 26-34 lb-ft (35-46 N•m).
37. Install speedometer drive gear (16) on main shaft (7) with two snaprings (15).
38. Run a 1/8 in. (3 mm) bead of silicone compound on sealing surface of rear retainer (12) and install on rear half-case (11) with four capscrews (14). Tighten capscrews (14) to 26-34 lb-ft (35-46 N•m).
39. Install snapring (13) on mainshaft assembly (7). Lift mainshaft (7) as necessary to clear groove (17) for snapring (13). Ensure snapring (13) is fully seated in groove (17).
40. Run a 1/8 in. (3 mm) bead of silicone compound on flange sealing surface of rear retainer (12).
41. Using extension housing seal installer, install rear output drive seal (19) on rear extension (18).
42. Install rear extension (18) on rear retainer (12) with three capscrews (20). Tighten capscrews (20) to 26-34 lb-ft (35-46 N•m).



## 18-4. TRANSFER CASE REPAIR (MODEL 242) (Cont'd)

43. Install front output yoke (25) on shaft (23) with lockwasher (24) and nut (21). Tighten nut (21) to 90-130 lb-ft (122-176 N•m).
44. Install driven gear (30), O-ring (29), and pinion adapter (28) in rear retainer (12) with clamp (27) and capscrew (26). Tighten capscrew (26) to 12-15 lb-in. (1.4-1.7 N•m).
45. Move shift range lever (22) to make sure transfer shifts into four detent positions. May have to turn shafts to obtain full detent engagement.




FOLLOW-ON TASK: Install transfer case (para. 8-3).

# CHAPTER 19
# DIFFERENTIAL REPAIR

## 19-1. INTRODUCTION

This chapter contains maintenance instructions for disassembly and repair of propeller differential components at the General Support maintenance level. Some subassemblies and parts must be removed before differential components can be accessed. They are referenced to other paragraphs of this manual.

## 19-2. DIFFERENTIAL DISASSEMBLY AND REPAIR TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 19-3. | Differential Repair | 19-2 |

## 19-3. DIFFERENTIAL REPAIR

**This task covers:**

**a. Disassembly**
**b. Cleaning**
**c. Inspection**
**d. Assembly**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)
Dial indicator (Appendix G, Item 95)

**Special Tools**

Differential housing spreader (Appendix G, Item 128)
Pinion setting gauge set (Appendix G, Item 86)
Pinion setting gauge set (Appendix G, Item 87)
Rear pinion bearing cup remover (Appendix G, Item 81)
Front pinion bearing cup remover (Appendix G, Item 82)
Rear pinion bearing cup installer (Appendix G, Item 84)
Front pinion bearing cup installer (Appendix G, Item 85)
Yoke seal installer (Appendix G, Item 54)
Driver handle (Appendix G, Item 34)
Output shaft installer (Appendix G, Item 79)
Axle holding fixture adapters (Appendix G, Item 80)

**Materials/Parts**

Four O-rings (Appendix E, Item 149)
Three locknuts (Appendix E, Item 53)
Spacer sleeve (Appendix E, Item 247)
Plain seal (Appendix E, Item 231)
Two plain seals (Appendix E, Item 230)
Lubricating oil (Appendix B, Item 30)
Silicone sealant (Appendix B, Item 43)
Four guide pins 5992390 (Appendix C, Fig. 1)

**Personal Required**

One mechanic
One assistant

**Manual References**

TM 9-2320-280-24P

**Equipment Condition**

Differential removed (para. 9-5).

**Maintenance Level**

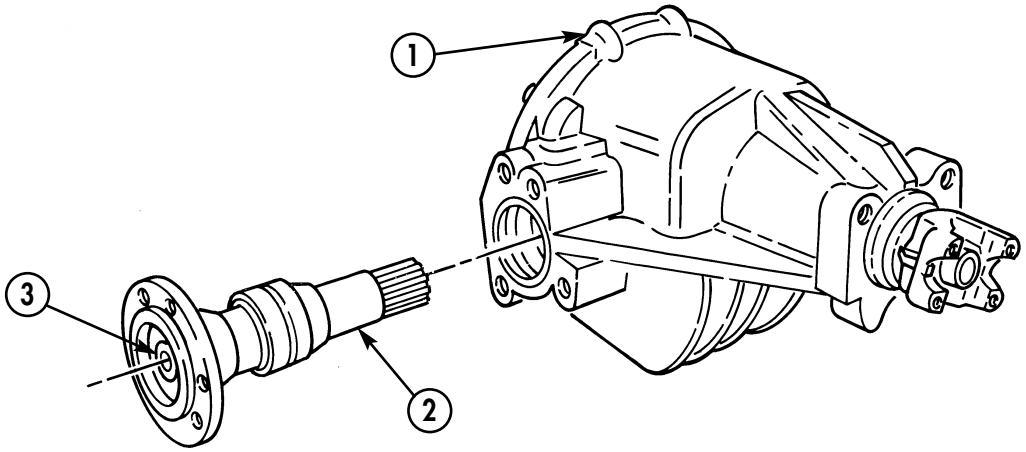
General support

**NOTE**

- Work area should be clean, well ventilated, and free from blowing dirt and dust.
- Refer to axle differential housing identification part number, located on housing, before ordering any replacement parts.

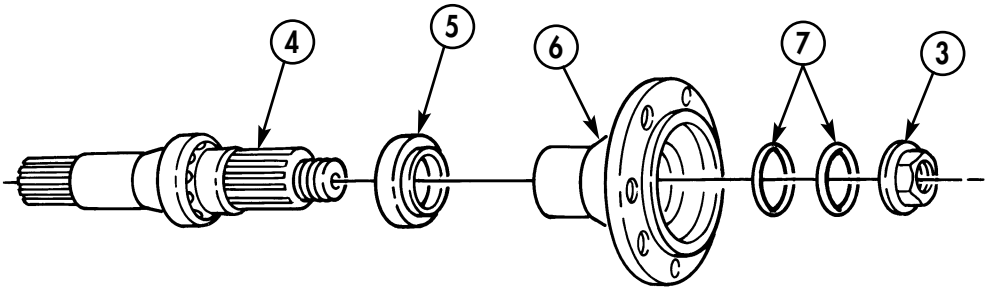
### a. Disassembly

1. Loosen locknut (3) on output shaft assembly (2).
2. Using slide hammer, remove output shaft assembly (2) from differential housing (1).

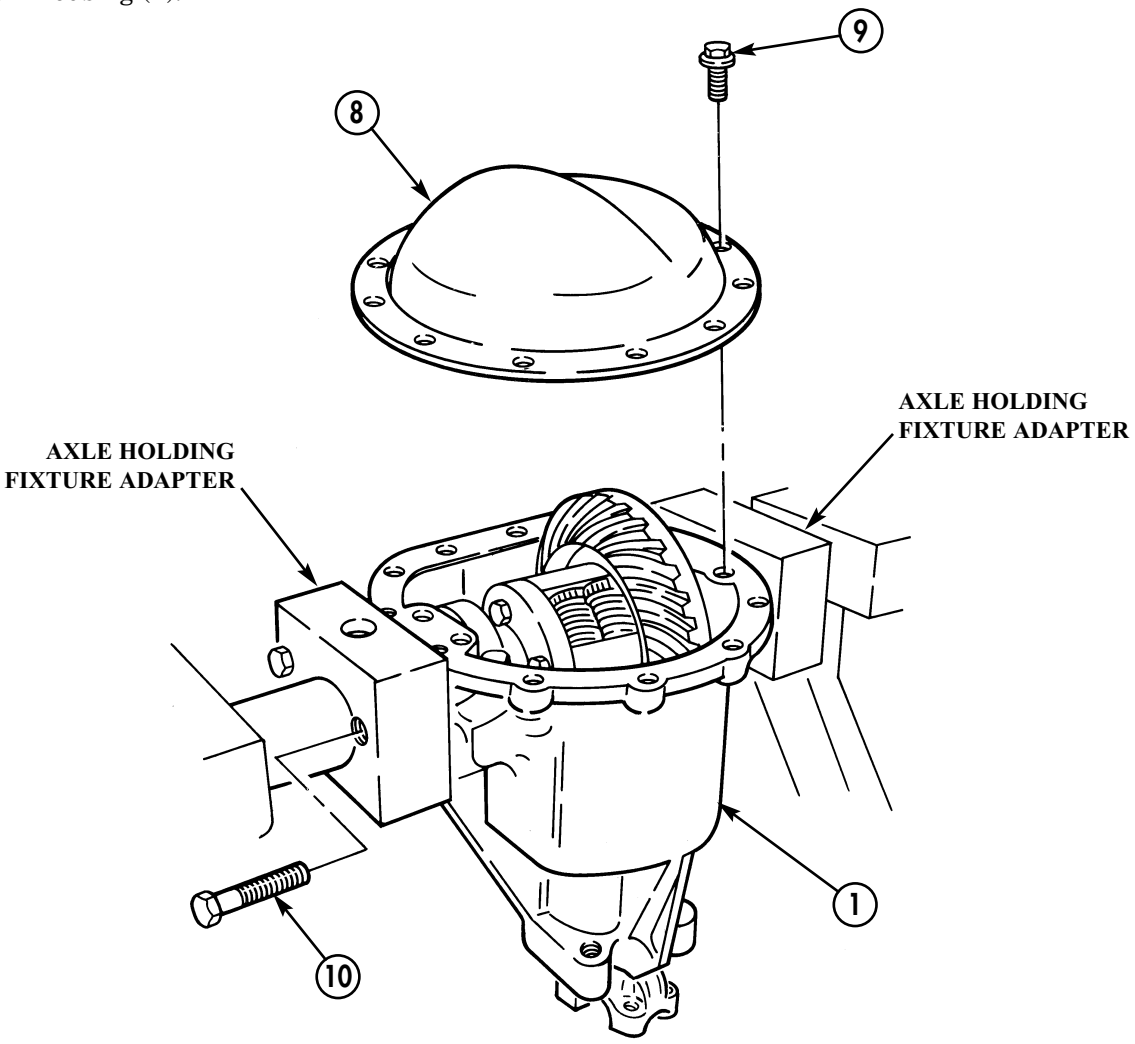


## 19-3. DIFFERENTIAL REPAIR (Cont'd)

3. Remove locknut (3), two O-rings (7), output flange (6), and seal (5) from output shaft (4). Discard O-rings (7), seal (5), and locknut (3).
4. Repeat steps 1 through 3 for opposite side.




5. Install axle holding fixture adapters on housing (1) with four capscrews (10). Place housing (1) in holding stand.
6. Position housing (1) so differential cover (8) faces up. Remove twelve capscrews (9) and cover (8) from housing (1).



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

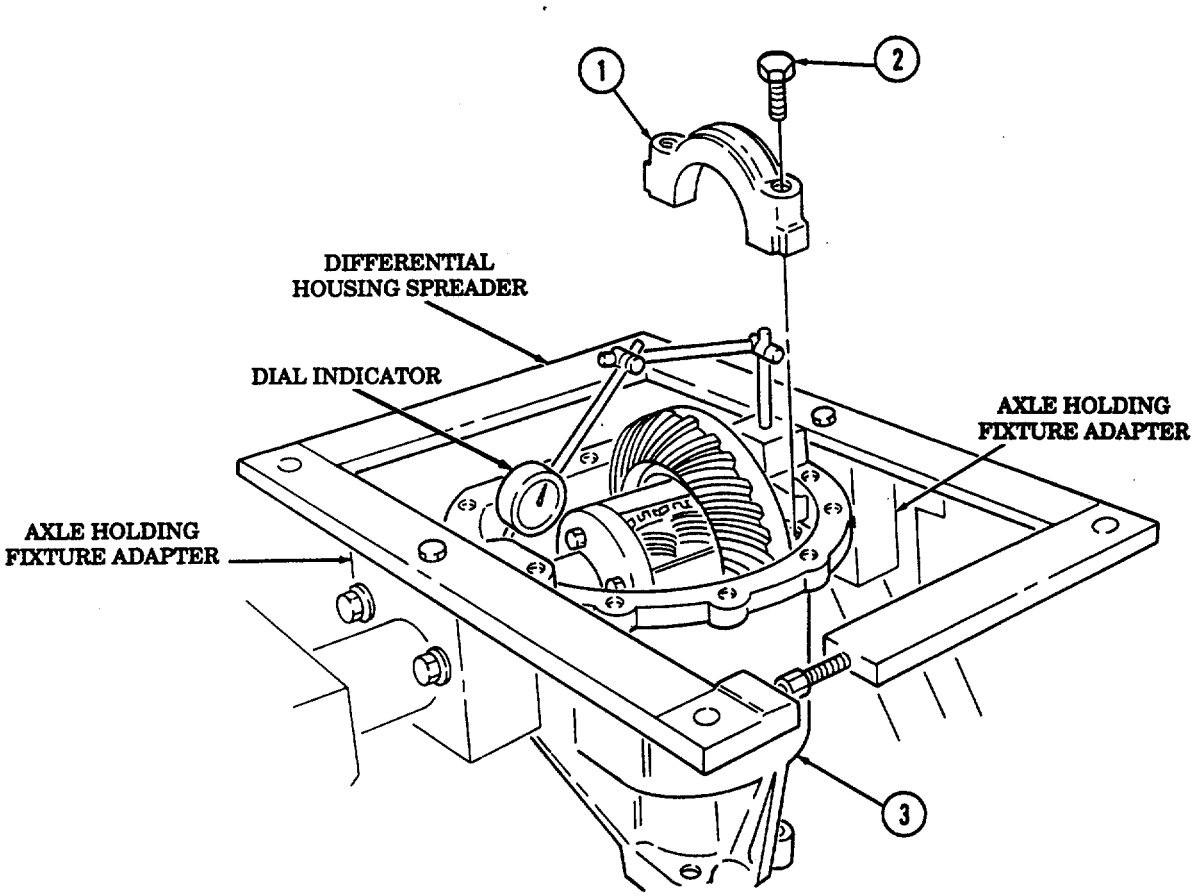
7. Mark two bearing caps (1) and housing (3) for assembly and remove four capscrews (2) and two bearing caps (1) from housing (3).

8. Install differential housing spreader into holes in axle holding fixture adapters and install dial indicator to read from each end of housing (3). Dial indicator must have preload setting of 0.020 in. _ (0.5 mm).

**CAUTION**

Over-tightening of differential housing spreader will damage differential housing.

9. Spread housing (3) 0.010 in. (0.25 mm) and remove dial indicator.

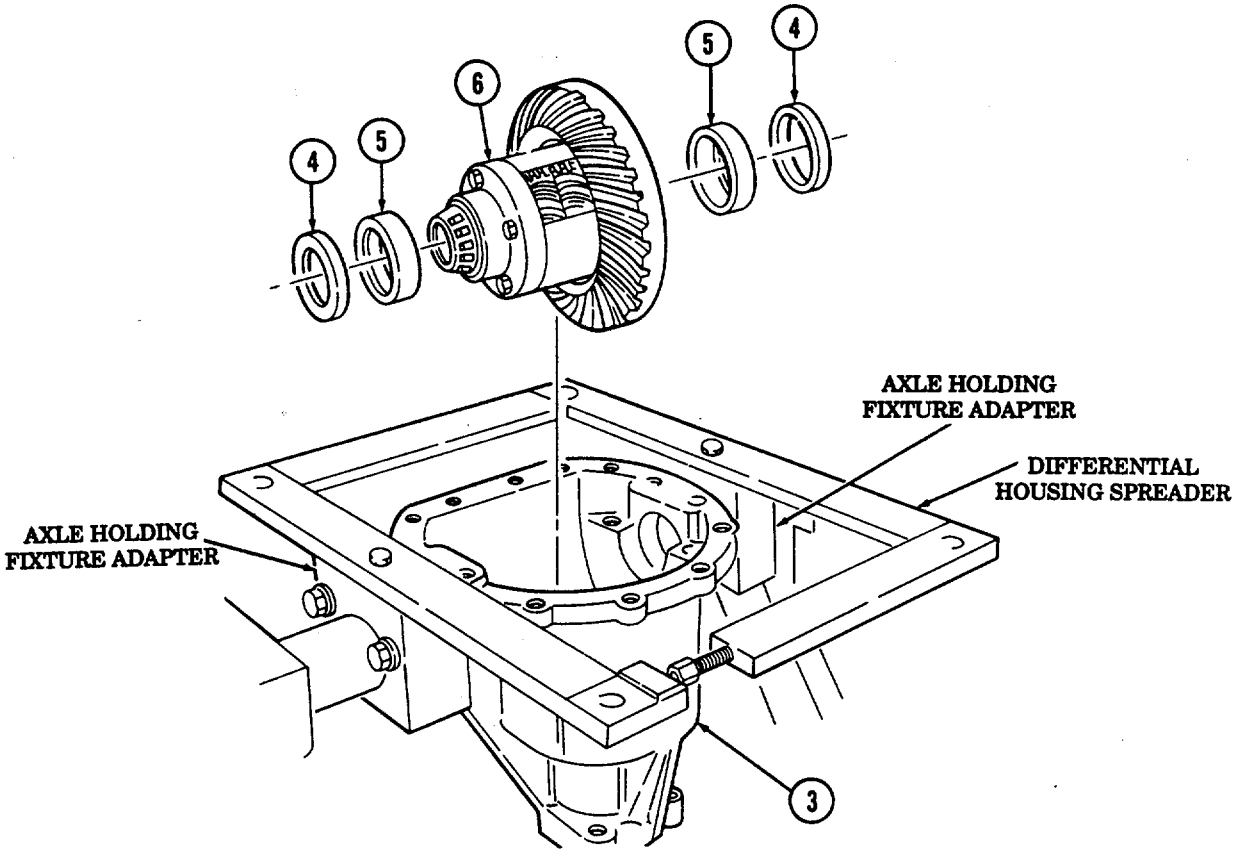


**19-3. DIFFERENTIAL REPAIR (Cont'd)**

**NOTE**
Tag bearing shims and bearing cups for assembly.

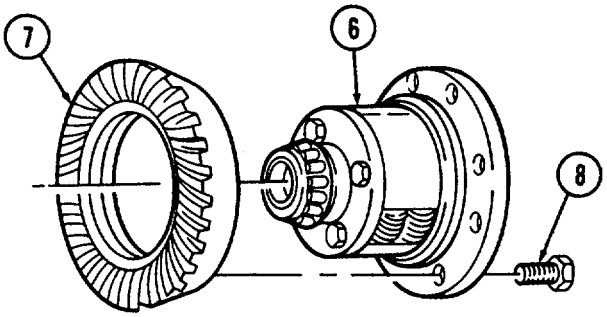
10. Remove differential case (6), two bearing cups (5), and shims (4) from housing (3).

11. Relieve pressure on housing spreader and remove from housing (3).



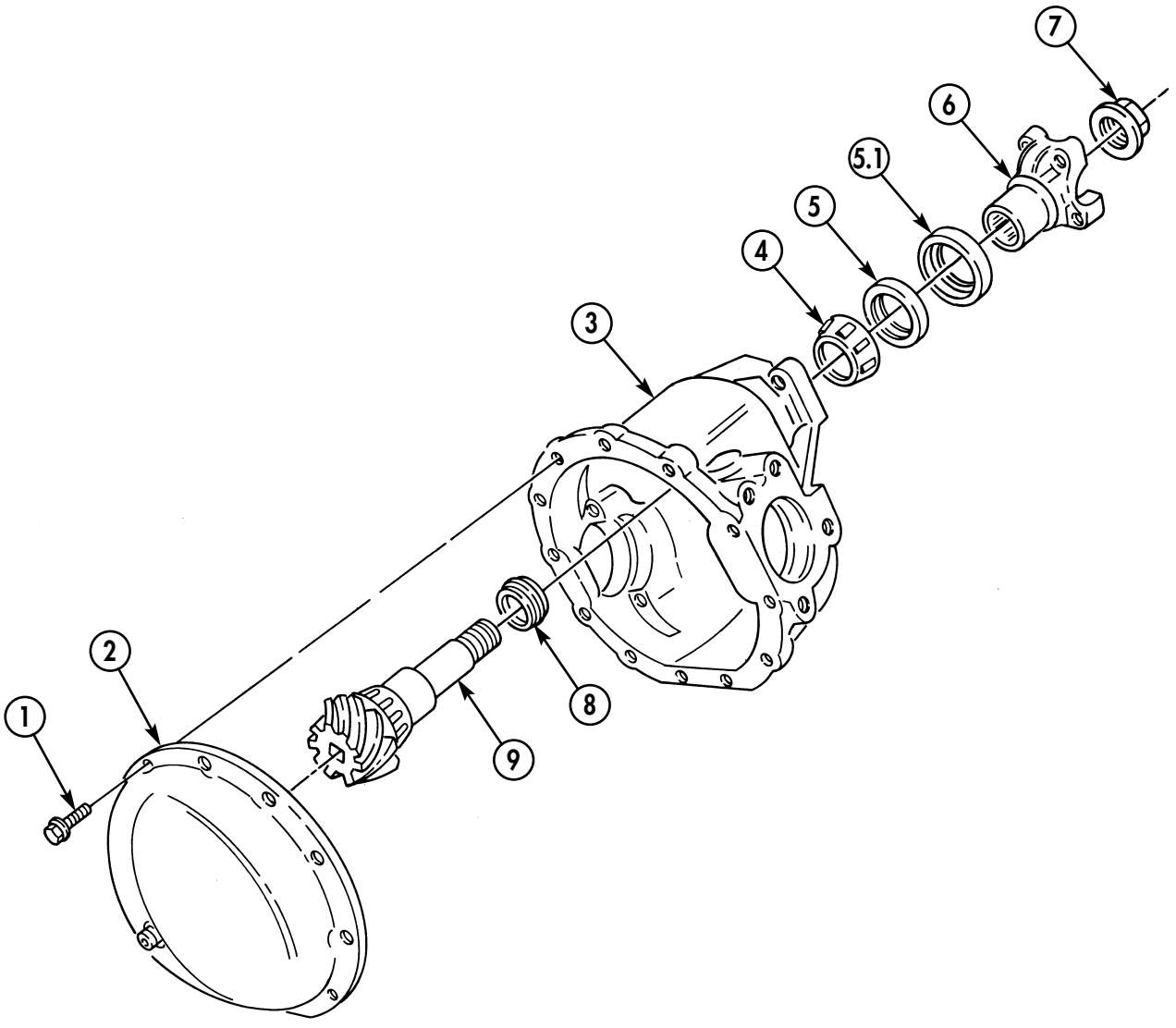

**CAUTION**
Do not chisel or wedge ring gear from differential case or damage may result.

12. Remove eight capscrews (8) and ring gear (7) from differential case (6).



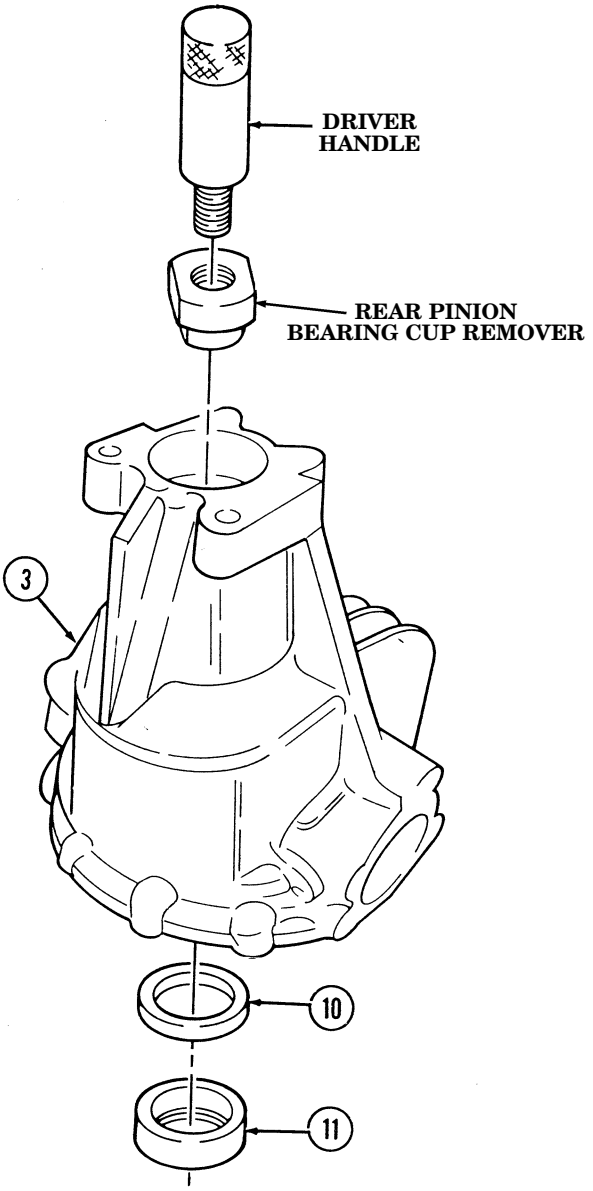
## 19-3. DIFFERENTIAL REPAIR (Cont'd)

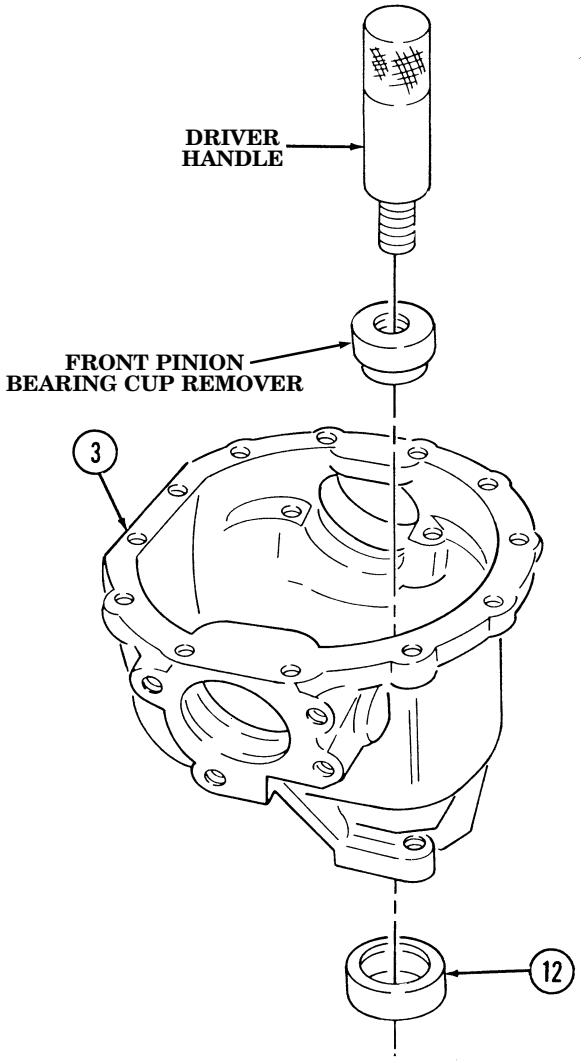
13. Rotate housing (3) 90 degrees. Install cover (2) and two capscrews (1) on housing (3).
14. Remove locknut (7) securing pinion yoke (6) and dirt deflector (5.1) to pinion gear (9). Discard locknut (7).
15. Remove pinion yoke (6) and dirt deflector (5.1) from pinion gear (9).
16. Drive pinion gear (9) out of front pinion bearing (4).
17. Remove two capscrews (1), cover (2), pinion gear (9), and spacer sleeve (8) from housing (3). Discard spacer sleeve (8).
18. Remove seal (5) and front pinion bearing (4) from housing (3). Discard seal (5).



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

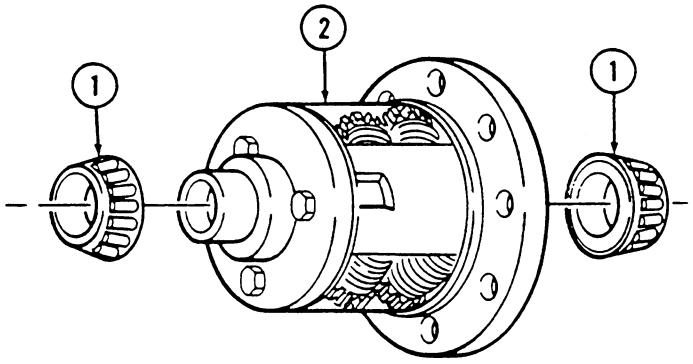
19. Rotate front of housing (3) upward 90 degrees. Using driver handle and rear pinion bearing cup remover, remove rear pinion bearing cup (11) and pinion depth shim (10) from housing (3).
20. Rotate housing (3) 180 degrees. Using driver handle and front pinion bearing cup remover, remove front pinion bearing cup (12) from housing (3).

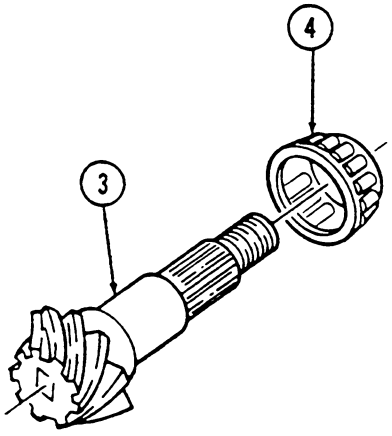


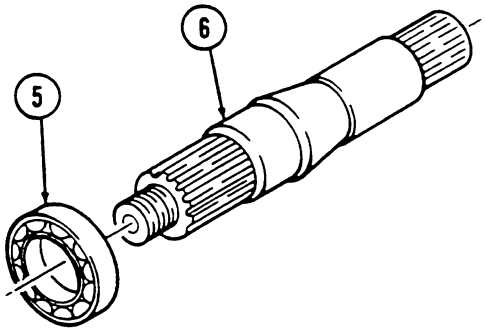



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

21. Remove two differential side bearings (1) from differential case (2).
22. Remove rear pinion bearing (4) from pinion gear (3).
23. Remove bearings (5) from output shafts (6).



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

**b. Cleaning**

Clean all differential parts in accordance with para. 2-13.

**c. Inspection**

**NOTE**

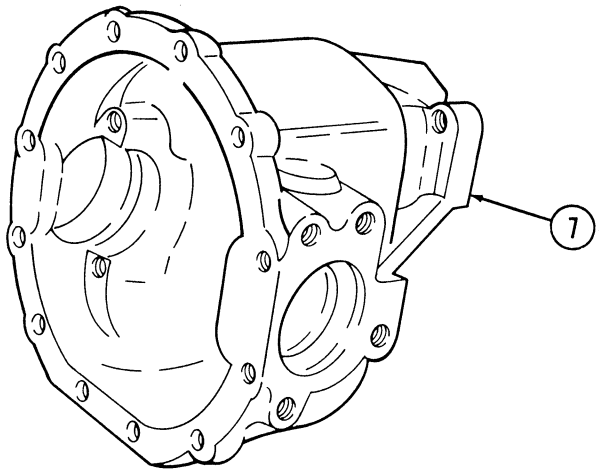
For general inspection instructions, refer to para. 2-14.

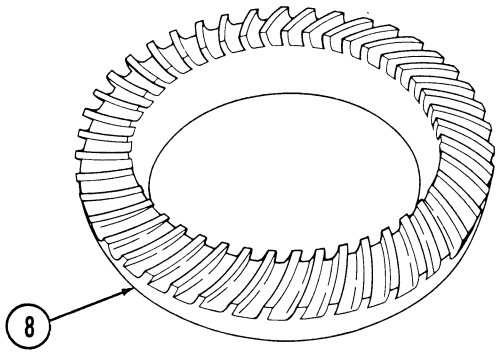
1. Inspect housing (7) and all threaded holes for damage. Repair any damaged threads with thread repair inserts. Replace differential if housing (7) is damaged.

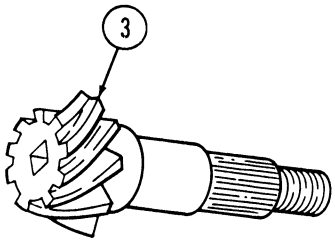
**NOTE**

Ring and pinion gears must be replaced as matched set.

2. Inspect splines and gear teeth on pinion gear (3) and ring gear (8) for damage. Replace both pinion gear (3) and ring gear (8) if either are damaged.



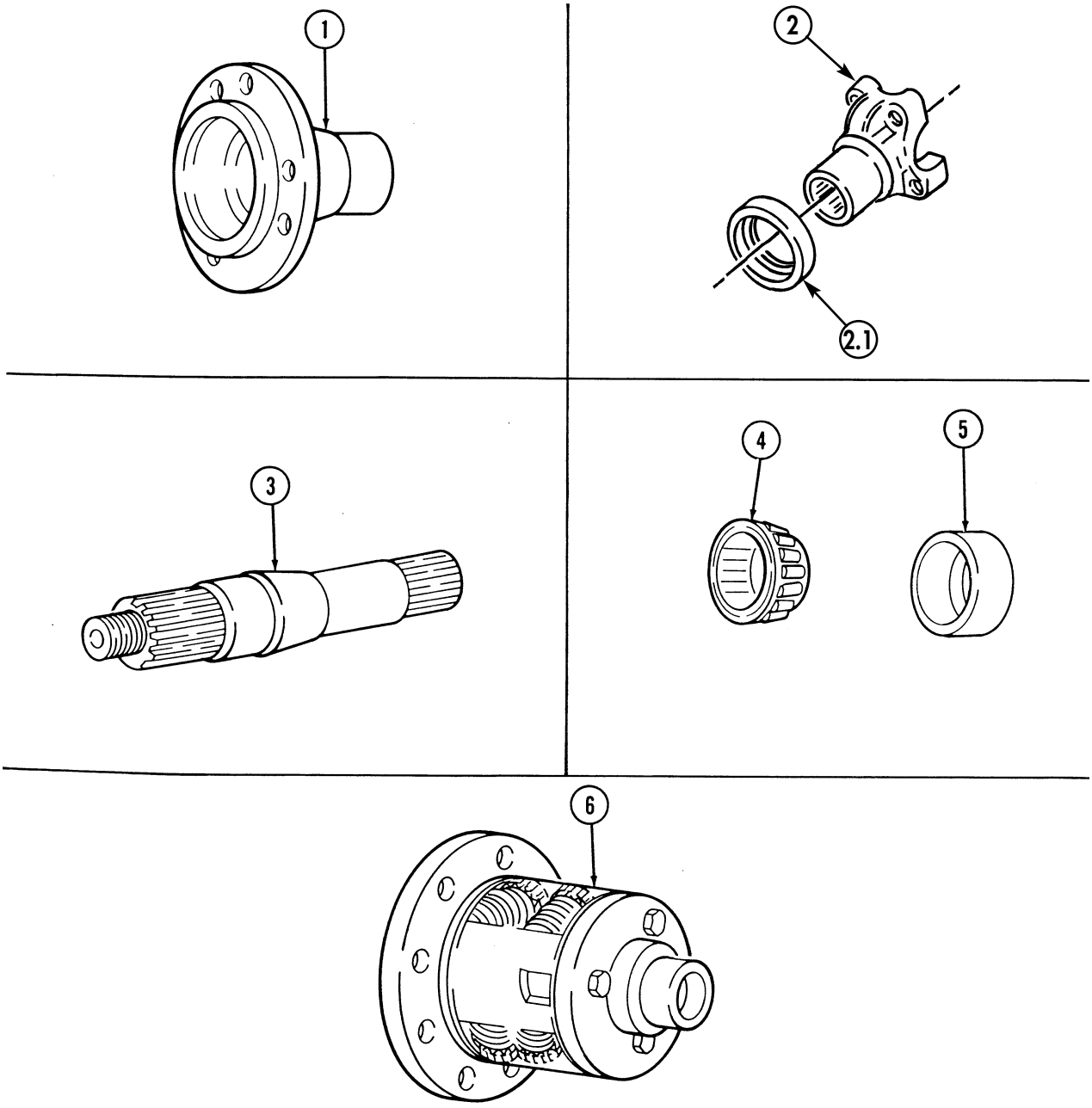
## 19-3. DIFFERENTIAL REPAIR (Cont'd)

3. Inspect splines and sealing surfaces on output flanges (1), pinion yoke (2), dirt deflector (2.1), and output shafts (3) for damage. Replace if damaged.

**NOTE**

- If rear pinion yoke is being replaced, a new slinger must be installed on new pinion yoke.
- Push rear pinion yoke into slinger until slinger is seated against rear shoulder of yoke.

4. Inspect all bearings (4) and bearing cups (5) for damage. Replace bearings (4) and bearing cups (5) in matched sets if either are damaged.
5. Inspect differential case (6) for damage. Replace if damaged.



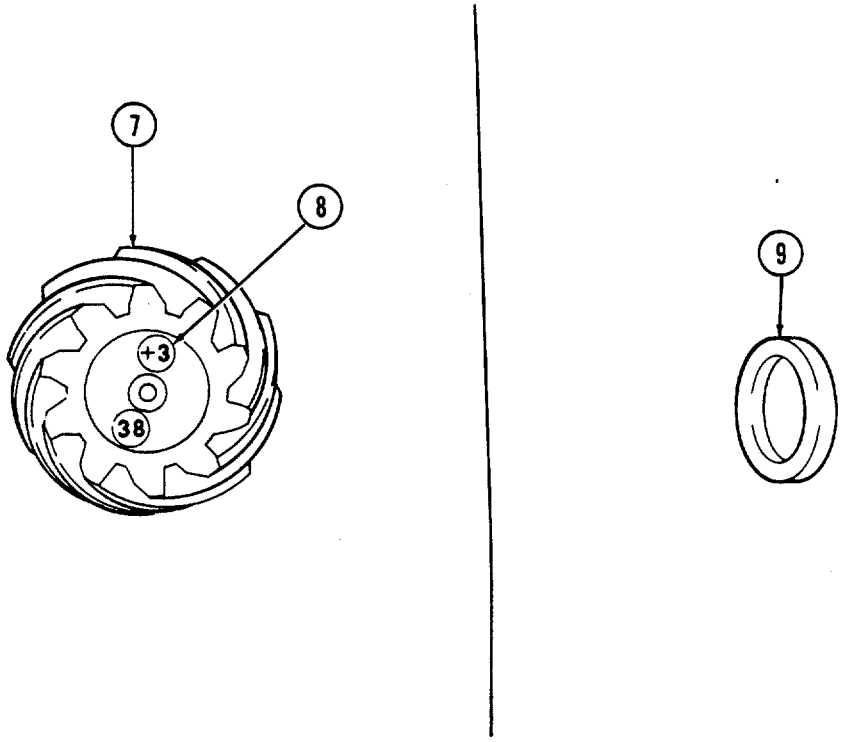
## 19-3. DIFFERENTIAL REPAIR (Cont'd)

### d. Assembly

**NOTE**

- For general assembly instructions, refer to para. 2-16.
- Pinion gear depth is the distance from the end face of the pinion to the center line of the output shafts. The dimension is controlled by shims between pinion gear rear bearing cup and differential housing. The pinion gear is etched with two identifying numbers, the first number identifies ring gear and pinion gear as a matched set, the second number represents "pinion depth variance" and is preceded by a plus (+) or minus (-), this number represents the amount in thousandths the gear set varied from the "standard setting" 2.547 in. (6.46 cm).
- If using original gear set, use original pinion depth shim as a starter shim and proceed to step 4.

1. Measure thickness of original pinion depth shim (9) and record for reference.
2. Check pinion depth variance numbers (8) marked on old and new pinion gears (7) and record for references.



**19-3. DIFFERENTIAL REPAIR (Cont'd)**

**NOTE**

- If the old pinion is marked -3 and the new pinion is marked +2, the procedure would be as follows: Refer to Old Pinion Marking column at left side of table and locate -3 in this column. Then read to right, across table, until under +2 in New Pinion Marking column. Box where two columns intersect is amount of shim thickness change required. In this case, the number in the intersecting box is -0.005 in. (0.12 mm) which represents the amount to be subtracted from the old shim thickness. If the box number had been a + figure, this amount would be added to the old shim thickness.
- This table determines an initial shim thickness. The actual pinion depth measurement must be performed and final shim thickness adjusted as necessary.
- Pinion shims are available from 0.084-0.111 in. (2.13-2.82 mm) in increments of 0.0005 in. (0.0125 mm).

3. Refer to Old and New Pinion Marking columns on pinion variance table. Note on table where old and new pinion depth variances intersect, this will determine amount to be added or subtracted from original pinion depth shim for desired pinion depth 'starter shim".

*Table 9-1. Pinion Variance Table Inches)*

| OLD | NEW PINION MARKING | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PINION | | | | | | | | | |
| MARKING | -4 | -3 | -2 | -1 | 0 | +1 | +2 | +3 | +4 |
| +4 | +0.008 | +0.007 | +0.006 | +0.005 | +0.004 | +0.003 | +0.002 | +0.001 | 0 |
| +3 | +0.007 | +0.006 | +0.005 | +0.004 | +0.003 | +0.002 | +0.001 | 0 | -0.001 |
| +2 | +0.006 | +0.005 | +0.004 | +0.003 | +0.002 | +0.001 | 0 | -0.001 | -0.002 |
| +1 | +0.005 | +0.004 | +0.003 | +0.002 | +0.001 | 0 | -0.001 | -0.002 | -0.003 |
| 0 | +0.004 | +0.003 | +0.002 | +0.001 | 0 | -0.001 | -0.002 | -0.003 | -0.004 |
| -1 | +0.003 | +0.002 | +0.001 | 0 | -0.001 | -0.002 | -0.003 | -0.004 | -0.005 |
| -2 | +0.002 | +0.001 | 0 | -0.001 | -0.002 | -0.003 | -0.004 | -0.005 | -0.006 |
| -3 | +0.001 | 0 | -0.001 | -0.002 | -0.003 | -0.004 | -0.005 | -0.006 | -0.007 |
| -4 | 0 | -0.001 | -0.002 | -0.003 | -0.004 | -0.005 | -0.006 | -0.007 | -0.008 |

## 19-3. DIFFERENTIAL REPAIR (Cont'd)

4. Rotate housing (2) so front pinion bearing cup bore faces up.
5. Lubricate outside diameter of front pinion bearing cup (1) with lubricating oil. Using driver handle and front pinion bearing cup installer, install cup (1) in housing (2).

**NOTE**

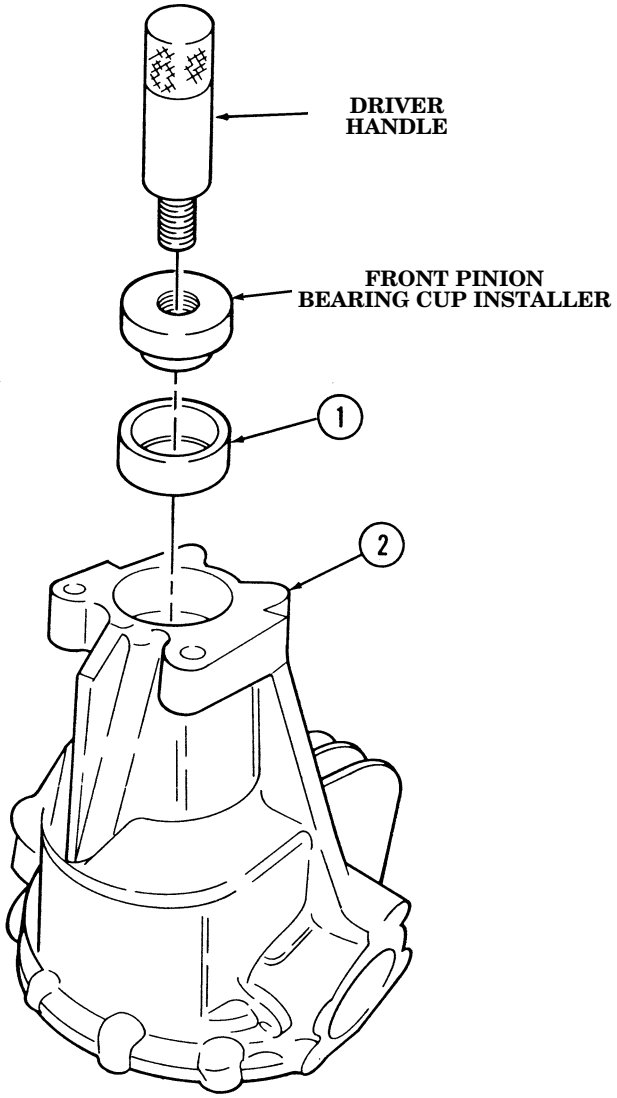
If repairing P/N 5593882, perform steps 6 through 22 and 37 through 41. If repairing P/N 12342615, perform steps 23 through 36.

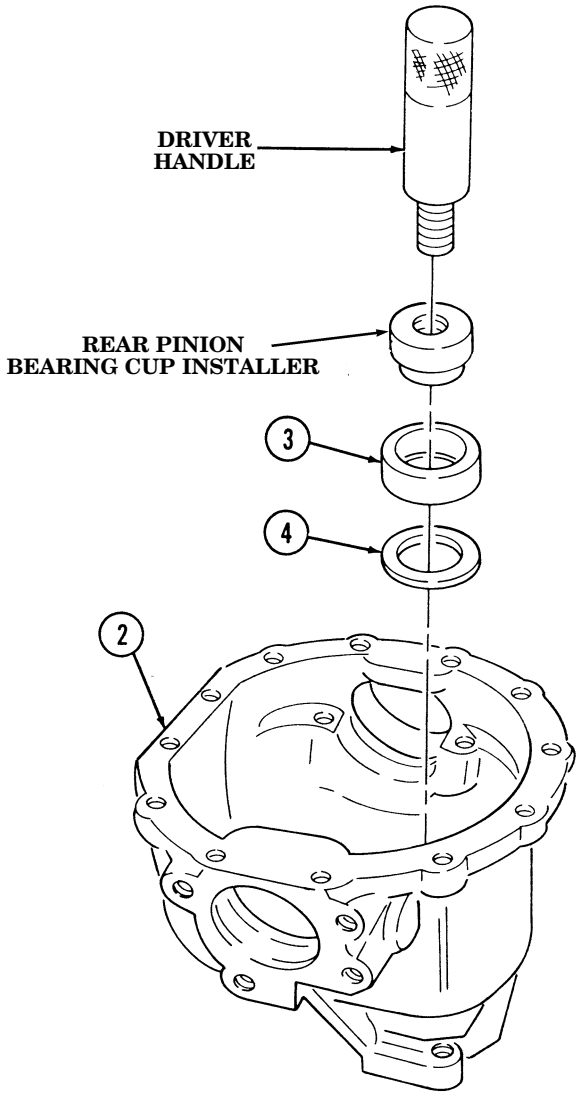
6. Rotate housing (2) 180 degrees. Lubricate outside diameter of rear pinion bearing cup (3) with lubricating oil.

**NOTE**

If the pinion shim is beveled, be sure the beveled side faces bottom of bearing cup bore.

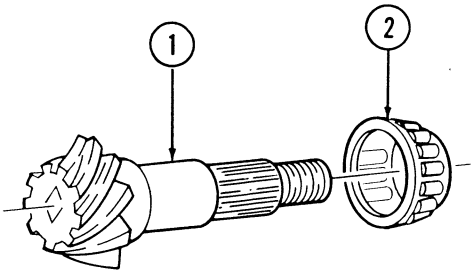
7. Using driver handle and rear pinion bearing cup installer, install "starter shim" (4) and rear pinion bearing cup (3) in housing (2).



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

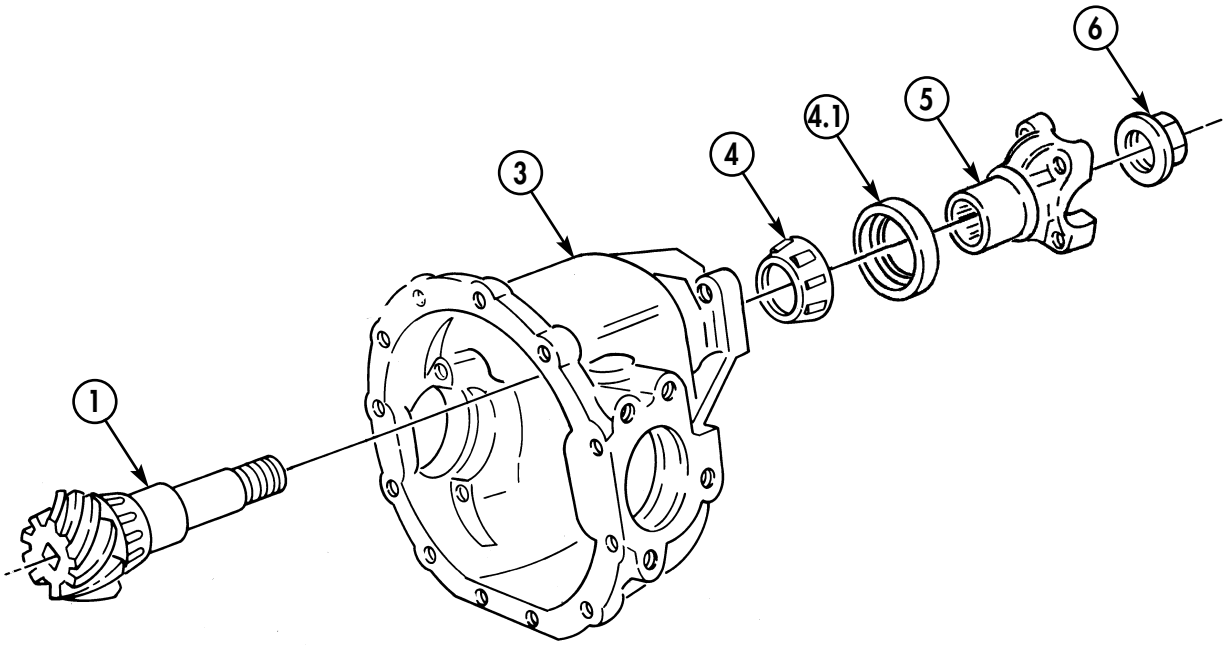
8. Install rear pinion bearing (2) on pinion gear (1).




**NOTE**

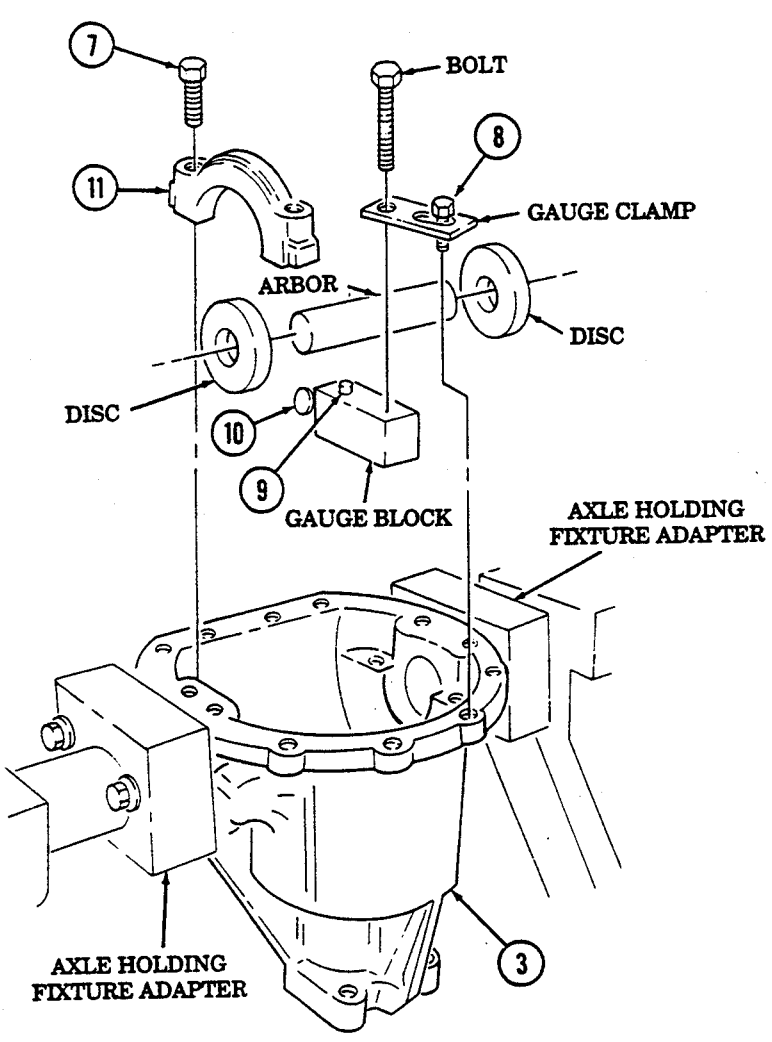
Do not install a replacement pinion nut and shim assortment at this time as the pinion gear will be removed after depth measurement.

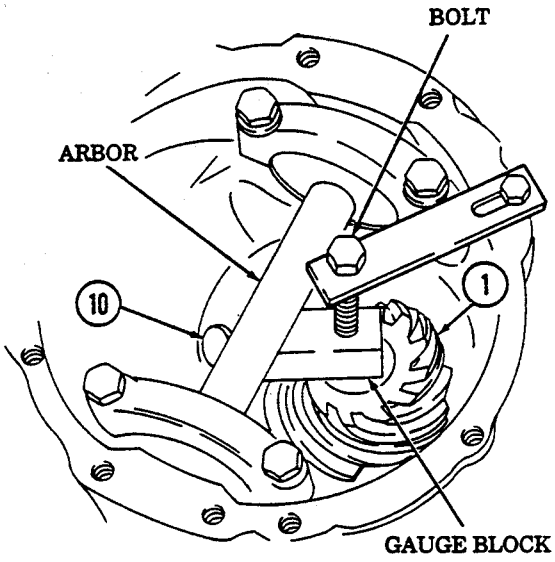
9. Rotate housing (3) 90 degrees and install pinion gear (1).
10. Install front pinion bearing (4), dirt deflector (4.1), pinion yoke (5), and original pinion nut (6).
11. Tighten locknut (6) only enough to remove pinion bearing end play.

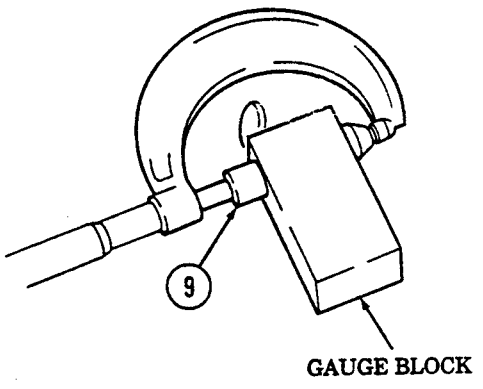


## 19-3. DIFFERENTIAL REPAIR (Cont'd)

12. Rotate front of housing (3) downward 90 degrees. Using pinion setting gauge set, assemble arbor and two discs and install in housing (3).
13. Install two bearing caps (11) and four capscrews (7) in housing (3) and tighten capscrews (7) finger tight.
14. Install gauge clamp on block and housing (3) with bolt and capscrew (8).
15. Depress plunger (9) on gauge block and tighten thumbscrew (10).
16. Position gauge block on end face of pinion gear (1) so gauge plunger (9) will contact bottom of arbor.
17. Tighten bolt on gauge clamp to hold gauge block in position.
18. Loosen thumbscrew (10) on gauge block to release plunger (9). When plunger (9) contacts bottom of arbor, tighten thumbscrew (10).
19. Loosen bolt on gauge clamp and remove gauge block from housing (3).
20. Measure gauge block. This dimension represents "measured pinion depth". Record for reference.
21. Remove capscrew (8), bolt, and gauge clamp from housing (3).
22. Remove four capscrews (7), two bearing caps (11), discs, and arbor from housing (3).



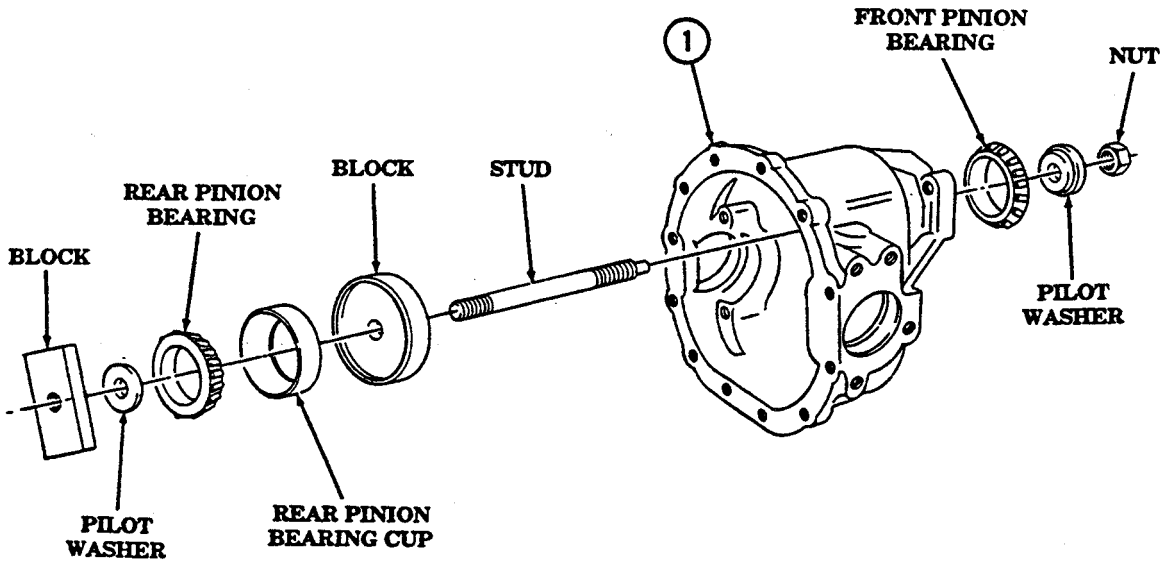



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

**NOTE**

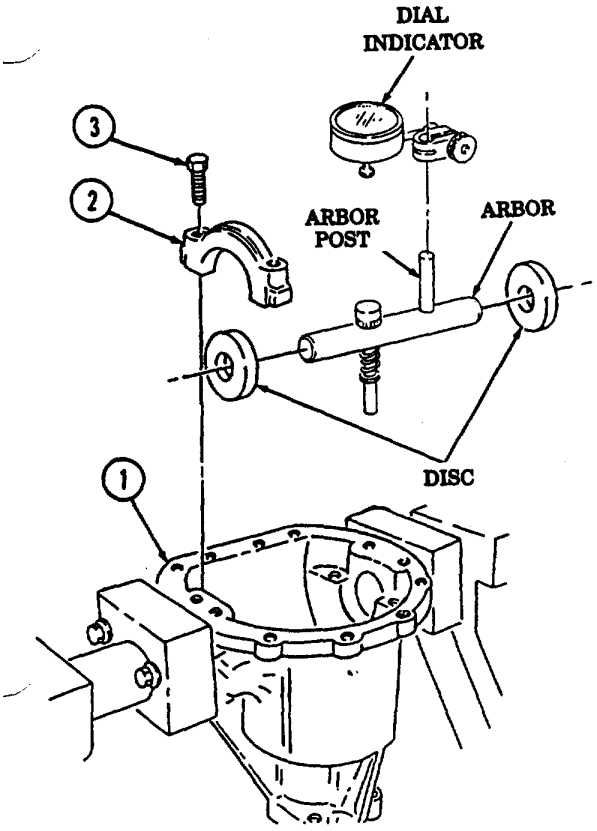
If repairing P/N 12342615, perform steps 23 through 36.

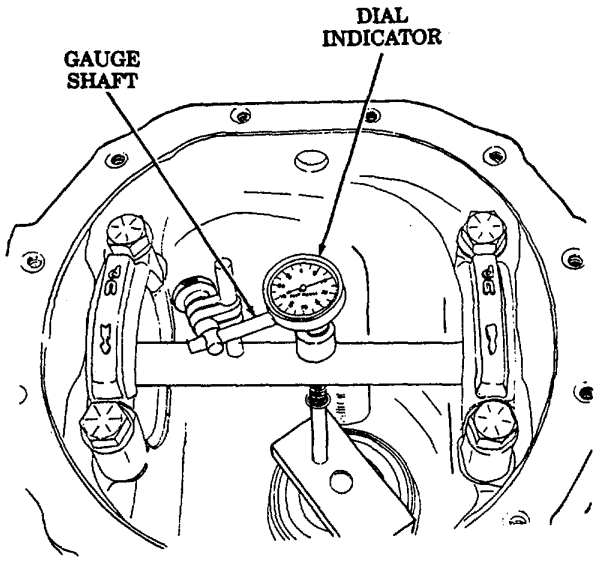
23. Using pinion setting gauge set, install block, rear pinion bearing cup, rear pinion bearing, and pilot washer on stud and secure with block.
24. Position stud assembly in housing (1) and install with front pinion bearing, pilot washer, and nut. Tighten nut to 10 lb-in. (1.13 N•m). Rotate the assembly several revolutions to seat the bearings and recheck the torque.
25. Rotate front of housing downward 90 degrees. Assemble arbor and two discs and install in housing.
26. Install two bearing caps (2) and four capscrews (3) in housing (1) and finger tighten capscrews (3).
27. Position arbor on block and install dial indicator to arbor post. Preload the dial indicator until the needle rotates approximately one full turn clockwise. Tighten the dial indicator in this position and recheck.
28. Rotate gauge shaft slowly back and forth until the dial indicator reads the greatest deflection. At the point of greatest deflection, set the dial indicator to zero. Repeat the rocking action of the gauge shaft to verify the gauge setting.
29. After the zero setting is obtained, rotate gauge shaft until the dial indicator plunger does not touch the block.
30. Record the number of the dial indicator reading. Example: If the pointer moved counterclockwise and stops between 0 and 11, add .100" to measurement for shim thickness. If the pointer moves counterclockwise and stops between 99 and 84, correct shim thickness is indicated.
31. This reading indicates the shim thickness that is required of a pinion that is etched with a zero (0) on the pinion head. If the pinion being installed has a plus (+) or minus (-) etching, then an adjustment of the shim thickness is required. Example: If a pinion is etched "+3", then .003" less shim thickness is required. Subtract .003" from the indicator reading. If a pinion is etched "-3" then .003" more shim thickness is required. Add .003" to the indicator reading.
32. Remove dial indicator from arbor.
33. Remove four capscrews (3), two bearing caps (2), discs, and arbor from housing (1).

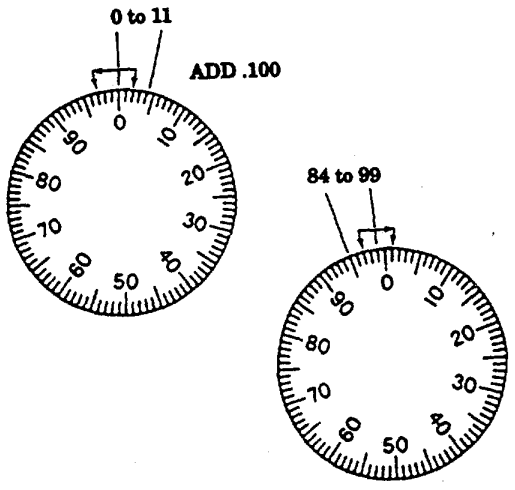


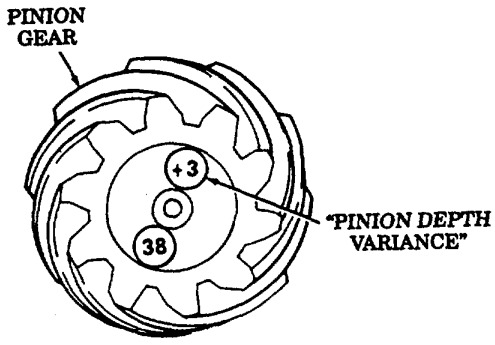
## 19 - 3. DIFFERENTIAL REPAIR (Cont'd)

34. Remove nut, pilot washer, front pinion bearing and stud assembly from housing.
35. Remove block, pilot washer, rear pinion bearing, rear pinion bearing cup and block from stud.
36. Proceed to step 42. DIAL



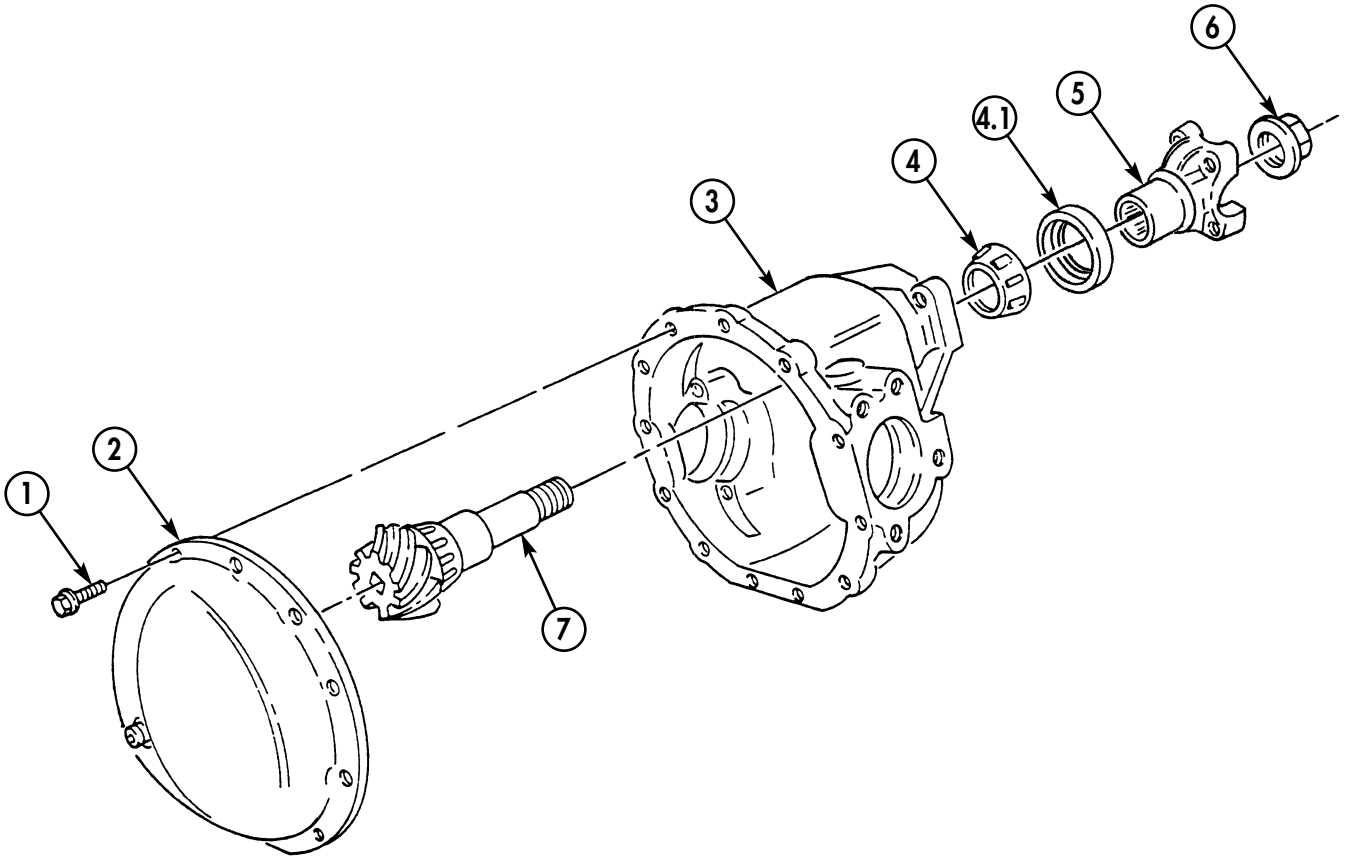



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

**NOTE**

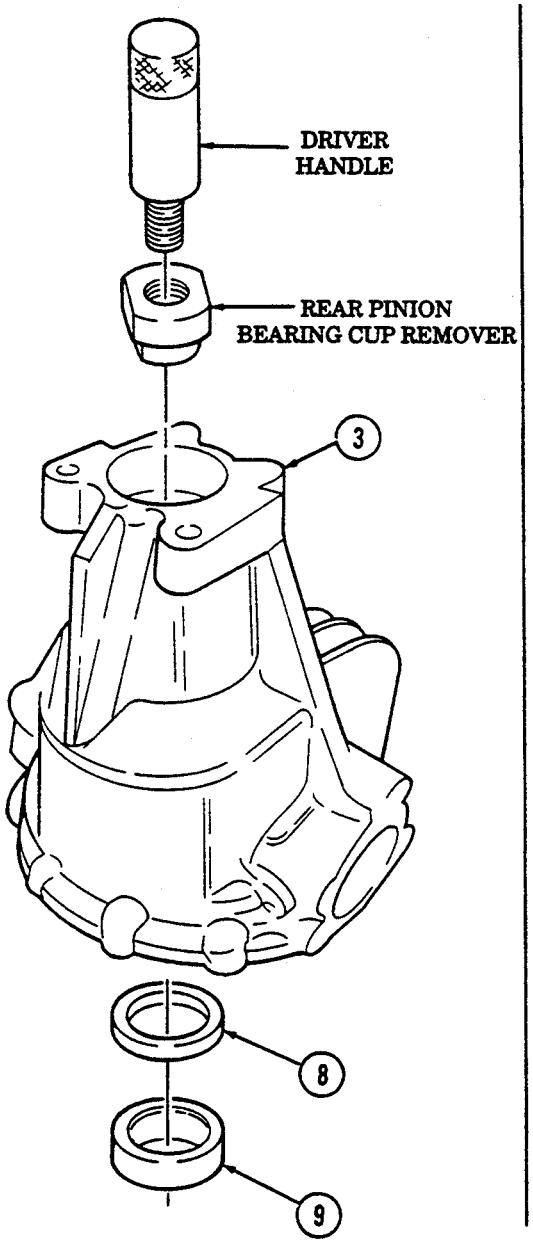
If repairing P/N 5593882, perform steps 37 through 41, then proceed to step 42.2

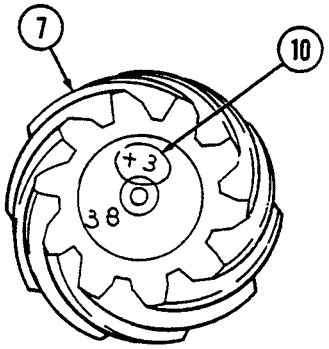
37. Rotate housing (3) 90 degrees. Remove locknut (6), pinion yoke (5), and dirt deflector (4.1) from pinion gear (7). Discard locknut (6).
38. Install cover (2) with two capscrews (1) on housing (3).
39. Drive pinion gear (7) out of front pinion bearing (4).
40. Remove two capscrews (1), cover (2), pinion gear (7), and front pinion bearing (4) from housing (3).



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

41. Rotate front of housing (3) upward 90 degrees. Using driver handle and rear pinion bearing cup remover, remove rear pinion bearing cup (9) and "starter shim" (8) from housing (3).
42. Note "pinion depth variance" (10) marked on pinion gear (7). If number is preceded by a plus (+) sign, add that amount in thousands to "standard setting" 2.547 in. (6.46 cm). If number is preceded by minus (-) sign, subtract that amount in thousands from "standard setting" 2.547 in. (6.46 cm). The result of this addition or subtraction is "desired pinion depth". Record for references.
43. Measure thickness of "starter shim" (8) and add this dimension to "measure pinion depth" (step 20). Result of this addition is "total measured pinion depth". Record for reference.
44. Subtract "desired pinion depth" (step 28) from "total measured pinion depth" (step 29). Result of this subtraction is correct pinion depth shim (8) thickness.



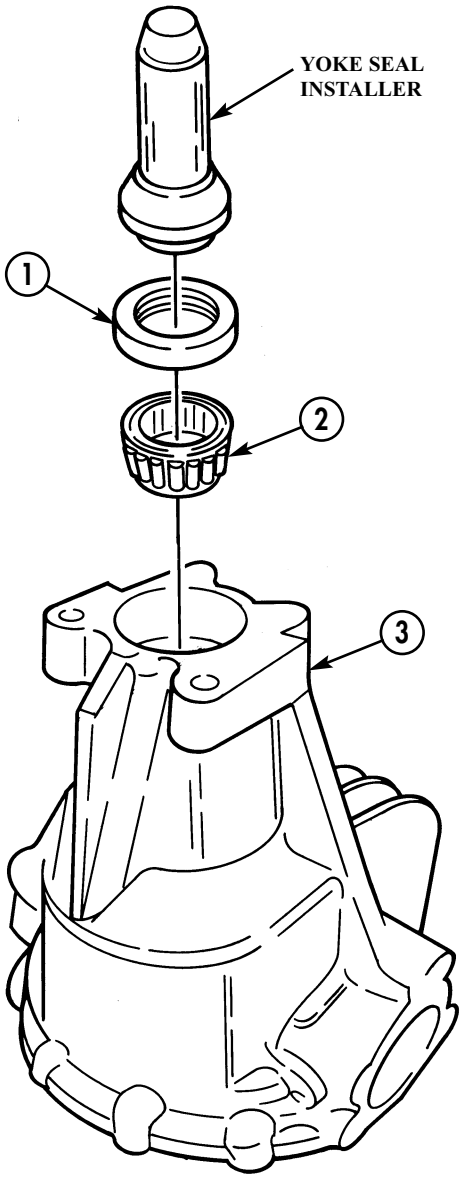
## 19-3. DIFFERENTIAL REPAIR (Cont'd)

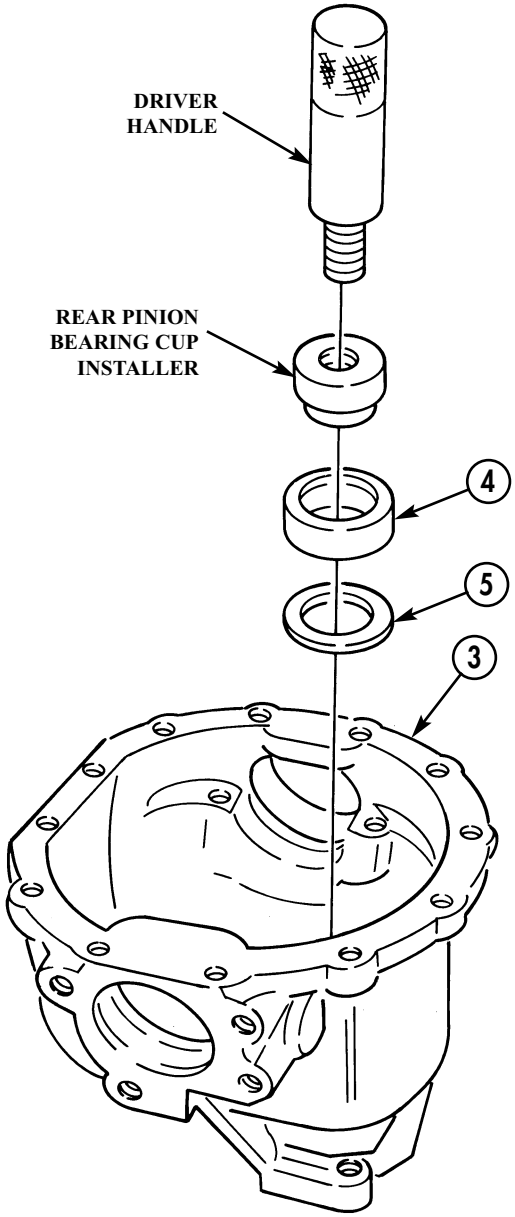
45. Lubricate front pinion bearing (2) and seal (1) with lubricating oil. Using yoke seal installer, install front pinion bearing (2) and seal (1) in housing (3).
46. Rotate housing (3) 180 degrees. Lubricate outside diameter of rear pinion bearing cup (4) with lubricating oil.

**NOTE**

If pinion shim is beveled, be sure beveled side faces bottom of bearing cup bore.

47. Using driver handle and rear pinion bearing cup installer, install correct thickness pinion shim (5) and rear pinion bearing cup (4) in housing (3).



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

48. Rotate housing (3) 90 degrees. Lubricate rear pinion bearing (6) with lubricating oil.

**CAUTION**

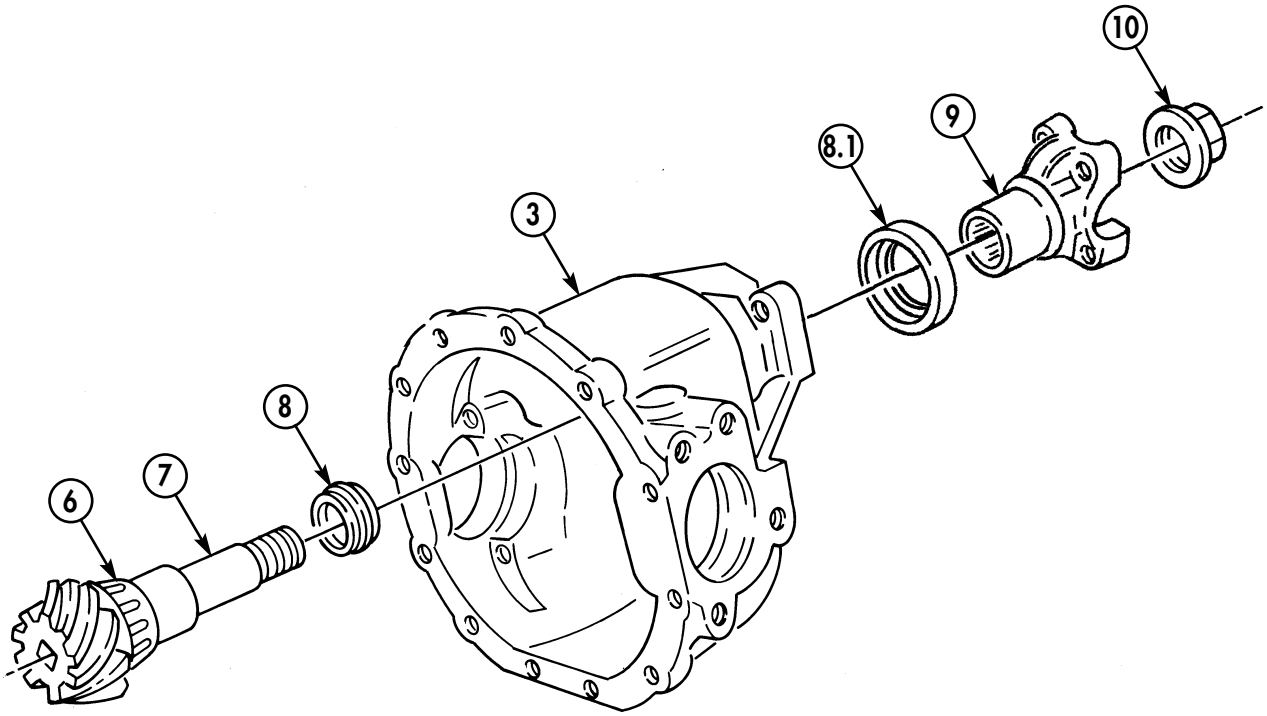
Spacer sleeve controls pinion bearing preload. Do not reuse old spacer or pinion bearing damage may result.

49. Install spacer sleeve (8) on pinion gear (7) and install pinion gear (7) in housing (3).
50. Install pinion yoke (9) and dirt deflector (8.1) with locknut (10) on pinion gear (7).

**CAUTION**

Do not exceed specified preload torque on pinion bearings. Do not loosen locknut to replace preload torque or pinion bearing damage may result. If specified torque is exceeded, remove pinion gear and replace collapsible spacer and locknut and adjust preload again.

51. Tighten locknut (10) only enough to remove end play and seat pinion bearings in housing (3). Rotate pinion yoke (9) while tightening, to seat bearings evenly.
52. Measure torque required to rotate pinion gear (7). Correct pinion bearing preload torque is 17-25 lb-in. (2-3 N•m) with new bearings and 10-15 lb-in. (1-2 N•m) with used bearings.
53. Continue to tighten locknut (10) in small increments until pinion bearing preload torque meets specifications.



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

54. Install two side bearings (1) on differential case (2).

**NOTE**

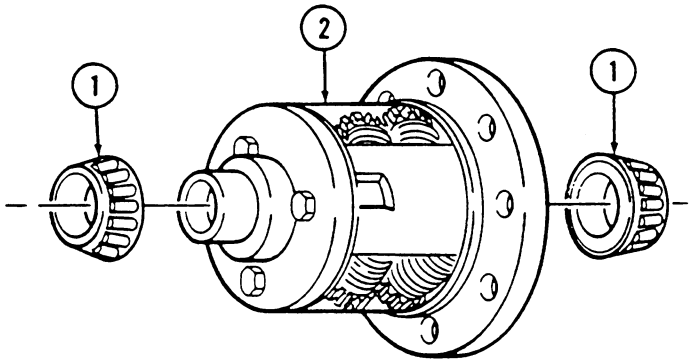
Side bearing shims are available in thickness from 0.077-0.117 in. (1.95-2.97 mm) in increments of 0.001 in. (.025 mm).

55. Rotate housing (7) downward 90 degrees. Install two side bearing cups (4) and side bearings shims (3) on side bearings (1). Use 0.080 in. (2 mm) shims (3) as a starting point.
56. Install differential case (2), two bearing cups (4), and shims (3) in housing (7).
57. Install two bearing caps (5) and four capscrews (6) in housing (7). Snug capscrews (6).
58. Mount dial indicator on housing (7) and index indicator to read off ring gear mounting surface of differential case (2).
59. Pry between differential case (2) and bearing cap (5) on one side and zero indicator. Pry on opposite side to read end play.
60. Amount read on indicator is shim thickness that should be added to side bearing shims (3) to arrive at zero end play. Add necessary shims (3) and repeat procedure to ensure accuracy.
61. Tighten four capscrews (6) to 87 lb-ft (118 N•m).
62. Rotate differential case (2) and check runout. Runout should not exceed 0.002 in. (0.05 mm).
63. Remove dial indicator from housing (7).

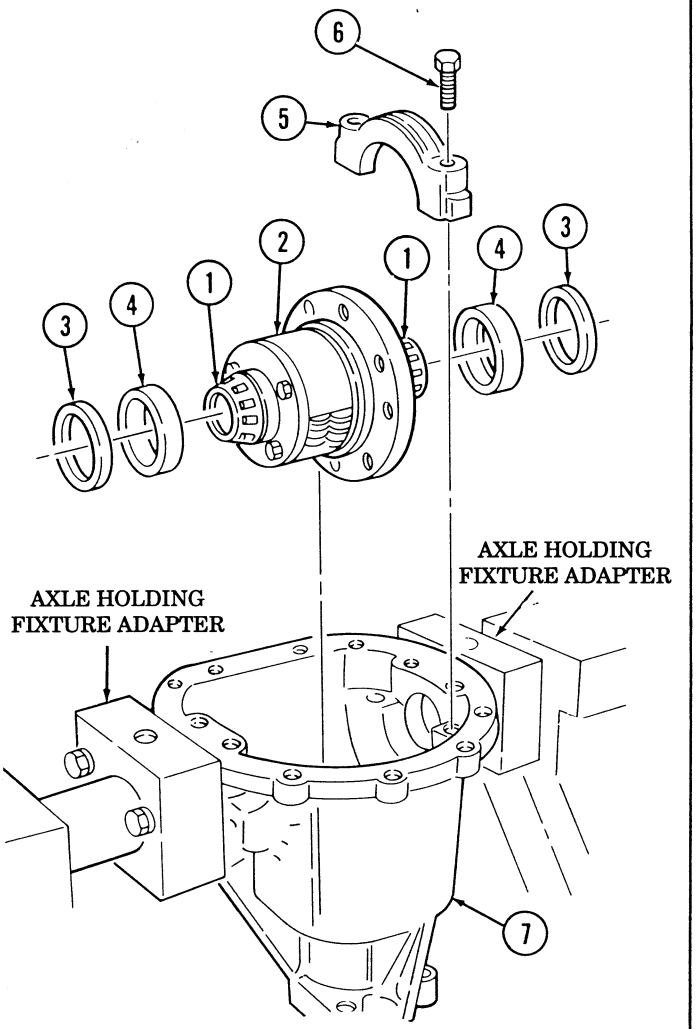
**NOTE**

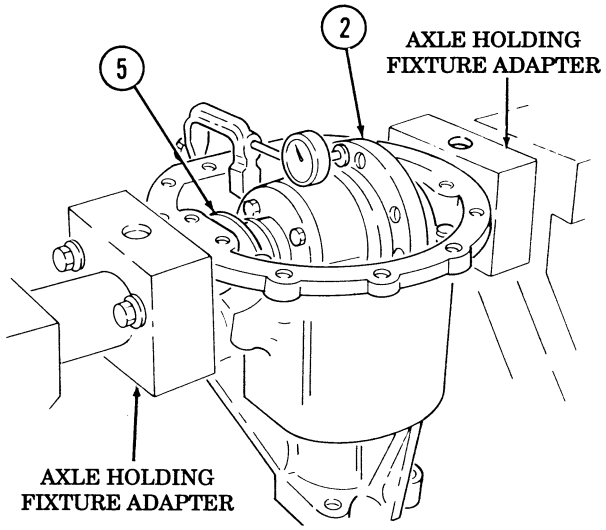
Tag shims and bearing cups for assembly.

64. Remove four capscrews (6), two bearing caps (5), differential case (2), bearing cups (4), and shims (3) from housing (7).



## 19-3. DIFFERENTIAL REPAIR (Cont'd)



## 19-3. DIFFERENTIAL REPAIR (Cont'd)

65. Install four guide pins in ring gear (2).
66. Support ring gear (2) with wood blocks in press.
67. Press differential case (3) on ring gear (2).
68. Remove four guide pins from ring gear (2).
69. Install ring gear (2) on differential case (3) with eight capscrews (1). Tighten capscrews (1) to 95-115 lb-ft (129-156 N•m).
70. Install two side bearing shims (4), previously selected to remove differential case side play, side bearing cups (5), and differential case (3) in housing (8).
71. Install two bearing caps (6) on housing (8) with four capscrews (7). Tighten capscrews (7) to 55-70 lb-ft (75-95 N•m).
72. Attach dial indicator to housing (8) and index indicator to read off drive side of ring gear tooth (9) at a right angle.

**NOTE**

Backlash must be checked at four equally spaced points on ring gear and must not vary more than 0.002 in. (0.50 mm) between four points checked.

73. Move ring gear (2) back and forth while holding pinion yoke (10) stationary. Note backlash registered on indicator.
74. Ring gear backlash should be 0.005-0.009 in. (0.12-0.22 mm) with 0.008 in. (0.20 mm) desired. If backlash must be adjusted, perform steps 75 through 78, if not go to step 79.

**NOTE**

Tag shims and bearing cups for assembly.

75. Remove four capscrews (7), two bearing caps (6), bearing cups (5), shims (4), and differential case (3) from housing (8).

**NOTE**

The following example will explain the procedure for adjusting backlash: If side play was removed using 0.090 in. (2.28 mm) shims on each side totaling 0.180 in. (4.57 mm) and backlash, when checked, is found to be 0.011 in. (0.27 mm), add 0.004 in. (0.10 mm) to shim on ring gear side and subtract 0.004 in. (0.10 mm) from shim on opposite side to correct backlash. This will result in 0.094 in. (2.38 mm) shim on ring gear side and 0.086 in. (2.18 mm) shim on other side. Backlash will be approximately 0.007 to 0.008 in. (0.17 to 0.20 mm). "Total shim thickness" remains 0.180 in. (4.57 mm).

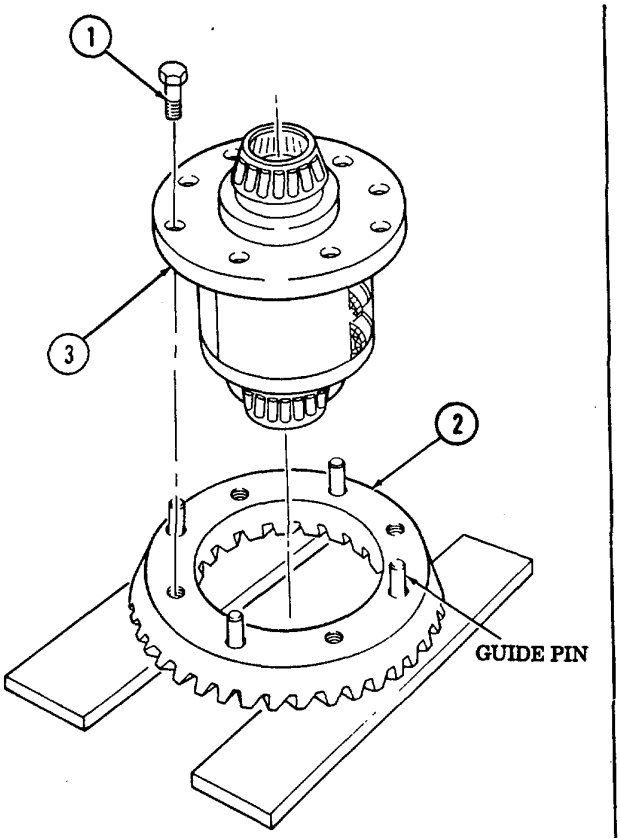
76. To increase backlash, install thinner shim (4) on ring gear side and thicker shim (4) on opposite side. To decrease backlash, install thicker shim (4) on ring gear side and thinner shim (4) on opposite side. Do not change "total shim thickness".
77. Install two shims (4), bearing cups (5), differential case (3), and two bearing caps (6) on housing (8) with four capscrews (7). Tighten capscrews (7) to 87 lb-ft (118 N•m).
78. Mount dial indicator and recheck backlash. If necessary, repeat steps 76 through 78.

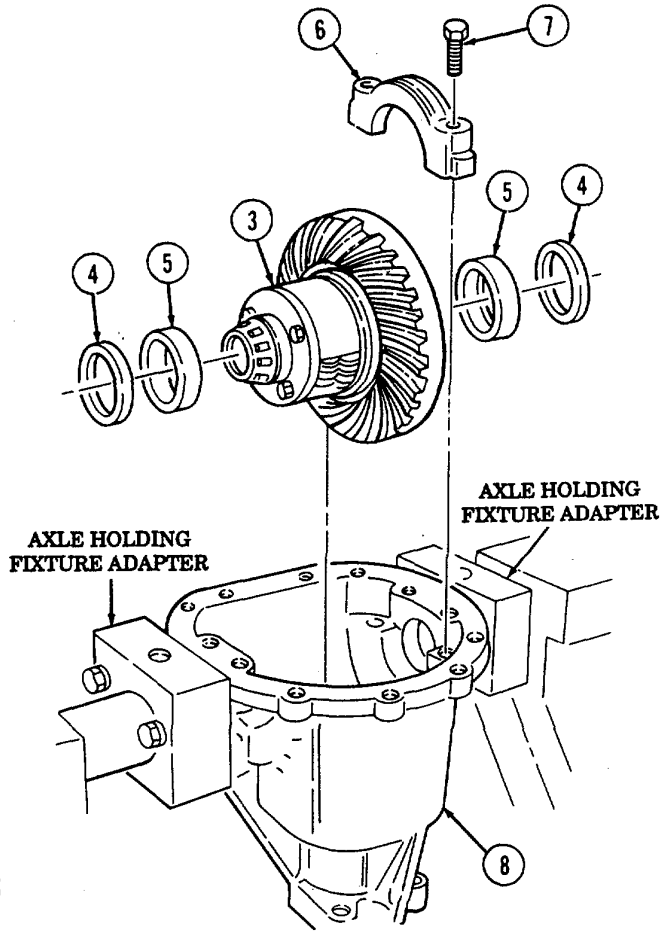
**NOTE**

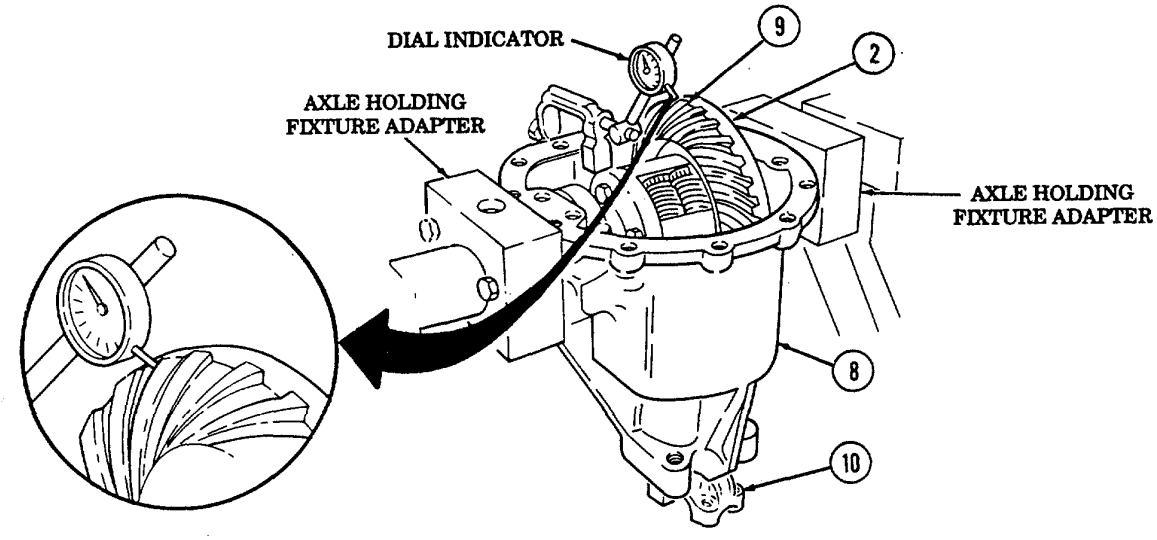
Tag shims and bearing cups for assembly.

79. Remove four capscrews (7), two bearing caps (6), bearing cups (5), shims (4), and differential case (3) from housing (8).

## 19 - 3. DIFFERENTIAL REPAIR (Cont'd)



## 19 - 3. DIFFERENTIAL REPAIR (Cont'd)

80. Install differential housing spreader into holes in axle holding fixture adapters and install dial indicator to read from each end of housing (1). Indicator must have preload setting of 0.020 in. (0.50 mm).

**CAUTION**

Over-spreading of differential housing spreader will damage housing.

81. Spread housing (1) 0.010 in. (0.25 mm) and remove dial indicator.

**NOTE**

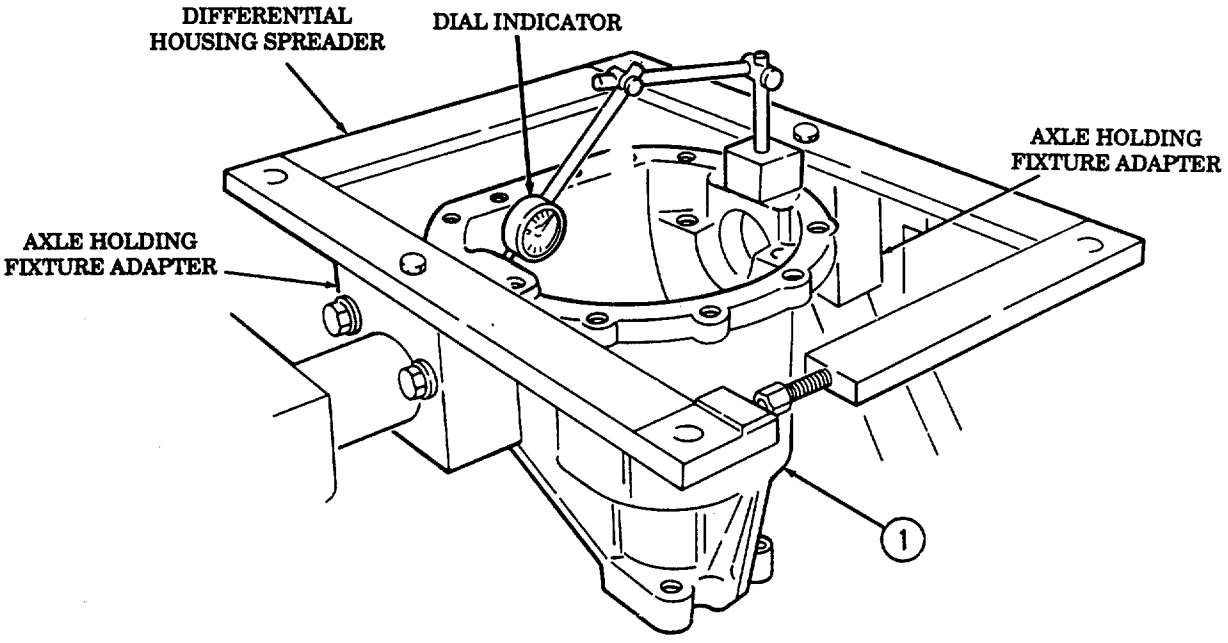
Differential bearings must be preloaded to compensate for heat and loads during operation.

82. Preload differential case side bearings (4) by increasing shims (2) thickness at each side of differential case (5) by 0.004 in. (0.10 mm) for a total bearing preload of 0.008 in. (0.20 mm).
83. Lubricate side bearings (4) with lubricating oil and install differential case (5), two bearing cups (3), shims (2), and bearing caps (6) in housing (1) with four capscrews (7).

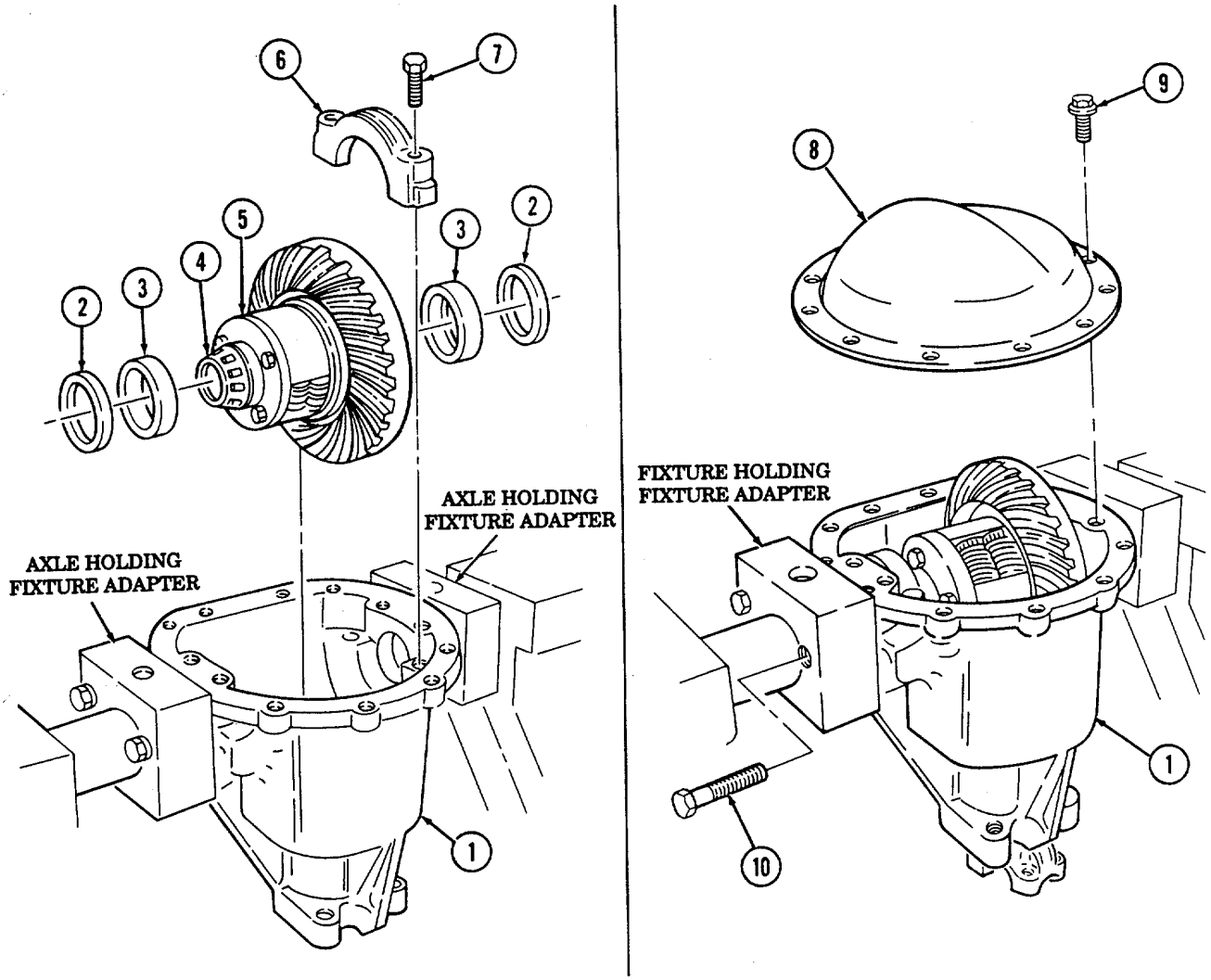
**NOTE**

Preloaded differential bearings may change backlash setting. Check and correct backlash if necessary.

84. Remove housing spreader and tighten four capscrews (7) to 87 lb-ft (118 N.m).
85. Apply silcone sealant to cover (8) sealing surface and install cover (8) on housing (1) with twelve capscrews (9). Tighten capscrews (9) to 16 lb-ft (22 N.m).
86. Remove housing (1) from holding fixture.
87. Remove four capscrews (10) and two axle holding fixture adapters from housing (1).

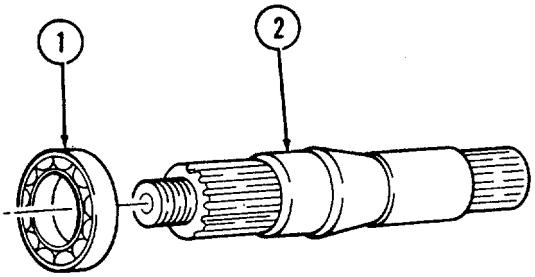


## 19 - 3. DIFFERENTIAL REPAIR (Cont'd)

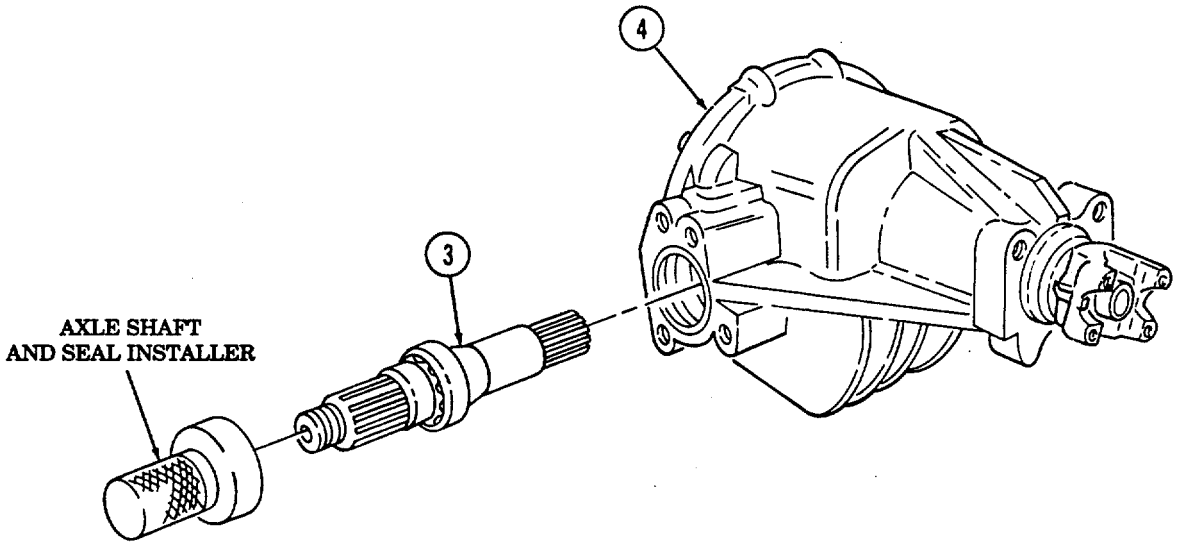


## 19 - 3. DIFFERENTIAL REPAIR (Cont'd)

88. Using press, install two output shaft bearings (1) on ouput shafts (2).

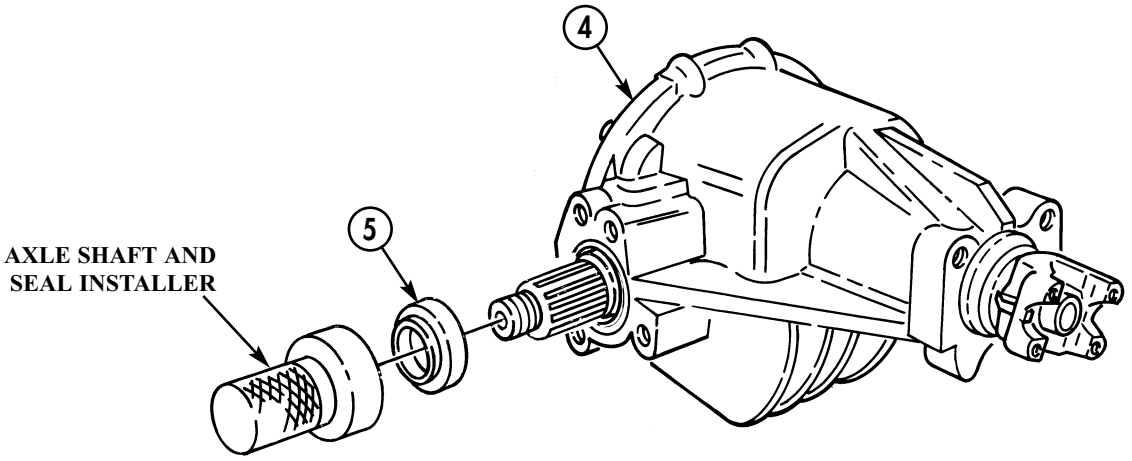



89. Using axle shaft and seal installer, install two output shaft assemblies (3) into housing (4).

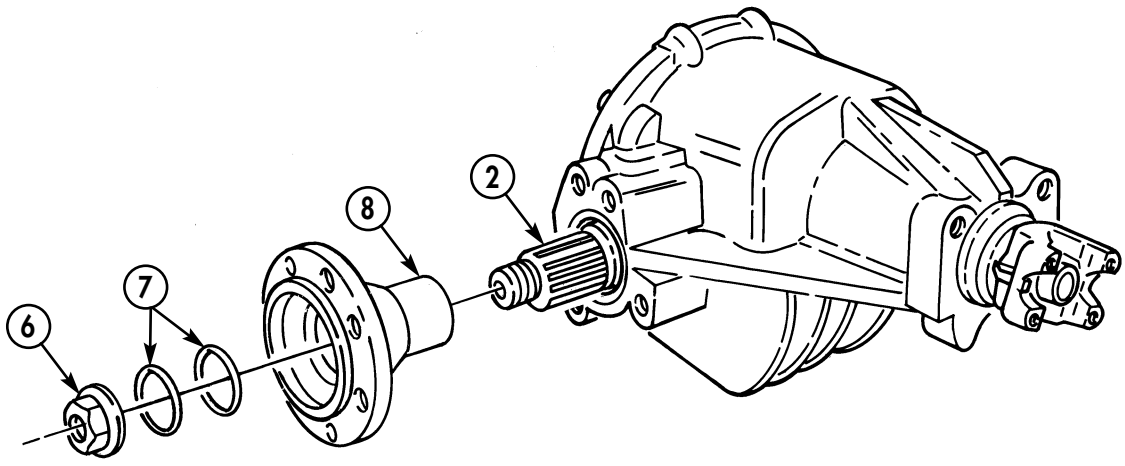


## 19-3. DIFFERENTIAL REPAIR (Cont'd)

90. Using axle shaft and seal installer, install two seals (5) in housing (4).




91. Lubricate sealing surface on two output flanges (8) with lubricating oil.
92. Install two output flanges (8), four O-rings (7), and two locknuts (6) on output shafts (2). Tighten locknuts (6) finger tight.




FOLLOW-ON TASK: Install differential (para. 9-5).

# CHAPTER 20
# STEERING SYSTEM REPAIR

## 20-1. INTRODUCTION

This chapter contains maintenance instructions for repair of steering system components at the General Support maintenance level. Some subassemblies and parts must be removed before steering system components can be accessed. They are referenced to other paragraphs of this manual or TM 9-2320-280-20.

## 20-2. STEERING SYSTEM REPAIR TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 20-3. | Deleted | 20-2 |
| 20-4. | Steering Alignment | 20-21 |

## 20-4. STEERING ALIGNMENT

**This task covers:**

**a. Caster and Camber Check**

**b. Caster and Camber Adjustment**

**c. Toe Check and Adjustment**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)
Alignment equipment (Appendix G, Item 142)

**Manual References**

TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

Tires inflated to proper pressure (TM 9-2320-280-10).

**Maintenance Level**

General support

### a. Caster and Camber Check

**NOTE**

The alignment check will be made on a level surface with front tires in the straight-ahead position. Vehicles will be checked at curb weight only.

1. Check caster and compare to the specifications in table 20-1 for bias tires and table 20-2 for radial tires.
2. Check camber and compare to the specifications in table 20-1 for bias tires and table 20-2 for radial tires.
3. If either caster or camber does not meet specifications, go to task b.

*Table 20-1. Alignment Specifications for Bias Tires.*

| MODEL | CASTER FRONT/REAR (±1.5°) | CAMBER FRONT/REAR (+1.5°,-0.5°) | TOE FRONT/REAR (±0.13 in. (3.3 mm)) |
|---|---|---|---|
| M998, M1025, M1026, M1035, M1038, M1043, M1044 | 2.0°/0.0° | 0.8°/1.7° | 0.4 in. (10.2 mm)/ -0.4 in. (-10.2 mm) |
| M966, M1036, M1037, M1042, M1045, M1046 | 2.0°/0.0° | 0.8°/1.5° | 0.3 in. (7.6 mm)/ -0.3 in. (-7.6 mm) |
| M996, M997, M1121 | 2.0°/0.0° | 0.8°/1.7° | 0.3 in. (7.6 mm)/ -0.3 in. (-7.6 mm) |

*Table 20-2. Alignment Specifications for Radial Tires.*

| MODEL | CASTER FRONT/REAR (±1.5°) | CAMBER FRONT/REAR (±1.0°) | TOE FRONT/REAR (±0.6 in. (1.6 mm)) |
|---|---|---|---|
| M996, M996A1, M998, M998A1, M1025, M1025A1, M1025A2, M1026, M1026A1, M1035, M1035A1, M1035A2, M1036, M1038, M1038A1, M1043, M1043A1, M1043A2, M1044, M1044A1, M1045, M1045A1, M1045A2, M1046, M1046A1, M1121 | +1.50°/0.0° | +0.68°/+1.50° | 0.13 in. (3.3 mm)/ -0.13 in. (-3.3 mm) |
| M997, M997A1, M997A2, M1037, M1042 | +1.44°/0.0° | +0.68°/+1.44° | 0.09 in. (2.3 mm) -0.09 in. (-2.3 mm) |
| M1097, M1097A1, M1097A2, M1123 | +1.44°/0.0° | +0.38°/+2.12° | 0.09 in. (2.3 mm) -0.09 in. (-2.3 mm) |

## 20-4. STEERING ALIGNMENT (Cont'd)

**b. Caster and Camber Adjustment**

**NOTE**

Caster and camber adjustments are basically the same for all four wheels. This procedure covers the right front wheel.

1. Remove wheel (TM 9-2320-280-20).
2. Remove two nuts (7), washers (2), capscrews (1), and washers (2) from upper control arm (8) and mounting brackets (3).
3. Loosen two capscrews (6) and four nuts (5) on two mounting brackets (3) and airlift bracket (4).

**NOTE**

Shims are available in 0.06-in. (1.52 mm) and 0.12-in. (3.05 mm) thicknesses.

4. Add or subtract shim(s) (9) as required to bring caster and/or camber withing specifications (table 20-1 or 20-2). Suspension alignment change in relation to shim selection is shown in table 20-3.

*Table 20-3. Suspension Alignment Change.*

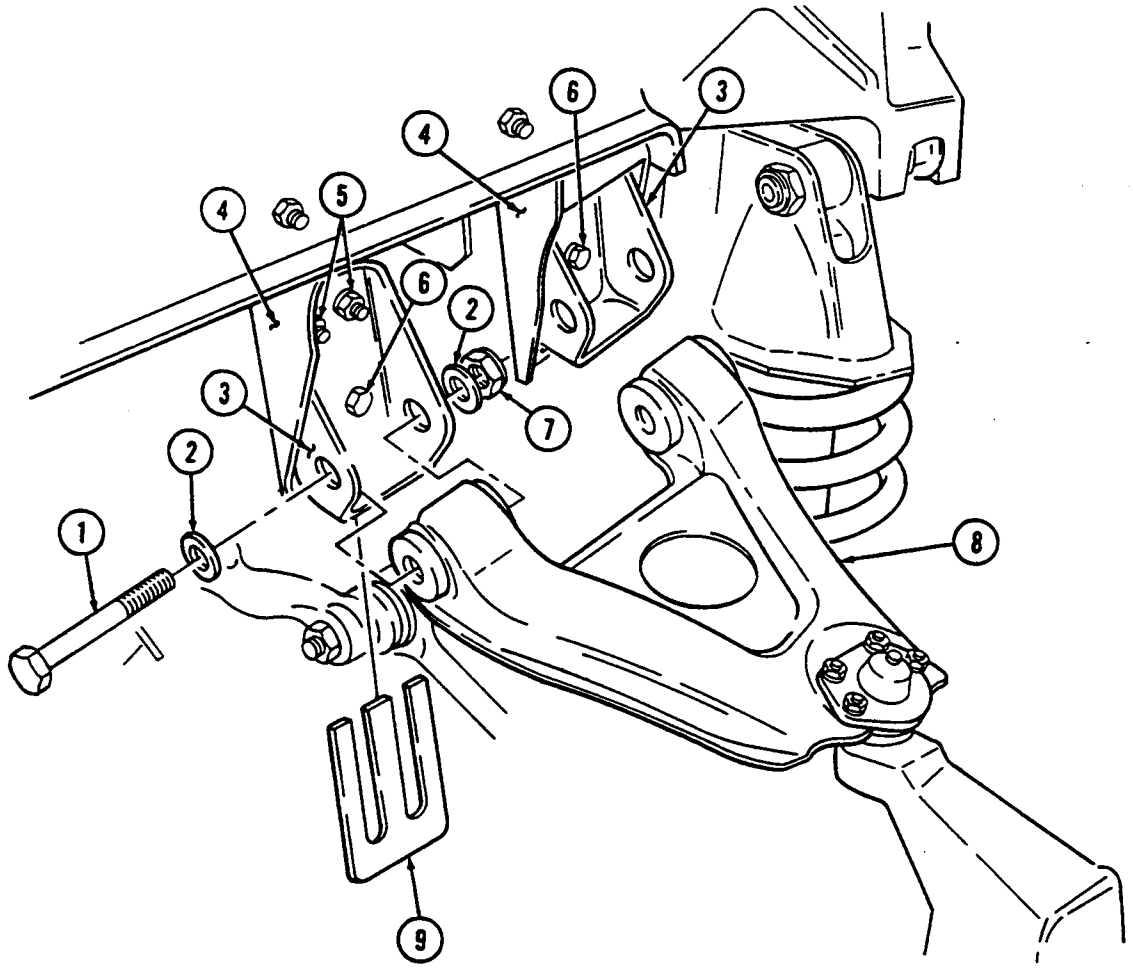
**NOTE**

- Subtracting shims will affect caster/camber in the opposite direction as compared to adding shims.
- For 0.06-in. (1.52-mm) shims, reduce the values in the table by half.
- For larger changes, combinations of additions or subtractions will provide desired results.

| FRONT SUSPENSION | | | |
|---|---|---|---|
| **LOCATION** | **SHIM** | **CASTER** | **CAMBER** |
| Front shim only | +0.12 in. (3.05 mm) | +0.6° | +0.5° |
| Rear shim only | +0.12 in. (3.05 mm) | -0.6° | 0.0° |
| Front and rear shims | +0.12 in. (3.05 mm) | 0.0° | +0.5° |
| **REAR SUSPENSION** | | | |
| **LOCATION** | **SHIM** | **CASTER** | **CAMBER** |
| Front shim only | +0.12 in. (3.05 mm) | +0.5° | -0.1° |
| Rear shim only | +0.12 in. (3.05 mm) | -0.5° | +0.6° |
| Front and rear shims | +0.12 in. (3.05 mm) | 0.0° | +0.5° |

5. Tighten two capscrews (6) and four nuts (5) on two mounting brackets (3) to 90 lb-ft (122 N•m).
6. Install upper control arm (8) on mounting brackets (3) with two washers (2), capscrews (1), washers (2), and nuts (7). Tighten nuts (7) to 260 lb-ft (353 N•m).
7. Install wheel (TM 9-2320-280-20).
8. Go to task a, and repeat steps 1 through 3.

## 20-4. STEERING ALIGNMENT (Cont'd)




**c. Toe Check and Adjustment**

Check toe (TM 9-2320-280-20) and adjust if necessary.

# CHAPTER 21
# FRAME REPAIR

## 21-1. INTRODUCTION

This chapter contains maintenance instructions for repair of frame components at the General Support maintenance level. Some subassemblies and parts must be removed before frame components can be accessed. They are referenced to other paragraphs of this manual or to TM 9-2320-280-20 and TM 9-2320-280-10.

## 21-2. GENERAL

Refer to technical bulletin (TB 9-2300-247-40) for repairs on frames used on the M998 series vehicles. Refer to TM 9-2320-280-24P for authorized replacement parts used in frame repair.

## 21-3. FRAME REPAIR TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 21-4. | Frame Inspection and Repair | 21-2 |
| 21-5. | Right Front Body Mount Bracket Replacement | 21-11 |
| 21-6. | Right Intermediate Body Mount Bracket Replacement | 21-12 |
| 21-7. | Left Intermediate Body Mount Bracket Replacement | 21-13 |
| 21-8. | Rear Crossmember Bracket and Rear Body Mount Bracket Replacement | 21-14 |
| 21-9. | Rear Bumper Mounting Bracket and Tiedown Bracket Replacment | 12-15 |

# 21-4. FRAME INSPECTION AND REPAIR

**This task covers:**

**a. General Information**
**b. Powertrain Lift Sling Installation**
**c. Inspection**
**d. Preparation and Materials**
**e. Repair Procedures**
**f. Powertrain Lift Sling Removal**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: Automotive (Appendix G, Item 1)

**Materials/Parts**

Lock pin (Appendix E, Item 171)
Powertrain lift sling (Appendix C, Fig. 14, 15)

**References**

TM 9-2320-280-10
TM 9-2320-280-20
TM 9-2320-280-24P
TC 9-237
TB 750-98-23
TM 43-0139

**Equipment Condition**

- Vehicle stripped of mission and stowed equipment (TM 9-2320-280-10).
- Vehicle undercarriage clean and free of mud and debris.

**General Safety Instructions**

- When using power-driven equipment to straighten frames, all personnel must stand clear.
- Shim material must be under jackstands.
- Ensure shoulder bolts have a raised metal "10.9" material strength indicator on the head of the bolts

**Maintenance Level**

General support

## a. General Information

1. Frame rails are constructed by arc-welding two "C" channels of preformed steel together to form a box-cross section.
2. Frame rails are internally reinforced at bolt hole locations by bushings or full cross-section spacers to prevent channels from collapsing from attaching load.

**NOTE**

Crossmembers and crossmember brackets must be replaced if damaged.

3. The frame is made by bolting two non-identical frame rails to crossmembers. Crossmembers are held to more stringent dimensional tolerances and must be replaced if damaged.
4. The type of repairs attempted will vary considerably depending on equipment, type of facilities, and skill of available personnel. Also the choice of procedures will be influenced by parts supply status and the operational situation.
5. Mechanical forces involved in frame straightening can lead to safety problems, which all personnel must constantly keep in consideration.
6. The removal of frame constraints (loosening of crossmember and bracket fastenings) is critical to allow enough freedom of movement when straightening frame.
7. The objective of a repair procedure is to return the vehicle to a mission-safe (operationally and mechanically) condition within a reasonable time and cost expenditure.
8. For ease of frame maintenance, use powertrain lift sling. (Refer to para. b.)

## 21-4. FRAME INSPECTION AND REPAIR (Cont'd)

**b. Powertrain Lift Sling Installation**

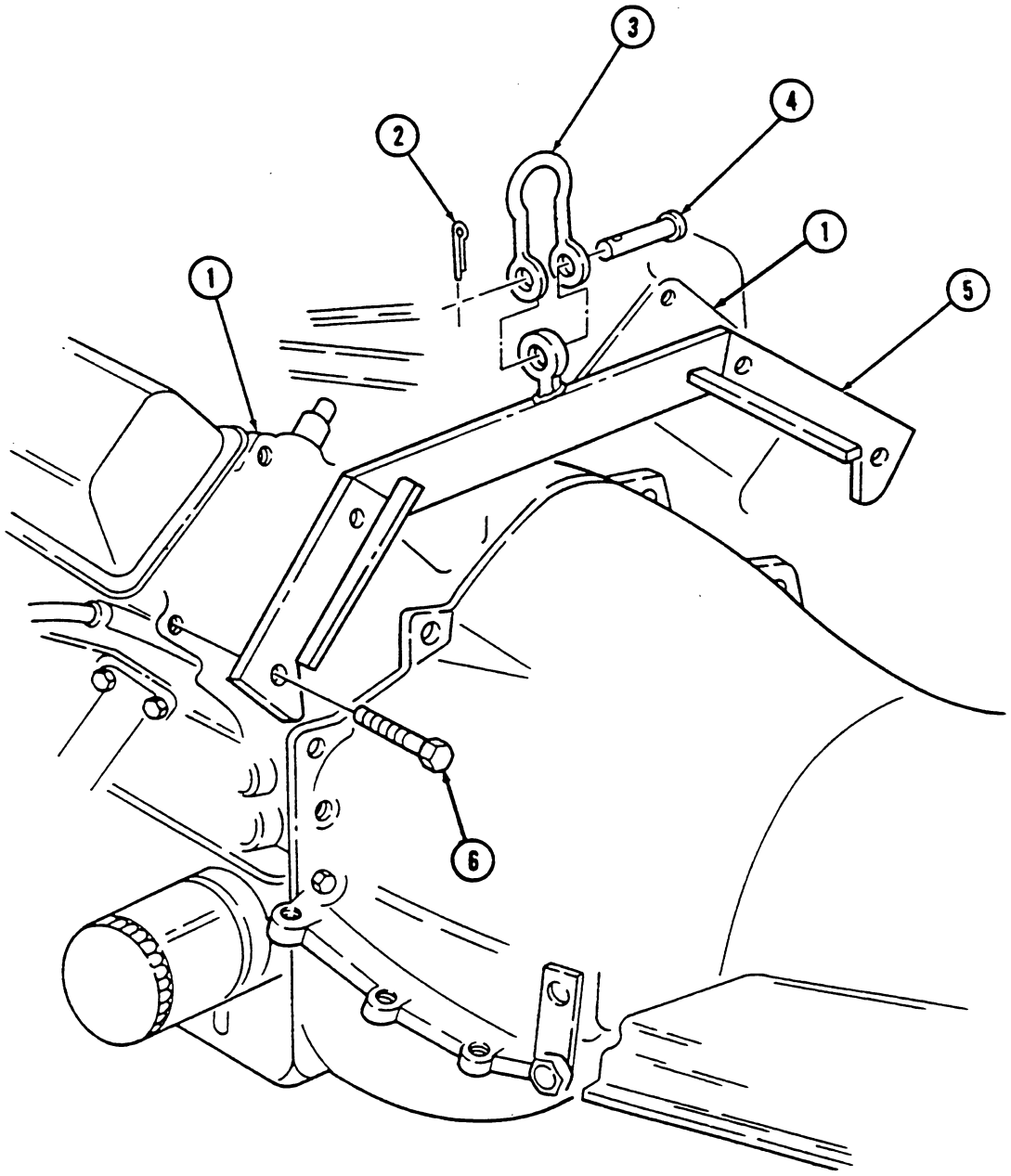
**WARNING**

To avoid possible injury to personnel and damage to equipment, ensure shoulder bolts have a raised metal “10.9” material strength indicator on the head of the bolts.

**NOTE**

Rope lift slings are awkward and potentially hazardous to personnel and can cause damage to equipment. Replace rope lift sling with powertrain lift sling.

1. Install powertrain lift sling (5) on cylinder heads (1) with four shoulder bolts (P/N 11502788) (6).
2. Install shackle (P/N NAS1042-14) (3) on powertrain lift sling (5) with pin (4) and lock pin (2).



## 21-4. FRAME INSPECTION AND REPAIR (Cont'd)

**c. Inspection**

1. Visual inspection. This is the first and most critical step in forming the decision of whether to repair or replace a damaged frame component. Factors to be noted in visual inspection:
   (a) Transverse tears, cracks, and breaks that extend over one tangent or radius and into 5/32 in. (3.97 mm) of an associated tangent or radius must be replaced (refer to view A).
   (b) Transverse tears, cracks, or breaks that extend over the tangent or radius can be repaired by welding and reinforcing, providing the crack does not extend into 5/32 in. (3.97 mm) of an associated tangent or radius (refer to view B).
   (c) Tears, cracks, or breaks on the inside face of the frame rail that extend to within 3 in. (7.6 cm) of a bolted-on crossmember are unrepairable, and frame rail must be replaced.
   (d) Tears, cracks, or breaks that extend into a hole or from a hole in the frame rails must first have a dye penetrant test performed at the hole to determine if secondary cracks exist (refer to TC 9-237). The crack is unrepairable if a secondary crack exists; the frame rail must be replaced (refer to view C).
   (e) Tears, cracks, or breaks that extend into a hole or from a hole that does not have any existing secondary cracks may be repaired by welding with the use of a pre-drilled reinforcement (dutchman/ fishplate) (refer to view B and task e).
   (f) Short longitudinal cracks (up to 6 in. (15.2 cm)) or split welds can be repaired by installing a reinforcement (dutchmen/fishplate) and heli-arc welding (refer to view B).
   (g) Twisted frame rails are unrepairable; replace (refer to view C).

2. Measurements. Select a hard and level surface with area 1-1/2 times the size of the vehicle.
   (a) Vertical (or side view) measurement.
      (1) Raise vehicle at four points until all four wheels are off the surface. (Refer to TM 9-2320-280-20).

**WARNING**

Shim material must be under jackstand. Do not use shims on top of jackstand. Vehicle could be knocked off jackstand, causing personnel injury or damage to equipment.

      (2) Measure the height to the bottom of frame near each jackstand. Place shim(s) under jackstands as necessary until all four heights are equal.

**NOTE**

Measurements must be taken at identical locations on left and right frame rails. Failure to do so will result in faulty indication.

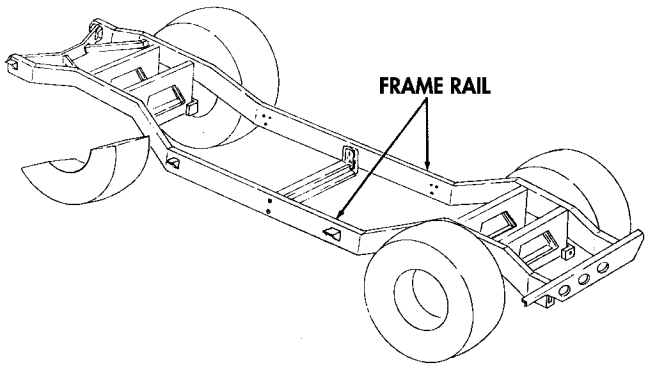
      (3) Select, measure, and record the frame rail height at several different positions on either frame rail.
      (4) Measure and record frame rail height at corresponding points on opposite frame rail.
      (5) Right and left frame rail comparable points deviating more the 1/8 in. (3 mm) for each 2 ft linear distance indicates a vertically bent frame. Record deviations.

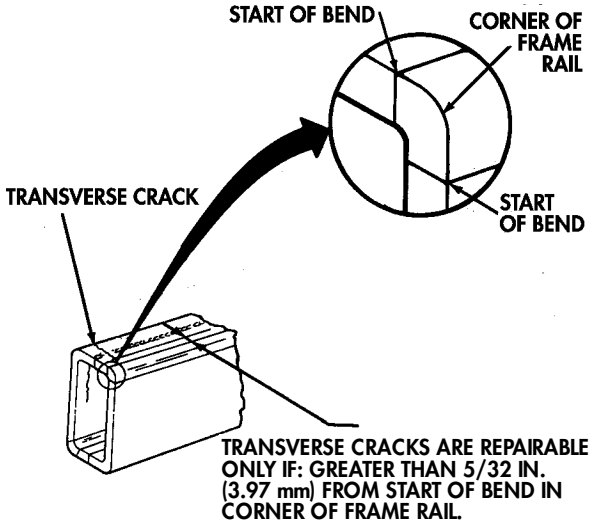
**NOTE**

If measured frame rails are out of tolerance, notify supervisor. If frame rails are verified to be out of tolerance, vehicle will be classified as unserviceable.

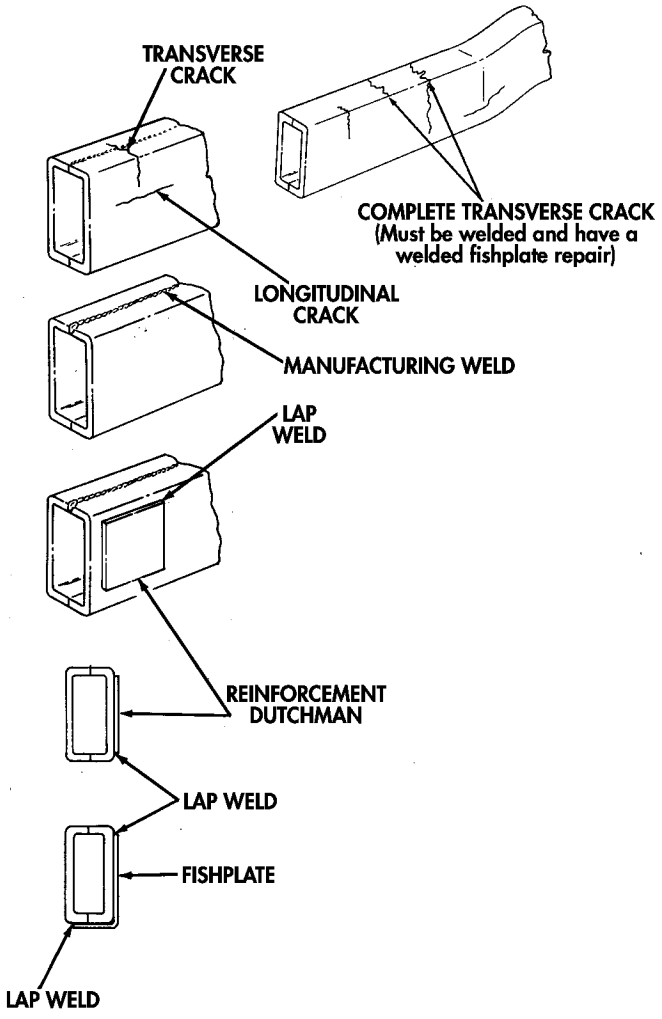
      (6) Lower vehicle from jackstands. (Refer to TM 9-2320-280-20).

## 21-4. FRAME INSPECTION AND REPAIR (Cont'd)

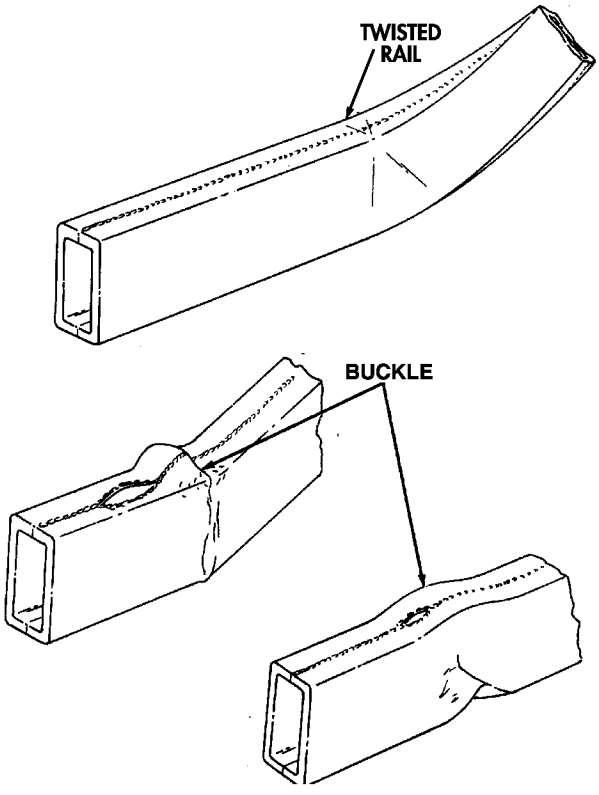



VIEW A




VIEW B




VIEW C

**21 - 4. FRAME INSPECTION AND REPAIR (Cont'd)**

(b) Horizontal (bowing) Measurement.

(1) Select a smooth level surface and drive the vehicle into position from a 12 ft (3.7 m) straight line of travel. Apply parking brake gently to bring vehicle to a stop. Chock wheels (TM 9-2320-280-10) and release parking brake.

(2) Measure height of frame rails (3) and (6) at each end near center of crossmembers (2) and(4). If heights vary by more than 1/8-5/16 in. (3-8 mm), jack-up and install jackstands to bring frame to leveling tolerance (step 2a (1) and (2)).

(3) Hold a string with plumb bob (7), as shown, along frame rail (6) at intersection of crossmember (2). Mark location (8) where plumb bob (7) stops moving. Do this for all four corners of frame.

**NOTE**

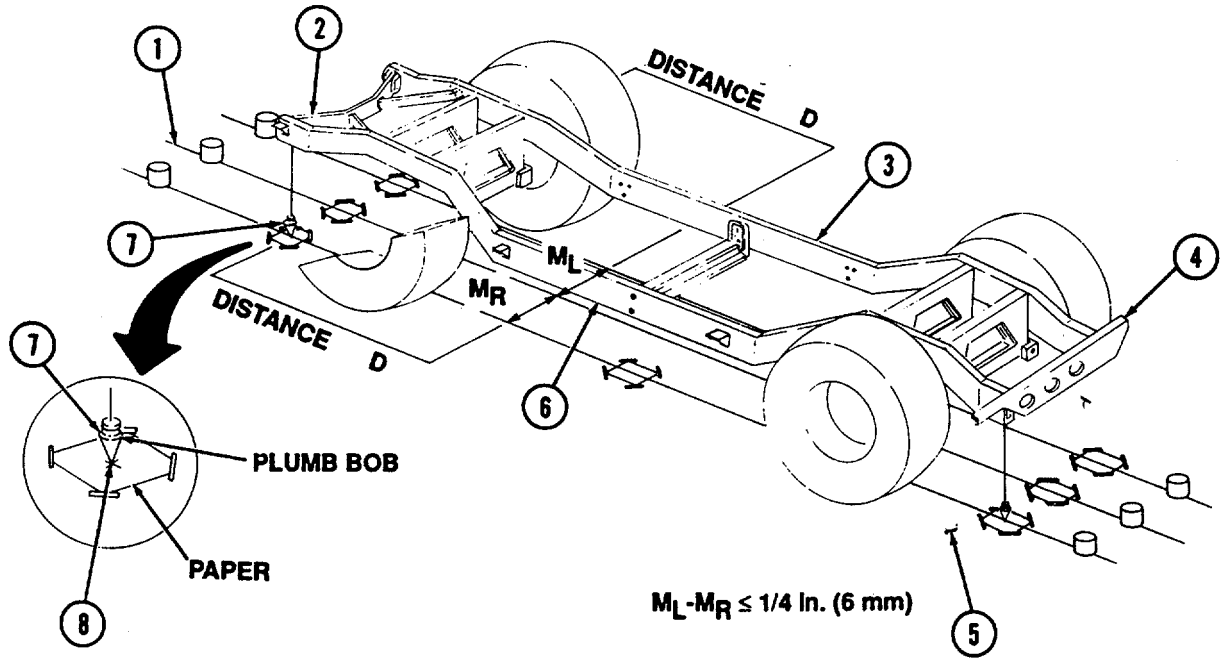
- Strings used for horizontal bow measurement will remain in place until procedure (c), frame skew, is completed.
- To ensure measurements are precise, string must be pulled tight and secured.

(4) Stretch string tightly on floor (5) between front and rear plumb bob (7) marks under each frame rail (3) and (6).

(5) Measure front and rearmost crossmembers (2) and (4) to determine center point. Drop a plumb bob (7) from these points to the ground. Mark location where plumb bob (7) stops moving.

(6) Stretch string tightly on floor (5) between front and rear plumb bob (7) marks under crossmembers (2) and (4) to determine centerline (1).

(7) Measure an equal distance along right and left strings to select measure points and measure from these right and left points to center string. Mark these points on string. The distance from right and left points to center string should be within 1/4 in. (6 mm) of being equal. If not, one frame rail is bowed. Repeat this procedure for several other points along frame. Record deviations.



**21 - 4. FRAME INSPECTION AND REPAIR (Cont'd)**

(c) Diagonal (skew) Measurement

**NOTE**

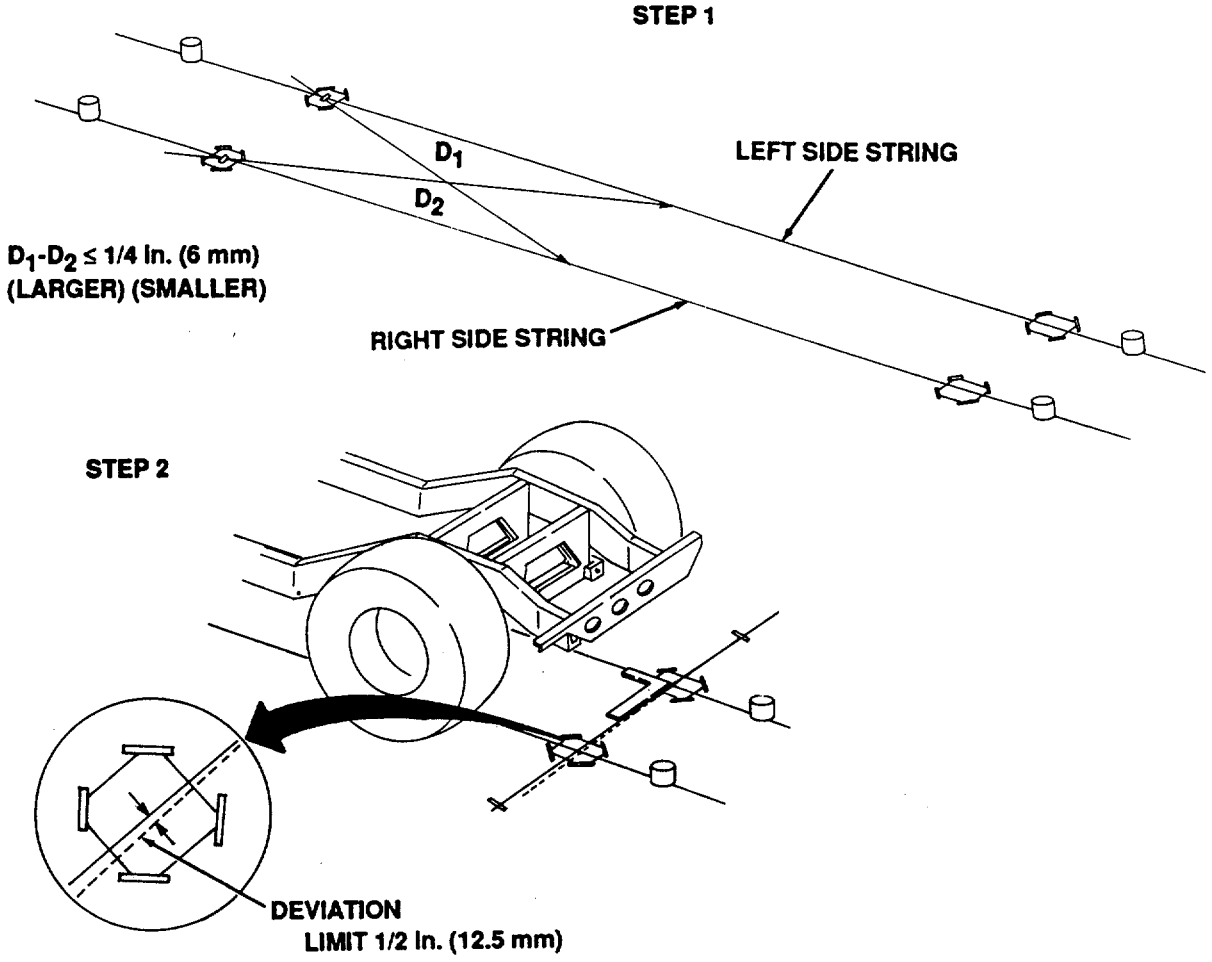
The following two steps are alternate procedures to determine if frame rails are skewed.

(1) Measure diagonally from one point on right or left string to adjacent point on opposite side string. Compare to the opposite diagonal measurement. If these two measurements differ by more than 1/4 in. (6 mm), the two frame rails are skewed. Repeat this procedure at other sets of four measuring points to confirm skew. Record deviations.

(2) Position a string across two plumb bob points at corresponding (or end) points of frame rail string. Place a square with one leg coincident with frame rail string. Run a line or string along other leg of square as far as opposite frame rail string. Measure deviation of end string and square leg line at opposite frame rail string. Any deviation means the two frame rails are skewed and, consequently, the crossmembers are not at square angles to frame rails. A deviation of 1/2 in. (12.7 mm) makes a vehicle "dog track" and it is difficult to align wheels. Record deviations.

**NOTE**

If measured frame rails are out of tolerance, notify supervisor. If frame rails are verified to be out of tolerance, truck will be classified as unserviceable.



**21 - 4. FRAME INSPECTION AND REPAIR (Cont'd)**

(d) Decisions as to whether or not to repair the frame will be made in accordance to the following factors:
- (1) Provisions of TB 750-98-23 regarding time and materials versus replacement.
- (2) Supply and operational considerations.
- (3) Appropriate facilities available.
- (4) Personnel skill levels.
- (5) Influence of other collateral repairs that may be required to return the vehicle to a serviceable condition.
- (6) Buckled frame rails with both vertical and horizontal bending are extremely difficult to repair; recommend item be replaced.
- (7) Frame rails that are twisted generally are unrepairable; replace item.
- (8) Frame rails that are bent upward, resulting in torn metal in bottom of rail, cannot be welded only, but also must have a welded-on fishplate repair. If fishplate would block mounting parts and bolt holes, replace frame rail.

d. Preparation and Materials

1. To perform a repair on the frame, a plan is needed due to the large variability of steps and methods to be employed. This plan is influenced by:
   (a) Bending-type repair:
   - (1) Suitable vehicle restraints.
   - (2) Solid anchors for pulling or seating snatch blocks.
   - (3) Pulling (pushing) power source, either mechanical or hydraulic.

   (b) Frame rail (and possibly one or more crossmembers) replacement requires a quantity of suitable blocking material.
   (c) Patches, dutchman, fishplates, and reinforcements:
   - (1) Bulk steel plate of grade SAE 950 or equivalent (of equal or greater thickness).
   - (2) Scrap material of like metal from salvage or cannabilization.
   - (3) Heli-arc welding rods of type AWS A5.20 (E 707-1) or equivalent.

   (d) In critical situations, 1/4 in. (6 mm) construction grade steel angle or plate may be used.
2. Based on factors of subtasks b and c, prepare a plan to accomplish the task of returning the vehicle to mission serviceable status.

e. Repair Procedures

**CAUTION**

Bulk heating of frame rails to remove bends and buckles is not an approved procedure. The strength characteristics of the metal are affected. The repair may fail, causing damage to equipment.

**NOTE**

The repair or replacement procedure will vary with type(s) and location(s) of failure(s). For this reason, much of the repair work is dependent on skill of the mechanics, supply status, and operational situation. The removal/replacement of parts, bolts, and brackets affecting the repair are left to the discretion of the mechanics and will be governed by the instructions in this manual, TM 9-2320-280-20, and repair parts manual.

## 21-4. FRAME INSPECTION AND REPAIR (Cont'd)

**NOTE**

Transverse tear, crack, and break repairs (all welding on frame) will use reinforcements (dutchman/fishplate), and be heli-arc type as given in TC-9-237, providing tears, cracks, or breaks are repairable (refer to task c.)

1. Crack repair. (All welding on frame will be heli-arc type as given in TC 9-237.) Cracks not extending across two adjacent faces of the frame rail may be welded.
   (a) Stop drill crack with 1/8 in. (3 mm) drill hole.
   (b) Vee-notch crack.
   (c) Heli-arc weld crack with approved welding rod.
   (d) If reinforcement or fishplate is to be added, grind weld flush to surface of rail.
   (e) Install reinforcements (dutchmen/fishplate) and lap-weld.
2. Welded reinforcements or fishplates will not be less than 6 in. (15.2 cm) in length along frame rail.
3. Bolt on reinforcements or fishplates will not be less than 8 in. (20.3 cm) in length. Long bottom edge of fishplate will be heli-arc lap welded to frame component.
4. Puncture holes only in side faces of frame rails may be repaired with combinations of fishplates and/or reinforcements. Welded type only will be used. Puncture holes in bottom face are not reparable, replace frame rail.
5. Bolted on repairs will use grade eight bolts, hardened washers and nuts. Use proper torque when tightening nuts. (Refer to Appendix D when no other torque value is provided.)
6. Bending repair:

**WARNING**

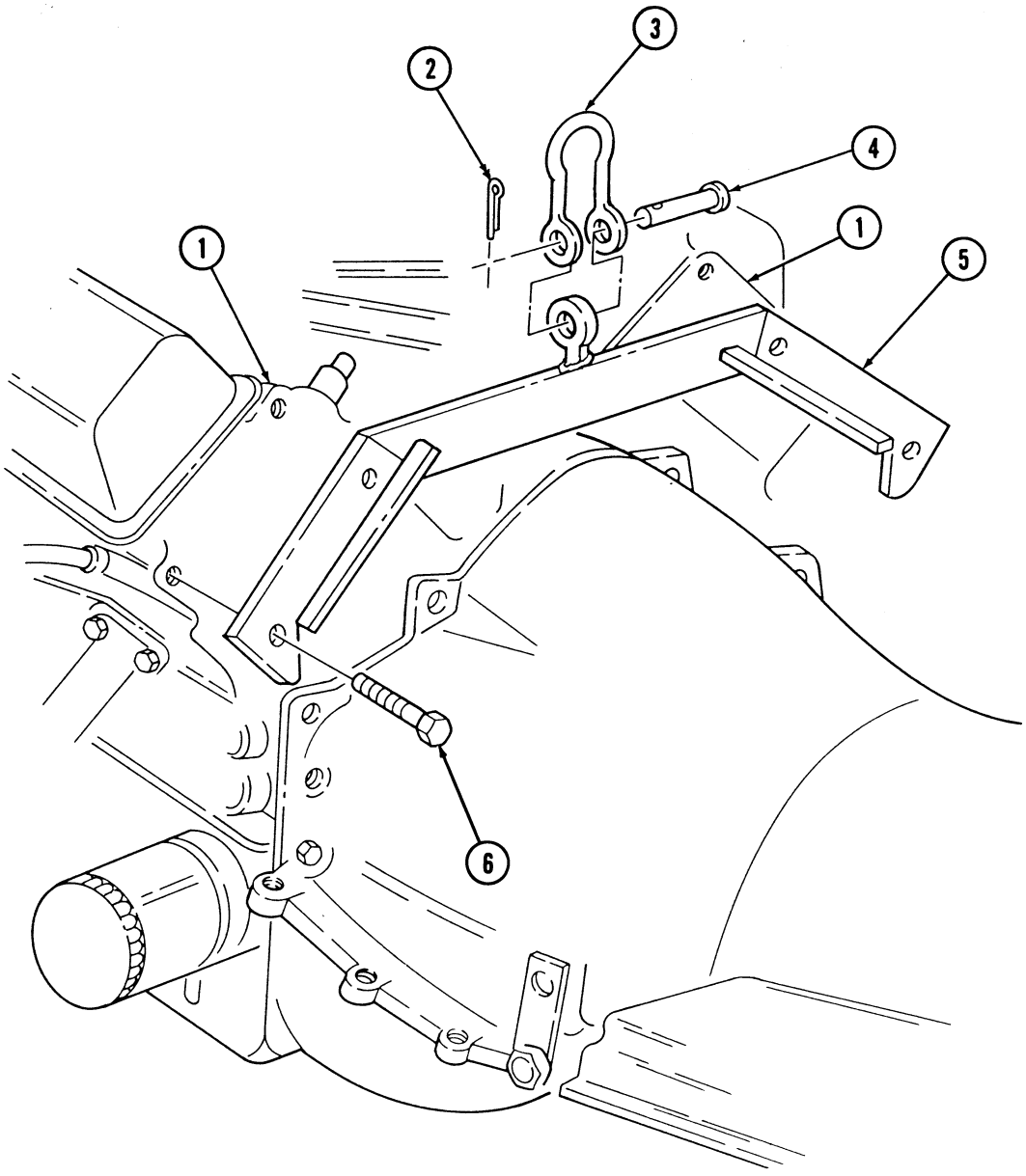
When performing frame rail straightening repairs accomplished with power driven mechanical or hydraulic means, all personnel will stand clear of vehicle. Failure or malfunction of equipment may cause injury to personnel.

   (a) Do not attempt to repair a bend when:
      (1) Buckling to a height of 1/4 in. (6 mm) on any one face of frame box is involved. If more than one face of frame box is involved with bending, replace part.
      (2) Bending also includes more than very minor twisting.
      (3) If part is bent in two directions, replace part.
      (4) If bending involves a collapse of one or more faces of frame box at a suspension or body attachment point, replace part.
   (b) When performing straightening repair with frame on vehicle:
      (1) Use spreader plates or wood blocking to distribute chain force to avoid damage to frame box section.
      (2) Be sure to loosen sufficient length of frame to allow frame force points to move without causing other damage.
      (3) Restrain vehicle movement in both directions along line of force application.
   (c) Vertical bends, except at end sections, require removal of frame rail or crossmember from vehicle. Straightening is done by using before and after dimensional measurements.
   (d) Application of bulk heating to frame components is not authorized; metal properties are irreversibly degraded.
   (e) At the conclusion of a bend repair, carefully inspect welds in vicinity of repair and area of force application. Any evidence of cracking or chipping of welds must be repaired. (Refer to step 2.)
   (f) Spot paint repaired areas using Chemical Agent Resistant Coating (CARC), following TM 43-0139, Painting Instructions For Field Use.
7. Front and rear wheel alignment checks (TM 9-2320-280-20) will be made after all frame repairs.

## 21-4. FRAME INSPECTION AND REPAIR (Cont'd)

**f. Powertrain Lift Sling Removal**

1. Remove lock pin (2), pin (4), and shackle (P/N NAS1042-14) (3) from powertrain lift sling (5).
2. Remove four shoulder bolts (P/N 11502788) (6) and powertrain lift sling (5) from cylinder heads (1).



## 21-5. RIGHT FRONT BODY MOUNT BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Three locknuts (Appendix E, Item 65)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Right front body mount removed (para. 22-3).

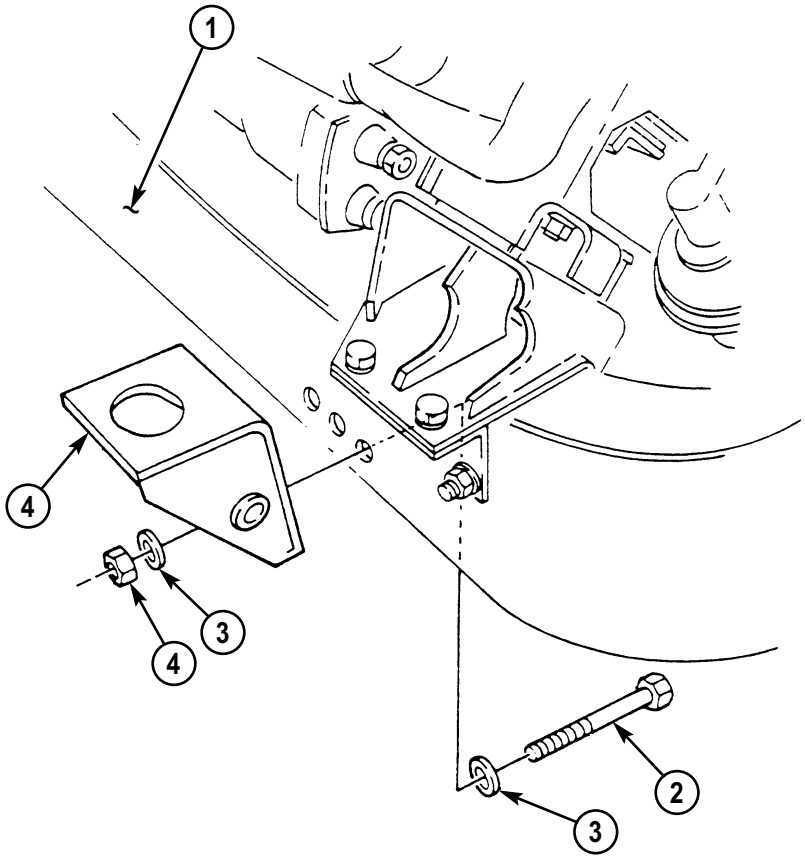
**Maintenance Level**
General support

### a. Removal

Remove three locknuts (4), washers (3), capscrews (2), washers (3), and right front body mount bracket (5) from frame rail (1). Discard locknuts (4).

### b. Installation

Install right front body mount bracket (5) on frame rail (1) with three washers (3), capscrews (2), washers (3), and locknuts (4). Tighten locknuts (4) to 90 lb-ft (122 N•m).




FOLLOW-ON TASK: Install right front body mount (para. 22-3).

## 21 - 6. RIGHT INTERMEDIATE BODY MOUNT BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Equipment Condition**
Right intermediate body mount removed
(para. 22-3).

**Materials/Parts**
Sealing compound (Appendix B, Item 50)

**Maintenance Level**
General support

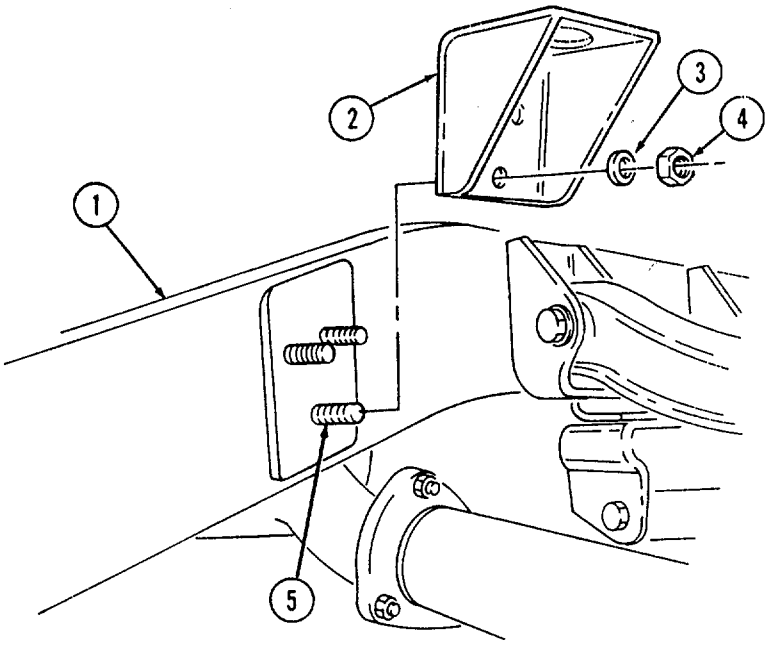
**Manual References**
TM 9-2320-280-24P

### a. Removal

Remove three capscrews (1), washers (2), and bracket (3) from frame rail (4).

### b. Installation

Apply sealing compound to three capscrews (1) and install bracket (3) on frame rail (4) with three washers (2) and capscrews (1). Tighten capscrews (1) to 65-87 lb-ft (88-118 N.m).




FOLLOW-ON TASK: Install right intermediate body mount (para. 22-3).

## 21-7. LEFT INTERMEDIATE BODY MOUNT BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**

Three locknuts (Appendix E, Item 65)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P

**Equipment Condition**

- Left intermediate body mount removed (para. 22-3).
- Tailpipe hanger removed (TM 9-2320-280-20).

**Maintenance Level**

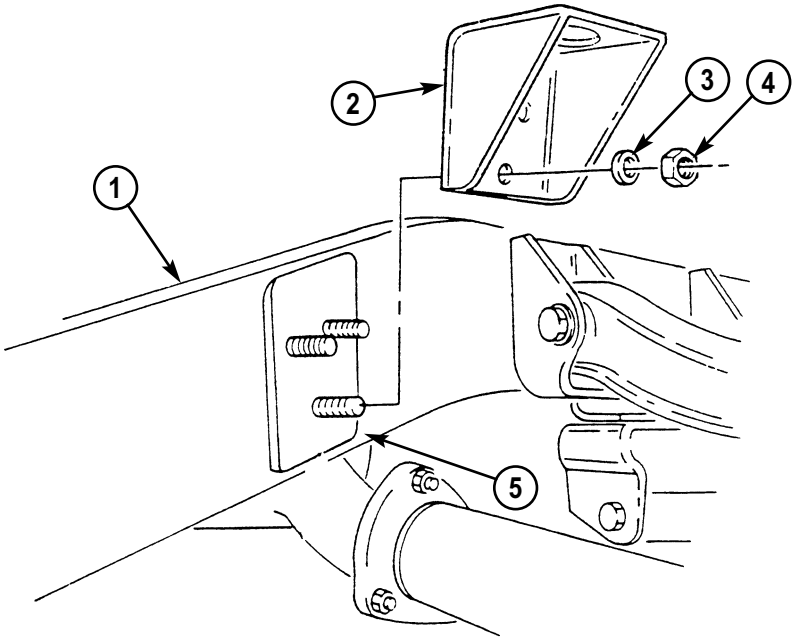
General support

**a. Removal**

Remove three locknuts (4), washers (3), and bracket (2) from frame rail (1), Discard locknuts (4).

**b. Installation**

Install bracket (2) on three capscrews (5) and frame rail (1) with three washers (3) and locknuts (4). Tighten locknuts (4) to 90 lb-ft (22 N•m).




FOLLOW-ON TASKS:
- Install tailpipe hanger (TM 9-2320-280-20).
- Install left intermediate body mount (para. 22-3).

# 21-8. REAR CROSSMEMBER BRACKET AND REAR BODY MOUNT BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Six locknuts (Appendix E, Item 65)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Rear body mount removed (para. 22-3).

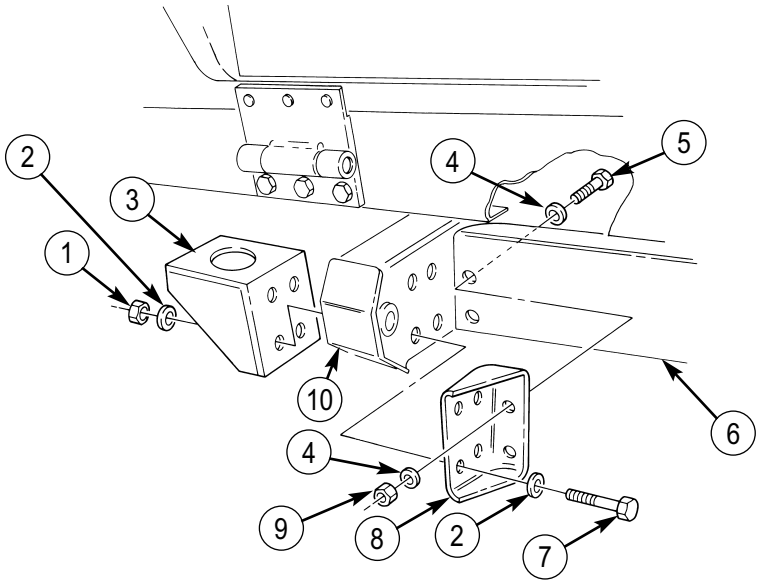
**Maintenance Level**
General support

## a. Removal

1. Remove four locknuts (1), washers (2), capscrews (7), washers (2), and rear body mount bracket (3) from crossmember bracket (8) and frame rail (10). Discard locknuts (1).
2. Remove two locknuts (9), washers (4), capscrews (5), washers (4), and rear crossmember bracket (8) from rear crossmember (6). Discard locknuts (9).

## b. Installation

1. Install rear crossmember bracket (8) on rear crossmember (6) with two washers (4), capscrews (5), washers (4), and locknuts (9).
2. Install body mount bracket (3) on frame rail (10) with four washers (2), capscrews (7), washers (2), and locknuts (1).
3. Install rear body mount (para. 22-3).
4. Tighten locknuts (9) and (1) to 90 lb-ft (122 N•m).



# 21-9. REAR BUMPER MOUNTING BRACKET AND TIEDOWN BRACKET REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Applicable Models**
M996, M996A1, M997, M997A1, M997A2, M1037, M1042

**Tools**
General mechanic's tool kit: automotive (Appendix G, Item 1)

**Materials/Parts**
Eight locknuts (Appendix E, Item 65)

**Manual References**
TM 9-2320-280-24P

**Equipment Condition**
Rear body mount removed (para. 22-3).

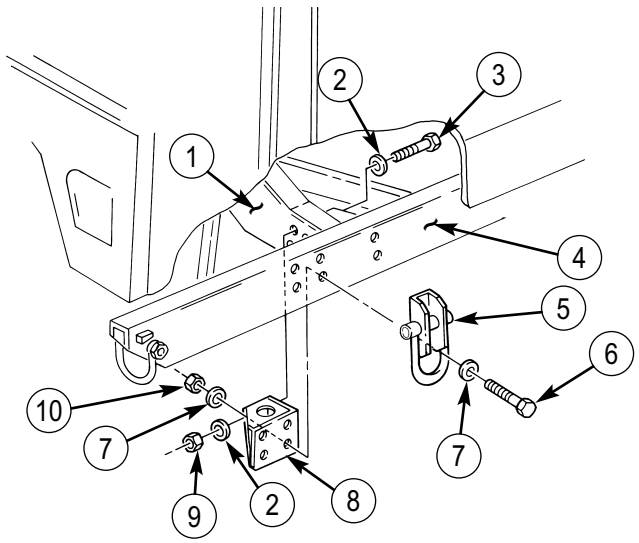
**Maintenance Level**
General support

**a. Removal**

1. Remove four locknuts (10), washers (7), capscrews (6), washers (7), and tie bracket (5) from bumper mounting bracket (8) and bumper (4). Discard locknuts (10).
2. Remove four locknuts (9), washers (2), capscrews (3), washers (2), and mounting bracket (8) from frame rail (1). Discard locknuts (9).

**b. Installation**

1. Install mounting bracket (8) on frame rail (1) with four washers (2), capscrews (3), washers (2), and locknuts (9).
2. Install tiedown bracket (5) on bumper (4) and mounting bracket (8) with four washers (7), capscrews (6), washers (7), and locknuts (10).
3. Tighten locknuts (9) and locknuts (10) to 90 lb-ft (122 N•m).




FOLLOW-ON TASK: Install rear body mount (para. 22-3).

# CHAPTER 22
# BODY REPAIR

## 22-1. INTRODUCTION

This chapter contains maintenance instructions for repair of body components at the Direct Support and General Support maintenance levels. Some subassemblies and parts must be removed before body components can be accessed. They are referenced to other paragraphs of this manual.

## Section I. BODY MAINTENANCE

## 22-2. BODY MAINTENANCE TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 22-3. | Mount Replacement | 22-2 |

## 22-3. BODY MOUNT REPLACEMENT

**This task covers:**

**a. Removal** **b. Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit: automotive (Appendix G, Item 1)

**Equipment Condition**

Hood raised and secured (front mounts only) (TM 9-2320-280-10).

**Manual References**

TM 9-2320-280-10
TM 9-2320-280-24P

**Maintenance Level**

General support

**NOTE**

- Removal and installation procedures for intermediate and rear body mounts are identical.
- On front body mounts, capscrew is inserted down through upper cushion.
- This procedure covers the left intermediate body mount.

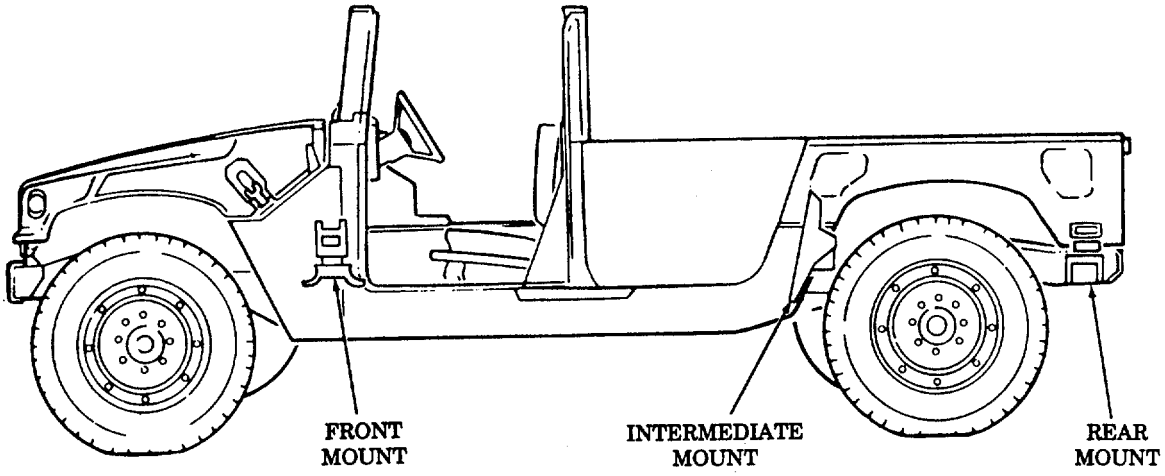
**a. Removal**

1. Remove nut (2), washer (1), capscrew (7), washer (8), and spacer (9) from sleeve (4), upper cushion (5), lower cushion (10), body bracket (3), and frame bracket (6).
2. Place jack under body reinforcements adjacent to body mount to be removed.
3. Raise the body far enough to separate the upper cushion (5) from lower cushion (10) and remove sleeve (4), upper cushion (5), and lower cushion (10).

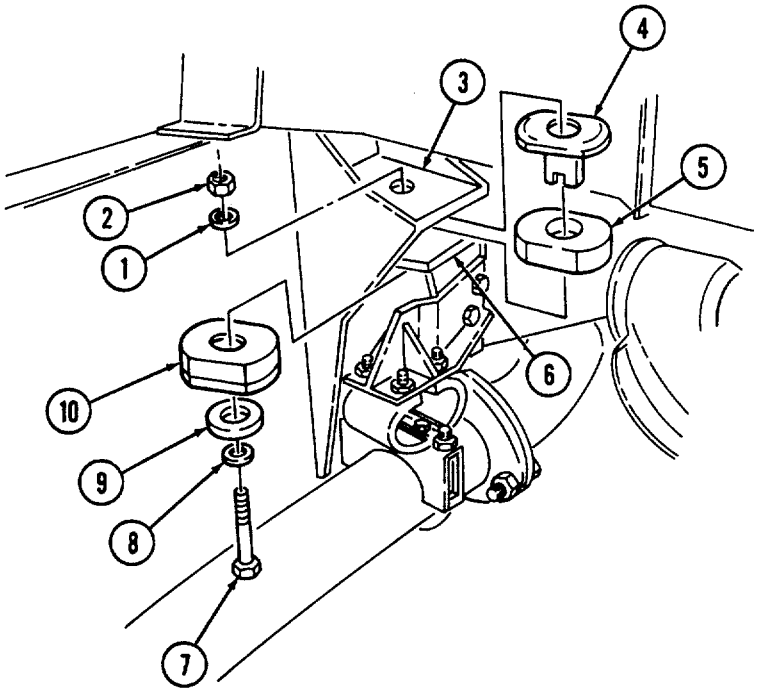
**b. Installation**

1. Install lower cushion (10), sleeve (4), and upper cushion (5) between body bracket (3) and frame bracket (6).
2. Lower body and align lower cushion (10), sleeve (4), upper cushion (5), and body bracket (3). Install with spacer (9), washer (8), capscrew (7), washer (1), and nut (2). Tighten nut (2) to 90 lb-ft (122 N•m).

**22 - 3. BODY MOUNT REPLACEMENT (Cont'd)**




**LEFT SIDE BODY MOUNT LOCATIONS**




FOLLOW-ON TASK: Lower and secure hood (Front mounts only) (TM 9-2320-280-10).

## Section II. BODY REPAIR

## 22-4. BODY REPAIR TASK SUMMARY


| TASK PARA. | PROCEDURES | PAGE NO. |
|---|---|---|
| 22-5. | General | 22-5 |
| 22-6. | Inspection | 22-5 |
| 22-7. | Rivet Replacement | 22-7 |
| 22-8. | Aluminum Repair | 22-10 |
| 22-9. | Fiberglass Repair | 22-16 |
| 22-9.1. | Floor Panel Repair | 22-16.2 |
| 22-9.2. | Left Front Floor Panel Repair | 22-16.3 |
| 22-9.3. | Left Rear Floor Panel Repair | 22-16.23 |
| 22-9.4. | Right Front Floor Panel Repair | 22-16.52 |
| 22-9.5. | Right Rear Floor Panel Repair | 22-16.72 |
| 22-10. | Ambulance Exterior Body Repair | 22-18 |

## 22-5. GENERAL

**a.** The M998 body is constructed of aluminum alloys that have been heat-treated to obtain high strength. Welding cannot be used to make body repairs. Heat generated in welding will reverse the heat treatment process and cause a great reduction in strength of material.

**b.** The M998 hood and engine access cover are made of fiberglass (sheet molding compound). Cracks, splits, or holes may be repaired with a glass reinforced plastic laminate repair kit, MILIR-19907C. (Refer to para. 22-9).

**c.** Solid 3/16-inch diameter aluminum rivets are the primary method of joining body components. The rivet is inserted into a hole through two pieces of metal, and a second head is formed by manual or pneumatic impacting or by squeezing the rivet. A bucking bar is used to backup the rivet to form the rivet head. When making repairs, use blind rivets of the same size, or oversize, diameter with the appropriate grip length. Rivets 3/16-inch in diameter are identified in appendix F, table F-1. For other rivets that may be needed, the NSN for the rivet can be determined by cross-referencing the rivet part number to an NSN. To determine the proper rivet part number, the following part number breakdown is provided:

MS20600 - basic MS number
AD - indicates aluminum
6 - indicates rivet sleeve diameter in 1/32-inch increments (6 x 1/32 = 6/32 = 3/16-inch)
W - indicates serrated stem rivet
2 - indicates maximum grip length in 1/16-inch increments (2 x 1/16 = 2/16 = /8-inch)

**d.** Blind structural aluminum rivets of 3/1l6-inch diameter are used in applications where there is access from only one side of the part. Blind rivets are installed using a tool that pulls on the rivet stem causing a bulbed head to form on the back side of the part. Fastening is complete when stem breaks off. High strength is obtained in blind structural rivets by mechanically locking the remaining stem inside rivet body.

**e.** Steel pull-type lockbolt fasteners of 3/16-inch and 1/4-inch diameter are used where tension or high shear loads exist. Lockbolts are two-piece unthreaded fasteners. One part is a high-strength, steel-headed, bolt-like part with serrations on its shank. The mating part is a collar which is swaged over the serrations causing the fastener to be locked in place.

**f.** To facilitate repairs to the body, it is acceptable to replace lockbolts and rivets with 3/16-inch AN3 series and 1/4-inch AN4 series bolts. Do not replace lockbolts with rivets. Standard threaded fasteners should not be used as these will quickly wear the aluminum structure. Bolt lengths should be chosen so that the cylindrical portion of the bolt is bearing on all members being joined. AN3 and AN4 series bolts are identified in appendix F, table F-3. Tighten all bolts to 70-75 lb-in. (8-8.5 N·m).

**g.** Fatigue strength of riveted joints and seams is increased by applying one part epoxy adhesive. This adhesive requires special material storage and metal preparation along with a low temperature heat cycle for curing. Because of its impracticality in field repairs, epoxy adhesive will not be used. Where possible, extra rivets and thicker metal gages should be used instead of adhesives. When making repairs, note epoxy applications. Parts may be difficult to separate, even after rivets are removed.

## 22-6. INSPECTION

**a.** General. The damaged area should be thoroughly cleaned and inspected to determine cause and extent of damage. Body parts should be inspected for holes, cracks, dents, distortion, or breaks. Fasteners should be inspected for breaks, stretching, looseness, cocked heads, or hole elongation. Seams, flanges, and joints should be inspected for straightness or local deformation as an indication that fasteners may have been stretched or holes elongated. It is possible for this to happen and fasteners still appear to be tight in their holes. In addition, make thorough inspection of adjacent areas to determine if high loads have been transmitted from the damaged area to other areas. This can result in secondary damage in the form of distorted panels or seams, loosened or sheared fasteners, elongated fastener holes, and cracks.

**b.** Classification. After extent of damage has been determined, affected parts should be classified into one If the following categories:

- Negligible damage
- Damage repairable by patching
- Damage repairable by insertion
- Damage necessitating replacement of parts

**1. Negligible damage.** Minor dents, nicks, scores, cracks, and holes in body panels which are within or are brought within reasonable limits by a simple procedure, without extensive rework, are considered negligible damage. These defects should be considered more serious if located in main structural members such as body side rails, "A" pillars, or floor crossmembers rather than in body panels such as cowls or rear wheelhouses. Deep wrinkles of undetermined origin in body panels should not be classed as negligible until the source of wrinkles has been investigated and positively identified. Damage other than small dents, holes, nicks, and scratches will require repair or replacement of the part. Refer to pars 22-8.f for repair of negligible damage.

**(a) Negligible cracks.** Isolated cracks less than 0.50 in. (1.27 cm) long may be classified as negligible cracks provided they are stop drilled at each end to stop propagation.

**(b) Negligible holes.** Isolated holes no more than 0.50 in. (1.27 cm) diameter, after they are made round with smooth edges are classified as negligible holes, provided the distance from the edge of the hole to the nearest line of rivets exceeds the diameter of the hole.

**(c) Negligible dents and distortion.** Small dents and distorted areas may be classed as negligible if they can be repaired by hammering or bending without causing the material to crack. Heat may not be used for reforming.

**2. Damage repairable by patching.** Damage beyond negligible must be repaired, or the section. Replaced. Patches can often be applied over damaged body panels provided damaged area is first trimmed to remove sharp edges or notches which could cause the start of new cracks. The patch must then be sized to overlap the area to allow for attaching rivets. Refer to para. 22-8.g for repair by patching.

**3. Damage repairable by insertion.** In certain cases, patch repairs may not be desirable because of impracticality or because a flush surface is desired. In this case, damaged area must be cut away and a partial replacement of equivalent material inserted flush with adjacent areas and backed up with a doubler. Refer to para. 22-8.h for repair by insertion.

**4. Damage necessitating replacement of parts.** Parts too badly damaged for repair, or where replacement is easier than repair, fall into this category. Repair of welded assemblies such as body mounts are also in this category. Welded assemblies cannot be re-welded without destroying strength of the part and must be replaced.

**c. Rivet Failure.** Signs of rivet failure include tipped heads, looseness, and sometimes chipped or cracked paint. If heads are tipped in the same direction and rivets are loose in consecutive groups, the joint had undergone excessive load. Rivet heads which are tipped in different directions, and are not in groups may be improperly installed. With chipped or cracked paint, it may be necessary to remove paint to check true condition of rivets. Rivets subjected to critical loads but showing no distortion, should be inspected if failure is suspected. The head should be drilled off, and the shank should be carefully punched out. Failure is indicated by notched rivet shank and misaligned holes. Flush rivets showing head slippage within the dimple or countersink indicate either sheet bearing or rivet shear failure and must be removed for inspection and replacement. If failure of rivets cannot be detected by visual inspection, the joint can be checked by drilling and punching out several rivets. If rivet shanks are notched, rivets should be replaced with next larger size rivets. If rivet holes show elongation due to local failure in tearing of the sheet, next larger size rivet must be used in replacement. Any deformation of the sheet around the rivet, tear outs, or cracks between rivets usually indicates partially failed or damaged rivets. Complete repair of the joint will require replacement by next larger size rivets. Use the next .031 in. (0.79 mm) larger diameter rivet to obtain a tight joint when original hole has been enlarged. If original size rivet is installed, the rivet would not be able to carry its share of the shear load, and the joint would not meet its strength requirements.

**d. Lockbolt Failure.** Lockbolts are used to withstand tension loads and high shear loads. These fasteners are installed in their holes with an interference fit. No looseness can be permitted. Lockbolts showing evidence of being stretched, broken, loose in their holes, or having heads that do not set flat against the surface must be replaced. Guidelines used in 22-6.c for detecting rivet failures also apply to lockbolts.

## 22-7. RIVET REPLACEMENT

**NOTE**

When removing rivets, care should be taken to not enlarge rivet hole as this would require use of an oversize or larger rivet for replacement.

**a. Solid Rivet Removal.**

**1.** File a flat surface on the manufactured head if accessible. It is always preferable to work on manufactured head rather than the one that is bucked over, since the former will always be more symmetrical about the shank.

**2.** Indent center of the filed surface with a center punch.

**3.** Drill through rivet head. Be sure to use a drill slightly smaller than diameter of rivet shank to avoid making rivet hole oversized.

**4.** Shear weakened rivet head off with a sharp chisel. For this operation support back side of rivet and cut rivet head along direction of rivet line or panel edge. This will prevent distortion of the panel

**5.** Firmly support the panel from the opposite side and drive out shank with a pin punch. If rivet is unduly tight because of swelling between sheets, drill rivet shank out with an undersize drill.

**b. Blind Rivet Removal.**

**1.** File a small flat space on rivet head.

**2.** Center punch the flat space. Support rivet backside, if possible.

**3.** Using a small drill about the size of rivet pin, drill off tapered end of pin which forms the lock.

**4.** Shear lock using a pin punch to drive out pin.

**5.** Pry out remainder of locking collar.

**6.** Using a drill slightly smaller than rivet shank, drill almost through rivet head.

**7.** Pry off rivet head with a pin punch.

**8.** Tap out rivet shank with a pin punch.

**c. Lockbolt Removal.**

**1.** Work from the head side of lockbolt, if accessible. File a small flat space on the head if rounded.

**2.** Center punch the head.

**3.** Using a hardened drill slightly smaller than lockbolt, drill through the head. In cases where lockbolts are too hard to be drilled with available drills, grind the head down using a cutoff wheel or carbide bit in a die grinder. When using grinder method, cut the head down until it is very thin, but do not grind it completely off or touch the body part with grinding tool.

**4.** Use a pin punch to pry off head or shear it off with a sharp chisel. Make sure the part is adequately supported while performing this step.

**5.** Drive lockbolt out of its hole with a pin punch Care must be taken so that hole or part is not distorted.

**NOTE**

In cases where lockbolt head is inaccessible, the locking collar must be removed. It is best to removed collars by grinding or by splitting them axially with a sharp chisel.

**d. Rivet Hole Drilling.**

1. Center punch all new rivet locations. Center punch mark must be large enough to prevent drill from slipping out of position, yet it must not dent the surface of the material. To prevent denting, place a bucking bar behind material during punching.

2. Make sure drill is the correct size (tables 22-1 and 22-2) and point is properly ground. A no. 10 drill is used to install standard 3/16-inch blind rivets.

*Table 22-1. Drill Sizes for Solid Shank Rivets*

| RIVET DIAMETER (INCH) | DRILL SIZE | DRILL DIAMETER (INCH) |
|---|---|---|
| 1/16 | #51 | 0.0670 |
| 3/32 | #41 | 0.0960 |
| 1/8 | #30 | 0.1285 |
| 5/32 | #21 | 0.1590 |
| 3/16 | #10 | 0.1910 |
| 1/4 | F | 0.2570 |
| 5/16 | P | 0.3230 |
| 318 | W | 0.3860 |

*Table 22-2. Drill Sizes for Blind Rivets*

| NOMINAL DIAMETER (INCH) | | | | OVERSIZE DIAMETER (INCH) | | | |
|---|---|---|---|---|---|---|---|
| RIVET DIAMETER | DRILL SIZE | MINIMUM | MAXIMUM | RIVET DIAMETER | DRILL SIZE | MINIMUM | MAXIMUM |
| 1/8 | #30 | 0.129 | 0.132 | 1/8 | #27 | 0.143 | 0.146 |
| 5132 | #20 | 0.160 | 0.164 | 5/32 | #16 | 0.176 | 0.180 |
| 3116 | #10 | 0.192 | 0.196 | 3/16 | #5 | 0.205 | 0.209 |

3. Place drill in center mark for new rivet locations, or align drill with old hole when replacing old rivets with oversize rivets. When using a power drill, give the bit a few turns with fingers before starting motor. This will help assure that drill does not jump out of position when motor is started.

**NOTE**

- While drilling, hold drill at 90 degree angle to material surface. Avoid letting drill wobble, making oblong holes.
- Avoid excessive pressure. Let drill bit do the cutting.
- Do not push drill through material.

4. Remove all burrs with a metal countersink or file.

5. Clean away all drill chips. Care must be taken to assure that no chips are trapped between sheets of metal.

6. Apply sealing compound (Appendix B, Item 47) to hole and surrounding area.

**e. Hole Countersinking.**

**NOTE**

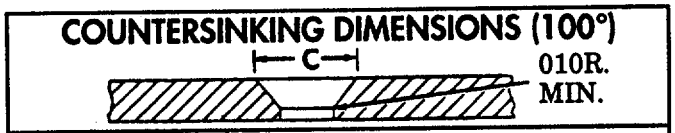
Some rivet installations in the body require that rivet head be flush with the material surface, in these instances, countersunk or flush head rivets are used.

1. When using countersunk rivets, rivet holes must be countersunk with a tool having a 100° taper so rivet head will fit flush with surface.
2. When using a hand-operated countersink, the hole must be tried with a rivet so the recess will not be too deep or too shallow. It is best to use a countersink with a stop on it so depth of countersink can be controlled. Typical countersinking dimensions for blind rivets are shown in table 22-3. The minimum sheet thickness that can be machined for 100° countersink rivets is given in table 22-4.

3. Do not remove edge of hole on blind side of joint.

*Table 22-3. Countersinking Dimensions for*

*100° Countersunk Blind Rivets*




| RIVET DIAMETER (INCH) | C (INCH) | |
|---|---|---|
| | MINIMUM | MAXIMUM |
| 1/8 | 0.222 | 0.228 |
| 5/32 | 0.283 | 0.289 |
| 3/16 | 0.350 | 0.356 |

010R.

MIN.

Table 22-4. Minimum Sheet Gauge for 100° Machine Countersink

| RIVET SIZE (INCH) | 3/32 | 1/8 | 5/32 | 3/16 | 1/4 |
|---|---|---|---|---|---|
| GAUGE (INCH) | 0.040 | 0.050 | 0.064 | 0.072 | 0.072 |

**f. Blind Rivet Driving Practices and Precautions.**

1. Rivets should be inspected for proper installation. The grip length of each rivet is marked on top of its head to provide positive identification. Use of proper grip length will produce a rivet installation where locking collar is flush with top surface of rivet head. Tolerance limit on flushness is 0.020 in. (0.5 mm).
2. For proper rivet installation, it is imperative that holes be properly prepared, tools be in good working order, and rivets properly applied. When problems occur, the source of trouble could be in any of these areas.

**g. Blind Rivet Installation.**

**NOTE**

- Prior to installing blind rivets, the hole must be prepared, and the parts aligned and damped firmly in place. These steps are the same as for solid riveting operations (refer to para 22-5.d). Proper drill sizes for standard and oversized blind rivets are given in table 22-2. Countersinking dimensions and minimum sheet gauge for countersunk blind rivets are shown in tables 22-3 and 2-24.
- It is very important that the proper length rivet is selected for each application. Rivet lengths are sized by the range of material thickness that the rivet will grip. Selecting the proper rivet length is critical because rivets can tolerate only 1/16-inch variation in material thickness for each particular rivet length. Rivet grip lengths are called out as a "dash number" at the end of the manufacturer's part number. Grip lengths are determined as shown in appendix F, table F-1.
- For double-dimpled sheets, add countersunk head height to material thickness.
- Use rivet installation tool kit, D-100-MIL1, and puller head adapters, if required, for all blind rivets.

1. Insert rivet stem into pulling head of rivet gun or adapter.
2. Hold rivet gun in line with axis of rivet as accurately as possible.
3. Apply a steady, firm pressure against rivet head.
4. Squeeze handles of manual gun. The rivet clamping action will pull sheets together, seat rivet head, and break stem flush with head of rivet.

## 22-8. ALUMINUM REPAIR

**CAUTION**

Repairs should not be made on the body using welding or heat for forming. Heat will only weaken material and cause further problems.

a. Material. Aluminum material used for repair should be of the same alloy and temper as original, if possible. In general, 6061-T6 aluminum alloy should be used. Material thickness must be the same or thicker. This alloy will work well for flat repairs, but is not well suited to bending because it is quite hard and cracks easily when bent sharply. When bends must be made, use softer 6061-T4 aluminum alloy and increase material thickness by at least 50 percent. As a general rule of thumb, 6061-T4 alloy should be bent with a minimum bend radius of one to two times material thickness, whereas 6061-T6 alloy requires at least three times material thickness radius for bends. In all cases, bends should be closely inspected for cracks. A suitable method for avoiding cracks during bending is to obtain angles that are extruded from 6061-T6 alloy or use preformed angles for repairs. Bulk aluminum is identified in appendix F, table F-2.

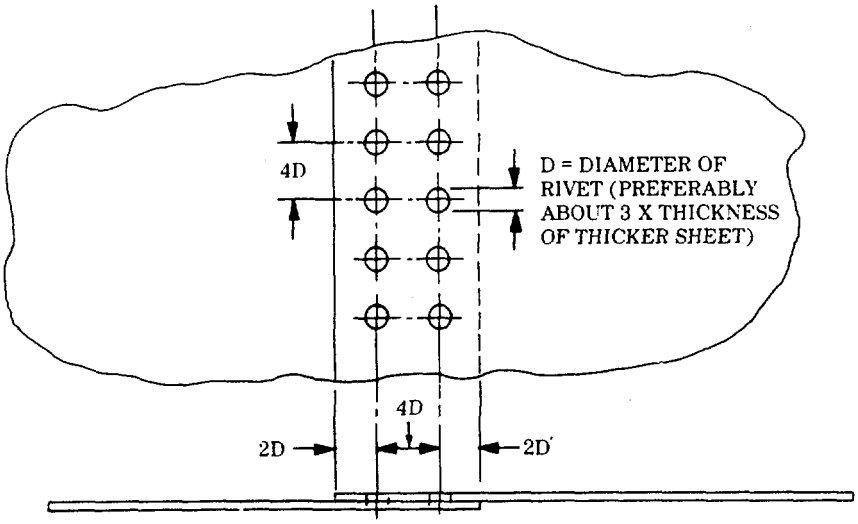
b. Epoxy Adhesive. Where it is necessary to remove parts, note that epoxy adhesive is used in joints. Use care in parts removal to avoid unnecessary distortion. Parts should be separated by peeling them apart using a knife or chisel to start the peeling action. Before parts are reassembled, it will be necessary to remove any remaining cured epoxy from joints so parts will fit together with good, even contact. Use of epoxy requires special storage and application procedures which do not lend themselves to field repairs. For this reason, epoxy will not be used for repair. To compensate for the lack of epoxy, additional rivets should be used when making repairs to existing joints.

c Rivet Patterns.

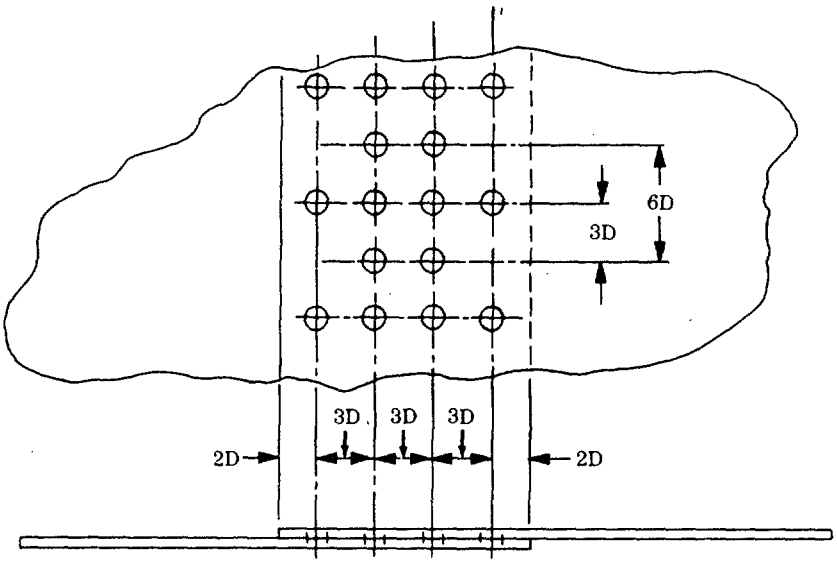
1. Rivet patterns are denoted by rivet spacing and rivet edge distance. Rivet edge distance is the distance from center of rivet to nearest edge of sheet. Rivet spacing is defined as the distance from center of rivet to center of adjacent rivet

2. Required rivet spacing is determined by strength needed in the joint. A general feel for strength required can be obtained by inspecting rivet patterns in surrounding areas. Body repairs made using single rows of rivets should be performed using rivet spacing not greater than 1.5 in. (4 cm) and not less than 0.625 in. (16 mm). Use one inch rivet spacing as a general practice for repairs. Rivet spacing used in original construction may be greater due to additional strength obtained by using epoxy adhesive. Do not use rivet edge distances less than 0.375 in (10 mm).

3. High strength joints or large area patches may require use of double or multiple rows of rivets to obtain sufficient strength




**DOUBLE ROW RIVETING PATTERN**




**TRIPLE OR MULTIPLE ROW RIVETING PATTERN**

4. Care must be taken to assure rivet hole patterns are transferred accurately in the case where a part with no holes is mated to one which already has rivet holes. Hole patterns may be transferred using one of the following methods:

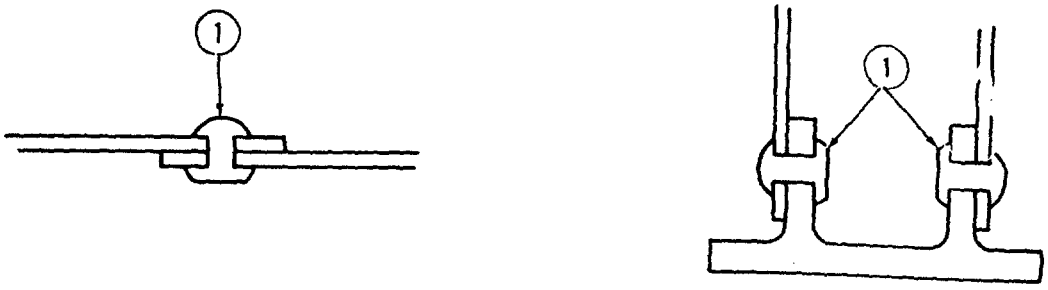
(a) Lay new part in place and use holes in mating part as a drill template. This requires new part be underneath the mating part. Care must be taken not to distort original holes.

(b) Use removed part as a drill template by clamping the old and new parts together. This requires parts nest flat and rivet flange be undistorted.

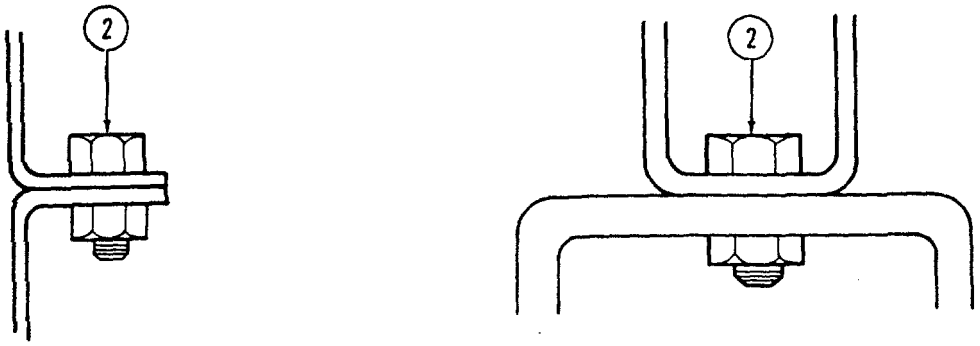
**d. Joint Designs.**

1. Loads are applied through a joint to fasteners that hold it together. These loads are applied to fasteners in the form of shear loads or tension loads. If load is perpendicular to axis of fasteners, the fastener is loaded in shear. The fastener is loaded in tension when load is along axis of fastener causing a pull on each end of fastener.

2. Rivets (1) are designed to be loaded in shear. Do not create any new joints during repairs which cause rivets to be used in a tension application. Bolts (2) should be used for tension applications or substituted for rivets in very high shear load applications.




**RIVETS LOADED IN SHEAR**




**BOLTS REPLACING RIVETS LOADED IN TENSION**

**e. Repair Parts Preparation.**

1. Repair parts or patches should be painted with epoxy primer before installation.

2. Apply sealing compound (Appendix B, Item 47) to mating surfaces to prevent corrosion.

3. Install part or patch as detailed in 22-8.g and 22-8.h.

4. Paint repaired area with epoxy primer.

5. Paint repaired area with polyurethane as required.

**f. Repair of Negligible Damage.**

1. Negligible cracks as defined in para. 22-6.b are repaired by drilling a small hole at each end of crack to stop crack propagation. This is called "stop drilling". Table 22-5 gives proper drill sizes for 'stop drilling" cracks.

2. Negligible holes are repaired by rounding and smoothing edges of hole to alleviate stress risers caused by sharp notches.

**CAUTION**

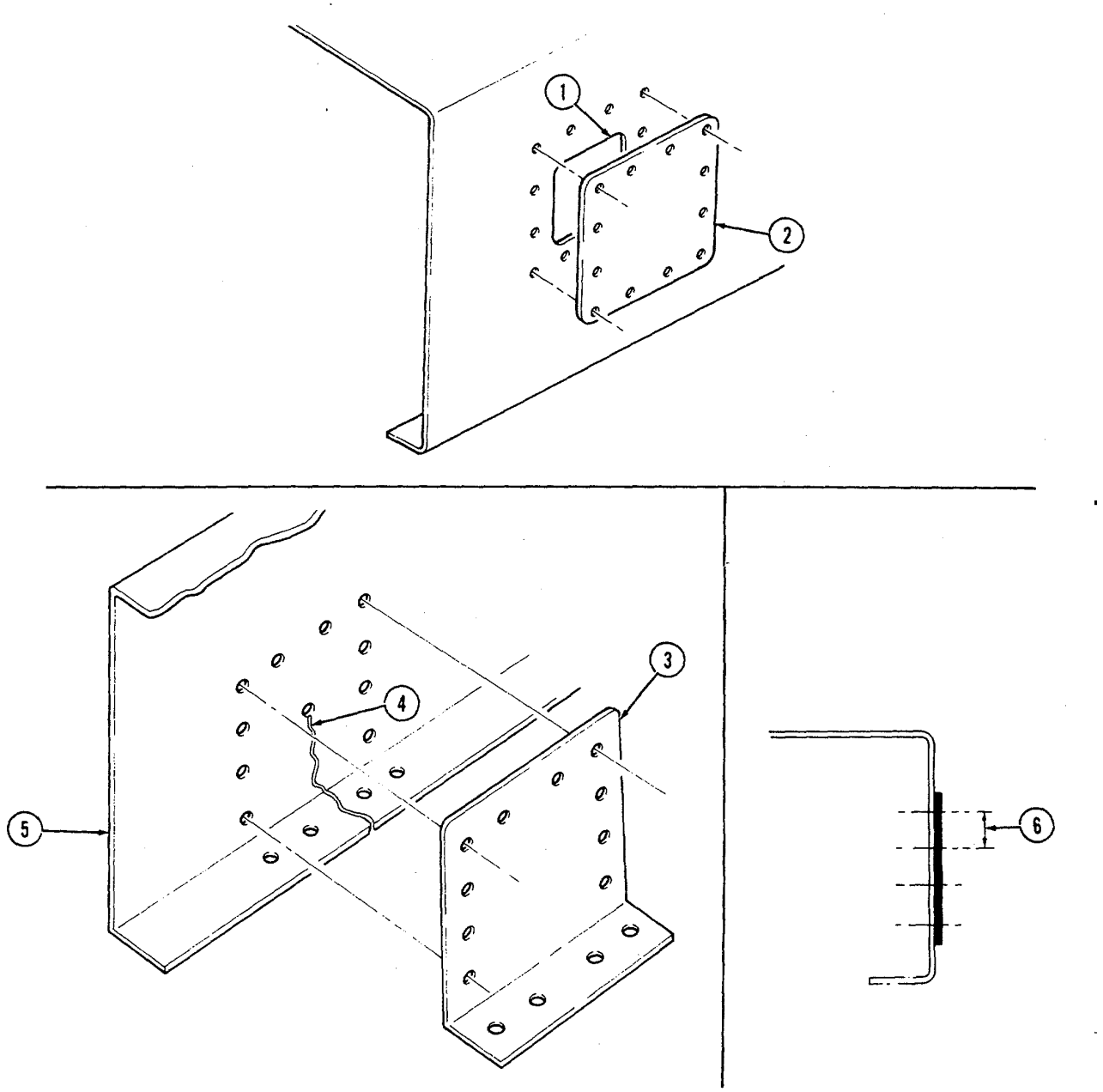
Heat will never be used to reform parts because it greatly reduces part strength.

3. Small dents and distorted areas may be repaired by bending or hammering, as long as the operation does not cause materials to crack or tear. Sharp bends should not be attempted.

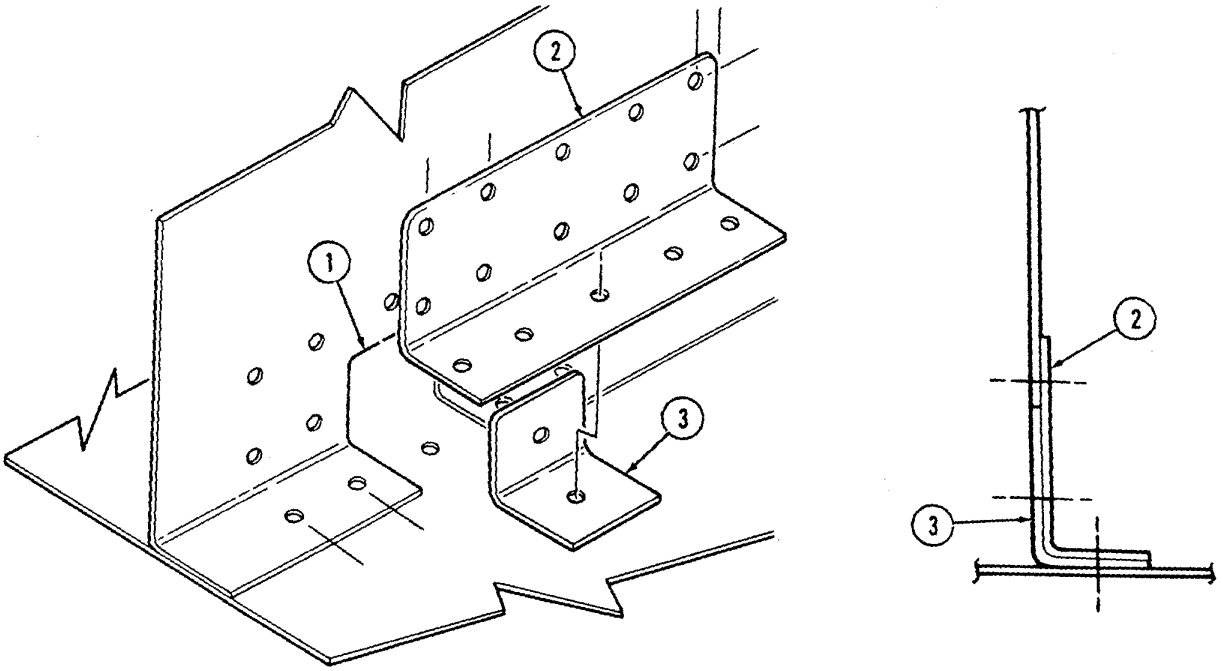
*Table 22-5. Stop Drill Sizes for Negligible Cracks.*

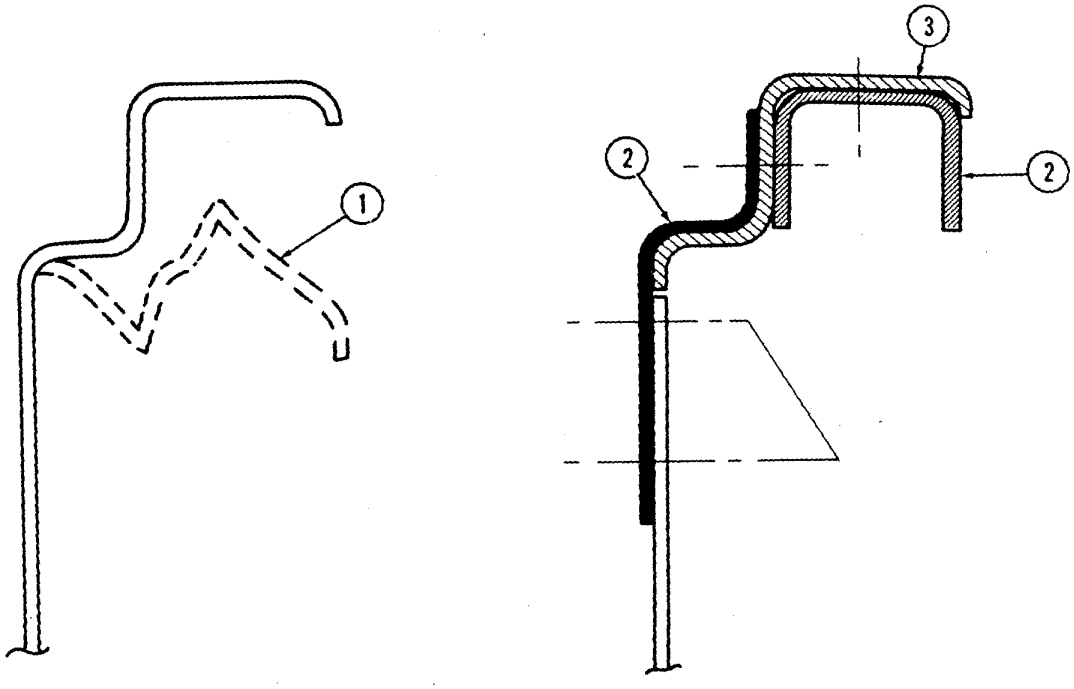
| SHEET THICKNESS (INCH) | MINIMUM STOP DRILL SIZE NO. |
|---|---|
| 0-0.032 | 40 |
| 0.033 and thicker | 30 |

**g. Repair by Patching**. Most body panel damage that exceeds the limits of negligible damage may be repaired by patching. This procedure involves removal of damaged area (1) and application of a patch (2) to cover the area (1). The damaged area is prepared by removal of the damage followed by rounding or smoothing of all corners and edges. This helps to assure that cracks will not spread into undamaged areas. In the case of a large crack (4), it may be desirable to stop-drill the crack (4), rather than cut out a portion of the panel (5) or structural member. Repair is completed by applying a large overlapping patch (3) over the area that was damaged. The overlap must be sufficient to allow the observance of proper rivet edge distance (6) (para. 22-8.c). Large areas of damage are best repaired using a patch that is attached with multiple rows of rivets (para. 22-8.c).



**h. Repair by Insertion**. For damage that is large or more severe in nature than a crack or hole, it is often desirable to remove damaged area (1), insert a piece of material (3) into removed area and reinforce this with a doubler (2). This is termed repair by insertion. This method or repair is typically stronger and stiffer than an added patch.



## 22-9. FIBERGLASS REPAR

### a. General

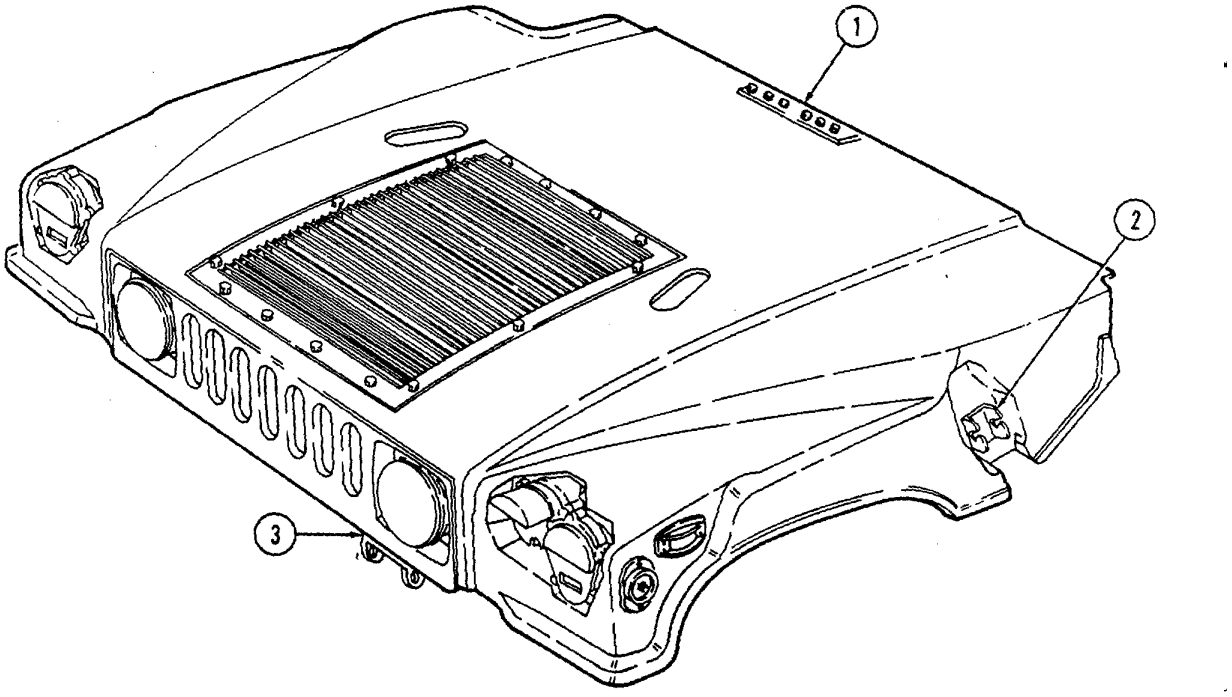
The M998 hood and engine access cover are made of fiberglass ( sheet molding compound). Cracks, splits, or holes may be repaired with a glass reinforced plastic laminate repair kit, MIL-R-19907c, NSN 2090-00-372-6064.

### b. Inspection

NOTE

Hood surface has a thin layer of gel coat that may appear cracked in a “spiderweb”-like pattern due to hood flexing. No repair is required.

1. Examine cracks to determine if they are surface only, or are deep brakes into material thickness.
2. If filler material chips off at bonding flanges, appearing as cracked but not broken through, area need not be repaired.
3. If a total penetration crack greater than one inch exists in critical areas: hinges (3), latches (2), or hood stop (1) areas, repair immediately.
4. If total penetration cracks exist in non-critical areas, do not repair until size is greater than three inches.
5. If severe breaks develop in one area, remove fragmented material and use repair procedure for holes.



**c. Repair**

**NOTE**

Complete, detailed procedures for fiberglass repair are provided with repair kit, MIL-R-19907C.

1. Repairing cracks or splits.

**WARNING**

When sanding fiberglass, personal protective equipment (respirator, goggles/shield, gloves, coveralls, etc.) must be used. Failure to do this may result in injury.

(a) Using sandpaper, remove dirt and paint 3-4 in. (8-10 cm) around area of crack.

(b) Rough sand surface to which mat will be added; underside of surface if possible. Surface must be dry.

(c) Bevel edges of crack in a broad "V".

(d) Cut a piece of mat and apply to underside of surface with resin mixture. Extend patch beyond break about 2 in. (5 cm). Press patch firmly into place. Saturate patch with additional layer of resin and then allow 1 to 3 hours to cure.

(e) At the same time, cover top exposed surface with resin, allowing 1 to 3 hours to cure.

(f) For stressed areas, lightly sand first patch and add another patch layer, repeating steps 1.d and 1.e.

(g) Finish sand exposed surface.

(h) Prime and paint.

2. Repairing holes.

(a) Remove damaged material. Bevel edges approximately 20° at outside edge of hole.

(b) Remove dirt and paint in area of hole extending away 3-4 in. (8-10 cm), using sandpaper.

(c) Rough sand top and underside of surface to which mats will be added.

(d) Cut two same sized pieces of fiberglass mat that will extend past edge of hole about 2 in. (5 cm).

(e) Coat both top and underside surface and saturate both pieces of mat with the resin mixture.

(f) When tacky, apply one mat to the inner surface and one to the outer surface. Press the two patches together.

(g) Allow 1 to 3 hours to cure. Additional coats of resin may be added if necessary for appearance purposes. Sand lightly between coats.

(h) Finish sand exposed surface.

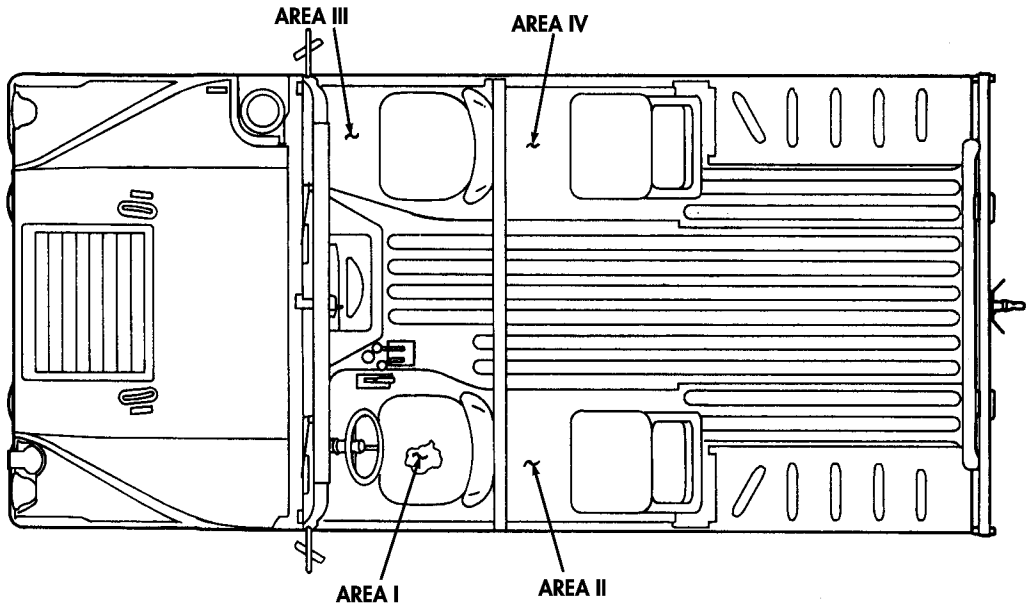
(i) Prime and paint.

## 22-9.1. FLOOR PANEL REPAIR

The M998 floor panels that are damaged can be repaired by using sheet metal sections cut to the required size and installed using the following procedures. Each repair section can be installed independent of each other. Refer to paras. 22-5 through 22-8 for general repair criteria, inserting rivets, drilling, and repair of aluminum.

The vehicle floor is divided into the four areas defined below.

- AREA I – Left Front Floor Panel. Refer to para. 22-9.2 for repair of this panel.
- AREA II – Left Rear Floor Panel. Refer to para. 22-9.3 for repair of this panel.
- AREA III – Right Front Floor Panel. Refer to para. 22-9.4 for repair of this panel.
- AREA IV – Right Rear Floor Panel. Refer to para. 22-9.5 for repair of this panel.



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR

**This task covers:**

**a. Left Front Insert Panel Fabrication**
**b. Metal Strips Fabrication**
**c. Left Front Floor Panel Removal**
**d. Metal Strip A and Insert Panel Assembly**
**e. Metal Strip C and Insert Panel Assembly**
**f. Metal Strip D and Insert Panel Assembly**
**g. Metal Strip B and Insert Panel Assembly**
**h. Left Front Floor Panel and Insert Panel Drilling**
**i. Insert Panel and Left Front Floor Panel Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix G, Item 1)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P
TM 43-0139

**Materials/Parts**

One hundred five blind rivets
(Appendix E, Item 194)
Twenty-five solid rivets (Appendix E, Item 198)
Sheet metal (Appendix E, Item 245)
Adhesive (Appendix B, Item 1.1)
Adhesive sealant (Appendix B, Item 4.1)

**Equipment Condition**

- Fire extinguisher mount bracket removed (TM 9-2320-280-20).
- Driver's seat assembly removed (TM 9-2320-280-20).
- Front and rear seat support panels removed (TM 9-2320-280-20).
- Left floor insulation removed (TM 9-2320-280-20).

**Maintenance Level**

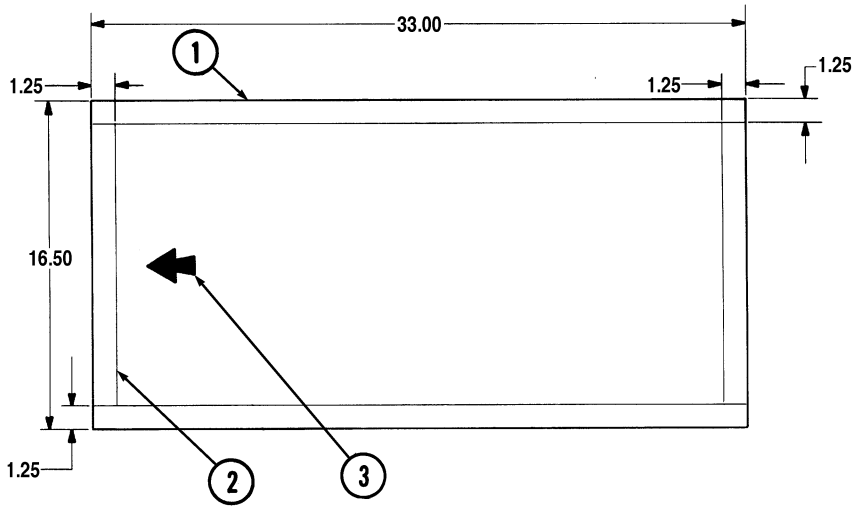
General Support

### a. Left Front Insert Panel Fabrication

**NOTE**

All dimensions are in inches.

1. Cut insert panel (1) from sheet metal as shown and mark four reference lines (2) and directional arrow (3) on insert panel (1).



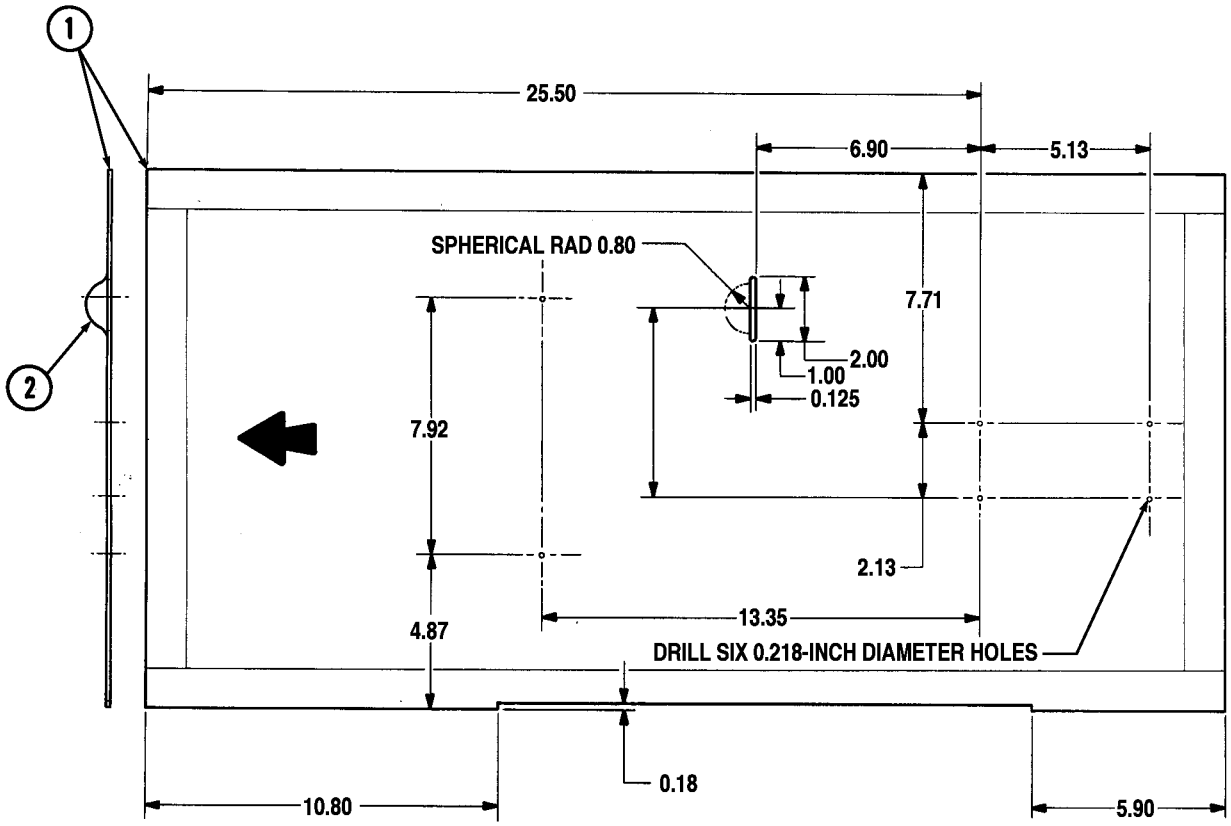
## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

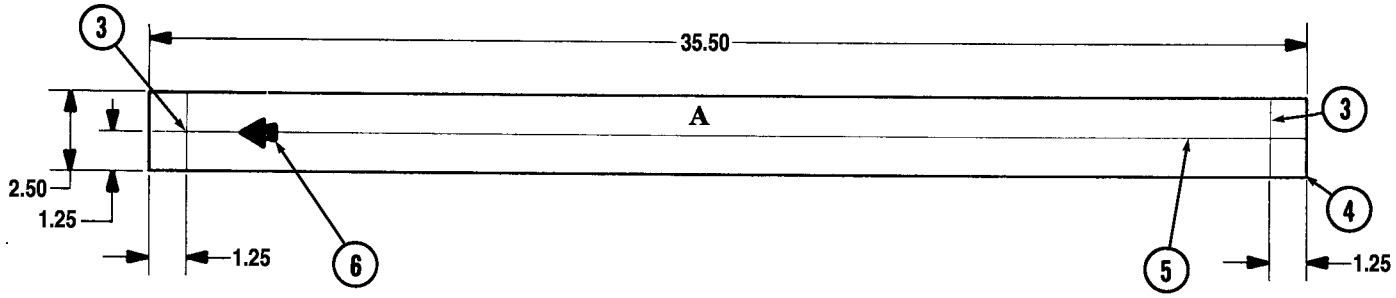
2. Locate, mark, and drill six 0.218-in. diameter holes through insert panel (1).
3. Fabricate drain hole (2) in insert panel (1).
4. Cut and remove 0.18 in. of material from insert panel (1), remove all burrs, and round sharp edges on insert panel (1).

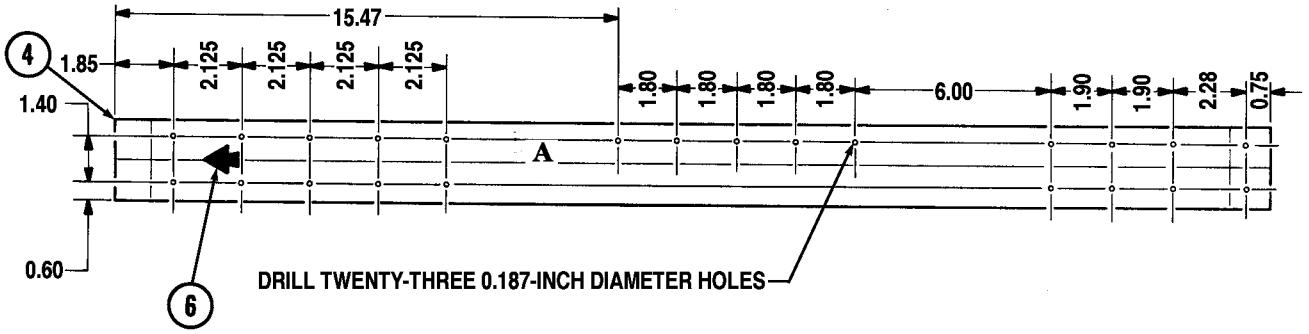
**b. Metal Strips Fabrication**

1. Cut metal strip (4) from sheet metal and mark two reference lines (3), centerline (5), directional arrow (6), and letter A on metal strip (4).
2. Locate, mark, and drill twenty-three 0.187-in. diameter holes in metal strip A (4).

## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

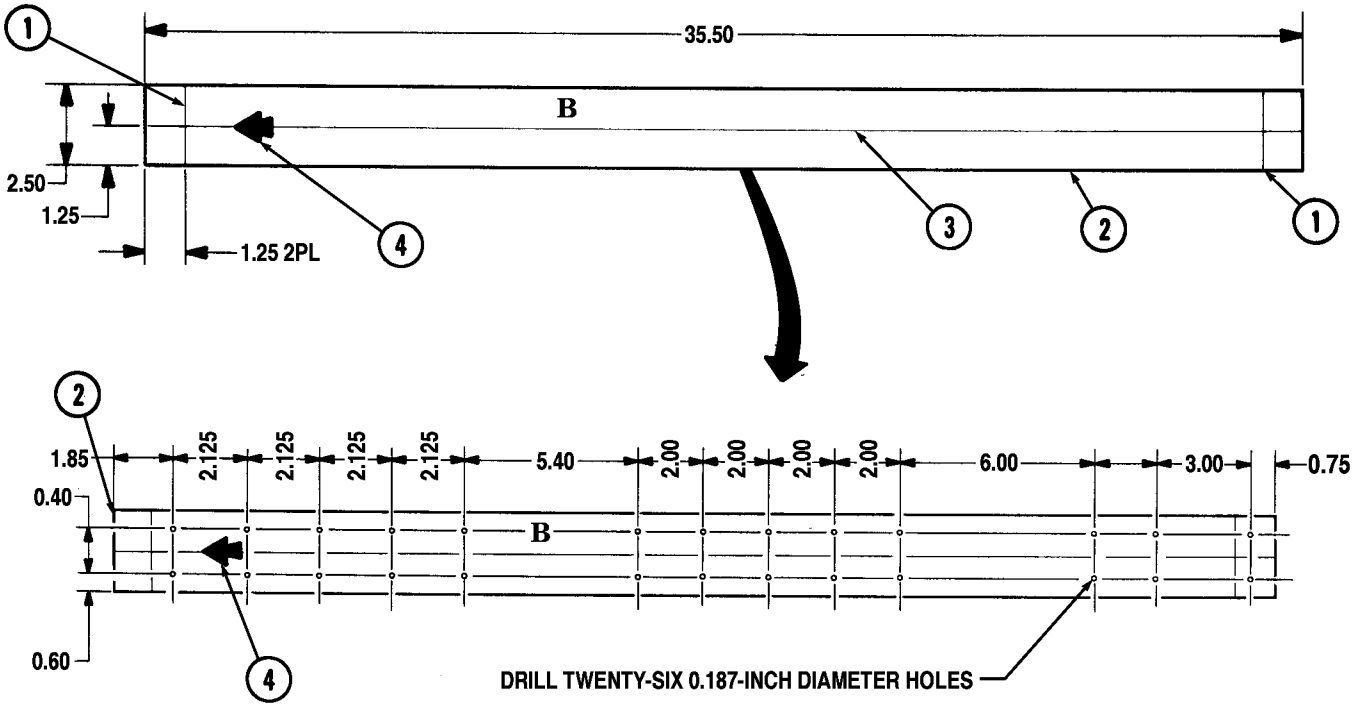


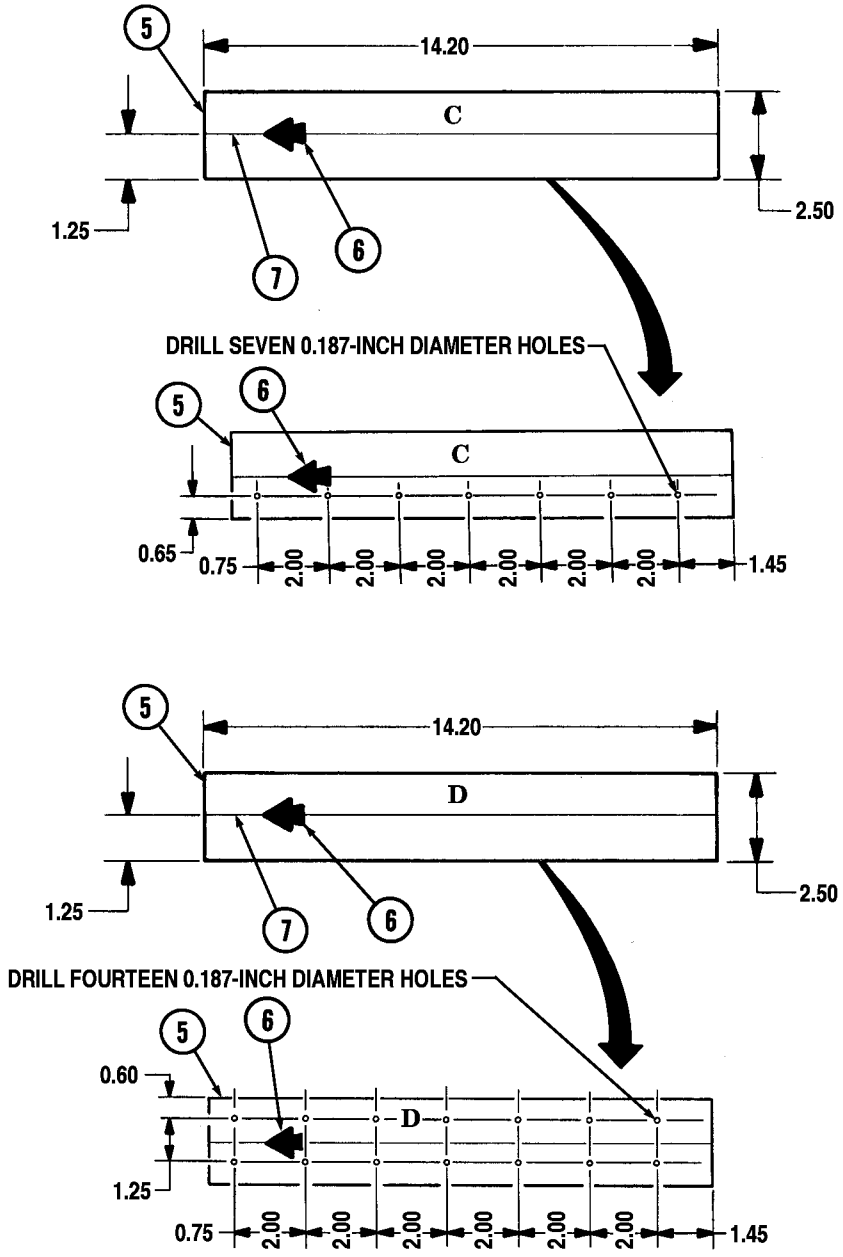



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

3. Cut metal strip (2) from sheet metal, and mark two reference lines (1), centerline (3), directional arrow (4), and letter B on metal strip (2).
4. Locate, mark, and drill twenty-six 0.187-in. diameter holes through metal strip B (2).
5. Cut two metal strips (5) from sheet metal, and mark centerlines (7), directional arrows (6), and letters C and D on metal strips (5).
6. Place metal strip C (5) on a suitable work surface, with arrow (6) facing up and left.
7. Locate, mark, and drill seven 0.187-in. diameter holes through metal strip C (5).
8. Place metal strip D (5) on a suitable work surface, with arrow (6) facing up and left.
9. Locate, mark, and drill fourteen 0.187-in. diameter holes through metal strip D (5).



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

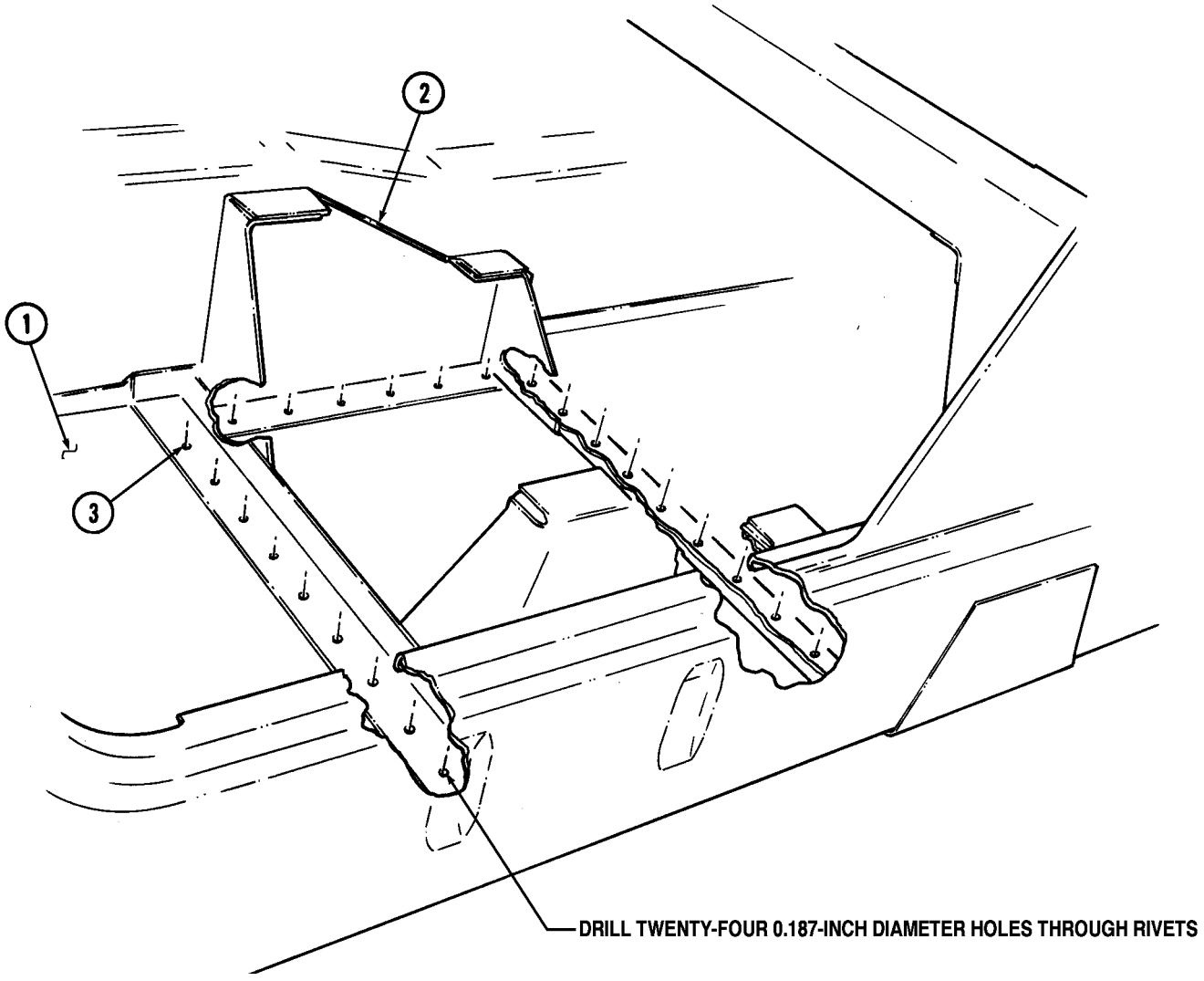
### c. Left Front Floor Panel Removal

1. Using a 0.187-in. drill bit, remove twenty-four rivets (3) from left front seat support (2) and left front floor panel (1).
2. Position insert panel (5), with arrow facing down and toward front of vehicle, to underside of left front floor panel (4) and align mount holes (6).
3. Using insert panel (5) as a template, scribe an outline (7) on left front floor panel (4).

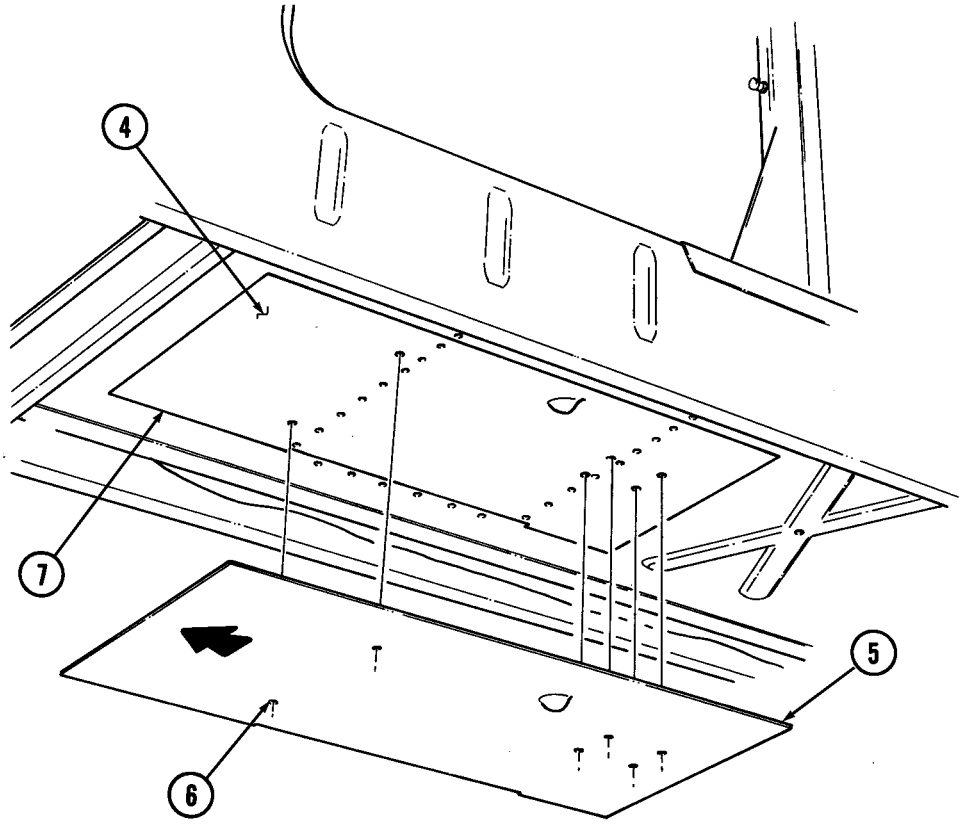
**NOTE**

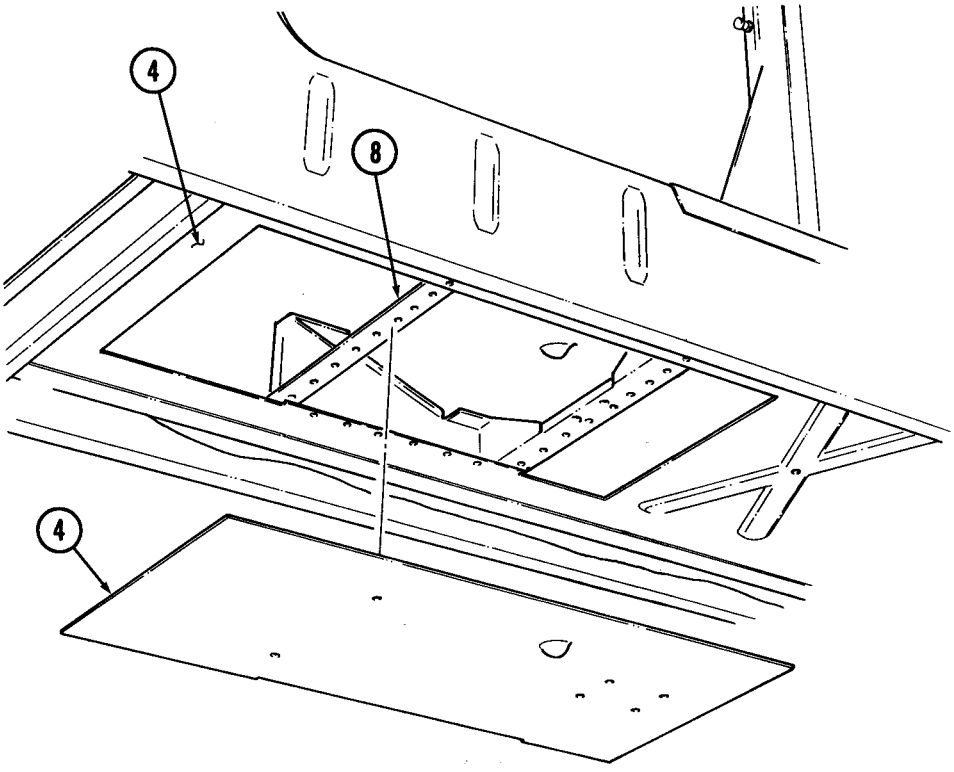
Do not cut through front seat support when removing left front floor panel section.

4. Using scribed outline marked in step 3, cut and remove floor panel (4).
5. Remove sharp edges and burrs on left front floor panel (1).
6. Remove adhesive residue and clean left front seat support (8).



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)



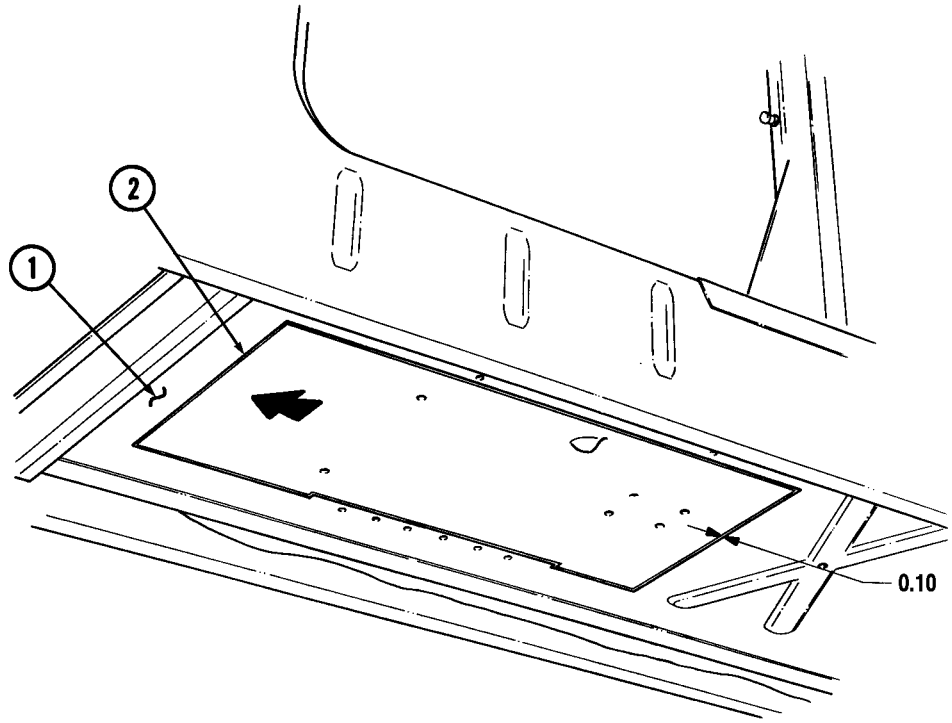



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

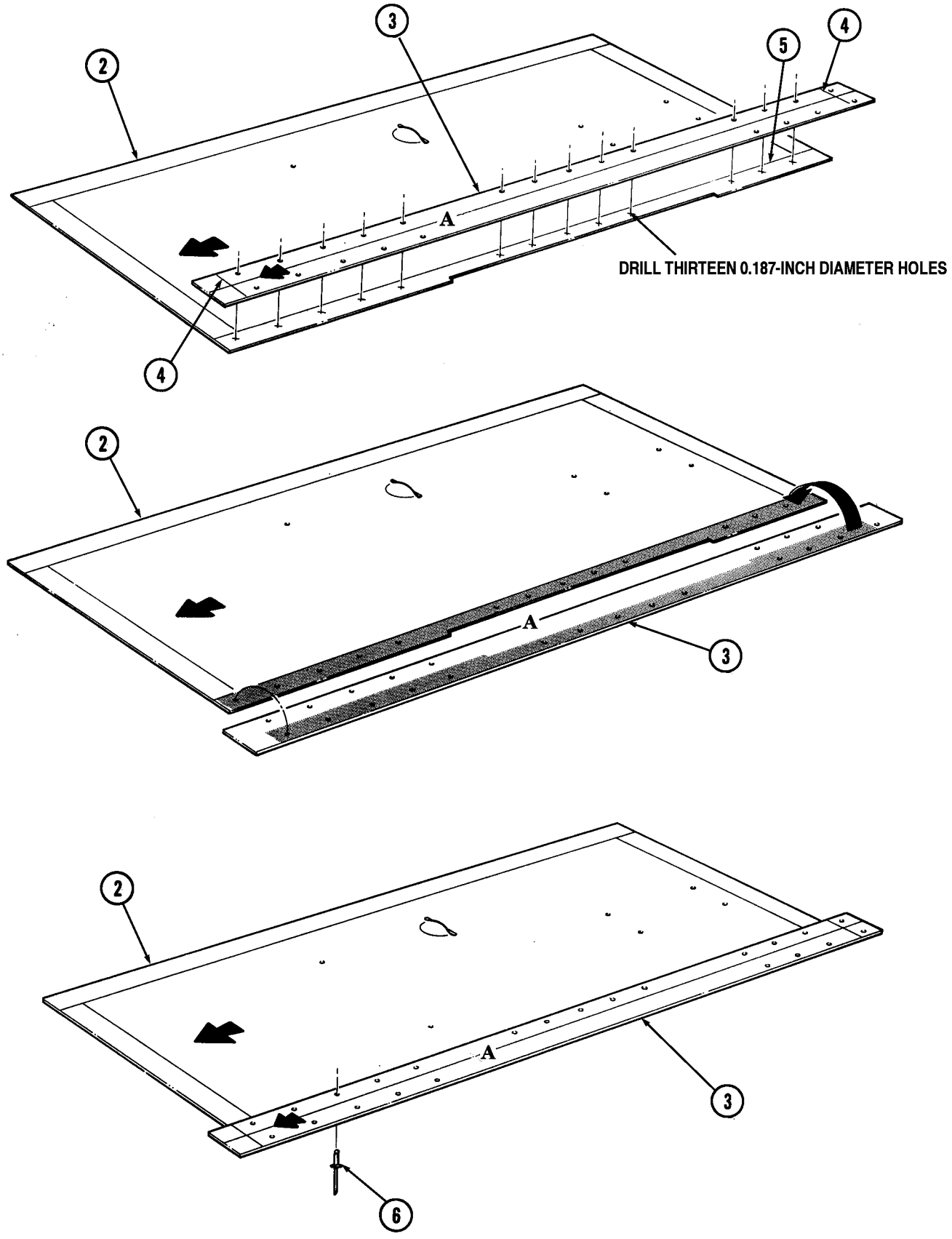
7. Position insert panel (2), with arrow facing down and toward front of vehicle, to underside of left front floor panel (1).
8. Obtain a minimum clearance of 0.10 in. between edges of insert panel (2) and left front floor panel (1).
9. Remove insert panel (2).

**d. Metal Strip A and Insert Panel Assembly**

1. Position metal strip A (3), with arrow facing up and left, on insert panel (2). Align reference lines (5) and (4) with edges of metal strip A (3).
2. Using metal strip A (3) as a template, locate, mark, and drill thirteen 0.187-in. diameter holes through insert panel (2).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (2) and metal strip A (3).
4. Install metal strip A (3) on insert panel (2) with thirteen rivets (6).
5. Remove adhesive residue and clean edges of metal strip A (3) and insert panel (2).



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)



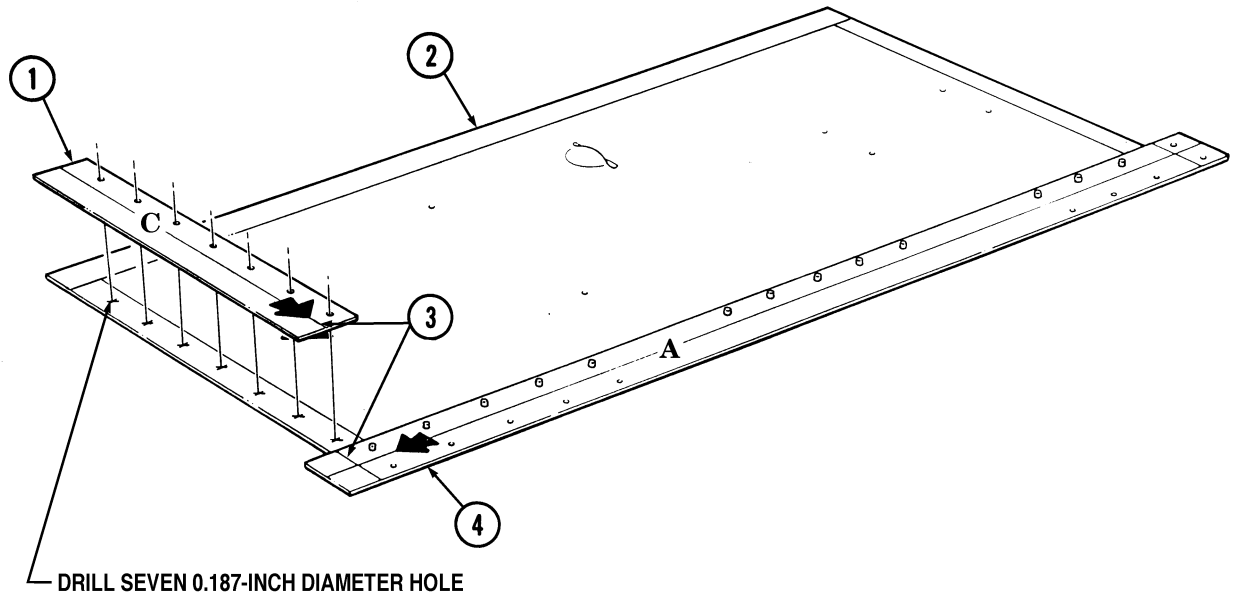
## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

**e. Metal Strip C and Insert Panel Assembly**

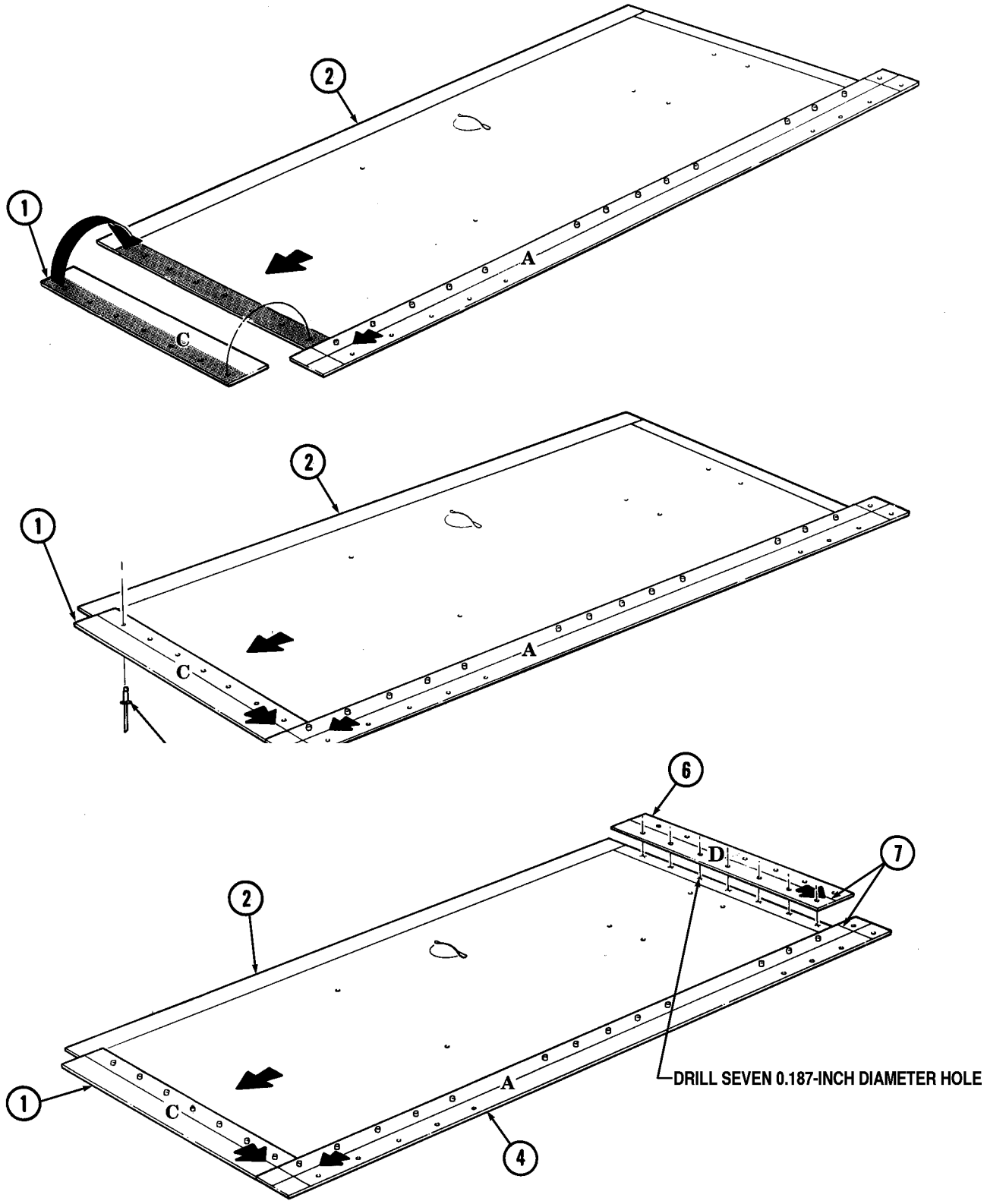
1. Position metal strip C (1), with arrow facing up and toward metal strip A (4) on insert panel (2). Align reference lines (3).
2. Using metal strip C (1) as a template, locate, mark, and drill seven 0.187-in. diameter holes in insert panel (2). Remove metal strip C (1).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (2) and metal strip C (1).
4. Position metal strip C (1) on insert panel (2) and install with seven rivets (6).
5. Remove any adhesive residue and clean edges of metal strip C (1) and insert panel (2).

**f. Metal Strip D and Insert panel Assembly**

1. Position metal strip D (6), with arrow facing up and toward metal strip A (4), on insert panel (2). Align reference lines (7).
2. Using metal strip D (6) as a template, locate, mark, and drill seven 0.187-in. diameter holes through insert panel (2).



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

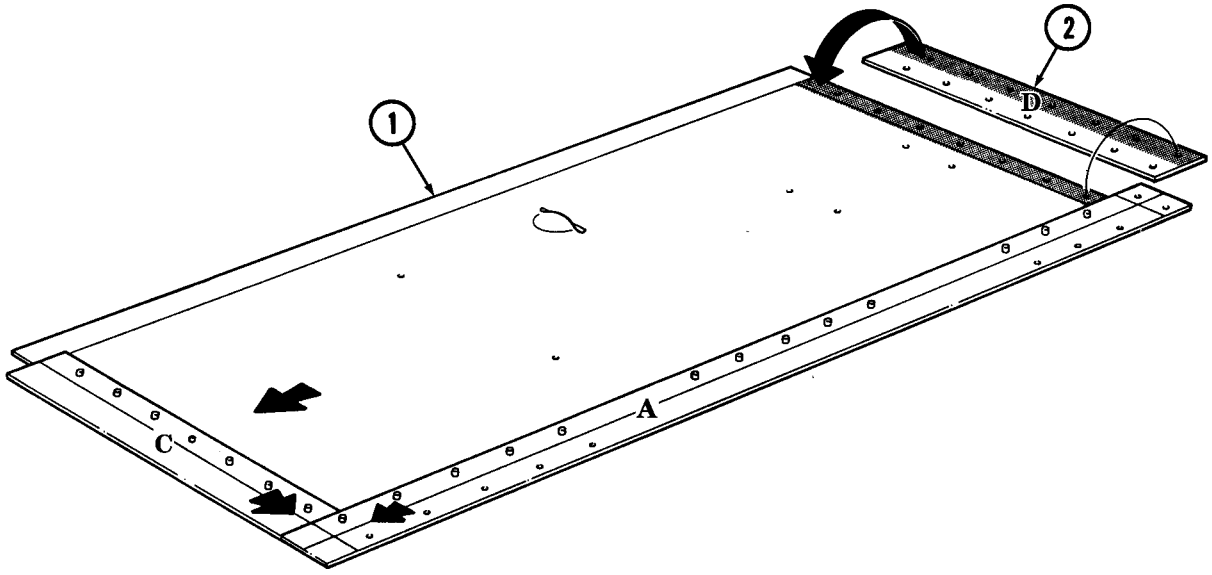


## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

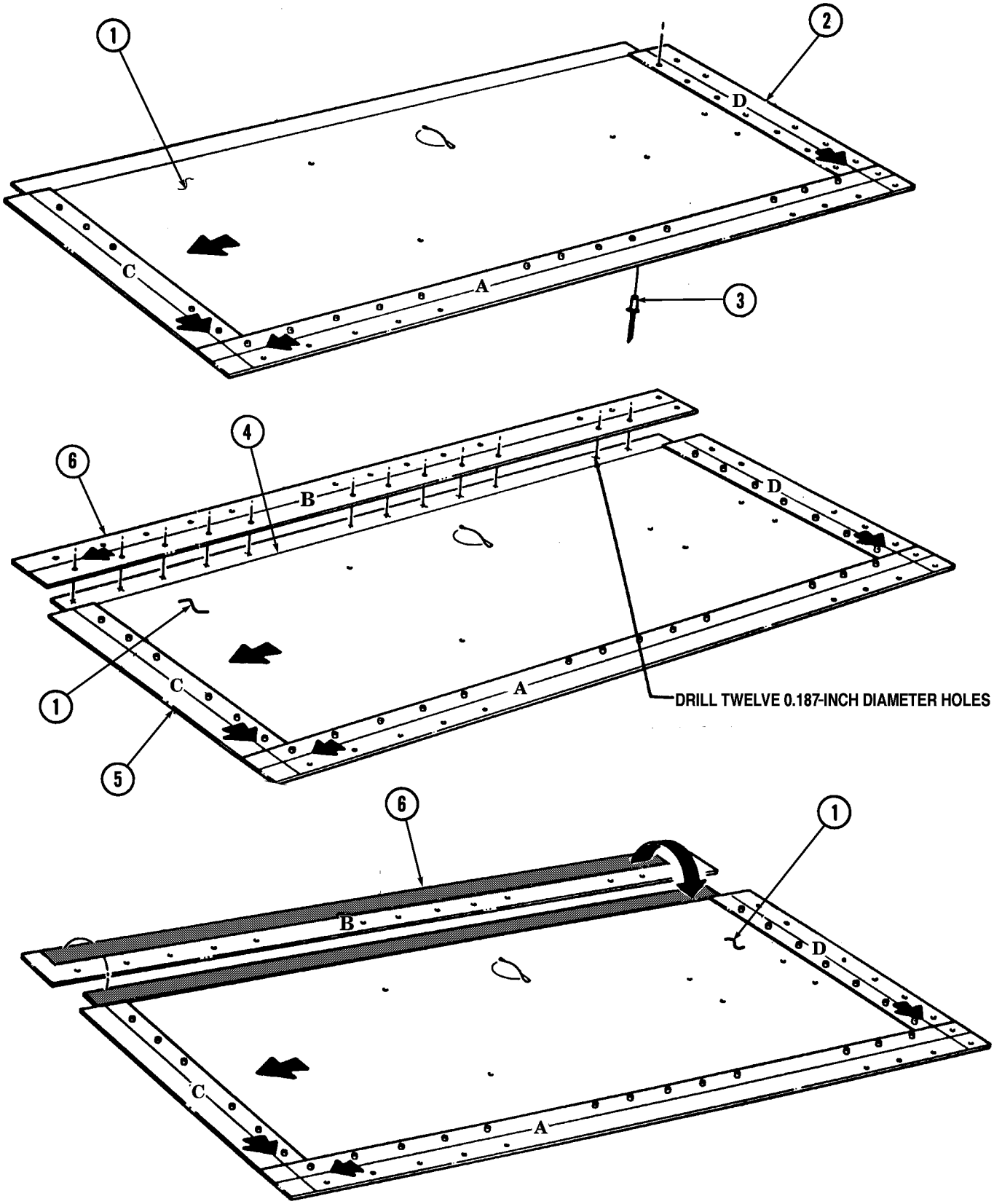
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded mating surface of insert panel (1) and metal strip D (2).
4. Position metal strip D (2) on insert panel (1) and install with seven rivets (3).
5. Remove any adhesive residue and clean edges of metal strip D (2) and insert panel (1).

**g. Metal Strip B and Insert Panel Assembly**

1. Position metal strip B (6), with arrow facing up and toward metal strip C (5), on insert panel (1). Align reference line (4) with edge of metal strip B (6).
2. Using metal strip B (6) as a template, locate, mark, and drill twelve 0.187-in. diameter holes through insert panel (1).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (1) and metal strip B (6).



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

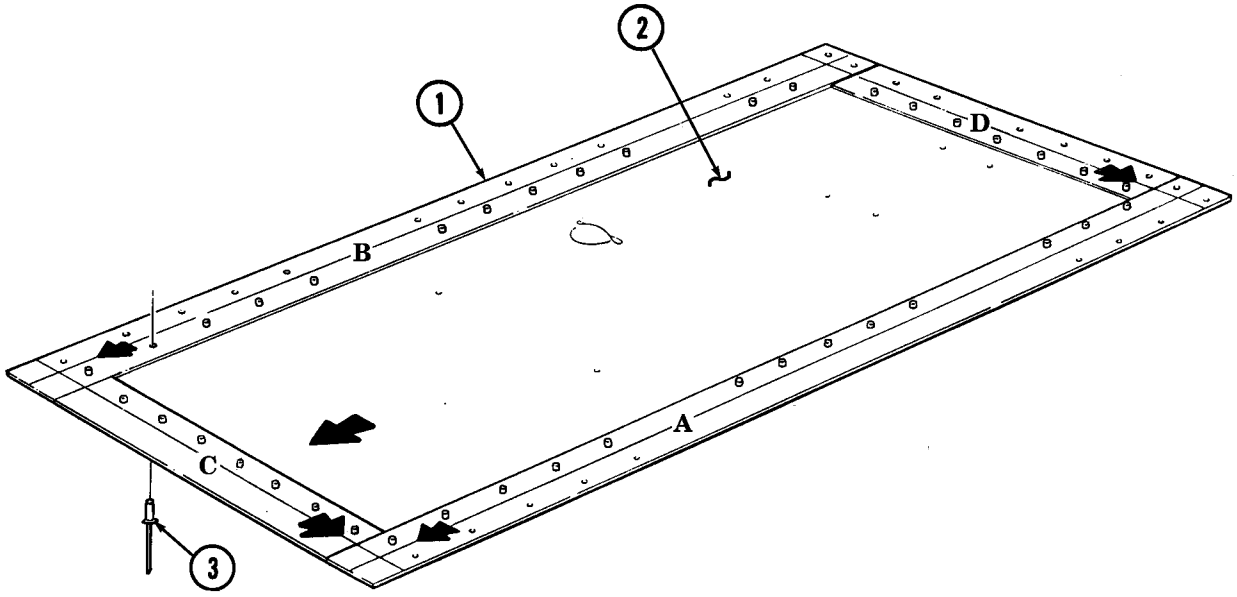


## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

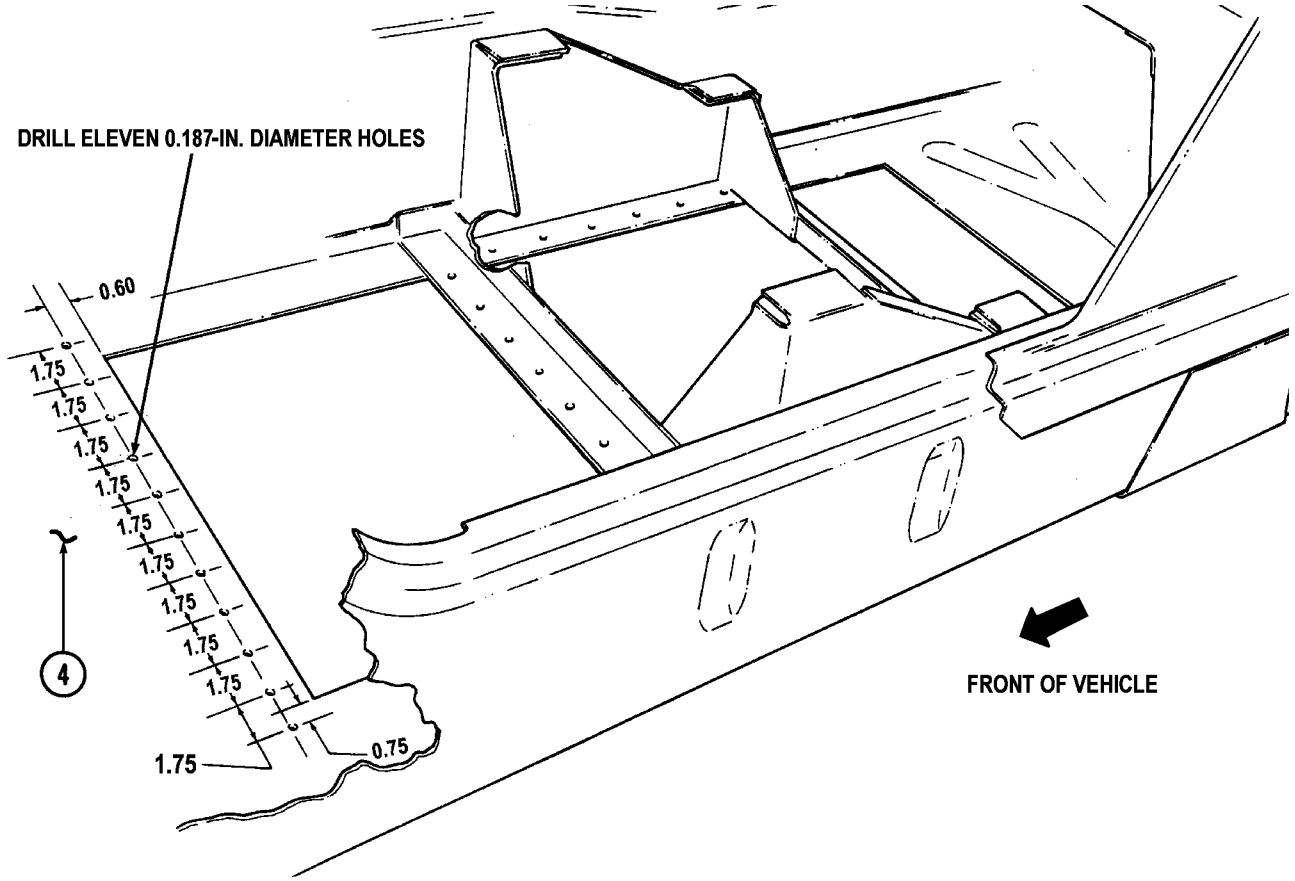
4. Position metal strip B (1) on insert panel (2) and install with twelve rivets (3).
5. Remove any adhesive residue, and clean edges of metal strip B (1) and insert panel (2).

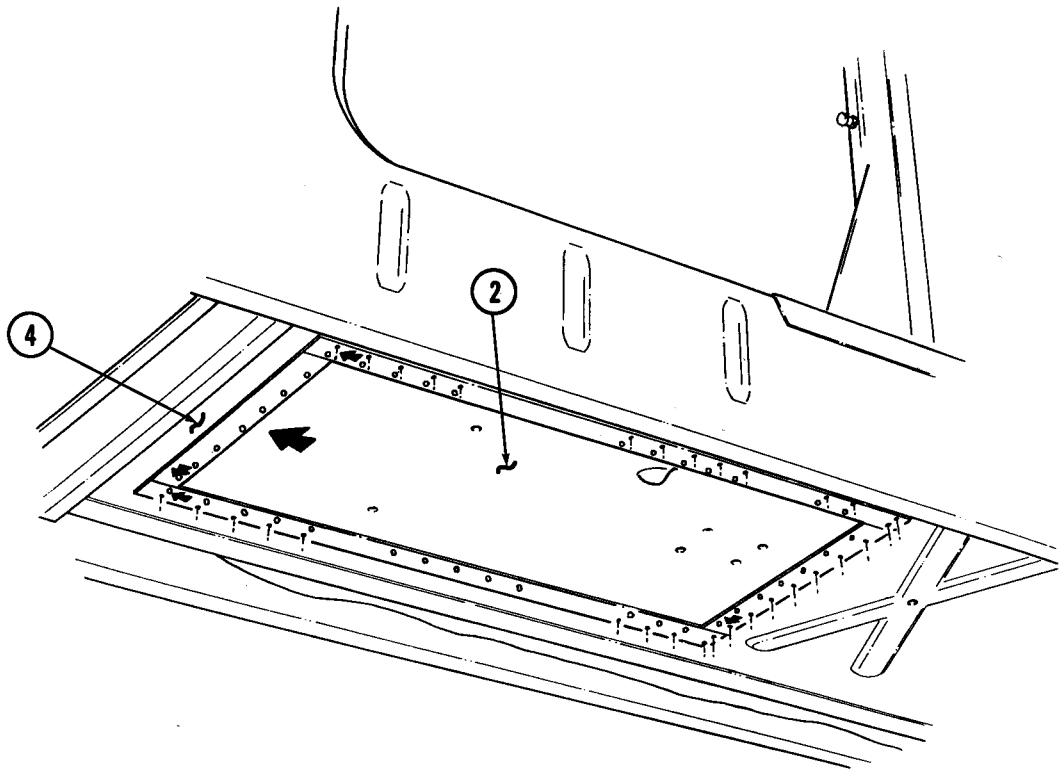
**h. Left Front Floor Panel and Insert Panel Drilling**

1. Locate, mark, and drill eleven 0.187-in. diameter holes through left front floor panel (4).
2. Position insert panel (2) on underside of left front floor panel (4), with arrow facing down and toward front of vehicle.



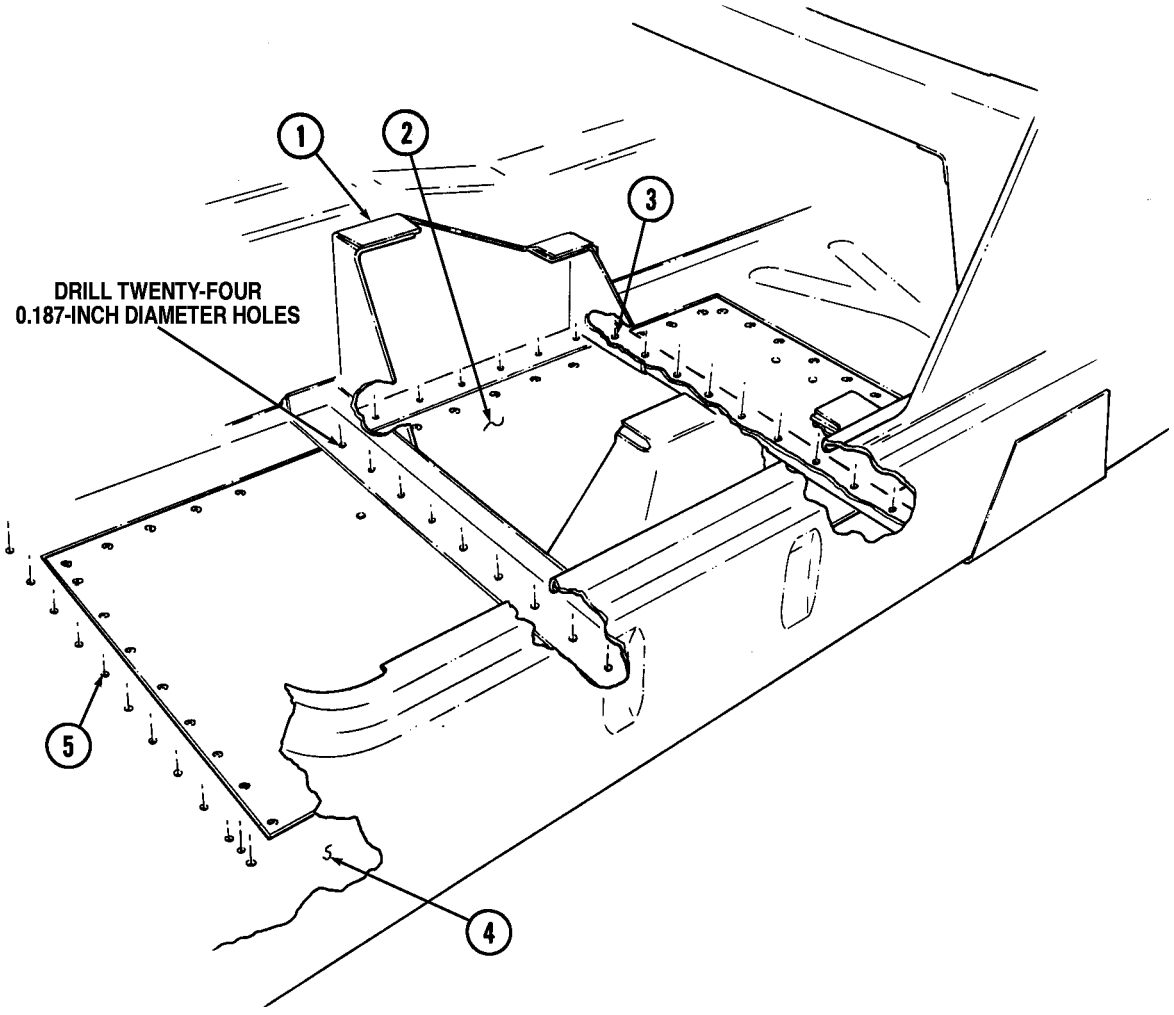
## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)



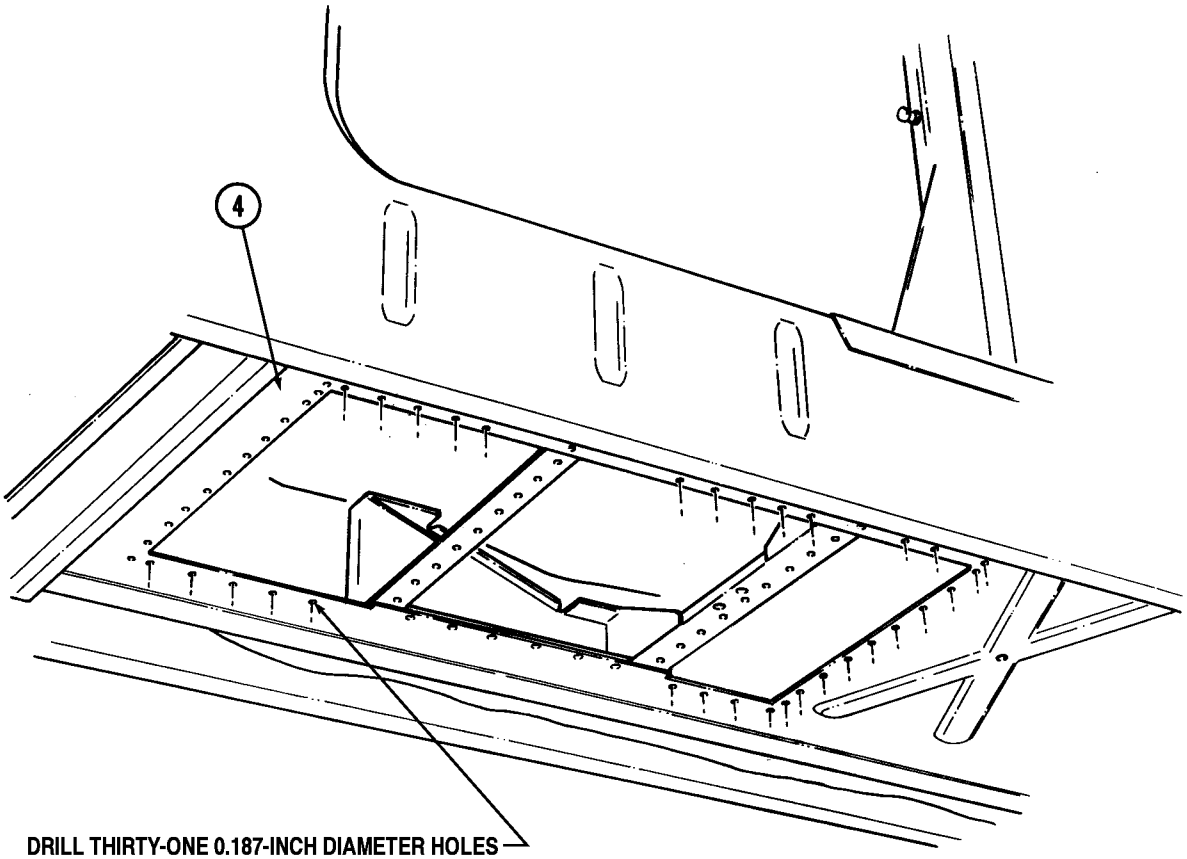



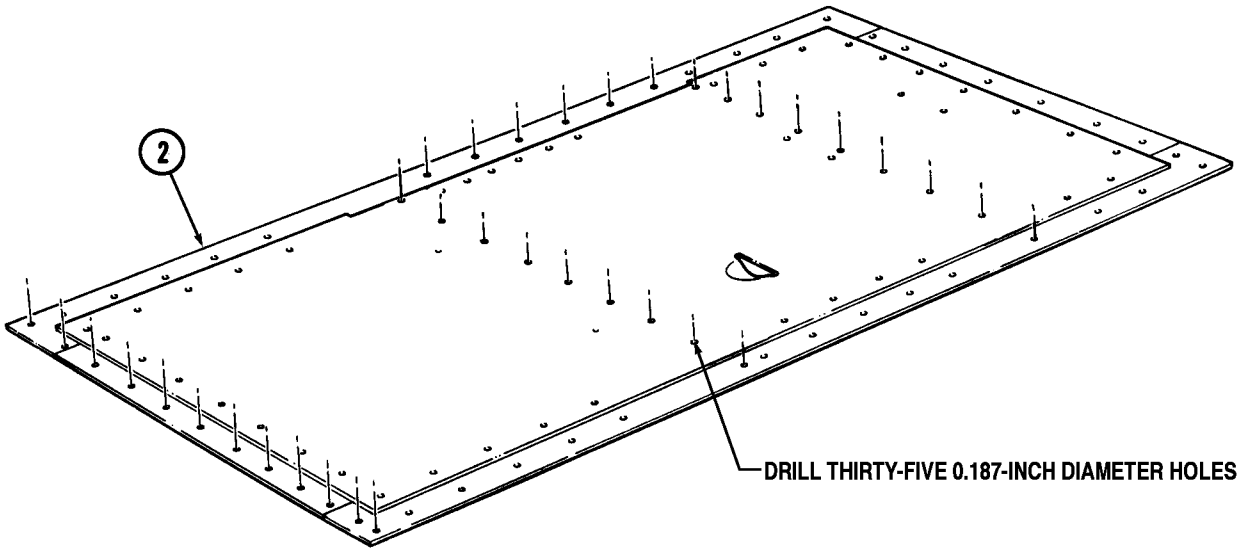
## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

3. Using left front seat support (1) as a template, locate and mark twenty-four holes (3) on insert panel (2).
4. Using left front floor panel (4) as a template, mark eleven hole locations (5) on insert panel (2).
5. Using insert panel (2) as a template, mark thirty-one hole locations (5) on underside of left front floor panel (4). Remove insert panel (2).
6. Drill thirty-one 0.187-in. diameter holes marked in step 5 through underside of left front floor panel (4).
7. Drill thirty-five 0.187-in. diameter holes marked in steps 3 and 4 through insert panel (2).



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

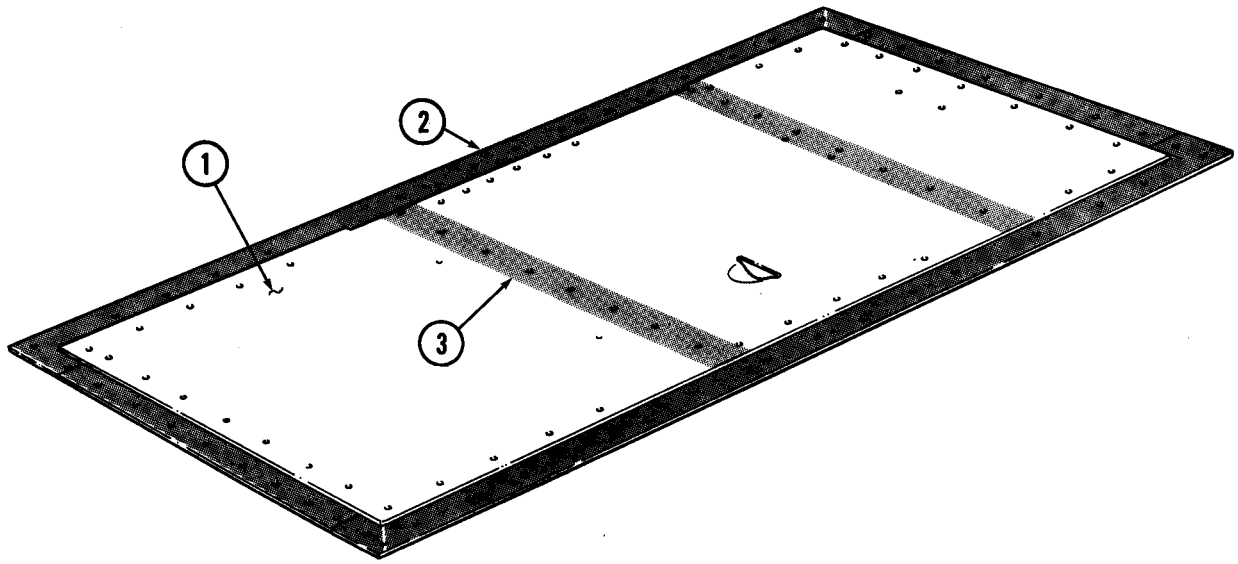


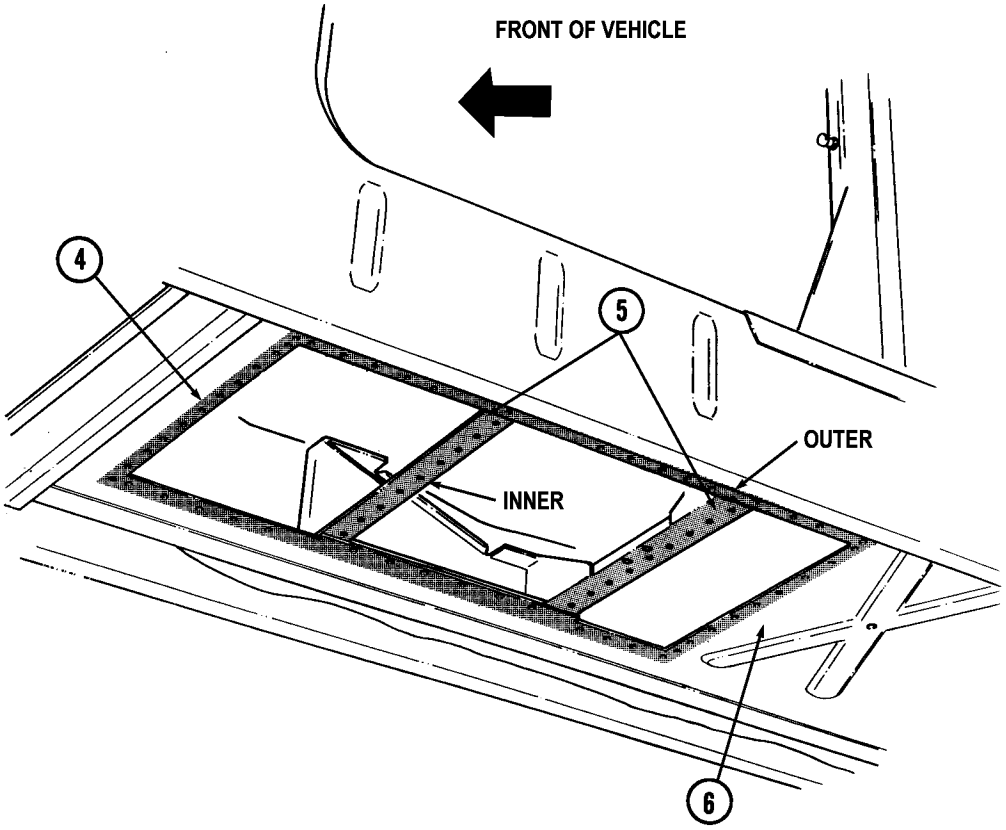
## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

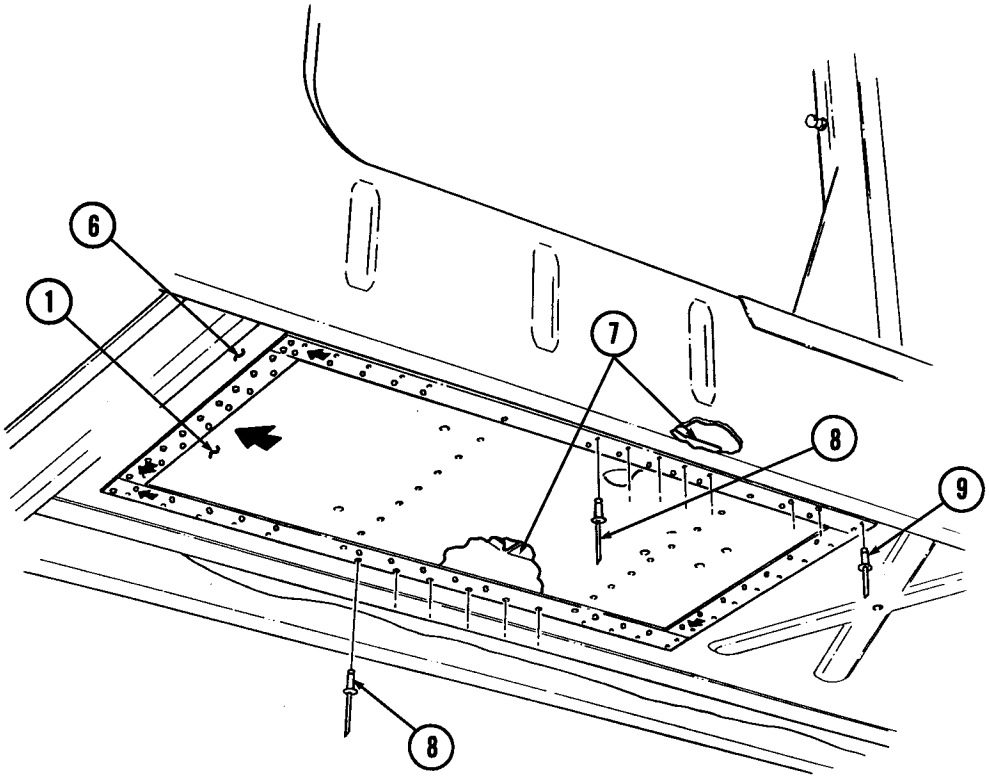
### i. Insert Panel and Left Front Floor Panel Installation

1. Apply approximately 0.125-in. thickness of adhesive sealent to outer shaded area (2) of insert panel (1).
2. Apply adhesive sealant to inner shaded area (5) on underside of left front seat supports (3).
3. Apply approximately 0.125-in. thickness of adhesive sealent to inner shaded area (4) of left front panel underside (6).
4. Position insert panel (1) to underside of left front floor panel (6), with arrow facing down and toward front of vehicle.
5. Install insert panel (1) on underside of left front floor panel (6) and left front seat support (7) with eleven rivets (8) and three rivets (9).



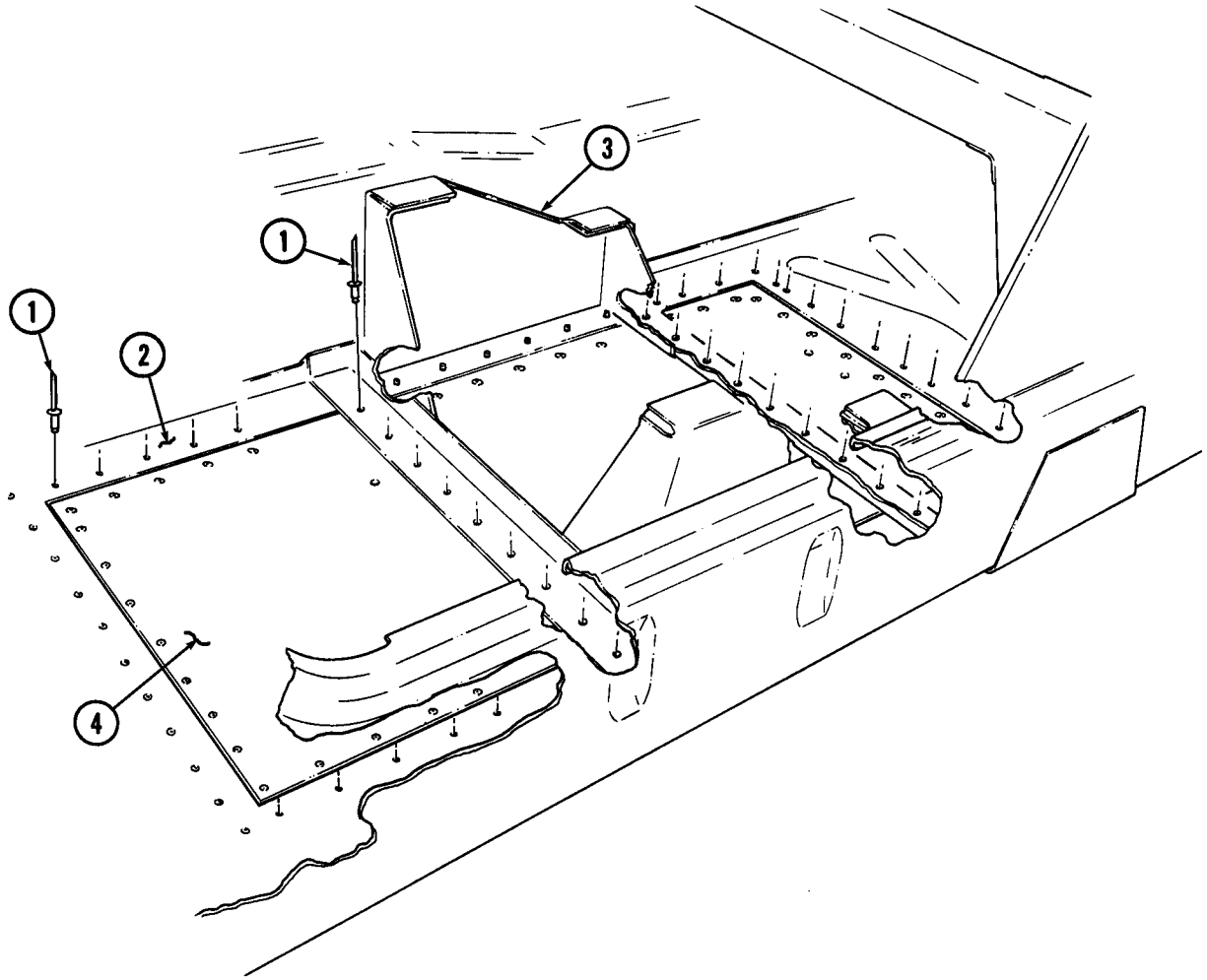
## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)



## 22-9.2. LEFT FRONT FLOOR PANEL REPAIR (Cont'd)

6. Secure insert panel (4) to left front seat support (3) with eighteen rivets (1).
7. Secure insert panel (4) to left front floor panel (2) with thirty-four rivets (1).
8. Spot-paint insert panel (4), left front seat support (3), and left front floor panel (2) (TM 43-0139).




FOLLOW-ON TASKS:
- Install left floor insulation (TM 9-2320-280-20).
- Install front and rear seat support panels (TM 9-2320-280-20).
- Install driver's seat assembly (TM 9-2320-280-20).
- Install fire extinguisher mount bracket (TM 9-2320-280-20).

## 22-9.3. LEFT REAR FLOOR PANEL REPAIR

**This Task Covers:**

**a. Left Rear Insert Panel Fabrication**
**b. Reinforcement Strips Fabrication**
**c. Metal Strips Fabrication**
**d. Left Rear Floor Panel Removal**
**e. Reinforcement Strip A and Insert Panel Assembly**
**f. Reinforcement Strip B and Insert Panel Assembly**
**g. Metal Strip C and Insert Panel Assembly**
**h. Metal Strip D and Insert Panel Assembly**
**i. Metal Strip E and Insert Panel Assembly**
**j. Metal Strip F and Insert Panel Assembly**
**k. Left Rear Floor Panel and Insert Panel Drilling**
**l. Insert Panel and Left Rear Floor Panel Insulation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool kit:
automotive (Appendix B, Item 1)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P
TM 43-0139

**Materials/Parts**

One hundred ten blind rivets
(Appendix E, Item 194)
Seventy blind rivets (Appendix E, Item 195)
Adhesive (Appendix B, Item 1.1)
Adhesive sealant (Appendix B, Item 4.1)
Sheet metal (Appendix E, Item 245)

**Equipment Condition**

- Left rear seat back removed (TM 9-2320-280-20).
- Left rear seat bottom removed (TM 9-2320-280-20).
- Left floor insulation removed (TM 9-2320-280-20).

**Maintenance Level**

General support

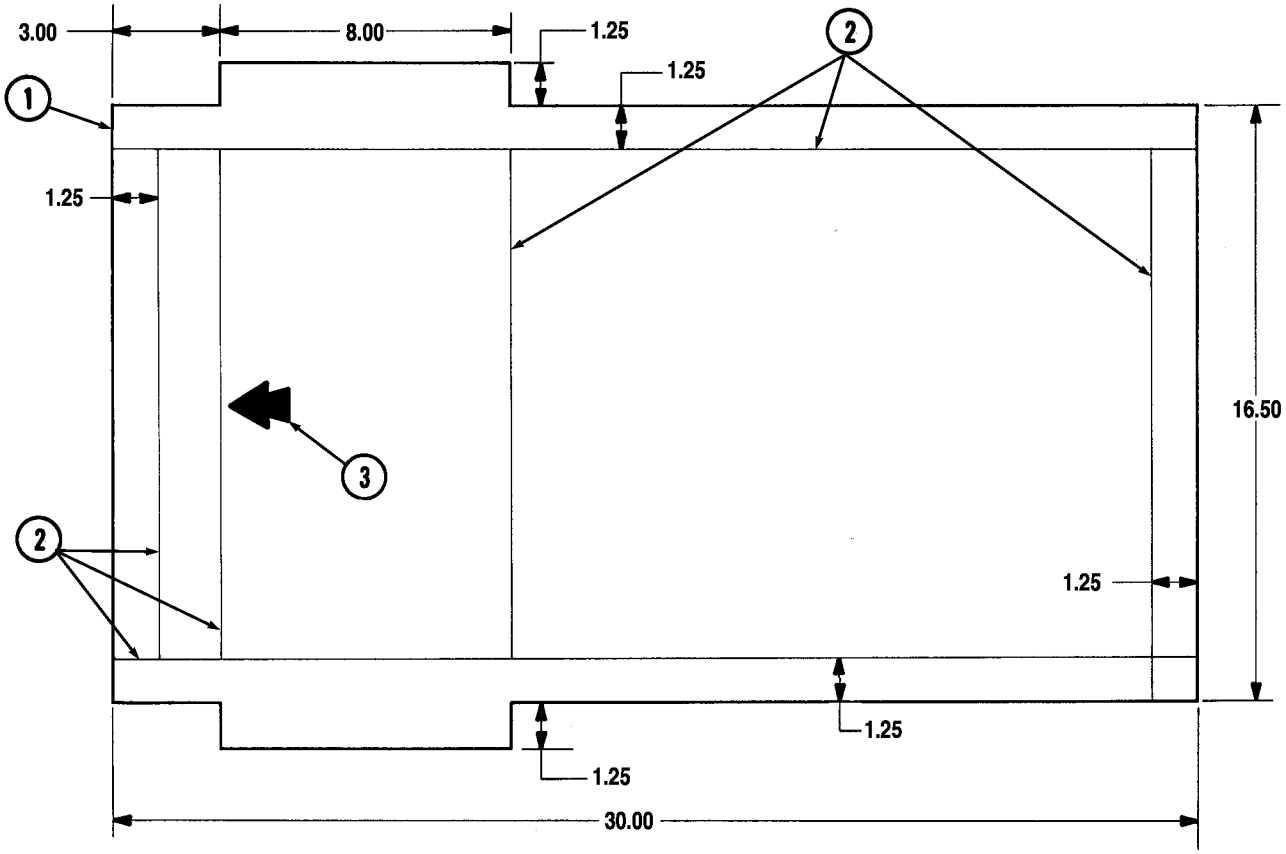
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

**NOTE**

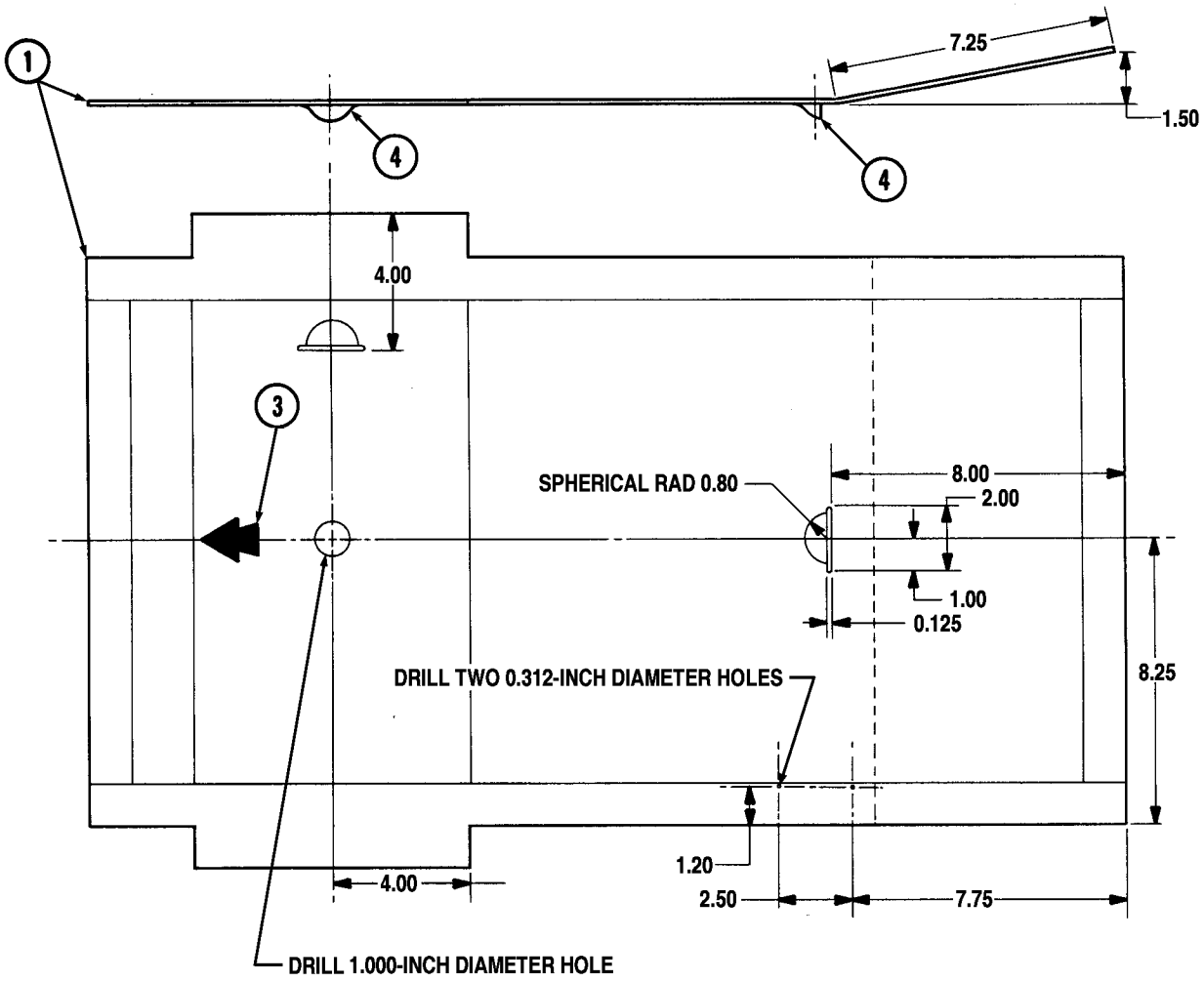
All dimensions in this procedure are in inches.

**a. Left Rear Insert Panel Fabrication**

1. Cut insert panel (1) from sheet metal as shown, and mark six reference lines (2) and directional arrow (3) on insert panel (1).
2. Locate, mark, and drill two 0.312-in. diameter holes through insert panel (1).
3. Locate, mark, and drill a 1.000-in. diameter hole through insert panel (1).
4. Fabricate two drain holes (4) in insert panel (1).
5. Bend insert panel (1) 1.50 in.
6. Remove all burrs and round all sharp edges on insert panel (1).



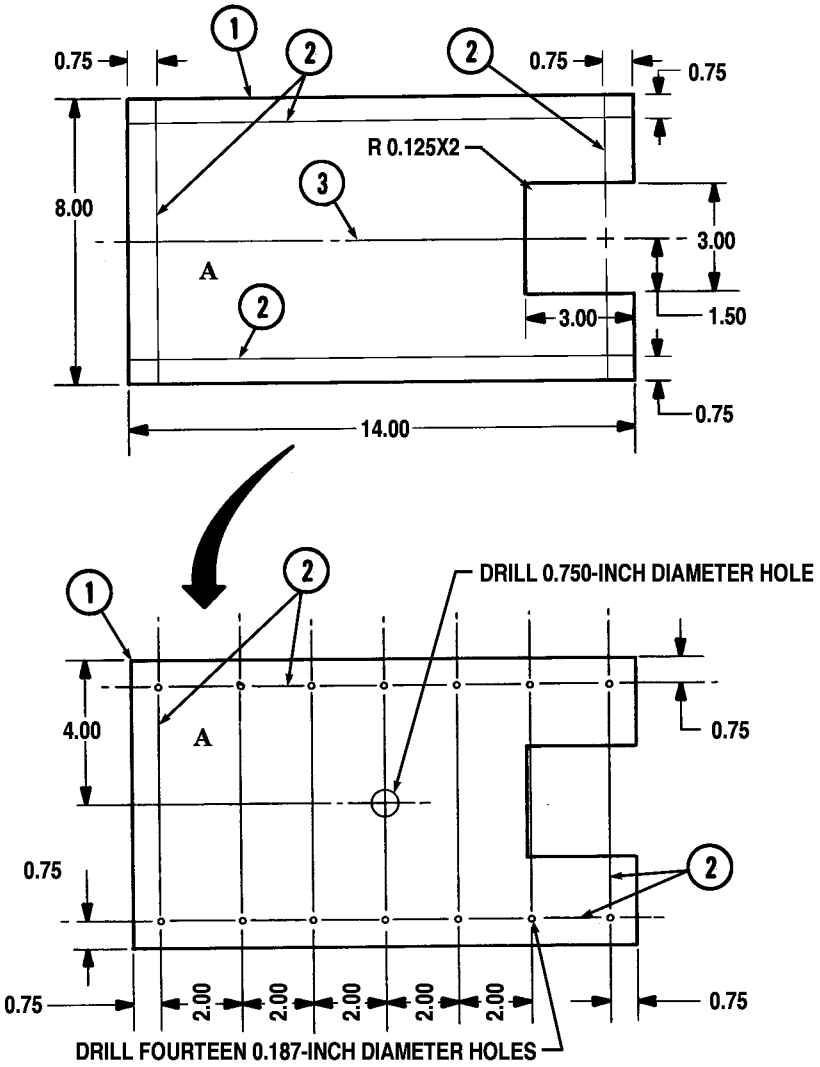
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

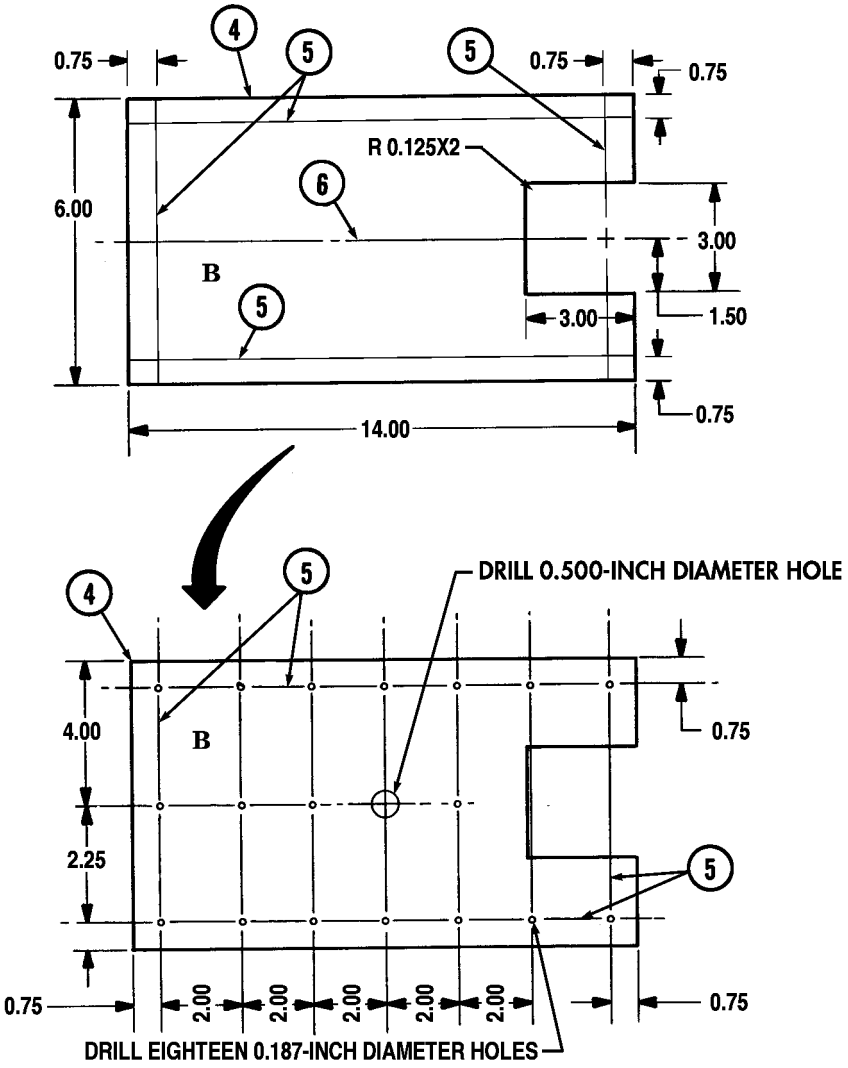
**b. Reinforcement Strips Fabrication**

1. Cut reinforcement strip (1) from sheet metal, and mark four reference lines (2), centerline (3), and letter A on reinforcement strip (1).
2. Locate, mark, and drill fourteen 0.187-in. diameter holes and one 0.750-in. diameter hole through reinforcement strip A (1).
3. Remove all burrs and round all sharp edges on reinforcement strip A (1).



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

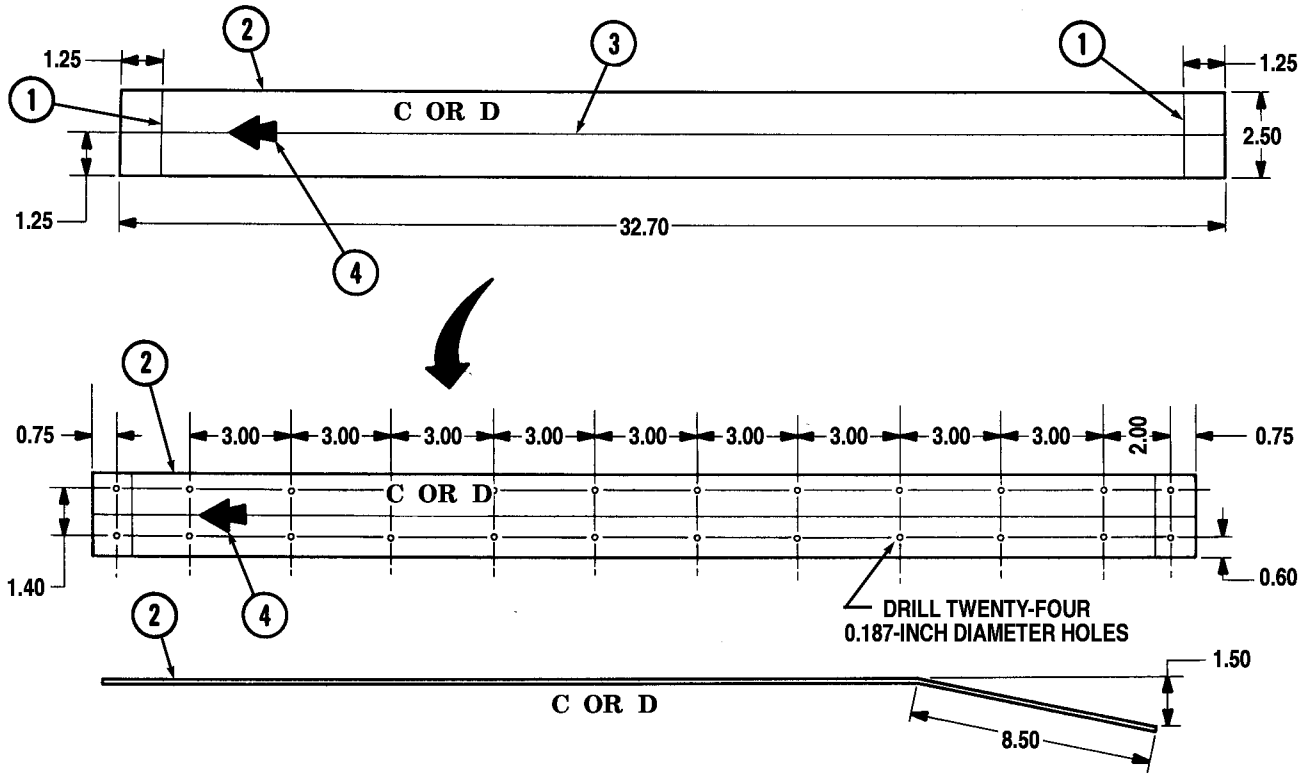
4. Cut reinforcement strip (4) from sheet metal, and mark four reference lines (5), centerline (6), and letter B on reinforcement strip (4).
5. Locate, mark, and drill eighteen 0.187-in. diameter holes and one 0.500-in. diameter hole through reinforcement strip B (4).
6. Remove all burrs and round all sharp edges of reinforcement strip B (4).



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

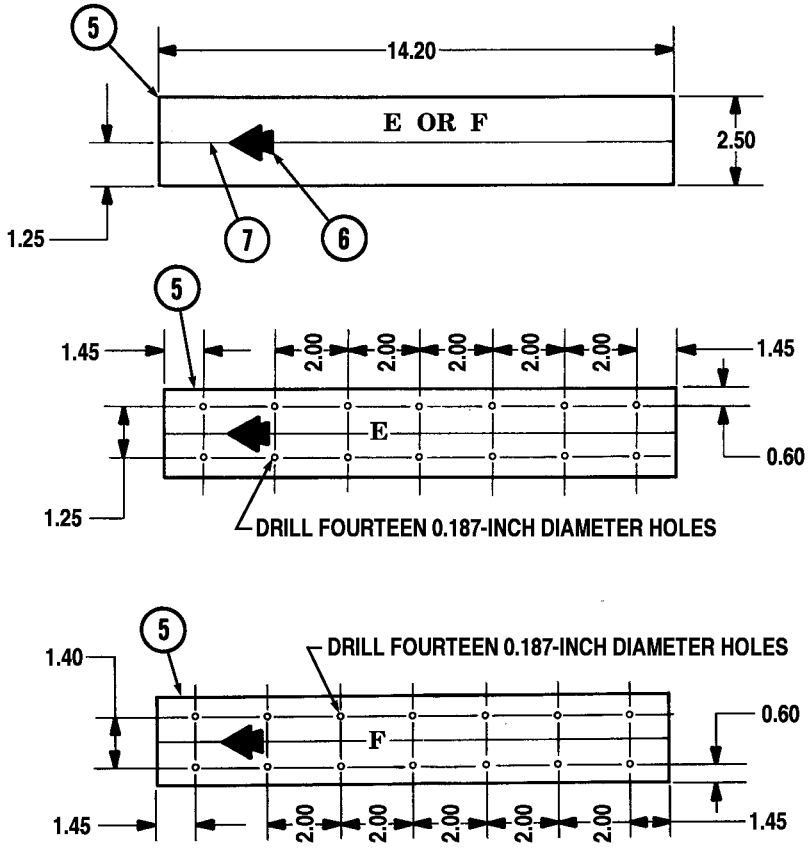
**c. Metal Strips Fabrication**

1. Cut two metal strips (2) from sheet metal, and mark two reference lines (1), centerline (3), and directional arrow (4). Identify two metal strips (2) as C and D.
2. Place metal strips C and D (2) on a suitable work surface with arrow (4) facing up and left.
3. Locate, mark, and drill twenty-four 0.187-in. diameter holes through metal strips C and D (2).
4. Bend metal strips C and D (2) 1.50 in.



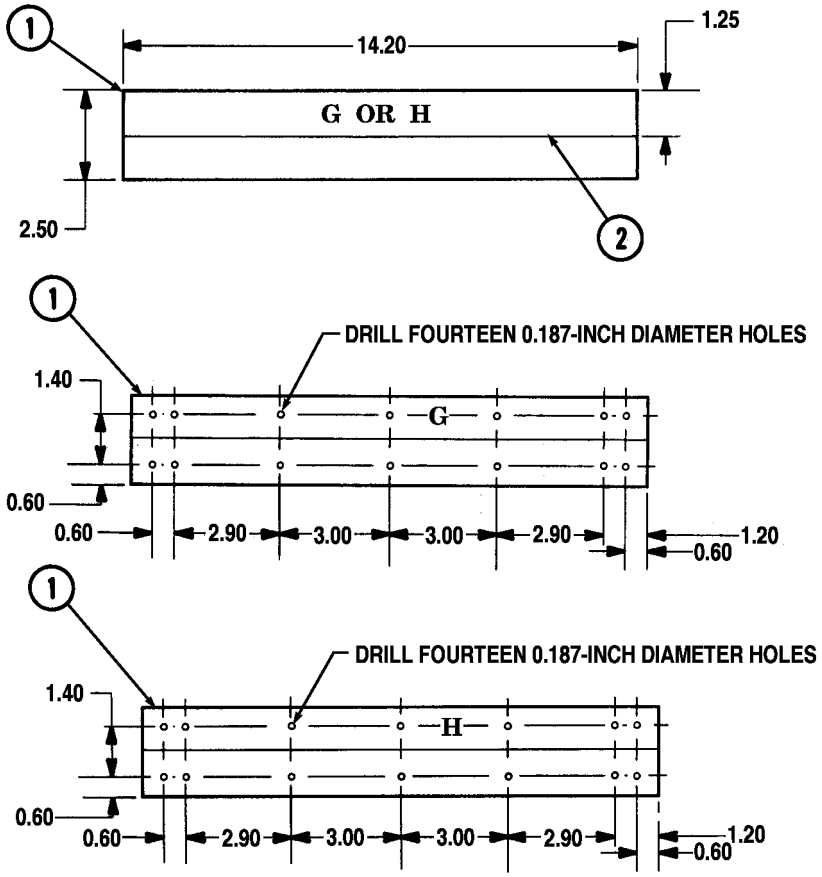
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

5. Cut two metal strips (5) from sheet metal, and mark centerline (7), and directional arrow (6). Identify metal strips (5) as E and F.
6. Locate, mark, and drill fourteen 0.187-in. diameter holes through metal strips E and F (5).



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

7. Cut two metal strips (1) from sheet metal, and mark centerline (2). Identify metal strips (1) as G and H.
8. Locate, mark, and drill fourteen 0.187-in. diameter holes through metal strips G and H (1).



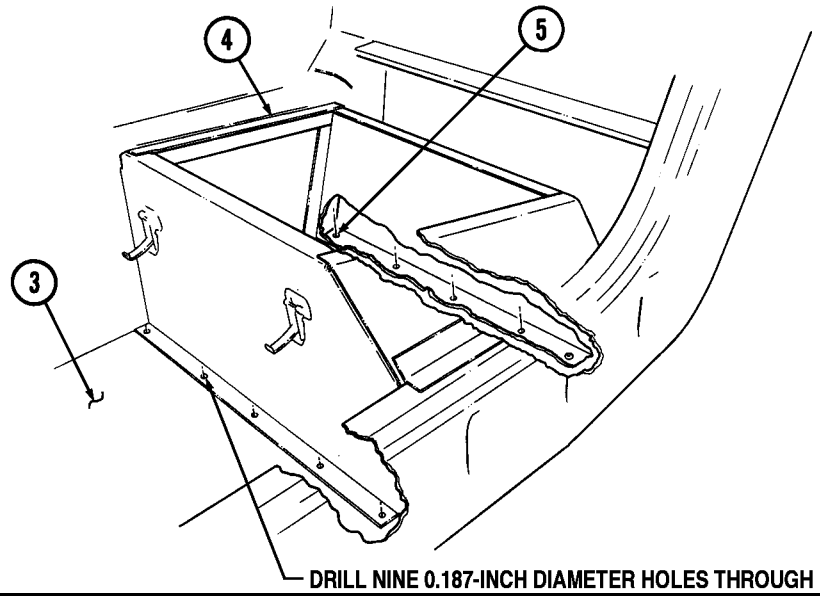
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

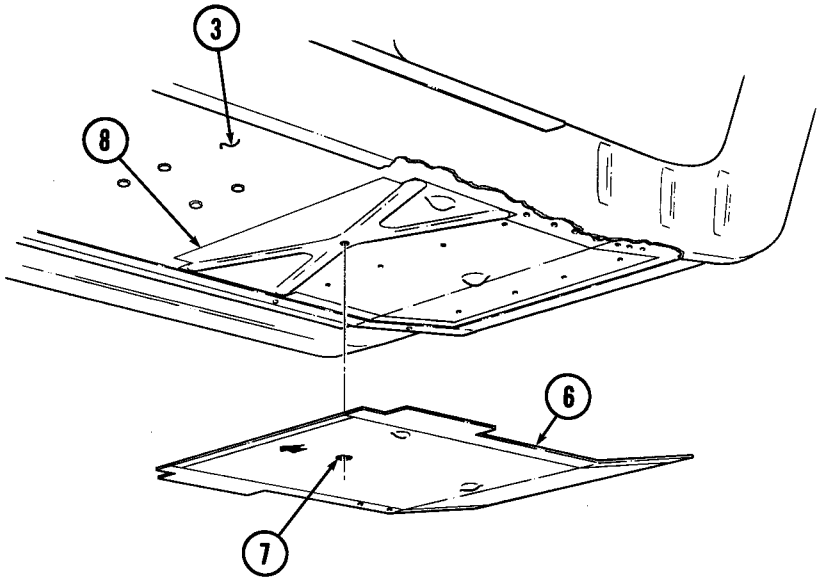
**d. Left Rear Floor Panel Removal**

**NOTE**

If vehicle is not equipped with left rear seat support installed, proceed to step 2.

1. Using a 0.187-in. drill bit, remove nine rivets (5) from left rear seat support (4) and left rear floor panel (3).
2. Position insert panel (6), with arrow facing down and toward front of vehicle, to underside of left rear floor panel (3) and align mount hole (7).
3. Using insert panel (6) as a template, scribe outline (8) on left rear floor panel (3).



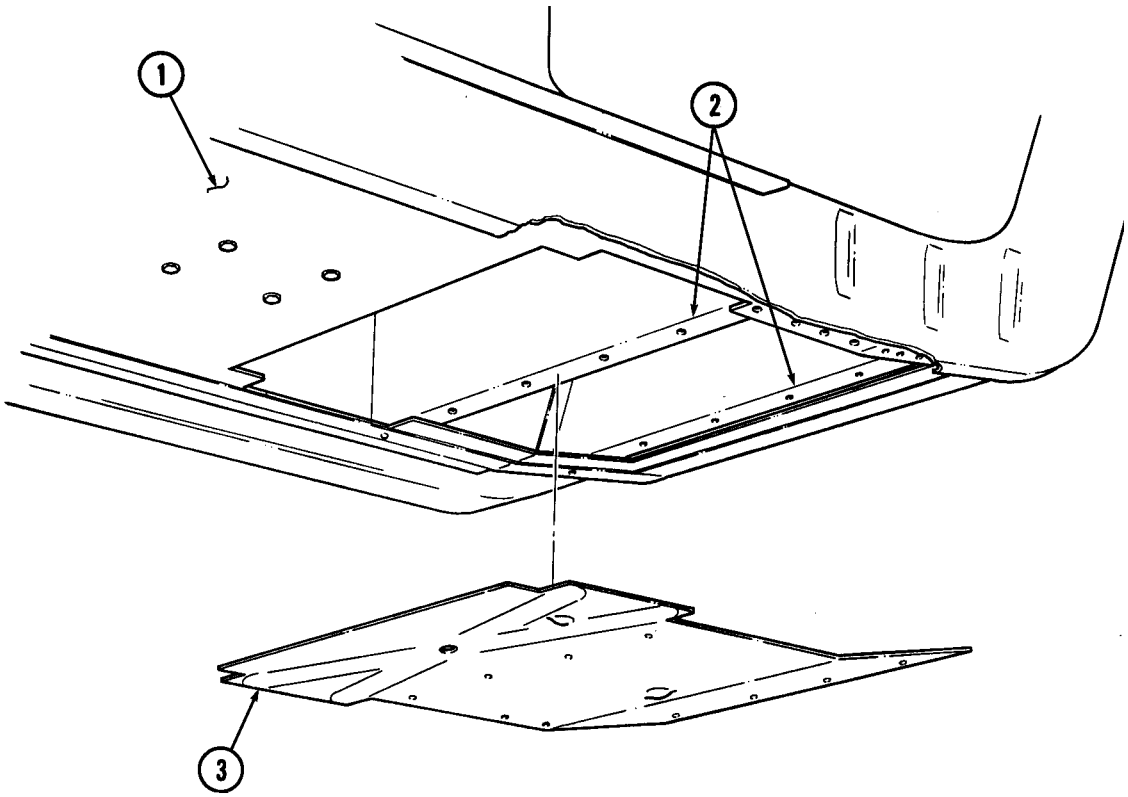



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

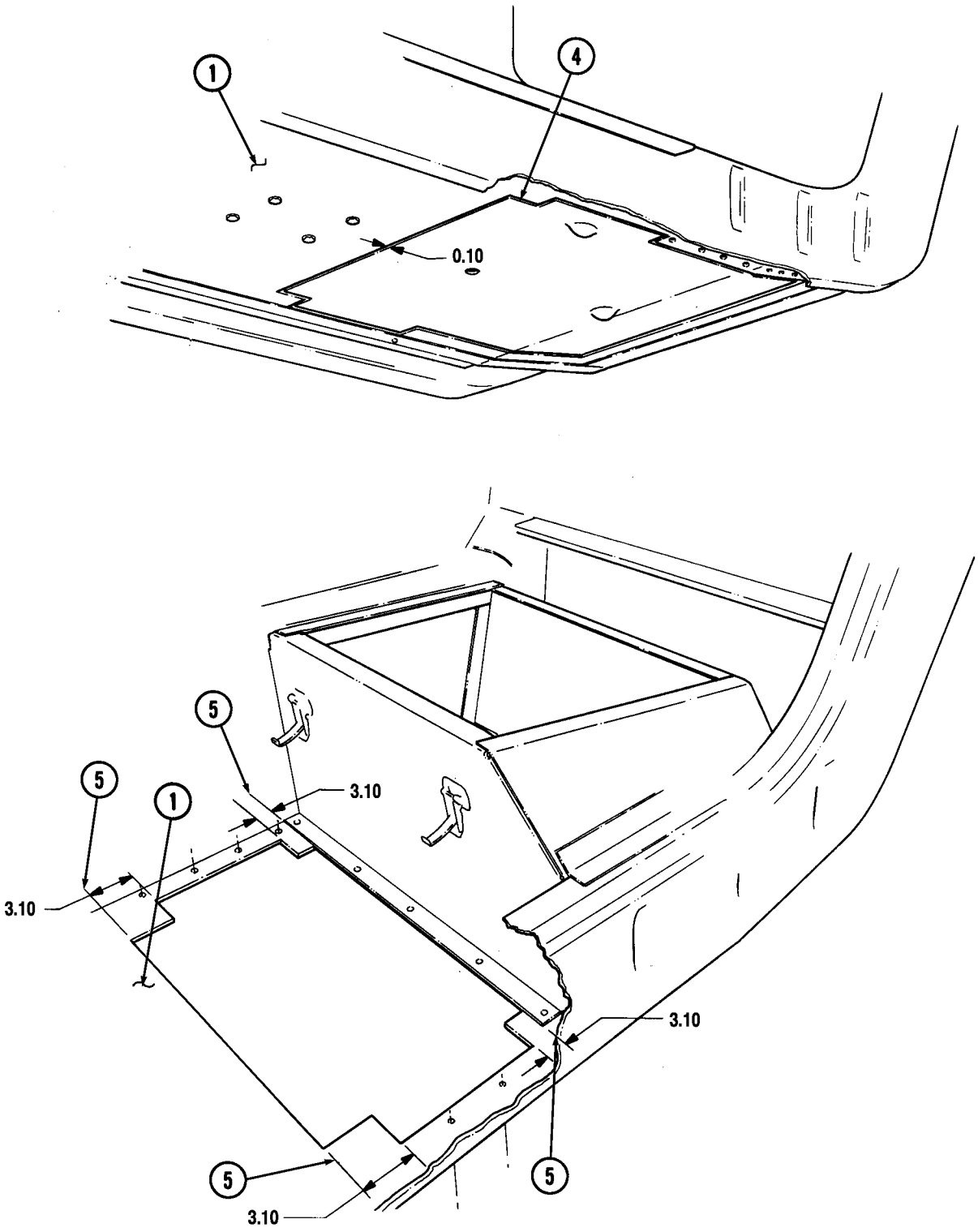
**NOTE**

Do not cut through rear seat support when removing left rear floor panel section.

4. Using scribed outline marked in step 3, cut and remove floor panel (3) from left rear floor panel (1).
5. Remove sharp edges and burrs from left rear floor panel (1).
6. Remove adhesive residue and clean left rear seat support (2).
7. Position insert panel (4), with arrow facing down and toward front of vehicle, on underside of left rear floor panel (1).
8. Obtain a minimum clearance of 0.10 in. between edges of insert panel (4) and left rear floor panel (1).
9. Remove insert panel (4).
10. Locate and mark four reference lines (5) on left rear floor panel (1).



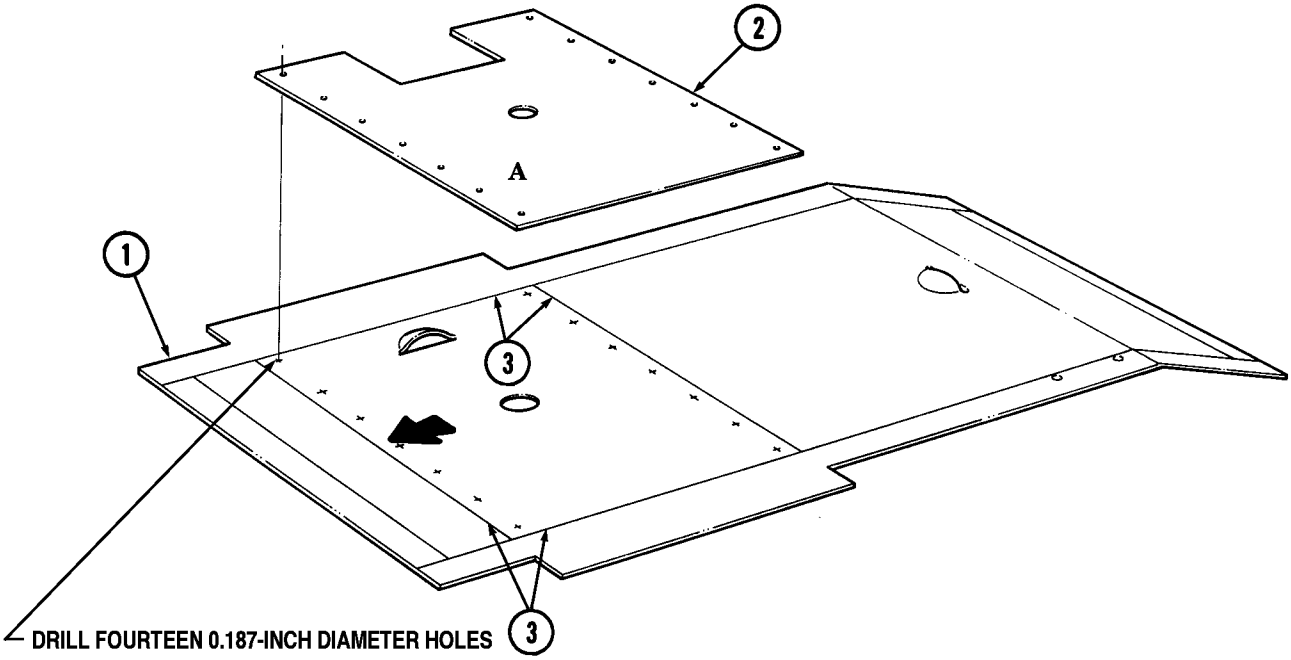
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)



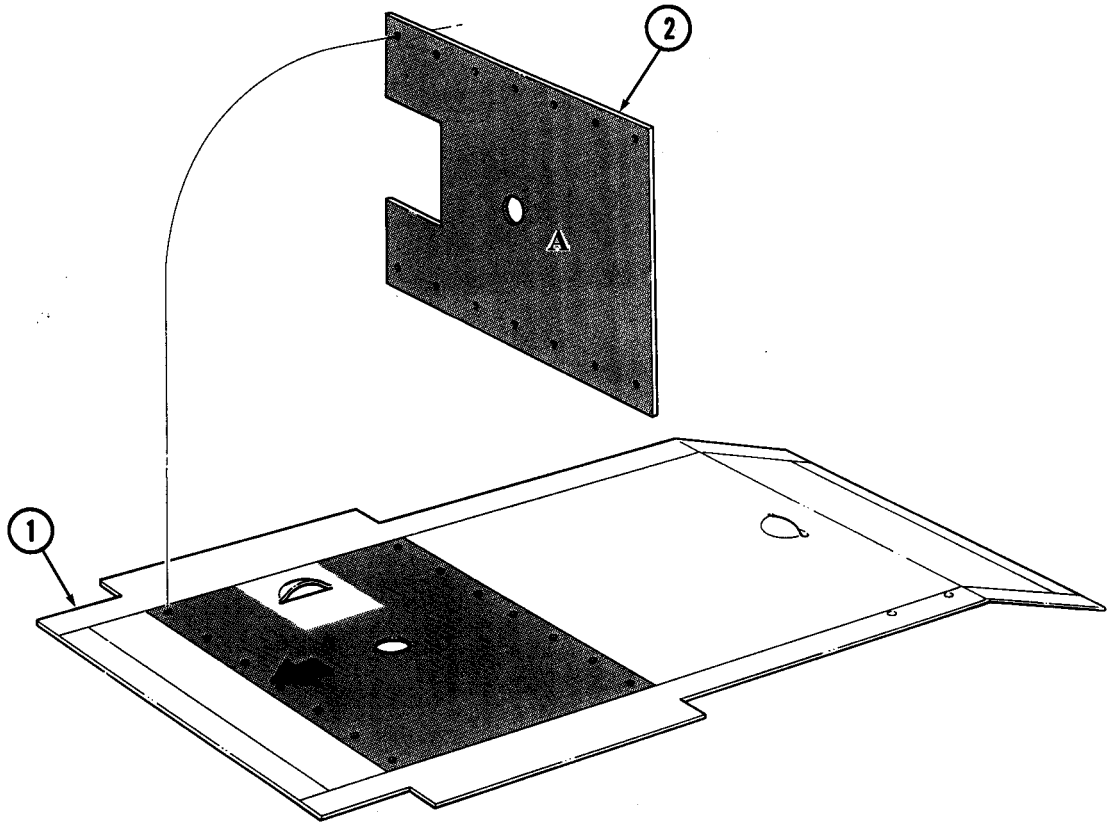
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

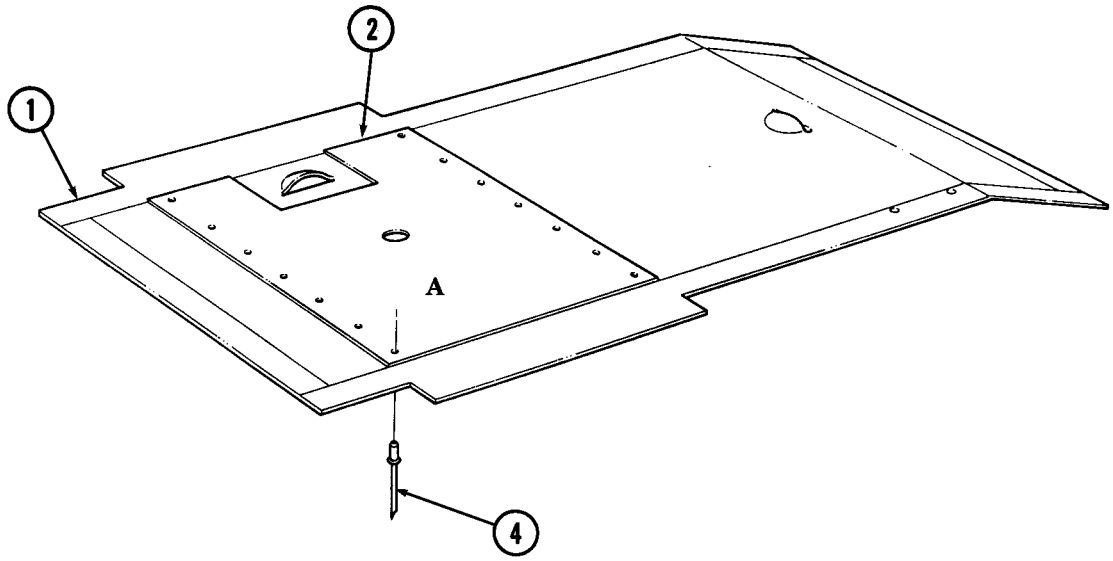
**e. Reinforcement Strip Aand Insert Panel Assembly**

1. Position reinforcement strip A (2) on insert panel (1). Align reference lines (3) with edges of reinforcement strip A (2).
2. Using reinforcement strip A (2) as a template, locate, mark, and drill fourteen 0.187-in. diameter holes through insert panel (1). Remove reinforcement strip A (2).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surfaces of insert panel (1) and reinforcement strip A (2).
4. Position reinforcement strip A (2) on insert panel (1) and install with fourteen rivets (4).
5. Remove any adhesive residue and clean edges on reinforcement strip A (2) and insert panel (1).



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

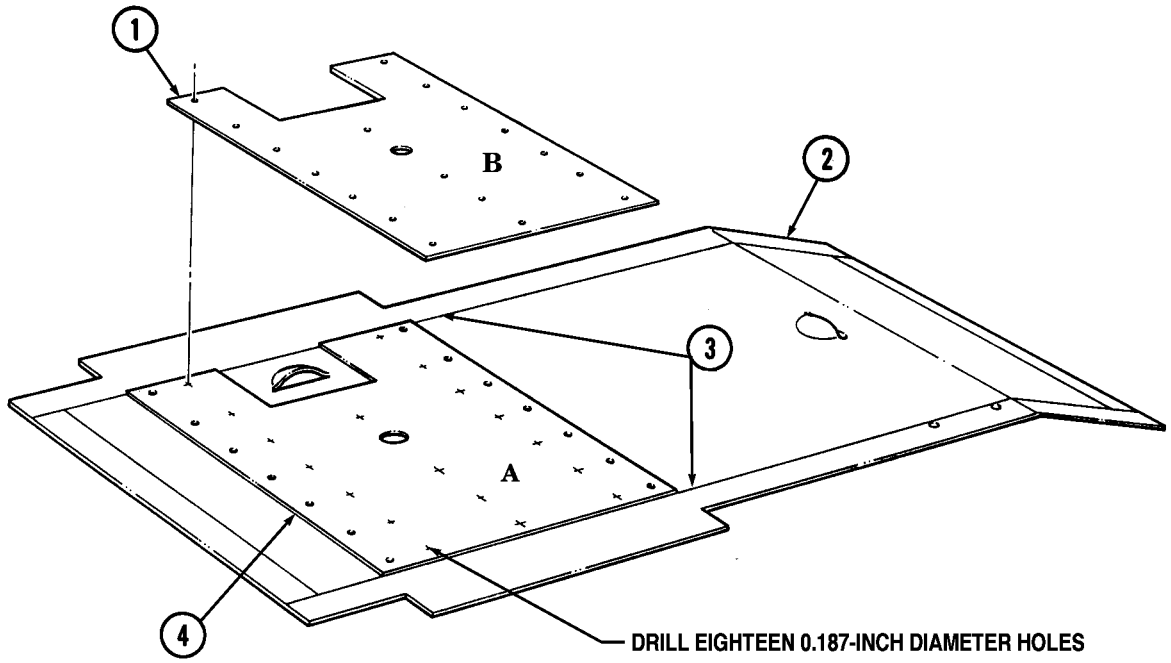


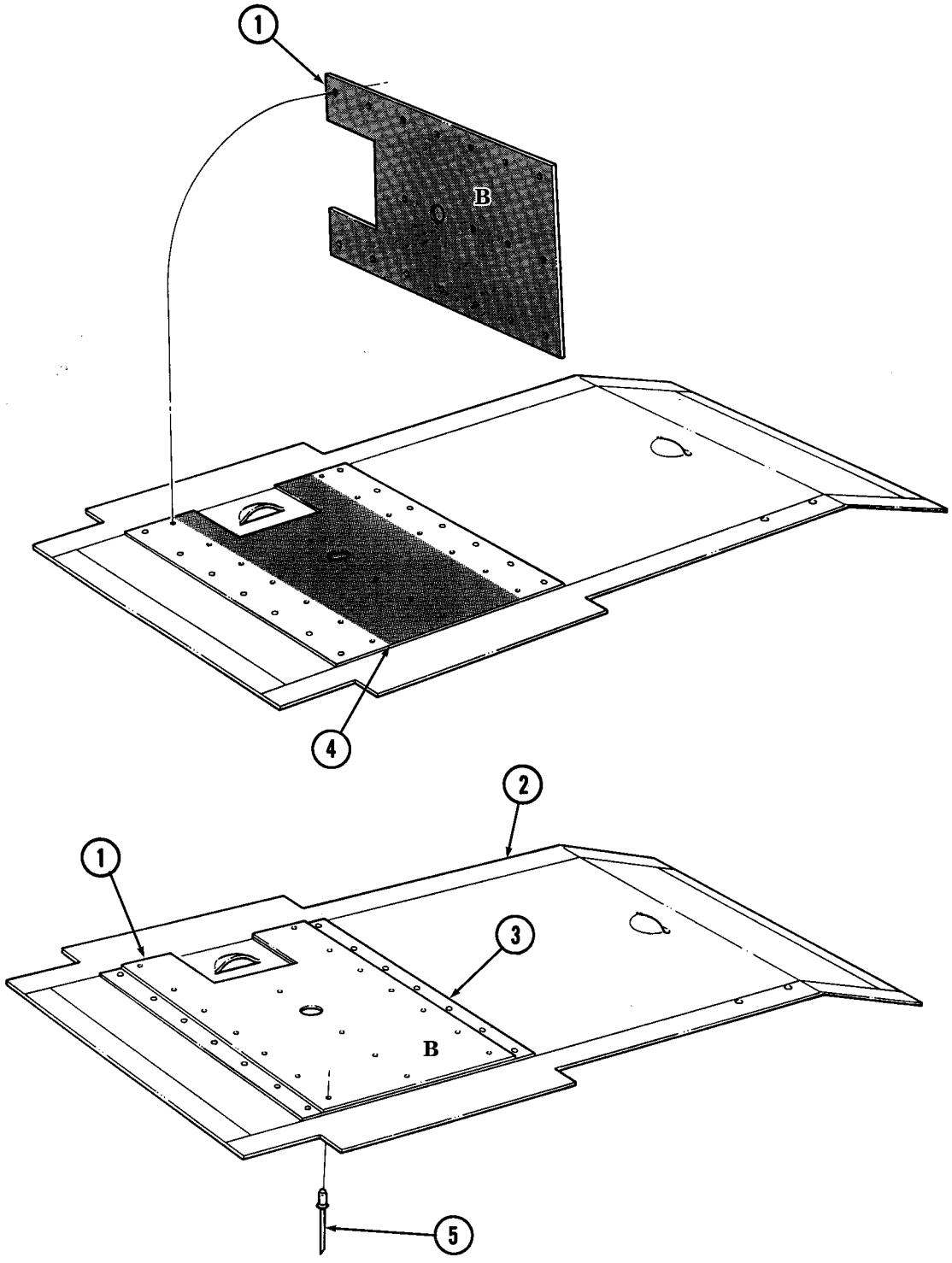
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

**f. Reinforcement Strip B and Insert Panel Assembly**

1. Position reinforcement strip B (1) on insert panel (2), and align reference lines (3) with edges of reinforcement strip B (1).
2. Using reinforcement strip B (1) as a template, locate, mark, and drill eighteen 0.187-in. diameter holes through reinforcement strip A (4) and insert panel (2).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of reinforcement strip A (4) and reinforcement strip B (1).
4. Position reinforcement strip B (1) on reinforcement strip A (4) and install with eighteen rivets (5).
5. Remove any adhesive residue and clean edges of reinforcement strip B (1), reinforcement strip A (4) and insert panel (2).



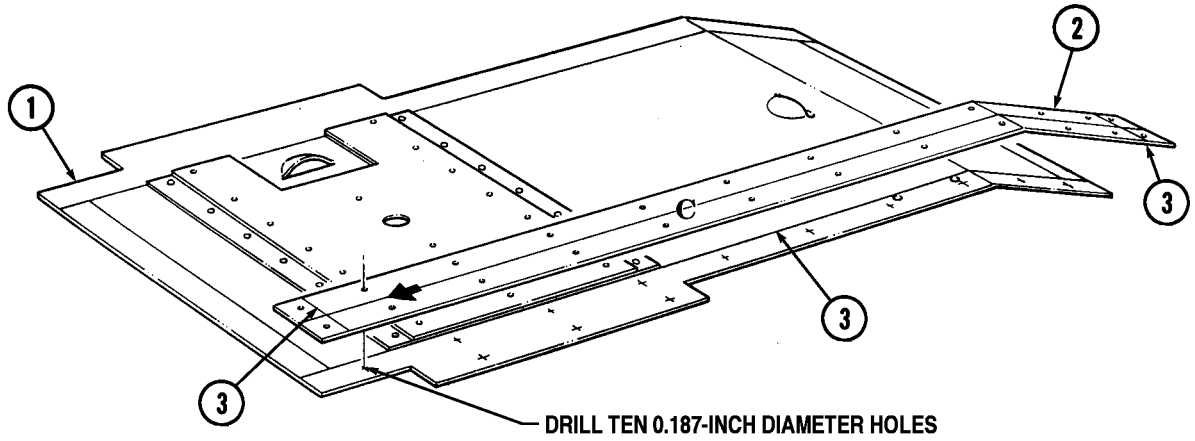
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)



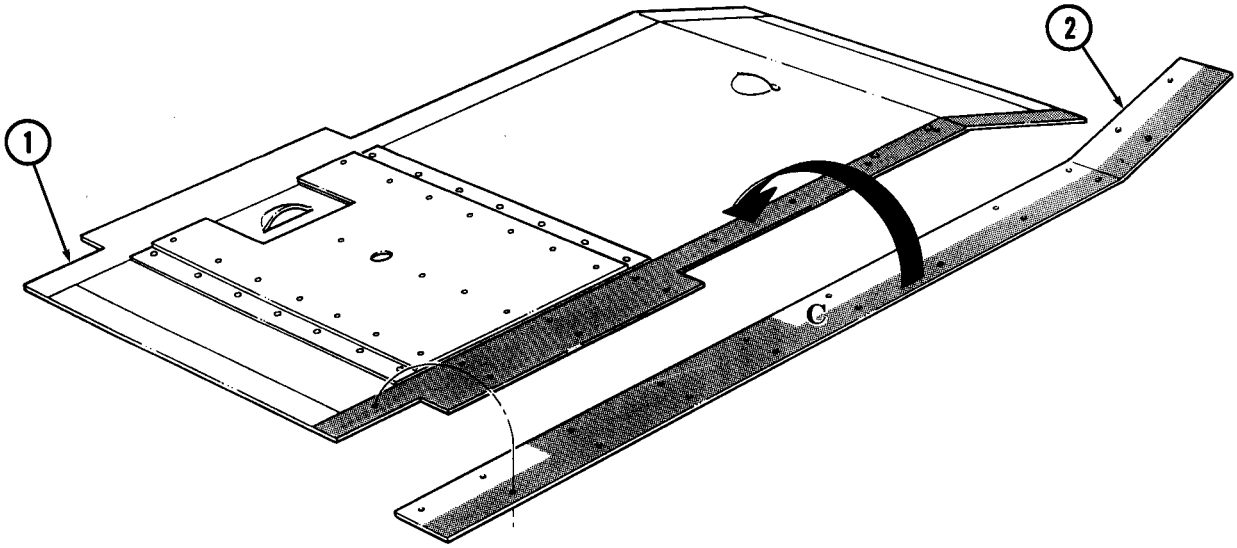
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

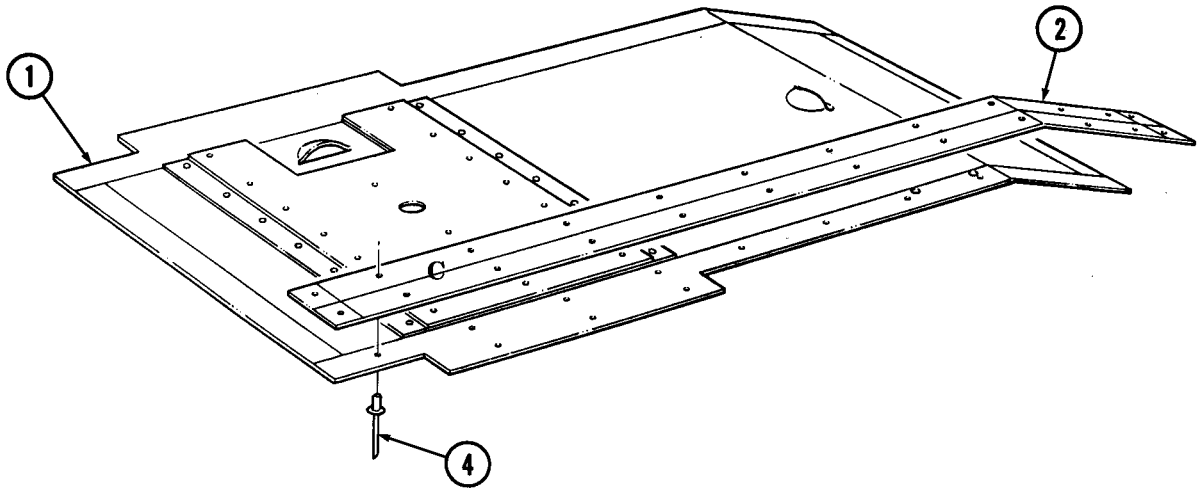
**g. Metal Strip C and Insert Panel Assembly**

1. Position metal strip C (2), with arrow facing up and toward left, on insert panel (1). Align reference lines (3) with edges of insert panel (1).
2. Using metal strip C (2) as a template, locate, mark, and drill ten 0.187-in. diameter holes through insert panel (1).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (1) and metal strip C (2).
4. Position metal strip C (2) on insert panel (1) and install with ten rivets (4).
5. Remove any adhesive residue and clean edges on metal strip C (2) and insert panel (1).



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

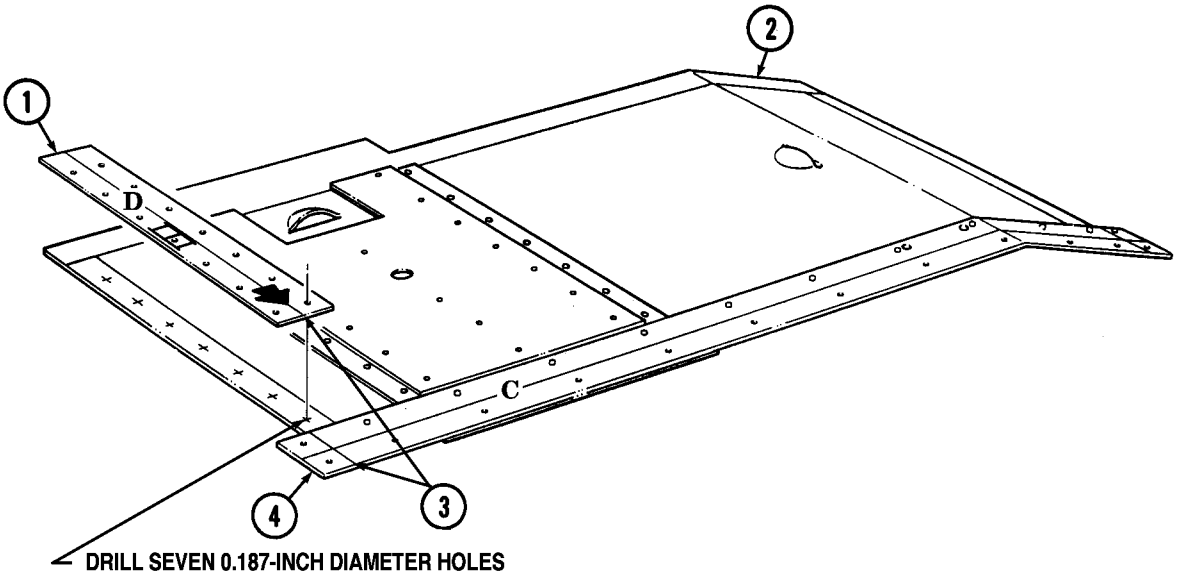


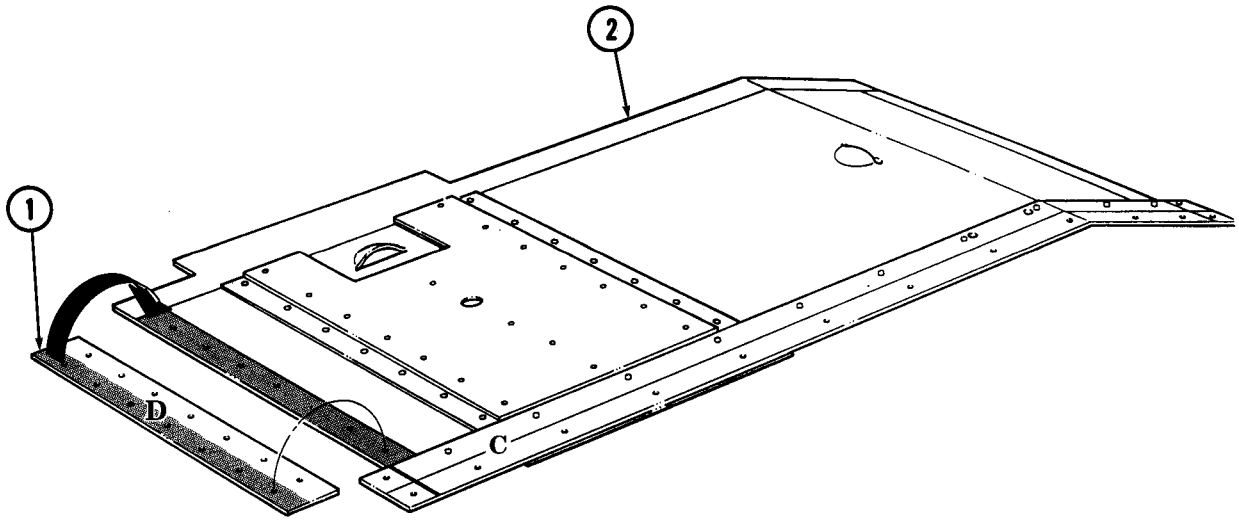
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

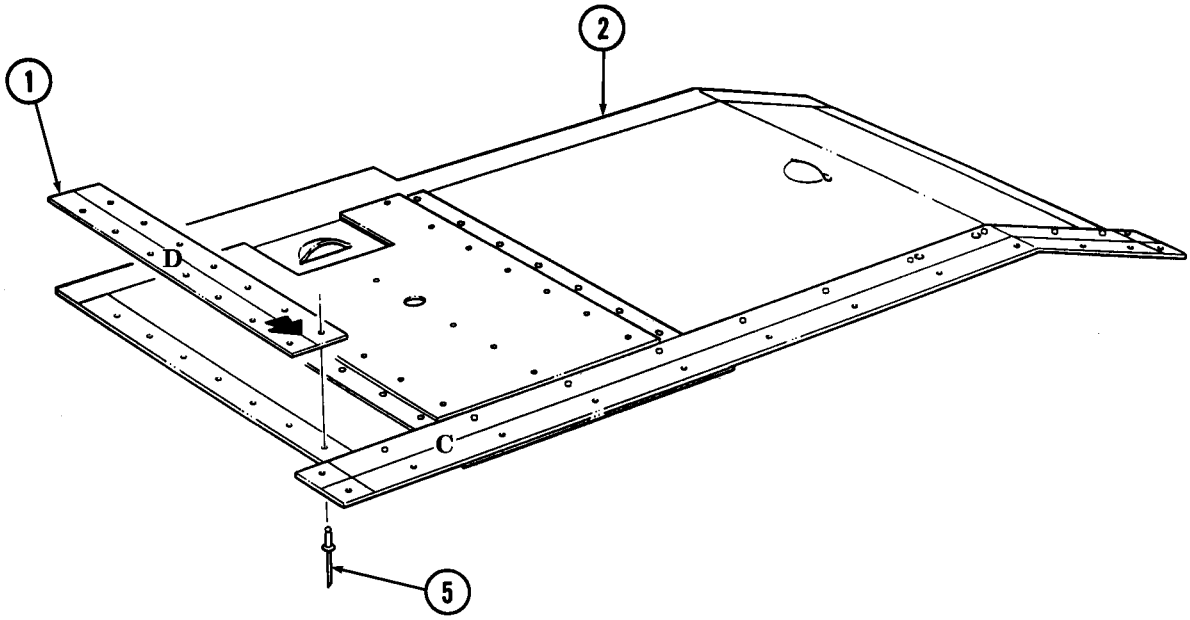
**h. Metal Strip D and Insert Panel Assembly**

1. Position metal strip D (1), with arrow facing up and toward metal strip C (4), on insert panel (2). Align reference lines (3).
2. Using metal strip D (1) as a template, locate, mark, and drill seven 0.187-in. diameter holes through insert panel (2). Remove metal strip D (1).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (2) and metal strip D (1).
4. Position metal strip D (1) on insert panel (2) and install with seven rivets (5).
5. Remove any adhesive residue and clean edges on metal strip D (1) and insert panel (2).



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

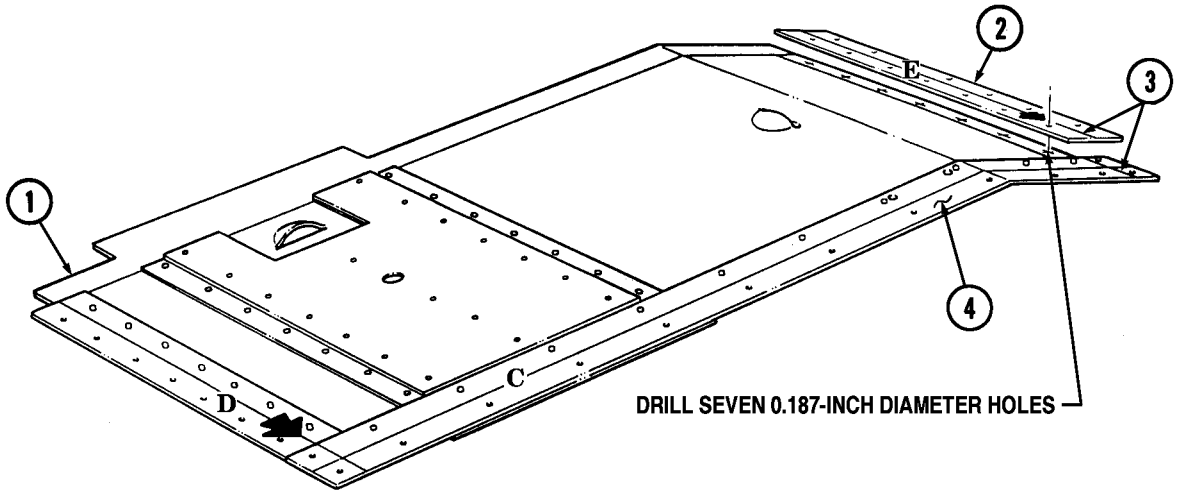


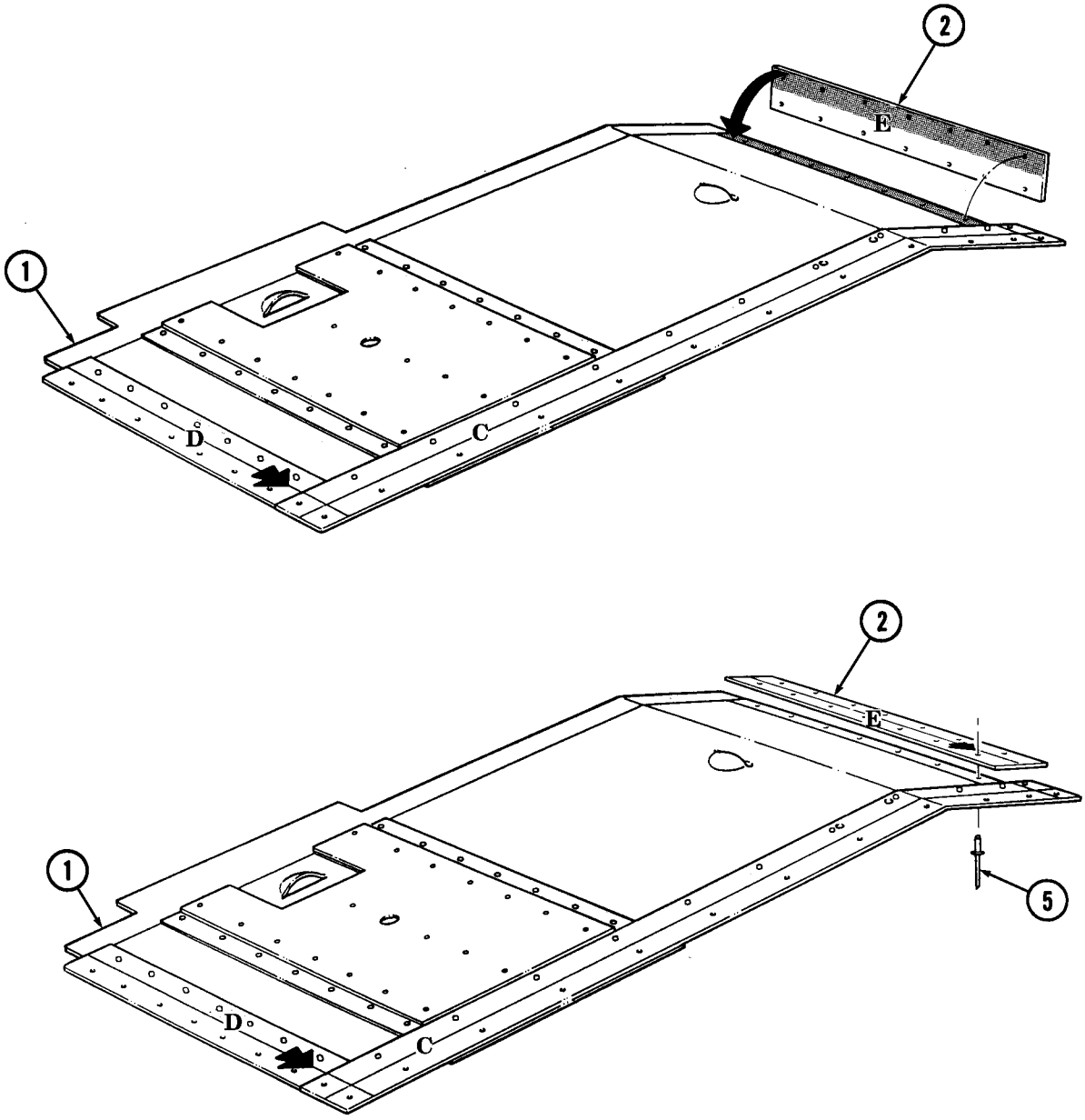
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

**i. Metal Strip E and Insert Panel Assembly**

1. Position metal strip E (2), with arrow facing up and toward metal strip C (4), on insert panel (1). Align reference lines (3).
2. Using metal strip E (2) as a template, locate, mark, and drill seven 0.187-in. diameter holes through insert panel (1). Remove metal strip E (2).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (1) and metal strip E (2).
4. Position metal strip E (2) on insert panel (1) and install with seven rivets (5).
5. Remove any adhesive residue and clean edges on metal strip E (2) and insert panel (1).



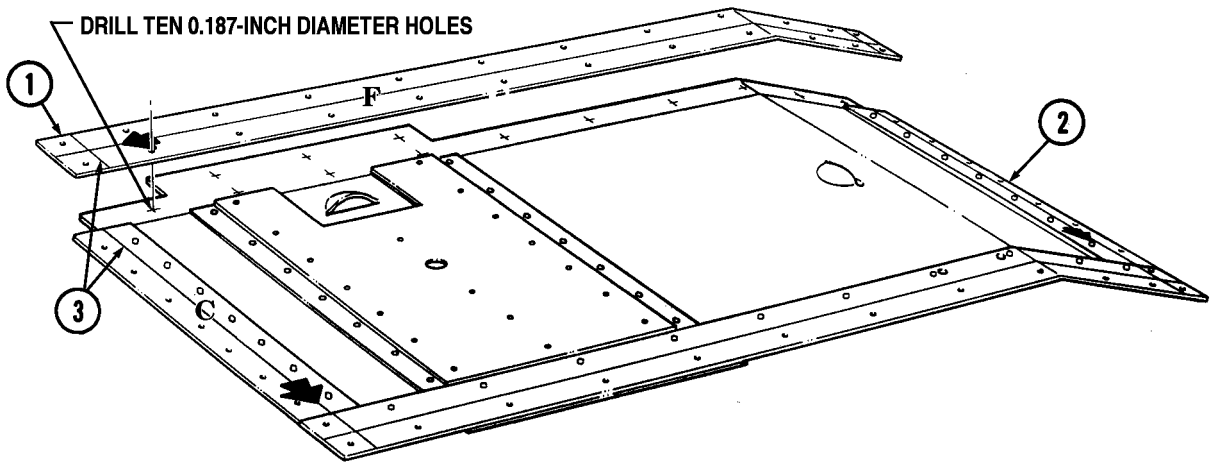
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)



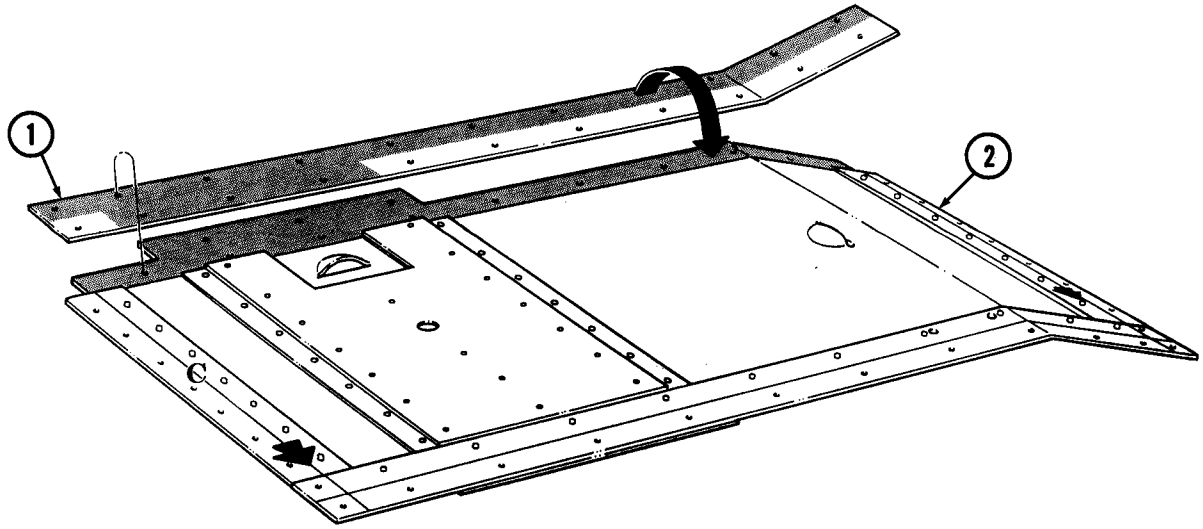
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

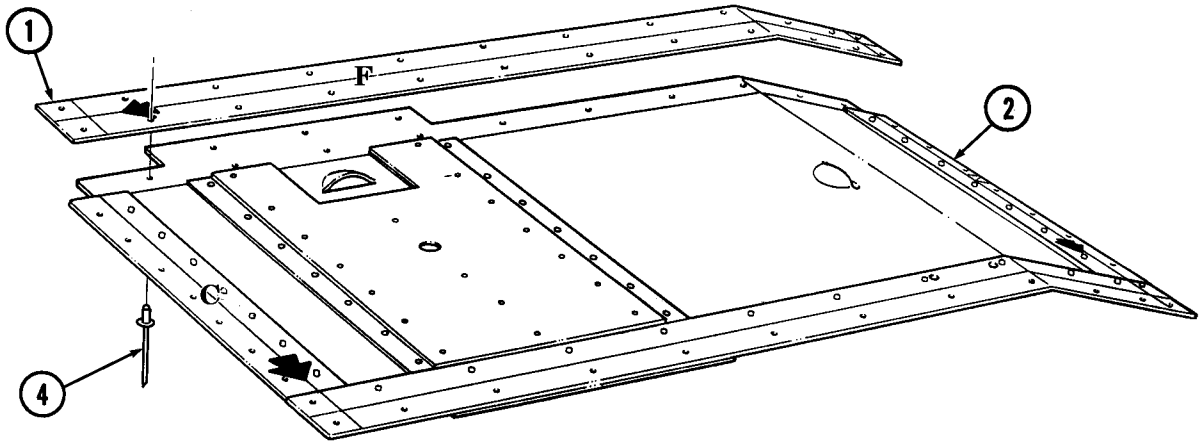
**j. Metal Strip Fand Insert Panel Assembly**

1. Position metal strip F (1), with arrow facing up and toward metal strip C (3), on insert panel (2). Align reference lines (3).
2. Using metal strip F (1) as a template, locate, mark, and drill ten 0.187-in. diameter holes in insert panel (2). Remove metal strip F (1).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (2) and metal strip F (1).
4. Position metal strip F (1) on insert panel (2) and install with ten rivets (4).
5. Remove any adhesive residue and clean edges on metal strip F (1) and insert panel (2).



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)



## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

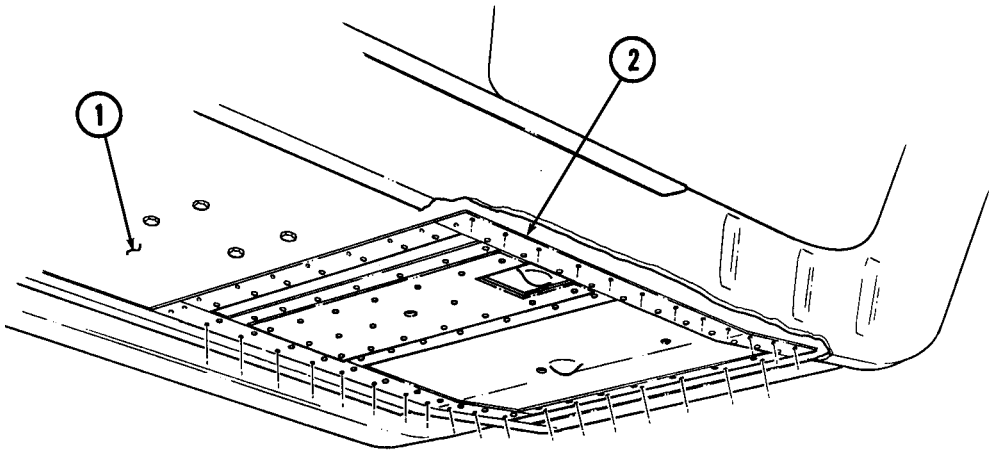
**k. Left Rear Floor Panel and Insert Panel Drilling**

1. Position insert panel (2) to underside of left rear floor panel (1).

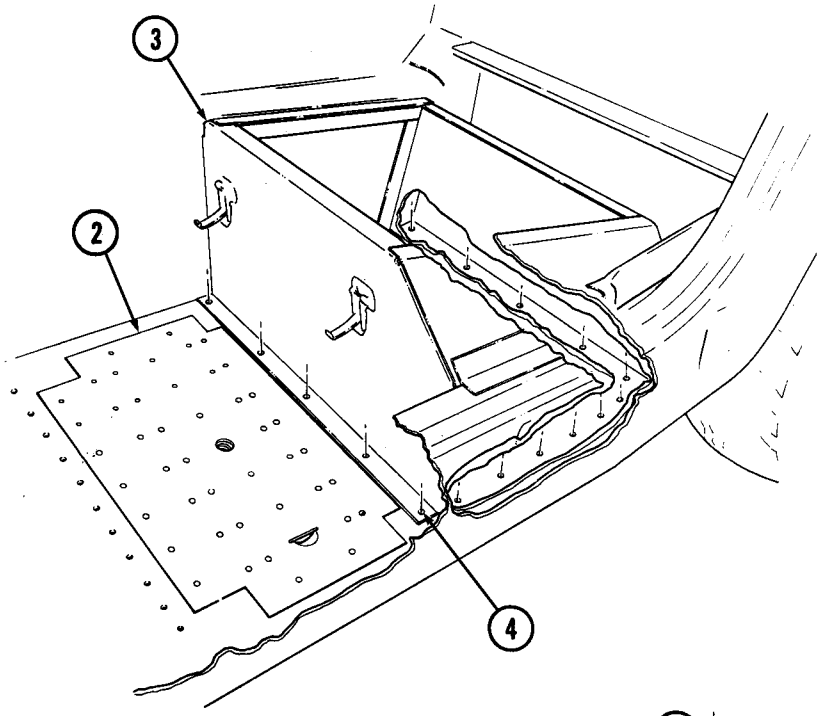
**NOTE**

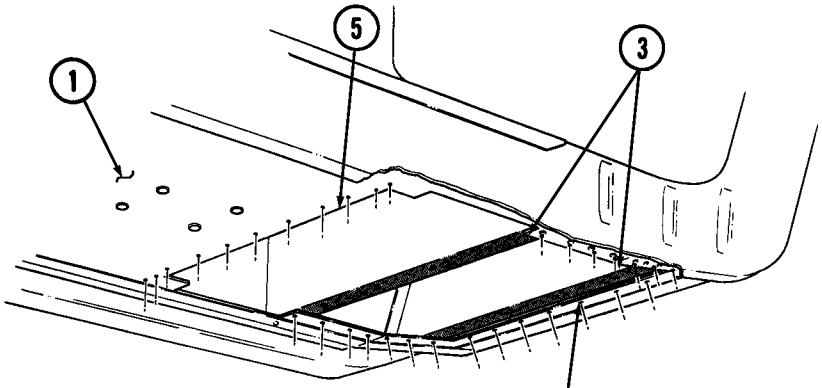
If vehicle is not equipped with left rear seat support installed, proceed to step 3.

2. Using left rear seat support (3) as a template, mark sixteen hole locations (4) on insert panel (2).
3. Using insert panel (2) as a template, mark forty-two hole locations (5) on underside of left rear floor panel (1). Remove insert panel (2).
4. Drill forty-two 0.187-in. diameter holes through underside of left rear floor panel (1).
5. Drill nine 0.187-in. diameter holes through insert panel (2).

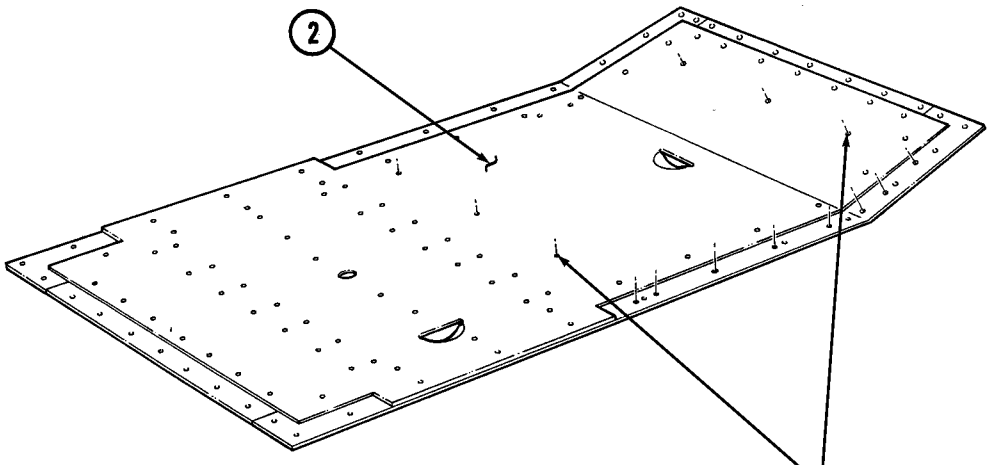


## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)




DRILL FORTY-TWO 0.187-INCH DIAMETER HOLES




DRILL NINE 0.187-INCH DIAMETER HOLES

## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

### l. Insert Panel and Left Rear Floor Panel Installation

**NOTE**

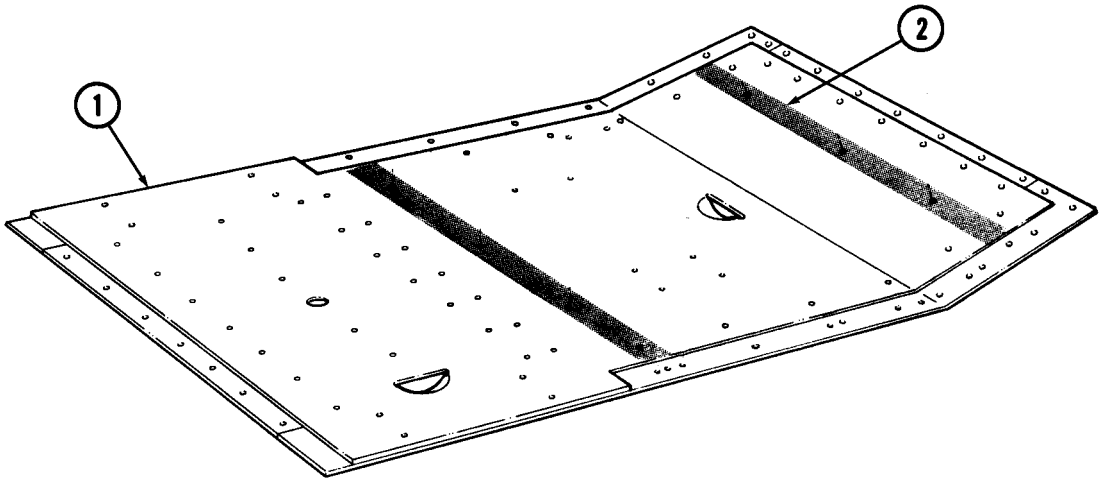
If vehicle is not equipped with left rear seat support, proceed to step 3.

1. Apply approximately 0.125-in. thickness of adhesive sealant to inner shaded area (2) of insert panel (1).
2. Apply approximately 0.125-in. thickness of adhesive sealant to outer shaded area (3) of insert panel (1).

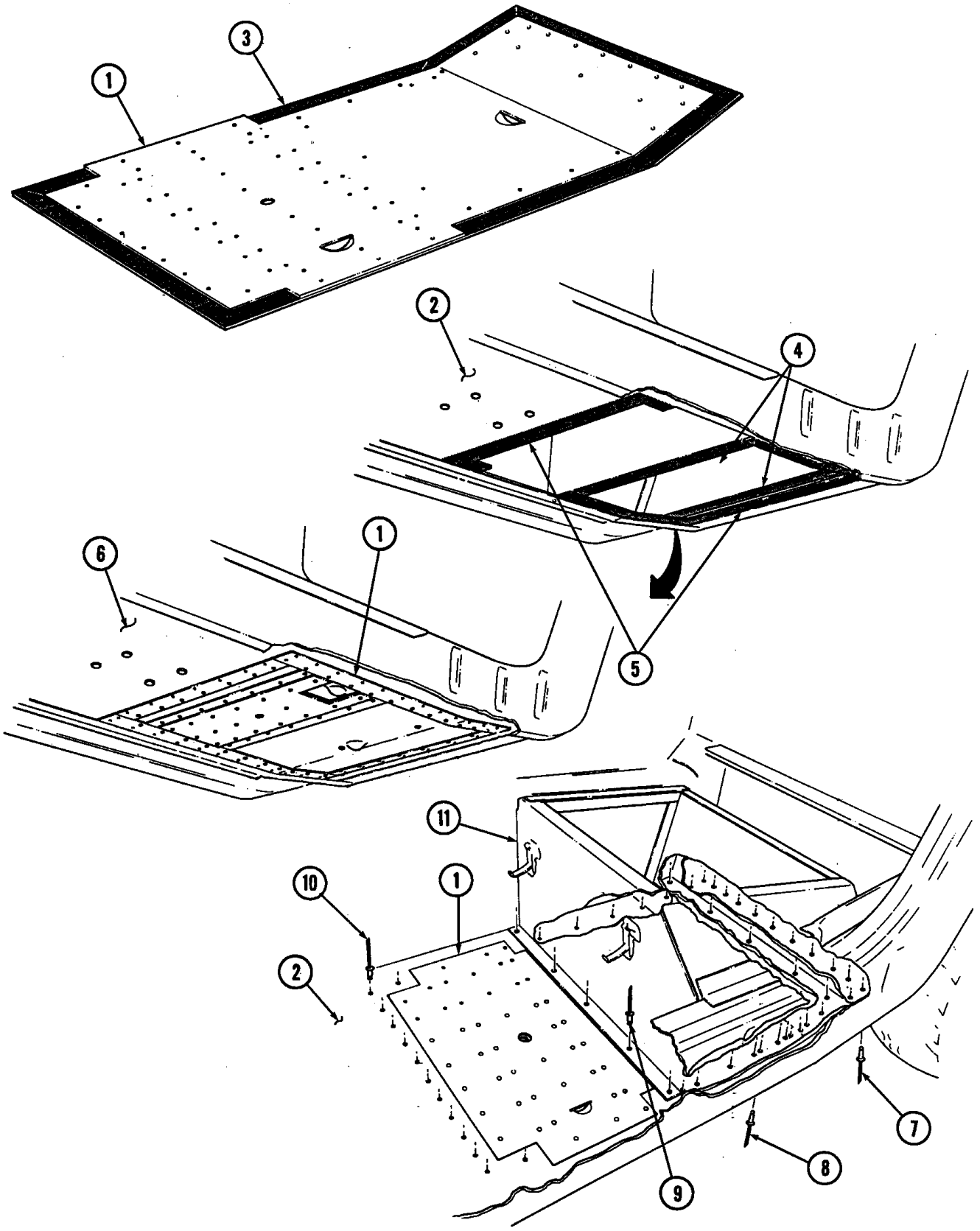
**NOTE**

If vehicle is not equipped with left rear seat support, proceed to step 5.

3. Apply adhesive sealant to inner shaded area (4) on underside of left rear seat support (11).
4. Apply approximately 0.125-in. thickness of adhesive sealant to outer shaded area (5) on underside of left rear panel (6).
5. Position insert panel (1) to underside of left rear floor panel (6).
6. Install insert panel (1) on left rear seat support (11) with ten rivets (8).
7. Secure insert panel (1) on underside of left rear seat support (11) with five rivets (9).
8. Secure insert panel (1) on left rear floor panel (6) with thirteen rivets (7) and eighteen rivets (10).



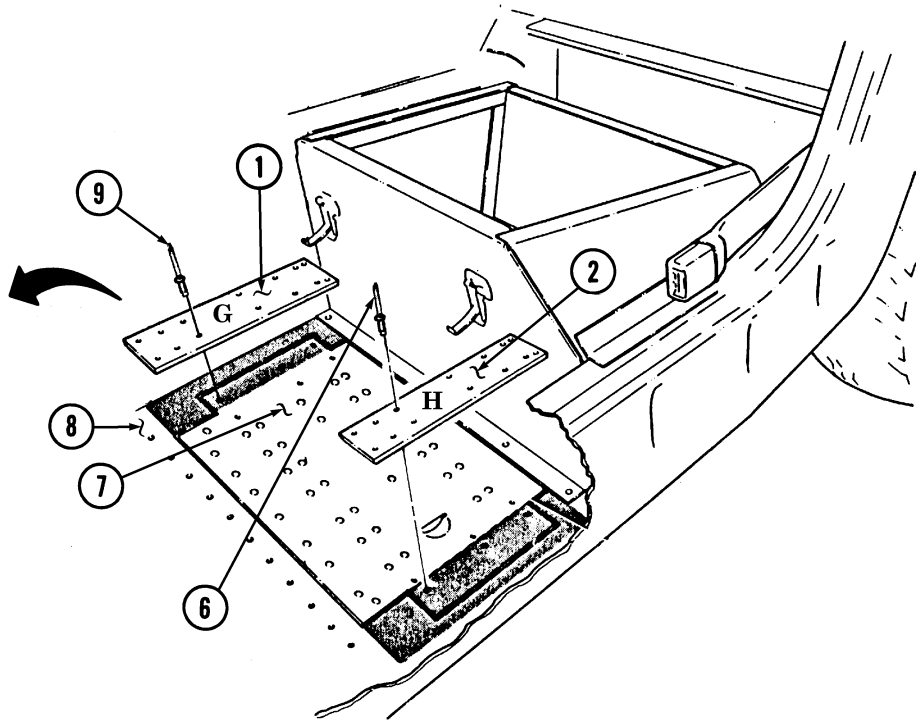
## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

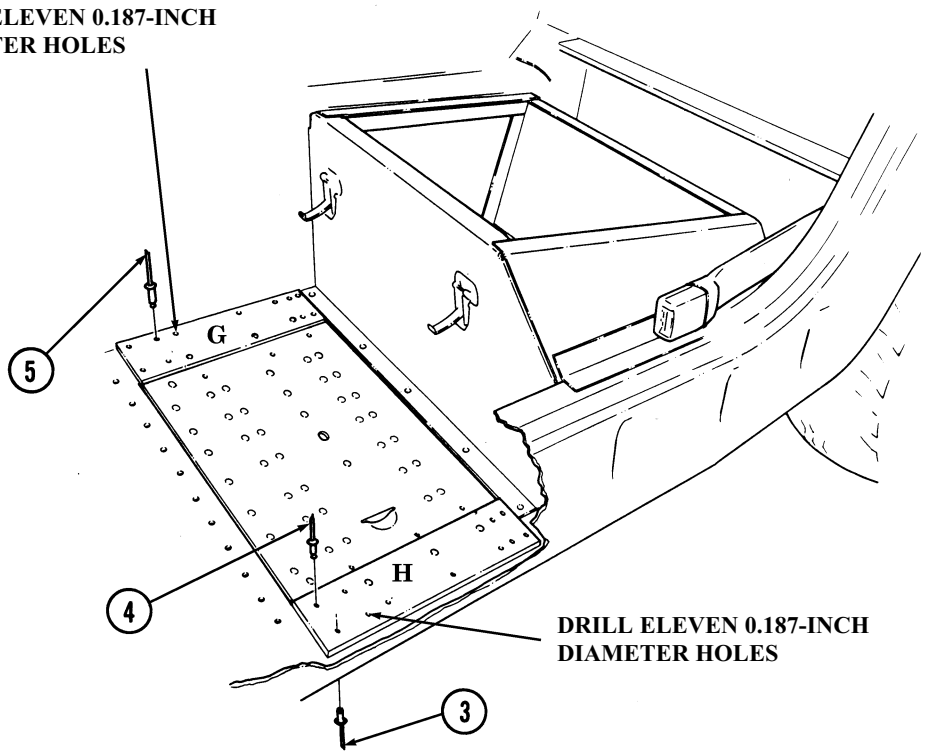


## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)

9. Apply approximately 0.125-in. thickness of adhesive sealant to metal strip G (1).
10. Apply adhesive sealant to shaded area of left rear floor panel (8) and insert panel (7).
11. Position metal strip G (1) on left rear floor panel (8) and insert panel (7) and install three rivets (9).
12. Using metal strip G (1) as a template, locate and drill eleven 0.187-in. diameter holes through left rear floor panel (8) and insert panel (7).
13. Secure metal strip G (1) on left rear floor panel (8) and insert panel (7) with eleven rivets (5).
14. Apply approximately 0.125-in. thickness of adhesive sealant to metal strip H (2).
15. Apply adhesive sealant to area shaded on left rear floor panel (8) and insert panel (7).
16. Position metal strip H (2) on left rear floor panel (8) and insert panel (7) and install three rivets (6).
17. Using metal strip H (2) as a template, locate, mark, and drill eleven 0.187-in. diameter holes through left rear floor panel (8) and insert panel (7).
18. Secure metal strip H (2) on left rear floor panel (8) and insert panel (7) with four rivets (4) and seven rivets (3).
19. Spot-paint insert panel (7) and left rear floor panel (8) (TM 43-0139).

## 22-9.3. LEFT REAR FLOOR PANEL REPAIR (Cont'd)




FOLLOW-ON TASKS:
- Install left floor insulation (TM 9-2320-280-20).
- Install left rear seat back (TM 9-2320-280-20).
- Install rear seat bottom (TM 9-2320-280-20.)
- Replace stored contents in left rear seat compartment (TM 9-2320-280-20).

## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR

**This Task Covers:**

**a. Right Front Insert Panel Fabrication**
**b. Metal Strips Fabrication**
**c. Right Front Floor Panel Removal**
**d. Metal Strip A and Insert Panel Assembly**
**e. Metal Strip B and Insert Panel Assembly**
**f. Metal Strip C and Insert Panel Assembly**
**g. Right Front Floor Panel and Battery Tray Drilling**
**h. Right Front Floor Panel and Insert Panel Drilling**
**i. Battery Tray Panel and Right Front Floor Panel Installation**
**j. Insert Panel and Right Front Floor Panel Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool set:
automotive (Appendix G, Item 1)

**Manual References**

TM 9-2320-280-24P
TM 9-2320-280-20
TM 43-0139

**Materials/Parts**

Seventy-five blind rivets
(Appendix E, Item 194)
Fifty-five blind rivets (Appendix E, Item 195)
Adhesive (Appendix B, Item 1.1)
Adhesive sealant (Appendix B, Item 4.1)
Front battery holdown bracket
(Appendix E, Item 3)
Rear battery holdown bracket
(Appendix E, Item 4)
Battery tray (Appendix E, Item 257)
Sheet metal (Appendix E, Item 245)

**Equipment Condition**

- Battery cover removed (TM 9-2320-280-20).
- Batteries removed (TM 9-2320-280-20).
- Battery tray removed (TM 9-2320-280-20).
- Right front floor insulation removed (TM 9-2320-280-20).

**Maintenance Level**

General Support

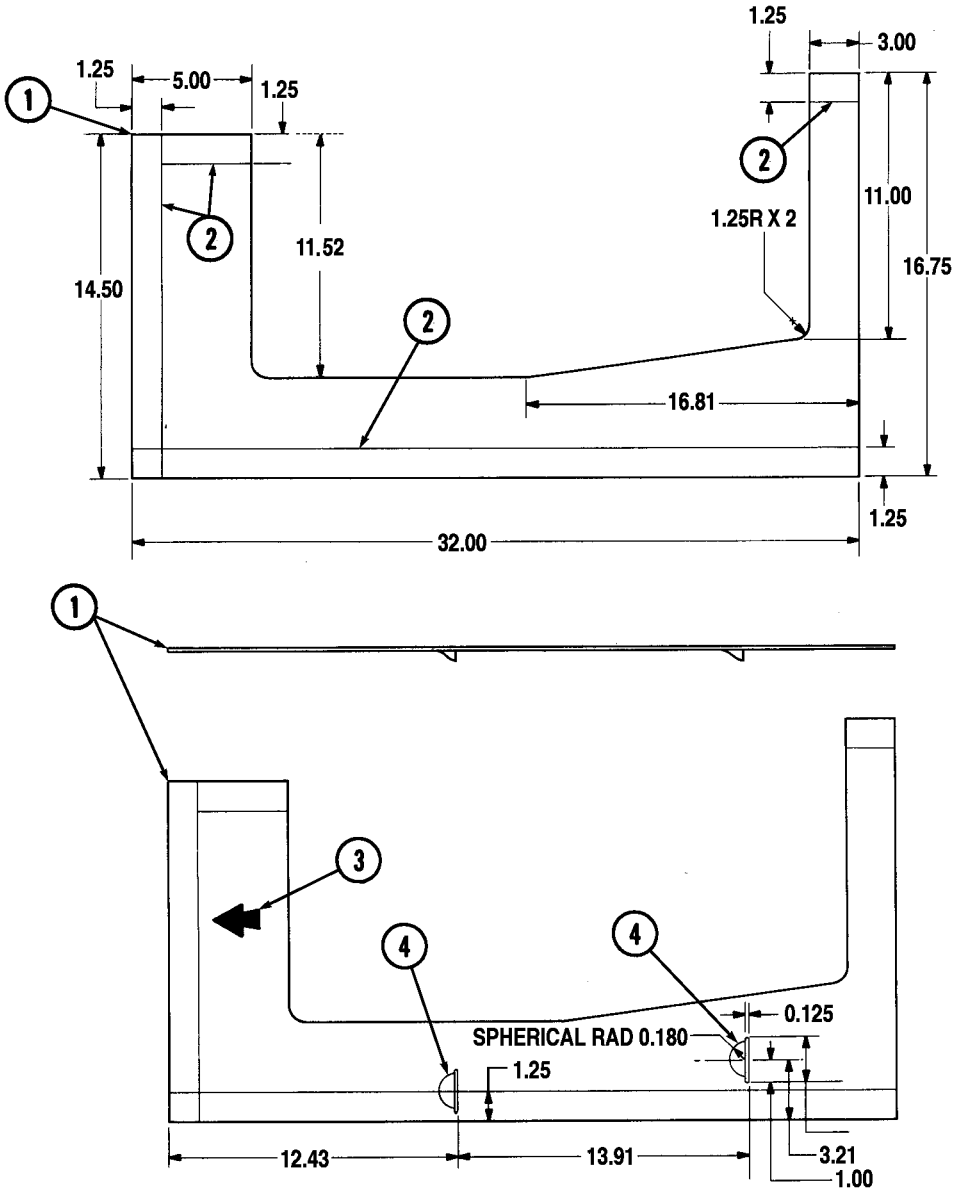
**NOTE**

All dimensions in this procedure are in inches.

### a. Right Front Insert Panel Fabrication

1. Cut insert panel (1) from sheet metal, and mark four reference lines (2) and directional arrow (3) on insert panel (1).
2. Fabricate two drain holes (4) in insert panel (1).
3. Remove all burrs and round all sharp edges of insert panel (1).

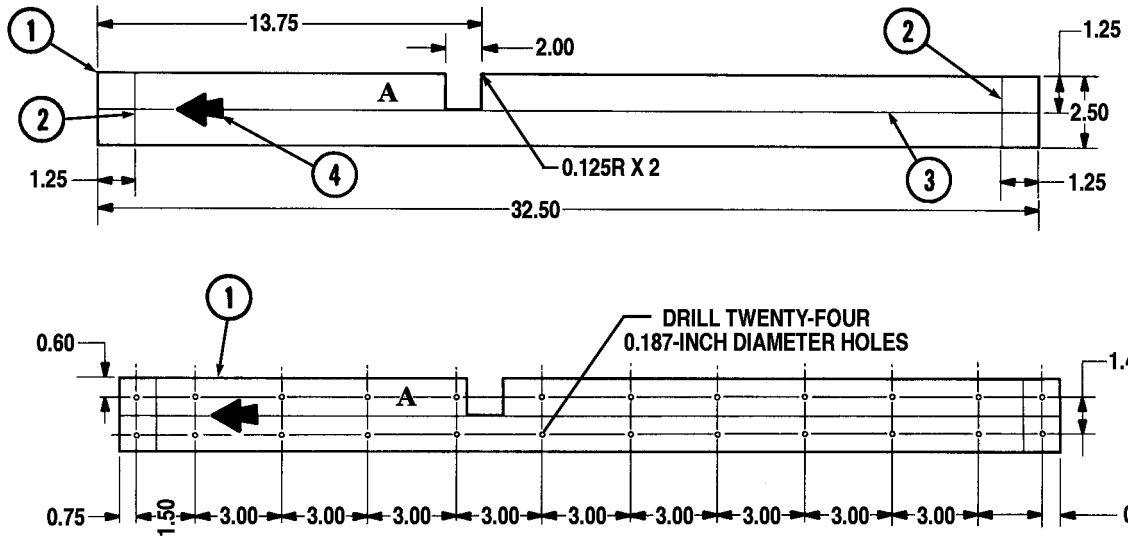
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)



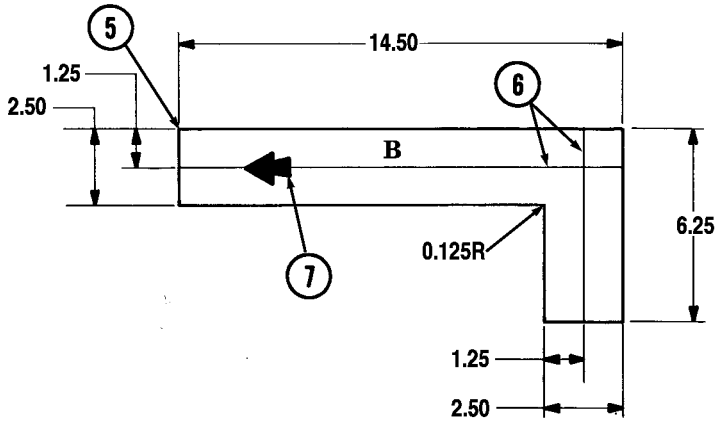
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

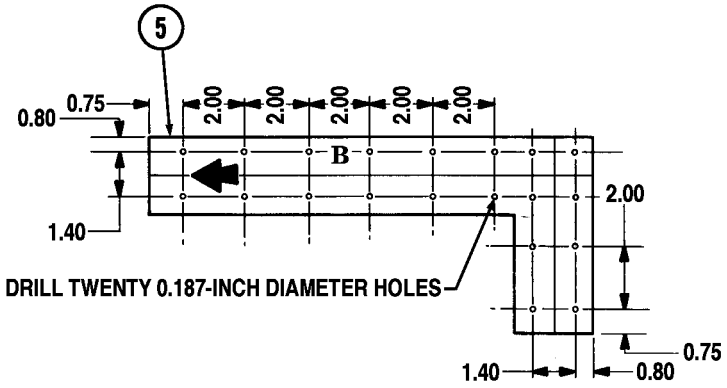
**b. Metal Strips Fabrication**

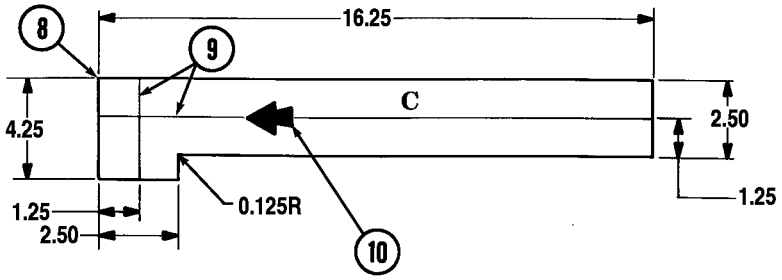
1. Cut metal strip (1) from sheet metal, and mark two reference lines (2), centerline (3), and directional arrow (4). Identify metal strip (1) as A.
2. Locate, mark, and drill twenty-four 0.187-in. diameter holes through metal strip A (1).
3. Cut metal strip (5) from sheet metal, and mark two centerlines (6), and directional arrow (7). Identify metal strip (5) as B.
4. Locate, mark, and drill twenty 0.187-in. diameter holes in metal strip B (5).
5. Cut metal strip (8) from sheet metal, and mark two centerlines (9), and directional arrow (10). Identify metal strip (8) as C.
6. Locate, mark, and drill eighteen 0.187-in. diameter holes through metal strip C (8).

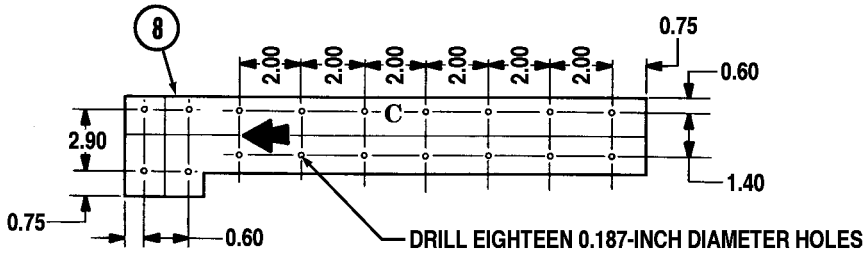


## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)



## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

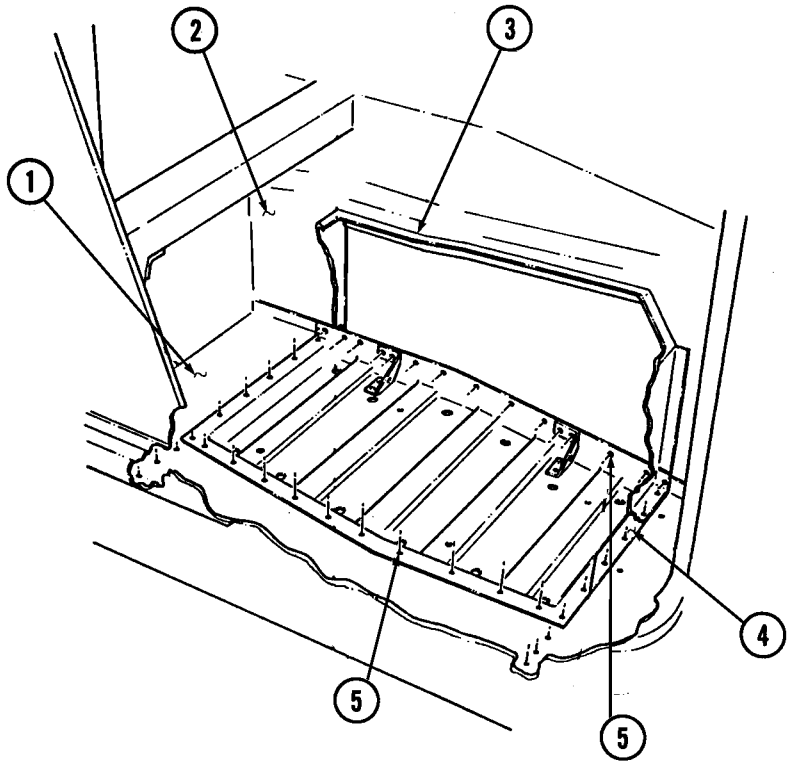
**c. Right Front FloorPanel Removal**

1. Using a 0.187-in. drill bit, remove twenty-eight rivets (5) from right front seat support (3), battery tray (4), and right front floor panel (1).
2. Using a 0.187-in. drill bit, remove fifteen rivets (5) from battery tray (4) and tunnel (2).
3. Position insert panel (6), with arrow facing down and toward front of vehicle, to underside of right front floor panel (1) and align to battery tray (4).
4. Using insert panel (6) as a template, scribe an outline (8) on right front floor panel (1).

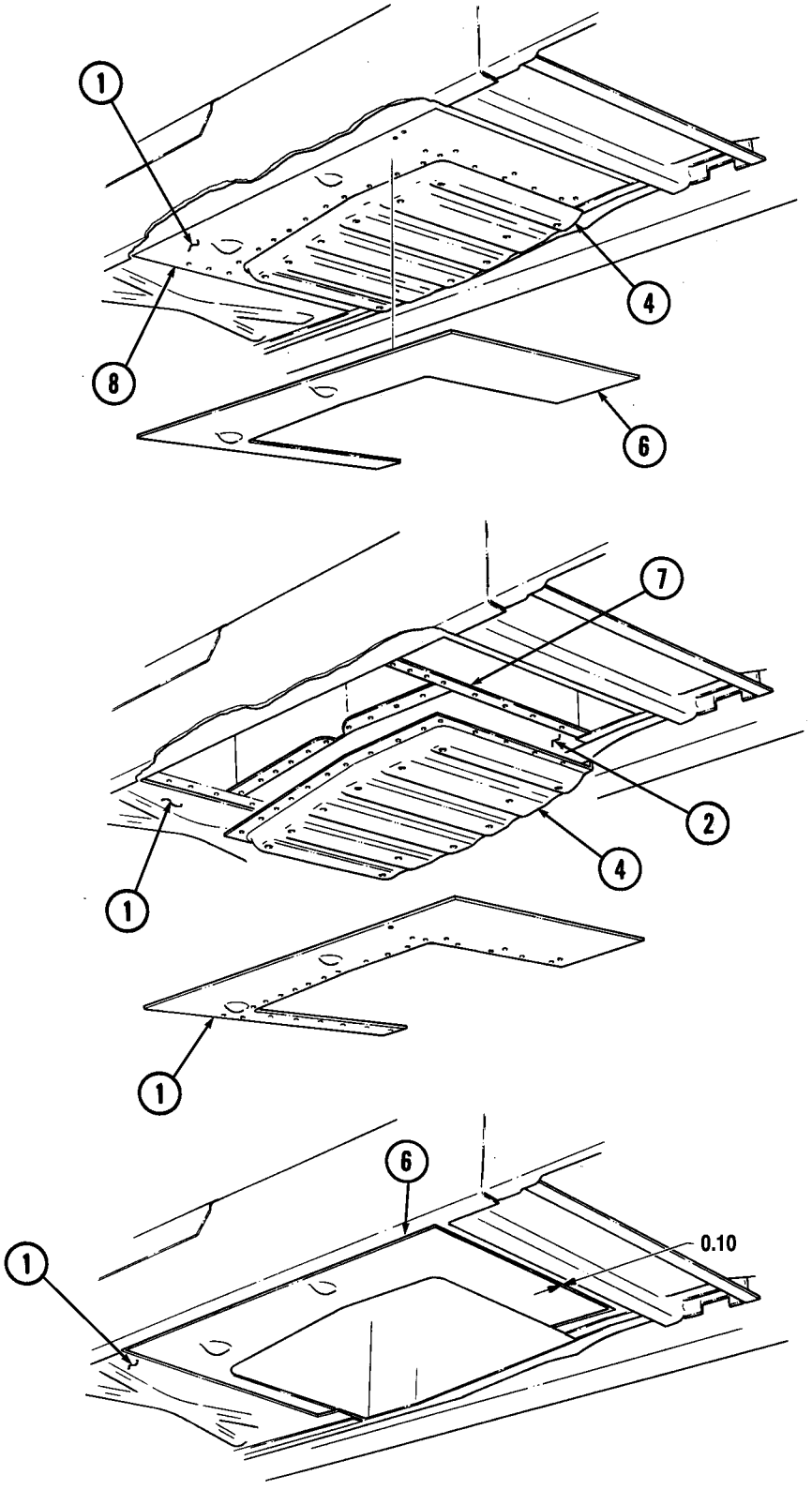
**NOTE**

Do not cut through front seat support when removing right front panel section.

5. Using scribed outline (8), cut and remove right front floor panel (1).
6. Remove battery tray (4).
7. Remove sharp edges and burrs on right front floor panel (1).
8. Remove any adhesive residue and clean left front seat support (7) and tunnel (2).
9. Position insert panel (6), with arrow facing down and toward front of vehicle, to underside of right front floor panel (1).
10. Obtain a minimum clearance of 0.10 in. between edges of insert panel (6) and right front floor panel (1).
11. Remove insert panel (6).



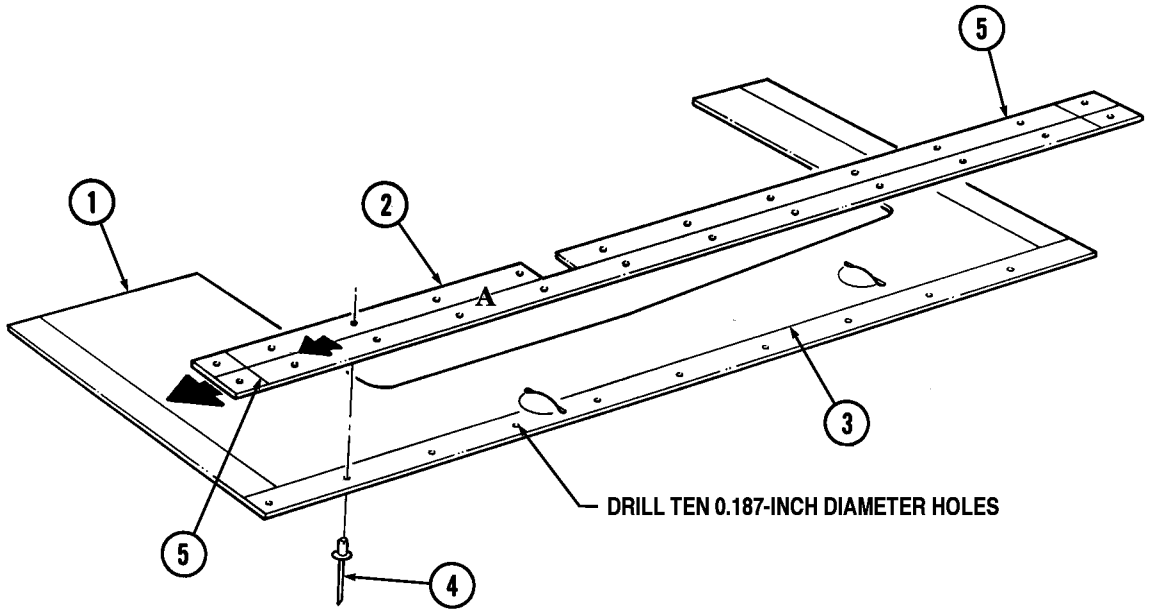
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)



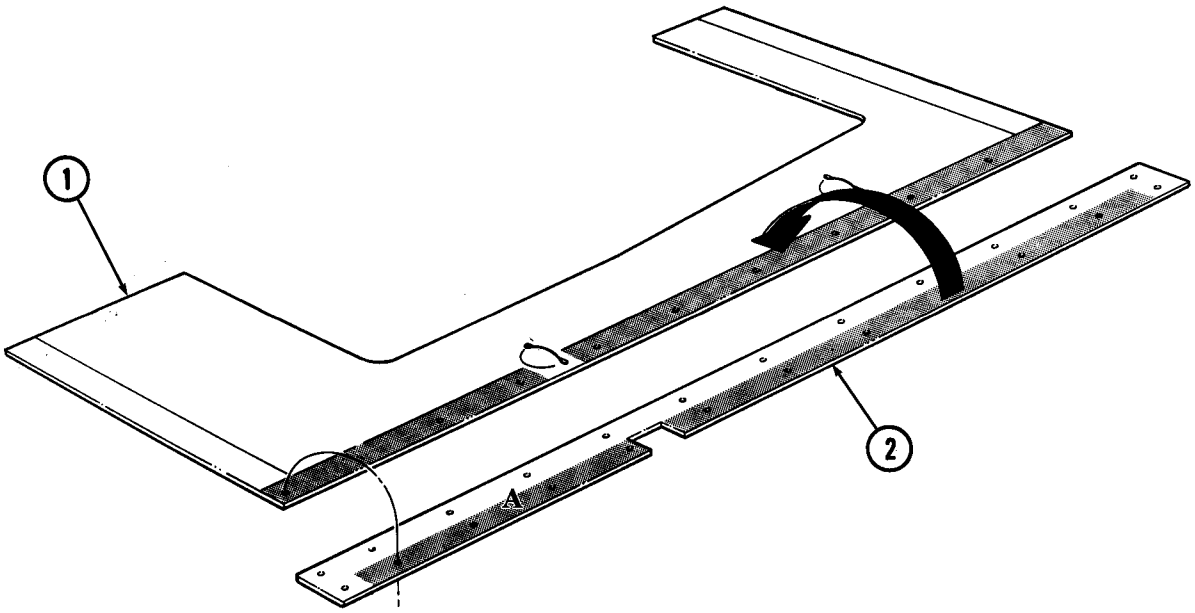
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

**d. Metal Strip Aand Insert Panel Assembly**

1. Position metal strip A (2), with arrow facing up and toward left, on insert panel (1). Align reference line (3) with edge of metal strip A (2) and reference lines (5) with edge of insert panel (1).
2. Using metal strip A (2) as a template, locate, mark, and drill ten 0.187-in. diameter holes through insert panel (1). Remove metal strip A (2).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (1) and metal strip A (2).
4. Position metal strip A (2) on insert panel (1) and install with ten rivets (4).
5. Remove any adhesive residue and clean edges of metal strip A (2) and insert panel (1).



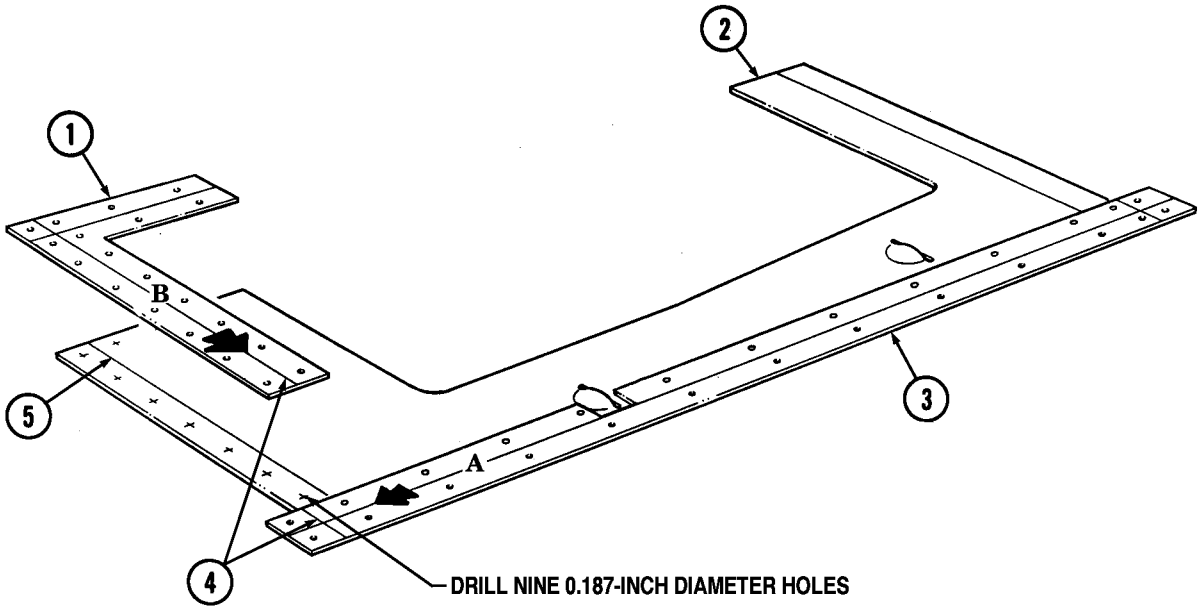
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)



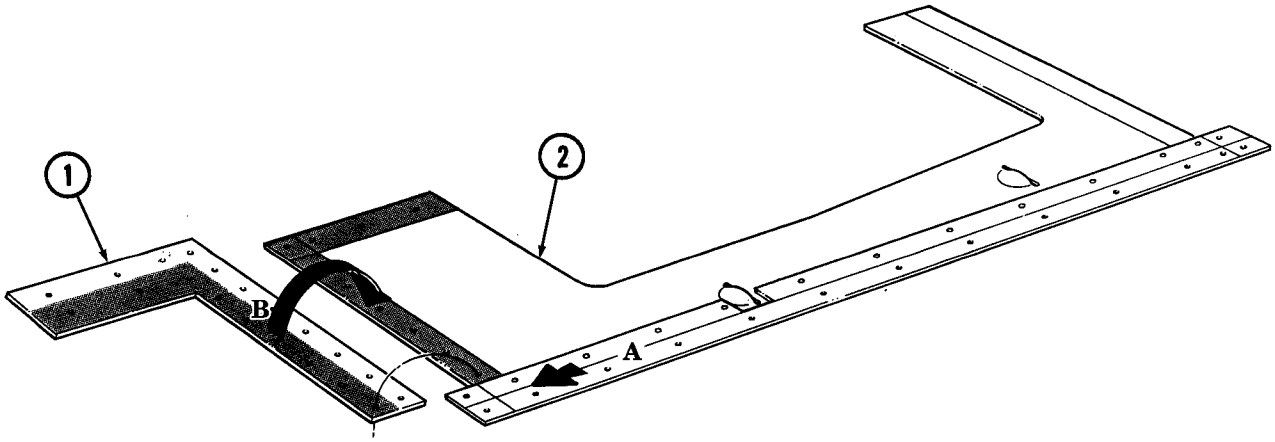
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

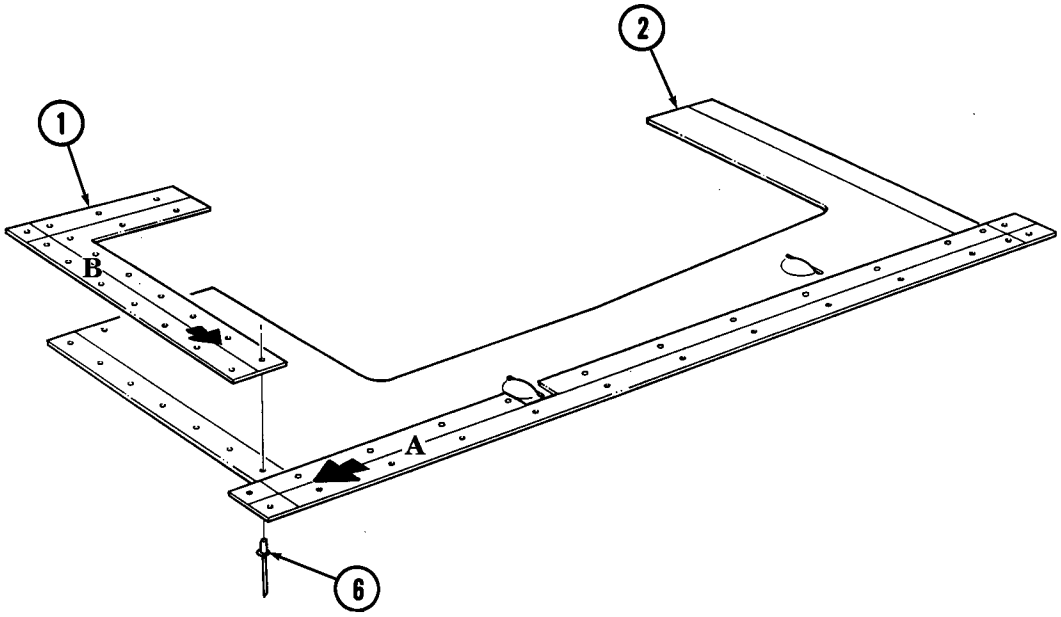
**e. Metal Strip B and Insert Panel Assembly**

1. Position metal strip B (1), with arrow facing up and toward metal strip A (3), on insert panel (2). Align reference lines (4) on metal strips A (3) and B (1) and line (5) with edge of metal strip B (1).
2. Using metal strip B (1) as a template, locate, mark, and drill nine 0.187-in. diameter holes through insert panel (2).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (2) and metal strip B (1).
4. Position metal strip B (1) on insert panel (2) and install with nine rivets (6).
5. Remove any adhesive residue and clean edges of metal strip B (1) and insert panel (2).



## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

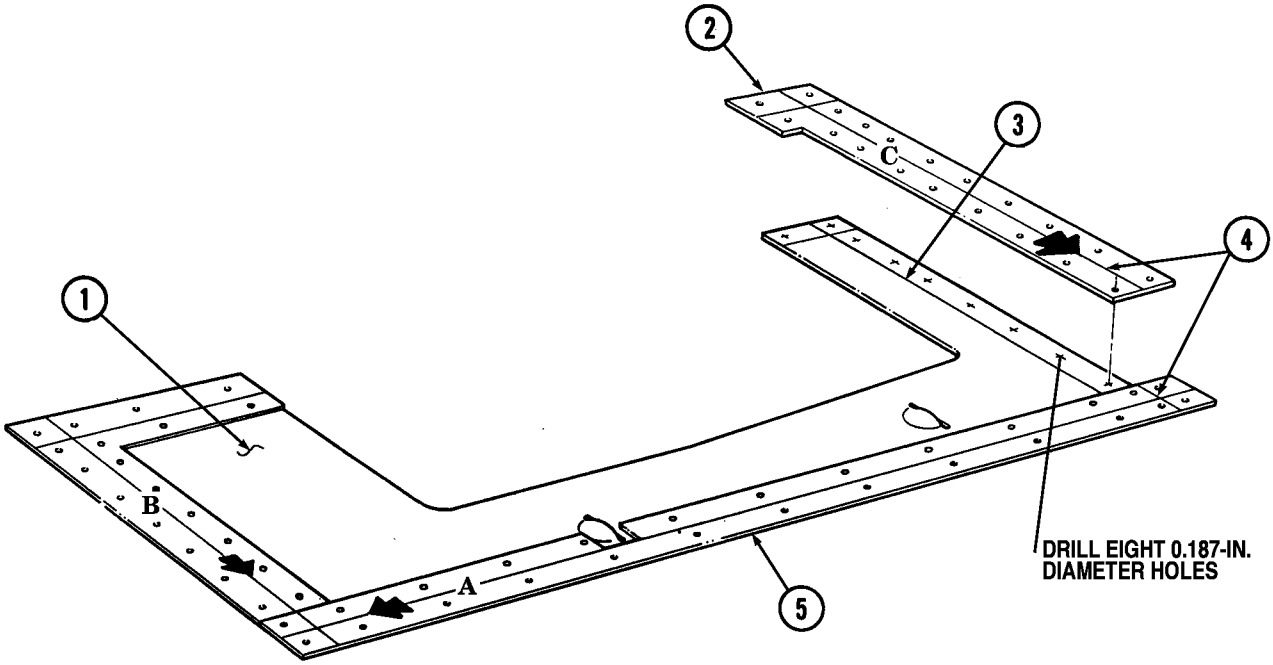


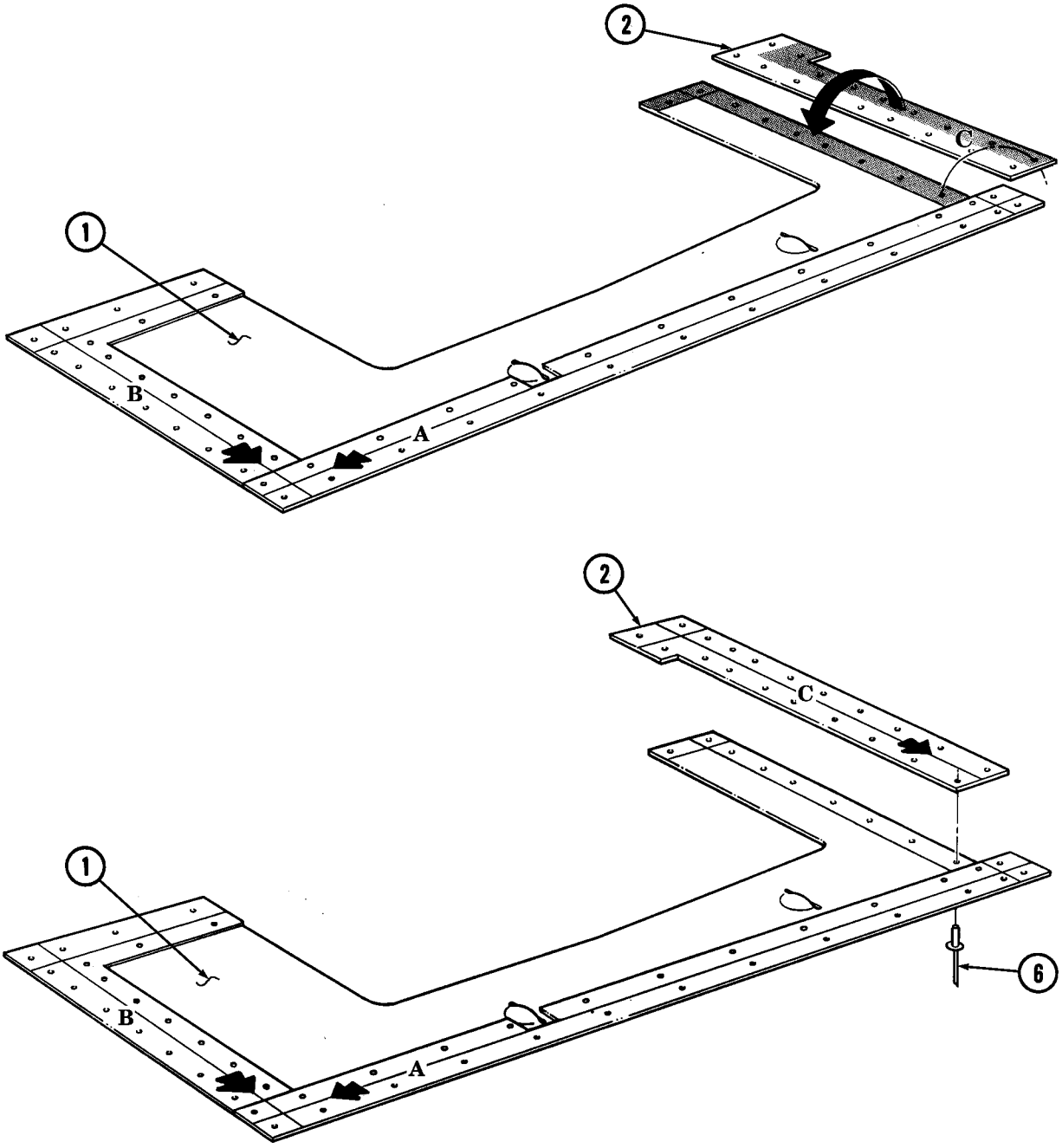
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

**f. Metal Strip C and Insert Panel Assembly**

1. Position metal strip C (2), with arrow facing up and toward metal strip A (5), on insert panel (1). Align reference lines (4) of metal strip A (5) and C (2) and line (3) with edge of metal strip C (2).
2. Using metal strip C (2) as a template, locate, mark, and drill eight 0.187-in. diameter holes through insert panel (1).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (1) and metal strip C (2).
4. Position metal strip C (2) on insert panel (1) and install with eight rivets (6).
5. Remove any adhesive residue and clean edges of metal strip C (2) and insert panel (1).



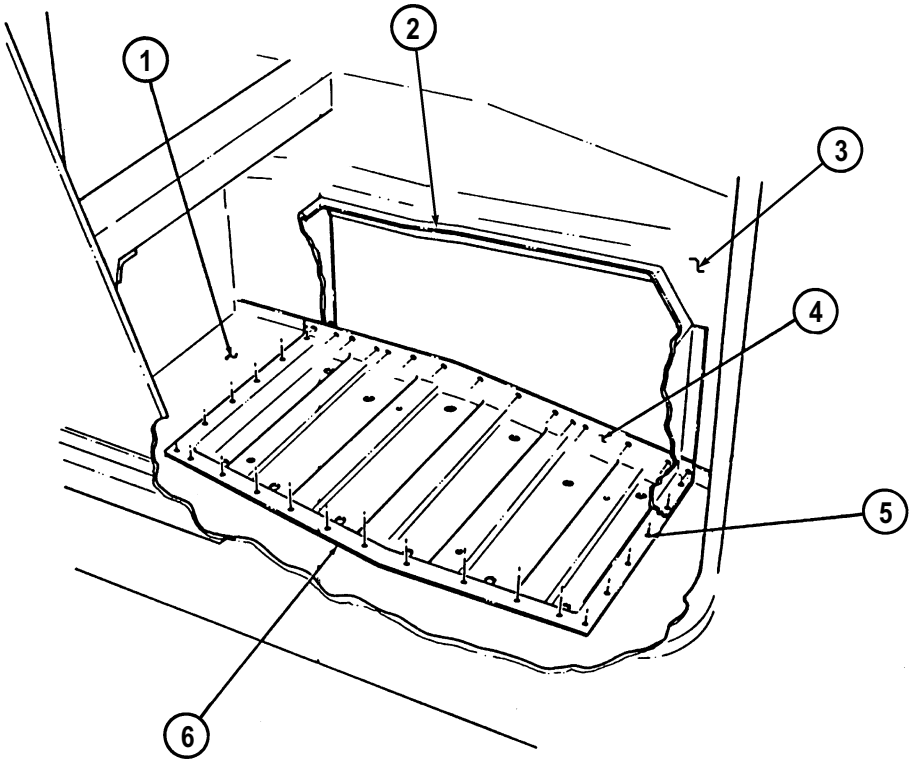
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)



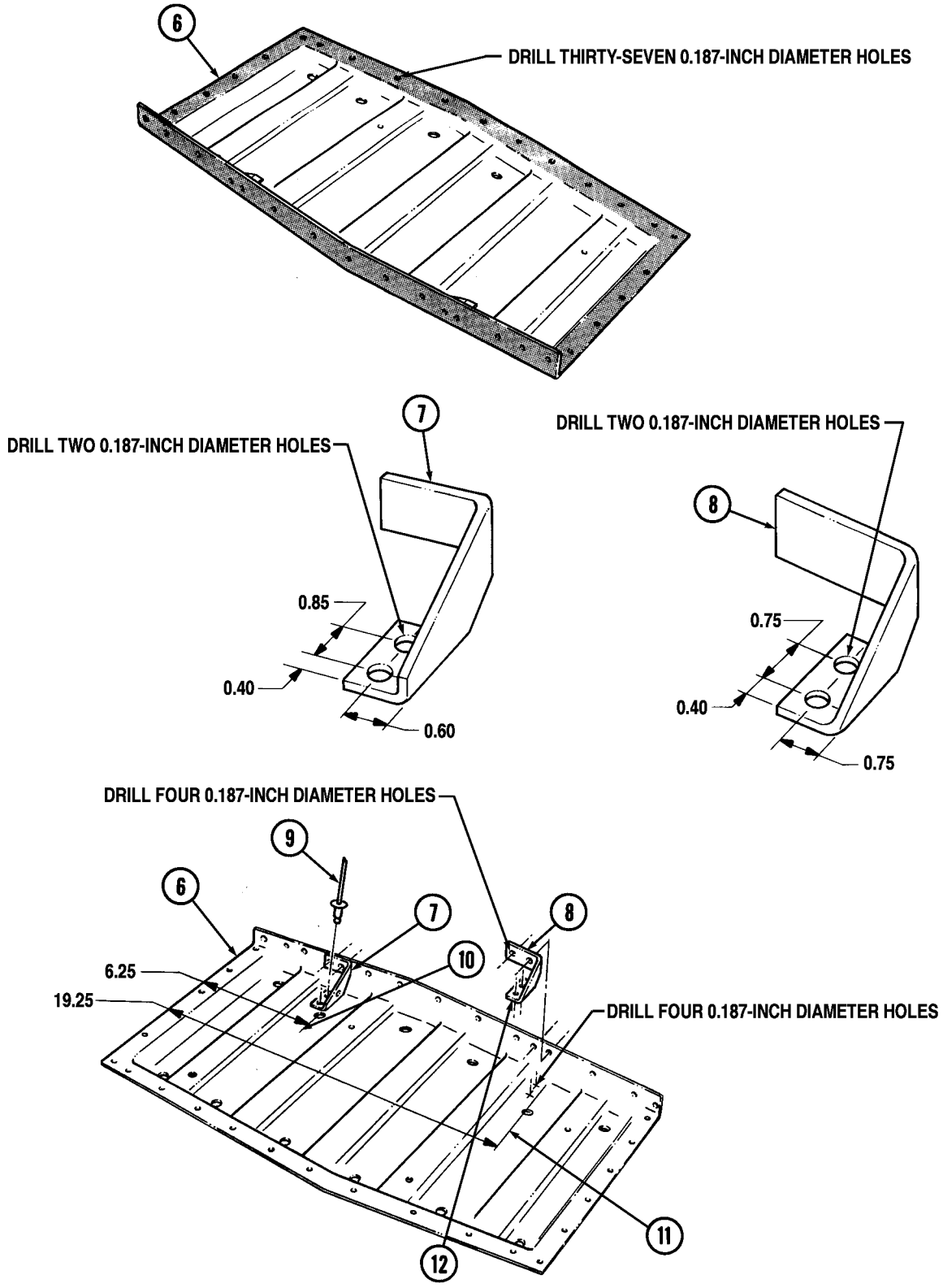
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

**g. Right Front Floor Panel and Battery Tray Drilling**

1. Position battery tray (6) on underside of right front floor (1), right front seat support (2), and tunnel (4).
2. Using right front seat support (2) as a template, mark twenty-two hole locations (5) on battery tray (6).
3. Using right tunnel (4) as a template, mark fifteen hole locations (3) on battery tray (6).
4. Drill thirty-seven 0.187-in. diameter holes, marked in steps 2 and 3, through battery tray (6).
5. Locate, mark, and drill two 0.187-in. diameter holes through holddown bracket (7).
6. Locate, mark, and drill two 0.187-in. diameter holes through holddown bracket (8).
7. Mark reference lines (10) and (11) on battery tray (6).
8. Position holddown bracket (8) to reference line (11) on battery tray (6).
9. Using holddown bracket (8) as a template, locate, mark, and drill two 0.187-in. diameter holes through battery tray (6).
10. Install holddown bracket (8) on battery tray (6) with two rivets (9).
11. Using battery tray (6) as a template, locate, mark, and drill two 0.187-in. diameter holes through holddown bracket (8).
12. Position holddown bracket (7) to reference line (10) on battery tray (6).
13. Using holddown bracket (7) as a template, locate, mark, and drill two 0.187-in. diameter holes through battery tray (6).
14. Install holddown bracket (7) on battery tray (6) with two rivets (9).
15. Using battery tray (6) as a template, locate, mark, and drill two 0.187-in. diameter holes through holddown bracket (7).



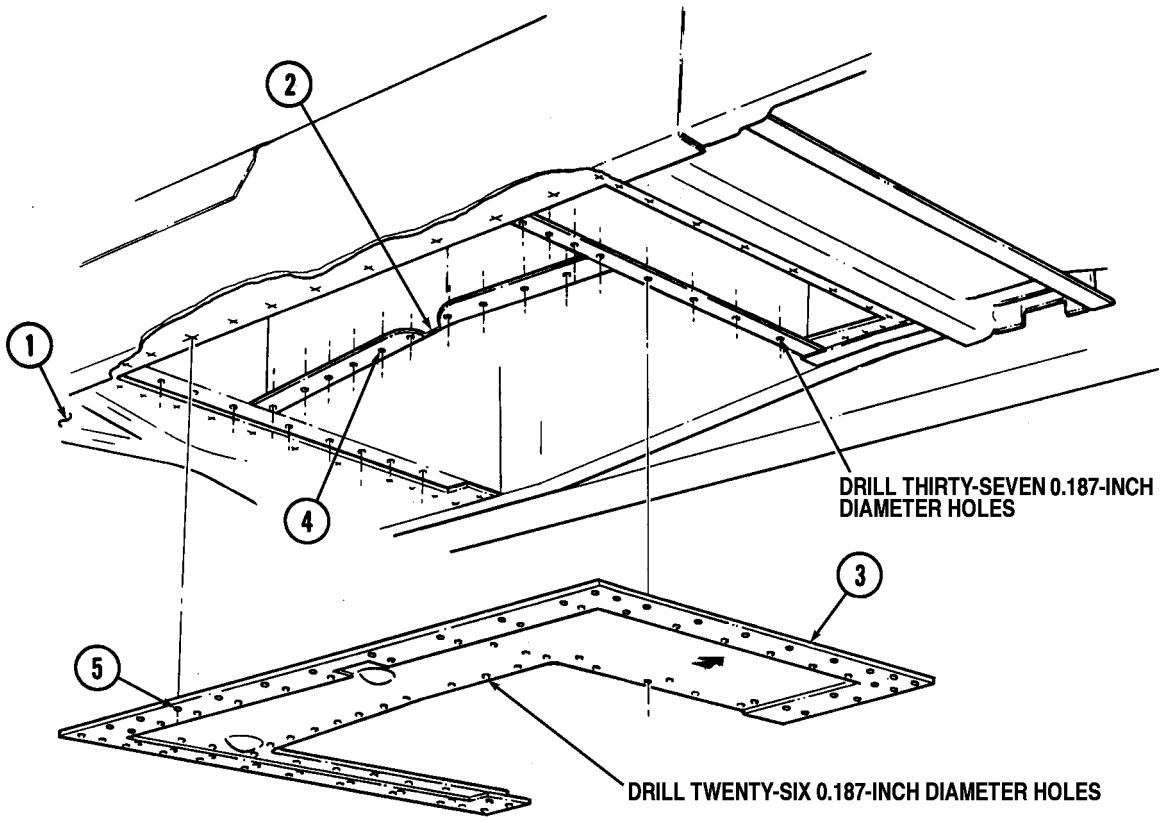
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)



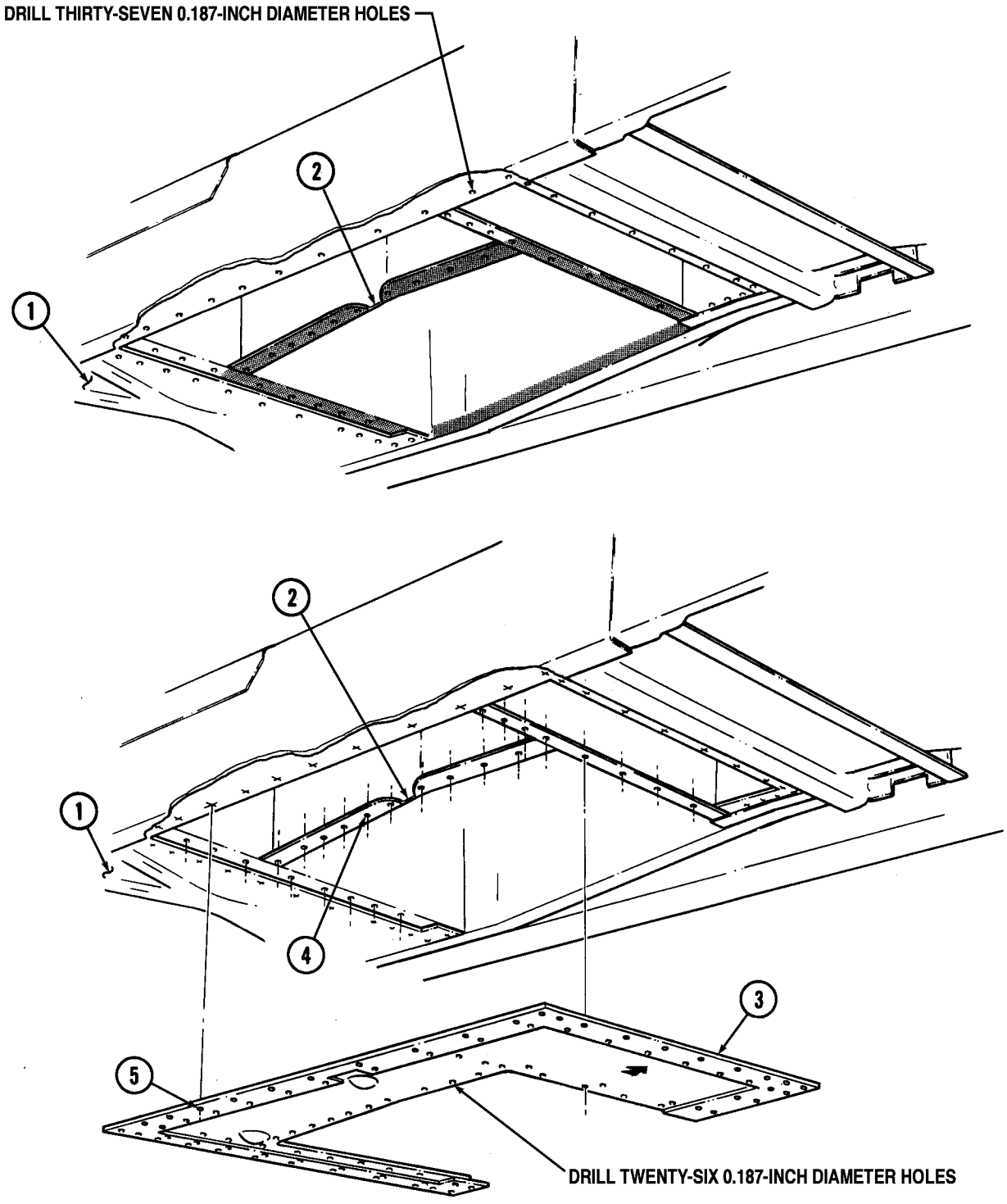
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

**h. Right Front Floor Panel and Insert Panel Drilling**

1. Position insert panel (3) on underside of right front floor panel (1) with arrow facing down and toward front of vehicle.
2. Using right front seat support (2) as a template, mark twenty-six hole locations (4) on insert panel (3).
3. Using insert panel (3) as a template, mark thirty-seven hole locations (5) on underside of right front floor panel (1).
4. Drill thirty-seven 0.187-in. diameter holes, marked in step 3, through underside of right front floor panel (1).
5. Drill twenty-six 0.187-in. diameter holes, marked in step 2, through insert panel (3).



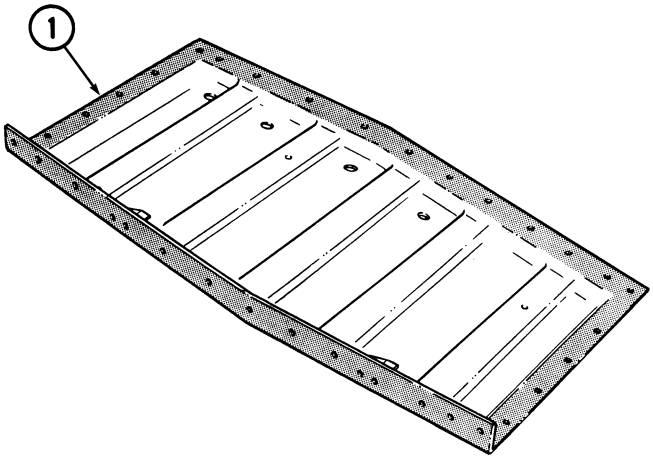
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

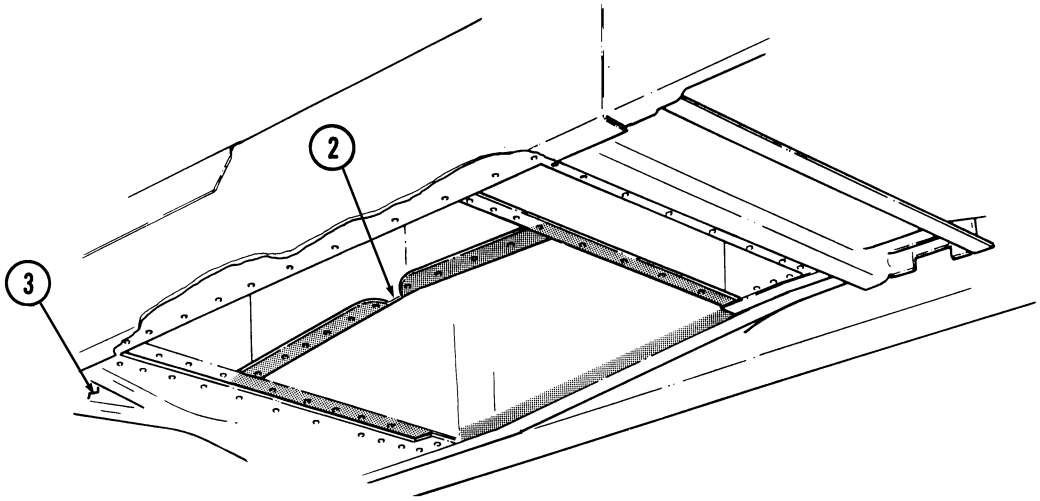


## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

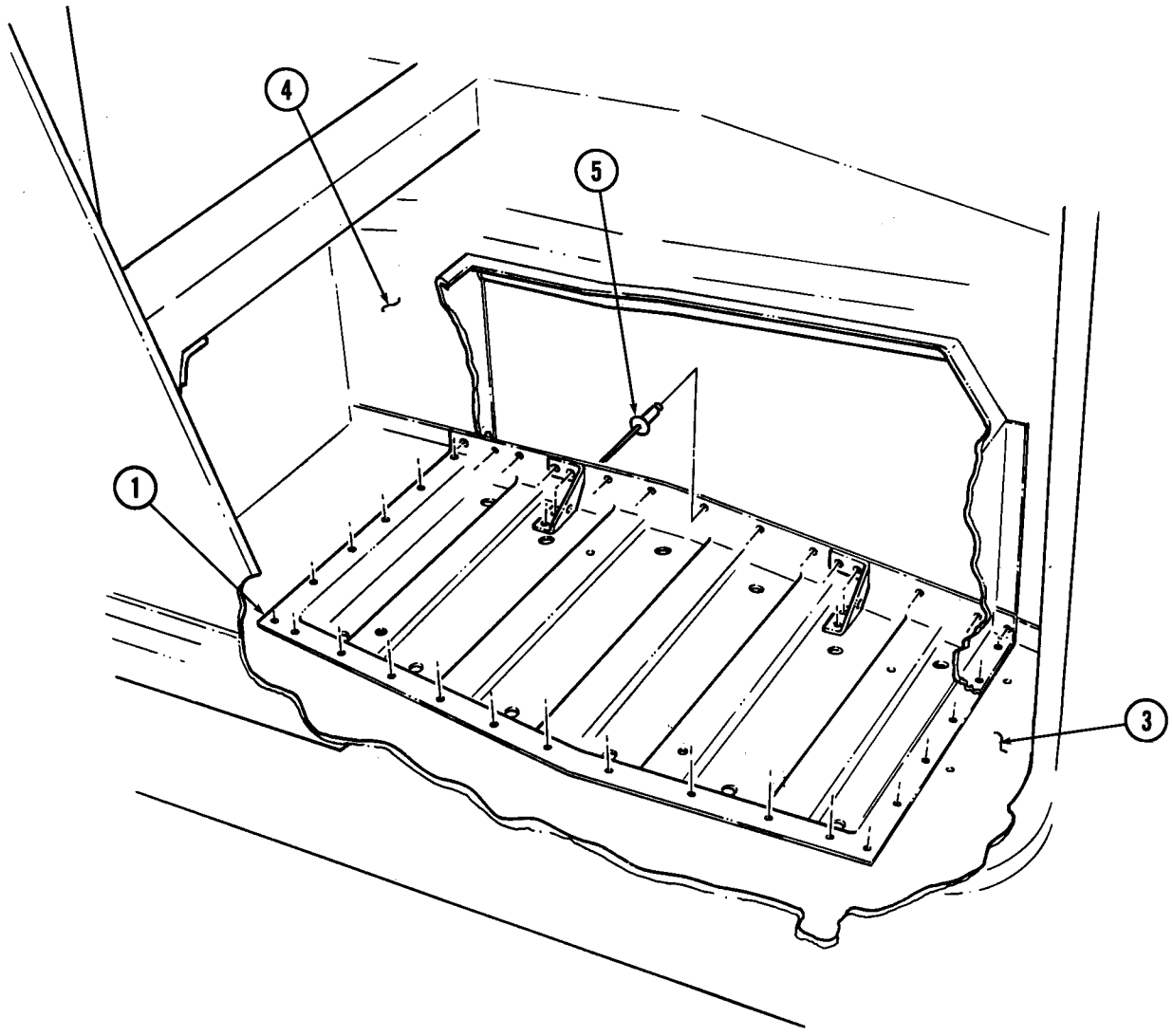
**i. Battery Tray Panel and Right Front Floor Panel Installation**

1. Place battery tray (1) on a suitable work surface.
2. Apply approximately 0.125-in. thickness of adhesive sealant to shaded area on battery tray (1).
3. Apply adhesive sealant to shaded area on underside of right front seat support (2).
4. Position battery tray (1) on underside of right front floor (3).
5. Install battery tray (1) on tunnel (4) with fifteen rivets (5).



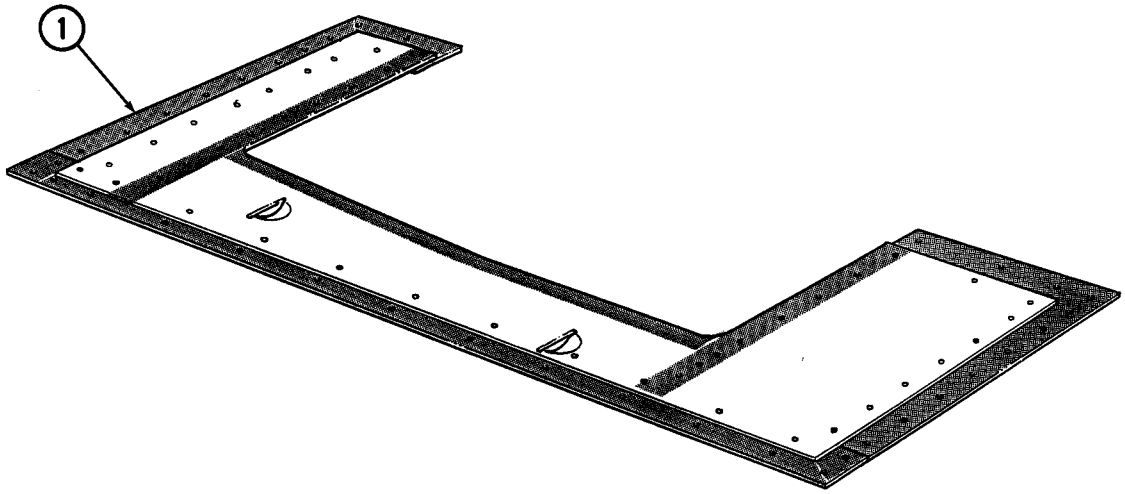
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)



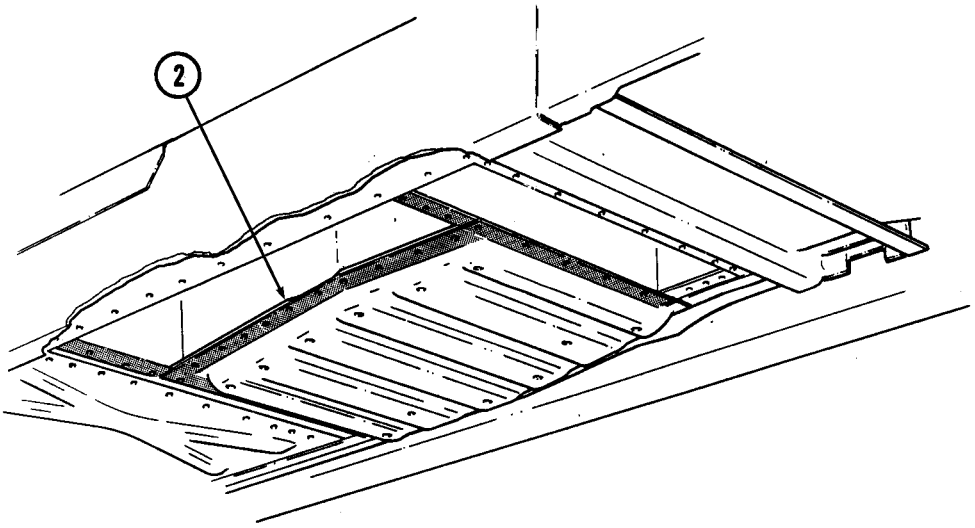
## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)

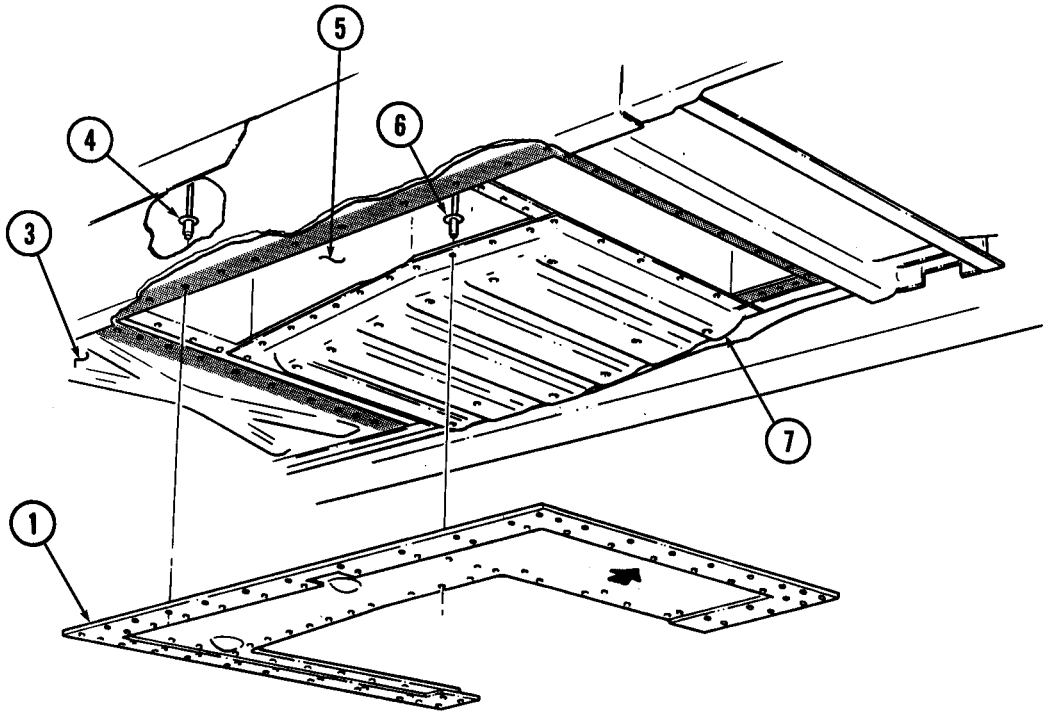
**j. Insert Panel and Right Front FloorPanel Installation**

1. Apply approximately 0.125-in. thickness of adhesive sealant to shaded area of insert panel (1).
2. Apply adhesive sealant to shaded area on underside of right front seat support (2).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded area on underside of right front panel (3).
4. Position insert panel (1) on underside of right front floor panel (3) with arrow facing down and toward front of vehicle.
5. Install insert panel (1) on right front seat support (5) and battery tray panel (7) with twenty-six rivets (6).
6. Secure insert panel (1) on right front floor panel (3) with thirty-seven rivets (4).
7. Spot-paint insert panel (1), battery tray panel (7), right front floor panel (3), and right front seat support (5). (Refer to TM 43-0139.)



## 22-9.4. RIGHT FRONT FLOOR PANEL REPAIR (Cont'd)




FOLLOW-ON TASKS:
- Install right floor insulation (TM 9-2320-280-20).
- Install battery tray (TM 9-2320-280-20).
- Install batteries (TM 9-2320-280-20).
- Install battery cover (TM 9-2320-280-20).

## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

**This task covers:**

**a. Right Rear Insert Panel Fabrication**
**b. Reinforcement Strips Fabrication**
**c. Metal Strips Fabrication**
**d. Right Rear Floor Panel Removal**
**e. Reinforcement Strip A and Insert Panel Assembly**
**f. Reinforcement Strip B and Insert Panel Assembly**
**g. Metal Strip C and Insert Panel Assembly**
**h. Metal Strip E and Insert Panel Assembly**
**i. Metal Strip D and Insert Panel Assembly**
**j. Right Rear Floor Panel and Insert Panel Drilling**
**k. Insert Panel and Right Rear Floor Panel Installation**

**INITIAL SETUP:**

**Tools**

General mechanic's tool set automotive (Appendix G, Item 1)

**Manual References**

TM 9-2320-280-20
TM 9-2320-280-24P
TM 43-0139

**Materials/Parts**

Eighty-five blind rivets (Appendix E, Item 194)
Sixty blind rivets (Appendix E, Item 195)
Adhesive (Appendix B, Item 1.1)
Adhesive sealant (Appendix B, Item 4.1)
Sheet metal (Appendix E, Item 245)

**Equipment Condition**

- Right seat back removed (TM 9-2320-280-20).
- Right rear seat bottom removed (TM 9-2320-280-20).
- Right rear floor insulation removed (TM 9-2320-280-20).

**Maintenance Level**

General Support

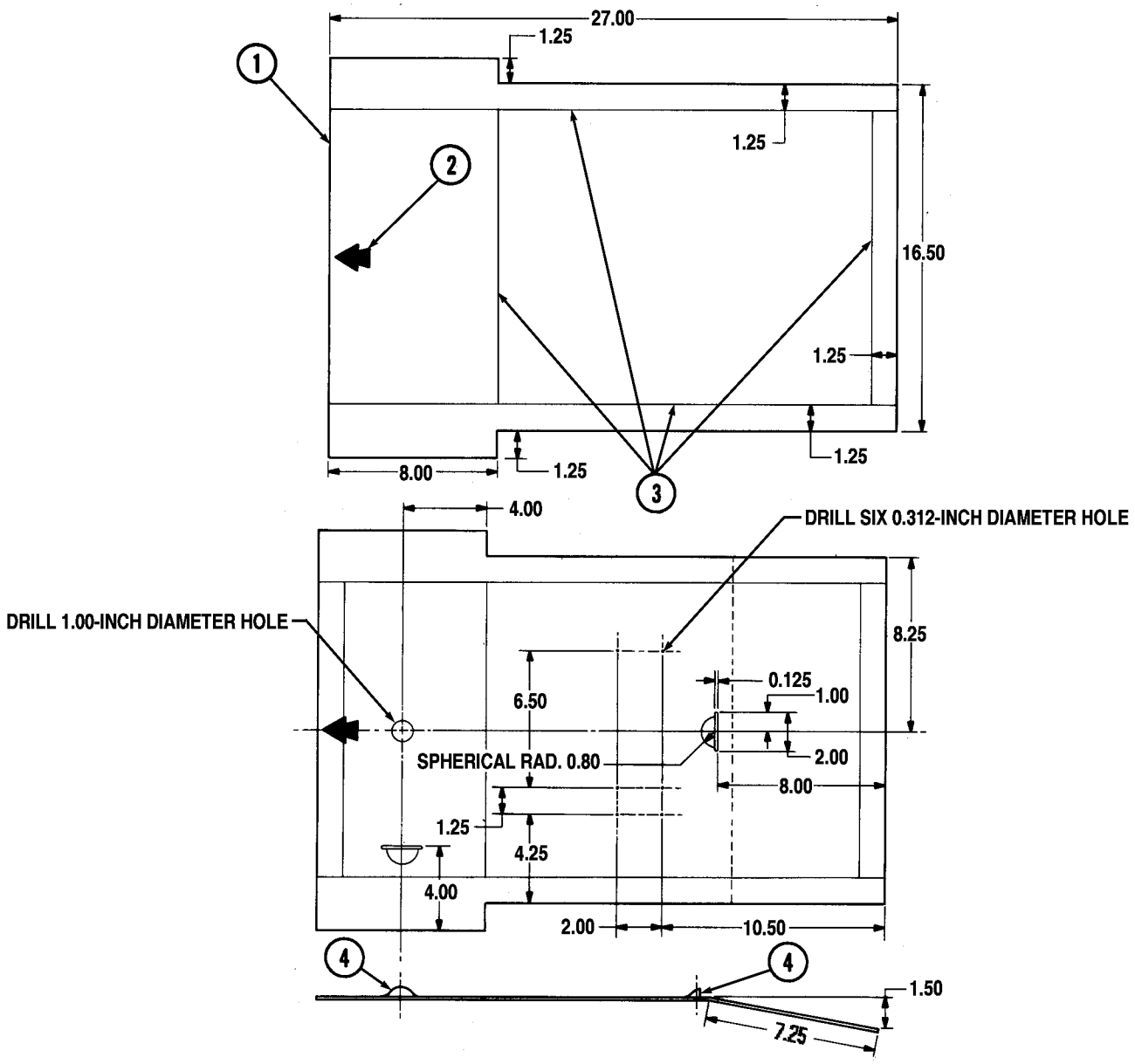
**NOTE**

All dimensions in this procedure are in inches.

### a. Right Rear Insert Panel Fabrication

1. Cut insert panel (1) from sheet metal, and mark four reference lines (3) and directional arrow (2) on insert panel (1).
2. Locate, mark, and drill six 0.312-in. diameter holes and one 1.00-in. diameter hole through insert panel (1).
3. Fabricate two drain holes (4) in insert panel (1).
4. Bend insert panel (1) 1.50 in.
5. Remove all burrs and round all sharp edges of insert panel (1).

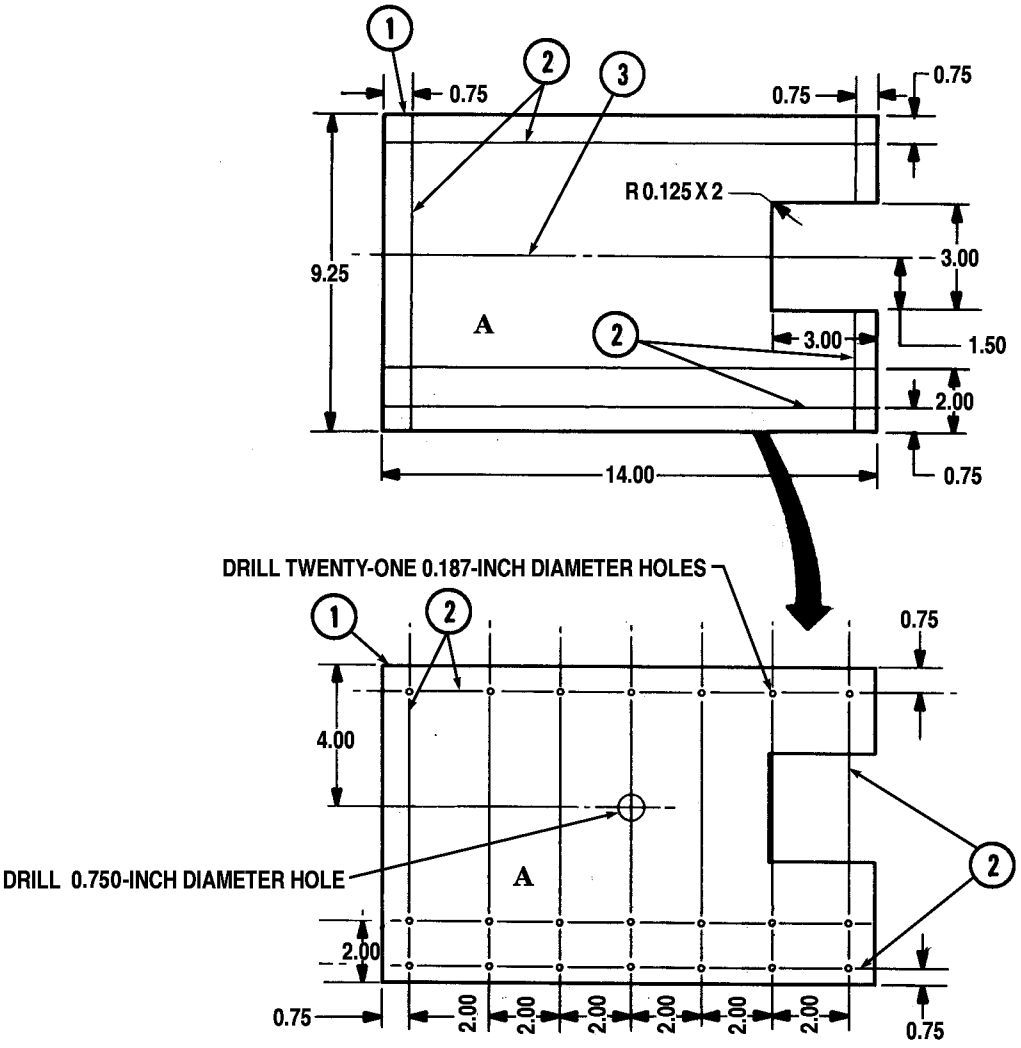
## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)



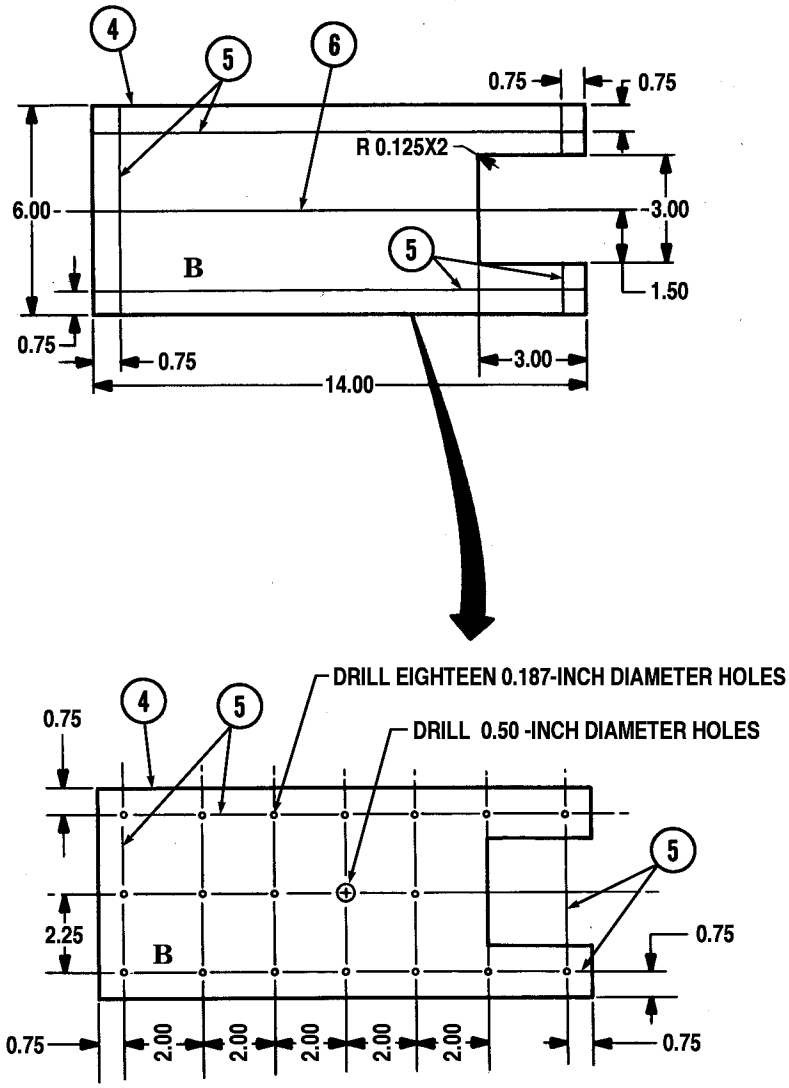
## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

**b. Reinforcement Strips Fabrication**

1. Cut reinforcement strip (1) from sheet metal, and mark four reference lines (2), centerline (3), and identify as A on reinforcement strip (1).
2. Locate, mark, and drill twenty-one 0.187-in. diameter holes and a 0.750-in. diameter hole through reinforcement strip A (1).
3. Remove all burrs and round sharp edges of reinforcement strip A (1).
4. Cut reinforcement strip (4) from sheet metal, and mark four reference lines (5) and centerline (6). Identify reinforcement strip (1) as B.
5. Locate, mark, and drill eighteen 0.187-in. diameter holes and a 0.500-in. diameter hole through reinforcement strip B (4).
6. Remove all burrs and round sharp edges of reinforcement strip B (4).



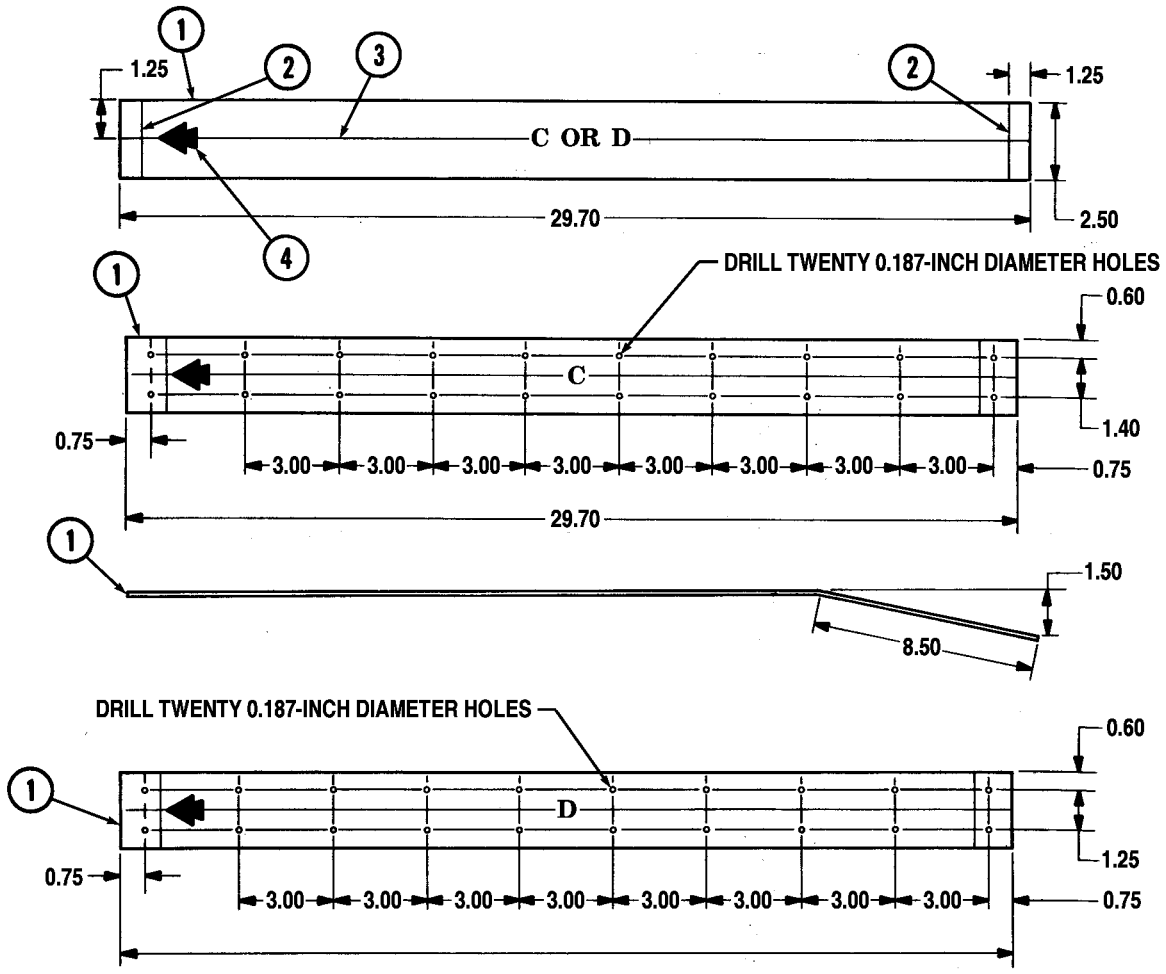
## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

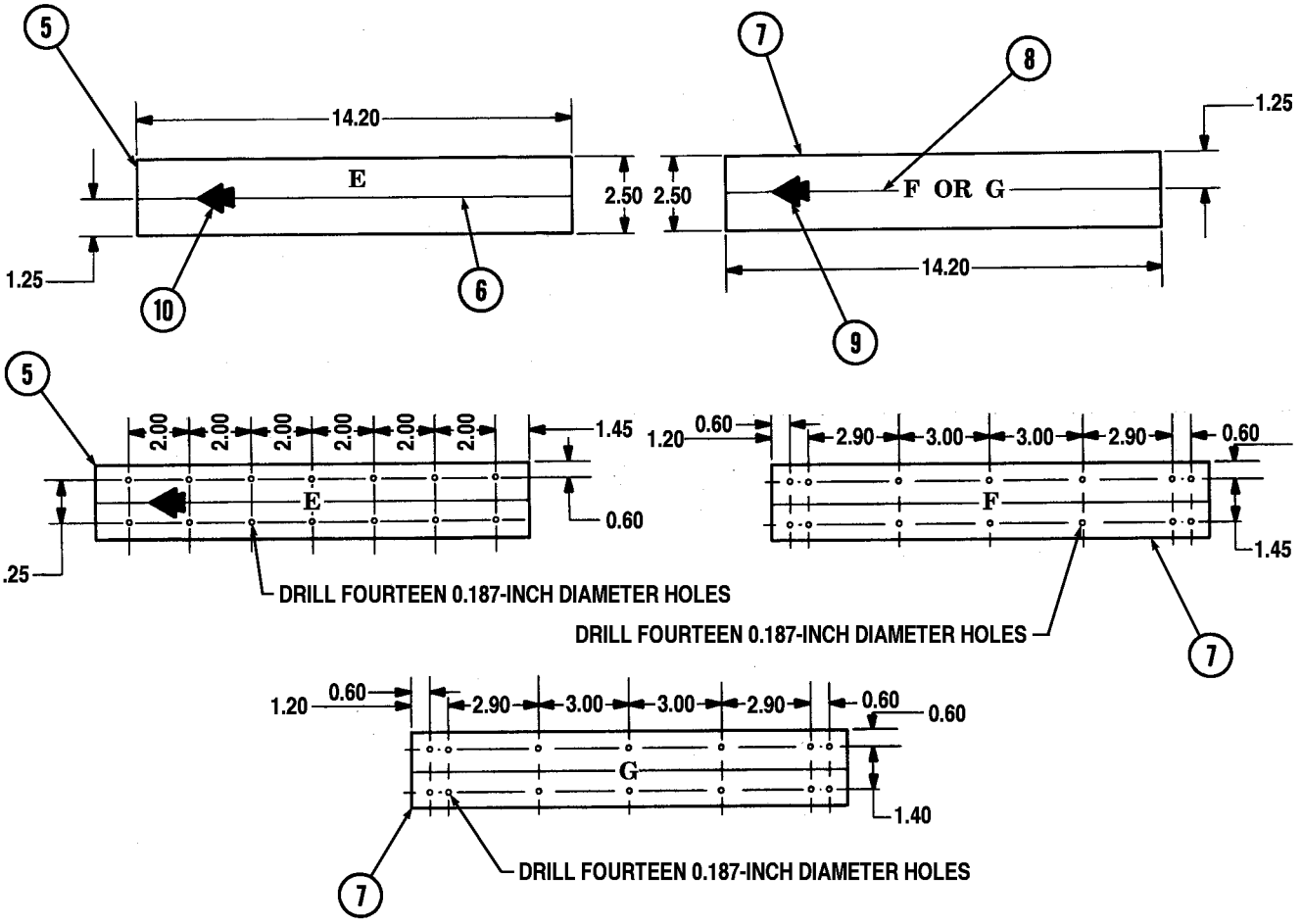
**c. Metal Strips Fabrication**

1. Cut two metal strips (1) from sheet metal, and mark two reference lines (2), centerline (3), and directional arrow (4), and identify as metal strips C and D.
2. Locate, mark, and drill twenty 0.187-in. diameter holes through metal strip C (1).
3. Bend metal strip C (1) 1.50 in.
4. Place metal strip D (1), on a suitable work surface, with arrow facing up and to the left.
5. Locate, mark, and drill twenty 0.187-in. diameter holes through metal strip D (1).
6. Bend metal strip D (1) 1.50 in.



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

7. Cut metal strip (5) from sheet metal, and mark center line (6) and directional arrow (10). Identify metal strip (5) as E.
8. Place metal strip E (5) on a suitable work surface, with arrow facing up and left.
9. Locate, mark, and drill fourteen 0.187-in. diameter holes in metal strip E (5).
10. Cut two metal strips (7) from sheet metal, and mark center line (8), and directional arrow (9). Identify metal strips (7) as F and G.
11. Locate, mark, and drill fourteen 0.187-in. diameter holes in metal strip F (7).
12. Locate, mark, and drill fourteen 0.187-in. diameter holes in metal strip G (7).



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

**d. Right Rear Floor Panel Removal**

**NOTE**

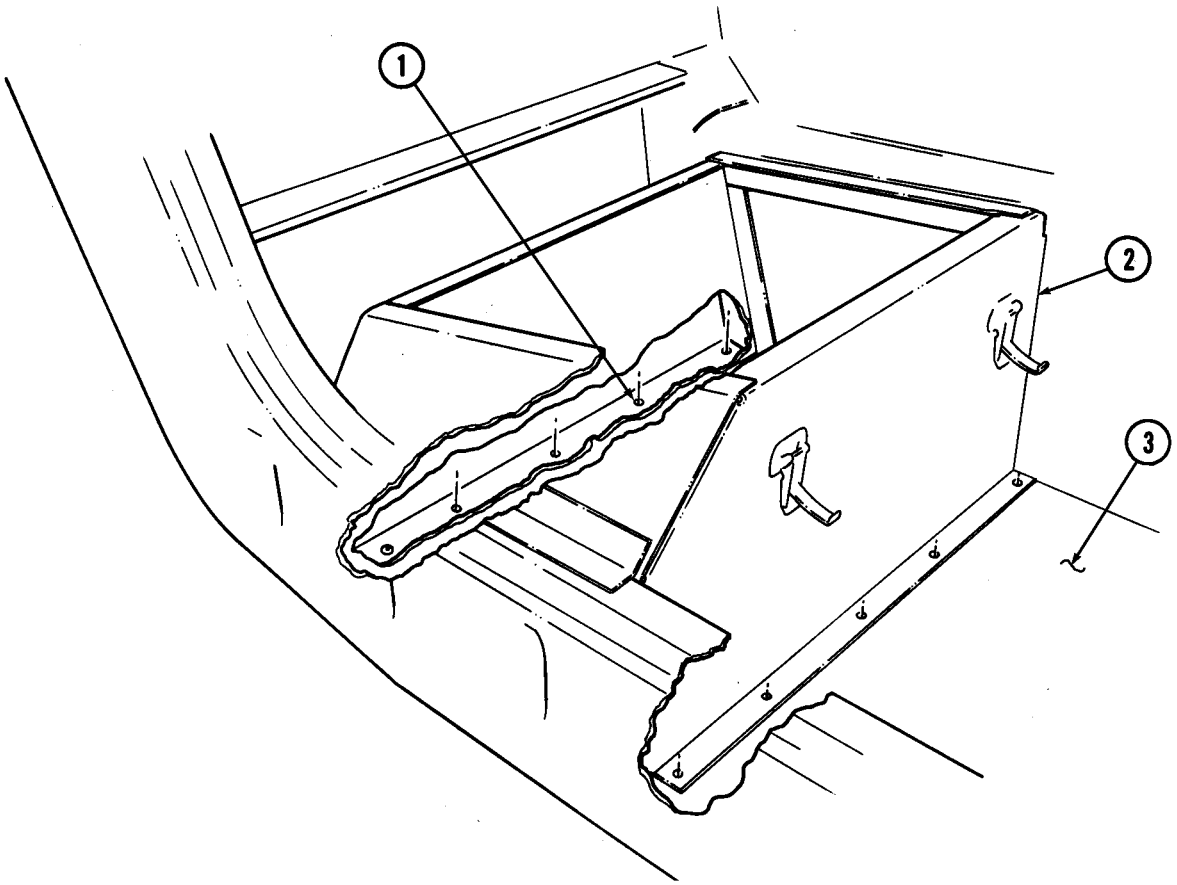
If vehicle is not equipped with right rear seat support installed, proceed to step 2.

1. Using a 0.187-in. drill, remove nine rivets (1) from right rear sear support (2) and right rear floor panel (3).
2. Position insert panel (4), with arrow facing down and toward front of vehicle, on underside of right rear floor panel (3) and align mount hole (5) with hole in floor panel (3).
3. Using insert panel (4) as a template, scribe an outline (6) on right rear floor panel (3).

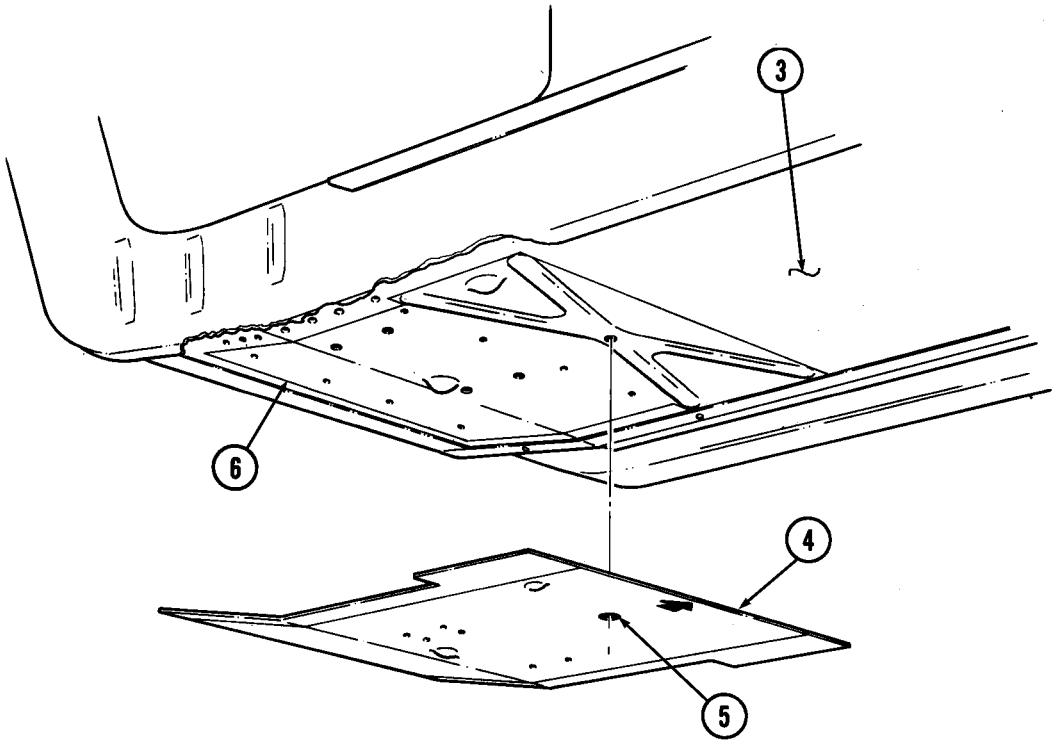
**NOTE**

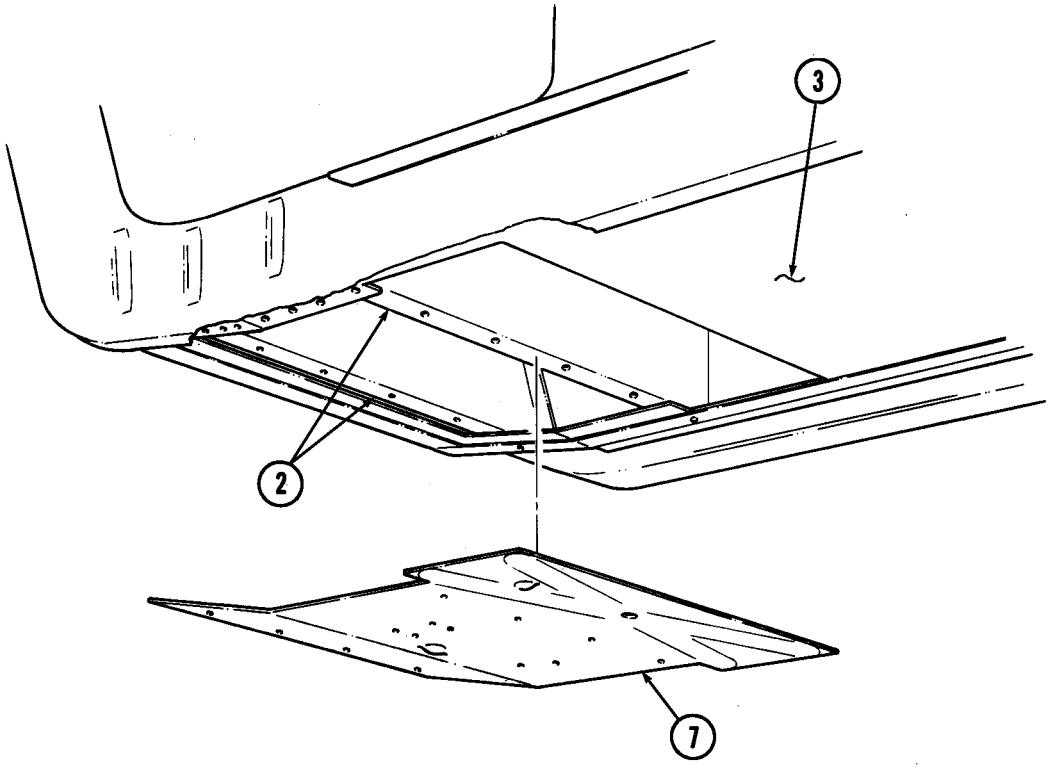
Do not cut through rear seat support when removing right rear floor panel section.

4. Using scribed outline marked in step 3 as a guide, cut and remove floor panel (7).
5. Remove sharp edges and burrs on floor panel (3).
6. Remove adhesive residue and clean right rear seat support (2),



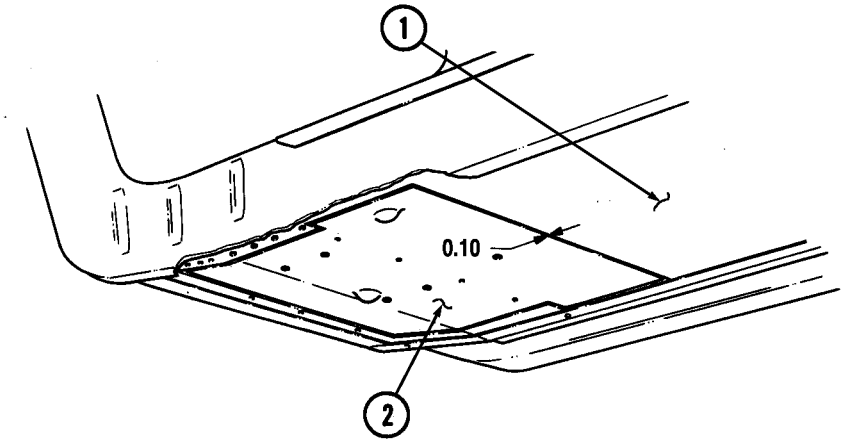
## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

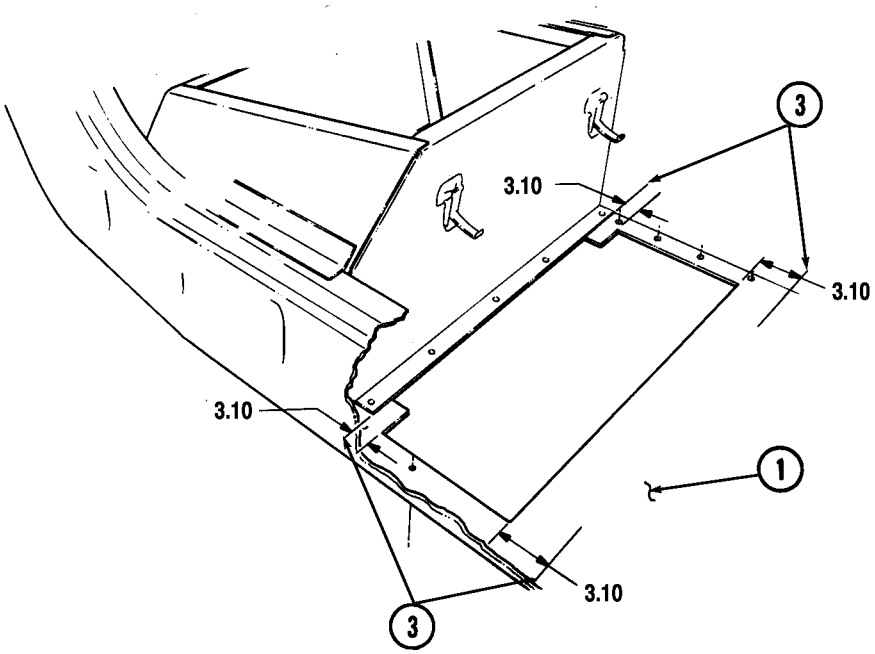


## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

7. Position insert panel (2), with arrow facing down and toward front of vehicle, on underside of right rear floor panel (1).
8. Obtain a minimum clearance of 0.10 in. between edges of insert panel (2) and right rear floor panel (1).
9. Remove insert panel (2).
10. Locate and mark four reference lines (3) on right rear floor panel (1).

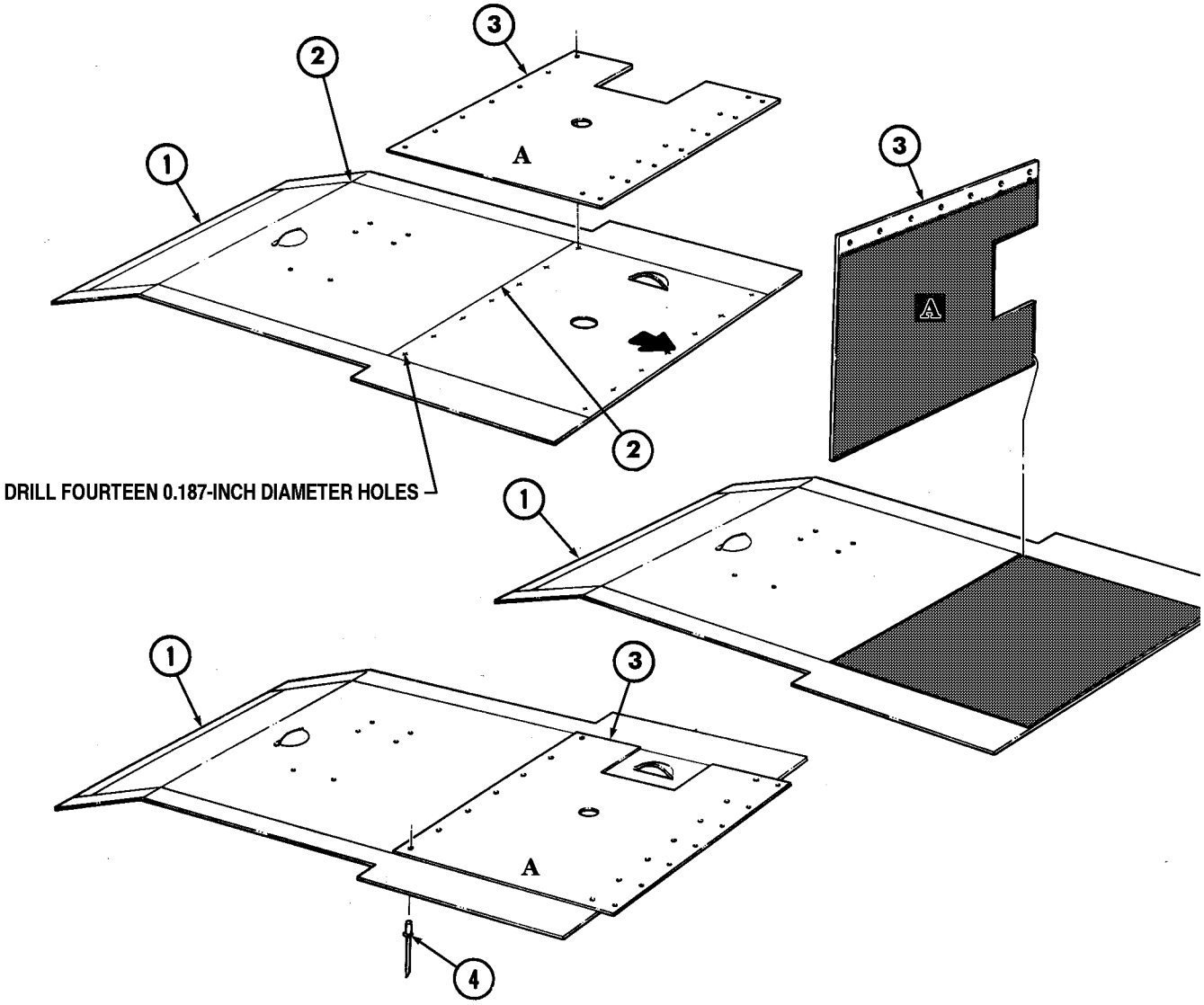


## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

**e. Reinforcement Strip Aand Insert Panel Assembly**

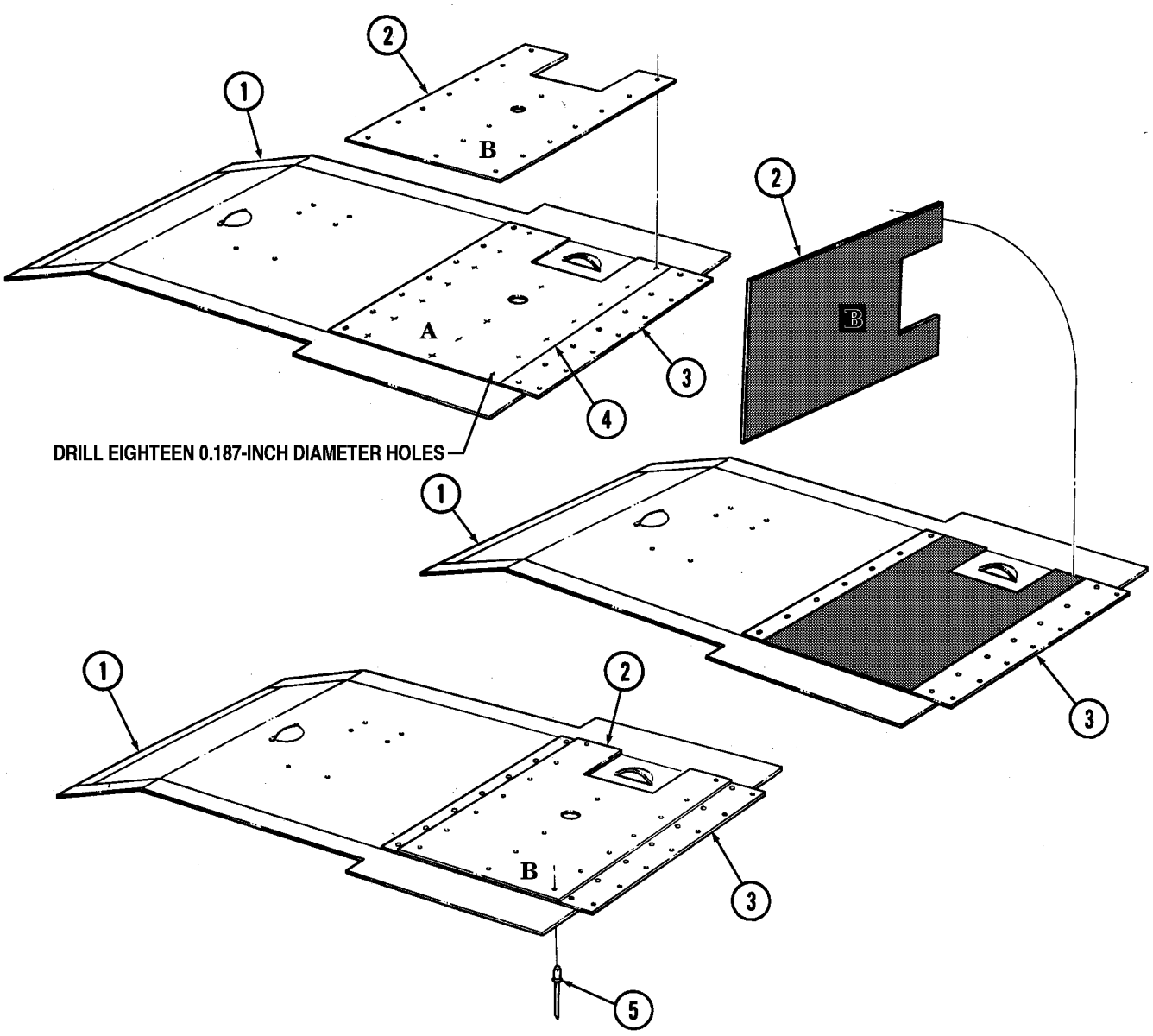
1. Position reinforcement strip A (2) on insert panel (1). Align reference line (3) with edge of reinforcement strip A (2).
2. Using reinforcement strip A (2) as a template, locate, mark, and drill fourteen 0.187-in. diameter holes through insert panel (1). Remove reinforcement strip A (2).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (1) and reinforcement strip A (2).
4. Position reinforcement strip A (2) on insert panel (1) and install with fourteen rivets (4).
5. Remove any adhesive residue and clean edges of reinforcement strip A (2) and insert panel (1).



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

### f. Reinforcement Strip B and Insert Panel Assembly

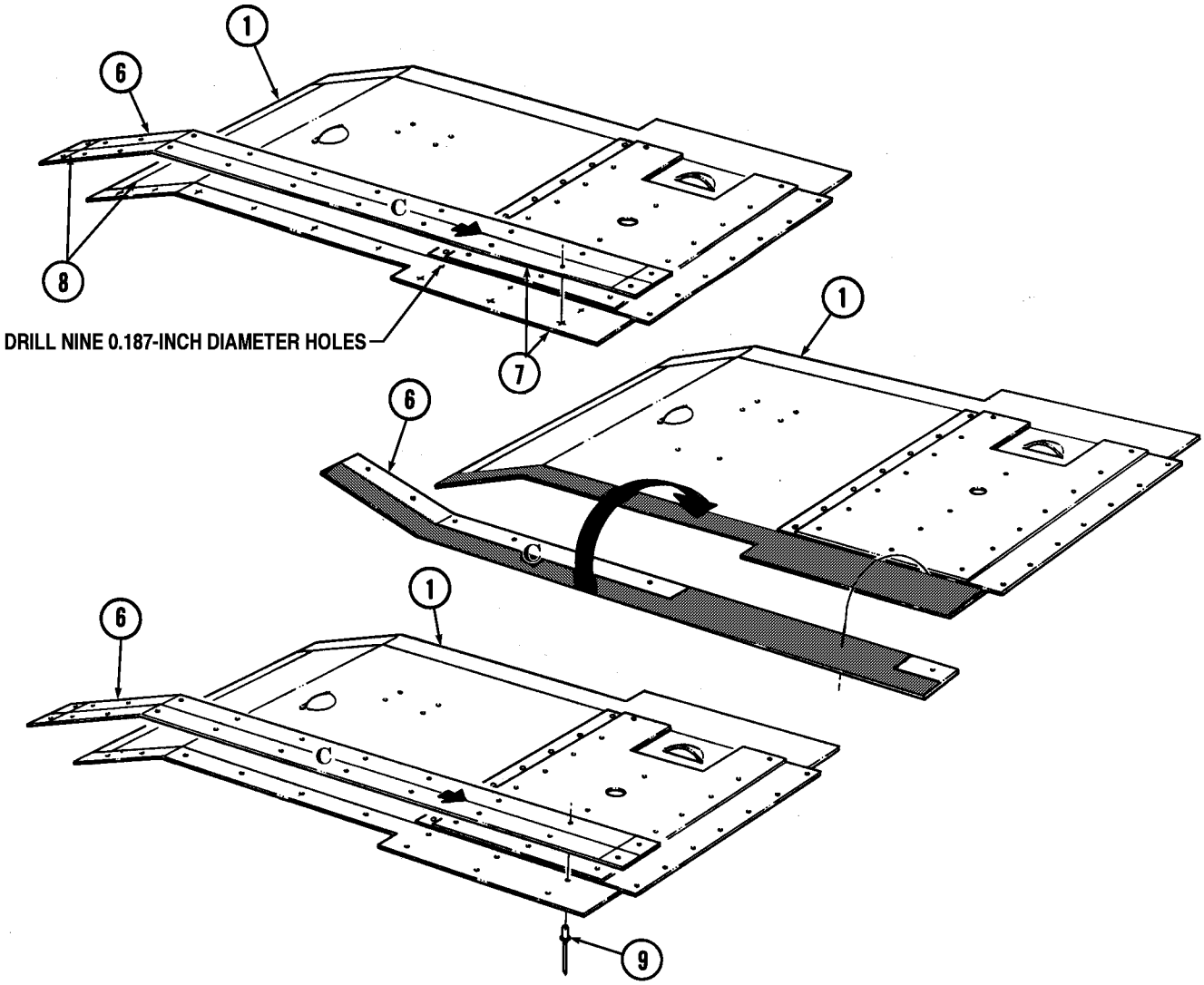
1. Position reinforcement strip B (2) on reinforcement strip A (3). Align between reference line (4) and side edge of reinforcement strip B (2).
2. Using reinforcement strip B (2) as a template, locate, mark, and drill eighteen 0.187-in. diameter holes in reinforcement strip A (3) and insert panel (1). Remove reinforcement strip B (2).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surfaces of reinforcement strip A (3) and reinforcement strip B (2).
4. Position reinforcement strip B (2) on reinforcement strip A (3) and install with eighteen rivets (5).
5. Remove any adhesive residue and clean edges of reinforcement B (2), reinforcement strip A (3), and insert panel (1).



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

**g. Metal Strip C and Insert Panel Assembly**

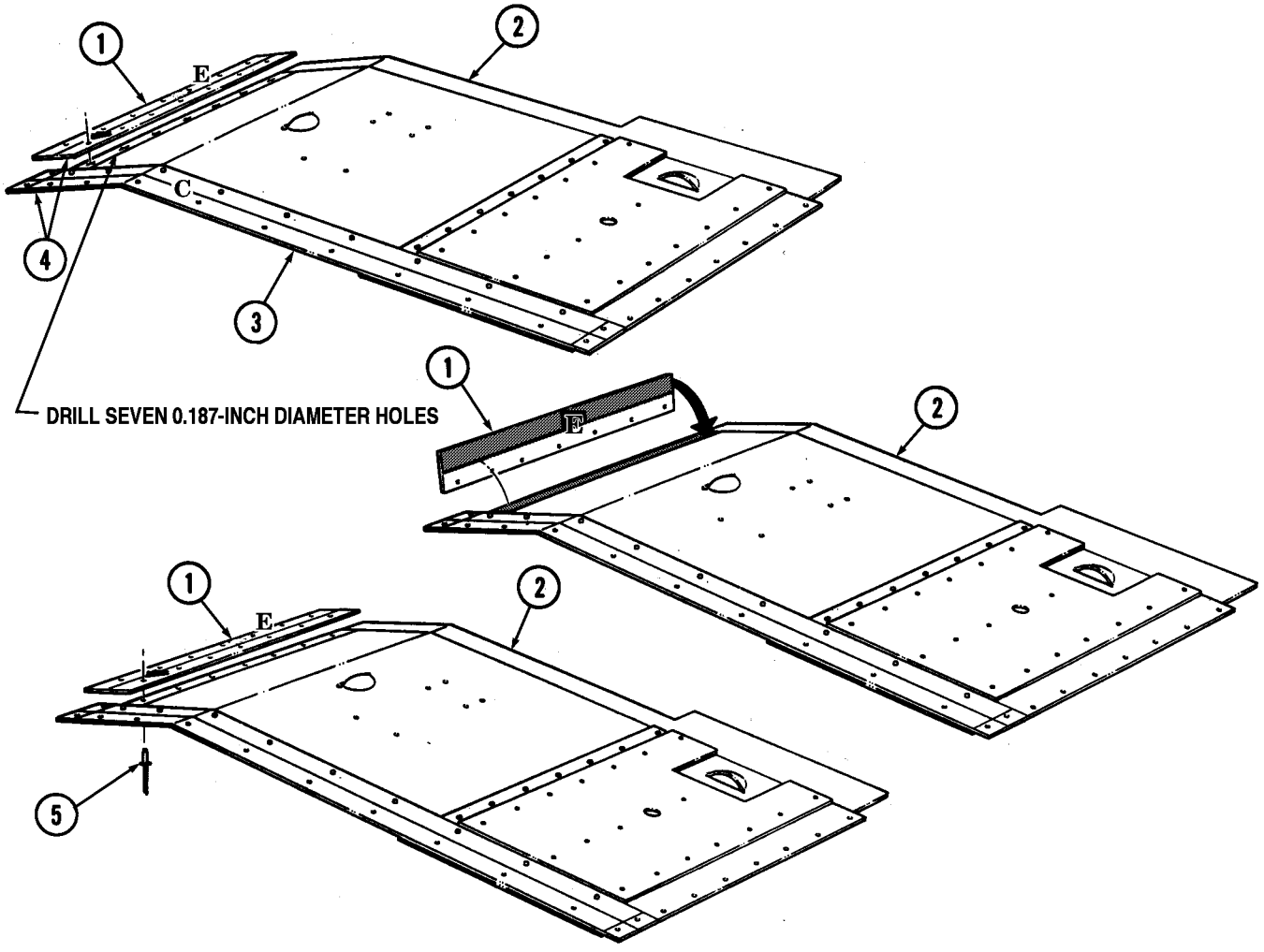
1. Position metal strip C (6) with arrow facing up and toward right on insert panel (1). Align reference lines (8) and insert panel edges (7).
2. Using metal strip C (6) as a template, locate, mark, and drill nine 0.187-in. diameter holes through insert panel (1).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (1) and metal strip C (6).
4. Position metal strip C (6) on insert panel (1) and install with nine rivets (9).
5. Remove any adhesive residue and clean edges of metal strip C (6) and insert panel (1).



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

**h. Metal Strip E and Insert Panel Assembly**

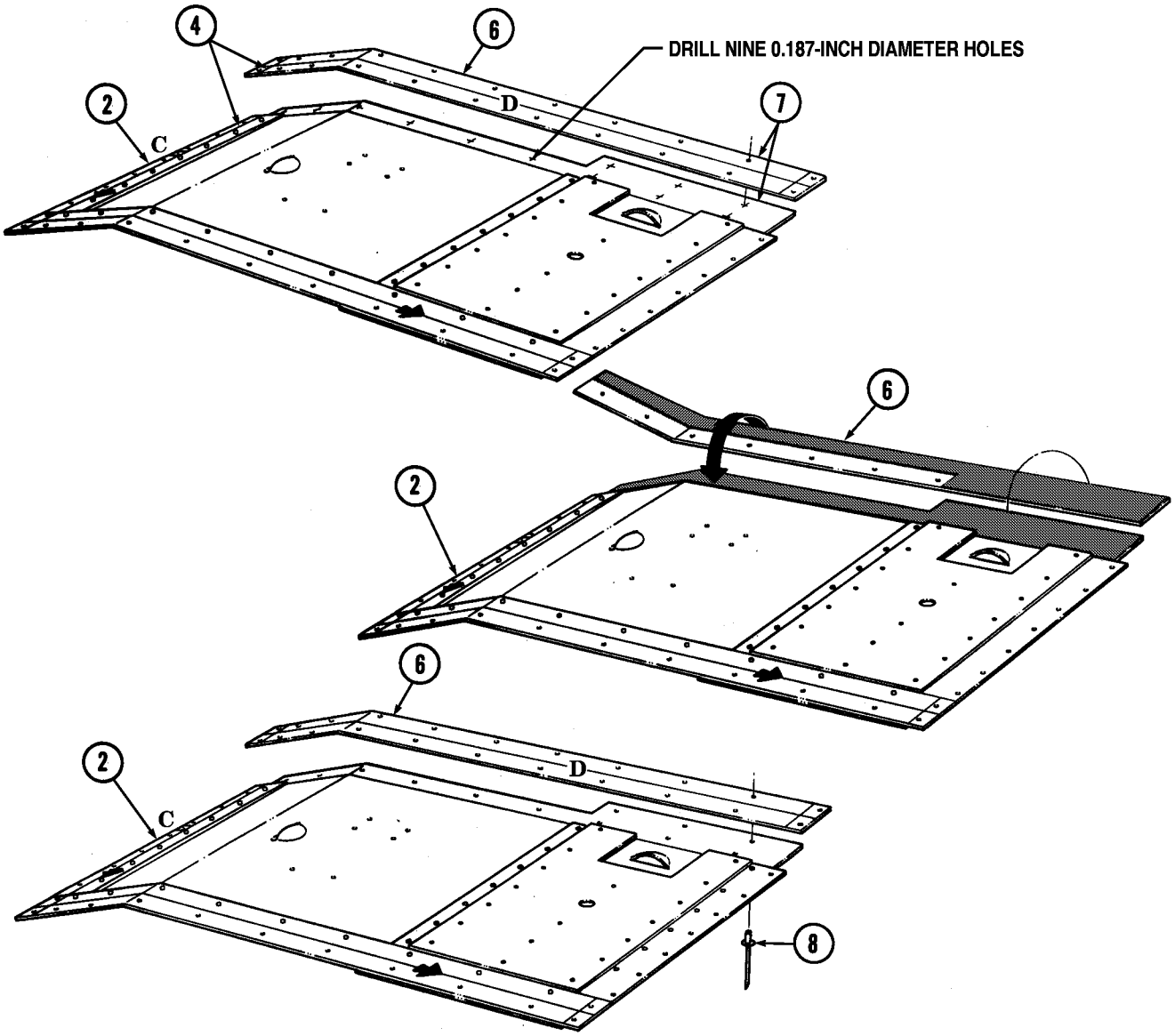
1. Position metal strip E (1), with arrow facing up and toward metal strip C (3), on insert panel (2) and align reference lines (4).
2. Using metal strip E (1) as a template, locate, mark, and drill seven 0.187-in. diameter holes through insert panel (2). Remove metal strip E (1).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (2) and metal strip E (1).
4. Position metal strip E (1) on insert panel (2) and install with seven rivets (5).
5. Remove any adhesive residue and clean edges of metal strip E (1) and insert panel (2).



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

### i. Metal Strip D and Insert Panel Assembly

1. Position metal strip D (6), with arrow facing up and right, onto insert panel (2). Align reference lines (4) and insert panel edges (7).
2. Using metal strip D (6) as a template, locate, mark, and drill nine 0.187-in. diameter holes through insert panel (2). Remove metal strip D (6).
3. Apply approximately 0.125-in. thickness of adhesive sealant to shaded surface of insert panel (2) and metal strip D (6).
4. Position metal strip D (6) on insert panel (2) and install with nine rivets (8).
5. Remove any adhesive residue and clean edges of metal strip D (6) and insert panel (2).



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

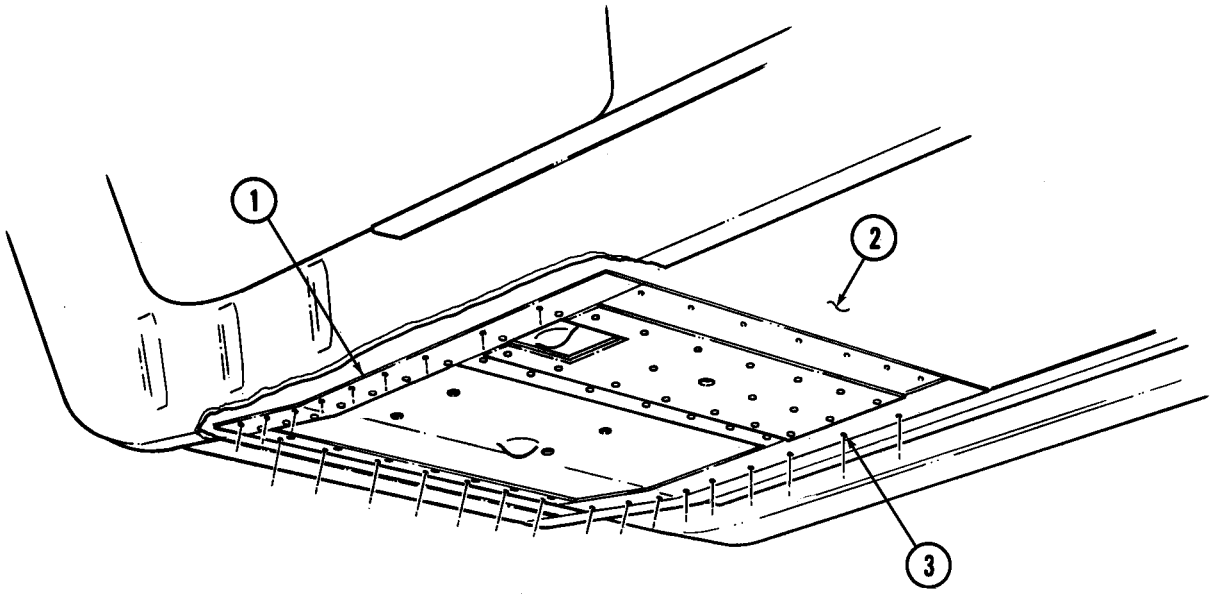
**j. Right Rear Floor Panel and Insert Panel Drilling**

1. Position insert panel (1) on underside of right rear floor panel (2).

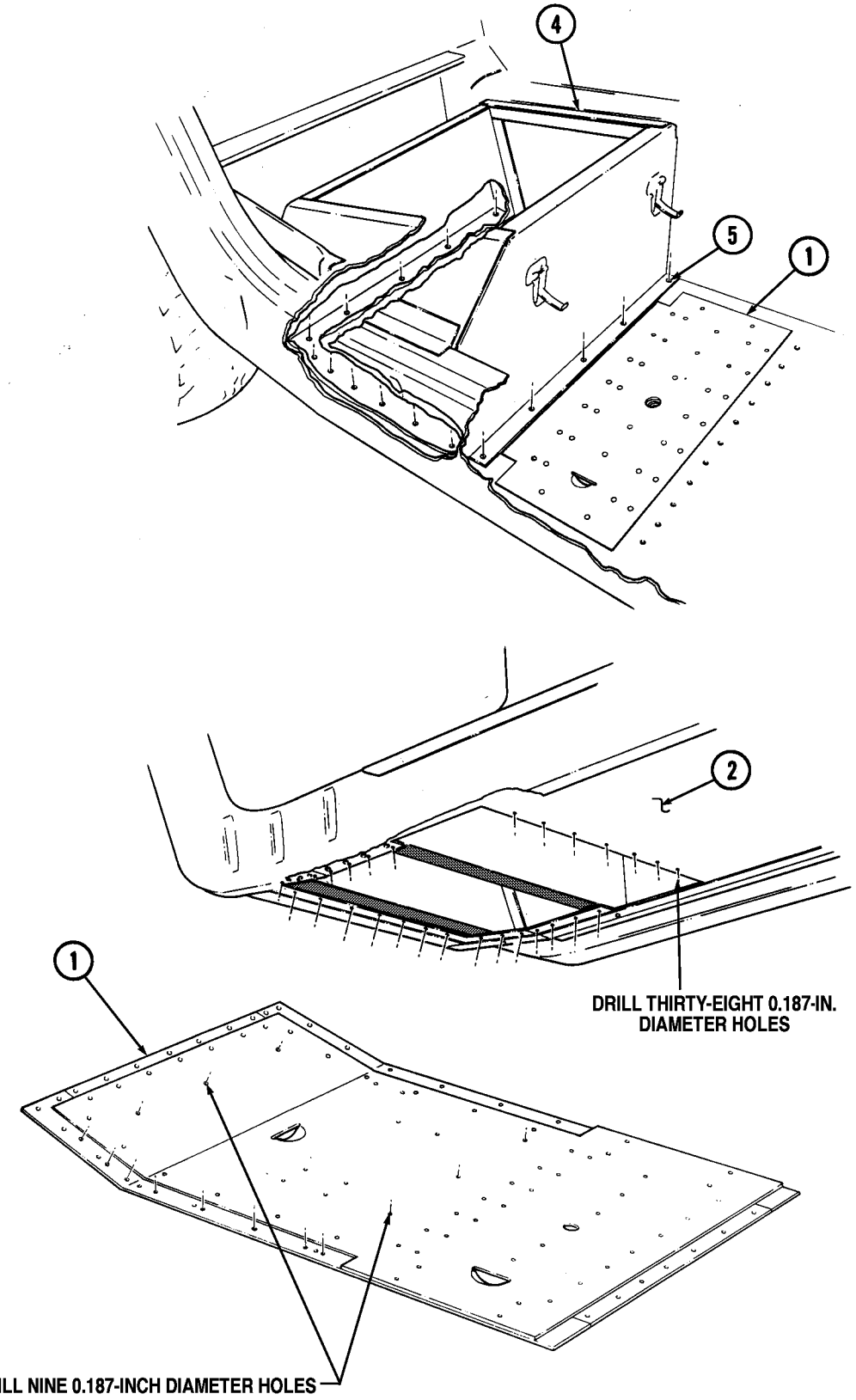
**NOTE**

If vehicle is not equipped with right rear seat support installed, proceed to step 3.

2. Using right rear seat support (4) as a template, locate and mark sixteen hole locations (5) on insert panel (1).
3. Using insert panel (1) as a template, mark thirty-eight hole locations (3) on underside of right rear floor panel (2). Remove insert panel (1).
4. Drill thirty-eight 0.187-in. diameter holes in underside of right rear floor panel (2).
5. Drill nine 0.187-in. diameter holes through insert panel (1).



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

**k. Insert Panel and Right Rear Floor Panel Installation**

**NOTE**

If vehicle is equipped with right rear seat support, proceed to step 2.

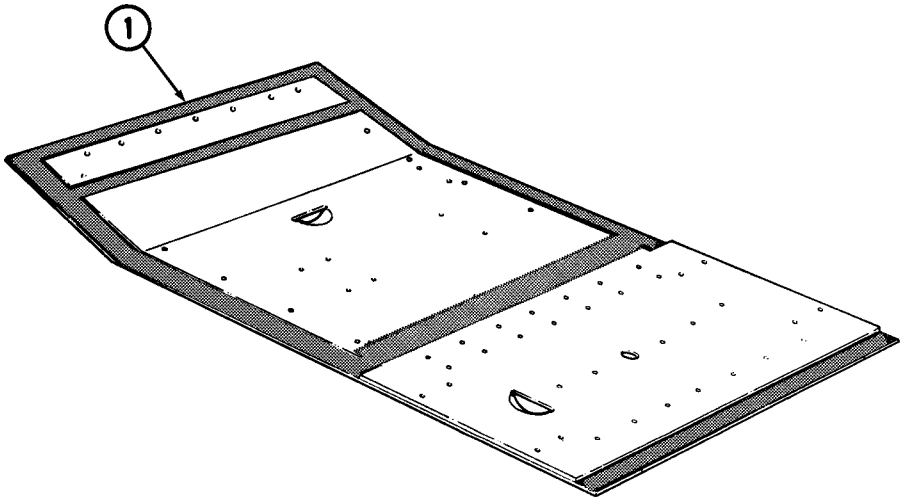
1. Apply approximately 0.125-inch thickness of adhesive sealant to shaded area of insert panel (1).

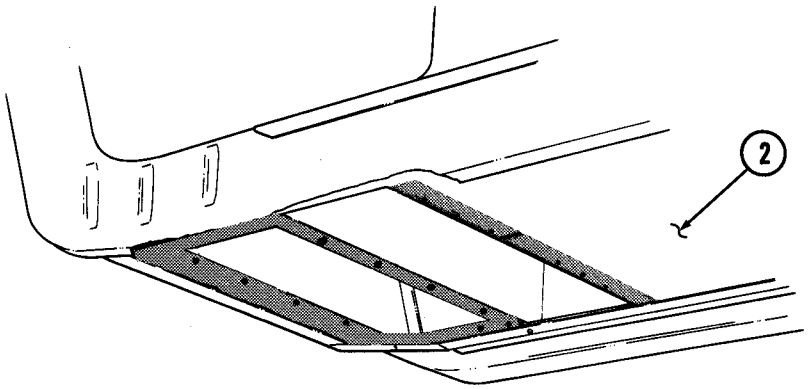
**NOTE**

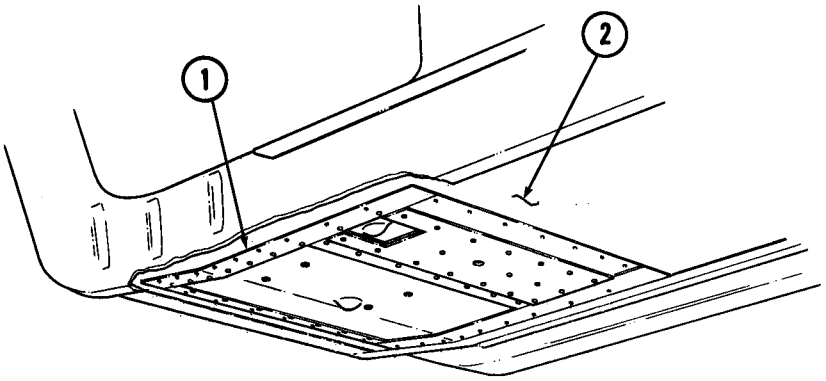
If vehicle is not equipped with right rear seat support, proceed to step 3.

2. Apply adhesive sealant to shaded area on underside of right rear panel (2).
3. Position insert panel (1) on underside of right rear floor panel (2).

## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

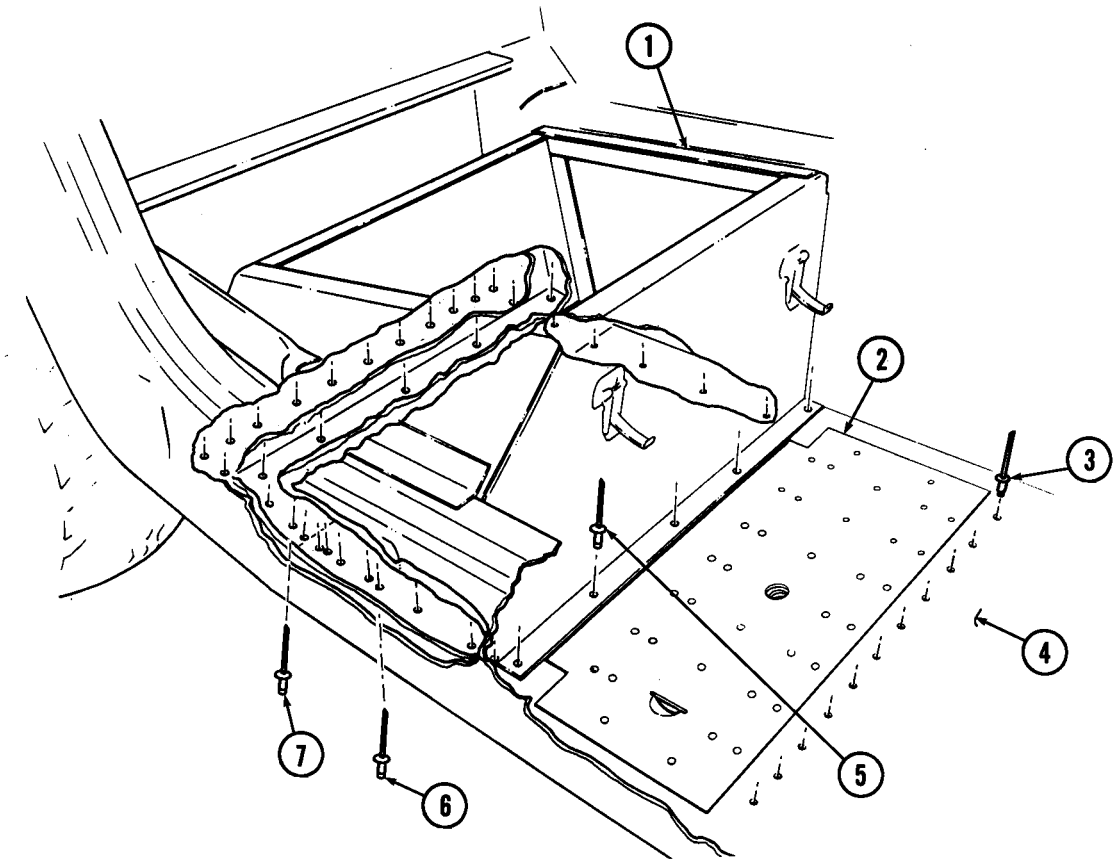


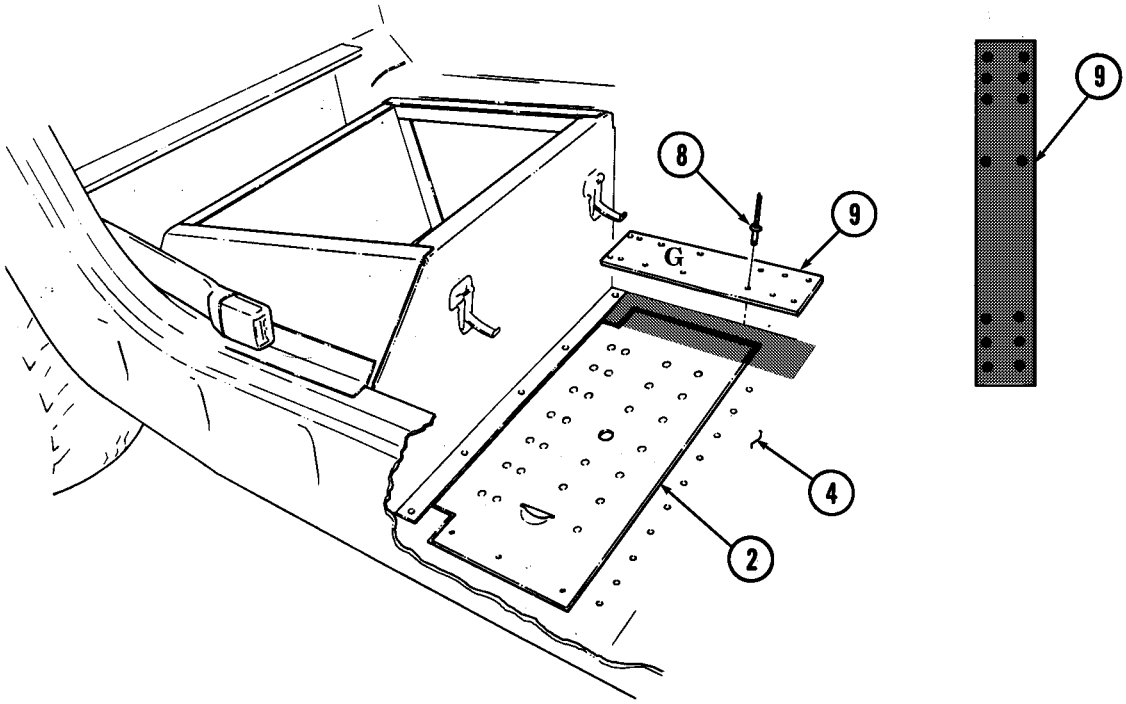



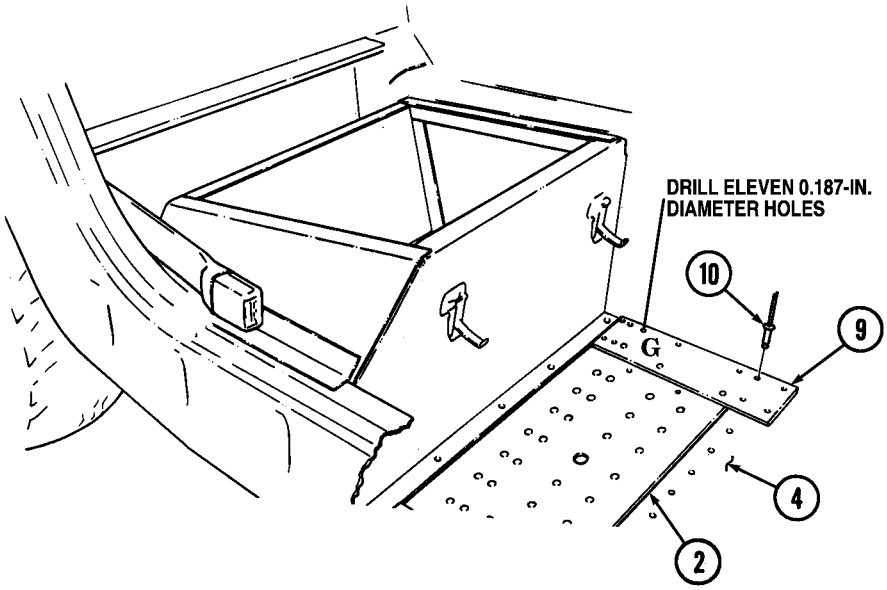
## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

4. Install insert panel (2) on right rear floor panel (4) with ten rivets (6).
5. Secure insert panel (2) on right rear seat support (1) with five rivets (5).
6. Secure insert panel (2) on right rear floor panel (4) with thirteen rivets (7) and sixteen rivets (3).
7. Apply approximately 0.125-in. thickness adhesive sealant to shaded area of metal strip G (9).
8. Apply adhesive sealant to shaded area of right rear floor panel (4) and insert panel (2).
9. Position metal strip G (9) on right rear floor panel (4) and insert panel (2) and install with three rivets (8).
10. Using metal strip G (9) as a template, locate, mark, and drill eleven 0.187-in. diameter holes through right rear floor panel (4) and insert panel (2).
11. Secure metal strip G (9) to insert panel (2) with eleven rivets (10).



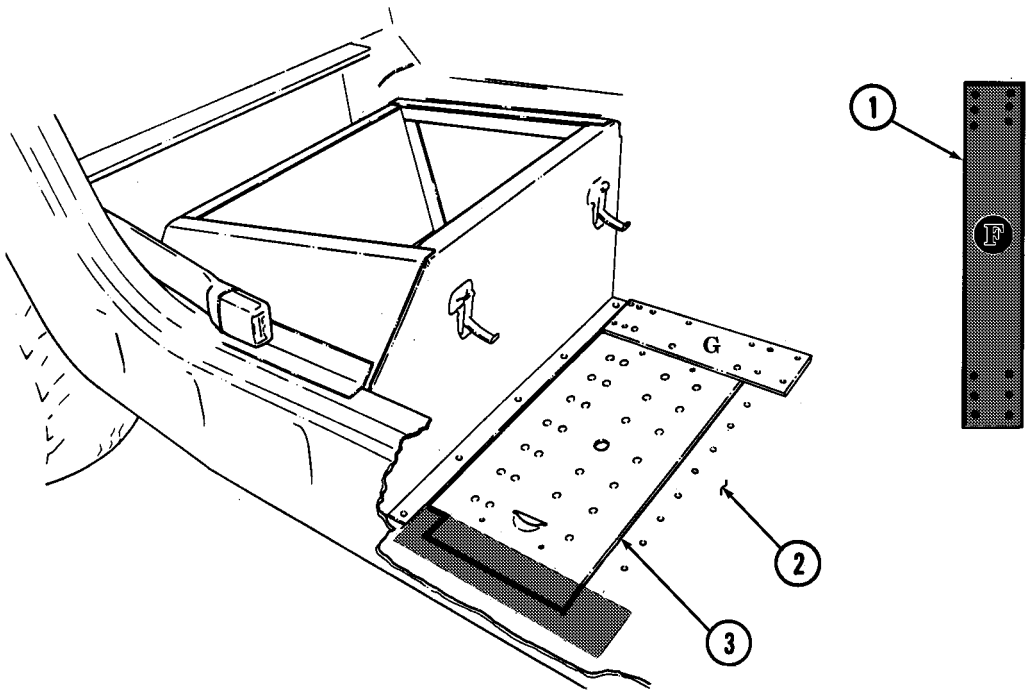
## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)



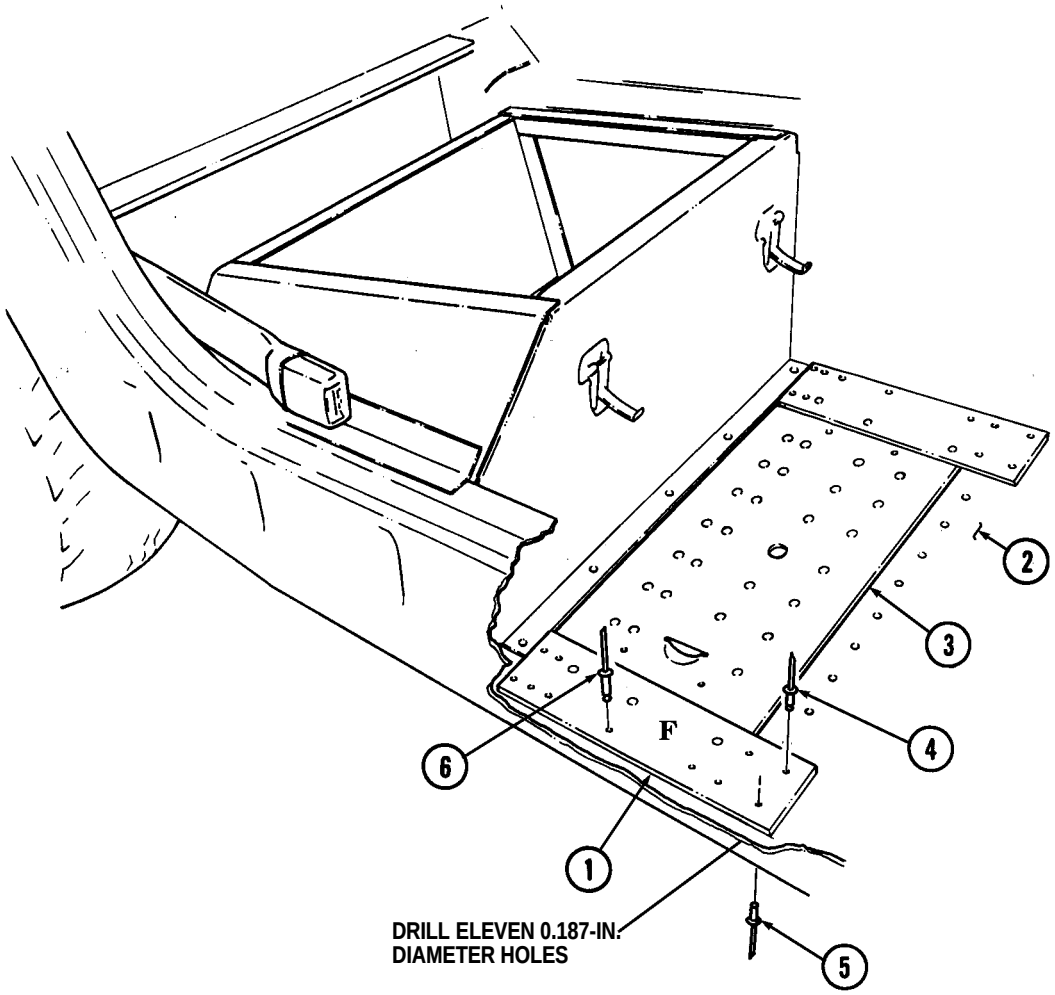



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)

12. Apply approximately 0.125-in. thickness of adhesive sealant to shaded area of metal strip F (1).
13. Apply adhesive sealant to shaded area on right rear floor panel (2) and insert panel (3).
14. Position metal strip F (1) on right rear floor panel (2) and insert panel (3), and install metal strip F (1) on insert panel (3) with three rivets (6).
15. Using metal strip F (1) as a template, locate, mark, and drill eleven 0.187-in. diameter holes through right rear floor panel (2) and insert panel (3).
16. Secure metal strip F (1) to right rear floor panel (2) and insert panel (3) with four rivets (4).
17. Secure metal strip F (1) on insert panel (3) and right rear floor panel (2) with seven rivets (5).
18. Spot-paint insert panel (3) and right rear floor panel (2). (Refer to TM 43-0139.)



## 22-9.5. RIGHT REAR FLOOR PANEL REPAIR (Cont'd)




FOLLOW-ON TASKS:
- Install right rear floor insulation (TM 9-2320-280-20).
- Install right rear seat back (TM 9-2320-280-20).
- Install right rear seat bottom (TM 9-2320-280-20).
- Replace stored contents in right rear seat compartment (TM 9-2320-280-20).

## 22-10. AMBULANCE EXTERIOR BODY REPAIR

**This task covers:**

a. **Left Nose Cap Repair**
b. **Left Side Outer Roof Panel Repair**
c. **Left Front Nose Panel Repair**
d. **Rear Roof Panel Repair**
e. **Left Rear Corner Roof Panel Repair**
f. **Left Rear Lower/Upper Body Panel Repair**
g. **Left Lower Body Panel Repair**
h. **Left Rear Side Corner Body Panel Repair**
i. **Right Front Nose Panel Repair**
j. **Right Nose Cap Repair**
k. **Right Rear Corner Roof Panel Repair**
l. **Right Side Outer Roof Panel Repair**
m. **Right Rear Side Corner Body Panel Repair**
n. **Right Lower Body Panel Repair**
o. **Right Rear Lower/Upper Body Panel Repair**

**INITIAL SETUP:**

**Applicable Models**
M997, M997A1, M997A2

**Tools**
General mechanic's tool kit:
automotive (Appendix G, Item 1)

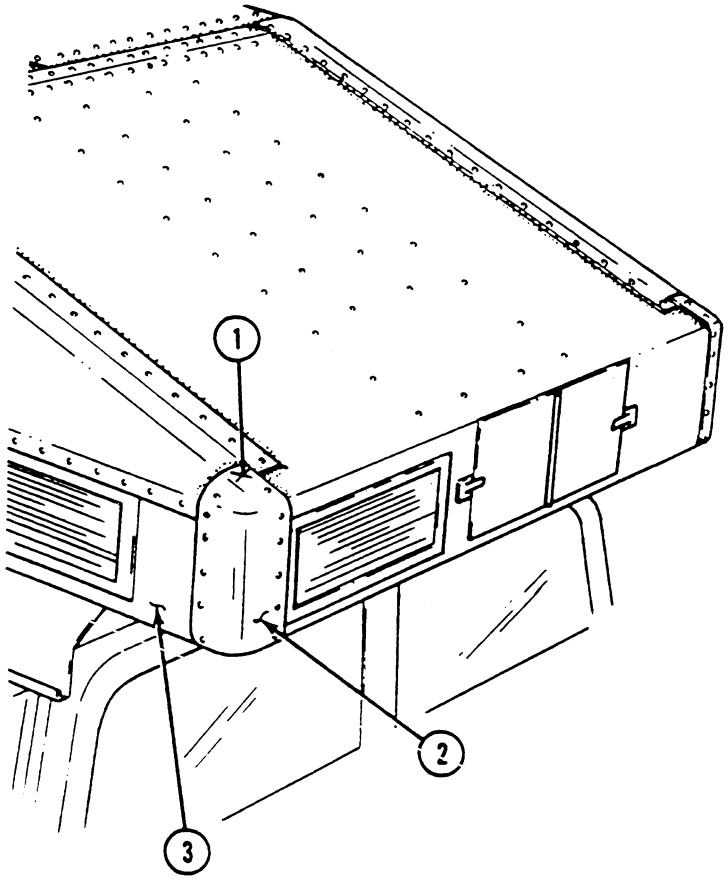
**Manual References**
TM 9-2320-280-20
TM 9-2320-280-24P
TM 43-0139

**Materials/Parts**
Three hundred blind rivets (Appendix E, Item 194)
One hundred blind rivets (Appendix E, Item 195)
One hundred blind rivets (Appendix E, Item 196)
Adhesive sealant (Appendix B, Item 3)
Wicking sealant (Appendix B, Item 59)
Adhesive (Appendix B, Item 1)

**Maintenance Level**
General Support

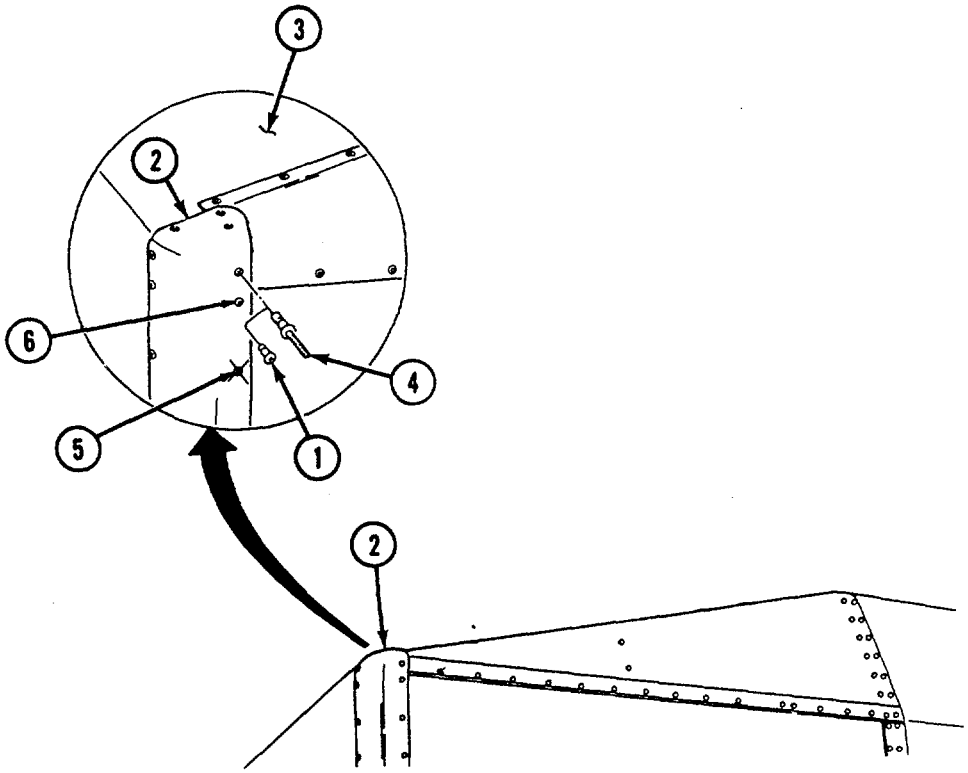
### a. Left Nose Cap Repair

1. Scribe two lines centered over each of the seventeen rivets (1) on nose cap (2). Extend scribed lines about 1.00-in. (25.4 mm) onto body panels (3).



## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

2. Using a 0.187-in. (4.75 mm) drill, remove seventeen rivets (1) from nose cap (2) and body panels (3).
3. Remove nose cap (2) from body panel (3).
4. Remove adhesive residue and clean body panels (3). Do not remove marked scribed lines (5).
5. Position nose cap (2) on body panels (3 and transfer previously marked scribed lines (5) to nose cap (2).
6. Using scribed lines (5) marked in step 5, drill seventeen 0.187-in. (4.75 mm) diameter holes (6) on nose cap (2).
7. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to nose cap (2) and body panels (3).
8. Install nose cap (2) on body panels (3) with seventeen rivets (4).
9. Spot paint nose cap (2) and body panels (3) as necessary (TM 43-0139).
10. Apply wicking sealant to seventeen rivets (4).

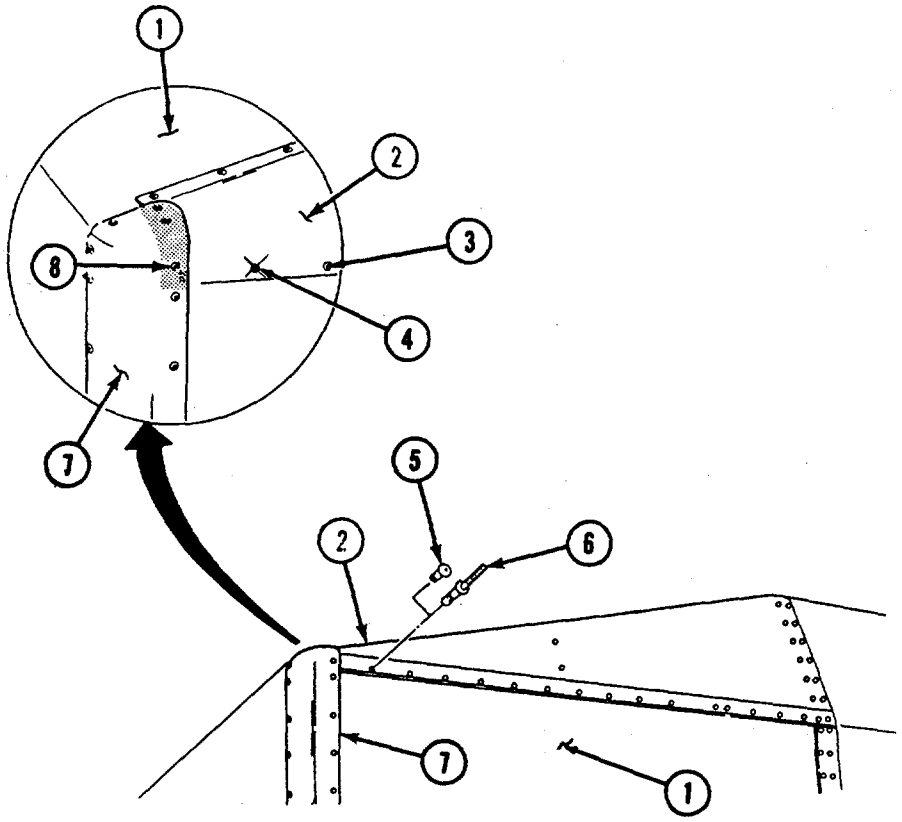


**22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)**

**b.Left Side Outer Roof Panel Repair**

1. Remove left nose cap (7) (para. a.).
2. Scribe two lines (4) centered over forty-seven
3. Using a 0.187-in. (4.75 mm) drill, remove forty-seven rivets (5) from outer roof panel (2) and body panel (1).
4. Remove side outer roof panel (2).
5. Remove adhesive residue and clean body panels (1). Do not remove scribed lines (4).
6. Position side outer roof panel (2) on body panel (1)and transfer previously marked scribed lines (4) to panel (2). Remove side outer roof panel (2).
7. Using scribed lines (4) marked in step 6, drill forty-seven 0.187-in. (4.75mm) diameter holes (3) on left outer roof panel (2).
8. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to side outer roof panel (2) and body panels (1).
9. Install side outer roof panel (2) on body panel (1) with forty-seven rivets (6)
10. Position left nose cap (7) on body panel (1) and side outer roof panel (2).
11. Using nose cap (7) as a template, drill three 0.187-in. (4.75) diameter holes (8) through left side outer roof panel (2). Remove nose cap (7).
12. Install nose cap (7) (para. a.).
13. Spot paint side outer roof panel (2) and body panels (1) (TM 43-0139.)
14. Apply wicking sealant to forty-seven rivets (6).

**22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)**

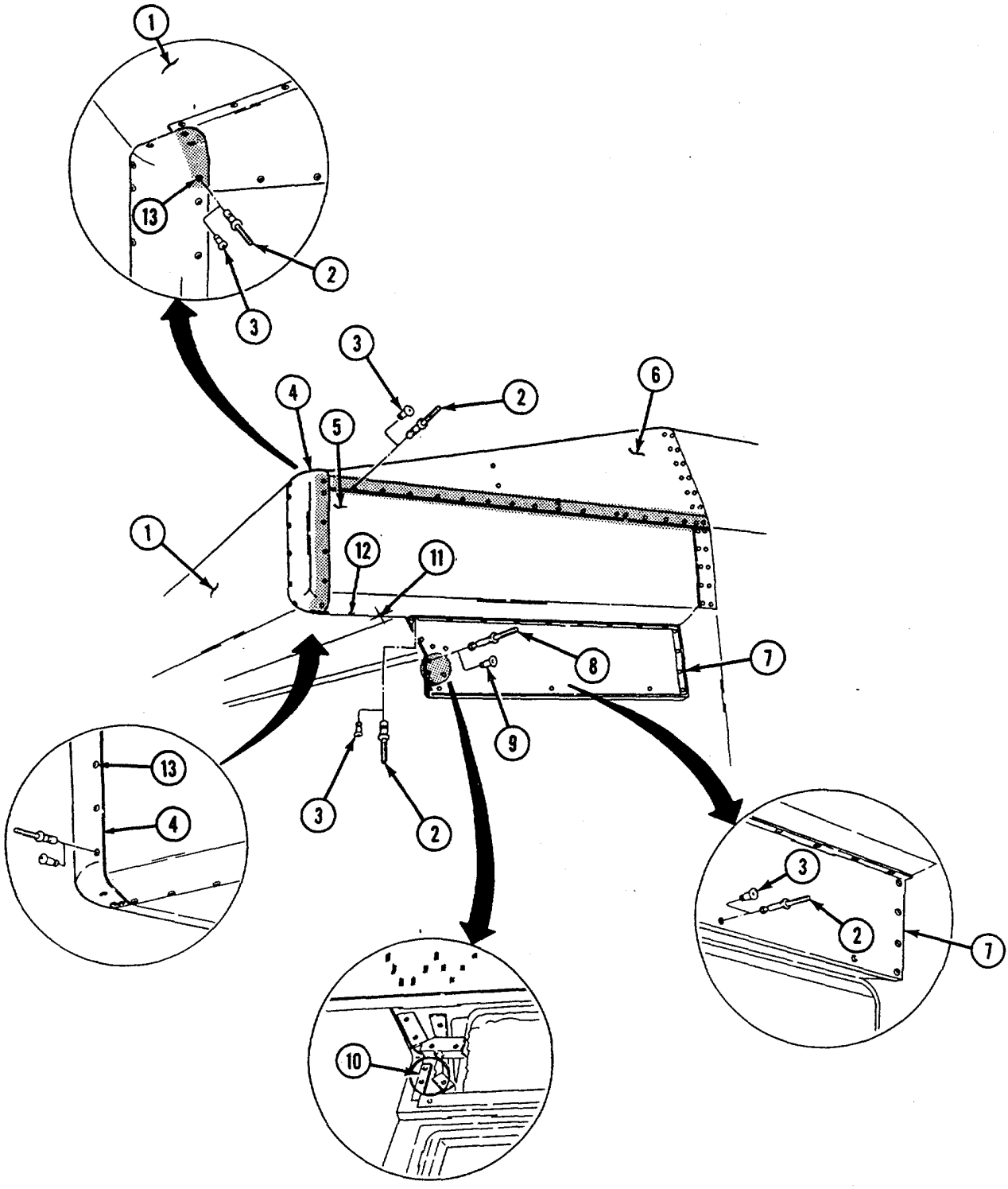


## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### c. Left Front Nose Panel Repair

1. Using a 0.125in. (3.175 mm) drill, remove three rivets (9) from side panel (7) and window support (10).
2. Using a 0.187-in. (4.75 mm ) drill, remove twenty-one rivets (3) and side panel (7) from window support (10) and body panels (1).
3. Remove adhesive residue and clean side panel (7), window support (10), and body panels (1).
4. Remove left nose cap (4) (para a).
5. Remove left side outer roofpanel (6) (para. b.).
6. Scribe two lines (11) centered over thirteen rivets (3) on front nose panel (5). Extend scribed lines (11) a minimum of 1.00-in. (25.4 mm) onto body panels (1).
7. Using a 0.187-in. (4.75 mm) drill, remove thirteen rivets (3) from nose panel (5) and body panels (1).
8. Remove front nose panel (5).
9. Remove adhesive residue and clean body panels (1).
10. Position front nose panel (5) on body panels (1), and transfer scribed lines (11) marked in step 6 to panel (5). Remove front nose panel (5).
11. Using scribed lines (11) marked in step 10, drill thirteen 0.187-in. (4.75 mm) diameter holes (12) on front nose panel (5).
12. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to front nose panel (5) and body panels (1).
13. Install front nose panel (5) on body panels (1) with thirteen rivets (2).
14. Position left side outer roof panel (6) on body panels (1) and front nose panel (5).
15. Using left side outer roof panel (6) as a template, drill seventeen 0.187-in. (4.75 mm) diameter holes (12) through front nose panel (5). Remove left side outer roof panel (6).
16. Install left side outer roof panel (6) (para b.).
17. Position nose cap (4) on body panels (1), front nose panel (5), and left side outer roof panel (6).
18. Using nose cap (4) as a template, drill nine 0.187-in. (4.75 mm) diameter holes (13) through front nose panel (5) and left side outer roof panel (6).
19. Install nose cap (4) (para a).
20. Apply wicking sealant on thirteen rivets (2).
21. Apply approximately 0.125-in. (3.175 mm) thickness of silaprene adhesive sealant to side panel (7), window support (10), and body panels (1).
22. Install side panel (7) on window support (10) and body panels (1) with three rivets (8).
23. Install side panel (7) on front nose panel (5) and body panels (1) with twenty-one rivets (2).
24. Spot paint side panel (7), front nose panel (5), and body panels (1).
25. Apply wicking sealant to twenty-four rivets (2).

## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)



## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### d. Rear Roof Panel Repair

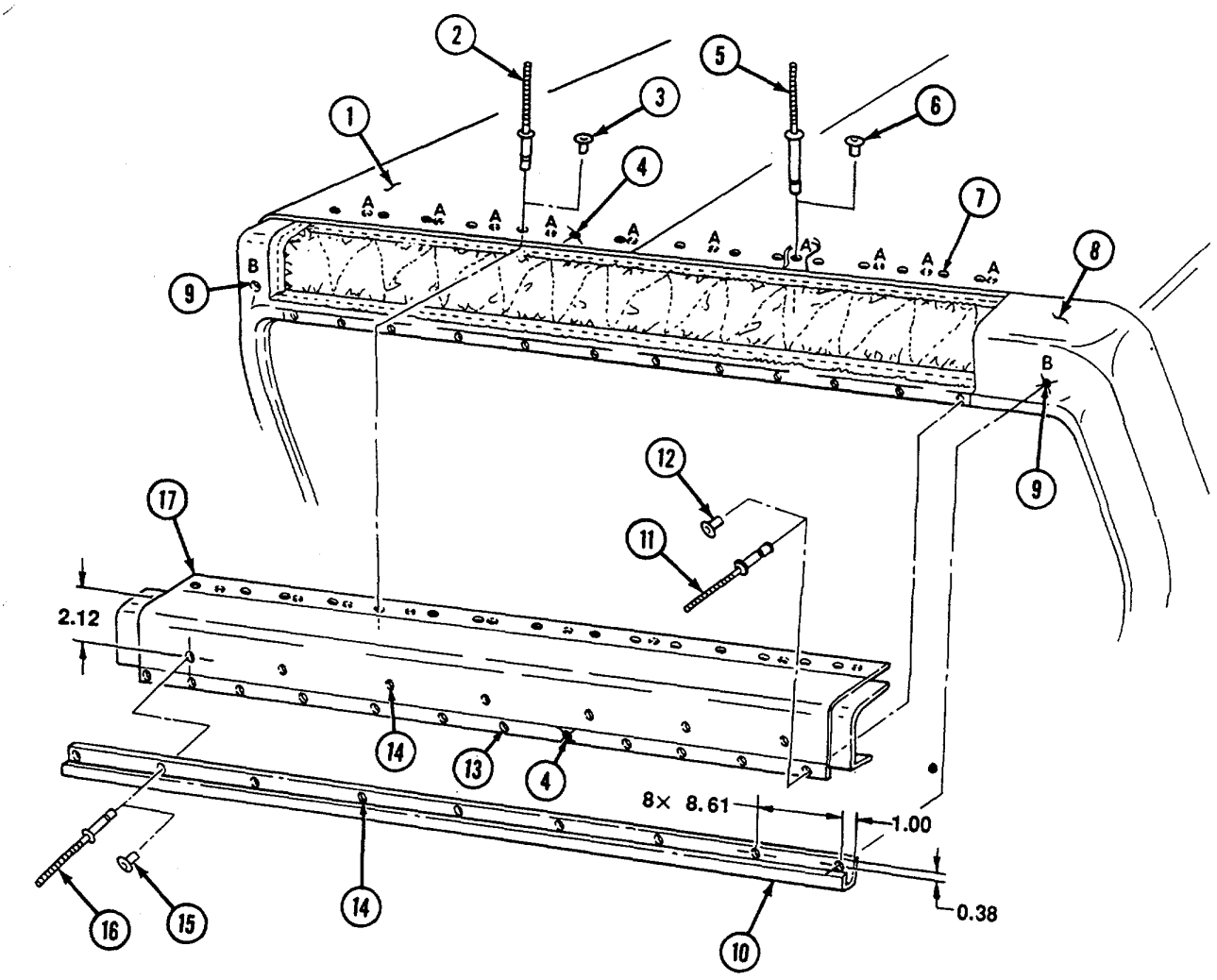
1. Remove door weatherstrip (TM 9-2320-280-20.)
2. Remove left rear corner roof panel (para. e.) (M
3. Scribe two lines (9) centered over rivet (15) marked "B" on drip rail (10). Extend scribed lines a minimum of 1.00-in. (25.4 mm) into right rear corner roof panel (8).
4. Using a 0.187-in. (4.75 mm) drill, remove rivet (15) marked "B" from drip rail (10) and right rear corner roof panel (8).
5. Scribe two lines (4) centered over twenty-seven rivets (3) onto rear roof panel (17). Extend scribed lines a minimum of 1.00-in. (25.4 mm) onto body panels (1).
6. Using a 0.125-in (3.175 mm) drill, remove twelve rivets (12) from rear roof panel (17) and body panels (1).
7. Using a 0.187-in. (4.75 mm) drill, remove fifteen rivets (3) from a rear roof panel (17) and body panels (1).

NOTE

The ten rivets that secure the rear roof panel to horizontal support braces are not visible because they are covered by body panels.

8. Separate body panels (1) from rear roof panel (17).
9. Scribe ten lines marked 'A" onto exterior side of body panels (1) and center punch locations marked 'A".
10. Drill ten 0.125-in. (3.175 mm) diameter pilot holes through body panels (1) marked "A" in step 9.
11. Using a 0.187-in. (4.75 mm) drill, remove ten rivets (6) marked "A" in steps 9 and 10 from rear roof panel (17) and body panels (1).
12. Remove rear roof panel (17).
13. Remove adhesive residue and clean body panels (1). Do not remove scribed lines (4) and "A" marked in steps 5 and 9.
14. Position rear roof panel (17) on body panels (1) and transfer scribed lines (4) and 'A" marked in steps 5 and 9. Remove rear roof panel (17).
15. Using scribed lines (4) marked in step 14, drill twelve 0.125in (3.175 mm) diameter holes (13) in rear roof panel (17).
16. Using scribed lines (4) and "A" marked in step 14, drill twenty-five 0.187-in. (4.75 mm) diameter holes (7) in rear roof panel (17).
17. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to rear roof panel (17) and body panels (1).
18. Install rear roof panel (17) on body panels (1) with twelve rivets (11), ten rivets (5), and fifteen rivets (2).
19. Install left rear corner roof panel (para. e)
20. Using rear drip rail (10), locate, mark, and drill nine 0.187-in. (4.75 mm) diameter holes in rear drip rail (10).
21. Position rear drip rail (10) on holes (9) marked "B" on rear corner roof panels (8). Using rear drip rail (10) as a template, transfer seven hole locations (14) onto roof panel (17). Remove rear drip rail (10).
22. Drill seven 0.187-in. (4.75 mm) diameter holes (14) marked in step 21.
23. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to rear drip rail (10) and rear roof panel (17).
24. Install rear drip rail (10) on rear roof panel (17) with nine rivets (16).
25. Spot paint rear roof panel (17), rear corner roof panel (8), rear drip rail (10), and body panels (1) (TM 43-0139.)
26. Apply wicking sealant to rivets (2), (4), and (11).
27. Install door weatherstrip (TM 9-2320-280-20.)

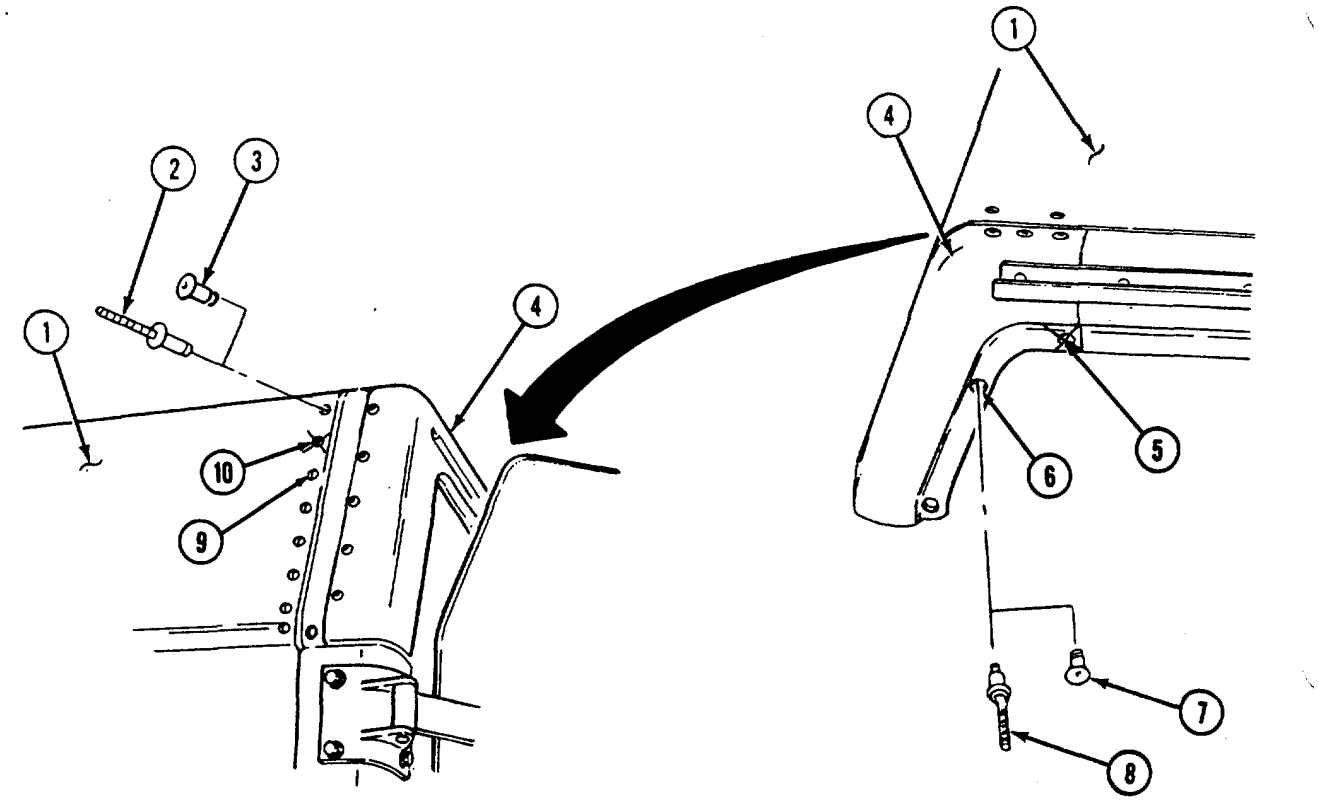
## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)



## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### e. Left Rear Corner Roof Panel Repair

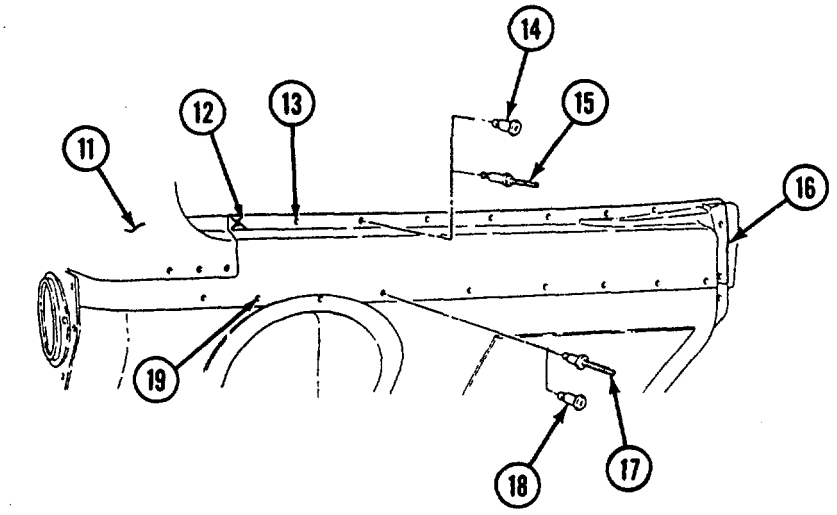
1. Remove door weatherstrip. (TM 9-2320-280-20.)
2. Scribe two lines (10) and (5) centered over fifteen rivets (3) and (7) on rear corner roof panel (4) and body panels (1).
3. Using a 0.125-in. (3.175 mm) drill, remove three rivets (7) from rear corner roof panel (4) and body panels (1).
4. Using a 0.187-in. (4.75 mm) drill, remove twelve rivets (3) from rear corner roof panel (4) and body panels (1). Remove rear corner roof panel (4).
5. Remove adhesive residue and clean body panels (1). Do not remove scribed lines (10) and (5) marked in step 2.
6. Position rear corner roof panel (4) on body panels (1) and transfer scribed lines (10) and (5) marked in step 2. Remove rear corner roof panel (4).
7. Using scribed lines (5) marked in step 6, drill three 0.125-in. (3.175 mm) diameter holes (6) in rear corner roof panel (4).
8. Using scribed lines (10) marked in step 6, drill twelve 0.187-in. (4.75 mm) diameter holes (9) in rear corner roof panel (4).
9. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to rear corner roof panel (4) and body panels (1).
10. Install rear comer roof panel (4) on body panel (1) with fifteen rivets (8) and (2).
11. Spot paint rear corner roof panel (4) and body panels (1) (TM 43-0139.)
12. Apply wicking sealant to fifteen rivets (8) and (2).



## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

f. Left Rear Lower/Upper Body Panel Repair

1. Remove door weatherstrip (TM 9-2320-280-20.)
2. Scribe two lines (12) centered over twenty-one rivets (14) on rear lower/upper body panel (16). Extend scribed lines (12) a minimum of 1.00-in. onto body panels (11).
3. Using a 0.125-in. (3.175 mm) drill, remove ten rivets (14) from rear lower/upper body panel (16) and body panels (11).
4. Using a 0.187-in. (4.75 mm) drill, remove eleven rivets (18) from rear lower/upper body panel (16) and body panels (11).
5. Remove rear lower/upper body panel (16).
6. Remove adhesive residue and clean body panels (11). Do not remove scribed lines (12) marked in step 2.
7. Position rear lower/upper body panel (16) on body panels (11) and transfer scribed lines (12) marked in step 2. Remove rear lower/upper body panel (16).
8. Using scribed lines (12) marked in step 7, drill ten 0.125-in. (3.175 mm) diameter holes (13) in rear lower/upper body panel (16).
9. Using scribed lines (12) marked in step 7, drill eleven 0.187-in. (4.75 mm) diameter holes (19) in rear lower/upper body panel (16).
10. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to rear lower/upper body panel (16) and body panels (11).
11. Install rear lower/upper body panel (16) on body panels (11) with ten rivets (15) and eleven rivets (17).
12. Spot paint rear lower upper body panel (16) and body panels (11) (TM 43-0139.)
13. Apply wicking sealant to eleven rivets (17) installed in step 11.
14. Install door weatherstrip (TM 9-2320-280-20.)



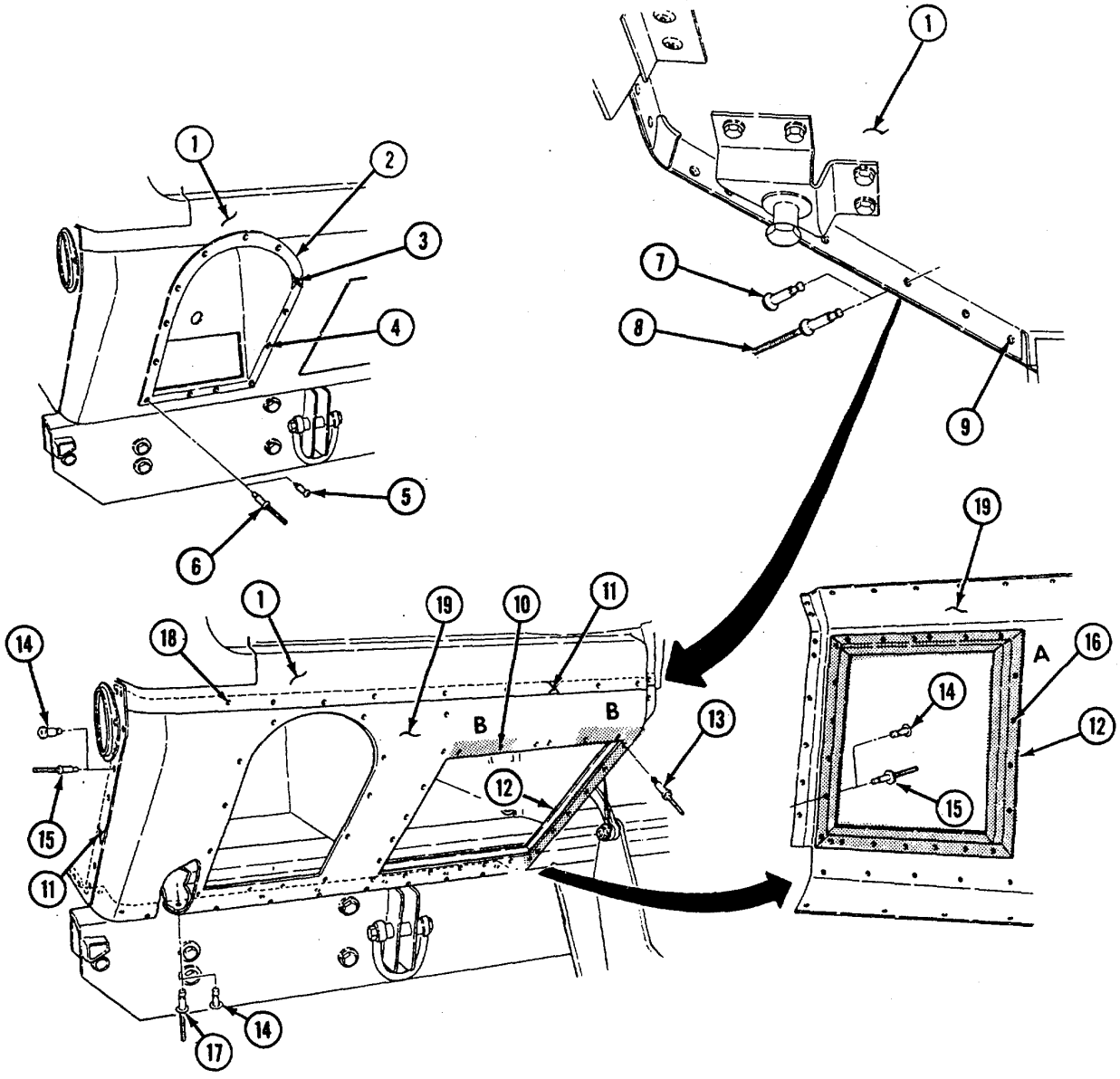
## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### g. Left Lower Body Panel Repair

1. Remove door weatherstrip (TM 9-2320-280-20).
2. Disconnect battery ground cable (TM 9-2320-280-20).
3. Remove backup light assembly (TM 9-2320-280-20).
4. Remove tail lamp assembly (TM 9-2320-280-20).
5. Scribe two lines (3) centered over thirteen rivets (5) on tail lamp housing bracket (2). Extend scribed lines (3) a minimum of 1.00-in. (25.4 mm) onto body panels (1).
6. Using a 0.187-inr (4.75 mm) drill, remove thirteen rivets (5) from tail lamp housing bracket (2) and body panels (1). Remove tail lamp housing bracket (2).
7. Remove adhesive residue and clean body panels (1). Do not remove scribed lines (3) marked in step 5.
8. Position tail lamp housing bracket (2) on body panel (1) and transfer scribed lines (3) marked in step 5.
9. Using scribed lines (3) marked in step 8, drill thirteen 0.187-in. (475 mm) diameter holes (4) in tail lamp housing bracket (2).
10. Remove litter stowage door (TM 9-2320-280-20).
11. Scribe two lines (11) centered over sixty-seven rivets (14) and (7) on lower body panel (19). Extend scribed lines (11) a minimum of 1.00-in. (25.4 mm) onto body panels (1).
12. Using a 0.125-in. (3.175 mm) drill, remove eight rivets (7) from lower body panel (19) and body panels (1).
13. Using a 0.187-in. (4.75 mm) drill, remove fifty-nine rivets (14) from lower body panel (19) and body panels (1).
14. Remove lower body panel (19).
15. Remove adhesive residue and clean body panels (1). Do not remove scribed lines (11) marked in step 11.
16. Remove nineteen rivets (14) from litter stowage opening bracket (12) and lower body panel (19).
17. Position lower body panel (19) on body panel (1) and transfer scribed lines (11) marked in step 11 onto lower body panel (19). Remove lower body panel (19).
18. Using scribed lines (11) marked in step 17, as a template, drill seven 0.125-in. (3.175 mm) diameter holes (9) in lower body panel (19).
19. Using scribed lines (11) marked in step 17, drill fifty-nine 0.187-in. (4.75 mm) diameter holes (18) in lower body panel (19).
20. Using lower body panel (19) removed in step 14 as a template, position litter stowage opening bracket (12) to mount holes (16) marked "A", locate, and mark twenty-three mount holes (16) marked "A" onto litter stowage opening bracket (12). Remove litter stowage bracket (12).
21. Drill twenty-three 0.187-in. (4.75 mm) diameter holes (16) in litter stowage opening bracket (12) marked in step 20.
22. Align mount holes (16) marked "A" on litter stowage opening bracket (12) and lower body panel (19).
23. Using litter stowage opening bracket (12) as a template, locate, and drill eleven 0.187-in. (4.75 mm) diameter holes (10) in lower body panel (19). Remove litter stowage opening bracket (12).
24. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to litter stowage opening bracket (12) and lower body panel surface (19).
25. Install litter stowage opening bracket (12) on lower body panel (19) mount holes (10) marked "B" with eleven rivets (13).
26. Install litter stowage door (TM 9-2320-280-20).
27. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to lower body panel (19), litter stowage opening bracket (12), and body panels (1).

**22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)**

28. Install lower body panel (19) on body panels (1) with eight rivets (8), sixteen rivets (17), and forty-one rivets (15).
29. Position tail lamp housing bracket (2) on lower bodypanel (19) and body panels (1).
30. Using tail lamp housing bracket (2) as a template, locate, mark, and drill thirteen 0.187-inch (4.75 mm) diameter holes (4) in lower body panel (19) and body panels (1). Remove tail lamp housing bracket (2).
31. Apply approximately 0.125inch (3.175 mm) thickness of adhesive to tail lamp housing bracket (2), lower body panel (19), and body panels (1)
32. Install tail lamp housing bracket (2) on lower body panel (19) and body panels (1) with thirteen rivets (6).
33. Spot paint tail lamp housing bracket (2), litter stowage opening bracket (12), and body panels (1) (TM 43-0139.)
34. Apply wicking sealant to eighty-one rivets (13), (8), (17), (15), and (6) installed in steps 25, 28, and 32.
35. Install tail lamp assembly CIM 9-2320-280.20).
36. Install backup light assembly (TM 9-2320-280-20).
37. Install battery ground cable (TM 9-2320-280-20).
38. Install door weatherstrip (TM9-2320-280.20.)



## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### h. Left Rear Side Corner body Panel Repair

1. Remove door weatherstrip (TM 9-2320-280-20).
2. Remove left rear door assembly (TM 9-2320-280-20).
3. Remove rear hinge assemblies (TM 9-2320-280-20).
4. Remove left rear lower/upper body panel (para. f).
5. Scribe two lines (3) centered over seventeen rivets (4) and (5) on rear side corner body panel (2). Extend scribed lines (3) a minimum of 1.00-in. onto body panels (1).
6. Using a 0.125-in. (3.175 mm) drill, remove seven rivets (4) from rear side corner body panel (2) and body panels (1).
7. Using a 0.187-in. (4.75 mm) drill, remove ten rivets (5) from rear side corner body panel (2) and body panels (1).

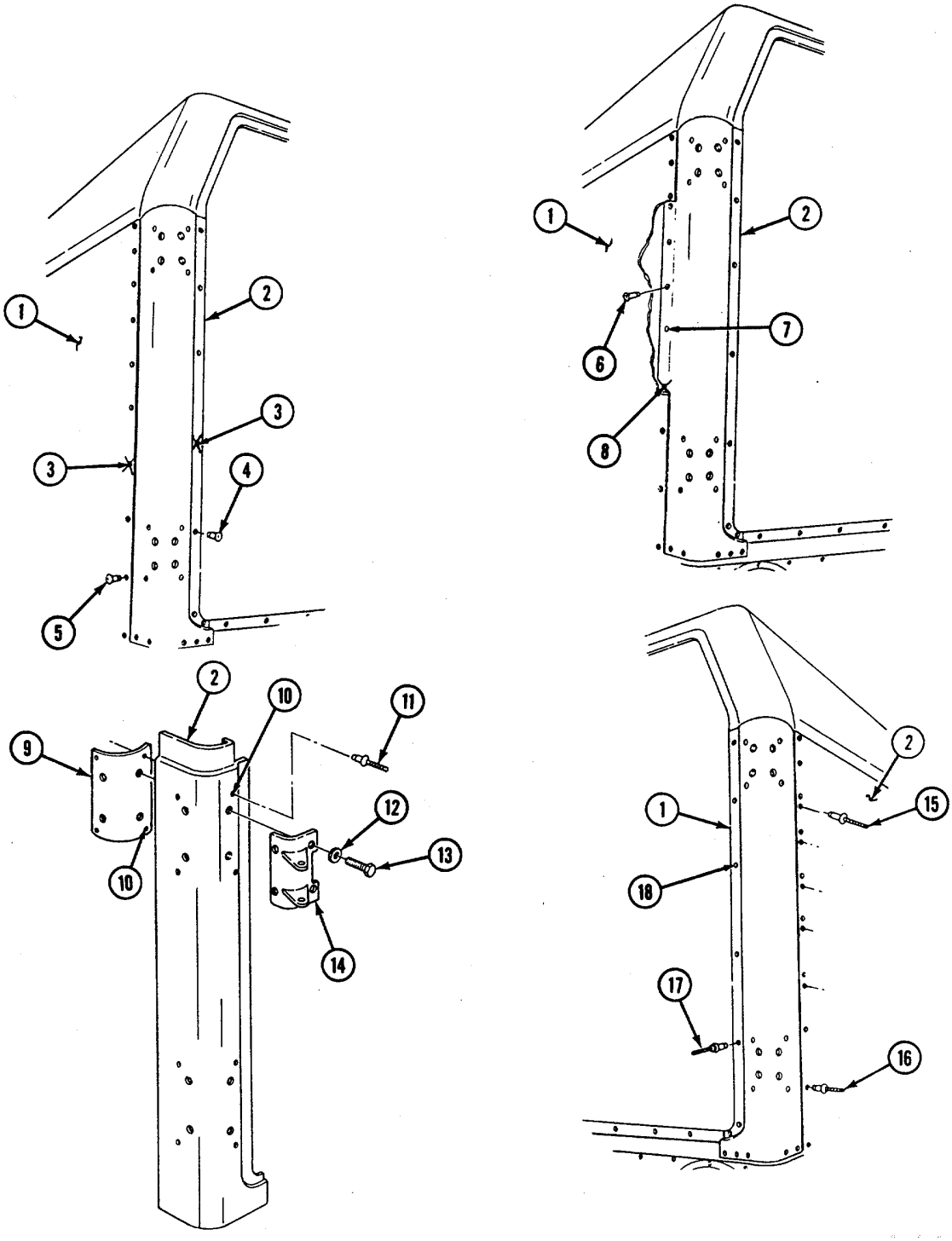
**NOTE**

Five rivets that secure rear side corner body panel to vertical support braces are not visible because they are covered by body panels.

8. Separate body panel (1) from rear side corner body panel (2).
9. Scribe five lines (8) onto exterior side of body panels (1); center punch hole (7) locations.
10. Drill five 0.125-in. (3.175 mm) diameter pilot holes (7) through body panel (1) marked in step 9.
11. Using a 0.187-in. (4.75 mm) diameter drill, remove five rivets (6) marked in steps 9 and 10.
12. Remove rear side comer body panel (2).
13. Remove adhesive residue and clean body panels (1). Do not remove scribed lines (3) and (8) marked in steps 5 and 9.
14. Using rear side corner body panel (2), locate, mark, and drill eight 0.187-in. (4.75 mm) diameter holes (10) in rear side comer body panel (2).
15. Apply approximately 0.125-in. (3.175 mm) thickness of silaprene adhesive sealant to two reinforcement assemblies (9) and rear side corner body panel (2).
16. Install two reinforcement assemblies (9) on rear side comer body panel (2) with two existing rear hinge assemblies (14), eight washers (12), and screws (13).
17. Using holes (10) drilled in step 14 on rear side comer body panel (2) as templates, drill eight 0.187-in. diameter holes (10) through two reinforcement assemblies (9).
18. Secure rear side comer body panel (2) and two reinforcement assemblies (9) together with eight rivets (11).
19. Remove eight screws (13), washers (12) and two rear hinge assemblies (14).
20. Position rear side comer body panel (2) to body panels (1) and transfer scribed lines (3) and (8) marked in steps 5 and 9. Remove rear side body panel (2).
21. Using scribed lines (8) marked in step 20, drill seven 0.125-in. diameter holes (7) in rear side corner body panel (2).
22. Using scribed lines (3) marked in step 20, drill twenty-two 0.187-in. diameter holes (18) in rear side comer body panel (2).
23. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to rear side corner body panel (2) and body panels (1).
24. Install rear side corner body panel (2) on body panels (1) with five rivets (15), and seventeen rivets (16) and (17).
25. Install left rear lower/upper body panel (para. C).

**22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)**

26. Spot paint rear side corner body panel (2) and body panels (1) (TM 43-0139).
27. Apply wicking sealant to thirty-seven rivets (16), (17), and (11).
8. Install rear hinge assemblies (TM 9-2320-280-20).
29. Install left rear door assembly (TM 9-2320-280-20).
30. Install door weatherstrip (TM 9-2320-280-20).

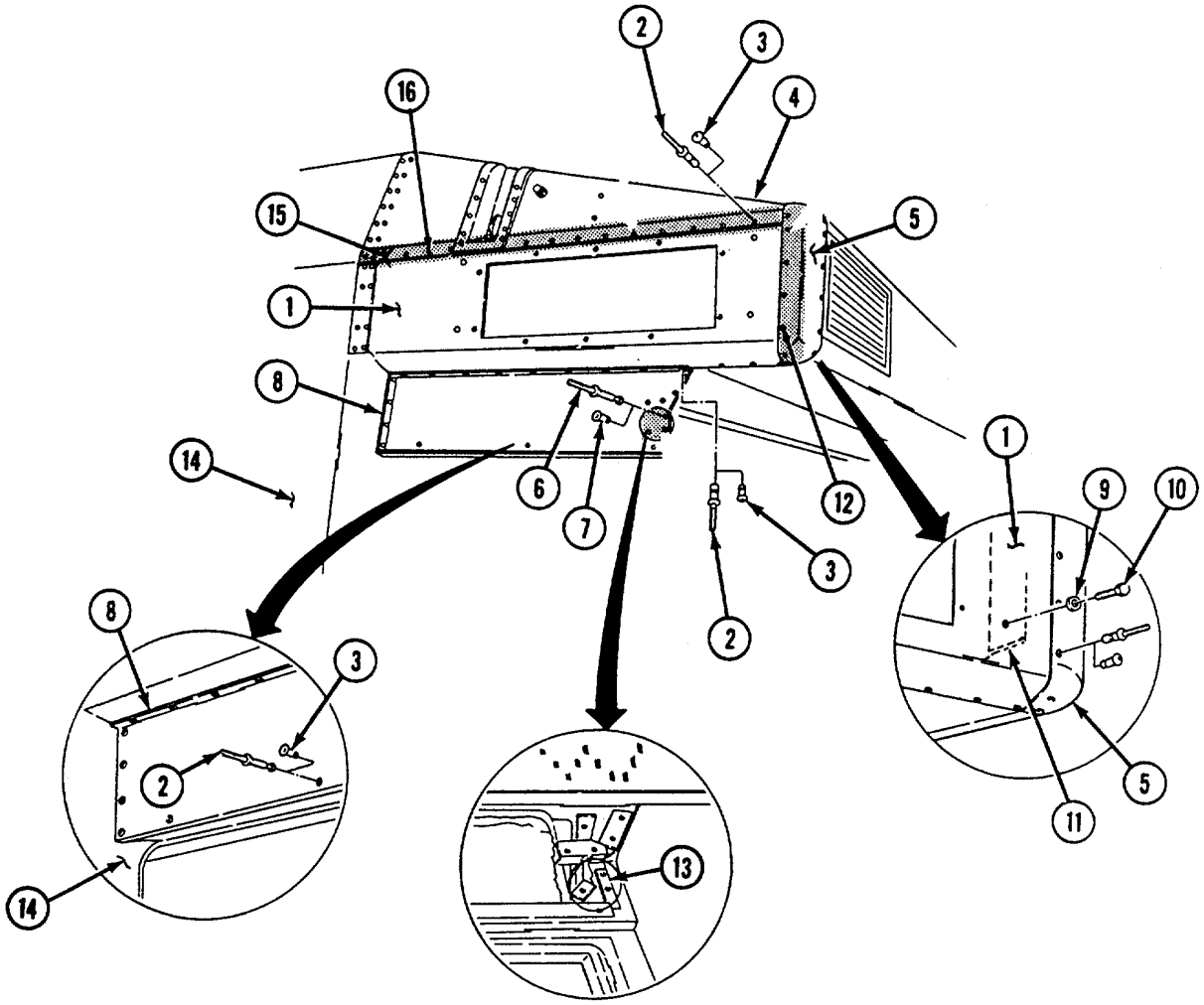


## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### i. Right Front Nose Panel Repair

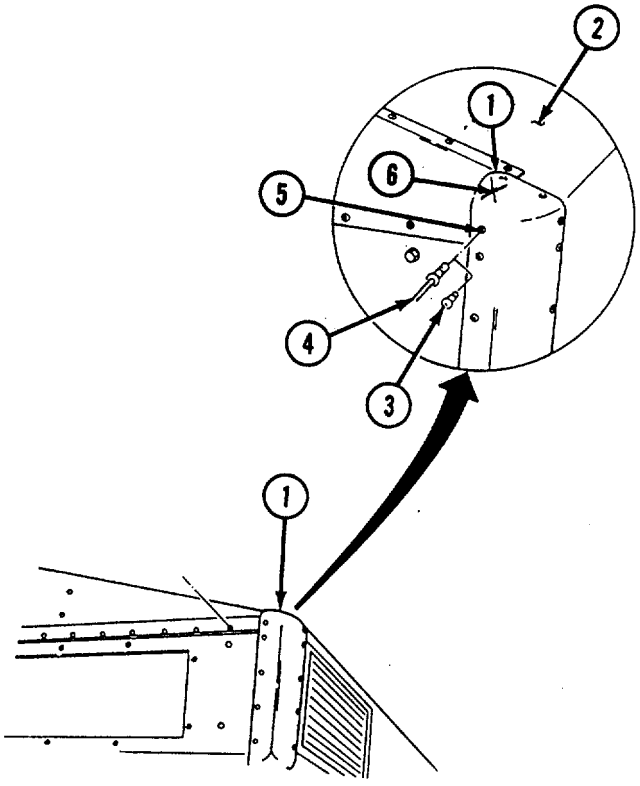
1. Using a 0.125-in. (3.175 mm) drill remove three rivets (7) from side panel (8) and window support (13).
2. Using a 0.187-in. (4.75 mm ) drill, remove twenty-one rivets (3) from side panel (8), window support (13), and body panels (14).
3. Remove side panel (8).
4. Remove adhesive residue and clean window support (12) and side panel (8).
5. Remove right nose cap (par j.).
6. Remove right side outer roof panel (para 1.).
7. Scribe two lines (15) centered over thirteen rivets (3) on front nose panel (1). Extend scribed lines (15) a minimum of 1.00-in. (25.4 mm) onto body panels (14).
8. Using a 0.187-in. (4.75 mm) drill, remove thirteen rivets (3) from nose panel (1) and body panels (14).
9. Remove four capscrews (10) and washers (9) from heater support bracket (11) and front nose panel (1).
10. Remove front nose panel (1).
11. Remove adhesive residue and clean body panels (14). Do not remove scribed lines (15) marked in step 7.
12. Position front nose panel (1) on body panels (14) and transfer scribed lines (15) marked in step 7. Remove nose panel (1).
13. Using scribed lines (15) marked in step 12, drill thirteen 0.187-in. (4.75 mm) diameter holes (12) in front nose panel (1).
14. Apply approximately 0.125-in (3.175 mm) thickness of adhesive sealant to front nose panel (1).
15. Install front nose panel (1) on body panels (14) with thirteen rivets (2).
16. Install four washers (9) and capscrews (10) on front nose panel (1) and heater support bracket (11). -'
17. Position side outer roof panel (4), removed in step 6, on body panels (14) and front nose panel (1).
18. Using side outer roof panel (4) as a template, drill seventeen 0.187-in. (4.75 mm) diameter holes (16) through front nose panel (1). Remove side outer roof panel (4).
19. Install right side outer roof panel (para L).
20. Position nose cap (5) removed in step 5, on body panel (14), front nose panel (1), and side outer roof panel (4).
21. Using nose cap (5) as a template, drill nine 0.187-in. (4.75 mm) diameter holes (12) through front nose panel (1) and side outer roof panel (4). Remove nose cap (5).
22. Install right nose cap (para. j.).
23. Apply wicking sealant to thirteen rivets (2) installed in step 15.
24. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to side panel (8), window support (13), and body panels (14).
25. Install side panel (8) on window support (13) and body panels (14) with three rivets (6).
26. Install side panel (8) on front nose panel (1) and body panels (14) with twenty-one rivets (2).
27. Apply wicking sealant to twenty-four rivets (2) and (6) installed in steps 25 and 26.
28. Spot paint side panel (8), front nose panel (1), side outer roof panel (4), nose cap (5) and body panels (14) (TM 43-0139).

## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)



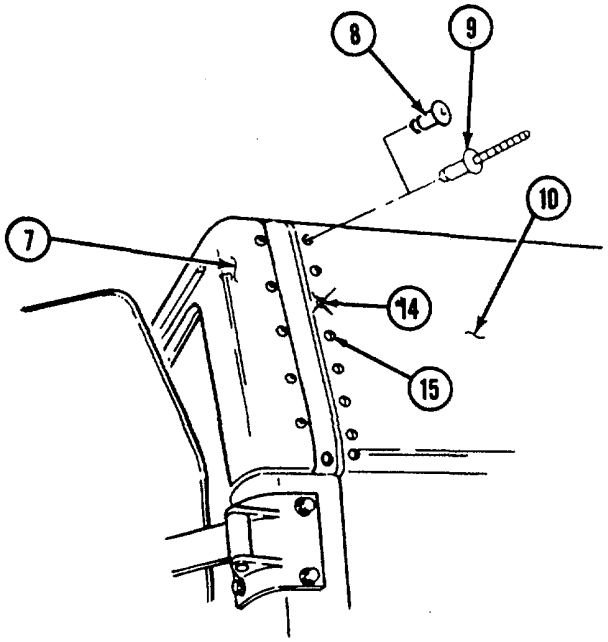
## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

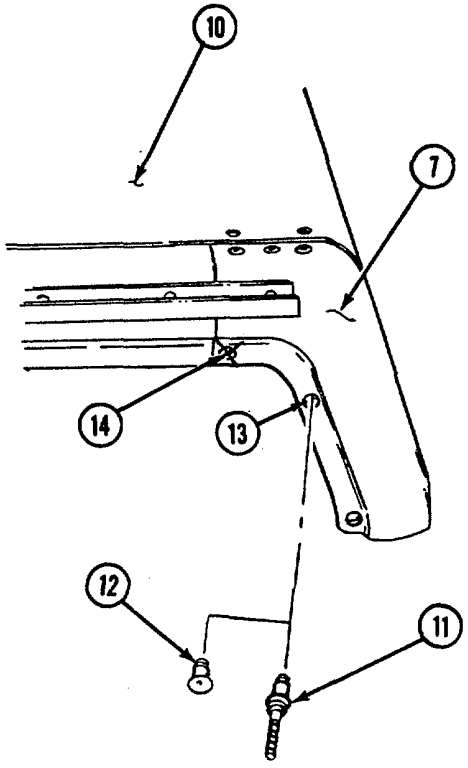
1. Scribe two lines (6) centered over seventeen rivets (3) on nose cap (1). Extend lines (6) a minimum of 1.00-in. (25.4 mm) onto body panels (2).
2. Using a 0.187-in. (4.75 mm) drill, remove seventeen rivets (3) from nose cap (1) and body panel (2).
3. Remove nose cap (1).
4. Remove adhesive residue and clean body panels (2). Do not remove scribed lines (6).
5. Position nose cap (1) on body panels (2) and transfer scribed lines (6) marked in step 1. Remove nose cap (1).
6. Using scribed lines (6) marked in step 5, drill seventeen 0.187-in. (4.75 mm) diameter holes (5) in nose cap (1).
7. Apply approximately 0.125-in. (3.175 mm) thickness of silaprene adhesive sealant to nose cap (1) and body panels (2).
8. Install nose cap (1) on body panels (2) with seventeen rivets (4).
9. Spot paint nose cap (1) and body panel (2) (TM 43-0139).
10. Apply wicking sealant to seventeen rivets (4) installed in step 8.



## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

1. Remove door weatherstrip (TM 9-2320-280-20).
2. Scribe two lines (14) centered over fifteen rivets (8) and (12) on rear comer roof panel (7) and body panels (10). Extend scribed lines (14) a minimum of 1.00-in. (25.4 mm) onto body panels (10).
3. Using a 0.125-in. (3.175 mm) drill, remove three rivets (12) from rear comer roof panel (7) and body panels (10).
4. Using a 0.187-in. (4.75 mm) drill, remove twelve rivets (8) from rear corner roof panel (7) and body panels (10). Remove rear comer roof panel (7).
5. Remove adhesive residue and clean body panels (10). Do not remove scribed lines (14) marked in step 2.
6. Install rear comer roof panel (7) on body panels (10) and transfer scribed lines (14) marked in step 2. Remove rear corner roof panel (7).
7. Using scribed lines (14) marked in step 6, drill three 0.125-in. diameter holes (13) in rear comer roof panel (7).
8. Using scribed lines (14) marked in step 6, drill eleven 0.187-in. diameter holes (15) in rear corner roof panel (7).
9. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to rear corner roof panel (7) and body panels (10).
10. Install rear comer roof panel (7) on body panels (10) with three rivets (11) and twelve rivets (9).
11. Spot paint rear comer roof panel (1) and body panels (10) (TM 43-0139).
12. Apply wicking sealant to twelve rivets (9).
13. Install door weatherstrip (TM 9-2320-280-20).



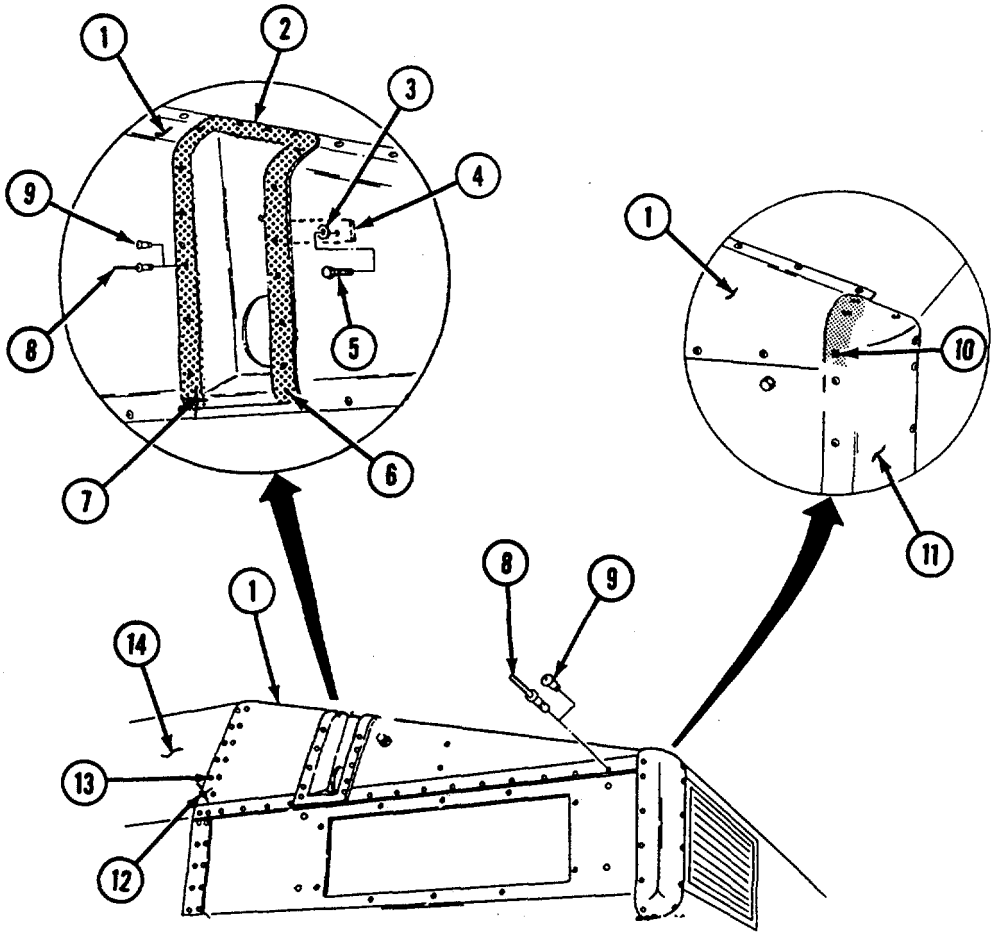



## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### l. right Side Outer Roof Panel Repair

1. Remove right nose cap (para. j.).
2. Remove capscrew (5) and washer (3) from air conditioner support bracket (4) and side outer roof panel (1). '
3. Remove heater exhaust tube (TM 9-2320-280-20.)
4. Scribe two lines (7) centered over eighteen rivets (9) on side outer roof panel (1). Extend scribed lines (7) a minimum of 1.00-in. (25.4 mm) onto body panels (14).
5. Using a 0.187-in. (4.75 mm) drill, remove eighteen rivets (9) from heater exhaust support shield (2), side outer roof panel (1), and body panels (14).
6. Remove heater exhaust support shield (2).
7. Remove adhesive residue and clean side outer roof panel (1) and body panels (14). Do not remove scribed lines (7) marked in step 4.
8. Position heater exhaust support shield (2) on side outer roof panel (1) and body panels (14). Transfer scribed lines (7) marked in step 4. Remove heater exhaust support shield (2).
9. Using scribed lines (7) marked in step 8, drill eighteen 0.187-in. (4.75 mm) diameter holes (6) in heater exhaust support shield (2).
10. Scribe two lines (12) centered over twenty rivets (9) on side outer roof panel (1). Extend scribed lines (12) a minimum of 1.00-in. (25.4 mm) into body panels (14).
11. Using a 0.187-in. (4.75 mm) drill, remove twenty rivets (9) from side outer roof panel (1) and body panels (14).
12. Remove side outer roof panel (1).
13. Remove adhesive residue and clean body panels (14). Do not remove scribed lines (12) marked in step 10.
14. Position side outer roof panel (1) to body panels (14) and transfer scribed lines (12) marked ink/ step 10. Remove side outer roof panel (1).
15. Using scribed lines (12) marked in step 14, drill twenty 0.187-in. (4.75 mm) diameter holes (13) in side outer roof panel (1).
16. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to side outer roof panel (1) and body panels (14).
17. Install side outer roof panel (1) on body panels (14) with twenty rivets (8).
18. Position nose cap (11) removed in step 1 on body panels (14) and side outer roof panel (1).
19. Using nose cap (11) as a template, drill three 0.187-in. (4.75 mm) diameter holes (10) through side outer roof panel (1). Remove nose cap (11).
20. Install right nose cap (para. j.).
21. Install washer (3) and capscrew (5) on side outer roof panel (1) and air conditioner support bracket (4).
22. Position heater exhaust support shield (2) removed in step 8 on side outer roof panel (1).
23. Using heater exhaust support shield (2) as a template, drill eighteen 0.187-in. (4.75 mm) diameter holes (6) through side outer roof panel (1) and body panels (14). Remove heater exhaust support shield (2).
24. Apply approximately 0.125in (3.175 mm) thickness of adhesive sealant to heater exhaust support shield (2), side outer roof panel (1), and body panels (14).
25. Install heater exhaust support shield (2) on side outer roof panel (1) and body panels (14) with eighteen rivets (8).
26. Install heater exhaust tube (TM 9-2320-280-20).
27. Spot paint side outer roof panel (1), heater exhaust support shield (2), and body panels (14) (TM 43-0139).
28. Apply wicking sealant on thirty-eight rivets (8) installed in steps 17 and 25.

## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)



## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### m. Right Rear Side Corner body Panel Repair

1. Remove door weatherstrip (TM 9-2320-280-20).
2. Remove right rear door assembly (TM 9-2320-280-20).
3. Remove rear hinge assemblies (TM 9-2320-280-20).
4. Remove right rear lower/upper body panel (para. o.).
5. Scribe two lines (4) centered over seventeen rivets (4) on rear side comer body panel (1). Extend scribed lines (4) a minimum of 1.00-in. (25.4 mm) onto body panels (2).
6. Using a 0.125-in. (3.175 mm) drill, remove seven rivets (4) from rear side corner body panel (1) and body panels (2).
7. Using a 0.187-in. (4.75 mm) drill, remove ten rivets (3) from rear side corner body panel (1) and body panels (2).

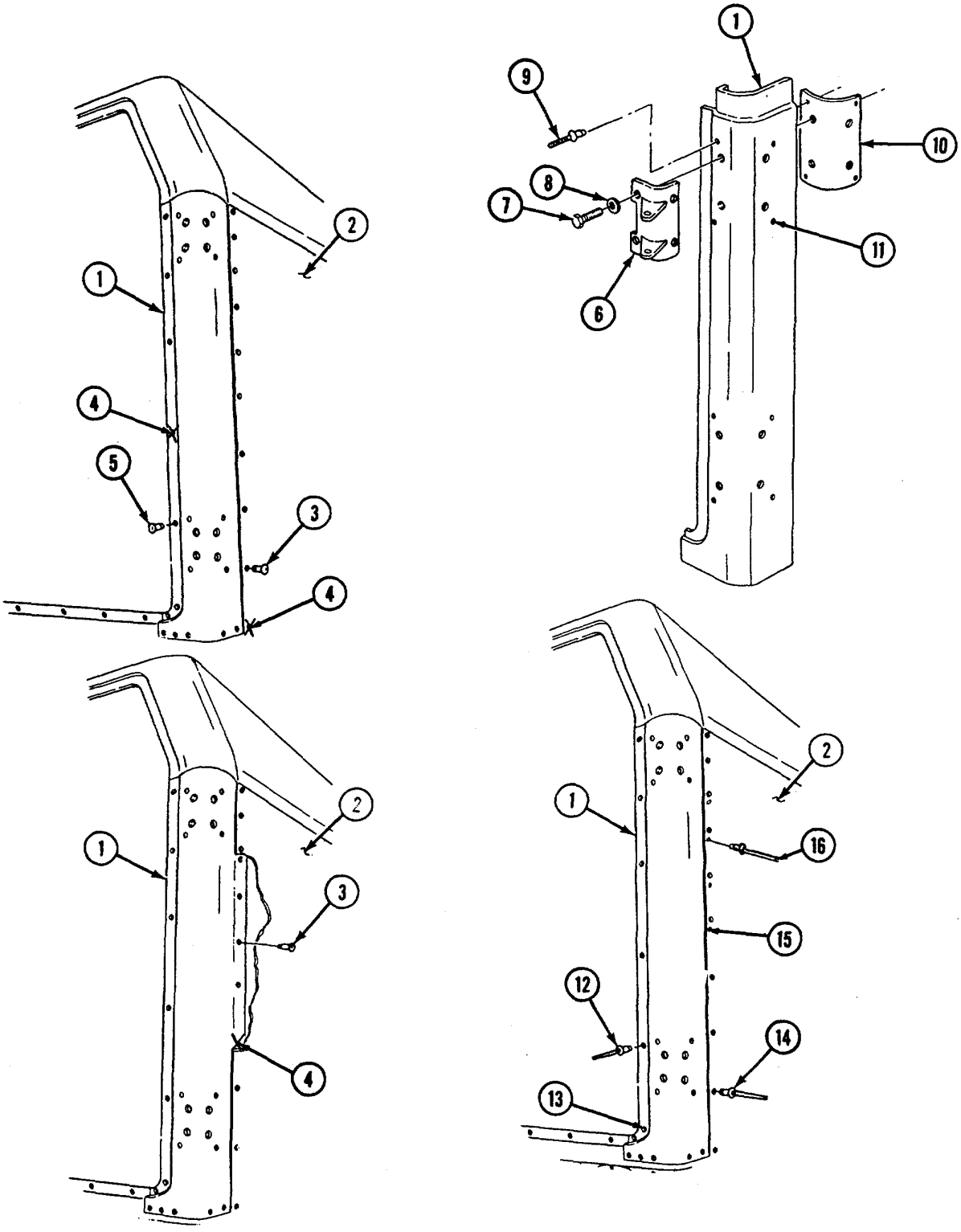
**NOTE**

Five rivets that secure rear side corner body panel to vertical support braces are not visible because they are covered by body panels.

8. Separate body panels (2) from rear side corner body panel (1).
9. Transfer five lines (4) onto exterior side of body panels (2) and center punch locations.
10. Drill five 0.125-in. (3.175 mm) diameter pilot holes through body panel (2) marked in step 9.
11. Using a 0.187-in. (4.75 mm) diameter drill, remove five rivets (3) marked in steps 9 and 10.
12. Remove rear side corner body panel (1).
13. Remove adhesive residue and clean body panels (2). Do not remove scribed lines (4) marked in steps 5 and 9.
14. Using rear side corner body panel (1), locate, mark, and drill eight 0.187-in. (4.75 mm) diameter"/ holes (11) in rear side corner body panel (1).
15. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to two reinforcement assemblies (10) and rear side corner body panel (1).
16. Install two reinforcement assemblies (10) in rear side corner body panel (1) with two existing rear hinge assemblies (6), eight washers (8), and screws (7).
17. Using holes (11) drilled in step 14 on rear side corner body panel (2) as templates, drill eight 0.187-in. (4.5 mm) diameter holes (11) through two reinforcement assemblies (10).
18. Secure rear side corner body panel (2) and two reinforcement assemblies (10) together with eight rivets (9).
19. Remove eight screws (7), washers (8), and two rear hinge assemblies (6) installed in step 16.
20. Position rear side corner body panel (1) to body panels (2) and transfer scribed lines (4) marked in steps 5 and 9. Remove rear side body panel (1).
21. Using scribed lines (4) marked in step 20, drill seven 0.125-in. (3.175 mm) diameter holes (13) in rear side corner body panel (1).
22. Using scribed lines (4) marked in step 20, drill twenty-two 0.187-in. (4.5 mm) diameter holes (15) in rear side corner body panel (1).
23. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to rear side corner body panel (1) and body panels (2).
24. Install rear side corner body panel (1) to body panels (2) with seven rivets (14), five rivets (16), an seventeen rivets (12).
25. Install lower/upper body panel (para. o.).
26. Spot paint rear side corner body panel (1) and body panels (2) (TM 43-0139).

## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

27. Apply wicking sealant to thirty rivets (9), (16), and (12) installed in steps 18 and 24.
28. Install rear hinge assemblies (TM 9-2320-280-20).
29. Install right rear door assembly (TM 9-2320-280-20).
30. Install door weatherstrip (TM 9-2320-280-20).

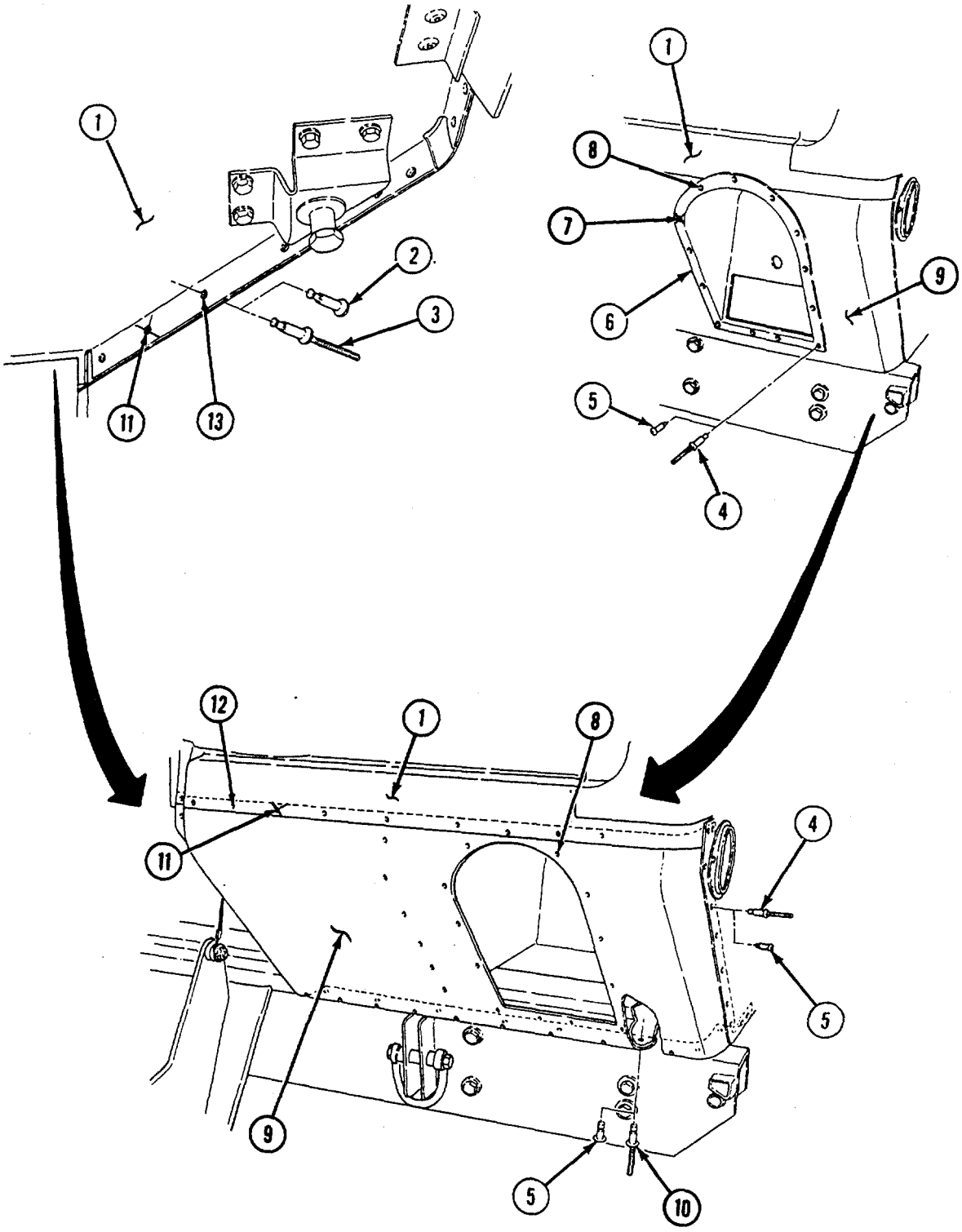


## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### n. Right Lower Body Panel Repair

1. Remove door weatherstrip (TM 9-2320-280-20).
2. Disconnect battery ground cable (TM 9-2320-280-20).
3. Remove backup light assembly (TM 9-2320-280-20).
4. Remove tail lamp assembly (TM 9-2320-280-20).
5. Scribe two lines (7) centered over thirteen rivets (5) on tail lamp housing bracket (6). Extend scribed lines (7) a minimum of 1.00-inch (25.4 mm) onto body panels (9).
6. Using a 0.187-inch (3.175 mm) drill, remove thirteen rivets (5) from tail lamp housing bracket (6) and body panels (1). Remove tail lamp housing bracket (6).
7. Remove adhesive residue and clean body panels (1). Do not remove scribed lines (7) marked in step 5.
8. Position tail lamp housing bracket (6) on body panels (1) and transfer scribed lines (7) marked in step 5. Remove tail lamp housing bracket (6).
9. Using scribed lines (7) marked in step 8, drill thirteen 0.187-in. (4.75 mm) diameter holes (8) in tail lamp housing bracket (6).
10. Scribe two lines (11) centered over fifty-three rivets (2) and (5) on lower body panel (9). Extend scribed lines (11) a minimum of 1.00-in. (25.4 mm) onto body panels (1).
11. Using a 0.125-in. (3.175 mm) drill, remove eight rivets (2) from lower body panel (9 ) and body panels (1).
12. Using a 0.187-in. (4.75 mm) drill, remove forty-five rivets (5) from lower body panel (9) and body panels (1).
13. Remove adhesive residue and clean body panels (1). Do not remove scribed lines (11) marked in step 10.
14. Position lower body panel (9) on body panels (1) and transfer scribed lines (11) marked in step 10. Remove lower body panel (9).
15. Using scribed lines (11) marked in step 14, drill eight 0.125-in. (3.175 mm) diameter holes (13) in lower body panel (9).
16. Using scribed lines (11) marked in step 14, drill forty-five 0.187-in. (4.75 mm) diameter holes (12) in lower body panel (9).
17. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to lower body panel (9) and body panels (1).
18. Install lower body panel (9) on body panels (1) with eight rivets (3), sixteen rivets (10), and twenty-nine rivets (4).
19. Position tail lamp housing bracket (6) on lower body panel (9) and body panels (1).
20. Using tail lamp housing bracket (6) as a template, locate, mark, and drill thirteen 0.187-in. (4.75 mm) diameter holes (8) in lower body panel (9) and body panels (1). Remove tail lamp housing bracket (6).
21. Apply approximately 0.125-in. (3.175 mm) thickness of sealant to tail lamp housing bracket (6), lower body panel (9), and body panels (1).
22. Install tail lamp housing bracket (6) on lower body panel (9) and body panels (1) with thirteen rivets (4).
23. Apply wicking sealant to fifty-five rivet heads (4) and (10).
24. Spot paint tail lamp housing bracket (6), lower body panel (9), and body panels (1) (TM 43-0139.)
25. Install tail lamp assembly. (TM 9-2320-280-20).
26. Install backup light assembly (TM 9-2320-280-20).
27. Install battery ground cable (TM 9-2320-280-20).
28. Install door weatherstrip (TM 9-2320-280-20).

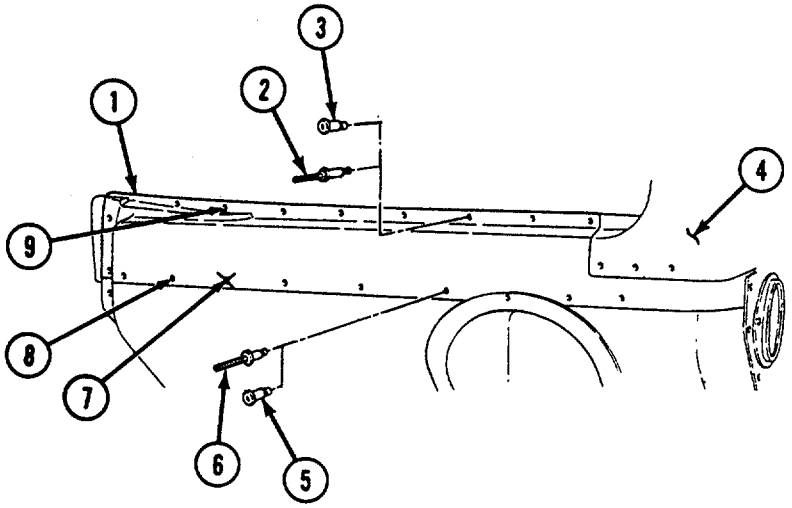
## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)



## 22-10. AMBULANCE EXTERIOR BODY REPAIR (Cont'd)

### o. Right Rear/Lower/Upper body Panel Repair

1. Remove door weatherstrip (TM 9-2320-280-20).
2. Scribe two lines (7) centered over twenty-one rivets (3) and (5) on rear lower/upper body panel (1). J Extend scribed lines (7) a minimum of 1.00-in. (25.4 mm) onto body panels (4).
3. Using a 0.125-in. (3.175 mm) drill, remove ten rivets (3) from rear lower/upper body panel (1) and body panels (4).
4. Using a 0.187-in. (4.75 mm) drill, remove eleven rivets (5) from rear lower/upper body panel (1) and body panels (4).
5. Remove rear lower/upper body panel (1).
6. Remove adhesive residue and clean body panels (4). Do not remove scribed lines (7) marked in step 2.
7. Position rear lower/upper body panel (1) on body panels (4) and transfer scribed lines (7) marked in step 2. Remove rear lower/upper body panel (1).
8. Using scribed lines (7) marked in step 7, drill ten 0.125-in. (3.175 mm) diameter holes (9) in rear lower/upper body panel (1).
9. Using scribed lines (7) marked in step 7, drill eleven 0.187-in. diameter holes (8) in rear lower/upper body panel (1).
10. Apply approximately 0.125-in. (3.175 mm) thickness of adhesive sealant to rear lower/upper body panel (1) and body panels (4).
11. Install rear lower/upper body panel (1) on body panels (4) with ten rivets (2) and eleven rivets (6).
12. Spot paint rear lower/upper body panel (1) and body panels (4) (TM 43-0139).
13. Apply wicking sealant to eleven rivet heads (6) installed in step 11.
14. Install door weatherstrip (TM 9-2320-280-20).



# APPENDIX A
# REFERENCES

## A-1. SCOPE

This appendix lists all forms, field manuals, and technical manuals for use with this vehicle.

## A-2. DEPARTMENT OF THE ARMY PAMPHLETS

Consolidated Index of Army Publications and Blank Forms ..... DA P 25-30
The Army Maintenance Management System (TAMMS) ..... DA P 738-750

## A-3. FORMS

Recommended Changes to Publications and Blank Forms ..... DA Form 2028
Recommended Changes to Equipment Technical Publications ..... DA Form 2028-2
Hand Receipt/Annex Number ..... DA Form 2062
Exchange Tag ..... DA Form 2402
Equipment Inspection and Maintenance Worksheet ..... DA Form 2404
Equipment Inspection and Maintenance Worksheet (Automated) ..... DA Form 5988-E
Maintenance Request ..... DA Form 2407
Maintenance Request (Automated) ..... DA Form 5990-E
The Army Maintenance Management System (TAMMS) ..... DA Pam 738-750
Preventive Maintenance Schedule and Record ..... DD Form 314
Preventive Maintenance Schedule and Record (Automated) ..... DA Form 5986-E
Processing and Deprocessing Record for Shipment, Storage, and Issue of Vehicles and Spare Engines ..... DD Form 1397
Quality Deficiency Report ..... SF 368

## A-4. FIELD MANUALS

Operation and Maintenance of Army Materiel in Cold Weather (0°F to -65°F) ..... FM 9-207
First Aid for Soldiers ..... FM 21-11
Manual for the Wheeled Vehicle Driver ..... FM 21-305
Browning Machinegun Caliber .50 HB, M2 ..... FM 23-65
Machinegun 7.62, M60 ..... FM 23-67
Basic Cold Weather Manual ..... FM 31-70
Northern Operations ..... FM 31-71
Army Motor Transport Units and Operations ..... FM 55-30
Mountain Operations ..... FM 90-6

## A-5. MILITARY STANDARDS

Inspection, Penetrant Methods ..... MIL-STD-6866
Inspection Process, Magnetic Particles ..... MIL-STD-1949

## A-6. TECHNICAL MANUALS

Inspection, Care, and Maintenance of Antifriction Bearings. ..... TM 9-214
Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Materiel and Related Materials (Including Chemicals) ..... TM 9-247
Operator's and Organizational Maintenance Manual for TOW 2 Weapon System, Guided Missile System ..... TM 9-1425-450-12
Operator's and Organizational Maintenance Manual for TOW Weapon System, Guided Missile System ..... TM 9-1425-472-12
Operator's Manual ..... TM 9-2320-280-10
Hand Receipt ..... TM 9-2320-280-10-HR
Unit Maintenance, Technical Manual ..... TM 9-2320-280-20
Unit, Direct Support and General Support Maintenance Repair Parts and Special Tools List ..... TM 9-2320-280-24P
Operator's, Unit, Direct Support and General Support Maintenance Manual for Care, Maintenance, Repair, and Inspection of Pneumatic Tires and Inner Tubes ..... TM 9-2610-200-14
Direct Support and General Support Maintenance: Engine, Diesel: 8 Cylinder, Naturally Aspirated Fuel Injected, Water Cooled DDA Model 6.2 Liter and DDA Model 6.5 Liter ..... TM 9-2815-237-34
Direct Support and General Support Maintenance Repair Parts and Special Tools List, Engine, Diesel: 8 Cylinder, Naturally Aspirated, Fuel Injected Water Cooled, DDA Model 6.2 Liter and DDA Model 6.5 Liter ..... TM 9-2815-237-34P
Operator's and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Test Stand Automotive ..... TM 9-4910-485-12
Operator's and Organizational Maintenance Manual for Test Stand, Automotive Generator, Alternator Starter and Associated Equipment. ..... TM 9-4910-663-12
Operator's Organizational, Direct Support, and General Support Maintenance Manual for Lead-Acid Storage Batteries ..... TM 9-6140-200-14
Marking, Packaging, and Supplies and Equipment: General Packaging Instructions for Field Use ..... TM 746-10
Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use ..... TM 750-244-6
Cooling Systems: Tactical Vehicles ..... TM 750-254
Painting Instructions For Field Use ..... TM 43-0139

## A-7. TECHNICAL BULLETINS

Tactical Wheeled Vehicles: Repair of Frames ..... TB 9-2300-247-40
Security of Tactical Wheeled Vehicles ..... TB 9-2300-422-20
Equipment Improvement Report and Maintenance Digest ..... TB 43-0001-62
Use of Antifreeze Solutions, Antifreeze Extended and Cleaning Compounds Test Kit in Engine Cooling Systems ..... TB 750-651
Calibration Requirements for the Maintenance of Army Materiel ..... TB 43-1800
Maintenance Expenditure Limits ..... TB 750-98-23
Rustproofing Various Trucks and Trailers. ..... TB 43-0213
Painting Instructions for Field Use. ..... TB 43-0139

## A-8. MISCELLANEOUS PUBLICATIONS

Operator's Manual “Welding Theory and Application” ..... TC 9-237

## A-9. ARMY REGULATIONS

The Army Integrated Publishing and Printing Program ..... AR 25-30
Dictionary of United States Army Terms ..... AR 310-25
Prevention of Motor Vehicle Accidents ..... AR 385-55
Army Materiel Policy and Retail Maintenance Operation ..... AR 750-1
Army Acquisition Policy ..... AR 70-1
Expendable/Durable Items (Except: Medical, Class V, Repair Parts and Heraldic Items) ..... CTA 50-970

# APPENDIX B
# EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

## SECTION I. INTRODUCTION

### B-1. SCOPE

This appendix lists expendable/durable supplies and materials you will need to maintain the M998 series vehicles.These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

### B-2. EXPLANATION OF COLUMNS

**a. Column (1) Item Number.** This number is assigned to the entry in the listing and is referenced in "Initial Setup" of applicable tasks under the heading of "Material/Parts."

**b. Column (2) Level.** This column identifies the lowest level of maintenance that requires the listed item.

C —Operator/Crew
O —Unit Maintenance
F —Direct Support Maintenance
H —General Support Maintenance

**c. Column (3) – National Stock Number.** This is the National stock number assigned to the item; use it to request or requisition the item.

**d. Column (4) – Description.** Indicates the Federal Item name and, if required, a description to identify the item. The last line for each item indicates the Commercial and Government Entity Code (CAGEC) in parentheses followed by the part number.

**e. Column (5) – Unit of Measure (U/M).** Indicates the measure used in performing the actual maintenance function. This measure is expressed by an alphabetical abbreviation (QT, GAL.). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

| (1) ITEM NUMBER | (2) LEVEL | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 1 | F | | ADHESIVE: type II, class I<br>(80244) MIL-A-46050 | |
| | | 8040-01-167-2613 | 5 Ounce Tube | OZ |
| | | 8040-01-090-9320 | 1 Pint | PT |
| 1.1 | F | | ADHESIVE: 20251<br>(05972) | |
| | | 8040-01-154-0038 | 25 CC Can | CC |
| 2 | O | | ADHESIVE SEALANT: silicone, RTV, general purpose<br>(80244) MIL-A-46106, type I | |
| | | 8040-00-833-9563 | 5 Ounce Tube | OZ |
| 3 | F | | ADHESIVE SEALANT: | |
| | | 8040-00-078-9774 | (71984) 732 RTV | N/A |
| 4 | O | | ADHESIVE: Silicone, RTV<br>(81349) MIL-A-46146 | |
| | | 8040-00-938-1535 | 12 Ounce Cartridge | OZ |
| 4.1 | H | | ADHESIVE: sealing compound,<br>(00333) M6325-11 OZ | |
| | | 8030-01-347-0964 | 11 Ounce Cartridge | OZ |
| 5 | C | | ANTIFREEZE: arctic-type<br>(81349) MIL-A-11755 | |
| | | 6850-00-174-1806 | 55 Gallon Drum | GAL. |
| 6 | C | | ANTIFREEZE: ethylene glycol, inhibited,<br>heavy duty, single package<br>(81349) MIL-A-46153 | |
| | | 6850-00-181-7929 | 1 Gallon Container | GAL. |
| | | 6850-00-181-7933 | 5 Gallon Container | GAL. |
| 7 | O | | ANTISEIZE COMPOUND: conductive<br>(81349) MIL-A-907 | |
| | | 8030-00-059-2761 | .25 Pound Can | LB |
| 8 | F | | ANTISEIZE COMPOUND: mica-base<br>(81349) MIL-A-13881 | |
| | | 8030-00-753-4953 | 1 Pound Can | LB |

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (Cont'd)

| (1) ITEM NUMBER | (2) LEVEL | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 9 | C | | BRAKE FLUID: silicone, automotive, all weather, operational and preservative (81349) MIL-B-46176 | |
| | | 9150-01-102-9455 | 1 Gallon Can | GAL. |
| | | 9150-01-123-3152 | 5 Gallon Can | GAL. |
| 10 | F | | CLOTH: abrasive, crocus (58536) A-A-1206 | |
| | | 5350-00-221-0872 | 50 Sheet Package | SH |
| | | 5350-00-268-3116 | 50 Yard Roll | YD |
| 11 | F | | COATING COMPOUND: plastic, waterproof (15819) 989 | |
| | | N/A | N/A | N/A |
| 12 | F | | CORD, FIBROUS: tying, neoprene (81349) MIL-Y-1140 | |
| | | 4020-01-072-9579 | 668 Yard Tube | YD |
| 13 | C | | DETERGENT: general purpose, liquid (81349) MIL-D-16791 | |
| | | 7930-00-282-9699 | 1 Gallon Container | GAL. |
| 14 | C | | DRYCLEANING SOLVENT: (81348) P-D-680, Type II | |
| | | 6850-00-110-4498 | 1 Pint Can | PT |
| | | 6850-00-274-5421 | 5 Gallon Drum | GAL. |
| | | 6850-00-285-8011 | 55 Gallon Drum | GAL. |
| | | 6850-00-637-6135 | Bulk | GAL. |
| 15 | F | | FLUSHING AGENT: R-111 (81348) BBF1421 | |
| | | 6830-00-281-3036 | 200 Pound Drum | LB |
| 16 | C | | FUEL OIL: diesel, regular, DF-2 (81348) VV-F-800 | |
| | | 9140-00-286-5295 | 5 Gallon Can | GAL. |
| | | 9140-00-286-5296 | 55 Gallon Drum | GAL. |
| 17 | C | | FUEL OIL: diesel, winter, DF-1 (81348) VV-F-800 | |
| | | 9140-00-286-5287 | 5 Gallon Can | GAL. |
| | | 9140-00-286-5288 | 55 Gallon Drum | GAL. |

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (Cont'd)

| (1) ITEM NUMBER | (2) LEVEL | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 18 | C | | FUEL OIL: diesel, arctic, DF-A (81348) VV-F-800 | |
| | | 9140-00-286-5282 | 5 Gallon Can | GAL. |
| | | 9140-00-286-5284 | 55 Gallon Drum | GAL. |
| 19 | F | | GREASE: aircraft, general purpose, wide, temperature range (81349) MIL-G-81322 | |
| | | 9150-00-181-7724 | 8 Ounce Tube | OZ |
| | | 9150-00-944-8953 | 1 Pound Can | LB |
| | | 9150-00-145-0268 | 5 Pound Can | LB |
| | | 9150-00-935-5851 | 35 Pound Can | LB |
| 20 | F | | GREASE: aircraft and instrument, gear and actuator screw (81349) MIL-G-23827 | |
| | | 9150-00-985-7246 | 1-3/4 Pound Can | LB |
| | | 9150-00-985-7247 | 6-1/2 Pound Can | LB |
| | | 9150-00-985-7248 | 35 Pound Can | LB |
| 21 | C | | GREASE: automotive and artillery (81349) MIL-G-10924 | |
| | | 9150-00-935-1017 | 14 Ounce Cartridge | OZ |
| | | 9150-00-190-0904 | 1-3/4 Pound Can | LB |
| | | 9150-00-190-0905 | 6-1/2 Pound Can | LB |
| 22 | H | | GREASE: bushing (96485) Moly Grease #1 | |
| | | N/A | N/A | NA |
| 23 | C | | HYDRAULIC FLUID: transmission (24617) Dexron® II | |
| | | 9150-00-698-2382 | 1 Quart Can | QT |
| | | 9150-00-657-4959 | 5 Gallon Can | GAL. |
| 24 | C | | HYDRAULIC FLUID: transmission or power steering (24617) Dexron® III | |
| | | 9150-01-353-4799 | 1 Quart Can | QT |
| | | 9150-01-144-9968 | 55 Gallon Can | GAL. |

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (Cont'd)

| (1) ITEM NUMBER | (2) LEVEL | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 25 | F | | INSULATING COMPOUND: (76381) Scotchcast No. 10 Resin | |
| | | 5970-00-186-6529 | Kit | EA |
| 26 | F | | INSULATION: (81349) MIL-I-23053 | |
| | | | N/A | N/A |
| 27 | F | 5970-00-740-2971 | INSULATION VARNISH: (08800) 1201 | |
| | | 5970-00-583-0401 | 1 Quart Can | QT |
| 28 | C | | LUBRICATING OIL: gear, multipurpose, GO 75 (81349) MIL-L-2105 | |
| | | 9150-01-035-5390 | 1 Quart Can | QT |
| | | 9150-01-035-5391 | 5 Gallon Drum | GAL. |
| 29 | C | | LUBRICATING OIL: gear, multipurpose, GO 80/90 (81349) MIL-L-2105 | |
| | | 9150-01-035-5392 | Quart Can | QT |
| | | 9150-01-035-5393 | 5 Gallon Drum | GAL. |
| 30 | C | | LUBRICATING OIL: internal combustion engine, arctic, OEA (81349) MIL-L-46167 | |
| | | 9150-00-402-4478 | 1 Quart Can | QT |
| | | 9150-00-402-2372 | 5 Gallon Drum | GAL. |
| | | 9150-00-491-7197 | 55 Gallon Drum | GAL. |
| 31 | C | | LUBRICATING OIL: internal combustion engine, tactical service, OE/HDO 10 (81349) MIL-L-2104 | |
| | | 9150-00-189-6727 | 1 Quart Can | QT |
| | | 9150-00-186-6668 | 5 Gallon Can | GAL. |
| | | 9150-00-191-2772 | 55 Gallon Drum | GAL. |
| 32 | C | | LUBRICATING OIL: internal combustion engine, tactical service, OE/HDO 30 (81349) MIL-L-2104 | |
| | | 9150-00-186-6681 | 1 Quart Can | QT |
| | | 9150-00-188-9858 | 5 Gallon Drum | GAL. |
| | | 9150-00-189-6729 | 55 Gallon Drum | GAL. |

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (Cont'd)

| (1) ITEM NUMBER | (2) LEVEL | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 33 | C | | LUBRICATING OIL: internal combustion engine, tactical service, OE/HDO/15/40 (81349) MIL-L-2104 | |
| | | 9150-01-152-4117 | 1 Quart Can | QT |
| | | 9150-01-152-4118 | 5 Gallon Drum | GAL. |
| | | 9150-01-152-4119 | 55 Gallon Drum | GAL. |
| 34 | F | | LUBRICATING OIL: general purpose, corrosion resistive and oxidation resistant (92895) | |
| | | 9150-00-273-2389 | 4 Ounce Can | OZ |
| 35 | F | | LUBRICATING OIL: refrigerant, compressor (59595) CAPELLA WF-68 | |
| | | 9150-00-071-4712 | 1 Gallon Can | GAL. |
| 35.1 | | | Deleted | |
| 35.2 | F | | LUBRICATING OIL, PAG: refrigerant | |
| | | N/A | 6 Ounce Can | OZ |
| 36 | F | 9515-00-204-3988 | METAL STRIP: hot rolled finish (81346) ASTM A569 | N/A |
| 37 | F | | NITROGEN: (81348) BB-N-411 | |
| | | 6830-01-124-3351 | Cylinder | N/A |
| 38 | H | | PETROLATUM: technical (81348) VV-P-236 | |
| | | 9150-00-250-0926 | 1-3/4 Pound Can | LB |
| | | 9150-00-250-0933 | 7-1/2 Pound Can | LB |
| 39 | H | | PIGMENT, PAINT PRODUCTS: ultramarine, blue | |
| | | 8010-00-060-6020 | 1/2 Pint Can | PT |
| 40 | F | | PRIMER: weld-through (81349) MIL-P-46106 | |
| | | 8010-01-296-7851 | 1 Gal. Container | GAL. |
| 41 | C | | RAG: wiping, cotton and cotton-synthetic (58536) A-A-531 | |
| | | 7920-00-205-1711 | 50 Pound Bale | LB |

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (Cont'd)

| (1) ITEM NUMBER | (2) LEVEL | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 42 | | | REFRIGERANT: R-12<br>(80244) BB-AF1421TY 12 | |
| | | 6830-00-531-8102 | 150 Pound Cylinder | CYL. |
| 42.1 | | | Deleted | |
| 42.2 | F | | REFRIGERANT: R-134a<br>(25827) HFC-134A | |
| | | 6830-01-370-6207 | 43 Pound Cylinder | LB |
| 43 | O | | SEALANT: silicone, RTV<br>(11862) 1052734 | |
| | | 6850-01-159-4844 | 8-1/2 Ounce Tube | OZ |
| 44 | | | Deleted | |
| 45 | F | | SEALING COMPOUND: | |
| | | 8030-01-374-3504 | 50 Milliliter Tube | ML |
| | | 8030-01-374-2338 | 300 Milliliter Cartridge | ML |
| 46 | F | | SEALING COMPOUND: adhesive, elastomeric<br>(00333) M6325 | |
| | | 8030-01-347-0964 | 11 Ounce Cartridge | OZ |
| 47 | O | | SEALING COMPOUND: corrosion-resistant<br>(81349) MIL-S-81733, type II | |
| | | 8030-00-009-5023 | Kit | EA |
| 48 | F | | SEALING COMPOUND: gasket, non-hardening<br>(80244) MIL-S-45180, type II | |
| | | 8030-00-291-1787 | 1 Pint Can | PT |
| 49 | O | | SEALING COMPOUND: pipe, anaerobic, with teflon<br>(05972) 59231 | |
| | | 8030-01-054-0740 | 50 Milliliter Tube | ML |
| 50 | O | | SEALING COMPOUND: thread-locking,<br>high strength (80244) MIL-S-46163, type I,<br>grade K | |
| | | 8030-00-148-9833 | 10 CC Bottle | CC |
| 51 | O | | SEALING COMPOUND:<br>thread-locking, medium strength<br>(80244) MIL-S-46163, type II, grade N | |
| | | 8030-01-025-1692 | 250 CC Bottle | CC |
| 52 | F | | SEALING COMPOUND: windshield<br>(04963) 847H | |
| | | 8030-00-165-6547 | 1 Quart Container | QT |
| 53 | F | | SEALING COMPOUND: type II, synthetic<br>rubber (81349) MIL-S-12158 | |
| | | 8030-00-159-8177 | 1 Quart Container | QT |

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST (Cont'd)

| (1) ITEM NUMBER | (2) LEVEL | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 54 | F | | SEALING COMPOUND: synthetic rubber (71984) 737RTV | |
| | | 8030-01-328-0574 | 3 Ounce Package | OZ |
| 55 | F | | SEALING COMPOUND: anaerobic/loctite 290 (81349) MIL-S-46163 | |
| | | 8030-00-111-2762 | 50 CC Bottle | CC |
| 56 | F | | SILICONE COMPOUND: thermal insulating (71984) DC 340 | |
| | | 6850-00-927-9461 | 2 Ounce Package | OZ |
| 56.1 | F | | SILICONE COMPOUND: silicone RTV rubber sealant (7X677) 12346193 | |
| | | 6850-01-159-4844 | 10 oz. tube | TU |
| | | 6850-01-137-8525 | 5 Ounce Tube | OZ |
| 57 | O | | SILICONE COMPOUND: dielectric calloid non-melting, heat stable, NATO code no. S-736 (81349) MIL-S-8660 | |
| | | 6850-00-880-7616 | 8 Ounce Tube | OZ |
| | | 6850-00-295-7685 | 10 Pound Can | LB |
| 58 | F | | TAPE: (04963) Y-9485 | |
| | | 9320-01-244-0046 | 1 Roll | YD |
| 59 | F | N/A | WICKING SEALANT: (71961) 6099 | OZ |
| 60 | F | N/A | WOOL, METALLIC: type III, medium (58536) A-A-1043 | |
| | | 5350-00-242-4404 | 1 Pound Package | LB |

# APPENDIX C
# ILLUSTRATED LIST OF MANUFACTURED ITEMS

## Section I. INTRODUCTION

### C-1. SCOPE

This appendix includes complete instructions for making items authorized to be manufactured or fabricated at organizational, direct support, and general support maintenance.

### C-2. GENERAL

**a.** A part number index in alphanumeric order is provided for cross-referencing the part number of the item to be manufactured to the figure which covers fabrication criteria.

**b.** All bulk materials needed for manufacture of an item are listed by part number or specification number in a tabular list on the illustration.

*Table C-1. Manufactured Items Part Number Index*

| PART NUMBER | FIGURE NUMBER | PART NUMBER | FIGURE NUMBER |
|---|---|---|---|
| 5992390 | C-1 | N/A | C-24 |
| 5992391 | C-2 | NA | C-25 |
| 5992392 | C-3 | N/A | C-26 |
| 5992393 | C-4 | QQS634 | C-27 |
| 5992394 | C-5 | QQS634 | C-28 |
| 5592395 | C-6 | QQS634 | C-29 |
| 5992396 | C-7 | QQS630 | C-30 |
| 5992397 | C-8 | QQS741 | C-31 |
| 5992398 | C-9 | QQS741 | C-32 |
| 5992399 | C-10 | QQS741 | C-33 |
| 5992400 | C-11 | 3593Y19 | C-34 |
| 5992401 | C-12 | 3593Y19 | C-35 |
| 5992402 | C-13 | N/A | C-36 |
| 5992403 | C-14 | N/A | C-37 |
| 5992404 | C-15 | N/A | C-38 |
| 5992405 | C-16 | N/A | C-39 |
| 5992406 | C-17 | N/A | C-40 |
| N/A | C-18 | N/A | C-41 |
| N/A | C-19 | N/A | C-42 |
| QQS698 | C-20 | N/A | C-43 |
| QQS634 | C-21 | N/A | C-44 |
| QQ-A-200/8 | C-22 | N/A | C-45 |
| QQ-A-200/8 | C-23 | N/A | C-46 |
| | | N/A | C-47 |
| | | N/A | C-48 |

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

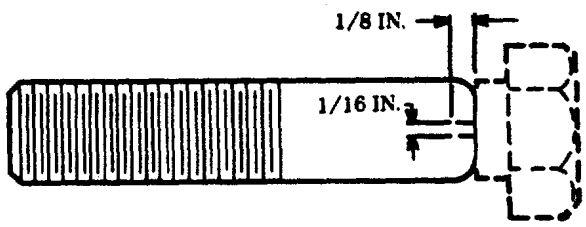



*Figure C-1. Differential Guide Pin, 5992390*

**INSTRUCTIONS:**

1. Fabricate from screw, NSN 5305-00-709-8540.
2. Cut off head of screw.
3. Round off edge of non-threaded end as shown above.
4. Cut a slit approximately 1/16 in. wide and 1/8 in. deep in non-threaded end as shown above.
5. Remove any burrs after cutting.

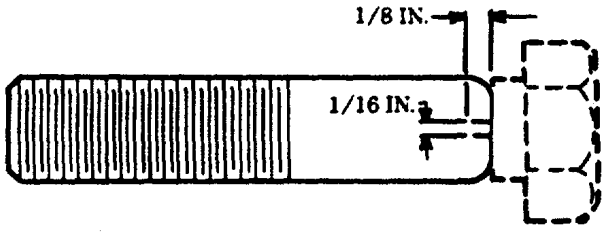



*Figure C-2. Transmission Guide Pin, 5992391*

**INSTRUCTIONS:**

1. Fabricate from screw, NSN 5306-00-226-4833.
2. Cut off head of screw.
3. Round off edge of non-threaded end as shown above.
4. Cut a slit approximately 1/16 in. wide and 1/8 in. deep in non-threaded end as shown above.
5. Remove any burrs after cutting.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| **STOCK SIZE** | **DESCRIPTION** | **SPECIFICATION** |
| 3/8" X 3/8" | ALUMINUM | |

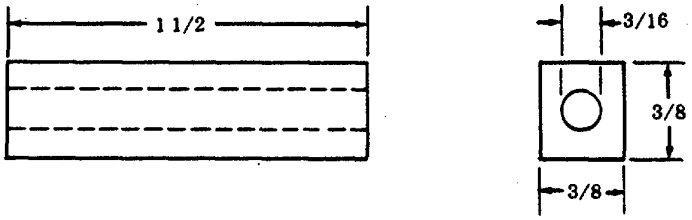



*Figure C-3. Core Shaft Nut Tool, 5992392*

**INSTRUCTIONS:**

1. Cut to length from 3/8" square aluminum stock, NSN 9530-00-236-7723 or NSN 9530-00-061-0463.
2. Drill 3/16" hole through middle of stock.
3. Remove all burrs.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| **STOCK SIZE** | **SPECIFICATION** | **DESCRIPTION** |
| 2" X 4" (Nom) and 2" X 12" (Nom) | WOOD | MMM-L-751 |

| LUMBER, SOFTWOOD | | | NAILS (FF-N-105) | |
|---|---|---|---|---|
| **PIECE** | **CUT LENGTH (INCHES)** | **MANUFACTURED FROM** | **SIZE** | **QTY** |
| A (2 ea) | 15-3/4 | 2" X 4" (Nom) | 12D | 12 ea |
| B | 8-1/4 | 2" X 4" (Nom) | | |
| C | 8-1/4 | 2" X 4" (Nom) | | |
| D | 8-3/4 | 2" X 12" (Nom) | | |

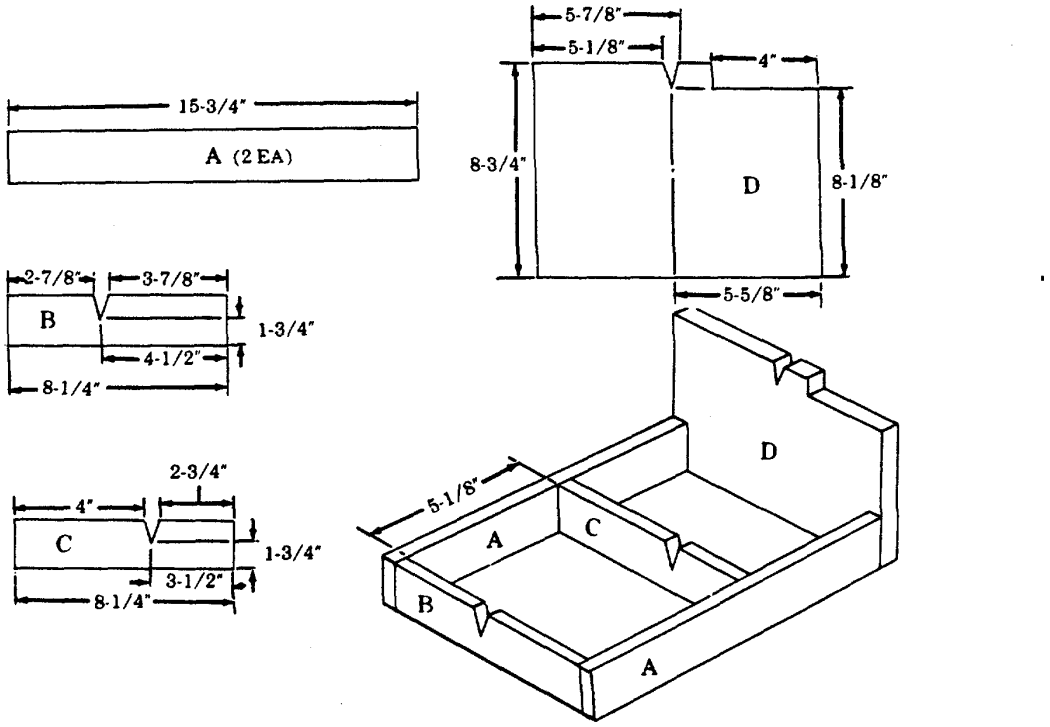



*Figure C-4. Transfer Case Support Stand, 5992393*

**INSTRUCTIONS:**

1. Cut four pieces of wood, "A" (2 ea), "B", and "C" to length shown, using NSN 5510-00-220-6146.
2. Cut one piece of wood, "D", to length shown, using NSN 5510-00-220-6250.
3. Cut a "VEE" notch in pieces "B", "C", and "D" in locations shown.
4. Cut a rectangular notch in piece "D" in location shown.
5. Using two nails at each joint, NSN 5310-00-753-3884 (5 pound box), assemble pieces "A", "B", "C", and "D" as shown.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

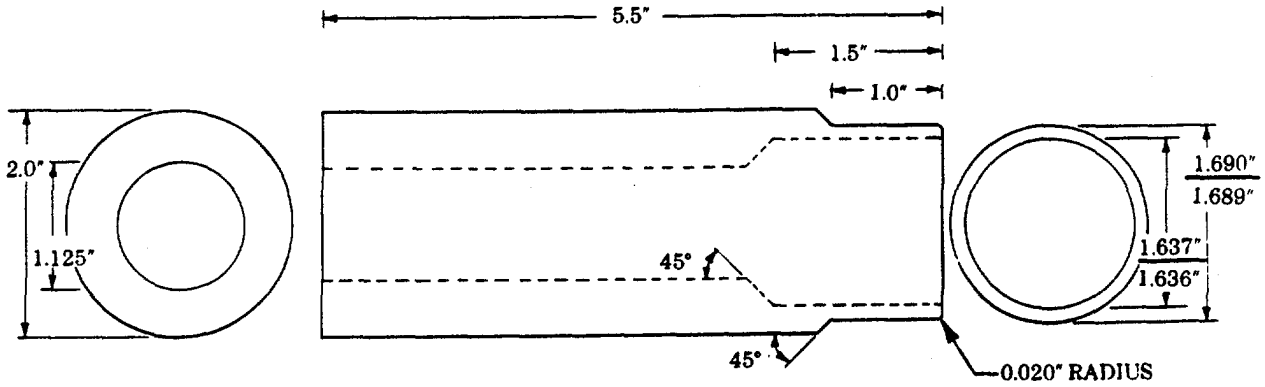



*Figure C-5. 100 Ampere Alternator Seal Sleeve Tool, 5992394*

**INSTRUCTIONS:**

1. Fabricate from cold rolled steel.
2. Exterior to be smooth and free from burrs after machining.

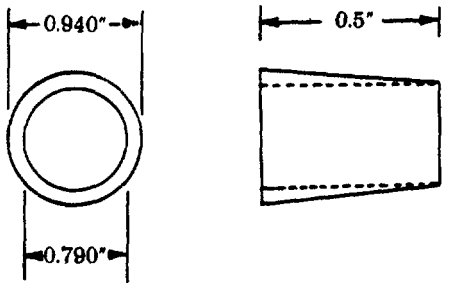



*Figure C-6. 60 Ampere Alternator Seal Sleeve Tool, 5992395*

**INSTRUCTIONS:**

1. Fabricate from aluminum tubing.
2. Exterior to be smooth and free from burrs after machining.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| **STOCK SIZE** | **DESCRIPTION** | **SPECIFICATION** |
| 10 x 12 FT (NOM)<br>.50-IN. THICK (NOM)<br>2.50-IN. WIDE (NOM) | BAR, METAL | ASTM A108 |
| 8 x 12 FT (NOM)<br>.3124-IN. THICK (NOM)<br>6.00-IN. WIDE (NOM) | BAR, METAL | ASTM A108 |
| 12 FT (NOM)<br>.3760-IN. THICK (NOM)<br>2.50-IN. WIDE (NOM) | BAR, METAL | ASTM A108 |

| POWERTRAIN LIFT SLING ASSEMBLY | | |
|---|---|---|
| **PIECE** | **CUT LENGTH** | **MANUFACTURED FROM NSN** |
| A. LIFT SLING BEAM | 14.50-IN. | 9510-00-542-2484 |
| B. LIFT HOOK | 6.10-IN. | 9510-00-542-2484 |
| C. SLING REINFORCEMENT (2) | 3.25-IN. | 9510-00-596-3868 |
| D. LEFT SIDE BRACKET REINFORCEMENT | 7.35-IN. | 9510-00-596-3868 |
| E. RIGHT SIDE BRACKET REINFORCEMENT | 7.38-IN. | 9510-00-596-3868 |
| F. LEFT SIDE BRACKET | 9.60-IN. | 9510-00-955-9277 |
| G. RIGHT SIDE BRACKET | 9.50-IN. | 9510-00-955-9277 |

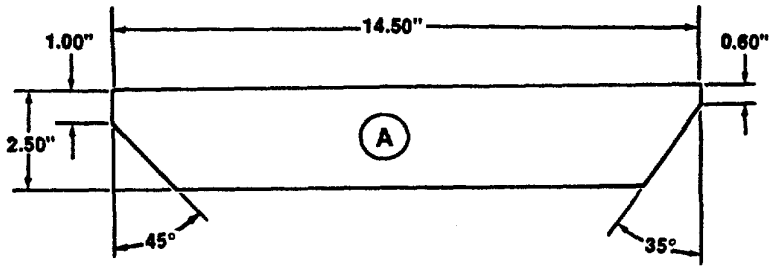



*Figure C-7. Lift Sling Beam, 5992396*

**INSTRUCTIONS:**

Using NSN 9510-00-542-2484 metal bar, fabricate lift sling beam “A".

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

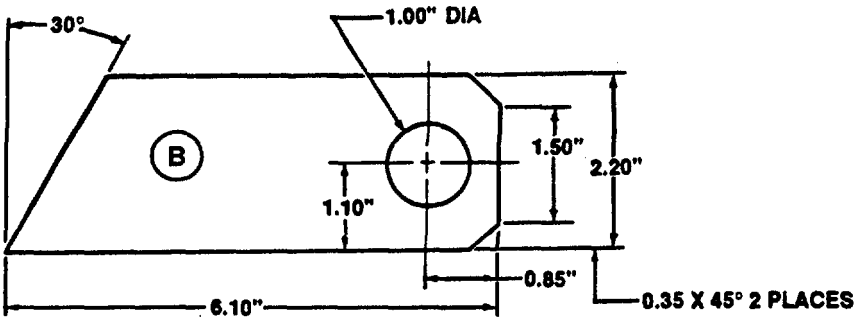



*Figure C-8. Lift Hook, 5992397*

**INSTRUCTIONS:**

Using NSN 9510-00-542-2484 metal bar, fabricate lift hook “B".

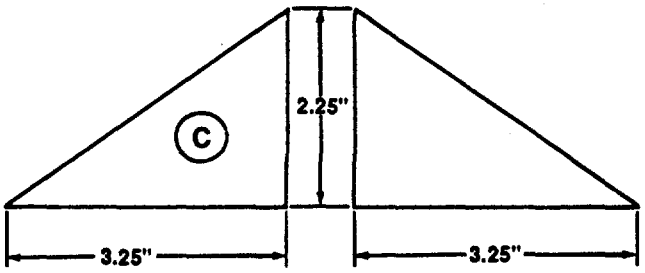



*Figure C-9. Sling Reinforcement, 5992398*

**INSTRUCTIONS:**

Using NSN 9510-00-866-2878 metal bar, fabricate two sling reinforcements “C".

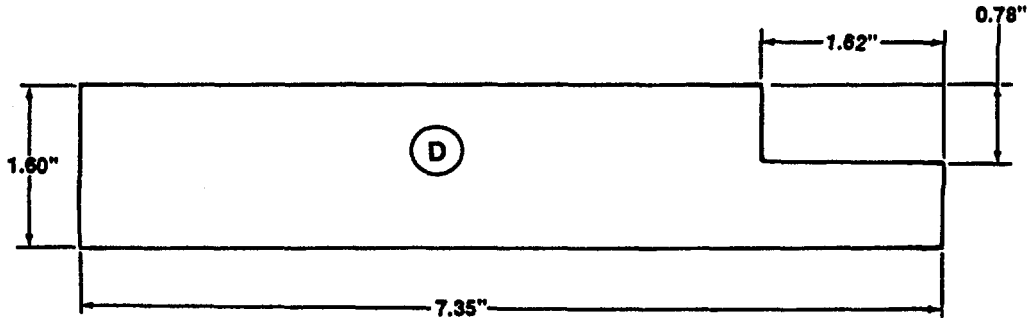



*Figure C-10. Left Side Bracket Reinforcement, 5992399*

**INSTRUCTIONS:**

Using NSN 9510-00-866-2878 metal bar, fabricate left side bracket reinforcement "D".

**Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)**

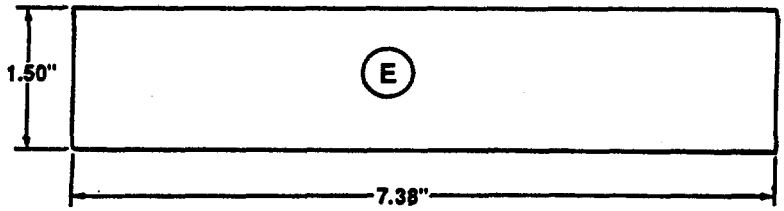



*Figure C-11. Right Side Bracket Reinforcement 5992400*

**INSTRUCTIONS:**

Using NSN 9510-00-866-2878 metal bar, fabricate right side bracket reinforcement “E".

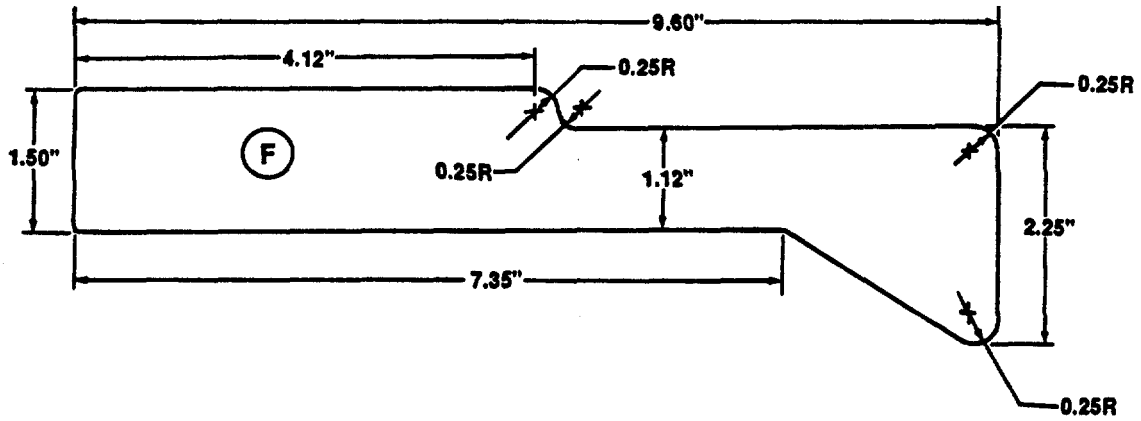



*Figure C-12. Left Side Bracket 5992401*

**INSTRUCTIONS:**

Using NSN 9510-00-955-9277 metal bar, fabricate left side bracket "F".

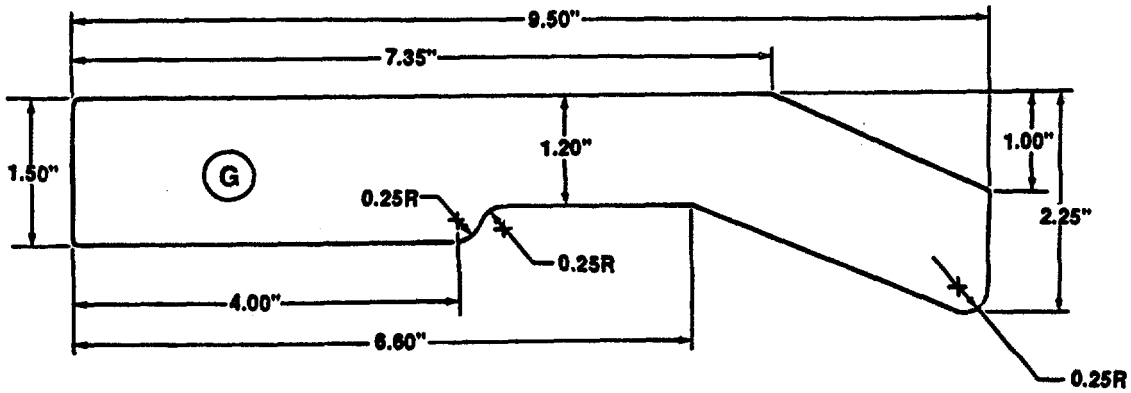



*Figure C-13. Right Side Bracket 5992402*

**INSTRUCTIONS:**

Using NSN 9510-00-955-9277 metal bar, fabricate right side bracket “G".

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

**ASSEMBLY INSTRUCTIONS:**

**NOTE**

- All dimensions are in inches.
- Remove all burrs and sharp edges after each fabrication.

1. Position lift hook (3) on lift sling beam (2) and weld into place.
2. Position two sling reinforcements (1) and (4) on lift sling beam (2) and lift hook (3), and weld into place.
3. Position right side bracket (8) on lift sling beam (2) and weld into place.
4. Position right side bracket reinforcement (7) on lift sling beam (2) and right side bracket (8) and weld into place.
5. Position left side bracket (5) on lift sling beam (2) and weld into place.
6. Position left side bracket reinforcement (6) on lift sling beam (2) and left side bracket (5), and weld into place.
7. Locate, mark, and drill four 0.437-inch diameter holes through powertrain lift sling.
8. Paint powertrain lift sling. (Refer to TM 43-0139).
9. Complete load test for powertrain lift sling using a 1-ton weight.
10. Check powertrain lift sling for weld cracks by using a dye penetrant inspection method.

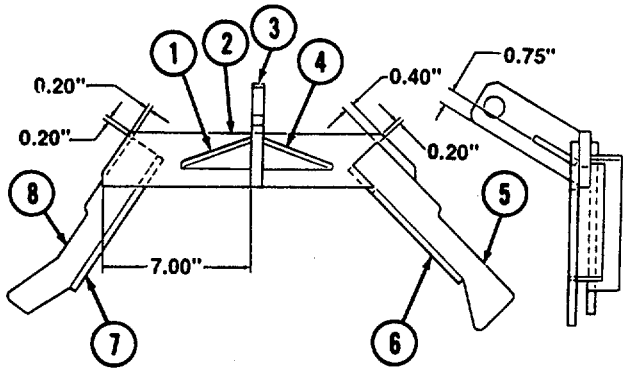



*Figure C-14. Powertrain Lift Sling, 5992403*

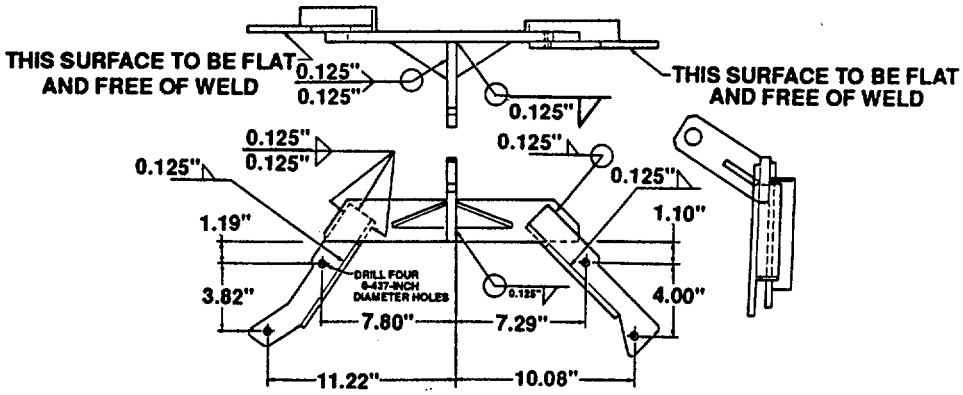



*Figure C-15. Powertrain Lift Sling, 5992404*

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

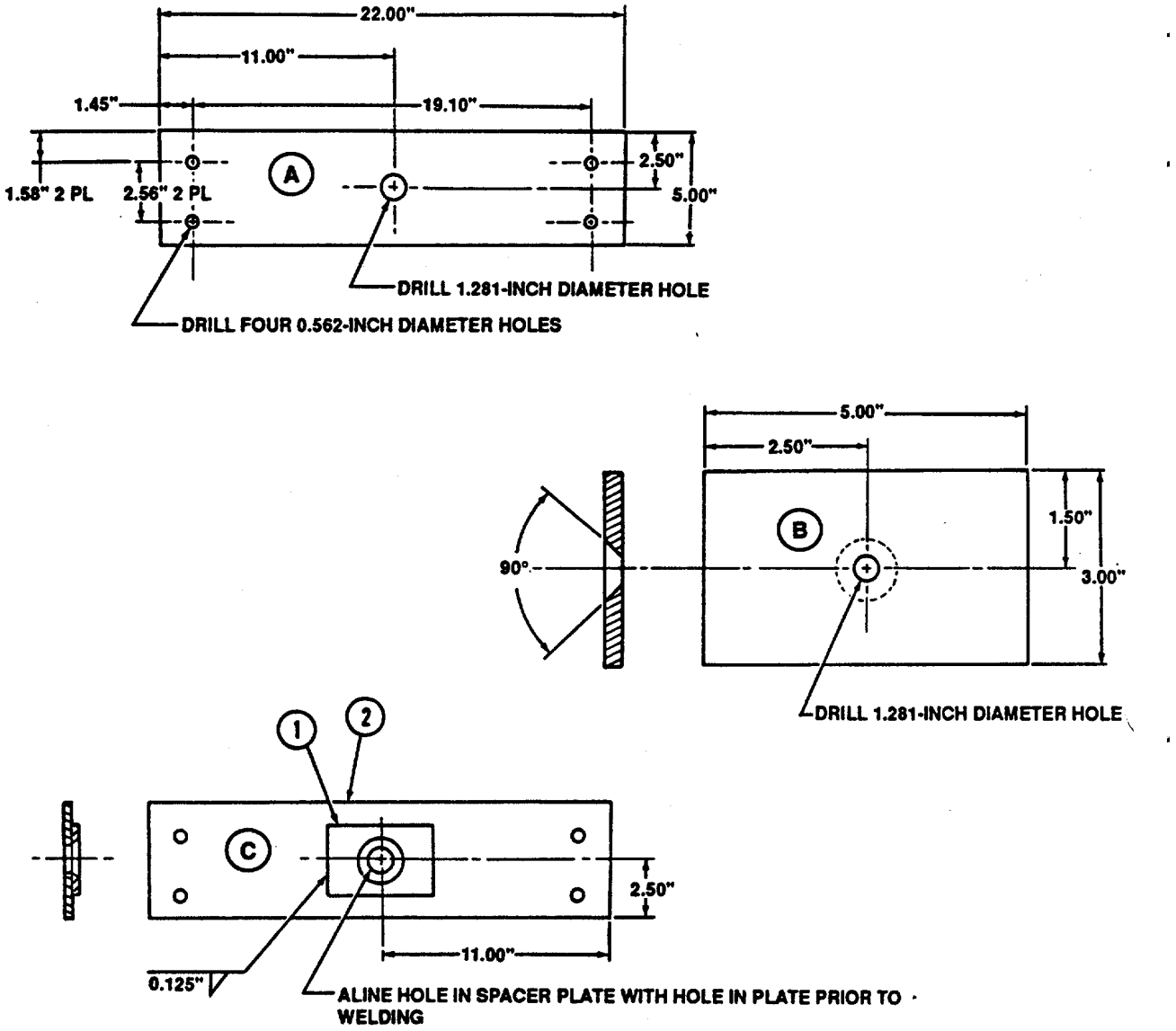



*Figure C-16. Front Bumper Tow Pintle Plate Assembly (Front), 5992405*

**INSTRUCTIONS:**

**NOTE**

- All dimensions are in inches.
- Remove all burrs and sharp edges after each fabrication.

1. Using NSN 9510-01-043-3616 metal bar, fabricate plate as shown in “A".
2. Using NSN 9510-01-043-3616 metal bar, fabricate spacer plate as shown in “B".
3. To fabricate front plate, position spacer plate (1) on plate (2) and weld into place as shown in “C".

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

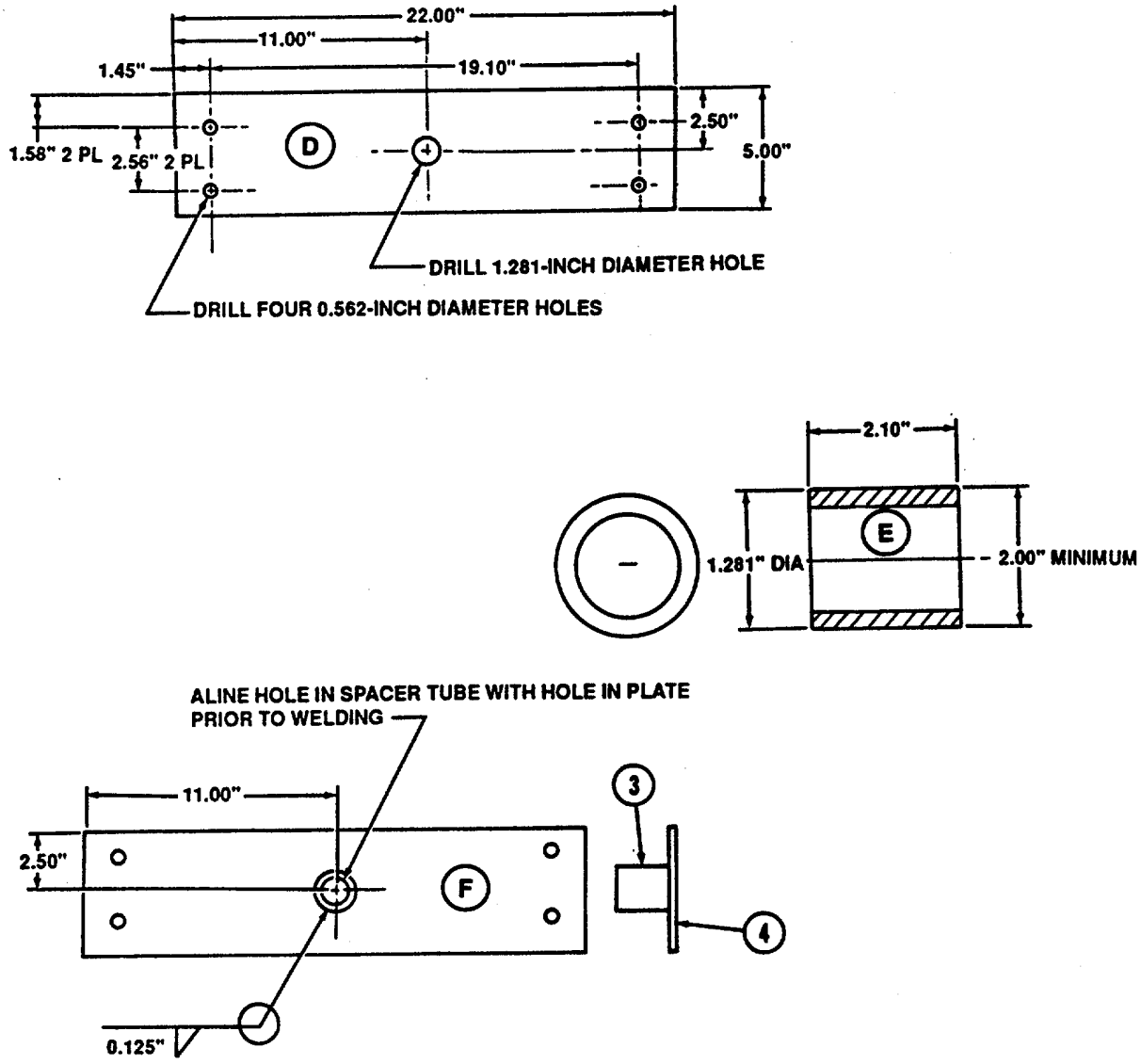



*Figure C-17. Front Bumper Low Pintle Plate Assembly (Back), 5992406*

**INSTRUCTIONS:**

**NOTE**

- All dimensions are in inches.
- Remove all burrs and sharp edges after each fabrication.

1. Using NSN 9510-01-043-3616 metal bar, fabricate plate as shown in “D”.
2. Using NSN 9510-01-813-5343 metal bar, fabricate spacer tube as shown in "E”.
3. To fabricate back plate, position spacer tube (3) on plate (4) and weld into place as shown in “F”

**Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)**

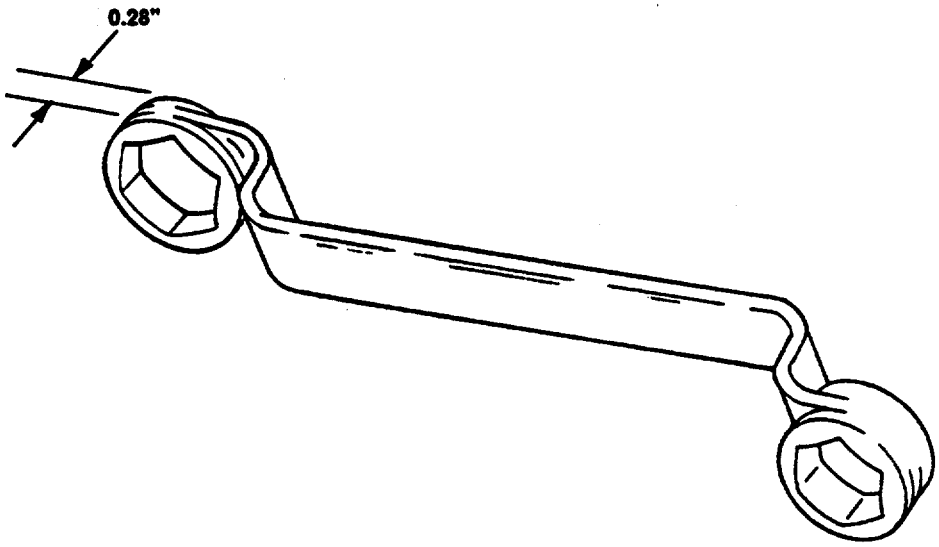



*Figure C-18. Modified Box Wrench*

**INSTRUCTONS:**

Modify a 1-in. box wrench by grinding it down to a thickness of 0.28 in. (7.11 mm).

**Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)**

| MATERIAL BLOCK | | |
|---|---|---|
| **STOCK SIZE** | **DESCRIPTION** | **SPECIFICATION** |
| N/A | 3/4 to 1-hp electric motor w/on-off switch | |
| N/A | Pulley to fit motor | |
| N/A | Drive belt | |
| N/A | Pressure hose (cut to length) with quick disconnect | |
| N/A | Guard | |
| N/A | Drain Pan | |
| N/A | Wire Mesh | |

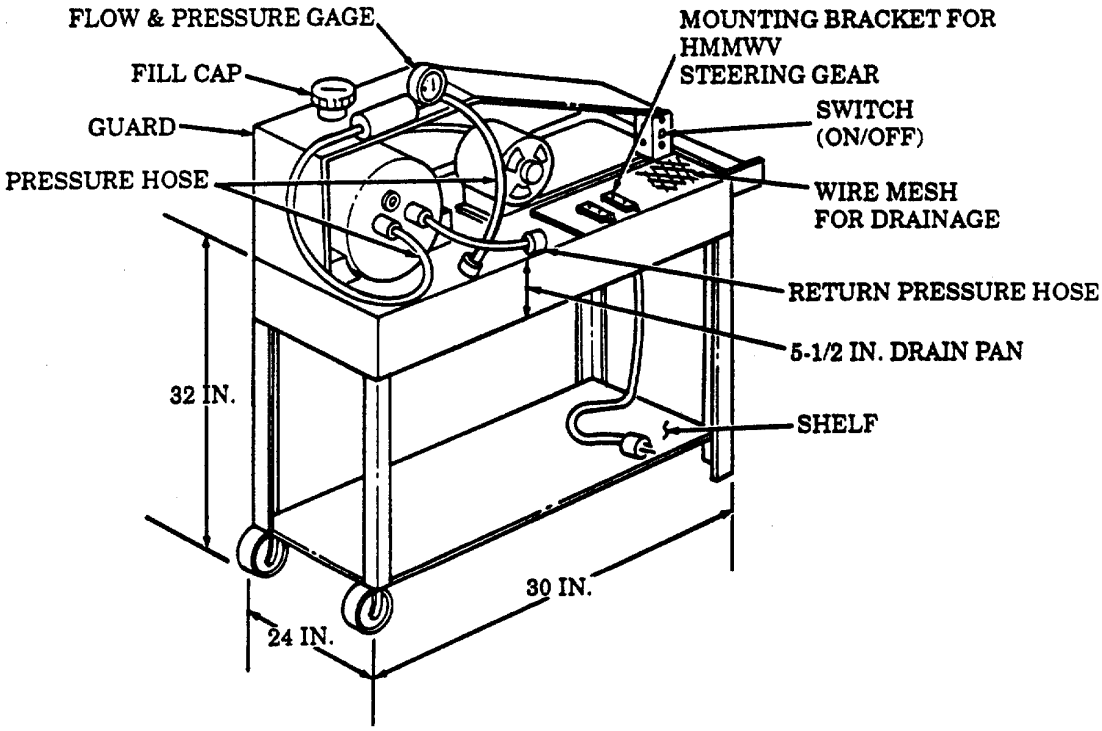



*Figure C-19. Power Steering Pump and Steering Gear Test Stand*

**INSTRUCTIONS:**

**NOTE**

Materials and size depends upon availability.

1. Construct test stand using available materials and Figure C-20 as a guide.

**Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)**

| MATERIAL BLOCK | | |
|---|---|---|
| **STOCK SIZE** | **DESCRIPTION** | **SPECIFICATION** |
| N/A | LIGHT DIVERTER | ASTM A569 |

| SHEET | | |
|---|---|---|
| **PART NUMBER** | **CUT LENGTH (INCHES)** | **MANUFACTURED FROM NSN** |
| QQS698 | AS SHOWN | 9515-00-640-4201 |

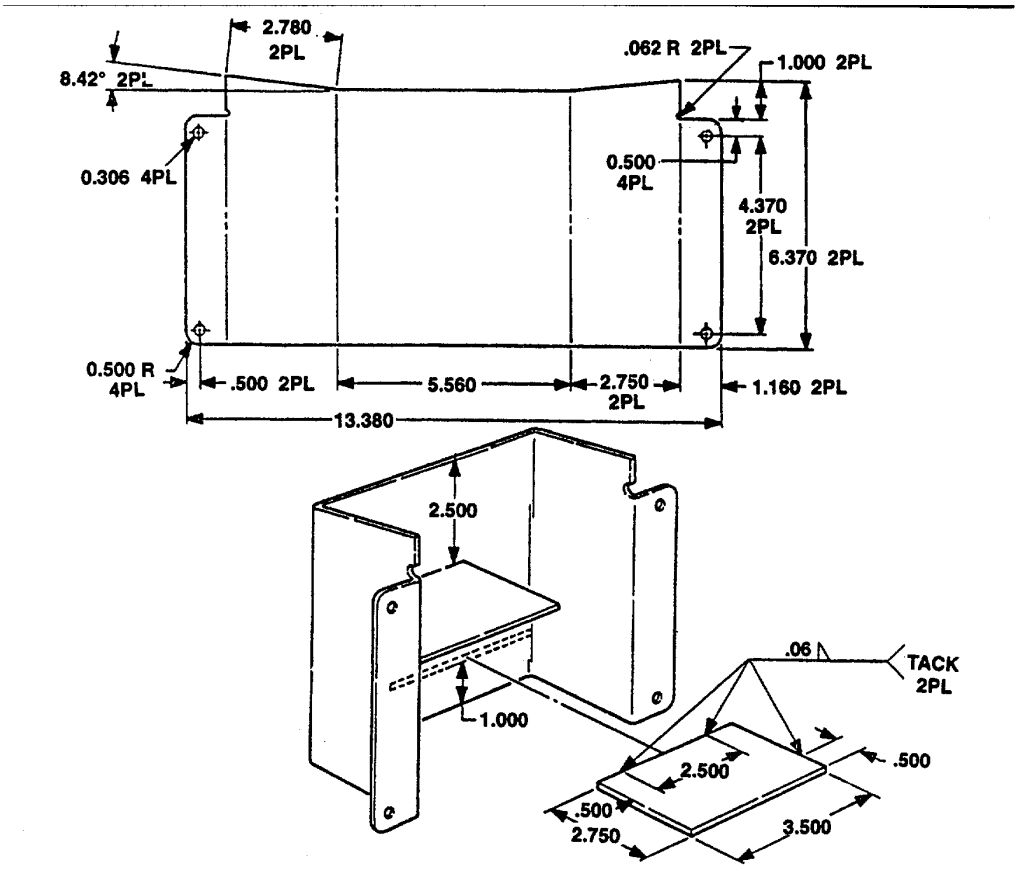



*Figure C-20. Light Diverter, QQS698*

**INSTRUCTIONS:**

1. Fabricate light diverter according to dimensions shown.
2. Remove all burrs and sharp edges.
3. Clean per SPEC TT-C-490. Treat per SPEC Type I or II, or SPEC TT-C-490.
4. Prime per SPEC TT-C-490. Treat per SPEC Type I or II, or SPEC TT-C-490.
5. Finish-paint per SPEC MILC-46168.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| **STOCK SIZE** | **DESCRIPTION** | **SPECIFICATION** |
| .375-IN. THICK<br>.188-IN. THICK | BAR, METAL<br>ALUMINUM | ASTM A108<br>QQ-A-200/18 |

| BOTTOM SUPPORT SLING ASSEMBLY | | |
|---|---|---|
| **PIECE** | **CUT LENGTH** | **MANUFACTURED FROM NSN** |
| A. SUPPORT HOOK (2) | 12.00-IN. | 9510-00-813-5322 |
| B. BRACE (2) | 14.00-IN. | 9540-00-197-9865 |
| C. BOTTOM SUPPORT | 38.00-IN. | 9540-00-197-9865 |

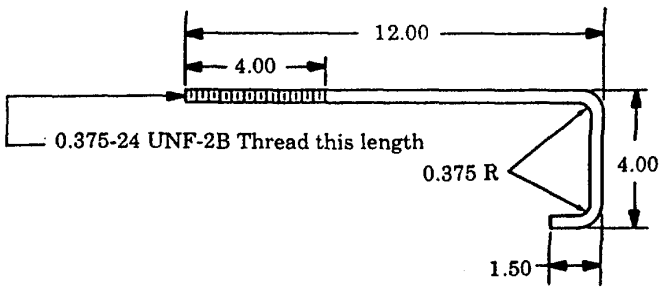



*Figure C-21. Support Hook, QQS634*

**INSTRUCTIONS:**

Using NSN 9510-00-813-5322 metal bar, fabricate two support hooks "A".

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd )

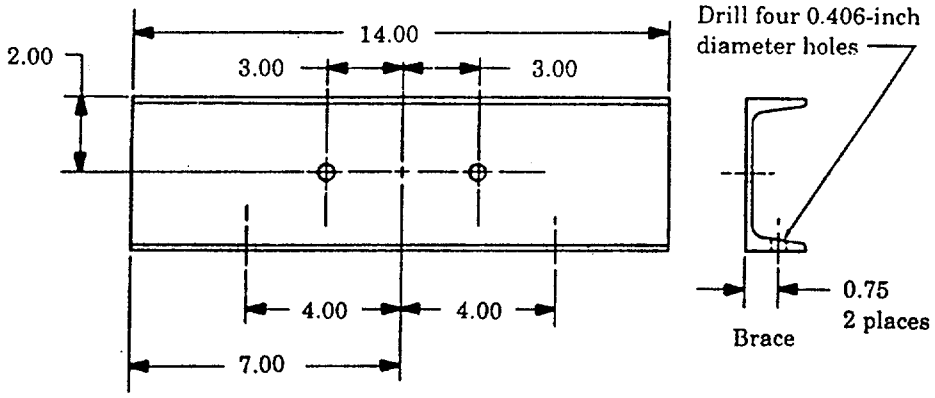



*Figure C-22. Brace QQ-A-200118*

**INSTRUCTIONS:**

Using NSN 9540-00-197-9865 aluminum channel, fabricate two braces "B".

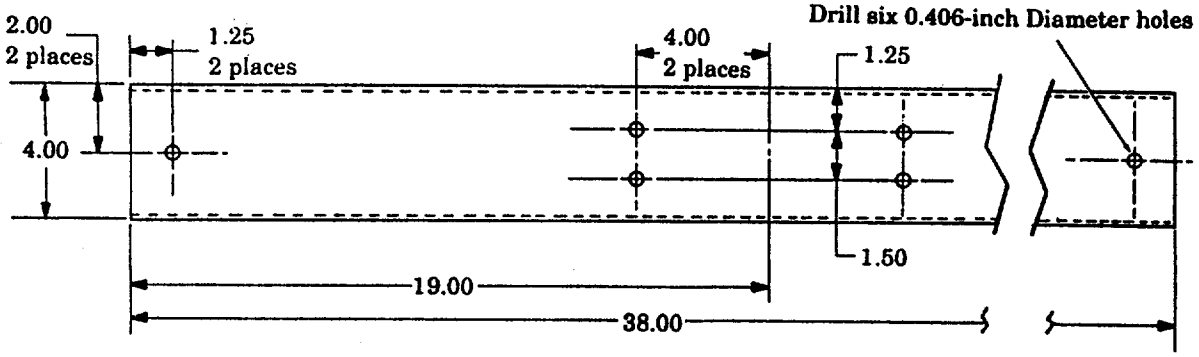



*Figure C-23. Support, QQ-A-200118*

**INSTRUCTIONS:**

Using NSN 9540-00-197-9865 aluminum channel, fabricate support "C".

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

**ASSEMBLY INSTRUCTIONS:**

**NOTE**
All dimensions are in inches.
Remove all burrs and sharp edges after each fabrication.

1. Positions two braces (1) on support (7) and install with six bolts (3), twelve washers (2) and six nuts (8).
2. Install two support hooks (4) on support (7) with four washers (5) and nuts (6).

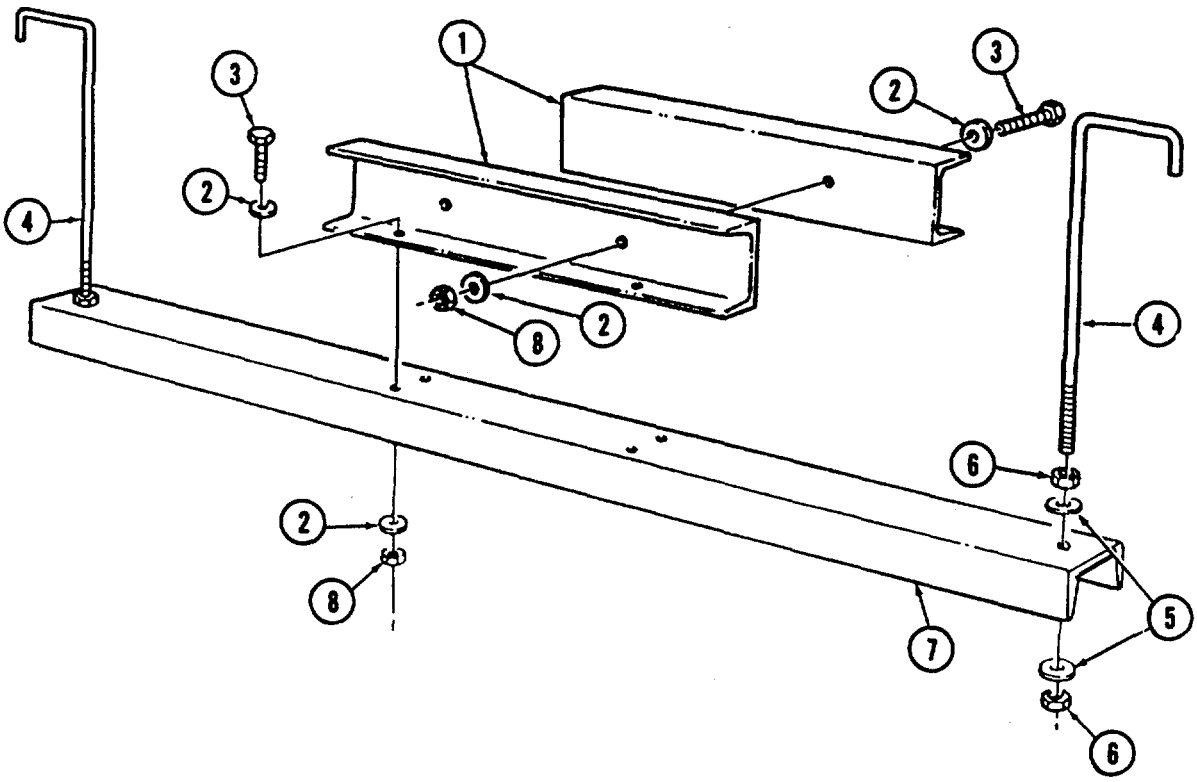



*Figure C-24. Bottom Support Sling*

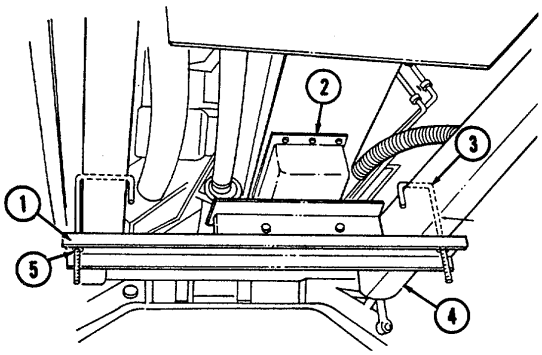
## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

INSTALLATION INSTRUCTIONS:

**NOTE**

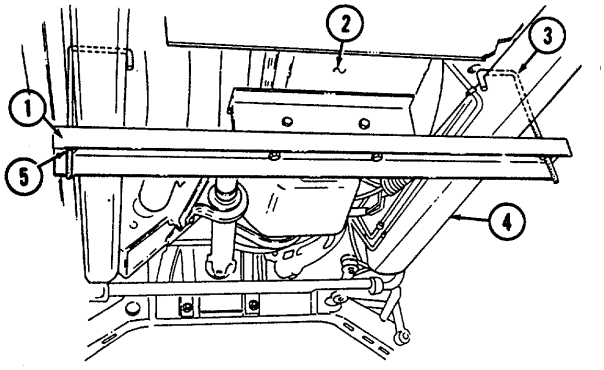
- Bottom support sling must be installed prior to engine or transmission removal.
- When performing Step 1, ensure support hooks are positioned flat on frame rail to prevent damage to oil and vent lines. Ensure nuts on support hooks are adjusted evenly to keep from bending engine or transmission oil pan.

1. Position bottom support sling (1) under engine or transmission oil pan (2).
2. Slide support hooks (3) over frame rails (4) and hand tighten four nuts (5) until support sling (1) is snug against oil pan (2). Tighten nuts (5) two more complete turns.




(SLING SUPPORTING ENGINE)

*Figure C-25. Bottom Support*




(SLING SUPPORTING TRANSMISSION)

*Figure C-26. Bottom Support*

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| | MATERIAL BLOCK | |
|---|---|---|
| STOCK SIZE | DESCRIPTION | SPECIFICATION |
| .125-IN. THICK | BAR, METAL | ASTM A108 |
| .125-IN. THICK | BAR, METAL | ASTM A108 |
| .125-IN. THICK | BAR, METAL | ASTM A108 |
| .155-IN. THICK | STEEL, ANGLE | ASTM A575 |
| .125-IN. THICK | STEEL, ANGLE | ASTM A36 |
| .125-IN. THICK | STEEL, ANGLE | ASTM A36 |
| .125-IN. THICK | STEEL, ANGLE | ASTM A36 |
| .250-IN. DIAMETER | STEEL, CHAIN | RR-C-271 |
| .250-IN. DIAMETER | STEEL, CHAIN | RR-C-271 |

| OVERHEAD SUPPORT SUNG | | |
|---|---|---|
| PIECE | CUT LENGTH | MANUFACTURED FROM NSN |
| A. ENGINE BRACKET (2) | 3.50-IN. | 9510-00-294-0986 |
| B. L.H. TRANSMISSION BRACKET | 8.10-IN. | 9510-00-294-0986 |
| C. R.H. TRANSMISSION BRACKET | 8.10-IN. | 9510-00-294-0986 |
| D. "A" FRAME BRACKET | 8.0-IN. | 9520-00-061-6507 |
| E. CENTER SUPPORT BEAM | 19.5-IN. | 9520-00-277-4925 |
| F. INNER FLOOR SUPPORT | 5.0-IN. | 9520-00-277-4925 |
| G. OUTER FLOOR SUPPORT | 10.0-IN. | 9520-00-277-4925 |
| H. ENGINE SUPPORT CHAIN | 14.00-IN. | 4010-00-174-4879 |
| I. TRANSMISSION SUPPORT CHAIN | 25.00-IN. | 4010-00-174-4879 |

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Contd)

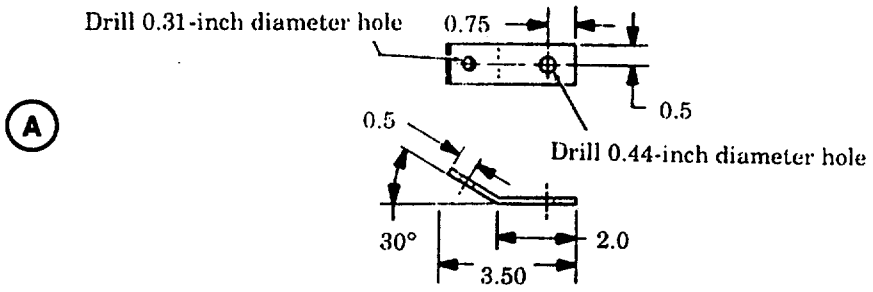



*Figure C-27. Engine Bracket, QQS634*

**INSTRUCTIONS:**

Using NSN 9510-00-294-0986 metal bar, fabricate two engine brackets 'A".

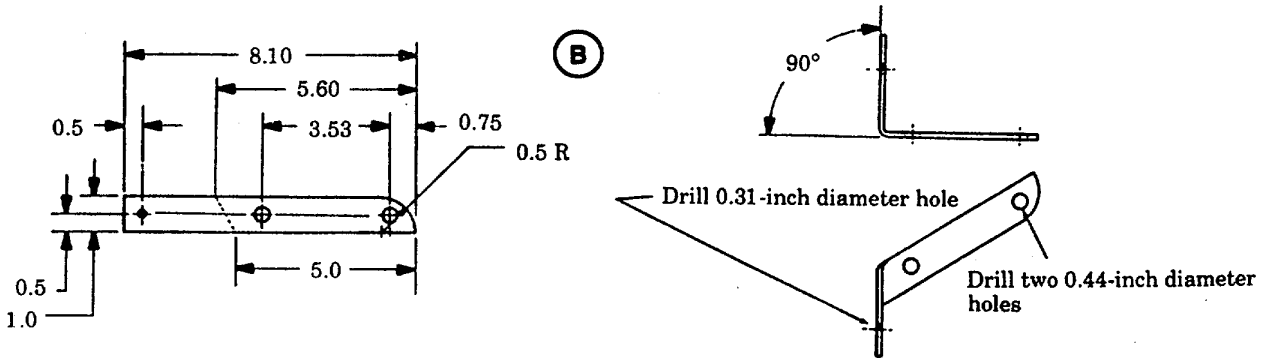



*Figure C-28. L. H. Transmission Brackets, QQS634.*

**INSTRUCTIONS:**

Using NSN 9510-00-294-0986 metal bar, fabricate L. H. transmision bracket 'B".

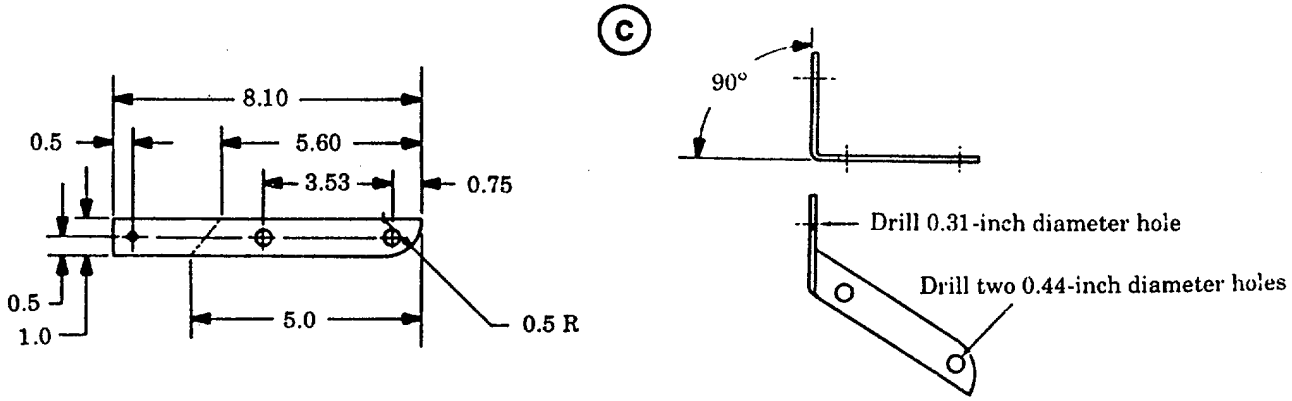



*Figure C-29. R. H. Transmission Bracket, QQS634*

**INSTRUCTIONS:**

Using NSN 9510-00-294-0986 metal bar, fabricate R. H. transmission bracket. "C".

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

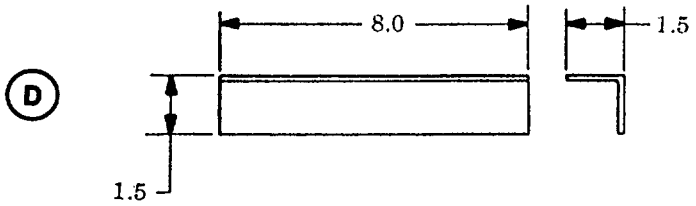



*Figure C-30. A-Frame Brace, QQS630*

**INSTRUCTIONS:**

Using NSN 9520-00-061-6507 steel angle, fabricate 'A" frame brace 'D".

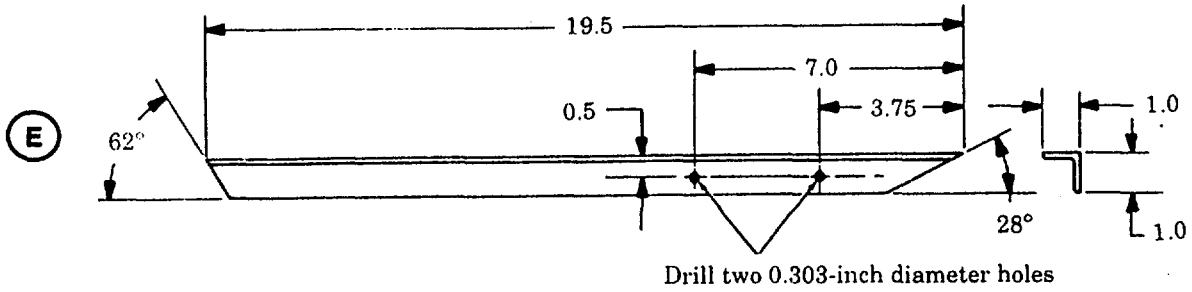



*Figure C-31. Center Support Beam, QQS741*

**INSTRUCTIONS:**

Using NSN 9520-00-277-4925 steel angle, fabricate center support beam "E".

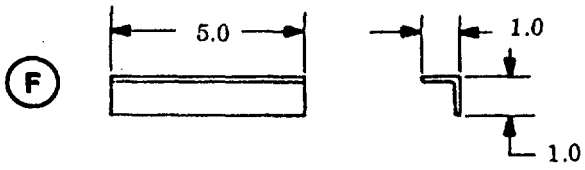



*Figure C-32. Inner Floor Support, QQS741*

**INSTRUCTIONS:**

Using NSN 9520-00-277-4925 steel angle, fabricate inner floor support "F".

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

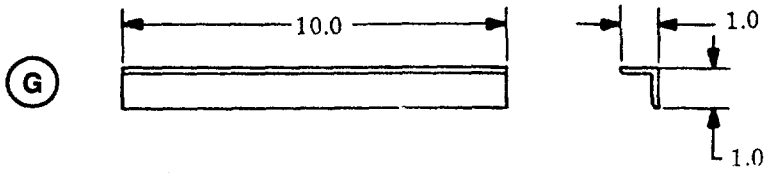



*Figure C-33. Outer Floor Support, QQS741*

**INSTRUCTIONS:**

Using NSN 9520-00-277-4925 steel angle, fabricate outer floor support "G".

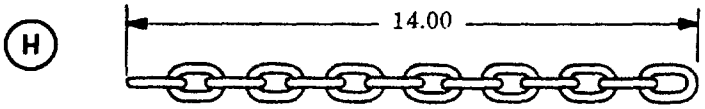



*Figure C-34. Engine Support Chain*

**INSTRUCTIONS:**

Using NSN 4010-00-174-4879 steel chain, fabricate engine support chain "H".

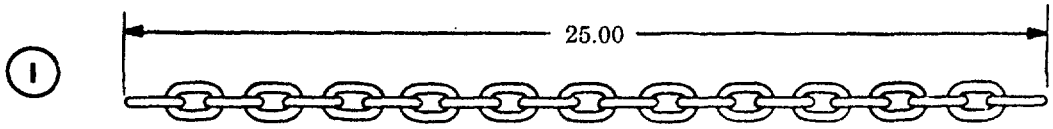



*Figure C-35. Transmission Support Chain*

**INSTRUCTIONS:**

Using NSN 4010-00-174-4879 steel chain, fabricate transmission support chain 'I".

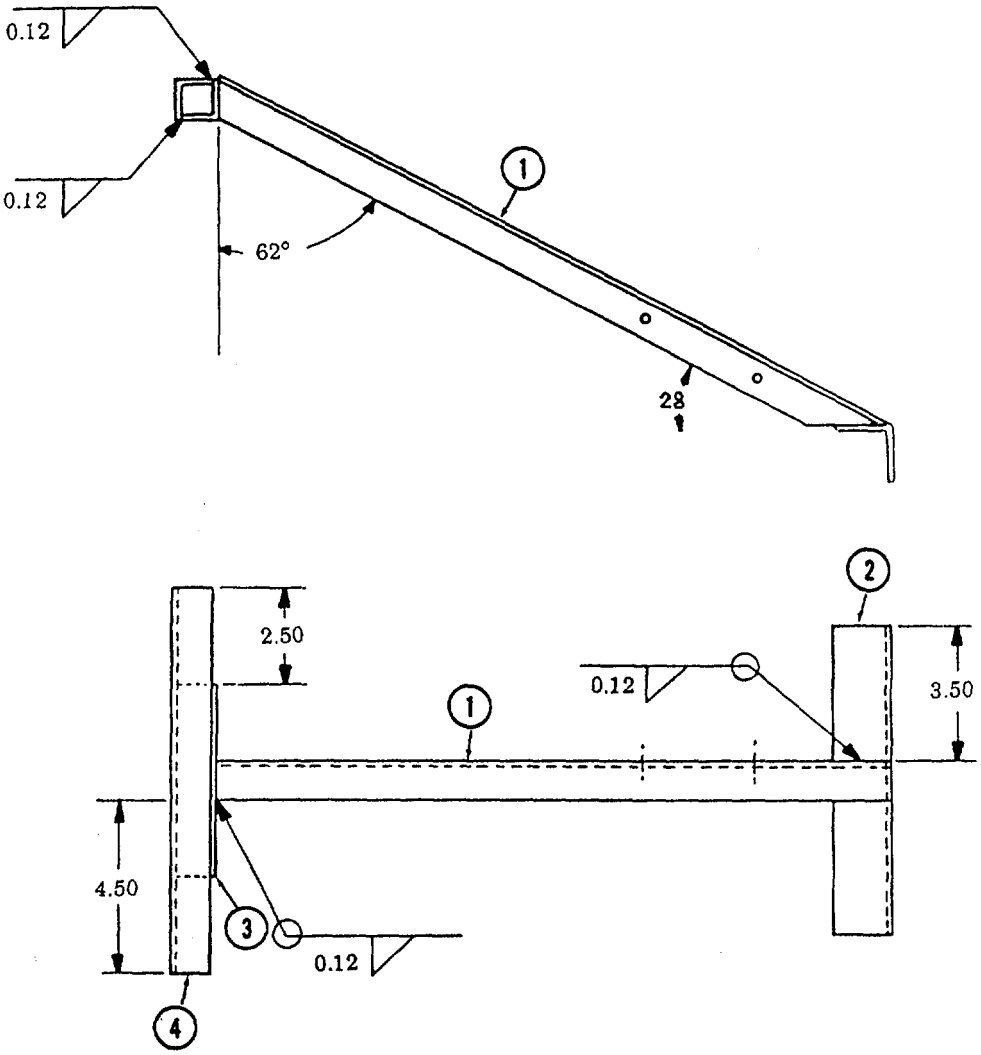
## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

ASSEMBLY INSTRUCTIONS:

**NOTE**

All dimensions are in inches.
Remove all burrs and sharp edges after each fabrication.

1. Position outer floor support (4) on inner floor support (3) and weld into place.
2. Position center support beam (1) on inner floor support (3) and weld into place.
3. Position "A" frame brace (2) on center support beam (1) and weld into place.



## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

ASSEMBLY INSTRUCTIONS (Cont'd):

**NOTE**

- All dimensions are in inches.
- Remove all burrs and sharp edges after each fabrication.
- Perform step 4 if rigging over head support sling for transmission use.
- Perform step 5 if rigging over head support for engine use.

4. Position L.H. and R. H. transmission bracket (1) to the ends of support chain (14) and install two bolts (2), four washers (3), and two nuts (13).

5. Position two engine brackets (15) to the ends of support chain (14) and install two bolts (2), four washers (3), and two nuts (13).

6. Install eye bolt (4) and eye bolt (6) in turn buckle (5).

**NOTE**

Perform steps 7 and 8 if rigging overhead support sling for transmission use.
Perform steps 9 and 10 if rigging overhead support sling for engine use.

7. Position R.H. eye bolt (6) to hole (9) in overhead support sling (11) and install bolt (7), two washers (8), and nuts (12). Do not tighten nuts (12) or use hole (10).

8. Using Centerlink, install support chain (14) on L. H. eye bolt (4) with bolt (2), two washer (3), and nut (13).

9. Position R. H. eye bolt (6) to hole (10) in overhead support sling (11) and install nut (12). Do not tighten nuts (12) or use hole (10).

10. Using Center link, install support chain (14) on L.H. eye bolt (4) and install bolt (2), two washers (3), and (13).

**Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)**

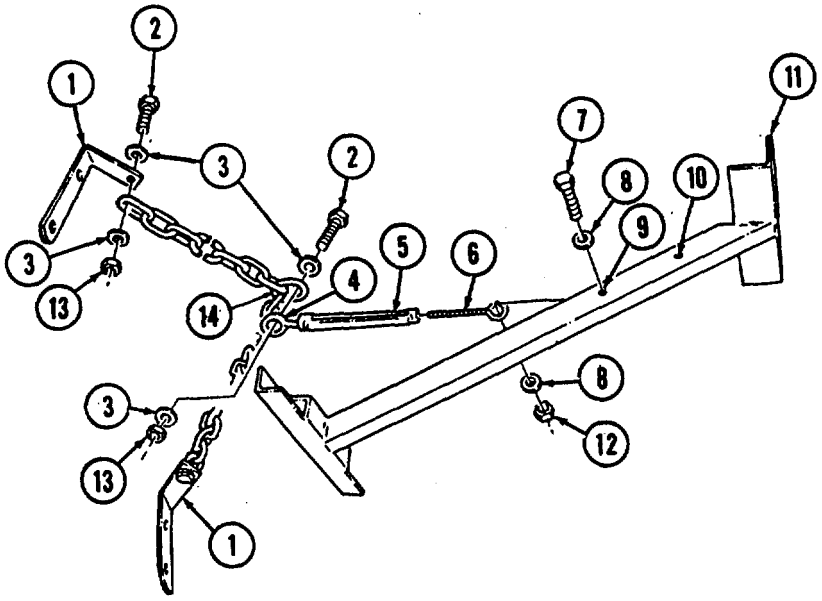



*Figure C-37. Overhead Support Sling For Transmission*

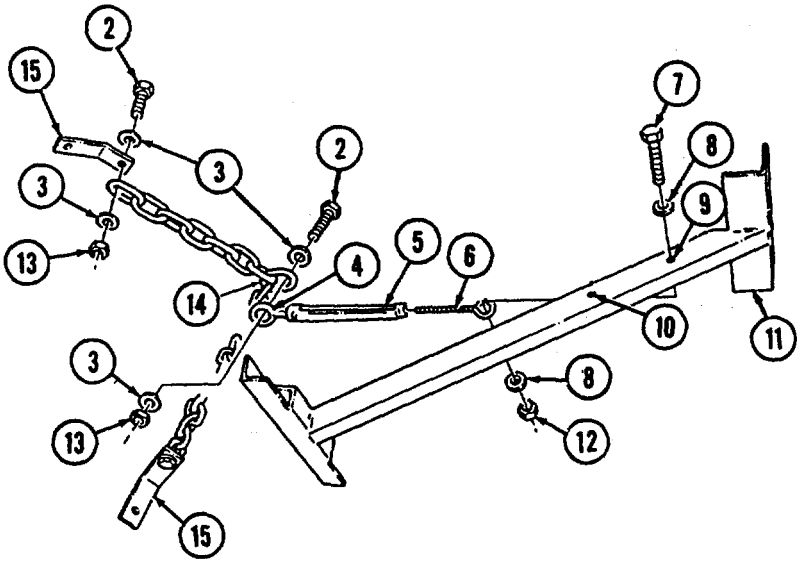



*Figure C-38. Overhead Support Sling For Engine*

## Section II ILLUSTRATED MANUFACTURING INSTRUCTIONS (Contd)

INSTALLATION INSTRUCTIONS:

**NOTE**

- Perform the engine removal procedures para 3-22 or 3-24 to a point prior to supporting transmission for engine removal.
- Perform steps 1 through 3 to secure transmission.

1. Position overhead support sling (2) on floor (3) and 'A" Frame (1).

**NOTE**

- Use converter housing cover bolts to install transmission brackets on transmission housing.
- When performing step 2 it might be necessary to shift engine support chain link on L. H. eye bolt to adjust for securing transmission to transmission bracket.

2. Install transmission bracket (7) on transmission housing (4) with four existing bolts (5) and washers (6).
3. Tighten turn buckle (9) to remove slack from transmission chain (8).
4. Continue engine removal procedure para. 3-22 or 3-24.

**NOTE**

- Perform transmission removal procedure para. 7-6 or 7-8 to point prior to supporting engine for transmission removal.
- Perform steps 5 through 8 to secure engine.

5. Position overhead support sling (2) on floor (3) and A'" frame (1).

**NOTE**

- Use converter housing cover bolts and washers to install engine brackets on back of cylinder head.
- When performing step 6, it might be necessary to shift engine support chain link on L.H. eye bolt, to adjust for securing engine cylinder head to engine bracket.

6. Install engine brackets (10) to engine cylinder head (11) with two existing bolts (5) and washers (6).
7. Tighten turn buckle (9) to remove slack from engine bracket chains (8).
8. Continue transmission removal procedure para. 7-6 or 7-8.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

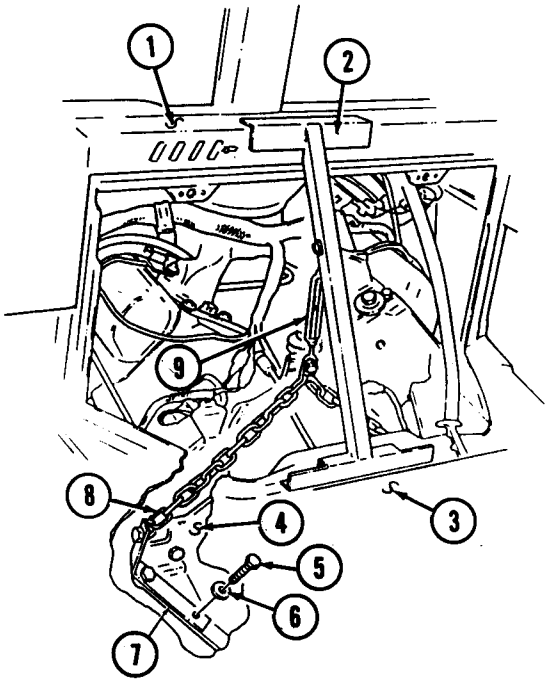



*Figure C-39. Overhead Support Sling Transmission.*

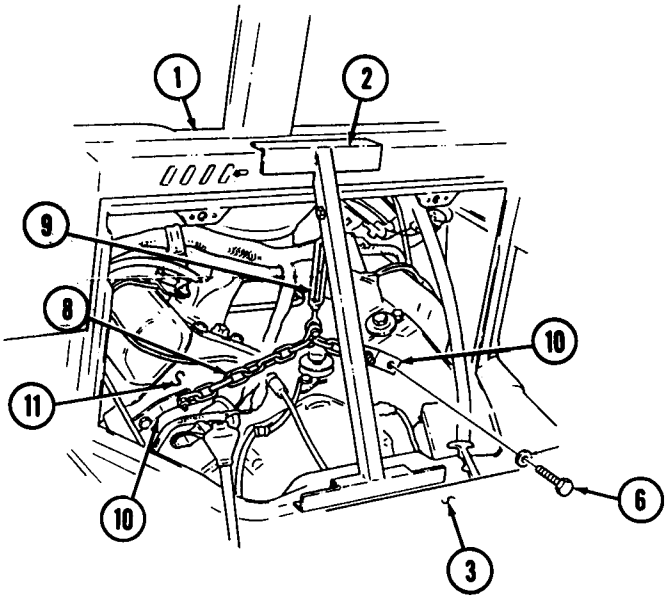



*Figure C-40. Overhead Support Sling Engine.*

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| STOCK SIZE | DESCRIPTION | SPECIFICATION |
| 0.188-IN. THICK | STRIP, METAL | ASTM A569 |

| SHEET | | |
|---|---|---|
| PART NUMBER | CUT TO SIZE (INCHES) | MANUFACTURED FROM NSN |
| N/A | AS SHOWN | 9515-00-814-7316 |

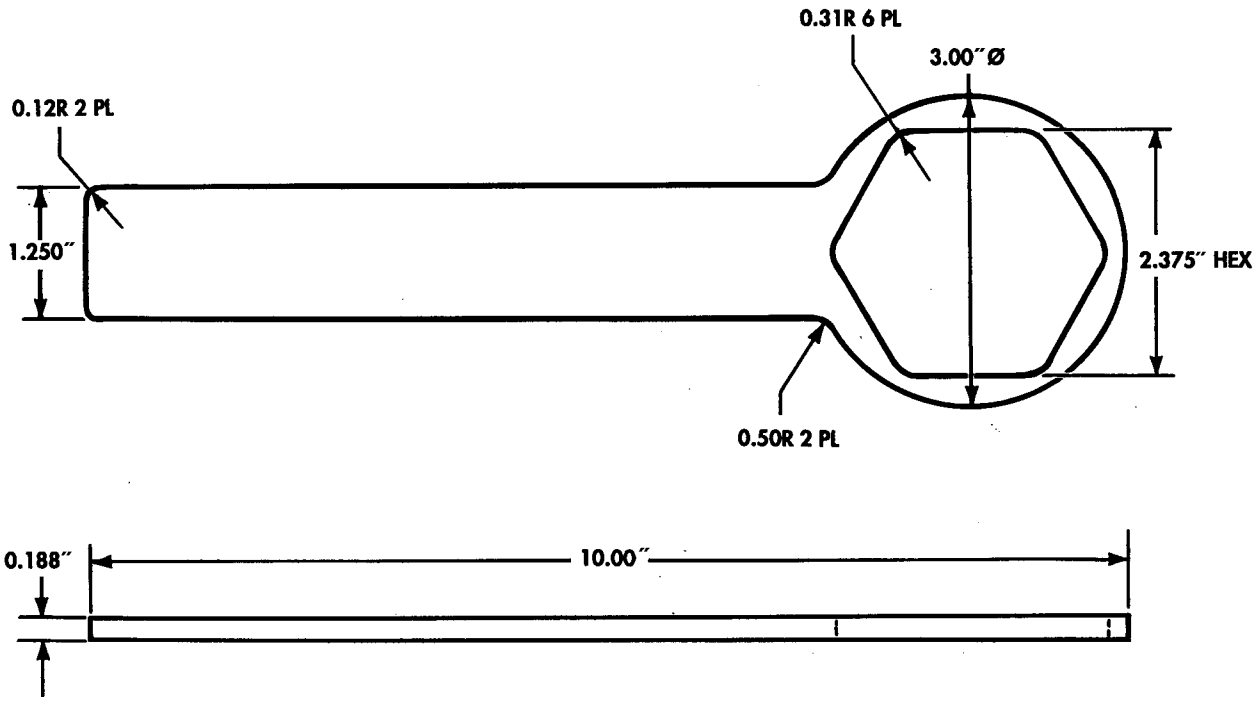



*Figure C-41. Hex Wrench.*

**INSTRUCTIONS:**

1. Cut one piece of steel sheet metal to size as shown.
2. Remove all burrs and sharp edges.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| STOCK SIZE | DESCRIPTION | SPECIFICATION |
| 0.125-IN. THICK<br>0.188-IN. THICK | STRIP, METAL | ASTM A569 |

| SHEET | | |
|---|---|---|
| PART NUMBER | CUT TO SIZE (INCHES) | MANUFACTURED FROM NSN |
| N/A | AS SHOWN | 9515-00-596-2044<br>9515-00-814-7316 |

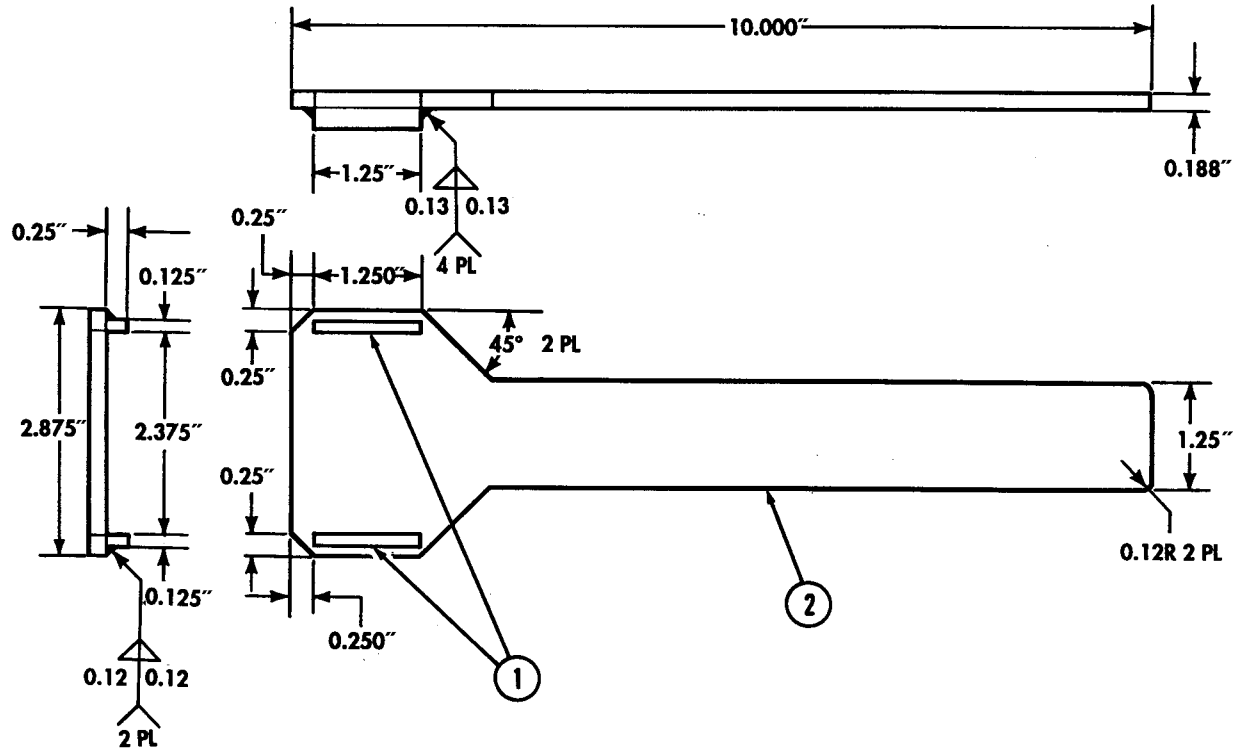



*Figure C-42. Open End Wrench.*

**INSTRUCTIONS:**

1. Cut one piece of steel sheet metal 0.188-in. thick to make handle (2) as shown.
2. Cut two pieces of sheet metal 0.125-in. thick to make two jaws (1) as shown.
3. Weld two jaws (1) to handle (2) as shown.
4. Remove all burrs and sharp edges.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| STOCK SIZE | DESCRIPTION | SPECIFICATION |
| 0.25-IN. THICK | BAR, METAL | ASTM A569 |

| SHEET | | |
|---|---|---|
| PART NUMBER | CUT TO SIZE (INCHES) | MANUFACTURED FROM NSN |
| N/A | AS SHOWN | 9510-00-813-4714 |

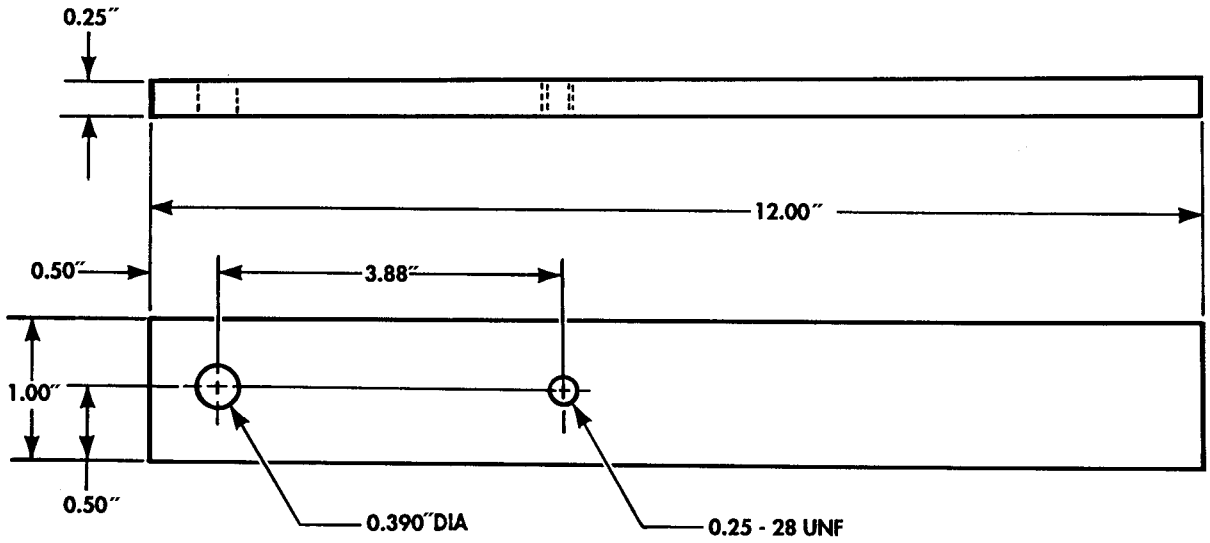



*Figure C-43. Parking Brake Spring Tool.*

**INSTRUCTIONS:**

1. Using NSN 9510-00-813-4714 metal bar, fabricate parking brake tool.
2. Remove all burrs and sharp edges.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

**ASSEMBLY INSTRUCTIONS:**

1. Position bar (2) across parking brake spring (4) and install on parking brake lever (5) using NSN 5305-00-725-2317 screw (1) and NSN 5310-00-761-0654 nut (6).
2. Install NSN 5305-00-068-0515 screw (3) in bar (2).
3. Remove parking brake spring (4) from parking brake lever (5) and caliper housing (7) by turning bar (2) clockwise.
4. Remove nut (6), screw (1), and bar (2) from parking brake lever (5).

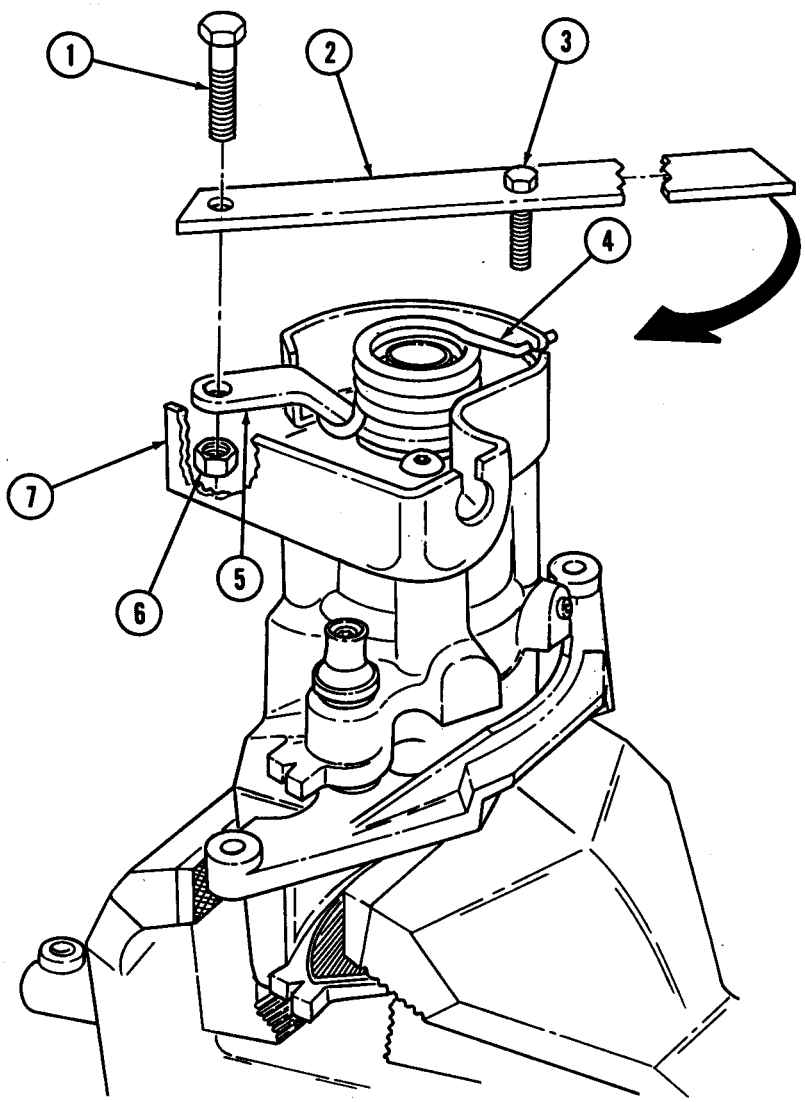



*Figure C-44. Instuctions for Parking Brake Spring Tool.*

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| STOCK SIZE | DESCRIPTION | SPECIFICATION |
| 1.312 IN. THICK | BAR, METAL, ALUMINUM | ASTM B211 |

| ALUMINUM SPACER | | |
|---|---|---|
| PART NUMBER | CUT TO SIZE (INCHES) | MANUFACTURED FROM NSN |
| N/A | AS SHOWN | 9530-01-262-8866 |

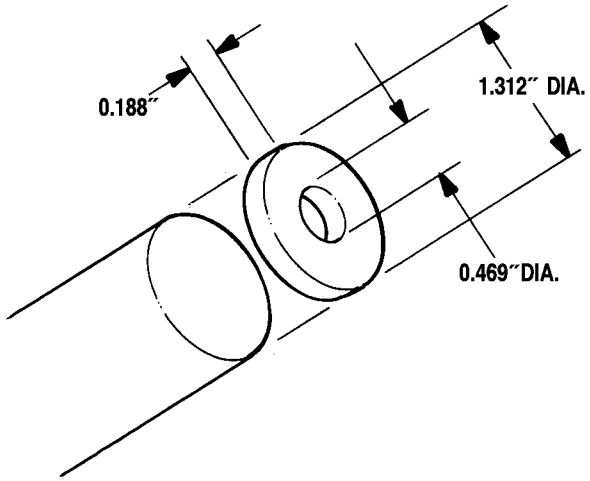



*Figure C-45. Alternator Bracket Spacer.*

**INSTRUCTIONS:**

1. Fabricate spacer to dimensions shown.
2. Locate, mark, and drill 0.469-in. diameter hole in spacer.
3. Remove all burrs and sharp edges.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| STOCK SIZE | DESCRIPTION | SPECIFICATION |
| 0.50-IN. THICK | PLATE, METAL, STEEL | ASTM A36 |

| DRILL FIXTURE | | |
|---|---|---|
| PART NUMBER | CUT TO SIZE (INCHES) | MANUFACTURED FROM NSN |
| N/A | AS SHOWN | 9515-00-969-5124 |

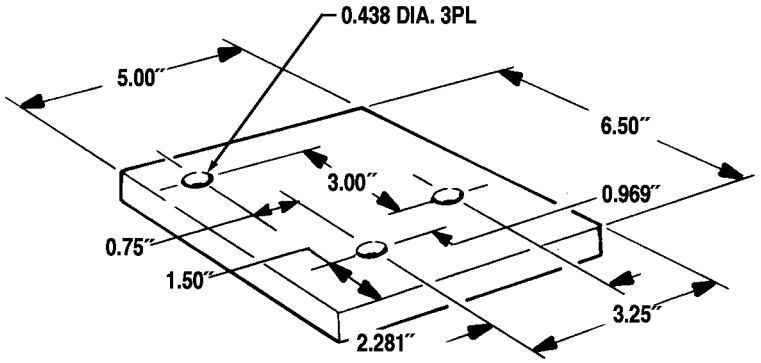



*Figure C-46. Drill Fixture.*

**INSTRUCTIONS:**

1. Cut piece from steel plate 0.50-in. thick to fabricate fixture as shown.
2. Locate, mark, and drill three 0.438-in. diameter holes in metal plate.
3. Remove all burrs and sharp edges.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

| MATERIAL BLOCK | | |
|---|---|---|
| STOCK SIZE | DESCRIPTION | SPECIFICATION |
| 0.625-IN. THICK | BAR, METAL, STEEL | ASTM A108 |
| 1.000-IN. THICK | BAR, METAL, STEEL | ASTM A108 |
| 0.375-IN. THICK | BAR, METAL, STEEL | ASTM A108 |

| MATERIALS | | |
|---|---|---|
| REQ'D | DESCRIPTION | MANUFACTURED FROM NSN |
| 2 | WASHER, FLAT | 5310-01-186-1254 |

| CYLINDER HEAD LIFTING DEVICE | | |
|---|---|---|
| PART NUMBER | CUT TO SIZE (INCHES) | MANUFACTURED FROM NSN |
| N/A | 14 | 9510-00-224-1692 |
| N/A | 11.5 | 9510-00-287-9402 |
| N/A | 8 | 9510-00-596-1405 |

**INSTRUCTIONS:**

1. Cut a 14-in. long section (1) of metal bar from NSN 9510-00-224-1692 as shown in figure C-47. Bend metal bar (1) as shown in figure C-47.
2. Cut an 11.5-in. long section (2) from NSN 9510-00-287-9402 as shown in figure C-47. Bend metal bar (2) as shown in figure C-48.
3. Cut an 8-in. long section (3) from NSN 9510-00-596-1405 as shown in figure C-47. Locate, mark, and drill four 0.437-in. diameter holes through metal bar (3) as shown in figure C-48.
4. Remove all burrs and sharp edges.
5. Weld all three metal bars together as shown in figure C-48. All welds will be in accordance with MIL-STD-1261 Class 2. All weld sizes are minimal.

## Section II. ILLUSTRATED MANUFACTURING INSTRUCTIONS (Cont'd)

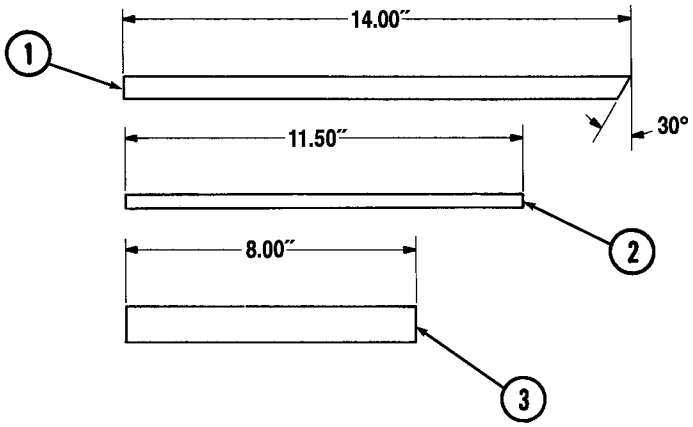



*Figure C-47. Bars For Cylinder Head Lifting Device.*

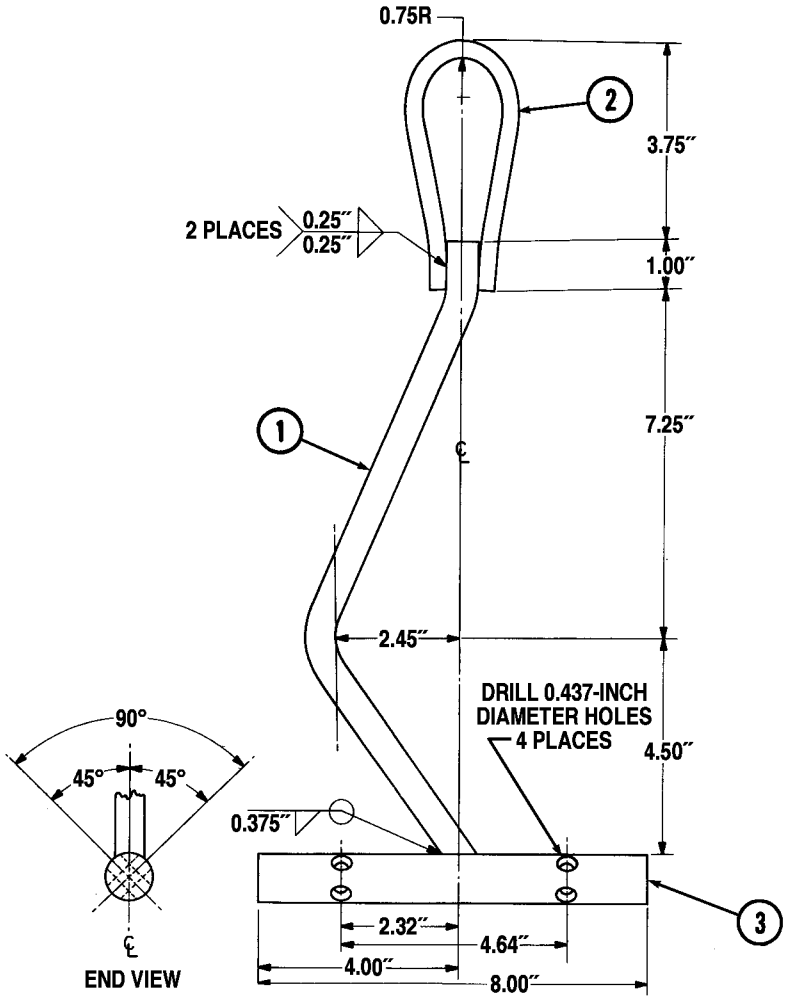



*Figure C-48. Cylinder Head Lifting Device.*

# APPENDIX D
# TORQUE LIMITS

## D. GENERAL

This section provides general torque limits for screws used on the M998 series vehicles. Special torque limits are indicated in the maintenance procedures for applicable components. The general torque limits given in this appendix shall be used when specific torque limits are not indicated in the maintenance procedure. Unless otherwise specified, standard torque tolerance shall be + 10 percent. These general torque limits cannot be applied to screws that retain rubber components. The rubber components will be damaged before the correct torque limit is reached. If a special torque limit is not given in the maintenance instructions, tighten the screw or nut until it touches the metal bracket, then tighten it one more turn.

## D2. TORQUE LIMITS

Table D-1 lists dry torque limits. Dry torque limits are used on screws that do not have lubricants applied to the threads. Table D-2 lists wet torque limits. Wet torque limits are used on screws that have high pressure lubricants applied to the threads.

## D-3. HOW TO USE TORQUE TABLE

c. Under the heading SIZE, look down the left-hand column until you find the diameter of the screw you are installing (there will usually be two lines beginning with the same size).

d. In the second column under SIZE, find the number of threads per inch that matches the number of threads you counted in step

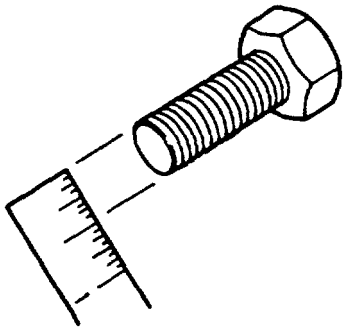
CAPSCREW HEAD MARKINGS

Manufacturer's marks may vary.
These are all SAE Grade 5
(3-line).

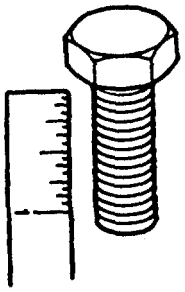


e. To find the grade of screw you are installing, match the markings on the head to the correct picture of CAPSCREW HEAD MARKINGS on the torque table.

f. Look down the column under the picture you found in step e. until you find the torque limit (in lb-ft or N.m) for the diameter and threads per inch of the screw you are installing.

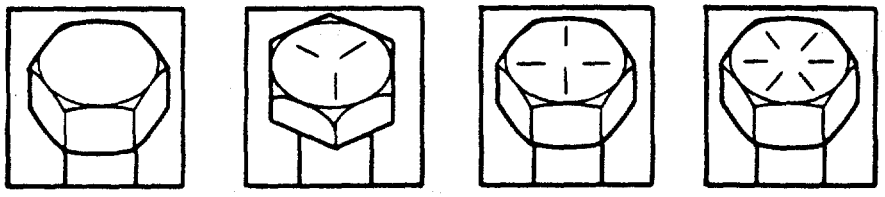


a. Measure the diameter of the screw you are installing.



b. Count the number of threads per inch.

*Table D-1. Torque Limits for Dry Fasteners*

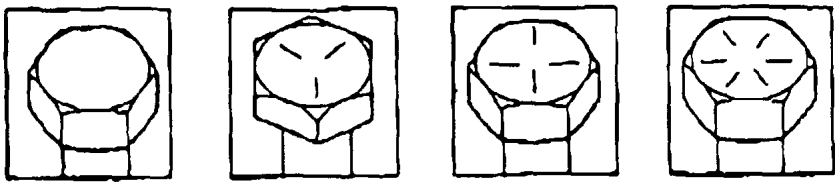


CAPSCREW HEAD MARKINGS

| SIZE | | | TORQUE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | SAE GRADE NO. 1 or2 | | SAE GRADE NO.5 | | SAE GRADE NO. 6 or 7 | | SAE GRADE NO. 8 | |
| DIA. INCHES | THREADS PER INCH | MILLIME TERS | POUND FEET | NEWTON METERS | POUND FEET | NEWTON METERS | POUND FEET | NEWTON METERS | POUND FEET | NEWTON METERS |
| 1/4 | 20 | 6.35 | 5 | 6.78 | 8 | 10.85 | 10 | 13.56 | 12 | 16.27 |
| 1/4 | 28 | 6.35 | 6 | 8.14 | 10 | 13.56 | - | - | 14 | 18.98 |
| 5/16 | 18 | 7.94 | 11 | 14.92 | 17 | 23.05 | 19 | 25.76 | 24 | 32.52 |
| 5/16 | 24 | 7.94 | 13 | 17.63 | 19 | 25.76 | - | - | 27 | 36.61 |
| 3/8 | 16 | 9.53 | 18 | 24.41 | 31 | 42.04 | 34 | 46.10 | 44 | 59.66 |
| 3/8 | 24 | 9.53 | 20 | 27.12 | 35 | 47.46 | - | - | 49 | 66.44 |
| 7/16 | 14 | 11.11 | 28 | 37.97 | 49 | 66.44 | 55 | 74.58 | 70 | 94.92 |
| 7/16 | 20 | - | 30 | 40.68 | 55 | 74.58 | - | | 78 | 105.77 |
| 1/2 | 13 | 12.70 | 39 | 52.88 | 75 | 101.70 | 85 | 115.26 | 105 | 142.38 |
| 1/2 | 20 | - | 41 | 55.60 | 85 | 115.26 | - | - | 120 | 162.72 |
| 9/16 | 12 | 14.29 | 51 | 69.16 | 110 | 149.165 | 120 | 162.72 | 155 | 210.18 |
| 9/16 | 18 | - | 55 | 74.58 | 120 | 162.72 | - | - | 170 | 230.52 |
| 5/8 | 11 | 15.88 | 63 | 85.43 | 150 | 203.40 | 167 | 226.45 | 210 | 284.76 |
| 5/8 | 18 | - | 95 | 128.82 | 170 | 230.52 | - | - | 240 | 325.44 |
| 3/4 | 10 | 19.05 | 105 | 142.38 | 270 | 366.12 | 280 | 379.68 | 375 | 508.50 |
| 3/4 | 16 | - | 115 | 155.94 | 295 | 400.02 | - | - | 420 | 569.52 |
| 7/8 | 9 | 22.23 | 160 | 216.96 | 395 | 535.62 | 440 | 596.64 | 605 | 820.38 |
| 7/8 | 14 | - | 175 | 237.30 | 435 | 589.86 | - | - | 675 | 915.30 |
| 1 | 8 | 25.40 | 235 | 318.66 | 590 | 800.04 | 660 | 894.96 | 910 | 1233.96 |
| 1 | 14 | - | 250 | 339.00 | 660 | 894.96 | - | - | 990 | 1342.44 |
| 1-1/8 | - | 25.58 | - | - | 800- | 1084.8 | - | - | 1280- | 1735.7- |
| | - | | - | - | 880 | 1193.3 | - | - | 1440 | 1952.8 |
| 1/1/4 | | 31.75 | | | | | | | 1820- 2000 | 2467.9- 2712.0 |
| 1-3/8 | | 34.93 | - | - | 1460- | 1979.8- | - | - | 2380- | 3227.3 |
| | | | - | - | 1680 | 2278.1 | - | - | 2720 | 3688.3 |
| 1-1/2 | | 38.10 | | | 1940- 2200 | 2630.6 2983.2 | | | 3160- 3560 | 4285.0 4827.4 |

*Table D-2. Torque Limits for Wet Fasteners*

CAPSCREW HEAD MARKINGS



| SIZE | | | TORQUE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | SAE GRADE NO. 1 or 2 | | SAE GRADE NO. 5 | | SAE GRADE NO. 6 or 7 | | SAE GRADE NO. 8 | |
| DIA. INCHES | THREADS PER INCH | MILLIMETERS | POUND FEET | NEWTON METERS | POUND FEET | NEWTON METERS | POUND FEET | NEWTON METERS | POUND FEET | NEWTON METERS |
| 1/4 | 20 | 6.35 | 4.5 | 6.10 | 7.2 | 9.76 | 9.0 | 12.20 | 10.8 | 14.64 |
| 1/4 | 28 | 6.35 | 5.4 | 7.33 | 9.0 | 12.20 | – | – | 12.6 | 17.08 |
| 5/16 | 18 | 7.94 | 9.9 | 13.43 | 15.3 | 20.75 | 17.1 | 23.18 | 21.6 | 29.27 |
| 5/16 | 24 | 7.94 | 11.7 | 15.87 | 17.1 | 23.18 | – | – | 24.3 | 32.95 |
| 3/8 | 16 | 9.53 | 16.2 | 21.97 | 27.9 | 37.84 | 30.6 | 41.49 | 39.6 | 53.69 |
| 3/8 | 24 | 9.53 | 18.0 | 24.41 | 31.5 | 42.71 | – | – | 44.1 | 59.80 |
| 7/16 | 14 | 11.11 | 25.2 | 34.17 | 44.1 | 59.80 | 49.5 | 67.12 | 63.0 | 85.42 |
| 7/16 | 20 | – | 27.0 | 36.61 | 49.5 | 67.12 | – | – | 70.2 | 95.19 |
| 1/2 | 13 | 12.70 | 35.1 | 47.59 | 67.5 | 91.53 | 76.5 | 103.73 | 94.5 | 128.14 |
| 1/2 | 20 | – | 36.9 | 50.04 | 76.5 | 103.73 | – | – | 108.0 | 146.45 |
| 9/16 | 12 | 14.29 | 45.9 | 62.24 | 99.0 | 134.24 | 108.0 | 146.45 | 139.5 | 189.16 |
| 9/16 | 18 | – | 49.5 | 67.12 | 108.0 | 146.45 | – | – | 153.0 | 207.47 |
| 5/8 | 11 | 15.88 | 56.7 | 76.89 | 135.0 | 183.06 | 150.3 | 203.80 | 189.0 | 256.28 |
| 5/8 | 18 | – | 85.5 | 115.94 | 153.0 | 207.47 | – | – | 216.0 | 296.90 |
| 3/4 | 10 | 19.05 | 94.5 | 128.14 | 243.0 | 329.51 | 252.0 | 341.71 | 337.5 | 457.65 |
| 3/4 | 16 | – | 103.5 | 140.35 | 265.5 | 360.02 | – | – | 378.0 | 512.50 |
| 7/8 | 9 | 22.23 | 144.0 | 195.26 | 355.5 | 482.06 | 396.0 | 536.98 | 544.5 | 738.34 |
| 7/8 | 14 | – | 157.5 | 213.57 | 391.5 | 530.87 | – | – | 607.5 | 823.77 |
| 1 | 8 | 25.40 | 211.5 | 286.79 | 531.0 | 720.04 | 594.0 | 805.46 | 819.0 | 1110.56 |
| 1 | 14 | – | 225.0 | 305.10 | 594.0 | 805.46 | – | – | 891.0 | 1208.20 |
| 1-1/8 | – | 25.58 | – | – | 720.0-792.0 | 976.32-1073.97 | – | – | 1152.0-1296.0 | 1562.13-1757.52 |
| 1-1/4 | – | 31.75 | – | – | – | – | – | – | 1638-1800 | 2221.11-2440.80 |
| 1-3/8 | – | 34.93 | – | – | 1314.0-1512.0 | 1781.82-2050.29 | – | – | 2142.0-2448.0 | 2904.57-3319.47 |
| 1-1/2 | – | 38.10 | – | – | 1746.0-1980.0 | 2367.54-2684.88 | – | – | 2844.0 3204.0 | 3856.5-4344.66 |

# APPENDIX E
# MANDATORY REPLACEMENT PARTS

## Section I. INTRODUCTION

### E-1. SCOPE

This appendix lists mandatory replacement parts you will need to maintain M998 series vehicles.

### E-2. EXPLANATION OF COLUMNS

**a. Column (1) - Item Number.** This number is assigned to each entry in the listing and is referenced in the "Initial Setup" of applicable tasks under the heading of "Material/Parts".

**b. Column (2) - Nomenclature.** Name or identification of the part.

**c. Column (3) - Part Number.** The manufacturer's part number.

**d. Column (4) - National Stock Number.** The national stock number of the part.

## Section II. MANDATORY REPLACEMENT PARTS

| (1) ITEM NO | (2) NOMENCLATURE | (3) PART NUMBER | (4) NATIONAL/NATO STOCK NUMBER |
|---|---|---|---|
| 1 | Bearing, Washer, Thrust | 13826 | 3120-01-306-3577 |
| 2 | Bearing, Washer, Thrust | 8623300 (.060–.064) | 3120-01-155-4462 |
| | | 8623301 (.071–.075) | 3120-01-155-4463 |
| | | 8623302 (.082–.086) | 3120-01-182-8417 |
| | | 8623303 (.093–.097) | 3120-01-155-4464 |
| | | 8623304 (.104–.108) | 3120-01-155-4465 |
| | | 8623305 (.113–.119) | 3120-01-155-4466 |
| | | 8623306 (.126–.130) | 3120-01-155-4467 |
| 3 | Bracket, Battery Front | 12339904 | 5340-01-470-7135 |
| 4 | Bracket, Battery Rear | 12339905 | 5340-01-470-7160 |
| 5 | Brush, Electrical | A0010095461 | 5977-01-270-1466 |
| 6 | Burner Assembly, Spa | G706055 | 4520-01-284-7099 |
| 7 | Bushing | 8623941 | 3120-01-166-3677 |
| 8 | Disk, Clutch | 29530330 | 2520-00-172-1947 |
| 9 | Gasket | 10137486 | 5330-01-150-5944 |
| 10 | Gasket | 10137492 | 5330-01-147-9808 |
| 11 | Gasket | 10163736 (6.2 liter) | 5330-01-157-6757 |
| | | 12554979 (6.5 liter) | 5330-01-442-2876 |
| 12 | Gasket | 10948235 | 5330-00-089-0978 |
| 13 | Gasket | 13848 | 5330-01-211-0717 |
| 14 | Gasket | 14964 | 5330-01-306-7887 |
| 15 | Gasket | 14022649 | 5330-01-156-5147 |
| 16 | Gasket | 14025557 | 5330-01-150-1215 |
| 17 | Gasket | 15633464 | 5330-01-157-0856 |
| 18 | Gasket | 27244 | 5330-01-234-2615 |
| 19 | Gasket | 12338339 | 5330-01-200-0466 |
| 20 | Gasket | 12338382 | 5330-01-246-1822 |
| 21 | Gasket | 702903 | 5330-00-089-0978 |
| 22 | Gasket | 8623174 | 5330-01-150-5928 |
| 23 | Gasket | 8675728 | 5330-01-478-4797 |
| 24 | Gasket | 8623263 | 5330-00-001-1984 |
| 25 | Gasket | 8623561 | 5330-01-152-5942 |
| 26 | Gasket | 8623978 | 5330-01-152-5941 |
| 27 | Gasket | 8677782 | 5330-01-409-1665 |

## Section II. MANDATORY REPLACEMENT PARTS

| (1) ITEM NO | (2) NOMENCLATURE | (3) PART NUMBER | (4) NATIONAL/NATO STOCK NUMBER |
|---|---|---|---|
| 28 | Gasket | 8655625 | 5330-01-148-7492 |
| 29 | Gasket | 91599 | 5330-01-372-0636 |
| 30 | Gasket | 96768 | 5330-01-272-8337 |
| 31 | Gasket | 15605 | 5330-00-144-5285 |
| 32 | Gasket | 8657163 | 5330-01-251-1607 |
| 33 | Gasket | 95498 | 5330-01-270-3668 |
| 34 | Gasket | 8657163 | 5330-01-251-1607 |
| 35 | Gasket | 10137488 | 5330-01-149-0874 |
| 36 | Gasket | 123382 | 5330-01-196-1628 |
| 37 | Gasket | 95483 | 5330-01-272-9071 |
| 38 | Gasket | 8670393 | 5330-01-151-6106 |
| 39 | Gasket Kit | 8385-9611 | 5330-01-288-1307 |
| 40 | Gasket Kit | 24204441 | 5330-01-398-3724 |
| 41 | Gasket Kit, Commutator End Head | MES-95S | 5330-00-138-0251 |
| 42 | Gasket Set | 36-630 | 5330-01-190-7510 |
| 43 | Gasket Set | SAT-32S | 5330-01-190-7509 |
| 44 | Key, Machine | 1869 | 5315-01-265-8771 |
| 45 | Key, Special | 106751 | 5315-00-393-5865 |
| 46 | Key, Woodruff | N9451 | 5315-01-348-6680 |
| 47 | Kit, Pinion Stop and Snapring | 90-2841 | 2920-01-191-6534 |
| 48 | Kit, Seal | 5741908 | 2540-01-289-8330 |
| 49 | Kit, Seal | 5740448 | 2530-01-097-7659 |
| 50 | Kit, Service Brake Caliper | 5579865 | 2530-01-179-7511 |
| 51 | Kit, Thrust Washer & Spacer | 90-2840 | 3120-01-191-4637 |
| 52 | Locknut | 22FT832 | 5310-00-582-5765 |
| 53 | Locknut | 5579442 | 5310-01-175-0617 |
| 54 | Locknut | MS51943-31 | 5310-00-061-4650 |
| 55 | Locknut | 6779 | 5310-01-213-4174 |
| 56 | Locknut | 706131 | 5310-01-287-6543 |
| 57 | Locknut | MS51943-34 | 5310-00-241-6658 |
| 58 | Locknut | MS20365-1032C | 5310-00-282-0512 |
| 59 | Locknut | MS21045-6 | 5310-00-982-4908 |
| 60 | Locknut | 9419471 | 5310-01-432-6727 |
| 61 | Locknut | MS51943-32 | 5310-00-935-9022 |

## Section II. MANDATORY REPLACEMENT PARTS

| (1) ITEM NO | (2) NOMENCLATURE | (3) PART NUMBER | (4) NATIONAL/NATO STOCK NUMBER |
|---|---|---|---|
| 62 | Locknut | 9419455 | 5310-01-119-3668 |
| 63 | Locknut | MS51943-35 | 5310-00-935-9021 |
| 64 | Locknut | MS51988-8 | 5310-00-447-8774 |
| 65 | Locknut | MS51943-39 | 5310-00-488-3889 |
| 66 | Locknut | MS51943-45 | 5310-00-409-3333 |
| 67 | Locknut | N9416 | 5310-01-348-8360 |
| 68 | Locknut | N9099 | 5310-01-165-1312 |
| 69 | Locknut | N9534 | 5310-01-439-9422 |
| 70 | Locknut | N9092 | 5310-01-390-5105 |
| 71 | Locknut | 90-2188 | 5310-01-027-9392 |
| 72 | Locknut | 12387349 | 5310-00-061-4651 |
| 73 | Locknut | 9442939 | 5310-01-149-4407 |
| 74 | Locknut | 74107 | 5310-01-270-8415 |
| 75 | Locknut | 8712289 | 5310-00-044-3340 |
| 76 | Locknut | N9406 | 5310-01-362-6171 |
| 77 | Locknut | MS21045-3 | 5310-00-061-7326 |
| 78 | Locknut | MS35649-205 | 5310-00-934-9764 |
| 79 | Locknut | 8712289-5 | 5310-00-044-3342 |
| 80 | Locknut | MS51943-33 | 5310-00-814-0673 |
| 81 | Locknut | 8712289 | 5310-00-044-3340 |
| 82 | Locknut | 5593048 | 5310-01-252-0481 |
| 83 | Locknut | 271172 | 5310-01-152-0598 |
| 84 | Locknut | MS21245-L10 | 5310-00-449-2381 |
| 85 | Locknut, Assembled | 5593033 | 5310-01-252-2999 |
| 86 | Lockwasher | 11582 | 5310-01-213-9964 |
| 87 | Lockwasher | 12Z22PC849 | 5310-00-274-8710 |
| 88 | Lockwasher | 9424258 | 5310-01-199-3440 |
| 89 | Lockwasher | 120384 | 5310-00-482-9493 |
| 90 | Lockwasher | MS35340-43 | 5310-00-721-7809 |
| 91 | Lockwasher | 120384 | 5310-00-584-5272 |
| 92 | Lockwasher | 120382 | 5310-00-012-0382 |
| 93 | Lockwasher | 123153 | 5310-01-185-4672 |
| 94 | Lockwasher | 202755 | 5310-01-270-2661 |
| 95 | Lockwasher | 2434 | 5310-00-775-5139 |

## Section II. MANDATORY REPLACEMENT PARTS

| (1) ITEM NO | (2) NOMENCLATURE | (3) PART NUMBER | (4) NATIONAL/NATO STOCK NUMBER |
|---|---|---|---|
| 96 | Lockwasher | MS35338-42 | 5310-00-045-3299 |
| 97 | Lockwasher | 36895 | 5310-00-045-3299 |
| 98 | Lockwasher | 475005 | 5310-00-061-0004 |
| 99 | Lockwasher | 5592927 | 5310-01-253-8957 |
| 100 | Lockwasher | 11500207 | 5310-01-206-7306 |
| 101 | Lockwasher | 115544 | 5310-00-559-0070 |
| 102 | Lockwasher | MS21333-72 | 5310-00-209-0786 |
| 103 | Lockwasher | MS35338-45 | 5310-00-407-9566 |
| 104 | Lockwasher | MS35338-46 | 5310-00-637-9541 |
| 105 | Lockwasher | MS35338-65 | 5310-00-011-5093 |
| 106 | Lockwasher | MS51415-9 | 5310-01-216-7390 |
| 107 | Lockwasher | MS35338-47 | 5310-00-209-0965 |
| 108 | Lockwasher | N9459 | 5310-01-348-8393 |
| 109 | Lockwasher | N9461 | 5310-01-348-8392 |
| 110 | Lockwasher | N9015 | 5310-01-046-0186 |
| 111 | Lockwasher | N9265 | 5310-01-136-4888 |
| 112 | Lockwasher | 4210973 | 5310-01-148-2687 |
| 113 | Lockwasher | 4210973 | 5310-01-186-5237 |
| 114 | Lockwasher | 26351 | 5310-01-210-0819 |
| 115 | Lockwasher | 1459-254 | 5310-00-171-1734 |
| 116 | Lockwasher | M535338-41 | 5310-00-045-4007 |
| 117 | Lockwasher | M535338-43 | 5310-00-045-3296 |
| 118 | Lockwasher | 36896 | 5301-01-162-9661 |
| 119 | Lockwasher | 116121 | 5310-00-011-6121 |
| 120 | Lockwasher | MS35338-44 | 5310-00-582-5965 |
| 121 | Lockwasher | 120217 | 5310-00-922-2017 |
| 122 | Nut, Push-On | 12339313 | 5310-01-188-6861 |
| 123 | Nut, Assembled, Plain | 271169 | 5310-00-124-9265 |
| 124 | Nut, Assembled, Plain | 271184 | 5310-00-933-4310 |
| 125 | O-Ring | 718768-23 | 5330-00-089-0998 |
| 126 | O-Ring | 3921936 | 5331-01-232-2145 |
| 127 | O-Ring | 2-016 N674-7 | 5331-00-984-3750 |
| 128 | O-Ring | 274244 | 5330-00-935-9136 |
| 129 | O-Ring | 27607 | 5330-00-154-8353 |

## Section II. MANDATORY REPLACEMENT PARTS

| (1) ITEM NO | (2) NOMENCLATURE | (3) PART NUMBER | (4) NATIONAL/NATO STOCK NUMBER |
|---|---|---|---|
| 130 | O-Ring | 8385-0520 | 5331-01-288-1062 |
| 131 | O-Ring | 56480 | 5331-00-185-0075 |
| 132 | O-Ring | 300442 | 5331-01-160-9857 |
| 133 | O-Ring | 300448 | 5331-01-061-3000 |
| 134 | O-Ring | 12339002 | 5331-01-195-8889 |
| 135 | O-Ring | 5740012 | 5331-00-451-0118 |
| 136 | O-Ring | 5740099 | 5330-01-174-8618 |
| 137 | O-Ring | 718768-23 | 5330-00-089-0998 |
| 138 | O-Ring | 5741062 | 5331-01-209-7726 |
| 139 | O-Ring | 983-110.01 | |
| 140 | O-Ring | 983-9537044DO | |
| 141 | O-Ring | WH11-105 | |
| 142 | O-Ring | 24202358 | 5331-01-414-4161 |
| 143 | O-Ring | 2-015C557-70 | 5331-01-166-1712 |
| 144 | O-Ring | 5597916 | 5331-01-265-8809 |
| 145 | O-Ring | 24202357 | 5331-01-480-0748 |
| 146 | O-Ring | 8661586 | 5331-01-414-4159 |
| 147 | O-Ring | 8661789 (1995, 96, 97) | 5331-01-462-7294 |
| | | 24205833 (1998) | 5331-01-477-6762 |
| 148 | O-Ring | 15715 | 5331-01-358-9545 |
| 149 | O-Ring | 5939517 | 5331-01-084-1200 |
| 150 | O-Ring Seal | 24202357 | 5331-01-480-0748 |
| 151 | O-Ring | XA-744Z | 5331-00-137-3450 |
| 152 | O-Ring, Drum End | 983-AS5680357 | |
| 153 | O-Ring, Square Cut | 983-WH11-009 | 5331-00-137-3450 |
| 154 | Parts Kit, Direct Clutch | 9103-9800 | 2520-01-289-3617 |
| 155 | Parts Kit, Caliper | 57K3512 | 2530-01-455-9330 |
| 156 | Parts Kit, Engine | 5703776-1 | 2920-01-222-2183 |
| 157 | Parts Kit, Engine | 90-2837 | 2920-01-192-2956 |
| 158 | Parts Kit, Fluid Pre | 6437741 | 4330-01-121-6350 |
| 159 | Parts Kit, Hydraulic | 8684221 | 2520-01-398-4589 |
| 160 | Parts Kit, Linear AC | 5740462 | 3040-01-123-4942 |
| 161 | Parts Kit, Solenoid | 90-816 | 2920-01-192-2959 |
| 162 | Parts Kit, Steering | 7817725 | 2530-01-033-4237 |

## Section II. MANDATORY REPLACEMENT PARTS

| (1) ITEM NO | (2) NOMENCLATURE | (3) PART NUMBER | (4) NATIONAL/NATO STOCK NUMBER |
|---|---|---|---|
| 163 | Parts Kit, Steering | 5740458 | 2530-01-034-1715 |
| 164 | Parts Kit, Steering | 5740499 | 2530-00-960-9363 |
| 165 | Pin, Cotter | MS24665-349 | 5315-00-187-9538 |
| 166 | Pin, Cotter | MS24665-377 | 5315-00-285-7161 |
| 167 | Pin, Cotter | MS24665-208 | 5315-00-829-1480 |
| 168 | Pin, Cotter | X601 | 5315-00-842-3044 |
| 169 | Pin, Cotter | 103384 | 5315-01-191-2611 |
| 170 | Pin, Lock | MS24665-351 | 5315-00-839-5821 |
| 171 | Pin, Lock | 10166 | 5315-01-284-9812 |
| 172 | Pin, Spring | 9412281 | 5315-01-173-3397 |
| 173 | Pin, Spring | 456369 | 5315-01-196-0277 |
| 174 | Pin, Straight Headle | 91386 | 5315-00-576-0265 |
| 175 | Plug, Expansion | 24200224 | 4730-01-460-5520 |
| 176 | Preformed Packing | 8642581 | 5340-01-291-5723 |
| 177 | Preformed Packing | 60198 | 5330-00-823-4881 |
| 178 | Preformed Packing | 99514 | 5330-01-145-5376 |
| 179 | Preformed Packing | 2-113N497-70 | 5330-01-184-6492 |
| 180 | Preformed Packing | 8627627 | 5330-01-155-4383 |
| 181 | Preformed Packing | 24202360 | 5330-01-478-5994 |
| 182 | Preformed Packing | 8623143 | 5330-01-155-4382 |
| 183 | Preformed Packing | 24202361 | 5330-01-478-3900 |
| 184 | Preformed Packing | 8661639 | 5330-01-470-6543 |
| 185 | Preformed Packing | 24201388 | 5310-01-456-7886 |
| 186 | Preformed Packing | 8661647 | 5330-01-478-6569 |
| 187 | Retainer, Packing | 8658110 | 5330-01-043-5572 |
| 188 | Retainer, Packing | 8626356 | 5330-01-165-4333 |
| 189 | Retainer, Packing | 8675729 | 5330-01-409-1664 |
| 190 | Ring, Retaining | NAS670-62 | 5365-00-803-7305 |
| 191 | Rivet, Blind | AD42BS | 5320-00-899-0981 |
| 192 | Rivet, Blind | CR3213-6-3 | 5320-01-135-7319 |
| | | CR3243-6-3 | 5320-01-033-8638 |
| 193 | Rivet, Blind | 5593050 | 5320-01-254-4251 |
| 194 | Rivet, Blind | MGLP-B6-4 | 5320-01-271-6357 |
| 195 | Rivet, Blind | 12339355-2 | 5320-01-264-5978 |

## Section II. MANDATORY REPLACEMENT PARTS

| (1) ITEM NO | (2) NOMENCLATURE | (3) PART NUMBER | (4) NATIONAL/NATO STOCK NUMBER |
|---|---|---|---|
| 196 | Rivet, Blind | CR3212-4-4 | 5320-01-136-3562 |
| 197 | Rivet, Blind | CR-213-4-5 | 5320-01-259-7423 |
| 198 | Rivet, Solid | BACR15ET7-AD11 | 5320-01-264-5977 |
| 199 | Screw, Assembled-Washer | 170677 | 5305-00-456-2582 |
| 200 | Screw, Assembled-Washer | 454542 | 5305-00-499-7694 |
| 201 | Screw, Assembled-Washer | 12340515 | 5305-01-215-5174 |
| 202 | Seal | 27163 | 5330-01-233-8597 |
| 203 | Seal | N9539 | |
| 204 | Seal | 24202359 | |
| 205 | Seal | 100276 | 5330-01-272-7454 |
| 206 | Seal, Center | 8623101 | 5330-00-001-4904 |
| 207 | Seal, Outer | 8623121 | 5330-01-146-6053 |
| 208 | Seal | 8654716 | 5330-01-324-0906 |
| 209 | Seal | 6009472 | 5330-01-174-8145 |
| 210 | Seal, Air | 8623102 | 2840-00-001-4903 |
| 211 | Seal, Direct Clutch | 24209225 | |
| 212 | Seal, Drain Plug | 27609 | 5330-01-233-2778 |
| 213 | Seal, Inner | 24207501 (1997, 98) | |
| | | 8677582 (1995, 96) | |
| 214 | Seal, Nonmetallic | 12267802 | 5330-01-080-3253 |
| 215 | Seal, Nonmetallic | 354944 | 5330-01-282-2214 |
| 216 | Seal, Piston, Inner | 8677582 | |
| 217 | Seal, Piston, Outer | 8677483 | |
| 218 | Seal, Oil | 23016599 | 5330-00-001-1996 |
| 219 | Seal, Outer | 3947086 | 5330-00-001-4904 |
| 220 | Seal, Outer | 8677583 | |
| 221 | Seal, Plain | 8661760 | 5330-01-414-6607 |
| 222 | Seal, Plain | 23015880 | 5330-01-146-6053 |
| 223 | Seal, Plain | 8661893 | 5330-01-460-8987 |
| 224 | Seal, Plain | 8661894 | 5330-01-468-3604 |
| 225 | Seal, Plain | 95483 | 5330-01-272-9071 |
| 226 | Seal, Plain | 95513 | 5330-01-272-5474 |
| 227 | Seal, Plain | 14022683 (Rear) | 5330-01-150-7744 |
| | | 23502587 (Front) | 5330-01-378-8572 |

## Section II. MANDATORY REPLACEMENT PARTS

| (1) ITEM NO | (2) NOMENCLATURE | (3) PART NUMBER | (4) NATIONAL/NATO STOCK NUMBER |
|---|---|---|---|
| 228 | Seal, Plain | 2994-2106 | 5330-01-180-9099 |
| 229 | Seal, Plain | 5740017 | 5330-01-168-3870 |
| 230 | Seal, Plain | 6009472 | 5330-01-174-8145 |
| 231 | Seal, Plain | 41292 | 5330-01-174-8146 |
| 232 | Seal, Input | 29940-2094 | 5330-01-203-6551 |
| 233 | Seal, Plain | 5741514 | 5330-01-358-9532 |
| 234 | Seal, Plain | 8626916 | 5330-01-025-4212 |
| 235 | Seal, Plain | 29960-0511 | 5330-01-358-9532 |
| 236 | Seal, Plain | 8661602 | 5330-01-379-1139 |
| 237 | Seal, Plain | 17150 | 5330-01-309-8465 |
| 238 | Seal, Plain | 5740124 | 5330-01-147-9698 |
| 239 | Seal, Plain | 16104 | 5330-01-358-9540 |
| 240 | Seal, Plain | 16214 | 5330-01-358-9541 |
| 241 | Seal, Spindle | 534059 | 5330-01-456-3884 |
| 242 | Seal, Plain | 10191640 | 5330-01-398-3777 |
| 243 | Seal, Plain | 71X6284 | 5330-00-497-4633 |
| 244 | Seal, Shaft, Pitman | 5740452 | 5330-01-096-9650 |
| 245 | Sheet Metal | AMS-QQA250-11 | 9535-00-541-7194 |
| 246 | Spacer, Ring | 5938630 | 5365-01-358-4642 |
| 247 | Spacer, Sleeve | 5579450 | 5365-01-180-2585 |
| 248 | Strap, Output | AMA-95 | 2920-01-212-5816 |
| 249 | Strap, Tiedown | MS3367-2-9 | 5975-00-156-3253 |
| 250 | Strap, Tiedown | MS3367-3-0 | 5975-00-985-6630 |
| 251 | Strap, Tiedown | MS3367-1-9 | 5975-00-074-2072 |
| 252 | Strap, Tiedown | MS3367-7-0 | 5975-01-034-5871 |
| 253 | Strap, Tiedown | 600-9084-002 | 5975-00-984-6582 |
| 254 | Strap, Tiedown | PLT2S | 5975-01-128-0390 |
| 255 | Strap, Tiedown | MS3367-5-9 | 5975-00-111-3208 |
| 256 | Thermaseal, Heater | 12275161 | 2540-01-123-1218 |
| 257 | Tray, Battery | 12338765 | 6160-01-470-4172 |
| 258 | Tubing, Nonmetallic | SAE-J844 | 9330-01-139-3383 |
| 259 | Washer, Copper | 983-0062 | |
| 260 | Washer, Key | 5584462 | 5310-01-213-4185 |
| 261 | Washer, Seal | 300612 | |

## Section II. MANDATORY REPLACEMENT PARTS

| (1) ITEM NO | (2) NOMENCLATURE | (3) PART NUMBER | (4) NATIONAL/NATO STOCK NUMBER |
|---|---|---|---|
| 262 | Washer, Seal | 300601 | |
| 263 | Washer, Shouldered | 12500 | 5310-00-830-7825 |
| 264 | Washer, Spring Tension | NAF36347-18 | 5310-01-032-4827 |

# APPENDIX F
# BODY REPAIR MATERIALS

## F-1. SCOPE

This appendix is provided to facilitate identification of HMMWV body repair materials.

*Table F-1. Rivet Grip Length Determination*

| MATERIAL THICKNESS RANGE (INCH) | | RIVET GRIP | NSN |
|---|---|---|---|
| MINIMUM | MAXIMUM | NO. | |
| 1/16 | 1 | | 5320-00-616-4350 |
| 1/8 | 2 | | 5320-00-584-1285 |
| 1/8 | 3/16 | 3 | 5320-00-582-3268 |
| 3/16 | 1/4 | 4 | 5320-00-582-3276 |
| 1/4 | 5/16 | 5 | 5320-00-582-3301 |
| 5/16 | 3/8 | 6 | 5320-00-582-3499 |
| 3/8 | 7/16 | 7 | 5320-00-813-4144 |
| 7/16 | 1/2 | 8 | 5320-00-616-4349 |
| 1/2 | 9/16 | 9 | 5320-00-753-3809 |
| 9/16 | 5/8 | 10 | 5320-00-821-1090 |
| 5/8 | 11/16 | 11 | 5320-00-639-2669 |
| 11/16 | 3/4 | 12 | 5320-00-996-9871 |

*Table F-2. Bulk Aluminum NSNs*

| NSN | TEMPER | THICKNESS (IN.) | WIDTH (IN.) | LENGTH (FT) |
|---|---|---|---|---|
| 9535-00-250-6503 | T-6 | .050 | 36 | 8 |
| 9535-01-048-6208 | T-6 | .060 | 48 | 12 |
| 9535-00-250-6908 | T-6 | .080 | 48 | 12 |
| 9535-00-234-8717 | T-6 | .125 | 48 | 12 |
| 9535-00-232-1885 | T-6 | .125 | 48 | 8 |
| 9535-00-541-7194 | T-4 | .050 | 48 | 12 |
| 9535-00-232-7554 | T-4 | .080 | 48 | 12 |
| 9535-00-596-3784 | T-4 | .125 | 48 | 12 |
| 9535-00-188-1574 | T-4 | .187 | 48 | 12 |

*Table F-3. AN3 and AN4 Series Bolts*

| AN3 AND AN4 SERIES BOLTS | | | | | | |
|---|---|---|---|---|---|---|
| AN3 | | | AN4 | | | |
| DASH NO. | GRIP LENGTH (IN.) | BOLT LENGTH (IN.) | NSN | GRIP LENGTH (IN.) | BOLT LENGTH (IN.) | NSN |
| 7A | 1/2 | 29/32 | 5306-00-151-0785 | 7/16 | 29/32 | 5306-00-515-8064 |
| 10OA | 5/8 | 1-1/32 | 5306-00-151-0784 | 9/16 | 1-1/32 | 5306-00-151-1424 |
| 11A | 3/4 | 1-5/32 | 5306-00-685-3027 | 11/32 | 1-5/32 | 5306-00-151-1423 |
| 12A | 7/8 | 1-9/32 | 5306-00-151-0782 | 13/16 | 1-9/32 | 5306-00-151-1422 |
| 13A | 1 | 1-13/32 | 5306-00-151-0781 | 15/16 | 1-13/32 | 5306-00-151-1421 |
| 14A | 1-1/8 | 1-17/32 | 5306-00-151-0780 | 1-1/16 | 1-17/32 | 5306-00-151-1420 |
| 15A | 1-1/4 | 1-21/32 | 5306-00-151-0779 | 1-3/16 | 1-21/32 | 5306-00-151-1419 |
| 16A | 1-3/8 | 1-25/32 | 5306-00-151-0778 | 1-5/16 | 1-25/32 | 5306-00-151-1418 |
| 17A | 1-1/2 | 1-29/32 | 5306-00-151-0777 | 1-7/16 | 1-29/32 | 5306-00-151-1417 |
| 20A | 1-5/8 | 2-1/32 | 5306-00-151-0776 | 1-9/16 | 1-1/32 | 5306-00-151-1416 |

Example:

PN AN3-7A is a 3/16-inch bolt, 29/32-inch long with a 1/2-inch grip length.

PN AN4-7A is a 1/4-inch bolt, 29/32-inch long with a 7/16-inch grip length.

The NSNs for washers and locknuts for use with the AN series bolts are:

| NOMENCLATURE | 3/16-INCH NSN | 1/4-INCH NSN |
|---|---|---|
| Washer | 5310-00-167-0812 | 5310-00-809-3078 |
| Self-locking nut | 5310-00-017-5108 | 5310-00-877-5796 |

# APPENDIX G
# TOOL IDENTIFICATION LIST

## SECTION I. INTRODUCTION

### G-1. SCOPE

This index lists common tools, special tools, and test equipment needed to maintain the M998 series vehicles.

### G-2. EXPLANATION OF COLUMNS

a. Column (1) - Item Number. This number is assigned to each entry in the listing and is referenced in the "Initial Setup" of applicable tasks under the heading of Test Equipment, "Tools," and "Special Tools."

b. Column (2) - Item Number. Name or identification of the tool or test equipment.

c. Column (3) - National Stock Number. The national stock number of the tool or test equipment.

d. Column (4) - Part Number. The manufacturer's part number.

e. Column (5) - Reference. This column lists the references used to identify and illustrate the tools and test equipment needed for maintaining the M998 series vehicles.

## Section II. TOOL IDENTIFICATION LIST (Cont'd)

| (1) Item Number | (2) Item Name | (3) National Stock Number | (4) Part Number | (5) Reference |
|---|---|---|---|---|
| 1 | Tool Kit, General Mechanic's: Automotive | 5180-00-177-7033 | | SC 5180-90-N26 |
| 2 | Shop Equipment, Automotive Maintenance and Repair: Organizational Maintenance, Common #1, Less Power | 4190-00-754-0654 | | SC 4910-95-A74 |
| 3 | Shop Equipment, Automotive Maintenance and Repair: Organizational Maintenance, Supplemental #1, Less Power | 4910-00-754-0653 | | SC 4910-95-A73 |
| 4 | Shop Equipment, Automotive Maintenance and Repair: Organizational Maintenance, Common #2, Less Power | 4910-00-754-0650 | | SC 4910-95-A72 |
| 5 | Tool Kit, Body and Fender | 5180-00-754-0643 | | SC 5180-90-N34 |
| 6 | Shop Equipment, Automotive Maintenance and Repair: Field Maintenance, Basic, Less Power | 4910-00-754-0705 | | SC 4910-95-A31 |
| 7 | Shop Equipment, Automotive Maintenance and Repair: Field Maintenance, Supplemental #1, Less Power | 4910-00-754-0706 | | SC 4910-95-A62 |
| 8 | Shop Equipment, Automotive Maintenance and Repair: Field Maintenance, Supplemental #2, Less Power | 4910-00-754-0707 | | SC 4910-95-A63 |
| 9 | Shop Equipment, Fuel and Electrical System Engine: Field Maintenance, Basic, Less Power | 4910-00-754-0714 | | SC 4940-95-B20 |
| 10 | Shop Equipment, Automotive Maintenance and Repair: Field Maintenance, Wheeled Vehicles, Post, Camp and Station, Set A | 4910-00-348-7696 | | SC 4910-95-A02 |
| 11 | Special Tool Kit, Organizational | 5180-01-387-5455 | 57K0267 | |
| 12 | Special Tool Kit, Direct Support | 5180-01-388-7560 | 57K0268 | |
| 13 | Special Tool Kit, General Support | 5180-01-389-7561 | 57K0266 | |
| | **NOTE**<br>The optional metric tools listed below are required for maintenance of this vehicle. | | | |
| 14 | Metric Wrench Set, 10-32 mm, Open End/Box End | 5120-01-119-0010 | | |

## Section II. TOOL IDENTIFICATION LIST (Cont'd)

| (1) Item Number | (2) Item Name | (3) National Stock Number | (4) Part Number | (5) Reference |
|---|---|---|---|---|
| 15 | Metric Socket Set, 6-26 mm, Std., 6 pt., 3/8 in. Drive | 5120-01-117-3876 | B107.7 | |
| 16 | Metric Socket Set, Std., 6 pt., 3/8 in. Drive, Deep Reach | 5120-01-112-9543 | B107.5 | |
| 17 | Metric Allen Wrench Kit | 5120-01-046-5079 | B18.3.2M | |
| 18 | Metric Tap and Die Kit | 5136-01-119-0005 | TDM99117 | |
| 19 | Tool Kit, Service Refrigeration Unit | 5180-00-596-1474 | | |
| 20 | Gauge, Timing Bracket | 6620-01-231-3671 | MT95 | |
| 21 | Meter, Dynamic Timing | 5180-01-186-3114 | J 33127 | |
| 22 | Sling, Engine Lifting | 4910-01-193-7808 | J 33139 | TM 9-2320-280-24P |
| 23 | Stand – Engine Repair | 4910-00-506-0037 | 1725A | TM 9-2320-280-24P |
| 24 | Remover, Hydraulic Valve Lifter | 5120-01-209-6870 | J 29834 | TM 9-2320-280-24P |
| 25 | Remover, Fuel Injection Nozzle | 5120-01-171-5233 | J 29873 | TM 9-2320-280-24P |
| 26 | Retaining Tool | | J 26528 | |
| 27 | Gauge, Belt Tension | 6635-01-093-3710 | J 23600B | |
| 28 | Socket Torx | 5120-01-227-3159 | TLE60 | |
| 29 | Fixture, Transmission Holding | 5120-01-198-7583 | J 8763-02 | |
| 30 | Base, Transmission Holding Fixture | 5120-01-144-4484 | J 3289-20 | |
| 31 | Holding Tool, Transmission Gear Unit Assembly | 4910-01-178-8865 | J 21795-02 | |
| 32 | Adapter, Slide Hammer, 3/8-16 | 5120-01-130-8865 | J 6471-2 | |
| 33 | Bushing Service Set | 5180-01-195-9777 | J 21465-01 | |
| 34 | Driver Handle | 5120-00-677-2259 | J 8092 | |
| 35 | Compressor, Clutch Spring | 5120-01-210-8793 | J 4670-01 | |
| 36 | Adapter, Clutch Spring Compressor | 4910-01-210-8793 | J 21664 | |
| 37 | Gauge, Band Apply Sector | 4910-01-178-0722 | J 21370 | |
| 38 | Alignment Tool, Intermediate Clutch Pack | 4910-01-209-0729 | J 24396 | |
| 39 | Installer, Oil Pump Seal | 5120-01-176-1845 | J 21359A | |
| 40 | Gauge, Pressure 0-300 PSI | 6685-00-880-8753 | 8030176 | |

## Section II. TOOL IDENTIFICATION LIST (Cont'd)

| (1) Item Number | (2) Item Name | (3) National Stock Number | (4) Part Number | (5) Reference |
|---|---|---|---|---|
| 41 | Adapter, Holding Tool, Use W/J 8763-02 | 5120-01-422-1326 | J 38655 | |
| 42 | Adapter, Torque, 3/8 | 5120-01-367-3536 | FTX40A | |
| 43 | Remover/Installer Tool, Oil Pump | 5120-01-422-1308 | J 37789 | |
| 44 | Installer/Remover, Gear Unit | 5120-01-422-1300 | J 38868-A | |
| 45 | Adapter, Spring Clutch Compression, Use W/J 23327 | 5120-01-422-1329 | J 38734 | |
| 46 | Seal Protectors, Forward Clutch Piston, Kit Includes J 38732-1 and J 21362-1 | 5120-01-422-1301 | J 38732 | |
| 47 | Compressor, Clutch Spring | 4910-01-178-0724 | J 23327 | |
| 48 | Adapter, Compressor, Clutch Spring, Use W/J 23327 | 5120-01-410-8216 | J 25018-A | |
| 49 | Seal Piston and Housing, Fourth Clutch | 5180-01-422-0138 | J 38731 | |
| 50 | Installer/Sizer/Pusher, Turbine Shaft Seal, Includes J 387311, J 38731-2, J 38731-3 | 5120-01-408-7051 | J 38736 | |
| 51 | Installer/Sizer/Pusher, Oil Pump Seal Ring J 38739-1, J 38739-2, J 38739-3 | 5180-01-472-1294 | J 38739 | TM 9-2320-280-24P |
| 52 | Gauge Pin, Band Apply, Use W/J 38737 | 5120-01-423-0032 | J 21370-10 | |
| 53 | Tool Pin Checking, Band Apply | 5120-01-422-1313 | J 38737 | |
| 54 | Installer, Yoke Seal | 4910-01-179-5530 | J 29162 | |
| 55 | Adapter, Slide Hammer | | J 6471-8 | TM 9-2320-280-24P |
| 56 | Installer, Front Output Shaft Rear Bearing | 5120-01-195-2721 | J 29163 | TM 9-2320-280-24P |
| 57 | Installer, Rear Output Shaft Bearing | 5120-01-196-0084 | J 29166 | TM 9-2320-280-24P |
| 58 | Installer, Front Output Shaft Front Bearing | 5120-01-170-3728 | J 29167 | TM 9-2320-280-24P |
| 59 | Remover, Front Output Shaft Front Bearing | 5120-01-169-4876 | J 29168 | TM 9-2320-280-24P |
| 60 | Remover, Input Gear Bearing | 5120-01-195-4551 | J 29170 | TM 9-2320-280-24P |
| 61 | Installer, Input Gear Bearing | 5120-01-185-7955 | J 29169 | TM 9-2320-280-24P |

## Section II. TOOL IDENTIFICATION LIST (Cont'd)

| (1) Item Number | (2) Item Name | (3) National Stock Number | (4) Part Number | (5) Reference |
|---|---|---|---|---|
| 62 | Installer, Rear Retainer Bearing | 5120-01-185-8024 | J 7818 | TM 9-2320-280-24P |
| 63 | Installer, Main Shaft Bearing | 5120-01-265-4872 | J 36307 | TM 9-2320-280-24P |
| 64 | Remover, Annulus Gear Bushing | 5120-01-185-7956 | J 29185 | TM 9-2320-280-24P |
| 65 | Installer, Annulus Gear Bushing | 5120-01-247-6629 | J 29185-2 | TM 9-2320-280-24P |
| 66 | Handle Drive | 5120-00-677-2259 | J 8092 | TM 9-2320-280-24P |
| 67 | Installer, Bushing Remover/Bearing | 5120-01-357-3633 | J 33826 | TM 9-2320-280-24P |
| 68 | Installer, Mainshaft Pilot Bearing | 5120-01-389-9992 | J 39636 | TM 9-2320-280-24P |
| 69 | Installer, Input Gear Seal | 5120-01-389-9992 | J 33831 | TM 9-2320-280-24P |
| 70 | Remover/Installer, Output Shaft Front Bearing | | J 33832 | TM 9-2320-280-24P |
| 71 | Installer, Output Shaft Seal (242) | 5120-01-277-1680 | J 22661 | TM 9-2320-280-24P |
| 72 | Extension Housing Bushing Remover | 5120-01-357-3631 | J 33839 | TM 9-2320-280-24P |
| 73 | Remover, Universal Bearing and Bushing | 5120-01-201-7857 | J 29369 | TM 9-2320-280-24P |
| 74 | Bearing Tool | 5120-01-357-9123 | J 9276-3 | TM-9-2320-280-24P |
| 75 | Installer, Extension Housing Seal | 5120-01-361-3101 | J 33843 | TM 9-2320-280-24P |
| | Installer, Extension Housing Seal | 5120-01-414-1849 | J 38869 | TM 9-2320-280-24P |
| 76 | Installer, Bearing and Bushing | 5120-01-185-7968 | J 29174 | TM 9-2320-280-24P |
| 77 | Arbor Press | | AA 51195 | |
| 78 | Screw Extractor Set | 5120-00-610-1888 | E 1020 | |
| 79 | Installer, Axle Shaft and Seal | 5120-01-187-3659 | J 33142 | TM 9-2320-280-24P |
| 80 | Adapters, Axle Holding Fixture | 5120-01-218-8235 | J 33149-A | TM 9-2320-280-24P |
| 81 | Remover, Pinion Rear Bearing Cup | 5120-01-185-7957 | J 21786 | TM 9-2320-280-24P |
| 82 | Remover, Pinion Front Bearing Cup | 5120-01-187-3660 | J 21787 | TM 9-2320-280-24P |
| 83 | Installer, Yoke Seal (218) | 4910-01-179-5530 | J 29162 | TM 9-2320-280-24P |
| 84 | Installer, Pinion Rear Bearing Cup | 5120-01-185-7962 | J 8608 | TM 9-2320-280-24P |
| 85 | Installer, Pinion Front Bearing Cup | 5120-01-185-7964 | J 8611-01 | TM 9-2320-280-24P |
| 86 | Set, Pinion Setting Gauge | 5180-01-216-8643 | J 35199 | TM 9-2320-280-24P |
| 87 | Set, Pinion Setting Gauge | 5180-01-363-8079 | J 39524 | TM 9-2320-280-24P |

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| (1) Item Number | (2) Item Name | (3) National Stock Number | (4) Part Number | (5) Reference |
|---|---|---|---|---|
| 88 | Installer, Geared Hub Input Seal | 5120-01-187-3607 | J 33143 | TM 9-2320-280-24P |
| 89 | Wrench, Geared Hub Locknut | 5120-01-185-7963 | J 33144 | TM 9-2320-280-24P |
| 90 | Installer, Geared Hub Spindle Seal | 5120-01-229-0842 | J 35184 | |
| 91 | Deleted | | | |
| 92 | Carbon Pile | 6110-00-038-0074 | A 1705070 | |
| 93 | Armature Test Set | | 1231009 | |
| 94 | Test Stand | 4928-00-939-9489 | 667035 | |
| 95 | Dial Indicator | 5210-00-277-8840 | 196A | |
| 96 | Micrometer | 5210-00-554-7134 | GCG-C-105 | SC4910-95-A63 |
| 97 | Remover and Installer, Adjuster Plug Bearing | 5120-01-185-7965 | J 6221 | TM 9-2320-280-24P |
| 98 | Remover and Installer, Pitman Shaft Bearing | 5120-01-082-6447 | J 6278 | TM 9-2320-280-24P |
| 99 | Wrench, Spanner | 5120-01-082-6436 | J 7624 | TM 9-2320-280-24P |
| 100 | Arbor, Rack Piston | 5120-01-179-1032 | J 21552 | TM 9-2320-280-24P |
| 101 | Tool Kit, Compressor | | J 29642-B | |
| 102 | Tool Kit, Compressor | 5180-01267-2907 | J 29642-C | |
| 103 | Flushing Cylinder | 4310-01-248-8460 | ACT71 | |
| 103.1 | Reusable Cylinder | | RRC-910-1-4 | |
| 104 | Flush Gun | 4910-00-357-1374 | 10351 | |
| 105 | Vacuum Pump | 4310-00-460-5237 | 3305 | |
| 106 | Adapter, Torque, 9/16 in. | 5120-01-367-3582 | SRES 18 | |
| 107 | Adapter, Torque, 3/4 in. | 5120-01-367-3585 | SRES 24 | TM 9-2320-280-24P |
| 108 | Adapter, Socket, 3/8 in. to 1/2 in. Drive | 5120-00-240-8702 | 11655788-2 | TM 9-2320-280-24P |
| 109 | Adapter, Torque, 9/16 in. | | SRES 19 | TM 9-2320-280-24P |
| 110 | Crowfoot, 3/8 in. Drive, 5/8 in. | 5120-00-184-8400 | AN8506-6 | TM 9-2320-280-24P |
| 111 | Crowfoot, 3/8 in. Drive, 19 mm | 5120-01-230-9421 | J 35160 | TM 9-2320-280-24P |
| 112 | Crowfoot, 3/8 in. Drive, 9/16 in. | 5120-00-335-1094 | FC 18A | TM 9-2320-280-24P |
| 113 | Crowfoot, 3/8 in. Drive, 7/8 in. | 5120-01-335-1099 | FC 28A | TM 9-2320-280-24P |
| 114 | Socket, Deep Well, 12 pt., 3/8 in. | 5120-00-277-1463 | SF121 | TM 9-2320-280-24P |
| 115 | Driver, Hex Head, 8 mm | 5120-01-053-4159 | FAM8A | TM 9-2320-280-24P |
| 116 | Crowfoot, 3/8 in. Drive, 9/16 in. | 5120-00-484-8397 | AN8506-3 | TM 9-2320-280-24P |
| 117 | Driver, Hex Head, 5/32 in. | 5120-01-367-3456 | FA5A | TM 9-2320-280-24P |

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| 118 | "C" Clamp | 5120-01-180-0908 | A-A-429 | |
| 119 | Connector Repair Kit | 5180-00-876-9336 | 7550526 | |
| 120 | Multimeter | 6625-01-139-2512 | AN/PSM-45 | SC 4910-95-CL-A74 |
| 121 | Puller Kit | 5120-01-011-7938 | C-3894-A | |
| 122 | Socket, 1-1/2 in. Drive, 3/4 in. | 5120-00-293-0094 | 47148 | |
| 123 | Puller, Steering Wheel | 5120-00-620-0020 | 6200020 | |
| 124 | Vise Insert | 5120-00-221-1506 | 404-4 | |
| 125 | Universal Joint Bearing Kit | 5120-01-210-4096 | 7057 | |
| 126 | Installer, Rear Main Seal (6.2 L) | 5120-01-210-8792 | J 33153 | TM 9-2320-280-24P |
| 127 | Installer, Rear Main Seal (6.5 L) | 5120-01-422-0334 | J 39084 | TM 9-2320-280-24P |
| 128 | Spreader Housing, Differential | 4910-00-105-2823 | W-129 | |
| 129 | Analyzer, Power Steering | 5180-01-185-7966 | 12342943 | |
| 130 | 24 Volt DC Power Source | 6140-01-210-1964 | MS52149-1 | |
| 131 | Graduated Beaker, 1.7oz (50 cc) | 6640-00-050-4049 | L-122 | |
| 132 | Fuel Container, 1 gal (3.785 L) | 4330-00-531-4343 | 300-10 | |
| 133 | Ammeter (50 ampere) | 6625-00-190-5576 | 4951-693 | |
| 134 | Pliers, Needlenose | 5120-01-174-4496 | S111-25-2848 | |
| 135 | Crowfoot, 3/8 in. Drive, 16 mm | 5120-01-242-8165 | J 35159 | TM 9- 2320-280-24P |
| 136 | Puller | 5120-00-595-9305 | GGGP781 | TM 9-2320-280-24P |
| 137 | Manifold Gauge Set | 4130-01-032-2912 | 622-C | |
| 138 | Blind Hole Puller Set | 5120-00-140-3557 | CG-46 | |
| 139 | Installer, Seal (242) | 5120-01-414-1849 | J 38869 | |
| 140 | Installer, Seal (242) | 5120-01-437-0480 | 6888 | |
| 141 | Handle, Drive (242) | 5120-01-026-1666 | C-4171 | |
| 142 | Equipment, Alignment | 4910-01-154-1820 | DFP-134 | |
| 143 | Center Support Thread Reamer | | J39919 | |

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|---|---|---|---|---|---|---|
| 1 | 2-12.2 | | | | 2-1 | Under Torque Converter Clutch Solenoid, resistance between pins S and E should be 10-14 ohms. |
| 2 | 3-137 | 3-24 | | | | When disconnecting oil cooler supply line in step 116, oil will spill out. Need to have a container ready to catch oil. |

SAMPLE

**Reference to line numbers within the paragraph or subparagraph.*

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# THE METRIC SYSTEM AND EQUIVALENTS

### LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1,000 Millimeters = 39.37 Inches
1 Kilometer = 1,000 Meters = 0.621 Miles

### SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

### CUBIC MEASURE

1 Cu Centimeter = 1,000 Cu Millimeters = 0.06 Cu Inches
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

### LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1,000 Milliliters = 33.82 Fluid Ounces

### TEMPERATURE

Degrees Fahrenheit (F) = °C • 9 ÷ 5 + 32
Degrees Celsius (C) = F° - 32 • 5 ÷ 9
212° Fahrenheit is equivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius

### WEIGHTS

1 Gram = 0.001 Kilograms = 1,000 Milligrams = 0.035 Ounces
1 Kilogram = 1,000 Grams = 2.2 Lb
1 Metric Ton = 1,000 Kilograms = 1 Megagram = 1.1 Short Tons

## APPROXIMATE CONVERSION FACTORS

| TO CHANGE | TO | MULTIPLY BY |
|---|---|---|
| Inches | Millimeters | 25.4 |
| Inches | Centimeters | 2.540 |
| Feet | Meters | 0.305 |
| Yards | Meters | 0.914 |
| Miles | Kilometers | 1.609 |
| Square Inches | Square Centimeters | 6.451 |
| Square Feet | Square Meters | 0.093 |
| Square Yards | Square Meters | 0.836 |
| Square Miles | Square Kilometers | 2.590 |
| Acres | Square Hectometers | 0.405 |
| Cubic Feet | Cubic Meters | 0.028 |
| Cubic Yards | Cubic Meters | 0.765 |
| Fluid Ounces | Milliliters | 29.573 |
| Pints | Liters | 0.473 |
| Quarts | Liters | 0.946 |
| Gallons | Liters | 3.785 |
| Ounces | Grams | 28.349 |
| Pounds | Kilograms | 0.4536 |
| Short Tons | Metric Tons | 0.907 |
| Pound-Feet | Newton-Meters | 1.356 |
| Pounds Per Square Inch | Kilopascals | 6.895 |
| Miles Per Gallon | Kilometers Per Liter | 0.425 |
| Miles Per Hour | Kilometers Per Hour | 1.609 |

| TO CHANGE | TO | MULTIPLY BY |
|---|---|---|
| Millimeters | Inches | 0.03937 |
| Centimeters | Inches | 0.3937 |
| Meters | Feet | 3.280 |
| Meters | Yards | 1.094 |
| Kilometers | Miles | 0.621 |
| Square Centimeters | Square Inches | 0.155 |
| Square Meters | Square Feet | 10.764 |
| Square Meters | Square Yards | 1.196 |
| Square Kilometers | Square Miles | 0.386 |
| Square Hectometers | Acres | 2.471 |
| Cubic Meters | Cubic Feet | 35.315 |
| Cubic Meters | Cubic Yards | 1.308 |
| Milliliters | Fluid Ounces | 0.034 |
| Liters | Pints | 2.113 |
| Liters | Quarts | 1.057 |
| Liters | Gallons | 0.264 |
| Grams | Ounces | 0.035 |
| Kilograms | Pounds | 2.2046 |
| Metric Tons | Short Tons | 1.102 |
| Newton-Meters | Pound-Feet | 0.738 |
| Kilopascals | Pounds Per Square Inch | 0.145 |
| Kilometers Per Liter | Miles Per Gallon | 2.354 |
| Kilometers Per Hour | Miles Per Hour | 0.621 |

