TM 9-2350-311-34-2

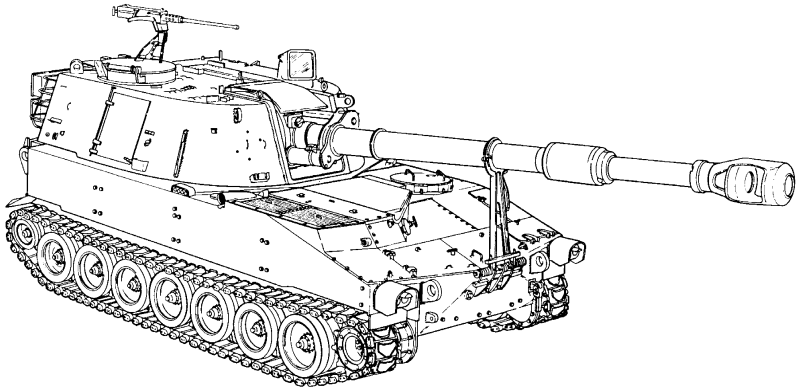
Supersedes copy dated November 1986 and all changes

DEPARTMENT OF THE ARMY
TECHNICAL MANUAL

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR

CAB, ARMAMENT, SIGHTING AND FIRE CONTROL, ELEVATING AND TRAVERSING SYSTEMS AND ASSOCIATED COMPONENTS HOWITZER, MEDIUM, SELF-PROPELLED 155MM

M109A2 (2350-01-031-0586)(EIC:3EZ)
M109A3 (2350-01-031-8851)(EIC:3E2)
M109A4 (2350-01-277-5770)(EIC:3E8)
M109A5 (2350-01-281-1719)(EIC:3E7)



DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

HEADQUARTERS, DEPARTMENT OF THE ARMY

02 SEPTEMBER 1994

CARBON MONOXIDE POISONING CAN BE DEADLY

Carbon monoxide is a colorless, odorless, deadly poisonous gas, which, when breathed, deprives the body of oxygen and causes suffocation. Exposure to air contaminated with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, apparent drowsiness, coma, permanent brain damage, or even death from severe exposure.

Carbon monoxide occurs in the exhaust fumes of fuel-burning heaters and internal-combustion engines and becomes dangerously concentrated under conditions of inadequate ventilation. The following precautions must be observed to ensure the safety of personnel whenever the personnel heater, main, or auxiliary engine of any vehicle is operated for maintenance purposes or tactical use.

Do not operate heater or engine of vehicle in an enclosed area unless it is adequately ventilated.

Do not drive any vehicle with inspection plates, cover plates, or engine compartment doors removed unless necessary for maintenance purposes.

Be alert at all times during vehicle operation for exhaust odors and exposure symptoms. If either are present, immediately ventilate personnel compartments. If symptoms persist, remove affected personnel from vehicle and treat as follows: expose to fresh air; keep warm; do not permit physical exercise; and if necessary, administer artificial respiration.

THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS ADEQUATE VENTILATION.

WARNING

RADIATION HAZARD

TRITIUM GAS (H_3)

Rules and Regulations

This item contains radioactive material. Control of this radioactive material is mandated by federal law. Immediately report any suspected lost or damaged items to your Radiation Protection Officer. If your Radiation Protection Officer can not be reached contact the TACOM-ACALA Safety Office.

Copies of the following rules and regulations are maintained at HQ, TACOM ACALA, Rock Island, IL 61299-7630. Copies may be requested or information obtained by contacting the ACALA Radiological Protection Officer (RPO), DSN 793-2965/2995/2962, Commercial (309) 782-2965/2995/2962. After duty hours, contact the staff duty officer through the operator at DSN 793-6001, Commercial (309) 782-6001.

1. 10 CFR Part 19 - Notices, Instructions and Report to Workers; Inspections.
2. 10 CFR Part 20 - Standards for Protection Against Radiation.
3. 10 CFR Part 21 - Reporting of Defects and Noncompliance.
4. NRC license, license conditions, and license application.

Safety Precautions

The radioactive material used in the M1A1 collimator and the M140 alinement device is tritium gas (H3) sealed in Pyrex tubes. These sources illuminate the instrumentation for night operations. Tampering with or removing the source in the field is prohibited by Federal Law. They pose no significant hazard when intact. However, if an M1A1 collimator or an M140 alinement device is discovered to be broken, damaged, or defective, the following procedures will be followed:

1. Evacuate to a safe distance upwind and cordon off immediate area around device.
2. Immediately notify the Installation Radiation Protection Officer (RPO) and the Installation Safety Officer (SO).
3. All personnel will stand fast at the safe area until released by the RPO or the SO.
4. Follow the RPO's instruction for decontamination so as to avoid excess spread of tritium contamination.
5. Personnel exposed to tritium will notify medical personnel.

WARNING

RADIATION HAZARD

TRITIUM GAS (H_3)

Rules and Regulations (Cont)

Identification

Radioactive self-luminous sources are identified by means of radioactive warning labels (as above). These labels should not be defaced or removed, and should be replaced immediately when necessary. Refer to the local RPO or the ACALA RPO for instructions on handling, storage, or disposal.

Storage

When radioactively illuminated instruments are defective, items must be placed in a plastic bag (item 7, Appx B) and packaged in the shipping container. Spare equipment must be stored in the shipping container, as received, until installed on the weapon. Storage of these items is recommended to be in an outdoor shed-type storage or unoccupied building.

WARNING

- Do not use mineral spirits or paint thinner to clean the howitzer. Mineral spirits and paint thinners, are highly toxic and combustible. Prolonged breathing can cause dizziness, nausea, and even death. Do not use these materiels.
- Avoid prolonged contact with cleaning solvents and adhesives. To prevent damage to eyes, skin, and lungs:

  Always use cleaning solvents and adhesives in a well ventilated area.

  Do not permit smoking.

  Do not use near open flame.

  Avoid contact with skin.

  Wear gloves and eye protection.
- When removing and installing heavy items, make sure to have sufficient personnel and adequate lifting equipment. Equipment can cause serious injury if dropped.
- Do not drop tank of compressed nitrogen gas. Do not tap nitrogen tank. Tank can explode when tapped or dropped. When using in confined areas, use extreme care; gas could cause suffocation.
- Make sure nitrogen cylinder contains dry nitrogen. Dry nitrogen tanks are marked with one or two black bands. Wet nitrogen can cause corrosion. Certain other gases can cause accumulator to explode, resulting in possible injury.
- High pressure gas is used in charging the accumulators and fire control equipment. Do not exceed recommended psi when charging these components. Keep face and body clear of release valves. Failure to observe safety precautions may result in injury or death.
- Refer to FM 4-25.11, First Aid For Soldiers, for correct procedures to be taken if personnel are injured.
- Refer to TM 9-1300-206, Ammunition and Explosives Standards, for correct procedures involving the use of ammunition. Incorrect use of ammunition can cause serious injury or death.
- Ensure valves are closed prior to disassembly to prevent sudden release of nitrogen pressure.
- Care should be taken to prevent contamination of recuperator cylinder during disassembly and assembly.
- Prior to removing valve cap ensure that the pneumatic valve is closed to prevent release of nitrogen pressure. This will prevent serious injury or damage to equipment caused by sudden release of nitrogen pressure.
- Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.

WARNING

CHEMICAL AGENT RESISTANT COATING (CARC) PAINT

CARC paint contains isocyanate, a constituent that can cause respiratory effects during and after the application of the material. During the application of CARC paint, coughing, shortness of breath, pain on respiration, increased sputum, and chest tightness may occur. CARC paint also produces itching and reddening of the skin, a burning sensation of the throat and nose, and watering of the eyes.

An allergic reaction may occur after initial exposure (ranging from a few days to a few months later), producing asthmatic symptoms including coughing, wheezing, tightness in the chest, or shortness of breath.

The following precautions must be observed to ensure the safety of personnel when CARC paint is applied.

- For brush/roller painting in confined spaces, an airline respirator is required, unless an air sampling shows exposure to be below standards. If the air sampling is below standards, either chemical cartridge or airline respirators are required.
- Spot painters applying CARC paint by brush or roller must wear clothing and gloves affording full coverage.
- Do not use water, alcohol, or amine based solvents to thin or remove CARC paints. Use of these solvents with CARC paints can produce chemical reactions resulting in nausea, disease, burns, or severe illness to personnel.
- Do not use paint solvents to remove paint/coating from your skin.
- Mix paint/coating in a well ventilated mixing room or spraying area away from open flames. Personnel mixing paint/coating should wear eye protection.
- Use paint/coating with adequate ventilation.
- Personnel grinding or sanding on painted equipment should use high efficiency air purifying respirators.
- Do not weld or cut CARC-coated metal because substances causing skin or respiratory irritation may be released. Before applying any heat, sand or grind the paint down to bare metal on an area four inches to either side of where the heat is to be applied. Remove paint from the other side of the metal, if it is painted.

CHANGE NO. 3

**HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 31 DECEMBER 2008**

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR CAB, ARMAMENT, SIGHTING AND FIRE CONTROL, ELEVATING AND TRAVERSING SYSTEMS AND ASSOCIATED COMPONENTS HOWITZER, MEDIUM, SELF-PROPELLED 155MM

**M109A2 (2350–01–031–0586) (EIC: 3EZ)
M109A3 (2350–01–031–8851) (EIC: 3E2)
M109A4 (2350–01–277–5770) (EIC: 3E8)
M109A5 (2350–01–281–1719) (EIC: 3E7)**

TM 9–2350–311–34–2, 2 September 1994, is changed as follows:

1. The purpose of this change is to update TM 9-2350-311-34-2.
2. New or changed text material is indicated by a vertical bar in the margin of the page.
3. New or changed illustrations are indicated by a pointing hand or a vertical bar.
4. Remove old pages and insert new pages as indicated below:

Remove pages	Insert pages
c and d	c and d
A and B	A and B
i and ii	i and ii
1-3 and 1-4	1-3 and 1-4
2-7 through 2-10	2-7 through 2-10
6-65 and 6-66	6-65 and 6-66
None	6–66.1/(6–66.2 blank)
7-7 through 7-14	7-7 through 7-14
9-17 through 9-22	9–17 through 9-22
A-1 through A-4	A-1 through A-4
2028-2 Sample	2028 Sample (Part I and Part II)
All 2028-2s	2028 (Part I and Part II)
Front Cover/Pin	Front Cover/Pin
Metric Chart/Pin	Metric Chart/Pin

5. File this change in front of the publication.

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0800807

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 371440 requirements for TM 9-2350-311-34-2.

CHANGE

NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON D.C., 31 JULY 1998

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR CAB, ARMAMENT, SIGHTING AND FIRE CONTROL, ELEVATING AND TRAVERSING SYSTEMS, AND ASSOCIATED COMPONENTS HOWITZER, MEDIUM, SELF-PROPELLED, 155MM

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M109A5 (2350-01-281-1719) (EIC: 3E7)

TM 9-2350-311-34-2, 2 September 1994, is changed as follows:

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

Remove pages	Insert pages
a through d	a through d
i and ii	i and ii
1-3 through 1-8	1-3 through 1-8
1-31 and 1-32	1-31 and 1-32
2-3 through 2-6	2-3 through 2-6
2-9 through 2-14	2-9 through 2-14
2-19 and 2-20	2-19 and 2-20
2-27 and 2-28	2-27 and 2-28
2-37 and 2-38	2-37 and 2-38
None	2-38.1 and 2-38.2
2-39 and 2-40	2-39 and 2-40
None	2-40.1 and 2-40.2
2-49 through 2-54	2-49 through 2-54
2-59/(2-60 blank)	2-59/(2-60 blank)
3-1 through 3-4	3-1 through 3-4
4-1 through 4-9/(4-10 blank)	4-1 through 4-9/(4-10 blank)
5-1 and 5-2	5-1 and 5-2
5-5 through 5-12	5-5 through 5-12
None	5-12.1 and 5-12.2

Remove pages	Insert pages
5-35 through 5-40	5-35 through 5-40
5-43 through 5-46	5-43 through 5-46
5-51 through 5-60	5-51 through 5-60
5-67 and 5-68	5-67 and 5-68
5-71 through 5-76	5-71 through 5-76
5-91 through 5-110	5-91 through 5-10
None	5-110.1 and 5-110.2
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11-9 and 11-10	11-9 and 11-10
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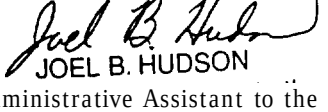
14-1 through 14-4	14-1 through 14-4
None	14-4.1 through 14-4.6
14-5 and 14-6	14-5 and 14-6
14-9 through 14-26	14-9 through 14-26
B-1 through B-3/(B-4 blank)	B-1 through B-4
C-1 and C-2	C-1 and C-2
None	C-17/(C-18 blank)
E-3 through E-6	E-3 through E-6
F-1/(F-2 blank)	F-1/(F-2 blank)
Index 1 through Index 4	Index 1 through Index 4

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

By Order of the Secretary of the Army:

DENNIS J. REIMER
General, United States Army
Chief of Staff

Official:



Administrative Assistant to the
Secretary of the Army
04953

DISTRIBUTION: To be distributed in accordance with the initial distribution for 371440 requirements for TM 9-2350-311-34-2.

CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D. C., 1 February 1996

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR CAB, ARMAMENT, SIGHTING AND FIRE CONTROL, ELEVATING AND TRAVERSING SYSTEMS, AND ASSOCIATED COMPONENTS HOWITZER, MEDIUM, SELF-PROPELLED, 155MM

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Remove pages	Insert pages
a through d	a through d
1-5 and 1-6	1-5 and 1-6
1-35 and 1-36	1-35 and 1-36

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

By Order of the Secretary of the Army:

DENNIS J. REIMER
General, United States Army
Chief of Staff

Official:
YVONNE M. HARRISON
Administrative Assistant to the
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01191

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INSERT LATEST CHANGED PAGES.
DESTROY SUPERSEDED PAGES

LIST OF EFFECTIVE PAGES

Note: The portion of the text affected by the changes is indicated by a vertical line in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Date of issue for original and changed pages are:

Original ..... 0 ..... 2 September, 1994
Change ..... 1 ..... 1 February, 1996
Change ..... 2 .....31 July, 1998
Change ..... 3 ..... 31 December 2008

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 548, CONSISTING OF THE FOLLOWING:

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Change 2 Errata (2)	2
Change 1 Errata	1
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d	3
e	0
f Blank	0
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2-7	0
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2-9	3
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2-14	2
2-15 – 2-18	0
2-19	2
2-20 – 2-26	0
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2-29 – 2-36	0
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4-8	0
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C-2 – C-16	0
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G-2 Blank	0
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Index-3	2
Index-4 – Index 6	0
FO-1	0
FO-2	0
FO-3	0
FO-4	0
Blank	0
DA Form 2028 Sample (Part I)	3
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DA Form 2028	3
Metric Page	3
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*Zero in this column indicates an original page

TECHNICAL MANUAL
No. 9-2350-311-34-2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 2 September 1994

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR CAB, ARMAMENT, SIGHTING AND FIRE CONTROL, ELEVATING AND TRAVERSING SYSTEMS, AND ASSOCIATED COMPONENTS HOWITZER, MEDIUM, SELF-PROPELLED 155MM

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Equipment Technical Publications), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is https://aeps.ria.army.mil. The DA Form 2028 is located under the Public Applications section in the AEPS Public Home Page. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or E-mail your letter or DA Form 2028 direct to: TACOM Life Cycle Management Command ATTN: AMSTA-LC-LMPP/TECH PUBS, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The email address is ROCK-TACOM-TECH-PUBS@conus.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

TABLE OF CONTENTS

*This manual supersedes the following manual: TM 9-2350-311-34-2, November 1986, and all changes.

TABLE OF CONTENTS — CONTINUED

HOW TO USE THIS MANUAL

This manual consists of:

1. Instructions for direct and general support maintenance on the M109A2/M109A3/M109A4/M109A5, 155MM, Self-Propelled, Medium, Howitzer cab systems and components. These tasks are listed in the Maintenance Allocation Chart (MAC) contained in TM 9-2350-311-20-2.

2. Location and description of the M109A2/M109A3/M109A4/M109A5 howitzer cab systems and components.

3. Cab systems/components maintenance procedures to:

   a. Perform troubleshooting of malfunctioning systems/components (isolation of malfunction causes).

   b. Remove, repair, and install cab system/components.

4. Appendixes for detailed listings of:

   Appendix A. References applicable to M109A2/M109A3/M109A4/M109A5 howitzer, including supply catalogs, forms, and other M109A2/M109A3/M109A4/M109A5 publications.

   Appendix B. Expendable and durable items list.

   Appendix C. Illustrated list of manufactured items.

   Appendix D. Torque limits.

   Appendix E. Mandatory replacement parts list.

   Appendix F. Tool identification list.

   Appendix G. Hydraulic schematic symbols.

   Index

   Foldouts (FOs): Electrical and hydraulic schematics.

Indexing

Five major indexing procedures are used in this manual to help mechanics locate information rapidly.

1. Cover Index: Lists sections of text and page number. Includes index mark which lines up with index marks on the actual page of reference.

   Example: Troubleshooting 2-17

2. Table of Contents.

3. Chapter and section indexes listing data/information covered within the chapter and section.

4. Quick Guide to Troubleshooting identifies system malfunction and provides paragraph references for specific troubleshooting procedures or maintenance action.

5. Index: Alphabetical listing of information.

HOW TO USE THIS MANUAL - CONTINUED

Maintenance Text and Illustrations (Chapters 3 through 14)

1. Maintenance procedures are to be performed in the sequence shown in the text and illustrations. Step 1 must be performed before Step 2. Procedure A must be performed before Procedure B, and so on.

2. Equipment illustrations use numbers to identify parts of the system/components.

   Example: Remove two cap screws (7) and two lockwashers (8).

3. This manual is written to include all parts authorized to be used or repaired at the direct and general support level using Repair Parts and Special Tools List (RPSTL) (TM 9-2350-311-24P-2) as a guide. All parts with SMR code maintenance levels "F" and "H" are mentioned in the order of functional group codes whenever possible, to enable location in the RPSTL.

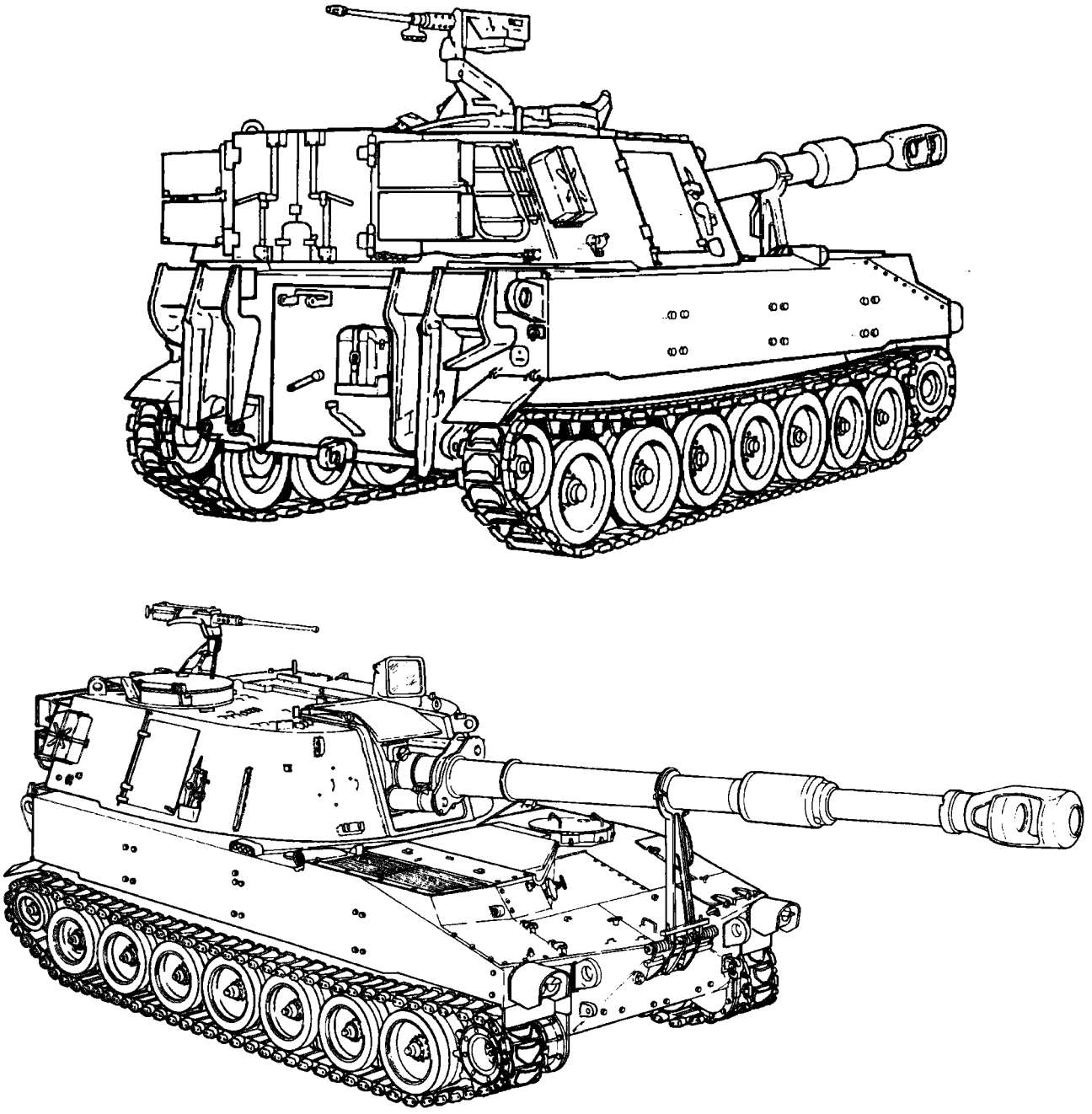
CHAPTER 1
INTRODUCTION

GENERAL

This chapter provides the maintenance mechanic with basic information on the M109 howitzer series' primary armament, elevating, traversing, and other cab-related components. This information is provided through a physical description of major components, which the mechanic is required to maintain, service, inspect, replace, or repair.

Additional information is provided as reference and guidance on use of forms, maintenance of records, and filing of reports.

CONTENTS



M109A2/M109A3/M109A4/M109A5

Section I. GENERAL INFORMATION

1-1 SCOPE

a. Type of Manual: Direct support and general support maintenance.

b. Model Number and Equipment Name: M109A2/M109A3/M109A4/M109A5 Howitzer, Medium, Self-Propelled, 155MM. This manual deals with maintenance of the cab and associated components. TM 9-2350-311-34-1 deals with maintenance of the hull and associated components.

c. Purpose of Equipment: The howitzer cab, containing the M185 or M284 155MM cannon and secondary armament M2 heavy barrel caliber 50 machine gun, provides the firepower for the howitzer. The cab components also provide the fire control for the 155MM cannon.

1-2 MAINTENANCE FORMS, RECORDS, AND REPORTS

a. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by (as applicable) DA PAM 750-8, Army Maintenance Management System User's Manual; DA PAM 738-751, Functional Users Manual for the Army Maintenance Management System-Aviation (TAMMS-A); or AR 700-138, Army Logistics Readiness and Sustainability.

b. Accidents involving injury to personnel or damage to materiel will be reported on DA Form 285 (Accident Report) in accordance with AR 385-40. Explosives and ammunition malfunctions will be reported in accordance with AR 75-1.

c. For information on ammunition refer to SB 742-1, Ammunition Surveillance Procedures; and AR 700-22, Worldwide Ammunition Reporting System (WARS).

1-3 DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Refer to TM 750-244-6 for procedures on how to destroy the M109 self-propelled howitzer. You will find procedures for destruction of munitions in TM 43-0002-33 (improved conventional munitions). Procedures for destruction of chemical munitions are outlined in TM 3-250. For general guidelines to follow in destruction of equipment to prevent enemy use, refer to TM 9-2350-311-20-2.

1-4 CALIBRATION

For fire control alinement tests and measurements, refer to TM 9-2350-311-10.

For illustration and description of how to synchronize, adjust, and test the M109 series sighting and fire control equipment, refer to TM 9-2350-311-20-2.

For direct and general support maintenance procedures and Repair Parts and Special Tools List (RPSTL) on M117/M117A2 panoramic telescope, M145/M145A1 telescope mount, M118A2/M118A3 elbow telescope, M146 telescope mount, M15 elevation quadrant, and M42 tank periscope, refer to TM 9-1240-401-34&P.

For M1A1 collimator maintenance procedures and RPSTL, refer to TM 9-1240-324-34&P.

1-5 PREPARATION FOR STORAGE OR SHIPMENT

Instructions on proper storage and shipment of the M109 self-propelled howitzer are covered in TM 9-2350-311-20-2.

1-6 OFFICIAL NOMENCLATURE, NAMES, AND DESIGNATIONS

Nomenclature in this manual was chosen in accordance with the terms used for provisioning as they appear in the RPSTL (TM 9-2350-311-24P-2) and Maintenance Allocation Chart (MAC) (TM 9-2350-311-20-2). A few tools and cab components, however, are referred to by names more common than those in the RPSTL. In many cases the more common name is a shorter name for the same component.

Nomenclature Cross-Reference

Manual Nomenclature	Official Nomenclature
Actuating valve	Valve assembly, actuating, rammer
Assistant gunner's control assembly	Control assembly, right gunner's
Cab ammunition rack assembly	Projectile stowage rack assembly
Cap screw	Hexagon head cap screw
Connector	Electrical plug connector
Contact board (or ring segment)	Electrical contact race ring (or electrical segment)
Elevation selector valve assembly	Selector valve assembly
Equilibrated elevating cylinder	Cannon equilibrator

Manual Nomenclature	Official Nomenclature
Fluid level gage	Gage rod-cap, liquid
Gunner's control assembly	Control assembly, left gunner's
Howitzer	155MM medium self-propelled howitzer, M109A2/M109A3/M109A4/M109A5
Hygroscopic breather	Filter-drier, relief
Lockwire	Safety wire/nonelectrical wire
M178 mount	Howitzer M178 mount
M182 mount	Howitzer M182 mount
Operating handle	Breechblock handle
Panoramic telescope ballistic cover	Ballistic cover assembly
Turret lock	Turret mechanism

1-7 REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

If your howitzer 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. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to: Commander, U.S. Army Armament Research, Development and Engineering Center, ATTN: AMSTA-AR-QAW-A (R)/Customer Feedback Center, Rock Island, IL 61299-7300.

1-8 WARRANTY INFORMATION

The M109 howitzer series is no longer warranted.

1-9 SAFETY, CARE, AND HANDLING

WARNING

Nuclear, Biological, and Chemical (NBC) agents can kill you. If NBC exposure is suspected, all air filter media must be handled by personnel wearing full NBC protective equipment (FM 3-4).

WARNING

The M1A1 collimator is radioactively illuminated. Check for presence of illumination and damage. If discovered broken, damaged, or defective, follow the procedures on page b.

The M140 alinement device is radioactively illuminated. Check for loss of luminescence, breakage, damage, or defects. If present, follow the procedures on page b.

a. Deleted.

b. Prior to any maintenance action (e.g., purging or charging M1A1 collimator) check for illumination using following procedure:

1 Device must be kept in the dark for at least four hours prior to performing the illumination test. This is to prevent exterior light from activating the phosphor.

2 Adjust eyes to dark and check for illumination in the dark or a low light environment. If slight glow/haze appears, device is considered illuminated and maintenance actions may proceed.

3 If illumination is not observed, source is considered broken. Entire device must be evacuated to depot level maintenance for repair/disposal (refer to AR 385-11). Take the following actions:

(a) Seal entire device in two plastic bags (item 7, Appx B) and place in a strong, tight container (such as fiberboard box (item 9, Appx B) with all seams secured using tape (item 36, Appx B) (masking tape is not authorized).

(b) Label the container: CAUTION - BROKEN H_3 SOURCE. DO NOT OPEN.

(c) Wash hands thoroughly with nonabrasive soap and water.

(d) Immediately notify the local Radiation Protection Officer (RPO).

1-10 CORROSION PREVENTION AND CONTROL (CPC)

Corrosion Prevention and Control (CPC) of Army materiel is a continuing concern. It is important that any corrosion problems with the howitzer be reported so that the problem can be corrected and improvements can be made to prevent the problem in the future.

While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of these materials may be a corrosion problem.

If a corrosion problem is identified, it can be reported using SF 368, Product Quality Deficiency Report. Use of keywords such as “corrosion,” “rust,” “deterioration,” or “cracking” will ensure that the information is identified as a CPC problem.

The form should be submitted to:

Commander
U.S. Army Armament Research, Development and Engineering Center
ATTN: AMSTA-AR-QAW-A (R)
Customer Feedback Center
Rock Island, IL 61299-7300

1-11 NUCLEAR HARDNESS

Not applicable.

1-12 SECURITY MEASURES FOR ELECTRONIC DATA

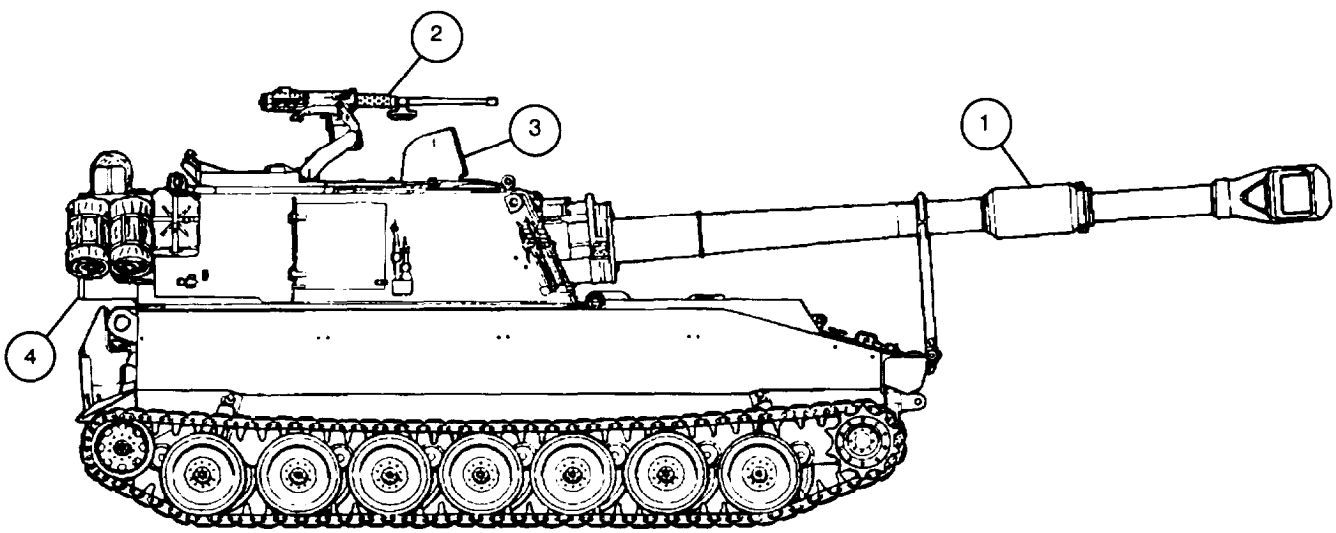
Not applicable.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-13 EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

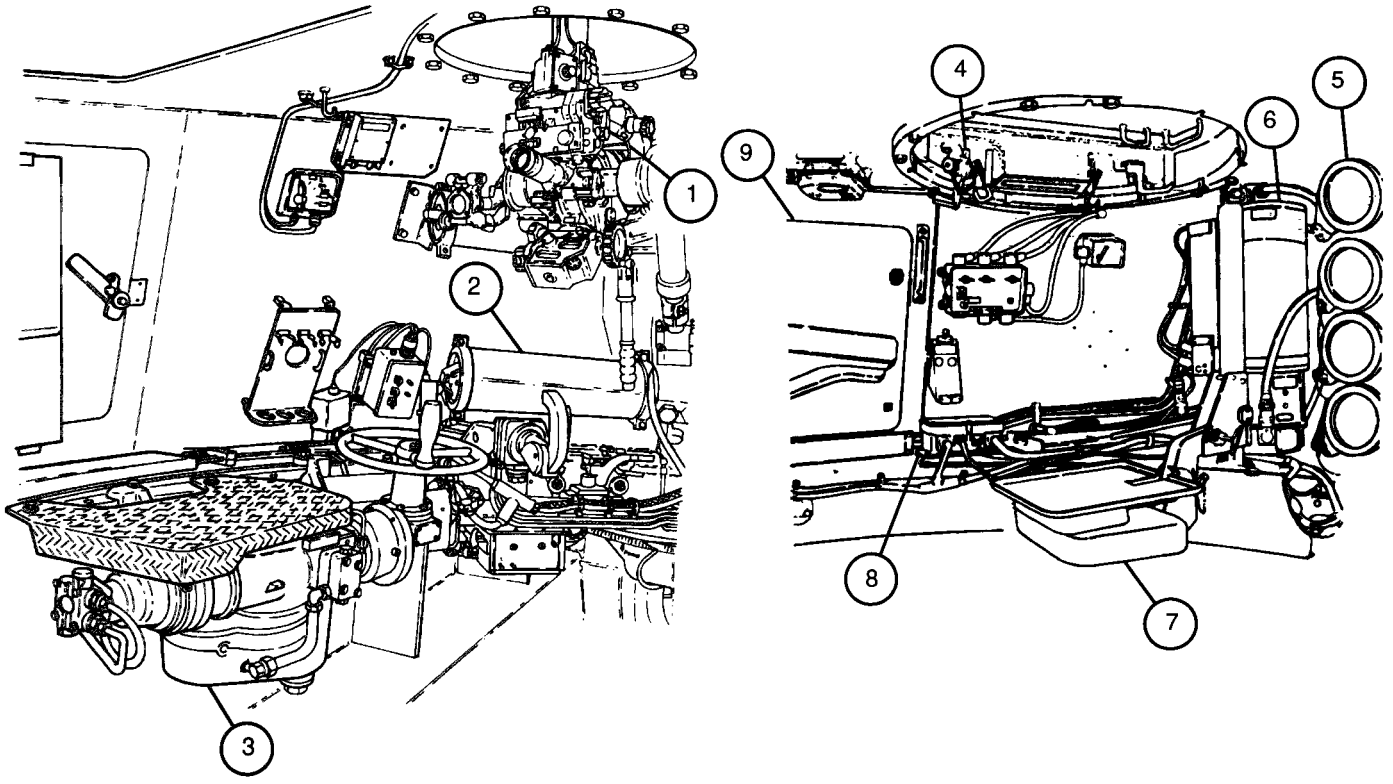
Refer to TM 9-2350-311-10 and TM 9-2350-311-20-2 for equipment characteristics, capabilities, and features of the M109 series howitzer.

CAB EXTERIOR



LEGEND:
1. 155mm cannon assembly
2. Caliber 50 machine gun, M2, heavy barrel
3. Panoramic telescope ballistic cover
4. Stowage - external (bustle)

CAB INTERIOR



LEGEND:

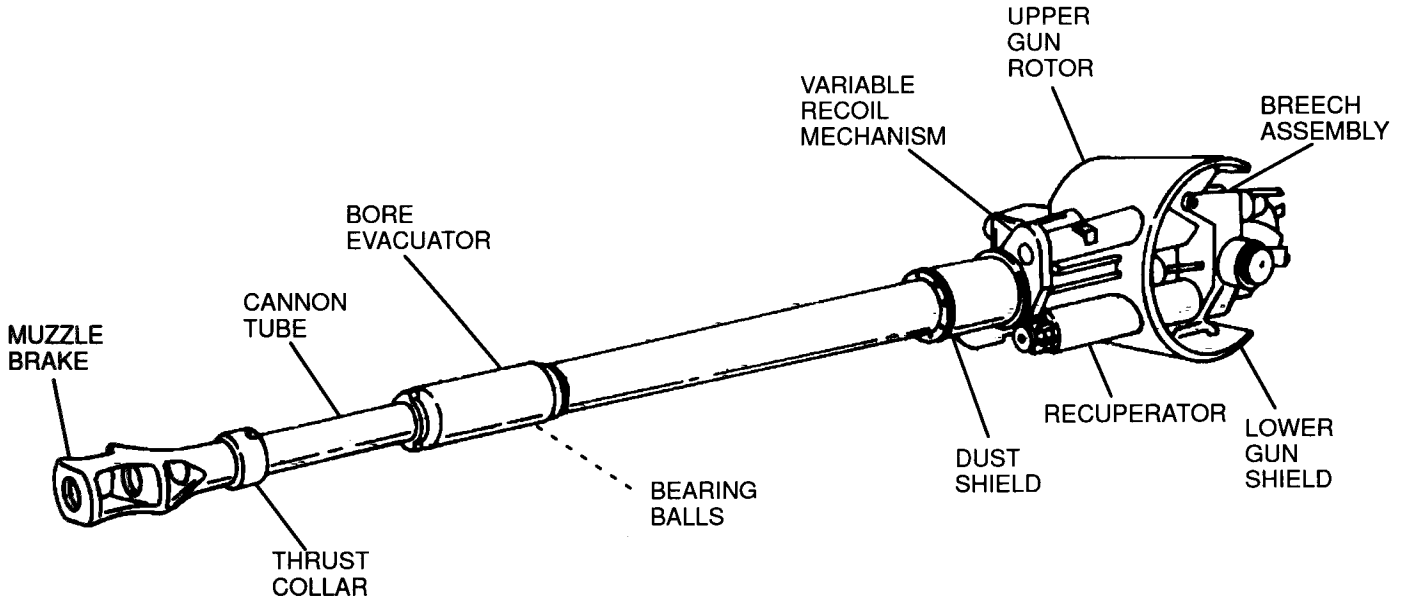
1. Sighting equipment
2. Equilibration accumulator
3. Traversing mechanism
4. Commander's cupola
5. Cab ammunition rack assembly
6. Power pack assembly and hydraulic fluid reservoir
7. Commander's seat
8. Power relay box assembly
9. Side door assembly

1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

This section covers the description of the M185 or M284 155mm cannon assembly, M178 or M182 mount, equilibrated elevating mechanism assembly, gunner's and assistant gunner's control assemblies, rammer assembly, traversing mechanism, power pack assembly, and related cab subassemblies. The description furnished below is supplemental to information given in TM 9-2350-311-10 and TM 9-2350-311-20-2.

NOTE

The M185 cannon assembly and the M178 mount together are applied to M109A2/M109A3/M109A4 howitzers. The M284 cannon assembly and the M182 mount together are applied to the M109A5 howitzer. Their function and maintenance are similar; however, the M109A5 howitzer configuration is designed to accommodate a larger charge.



1-14.1 Location and Description of M185 and M284 155mm Cannon Assembly

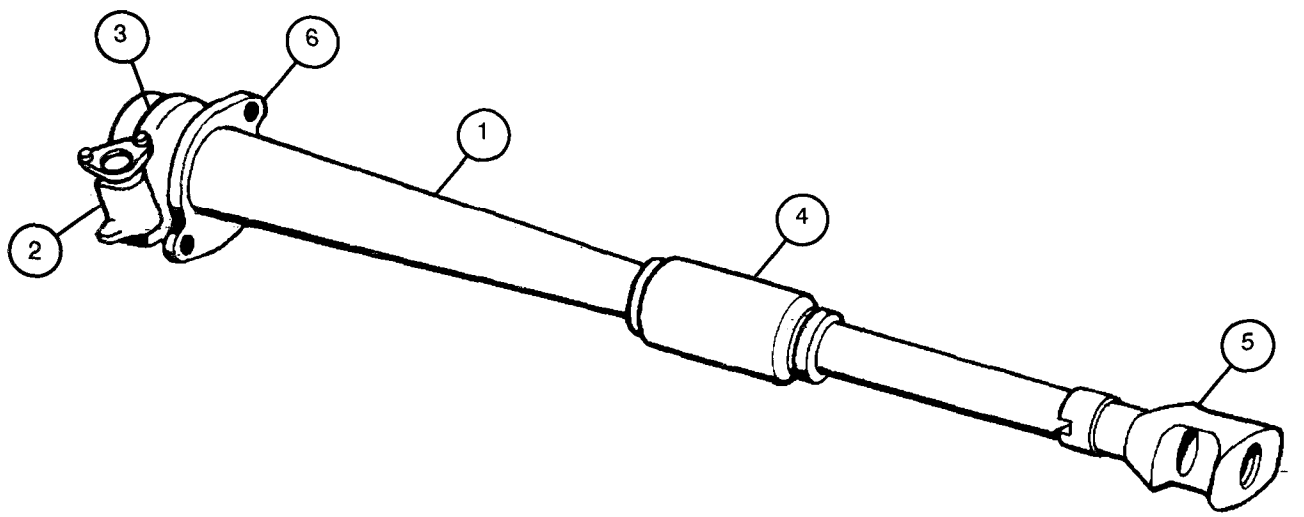
a. Cannon Tube. The cannon tube (1) is designed with a chamber for the propellant charge and projectile and is rifled throughout the length of the bore to assure accuracy and repeatability of the flight of the projectile to the target. Interrupted threads on the outside diameter at the breech assembly (2) end of cannon tube facilitate mounting of the cannon tube into the breech ring (3). Additional threaded areas on the cannon tube allow mounting of the bore evacuator (4) and muzzle brake (5).

b. Breech Ring. The breech ring (3) and band (6) connect the cannon tube (1) and recoil system, as well as mount the breech mechanism.

c. Bore Evacuator. The bore evacuator (4) vents the cannon tube (1) of gases after a round has been fired, thereby preventing contaminated gases from entering the cab.

d. Muzzle Brake. The muzzle brake (5) reduces the force of recoil and forward muzzle flash, by deflecting gases to the side.

e. Breech Assembly. The breech assembly (2) contains the cannon tube (1) chamber, locking mechanism, and firing mechanism. The semiautomatic screw block-type breech mechanism is designed for separate loading ammunition. The principle components of the breech assembly are: the breechblock assembly, carrier assembly, operating crank assembly, spindle assembly, M35/M49 firing mechanism, and the operating handle.



1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

1-14.1 Location and Description of M185 and M284 155mm Cannon Assembly - Continued

1 BREECHBLOCK ASSEMBLY. The breechblock assembly (7) locks the projectile and powder charge within the chamber and remains in closed position until opened by operating cam (8) during later stages of counter recoil cycle.

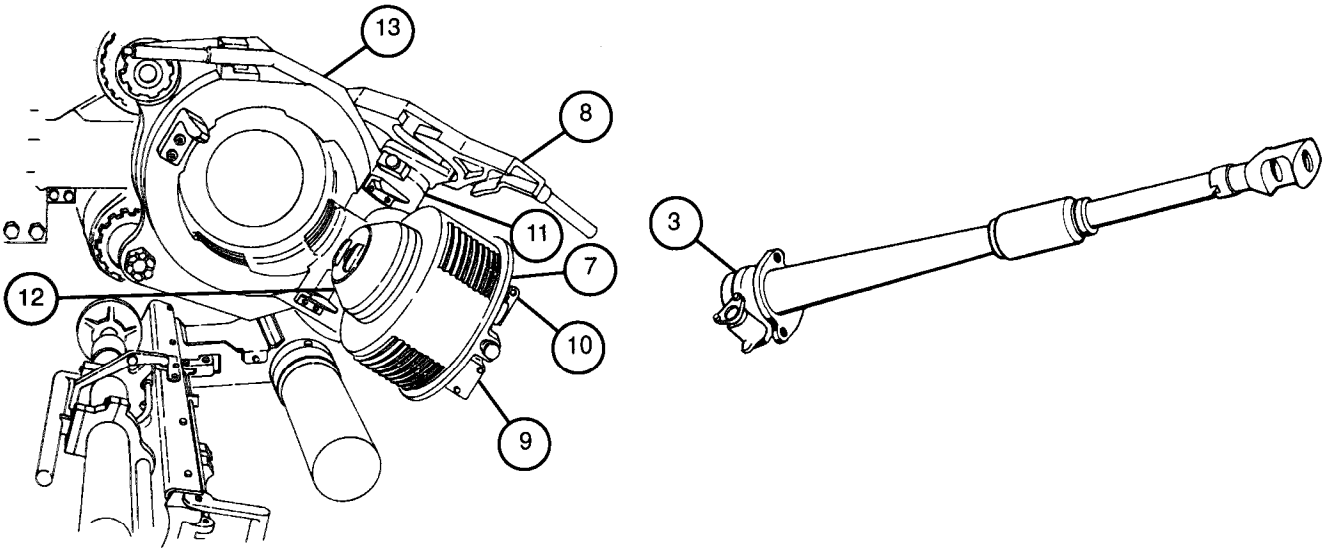
2 CARRIER ASSEMBLY. The carrier assembly (9) mounts the breechblock assembly (7) and firing mechanism (10). A system of springs and gears within the carrier assembly opens and closes the breechblock assembly. The breechblock assembly is opened by power transmitted through gearing from the operating crank assembly (11). Compression-type coil springs transmit power through gearing to lock the breechblock assembly after it has been closed by torsion from the closing spring pack.

3 OPERATING CRANK ASSEMBLY. The operating crank assembly (11), mounted on breech ring (3) rides within cam paths machined in operating cam (8). A portion of counter recoil force is converted by action of the operating cam and the operating crank assembly to torque which is transmitted to carrier assembly (9) gearing.

4 SPINDLE ASSEMBLY. The spindle assembly (12), mounted on the forward face of breechblock assembly (7), serves as a seal between chamber and breechblock assembly, preventing entry of gases from the chamber to the cab at time of firing.

5 M35/M49 FIRING MECHANISM. The firing mechanism (10) is a continuous pull, percussion type. Impact force is transmitted through a firing pin in the firing block which strikes a percussion-type primer, detonating the propellant powder charge. M35 firing mechanisms on M185 cannon assemblies are not interchangeable with M49 firing mechanisms on M284 cannon assemblies.

6 OPERATING HANDLE. The operating handle (13) connected to operating crank assembly (11) allows manual opening and closing of the breech mechanism and is normally kept in stowed position, latched to the operating handle stop.



1-14.2 Location and Description of M178/M182 Mount

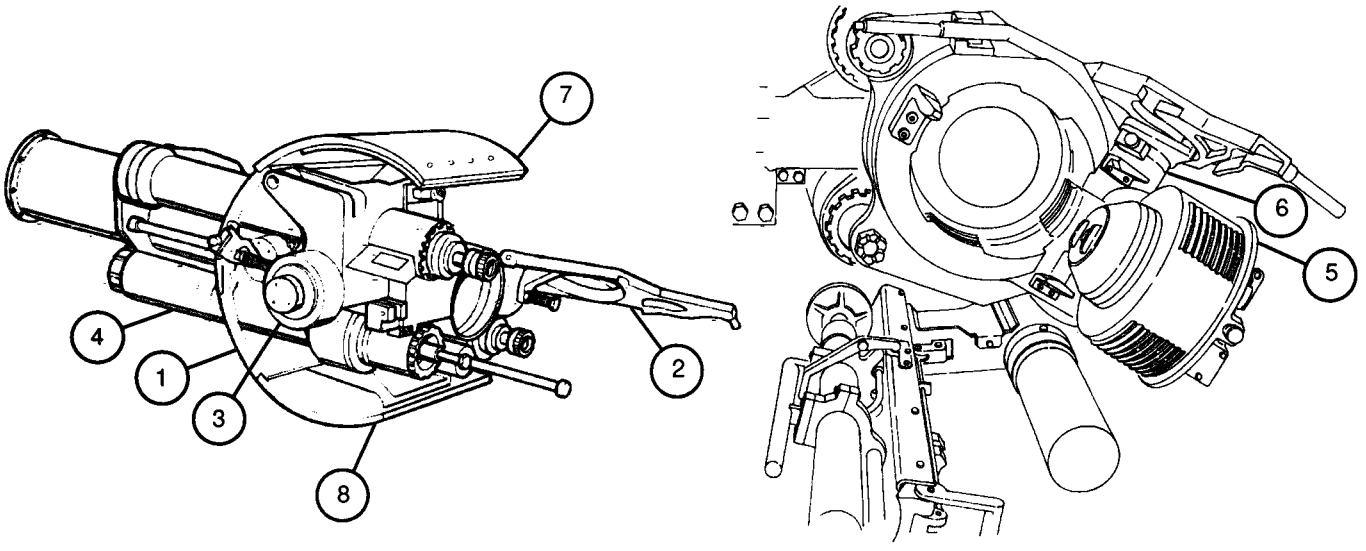
The M178/M182 mount attaches the 155mm cannon to the vehicle cab. It permits the 155mm cannon to be elevated or depressed within prescribed limits and to slide rearward and forward on machined surfaces during recoil and counter recoil cycles. Major components of the M178/M182 mount are as follows:

a. Cradle. The cradle assembly (1) is a machined casting in which the 155mm cannon rides and which carries the components of the variable recoil system, operating cam (2), trunnion roller bearings (3), and recuperator cylinder (4).

b. Operating Cam. The operating cam (2) is a flat plate with cam paths machined into it and is hinged to the cradle assembly (1). The operating cam assists in unlocking and opening breechblock assembly (5) and holds it open after the weapon returns to battery. When the operating cam is lifted manually from contact with operating crank assembly (6), the breechblock assembly is allowed to close and lock automatically.

c. Trunnion Roller Bearings. Trunnion roller bearings (3), mounted on the sides of cradle assembly (1), are attached to the cab by trunnion brackets and caps and carry the weight of the cannon and mount. This permits the cannon to be elevated and depressed within limits set by stops welded to the mount.

d. Upper and Lower Rotors. The upper gun rotor (7) and lower gun shield (8) are heavy aluminum plate extensions bolted to the gun shield. These aluminum plates function to provide protection from the effects of enemy fire.



1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

1-14.2 Location and Description of M178/M182 Mount - Continued

e. Variable Recoil Assembly. The variable recoil assembly (9) compensates for the cannon's recoil after firing. Principle components of the variable recoil assembly are variable recoil cylinders (10), buffer cylinder (11), hydraulic replenisher accumulator (12), and recuperator cylinder (4). The variable recoil cylinders are governed by an actuator assembly (13) which shortens the length of recoil in relation to the weapon's elevation. In effect, a shorter recoil is allowed for higher elevations.

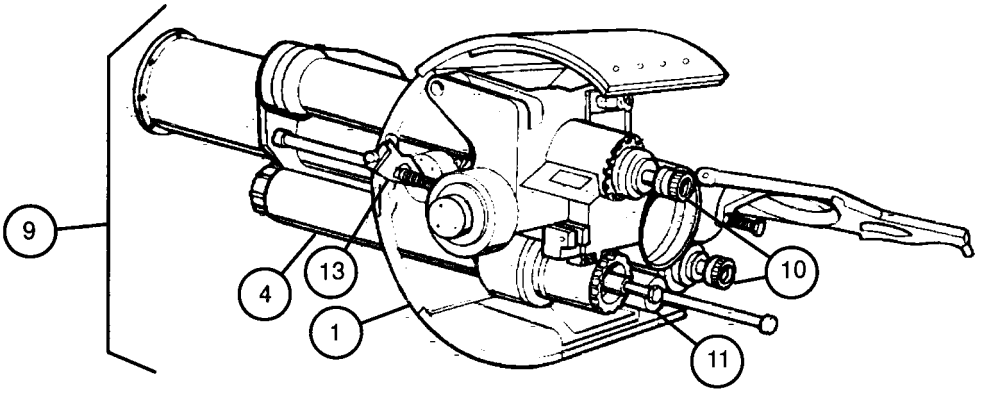
1 VARIABLE RECOIL CYLINDERS. The variable recoil cylinders (10) operate hydraulically to restrict recoil length and are attached to the cradle assembly (1) and breech ring band (14). Pistons contain orifices to allow hydraulic fluid to flow from one side of piston to other during recoil. Orifices are tapered to provide a progressively greater restriction of flow as the weapon approaches full recoil. Rotation of inner orifices regulates the length of recoil. During counter recoil, these same orifices permit a return flow of hydraulic fluid past the piston.

2 BUFFER CYLINDER. Buffer cylinder (11) functions to govern action of recuperator cylinder (4) and eases weapon into battery. Buffer cylinder operates hydraulically and contains a spring-loaded piston which is free to move rearward during recoil. Buffer cylinder is filled with hydraulic fluid which passes freely through a flutter valve in the piston during rearward movement. During counter recoil, the flutter valve closes and piston rod contacts the forward face of breech ring band (14). Hydraulic fluid is now permitted only through three orifices in flutter valve. Restriction of hydraulic fluid flow by piston counteracts action of recuperator cylinder.

3 ACTUATOR ASSEMBLY. Orifices in the variable recoil cylinders (10) and pistons are alined to provide a predetermined orifice area. Actuator assembly (13), which is sensitive to elevation or depression of cannon, functions through gearing to alter orifice opening within variable recoil cylinders. Shorter recoil results from reduced orifice openings.

4 HYDRAULIC REPLENISHER ACCUMULATOR. The hydraulic replenisher accumulator (12) functions to maintain proper hydraulic fluid level in the buffer cylinder (11) and variable recoil cylinders (10). Hydraulic fluid is forced through tubes to the buffer cylinder and variable recoil cylinders. A gas valve supplies pressured hydraulic fluid. Hydraulic replenisher accumulator is located in right front of cab, mounted to the wall.

f. Recuperator Cylinder. The recuperator cylinder (4) operates pneumatically and returns the weapon from full recoil to battery position. During recoil, a piston connected to breech ring band (14) moves within the recuperator cylinder against a preload of 700 ± 50 psi (4826 ± 345 kPa) of nitrogen at 70°F (21°C). When the recoil force is spent, nitrogen pressure working against the piston returns the cannon to battery.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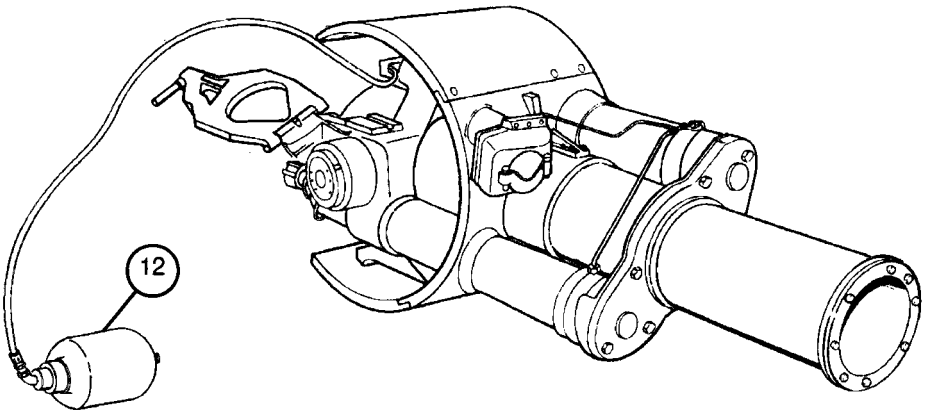
4
13
1
10
11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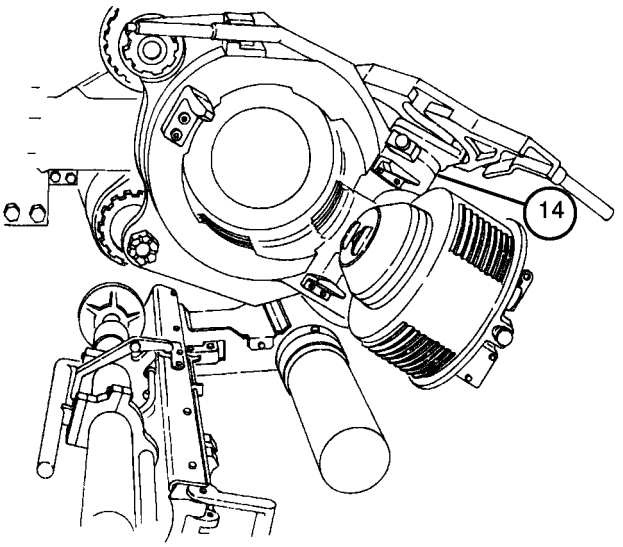
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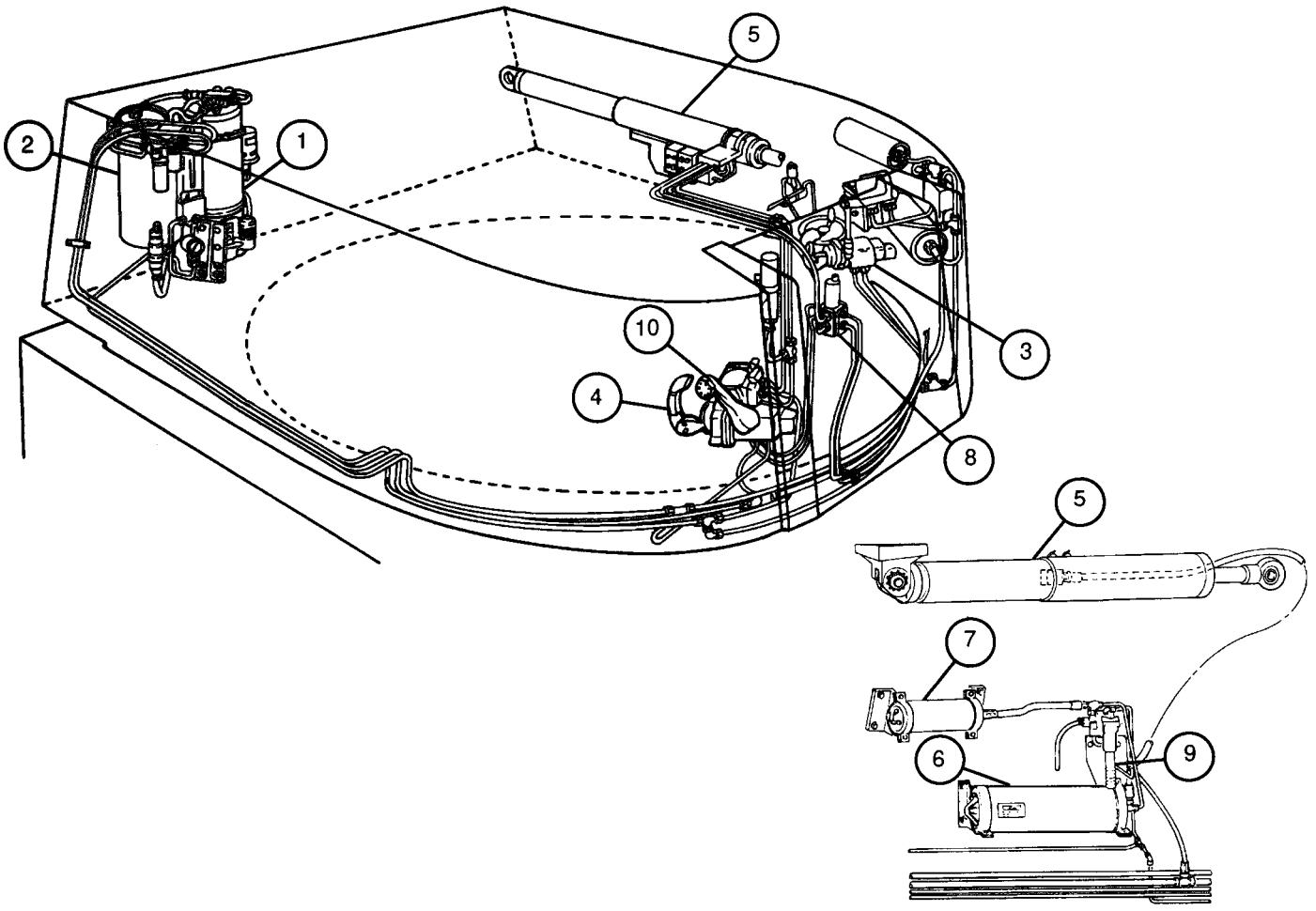
1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

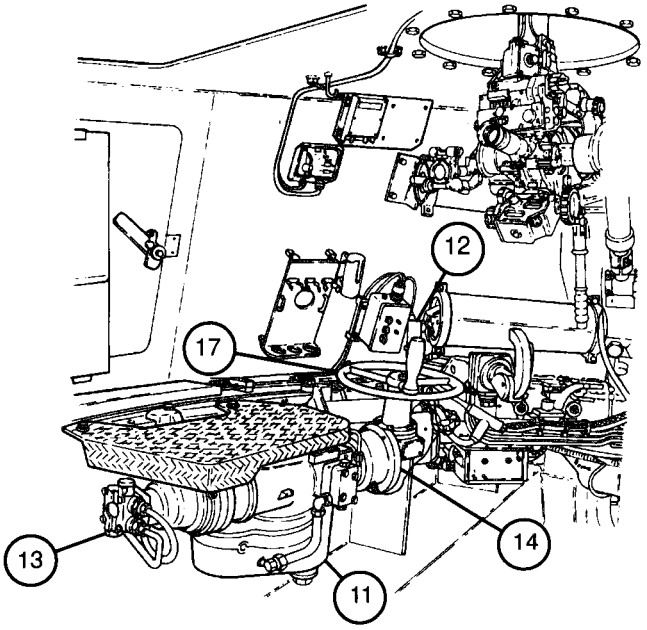
1-14.3 Location and Description of Cab Hydraulic Systems

The elevating system, traversing system, and projectile rammer hydraulic systems are supplied with pressurized hydraulic fluid by power pack assembly (1). The top part of the power pack assembly is a power pack hydraulic fluid reservoir which contains a hydraulic rotary pump driven by a direct current motor in the base of the power pack assembly. Immediately next tothepowerpackassembly is the main accumulator (2) which ensures constant hydraulic pressure during operation of any hydraulic system.

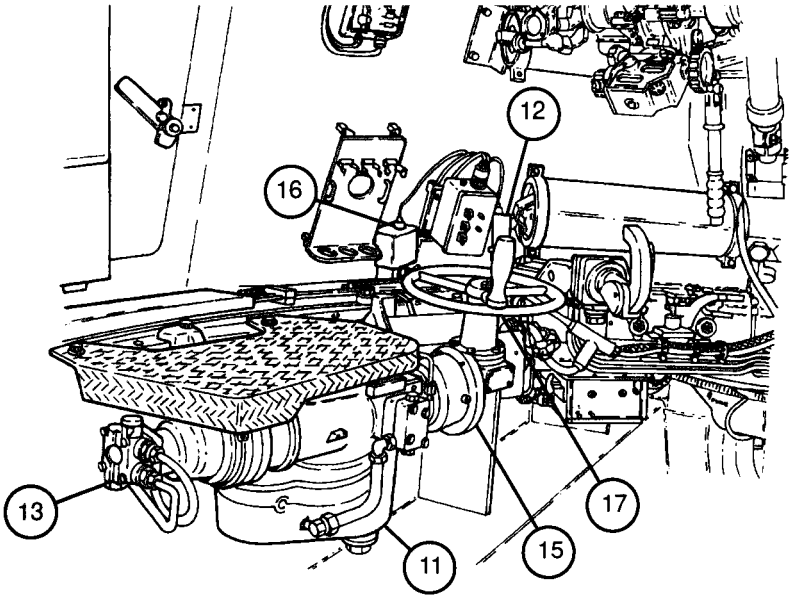
a. Elevating System. The elevating system is used to elevate, depress, and balance the cannon. It maybe controlled from either gunner's control assembly (3) or assistant gunner's control assembly (4). The elevating system consists of equilibrated elevating cylinder (5), primary accumulator (6), secondary accumulator (7), elevation selector valve assembly (8), and hand pump (9) for adjusting balance of the equilibrated elevating cylinder. The manual elevating hand pump (10) mounted on assistant gunner's control assembly provides ability to operate elevating system in the event of hydraulic power failure.



b. Traversing System. The cab traversing system consists of a traversing mechanism (11) and bypass valve assembly (12). The traversing mechanism is driven by a fixed-displacement hydraulic motor (13) through either an electrically operated clutch (14) (M109A2/M109A3 howitzers) or a hydraulic clutch (15) (M109A4/M109A5 howitzers). Hydraulic pressure is transmitted through a solenoid-operated clutch valve (16) to the hydraulic clutch in M109A4/M109A5 howitzers. In the event of solenoid or electrical control circuit failure, the clutch valve can be operated manually to activate hydraulic pressure. The bypass valve assembly, when activated by the gunner, allows only manual operation of traversing mechanism. A manual traverse handwheel (17) is used to operate the traversing mechanism manually.



TRAVERSING MECHANISM (M109A2/M109A3 HOWITZERS)

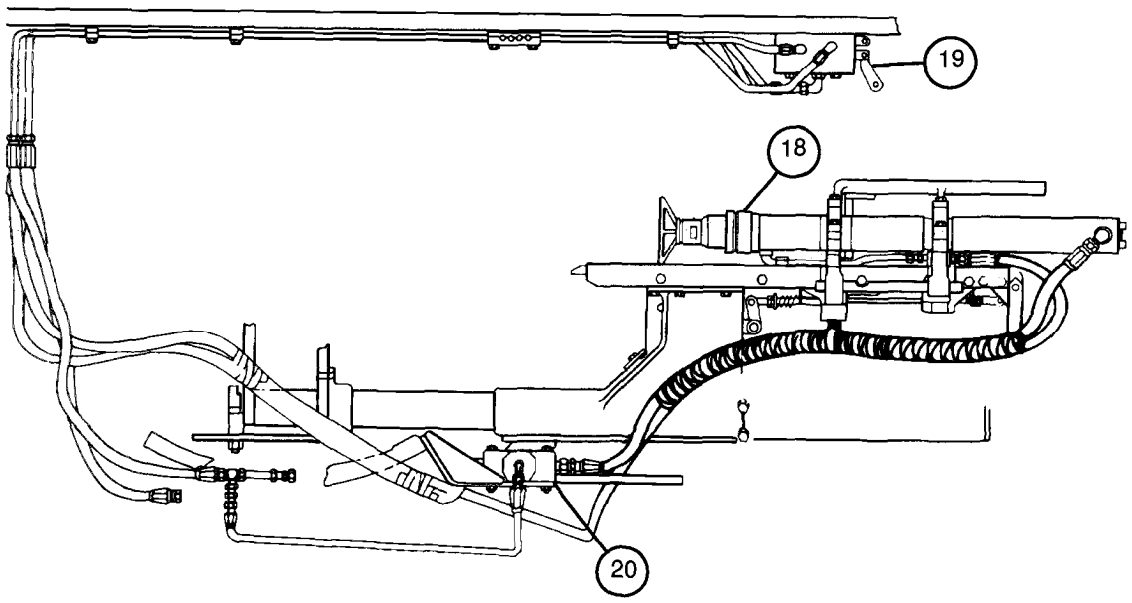


TRAVERSING MECHANISM (M109A4/M109A5 HOWITZERS)

1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

1-14.3 Location and Description of Cab Hydraulic Systems - Continued

c. Rammer System. The rammer cylinder assembly (18) is a hydraulically operated device which is controlled by a hand-operated rammer actuating valve (19) on the cab roof. No electrical circuits are used in the rammer system. A blocking valve (20) prevents the rammer from being operated unless it is correctly alined with the firing chamber of the cannon.



1-14.4 Location and Description of Overall Cab Electrical System

The cab uses a 28 volt DC electrical system with power furnished from the hull. Electrical contact is made with bus bars fastened to a 1/5th segment of the hull race ring. Power reaches the cab through whichever one of the five contact arm assemblies (1) happens to be in contact with the bus bars on the hull. Three intercom lines and two telephone lines go directly to amplifier AM1780/VRC (2). The cab power line comes into the power relay box assembly (3) and power is distributed through the following circuits:

a. Wire 100 provides main cab power. Its connection to the gunner's selector switch box assembly (4) allows ON/OFF control of all power to the cab, MAN UAUPOWER control of traverse, elevation control, and lighting of circuits. Wire 100 also provides power to the nuclear, biological, and chemical (NBC) protection system in M109A4/M109A5 howitzers.

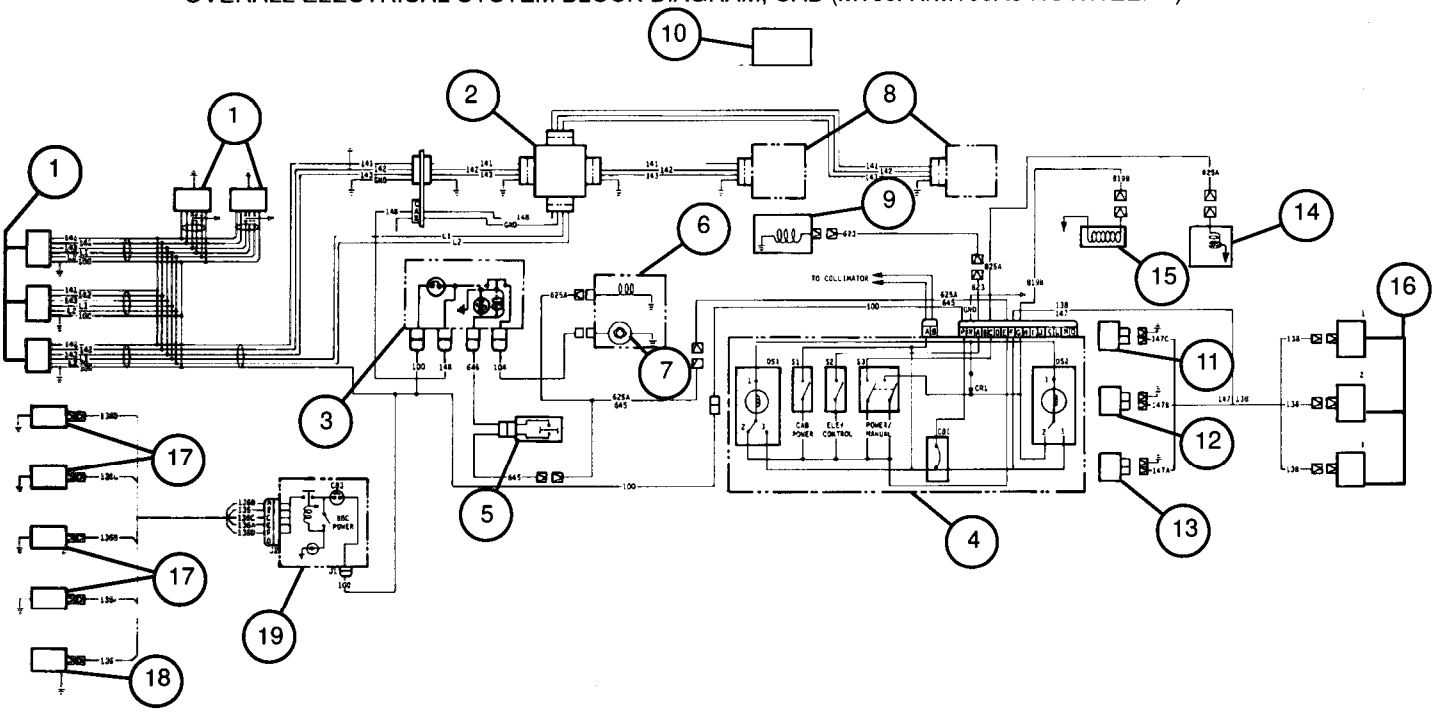
b. Wire 148 provides power to amplifier AM1780/VRC (2).

c. Wire 645 provides power to pressure switch (5) for control of power pack assembly (6) direct current motor (7).

d. Wire 104 provides power to power pack assembly (6) direct current motor (7).

e. Wire 141, 142, 143, L1, and L2 support intercommunication/telephone circuits.

OVERALL ELECTRICAL SYSTEM BLOCK DIAGRAM, CAB (M109A4/M109A5 HOWITZERS)



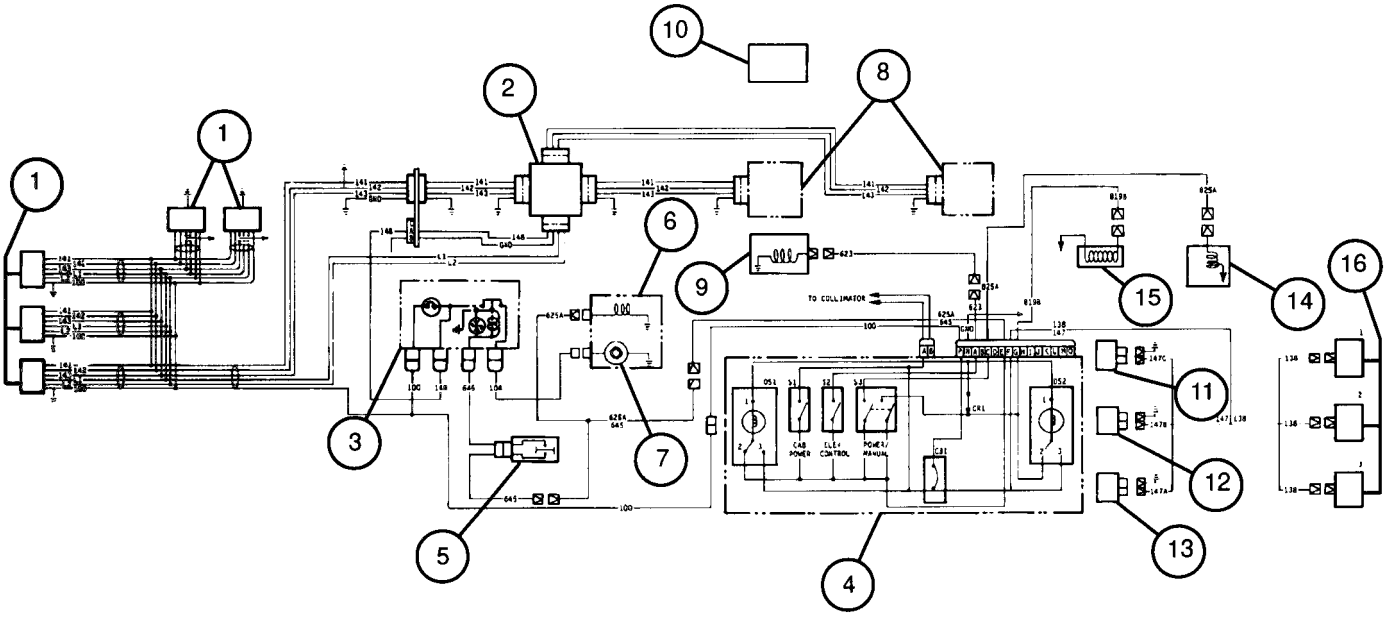
LEGEND:

1. Contact arm assembly (5)
2. Amplifier AM1780/VRC
3. Power relay box assembly
4. Gunner's selector switch box assembly
5. Pressure switch
6. Power pack assembly
7. Direct current motor
8. Intercom control box C2298/VRC (2)
9. Elevation selector valve assembly
10. Assistant gunner's control handle
11. M15 elevation quadrant
12. M117/M117A2 panoramic telescope
13. M118A2/M118A3 elbow telescope
14. Traverse mechanism bypass valve assembly
15. Clutch valve solenoid
16. Dome light assemblies (3)
17. NBC M3 electrical air heater (4)
18. M2A2 air purifier
19. NBC control box assembly

1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

1-14.4 Location and Description of Overall Cab Electrical System - Continued

OVERALL ELECTRICAL SYSTEM BLOCK DIAGRAM, CAB (M109A2/M109A3 HOWITZERS)



NOTE

Some howitzers are only equipped with 3 contact arm assemblies.

LEGEND:

1. Contact arm assembly (3 or 5)
2. Amplifier AM1780/VRC
3. Power relay box assembly
4. Gunner's selector switch box assembly
5. Pressure switch
6. Power pack assembly
7. Direct current motor
8. Intercom control box C2298/VRC (2)
9. Elevation selector valve assembly
10. Assistant gunner's control handle
11. M15 elevation quadrant
12. M117/M117A2 panoramic telescope
13. M118A2/M118A3 elbow telescope
14. Traverse mechanism bypass valve assembly
15. Traverse mechanism clutch
16. Dome light assemblies (3)

1-14.5 Location and Description of Equilibrated Elevation Mechanism Assembly

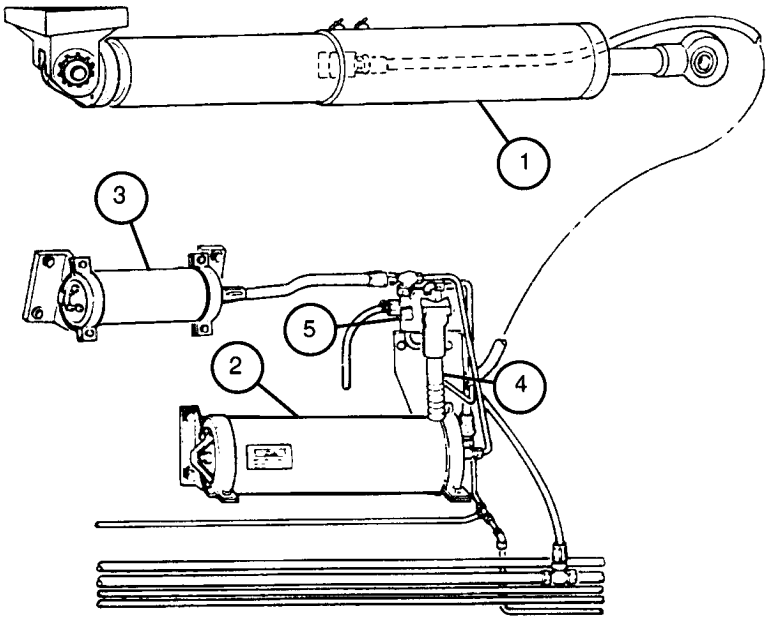
The howitzer has an equilibrated elevating cylinder (1) which will elevate, depress, and balance the cannon by applying a force equal and opposite to the weapon unbalance force. An integral equilibration system acts hydro-pneumatically to exert a preload on the vehicle elevating system and permits the cannon to be elevated or depressed with equal effort. Principle components of the system are primary accumulator (2), secondary accumulator (3), equilibrated elevating cylinder, hand pump (4), and manifold (5).

a. Primary and Secondary Accumulators. The primary accumulator (2) and secondary accumulator (3) are cylinders containing hydraulic fluid and compressed nitrogen separated by a floating piston. Hydraulic fluid is forced through a tube from the primary accumulator and secondary accumulator to equilibrated elevating cylinder (1) by action of compressed nitrogen acting against the floating piston.

b. Equilibrated Elevating Cylinder. The rear end of equilibrated elevating cylinder (1) is attached to a bracket on the ceiling of the cab by a pin and bearing. At the forward end, the piston rod is similarly attached to an arm of the cradle assembly. Horizontal travel of the piston causes rotation of the cradle assembly and cannon around the trunnion.

c. Hland Pump. The hand pump (4) is incorporated into the system to permit adjustment by increasing hydraulic fluid pressure. This permits the equilibration system to be adjusted to compensate for variations in ground slope and temperature (TM 9-2350-311-10).

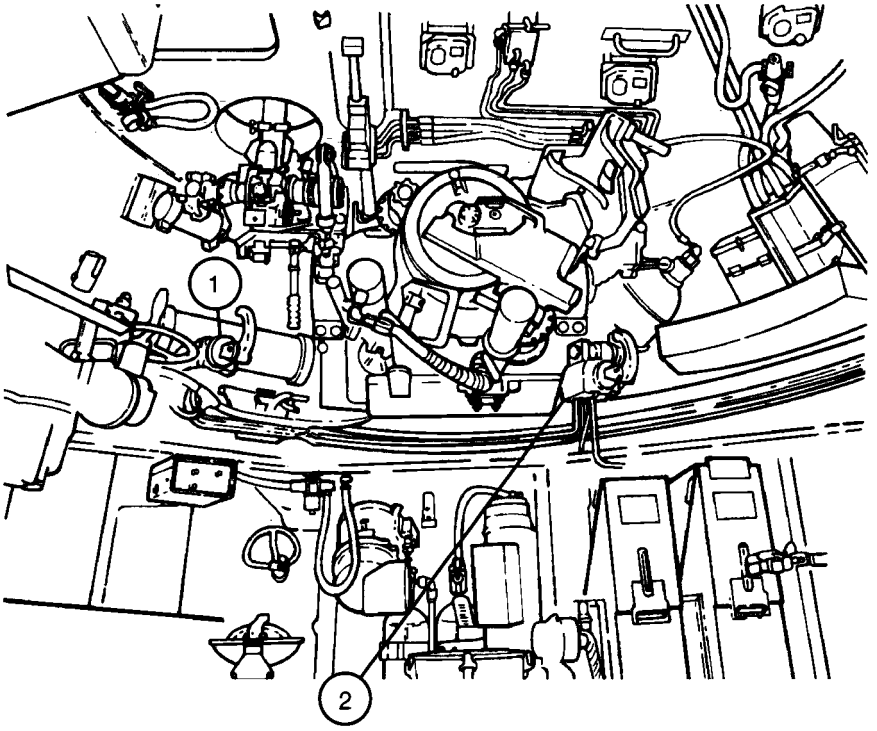
d. Manifold. The manifold (5) controls the flow of hydraulic fluid to equilibrated elevating cylinder (1).



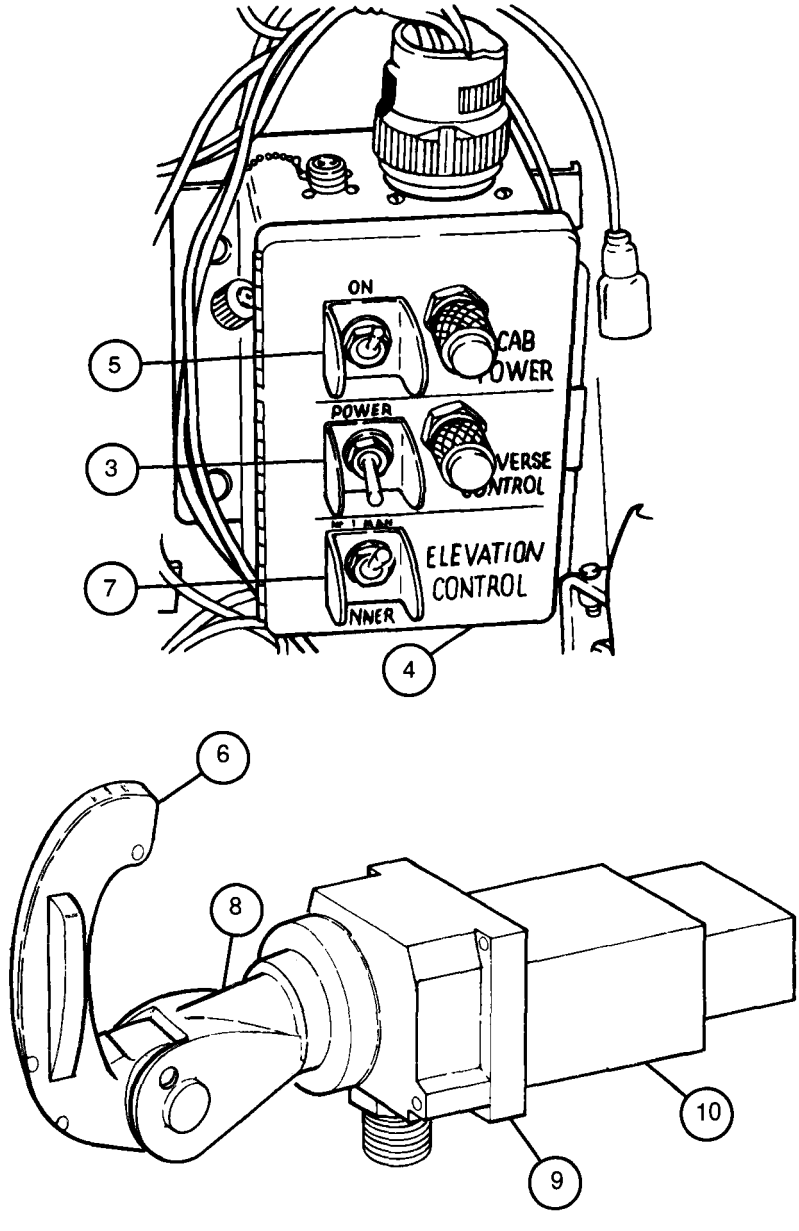
1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

1-14.6 Location and Description of Gunner's and Assistant Gunner's Control Assemblies

Elevating and traversing system has gunner's control assembly (1) and assistant gunner's control assembly (2). Gunner's control assembly is located at left front of cab. Assistant gunner's control (No. 1 Man) is located at the right front of cab.



a. Gunner's Control Assembly. Manual traversing can only be done at the gunner's position with TRAVERSE CONTROL switch (3) on gunner's selector switch box assembly (4) in MANUAL position. To traverse with hydraulic power, CAB POWER switch (5) on the gunner's selector switch box assembly must be in ON position. TRAVERSE CONTROL switch may be in POWER position. Moving the gunner's control handle (6) to one side or the other will cause the cab to traverse in that direction under hydraulic power. To elevate hydraulically, ELEVATION CONTROL switch (7) must be in GUNNER position. Moving the gunner's control handle backwards toward the operator will then elevate the cannon. Moving the gunner's control handle forward will depress the cannon hydraulically. The gunner's control assembly consists of the gunner's control handle, bracket (8), traversing cam, elevating rod, arm assembly spools, sleeves, centering springs, and miscellaneous components enclosed in a housing assembly (9) and a control valve body group (10).



1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

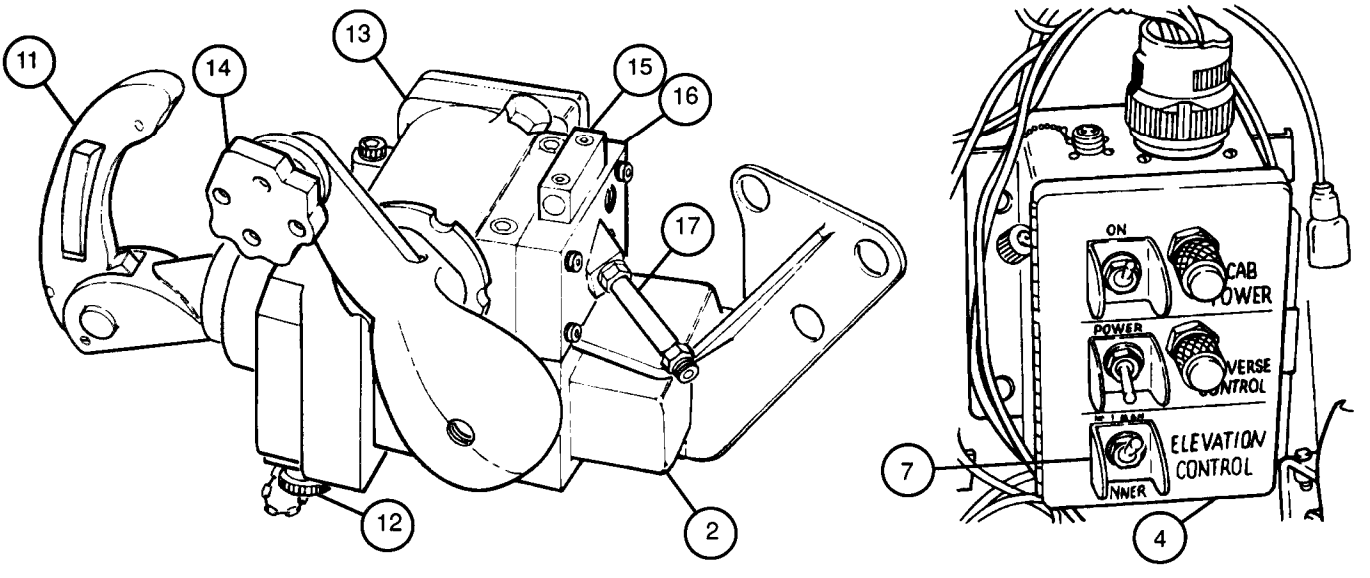
1-14.6 Location and Description of Gunner's and Assistant Gunner's Control Assemblies - Continued

b. Assistant Gunner's Control Assembly. The assistant gunner's control assembly (2) operated by the assistant gunner is used only to elevate and depress the cannon. To operate with hydraulic power, ELEVATION CONTROL switch (7) on gunner's selector switch box assembly (4) must be in NO. 1 MAN position. Moving assistant gunner's control handle (11) forward or backward will depress orelevatethecannon inthesame manneras with the gunner's control assembly. The assistant gunner's control handle cannot be used to traverse the cab, however; the traversing ports (TL and TR) are closed with plugs and the inactive electrical receptacle is covered with an electrical connector cover (12) on both the gunner's and assistant gunner's control assemblies.

c. Manual Elevating Hand Pump. Manual elevating hand pump (13) mounted on top of assistant gunner's control handle (11) is used to manually elevate or depress the cannon. It is essentially a piston type pump containing eight sliding pistons. Rotating hand crank (14) clockwise causes hydraulic fluid to flow in the manual elevating system, depressing the cannon. Rotating the hand crank counterclockwise reverses the hydraulic fluid flow and elevates cannon. As the hand crank is turned, an eccentric pump shaft is rotated, which in turn rotates a slide. As this slide rotates, it cams eight spring-loaded pistons in sequence so that hydraulic fluid flow is initiated through the manual elevating system. When the direction of the hand crank is reversed, an integral slide rotates in the opposite direction, reversing caroming sequence and flow of hydraulic fluid. The cannon maybe elevated or depressed manually without energizing the power control system. The rate at which the cannon is elevated or depressed is controlled by the rotation speed of hand crank.

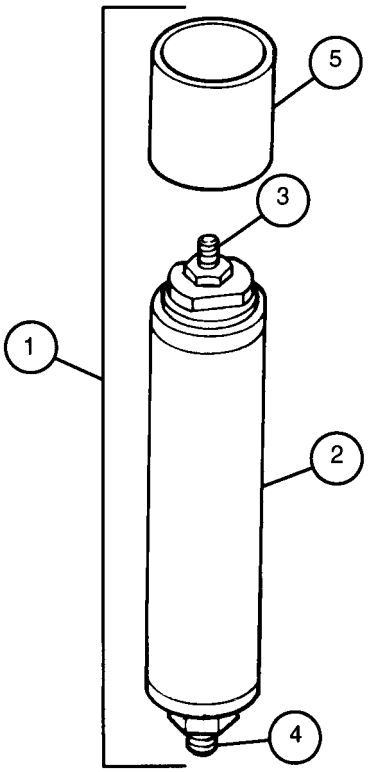
d. Shuttle Valve Assembly. The shuttle valve assembly (15), attached to the top of manifold (16), controls pressure of the manual circuit in case of hand pumping. The pump case is pressurized to keep rotational effort of hand crank (14) at a minimum. Since low pressure will change to opposite side of the pump when the hand crank rotation is reversed, the shuttle valve assembly will be shuttled to the opposite side by high pressure of the manual circuit and maintain low pressure in the pump casing. The shuttle valve assembly will shuttle each time rotation of the hand crank is changed.

e. Check Valve. The check valve (17) is a one-way valve that permits hydraulic fluid to be directed from the reservoir into the manual elevating hydraulic system as required, but will not permit hydraulic fluid to return to the reservoir.



1-14.7 Location and Description of Manual Pump Accumulator Assembly

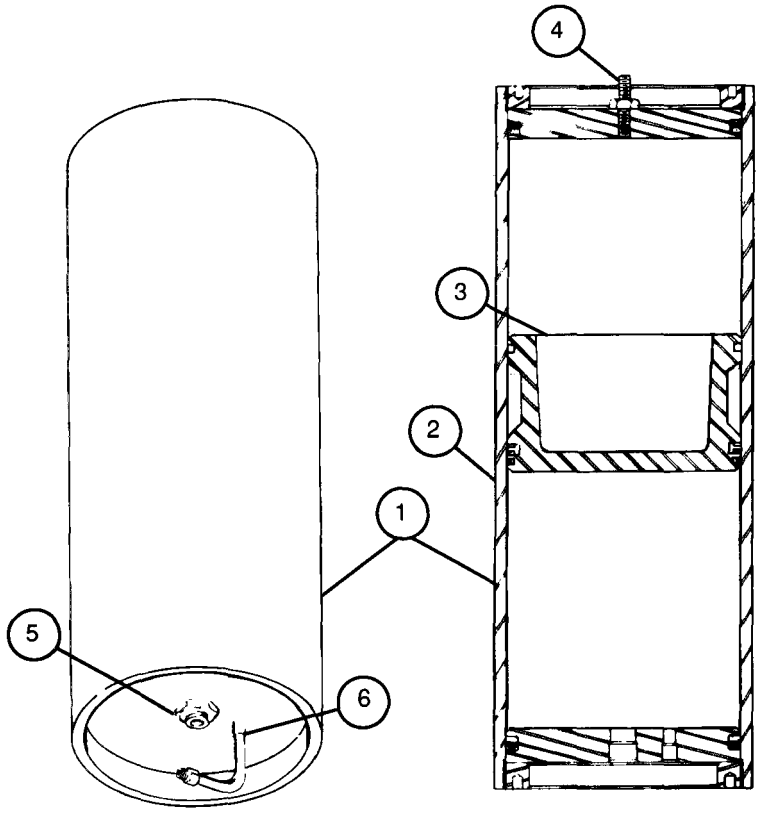
Manual pump accumulator assembly (1) is mounted at the right front side of the trunnion bracket above the manual elevating hand pump. It maintains a minimum pressure on hydraulic fluid in the manual elevating hydraulic system. It assures an immediate response in the manual system when sudden demands for quantities of hydraulic fluid cause excessive pressure drops. The manual pump accumulator assembly consists of a cylinder (2) housing a floating piston. The top end of this cylinder contains a gas valve (3), while the bottom end has a threaded linear cap (4). The top of the cylinder is precharged with dry nitrogen under pressure. This pressure is applied against hydraulic fluid at the bottom of the cylinder. Dry nitrogen and hydraulic fluid are separated by a floating piston. The manual elevating hydraulic system is charged by turning the manual elevating hand pump handle counterclockwise until initial movement of the elevating mechanism is detected. This will charge the manual pump accumulator assembly with hydraulic fluid under pressure. An accumulator cap (5) covers a gas valve.



1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

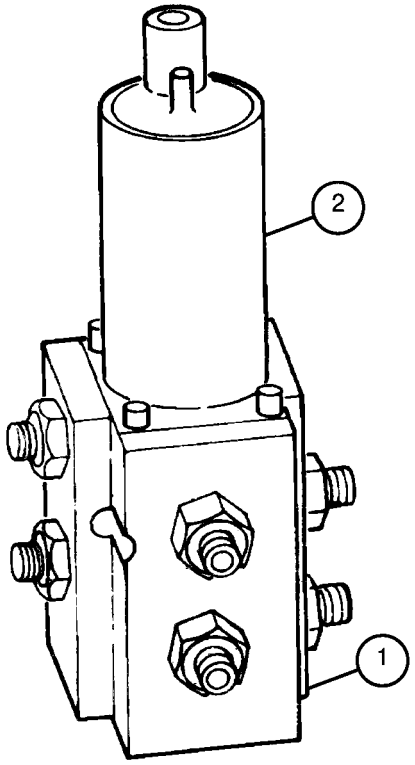
1-14.8 Location and Description of Main Accumulator Assembly

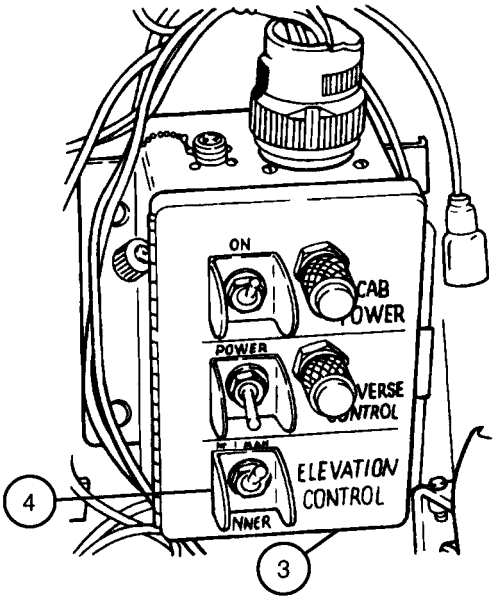
The main accumulator assembly (1), mounted at the right rear of cab, consists of a sealed cylinder (2) housing a floating piston (3). The top end of the cylinder contains a gas valve (4), while the bottom end has a central port (5) and a side port (6). The central port at the bottom end is connected to a relief valve and power pack assembly pressure regulator valve. The side port is connected to a pressure gage and pressure switch. The top of the cylinder is precharged with dry nitrogen under pressure. Pressure is applied against hydraulic fluid at the bottom of the cylinder. Dry nitrogen and hydraulic fluid are separated by a floating piston. Pressurized hydraulic fluid is supplied to the main accumulator assembly by a hydraulic pump located in the power pack assembly reservoir.



1-14.9 Location and Description of Elevation Selector Valve Assembly

The elevation selector valve assembly (1) is located at the right front of cab, forward of the manual elevation accumulator. It is actuated by a solenoid (2) energized by gunner's selector switch box assembly (3) ELEVATION CONTROL switch (4) to determine which control assembly (gunner's or assistant gunner's) regulates hydraulic fluid flow into the equilibrated elevating cylinder.

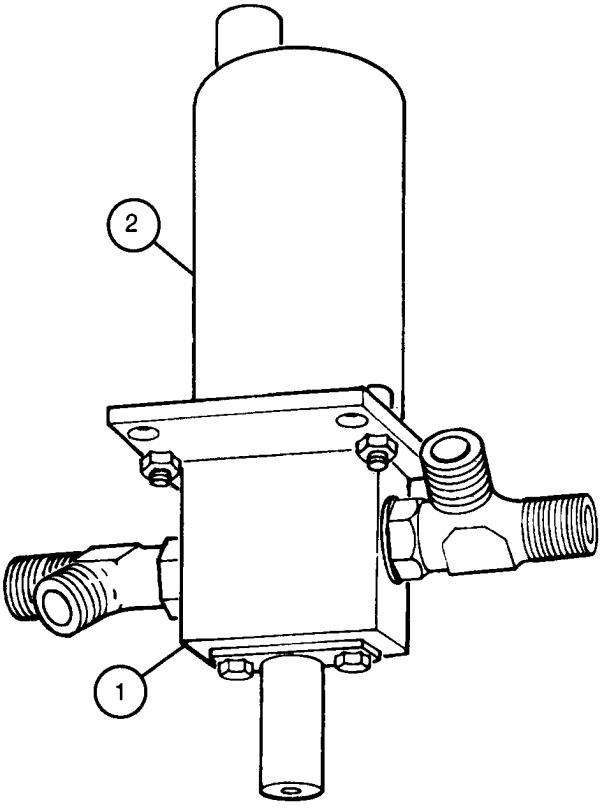




1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

1-14.10 Location and Description of Bypass Valve Assembly

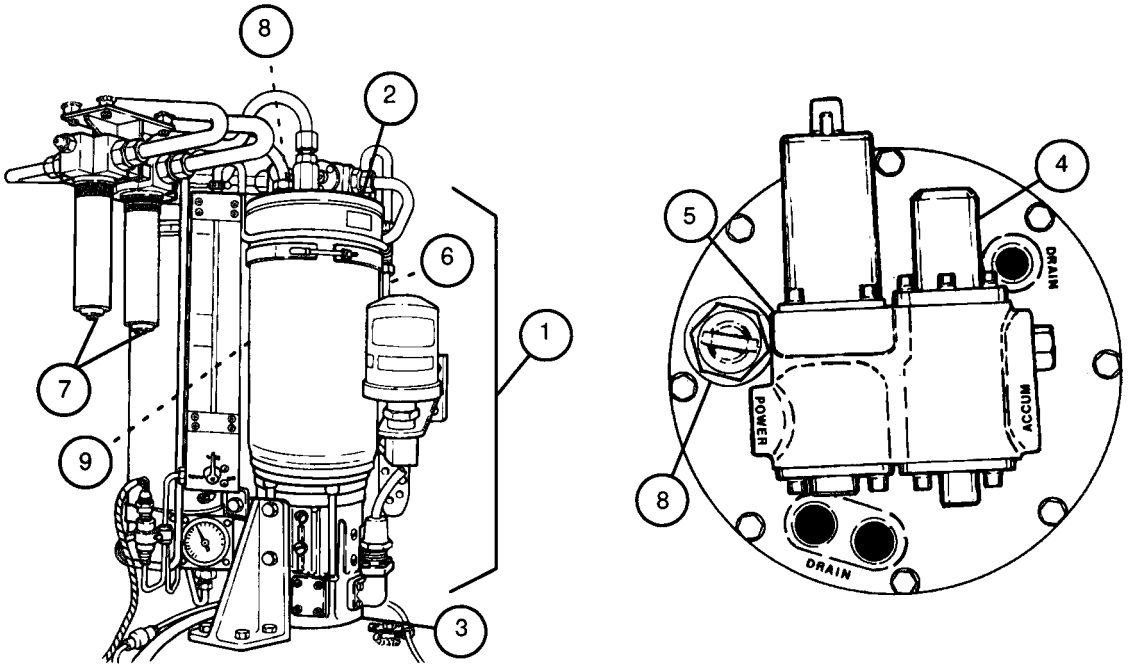
The bypass valve assembly (1) is located at the left side of the cab, forward of the gunner's selector switch box assembly. It is actuated by solenoid (2). When the cab traversing mechanism is under manual control, the bypass valve assembly redirects hydraulic fluid flow so that it bypasses the traversing mechanism hydraulic motor. During power operation, the traversing mechanism bypass valve closes and the direct current motor drives the traversing mechanism.



1-14.11 Location and Description of Power Pack Assembly

The power pack assembly (1) mounted at the right rear of the cab, provides a supply of hydraulic fluid at a constant pressure for control and actuation of elevating, traversing, and ramming systems. It consists of a power pack reservoir (2), direct current motor (3), cover reservoir and body regulator valve (4), power valve (5), internal filter (6) on M109A2/M109A3 howitzers or two hydraulic external filters (7) on M109A4/M109A5 howitzers, and fluid level gage (8).

a. Power Pack Reservoir. The power pack reservoir (2) supplies hydraulic fluid to gear-type rotary pump (9) and retains any hydraulic fluid that is not being used by the system. At the base of the power pack reservoir is a direct current motor (3), the prime source of power for the system.



1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

1-14.11 Location and Description of Power Pack Assembly - Continued

b. Direct Current Motor. The direct current motor (3) is a 5-horse power, compound-wound, waterproof, fully enclosed, sealed motor. Through a coupling, it drives rotary pump (9). ON and OFF operation of the direct current motor is controlled by main accumulator pressure switch (10) and hydraulic pump motor relay.

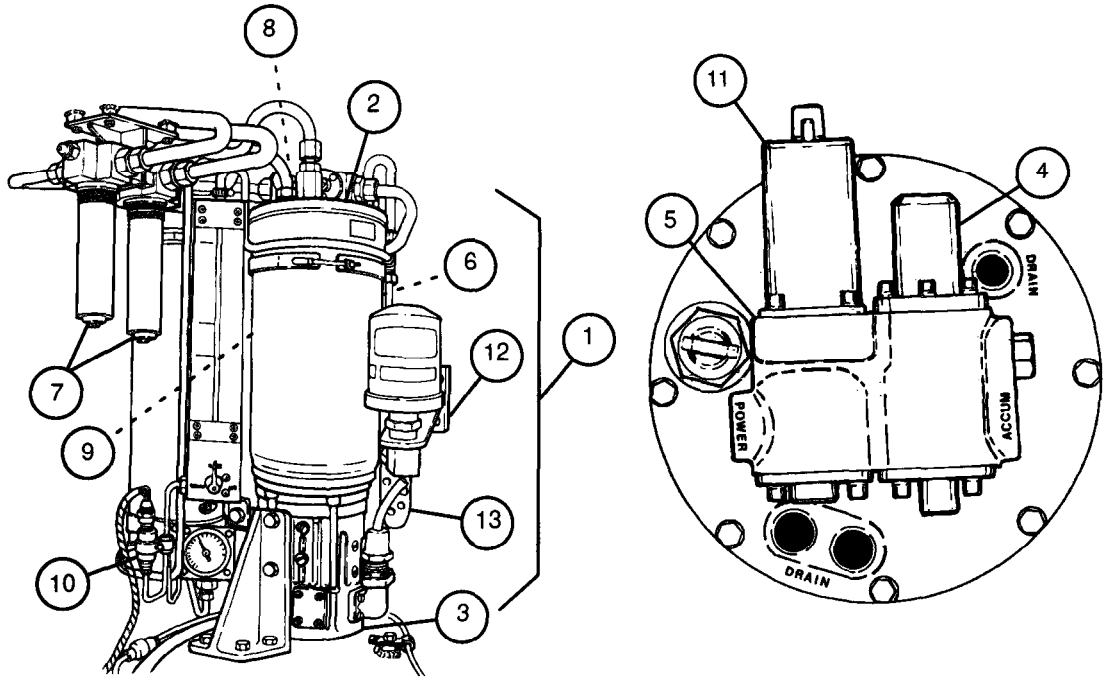
c. Cover Reservoir and Body Regulator Valve. The cover reservoir and body regulator valve (4) keeps operating hydraulic fluid pressure at a constant level. For a given input handle position, a system output will be maintained at a constant speed.

d. Power Valve. The power valve (5) provides operating pressure for elevating, traversing, and ramming systems. The power valve, operated by a solenoid (11) is activated when CAB POWER switch is placed in ON position.

e. Filter. The internal filter (6) on M109A2/M109A3 howitzers connects top of rotary pump (9) to cover of power pack reservoir (2). The two hydraulic external filters (7) on M109A4/M109A5 howitzers connect to the drain and pressure lines coming from the power pack assembly (1). The filter(s) prevents foreign particles, which may be present in the reservoir hydraulic fluid supply, from entering the valve system.

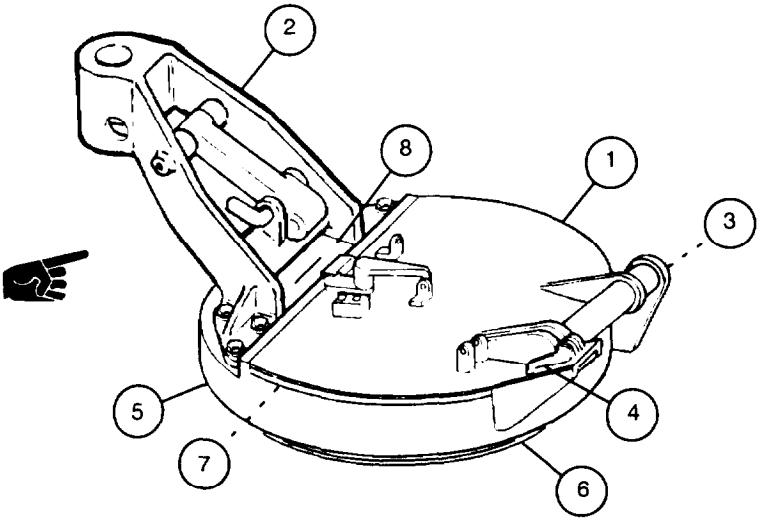
f. Fluid Level Gage. The fluid level gage (8) is located on the cover of power pack reservoir (2) within the strainer. It consists of a filler cap, filter element, and dipstick. It is used for measuring and filling the power pack reservoir with hydraulic fluid. The strainer is an additional filter to filter out foreign matter from hydraulic fluid being added to the power pack reservoir.

g. Hydroscopic Breather and Air Line Filter (M109A4/M109A5 howitzers). The hydroscopic breather (12) and air line filter (13) are located at the bottom of a power pack drain line. They filter accumulated air and condensation trapped in the hydraulic system due to oil temperature fluctuations and exposure during maintenance.

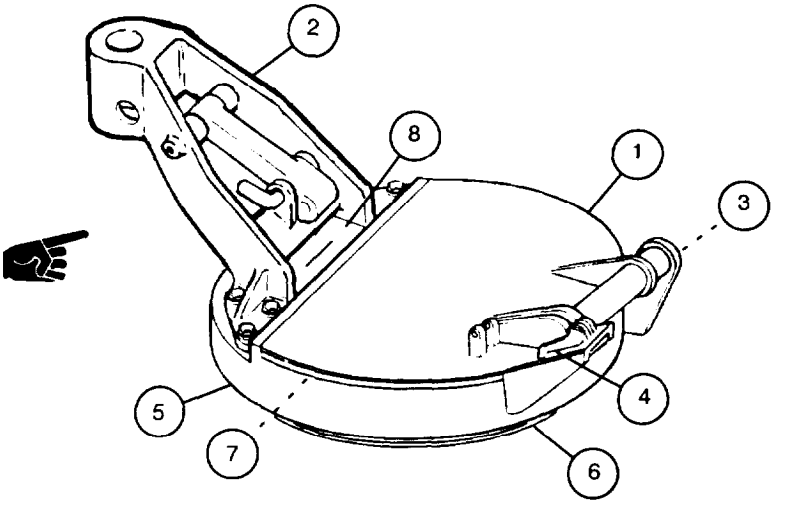


1-14.12 Location and Description of Commander's Cupola

The hatch cover (1) of the commander's cupola is hinged on the side opposite the machine gun support assembly (2) and counterbalanced with a torsion bar (3) for ease of opening. A spring-loaded latch (4) holds the hatch cover in full open position and creates a positive lock in closed position. Cupola body assembly (5) is supported by a mechanism of bearing rings (6) and bearing balls to permit easy 360° manual traverse. A spring-loaded latch (7) can lock commander's cupola in traverse at intervals of 30° around the circle. A periscope slot (8) at the front of the commander's cupola permits mounting of a periscope for observation by the commander.



COMMANDER'S CUPOLA WITH OUTSIDE LATCH (SOME M109A3/M109A4/M109A5 HOWITZERS)

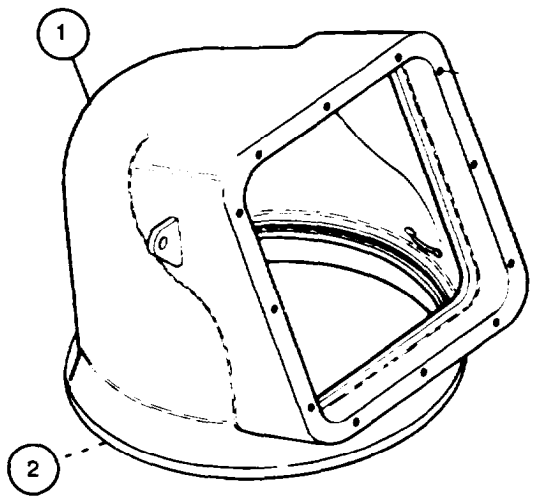


COMMANDER'S CUPOLA WITHOUT OUTSIDE LATCH
(ALL M109A2 AND SOME M109A3/M109A4/M109A5 HOWITZERS)

1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

1-14.13 Location and Description of Panoramic Telescope Ballistic Cover

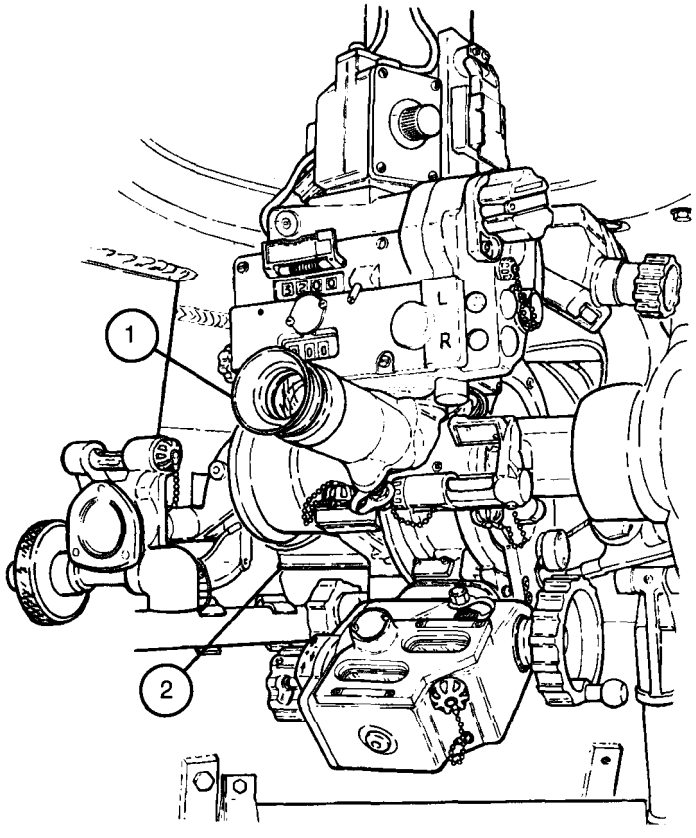
The purpose of the panoramic telescope ballistic cover (1) is to prevent muzzle blast from entering the crew compartment and to protect the gunner and telescope from inclement weather and small arms fire. The panoramic telescope ballistic cover is mounted on race rings (2) and bearing balls to give 360° traverse. It can be locked in any position by two setscrews or rotated manually by two webbing straps. Traverse of the panoramic telescope ballistic cover is independent of the M117/M117A2 panoramic telescope.



1-14.14 Location and Description of Overall Sighting and Fire Control System

The howitzer is provided with a sighting and fire control system capable of delivering director indirect fire. Location and description of the specific equipment is as follows:

a. M117/M117A2 Panoramic Telescope and M145/M145A1 Telescope Mount. The M117/M117A2 panoramic telescope (1) and M145/M145A1 telescope mount (2) are mounted at the gunner's position and are used for indirect fire. The M145/M145A1 telescope mount provides an adjustable base with azimuth and elevation controls. It holds the M117/M117A2 panoramic telescope sight in position. The head of the scope sights through the panoramic telescope ballistic cover on top of the cab. For information on the M117/M117A2 panoramic telescope and M145/M145A1 telescope mount, refer to TM 9-1240-401-34&P.

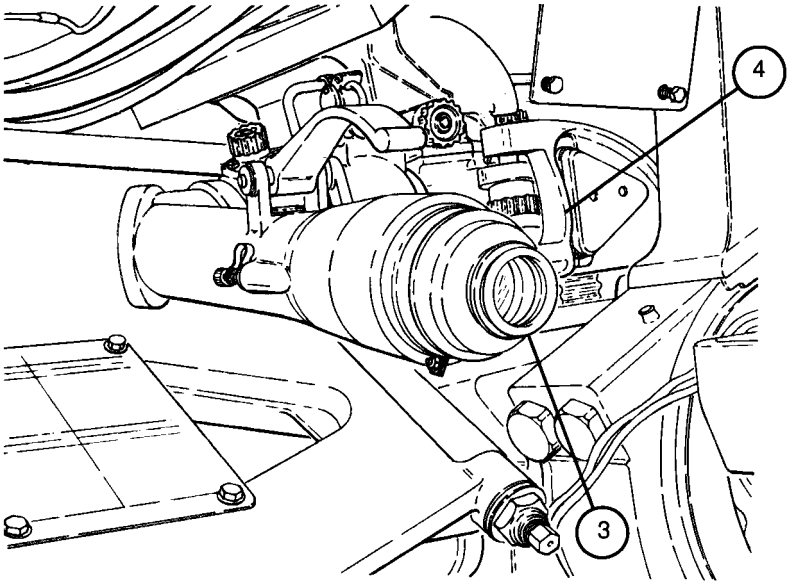


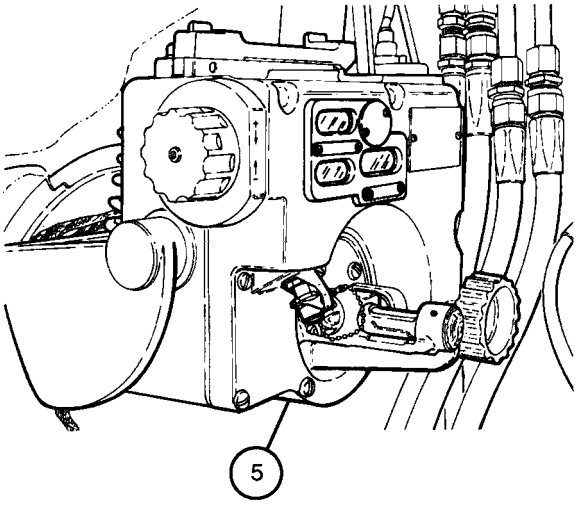
1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

1-14.14 Location and Description of Overall Sighting and Fire Control System - Continued

b. M118A2/M118A3 Elbow Telescope and M146 Telescope Mount. The M118A2/M118A3 elbow telescope (3) and M146 telescope mount (4) are mounted at No. 1 man's position and used for direct fire. Sighting is through an aperture on the right side of the cannon tube. The M146 telescope mount provides base that can be adjusted. It holds the M118A2/M118A3 elbow telescope. For information on the M118A2/M118A3 elbow telescope and M146 telescope mount, refer to TM 9-1240-401-34&P.

c. M15 Elevation Quadrant. The M15 elevation quadrant (5) is mounted on the trunnion at No. 1 man's position. It gives an accurate, direct reading of the gun elevation. It is used for a cross check against the other equipment. For further information on the M15 elevation quadrant, refer to TM 9-1290-322-34.

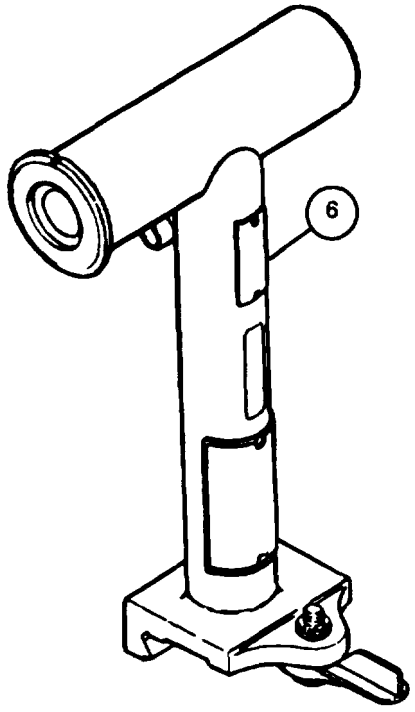




WARNING

The M140 alinement device is radioactively illuminated. Check for loss of luminescence, breakage, damage, or defects. If present, follow the procedures on page b.

d. M140 Alinement Device. M140 alinement device (6) is used to aline or to check alinement of sighting equipment when positioned on a bracket next to cannon tube. M118A2/M118A3 elbow telescope sights through the M140 alinement device permitting check of crosshair positions. When mounted on hull bracket, M117/M117A2 panoramic telescope sights through M140 alinement device to check crosshair alinement. The M140 alinement device contains radioactive tritium gas (H_3). For information on DS/GS repairs of the M140 alinement device refer to TM 9-4931-710-14&P.



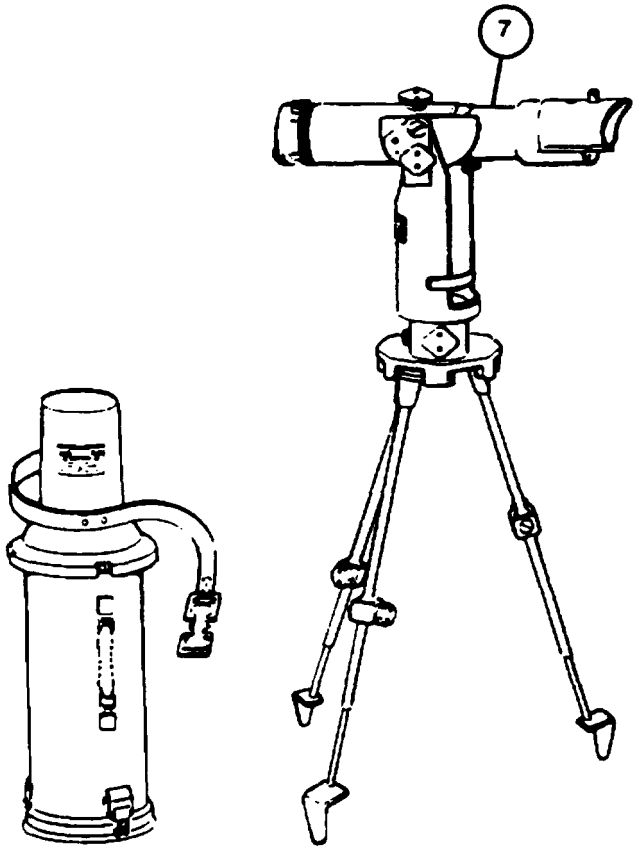
1-14 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS — CONTINUED

1-14.14 Location and Description of Overall Sighting and Fire Control System — Continued

WARNING

The M1A1 collimator is radioactively illuminated. Check for presence of illumination and damage. If discovered broken, damaged, or defective, follow the procedures on page b.

e. M1A1 Collimator. When in use, the M1A1 collimator (7) is mounted on a tripod a short distance from vehicle. Its illuminated retitles provide a fixed reference point to correct sighting after a round has bean fired. The M1A1 collimator contains radioactive tritium gas (H_3). For information on M1A1 collimator, refer to TM 9-1240-324-34&P.



• U.S. GOVERNMENT PRINTING OFFICE: 1996-746-045/20074

1-15 DIFFERENCES BETWEEN MODELS

Most of the differences among components of M109A2 and M109A3 howitzers concern the M109A3 model. There are 103 differences in the cabs of the M109A3 vehicle population. Variations among M109A2 vehicles and differences between M109A2 and M109A3 vehicles are minimal.

M109A4 howitzers have updated hydraulic components and an added NBC system plus reliability and maintainability. M109A5 howitzers have been updated from the M109A4 models. In addition to all M109A4 updates, the M109A5 model also modifies the M185 cannon assembly to an M284 cannon assembly and M178 mount to an M182 mount.

The maintenance procedures in this manual will call the mechanic's attention to any differences in cab components which will affect the mechanic's performance of direct and general support maintenance tasks. Where parts which must be removed or inspected differ significantly in appearance, a cutaway view will be used to show the alternate parts.

Part differences not relevant to the direct and general support mechanic will not be mentioned or pictured.

Below are some examples of cab component differences important to the direct and general support mechanic.

Functional group and part		Number of Variations	How assemblies/Darts differ
00	Protective shields, race ring	3	All M109A2/M109A4/M109A5 vehicles have five protective shields. All M109A3 vehicles with three contact arms have four protective shields. All M109A3 vehicles with five contact arms have five protective shields. Protective shields mount on race differently. Some M109A3 howitzers do not have a turret shield behind the commander's seat.
01	Bearing assembly	2	Some vehicles have 212 bearing balls mounted on 106 race ring spacers. Other vehicles have 213 bearing balls mounted on helical compression springs.
02	Dust shield	2	M109A5 howitzers have added an extra retainer and replaced seals on dust shield.
02	Variable recoil assembly	2	M109A5 howitzers have replaced many seal configurations from kit 5910844 with dust boots. Also a recoil nut modification has been added to M109A5 vehicles.

1-15 DIFFERENCES BETWEEN MODELS - CONTINUED

Functional group and part		Number of Variations	How assemblies/Darts differ
02	Variable recoil actuator follower	2	Some M109A3 howitzers use eye bolts with separate tension adjustment hex nuts. Some M109A3 and all M109A2 vehicles use eye bolts with integral tension adjustment hex nuts.
02	Variable recoil actuator assembly	2	Some M109A3 howitzers mount cam lever on a shaft and ball bearing. Some M109A3 and all M109A2 vehicles mount cam lever on a shouldered bolt and roller.
03	Equilibration manifold assembly, equilibration hand pump assembly	2	Some M109A3 howitzers have equilibration manifold assembly with integral check valves. Some M109A3 and all M109A2 howitzers have equilibration manifold assemblies tapped and threaded to connect to separate check valves.
03	Power pack assembly	2	M109A4/M109A5 howitzers have eliminated internal hydraulic filter of M109A2/M109A3 howitzers, replacing it with two external filters.
03	Power pack assembly direct current motor	2	Two different types of direct current motors are used on vehicles. The different types of direct current motors are interchangeable, but individual parts are not interchangeable between direct current motors.
03	Equilibrated elevation mechanism assembly	2	Some howitzers have modified equilibrated elevation mechanism assemblies with new internal seals and bearings.
06	Segment ring and contact arm assemblies	2	Segment ring for vehicles with 3 contact arm assemblies have more attaching hardware than segment ring on vehicles having 5 contact arm assemblies. Also, vehicles with 3 contact arm assemblies have a segment ring cover. Vehicles with 5 contact arm assemblies have no segment ring cover.

Functional group and part		Number of Variations	How assemblies/parts differ
09	Traversing mechanism	2	M109A4/M109A5 howitzers have modified traversing mechanisms. The electric clutch has been replaced by a hydraulic clutch. The brush assembly has been eliminated, and a clutch valve replaces it. A different handwheel is also used.
10	Cover assembly, commander's cupola	2	Some M109A3 howitzers have cover with outside locking latch. Some M109A3 howitzers and all M109A2 howitzers have no outside latch.

1-16 EQUIPMENT DATA

Tabulated data concerning the M185/M284 cannon assembly, M178/M182 mount, equilibrated system, rammer, and equilibrated elevating cylinder can be found below. Data following applies to both mount and cannon configurations unless otherwise specified. This is supplemental to data contained in TM 9-2350-311-20-2.

M185/M284 CANNON ASSEMBLY

Bore diameter . . . . . 155 mm

Center ofgravity oftube/barrel assembly . . . . . 93.87 in. (238cm) (M185)
(forward from rear of tube) 113.37 in. (288 cm) (M284)

Center of gravity of cannon/cannon assembly . . . . . 98.12 in. (249 cm)(M185)
(complete from rear face of breech ring) 102 in. (259 cm) (M284)

Length:

Tube . . . . . 238.5 in. (605.8 cm) (M185)
240 in. (609.6 cm) (M284)

Cannon . . . . . 271.38 in. (689 cm) (M185)
274.12 in. (696 cm) (M284)

Weight:

Tube . . . . . 3166 lb (1436 kg)

Muzzle brake . . . . . 350 lb (159 kg)

Evacuator chamber (approx) . . . . . 75 lb (34kg)

Cannon (complete) . . . . . 4320 lb (1960kg) (M185)
4390 lb (1991 kg) (M284)

1-16 EQUIPMENT DATA - CONTINUED

Rifling:

Length . . . . . 199.15 in. (506 cm) (M185)
200 in. (508 cm) (M284)

Depth of groove . . . . . 0.05 in. (0.127 cm)

Width of lands . . . . . 0.15 in. (0.381 cm)

Number of grooves 48

Twist . . . . . Uniform right hand:
one turn in 20 calibers

Type of breech mechanism . . . . . Semiautomatic screw block

Type of firing mechanism . . . . . Continuous Pull Percussion

Effective range . . . . . 18,000 meters

Tube life . . . . . TM 9-1000-202-14

Ammunition . . . . . Separate loading (TM 9-2350-311-10)
for authorized ammunition

M178/M182 MOUNT

Weight of cradle assembly . . . . . 1200 lb (544.32 kg)

Length of mount (minus howitzerdust shield) (approx) . . . . . 48-3/4 in.(124 cm)

Overall height of mount (with rotors) (approx) . . . . . 37 in. (94 cm)

Overall width of mount (approx) . . . . . 43 in. (109 cm)

Elevation (max) . . . . . +1333 mils

Depression (max) . . . . . -53 mils

Variable recoil assembly:

Length of recoil (from -53 mils to +906 mils elevation) . . . . . 36 in. (91 cm)

Length of recoil (+1333 mils elevation) . . . . . 24 in. (61 cm)

Preload on recuperator (nitrogen pressure) . . . . . 700 psi (4827 kPa)

Preload on replenisher accumulator:

Nitrogen pressure . . . . . 7-8 psi (48-55 kPa)

Hydraulic fluid (item 22, Appx B) pressure . . . . . 17-24 psi (117-165 kPa)

EQUILIBRATION SYSTEM

Preload in accumulators

Nitrogen pressure:

Primary . . . . . 850 to 900psi (5861 to 6206 kPa)

Secondary . . . . . 1500 ± 50 psi (10,342 ± 345 kPa)

EQUILIBRATED ELEVATING CYLINDERANDRAMMER

Hydraulic pressure source . . . . . Cab power hydraulic system

Regulated system hydraulic pressure available . . . . . .875 to 950 psi (6033-6550 kPa)

CABTRAVERSING MECHANISM

Traverse of cab . . . . . 360° (6400 mils)

Hydraulic motor:

Estimated displacement per revolution . . . . . 0.687 cu in. (11.26 cc)

Maximum speed . . . .4800 rPm

Maximum operating speed . . . .3600 rPm

MANUALELEVATING ACCUMULATOR

Capacity, hydraulic oil . . . . . 10 cu in. (163.9 cc)

MAINACCUMULATOR

Type . . . . . Floating piston

POWERPACKASSEMBLY (COMPLETE)

Capacity, hydraulic fluid . . . . . 11.25 qt (10-65 l)

Direct current motor:

Rated speed (full load) . . . . . 3800 rpm

Rated power . . . . . .5 hp

Rotation (as viewed from drive end) . . . . . Clockwise

1-17 EQUIPMENT CONFIGURATION

Not applicable.

CHAPTER 2
GENERAL CAB MAINTENANCE

GENERAL

This chapter contains information on repair parts, tools, inspection procedures, general maintenance procedures, and troubleshooting. All information in this chapter is presented for implementation by direct and general support level maintenance.

CONTENTS Page

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

2-1 COMMON TOOLS AND EQUIPMENT

a. For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE), CTA 50-970, or CTA 8-100, as applicable to your unit.

b. The tool kits assigned to the mechanic for performance of maintenance procedures are Artillery: Field Maintenance Tool Kit (SC 4933-95-CL-A06) and Artillery and Turret Mechanic's Tool Kit (SC 5180-95-CL-A12). Other tools required for performance of direct and general support maintenance procedures are identified in the initial setup with a reference to Appendix F, Tool Identification List.

2-2 SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

Special tools required for direct and general support maintenance of the cab are listed in the Maintenance Allocation Chart (MAC) located in TM 9-2350-311-20-2, for information only. This list is not to be used for requisitioning parts.

Special tools can be ordered using the information contained in the Repair Parts and Special Tools List (RPSTL) (TM 9-2350-311-24P-2). Fabricated tools required for all direct and general support maintenance of the cab are listed in Appendix C, Illustrated List of Manufactured Items.

2-3 REPAIR PARTS

Repair parts are listed and illustrated in the Repair Parts and Special Tools List (RPSTL) (TM 9-2350-311-24P-2), covering direct and general support maintenance for this equipment.

Mandatory replacement parts for direct and general support maintenance of the cab are identified in the initial setup with a reference to Appendix E, Mandatory Replacement Parts List.

Section II. INSPECTION PROCEDURES

2-4 GENERAL INSPECTION AND TYPES OF INSPECTION

Inspections are made to: determine serviceability of an item, recognize conditions that would cause failure, and assure proper application of maintenance policies at prescribed levels.

Inspection and repair data are included with exploded view illustrations in Chapters 3 through 14.

Inspection and repair tabulated data give inspection requirements. Wear limits are listed which indicate the point to which parts may be worn before replacement. Normally all parts which have not been worn beyond dimensions given or damaged by corrosion will be approved for service.

NOTE

Make sure that identification markings on major assemblies correspond to those entered in weapon record book.

2-4.1 General Inspection Guidelines

a. Inspect Cast Parts

Ensure there are no fractures and inspect interiors for scores and burrs.

b. Inspect Pistons, Spools, and Sleeves

NOTE

- Inspection of sleeves is to be accomplished without removing sleeves from valve bodies. Instead, use a small mirror and pencil-type flashlight.
- Spools and sleeves are non-interchangeable. If one part is rejected, also reject its mating part.

Ensure bores and parts are clean and free of foreign matter and burrs.

c. Inspect Bail Bearings

1 Inspect all bearings in accordance with TM 9-214, Inspection and Care of Bearings. This reference also pro vides information on cleaning, lubrication, and evaluation of life of bearings.

2 Inspect ball check valves for cracks, fractures, signs of galling, pitting, or corrosion. Take several measurements of the diameter of each ball to check for roundness and proper diameter. Replace ball if damaged.

3 Perform maintenance functions on bearings in accordance with TM 9-214.

d. Inspect Bushing-Type Bearings

CAUTION

Never scribe-mark bearing surfaces as it may cause permanent damage to parts.

NOTE

- Observe position of defective bearing within housing in order to replace new bearing in a similar manner.
- Inspection of bearings is to be accomplished without removal of bearings. Instead, use a small mirror and pencil-type flashlight.

1 Inspect bearing for cracks, fractures, and signs of galling, pitting, scoring, or corrosion.

2 Replace bearing if damaged,

e. Do Not Inspect Seals, Gaskets, and Preformed Packings

Replace all seals, gaskets, and preformed packings.

f. Inspect Gears

1 Inspect gears for wear, nicks, flaking, scoring, and burring. Check gears that have been shrunk or pressed with component parts.

2-4 GENERAL INSPECTION AND TYPES OF INSPECTION - CONTINUED

2-4.1 General Inspection Guidelines - Continued

WARNING

Solvents can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If solvent gets on skin or clothing, wash immediately with soap and water.

2 Remove minor nicks with a fine stone (SC 5180-95-CL-A12) or crocus cloth (item 12, Appx B) that has been dipped in cleaning compound (item 11.1, Appx B). Replace gears if teeth are damaged.

g. Inspect Splined Parts

1 Inspect splines and shafts for cracks, fractures, scores, and deformation.

2 Replace any splined part if splines do not permit secure fit.

3 Replace shafts if cracked, fractured, scored or deformed.

h. Inspect Threaded Parts

Inspect all screws, bolts, nuts, studs, and threaded holes for worn or damaged threads.

i. Inspect Snap Rings

1 Inspect snap rings for damage that would impair use.

2 Replace snap rings if damaged.

j. Inspect Soldered Joints

1 Inspect soldered components for cold joints. If soldered component or wire lead is mobile, desolder and solder the joint again (TM 9-2350-311-20-2 and TB SIG 222).

2 Inspect soldered electrical components for solder bridges. Desolder and resolder to eliminate bridges (TM 9-2350-311-20-2).

k. Inspect Welds

Inspect all weldments for broken or defective welds.

l. Inspect Finishes and Plated Surfaces

1 Inspect all painted surfaces. Repaint surfaces where required.

2 Inspect plated surfaces for signs of flaking, wear, or deterioration of plating.

3 Remove old plating, if necessary. Replace according to standard shop practice.

m. Inspect for Emulsified Hydraulic Fluids

Emulsified hydraulic fluid in hydraulic systems, characterized by milky color, can result from air becoming trapped in the fluid or from nitrogen leaking past piston seals. If milky hydraulic fluid is observed, drain, purge, and refill hydraulic system (TM 9-2350-311-20-2). Observe hydraulic fluid again after several days. If hydraulic fluid is again emulsified, repair defective cylinder.

2-4.2 Types of Inspection

a. Initial Inspection

Initial inspection information is included to aid maintenance personnel in determining cause of unserviceability, extent of repairs, and an estimate of replacement parts needed.

b. Maintenance Shop Inspection

In the event materiel is received in a maintenance shop for repair without complete information regarding deficiencies, perform a complete maintenance shop inspection to determine required parts. Refer to AR 750-1.

c. Visual Inspections

Inspections made while components are mounted in vehicle, are generally visual and are to be performed before attempting to operate these components. The purpose of these inspections is to determine condition of materiel and to take precautions to prevent any further damage if operation is faulty.

d. Inspection Following Removal

Inspection after materiel is removed from vehicle is performed to verify diagnosis made while installed and to uncover further defects.

e. In-Process Inspection

In-process inspection instructions on materiel are contained at end of each repair chapter together with applicable repair instructions.

f. Final Inspection

Final inspection instructions for materiel in supporting maintenance shops are contained in para 2-5.

g. Hydraulic System Inspection

Hydraulic system inspection tests on components and system can only be checked with elevating system, traversing system, and rammer valve completely installed in vehicle. Refer to TM 9-2350-311-20-2 for checkout procedure of system and external leakage allowance criteria for components.

h. DS/GS Pre-Embarkation Inspection

Para 2-6 provides pre-embarkation inspection procedures. This inspection determines whether preventive maintenance has been performed. It is critical that equipment in units alerted for overseas movement be in good working order.

i. Inspection of Materiel in the Hands of Troops

Inspection of materiel in the hands of the troops is performed after pre-embarkation inspection and is part of the preparation for overseas movement. Para 2-7 details this inspection performed by direct and general support maintenance.

2-5 FINAL INSPECTION

Final inspection is performed after repair has been completed to ensure that cab, howitzer, cannon mount, elevating system, traversing system, rammer, and all components are in serviceable condition before returning to user. All materiel will meet performance and serviceability requirements of this section prior to acceptance for delivery.

a. Final Inspection

1 Check all painted surfaces for conformance to the standards of TM 43-0139.

2 Ensure that all unpainted surfaces are lightly coated with grease (item 21, Appx B).

3 Inspect nuts, bolts, screws, pins, and fastening devices for security of installation.

4 Observe rotating parts in motion to determine if smooth operation without excessive play and/or binding exists.

5 Test operation of exterior spring-loaded device to ensure proper spring compression.

6 Inspect locations of gaskets, seals, wipers, ports, and packings for evidence of leakage.

7 Inspect hydraulic tubes, fittings, and components for leakage. Exercise hydraulic components (TM 9-2350-311-10 and TM 9-2350-311-20-2).

8 Check for proper nitrogen pressure in recuperator, elevating system, and traversing system.

9 Examine canvas items for tears or deterioration.

10 Make sure a detailed inspection of repaired systems and components, as described above in the paragraph on general inspection, has been performed.

11 Check level of howitzer cannon trunnions and gun travel lock alinement (TM 9-2350-311-20-2).

b. Repair Parts and Equipment

All repair parts and equipment must be complete or requisitions initiated for procurement of damaged, missing, or unserviceable parts.

c. Lubrication

Lubrication must be complete and in accordance with TM 9-2350-311-10 and TM 9-2350-311-20-2.

2-6 DS/GS PRE-EMBARKATION INSPECTION FOR OVERSEAS ALERT

Prior to inspection of materiel in hands of troops preparatory to overseas movement, a general pre-embarkation inspection is performed to determine whether preventive maintenance has been accomplished. Neglect of maintenance must be reported to higher authority.

Pre-Embarkation Inspection Procedures

1 The howitzer M185 or M284 cannon and M178 or M182 mount, either in the hands of troops alerted for overseas movement, or supporting maintenance shops being processed for oversea shipment, must conform to standards as set forth herein. All replacement materiel issued from storage or withdrawn from higher levels of maintenance expressly for replacement of like serviceable materiel will conform in detail to standards of overhauled materiel.

2 Inspect all components and assemblies for smooth operation and satisfactory performance. Replace all incomplete or unserviceable components or assemblies.

3 Inspect all screws and locking devices for secure installation.

4 Paint on materiel must be of regulation color and luster and must cover all specified surfaces thoroughly and sufficiently in order to prevent corrosion.

5 Inspect all points of lubrication for compliance with TM 9-2350-311-10 and TM 9-2350-311-20-2.

6 Inspect all unpainted metal surfaces and coat with film of preservative lubricant (TM 9-2350-311-10 and TM 9-2350-311-20-2). This coating of oil is only a protection until materiel is processed for shipment.

7 The vehicle must be accompanied by complete sets of unit spare parts and equipment, as normally issued with the vehicle when shipped overseas.

8 Inspect all accessories, tools, and spare parts for serviceability and completeness. All defective items must be replaced. It normally is not necessary to inspect items in sealed packages since they have been inspected for serviceability prior to packaging and during storage.

9 Perform inspections as prescribed for inspection of materiel in the hands of troops (para 2-7).

2-7 INSPECTION OF MATERIEL IN THE HANDS OF TROOPS

WARNING

Before starting an inspection on armament, be sure to clean weapon. Do not actuate firing mechanism until weapon has been cleared. Inspect chamber to ensure that it is empty and no ammunition is in position to be introduced. Avoid having live ammunition in vicinity of work area. Serious injury or death could result to personnel.

Materiel in the Hands of Troops Inspection Procedures

NOTE

Refer to AR 750-1 and DA PAM 750-8 for responsibilities and fundamental duties of inspecting personnel, including necessary notice and preparations to be made, forms to be used, and general procedures and methods to be followed by inspectors.

1 Determine degree of serviceability, completeness, and readiness for immediate use, with special reference to safe and proper functioning of the materiel. If materiel is found unserviceable or incipient failures are disclosed, deficiencies will be corrected on the spot or advice given as to corrective measures when applicable, or, if necessary, materiel will be tagged for delivery to, and repaired by maintenance personnel.

2 Determine cause of mechanical and functional difficulties that troops may be experiencing and check for apparent results of lack of knowledge, misinformation, neglect, improper handling and storage, security, and preservation.

3 Inspect to see that all authorized modifications have been applied, that no unauthorized alterations have been made, and that no work beyond the authorized scope of unit is being attempted. Check index in DA PAM 25-30 and the current Modification Work Order (MWO) files for any MWOs printed after this publication.

4 Instruct personnel in proper preventive maintenance procedures if found inadequate.

5 Check completeness of unit maintenance allowances and procedures for obtaining replacements.

6 Inspect lettering on name plates and direction plates for legibility.

7 Inspect materiel for paint which has deteriorated or chipped off, exposing bare metal.

8 Determine when materiel was last exercised if not recently fired. Refer to TB 9-1000-234-13 for exercising.

9 Note general appearance and check exterior for missing or broken parts.

10 Check storage conditions of general supplies and ammunition.

11 Initiate a thorough report on materiel “not fully mission capable” with reasons for further appropriate action.

12 Report to responsible officer any carelessness, negligence, unauthorized modifications, or tampering. This report should be accompanied by recommendations for correcting unsatisfactory conditions.

13 Inspection will be inclusive of all assemblies and parts described herein. All bolts, screws, nuts, and mounting and locking devices will be securely installed.

NOTE

Make sure that identification markings on major assemblies correspond to those entered in Weapon Record Data book.

14 See that Weapon Record Data entries (DA Form 2408-4) (which provide a continuous record of firings and other related service life data pertaining to weapon tubes) are complete and up-to-date as required by the provisions of DA PAM 750-8.

15 Ensure all components and assemblies of the mount operate smoothly and perform satisfactorily.

16 Painting procedures will conform to those outlined in TM 43-0139 and changes.

17 Lubrication must be complete and in accordance with lubrication charts in TM 9-2350-311-10 and TM 9-2350-311-20-2.

18 Cleaning will be performed in accordance with TM 9-2350-311-10 and TM 9-2350-311-20-2.

19 On completion of inspection, all unpainted surfaces will be coated lightly with a film of CLP (item 11, Appx B) per TM 9-2350-311-10 and TM 9-2350-311-20-2.

20 All accessories and spare parts will be inspected for serviceability and completeness.

21 Minor indentations, scratches, or rust pits will not be cause for rejection or replacement of parts unless the damage is of sufficient magnitude to cause unsatisfactory functioning of component or assembly.

Section III. GENERAL MAINTENANCE PROCEDURES

2-8 DISASSEMBLY AND ASSEMBLY PROCEDURES

NOTE

Gears, bearings, sleeves, and other components mounted on shaft may require use of arbor press (item 13, Appx F) for disassembly and assembly.

Complete disassembly of a component is not always necessary to make a required repair or replacement. Good judgment should be used to keep disassembly operations to a minimum.

In disassembling a unit, first follow basic inspection procedures, then remove as many major components and subassemblies as possible. These components may then be reduced, as necessary, into individual parts.

During disassembly, tag critical parts such as bearings and electrical harnesses and leads, to facilitate reassembly. This is especially important for electrical equipment if circuit number tags are illegible or missing.

2-8 DISASSEMBLY AND ASSEMBLY PROCEDURES — CONTINUED

CAUTION

Never scribe-mark bearing surfaces.

Mark gears on mating teeth by scribe marks, or with dye, indelible ink, or paint, to be certain of correct positioning at assembly. Use of chalk or crayon for marking should be avoided because of lack of permanence.

During assembly, subassemblies should be assembled first, combined into major components where possible, and then installed to form a complete component.

Records to provide repair and replacement data and statistics should be carefully prepared and maintained according to DA PAM 750-8.

2-9 CLEANING

Refer to TM 9-247 for instructions on cleaning and for necessary cleaning materials. Also refer to TM 9-2350-311-10 and TM 9-2350-311-20-2 for specific areas to be cleaned.

WARNING

Breathing vapor from degreasing solutions can cause headache, dizziness, loss of muscular control, coma, permanent brain damage, or death. Make sure area is well ventilated as a preventive measure.

a. Cleaning of Materiel Received from Storage

Materiel received by support maintenance units from storage will be cleaned by dip-tank, vapor-degreaser, or steam method, whichever is applicable or available. Descriptions of these methods follow. If some time is to elapse before the start of repair operations, apply a coating of CLP (item 11, Appx B) to all finished metal surfaces to prevent rusting.

CAUTION

Do not immerse sealed-typed ball bearings in cleaning compound (item 11.1, Appx B) or hot oil.

1 Dip-tank method. Disassemble as required. Using rubber gloves, place parts in a perforated metal basket, submerge, and agitate in a tank containing cleaning compound (item 11.1, Appx B).

2 Vapor-degreaser method. Tanks containing a heated solution of trichlorethylene or perchloroethylene (Type II) are used for degreasing items that are very greasy or oily and are not readily cleaned by dip-tank method. Place parts in a perforated metal basket, and submerge just below the vapors in the tank, keeping the basket in this position until all of the grease, oil, or dirt melts and runs off the parts. If necessary, materiel may be washed with degreasing spray unit.

3 Steam method. Place parts in a perforated metal basket and steam treat until clean. This method is less efficient than the vapor-degreaser method and may require additional cleaning of parts to remove final traces of grease, oil, or dirt, particularly from recesses.

b. Cleaning After Repair

After repair operation and prior to assembly, remove shop dirt and other foreign matter from all metal surfaces. This is accomplished by the dip-tank or vapor-degreaser methods or by cleaning with cloths (item 13, Appx B) soaked in cleaning compound (item 11.1, Appx B).

c. Cleaning After Shop Inspection

After in-process shop inspections, dip parts in a tank containing fingerprint remover oil (item 14, Appx B). Using rubber gloves, remove parts and dry thoroughly with compressed air (provided with moisture filter traps) or by wiping with clean, lint-free dry cloths (item 13, Appx B). Apply preservatives as soon as possible after cleaning.

2-10 REPAIR OR REPLACEMENT OF PARTS

2-10.1 Replacement of Parts

a. Unserviceable and unrepairable assemblies will be broken down into Items of Issue, and serviceable parts will be returned to stock. Parts or assemblies which cannot be repaired, selective-fitted, or reclaimed to standards contained in this manual will be salvaged and new parts used to replace them.

b. Inspection

Inspect the following:

Item	Discard
Springs	Broken, kinked, cracked or for non-conformance to repair data standards
Screws, bolts, nuts	Threads are stripped or cracked

c. If a required part is not available, reconditioning of old part should be considered. Such parts should be inspected carefully after reconditioning to determine their suitability and probable service life. Replacement parts should be requisitioned immediately.

d. Mandatory replacement parts for direct and general support maintenance of the cab are identified in the initial setup with a reference to Appendix E, Mandatory Replacement Parts List.

e. Use tools that are suitable for the work to be performed to avoid damage to tools and equipment or injury to personnel.

f. Special tools are listed in Appendix F, Tool Identification List. Fabricated tools are listed and illustrated in Appendix C, Illustrated List of Manufactured Items. These tools should only be used for maintenance operations for which they were designed, and personnel should be carefully instructed in their specialized operation.

2-10.2 Removing Burrs, Scratches and Raised Metal

a. Use fine mill file (SC 5180-95CL-A12), soft stone (SC 5180-95-CL-A12), or crocus cloth (item 12, Appx B) dipped in light oil (item 23, Appx B) to remove burrs, scratches or raised metal.

b. When filing aluminum, clean file often with steel file brush (SC 4933-95-CL-A06) to avoid lodging file with aluminum particles which will gouge work surface.

2-10 REPAIR OR REPLACEMENT OF PARTS - CONTINUED

2-10.3 Repairing Damaged Threads

a. When determined feasible by inspection, damaged threads should be repaired by retapping, use of thread die, or by chasing on lathe.

b. Tapped holes for screw thread inserts that have mutilated threads may be repaired by:

1 Drilling and tapping hole oversize and installing larger inserts.

2 Filling tapped hole by welding, redrilling, and tapping hole to original size.

2-11 REMOVAL AND INSTALLATION OF SCREW THREAD INSERTS (ONE-PIECE TYPE)

This task covers: a. Removal b. Installation

INTIAL SETUP

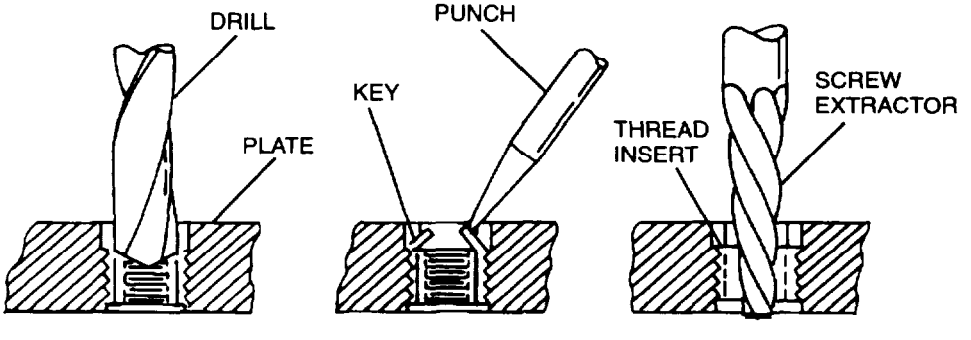
Tools
Artillery field maintenance tool kit
(SC 4933-95-CL-A06)

a. Removal

1 Drill thread insert. Refer to table on following page for drill size and depth.

2 Deflect keys inward and break off.

3 Remove remainder of thread insert with screw extractor.

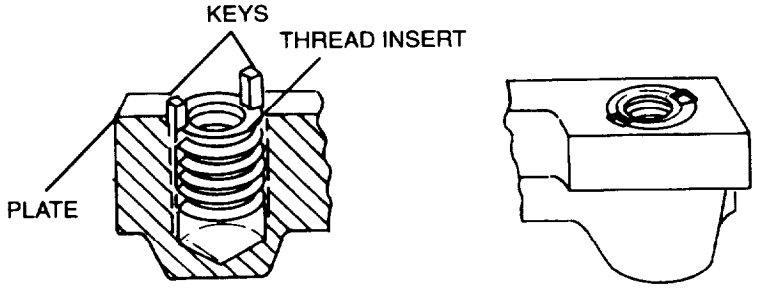


THREAD INSERT		TAP DRILL Diameter	COUNTERSINK Diameter	REMOVAL DRILL	
Internal Thread	External Thread			Diameter	Drilling Depth
10-24 10-32	3/8-16	Q (0.332)	25-64	9/32	1/4
1/4-20 1/4-28	7/16-14	X (0.397)	29/64	11/32	1/4
5/16-18 5/16-24	1/2-13	29/64	33/64	13/32	1/4
3/8-16 3/8-24	9/16-12	33-64	37/64	15/32	1/4
7/16-14 7/16-20	5/8-11	37-64	41/64	17/32	1/4
1/2-13 1/2-20	11/16-11	41/64	45/64	19/32	1/4

b. Installation

1 Screw thread insert in until 0.010 to 0.030 inch (0.254 to 0.762 mm) below surface of plate.

2 Drive keys in flush with plate.



2-12 PAINTING

WARNING

CARC paint is extremely hazardous. Refer to appropriate warnings at the front of this manual.

a. Clean and repaint all surfaces on which paint has deteriorated or become damaged.

b. Do not paint electrical harnesses or leads.

c. Prime paint interior surfaces including engine compartment, and hull exterior with enamel, MIL-C-22750 (item 18, Appx B).

d. Apply coat of white semi-gloss enamel No. 17875 to interior of cab with enamel, MIL-P-53022 (item 17, Appx B).

e. Paint walkways on hull exterior with MIL-W-5044 (item 16, Appx B).

f. Refer to TM 9-2350-311-20-2 and TB 43-0209 for application of stencil.

2-13 LUBRICATION

Refer to TM 9-2350-311-10 and TM 9-2350-311-20-2 which covers lubrication.

2-14 WELDING

Refer to TM 9-237, Welding Theory and Application Operator's Manual, for welding instructions and welding materiels.

2-15 SOLDERING

For general soldering instructions, see TM 9-2350-311-20-2. For overall soldering procedures, refer to TB SIG 222.

2-16 APPLICATION OF ADHESIVES

WARNING

Adhesives can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive gets on skin or clothing, wash immediately with soap and water.

a. Clean surfaces to be bonded. Surface must be free of grease, paint, talc, soapstone, or any foreign substance.

b. Stir adhesives until fluid. Apply an even coat of adhesive to each mating surface. Let dry until tacky. Temperature and humidity will affect drying time.

c. Apply another even coat of adhesive to both coated surfaces. Let dry until tacky (approximately 20 minutes). Adhesive is right consistency when it will not transfer to finger when touched lightly.

CAUTION

Do not attempt to pull or pry on either bonded surface after mating or damage to materiel or equipment may occur.

d. Press mating surfaces together. Use a roller or other suitable tool to ensure full contact between surfaces.

2-17 ELECTRICAL TEST EQUIPMENT AND ELECTRICAL TESTING

To use electrical test equipment refer to TM 9-2350-311-20-2.

2-18 SHAFTS, GEARS, AND BEARINGS

Most gears and bearings are installed on shafts tightly. Use arbor press, gear pullers, or other appropriate tools for removal and installation. General inspection guidelines for gears and bearings are outlined in para 2-4.1.

2-19 INSTRUCTION AND IDENTIFICATION PLATES

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools
Artillery field maintenance tool kit
(SC 4933-95-CL-A06)

a. Removal

NOTE

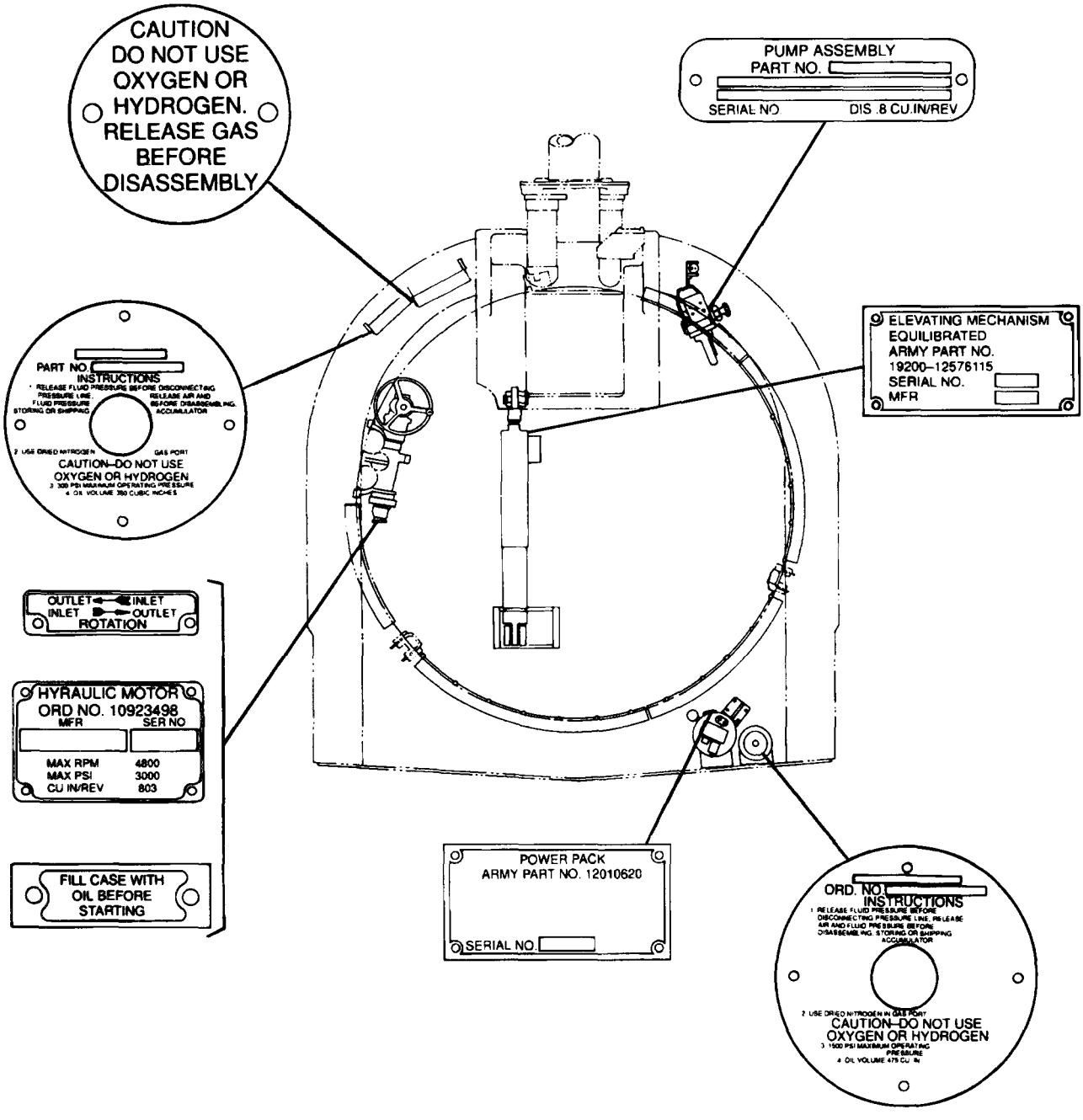
Only replace instruction and identification plates which are damaged or unreadable.

Remove all screws securing instruction or identification plate to mounting surface.

2-19 INSTRUCTION AND IDENTIFICATION PLATES - CONTINUED

b. Installation

Secure instruction or identification plate to mounting surface with screws.



Section IV. TROUBLESHOOTING

2-20 GENERAL

Information in this section is for use by maintenance personnel in conjunction with and as a supplement to, the troubleshooting sections in TM 9-2350-311-10 and TM 9-2350-311-20-2. This section provides a continuation of troubleshooting instructions where a remedy in TM 9-2350-311-20-2 refers to support maintenance.

The purpose of troubleshooting is to make a quick and accurate diagnosis of a problem in order to correct it without unnecessary labor and expense, to avoid further damage to a component, and to restore vehicle system to full operational capability.

2-21 INITIAL SETUP

Tools, materials/parts, and any conditions necessary to complete a troubleshooting task will be listed at the beginning of each troubleshooting tree.

2-22 WICK GUIDE TO TROUBLESHOOTING

2-22.1 Contents of Quick Guide to Troubleshooting

The QUICK GUIDE TO TROUBLESHOOTING lists the items to check, possible symptoms with each item, and a reference to a paragraph where a corrective action for the problem can be found.

2-22.2 Inspection

Always conduct a detailed and thorough visual inspection before operating or disassembling a component. Look for damaged, distorted, or deformed parts; loose electrical connections; hydraulic oil leakage; dirt or foreign matter; evidence of overheating, as indicated by burnt paint or blued steel; insufficient or excess lubrication; excessive wear; loose fittings or missing fasteners; rust or corrosion; obstructions and interferences with other parts; or any other abnormalities.

2-22 QUICK GUIDE TO TROUBLESHOOTING - CONTINUED

2-22.3 General Troubleshooting Procedures

Refer to the samples below and follow these instructions for using the QUICK GUIDE TO TROUBLESHOOTING (sample A) and troubleshooting procedures (sample B).

a. Determine the symptom.

b. Locate the symptom (1) in the Quick Guide to Troubleshooting.

c. Locate the troubleshooting paragraph (2) reference for your symptom or maintenance action.

d. Turn to the troubleshooting procedure (3) identified in the Quick Guide to Troubleshooting.

e. Study the function description, pictorial view, and electrical schematic located at the beginning of each section.

f. Perform corrective action (4) as required by troubleshooting procedure.

g. Verify that the corrective action eliminated the symptom.

SAMPLE A

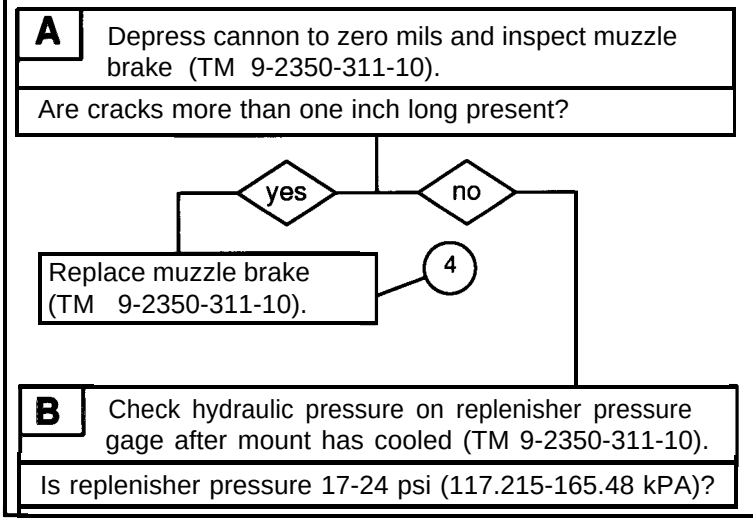
QUICK GUIDE TO TROUBLESHOOTING - CONTINUED

ITEM (1)	SYMPTOM	PARAGRAPH (2)
CANNON	JERKY RECOIL.	
CAB HYDRAULIC SYSTEM	HYDRAULIC PUMP MOTOR OPERATES WHEN MASTER SWITCH IS ON AND CAB POWER SWITCH IS OFF. Replace electromagnetic relay in power relay box assembly.	8-12

SAMPLE B

3-3 TROUBLESHOOTING CHART - CONTINUED

b. CANNON - CONTINUED (3) (1) JERKY RECOIL.



2-22.4 Quick Guide to Troubleshooting List

ITEM	SYMPTOM	PARAGRAPH
BREECH MECHANISM	BREECH DOES NOT OPEN MANUALLY.	2-23a.(1)
	BREECH DOES NOT CLOSE COMPLETELY.	2-23a.(2)
	BREECH DOES NOT OPEN AUTOMATICALLY AFTER FIRING. Repair operating crank assembly.	5-7
	BREECHBLOCK OVERROTATES. Inspect breechblock notch for wear.	5-6
CANNON AND MOUNT	JERKY RECOIL. EXCESSIVE RECOIL FORCE. EXCESSIVE RECOIL TRAVEL AT HIGH ANGLE OF FIRE. INSUFFICIENT RECOIL TRAVEL.	2-23b.(1)
	CANNON DOES NOT RETURN TO BATTERY.	2-23b.(2)
	PRIMER DOES NOT FIRE. Repair breech mechanism.	5-5
	ARROWS ON SPUR GEAR SECTOR WILL NOT ALINE OR DO NOT SEPARATE.	2-23b.(3)
	VARIABLE RECOIL SYSTEM WILL NOT MAINTAIN PROPER HYDRAULIC PRESSURE.	2-23b.(4)
CAB TRAVERSING SYSTEM	CAB WILL NOT TRAVERSE UNDER POWER OR MANUALLY, BUT HYDRAULIC PRESSURE IS NORMAL AND CAB LIGHTING OPERATES.	2-23c.(1)
	MANUAL TRAVERSE HANDWHEEL ROTATES WHILE TRAVERSING IN POWER.	2-23c. (2)
	CAB WILL NOT TRAVERSE UNDER POWER, MANUAL OPERATION IS NORMAL.	2-23c. (2.1)
	CAB WILL NOT TRAVERSE FREELY IN MANUAL OR POWER MODES.	2-23c.(3)
	CAB CREEPS.	2-23c.(4)
	HANDWHEEL SLIPS WHEN OPERATED MANUALLY.	2-23c.(5)
	TRAVERSING MECHANISM ASSEMBLY OVERHEATS. Repair or replace oil pump.	9-5
	GUNNER'S CONTROL HANDLE BINDS WHEN TRAVERSING.	2-23c.(6)
	NOISY OPERATION WHILE TRAVERSING.	2-23c.(7)
ELEVATING SYSTEM	CANNON DOES NOT ELEVATE OR DEPRESS UNDER POWER OR MANUALLY, BUT HYDRAULIC PRESSURE IS NORMAL. Repair or replace safety relief elevation valve assembly.	6-12
	CANNON DOES NOT ELEVATE OR DEPRESS SMOOTHLY.	2-23d.(1)
	CANNON WILL NOT MOVE UNDER POWER FROM EITHER CONTROL HANDLE, BUT MANUAL OPERATION IS NORMAL. Repair or replace selector valve assembly.	6-13
	CANNON DOES NOT ELEVATE OR DEPRESS USING MANUAL ELEVATION SYSTEM OR SYSTEM IS INEFFICIENT, BUT CANNON WILL OPERATE UNDER POWER. Repair or replace axial pump.	6-16
	CANNON CREEPS UP OR DOWN.	2-23d.(2)
	HYDRAULIC FLUID LEAKS FROM FRONT OR REAR OF EQUILIBRATED ELEVATION MECHANISM ASSEMBLY. Repair or replace equilibrated elevation mechanism assembly.	6-11

2-22 QUICK GUIDE TO TROUBLESHOOTING - CONTINUED

2-22.4 Quick Guide to Troubleshooting List - Continued

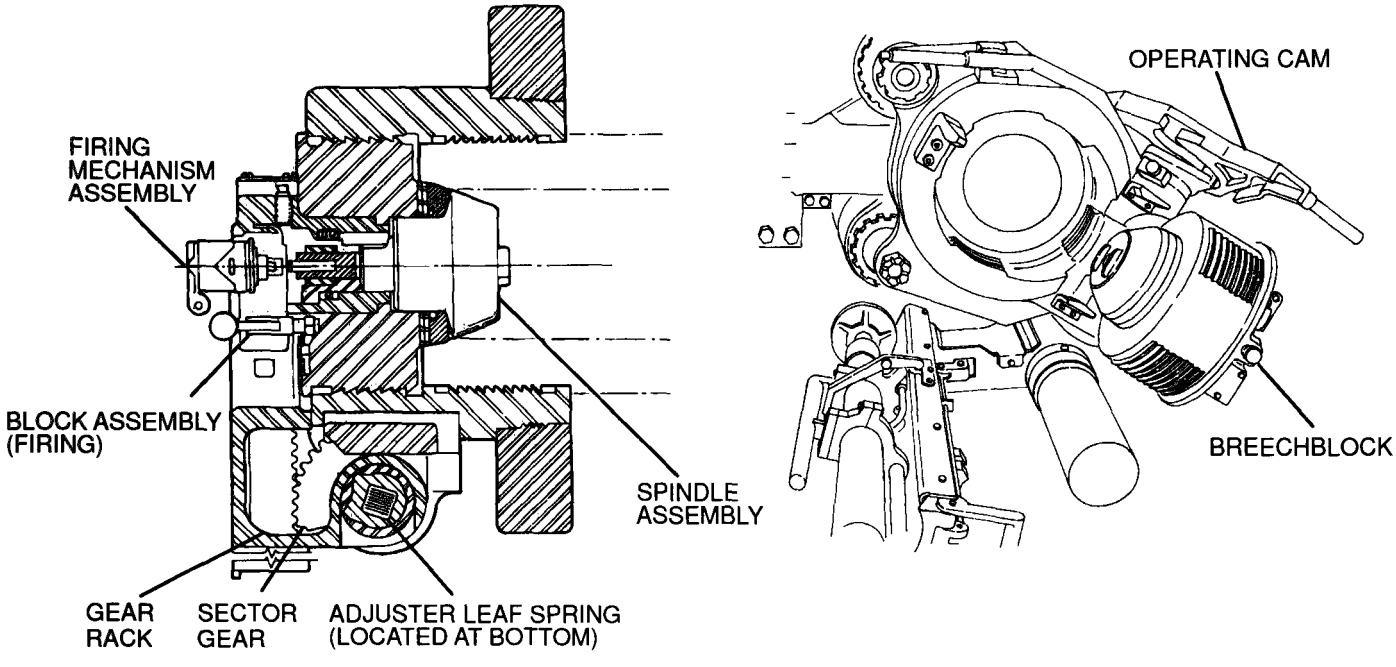
ITEM	SYMPTOM	PARAGRAPH
CAB HYDRAULIC SYSTEM	POWER PACK HYDRAULIC PUMP MOTOR DOES NOT OPERATE, BUT CAB LIGHTING SYSTEM OPERATES NORMALLY. Replace direct current motor of power pack assembly.	6-1
	HYDRAULIC PRESSURE IS NORMAL, BUT HYDRAULIC POWER IS NOT BEING SUPPLIED. Inspect and repair spools and sleeves of cover assembly.	6-2
	HYDRAULIC FLUID OVERFLOWS FROM TOP OF SIGHT GAGE OR CONTAMINATED CRYSTALS IN HYGROSCOPIC BREATHER. Repair or replace main accumulator assembly.	6-7
	HYDRAULIC PUMP MOTOR ON/OFF CYCLE IS RAPID.	2-23e.(1)
	MAIN ACCUMULATOR WILL NOT HOLD DRY NITROGEN CHARGE. Repair or replace main accumulator assembly.	6-7
	GUNNER'S OR ASSISTANT GUNNER'S CONTROL HANDLE DOES NOT RETURN TO NEUTRAL POSITION WHEN RELEASED.	2-23e.(2)
RAMMER HYDRAULIC SYSTEM	RAMMER DOES NOT OPERATE PROPERLY. Inspect and repair rammer cylinder assembly.	7-2
PANORAMIC TELESCOPE BALLISTIC COVER	EXTREME EFFORT REQUIRED TO TRAVERSE PANORAMIC TELESCOPE BALLISTIC COVER. Check brakes for proper operation. Clean and inspect bearing balls. Replace as necessary.	Chapter 13

2-23 TROUBLESHOOTING CHART

a. BREECH MECHANISM

The breech mechanism consists of the breech operating handle with detent plunger, cradle cam, clutch pin, firing mechanism block assembly with firing mechanism, and spring pack. Below is a pictorial view of the breech mechanism.

The breech operating handle is used to open the breech prior to firing. The breech will open automatically after firing of the cannon. The cradle cam is used to close the breech. The firing mechanism is used with a primer to fire the cannon.



2-23 TROUBLESHOOTING CHART - CONTINUED

a. BREECH MECHANISM - CONTINUED (1) BREECH DOES NOT OPEN MANUALLY

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

References
TM 9-2350-311-10

A Check the operating handle for proper operation (TM 9–2350–311–10).

Does it operate properly?

yes / no

Repair or replace operating handle (para 5–9).

B Check the crank assembly for proper operation.

Does it operate properly?

yes / no

Repair or replace operating crank assembly (para 5–7).

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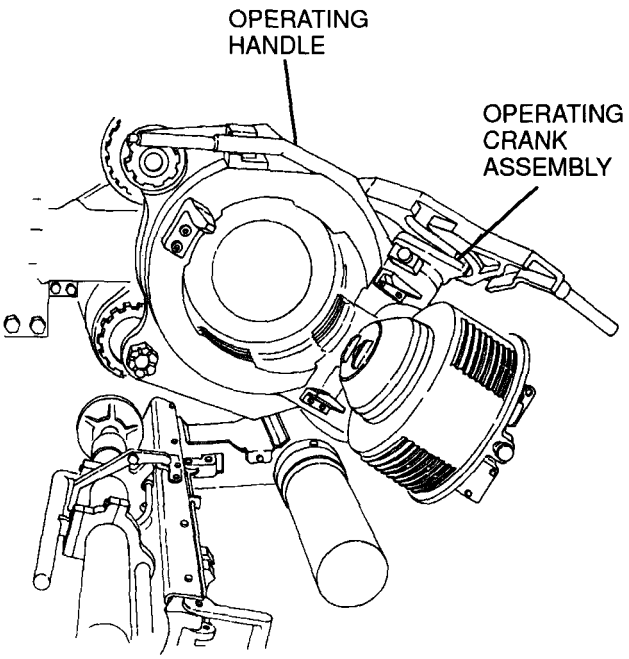


CONTINUED FROM STEP B

C Inspect sector gear and gear rack (para 5–8).

Is sector gear or gear rack defective?

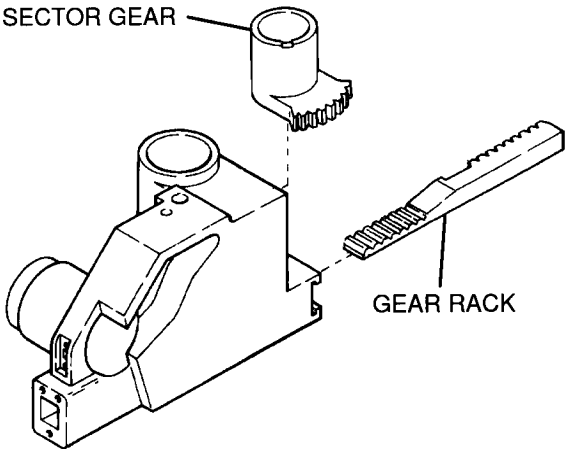
yes

no

Repair breech mechanism (para 5–5).

Replace defective parts (para 5–8).

END OF TASK



2-23 TROUBLESHOOTING CHART - CONTINUED

a. BREECH MECHANISM - CONTINUED (2) BREECH DOES NOT CLOSE COMPLETELY.

INITIAL SETUP

Tools

Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

WARNING

If breech is not closed completely, do not attempt firing, as it may result in death or injury to crew.

NOTE

Breech is completely closed when witness marks aline.

A Inspect breechblock assembly (para 5–6).

Is breechblock assembly defective?

yes

Repair or replace breech-block assembly (para 5–6).

no

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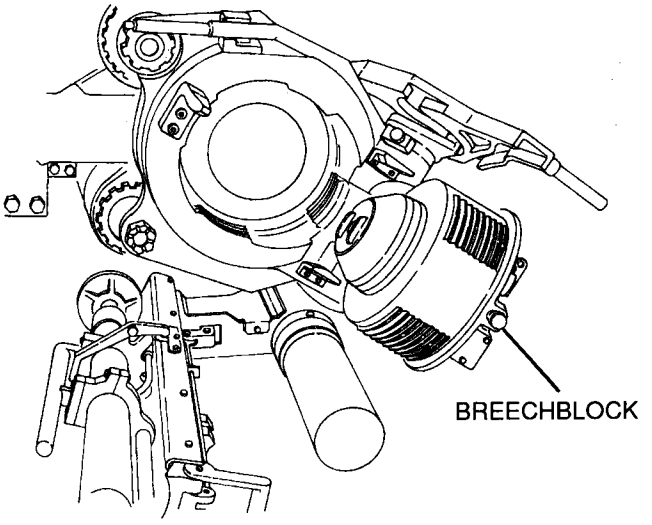


CONTINUED FROM STEP B

B Inspect sector gear and gear rack (para 5–8).

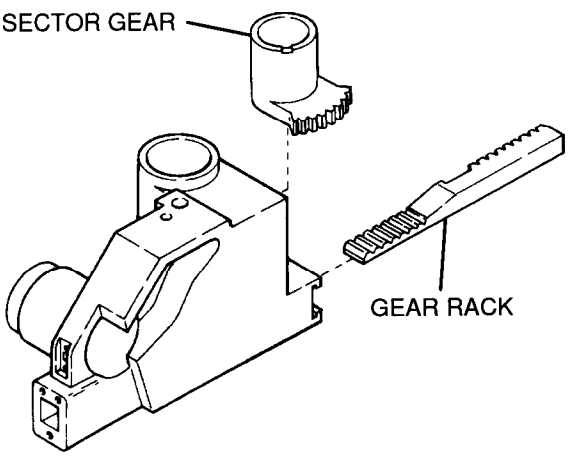
Is sector gear or gear rack defective?

yes

Replace defective parts (para 5–8).

no

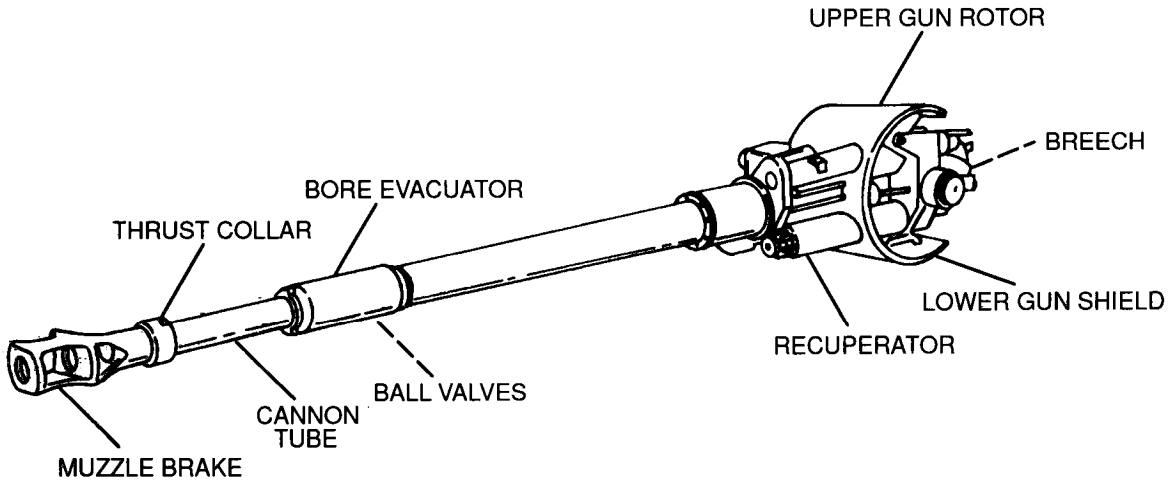
Repair breech mechanism (para 5–5).

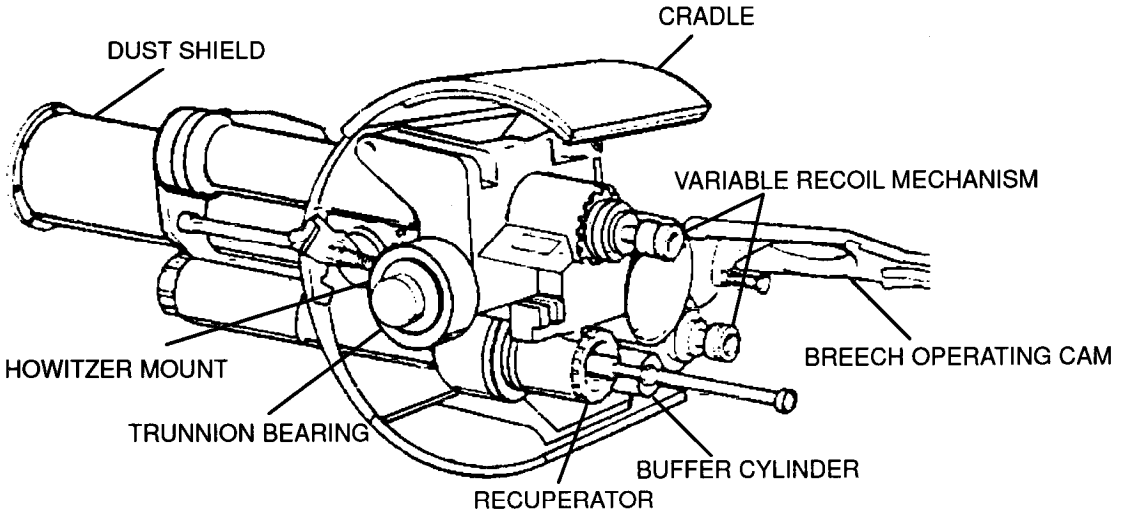


2-23 TROUBLESHOOTING CHART - CONTINUED

b. CANNON AND MOUNT

The cannon consists of the muzzle brake, thrust collar, cannon tube, bore evacuator, breech assembly, and firing mechanism. The mount consists of the variable recoil mechanism, dust shield, breech operating cam, buffer cylinder, recuperator, and cradle. Below is a pictorial view of the cannon with all the major assemblies installed. The muzzle brake and variable recoil mechanism reduce and absorb the recoil of the cannon tube during the firing sequence. The breech assembly houses the projectile and propellant during a firing. The firing mechanism is used to fire the cannon.





b. CANNON AND MOUNT — CONTINUED	(1) JERKY RECOIL. EXCESSIVE RECOIL FORCE. EXCESSIVE RECOIL TRAVEL AT HIGH ANGLE OF FIRE. INSUFFICIENT RECOIL TRAVEL.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

References
TM 9-2350-311-10
TM 9-2350-311-20-2

A Operate the variable recoil system (TM 9-2350-311-10).

Were there any leaks or a drop in pressure during operation?

yes → Inspect and repair recuperator assembly (para 5-11).

no →

B Inspect buffer assembly (TM 9-2350-311-20-2).

Is buffer assembly defective?

yes → Repair or replace buffer assembly (para 5-13).

no →

C Inspect recoil rods for leaks (para 5-12).

Are recoil rods defective?

yes → Repair or replace recoil (para 5-12).

no →

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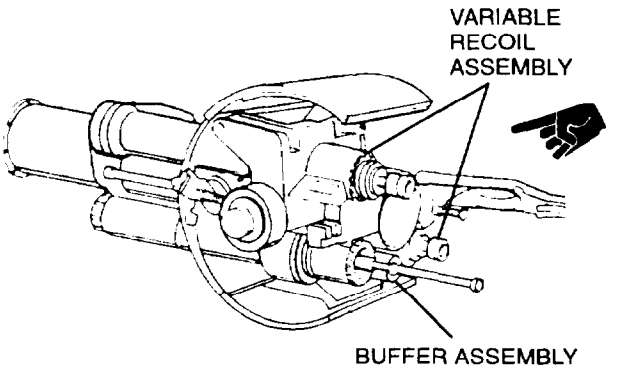


2-23 TROUBLESHOOTING CHART — CONTINUED

b. CANNON AND MOUNT — CONTINUED	(1) JERKY RECOIL. EXCESSIVE RECOIL FORCE. EXCESSIVE RECOIL TRAVEL AT HIGH ANGLE OF FIRE. INSUFFICIENT RECOIL TRAVEL. — CONTINUED

CONTINUED FROM STEP C

D Perform inspection of variable recoil (TM 9-2350-311-10).

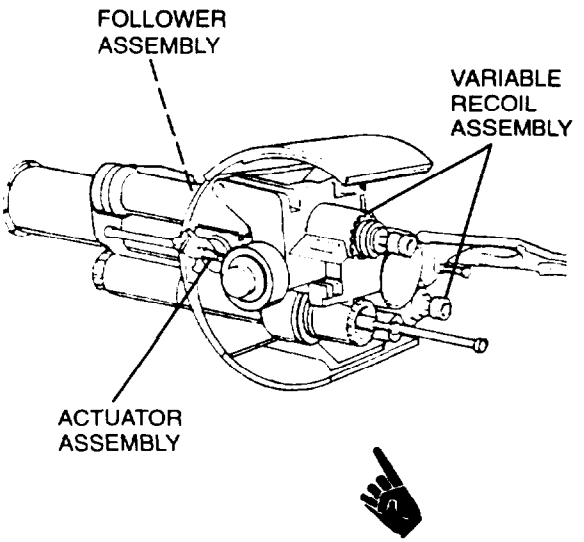
Do arrows on spur gear sector separate?

yes

Repair or replace actuator assembly (para 14-3) and follower assembly (para 5-14).

no

Perform troubleshooting procedure (para 2-23b.(3)).



END OF TASK

b. CANNON AND MOUNT - CONTINUED (2) CANNON DOES NOT RETURN TO BATTERY.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

References
TM 9-2350-311-10

A Inspect and repair recuperator assembly (para 5–11).

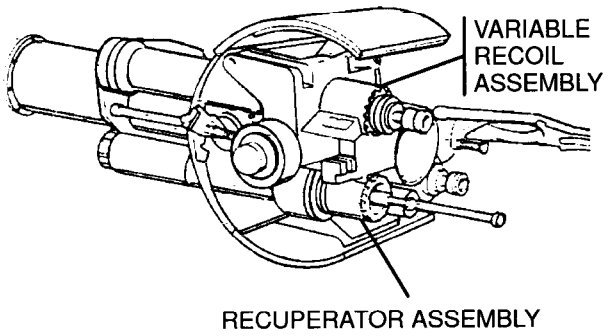
Does cannon return to battery?

yes

Verify fault is corrected. Continue normal operations.

no

Inspect and repair variable recoil assembly (para 5–12).



END OF TASK

2-23 TROUBLESHOOTING CHART - CONTINUED

b. CANNON AND MOUNT - CONTINUED

(3) ARROWS ON SPUR GEAR SECTOR WILL NOT ALINE OR DO NOT SEPARATE.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Personnel Required
2

Equipment Condition
Travel lock stowed (TM 9-2350-311-10)
Dust shield and variable recoil access cover removed (TM 9-2350-311-20-2)

A Elevate cannon assembly above 750 mils (TM 9–2350–311–10) while having assistant watch connecting link for both internal and external rotation.

Does connecting link rotate while index arrows separate?

yes → Repair variable recoil assembly (para 5–12).

no →

B
1. Depress cannon assembly to 100 mils (TM 9–2350–311–10).
2. Remove spur gear from connecting link (para 5–12).
3. Elevate cannon assembly while having assistant watch connecting link for rotation.

Does connecting link rotate?

yes → Repair or replace actuator assembly (para 14–3) and follower assembly (para 5–14).

no →

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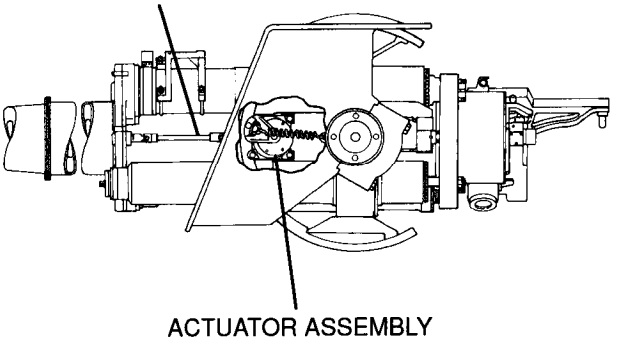

CONTINUED FROM STEP B

C

1. Depress cannon assembly to 100 mils (TM 9–2350–311–10).
2. Attempt to rotate spur gear sector by placing a large, flat blade screwdriver into the teeth of the spur gear sector across the connecting link. Apply light pressure.

Does spur gear sector rotate freely in both directions until both pawls on upper recoil cylinder are reached.

yes → Repair variable recoil assembly (para 5–12).

no →

D

1. Remove upper sector gear (para 5–12).
2. Attempt to rotate spur gear sector by placing a large, flat blade screwdriver into the teeth of the spur gear sector across the connecting link. Apply light pressure.

Does spur gear sector rotate freely?

yes → Replace upper sector gear (para 5–12).

no →

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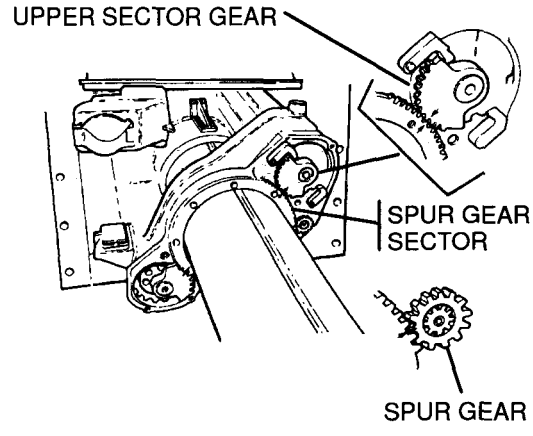


2-23 TROUBLESHOOTING CHART - CONTINUED

b. CANNON AND MOUNT - CONTINUED

(3) ARROWS ON SPUR GEAR SECTOR WILL NOT ALINE OR DO NOT SEPARATE. - CONTINUED

CONTINUED FROM STEP D

E

1. Install upper sector gear (para 5–12).
2. Remove lower sector gear (para 5–12).
3. Attempt to rotate spur gear sector by placing a large, flat blade screwdriver into the teeth of the spur gear sector across the connecting link. Apply light pressure.

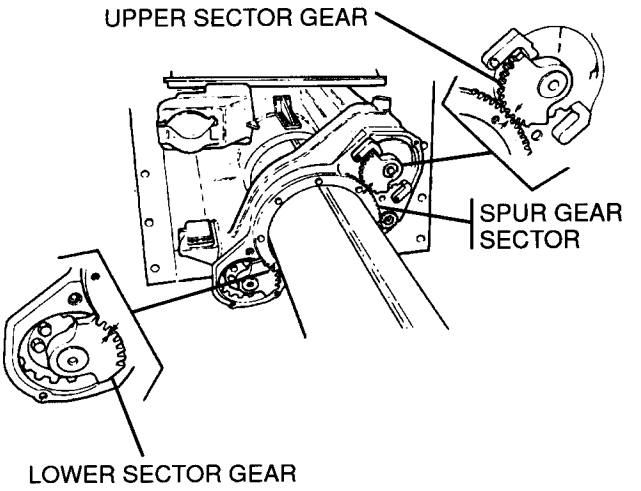
Does spur gear sector rotate freely?

yes

Replace lower sector gear (para 5–12).

no

Repair variable recoil assembly (para 5–12).



END OF TASK

b. CANNON AND MOUNT - CONTINUED

(4) VARIABLE RECOIL SYSTEM WILL NOT MAINTAIN PROPER HYDRAULIC PRESSURE.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

A Check variable recoil assembly for leaks.

Is variable recoil assembly defective?

yes

Repair or replace variable recoil assembly (para 5–12).

no

B Check replenisher accumulator assembly for leaks.

Is replenisher accumulator assembly defective?

yes

Repair or replace replenisher accumulator assembly (para 5–15).

no

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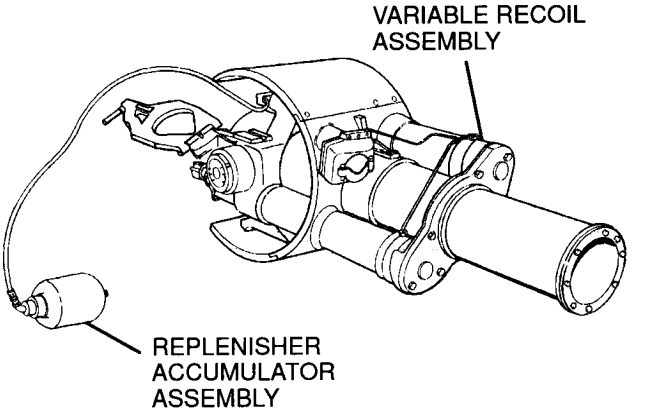


2-23 TROUBLESHOOTING CHART - CONTINUED

b. CANNON AND MOUNT - CONTINUED

(4) VARIABLE RECOIL SYSTEM WILL NOT MAINTAIN PROPER HYDRAULIC PRESSURE. - CONTINUED

CONTINUED FROM STEP B

C Check buffer assembly for defects.

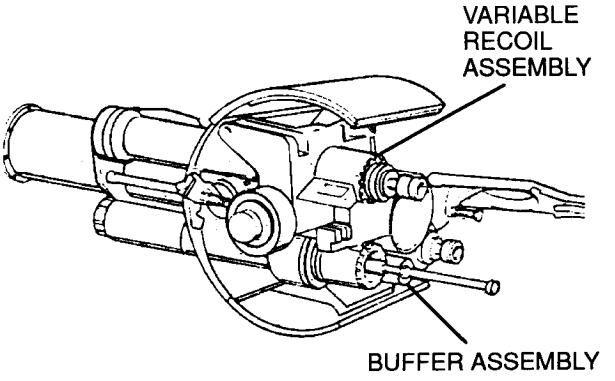
Is buffer assembly defective?

yes

Repair or replace buffer assembly (para 5–13).

no

Repair or replace variable recoil assembly (para 5–12).



END OF TASK

c. CAB TRAVERSING SYSTEM

The cab traversing system consists of the gunner's selector switch box assembly, hydraulic motor, bypass valve assembly and solenoid, clutch mechanism, and gunner's control handle. The M109A4/M109A5 howitzers have an additional clutch valve.

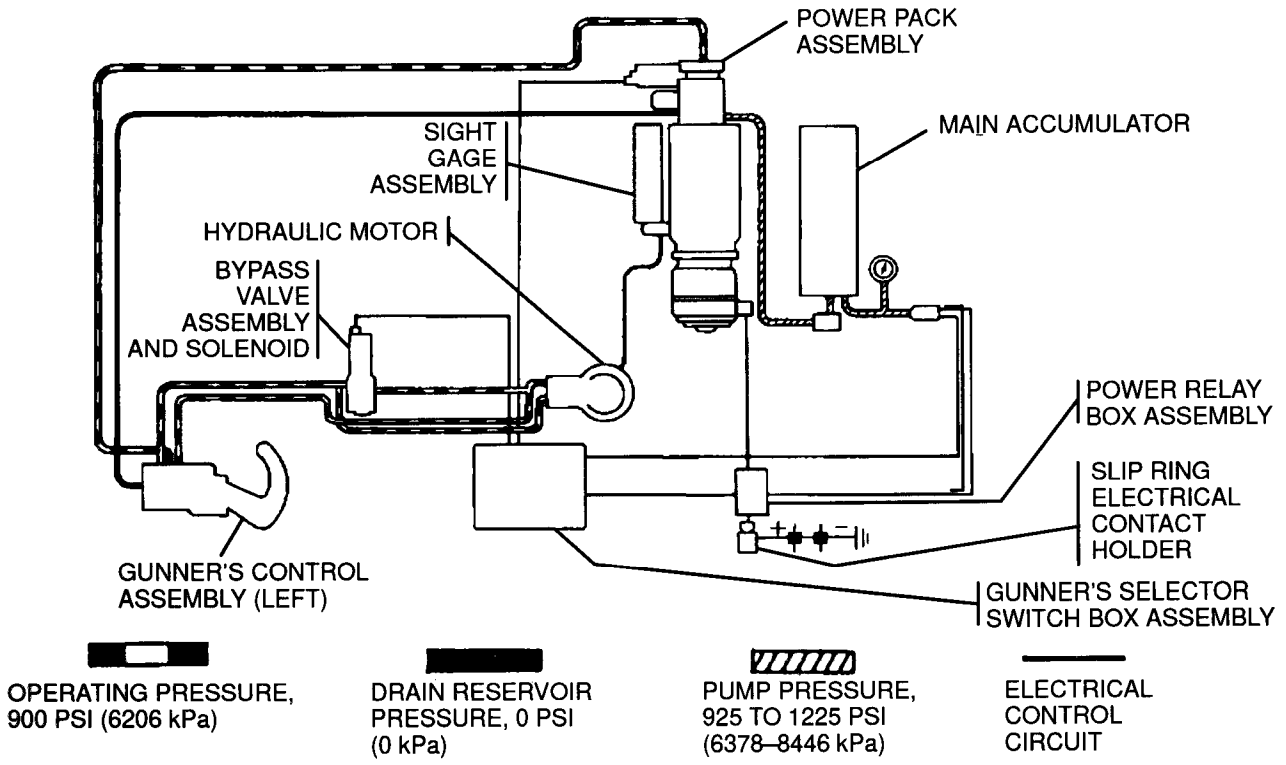
The gunner's selector switch box assembly is used to electrically switch the cab traversing mechanism between power and manual traversing.

The bypass valve assembly and solenoid combination controls the hydraulic power between the manual and power modes. In the power mode, the solenoid will push out the plunger to divert the hydraulic fluid to the hydraulic motor. In the manual mode, the plunger will retract and disengage the hydraulic motor.

The clutch mechanism controls the mechanical switching between the two modes and is controlled electrically (M109A2/M109A3 howitzers) or hydraulically (M109A4/M109A5 howitzers). The clutch valve in the M109A4/M109A5 howitzers controls the flow to the clutch.

The gunner's control handle operates the power traversing of the cab and the handwheel assembly operates the manual traversing of the cab.

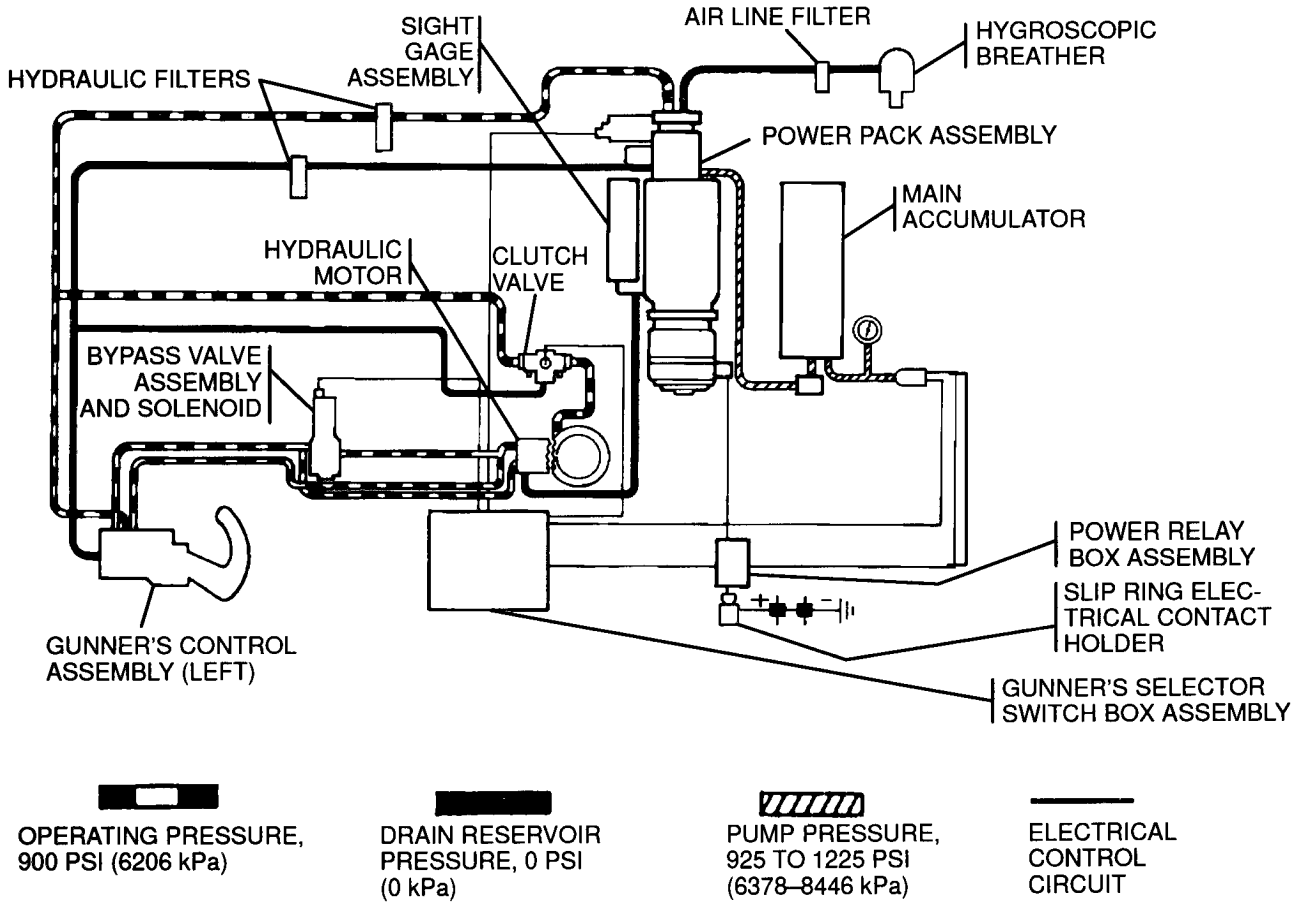
CAB TRAVERSING SYSTEM (M109A2/M109A3 HOWITZERS)



2-23 TROUBLESHOOTING CHART - CONTINUED

c. CAB TRAVERSING SYSTEM - CONTINUED

CAB TRAVERSING SYSTEM (M109A4/M109A5 HOWITZERS)



c. CAB TRAVERSING SYSTEM — CONTINUED

(1) CAB WILL NOT TRAVERSE UNDER POWER OR MANUALLY, BUT HYDRAULIC PRESSURE IS NORMAL AND CAB LIGHTING OPERATES.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Equipment Condition
Vehicle MASTER switch to OFF (TM 9-2350-311-10)
CAB POWER switch to OFF (TM 9-2350-311-10)
TRAVERSE CONTROL switch to MANUAL (TM 9-2350-311-10)

A Traverse cab manually (TM 9-2350-311-10).

Does cab traverse manually?

yes → Go to step H.

no

B Inspect traversing mechanism assembly for proper installation (para 9-1).

Is traversing mechanism assembly installed properly?

yes

no → Install traversing mechanism assembly properly (para 9-1).

C Remove no-back housing assembly (para 9-2). Attempt to traverse in power.

Does cab traverse in power mode?

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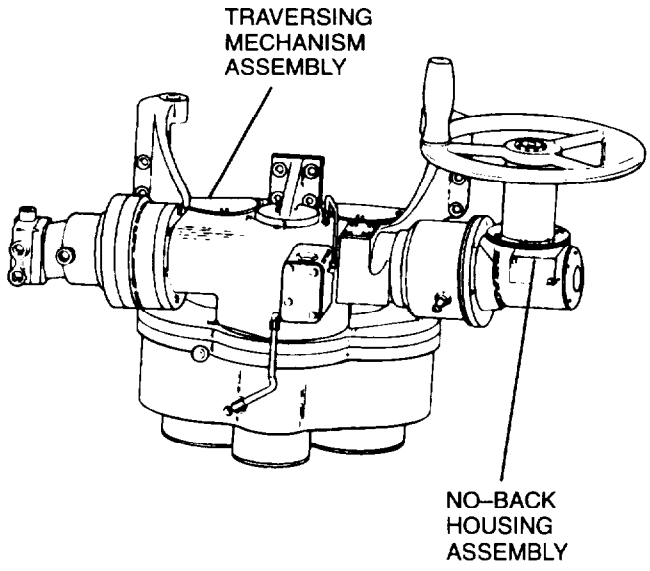

2-23 TROUBLESHOOTING CHART — CONTINUED

c. CAB TRAVERSING SYSTEM — CONTINUED

(1) CAB WILL NOT TRAVERSE UNDER POWER OR MANUALLY, BUT HYDRAULIC PRESSURE IS NORMAL AND CAB LIGHTING OPERATES. — CONTINUED

CONTINUED FROM STEP C

yes / no

Replace no-back assembly (para 9-2).

D Remove, disassemble and inspect bevel gear housing (para 9-3).

Does bevel gear housing have damage or improper adjustments?

yes / no

Repair, replace and adjust bevel gear housing (para 9-3).

E Using gear shaft assembly, insert into clutch and attempt to manually traverse using wrench (para 9-3).

Does cab traverse manually?

yes / no

Reassemble traverse mechanism. Verify fault is corrected.

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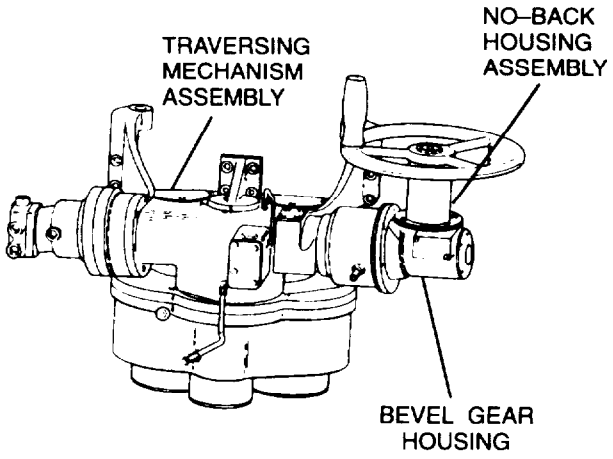

CONTINUED FROM STEP E

F Remove and disassemble traverse mechanism (para 14–4).

Is traverse mechanism servicable?

yes

no

Repair or replace traversing mechanism assembly (para 14–4).

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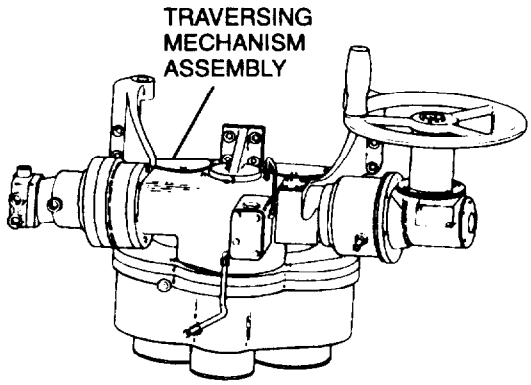


2-23 TROUBLESHOOTING CHART — CONTINUED

c. CAB TRAVERSING SYSTEM — CONTINUED

(1) CAB WILL NOT TRAVERSE UNDER POWER OR MANUALLY, BUT HYDRAULIC PRESSURE IS NORMAL AND CAB LIGHTING OPERATES. — CONTINUED

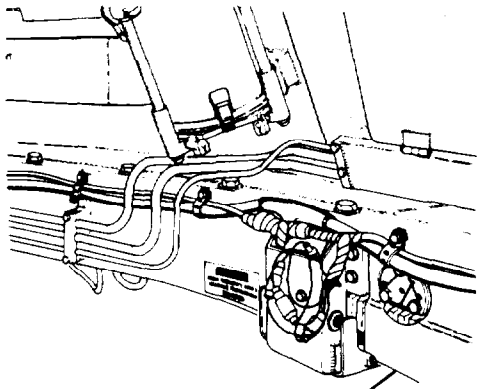
CONTINUED FROM STEP F

G Inspect bearing/race ring assembly for damage (Chapter 4).

Is bearing/race ring assembly damaged?

yes → Repair bearing/race ring assembly (Chapter 4).

no



BEARING/RACE RING ASSEMBLY

CONTINUED FROM STEP A OR G

H

1. Turn vehicle MASTER switch to ON (TM 9-2350-311-10).
2. Turn CAB POWER switch to ON (TM 9-2350-311-10).
3. Turn TRAVERSE CONTROL switch to POWER (TM 9-2350-311-10).
4. Power traverse cab.

Does cab traverse in power?

yes → Verify fault is corrected. Continue normal operations.

no

CONTINUED ON NEXT PAGE

CONTINUED FROM STEP H

I Check for defective gunner's control assembly (para 6–18).

Is gunner's control assembly defective?

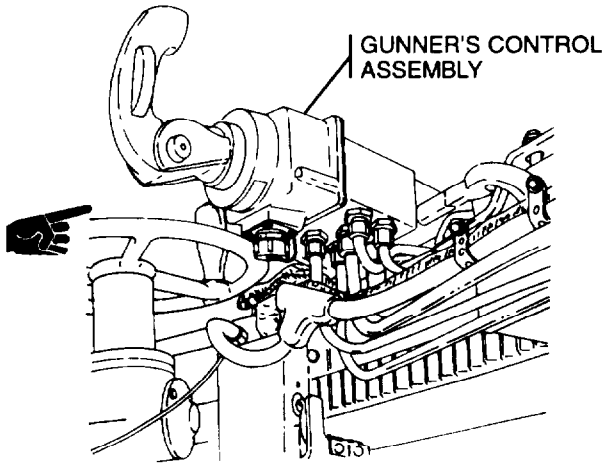
yes

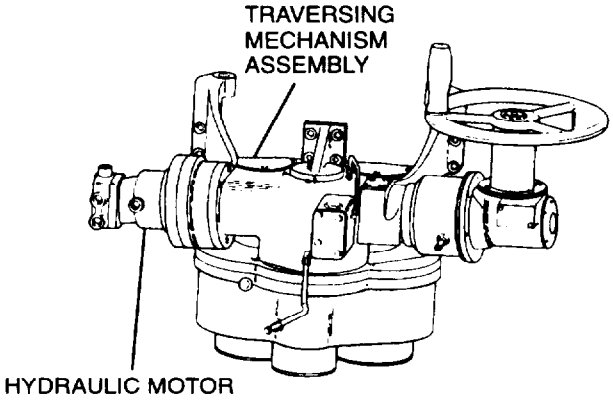
Repair or replace gunner's control assembly (para 6–18).

no

Repair or replace traversing mechanism assembly hydraulic motor (para 14–5).

END OF TASK





2–23 TROUBLESHOOTING CHART — CONTINUED

c. CAB TRAVERSING SYSTEM — CONTINUED

(2) MANUAL TRAVERSE HANDWHEEL ROTATES WHILE TRAVERSING IN POWER.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180–95–CL–A12)

Materials/Parts
Gasket (item 132, Appx E) M109A2/M109A3
Gasket (item 164, Appx E) M109A4/M109A5

Equipment Condition
Vehicle MASTER switch to ON (TM 9–2350–311–10)
Cab POWER switch to ON (TM 9–2350–311–10)
TRAVERSE CONTROL switch to MANUAL (TM 9–2350–311–10)

A

1. Remove four screws (1) (M109A4/M109A5), or two bolts (1) (M109A2/M109A3), access cover (2), and gasket (3) from mechanical housing (4).
2. Turn TRAVERSE CONTROL switch to POWER.

Does gearshaft assembly move?

yes

no

Adjust round nuts on gearshaft assembly (para 9–3 or 9–4).

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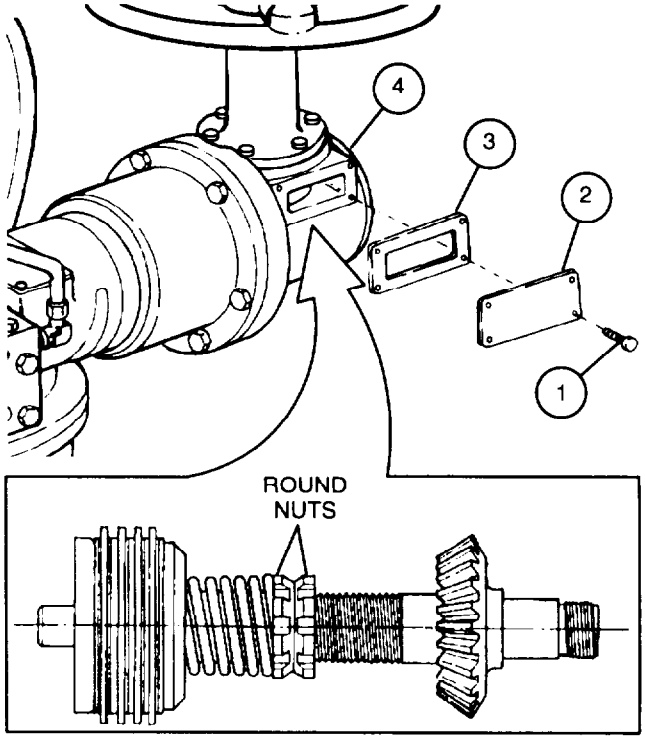


B Disassemble no-back bearing (para 9–2) and check for damaged components.

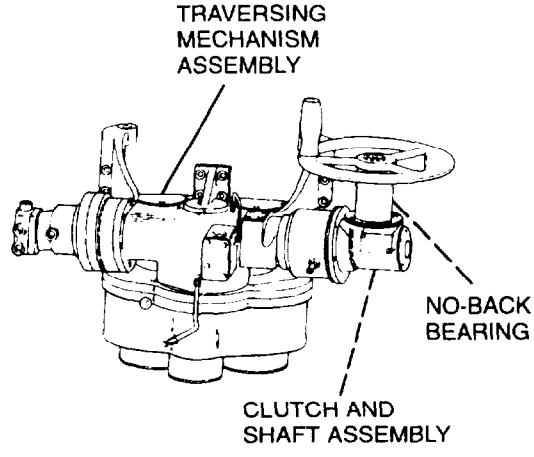
Are components of no-back bearing damaged?

yes

Repair or replace no-back bearing (para 9–2).

no

Repair or replace clutch and gear shaft assembly (para 9–3 or 9–4).



END OF TASK

2-23 TROUBLESHOOTING CHART — CONTINUED

c. CAB TRAVERSING SYSTEM — CONTINUED

(2.1) CAB WILL NOT TRAVERSE UNDER POWER, MANUAL OPERATION IS NORMAL.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Gasket (item 164, Appx E)

Equipment Condition
Vehicle MASTER switch to ON (TM 9-2350-311-10)
Cab POWER switch to ON (TM 9-2350-311-10)
TRAVERSE CONTROL switch to MANUAL (TM 9-2350-311-10)

A

1. Remove four screws (1) (M109A4/M109A5), or two bolts (1) (M109A2/M109A3), access cover (2), and gasket (3) from mechanical housing (4).
2. Turn TRAVERSE CONTROL switch to POWER.

Does gearshaft assembly move?

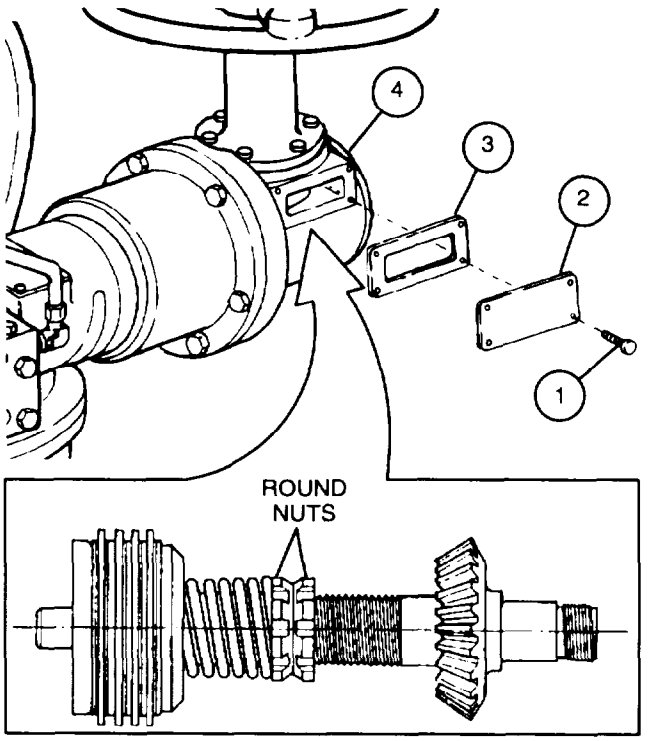
yes

Repair traversing mechanism assembly (para 9-1).

no

Adjust round nuts on gearshaft assembly (para 9-3 or 9-4).

END OF TASK



c. CAB TRAVERSING SYSTEM - CONTINUED

(3) CAB WILL NOT TRAVERSE FREELY IN MANUAL OR POWER MODES.

INITIAL SETUP

Tools

Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

A Inspect traversing mechanism assembly for proper installation (para 9–1).

Is traversing mechanism assembly installed properly?

yes

no

Install traversing mechanism assembly properly (para 9–1).

B Check to ensure block is not binding on gearshaft (para 14–4).

Is block binding on gearshaft?

yes

no

Adjust block (para 14–4).

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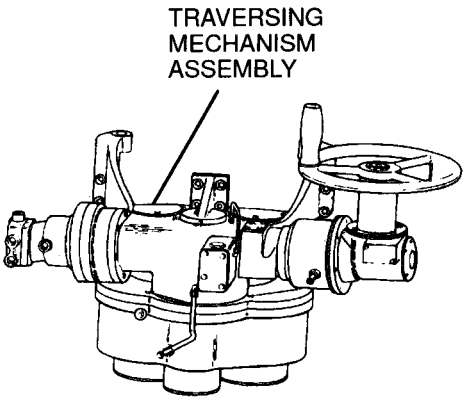
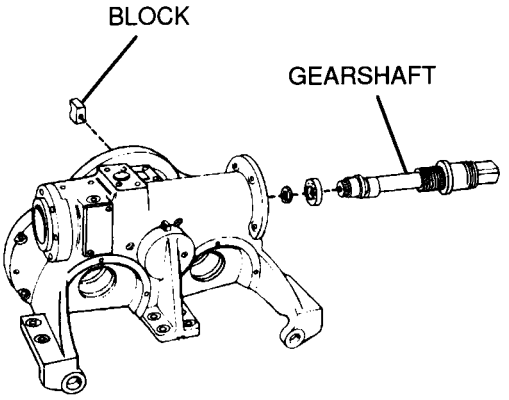




2-23 TROUBLESHOOTING CHART - CONTINUED

c. CAB TRAVERSING SYSTEM - CONTINUED

(3) CAB WILL NOT TRAVERSE FREELY IN MANUAL OR POWER MODES. - CONTINUED

CONTINUED FROM STEP B

C Inspect traversing mechanism assembly for damaged components (para 14–4).

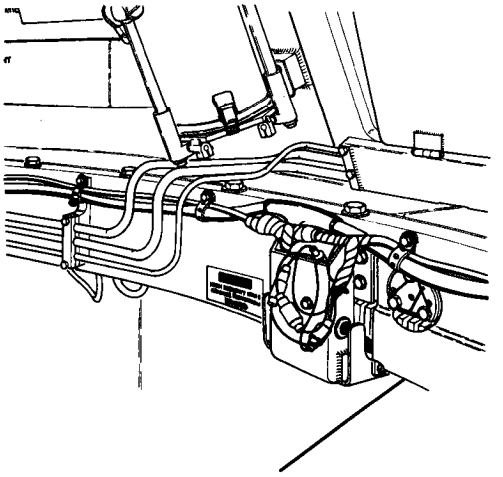
Are components of traversing mechanism assembly damaged?

yes

Repair or replace traversing mechanism assembly (para 14–4).

no

Inspect and repair bearing/race ring assembly (Chapter 4).



BEARING/RACE RING ASSEMBLY

END OF TASK

c. CAB TRAVERSING SYSTEM - CONTINUED (4) CAB CREEPS.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

References
TM 9-2350-311-20-2

A Inspect fluid filter element of power pack assembly (M109A2/M109A3 howitzers) (para 6–1) or inspect filter elements (M109A4/M109A5 howitzers) (TM 9–2350–311–20–2).

Are filter elements contaminated?

yes

Replace fluid filter element (M109A2/M109A3 howitzer) (para 6–1) or replace filter elements (M109A4/M109A5 howitzer) (TM 9–2350–311–20–2).

no

B Check position of gunner's control handle.

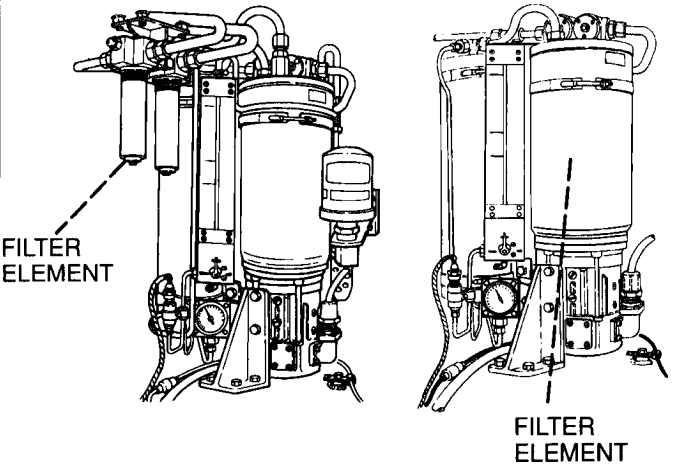
Is gunner's control handle in neutral position?

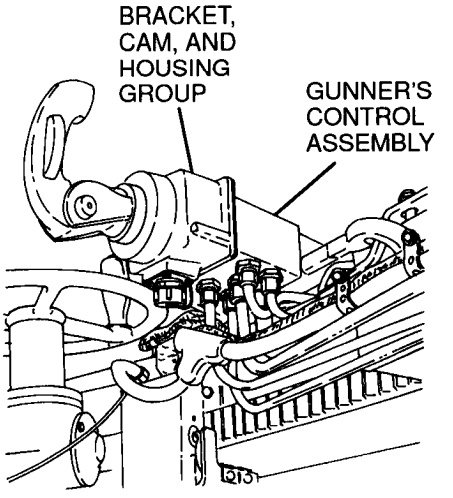
yes

Repair or replace gunner's control assembly (para 6–18).

no

Repair bracket, cam, and housing group (para 6–19) and gunner's control assembly (para 6–18).





END OF TASK

2-23 TROUBLESHOOTING CHART - CONTINUED

c. CAB TRAVERSING SYSTEM - CONTINUED

(5) HANDWHEEL SLIPS WHEN OPERATED MANUALLY.

INITIAL SETUP

Tools

Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

A Disassemble handwheel assembly and no-back bearing and check for damaged or missing components (para 9–2).

Are any components damaged or missing?

yes → Replace missing components and repair or replace damaged components (para 9–2).

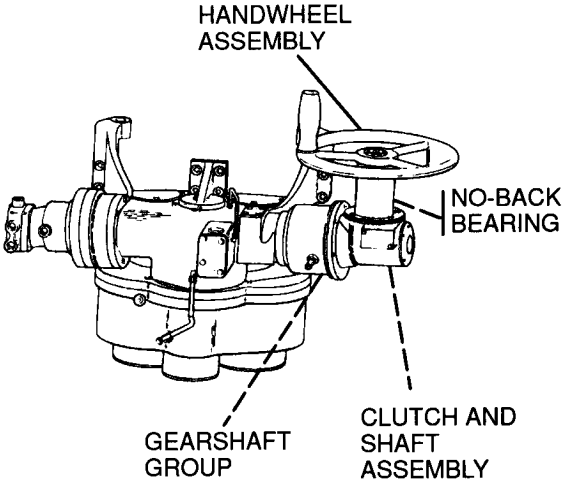
no →

B Inspect clutch and shaft assembly for damage (para 9–3 or 9–4).

Is clutch and shaft assembly damaged?

yes → Repair or replace clutch and shaft assembly (para 9–3 or 9–4).

no → Inspect and repair gearshaft group of traversing mechanism assembly (para 14–4).



END OF TASK

c. CAB TRAVERSING SYSTEM - CONTINUED

(6) GUNNER'S CONTROL HANDLE BINDS WHEN TRAVERSING.

INITIAL SETUP

Tools

Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

A Inspect gunner's control assembly for defective ball bearing (para 6–19).

Is ball bearing defective?

yes

Replace ball bearing (para 6–19).

no

B Inspect gunner's control assembly for damaged components (para 6–18).

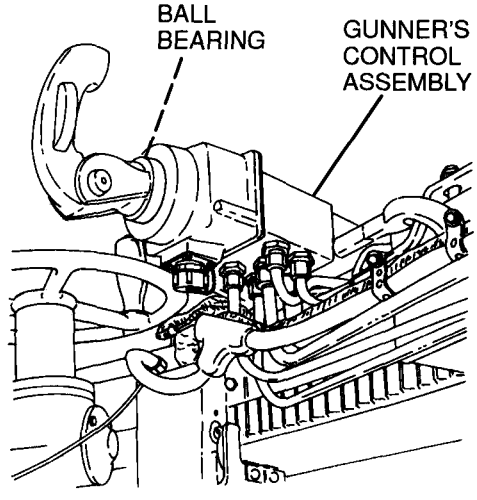
Are components of gunner's control assembly damaged?

yes

Repair or replace gunner's control assembly (para 6–18).

no

Check to ensure gunner's control assembly is properly assembled (para 6–18).



END OF TASK

2-23 TROUBLESHOOTING CHART - CONTINUED

c. CAB TRAVERSING SYSTEM - CONTINUED

(7) NOISY OPERATION WHILE TRAVERSING.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

References
TM 9-2350-311-10
TM 9-2350-311-20-2

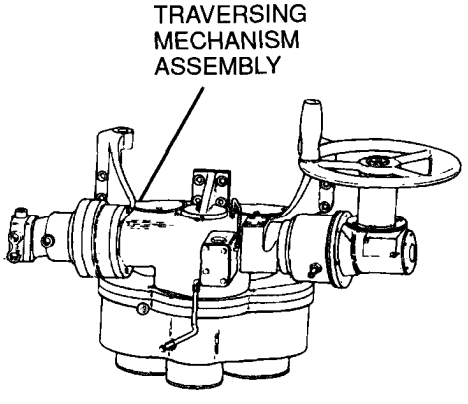
A Inspect traversing mechanism assembly for proper installation (para 9–1).

Is traversing mechanism assembly installed properly?

yes

no

Install traversing mechanism assembly properly (para 9–1).



B Traverse cab (TM 9–2350–311–10) and listen to identify the location of the noise.

Is noise coming from bearing/race ring assembly?

yes

no

Clean and lubricate bearing/race ring assembly (TM 9–2350–311–20–2).

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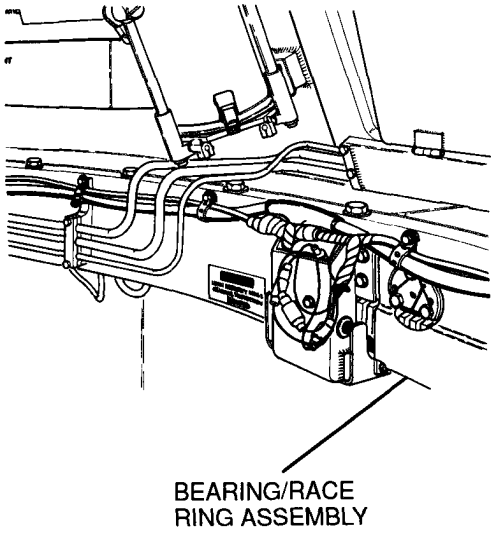


CONTINUED FROM STEP B

C Traverse cab in power mode (TM 9–2350–311–10) and listen to identify the location of the noise.

Is noise coming from the hydraulic motor?

yes

Repair or replace hydraulic motor (para 14–5).

no

D Traverse cab manually (TM 9–2350–311–10) and listen to identify the location of the noise.

Is noise coming from manual side of traversing mechanism assembly?

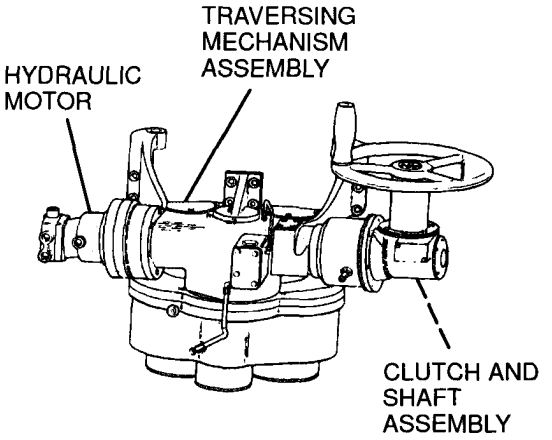
yes

Repair or replace clutch and shaft assembly (para 9–3 or 9–4).

no

Inspect and repair traversing mechanism assembly (para 14–4).

END OF TASK



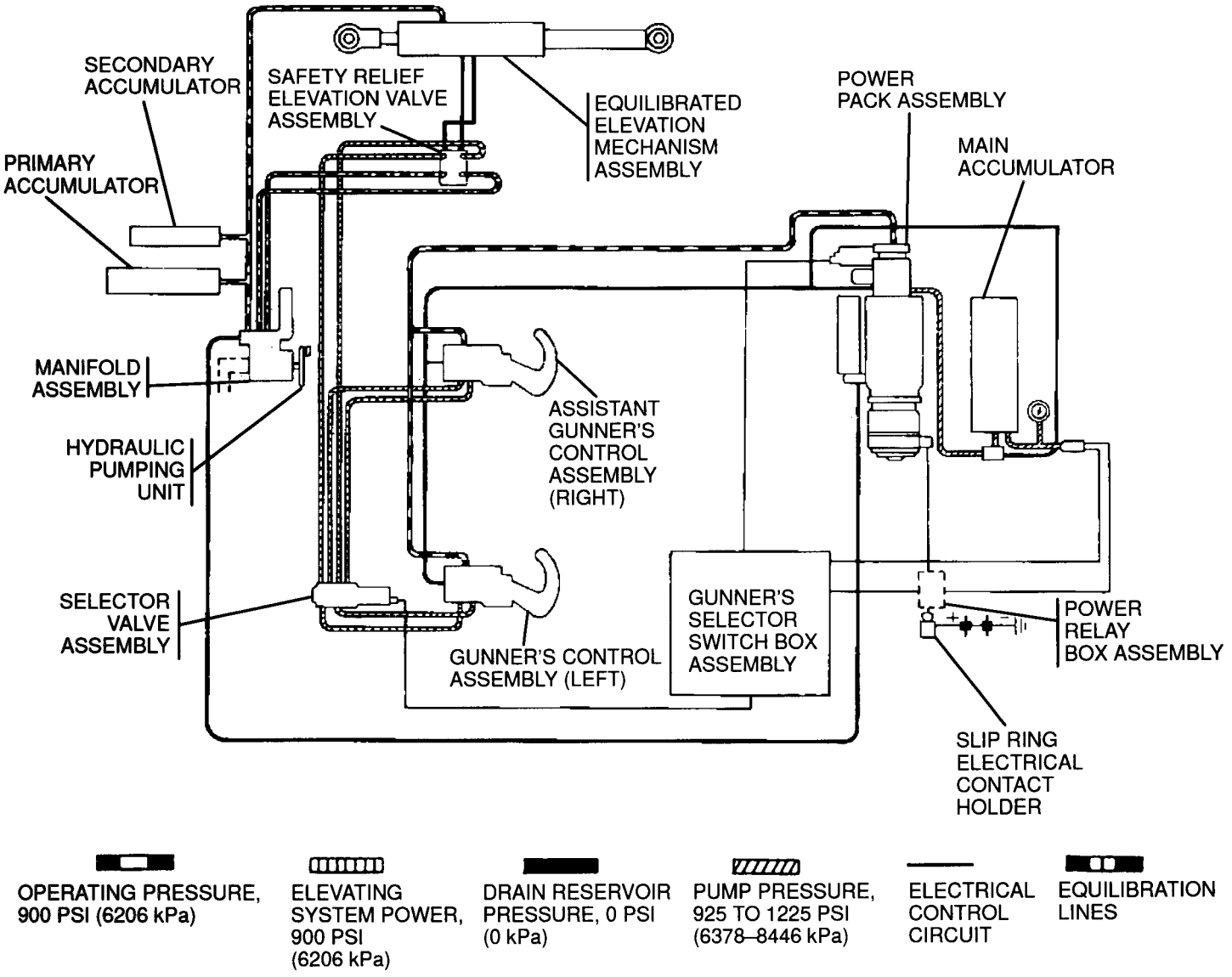
2-23 TROUBLESHOOTING CHART - CONTINUED

d. ELEVATING SYSTEM

The elevating system consists of a gunner's selector switch box assembly, assistant gunner's control assembly, gunner's control assembly, selector valve assembly, hydraulic pumping unit, manifold assembly, primary accumulator, secondary accumulator, safety relief elevation valve assembly, and the equilibrated elevation mechanism assembly.

The gunner's selector switch box assembly is used to electrically switch between power and manual elevation through the selector valve assembly. The selector valve assembly allows for the powered elevation control from either of gunner's control assemblies. The gunner's control assembly hydraulically operates the equilibrated elevation mechanism assembly through the safety relief elevation valve assembly.

The equilibrated elevation mechanism assembly can also be operated manually using the hydraulic pumping unit at the manifold assembly. Hydraulic pressure is supplied by the primary and secondary accumulators and through the equilibration lines.



d. ELEVATING SYSTEM — CONTINUED

(1) CANNON DOES NOT ELEVATE OR DEPRESS SMOOTHLY.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180–95–CL–A12)

References
TM 9–2350–311–20–2

A Inspect bearings and headed grooved pins in equilibrated elevation mechanism assembly eyes for damage (para 6–11).

Are bearings or headed grooved pins damaged?

yes → Replace bearings or headed grooved pins (para 6–11).

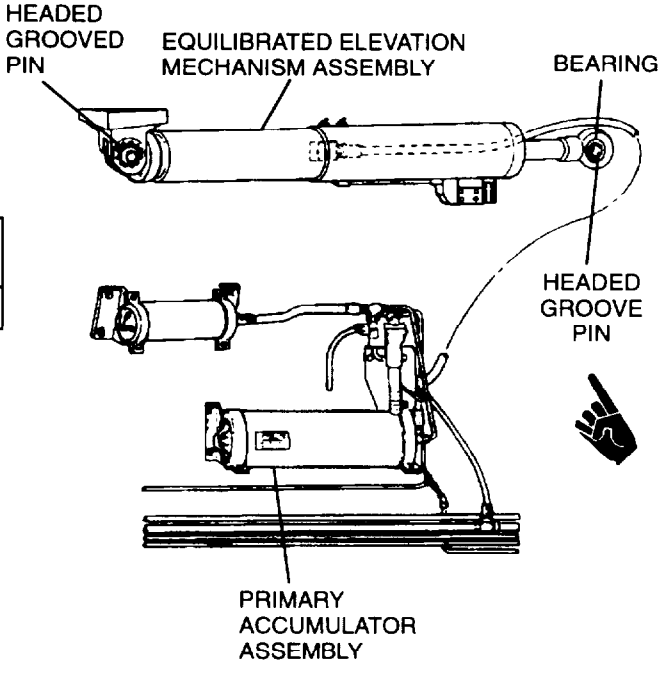
no →

B Check nitrogen pressure in primary accumulator assembly (TM 9–2350–311–20–2).

Is pressure between 850 to 900 psi (5861 to 6206 kPa)?

yes →

no → Charge primary accumulator assembly (TM 9–2350–311–20–2). If charge does not hold, repair or replace primary accumulator assembly (para 6–8).



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2-23 TROUBLESHOOTING CHART — CONTINUED

d. ELEVATING SYSTEM — CONTINUED

(1) CANNON DOES NOT ELEVATE OR DEPRESS SMOOTHLY. — CONTINUED

CONTINUED FROM STEP B

C Check nitrogen pressure in secondary accumulator assembly (TM 9-2350-311-20-2).

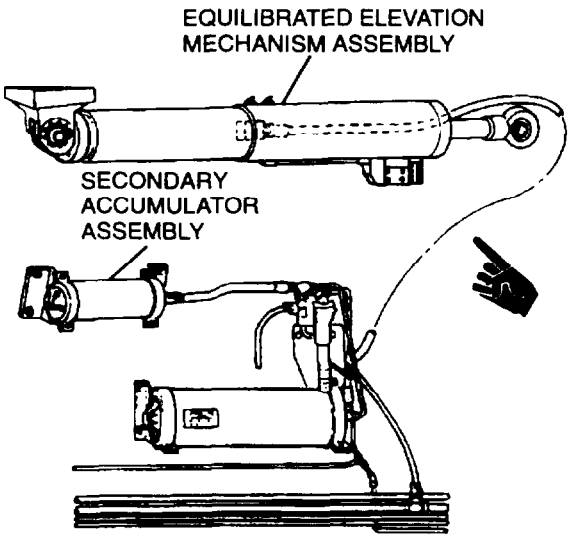
Is pressure between 1450 to 1550 psi (9998 to 10687 kPa)?

yes

no

Charge secondary accumulator assembly (TM 9-2350-311-20-2). If charge does not hold, repair or replace secondary accumulator assembly (para 6-9).

Repair or replace equilibrated elevation mechanism assembly (para 6-11).



END OF TASK

d. ELEVATING SYSTEM — CONTINUED (2) CANNON CREEPS UP OR DOWN.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Utility pail (item 11, Appx F)

References
TM 9-2350-311-10
TM 9-2350-311-20-2

A 1. Bleed air from hydraulic system (TM 9-2350-311-20-2).
2. Elevate and depress cannon assembly (TM 9-2350-311-10).

Does cannon assembly creep?

yes → **B**

no → Verify fault is corrected. Continue normal operations.

B Check hydraulic lines and fittings from equilibrated elevation mechanism assembly (TM 9-2350-311-20-2).

Are there any leaks?

yes → Tighten loose connections and replace damaged lines (TM 9-2350-311-20-2).

no → **C**

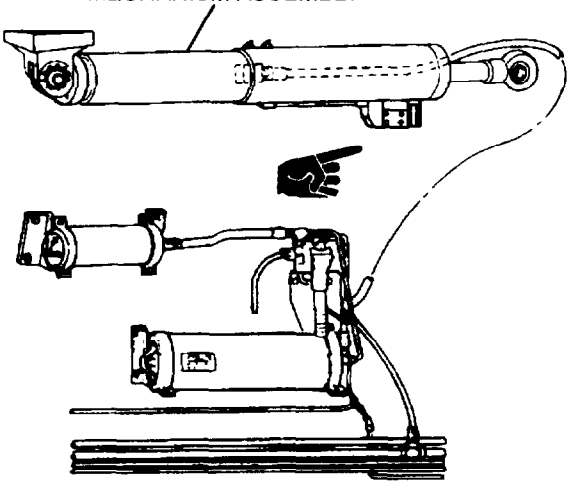
C Check gunner's and assistant gunner's control assemblies for improperly adjusted or disconnected connecting link.

Is connecting link improperly adjusted or disconnected?

yes → Repair or replace control assemblies (para 6-18).

no → CONTINUED ON NEXT PAGE

EQUILIBRATED ELEVATION MECHANISM ASSEMBLY



2-23 TROUBLESHOOTING CHART — CONTINUED

d. ELEVATING SYSTEM — CONTINUED

(2) CANNON CREEPS UP OR DOWN. — CONTINUED

CONTINUED FROM STEP C

D 1. Elevate and depress cannon assembly (TM 9-2350-311-10).
2. Observe hydraulic pressure of power pack assembly.

Is pressure normal?

yes

no — Troubleshoot hydraulic system (para 2-23e.).

E Observe equilibrated elevation mechanism assembly for leaks or damage (para 6-11)?

Does the equilibrated elevation mechanism assembly show signs of leaks or damage?

yes — Repair or replace equilibrated elevation mechanism assembly (para 6-11).

no

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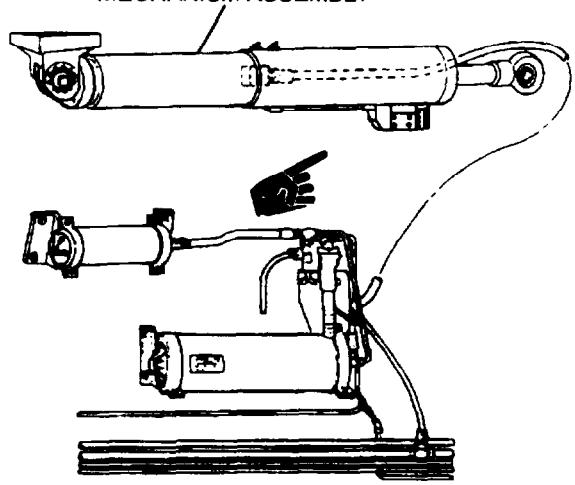
EQUILIBRATED ELEVATION MECHANISM ASSEMBLY



CONTINUED FROM STEP E

F Check nitrogen pressure in primary accumulator assembly (TM 9–2350–311–20–2).

Is pressure between 850 to 900 psi (5861 to 6206 kPa)?

yes

no

Charge primary accumulator assembly (TM 9–2350–311–20–2). If charge does not hold, repair or replace primary accumulator assembly (para 6–8).

G Check nitrogen pressure in secondary accumulator assembly (TM 9–2350–311–20–2).

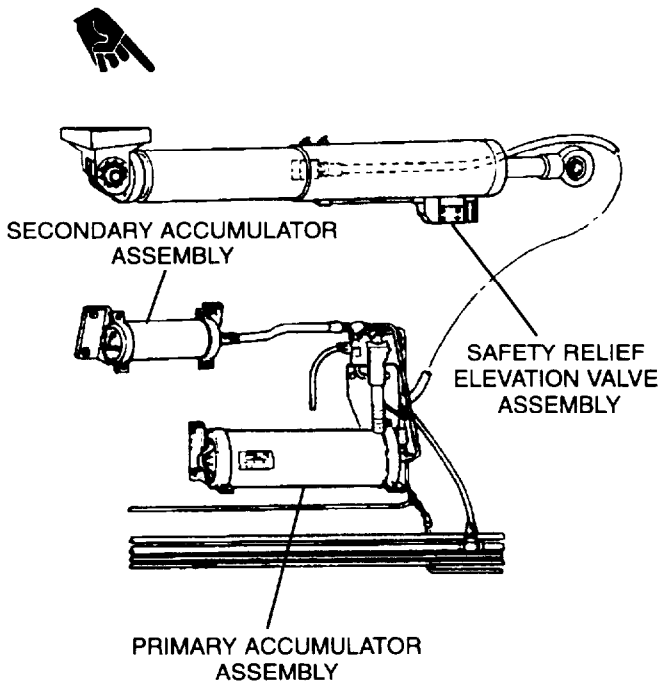
Is pressure between 1450 to 1550 psi (9998 to 10687 kPa)?

yes

no

Charge secondary accumulator assembly (TM 9–2350–311–20–2). If charge does not hold, repair or replace secondary accumulator assembly (para 6–9).

Replace safety relief elevation valve assembly (para 6–12).



END OF TASK

2-23 TROUBLESHOOTING CHART — CONTINUED

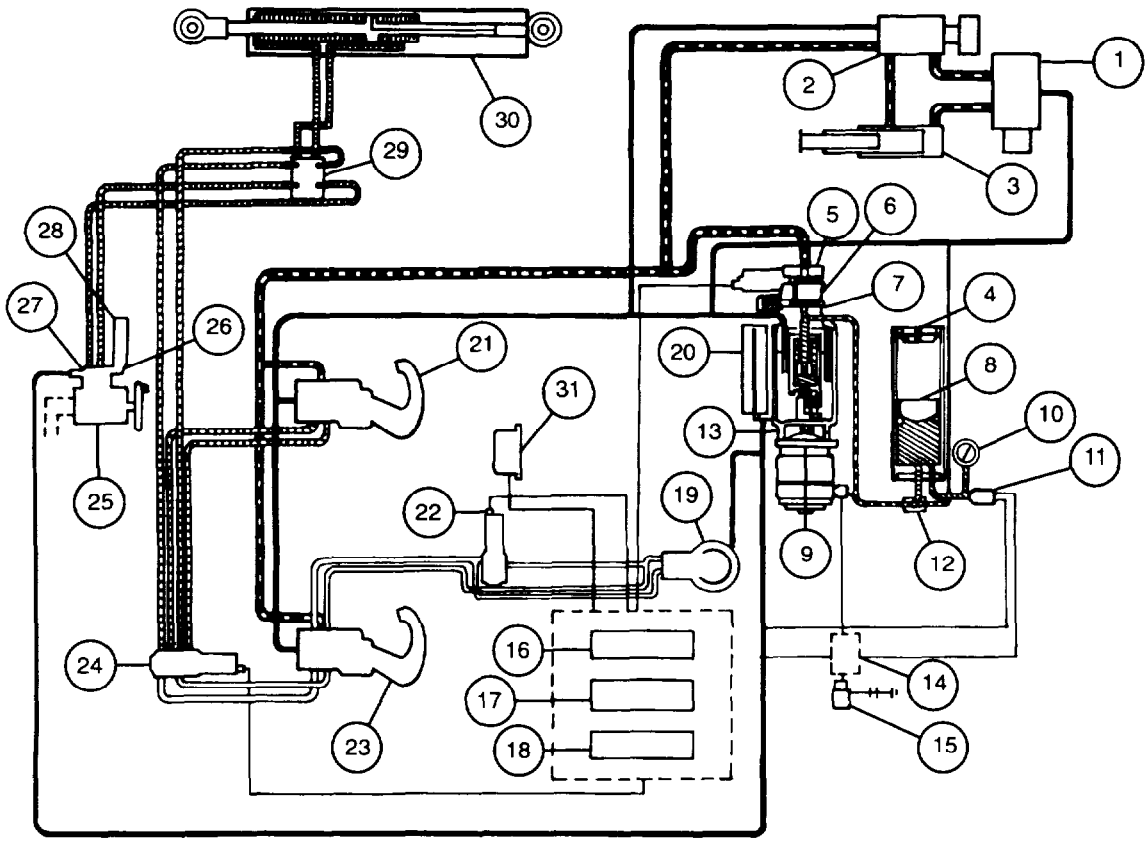
e. CAB HYDRAULIC SYSTEM

The cab hydraulic system consists of the hydraulic components of the cab elevating system, the cab traversing system, the hydraulic pump, the main accumulator, and the electrical contacts to the hull.

The hydraulic system receives electrical power through the slip ring brush holder and power relay box assembly. Electricity is provided to the gunner's selector switch box assembly, the hydraulic pump, and the main accumulator pressure switch.

Hydraulic power is provided to the system by way of the pressure regulator, power valve, and power pack assembly.

Other components include sight gage assembly, pump reservoir, and system pressure gage.



OPERATING PRESSURE, 900 PSI (6206 kPa)

ELEVATING SYSTEM POWER

DRAIN RESERVOIR PRESSURE, 0 PSI (0 kPa)

PUMP PRESSURE, 925 TO 1225 PSI (6378–8446 kPa)

ELECTRICAL CONTROL CIRCUIT

TRAVERSING SYSTEM POWER

CAB HYDRAULIC SYSTEMS (M109A2/M109A3 HOWITZERS)

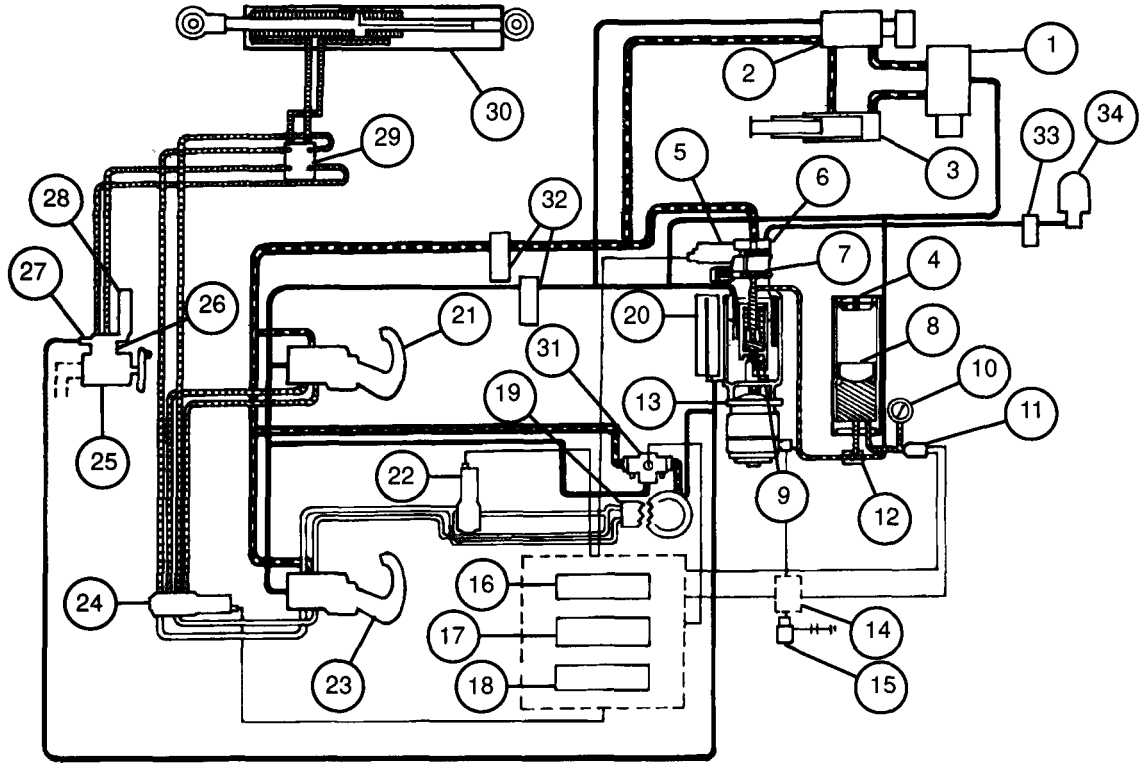
LEGEND:

1. Rammer blocking valve
2. Rammer actuating valve
3. Rammer assembly
4. Main accumulator
5. Power pack assembly
6. Power valve
7. Pressure regulator
8. Cylinder
9. Pump
10. Pressure gage (2000 psi (13790 kPa))
11. Pressure switch (925 to 1225 psi (6378 to 8446 kPa))
12. Safety relief valve
13. Reservoir
14. Power relay box assembly
15. Slip ring electrical contact holder
16. ELEVATION CONTROL switch
17. TRAVERSE CONTROL switch
18. CAB POWER switch
19. Traversing mechanism hydraulic motor
20. Sight gage assembly
21. Right gunner's control assembly
22. Hydraulic bypass valve assembly motor
23. Left gunner's control assembly
24. Selector valve assembly
25. Hydraulic pumping unit
26. Shuttle valve and manifold assemblies
27. Check valve
28. Manual elevation accumulator
29. Safety relief elevation valve assembly
30. Equilibrated elevation mechanism assembly
31. Clutch

2-23 TROUBLESHOOTING CHART - CONTINUED

e. CAB HYDRAULIC SYSTEM - CONTINUED

CAB HYDRAULIC SYSTEMS (M109A4/M109A5 HOWITZERS)



OPERATING PRESSURE, 900 PSI (6206 kPa)
ELEVATING SYSTEM POWER
DRAIN RESERVOIR PRESSURE, 0 PSI (0 kPa)
PUMP PRESSURE, 925 TO 1225 PSI (6378–8446 kPa)
ELECTRICAL CONTROL CIRCUIT
TRAVERSING SYSTEM POWER

LEGEND:

1. Rammer blocking valve
2. Rammer actuating valve
3. Rammer assembly
4. Main accumulator
5. Power pack assembly
6. Power valve
7. Pressure regulator
8. Cylinder
9. Pump
10. Pressure gage (2000 psi (13790 kPa))
11. Pressure switch (925 to 1225 psi (6378 to 8446 kPa))
12. Safety relief valve
13. Reservoir
14. Power relay box assembly
15. Slip ring electrical contact holder
16. ELEVATION CONTROL switch
17. TRAVERSE CONTROL switch
18. CAB POWER switch
19. Traversing mechanism hydraulic motor
20. Sight gage assembly
21. Right gunner's control assembly
22. Hydraulic motor bypass valve assembly motor
23. Left gunner's control assembly
24. Selector valve assembly
25. Hydraulic pumping unit
26. Shuttle valve and manifold assemblies
27. Check valve
28. Manual elevation accumulator
29. Safety relief elevation valve assembly
30. Equilibrated elevation mechanism assembly
31. Clutch valve
32. Hydraulic filters
33. Air line filter
34. Hydroscopic breather

e. CAB HYDRAULIC SYSTEM - CONTINUED	(1) HYDRAULIC PUMP MOTOR ON/OFF CYCLE IS RAPID.

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

A Inspect components of cover assembly for defects (para 6–2).

Are components of cover assembly defective?

yes

Repair or replace cover assembly (para 6–2).

no

B Inspect filter assembly (para 6–3) for M109A2/M109A3 howitzers or body assembly (para 6–4) for M109A4/M109A5 howitzers.

Are there any defects or does bearing ball jam in head?

yes

Repair or replace filter assembly (para 6–3) for M109A2/M109A3 howitzers or body assembly (para 6–4) for M109A4/M109A5 howitzers.

no

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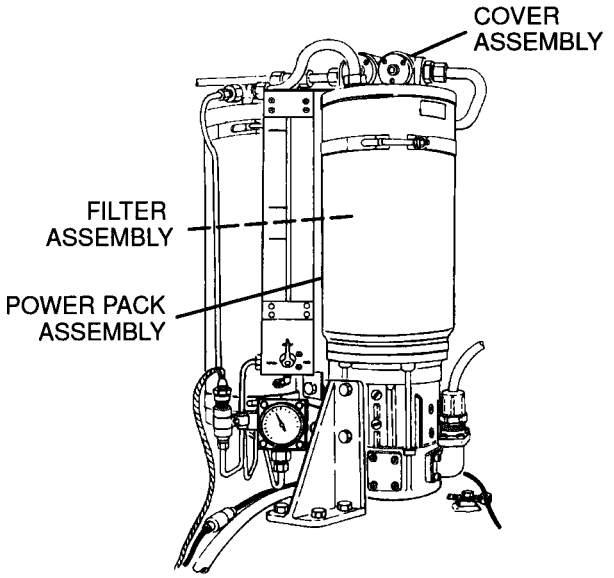
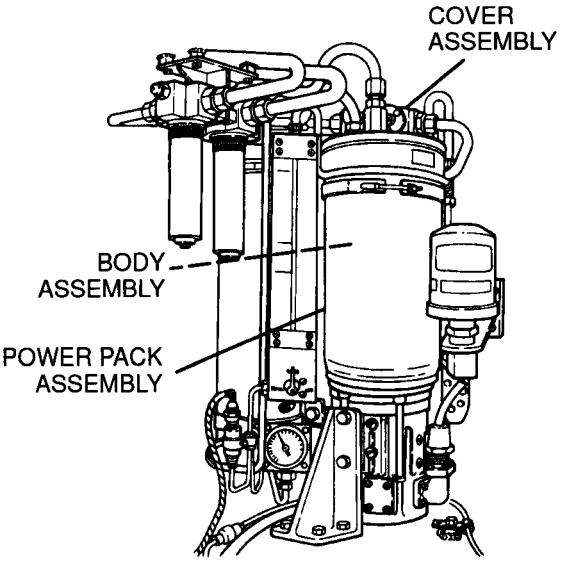


M109A2/M109A3 HOWITZERS

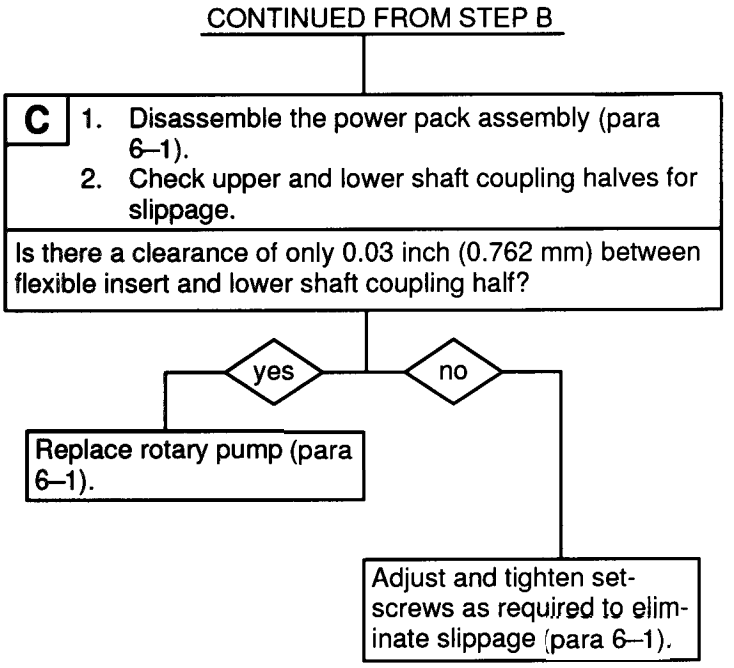


M109A4/M109A5 HOWITZERS

2-23 TROUBLESHOOTING CHART - CONTINUED

e. CAB HYDRAULIC SYSTEM - CONTINUED

(1) HYDRAULIC PUMP MOTOR ON/OFF CYCLE IS RAPID. - CONTINUED



END OF TASK

e. CAB HYDRAULIC SYSTEM — CONTINUED

(2) GUNNER'S OR ASSISTANT GUNNER'S CONTROL HANDLE DOES NOT RETURN TO NEUTRAL POSITION WHEN RELEASED.

INITIAL SETUP

Tools

Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

A Identify model of howitzer.

Is howitzer an M109A2 or M109A3?

yes / no

no → Go to step C.

B Inspect fluid filter element of power pack assembly (para 6-1).

Is fluid filter element contaminated?

yes / no

yes → Repair and/or replace fluid filter element (para 6-1).

C Inspect control assembly for damaged or unserviceable parts (para 6-18).

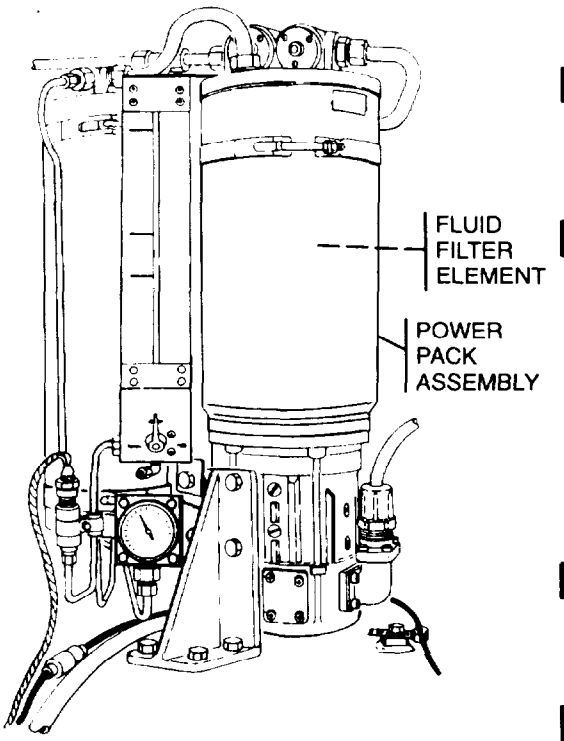
Are components of control assembly defective?

yes / no

yes → Repair and/or replace faulty control (para 6-18).

no → Drain hydraulic system (TM 9-2350-311-20-2).
Replace filter elements (para 6-3).
Fill and charge system (TM 9-2350-311-20-2).
Verify fault is corrected.

END OF TASK



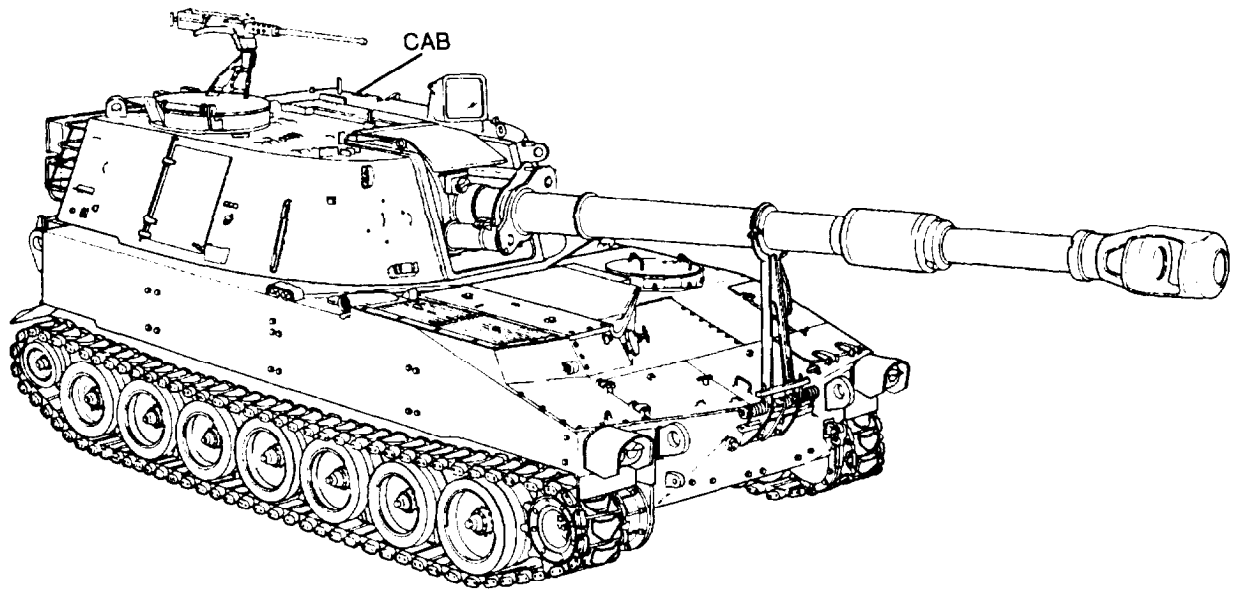
M109A2/M109A3 HOWITZERS

CHAPTER 3
DIRECT SUPPORT MAINTENANCE OF CAB

GENERAL

This chapter illustrates and describes removal and installation of cab. These procedures are functions authorized for direct support level maintenance.

CONTENTS



CAB

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Fabricated cab stand (Figure C-4, Appx C)
Sling, turret lifting (item 21, Appx F)
Tape (item 35, Appx B)

Materials/Parts
Self-locking bolts (27) (item 90, Appx E)
Self-locking bolts (3) (item 91, Appx E)

Personnel Required
3

Equipment Condition
Park vehicle on level ground
Vehicle MASTER switch to OFF (TM 9-2350-311-10)
CAB POWER switch to OFF (TM 9-2350-311-10)
Disconnect battery ground cable (TM 9-2350-311-20-1)
Discharge hydraulic pressure (TM 9-2350-311-20-2)
Traversing mechanism cover plate removed (TM 9-2350-311-20-2)
Turret lock assembly removed (TM 9-2350-311-20-2)
Turret (cab) bearing protective shields removed (TM 9-2350-311-20-2)
Gunners control bracket removed (TM 9-2350-311-20-2)

a. Removal

1 Manually elevate cannon assembly (1) to maximum elevation. Remove three self-locking bolts (2) from bottom of trunnion support bracket outside cab. Depress cannon assembly to maximum depression. Discard self-locking bolts.

2 Drain hydraulic system (TM 9-2350-311-20-2).

3 Remove traversing mechanism (3) (para 9-1).

NOTE

Do not disconnect electrical cables from contact arm assemblies in step 4. Lay contact arm assemblies on top of cab electrical contact segment ring. Secure contact arm assemblies with tape.

4 Remove contact arm assemblies (4) (TM 9-2350-311-20-2).

5 Remove 27 self-locking bolts (5) and 27 flat washers (6). Discard self-locking bolts.

WARNING

- Use a lifting device with a capacity of at least 15,000 pounds (6804 kg) to avoid possible injury or death. A lifting device with insufficient lifting capacity could break due to stress.
- Personnel should wear steel-tipped safety shoes and safety glasses to avoid possible injury.

6 Position fabricated cab stand (7) adjacent to cab (8). Position shackles (9) and turret lifting sling (10) behind cab and fabricated cab stand.

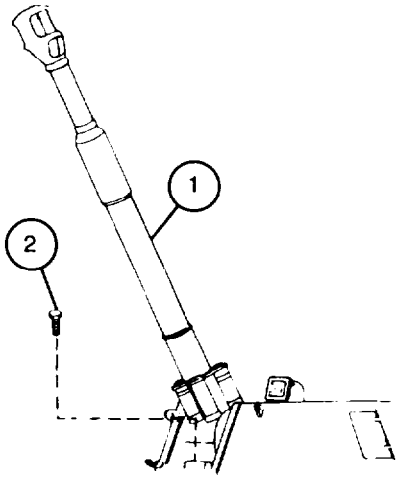
NOTE

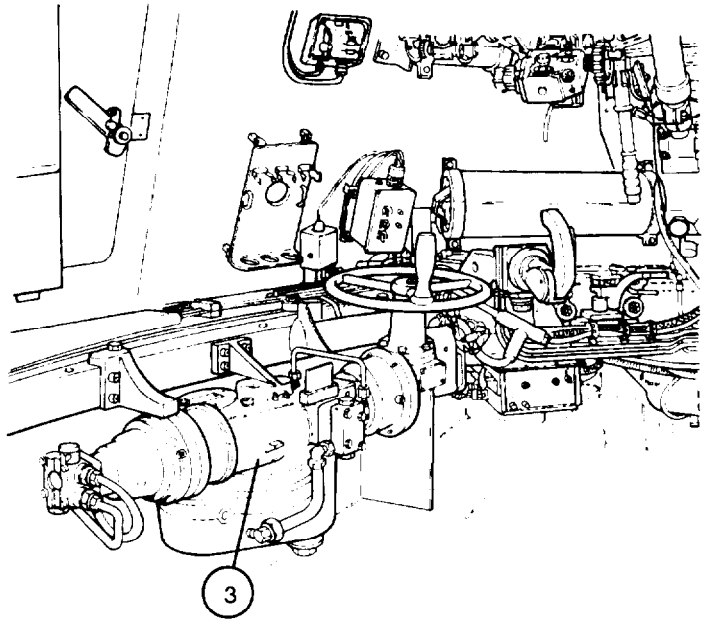
Make sure shackles are attached either to both forward or both aft lifting eyes. This procedure will allow adjustments for level attitude as cab is being lifted.

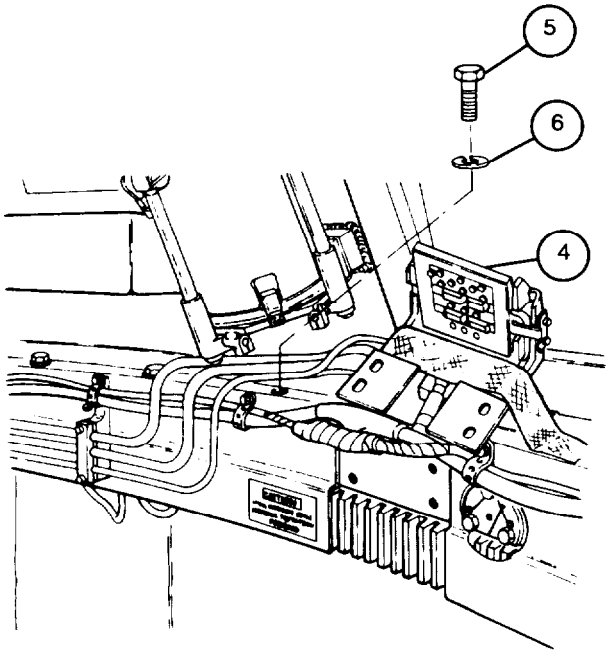
7 Attach four shackles (9) of the turret lifting sling (10) to four cab lifting eyes (11) as shown.

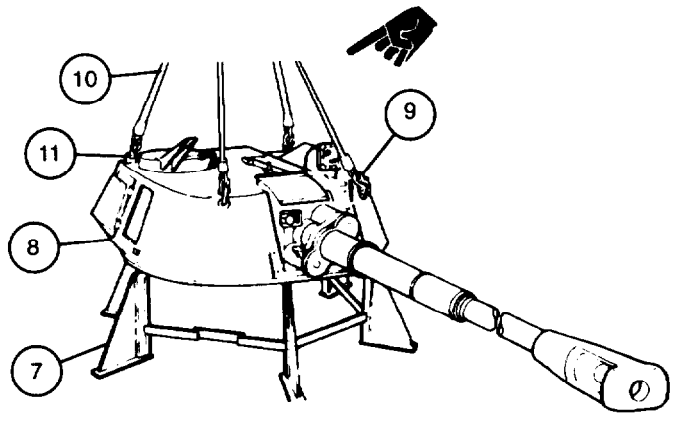
8 Raise cab (8) slowly and position on fabricated cab stand (7).

9 Detach four shackles (9) of the turret lifting sling (10).









CAB - CONTINUED

b. Installation

WARNING

- Use a lifting device with a capacity of at least 15,000 pounds (6804 kg) to avoid possible injury or death. A lifting device with insufficient lifting capacity could break due to stress.
- Personnel should wear steel-tipped safety shoes and safety glasses to avoid possible injury.

1 Attach four shackles (9) and turret lifting sling (10) to four cab lifting eyes (11) as shown.

2 Raise cab (8) slowly and position over hull (12).

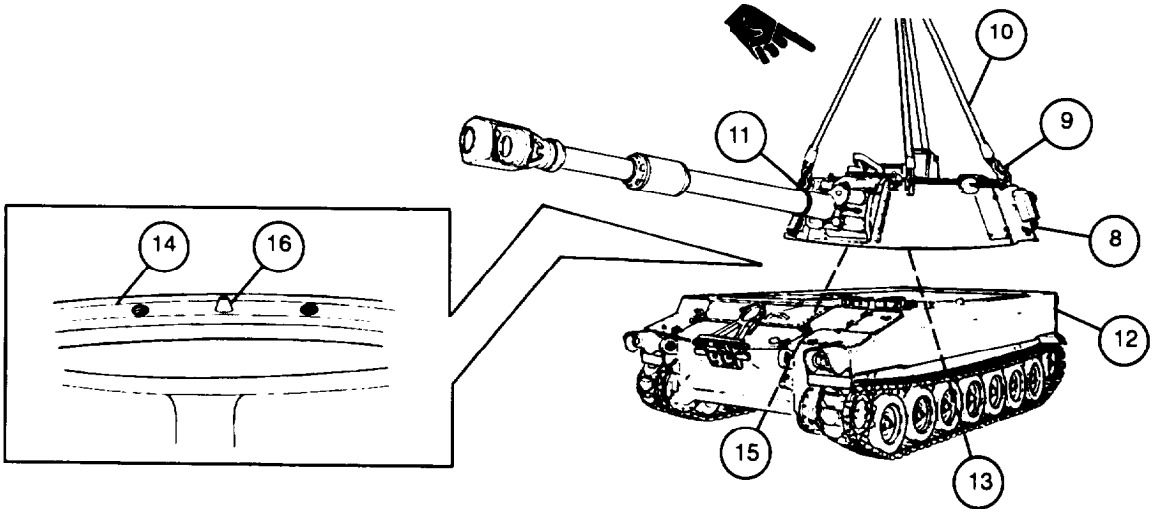
NOTE

A guide rope may be used to aline race ring alining pins with alining holes on race ring.

3 Aline bolt holes (13) in cab (8) with race assembly (14). Aline alining hole (15) with race locating pin (16).

4 Lower cab (8) onto hull (12) slowly.

5 Detach four shackles (9) and remove turret lifting sling (10) from four cab lifting eyes (11).



6 Install 27 flat washers (6) and 27 new self-locking bolts (5). Torque to 248-302 lb-ft (336-410 N·m).

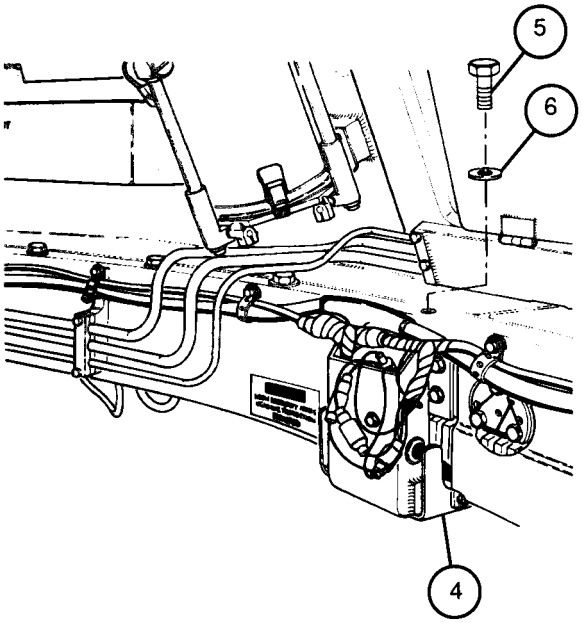
7 Untape contact arm assemblies (4) from top of electrical contact segment ring.

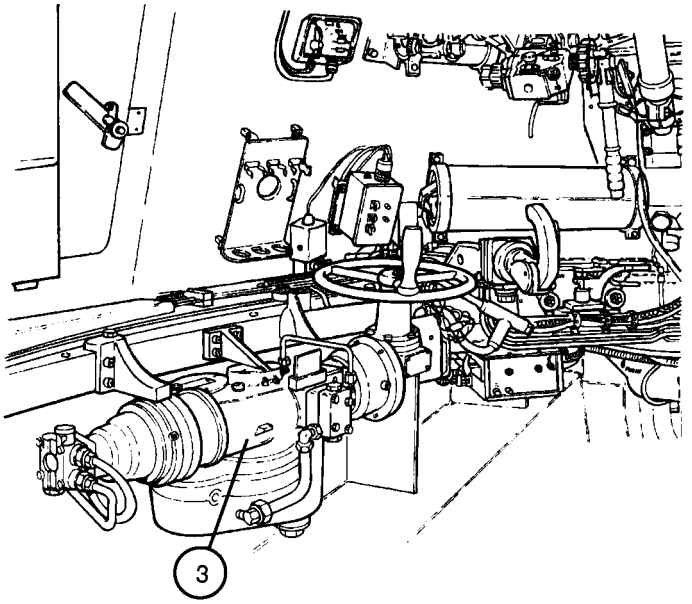
8 Install contact arm assemblies (4).

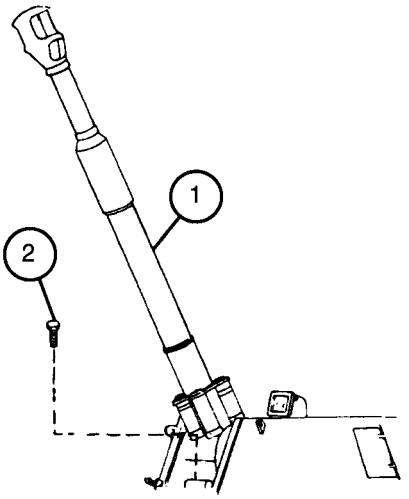
9 Install traversing mechanism (3) (para 9-1).

10 Fill hydraulic system (TM 9-2350-311-20-2).

11 Manually elevate cannon assembly (1) to maximum elevation. Install three new self-locking bolts (2) in bottom of trunnion bracket outside cab. Torque to 320 lb-ft (434 N·m).





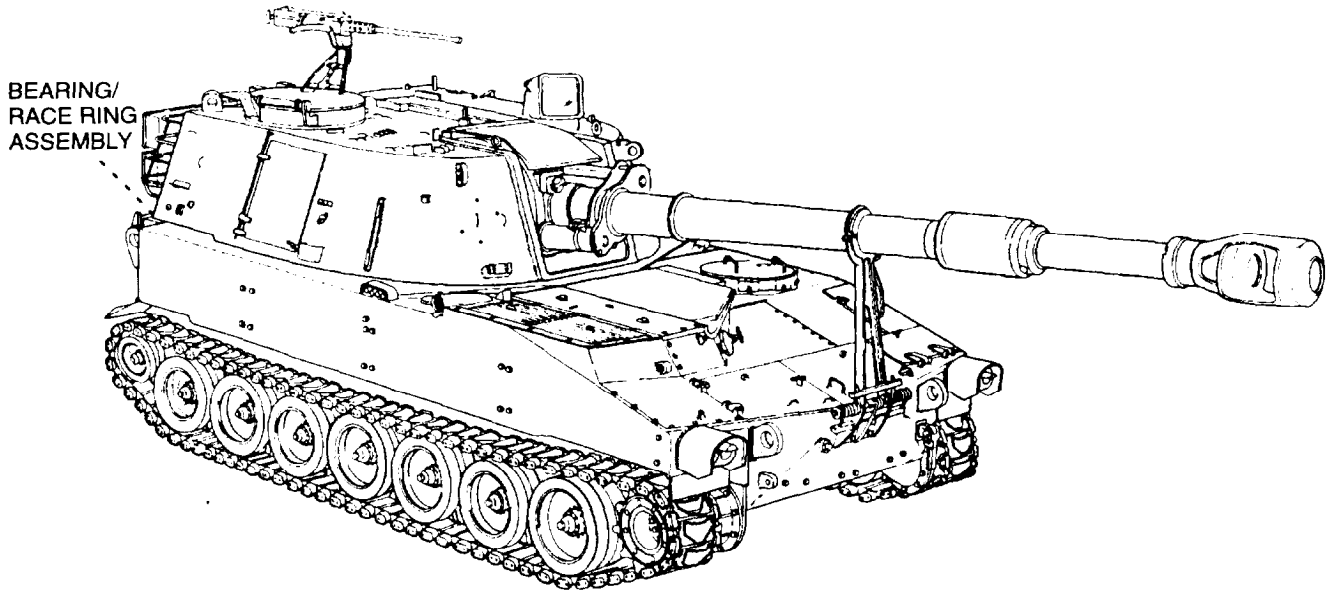


CHAPTER 4
DIRECT SUPPORT MAINTENANCE OF BEARING/RACE RING ASSEMBLY

GENERAL

This chapter illustrates and describes removal, disassembly, inspection and repair, assembly, and installation of the bearing/race ring assembly. These procedures are functions authorized for direct support level maintenance.

CONTENTS



BEARING/RACE RING ASSEMBLY

This task covers:
a. Removal
b. Disassembly
c. Inspection
d. Assembly
e. Installation

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Eye bolts (3) (item 4, Appx F)
Lubrication fittings (3) (item 9, Appx F)
Sling, turret lifting (item 21, Appx F)
Tweezers (item 26, Appx F)

Materials/Parts
Grease (item 21, Appx B)
Lockwire (item 36, Appx E)
Lockwire (item 39, Appx E)
Wooden blocks (3) (item 37, Appx B)

Personnel Required
3

Equipment Condition
Cab removed (Chapter 3)
Contact arm assemblies removed (TM 9-2350-311-20-2)

a. Removal

WARNING

Personnel should wear steel-tipped safety shoes and safety glasses to avoid possible injury.

NOTE

- Bearing/race ring assembly components vary between vehicles.
- Vehicles with five contact arm assemblies have bearing assemblies with these characteristics:

  212 bearing balls are separated by 106 race ring spacers.
- Not all vehicles with three contact arm assemblies have same race ring assembly components. Some vehicles have 212 bearing balls mounted on 106 race ring spacers. Other vehicles have 213 bearing balls mounted on 213 helical compression springs. When maintenance inspections call for replacement of bearing balls, helical compression springs are replaced by race ring spacers.
- Vehicles having three contact arm assemblies (which have not had helical compression springs replaced by race ring spacers) have these characteristics:

  213 bearing balls are separated by 213 helical compression springs.

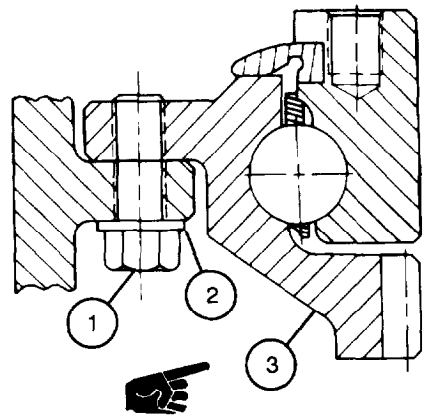
1 Remove 48 bolts (1) and 48 flat washers (2) from bottom of bearing/race ring assembly (3).

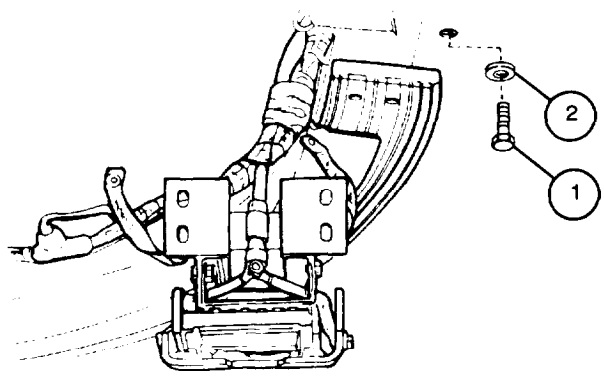
2 Install three eye bolts (4) in outer race (5) bolt holes at 120° intervals (every 16th hole) as shown.

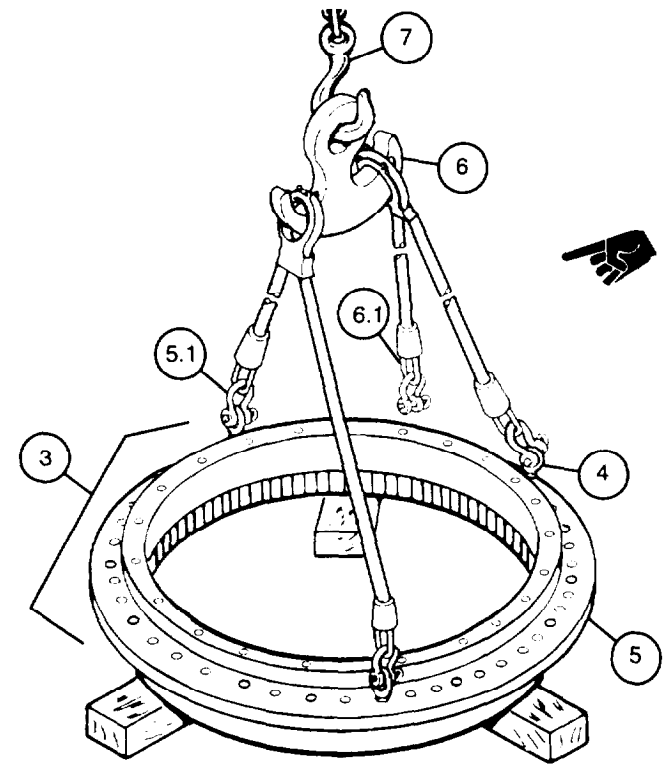
3 Attach three of the four shackles (5.1) of the turret lifting sling (6) to three eye bolts (4). Secure the fourth leg (6.1) of the lifting sling to its companion leg to prevent damage or injury. Attach hoist (7) to turret lifting sling as shown.

4 Lift bearing/race ring assembly (3) out of hull and position on wooden blocks as shown.

5 Detach hoist (7) and the three shackles (5.1) of the turret lifting sling (6). Remove three eye bolts (4).







BEARING/RACE RING ASSEMBLY - CONTINUED

b. Disassembly

1 Remove lockwire (8) and three cap screws (9) from inner race (10). Discard lockwire.

2 Screw two bolts into ball turret cover (11) guide holes (12) to remove ball turret cover from headless straight pin (13) on inner race (10).

NOTE

Some race ring assemblies have an inflatable seal held in place by a seal retainer,

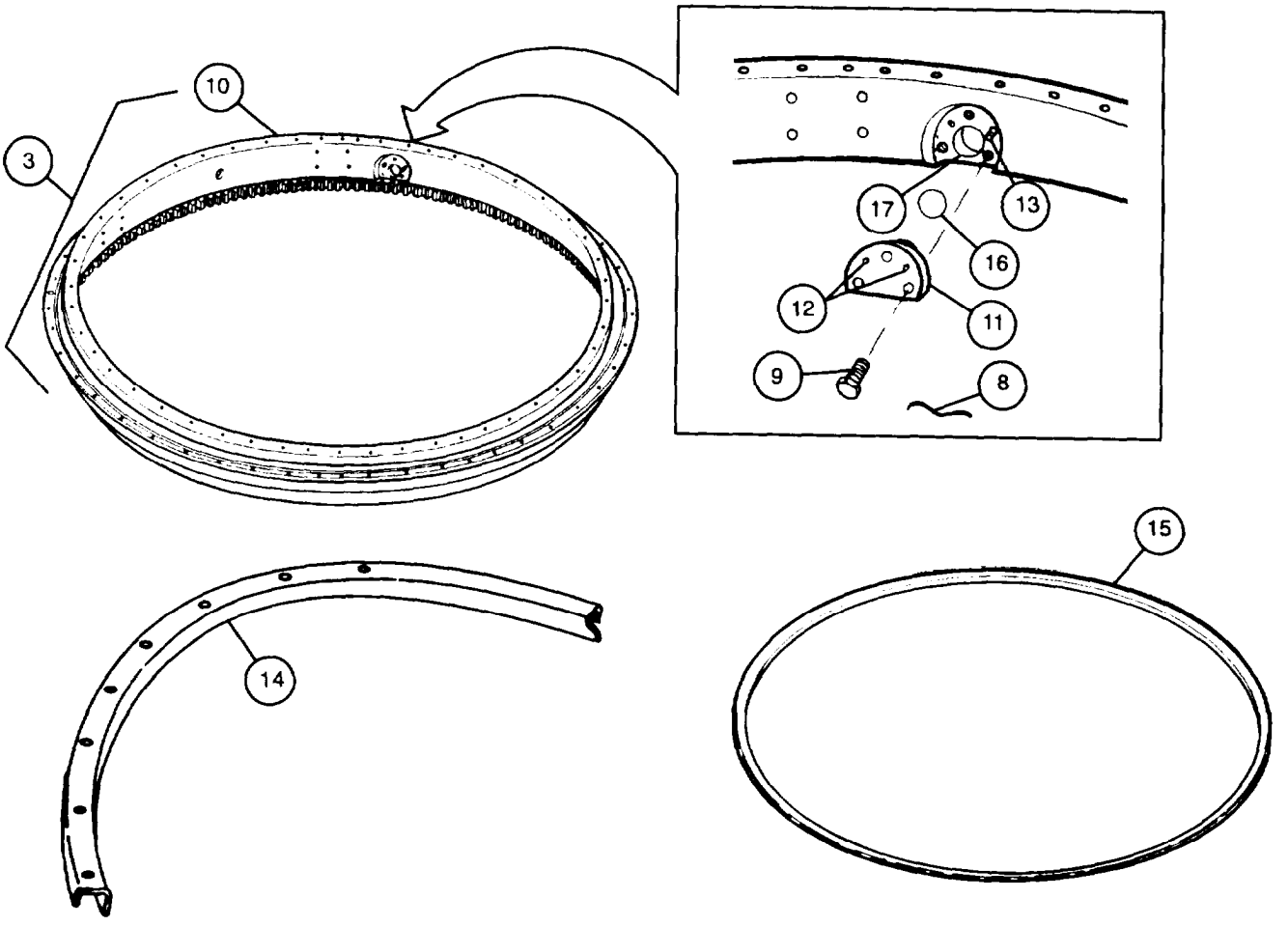
3 Remove seal retainer (14) if necessary.

4 Remove seal (15) from inner race (10).

NOTE

If bearing balls do not roll out of access hole easily, use long thin tweezers to pull bearing balls from access hole.

5 Rotate inner race (10) to remove 212 or 213 bearing balls (16) from access hole (17).

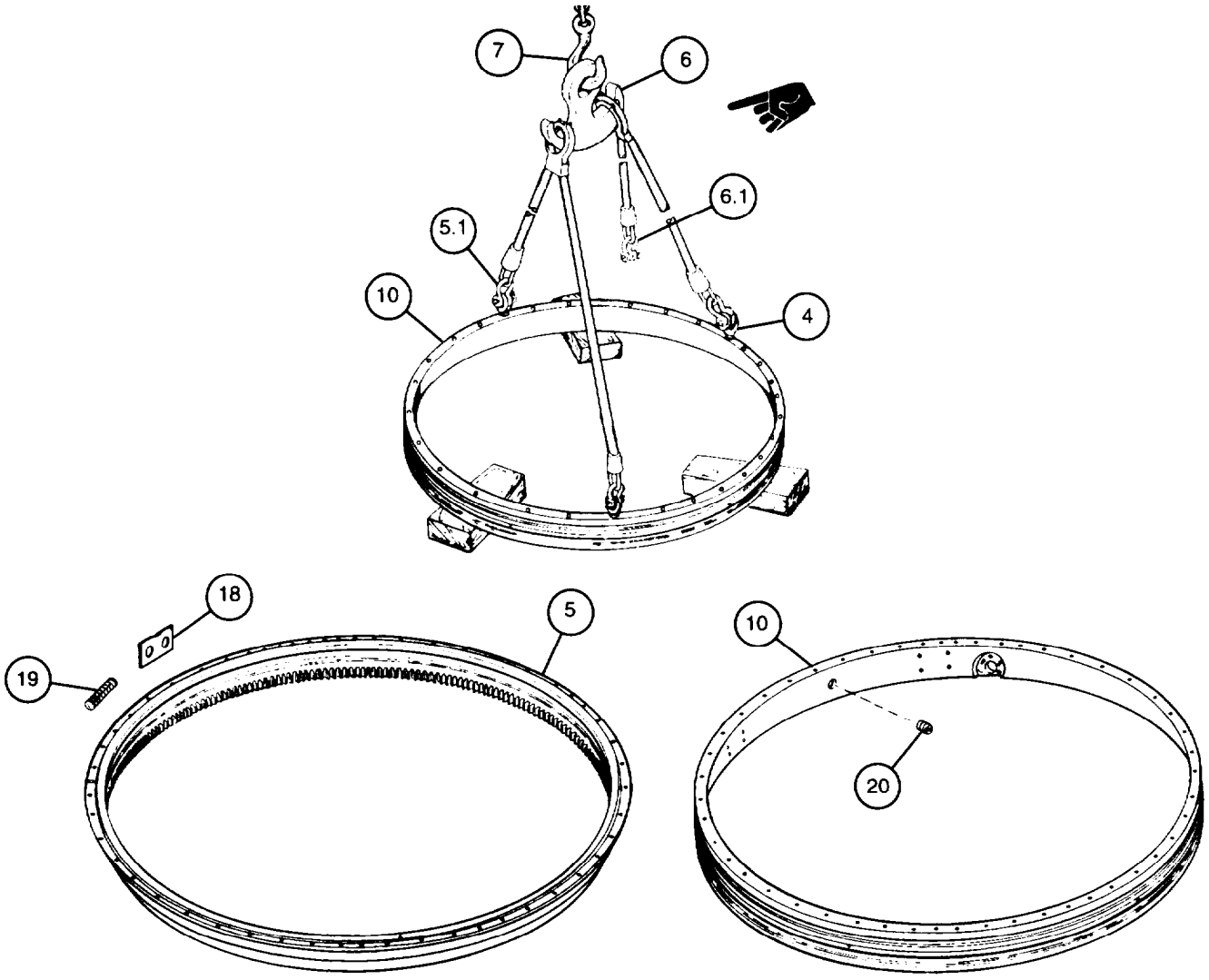


6 Attach three eye bolts (4) to inner race (10) at approximate 120° intervals (every 9th hole) as shown.

7 Attach three of the four shackles (5.1) of the turret lifting sling (6) to three eye bolts (4). Secure the fourth leg (6.1) of the turret lifting sling to its companion leg to prevent injury or damage. Attach hoist (7) to turret lifting sling as shown. Lift inner race (10) out of bearing/race ring assembly (3). Position inner race on wooden blocks.

8 Remove 106 race ring spacers (18) or 213 helical compression springs (19) from outer race (5). Discard helical compression springs, if present.

9 Remove three plugs (20) from inner race (10).



BEARING/RACE RING ASSEMBLY - CONTINUED

c. Inspection

NOTE

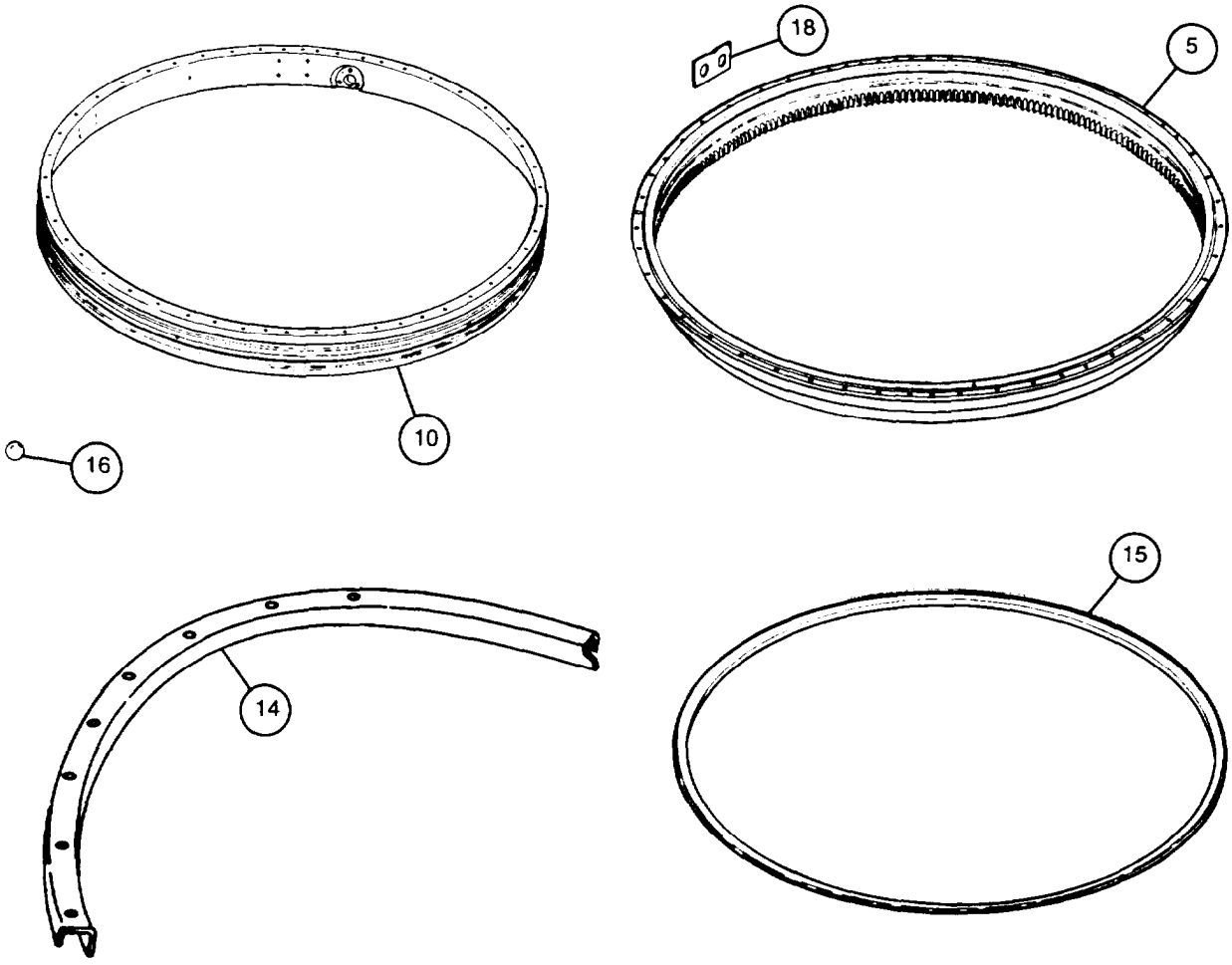
If helical compression springs were found in race ring assembly, replace with race ring spacers.

1 Inspect inner race (10) and outer race (5). Retap if threads are damaged. Remove minor nicks from race to teeth with a fine stone. Replace entire bearing/race ring assembly (3) if inner race or outer race is cracked, broken, distorted, or teeth are badly marred, chipped, or broken.

2 Inspect seal retainer (14) and seal (15). Replace bearing/race ring assembly (3) if seal retainer or seal are cracked, worn, or damaged.

3 Inspect and measure bearing balls (16). Replace if pitted, out-of-round, or if diameter is less than 1.249 inches (3.17 cm).

4 Inspect race ring spacers (18). Replace if damaged.



d. Assembly

NOTE

Any race ring assembly having 213 helical compression springs must have helical compression springs replaced with 106 race ring spacers.

1 Apply grease to 106 race ring spacers (18). Position 106 race ring spacers around outer race (5).

2 Position inner race (10) in outer race (5).

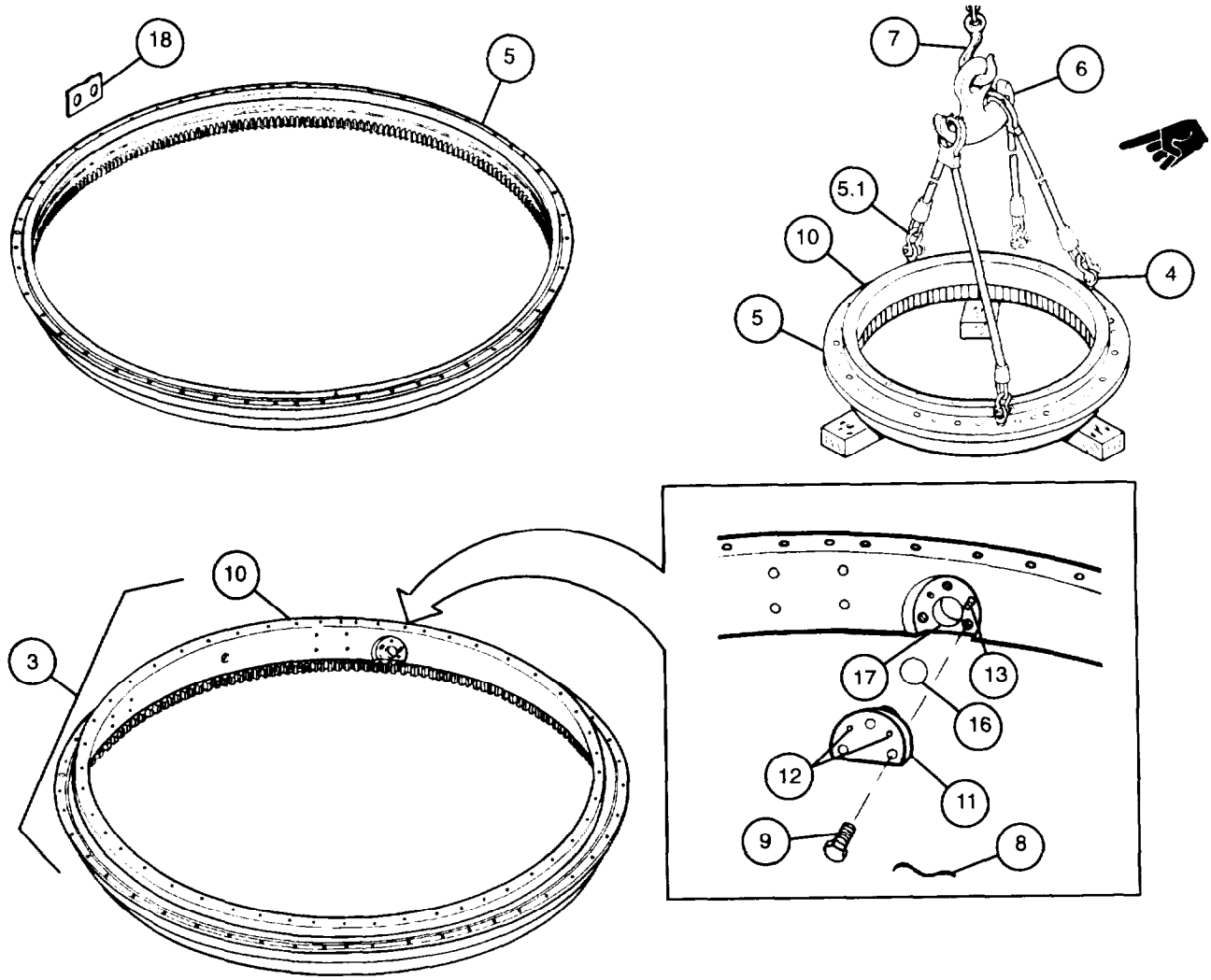
NOTE

Relieve binding of inner race during installation of bearing balls by using small pry bar.

3 Detach hoist (7) and the three shackles (5.1) of the turret lifting sling (6). Remove three eye bolts (4).

4 Rotate inner race (10) and install 212 bearing balls (16) into 106 race ring spacers (18) through access hole (17). Use long, thin tweezers to position 106 race ring spacers for insertion of 212 bearing balls.

5 Install ball turret cover (11) on inner race (10) over headless straight pin (13) using ball turret cover guide holes (12). Install three cap screws (9) and new lockwire (8).



BEARING/RACE RING ASSEMBLY - CONTINUED

d. Assembly - Continued

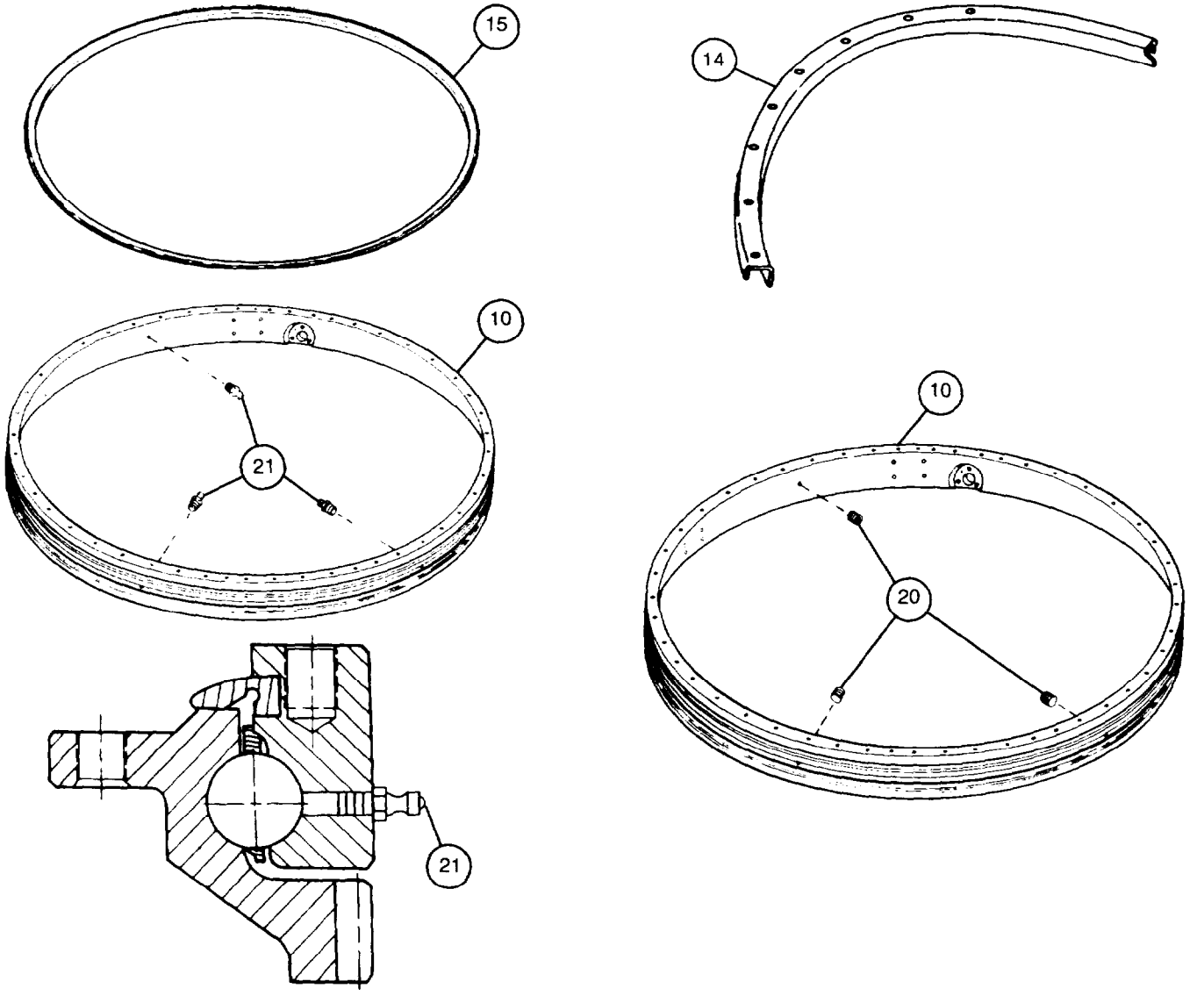
6 Install new seal (15) on inner race (10), if necessary.

7 Install seal retainer (14) if necessary.

8 Install three lubrication fittings (21) in plug holes for three plugs (20).

9 Rotate inner race (10) slowly, applying grease at lubrication fittings (21). Apply 0.5 to 0.75 pound (0.2268 to 0.3402 kg) of grease.

10 Remove three lubrication fittings (21). Install three plugs (20) in inner race (10).



e. Installation

1 Install three eye bolts (4) in outer race (5) bolt holes at 120° intervals (every 16th hole) as shown.

2 Attach three of the four shackles (5.1) of the turret lifting sling (6) to three eye bolts (4). Secure the fourth leg (6.1) of the turret lifting sling to its companion leg to prevent injury or damage. Attach hoist (7) to turret lifting sling as shown.

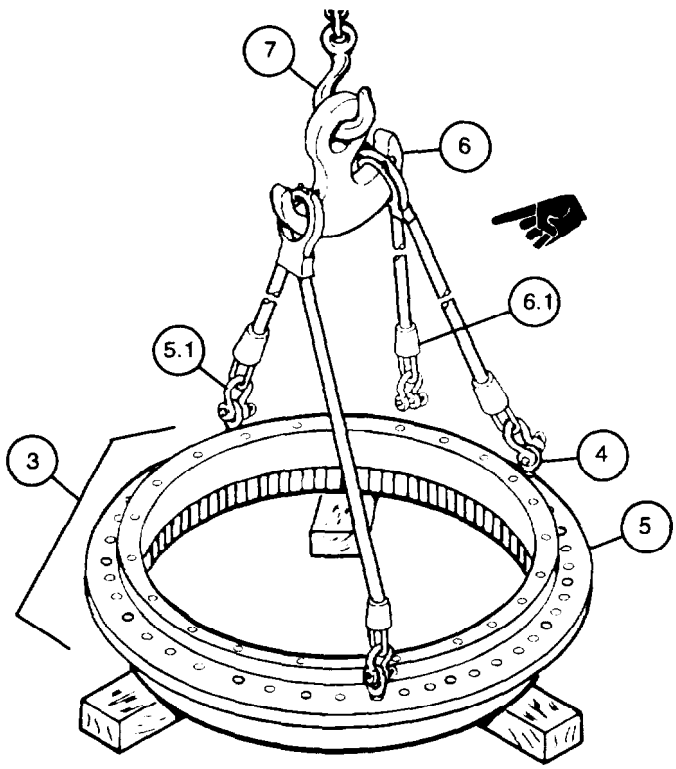
3 Lift bearing/race ring assembly (3) and position over hull. Aline unthreaded bearing/race ring assembly alinement holes with hull mounted alinement pins (22).

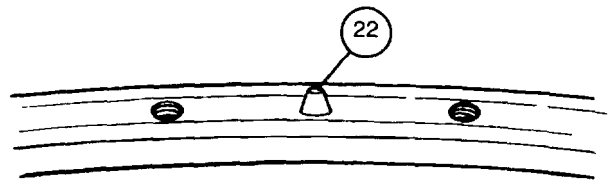
4 Aline bolt holes in outer race ring (5) with mating holes in hull mounting surface. Lower bearing/race ring assembly (3) into hull.

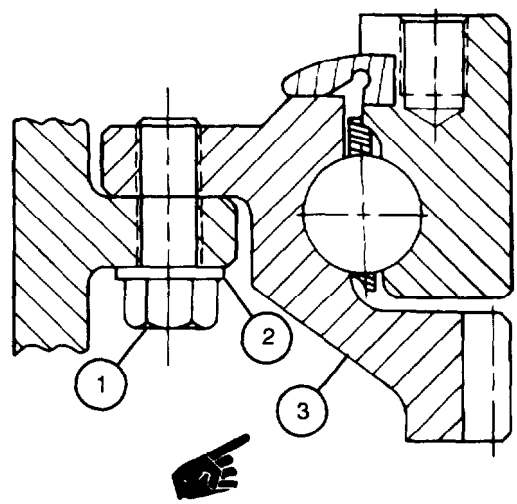
5 Detach hoist (7) and the three shackles (5.1) of the turret lifting sling (6). Remove three eye bolts (4).

6 Install four flat washers (2) and four bolts (1) in bottom of bearing/race ring assembly (3) at 90° intervals (every 12th bolt hole) to ensure alinement of ring to hull.

7 Install 44 flat washers (2) and 44 bolts (1). Torque all 48 bolts to 248 to 302 lb-ft (336 to 410 Nm).





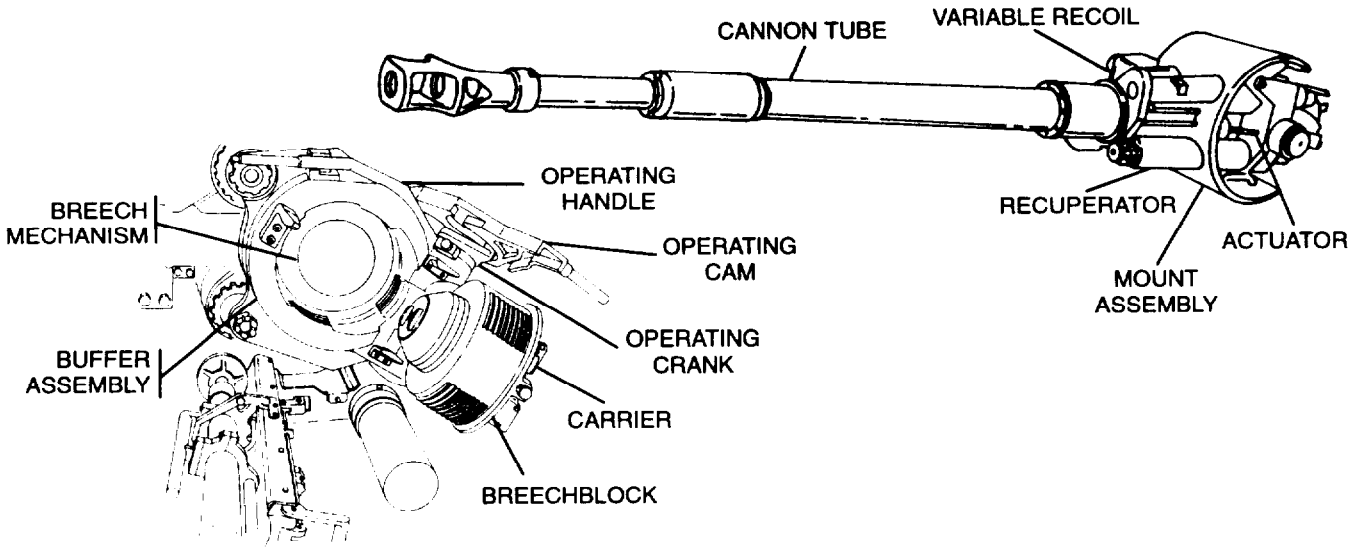


CHAPTER 5
DIRECT SUPPORT MAINTENANCE OF MOUNT AND HOWITZER ASSEMBLY

GENERAL

This chapter illustrates and provides maintenance procedures for the mount and howitzer assembly. These procedures are functions authorized for direct support level maintenance. The paragraphs deal, as applicable, with removal, disassembly, inspection, repair, assembly, and installation.

CONTENTS



5-1 MOUNT AND HOWITZER WITH TRUNNION BRACKET

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Fabricated cannon tube hydraulic tripod (Figure C-5, Appx C)
Fabricated cradle mount tripod (Figure C-6, Appx C)
Sling, turret lifting (item 21, Appx F)
Sling, gun tube (item 19, Appx F)

Materials/Parts
Key washer (item 30, Appx E)
Lo&washers (15) (item 71, Appx E)
Self-locking bolts (3) (item 91, Appx E)
Self-locking nuts (20) (item 159.1, Appx E)
Webbing strap (item 34, Appx B)
Wooden blocks (item 37, Appx B)

Personnel Required
4

Equipment Condition
Park vehicle on level ground
CAB POWER switch to OFF (TM 9-2350-311-10)
Vehicle MASTER switch to OFF (TM 9-2350-311-10)
Disconnect batteries (TM 9-2350-311-10)
M118A2/M118A3 elbow telescope removed (TM 9-2350-311-10)
M146 telescope mount removed (TM 9-2350-311-20-2)
Center cannon assembly and elevate 300 mils (TM 9-2350-31 l-l 0)
Turret lock in LOCKED position (TM 9-2350-311-10)
M15 elevation quadrant removed (TM 9-2350-311-20-2)
Ml 117/M117A2 panoramic telescope removed (TM 9-2350-311-10)
M145/M145A1 telescope mount removed (TM 9-2350-311-20-2)
M42 tank periscope and cover removed (TM 9-2350-311-20-2)
Collimator bracket assembly removed (TM 9-2350-311-20-2)
Drain hydraulic system (TM 9-2350-311-20-2)
Disconnect lines and fittings required to remove mount and howitzer (TM 9-2350-311-20-2)
Rammer actuating valve removed (TM 9-2350-311-20-2)
Rammer assembly removed (TM 9-2350-311-20-2)
Rammer support assembly removed (para 7-1)
Discharge hydraulic pressure in replenisher assembly and drain (TM 9-2350-311-20-2)
Accumulator assembly (manual pump) removed (TM 9-2350-311-20-2)
Elevation selector valve assembly removed (TM 9-2350-311-20-2)
Cab weather cover removed (TM 9-2350-311-20-2)
Panoramic telescope ballistic cover removed (TM 9-2350-311-20-2)
M15 quadrant mounting bracket removed (para 11-1)

a. Removal

WARNING

Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

NOTE

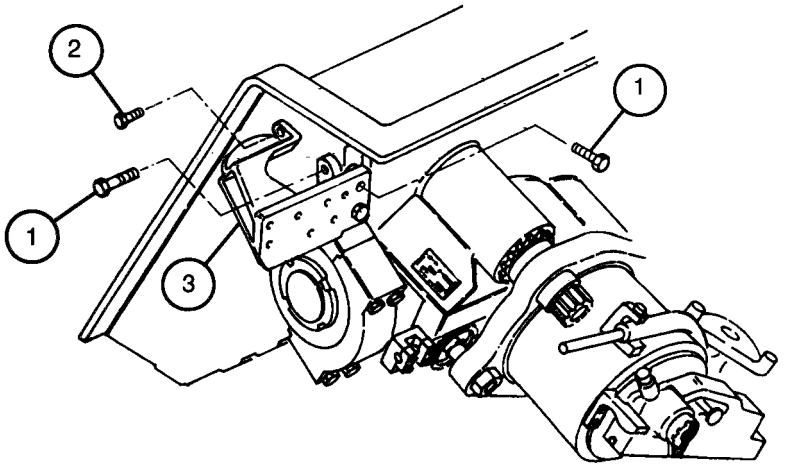
Do not remove alinement plate from panoramic support. Alinement plate is alined to vehicle at depot.

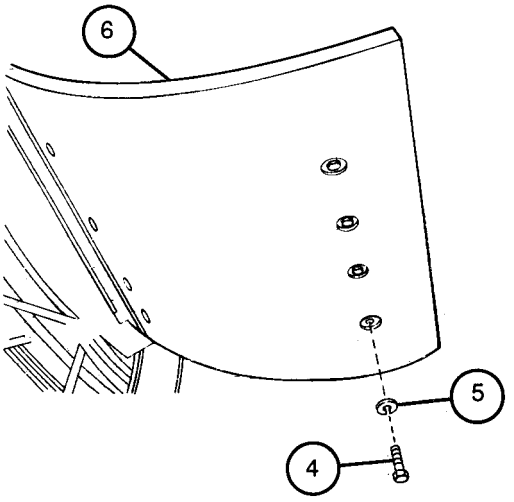
1 Remove four cap screws (1), two cap screws (2), and panoramic support (3).

WARNING

Support lower gun shield during removal. Lower gun shield weighs approximately 57 pounds (26 kg) and may cause injury if dropped.

2 Remove eight cap screws (4), eight lockwashers (5), and lower gun shield (6). Discard lockwashers.





5-1 MOUNT AND HOWITZER WITH TRUNNION BRACKET - CONTINUED

a. Removal - Continued

3 Remove seven cap screws (7) and seven lockwashers (8) on upper gun rotor (9). Upper gun rotor will remain in place until cannon assembly (10) is elevated. Discard lockwashers.

CAUTION

Failure to open bleeder valves could damage elevating piston rod.

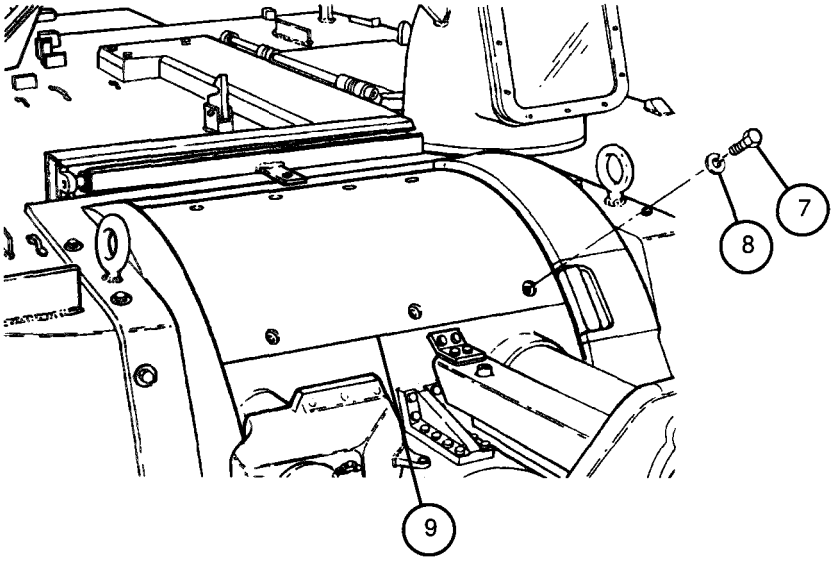
4 Open front and rear bleeder valves on the equilibrated elevation mechanism assembly. This will prevent bending of elevating piston rod (11).

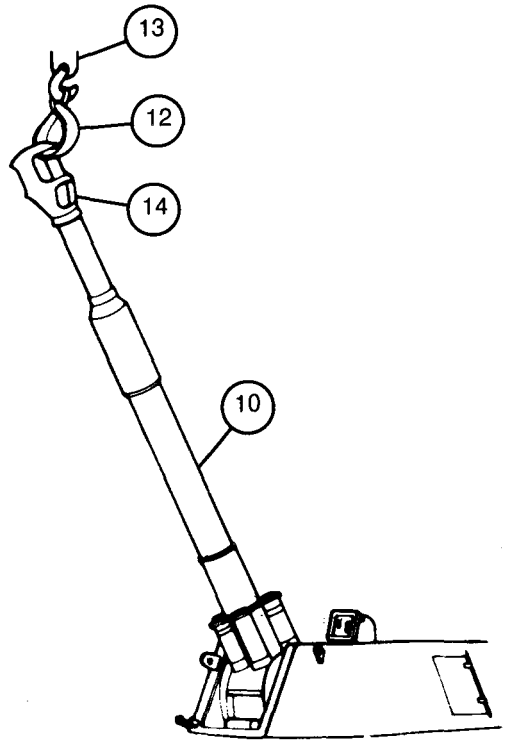
5 Attach gun tube sling (12) and hoist (13) to muzzle brake (14).

WARNING

Two personnel are required for removal of upper gun rotor. Upper gun rotor weighs approximately 75 pounds (34 kg) and may cause injury if dropped.

6 Raise cannon assembly (10) to maximum elevation and remove upper gun rotor (9) from inside cab.



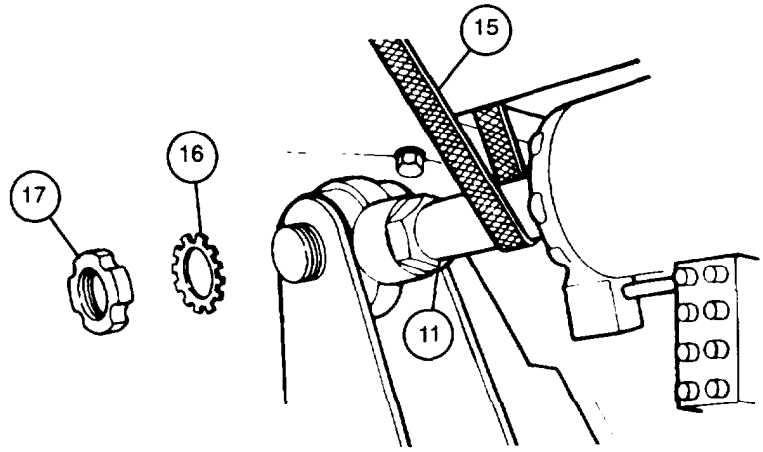


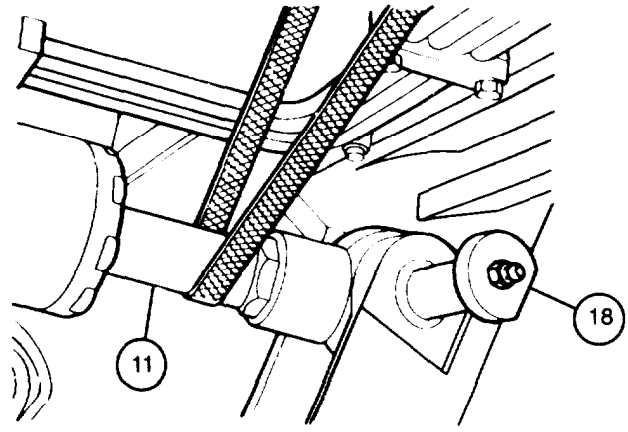
7 Support elevating piston rod (11) with supporting strap (15) through ballistic cover hole and around elevating piston rod.

8 Unlock key washer (16).

9 Remove round nut (17) and key washer (16) at forward end of elevating piston rod (11). Discard key washer.

10 Rotate headed grooved pin (18) to a position where flat surface on head will clear recoil cylinder. Use brass drift and hammer to drive out headed grooved pin.





5-1 MOUNT AND HOWITZER WITH TRUNNION BRACKET - CONTINUED

a. Removal – Continued

11 With cannon assembly (10) still at maximum elevation, remove three self-locking bolts (19) from bottom of trunnion bracket assembly (20). Depress cannon assembly as required. It is permissible to depress cannon as far as travel lock position. Discard self-locking bolts.

NOTE

Retain shims and plate spacers unless new components are to be installed.

12 Remove five cap screws (21), five self-locking nuts (22), five flat washers (23), and shims (24) from left side of trunnion bracket assembly (20). Discard self-locking nuts.

13 Remove five cap screws (25), five self-locking nuts (26), and five flat washers (27) from right side of trunnion bracket assembly (20). Discard self-locking nuts.

14 Remove two cap screws (28), cap screw (29), three self-locking nuts (30), three flat washers (31), and shims (32) from top left side of trunnion bracket assembly (20). Discard self-locking nuts.

15 Remove cap screw (33), self-locking nut (34), shims or plate spacers (35), and plate spacer (36) from top center hole of trunnion bracket assembly (20). Discard self-locking nut.

16 Remove remaining six cap screws (37), six self-locking nuts (38), six flat washers (39), and shims or plate spacers (40) from top of trunnion bracket assembly (20). Discard self-locking nuts.

17 Remove gun tube sling (12) and hoist (13) from muzzle brake (14).

18 Remove assistant gunner's control assembly (TM 9-2350-311-20-2).

19 Depress cannon assembly to 0 mils.

20 Attach three of the four shackles (40.1) of the turret lifting sling (41) and gun tube sling (12) to trunnion bracket assembly (20), cannon assembly (10), and mount (42), as shown. Secure the fourth leg (43) of the turret lifting sling to its companion leg to prevent injury or damage.

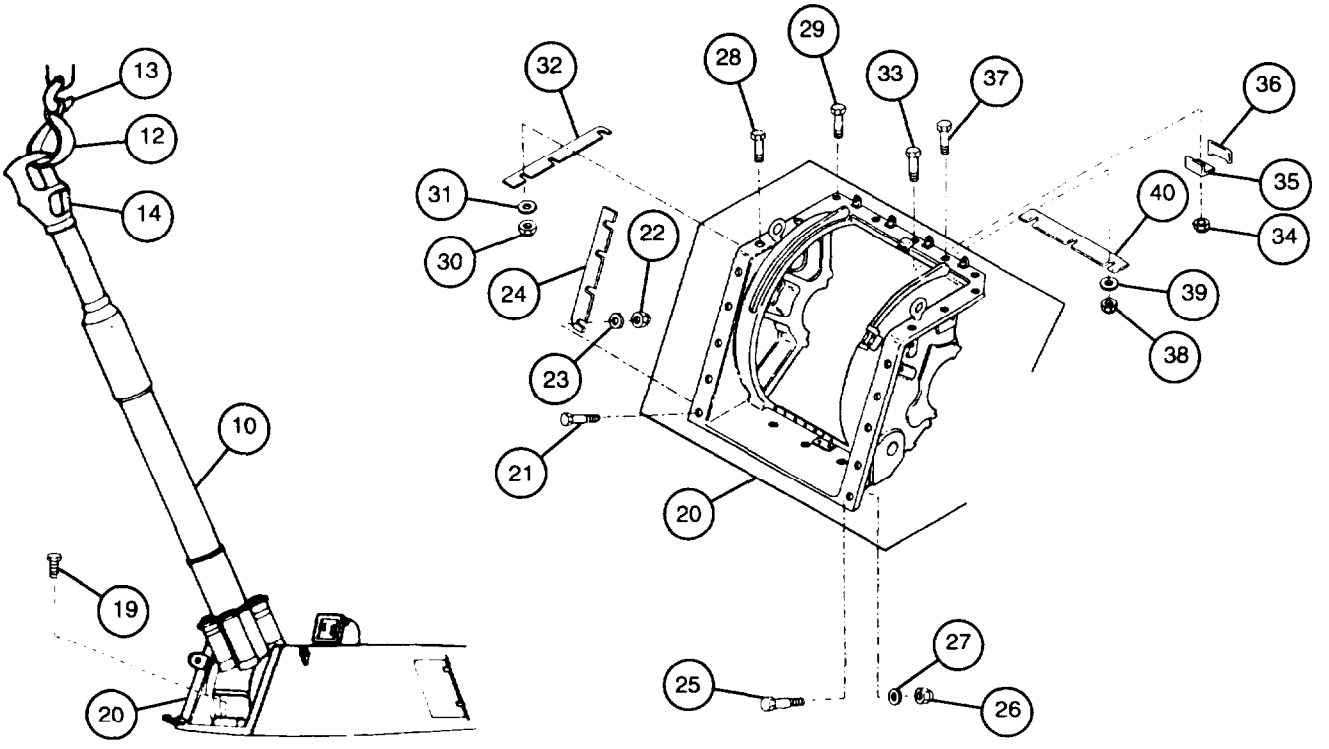
CAUTION

During removal of cannon, mount, and trunnion bracket, guide trunnion bracket carefully so that breech operating cam of cannon will not damage right side hydraulic lines inside cab.

21 Raise trunnion bracket assembly (20) slightly, then withdraw trunnion bracket horizontally from cab.

22 Place cannon assembly (10), mount (42), and trunnion bracket assembly (20) on blocks or fabricated cannon tube tripod and fabricated cradle mount tripod.

23 Remove turret lifting sling (41) and gun tube sling (12) from trunnion bracket assembly (20).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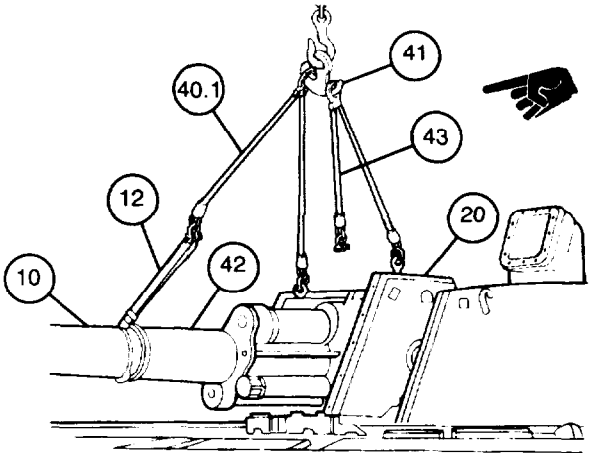
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5-1 MOUNT AND HOWITZER WITH TRUNNION BRACKET - CONTINUED

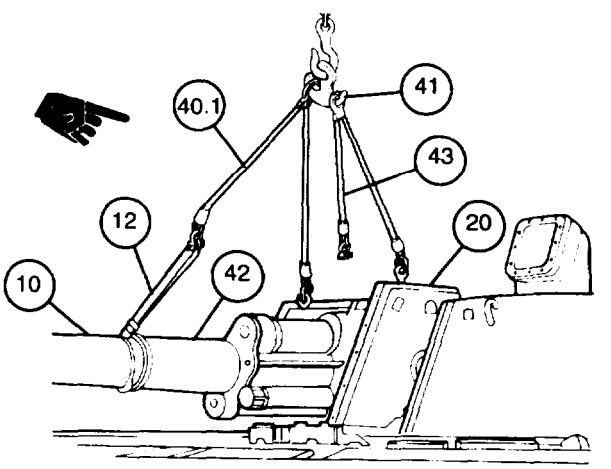
b. Installation

Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

1 Attach three of the four shackles (40.1) of the turret lifting sling (41) and gun tube sling (12) to trunnion bracket assembly (20), mount (42), and cannon assembly (10), as shown. Secure the fourth leg (43) of the turret lifting sling to its companion leg to prevent injury or damage.

During installation of cannon assembly, mount, and trunnion bracket, guide trunnion bracket carefully so that breech operating cam of cannon assembly will not damage right side hydraulic lines inside cab.

2 Raise cannon assembly (10), mount (42), and trunnion bracket assembly (20) and move horizontally to install trunnion bracket in cab.



3 Install plate spacer (36), shims or plate spacers (35), new self-locking nut (34), and cap screw (33) inside cab on top of trunnion bracket assembly (20) at center top screw hole.

4 Install shims or plate spacers (40), six flat washers (39), six new self-locking nuts (38), and six cap screws (37) on top of trunnion bracket assembly (20).

5 Install shims (32), three flat washers (31), three new self-locking nuts (30), cap screw (29), and two cap screws (28) on top left side of trunnion bracket assembly (20). Cap screw (29) is longer than cap screws (28).

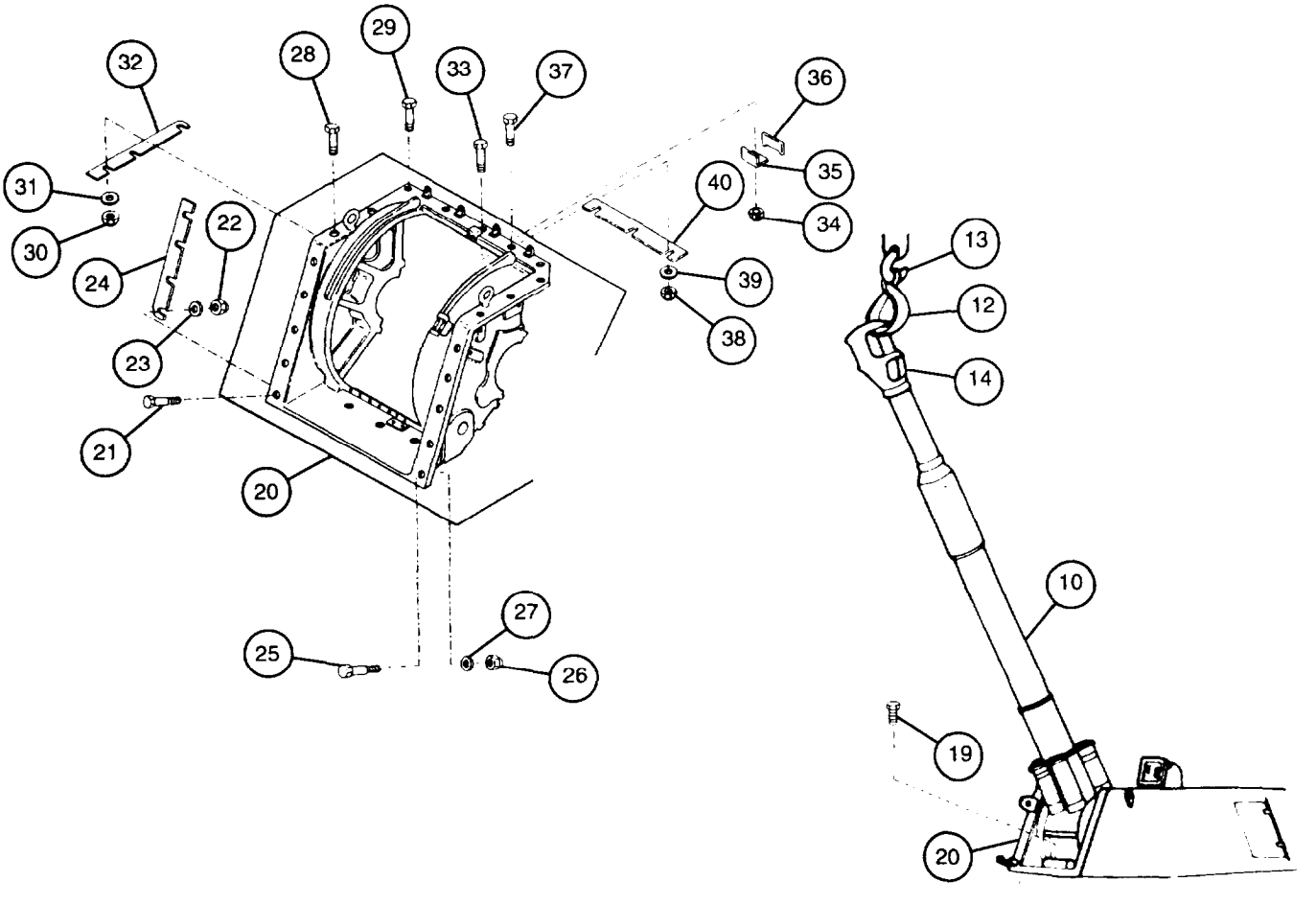
6 Install five flat washers (27), five new self-locking nuts (26), and five cap screws (25) in right side of trunnion bracket assembly (20). Cap screws are 3.25 inches (8.3 cm) long.

7 Install shims (24), five flat washers (23), five new self-locking nuts (22), and five cap screws (21) in left side of trunnion bracket assembly (20). Cap screws are 2.75 inches (7.0 cm) long.

8 Remove turret lifting sling (41) and gun tube sling (12) from trunnion bracket (20) and attach gun tube sling and hoist (13) to muzzle brake (14).

9 Elevate cannon assembly (10) to maximum elevation and install three new self-locking bolts (19) in bottom of trunnion bracket assembly (20). Torque bolts to 270 lb-ft (366 Nm).

10 Install assistant gunner's control assembly (TM 9-2350-311-20-2).



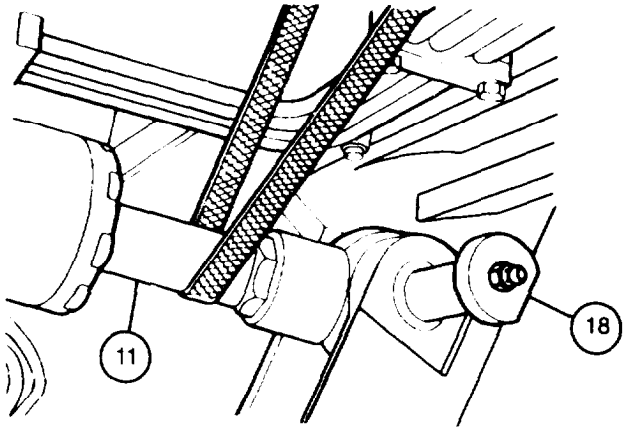
5-1 MOUNT AND HOWITZER WITH TRUNNION BRACKET - CONTINUED

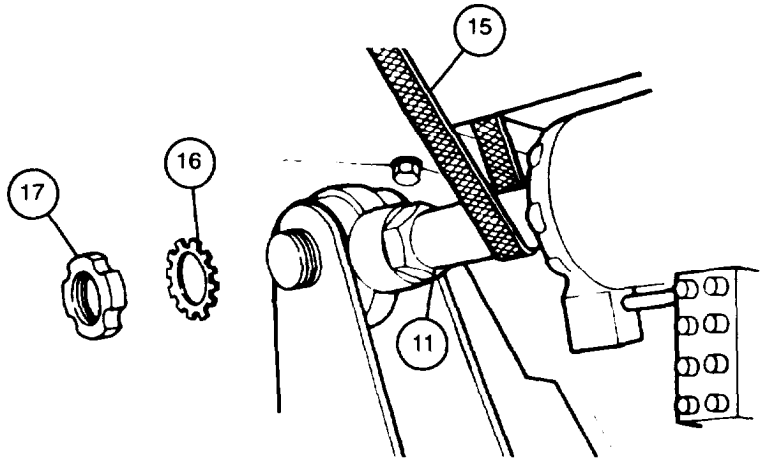
b. Installation - Continued

11 Position headed grooved pin (18) so that flat surface on head will clear recoil cylinder and insert headed grooved pin into forward end of elevating piston rod (11).

12 Install new key washer (16) and round nut (17) at forward end of elevating piston rod (11). Bend tabs of key washer over round nut to lock.

13 Remove supporting strap (15) from around elevating piston rod (11).





WARNING

Two personnel are required for installation of upper gun rotor. Upper gun rotor weighs approximately 75 pounds (34 kg) and may cause injury if dropped.

14 With cannon assembly (10) still at maximum elevation, install upper gun rotor (9) from inside cab.

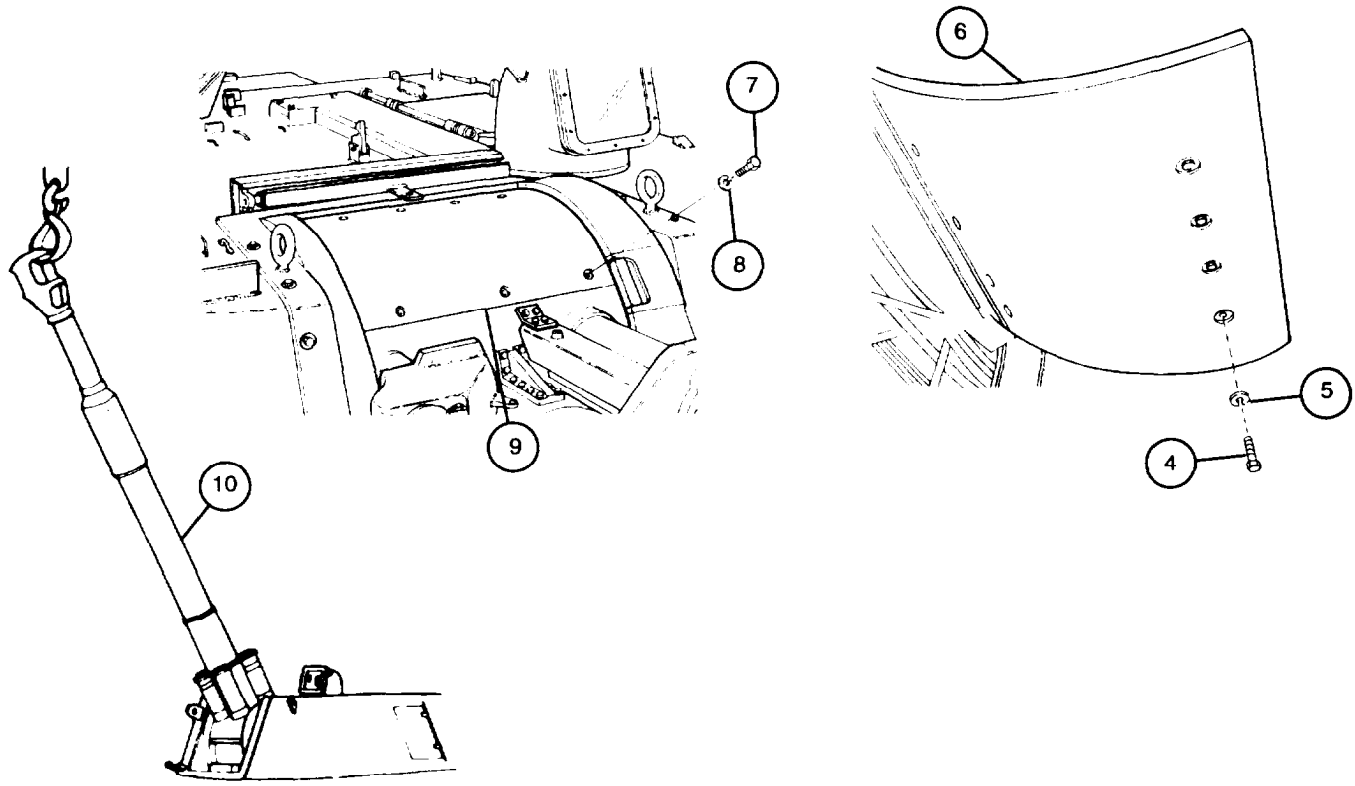
15 Depress cannon assembly (10) to approximately 300 mils.

16 Install seven new lo&washers (8) and seven cap screws (7) on upper gun rotor (9).

WARNING

Support lower gun shield during installation. Lower gun shield weighs approximately 57 pounds (26 kg) and may cause injury if dropped.

17 Install lower gun shield (6) eight new lockwashers (5), and eight cap screws (4).



18 Inspect headless straight pin (44) in trunnion bracket (45) before installing panoramic support (3). If headless straight pin is damaged or a new panoramic support is being installed perform steps 19 through 22, otherwise go to step 23.

19 Grind headless straight pin (44) flush with trunnion bracket (45).

20 Install panoramic support (3), two cap screws (2), and four cap screws (1).

NOTE

- If panoramic support is not new, use existing hole in panoramic support as a template to drill hole through trunnion bracket.
- If panoramic support is new, use illustration for location to drill hole.

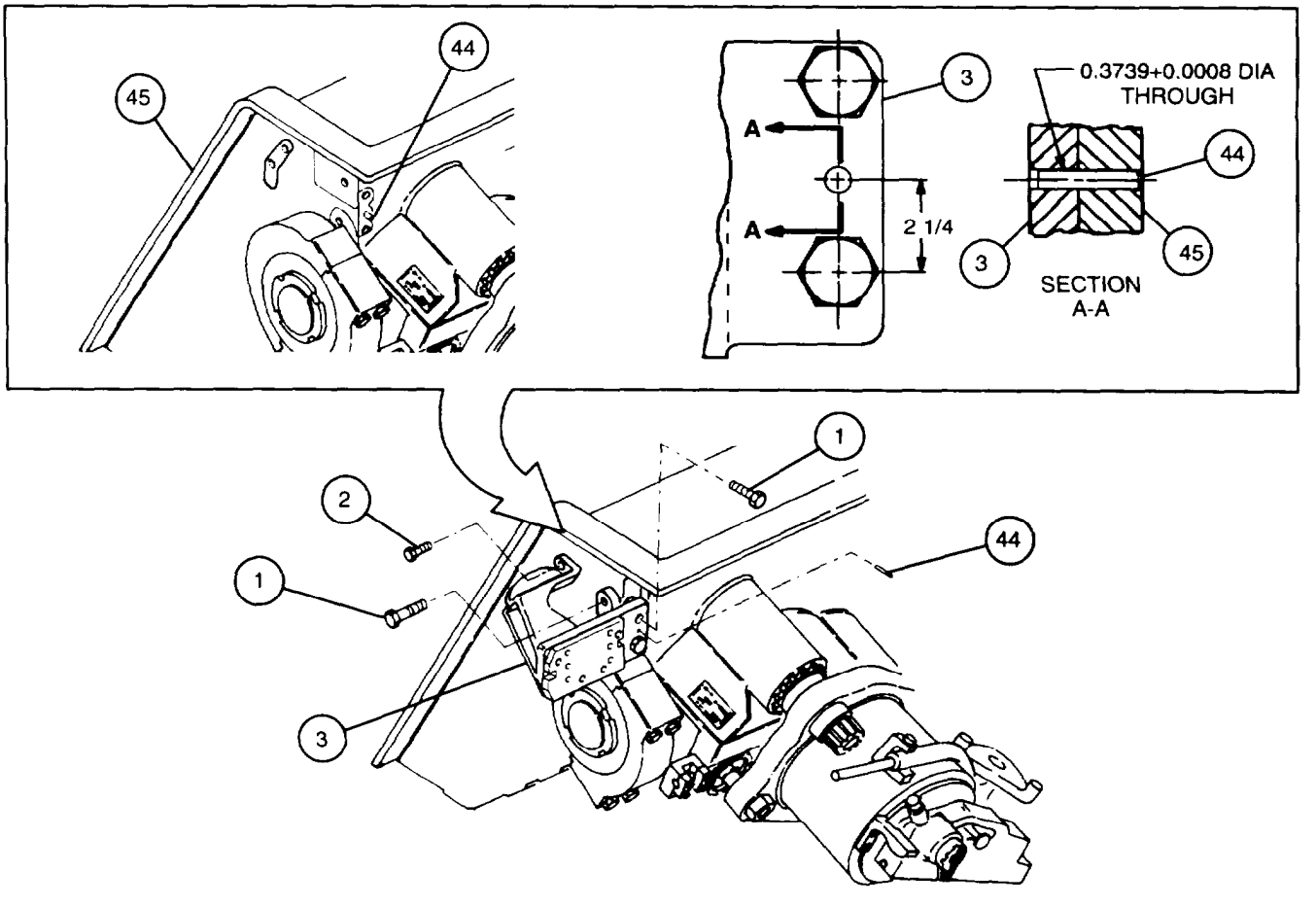
21 Drill a 0.3739 + 0.0008 inch (9.497 + 0.02 mm) hole through the panoramic support (3) and trunnion bracket (45).

22 Install new headless straight pin (44).

NOTE

Aline hole in panoramic support with headless straight pin in trunnion bracket.

23 Install panoramic support (3), two cap screws (2), and four cap screws (1).



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5-2 CANNON ASSEMBLY (CAB ON VEHICLE)

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Fabricated breech stand (Figure C-3, Appx C)
Fabricated lifting arm and eye bolt lifting bracket (Figure C-10, Appx C)
Trolley, l-beam (item 25, Appx F)

Materials/Parts
Cotter pin (item 48, Appx E)
Key washers (2) (item 114, Appx E) M109A2/M109A31M109A4
Key washers (2) (item 143, Appx E) M109A5
Lockwashers (3) (item 70, Appx E) M109A2/M109A3/M109A4
Lockwire (item 36, Appx E) M109A5

Personnel Required
3

Equipment Condition
Park vehicle on level ground
Apply vehicle brake lock handle
Travel lock removed and stowed (TM 9-2350-311-10)
Center cannon assembly and depress to 0 mils (TM 9-2350-311-10)
Turret lock in LOCKED position (TM 9-2350-311-10)
Commanders seat stowed and latched (TM 9-2350-311-10)
M118A2/M118A3 elbow telescope removed (TM 9-2350-311-10)
Discharge hydraulic pressure (TM 9-2350-311-20-2)
Rammer assembly in stowed position (TM 9-2350-311-10)
Nitrogen pressure released from recuperator assembly (para 5-11)

a. Removal

WARNING

- Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.
- When working on mount and cannon assembly breech components with cannon assembly pushed out of battery, block cannon assembly by placing fabricated breech stand under breech body to prevent accidental elevation of cannon assembly and possible injury to personnel or damage to equipment.

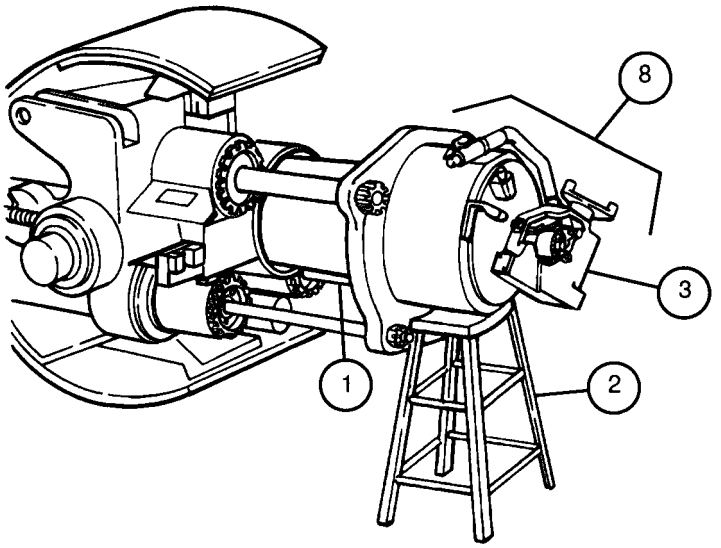
1 Push cannon assembly (1) out of battery approximately 24 inches (61 cm) (TM 9-2350-311-20-2) and place fabricated breech stand (2) beneath breech ring body (3).

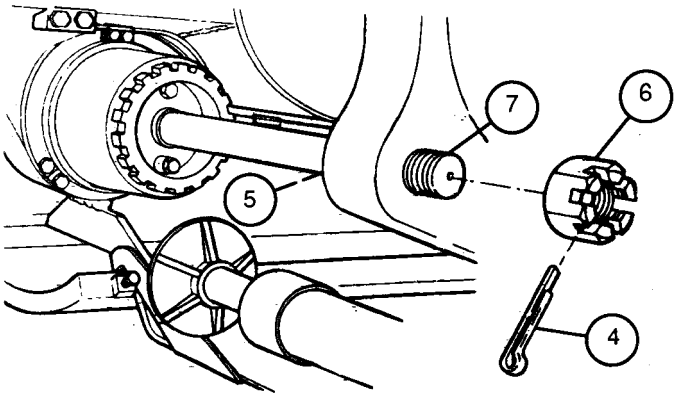
2 Drain all hydraulic fluid from equilibration system (TM 9-2350-311-20-2).

3 Remove and discard cotter pin (4).

4 While holding shaft collar (5) with pipe wrench, remove slotted nut (6) from recuperator piston shouldered shaft (7).

5 Disassemble breech mechanism (8) (para 5-5), if required.





5-2 CANNON ASSEMBLY (CAB ON VEHICLE) - CONTINUED

a. Removal - Continued

6 Remove cannon tube (9) (para 5-4).

NOTE

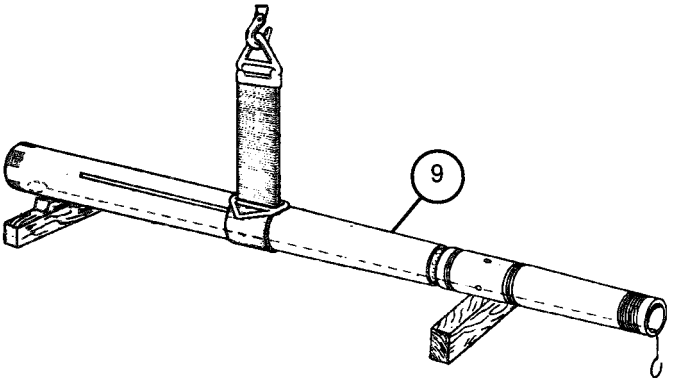
- Breech ring body can be removed without removing rammer. Rammer not illustrated for clarification only.
- Lockwire is used to secure interlocking stop to M284 cannon. Three lockwashers are used on M185 cannon.

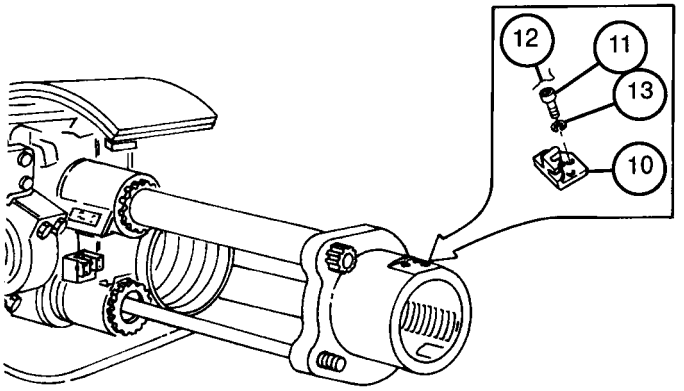
7 Remove interlocking stop (10) by removing three cap screws (11) with lockwire (12) or three lockwashers (13). Discard lockwashers or lockwire.

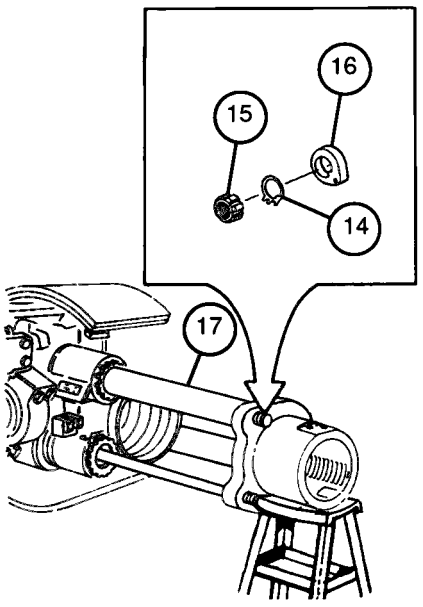
8 Bend tabs of two key washers (14) to disengage from slots of two round nuts (15).

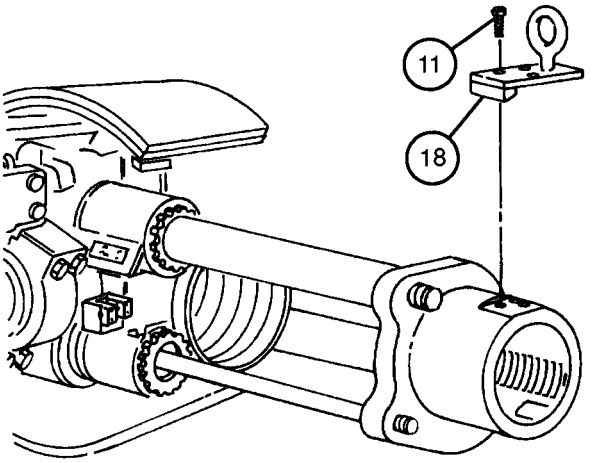
9 Remove two round nuts (15), two key washers (14), and two keyway washers (16) from variable recoil cylinder rods (17). Discard key washer.

10 Install fabricated eyebolt lifting bracket (18) using three cap screws (11) from interlocking stop (10).









11 Insert fabricated lifting arm (19) through gunner's escape hatch and attach to fabricated eyebolt lifting bracket (18) with flat washer (20) and nut (21).

12 Support weight of breech ring body (3) with fabricated lifting arm (19) and l-beam trolley (22).

WARNING

Maintain tension on l-beam trolley and fabricated lifting arm when removing breech to prevent injury to personnel or damage to equipment.

13 Remove fabricated breech stand (2) from under breech ring body (3).

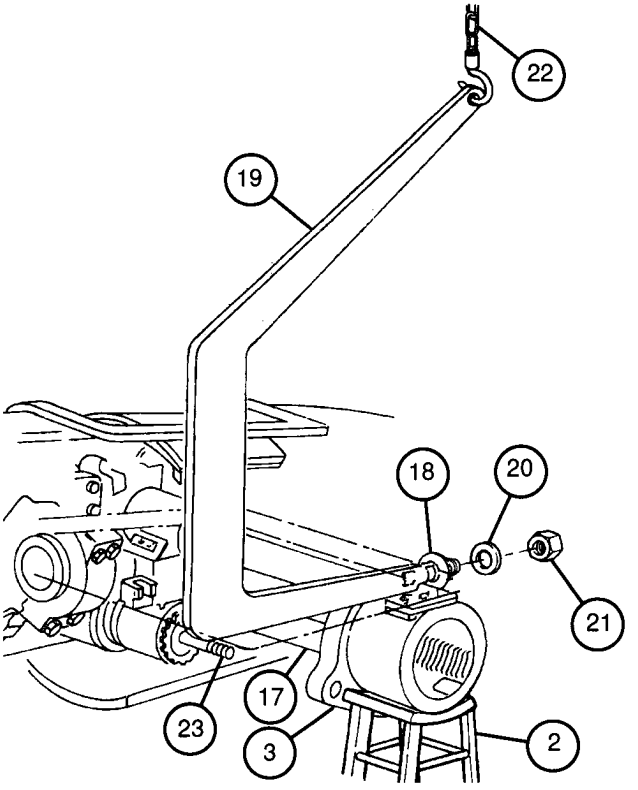
CAUTION

Use care when removing breech ring to prevent damage to rammer assembly.

14 Remove breech ring body (3) from variable recoil cylinder rods (17) and recuperator rod (23). Rotate breech ring body approximately 90° to clear rammer assembly and lower to floor of vehicle.

15 Remove fabricated lifting arm (19) from breech ring body (3) and raise through gunner's escape hatch. Remove fabricated lifting arm from l-beam trolley (22).

16 Attach breech ring body (3) to l-beam trolley (22). Lift out through gunner's escape hatch or through rear hull door (not shown).



5-2 CANNON ASSEMBLY (CAB ON VEHICLE) - CONTINUED

b. Installation

WARNING

Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

NOTE

Cab must be centered facing front of vehicle with turret lock in LOCKED position.

1 Attach breech ring body (3) to l-beam trolley (22). Lower onto floor of vehicle through gunner's escape hatch or hull rear door (not shown).

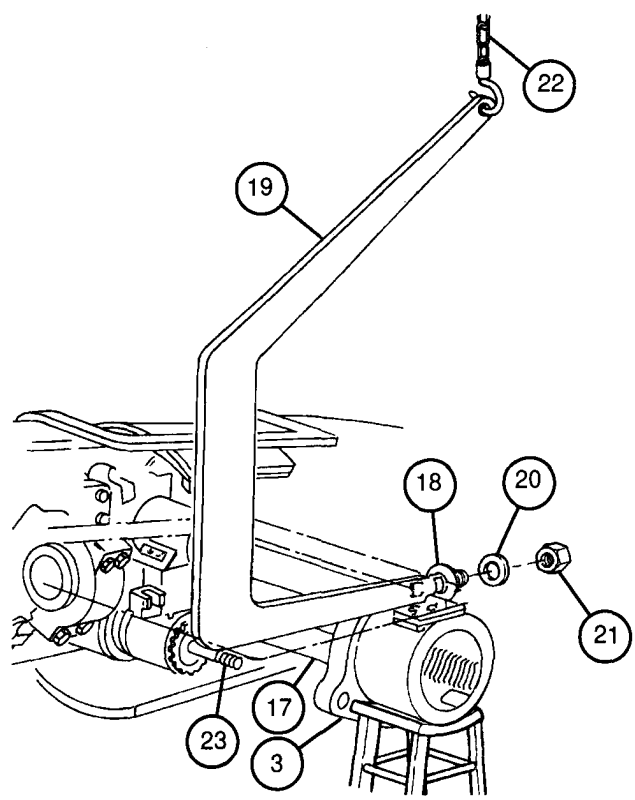
2 Detach l-beam trolley (22) from breech ring body (3). Attach fabricated lifting arm (19) to l-beam trolley and lower through gunner's escape hatch.

3 Attach fabricated lifting arm (19) to fabricated eyebolt lifting bracket (18) on breech ring body (3) with flat washer (20) and nut (21).

CAUTION

Use care to prevent breech ring body from damaging rammer assembly.

4 Lift and install breech ring body (3) onto variable recoil cylinder rods (17) and recuperator rod (23).



NOTE

Be sure single tab of key washer is alined in keyway of keyway washer on M182 mount.

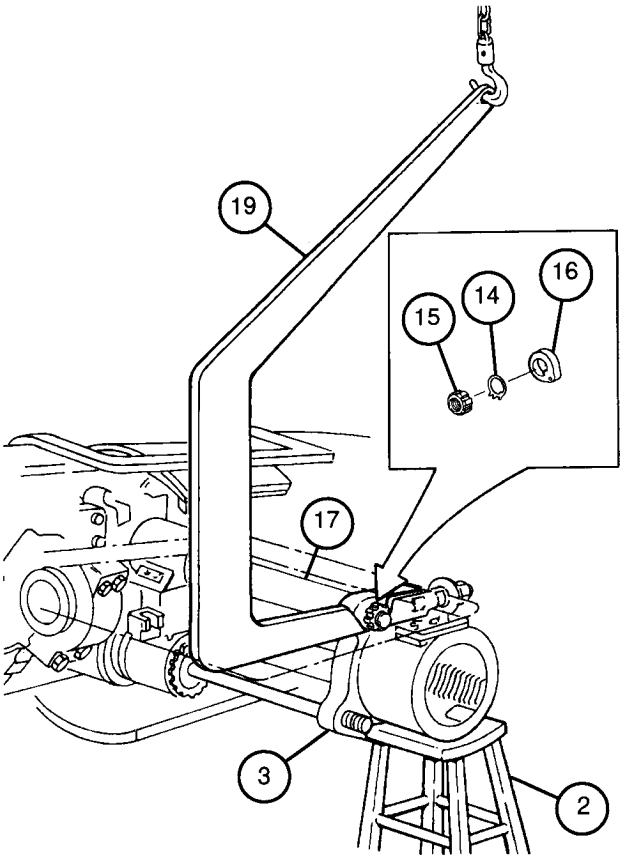
5 Install two keyway washers (16), two new key washers (14), and two round nuts (15) onto variable recoil cylinder rods (17). Bend tabs of two key washers over two round nuts to lock.

WARNING

When working on mount and cannon assembly breech components with cannon assembly pushed out of battery, block cannon assembly with fabricated breech stand under breech ring body to prevent accidental elevation of cannon assembly and possible injury to personnel or damage to equipment.

6 Install fabricated breech stand (2) into position under breech ring body (3) to hold mount in position.

7 Remove fabricated lifting arm (19) from breech ring body (3) and raise through gunner's escape hatch.



5-2 CANNON ASSEMBLY (CAB ON VEHICLE) - CONTINUED

b. Installation - Continued

8 While holding shaft collar (5) with pipe wrench, install slotted nut (6) on recuperator piston shouldered shaft (7). Slotted nut should be tightened until slotted nut and shaft collar are just beginning to touch breech ring body (3).

9 Loosen slotted nut (6) 1/6 to 1/3 turn while alining cotter pin (4) hole in recuperator piston shouldered shaft (7) with slots in slotted nut. Install new cotter pin.

10 Remove fabricated eyebolt lifting bracket (18) and three cap screws (11) from top of breech ring body (3).

NOTE

Lockwire is used to secure interlocking stop on M284 cannon. Three lockwashers are used on M185 cannon.

11 Install interlocking stop (10) using three cap screws (11) from fabricated eyebolt lifting bracket (18) with new lockwire (12) or three new lockwashers (13).

12 Assemble breech mechanism (8) (para 5-5), if disassembled.

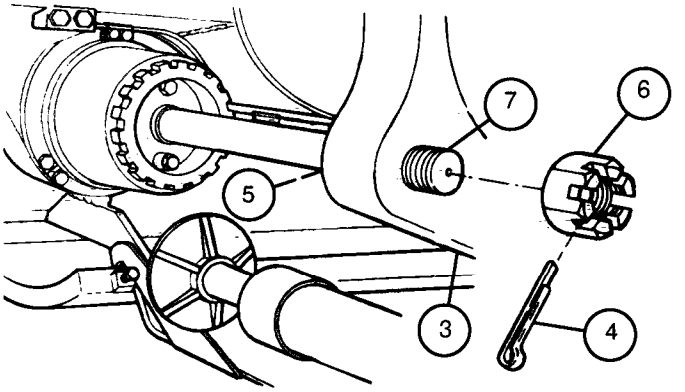
13 Install cannon tube (9) (para 5-4).

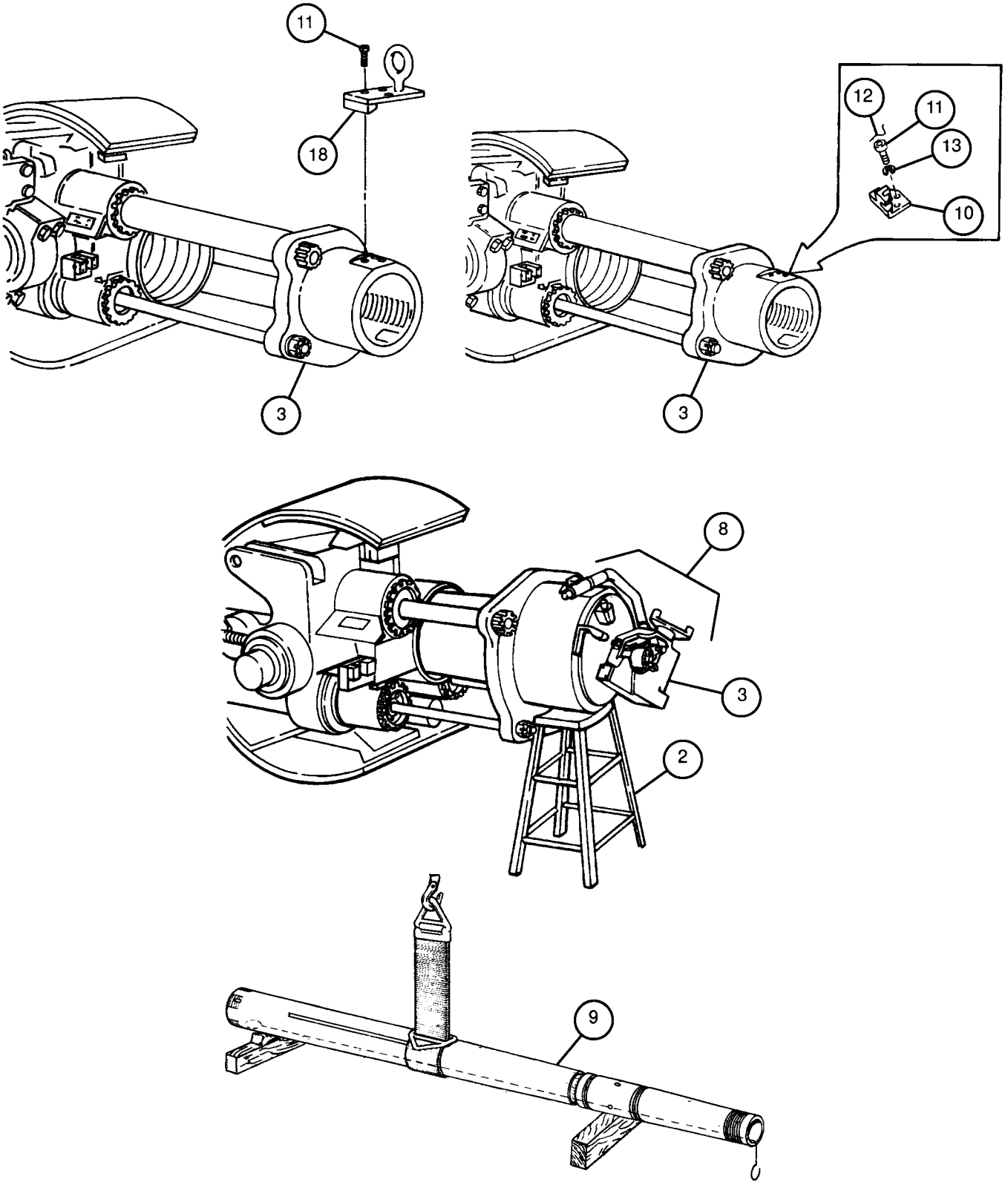
14 Fill equilibration system with hydraulic fluid (TM 9-2350-311-20-2).

15 Remove fabricated breech stand (2) from under breech ring body (3).

NOTE

- After cannon assembly replacement, all fire control components must be checked for alinement (TM 9-2350-311-20-2).
- Adjustment of operating cam roller clearance is required after cannon assembly replacement (TM 9-2350-311-20-2).

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5-3 CANNON ASSEMBLY (MOUNT OFF CAB)

This task covers: a. Disassembly b. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Sling, gun tube (item 19, Appx F)
Trolley, l-beam (item 25, Appx F)

Materials/Parts
Cotter pin (item 48, Appx E)
Key washers (2) (item 114, Appx E) M109A2/M109A3/M109A4
Key washers (2) (item 143, Appx E) M109A5
Webbing straps (2) (item 34, Appx B)
Wooden blocks (item 37, Appx B)

Personnel Reauired
3

Equipment Condition
Muzzle brake removed (TM 9-2350-311-10)
Thrust collar removed (TM 9-2350-311-10)
Bore evacuator removed (TM 9-2350-311-10)
Dust shield removed (TM 9-2350-311-20-2)
Torque key removed (TM 9-2350-311-20-2)
Nitrogen pressure released from recuperator assembly (para 5-11)

a. Disassembly

WARNING

Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

NOTE

Trunnion bracket does not have to be removed for cannon assembly removal.

1 Remove and discard cotter pin (1).

2 While holding shaft collar (2) with pipe wrench, remove slotted nut (3) from recuperator piston shouldered shaft (4).

3 Unlock two key washers (5). Remove two round nuts (6), two key washers (5), and two keyway washers (7) from two variable recoil cylinder rods (8) using spanner wrench. Discard key washers.

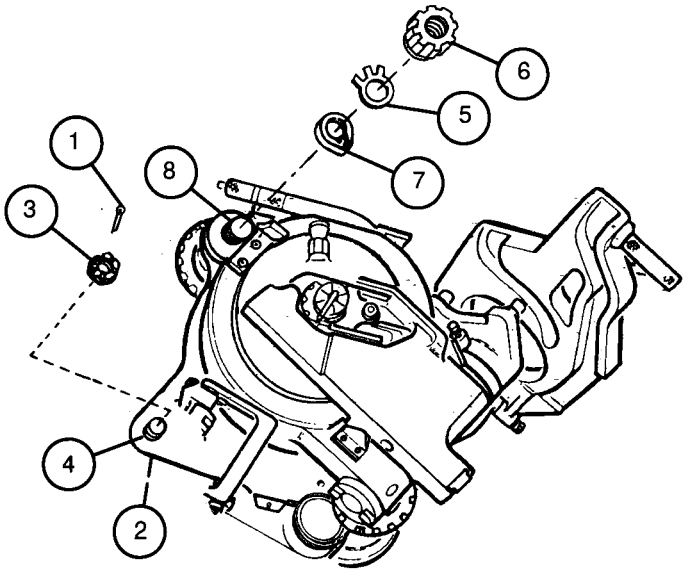
4 Attach two webbing straps (9) to cannon assembly (10) and to l-beam trolley (not shown).

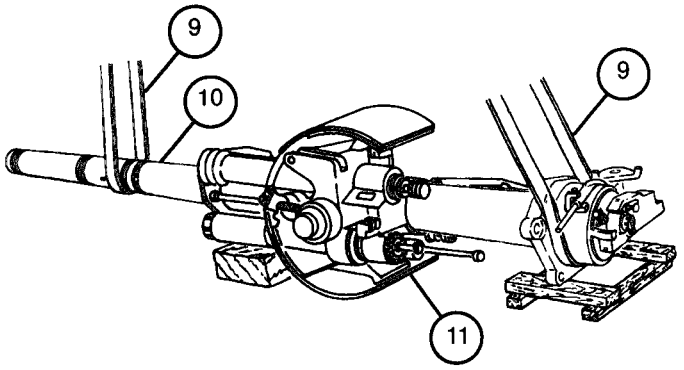
5 Raise l-beam trolley (not shown) to remove slack from two webbing straps (9) and slide cannon assembly (10) rearward 3 feet (91.4 cm).

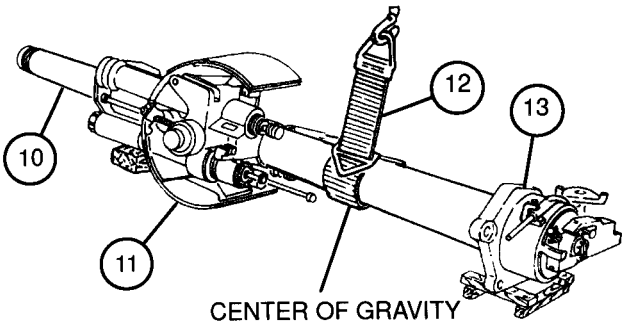
6 Lower cannon assembly (10) and mount (11) as an assembly onto wooden blocks.

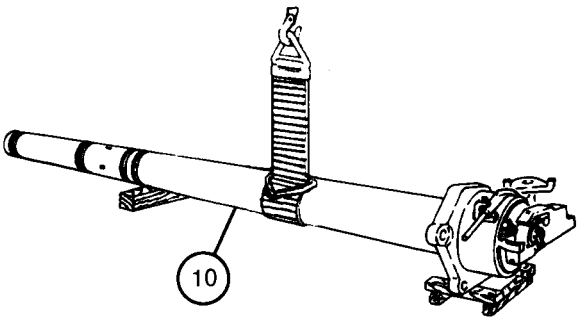
7 Remove two webbing straps (9) and attach gun tube sling (12) to cannon assembly (10) at center of balance (approximately 102 inches (259.1 cm) for M284 cannon and 98 inches (248.9 cm) for M185 cannon) forward of rear face of breech ring band (13). Ensure center of balance is marked on cannon assembly.

8 Raise cannon assembly (10) slightly and slide rearward completely out of mount (11). Place cannon assembly on wooden blocks.









5-3 CANNON ASSEMBLY (MOUNT OFF CAB) - CONTINUED

b. Assembly

WARNING

Wear gloves and steel-tipped safety shoes to avoid possible injury while handling heavy equipment.

1 Attach gun tube sling (12) to cannon assembly (10) at center of balance.

2 Raise cannon assembly (10) slightly and slide forward through mount (11) until breech ring band (13) is 4 feet (1.219 m) from mount (11).

3 Lower l-beam trolley (not shown) to slacken gun tube sling (12) and remove gun tube sling.

4 Attach two webbing straps (9) to cannon assembly (10) and to l-beam trolley (not shown).

5 Raise l-beam trolley (not shown) to remove slack from two webbing straps (9) and slide cannon assembly (10) forward to position in mount (11).

NOTE

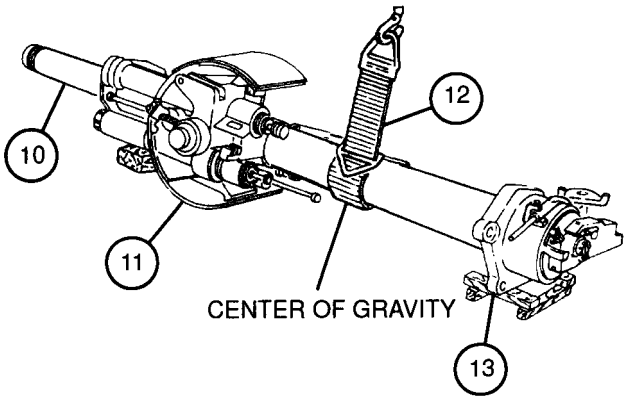
Be sure single tab of key washer is alined in keyway of keyway washer on M182 mount.

6 Install two new keyway washers (7), two new key washers (5), and two round nuts (6) on two variable recoil cylinder rods (8) using spanner wrench. Bend tabs of two key washers over two round nuts to lock.

7 While holding shaft collar (2) with pipe wrench, install slotted nut (3) on recuperator piston shouldered shaft (4).

8 Install new cotter pin (1).

9 Remove two webbing straps (9) and wooden blocks.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CENTER OF GRAVITY
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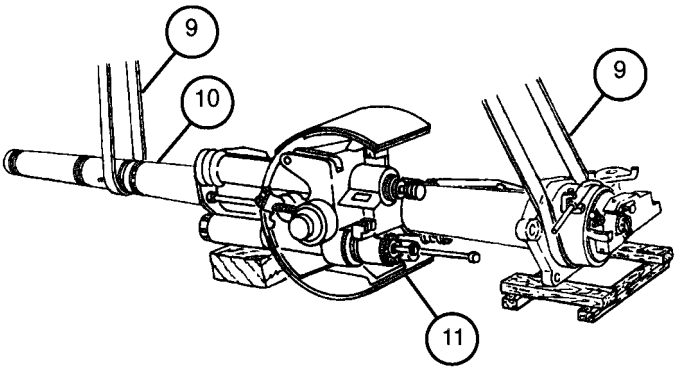
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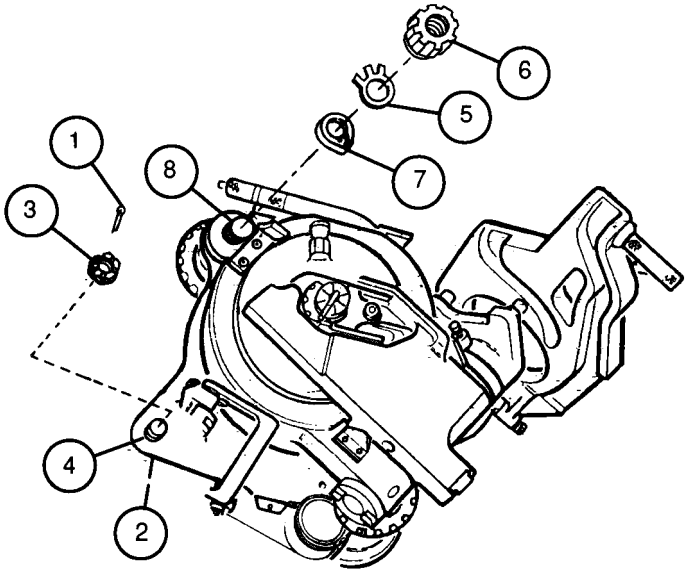
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5-4 CANNON TUBE

This task covers: a. Removal b. Inspection
c. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Fabricated breech stand (Figure C-3, Appx C)
Fabricated eyebolt assembly (Figure C-7, Appx C)
Sling, gun tube (item 19, Appx F)
Trolley, I-beam (item 25, Appx F)
Wrench, pipe, chain-type (item 27, Appx F)
OR
4" x 4" wooden block, min. 5' long (item 37, Appx B)

Materials/Parts
Rag (item 26, Appx B)
Rope (item 27, Appx B)

Personnel Required
4

Equipment Condition
Park vehicle on level ground
Apply vehicle brake lock handle
Vehicle MASTER switch to OFF (TM 9-2350-311-10)
Travel lock removed and stowed (TM 9-2350-311-10)
Cannon assembly positioned at 0° traverse and 0° elevation (TM 9-2350-311-10)
Drain equilibration system manifold (TM 9-2350-311-20-2)
Turret lock in LOCKED position (TM 9-2350-311-10)
Muzzle brake removed (TM 9-2350-311-10)
Bore evacuator removed (TM 9-2350-311-10)
Dust shield removed (TM 9-2350-311-20-2)
Torque key removed (TM 9-2350-311-20-2)

a. Removal

WARNING

- Wear gloves and steel-tipped safety shoes to avoid possible injury.
- When working on mount and cannon assembly breech components with cannon assembly pushed out of battery, block cannon assembly by placing fabricated breech stand under breech body to prevent accidental elevation of cannon assembly and possible injury to personnel or damage to equipment.

NOTE

Cannon assembly may have to be pushed out of battery (TM 9-2350-311-20-2) to gain access to cap screw.

1 Loosen cap screw (1).

2 Slide breech ring machine key (2) up and out of slot (3). Do not remove cap screw or breech ring machine key.

3 Tighten cap screw (1).

4 Push cannon assembly into battery if pushed out.

5 Open breechblock.

CAUTION

Tie a greased rag around hook of 30-foot cable or rope to avoid damage to lands of cannon tube.

6 Thread one end of 30-foot cable or rope (4) (with hooks at each end) through cannon tube (5) until hook comes out muzzle end.

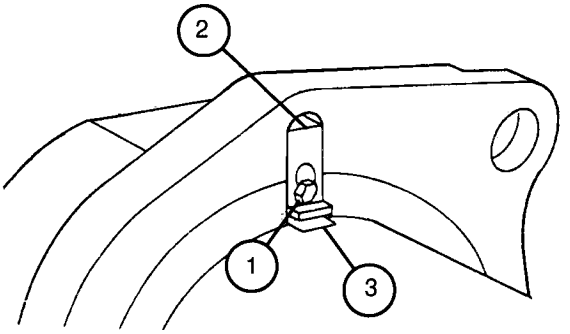
7 Remove greased rag from 30-foot cable or rope (4) hook.

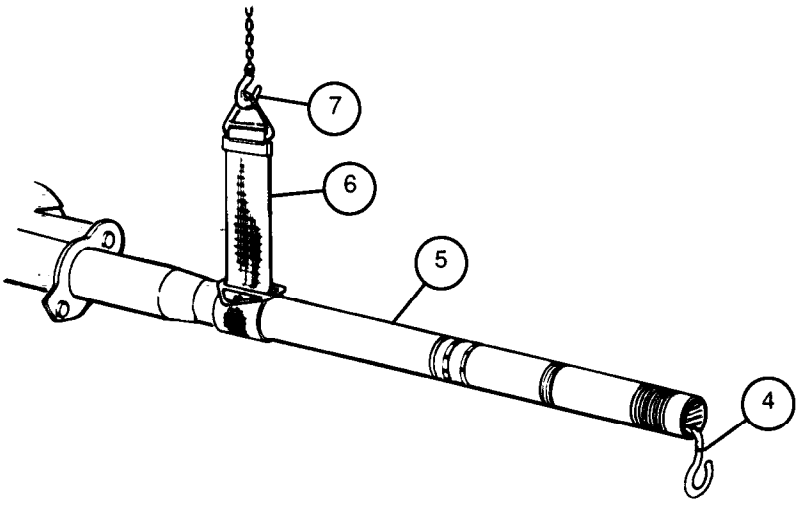
WARNING

Use l-beam trolley with lifting capacity of at least 3200 pounds (1452 kg) for M185 cannon or 3750 pounds (1701 kg) for M284 cannon to prevent injury to personnel.

8 Attach gun tube sling (6) in choke hitch at point of cannon tube (5) indicated as center of balance. Center of balance for M185 cannon is 144-5/8 inches (367.35 cm) from face of muzzle. Center of balance for M284 cannon is 145 inches (368.3 cm) from face of muzzle. Ensure center of balance is marked on cannon tube.

9 Attach l-beam trolley (7) to sustain weight of cannon tube (5), but do not lift cannon tube.





5-4 CANNON TUBE - CONTINUED

a. Removal - Continued

10 Place fabricated breech stand (8) between the breech ring (9) and the floor of the vehicle, as required, to support the breech ring after withdrawal of cannon assembly.

NOTE

Refer to steps 13 through 15 for alternate method of rotating cannon tube if chain-type pipe wrench is NOT available.

11 install chain-type pipe wrench (10) on cannon tube (5) at a location without critical external features.

NOTE

- Cannon tube is rotated 45° when keyway on cannon tube is alined with upper left bolt hole for dust shield.
- If cannon tube is difficult to rotate, some of the nitrogen pressure in the recuperator assembly may have to be discharged (para 5-11) to relieve binding on breech ring band.

12 Rotate cannon tube (5) 45° counterclockwise to disengage cannon tube from breech ring (9) threads.

NOTE

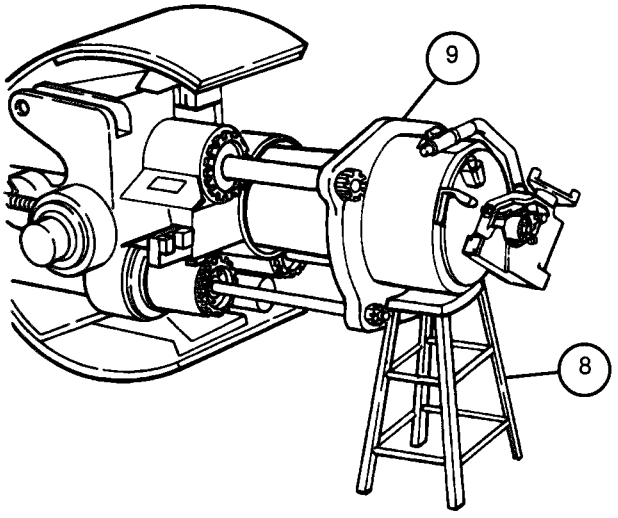
If chain-type pipe wrench has been used, skip to step 17.

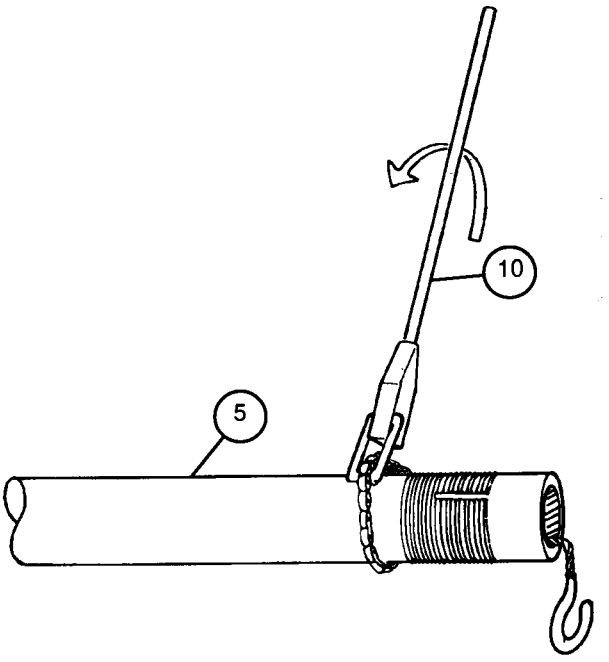
13 Install muzzle brake (11) (TM 9-2350-311-10).

14 Insert a 4 x 4 inch wooden block at least 5 feet long into muzzle brake (11).

15 Using wooden block for leverage, rotate muzzle brake (11) and cannon tube (5) 45° counterclockwise to disengage cannon tube from breech ring (9) threads.

16 Remove muzzle brake (11).

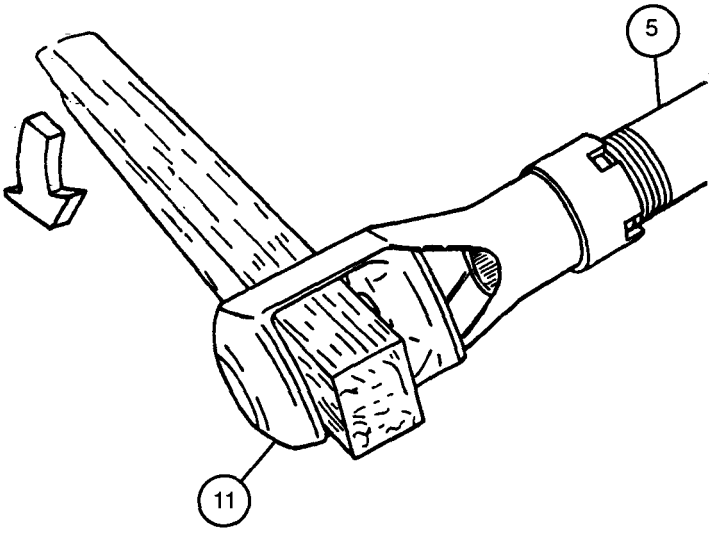


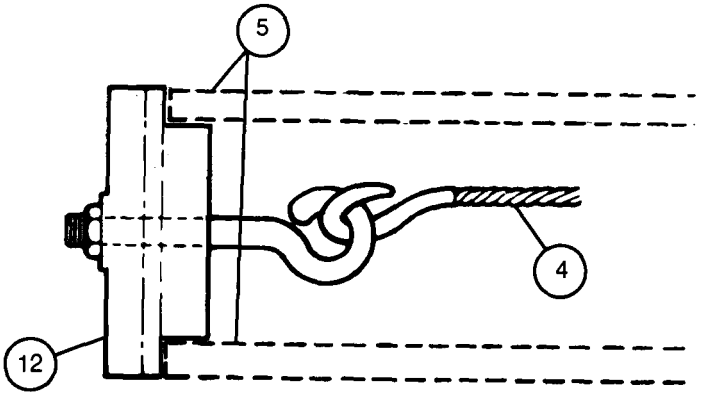


WARNING

Breech ring must be supported prior to removal of cannon assembly to prevent injury to personnel.

17 Connect fabricated eyebolt assembly (12) to 30-foot cable or rope (4) in breech ring (9) and center at rear face of cannon tube (5) as cable or rope is pulled tight from muzzle end.





5-4 CANNON TUBE - CONTINUED

a. Removal - Continued

WARNING

Use l-beam trolley with lifting capacity of at least 3200 pounds (1452 kg) for M185 cannon or 3750 pounds (1701 kg) for M284 cannon to prevent injury to personnel.

18 Attach muzzle end of 30-foot cable or rope (4) horizontally to hoist (13) and a fixed point, or to a vehicle. Keep 30-foot cable or rope tight.

19 Attach guide ropes to muzzle end of cannon tube (5).

CAUTION

As cannon tube is withdrawn horizontally, the hoist sustaining the weight of the cannon tube should follow this movement to maintain the gun tube sling vertical and tight. Use care and withdraw slowly to prevent damage.

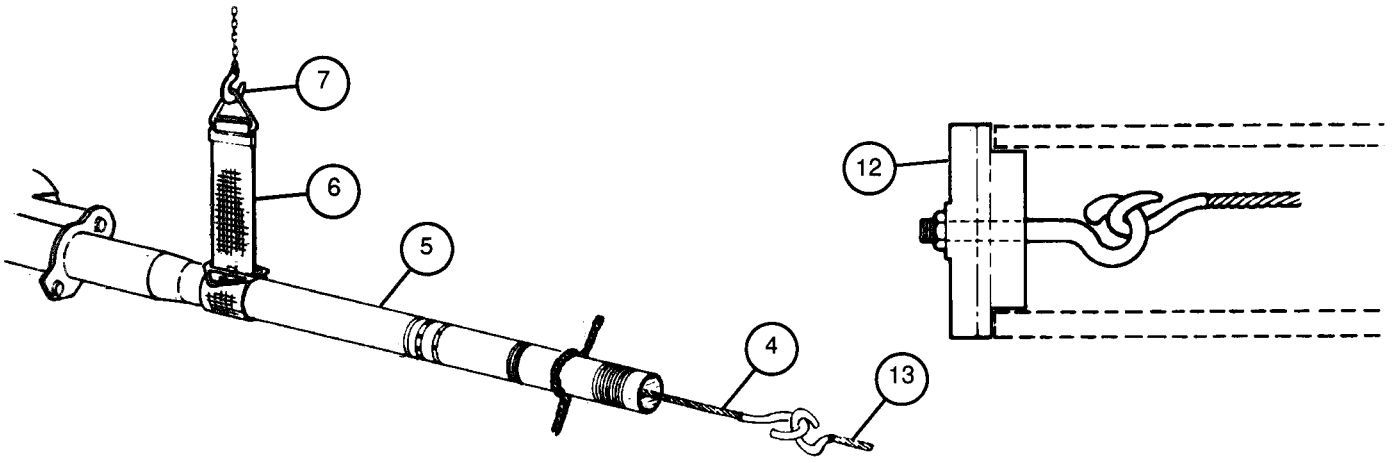
NOTE

Use guide ropes to help balance and prevent swinging of cannon tube during removal.

20 Withdraw cannon tube (5) from mount. Unhook muzzle end of 30-foot cable or rope (4). Place cannon tube on blocks, or other stable support with wedges at breech end to prevent any rolling. Place blocks on level hardened surface, such as concrete or equivalent.

21 Tie greased rag to hook.

22 Remove fabricated eyebolt assembly (12) and 30-foot cable or rope (4) hook along with greased rag from cannon tube (5).



b. Inspection

To inspect torque key (14), measure width of bottom surface in at least three places. Replace torque key on M185 cannon if width is less than 31/32 inch (24.6 mm) at any point along bottom of taper or if torque key on M284 cannon is less than 1-9/16 inches (3.97 cm) (TM 9-2350-311-20-2).

c. Installation

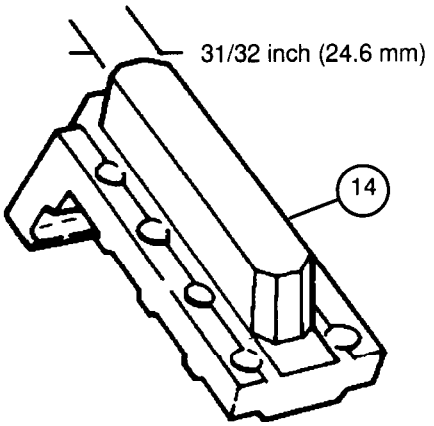
1 Wrap one hook of 30-foot cable or rope (4) with greased rag and thread through muzzle end of cannon tube (5). Allow other end of rope to dangle out of muzzle end.

2 Attach gun tube sling (6) in choke hitch at point in cannon tube (5) indicated as center of balance.

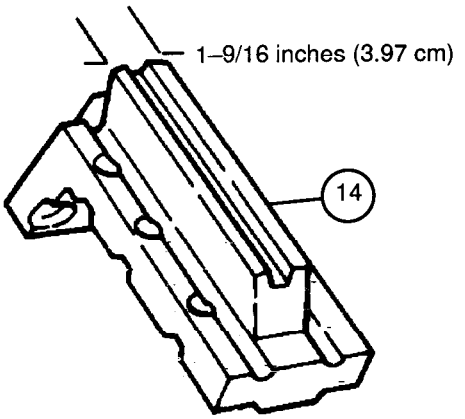
WARNING

Use l-beam trolley with lifting capacity of at least 3200 pounds (1452 kg) for M185 cannon or 3750 pounds (1701 kg) for M284 cannon to prevent injury to personnel.

3 Attach gun tube sling (6) to l-beam trolley (7).



M178 MOUNT CONFIGURATION



M182 MOUNT CONFIGURATION

5-4 CANNON TUBE - CONTINUED

c. Installation - Continued

NOTE

- Mount in vehicle should be horizontal. Breech ring key should be up and secured out of the way.
- Torque key groove should be canted 45 degrees counterclockwise from its normal position for installation purposes. If torque key groove is not in this position for installation and chain-type pipe wrench is available, perform step 4. If chain-type pipe wrench is not available, perform steps 5 through 7.

4 Loosen gun tube sling (6). Move one wedge away from cannon tube (5) making it free to rotate. Using chain-type pipe wrench (10), rotate cannon tube 45°. Slide wedge back into place to hold cannon tube in position. Tighten gun tube sling.

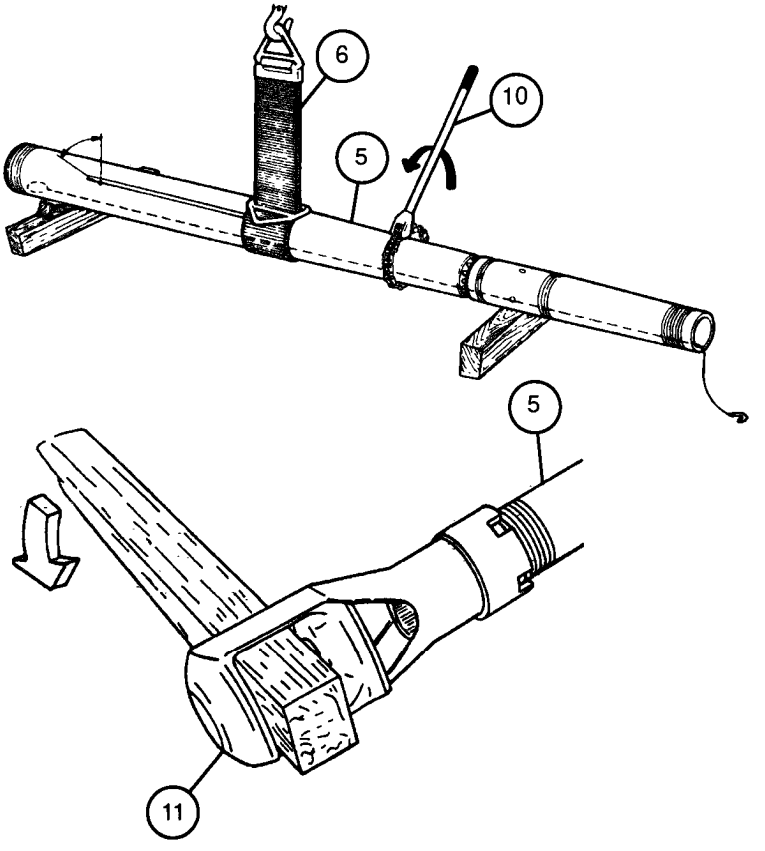
NOTE

If chain-type pipe wrench has been used, skip to step 9.

5 Install muzzle brake (11) (TM 9-2350-311-10).

6 Install a 4 x 4 inch wooden block at least 5 feet long into muzzle brake (11).

7 Using wooden block for leverage, rotate muzzle brake (11) and cannon tube (5) 45°. Use wedge to hold cannon tube in position.



8 Before installation, cieanand lube mount cradle bearings andcannon tubeouter surface (para 2-9).

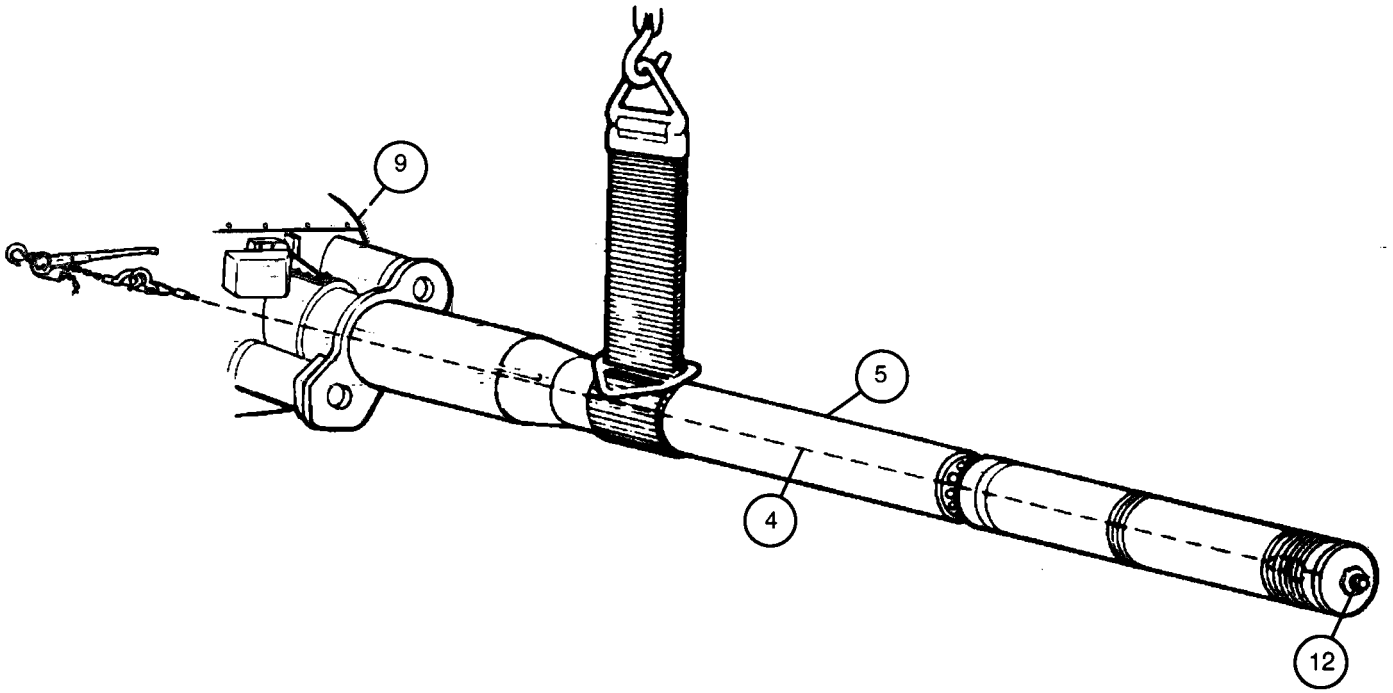
9 Lift cannon tube (5) horizontally and insert breech end into mount. Push cannon tube carefully into mount and attach fabricated eyebolt assembly (12) to 30-foot cable or rope (4) hook at muzzle.

NOTE

If nitrogen has not been released from recuperator assembly, the breech ring band maybe out of line and will prevent cannon tube installation. If necessary, release recuperator assembly pressure (TM 9-2350-311-20-2).

10 Draw 30-foot cable or rope (4) tight from within cab. Pull cannon tube (5) into mount until breech end is flush with rear shoulder of breech ring (9).

11 Attach come-along to rear hook of 30-foot cable or rope (4) if necessary to seat cannon tube (5) in breech ring (9).



5-4 CANNON TUBE - CONTINUED

c. Installation - Continued

WARNING

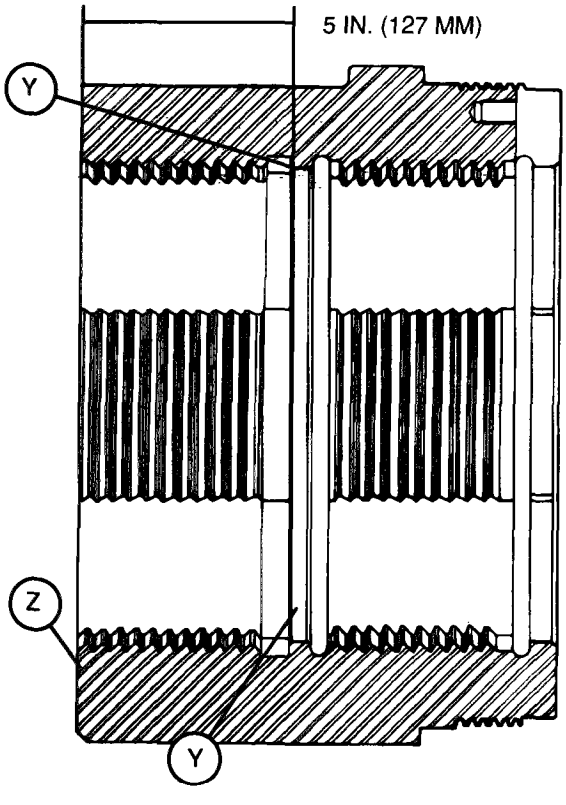
An incorrect fit and/or thread damage may allow propellent gases to leak into crew compartment when cannon assembly is fired or may cause failure of the breech assembly.

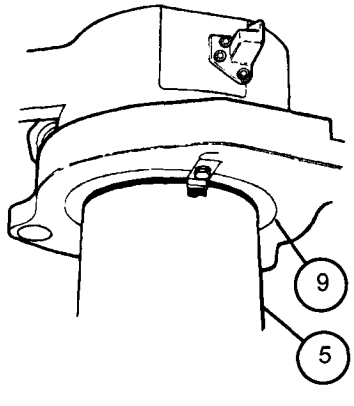
CAUTION

Do not attempt to lock cannon tube into breech by turning 45 degrees unless all three fit indications have been checked. Attempting to rotate an improperly fitted cannon into locked position can result in damage to the breech or cannon threads that will not be detectable by visual inspection.

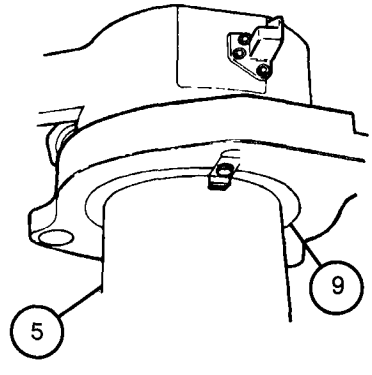
12 To ensure proper fit of cannon tube (5) and breech ring (9), inspect inner breech ring surfaces. Rear face of cannon tube must be flush with rear shoulder of breech ring (Y). Distance from rear face of cannon tube to rear face of breech ring (Z) must be no more than five inches (12.7 cm).

13 Inspect cannon tube (5) at front face of breech ring (9). Machined end of cannon tube should not show if cannon tube is properly installed in breech ring. There should be no gap between front face of breech ring and the facing cannon tube.





EXCESSIVE GAP
IMPROPER FIT



NO GAP
CORRECT FIT

NOTE

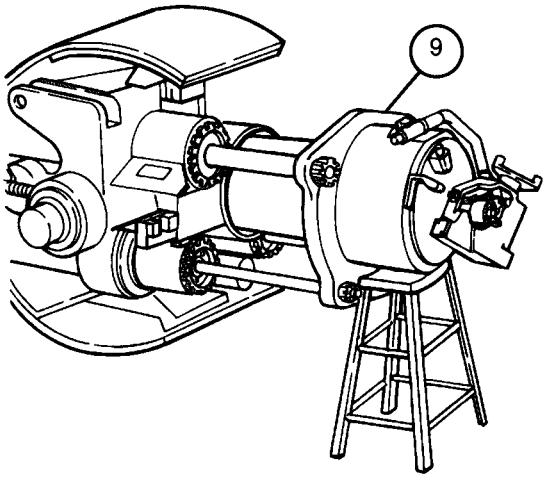
There is an alternate method for rotating cannon tube for installation if chain-type pipe wrench is not available and muzzle brake has not been removed. To use alternate method, perform steps 16 and 17 instead of 14 and 15.

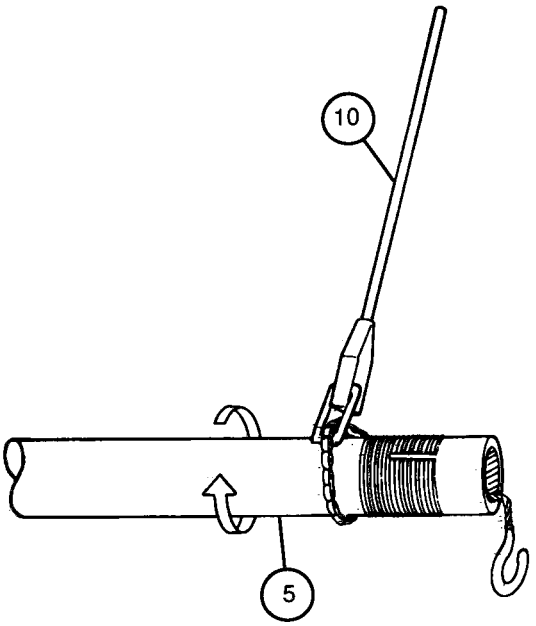
14 Place chain-type pipe wrench (10) on cannon tube (5) at a location without critical external features.

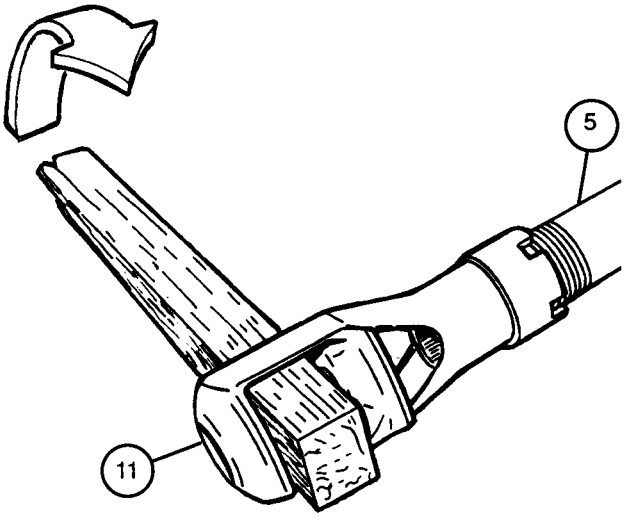
15 Rotate cannon tube (5) 45° clockwise to engage cannon tube and breech ring (9) threads.

16 Insert available 4 x 4 inch wooden block at least 5 feet long into muzzle brake (11).

17 Using wooden block for leverage, rotate muzzle brake (11) and cannon tube (5) 45° clockwise to engage cannon tube and breech ring (9) threads.







5-4 CANNON TUBE - CONTINUED

c. Installation - Continued

18 To install breech ring machine key (2), loosen cap screw (1). Slide breech ring machine key downward into slot (3) and tighten cap screw.

19 Charge recuperator assembly (TM 9-2350-311-20-2).

20 Remove l-beam trolley (7), gun tube sling (6), and chain-type pipe wrench (10) or 4 x 4 inch wooden block from cannon tube (5). Remove fabricated breech stand (8) from under breech ring (9).

WARNING

Cannon assembly will not be fired until cannon tube and breech ring are properly assembled, alined and adjusted.

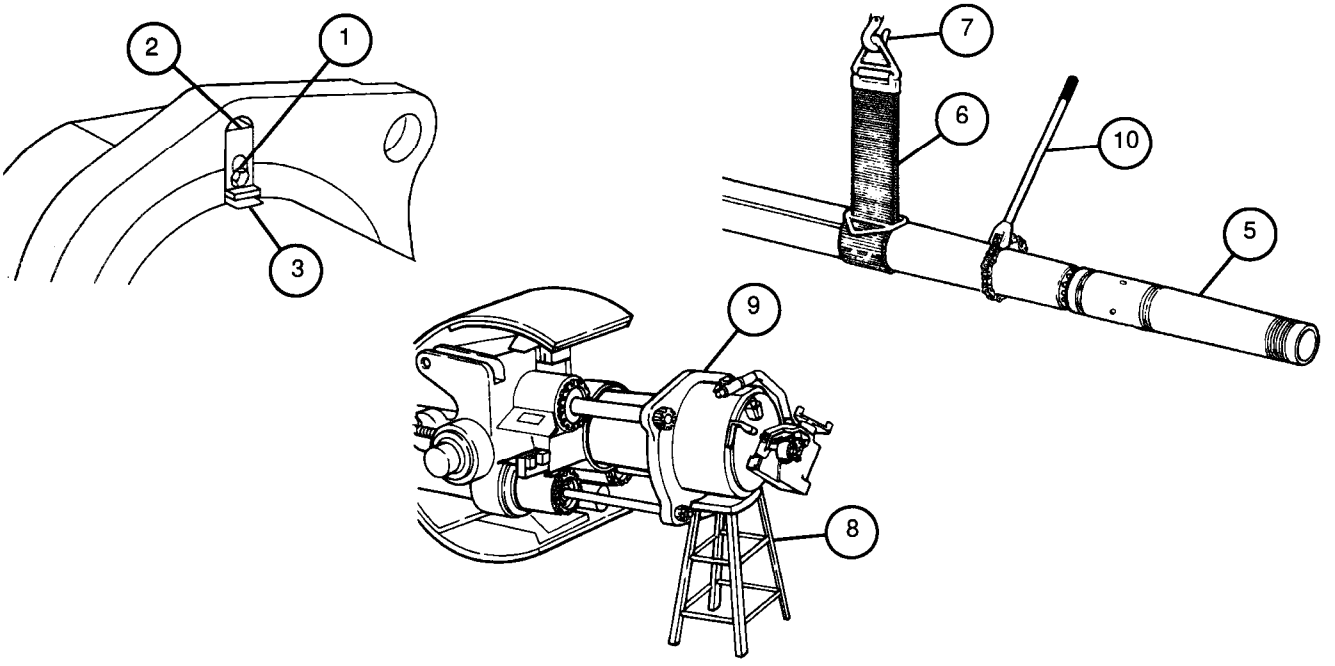
21 inspect position of breech ring machine key (2). Breech ring machine key should fill all but the rounded end of the slot. This is difficult to see with cannon assembly installed in mount; feel with little finger to make sure.

CAUTION

After anew M284 cannon assembly or its machine key has been installed, a zone 6 charge must be fired to mate machine key and the cannon tube. Failure to follow this procedure could result in equipment damage.

NOTE

- After cannon assembly replacement, all fire control components must be checked for alinement (TM 9-2350-311-20-2).
- Adjustment of operating cam roller clearance is required after cannon assembly replacement (TM 9-2350-311-20-2).



5-5 BREECH MECHANISM

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanics' tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Lockwashers (4) (item 69, Appx E) M109A2/M109A3/M109A4
Lockwashers (3) (item 70, Appx E) M109A2/M109A3/M109A4
Lockwashers (2) (item 77, Appx E)
Lockwire (item 36, Appx E) M109A5

Personnel Required
3

References
TM 9-1000-202-14

Equipment Condition
Carrier assembly removed (TM 9-2350-311-20-2)

a. Disassembly

WARNING

- Wear steel-tipped safety shoes, safety glasses and gloves to avoid possible injury.
- Make sure breechblock is in closed position to avoid possible injury.
- Springs of breechblock are under 130 lb-ft (176 Nm) load pressure. Use extreme care when removing components of the breech mechanism to avoid possible injury.

5-5 BREECH MECHANISM - CONTINUED

a. Disassembly - Continued

NOTE

- Do not remove breech ring from cannon.
- Lockwire is used to secure interlocking stop to breech ring body of M284 cannon. Three lockwashers are used on the M185 cannon.

1 Remove three cap screws (1) three lockwashers (2) or lockwire (3) and interlocking stop (4) from breech ring body (5). Discard lockwashers or lockwire.

NOTE

Lockwire is used to secure left (lower) and right (upper) catches of M284 cannon. Four lockwashers are used on M185 cannon.

2 Remove two cap screws (6) two lockwashers (7) or lockwire (8) and right (upper) catch (9). Discard lockwashers or lockwire.

3 Remove two cap screws (10), two lockwashers (11) or lockwire (12), and left (lower) catch (13). Discard lockwashers or lockwire.

4 Remove two cap screws (14) two lockwashers (15) and control cam (16). Discard lockwashers.

5 Deleted.

6 Deleted.

b. Inspection

1 Inspect breech ring body (5) (TM 9-1000-202-14) and replace as required.

2 Measure inside diameter of upper breech ring lug (17) and replace breech ring body (5) if greater than 2.910 inches (7.39 cm).

3 Measure inside diameter of lower breech ring lug (18) and replace breech ring body (5) if greater than 3.004 inches (7.63 cm).

4 Inspect interlocking stop (4). Replace if cracked or deformed.

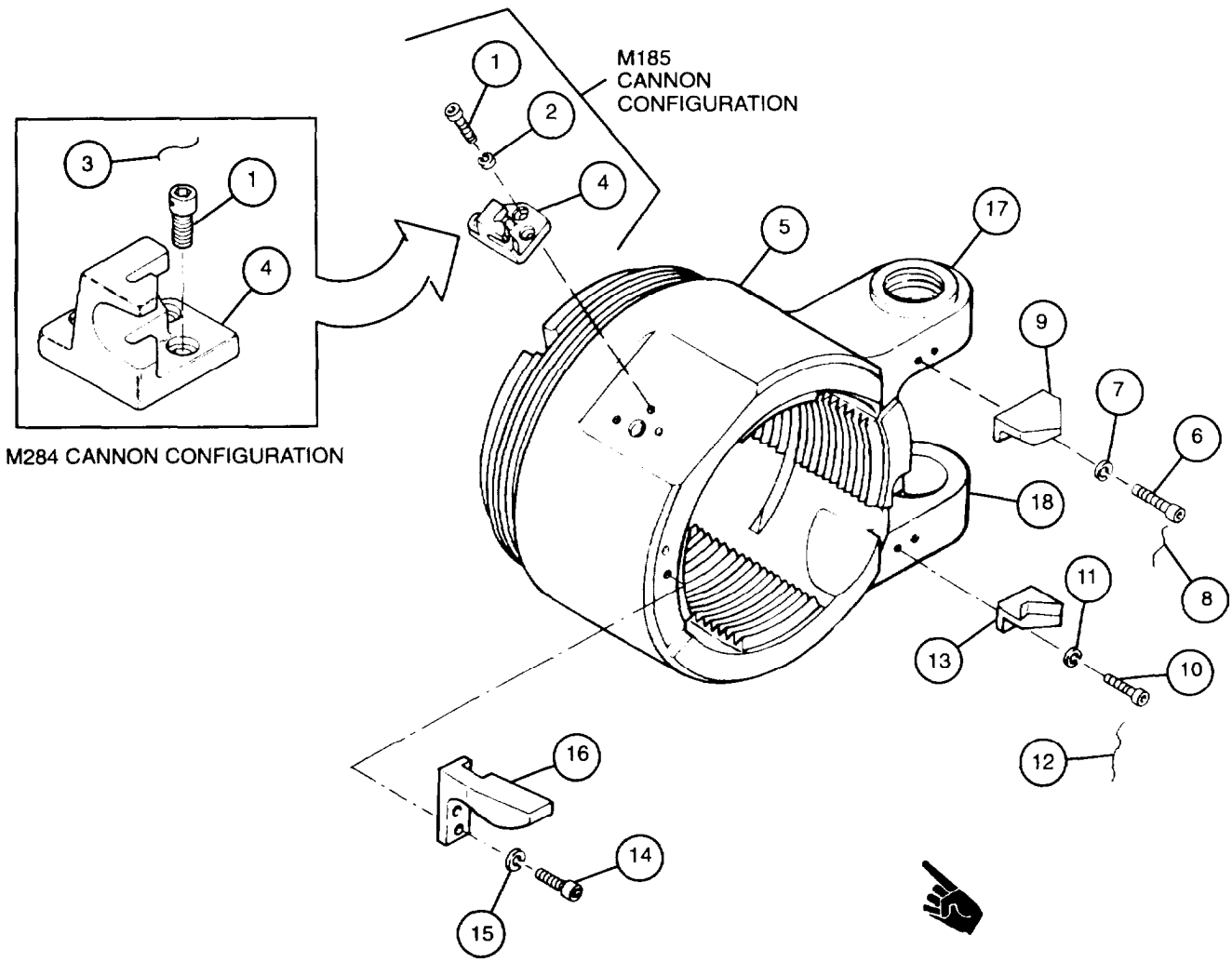
5 Inspect right (upper) catch (9). Replace if cracked or deformed.

6 Inspect left (lower) catch (13). Replace if cracked or deformed.

7 Deleted.

8 Inspect control cam (16). Replace if cracked or distorted.

9 Deleted.



5-5 BREECH MECHANISM - CONTINUED

c. Assembly

1 Deleted.

2 Deleted.

3 Install control cam (16) with two new lockwashers (15) and two cap screws (14).

NOTE

Lockwire is used to secure left (lower) and right (upper) catches of M284 cannon. Lockwashers are used on M185 cannon.

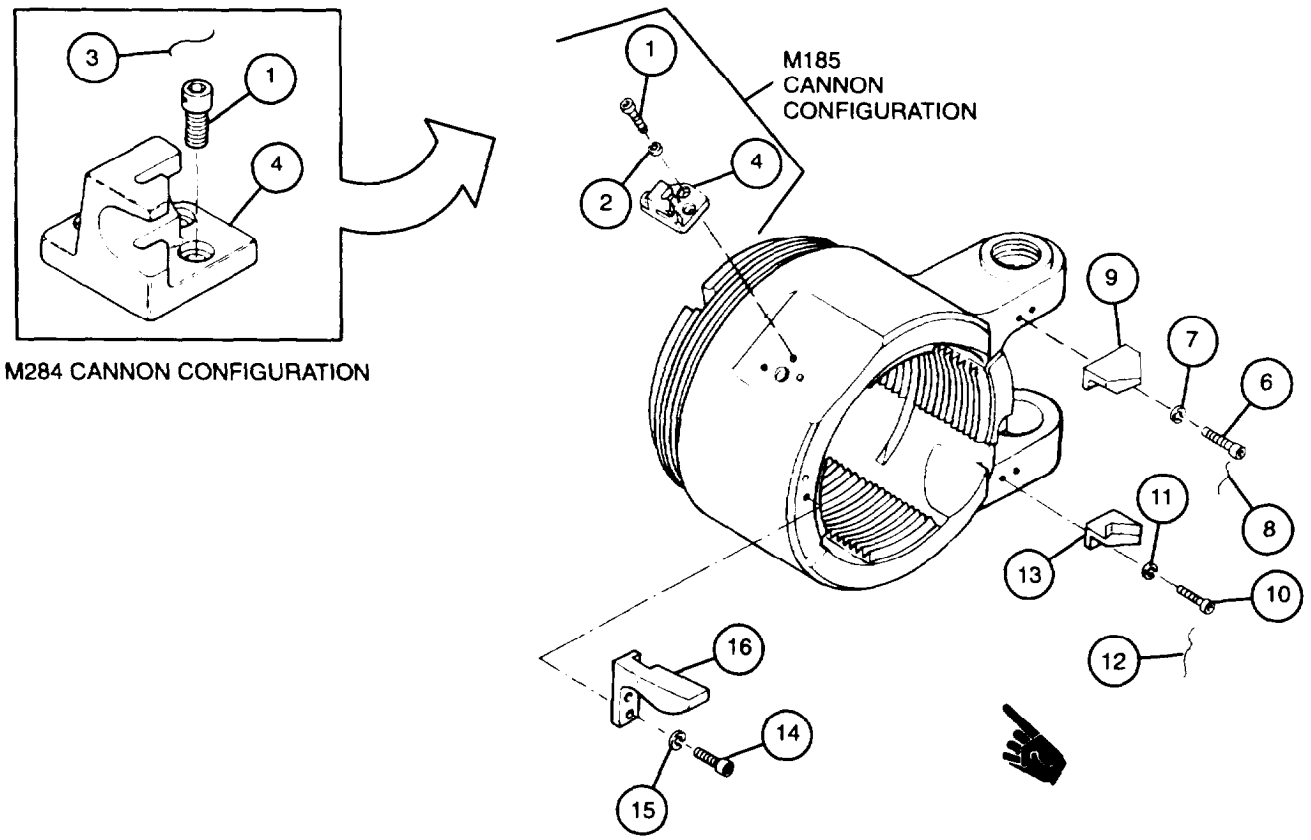
4 Install left (lower) catch (13) with two new lockwashers (11) or new lockwire (12), and two cap screws (10).

5 Install right (upper) catch (9) with two new lockwashers (7) or new lockwire (8) and two cap screws (6).

NOTE

Lockwire is used on M284 cannon to secure interlocking stop and three lockwashers are used on M185 cannon.

6 Install interlocking stop (4) with three new lo&washers (2) or new lockwire (3), and three cap screws (1).



5-6 BREECHBLOCK ASSEMBLY

This task covers: a. Disassembly b. Inspection and Repair
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Spring pin (item 6, Appx E)

Personnel Required
2

Equipment Condition
Breechblock assembly removed (TM 9-2350-311-10)

a. Disassembly

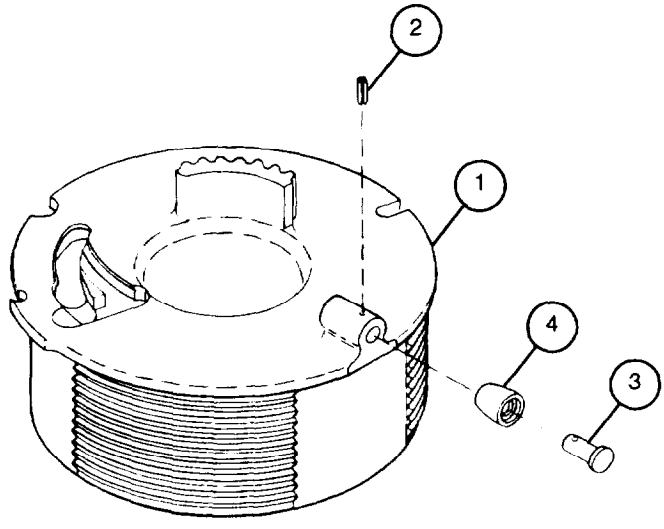
WARNING

- Breechblock weighs approximately 125 pounds (57 kg). Two personnel are required to remove breechblock to prevent injury.
- Wear steel-tipped safety shoes to avoid possible injury.

1 Place breechblock (1) on solid surface.

2 Remove and discard spring pin (2).

3 Remove headed straight pin (3) and roller (4) from breechblock (1).



5-6 BREECHBLOCK ASSEMBLY - CONTINUED

b. Inspection and Repair

1 Inspect breechblock (1) for damaged threads. Repair threads or replace breechblock.

2 Measure breechblock (1) hole diameter (5). Replace if greater than 4.318 inches (10.968 cm).

3 Inspect gear segment (6) of breechblock (1). Replace breechblock if damaged or distorted.

4 Replace roller (4) if broken, cracked, if outside diameter is less than 0.995 inch (25.273 mm), or if inside diameter is greater than 0.506 inch (12.852 mm).

5 Inspect headed straight pin (3). Replace if damaged or distorted.

6 Deleted.

c. Assembly

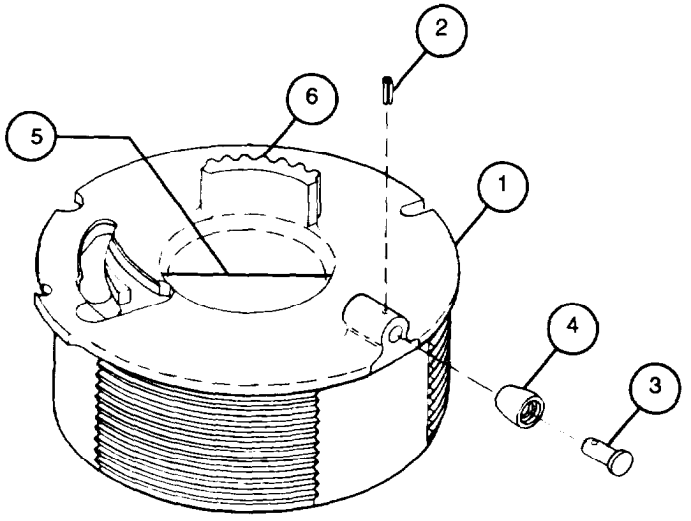
NOTE

If headed straight pin is new from supply, preform step 2.

1 Install roller (4) and headed straight pin (3) in breechblock (1).

2 Drill a 5/32 hole in the headed straight pin using the hole in the breechblock as a pilot hole. Ensure roller (4) is free to turn and not bound.

3 Install new spring pin (2).



5-7 OPERATING CRANK ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Spring pins (2) (item 5, Appx E)

Equipment Condition
Operating crank assembly removed (TM 9-2350-311-20-2)

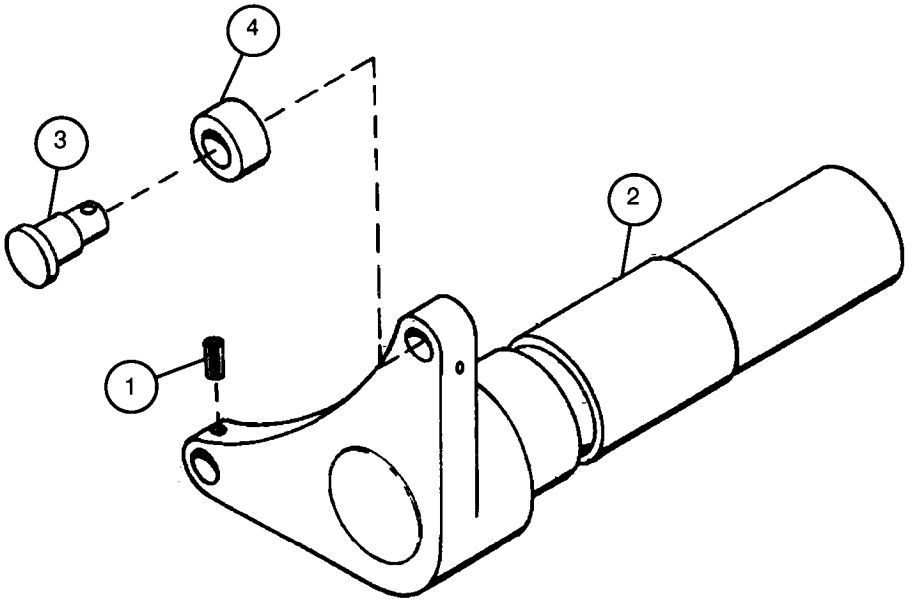
a. Disassembly

WARNING

Wear safety glasses and safety shoes to prevent injury due to falling or flying objects.

1 Remove two spring pins (1) from breech crank (2). Discard spring pins.

2 Remove two headed shoulder pins (3) and two crank rollers (4).



5-7 OPERATING CRANK ASSEMBLY - CONTINUED

b. Inspection

1 Inspect two headed shoulder pins (3) and replace if cracked or deformed.

2 Inspect two crank rollers (4) and replace if cracked or deformed. Measure inside diameter of crank rollers and replace if greater than 0.878 inch (22.301 mm). Measure outside diameter of crank rollers and replace if less than 1.245 inches (3.162 cm).

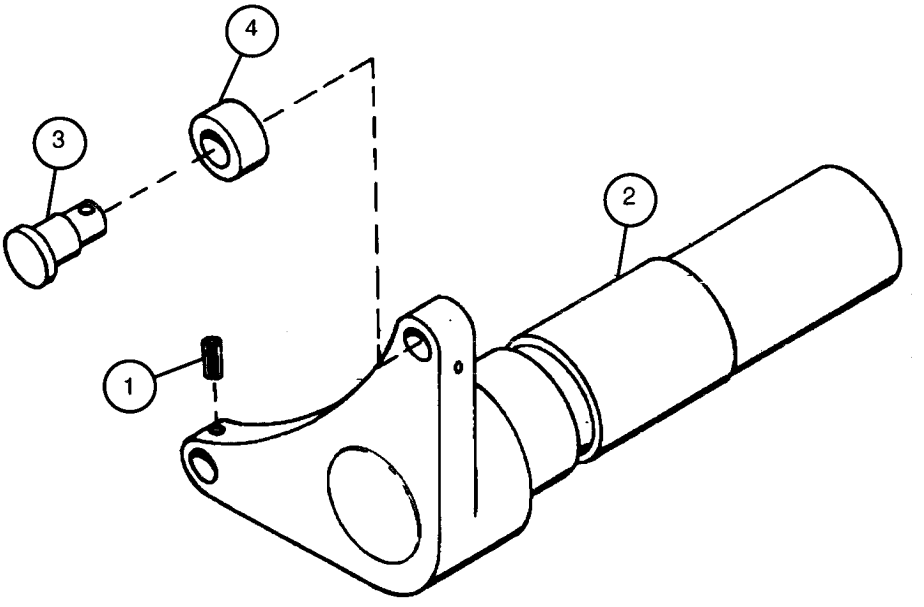
3 Inspect breech crank (2) and replace if there are visible cracks. Measure outside diameter of breech crank and replace if less than 2.89 inches (7.34 cm). Measure inside diameter of crank headed shoulder roller pin holes and replace breech crank if greater than 0.69 inch (17.53 mm).

c. Assembly

1 Place breech crank (2) on solid surface.

2 Install two crank rollers (4) and two headed shoulder pins (3).

3 Install two new spring pins (1) to secure two crank rollers (4).



5-8 CARRIER ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Lockwashers (3) (item 87, Appx E) M109A2/M109A3/M109A4
Lockwire (item 35, Appx E) M109A5

Equipment Condition
Carrier assembly removed and disassembled (TM 9-2350-311-20-2)

a. Disassembly

NOTE

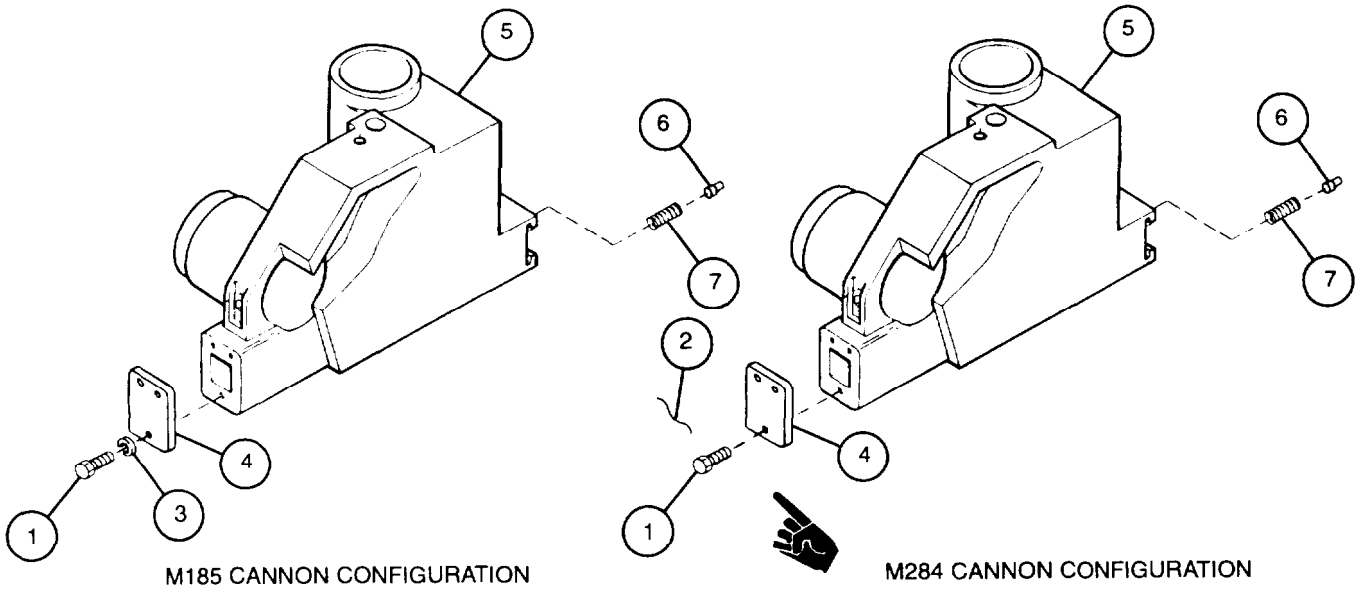
- Lockwire is used to secure access cover to carrier housing of M284 cannon.
- Lockwasher is used to secure access cover to carrier housing of M185 cannon.

1 Remove three cap screws (1), lockwire (2) or three lockwashers (3), and access cover (4) from carrier housing (5). Discard lockwashers and lockwire.

NOTE

Headless shoulder pin is staked in two places 180° apart. Do not remove unless damaged.

2 Remove headless shoulder pin (6) and helical compression spring (7)



5-8 CARRIER ASSEMBLY - CONTINUED

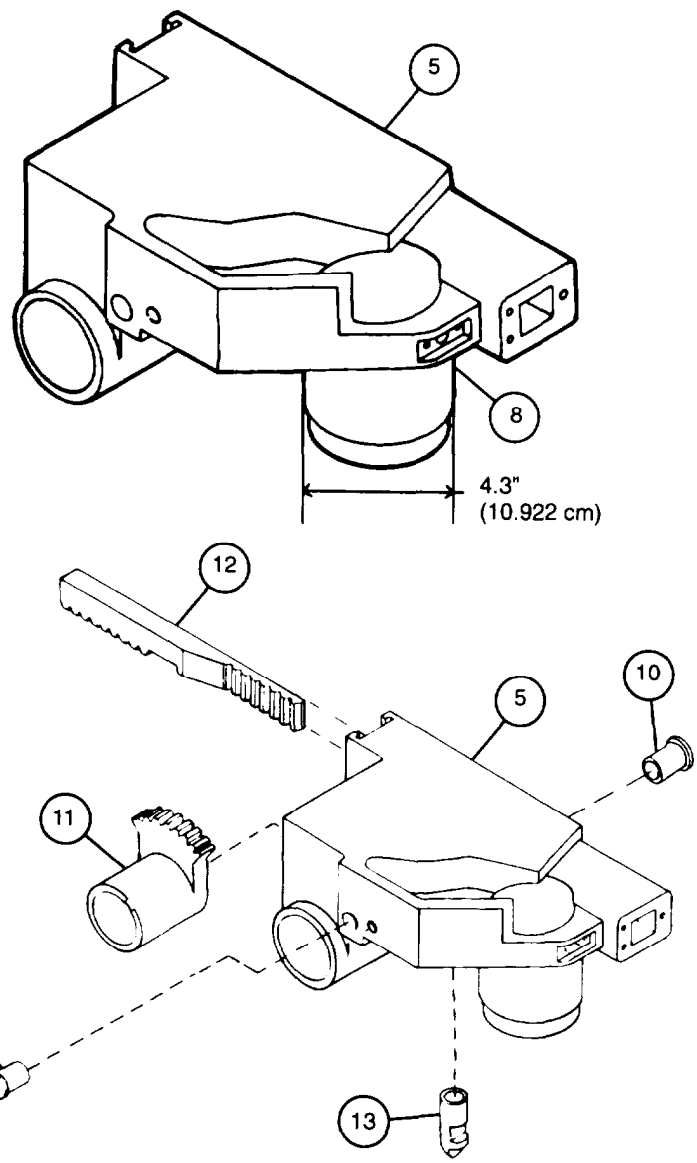
b. Inspection

1 Inspect carrier housing (5). Measure outside diameter of carrier housing shaft (8) and replace if less than 4.300 inches (10.922 cm).

2 Inspect left and right sleeve bushings (9 and 10). Replace if they show excessive wear. Measure inside diameter of left and right sleeve bushings and replace if greater than 0.8185 inch (20.7899 mm).

3 Measure backlash of sector gear (11) and gear rack (12). Replace sector gear and gear rack if backlash is greater than 0.010 inch (0.254 mm).

4 Inspect and measure detent plunger (13). Replace if deformed more than 1/32 inch (0.8 mm).



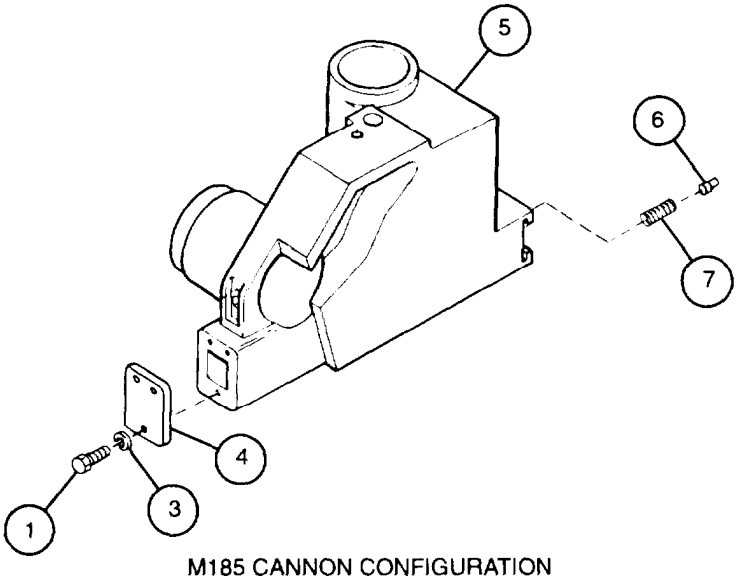
c. Assembly

NOTE

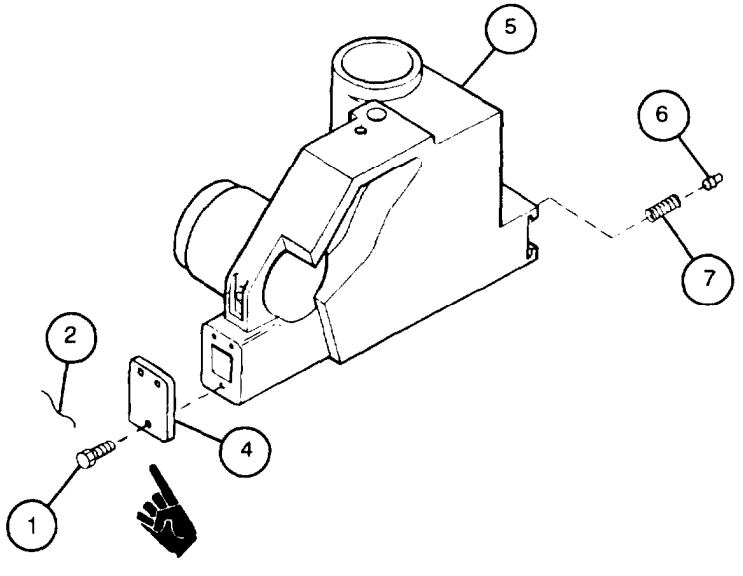
- Lockwire is used to secure access cover to carrier housing of M284 cannon.
- Lockwasher is used to secure access cover to carrier housing of M185 cannon.

1 Install access cover (4) to carrier housing (5) with three new lockwashers (3) or new lockwire (2), and three cap screws (1).

2 Install helical compression spring (7) and headless shoulder pin (6). Stake headless shoulderpin in two places 180° apart.



M185 CANNON CONFIGURATION



M284 CANNON CONFIGURATION

5-9 HANDLE ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Spring pin (item 3, Appx E)
Spring pin (item 94, Appx E)

Equipment Condition
Handle assembly removed (TM 9-2350-311-20-2)

a. Disassembly

1 Place handle assembly (1) on a solid work surface. Actuate detent plunger (2) to see if it returns to locked position.

2 Remove spring pin (3), detent plunger (2), and helical compression spring (4) from operating handle (5). Discard spring pin.

3 Actuate clutch disk (6) to see if it returns to position when released.

4 Remove spring pin (7), helical compression spring (8), and clutch disk (6) from operating handle (5). Discard spring pin.

b. Inspection

1 Inspect helical compression spring (4). Replace if distorted or it failed to return detent plunger (2) to locked position when actuated during disassembly procedure.

2 Measure inside diameter of operating handle (5). Replace if greater than 3.743 inches (9.507 cm).

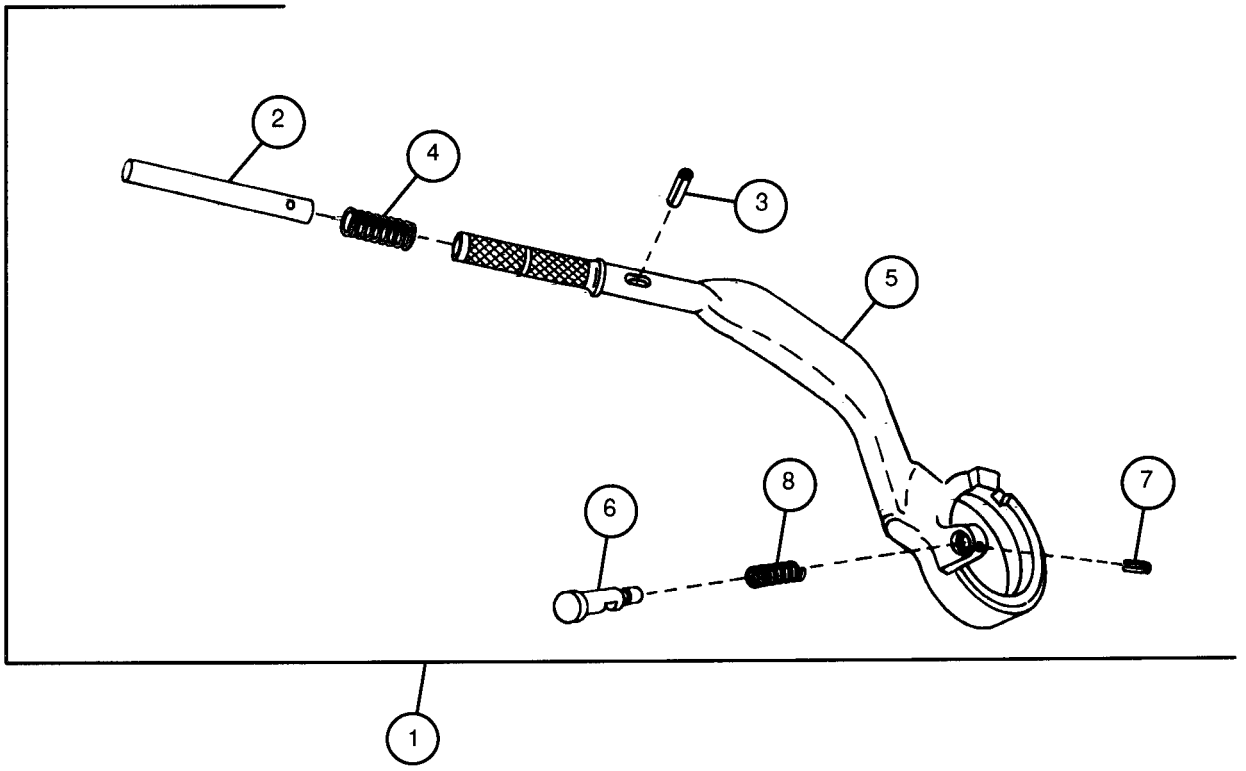
3 Inspect helical compression spring (8). Replace if distorted or it failed to return clutch disk (6) to proper position during disassembly procedure.

4 Inspect clutch disk (6). Replace if nicked, distorted, or cracked.

c. Assembly

1 Install helical compression spring (8) and clutch disk (6). Secure by installing new spring pin (7).

2 Install helical compression spring (4) and detent plunger (2). Secure detent plunger by pushing into operating handle (5) and installing new spring pin (3).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5-10 BREECH CAM AND PIN ASSEMBLY

This task covers: a. Removal/Disassembly b. Inspection
c. Assembly/Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Fabricated hinge pin bushing driver (Figure C-9, Appx C)

Materials/Parts
Bushings (2) (item 118, Appx E)
Self-locking nut (item 42, Appx E)
Self-locking nut (item 43, Appx E)
Spring pin (item 106, Appx E)

Personnel Reauired
2

Equipment Condition
M118A2/M118A3 elbow telescope removed (TM 9-2350-311-10)
Cannon tube in travel lock (TM 9-2350-311-10)
Damper assembly removed (TM 9-2350-311-20-2)

a. Removal/Disassembly

WARNING

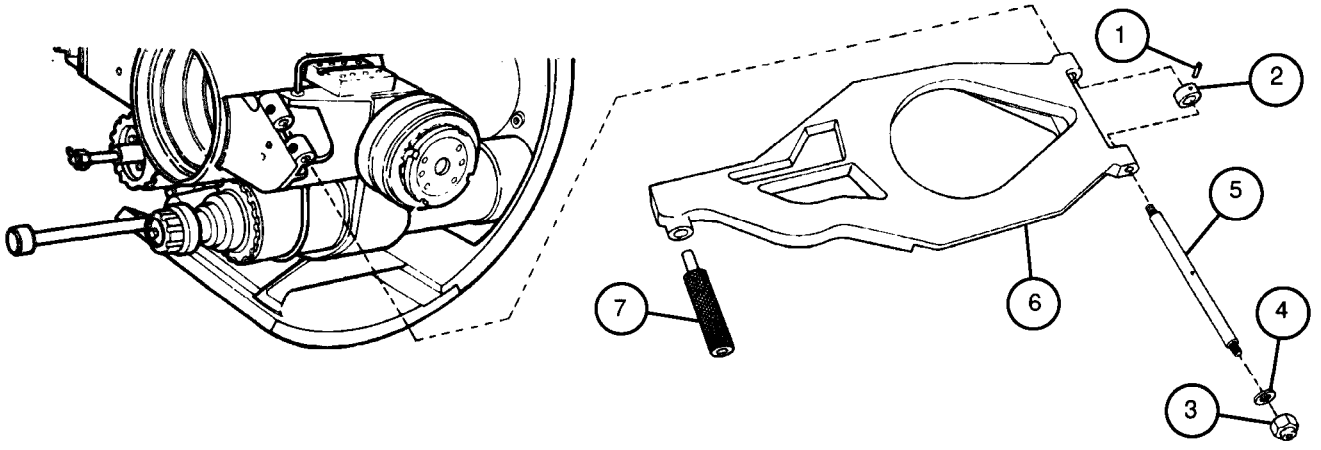
Wear safety shoes, gloves, and safety glasses to prevent injury.

1 Drive out spring pin (1) from pin collar (2). Discard spring pin.

2 Remove self-locking nut (3), flat washer (4), breech cam pin (5), and pin collar (2).

3 Lift off breech cam (6).

4 Remove cam assembly handle (7) from breech cam (6).



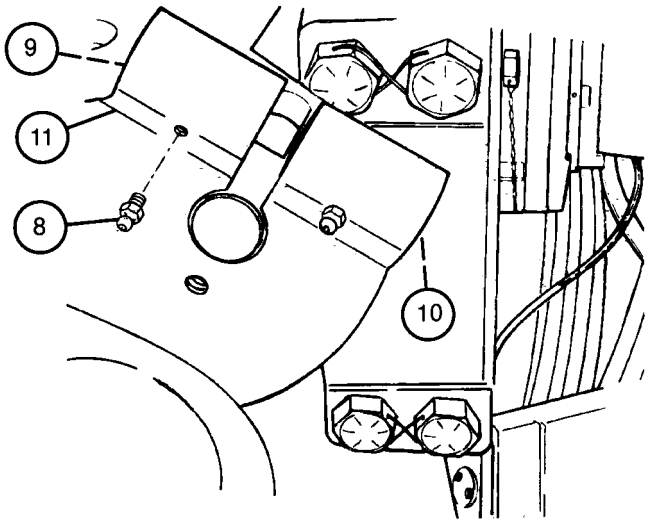
5 Remove two lubrication fittings (8).

6 Remove blade from hacksaw. Insert blade through bushings (9 and 10) in hinge (11). Assemble blade to hacksaw frame.

CAUTION

Use care not to damage inside of hinge when cutting bushings with hacksaw. Once bushings are cut, they can be driven out of hinge.

7 Cut bushings (9 and 10) through to hinge (11) in one place. Remove hacksaw from hinge.



5-10 BREECH CAM AND PIN ASSEMBLY - CONTINUED

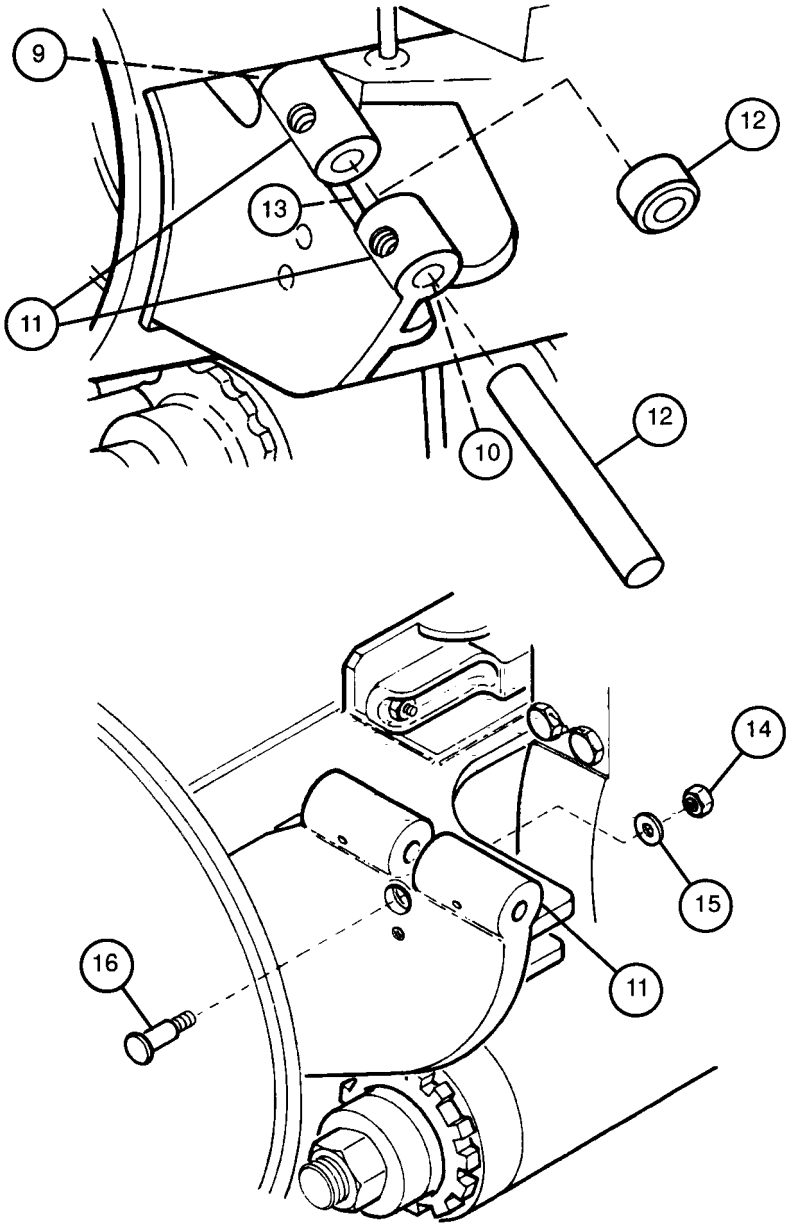
a. Removal/Disassembly - Continued

8 Insert hinge pin bushing driver (12) into gap (13) left by pin collar.

9 Drive left bushing (9) out of hinge (11). Discard bushing.

10 Repeat step 8 and drive right bushing (10) out of hinge (11). Discard bushing.

11 Remove self-locking nut (14), flat washer (15), and cam stop (16) from mount below hinge (11).



b. Inspection

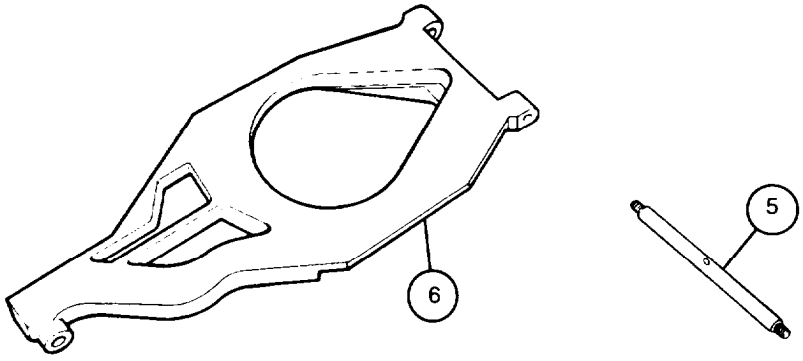
1 Measure outside diameter of breech cam pin (5) bearing surface. Replace if less than 0.748 inch (18.999 mm).

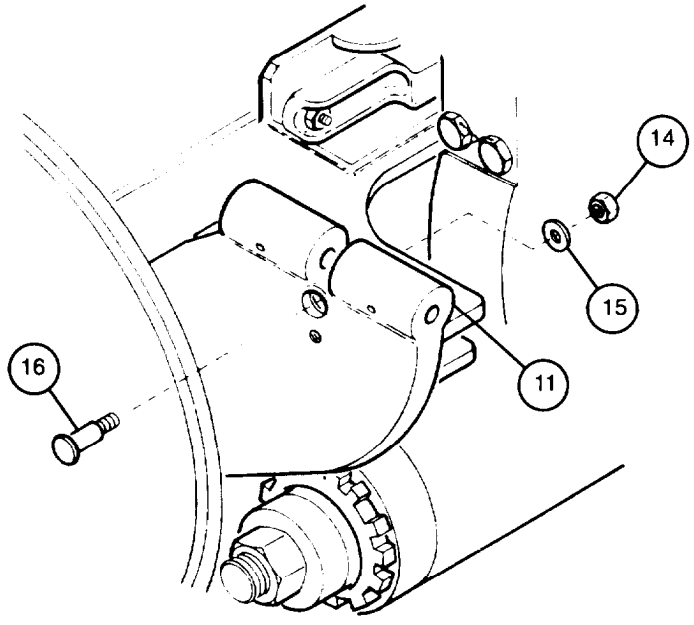
2 Measure inside diameter of left hinge pinhole of breech cam (6). Replace breech cam if greater than 0.7505 inch (19.06 mm).

3 Inspect breech cam (6). Replace if there are any cracks or if cam path is distorted.

c. Assembly/Installation

1 Install cam stop (16), flat washer (15), and new self-locking nut (14) at mount below hinge (11).





5-10 BREECH CAM AND PIN ASSEMBLY - CONTINUED

c. Assembly/Installation - Continued

2 Bore new bushings (9 and 10) to an inside diameter of 0.740 ± 0.005 inch (18.8 ± 0.13 mm).

3 Install new bushing (9) with hinge pin bushing driver (12).

4 Install new bushing (10) with hinge pin bushing driver (12).

CAUTION

Be careful not to damage threads in lubrication holes when drilling holes in new bushings. Remove all burrs from drilled holes in bushings. This will prevent improper fit.

NOTE

Use a 90° angle electrical drill. If not available, push cannon assembly out of battery (TM 9-2350-311-20-2) and use regular style drill.

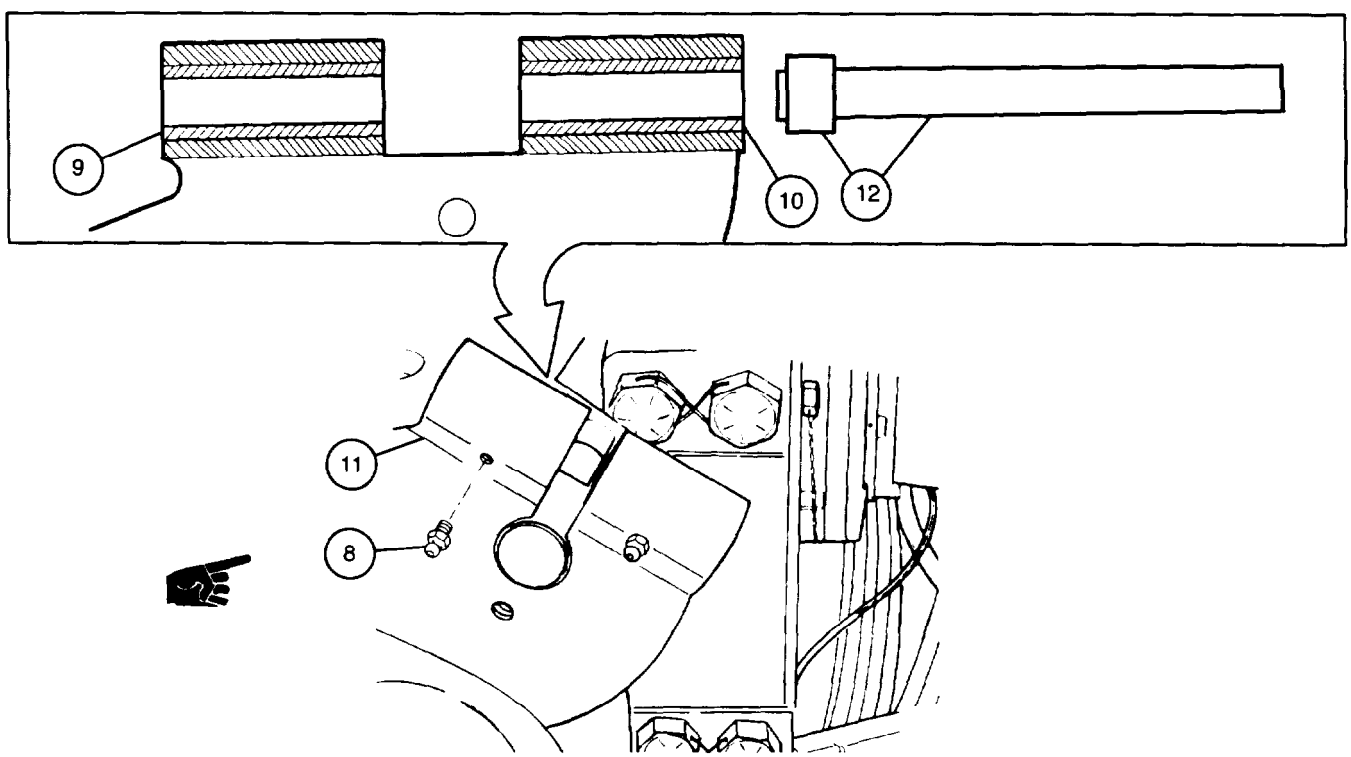
5 Drill 1/8 inch (3.2 mm) hole in new bushings (9 and 10) through lubrication fitting (8) holes.

NOTE

New bushings must be reamed in one operation as shown so they will be in line with each other.

6 Ream bushings (9 and 10) with a hand reamer, 3/4 inch (19.05 mm) in diameter.

7 Install two lubrication fittings (8) on hinge (11).



8 Install cam assembly handle (7) in breech cam (6).

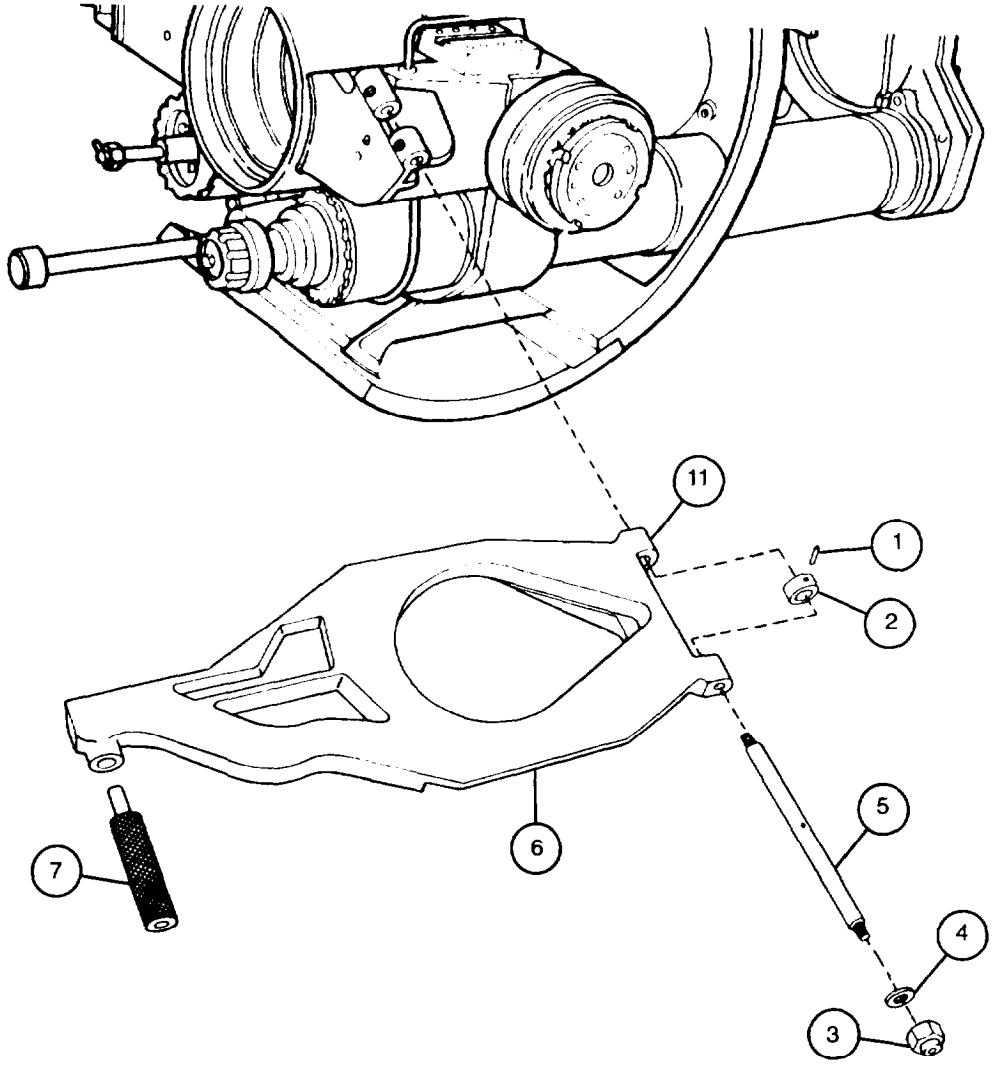
9 Lift breech cam (6) into position (holes in cam assembly alined with hinge (11)). Support breech cam.

10 Install breech cam pin (5) and pin collar (2). Make sure that holes in pin collar are alined with holes in breech cam pin.

11 Install flat washer (4) and new self-locking nut (3). Do not tighten self-locking nut at this time.

12 Install new spring pin (1) and tighten self-locking nut (3).

13 Adjust operating cam (TM 9-2350-311-20-2).



5-11 RECUPERATOR ASSEMBLY

This task covers:
a. Removal
b. Disassembly
c. Inspection
d. Assembly
e. Installation

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Drain pan (item 12, Appx F)
Fabricated breech stand (Figure C-3, Appx C)
Field artillery shop set

Materials/Parts
Adhesive (item 4, Appx B)
Cotter pin (item 47, Appx E)
Cotter pin (item 48, Appx E)
Grease (item 21, Appx B)
Gasket (item 112, Appx E)
Gasket (item 126, Appx E)
Hydraulic fluid (item 22, Appx B)
Lockwire (item 36, Appx E)
Lockwire (item 37, Appx E)
Lockwire (item 39, Appx E)
Piston wiper (item 113, Appx E)
Rag (item 26, Appx B)
Retaining rings (2) (item 103, Appx E)
Seal replacement parts kit (item 152, Appx E)
Self-locking nuts (2) (item 161, Appx E)
Spring pin (item 10, Appx E)
Spring pins (2) (item 6, Appx E)
Webbing strap (item 34, Appx B)
Wooden blocks (V) (item 37, Appx B)

Personnel Required
3

Equipment Condition
Cannon assembly depressed to 0 mils (TM 9-2350-311-10)
Lower gun shield removed (para 5-1)

a. Removal

WARNING

- Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.
- Level cannon before venting nitrogen to avoid serious injury to personnel or damage to equipment caused by cannon assembly sliding out of battery.
- Keep all parts of body clear to prevent serious injury when venting nitrogen. High pressure nitrogen must be completely vented before the drain plug is loosened to prevent serious injury caused by escaping hydraulic fluid.
- Ensure valves are closed prior to disassembly to prevent sudden release of nitrogen pressure.
- Care should be taken to prevent contamination of recuperator cylinder during disassembly and assembly.
- Prior to removing valve cap ensure that the pneumatic valve is closed to prevent release of nitrogen pressure. This will prevent serious injury or damage to equipment caused by sudden release of nitrogen pressure.

1 Remove valve cap (1) from right front of recuperator cylinder (2) and loosen nut on pneumatic valve (3) two turns to release nitrogen. Replace valve cap when recuperator cylinder has been vented completely.

2 Remove lockwire (4) from six cap screws (5). Remove six cap screws, cover adapter group (6), and gasket (7) from front end of recuperator cylinder (2). Discard gasket and lockwire.

3 Loosen front drain plug (8) and catch hydraulic fluid in a shallow drain pan. When hydraulic fluid is drained, tighten front drain plug.

4 Remove and discard cotter pin (9).

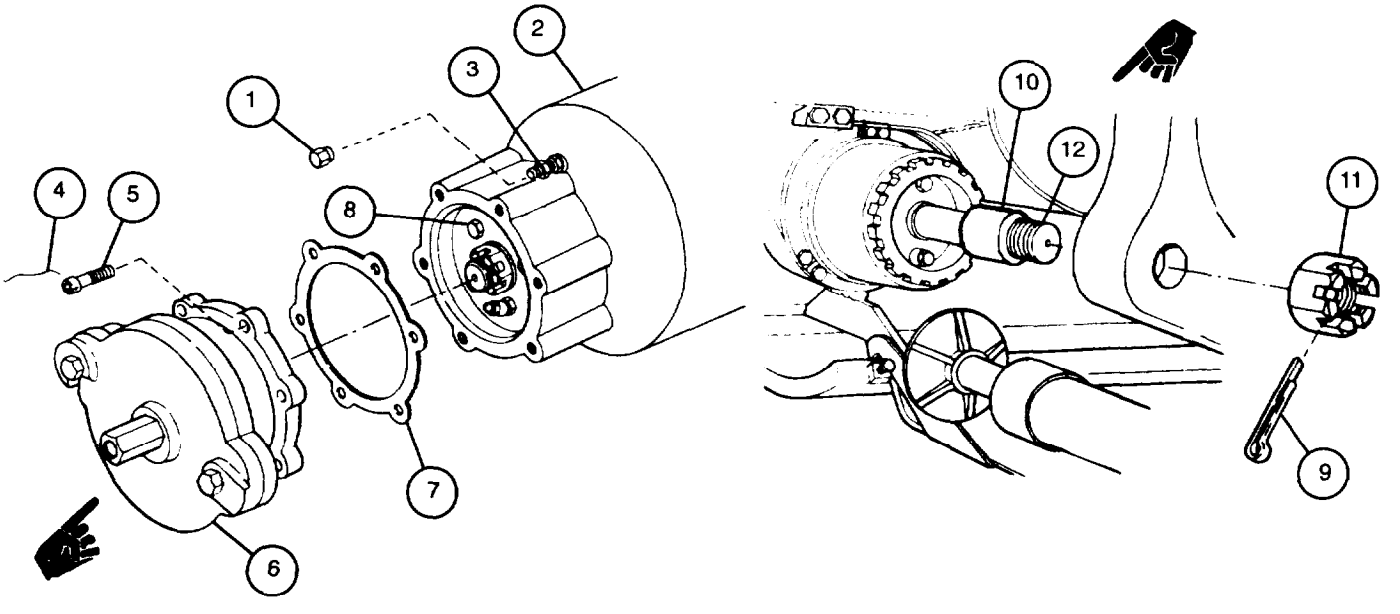
5 While holding shaft collar (10) with pipe wrench, remove rear slotted nut (11) from shouldered shaft (12).

6 Push cannon assembly out of battery about 18 inches (45.7 cm) (TM 9-2350-311-20-2).

WARNING

Block cannon assembly with fabricated breech stand when working on mount components with cannon assembly pushed out of battery. This will prevent serious injury or damage to equipment caused by accidental elevation of the cannon assembly.

7 Block cannon assembly with fabricated breech stand.



5-11 RECUPERATOR ASSEMBLY - CONTINUED

a. Removal - Continued

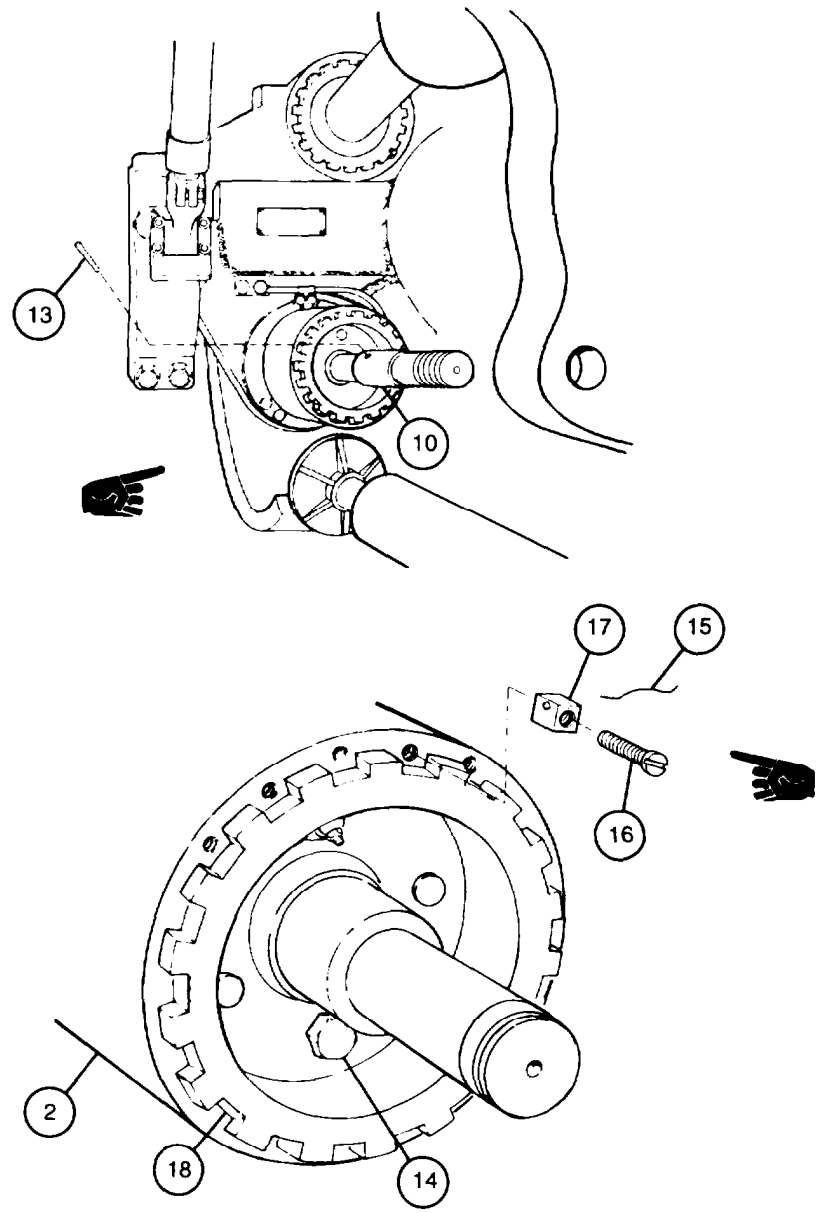
8 Remove spring pin (13) with suitable punch. Discard spring pin.

9 Unscrew and remove shaft collar (10).

10 Remove drain plug (14) at rear of recuperator cylinder (2) and drain hydraulic fluid in drain pan. Reinstall drain plug.

11 Remove lockwire (15), cap screw (16), and machine key (17). Discard lockwire.

12 Remove externally threaded ring (18) using spanner wrench.



CAUTION

Use care not to damage threads on rear of shouldered shaft.

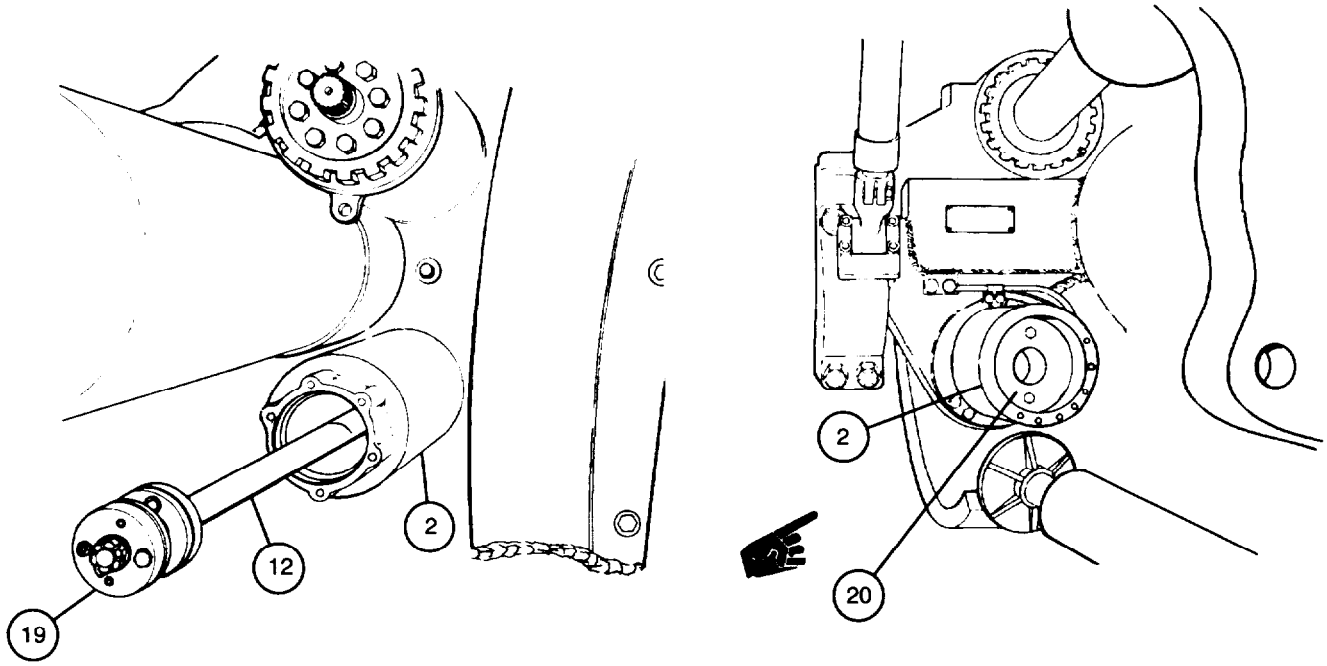
13 Push shouldered shaft (12) forward into recuperator cylinder (2). As piston group (19) comes out of front of recuperator cylinder (outside cab), it must be supported by an assistant to prevent damage inside of recuperator cylinder wall shoulder shaft threads.

14 Outside assistant must pull the piston group (19) and shouldered shaft (12) forward sufficiently to disengage the other end of the shouldered shaft from the cylinder head group at the rear of the recuperator cylinder (2).

15 Gently push shouldered shaft (12) back into position, locating cylinder head group (20) with end of shouldered shaft. Tap cylinder head group out back end of recuperator cylinder (2).

Do not touch shouldered shaft with bare hands. Oils on skin will etch polished surface of shouldered shaft, allowing rust to form.

16 Wrap shouldered shaft (12) with a rag and remove it from the front end of the recuperator cylinder (2).



5-11 RECUPERATOR ASSEMBLY – CONTINUED

a. Removal – Continued

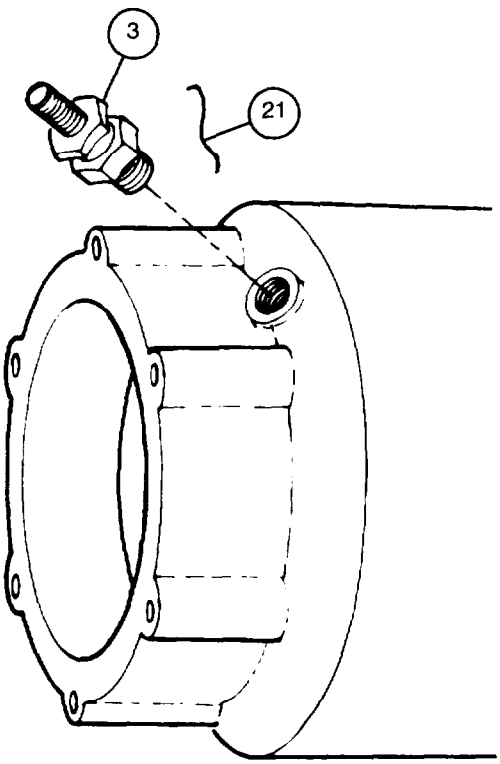
17 Remove lockwire (21) from pneumatic valve (3). Remove pneumatic valve. Discard lockwire and preformed packing.

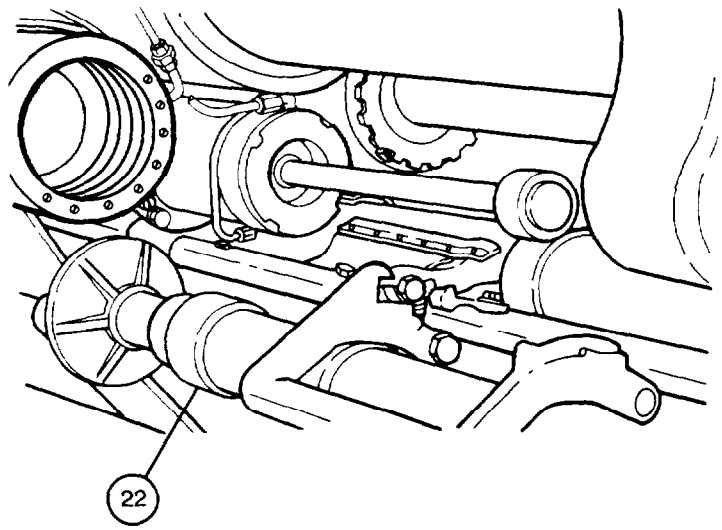
WARNING

Block cannon assembly with fabricated breech stand when working on mount components with cannon assembly pushed out of battery. This will prevent serious injury to personnel or damage to equipment caused by accidental elevation of the cannon assembly.

18 Push cannon assembly out of battery 37-1/2 inches (95.25 mm) (TM 9-2350-311-20-2).

19 Retract rammer assembly (22) and swing cylinder down for clearance (TM 9-2350-311-10).





20 Remove paint to bare metal from front bearing surface of the recuperator cylinder (2).

21 Remove lockwire (23) and six cap screws (24) from recuperator clamp (25). Discard lockwire.

22 Position hydraulic jack (port-a-power) (26) using appropriate adapters with a 6 x 4 x 2 inch block on front face of the recuperator cylinder (2) and suitable blocks on cannon assembly travel lock.

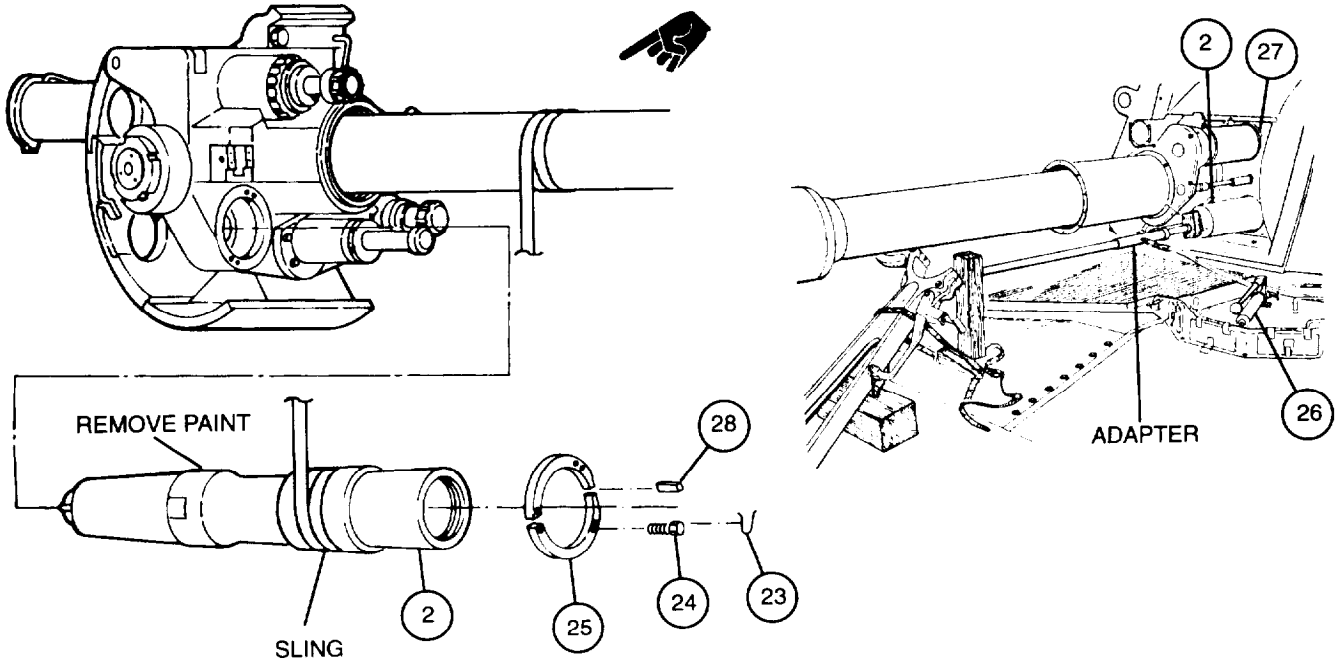
23 Press recuperator cylinder (2) rearward approximately 1/8 inch (3.18 mm) and remove recuperator clamp (25) from groove of recuperator cylinder.

WARNING

Use care while removing recuperator cylinder. Recuperator cylinder weighs approximately 177 pounds (80 kg) and can cause serious injury to personnel or damage to equipment if dropped.

24 Using sling, wrap around gun tube to support recuperator cylinder (2), continue to press recuperator cylinder rearward through mount (27). When recuperator cylinder clears rear of mount, lower to floor, and remove through rear door.

25 Remove machine key (28) from keyway.



5-11 RECUPERATOR ASSEMBLY – CONTINUED

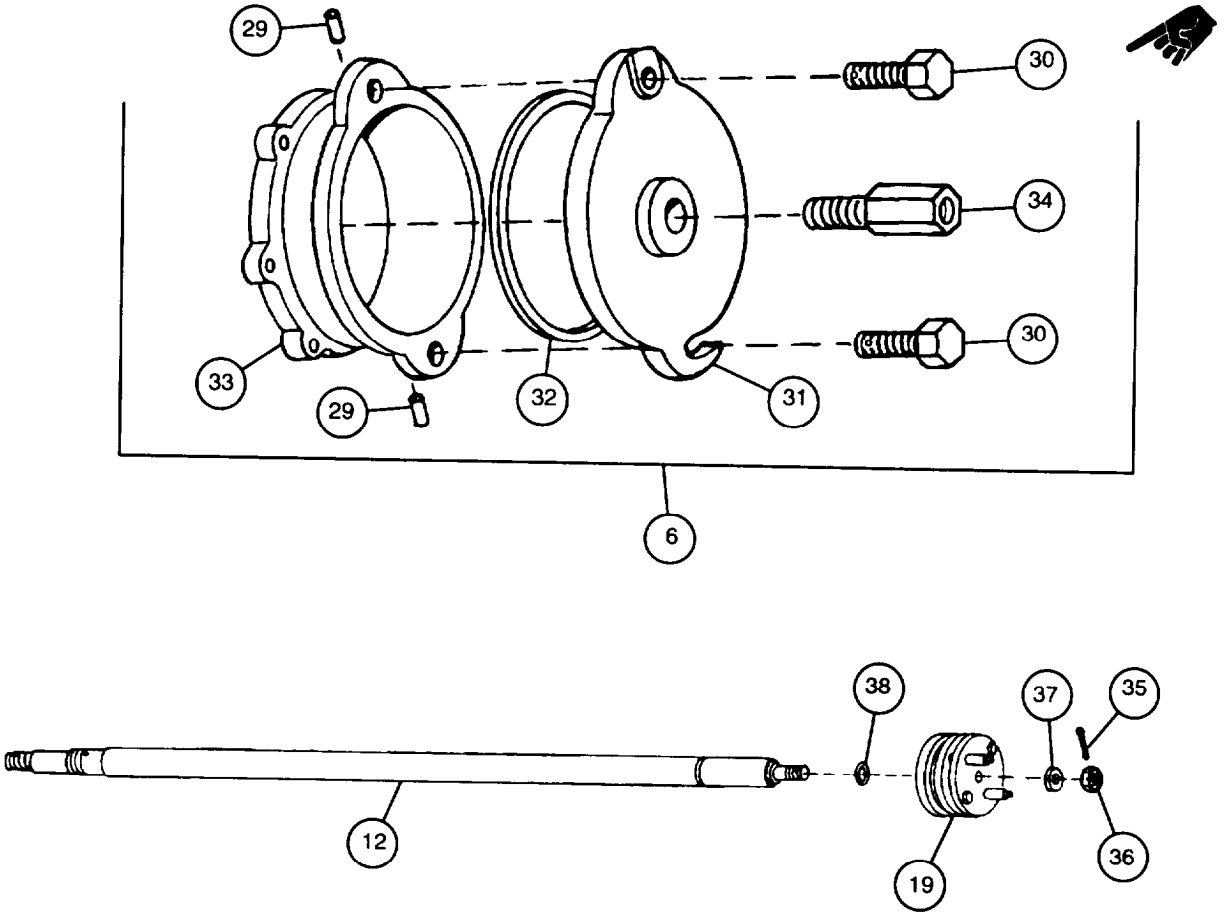
b. Disassembly

1 To disassemble cover adapter group (6) remove two spring pins (29) from two cap screws (30). Discard spring pins.

2 Remove two cap screws (30), cover (31), and gasket (32) from cover adapter (33). Discard gasket.

3 Remove safety relief valve (34) from cover (31).

4 Remove cotter pin (35), slotted nut (36), flat washer (37), piston group (19), and retaining ring (38) from shouldered shaft (12). Discard cotter pin and retaining ring.

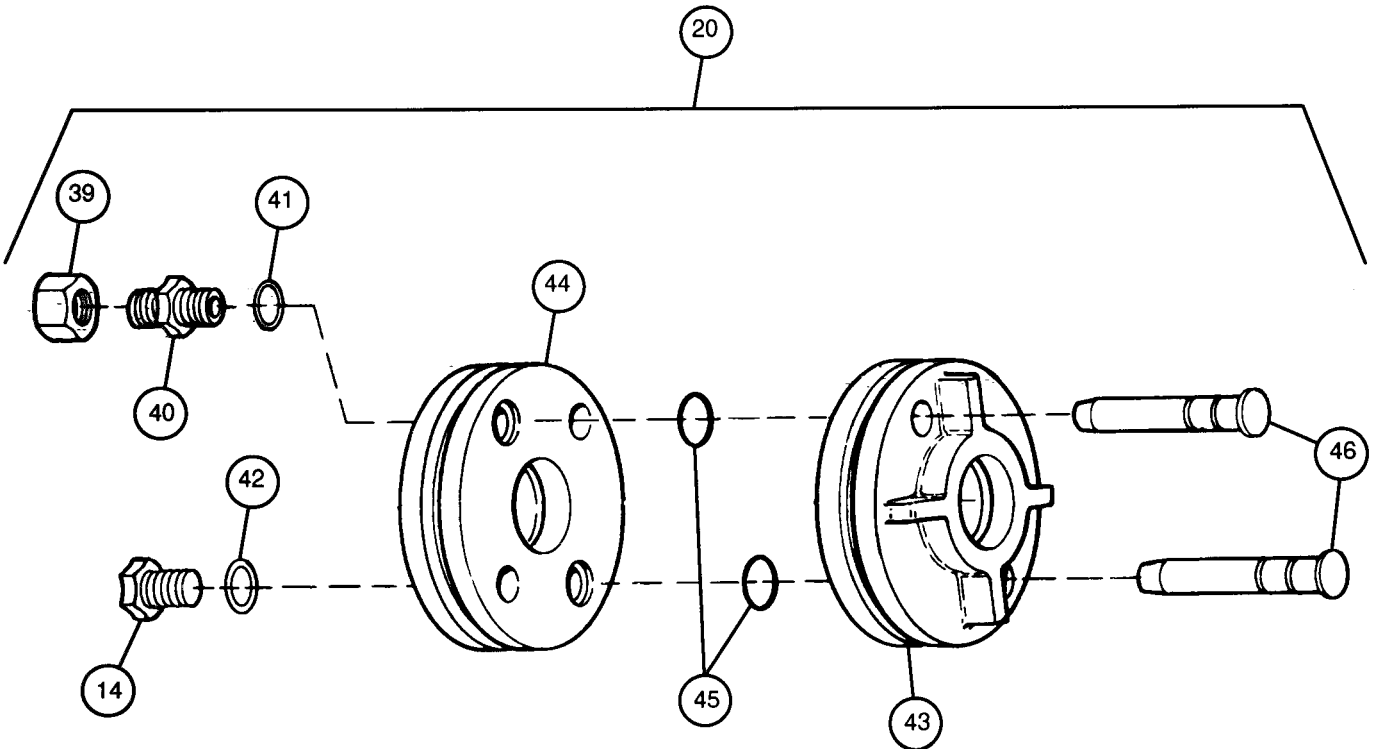


5 To disassemble the cylinder head group (20), remove valve cap (39), check valve (40), and preformed packing (41). Discard preformed packing.

6 Remove drain plug (14) and preformed packing (42). Discard preformed packing.

7 Separate inner cylinder head (43) and outer cylinder head (44) and remove two retaining rings (45). Discard retaining rings.

8 Separate pin and seal group (46).



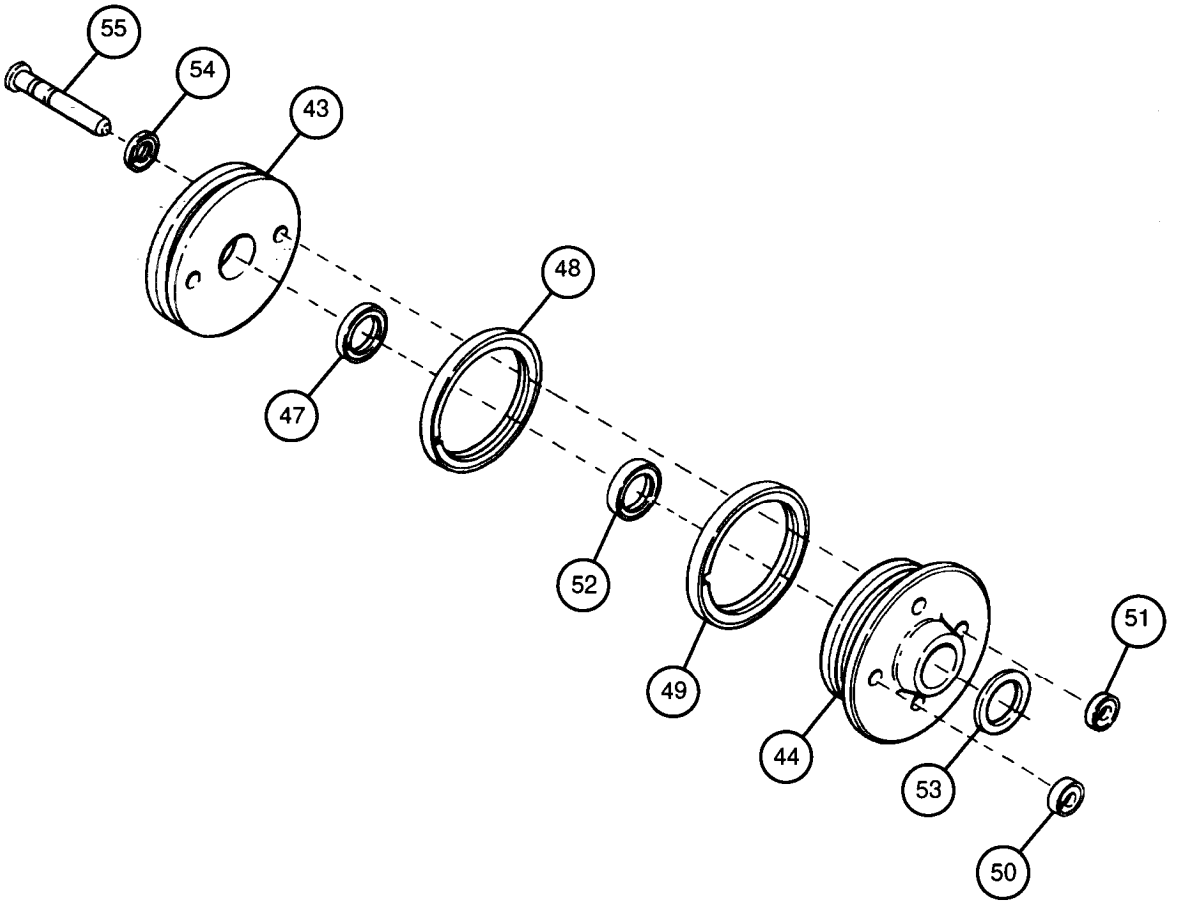
5-11 RECUPERATOR ASSEMBLY - CONTINUED

b. Disassembly - Continued

9 Remove seal assemblies (47 and 48) from inner cylinder head (43). Discard seal assemblies.

10 Remove seal assemblies (49, 50, 51, and 52) from outer cylinder head (44). Remove piston wiper (53). Discard seal assemblies and piston wiper.

11 Remove two seal assemblies (54) from two headed grooved pins (55). Discard seal assemblies.

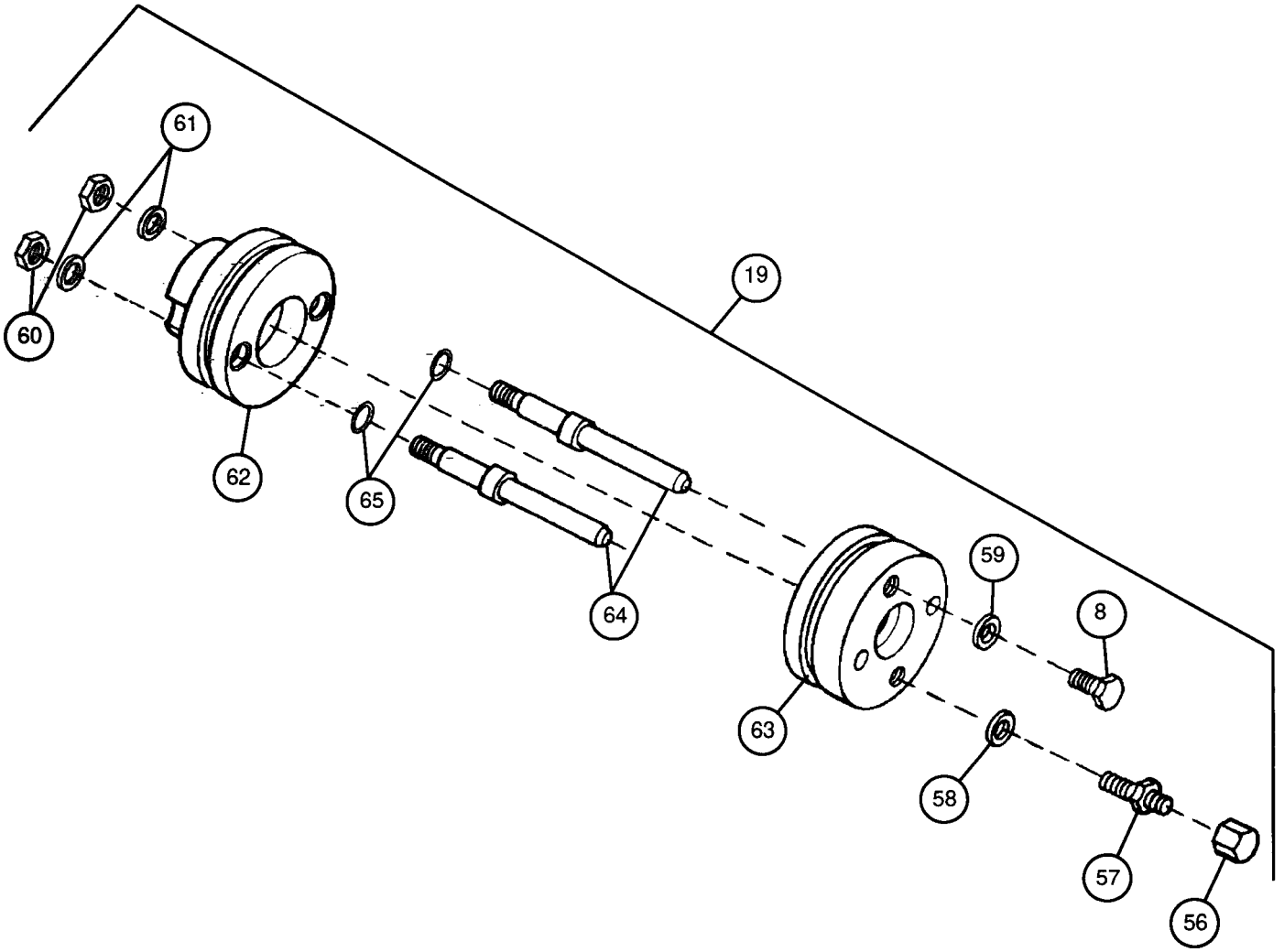


12 To disassemble piston group (19), remove valve cap (56), check valve (57), and preformed packing (58). Discard preformed packing.

13 Remove drain plug (8) and preformed packing (59). Discard preformed packing.

14 Remove two self-locking nuts (60) and two flat washers (61). Separate the inner piston (62) and outer piston (63), and remove two shouldered shafts (64). Discard self-locking nuts.

15 Remove two preformed packings (65) from two shouldered shafts (64) and discard.

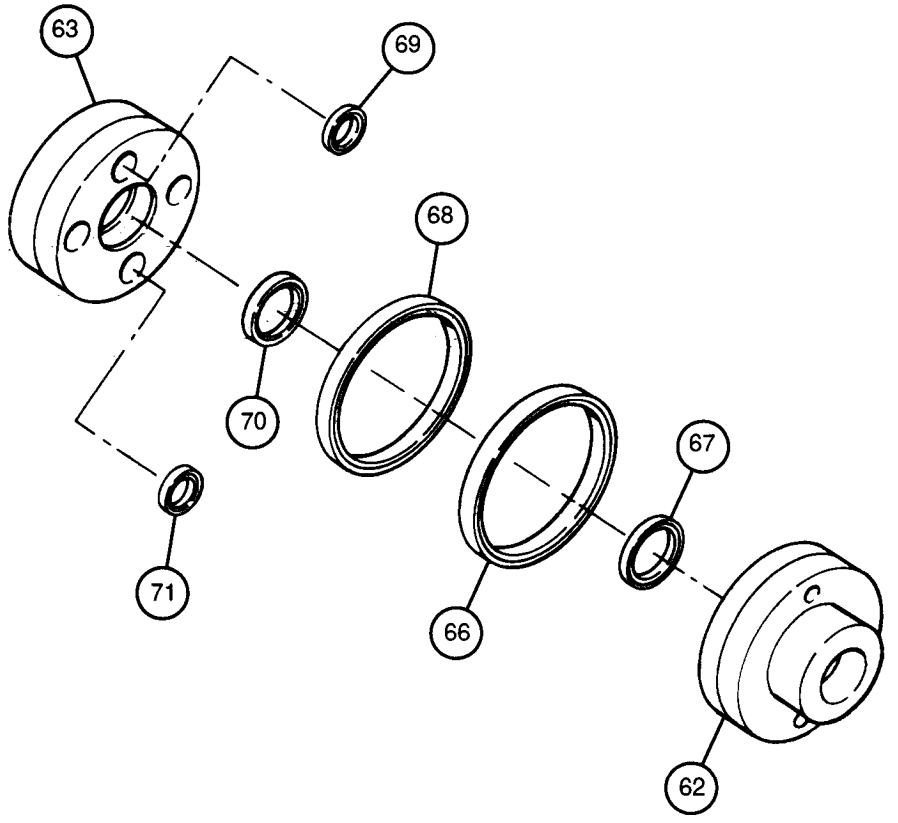


5-11 RECUPERATOR ASSEMBLY - CONTINUED

b. Disassembly - Continued

16 Remove seal assemblies (66 and 67) from inner piston (62). Discard seal assemblies.

17 Remove seal assemblies (68, 69, 70, and 71) from outer piston (63). Discard seal assemblies.



c. Inspection

1 Inspect externally threaded ring (18). Replace if cracked, spanner slot shoulders are rounded, or if threads are mutilated.

2 Inspect recuperator cylinder (2) for any indication of surface cracks or if bore is scratched, scored, or galled. Replace if damaged.

3 Measure recuperator cylinder (2) inside diameter. Replace if greater than 3.877 inches (9.848 cm).

4 Inspect pneumatic valve (3). Replace if damaged in any way that could affect operation.

5 Inspect shouldered shaft (12) for nicks, scratches, cracks, or mutilation of threads. Replace if damaged.

6 Measure shouldered shaft (12) outside diameter. Replace if less than 1.6215 inches (4.119 cm).

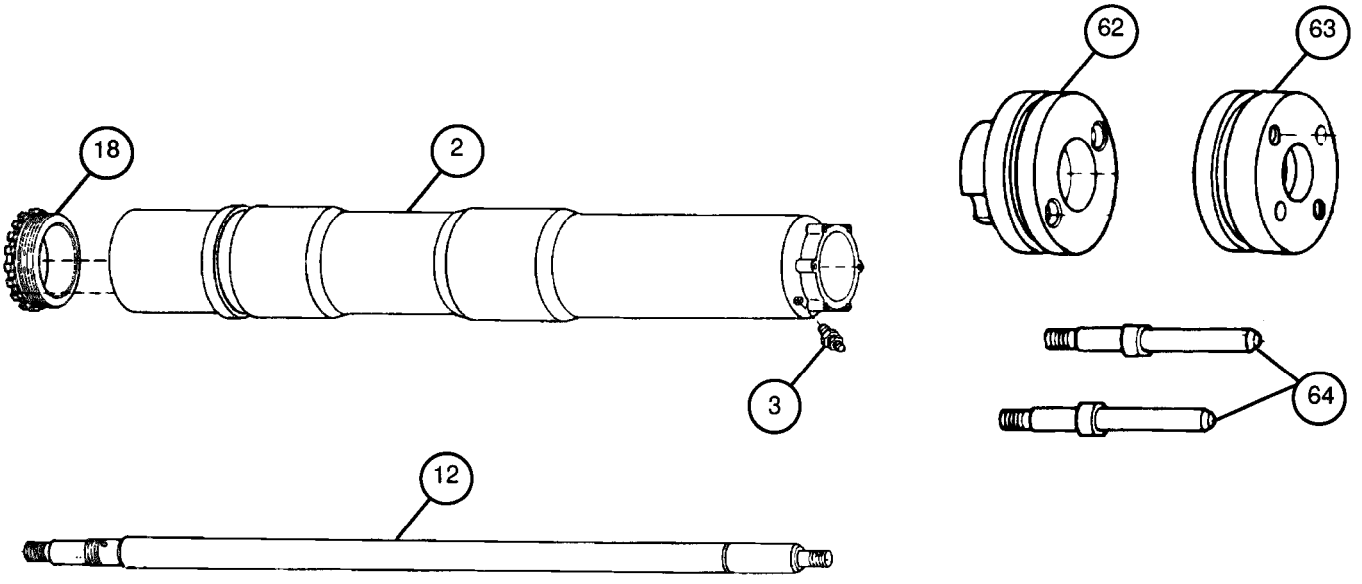
NOTE

Inner and outer pistons are a matched set. If either component is defective, both must be replaced.

7 Inspect and measure inner piston (62) and outer piston (63). Replace if marked or damaged in any way to affect operation. Replace if outside diameter is less than 3.869 inches (9.827 cm).

8 Inspect two shouldered shafts (64) for straightness, nicks, cracks, or burrs. Replace if damaged.

9 Measure two shouldered shafts (64). Replace if outside diameter is less than 0.499 inches (12.675 mm).



5-11 RECUPERATOR ASSEMBLY - CONTINUED

c. Inspection - Continued

NOTE

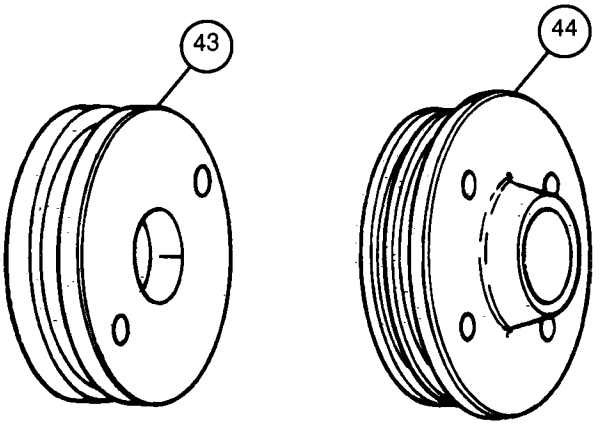
Inner and outer cylinder heads are a matched set. If either component is defective, both must be replaced.

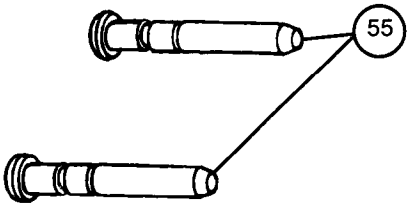
10 Inspect inner cylinder head (43) and outer cylinder head (44). Replace if cracked, nicked, or damaged in any way affecting operation.

11 Measure inner cylinder head (43) and outer cylinder head (44). Replace inner cylinder head if outside diameter is less than 5.493 inches (13.95 cm). Replace outer cylinder head if outside diameter is less than 5.74 inches (14.58 cm).

12 Inspect two headed grooved pins (55) and replace if not straight or if nicked, cracked, or burred.

13 Measure two headed grooved pins (55). Replace if outside diameter is less than 0.499 inches (12.675 mm).





d. Assembly

CAUTION

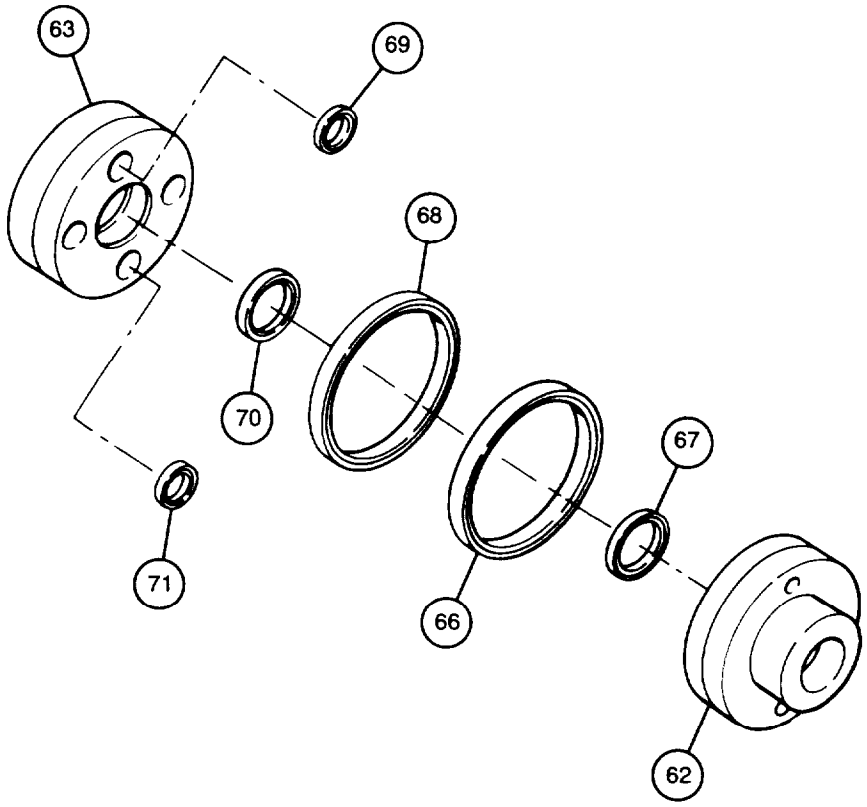
During assembly and installation of recuperator assembly, use extreme care to prevent contamination.

NOTE

Coat all preformed packings, seals, piston group, and cylinder head group with hydraulic fluid before installation.

1 Install new seal assemblies (71, 70, 69, and 68) on outer piston (63).

2 Install new seal assemblies (67 and 66) on inner piston (62).



5-11 RECUPERATOR ASSEMBLY – CONTINUED

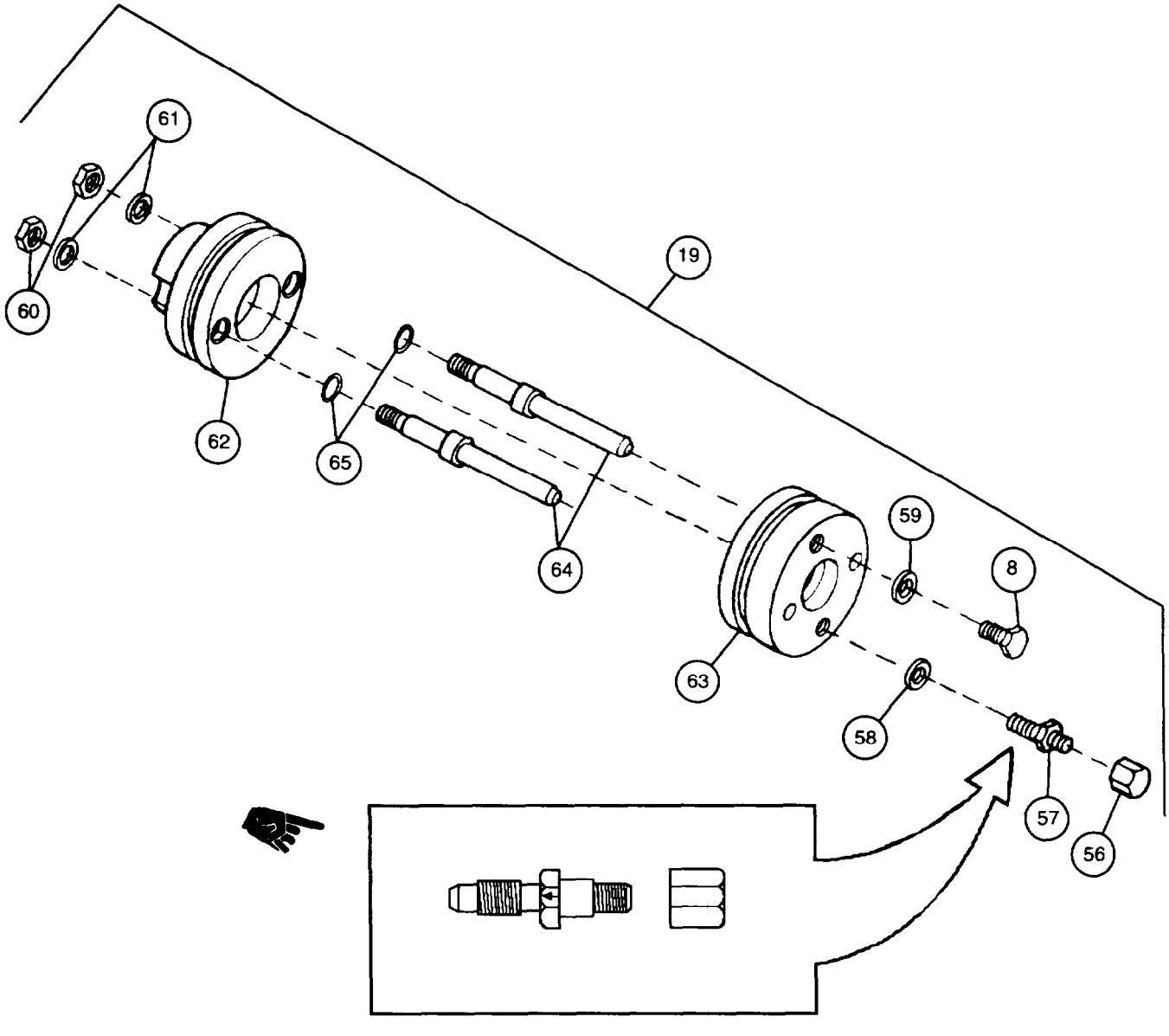
d. Assembly – Continued

3 Assemble piston group (19) by installing two new preformed packings (65) and two shouldered shafts (64). Assemble outer piston (63) and inner piston (62) with "X" marks coinciding.

4 Install two flat washers (61) and two new self-locking nuts (60).

5 Install new preformed packing (59) and drain plug (8).

6 Install new preformed packing (58) and check valve (57). Ensure valve direction fluid flow is pointing toward outer piston (63). Torque check valve to a maximum of 120 lb-in (13.56 Nm) and install valve cap (56).



7 Install two new seal assemblies (54) on two headed grooved pins (55).

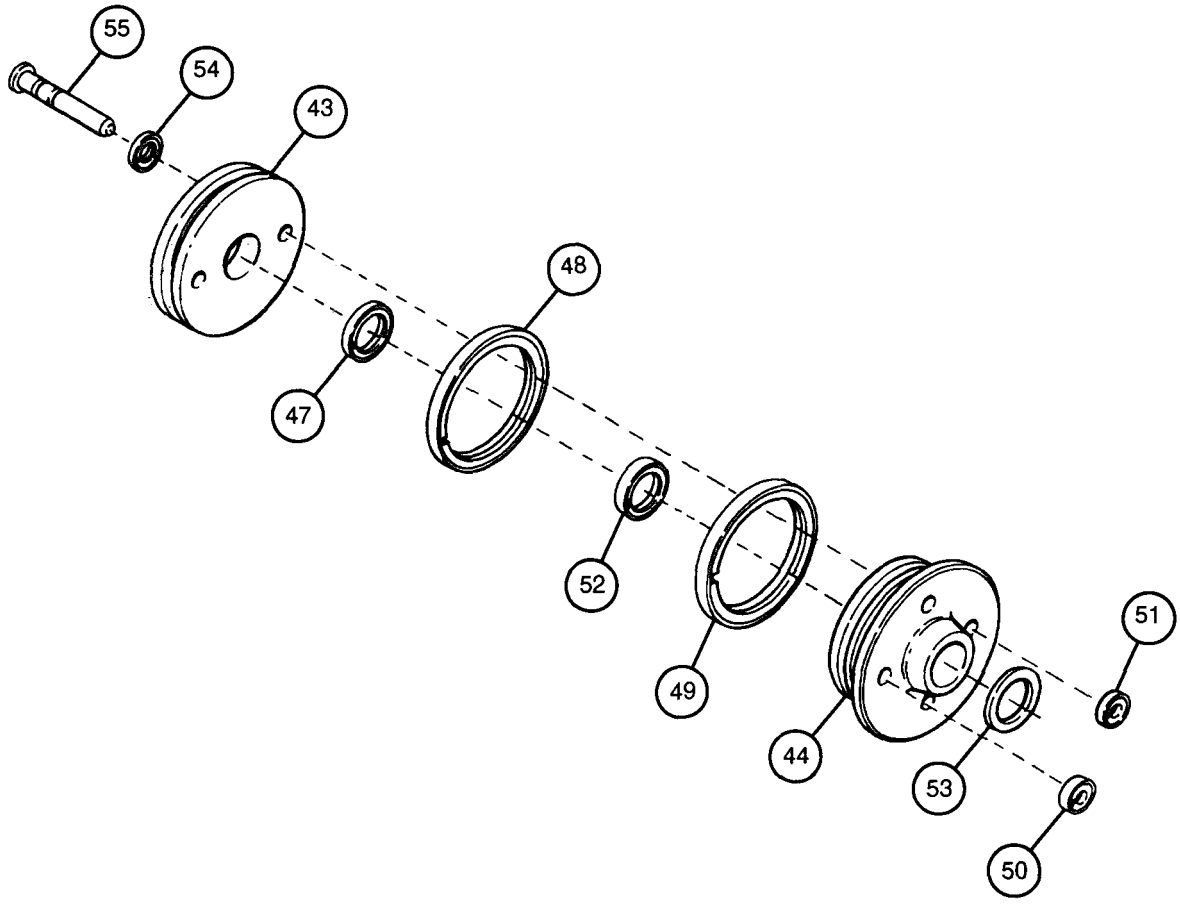
WARNING

Adhesives can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive gets on skin or clothing, wash immediately with soap and water.

8 Split new piston wiper (53) diagonally 3/4 inch (19.05 mm) front to rear and cement in place on outer cylinder head (44) using adhesive.

9 Install new seal assemblies (52, 51, 50, and 49) on outer cylinder head (44).

10 Install new seal assemblies (48 and 47) on inner cylinder head (43).



5-11 RECUPERATOR ASSEMBLY - CONTINUED

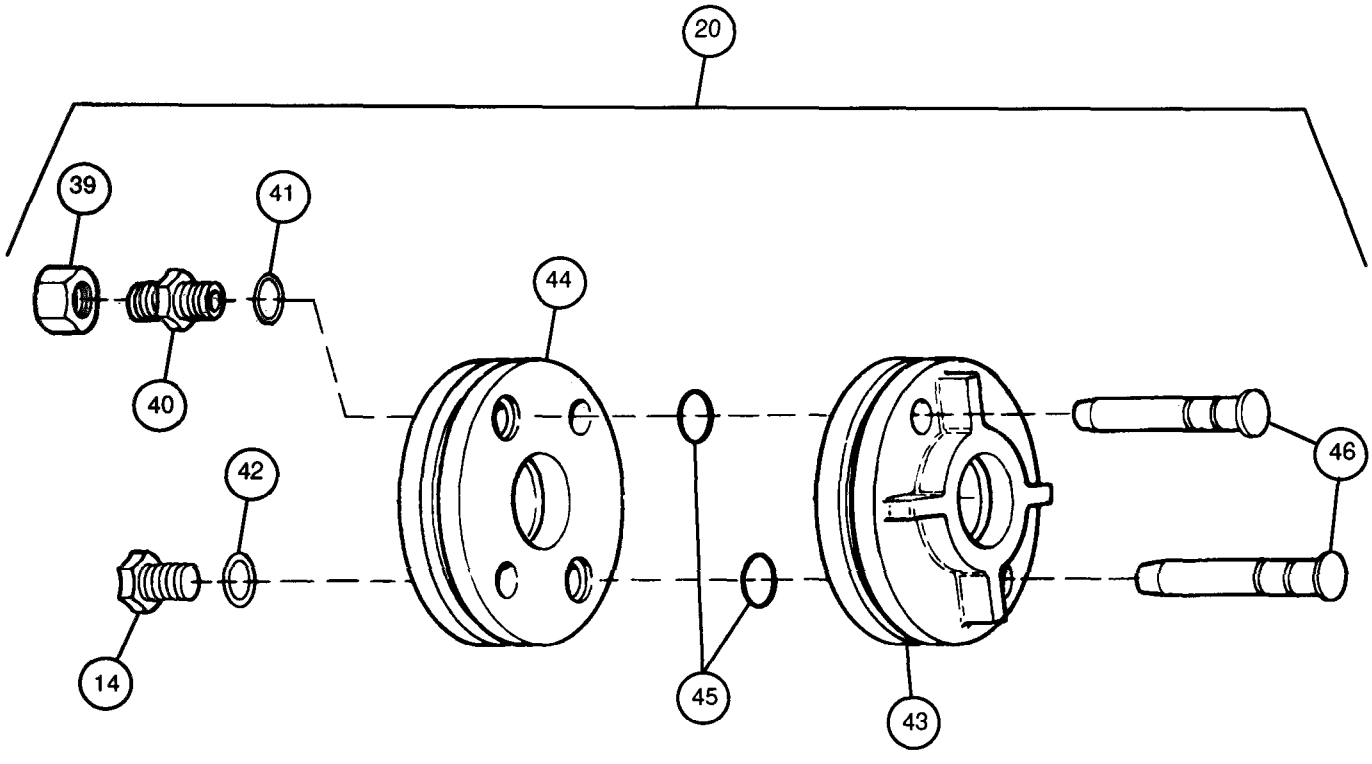
d. Assembly - Continued

11 To assemble the cylinder head group (20), install the pin and seal group (46) in the inner cylinder head (43).

12 Install two retaining rings (45) and assemble inner cylinder head (43) and outer cylinder head (44).

13 Install new preformed packing (42) and drain plug (14).

14 Install new preformed packing (41) and check valve (40). Torque check valve to 120 lb-in (13.56 N·m) maximum and install valve cap (39).

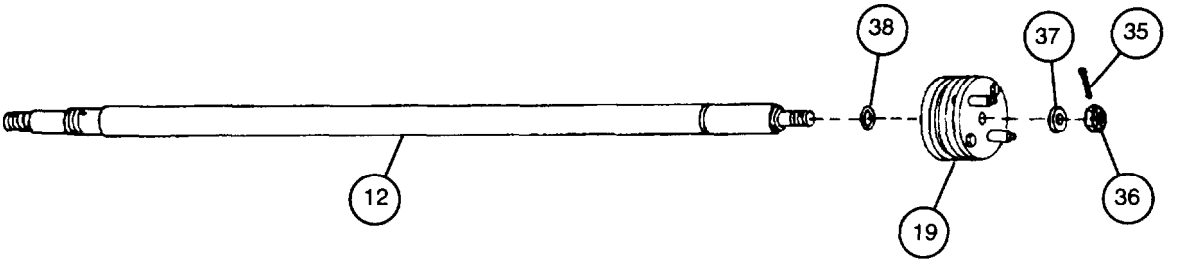


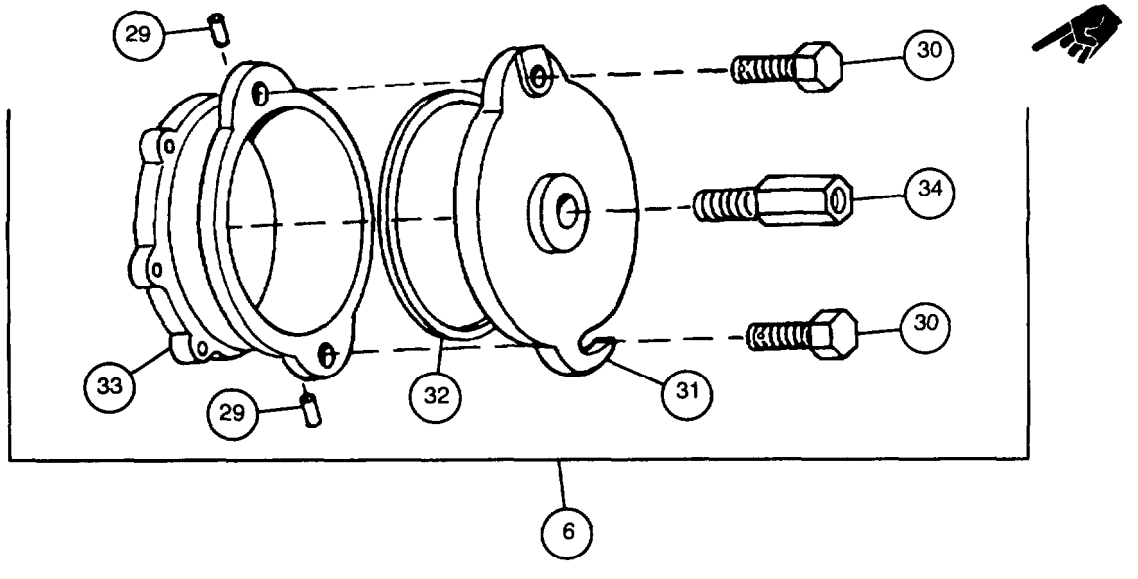
15 Install retaining ring (38), piston group (19), flat washer (37), slotted nut (36), and new cotter pin (35) on shouldered shaft (12).

16 Assemble cover adapter group (6) by installing safety relief valve (34).

17 Install new gasket (32), cover (31), and two cap screws (30) on cover adapter (33).

18 Install two new spring pins (29).





5-11 RECUPERATOR ASSEMBLY – CONTINUED

e. Installation

CAUTION

Use extreme care when installing recuperator cylinder and components to prevent contamination.

1 Clean the two large diameters of the recuperator cylinder (2) removing all paint, nicks, scratches, and gouges. Coat two diameters with grease.

2 Remove all paint, nicks, scratches, and gouges from the mount (27) at the bearing surface for the recuperator cylinder (2).

3 Install machine key (28) in keyway.

WARNING

Use care while installing the recuperator cylinder. Recuperator cylinder weighs approximately 177 pounds (80 kg) and can cause serious injury to personnel or damage to equipment if dropped.

4 Using webbing strap inside cab to support recuperator cylinder (2), position milled flat on left side of recuperator cylinder and slide forward until bearing surfaces meet.

NOTE

Do not press recuperator cylinder all the way into mount. Stop approximately 1/8 inch (3.18 mm) short of retainer groove.

5 Position hydraulic jack (port-a-power) (26) between blocks of wood against breech ring of cannon assembly and rear face of recuperator cylinder (2). Press recuperator cylinder to approximately 1/8 inch (3.18 mm) short of recuperator clamp (25) groove.

6 Position recuperator clamp (25) in groove and aline screw holes. Press recuperator cylinder (2) until recuperator clamp rings contact mount.

7 Remove hydraulic jack (port-a-power) (26) and install six cap screws (24) and new lockwire (23).

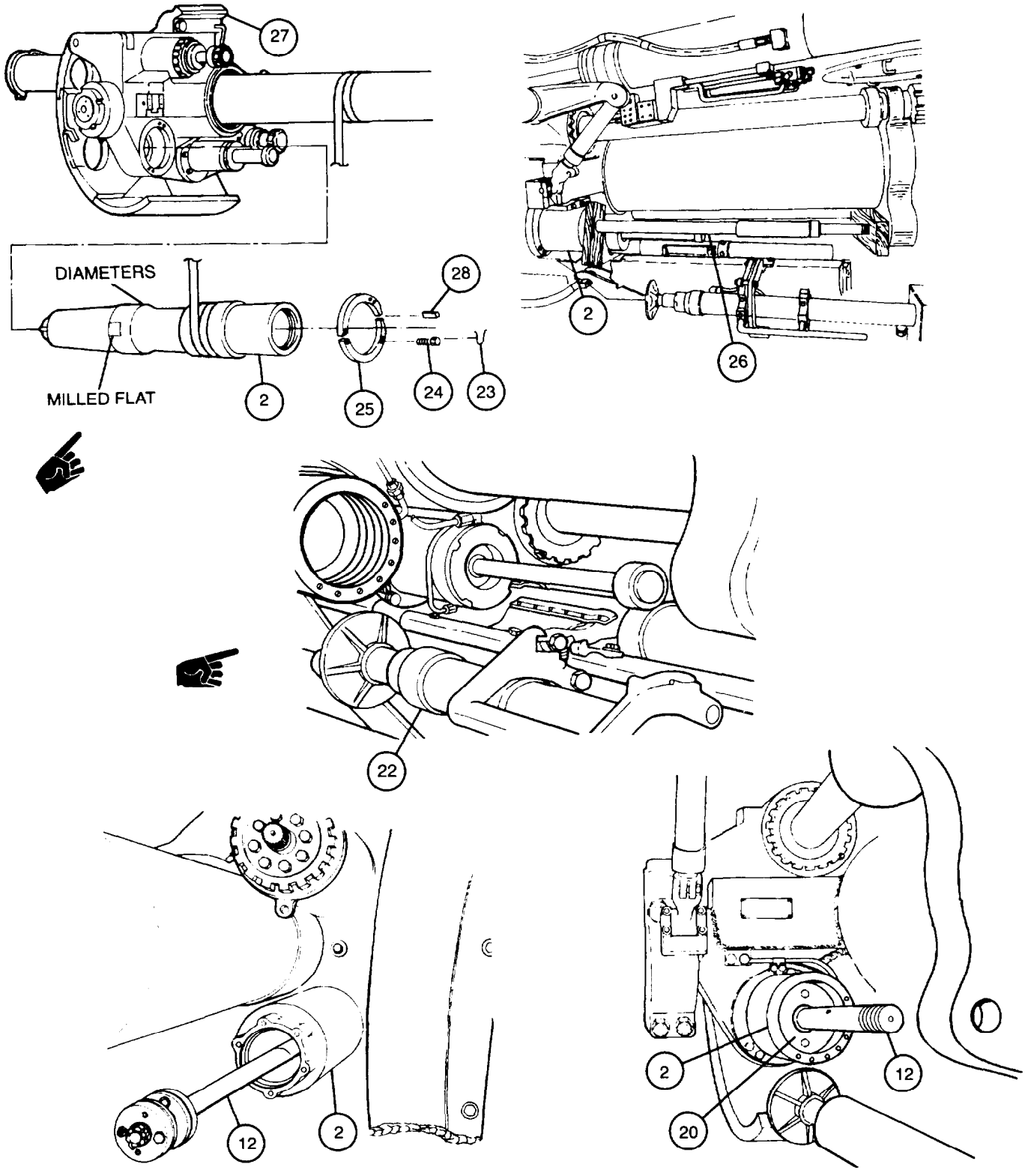
8 Swing cylinder up until it latches and return rammer assembly (22) to stowed position (TM 9-2350-31 l-l 0).

CAUTION

Do not touch shouldered shaft with bare hands. Oils on skin will etch polished surface of shouldered shaft, allowing rust to form.

9 Wrap shouldered shaft (12) with clean rag and gently insert into recuperator cylinder (2) from the outside. Slowly push forward until inside end extends from recuperator cylinder slightly. Remove rag from shouldered shaft.

10 Slide cylinder head group (20) onto inside end of shouldered shaft (12) and gently tap cylinder head group into end of recuperator cylinder (2).


27
DIAMETERS
MILLED FLAT
2
25
24
23
28
2
26
22
12
2
2
12
20

5-11 RECUPERATOR ASSEMBLY – CONTINUED

e. Installation – Continued

NOTE

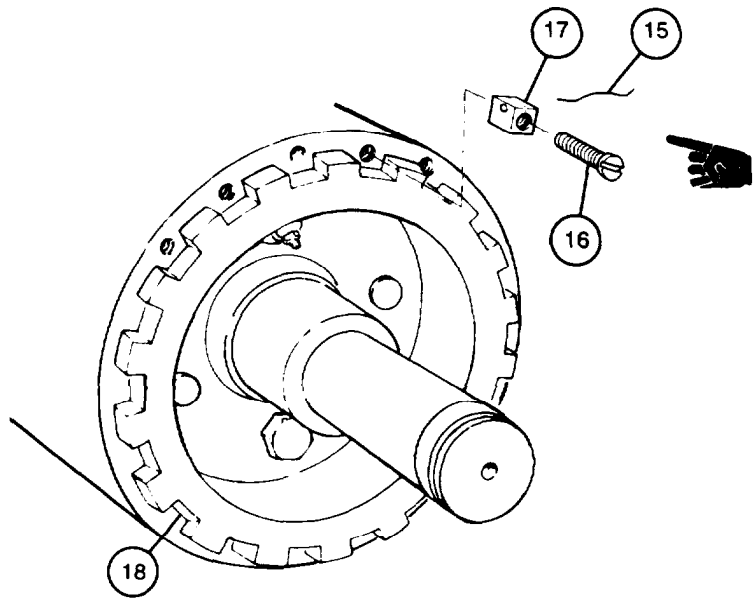
Ensure that drain is at bottom prior to tightening externally threaded ring.

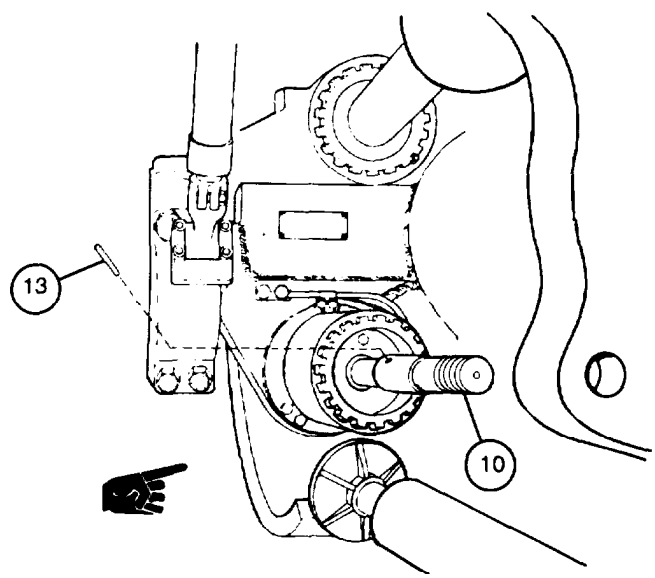
11 Install externally threaded ring (18) and tighten, using suitable spanner wrench.

12 Install machine key (17), cap screw (16), and new lockwire (15).

13 Install shaft collar (10) and new spring pin (13).

14 Return cannon assembly to battery (TM 9-2350-311-20-2).





15 While holding shaft collar (10) with pipe wrench, install rear slotted nut (11) on shouldered shaft (12). Slotted nut should be tightened until slotted nut and shaft collar are just beginning to touch breech ring body (72).

16 Loosen slotted nut (11) 1/6 to 1/3 turn while alining cotter pin (9) hole in shouldered shaft (12) with slots in slotted nut. Install new cotter pin.

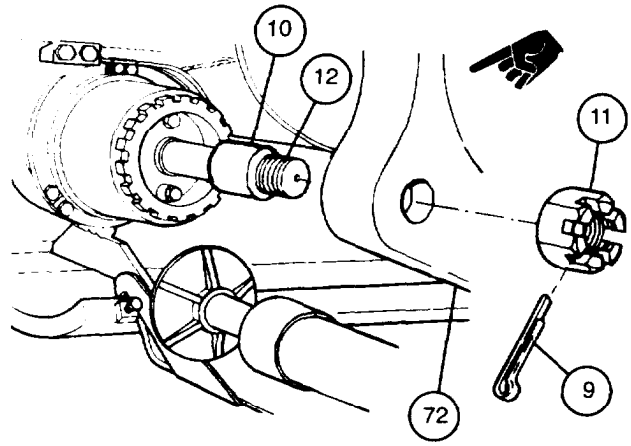
17 Install new gasket (7), cover adapter group (6), six cap screws (5), and new lockwire (4) on front of recuperator cylinder (2).

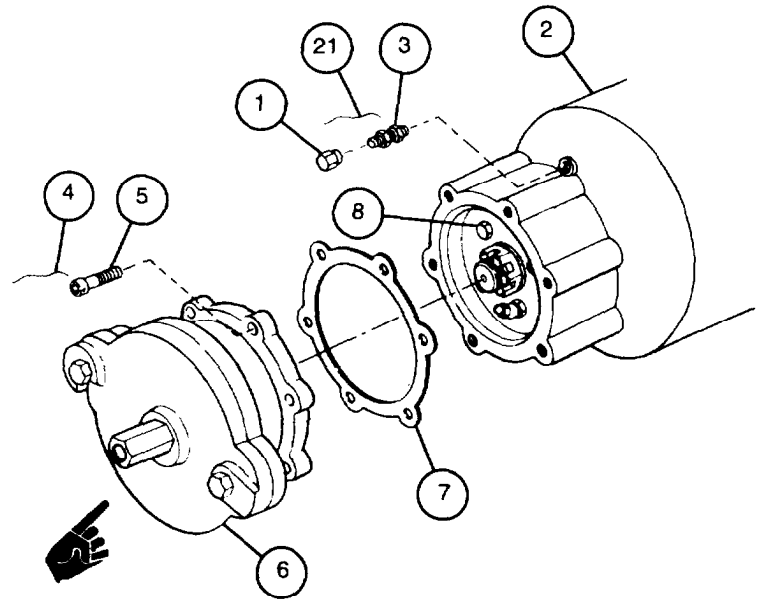
18 Install pneumatic valve (3) and new lockwire (21). Torque valve to 120 lb-in (13.56 Nm).

19 Service recuperator assembly with hydraulic fluid (TM 9-2350-311-20-2).

20 Service recuperator assembly with nitrogen (TM 9-2350-311-20-2).

21 Install valve cap (1) to right front of recuperator cylinder (2).





5-12 VARIABLE RECOIL ASSEMBLY

This task covers: a. Removal b. Disassembly c. Inspection and Repair d. Assembly e. Installation

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Drain pan (item 12, Appx F)
Fabricated breech stand (Figure C-3, Appx C)
Hose, non-metallic (item 7, Appx F)

Materials/Parts
Caps and plugs (item 10, Appx B)
Cotter pin (item 48, Appx E)
Grease (item 21.1, Appx B)
Grease (item 21.2, Appx B)
Hydraulic fluid (item 22, Appx B)
Key washer (item 114, Appx E) M109A2/M109A3/M109A4
Key washer (item 143, Appx E) M109A5
Lockwasher (item 82, Appx E)
Lockwashers (6) (item 83, Appx E)
Lockwashers (3) (item 88, Appx E)
Lockwashers (4) (item 144, Appx E)
Lockwire (item 36, Appx E)
Lockwire (item 39, Appx E)
Preformed packings (4) (item 155, Appx E)
Rag (item 26, Appx B)
Seal replacement parts kit (item 142, Appx E) M109A5
Seal replacement parts kit (item 151, Appx E) M109A2/M109A3/M109A4
Self-locking bolt (item 101, Appx E) M109A2/M109A3/M109A4
Self-locking bolt (item 102, Appx E) M109A5
Spring pins (3) (item 13, Appx E)

Personnel Required
3

References
TM 9-2350-311-20-2

Equipment Condition
Travel lock stowed (TM 9-2350-311-10)
Muzzle brake removed (TM 9-2350-311-10)
Bore evacuator removed (TM 9-2350-311-10)
Dust shield and variable recoil access cover removed (TM 9-2350-311-20-2)
Depress cannon to 0 mils (TM 9-2350-311-10)
Engine grille covered with tarpaulin (TM 9-2350-311-10)

a. Removal

WARNING

- Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.
- All internal components of the recoil assembly are heavy and care should be used to prevent binding of components during removal.

NOTE

Variable recoil assembly can be disassembled and repaired with mount and cannon assembly installed in vehicle.

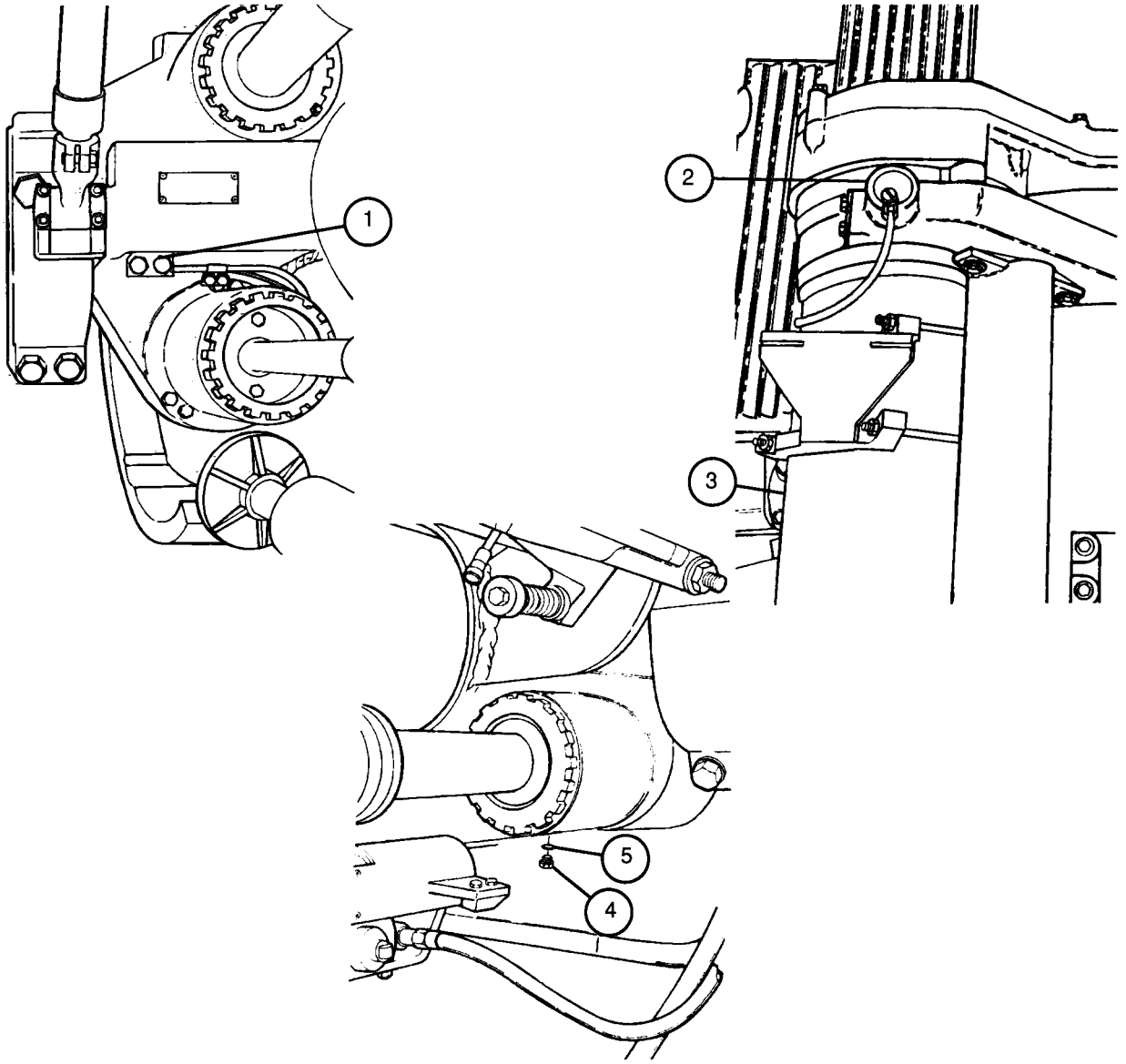
1 Open accumulator replenisher right manifold bleeder plug (1) and discharge hydraulic pressure by draining fluid into drain pan.

2 Install hose on bleeder “T" (2).

3 Open bleeder “T" (2) at front of left variable recoil cylinder (3).

4 Remove two variable recoil cylinder (3) drain plugs (4) and two preformed packings (5) at rear of each variable recoil cylinder. Discard preformed packings.

5 Drain system and catch hydraulic fluid using drain pan. Install plug on variable recoil cylinder (3).



5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

a. Removal - Continued

6 Measure backlash between spur gear sector (6), spur gear (7), and two sector gears (8) before removal.

(a) Measure backlash between one sector gear (8) and spur gear sector (6). Replace if greater than 0.018 inches (0.46 mm).

(b) Measure backlash between spur gear (7) and spur gear sector (6). Replace if greater than 0.018 inches (0.46 mm).

(c) Measure backlash between other sector gear (8) and spur gear sector (6) and replace if greater than 0.018 inches (0.46 mm).

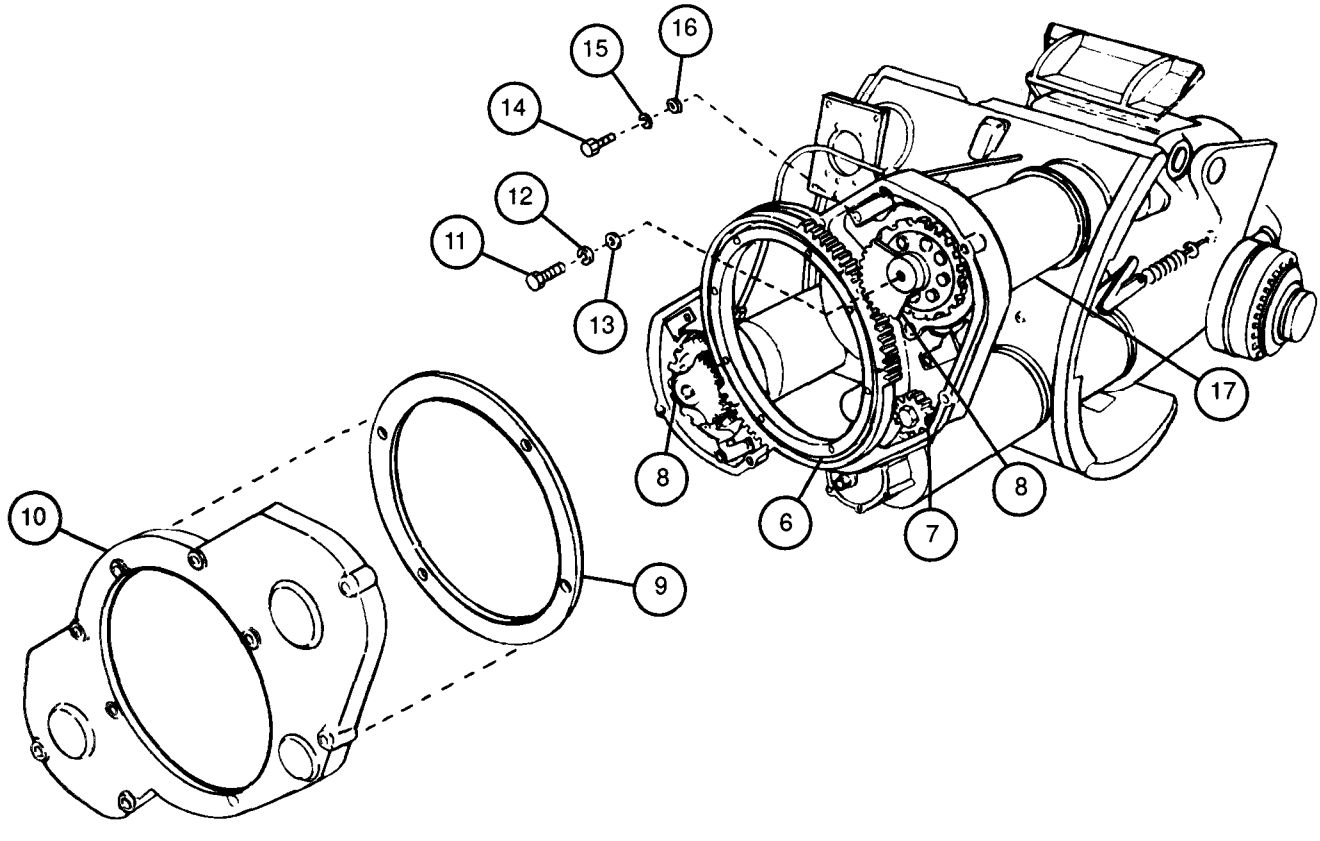
7 Remove gasket (9) from variable recoil access cover (10) and discard.

NOTE

Note alinement of index arrows on spur gear sector, spur gear, and sector gears before removing housing assembly.

8 Remove two cap screws (11), two lockwashers (12), two flat washers (13), and two sector gears (8). Discard lockwashers.

9 Remove four cap screws (14), four lockwashers (15), and four flat washers (16) from variable recoil housing (17). Discard lockwashers.



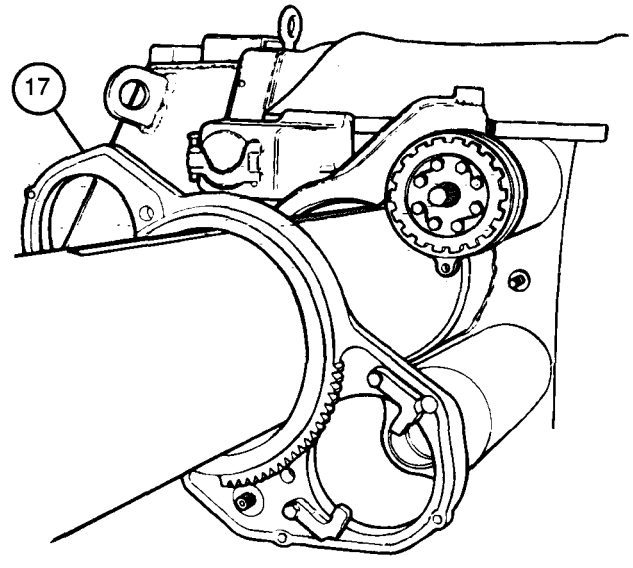
10 Slide variable recoil housing (17) forward along cannon tube and remove.

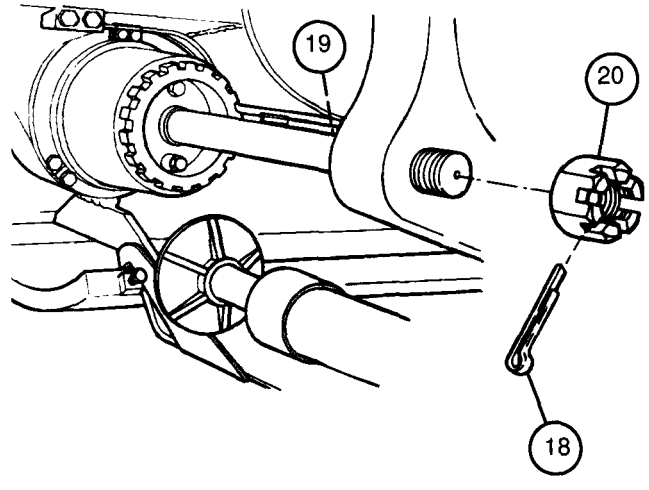
WARNING

Level cannon assembly to avoid serious injury to personnel or damage to equipment caused by cannon assembly sliding out of battery.

11 Remove and discard cotter pin (18).

12 While holding shouldered shaft collar (19) with pipe wrench, remove rear slotted nut (20) from recuperator assembly.





5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

a. Removal - Continued

13 Push cannon assembly out of battery 18 inches (45.7 cm) (TM 9-2350-311-20-2).

WARNING

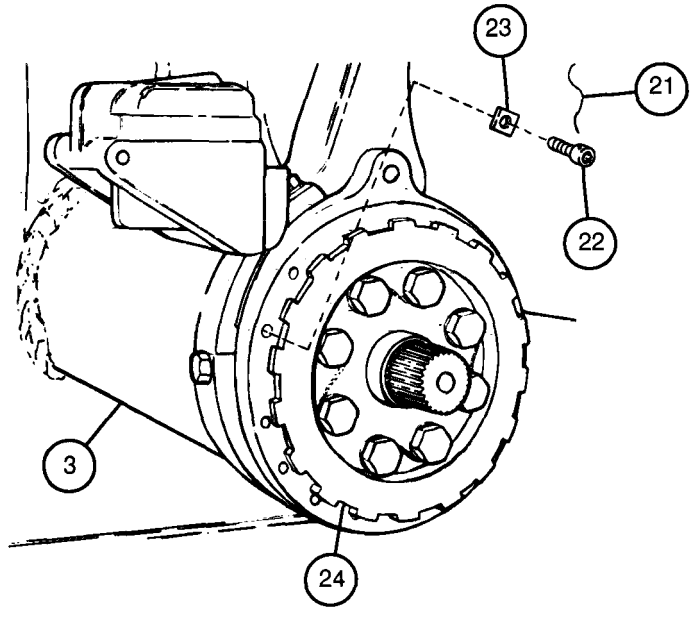
Block cannon assembly with fabricated breech stand when working on mount components with cannon assembly pushed out of battery. This will prevent serious injury to personnel or damage to equipment caused by accidental elevation of the cannon assembly.

NOTE

Both variable recoil cylinders are identical. Removal instructions pertain to one. Repeat instructions for remaining variable recoil cylinder.

14 Remove lockwire (21), cap screw (22), and machine key (23) from front of variable recoil cylinder (3). Discard lockwire.

15 Remove machine bushing (24) from front of variable recoil cylinder (3) using spanner wrench.



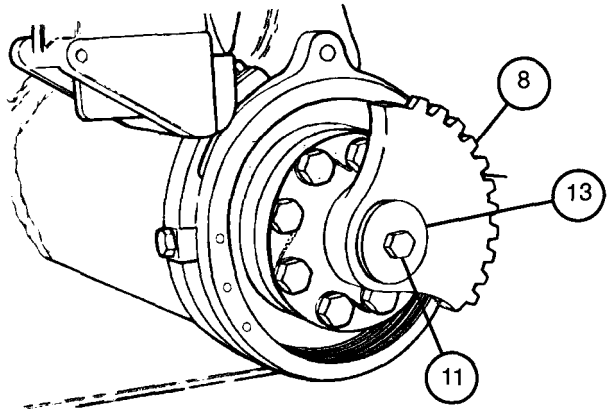
16 Install sector gear (8), flat washer (13), and cap screw (11) to provide leverage.

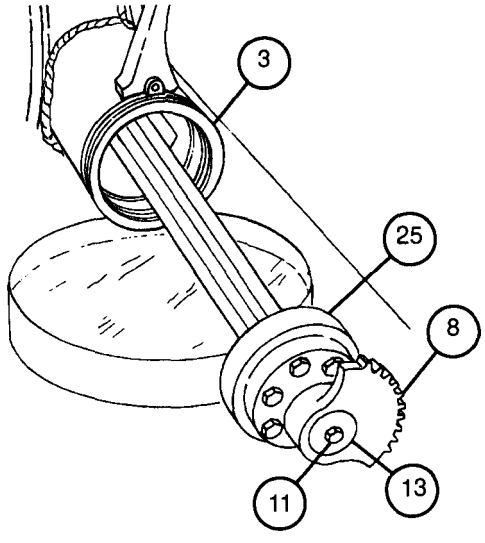
WARNING

Use gloves or rags to grip inner orifice. Edge of inner orifice is extremely sharp and could cause injury.

17 Place drain pan under variable recoil cylinder (3) to catch hydraulic fluid while withdrawing inner orifice and front follower group (25). Using a prybar, pry inner orifice and front follower group out of variable recoil cylinder.

18 Remove cap screw (11), flat washer (13), and sector gear (8) from inner orifice and front follower group (25).





5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

a. Removal - Continued

NOTE

Compare mount model number with illustration before performing steps 19 through 22.

19 Bend tabs of key washer (26) to disengage it from slots in round nut (27) at rear of variable recoil cylinder (3).

20 Remove round nut (27).

21 Remove and discard key washer (26).

22 Remove keyway washer (28) and sleeve spacer (29).

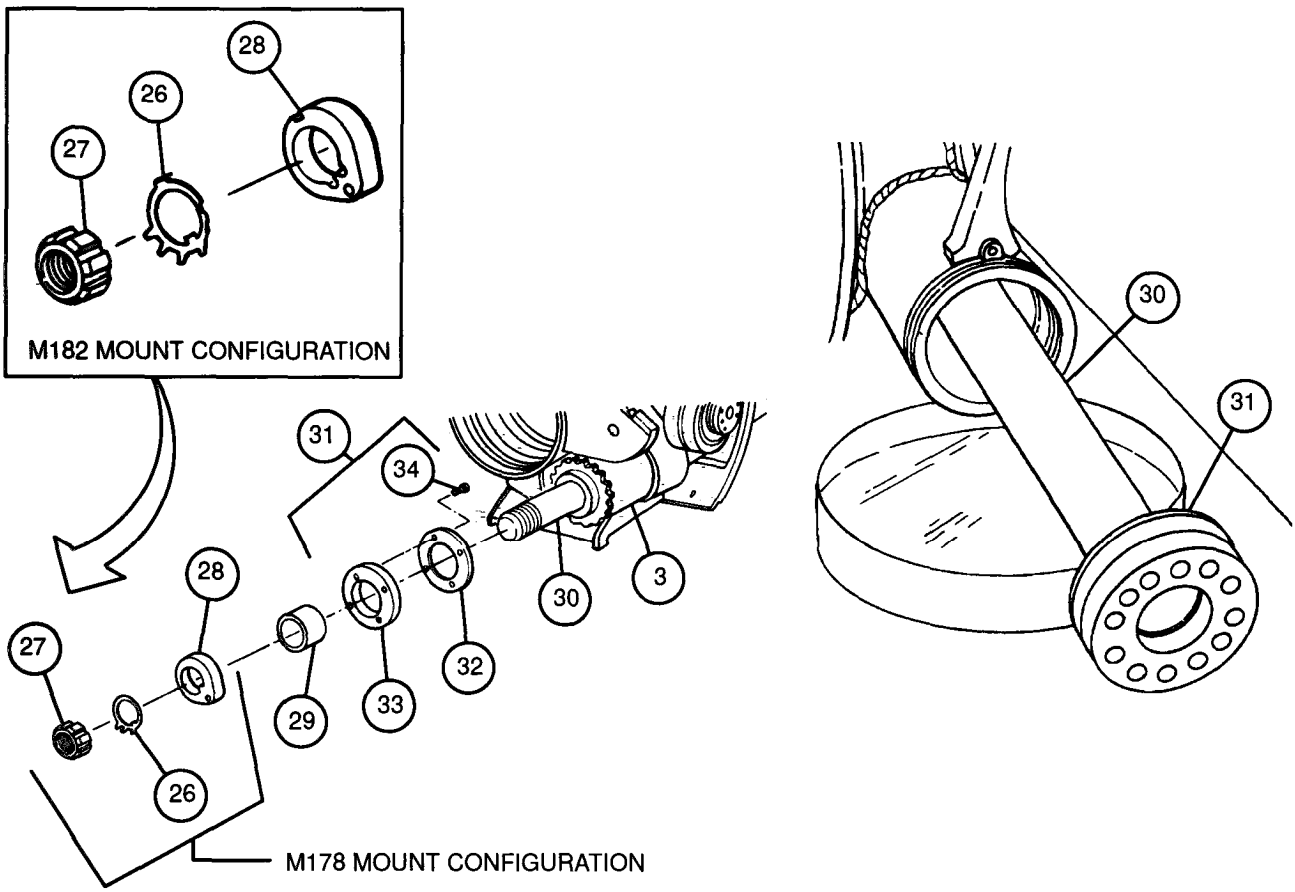
23 Move actuating piston assembly (30) forward to prepare for removal out the front of the variable recoil cylinder (3), but do not remove at this time.

24 Remove retaining plate group (31) from rear of actuating piston assembly (30) as actuating piston assembly is pushed into variable recoil cylinder (3).

NOTE

- Do not disassemble unless repair is necessary.
- Retain plate spacer unless new components are to be installed.

25 Separate plate spacer (32) and retaining plate (33) by removing four machine screws (34).



26 Remove lockwire (35), cap screw (36), and machine key (37). Discard lockwire

27 Remove machine bushing (38) using spanner wrench.

28 Use piston rod to tap gently on rear follower group (39).

29 Remove rear follower group (39) from rear of variable recoil cylinder (3).

CAUTION

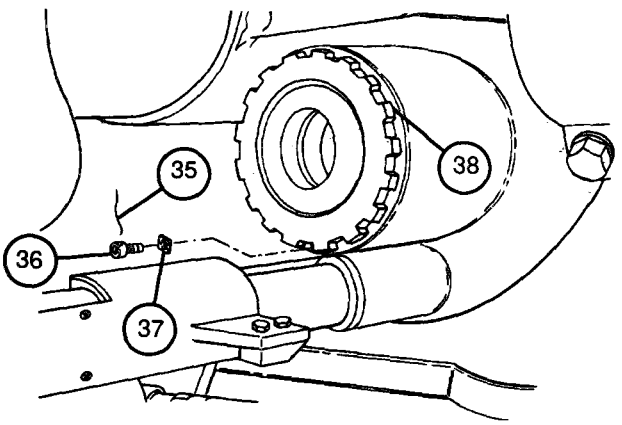
Use care not to scratch or damage piston rod during removal.

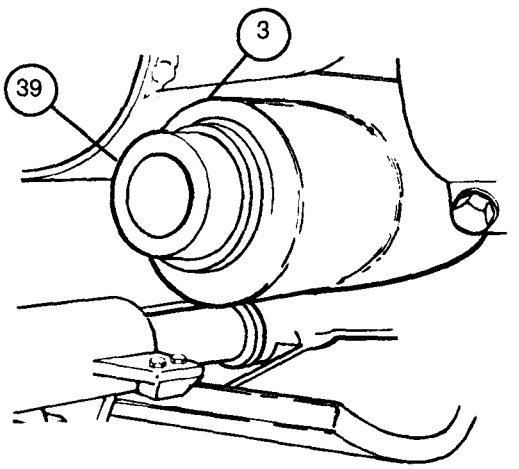
NOTE

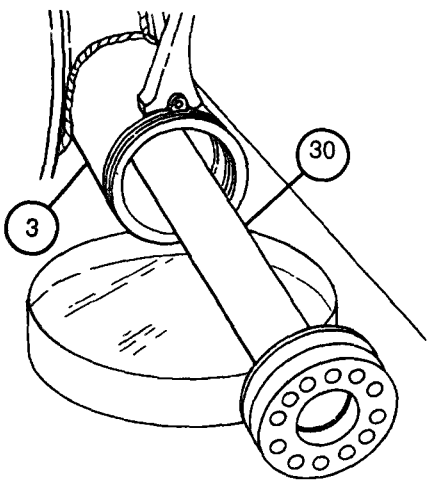
Do not disassemble actuating piston assembly. If damaged or leaks at plug, replace actuating piston assembly.

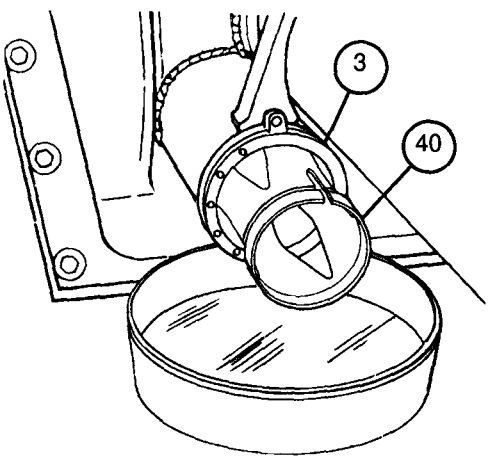
30 Remove actuating piston assembly (30) from front of variable recoil cylinder (3).

31 Slide outer orifice restrictor (40) out of front of variable recoil cylinder (3). If outer orifice restrictor is tight, a sliding hammer type puller may be used.









5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

b. Disassembly

1 To disassemble variable recoil housing (17), remove two machine bolts (41), two flat washers (42), and two pawls (43) from variable recoil housing.

2 Remove four machine screws (44), ring gear retainer (45), shim (46), spur gear sector (6), bearing (47), and ring spacer (48) from variable recoil housing (17).

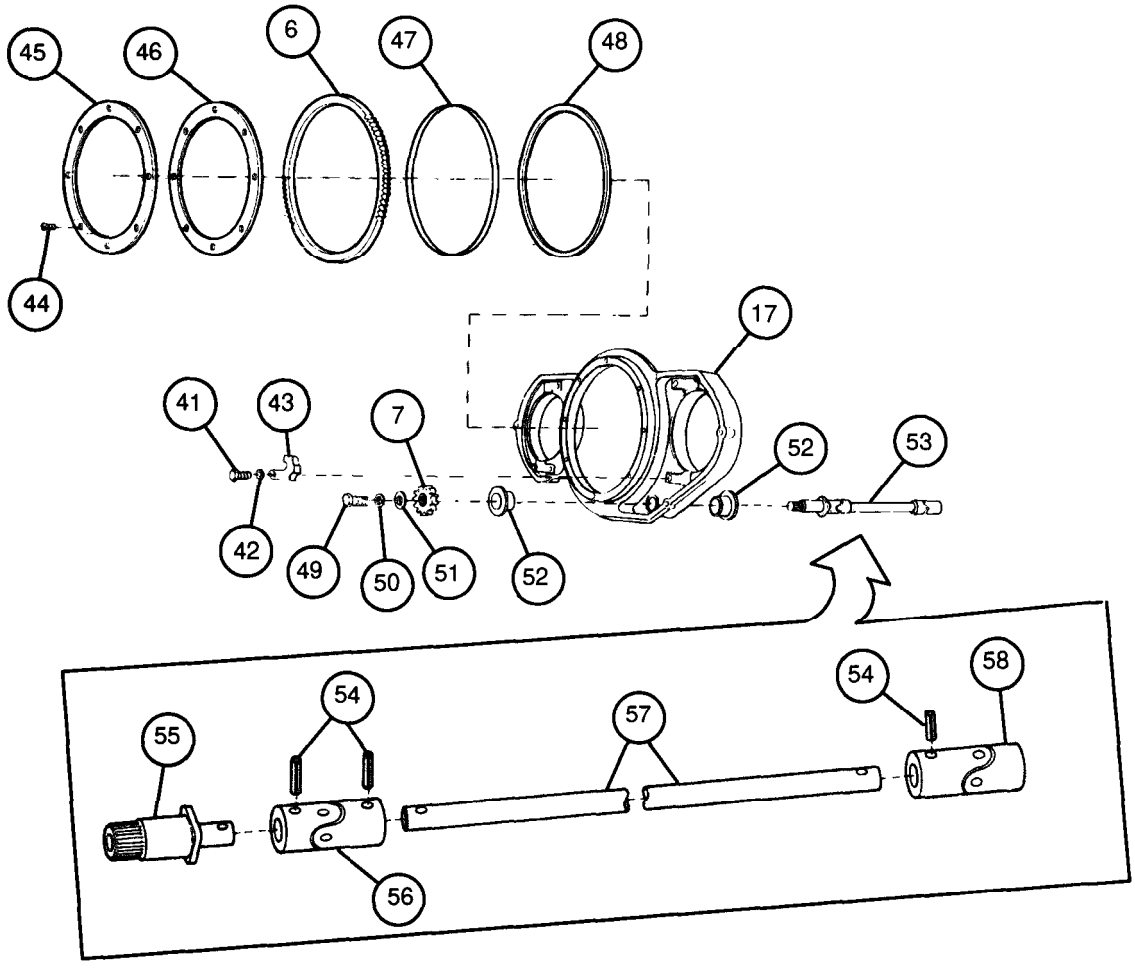
NOTE

Do not remove bearings from variable recoil housing unless installation of new sleeve bearings is necessary.

3 Remove cap screw (49), lockwasher (50), flat washer (51), spur gear (7), two sleeve bearings (52), and connecting link (53) from variable recoil housing (17). Discard lockwasher.

4 To disassemble connecting link (53), remove three spring pins (54). Discard spring pins.

5 Separate straight shaft (55), front universal joint (56), straight pin (57), and rear universal joint (58).



NOTE

Both inner orifice and front follower groups are identical. Disassembly instructions pertain to one. Repeat instructions for remaining group.

6 To disassemble inner orifice and front follower group (25), remove lockwire (59), and eight cap screws (60) from front retaining plate (61). Discard lockwire.

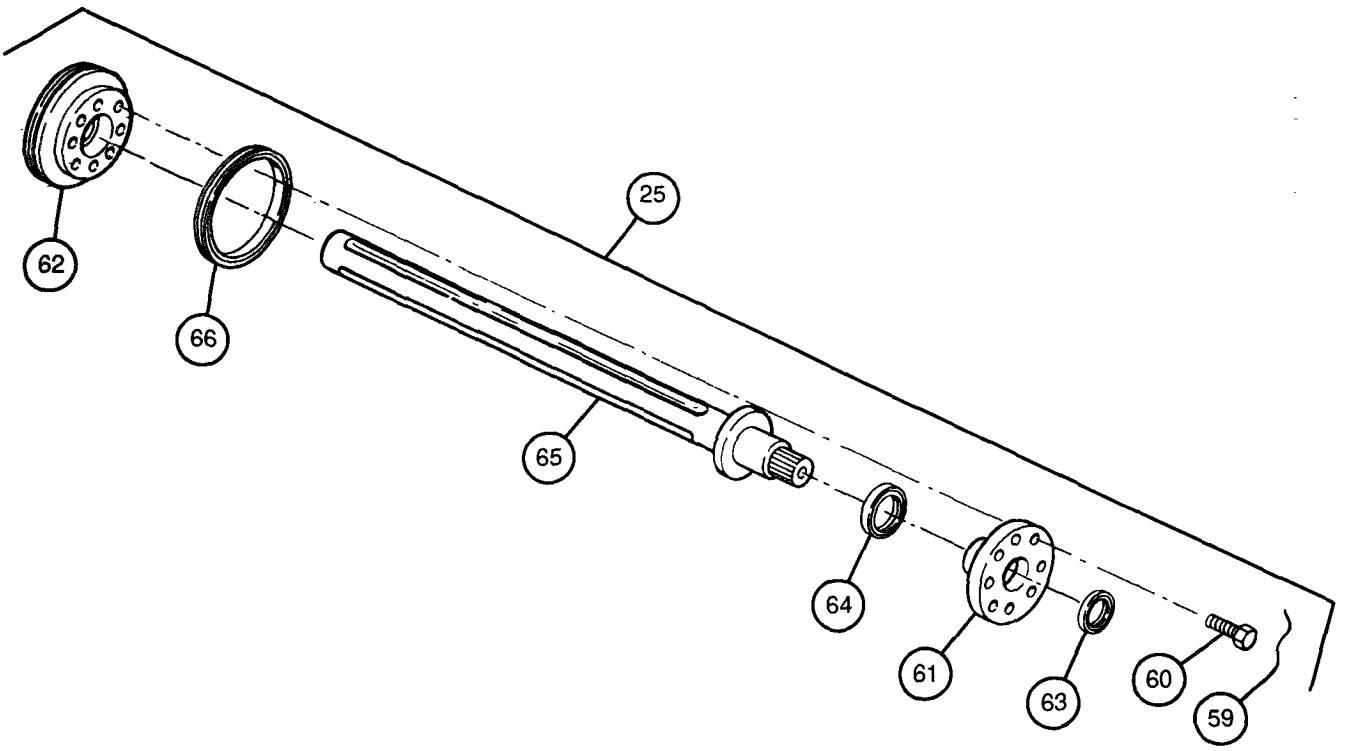
7 Remove front retaining plate (61) from front follower (62).

8 Remove seal assembly (63) from inside the shaft hole of front retaining plate (61). Discard seal assembly.

9 Remove seal assembly (64) from outside of front retaining plate (61). Discard seal assembly.

10 Remove front follower (62) from piston rod (65).

11 Remove seal assembly (66) from outside of front follower (62). Discard seal assembly.



5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

b. Disassembly - Continued

NOTE

Both rear follower groups are identical. Disassembly procedures pertain to one. Repeat procedures for remaining group.

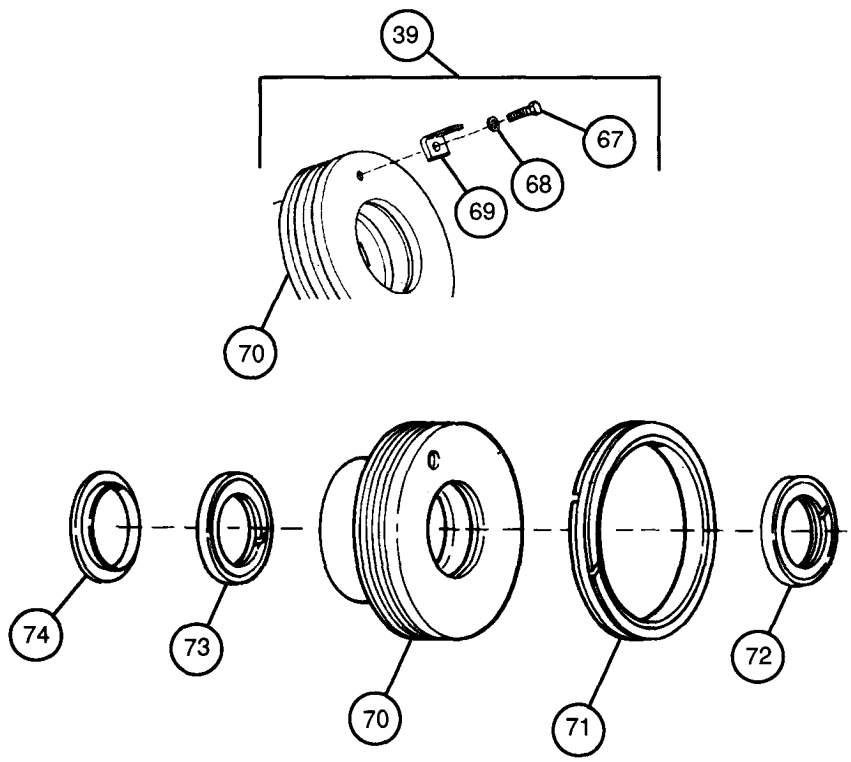
12 To disassemble rear follower group (39), place on solid surface and remove self-locking bolt (67), lockwasher (68), and key (69) from rear follower (70). Discard lockwasher and self-locking bolt.

13 Remove seal assembly (71) from outside of rear follower (70). Discard seal assembly.

14 Remove seal assembly (72) from inside front of rear follower (70). Discard seal assembly.

15 Remove seal assembly (73) from inside rear of rear follower (70). Discard seal assembly.

16 Remove ring wiper (74) from rear follower (70). Discard ring wiper.



c. Inspection and Repair

1 Inspect variable recoil housing (17). Replace if cracked or distorted. Repair or replace variable recoil housing if any burrs are evident on gasket surfaces.

2 Inspect spur gear (7). Replace if cracked, broken, or if splines are distorted.

3 Inspect two sleeve bearings (52). Replace if cracked, broken, or distorted.

4 Inspect straight shaft (55). Replace if cracked, broken, distorted, or if splines are mutilated.

5 Inspect ring spacer (48). Replace if cracked, broken, or distorted.

6 Inspect bearing (47). Replace if cracked, broken, or distorted.

7 Inspect spur gear sector (6). Replace if cracked, broken, or distorted.

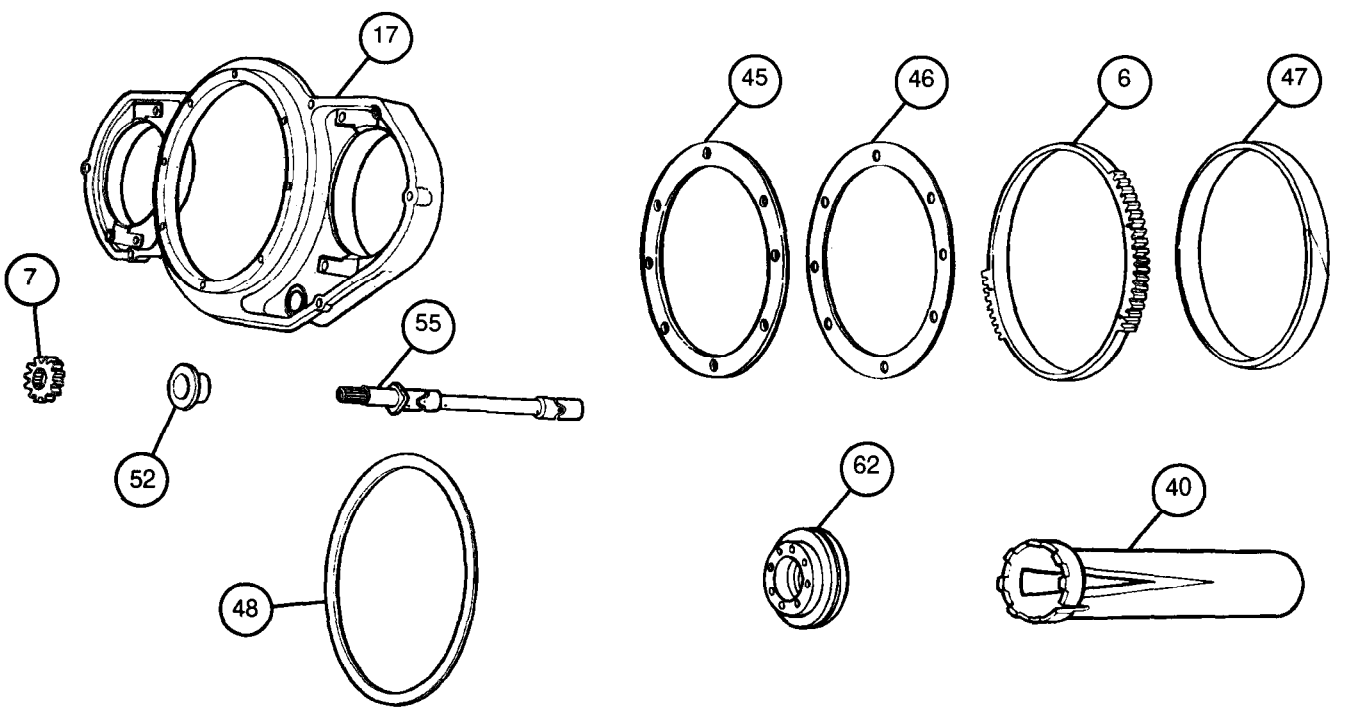
8 Measure inside diameter of spur gear sector (6). Replace if greater than 13.277 inches (33.724 cm).

9 Inspect shim (46). Replace if cracked, broken, or distorted.

10 Inspect ring gear retainer (45). Replace if cracked, broken, or distorted.

11 Inspect outer orifice restrictor (40). Replace if cracked, burred, or distorted. Measure inside diameter. Replace if greater than 5.502 inches (13.975 cm).

12 Inspect front follower (62). Replace if cracked, burred or distorted.



5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

c. Inspection and Repair - Continued

13 Inspect piston rod (65). Replace if cracked, burred, or distorted. Measure outer diameter of orifice area. Replace if less than 1.992 inches (5.06 cm).

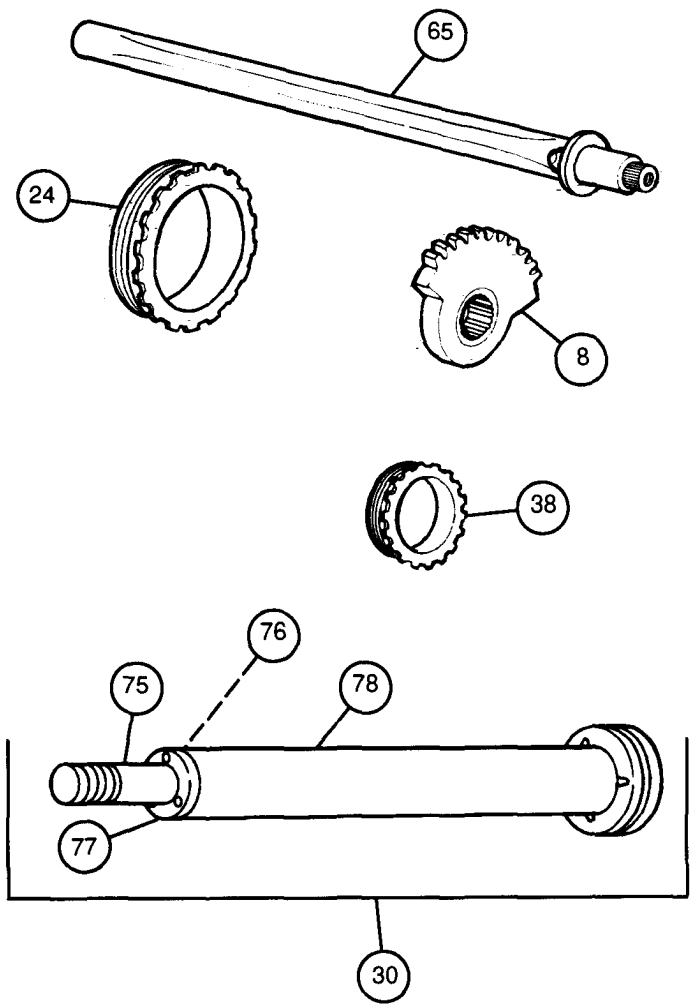
14 Inspect machine bushing (24). Replace if cracked, if spanner shoulders are rounded, or if threads are mutilated.

15 Inspect two sector gears (8). Replace if gear teeth are cracked or broken or if splines are distorted.

16 Inspect machine bushing (38). Replace if cracked, if spanner slot shoulders are rounded, or if threads are mutilated.

17 Inspect plug (75) for mutilated threads and leakage around preformed packing (76). If leaks exist, replace preformed packing. If condition continues, replace actuating piston assembly (30).

18 Inspect for broken spring pins (77) and cracked, burred, or distorted piston tube (78). If any of the items are unserviceable, replace actuating piston assembly (30).



d. Assembly

NOTE

Both rear follower groups are identical. Assembly procedures pertain to one. Repeat procedures for remaining group.

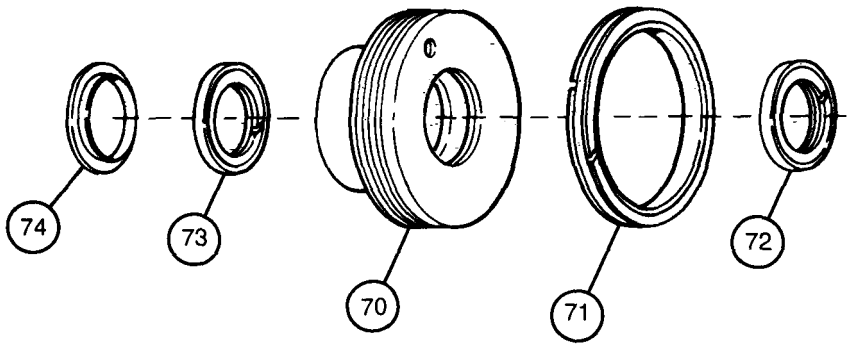
1 Install new seal assembly (73) inside rear of rear follower (70).

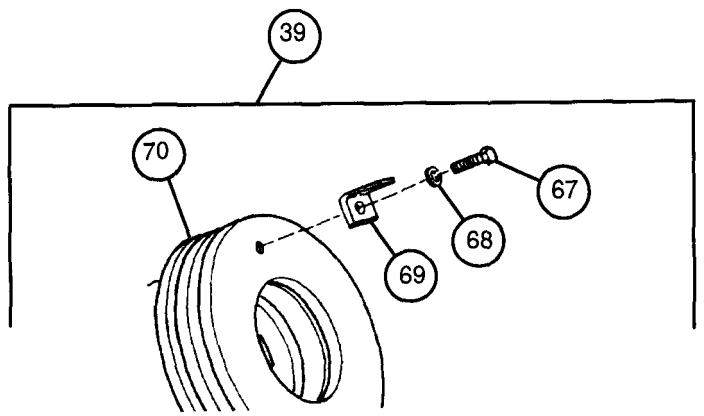
2 Install new ring wiper (74) on rear follower (70). If M109A2 through M109A4 model, cement split in ring wiper with adhesive (item 1, Appx B).

3 Install new seal assembly (72) inside front of rear follower (70).

4 Install new seal assembly (71) on outside of rear follower (70).

5 Install key (69), new lockwasher (68), and new self-locking bolt (67) in rear follower group (39).





5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

d. Assembly - Continued

NOTE

- Both inner orifice and front follower groups are identical. Assembly procedures are written for one but apply to both.
- When replacing seal assemblies, stagger gaps in adjacent rings 180°.

6 To assemble inner orifice and front follower group (25), install new seal assembly (66) on outside of front follower (62).

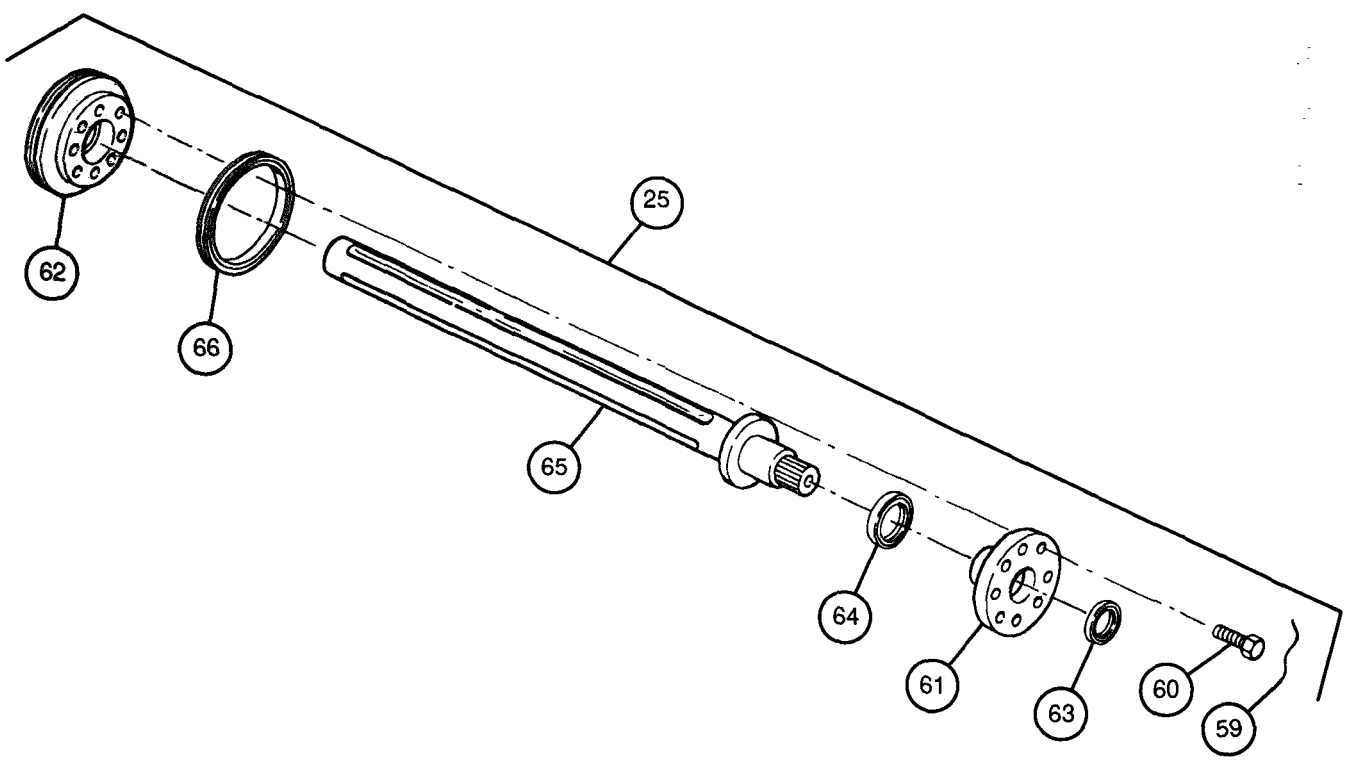
7 Install front follower (62) on piston rod (65).

8 Install new seal assembly (64) on outside of front retaining plate (61).

9 Install new seal assembly (63) inside shaft hole of front retaining plate (61).

10 Install front retaining plate (61) on front follower (62).

11 Install eight cap screws (60) and new lockwire (59) in front retaining plate (61).



12 To assemble connecting link (53), connect straight pin (57) to rear universal joint (58). For new parts, drill straight pin and rear universal joint and install new spring pin (54).

NOTE

Front universal joint and front of straight pin are not drilled for spring pins until spur gears and sector gears are alined.

13 Install front universal joint (56) onto straight pin (57) and install straight shaft (55) into front universal joint.

14 Install connecting link (53) onto bevel gearshaft (79) of actuator assembly (80).

NOTE

- Install spur gear sector with alinement arrow pointing to front housing assembly.
- Refer to figure below for alinement of straight shaft.

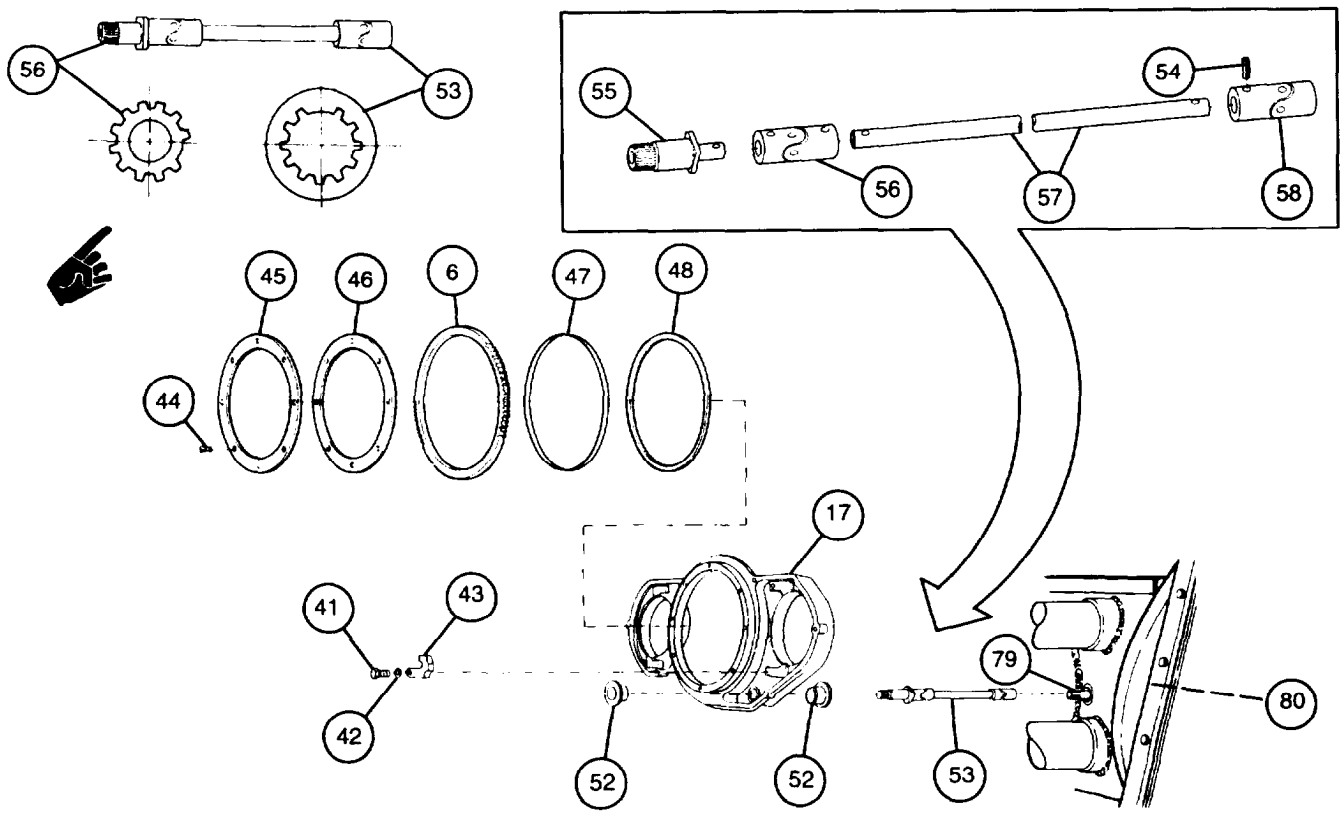
15 Coat spur gear sector (6) with grease (item 21.1, or 21.2, Appx B) before installation.

16 Install ring spacer (48), bearing (47), and spur gear sector (6).

17 Install shim (46), ring gear retainer (45), and four machine screws (44) in variable recoil housing (17).

18 Install two sleeve bearings (52) if new parts, Ream to 1.000 ± 0.001-in. (25.4 ± 0.025 mm) ID.

19 Install two pawls (43), two new flat washers (42), and two machine bolts (41) in variable recoil housing (17). Torque bolts to 18 lb-ft (24 N•m).



5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

e. Installation

CAUTION

Use care not to scratch or damage actuating piston rod during installation.

1 Slide outer orifice restrictor (40) into front of variable recoil cylinder (3), making sure slot of outer orifice restrictor is at top, lined up with lubrication fitting.

2 Install actuating piston assembly (30) approximately half-way into front of variable recoil cylinder (3).

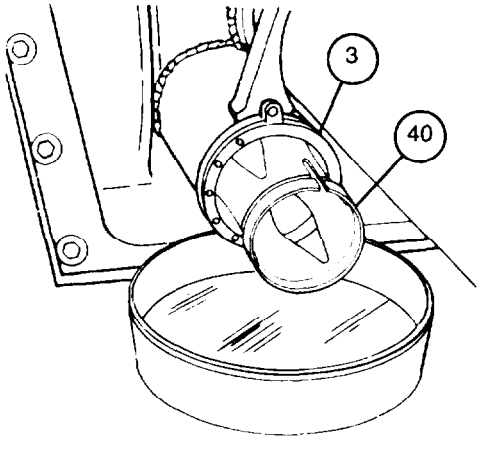
NOTE

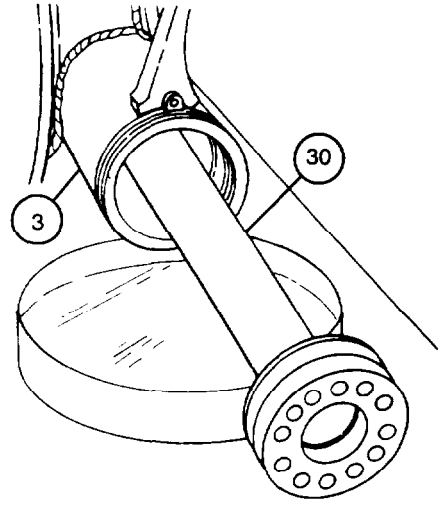
Aline key on rear follower with recesses in outer orifice.

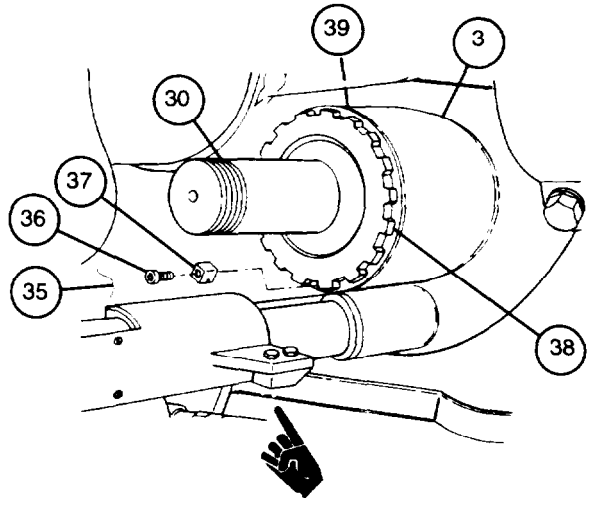
3 Slide actuating piston assembly (30) further into variable recoil cylinder (3). Install rear follower group (39) at rear of variable recoil cylinder, over rod of actuating piston assembly.

4 Install machine bushing (38) using spanner wrench.

5 Install machine key (37) and cap screw (36) using hex head wrench. Install new lockwire (35).







6 Install four machine screws (34) in retaining plate (33) and plate spacer (32).

7 Install retaining plate group (31) on rear of actuating piston assembly (30) as actuating piston assembly is pushed into position through cannon assembly.

NOTE

Compare mount model numbers with illustrations before performing steps 8 through 11.

8 Install sleeve spacer (29) and keyway washers (28) at threaded end of actuating piston assembly (30).

NOTE

Be sure single tab of key washer is alined in keyway of keyway washer.

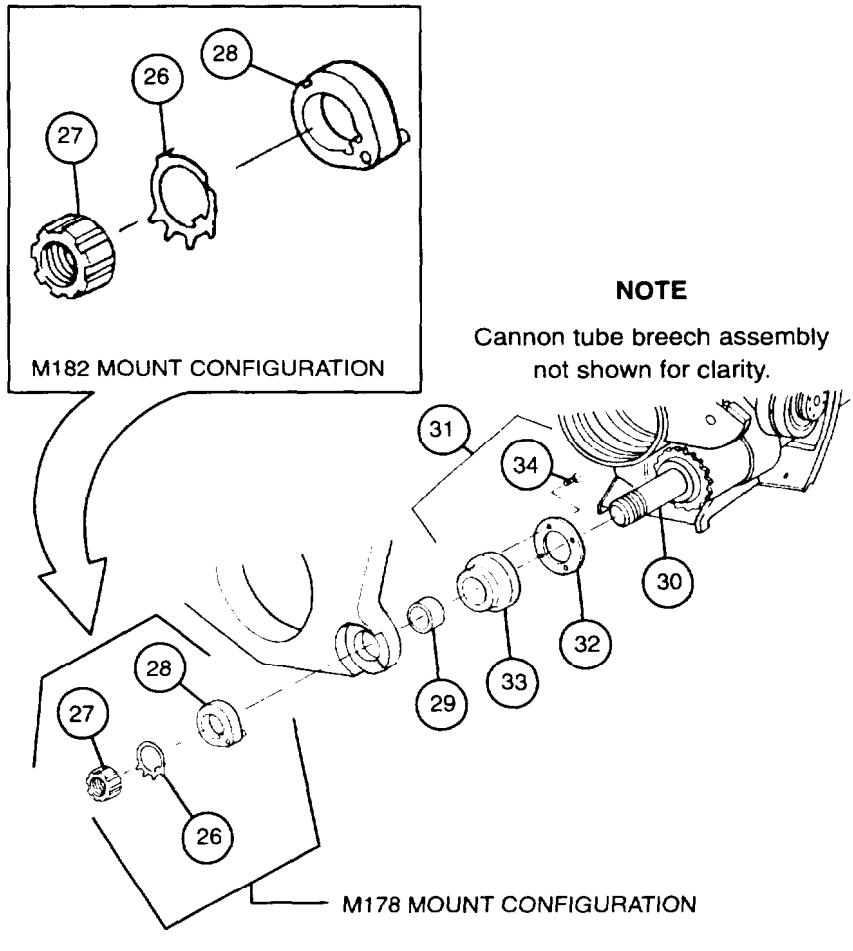
9 Install new key washer (26).

NOTE

Install round nut with tapered side of the nut facing the mount.

10 Install round nut (27) using spanner wrench. To ensure recoil rod is pulled through breech ring adapter band, loosen round nut. Retighten nut until it begins to press against key washer (26).

11 If tabs on key washer (28) do not line up with slots in round nut (29), tighten or loosen nut as required, but no more than 15 degrees either way, to get tabs and slots to line up. Bend down two tabs on the key washer, 90 degrees apart, into slots in the nut to lock nut in place.



5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

e. Installation - Continued

WARNING

Use gloves or rags to grip inner orifice. Edge of inner orifice is extremely sharp and could cause injury.

12 Install inner orifice and front follower group (25) into variable recoil cylinder (3).

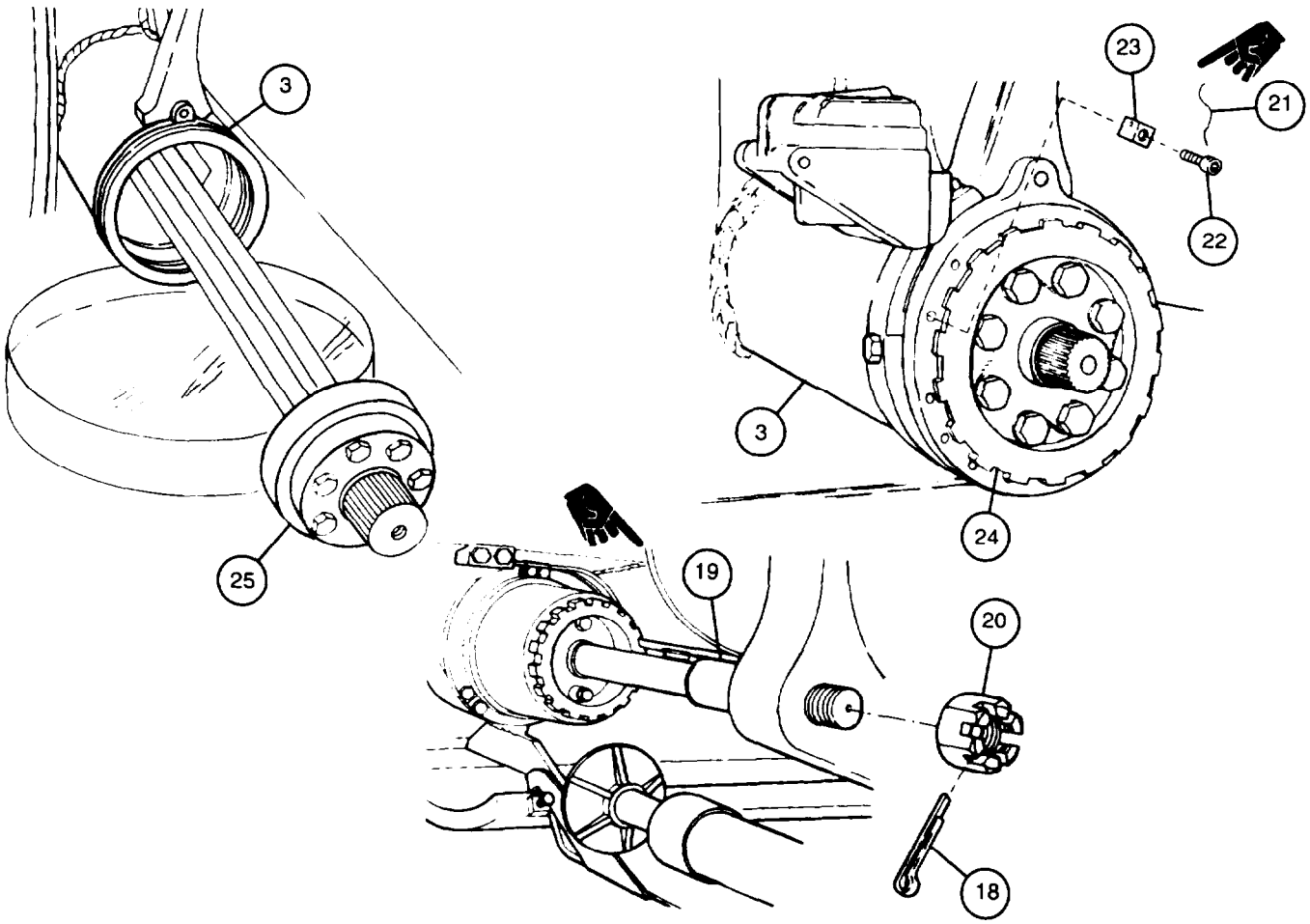
13 Install machine bushing (24) on front of variable recoil cylinder (3) using spanner wrench.

14 Install machine key (23), cap screw (22), and new lockwire (21) in front of variable recoil cylinder (3).

15 While holding shouldered shaft collar (19) with pipe wrench, install rear slotted nut (20) on recuperator assembly until rear slotted nut and shouldered shaft collar just begins to touch breech ring adapter band. Then loosen rear slotted nut 1/6 to 2/3 of a turn while lining up the cotter pin hole in the recuperator rod with slots in the rear slotted nut.

16 Install new cotter pin (18).

17 Return cannon assembly into battery position (TM 9-2350-311-20-2).



NOTE

Spur gear (7) flat washer (51) new lockwasher (50), and cap screw (49) are installed after variable recoil housing assembly is installed on mount.

18 Install variable recoil housing (17) over end of cannon assembly and slide rearward along cannon assembly to position at mount.

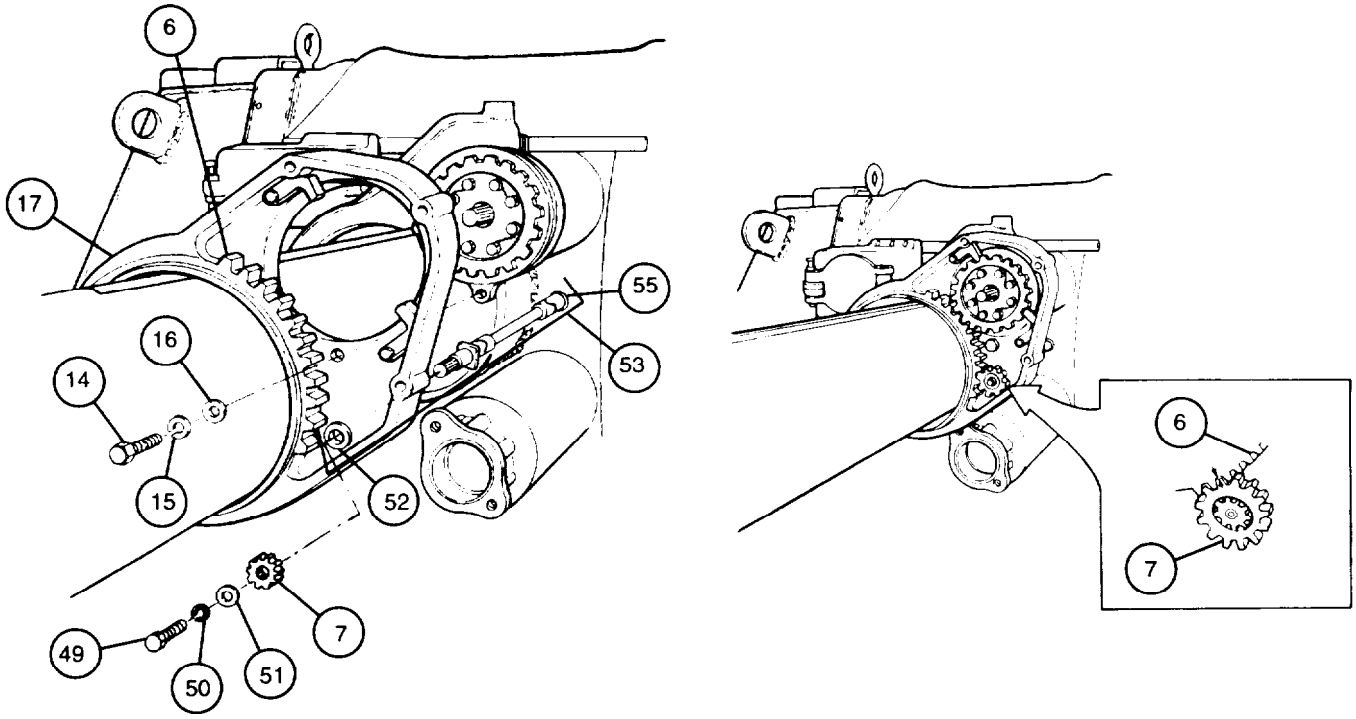
19 Before assembling, coat straight shaft (55), sleeve bearings (52), and spur gear (7) with grease (item 21.1, or 21.2, Appx B).

20 Slide straight shaft (55) of connecting link (53) through sleeve bearings (52) and position variable recoil housing assembly (17) on mount.

21 Install four flat washers (16), four new lockwashers (15), and four cap screws (14) on variable recoil housing (17).

22 Aline spur gear (7) with splines on straight shaft (55) and spur gear sector (6) arrow and install spur gear.

23 Install flat washer (51), new lockwasher (50), and cap screw (49). Do not torque cap screw at this time.



5-12 VARIABLE RECOIL ASSEMBLY - CONTINUED

e. Installation - Continued

24 Coat sector gears (8) and head of screws on front follower with grease (item 21.1, or 21.2, Appx B) before installing sector gears.

25 Aline sector gears (8) with splines on piston rod (65) and arrows on spur gear sector (6). Install sector gears.

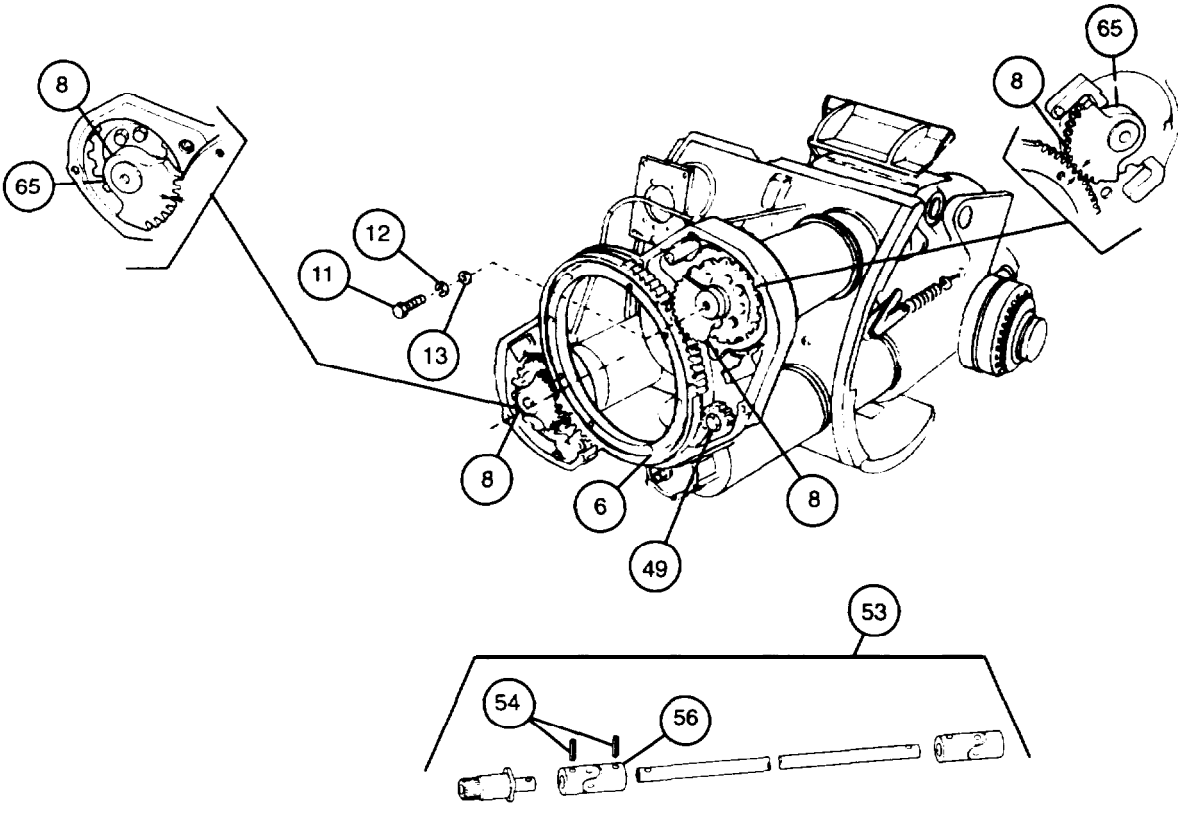
26 Install flat washer (13), new lockwasher (12), and cap screw (11) on each piston rod (65).

NOTE

Check alinement of piston rod, sector gears, spur gear sector, spur gear, and position of actuator output shaft.

27 With everything in proper alinement (for long recoil length), drill holes for spring pins (54) on front universal joint (56) of connecting link (53).

28 Install new spring pins (54) in front universal joint (56). Torque cap screw (49) to 35 lb-ft (47 N•m).



29 Install two new preformed packings (5) and recoil cylinder drain plugs (4) at rear of each recoil cylinder (3).

30 Recharge recuperator with nitrogen (TM 9-2350-311-20-2).

31 Close bleeder "T" (2) at front of left variable recoil cylinder (3).

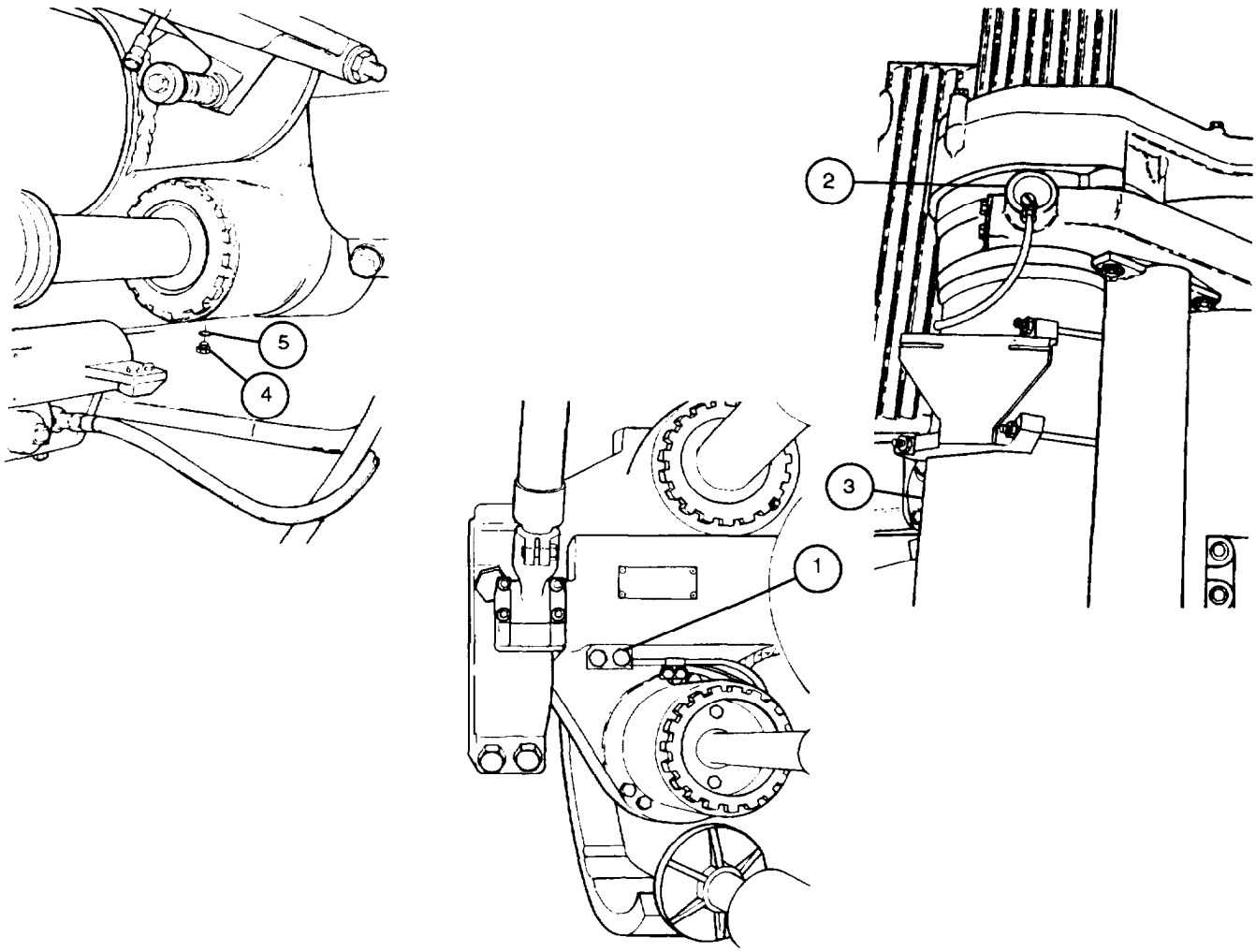
32 Remove hose from bleeder "T" (2).

33 Close accumulator replenisher right manifold bleeder plug (1).

34 Recharge replenisher hydraulic system with hydraulic fluid (TM 9-2350-311-20-2).

NOTE

Check variable recoil assembly for hydraulic leaks.



5-13 BUFFER ASSEMBLY

This task covers:
a. Removal
b. Disassembly
c. Inspection
d. Assembly
e. Installation

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Fabricated breech stand (Figure C-3, Appx C)

Materials/Parts
Cotter pin (item 48, Appx E)
Key washers (2) (item 121, Appx E)
Packing retainers (2) (item 61, Appx E)
Preformed packing (item 65, Appx E)
Preformed packing (item 99, Appx E)
Retaining ring (item 16, Appx E)
Retaining ring (item 17, Appx E)
Seal replacement parts kit (item 140, Appx E)
Seals (2) (item 162, Appx E)
Spring pins (2) (item 25, Appx E)

Personnel Required
2

Equipment Condition
Drain replenisher hydraulic system (para 5-12)
Turret lock in locked position (TM 9-2350-311-10)

a. Removal

WARNING

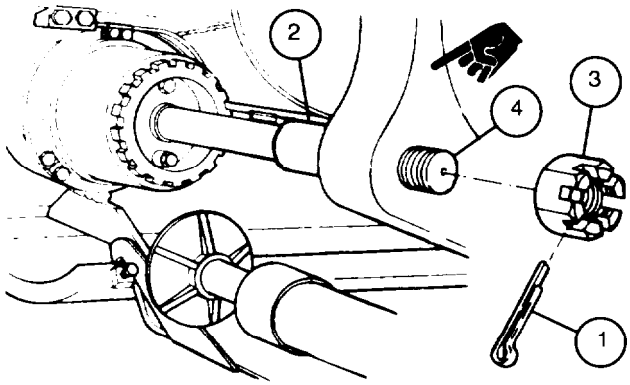
When working with cannon assembly pushed out of battery, block breechblock assembly with breech stand to prevent accidental elevation of cannon tube and injury to personnel.

NOTE

Buffer assembly can be removed and installed with mount and cannon assembly installed in vehicle.

1 Remove and discard cotter pin (1).

2 While holding shaft collar (2) with pipe wrench, remove rear slotted nut (3) from shouldered shaft (4).



3 Push cannon assembly out of battery 30 inches (76.2 cm) (TM 9-2350-311-20-2).

NOTE

When bottom hydraulic line is disconnected, remaining hydraulic fluid in recoil system will drain.

4 Disconnect three hydraulic lines at top nut (5) and bottom nut (6) on buffer assembly (7) and at front line nut (8).

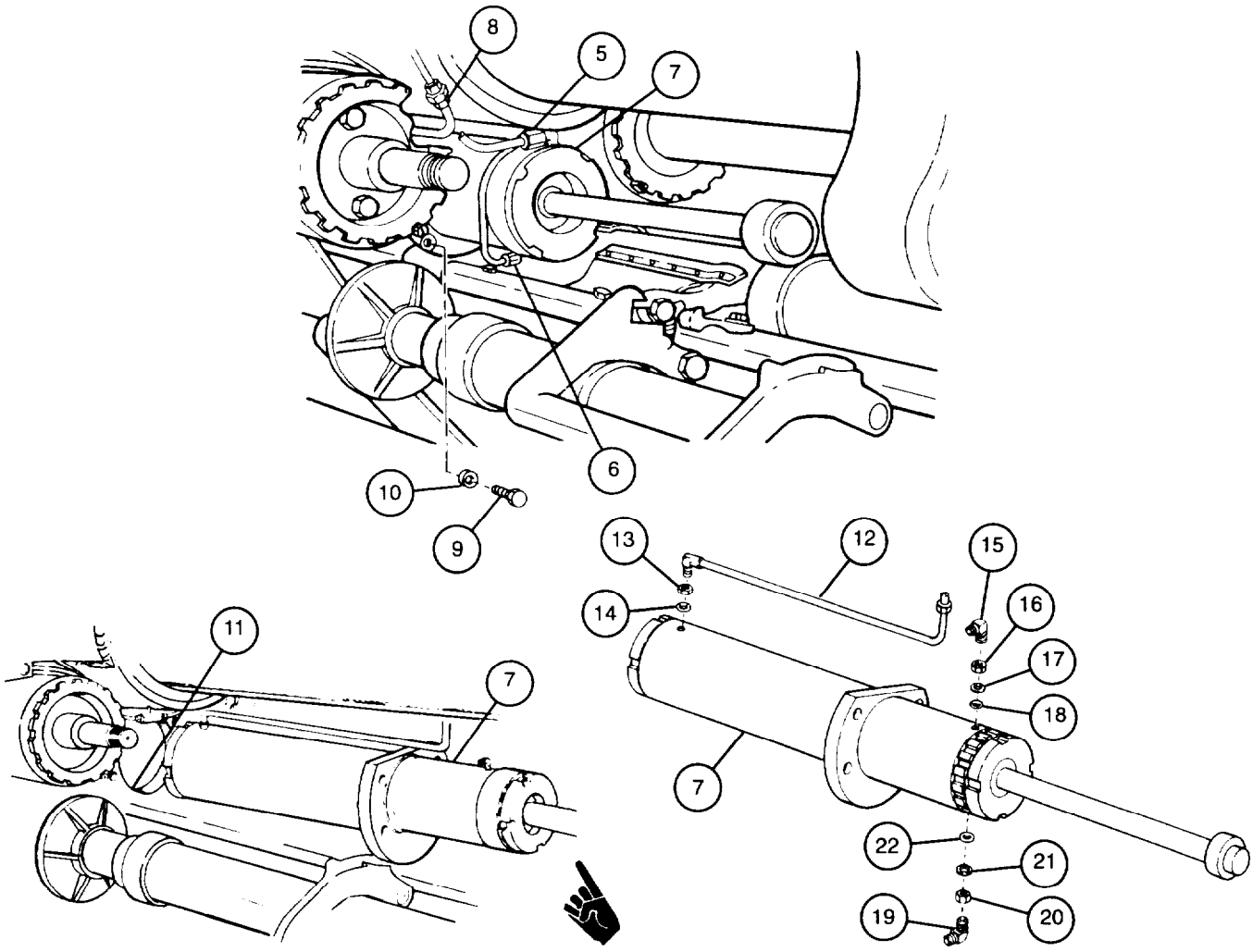
5 Remove four cap screws (9) and four flat washers (10) from buffer assembly (7) flange.

6 Withdraw buffer assembly (7) from cradle assembly (11).

7 Remove front tube (12), hex nut (13), and preformed packing (14) from front of buffer assembly (7). Discard preformed packing.

8 Remove tube elbow (15), hex nut (16), packing retainer (17), and preformed packing (18) from top, rear of buffer assembly (7). Discard preformed packing and packing retainer.

9 Remove tube elbow (19), hex nut (20), packing retainer (21), and preformed packing (22) from bottom, rear of buffer assembly (7). Discard preformed packing and packing retainer.



5-13 BUFFER ASSEMBLY - CONTINUED

b. Disassembly

1 Place buffer assembly (7) in vise and secure.

2 Push in bumper assembly (23) against helical compression spring (24) to gain access to round nut (25).

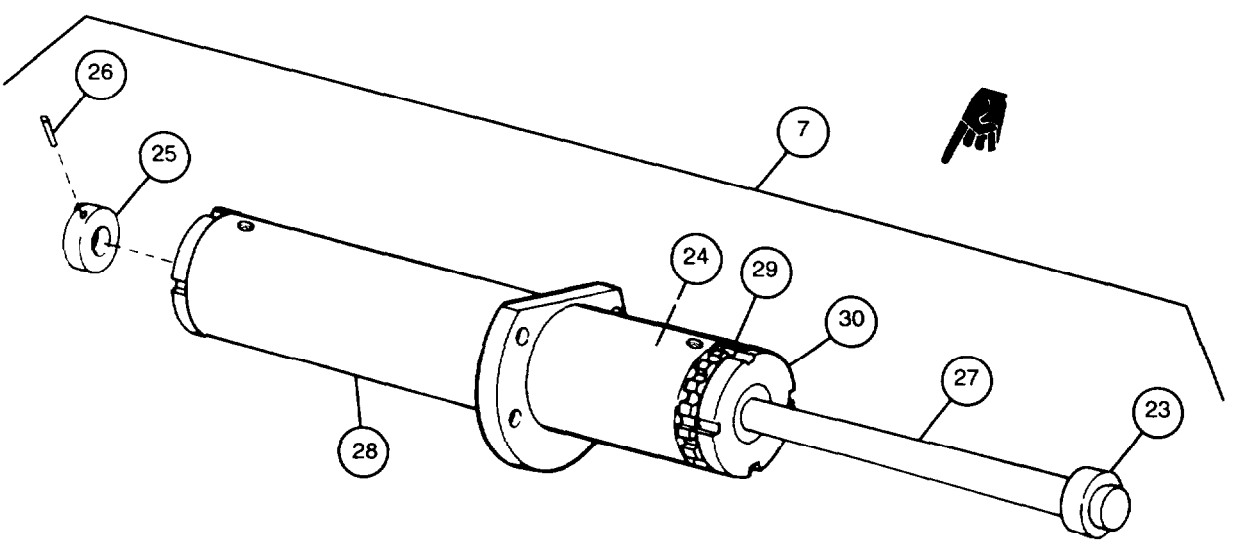
WARNING

Helical compression spring is under compression. Use care in disassembly to avoid possible injury to personnel.

3 Drive out spring pin (26) and remove round nut (25). Allow bumper assembly (23) and piston buffer rod (27) to extend fully out of buffer cylinder (28). Discard spring pin.

4 Disengage key washer (29) locking teeth from threaded bushing (30) at bumper assembly (23) end.

5 Restrain bumper assembly (23) against further extension. Have an assistant unscrew threaded bushing (30). Allow bumper assembly and piston buffer rod (27) to extend slowly.



6 Withdraw bumper assembly (23), and piston buffer rod (27) from buffer cylinder (28) along with seal (31), sleeve bushing (32), seal (33), preformed packing (34), packing retainer (35), key washer (29), machine bushing (30), linear actuating piston (36) with attached parts, and helical compression spring (24).

7 Remove bumper assembly (23) by driving out spring pin (37). Discard spring pin.

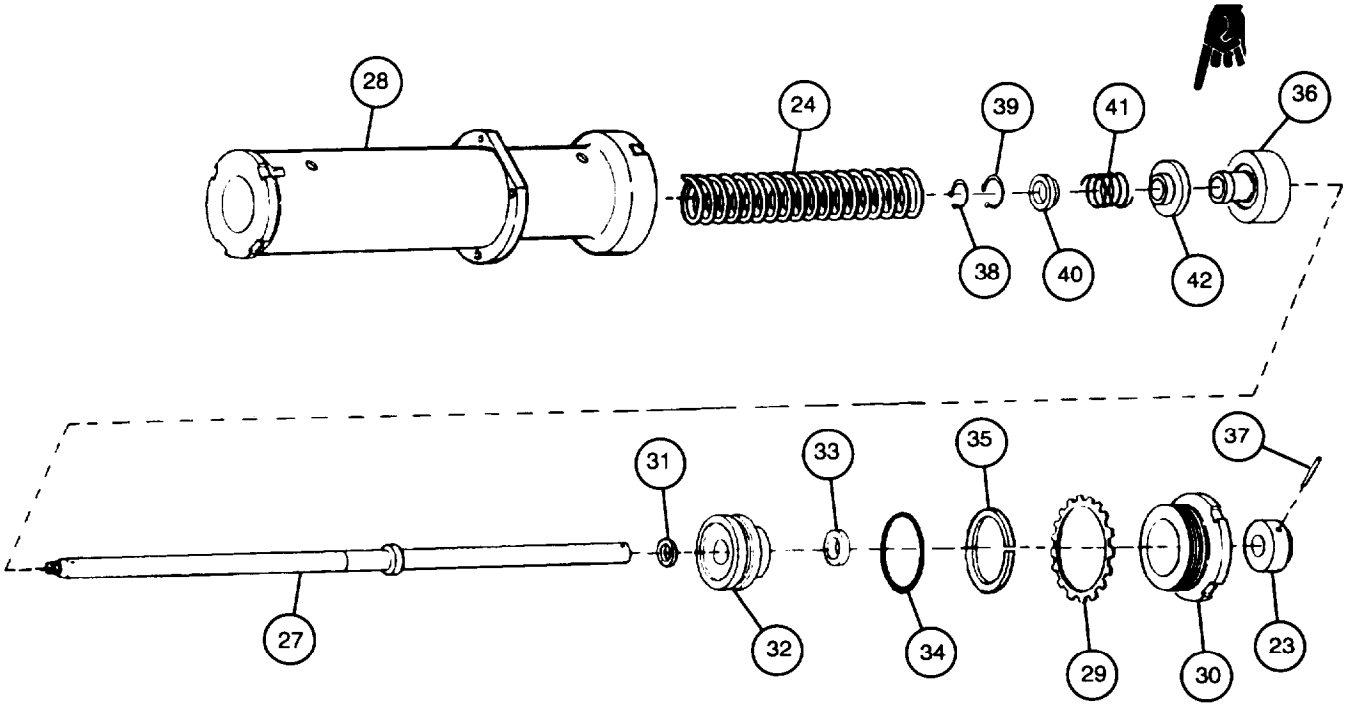
8 Remove threaded bushing (30), key washer (29), packing retainer (35), preformed packing (34), seal (31), sleeve bushing (32), and seal (33) from piston buffer rod (27). Discard key washer, packing retainer, preformed packing, and seals.

9 Remove and discard retaining ring (38). Separate piston (36) from rod (27).

WARNING

Helical compression spring is under compression. Use care in disassembly to avoid possible injury to personnel.

10 Remove and discard retaining ring (39). Separate guide (40), helical compression spring (41), valve (42), and linear actuating piston (36).



5-13 BUFFER ASSEMBLY - CONTINUED

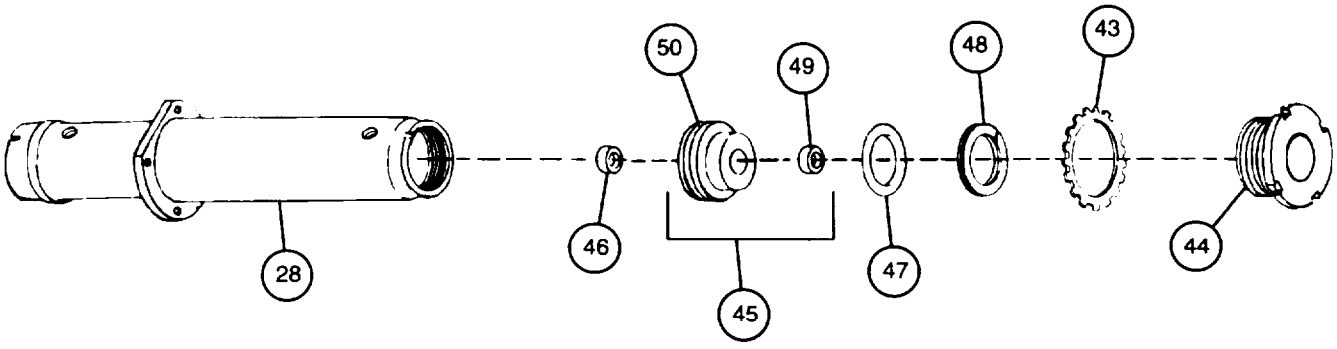
b. Disassembly - Continued

11 Disengage key washer (43) locking teeth from threaded bushing (44) at stop end.

12 Unscrew machine bushing (44) from buffer cylinder (28) and remove with key washer (43). Discard key washer.

13 Withdraw bushing assembly (45) along with seal (46), preformed packing (47), and packing retainer (48). Discard packing retainer and preformed packing.

14 Remove seals (46 and 49) from sleeve bushing (50). Discard seals.



c. Inspection

1 Inspect bumper assembly (23). Replace as an assembly if there are burrs, cracks, sharp edges, or other damage.

2 Inspect threaded bushings (30) and (44) for burrs or sharp edges. Replace if needed.

3 Using micrometer calipers, measure inside diameter of machine bushing (32) and sleeve bushing (50). Replace if inside diameter is greater than 1.000 inch (2.54 cm).

4 Inspect piston buffer rod (27) for damage, wear, or tolerance O.D. 0.995 in. (25.273 mm) minimum. Replace if scored, scratched, or O.D. is 0.995 in. (25.273 mm) minimum. Repair if threads are burred or nicked. Remove any paint on piston buffer rod.

5 Inspect buffer cylinder (28) for damage. Replace if exterior is cracked, dented, or deformed. Replace if interior is scratched or galled.

6 Measure inside diameter of buffer cylinder (28) in two places. At 20 inches (50.8 cm) from stop end, replace if greater than 3.51 inches (8.92 cm). At 8.5 inches (21.59 cm) from stop end, replace if greater than 3.5 inches (8.89 cm).

7 Inspect linear actuating piston (36) for damage. Replace if nicked, scratched, or burred.

8 Using calipers, measure outside diameter of linear actuating piston (36). Replace if less than 3.487 inches (8.857 cm).

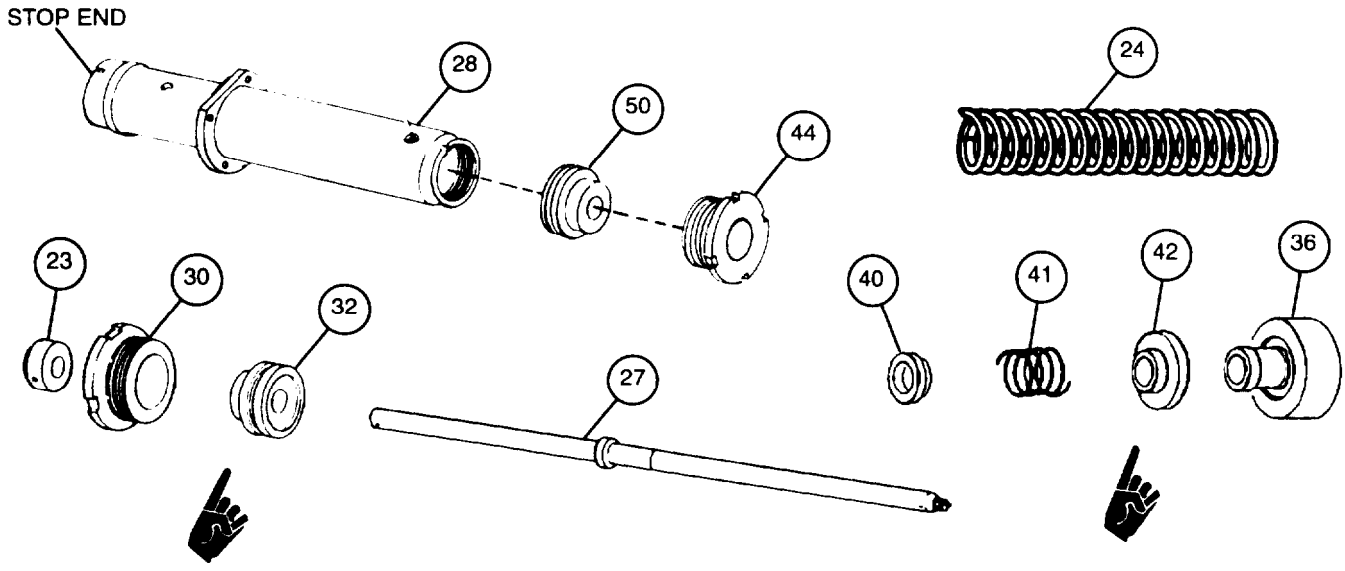
9 Inspect valve (42) for burrs or sharp edges. Replace as required.

10 Using calipers, measure valve (42) thickness. Replace if less than 0.12 inches (3.05 mm).

11 Inspect guide (40) for burrs or sharp edges. Replace as required.

12 Inspect helical compression spring (41). Replace if free length is less than 1.438 in. or is cracked or distorted.

13 Inspect helical compression spring (24). Replace if free length is less than 22.25 in. or is cracked or distorted.



5-13 BUFFER ASSEMBLY-CONTINUED

d. Assembly

NOTE

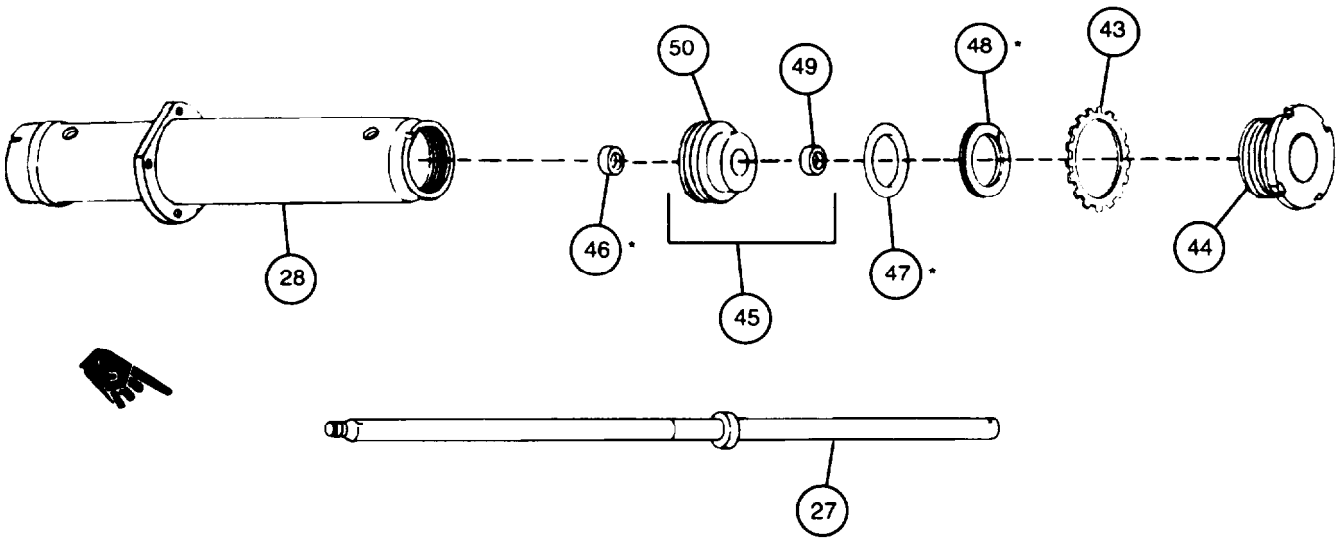
Replace seals (31 and 46), preformed packings (34 and 47), and packing retainers (35 and 48), using seal replacement part kit.

1 Install two new seals (46 and 49) onto machine bushing (50).

2 Install new preformed packing (47) and new packing retainer (48) on bushing assembly (45), and insert bushing assembly into buffer cylinder (28) using piston buffer rod (27) as a tool.

3 Install threaded bushing (44) with new key washer (43).

4 Engage key washer (43) locking teeth to threaded bushing (44) at stop end.



* PART OF KIT 12012358

5 Install linear actuating piston (36) to piston buffer rod (27) with new retaining ring (38).

6 Assemble linear actuating piston (36), valve (42), helical compression spring (41), and guide (40). Carefully compress helical compression spring. Install new retaining ring (39).

NOTE

Install rubber portion of seal before installing spacers.

7 Install new seal (31) new seal (33), into sleeve bushing (32). Install sleeve bushing, new preformed packing (34), and new packing retainer (35) onto piston buffer rod (27).

NOTE

If piston buffer rod is new from supply perform step 8.

8 Punch and drill two 0.156 + 0.004 in. (3.962 + 0.102 mm) holes through piston buffer rod (27) using bumper assembly (23) and round nut (25) for pilot holes.

9 Install helical compression spring (24) onto piston buffer rod (27) and install into buffer cylinder (28). Insert piston buffer rod through buffer cylinder until threaded portion extends beyond threaded bushing (44). Install rounded nut (25) and new spring pin (26).

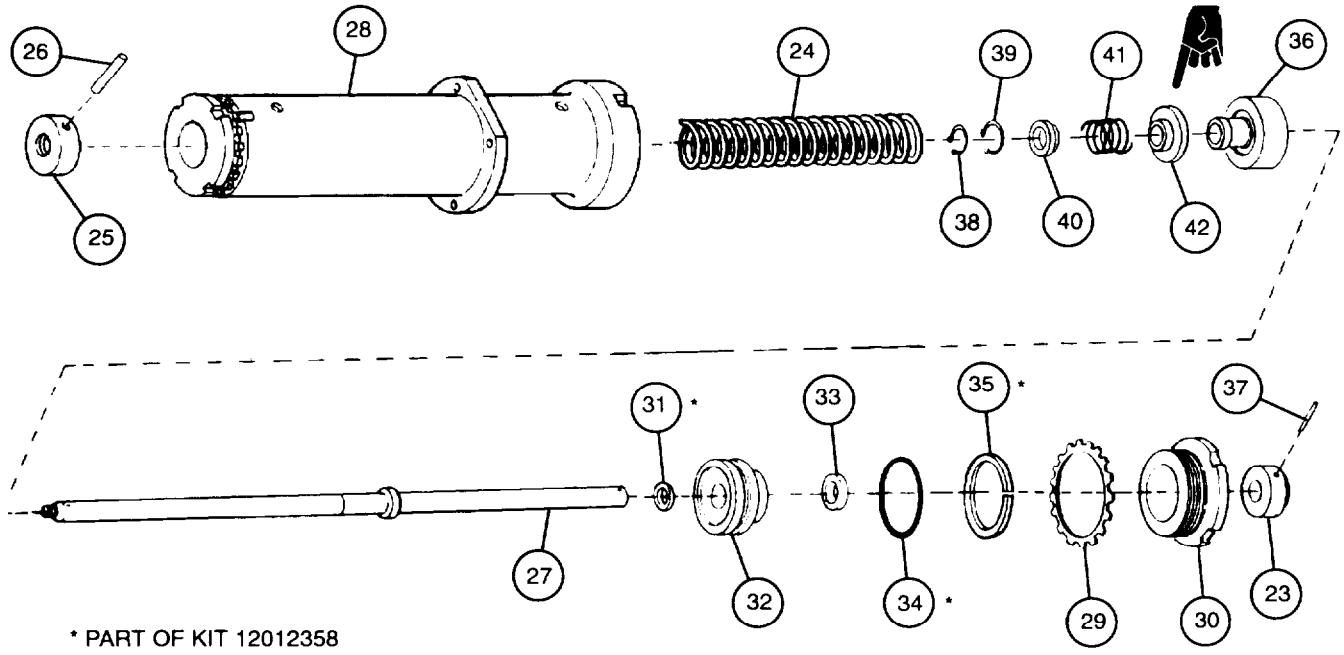
WARNING

Ensure helical compression spring is tightly compressed. Use care in assembly to prevent accidental release of helical compression spring, resulting in possible injury to personnel.

10 Push bumper assembly (23) to correctly position. Allow bumper assembly to extend slowly.

11 Install machine bushing (30), new key washer (29), bumper assembly (23), and new spring pin (37) on end of piston buffer rod (27).

12 Engage key washer (29) locking teeth to machine bushing (30) at bumper assembly end.



* PART OF KIT 12012358

5-13 BUFFER ASSEMBLY-CONTINUED

e. Installation

1 Install new preformed packing (14), hex nut (13), and front tube (12) onto front of buffer assembly (7).

2 Install new preformed packing (18), new packing retainer (17), hex nut (16), and tube elbow (15) onto top, rear of buffer assembly (7).

3 Install new preformed packing (22), new packing retainer (21), hex nut (20), and tube elbow (19) onto bottom, rear of buffer assembly (7).

4 Insert buffer assembly (7) into cradle assembly (11).

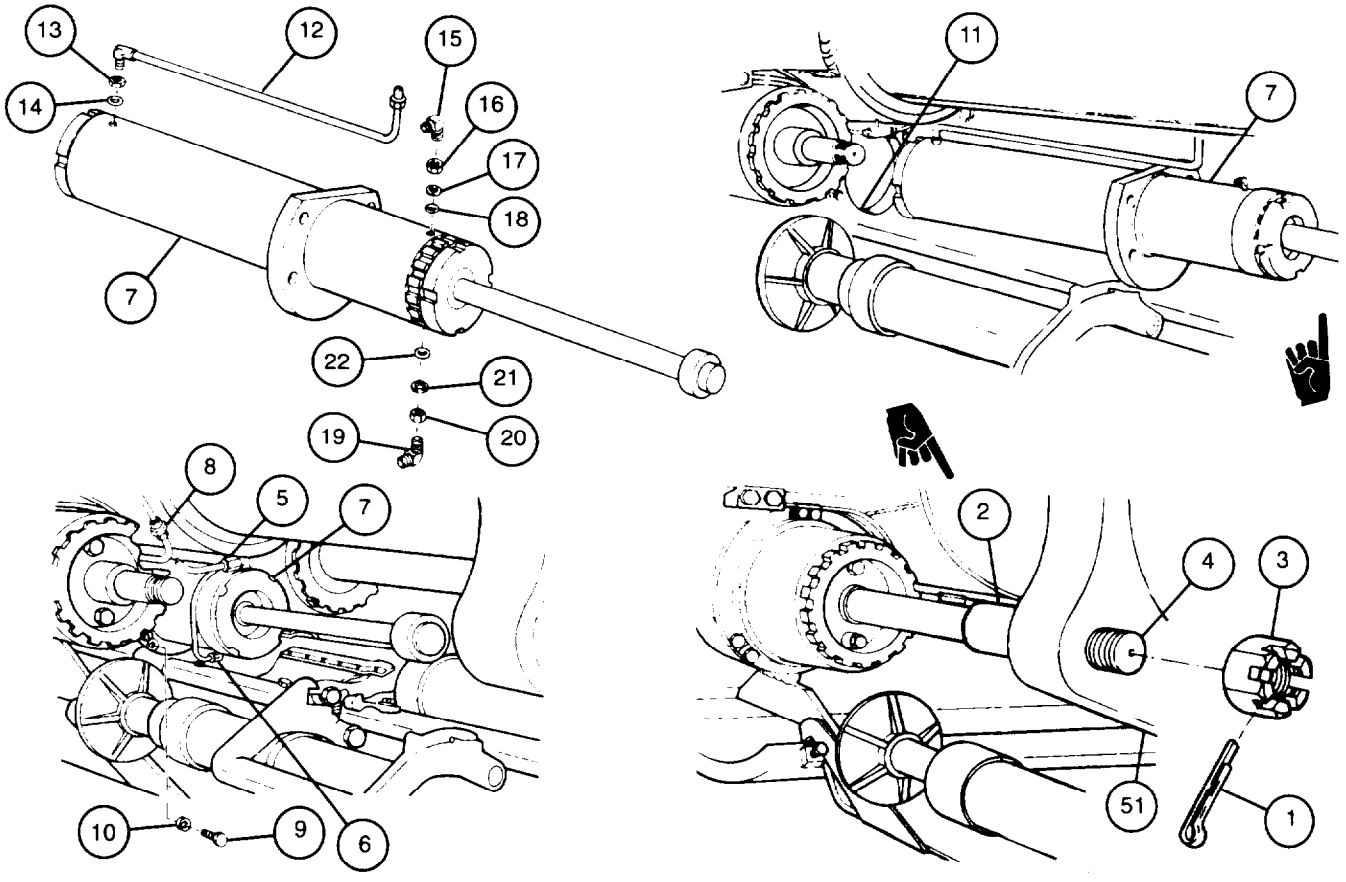
5 Install four flat washers (10) and four cap screws (9) into buffer assembly (7) flange. Torque cap screws to 38 lb-ft (52 N•m).

6 Connect three hydraulic lines at front line nut (8), and bottom nut (6) and top nut (5) on buffer assembly (7).

7 Return cannon assembly into battery.

8 While holding shaft collar (2) with pipe wrench, install rear slotted nut (3) on shouldered shaft (4). Shouldered nut should be tightened until slotted nut and shaft collar are just beginning to touch breech ring body (51). Loosen slotted nut 1/6 to 1/3 turn while alining cotter pin (1) hole in shouldered shaft with slots in slotted nut.

9 Install new cotter pin (1).



5-14 ACTUATOR AND FOLLOWER ASSEMBLIES

This task covers: a. Removal b. Inspection c. Installation d. Adjustment

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)

Materials/Parts
Adhesive (item 4, Appx B)
Lockwasher (item 72, Appx E)
Lockwashers (4) (item 86, Appx E)
Lockwire (item 36, Appx E)
Self-locking nut (item 41, Appx E)

Equipment Condition
Cab weather cover removed (TM 9-2350-311-20-2)
Upper gun rotor removed (para 5-1)
Dust shield and cover removed (TM 9-2350-311-20-2)
Cannon at 0 mils

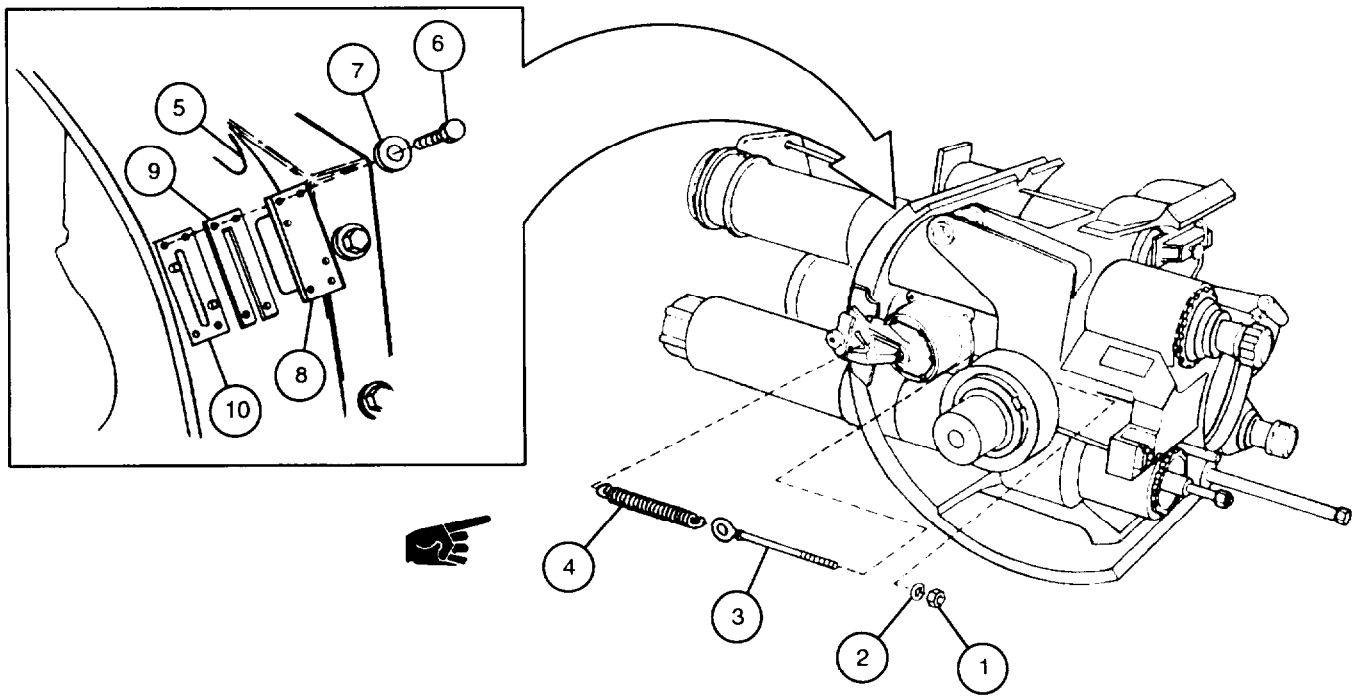
a. Removal

NOTE

- Actuator and follower procedures can be performed while mount and cannon are installed in vehicle.
- A maximum of four flat washers may be used per cap screw.

1 Remove self-locking nut (1), flat washer (2), eye bolt (3), and helical spring (4). Discard self-locking nut.

2 Remove lockwire (5), four cap screws (6), washers (7) if present, follower assembly (8), and shim pack (9) if present, from upper left front of trunnion bracket (10). Discard lockwire.



5-14 ACTUATOR AND FOLLOWER ASSEMBLIES - CONTINUED

a. Removal - Continued

3 Remove hex nut (11), lockwasher (12), lever (13), and woodruff key (14) from actuator housing (15). Discard lockwasher.

4 Elevate cannon assembly, remove upper front cap screw (16) and lockwasher (17). Discard lockwasher.

5 Depress cannon assembly and remove three cap screws (18) and three lockwashers (19). Discard lockwashers.

6 Using prybar, pry actuator housing (15) from mount. Two pin assemblies (20) may come off with actuator housing or stay in mount.

7 Move actuator housing (15) to the rear to disengage gearshaft (21) from universal joint. Remove actuator housing.

8 If pin assemblies (20) were removed with actuator housing (15), remove pin assemblies from actuator housing. Otherwise remove pin assemblies from mount.

9 If necessary, remove grommet (22).

b. Inspection

Inspect follower assembly (8). Replace if cracked or distorted.

c. Installation

WARNING

Adhesives can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive gets on skin or clothing, wash immediately with soap and water.

1 If removed, install grommet (22) using adhesive.

2 Install actuator housing (15) and depress cannon assembly. Move actuator assembly forward to engage gearshaft (21) to universal joint.

NOTE

Install the mounting cap screws loosely, then install pin assemblies and tighten mounting cap screws.

3 With cannon assembly depressed, install three new lockwashers (19) three cap screws (18), and lower rear pin assembly (20).

4 Elevate cannon assembly. Install new lockwasher (17) and front cap screw (16).

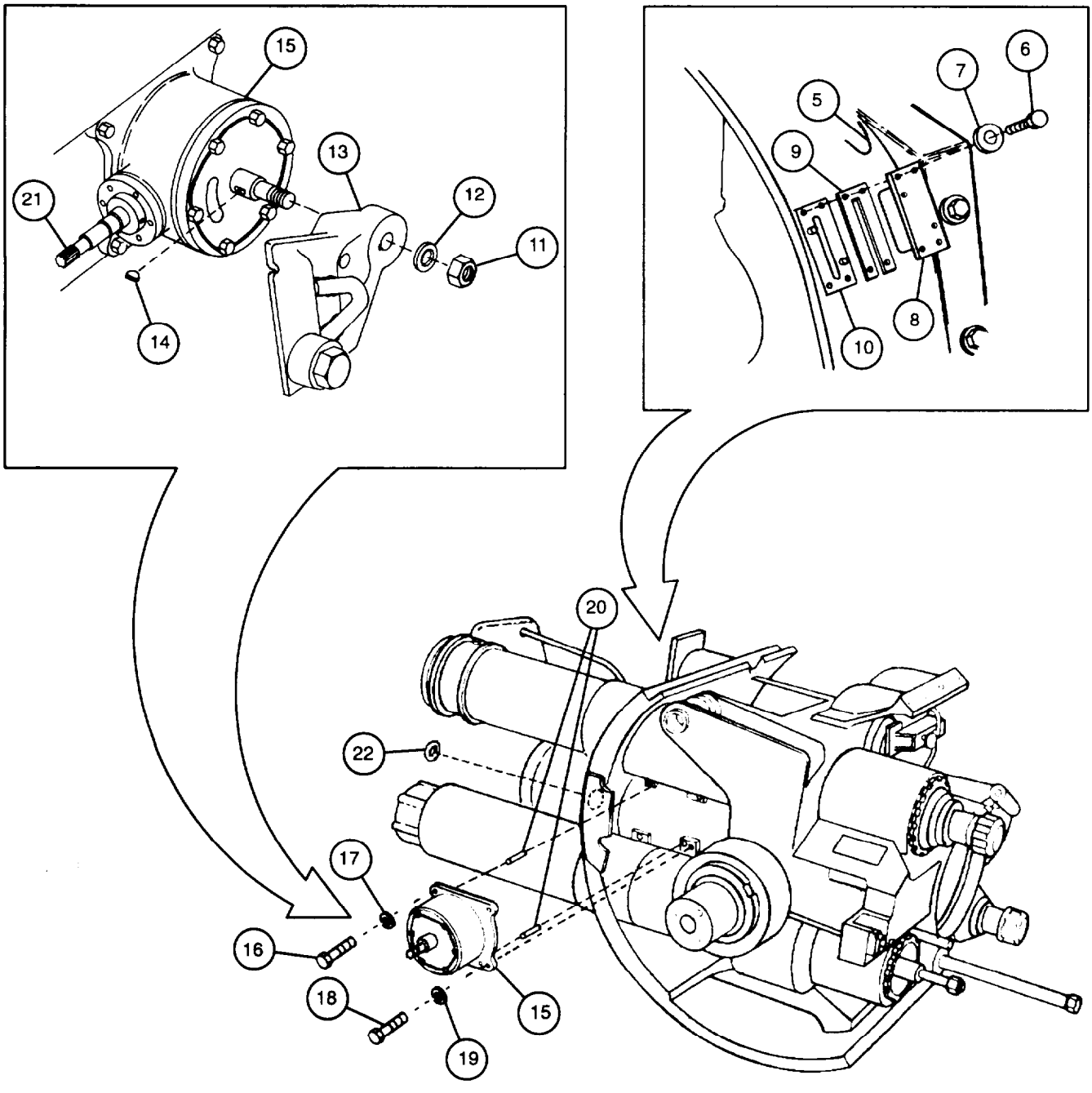
5 With cannon assembly still elevated, tap in upper front pin assembly (20) in actuator housing (15).

6 Install woodruff key (14), lever (13), new lockwasher (12), and hex nut (11).

NOTE

A maximum of four flat washers may be used per cap screw.

7 Install follower assembly (8), shim pack (9) if needed, washers (7) if needed, four cap screws (6) into upper left front of trunnion bracket (10). Install new lockwire (5) after proper adjustment has been preformed.



d. Adjustment

1 With cannon and mount still elevated to approx 55°, measure gap between sector gear and sector gear stop.

2 Depress cannon to approx 30°, measure gap between sector gear and sector gear stop.

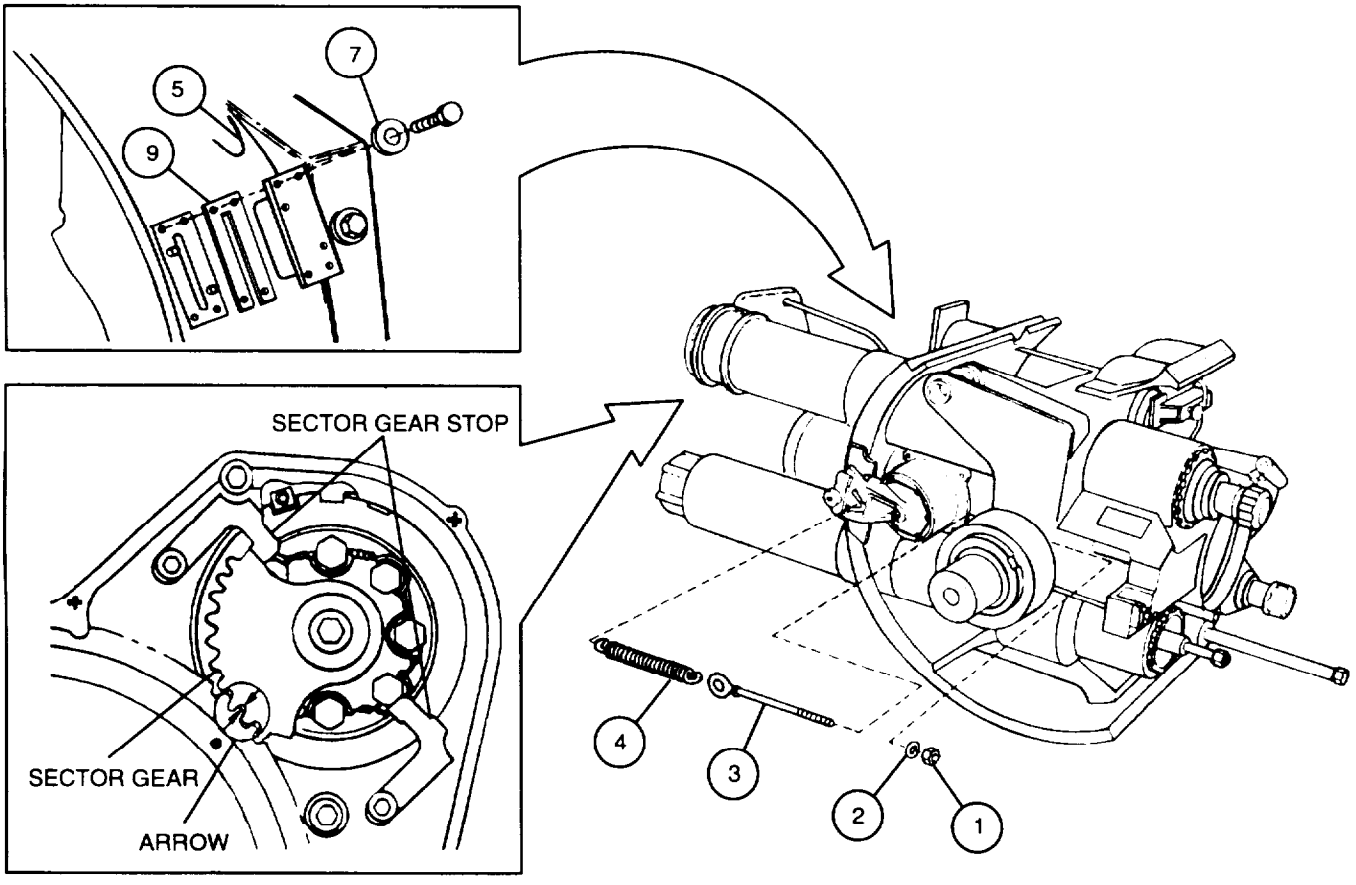
3 If gap between sector gear and sector gear stop exceeds 1/16"(1.588 mm) with full shim pack (9) installed, remove laminations from shim pack until 1/16"(1.588 mm) maximum dimension is obtained. Initial shim removal may be accomplished by using the following table:

GAP BETWEEN SECTOR GEAR AND SECTOR GEAR STOP	APPROXIMATE SHIM PACK THICKNESS REQUIRED
3/8	0.100 in. (2.54 mm)
1/4	0.140 in. (3.556 mm)
1/8	0.170 in. (4.318 mm)

4 Optional shim removal beyond charted values may be required in order to obtain 1/16 (1.588 mm) maximum gap. (If shim removal exceeds 0.180 in. (4.572 mm) add washer (7) under screw heads). Install new lockwire (5).

5 Install spring (4), eye bolt (3), flat washer (2) and new self-locking nut (1).

6 After cam has been properly shimmed and installed, arrows of sector gear, and spur gear sector must be alined to assure weapon in long recoil position prior to elevating weapon above 45°.



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5-15 REPLENISHER ACCUMULATOR ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)

Materials/Parts
Hydraulic fluid (item 22, Appx B)
Preformed packing (item 58, Appx E)
Self-locking nut (item 28, Appx E)

Personnel Required
2

Equipment Condition
Replenisher accumulator assembly removed (TM 9-2350-311-20-2)

a. Disassembly

1 Clamp accumulator (1) in a vise with padding to protect shell.

2 Remove round nut (2), using spanner wrench.

3 Remove shouldered washer (3).

4 Push regulating valve assembly (4) into accumulator shell (5) with palm of hand.

NOTE

Retaining ring is split and is bonded into rubber. It must be folded to remove from accumulator shell.

5 Lift preformed packing (6), ring spacer (7), and retaining ring (8) out of accumulator shell (5). Discard preformed packing.

6 Remove regulating valve assembly (4) from accumulator shell (5).

7 Remove self-locking nut (9), valve piston (10), helical compression spring (11), and fluid valve stem (12) from port (13). Discard self-locking nut.

NOTE

If cap MS 20813-1 is present on gas valve, retain for cap valve 9399173.

8 Remove cap assembly (14), pneumatic valve core (15), and hex nut (16).

9 Grasp accumulator bag (17) and gas valve (18) and compress to remove all gas. Withdraw from accumulator shell (5).

b. Inspection

1 Inflate accumulator bag (17) and submerge accumulator bag, gas valve (18), and pneumatic valve core (15) in water. Replace accumulator bag if there are signs of leakage or if gas valve is cracked or loose.

2 Inspect accumulator shell (5). Replace accumulator if cracked or distorted.

3 Inspect fluid valve stem (12). Replace if damaged.

c. Assembly

1 Assemble fluid valve stem (12), helical compression spring (11), valve piston (10), and new self-locking nut (9) into port (13).

2 Pour a small amount of hydraulic fluid into accumulator shell (5) as a cushioning fluid (heavy coating on interior of accumulator shell).

3 Deflate accumulator bag (17) and gas valve (18). Install pneumatic valve core (15).

4 Fold accumulator bag (17) and gas valve (18) to enter accumulator shell (5) with minimum friction. Guide gas valve stem with hand through hole in wider end of accumulator shell.

5 Install hex nut (16) securely.

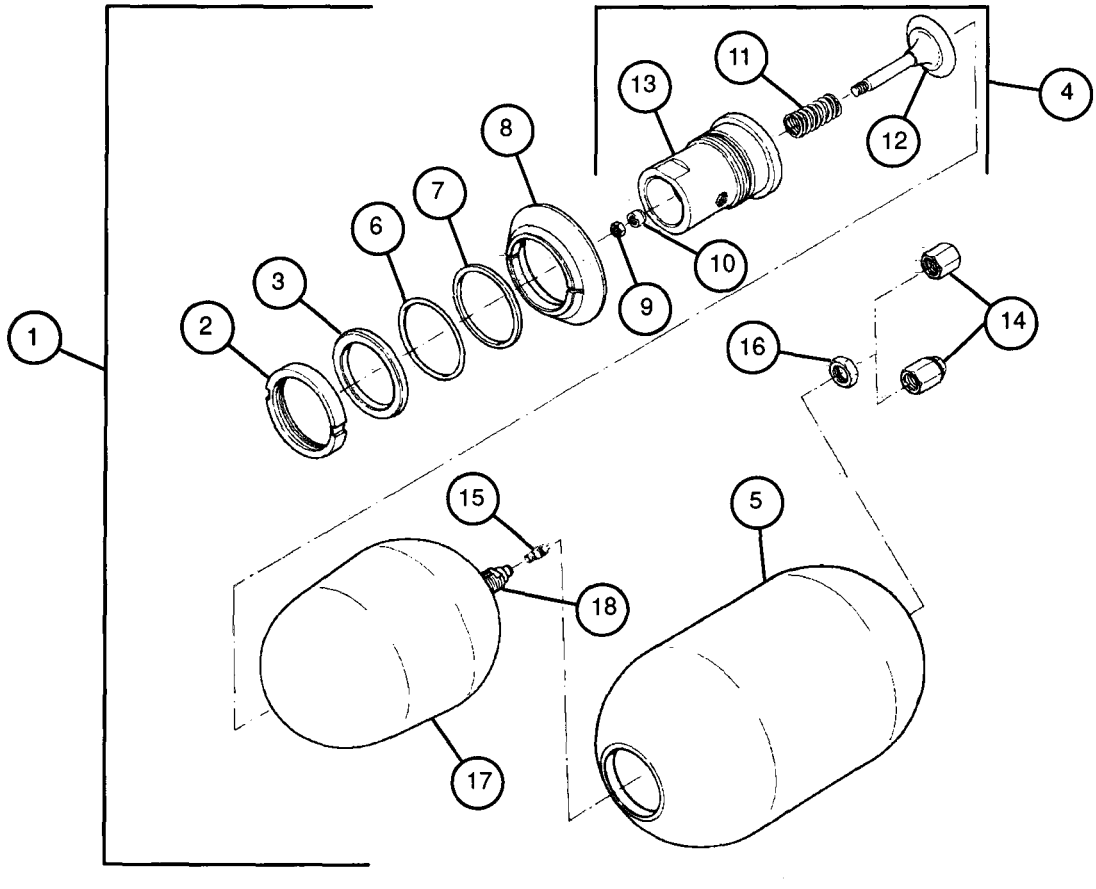
6 Install regulating valve assembly (4) into accumulator shell (5).

7 Place retaining ring (8) on regulating valve assembly (4) with small shoulder toward shell mount and fold to insert.

8 Place ring spacer (7) on regulating valve assembly (4) and install new preformed packing (6).

9 Withdraw regulating valve assembly (4) threaded portion through shell mouth. Pull until solidly seated and preformed packing (6) is squeezed.

10 Install shouldered washer (3) on regulating valve assembly (4), then install round nut (2). Tighten round nut securely.



5-16 VARIABLE RECOIL ASSEMBLY, HOSES, LINES, AND FITTINGS

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Cap and plug set (item 10, Appx B)
Cotter pins (2) (item 46, Appx E)
Locknuts (3) (item 2, Appx E)
LockWashers (4) (item 84, Appx E)
Packing retainer (item 61, Appx E)
Plastic bag (item 6, Appx B)
Preformed packing (item 63, Appx E)
Preformed packing (item 99, Appx E)
Preformed packings (3) (item 67, Appx E)
Preformed packings (4) (item 155, Appx E)

References
TM 9-2350-311-20-2

Equipment Condition
Replenisher assembly pressure discharged (para 5-14)
Discharge hydraulic pressure (TM 9-2350-311-20-2)

a. Removal

WARNING

Eye protection will be worn when performing maintenance procedures on all hydraulic components to avoid injury to personnel.

CAUTION

- All hydraulic lines and ports must be capped to prevent contaminants from entering the hydraulic system and causing internal damage to hydraulic components.
- All serviceable components must be placed in plastic bags to prevent contamination of hydraulic system during installation.

NOTE

- All hydraulic lines and components must be tagged before removal for identification during installation.
- The removal of hydraulic tubes and fittings must be restricted to those items that are to be replaced. Therefore, the legends in this chapter are for identification only.

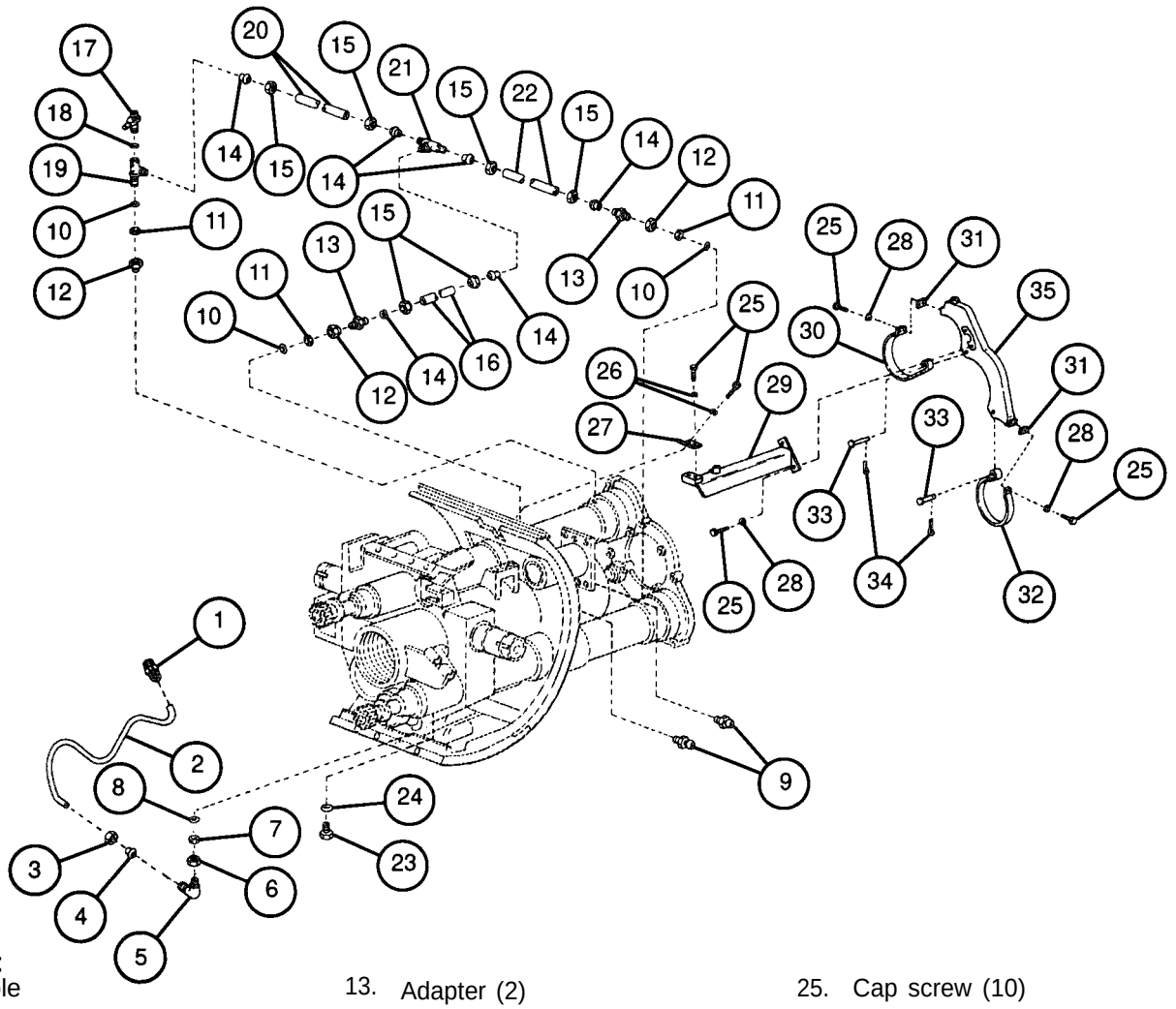
For removal, follow illustration and legend as a guide. Discard all locknuts, preformed packings, and packing retainers.

b. Installation

CAUTION

When installing any hydraulic fitting, tighten fitting to aline with the connecting lines. Repositioning can loosen threads, cause leaks, and damage preformed packings.

For installation, follow illustration and legend as a guide. After installation, check hydraulic fluid level (TM 9-2350-311-20-2).



LEGEND:

1. Nipple
2. Bent metallic tube
3. Nut
4. Clinch sleeve
5. Elbow
6. Nut
7. Packing retainer
8. Preformed packing
9. Lubrication fitting (2)
10. Preformed packing (3)
11. Flat washer (3)
12. Locknut (3)
13. Adapter (2)
14. Clinch sleeve (6)
15. Nut (6)
16. Metallic cylinder tube
17. Bleeder valve
18. Preformed packing
19. Tee
20. Bent metallic tube
21. Tee
22. Lower cylinder tube
23. Plug (4)
24. Preformed packing (4)
25. Cap screw (10)
26. Lockwasher (4)
27. Angle bracket
28. Flat washer (6)
29. Access cover
30. Retaining band
31. Plate spacer
32. Retaining band
33. Headed straight pin (2)
34. Cotter pin (2)
35. Access cover

5-17 VARIABLE RECOIL ASSEMBLY AND BUFFER AND REPLENISHER MANIFOLD, HOSES, LINES, AND FITTINGS

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Cap and plug set (item 10, Appx B)
LockWire (item 36, Appx E)
Packing retainer (item 61, Appx E)
Plastic bag (item 6, Appx B)
Preformed packing (item 67, Appx E)
Preformed packing (item 99, Appx E)
Preformed packings (3) (item 65, Appx E)
Self-locking nut (item 98, Appx E)

References
TM 9-2350-311-20-2

Equipment Condition
Replenisher assembly pressure discharged (para 5-14)
Discharge hydraulic pressure (TM 9-2350-311-20-2)

a. Removal

WARNING

Eye protection will be worn when performing maintenance procedures on all hydraulic components to avoid injury to personnel.

CAUTION

- All hydraulic lines and ports must be capped to prevent contaminants from entering the hydraulic system and causing internal damage to hydraulic components.
- All serviceable components must be placed in plastic bags to prevent contamination of hydraulic system during installation.

NOTE

- All hydraulic lines and components must be tagged before removal for identification during installation.
- The removal of hydraulic tubes and fittings must be restricted to those items that are to be replaced. Therefore, the legends in this chapter are for identification only.

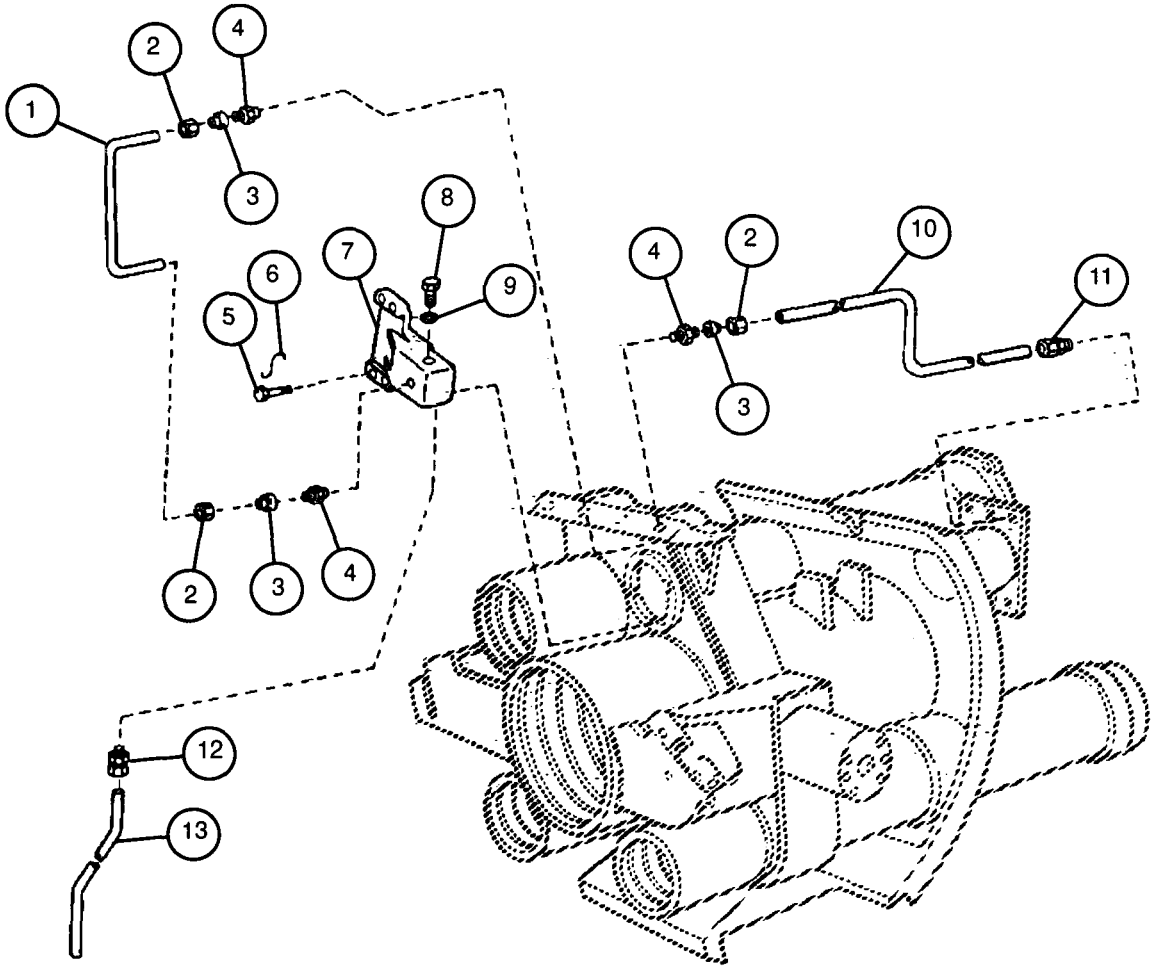
For removal, follow illustration and legend as a guide, Discard all lockwire, preformed packings, self-locking nuts, and packing retainers.

b. Installation

CAUTION

When installing any hydraulic fitting, tighten fitting to aline with the connecting lines. Repositioning can loosen threads, cause leaks, and damage preformed packings.

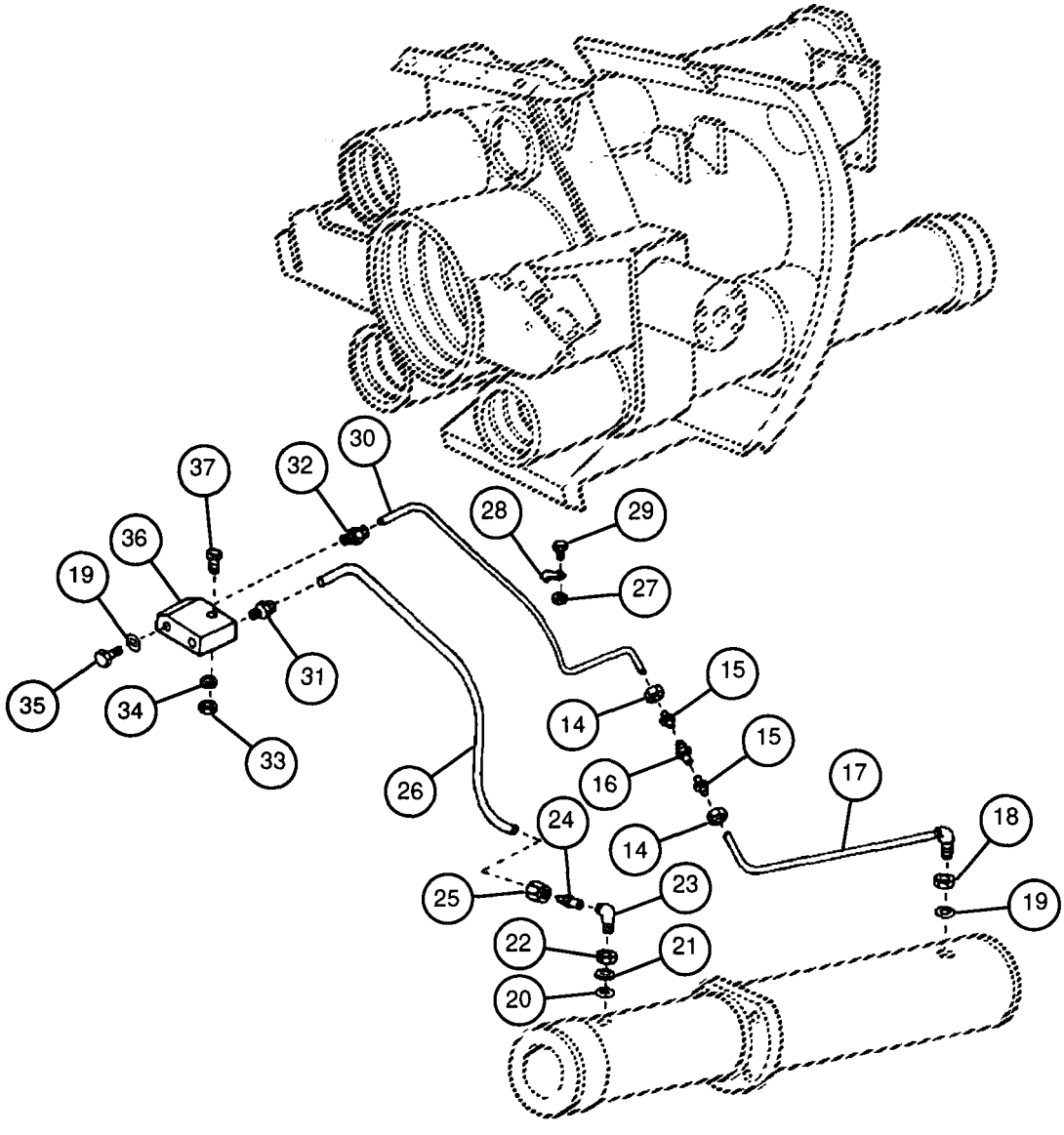
For installation, follow illustration and legend as a guide. After installation, check hydraulic fluid level (TM 9-2350-311-20-2).



LEGEND:

1. Bent metallic tube
2. Nut (3)
3. Clinch sleeve (3)
4. Adapter (3)
5. Cap screw (4)
6. Lockwire
7. Hydraulic replenisher manifold
8. Plug
9. Preformed packing
10. Bent metallic tube
11. Adapter
12. Adapter
13. Bent metallic tube

5-17 VARIABLE RECOIL ASSEMBLY AND BUFFER AND REPLENISHER MANIFOLD, HOSES, LINES AND FITTINGS - CONTINUED



LEGEND:

14. Nut (2)
15. Clinch sleeve (2)
16. Nipple (2)
17. Tube and fittings
18. Nut
19. Preformed packing (3)
20. Preformed packing
21. Packing retainer
22. Nut
23. Elbow
24. Sleeve
25. Electrical-mec post
26. Bent metallic tube
27. Self-locking nut
28. Loop clamp (2)
29. Cap screw (2)
30. Bent metallic tube
31. Adapter
32. Adapter
33. Nut
34. Flat washer
35. Plug (2)
36. Buffer coupling block
37. Cap screw (2)

CHAPTER 6
DIRECT SUPPORT MAINTENANCE OF CAB HYDRAULICS

GENERAL

This chapter illustrates and describes the maintenance of the cab hydraulic system, which supplies and controls fluid power to operate the howitzer elevating, cab traversing, and projectile rammer systems.

CONTENTS

6-1 POWER PACK ASSEMBLY

This task covers: a. Removal b. Disassembly c. Inspection and Repair d. Assembly e. Installation

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Sling assembly, lifting (item 18, Appx F)
Socket wrench, special (item 23, Appx F)

Materials/Parts
Cotter pins (item 45, Appx E)
Gasket (item 128, Appx E)
Hydraulic fluid (item 22, Appx B)
Lockwashers (8) (item 83, Appx E)
Lockwashers (6) (item 84, Appx E)
Lo&washers (2) (item 95, Appx E)
Lockwashers (4) (item 97, Appx E)
Lo&washers (3) (item 158, Appx E)
Lubricating oil (item 23, Appx B)
Preformed packing (item 53, Appx E)
Preformed packing (item 56, Appx E)
Preformed packing (item 57, Appx E)
Preformed packing (item 59, Appx E)
Preformed packing (item 171, Appx E)
Self-locking nut (item 40, Appx E)
Spring pin (item 12, Appx E)

Personnel Required
2

Equipment Condition
Discharge hydraulic pressure (TM 9-2350-311-20-2)
Drain hydraulic fluid (TM 9-2350-311-20-2)
Lines and fittings from power pack to pressure switch and gages disconnected (TM 9-2350-311-20-2)
Lines and fittings from cab to power pack disconnected (TM 9-2350-311-20-2)
Lines and fittings from hydraulic filters disconnected (Ml 09A4/M109A5) (TM 9-2350-311-20-2)
Lines and fittings from hygroscopic breather disconnected (M109A4/M109A5) (TM 9-2350-311-20-2)
Cab access cover removed (TM 9-2350-311-20-2)

a. Removal

1 Remove two cap screws (1) from power pack support (2) to disconnect pressure gage (3) and bottom of sight gage (4).

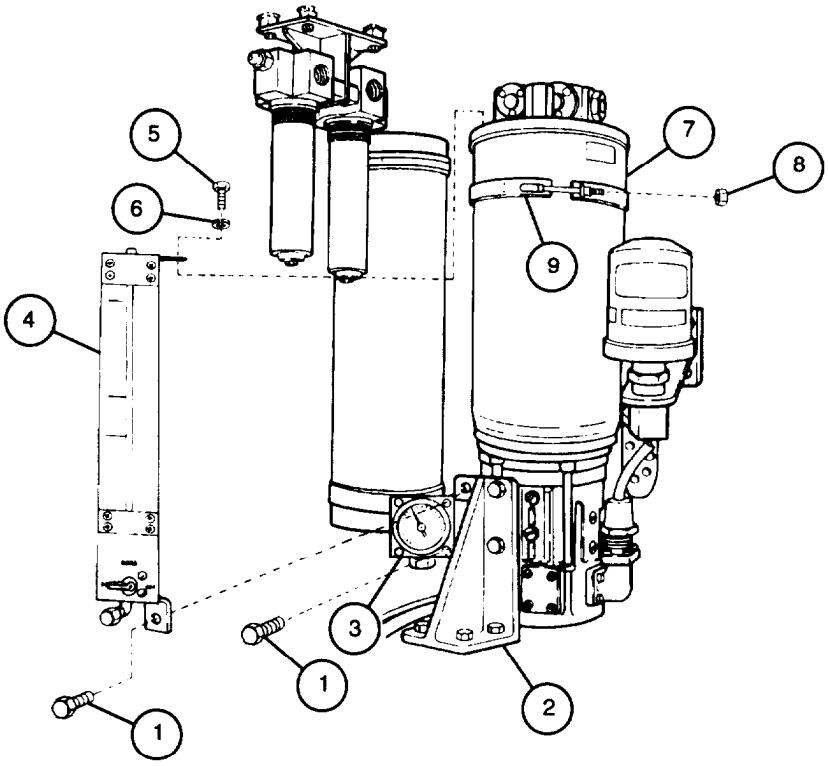
2 Remove one machine bolt (5) and one lo&washer (6) securing sight gage (4) to top of power pack assembly (7) and remove sight gage.

3 Install lockwasher (6) and machine bolt (5) in top of power pack assembly (7).

4 Remove self-locking nut (8) from hose clamp (9). Discard self-locking nut.

5 Remove two cap screws (10) and two lockwashers (11) from base of power pack assembly (7). Discard lockwashers.

6 Position lifting sling assembly (12) over power pack assembly (7) and secure with two cap screws (10).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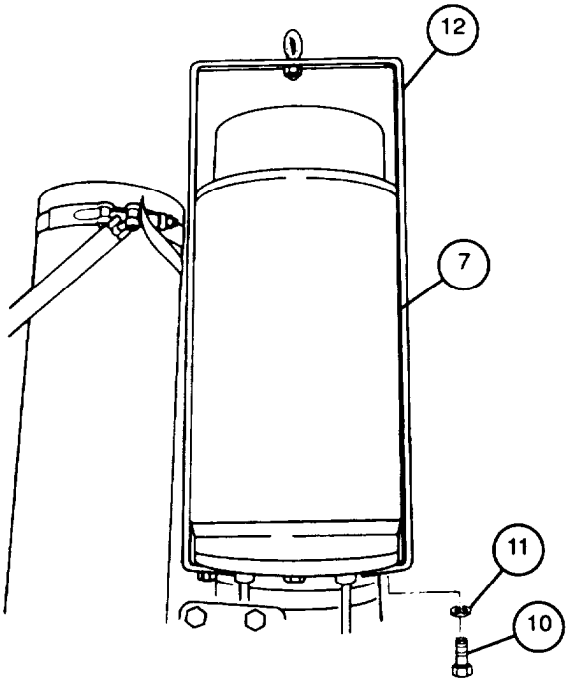
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6-1 POWER PACK ASSEMBLY - CONTINUED

a. Removal - Continued

7 Attach hoist (13) to lifting sling assembly (12). Take up slack in hoist cable.

8 Make sure weight of power pack assembly (7) is supported by hoist (13). Remove two cap screws (14) from power pack support (2). Discard lockwashers.

CAUTION

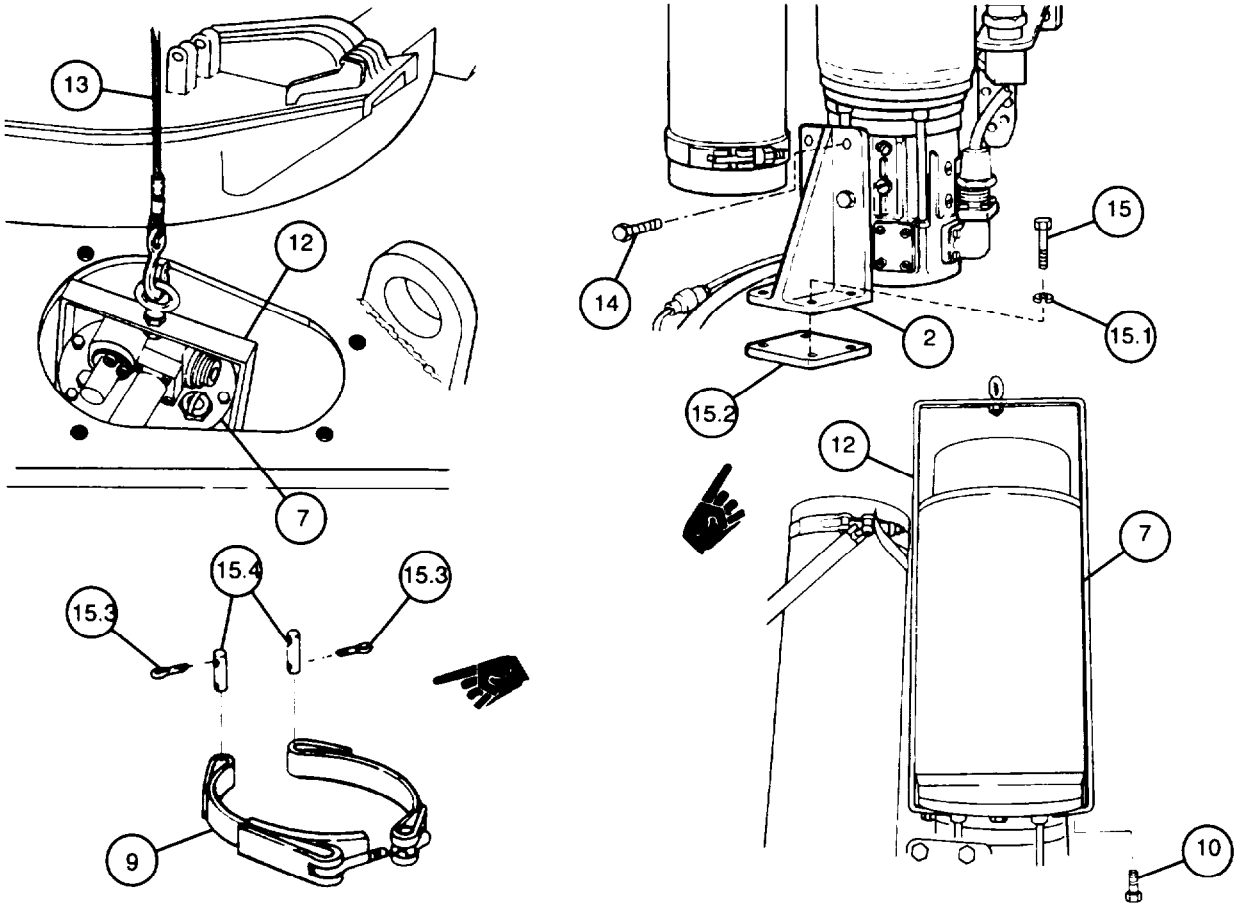
When removing or placing power pack assembly, observe caution to avoid bumping or damaging the solenoid or valve.

9 If necessary for replacement, remove four cap screws (15), four lockwashers (15.1) power pack support (2), and ring spacer (15.2). Discard lockwashers.

10 Remove power pack assembly (7) from cab by lifting out through access hole and place on a solid surface,

11 Remove hoist (13). Remove two cap screws (10) to remove lifting sling assembly (12) from power pack assembly (7).

12 If necessary for replacement, remove four cotter pins (15.3), two headless pins (15.4) and hose clamp (9). Discard cotter pins.



b. Disassembly

NOTE

Filter assembly has been modified to a body assembly in M109A4/M109A5 howitzers.

1 Remove remaining cap screws (10), two lockwashers (11), and direct current motor (16). Discard lockwashers.

2 Remove flexible insert (17).

3 Remove setscrew (18) from lower shaft coupling half (19).

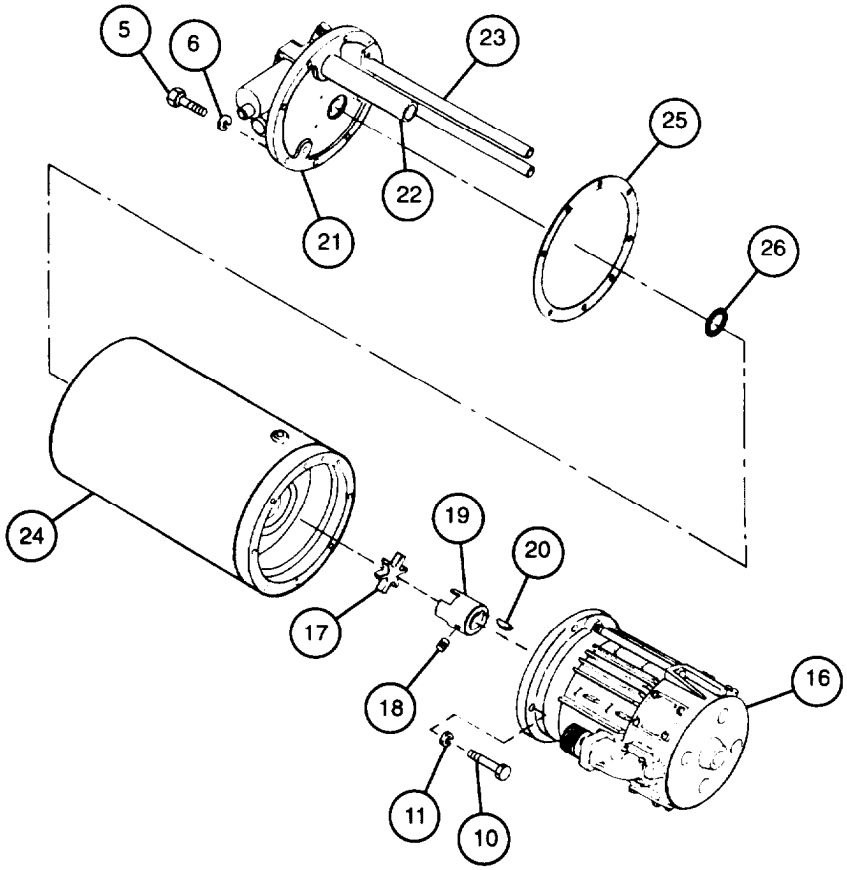
4 Remove lower shaft coupling half (19) and woodruff key (20) from motor shaft of direct current motor (16).

5 Remove eight machine bolts (5) and eight lockwashers (6). Discard lockwashers.

6 Remove cover assembly (21) with fluid filter element (22) and tube assembly (23) attached from power pack reservoir (24).

7 Remove and discard gasket (25)

8 Remove shim(s) (26). Tie shims together and save for assembly.



6-1 POWER PACK ASSEMBLY - CONTINUED

b. Disassembly - Continued

9 Withdraw fluid level gage (27) and preformed packing (28). Discard preformed packing.

10 Unscrew and remove fluid filter element (22) using special socket wrench.

11 Remove three cap screws (29) and three lockwashers (30) from cover assembly (21). Discard lockwashers.

12 Remove tube assembly (23).

13 Remove four cap screws (31) and four lockwashers (32) securing mount assembly (33) to power pack reservoir (24). Tap mount assembly lightly with soft face hand hammer to separate. Discard lo&washers.

14 Remove and discard preformed packing (34).

NOTE

If you have received a new power pack reservoir, perform step 15. If not, skip to step 16.

15 Remove plug (35) and preformed packing (36) from power pack reservoir (24). Discard preformed packing and plug.

16 Remove two hex nuts (37) and two lockwashers (38) securing rotary pump (39) to mount assembly (33). Remove rotary pump. Discard lockwashers.

17 Remove and discard preformed packing (40).

18 Remove setscrew (41) from upper shaft coupling half (42).

19 Remove upper shaft coupling half (42) and machine key (43) from rotary pump (39).

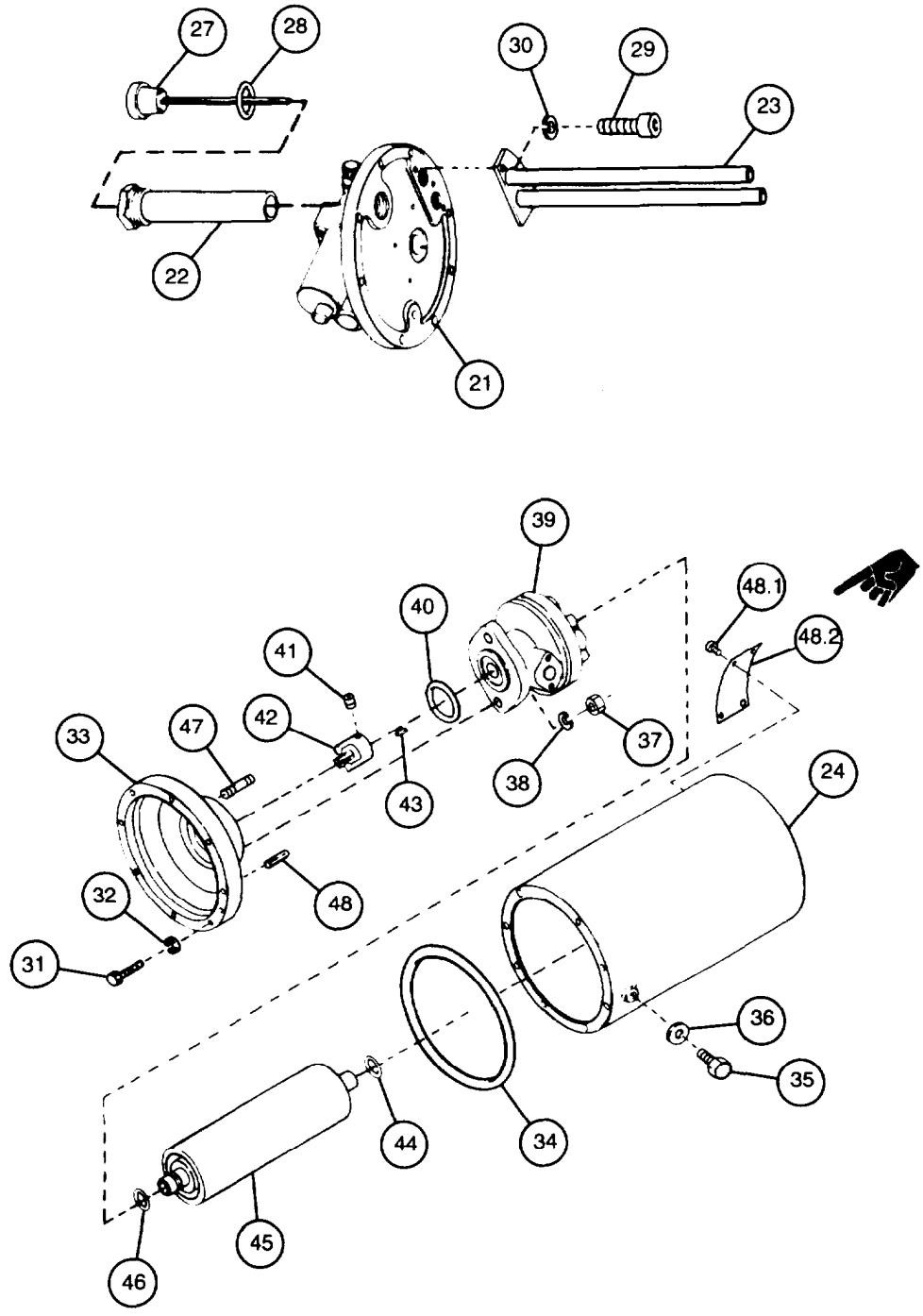
20 Remove preformed packing (44) from filter assembly/body assembly (45) and discard.

21 Separate filter assembly/body assembly (45) from rotary pump (39).

22 Remove preformed packing (46) from filter assembly/body assembly (45) and discard.

23 If necessary for replacement, remove two plain studs (47) and spring pin (48). Discard spring pin.

24 If necessary for replacement, remove four drive screws (48.1) and identification plate (48.2) from power pack reservoir (24).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6-1 POWER PACK ASSEMBLY-CONTINUED

c. Inspection and Repair

1 inspect fluid level gage (27). Replace if bent or distorted.

2 Inspect fluid filter element (22). Replace if cut or torn.

3 Inspect tube assembly (23). Replace if damaged.

4 Inspect power pack reservoir (24). Replace if cracked or if end surfaces are rough or distorted.

5 Inspect upper shaft coupling half (42), flexible insert (17), and lower shaft coupling half (19). Replace parts that are cracked, distorted, or worn.

6 Inspect mount assembly (33). Replace if cracked, distorted, or damaged.

7 Inspect rotary pump (39). Replace if defective.

8 Inspect two plain studs (47). Replace if bent, distorted, cracked, or damaged.

d. Assembly

CAUTION

All parts and inside surfaces must be free of contaminants during assembly.

1 If removed, install new spring pin (48) and two plain studs (47). Torque plain studs to 21-25 lb-ft (28-34 N•m).

1.1 If removed, secure identification plate (48.2) onto power pack reservoir (24) using four drive screws (48.1).

2 Install new preformed packing (46) on filter assembly/body assembly (45).

3 Install rotary pump (39) on filter assembly/body assembly (45).

4 Install new preformed packing (44) on filter assembly/body assembly (45).

5 Install setscrew (41) in upper shaft coupling half (42). Install machine key (43) and upper shaft coupling half on rotary pump (39) shaft.

6 Install new preformed packing (40) on rotary pump (39).

7 Before installing, flush new filter assembly (45) with hydraulic fluid.

8 Install rotary pump (39) onto mount assembly (33) with two new lo&washers (38) and two hex nuts (37). Torque hex nuts to 20-25 lb-ft (27-34 N•m).

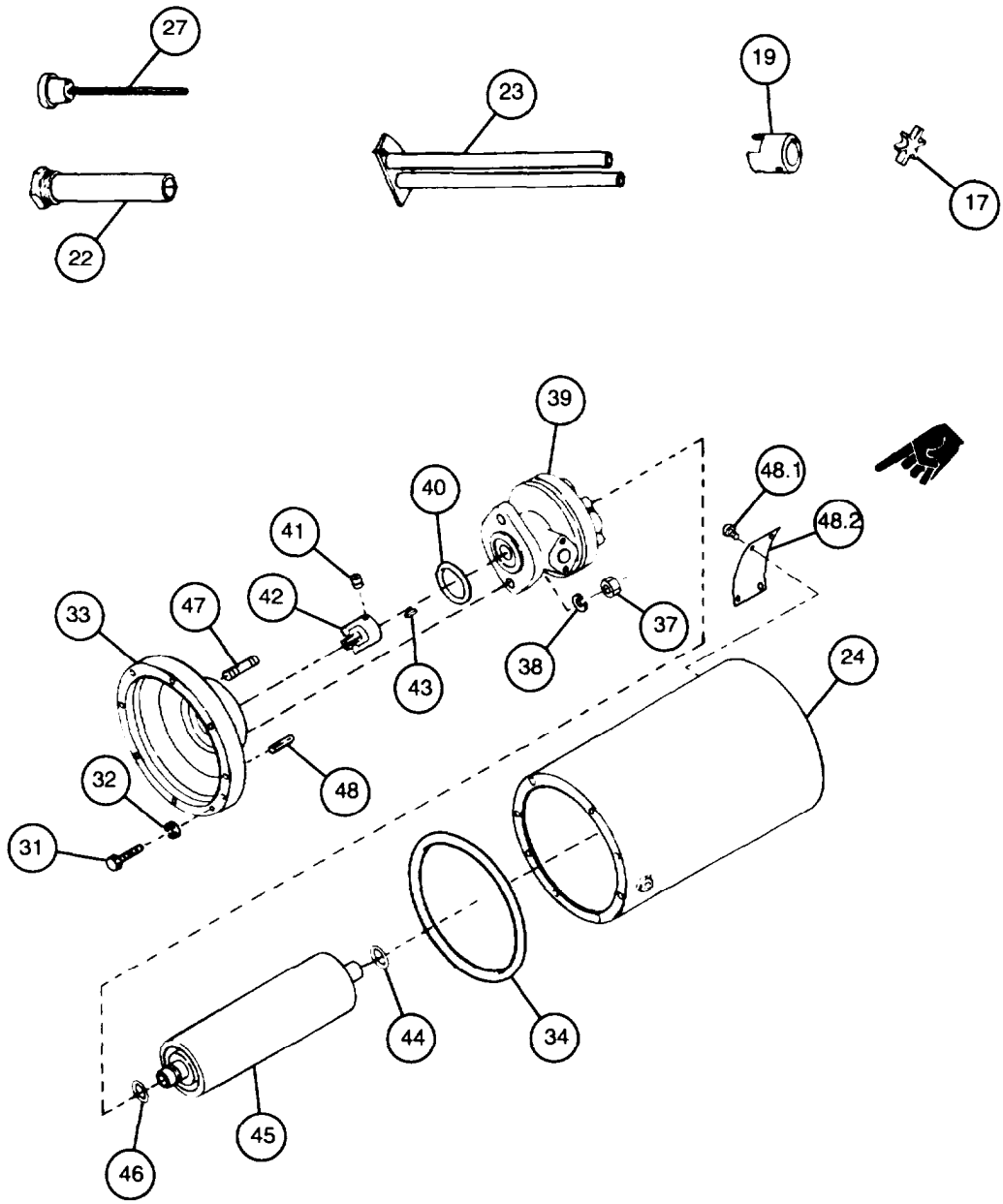
9 Deleted.

10 Install new preformed packing (34).

NOTE

Lubricate threads of four cap screws with clean lubricating oil before installation.

11 Install mount assembly (33) to power pack reservoir (24) using four new lockwashers (32) and four cap screws (31). Torque cap screws to 20-25 lb-ft (27-34 N•m).



6-1 POWER PACK ASSEMBLY - CONTINUED

d. Assembly - Continued

12 Secure tube assembly (23) to cover assembly (21) with three new lockwashers (30) and three cap screws (29).

13 Insert fluid filter element (22) and screw in until seated.

14 Insert fluid level gage (27) and new preformed packing (28).

15 Install shim(s) (26) saved during disassembly. Apply 60-100 psi (414-690 kPa) to filter assembly/body assembly (45) and shim as required to obtain a clearance of 0.010 to 0.020 inch (0.25 to 0.5 mm). Measure distances A and B. The shim thickness = A - B - 0.0156 inch.

16 Install new gasket (25).

NOTE

One of eight machine bolts is used to secure sight gage to power pack. Do not tighten at this time.

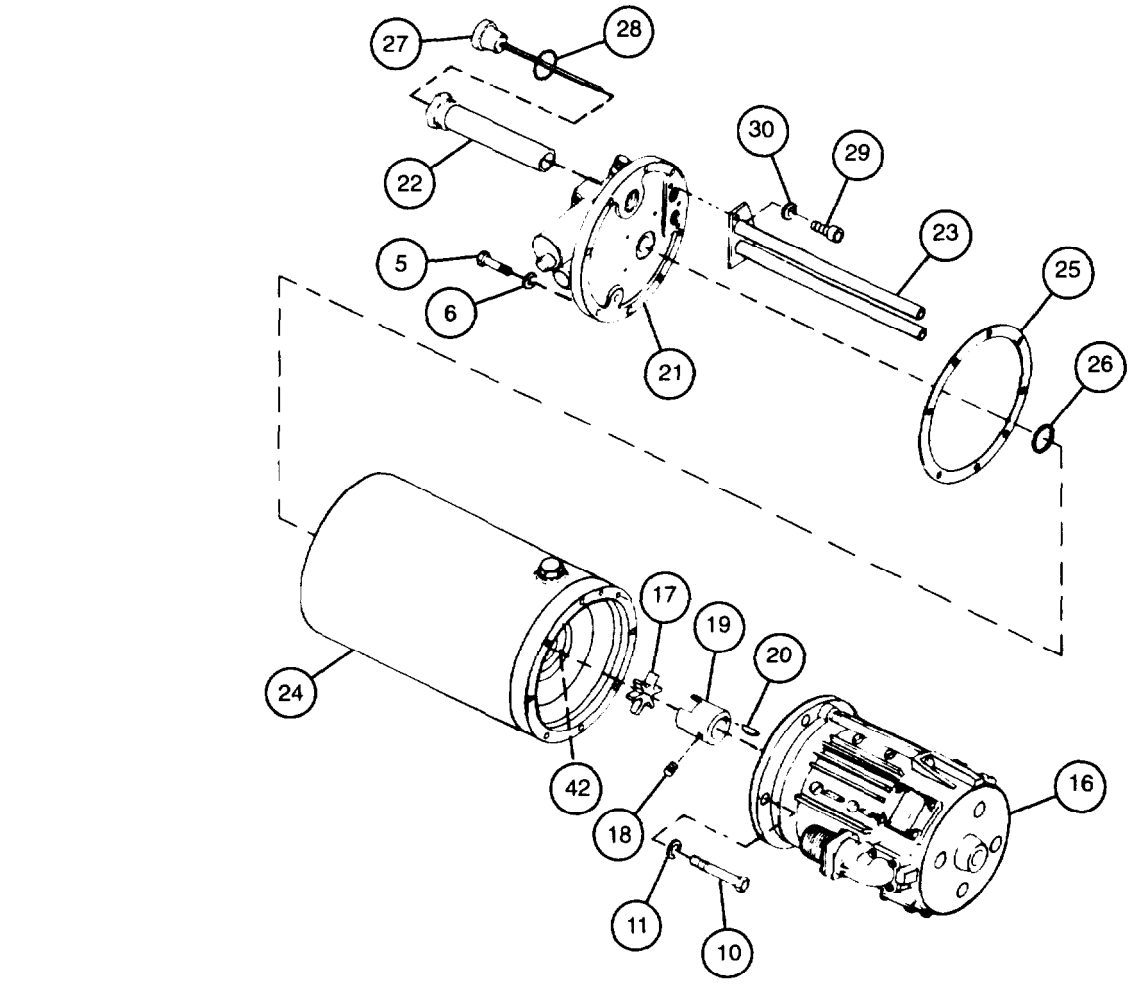
17 Secure cover assembly (21) to power pack reservoir (24) with eight new lockwashers (6) and eight machine bolts (5).

18 Position flexible insert (17) in upper shaft coupling half (42).

19 Install setscrew (18) in lower shaft coupling half (19). Install woodruff key (20) and lower shaft coupling half in direct current motor (16) shaft.

20 Adjust upper shaft coupling half (42) and lower shaft coupling half (19) to obtain 0.030 inch (0.8 mm) clearance between faces.

21 Secure direct current motor (16) to power pack reservoir (24) with two of four new lockwashers (11) and two of four cap screws (10). Torque cap screws to 20-25 lb-ft (27-34 N•m).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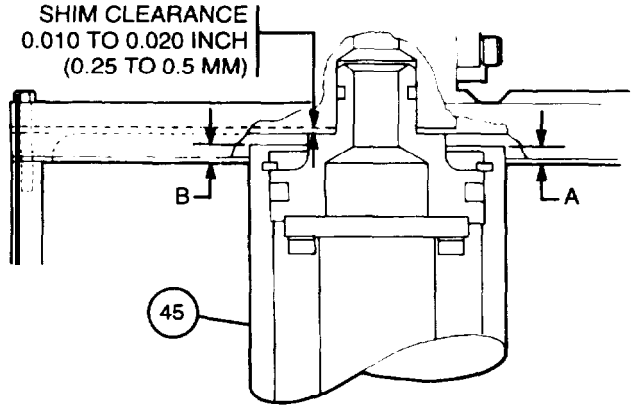
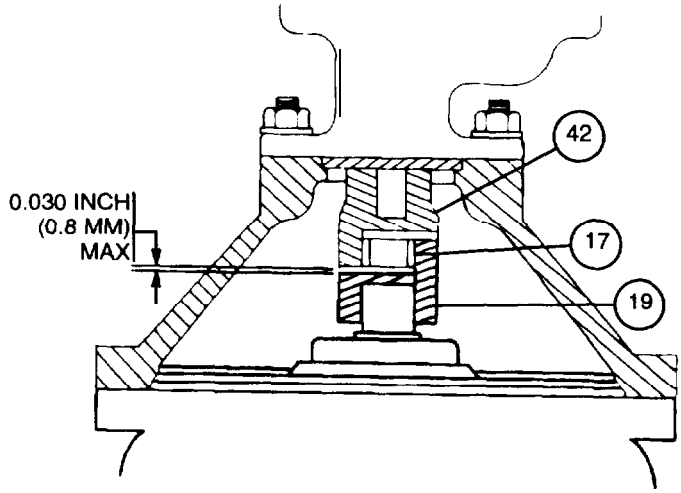

SHIM CLEARANCE
0.010 TO 0.020 INCH
(0.25 TO 0.5 MM)
B
A
45


0.030 INCH
(0.8 MM)
MAX
42
17
19

6-1 POWER PACK ASSEMBLY-CONTINUED

e. Installation

1 If removed, install hose clamp (9), two headless pins (15.4) and four new cotter pins (15.3).

2 Install ring spacer (15.2) power pack support (2), four new lockwashers (15.1) and four cap screws (15).

3 Position lifting sling assembly (12) over power pack assembly (7) and secure with two lockwashers (11) and two cap screws (10).

4 Attach hoist (13) to lifting sling assembly (12). Take up slack in cable.

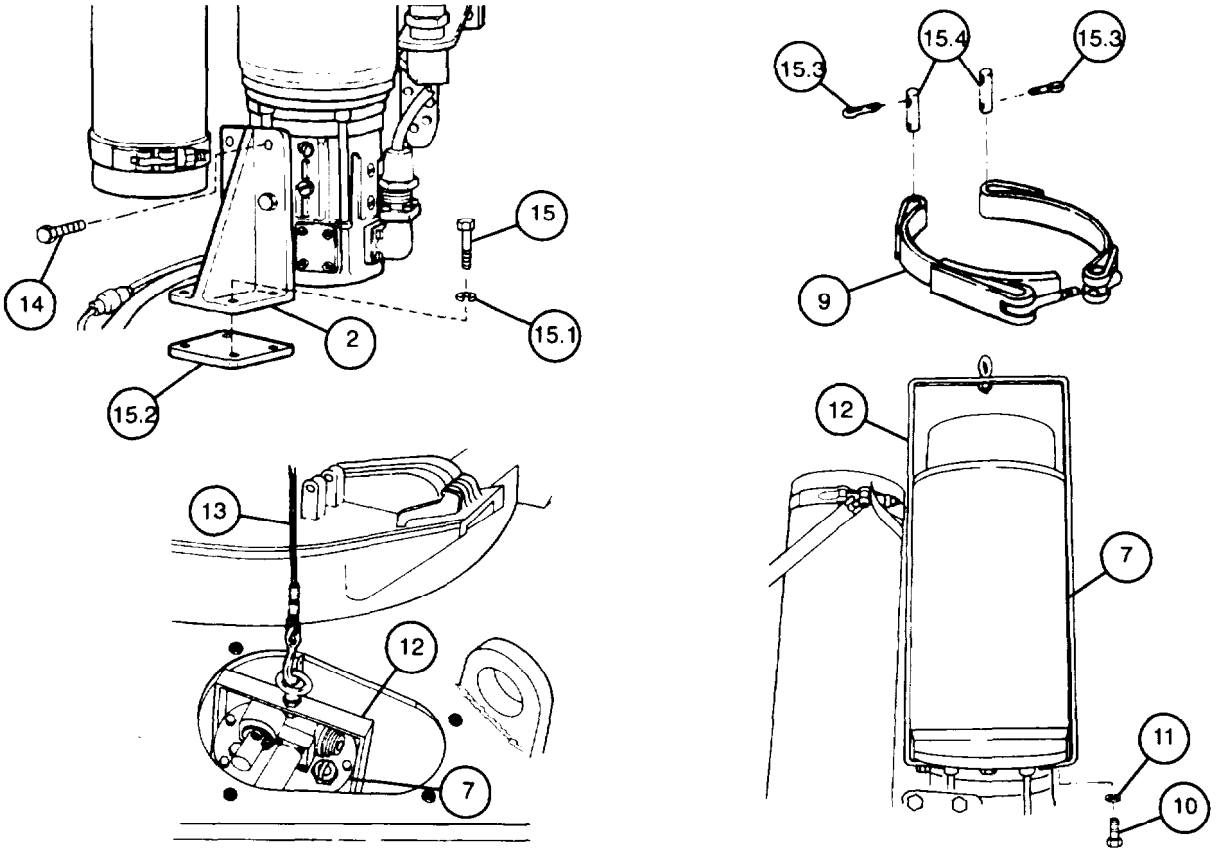
CAUTION

Be careful not to strike or damage the solenoid or valve.

5 Lower power pack assembly (7) through access hole into cab.

6 Make sure weight of power pack assembly (7) is supported by hoist (13). Secure power pack assembly to power pack support (2) with two cap screws (14).

7 Remove hoist (13). Remove two cap screws (10) to remove lifting sling assembly (12) from power pack assembly (7). Replace cap screws and two new lockwashers (11). Torque cap screws to 20-25 lb-ft (27-34 N•m).

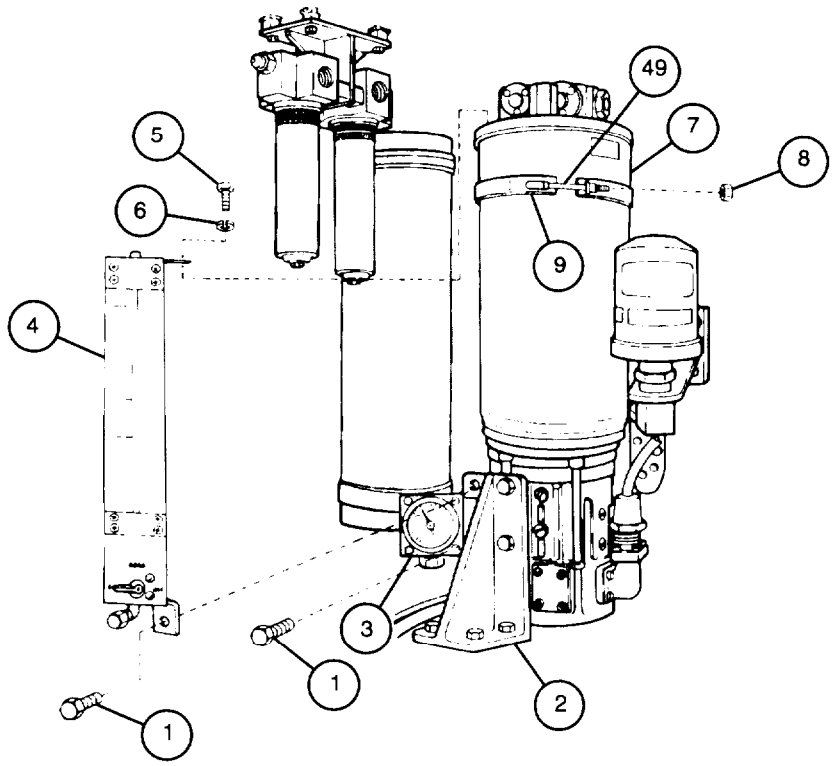


8 Secure power pack assembly (7) to hose clamp (9) by installing new self-locking nut (8).

9 Insert 0.002 feeler gage between power pack assembly (7) and hose clamp (9) in vicinity of T-bolt (49). Tighten hose clamp by adjusting self-locking nut (8) until feeler gage cannot be pulled loose. Back off self-locking nut slightly to remove feeler gage then tighten self-locking nut 1-1/4 to 1-1/2 turns.

10 Remove machine bolt (5) and lockwasher (6) at top of power pack assembly (7). Install sight gage (4) and secure at top of power pack assembly (7) with lockwasher (6) and machine bolt (5).

11 Secure pressure gage (3) and lower end of sight gage (4) to power pack support (2) with two cap screws (1).



6-2 COVER ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery field maintenance tool kit (SC 4933-95-CL-A12)
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)

Materials/Parts
Lockwashers (3) (item 158, Appx E)
Lockwashers (6) (item 96, Appx E)
Solenoid valve parts kit (item 115, Appx E)

Equipment Condition
Cover assembly removed (para 6-1) and placed on solid surface
Power pack solenoid removed (TM 9-2350-311-20-2)

a. Disassembly

1 Remove plug (1) and preformed packing (2) from cover (3). Discard preformed packing.

2 Remove hydraulic sleeve assembly spool (4).

3 Remove three cap screws (5), three lockwashers (6), and access cover (7). Discard lockwashers and cap screws.

4 Remove and discard gasket (8).

5 Remove power valve spring (9) and discard.

CAUTION

Avoid damaging finished surfaces of housing while removing hydraulic sleeve.

6 Remove hydraulic sleeve (10).

7 Remove four preformed packings (11) from hydraulic sleeve (10) and discard.

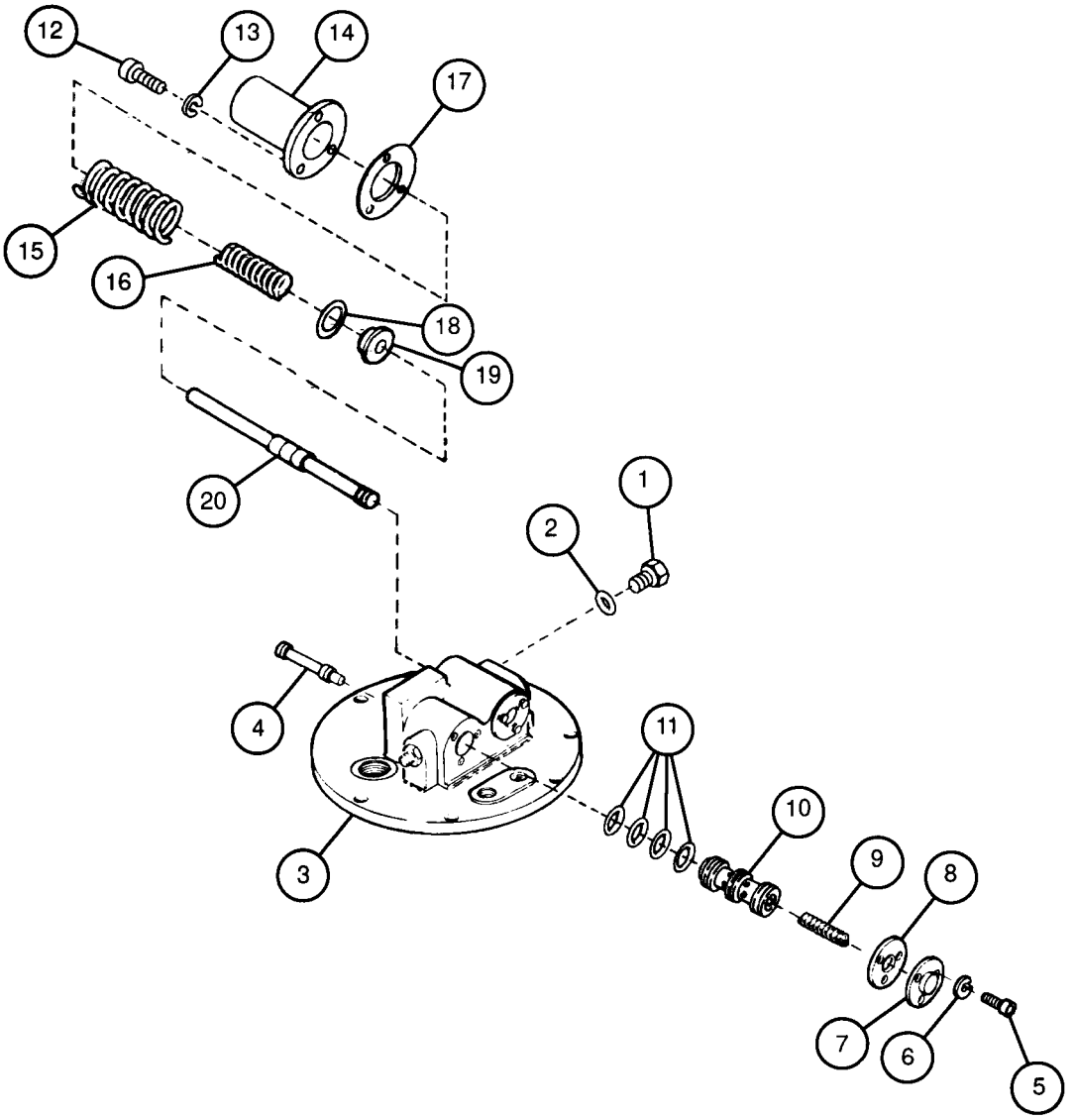
WARNING

Housing is is under extreme pressure, hold housing with a c-clamp while disassembling.

8 Remove three cap screws (12), three lo&washers (13), and housing (14). Discard lockwashers.

9 Remove and discard helical compression spring (15), helical compression spring (16), gasket (17), flat washer (18), and helical compression seat (19).

10 Remove power pack sleeve assembly spool (20).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6-2 COVER ASSEMBLY - CONTINUED

a. Disassembly - Continued

11 Remove three cap screws (21), three lockwashers (22), and retaining plate (23). Discard lockwashers.

12 Remove power pack sleeve group (24).

13 Remove four preformed packings (25) from power pack sleeve (26) and discard.

14 Remove retaining ring (27) while restraining power pack retainer (28). Discard retaining ring.

15 Remove power pack retainer (28) from power pack sleeve (26).

16 Remove preformed packing (29), helical compression spring (30), and snubber (31). Discard preformed packing and helical compression spring.

b. Inspection

1 Inspect power pack sleeve assembly spool (20) and power pack sleeve (26). Replace power pack sleeve assembly (32) if either piece is scratched or burred.

2 Inspect hydraulic sleeve assembly spool (4) and hydraulic sleeve (10). Replace hydraulic sleeve assembly (33) if either piece is scratched or burred.

3 Inspect cover (3). Replace if cracked, distorted, or damaged.

c. Assembly

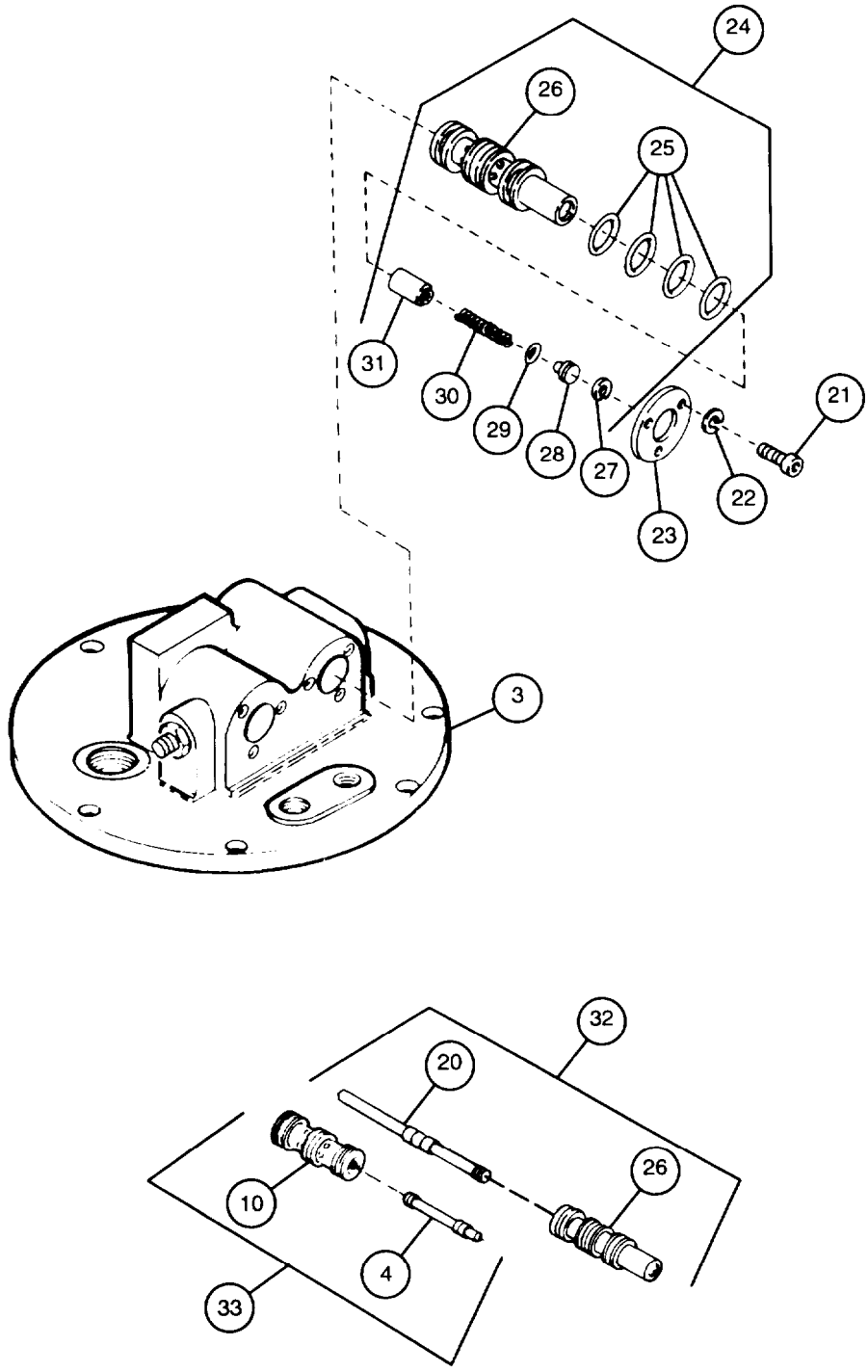
1 Install snubber (31), helical compression spring (30), new preformed packing (29), and power pack retainer (28) on power pack sleeve (26).

2 Compress power pack retainer (28) and install new retaining ring (27).

3 Install four new preformed packings (25) on power pack sleeve (26).

4 Insert power pack sleeve group (24) into cover (3).

5 Install retaining plate (23), three new lockwashers (22), and three cap screws (21).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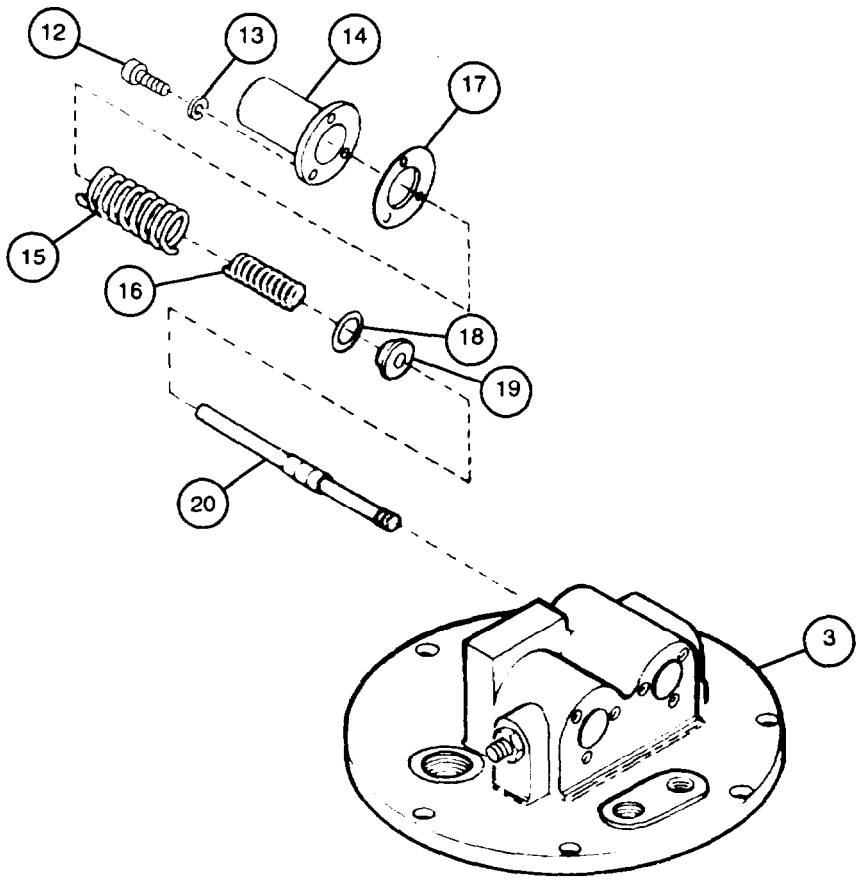
6-2 COVER ASSEMBLY - CONTINUED

c. Assembly - Continued

6 Install power pack sleeve assembly spool (20).

7 Install new helical compression seat (19), new flat washer (18), new helical compression spring (16), new helical compression spring (15), and new gasket (17).

8 Using c-clamp, secure housing (14) to cover (3) with three new lockwashers (13) and three cap screws (12). Remove c-clamp.



9 Install four new preformed packings (11) on hydraulic sleeve (10).

NOTE

The recess of the hydraulic sleeve faces away from the solenoid seat.

10 Insert hydraulic sleeve (10) into cover (3).

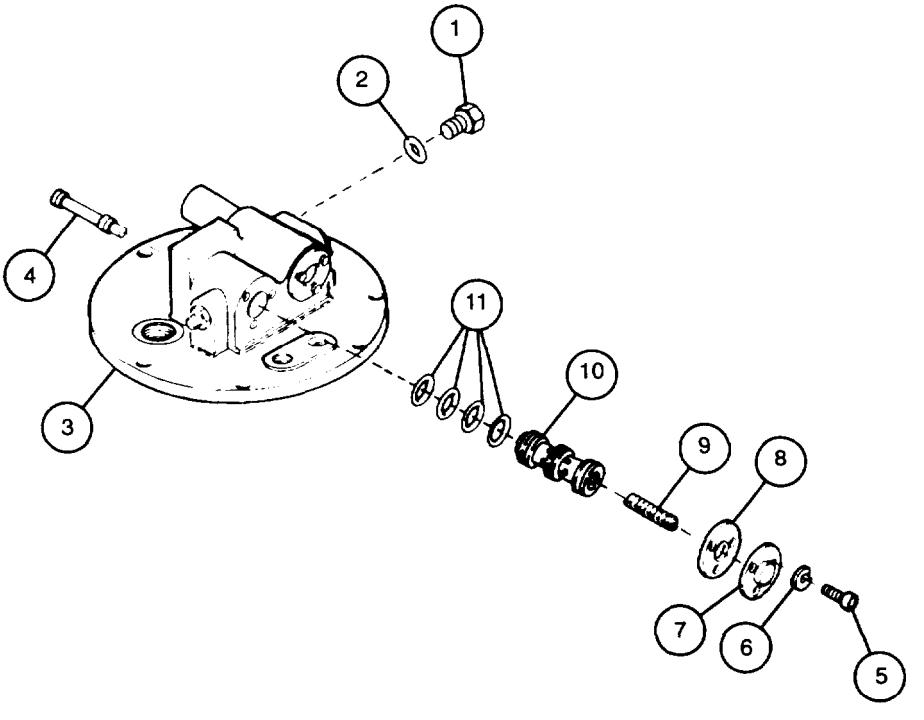
11 Install new power valve spring (9) in cover (3).

12 Install new gasket (8).

13 Install access cover (7). Secure with three new lockwashers (6) and three new cap screws (5).

14 Install hydraulic sleeve assembly spool (4).

15 Install new preformed packing (2) and plug (1) in cover (3).



6-3 FILTER ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Applicable Configuration
M109A2/M109A3 howitzers

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)

Materials/Parts
Filter element kit (item 134, Appx E)
Hydraulic fluid (item 22, Appx B)
Lockwashers (2) (item 158, Appx E)
Retaining rings (2) (item 22, Appx E)

Personnel Required
2

Equipment Condition
Filter assembly removed (para 6-1)

a. Disassembly

1. Remove retaining ring (1) at top end of fluid filter assembly (2) and discard.
2. Remove and discard filter assembly element (3) and preformed packing (4).
3. Remove retaining ring (5) at pump end of fluid filter assembly (2) and discard.
4. Remove head and ball check valve group (6) from filter body (7).
5. Remove preformed packing (8) from fluid filter head (9) and discard.
6. Remove two cap screws (10), two lockwashers (11), and fluid restrictor (12) from fluid filter head (9). Discard lockwashers.
7. Remove helical compression spring (13), power pack guide (14), and bearing ball (15) from fluid filter head (9).

b. Inspection

1. Inspect filter body (7) and replace if distorted or cracked.
2. Inspect helical compression spring (13) and replace if distorted, cracked, scratched, or damaged.
3. Inspect fluid filter head (9) and replace if cracked, distorted, or damaged.

c. Assembly

1 Install bearing ball (15), power pack guide (14), and helical compression spring (13) in fluid filter head (9).

2 Secure fluid restrictor (12) to fluid filter head (9) with two new lockwashers (11) and two cap screws (10).

3 Coat new preformed packing (8) with clean hydraulic fluid and install on fluid filter head (9).

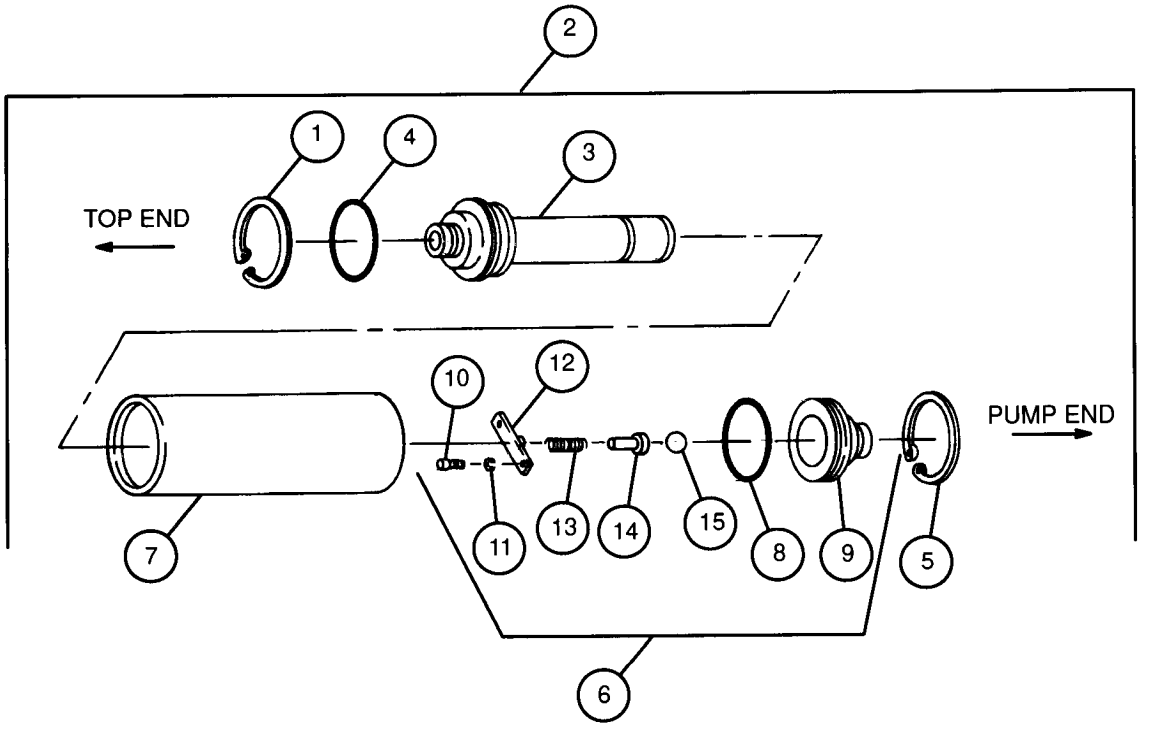
4 Insert head and ball check valve group (6) into filter body (7).

5 Install new retaining ring (5) at pump end of fluid filter assembly (2).

6 Coat new preformed packing (4) with clean hydraulic fluid and install on new filter assembly element (3).

7 Install filter assembly element (3) in filter body (7).

8 Install new retaining ring (1) at top end of fluid filter assembly (2).



6-4 BODY ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Applicabie Configuration
M109A4/M109A5 howitzers

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Hydraulic fluid (item 22, Appx B)
Lockwashers (2) (item 158, Appx E)
Preformed packings (2) (item 105, Appx E)
Retaining rings (2) (item 22, Appx E)

Personnel Required
2

Equipment Condition
Body assembly removed (para 6-1)

a. Disassembly

1 Remove retaining ring (1), filter cap (2), and preformed packing (3) at top end of body assembly (4). Discard retaining ring and preformed packing.

2 Remove retaining ring (5) at pump end of body assembly (4) and discard.

3 Remove head and ball check valve group (6) from filter body (7).

4 Remove preformed packing (8) from fluid filter head (9) and discard.

5 Remove two cap screws (10), two Iockwashers (11), and fluid restrictor (12) from fluid filter head (9). Discard lockwashers.

6 Remove helical compression spring (13), power pack guide (14), and bearing ball (15) from fluid filter head (9).

b. Inspection

1 Inspect filter body (7) and replace body assembly (4) if distorted or cracked.

2 Inspect helical compression spring (13) and replace if distorted, cracked, scratched, or damaged.

3 Inspect fluid filter head (9) and replace if cracked, distorted, or damaged.

c. Assembly

1 Install bearing ball (15), power pack guide (14), and helical compression spring (13) in fluid filter head (9).

2 Secure fluid restrictor (12) to fluid filter head (9) with two new lockwashers (11) and two cap screws (10).

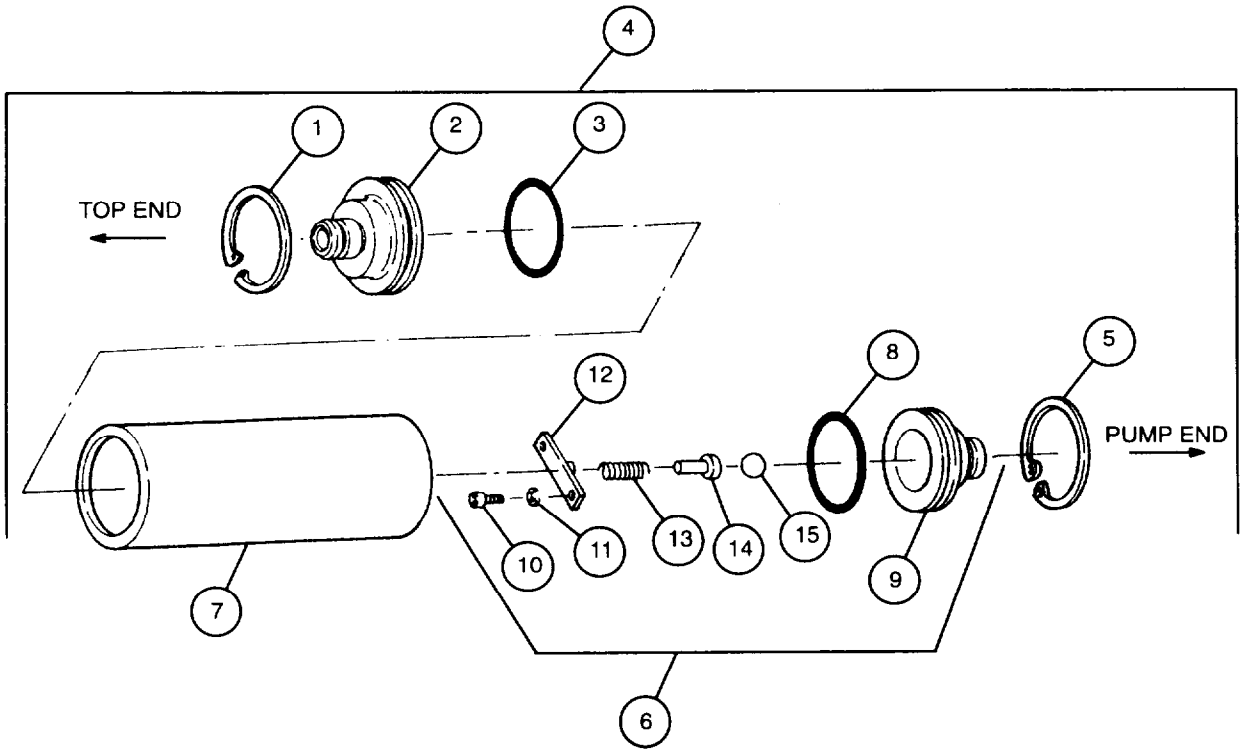
3 Coat new preformed packing (8) with clean hydraulic fluid and install on fluid filter head (9).

4 Inset-t head and ball check valve group (6) into filter body (7).

5 Install new retaining ring (5) at pump end of body assembly (4).

6 Coat new preformed packing (3) with clean hydraulic fluid and install on filter cap (2).

7 Install filter cap (2) and new retaining ring (1) at top end of body assembly (4).



6-5 BYPASS VALVE ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Lockwashers (2) (item 75, Appx E)
Lockwashers (4) (item 81, Appx E)
Lockwashers (2) (item 158, Appx E)
Preformed packing (item 49, Appx E)
Preformed packing (item 51, Appx E)

Equipment Condition
Bypass valve assembly removed (TM 9-2350-311-20-2)

a. Disassembly

1 Remove four cap screws (1), four lockwashers (2), and four hex nuts (3). Discard lockwashers.

2 Separate solenoid (4) from spacer (5).

3 Remove two cap screws (6), two lockwashers (7), and body (8) from spacer (5). Discard lockwashers.

4 Remove two cap screws (8.1) and spacer (5) from welded block.

5 Remove two cap screws (9), two lockwashers (10), cap (11), and helical compression spring (12) from body (8). Discard lockwashers.

6 Remove spool (13) from body (8).

7 Remove preformed packings (14 and 15) from spool (13) and discard.

b. inspection

1 Inspect body (8) and spool (13). Replace bypass valve body (16) if body or spool is cracked, distorted, scratched, or scored.

2 Inspect helical compression spring (12). Replace if cracked, broken, distorted, or scratched.

c. Assembly

1 Install new preformed packings (14 and 15) on spool (13).

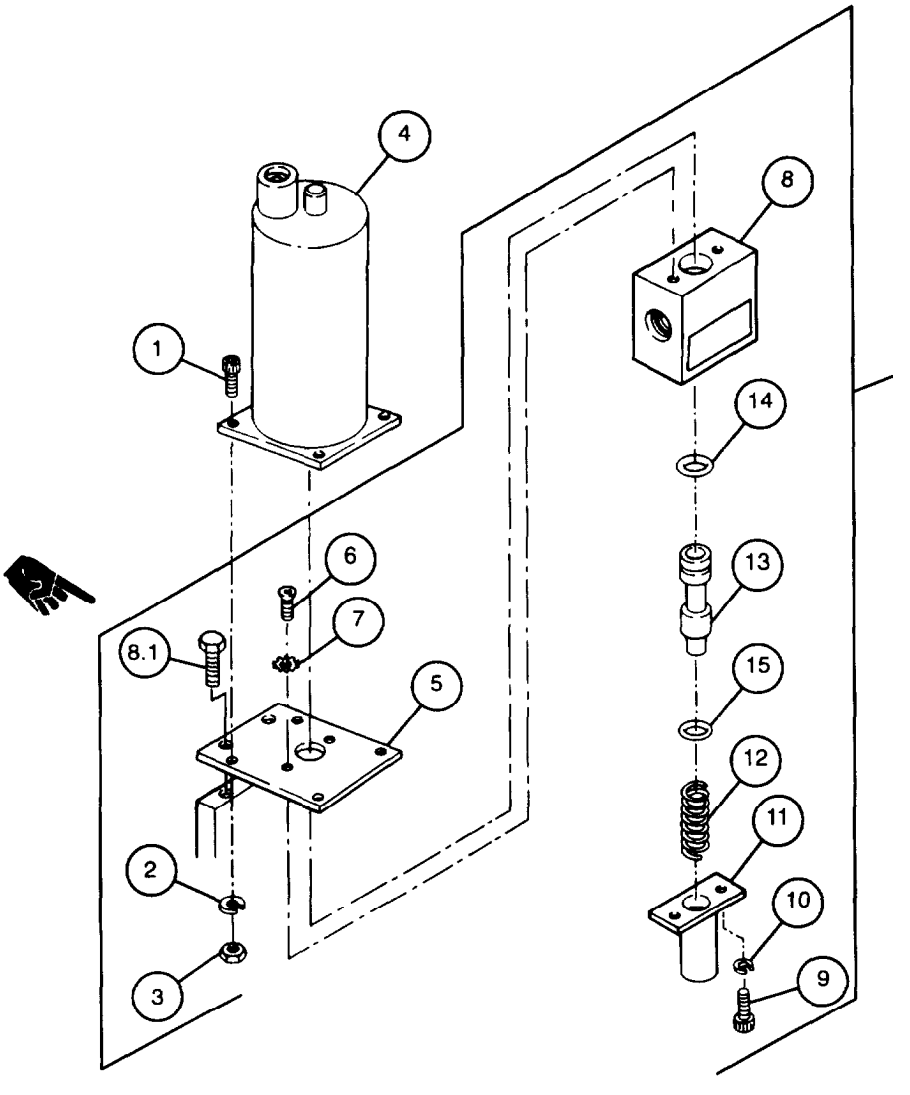
2 Insert spool (13) into body (8).

3 Install helical compression spring (12) and secure cap (11) to body (8) with two new lockwashers (10) and two cap screws (9).

4 Install two cap screws (8.1), and spacer (5) to welded block.

5 Install spacer (5) on body (8) and secure with two new lockwashers (7) and two cap screws (6).

6 Place solenoid (4) on spacer (5) and secure with four cap screws (1), four new lockwashers (2), and four hex nuts (3).



6-6 ACCUMULATOR ASSEMBLY (MANUAL PUMP)

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Accumulator parts kit (item 148, Appx E)
Hydraulic fluid (item 22, Appx B)
Retaining rings (6) (item 156, Appx E)

Equipment Condition
Accumulator assembly (manual pump) removed (TM 9-2350-311-20-2)

a. Disassembly

WARNING

Manual pump accumulator assembly contains dry nitrogen at a pressure of 75-90 psi (517-620 kPa). Do not disassemble until all pressure is relieved to avoid injury from trapped high pressure.

1 Remove accumulator cap (1).

2 If necessary for replacement, remove screw (1.1) and instruction plate (1.2) from accumulator cap (1).

3 Unscrew and remove air valve cap (2).

4 Depress valve core (3) and relieve all nitrogen pressure in accumulator assembly (4).

5 Unscrew and remove valve core (3) from valve body (5).

6 Unscrew and remove valve body (5).

7 Remove and discard preformed packing (6)

8 Remove two retaining rings (7) from outside of cylinder (8) at each end and discard.

9 Remove linear cap (9), cylinder tube nipple (10), and hydraulic piston (11) from cylinder (8).

10 Remove six packing retainers (12) and four preformed packings (13) from hydraulic piston (11) and discard.

b. Inspection

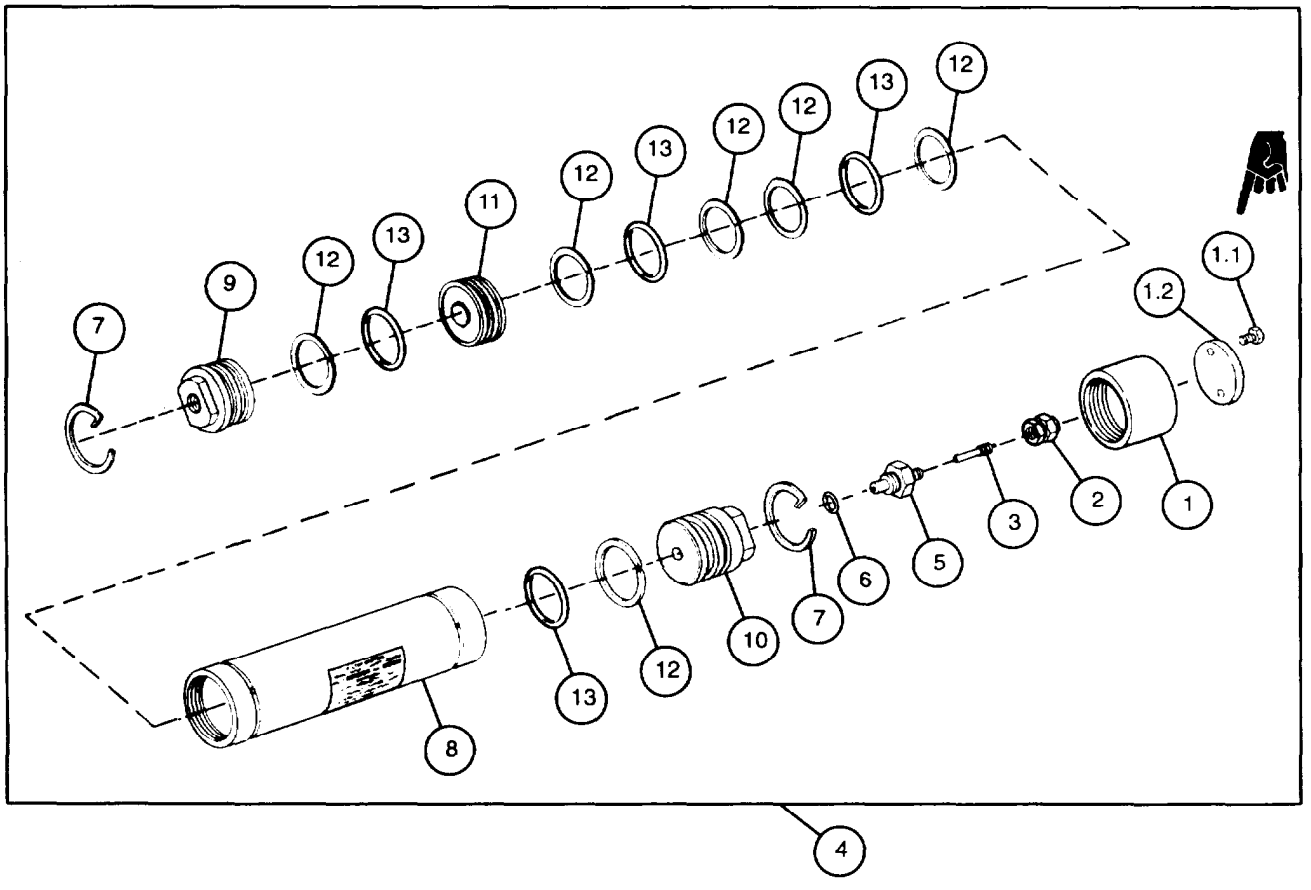
1 Inspect linear cap (9) and cylinder tube nipple (10). Replace if fractured.

2 Inspect cylinder (8). Replace accumulator assembly (4) if cylinder is cracked or scored inside, threads are damaged, or if inside diameter is greater than 1.518 inches (3.856 cm).

3 Inspect hydraulic piston (11). Replace if cracked, grooves are burred, or outside diameter is less than 1.5 inches (3.81 cm).

4 Inspect valve body (5). Replace if threads are damaged.

5 Inspect air valve cap (2). Replace if cracked.



6-6 ACCUMULATOR ASSEMBLY (MANUAL PUMP) - CONTINUED

c. Assembly

CAUTION

Do not distort preformed packings when installing. Be careful not to damage machined surfaces of hydraulic piston, inside surface of cylinder, or threads at each end of cylinder. Avoid damage when inserting hydraulic piston into cylinder.

1 Coat four new preformed packings (13) with hydraulic fluid. Install four preformed packings and six new packing retainers (12) on hydraulic piston (11).

2 Install hydraulic piston (11), cylinder tube nipple (10), and linear cap (9) in cylinder (8).

3 Ensure grooves in hydraulic piston (11) aline with holes in cylinder tube nipple (10) and linear cap (9).

4 Install two retaining rings (7) one at each end of cylinder (8).

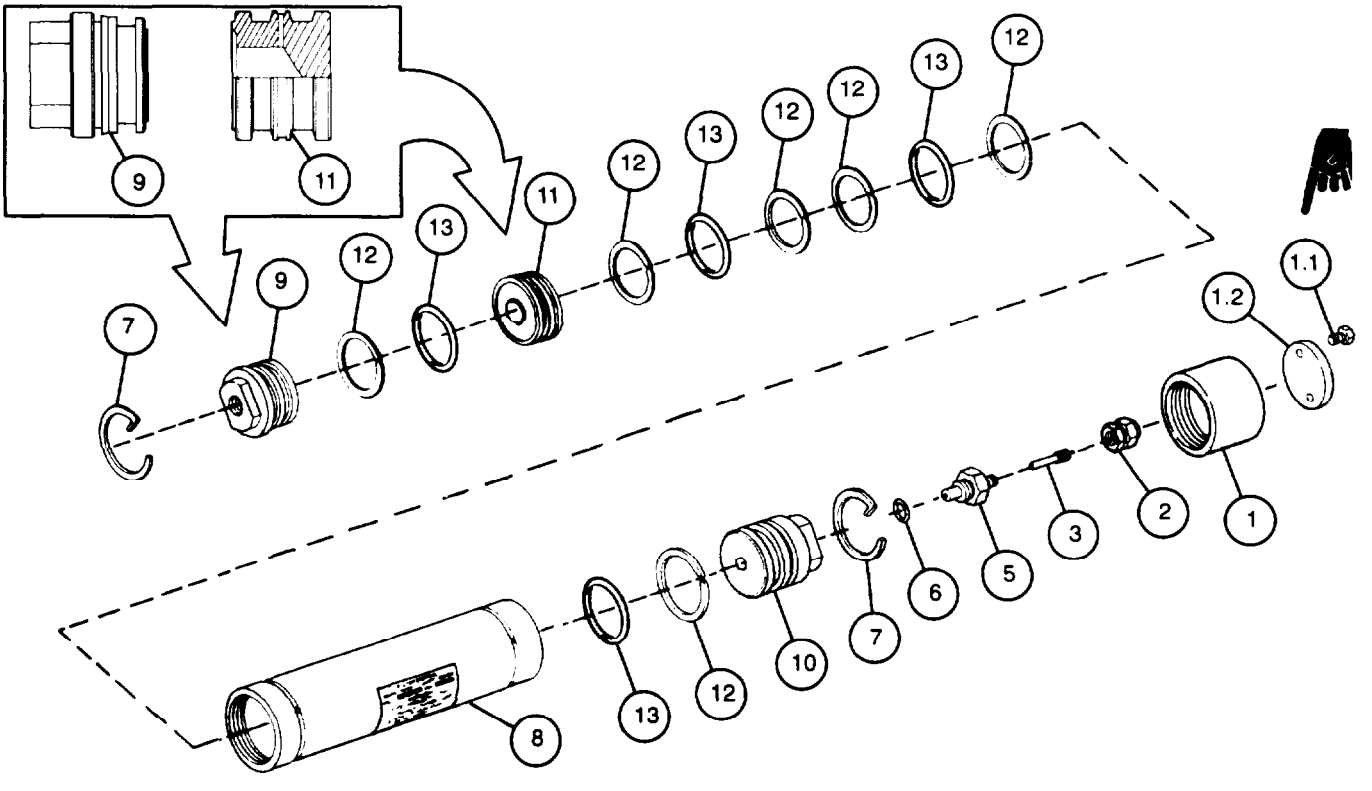
5 Coat new preformed packing (6) with hydraulic fluid. Install preformed packing and valve body (5) on cylinder tube nipple (10).

6 Screw valve core (3) into valve body (5).

7 Charge accumulator assembly (TM 9-2350-311-20-2). Test valve core (3) and all fittings for leaks. Replace if necessary.

8 Install air valve cap (2) and accumulator cap (1).

9 If necessary for replacement, install plate (1.2) and screw (1.1) on accumulator cap (1).



6-7 ACCUMULATOR ASSEMBLY (MAIN)

This task covers: a. Removal b. Disassembly c. Inspection d. Assembly e. Testing f. Installation

INITIAL SETUP

Tools
Artillery and turret mechanics tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Hydraulic accumulator parts kit (item 136, Appx E)
Hydraulic fluid (item 22, Appx B)
Preformed packing (item 62, Appx E)
Preformed packing (item 65, Appx E)
Preformed packing (item 66, Appx E)
Preformed packings (2) (item 60, Appx E)
Self-locking nuts (2) (item 40, Appx E)

Personnel Required
2

Equipment Condition
Discharge hydraulic pressure (TM 9-2350-311-20-2)
Drain hydraulic fluid (TM 9-2350-311-20-2)
Hydraulic filter assemblies removed (M109A4/M109A5) (TM 9-2350-311-20-2)
Hydraulic pressure switch removed (TM 9-2350-311-20-2)
Sight gage assembly and pressure gage removed (para 6-1)

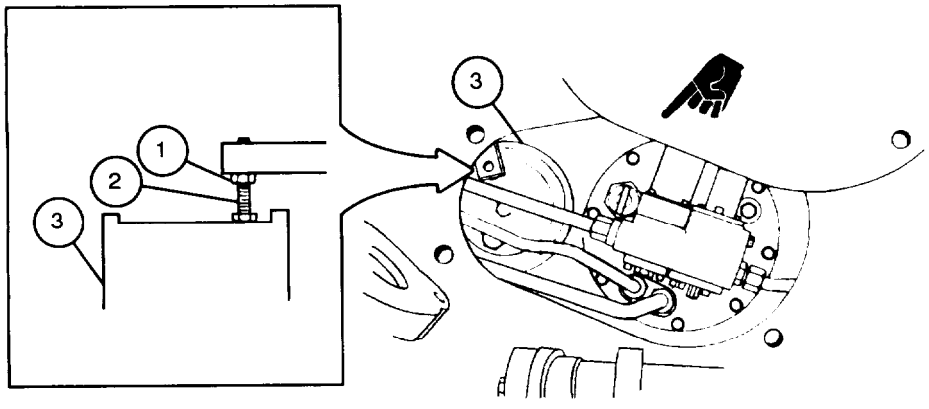
a. Removal

WARNING

Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.

1 Loosen hex nut (1).

2 Screw cap screw (2) at top of main accumulator assembly (3) upward until it clears top of main accumulator assembly.



6-7 ACCUMULATOR ASSEMBLY (MAIN) -CONTINUED

a. Removal - Continued

3 Remove nut (4), clinch sleeve (5), tube reducer (6), preformed packing (7), tube coupling (8), and tee (9) from underside of main accumulator assembly (3). Discard preformed packing.

4 Loosen nut (10) and clinch sleeve (11).

5 Disconnect tube (12) at safety relief valve assembly (13).

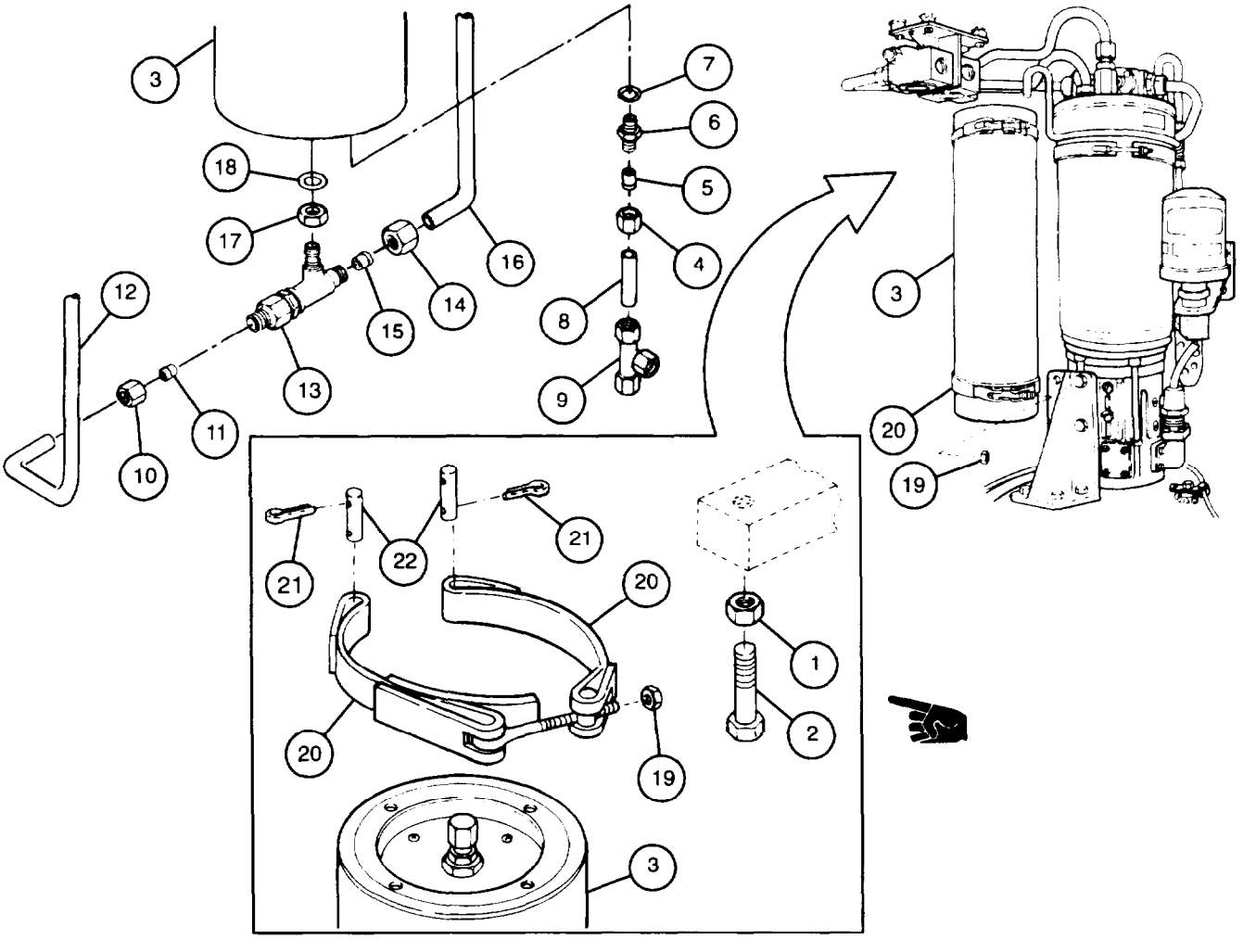
6 Remove nut (14) and clinch sleeve (15). Disconnect tube (16).

7 Remove hex nut (17), preformed packing (18), and safety relief valve assembly (13) from underside of main accumulator assembly (3). Discard preformed packing.

8 While supporting main accumulator assembly (3), remove two self-locking nuts (19) and open two loop clamps (20). Remove main accumulator assembly. Discard self-locking nuts.

9 Remove eight cotter pins (21), four headless straight pins (22), and two loop clamps (20). Discard cotter pins.

10 Remove hex nut (1) and cap screw (2).



b. Disassembly

WARNING

Main accumulator assembly contains high pressure nitrogen. Do not disassemble until all pressure is relieved to avoid injury from trapped high pressure.

1 Remove valve cap (23) from valve body (24). Depress valve core (25) to relieve precharged nitrogen pressure.

2 Remove two externally threaded rings (26), one at each end of cylinder (27).

3 Remove bottom dust protective cap (28) from cylinder (27).

4 Remove preformed packing (29) and packing retainer (30) from bottom dust protective cap (28) and discard.

5 Remove top dust protective cap (31) from cylinder (27).

6 If necessary for replacement, remove four screws (31.1) and instructional plate (31.2) from protective cap (31).

7 Remove preformed packing (32) and packing retainer (33) from top dust protective cap (31) and discard.

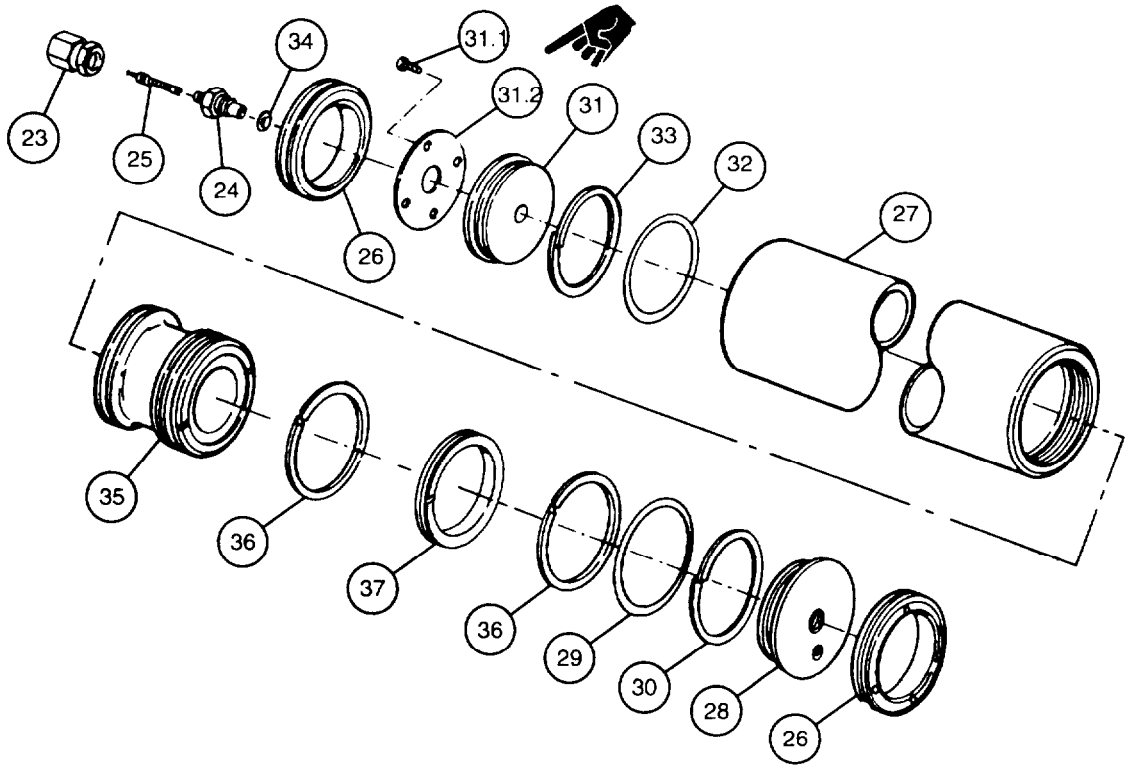
8 Remove valve core (25), valve body (24), and preformed packing (34) from top dust protective cap (31). Discard preformed packing.

NOTE

Be careful not to scratch finished surface of piston.

9 Remove accumulator piston (35) from cylinder (27).

10 Remove two ring guides (36) and seal assembly (37) from accumulator piston (35) and discard.



6-7 ACCUMULATOR ASSEMBLY (MAIN) - CONTINUED

c. Inspection

1 Inspect two externally threaded rings (26). Replace if threads are damaged.

2 Inspect valve cap (23). Replace if damaged.

3 Test valve core (25). Replace if it leaks.

4 Inspect valve body (24). Replace if damaged.

5 Inspect dust protective caps (28 and 31). Replace if damaged.

6 Inspect cylinder (27). Replace main accumulator assembly (3) if cracked, inside is scored, or inside diameter is greater than 6.547 inches (16.63 cm).

7 Inspect accumulator piston (35). Replace if cracked or scored. Measure fit of accumulator piston in cylinder (27) and replace if greater than 0.012 inch (0.3 mm).

d. Assembly

NOTE

Coat accumulator piston and inside of cylinder with clean hydraulic fluid before assembly.

1 Install new seal assembly (37), and two new ring guides (36) on accumulator piston (35).

NOTE

Be careful not to scratch finished surface of accumulator piston.

2 Insert accumulator piston (35) into cylinder (27).

3 Install new preformed packing (34), valve body (24), valve core (25), and valve cap (23) on top dust protective cap (31).

4 Install new packing retainer (33) and new preformed packing (32) on top dust protective cap (31).

5 If necessary for replacement, install instructional plate (31.2) and four screws (31.1) on protective cap (31).

6 Install top dust protective cap (31) on cylinder (27).

7 Install new packing retainer (30) and new preformed packing (29) on bottom dust protective cap (28).

8 Install bottom dust protective cap (28) on cylinder (27).

9 Install two externally threaded rings (26), one at each end of cylinder (27).

10 Charge main accumulator assembly (3) (TM 9-2350-311-20-2).

e. Testing

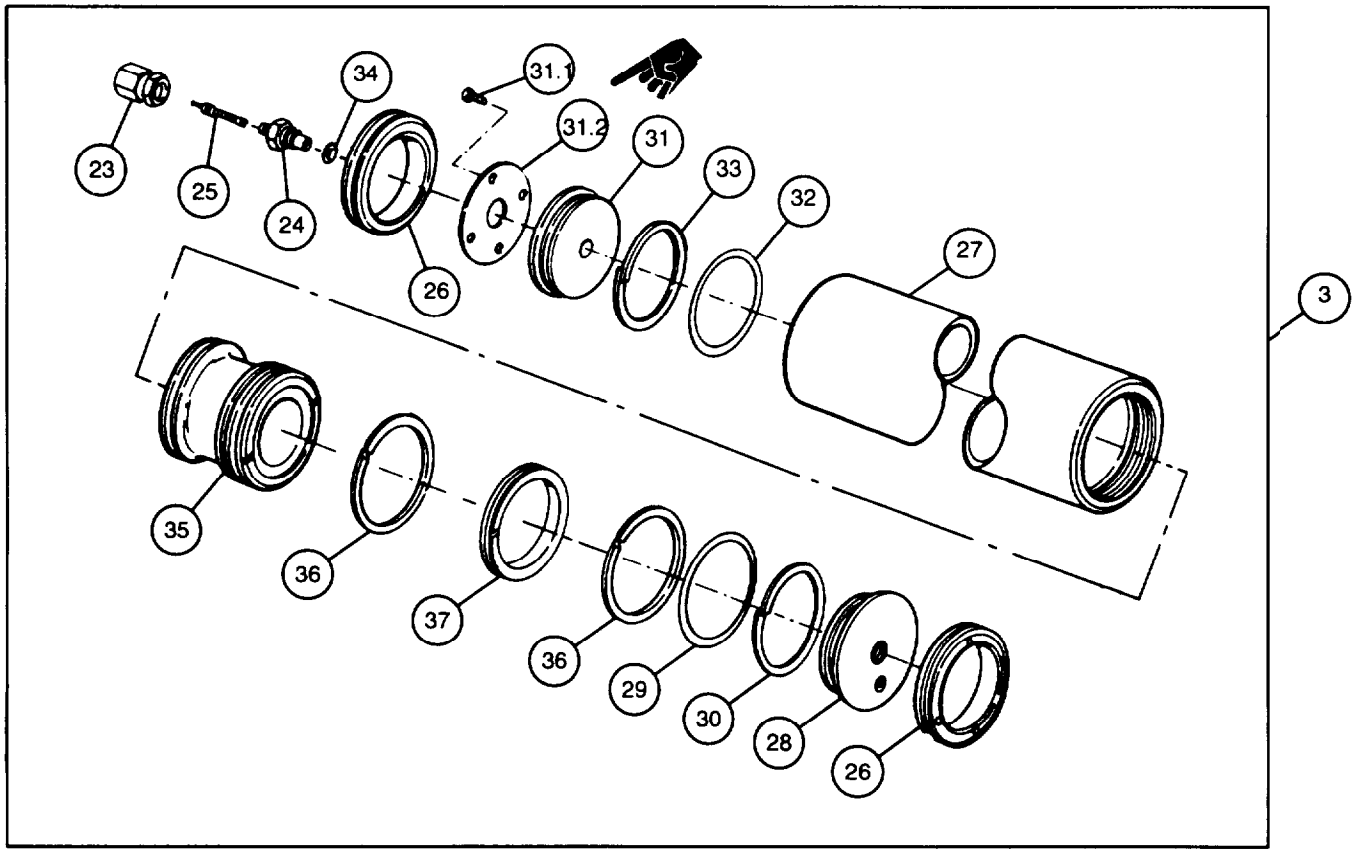
NOTE

The main accumulator assembly must be tested following repair before installation in the vehicle. Main accumulator assembly must be charged to 500- 50 psi (3448 -345 kPa) with dry nitrogen to perform test.

1 Plug ports in the bottom dust protective cap (28) of main accumulator assembly (3).

2 Submerge main accumulator assembly (3) completely in water for a period of ten minutes. There must be no evidence of leakage during this period. If there is a leakage, release nitrogen pressure, disassemble, inspect, repair, assemble, service (TM 9-2350-311-20-2), and retest before installation.

3 Remove main accumulator assembly (3) from water and dry thoroughly. If main accumulator assembly is to be stored or transported, relieve all nitrogen pressure.



6-7 ACCUMULATOR ASSEMBLY (MAIN) - CONTINUED

f. Installation

1 Install hex nut (1) and cap screw (2).

1.1 Install four headless straight pins (22) eight new cotter pins (21), and two loop clamps (20).

1.2 Position main accumulator assembly (3) in installed position and support. Install two new self-locking nuts (19) and draw loop clamps (20) closed around main accumulator assembly.

2 Insert 0.002 feeler gage between main accumulator assembly (3) and loop clamp (20) in vicinity of T-bolt (38). Tighten loop clamp by adjusting self-locking nut (19) until feeler gage cannot be pulled loose. Back off self-locking nut slightly to remove feeler gage, then tighten self-locking nut 1-1/4 to 1-1/2 turns.

3 Install new preformed packing (18), hex nut (17), and safety relief valve assembly (13) to underside of main accumulator assembly (3).

4 Connect tube (16).

5 Install clinch sleeve (15) and nut (14).

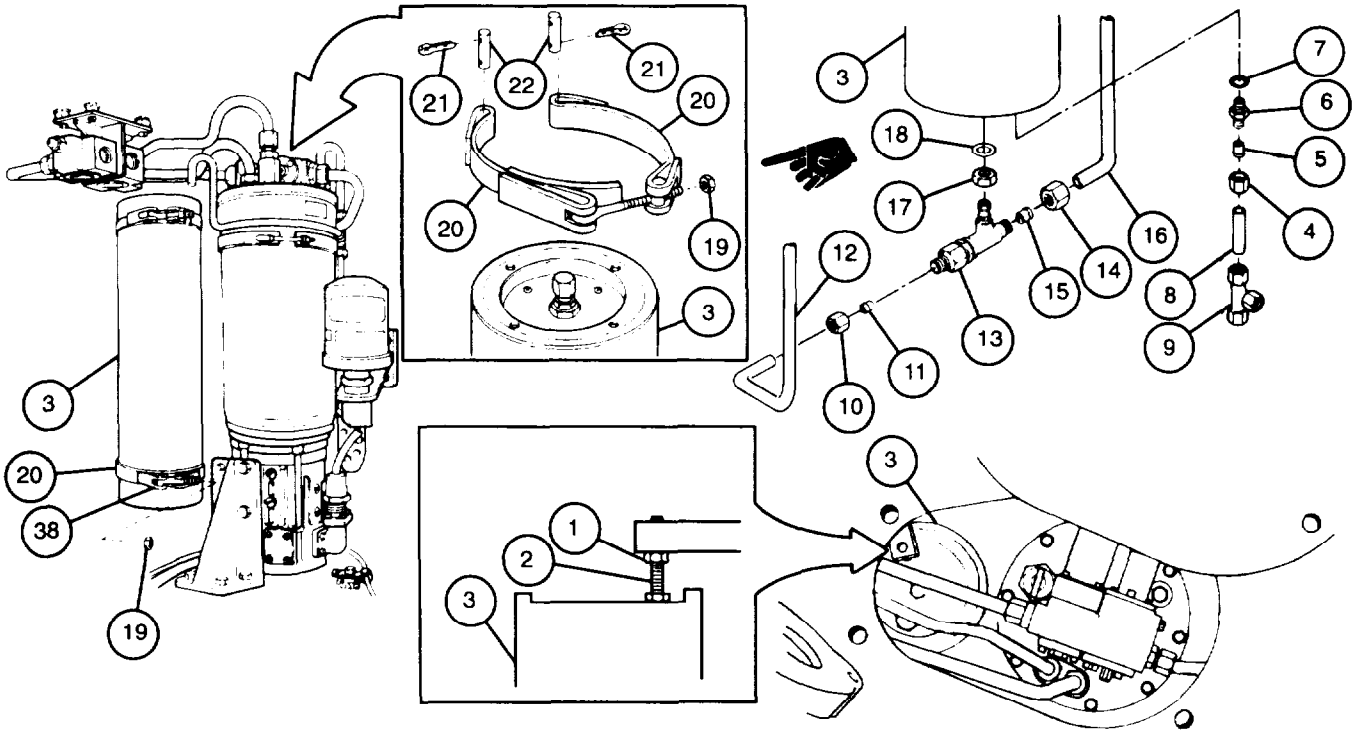
6 Install clinch sleeve (11) and nut (10).

7 Connect tube (12) at safety relief valve assembly (13).

8 Install new preformed packing (7), tube reducer (6), clinch sleeve (5) nut (4) tube coupling (8), and tee (9) to underside of main accumulator assembly (3).

9 At top of main accumulator assembly (3) turn cap screw (2) down until it engages tapped hole in main accumulator assembly fully.

10 Tighten hex nut (1).



6-8 ACCUMULATOR ASSEMBLY (PRIMARY)

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Hydraulic fluid (item 22, Appx B)
Hydraulic parts kit (item 137, Appx E)

Equipment Condition
Accumulator assembly (primary) removed (TM 9-2350-311-20-2)

a. Disassembly

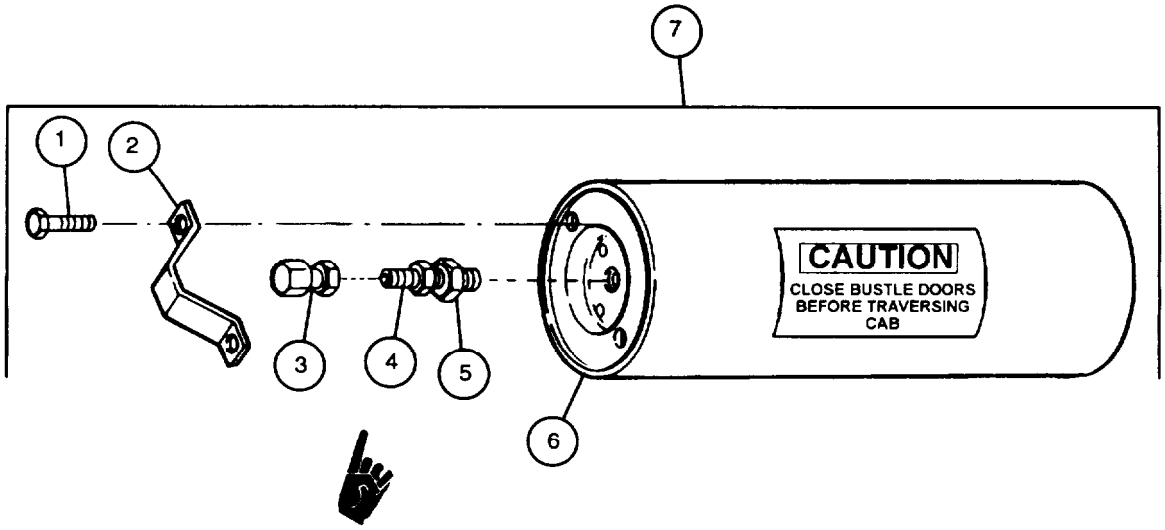
1 Remove two cap screws (1) and retaining strap (2).

WARNING

Primary accumulator assembly contains high pressure nitrogen. Do not disassemble until all pressure is relieved to avoid injury from trapped high pressure.

2 Remove air valve cap (3) and loosen check valve nut (4) on air relay valve (5) to release nitrogen precharge pressure from accumulator cap (6) on primary accumulator assembly (7).

3 Remove air relay valve (5).



6-8 ACCUMULATOR ASSEMBLY (PRIMARY) - CONTINUED

a. Disassembly - Continued

4 Push accumulator cap (6) into cylinder (8) about 1 inch (2.54 cm) and remove three segments of accumulator ring (9).

5 Remove accumulator cap (6) from cylinder (8).

6 Remove packing retainer (10) and preformed packing (11) from accumulator cap (6) and discard.

7 If necessary for replacement, remove drive screw (11 .1) and instruction plate (11.2) from accumulator cap (6).

8 Remove two cap screws (12) and two flat washers (13) from chassis base (14).

9 Push chassis base (14) into cylinder (8) about 1 inch (2.54 cm) and remove three segments of accumulator ring (15).

10 Remove chassis base (14).

11 Remove packing retainer (16) and preformed packing (17) from chassis base (14) and discard.

NOTE

Use care to protect machined surfaces of the hydraulic piston and inside diameter of cylinder from scratches when removing hydraulic piston.

12 Remove hydraulic piston (18) from cylinder (8).

13 Remove four packing retainers (19) and two preformed packings (20) from hydraulic piston (18) and discard.

b. Inspection

1 Inspect air relay valve (5). Replace if damaged.

2 Inspect accumulator cap (6). Replace if threads are damaged or burred.

3 Inspect hydraulic piston (18). Replace if cracked, damaged, or burred.

4 Inspect chassis base (14). Replace if cracked, damaged, or burred.

5 Inspect interior of cylinder (8). Replace if scratched, scored, or pitted.

c. Assembly

CAUTION

Be careful not to scratch finished surfaces during assembly.

1 Install two new preformed packings (20) and four new packing retainers (19) on hydraulic piston (18).

2 Coat hydraulic piston (18) with hydraulic fluid and carefully insert into cylinder (8).

3 Install new preformed packing (17) and new packing retainer (16) on chassis base (14).

4 Coat chassis base (14) with hydraulic fluid and carefully insert into cylinder (8) far enough so that groove for accumulator ring (15) is accessible.

5 Install accumulator ring (15) in groove of cylinder (8).

6 Install two flat washers (13) and two cap screws (12) to secure chassis base (14).

7 If necessary for replacement, install instruction plate (11.2) and drive screw (11 .1) on accumulator cap (6).

8 Install new preformed packing (11) and new packing retainer (10) on accumulator cap (6).

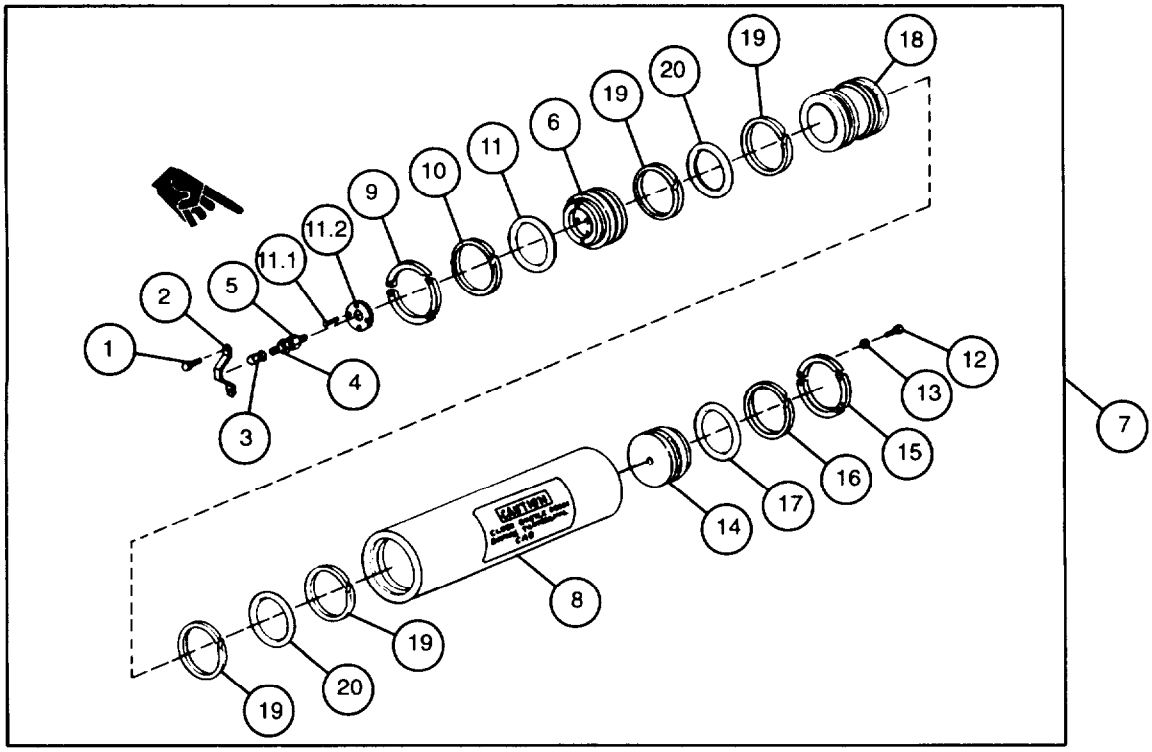
9 Coat accumulator cap (6) with hydraulic fluid and carefully insert into cylinder (8) far enough so that groove for accumulator ring (9) is accessible.

10 Install accumulator ring (9) in groove inside cylinder (8).

11 Install air relay valve (5). Tighten check valve nut (4).

12 Install air valve cap (3) retaining strap (2), and two cap screws (1).

13 Charge primary accumulator assembly (7) (TM 9-2350-311-20-2).



6-9 ACCUMULATOR ASSEMBLY (SECONDARY)

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Materials/Parts
Hydraulic fluid (item 22, Appx B)
Hydraulic parts kit (item 138, Appx E)
Equipment Condition
Accumulator assembly (secondary) removed (TM 9-2350-311-20-2)

a. Disassembly

1 Remove two machine screws (1) and guard (2).

WARNING

Secondary accumulator assembly contains high pressure nitrogen. Do not disassemble until all pressure is relieved to avoid injury from trapped high pressure.

2 Remove air valve cap (3) and loosen check valve nut (4) on air relay valve (5) to release nitrogen precharge pressure from secondary accumulator assembly (6).

3 Remove air relay valve (5).

4 Remove three cap screws (7) and valve stop plate (8).

5 Push accumulator head (9) into cylinder (10) about 1 inch (2.54 cm) and remove three segments of accumulator ring (11).

6 Remove accumulator head (9) from cylinder (10).

7 Remove packing retainer (12) and preformed packing (13) from accumulator head (9) and discard.

8 Remove three cap screws (14) and valve stop plate (15).

9 Push chassis base (16) into cylinder (10) about 1 inch (2.54 cm) and remove three segments of accumulator ring (17).

10 Remove chassis base (16) from cylinder (10).

11 Remove packing retainer (18) and preformed packing (19) from chassis base (16) and discard.

12 Remove hydraulic piston (20) from cylinder (10).

13 Remove four packing retainers (21) and two preformed packings (22) from hydraulic piston (20) and discard.

b. Inspection

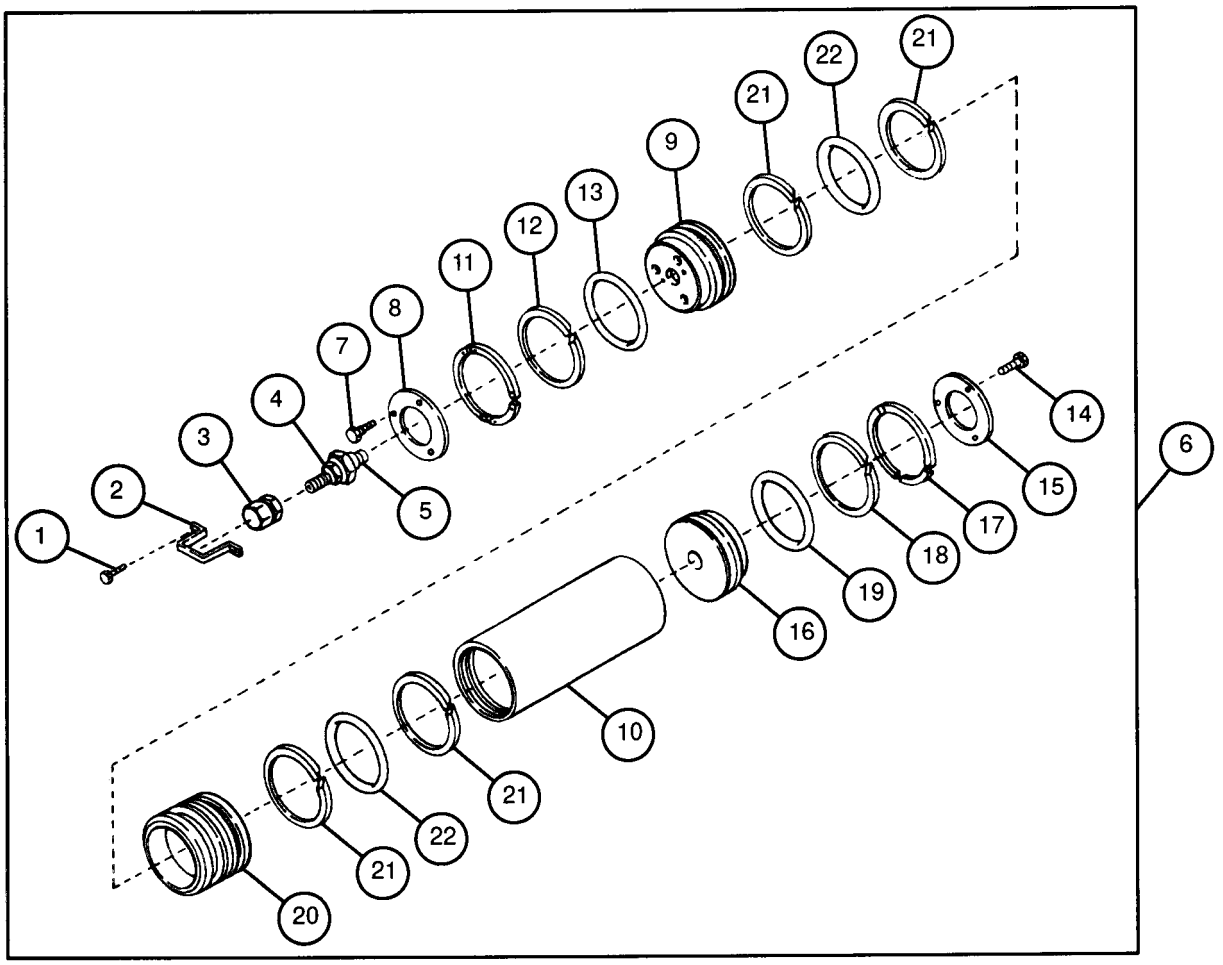
1 Inspect air relay valve (5). Replace if damaged.

2 Inspect accumulator head (9). Replace if threads are damaged or burred.

3 Inspect chassis base (16). Replace if cracked, damaged, or burred.

4 Inspect hydraulic piston (20). Replace if cracked, damaged, or burred.

5 Inspect cylinder (10). Replace if scratched, scored, or pitted.



6-9 ACCUMULATOR ASSEMBLY (SECONDARY) - CONTINUED

c. Assembly

CAUTION

Be careful not to scratch finished surfaces during assembly.

1 Install two new preformed packings (22) and four new packing retainers (21) on hydraulic piston (20).

2 Coat hydraulic piston (20) with hydraulic fluid. Carefully insert into cylinder (10).

3 Install new preformed packing (19) and new packing retainer (18) on chassis base (16).

4 Coat chassis base (16) with hydraulic fluid and carefully insert into cylinder (10) far enough that groove for accumulator ring (17) is accessible.

5 Install three segments of accumulator ring (17) in groove of cylinder (10).

6 Install valve stop plate (15) and secure with three cap screws (14).

7 Install new preformed packing (13) and new packing retainer (12) on accumulator head (9).

8 Coat accumulator head (9) with hydraulic fluid and carefully insert into cylinder (10) far enough that groove for accumulator ring (11) is accessible.

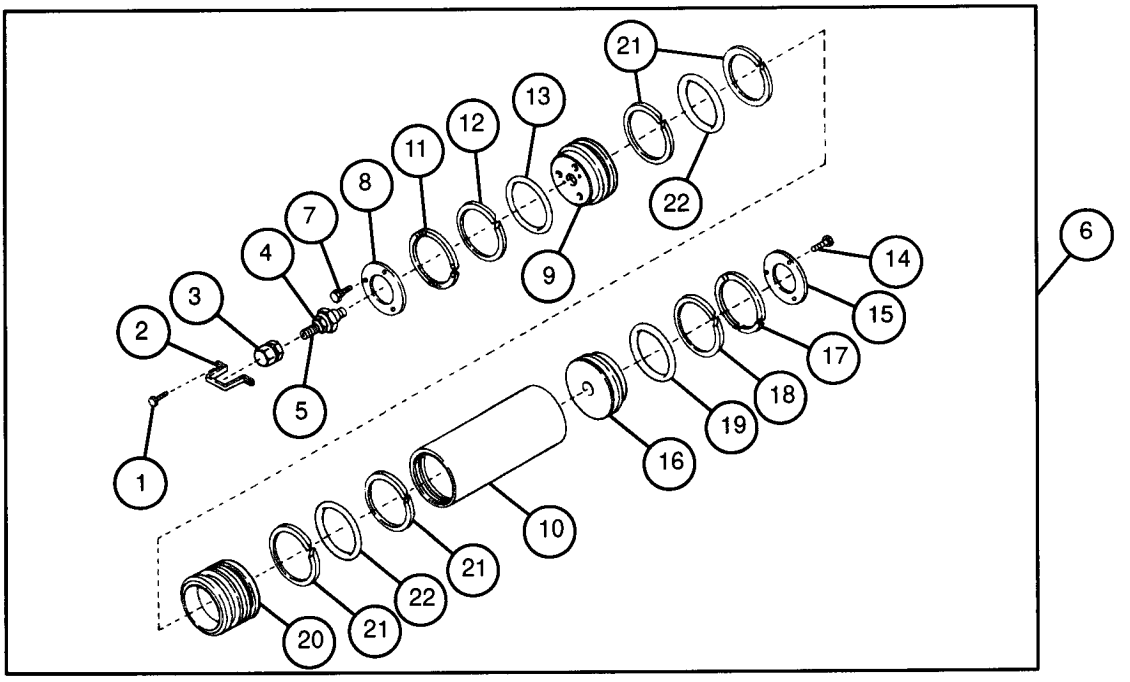
9 Install three segments of accumulator ring (11).

10 Install valve stop plate (8) and fasten to accumulator head (9) with three cap screws (7).

11 Install air relay valve (5). Tighten check valve nut (4).

12 Install air valve cap (3), guard (2), and two machine screws (1).

13 Charge secondary accumulator assembly (6) (TM 9-2350-311-20-2).



6-10 EQUILIBRATION MANIFOLD ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly d. Adjustment

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Utility pail (item 11, Appx F)

Materials/Parts
Cap and plug set (item 10, Appx B)
Hydraulic fluid (item 22, Appx B)
Lockwire (V) (item 36, Appx E)
Parts kit (item 135, Appx E)
Spring pins (2) (item 24, Appx E)

Equipment Condition
Equilibration manifold assembly removed (TM 9-2350-311-20-2)

a. Disassembly

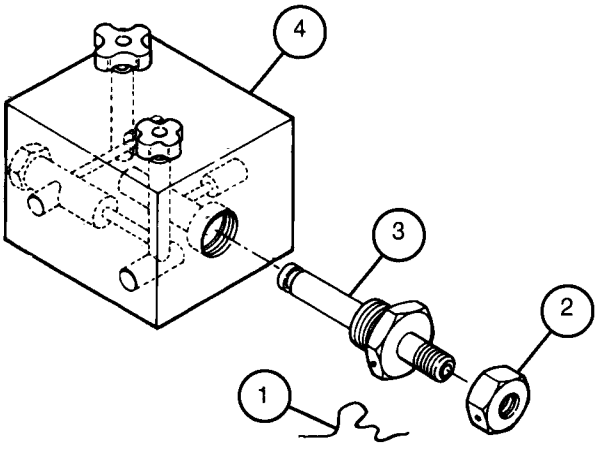
NOTE

Do not disassemble equilibration manifold assembly unless there has been leakage.

1 Remove and discard lockwire (1).

2 Remove outer nut (2) from valve (3).

3 Remove valve (3) from manifold (4).



6-10 EQUILIBRATION MANIFOLD ASSEMBLY - CONTINUED

a. Disassembly - Continued

4 Remove preformed packing (5), packing retainer (6), and preformed packing (7) from valve (3) and discard.

5 Remove two spring pins (8), drain valve knob (9), and equilibrator valve knob (10) from manifold (4). Discard spring pins.

b. Inspection

1 Inspect manifold (4). Replace equilibration manifold assembly (11) if manifold is cracked or damaged.

2 Inspect valve (3). Replace if distorted, cracked, or threads damaged.

c. Assembly

1 Install new preformed packing (7), new packing retainer (6), and new preformed packing (5) on valve (3).

2 Coat valve (3) with hydraulic fluid and carefully install in manifold (4).

3 Install outer nut (2) on valve (3).

4 Install drain valve knob (9), equilibrator valve knob (10), and two new spring pins (8) on manifold (4).

5 Install lew lockwire (1) to secure outer nut (2) to valve (3).

6 Adjust equilibration manifold assembly (11) (para 6-10d.).

d. Adjustment

NOTE

Be careful not to get dirt or other foreign material into valve ports.

1 Turn drain valve knob (9) clockwise to close drain port (12).

2 Turn equilibrator valve knob (10) to open valve.

3 Plug ACC port (13) and MANPUMP port (14).

WARNING

Hydraulic fluid flow from RET port will be under high pressure. Use caution to prevent serious injury.

4 Connect hose to RET port (15) and direct flow into a utility pail.

NOTE

If opening pressure of valve is not obtained in step 5, perform steps 6 through 10 to adjust opening pressure.

5 Apply hydraulic pressure to PRESSURE port (16) increasing from 0-3300 psi (0-22754 kPa). Valve (3) should open at 3200 ± 100 psi (22064 + 690 kPa). Opening of valve is indicated by flow from RET port (15).

6 Remove lockwire (1).

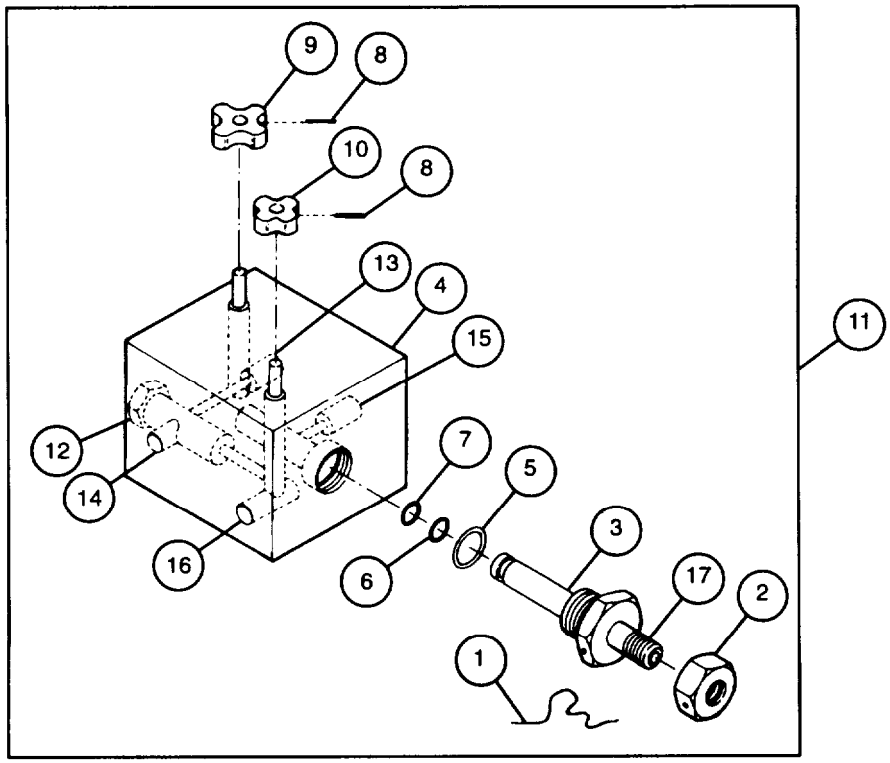
7 Loosen outer nut (2) by turning counterclockwise.

8 To increase opening pressure, rotate adjusting screw (17) clockwise with a hex key. To decrease opening pressure, rotate adjusting screw counterclockwise.

9 Tighten outer nut (2).

10 Measure valve (3) opening pressure (step 5). Repeat steps 6 through 10 as necessary until opening pressure of 3200 ± 100 psi (22064 ± 690 kPa) is obtained.

11 When proper pressure setting is obtained, install new lockwire (1) to secure outer nut (2) to valve (3).



6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY

This task covers:
a. Removal
b. Disassembly
c. Inspection
d. Assembly
e. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95CL-A06)
Brass guide rods, 5/16 inch dia. (Figure C-2, Appx C) (Unmodified)
Brass guide rods, 1/4 inch dia. (Figure C-2, Appx C) (Unmodified)
Spanner attachment (item 24, Appx F) (Modified)
End cap guide tool (item 3, Appx F)
Eye bolt (item 5, Appx F)
Guide tool assembly (Figure C-8, Appx C)
Rod guide tool (item 15, Appx F) (Modified)
Seal inserter (item 17, Appx F) (Modified)
Sling, gun tube (item 19, Appx F)
Socket, socket wrench (item 22, Appx F) (Modified)
Spanner (Figure C-11, Appx C) (Unmodified)
Utility pail (item 11, Appx F)

Materials/Parts
Hydraulic fluid (item 22, Appx B)
Key washers (2) (item 30, Appx E)
Lockwire (V) (item 36, Appx E)
Preformed packing (item 65, Appx E)
Preformed packings (2) (item 1, Appx E) (Unmodified)
Preformed packings (2) (item 51, Appx E) (Modified)
Preformed packings (3) (item 63, Appx E)
Seal replacement parts kit (item 141, Appx E) (Modified)
Seal replacement parts kit (item 153, Appx E) (Unmodified)
Sealing compound (item 29, Appx B)
Tape (item 35, Appx B) (Modified)
Webbing strap (item 34, Appx B)

Personnel Required
2

References
TM 9-214

Equipment Condition
Lines and fittings from equilibrated elevating cylinder disconnected (TM 9-2350-311-20-2)
Lines and fittings from elevation selector valve assembly disconnected (TM 9-2350-311-20-2)

NOTE

Equilibrated elevation mechanism assemblies may be modified or unmodified. Modified equilibrated elevation mechanism assemblies are identified on the data plate by part number 12576115 and unmodified by part number 11636282. Also, modified equilibrated elevation mechanism assemblies have setscrews in the nut beside the bearings, whereas the unmodified ones do not.

a. Removal

WARNING

Wear safety glasses and steel-tipped safety shoes to avoid possible injury while handling equipment.

CAUTION

Failure to open bleeder valves could damage elevating piston rod.

1 Position utility pail to catch draining hydraulic fluid and open bleeder valves (1 and 2) on equilibrated elevation mechanism assembly (3).

2 Attach gun tube sling (4) and hoist (5) to muzzle brake (6). Slowly raise cannon assembly (7).

3 Support elevating piston rod (8) with supporting strap (9).

4 Unlock key washer (10).

5 Remove round nut (11) and key washer (10) at forward end of elevating piston rod (8). Discard key washer.

6 Remove lubrication fitting (12), if necessary for replacement.

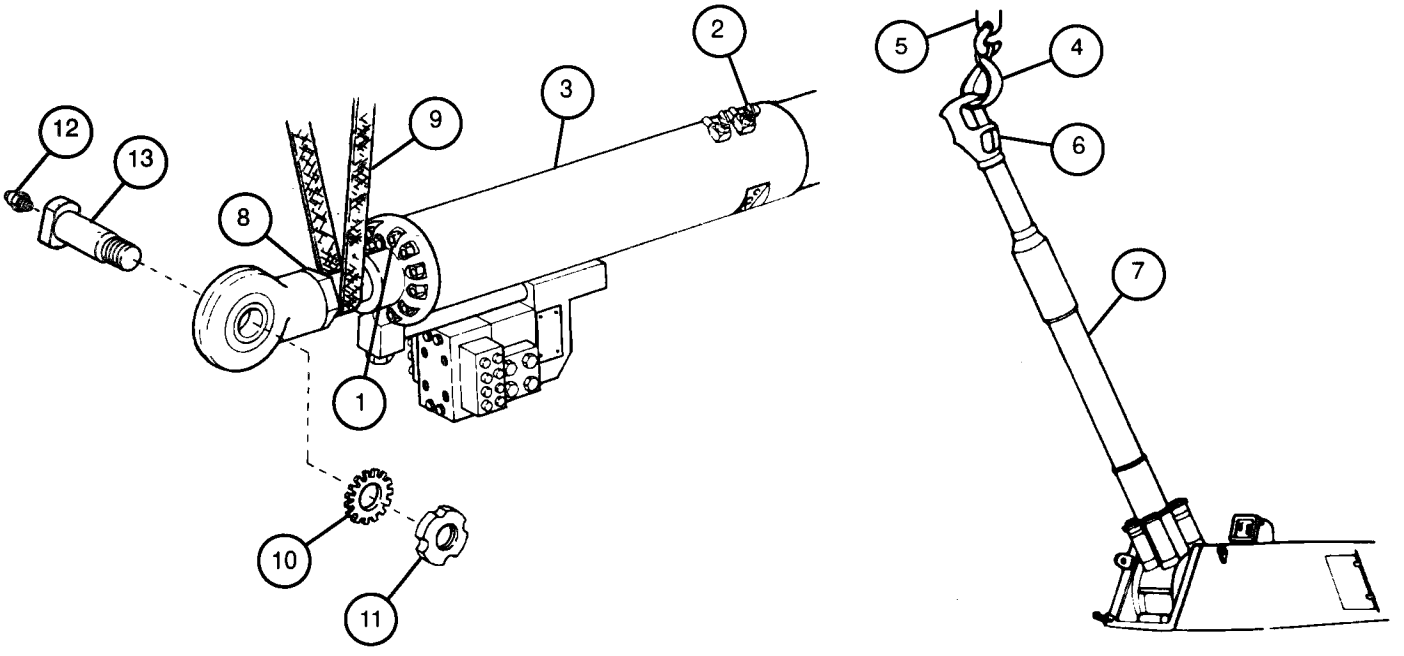
7 Rotate headed grooved pin (13) to a position where flat surface on head will clear recoil cylinder. Remove headed grooved pin.

CAUTION

Use care to avoid damage to machined surface of elevating piston rod.

8 Lower front end of equilibrated elevation mechanism assembly (3) to vertical position.

9 Lower cannon assembly (7) with hoist (5). Remove gun tube sling (4) and hoist.



6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

a. Removal - Continued

10 Remove lockwire (14), 10 cap screws (15), cap screw (16), and flat washer (17) from mounting bracket (18) on equilibrated elevation mechanism assembly (3). Discard lockwire.

11 Install eye bolt (19) in center screw hole of mounting bracket (18).

12 Attach hoist (5) to eye bolt (19). Raise mounting bracket (18) and equilibrated elevation mechanism assembly (3) clear of cab. Place equilibrated elevation mechanism assembly on a solid surface.

13 Remove locking setscrew (20) from mounting bracket (18).

14 Remove centering setscrew (21) underneath locking setscrew (20).

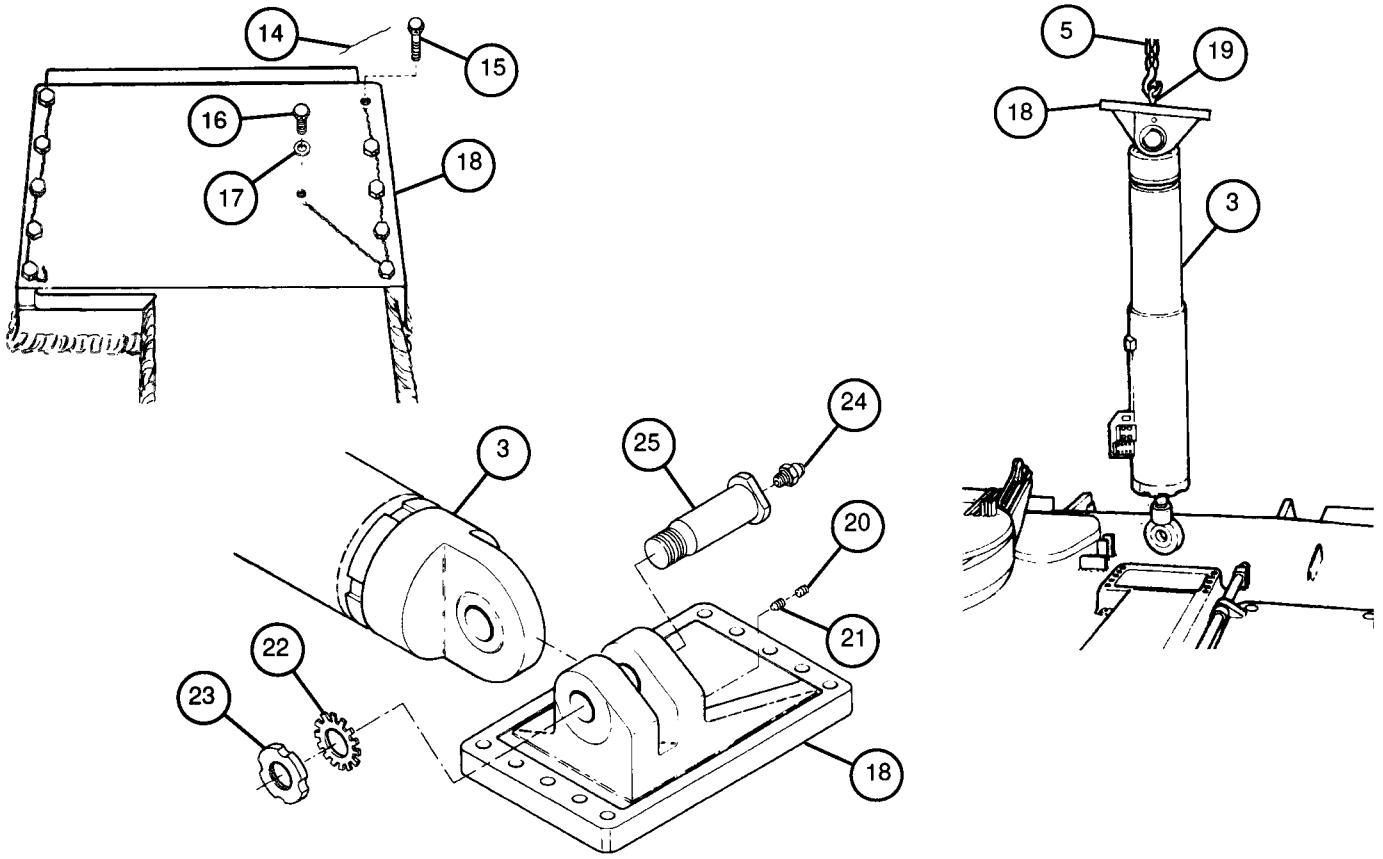
15 Unlock key washer (22).

16 Remove round nut (23) and key washer (22) at rear end of equilibrated elevation mechanism assembly (3). Discard key washer.

17 Remove lubrication fitting (24), if necessary for replacement.

18 Rotate headed grooved pin (25) to a position where flat surface will clear mounting bracket (18). Use brass drift and hammer to drive out headed grooved pin.

19 Separate equilibrated elevation mechanism assembly (3) from mounting bracket (18).



b. Disassembly

1 Remove two cap screws (26) from manifold (27). Remove manifold from tube coupling (28).

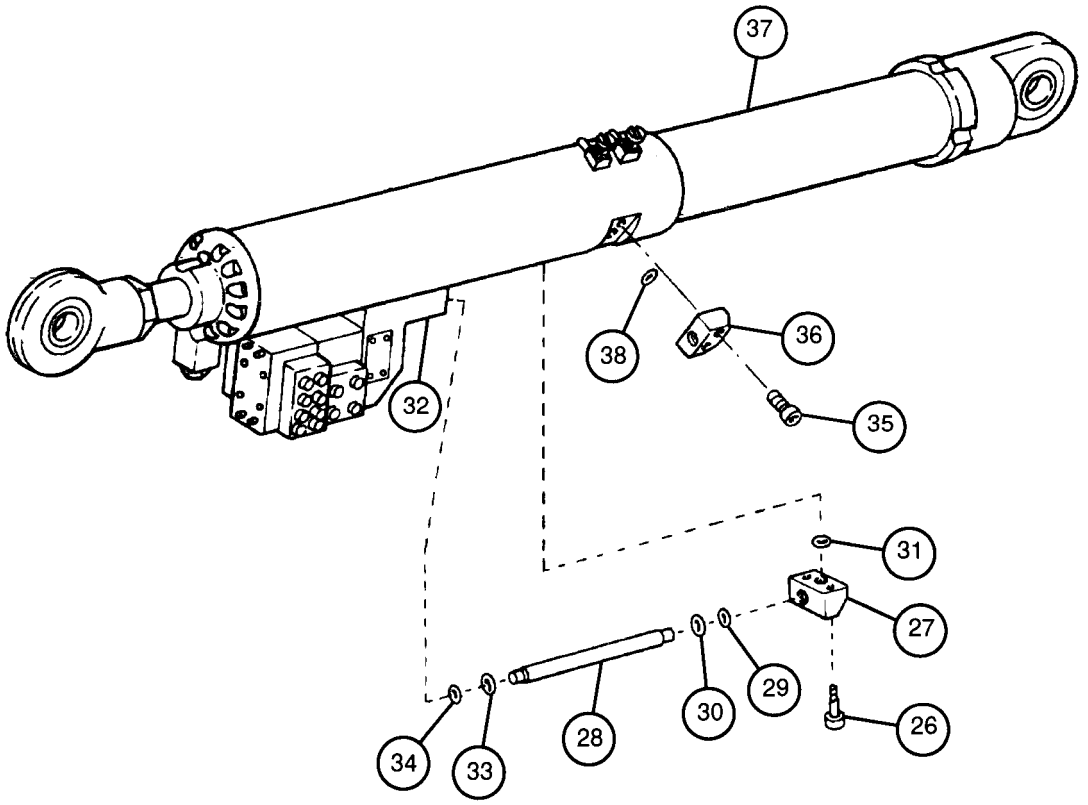
2 Remove preformed packing (29), packing retainer (30), and preformed packing (31) from manifold (27) and discard.

3 Remove tube coupling (28) from bracket assembly (32).

4 Remove packing retainer (33) and preformed packing (34) from bracket assembly (32) and discard.

5 Remove two cap screws (35) and fluid restrictor (36) from cannon equilibrator (37).

6 Remove preformed packing (38) from fluid restrictor (36) and discard.



6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

b. Disassembly - Continued

7 Remove four cap screws (39) and two machine bolts (40) from bracket assembly (32).

8 Remove safety relief elevation valve assembly (41) with tube coupling (42) from cannon equilibrator (37).

9 Remove tube coupling (42), two packing retainers (43), and two preformed packings (44). Discard packing retainers and preformed packings.

10 Remove bleeder valve (2), bleeder valve (45), and two preformed packings (46) from cannon equilibrator (37). Discard preformed packings.

NOTE

Perform step 11 for unmodified equilibrated elevation mechanism assembly or step 12 for modified equilibrated elevation mechanism assembly.

11 Loosen round nut (47) with spanner wrench.

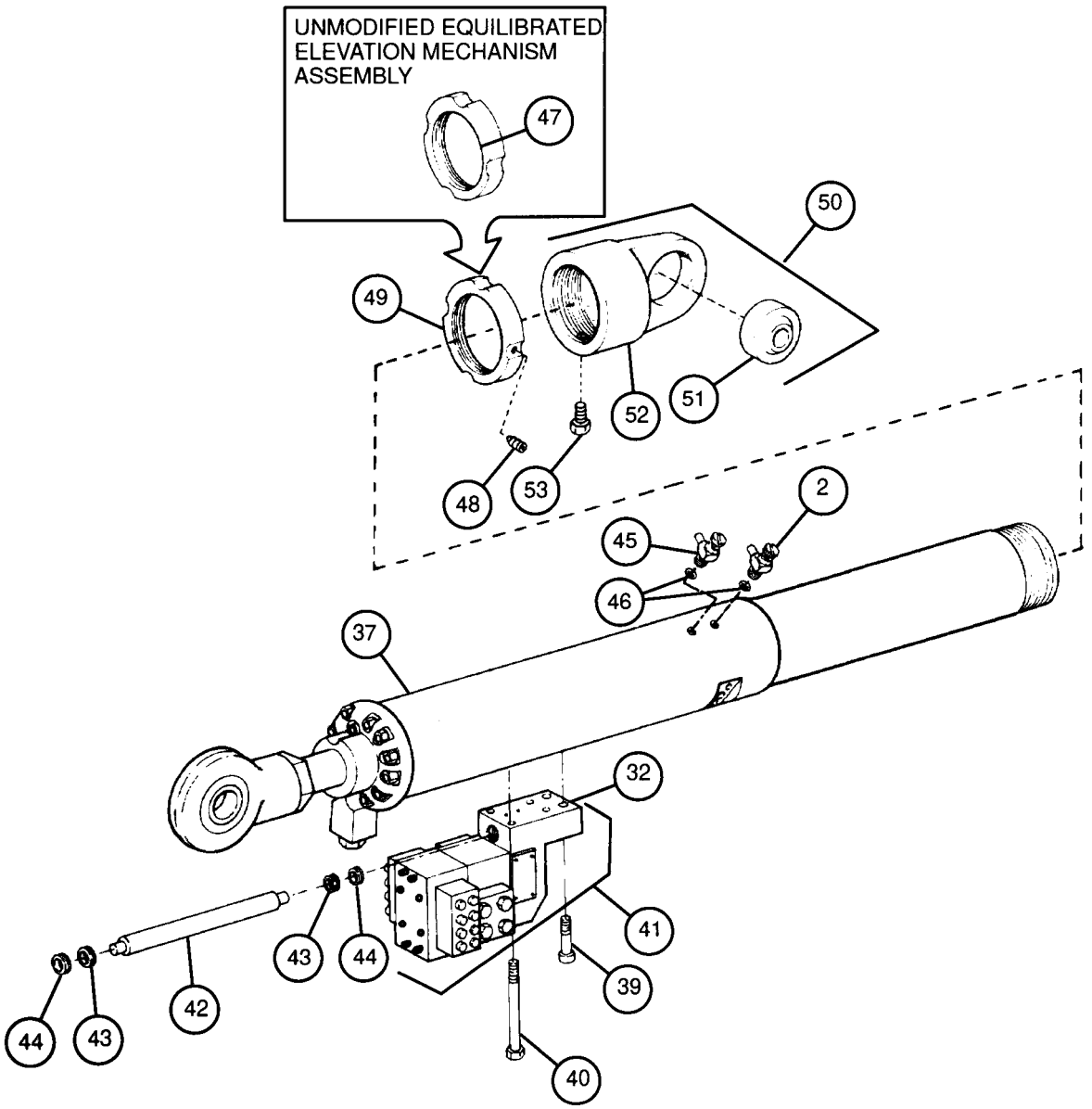
12 Remove two setscrews (48) and loosen round nut (49) with spanner wrench.

13 Remove end rod plain bearing (50) from cannon equilibrator (37).

14 If required for replacement, remove bearing (51) from eye (52).

15 Remove breather (53) from eye (52).

16 Remove round nut (47 or 49) from cannon equilibrator (37).


UNMODIFIED EQUILIBRATED
ELEVATION MECHANISM
ASSEMBLY
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6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

b. Disassembly - Continued

CAUTION

Extensive effort is required to loosen piston adapter which has been torqued to 450 lb-ft (610 N·m). Avoid side loads to piston adapter that would damage walls of cannon equilibrator.

NOTE

- Perform step 17 for unmodified elevation mechanism assembly or step 18 for modified elevation mechanism assembly.
- Restrain cannon equilibrator and end rod plain bearing while loosening piston adapter.

17 Using spanner, loosen piston adapter (54) at rear of cannon equilibrator (37) by turning counterclockwise.

18 Apply tape to spanner attachment. Using spanner attachment, loosen piston adapter (54) at rear of cannon equilibrator (37) by turning counterclockwise.

19 Restrain end rod plain bearing (55) and loosen hex nut (56).

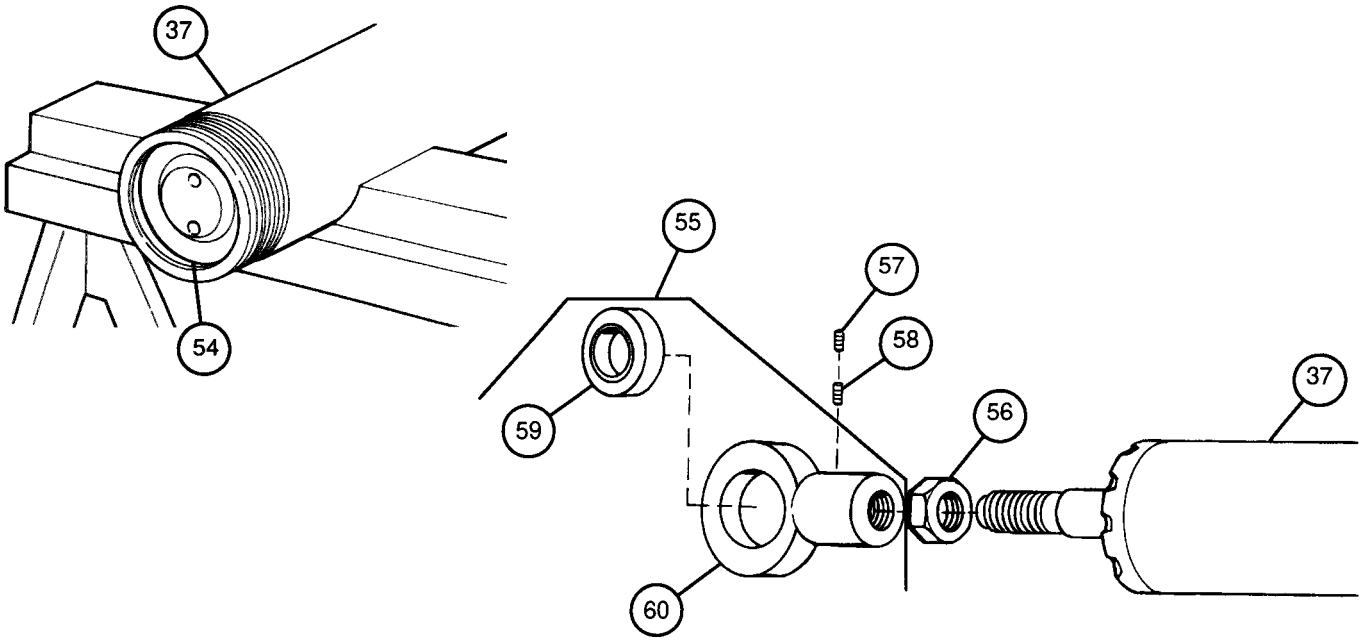
20 Remove locking setscrew (57).

21 Remove centering setscrew (58) underneath locking setscrew (57).

22 Remove end rod plain bearing (55).

23 If required for replacement, remove bearing (59) from eye (60).

24 Remove hex nut (56).



25 Remove bleeder valve (1) and preformed packing (61). Discard preformed packing.

26 Remove plug (62) and preformed packing (63). Discard preformed packing.

CAUTION

Use caution while removing cap screws to avoid damaging threads of elevating piston rod.

NOTE

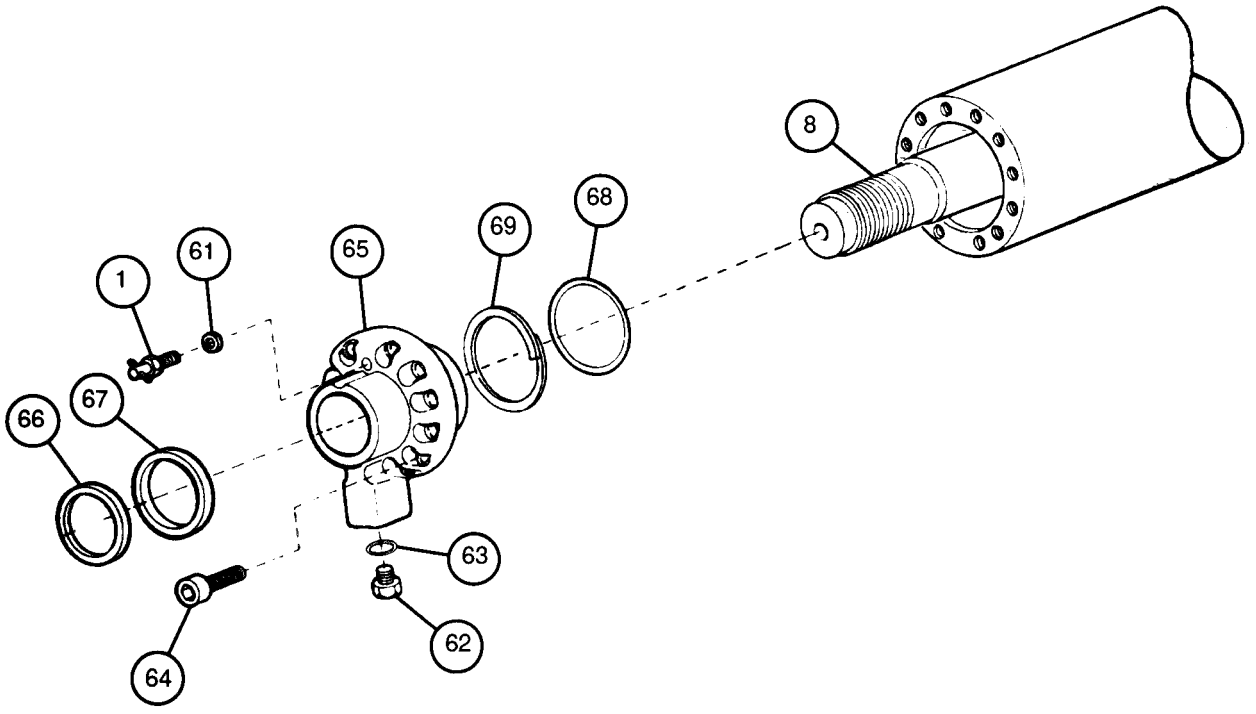
Catch excess draining hydraulic fluid in utility pail.

27 Remove 12 cap screws (64) from cap (65).

28 Support elevating piston rod (8) and remove cap (65).

29 Remove ring scraper (66) and seal ring (67) and discard.

30 Remove preformed packing (68) and split ring (69) from rear of cap (65) and discard.



6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

b. Disassembly - Continued

CAUTION

Be careful when removing piston adapter to avoid scratching smooth, finished, inner bore of cannon equilibrator.

31 Unscrew piston adapter (54) and remove from rear of cannon equilibrator (37).

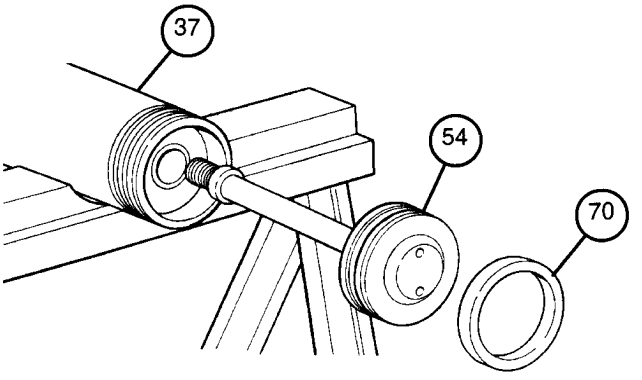
32 Remove seal (70) from piston adapter (54) and discard.

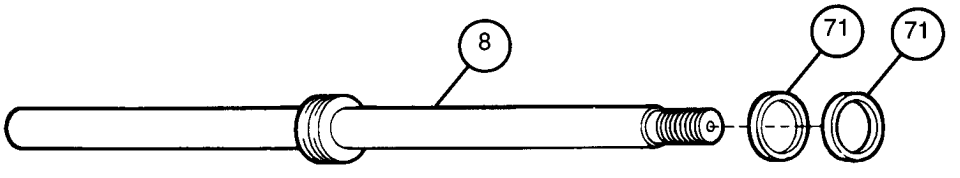
CAUTION

Be careful when removing elevating piston rod to avoid scratching smooth, finished, inner bore of cannon equilibrator.

33 Restrain cannon equilibrator (37) and withdraw elevating piston rod (8) from front end of elevating cylinder.

34 Remove two seals (71) from elevating piston rod (8) and discard.





NOTE

Steps 35 through 44 pertain to unmodified equilibrated elevation mechanism assembly.

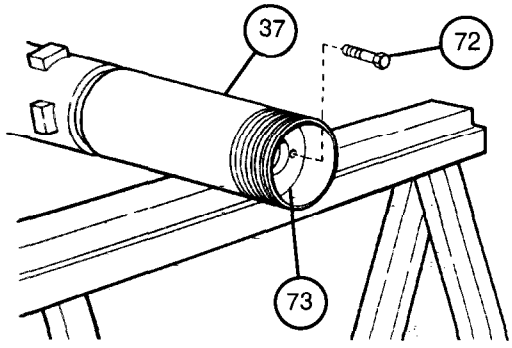
35 Restrain cannon equilibrator (37) and remove two cap screws (72) from rear cylinder bearing (73).

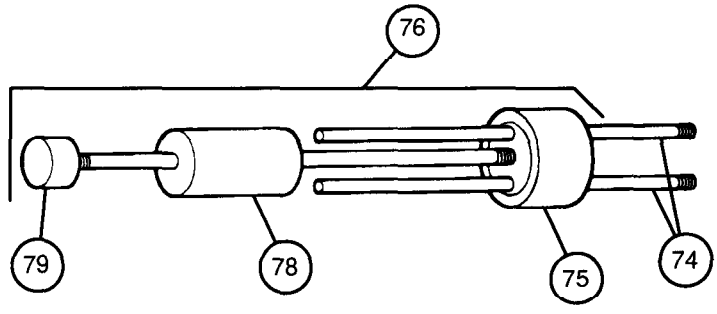
36 Place two 5/16 inch diameter brass guide rods (74) through bearing guide (75) of guide tool assembly (76). Screw two 5/1 6 inch diameter brass guide rods into rear cylinder bearing (73).

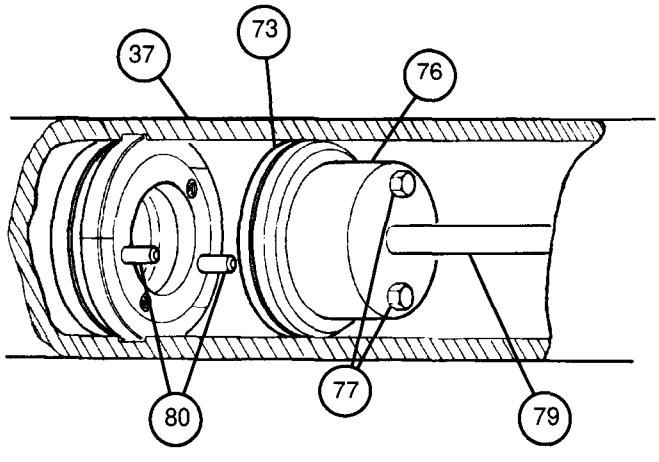
37 Slide guide tool assembly (76) into cannon equilibrator (37) on two 5/16 inch diameter brass guide rods (74) until bearing guide (75) fits into cannon equilibrator center.

38 Replace two 5/16 inch diameter brass guide rods (74), one at a time, with two 5/16 inch 24 UNF cap screws (77) that belong to guide tool assembly (76).

39 Remove rear cylinder bearing (73) from cannon equilibrator (37) by tapping slide (78) against rod end (79) to separate from two headless straight pins (80).







6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

b. Disassembly - Continued

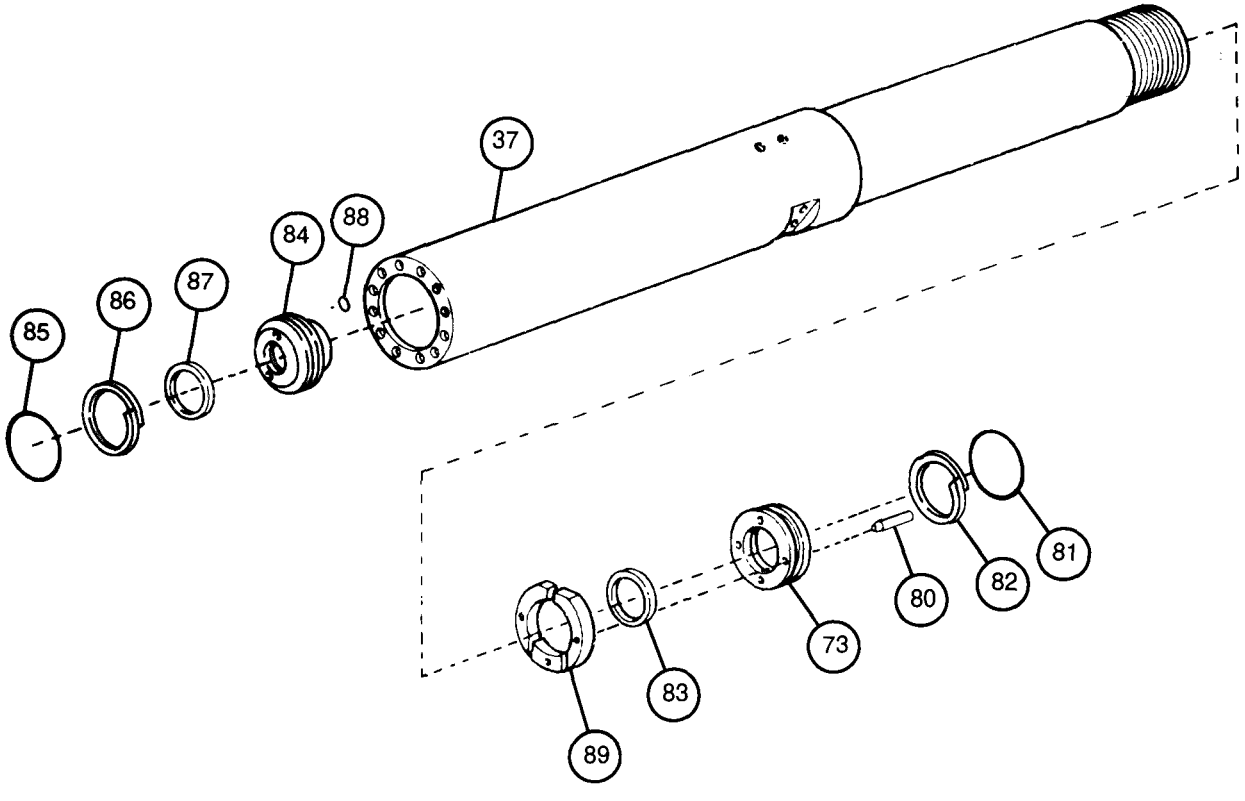
40 Remove preformed packing (81), split ring (82), and seal ring (83) from rear cylinder bearing (73) and discard.

41 Remove front cylinder bearing (84) from front of cannon equilibrator (37) as in steps 36 through 38.

42 Remove preformed packing (85), split ring (86), seal ring (87), and four preformed packings (88) from front cylinder bearing (84) and discard.

43 Remove two headless straight pins (80).

44 Remove wiper ring (89) consisting of three key segments from cannon equilibrator (37).



NOTE

Steps 45 through 52 pertain to modified equilibrated elevation mechanism assembly.

45 Restrain sleeve bearing (90) with spanner attachment and extension (91). Using socket wrench socket with extension, remove nut (92) from sleeve bearing. Remove spanner attachment and socket wrench socket.

46 Insert guide tool assembly (76) into front of cannon equilibrator (37). Insert two 5/16 inch 24 UNF cap screws (77) that belong to guide tool assembly through holes in bearing guide (75) and holes of sleeve bearing (90) and tighten.

47 Remove sleeve bearing (90) from cannon equilibrator (37) by tapping guide tool assembly (76) slide (78) against rod end (79). Slide guide tool assembly and attached sleeve bearing from cannon equilibrator.

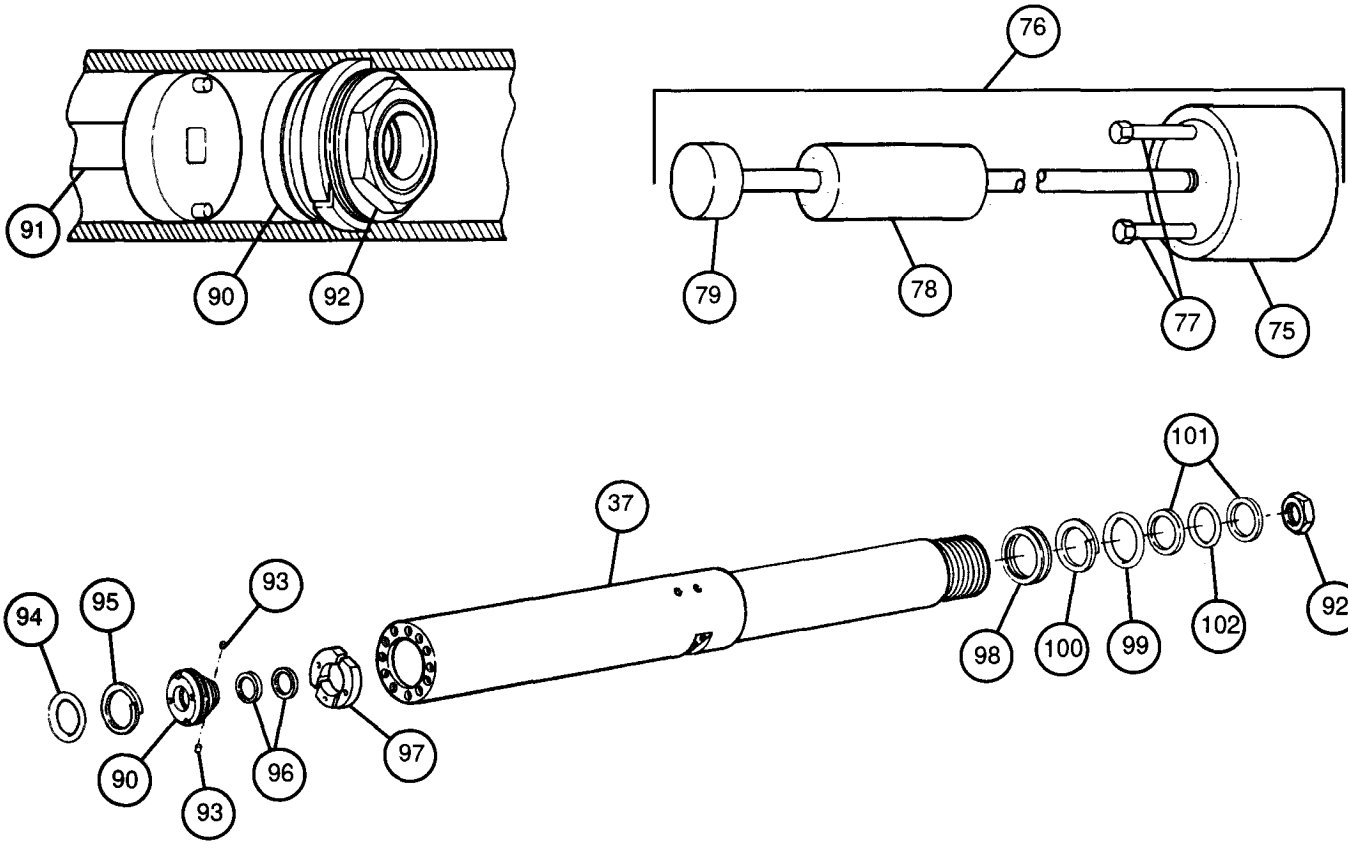
48 Remove two pellets (93) from sleeve bearing (90) and discard.

49 Remove preformed packing (94), split ring (95), and two seals (96) from sleeve bearing (90) and discard.

50 Remove wiper ring (97) consisting of three key segments from cannon equilibrator (37).

51 Using guide tool assembly, remove packing retainer (98) from cannon equilibrator (37).

52 Remove preformed packing (99), split ring (100), two retainers (101), and preformed packing (102) from packing retainer (98) and discard.



6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

c. Inspection

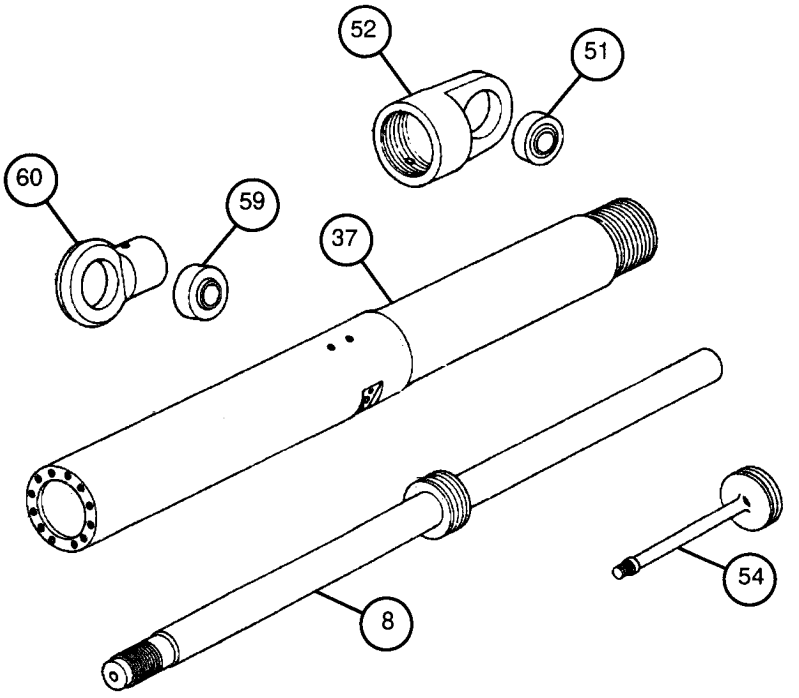
1 Inspect bearings (51 and 59) and replace if damaged. Refer to TM 9-214 for proper cleaning, inspection and lubrication procedures.

2 Inspect eyes (60 and 52). Replace if cracked or distorted. If threads have nicks, burrs, or other damage, repair threads and use again.

3 Inspect piston adapter (54). Replace if scored or scratched.

4 Inspect elevating piston rod (8). Replace if scored or scratched.

5 Inspect cannon equilibrator (37). Replace if cracked, distorted, or bore is scored or scratched.



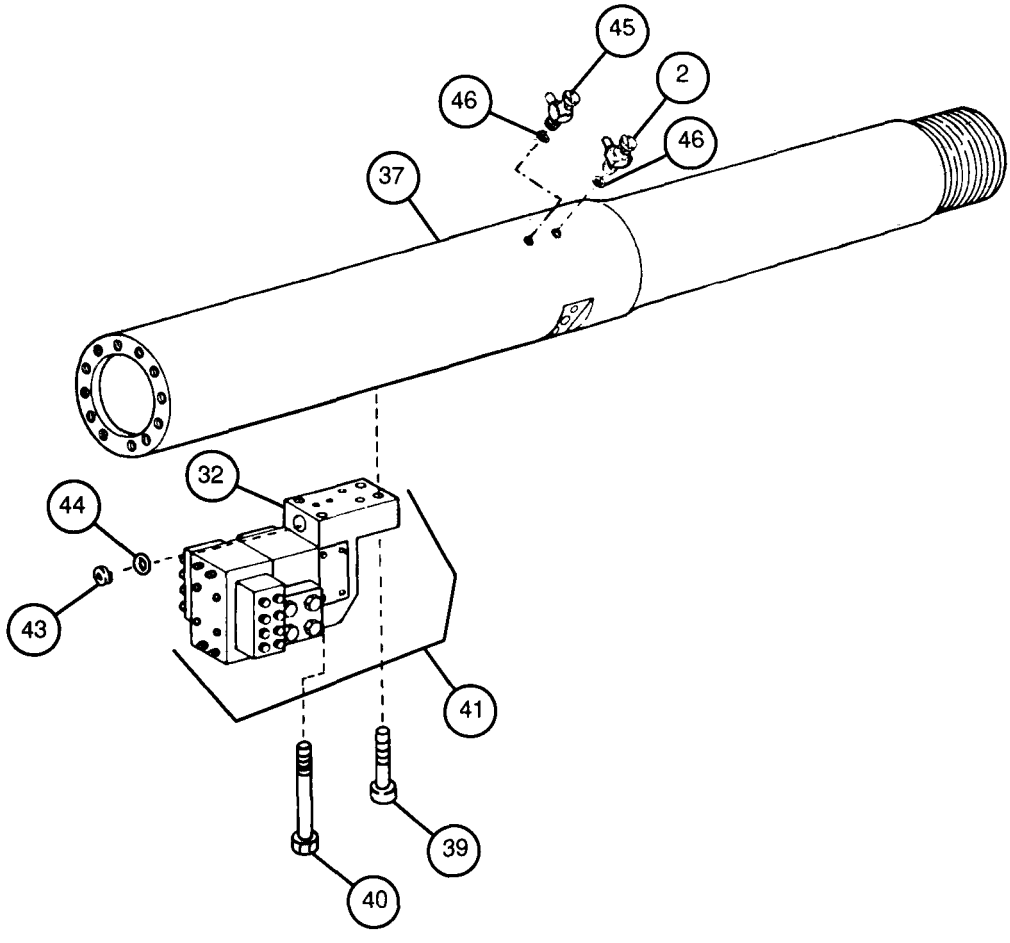
d. Assembly

1 Install two new preformed packings (46), bleeder valve (45), and bleeder valve (2) in cannon equilibrator (37).

2 Install one of two new preformed packings (44) and one of two new packing retainers (43) in bracket assembly (32).

3 Apply sealing compound to four cap screws (39) and two machine bolts (40). Install safety relief elevation valve assembly (41) to cannon equilibrator (37) with four cap screws, and two machine bolts. Torque cap screws and machine bolts to 20 lb-ft (27 N·m).

4 Lubricate the inside of cannon equilibrator (37) with hydraulic fluid.



6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

d. Assembly - Continued

NOTE

Steps 5 through 15 pertain to unmodified equilibrated elevation mechanism assembly.

5 Lubricate two headless straight pins (80), new seal ring (87), new preformed packing (85), new split ring (86), and four new preformed packings (88) with hydraulic fluid and install securely on front cylinder bearing (84).

6 Insert two 5/16 inch 24 UNF cap screws (77) through bearing guide (75) and tighten into front cylinder bearing (84).

7 Slide bearing guide (75) into cannon equilibrator (37) from the front end. Have an assistant place and hold three key segments of wiper ring (89) in center groove (103) while front cylinder bearing (84) is pushed into place. Be careful that new preformed packing (85) on front cylinder bearing is not cut or damaged as it passes over oil port (104). Observe new preformed packing through oil port.

8 Remove two 5/16 inch 24 UNF cap screws (77) from front cylinder bearing (84) and bearing guide (75).

9 Withdraw bearing guide (75) from cannon equilibrator (37).

10 Lubricate new seal ring (83), new preformed packing (81), and new split ring (82) with hydraulic fluid. Install on rear cylinder bearing (73).

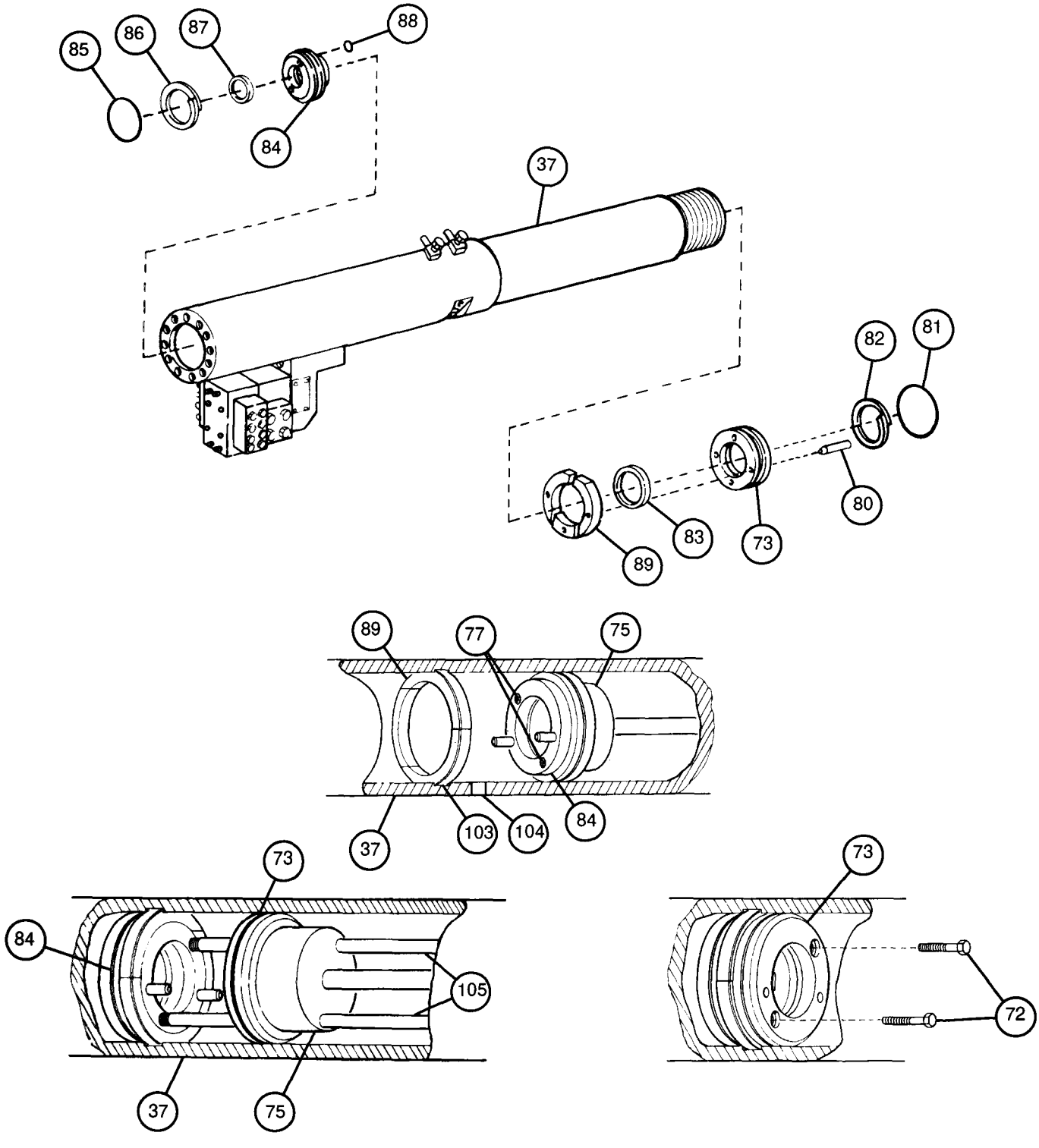
11 Place rear cylinder bearing (73) on bearing guide (75).

12 Insert two 1/4 inch 28 UNF guide rods (105) through bearing guide (75), rear cylinder bearing (73), and rear of cannon equilibrator (37). Screw two 1/4 inch 28 UNF guide rods into mating holes of front cylinder bearing (84) to ensure proper alinement of pin and cap screw holes in front cylinder bearing and rear cylinder bearing.

13 Slide rear cylinder bearing (73) into cannon equilibrator (37).

14 Remove bearing guide (75) by unscrewing two 1/4 inch 28 UNF guide rods (105).

15 Apply sealing compound to two cap screws (72) and install through rear cylinder bearing (73). Torque cap screws to 9 lb-ft (12 N·m).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6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

d. Assembly - Continued

NOTE

- Steps 16 through 23 pertain to modified equilibrated elevation mechanism assembly.
- Two different designs of seal rings are approved for use in the cannon equilibrator.
- One of these designs is a closed seal and can be installed with either face to the pressurized side of the cannon equilibrator.
- The other approved seal design is “unidirectional” and has an open face on one side exposing an o-ring “energizer.” This open face must be installed facing the pressurized side of the cannon equilibrator to seal effectively.

16 Lubricate new preformed packing (94), new split ring (95), and two new seal rings (96) with hydraulic fluid and install on sleeve bearing (90).

17 Install two new pellets (93) in sleeve bearing (90).

NOTE

Installation of key segments and sleeve bearing requires two people.

18 Install three key segments of wiper ring (97) in center groove (103) inside cannon equilibrator (37). Hold in place until sleeve bearing (90) is installed.

CAUTION

Use seal inserter when installing sleeve bearing in cannon equilibrator to prevent damage to seals on the front cylinder bearing when passing oil port.

19 Insert seal inserter (106) into port (not shown) on cannon equilibrator (37). Lubricate sleeve bearing (90) with hydraulic fluid and carefully slide into front end of cannon equilibrator. Use guide tool assembly (not shown) to push into position.

20 Remove seal inserter (106) and guide tool assembly (not shown).

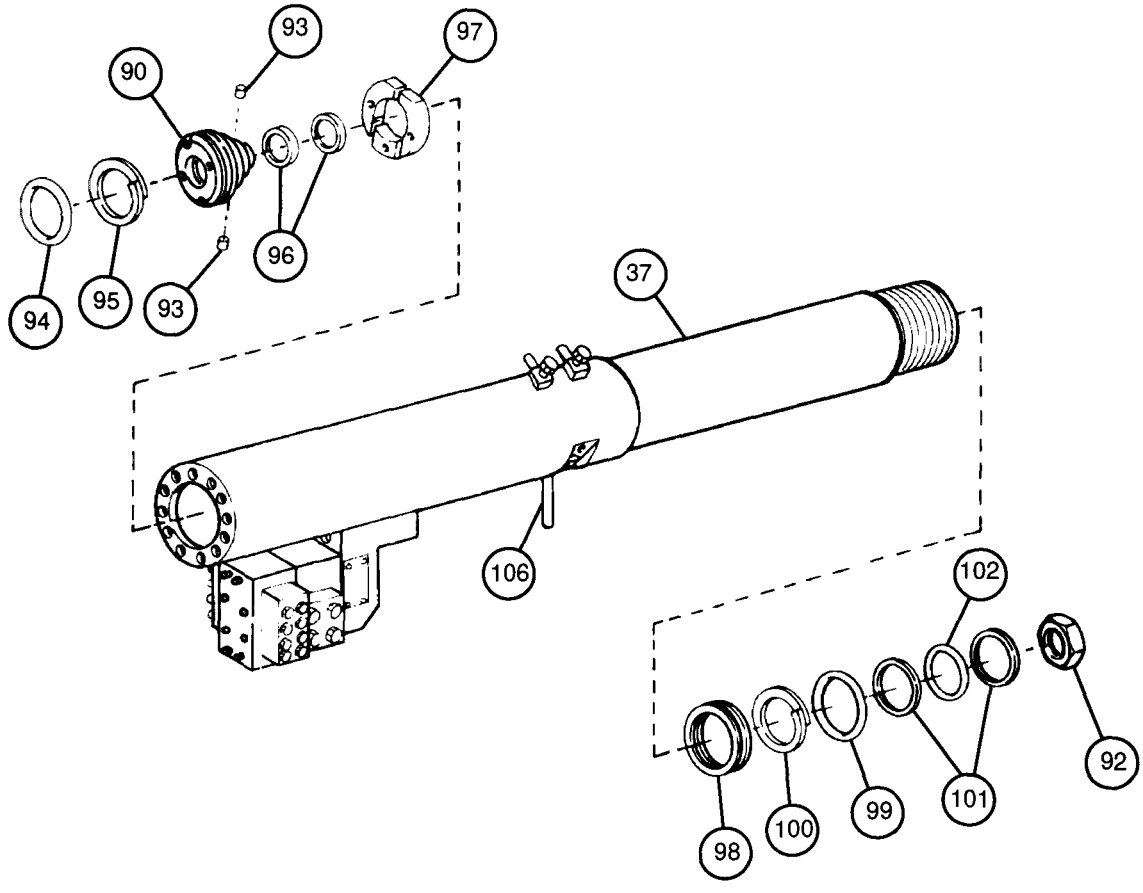
21 Lubricate new preformed packing (99), new split ring (100), new preformed packing (102), and two new retainers (101) with hydraulic fluid and install on packing retainer (98).

CAUTION

Use seal inserter when installing packing retainer in cannon equilibrator to prevent damage to seals on the rear half when passing oil port.

22 Insert seal inserter (106) into port (not shown) on cannon equilibrator (37). Carefully slide packing retainer (98) into cannon equilibrator and onto end of sleeve bearing (90) using spanner attachment (91).

23 Using spanner attachment (91) with extension, restrain sleeve bearing (90) to install and tighten nut (92) on back of sleeve bearing. Torque nut to 80-100 lb-ft (108-136 N·m). Remove spanner attachment.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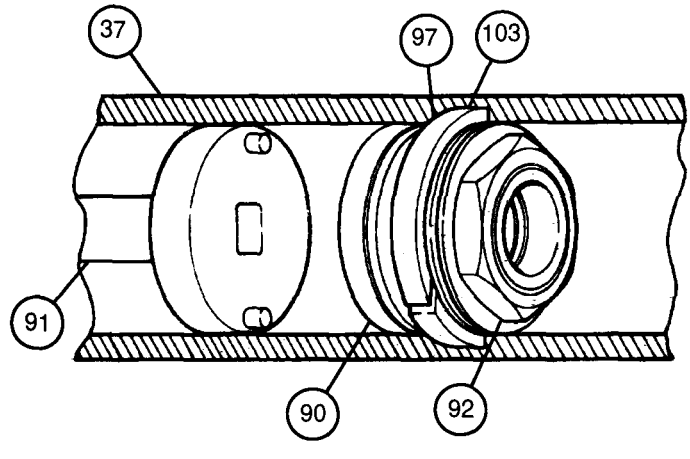
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6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

d. Assembly - Continued

24 Install new preformed packing (38) in fluid restrictor (36).

25 Apply sealing compound to two cap screws (35). Install fluid restrictor (36) to cannon equilibrator (37) with two cap screws. Torque cap screws to 20 lb-ft (27 N·m).

26 Install new preformed packing (34) and new packing retainer (33) in bracket assembly (32).

27 Install tube coupling (28) to bracket assembly (32).

28 Install two new preformed packings (29 and 31) and new packing retainer (30) in manifold (27).

29 Connect manifold (27) to tube coupling (28).

30 Apply sealing compound to threads of two cap screws (26). Install manifold (27) to cannon equilibrator (37) with two cap screws. Torque cap screws to 20 lb-ft (27 N·m).

31 Lubricate two new seals (71) with hydraulic fluid. Install on elevating piston rod (8).

NOTE

- Perform step 32 for unmodified equilibrated elevation mechanism assembly or step 33 for modified equilibrated elevation mechanism assembly.
- Be careful not to scratch smooth, finished, inner bore of cannon equilibrator or to damage new seals.

32 Restrain cannon equilibrator (37) and install elevating piston rod (8) into cannon equilibrator through front end.

33 Restrain cannon equilibrator (37). Insert rod guide tool (not shown) into equilibration end of elevating piston rod (8). Install elevating piston rod in cannon equilibrator (37) through front end. Remove rod guide tool.

34 Lubricate new seal ring (70) with hydraulic fluid and install on piston adapter (54).

NOTE

Perform step 35 for unmodified equilibrated elevation mechanism assembly or step 36 for modified equilibrated elevation mechanism assembly.

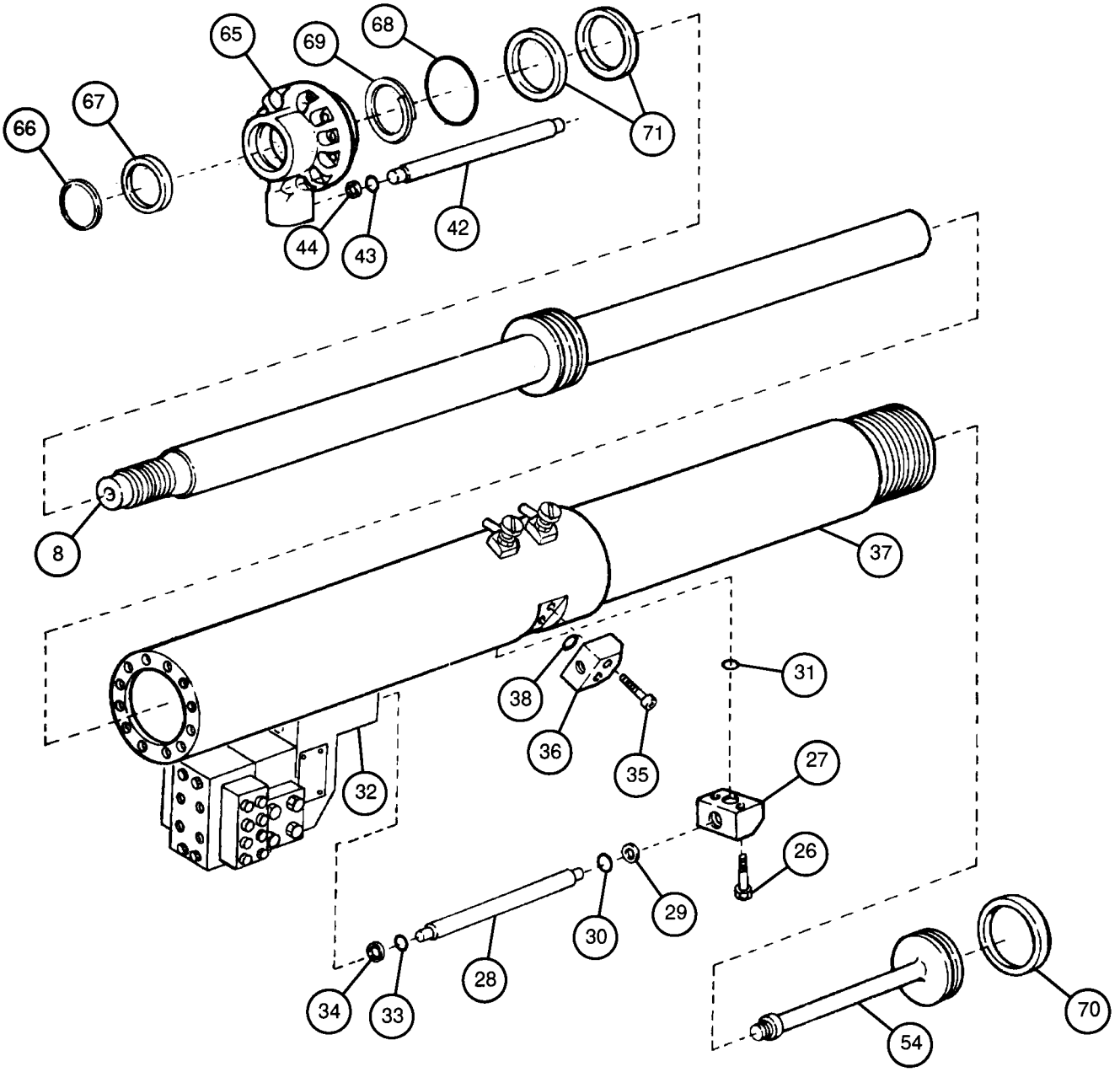
35 Install piston adapter (54) by screwing it into rear of elevating piston rod (8) by hand.

36 Apply sealing compound to piston adapter (54) and screw it into rear of elevating piston rod (8) using spanner attachment (not shown).

37 Lubricate new preformed packing (68), new split ring (69), new seal ring (67), and new ring scraper (66) with hydraulic fluid. Install on cap (65).

38 Lubricate remaining new preformed packing (44) and remaining new packing retainer (43) with hydraulic fluid and install in cap (65).

39 Install tube coupling (42) in cap (65).



6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY - CONTINUED

d. Assembly - Continued

40 Place cap (65) on elevating piston rod (8).

41 Lubricate end cap guide tool (not shown) with hydraulic fluid and install over elevating side of elevating piston rod (8). Position cap (65) on end cap guide tool and push into place on cannon equilibrator (37) attaching tube coupling (42) to bracket assembly (32).

42 Apply sealing compound to threads of 12 cap screws (64). Install 12 cap screws, securing cap (65) to cannon equilibrator (37). Torque 12 cap screws to 90 lb-ft (122 N·m).

43 Remove end cap guide tool (not shown).

44 Install new preformed packing (61) and bleeder valve (1) on cap (65).

45 Install new preformed packing (63) and plug (62).

NOTE

End rod plain bearing must bottom out on elevating piston rod before installing locking setscrew.

46 Apply sealing compound to threads of hex nut (56) and install hex nut in elevating piston rod (8).

47 If removed, install bearing (59) in eye (60) and stake in place.

48 Install end rod plain bearing (55) on elevating piston rod (8) and clinch tight with hex nut (56).

49 Apply sealing compound to threads of locking setscrew (57) and centering setscrew (58). Install centering setscrew and locking setscrew in end rod plain bearing (55) and torque to 9 lb-ft (12 N·m).

50 Restrain end rod plain bearing (55) and torque hex nut (56) to 200 lb-ft (271 N·m).

51 Restrain end rod plain bearing (55). Apply sealing compound to piston adapter (54). Using spanner wrench alternately torque to 450 ± 50 lb-ft (610 ± 68 N·m) and loosen piston adapter three times before final torquing to 450 lb-ft (610 N·m). After final torquing be sure there is a minimum of 0.001 inch (0.03 mm) between piston adapter and inner bore of cannon equilibrator (37).

52 Install round nut (47 or 49) on cannon equilibrator (37).

53 Install breather (53) on eye (52).

54 If removed, install bearing (51) in eye (52) and stake in place.

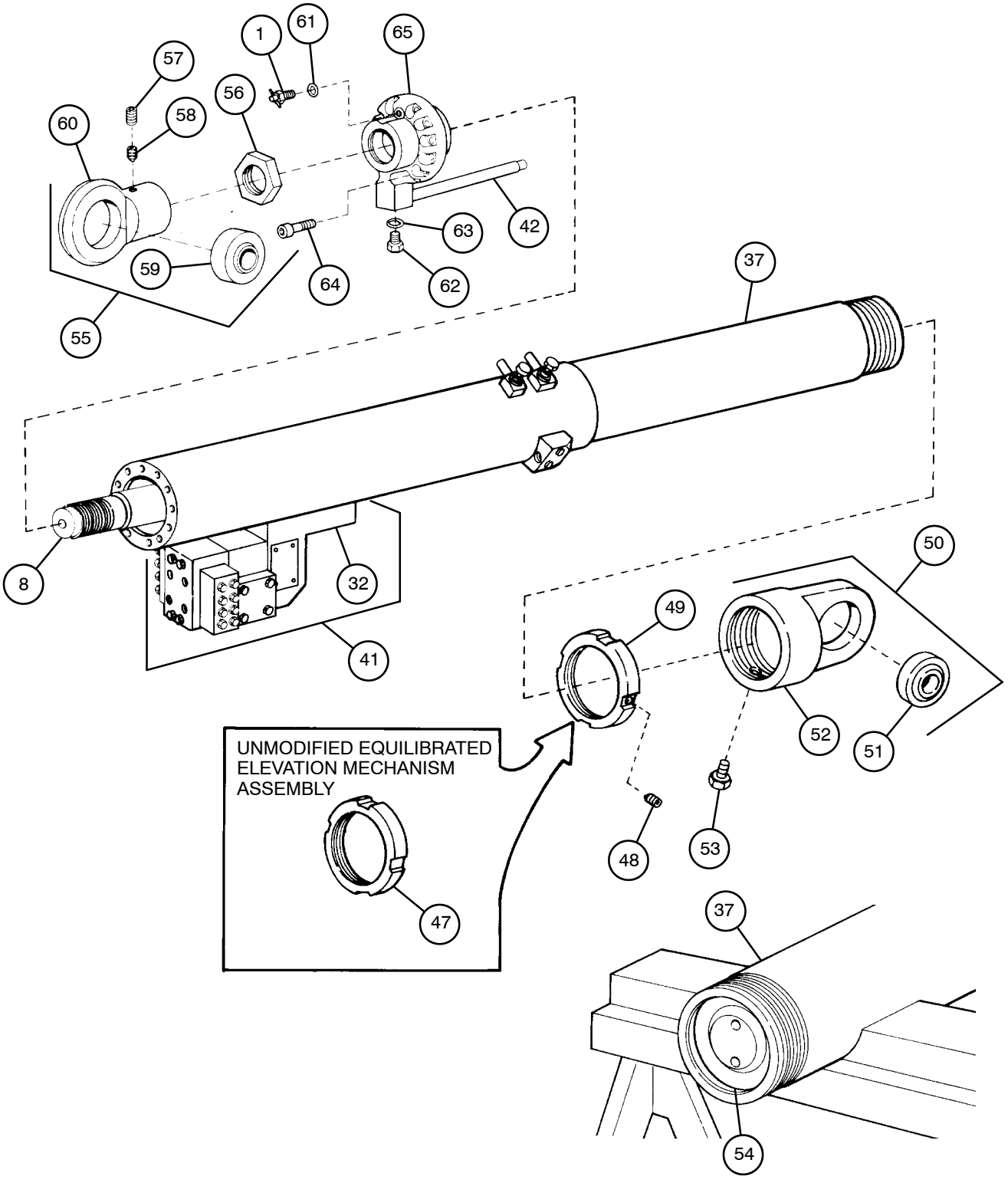
55 Install end rod plain bearing (50) on cannon equilibrator (37) until it bottoms on cannon equilibrator, then back end rod plain bearing off as necessary so that eye (52) is in line with safety relief elevation valve assembly (41).

56 Tighten round nut (47 or 49) with spanner wrench against end rod plain bearing (50).

NOTE

Step 57 pertains only to modified equilibrated elevating mechanism assembly.

57 Apply sealing compound to two setscrews (48) and install in round nut (49). Torque setscrews to 9 lb-ft (12 N·m).



6-11 EQUILIBRATED ELEVATION MECHANISM ASSEMBLY — CONTINUED

e. Installation

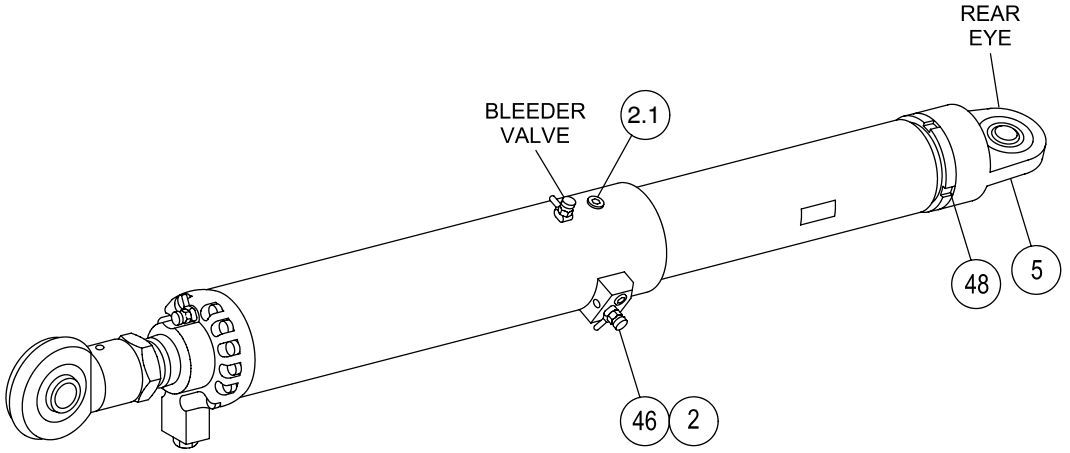
NOTE

If elevation cylinder 13008227 is received as a replacement cylinder, perform steps 1, 1A, and 1B. If not, perform step 1C.

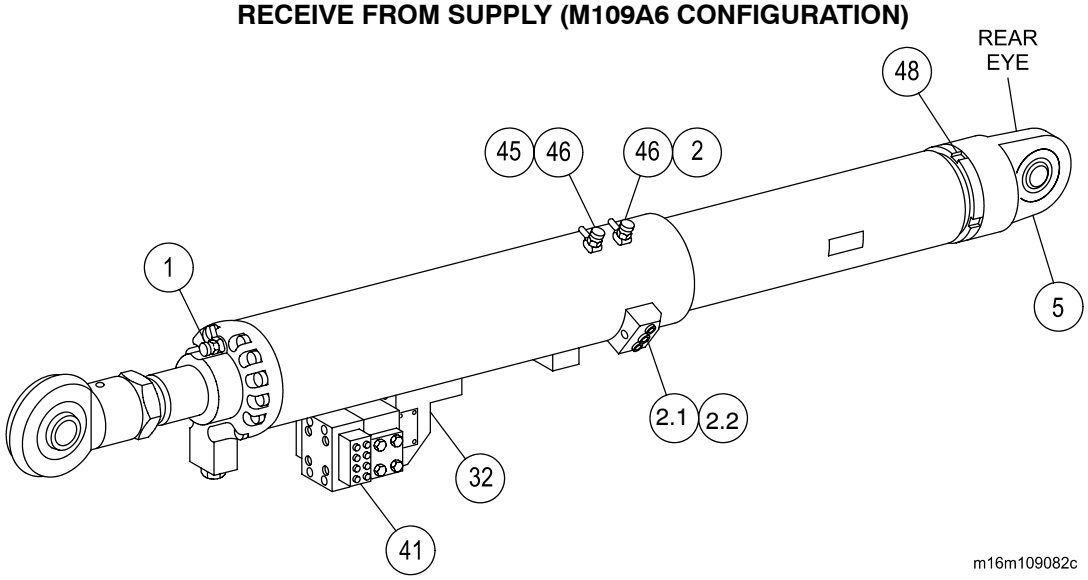
1 Reverse position of plug (2.1) and packing (2.2) with bleeder valve (45) and packing (46). Install new packings (2.2) and (46).

1A Remove set screws (48), loosen and turn rear eye (5) as necessary to align with safety relief valve (1). Install set screws (48).

1B Install bracket assembly (32) and safety elevation relief valve (41).



RECEIVE FROM SUPPLY (M109A6 CONFIGURATION)



M109A2-A5 CONFIGURATION

e. Installation - Continued

1C Place end rod plain bearing (50) of equilibrated elevation mechanism assembly (3) in mounting bracket (18).

2 Install headed grooved pin (25), new key washer (22), and round nut (23). Bend tabs of key washer over round nut to lock.

NOTE

Lubrication fitting may not be present.

3 Install lubrication fitting (24) if removed.

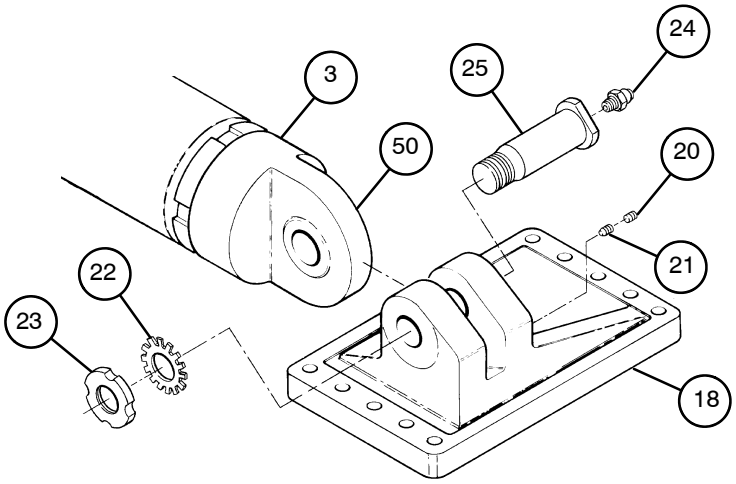
4 Apply sealing compound to threads of centering setscrew (21). Install by turning centering setscrew until equal clearance is obtained between end rod plain bearing (50) and mounting bracket (18) on each side of end rod plain bearing.

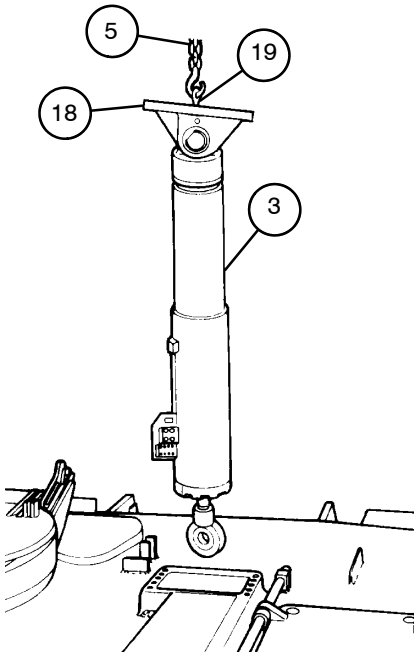
5 Apply sealing compound to threads of locking setscrew (20). Install in mounting bracket (18) directly over centering setscrew (21).

6 Inspect area of cab roof to which mounting bracket (18) will be attached. Repair defects as required before installing equilibrated elevation mechanism assembly (3).

7 Install eye bolt (19) into center screw hole of mounting bracket (18).

8 Attach hoist (5) to eye bolt (19). Raise equilibrated elevation mechanism assembly (3) and mounting bracket (18) to position over cab roof. Lower through hole in cab roof.





9 Position mounting bracket (18) in place on inside cab roof and secure by installing 10 cap screws (15), flat washer (17), and cap screw (16). Torque cap screws to 225 lb-ft (305 N·m) for mounting bracket (PN 8449198) and 110 lb-ft (149 N·m) for mounting bracket (PN 11636277).

10 Secure 10 cap screws (15) and cap screw (16) with new lockwire (14).

11 Install gun tube sling (4) to muzzle brake (6) of cannon assembly (7) and raise cannon assembly with hoist (5).

NOTE

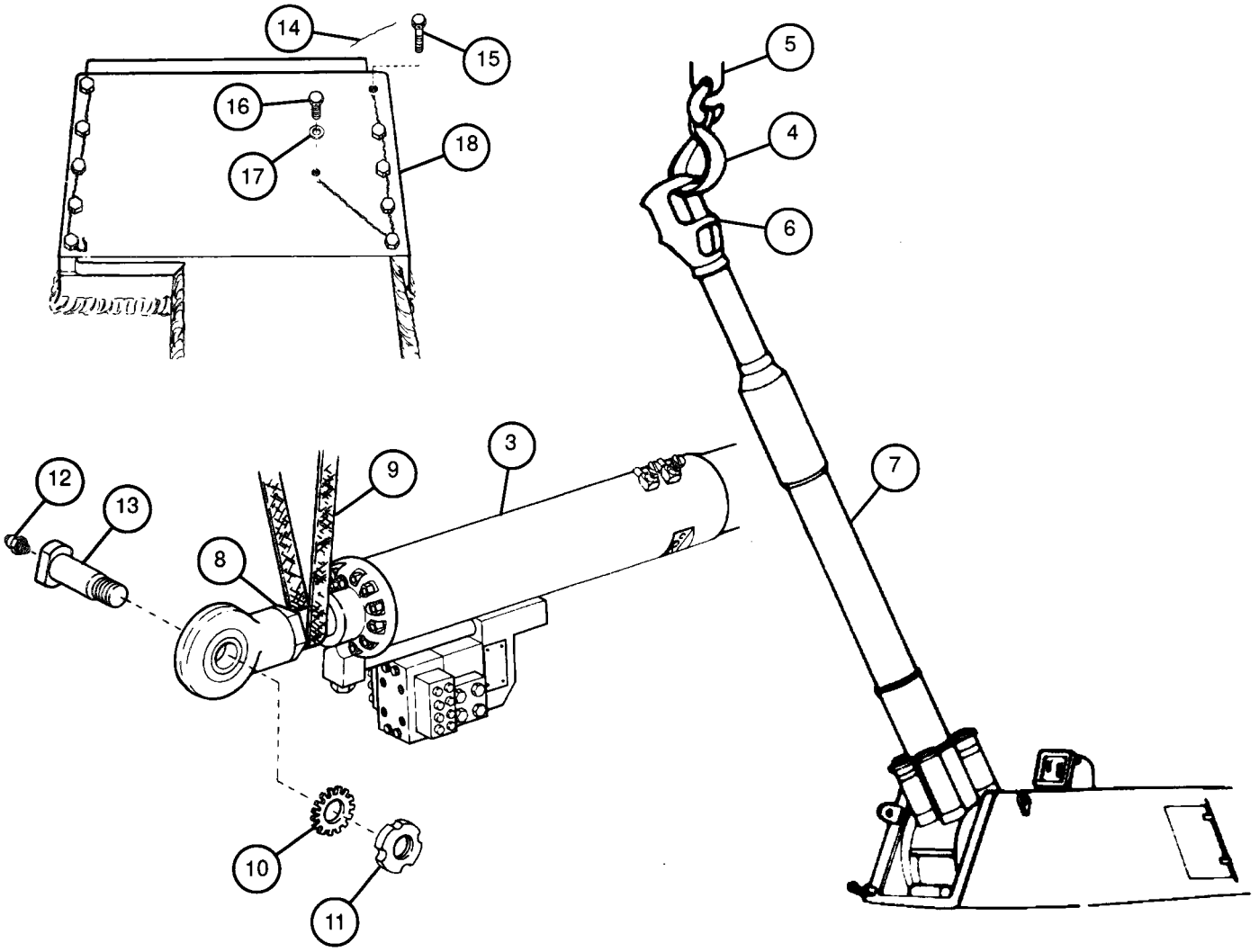
Be careful to protect machined surface of elevating piston rod from scratches and damage when installing.

12 Support elevating piston rod (8) with supporting strap (9) and raise front end of equilibrated elevation mechanism assembly (3) toward mount inside cab.

13 Install headed grooved pin (13), new key washer (10), and round nut (11). Bend tabs of key washer over round nut to lock.

14 Install lubrication fitting (12) if removed.

15 Lower cannon assembly (7) with hoist (5).



6-12 SAFETY RELIEF ELEVATION VALVE ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Lockwashers (8) (item 84, Appx E)
Lockwashers (4) (item 108, Appx E)
Preformed packings (4) (item 51, Appx E)
Preformed packings (2) (item 163, Appx E)

Equipment Condition
Safety relief elevation valve assembly removed (para 6-11)

a. Disassembly

WARNING

Wear safety glasses and steel-tipped shoes to avoid possible injury while handling equipment.

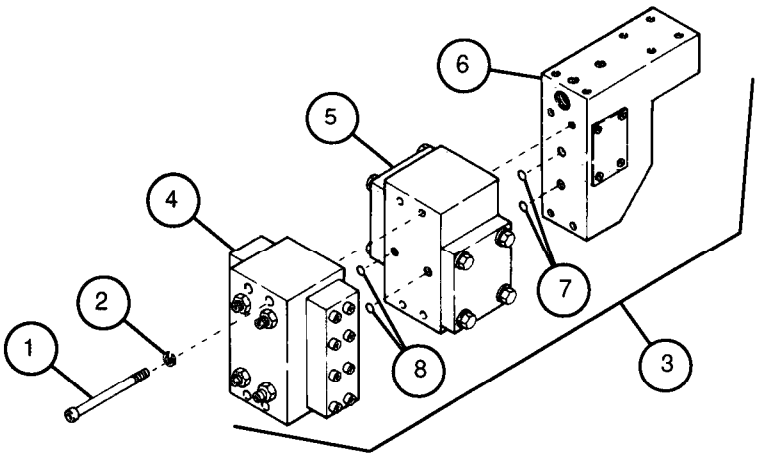
NOTE

There are three different valve assemblies identifiable by number stamped in body. Valve assemblies with part numbers 8744652 and 1178342 are not repaired, but instead are replaced by valve assembly 11784023.

1 Remove four cap screws (1) and four lockwashers (2) from safety relief elevation valve assembly (3). Separate valve assembly (4), manifold assembly (5), and bracket assembly (6). Discard lockwashers.

2 Remove two preformed packings (7) from face of bracket assembly (6) and discard.

3 Remove two preformed packings (8) from face of manifold assembly (5) and discard.



WARNING

Access covers hold helical compression springs under compression. Restrain access covers to avoid injury.

4 Loosen eight cap screws (9) gradually until all spring compression is relieved. Remove eight cap screws, eight lockwashers (10), and two access covers (11). Discard lockwashers.

5 Remove two helical compression springs (12), two preformed packings (13), shims (14) (if present), two headed straight pins (15), and two bearing balls (16) from block (17). Discard preformed packings. Retain shims for use in assembly.

b. Inspection

1 Inspect bail seat in block (17) and access covers (11). If damaged, replace manifold assembly (5).

2 Inspect all other parts. Replace any that are damaged, distorted, scratched on machined surfaces, or have damaged threads.

3 Check for blockage in bracket assembly (6). Clear blockage.

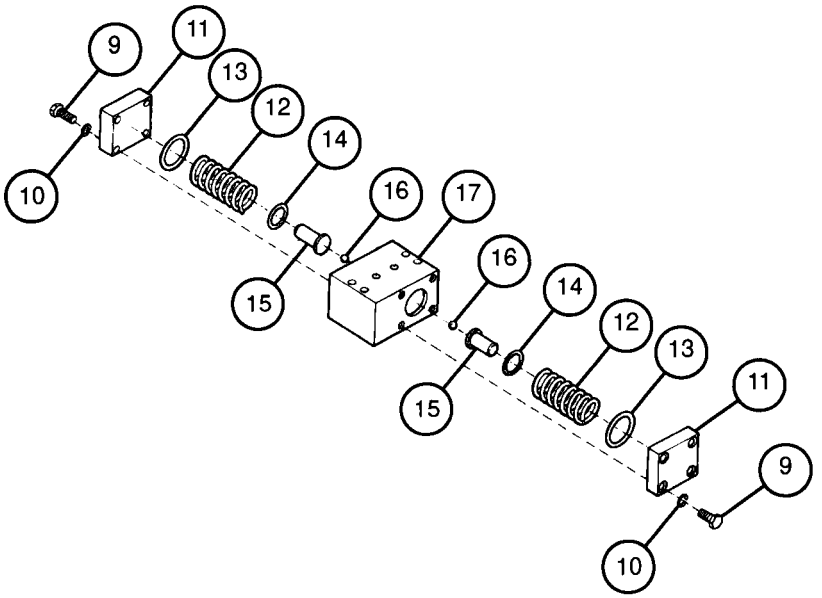
c. Assembly

1 Install two bearing balls (16), two headed straight pins (15), shims (14) (if present), two new preformed packings (13), and two helical compression springs (12) in block (17).

WARNING

Access covers must hold helical compression springs under high compression load. Restrain access covers while assembling to avoid injury.

2 Install two access covers (11), eight new lockwashers (10), and eight cap screws (9). Tighten eight cap screws gradually until helical compression springs (12) are fully compressed.



6-12 SAFETY RELIEF ELEVATION VALVE ASSEMBLY - CONTINUED

c. Assembly - Continued

3 Install two new preformed packings (8) in face of manifold assembly (5).

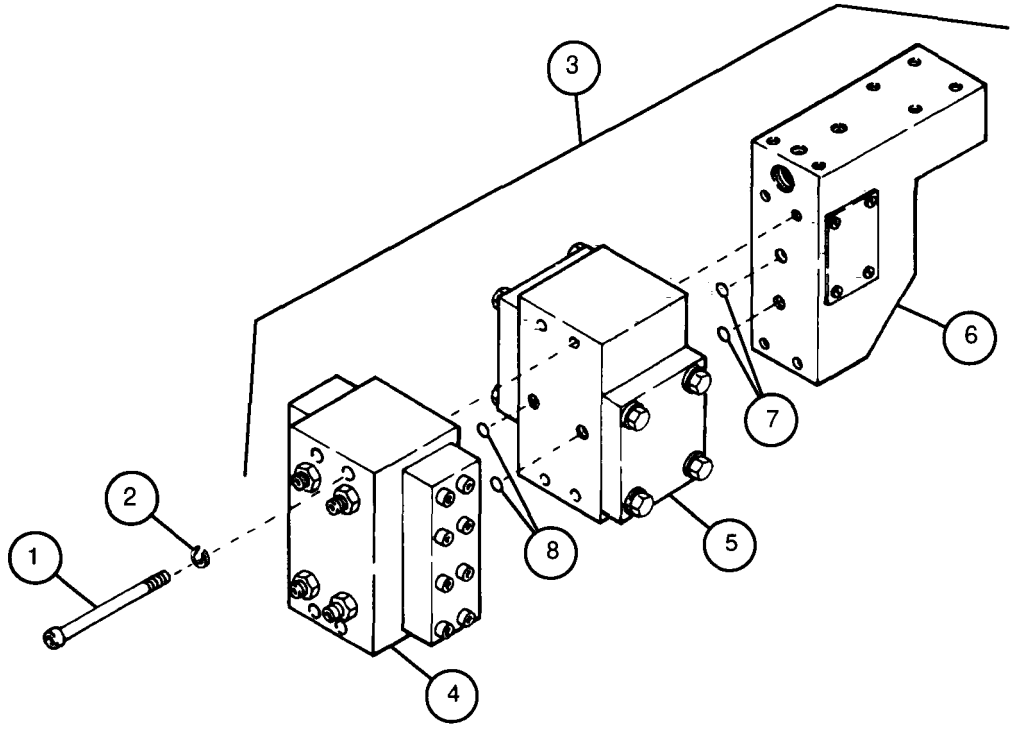
4 Install two new preformed packings (7) in face of bracket assembly (6).

NOTE

Position valve assembly so that plugs are at the bottom when attaching to manifold assembly and bracket assembly.

5 Assemble bracket assembly (6), valve assembly (4), and manifold assembly (5).

6 Install four new lockwashers (2) and four cap screws (1) to secure components of safety relief elevation valve assembly (3).



6-13 SELECTOR VALVE ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Hydraulic fluid (item 22, Appx B)
Lockwashers (4) (item 80, Appx E)
Seal replacement parts kit (item 168, Appx E)

Equipment Condition
Selector valve assembly and solenoid removed (TM 9-2350-311-20-2)

a. Disassembly

1 Remove four cap screws (1), four lockwashers (2), and body assembly plate (3) from body assembly (4). Discard lockwashers.

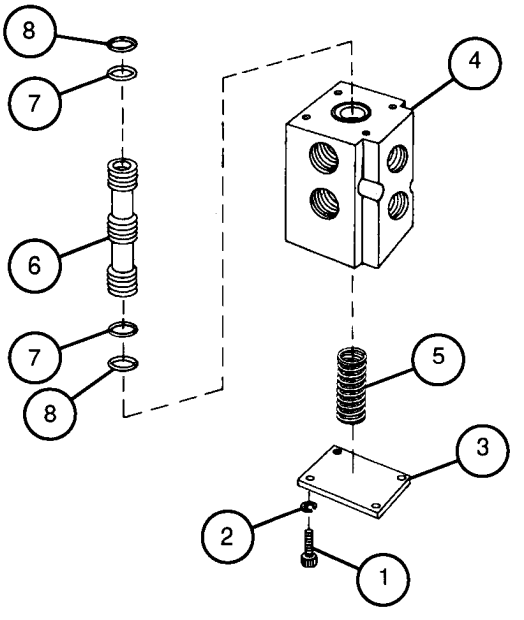
2 Remove helical compression spring (5).

3 Remove selector valve spool (6).

NOTE

Some selector valve assemblies may not have packing retainers.

4 Remove and discard two preformed packings (7) and two packing retainers (8).



6-13 SELECTOR VALVE ASSEMBLY - CONTINUED

b. Inspection

1 Inspect helical compression spring (5). Replace if cracked, distorted, scratched, or tension is weak.

2 Inspect sleeve (9) within body assembly (4). Replace valve assembly body (10) if sleeve is cracked or distorted.

3 Inspect selector valve spool (6). Replace valve body assembly (10) if selector valve spool is cracked or distorted.

c. Assembly

NOTE

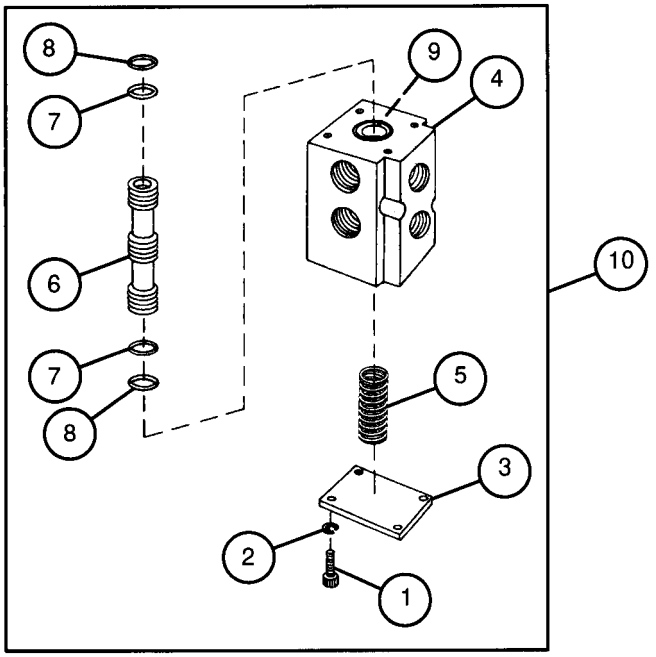
Coat all internal parts with clean hydraulic fluid before assembly and avoid scratching finished surfaces.

1 Install two new packing retainers (8) (if present) and two new preformed packings (7) on selector valve spool (6).

2 Insert selector valve spool (6) into body assembly (4), being careful not to cut two preformed packings (7).

3 Install helical compression spring (5) into body assembly (4).

4 Secure body assembly plate (3) to body assembly (4) with four new lockwashers (2) and four cap screws (1). Tighten cap screws evenly and gradually.



6-14 ASSISTANT GUNNER'S CONTROL ASSEMBLY

This task covers: a. Disassembly b. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95CL-A12)

Materials/Parts
Lockwashers (3) (item 73, Appx E)
Lockwashers (5) (item 81, Appx E)
Lockwashers (3) (item 96, Appx E)
Lockwashers (2) (item 158, Appx E)
Preformed packing (item 67, Appx E)
Preformed packings (3) (item 49, Appx E)
Preformed packings (3) (item 50, Appx E)
Preformed packings (2) (item 68, Appx E)

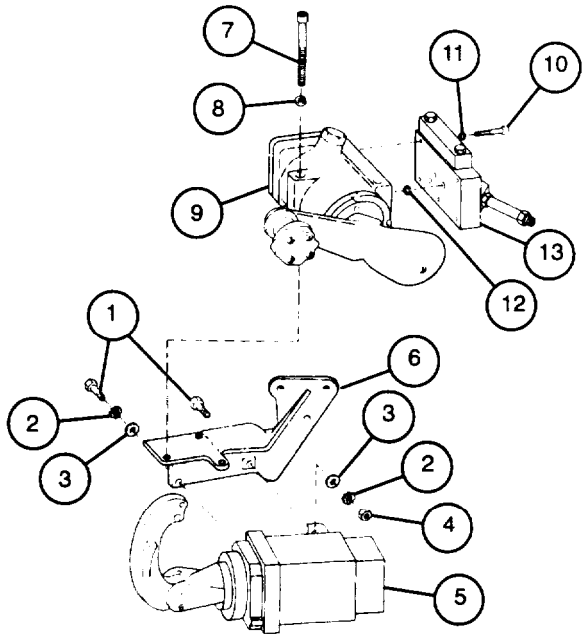
Equipment Condition
Assistant gunner's control assembly removed (TM 9-2350-311-20-2)

a. Disassembly

1 Remove three machine bolts (1), three lockwashers (2) three flat washers (3), hex nut (4), and assistant gunner's control grip assembly (5) from elevation bracket (6). Discard lockwashers.

2 Remove three cap screws (7) three lockwashers (8), and hydraulic pumping unit (9) from elevation bracket (6). Discard lo&washers.

3 Remove five cap screws (10), five lockwashers (11), three preformed packings (12), and manifold assembly (13) from hydraulic pumping unit (9). Discard preformed packings and lockwashers.



6-14 ASSISTANT GUNNER'S CONTROL ASSEMBLY - CONTINUED

a. Disassembly - Continued

4 Remove two cap screws (14), two lockwashers (15), three preformed packings (16) and shuttle valve assembly (17) from manifold assembly (13). Discard preformed packings and lockwashers.

5 Remove check valve (18) and preformed packing (19) from manifold assembly (13). Discard preformed packing.

6 Remove plug (20) preformed packing (21), and electrical cover (22). Discard preformed packing.

b. Assembly

1 Install electrical cover (22) new preformed packing (21) and plug (20).

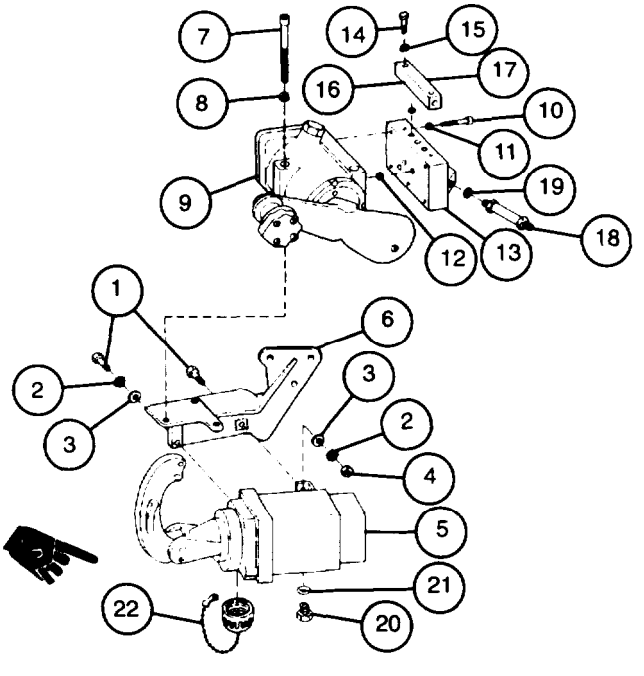
2 Install new preformed packing (19) and check valve (18) in manifold assembly (13).

3 Install three new preformed packings (16) shuttle valve assembly (17), two new lockwashers (15) and two cap screws (14) on manifold assembly (13).

4 Install three new preformed packings (12) manifold assembly (13), five new lockwashers (11), and five cap screws (10) on hydraulic pumping unit (9).

5 Secure hydraulic pumping unit (9) to elevation bracket (6) with three new lockwashers (8) and three cap screws (7).

6 Secure assistant gunner's control grip assembly (5) to elevation bracket (6) using hex nut (4), three new lockwashers (2), three flat washers (3), and three machine bolts (1).



6-15 SHUTTLE VALVE ASSEMBLY

This task covers: a. Disassembly b. Inspection c. Assembly

INITIAL STEUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
No. 4-40 machine screws (2) (item 16, Appx F)

Materials/Parts
Preformed packings (2) (item 51, Appx E)

Equipment Condition
Shuttle valve assembly removed (para 6-14)

a. Disassembly

1 Remove two spool plugs (1) by screwing a No. 4-40 machine screw (2) into each spool plug (1) and pulling out of spool (3).

2 Remove and discard two preformed packings (4).

3 Remove spool (3) from body assembly (5).

b. Inspection

1 Inspect two spool plugs (1). Replace shuttle valve assembly (6) if spool plugs are cracked, distorted, or outside diameter is less than 0.434 inch (11 mm).

2 Inspect spool (3). Replace shuttle valve assembly (6) if spool is scratched, cracked, or outside diameter is less than 0.317 inch (8 mm).

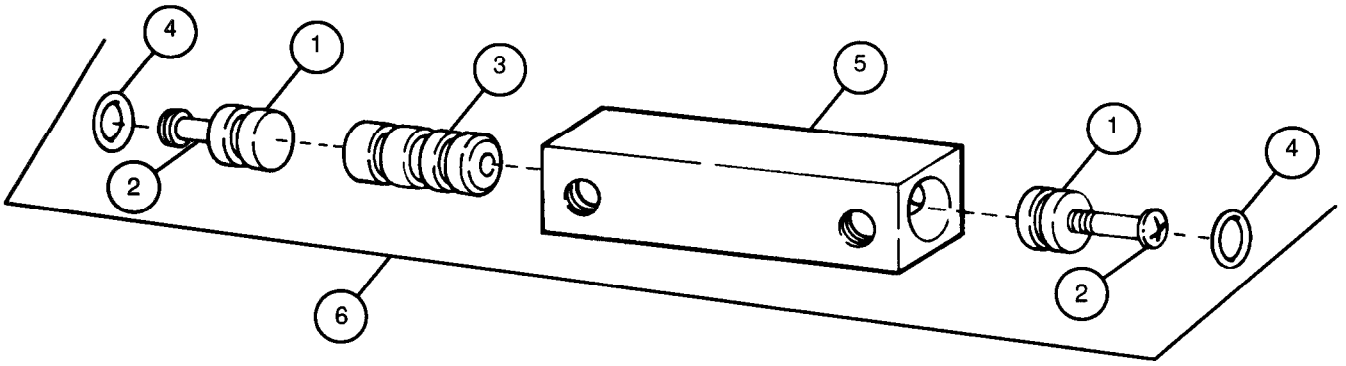
3 Inspect body assembly (5). Replace shuttle valve assembly (6) if body assembly is cracked, distorted, or damaged, or if fit of spool (3) in hole is greater than 0.005 inch (0.127 mm).

c. Assembly

1 Install spool (3) in body assembly (5).

2 Install two new preformed packings (4) on two spool plugs (1).

3 Install two spool plugs (1) in body assembly (5), being careful not to cut preformed packings (4).



6-16 AXIAL PUMP

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (Sc 5180-95-CL-A12)

Materials/Parts
Key washer (item 154, Appx E)
Lockwashers (4) (item 82, Appx E)
Hydraulic axial parts kit (item 149, Appx E)

References
TM 9-214

Equipment Condition
Hydraulic pumping unit removed (para 6-14)
Hand pump crank removed (para 6-17)

a. Disassembly

1 Remove three washer assembled screws (1) and cover (2) from access cover (3).

2 Disengage tab of key washer (4) from slot in round nut (5).

3 Remove round nut (5) and key washer (4). Discard key washer.

NOTE

Inner ball bearing and sleeve spacer may come out with cover retainer, pump shouldered shaft, and ball bearing group.

4 Remove cover retainer, pump shouldered shaft, and ball bearing group (6) from hand pump housing (7).

5 Remove four machine bolts (8), four lockwashers (9), and access cover (3). Discard lockwashers.

6 Remove eight pump retainers (10).

7 Remove and discard eight piston helical springs (11), eight piston spring guides (12), and eight piston helical springs (13).

8 Remove eight pistons (14).

9 Withdraw block assembly (15) from hand pump housing (7).

10 Remove four preformed packings (16) from block assembly (15) and discard.

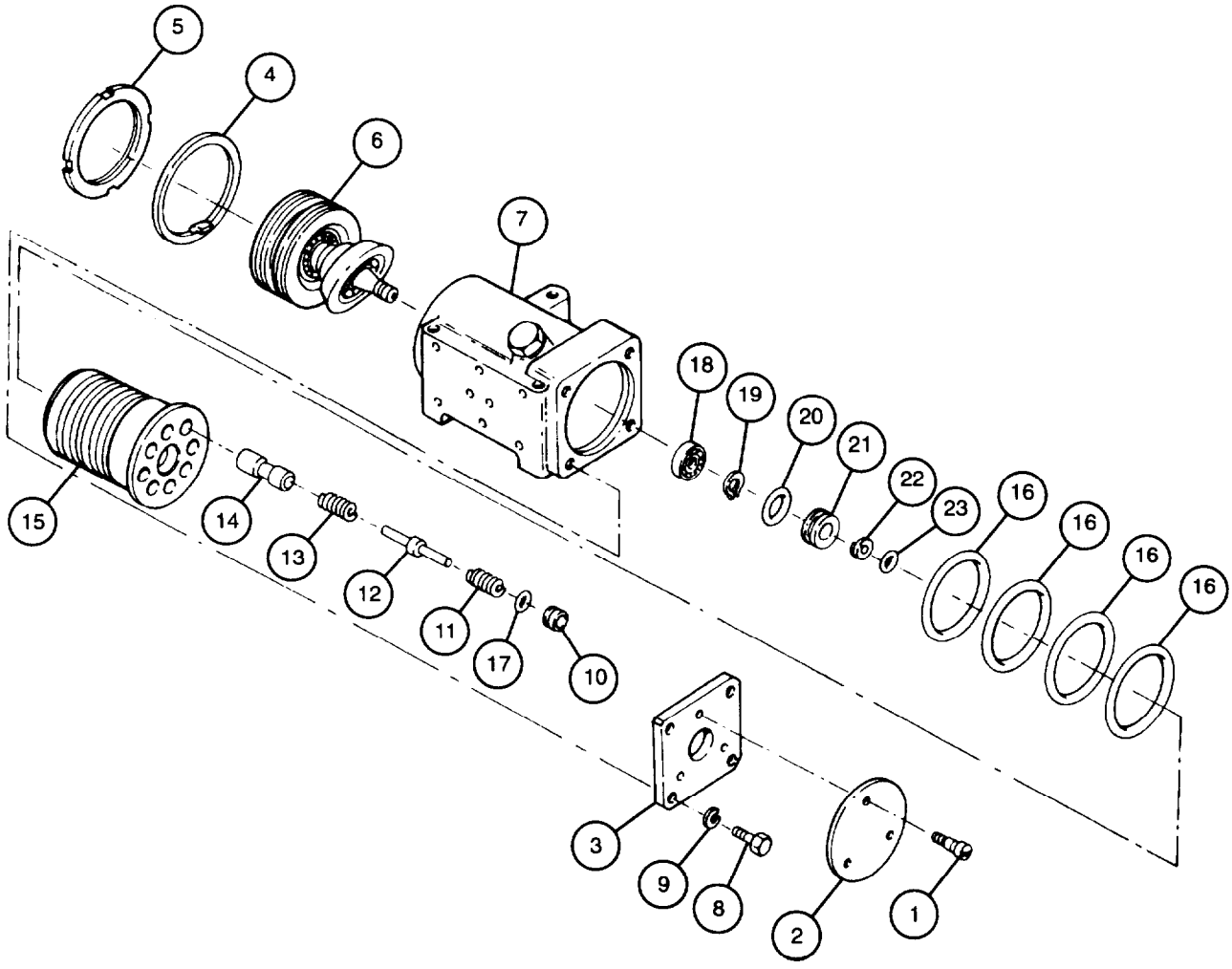
11 Remove eight preformed packings (17) from eight pump retainers (10) and discard.

12 Remove ball bearing (18) if it did not come out with cover retainer, pump shouldered shaft, and ball bearing group (6) in step 4.

13 Remove and discard retaining ring (19) and preformed packing (20).

14 Remove sleeve spacer (21) if it did not come out in step 4.

15 Remove packing retainer (22) and preformed packing (23) from inside sleeve spacer (21) and discard.



6-16 AXIAL PUMP - CONTINUED

a. Disassembly - Continued

16 Disassemble cover retainer, pump shouldered shaft, and ball bearing group (6) as follows:

(a) Remove preformed packing (24) from cover retainer (25) and discard.

(b) Remove cover retainer (25) from pump shouldered shaft (26).

(c) Remove preformed packing (27) packing retainer (28) preformed packing (29) and sleeve spacer (30) as an assembly.

(d) Remove preformed packing (27) from outside of sleeve spacer (30) and discard.

(e) Remove packing retainer (28) and preformed packing (29) from inside of sleeve spacer (30) and discard.

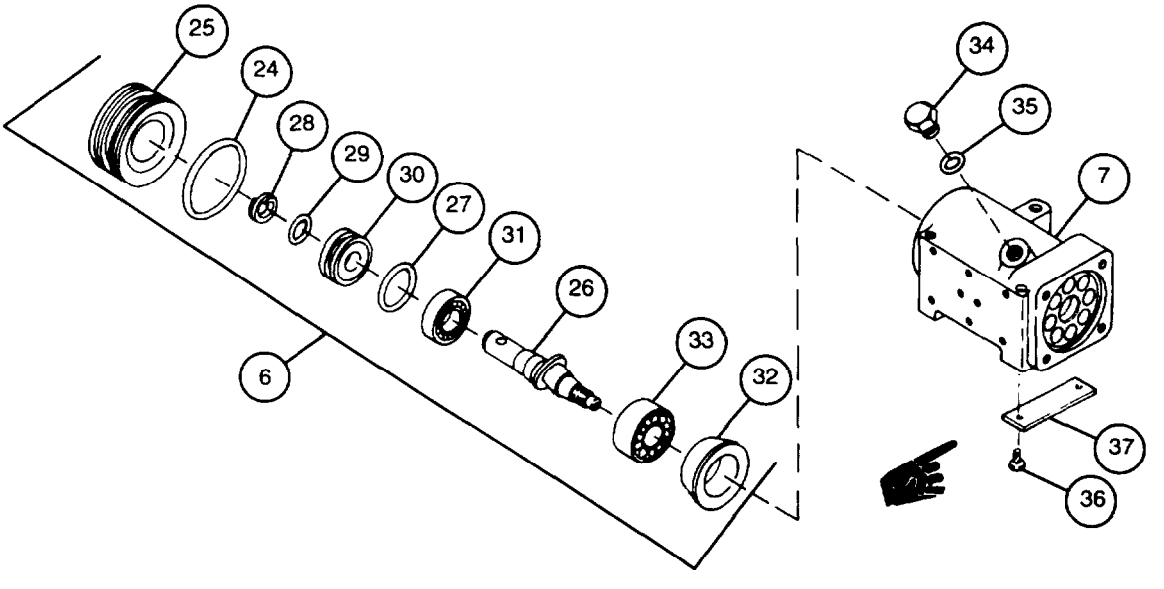
(f) Remove ball bearing (31) from pump shouldered shaft (26).

(g) Remove spring retainer (32) from ball bearing (33).

(h) Remove ball bearing (33) from pump shouldered shaft (26).

17 Remove machine plug (34) and preformed packing (35) from bleeder hole in hand pump housing (7). Discard preformed packing.

18 If necessary for replacement, remove four drive screws (36) and identification plate (37).



b. Inspection

1 Inspect ball bearing (18) (TM 9-214).

2 Replace sleeve spacer (21) if outside diameter is less than 0.871 inch (22 mm) or inside diameter is greater than 0.38 inch (10 mm).

3 Inspect block assembly (15). Replace block assembly if any cylinder bore inside diameter is greater than 0.501 inch (13 mm).

4 Inspect eight pistons (14). Replace block assembly (15) if any piston outside diameter is more than 0.001 inch (0.025 mm) less than its respective numbered piston bore inside diameter. (Example: If piston bore is 0.500 inch (12.7 mm), then outside diameter must be between 0.499 and 0.4999 inch (12.67 and 12.697 mm)).

5 Inspect access cover (3) and hand pump housing (7). Replace if cracked, distorted, or damaged.

6 Inspect cover retainer (25). Replace if inside diameter is less than 1.387 inches (3.523 cm).

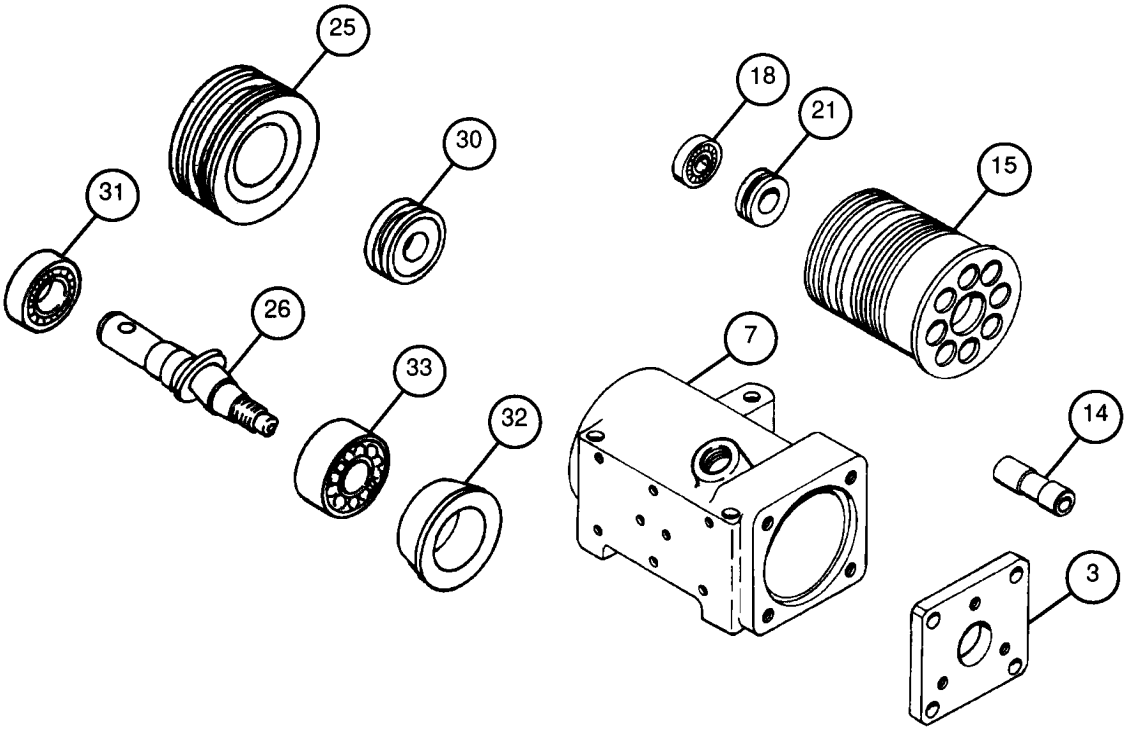
7 Inspect pump shouldered shaft (26). Replace if outside diameter is less than 0.668 inch (17 mm).

8 Inspect sleeve spacer (30). Replace if outside diameter is less than 1.37 inches (3.48 cm) or inside diameter is greater than 0.673 inch (17 mm).

9 Inspect ball bearing (31) (TM 9-214).

10 Inspect spring retainer (32). Replace if inside diameter is greater than 1.57 inches (3.99 cm).

11 Inspect ball bearing (33) (TM 9-214).



6-16 AXIAL PUMP - CONTINUED

c. Assembly

1 Install new preformed packing (23) inside sleeve spacer (21).

2 Install new packing retainer (22) inside sleeve spacer (21) on pump shouldered shaft (26) end.

3 Install sleeve spacer (21).

4 Install new preformed packing (20), new retaining ring (19), and ball bearing (18).

5 Install eight new preformed packings (17) in eight pump retainers (10).

6 Install four new preformed packings (16).

7 Install block assembly (15) in hand pump housing (7).

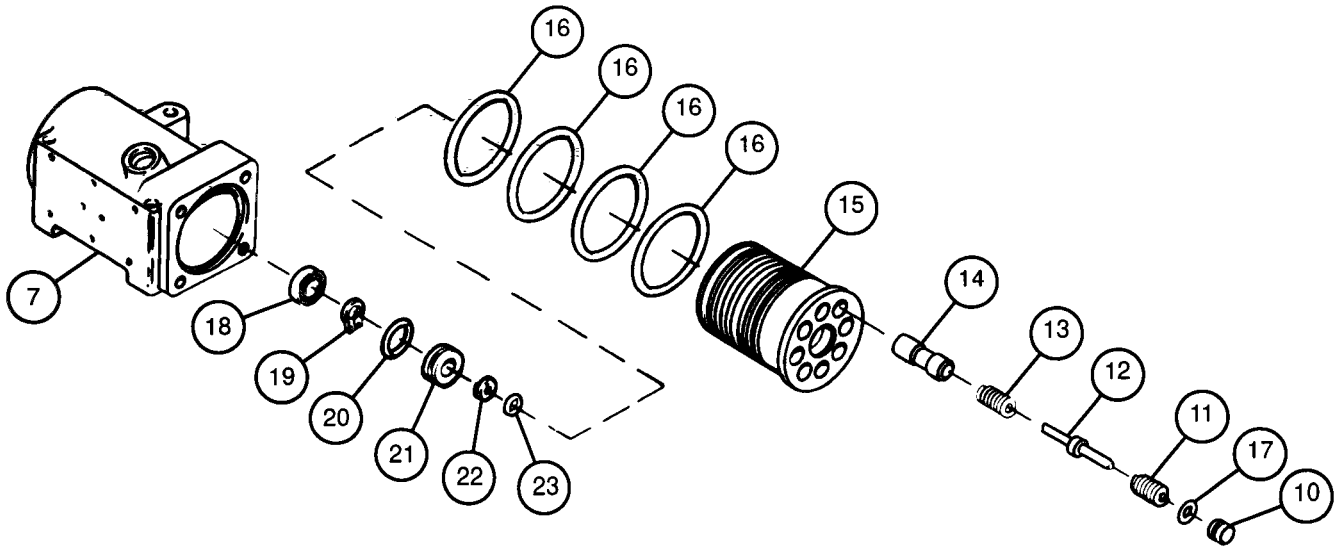
NOTE

Number marked on piston must mate with number marked on block assembly.

8 Install eight pistons (14).

9 Install eight new piston helical springs (13), eight new piston spring guides (12), and eight new piston helical springs (11).

10 Install eight pump retainers (10).



11 Install new preformed packing (35) and machine plug (34) in bleeder hole of hand pump housing (7).

12 Assemble cover retainer, pump shouldered shaft, and ball bearing group (6) as follows:

(a) Install ball bearing (33) onto pump shouldered shaft (26) to within 0.25 inch (6.35 mm) of pump shouldered shaft shoulder.

(b) Install spring retainer (32) on ball bearing (33).

(c) Install ball bearing (31) on pump shouldered shaft (26).

NOTE

Be sure that packing retainer is installed to seat in inner recess of sleeve spacer and is facing toward the end of pump shouldered shaft.

(d) Install new preformed packing (29) and new packing retainer (28) on inside of sleeve spacer (30).

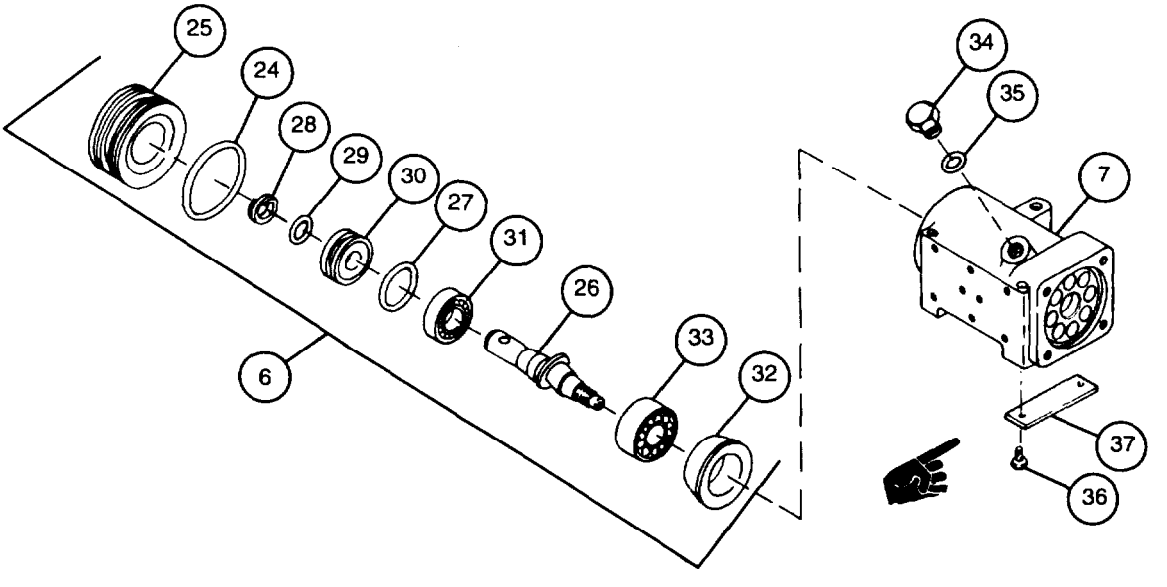
(e) Install new preformed packing (27) on outside of sleeve spacer (30).

(f) Install sleeve spacer (30), preformed packing (29) packing retainer (28), and preformed packing (27) as an assembly.

(g) Install cover retainer (25) on pump shouldered shaft (26).

(h) Install new preformed packing (24) on cover retainer (25).

13 If necessary for replacement, install identification plate (37) using four drive screws (36).



6-16 AXIAL PUMP - CONTINUED

c. Assembly - Continued

14 Install access cover (3), four new lockwashers (9) and four machine bolts (8).

WARNING

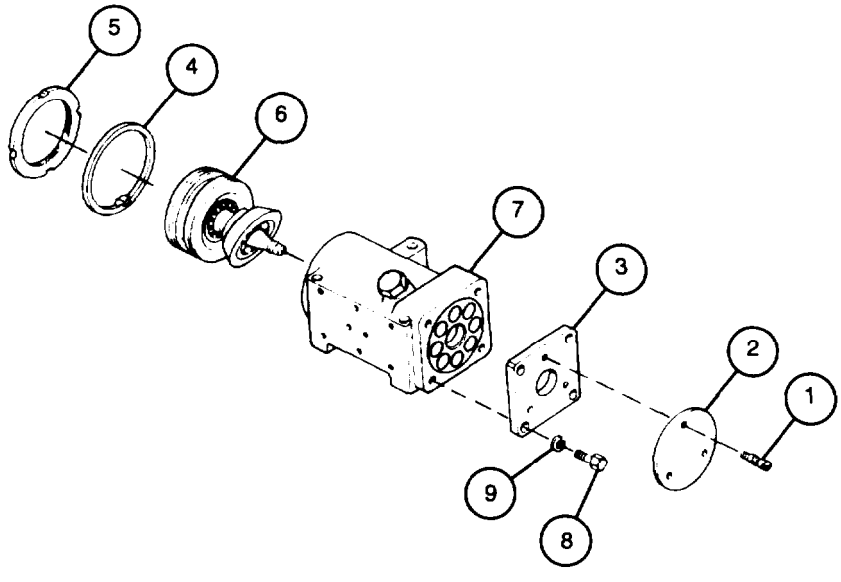
Use extreme caution when installing cover retainer because of spring-loaded components within hand pump housing. Restrain pump shouldered shaft and cover retainer during assembly to avoid injury.

15 Install cover retainer, pump shouldered shaft, and ball bearing group (6) in hand pump housing (7).

16 Install new key washer (4) and round nut (5).

17 Bend tab of key washer (4) to engage slot in round nut (5).

18 Secure cover (2) to access cover (3) with three washer assembled screws (1).



6-17 HAND PUMP CRANK

This task covers: a. Disassembly b. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Lockwashers (4) (item 79, Appx E)
Self-locking insert (item 120, Appx E)
Self-locking nut (item 44, Appx E)

a. Disassembly

1 Remove cap screw (1) securing hand pump crank (2) to axial pump (3).

2 Remove round nut (4) and shaft collar (5).

3 Remove five washer assembled screws (6) and access cover (7).

4 Remove two plugs (8) from arm pump handle (9).

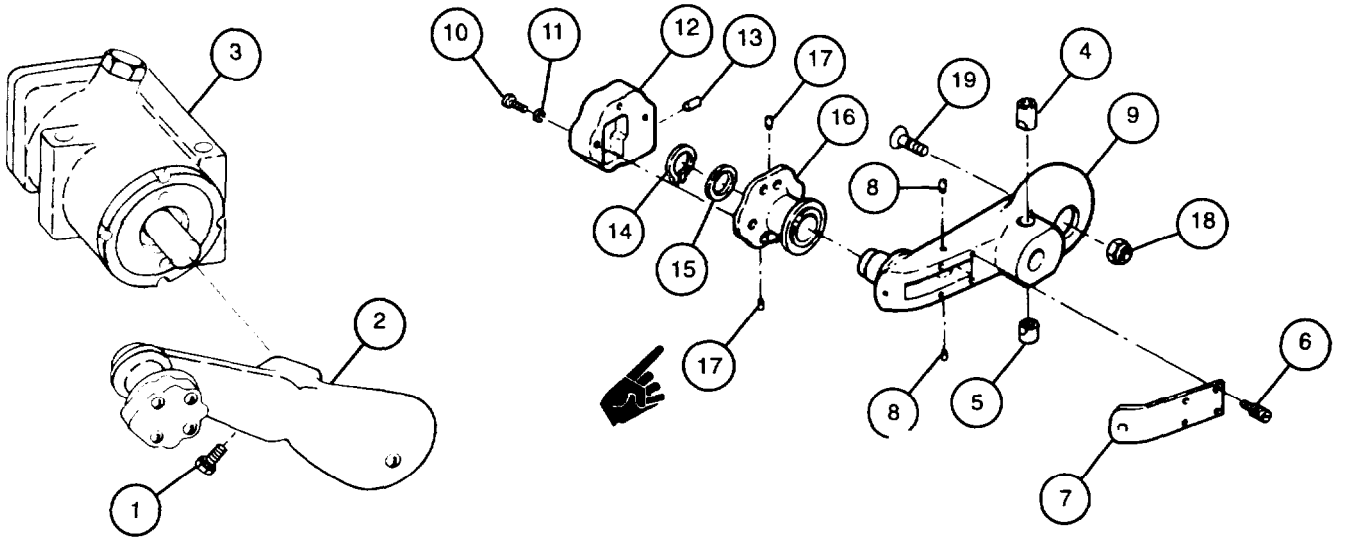
5 Remove four machine screws (10), four lockwashers (11), and knob cap (12). Discard lockwashers.

6 Remove self-locking insert (13) from knob cap (12) and discard.

7 Remove retaining ring (14) ring spacer (15), and knob (16) from arm pump handle (9).

8 Remove two plugs (17) from knob (16).

9 Remove self-locking nut (18) and machine screw (19) from arm pump handle (9). Discard self-locking nut.



6-17 HAND PUMP CRANK - CONTINUED

b. Assembly

1 Install machine screw (19) and new self-locking nut (18) on arm pump handle (9).

2 Install two plugs (17) in knob (16).

3 Install knob (16) ring spacer (15) and retaining ring (14) on arm pump handle (9).

4 Install new self-locking insert (13) in knob cap (12).

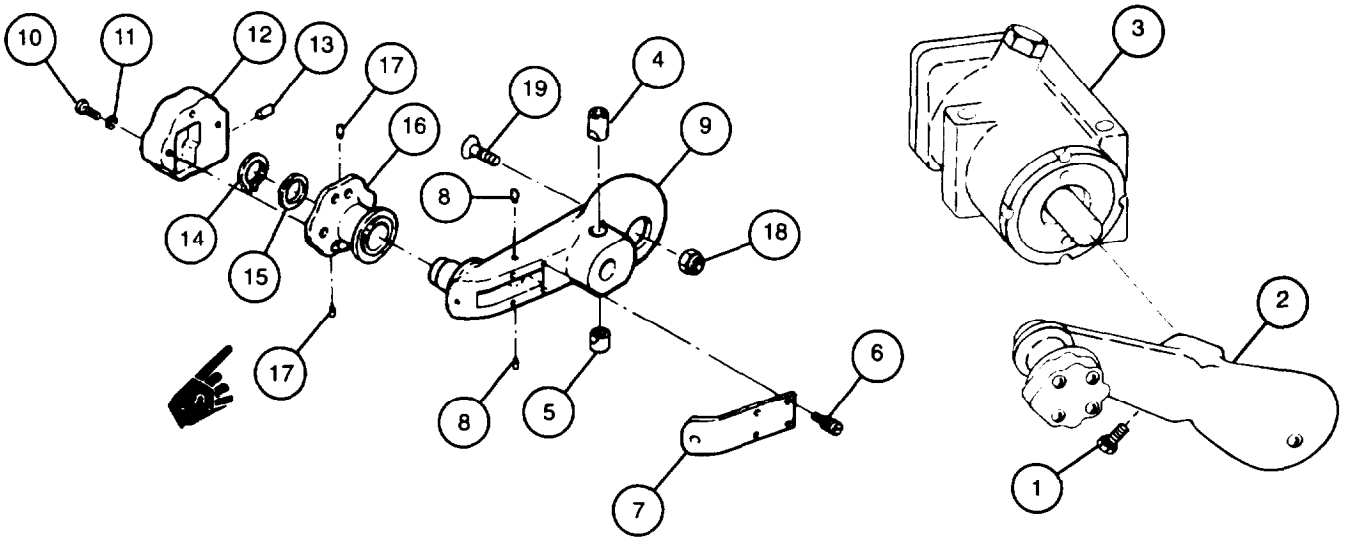
5 Install knob cap (12) four new lockwashers (11) and four machine screws (10) to knob (16).

6 Install two plugs (8) to arm pump handle (9).

7 Install access cover (7) and five washer assembled screws (6).

8 Install shaft collar (5) and round nut (4).

9 Secure hand pump crank (2) to axial pump (3) with cap screw (1).



6-18 CONTROL ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

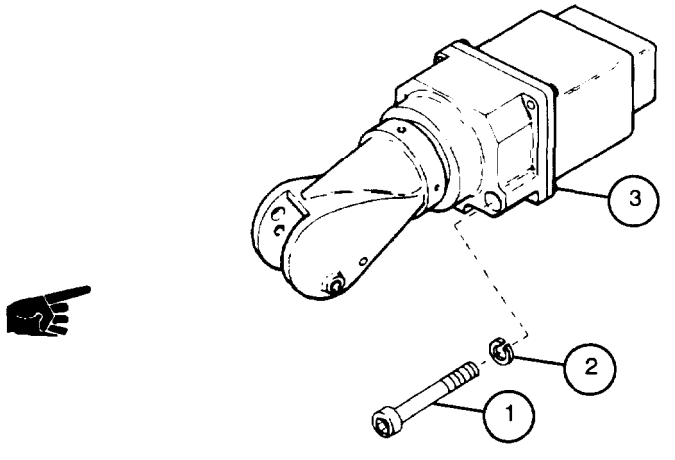
Materials/Parts
Adhesive (item 2, Appx B)
Hydraulic fluid (item 22, Appx B)
Lockwashers (3) (item 81, Appx E)
Lockwashers (6) (item 82, Appx E)
Lockwashers (5) (item 96, Appx E)
Preformed packing (item 67, Appx E)
Preformed packings (14) (item 54, Appx E)
Preformed packings (4) (item 104, Appx E)
Retaining ring (item 14, Appx E)
Retaining rings (2) (item 15, Appx E)
Retaining rings (2) (item 19, Appx E)
Retaining rings (2) (item 159, Appx E)
Sealing compound (item 28, Appx B)

References
TB SIG 222

Equipment Condition
Control assembly (gunner's or assistant gunner's) removed (TM 9-2350-311-20-2)
Gunners/assistant gunner's control assembly handles removed (TM 9-2350-311-20-2)

a. Disassembly

1 Remove cap screw (1) and lockwasher (2) from lower rear corner of bracket and housing group (3). Discard lockwasher.



6-18 CONTROL ASSEMBLY - CONTINUED

a. Disassembly - Continued

2 Remove three cap screws (4) three lockwashers (5) and control valve body assembly (6). Discard lockwashers.

3 Remove headless straight pin (7) from bracket and housing group (3).

4 Separate dust and moisture boot (8) from adhesive bonding and remove.

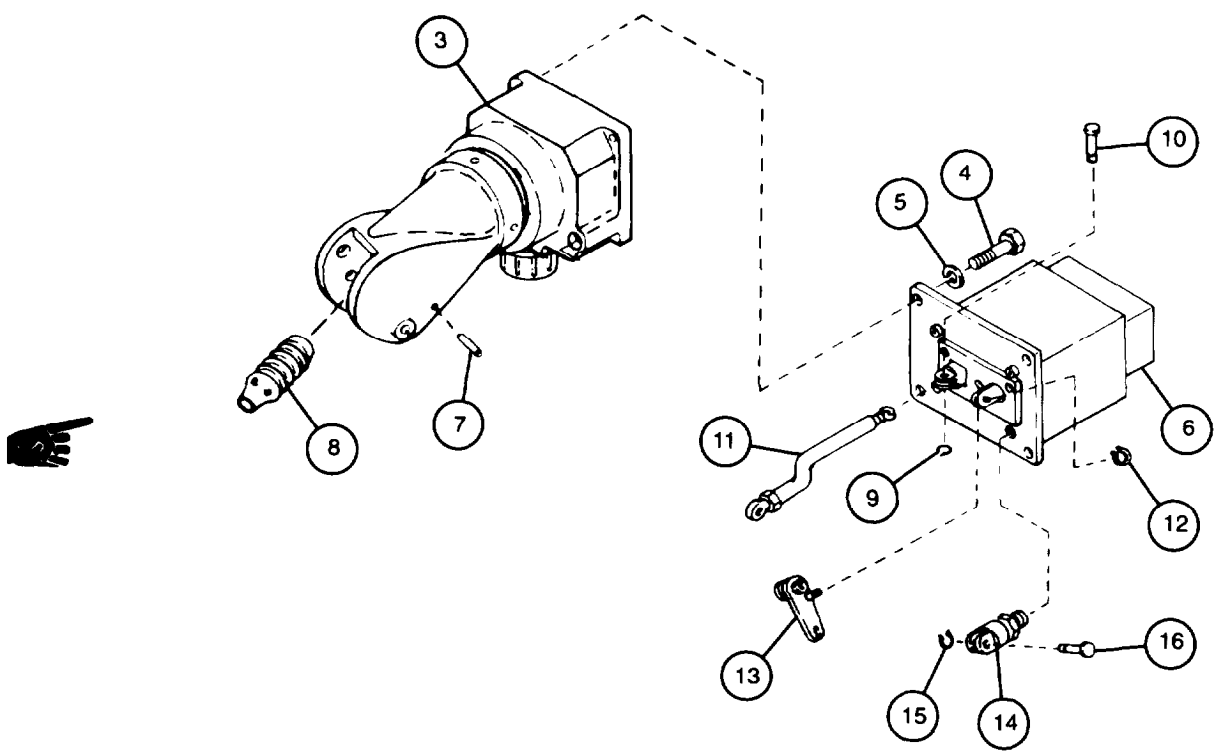
5 Remove retaining ring (9), headed grooved pin (10), and connecting link (11). Discard retaining ring.

6 Remove retaining ring (12) and discard.

7 Disengage and remove remote control lever (13).

8 Unscrew and remove end rod clevis (14).

9 Remove retaining ring (15) and headed grooved pin (16) from end rod clevis (14). Discard retaining ring.



10 Remove hex nut (17) from end rod clevis (14).

11 Unscrew two eye bolts (18) from each end of connecting link (11).

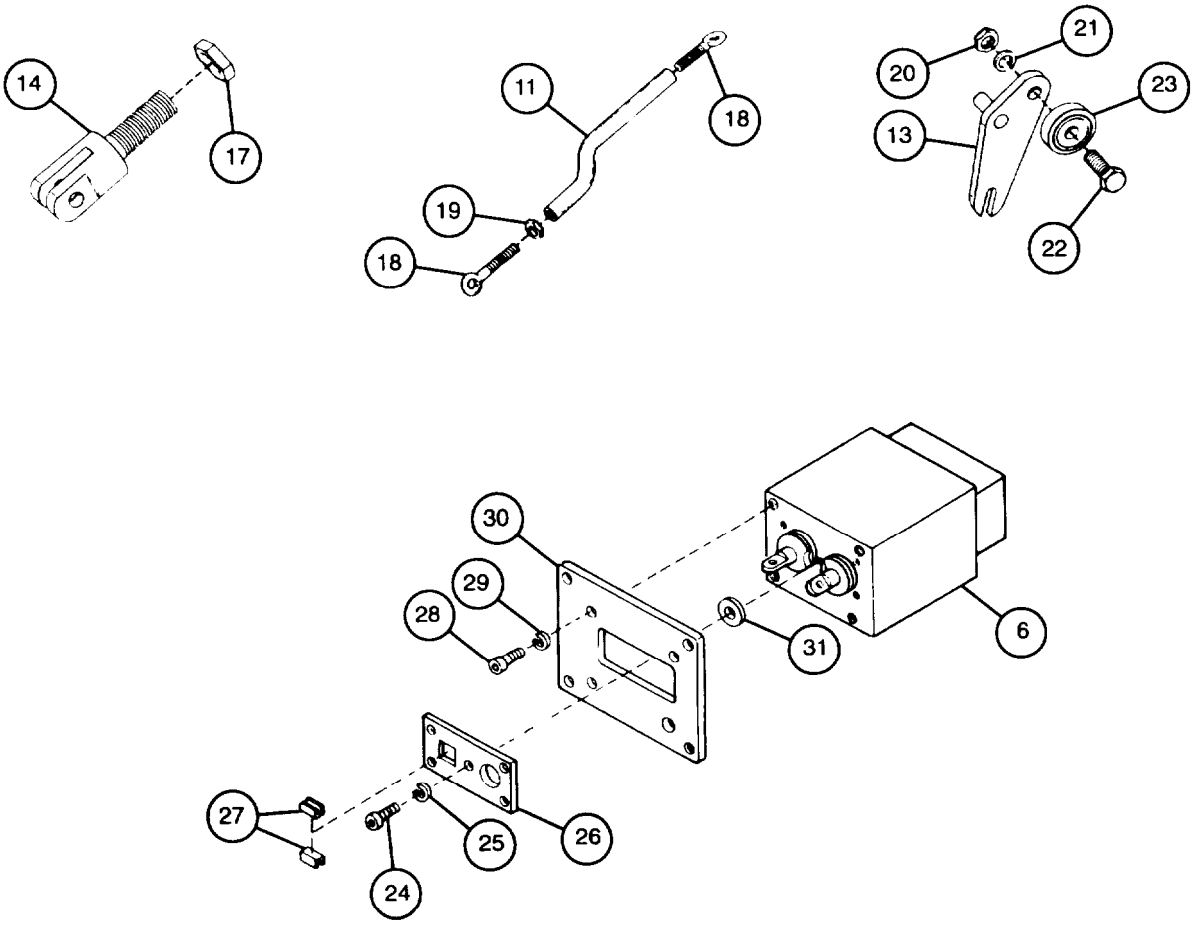
12 Remove hex nut (19) from one eye bolt (18).

13 Remove hex nut (20), lockwasher (21) machine bolt (22) and ball bearing (23) from remote control lever (13). Discard lockwasher.

14 Remove five cap screws (24) five lockwashers (25) and cover plate (26). Discard lockwashers.

15 Remove two guides (27) from cover plate (26).

16 Remove three cap screws (28) three lockwashers (29) plate (30) and flat washer (31) from control valve body assembly (6). Discard lockwashers.



6-18 CONTROL ASSEMBLY - CONTINUED

a. Disassembly - Continued

WARNING

Restrain gunner's control cover while removing cap screws to avoid injury. Gunner's control cover holds two helical compression springs.

17 Remove four cap screws (32), four lockwashers (33), and gunner's control cover (34). Discard lockwashers.

18 Remove two helical compression springs (35) and support (36).

WARNING

Retaining rings and retainers hold small helical compression springs. Restrain retainer as retaining ring is removed to avoid injury.

19 Remove two retaining rings (37), two flat washers (38) two helical compression springs (39) and two helical compression seats (40). Discard retaining rings.

20 Remove two retaining rings (41) and discard.

21 Withdraw traversing sleeve and slide assembly (42) out of front end of body (43).

22 Remove elevating sleeve and slide assembly (44) plug (45) and preformed packing (46). Discard preformed packing.

23 Remove two preformed packings (47) from elevating sleeve and slide assembly (44) and discard.

24 Remove seven preformed packings (48) from elevating sleeve and slide assembly (44) and discard.

25 Remove two preformed packings (49) from traversing sleeve and slide assembly (42) and discard.

26 Remove seven preformed packings (50) from traversing sleeve and slide assembly (42) and discard.

b. Inspection

1 Inspect connecting link (11). Replace if bent, distorted, or damaged.

2 Inspect remote control lever (13). Replace if bent, distorted, or damaged.

3 Inspect end rod clevis (14). Replace if bent or threads are damaged.

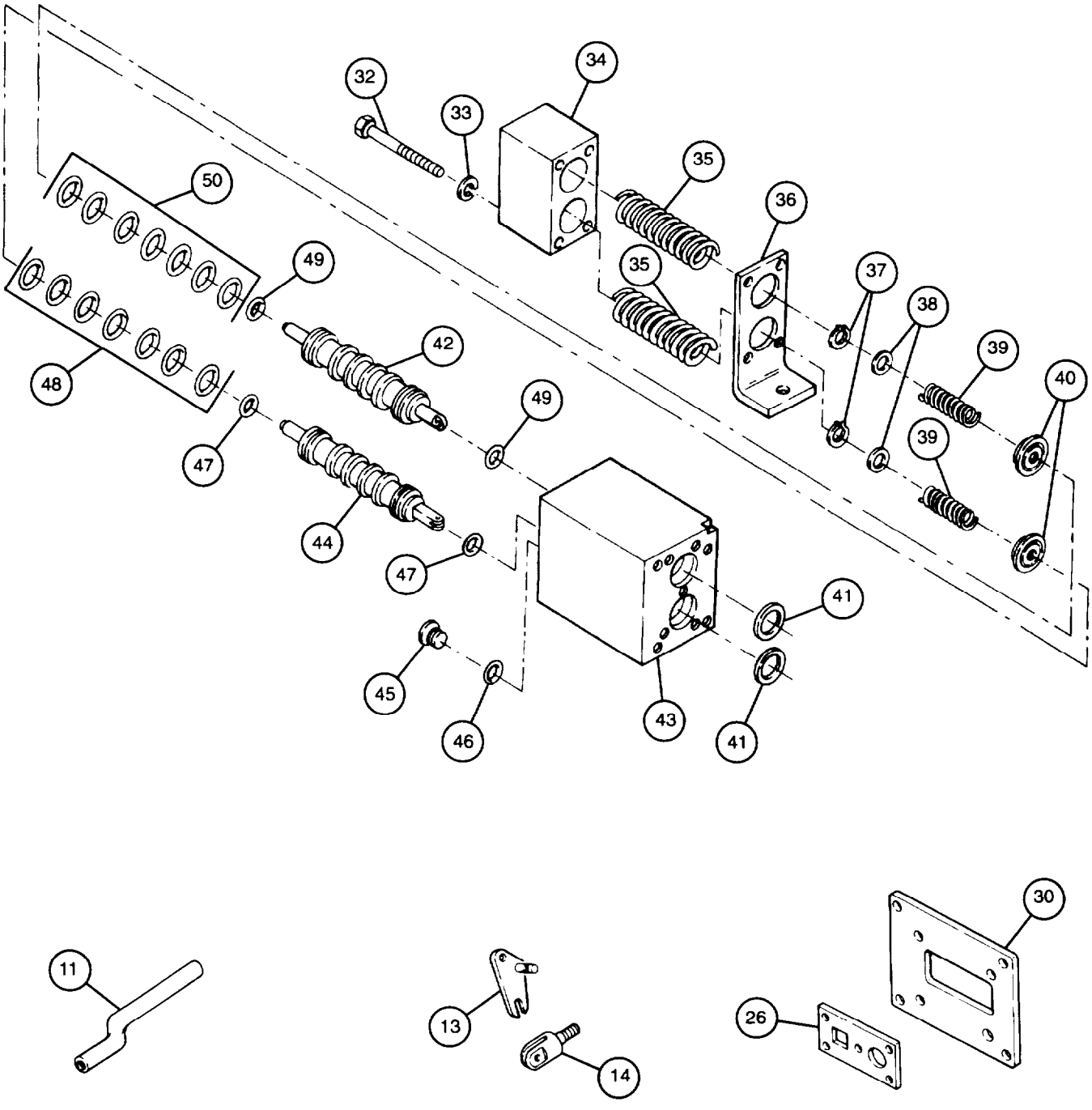
4 Inspect cover plate (26). Replace if it does not fit flat on plate (30).

5 Inspect plate (30). Replace if cracked or warped.

6 Inspect gunner's control cover (34) and body (43). Replace if cracked, distorted, or damaged.

7 Inspect two helical compression springs (35) and two helical compression springs (39). Replace if cracked. fatigued, or scratched.

8 Inspect traversing and elevating sleeve and slide assemblies (42 and 44). Replace if damaged.



6-18 CONTROL ASSEMBLY - CONTINUED

c. Assembly

NOTE

Coat sleeves and slide assemblies and preformed packings with hydraulic fluid before assembling. Install preformed packings without distorting them. Avoid contaminating finished surfaces.

1 Install seven new preformed packings (50) on traversing sleeve and slide assembly (42).

2 Install two new preformed packings (49) on traversing sleeve and slide assembly (42).

3 Install seven new preformed packings (48) on elevating sleeve and slide assembly (44).

4 Install two new preformed packings (47) on elevating sleeve and slide assembly (44).

5 Apply sealing compound to new plug (45). Install new preformed packing (46) plug (45) and elevating sleeve and slide assembly (44).

6 Insert traversing sleeve and slide assembly (42) into front end of body (43).

WARNING

Retaining rings and retainers hold small helical compression springs. Restrain retainer as retaining ring is installed to avoid injury.

7 Install two new retaining rings (41), two helical compression seats (40) two helical compression springs (39), two flat washers (38), and two new retaining rings (37).

8 Install two helical compression springs (35) and support (36).

WARNING

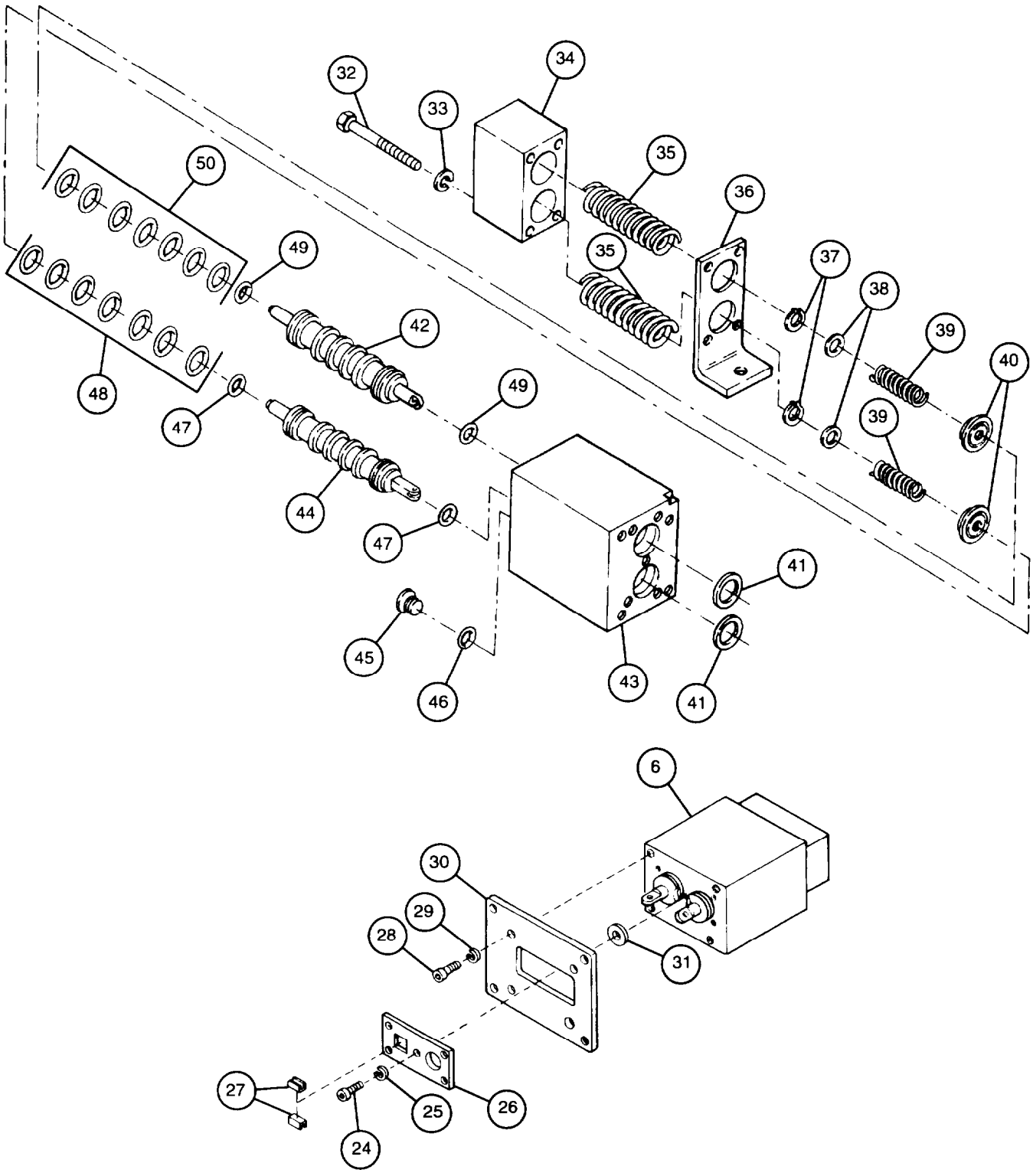
Restrain gunner's control cover while installing cap screws to avoid injury. Gunner's control cover holds two helical compression springs.

9 Install gunner's control cover (34), four new lockwashers (33) and four cap screws (32).

10 Install flat washer (31), plate (30) three new lockwashers (29), and three cap screws (28) on control valve body assembly (6).

11 Install two guides (27) on cover plate (26).

12 Install cover plate (26), five new lockwashers (25), and five cap screws (24). Torque cap screws to 30-35 in-lb (3-4 N•m).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6-18 CONTROL ASSEMBLY - CONTINUED

c. Assembly - Continued

13 Install ball bearing (23), machine bolt (22), new lockwasher (21), and hex nut (20) on remote control lever (13).

14 Install hex nut (19) on one eyebolt (18).

15 Screw one eye bolt (18) into each end of connecting link (11).

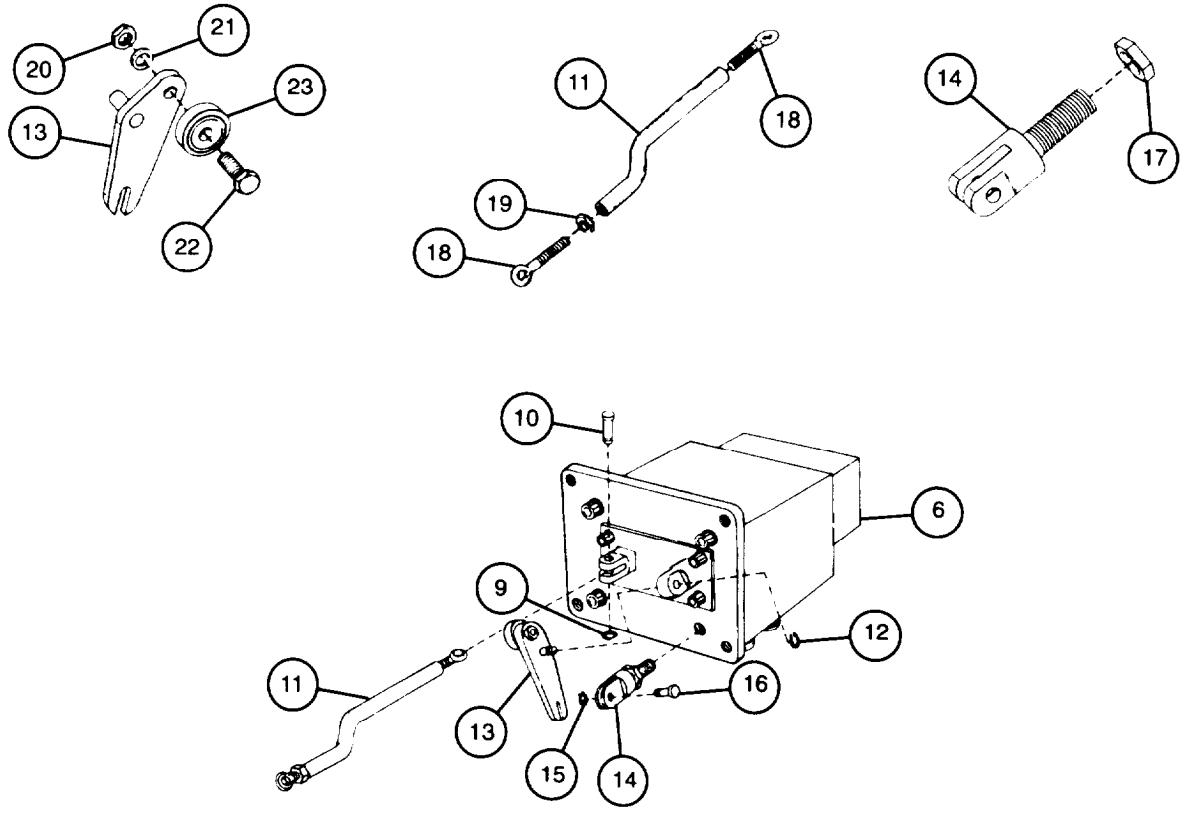
16 Install hex nut (17) on end rod clevis (14).

17 Install new retaining ring (15) and headed grooved pin (16) on end rod clevis (14).

18 Screw end rod clevis (14) into control valve body assembly (6).

19 Install remote control lever (13) and new retaining ring (12).

20 Install connecting link (11) headed grooved pin (10), and new retaining ring (9).



WARNING

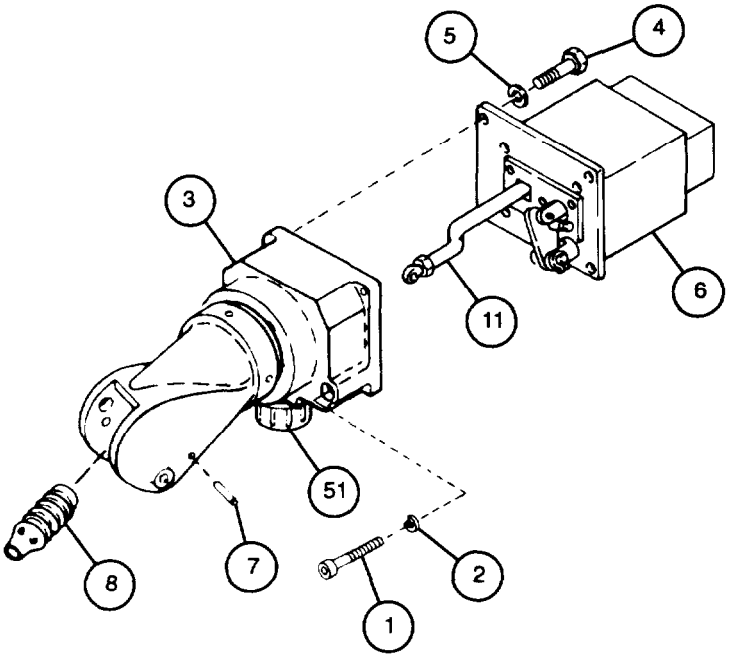
Adhesives can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive gets on skin or clothing, wash immediately with soap and water.

21 Bond dust and moisture boot (8) to bracket and housing group (3) with adhesive.

22 Install headless straight pin (7) to bracket and housing group (3).

23 Assemble control valve body assembly (6) group to bracket and housing group (3) ensuring connecting link (11) and electrical lead assembly (51) is routed through moisture boot (8) and secure with three new lockwashers (5) and three cap screws (4).

24 Install new lockwasher (2) and cap screw (1) in lower rear corner of bracket and housing group (3).



6-19 BRACKET, CAM, AND HOUSING GROUP

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Grease (item 21, Appx B)
Sealing compound (item 29, Appx B)

References
TM 9-214

Equipment Condition
Bracket and housing group removed (para 6-18)

a. Disassembly

1 Remove three flat setscrews (1) and three cup point setscrews (2) from bracket (3).

2 Remove bracket (3) from control cam (4).

3 Withdraw control cam (4) from housing (5).

4 Remove four machine screws (6) and four flat washers (7).

5 Remove ball bearing (8).

6 Remove two headless straight pins (9) from housing (5).

7 Remove headless straight pin (10) from control cam (4).

8 Remove decal (11) if damaged.

b. Inspection

1 Inspect control cam (4) for burrs and smooth any found.

2 Inspect ball bearing (8) (TM 9-214).

3 Inspect inside surface of housing (5). Repair if scratched or burred.

4 Inspect bracket (3). Replace if cracked, distorted, or damaged.

c. Assembly

1 Install headless straight pin (10) in control cam (4).

2 Install two headless straight pins (9) in housing (5).

3 Lubricate ball bearing (8) with grease and install in housing (5).

4 Apply sealing compound to threads of four machine screws (6).

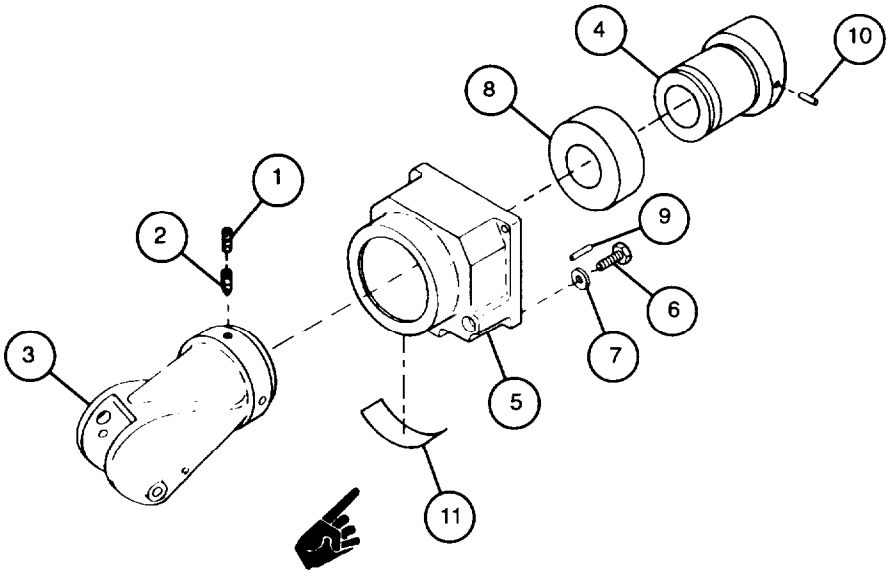
5 Install four flat washers (7) and four machine screws (6).

6 Install control cam (4) in housing (5).

7 Attach bracket (3) to control cam (4).

8 Install three cup point setscrews (2) and three flat setscrews (1) in bracket (3)

9 If removed, install decal (11).

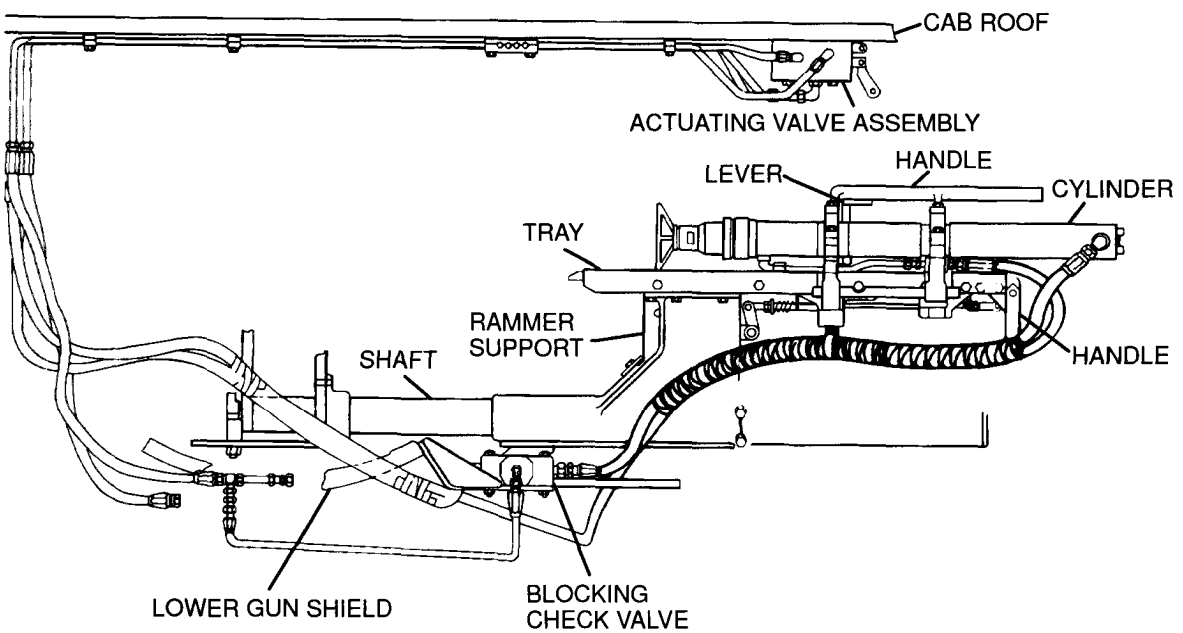


CHAPTER 7
DIRECT SUPPORT MAINTENANCE OF RAMMER SYSTEM

GENERAL

This chapter illustrates and describes maintenance of the weapon mounted projectile rammer system. The rammer assembly is a hydraulically powered device which is controlled by a hand operated actuating valve assembly. No electrical circuits are used in the system. A second valve in the system, the blocking check valve, prevents rammer assembly from being operated unless it is correctly alined with the chamber.

CONTENTS



7-1 RAMMER ASSEMBLY

This task covers:
a. Removal
b. Disassembly
c. Inspection and Repair
d. Assembly
e. Installation
f. Adjustment

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Antiseizing compound (item 5, Appx B)
Cotter pins (2) (item 45, Appx E)
Grease (item 21, Appx B)
Gasket cover (item 127, Appx E)
LockWashers (8) (item 71, Appx E)
LockWashers (7) (item 75, Appx E)
LockWashers (6) (item 84, Appx E)
LockWire (item 39, Appx E)
Lockwire (item 107, Appx E)
Retaining rings (2) (item 125, Appx E)
Sealing compound (item 29, Appx B)
Spring pin (item 4, Appx E)

Personnel Required
2

Equipment Condition
Cannon set at 0° elevation (TM 9-2350-311-10)
Discharge and drain hydraulic system (TM 9-2350-311-20-2)
Rammer lines and fittings removed (TM 9-2350-311-20-2)
Tension on adjuster relieved (TM 9-2350-311-10)

a. Removal

1 Remove four hex nuts (1), four cap screws (2), four lockwashers (3), and blocking check valve (4). Discard lockwashers.

CAUTION

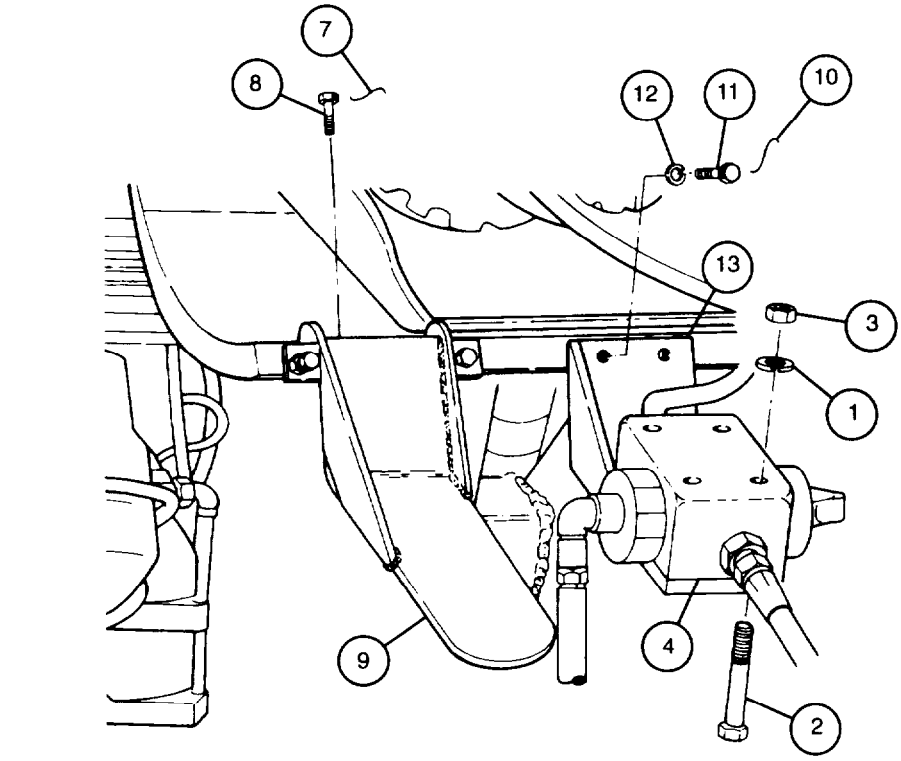
Be careful when opening breechblock with spring tension released. Use operating handle to support breechblock as it is being opened. Otherwise, carrier will slam open and maybe damaged.

2 Open breechblock (5).

3 Move rammer assembly (6) to ram position.

4 Remove lockwire (7), two cap screws (8), and rammer mounting bracket (9). Discard lockwire.

5 Remove lockwire (11), two cap screws (11), two lockwashers (12), and angle bracket (13). Discard lockwashers and lockwire.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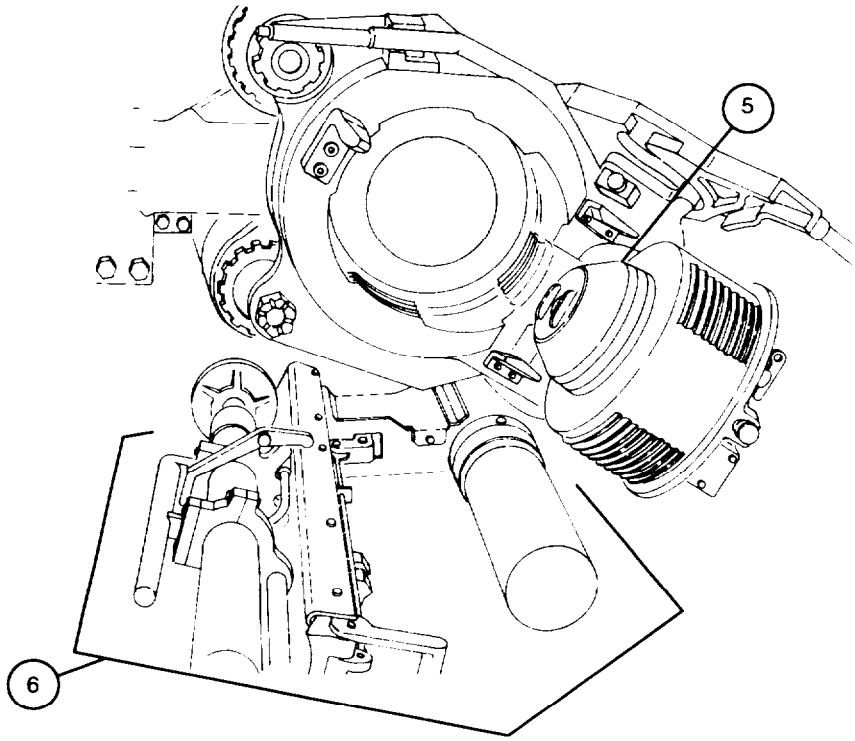
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7-1 RAMMER ASSEMBLY-CONTINUED

a. Removal - Continued

WARNING

Weight of lower gun shield is approximately 57 pounds (26 kg). Two persons are required for removal of lower gun shield to avoid injury.

6 Remove eight cap screws (14) eight lockwashers (15), and lower gun shield (16). Discard lockwashers.

7 Remove two pipe plugs (17) from lower gun shield (16) if threads are cracked or stripped.

8 Loosen two hex nuts (18) and two setscrews (19).

9 Remove two cap screws (20) and retaining plate (21) from mount (22).

NOTE

When rammer assembly has been removed to facilitate tray removal of cannon, replace lower gun shield and stow rammer assembly with hoses attached on cab floor directly beneath cannon mount.

10 Remove cap screw (23) from rammer bumper (24) and sleeve spacer (25).

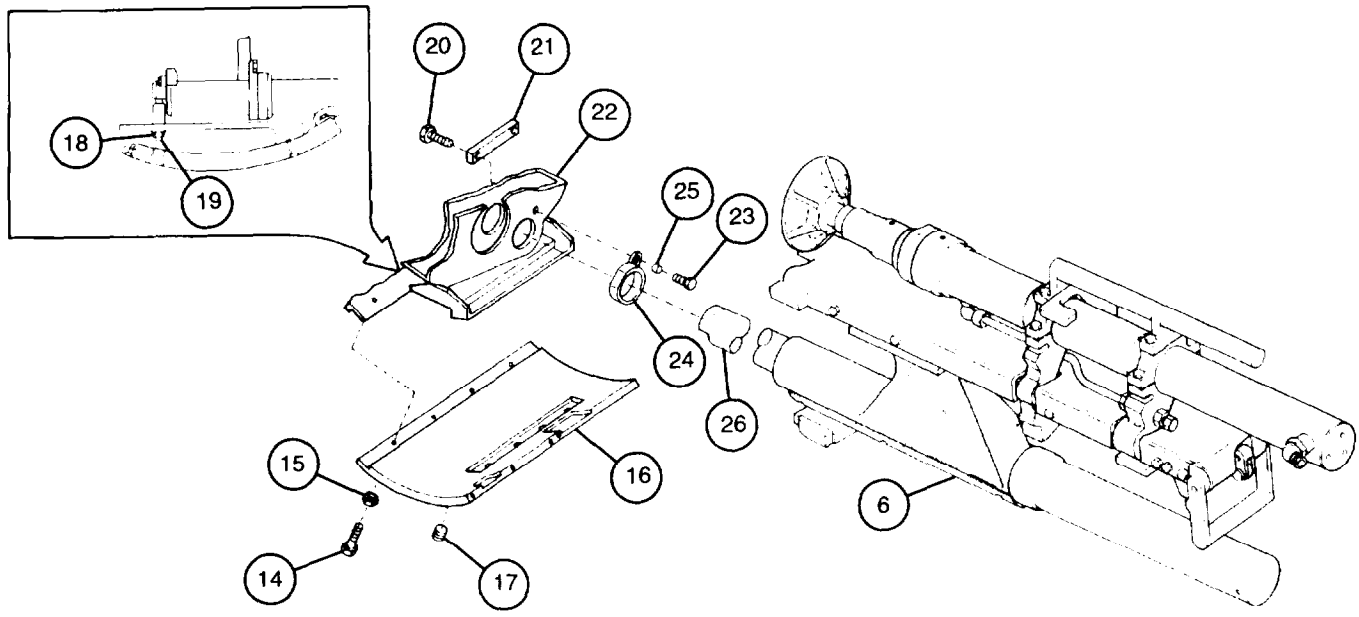
WARNING

Weight of rammer assembly and shaft assembly is approximately 198 pounds (90 kg). Two persons are required for removal and installation to avoid injury.

11 Slide rammer assembly (6) with rammer bumper (24) and sleeve spacer (25) rearward on shaft (26) until clear of mount (22).

12 Reset tension on adjuster (TM 9-2350-311-10).

13 Close breechblock (5).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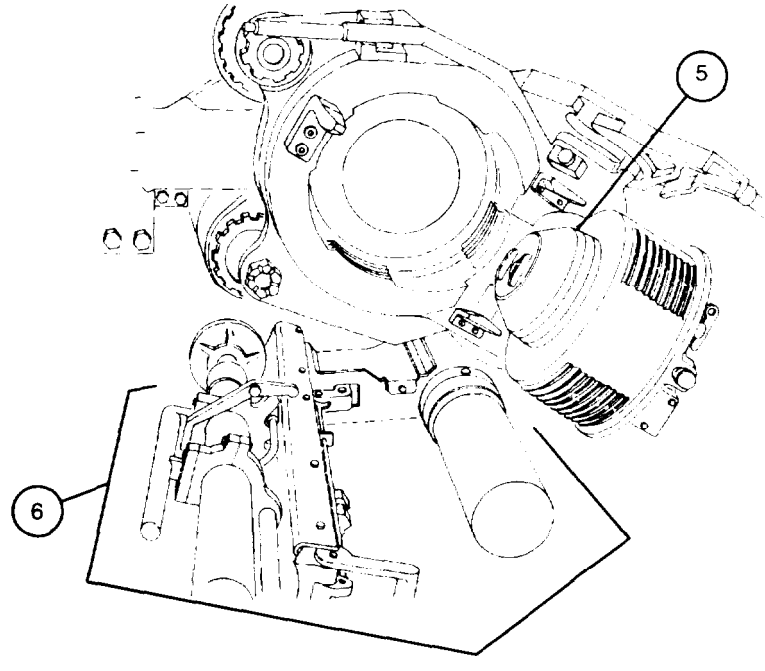
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7-1 RAMMER ASSEMBLY - CONTINUED

b. Disassembly

1 Remove elbow (26.1) metallic tube (26.2) adapter (26.3) and adapter (26.4).

2 Remove four cap screws (27) four fiat washers (28) and rammer handle (29).

3 Remove four cap screws (30) and two caps (31). Identify each cap with its cylinder support (32). Two caps and front and rear cylinder supports are matched sets.

4 Remove and discard upper half of retaining ring (33).

5 Remove cylinder assembly (34).

6 Remove and discard lower half of retaining ring (33).

7 Remove cotter pin (35) and flat washer (36) from headed straight pin (37). Discard cotter pin.

8 Withdraw headed straight pin (37) from rod end bearing (38).

9 Remove two cap screws (39) and two flat washers (40) from angle bracket (41).

10 Remove four cap screws (42) and handle group (43) from loader-rammer tray (44).

11 Remove seven cap screws (45), two cap screws (46) latch (47) and loader-rammer tray (44).

12 Remove two cap screws (48) and mounting bracket (49) from loader-rammer tray (44).

NOTE

A 0.25 inch (6.4 mm) threaded hole in end of electrical post can be used to install a pulling device to remove electrical post.

13 Remove electrical post (50).

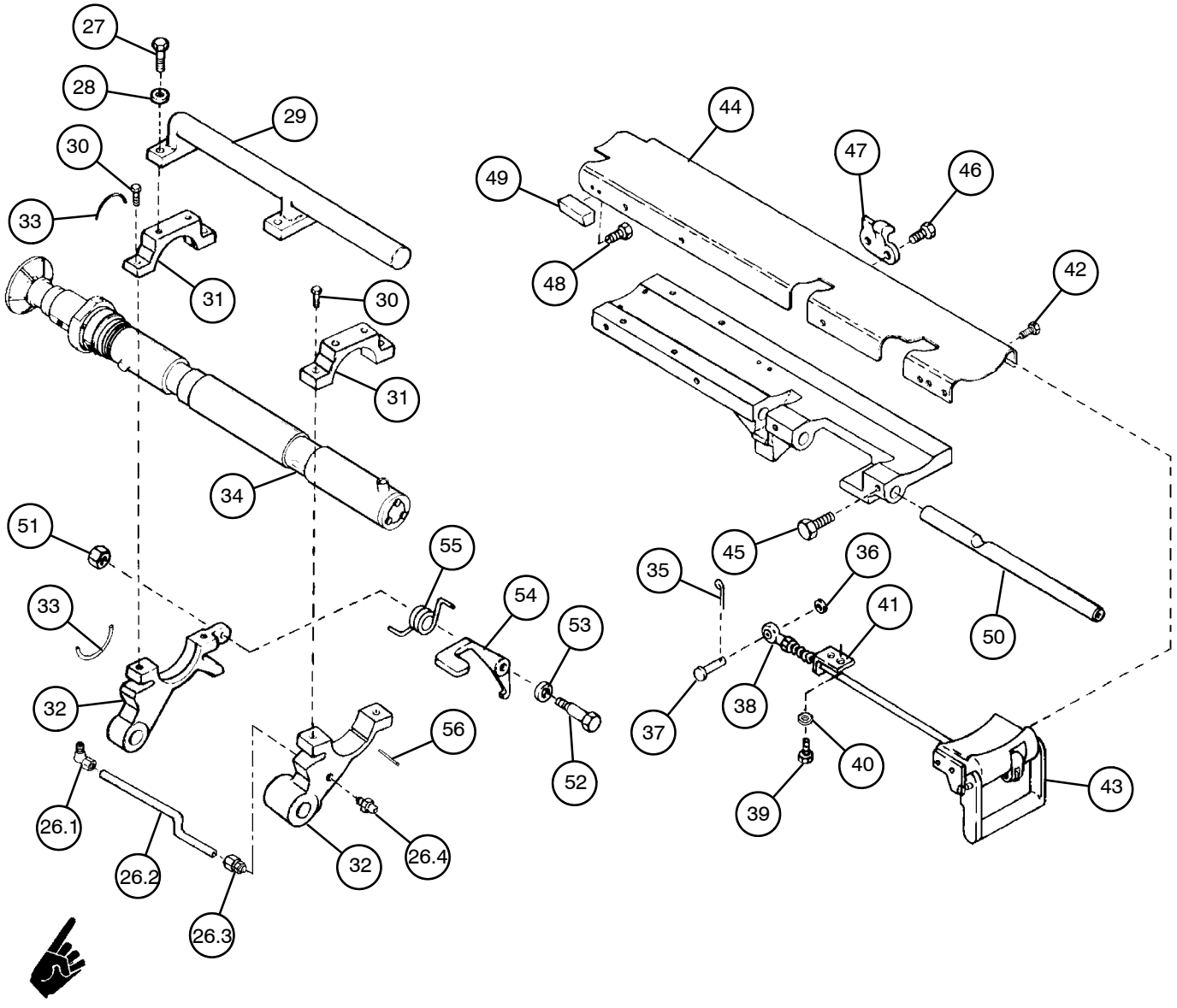
NOTE

Front and rear cylinder supports and two caps are matched sets. Keep parts together when disassembled.

14 Remove two front and rear cylinder supports (32) and retain together with two caps (31).

15 Remove hex nut (51) shoulder bolt (52), flat washer (53), lock-release lever (54) and helical torsion spring (55) from front cylinder support (32).

16 Remove machine key (56) from rear cylinder support (32).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7-1 RAMMER ASSEMBLY — CONTINUED

b. Disassembly — Continued

17 Remove two cap screws (57), four cap screws (58), and tray support (59) from flange of rammer support (60).

18 Remove five machine screws (61), five flat washers (62), and cover assembly (63) from rammer support (60).

19 Remove and discard spring pin (64).

20 Remove cotter pin (65), flat washer (66), headed straight pin (67), and actuating lock lever (68). Discard cotter pin.

21 Remove headless shoulder pin (69), dial pointer (70), helical compression spring (71), flat washer (72), and rammer switch actuator (73).

22 Remove seven machine screws (74), seven lockwashers (75), access cover (76), and cover gasket (77) from rammer support (60). Discard lockwashers and gasket cover.

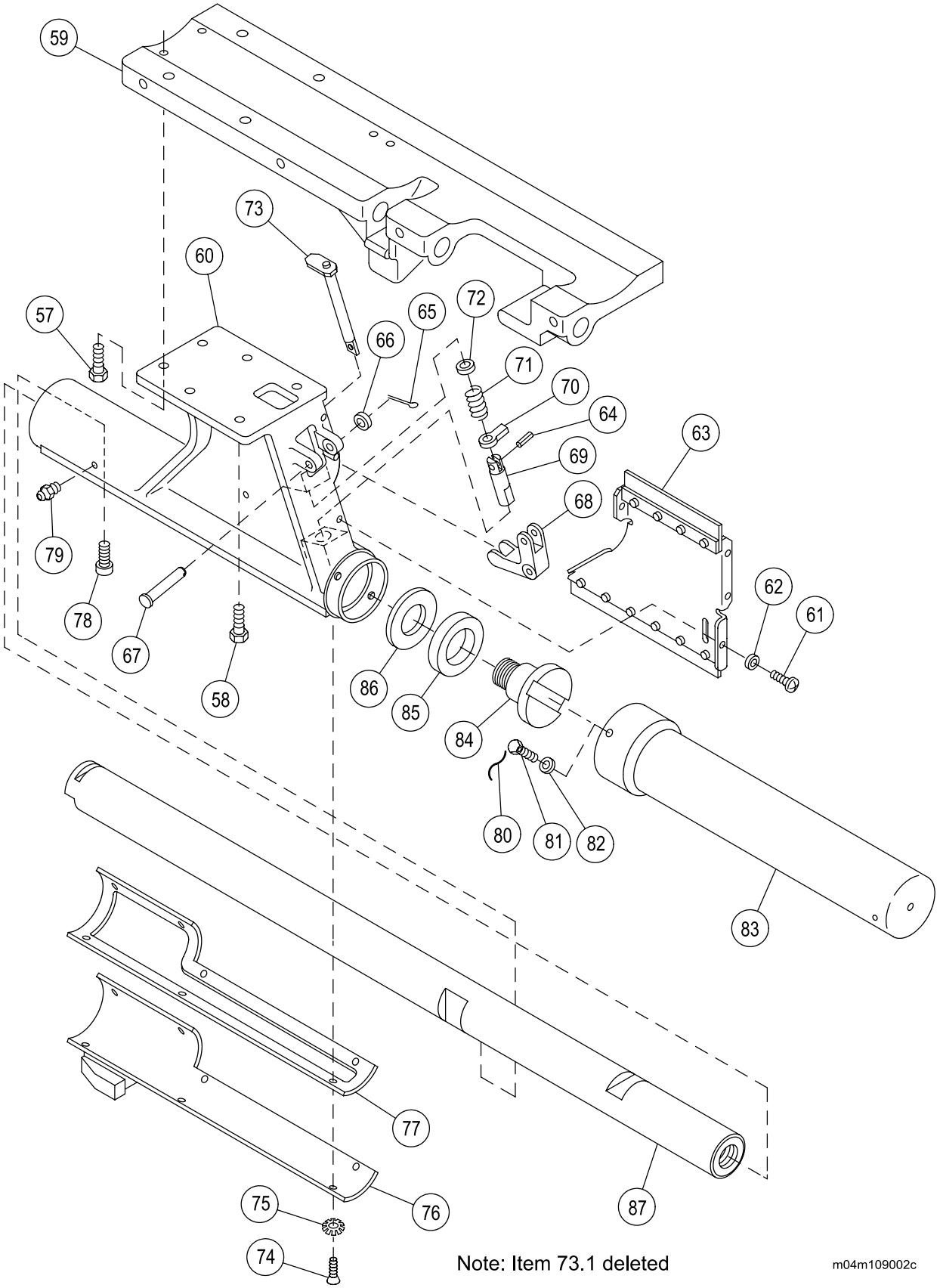
23 Remove cap screw (78).

24 Remove two lubrication fittings (79).

25 Remove lockwire (80), four cap screws (81), four spring tension washers (82), and cover assembly (83) from rear of rammer support (60). Discard lockwire.

26 Remove shoulder screw (84), nonmetallic bushing (85), and flat washer (86).

27 Remove straight shaft (87) from rammer support (60).



Note: Item 73.1 deleted

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7-1 RAMMER ASSEMBLY — CONTINUED

c. Inspection and Repair

1 Inspect rammer handle (29). Replace if cracked, broken, or distorted.

2 Inspect lock-release lever (54). Replace if cracked or severely worn.

3 Inspect helical torsion spring (55). Replace if distorted or cracked.

4 Inspect matched sets of front and rear cylinder supports (32) and caps (31). Remove burrs. Chase threads if damaged. Replace as matched sets if cracked or distorted.

5 Inspect loader-rammer tray (44). Replace if cracked, broken, or distorted.

6 Inspect electrical post (50) for burrs or other damage. Replace if cracked or distorted.

7 Inspect tray support (59). Replace if cracked, broken, or distorted. Remove burrs. Chase damaged threads.

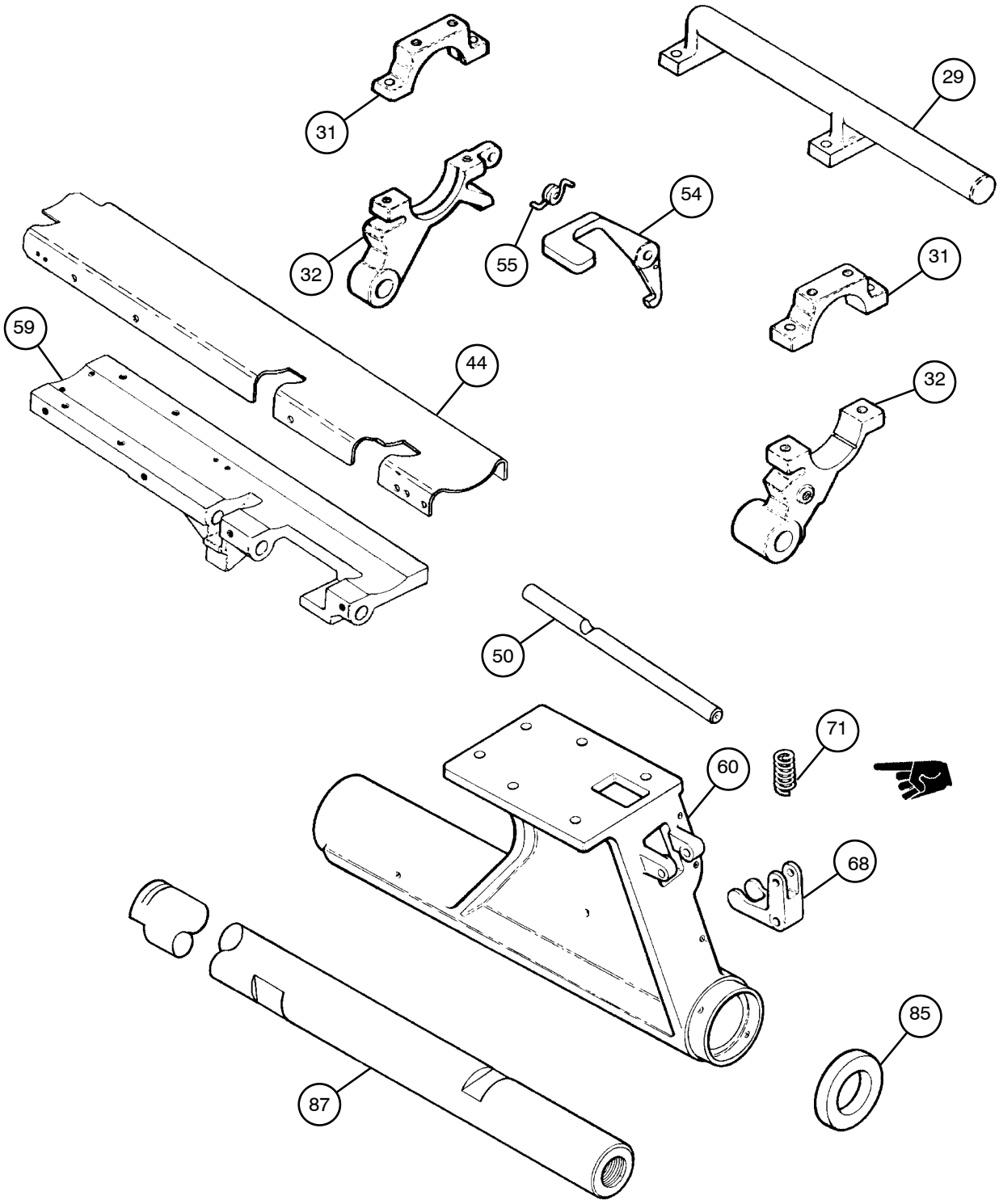
8 Inspect helical compression spring (71). Replace if cracked or distorted.

9 Inspect actuating lock lever (68). Replace if cracked or severely worn.

10 Inspect rammer support (60) for burrs, cracks, or visible damage. Remove burrs. Replace if cracked or damaged. Chase damaged threads.

11 Inspect nonmetallic bushing (85). Replace if brittle, cracked, or distorted.

12 Inspect straight shaft (87) for burrs, wear, or damaged threads. Remove burrs. Replace if cracked or damaged. Chase damaged threads.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7-1 RAMMER ASSEMBLY — CONTINUED

d. Assembly

1 Install straight shaft (87) on rammer support (60).

2 Install flat washer (86), nonmetallic bushing (85), and shoulder screw (84).

3 Install shaft cover assembly (83), four spring tension washers (82), and four cap screws (81) on rear of rammer support (60). Secure four cap screws with new lockwire (80).

4 Install two lubrication fittings (79).

5 Install cap screw (78).

6 Install new cover gasket (77), access cover (76), seven new lockwashers (75), and seven machine screws (74) on rammer support (60).

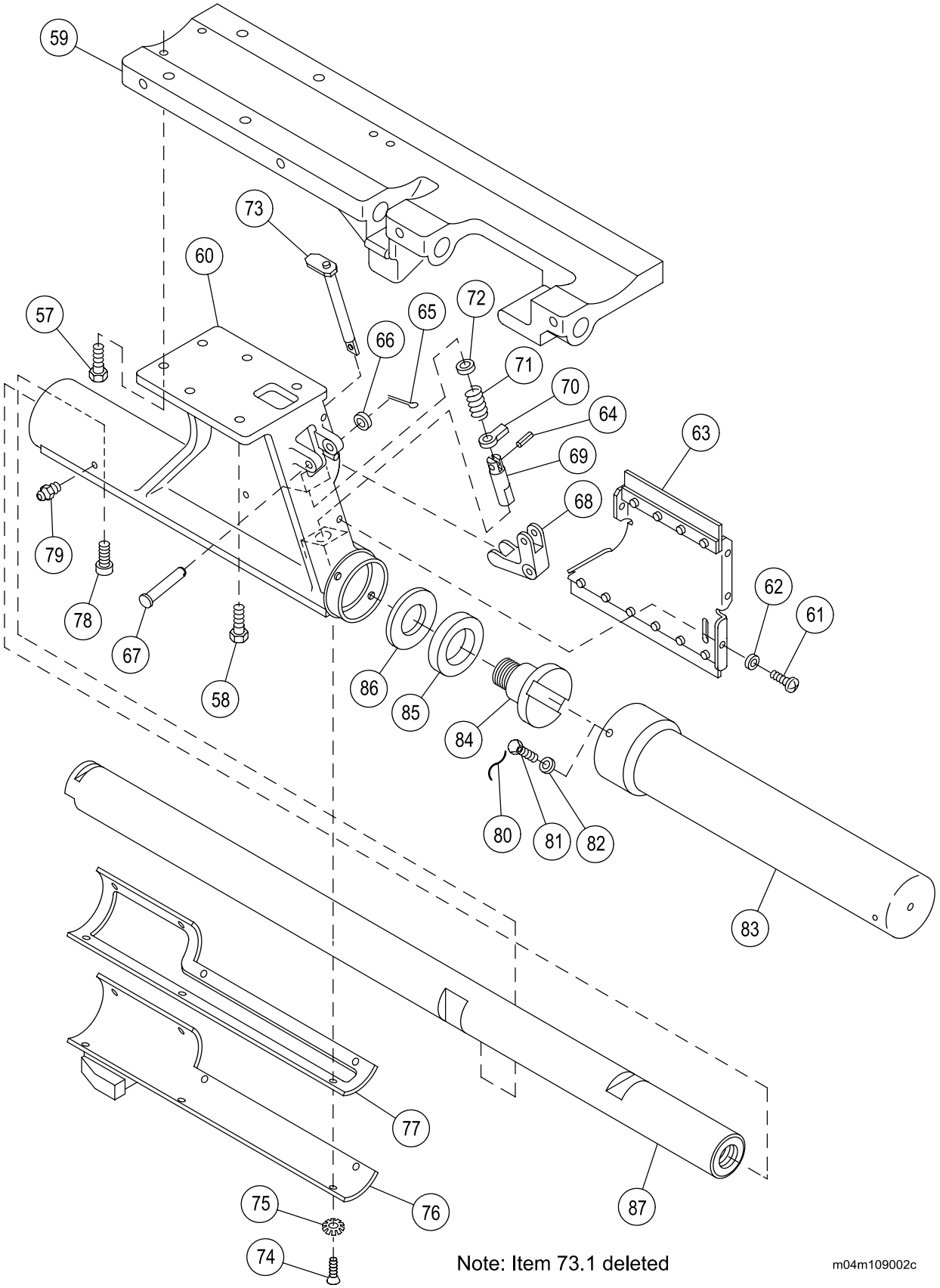
7 Install rammer switch actuator (73), flat washer (72), helical compression spring (71), dial pointer (70), and headless shoulder pin (69).

8 Install actuating lock lever (68), headed straight pin (67), flat washer (66), and new cotter pin (65).

9 Install new spring pin (64).

10 Install cover assembly (63), five flat washers (62), and five machine screws (61) to rammer support (60).

11 Apply sealing compound to threads of four cap screws (58) and two cap screws (57). Install tray support (59), four cap screws (58), and two cap screws (57) to flange of rammer support (60). Torque cap screws to 32–39 lb-ft (43–53 N·m).



Note: Item 73.1 deleted

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7-1 RAMMER ASSEMBLY — CONTINUED

d. Assembly — Continued

12 Install machine key (56) in rear cylinder support (32).

13 Apply sealing compound to threads of hex nut (51) and shoulder bolt (52). Install helical torsion spring (55), lock-release lever (54), flat washer (53), shoulder bolt (52), and hex nut (51) to front cylinder support (32). Torque shoulder bolt to 34–42 lb-ft (46–57 N·m).

NOTE

Front and rear cylinder supports and caps are matched sets.

14 Install front and rear cylinder supports (32) and caps (31).

15 Install electrical post (50).

16 Install mounting bracket (49) and two cap screws (48) to loader-rammer tray (44).

17 Apply sealing compound to threads of seven cap screws (45). Install loader-rammer tray (44), latch (47), two cap screws (46), and seven cap screws. Torque five cap screws to 32–39 lb-ft (43–53 N·m).

18 Install handle group (43) and four cap screws (42) on loader-rammer tray (44).

19 Install two flat washers (40) and two cap screws (39) on angle bracket (41).

20 Insert headed straight pin (37) into rod end bearing (38).

21 Install flat washer (36) and new cotter pin (35) on headed straight pin (37).

22 Install new lower half of retaining ring (33).

23 Install cylinder assembly (34).

24 Install new upper half of retaining ring (33).

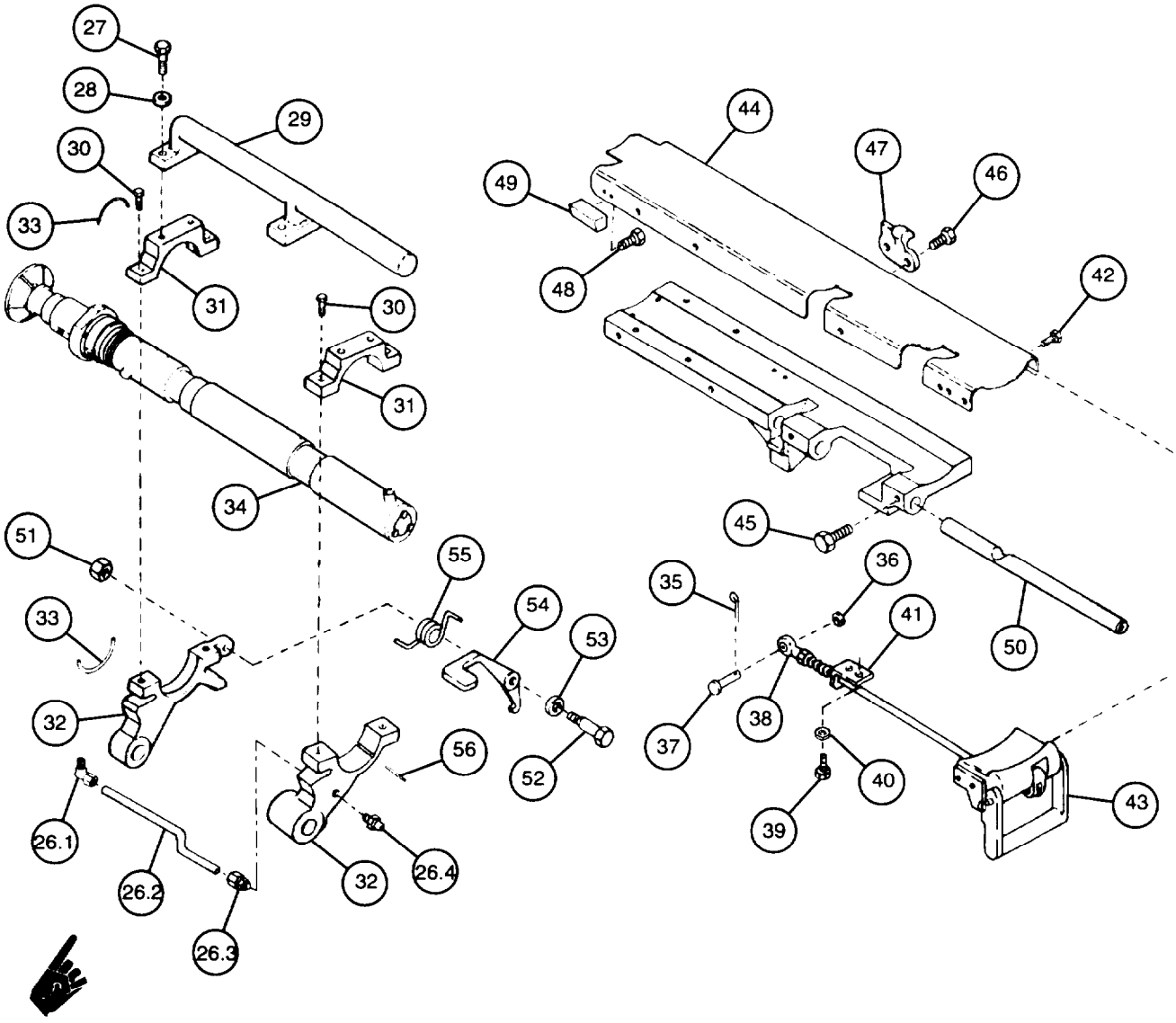
NOTE

Be sure to install two caps with their respective matched front and rear cylinder supports.

25 Install two caps (31) and four cap screws (30).

26 Install rammer handle (29), four flat washers (28), and four cap screws (27).

27 Install adapter (26.4), adapter (26.3), metallic tube (26.2), and elbow (26.1).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7-1 RAMMER ASSEMBLY - CONTINUED

e. Installation

1 Relieve tension on adjuster (TM 9-2350-311-10).

2 Open breechblock (5).

WARNING

Weight of rammer assembly and shaft assembly is approximately 198 pounds (90 kg). Two persons are required for installation to avoid injury.

3 Slide rammer assembly (6) with rammer bumper (24) and sleeve spacer (25) into mount (22) on shaft (26).

4 Install cap screw (23) to rammer bumper (24) and sleeve spacer (25).

5 Secure retaining plate (21) to mount (22) with two cap screws (20).

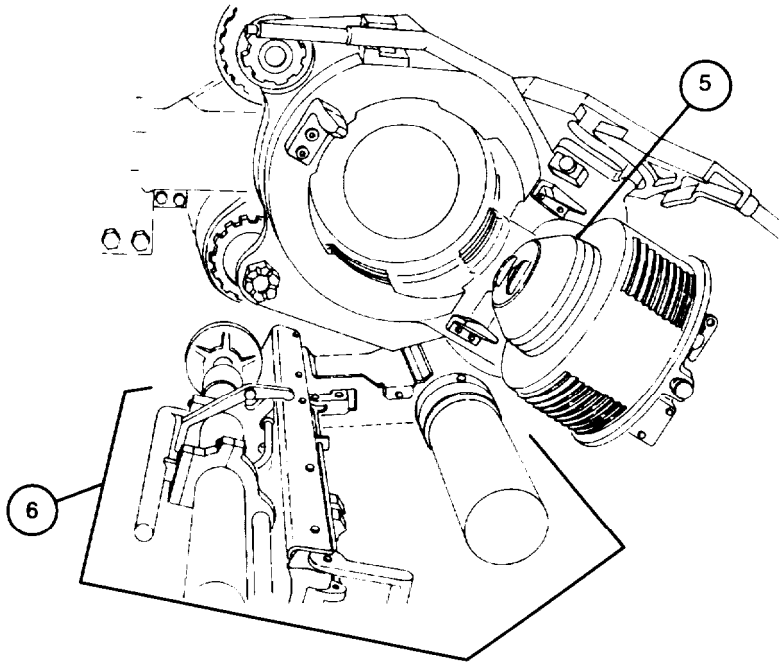
6 Adjust rammer assembly (para 7-1f.).

WARNING

Weight of lower gun shield is approximately 57 pounds (26 kg). Two persons are required for installation of lower gun shield to avoid injury.

7 Install lower gun shield (16) eight new lockwashers (15), and eight cap screws (14).

8 If removed, install two new pipe plugs (17) into lower gun shield (16).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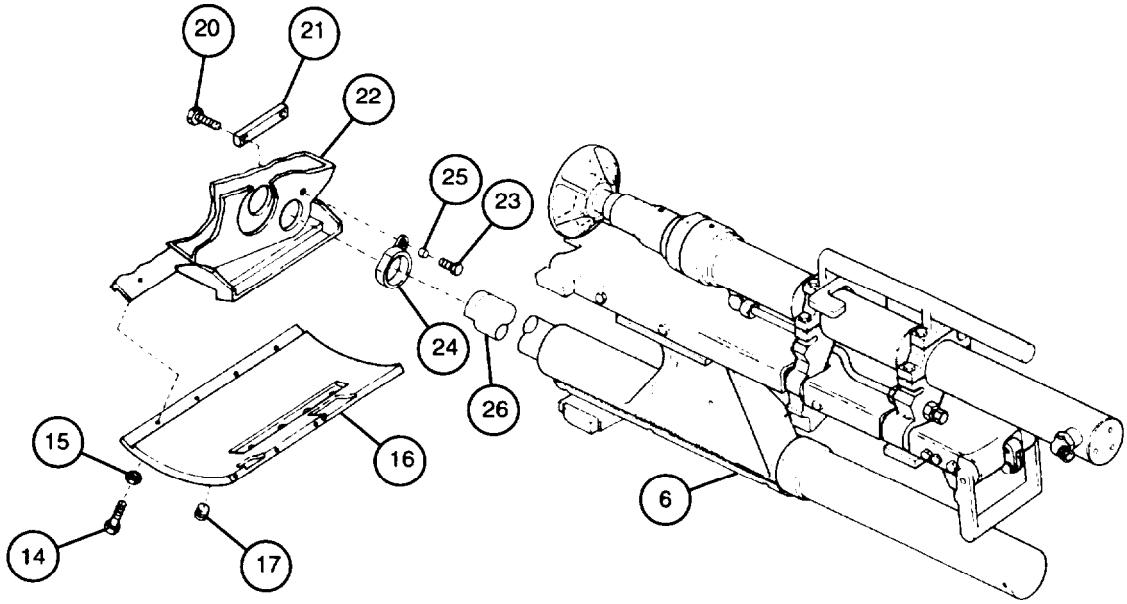
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7-1 RAMMER ASSEMBLY - CONTINUED

e. Installation - Continued

9 Install angle bracket (13) two new lockwashers (12), and two cap screws (11). Do not tighten two cap screws yet.

NOTE

Do not spot paint bridge cover clamp or plunger. Lubricate with grease.

10 Adjust angle bracket (13) so that plunger (88) of blocking check valve (4) is depressed when rammer assembly (6) is in ram position, then tighten two cap screws (11). Secure two cap screws with new lockwire (10).

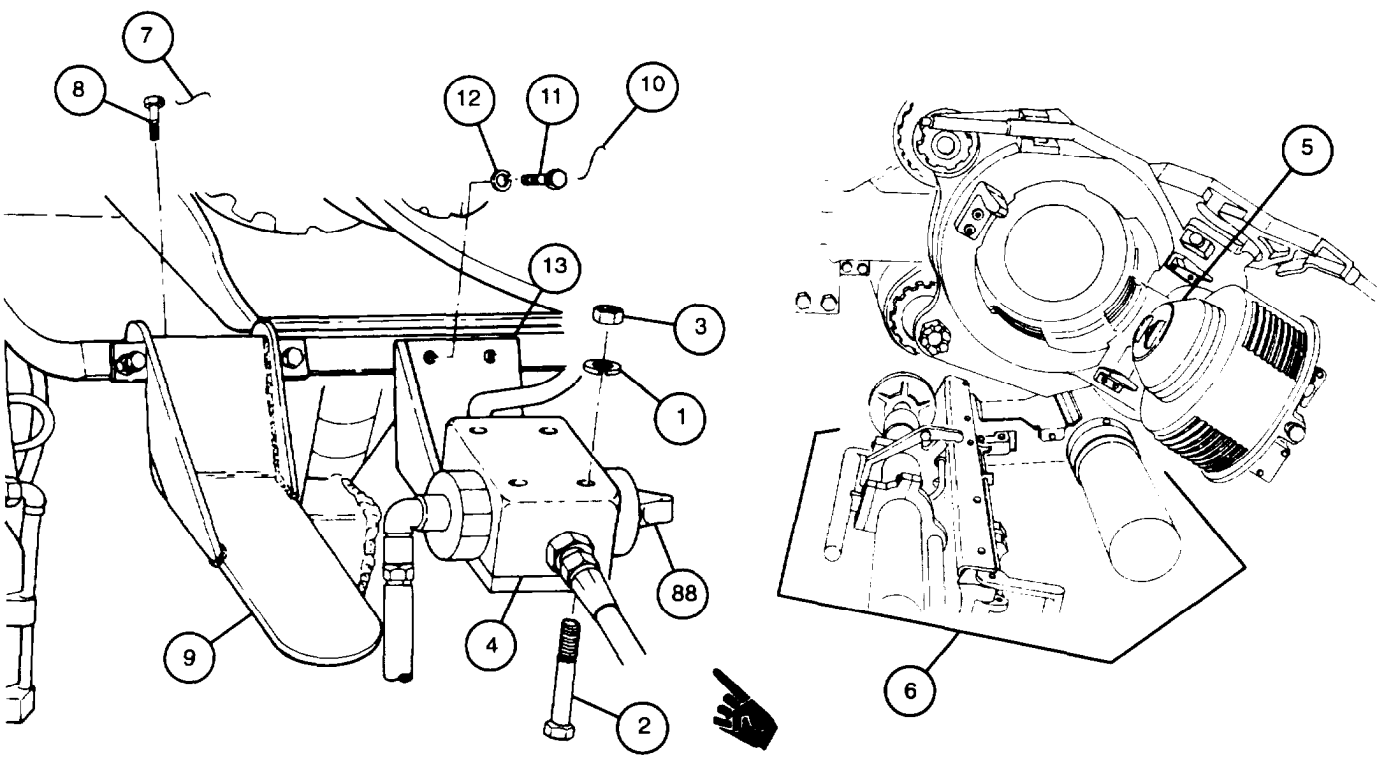
11 Install rammer mounting bracket (9), two cap screws (8), and new lockwire (7).

12 Move rammer assembly (6) to retracted position.

13 Reset tension on adjuster (TM 9-2350-311-10).

14 Close breechblock (5).

15 Install blocking check valve (4), four new lockwashers (3), four cap screws (2) and four hex nuts (1).



f. Adjustment

NOTE

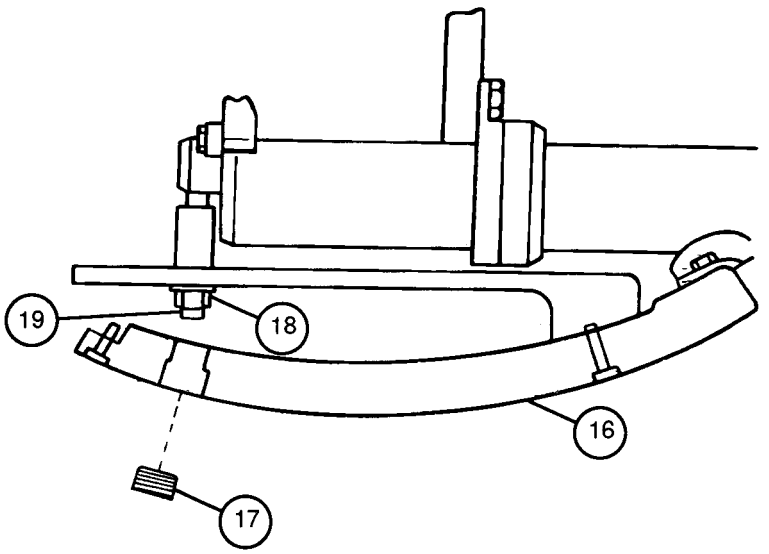
This alinement procedure can be done during installation of rammer assembly or with lower gun shield and rammer assembly already installed.

1 Remove two pipe plugs (17) from access holes of lower gun shield (16).

2 Loosen two hex nuts (18) and adjust two setscrews (19) through access holes to aline rammer assembly in cannon breech.

3 Hold setscrews (19) with a wrench and tighten two hex nuts (18).

4 Apply antiseizing compound and install two pipe plugs (17).



7-2 CYLINDER ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4930-95-CL-A06)

Materials/Parts
Hydraulic fluid (item 22, Appx B)
LockWire (item 39, Appx E)
Lockwire (item 107, Appx E)
Rammer cylinder seal replacement parts kit (item 150, Appx E)
Retaining ring (item 122, Appx E)
Retaining ring (item 123, Appx E)
Retaining ring (item 124, Appx E)
Self-locking nut (item 160, Appx E)

Equipment Condition
Cylinder assembly removed (para 7-1)

a. Disassembly

1 Remove and discard lockwire (1).

2 Remove three cap screws (2), self-locking nut (3), sleeve spacer (4), and pillow block cap (5). Discard self-locking nut.

3 Remove self-alining bearing (6), bearing collar (7), and bearing cap (8).

4 Remove and discard piston wiper (9), packing retainer (1O), and preformed packing (11).

5 Remove lockwire (12), machine plug (13), and preformed packing (14). Discard lockwire and preformed packing.

6 Remove outer end housing (15).

7 Remove and discard preformed packing (16) and flat washer (17).

8 Remove setscrew (18). Separate guide (19) and cylinder externally threaded ring (20).

9 Remove guide (19) from rammer piston tube (21).

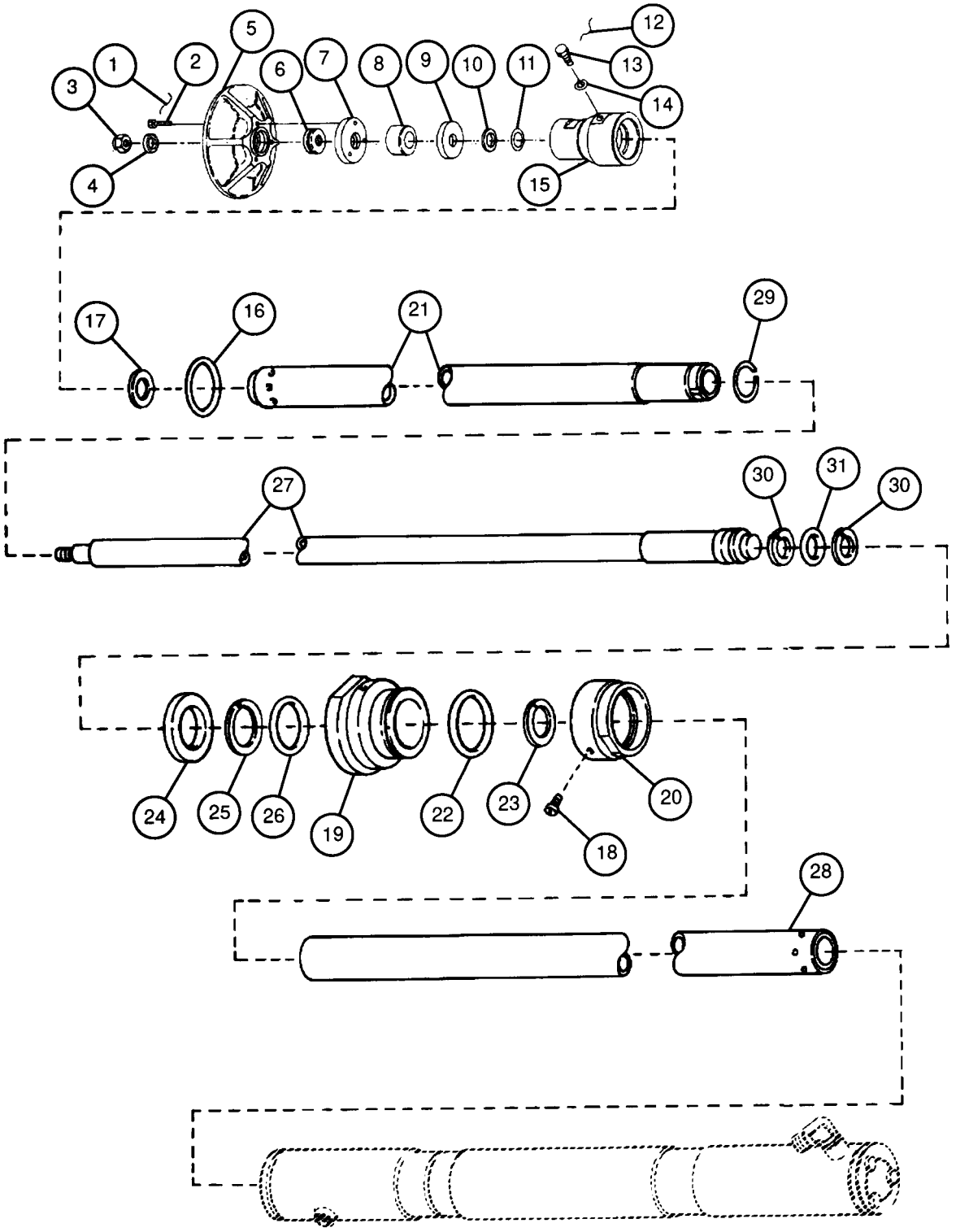
10 Remove and discard preformed packing (22) and retaining ring (23).

11 Remove and discard guide wiper (24), packing retainer (25), and preformed packing (26).

12 Remove rammer piston tube (21) and rammer actuating piston (27) from outer rammer piston tube (28) and separate.

13 Remove and discard retaining ring (29).

14 Remove and discard two packing retainers (30) and preformed packing (31).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7-2 CYLINDER ASSEMBLY - CONTINUED

a. Disassembly - Continued

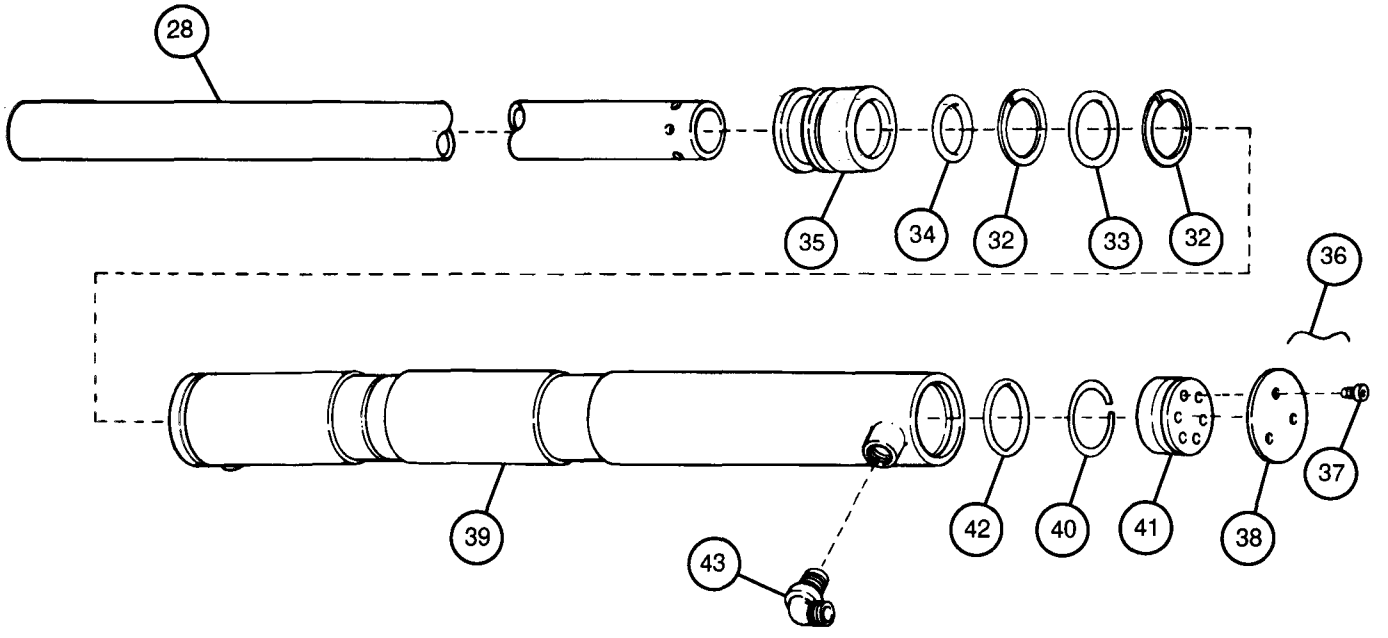
15 Remove two packing retainers (32), preformed packing (33), preformed packing (34), and sleeve bushing (35) from outer rammer piston tube (28). Discard packing retainers and preformed packings.

16 Remove lockwire (36), three internal bolts (37), and plate (38) from outer piston cylinder (39).

17 Remove retaining ring (40) and linear head (41). Discard retaining ring.

18 Remove and discard preformed packing (42).

19 Remove elbow (43) from outer piston cylinder (39).



b. Inspection

1 Inspect pillow block cap (5). Replace if scratched, scarred, or severely worn.

2 Inspect outer end housing (15). Replace if cracked or if threads are damaged.

3 Inspect linear head (41). Replace if broken.

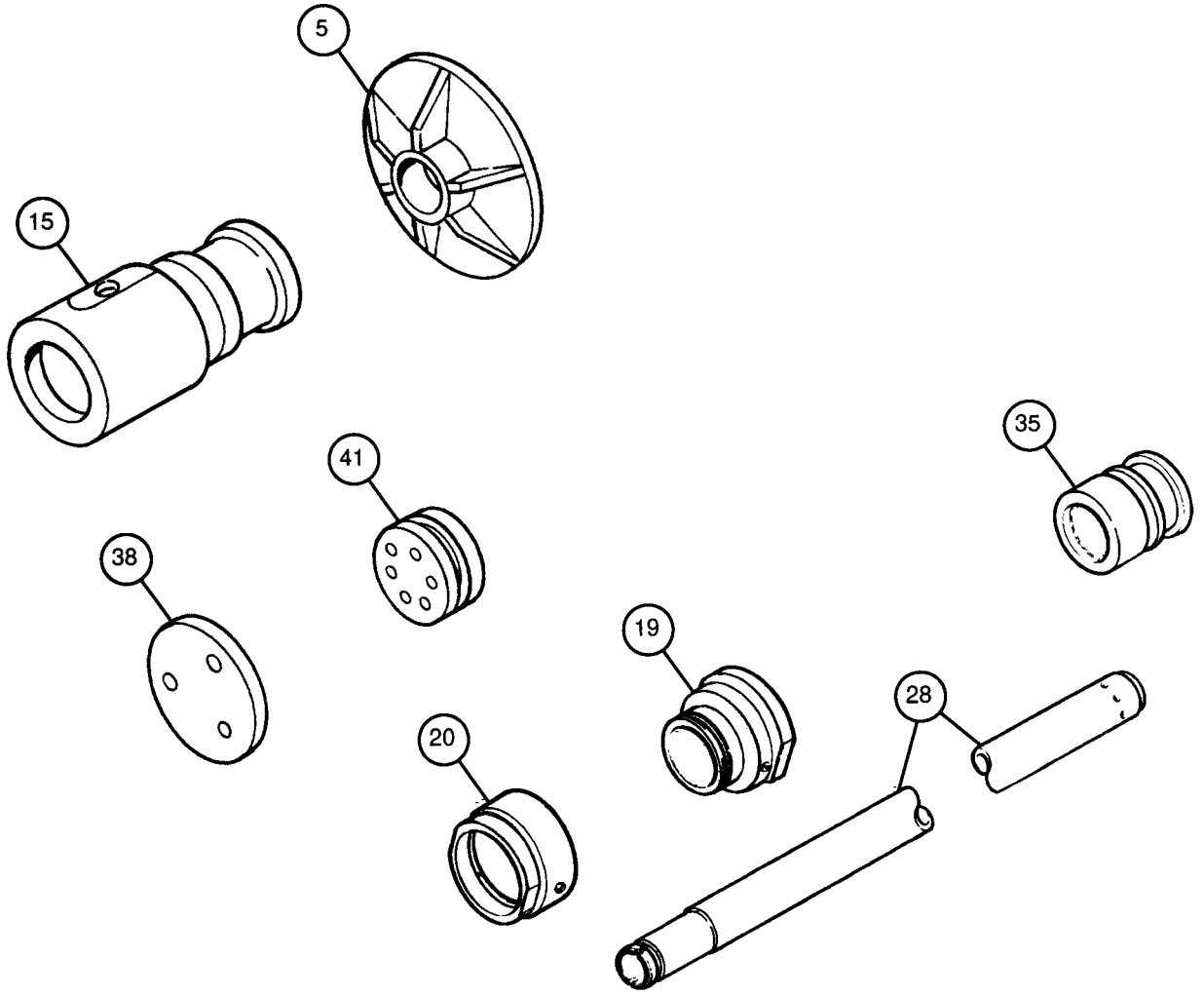
4 Inspect plate (38). Replace cylinder assembly if broken.

5 Inspect outer rammer piston tube (28). Replace cylinder assembly if scratched, broken, or severely worn.

6 Inspect sleeve bushing (35). Replace if cracked, burred, nicked, or distorted.

7 Inspect guide (19). Replace cylinder assembly if cracked, burred, nicked, or distorted.

8 Inspect cylinder externally threaded ring (20). Replace if cracked, burred, nicked, or distorted.



7-2 CYLINDER ASSEMBLY - CONTINUED

b. Inspection - Continued

9 Inspect sleeve spacer (4). Replace if distorted.

10 Inspect self-alining bearing (6). Replace if distorted or excessively worn.

11 Inspect bearing collar (7). Replace if distorted or excessively worn.

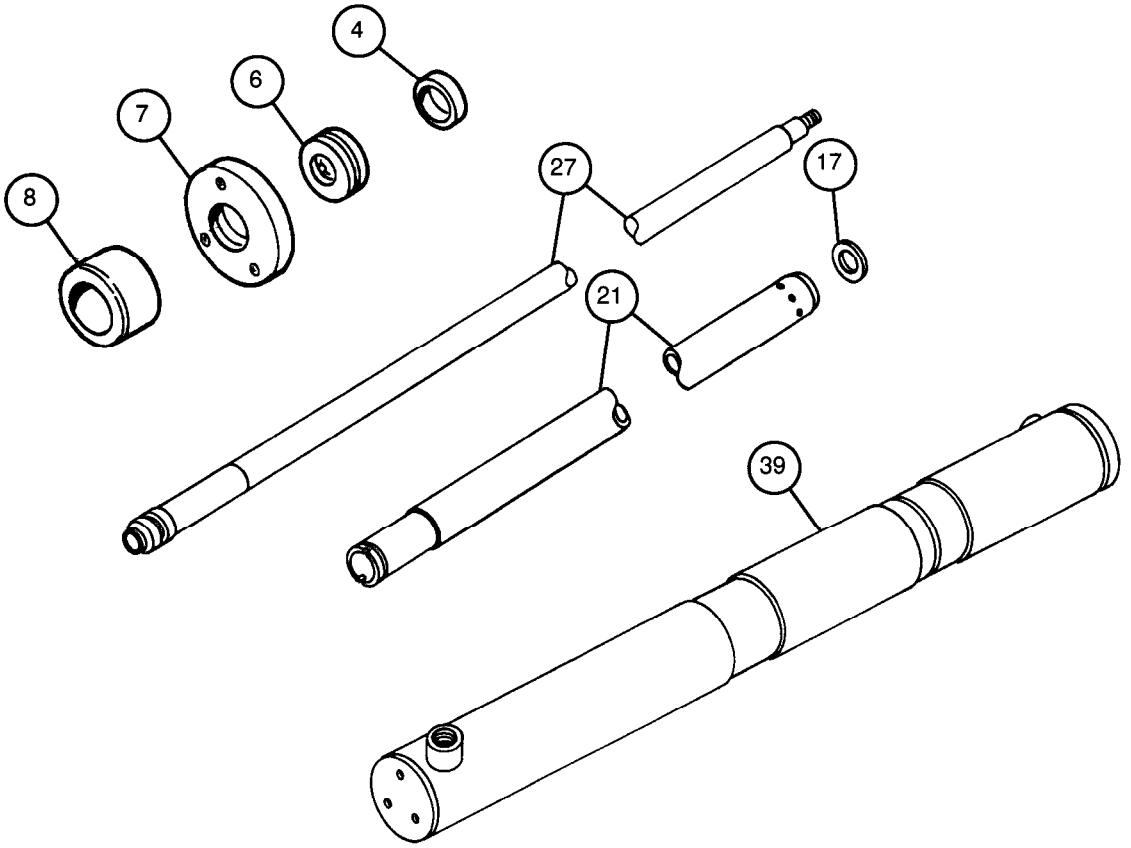
12 Inspect bearing cap (8). Replace if cracked, burred, nicked or distorted.

13 Inspect flat washer (17). Replace if distorted.

14 Inspect rammer piston tube (21). Replace cylinder assembly if cracked, nicked, burred, distorted, or if inside diameter is greater than 0.898 inch (22.8 mm).

15 Inspect rammer actuating piston (27). Replace if cracked, nicked, burred, distorted, or if outside diameter is less than 0.892 inch (22.7 mm).

16 Inspect outer piston cylinder (39). Replace cylinder assembly if cracked, nicked, burred, distorted, or if inside diameter is greater than 2.155 inches (5.474 cm).



c. Assembly

NOTE

Coat all new preformed packings with hydraulic fluid before installing.

1 Install elbow (43) on outer piston cylinder (39).

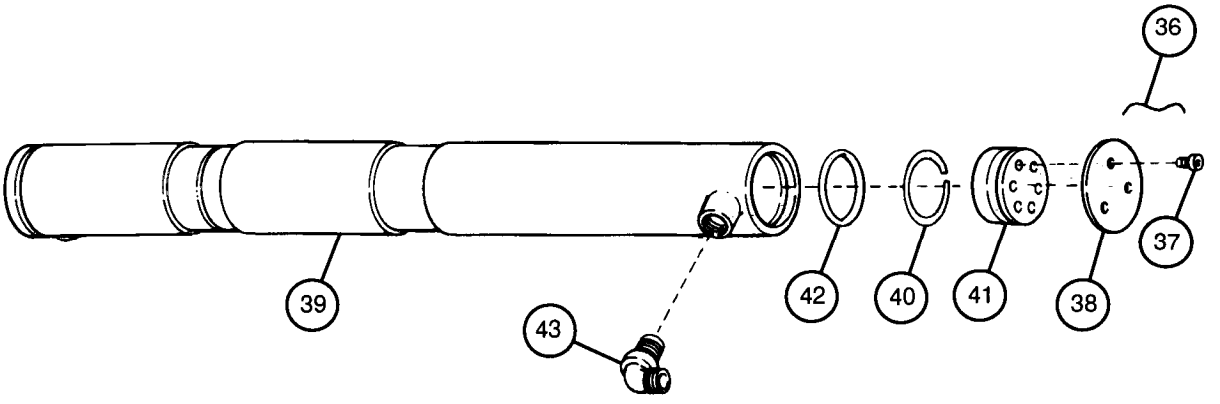
2 Install new preformed packing (42) on linear head (41).

3 Install new retaining ring (40).

4 Install linear head (41) with attached parts.

5 Secure plate (38) to outer piston cylinder (39) using three internal bolts (37).

6 Secure three internal bolts (37) with new Iockwire (36).



7-2 CYLINDER ASSEMBLY - CONTINUED

c. Assembly - Continued

7 Install new preformed packing (34), sleeve bushing (35), two new packing retainers (32), and new preformed packing (33) on outer rammer piston tube (28).

8 Install two new packing retainers (30) and new preformed packing (31).

9 Install new retaining ring (29).

10 Install new preformed packing (16) and flat washer (17).

11 Assemble rammer actuating piston (27) and rammer piston tube (21) and install in outer rammer piston tube (28).

12 Install outer rammer piston tube (28).

13 Install new preformed packing (26), new packing retainer (25), and new guide wiper (24) to guide (19).

14 Install new preformed packing (22) and new retaining ring (23) on guide (19).

15 Assemble guide (19) and cylinder externally threaded ring (20). Install setscrew (18).

16 Install guide (19) with attached components onto outer piston cylinder (39).

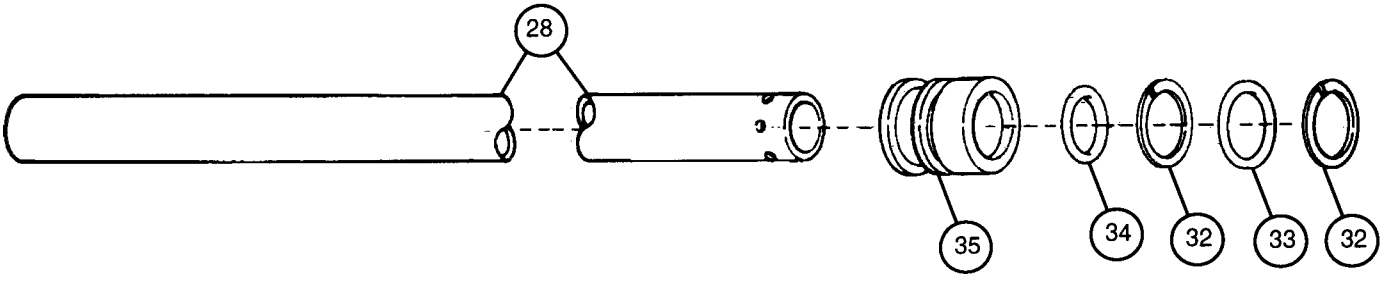
17 Install new preformed packing (14) and machine plug (13) in outer end housing (15). Secure machine plug with new lockwire (12).

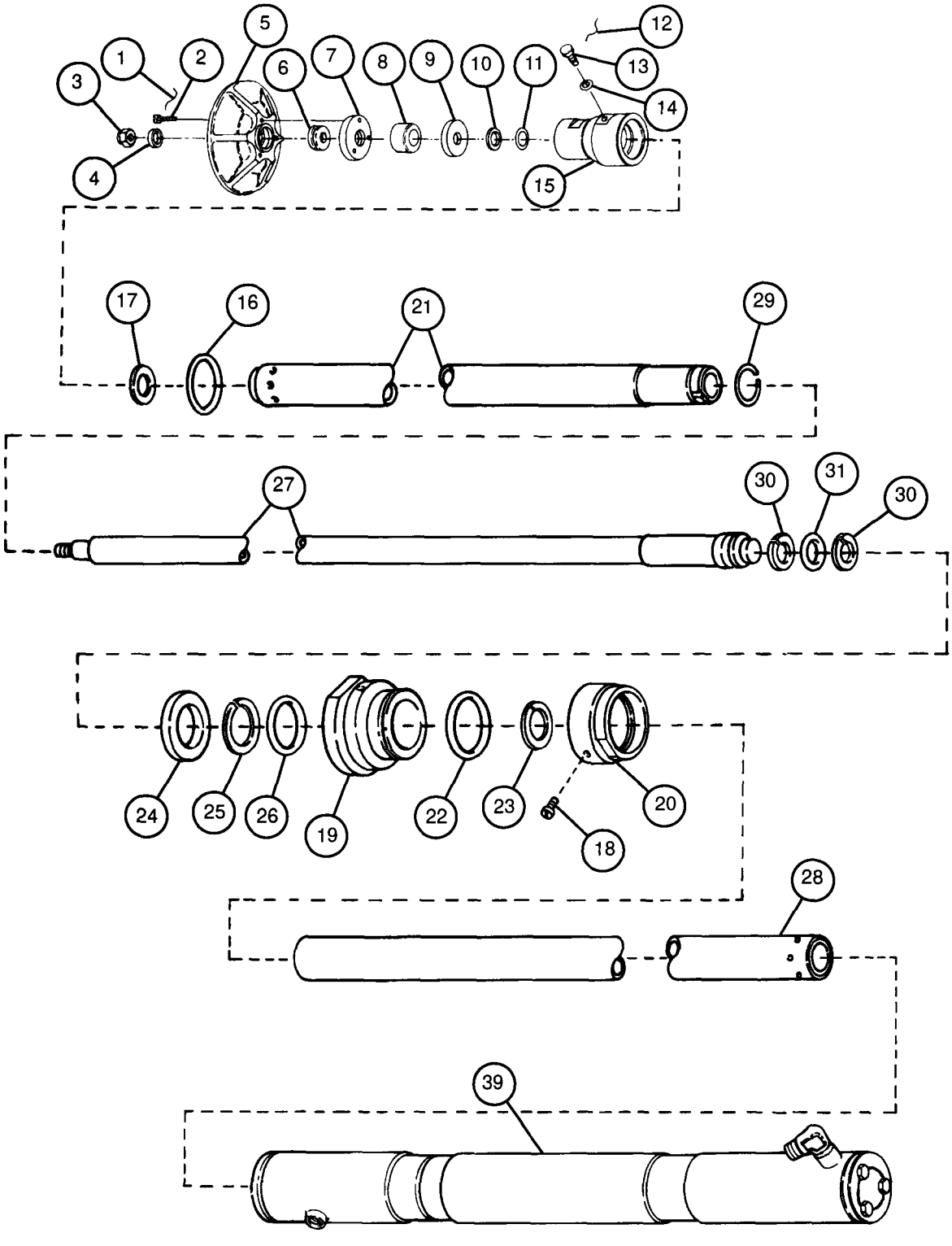
18 Install new preformed packing (11), new packing retainer (10), and new piston wiper (9).

19 Install bearing cap (8), bearing collar (7), and self-alining bearing (6).

20 Install pillow block cap (5), sleeve spacer (4), new self-locking nut (3), and three cap screws (2).

21 Secure three cap screws (2) with new lockwire (1).

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7-3 ACTUATING VALVE ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Hydraulic fluid (item 22, Appx B)
LockWashers (4) (item 76, Appx E)
LockWashers (4) (item 81, Appx E)
Preformed packings (2) (item 50, Appx E)
Preformed packings (2) (item 52, Appx E)
Preformed packings (2) (item 64, Appx E)
Retaining ring (item 139, Appx E)
Spring pins (2) (item 11, Appx E)

Equipment Condition
Actuating valve assembly removed (TM 9-2350-311-20-2)

a. Disassembly

1 Remove two machine plugs (1) and two preformed packings (2). Discard preformed packings.

WARNING

Helical compression springs beneath access cover are under high preload. Make provision to restrain access cover during disassembly.

2 Remove four cap screws (3), four lockwashers (4), and access cover (5). Discard lockwashers.

3 Remove two spring pins (6) and manual control lever (7). Discard spring pins.

4 Remove four cap screws (8), four lockwashers (9), and access cover (10). Discard lockwashers.

5 Withdraw valve spool (11) from body (12).

6 Remove two preformed packings (13) from valve spool (11) and discard.

7 Remove retaining ring (14) and helical compression spring (15) from valve spool (11). Discard retaining ring.

8 Remove two plugs (16) and two preformed packings (17). Discard preformed packings.

9 Remove sleeve (18).

b. Inspection

1 Inspect helical compression spring (15). Replace if cracked, nicked, distorted, or broken.

2 Inspect body (12). Replace entire valve body assembly (19) if valve body is cracked or distorted.

3 Inspect valve spool (11) and sleeve (18). Replace entire valve body assembly (19) if valve spool or sleeve is cracked, distorted, or scored.

c. Assembly

1 Install sleeve (18).

2 Install two new preformed packings (17) and two plugs (16).

3 Install new retaining ring (14) and two new preformed packings (13) on valve spool (11).

4 Coat helical compression spring (15) and valve spool (11) with hydraulic fluid. Install helical compression spring and valve spool in body (12).

5 Install access cover (10), four new lockwashers (9), and four cap screws (8).

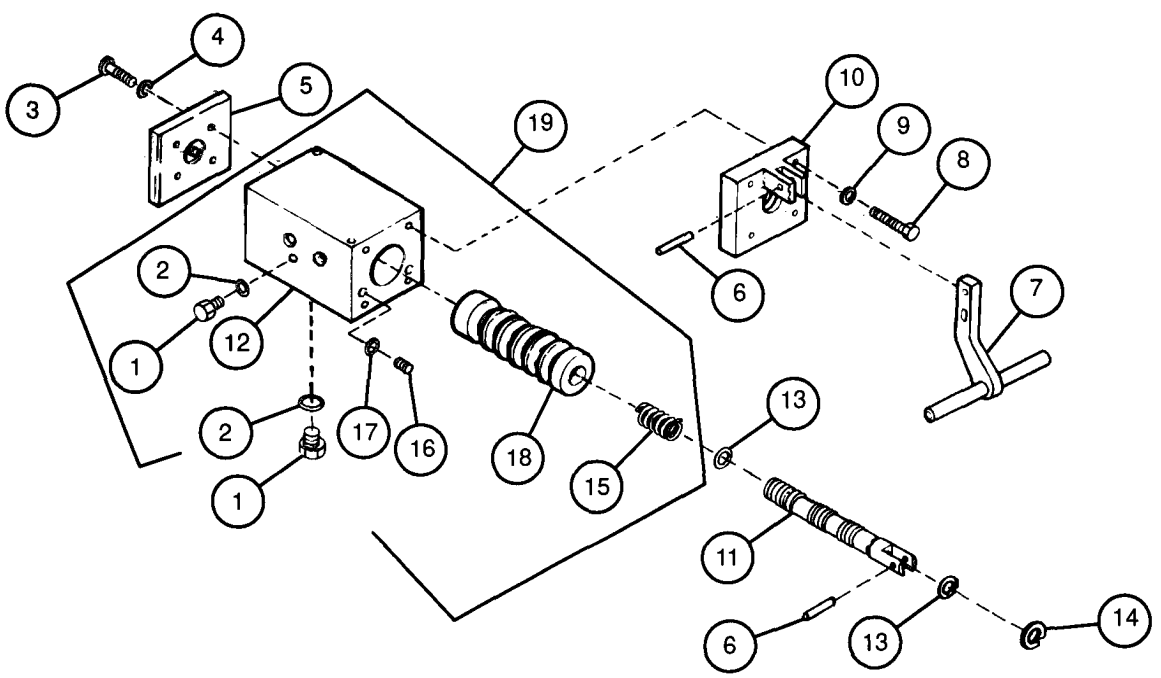
6 Install manual control lever (7) and two new spring pins (6).

WARNING

Helical compression spring must be compressed to assemble. Make provision to contain parts against sudden release during assembly.

7 Install access cover (5), four new lockwashers (4), and four cap screws (3).

8 Install two new preformed packings (2) and two machine plugs (1).

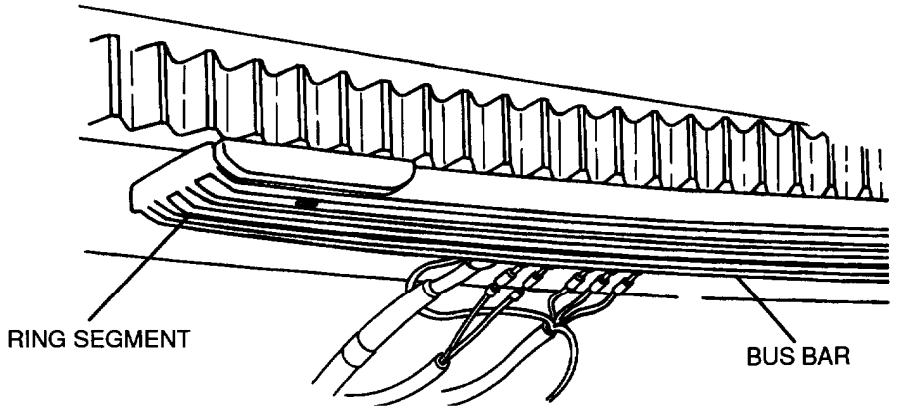


CHAPTER 8
DIRECT SUPPORT MAINTENANCE OF ELECTRICAL CONTACT SEGMENT RING

GENERAL

This chapter describes and illustrates inspection and repair procedures for the electrical contact segment ring. These maintenance procedures are functions authorized for direct support level maintenance.

CONTENTS



ELECTRICAL CONTACT SEGMENT RING

This task covers: Inspection and Repair

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95CL-A12)
Artillery field maintenance tool kit SC 4933-95-CL-A06)

Materials/Parts
Adhesive (item 2, Appx B)
Epoxy adhesive (item 3, Appx B)
Metal bar (copper) (item 8, Appx B)

References
TM 9-2350-311-20-2

Equipment Condition
Vehicle MASTER switch to OFF (TM 9-2350-311-10)
CAB POWER switch to OFF (TM 9-2350-311-10)
Batteries disconnected (TM 9-2350-311-10)

Inspection and Repair

WARNING

Personnel must wear safety glasses to avoid eye injury.

NOTE

- See TM 9-2350-311-20-2 for removal and installation of electrical contact segment ring.
- Vehicles with three contact arm assemblies have an electrical contact segment ring consisting of two ring segments.
- Vehicles with five contact arm assemblies have one ring segment.
- Bus bars are the two wide polished metal contact strips on ring segment(s).
- Be careful not to damage polished metal surfaces on contact strips.

1 Clean bus bars (1) of ring segment(s) (2) with wire brush. Clean narrow polished metal contact strips (3).

WARNING

Adhesives can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive gets on skin or clothing, wash immediately with soap and water.

2 Inspect ring segment(s) (2) for cracks. Repair cracks with epoxy adhesive.

3 Inspect bus bars (1) and narrow polished metal contact strips (3) for looseness. Bond loose bus bars or narrow polished metal contact strips to ring segment(s) (2) with epoxy adhesive.

4 Inspect bus bars (1) for metal mounds caused by arcing. Use wood chisel (or similar sharp tool) and soft-headed mallet to remove any metal mounds.

5 Inspect bus bars (1) for small surface pits. Fill very small surface pits with epoxy adhesive.

6 Inspect bus bars (1) for large damaged areas or deep pits. Repair as follows:

(a) Ream out large damaged areas to a constant depth of 0.125 ± 0.001 inch (3.0 ± 0.025 mm).

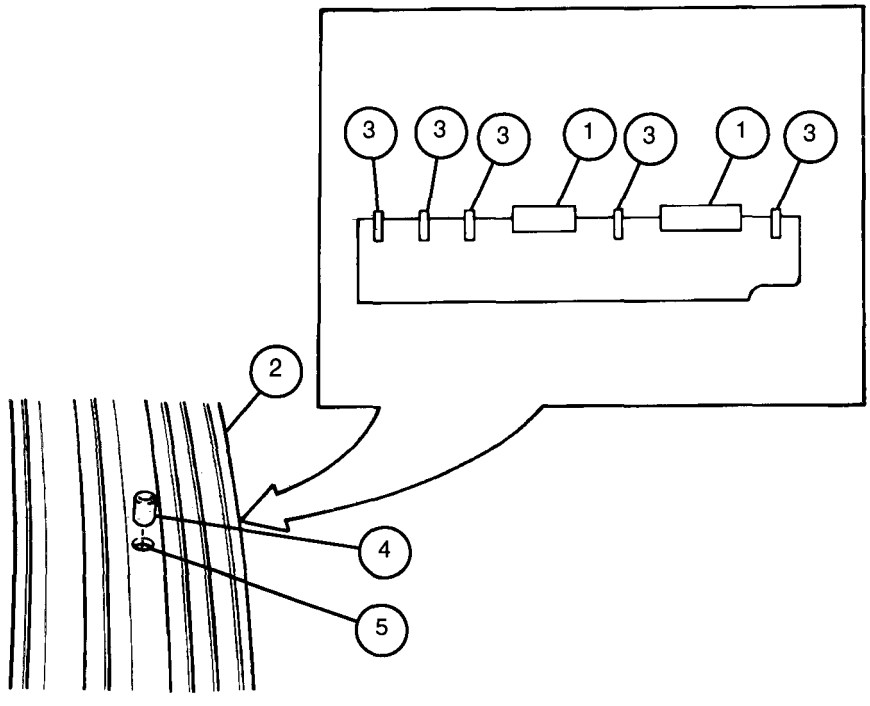
(b) Machine copper insert (4) of 0.125 ± 0.001 inch (3.0 ± 0.025 mm) thickness. Do not allow more than 1/64 inch (0.4 mm) at ends and 1/32 inch (0.8 mm) along sides for adhesive. Electrical contact with bus bars (1) should be made by base of copper insert.

(c) Bond copper insert (4) into reamed area (5) with adhesive. Check surface for smoothness after copper insert bond has cured.

NOTE

Avoid filing polished metal surface off bus bars.

(d) If necessary, file copper insert (4) smooth to within 0.001 inch (0.025 mm) of bus bars (1).

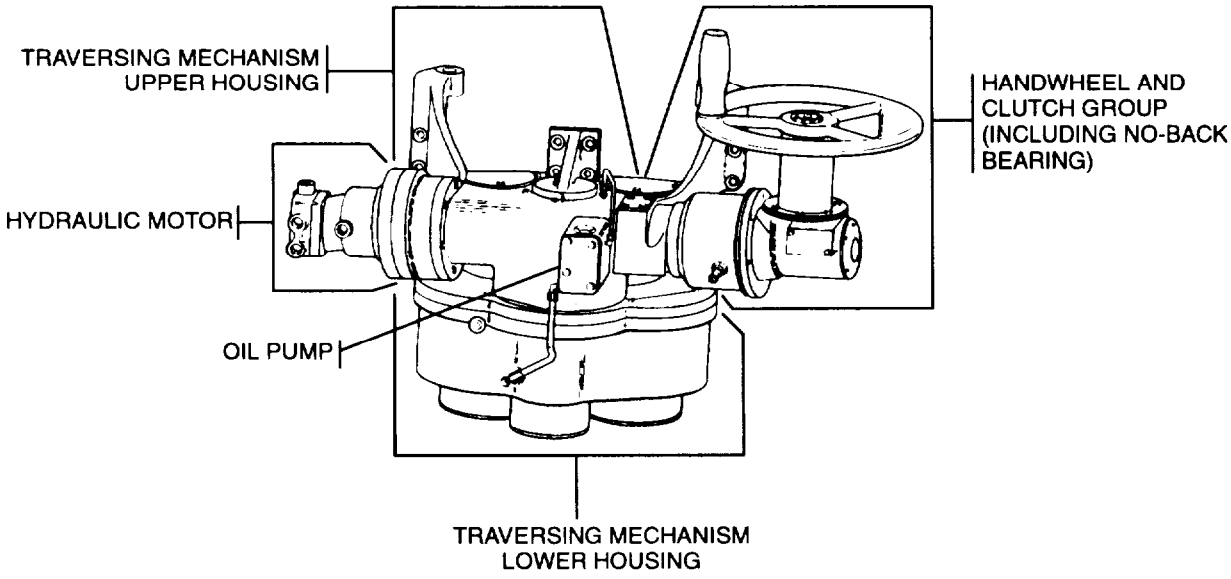


CHAPTER 9
DIRECT SUPPORT MAINTENANCE OF TRAVERSING MECHANISM ASSEMBLY

GENERAL

This chapter illustrates and describes the repair of the traversing mechanism assembly which consists of the major groups and important components illustrated below.

CONTENTS



9-1 TRAVERSING MECHANISM ASSEMBLY

This task covers: a. Removal b. Disassembly c. Inspection d. Assembly e. Installation

INITIAL SETUP

Tools

Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Drain pan (item 12, Appx F)
Sling, multiple leg (item 20, Appx F)

Materials/Parts

Gasket (item 133, Appx E)
Lockwashers (4) (item 96, Appx E)
Sealing compound (item 29, Appx B)
Self-locking bolts (2) (item 93.1, Appx E)
Webbing strap (item 34, Appx B)

Personnel Required

2

Equipment Condition

Turret lock in LOCKED position (TM 9-2350-311-10)
Vehicle MASTER switch to OFF (TM 9-2350-311-10)
CAB POWER switch to OFF (TM 9-2350-31 1-10)
Discharge hydraulic pressure (TM 9-2350-311-20-2)
Electrical contact assembly removed (TM 9-2350-311-20-2) M109A2/M109A3
Traversing mechanism cover plate removed (TM 9-2350-311-20-2)
Lines and fittings from traversing mechanism disconnected (TM 9-2350-311-20-2)
Oil pump and lines removed (para 9-5)
Clutch assembly removed (para 9-3) or gearshaft assembly removed (para 9-4)

a. Removal

1 Remove four cap screws (1) four lockwashers (2) and hydraulic motor (3) from adapter (4) on traversing mechanism upper housing (5). Discard lockwashers.

2 Remove woodruff key (6) from hydraulic motor (3) shaft.

3 Place drain pan below drain plug (7) at bottom center of traversing mechanism lower housing (8) and drain 7 pints (3.31 l) of lubricating oil. Replace drain plug.

4 Remove screw (9) from multiple leg sling (10). Separate halves of the multiple leg sling and attach to traversing mechanism upper housing (5). Replace screw.

5 Lower lifting strap (11) through gunner's escape hatch and attach to eye (12) of multiple leg sling (10). Take up slack.

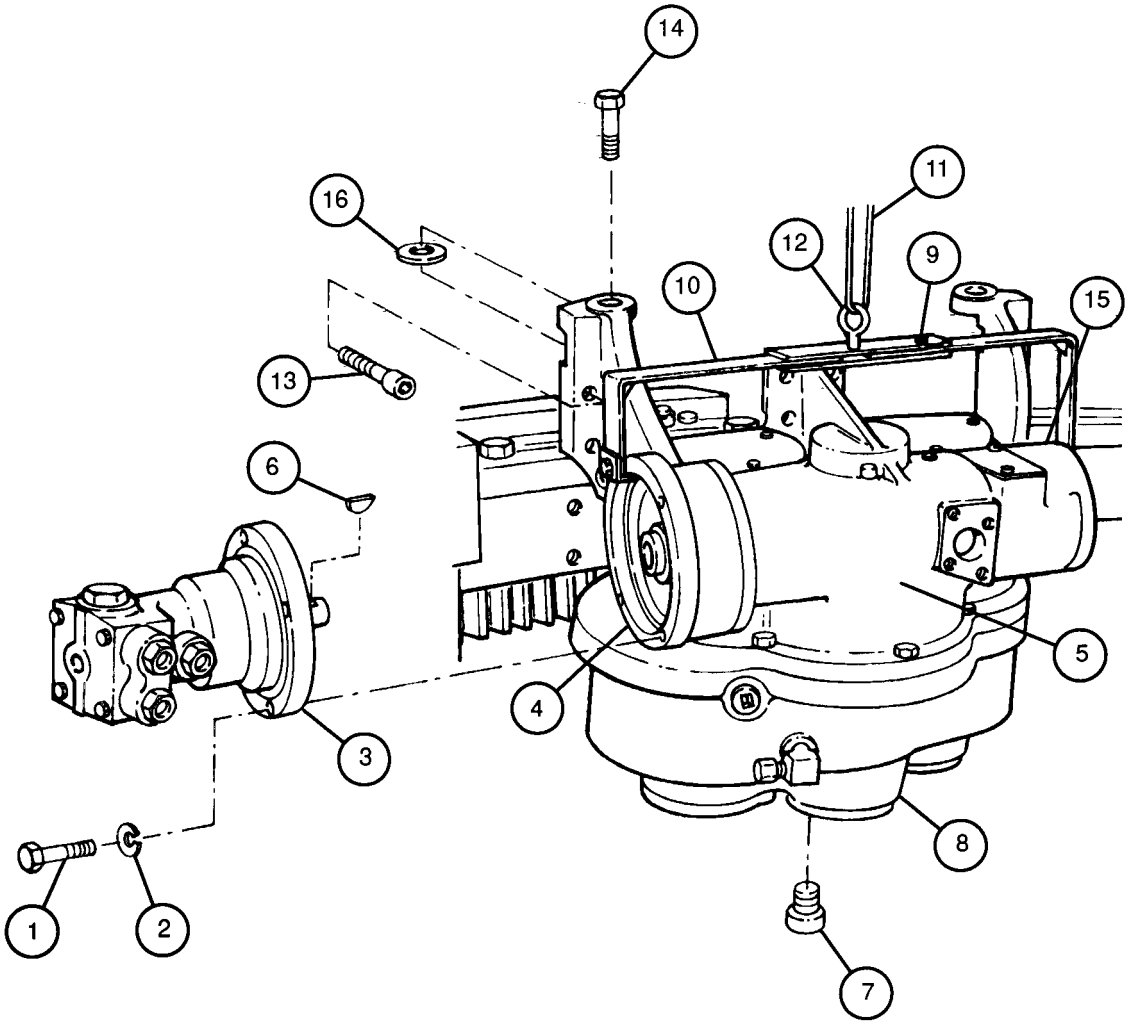
6 Remove eight cap screws (13) and two self-locking bolts (14). Discard self-locking bolts.

7 Lift traversing mechanism (15) through gunner's escape hatch and remove multiple leg sling (10).

NOTE

Retain shims unless new components are to be installed.

8 Remove shim(s) (16), if used, from between upper mounting flanges and top of cab inner race ring.



9-1 TRAVERSING MECHANISM ASSEMBLY - CONTINUED

b. Disassembly

1 Remove six washer assembled bolts (17) and two access covers (18).

2 If necessary for replacement, remove lubrication fitting (19) and plug (20).

3 Remove two washer assembled bolts (21), access cover (22), and gasket (23). Discard gasket.

4 Remove five cap screws (24) and separate adapter (4) from traversing mechanism upper housing (5).

5 Remove, tag, and save shim(s) (25) for reuse during assembly.

c. Inspection

Replace adapter (4) if cracked, broken, or distorted.

d. Assembly

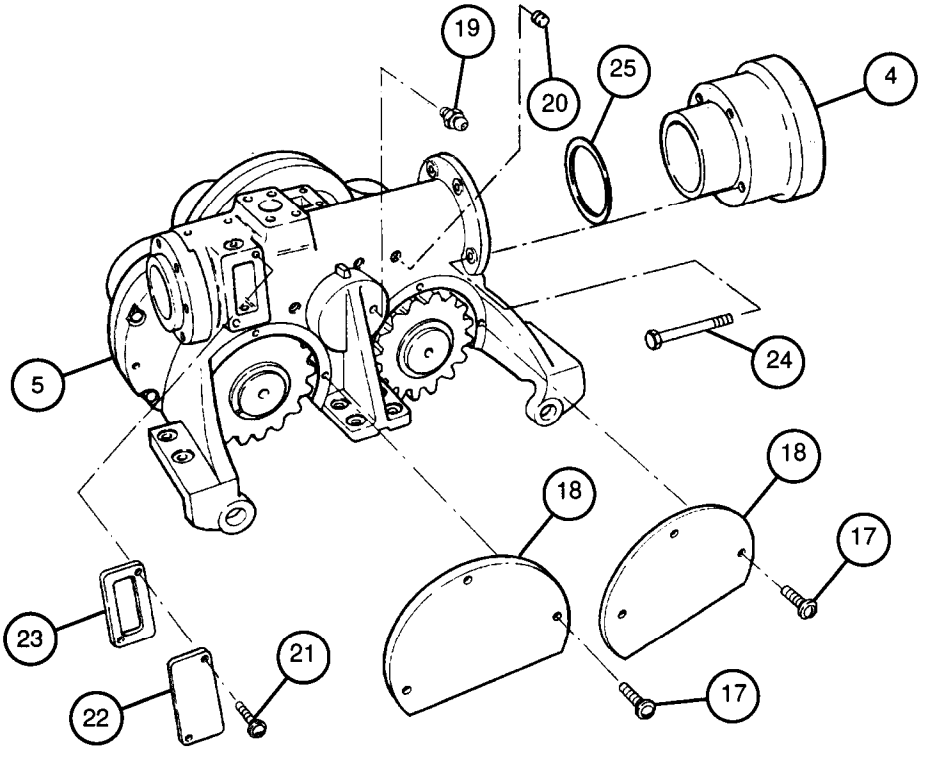
1 Install original shim(s) (25) retained from disassembly.

2 Secure adapter (4) to traversing mechanism upper housing (5) with five cap screws (24).

3 Install new gasket (23), access cover (22), and two washer assembled bolts (21).

4 If removed, install lubrication fitting (19) and plug (20).

5 Install two access covers (18) and six washer assembled bolts (17).



e. Installation

1 Remove screw (9) from multiple leg sling (10). Separate halves of multiple leg sling and attach to traversing mechanism upper housing (5). Replace screw.

2 Attach lifting strap (11) to eye (12) of multiple leg sling (10). Take up slack.

3 Install shim(s) (16) as required, if used.

4 Lower traversing mechanism (15) through gunner's escape hatch.

5 Apply sealing compound to eight cap screws (13).

6 Install two new self-locking bolts (14) and eight cap screws (13). Torque two self-locking bolts to 248-302 lb-ft (336-410 N•m) and eight cap screws to 80-100 lb-ft (108-136 N•m).

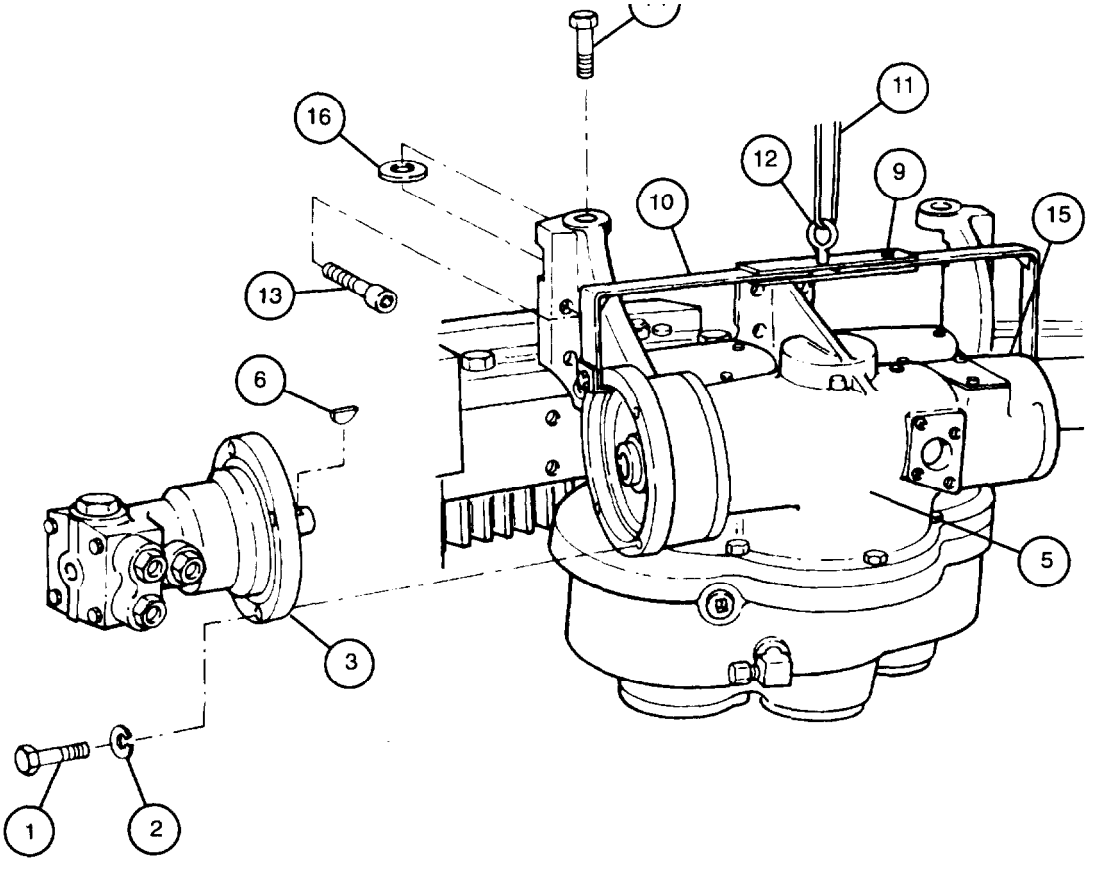
7 Remove multiple leg sling (10).

8 Install woodruff key (6) in keyway of hydraulic motor (3) shaft.

9 Aline woodruff key (6) with keyway in shaft in traversing mechanism upper housing (5).

10 Install hydraulic motor (3) and secure with four new lockwashers (2) and four cap screws (1).

11 Fill traversing mechanism (15) with lubricating oil (TM 9-2350-311-10).



9-2 NO-BACK BEARING

This task covers: a. Removal b. Disassembly c. Assembly d. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Arbor press (item 13, Appx F)

Materials/Parts
Grease (item 21, Appx B)
Gasket (item 132, Appx E)
Key washer (item 27, Appx E)
Lubricating oil (item 23, Appx B)
No-back device parts kit (item 117, Appx E)
Preformed packing (item 53, Appx E) M109A4/M109A5
Retaining ring (item 20, Appx E)
Seal (item 167, Appx E) M109A4/M109A5
Sealing compound (item 31, Appx B)

Equipment Condition
Turret lock in LOCKED position (TM 9-2350-31 l-l 0)
CAB POWER switch to OFF (TM 9-2350-311-10)
Vehicle MASTER switch to OFF (TM 9-2350-311-10)
Handwheel assembly removed (TM 9-2350-311-20-2)

a. Removal

1 Remove woodruff key (1) from shouldered shaft (2).

NOTE

Step 2 applies to only M109A4/M109A5 howitzers.

2 Remove dust protective cap (3) preformed packing (4), and seal (5). Discard preformed packing and seal.

3 Remove six cap screws (6).

NOTE

Retain shims unless new components are to be installed.

4 Remove mechanical housing (7) and shim(s) (8) from mechanical housing (9).

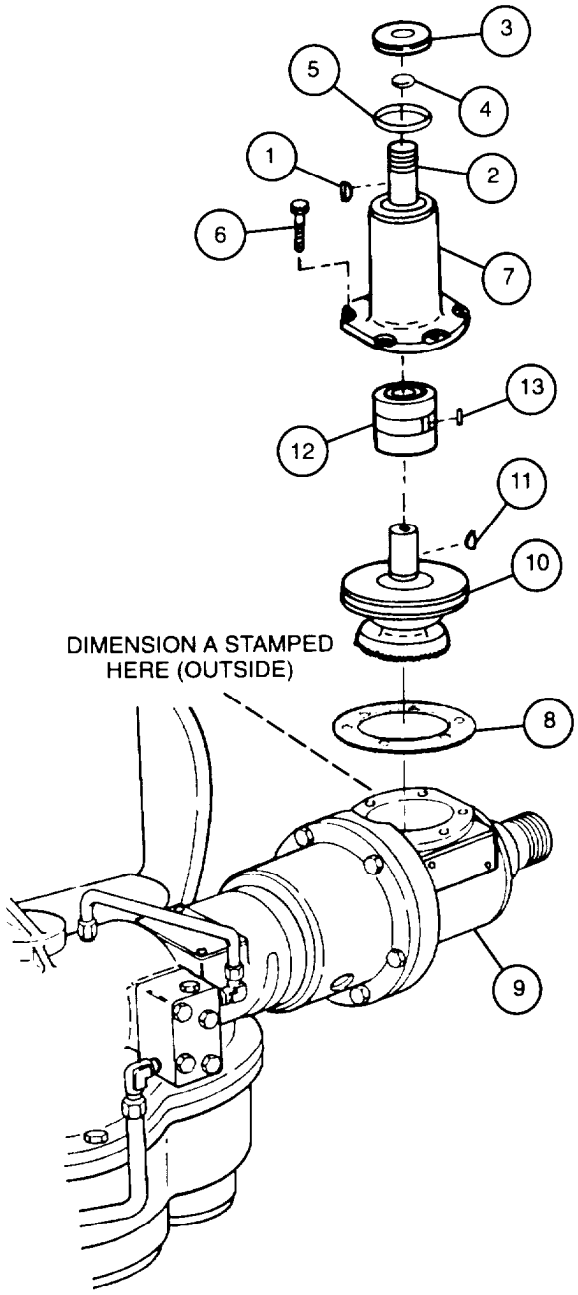
5 Note and record dimension "A" stamped on mechanical housing (9).

6 Remove bevel gearshaft assembly (10) and woodruff key (11) from mechanical housing (7).

NOTE

No-back bearing components will separate when removed from shouldered shaft and mechanical housing.

7 Remove no-back bearing (12) and pin (13) from shouldered shaft (2). Discard pin.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9-2 NO-BACK BEARING - CONTINUED

b. Disassembly

1 Remove traversing mechanism ring (14) ball bearing (15) and shouldered shaft (2) from mechanical housing (7).

2 Separate ball bearing (15) from shouldered shaft (2).

3 Remove woodruff key (16) from shouldered shaft (2).

4 Only if necessary for replacement, remove sleeve spacer (17) from mechanical housing (7).

5 Remove gasket (18) from bearing retainer (19). Discard gasket.

6 Straighten locking tabs on key washer (20).

7 Remove round nut (21) and key washer (20). Discard key washer.

8 Remove bearing retainer (19) from bevel gearshaft (22).

9 Note and record dimension “B” stamped on bevel gearshaft (22).

10 Remove retaining ring (23) and ball bearing (24) from bearing retainer (19). Discard retaining ring.

11 Measure and record thickness of ball bearing (24) for dimension "D" Also note and record dimension “C” stamped on bearing retainer (19).

12 Separate upper drive bearing (25) lower drive bearing (26) lock ring (27) and lockbar (28) with six springs (29). Discard springs.

c. Assembly

1 If removed, use an arbor press to install sleeve spacer (17) on shouldered shaft (2).

2 Assemble shouldered shaft (2) and ball bearing (15) with seal side out and install in mechanical housing (7).

3 Install traversing mechanism ring (14) in mechanical housing (7).

4 Install lower woodruff key (16) in shouldered shaft (2).

NOTE

Number of springs required in spring pack may vary depending on spring tension.

5 Apply lubricating oil to lockbar (28) and install six new springs (29) onto lower drive bearing (26).

6 Apply lubricating oil to bore of lock ring (27) and install with upper drive bearing (25) onto lower drive bearing (26), ensure that six springs (29) and lockbar (28) remain in place and lower and upper drive bearing interlock.

7 Pack ball bearings and coat internal gearing with grease before assembly.

8 Install ball bearing (24) and new retaining ring (23) in bearing retainer (19).

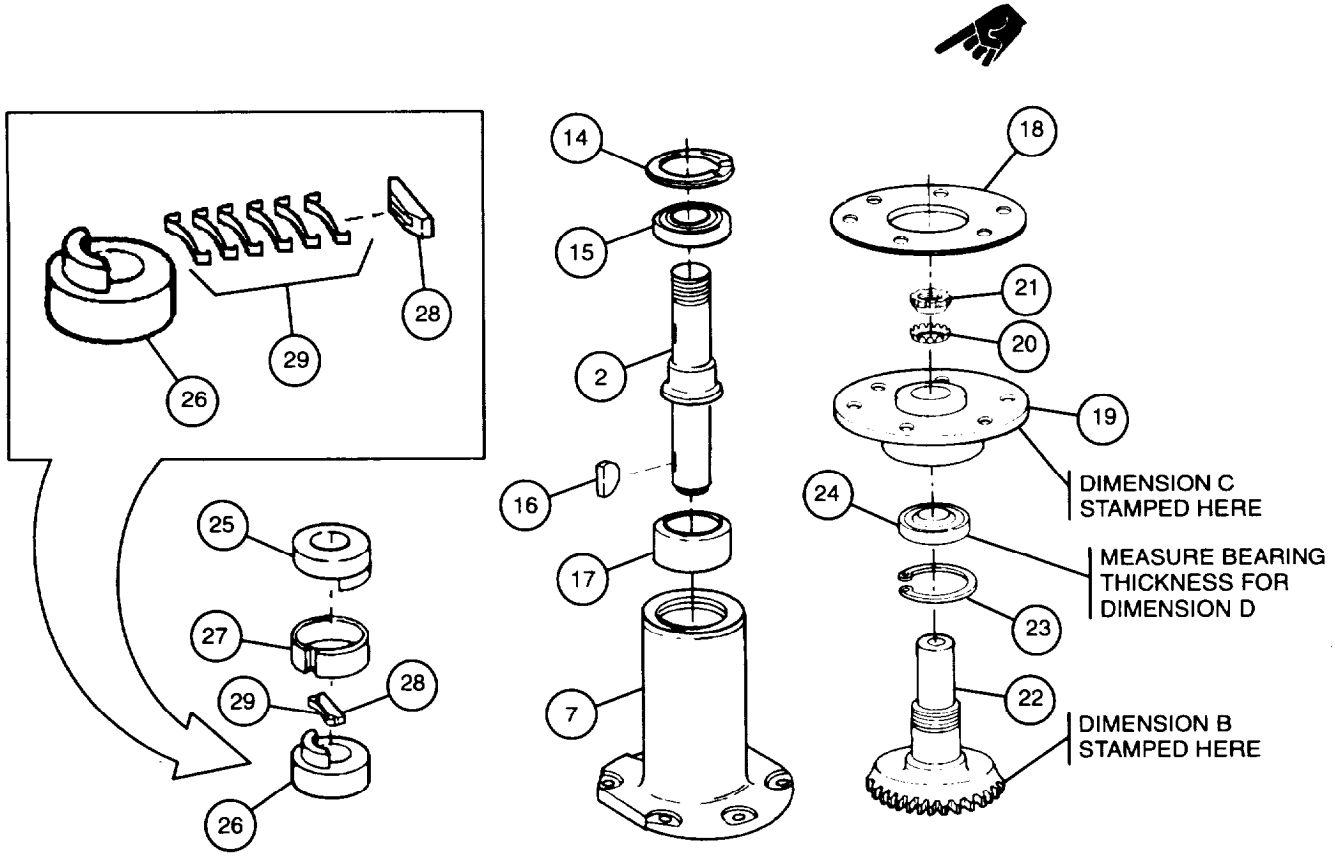
9 Calculate thickness of new shim(s) (8) (not shown). Shim thickness is equal to B + C + D - A to give a 0.002 to 0.004 inch (0.05 to 0.10 mm) backlash on M109A2/M109A3 howitzers or a 0.001 to 0.004 inch (0.025 to 0.10 mm) backlash on M109A4/M109A5 howitzers. Peel off laminations to obtain required thickness.

10 Install new key washer (20) and round nut (21) on bearing retainer (19).

11 Bend locking tabs of key washer (20) to secure round nut (21).

12 Apply sealing compound to new gasket (18) and install on bearing retainer (19).

13 Install bearing retainer (19) on bevel gearshaft (22).



9-2 NO-BACK BEARING -CONTINUED

d. Installation

NOTE

If new shim(s) are to be installed, ensure that the required thickness was calculated. Refer to c. assembly, step 9.

1 Install shim(s) (8) on mechanical housing (9).

2 Install pin (13) and no-back bearing (12) on shouldered shaft (2), ensuring that lower woodruff key (16) on shouldered shaft alines with upper drive bearing (25) of no-back bearing.

3 Install woodruff key (11) and bevel gearshaft assembly (10) in mechanical housing (7), ensuring that woodruff key alines with lower drive bearing (26).

4 Install mechanical housing (7) with bevel gearshaft assembly (10) in mechanical housing (9).

5 Install six cap screws (6).

NOTE

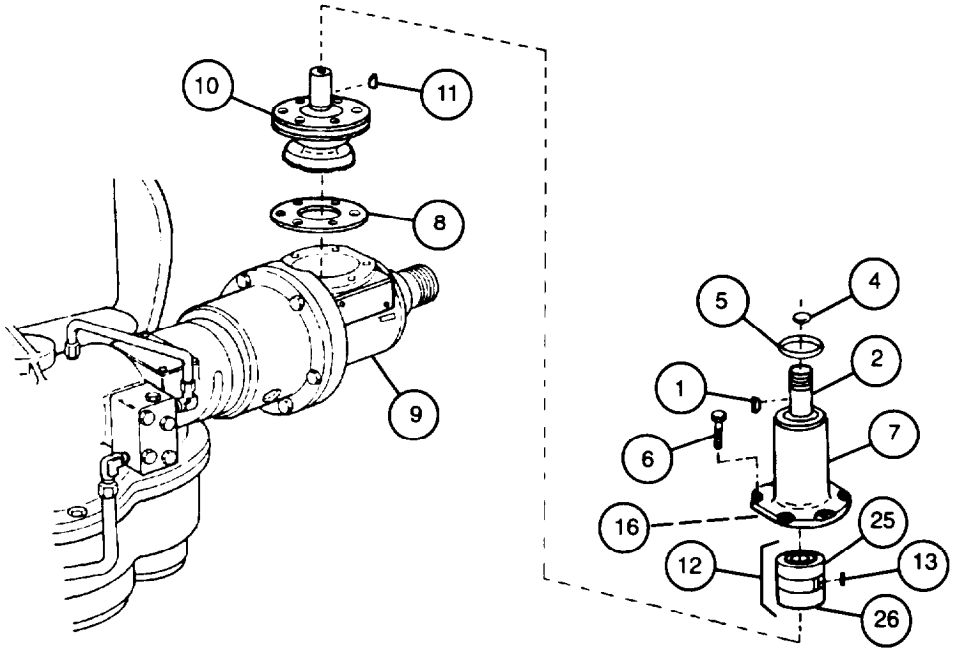
Step 5 applies to only M109A4/M109A5 howitzers.

6 Install new seal (5), new preformed packing (4), and dust protective cap (3) on shouldered shaft (2).

NOTE

To fully seat preformed packing in M109A4/M109A5 traversing mechanisms, use handwheel assembly round nut to tighten dust protective cap against preformed packing. Upper woodruff key cannot be installed otherwise.

7 Install upper woodruff key (1) in shouldered shaft (2).



9-3 CLUTCH ASSEMBLY

This task covers: a. Disassembly
b. Inspection
c. Assembly

INITIAL SETUP

Applicable Configuration
M109A2/M109A3 howitzers

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Torque adapter (item 1, Appx F)

Materials/Parts
Grease (item 21, Appx B)
Gasket (item 133, Appx E)
Gasket (item 129, Appx E)
Gasket (item 130, Appx E)
Gasket (item 131, Appx E)
Key washer (item 26, Appx E)
Retaining ring (item 18, Appx E)
Sealing compound (item 29, Appx B)

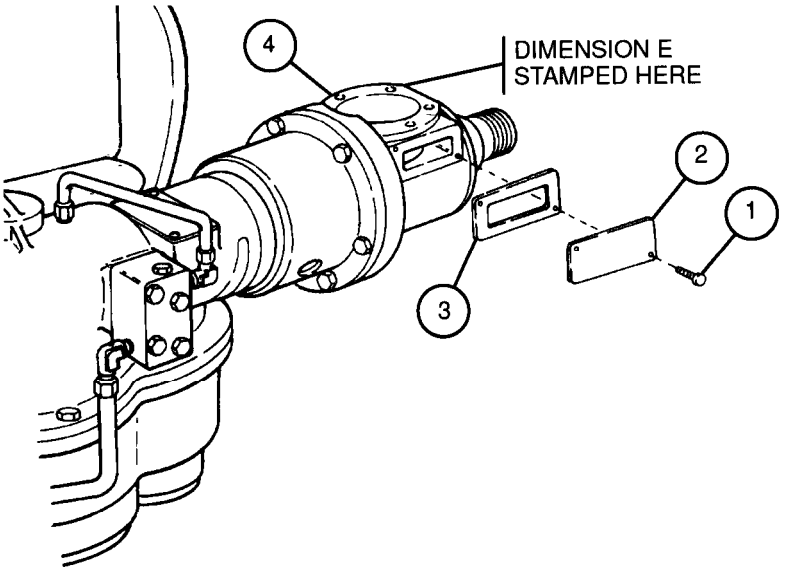
References
TM 9-214

Equipment Condition
Discharge hydraulic pressure (TM 9-2350-311-20-2)
Electrical contact assembly removed (TM 9-2350-311-20-2)
No-back bearing removed (para 9-2)

a. Disassembly

1 Remove two bolts (1), access cover (2), and gasket (3). Discard gasket.

2 Note and record dimension "E" on side of mechanical housing (4).



9-3 CLUTCH ASSEMBLY - CONTINUED

a. Disassembly - Continued

3 Remove four cap screws (5) and access cover (6).

4 Remove and discard gasket (7).

5 Bend locking tabs on key washer (8) to disengage key washer from round nut (9).

6 Remove round nut (9) and key washer (8) from gearshaft assembly (10). Discard key washer.

7 Remove retaining plate (11) and ball bearing (12) from gearshaft assembly (10). Support end of gearshaft assembly.

8 Note and record dimension “G” stamped on retaining plate (11).

NOTE

Retain shims unless new components are to be installed.

9 Remove shim(s) (13).

10 Remove six cap screws (14) and mechanical housing (4).

11 Remove and discard gasket (15).

12 Note and record dimension “F" stamped on end of gearshaft assembly (10).

13 Remove gearshaft assembly (10), retaining ring (16), ball bearing (17), and clutch assembly (18) as an assembly unit from mechanical housing (19).

14 Remove retaining ring (16) from groove in shaft of clutch assembly (18) and discard.

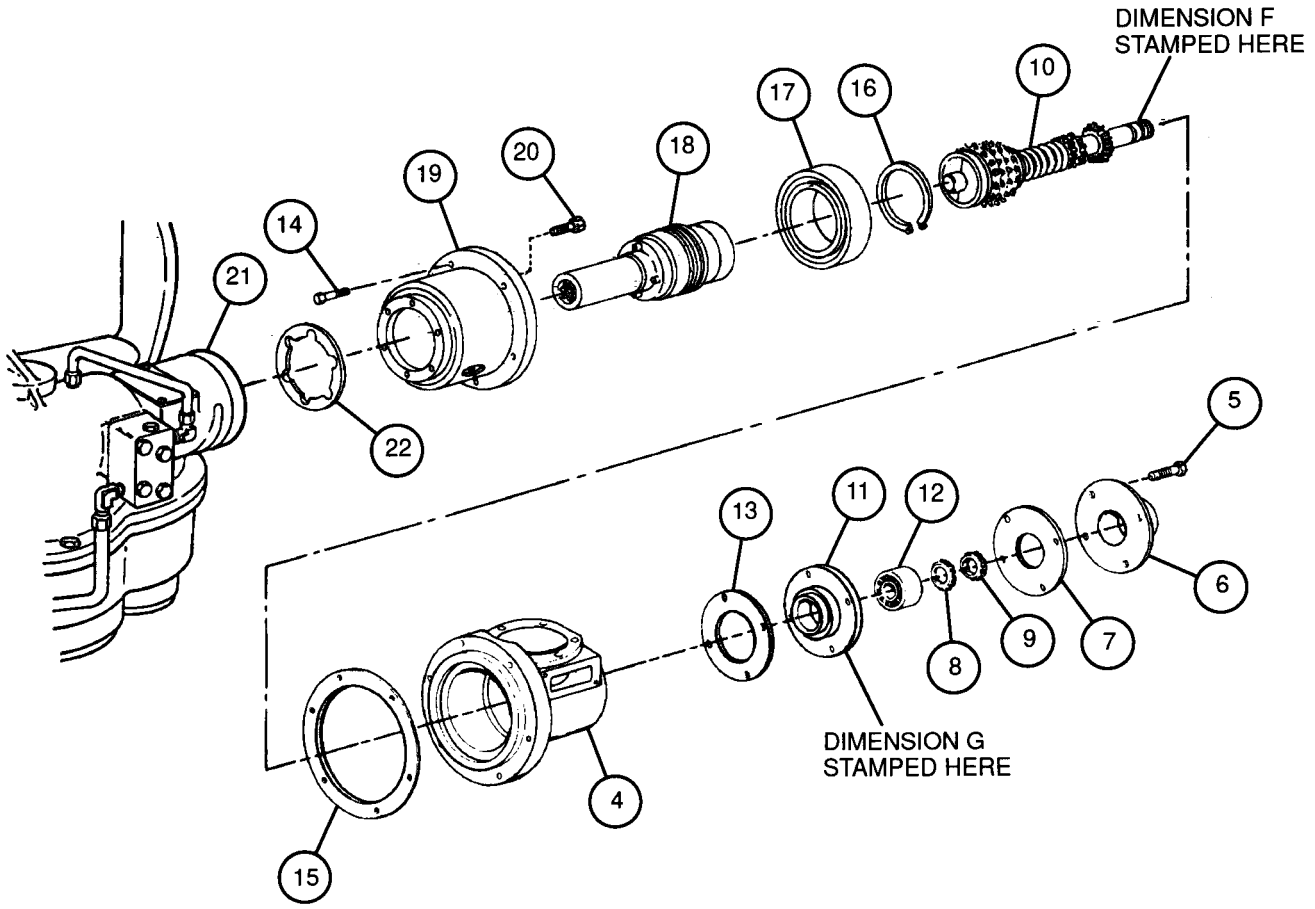
15 Remove ball bearing (17) from clutch assembly (18).

16 Remove six cap screws (20) and mechanical housing (19) from traversing mechanism (21).

17 Remove and discard gasket (22).

b. Inspection

For proper cleaning and inspection procedures for ball bearings (12 and 17), refer to TM 9-214.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9-3 CLUTCH ASSEMBLY - CONTINUED

c. Assembly

1 Set clutch on gearshaft assembly (10) to break away at 250 ± 25 inch-pounds (28.3 ± 2.8 N·m) by torquing nut (23) located on gearshaft assembly.

2 Install new gasket (22).

3 Apply sealing compound to six cap screws (20). Secure mechanical housing (19) to traversing mechanism (21) with six cap screws (20).

4 Pack ball bearing (17) and coat internal gearing with grease. Do not apply grease to toothed plates of gearshaft assembly (10). Install ball bearing on clutch assembly (18).

5 Install clutch assembly (18), ball bearing (17), and gearshaft assembly (10) as an assembly into mechanical housing (19). Support gearshaft assembly.

6 Install new retaining ring (16) into groove in shaft of clutch assembly (18).

7 Apply sealing compound to six cap screws (14). Install new gasket (15), mechanical housing (4), and six cap screws.

8 Install shim(s) (13) as required. Shim thickness must be equal to dimensions F + G - E to give 0.002 to 0.004 inch (0.05 to 0.10 mm) backlash at assembly. Use one shim and peel off laminations to obtain proper thickness.

CAUTION

To prevent equipment damage, do not overpack bevel gear mechanical housing with grease during assembly.

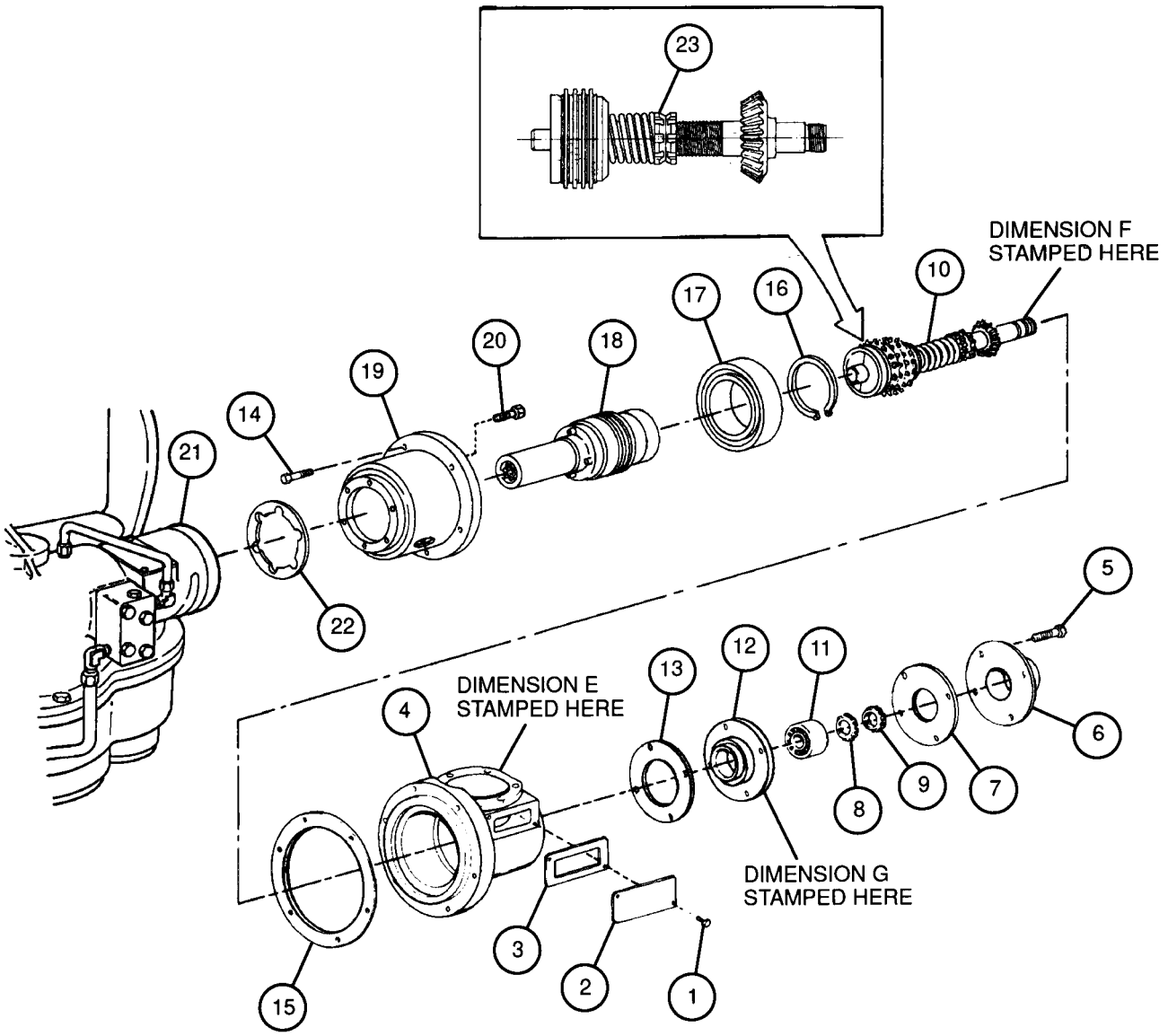
9 Pack ball bearing (12) with grease. Press ball bearing into retaining plate (11) and install on gearshaft assembly (10).

10 Install new key washer (8) and round nut (9) on gearshaft assembly (10). Bend locking tabs of key washer into slot in round nut to secure it.

11 Install new gasket (7), access cover (6), and four cap screws (5).

12 Check backlash of bevel gears through hole in mechanical housing (4). Adjust shim (13) thickness until backlash of 0.002 to 0.004 inch (0.05 to 0.10 mm) is obtained.

13 Install new gasket (3), access cover (2), and two bolts (1).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9-4 GEARSHAFT ASSEMBLY

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Applicable Confirmation
M109A4/M109A5 howitzers

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Torque adapter (item 1, Appx F)
Utility pail (item 11, Appx F)

Materials/Parts
Gasket (item 129, Appx E)
Gasket (item 130, Appx E)
Gasket (item 131, Appx E)
Gasket (item 164, Appx E)
Key washers (2) (item 26, Appx E)
Lubricating oil (item 24, Appx B)
Lubricating oil (item 25, Appx B)
Packing assemblies (3) (item 165, Appx E)
Preformed packings (2) (item 65, Appx E)
Retaining ring (item 21, Appx E)
Seal (item 166, Appx E)
Sealing compound (item 29, Appx B)
Sealing compound (item 31, Appx B)
Self-locking screws (6) (item 23, Appx E)

References
TM 9-214

Equipment Condition
Discharge hydraulic system (TM 9-2350-311-20-2)
No-back bearing removed (para 9-2)

a. Disassembly

1 Remove four machine screws (1), access cover (2), and gasket (3). Discard gasket.

2 Note and record dimension "E" on side of mechanical housing (4).

NOTE

Have utility pail available to drain oil from mechanical housing.

3 Remove four cap screws (5) and access cover (6).

4 Remove and discard gasket (7).

5 Bend locking tabs on key washer (8) to disengage key washer from round nut (9).

6 Remove round nut (9) and key washer (8) from gearshaft (10). Discard key washer.

7 Remove retaining plate (11) and ball bearing (12) from gearshaft (10). Support end of gearshaft.

8 Note and record dimension “G” stamped on retaining plate (11).

NOTE

Retain shims unless new components are to be installed.

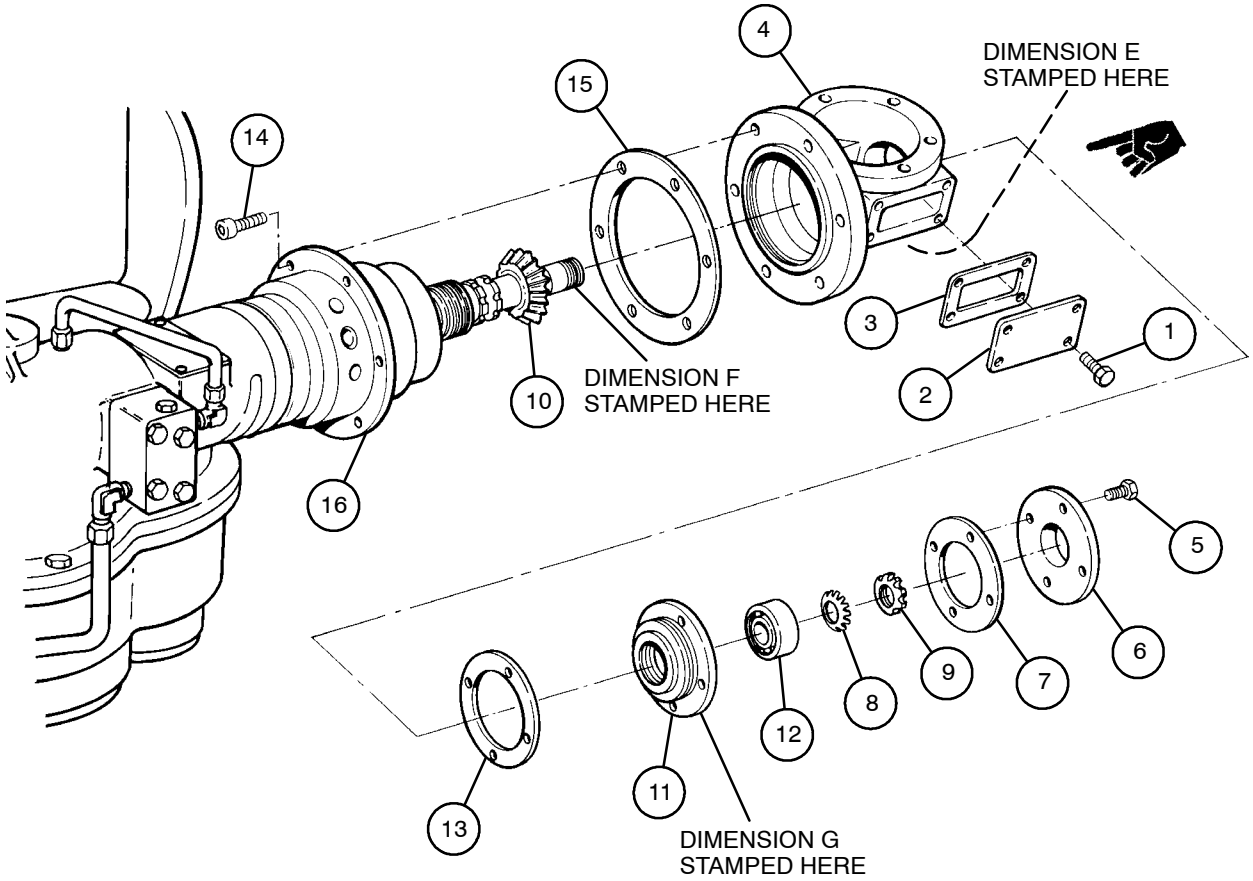
9 Remove shim(s) (13).

10 Remove six cap screws (14) and mechanical housing (4). Support gearshaft (10).

11 Remove and discard gasket (15).

12 Note and record dimension “F” stamped on end of gearshaft (10).

13 Remove gearshaft (10) from mechanical housing (16).



9-4 GEARSHAFT ASSEMBLY — CONTINUED

a. Disassembly — Continued

14 Back two round nuts (17) off threads toward bevel gear end.

15 Remove two plate segments (18).

16 Remove retaining plate (19), five sliding sleeve clutches (20), and four clutch disks (21).

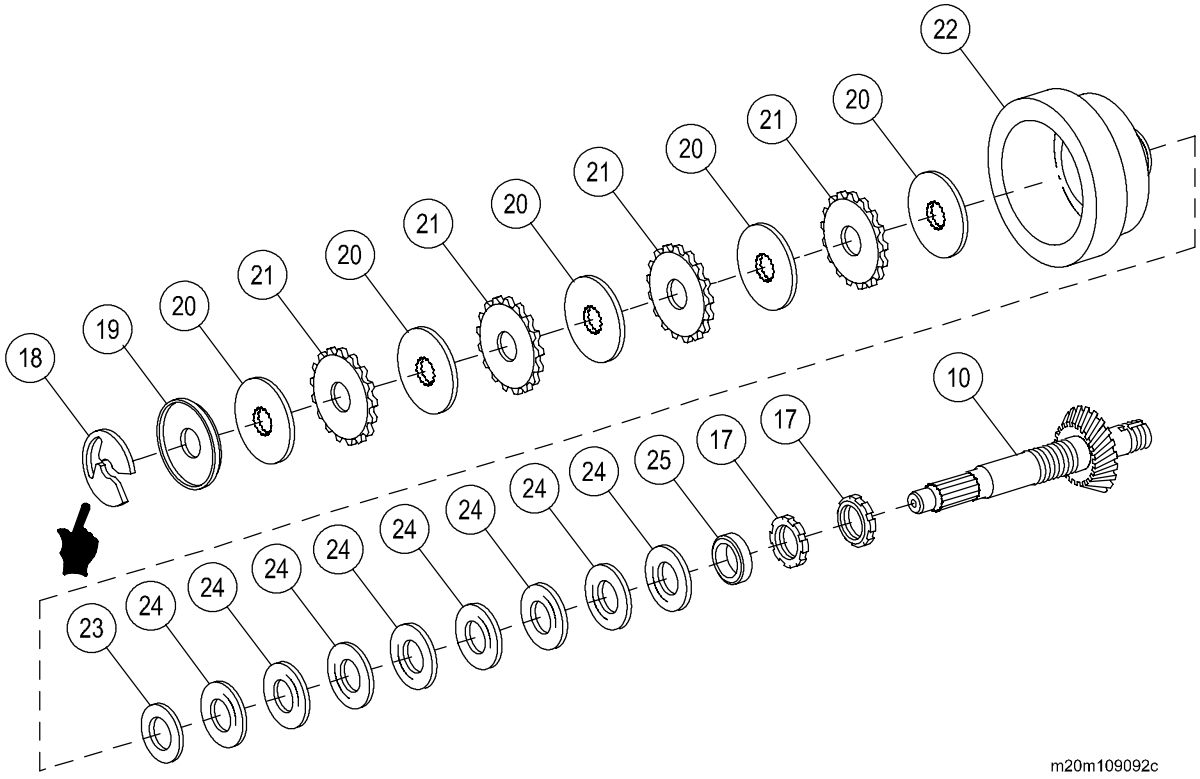
17 Remove mechanical housing (22) and flat washer (23).

NOTE

Note position of spring tension washers for assembly.

18 Remove eight spring tension washers (24).

19 Remove sleeve spacer (25) and two round nuts (17) from gearshaft (10).



20 Remove six self-locking screws (26) from inside housing, and remove mechanical housing (16) and gasket (27) from traversing mechanism (28). Discard gasket and self-locking screws.

21 Remove four cap screws (29) and shaft coupling half (30) from shaft adapter (31).

22 Place clutch and shaft assembly in vise. Remove sleeve bearing (32).

23 Bend locking tabs on key washer (33) to disengage key washer from round nut (34).

24 Remove round nut (34) and key washer (33). Discard key washer.

25 Pull clutch shaft (35) and sleeve bearing (36) from shaft adapter (31) and mechanical housing (16). Remove woodruff key (37) from clutch shaft.

NOTE

Do not remove inner bearing ring or roller bearing unless damaged and repair is necessary.

26 Remove shaft adapter (31) from inner bearing ring (38) and roller bearing (39) by forcing shaft adapter out of mechanical housing (16).

27 Remove two plugs (40) and two preformed packings (41). Discard preformed packings.

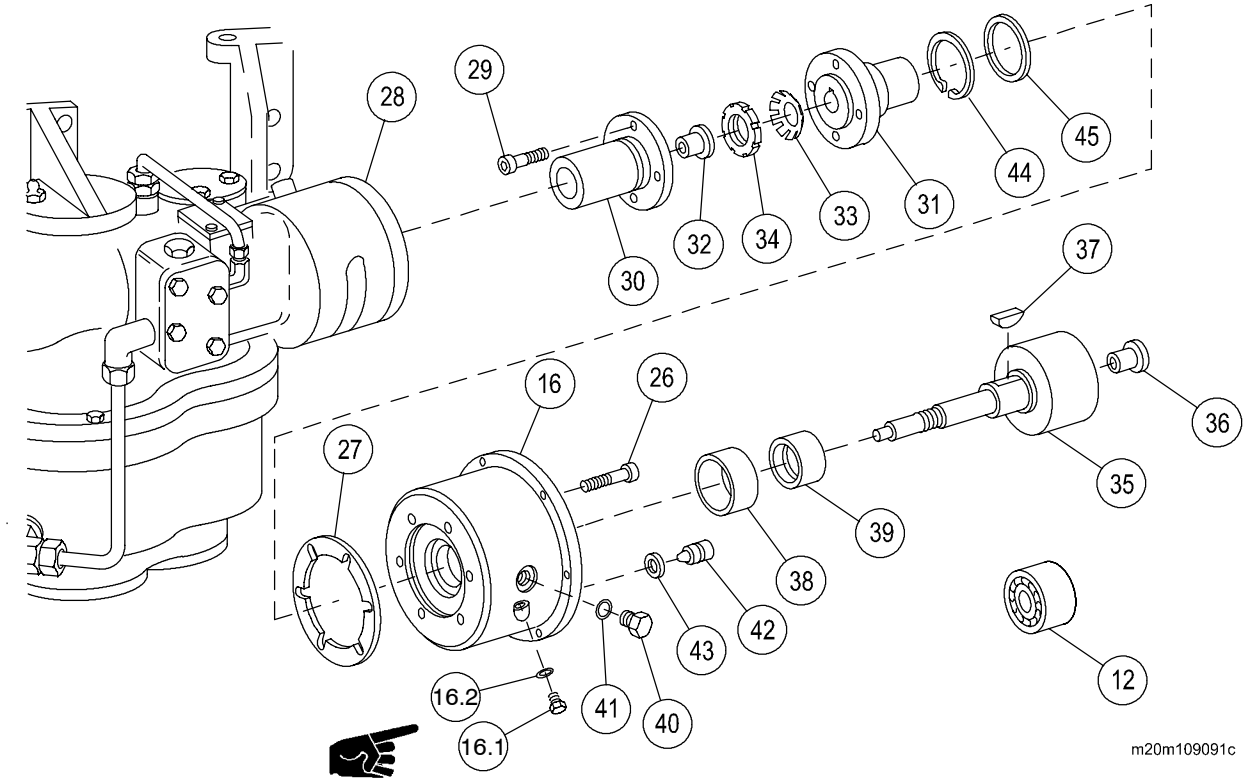
28 Push three valve pistons (42) and three packing assemblies (43) out of mechanical housing (16). Discard packing assemblies.

29 Remove retaining ring (44) to release seal (45). Discard retaining rings and seal.

30 Remove four plugs (16.1) and four preformed packings (16.2) from mechanical housing (16). Discard preformed packing.

b. Inspection

For proper cleaning and inspection procedures for ball bearing (12) and sleeve bearings (32 and 36), refer to TM 9-214.



9-4 GEARSHAFT ASSEMBLY — CONTINUED

c. Assembly

1 Install two round nuts (17) loosely on gearshaft (10).

2 Install sleeve spacer (25).

3 Install eight spring tension washers (24) on gearshaft (10) according to orientation in illustration.

4 Install flat washer (23) and mechanical housing (22) on gearshaft (10).

5 Soak four clutch disks (21) in lubricating oil (item 25, Appx B) before installing.

6 Install five sliding sleeve clutches (20) and four clutch disks (21) on gearshaft (10) in mechanical housing (22). Alternate sliding sleeve clutches with clutch disks. Aline gear teeth of clutch disks for installation in mechanical housing (not shown).

7 Degrease two plate segments (18) and retaining plate (19) and apply sealing compound (item 31.1, Appx B) to plate segments from outer edge inward 0.5 inch (12.7 mm) by 180°.

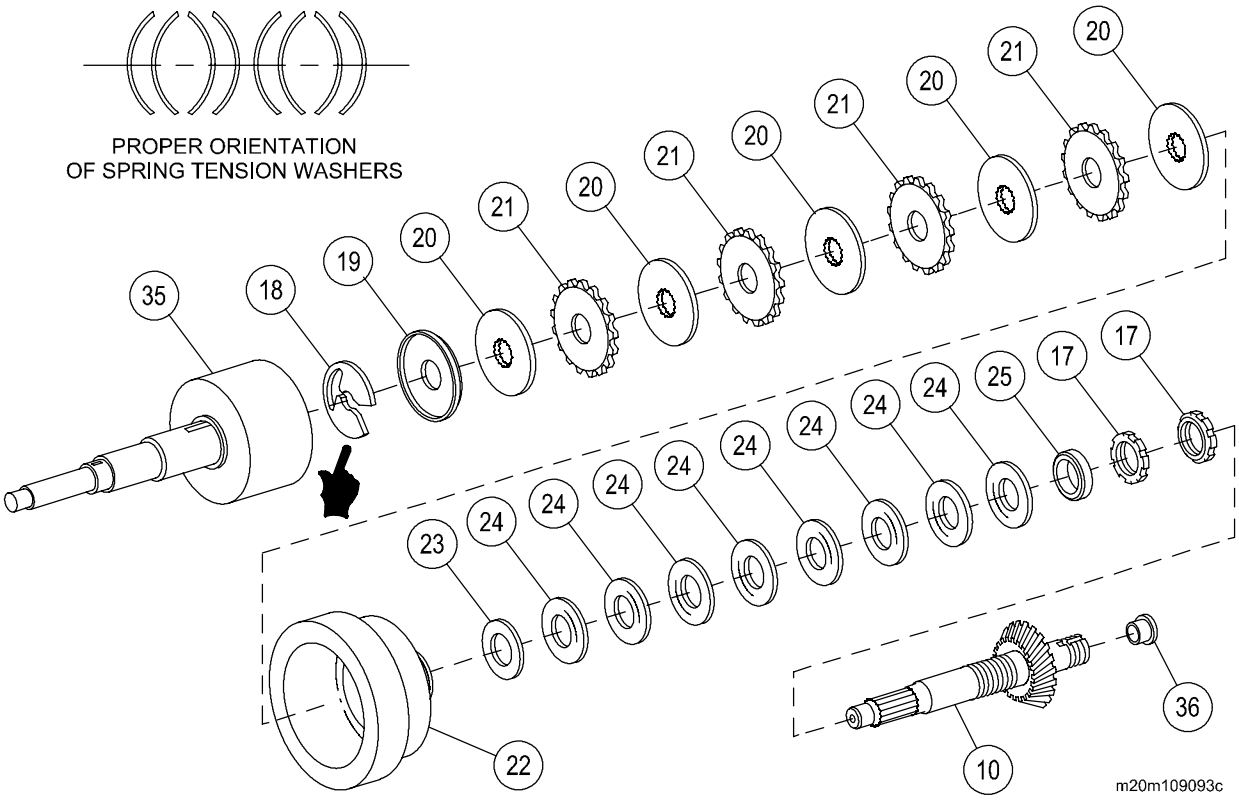
8 Install retaining plate (19) against sliding sleeve clutch (20).

9 Position two plate segments (18) in groove of gearshaft (10) with sealing compound against retaining plate (19). Hold plate segments in place and hand-tighten round nut (17) against sleeve spacer (25) until plate segments are secure.

10 Install sleeve bearing (36) on end of gearshaft (10) and position gearshaft in cup of clutch shaft (35).

11 Place gearshaft (10) and clutch shaft (35) in a vise.

12 Using a torque wrench and adapter on hex end of gearshaft (10), set round nut (17) (closest to spring tension washer (24)) to break away at 250 ± 25 inch-pounds (28.3 ± 2.8 N·m). Tighten remaining round nut (17).


PROPER ORIENTATION
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9-4 GEARSHAFT ASSEMBLY — CONTINUED

c. Assembly — Continued

13 Install two new preformed packings (41) and two plugs (40) in mechanical housing (16).

13A Install four plugs (16.1) and four new preformed packings (16.2) in mechanical housing (16).

14 Install new seal (45) in mechanical housing (16) and secure with new retaining ring (44).

15 Install three new packing assemblies (43) and three valve pistons (42) into mechanical housing (16).

16 Position shaft adapter (31) in mechanical housing (16).

17 Install inner bearing ring (38) and roller bearing (39) on shaft adapter (31).

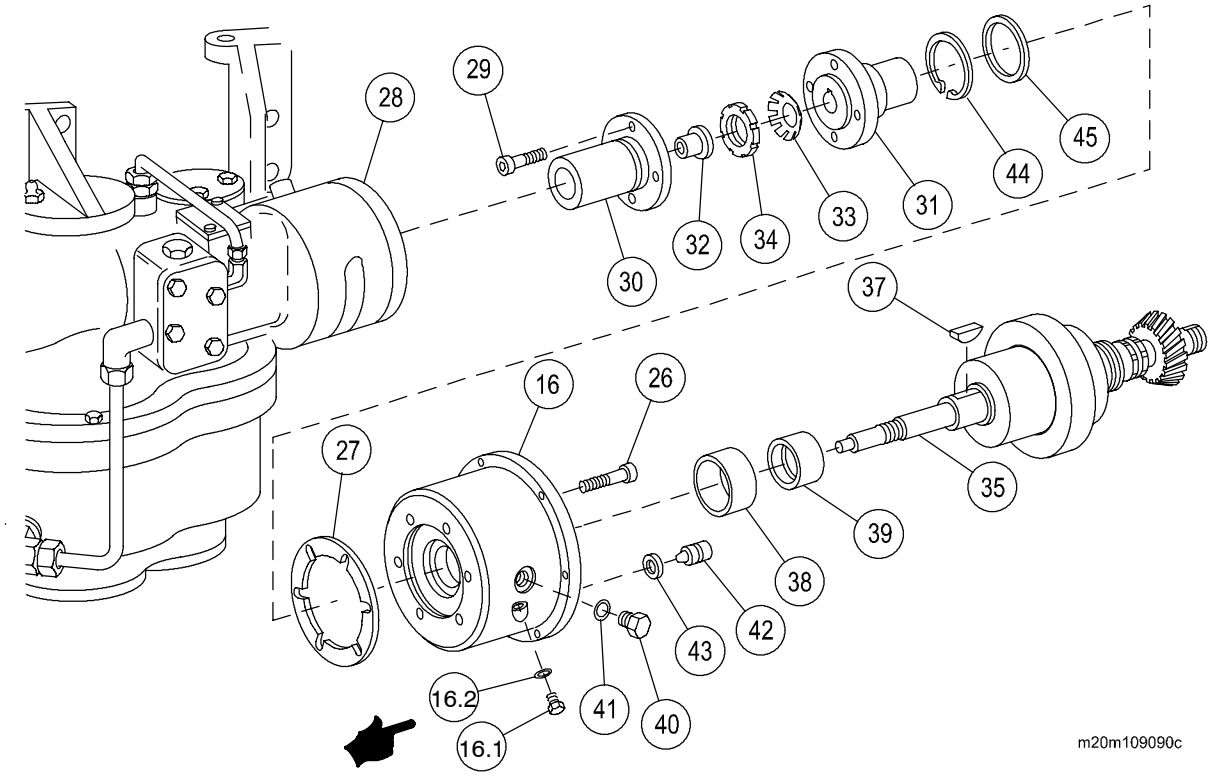
18 Install woodruff key (37) in clutch shaft (35) and install clutch shaft in mechanical housing (16).

19 Install new key washer (33) and round nut (34) on clutch shaft (35). Bend locking tabs of key washer to secure round nut.

20 Install sleeve bearing (32) and shaft coupling half (30) on clutch shaft (35) and secure to shaft adapter (31) using four cap screws (29).

21 Apply sealing compound (item 31, Appx B) to new gasket (27) and install with mechanical housing (16) on traversing mechanism (28) using six new self-locking screws (26).

22 Position and support gearshaft (10) in sleeve bearing (36) and clutch shaft (35).



23 Apply sealing compound (item 29, Appx B) to six cap screws (14).

24 Apply sealing compound (item 31, Appx B) to new gasket (15) and install on mechanical housing (4) using six cap screws (14).

25 Install shim(s) (13). Shim thickness must be equal to dimensions F + G - E to give 0.001 to 0.004 inch (0.025 to 0.10 mm) backlash at assembly. Use one shim and peel off laminations to obtain proper thickness.

26 Coat ball bearing (12) with lubricating oil (item 24, Appx B). Press ball bearing into retaining plate (11) and install on gearshaft (10).

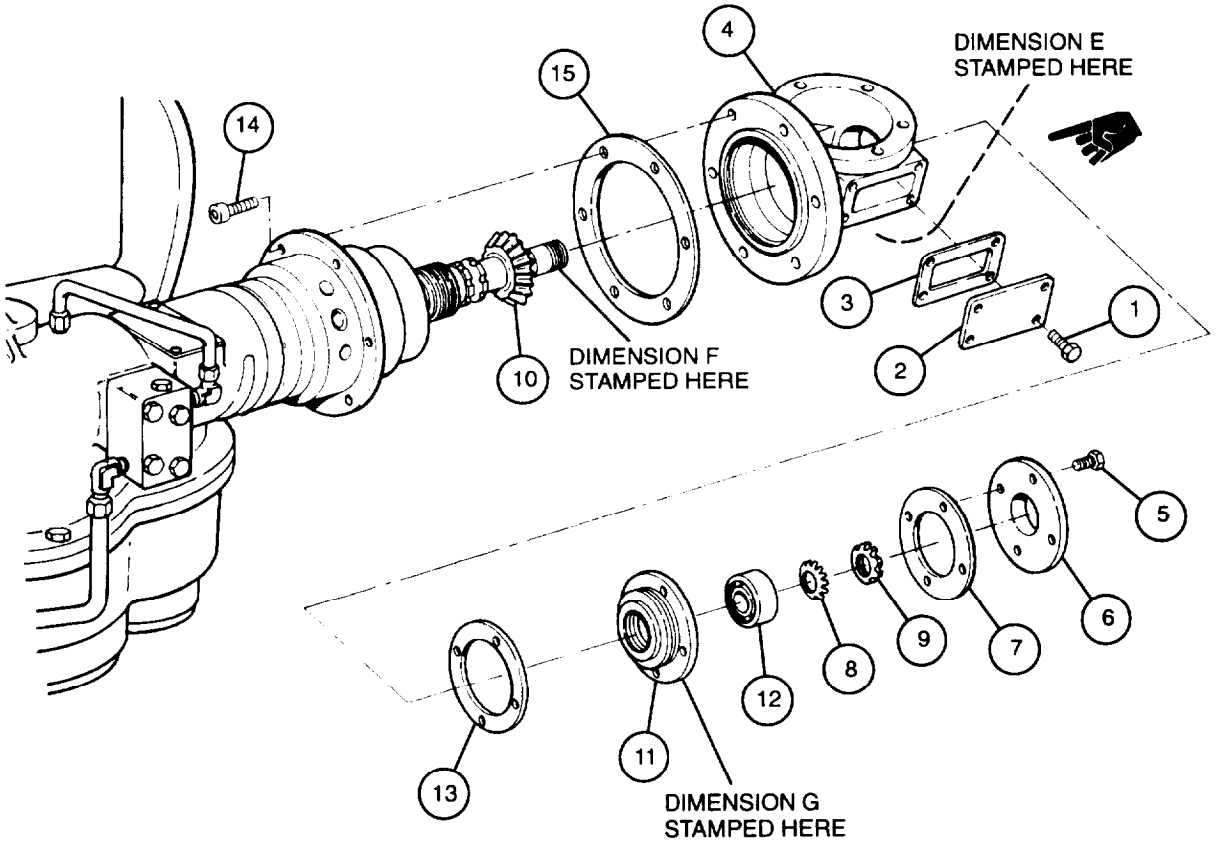
27 Install new key washer (8) and round nut (9) on gearshaft (10). Bend locking tabs of key washer into slot in round nut to secure it.

28 Apply sealing compound (item 31, Appx B) to new gasket (7) and install with access cover (6) using four cap screws (5).

29 Check backlash of bevel gears through hole in mechanical housing (4). Adjust shim (13) thickness until backlash of 0.001 to 0.004 inch (0.025 to 0.10 mm) is obtained.

30 Install new gasket (3), access cover (2), and four machine screws (1).

31 Fill mechanical housing (4) with lubricating oil (item 25, Appx B) to bottom edge of access hole.



9-5 OIL PUMP AND LINES

This task covers: a. Removal b. Disassembly c. Inspection d. Assembly e. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Drain pan (item 12, Appx F)

Materials/Parts
Hydraulic oil pump parts kit (item 116, Appx E)
Lo&washers (4) (item 82, Appx E)
Lubricating oil (4 quarts) (item 25, Appx B)

Equipment Condition
Discharge hydraulic pressure (TM 9-2350-311-20-2)
Traversing mechanism cover plate removed (TM 9-2350-311-20-2)

a. Removal

WARNING

Wear safety glasses and steel-tipped shoes to avoid possible injury while handling equipment.

1 Remove plug (1).

2 Place drain pan of at least two-gallon capacity below drain plug (2) at bottom center of traversing mechanism lower housing (3). Remove drain plug and drain lubricant. Install drain plug and tighten.

3 Disconnect outlet tube (4) by loosening compression hex nuts of adapter (5) and elbow (6).

4 Remove adapter (5) from traversing mechanism upper housing (7).

5 Remove elbow (6) from oil pump (8).

6 Disconnect inlet tube (9) and sleeve (10) by loosening two compression hex nuts (11) of elbow assembly (12) and elbow (13).

7 Remove elbow (13) from oil pump (8).

8 Remove cap (14) and remove elbow assembly (12) from traversing mechanism lower housing (3).

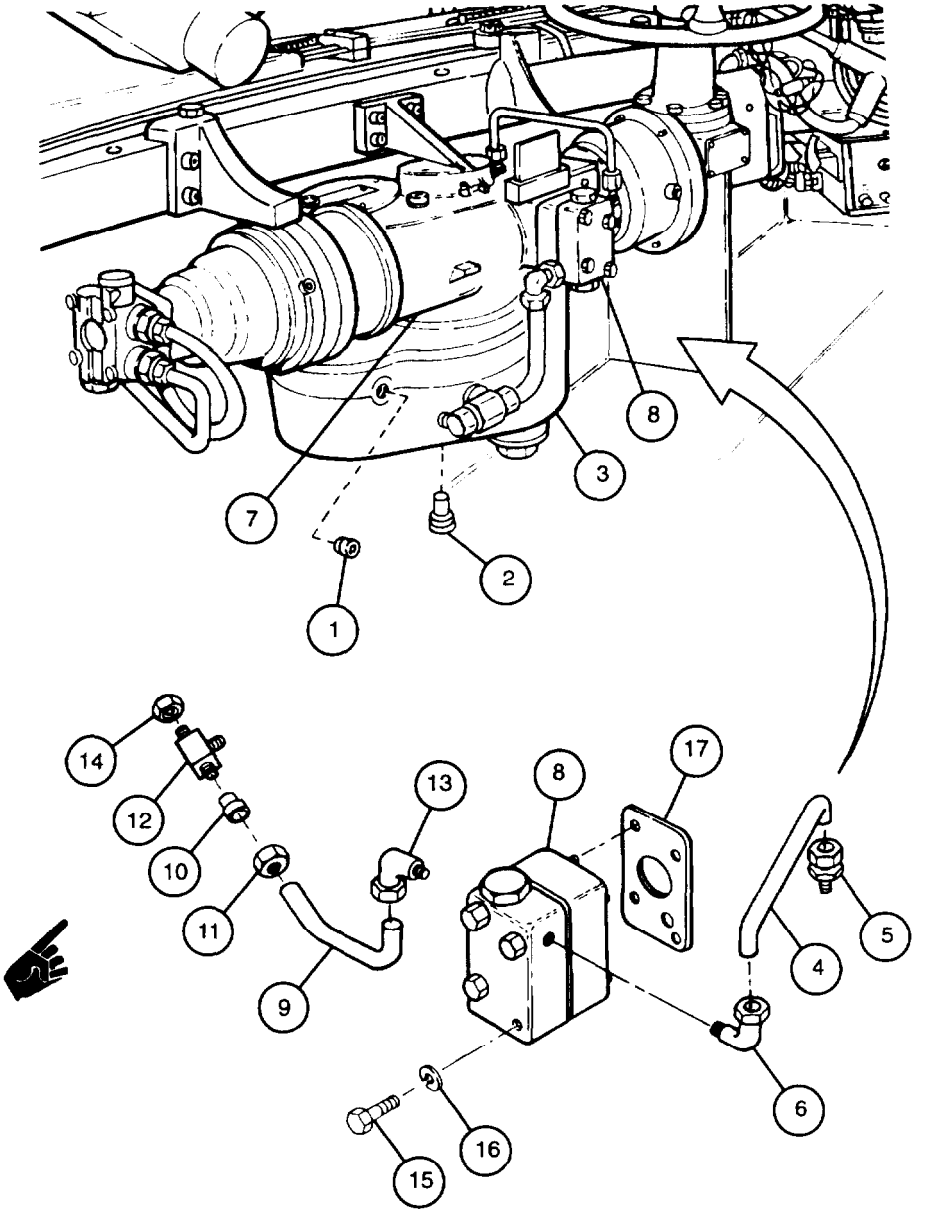
CAUTION

Oil pump is under spring tension. Care should be used when removing and installing.

NOTE

Hold oil pump parts together when removing from traversing mechanism upper housing. After removal, oil pump can be held together by assembling components and securing with self-locking nut supplied with hydraulic oil pump parts kit.

9 Remove four cap screws (15), four lockwashers (16), gasket (17), and oil pump (8) from traversing mechanism upper housing (7). Discard lockwashers and gasket.



9-5 OIL PUMP AND LINES -CONTINUED

b. Disassembly

1 Separate oil pump body (18) from retaining plate (19). Remove and discard gasket (20).

2 Remove two retaining rings (21) from headless grooved pin (22). Discard retaining rings.

3 Remove headless grooved pin (22), roller (23), and two flat washers (24) from clevis of stem assembly (25).

WARNING

Helical compression spring is under preload. Wear eye protection and make provision to contain parts when preload is released during disassembly.

NOTE

Threads of stem assembly may have been staked to secure plunger.

4 Unscrew plunger (26) from threaded end of stem assembly (25).

5 Remove stem assembly (25) and helical compression spring (27) from oil pump body (18). Discard helical compression spring.

6 Place retaining plate (19) in a soft-jawed vise.

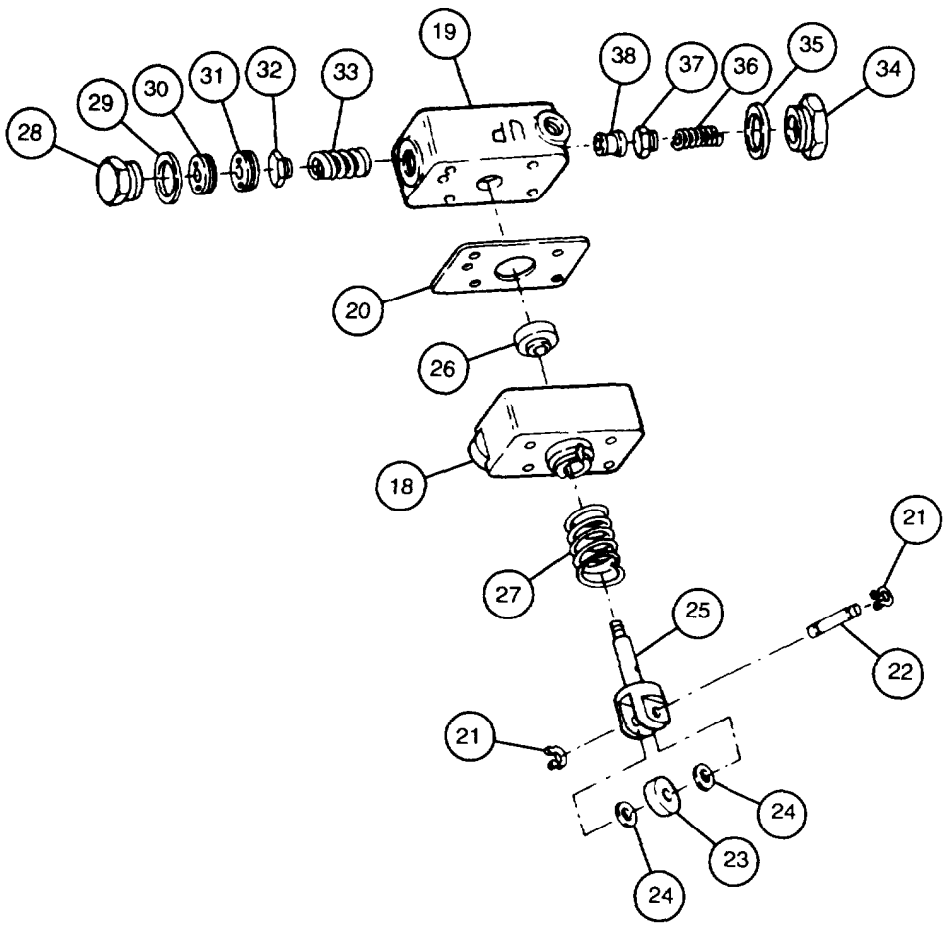
7 Remove and discard lower plug (28) and ring spacer (29).

WARNING

Helical compression springs are under preload. Wear eye protection and make provision to contain parts when preload is released during disassembly.

8 Remove externally threaded ring (30), inlet valve pump seat (31), inlet valve seat (32), and helical compression spring (33) from retaining plate (19) and discard.

9 Remove upper plug (34), ring spacer (35), helical compression spring (36), outlet valve plate (37), and outlet valve seat (38) from retaining plate (19) and discard.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9-5 OIL PUMP AND LINES -CONTINUED

c. Inspection

1 Measure inside diameter of roller (23). Replace if greater than 0.2540 inch (6.5 mm).

2 Measure outside diameter of stem of stem assembly (25). Replace if less than 0.3735 inch (9.5 mm).

3 Measure inside diameter of stem bore in oil pump body (18). Replace oil pump (8) if greater than 0.3755 inch (9.5 mm).

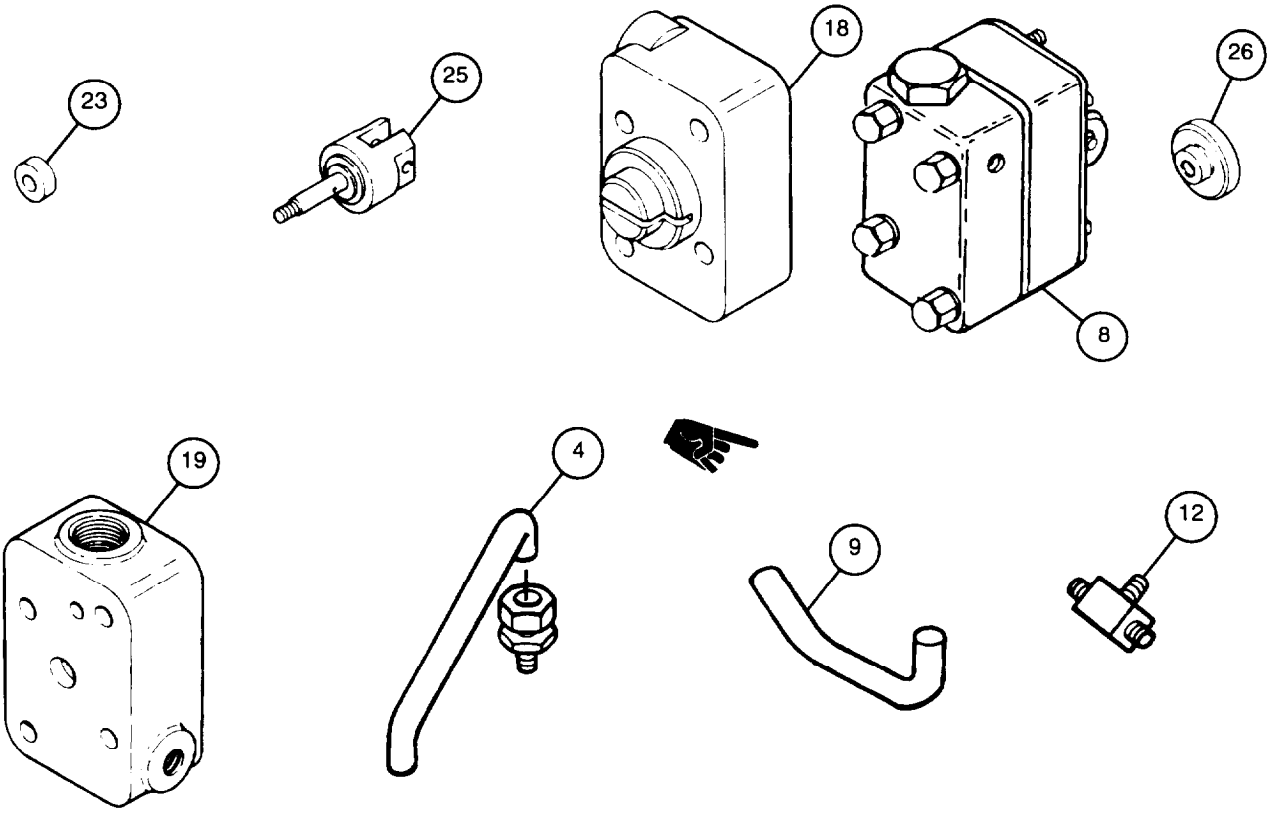
4 Measure inside diameter of plunger (26) bore in oil pump body (18). Replace oil pump (8) if greater than 0.9850 inch (25 mm).

5 Measure outside diameter of plunger (26). Replace if less than 0.9830 inch (25 mm).

6 Replace oil pump (8) if retaining plate (19) is fractured, cracked, or damaged.

7 Replace outlet tube (4) and inlet tube (9) if bent, crimped, cracked, or damaged.

8 Inspect collar assembly of elbow assembly (12) to be sure holes are clear. Blow low pressure air through elbow assembly to remove all foreign matter. Replace if damaged or obstructed.



d. Assembly

1 Place retaining plate (19) in a soft-jawed vise.

2 Install new outlet valve seat (38), new outlet valve plate (37), new helical compression spring (36), new ring spacer (35), and new upper plug (34) in retaining plate (19).

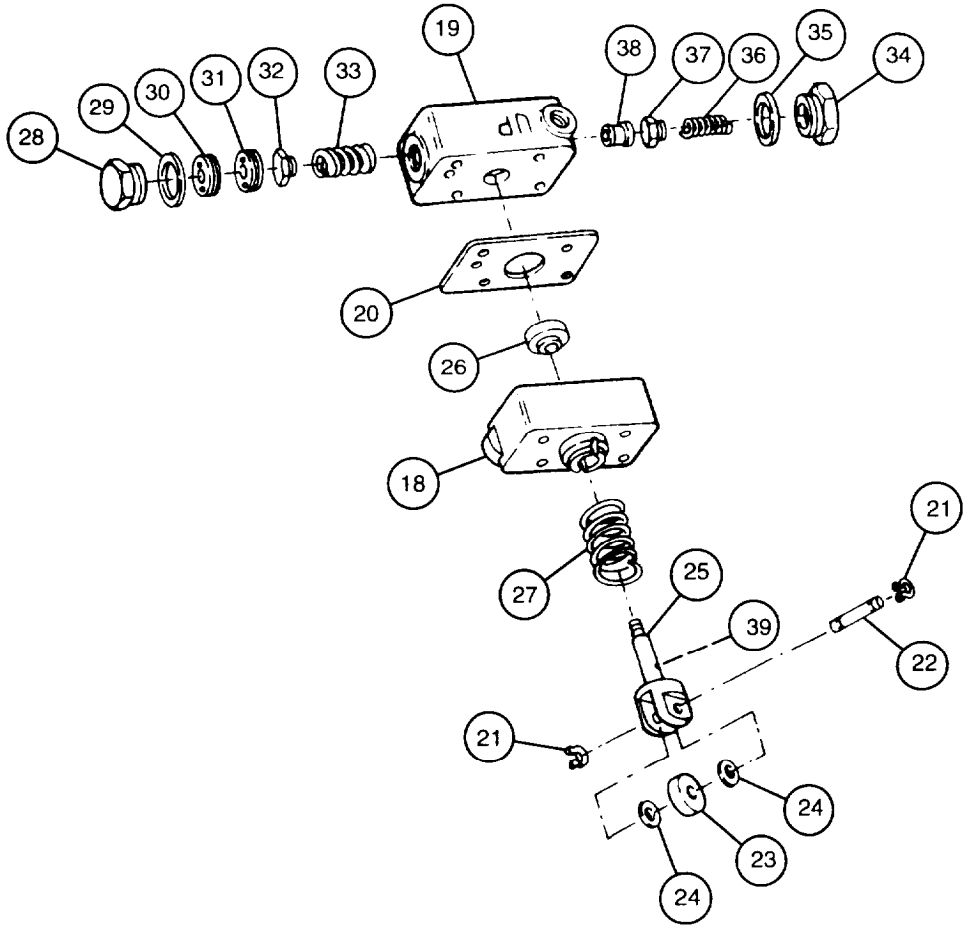
3 Install new helical compression spring (33), new inlet valve seat (32), new inlet valve pump seat (31), new externally threaded ring (30), new ring spacer (29), and new lower plug (28) in retaining plate (19).

4 Place new helical compression spring (27) on oil pump body (18). Insert stem assembly (25) through helical compression spring and oil pump body, alining pin (39) of stem assembly with slot in oil pump body.

5 Apply force to stem assembly (25) to compress helical compression spring (27) and thread plunger (26) onto stem of stem assembly. Turn plunger until it is completely seated on shoulder of stem assembly. Lightly peen stem assembly thread in one place to lock plunger to stem.

6 Install two flat washers (24), roller (23), and headless grooved pin (22) in clevis of stem assembly (25). Secure headless grooved pin with two new retaining rings (21).

7 Place a new gasket (20) between oil pump body (18) and retaining plate (19).



9-5 OIL PUMP AND LINES -CONTINUED

e. Installation

CAUTION

Oil pump is under spring tension. Care should be used when removing and installing.

NOTE

If the oil pump is held together with self-locking nut and screw, remove self-locking nut prior to installation.

1 Holding oil pump (8) together by hand, install four new lockwashers (16), and four cap screws (15) through oil pump.

2 Place new gasket (17) over cap screws (15).

3 Install oil pump (8) and new gasket (17) on traversing mechanism upper housing (7).

4 Install elbow (13) on oil pump (8).

5 Install elbow assembly (12) on traversing mechanism lower housing (3).

6 Install sleeve (10), nut (11), and inlet tube (9).

7 Install adapter (5) on traversing mechanism upper housing (7).

8 Install elbow (6) on oil pump (8).

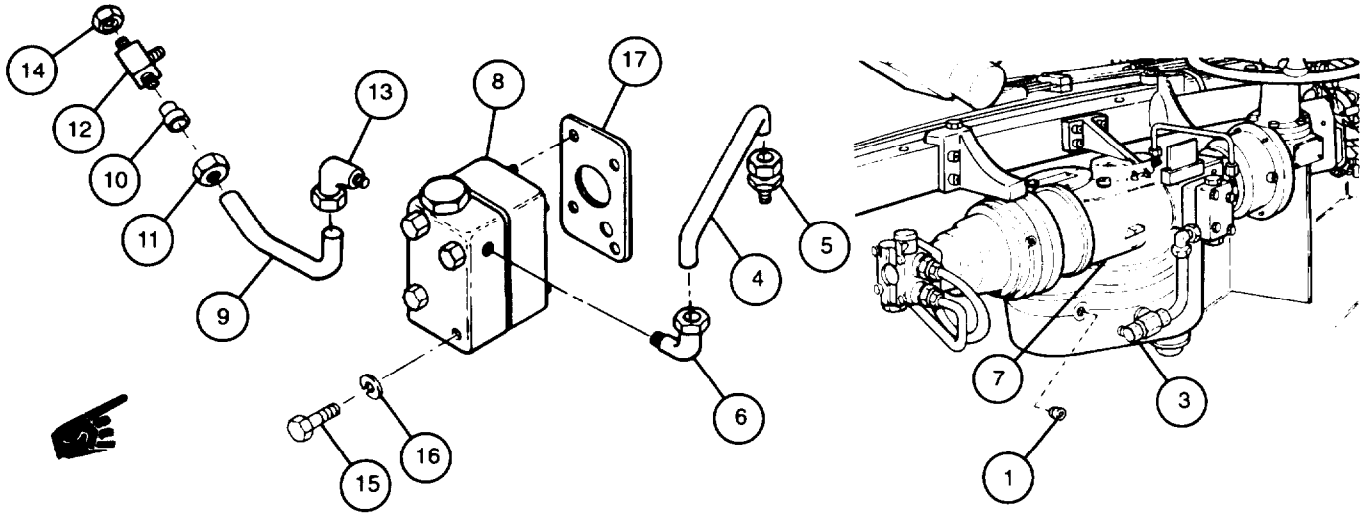
9 Install outlet tube (4).

10 Add approximately four quarts of lubricating oil or until oil is level with bottom of plug (1).

11 Install plug (1) and tighten.

12 Place drain pan below elbow assembly (12). Traverse cab manually or by power until a steady stream of oil comes out of unplugged branch of elbow assembly. This will purge any air from the lines.

13 Install cap (14) on elbow assembly (12).

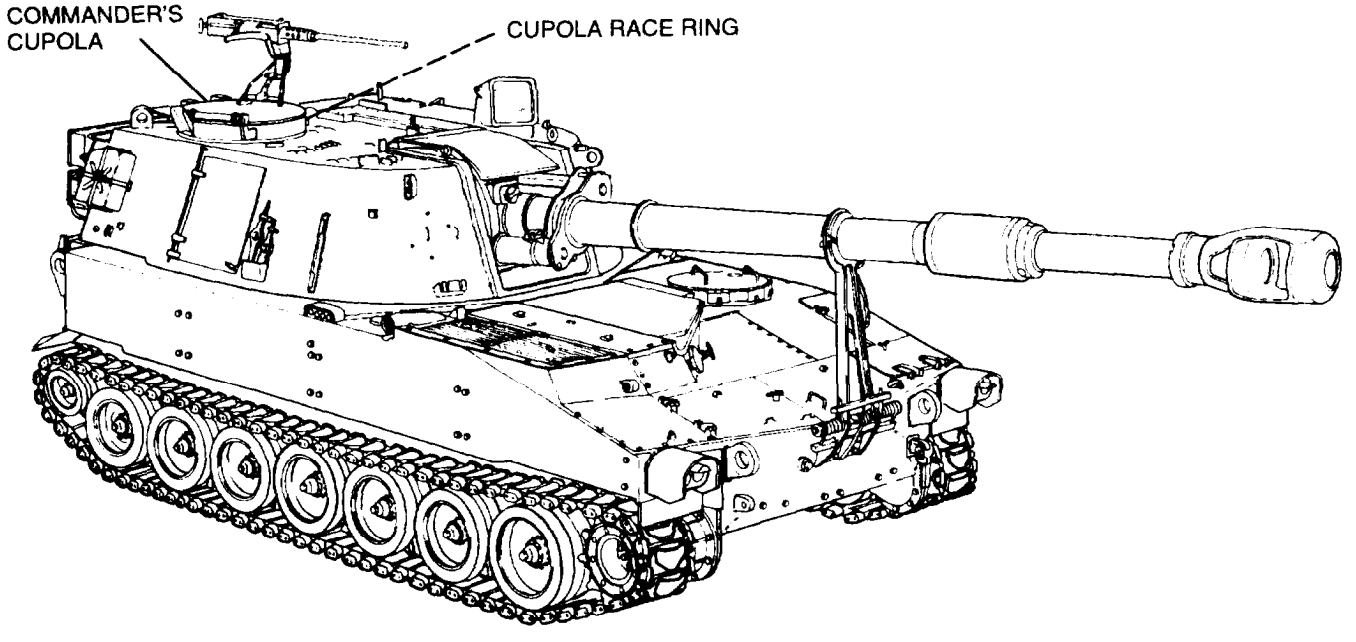


CHAPTER 10
DIRECT SUPPORT MAINTENANCE OF COMMANDER'S CUPOLA

GENERAL

This chapter illustrates and describes the removal, disassembly, assembly, installation, inspection, and repair procedures for the cupola race ring. These maintenance procedures are functions authorized for direct support level maintenance.

CONTENTS



CUPOLA RACE RING

This task covers: a. Removal b. Disassembly c. Inspection and Repair d. Assembly e. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Eye bolts (2) (item 6, Appx F)
Sling, turret lifting (item 21, Appx F)

Materials/Parts
Lockwashers (12) (item 97, Appx E)
Self-locking bolts (12) (item 93, Appx E)

Personnel Required
2

Equipment Condition
Machine gun mount support removed (TM 9-2350-311-20-2)

a. Removal

WARNING

Commander's cupola weighs 360 pounds (163 kg). Use hoist and turret lifting sling capable of lifting 1000 pounds (454 kilograms) to provide adequate lifting capacity and prevent injury.

NOTE

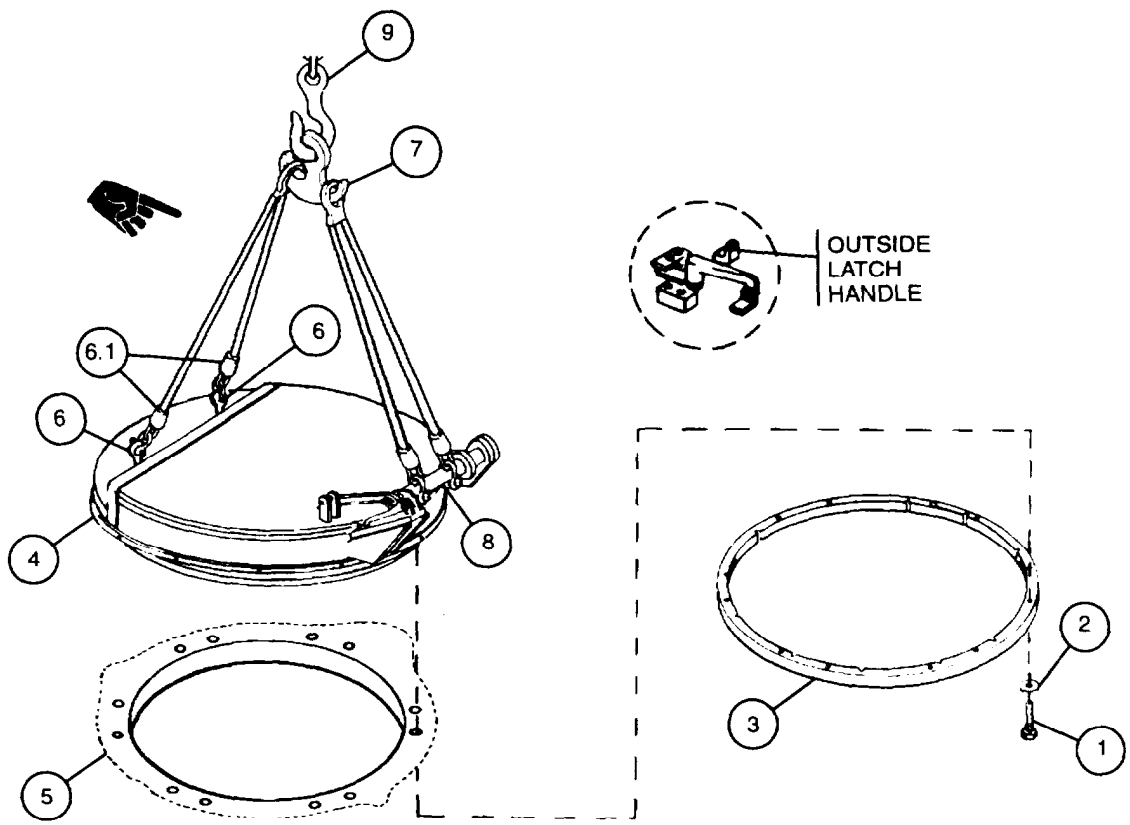
- Commander's cupola on later design vehicles does not have pictured outside latch handle.
- Only commander's cupolas with outside latch handles will have 12 flat washers.

1 Remove 12 self-locking bolts (1), 12 flat washers (2), and lock ring (3) that attach commander's cupola (4) to cab (5). Discard self-locking bolts.

2 Insert two eye bolts (6) in screw holes for machine gun mount support on commander's cupola (4).

3 Attach two shackles (6.1) of the turret lifting sling (7) to two eyebolts (6). Attach two shackles of the turret lifting sling to metallic tube (8).

4 Attach hoist (9) to turret lifting sling (7). Remove commander's cupola (4).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1

CUPOLA RACE RING - CONTINUED

b. Disassembly

1 Invert commander's cupola (4).

NOTE

Note that slot on inside of each bearing ring are in line.

2 Remove 12 washer assembled screws (10) and bearing shield (11).

3 Remove 12 cap screws (12) and lower bearing ring (13).

NOTE

Some cupola race rings may have 128 white, cream, or yellow bearing balls and 128 pink or red bearing balls.

4 Remove 252 white or cream bearing balls (14) and upper bearing ring (15).

5 Remove 12 cap screws (16), 12 lockwashers (17), and outer bearing ring (18). Discard lockwashers.

c. Inspection and Repair

1 Clean all parts of cupola race ring in accordance with standard maintenance procedures prescribed in Chap ter 2.

NOTE

Some cupola race rings may have 128 white, cream, or yellow bearing balls and 128 pink or red bearing balls.

2 Inspect 252 white or cream bearing balls (14) for scoring, burrs, or deformation. Replace as required.

3 Inspect bearing shield (11) and bearing rings (13, 15, and 18). Replace if cracked or distorted.

4 Inspect threads on bearing shield (11), bearing rings (13, 15, and 18), and commander's cupola body (19). Retap if damaged.

d. Assembly

1 Invert commander's cupola (4).

NOTE

Slot on inside of each bearing ring must be in line when bearing rings are assembled.

2 Install outer bearing ring (18), 12 new lockwashers (17), and 12 cap screws (16). Torque cap screws to 38 lb-ft (52 N·m).

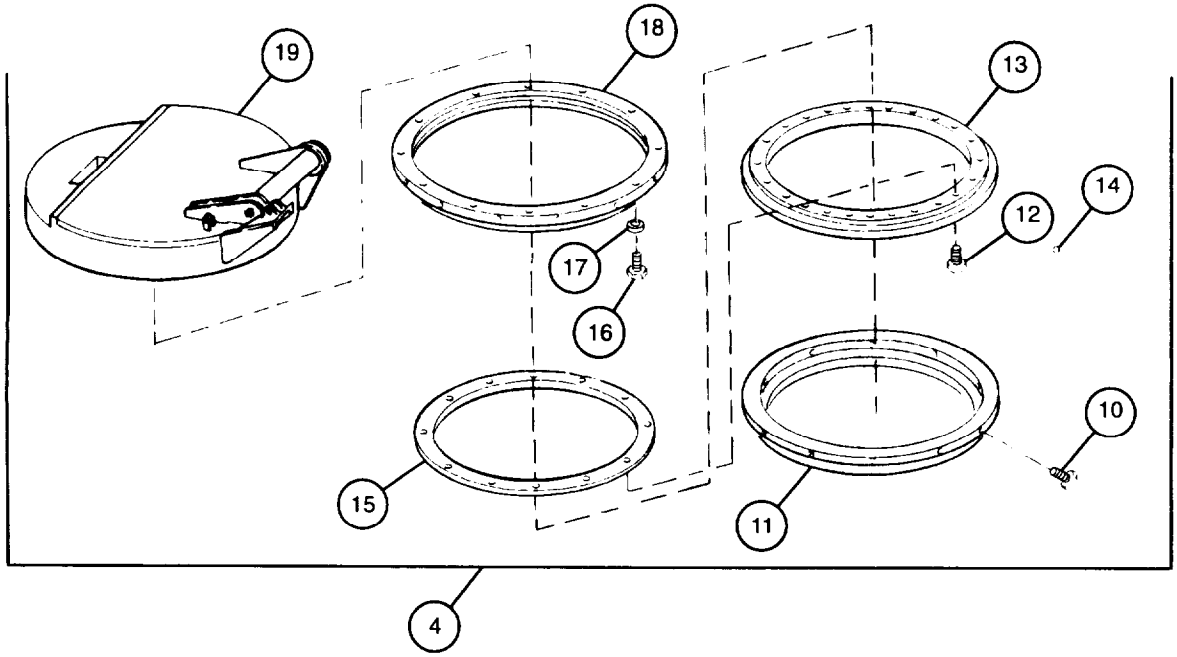
NOTE

Some cupola race rings may have 128 white, cream, or yellow bearing balls and 128 pink or red bearing balls. Install the white, cream, or yellow bearing balls alternately with 128 pink or red bearing balls.

3 Install upper bearing ring (15) and 252 white or cream bearing balls (14).

4 Install lower bearing ring (13) and 12 cap screws (12). Torque cap screws to 35 lb-ft (47 N·m).

5 Install bearing shield (11) and 12 washer assembled screws (10).



CUPOLA RACE RING - CONTINUED

e. Installation

WARNING

Commander's cupola weighs 360 pounds (163 kg). Use hoist and turret lifting sling capable of lifting 1000 pounds (454 kilograms) to provide adequate lifting capacity and prevent injury.

NOTE

Commander's cupola on later design vehicles does not have the pictured outside latch handle.

1 Insert two eye bolts (6) in screw holes for machine gun mount support on commander's cupola (4).

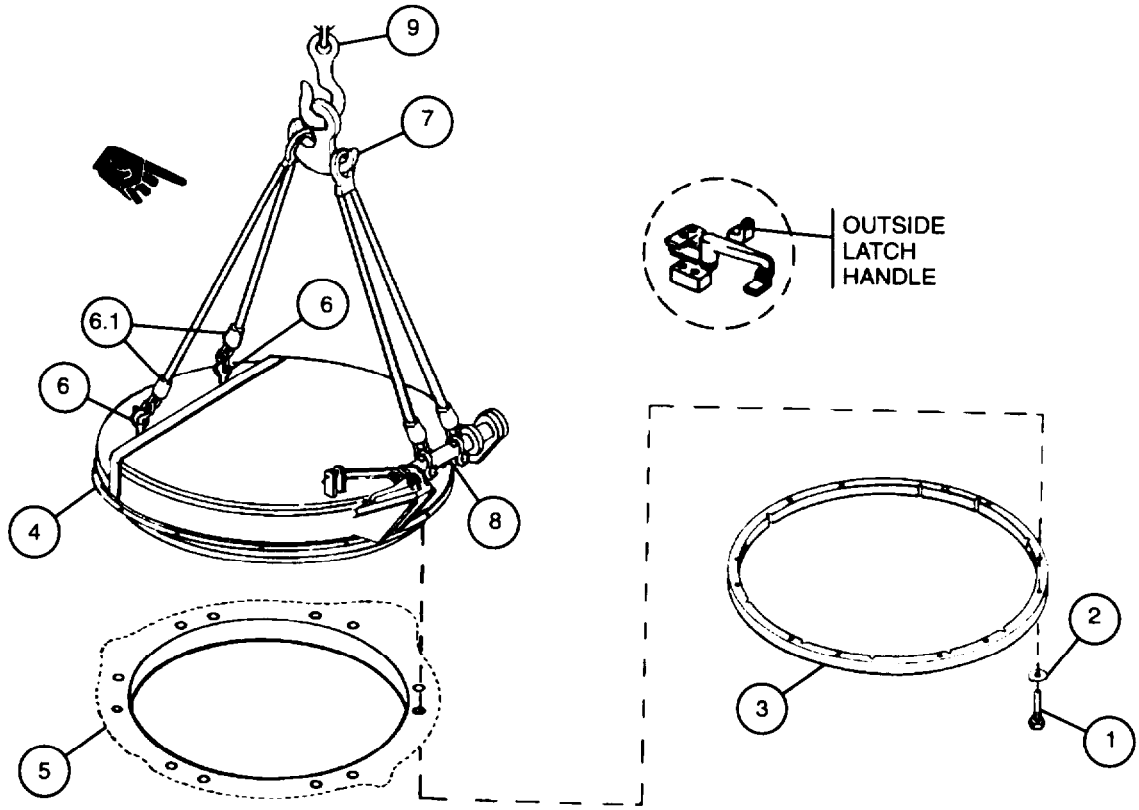
2 Attach two shackles (6.1) of turret lifting sling (7) to two eye bolts (6). Attach two shackles of turret lifting sling to metallic tube (8).

3 Attach hoist (9) to turret lifting sling (7). Lower commander's cupola (4) into position on cab (5).

NOTE

Only commander's cupolas with outside latch handles have 12 flat washers.

4 Install lock ring (3), 12 flat washers (2) and 12 new self-locking bolts (1) to attach commander's cupola (4) to cab (5). Torque self-locking bolts to 360 lb-ft (488 N·m).

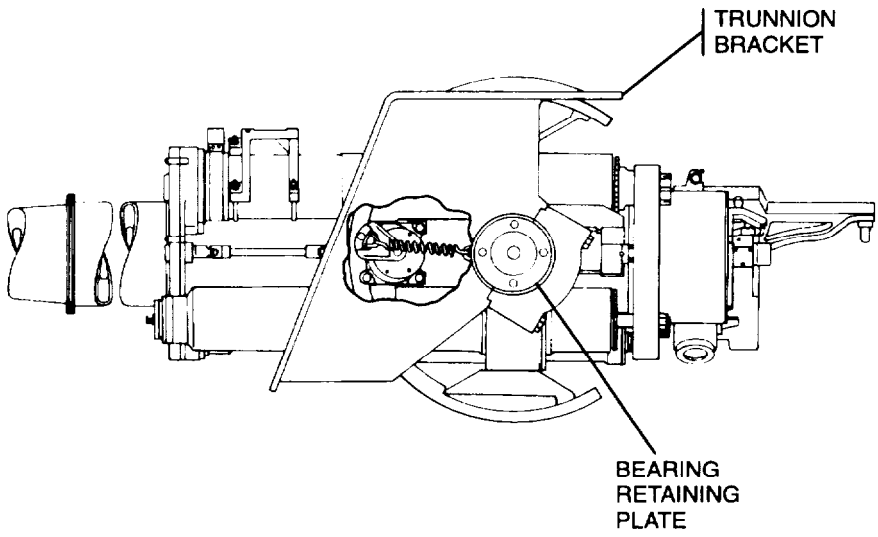


CHAPTER 11
DIRECT SUPPORT MAINTENANCE OF TRUNNION BRACKET

GENERAL

This chapter illustrates and provides removal and installation procedures for the trunnion bracket. These maintenance procedures are functions authorized for direct support level maintenance.

CONTENTS



11-1 M15 QUADRANT MOUNTING BRACKET

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Level, cross test (item 8, Appx F)
Quadrant, M1A1 gunner's (item 14.1, Appx F)

Materials/Parts
Lockwashers (4) (item 86, Appx E)
Pin assemblies (2) (item 157, Appx E)

Equipment Condition
M15 elevation quadrant removed (TM 9-2350-311-20-2)

a. Removal

1 Remove four cap screws (1) and four lockwashers (2) from M15 quadrant mounting bracket (3). Discard lockwashers.

2 Loosen nuts on two pin assemblies (4). Tap two pin assemblies in with brass hammer. Remove M15 quadrant mounting bracket (3) with two pin assemblies.

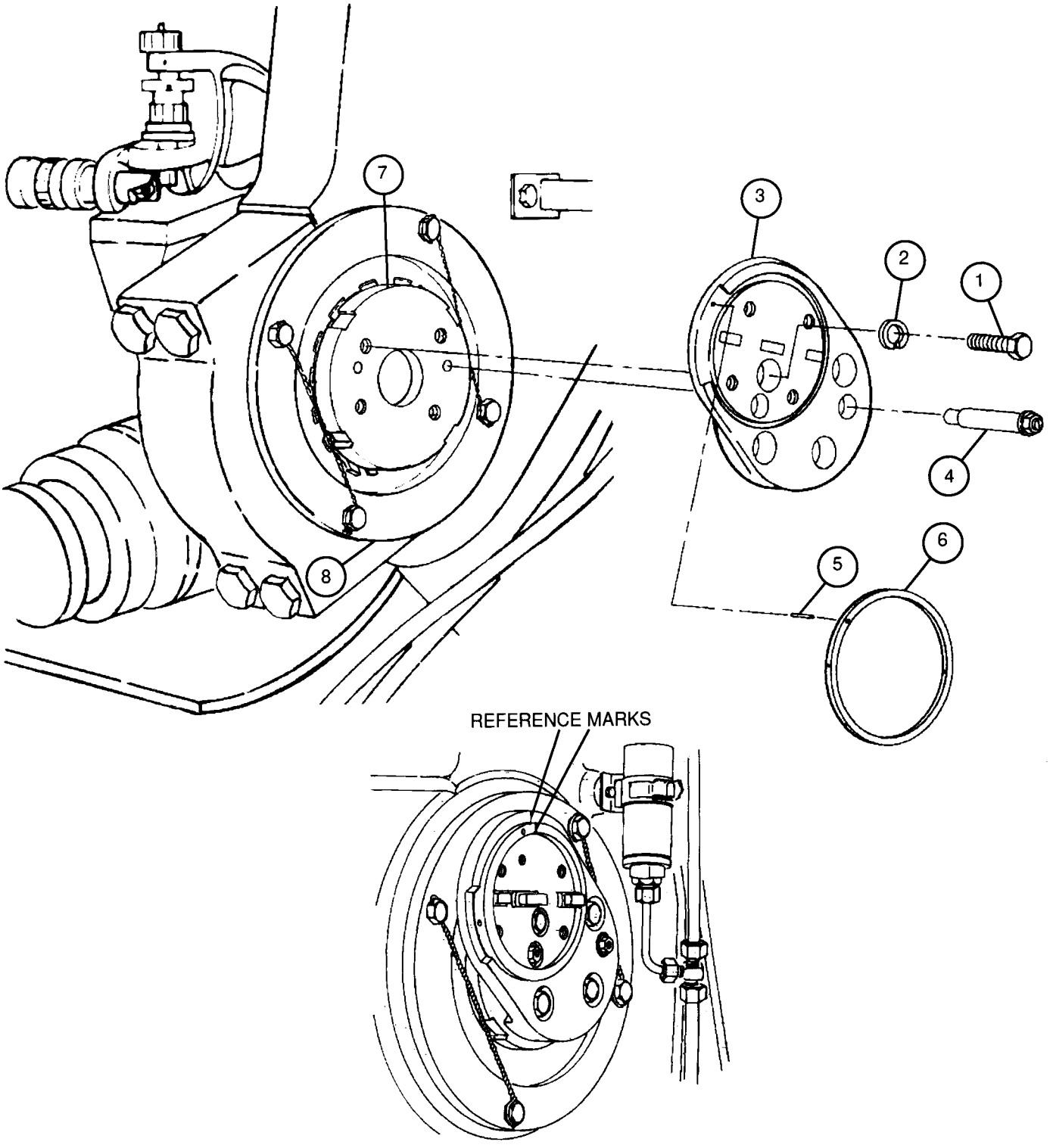
3 Remove two pin assemblies (4), headless straight pin (5) and quadrant ring (6) from M15 quadrant mounting bracket (3). Discard pin assemblies.

b. Installation

1 Make certain that all mating surfaces of M15 quadrant mounting bracket (3), cannon trunnion (7) and bearing retaining plate (8) are free of dirt, grease, and burrs.

2 Install M15 quadrant mounting bracket (3), four new lockwashers (2) and four cap screws (1). Hand tighten four cap screws only; do not tighten to final torque.

3 Install quadrant ring (6) on M15 quadrant mounting bracket (3) alining reference marks on quadrant ring with reference marks on M15 quadrant mounting bracket.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REFERENCE MARKS

11-1 M15 QUADRANT MOUNTING BRACKET - CONTINUED

b. Installation - Continued

4 Install cross test level (9) on M15 quadrant mounting bracket (3) using the four 1/2-20 x 1-3/4 cap screws (10) and flat washers (11) supplied with cross test level. Torque four cap screws to 20 lb-ft (27 N·m).

5 Place M1A1 gunner's quadrant (12), (end-for-end correction applied, and breech ring error applied) on breech quadrant seat (13). The M1A1 gunner's quadrant should read 0 elevation ± 0.5 mils. If M1A1 gunner's quadrant does not indicate this value, elevate or depress cannon assembly until M1A1 gunner's quadrant does indicate 0 elevation ± 0.5 mils.

6 Move M15 quadrant mounting bracket (3) as required until bubble in elevation level vial (14) of cross test level (9) is centered. Only a slight amount of movement of M15 quadrant mounting bracket should be required. When bubble in cross test level elevation level vial is centered, torque two accessible cap screws (1) which secure M15 quadrant mounting bracket to cannon trunnion (7) to 30 lb-ft (41 N·m).

7 Remove cross test level (9) from M15 quadrant mounting bracket (3). Tighten remaining two cap screws (1) to 30 lb-ft (41 N·m).

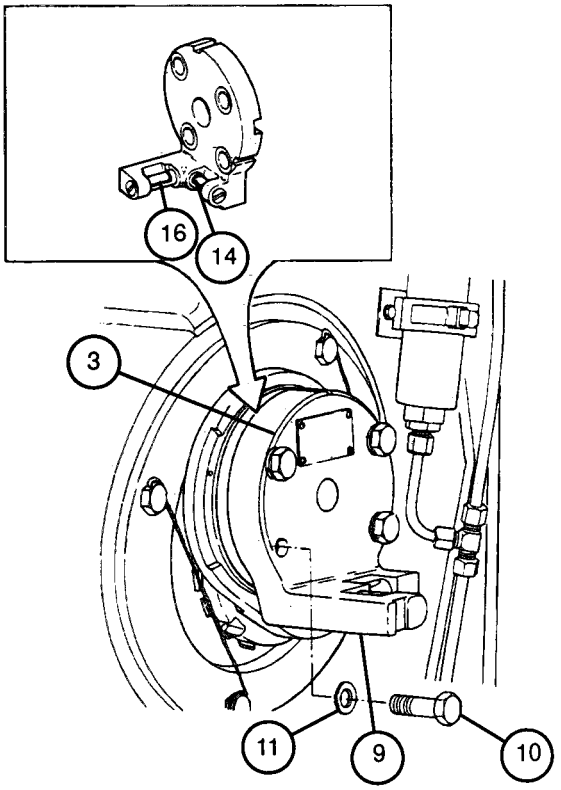
8 Repeat steps 4 through 7.

9 Drill and ream, as required, the two holes in the M15 quadrant mounting bracket (3) and cannon trunnion (7) for two new pin assemblies (4).

10 Install two new pin assemblies (4). Torque nuts on pin assemblies to 9 lb-ft (12 N·m).

11 Install cross test level (9) on M15 quadrant mounting bracket (3) and torque mounting cap screws (10) to 20 lb-ft (27 N·m).

12 Place M1A1 gunner's quadrant (12) on cant seats of breechblock. Level vial bubble (15) must be approximately centered. Remove M1A1 gunner's quadrant. Bubble in cross-level vial (16) of cross test level (9) must be approximately centered. Mark exact position of bubble ends with a felt-tipped marker or grease pencil.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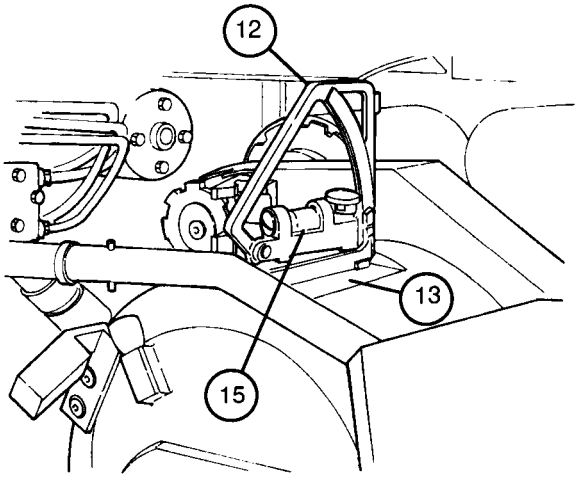
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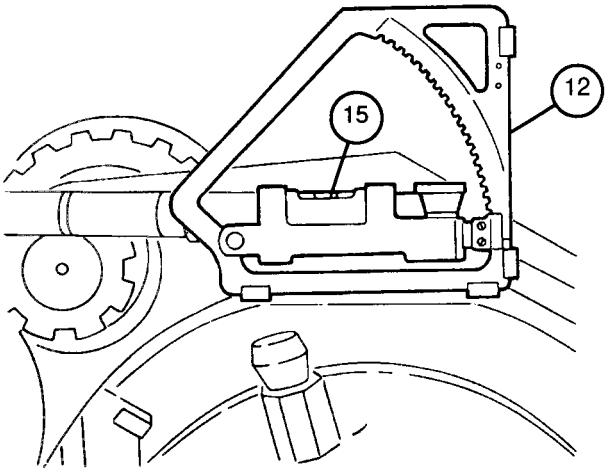
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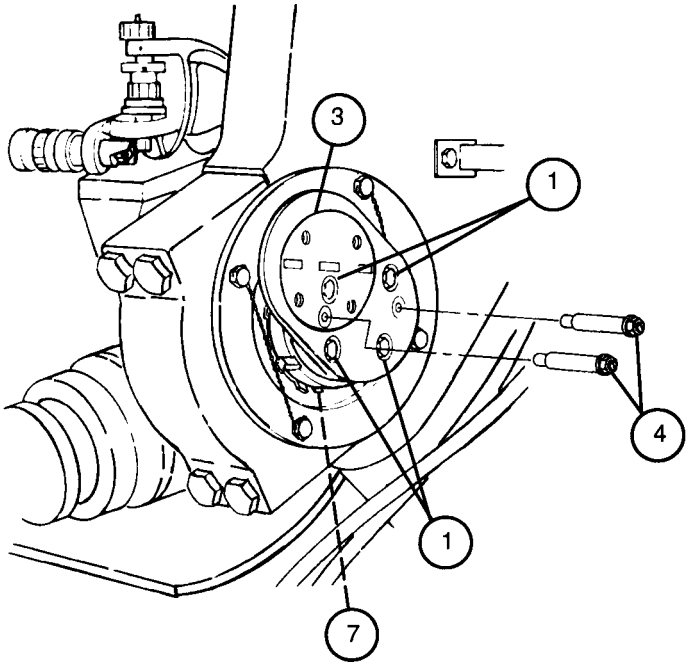
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7

11-1 M15 QUADRANT MOUNTING BRACKET - CONTINUED

b. Installation - Continued

13 Elevate cannon assembly to maximum elevation, observing bubble in cross-level vial (16) continuously. Bubble must remain stationary within 1/2 of a cross-level vial graduation. If bubble does not remain stationary, note the amount of deviation, then proceed to realine the quadrant ring (6) between M15 quadrant mounting bracket (3) and cross test level (9) as follows:

(a) With the weapon at maximum elevation, loosen four cap screws (10) securing cross test level (9) to M15 quadrant mounting bracket (3) just enough to loosen quadrant ring (6) without disturbing position of bubble in cross-level vial (16) of cross test level.

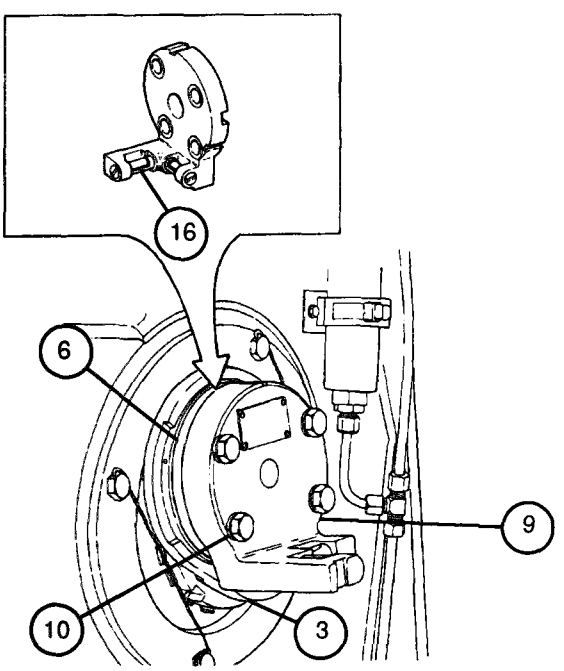
(b) Insert blade of a thin screwdriver or other similar tool into one of the holes on circumference of quadrant ring (6) and adjust position clockwise or counterclockwise so that one-half of deviation noted above is removed.

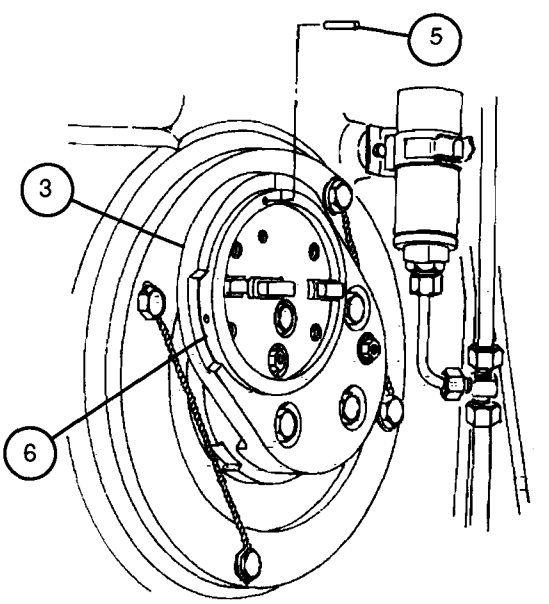
(c) Torque four cap screws (10) securing cross test level (9) to M15 quadrant mounting bracket (3) to 20 lb-ft (27 N·m).

(d) Depress and elevate cannon through full travel while noting position of bubble in cross-level vial (16) of cross test level (9). Bubble must remain stationary as cannon is elevated and depressed through full travel. Repeat step 13 (a), (b), and (c) until this condition prevails.

14 Mark location of quadrant ring (6) or secure quadrant ring in position. Remove cross test level (9) from M15 quadrant mounting bracket (3).

15 Make sure quadrant ring (6) is in correct position. Drill and ream holes as required in M15 quadrant mounting bracket (3) and quadrant ring for locating headless straight pin (5). Install a headless straight pin.





11-2 BEARING RETAINING PLATE

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Lockwire (V) (item 37, Appx E)

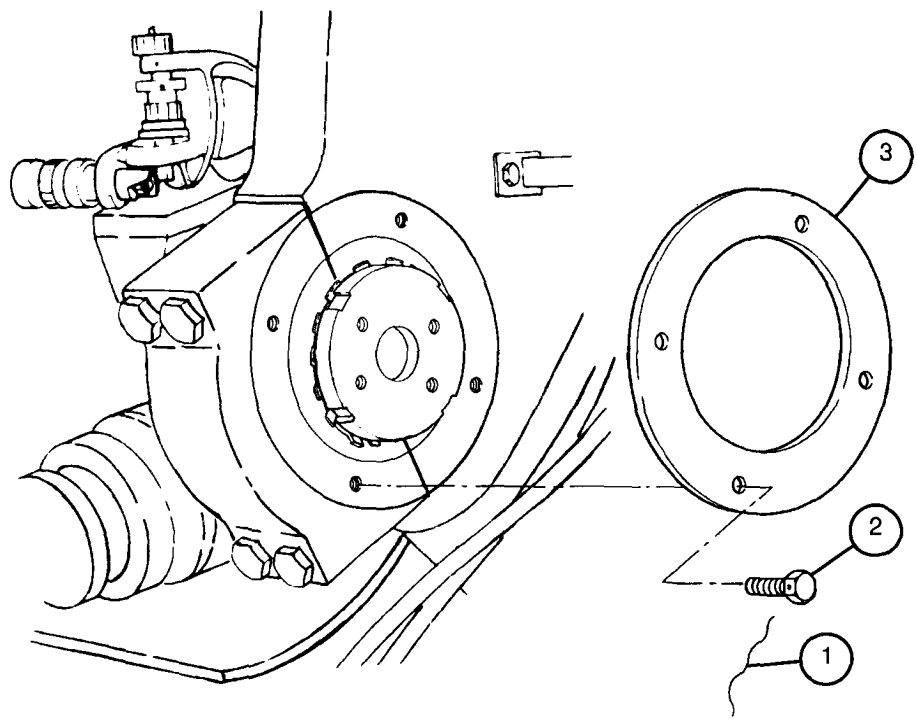
Equipment Condition
M15 quadrant mounting bracket removed (para 11–1)

a. Removal

Remove lockwire (1), four cap screws (2), and bearing retaining plate (3). Discard lockwire.

b. Installation

Install bearing retaining plate (3) using four cap screws (2) and new lockwire.



11-3 TRUNNION BRACKET

This task covers: a. Removal b. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Eye bolt (item 5, Appx F)
Fabricated cannon tube hydraulic tripod (Figure C-6, Appx C)
Fabricated cradle mount tripod (Figure C-6, Appx C)
Nut, hex (item 10, Appx F)

Materials/Parts
Lockwire (V) (item 37, Appx E)
Lockwire (V) (item 38, Appx E)

Personnel Required
2

Equipment Condition
Cannon, mount, and trunnion bracket assembly removed (para 5-1) and positioned on fabricated mount cradle tripod and fabricated cannon tube hydraulic tripod
Bearing retaining plate removed (para 11-2)

a. Removal

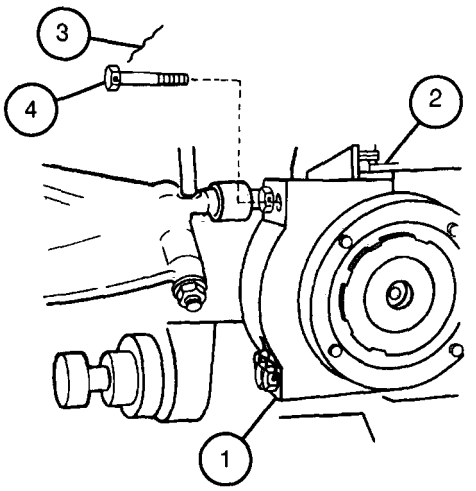
NOTE

Trunnion caps are matched to trunnion bracket and must be installed on same side from which removed.

1 Mark two trunnion caps (1) and trunnion bracket (2).

2 Remove lockwire (3) and four machine bolts (4) from each of two trunnion caps (1). Discard lockwire.

3 Remove two trunnion caps (1).



4 Install eye bolt (5) in top center hole of trunnion bracket assembly (2) and fasten with hex nut (6).

5 Attach hoist (7) to two fixed eye bolts (8) and eye bolt (5).

NOTE

When removing trunnion bracket, use care to clear variable recoil cover and housing group, dust shield, and bore evacuator.

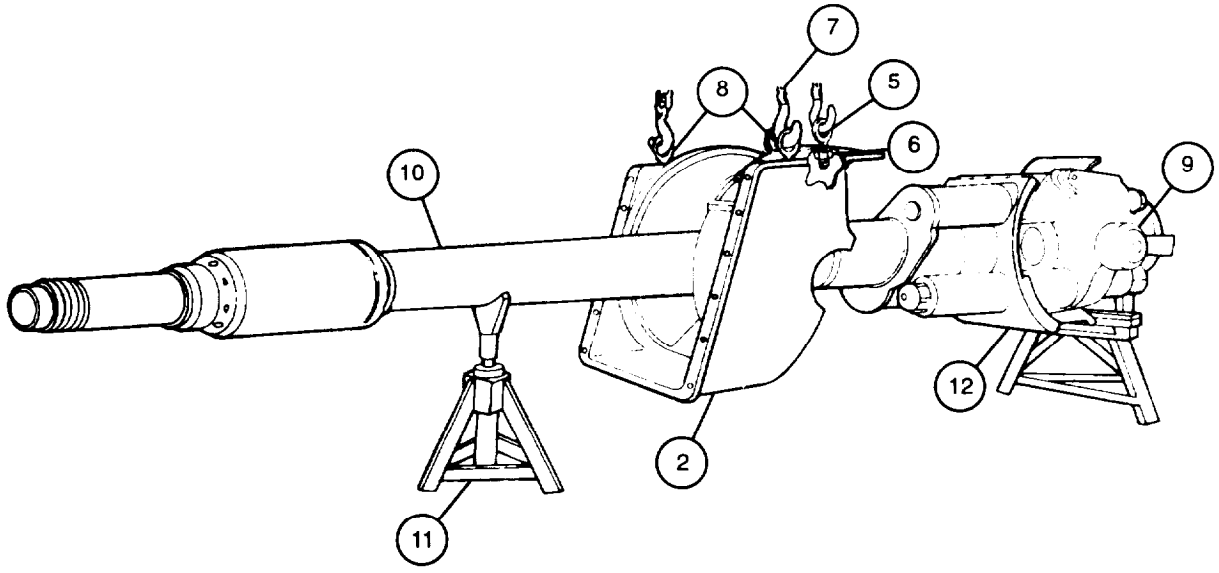
6 Raise trunnion bracket assembly (2) slightly off trunnion roller bearings (9) and move it forward along cannon tube (10).

CAUTION

To prevent damage to polished and finished surfaces, do not place tripod beneath bore evacuator or any other machined surface.

7 Using trunnion bracket assembly (2) to support cannon tube (10), reposition hydraulic tripod (11) towards muzzle end of cannon tube. Raise hydraulic tripod to support cannon tube.

8 Slide trunnion bracket assembly (2) toward muzzle end of cannon tube (10) next to hydraulic tripod (11). Use trunnion bracket assembly to support cannon tube and reposition hydraulic tripod (11) between trunnion bracket assembly and cradle (12) on a smooth portion of cannon tube remove trunnion bracket assembly from cannon tube.



11-3 TRUNNION BRACKET — CONTINUED

a. Removal — Continued

NOTE

Retain shims unless new components are to be installed.

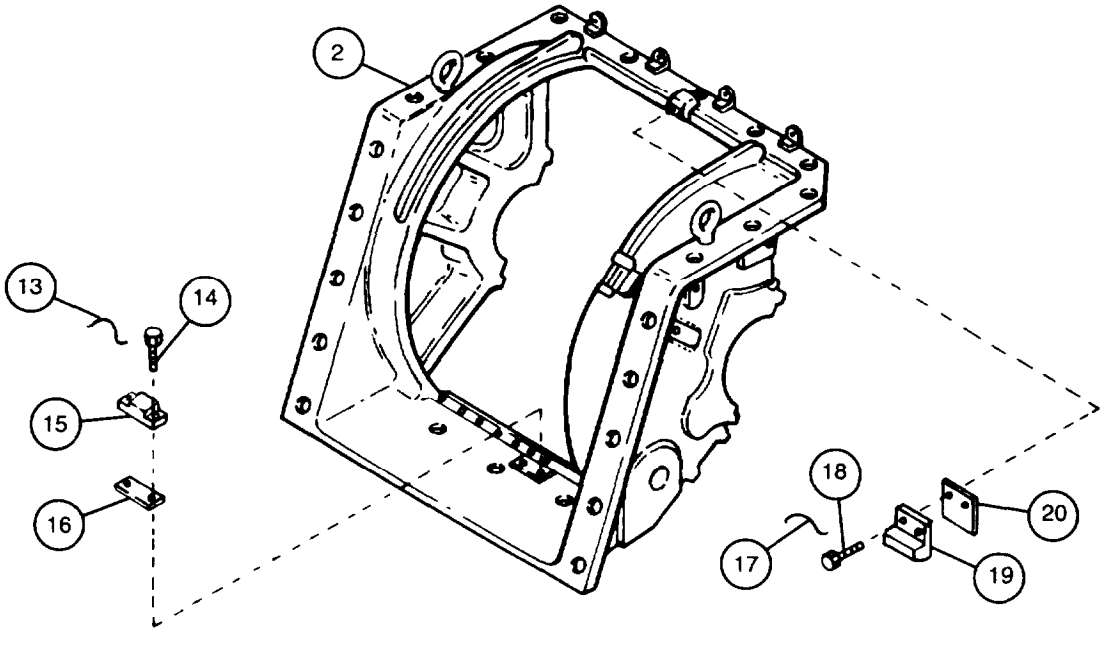
9 If necessary for replacement, remove lockwire (13) two cap screws (14) and shims (15 and 16) from trunnion bracket (2). Discard lockwire.

10 If necessary for replacement, remove lockwire (17), two cap screws (18), gun stop (19), and plate spacer (20) from trunnion bracket (2). Discard lockwire.

b. Installation

1 If removed, install plate spacer (20), gun stop (19) two cap screws (18), and new lockwire (17) on trunnion bracket (2).

2 If removed, install shim (16) and shim(s) (15) as required, two cap screws (14), and new lockwire (13) on trunnion bracket (2).



NOTE

Before trunnion bracket is installed on cannon and mount, cannon and mount must be resting on hydraulic tripod and cradle mount tripod.

3 Raise trunnion bracket (2) and slide over muzzle end of cannon tube (10) towards breech end.

4 As trunnion bracket (2) nears hydraulic tripod (11), support cannon tube (10) using trunnion bracket and reposition hydraulic tripod on a smooth portion towards muzzle end of cannon tube.

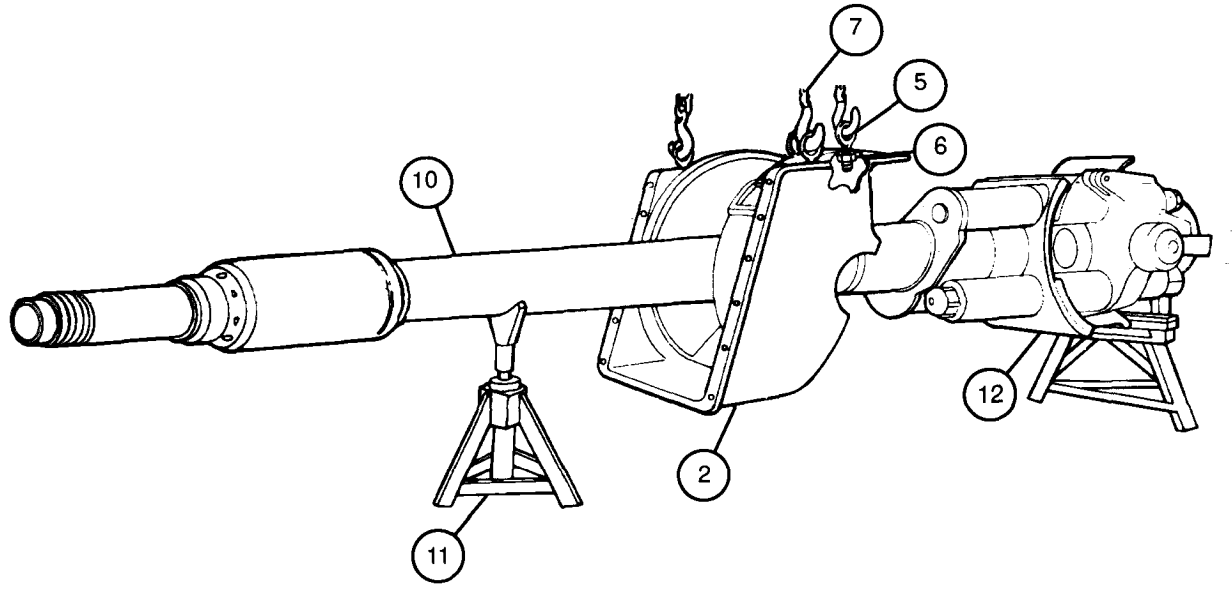
NOTE

When installing, use care to clear bore evacuator, dust shield, and variable recoil cover and housing group.

5 Move trunnion bracket (2) along cannon tube (10) toward cradle (12). Set in place on trunnion roller bearings (9).

6 Remove hoist (7).

7 Remove hex nut (6) and eye bolt (5).



11-3 TRUNNION BRACKET - CONTINUED

b. Installation - Continued

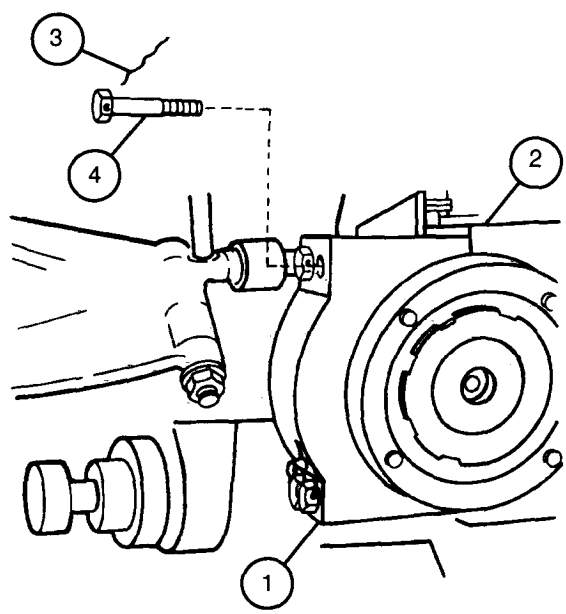
NOTE

Trunnion caps are matched to trunnion bracket.

8 Install each of two trunnion caps (1) at the side of trunnion bracket (2) from which it was removed.

9 Install four machine bolts (4) and torque to 425-450 lb-ft (576-610 N·m).

10 Secure four machine bolts (4) with new lockwire (3).

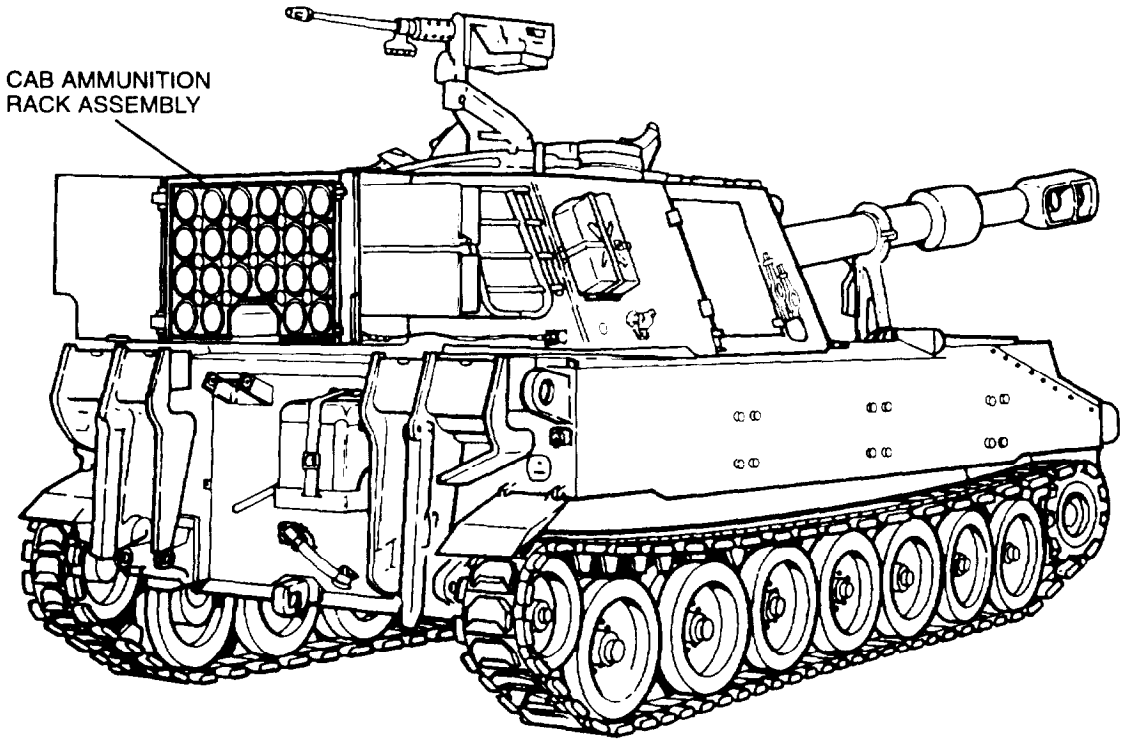


CHAPTER 12
DIRECT SUPPORT MAINTENANCE OF CAB AMMUNITION RACK ASSEMBLY

GENERAL

This chapter describes and illustrates removal and installation procedures for cab ammunition rack assembly. These maintenance procedures are functions authorized for direct support level maintenance.

CONTENTS



CAB AMMUNITION RACK ASSEMBLY

This task covers: a. Removal/Disassembly b. Assembly/Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Fabricated ammunition rack removal and lifting tool (Figure C-1, Appx C)
Sling, turret lifting (item 21, Appx F)
Trolley, l-beam (item 25, Appx F)
or
5-ton Wrecker

Personnel Required
3

Equipment Condition
Cab bustle door group (strike and bracket assemblies) removed (TM 9-2350-311-20-2)

a. Removal/Disassembly

WARNING

Weight of cab ammunition rack assembly is 960 pounds (435 kg). Personnel should wear steel-tipped safety shoes, safety glasses, and gloves to avoid injury. Exercise caution when handling cab ammunition rack assembly.

NOTE

Locking caps are located on cab ammunition rack assembly inside cab,

1 Rotate 31 locking caps (1) to OPEN position.

2 Holding 16 retainer assemblies (2) and six retainer assemblies (2.1) by the handles, remove from cab ammunition rack assembly (3).

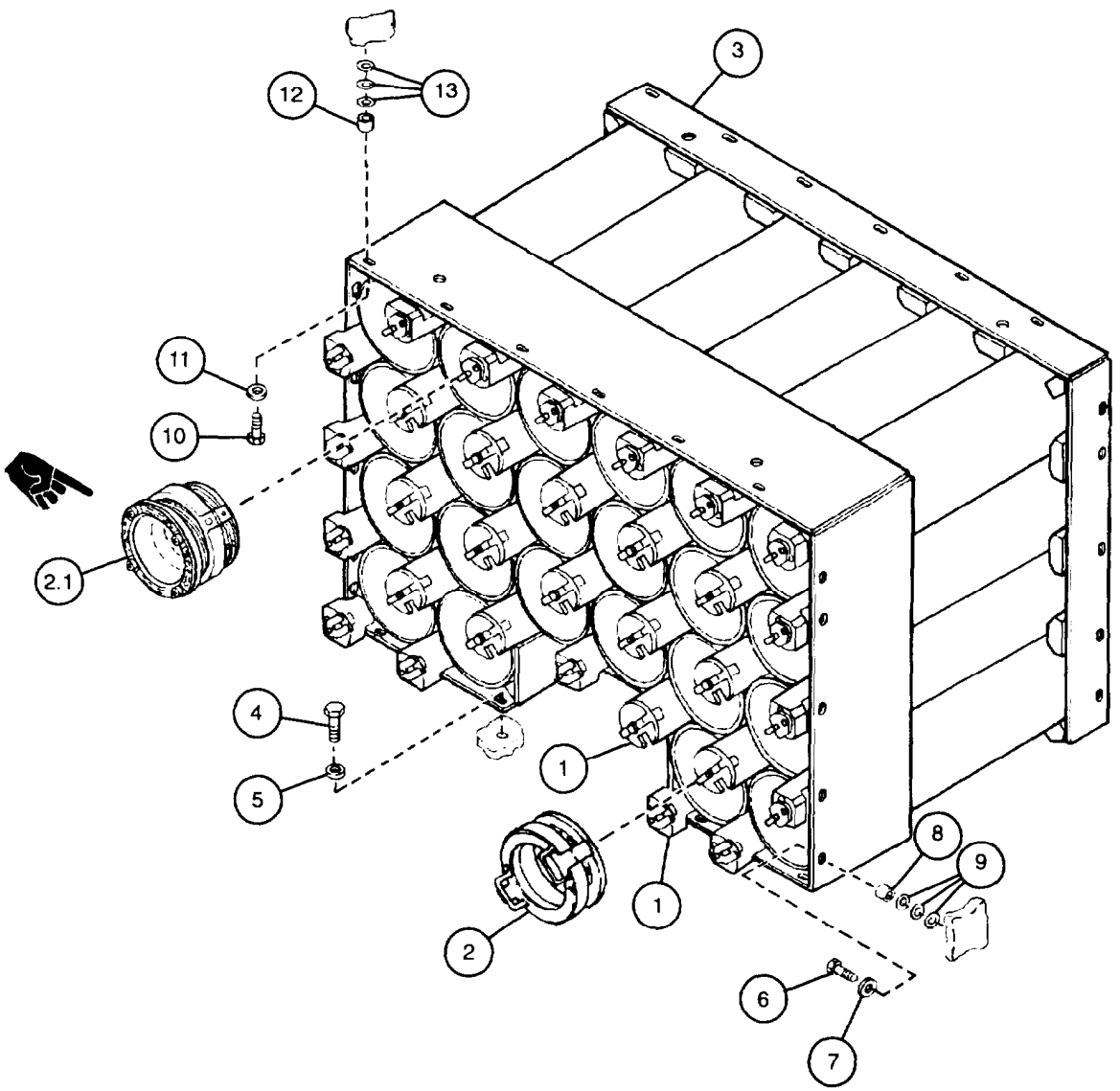
3 Remove eight cap screws (4) and eight flat washers (5) from cab ammunition rack assembly (3) perimeter.

NOTE

Retain shims unless new components are to be installed.

4 Remove 20 cap screws (6), 20 flat washers (7), 20 sleeve spacers (8), and shim(s) (9) from cab ammunition rack assembly (3) perimeter.

5 Remove 12 cap screws (10), 12 flat washers (11), 12 sleeve spacers (12), and shim(s) (13) from cab ammunition rack assembly (3) perimeter.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CAB AMMUNITION RACK ASSEMBLY — CONTINUED

a. Removal/Disassembly – Continued

6 Insert ammunition rack removal and lifting tool (14) into 3rd and 4th projectile tubes (15) on top row of cab ammunition rack assembly (3).

CAUTION

Use two personnel to guide cab ammunition rack assembly during removal to prevent damage to cab ammunition rack assembly or bustle.

7 Attach turret lifting sling (16) and I-beam trolley or wrecker (17) to ammunition rack removal and lifting tool (14).

8 Raise I-beam trolley or wrecker (17) to take up weight of cab ammunition rack assembly (3). Lift cab ammunition rack assembly out of bustle (18).

9 Remove eight cap screws (19) and bustle wear plate (20) from bustle (18).

10 Remove turret lifting sling (16) and I-beam trolley or wrecker (17) from ammunition rack removal and lifting tool (14).

11 Remove ammunition rack removal and lifting tool (14) from cab ammunition rack assembly (3)

b. Assembly/Installation

WARNING

Weight of cab ammunition rack assembly is 960 pounds (435 kg). Personnel should wear steel-tipped safety shoes, safety glasses, and gloves to avoid injury. Exercise caution when handling cab ammunition rack assembly.

1 Secure bustle wear plate (20) to bustle (18) with eight cap screws (19).

2 Insert ammunition rack removal and lifting tool (14) in 3rd and 4th projectile tubes (15) on top row of cab ammunition rack assembly (3).

3 Attach turret lifting sling (16) and I-beam trolley or wrecker (17) to ammunition rack removal and lifting tool (14).

4 Raise I-beam trolley or wrecker (17) to take up weight of cab ammunition rack assembly (3). Move I-beam trolley or drive wrecker to position cab ammunition rack assembly into bustle (18).

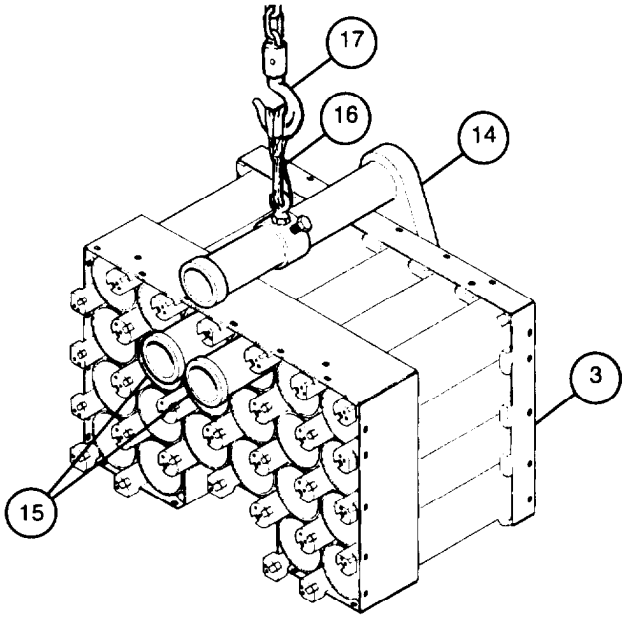
CAUTION

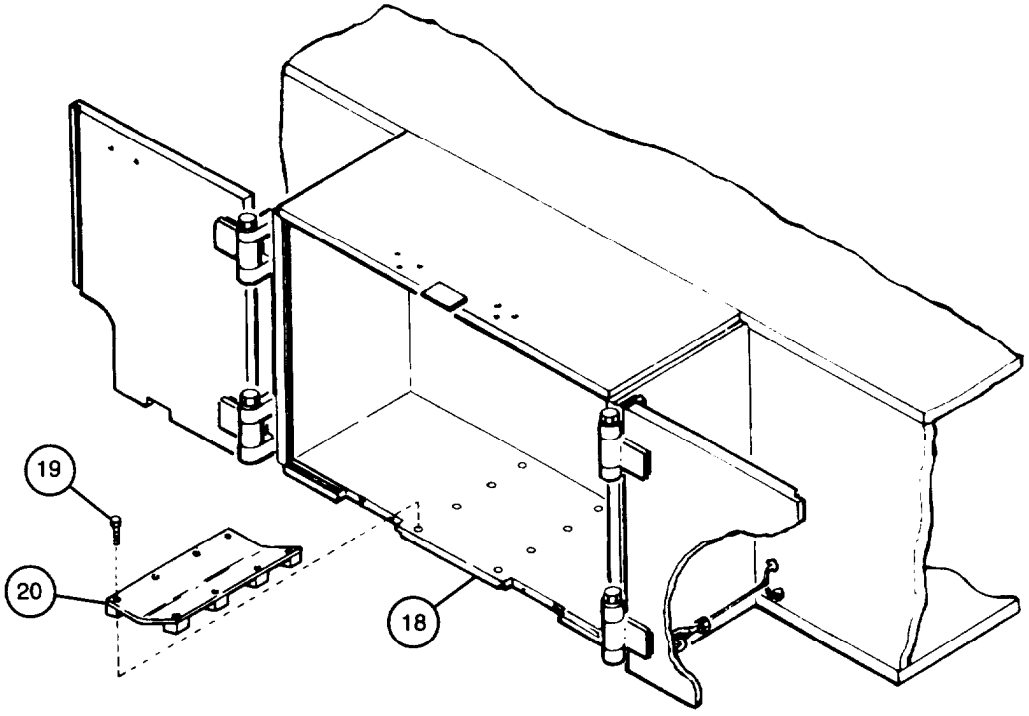
Use two personnel to guide cab ammunition rack assembly during installation to prevent damage to cab ammunition rack assembly or bustle.

5 Push cab ammunition rack assembly (3) into bustle (18).

6 Remove turret lifting sling (16) and l-beam trolley or wrecker (17) from ammunition rack removal and lifting tool (14).

7 Remove ammunition rack removal and lifting tool (14) from cab ammunition rack assembly (3).





CAB AMMUNITION RACK ASSEMBLY — CONTINUED

b. Assembly/Installation — Continued

8 Install shims (13) as required, 12 sleeve spacers (12), 12 flat washers (11), and 12 cap screws (10) in cab ammunition rack assembly (3) perimeter.

9 Install shims (9) as required, 20 sleeve spacers (8), 20 flat washers (7), and 20 cap screws (6) in cab ammunition rack assembly (3) perimeter.

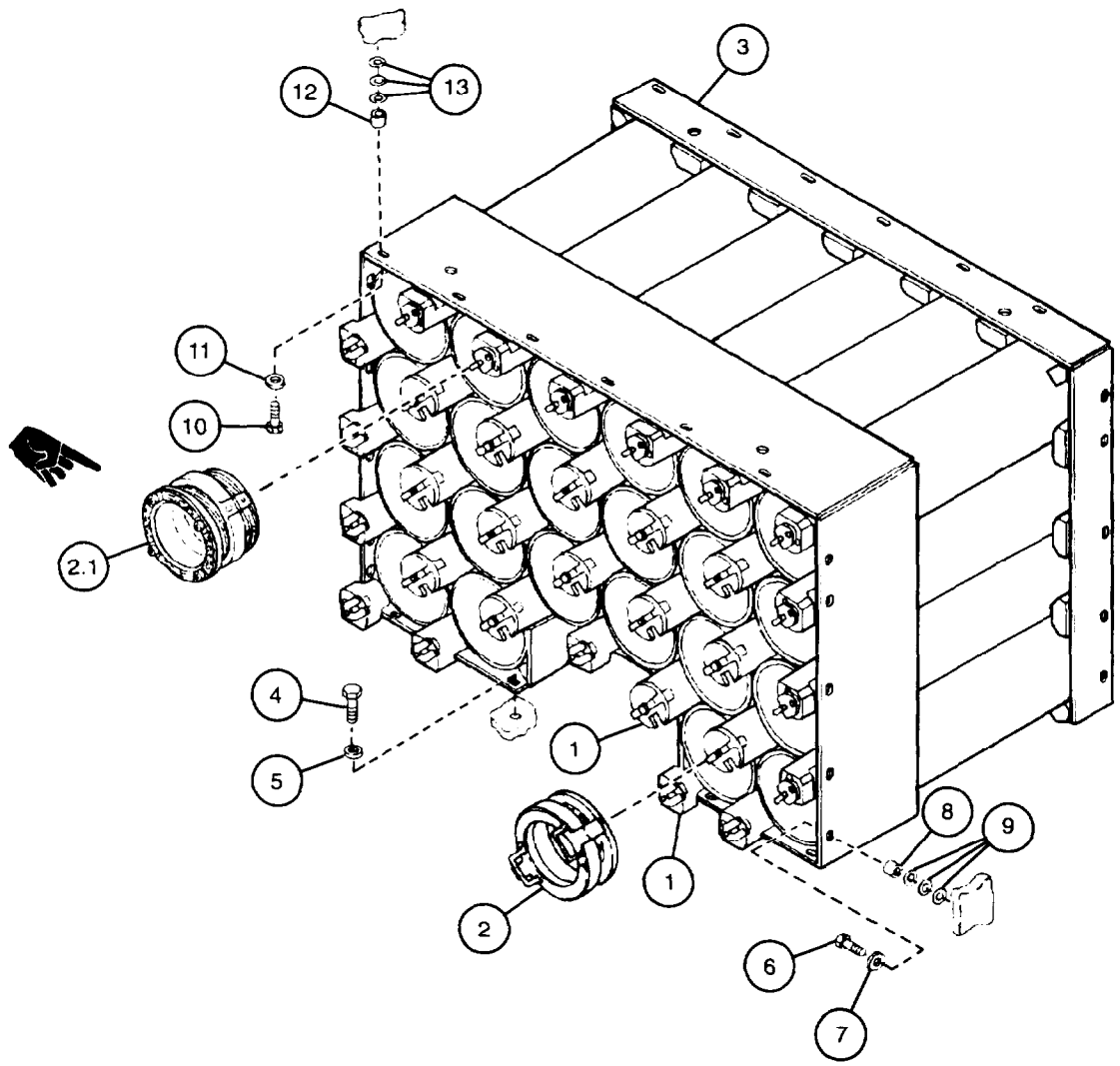
10 Install eight flat washers (5) and eight cap screws (4) in cab ammunition rack assembly (3) perimeter.

11 Hold six retainer assemblies (2.1) and 16 retainer assemblies (2) by handles and install in cab ammunition rack assembly (3).

NOTE

Locking caps are located on cab ammunition rack assembly inside cab.

12 Rotate 31 locking caps (1) to CLOSED position.

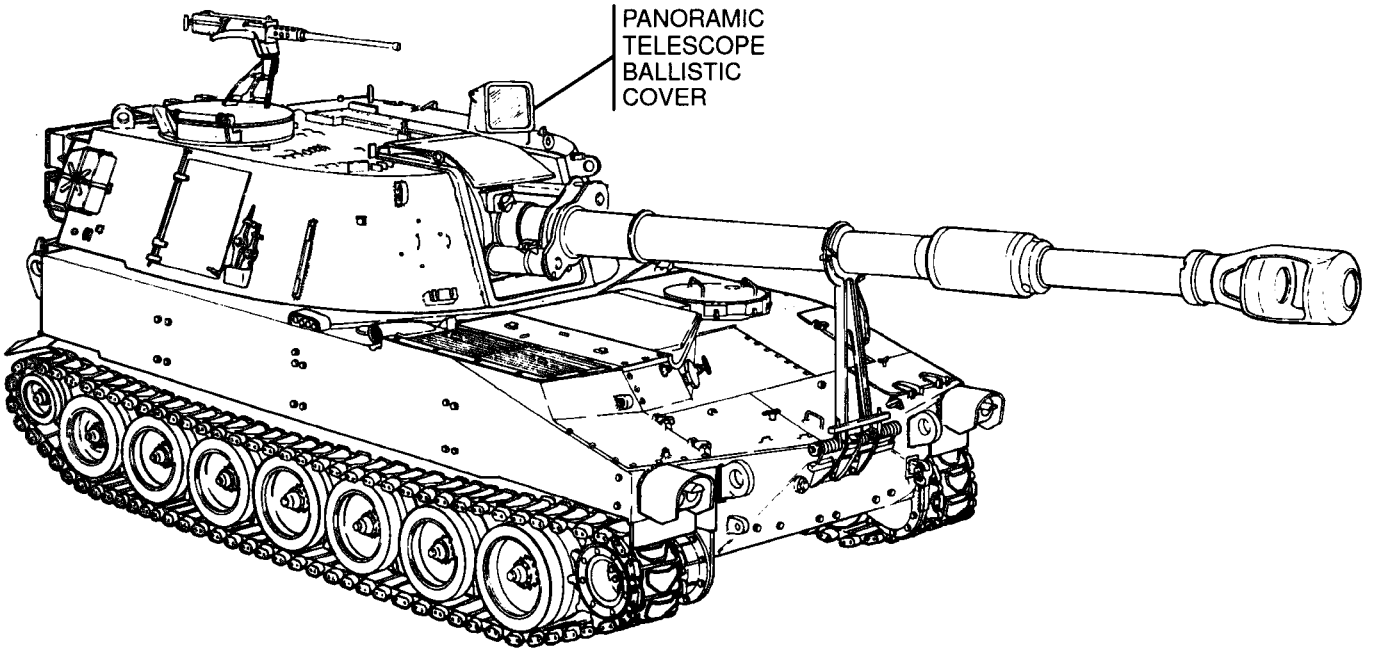


CHAPTER 13
DIRECT SUPPORT MAINTENANCE OF PANORAMIC TELESCOPE BALLISTIC COVER

GENERAL

This chapter describes and illustrates disassembly, inspection and repair, and assembly of the panoramic telescope ballistic cover. These procedures are functions authorized for direct support level maintenance.

CONTENTS



PANORAMIC TELESCOPE BALLISTIC COVER

This task covers: a. Disassembly b. Inspection and Repair
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit
(SC 5180-95-CL-A12)

Materials/Parts
Headless grooved pins (2) (item 89, Appx E)
Sealing compound (item 30, Appx B)
Seals (2) (item 169, Appx E)
Self-locking screws (12) (item 100, Appx E)

Personnel Required
2

Equipment Condition
Panoramic telescope ballistic cover removed
(TM 9-2350-311–20-2)

a. Disassembly

1 Remove 12 self-locking screws (1), optical holder (2), two seals (3), and window (4) from cover (5). Discard self-locking screws and seals.

2 Remove two webbing straps (6).

3 Remove eight cap screws (7).

WARNING

Cover is heavy and requires help of an assistant for removal to avoid injury.

NOTE

When cover is removed, upper ring maybe stuck in it, freeing bearing balls.

4 Remove cover (5).

NOTE

Retain shims unless new components are to be installed.

5 Remove upper ring (8) and shim(s) (9), if used, from lower ring (10).

6 Remove 58 white, off-white, or yellow, large bearing balls (11), 54 pink or red, medium bearing balls (12), and five small bearing balls (13).

7 Remove two headless grooved pins (14), two rod end clevis assemblies (15), two brake shoes (16), and two bolts (17). Discard headless grooved pins.

8 Remove two headless straight pins (18) from upper ring (8).

b. Inspection and Repair

1 Clean all parts (Chapter 2).

2 Inspect 58 white, off-white, or yellow, large bearing balls (11) for scoring, burrs, or deformation. Replace as required.

3 Inspect 54 pink or red, medium bearing balls (12) for scoring, burrs, or deformation. Replace as required.

4 Inspect five small bearing balls (13) for scoring, burrs, or deformation. Replace as required.

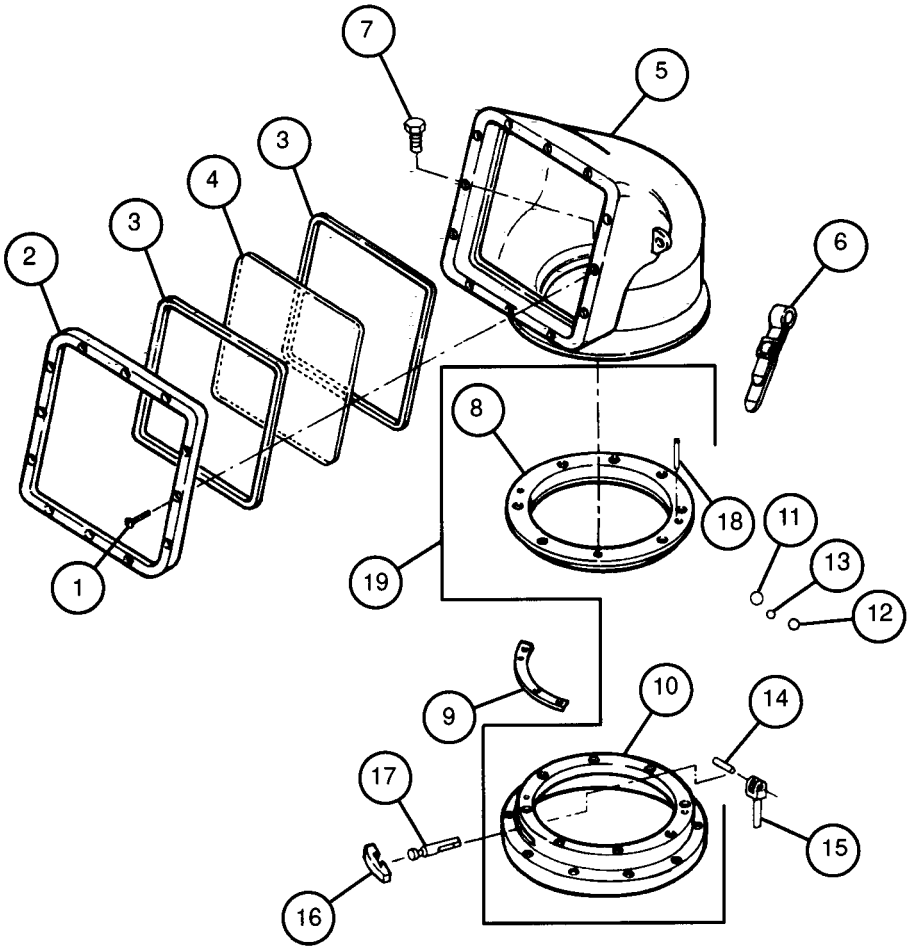
5 Inspect cover (5). Replace if cracked or distorted.

6 Inspect upper ring (8) and lower ring (10). Replace ring assembly (19) if cracked or distorted.

7 Inspect threaded holes of cover (5) and lower ring (10). Repair threads if damaged.

8 Inspect window (4). Replace if scratched, cracked, difficult to see through, or blemishes extend more than two inches from the window edge.

9 Inspect headless straight pins (18) and replace if bent, cracked, or otherwise damaged.



PANORAMIC TELESCOPE BALLISTIC COVER - CONTINUED

c. Assembly

1 Install two headless straight pins (18) in upper ring (8).

2 Install two bolts (17), two brake shoes (16), two rod end clevis assemblies (15), and two new headless grooved pins (14) in lower ring (10).

3 Place upper ring (8) and shim(s) (9) on lower ring (10). Make sure two headless straight pins (18) are engaged in holes of lower ring and holes in shim(s) are alined with holes in lower ring and upper ring.

4 Position cover (5) on lower ring (10).

NOTE

Bearing balls are to be arranged in five groups. Follow illustration as a guide when installing bearing balls.

5 Raise upper ring (8) from lower ring (10). Insert 58 white, off-white, or yellow, large bearing balls (11), 54 pink or red, medium bearing balls (12), and five small bearing balls (13) into groove formed by lower ring (10), upper ring (8), and cover (5).

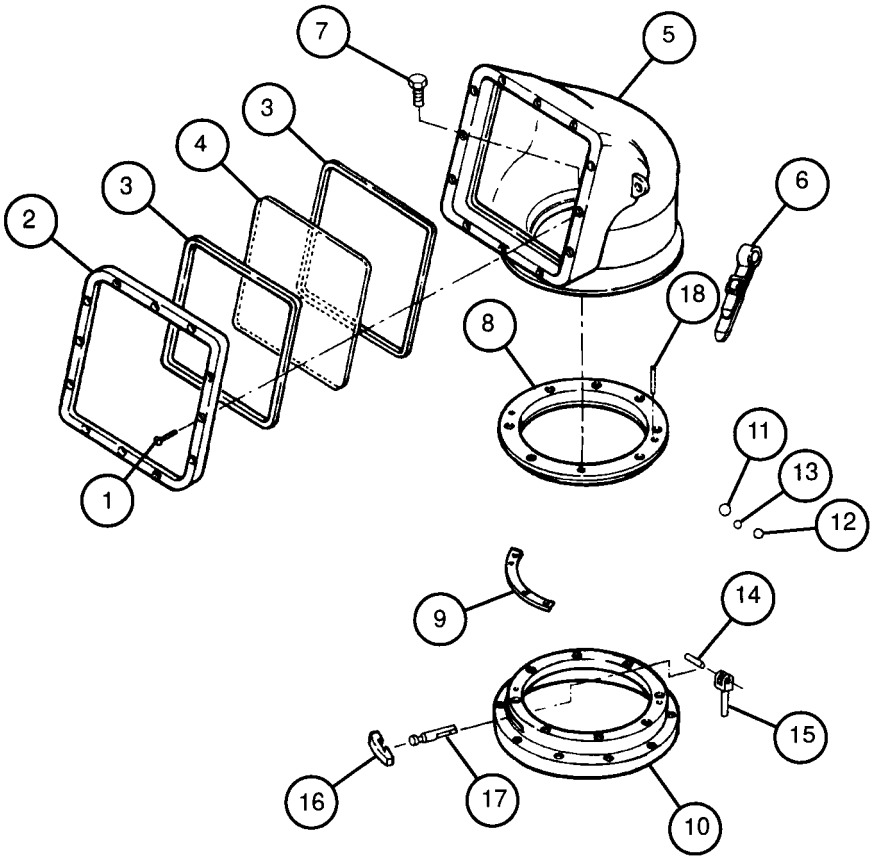
6 Secure lower ring (10), shim(s) (9), and upper ring (8) to cover (5) using eight cap screws (7). Torque cap screws to 34-42 lb-ft (46-57 N·m).

7 Install two webbing straps (6).

8 Rotate cover (5) to check operation. If cover binds, add or remove new shim(s) (9) as required to obtain smooth rotation.

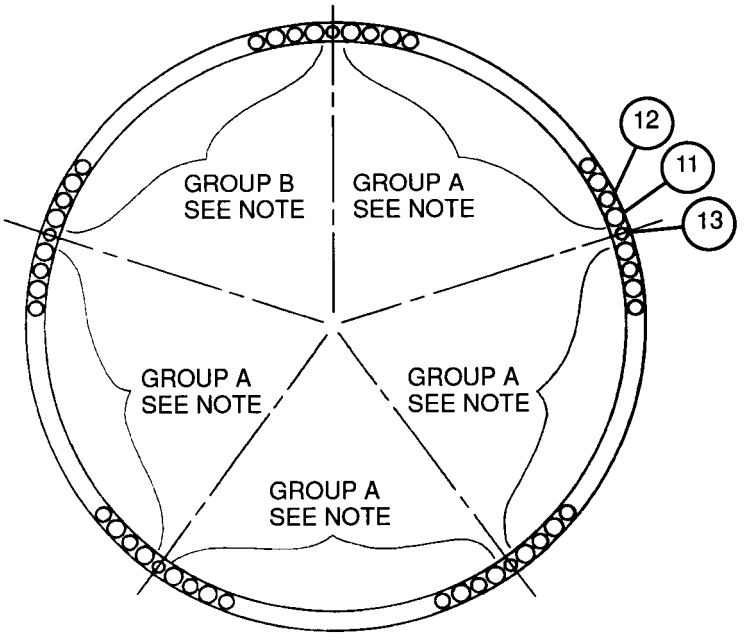
9 Install two new seals (3) and window (4). Small plate of window must face inside cover (5) and etched trademark or number on glass must face outward.

10 Apply sealing compound to edges of optical holder (2) which meets cover (5). Install optical holder and 12 new self-locking screws (1). Torque self-locking screws to 7-8 lb-ft (9-11 N·m).



NOTE

- Group A consists of 23 bearing balls alternating between 12 large bearing balls and 11 medium bearing balls.
- Group B consists of 20 bearing balls alternating between 10 large bearing balls and 10 medium bearing balls.
- Five small bearing balls are used to separate each group.

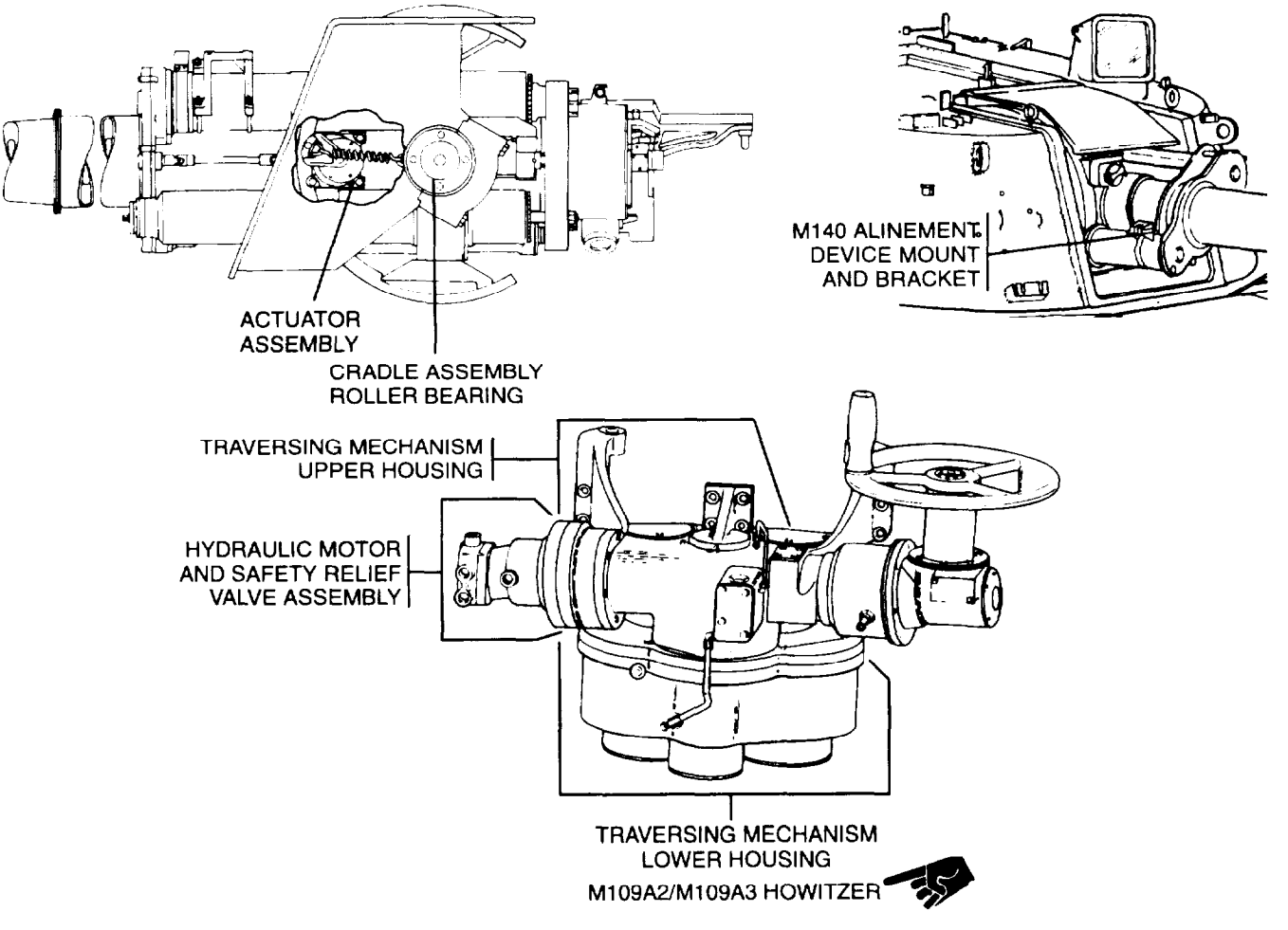


CHAPTER 14
GENERAL SUPPORT MAINTENANCE

GENERAL

This chapter illustrates and describes the repair performed by general support maintenance on the major components listed below.

CONTENTS



Section I. MOUNT AND HOWITZER ASSEMBLY

14-1 CRADLE ASSEMBLY ROLLER BEARINGS

This task covers: a. Removal b. Inspection
c. Installation

INITIAL SETUP

Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)
Bearing puller (item 14, Appx F)

Materials/Parts
Grease (item 21, Appx B)

Key washers (2) (item 34, Appx E)

References
TM 9-214

Equipment Condition
Mount and howitzer with trunnion bracket removed (para 5-1)
Bearing retaining plate removed (para 11-2)

a. Removal

1 Disengage tabs of key washer (1) from slot of round nut (2).

2 Remove round nut (2), key washer (1), spacer (3), and flat washer (4). Discard key washer.

3 Using a bearing puller, remove roller bearing (5), flat washer (6), and spacer (7).

4 Repeat steps 1 through 3 for second roller bearing (5).

b. Inspection

For proper cleaning and inspection procedures for roller bearings (5), refer to TM 9-214.

c. Installation

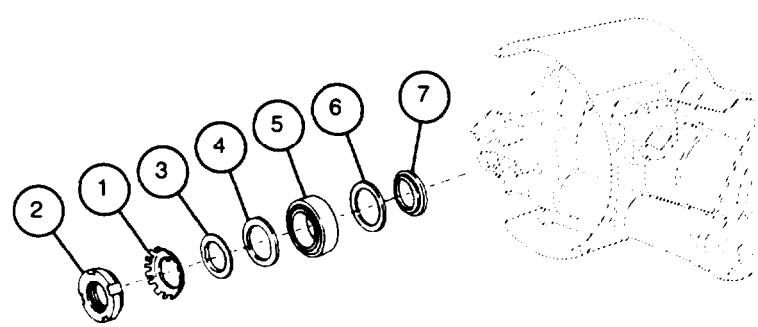
1 Pack roller bearing (5) with grease.

2 Install spacer (7), flat washer (6), roller bearing (5), flat washer (4), and spacer (3).

3 Install new key washer (1) and round nut (2). Bend tabs of key washer to secure round nut.

4 Lubricate roller bearing (5) until grease appears through sides of roller bearing.

5 Repeat steps 1 through 4 for second roller bearing (5).



14-2 M140 ALINEMENT DEVICE MOUNT AND BRACKET (DIRECT FIRE)

This task covers: a. Removal b. Disassembly c. Assembly d. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Lockwashers (2) (item 78, Appx E)
Lockwashers (4) (item 85, Appx E)

References
TM 9-2350-311-10

Equipment Condition
M140 alinement device removed (TM 9-2350-311-10)

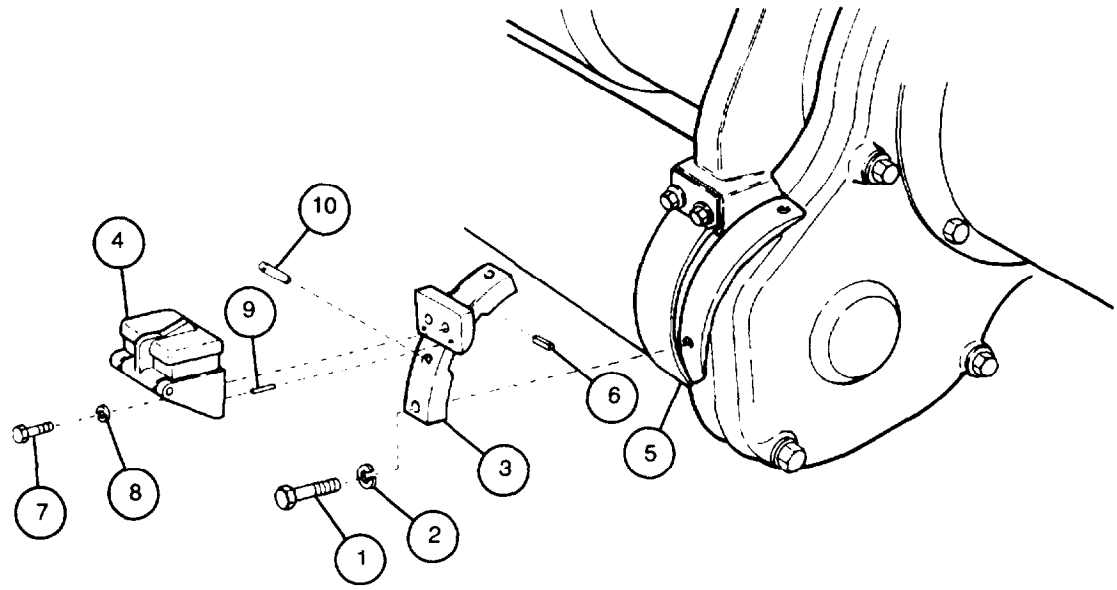
a. Removal

1 Remove two cap screws (1), two lockwashers (2), bracket (3) with M140 alinement device mount (4) attached from mount (5). Discard lockwashers.

2 Remove woodruff key (6).

3 Remove two cap screws (7), two lockwashers (8), and M140 alinement device mount (4) from bracket (3). Discard lo&washers.

4 Only if necessary for replacement, remove two headless straight pins (9) from M140 alinement device mount (4) and two headless straight pins (10) from bracket (3).



14-2 M140 ALINEMENT DEVICE MOUNT AND BRACKET (DIRECT FIRE) – CONTINUED

b. Disassembly

1 Remove two cap screws (11), two lockwashers (12), two flat washers (13), and dovetail door wedge (14) from base (15). Discard lockwashers.

2 Only if necessary for replacement, remove two headless straight pins (16).

c. Assembly

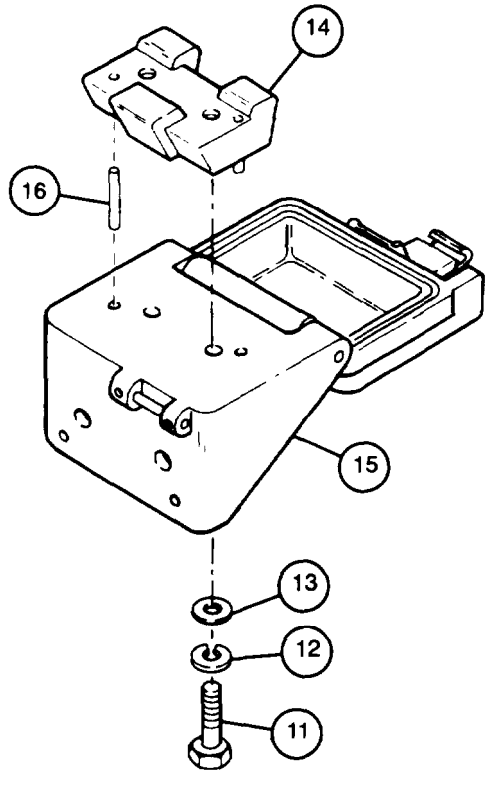
1 Secure dovetail door wedge (14) to base (15) using two flat washers (13), two new lo&washers (12), and two cap screws (11).

NOTE

Drill and ream holes for headless straight pins if M140 alinement device is new,

2 Drill two holes 0.2495 ± 0.0005 inches diameter.

3 Install two headless straight pins (16), if removed.



d. Installation

1 Level the gun trunnions using the plumbline method (TM 9-2350-311-10).

2 Ensure testing and scribing has been performed of the M145/M145A1 telescope mount (TM 9-2350-311-10).

3 Boresight the howitzer using the test target method of boresighting with the M118A2/M118A3 elbow telescope (TM 9-2350-311-10).

4 Secure M140 alinement device mount (4) to bracket (3) using two new lockwashers (8) and two cap screws (7).

5 Install woodruff key (6).

6 Secure bracket (3) to mount (5) using two new lockwashers (2) and two cap screws (1). Bracket and M140 alinement device mount (4) should be in line with M42 periscope.

7 Install M140 alinement device (TM 9-2350-311-10).

8 With an observer viewing through M118A2/M118A3 elbow telescope, aline bracket (3) and M140 alinement device mount (4) until the reticle of the M140 alinement device is in coincidence with boresight cross of M118A2/M118A3 elbow telescope reticle as shown, by loosening and tightening mounting cap screws (7 and 1). Torque cap screws to 45-50 lb-ft (61-68 N·m) when alinement of reticles is met.

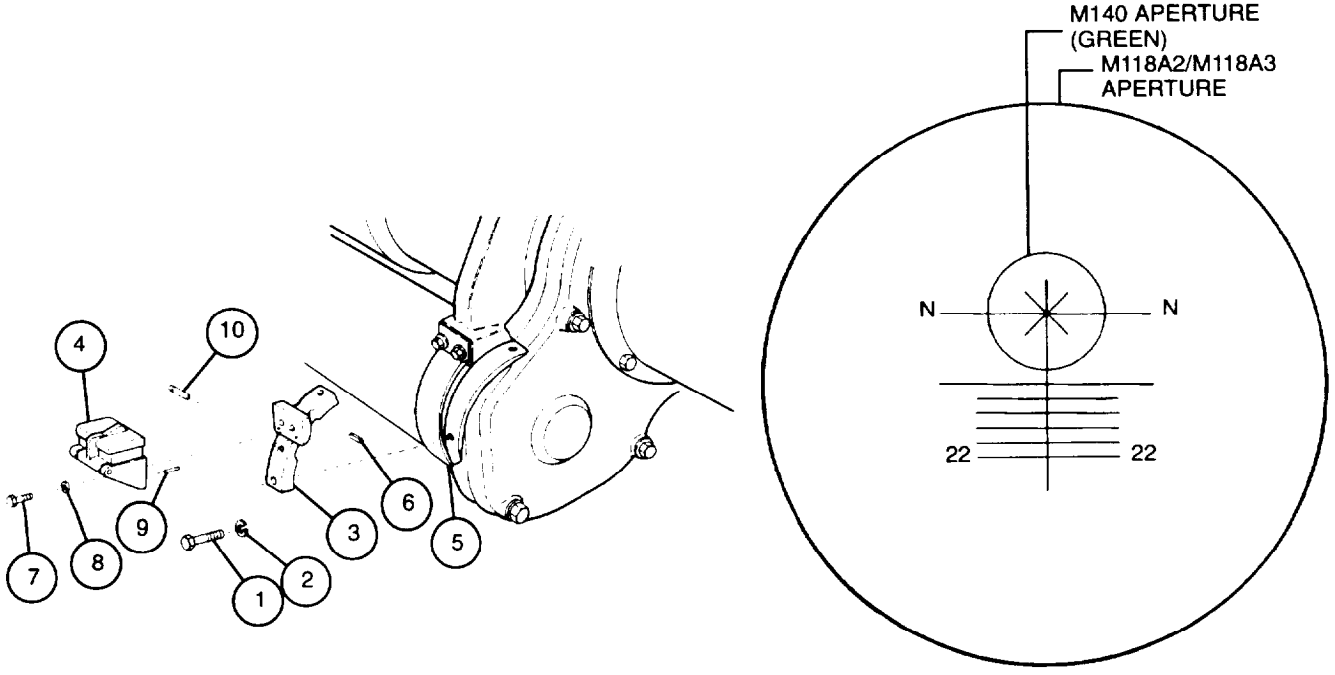
9 Remove Ml 40 alinement device (TM 9-2350-311-10).

NOTE

Drill and ream holes for four headless straight pins if M140 alinement device is new.

10 If removed, install two headless straight pins (10) in bracket (3) and two headless straight pins (9) in M140 alinement device mount (4).

11 Install M140 alinement device (TM 9-2350-311-10) and recheck coincidence of reticles which must be within 0.25 mils.



14-2.1 M140 ALINEMENT DEVICE MOUNT AND BRACKET (INDIRECT FIRE)

This task covers: a. Removal b. Disassembly c. Assembly d. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Lockwashers (2) (item 78, Appx E)
Lockwashers (2) (item 85, Appx E)

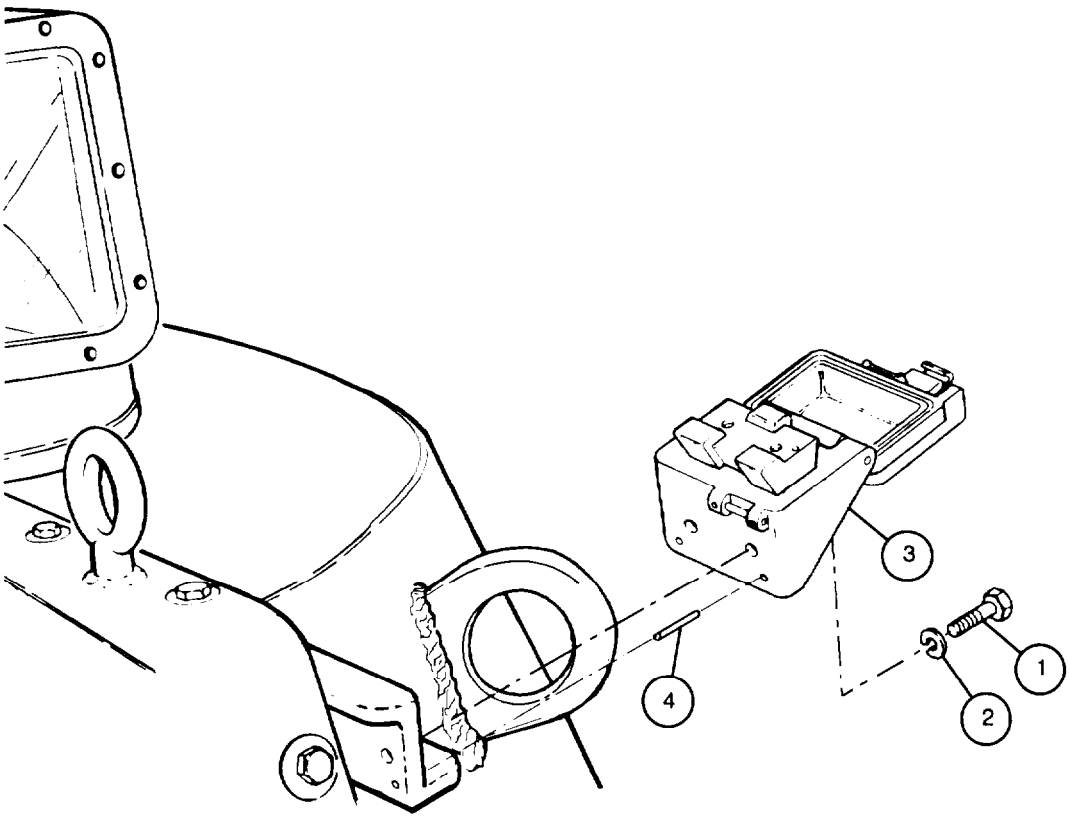
References
TM 9-2350-311-10

Equipment Condition
M140 alinement device removed (TM 9-2350-311-10)

a. Removal

1 Remove two cap screws (1), two lockwashers (2), and M140 alinement device mount (3) from cab. Discard lockwashers.

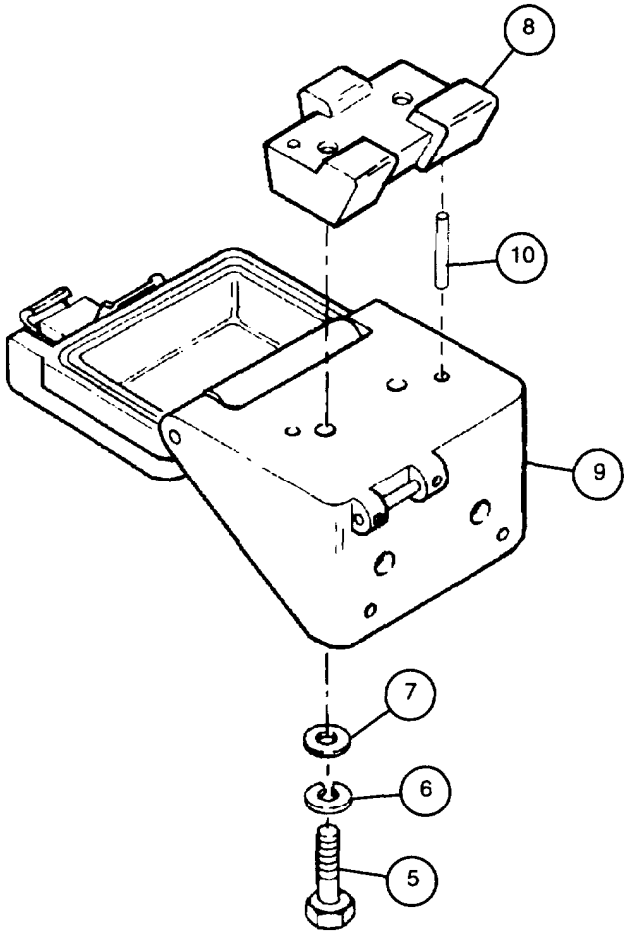
2 Only if necessary for replacement, remove two headless straight pins (4).



b. Disassembly

1 Remove two cap screws (5), two lockwashers (6), two flat washers (7), and dovetail door wedge (8) from base (9). Discard lockwashers.

2 Only if necessary for replacement, remove two headless straight pins (10).



14-2.1 M140 ALINEMENT DEVICE MOUNT AND BRACKET (INDIRECT FIRE) – Continued

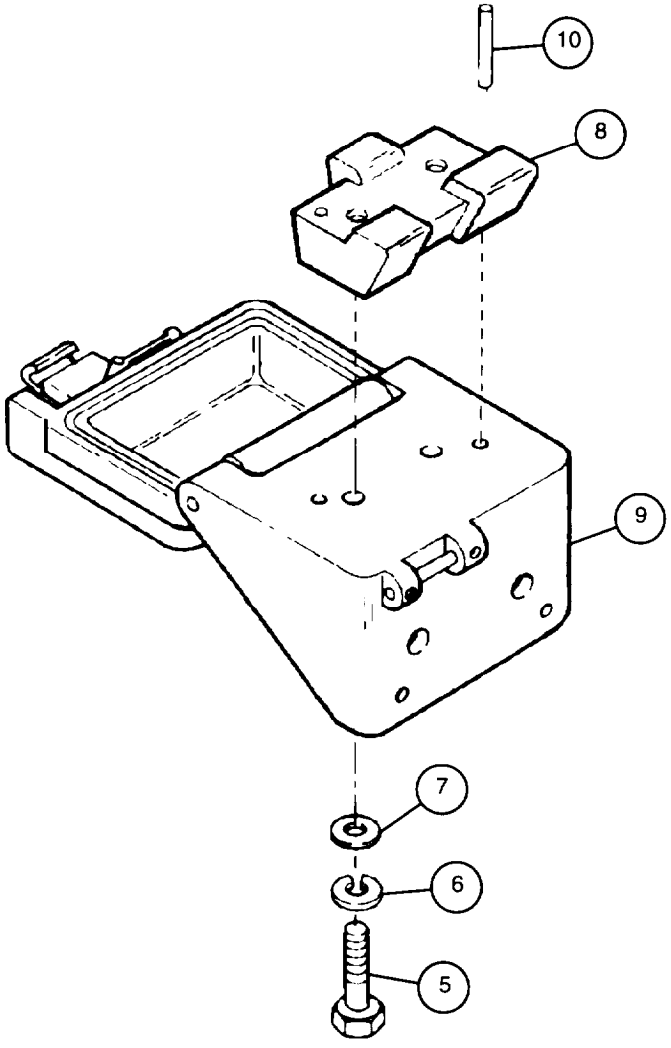
c. Assembly

1 Secure dovetail door wedge (8) to base (9) using two flat washers (7), two new lockwashers (6), and two cap screws (5).

NOTE

Drill and ream holes for headless straight pins if M140 alinement device mount is new

2 Install two headless straight pins (10), if removed.



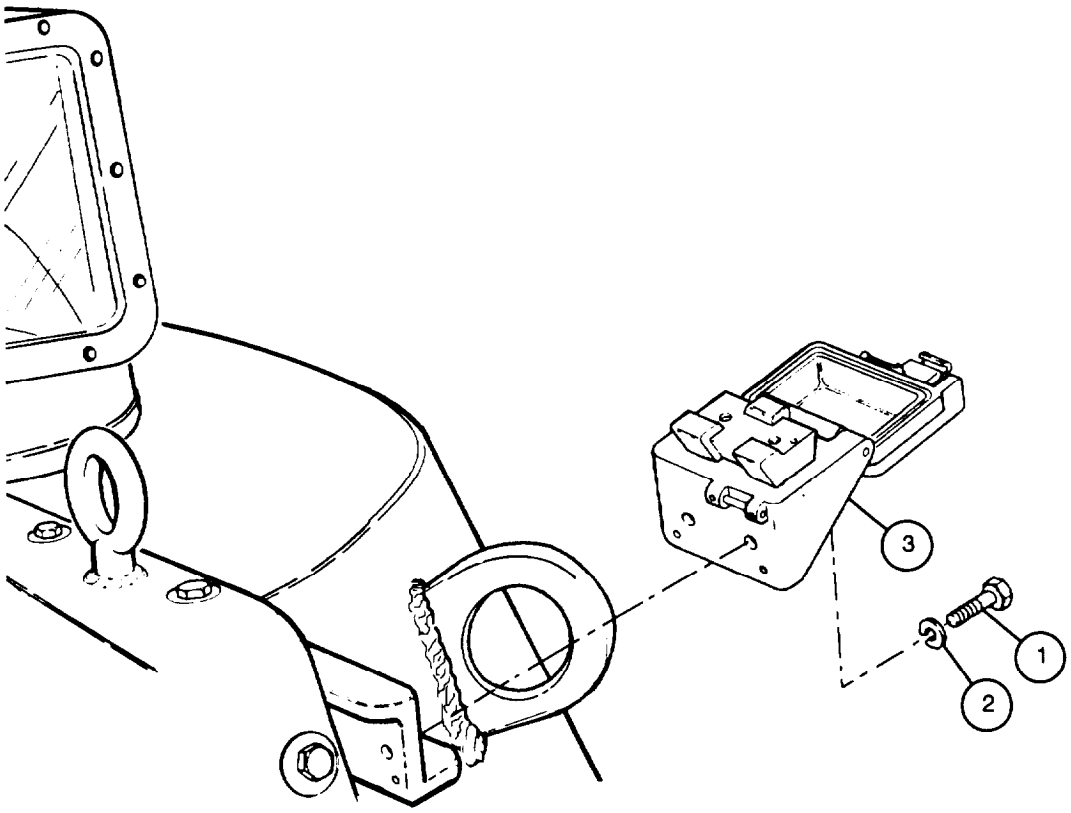
d. Installation

1 Level the gun trunnions using the plumbline method (TM 9-2350-311-10).

2 Ensure testing and scribing has been performed on the M145/M145A1 telescope mount (TM 9-2350-311-10).

3 Boresight the howitzer using the test target method of boresighting with the M117/M117A2 panoramic telescope (TM 9-2350-311-10).

4 Secure M140 alinement device mount (3) to cab using two new lockwashers (2) and two cap screws (1).



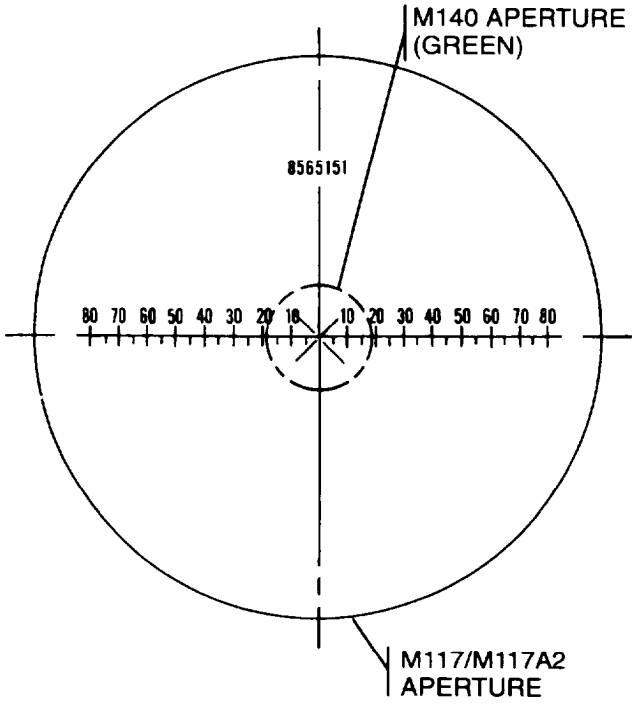
14-2.1 M140 ALINEMENT DEVICE MOUNT AND BRACKET (INDIRECT FIRE) — Continued

d. Installation – Continued

5 Install M140 alinement device (TM 9-2350-311-10).

6 With an observer viewing through the M117/M117A2 panoramic telescope, aline M140 alinement device mount (3) until the reticle of the M140 alinement device coincides with the M117/M117A2 panoramic telescope reticle, as shown, by loosening and tightening cap screws (1). Torque cap screws to 20-25 lb-ft (27-34 N·m) when alinement is met.

7 Remove M140 alinement device (TM 9-2350-311-10).

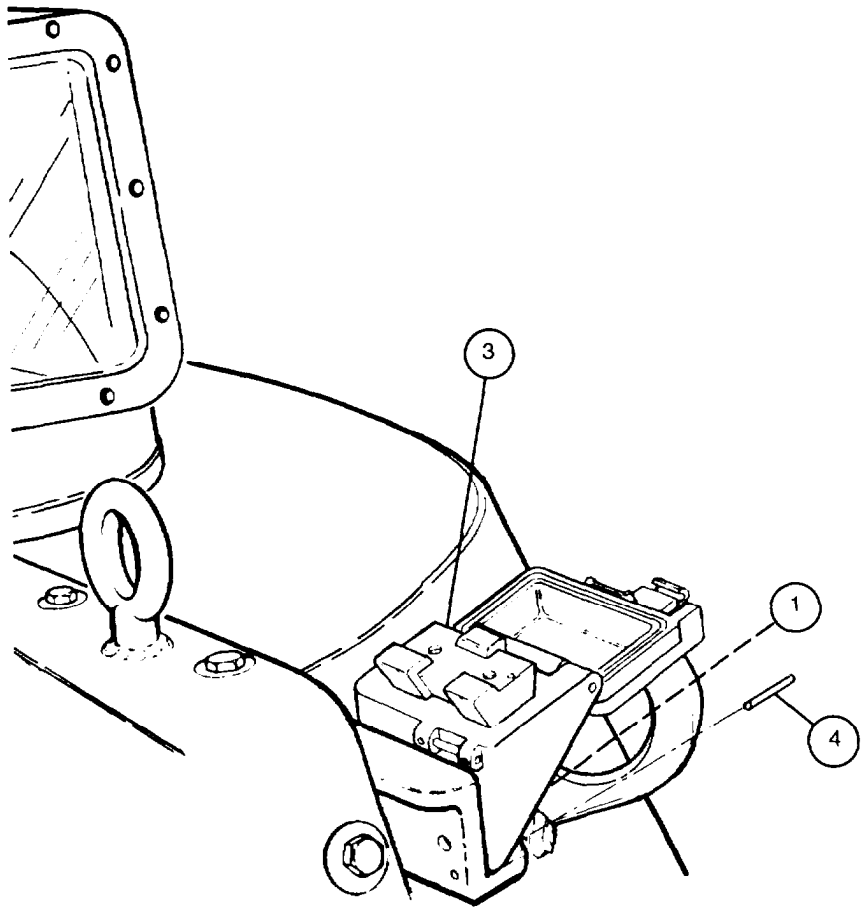


NOTE

Drill and ream holes for two headless straight pins if M140 alinement device is new.

8 If removed, install two headless straight pins (4).

9 Install M140 alinement device (TM 9-2350-311-10) and recheck coincidence of reticles which must be within 0.25 mils.



14-3 ACTUATOR ASSEMBLY

This task covers: a. Disassembly
b. Inspection and Repair
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Lockwire (V) (item 36, Appx E)
Spring pin (item 7, Appx E)
Spring pin (item 9, Appx E)

References
TM 9-214

Equipment Condition
Actuator and follower assembly removed (para 5-14)

a. Disassembly

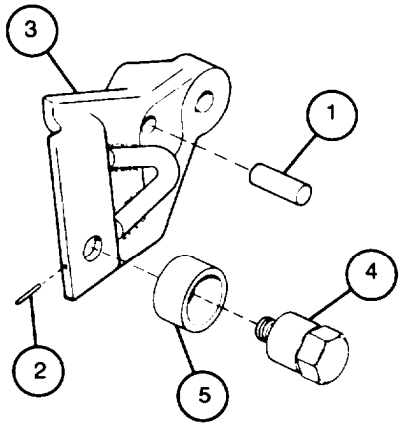
NOTE

Disassemble cam assembly lever only if required.

1 Remove headless straight pin (1), if necessary for replacement.

2 Remove spring pin (2) from lever (3) and discard.

3 Remove shoulder bolt (4) and sleeve bearing (5).



4 Remove spring pin (6) and sleeve spacer (7) from gearshaft assembly (8). Discard spring pin.

5 Remove lockwire (9) and six cap screws (10) from access cover (11). Discard lockwire.

6 Withdraw gearshaft (12) from housing assembly (13).

7 Remove two sleeve bearings (14) from access cover (11), if necessary for replacement.

8 Note matching arrows (15) on gearshaft (12) and bevel gearshaft (16).

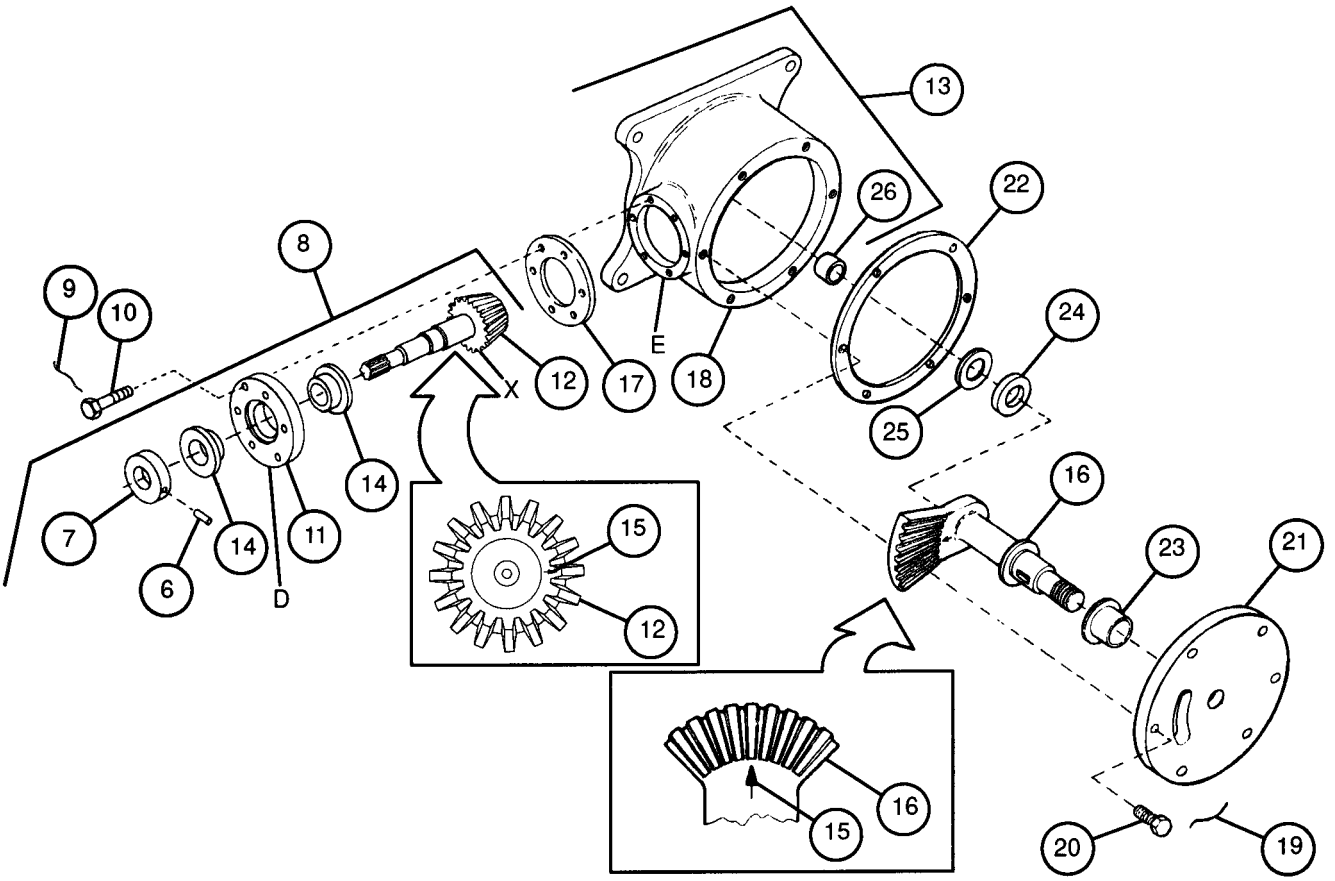
9 Remove shim(s) (17), if any. Measure thickness. Note dimension D etched on access cover (11), dimension X etched on gearshaft (12) and dimension E etched on actuator housing (18).

10 Remove lockwire (19) and six cap screws (20). Discard lockwire.

NOTE

Retain shims unless new components are to be installed.

11 Remove actuator cover (21), shim (22), sleeve bearing (23), bevel gearshaft (16), thrust washer bearing (24), shim(s) (25), and sleeve bearing (26) from actuator housing (18).



14-3 ACTUATOR ASSEMBLY - CONTINUED

b. Inspection and Repair

1 Measure inside diameter of two sleeve bearings (14). Replace if inside diameter is greater than 1.0005 inches (2.541 cm) (installed in pairs and reamed).

2 Inspect gearshaft (12). Replace if cracked or distorted. Measure outside diameter of bearing journal. Replace if outside diameter is less than 0.9995 inch (25.39 mm).

3 Inspect actuator housing (18). Replace if cracked or distorted.

4 Measure inside diameter of sleeve bearing (26). Replace if inside diameter is greater than 1.001 inches (2.543 cm) (installed and reamed).

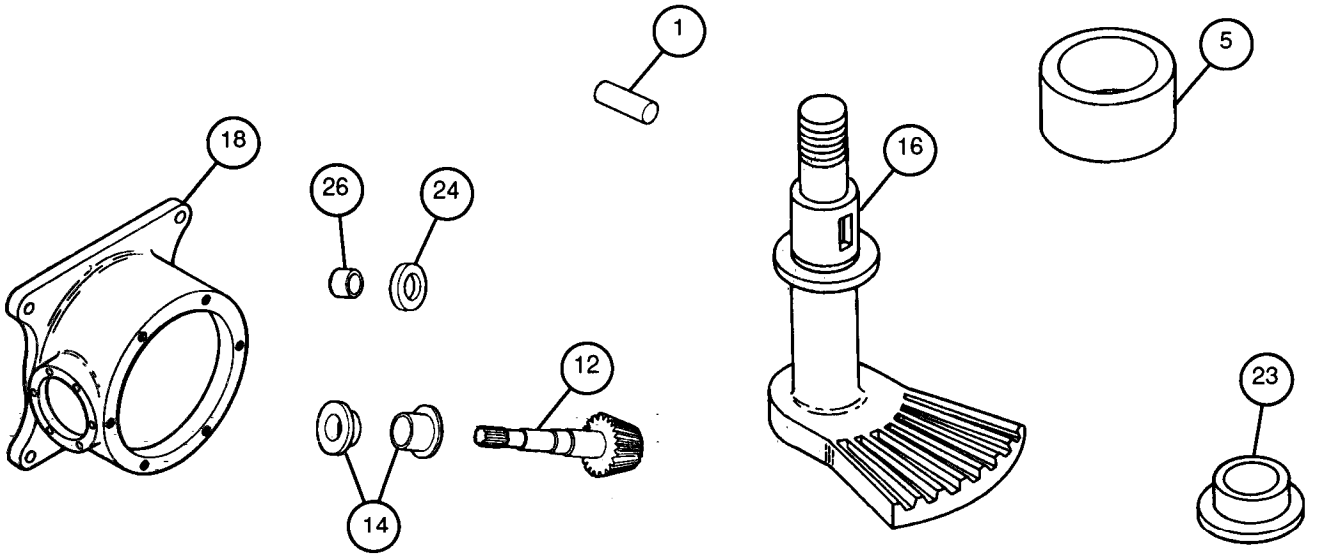
5 Measure thickness of thrust washer bearing (24). Replace if thinner than 0.12 inch (3.05 mm).

6 Inspect bevel gearshaft (16). Replace if cracked or distorted. Measure outside diameter of bearing journals. Replace if outside diameter is less than 0.998 inch (25.35 mm). Measure housing end and cover end. Replace if outside diameter is less than 1.123 inches (2.852 cm).

7 Measure inside diameter of sleeve bearing (23). Replace if inside diameter is greater than 1.126 inches (2.86 cm).

8 Inspect headless straight pin (1). Replace if worn or damaged.

9 For proper cleaning, inspection, and lubrication procedures for sleeve bearing (5), refer to TM 9-214.



c. Assembly

1 To determine dimension A for shim(s) (25), assemble thrust washer bearing (24) to bevel gearshaft (16). Measure dimension G and add to dimension XX (etched on bevel gearshaft). Subtract sum of G and XX from F (smaller dimension etched on actuator housing (18)). Formula is as follows: F - (G + XX) = dimension A, which is the required shim thickness.

2 Install required shim(s) (25) between sleeve bearing (26) and bevel gearshaft (16) with thrust washer bearing (24) and sleeve bearing (23) attached and insert into actuator housing (18).

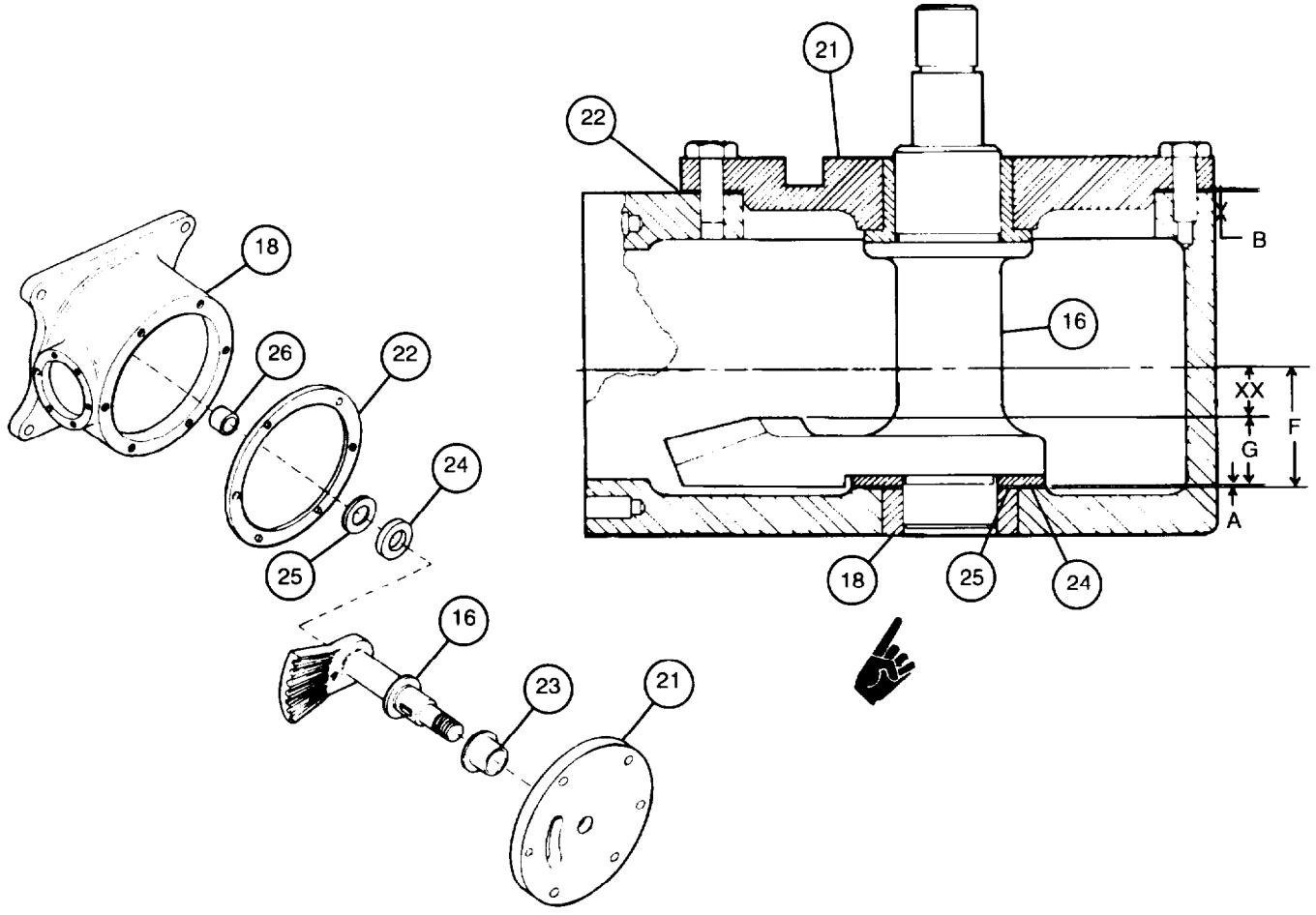
3 Assemble sleeve bearing (26), shim(s) (25), thrust washer bearing (24), bevel gearshaft (16), sleeve bearing (23), and actuator cover (21) in actuator housing (18) to determine shim(s) (22) needed for dimension B.

NOTE

Make sure all components are seated firmly against each other.

4 Using feeler gage, measure distance B at several points around actuator cover (21). Measurement should not vary. Install shim(s) (22) between actuator housing (18) and actuator cover (21) to ensure fit equal to dimension B plus 0.002 to 0.004 inch (0.05 to 0.10 mm).

PART NUMBER	SHIM THICKNESS
10895660	0.001 inch (0.03 mm)
10895661	0.002 inch (0.05 mm)
10895662	0.005 inch (0.13 mm)



14-3 ACTUATOR ASSEMBLY — CONTINUED

c. Assembly – Continued

5 Install shim(s) (22) and actuator cover (21).

6 Install six cap screws (20) and new lockwire (19).

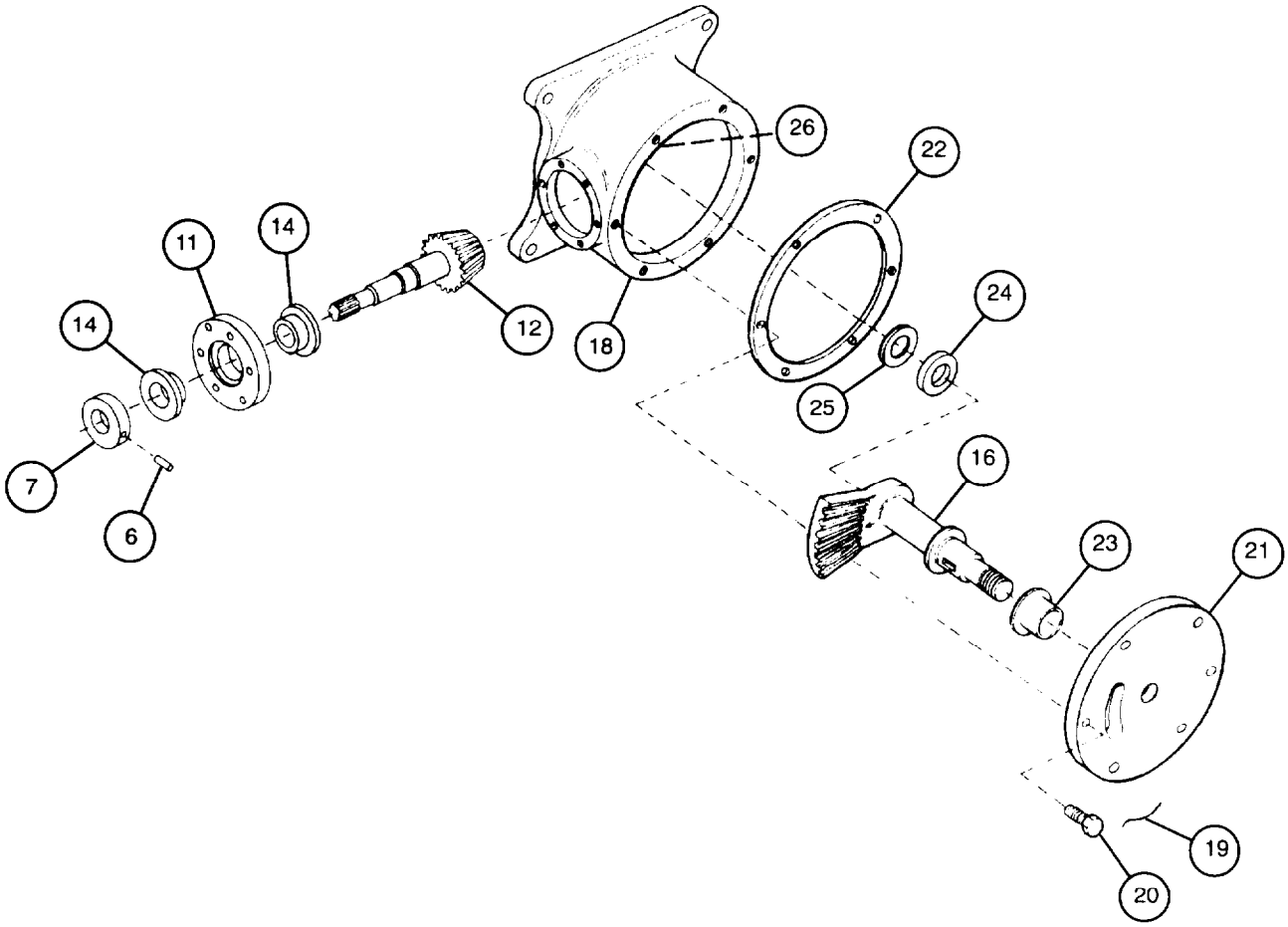
7 Install two sleeve bearings (14) in access cover (11) and install on gearshaft (12). Position sleeve spacer (7) on gearshaft to give 0.002 to 0.006 inch (0.05 to 0.15 mm) clearance between sleeve spacer and sleeve bearing.

NOTE

If gearshaft is new, perform step 8. Otherwise, skip to step 9.

8 Drill spring pin (6) hole in gearshaft (12).

9 Install spring pin (6) in sleeve spacer (7).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22
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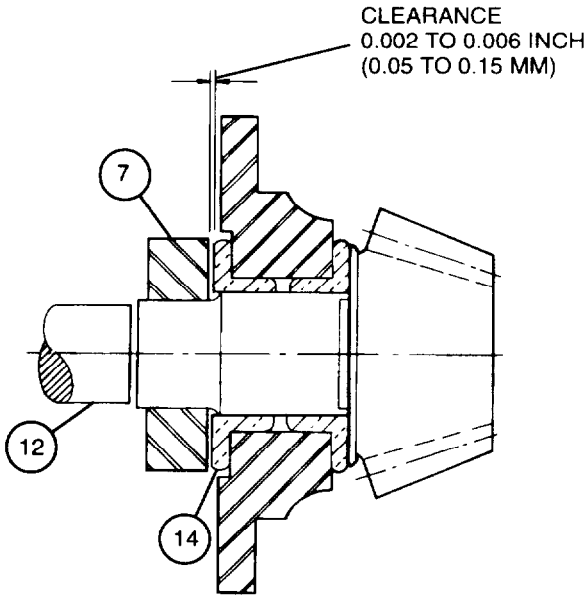

CLEARANCE
0.002 TO 0.006 INCH
(0.05 TO 0.15 MM)
7
12
14

14-3 ACTUATOR ASSEMBLY – CONTINUED

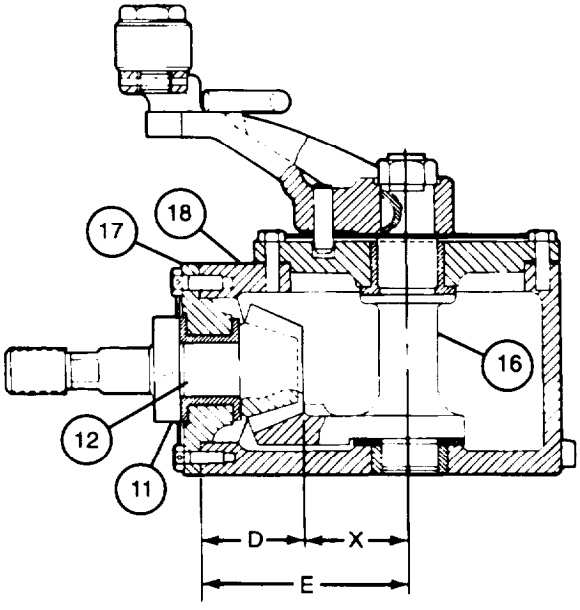
c. Assembly — Continued

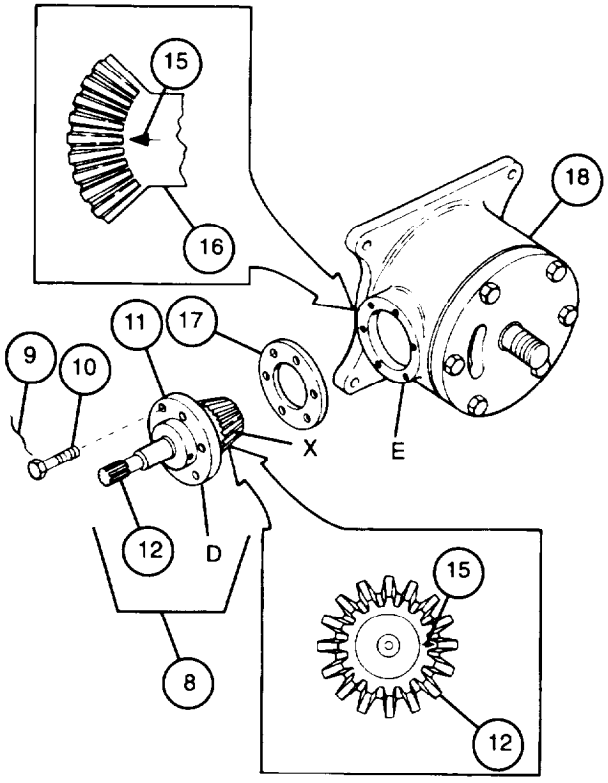
10 Backlash between gears should be 0.004 to 0.006 inch (0.10 to 0.15 mm). Determine shim(s) (17) required by adding dimension D etched on access cover (11) to dimension X etched on gearshaft (12) and subtracting dimension E etched on actuator housing (18) from sum ((D + X) - E = Required shims). Install required shim(s).

PART NUMBER	SHIM THICKNESS
10895666	0.001 inch (0.03 mm)
10895667	0.002 inch (0.05 mm)
10895668	0.005 inch (0.13 mm)

11 Install gearshaft assembly (8) in actuator housing (18) ensuring arrows (15) on gearshaft (12) and bevel gearshaft (16) match.

12 Install six cap screws (10) and new lockwire (9).



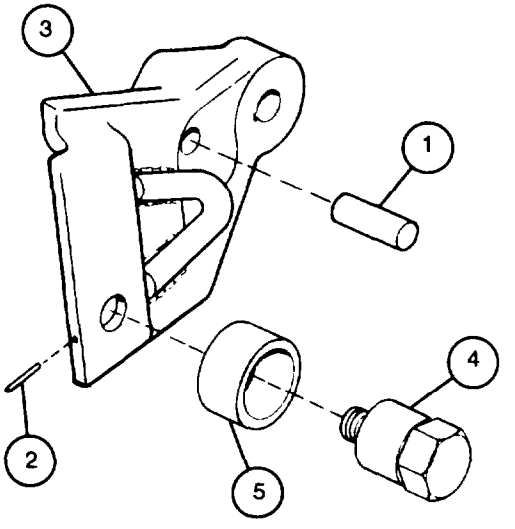


13 If installing a new shoulder bolt (4) or new lever (3), drill spring pin (2) hole in shoulder bolt and lever.

14 Install sleeve bearing (5) and shoulder bolt (4).

15 Install new spring pin (2) in lever (3).

16 Install new headless straight pin (1).



Section II. TRAVERSING MECHANISM ASSEMBLY

14-4 TRAVERSING MECHANISM ASSEMBLY

This task covers: a. Disassembly b. Inspection and Repair
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Artillery field maintenance tool kit (SC 4933-95-CL-A06)

Materials/Parts
Gasket (item 111, Appx E)
Gasket (item 119, Appx E)
Gaskets (2) (item 110, Appx E)
Key washer (item 29, Appx E)
Key washer (item 30, Appx E)
Key washer (item 31, Appx E)
Key washer (item 33, Appx E)
Key washers (2) (item 32, Appx E)
Lockwire (V) (item 36, Appx E)
Retaining ring (item 145, Appx E)
Retaining rings (2) (item 109, Appx E)
Sealing compound (item 29, Appx B)
Sealing compound (item 32, Appx B)
Seals (2) (item 170, Appx E)

Personnel Required
2

References
TM 9-214

Equipment Condition
Traversing mechanism assembly removed (para 9-1)

a. Disassembly

1 Remove six washer assembled bolts (1) and two access covers (2).

2 Remove two retaining rings (3), two spur gears (4), two seals (5), and two roller bearings (6). Discard seals and retaining rings.

3 Remove lockwire (7) and ten cap screws (8). Discard lockwire.

NOTE

If threaded holes exist on traversing mechanism upper housing, four cap screws, removed in step 3 can be inserted into these threaded holes to make separation of traversing mechanism upper and lower housing easier.

4 Separate traversing mechanism upper housing (9) from traversing mechanism lower housing (10).

5 Remove and discard gasket (11).

6 Remove ball bearing (12) from shouldered shaft (13).

7 Remove lockwire (14), setscrew (15), and block (16) from traversing mechanism upper housing (9). Discard lockwire.

8 Remove five cap screws (16.1) and adapter (17).

9 Remove gearshaft group (18) from traversing mechanism upper housing (9).

10 Straighten locking tabs on key washer (19).

NOTE

Retain shims unless new components are to be installed.

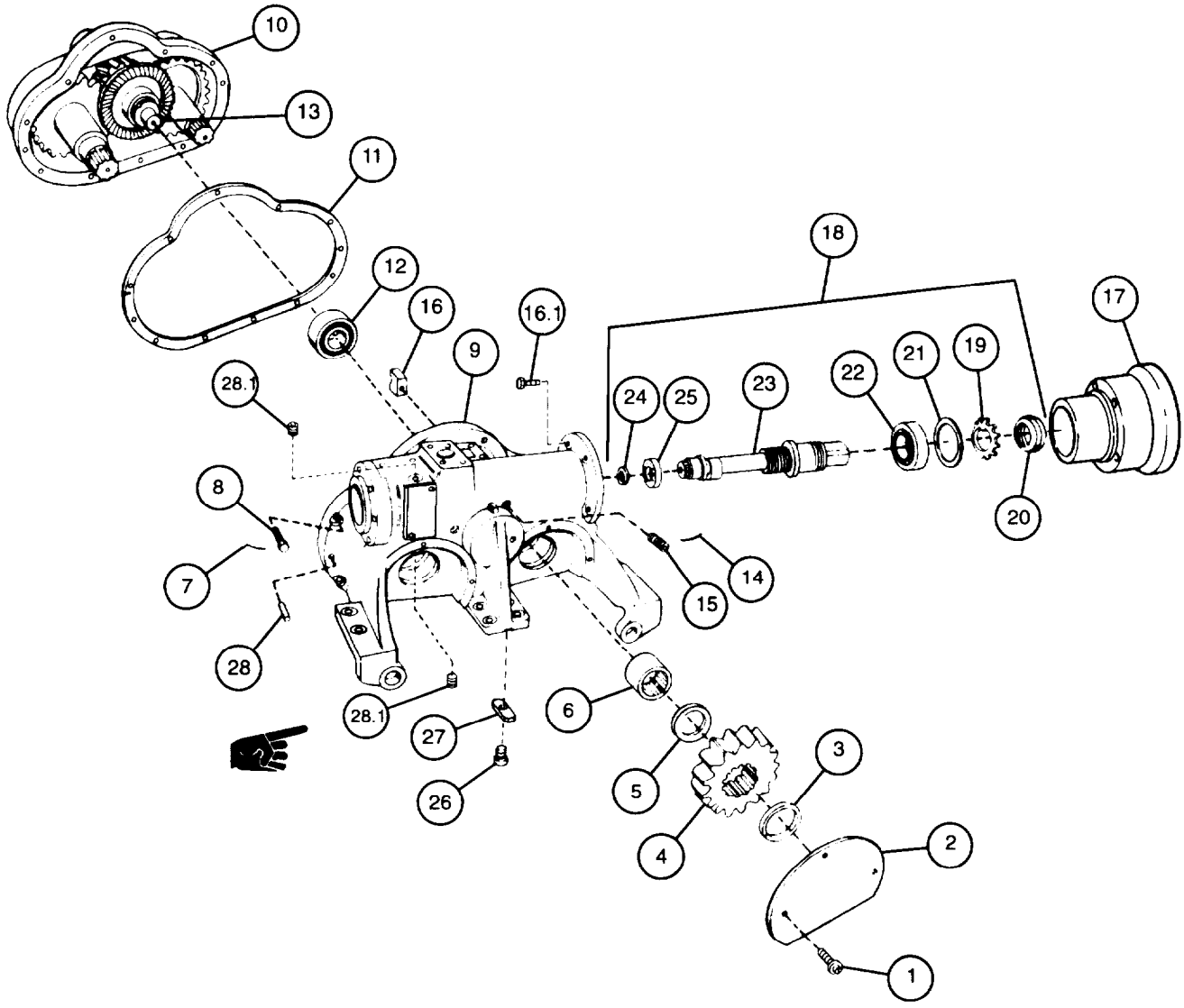
11 Remove round nut (20), key washer (19), shim(s) (21), and ball bearing (22) from gearshaft (23). Discard key washer.

12 Remove retaining ring (24) and ball bearing (25) from gearshaft (23). Discard retaining ring.

13 Remove cap screw (26) and machine key (27).

14 If necessary for replacement, remove headless straight pin (28).

14.1 If necessary for replacement, remove two plugs (28.1).



14-4 TRAVERSING MECHANISM ASSEMBLY — CONTINUED

a. Disassembly — Continued

15 Remove lockwire (29), four cap screws (30), (center) access cover (31), and gasket (32) from traversing mechanism lower housing (10). Discard lockwire and gasket.

16 Remove lockwire (33), 12 cap screws (34), and left and right access covers (35). Discard lockwire.

17 Remove and discard two gaskets (36).

18 Disengage tabs of key washer (37) from round nut (38).

19 Remove round nut (38) and key washer (37). Discard key washer.

NOTE

Retain shims unless new components are to be installed.

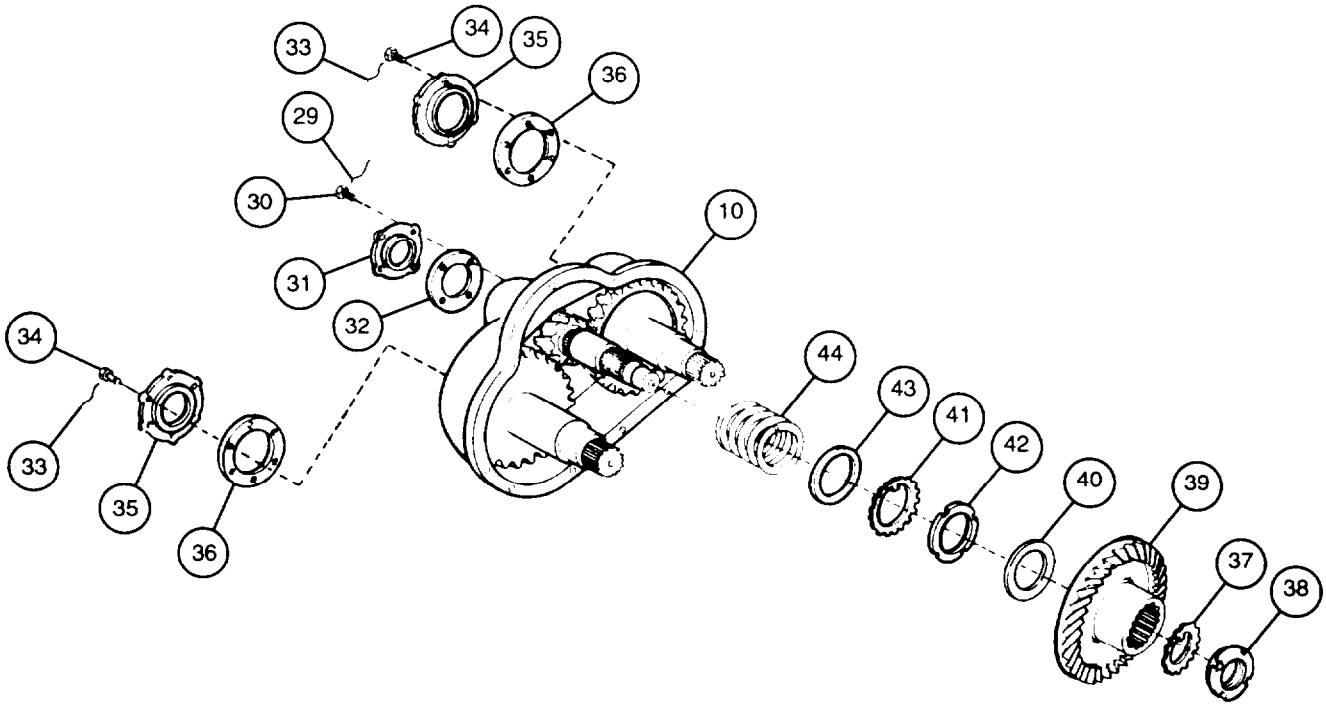
20 Remove bevel gear (39) and shim(s) (40)

21 Disengage tabs of key washer (41) from round nut (42).

WARNING

Helical compression spring is held under compression by round nut. To avoid injury, restrain helical compression spring while removing round nut.

22 Remove round nut (42), key washer (41), flat washer (43), and helical compression spring (44). Discard key washer.



23 Disengage tabs of two key washers (45) from two round nuts (46).

24 Remove two round nuts (46), two key washers (45), two ball bearings (47), and helical gearshaft (48). Discard key washers.

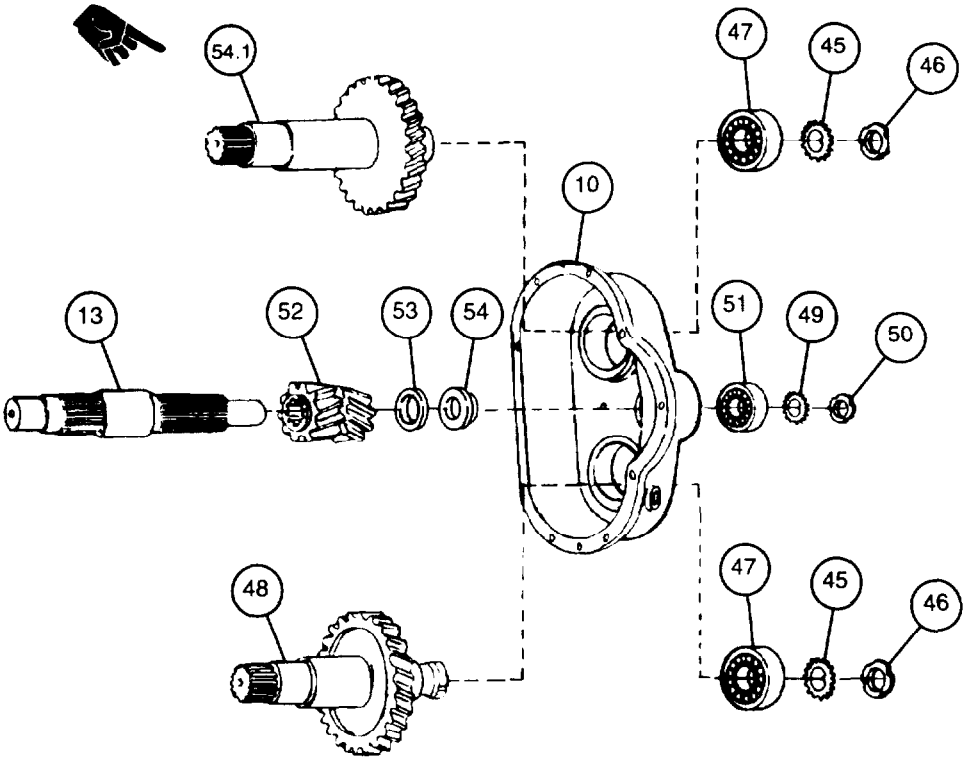
25 Disengage tabs of key washer (49) from round nut (50).

26 Remove round nut (50) key washer (49), and ball bearing (51). Discard key washer.

27 Withdraw shouldered shaft (13) from traversing mechanism lower housing (10).

28 Remove helical gear (52), shouldered washer (53) and ring spacer (54).

29 Remove helical gearshaft (54.1).



14-4 TRAVERSING MECHANISM ASSEMBLY - CONTINUED

b. Inspection and Repair

1 Inspect two spur gears (4). Replace if teeth are cracked or broken.

2 Inspect roller bearings (6) and ball bearings (12, 22, and 25) (TM 9-214).

3 Inspect gearshaft (23) and bevel gear (39). If teeth are cracked or broken, replace gearshaft and bevel gear as a matched set.

4 Inspect traversing mechanism upper housing (9). Replace if cracked.

5 Inspect setscrew (15). Replace if damaged.

6 inspect block (16). Replace if damaged or worn to less than 7/16 inch (11.125 mm).

7 Inspect ball bearings (47 and 51) (TM 9-214).

8 Inspect traversing mechanism lower housing (10). Replace if cracked.

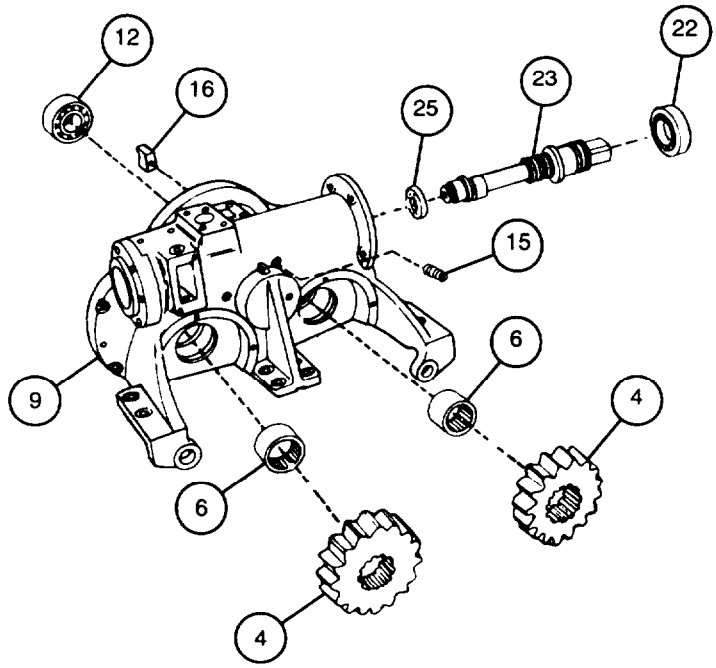
9 Inspect gear teeth of two helical gearshafts (48 and 54.1). Replace if teeth are cracked or broken.

10 Check backlash of helical gearshafts (48 and 54.1) with helical gear (52). Replace if backlash is greater than 0.010 inch (0.25 mm).

11 Inspect helical gear (52). Replace if teeth are cracked or broken.

12 Inspect threads and splines of shouldered shaft (13). Repair damaged threads. Replace if splines are cracked or broken.

13 Inspect helical compression spring (44). Replace if free standing length is not 2-7/8 in. (73.025mm), or if cracked, scratched, nicked, or distorted.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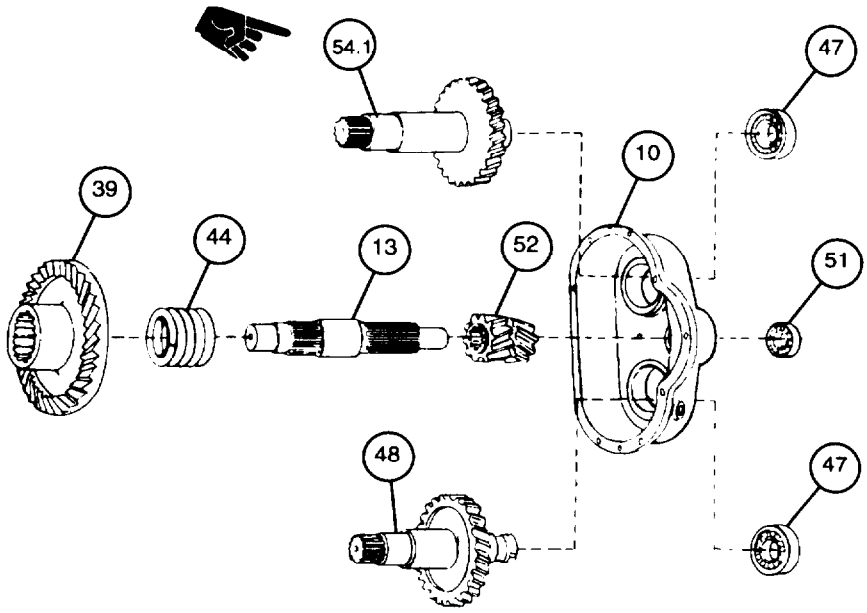
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14-4 TRAVERSING MECHANISM ASSEMBLY - CONTINUED

c. Assembly

1 Install helical gear (54.1) ball bearing (47) new key washer (45) and round nut (46).

1.1 Install helical gear (52) shouldered washer (53), and ring spacer (54) on shouldered shaft (13).

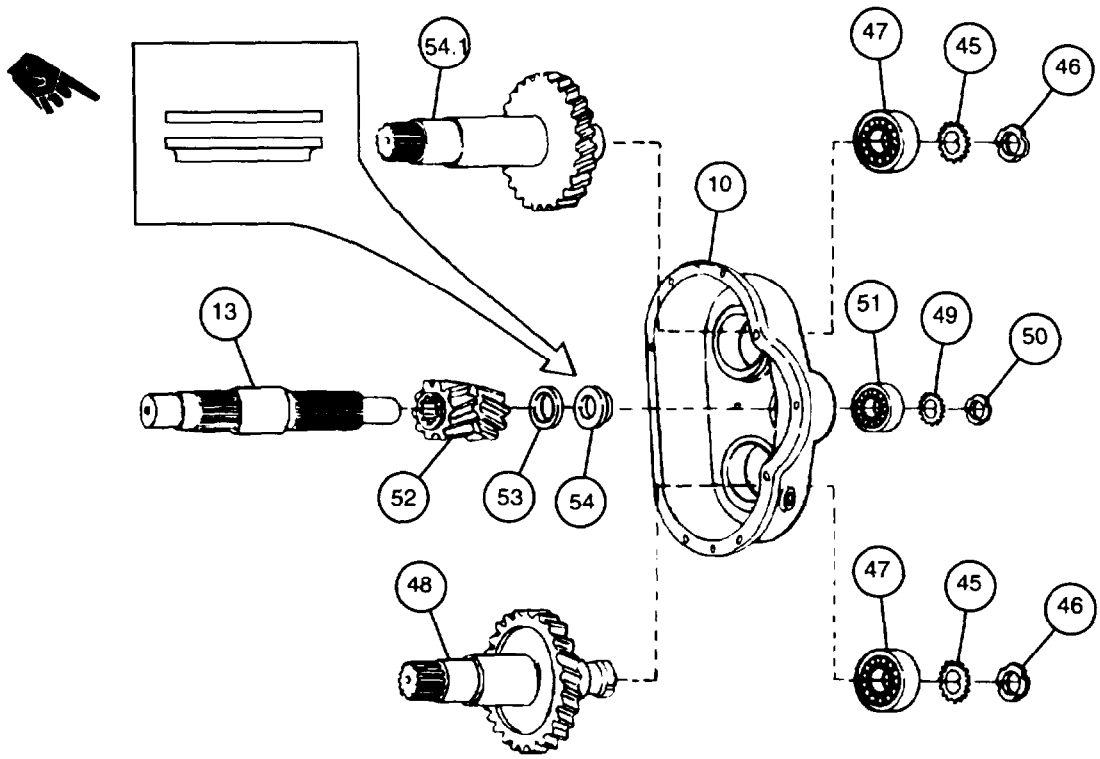
2 Install shouldered shaft (13) with assembled parts in traversing mechanism lower housing (10).

3 Install ball bearing (51) new key washer (49), and round nut (50).

4 Bend tabs of key washer (49) to secure round nut (50).

5 Install helical gearshaft (48), ball bearing (47) new key washer (45), and round nut (46).

6 Bend tabs of two key washers (45) to secure round nuts (46).



WARNING

Helical compression spring is held under compression by round nut. To avoid injury, restrain helical compression spring while installing round nut.

7 Install helical compression spring (44), flat washer (43), new key washer (41) and round nut (42). Tighten round nut until helical compression spring measures 1- 1 3/16 in. (46.037 mm).

8 Bend tabs of key washer (41) to secure round nut (42).

8.1 Check backlash of two helical gearshafts (48 and 54.1) with helical gear (52). Replace if backlash is greater than 0.010 inch (0.25 mm).

9 Install shim(s) (40). Required shim(s) = A + 0.003 inch (0.08 mm) - MD + X; where A is stamped on traversing mechanism lower housing (10), MD is stamped or etched on bevel gear (39), and X is measured at assembly from top of lower housing gasket to top of shouldered shaft (13) below bevel gear.

10 Install bevel gear (39).

11 Install new key washer (37) and round nut (38).

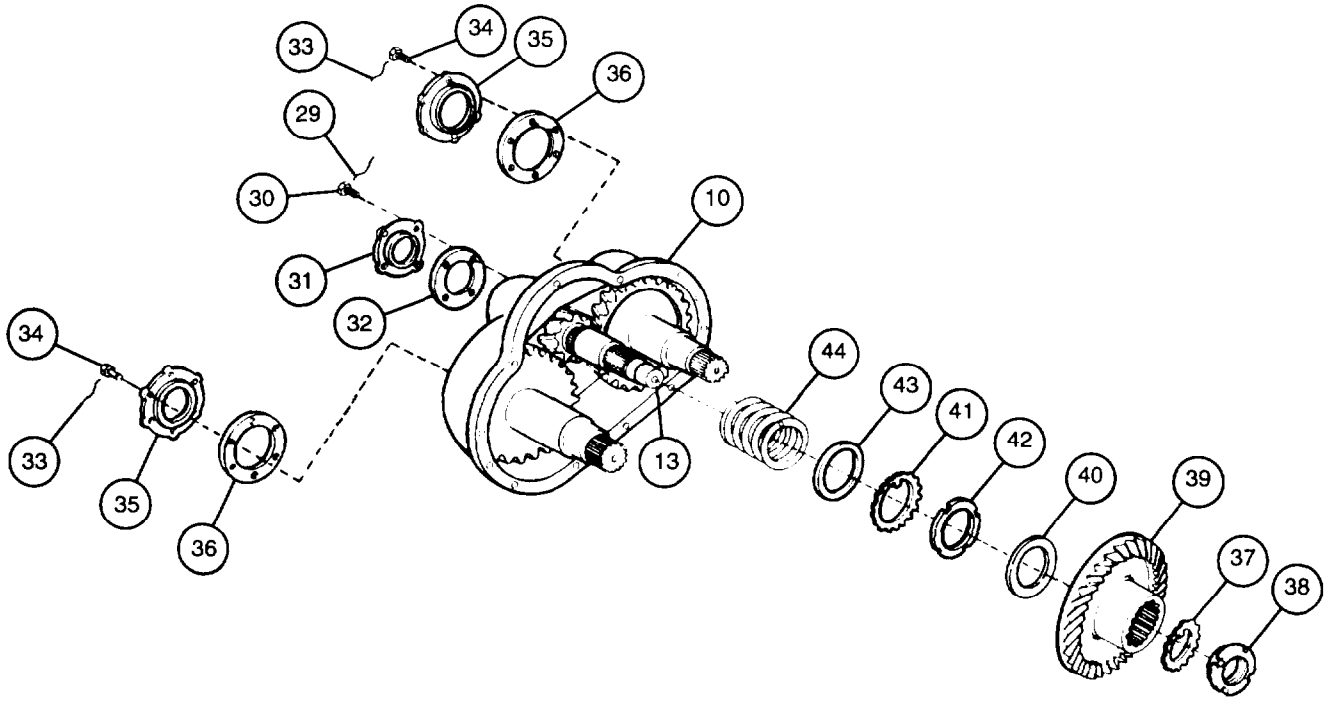
12 Bend tabs of key washer (37) to secure round nut (38).

13 Install two new gaskets (36), left and right access covers (35) and 12 cap screws (34).

14 Install new lockwire (33) to secure 12 cap screws (34) on left and right access covers (35).

15 Install new gasket (32), (center) access cover (31) and four cap screws (30).

16 Install new lockwire (29) to secure four cap screws (30) on (center) access cover (31).



14-4 TRAVERSING MECHANISM ASSEMBLY - CONTINUED

c. Assembly - Continued

NOTE

Preform step 16.1 if plugs were removed.

16.1 Apply sealing compound (item 29, Appx B) to two plugs (28.1) and install.

17 Install headless straight pin (28), if removed.

18 Install machine key (27) and cap screw (26).

19 install ball bearing (25) and new retaining ring (24) on gearshaft (23).

20 Install ball bearing (22), shim(s) (21) new key washer (19) and round nut (20) on gearshaft (23). Shim outer side of ball bearing as required to clamp outer race.

21 Bend tabs of key washer (19) to secure round nut (20).

22 Install gearshaft group (18) in traversing mechanism upper housing (9).

23 Install adapter (17) and five cap screws (16.1).

24 Install block (16) and setscrew (15) in traversing mechanism upper housing (9). Adjust setscrew so that block allows gearshaft (23) to move with slight drag.

25 Secure setscrew (15) with new lockwire (14).

26 Install ball bearing (12) on shouldered shaft (13).

27 Install new gasket (11) on traversing mechanism lower housing (10). If gasket does not match shape of housing well, it may be restored to proper contour by dipping in hot water for one to two minutes. Pat gasket dry and install on lower housing assembly. Repeat as necessary.

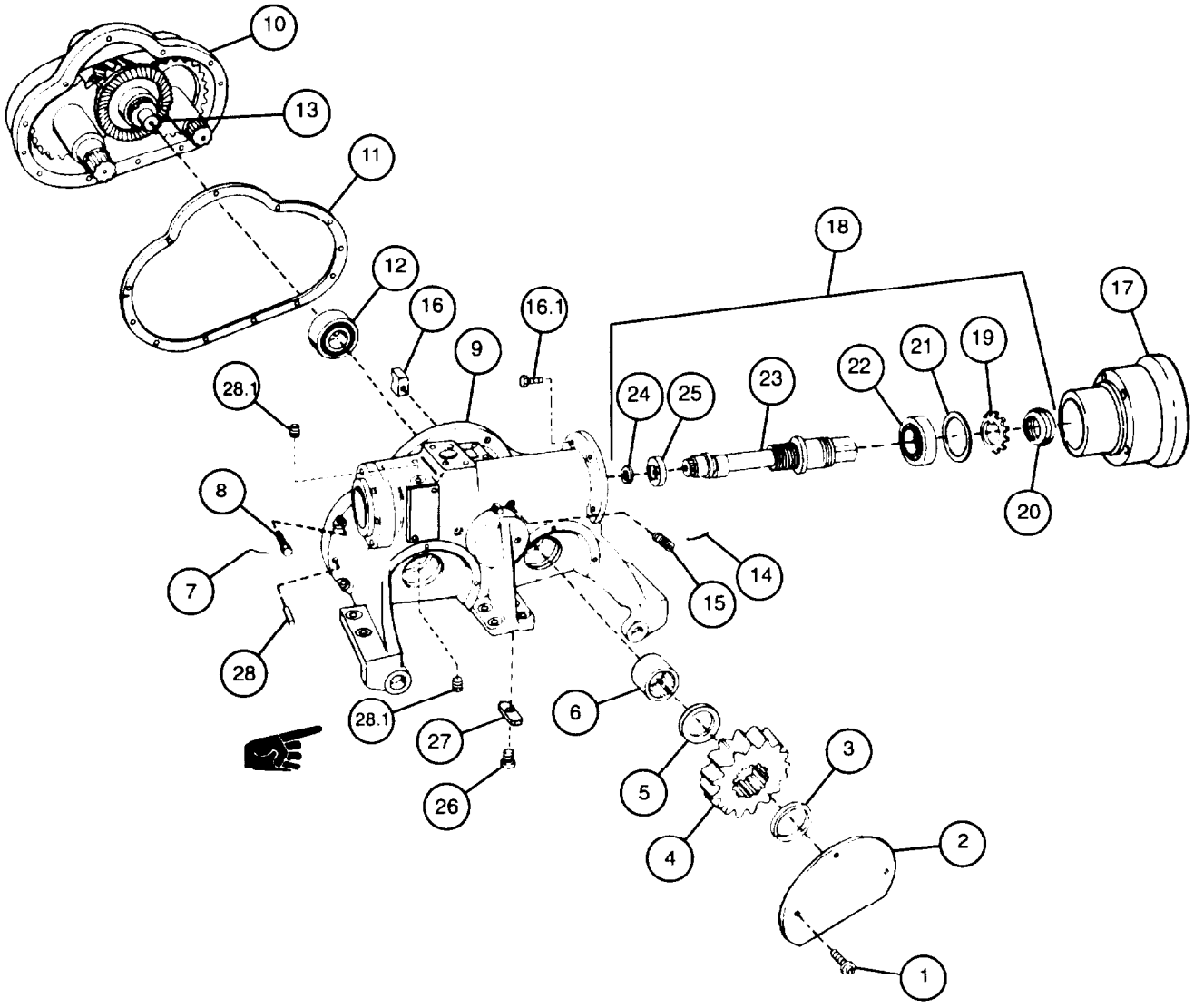
28 While ensuring gear teeth mesh correctly, secure traversing mechanism upper housing (9) to traversing mechanism lower housing (10) using ten cap screws (8). Check backlash between bevel gear (39) and gearshaft (23). If backlash exists, shim as required.

29 Install new lockwire (7) to secure ten cap screws (8).

30 Apply sealing compound to two new seals (5).

31 Install two roller bearings (6), two seals (5), two spur gears (4), and two new retaining rings (3).

32 Install two access covers (2) and six washer assembled bolts (1).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14-5 HYDRAULIC MOTOR

This task covers: a. Disassembly b. Inspection
c. Assembly

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)

Materials/Parts
Lockwire (item 35, Appx E)

Motor seal replacement parts kit (item 147, Appx E)

Equipment Condition
Hydraulic motor with safety relief valve assembly removed (para 9-1)
Safety relief valve assembly removed from hydraulic motor (para 14-6)

a. Disassembly

1 Remove lockwire (1) and 12 cap screws (2) from seal and bearing retainer sleeve (3). Discard lockwire.

CAUTION

Do not allow the bearings of the hydraulic drive unit to become misalined or jammed in seal and bearing retainer sleeve.

NOTE

When removing seal and bearing retainer sleeve, use care to prevent the parts of the hydraulic drive unit from separating.

2 Remove seal and bearing retainer sleeve (3) and hydraulic drive unit (4) from housing assembly (5).

3 Remove seal (6) and preformed packing (7) from seal and bearing retainer sleeve (3). Discard seal and preformed packing.

4 If necessary for replacement, remove six drive screws (8), instruction plate (9), and identification plate (10).

5 If necessary for replacement, remove two tapping screws (11) and instruction plate (12).

b. Inspection

1 Inspect seal and bearing retainer sleeve (3). If cracked or broken, replace hydraulic motor (13).

2 Inspect housing assembly (5). If cracked or broken, replace hydraulic motor (13).

c. Assembly

1 Install new preformed packing (7) into groove around outside of seal and bearing retainer sleeve (3).

2 Install new seal (6) on seal and bearing retainer sleeve (3).

3 Install seal and bearing retainer sleeve (3) over bearings on hydraulic drive unit (4).

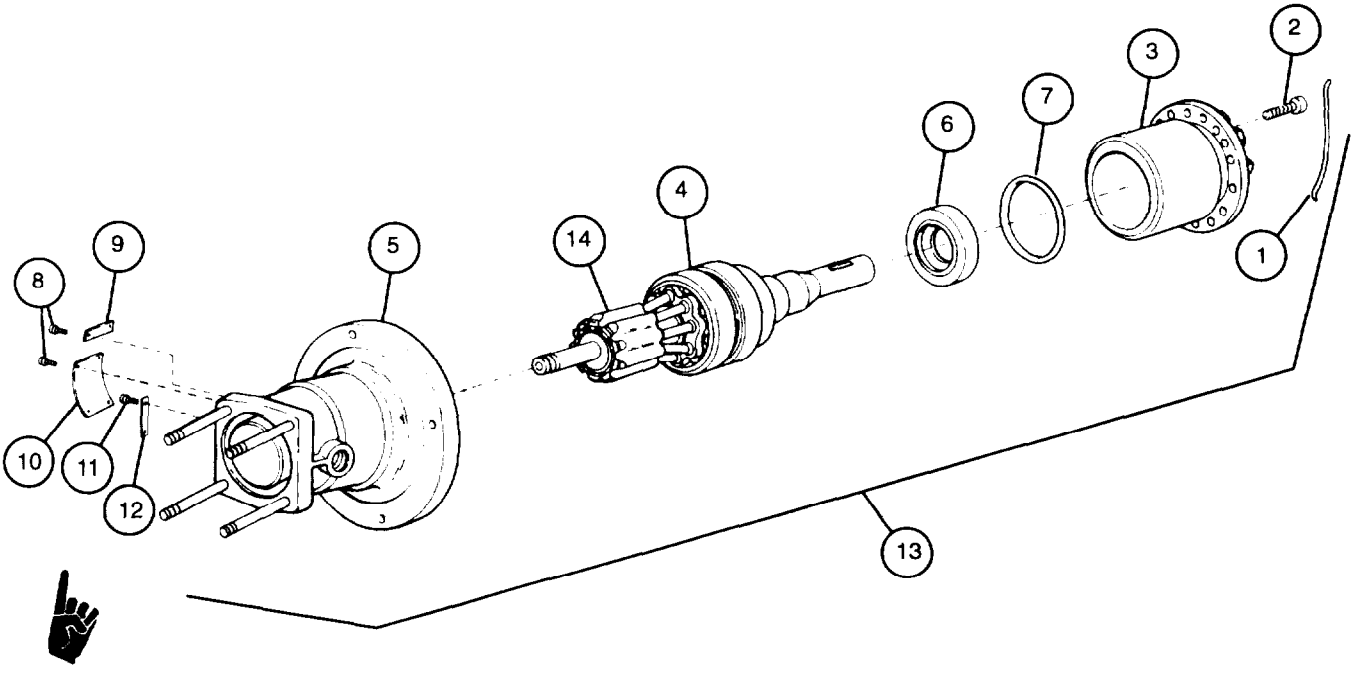
4 Carefully lower housing assembly (5) over hydraulic drive unit (4) while guiding cylinder block (14) along angle of housing assembly. When housing assembly reaches seal and bearing retainer sleeve (3) make sure it is squarely over seal and bearing retainer assembly to avoid misalining and jamming parts inside.

5 Install 12 cap screws (2) and torque to 12 in-lb (1.4 N.m).

6 Secure 12 cap screws (2) with new lockwire (1).

7 If necessary for replacement, install identification plate (10), instruction plate (9), and six drive screws (8).

8 If necessary for replacement, install instruction plate (12) and two tapping screws (11).



14-6 SAFETY RELIEF VALVE ASSEMBLY

This task covers:
a. Removal
b. Disassembly
c. Inspection
d. Assembly
e. Installation

INITIAL SETUP

Tools
Artillery and turret mechanic's tool kit (SC 5180-95-CL-A12)
Bolt, machine 1/4 - 20 x 2 inch long (item 2, Appx F)

Materials/Parts
Cloth (item 12, Appx B)
Hydraulic fluid (item 22, Appx B)
Lockwire (item 35, Appx E)
Motor seal replacement parts kit (item 147, Appx E)
Plastic bag (item 6, Appx B)
Preformed packings (2) (item 68, Appx E)

Personnel Required
2

Equipment Condition
Hydraulic motor with safety relief valve assembly removed (para 9-1)

References
MIL-STD-1949

a. Removal

NOTE

- The exterior of the safety relief valve assembly and hydraulic motor must be completely clean and dry before beginning removal of the relief valve plate.
- Removal of the relief valve plate must be performed only in a dust-free room with a filtered air supply. Personnel should coat hands with clean hydraulic fluid when handling relief valve plate.
- Because of the extremely smooth finish on the inside face of the relief valve plate, removal of the relief valve plate from the hydraulic motor housing assembly is not recommended unless it is necessary to service the internal parts of the hydraulic motor. To service the safety relief valve assembly parts, leave the relief valve plate attached to the hydraulic motor housing assembly and proceed to disassembly procedures (para 14-6b.).

1 Install a 1/4 - 20 x 2 inch long machine bolt in pin and bearing (1). Pull out on screw to compress safety relief valve assembly (2) helical compression spring (3).

2 Remove relief valve washer (4) and lockwire (5) from safety relief valve assembly (2) and discard.

3 Remove four plain nuts (6) from four studs (7).

NOTE

- The highly finished inside face of the relief valve plate must not be touched by bare hands. If relief valve plate must be stored or shipped, place finished face down on lint-free cloths saturated with clean hydraulic fluid and wrap in a plastic bag. Seal tightly to prevent the accumulation of moisture or dust.

- The pin and bearing must be held in place while the relief valve plate is removed. This prevents the cylinder block of the hydraulic motor (not visible in illustration) from adhering to the relief valve plate and being pulled from the pistons.

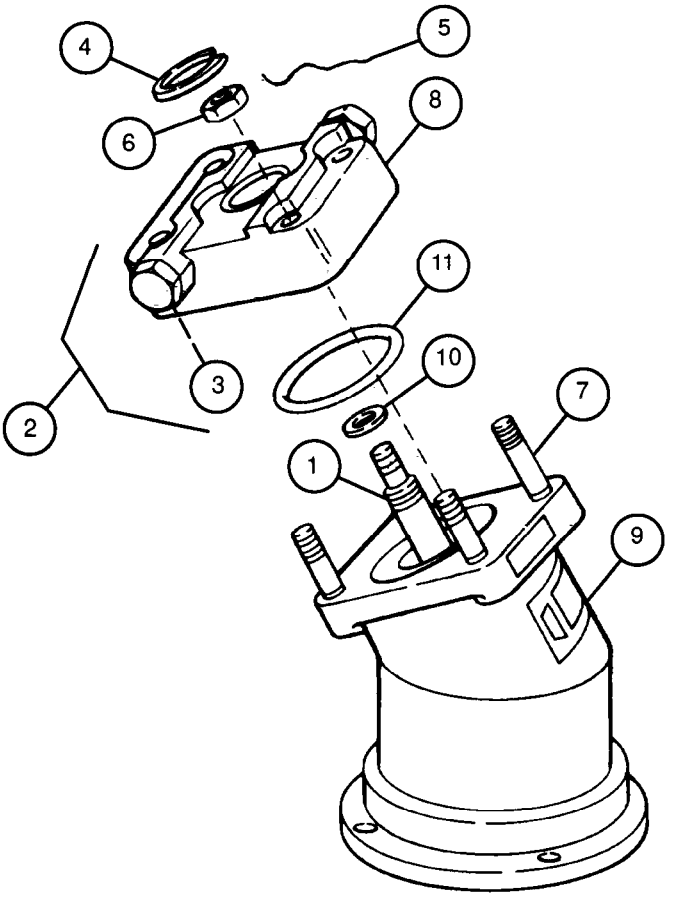
4 Exert a downward force with one hand on pin and bearing (1) while holding relief valve plate (8) with the other. Have an assistant hold housing assembly (9) firmly against top of stand. Pull up relief valve plate to remove it, all the while pressing down on pin and bearing.

NOTE

Do not remove the four studs from the hydraulic motor housing assembly.

5 Remove preformed packing (10) from pin and bearing (1). Discard preformed packing.

6 Remove preformed packing (11) from groove in housing assembly (9). Discard preformed packing.



14-6 SAFETY RELIEF VALVE ASSEMBLY - CONTINUED

b. Disassembly

WARNING

Helical compression spring is under a high compressive preload of 143 pounds (65 kg). Wear eye protection and make provision to contain parts when preload is released during disassembly by removal of plug to prevent injury.

CAUTION

To avoid damaging the finished inside surface of the relief valve plate, disassemble the safety relief valve assembly without removing the relief valve plate from the hydraulic motor housing assembly.

1 Remove plug (12).

2 Remove and discard preformed packing (13).

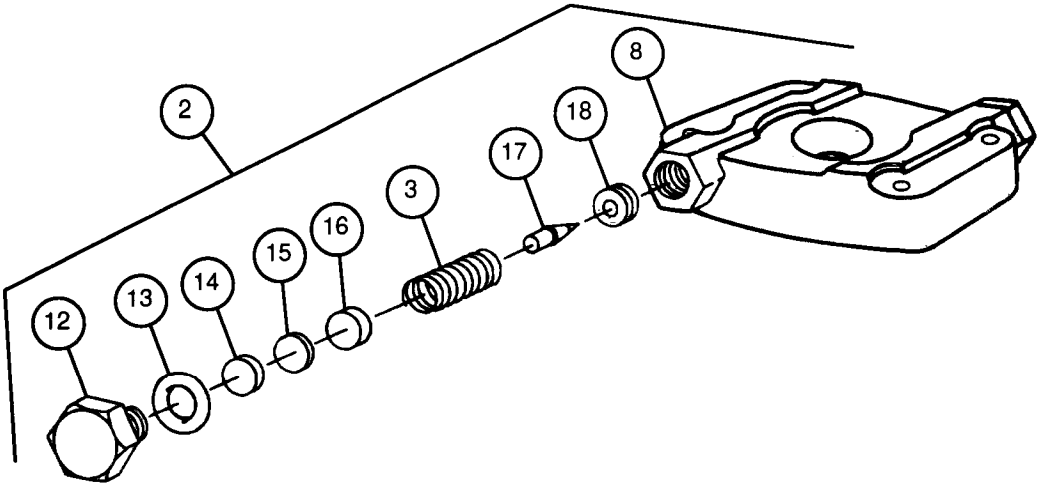
NOTE

Identify quantities and locations of solid discs (if present) for use again during assembly.

3 Remove solid discs (14 and 15), if present. Save solid discs for reuse in assembly.

4 Remove plate spacer (16), helical compression spring (3), valve piston (17), and relief valve seat (18) from relief valve plate (8).

5 Repeat steps 1 through 4 for remaining side of safety relief valve assembly (2).



c. Inspection

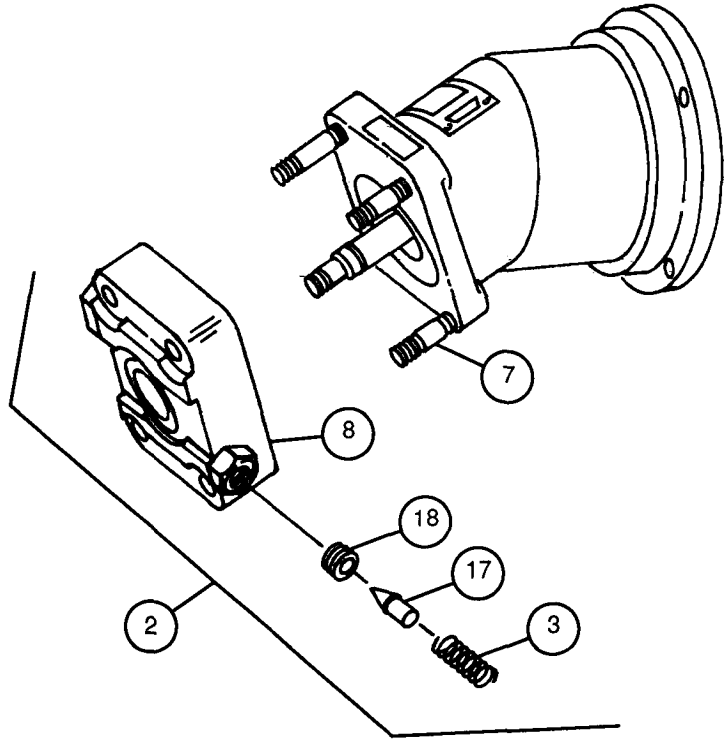
1 Inspect valve piston (17) and relief valve seat (18) for nicks, cracks, sharp chamfer, or any wear. Replace valve piston or relief valve seat if damaged.

2 Measure free length of helical compression spring (3). Replace if less than 1.24 inches (3.15 cm).

3 Inspect four studs (7). If four studs are missing, bent, broken, or have damaged threads, replace as required.

4 Inspect relief valve plate (8) for any visual sign of wear on the smooth finished inside surface. This surface will be highly polished and appear to be mirror-like. If damaged, replace safety relief valve assembly (2).

5 Make a magnetic particle inspection of the relief valve plate (8) (MIL-STD-1949).



14-6 SAFETY RELIEF VALVE ASSEMBLY - CONTINUED

d. Assembly

1 Install relief valve seat (18) and valve piston (17) in relief valve plate (8).

2 Install new preformed packing (13) on plug (12).

3 Position helical compression spring (3) on relief valve seat (18).

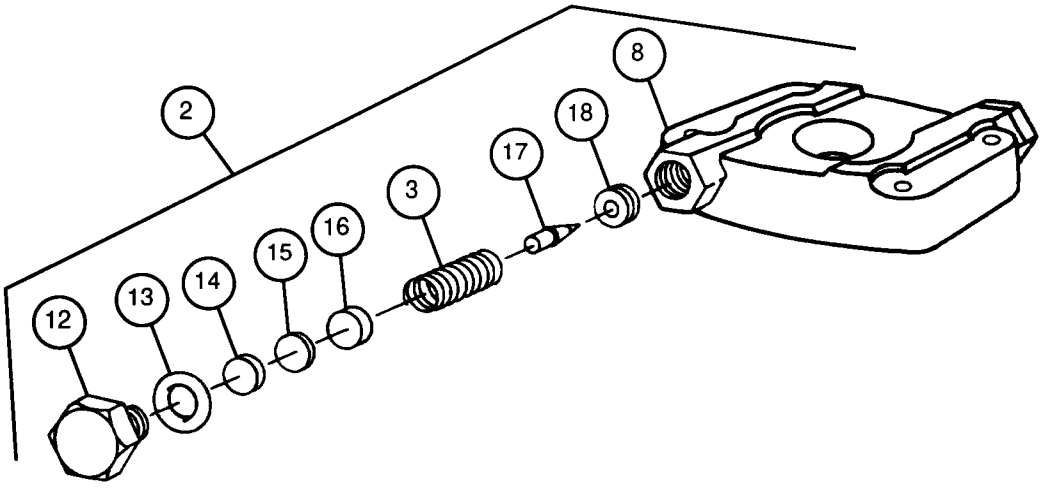
4 Install solid discs (14 and 15), if previously used, and plate spacer (16) on plug (12).

WARNING

Force required to compress helical compression spring is 143 pounds (65 kg). Wear eye protection and make provision to contain parts when compressing helical compression springs to prevent injury.

5 Install plug (12) with solid discs (14 and 15) and plate spacer (16), over end of helical compression spring (3). Compress helical compression spring and thread plug completely into relief valve plate (8).

6 Repeat steps 1 through 5 for remaining side of safety relief valve assembly (2).



e. Installation

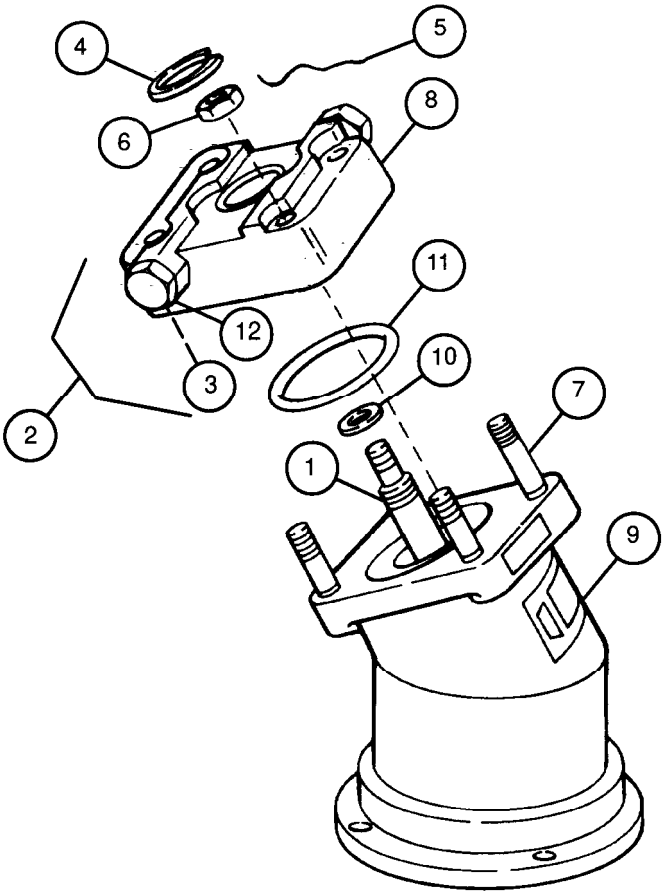
1 Install new preformed packing (10) in groove on pin and bearing (1).

2 Install new preformed packing (11) in groove in face of housing assembly (9).

3 Install relief valve plate (8) on housing assembly (9). Secure by installing four plain nuts (6) on four studs (7). Torque plain nuts to 18-20 lb-ft (24-27 N·m).

4 Secure four plain nuts (6) and two plugs (12) of safety relief valve assembly (2) with one continuous length of new lockwire (5).

5 Install a 1/4 - 20 x 2 inch long machine bolt in pin and bearing (1). Pull out on screw to compress safety relief valve assembly (2) helical compression spring (3) and install new relief valve washer (4).



APPENDIX A
REFERENCES

GENERAL

This appendix lists all pamphlets, forms, manuals, bulletins, regulations, supply catalogs, tables, and other references found in this manual. Appropriate indexes should be consulted frequently for latest applicable changes, revisions, and additions.

CONTENTS

A-1 PAMPHLETS

Consolidated Index of Publications and Blank Forms	DA PAM 25-30
Army Maintenance Management System (TAMMS) User's Manual	DA PAM 750-8
Functional Users Manual for the Army Maintenance Management System-Aviation (TAMMS-A)	DA PAM 738-751

A-2 FORMS

Accident Report	DA Form 285
Recommended Changes to Publications and Blank Forms	DA Form 2028
Weapon Record Data	DA Form 2408-4
Product Quality Deficiency Report	SF 368

A-3 MANUALS

NBC Protection	FM 3-4 (Superceded by FM 3-11.4)
First Aid for Soldiers	FM 4-25.11
Storage, Shipment, Handling, and Disposal of Chemical Agents and Hazardous Chemicals	TM 3-250

Inspection and Care of Bearings	TM 9-214
Welding Theory and Application Operator's Manual	TM 9-237 (Rescinded without replacement)
Materials Used in Cleaning	TM 9-247
General Maintenance Procedures for Fire Control Materiel	TM 9-254
Evaluation of Cannon Tubes	TM 9-1000-202-14
Direct Support and General Support Maintenance Manual Including Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools List) for Collimator Infinity Aiming Reference: M1A1 (Radioactive) (1240-00-332-1780)	TM 9-1240-324-34&P
Direct Support and General Support Maintenance Manual (Including Repair Parts and Special Tools and Depot Maintenance Repair Parts Lists) for Telescope Mount: M146 (1240-00-864-0348), Elbow Telescope: M118A2 (1240-01-092-2693), Elbow Telescope: M118A3 (1240-01-317-9241), Telescope Mount: M145 (1240-00-871-2969), Telescope Mount: M145A1 (1240-01-313-6842), Panoramic Telescope: M117 (1240-00-864-2930), Panoramic Telescope: M117A2 (1240-00-106-7754), Periscope: M42 (1240-00-864-2933), Linkage Assembly (1240-00-871-5475), and Linkage Assembly (1030-01-317-9117)	TM 9-1240-401-34&P
Direct Support and General Support Maintenance Manual for Quadrant, Fire Control: M15 NSN 1290-00-896-2236	TM 9-1290-322-34 (Superceded by TM 9-1240-401-34&P)
Direct Support and General Support Maintenance Repair Parts and Special Tools List for Fire Control Quadrant: M15 (NSN 1290-00-896-2236)	TM 9-1290-322-34P (Superceded by TM 9-1240-401-34&P)
Ammunition and Explosive Standards	TM 9-1300-206 (Rescinded without replacement)
Operator's Manual for Howitzer, Medium, Self-Propelled: 155MM, M109A2/M109A3/ M109A4/M109A5	TM 9-2350-311-10
Unit Maintenance Manual for Cab, Armament, Sighting and Fire Control, Elevating and Traversing Systems and Associated Components Howitzer, Medium, Self-Propelled 155mm M109A2 (2350-01-031-0586) (EIC:3EZ) M109A3 (2350-01-031-8851) (EIC:3E2), M109A4 (2350-01-277-5770) (EIC:3E8), M109A5 (2350-01-281-1719) (EIC:3E7)	TM 9-2350-311-20-2
Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Cab, Armament, Sighting and Fire Control, Elevating and Traversing Systems, and Associated Components Howitzer, Medium, Self-Propelled: 155MM M109A2 (NSN 2350-01-031-0586) (EIC:3EZ), M109A3 (NSN 2350-01-031-8851) (EIC:3E2), M109A4 (NSN 2350-01-277-5770) (EIC:3E8), M109A5 (NSN 2350-01-281-1719) (EIC:3E7)	TM 9-2350-311-24P-2

Direct Support and General Support Maintenance Manual for Hull, Powerplant, Drive Controls, Tracks, Suspension, and Associated Components Howitzer, Medium, Self-Propelled, 155mm, M109A2 (NSN 2350-01-031-0586) and Howitzer, Medium, Self-Propelled, M109A3 (NSN 2350-01-031-8851) and Howitzer, Medium, Self-Propelled: 155MM M109A4 (NSN 2350-01-277-5770) and Howitzer, Medium, Self-Propelled, 155mm, M109A5 (NSN 2350-01-281-1719)	TM 9-2350-311-34-1
Operator, Organizational, Direct Support and General Support Maintenance Manual (Including Repair Parts and Special Tools List) Alinement Device: M139 (4931-01-048-5834) and Alinement Device with Case: M140 (4931-01-187-9713)	TM 9-4931-710-14&P
Procedures for Destruction of Improved Conventional Munitions (ICM) to Prevent Enemy Use	TM 43-0002-33
Painting Instructions for Army Materiel	TM 43-0139
Destruction of Conventional Ammunition to Prevent Enemy Use	TM 750-244-5-1 (Superceded by TM 43-0002-33)
Procedures for Destruction of Tank Automotive Equipment to Prevent Enemy Use	TM 750-244-6

A-4 BULLETINS

Ammunition Surveillance Procedures	SB 742-1
Solder and Soldering	TB SIG 222
Exercising of Recoil Mechanisms and Equilibrators	TB 9-1000-234-13
Color, Marking, and Camouflage Painting	TB 43-0209

A-5 REGULATIONS

Notices, Instructions, and Report to Workers: Inspections	10 CFR Part 19
Standards for Protection Against Radiation	10 CFR Part 20
Reporting of Defects and Noncompliance	10 CFR Part 21
Malfunctions Involving Ammunition and Explosives	AR 75-1
Ionizing Radiation Protection	AR 385-11 (Superceded by AR 11-9)
Accident Reporting and Records	AR 385-40
Worldwide Ammunition Reporting System (WARS)	AR 700-22 Superceded by AR 700-19)
Army Logistics Readiness and Sustainability	AR 700-138
Army Materiel Maintenance Concepts and Policies	AR 750-1

A-6 SUPPLY CATALOGS

Consolidated Publication of Component Lists	SC 9999-01-SKO
Shop Equipment, Automotive Maintenance and Repair: Organizational Maintenance Common No. 2, Less Power	CL 4910-95-A72*
Shop Equipment, Automotive Maintenance And Repair: Organizational Maintenance Common No. 1, Less Power	CL 4910-95-A74*
Shop Equipment, Instrument and Fire Control Field Maintenance Less Power	CL 4931-95-A07*
Sets, Kits, and Outfits Component List for Tool Kit, Artillery: Field Maintenance Post, Camp and Station, Set A	CL 4933-95-A06*
Sets, Kits, and Outfits Component List for Shop Equipment, Artillery Maintenance: Field Maintenance, Set N, Less Power	CL 4933-95-A12*
Sets, Kits, and Outfits Components List for Artillery and Turret Mechanic's: Ordnance Tool Kit	CL 5180-95-A12*

A-7 TABLES

Army Medical Department Expendable/Durable Items	CTA 8-100
Expendable/Durable Items (Except: Medical, Class V, Repair Parts and Heraldic Items)	CTA 50-970
Modified Table of Organization and Equipment	MTOE

A-8 OTHER

Magnetic Particle Inspection	MIL-STD-1949
NRC License, License Conditions, and License Application (refer to warning page inside the front cover of the manual)	

*Contained in SC 9999-01-SKO, Consolidated Publication of Component Lists (EM0074)

APPENDIX B
EXPENDABLE AND DURABLE ITEMS LIST

CONTENTS

Section I. INTRODUCTION

B-1 SCOPE

This appendix lists expendable and durable items you will need to maintain the 155MM self-propelled howitzer at support level maintenance. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable 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 for referencing when required.

b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

C . . . . . Operator or Crew Maintenance
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 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)/Unit of Issue (U/I). This measure is expressed by a two-character alphabetical abbreviation (e.g. EA, IN, PR). If the unit of measure differs from the unit of issue as shown in the Army Master Data File (AMDF) requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE AND DURABLE ITEMS LIST

B-3 EXPENDABLE AND DURABLE ITEMS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) (U/M)/ (U/I
1	F	8040-00-165-8614	Adhesive: (81348) MMM-A-121	QT
2	F	8040-00-800-1811	Adhesive, epoxy: (22835) BB2902	KT
3	F	8040-00-270-8137	Adhesive, epoxy, type I: (81348) MMM-A-134	QT
4	0	8040-00-221-3811	Adhesive, reclaimed rubber, liquid, type II: (81348) MMM-A-1617	BT
5	F	8030-40-753-4953	Antiseizing compound: (81349) MIL-A-13881	LB
6	C	8105-00-269-4662	Bag, plastic: (81349) MIL-B-117	EA
7	0	8105-00-299-8532	Bag, plastic: (81348) PPP-B-26; 10 ea pkg	EA
8	F	9530-00-277-8537	Bar, metal (copper): (81346) ASTM B187	BR
9	0	8115-00-190-5020	Box, shipping: (81348) PPP-B-636; 10 ea pkg	EA
10	0		Cap and plug, dust protective: (81349) MIL-C-5501	EA
			Plugs:	
			Plug, threaded: (81349) M5501/	
		5340-00-804-1234	1-F2 ..... (.3125-24 UNF)	
		5340-01-167-3943	1-F3 ..... (.375-24 UNF)	
		5340-00-597-9433	1-F4 ..... (.4375-20 UNF)	
		5340-01-167-9321	1-F5 ..... (.500-20 UNF)	
		5340-00-82-1857	1-F6 ..... (.5625-18 UNF)	
		5340-00-804-1236	1-F8 ..... (.750-16 UNF)	
		5340-01-157-4193	1-F10 ..... (.875-14 UNF)	
		5340-00-804-1253	1-F16 ..... (1.3125-12 UNF)	
		5340-01-166-6861	1-F20 ..... (1.625-12 UNF)	
			Plug, threaded: (81349) M5501/	
		5340-01-206-5370	2-R2 ..... (.3125-24 UNF)	
		5340-00-804-1240	2-3 ..... (.375-24 UNF)	
		5340-01-154-2314	2-R4 ..... (.4375-20 UNF)	
		5340-01-154-7249	2-R5 ..... (.500-20 UNF)	
		5340-00-804-1243	2-6 ..... (.5625-18 UNF)	
		5340-01-142-3085	2-R8 ..... (.750-16 UNF)	
		5340-01-146-9729	2-R10 ..... (.875-14 UNF)	
		5340-01-138-2170	2-R12 ..... (1.0625-12 UNF)	
		5340-00-804-1222	2-16 ..... (1.3125-12 UNF)	
		5340-00-804-1225	2-20 ..... (1.625-12 UNF)	
			Cap and plug, Plug, non-threaded: (81349) M5501/	
			7-F2 (1/8 inch)	
		5340-01-065-9917	7-F4 ..... (1/4 inch)	
		5340-01-326-2579	7-F8 ..... (1/2 inch)	
		5340-00-804-0753	7-F21 ..... (1 inch)	
		5340-01-238-3768	7-F23 ..... (1 3/8 inch)	
		5340-01-194-3200	7-F25 ..... (1 1/2 inch)	

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) (U/M)/ (U/I)
10 (Cont)			Cap and plug, dust protective: (81349) MIL-C-5501 Plugs (Cont):	
			Cap, non-threaded: (81349) M5501/	
		5340-01-203-7790	9-F2 . . . . . (1/8 inch)	
		5340-00-804-7820	9-F3 . . . . . (5/32 inch)	
		5340-01-082-3003	9-F4 . . . . . (3/16 inch)	
		5340-01-107-7559	9-F5 . . . . . (1/4 inch)	
		5340-01-183-0961	9-F6 . . . . . (5/16 inch)	
		5340-01-170-6662	9-F7 . . . . . (3/8 inch)	
		5340-01-227-5837	9-F8 . . . . . (7/16 inch)	
		5340-01-187-8957	9-F9 . . . . . (1/2 inch)	
		5340-01-302-9269	9-F10 . . . . . (9/16 inch)	
		5340-00-827-0802	9-F11 . . . . . (5/8 inch)	
		5340-01-167-9312	9-F12 . . . . . (11/16 inch)	
		5340-01-044-2675	9-F13 . . . . . (3/4 inch)	
		5340-01-PAC-8660	9-F14 . . . . . (13/16 inch)	
		5340-00-597-4480	9-F15 . . . . . (7/8 inch)	
		5340-00-576-0780	9-F16 . . . . . (1.0 inch)	
		5340-01-215-0037	9-F17 . . . . . (1 1/8 inch)	
		5340-01-208-7825	9-F18 . . . . . (1 1/4 inch, .62 inch deep	
		5340-01-219-6760	9-F19 . . . . . (1 1/4) inch, 1.0 inch deep)	
			Cap, threaded: (81349) M5501/	
		5340-01-2 17-1 790	11-F2 . . . . . (.3125-24 UNF)	
		534040-515-0525	11-F3 . . . . . (.375-24 UNF)	
		5340-01-082-3004	11-F4 . . . . . (.4375-20 UNF)	
		5340-00-727-4774	11-F5 . . . . . (.50-20 UNF)	
		5340-00-664-0671	11-F6 . . . . . (.5625-18 UNF)	
		5340-01-167-9314	11-F7 . . . . . (.625-18 UNF)	
		5340-01-217-2324	11-F8 . . . . . (.625-24 UNF)	
		5340-01-097-8277	11-F9 . . . . . (.75-16 UNF)	
		5340-01-206-5372	11-F10 . . . . . (.75-20 UNF)	
		5340-01-097-8276	11-F11 . . . . . (.875-14 UNF)	
		5340-00-727-4778	11-F12 . . . . . (1.0625-12 UNF)	
		5340-01-PAC-8654	11-F13 . . . . . (1.125-18 UNF)	
		5340-00-598-6656	11-F14 . . . . . (1.250-18 UNF)	
		5340-00-727-4779	11-F15 . . . . . (1.3125-12 UNF)	
		5340-01-183-0976	11-F16 . . . . . (1.375-18 UNF)	
		5340-01-210-0511	11-F17 . . . . . (1.625-12 UNF)	
11	C	9150-01-053-6688	Cleaner, lubricant, preservative (CLP) grade 2: (81349) (MIL-L-63460)	GL
11.1	C		Cleaning compound, solvent - detergent: (OJVH6) PF DEGREASER	
		7930-01-328-2030	5 gal.	GL
		7930-01-328-4058	55 gal. drum	DR
12	0	5350-00-221-0872	Cloth, abrasive crocus, 50 sheets: (58536) A-A-1206	SH
13	C	7920-00-044-9281	Cloth, cleaning, low lint: (81349) MIL-G-85043	YD
14	F	8030-00-664-4017	Corrosion preventive (fingerprint remover): (81349) MIL-C-15074	QT
15			DELETED	
16	0	8010-00-141-7838	Enamel (olive drab): (81349) MIL-W-5044	GL
17	0	8010-01-193-0516	Enamel: (81349) MIL-P-53022	K-T
18	0	8010-01-350-4734	Enamel: (81349) MIL-C-22750	KT

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) (U/M)/ (U/I)
19	O	3439-00-009-8808	Flux, soldering: (81349) MILF14256	QT
20	C		Gloves, patient, exam: package of 100: (89875)	
		6515-01-150-2977	Size large, E-011	PG
		6515-01-150-2978	Size medium, E-012	PG
		6515-01-150-2976	Size small, E-010	PG
21	C	9150-01-197-7690	Grease, automotive art (GAA): (81349) M-10924-3-F	CN
21.1	C		Grease, general purpose (GGP): (81349) MIL-G-23549	
		9150-00-985-7316	1-3/4 lb CAN	CN
		9150-00-823-8047	35 LB CAN	CN
21.2	C		Grease, molybdenum disulfide for low and high temperatures (GMD): (81349) MIL-G-21164	
		9150-00-754-2595	1-3/4 lb CAN	LB
		9150-00-223-4004	6-1/2 lb can	LB
		9150-00-965-2003	35 lb can	CN
22	C	9150-00-935-9808	Hydraulic fluid, PET, OHT (98308) BRAYC0783C	GL
23	F	9150-00-231-6689	Oil, lubricating, Gen. PI. SPC: (81348) VVL800	QT
24	C	9150-01-035-5392	Oil, lubricating, gear (GO-80/90) 1 qt: (81349) MIL-L-2105 (use below 0° F)	QT
25	C	9150-01-035-5393	Oil, lubricating, gear (GO-80/90) 5 gal can: (81349) MIL-L-2105 (use below 0° F)	GL
26	C	7920-00-205-1711	Rag, wiping: (58536) A-A-531	LB
27	O	4020-00-741-3154	Rope: (81349) MIL-R-17343	RL
28	F	8030-00-275-8115	Sealing compound: (81349) MIL-S-11030	PT
29	O	8030-00-081-2333	Sealing compound, grade C, liquid, blue: (81349) MIL-S-22473	BT
30	F	8030-00-081-2286	Sealing compound, grade EV, liquid, purple: (81349) MIL-S-22473	BT
31	F	8030-00-551-1059	Sealing compound, type 2: (81349) MIL-S-45180	OZ
31.1	F	8030-00-142-9830	Sealing compound, type 2: (81349) MIL-S-46163	CC
32	H	8030-00-008-7207	Sealing compound, type 1-1/2: (81349) MIL-S-81733	PT
33	O	3439-01-094-3338	Solder, tin alloy: (81348) SN60WRAP1	OZ
34	O	5340-00-980-9277	Strap, webbing, tie-down, cargo, aircraft: (19207) 10900880	IN
35	O	5970-00-419-4291	Tape, insulation, electrical: (75037) 173-4INBLACK	RL
36	O	7510-01-146-7767	Tape, pressure sensitive: 2 inches, 5.08 cm wide, 60 yds (64.86 m): (81348) PPP-T-60	YD
37	F	5510-00-962-7141	Wooden block, 4 x 4: (81348) MM-L-736, type 1	IN

APPENDIX C
ILLUSTRATED LIST OF MANUFACTURED ITEMS

GENERAL

This appendix includes complete instructions for making items authorized to be manufactured or fabricated at direct and general support maintenance level.

All bulk materials needed for manufacture of an item are listed in notes on the illustrations.

CONTENTS

C-1 MANUFACTURED ITEMS LIST

C-2 MANUFACTURED ITEMS

NOTE

- All dimensions shown are in inches (mm).
- All welds 0.25 fillet.

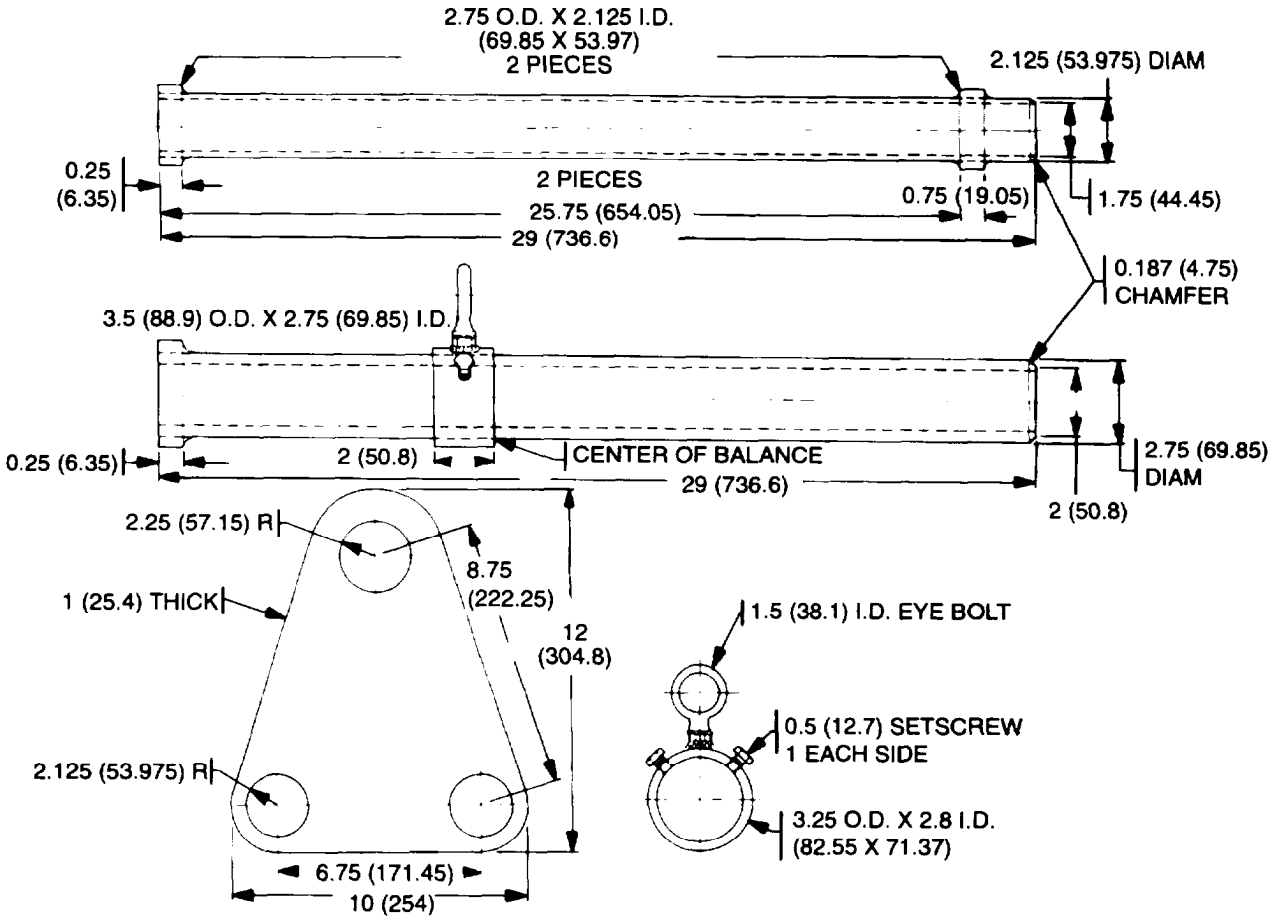


Figure C-1. Ammunition Rack Removal and Lifting Tool (Sheet 1 of 2)

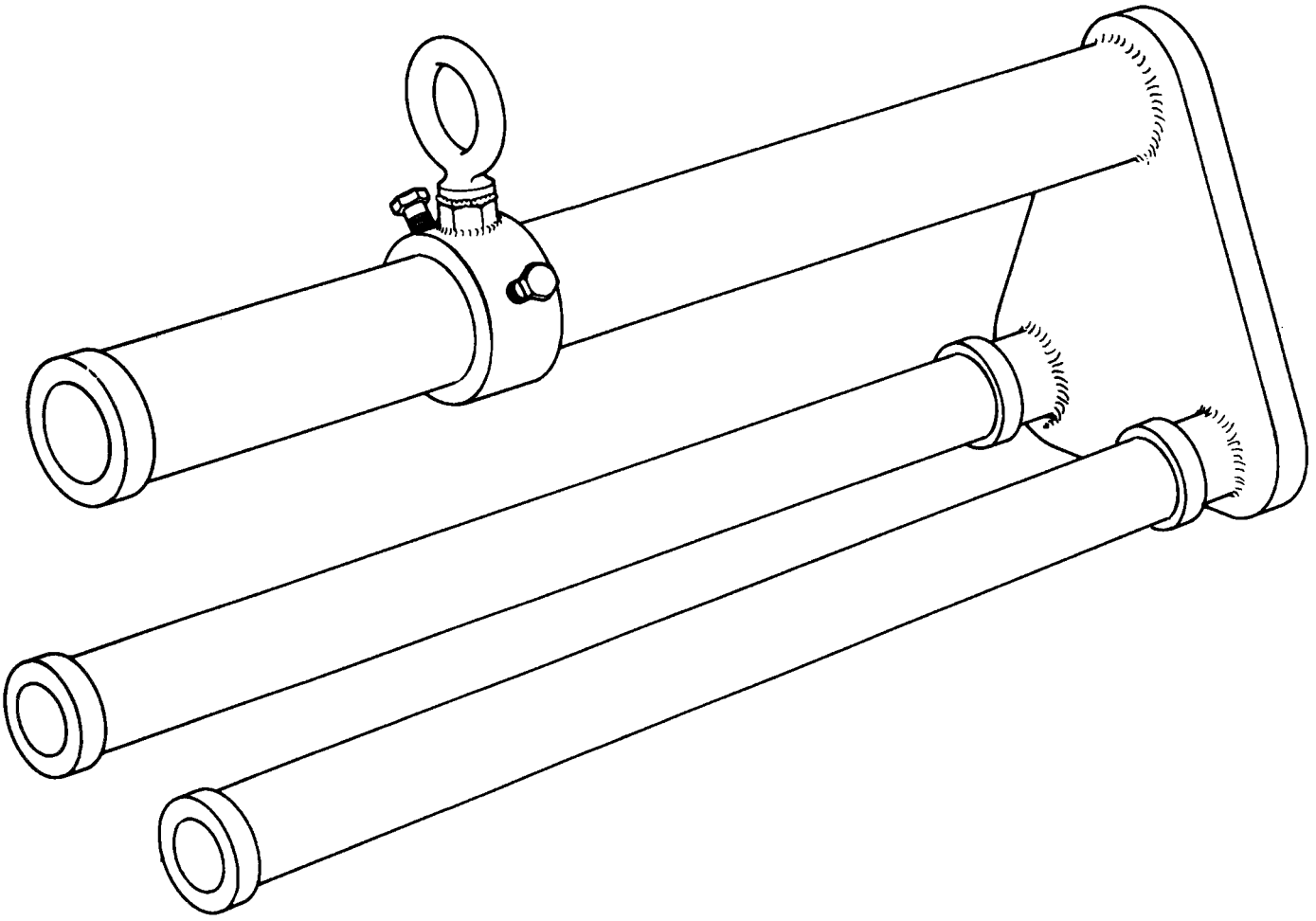


Figure C–1. Ammunition Rack Removal and Lifting Tool (Sheet 2 of 2)

C-2 MANUFACTURED ITEMS - CONTINUED

NOTE

All dimensions shown are in inches (mm).

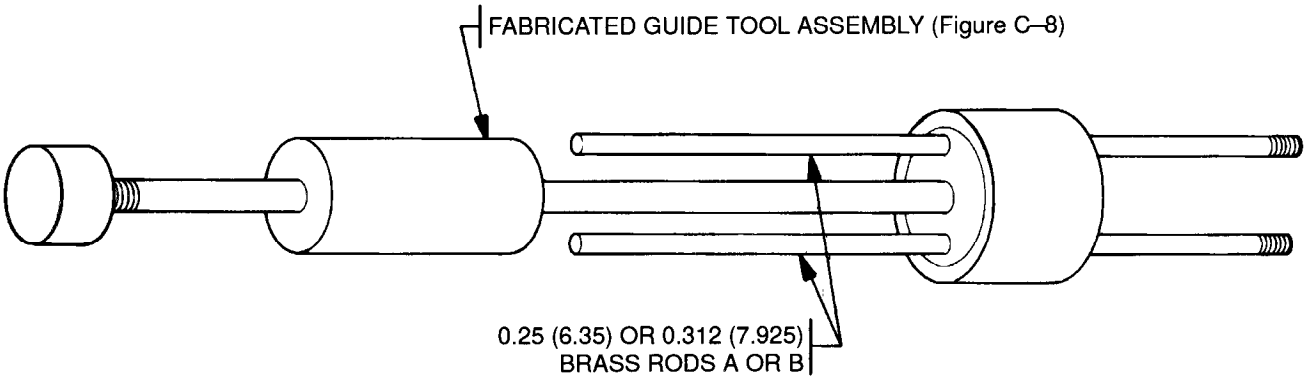
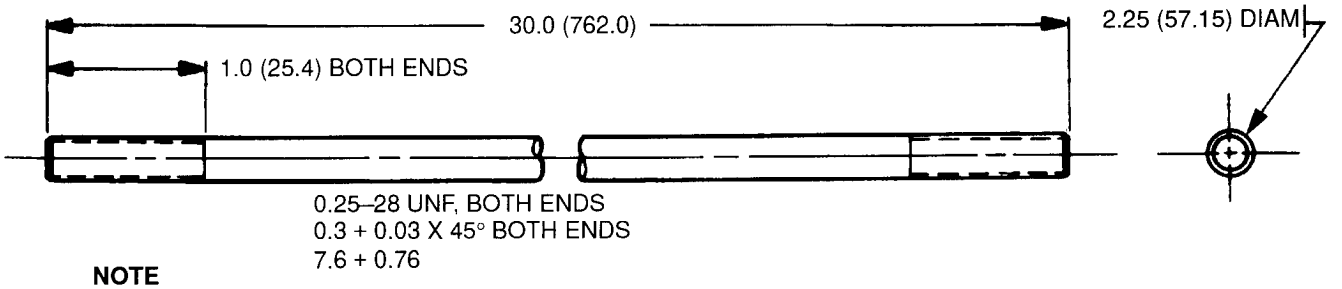


Figure C–2. Brass Guide Rods 5/16 Inch and 1/4 Inch (Sheet 1 of 2)

NOTE

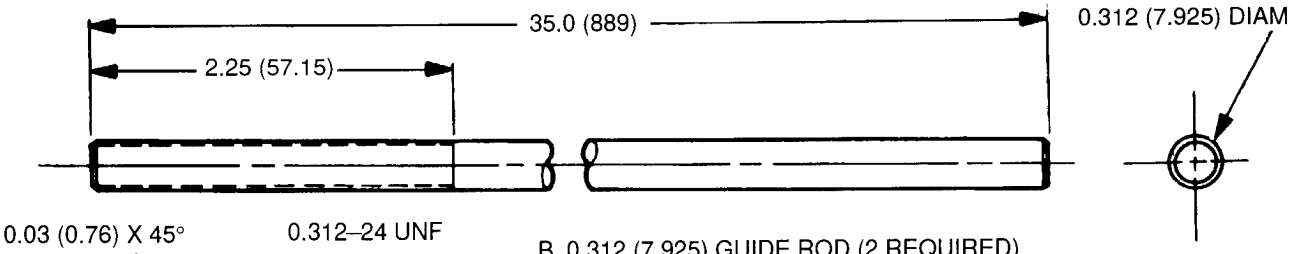
- All dimensions shown are in inches (mm).
- Materiel: brass, QQ-B–639.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27). Angles ± 5°.
- Finish 250 all over.



A. 0.25 (6.35) GUIDE ROD (2 REQUIRED)

NOTE

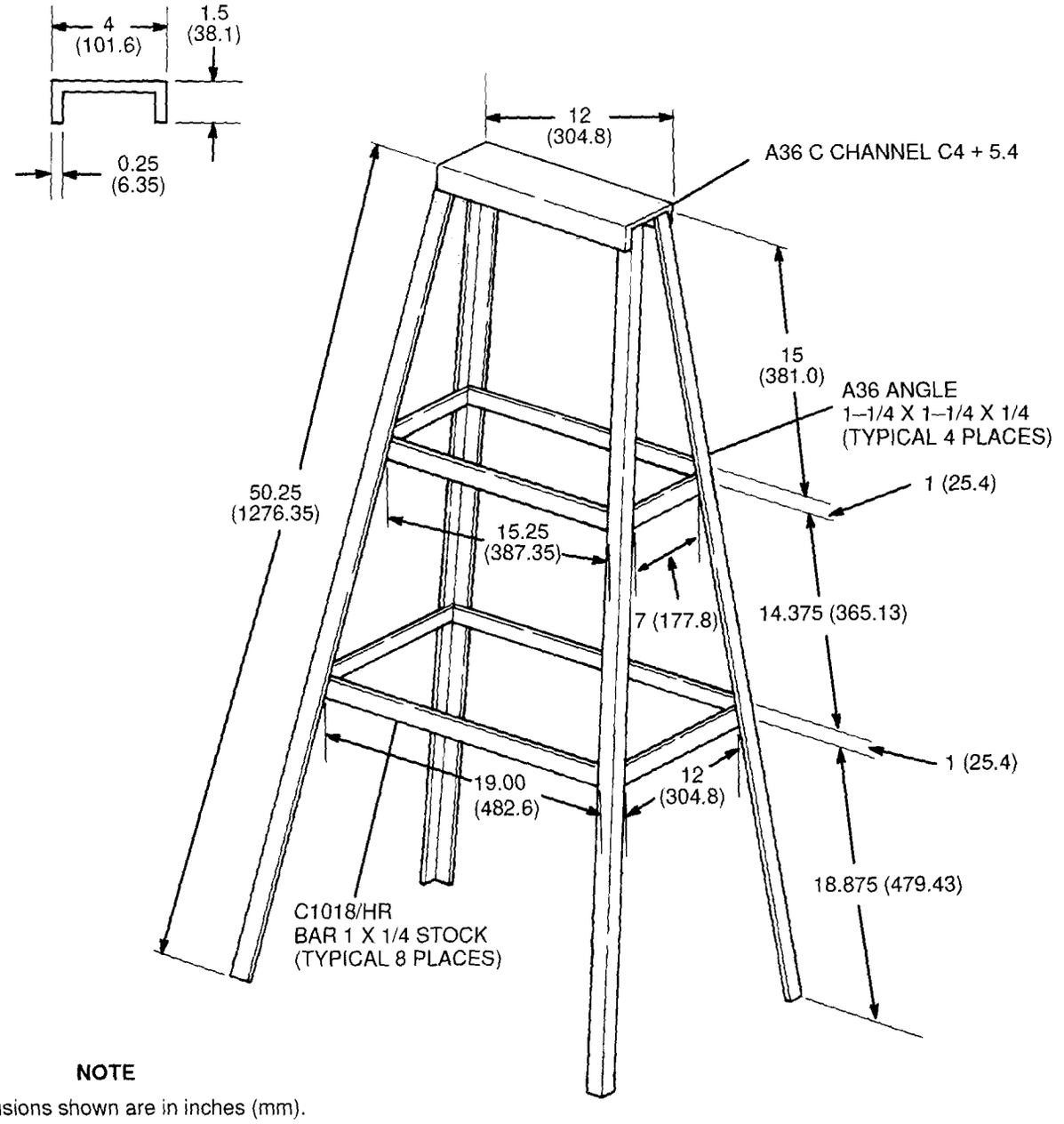
- Materiel: brass, QQ–B–639.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27).



B. 0.312 (7.925) GUIDE ROD (2 REQUIRED)

Figure C–2. Brass Guide Rods 5/16 Inch and 1/4 Inch (Sheet 2 of 2)

C-2 MANUFACTURED ITEMS - CONTINUED



NOTE

All dimensions shown are in inches (mm).

Figure C–3. Breech Stand

NOTE

- All dimensions shown are in inches (mm).
- All joints to have 0.25 fillet weld.

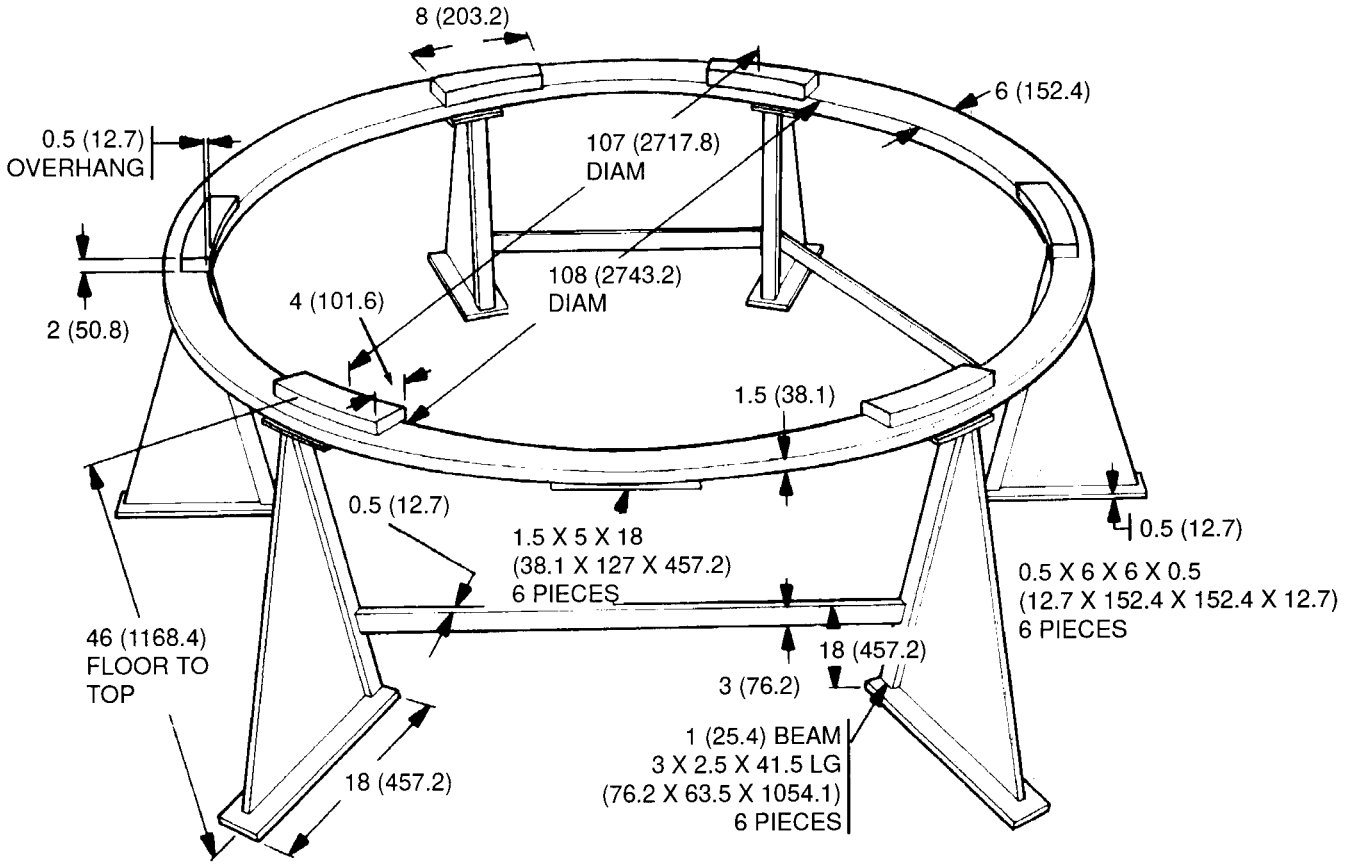


Figure C–4. Cab Stand

C-2 MANUFACTURED ITEMS - CONTINUED

NOTE

- All dimensions shown are in inches (mm).
- All joints to have 0.25 (6.35) fillet welds, unless otherwise shown.

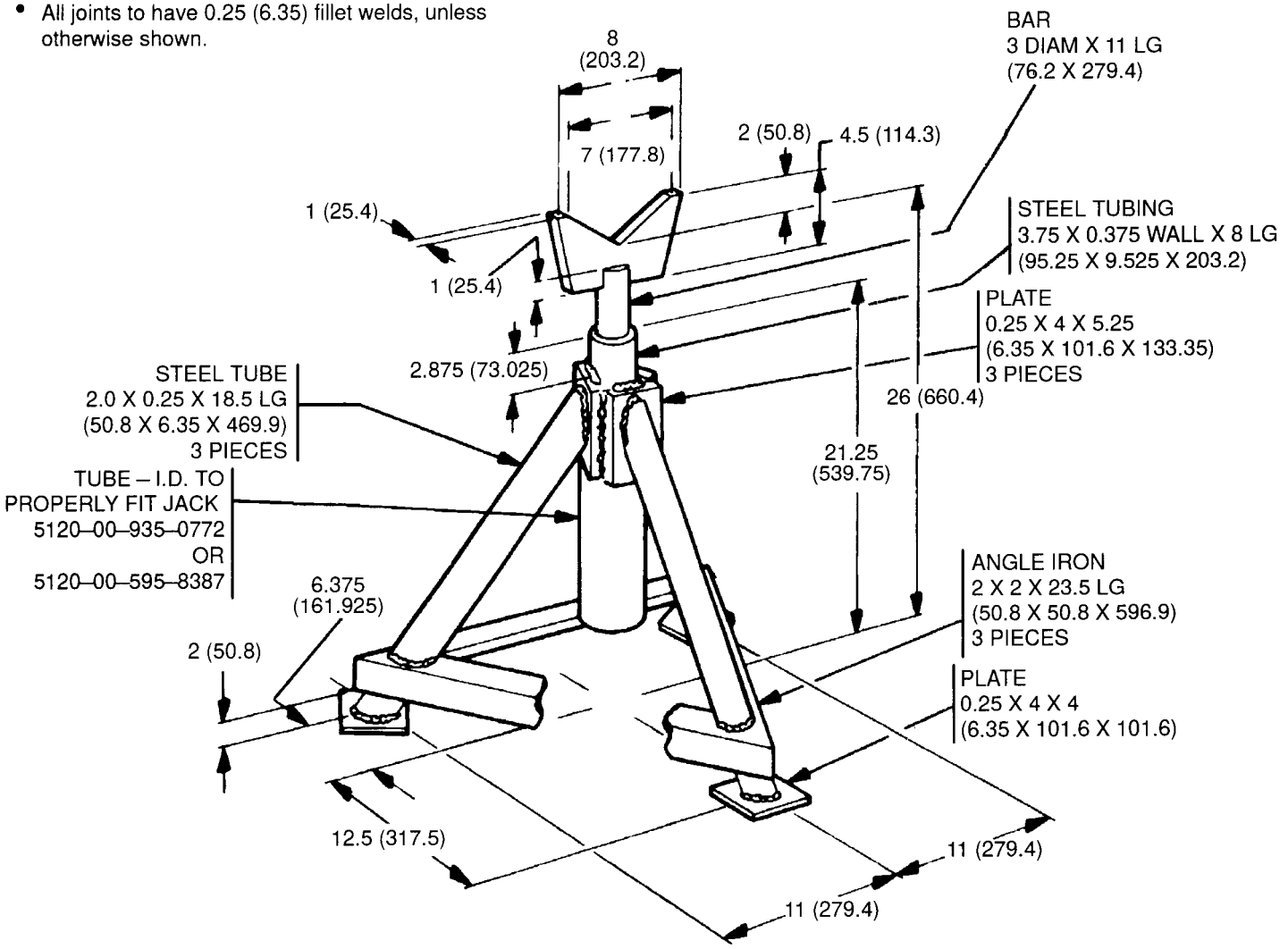


Figure C–5. Cannon Tube Hydraulic Tripod

NOTE

- All dimensions shown are in inches (mm).
- All joints to have 0.25 (6.35) fillet welds.

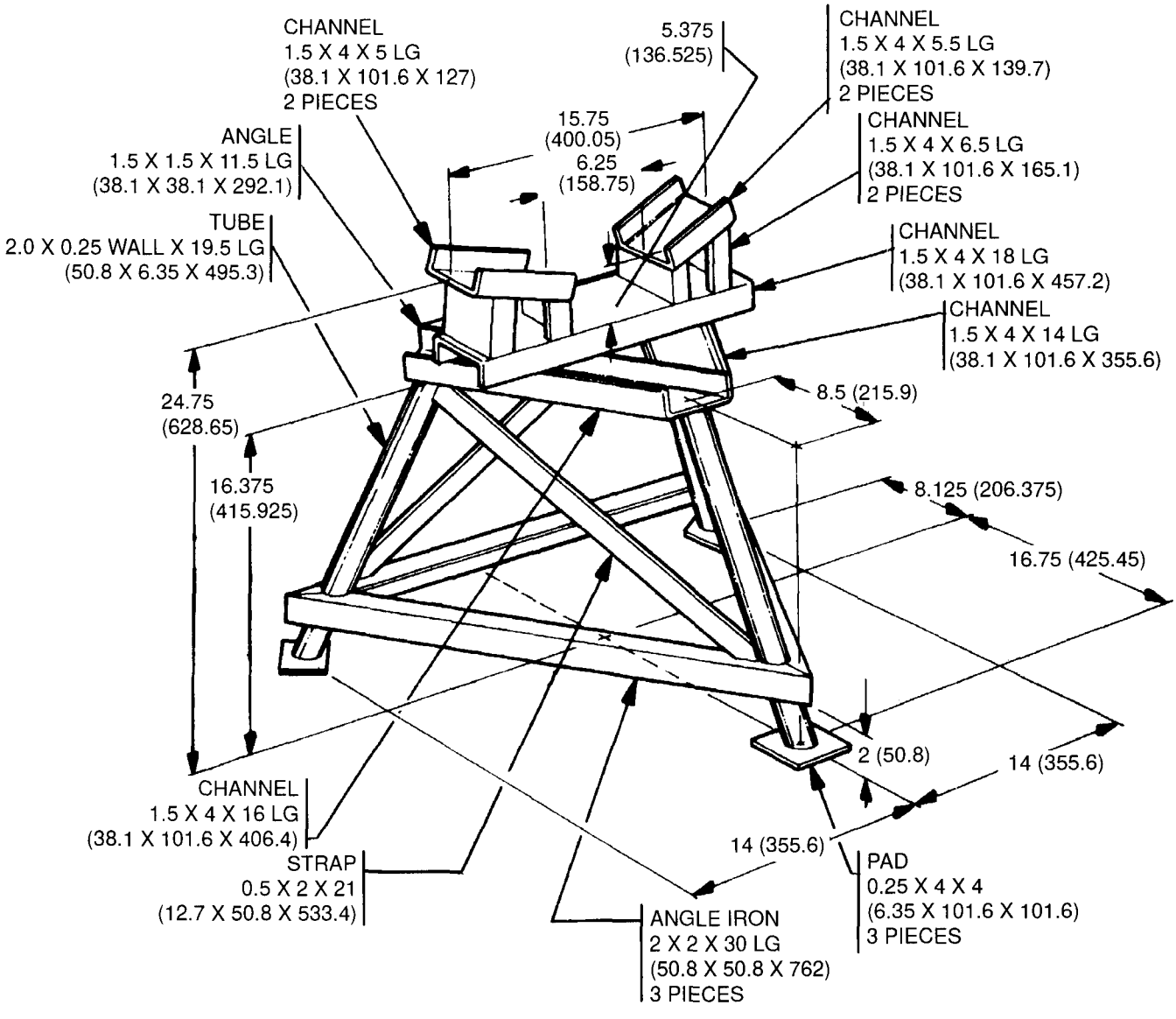
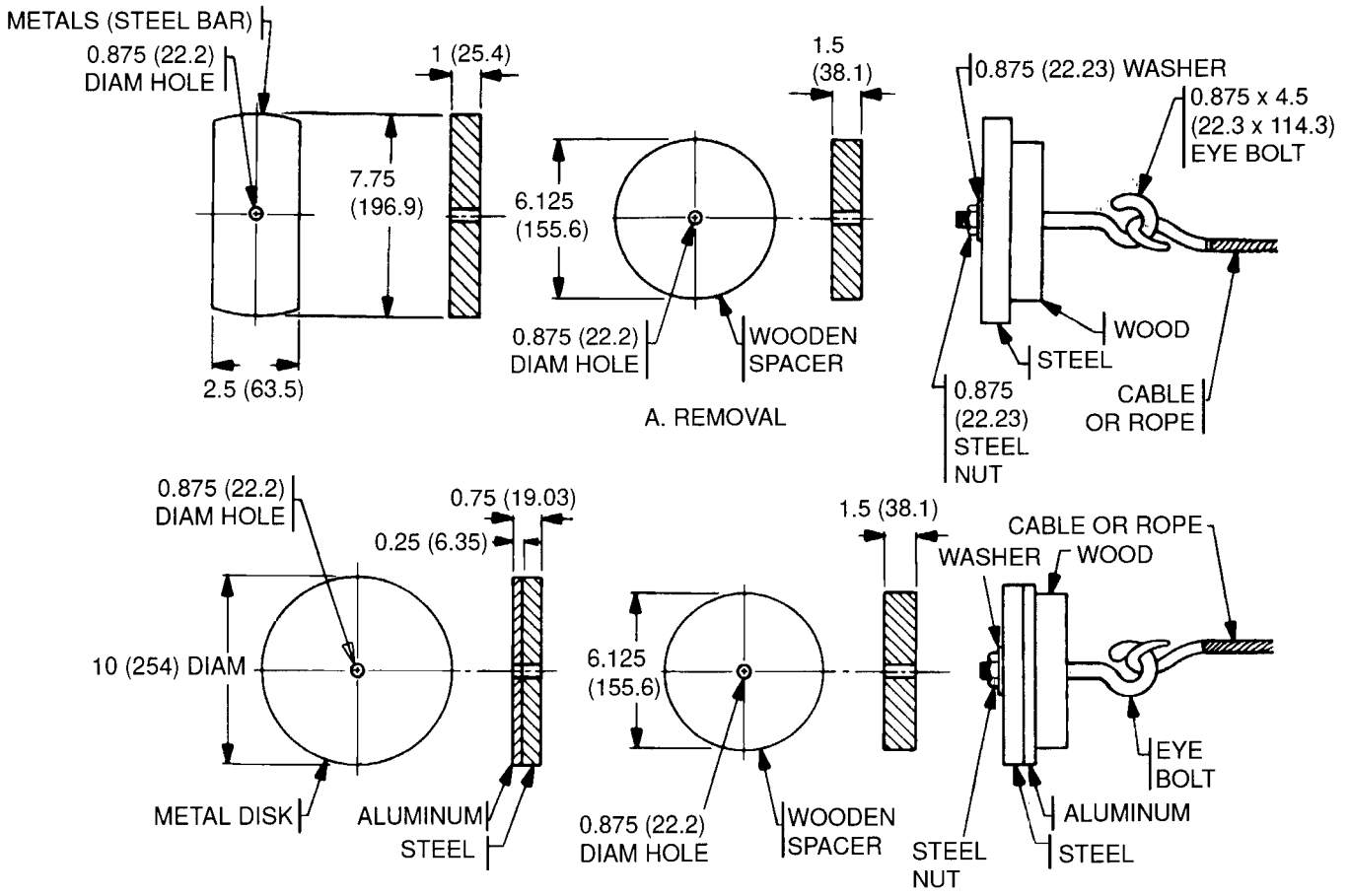


Figure C–6. Cradle Mount Tripod

C-2 MANUFACTURED ITEMS - CONTINUED



NOTE

All dimensions shown are in inches (mm).

Figure C–7. Eye Bolt Assembly

NOTE

- All dimensions shown are in inches (mm).
- Material: teflon, nylon or other suitable material.
- Remove all sharp edges and corners.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27).
- Finish 250 all over.

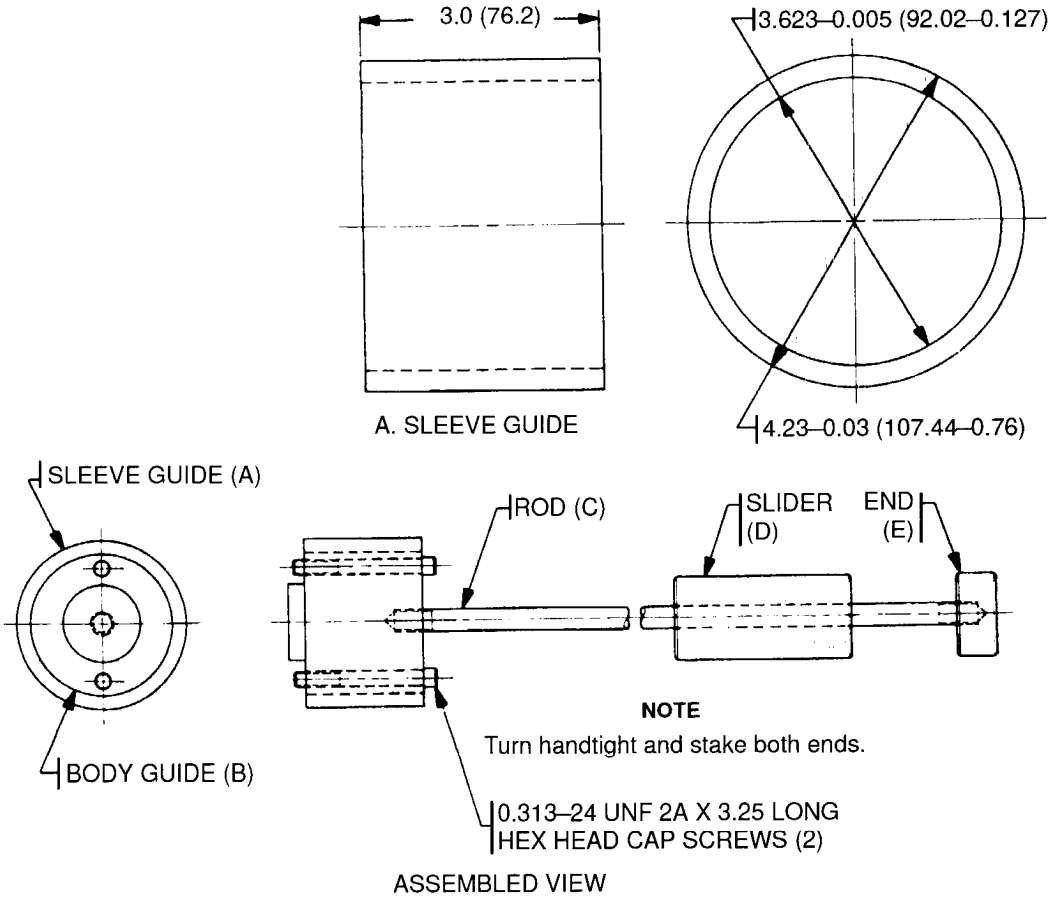
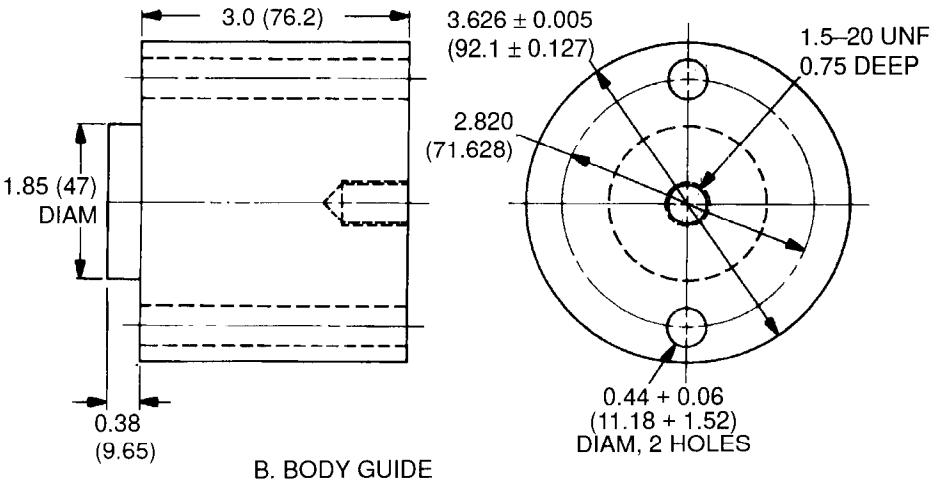


Figure C–8. Guide Tool Assembly (Sheet 1 of 3)

C-2 MANUFACTURED ITEMS - CONTINUED

NOTE

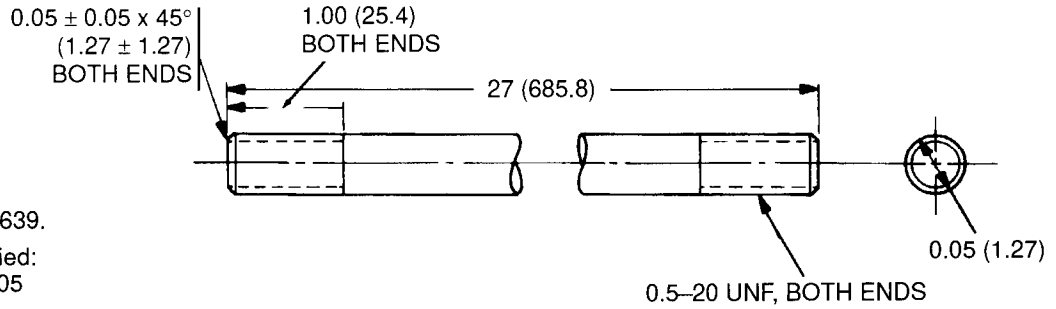
- All dimensions shown are in inches (mm).
- Material: AL, QQ–A–200 or QQ–Q–250; tool steel, QQ–S–624, QQ–S–631 or QQ–S–634.
- Remove all sharp edges and corners.
- Unless otherwise specified: three-place decimals ± 0.005 (0.127). Two-place decimals ± 0.01 (0.25).



B. BODY GUIDE

NOTE

- Material: Brass, QQ–B–639.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27). Angles ± 5°.

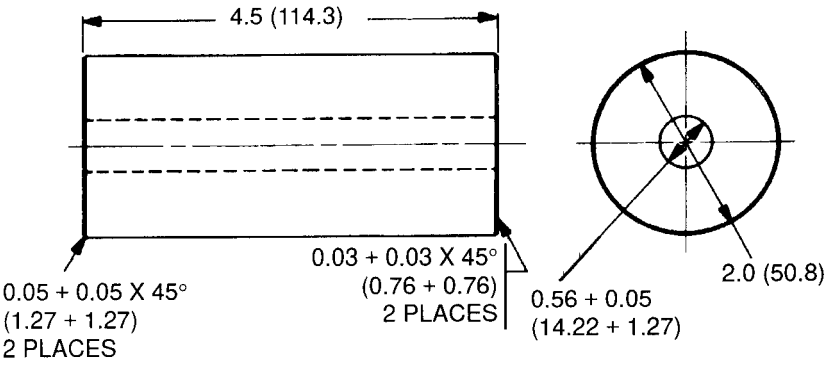


C. 0.5 ROD SLIDER

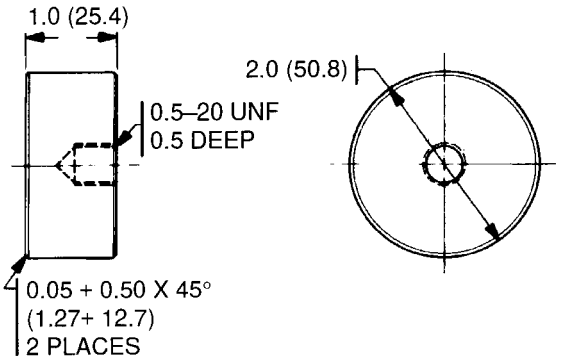
Figure C–8. Guide Tool Assembly (Sheet 2 of 3)

NOTE

- All dimensions shown are in inches (mm).
- Material: tool steel, QQ–S–631, QQ–S–634 or QQ–S–624.



D. SLIDER



E. END

NOTE

- Material: tool steel, QQ–S–631, QQ–S–634 or QQ–S–624; brass, QQ–B–639.
- Unless otherwise specified: two-place decimals ± 0.05 (1.27). Angles ± 5°.

Figure C–8. Guide Tool Assembly (Sheet 3 of 3)

C-2 MANUFACTURED ITEMS - CONTINUED

NOTE

- All dimensions shown are in inches (mm).
- Material: 4140.
- Heat treat to Rockwell C–40 to C–45.

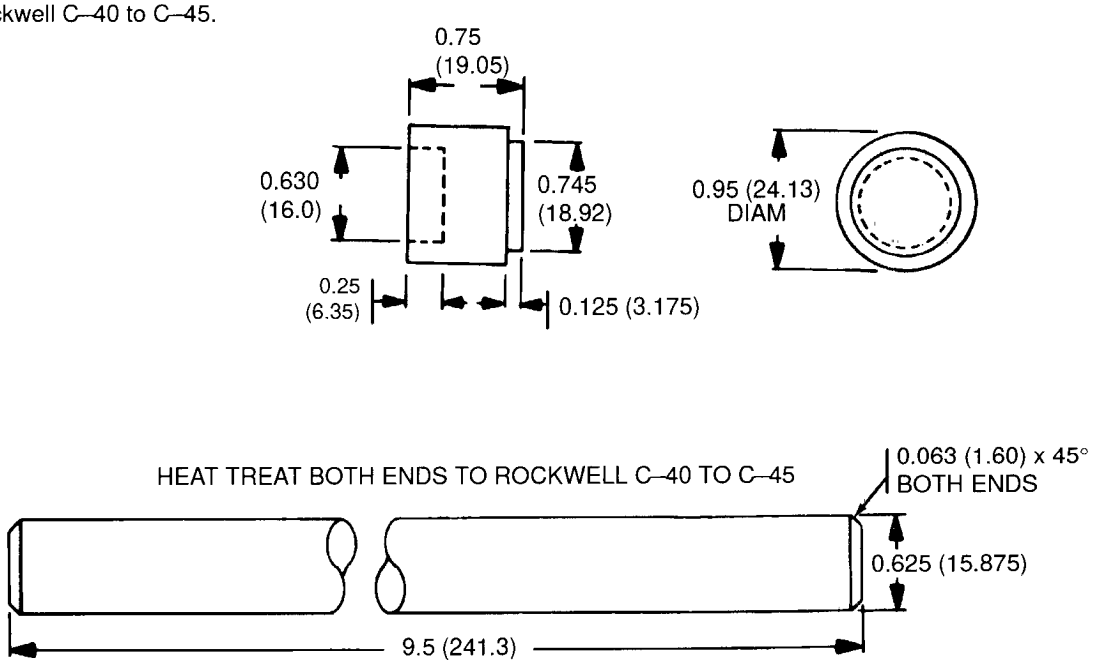


Figure C–9. Hinge Pin Bushing Driver

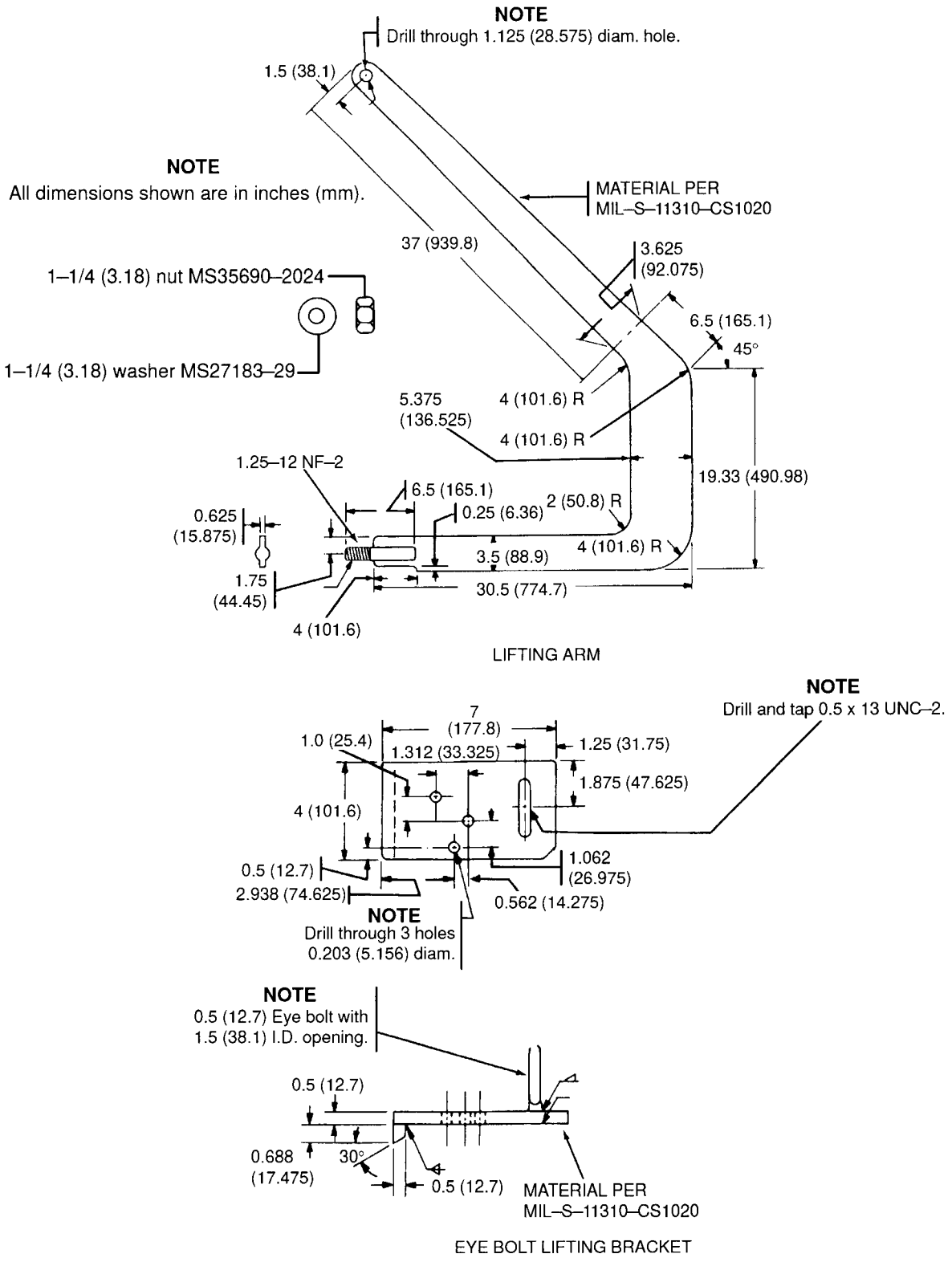
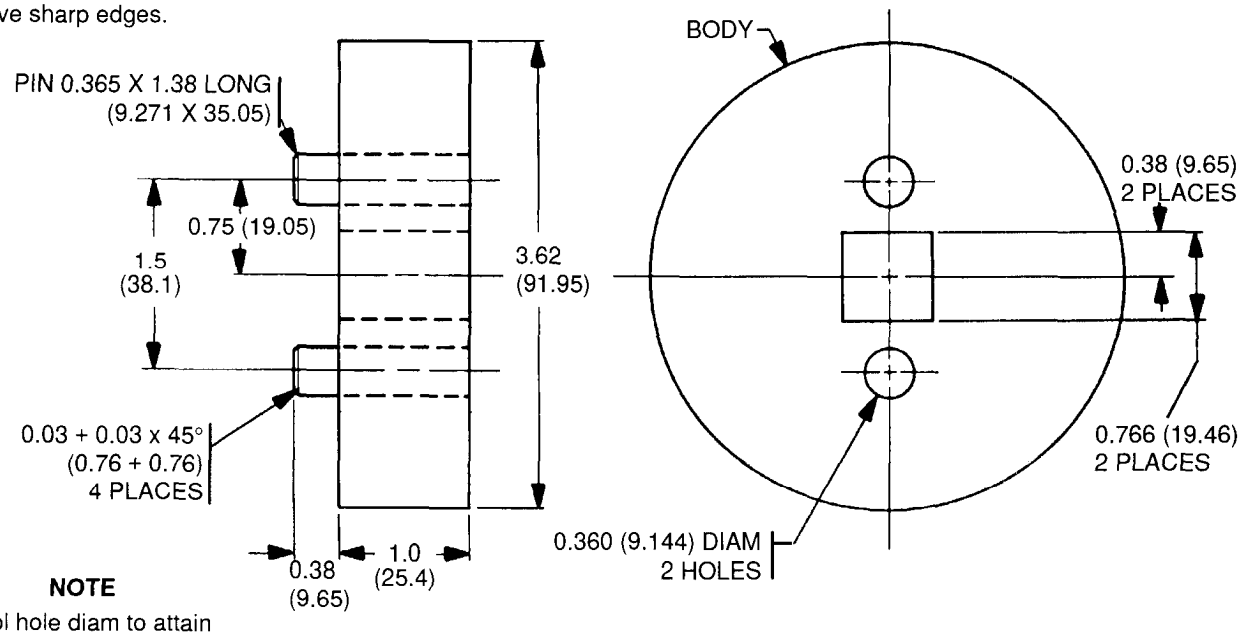


Figure C–10. Lifting Arm and Eye Bolt Lifting Bracket

C-2 MANUFACTURED ITEMS - CONTINUED

NOTE

- All dimensions shown are in inches (mm).
- Materiel: tool steel, medium to high carbon, QQ–S–634 or QQ–S–631 suitable.
- Remove sharp edges.



NOTE

- Control hole diam to attain press fit with pins.
- Unless otherwise specified: three-place decimals ± 0.005 (0.127). Two-place decimals ± 0.02 (0.51). Angles ± 5°.
- Finish 250 all over.

Figure C–11. Spanner

1 Cut one flat washer (P/N 11605242) in half.

2 Ensure spacers are free of burrs and sharp edges.

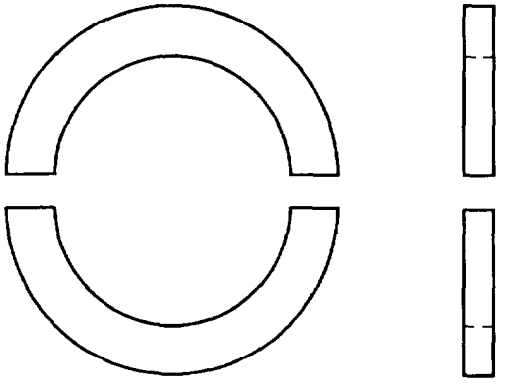


Figure C–12. Spacer

APPENDIX D
TORQUE LIMITS

GENERAL

This appendix provides general torque limits for screws used on the M109A2/M109A3/M109A4/M109A5 Howitzer. Specific 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.

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 specific 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.

This appendix also provides information on tightening metal fasteners, fastener size and thread pattern, and fastener grade.

CONTENTS

D-1 TORQUE LIMITS

Table D-1 lists wet torque limits.

D-2 HOW TO USE TORQUE TABLE

a. Measure diameter of screw you are installing.

b. Count the number of threads per inch or use a pitch gage.

c. Under heading “SIZE”, look down the left hand column until you find the diameter of the screw being installed (there will usually be two lines beginning with the same size).

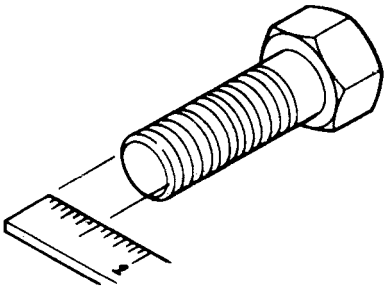
d. In the second column under’’SIZE”, find the number of threads per inch that matches the number of threads counted in step b.

e. To find the grade screw being installed, match markings on the head to the correct picture of cap screw head markings on the torque table.

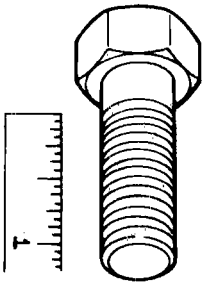
f. Look down the column under the picture found in step e, until you find the torque limit in Ib-ft or N·m for the diameter and threads per inch of the screw being installed.

NOTE

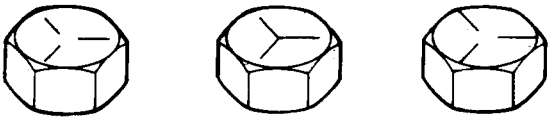
Manufacturer’s cap screw head marking may vary. These are all SAE grade 5 (3 line).



MEASURING DIAMETER

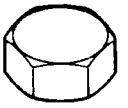
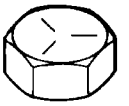
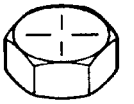
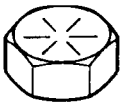


COUNTING THREADS/IN.



SAE GRADE 5 (3 LINE) MARKINGS

Table D-1 WET TORQUE LIMITS

SIZE			TORQUE							
			SAE GRADE NO. 1 OR 2		SAE GRADE NO. 5		SAE GRADE NO. 6 OR 7		SAE GRADE NO.9	
										
DIA. IN.	THREADS PER INCH	DIA MM	LB-FT	N·M	POUND-FEET	N·M	LB-FT	N·M	LB-FT	N·M
1/4	20	6.35	4.9	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	13.34	15.3	22.54	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	146.50
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	360.2	-	-	378.0	536.87
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	976.32	-	-	1152.0	1562.13
					792.0	1073.97			1296.0	1757.52
1-1/4	-	31.75	-	-	-	-	-	-	-	2221.11
										2440.80
1-3/8	-	34.93	-	-	1314.0	1781.82	-	-	2142.0	2904.57
					1512.0	2050.29			2448.0	3319.47
1–1/2	-	38.10	-	-	1746.0	2367.54	-	-	2844.0	3856.50
					1980.0	2684.88			3204.0	4344.66

D-3 TIGHTENING METAL FASTENERS

When torquing a fastener, select a torque wrench whose range (Table D-2) fits the required torque value. A torque wrench is most accurate from 25% to 75% of its stated range. A torque wrench with a stated range of 0 to 100 lb-ft will be most accurate from 25 to 75 lb-ft. Accuracy of readings will decrease as you approach 0 Ib-ft or 100 Ib-ft. The following ranges are based on this principle.

Table D-2 TORQUE RANGES

STATED RANGE	MOST EFFECTIVE RANGE
0-2000 lb-in (0-226 N·m)	4-13 Ib-ft (5-18 N·m)
0-600 lb-ft (0-813 N·m)	50-450 Ib-ft (68-610 N·m)
0-170 Ib-ft (0-230 N·m)	44-131 lb-ft (60-178 N·m)
15-75 Ib-ft (20-102 N·m)	30-60 Ib-ft (41-81 N·m)

D-4 FASTENER SIZE AND THREAD PATTERN

Threaded fasteners are categorized according to diameter of the fastener shank. Thread styles are divided into broad groups, the two most common being coarse (Unified Coarse-UNC) and fine (Unified Fine-UNF). These groups are defined by the number of threads per inch on the bolt shanks. In addition, threads are categorized by thread class (Table D-3), which is a measure of the degree of fit between the threads of the bolt or screw (external threads) and the threads of the attaching nut or tapped hole (internal threads). The most common thread class for bolts and screws is class 2.

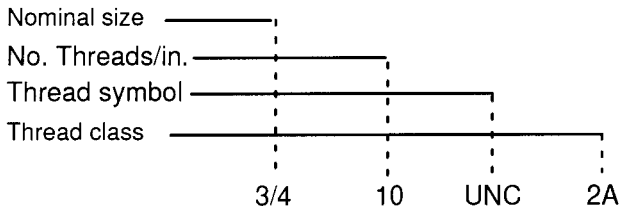
Table D-3 THREAD CLASSES AND DESCRIPTION

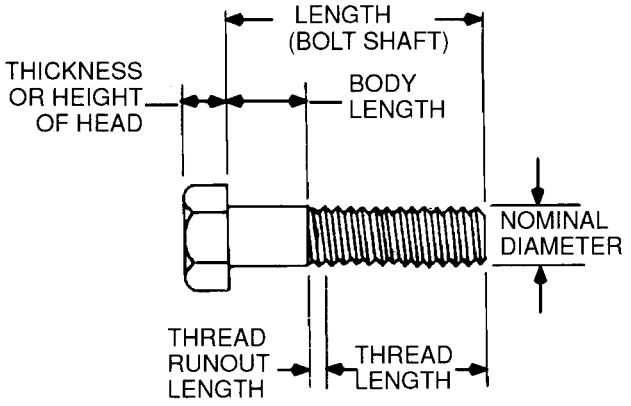
EXTERNAL	INTERNAL	FIT
1A	1B	Loose fit
2A	2B	Medium fit
3A	3B	Close fit

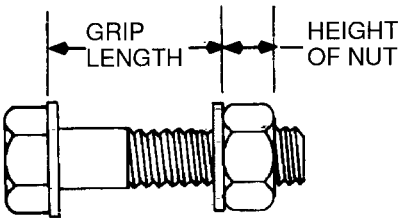
Thread patterns are designed as follows:

NOTE

Unless followed with -LH (e.g., 3/4-1 OUNC-2A-LH), threads are right-handed.







D-5 FASTENER GRADE

In addition to being classified by thread type, threaded fasteners are also classified by material. The most familiar fastener classification system is the SAE grading system (Table D-4).

Table D-4 SAE SCREW AND BOLT MARKINGS

SCREWS	BOLTS
SAE grade 2 No markings	SAE grade 6 Four radial dashes 90° apart
SAE grade 3 Two radial dashes 180° apart	SAE grade 7 Five radial dashes 72° apart
SAE grade 5 Three radial dashes 120° apart	SAE grade 8 Six radial dashes 60° apart

MARKINGS ON HEX LOCKNUTS

Grade A - no marks	Grade A - no marks	Grade A - no notches
Grade B - three marks	Grade B - letter B	Grade B - one notch
Grade C - six marks	Grade C - letter C	Grade C - two notches

APPENDIX E
MANDATORY REPLACEMENT PARTS LIST

GENERAL

This appendix is a cross-reference of item numbers to part numbers and is included for that purpose only.

CONTENTS

E-1 EXPLANATION OF COLUMNS

a. Column (1) - Item Number. This number is assigned to the entry in the listing for cross-referencing to the part number.

b. Column (2) - Part Number. indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specification, standards, and inspection requirements to identify an item or range of items.

c. Column (3) - Description. This column contains the nomenclature which appears on the first page of the task under the subheading “Materials/Parts”.

E-2 MANDATORY REPLACEMENT PARTS LIST

ITEM #	PART NUMBER	NOMENCLATURE
1	AN6227-9	Packing, preformed
2	AN6289-6	Locknut
3	MS16562-133	Pin, spring
4	MS16562-135	Pin, spring
5	MS16562-146	Pin, spring
6	MS16562-33	Pin, spring
7	MS16562-39	Pin, spring
8	MS16562-44	Pin, spring
9	MS16562-53	Pin, spring
10	MS16562-60	Pin, spring
11	MS16562-62	Pin, spring
12	MS16562-65	Pin, spring
13	MS16562-66	Pin, spring
14	MS16624-1025	Ring, retaining

E-2 MANDATORY REPLACEMENT PARTS LIST - CONTINUED

ITEM #	PART NUMBER	NOMENCLATURE
15	MS16624-1043	Ring, retaining
16	MS16624-1100	Ring, retaining
17	MS16624-1131	Ring, retaining
18	MS16624-1275	Ring, retaining
19	MS16624-5018-1	Ring, retaining
20	MS16625-1185	Ring, retaining
21	MS16625-1187	Ring, retaining
22	MS16625-1231	Ring, retaining
23	MS16998-50L	Screw, self-locking
24	MS171530	Pin, spring
25	MS171571	Pin, spring
26	MS172204	Washer, key
27	MS172205	Washer, key
28	MS17829-6F	Nut, self-locking
29	MS19070-062	Washer, key
30	MS19070-072	Washer, key
31	MS19070-082	Washer, key
32	MS19070-092	Washer, key
33	MS19070-102	Washer, key
34	MS19070-262	Washer, key
35	MS20995C32	Lockwire
36	MS20995C41	Lockwire
37	MS20995C47	Lockwire
38	MS20995C91	Lockwire
39	MS20995F41	Lockwire
40	MS21044N5	Nut, self-locking
41	MS21044N6	Nut, self-locking
42	MS21083N12	Nut, self-locking
43	MS21083N14	Nut, self-locking
44	MS21083N4	Nut, self-locking
45	MS2466-283	Pin, cotter
46	MS24665-298	Pin, cotter
47	MS24665-359	Pin, cotter

ITEM #	PART NUMBER	NOMENCLATURE
48	MS24665-625	Pin, cotter
49	MS28775-008	Packing, preformed
50	MS28775-010	Packing, preformed
51	MS28775-011	Packing, preformed
52	MS28775-015	Packing, preformed
53	MS28775-017	Packing, preformed
54	MS28775-022	Packing, preformed
55	MS28775-11	Packing, preformed
56	MS28775-210	Packing, preformed
57	MS28775-228	Packing, preformed
58	MS28775-235	Packing, preformed
59	MS28775-263	Packing, preformed
60	MS28775-437	Packing, preformed
61	MS28777-4	Retainer, packing
62	MS28778-10	Packing, preformed
63	MS28778-2	Packing, preformed
64	MS28778-3	Packing, preformed
65	MS28778-4	Packing, preformed
66	MS28778-5	Packing, preformed
67	MS28778-6	Packing, preformed
68	MS28778-8	Packing, preformed
69	MS35333-40	Washer, lock
70	MS35333-42	Washer, lock
71	MS35333-44	Washer, lock
72	MS35333-46	Washer, lock
73	MS35335-34	Washer, lock
74	MS35336-15	Washer, lock
75	MS35336-21	Washer, lock
76	MS35336-27	Washer, lock
77	MS35336-39	Washer, lock
78	MS35338-142	Washer, lock
79	MS35338-40	Washer, lock
80	MS35338-42	Washer, lock
81	MS35338-43	Washer, lock
82	MS35338-44	Washer, lock
83	MS35338-45	Washer, lock
84	MS35338-46	Washer, lock

E-2 MANDATORY REPLACEMENT PARTS LIST - CONTINUED

ITEM #	PART NUMBER	NOMENCLATURE
85	MS35338-47	Washer, lock
86	MS35338-48	Washer, lock
87	MS35338-61	Washer, lock
88	MS35338-65	Washer, lock
89	MS35677-17	Pin, grooved, headless
90	MS35764-1121	Bolt, self-locking
91	MS35764-1123	Bolt, self-locking
92	MS35764-1124	Bolt, self-locking
93	MS35764-1126	Bolt, self-locking
93.1	MS35764-1611	Bolt, self-locking
94	MS39086-229	Pin, spring
95	MS45904-84	Washer, lock
96	MS51848-10	Washer, lock
97	MS51848-12	Washer, lock
98	MS51922-1	Nut, self-locking
99	MS9020-04	Packing, preformed
100	MS90727-13L	Screw, self-locking
101	MS90727-5L	Bolt, self-locking
102	MS90728-5L	Bolt, self-locking
103	M27426-1100B	Ring, retaining
104	M83461/1-110	Packing, preformed
105	M83461/1-328	Packing, preformed
106	NAS561-8-26	Pin, spring
107	QQ-W-461	Lockwire
108	TM706	Washer, lock
109	10015592-042	Ring, retaining
110	10888211	Gasket
111	10888219	Gasket
112	10888797	Gasket
113	10895166	Wiper, piston
114	10895569	Washer, key
115	10914109	Parts kit, solenoid valve
116	10918677	Parts kit, hydraulic oil pump
117	10918926	Parts kit, no-back device
118	10922974	Bushing

ITEM #	PART NUMBER	NOMENCLATURE
119	10925314	Gasket
120	10930644-3	Insert, self-locking
121	10936118	Washer, key
122	10954476-1	Ring, retaining
123	10954476-2	Ring, retaining
124	10954476-3	Ring, retaining
125	10954667	Ring, retaining
126	10955765	Gasket
127	11604793	Gasket cover
128	11636004	Gasket
129	11636076	Gasket
130	11636077	Gasket
131	11636078	Gasket
132	11636079	Gasket
133	11652493	Gasket
134	11783940	Filter element kit
135	11784005	Parts kit
136	11784012	Parts kit, hydraulic accumulator
137	11838800	Parts kit, hydraulic
138	11838801	Parts kit, hydraulic
139	12012191	Ring, retaining
140	12012358	Parts kit, seal replacement
141	12576008	Parts kit, seal replacement
142	12576009	Parts kit, seal replacement
143	12576071	Washer, key
144	279332PC2	Washer, lock
145	340-0378-00	Ring, retaining
146	443340	Nut, self-locking
147	5703502	Parts kit, motor seal replacement
148	5703505	Parts kit, accumulator
149	5704210	Parts kit, hydraulic axial
150	5910813	Parts kit, rammer cylinder seal replacement
151	5910844	Parts kit, seal replacement
152	5910845	Parts kit, seal replacement
153	5911110	Parts kit, seal replacement
154	7363175	Washer, key
155	7387778	Packing, preformed

E-2 MANDATORY REPLACEMENT PARTS LIST - CONTINUED

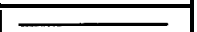
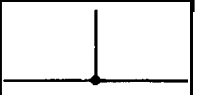
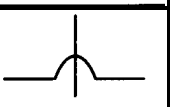
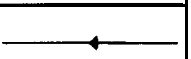
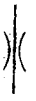
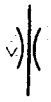
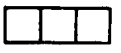
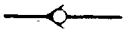
ITEM #	PART NUMBER	NOMENCLATURE
156	7973643	Ring, retaining
157	8267864	Pin assembly
158	8346053	Washer, lock
159	8712258	Ring, retaining
159.1	8712289	Nut, self-locking
160	8712289-3	Nut, self-locking
161	8712289-4	Nut, self-locking
162	8740907	Seal
163	9338491-1	Packing, preformed
164	9363649	Gasket
165	9363651	Packing assembly
166	9363652	Seal
167	9363653	Seal
168	9398966	Parts kit, seal replacement
169	9398972	Seal
170	9399044	Seal
171	9399122	Packing, preformed

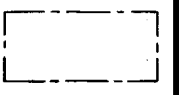
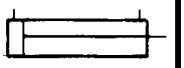
APPENDIX F
TOOL IDENTIFICATION LIST

ITEM	LEVEL	NOMENCLATURE	NSN	REFERENCE
1	F	Adapter, torque (10954669)	5120-00-933-7357	TM 9-2350-311-24P-2
2	H	Bolt, machine, 1/4 - 20 x 2 inch (MS35355-5)	5306-00-042-6921	
3	F	End cap guide tool (12910864)	1025-01-355-6627	TM 9-2350-311-24P-2
4	F	Eye bolt (5222910)	5306-00-522-2910	TM 9-2350-311-24P-2
5	F	Eye bolt (MS51937-5)	5306-00-975-0065	TM 9-2350-311-24P-2
6	F	Eye bolt (MS51937-8)	5306-00-150-3075	TM 9-2350-311-24P-2
7	C	Hose assembly, non-metallic (MIL-H-5593)	4720-00-277-8982	TM 9-2350-311-10
8	F	Level, cross test (8213259)	5210-00-863-5651	TM 9-2350-311-24P-2
9	O	Lubrication fitting (MS15003-1)	4730-00-050-4208	TM 9-2350-311-24P-2
10	F	Nut, plain hexagon (MS51971-5)	5310-00-768-0321	
11	C	Pail, utility (A-A-1273)	7240-00-160-0455	TM 9-2350-311-10
12	O	Pan, drain (450)	4910-00-387-9592	SC 4910-95-CL-A74
13	F	Press, arbor (MIL-P-80261)	3444-00-243-2654	SC 4931-95-CL-A07
14	H	Puller, bearing (1043)	5120-00-378-4293	SC 4910-95-CL-A72
14.1	C	Quadrant, M1A1 gunner's w/case (7197156)	1290-00-891-9999	TM 9-2350-311-10
15	F	Rod guide tool (12910863)	1025-01-355-6626	TM 9-2350-311-24P-2
16	F	Screw, machine, 1-1/2 inch x 4-40 (MS35206-223)	5305-00-984-4980	
17	F	Seal inserter (12910862)	5120-01-355-0860	TM 9-2350-311-24P-2
18	F	Sling assembly, lifting (10930417)	4910-00-976-3104	SC 4933-95-CL-A12
19	F	Sling, gun tube (8735440)	4933-00-699-9307	TM 9-2350-311-24P-2
20	F	Sling, multiple leg (10942192)	3940-00-678-8414	TM 9-2350-311-24P-2
21	F	Sling, turret lifting (8387711)	4910-00-776-8906	TM 9-2350-311 -24P-2
22	F	Socket, socket wrench (12910865)	5130-01-355-0819	TM 9-2350-311-24P-2
23	O	Socket wrench, special (10930422)	5120-00-976-3105	TM 9-2350-311-24P-2
24	F	Spanner attachment (12910866)	5120-01-368-3847	TM 9-2350-311-24P-2
25	F	Trolley, I-beam (MILH904)	3950-00-889-8746	TM 9-2350-311-24P-2
26	F	Tweezers (GGG-T-870)	5120-00-233-6985	
27	F	Wrench, pipe, chain-type (8769153)	5120-00-866-5850	

APPENDIX G
HYDRAULIC SCHEMATIC SYMBOLS

This appendix provides the hydraulic symbols used on the hydraulic schematic drawings.

LINES AND LINE FUNCTIONS	
LINE, WORKING	
LINE, PILOT	
LINE, DRAIN	
CONNECTOR	
LINE, JOINING	
LINE, PASSING	
DIRECTION OF FLOW	
LINE TO RESERVOIR	
RESTRICTION, FIXED	
RESTRICTION, VARIABLE	
BASIC VALUE SYMBOLS	
PRESSURE REDUCING VALVE	
BASIC VALVE ENVELOPE	
BASIC VALUE SYMBOL, MULTIPLE FLOW PATHS	
FLOW PATHS BLOCKED IN CENTER POSITION	
MULTIPLE FLOW PATHS (ARROW SHOWS FLOW DIRECTION)	
RELIEF VALVE, SPRING RETURNED	
CHECK VALVE	

MISCELLANEOUS COMPONENTS	
DIRECTION OF ROTATION (ARROW IN FRONT OF SHAFT)	
COMPONENT ENCLOSURE	
RESERVOIR, VENTED	
PRESSURE GAGE	
CYLINDER, DOUBLE ACTING	
KNOB	
MANUAL ACTUATOR, SPRING RETURNED	
SOLENOID	SOL
COMPONENT PORT	
MOTOR, HYDRAULIC, FIXED DISPLACEMENT	MF
PUMP, HYDRAULIC, FIXED DISPLACEMENT	PF
GAS (NITROGEN) -OVER- HYDRAULIC FLUID ACCUMULATOR	ACC
SWITCH, PRESSURE	PS
FILTER, HYDRAULIC FLUID	FLT
MOTOR, ELECTRIC	ELEC MOT
TRAVERSE LEFT	TL
TRAVERSE RIGHT	TR

ALPHABETICAL INDEX

ALPHABETICAL INDEX - CONTINUED

ALPHABETICAL INDEX - CONTINUED

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Subject **Paragraph**

R - Continued

S

T

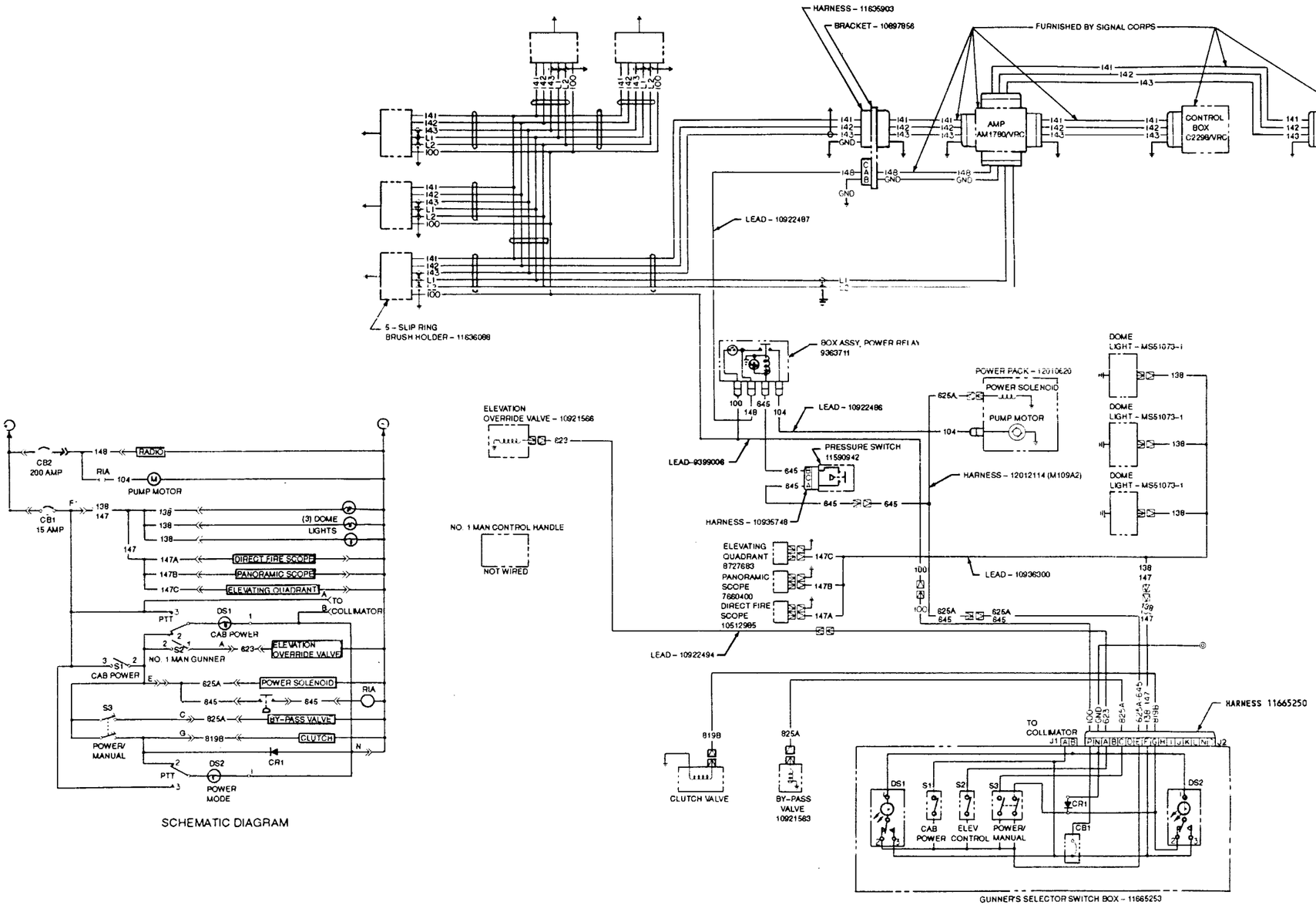
V

ALPHABETICAL INDEX - CONTINUED

Subject **Paragraph**

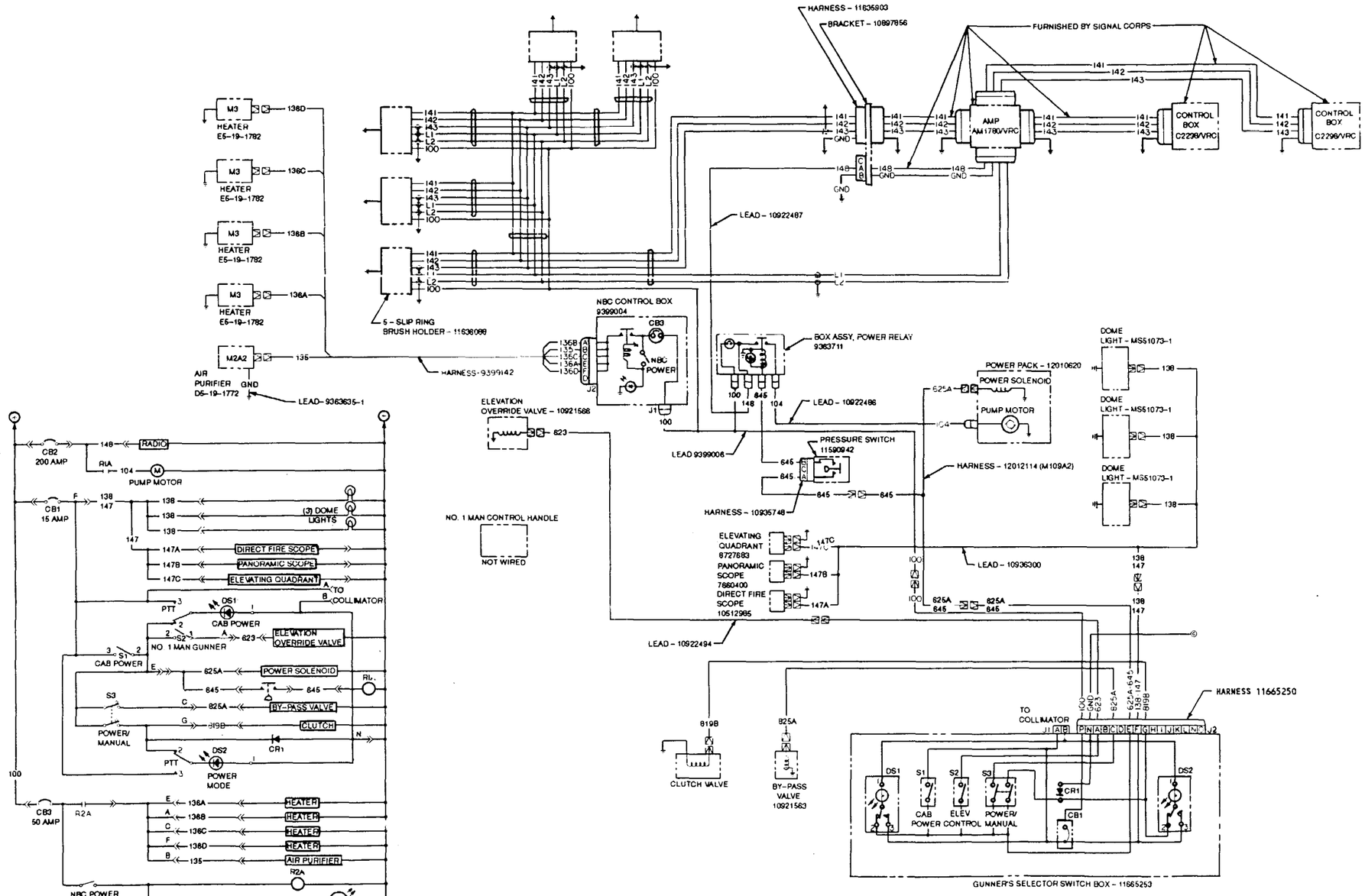
V - Continued

W



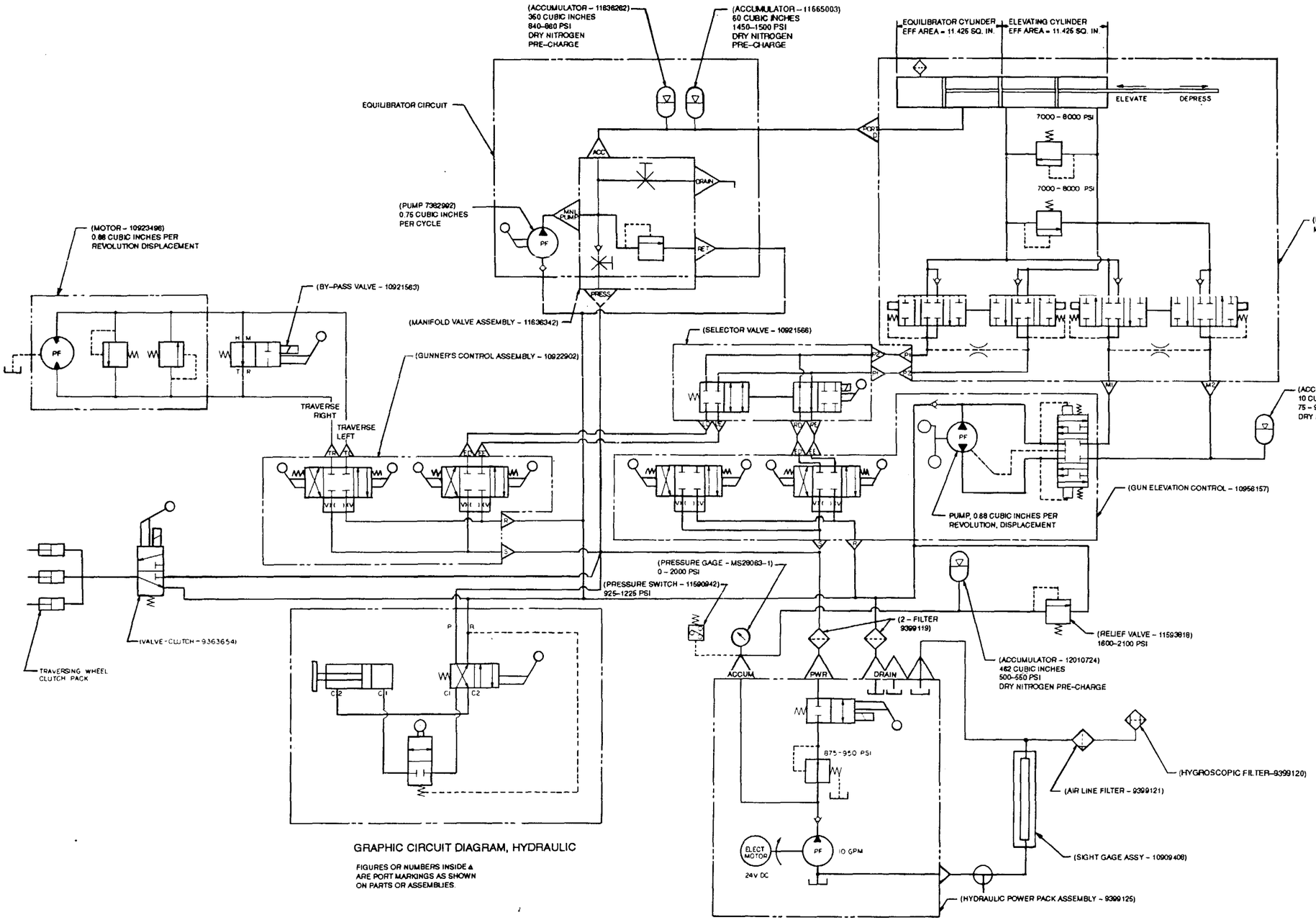
SCHEMATIC DIAGRAM

Figure FO-1 . Cab Electrical Schematic (M109A2/A3)



SCHEMATIC DIAGRAM

Figure FO–2. Cab Electrical Schematic (M109A4/A5)



GRAPHIC CIRCUIT DIAGRAM, HYDRAULIC

FIGURES OR NUMBERS INSIDE △ ARE PORT MARKINGS AS SHOWN ON PARTS OR ASSEMBLIES.

Figure FO-4. Cab Hydraulic Schematic (M109A4/A5)

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
07183

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ITEM	PAGE	PARA	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON
	1-6	1-3				Para 1-3 "DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE" should be "1-3 DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE"

*Reference to line numbers within the paragraph or subparagraph.

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**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 Meter = 0.3937 Inch
1 Decimeter = 10 Centimeters = 3.94 Inches
1 Meter = 10 Decimeters = 100 Centimeters
= 1000 Millimeters = 39.37 Inches
1 Dekameter = 10 Meters = 32.8 Feet
1 Hectometer = 10 Dekameters = 328.08 Feet
1 Kilometer = 10 Hectometers = 1000 Meters
= 0.621 Mile = 3,280.8 Feet
Millimeters = Inches times 25.4
Inches = Millimeters divided by 25.4

WEIGHTS

1 Centigram = 10 Milligrams = 0.154 Grain
1 Decigram = 10 Centigrams = 1.543 Grains
1 Gram = 0.001 Kilogram = 10 Decigrams
= 1000 Milligrams = 0.035 Ounce
1 Dekagram = 10 Grams = 0.353 Ounce
1 Hectogram = 10 Dekagrams = 3.527 Ounces
1 Kilogram = 10 Hectograms = 1000 Grams = 2.205 Pounds
1 Quintal = 100 Kilograms = 220.46 Pounds
1 Metric Ton = 10 Quintals = 1000 Kilograms = 1.102 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liter = 0.034 Fluid Ounce
1 Centiliter = 10 Milliliters = 0.34 Fluid Ounce
1 Deciliter = 10 Centiliters = 3.38 Fluid Ounces
1 Liter = 10 Deciliters = 1000 Milliliters = 33.82 Fluid Ounces
1 Dekaliter = 10 Liters = 2.64 Gallons
1 Hectoliter = 10 Dekaliters = 26.42 Gallons
1 Kiloliter = 10 Hectoliters = 264.18 Gallons

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inch
1 Sq Decimeter = 100 Sq Centimeters = 15.5 Sq Inches
1 Sq Meter (Centare) = 100 Sq Decimeters
= 10,000 Sq Centimeters = 10.764 Sq Feet
1 Sq Dekameter (Are) = 100 Sq Meters = 1,076.4 Sq Feet
1 Sq Hectometer (Hectare) = 100 Sq Dekameters = 2.471 Acres
1 Sq Kilometer = 100 Sq Hectometers = 1,000,000 Sq Meters
= 0.386 Sq Mile

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.061 Cu Inch
1 Cu Decimeter = 1000 Cu Centimeters = 61.02 Cu Inches
1 Cu Meter = 1000 Cu Decimeters = 1,000,000 Cu Centimeters
= 35.31 Cu Feet

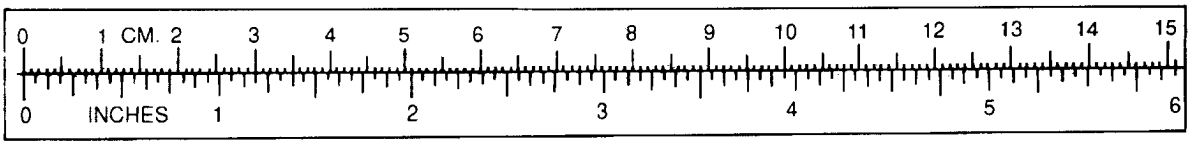
TEMPERATURE

5/9 (° F – 32°) = ° C
9/5 (° C + 32°) = ° F
–35° Fahrenheit is equivalent to –37° Celsius
0° Fahrenheit is equivalent to –18° Celsius
32° Fahrenheit is equivalent to 0° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
100° Fahrenheit is equivalent to 38° Celsius
212° Fahrenheit is equivalent to 100° Celsius

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.452
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	29.574
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.350
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound–Feet	Newton–Meters	1.356
Pounds–Inches	Newton–Meters	0.11298
Ounce–Inches	Newton–Meters	0.007062
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
Centimeters	Inches	0.394
Meters	Feet	3.281
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	2.205
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	2.352
Kilometers per Hour	Miles per Hour	0.621
° Fahrenheit	° Celsius	° C = (° F – 32) x 5/9
° Celsius	° Fahrenheit	° F = (9/5 x ° C) = 32



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