TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

TURBINE ENGINE, FIELD SERVICE MODEL AGT1500 (M1/1PM1) (P/N 12287428), TURBINE ENGINE, FIELD SERVICE MODEL AGT1500 (M1A1) (P/N 12324029), CONTAINER (NSN 8145-01-112-6574), TURBINE ENGINE WITH CONTAINER MODEL AGT1500 (M1/IPM1/M1A1) (P/N 5705196) (NSN 2835-01-216-8639), TURBINE ENGINE WITH CONTAINER MODEL AGT1500 WITH BATTLE FIELD OVERRIDE AND PULSE JET (M1A1/M1A2) (P/N 57K2919) (NSN 2835-01-408-7048)

HEADQUARTERS, DEPARTMENT OF THE ARMY

28 OCTOBER 1987

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D.C., 9 May 1998

CHANGE
NO. 6

DIRECT SUPPORT
AND
GENERAL SUPPORT

Maintenance Manual

TURBINE ENGINE, FIELD SERVICE MODEL AGT1500 (M1/IPM1) (P/N 12287428), TURBINE ENGINE, FIELD SERVICE MODEL AGT1500 (M1A1) (P/N 12324029), CONTAINER (NSN 8145-01-112-6574), TURBINE ENGINE WITH CONTAINER MODEL AGT1500 (M1/IPM1/M1A1) (P/N 5705196) (NSN 2835-01-216-8639), AND TURBINE ENGINE WITH CONTAINER MODEL AGT1500 WITH BATTLE FIELD OVERRIDE AND PULSE JET (M1A1/M1A2) (P/N 57K2919) (NSN 2835-01-408-7048)

TM 9-2835-255-34, 28 October 1987, is changed as follows:

1. Remove old pages and insert new pages as indicated below.
2. New or changed information is indicated by a vertical bar in the margin of the page.
3. Part of this change involves changing the distribution statement and the title.

Remove Pages	Insert Pages
i and ii	i and ii
3-3 and 3-4	3-3 and 3-4
3-17 thru 3-20	3-17 thru 3-20
3-23 thru 3-30	3-23 thru 3-30
3-35 and 3-36	3-35 and 3-36

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

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

Remove Pages	Insert Pages
3-39 thru 3-48	3-39 thru 3-48
3-51 and 3-52	3-51 and 3-52
3-61 thru 3-66	3-61 thru 3-66
3-73 thru 3-78	3-73 thru 3-78
3-85 thru 3-88	3-85 thru 3-88
3-91 thru 3-102	3-91 thru 3-102
3-107 thru 3-112	3-107 thru 3-112
3-119 thru 3-142	3-119 thru 3-142
3-147 thru 3-152	3-147 thru 3-152
3-155 thru 3-164	3-155 thru 3-164
3-167 and 3-168	3-167 and 3-168
3-171 and 3-172	3-171 and 3-172
3-177 and 3-178	3-177 and 3-178
3-181 and 3-182	3-181 and 3-182
3-187 and 3-188	3-187 and 3-188
3-191 thru 3-194	3-191 thru 3-194
3-197 and 3-198	3-197 and 3-198
3-225 thru 3-228	3-225 thru 3-228
3-231 thru 3-236	3-231 thru 3-236
3-239 and 3-240	3-239 and 3-240
3-243 thru 3-248	3-243 thru 3-248
3-251 and 3-252	3-251 and 3-252
3-257 thru 3-264	3-257 thru 3-264
3-269 thru 3-272	3-269 thru 3-272
3-275 and 3-276	3-275 and 3-276
3-279 thru 3-286	3-279 thru 3-286
3-289 thru 3-292	3-289 thru 3-292
3-295 thru 3-298	3-295 thru 3-298
3-301 and 3-302	3-301 and 3-302
3-305 thru 3-316	3-305 thru 3-316
3-321 and 3-322	3-321 and 3-322
3-325 thru 3-328	3-325 thru 3-328
3-333 and 3-334	3-333 and 3-334
3-337 and 3-338	3-337 and 3-338
5-1 and 5-2	5-1 and 5-2
	5-55 thru 5-130
6-1 and 6-2	6-1 and 6-2
6-17 thru 6-20.1/(6-20.2 blank)	6-17 thru 6-20
6-37 and 6-38	6-37 and 6-38

Remove Pages	Insert Pages
6-43 and 6-44	6-43 and 6-44
6-51/(6-52 blank)	6-51 thru 6-102
7-1 thru 7-2.3/(7-2.4 blank)	7-1 thru 7-2.4
7-45 thru 7-69/(7-70 blank)	7-45 thru 7-85/(7-86 blank)
8-1 thru 8-3/(8-4 blank)	8-1 thru 8-10
A-3/(A-4 blank)	A-3/(A-4 blank)
	B-5/(B-6 blank)
D-5 and D-6	D-5 thru D-7/(D-8 blank)
E-5/(E-6 blank)	E-5 and E-6
Index-1 thru Index-8	Index -1 thru Index-8
2028-2 Sample and Envelope	2028-2 Sample and Envelope
2028-2 and Envelope	2028-2 and Envelope
2028-2 and Envelope	2028-2 and Envelope
2028-2 and Envelope	2028-2 and Envelope
Front Cover	Front Cover

By Order of the Secretary of the Army:

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

Official:

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
04703

DISTRIBUTION: To be distributed in accordance with initial distribution number (IDN) 371559 requirements for TM 9-2835-255-34.

CHANGE
NO. 5

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D.C., *26 September 1994*

Direct Support and General Support Maintenance Manual

TURBINE ENGINE, FIELD SERVICE MODEL AGT1500 (M1/PM1) (P/N 12287428) AND TURBINE ENGINE, FIELD SERVICE MODEL AGT1500 (M1A1) (P/N 12324029) AND CONTAINER (NSN 8145-01-112 6574)

TM 9-2835-255-34, 28 October 1987, is changed as follows:

1. Remove old pages and insert new pages as indicated below.
2. New or change information is indicated by a vertical bar in the margin of the page.

Remove Pages	Insert Pages
3-1 thru 3-38	3-1 thru 3-340
A-1 and A-2	A-1 and A-2
B-3 and B-4	B-3 and B4
D-5 and D-6	D-5 and D-6
E-5/(E-6 blank)	E-5/(E-6 blank)
G-1 and G-2	G-1 and 3-G-2

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

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
07437

Distribution:
To be distribution in accordance with DA Form 12-37-E (Block 1559) requirements for TM9-2835-255-34.

CHANGE
NO.4

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D.C., 11 *September 1992*

Direct Support and General Support
Maintenance Manual

TURBINE ENGINE, FIELD SERVICE
MODEL AGT1500 (M1/PM1) (P/N 12287428)
AND
TURBINE ENGINE, FIELD SERVICE
MODEL AGT1500 (M1A1) (P/N12324029)
AND
CONTAINER
(NSN 8145-01-112-6574)

TM 9-2835-255-34,28 October 1987, is changed as follows:

1. Remove old pages and insert new pages as indicated below.

2. New or changed information is indicated by a vertical bar in the margin of the page.

Remove Pages	Insert Pages
C and d	C and d
5-1 and 5-2	5-1 and 5-2
5-33/(5-34 blank)	5-33 thru 5-54
6-1 and 6-2	6-1 and 6-2
None	6-22.1 thru 6-22.4
6-22.5 thru 6-22.7/(6-22.8 blank)	6-22.5 thru 6-22.8
6-31 and 6-32	6-31 thru 6-32.4
None	6-37 thru 6-51/(6-52 blank)
7-1 'and 7-2	7-1 thru 7-2.3/(7-2.4 blank)
7-3 and 7-4	7-3 and 7-4
7-23 and 7-24	7-23 thru 7-69/(7-70 blank)
A-1 and A-2	A-1 thru A-3/(A-4 blank)

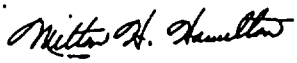
File this change sheet in front of the publication for reference purposes

Remove Pages	Insert Pages
B-1 thru B-4	B-1 thru B-4
D-1 thru-5/(D-6 blank)	D-1 thrul D-6
E-1 thru E-4	E-1 thru E-5/(E-6 blank)
None	F-5/(F-6 blank)
Index-1 thru Index-6	index-1 thru Index-8

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
02707

Distribution:
To be distributed in accordance with DA Form 12-37-E, Block No. 1559, Direct Support and General Supporl maintenance requirements for TM 9-2835-255-34.

CHANGE

NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D. C., *7 March 1991*

DIRECT SUPPORT
AND
GENERAL SUPPORT

Maintenance Manual

TURBINE ENGINE, FIELD SERVICE
MODEL AGT1500 (M1/1 PM1)(P/N 12287428)
AND
TURBINE ENGINE, FIELD SERVICE
MODEL AGT1500(M1A1) (PIN 12324029)
AND
CONTAINER
(NSN 8145-01-1 12-6574)

TM 9-2835-255-34, 28 October 1987, is changed as follows:

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

Remove Pages	Insert Pages
6-22.1 thru 6-22.4	None

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

By Order of the Secretary of the Army:

CARL E, VUONO
General, United States Army
Chief of Staff

PATRICIA P. HICKERSON
Colonel, United States ArmY
The *Adjutant Generai*

Distribution:

To be distributed in accordance wlth DAForm 12-37-E, Block 1559, Direct and General Support maintenance requirements for TM 9-2835-255-34.

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D. C., 21 November 1990

CHANGE

NO. 2

DIRECT SUPPORT
AND
GENERAL SUPPORT

Maintenance Manual

TURBINE ENGINE, FIELD SERVICE
MODEL AGT1500 (M1/IPM1) (PN 12287428)
AND
TURBINE ENGINE, FIELD SERVICE
MODEL AGT1500 (M1A1)(P/N 12324029)
AND
CONTAINER
(NSN 8145-01-112-6574)

TM 9-2835-255-34, 28 October 1987, is changed as follows:

1. Remove old pages and insert new pages as indicated below.

2. New or changed information is indicated by a vertical bar in the margin of the page.

Remove Pages	Insert Pages
Title Page	Title Page
c/(d blank)	c and d
3-23 and 3-24	3-23 and 3-24
3-37 and 3-38	3-37 and 3-38
4-1 thru 4-6	4-1 thru 4-6
5-1 and 5-2	5-1 and 5-2
5-5 thru 5-8	5-5 thru 5-8
5-11 thru 5-14	5-11 thru 5-14

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

Remove Pages	Insert Pages
6-1 thru 6-6	6-1 thru (6-5 blank)/6-6
6-9 thru 6-20	6-9 thru 6-20.1 /(6-20.2 blank)
None	6-22.1 thru 6-22.7(6 -22.8 blank)
7-1 and 7-2	7-1 and 7-2
7-5 and 7-6	7-5 and 7-6
7-17 and 7-18	7-17 and 7-18
9-1 and 9-2	9-1 and 9-2
9-5 and 9-6	9-5 and 9-6
9-19 thru 9-22	9-19 thru 9-22
9-27 and 9-28	9-27 and 9-28
9-43 and 9-44	9-43 and 9-44
9-47 and 9-48	9-47 and 9-48
9-51 and 9-52	9-51 and 9-52
9-61 and 9-62	9-61 and 9-62
B-3 and B-4	B-3 and B-4
D-1 thru D-4	D-1 thru D-5/(D-6 blank)
E-1 thru E-4	E-1 thru E-4
Index-1 thru Index-6	Index-1 thru Index-6

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

THOMAS F. SIKORA
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12–37–E (Block 1559) Direct Support and General Support maintenance requirements for TM9–2835–255–34.

CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 30 June 1989

INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE MANUAL

TURBINE ENGINE, FIELD SERVICE MODEL AGT 1500 (M1/IPM1) (P/N 12287428) AND TURBINE ENGINE, FIELD SERVICE MODEL AGT 1500 (M1A1) (P/N 12324029) AND CONTAINER (NSN 8145-01-112-8574)

TM 9-2835-255-34, 28 October 1987, is changed as follows:

1. Remove old pages and insert new pages as indicated below.

2. New or changed material is indicated by a vertical bar in the margin of the page.

Remove Pages	Insert Pages
5-1 and 5-2	5-1 and 5-2
5-31/(5-32 blank)	5-31 and 5-32
None	5-33/(5-34 blank)
D-3 and D-4	D-3 and D-4
E3 and E4	E-3 and E-4
Index-3 thru Index-6	Index-3 thru Index-6

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

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN II
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-37, Direct Support and General Support maintenance requirements for Tank, Combat, Full-Tracked, 105-MM, M1 Abrams and Tank, Main Battle, Full Tracked, 120-MM, M1A1. (Cumulative).

WARNING

CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU

Carbon monoxide is without color or smell, but can kill you. Breathing air with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Brain damage or death can result from heavy exposure. Carbon monoxide occurs in the exhaust fumes of fuel-burning heaters, internal combustion engines and in fumes caused by firing. Carbon monoxide can become dangerously concentrated under conditions of no air movement. Precautions must be followed to insure crew safety when the personnel heater or main or auxiliary engine of any vehicle is operated for any purpose.

1. **DO NOT operate personnel heater or engine of vehicle in a closed place unless the place is well-ventilated.**

2. **DO NOT idle engine for long periods of time without either the NBC main system or the TURRET BLOWER switch on. If tactical situation permits, open hatches.**

3. **DO NOT operate nuclear, biological, chemical, (NBC) system or use M25A1 mask to protect against carbon monoxide. They will only get rid of odors which would normally indicate the presence of carbon monoxide..**

4. **DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment doors removed unless necessary for maintenance purposes.**

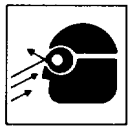
5. **DO NOT fire main gun or coax machinegun with NBC main system on or commander's and loader's hatches open.**

6. **BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either is present, IMMEDIATELY VENTILATE personnel compartments. If symptoms persist, remove affected crew to fresh air; keep warm; DO NOT PERMIT PHYSICAL EXERCISE; if necessary, give artificial respiration and get immediate medical attention (see FM 21-11).**

THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING

IS GOOD VENTILATION.

WARNING



MIL-C-81302 CLEANING COMPOUND (FREON) CAN KILL YOU

MIL-C-81302 Cleaning Compound (Freon) is a liquid without color that, during use, quickly turns to a gas heavier than air. Freon gas replaces oxygen needed for breathing and can kill you. Breathing high doses of air with Freon gas can cause a sleepy feeling, loss of concentration, a heavy feeling in the head, loss of muscle control, a change in heartbeat, or coma. Brain damage or death can result from heavy exposure. Freon gas can become dangerously concentrated under conditions of no air movement, such as in the bottom of a tank turret, or in a driver's station.

Freon can cause skin rash, and can blind you if it gets in your eyes.

Precautions must be followed to insure crew safety when Freon is being used for any purpose:

1. **DO NOT use Freon from an open container. Use only 16-ounce, or smaller, aerosol cans of Freon. The use of any other size or type of Freon is not allowed. Use the smallest amount of Freon possible to do a task.**

2. **DO NOT use Freon in a closed place unless the place has a lot of moving air. DO NOT use in a closed place by yourself, use the 'Buddy System.'**

3. **BE ALERT at all times for exposure symptoms when using Freon. Ignoring exposure symptoms can prevent escape from closed places. If symptoms are present, IMMEDIATELY REMOVE AFFECTED CREW TO FRESH AIR. DO NOT PERMIT PHYSICAL EXERCISE; if necessary, give artificial respiration, and get immediate medical attention. DO NOT GIVE STIMULANTS, such as coffee.**

4. **DO NOT use Freon near open fire. Freon may decompose and can produce poisonous gases that can cause injury or death.**

5. **ALWAYS WEAR protective clothing and rubber gloves when using Freon. Wash immediately with mild soap and water if Freon gets on skin or clothing. Do not wear clothing wet with Freon; remove and wash clothing before reuse.**

6. **ALWAYS WEAR safety glasses when using Freon. If Freon gets in your eyes, flush them with water for 15 minutes and then get medical attention.**

WARNING

Dry Cleaning Solvent P-D-680 is toxic and flammable. To avoid injury, wear protective goggles and gloves and use in a well-ventilated area. Avoid contact with skin, eyes; and clothes, and do not breathe vapors. Do not use near open fire or excessive heat. The flash point for Type l Dry Cleaning Solvent is IOO°F (38°C). and for Type ll is 138°F (50°C). If YOU become dizzy while using Dry Cleaning solvent get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

WARNING

Heavy parts can crush you. Keep out from under and clear of heavy parts at all times.

WARNING

Engine lubricating oils (MIL-L-23699 or MIL-L-7808) may contain tricresyl phosphate which, if taken internally, can produce paralysis. Engine oil may be absorbed through the skin. Wear long sleeves, gloves, goggles, and faceshield. If engine oil gets in your eyes, wash them immediately and get medical aid immediately. If engine oil gets on skin, thoroughly wash with soap and water. Wash hands thoroughly prior to eating or smoking. Application of these measures is considered an effective control of the hazard.

WARNING

Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chipguarding and personal protective equipment (goggles/faceshield, gloves, etc.).

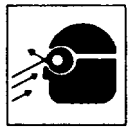
WARNING

Look at sling and lifting points for cuts. breaks. or wear before and during hoisting. Take off bad sling and get a new one. Sling can break and cause injury or death.

WARNING

Always wear eye protection when operating lathe. Failure to wear eye protection could result in serious injury.

WARNING



Oven cleaner is toxic. To avoid injury wear protective goggles and gloves and use in well-ventilated area. Avoid contact with eyes, skin, and clothing, and do not breathe vapors. If contact with eyes or skin is made, wash with water and get medical attention. If vapors cause discomfort, get fresh air immediately and get medical aid.

*TM 9-2835-255-34

TECHNICAL MANUAL

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 28 October 1987

INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE MANUAL

TURBINE ENGINE, FIELD SERVICE MODEL AGT1500 (M1/IPM1) (P/N 12287428), TURBINE ENGINE, FIELD SERVICE MODEL AGT1500 (M1AI) (P/N 12324029), CONTAINER (NSN 8145-01-112-6574), TURBINE ENGINE WITH CONTAINER MODEL AGT1500 (M1/IPM1/M1A1) (P/N 5705196) (NSN 2835-01-216-8639), AND TURBINE ENGINE WITH CONTAINER MODEL AGT1500 WITH BATTLE FIELD OVERRIDE AND PULSE JET (M1A1/M1A2) (P/N 57K2919) (NSN 2835-01-408-7048)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028-2 located in the back of this manual, directly to: Director, Armament and Chemical Acquisition and Logistics Activity, Al-TN: AMSTA-AC-NML, Rock Island, IL 61299-7630; (E-mail: AMSTA-AC-NML@ria-emh2.army.mil). A reply will be furnished to you.

TABLE OF CONTENTS

* This manual supersedes TM 9-2835-255-34,31 May 1983, including all changes.

TABLE OF CONTENTS (Continued)

HOW TO USE THIS MANUAL

The safest, easiest, and best way to do maintenance on the turbine engine is to use this manual. Learning to use this TM is as easy as reading through the next few pages. Knowing what's in this manual and how to use it will save you time, work, and help you avoid exposing yourself to unnecessary hazards while you do your job.

So, *where do you start?*

Right here if this is the first time you are using this TM. Be sure to completely read this section on how to use this manual first. There's a lot of information here you need to know.

ORGANIZATION

This manual is divided into two types of maintenance activities. These are: Troubleshooting or location of faults by symptoms you can detect and Maintenance Procedures that are used to correct faults and replace failed parts. You will be using the procedures in this manual to do one of these types of maintenance. Within this manual you will find the material organized in functional group code order like the Maintenance Allocation Chart in (TM 20-1). This allows the TM to be alined with its applicable Repair Parts and Special Tools List (RPSTL). For information on how to use the RPSTL, refer to the introduction in TM 9-2835-255-34P.

General Maintenance Instructions (GMI) are provided in Appendix F to assist you with common knowledge information which you might not use every day. They are provided in Appendix F as general instructions so the specific steps won't have to be included in every procedure. You should familiarize yourself with all the information in the GMI. GMI includes information on the following subjects:

- **Cleaning Mechanical Parts**
- **Painting**
- **Unpacking and Packing**
- **Protecting and Handling Engine**
- **Care of Tubes and Hoses**
- **Removing or Installing Connectors**
- **Care of Removed Parts and Components**
- **Care of Slings**
- **Silver Braze Inspection**

HOW TO FIND PROCEDURES

If you're using the manual to perform Troubleshooting, go to page 3-1 and read HOW TO USE TROUBLESHOOTING and proceed according to the instructions there. If you are using the manual to perform repair or replacement of a part that you already know is bad, you would start by locating the part to be replaced in the Alphabetical Index located at the back of the last part of this manual.

HOW TO USE THIS MANUAL - Continued

How do you find the correct procedure?

Look in the Alphabetical Index for a key noun from the vehicle system or part nomenclature. The Alphabetical Index lists each task under one or more headings. For example, the procedure for TOP WELDMENT REPLACEMENT, would be listed under "T" for "TOP Weldment" and also under "W" for "Weldment, Top."

Once you've located the correct procedure, read through it to determine if you have everything you need to perform the job, Make sure all the Equipment Conditions have been met. Familiarize yourself with the the potential hazards described by the WARNINGS and CAUTIONS. You must familiarize yourself with the entire maintenance procedure before beginning the maintenance task.

HOW TO USE A MAINTENANCE PROCEDURE

The first page of a maintenance procedure lists everything you will need to perform that procedure. The following paragraphs describe all the blocks of information you will find there.

APPLICABILITY. If the procedure is applicable to specific models, the data under this heading will identify those model differences to you. If the procedure is applicable to all models, it's assumed and this heading will not even be listed.

TOOLS. Individual tools from your mechanic's tool kit will not be listed under this heading. If any tools from this kit are required, the tool kit itself will be listed as the first item. Special tools, fabricated tools, and tools from any other source will be listed with a reference to a specific item and appendix number. The referenced appendix will provide you with the necessary information to find or make the tool. Appendix D will list all special tools, tools from supply catalog sets, kits and outfits, and tools which must be acquired through the GSA catalog. Appendix C will list the fabricated tools with complete fabrication instructions. In some procedures two of the same tool may be required to perform the specific steps but only one is included in the mechanic's tool kit. In such cases, the second tool will be listed as an additional requirement to the mechanic's tool kit.

SUPPLIES. If any expendable or consumable supplies are needed to perform the task, they will be listed under this heading along with the quantity in parentheses and a reference to an item and appendix in the back of the TM. The referenced appendix will give you the detailed information necessary to requisition the supply if you don't have it on hand, Replacement parts are not normally listed under this heading. The inspection steps in the removal or disassembly procedure will tell you which parts to replace. Mandatory repair parts (parts that are destroyed in disassembly or not normally re-used, such as gaskets and lockwashers) are listed under this heading by their nomenclature only. Refer to TM 9-2835-255-34P for information you need on repair parts.

PERSONNEL REQUIRED. The number of personnel required to perform the procedure will be listed here. You will find this heading only in procedures that require more than one person.

EQUIPMENT CONDITION. This heading will list only the special conditions you will have to meet in order to perform the procedure. In addition to these specific conditions any repairs must be done on clean work surface:

HOW TO USE THIS MANUAL - Continued

Procedures that must be completed before starting the specific job you are doing (Preliminary Procedures) will be listed in past tense with a page or TM reference. You will have to do all the procedures listed under "EQUIPMENT CONDITION" of those tasks also before starting the specific procedure you have set out to do. As an example, when the equipment condition of Spline shaft removed (page 6-2)" is listed and you go to that procedure and find an equipment condition of "Engine disconnected from transmission (TM 34-l)," then you must do that procedure also.

REFERENCES. These are other technical publications you will need to do the task. This heading will appear only when other references are needed,

FEATURES OF THE NEW PROCEDURE FORMAT

MULTIPLE EXPERIENCE LEVEL COVERAGE. This means that the TM is written with both SUMMARY and DETAIL steps. The SUMMARY steps in all capital letters are basic steps that the experienced mechanic requires to perform the job. The detail steps, if needed, follow immediately and are lettered and shown in regular case letters. This reduces the material the experienced mechanic needs to review to perform a job.

PICTORIAL WARNINGS. Certain general warnings are shown by pictures rather than by text within procedures. Refer to the list of WARNINGS found just after the front cover of this TM for the specific meaning of each pictorial warning used in this TM, You must become familiar with them. Until you are, always refer to the detailed WARNING in the front of the TM. These pictorial warnings are just as important as the specific text warnings that are also used throughout the TM. When you see a pictorial warning in the very beginning of the procedure you should heed the precautions throughout. For example, when you see the following pictorial warning,

then you should follow the precautions for keeping away from open fire and use in a well-ventilated area whenever you use the adhesive in the procedure. Failure to heed these warnings could result in injury or death to yourself or others,

USE OF TOOLS AND PERSONNEL. Each procedure lists the tool kits and tools that you will need for that procedure. The procedural steps will not tell you how and where to use common tools. Also, the procedural steps will not tell you which persons do which steps in procedures with more than one person. The mechanic responsible for the task should direct the rest of the personnel what to do. If you have difficulty determining what tools to use or how to use personnel see your supervisor for help.

HOW TO USE THIS MANUAL - Continued

REFERENCES. References from one procedure to another within this TM will be by page number. Referencing within other levels of maintenance, you will have to know which vehicle you are working on. References within other levels of maintenance direct you to the maintenance level and vehicle (i.e., TM 20-1). If you are working on an M1 or IPM1 engine, you will have to go to the 255 series manuals, and on the M1A1, the 264 series manuals. Referencing to other maintenance publications will be by the full TM identification. You will have to go to the Alphabetical Index of that TM to find the information you need.

PROCEDURE ORGANIZATION. Most of the procedures in this TM fall into the category of either a replacement or repair. These procedures will contain both the removal and installation or the disassembly and assembly steps in the same procedure.

LOCATING COMPONENTS. The use of locator illustrations in this TM have been minimized. Equipment which is specifically located in the performance of the procedures to meet the Equipment Conditions may not have locators in the beginning of the procedure. Where locators are required, they will usually be used in the beginning of the Removal subtask. Locators may be used in Installation subtasks. If for some reason you are in doubt of location of a component, refer to (TM 10). If YOU **still have trouble see your supervisor.**

CHAPTER 1

INTRODUCTION

SECTION I. GENERAL INFORMATION

SCOPE

Type of Manual: Intermediate Direct Support and Intermediate General Support

This manual contains use of container and troubleshooting and maintenance procedures for the following turbine engine and engine components.

- Top Weldment
- Engine Shipping Container
- Forward Engine Module
- Rear Engine Module
- Gearbox Module
- Accessory Gearbox
- Reduction Gearbox Lubrication System
- Starter Motor

Model Number and Equipment Name AGT1500 - Turbine Engine and Container

Purpose of Equipment: Provides propulsion power for the Abrams series tanks.

MAINTENANCE FORMS AND RECORDS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, as contained in the Maintenance Management update.

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Refer to TM 750-244-6 for instructions on destruction of army materiel to prevent enemy use.

PREPARATION FOR STORAGE AND SHIPMENT

Refer to (TM 20-1) for instructions on preparation for storage and shipment.

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR'S)

If your equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you do not like about your equipment. Let us know why you do not like the design. Tell us why a procedure is hard to perform. Put the improvement on an SF 368 (Quality Deficiency Report). Mail it to us at: Commander, U.S. Army Tank-Automotive Command, ATTN: AMSTA-QRT, Warren, MI 48397-5000. A reply will be furnished to you.

SECTION I. GENERAL INFORMATION (Continued)

WARRANTY INFORMATION

All parts warranted by the manufacturer and the period of coverage are called out in the Department of the Army Technical Bulletin TB 9-2835-255-14. Warranty starts on the date found on DA Form 2408-9 in the logbook. See details as described in TB 9-2835-255-14. Report all defects in materiel or workmanship to your supervisor who will take appropriate action.

SECTION II. EQUIPMENT DESCRIPTION AND DATA

Refer to (TM 10-1) and (TM 20-1) for Equipment Description and Data.

CHAPTER 2

GENERAL INSTRUCTIONS

SECTION I. REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

Refer to Maintenance Allocation Chart (TM 20-1) and Repair Parts and Special Tools List (TM 9-2835-255-34P) for special tools. Tools to be fabricated are located in Appendix C, Illustrated List of Manufactured Items.

REPAIR PARTS

Repair parts are listed and illustrated in the Repair Parts and Special Tools List (TM 9-2835-255-34P) covering Intermediate Direct Support and General Support Maintenance for this equipment.

SECTION IL SERVICE UPON RECEIPT

For Service upon Receipt refer to (TM 20-1).

CHAPTER 3

TROUBLESHOOTING

CHAPTER INDEX

OVERVIEW:

This chapter contains instructions for direct support (D/S) level trouble shooting of the Abrams tank engine assembly" It contains the following sections:

- Section I describes how to use Troubleshooting and includes a sample procedure.
- Section II contains the Fault Symptom Index which identifies and locates the correct troubleshooting procedure for a given engine symptom.
- Section III contains Troubleshooting which provides the troubleshooting procedures for the symptoms identified in Section II.

SECTION I. HOW TO USE TROUBLESHOOTING

SCOPE:

Troubleshooting is a step-by-step process for determining the cause of an engine problem. This section will explain the overall approach to the troubleshooting procedures presented in chapter 3. References within this manual will be by page number. Some references to other manuals will only be by TM number. If you are given a reference to TM 20-1, for instance, refer to the -20 manual for your engine and go to the index at the end of the last volume to find the proper task location. For further information on references, be sure to read How to Use This Manual on page iii.

PURPOSE:

There are four key steps needed for good troubleshooting:

- Identify the Symptom. To identify the symptom, read the DA Form 2404, 2407 or 5504 that was filled out and describes the engine symptom. If symptom is one that can be verified, such as low pressure compressor rubs when turned by hand, verify the symptom.

- Find the Procedure. Use the Fault Symptom Index (Section II) to locate your symptom and the paragraph and page number of the troubleshooting procedure you need. The symptom you have may not be worded exactly as described in the index but find the symptom that most closely resembles the engine malfunction.

- Isolate the Fault. All troubleshooting procedures are located in Troubleshooting (Section III). They are in the form of fault isolation flow charts; see Sample Procedure on page 3-4. Each flow chart begins with a specific fault symptom. Included at the beginning of most flow charts, is a brief description and illustration of the system or parts you are troubleshooting for that particular symptom. Refer to this to help you understand the troubleshooting logic in the flow chart. Step-by-step instructions for finding and correcting the fault are given for each symptom. Illustrations are included to show the location of test points and engine related hardware. Carefully answer each question in the flow chart.

- Verify the Repair. Most fault isolation procedures will lead to the replacement of a component. Follow the reference to the maintenance procedure, and replace the faulty part or module. If your symptom was one that could be verified, such as low pressure compressor rubs when turned by hand, make the repair, and verify that the symptom is gone. The statement verify problem is solved. " means to operate the engine to be sure Your symptom or any related symptom is no longer present. If your engine still has a problem after a troubleshooting procedure has been performed, it may have had more than one fault. Check the Fault Symptom Index for another troubleshooting procedure and continue to troubleshoot.

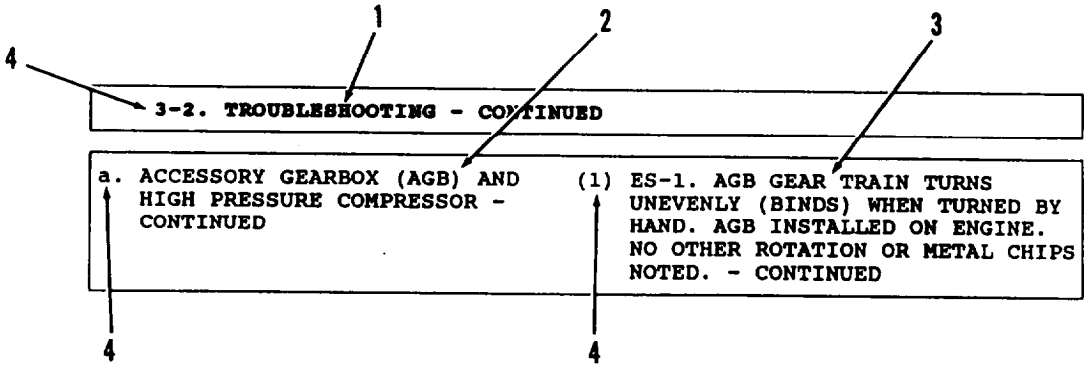
STANDARD TROUBLESHOOTING PRACTICES:

The following steps need to be performed each time you are doing a troubleshooting procedure. These standard practices will improve the accuracy of fault isolation and help prevent damage to the engine or test equipment.

- Debris taken from engine oil system strainer screens and magnetic chip collectors must be inspected carefully. Carbon debris can be mistaken for metal chips because the carbon is also slightly magnetic allowing it to stick to magnetic chip collects. To identify carbon, simply crush the debris between the fingers. If the debris crumbles, it is carbon. The presence of carbon in the oil system is normal and not cause for rejecting a component.
- Any time a connector is disconnected, it should be checked for cleanliness and broken, bent, or pushed in pins. If you find missing or damaged pins, repair or replace connector or harness as required.
- Ensure electrical connectors are fully mated. Hand tighten connectors whenever possible and only use plastic jaw pliers as a last resort. There are three types of locking mechanisms for engine electrical connectors. When connecting threaded connectors, if connector has alignment indicator mark, tighten connector until washer alines with indicator mark. If there is no indicator mark, ensure that connector is fully mated by turning connector until a metal-to-metal bottoming is felt. Wiggle harness slightly while turning connector to ensure that connector is fully mated. When connecting bayonet type connectors, turn connector until an audible click is heard.
- Always look for obvious damage to harnesses and all surrounding components while checking for loose electrical connectors or making harness disconnects. Remember to connect all cables and harnesses that were disconnected in order to get at the connector being checked. Replace all harnesses where outer shield is damaged to the extent that inner conductors are visible.
- Make sure all test connectors are covered with provided metal caps whenever testing is not being performed.

SAMPLE PROCEDURE:

These sample procedure blocks show the different parts of a fault isolation procedure and describe their purposes.



1. SECTION TITLE: Provides for dividing troubleshooting chapter into major sections. Appears on every page of a procedure along with items 2 and 3, as applicable, to make it easier to locate specific information.

2. PRINCIPLE COMPONENT NAME: Provides method of grouping faults under a specific heading. This may include faulty components, or it may include a part that indicates a fault (Example: AGB Magnetic Plug).

3. FAULT DESCRIPTION: Provides a fault symptom reference number and description as referenced by the Fault Symptom Index.

4. PARAGRAPH NUMBER: Section number, component letter and fault description number provide a paragraph number as referenced by the Fault Symptom Index (Example: para 3-2. a. (1)).

HOW TO USE TROUBLESHOOTING - CONTINUED

SAMPLE PROCEDURE - CONTINUED

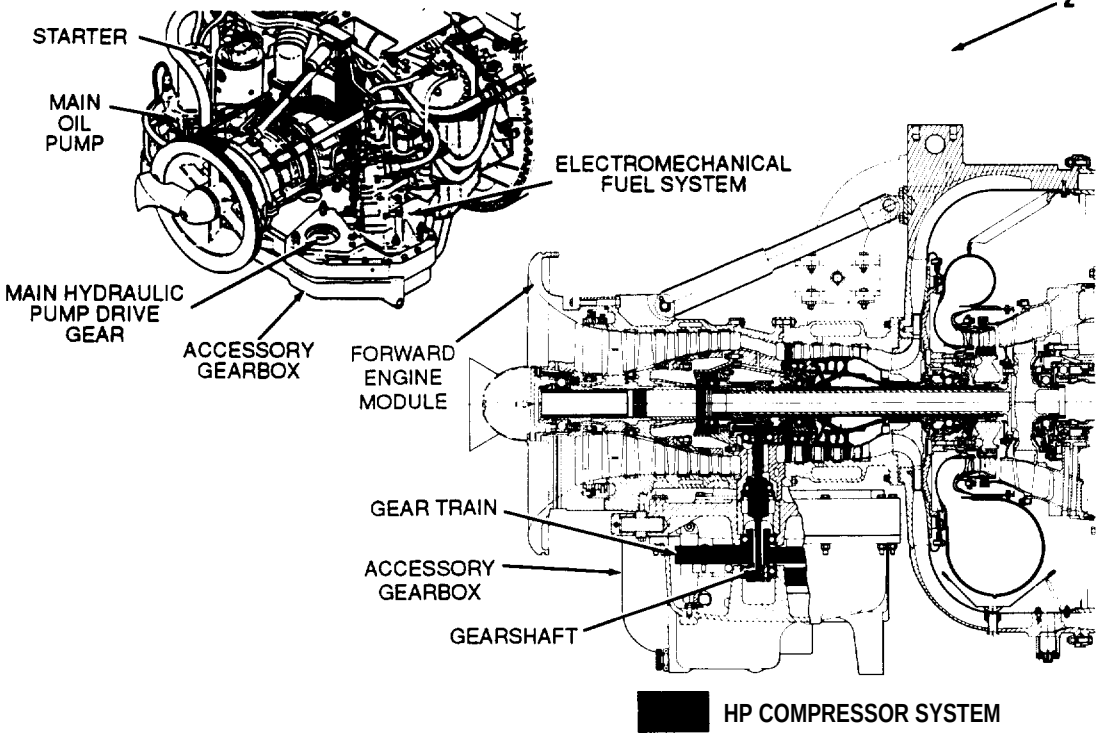
3-2. TROUBLE SHOOTING

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR	(1) ES-1. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND. AGB INSTALLED ON ENGINE. NO OTHER ROTATION OR METAL CHIPS NOTED.

This section contains troubleshooting to correct the cause of binding or uneven turning when the main hydraulic pump drive gear is turned by hand. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. The main oil pump, electro-mechanical fuel system (EMFS), and starter are mounted on and coupled to the AGB through splines and gears. During the start cycle, starter rotation causes the high pressure compressor system, through AGB gears, to turn. After the start cycle is completed, the drive sequence reverses, and the high pressure compressor system drives the AGB gear train. A damaged or broken gearshaft (coupling between AGB and high pressure compressor system) could cause uneven turning or binding to be felt at the AGB. If the high pressure compressor is damaged, it could cause binding within the forward engine module which could be felt when turning the AGB gears. Damaged AGB gears or contamination in the AGB would also cause this symptom. The art on this page provides an overview of the AGB gear train and the high pressure compressor system. Refer to this page along with in-text art while performing troubleshooting.

1

2

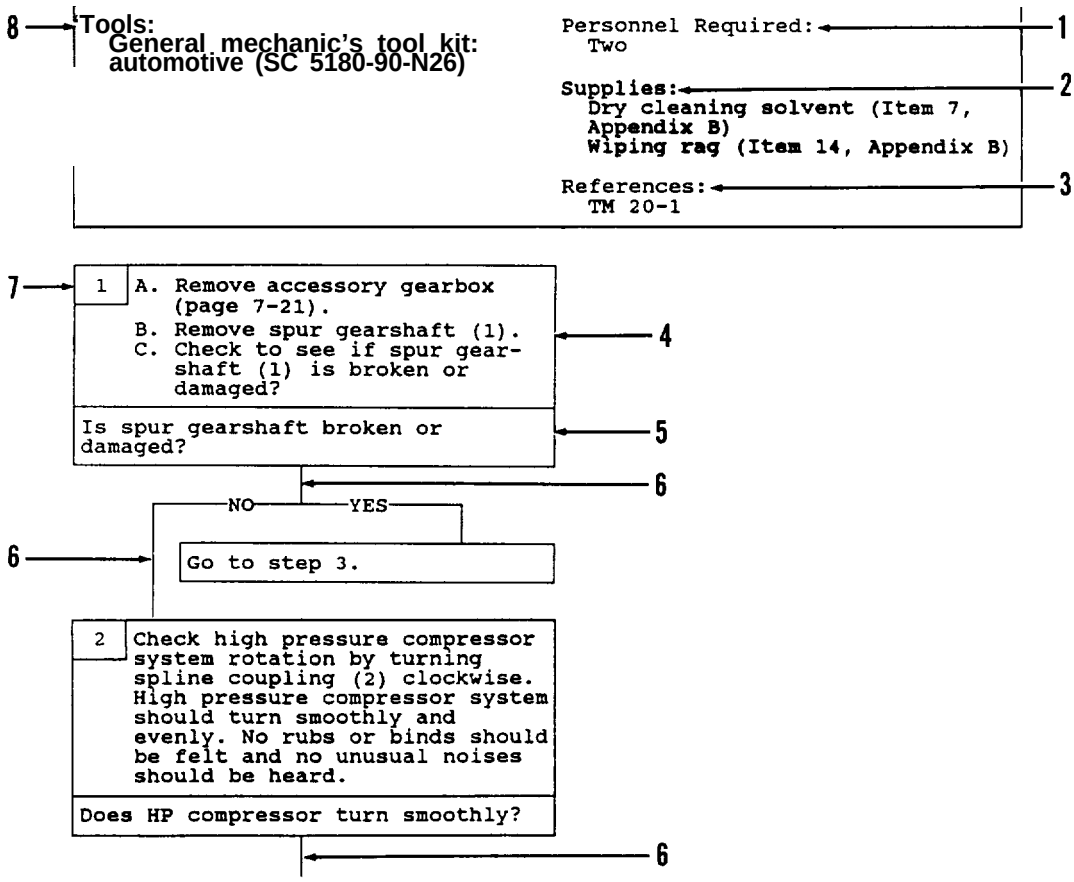


1. **TASK INTRODUCTION: Provides general explanation of components or system which might cause the fault symptom.**

2. **INTRODUCTION ART: Provides an overall view of components and systems referred to in the Task Introduction.**

HOW TO USE TROUBLESHOOTING - CONTINUED

SAMPLE PROCEDURE - CONTINUED



1. PERSONNEL REQUIRED: This is only used when more than one mechanic is required to perform the procedure.

2. SUPPLIES: This lists any supply items or mandatory replacement parts needed to perform the procedure.

3. REFERENCES: This is only used when other technical publications are needed to do the task.

4. STEP BLOCK: This tells you to perform one or more actions and provides references for further information when required. It may have a question block attached or flow lines may lead you to one or more question blocks.

5. QUESTION BLOCK: Asks a question about results of performed actions. Answer the question yes or no, then follow the flow line to the next block.

6. FLOW LINES: Provide the paths to follow to complete the procedure.

7. STEP NUMBER: Provides for sequencing and referencing of steps. All step references are to these numbers.

8. TOOLS: This lists special, fabricated, common tools not found in assigned tool box, or test equipment needed to do the procedure.

HOW TO USE TROUBLESHOOTING - CONTINUED

SAMPLE PROCEDURE - CONTINUED

CONTINUED FROM STEP 2

3 Check to see if IGV bellcrank spring pin (1) is loose, nxssxng or broken.

NOTE

Under normal operation, pin may extend up to l/4-inch out of bellcrank (2).

Is pin loose, missing or broken?

NO — YES

3 → Record the following symptom: "IGV bellcrank spring pin is loose missing *or* broken."

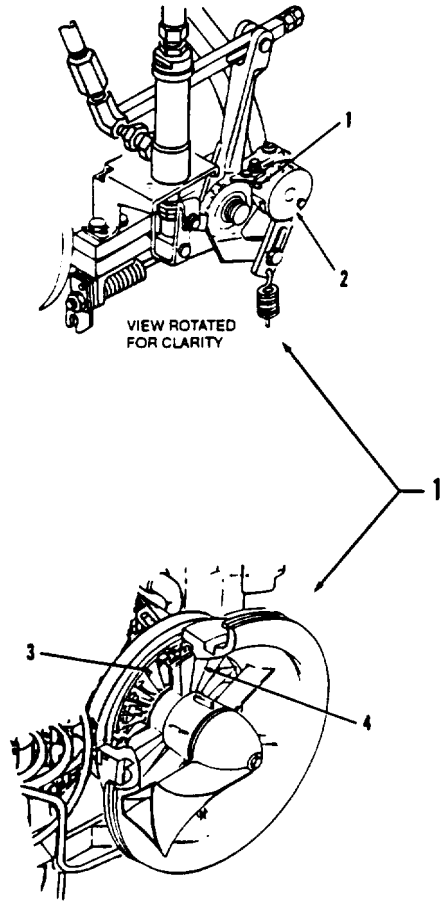
4 **WARNING**

Compressor blades are sharp and *can* cut you. Be careful not to pinch *fingers* between blades and vanes when turning compressor.

Check *rotation of* low pressure (LP) compressor (3) by reaching into engine inlet and through inlet guide vane (4) with finger. Compressor (3) should turn smoothly without rubbing or binding.

Does LP compressor turn smoothly without rubbing *or* binding?

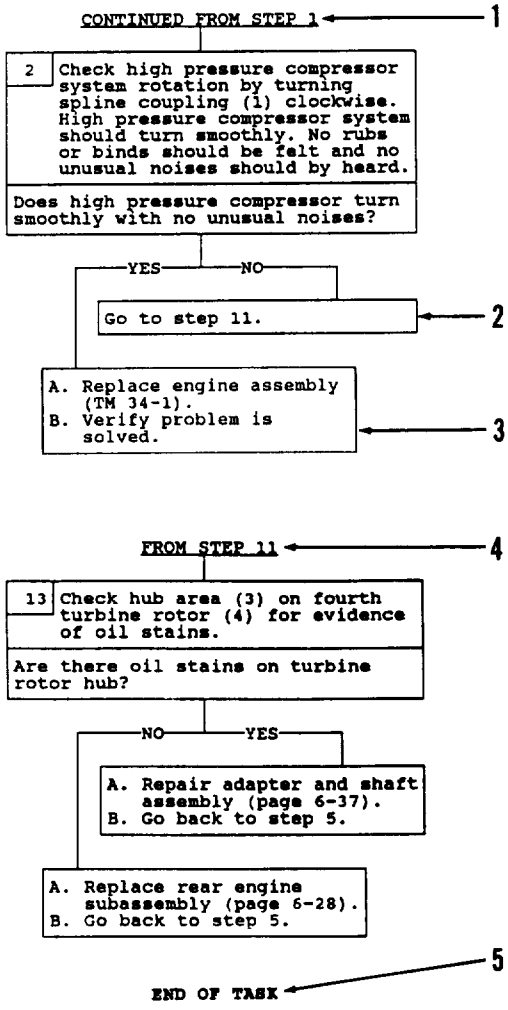
CONTINUED ON NEXT PAGE ⟵ 2



1. **PROCEDURAL ILLUSTRATION:** The illustration will show you where the components called out in the step block are located.
2. **BOTTOM PAGE CONNECTOR:** Indicates that procedure is continued on the following page.
3. **RECORD SYMPTOM BLOCK:** Tells you that a short note should be written to record a symptom. Includes an example of what should be recorded.

HOW TO USE TROUBLESHOOTING - CONTINUED

SAMPLE PROCEDURE - CONTINUED



1. TOP PAGE CONNECTOR: Indicates that procedure is continued from previous step.

2. GO TO STEP BLOCK: This block will send you to another part of the fault isolation procedure to continue troubleshooting.

3. CORRECTIVE ACTION BLOCK. This tells you how to correct a problem. In most cases it will give you a maintenance reference and tell you to replace a part. It may also tell you to verify that your repair has solved your problem. Verify problem is solved. means to Operate the engine to be sure your symptom or any related symptom is no longer present.

4. FROM STEP CONNECTOR: This indicates that the procedure is continued from a Go to Step Block.

5. END OF TASK: Tells you that fault isolation for this symptom is completed.

SECTION II. FAULT SYMPTOM INDEX

GENERAL:

The Fault Symptom Index contains a list of engine symptoms. Symptoms are grouped under related components (items) and each symptom has an engine symptom (ES) reference number. Also listed is the paragraph and page number for the appropriate troubleshooting procedure for each symptom.

3-1. FAULT SYMPTOM INDEX

ITEM (NUMBER)	SYMPTOM	PARAGRAPH	PAGE
ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR			
ES-1	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND. AGB INSTALLED ON ENGINE. NO OTHER ROTATION OR METAL CHIPS NOTED.	3-2. a. (1)	3-16
ES-2	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND.	3-2. a. (2)	3-20
ES-3	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED.	3-2. a. (3)	3-28
ES-4	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS.	3-2. a. (4)	3-33
ES-5	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS.	3-2. a. (5)	3-38
Es-6	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.	3-2. a. (6)	3-45

3-1. FAULT SYMPTOM INDEX - CONTINUED

ITEM (NUMBER)	SYMPTOM	PARAGRAPH	PAGE
ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR (CONTINUED)			
ES-7	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS.	3-2. a. (7)	3-50
ES-8	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.	3-2. a. (8)	3-56
ES-9	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS.	3-2. a. (9)	3-69
ES-10	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.	3-2. a. (10)	3-81
ES-11	AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.	3-2. a. (11)	3-96

3-1. FAULT SYMPTOM INDEX - CONTINUED

3-1. FAULT SYMPTOM INDEX - CONTINUED

3-1. FAULT SYMPTOM INDEX - CONTINUED

ITEM (NUMBER)	SYMPTOM	PARAGRAPH	PAGE
LOW PRESSURE COMPRESSOR			
ES-28	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED.	3-2. h. (1)	3-223
ES-29	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND.	3-2. h. (2)	3-228
ES-30	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF THE ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS.	3-2. h. (3)	3-237
ES-31	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS.	3-2. h. (4)	3-241
ES-32	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.	3-2. h. (5)	3-248
ES-33	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS.	3-2. h. (6)	3-253
ES-34	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS.	3-2. h. (7)	3-265

3-1. FAULT SYMPTOM INDEX - CONTINUED

ITEM (NUMBER)	SYMPTOM	PARAGRAPH	PAGE
LOW PRESSURE COMPRESSOR (CONTINUED)			
ES-35	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.	3-2. h. (8)	3-276
ES-36	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.	3-2. h. (9)	3-287
ES-37	LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.	3-2. h. (10)	3-293
MAIN OIL PUMP MAGNETIC PLUG			
ES-38	MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. NO OTHER ROTATION OR METAL CHIPS NOTED.	3-2. i. (1)	3-299
OIL PUMP TO OIL COOLER FLUID FILTER			
ES-39	METAL CHIPS ARE PRESENT IN THE OIL PUMP TO OIL COOLER FLUID FILTER. NO OTHER ROTATION OR METAL CHIPS NOTED.	3-2. j. (1)	3-302

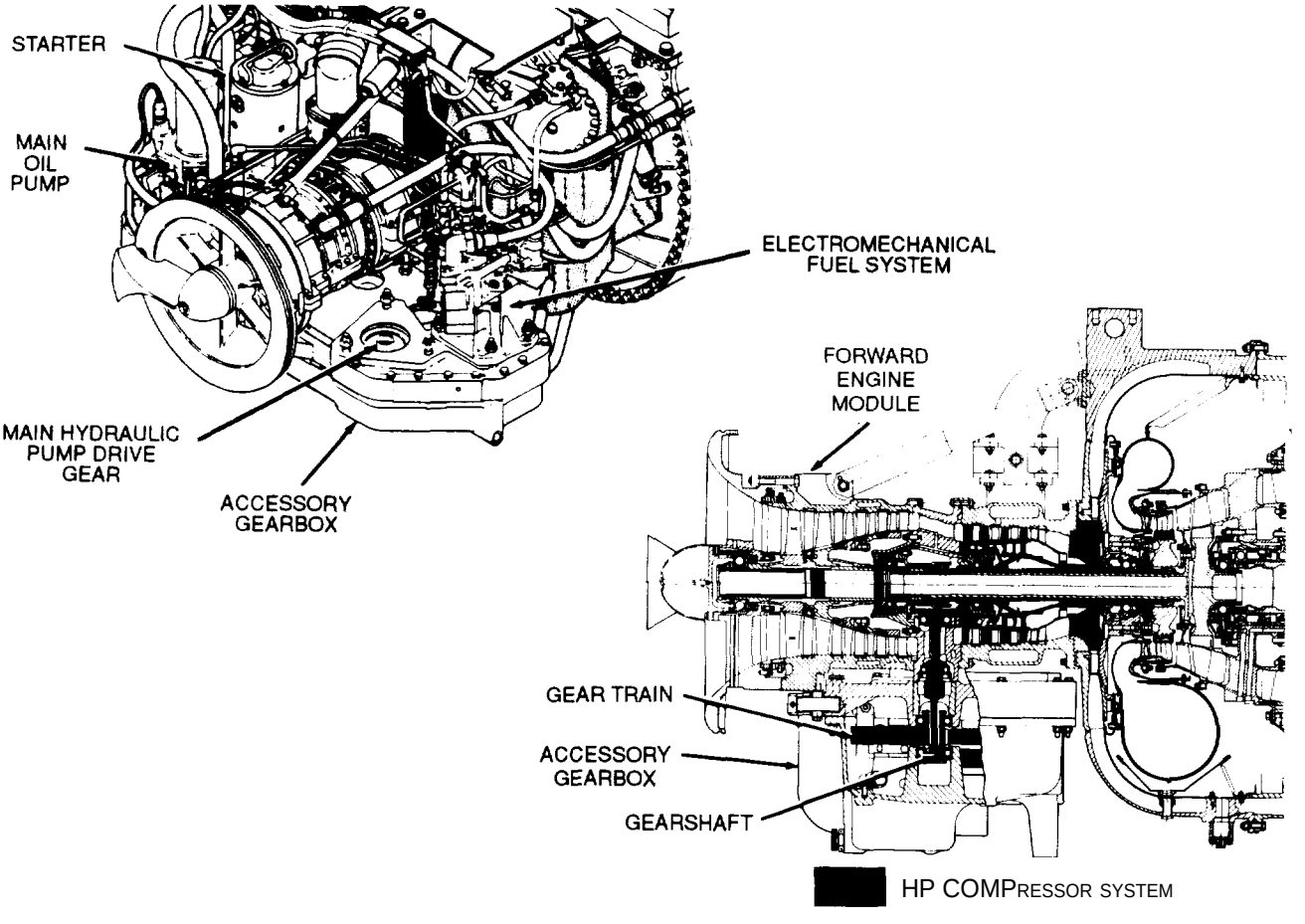
3-1. FAULT SYMPTOM INDEX - CONTINUED

SECTION III. TROUBLESHOOTING PROCEDURES

3-2. TROUBLESHOOTING

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR	(1)	ES-1. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND. AGB INSTALLED ON ENGINE. NO OTHER ROTATION OR METAL CHIPS NOTED.

This section contains troubleshooting to correct the cause of binding or uneven turning when the main hydraullc pump drive gear is turned by hand. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. The main oil pump, electro-mechanical fuel system (EMFS), and starter are mounted on and coupled to the AGB through splines and gears. During the start cycle, starter rotation causes the high pressure compressor system, through AGB gears, to turn. After the start cycle is completed, the drive sequence reverses, and the high pressure compressor system drives the AGB gear train. A damaged or broken gearshaft (coupling between AGB and high pressure compressor system) could cause uneven turning or binding to be felt at the AGB. If the high pressure compressor is damaged, it could cause binding within the forward engine module which could be felt when turning the AGB gears. Damaged AGB gears or contamination in the AGB would also cause this symptom. The art on this page provides an overview of the AGB gear train and the high pressure compressor system. Refer to this page along



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(1) ES-1. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND. AGB INSTALLED ON ENGINE. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26) AGB gear train handle (Item 42, Appendix D)	Supplies: Wiping rag (Item 14, Appendix B)

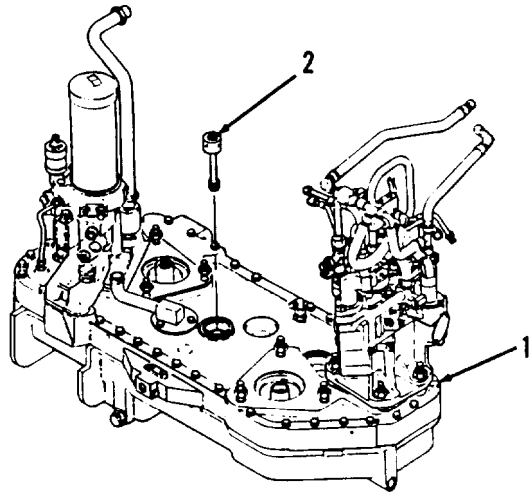
1	A. Remove AGB module (1) from engine (page 7-6). B. Remove spur gearshaft (2). C. Check to see if spur gearshaft (2) is broken or damaged.
Is gearshaft broken or damaged?	

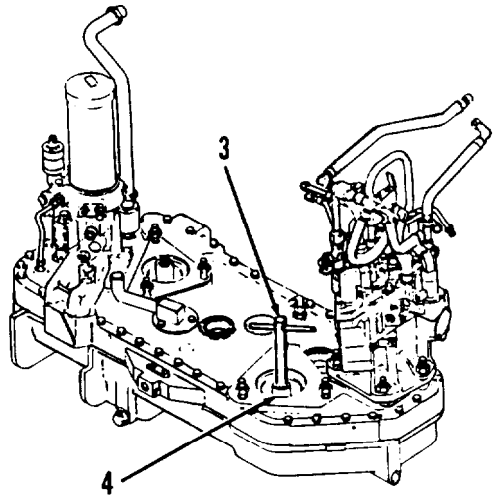
YES — NO

Go to step 3.

2	A. Put handle (3) in main hydraulic pump drive gear assembly (4). B. Check rotation of AGB gears by turning handle (3) clockwise. Handle should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.
Does handle turn smoothly with no unusual noises?	

CONTINUED ON NEXT PAGE





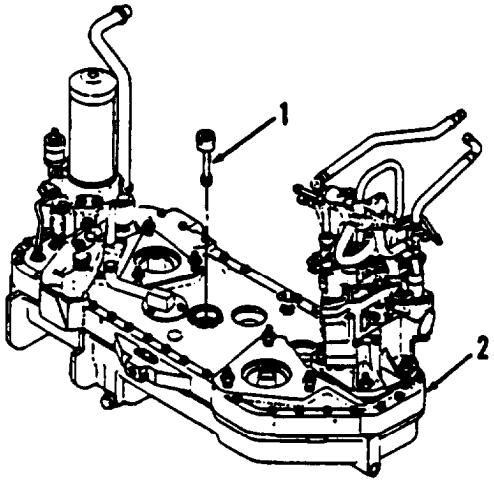
3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(1)	ES-1. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND. AGB INSTALLED ON ENGINE. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Put new spur gearshaft (1) in AGB (2).
B. Inspect splined coupling (3) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).
C. Verify problem is solved. Rotate gearshaft and check for binding. If binding is evident, replace forward engine module (page 5-13).

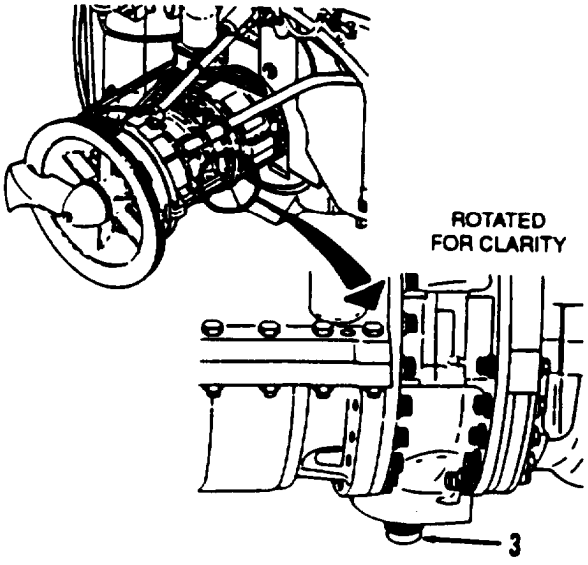


A. Clean AGB (page 7-46).
B. Verify problem is solved.

FROM STEP 1

3 Check high pressure compressor system rotation by turning splined coupling (3) in both directions. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does hi h pressure compressor turn smooth y with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(1)	ES-1. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND. AGB INSTALLED ON ENGINE. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 3

YES

A. Clean AGB (page 7-46).
B. Verify problem is solved.

NO

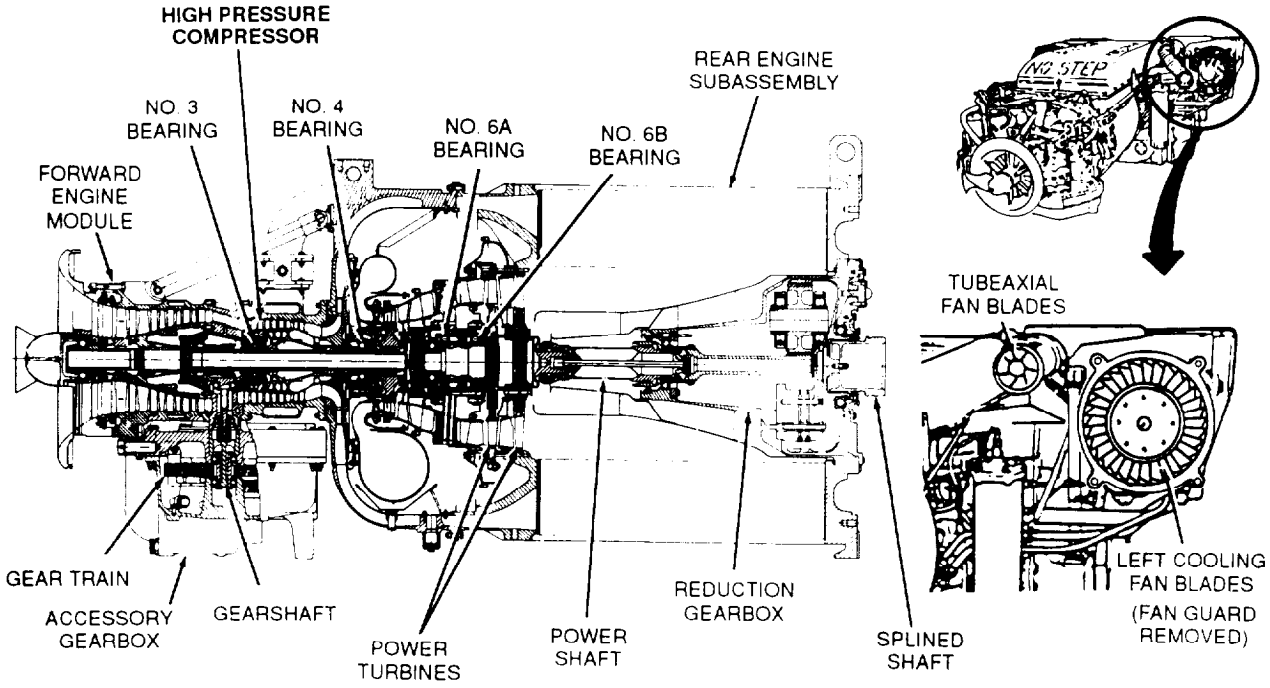
A. Inspect splined coupling (3) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).
B. Verify problem is solved. Rotate gearshaft and check for binding. If binding is evident, replace forward engine module (page 5-13).

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(2) ES-2. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND.

This, section contains troubleshooting to locate and correct the cause(s) of binding when the AGB gear train is turned by hand, along with rubbing or binding when the tubeaxial fan blades or left cooling fan blades are turned by hand. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module position No. 3 or 4 bearing, or AGB gears and/or bearings, binding will be felt when the AGB gear train is turned by hand. The power turbine and reduction gearbox (RGB) are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB bearings and/or gears, binding will be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The transmission is mechanically coupled to the RGB through a splined shaft. If there is internal transmission damage, binding will be felt when turning the tubeaxial fan or cooling fan blades by hand. Since the AGB and high pressure compressor assemblies have no mechanical connection with the power turbine and RGB assemblies, this symptom indicates two separate failures. The possibility exists of the transmission causing binding. The art on this page provides an overview of the AGB gear train/high pressure compressor and the power turbine/RGB systems. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED

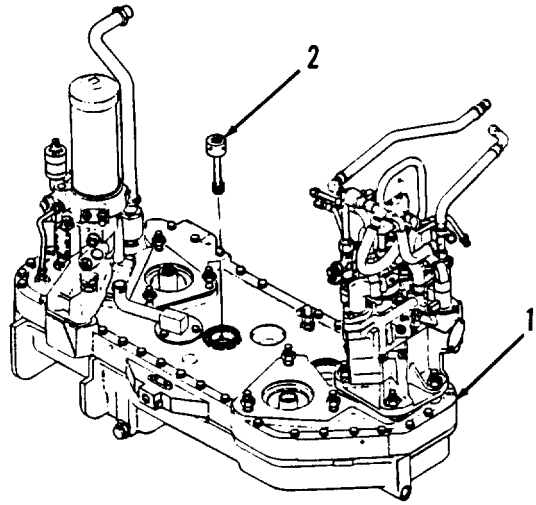
(2) ES-2. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
AGB gear train handle (Item 42, Appendix D)

Supplies:
Wiping rag (Item 14, Appendix B)

References:
TM 34-1

1 A. Disconnect engine assembly from transmission assembly (TM 34-1). .
B. Remove AGB module (1) from engine (page 7-6).
C. Remove spur gearshaft (2).
D. Check to see if spur gearshaft (2) is broken or damaged.

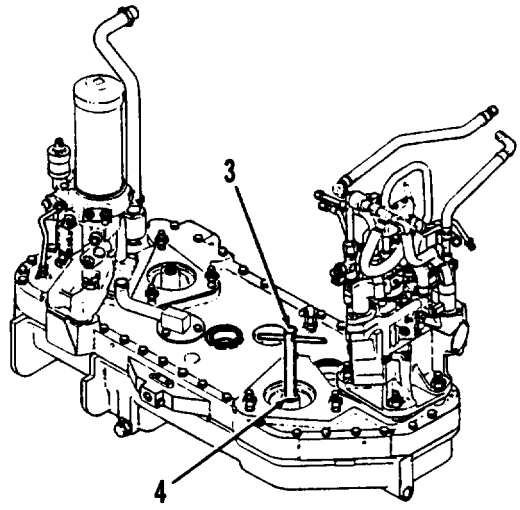


Is qearshaft broken or damaged?

YES — NO

Go to step 3.

2 A Put handle (3) in main hydraulic pump drive gear assembly (4).
B. Check rotation of AGB gears by turning handle (3) clockwise. Handle should turn smoothly. No rubs or or binds should be felt and no unusual noises should be heard.



Does handle turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED

(2) ES-2. . AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Put new spur gearshaft (1) in AGB (2).
B. Go to step 7.

A. Clean AGB (page 7-46).
B. Put new spur gearshaft (1) in AGB (2).

3 Check high pressure compressor system rotation by turning spline coupling (3) clockwise. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

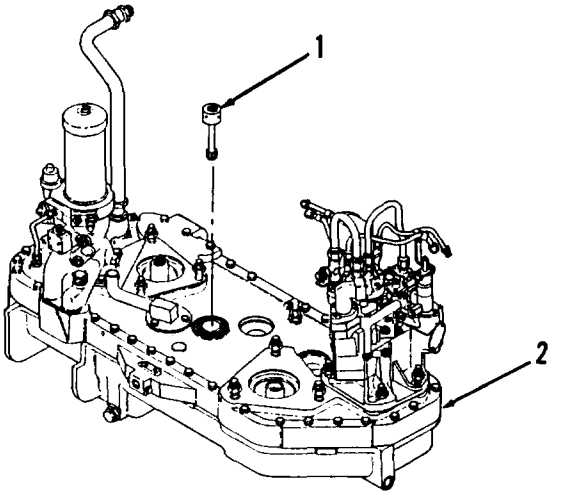
Does high pressure compressor turn smoothly with no unusual noises?

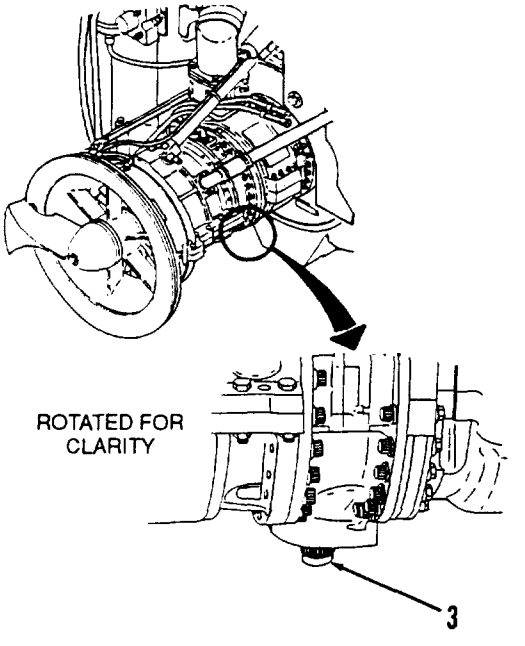
YES — NO

Go to step 7.

Clean AGB (page 7-46).

CONTINUED ON NEXT PAGE





3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED

(2) ES-2. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

CONTINUED FROM STEP 3

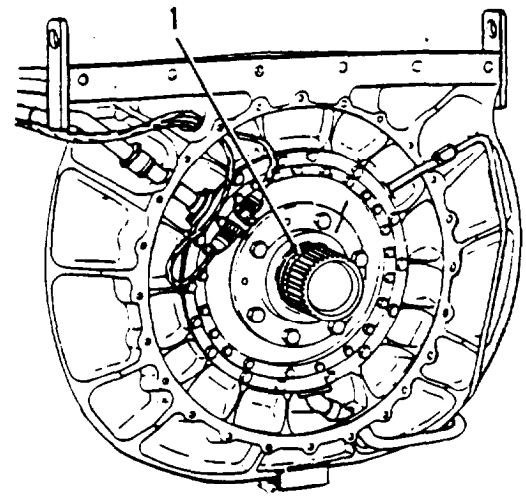
4

NOTE

Splined shaft (1) does not turn easily. You may have to use both hands and some force.

Check rotation of splined shaft (1) by turning shaft (1) clockwise. Shaft should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



NO

A. Troubleshoot transmission (TM 34-1).
B. Connect engine assembly to transmission assembly (TM 34-1).
C. Install AGB (page 7-22).
D. Verify problem is solved.

YES

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(2)	ES-2. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

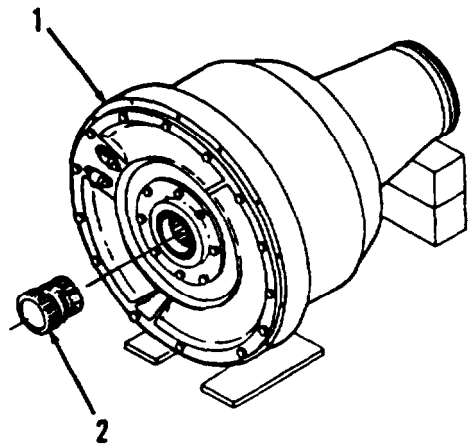
CONTINUED FROM STEP 4

5 A. Remove RGB assembly (page 8-17).
B. Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

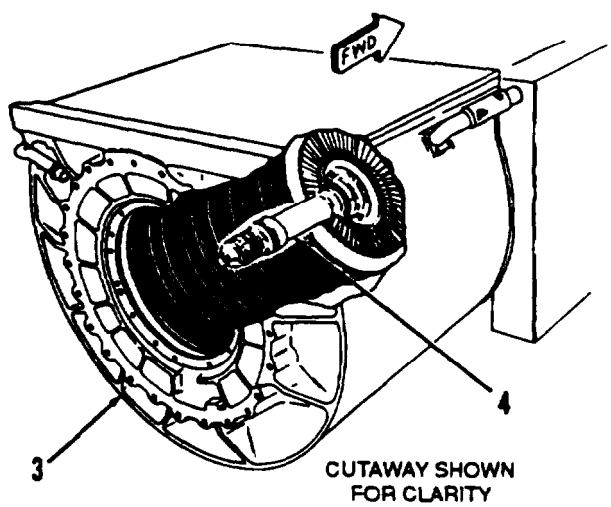
NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Verify problem is solved.



6 Check rotation of power turbine in rear engine subassembly (3) by turning shouldered shaft (4) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a.	ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(2) ES-2. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

YES:
A. Replace number 10 bearing (page 6-52).
B. Verify problem is solved.

NO:
A. Replace number 10 bearing (page 6-52).
B. Salvage Gas Turbine Power Unit (page 6-63).
C. Verify problem is solved.

FROM STEP 2 OR 3

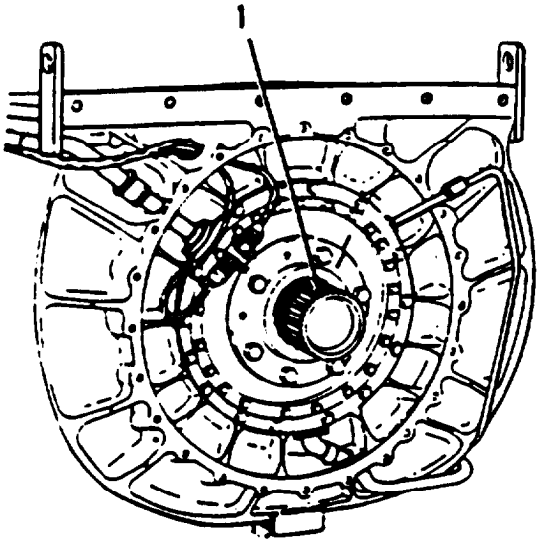
7

NOTE

Splined shaft (1) does not turn easily. You may have to use both hands and some force.

Check rotation of splined shaft (1) by turning shaft (1) clockwise. Shaft should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a.	ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(2) ES-2. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

CONTINUED FROM STEP 7

NO — YES

A. Inspect splined coupling (3) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5- 124).
B. Troubleshoot transmission (TM 34-1).
C. Install AGB (page 7-22).
D. Verify problem is solved.

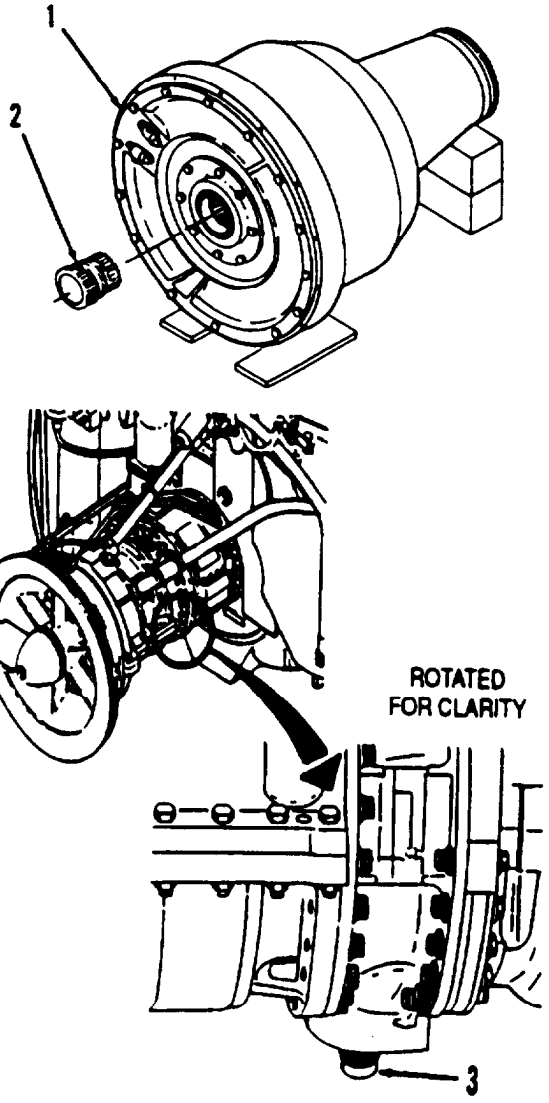
8 A. Remove RGB assembly (page 6-17).
B. Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

NO — YES

A. Inspect splined coupling (3) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).
B. Salvage Gas Turbine Power Unit (page 6-63).
C. Install AGB (page 7-22).
D. Verify problem is solved.

CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(2)	ES-2. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

CONTINUED FROM STEP 8

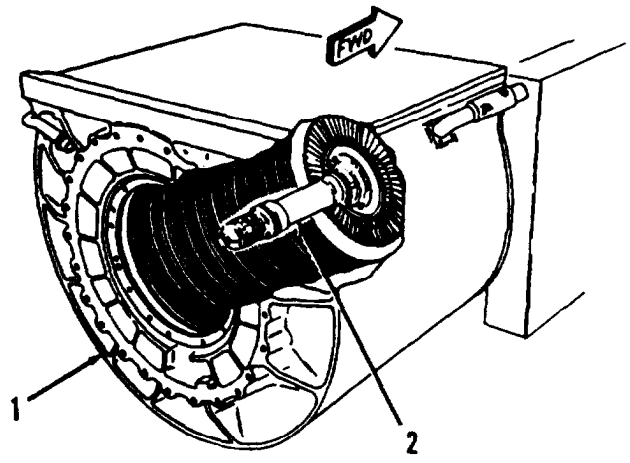
9 Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

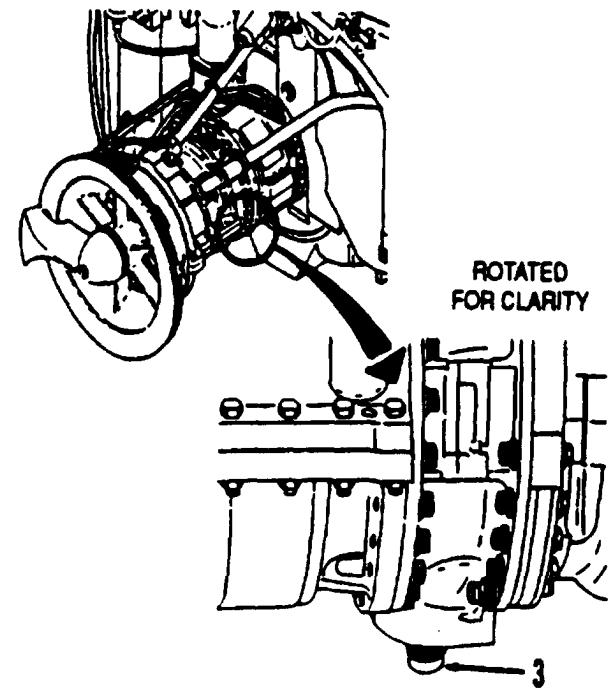
NO — YES

A. Inspect splined coupling (3) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).
B. Replace number 10 bearing (page 6-52).
C. Install AGB (page 7-22).
D. Verify problem is solved.

A. Replace engine assembly (TM34-1).
B. Verify problem is solved.



CUTAWAY SHOWN FOR CLARITY

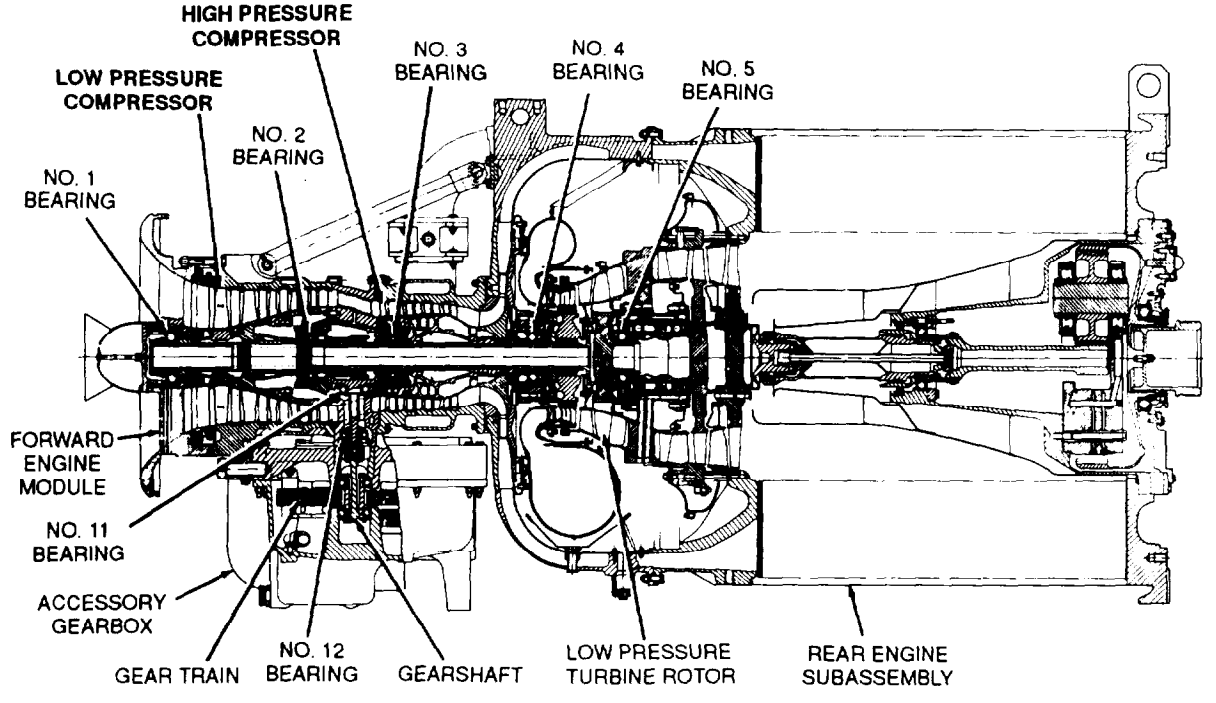


END OF TASK

3-2. TROUBLBSHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(3) ES-3. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED.

This section contains troubleshooting to locate and correct the cause(s) of AGB gear train binding when turned by hand, and low pressure compressor rubbing or binding when turned by hand. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module position No. 3, 4, 11 or 12 bearing, or AGB gears and/or bearings, binding will be felt when the AGB gear train is turned by hand. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The AGB and high pressure compressor assemblies have no mechanical connection with the low pressure compressor and low pressure turbine assemblies. This symptom indicates that two separate failures or one failure causing collateral damage has occurred. The art on this page provides an overview of the AGB gear train/high pressure compressor and low pressure compressor/low pressure turbine systems. Refer to this page along with the in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(3) ES-3. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

Tools:	Supplies:
General mechanic's tool kit: automotive (SC 5180-90-N26)	Wiping rag (Item 14, Appendix B)
AGB gear train handle (Item 42, Appendix D)	References: TM 34-1

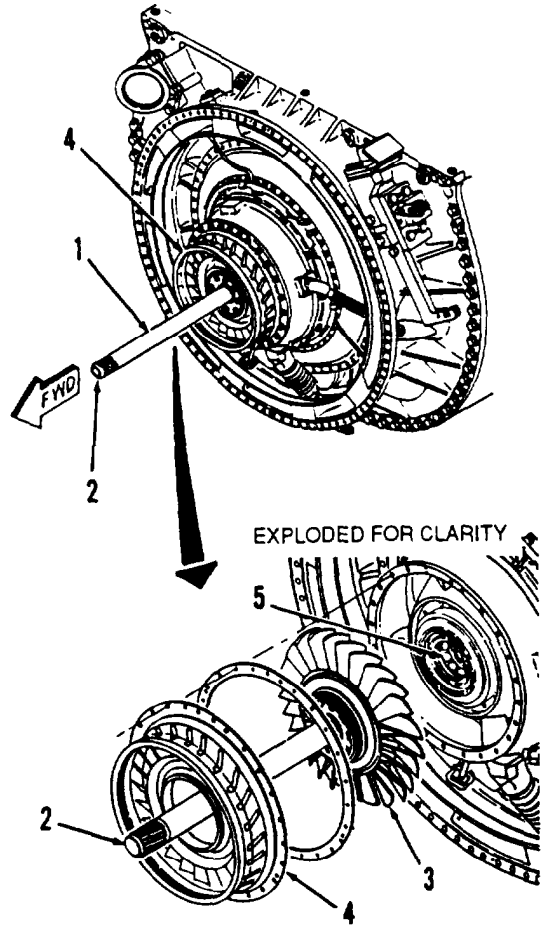
1 A. Remove AGB module (page 7-6).
B. Remove forward engine module (page 5-13).

CAUTION

Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

C. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
D. Turn shaft (1), listen and feel for rubbing or binding.

Does shaft turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(3)	ES-3. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 1

NO / YES

Go to step 3.

2

WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

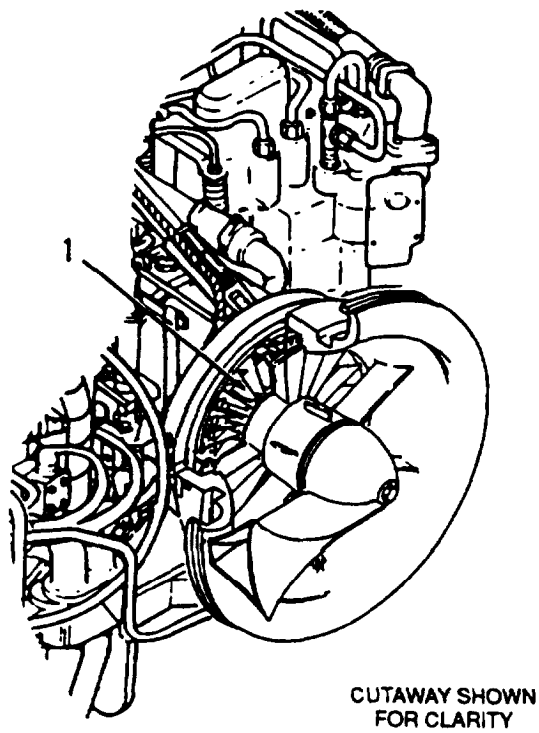
Turn low pressure compressor blades (1) by hand. Listen and feel for rubbing or binding.

Does low pressure compressor turn smoothly with no unusual noises?

NO / YES

A. Salvage GAS Turbine Power Unit (Page 6-63).
B. Go to step 4.

A. Replace engine assembly (TM 34-1).
B. Verify problem is solved.



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED

(3) ES-3. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

FROM STEP 1

3 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (1) by hand and high pressure compressor by ,turning spline couplIng (2). Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?

YES | NO

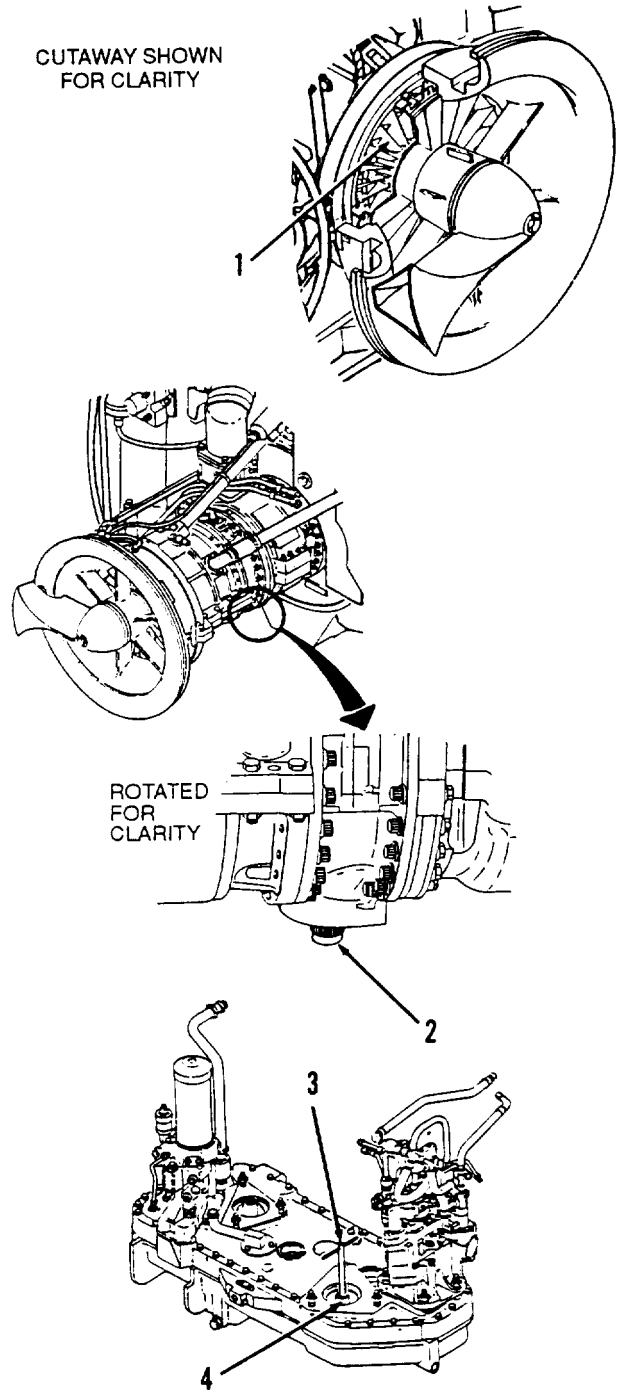
Replace forward engine module (page 5-13).

4 A. Put handle (3) in main hydraulic pump drive gear assembly (4).

B. Check rotation of AGB gears by turning handle (3) clockwise. Handle should turn smoothly. No rubs or binds should by felt and no unusual noises should be heard.

Does handle turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(3) ES-3. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 4

YES — NO

A. Clean AGB (page 7-46).
B. Verify problem is solved.

1

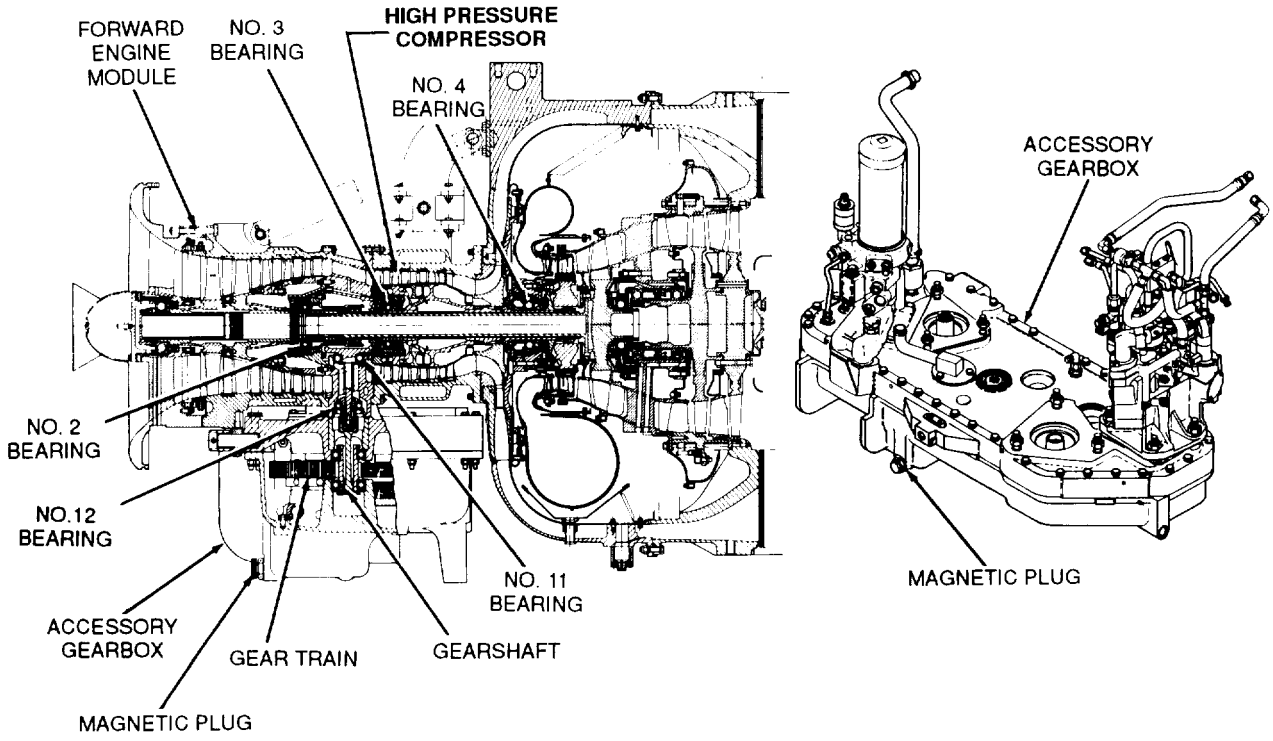
A. Install forward engine module (page 5-18).
B. Install AGB module (page 7-12).
C. Verify problem is solved.

END OF TASK

3-2.TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(4) ES-4. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of binding in the AGB gear train when turned by hand, when more than one half of the AGB magnetic plug is covered with metal chips. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module position No. 2, 3, 4, 11 or 12 bearing, or AGB gears and/or bearings, binding will be felt when the AGB gear train is turned by hand. The forward engine module bearings position number 2, 3, 4, 11 and 12 gravity scavenge lubricating oil into the AGB. This symptom indicates that one or more of these bearings has failed or that the AGB gears and/or bearings have failed. The art on this page provides an overview of the AGB/high pressure compressor assemblies mechanical and lubrication system interface. Refer to this page and the in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

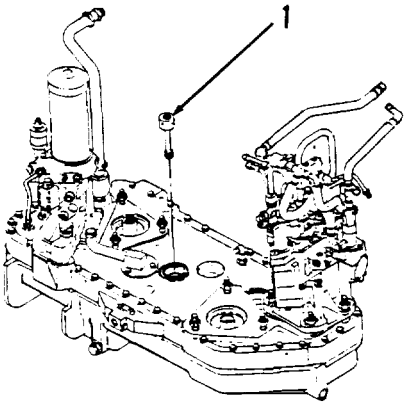
a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(4) ES-4. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)

Supplies:
Wiping rag (Item 14, Appendix B)

References:
TM 20-1

1 A. Remove AGB (page 7-21).
B. Remove spur gearshaft (1).
C. Check to see if spur gearshaft (1) is broken or damaged?

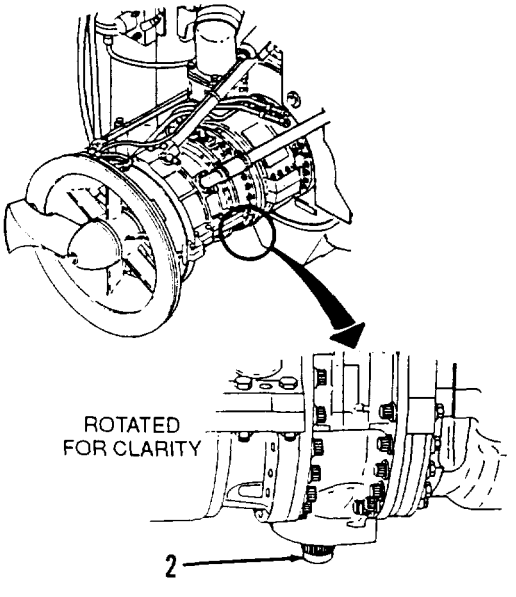


Is spur gearshaft broken or damaged?

NO — Go to step 3.

YES

2 Check high pressure compressor system rotation by turning spline coupling (2) clockwise. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.



Does high pressure compressor turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(4)	ES-4. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

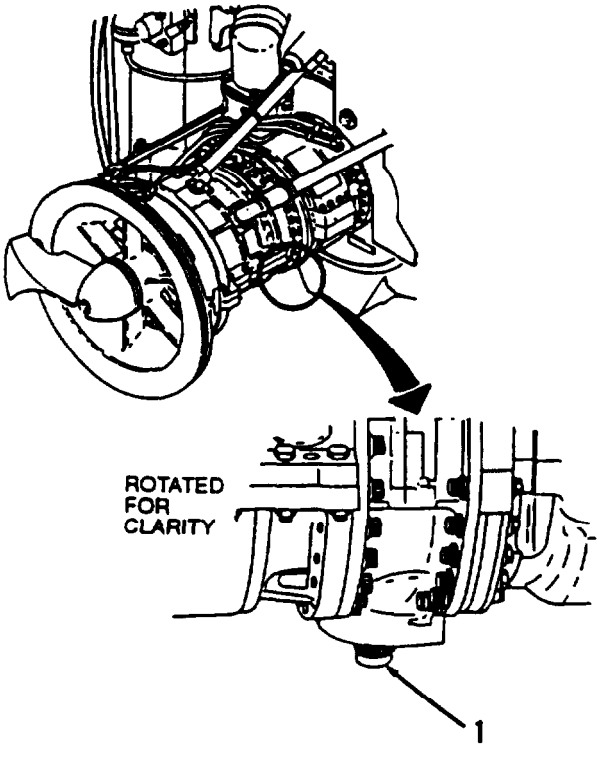
CONTINUED FROM STEP 2

YES

A. Clean AGB (page 7-46).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.

NO

A. Inspect splined coupling (1) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(4)	ES-4. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

FROM STEP 1

3 Check splined coupling (1) for damage to splines.

is splined coupling damaged?

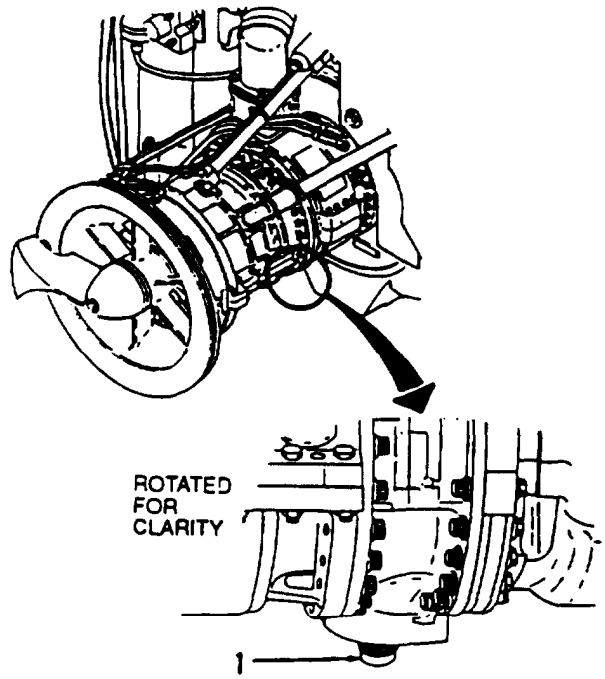
NO — YES

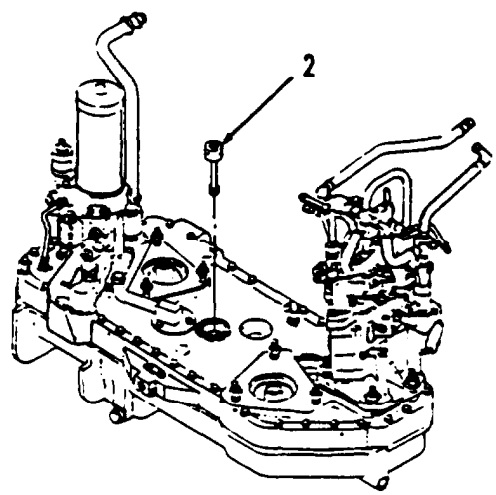
A. Replace number 12 bearing and splined coupling (page 5-124).
B. Replace spur gearshaft (2).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

4 Check high pressure compressor system rotation by turning splined coupling (1) in both directions. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does high pressure compressor turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE





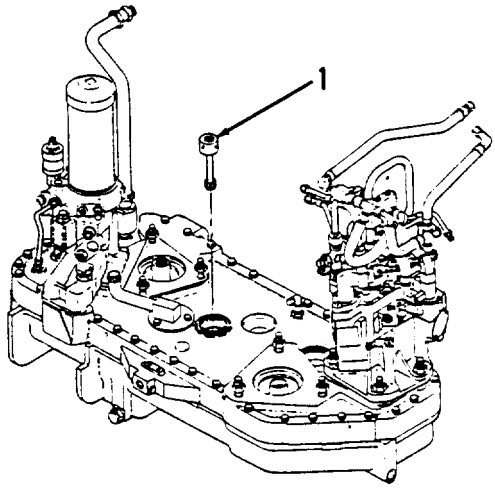
3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(4) ES-4. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 4

YES — NO

A. Replace forward engine module (page 5-13).
B. Replace spur gearshaft (1).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.



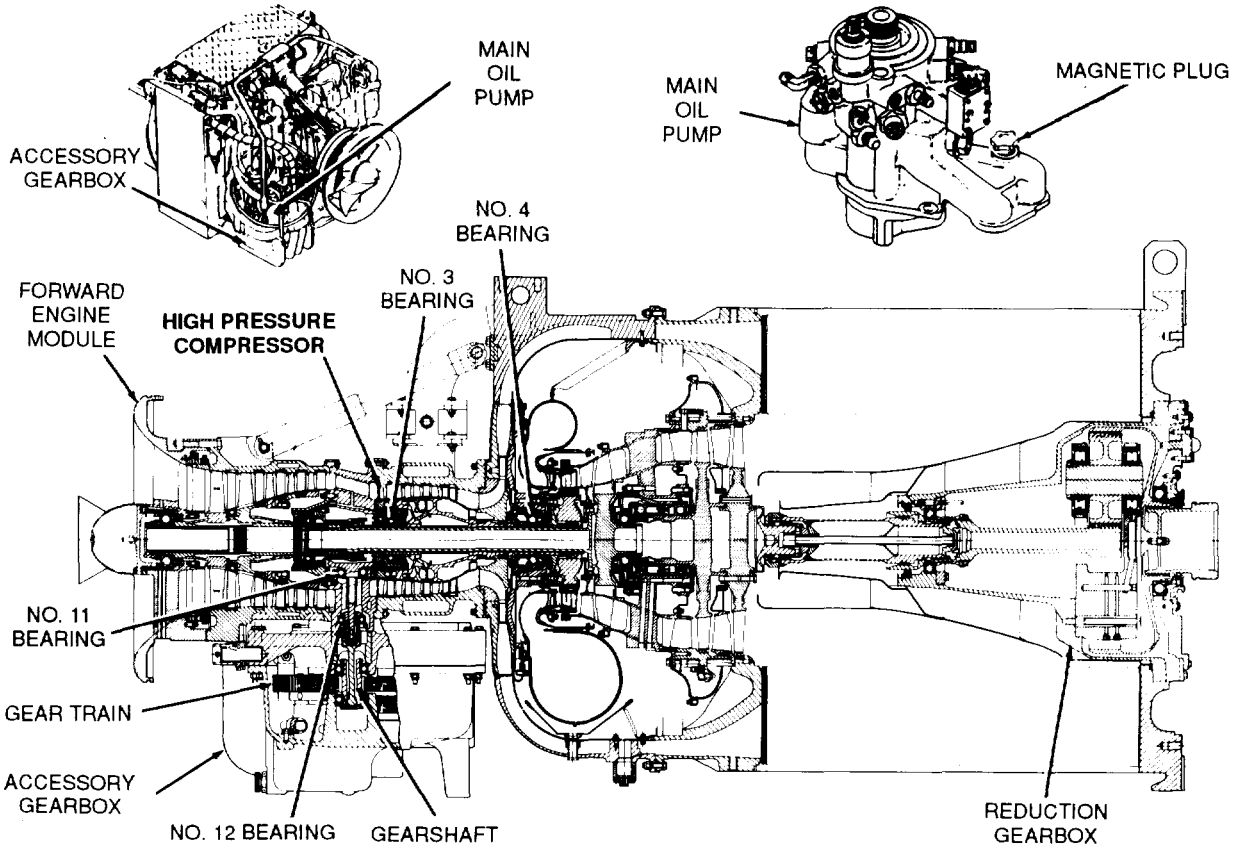
A. Replace spur gearshaft
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(5) ES-5. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of binding when the AGB gear train is turned by hand, and when more than one half of the main oil pump magnetic plug is covered with metal chips. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module position No. 3 or 4 bearing, intermediate housing position No. 11 or 12 bearing or AGB gears and/or bearings, binding will be felt when the AGB gear train is turned by hand. The reduction gearbox (RGB) oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. These two systems are totally independent of each other. The symptoms described above indicate two separate failures. The art on this page provides an overview of the systems described above. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED

(5) ES-5. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED.

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
AGB gear train handle (Item 42, Appendix D)
Metal pail (Item 136, Appendix D)

Supplies:
Dry cleaning solvent (Item 7, Appendix B)
Wiping rag (Item 14, Appendix B)

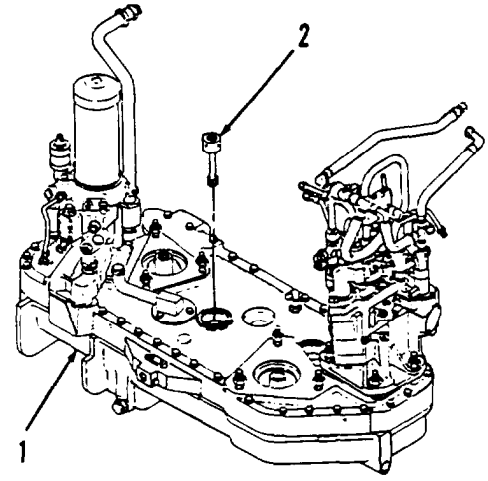
References:
TM 20-1

1 A. Remove AGB module (1) from engine (page 7-6).
B. Remove spur gearshaft (2).
C. Check to see if spur gearshaft (2) is broken or damaged?

Is spur gearshaft broken or damaged?

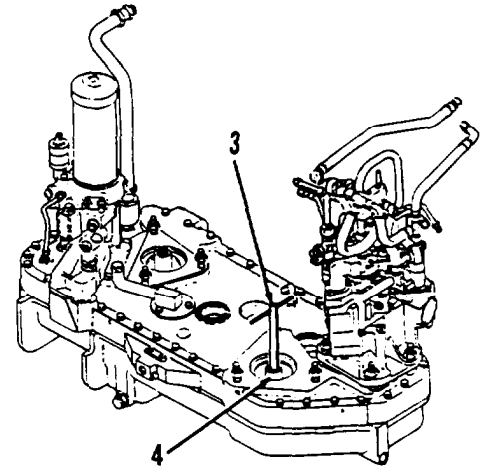
YES — NO

Go to step 4.



2 A. Put handle (3) in main hydraulic pump drive gear assembly (4).
B. Check rotation of AGB gears by turning handle (3) clockwise.
Handle should turn smoothly. No rubs or binds should by felt and no unusual noises should be heard.

Does handle turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED		
a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(5)	ES-5. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

N O — YES

A. Put new spur gearshaft (1) in AGB (2).
B. Inspect splined coupling for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).

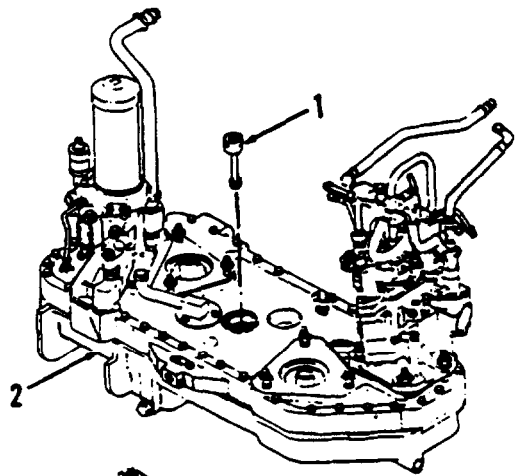
A. Clean AGB (page 7-47).
B. Put new spur gearshift (1) in AGB (2).

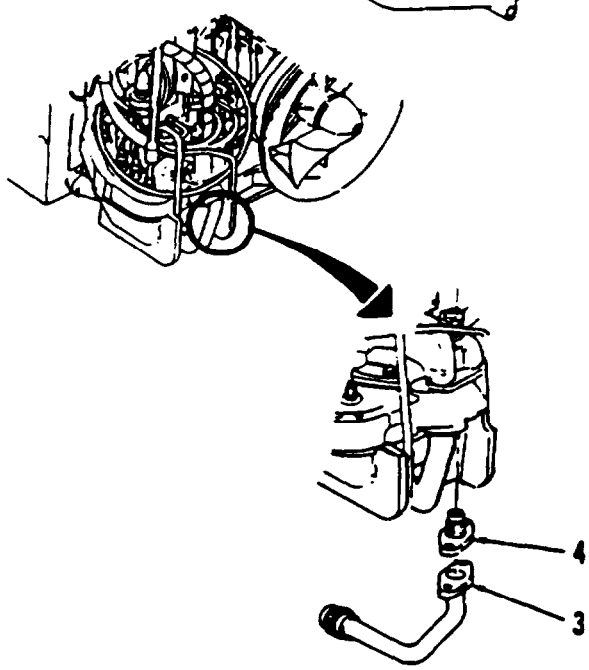
3 A. Remove forward RGB scavenge tube assembly (3) and screen (4) (TM 20- 1).

WARNING

B. Pour one quart of dry cleaning solvent through scavenge tube assembly (3) and into pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?





CONTINUED ON NEXT PAGE

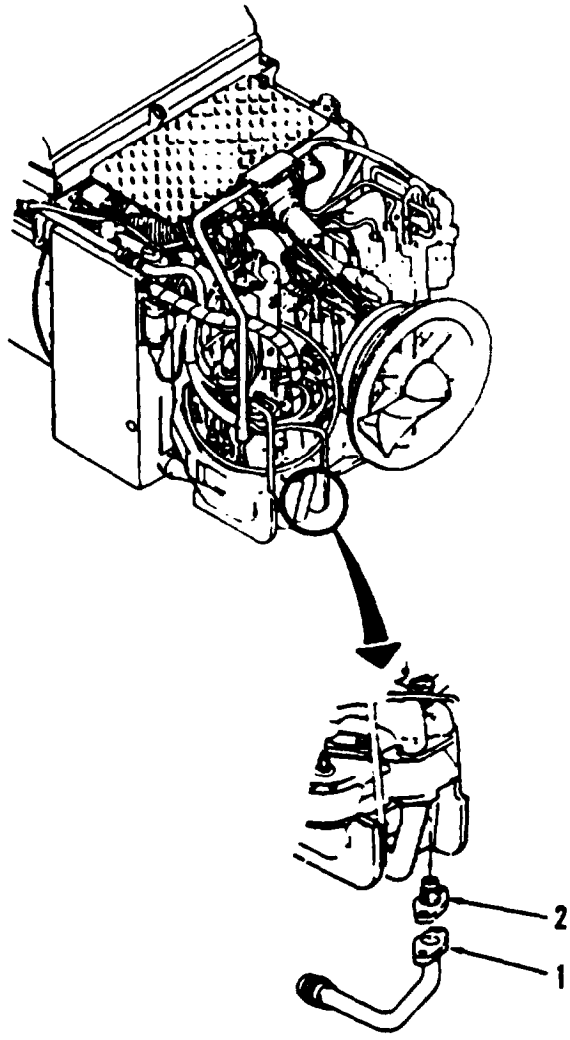
3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(5)	ES-5. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 3

NO — YES

A. Clean RGB lubrication system (page 8-1).
B. Replace number 10 bearing (page 6-52).
C. Replace engine oil pump TM-20-1
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F Verify problem is solved.



WARNING

A. Clean forward RGB scavenge tube assembly (1) and screen (2) with dry cleaning solvent and wiping rag.
B. Install forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).
C. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND (5) HIGH PRESSURE COMPRESSOR - CONTINUED	ES-5. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

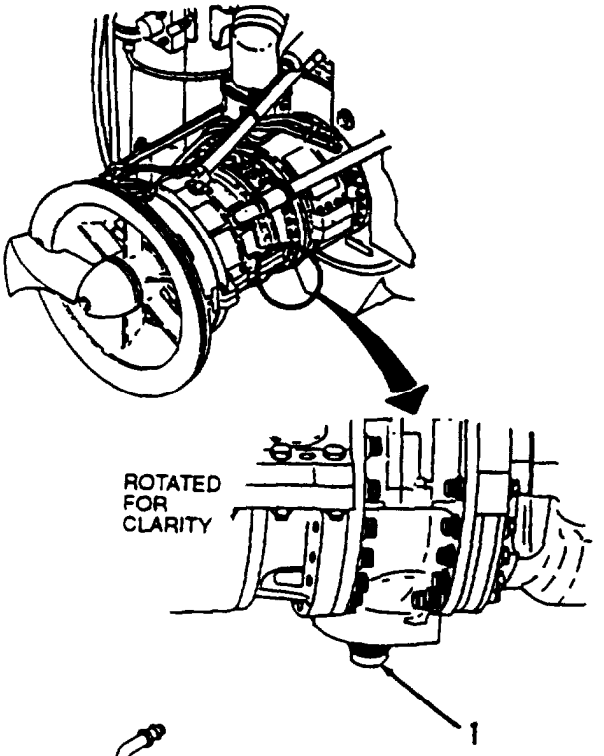
FROM STEP 1

3 Check high pressure compressor system rotation by turning splined coupling (1) in both directions. High pressure compressors system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does high pressure compressor turn smoothy with no unusual noises?

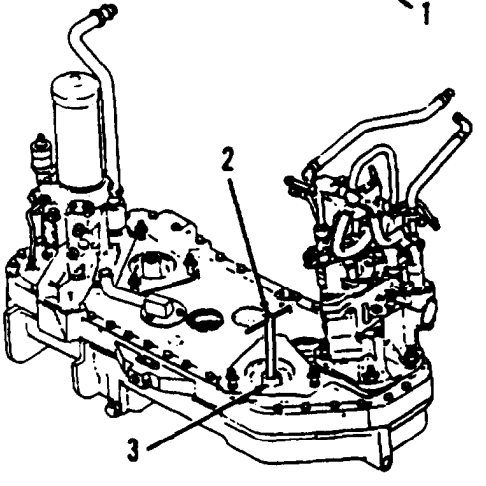
NO — YES

A. Clean AGB (page 7-46).
B. Go to step 6.



5
A. Put handle (2) in main hydraulic pump drive gear assembly (3).
B. Check rotation of AGB gears by turning handle clockwise. Handle should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does handle turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(5)	ES-5. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 5

YES — NO

Clean AGB (page 7-46).

Inspect splined coupling for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).

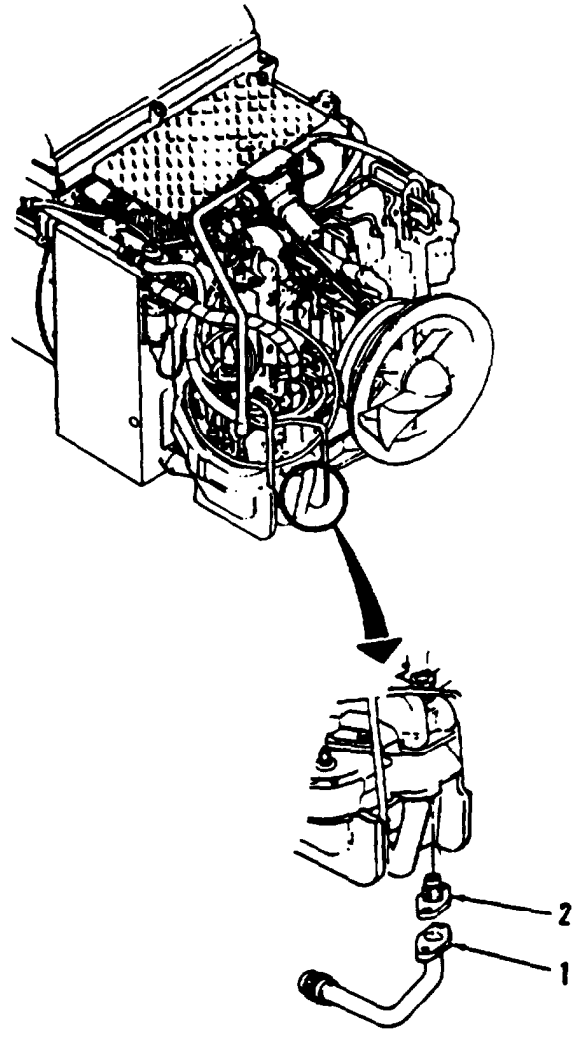
6

A. Remove forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).

WARNING

B. Pour one quart of dry cleaning solvent through scavenge tube assembly (1) and into pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(5)	ES-5. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

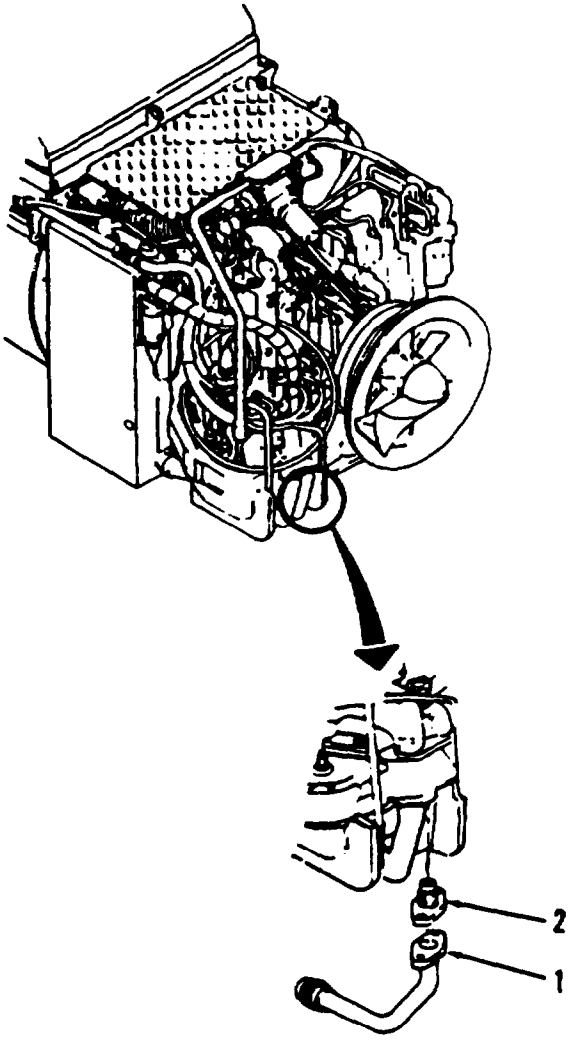
CONTINUED FROM STEP 6

NO — YES

A. Clean RGB lubrication system (page 8-1).
B. Replace number 10 bearing (page 6-52).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Verify problem is solved.

WARNING

A. Clean forward RGB scavenge tube assembly (1) and screen (2) with dry cleaning solvent and wiping rag.
B. Install forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).
C. Verify problem is solved.

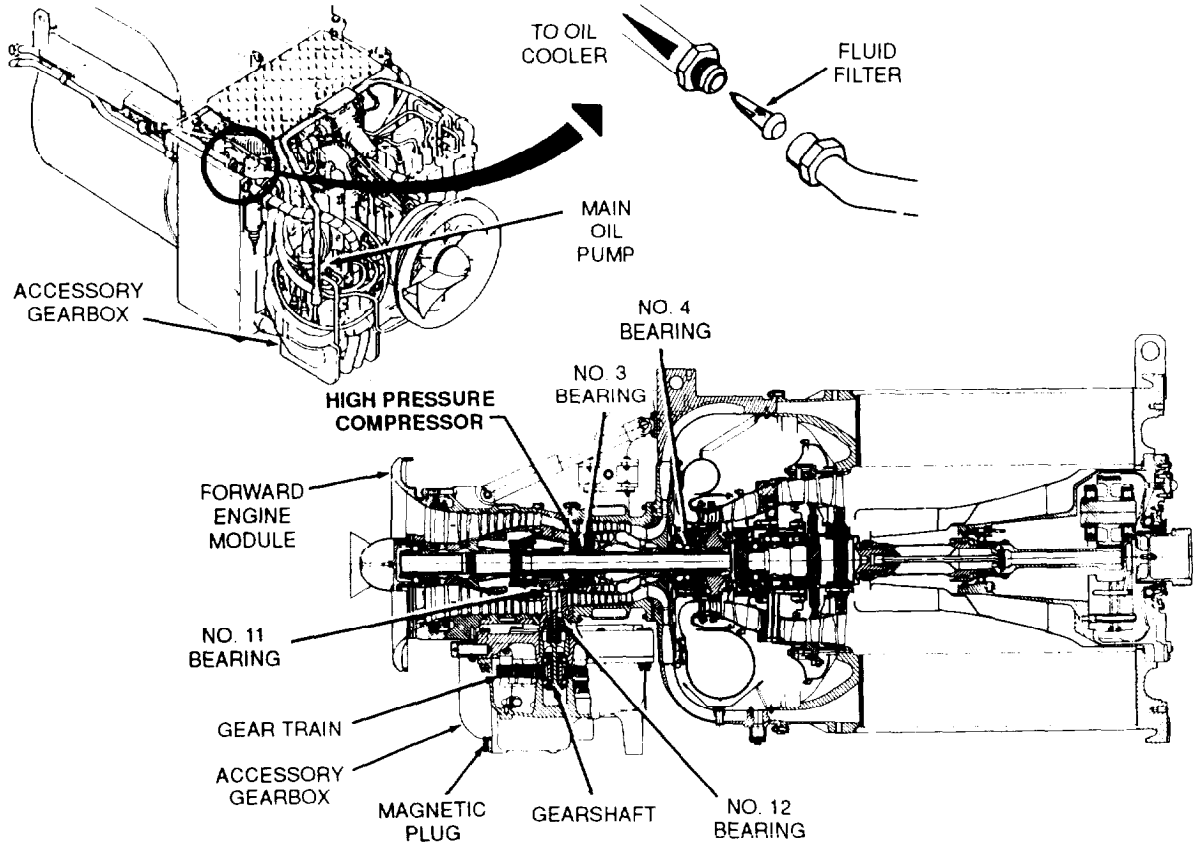


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(6) ES-6. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.

This section contains troubleshooting to locate and correct the cause(s) of binding in the AGB gear train when turned by hand, and when metal chips are present in the oil pump to oil cooler fluid filter. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module position No. 3, 4, 11 or 12 bearing, or AGB gears and/or bearings, binding will be felt when the AGB gear train is turned by hand. The lubrication system delivers hot oil, scavenged from bearing packages throughout the engine, through a fluid filter to the engine oil cooler. The cooled oil is then returned to the oil tank. Whenever metal chips are generated, the fluid filter will catch and retain most of the chips. Based on the above description, it would be logical to assume that forward engine module bearings may be faulty or that one of the AGB gears or bearings has failed. In either case, the AGB magnetic plug should also be more than one half covered with metal chips, unless it was already wiped clean. The art on this page provides an overview of the systems described above. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(6)	ES-6. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

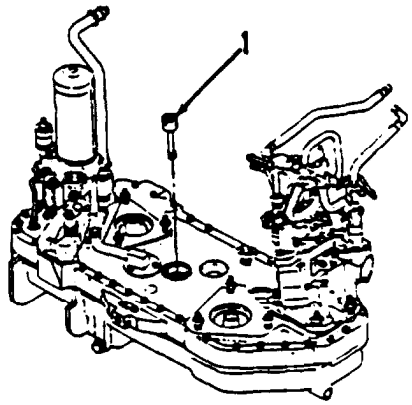
Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)

Supplies:
Wiping rag (item 14, Appendix B)

References:
TM 20 - 1

1 A. Remove AGB (page 7-21).
B. Remove spur gearshift (1).
C. Check to see if spur gearshift (1) is broken or damaged.

Is gearshaft broken or damaged?

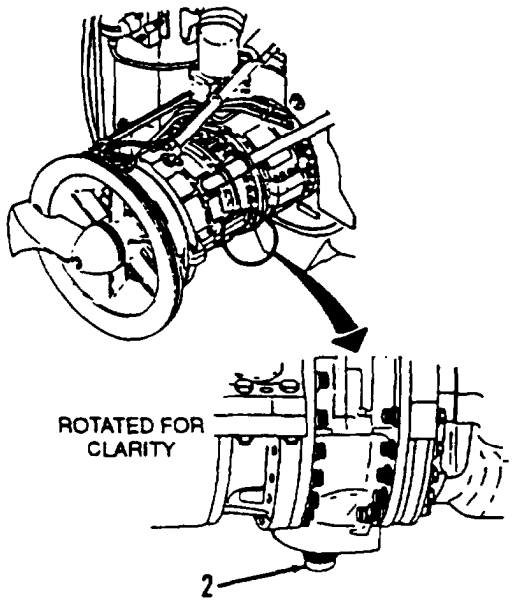


NO — YES

Go to step 3.

2 Check high pressure compressor system rotation by turning splined coupling (2) in both directions. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does high pressure compressor turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

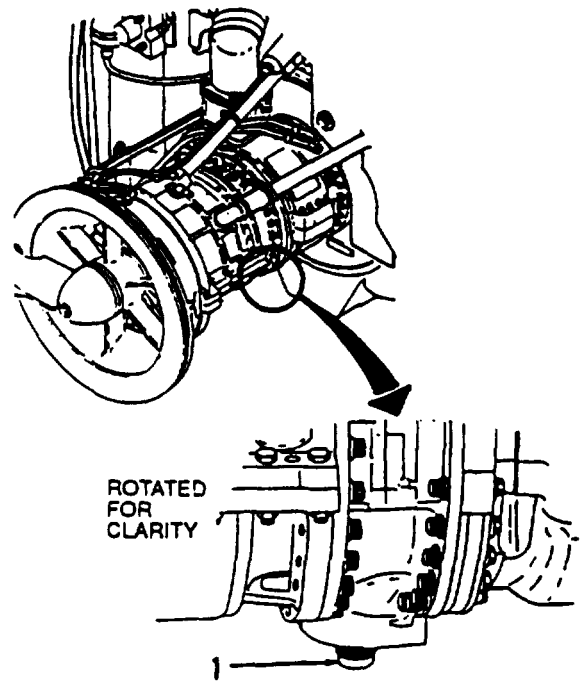
3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR CONTINUED	(6)	ES-6. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 2

YES — NO

A. Inspect splined coupling (1) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5- 124).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1)
F. Clean cooler and generator lines (TM 20-1).



A. Clean AGB (page 7-46).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a.	ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(6) ES-6. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

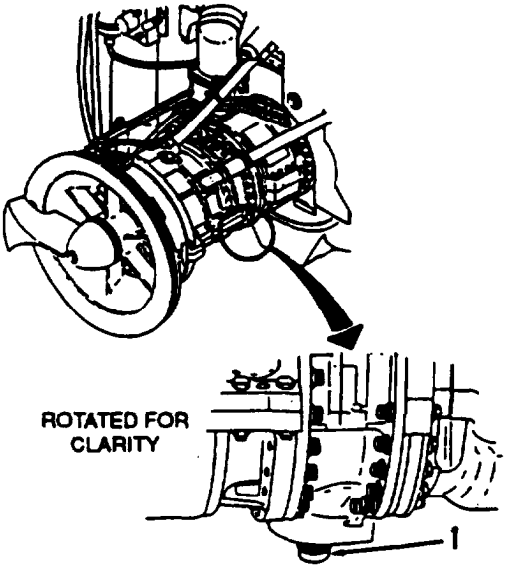
FROM STEP 1

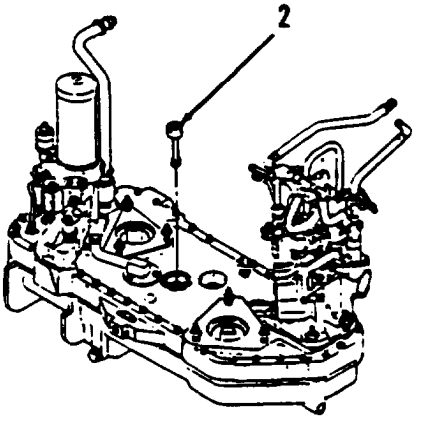
3 Check splined coupling (1) for damage to splines.

Is splined coupling damaged?

NO — YES

A. Replace number 12 bearing and splined coupling (page 5-124).
B. Replace spur gearshaft (2).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1)
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.





4 Check high pressure compressor system rotation by turning splined coupling (1) in both directions. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does high pressure compressor turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED

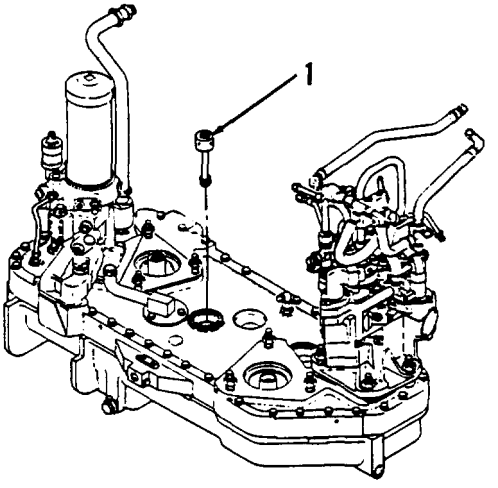
(6) ES-6. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

L

CONTINUED FROM STEP 4

NO ~ YES

A. Replace spur gearshaft (1).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.



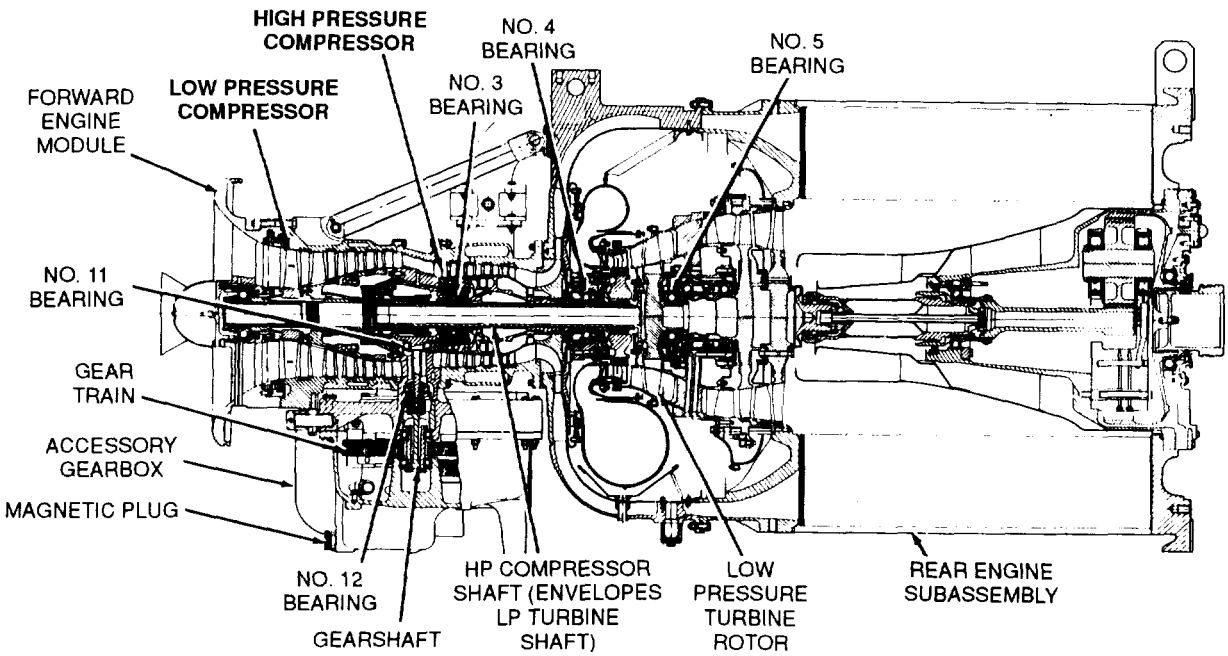
A. Replace forward engine module (page 5-13).
B. Replace spur gearshaft (1).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(7) ES-7. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of AGB gear train binding and low pressure compressor rubbing or binding when more than one half of the AGB magnetic plug is covered with metal chips. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module positi.on No. 3, 4, 11 or 12 bearing, or AGB gears and/or bearings, binding will be felt when the AGB gear train is turned by hand. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or bearings in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The low pressure turbine shaft normally runs inside of the high pressure compressor shaft without making contact. If a bearing supporting the high pressure compressor, low pressure compressor or low pressure turbine rotor fails, contact may occur between the two shafts. Binding will be felt when these assembles are rotated by hand. Metal chips on the AGB magnetic plug indicate a bearing has failed. The art on this page provides an overview of the high pressure compressor, low pressure compressor, low pressure turbine and AGB gear train systems. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLEBHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED

(7) ES-7. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
AGB gear train handle (Item 42, Appendix D)

Supplies:
Wiping rag (Item 14, Appendix B)

References:
TM 20-1
TM 34-1

1 A. Remove AGB module (page 7-6).
B. Remove forward engine module (page 5-13).

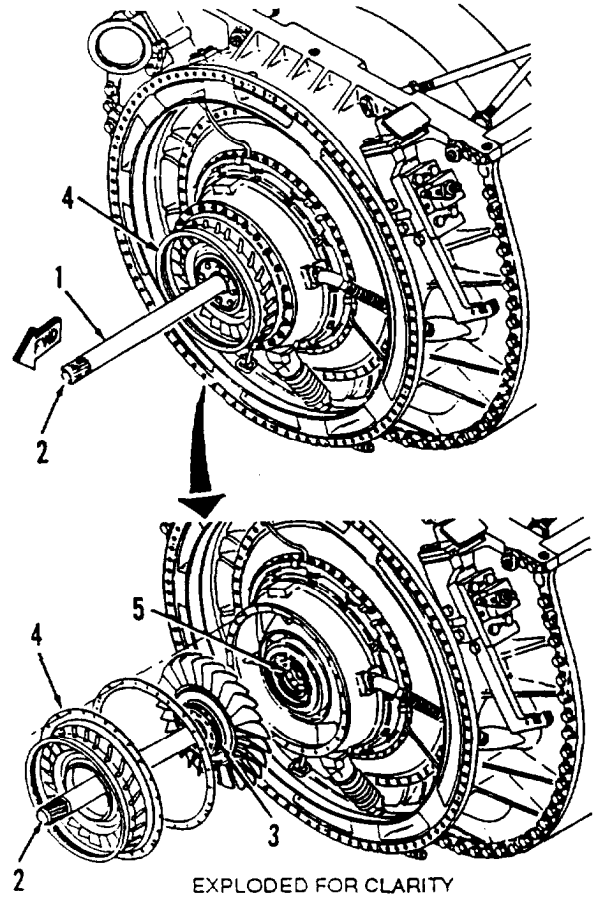
CAUTION
Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

C. Lift end (2) of shaft (1) slightly to center shaft (l), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
D. Turn shaft (1), listen and feel for rubbing or binding.

Does shaft turn smoothly with no unusual noises?

NO — YES

Go to step 3.



EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(7)	ES-7. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

2

WARNING

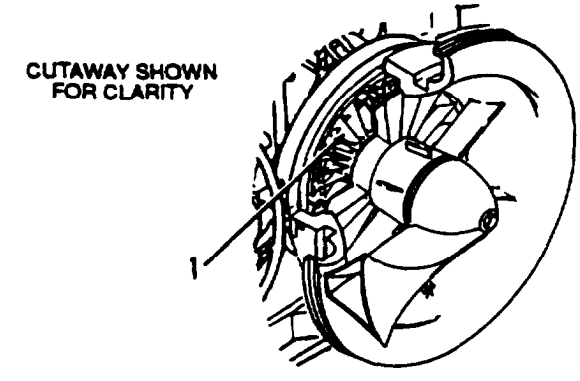
Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

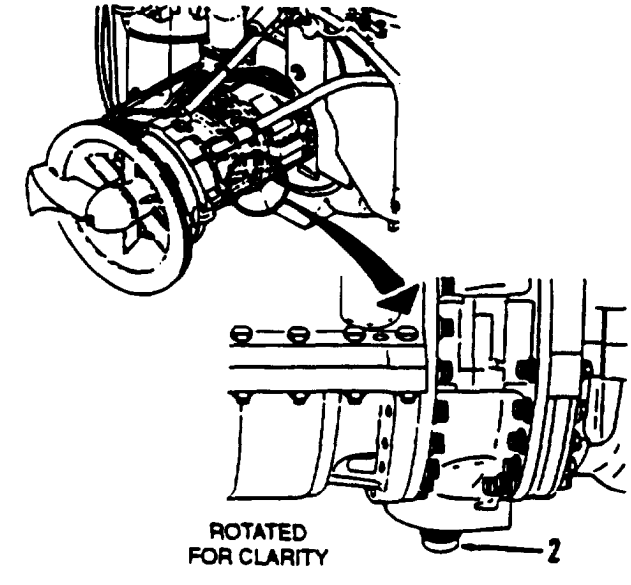
Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning splined coupling (2) in both directions. Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?

NO — YES

A. Salvage Gas Turbine Power Unit (page 6 -63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1)
D. Replace engine oil cooler (TM 20-1)
E. Replace engine AC generator (TM 20-1)
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.





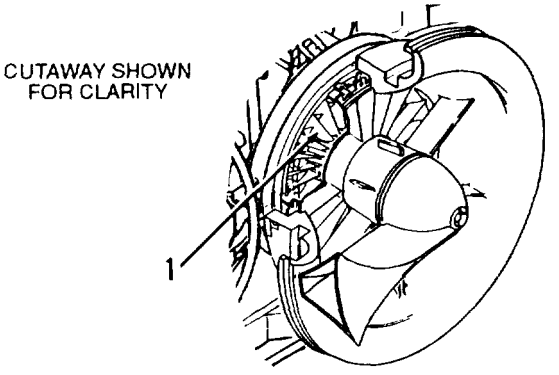
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(7) ES-7. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. Clean oil cooler and AC generator lines (TM 20-1).
E. Verify problem is solved.



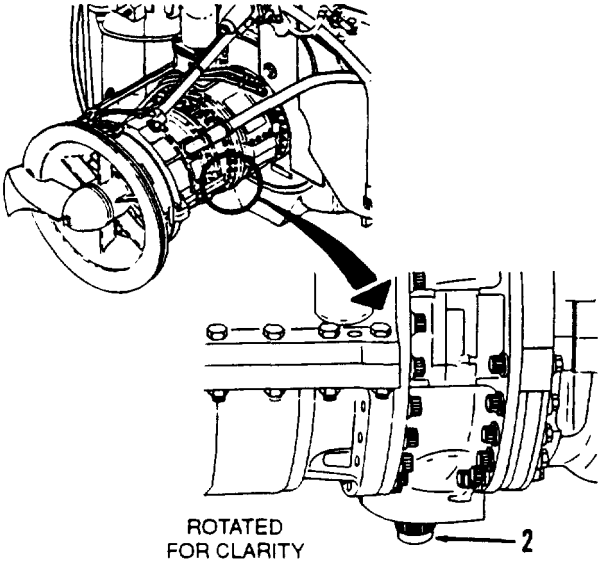
FROM STEP 1

3 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning spline coupling (2). Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?



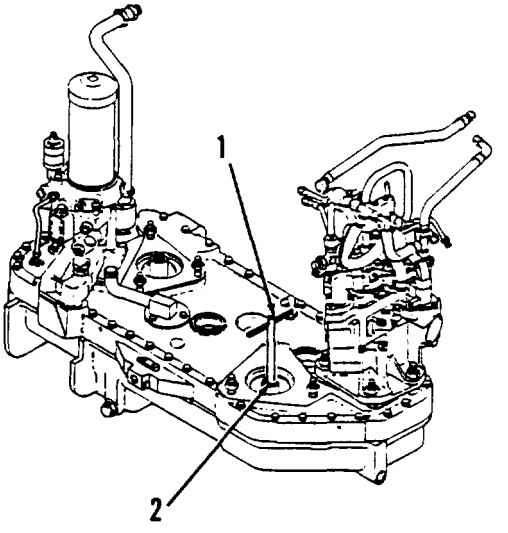
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(7) ES-7. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTNUED

CONTINUED FROM STEP 3

	YES	NO
4	A. Put handle (1) in main hydraulic pump drive gear assembly (2). B. Check rotation of AGB qears by turning handle (1). clockwise. Handle should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.	
Does handle turn smoothly with no unusual noises?		A. Replace forward engine module (page 5-13). B. Clean AGB (page 7-46). C. Replace engine oil pump TM 20-1. D. Replace engine oil cooler (TM 20-1). E. Replace engine AC generator (TM 20-1). F. Clean cooler and generator lines (TM 20-1). G. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(7) ES-7. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 4

YES

A. Clean AGB (page 7-46).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.

NO

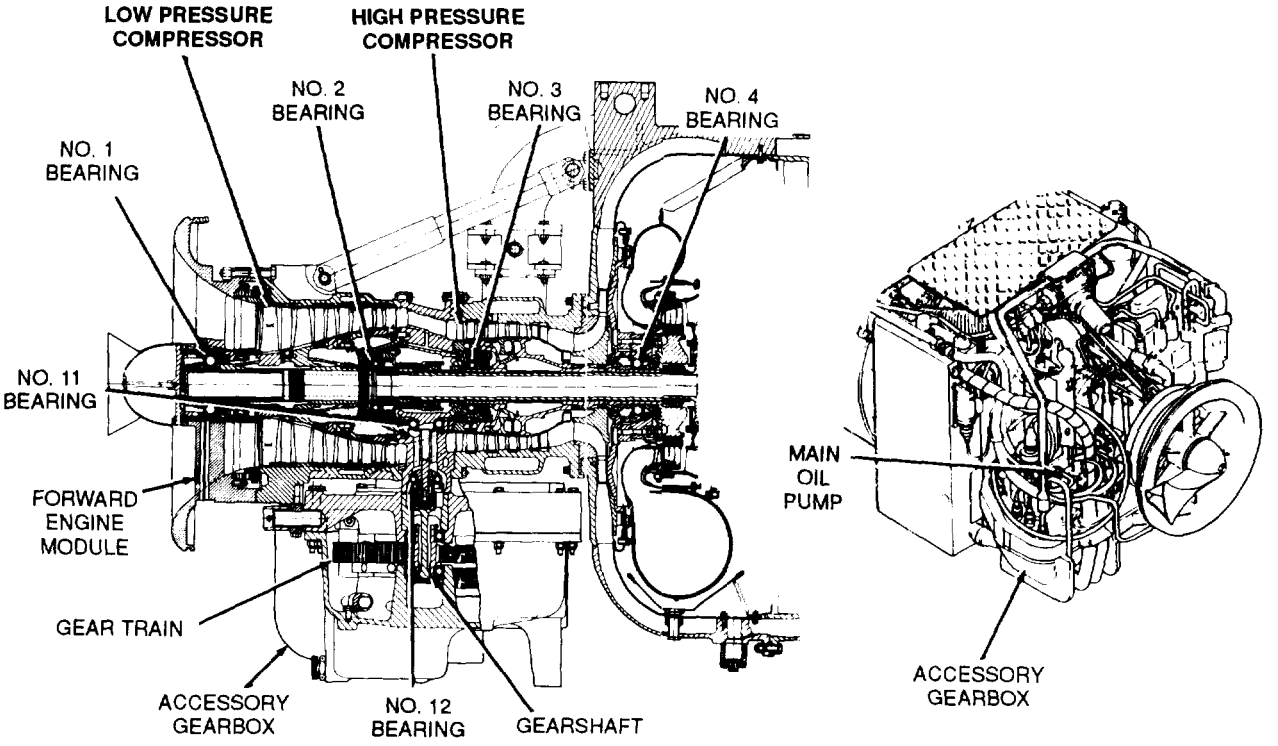
A. Install forward engine module (page 5-18).
B. Install AGB module (page 7-12).
C. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

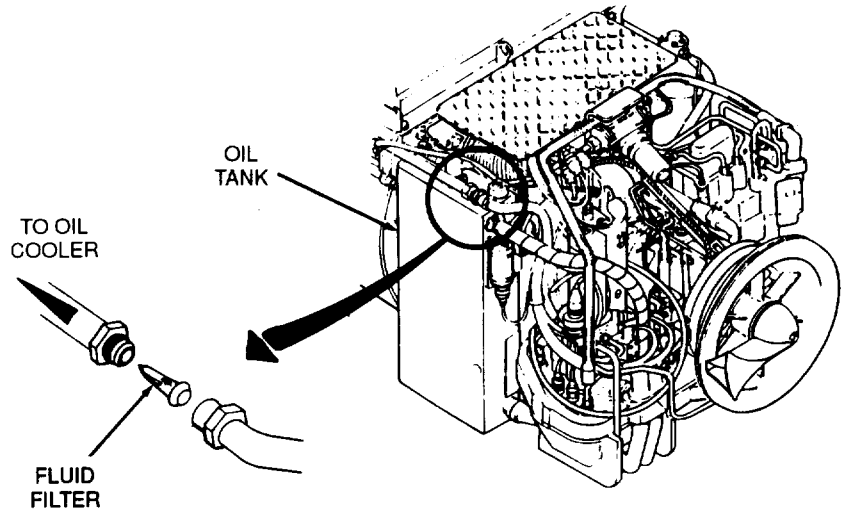
a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8) ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.

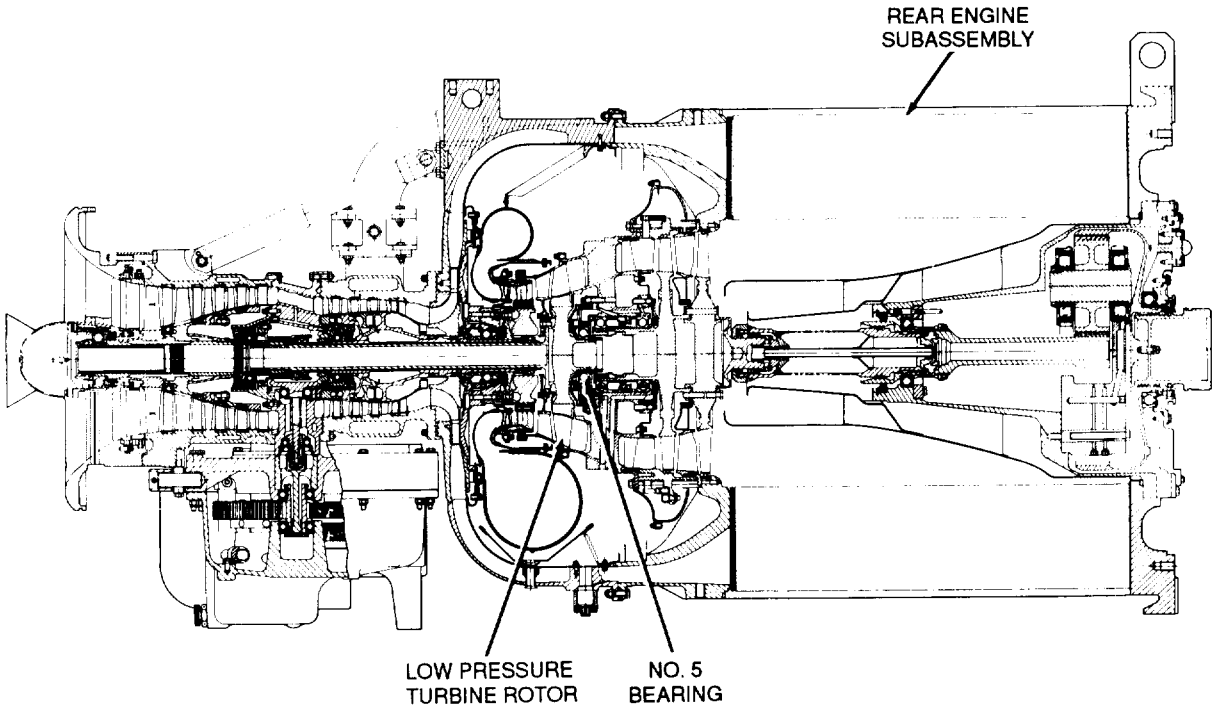
This section contains troubleshooting to locate and correct the cause(s) of binding in the AGB gear train when turned by hand, rubbinq or binding in the low pressure compressor when turned by hand, and metal chips in the oil pump to oil cooler fluid filter. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module position No. 3, 4, 11 or 12 bearing, or AGB gears and/or bearings, binding will be felt when the AGB gear train is turned by hand. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is rotated by hand. The lubrication system delivers hot oil, scavenged from bearing packages throughout the engine, through a fluid filter, to the engine oil cooler. The cooled oil is then returned to the oil tank. Whenever metal chips are generated, the fluid filter will catch and retain most of the chips. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8) ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED





3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8) ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26) AGB gear train handle (Item 42, Appendix D)	Supplies: Wiping rag (Item 14, Appendix B) References: TM 20-1 TM 34-1

1	A. Remove AGB module (page 7-6). . B. Remove forward engine module (page 5-13). . C. Remove reduction gearbox (RGB) assembly (page 6-17).

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8) ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 1

2 **CAUTION**

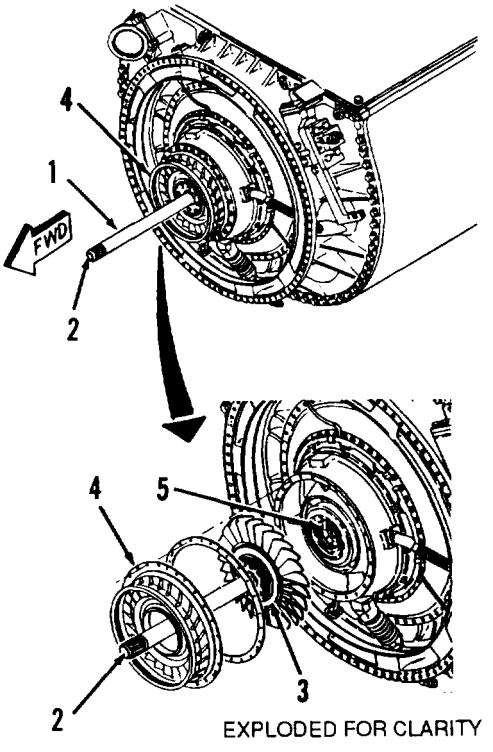
Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

A. Lift end (2) of shaft (1) slightly to center shaft (1). then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearinq (5).
B. Turn shaft (1), listen and feel for rubbing or binding.
C. Check rotation of power turbine in rear engine subassembly (6) by turning shouldered shaft (7) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

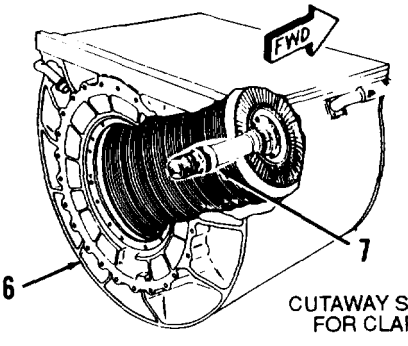
Do both shafts turn smoothly with No unusual noises?

NO — YES

Go to step 5.



EXPLODED FOR CLARITY



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8) ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

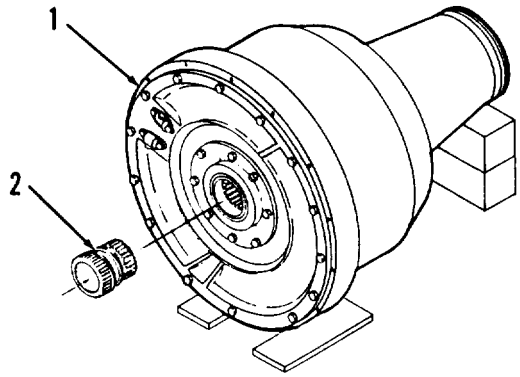
CONTINUED FROM STEP 2

3 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

NO — YES

Go to step 7.

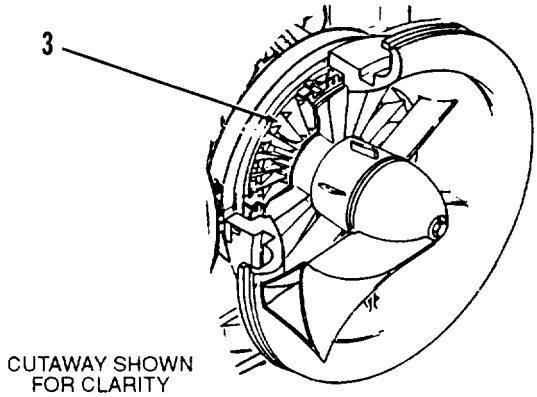


4 WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (3) by hand. Listen and feel for rubbing or binding.

Does low pressure compressor turn smoothly with no unusual noises?



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8)	ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 6

NO

A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. Clean cooler and generator lines (TM 20-1).
E. Verify problem is solved.

YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verity problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8) ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

FROM STEP 2

5 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning spline coupling (2). Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?

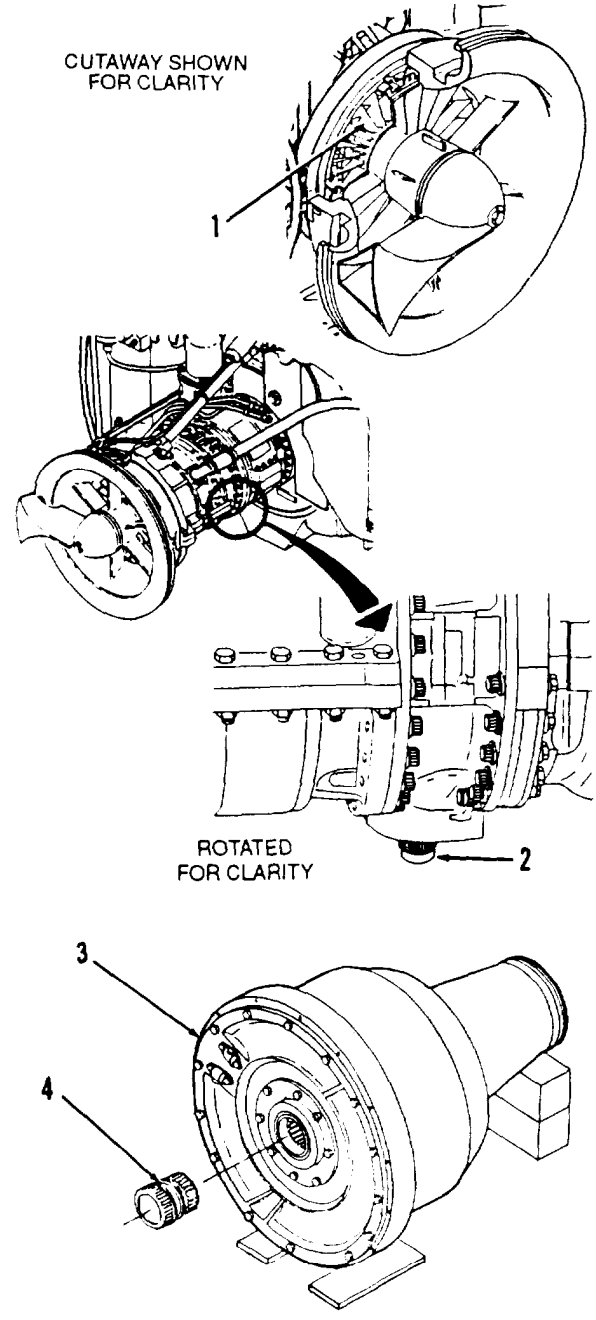
NO — YES

Go to step 8.

6 Check rotation of RGB assembly (3) by putting splined shaft (4) in RGB assembly and turning shaft (4) clockwise. Shaft should turn smoothly and no unusual noises should by heard.

Does shaft turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8) ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

A. Replace forward engine module (page 5-13).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Install RGB assembly (page 6-19).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8)	ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 6

A. Replace number 10 bearing (page 6-52).
B. Replace forward engine module (page 5-13).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

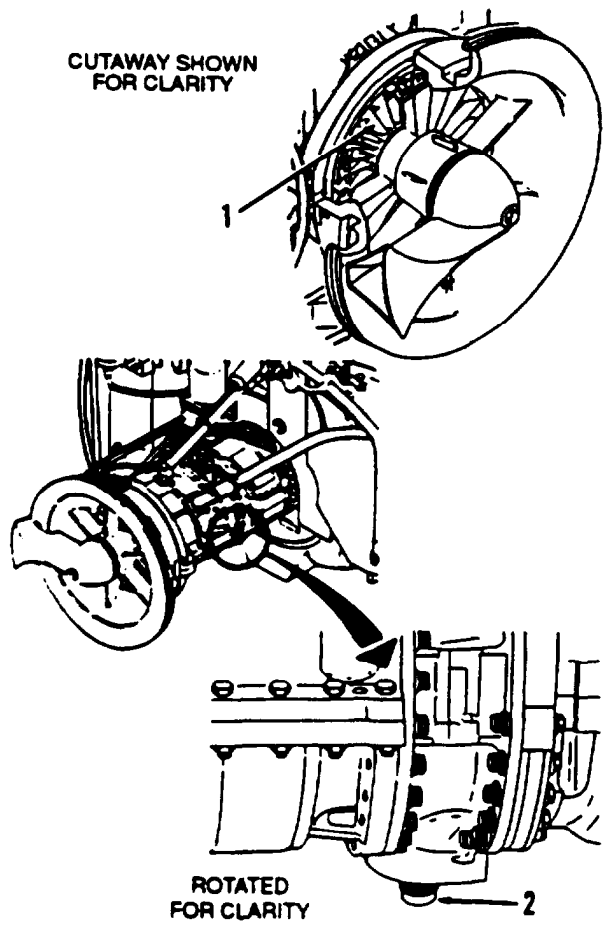
FROM STEP 3

7 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning splined coupling (2) in both directions. Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8)	ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 7

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace forward engine module (page 5-13).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8)	ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

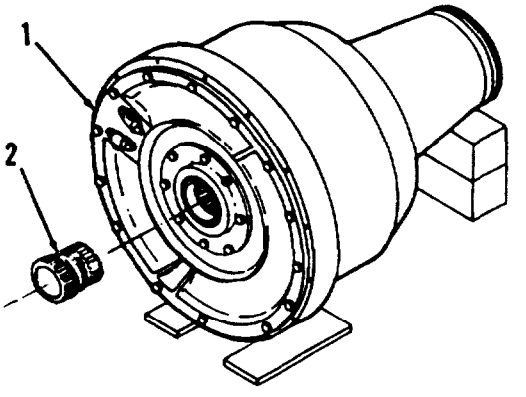
FROM STEP 5

8 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

YES — NO

A. Replace number 10 bearing (page 6-52).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.



CONTINUED ON NEXT PAGE

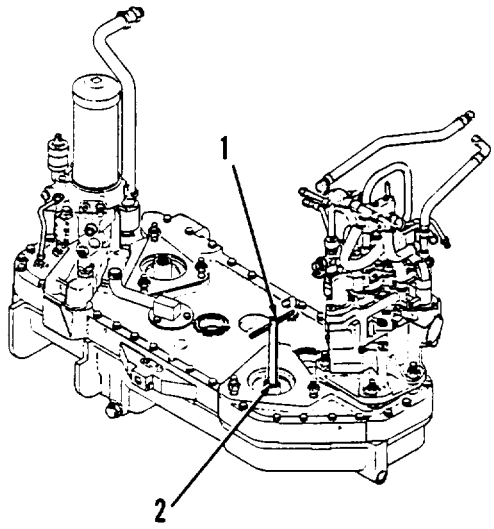
3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8) ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 8

9. **A.** Put handle (1) in main hydraulic pump drive gear assembly (2). .
B. Check rotation of AGB gears by turning handle (1) clockwise. Handle should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does handle turn smoothly with no unusual noises?



YES

NO

A. Clean AGB (page 7-46).
B. Replace engine oil pump (TM 20-1). .
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Install RGB assembly (page 6-19). .
G. Install forward engine module (page 5-18).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(8) ES-8. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 9

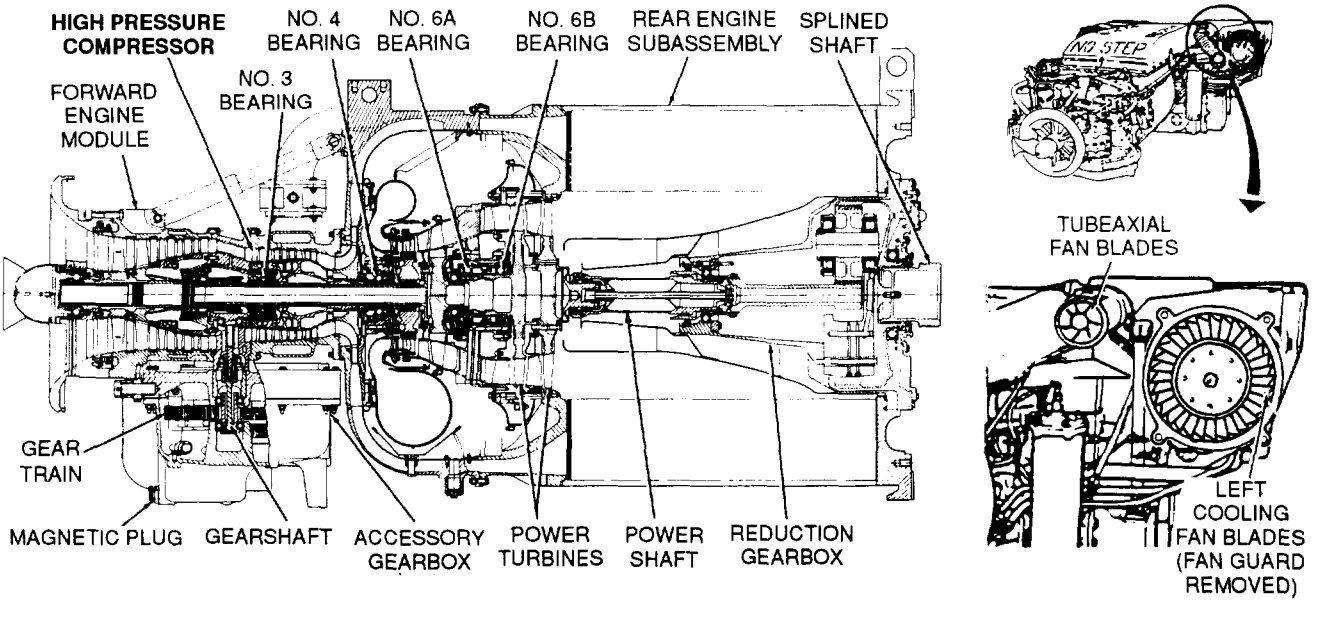
A. Install RGB assembly (page 6-19) .
B. Install forward engine module (page 5-18).
C. Install AGB module (page 7-12).
D. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of AGB gear train binding when turned by hand, and rubbing or binding when the tubeaxial fan blades or left cooling fan blades are turned by hand, when more than one half of the AGB magnetic plug is covered with metal chips. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module position No. 3 or 4 bearing, or AGB gears and/or bearings, binding w1ll be felt when the AGB gear train is turned by hand. The power turbine and reduction gearbox (RGB) are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB bearings and/or gears, binding w1ll be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The transmission is mechanically coupled to the RGB through a splined shaft. If there is internal transmission damage, binding will be felt when turning the tubeaxial fan blades or cooler fan blades by hand. These two systems are totally independent of each other. The symptoms described above indicate two separate failures. The art on this page provides an overview of the systems described above. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26) AGB gear train handle (Item 42, Appendix D)	Supplies: Wiping rag (Item 14, Appendix B) References: TM 20-1 TM 34-1

1	A. Remove AGB module (page 7-6). B. Remove forward engine module (page 5-13). . C. Remove RGB assembly (page 6-17). .

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

2 **CAUTION**

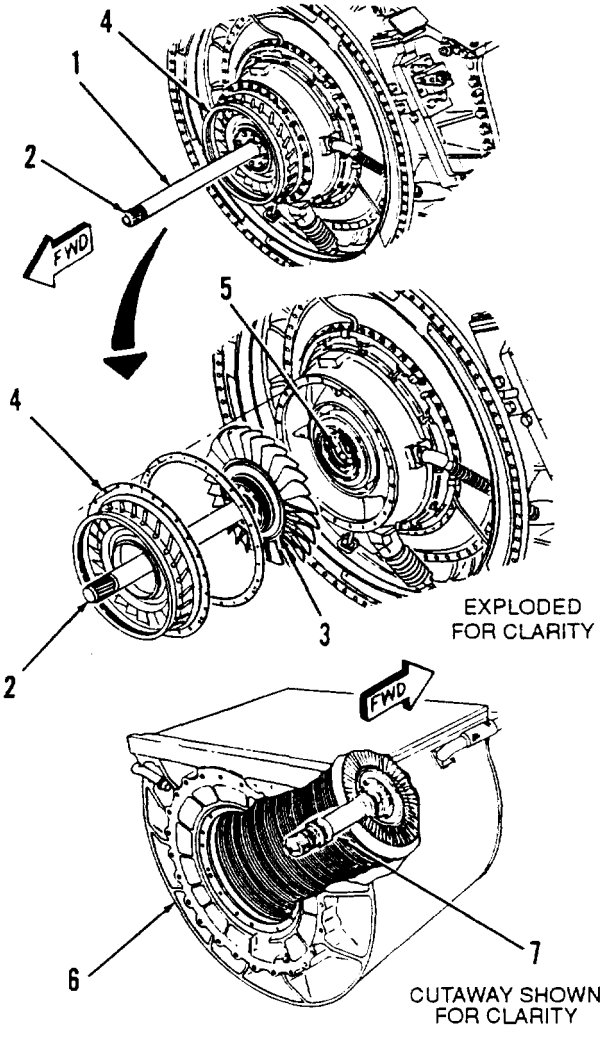
Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
B. Turn shaft (2). Listen and feel for rubbing or binding.
C. Check rotation of power turbine in rear engine subassembly (6) by turning shouldered shaft (7) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Do both shafts turn smoothly with no unusual noises?

NO **YES**

Go to step 5.



CONTINUED ON NEXT PAGE

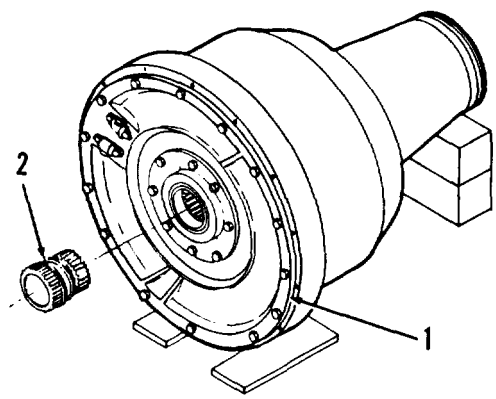
3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

3 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly. No unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



NO — YES

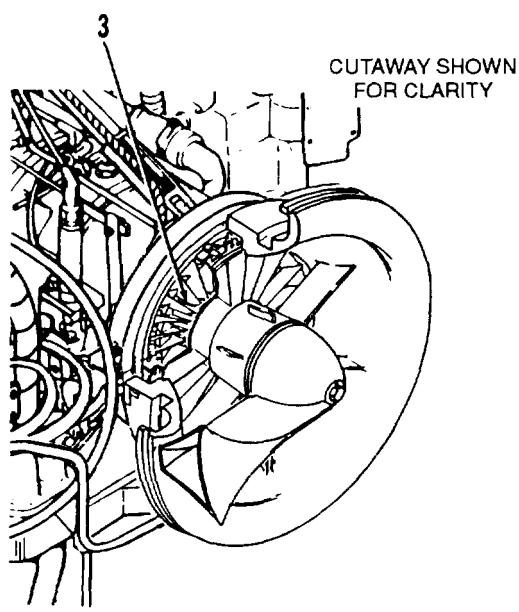
Go to step 7.

4 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (3) by hand. Listen and feel for rubbing or binding.

Does low pressure compressor turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9)	ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 4

NO

A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. Clean cooler and generator lines (TM 20-1).
E. Verity problem is solved.

YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1)
G. Clean cooler and generator lines (TM 20-1).
H. Verity problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

FROM STEP 2

5 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning spline coupling (2). Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?

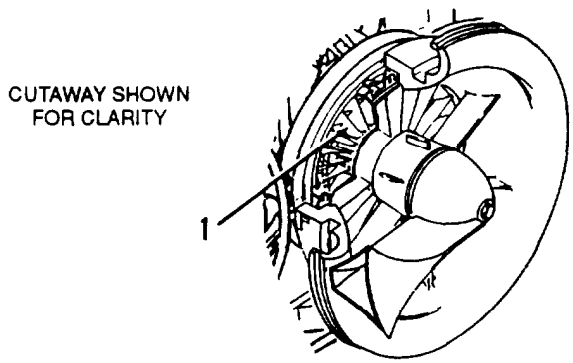
NO — YES

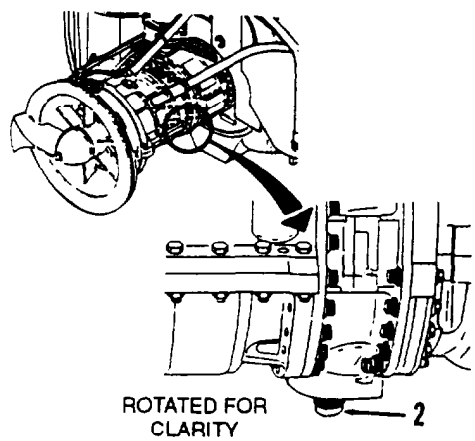
Go to step 8.

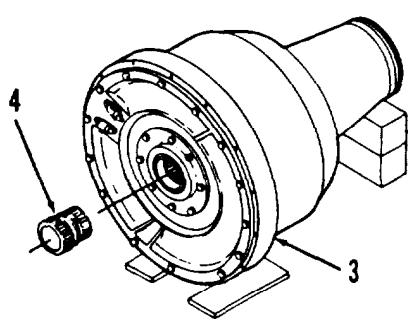
6 Check rotation of RGB assembly (3) by putting splined shaft (4) in RGB assembly and turning shaft (4) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE







3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HARD AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

A. Replace forward engine module (page 5-18).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Install RGB assembly (page 6-19).
H. Verify problem is solved.

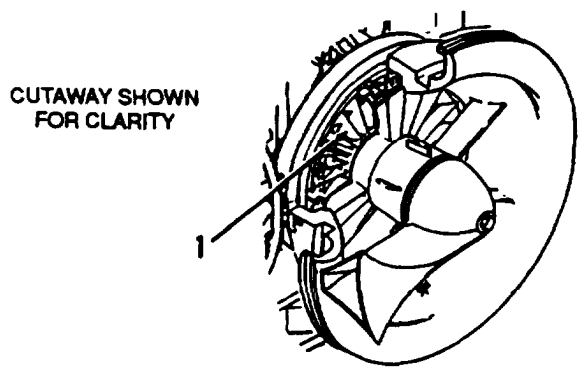
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a.	ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 6

A . Replace number 10 bearing (page 6-52).
B . Replace forward engine module (page 5-13).
C . Clean AGB (page 7-46).
D . Replace engine oil pump (TM 20-1).
E . Replace engine oil cooler (TM 20-1).
F . Replace engine AC generator TM 20-1).
G . Clean cooler and generator lines (TM 20-1).
H . Verify problem is solved.



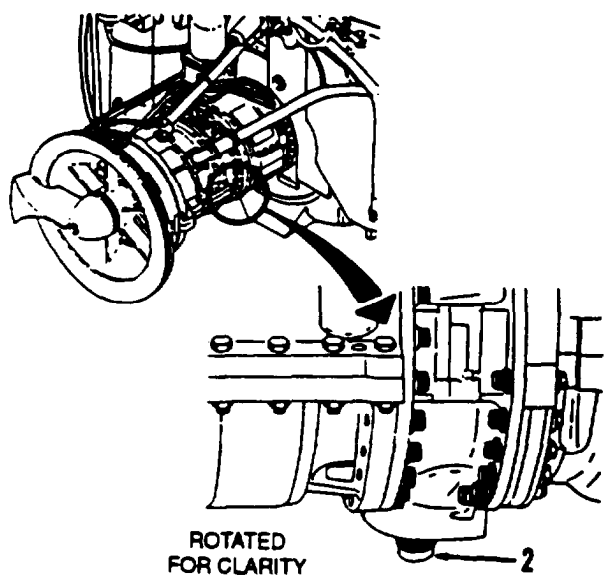
FROM STEP 3

7 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning splined coupling (2) in both directions. Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 7

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace forward engine module (page 5-13).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

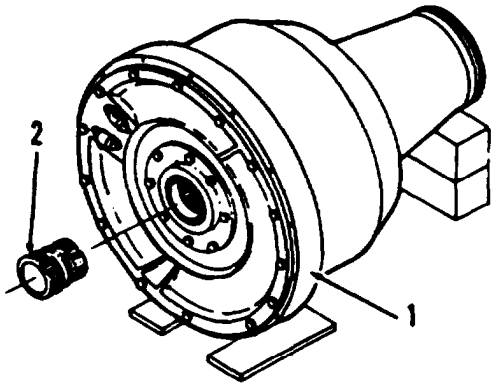
FROM STEP 5

8 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

YES — NO

A. Replace number 10 bearing (page 6-52).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verity problem is solved.



CONTINUED ON NEXT PAGE

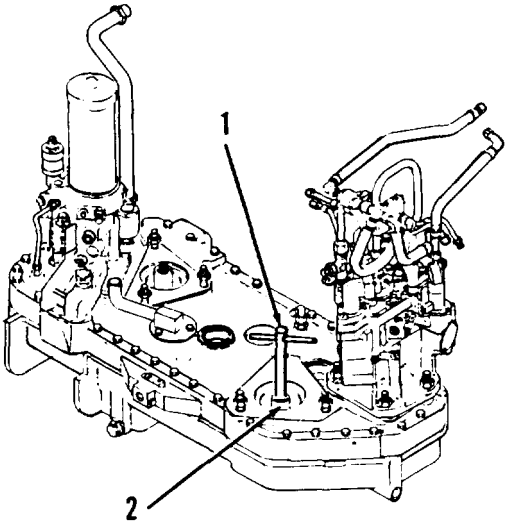
3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 8

9 A. Put handle (1) in main hydraulic pump drive gear assembly (2).
B. Check rotation of AGB gears by turning handle (1) clockwise. Handle should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does handle turn smoothly with no unusual noises?



YES — NO

A. Clean AGB (page 7-46).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1). .
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Install RGB assembly (page 6-19).
G. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(9) ES-9. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 9

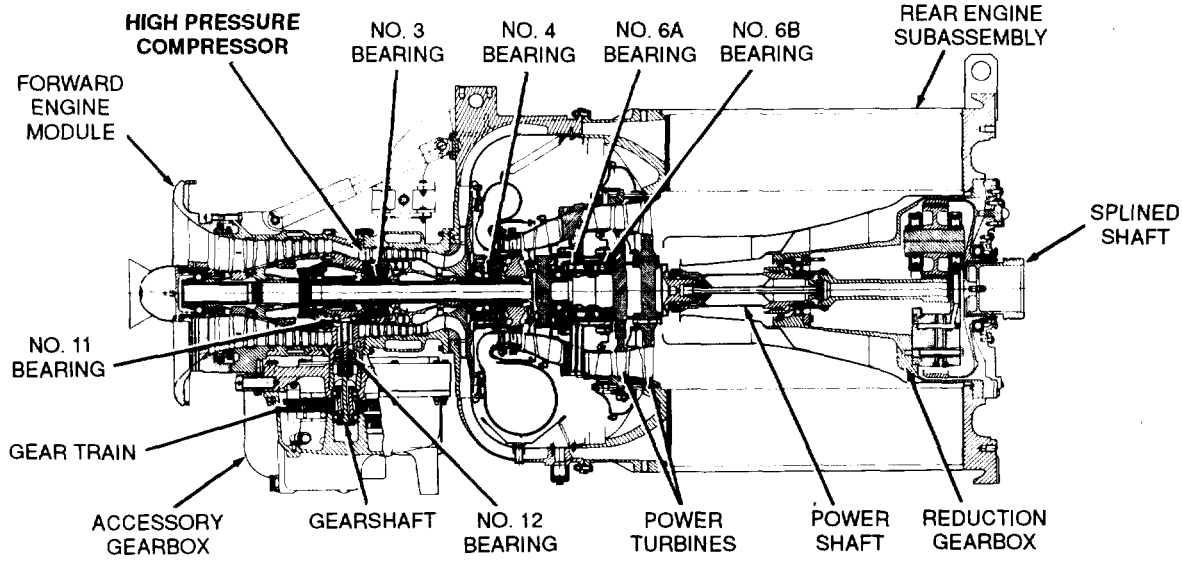
A. Install RGB assembly (page 6-19).
B. Install forward engine module (page 5-18).
C. Install AGB module (page 7-12).
D. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

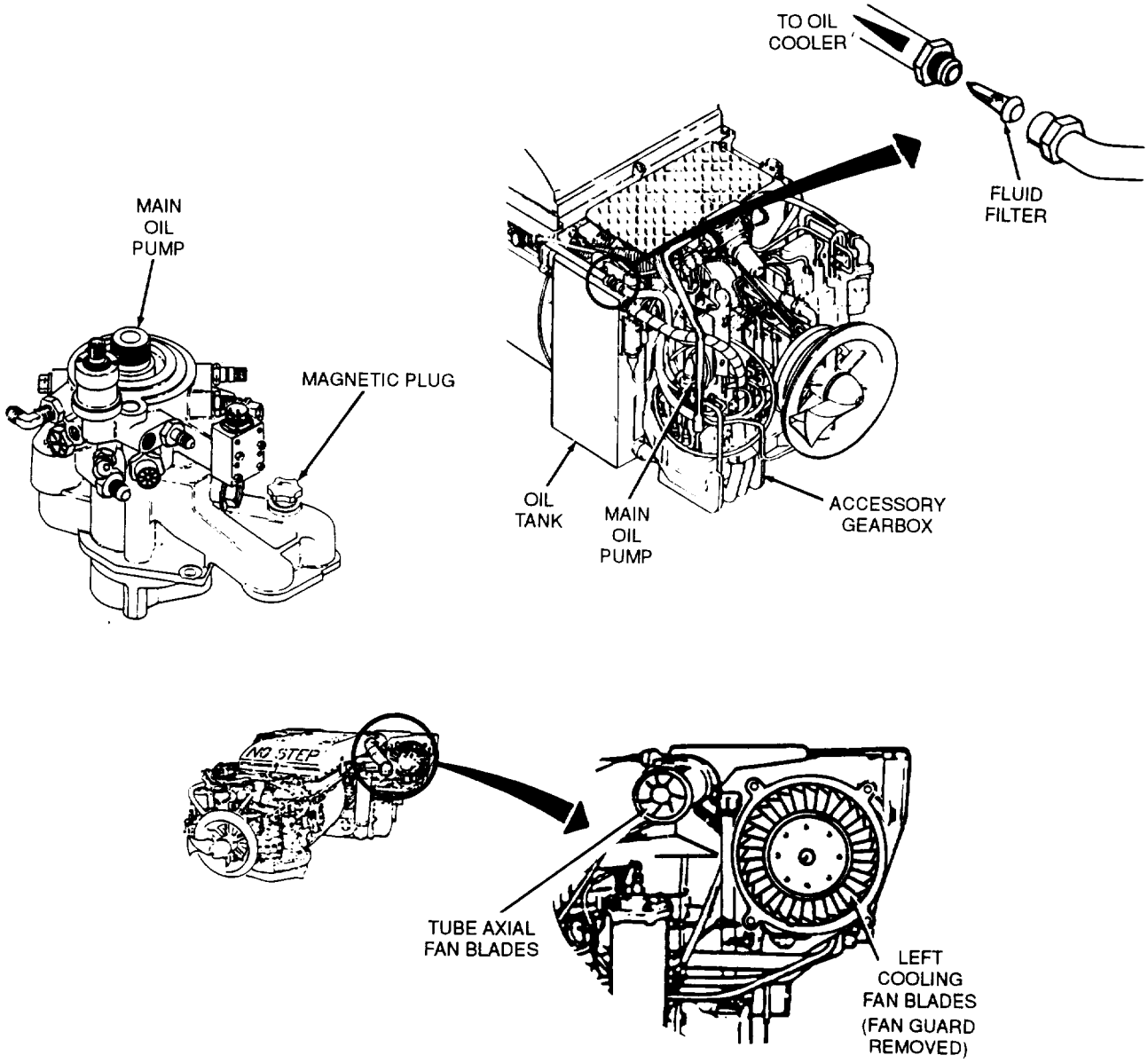
ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10)	ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.

This section contains troubleshooting to locate and correct cause(s) of binding in the AGB gear train when turned by hand, rubbing and binding when the tubeaxial fan blades or left cooling fan blades are turned by hand, and metal chips in the oil pump to oil cooler fluid filter. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module position No. 3, 4, 11 or 12 bearing, or AGB gears and/or bearings, binding will be felt when the AGB gear train is turned by hand. The power turbine and reduction gearbox (RGB) are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB bearings and/or gears, binding will be felt when the tubeaxial fan blades or left coolinq fan blades are turned by hand. The RGB oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. The transmission is mechanically coupled to the RGB through a splined shaft. If there is internal transmission damage, binding will be felt when turning the tubeaxial fan blades or cooler fan blades by hand. The lubrication system delivers hot oil, scavenged from bearing packages throughout the engine, through a fluid filter, to the engine 0il cooler. Cooled oil is then returned to the oil tank. Whenever metal chips are generated, the fluid filter will catch and retain most of the chips. Based on the above described symptoms, two separate failures may have occurred. The art on the following pages provides an overview-of the related systems. Refer to these pages along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED



3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

Tools:
- General mechanic's tool kit: automotive (SC 5180-90-N26)
- Metal pail (Item 136, Appendix D)

Supplies:
- Dry cleaning solvent (Item 7, Appendix B)
- Wiping rag (Item 14, Appendix B)

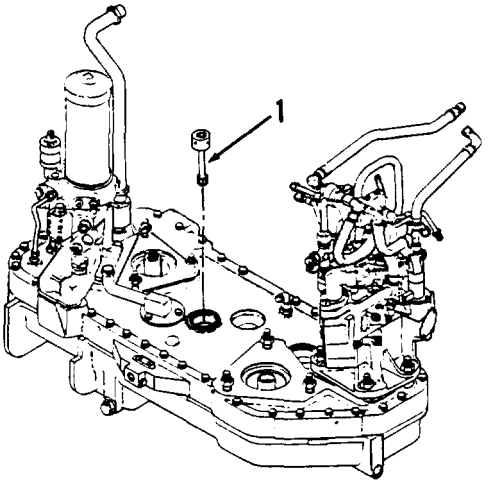
References:
- TM 20-1
- TM 34-1

1. A. Remove AGB (page 7-21).
   B. Remove RGB assembly (page 6-17).
   C. Remove spur gearshaft (1)
   D. Check to see if spur gearshaft (1) is broken or damaged.

Is spur gearshaft broken or damaged?

NO — Go to step 6.

YES



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

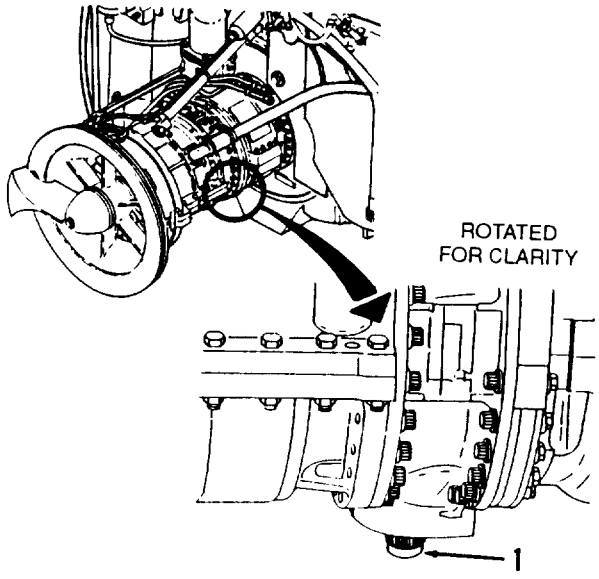
a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-IO. AGB GEAR TWIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 1

2	Check high pressure compressor system rotation by turning spline coupling (1) clockwise. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should by heard.
	Does high pressure compressor turn smoothly with no unusual noises?

YES — NO

Go to step 11.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

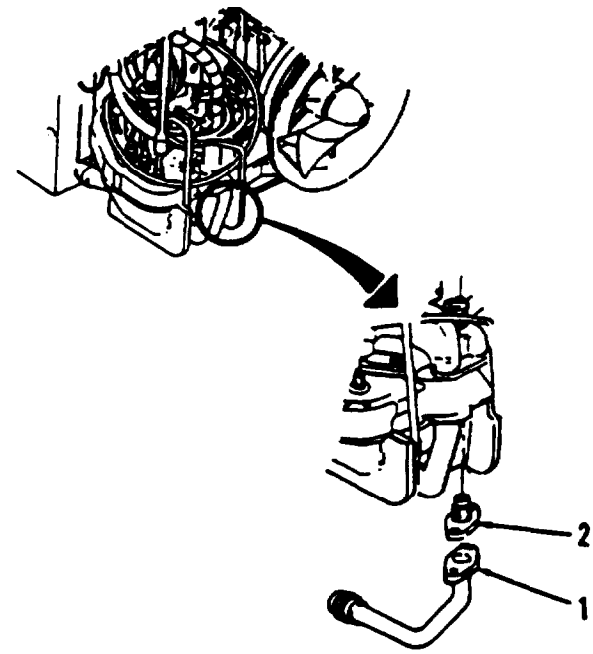
CONTINUED FROM STEP 2

3 A. Remove forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).

WARNING

B. Pour one quart of dry cleaning solvent through scavenge tube assembly (1) and into clean pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?



NO — YES

A. Clean AGB (page 7-46).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Replace engine oil pump (TM 20-1).
E. Verify problem is solved.

CONTINUED ON NEXT PAGE

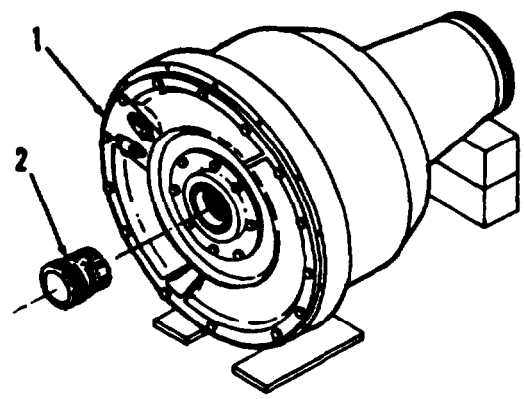
3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 3

4 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



NO

YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

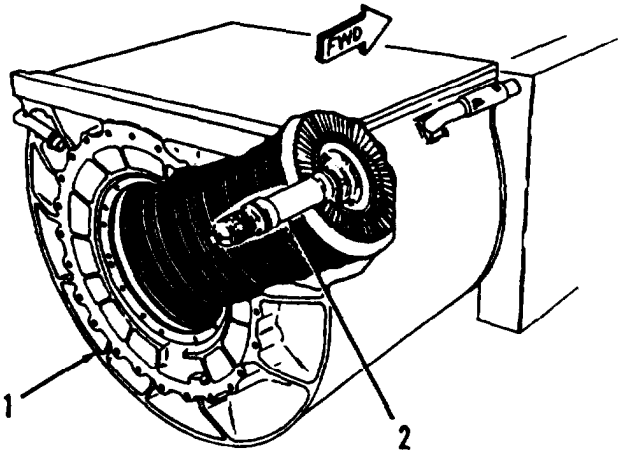
CONTINUED FROM STEP 4

5 Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

NO — YES

A. Replace number 10 bearing (page 6-52).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

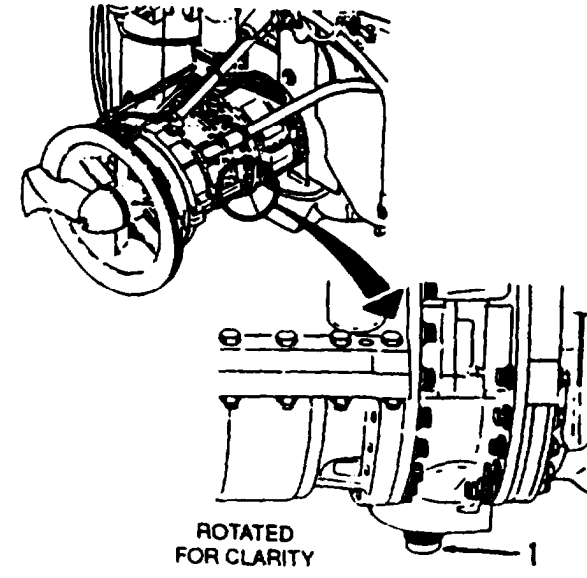
CONTINUED FROM STEP 5

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

FROM STEP 1

6 Check splined coupling (1) for damage to splines.

Is splined coupling damaged?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

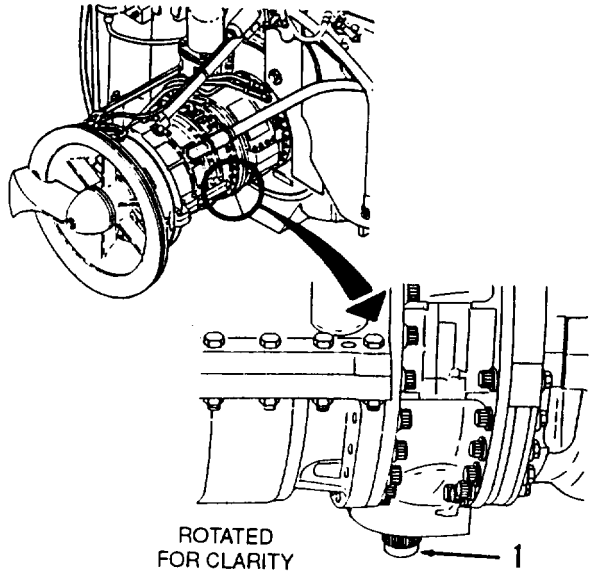
Go to step 11.

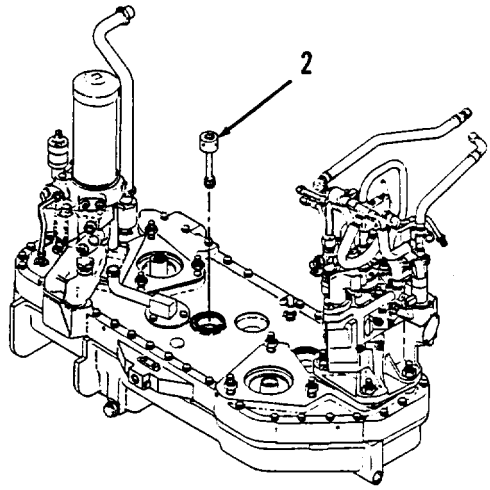
7	Check high pressure compressor system rotation by turning spline coupling (1) clockwise. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does high pressure compressor turn smoothly with no unusual noises?

NO — YES

A. Replace spur gearshaft (2).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1) .
D. Replace engine oil cooler (TM 20-1) .
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Go to step 8.





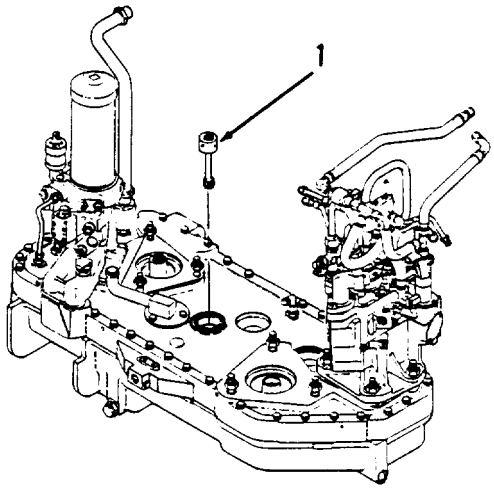
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 7

A. Replace spur gearshaft (1).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1) .
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).

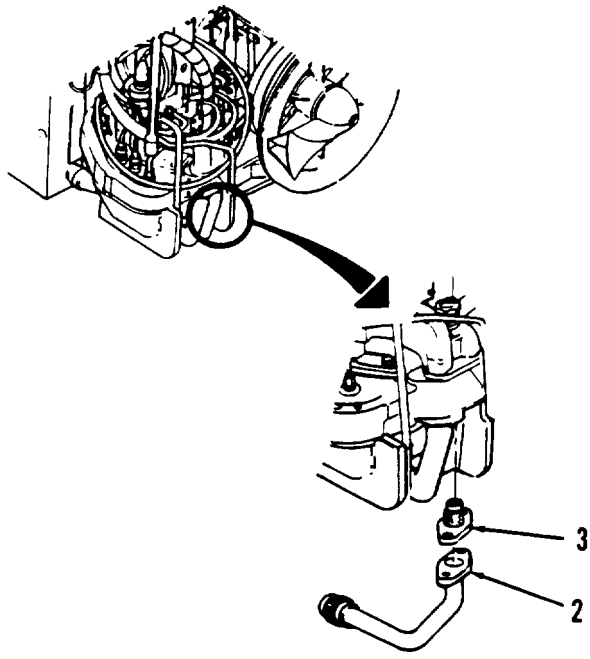


8 A. Remove forward RGB scavenge tube assembly (2) and screen (3) (TM 20-1) .

WARNING

B. Pour one quart of dry cleaning solvent through scavenge tube assembly (2) and into clean pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a.	ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

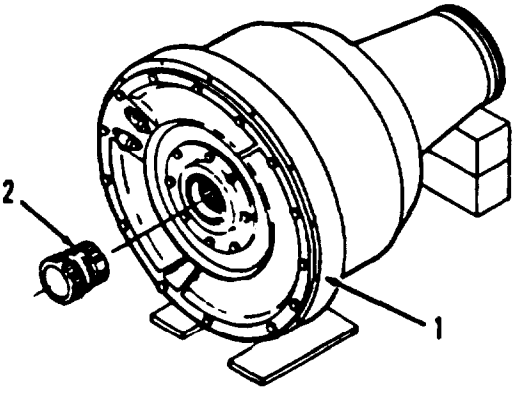
CONTINUED FROM STEP 8

NO — YES

A. Clean RGB lubrication system (page 8-1).
B. Clean AGB (page 7-46).
C. Replace number 10 bearing (page 6-52).
D. Replace engine oil pump
E. Verify problem is solved.

9 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

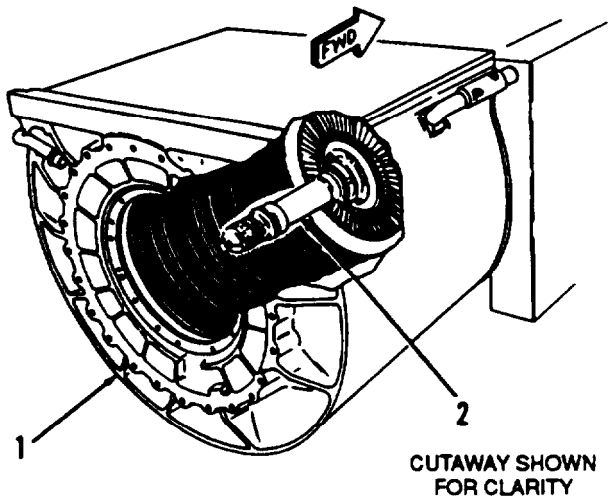
CONTINUED FROM STEP 9

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

10 Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 10

NO — YES

A. Replace number 10 bearing (page 6-52).
B. Clean AGB (page 7-46).
C. Replace engine oil pump
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND (10) HIGH PRESSURE COMPRESSOR - CONTINUED	ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

FROM STEP 2 OR 6

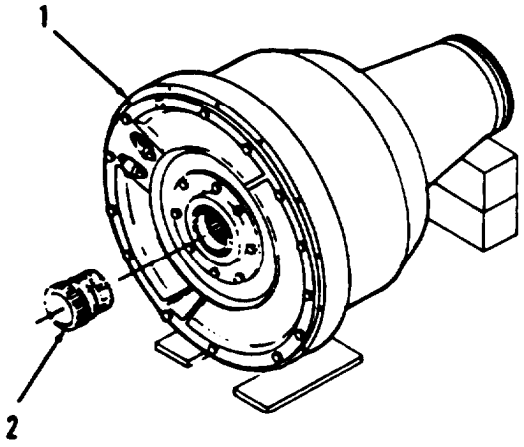
11 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

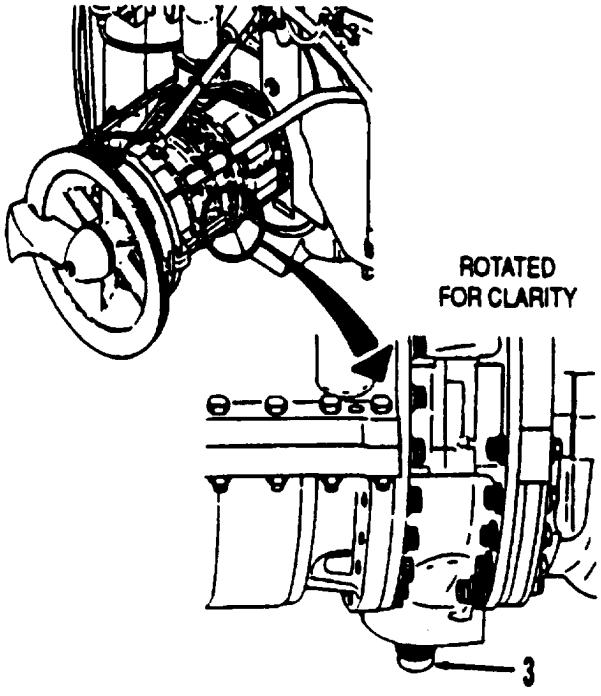
Does shaft turn smoothly with no unusual noises?.

NO — YES

A. Inspect splined coupling (3) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).
B. Salvage Gas Turbine Power Unit (page 6-63).
C. Clean AGB (page 7-46).
D. Replaced engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE





3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(10) ES-10. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STFP 11

12 Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

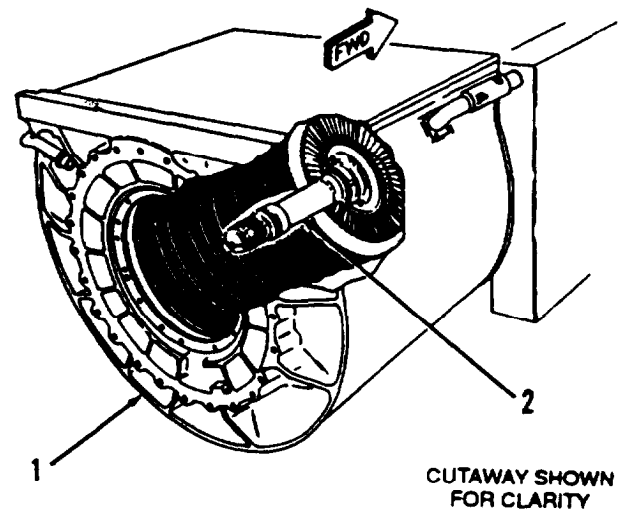
NO — YES

A. Inspect splined coupling (3) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).
B. Replace number 10 bearing (page 6-52).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

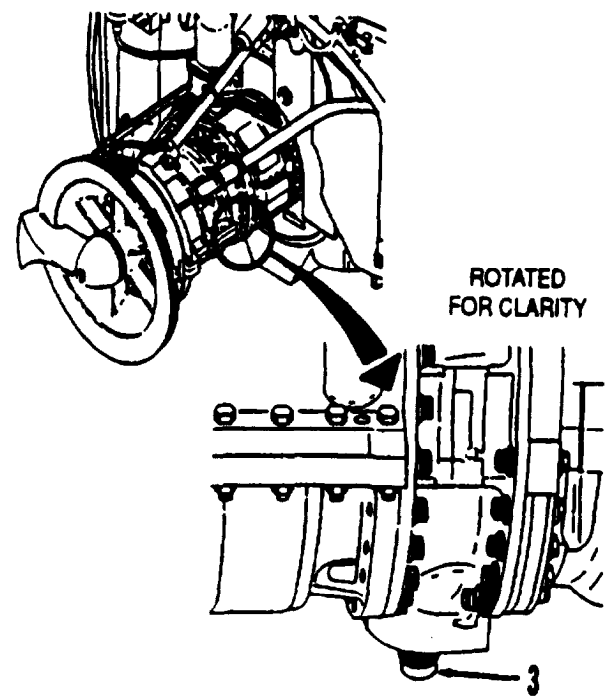
A. Replace engine assembly

B. Verify problem is solved.

END OF TASK



CUTAWAY SHOWN FOR CLARITY

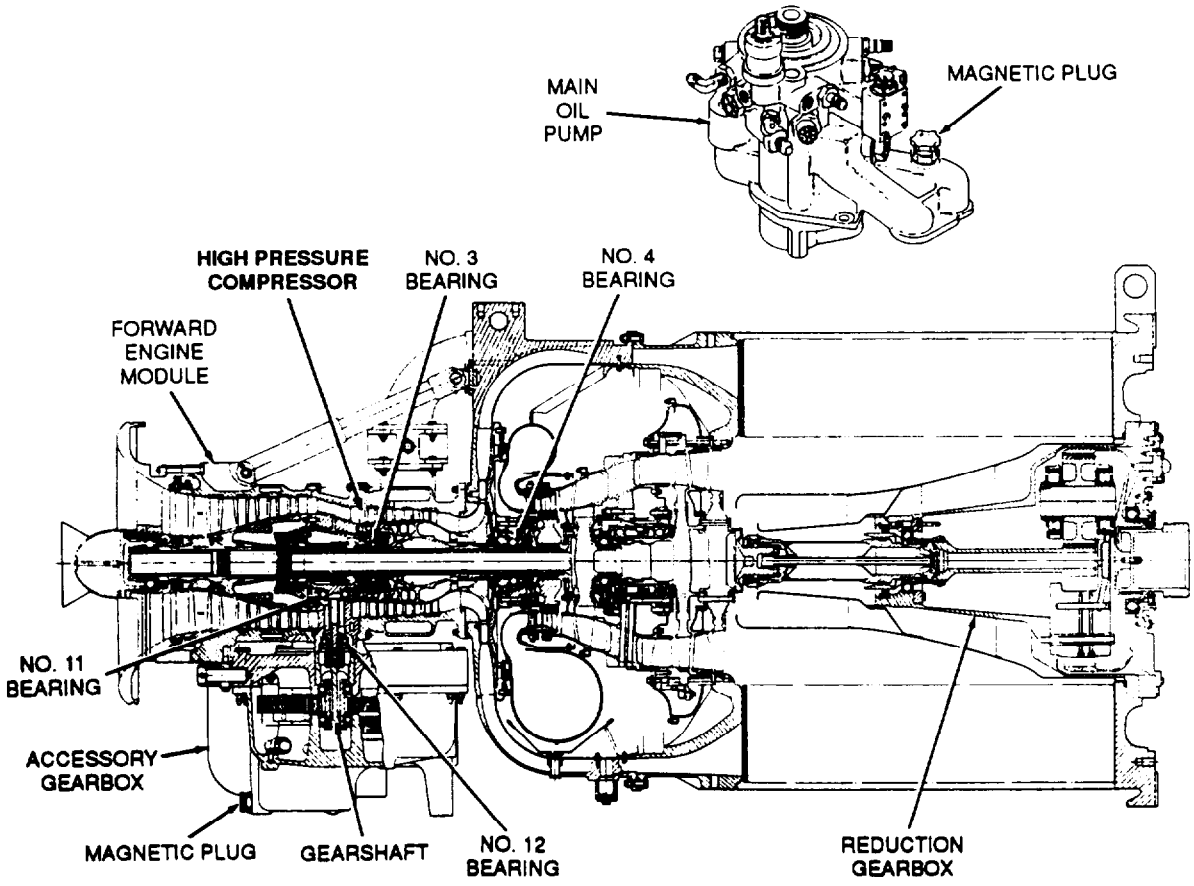


ROTATED FOR CLARITY

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(11) ES-11. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF' OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of binding in the AGB gear train when turned by hand, when more than one half of the AGB and main oil pump magnetic plugs are covered with metal chips. The AGB is coupled to the high pressure compressor in the forward engine module through a gearshaft. If there is damage to the high pressure compressor, forward engine module position No. 3, 4, 11 or 12 bearing, or AGB gears and/or bearings, binding will be felt when the AGB gear train is turned by hand. The reduction gearbox (RGB) oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. These two systems are totally independent of each other. The symptoms described above indicate two separate failures. The art on this page provides an overview of the systems described above. Refer to this page along with in-text art while doing troubleshooting.

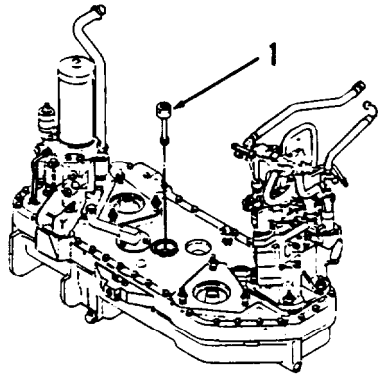


3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(11) ES-11. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

Tools:	Supplies:
General mechanic's tool kit: automotive (SC 5180-90-N26)	Wiping rag (Item 14, Appendix B)
	References: TM 20-1, TM 34-1

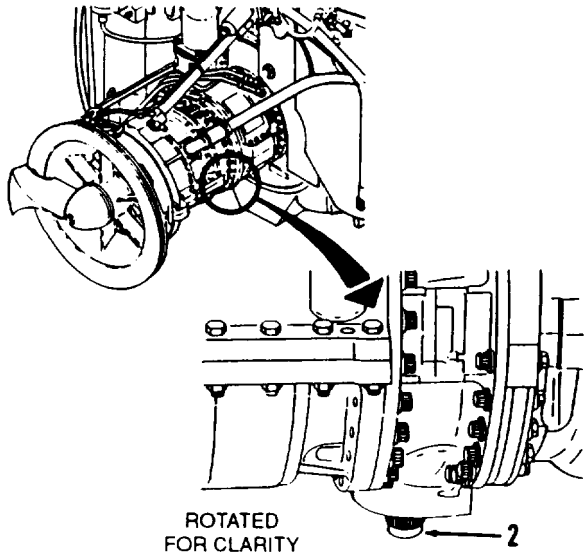
1.	A. Remove AGB (page 7-21). B. Remove spur gearshaft (1). C. Check to see if spur gearshaft (1) is broken or damaged.
Is spur gearshaft broken or damaged?	



NO — YES

Go to step 3.

2	Check high pressure compressor. system rotation by turning spline coupling (2) clockwise. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.
Does high pressure compressor turn smoothly with no unusual noises?	



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a.	ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(11) ES- 11. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

YES — NO

A. Replace forward engine module (page 5-13).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. de lace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Replace RGB (page 6-17).
H. Verify problem is solved.

A. Clean AGB (page 7-46).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Replace engine oil pump
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND (11) HIGH PRESSURE COMPRESSOR - CONTINUED	ES-11. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

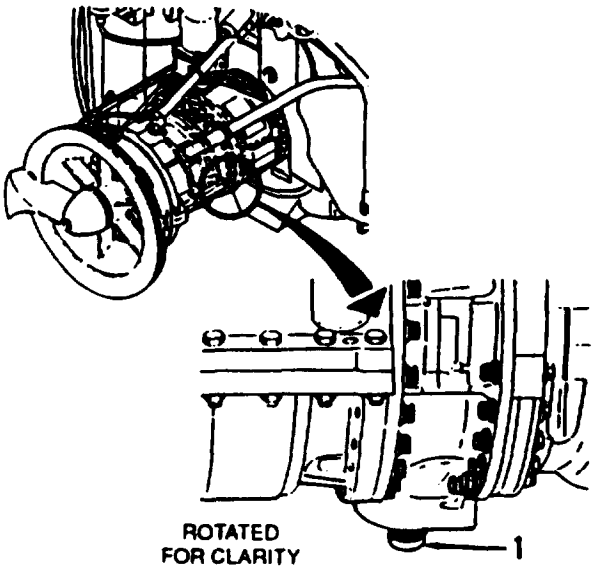
FROM STEP 1

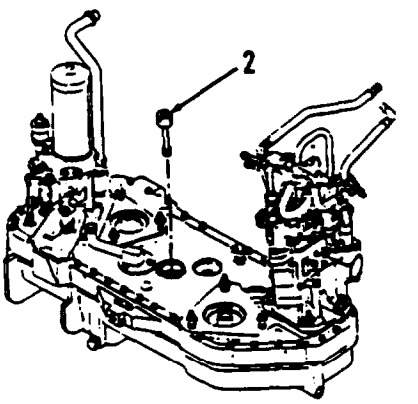
3 Check splined coupling (1) for damage to splines.

Is splined coupling damaged?

NO — YES

A. Replace number 12 bearing and splined coupling (page 5-124).
B. Replace spur gearshaft (2).
C. Clean AGB (page 7-46).
D. Clean RGB lubrication system (page 8-1).
E. Replace number 10 bearing (page 6-52).
F. Replace engine oil pump (TM 20-1).
G. Replace engine oil cooler (TM 20-1).
H. Replace engine AC generator (TM 20-1).
I. Clean cooler and generator lines (TM 20-1).
J. Verify problem is solved.





CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(11) ES-11. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB AND RAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 3

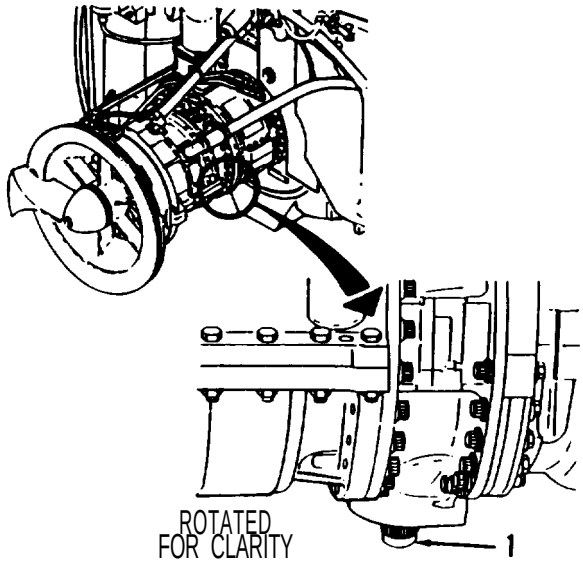
4 Check high pressure compressor system rotation by turning spline coupling (1) clockwise. High pressure compressor system should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

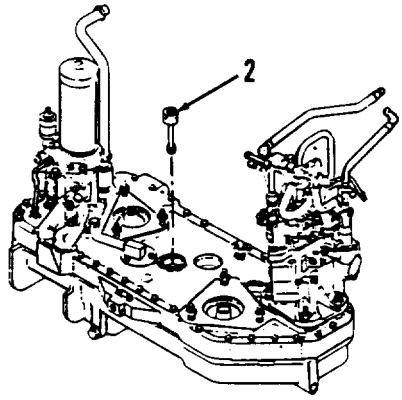
Does high pressure compressor turn smoothly with no unusual noises?

YES

NO

A. Replace forward engine module (page 5-13).
B. Replace spur gearshaft (2).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Replace RGB assembly (page 6-17).
I. Verify problem is solved.





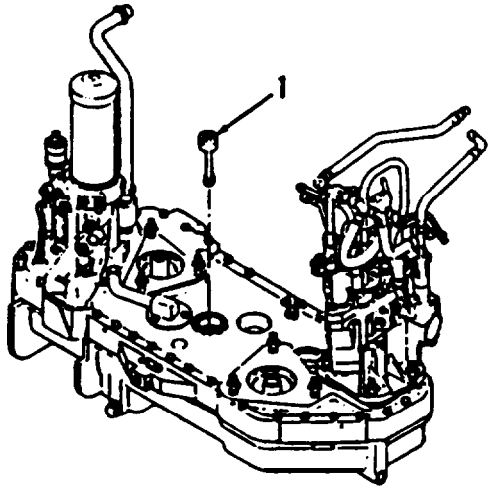
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND (11) HIGH PRESSURE COMPRESSOR - CONTINUED	ES-11. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND AND MORE THAN ONE HALF OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 4

A. Replaces spur gearshaft (1).
B. Clean AGB (page 7-46).
C. Clean RGB lubrication system (page 8-1).
D. Replace number 10 bearing (page 6-52).
E. Replace engine oil pump (TM 20-1).
F. Replace engine oil cooler (TM 20-1).
G. Replace engine AC generator (TM 20-1).
H. Clean cooler and generator lines (TM 20-1).
I. Verify problem is solved.



END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(12) ES-12. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF' OF AGB AND MAIN 0IL. PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.

Tools:	References:
General mechanic's tool kit: automotive (SC 5180-90-N26)	TM 20-1 TM 34-1

1. Replace engine assembly (TM 34-1).
2. Replace engine oil cooler (TM 20-1).
3. Replace engine AC generator (TM 20-1).
4. Clean cooler and generator lines (TM 20-1).
5. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING CONTINUED

a. ACCESSORY GEARBOX (AGB) AND HIGH PRESSURE COMPRESSOR - CONTINUED	(13) ES-13. AGB GEAR TRAIN TURNS UNEVENLY (BINDS) WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.

Tools:	References:
General mechanic's tool kit: automotive (SC 5180-90-N26)	TM 20-1 TM 34-1

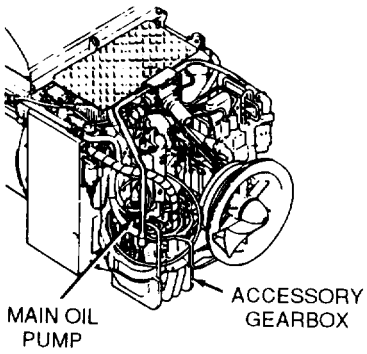
1. Replace engine assembly (TM 34-1).
2. Replace engine oil cooler (TM 20-1).
3. Replace engine AC generator (TM 20-1).
4. Clean cooler and generator lines (TM 20-1).
5. Verify problem is solved.

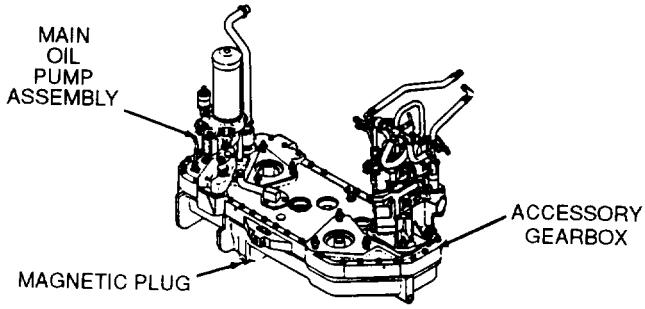
END OF TASK

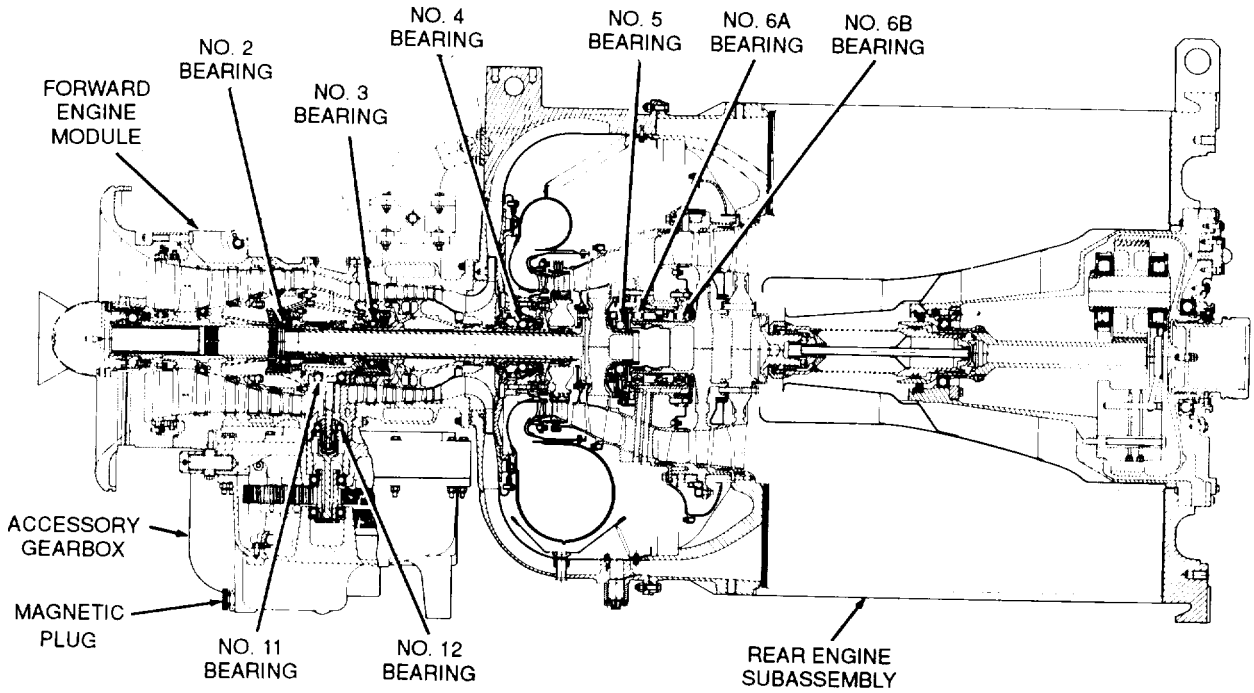
3-2. TROUBLESHOOTING - CONTINUED

b. ACCESSORY GEARBOX (AGB) MAGNETIC PLUG	(1) ES-14. MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. NO OTHER ROTATION OR METAL CHIPS NOTED.

This section contains troubleshooting to locate and correct the cause(s) of more than one half of the AGB magnetic plug being covered with metal chips when no other chip or rotational discrepancies were noted. The AGB acts as an oil sump to collect oil which is scavenged from bearings in the forward engine module and rear engine subassembly. The main Oil pump pumps the hot oil from the sump to the engine oil cooler. Based on the above description, it will be necessary to identify the source of the metal chips. The possibilities include the forward engine module, rear engine subassembly, and/or the AGB. The art on this page provides an overview of the lubrication system. Refer to this page along with in-text art while performing troubleshooting.







3-2. TROUBLESHOOTING - CONTINUED

b. ACCESSORY GEARBOX (AGB) MAGNETIC PLUG - CONTINUED	(1) ES-14. MORE THAN ONE HALF OF AGE MAGNETIC PLUG IS COVERED WITH METAL CHIPS. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
Metal pail (Item 136, Appendix D)

Supplies:
Dry cleaning solvent (Item 7, Appendix B)
Wiping rag (Item 14, Appendix B)

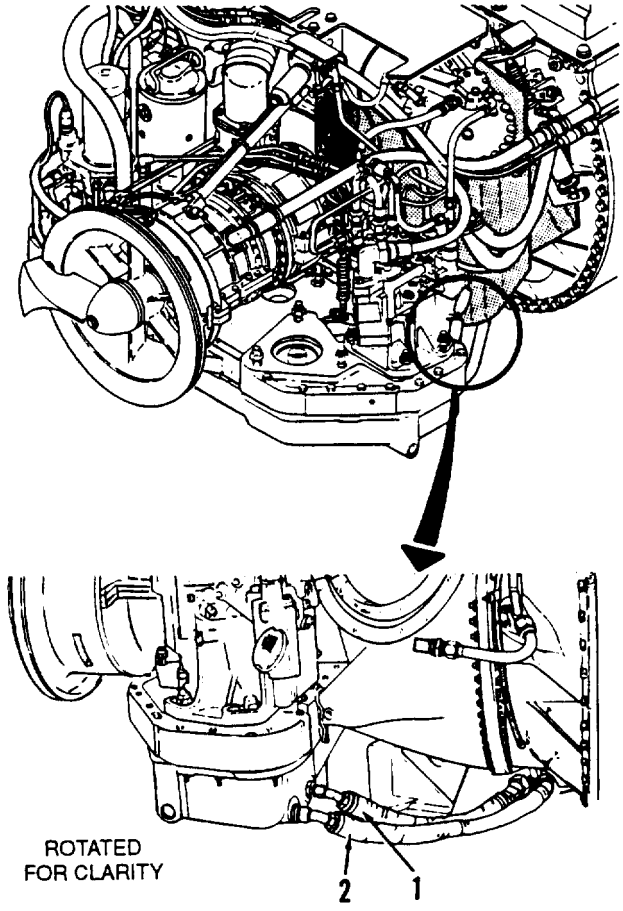
References:
TM 20-1

1 A. Remove No. 5 and 6A bearing scavenge hose assembly (1) and No. 6B scavenge hose assembly (2).

WARNING

B. Pour one quart of dry cleaning solvent through each hose (1, 2) and into clean pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

b. ACCESSORY GEARBOX (AGB) MAGNETIC PLUG - CONTINUED	(1) ES-14. MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

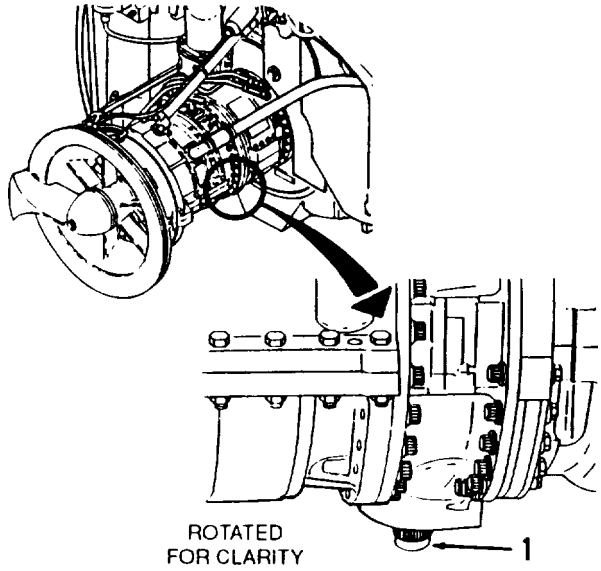
CONTINUED FROM STEP 1

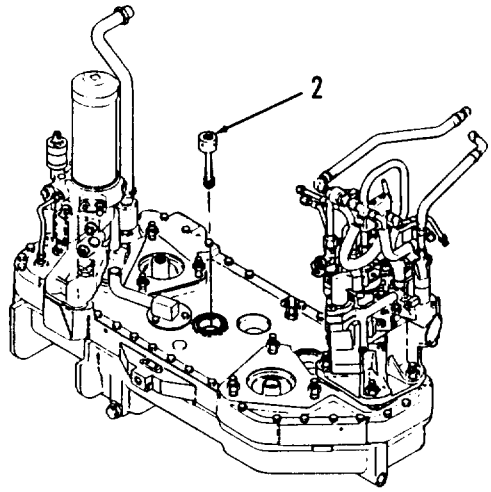
NO — YES

A. Replace rear engine subassembly (page 6-28).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC qenerator (TM 20-1).
D. Replace engine oil pump (TM 20-1).
E. Clean AGB (page 7-46).
F. verify problem is solved.

2 A. Remove AGB (page 7-21).
B. Check spline coupling (1) and spur gearshaft (2) for cracks, spline damage or breakage.

Is spline coupling or gearshaft damaged?





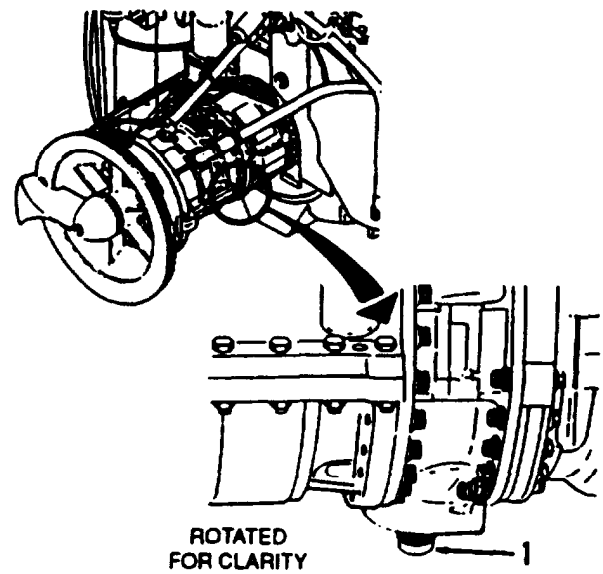
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED		
b. ACCESSORY GEARBOX (AGB) MAGNETIC PLUG - CONTINUED	(1)	ES-14. MORE THAN ONE HALF OF AGB MAGNETIC PLUG IS COVERED WITH METAL CHIPS. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

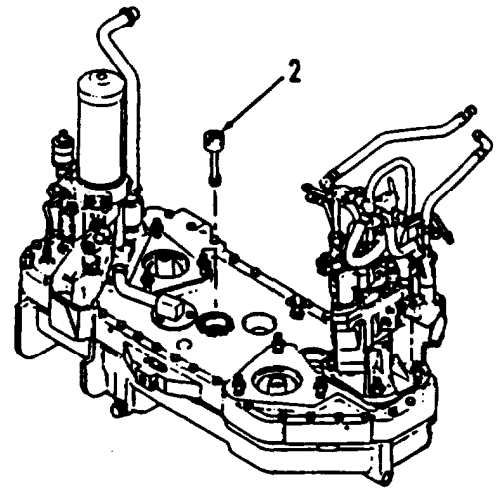
CONTINUED FROM STEP 2

NO — YES

A. Inspect splined coupling (1) for evidence of damage. If damaged, replace number 12 bearing and splined coupling (page 5-124).
B. Replace spur gearshaft (2).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.



A. Clean AGB (page 7-46).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.

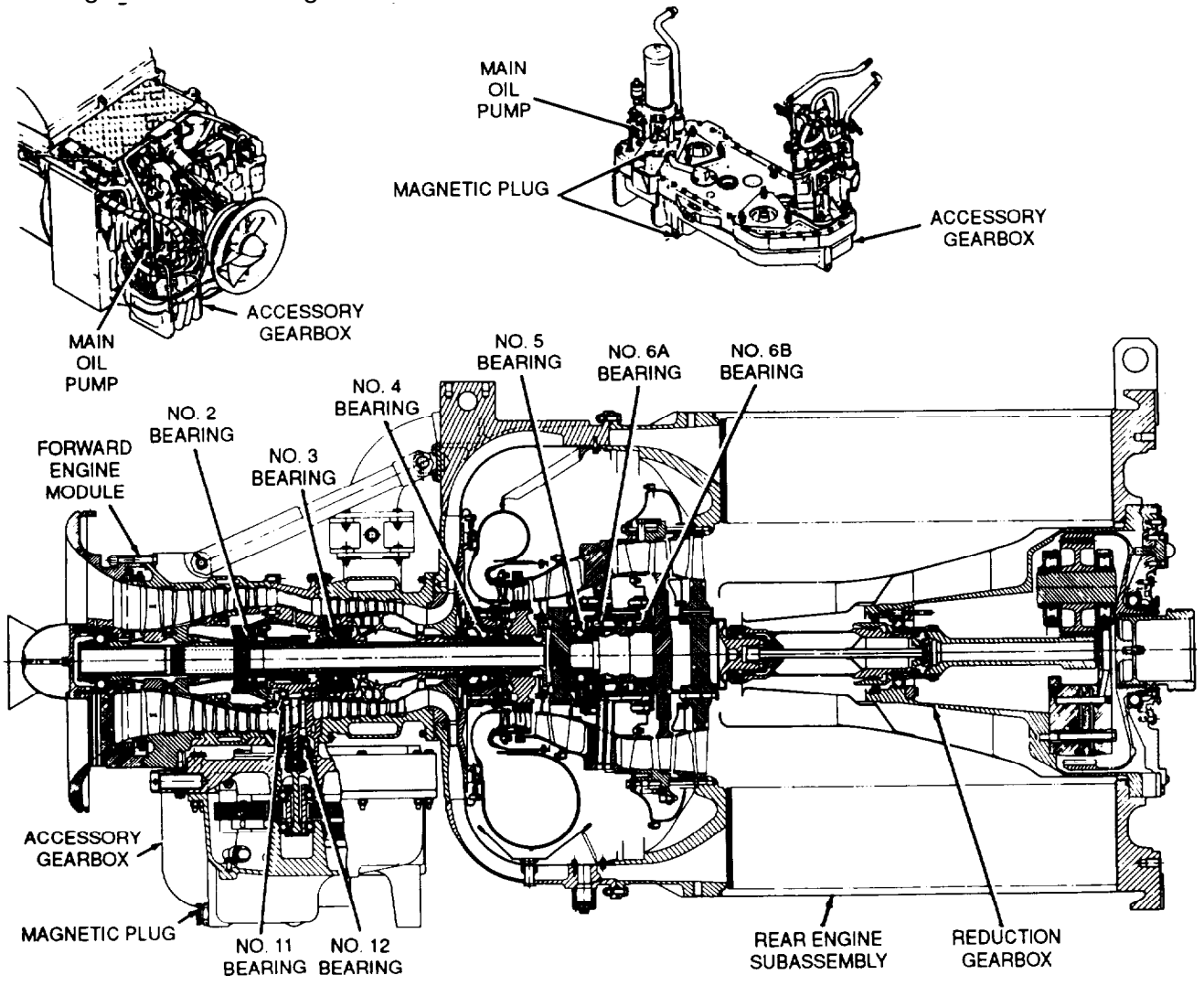


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

b. ACCESSORY GEARBOX (AGB) MAGNETIC PLUG - CONTINUED	(2) ES-15. MORE THAN ONE HALF OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of more than one half of each of the AGB and main oil pump magnetic plugs being covered with chips. The AGB acts as an oil sump to collect oil which is scavenged from bearings in the forward engine module and rear engine subassembly. The main oil pump pumps the hot oil from the sump to the engine oil cooler. It will be necessary to determine the source of metal chips on the AGB magnetic plug. Possible sources include the forward engine module rear engine subassembly, and/or the AGB. The reduction gearbox (RGB) oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. These two systems are totally independent of each other. The symptoms described above indicate two separate failures. The art on this page provides an overview of the systems described above. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

b. ACCESSORY GEARBOX (AGB) MAGNETIC PLUG - CONTINUED	(2) ES-15. MORE THAN ONE HALF' OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
Metal pail (Item 136, Appendix D)

Supplies:
Dry cleaning solvent (Item 7, Appendix B)
Wiping rag (Item 14, Appendix B)

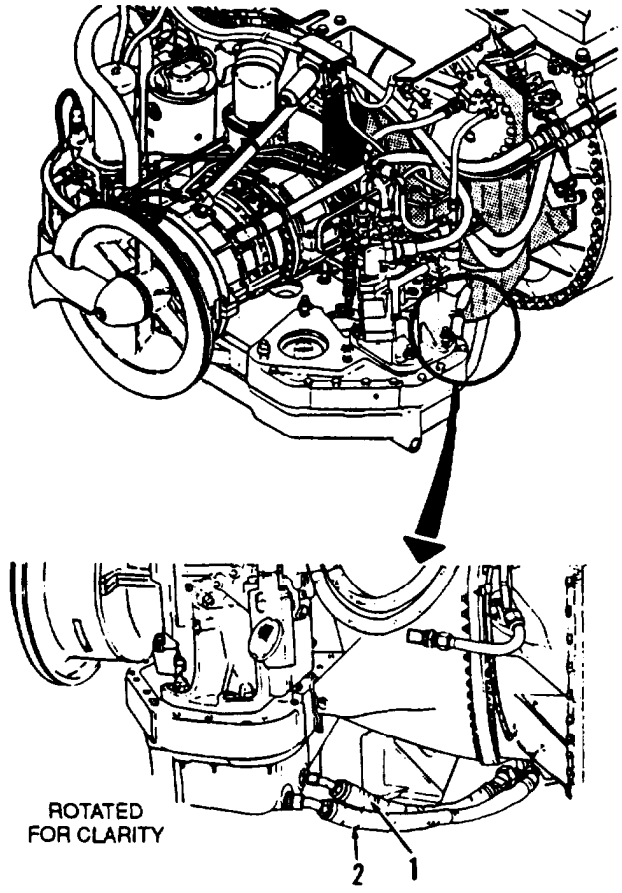
References:
TM 20-1

1 A. Remove No. 5 and 6A bearing scavenge hose assembly (1) and No. 6B scavenge hose assembly (2).

WARNING

B. Pour one quart of dry cleaning solvent through each hose (1, 2) and into clean pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?



CONTINUED ON NEXT PAGE

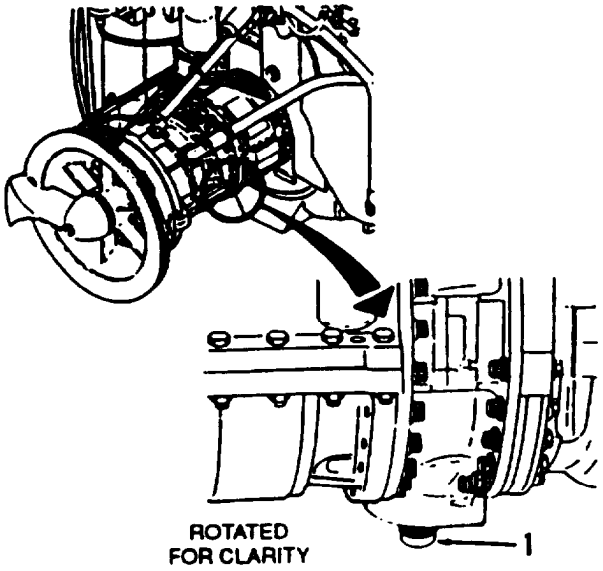
3-2. TROUBLESHOOTING - CONTINUED

b. ACCESSORY GEARBOX (AGB) MAGNETIC PLUG - CONTINUED	(2)	ES-15. MORE THAN ONE HALF OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

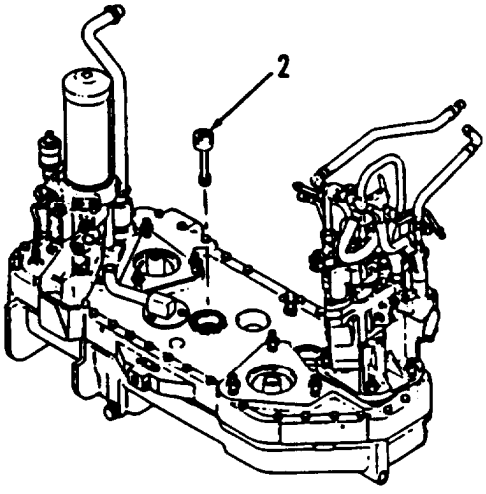
NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (6-52).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Replace engine oil pump (TM 20-1).
G. Clean AGB (page 7-46).
H. Verify problem is solved.



2 A. Remove AGB (page 7-21).
B. Check splined coupling (1) and spur gearshaft (2) For cracks, spline damage or breakage.

Is splined coupling or gearshaft damaged?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

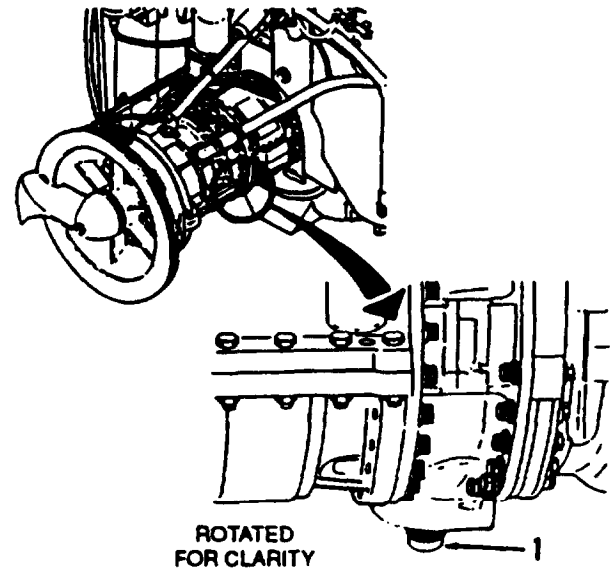
b. ACCESSORY GEARBOX (AGB) MAGNETIC PLUG - CONTINUED	(2)	ES-15. MORE THAN ONE HALF OF AGB AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

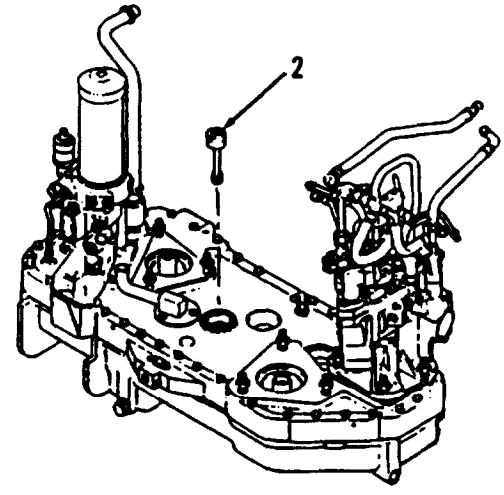
CONTINUED FROM STEP 2

NO — YES

A. Inspect splined coupling (1) for evidence of damage. If damaged, replace number 12 bearing and splined coupling page 5-124).
B. Replace spur gearshaft (2).
C. Replace number 10 bearing (page 6-52).
D. Clean AGB (page 7-46).
E. Replace engine oil pump (TM 20-1).
F Replace engine oil cooler (TM 26-1).
G. Replace engine AC generator (TM 20-1).
H. Clean cooler and generator lines (TM 29-1).
I. Verify problem is solved.

A. Clean AGB (page 7-46).
B. Replace number 10 bearing (page 6-52).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.



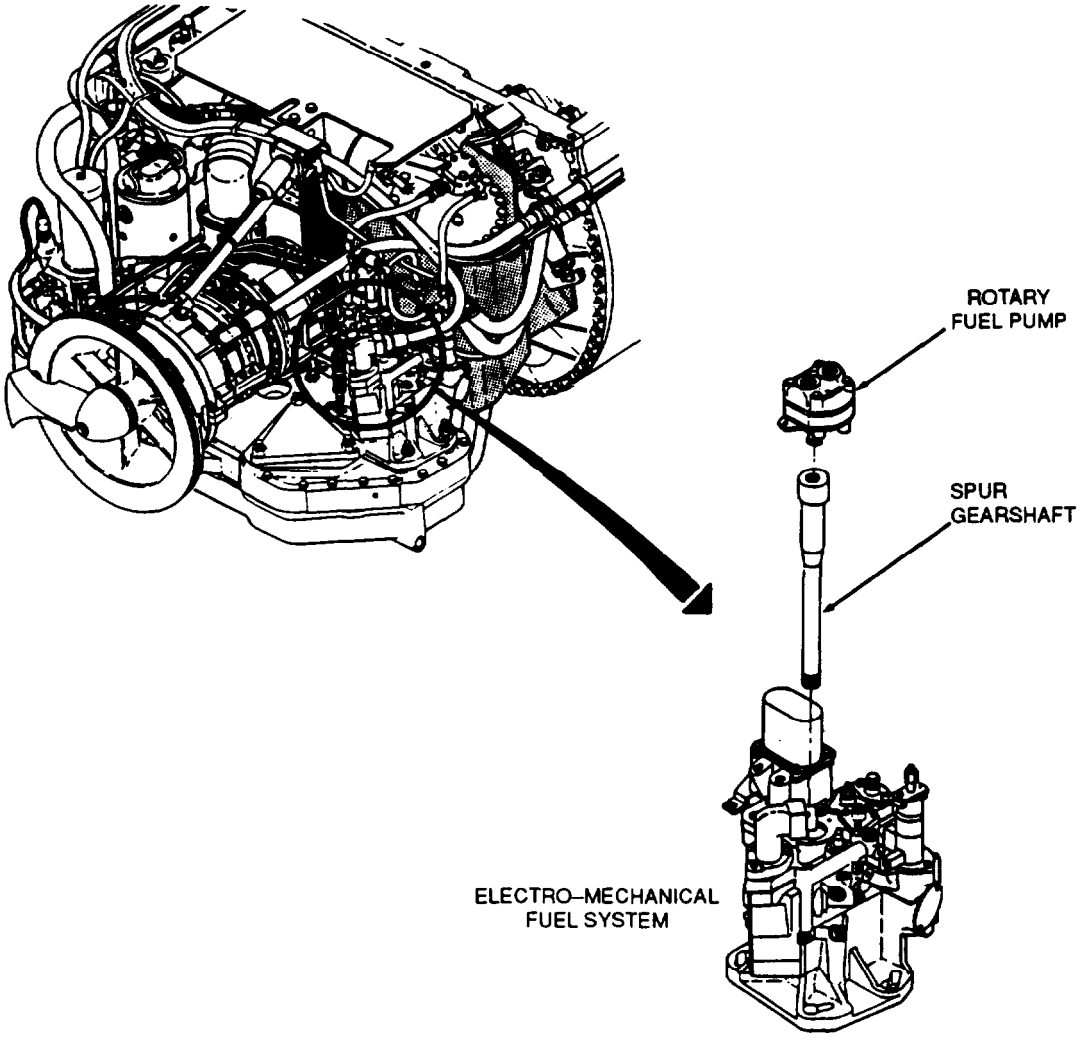


END OF TASK

3-2. TROUBLESHOOTING) - CONTINUED

c. ELECTRO-MECHANICAL FUEL SYSTEM (EMFS)	(1) ES-16. EMFS FAULTY

This section contains troubleshooting to check out the EMFS. When a faulty EMFS is suspected, a visual inspection of the electrical connector, rotary fuel pump and spur gear shaft shall be performed. Electrical resistance checks of the internal electrical components of the EMFS shall also be performed. It is possible, though unlikely, that an EMFS showing no electrical faults during the above inspections might prove faulty as a result of internal component mechanical failure. The art on this page provides an overview of the EMFS. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

c. ELECTRO-MECHANICAL FUEL SYSTEM (EMFS) - CONTINUED

(1) ES-16. EMFS FAULTY - CONTINUED

Tools:
- General mechanic's tool kit: automotive (SC 5180-90-N26)
- Digital multimeter (Item 144, Appendix D)
- TA1 continuity test probe kit (Item 143, Appendix D)
- Test lead set (Item 145, Appendix D)

Supplies:
- Wiping rag (Item 14, Appendix B)

References:
- TM 20-1

1 A. If installed, remove EMFS (TM 20-1).
B. Check to see if three locking pins (1) on J33 connector (2) are worn, cracked or broken off.

Are locking pins OK?

YES — NO

A. Replace EMFS (TM 20-1).
B. Verify problem is solved.

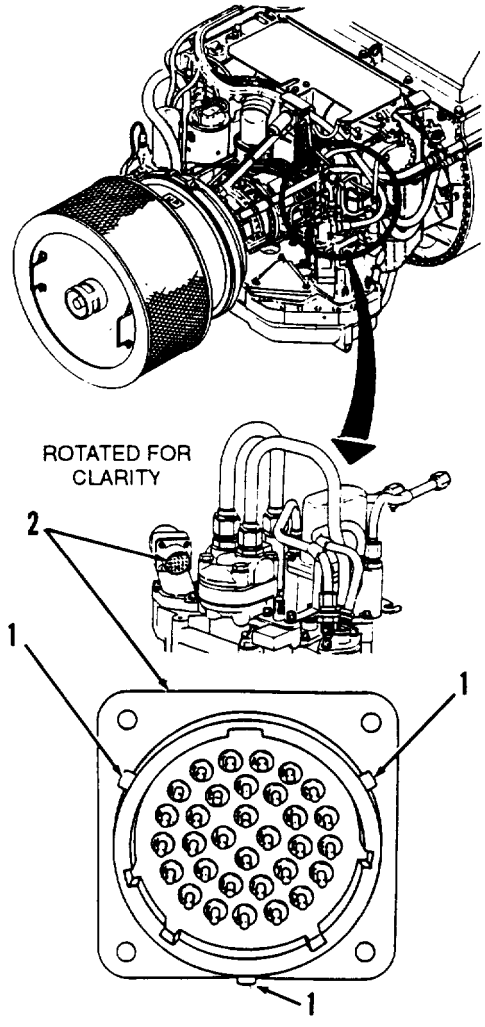
2 Check connector J33 (2) for missing or damaged electrical pins (contacts).

Are any electrical pins missing or damaged?

YES — NO

Go to step 4.

CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTING - CONTINUED

c. ELECTRO-MECHANICAL FUEL SYSTEM (EMFS) - CONTINUED

(1) ES-16. EMFS FAULTY - CONTINUED

CONTINUED FROM STEP 2

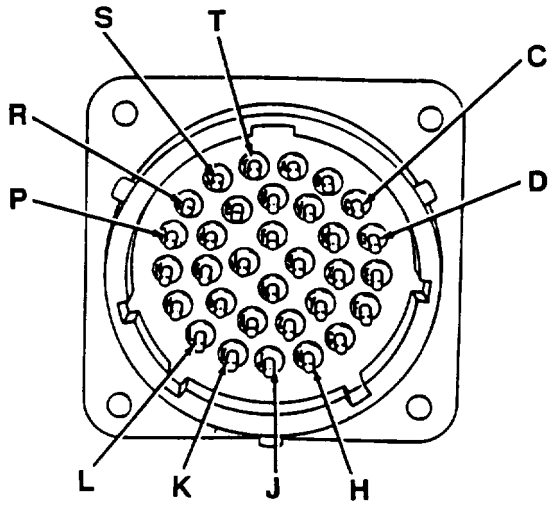
3 **NOTE**
The EMFS may be repaired if damage is limited to pins C, D, H, J, K, L, P, R, S or T on EMFS-J33. If any other pin is missing or damaged, the EMFS may not be repaired at direct support.

Check to see if any pins other than C, D, H, J, K, L, P, R, S or T are missing or damaged.

Are any other pins damaged?

NO — YES

A. Replace EMFS (TM 20-1).
B. Verify problem is solved.



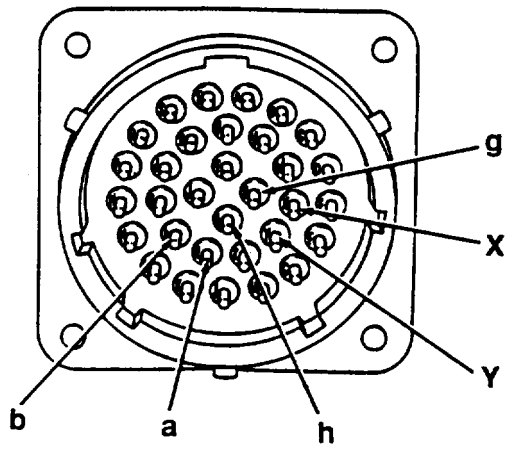
EMFS J33

4 A. Prepare multimeter for ohms test.
B. Test for 5 to 15 ohms between contacts on EMFS-J33 listed below:
- X and Y
- a and b
- g and h

Did multimeter show between 5 and 15 ohms for each test?

YES — NO

1,
A. Replace EMFS (TM 20-1).
B. Verify problem is solved.



EMFS J33

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

c. ELECTRO-MECHANICAL FUEL SYSTEM (EMFS) - CONTINUED

(1) ES-16. EMFS FAULTY - CONTINUED

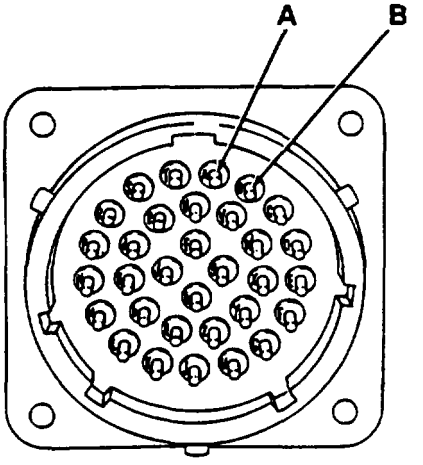
CONTINUED FROM STEP 4

5 Test for 35 to 60 ohms between contacts A and B on EMFS-J33.

Did multimeter show between 35 and 60 ohms?

YES — NO

A. Replace EMFS (TM 20-1).
B. Verify problem is solved.



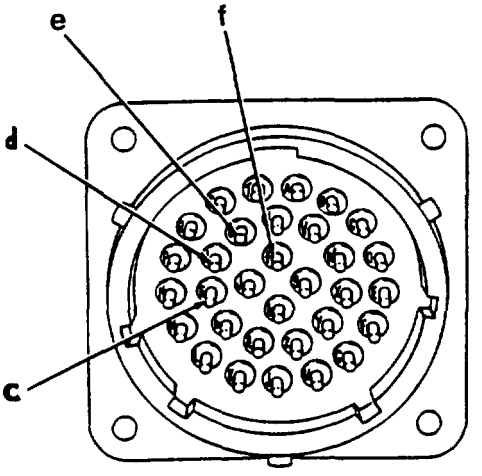
EMFS J33

6 Test for 30 to 60 ohms between contacts e and f on EMFS-J33.

Did multimeter show between 30 and 60 ohms?

YES — NO

A. Replace EMFS (TM 20-1).
B. Verify problem is solved.



EMFS J33

7 Test for 40 to 110 ohms between contacts c and d on EMFS-J33.

Did multimeter show between 40 and 110 ohms?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

c. ELECTRO-MECHANICAL FUEL SYSTEM (EMFS) - CONTINUED

(1) ES-16. EMFS FAULTY - CONTINUED

CONTINUED FROM STEP 7

YES — NO

A. Replace EMFS (TM 20-1).
B. Verify problem is solved.

8 **NOTE**
For remainder of tests, if any of the contacts are missing or damaqed, consider that test as not within limits.

Test for 25 to 35 ohms between contacts C and D on EMFS-J33.

Did multimeter show between 25 and 35 ohms?

YES — NO

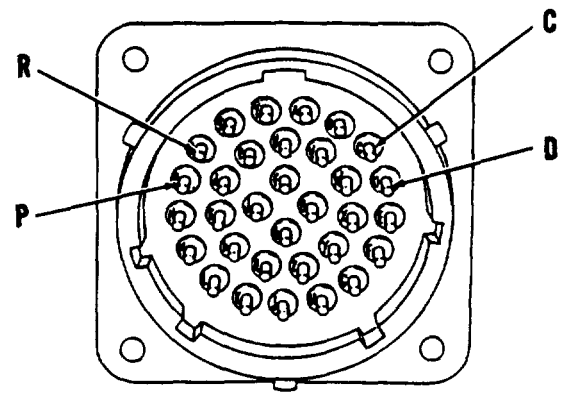
Replace direct linear valve (page 7-40).

9 Test for 5 to 50 ohms between contacts P and R on EMFS-J33.

Did multimeter show between 5 and 50 ohms?

YES — NO

A. Replace power turbine stator (PTS) power transformer (page 7-30).
B. Go to step 11.



EMFS J33

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

c. ELECTRO-MECHANICAL FUEL SYSTEM (EMFS) - CONTINUED

(1) ES-16. EMFS FAULTY - CONTINUED

CONTINUED FROM STEP 9

10 Test for 2 to 40 ohms between contacts S and T on EMFS-J33.

Did multimeter show between 2 and 40 ohms?

YES — NO

NO: Replace PTS power transformer (page 7-30).

11 Test for 5 to 50 ohms between contacts H and J on EMFS-J33.

Did multimeter show between 5 and 50 ohms?

YES — NO

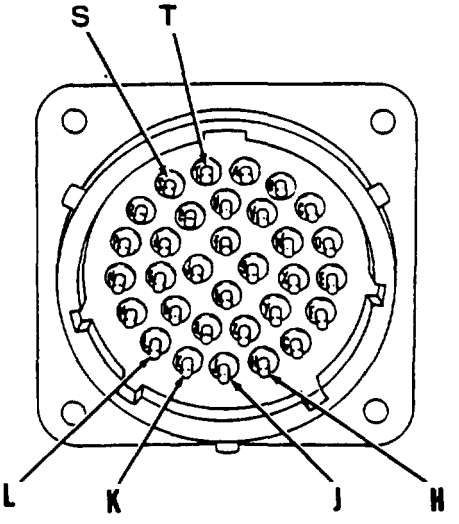
NO:
A. Replace inlet guide vane (IGV) power transformer (page 7-35).
B. Go to step 13.

12 Test for 2 to 40 ohms between contacts K and L on EMFS-J33.

Did multimeter show between 2 and 40 ohms?

YES — NO

NO: Replace IGV power transformer (page 7-35).



EMFS J33

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

c. ELECTRO-MECHANICAL FUEL SYSTEM (EMFS) - CONTINUED

(1) ES-16. EMFS FAULTY - CONTINUED

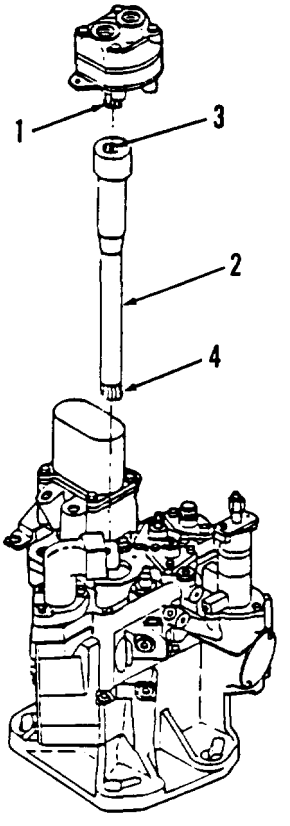
CONTINUED FROM STEP 12

13 A. Remove rotary pump (TM 20-1).
B. Remove spur gearshaft (TM 20-1).
C. Check rotary pump shaft (1) for cracks, mlsslng splines or excessive wear.
D. Check spur gearshaft (2) for excessive wear or damage to internal splines (3).

Are pump shaft or spur gearshaft internal splines damaged or worn?

NO — YES

A. Replace spur gearshaft (TM 20-1).
B. Replace rotary pump (TM 20-1).
C. Install EMFS (TM 20-1).
D. Verify problem is solved.

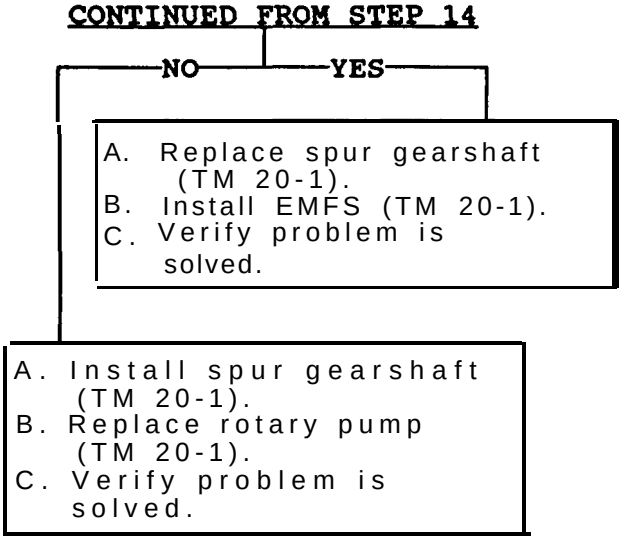


14 Check spur gearshaft (2) for bends, cracks, breakage or excessive wear of gear teeth (4).

Are shaft or gear teeth damaged or worn?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING -CONTINUED	
c. ELECTRO-MECHANICAL FUEL SYSTEM (EMFS) - CONTINUED	(1) ES-16. EMFS FAULTY - CONTINUED



END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY

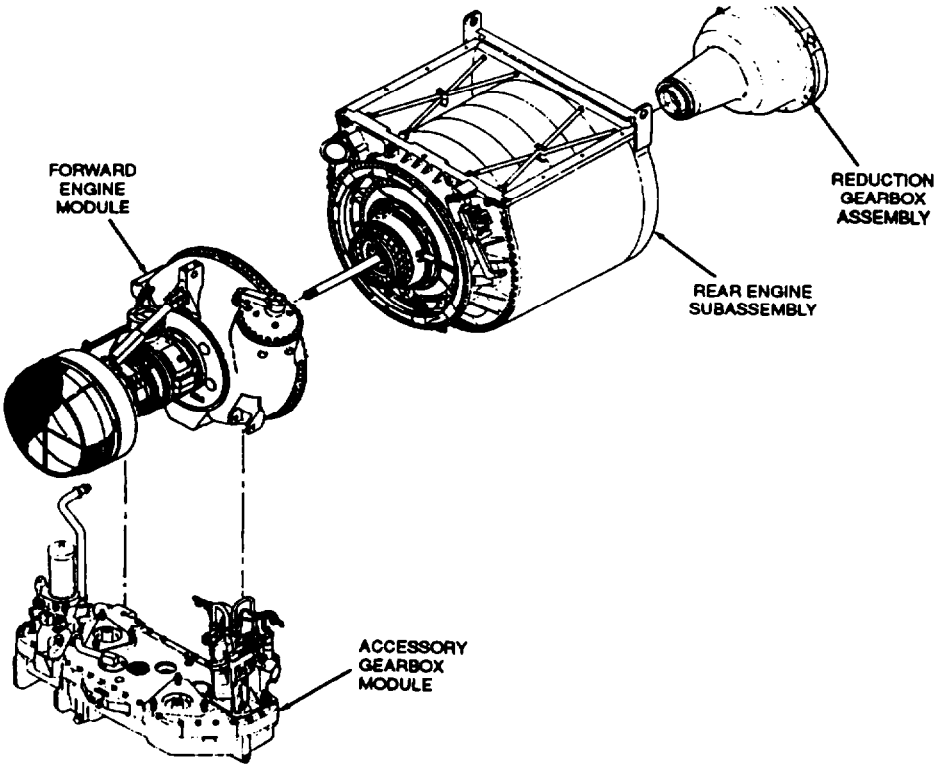
This section contains engine troubleshooting procedures in the event that the Organizational level of maintenance has concluded their diagnostic efforts with the message “Engine Faulty, Notify Direct Support Maintenance”. If a specific symptom has not been provided by Organizational Maintenance, a Rapid Functional Assessment (RFA) of the engine must be performed using the computerized Turbine Engine Diagnostics (TED) program included with the Ground Hop Support Set (GHSS). Performing the RFA will enable the mechanic to identify a symptom that can be diagnosed using an Engine Symptom (ES) on page 3-9 that more accurately defines the engine’s condition.

If results of the RFA indicate that the engine can be operated, then further diagnosis of the engine using TED and the GHSS should continue until a definite symptom can be identified and corrected or all evidence leads back to this procedure.

The troubleshooting procedure that follows has been created to accommodate an engine identified with any of the following symptoms:

Symptom	Details
Low Power	Reported by ORG Level as less than 60% during “Health Check”.
Aborted Start	60 second abort with T7 temperature limited to approx. 1200° F.
Abort During Operation	Engine aborts when NBC system activated or turret slewed.

Disassembly inspection of the engine and modules is required to isolate the fault and determine corrective action(s). The art on the following page provides an overview of the engine. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY - CONTINUED

Tools:
- AGB gear train handle (Item 42, Appendix D)
- General mechanic's tool kit: automotive (SC 5180-90-N26)
- Inspection mirror (Item 92, Appendix D)

Supplies:
- Wiping rag (Item 14, Appendix B)
- Writing paper (Item 41, Appendix B)
- Writing pen (Item 27, Appendix B)

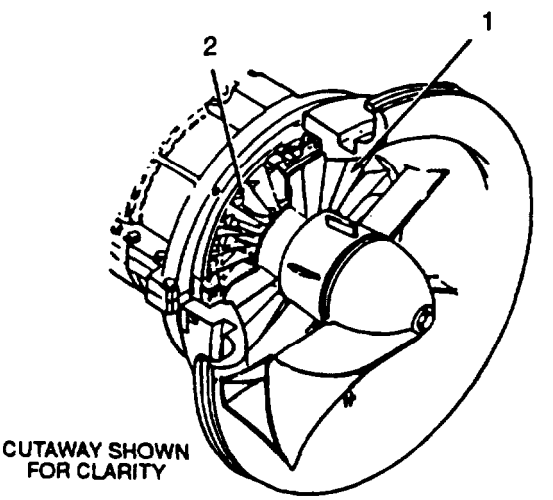
References:
- TM 20-1
- TM 34-1

NOTE

Do not replace any modules, assemblies or parts until you have answered all of the questions in this procedure. If your answer leads to replacement of a module, assembly or part, make a note that the item IS to be replaced. Final maintenance will be decided in step 12.

1. A. Remove engine air inlet screen (TM 20-1).
   B. Check inlet guide vanes (IGVs) (1) and first stage compressor blades (2) for foreign object damage (FOD) as listed below:
   - Inspect for missing blades (2).
   - Inspect vanes (1) and blades (2) for severe distortion.

Are vanes and blades OK?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY - CONTINUED

CONTINUED FROM STEP 1

YES — NO

A. Record note to replace forward engine module.
B. Go to step 3.

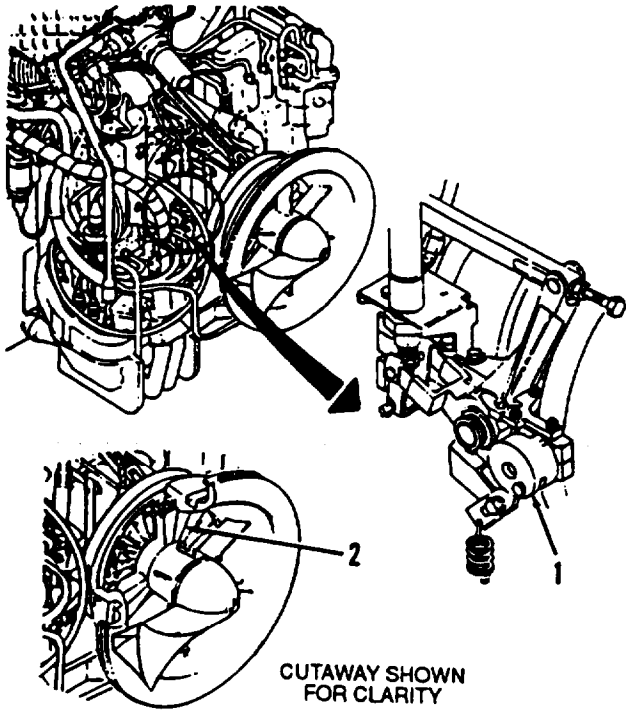
2 A. Rotate bellcrank (2) back

B. While moving bellcrank (2) check to see that IGVs (1) are moving open and closed. All vanes should move together. There should not be any vanes that do not move.

Do all IGVs move when bellcrank is turned?

NO — YES

Go to step 3.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY. - CONTINUED

CONTINUED FROM STEPS 1 AND 2

3	Inspect outside diameter of regenerator matrix (1), especially near the forward header (2) and rear header (3) all the way around for holes, cracks, or separation of plates.

Is matrix outside diameter OK?

YES — NO

A. Record note that regenerator matrix is unserviceable.
B. Go to step 5.

4	A. Remove reduction gearbox (RGB) assembly (page 6-17). B. Inspect inner diameter of regenerator matrix (4) for buckling or separation of plates, severe axial cracking or holes.

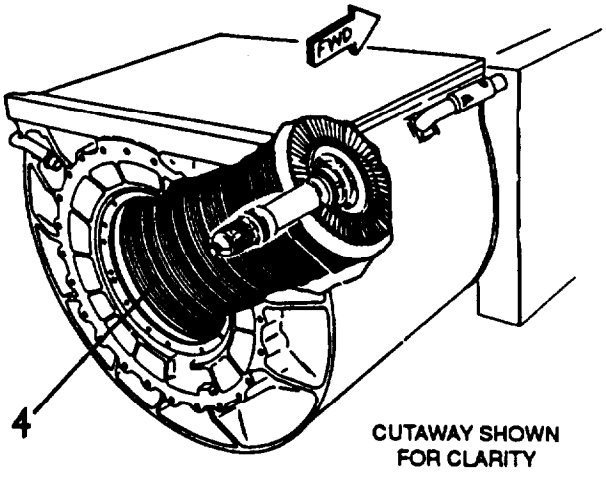
Is matrix inner diameter OK?

YES — NO

A. Record note that regenerator matrix is unserviceable.
B. Go to step 5.

CONTINUED ON NEXT PAGE

Art File



3-2. TROUBLESHOOTING - CONTINUED

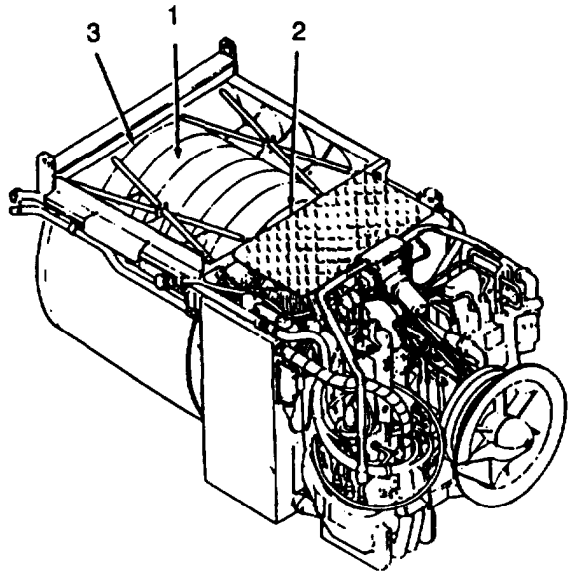
d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY - CONTINUED

CONTINUED FROM STEPS 1 AND 2

3	Inspect outside diameter of regenerator matrix (1), especially near the forward header (2) and rear header (3) all the way around for holes, cracks, or separation of plates.
Is matrix outside diameter OK?	

YES — NO

A. Record note that regenerator matrix is unserviceable.
B. Go to step 5.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY. - CONTINUED

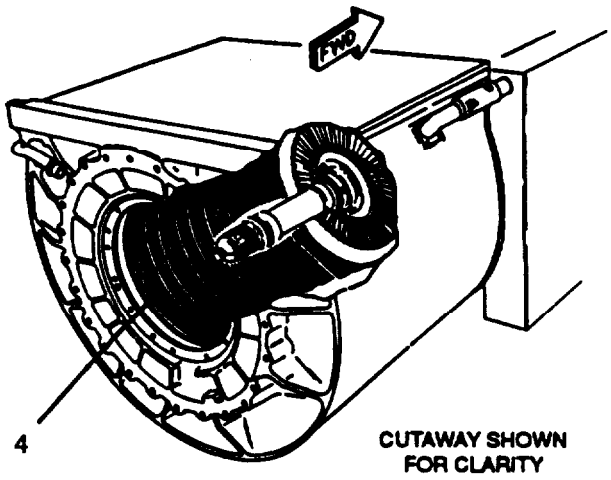
CONTINUED FROM STEP 3

A. Remove reduction gearbox (RGB) assembly (page 6-17).
B. Inspect inner diameter of regenerator matrix (4) for buckling or separation of plates, severe axial cracking or holes.

Is matrix inner diameter OK?

YES — NO

A. Record note that regenerator matrix Is unserviceable.
B. Go to step 5.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY - CONTINUED

5 A. Remove forward engine module (page 5-25).

CAUTION

Do not lean or hang anything on shaft (1). Damage to bearing, seal, or air seal may result

B. Check second turbine nozzle vanes (2) for damage as listed below:

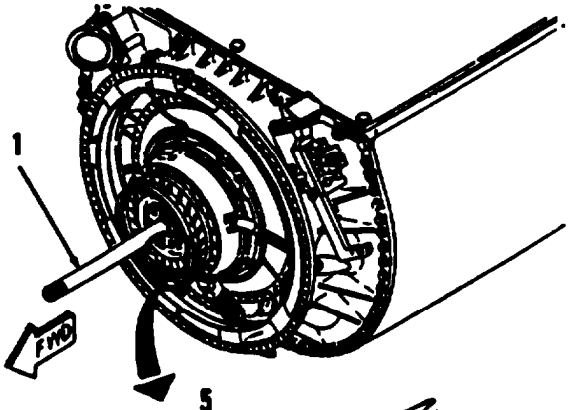
- Check edge of vanes (2) for cracks (3) longer than 1/4-inch.
- Check edges (4) where vanes (2) connect to shroud (5), for wear (6) deeper than 3/32-inch.
- Check both edges of vanes (2) for cracks (7) that could meet and cause loss of material.
- Check vanes (2) where they connect to shrouds (5,8), for cracks (9) longer than 7/16-inch.
- Check edge of vanes (2) for burns (10) that exceed the limits shown in Table A.

Are second turbine nozzle vanes OK?

YES — NO

A. Record note to replace second turbine nozzle.
B. Go to step 6.

CONTINUED ON NEXT PAGE



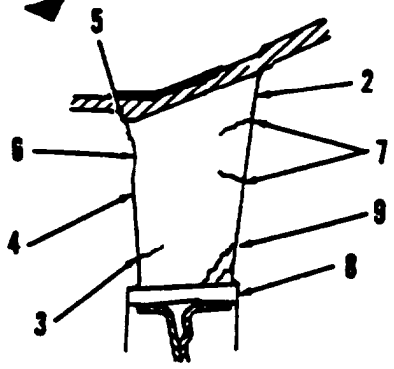
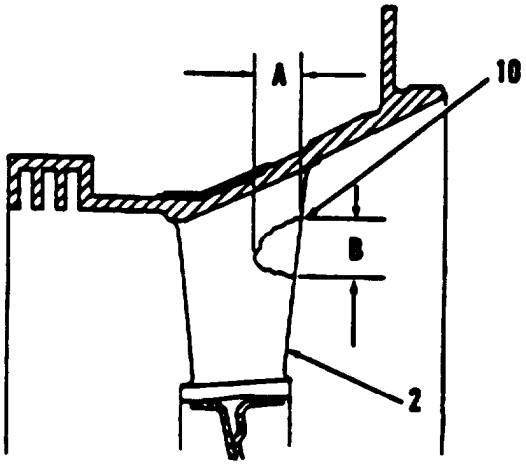


TABLE A

Dim A Inches	Dim B Inches	Maximum Number of Vanes Allowed
3/16	3/8	2
1/8	1/4	3



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY. - CONTINUED

CONTINUED FROM STEP 5

6 Look through nozzle (1) and check second turbine rotor for burnt or broken blades (2) or deposits of melted metal on blades (2).

Are second turbine rotor blades OK?

YES — NO

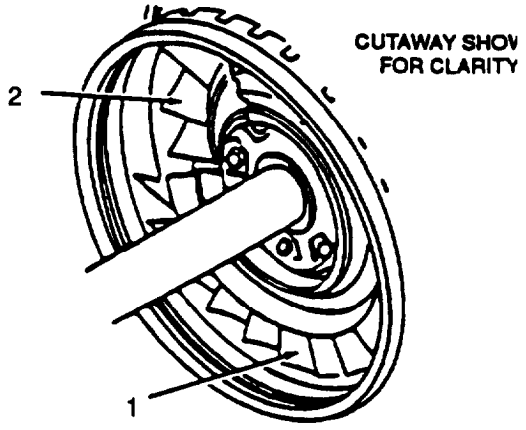
A. Record note that Gas Turbine Power Unit is unserviceable.

Have you previously recorded note to replace forward module?

YES — NO

Go to step 7.

Go to step 12.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

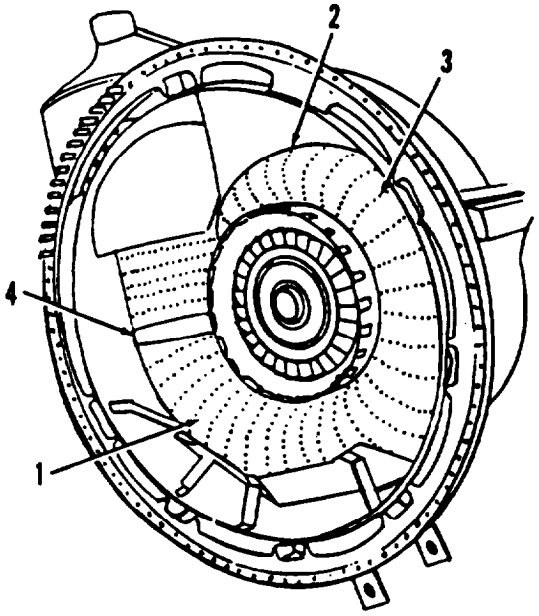
d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY - CONTINUED

CONTINUED FROM STEP 6

7 Inspect outside of collector (1) for burnt-through holes and unacceptable cracks as listed below:

- Any wider than 1/16-inch.
- Any running along bead (2) that are longer than 5-inches.
- Any longer than 3/4-inch progressing from bead (2) into either rear or forward half of collector (1).
- Any that converge and may cause loss of metal.
- Any around cooling holes (3) longer than 1/6-inch.
- Any in stiffening ring (4) longer than 1/6-inch.

Are there an burnt -through holes or unacceptable cracks in collector?



NO — YES

A. Record note to replace forward engine module.
B. Go to step 12.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY. - CONTINUED

CONTINUED FROM STEP 7

8 A. Remove combustor cover and liner (TM 20-1).
B. Look through combustion chamber (1) at inside of collector (2) and check for burnt-through holes.
C. inspect inside of collector (2) for unacceptable cracks as listed below:

- Any wider than 1 /16-inch.
- Any running along bead (3) that are longer than 5-inches.
- Any longer than 3/4-inch progressing from bead (3) into either rear or forward half of collector (2).
- Any that converge and may cause loss of metal.

NOTE

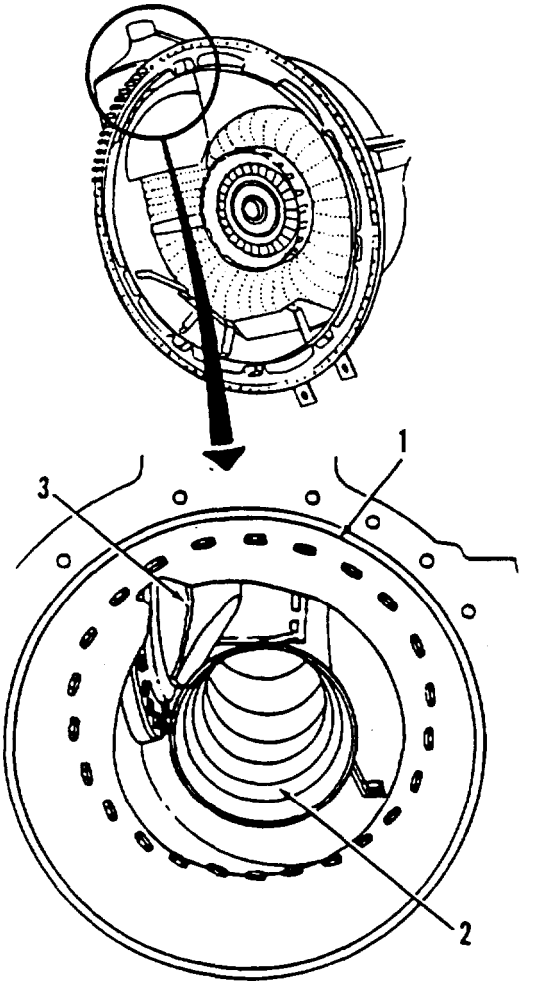
Loss or scratching of yellowish thermal coating on internal surfaces of collector (2) is OK.

D. Look inside collector (2) for foreign objects and take out any objects found.
E. Install combustor cover and liner (TM20-1).

Did inside of collector have burnt-through holes or unacceptable cracks?

NO — YES

A . Record note to replace forward engine module.
B . Go to step 12.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY - CONTINUED

CONTINUED FROM STEP 8

9 Visually inspect turbine rotor blades (1) and nozzle vanes (2) for damage as listed below:

NOTE

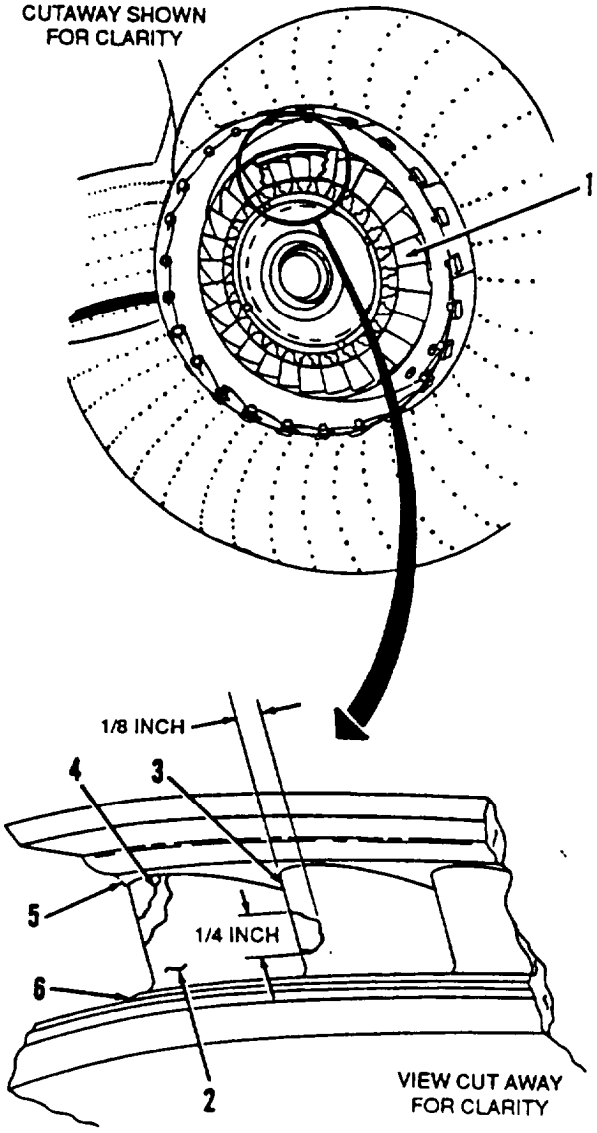
Measurements in this step are approximate.

- Burnt or broken blades (1).
- Melted metal deposits on blades (1).
- No more than four vanes (2) shall have burns or breaks on edge (3) wider than 1/4-inch and deeper than 1/8-inch.
- Check for cracks (4) longer than 7/16-inch where vanes (2) connect to shrouds (5, 6).

Are blades and vanes OK?

YES — NO

A. Record note to replace forward engine module.
B. Go to step 12.



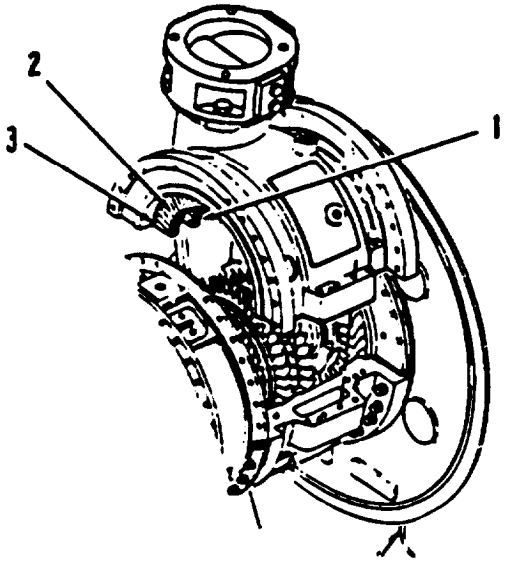
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED (1) ES-17. ENGINE FAULTY: - CONTINUED

10 A. Remove high pressure housing (top half) (page 5-1).
B. Check high pressure compressor vane assemblies (1) for missing vanes (2).
C. Inspect vanes (2) for severe distortion or wear, especially heavy loss of material close to outer shroud (3).

Are vane assemblies OK?



YES — NO

A . Install high pressure housing (top half) (page 5-3).
B . Record note to replace forward engine module.
C . Go to step 12.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED	
d. ENGINE - CONTINUED	(1) ES-17. ENGINE FAULTY - CONTINUED

CONTINUED FROM STEP 10

11 **WARNING**

Rotor blades (1) have sharp edges and can cut you. Use care when turning compressor rotor (2).

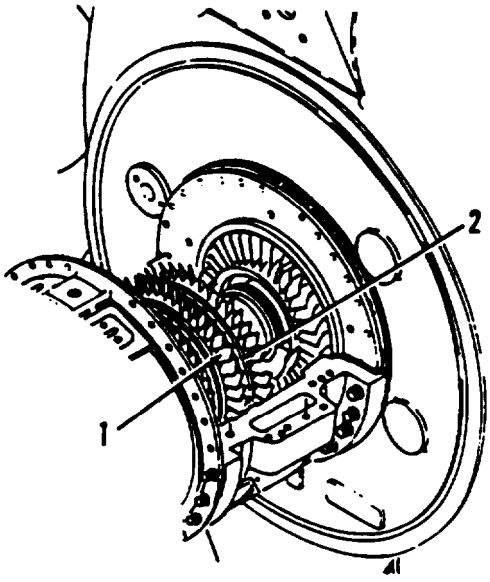
A. Slowly turn high pressure compressor rotor (2) and look for missing blades (1).
B. If no blades are missing, slowly turn compressor rotor (2) and look at glades (1) for for severe distortion.

Are blades OK?

YES — NO

A. Install high pressure housing (top half) (page 5-3).
B. Record note to replace forward engine module.
C. Go to step 12.

12 A. Review notes you recorded. Compare them against Table C and do action.
B. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED	
d. ENGINE - CONTINUED	(1) ES-17. ENGINE FAULTY

TABLE C

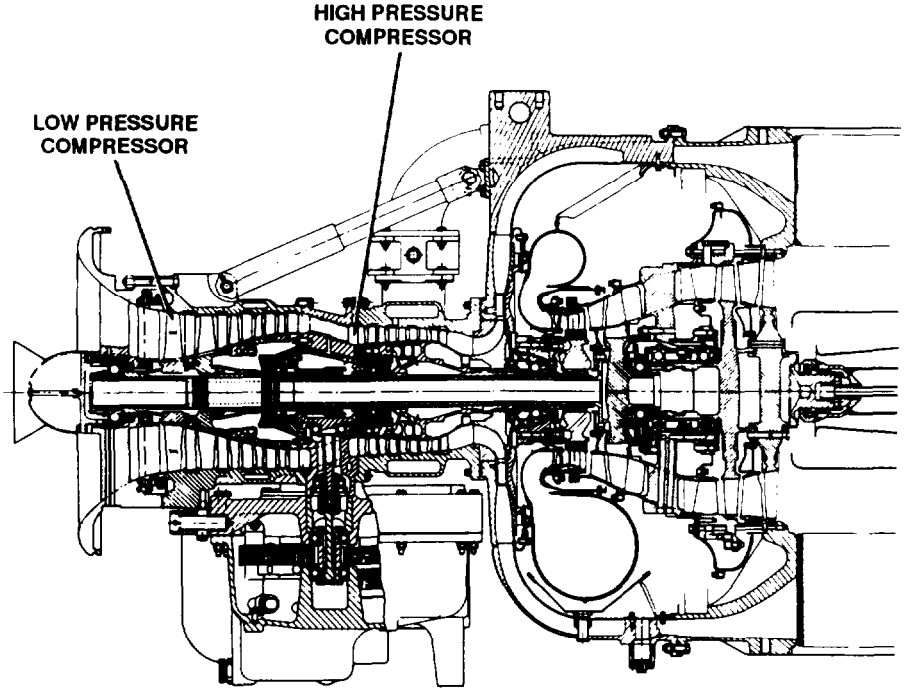
Notes Recorded	Action
• Replace forward engine module.	Replace forward engine module (page 5-13).
• Regenerator matrix unserviceable.	• If it was also noted that the gas turbine power unit was unserviceable, replace the rear engine module assembly (page 6-28). If the gas turbine power unit was found to be serviceable then salvage gas turbine power unit (page 6-63).
• Gas turbine power unit unserviceable.	• If it was also noted that the regenerator matrix was unserviceable, replace the rear engine module assembly (page 6-28). If the regenerator matrix was found to be serviceable then salvage gas turbine power unit (page 6-63).
• Replace IGV bellcrank spring pin.	• If it was also noted that the forward module is to be replaced, do not replace IGV bellcrank spring pin. If the forward module is not to be replaced and this note appears with any other combination of notes, replace IGV bellcrank spring pin (page 5-32).
• Replace second turbine nozzle.	• If it was also noted that the gas turbine power unit was unserviceable, do not replace the second turbine nozzle. If the gas turbine power unit is serviceable and this note appears with any other combination of notes, replace second turbine nozzle (page 6-92).

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE).

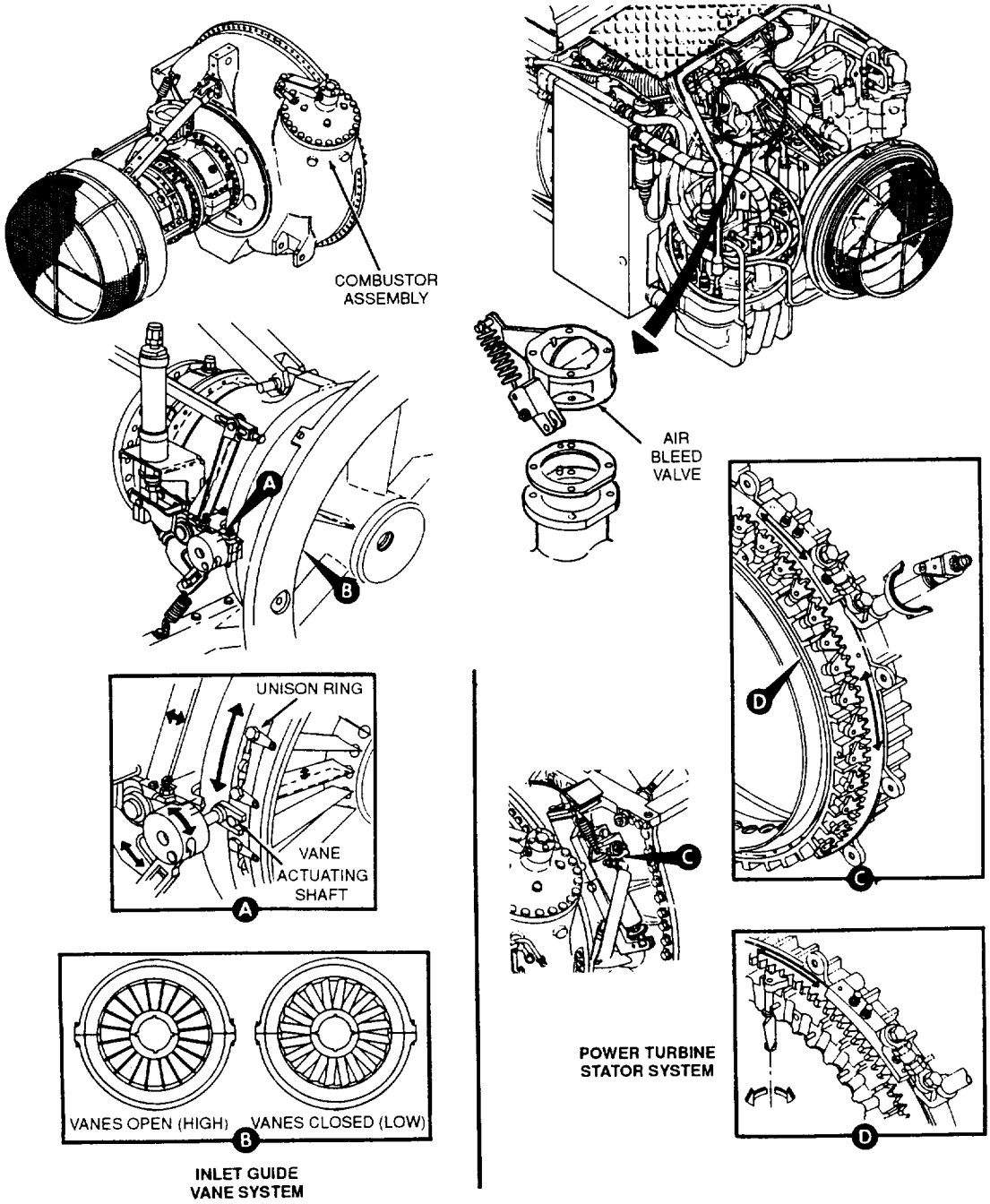
This section contains troubleshooting to locate and correct the cause (s) of engine compressor surge (stall). The compressor section delivers air at a specific pressure to the combustor section. If this air flow is not maintained, high pressure air in the combustor section will tend to discharge back into the compressor and cause compressor air flow to stop . Once pressures have neutralized, compressor airflow will resume until the compressor/combustor pressure ratio becomes unbalanced again, repeating the above cycle. This cyclic action can sound like a loud popping noise. The engine compressor air bleed valve system, variable inlet guide vane (IGV) system and variable power turbine stator (PTS) system function to maintain the balanced air pressure ratio. Foreign object damage (FOD) to compressor blades or vanes will prevent the compressor section from providing proper air pressure. A faulty air bleed valve system will not allow air to be bled from the compressor properly. A faulty IGV system will prevent the proper flow of air entering the compressor section. A faulty PTS system will prevent the proper control of airflow through the engine. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(2) ES-18 . ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

Tools:
- General mechanic's tool kit: automotive (SC 5180-90-N26)
- Punch (Item 102, Appendix D)

Supplies:
- Cotter pin (Item 114, Appendix E)
- Spring pin (Item 113, Appendix E)

NOTE

Minor surging during start cycle is very common and does not require troubleshooting as long as inlet guide vanes (IGVs) and air bleed valve are properly adjusted.

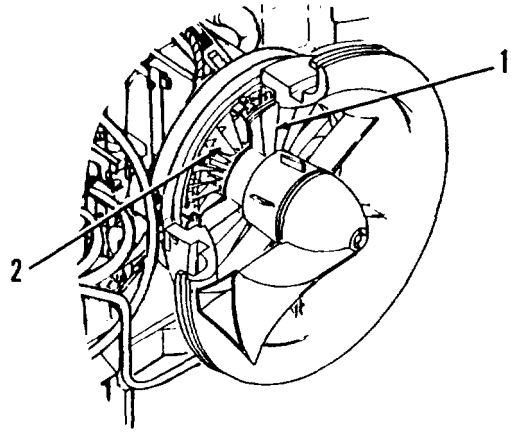
References:
- TM 20-1

1 A. Remove engine air inlet screen (TM 20-1).
B. Check IGVs (1) and first stage compressor blades (2) for FOD as listed below:
- Inspect for missing blades (2).
- Inspect vanes (1) and blades (2) for severe distortion.

Are vanes and blades OK?

YES — NO

A. Replace forward engine module (page 5-13).
B. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING CONTINUED

d. ENGINE - CONTINUED

(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

CONTINUED FROM STEP 1

2 Do procedure for Inlet Guide Vane (IGV) and Air Bleed Inspection/Adjustments or Inspection of Inlet Guide Vane (IGV)/{Air Bleed Butterfly Valve (TM 20-1

Were any adjustments made?

NO — YES

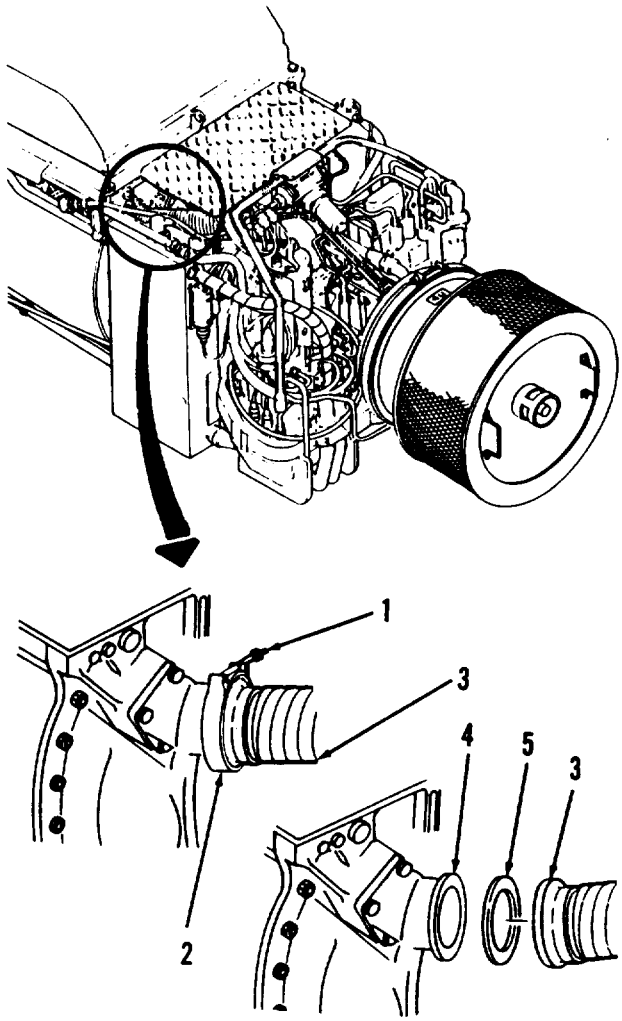
Verify problem is solved.

3 A. Remove self-locking nut (1), and remove grooved clamp coupling (2) from compressed air bleed tube assembly (3).
B. Move end of tube assembly (3) away from flange (4), and remove gasket (5).
C. Check inside of tube assembly (3) for metal chips.

Are there metal chips in tube assembly?

NO — YES

A. Replace forward engine module (page 5-13).
B. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

CONTINUED FROM STEP 3

4 A. Remove forward engine module (page 5-13).
B. Visually inspect turbine rotor blades (1) and nozzle vanes (2) for damage as listed below:

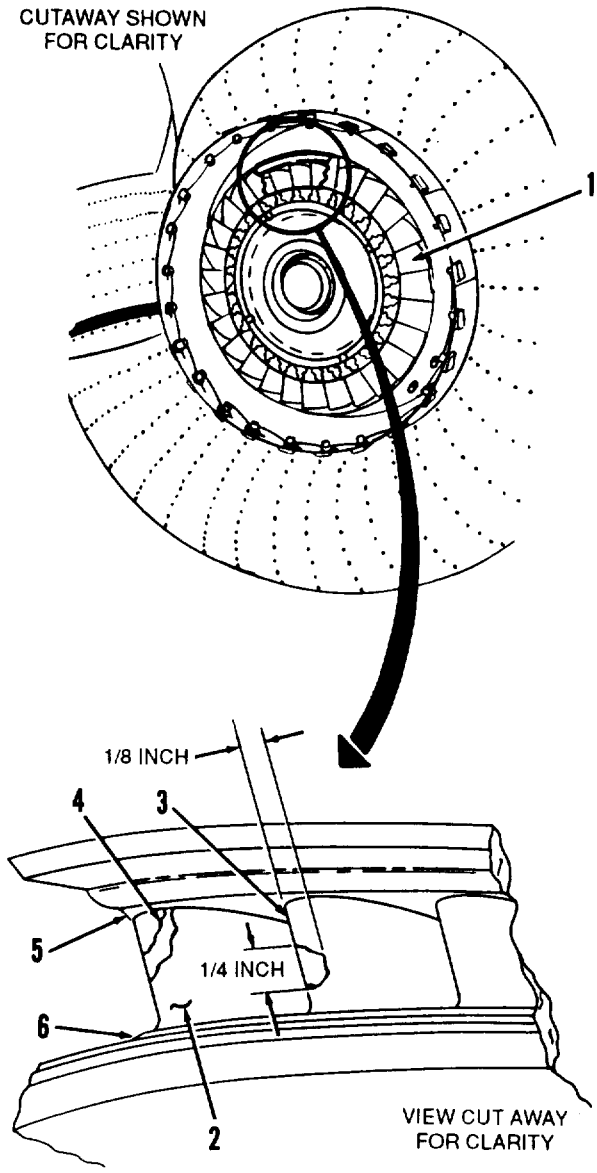
NOTE
Measurements in this step are approximate.

- Burnt or broken blades (1).
- Melted metal deposits on blades (1).
- No more than four vanes (2) shall have burns or breaks on edge (3) wider than l/4-inch and deeper than 1/8-inch.
- Check for cracks (4) longer than 7/16-inch where vanes (2) connect to shrouds (5, 6).

Are blades and vanes OK?

YES — NO

A. Replace forward engine module (page 5-18).
B. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

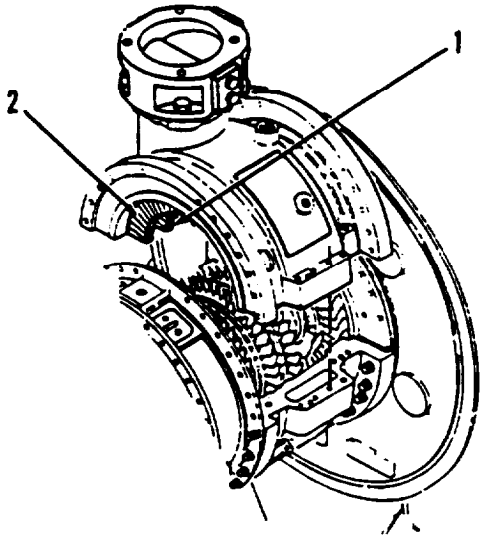
CONTINUED FROM STEP 4

5 A. Remove high pressure compressor housing (top half) (page 5-1).
B. Check high pressure compressor vane assemblies (1) for FOD as listed below:
- Inspect for missing vanes (2).
- Inspect vanes (2) for severe distortion.

Are vanes OK?

YES — NO

A. Install high pressure compressor housing (top half) (page 5-3).
B. Replace forward engine module (page 5-13).
C. Verify problem is solved.

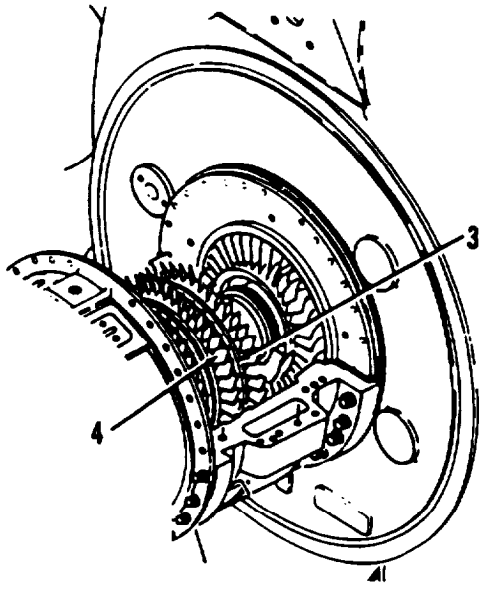


6 **WARNING**

Rotor blades have sharp edges and can cut you. Use care when turning compressor rotor.

Slowly turn high pressure compressor rotor (3) and check blades (4) for FOD as listed below:
- Inspect for missing blades (4).
- Inspect blades (4) for severe distortion or erosion.

Are blades OK?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

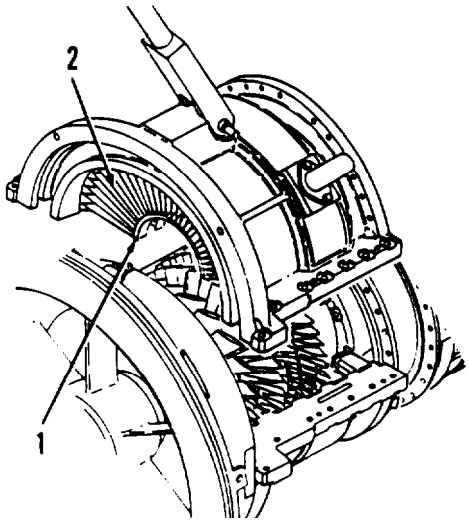
CONTINUED FROM STEP 6

YES — NO

A. Install high pressure compressor housing (top half) (page 5-3).
B. Replace forward engine module (page 5-18).
C. Verify problem is solved.

7 A. Install high pressure compressor housing (top half) (page 5-3).
B. Remove low pressure compressor housing (top half) (page 5-6).
C. Check low pressure compressor vane assemblies (1) for FOD as listed below:
- Inspect for missing vanes (2).
- Inspect vanes 2) for severe distortion.

Are vanes OK?



YES — NO

A. Install low pressure compressor housing (top half) (page 5-8).
B. Replace forward engine module (page 5-18).
C. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

CONTINUED FROM STEP 7

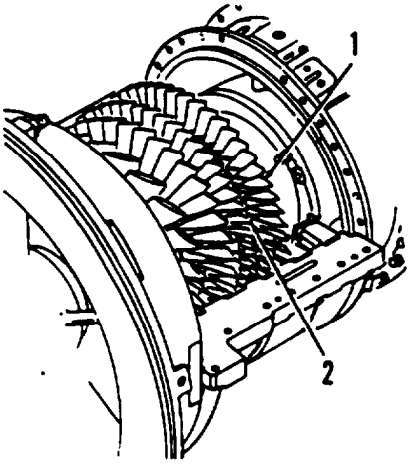
8 **WARNING**

Rotor blades have sharp edges and can cut you. Use care when turning compressor rotor.

Slowly turn low pressure compressor rotor (1) and check blades (2) for FOD as listed below:

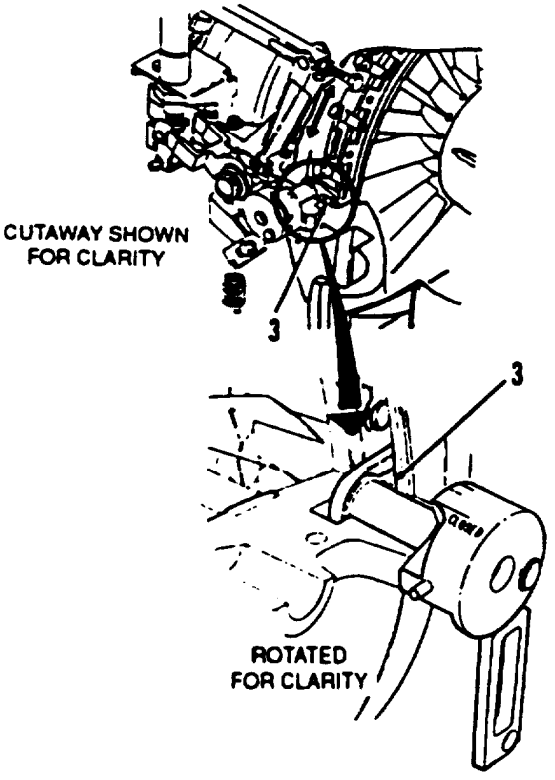
- Inspect for missing blades (2).
- Inspect blades (2) for severe distortion or erosion.

Are blades OK?



YES — NO

A. Install low pressure compressor housing (top half) (page 5-8).
B. Replace forward engine module (page 5-13).
C. Verify problem is solved.



Inspect IGV unison ring ball joint (3) for wear.

Is ball joint worn?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Install low pressure compressor housing (top half) (page 5-8).
B. Replace forward engine module (page 5-18).
C. Verify problem is solved.

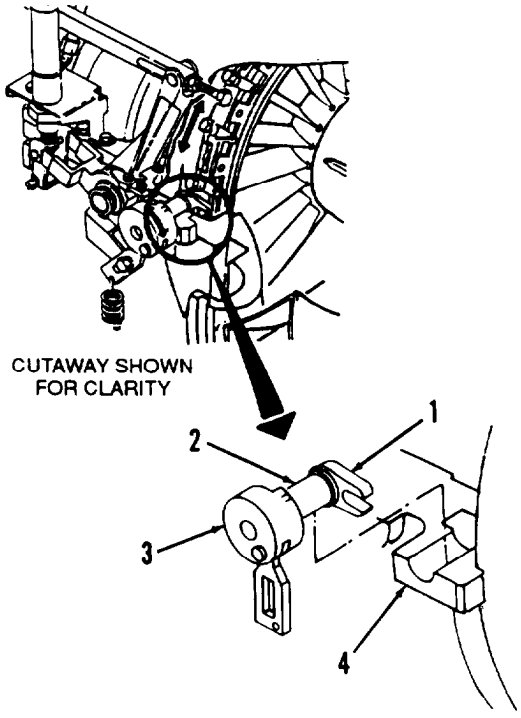
10 Inspect fork (1) on inlet guide control (2) for wear.

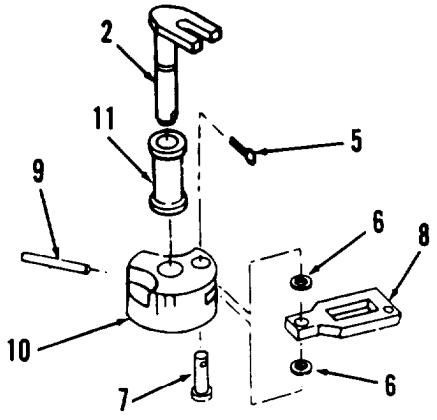
Is fork worn?

YES — NO

A. Install low pressure compressor housing (top half) (page 5-8).
B. Go to step 11.

A. Remove bellcrank, link and control (3) from lower case (4).
B. Remove cotter pin (5), two washers (6), pin (7) and link (8).
C. Remove spring pin (9). If more than 1/4-inch is exposed, use diagonal pliers. If less than 1/4-inch, use 3/32-inch punch.
D. Remove bellcrank (10). and bushing (11) from control (2).





CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

CONTINUED FROM STEP 10

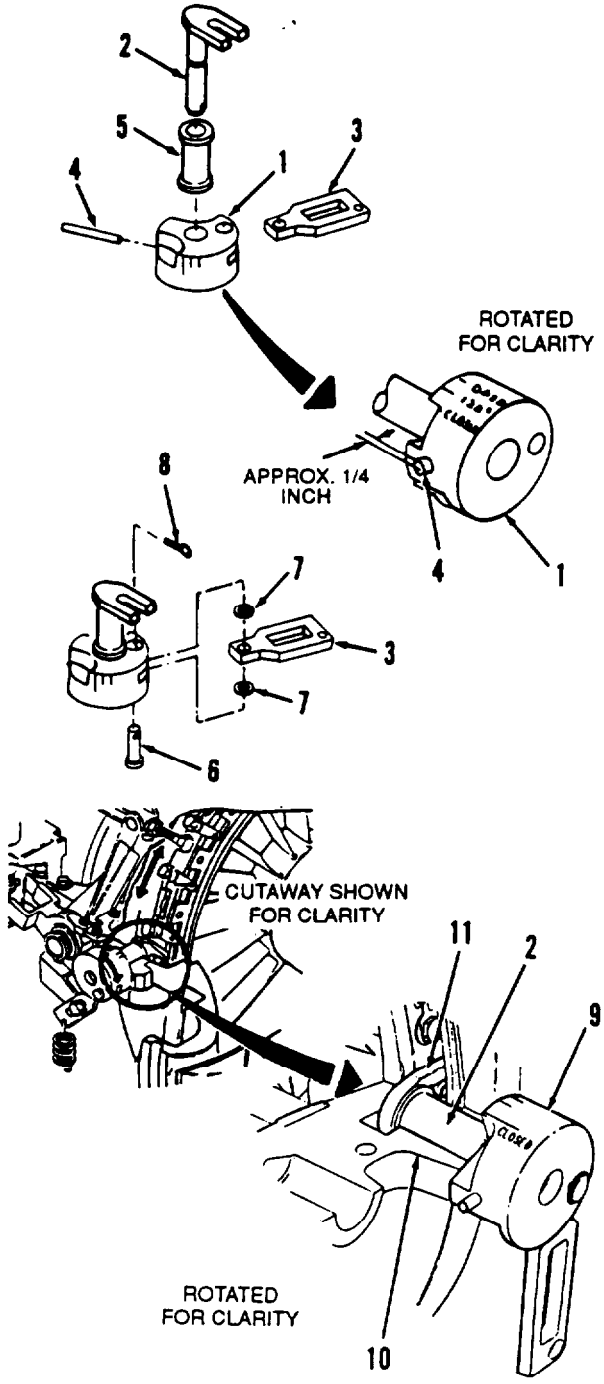
A. Inspect bellcrank (1), control (2), and link (3) for worn holes, bends, or other damage. Replace faulty parts.
B. Place bellcrank (1) on flat surface. Start new spring pin (4) into bellcrank (1).
C. Put bushing (5) on control (2), and place control (2) into bellcrank (1).

NOTE

When seated, spring pin (4) should extend about 1/4-inch out of bellcrank (1).

D. Use 3/32-inch punch to install spring pin (4) in bellcrank (1) and control (2) until seated.

E. Install pin (6), two washers (7), link (3), and new cotter pin (8).
F. Install bellcrank, link and control (9) in lower case (10), making sure that fork (11) of control (2) is positioned around ball joint on IGV unison ring.
G. Install low pressure compressor housing (top half) (page 5-8).
H. Install forward engine module (page 5-18).
I. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

FROM STEP 10

Do not lean or hang anything on shaft (1). Damage to bearing, seal, or air seal may result.

Check second turbine nozzle vanes (2) for damage as listed below:

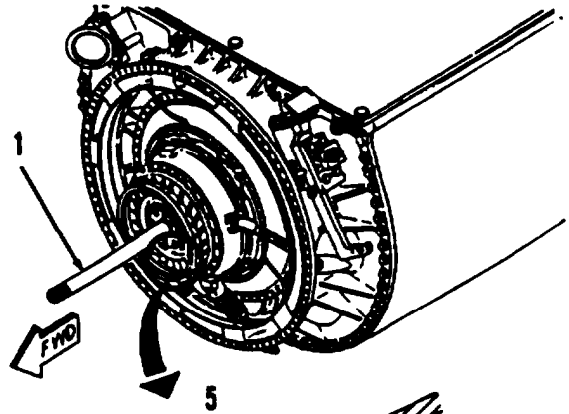
- Check edge of vanes (2) for cracks (3) longer than 1/4-inch.
- Check edges (4) where vanes (2) connect to shroud (5), for wear (8) deeper than 3/32-inch.
- Check both edges of vanes (2) for cracks (7) that could meet and cause loss of material.
- Check vanes (2) where they connect to shrouds (5,8), for cracks (9) longer than 7/16-inch.
- Check edge of vanes (2) for burns (10) that exceed the limits shown in Table A.

Are second turbine nozzle vanes OK?

YES — NO

A. Replace low pressure nozzle (page 6-92). Install forward engine module (page 5-13).
B. Verify problem is solved.

CONTINUED ON NEXT PAGE



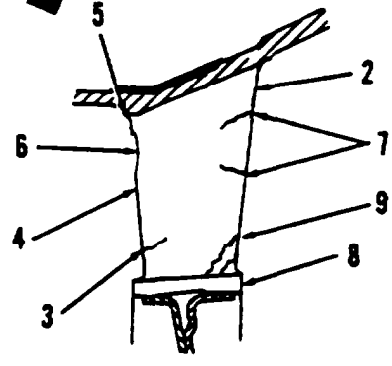
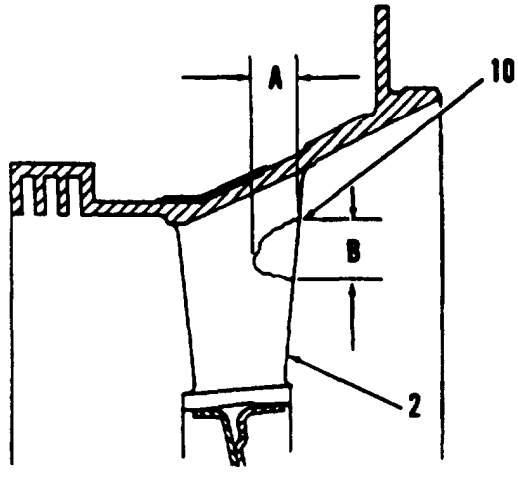


TABLE A

Dim A Inches	Dim B Inches	Maximum Number of Vanes Allowed
3/16	3/8	2
1/8	1/4	3



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(2) ES-18. ENGINE COMPRESSOR SURGES (STALLS) (LOUD POPPING NOISE HEARD FROM ENGINE). - CONTINUED

CONTINUED FROM STEP 11

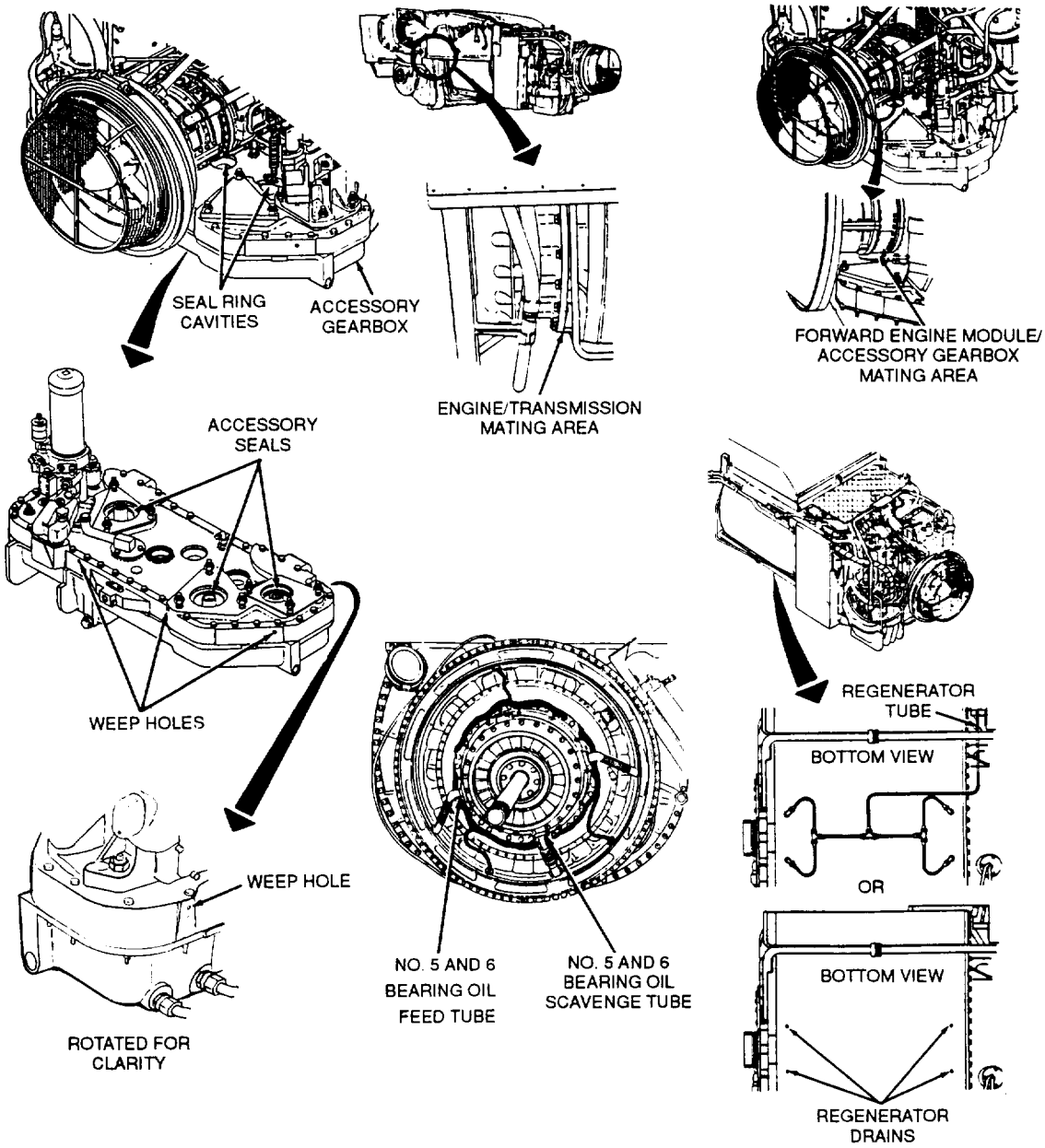
A. Replace forward engine module (page 5-18).
B. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR.

This section contains troubleshooting to locate and correct the cause(s) of lubricating oil usage in excess of one quart per hour. Oil leakage can occur from (but is not limited to) the accessory gearbox (AGB) accessory seals, seal ring cavities, weephole(s), forward engine module/AGB mating area, engine/transmission mating area, regenerator drains or tubes and/or the oil feed and scavenge line connections. The art on this page provides an overview of the affected system. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

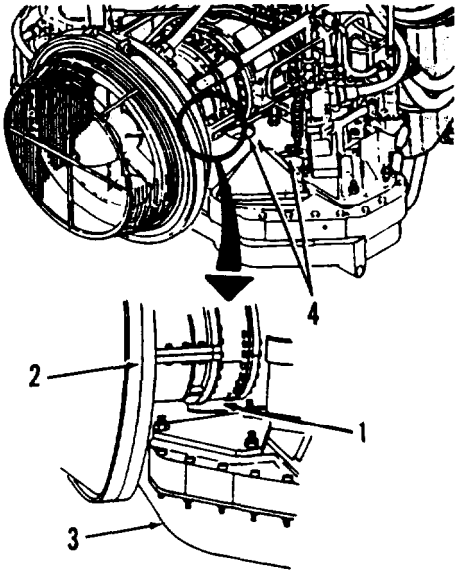
Tools:
- General mechanic's tool kit: automotive (SC 5180-90-N26)
- Torque wrench (Item 27, Appendix D)

References:
- TM 34-1

Supplies:
- Adhesive (Item 51, Appendix B)
- Antiseize compound (Item 2, Appendix B)
- Compression seal (Item 160, Appendix E)
- Dry cleaning solvent (Item 7, Appendix B)
- Lockwasher (Item 159, Appendix E) (4 required)
- Preformed packing (Item 23, Appendix E)
- Preformed packing (Item 28, Appendix E)
- Preformed packing (Item 55, Appendix E)
- Shortening compound (Item 20, Appendix B)
- Wiping rag (Item 14, Appendix B)

1 Check to see if there is evidence of oil leakage at mating area (1) between forward engine module (2) and AGB module (3).

Is there evidence of oil leakage at forward engine module and AGB module mating area?



Go to step 8.

2 Check to see if either seal cavity (4) is filled with oil.

Is either seal ring cavity filled

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

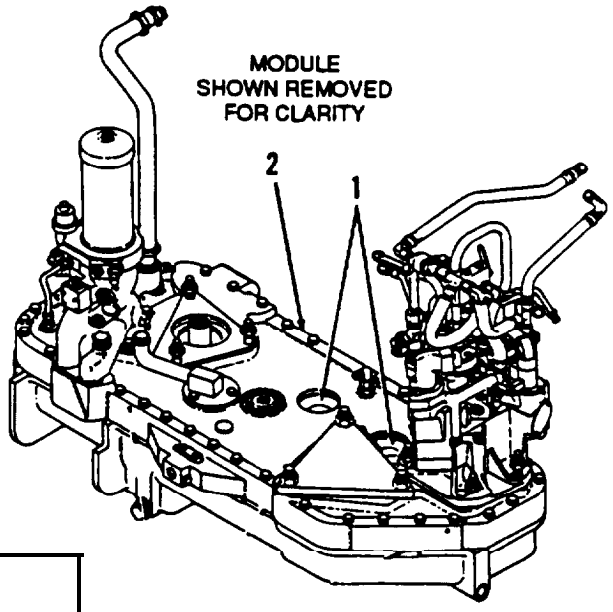
CONTINUED FROM STEP 2

NO — YES

A. Remove oil from seal ring cavities (1) and AGB cover (2).

WARNING

B. Clean area with dry cleaning solvent and rag.



2.1 **NOTE**

Adhesive may be present in some seal ring cavities. In order to inspect for missing retaining rings, the adhesive must be removed.

Inspect AGB for missing retaining rings.

Are retaining rings missing?

CONTINUED ON BLOCK 3

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

CONTINUED FROM STEP 2.1

NO — YES

A. Clean AGB (page 7-46).
B. Verify problem is solved.

WARNING

A. Seal cover to seal retaining ring with adhesive. If adhesive was already present, remove all old sealant and clean area thoroughly with dry cleaning solvent and rag. Seal cover to seal ring with new adhesive.
B. Verify problem is solved.

CONTINUED FROM STEP 2

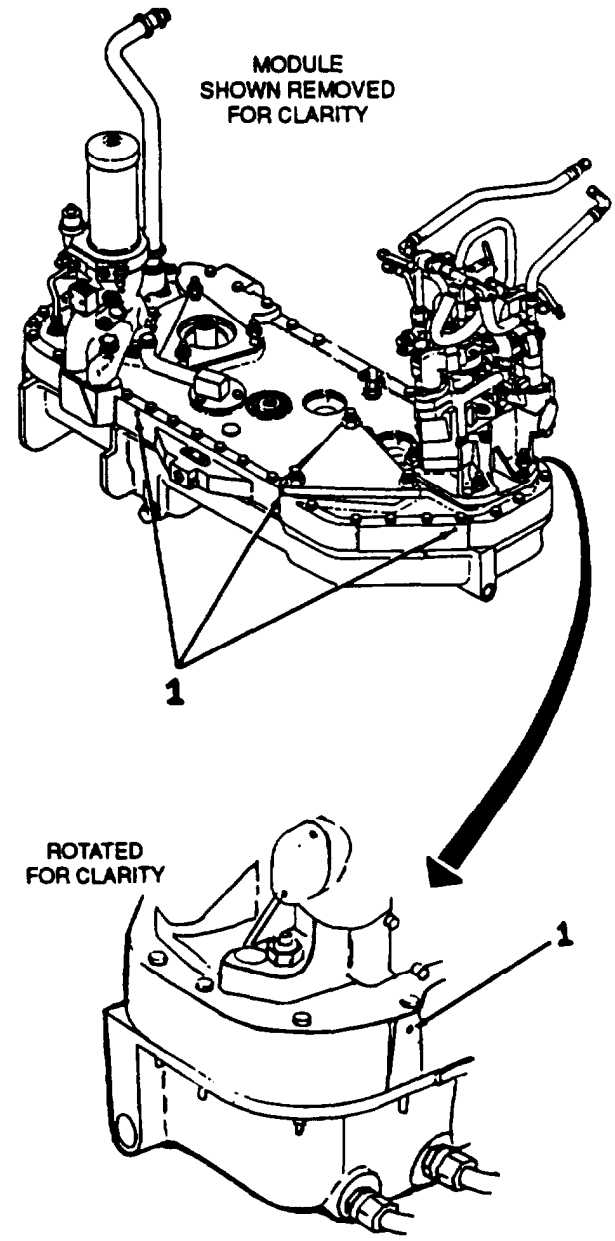
3 Check to see if there is evidence of oil leakage from any weep hole (1) (3 places).

Is there evidence of oil leakage from any weep hole?

NO — YES

A. Replace leaking accessory seal assembly (page 7-1).
B. Verify problem is solved.

CONTINUED ON TO PAGE 3-157



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

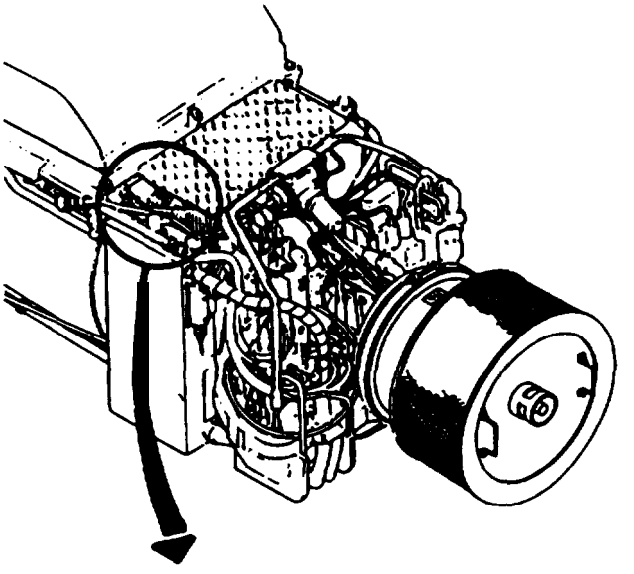
CONTINUED FROM STEP 3

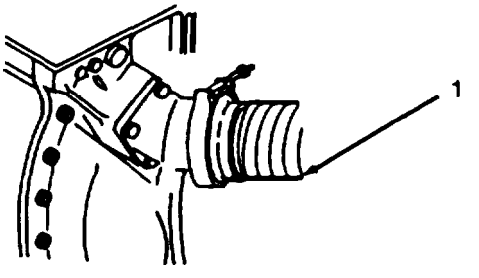
3.1	Check to see if there is evidence of oil leakage from HP bleed flex tube (1).
Is there evidence of oil leakage at flex tube?	

NO — YES

WARNING

A. Remove flex tube, clean thoroughly with dry cleaning solvent and air dry using compressed shop air. Install flex tube and run engine for 15 minutes.
B. If evidence of leakage reappears, replace No. 0.2 and 3 bearing seal/packing retainer (page 5-75).
C. Verify problem is solved.





CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

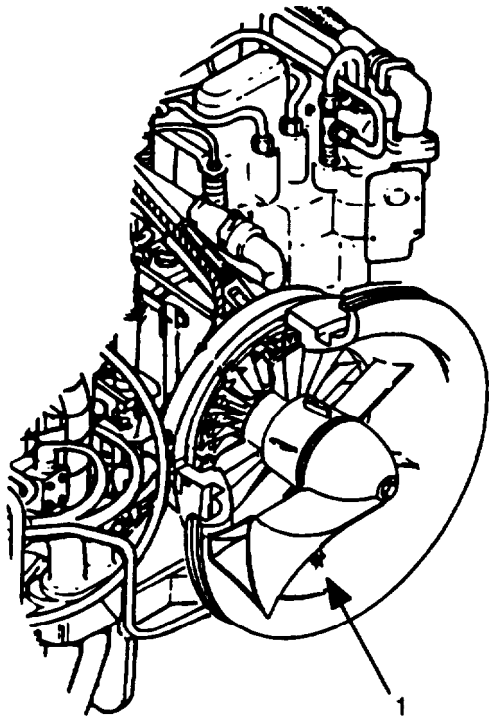
CONTINUED FROM STEP 3.1

3.2 Check to see if there is evidence of oil leakage from compressor inlet (1).

Is there evidence of oil leakage at compressor inlet?

NO — YES

A. Replace No. 1 bearing seal/packing retainer (page 5-55).
B. Verify problem is solved.

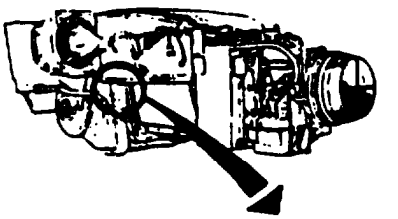


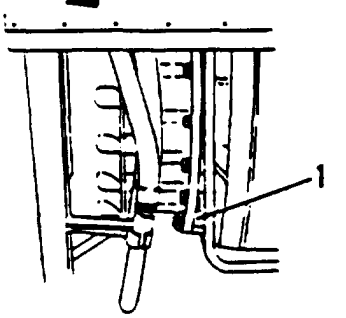
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED





4 Check to see if there is evidence of oil leakage from from engine/transmission mating area (1).

Is there evidence of oil leakage at engine/transmission mating area?

NO — YES

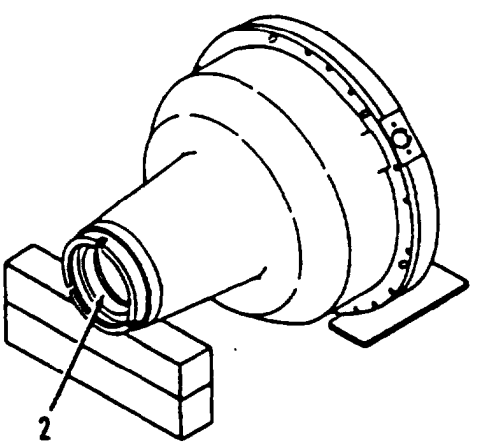
Go to step 10.

5
A. Remove reduction gearbox (RGB) assembly (page 6-17).
B. Inspect number 7 bearing seal area (2) for a heavy, rough coating of burnt oil deposits. A smooth black finish is OK.

Is seal area OK?

YES — NO

A. Replace No. 7 bearing seal (page 6-22.1)
B. Replace adapter and shaft assembly seal rings (page 6-22.5)
C. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

CONTINUED FROM STEP 5

6 Check adapter and shaft assembly seal rings (1) for evidence of oil leakage (carbon buildup).

Is there evidence of oil leakage past sealing rings?

YES — NO

NO → Go to step 9.

YES →

7 Check seal rings (1) to see if end gaps (2) are positioned 180 degrees apart.

Were seal ring end gaps 180 degrees apart?

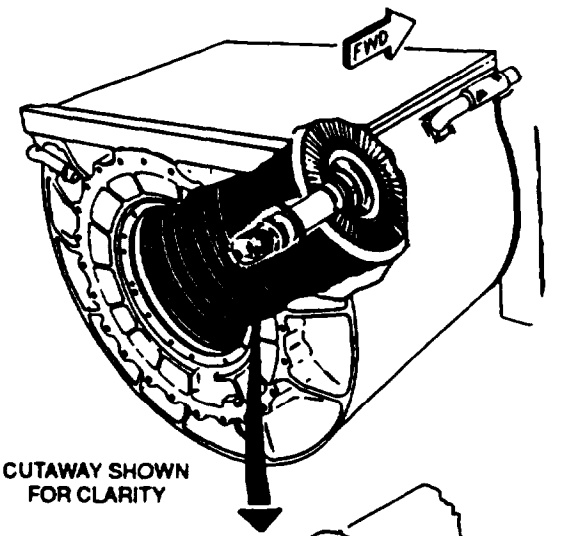
NO — YES

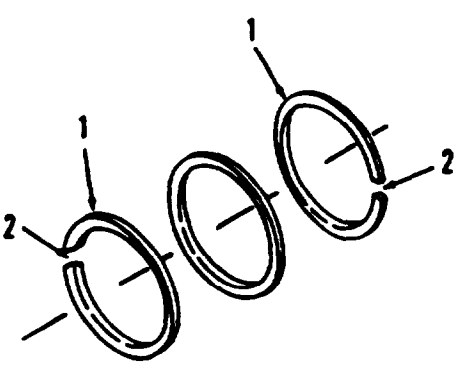
YES →

A. Replace adapter and shaft assembly seal rings (page 8-22.5)
B. Replace No. 7 bearing seal (page 6-22.1)
C. Verify problem is solved.

NO →

A. Reposition sealing rings (1) so that end gaps (2) are 180 degrees apart.
B. Verify problem is solved.





CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

FROM STEP 1

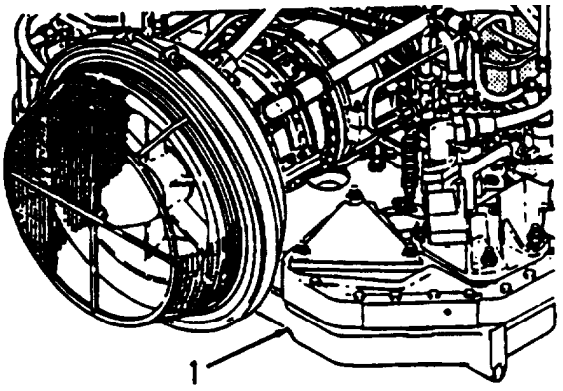
Check to see if AGB module (1) is loose at the attachment bosses by trying to move AGB module up and down.

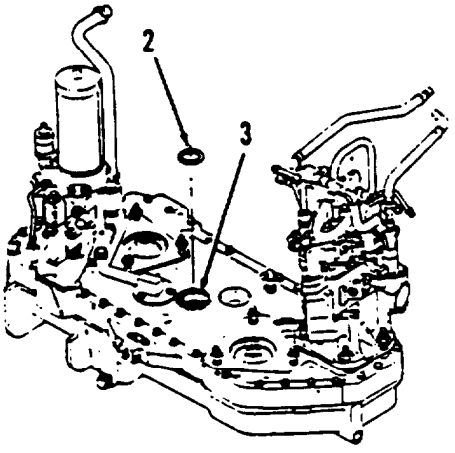
Is AGB module loose?

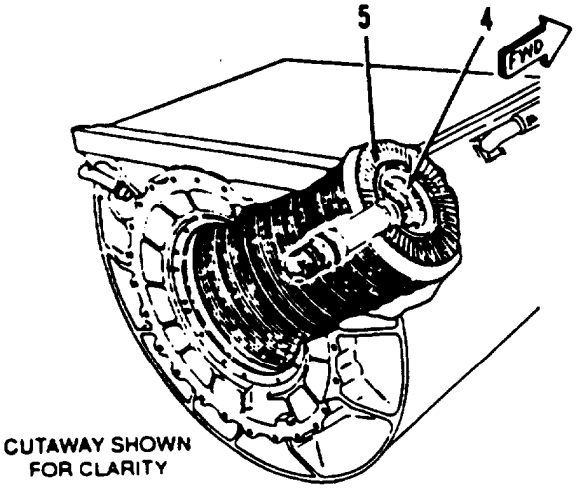
NO — YES

A. Replace forward engine module (page 5-13).
B. Verify problem is solved.

A. Remove AGB from engine (page 7-6).
B. Remove packing (2) from groove (3).
C. goat new packing with shortening compound, and put packing (2) in groove (3).
D. Install AGB module (page 7-12).
E. Verify problem is solved.







FROM STEP 6

9 Check hub area (4) on fourth turbine rotor (5) for evidence of oil stains.

Is there evidence of oil stains on rotor hub?

CONTINUED ON NEXT

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

CONTINUED FROM STEP 9

NO — YES

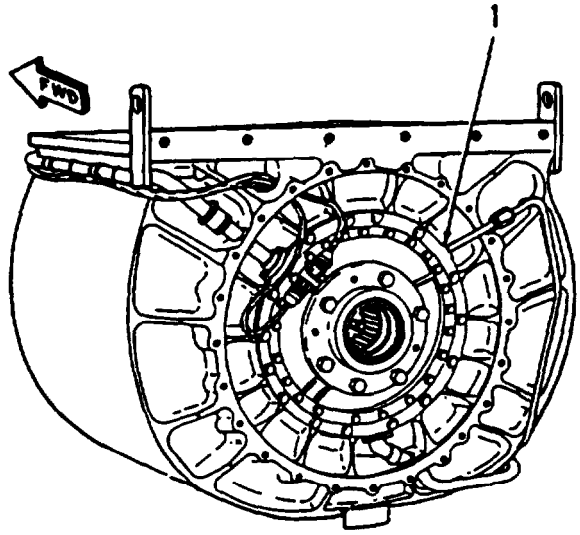
A. Repair adapter and shaft assembly (page 6-37).
B. Verify problem is solved.

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Verify problem is solved.

FROM STEP 4

10 A. Disconnect engine assembly from transmission assembly (TM 34-1).
B. Inspect oil service tube flange (1) for evidence of oil leakage.

Is there evidence of oil leakage at oil service tube flange?



CONTINUED ON NEXT PAGE

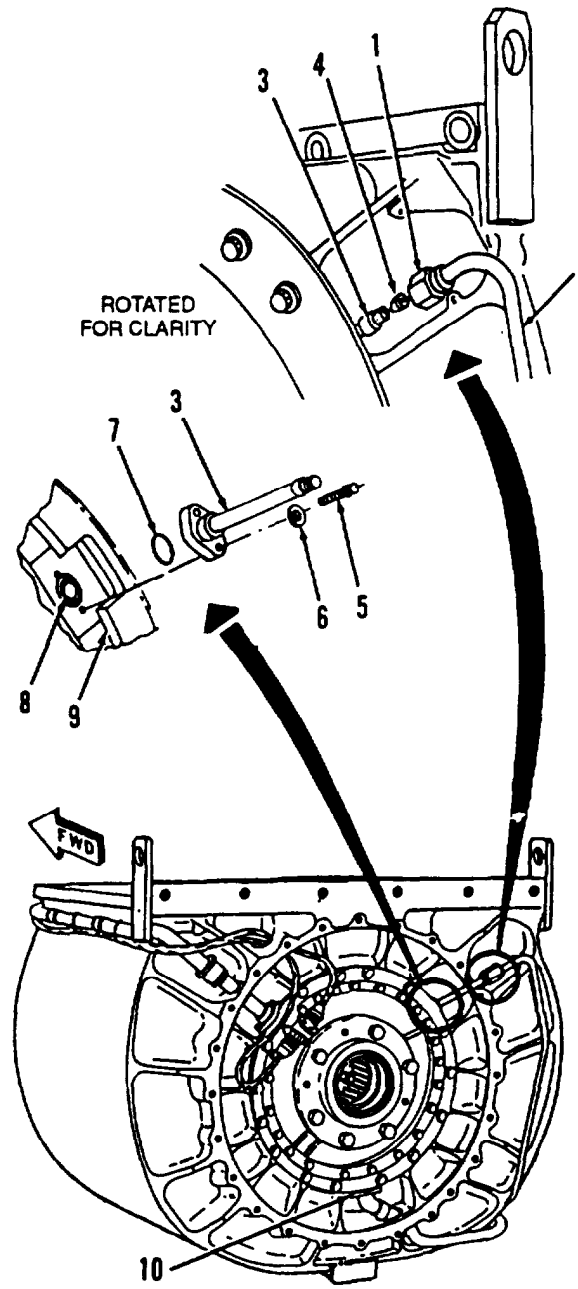
3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

CONTINUED FROM STEP 10

NO — YES

A. Loosen tube nut (1) and remove tube (2) from tube assembly (3). Remove compression sleeve (4).
B. Remove two bolts (5) and lockwashers (6). Remove tube assembly (3) and preformed packing (7).
C. Inspect parts for damage. Replace as required.
D. Apply shortening to new preformed packing (7) and install in groove (8) of reduction gearbox (RGB) housing (9).
E. Apply antiseize compound to two bolts (5). Place tube (3) on housing (9) and install bolts (5) and new lockwashers (6).
F. Install new compression sleeve (4) on tube nut (1). Align tubes (2, 3) and tighten nut (1).



11 Inspect oil scavenge tube (10) flange for evidence of oil leakage.

Is there evidence of oil leakage at oil scavenge tube flange?

CONTINUED ON NEXT PAGE

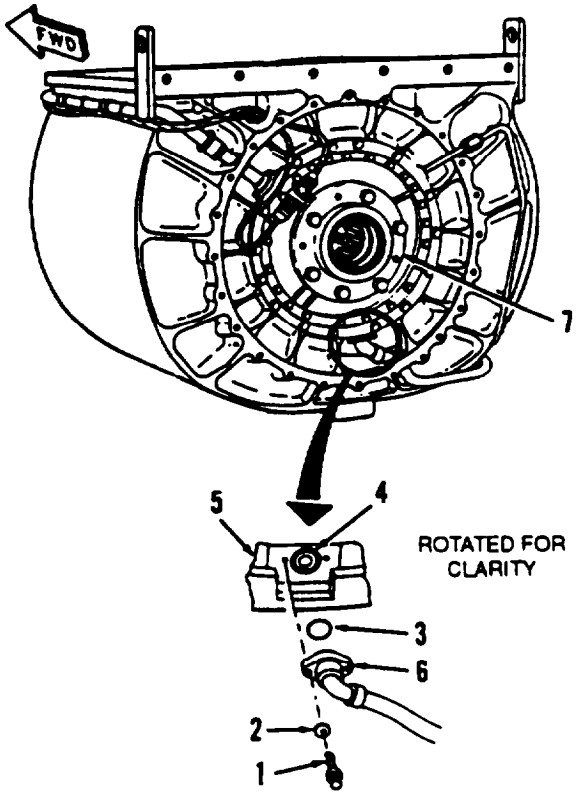
3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(3) ES- 19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

CONTINUED FROM STEP 11

NO — YES

A. Remove two bolts (1) and lockwashers (2). Move tube assembly (6) down and remove packing (3).
B. Apply shortening compound to new packing (3) and install in groove (4) in RGB housing 5).
C. Apply antiseize compound to two bolts (1). Align tube assembly (6) on housing (5) and Install two bolts (1) and new lockwashers (2).
D. Torque two bolts (1) between 70-95 lb-in (8-11N•m).

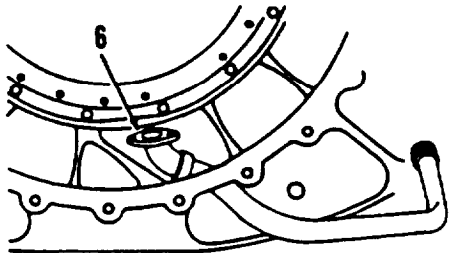


12 Look around edge of number 10 bearing retaining plate (7) for evidence of oil leakage.

Is there evidence of oil leakage around edge of plate?

NO — YES

A. Replace number 10 bearing retaining plate gasket (page 6-31).
B. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

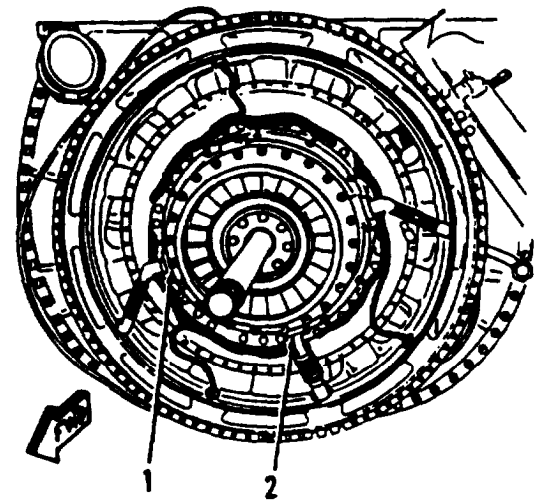
d. ENGINE - CONTINUED

(3) ES-19. ENGINE OIL CONSUMPTION IS MORE THAN ONE QUART PER HOUR. - CONTINUED

CONTINUED FROM STEP 12

13 A. Remove forward engine module (page 5-13).
B. Inspect mating area of tube assembly (1) and metal oil scavenge tube assembly (2) for evidence of oil coking, burnt oil or heavy carbon deposits.

Is there evidence oil coking, burnt oil or heavy carbon deposits at mating area of tube assemblies?



NO — YES

A. Replace internal pressure special seals and packing for tube assembly that was leaking.
- (For tube assembly (1), page 6-12).
- (For tube assembly (2), page 6-10).

B. Connect engine assembly to transmission assembly (TM34-1).
C. Verify problem is solved.

NOTE

If problem still exists, check alternator seal before continuing with the following steps.

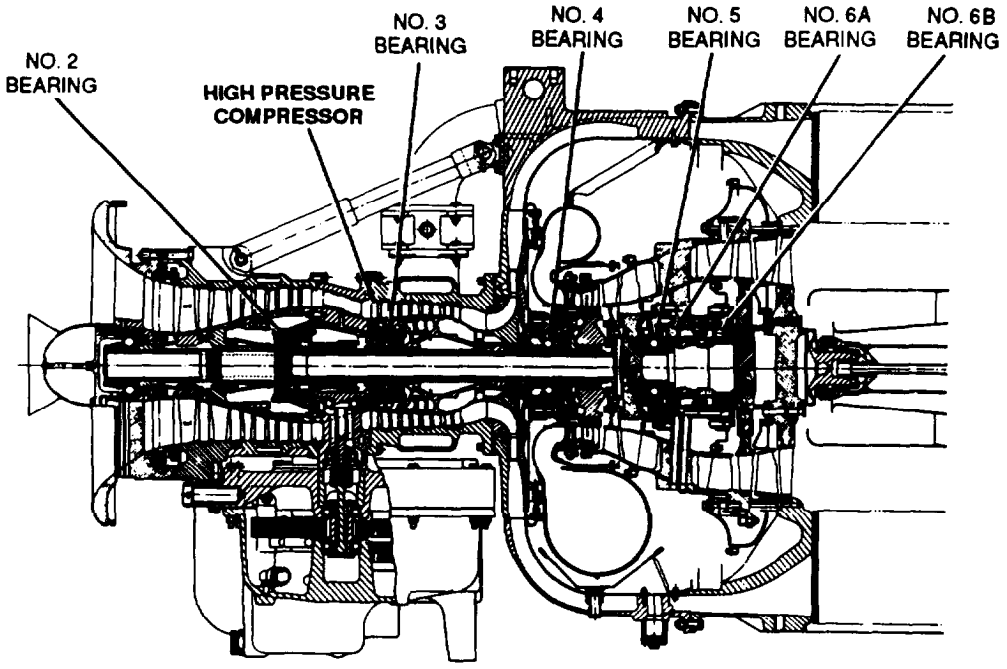
A. Replace forward engine module (page 5-13).
B. Replace rear engine subassembly (page 6-28).
C. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(4) ES-20. ENGINE SMOKES (BLUE SMOKE) DURING START AND/OR SHUTDOWN ONLY. OK DURING OPERATION.

This section contains troubleshooting to locate and correct the cause(s) of blue smoke during starting and/or shutdown (not during operation) Many of the bearing packages in the engine are air pressurized to assist the carbon face seals in sealing oil-wetted areas. If carbon face seals or packings do not seal properly, leakage will not occur past the seal if the air pressure is higher than the oil pressure in that package. Once the air pressure becomes lower than the oil pressure, oil will leak past the seal. During engine start, the high pressure compressor accelerates, building air pressure for the bearing packages. During engine shutdown, the high pressure compressor decelerates, reducing air pressure to the bearing packages. Therefore, oil pressure in the affected bearing package may be greater than the air pressure during the initial stages of the start cycle and during the latter stages of shutdown, causing oil to leak past the seal. The art on this page provides an overview of the high pressure compressor s stem and bearing package air pressurization. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(4) ES-20. ENGINE SMOKES (BLUE SMOKE) DURING START AND/OR SHUTDOWN ONLY. OK DURING OPERATION. - CONTINUED

Tools:	Supplies:
General mechanic's tool kit: automotive (SC 5180-90-N26)	Marker (Item 25, Appendix B) Penetrating oil (Item 44, Appendix B) Wiping rag (Item 14, Appendix B)

1 A. Remove forward engine module (page 5-13).

CAUTION

Do not lean or hang anything on shaft (1). Damage to bearing or seals may result.

B. Remove reduction gearbox (RGB) assembly (page 6-17).
C. Check power turbine nozzle (2) and turbine rotor blades (3) for evidence of oil.

Is there evidence of oil on nozzle or blades?

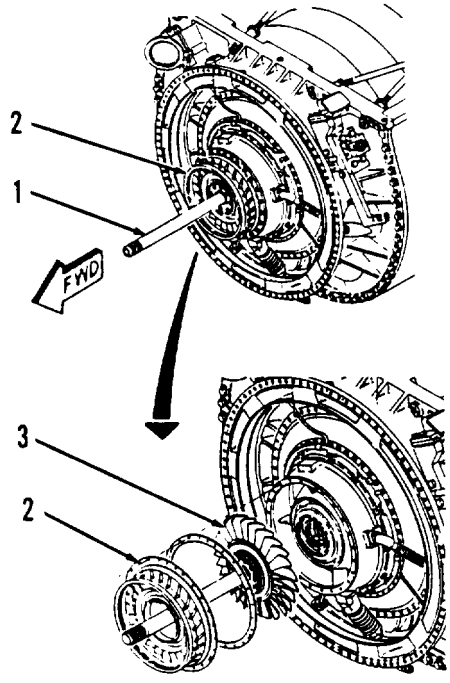
NO — YES

A. Replace forward engine module (page 5-18).
B. Go to step 4.

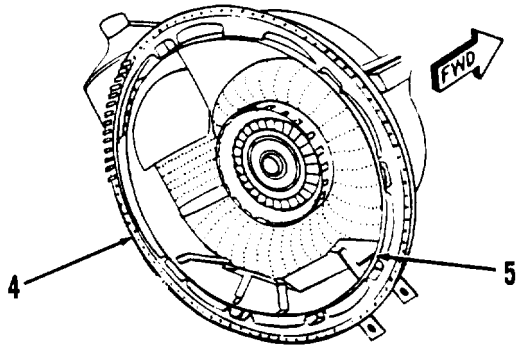
2 Check between air diffuser (4) and diffuser liner (5) for evidence of oil leakage.

Is there evidence of oil leakage between diffuser and liner?

CONTINUED ON NEXT PAGE



EXPLODED FOR CLARITY



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(4) ES-20. ENGINE SMOKES (BLUE SMOKE) DURING START AND/OR SHUTDOWN ONLY. OK DURING OPERATION. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Replace forward engine module (page 5-18).
B. Go to step 4.

3 Check for evidence of oil leakage from compressor shaft (1).

Is there evidence of oil leakage from compressor shaft?

NO — YES

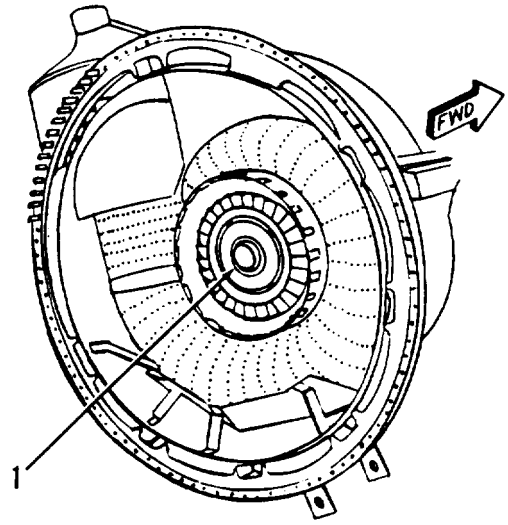
Replace forward engine module (page 5-18).

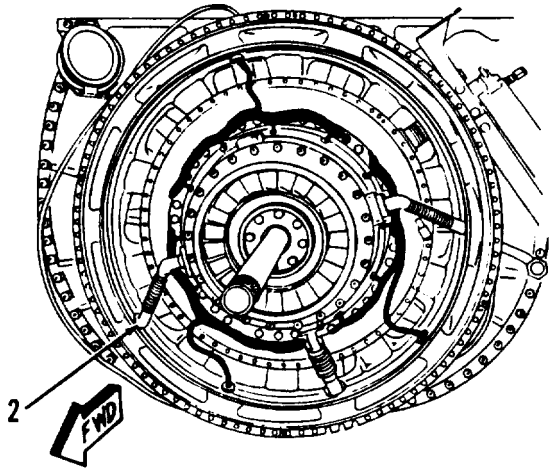
4 Check for evidence of oil leakage from No. 5 and 6 bearing 011 feed tube assembly (2).

Is there evidence of oil leakage at oil feed tube assembly?

NO — YES

Replace No. 5 and 6 bearing oil feed tube assembly and internal pressure special seals and packing (page 6-12).





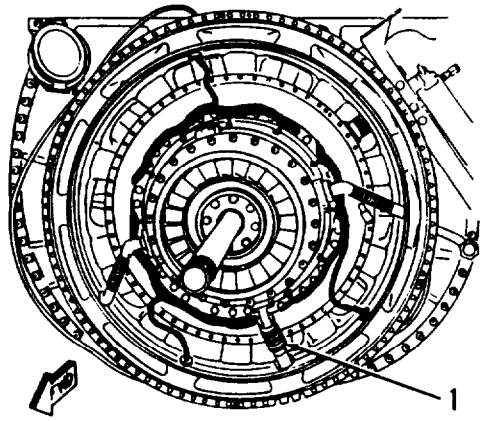
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(4) ES-20. ENGINE SMOKES (BLUE SMOKE) DURING START AND/OR SHUTDOWN ONLY. OK DURING OPERATION. - CONTINUED

CONTINUED FROM STEP 4

5	Check No. 5 and 6 bearing oil scavenge tube assembly (1) as listed below: • Check for evidence of leakage. • Check to see if part number etched on tube assembly ends in -02.
Is there evidence of oil leakage or is -02 part number installed?	



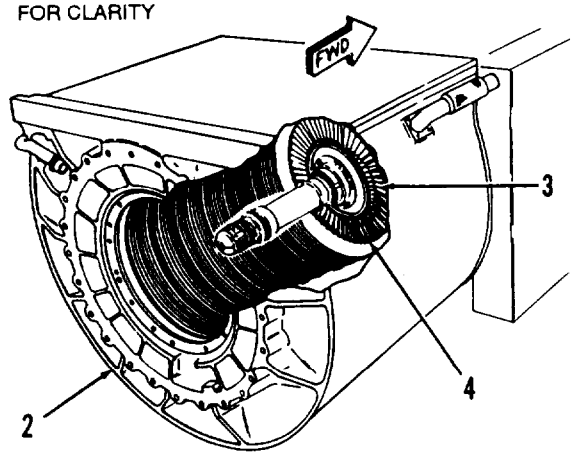
NO — YES

NOTE
Tube assembly with part number ending in -03 shall be used in lieu of part number ending in -02.

Replace No. 5 and 6 bearing oil scavenge tube assembly and internal pressure special seals (page 6-10).

6	Look into rear engine subassembly (2) and check power turbine rotor (3) for evidence of oil leakage at outer edge of blades (4).
Is there evidence of oil leakage at outer edge of power turbine rotor blades?	

CUTAWAY SHOWN FOR CLARITY



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(4) ES-20. ENGINE SMOKES (BLUE SMOKE) DURING START AND/OR SHUTDOWN ONLY OK DURING OPERATION. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Go to step 10.

7 Check shaft assembly (1) at adapter (2) for evidence of oil leakage.

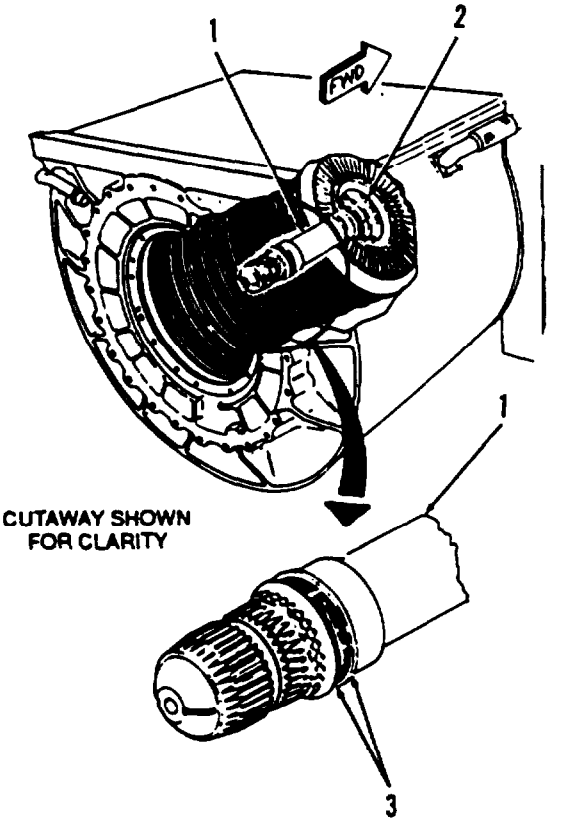
Is there evidence of leakage at adapter?

NO — YES

A. Repair adapter and shaft assembly (page 6-37).
B. Go to step 10.

8 Check shaft assembly (1) in area of sealing rings (3) for evidence of oil leakage past the sealing rings as indicated by heavy burnt oil deposits (coking).

Is there evidence of oil leakage past sealing rings?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(4) ES-20. ENGINE SMOKES (BLUE SMOKE) DURING START AND/OR SHUTDOWN ONLY. OK DURING OPERATION. - CONTINUED

CONTINUED FROM STEP 8

NO — YES

A. Replace adapter and shaft assembly seal rings (page 6-22.5).
B. Replace No. 7 bearing seal (page 6-22.1).
C. Install forward engine module (page 5-18).
D. Verify problem is solved.

9 Check seal rings (1) to see if split lines (gaps) (2) are facing 180 degrees away from each other.

Are gaps 180 degrees apart?

YES — NO

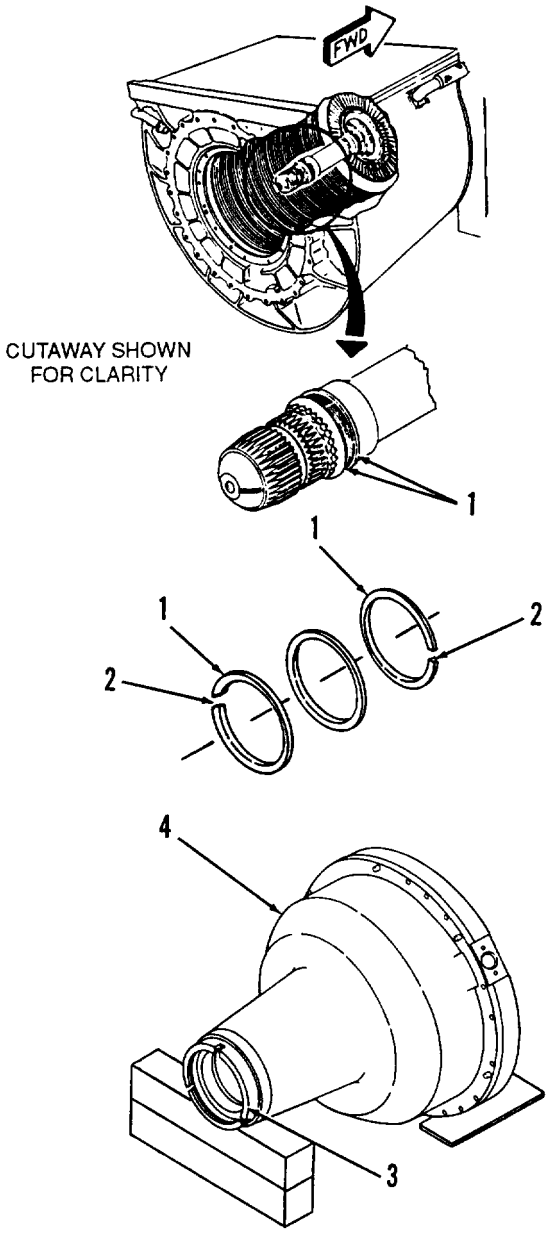
Position seal ring split lines (gaps) so they are 180 degrees apart.

10 **NOTE**
A thin smooth black finish is OK.

Check No. 7 bearing seal area (3) on RGB assembly (4) for a heavy rouqh coating of burnt oil deposits (coking).

Does seal area have heavy rough coating of burnt oil deposits (coking)?

CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(4) ES-20. ENGINE SMOKES (BLUE SMOKE) DURING START AND/OR SHUTDOWN ONLY. OK DURING OPERATION. - CONTINUED

CONTINUED FROM STEP 10

NO — YES

A. Replace No. 7 bearing seal (page 6-22.1).
B. Replace adapter and shaft assembly seal rings (page 6-22.5).
C. Install forward engine module (page 5-18).
D. Verify problem is solved.

11

CAUTION

Do not lean or hang anything on shaft (1). Damage to bearing or seals may result.

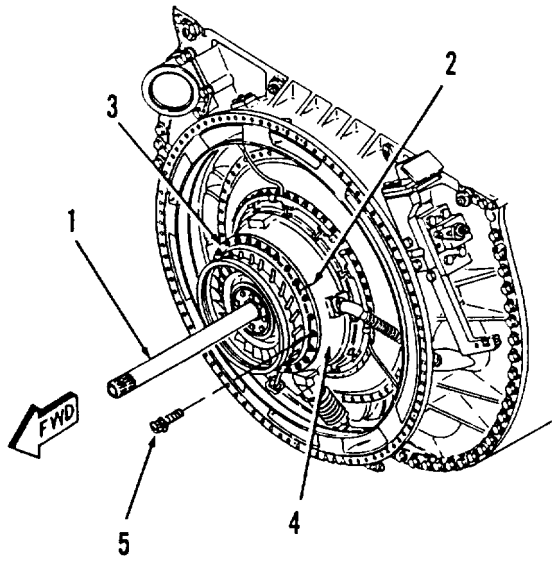
A. Using marker, place line (2) on nozzle (3) and power turbine housing (4).
B. Soak 24 bolts (5) with penetrating oil.

WARNING

Turbine rotor shaft (1) and turbine nozzle (3) must be supported when removing bolts (5) to prevent damage to parts and injury to personnel.

C. Support shaft (1) and nozzle (3). Cut lockwlre and remove 24 bolts (5).
D. Check to see if nozzle (3) separated from housinq (4).

Did nozzle separate from housing?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(4) ES-20. ENGINE SMOKES (BLUE SMOKE) DURING START AND/OR SHUTDOWN ONLY. OK DURING OPERATION. - CONTINUED

CONTINUED FROM STEP 11

NO — YES

Go to step 13.

12 NOTE

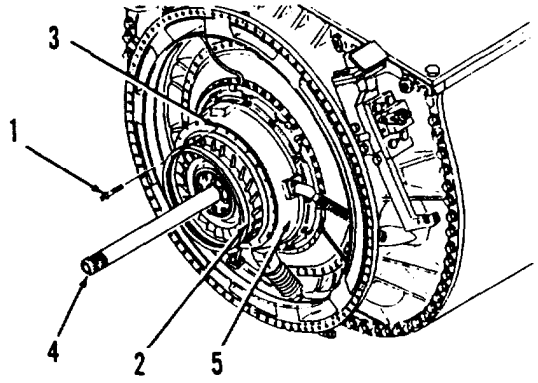
Three jackscrews (1) must be tightened evenly to prevent cocking of nozzle (2).

A. Using three bolts (1) as jackscrews, install bolts into three threaded holes (3) in nozzle (2).

WARNING

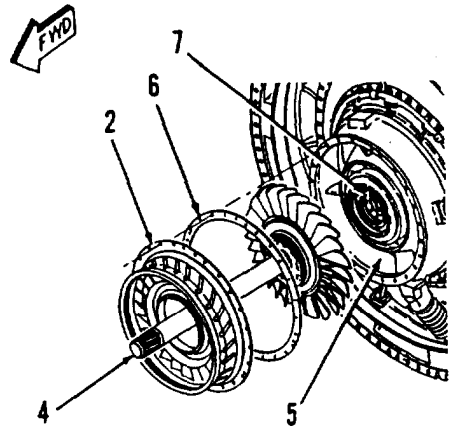
Shaft (4) and nozzle (2) must be supported when tightening jackscrews (1).

B. Support nozzle (2) and shaft (4) and tighten bolts (1) evenly until nozzle (2) is away from housing (5).



13 A. Remove shaft (4), nozzle (2) and spacer ring (6). Remove three bolts (1).

B. Check for evidence of oil leakage from No. 5 seal and diaphragm area (7).



Is there evidence of oil leakage at No. 5 seal and diaphragm?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

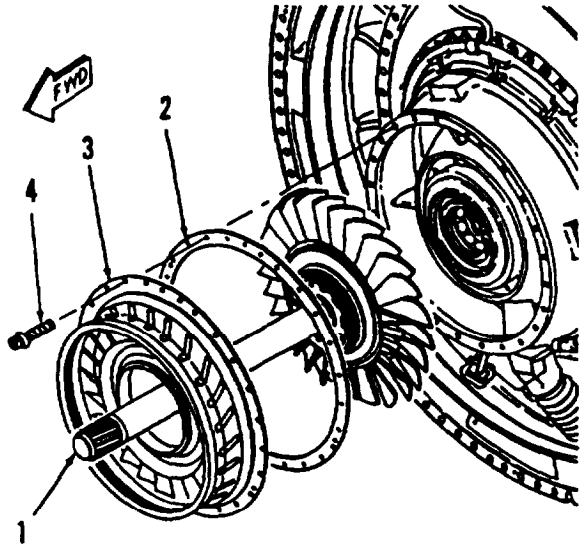
d. ENGINE - CONTINUED	(4) ES-20. ENGINE SMOKES (BLUE SMOKE) DURING START AND/OR SHUTDOWN ONLY. OK DURING OPERATION. - CONTINUED

CONTINUED FROM STEP 13

NO — YES

A. Replace No. 5 seal and diaphragm assembly (page 6-45).
B. Install RGB assembly (page 6-19).
C. Verity problem is solved.

A. Install shaft (1), spacer ring (2), turbine nozzle (3) and 24 bolts (4). Tighten bolts (4).
B. Salvage Gas Turbine Power Unit (page 6-63).
C. Verify problem is solved.

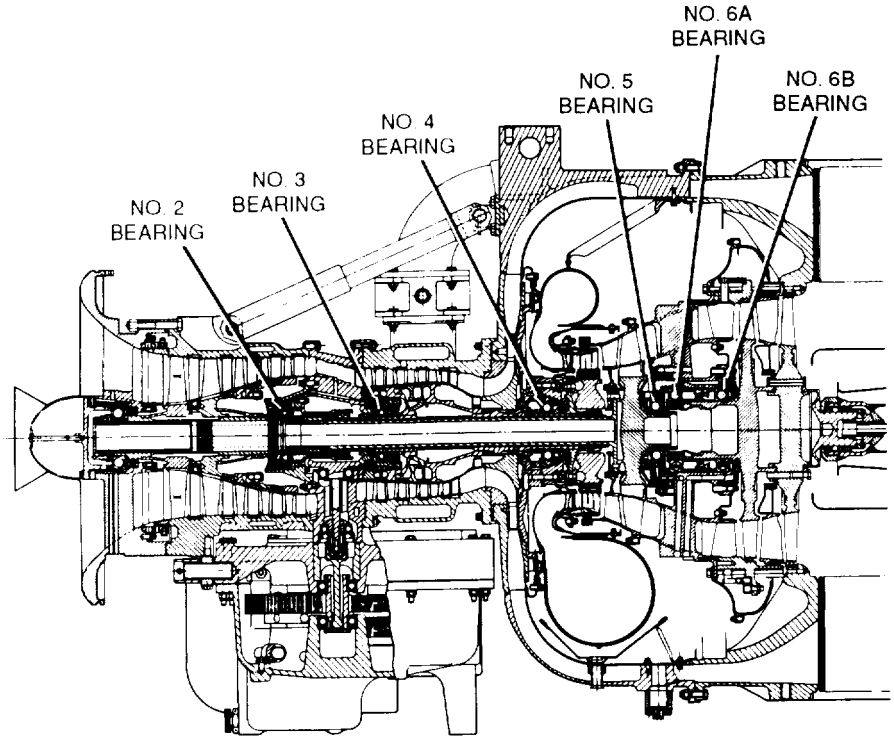


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

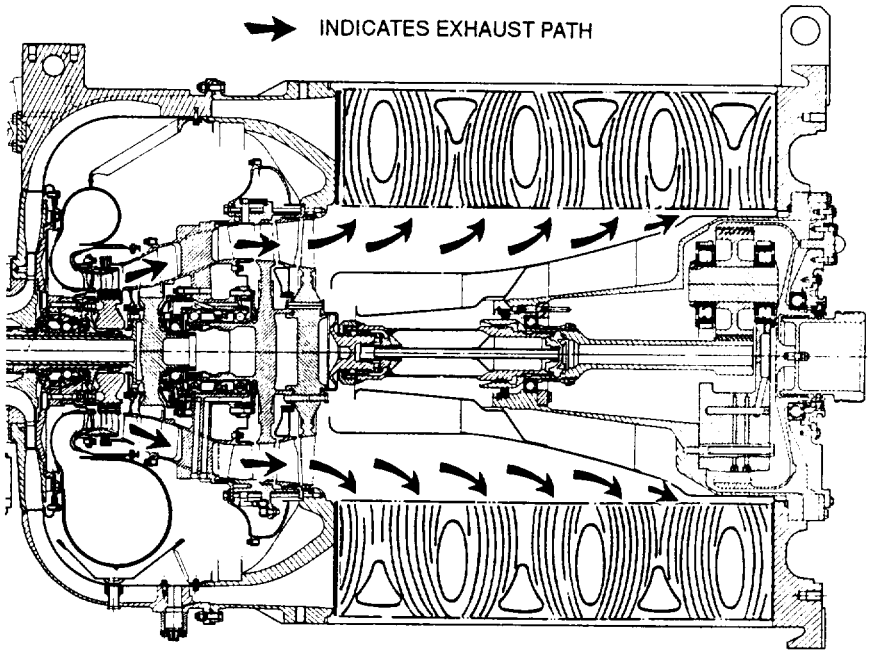
d. ENGINE - CONTINUED	(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN.

This section contains troubleshooting to locate and correct the cause(s) of blue smoke from the exhaust during start, operation and shutdown. Blue smoke is an indication of oil leakage past seals in,oil-wetted areas into the exhaust path of the engine. This symptom is,usuallY accompanied by excessive oil consumption. Many of the bearing packages in the engine are air pressurized to assist the carbon face seals in sealing oil-wetted areas. If carbon face seals or packings do not seal properly, leakage will not occur past the seal if the air pressure is higher than the oil pressure in that package. Once the alr pressure becomes lower than the oil pressure, oil w1ll leak past the seal. When carbon face seals or packings are severely damaqed, alr,pressure may prove insufficient to prevent 0il leakage, causing continuous smoke during start, operation and shutdown. The art on the following pages provides an overview of the exhaust system and related components. Refer to these pages along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN. - CONTINUED



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN. - CONTINUED

Tools:	Supplies:
General mechanic's tool kit: automotive (SC 5180-90-N26)	Marker (Item 25, Appendix B) Penetrating oil (Item 44, Appendix B) Wiping rag (Item 14, Appendix B)

1 A. Remove forward engine module (page 5-13).

CAUTION

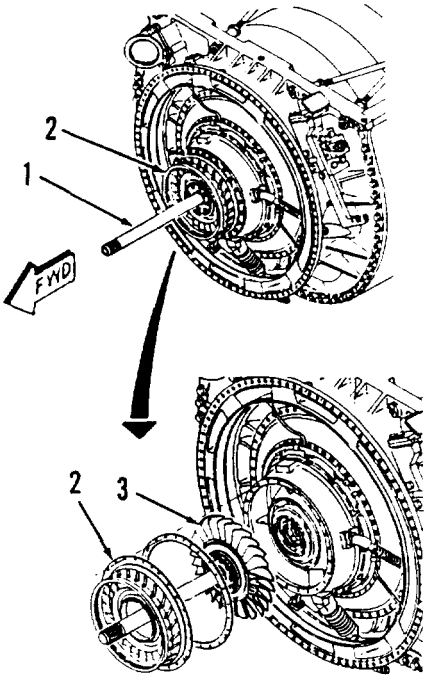
Do not lean or hang anything on shaft (1). Damage to bearing or seals may result.

B. Remove reduction gearbox (RGB) assembly (page 6-17).
C. Check power turbine nozzle (2) and turbine rotor blades (3) for evidence of oil.

Is there evidence of oil on nozzle or blades?

NO — YES

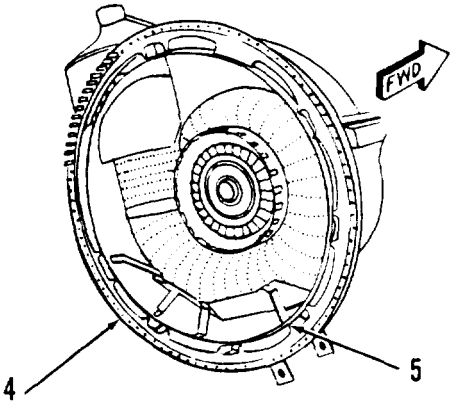
A. Replace forward engine module (page 5-18).
B. Go to step 4.



EXPLODED FOR CLARITY

2 Check between air diffuser (4) and diffuser liner (5) for evidence of oil leakage.

Is there evidence of oil leakage between diffuser and liner?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN. - CONTINUED

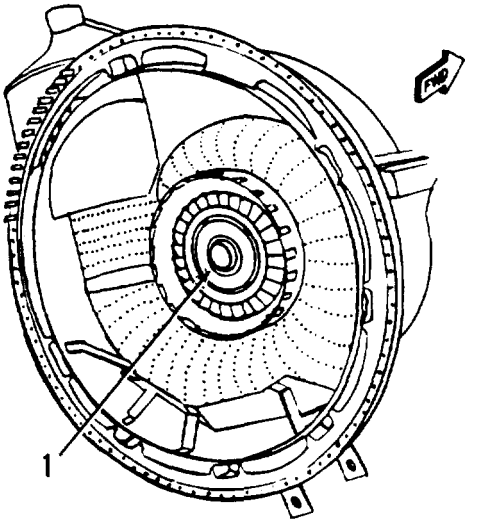
CONTINUED FROM STEP 2

NO — YES

A. Replace forward engine module (page 5-18).
B. Go to step 4.

3 Check for evidence of oil leakage from compressor shaft (1).

Is there evidence of oil leakage from compressor shaft?

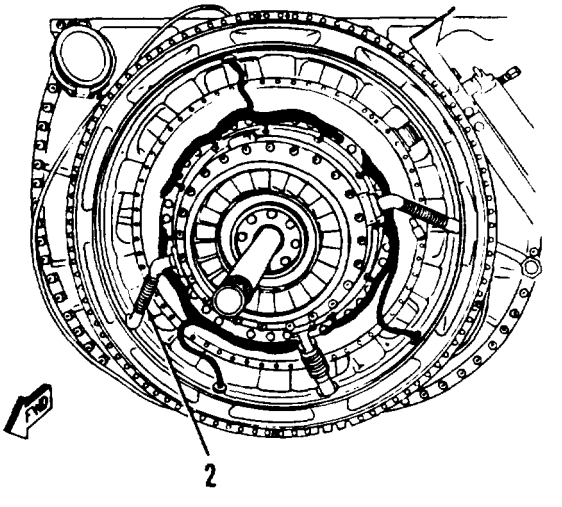


NO — YES

A. Replace forward engine module (page 5-18).
B. Go to step 4.

4 Check for evidence of oil leakage from No. 5 and 6 bearing oil feed tube assembly (2).

Is there evidence of oil leakage at oil feed tube assembly?



1 Replace No. 5 and 6 bearing oil feed tube assembly and internal pressure special seals and packing (page 6-12).

CONTINUED ON NEXT PAGE

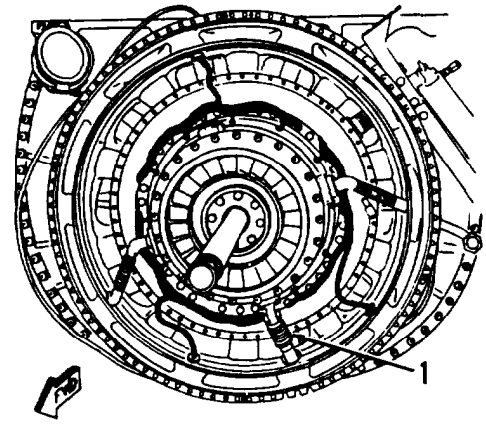
3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 4

5 Check No. 5 and 6 bearing oil scavenge tube assembly (1) as listed below:
- Check for evidence of leakage.
- Check to see if part number etched on tube assembly ends in -02.

Is there evidence of oil leakage or is -02 part number installed?



NO — YES

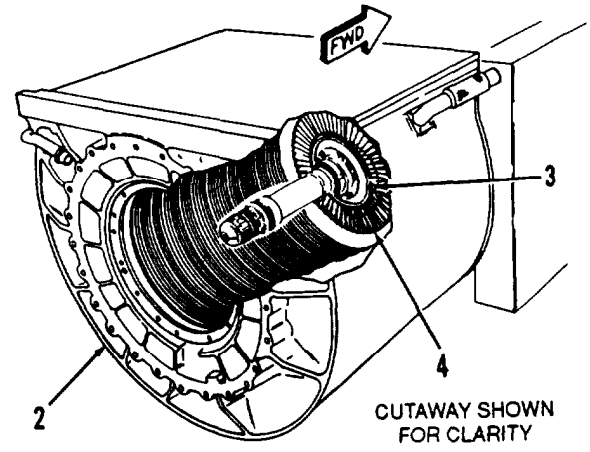
NOTE

Tube assembly with part number ending in -03 shall be used in lieu of part number ending in -02.

Replace No. 5 and 6 bearing oil scavenge tube assembly and internal pressure special seals (page 6-10).

6 Look into rear engine subassembly (2) and check power turbine rotor (3) for evidence of oil leakage at outer edge of blades (4).

Is there evidence of oil leakage at outer edge of power turbine rotor blades?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Go to step 10.

7 Check shaft assembly (1) at adapter (2) for evidence of oil leakage.

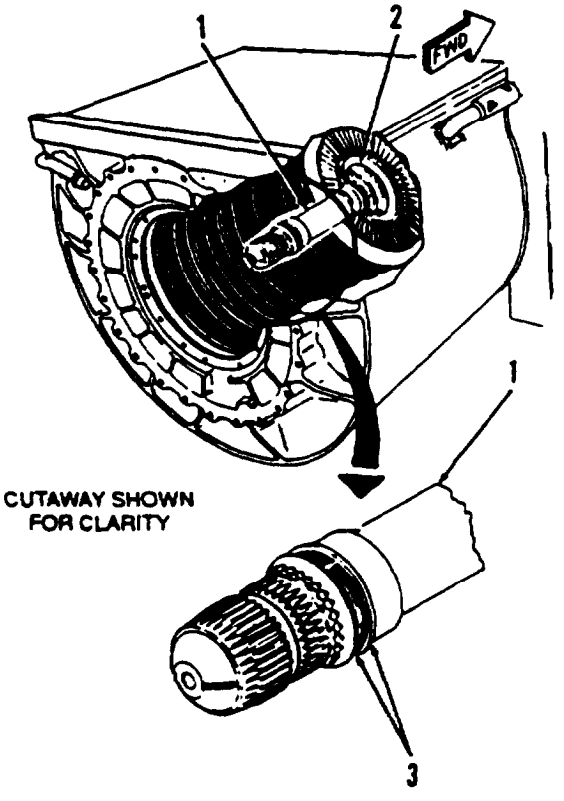
Is there evidence of leakage at adapter?

NO — YES

A. Repair adapter and shaft assembly (page 6-37).
B. Go to step 10.

8 Check shaft assembly (1) in area of sealing rings (3) for evidence of oil leakage past the sealing rings as indicated by heavy burnt oil deposits (coking).

Is there evidence of oil leakage past sealing rings?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING CONTINUED

d. ENGINE - CONTINUED

(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 8

NO — YES

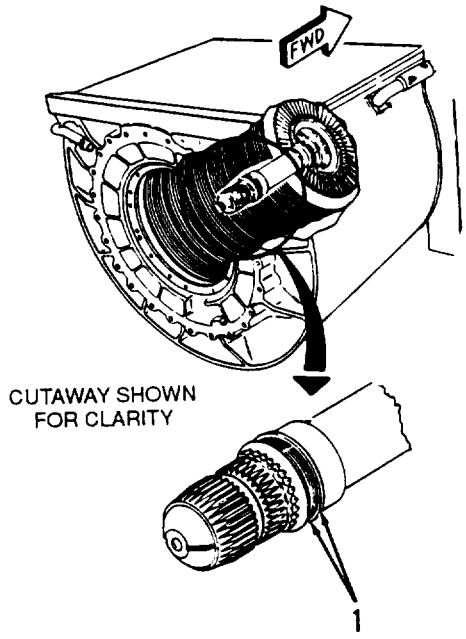
A. Replace adapter and shaft assembly seal rings (page 6-22.5).
B. Replace No. 7 bearing seal (page 6-22.1).
C. Install forward engine module (page 5-18).
D. Verify problem is solved.

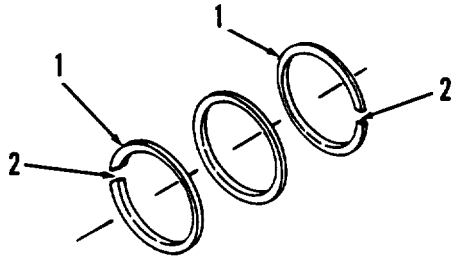
9 Check seal rings (1) to see if split lines (gaps) (2) are facing 180 degrees away from each other.

Are gaps 180 degrees apart?

YES — NO

Position seal ring split lines (gaps) so they are 180 degrees apart.

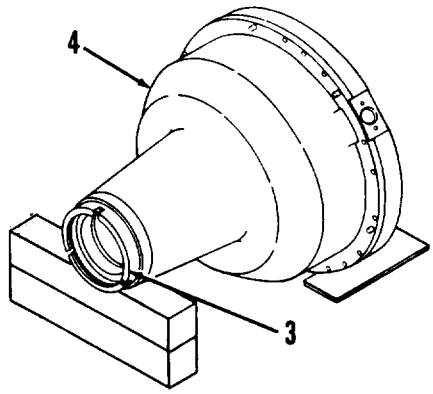




10 **NOTE**
A thin smooth black finish is OK.

Check No. 7 bearing seal area (3) on RGB assembly (4) for a heavy rough coating of burnt oil deposits (coking).

Does seal area have heavy rough coating of burnt oil deposits (coking).



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 10

NO — YES

A. Replace No. 7 bearing seal (page 6-22.1).
B. Replace adapter and shaft assembly seal rings (page 6-22.5).
C. Install forward engine module (page 5-18).
D. Verify problem is solved.

11 **CAUTION**

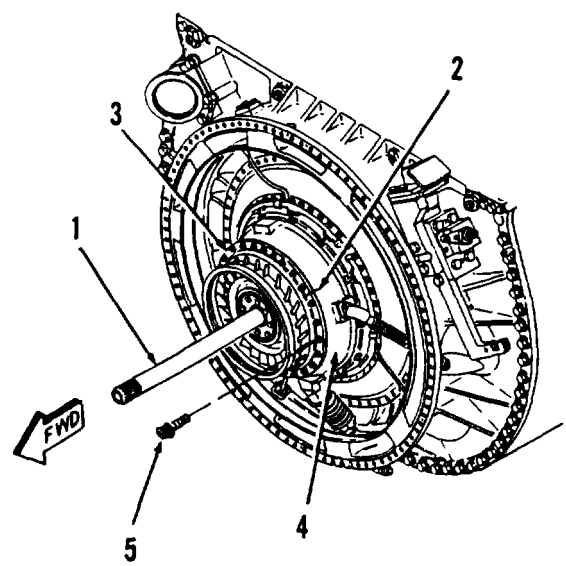
Do not lean or hang anything on shaft (1). Damage to bearing or seals may result.

A. Using marker, place line (2) on nozzle (3) and power turbine housing **(4).**
B. Soak 24 bolts (5) with penetrating oil.

WARNING

Turbine rotor shaft (1) and turbine nozzle (3) must be supported when removing bolts (5) to prevent damage to parts and injury to personnel.

C. Support shaft (1) and nozzle (3). Cut lockwlre and remove 24 bolts (5).
D. Check to see if nozzle (3) separated from housing (4).



Did nozzle separate from housing?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED

(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 1

NO — YES

Go to step 13.

12

NOTE

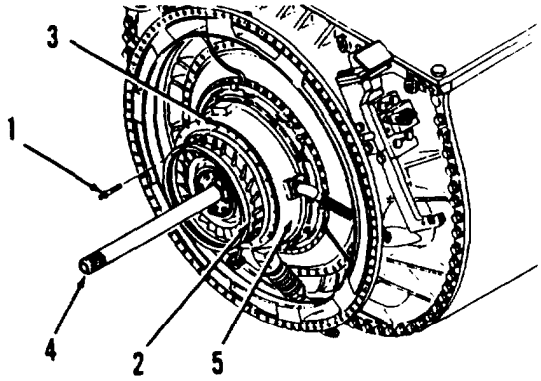
Three jackscrews (1) must be tightened evenly to prevent cocking of nozzle (2).

A. Using three bolts (1) as jackscrews, install bolts into three threaded holes (3) in nozzle (2).

WARNING

Shaft (4) and nozzle (2) must be supported when tightening jackscrews (1).

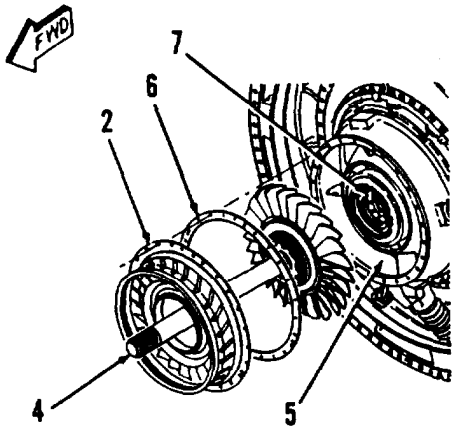
B. Support nozzle (2) and shaft (4) and tighten bolts (1) evenly until nozzle (2) is away from housing (5). Remove three bolts (1).



13

A. Remove shaft (4), nozzle (2) and spacer ring (6).

B. Check for evidence of oil leakage from No. 5 seal and diaphragm area (7).



Is there evidence of oil leakage at No. 5 seal and diaphragm?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(5) ES-21. ENGINE SMOKES (BLUE SMOKE) DURING START, OPERATION AND SHUTDOWN. - CONTINUED

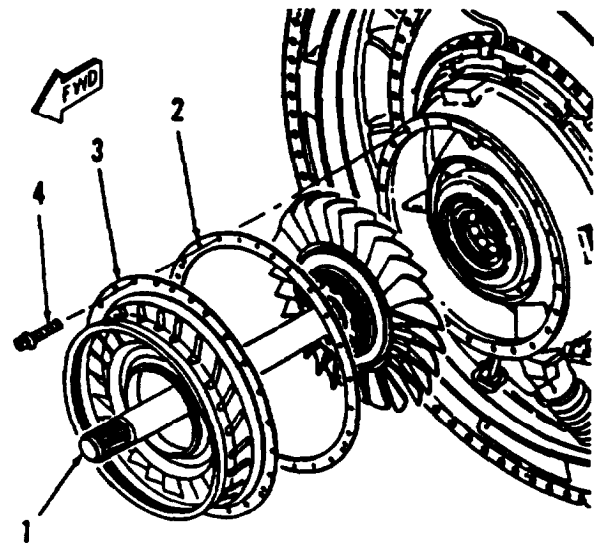
CONTINUED FROM STEP 13

NO

A. Install shaft (1), spacer ring (2), turbine nozzle (3) and 24 bolts (4). Tighten bolts (4).
B. Salvage Gas Turbine Power Unit (page 6-63).
C. Verify problem is solved.

YES

A. Replace No. 5 seal and diaphragm assembly (page 6-45).
B. Install RGB assembly (page 6-19).
C. Verify problem is solved.

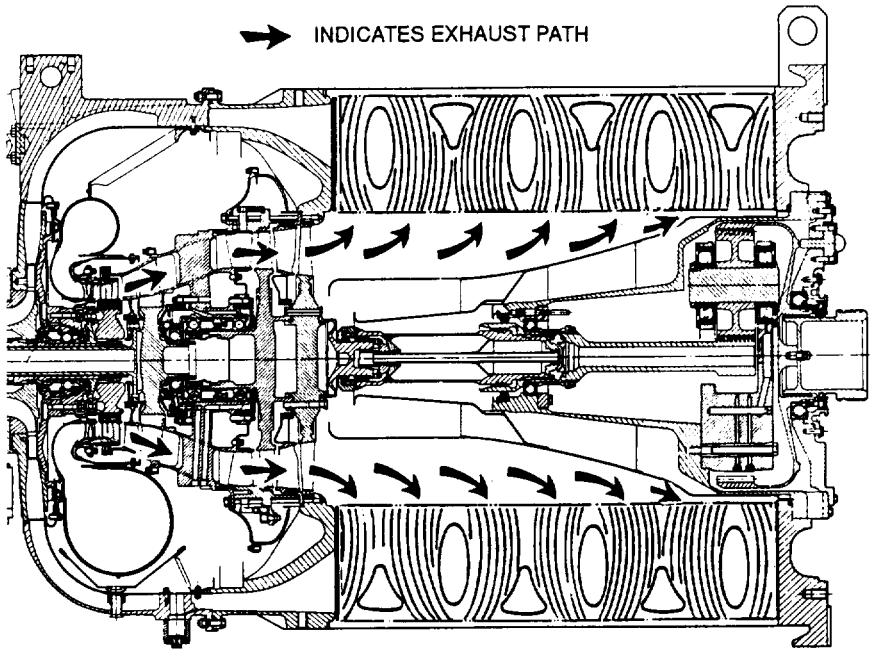


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

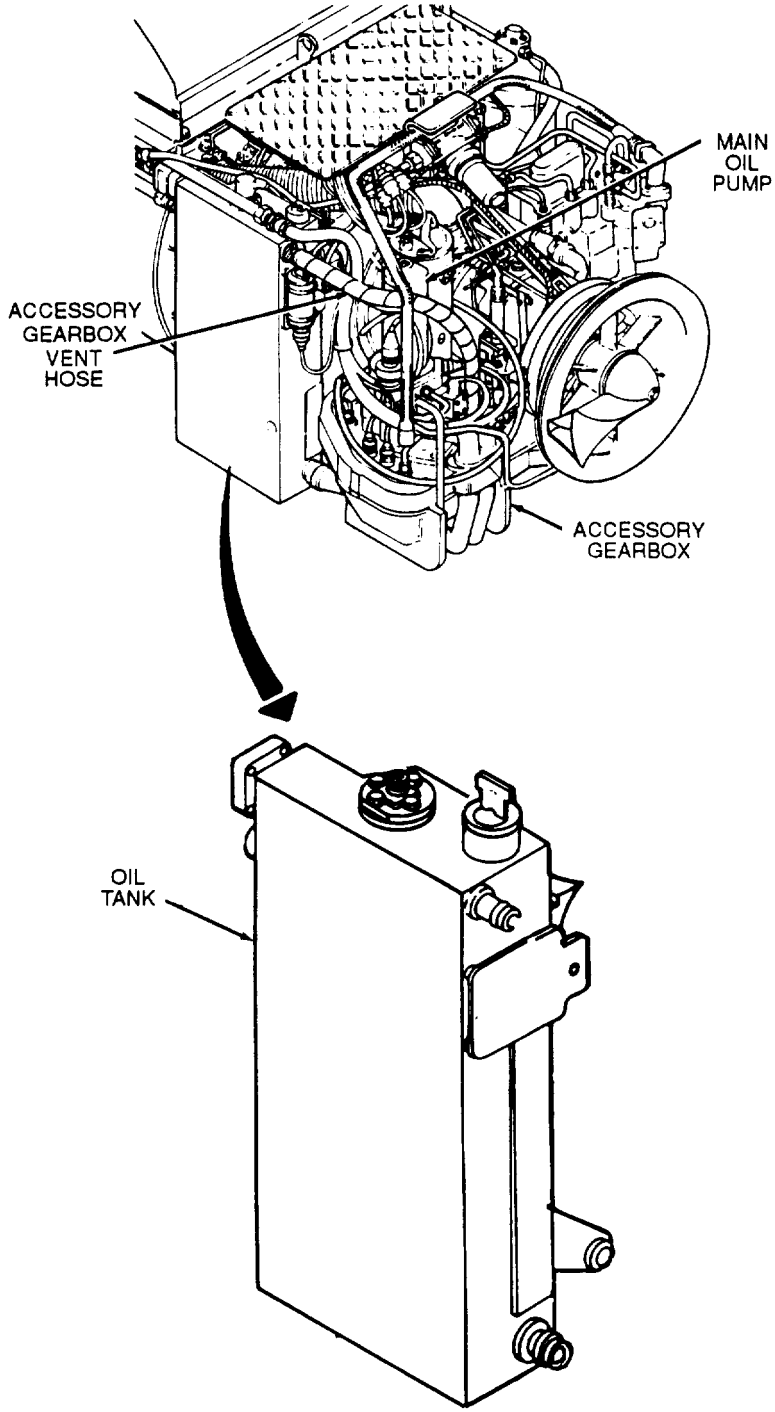
d. ENGINE - CONTINUED	(6) ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY. OK DURING START AND SHUTDOWN.

This section contains troubleshooting to locate and correct the cause(s) of blue smoke from the exhaust during operation only, and not during start or shutdown. Blue smoke is an indication of 0il leakage past seals in oil-wetted areas into the exhaust path of the engine. This symptom is usually accompanied by excessive oil consumption. There are many potential causes of oil leakage throughout the engine. It is important to carefully inspect the engine externally before disassembly to note evidence of internal oil leakage. This evidence may assist in fault isolating the problem to a module or component. If the oil reservoir is overfilled, accessory gearbox (AGB) vent hose blocked, or oil pump scavenging elements are damaged, oil scavenge pressures from the bearing packages will increase and flooding of the bearing packages will cause oil leakage past the seals. In addition to evidence noted during the external visual inspection, engine disassembly may be required to further fault isolate the condition. The art on the following pages provides an overview of the AGB, lubrication and exhaust systems and related components. Refer to these pages along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(6) ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY. OK DURING START AND SHUTDOWN. - CONTINUED



3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(6) ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY. OK DURING START AND SHUTDOWN. - CONTINUED

Tools:	Supplies:
General mechanic's tool kit: automotive (SC 5180-90-N26)	Marker (Item 25, Appendix B) Penetrating oil (Item 44, Appendix B) Wiping rag (Item 14, Appendix B)

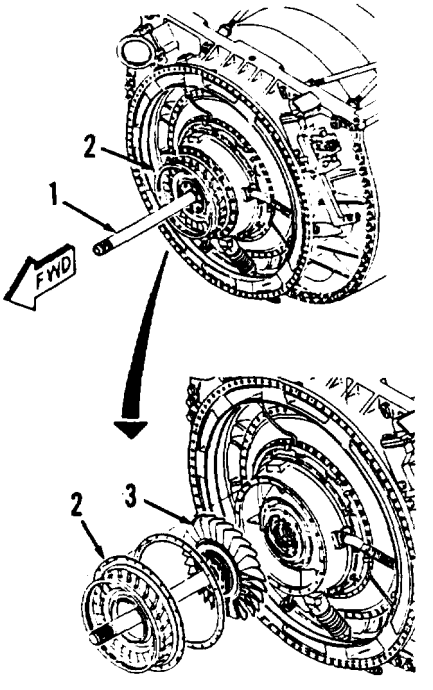
1 A. Remove forward engine module (page 5-13).

CAUTION

Do not lean or hang anvthing on shaft (1). Damage to bearing or seals may result.

B. Remove reduction gearbox (RGB) assembly (page 6-17).
C. Check power turbine nozzle (2) and turbine rotor blades (3) for evidence of oil.

Is there evidence of oil on nozzle or blades?



EXPLODED FOR CLARITY

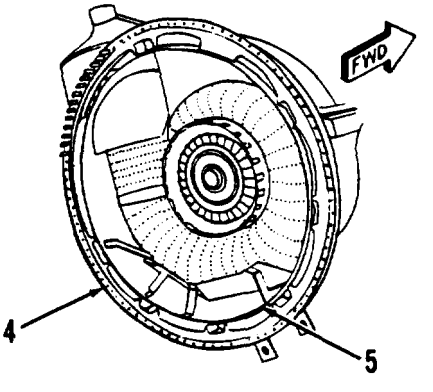
NO

YES

A. Replace forward engine module (page 5-18).
B. Go to step 4.

2 Check between air diffuser (4) and diffuser liner (5) for evidence of oil leakage.

Is there evidence of oil leakage between diffuser and liner?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(6) ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY. OK DURING START AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

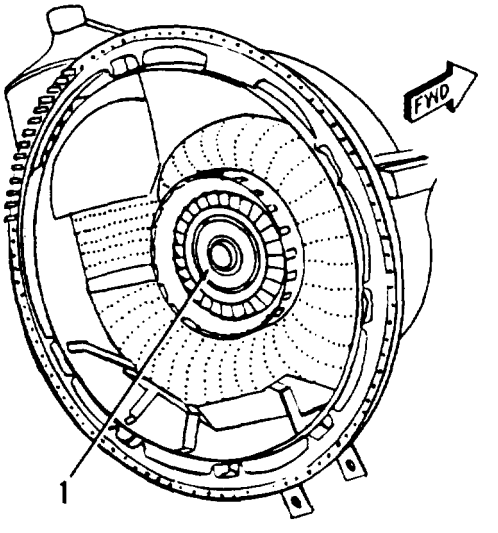
A. Replace forward engine module (page 5-18).
B. Go to step 4.

3 Check for evidence of oil leakage from compressor shaft (1).

Is there evidence of oil leakage from compressor shaft?

NO — YES

Replace forward engine module (page 5-18).

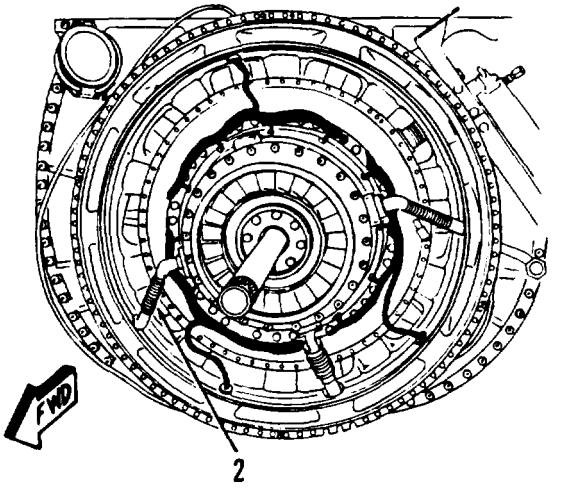


4 Check for evidence of oil leakage from No. 5 and 6 bearing Oil feed tube assembly (2).

Is there evidence of oil leakage at oil feed tube assembly?

NO — YES

Replace No. 5 and 6 bearing oil feed tube assembly and internal pressure special seals and packing (page 6-12).



CONTINUED ON NEXT PAGE

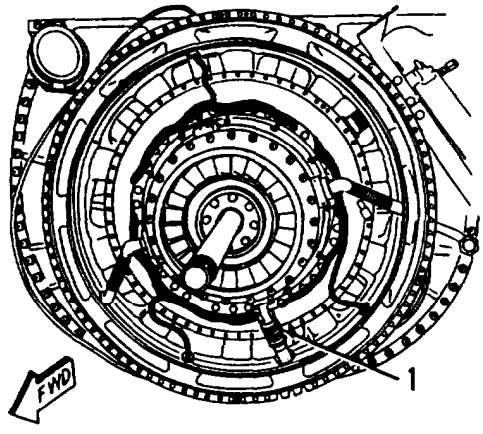
3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(6) ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY. OK DUPING START AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 4

5 Check No. 5 and 6 bearing oil scavenge tube assembly (1) as listed below:
- Check for evidence of leakage.
- Check to see if part number etched on tube assembly ends in -02.

Is there evidence of oil leakage or is -02 part number installed?



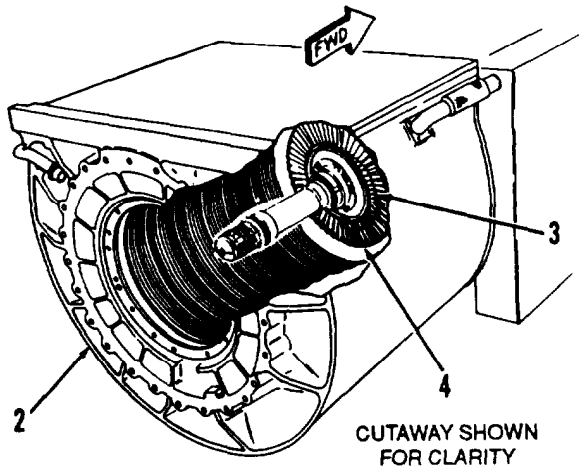
NO — YES

NOTE
Tube assembly with part number ending in -03 shall be used in lieu of part number ending in -02.

Replace No. 5 and 6 bearing oil scavenge tube assembly and internal pressure special seals (page 6-10).

6 Look into rear engine subassembly (2) and check power turbine rotor (3) for evidence of oil leakage at outer edge of blades (4).

Is there evidence of oil leakage at outer edge of power turbine rotor blades?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(6)	ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY OK DURING START AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Go to step 10.

7 Check shaft assembly (1) at adapter (2) for evidence of oil leakage.

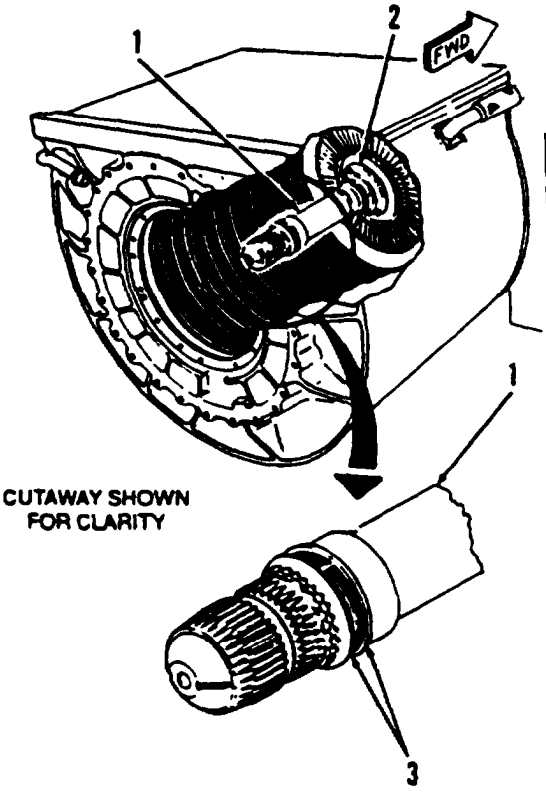
Is there evidence of leakage at adapter?

NO — YES

A. Repair adapter and shaft assembly (page 6-37).
B. Go to step 10.

8 Check shaft assembly (1) in area of sealing rings (3) for evidence of oil leakage past the sealing rings as in indicated by heavy burnt oil deposits (coking).

Is there evidence of oil leakage past sealing rings?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(6) ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY. OK DURING START AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 8

NO — YES

A. Replace adapter and shaft assembly seal rings (page 6-22.5).
B. Replace No. 7 bearing seal (page 6-22.1).
C. Install forward engine module (page 5-28).
D. Verify problem is solved.

9 Check seal rings (1) to see if split lines (gaps) (2) are facing 180 degrees away from each other.

Are gaps 180 degrees apart?

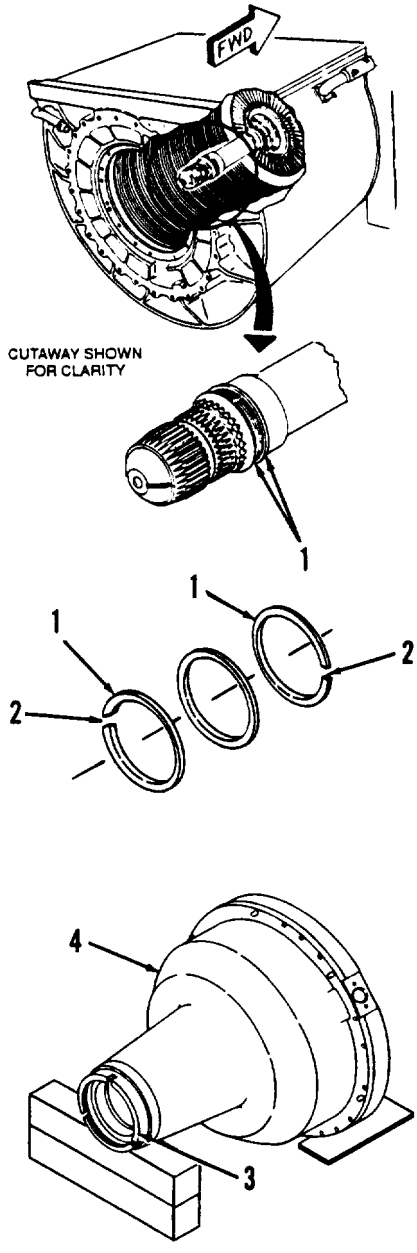
YES — NO

Position seal ring split lines (gaps) so they are 180 degrees apart.

10 **NOTE**
A thin smooth black finish is OK.

Check No. 7 bearing seal area (3) on RGB assembly (4) for a heavy rouqh coating of burnt oil deposits (coking).

Does seal area have heavy rough coating of burnt oil deposits (coking)?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(6) ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY. OK DURING START AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 10

NO — YES

A. Replace No. 7 bearing seal (page 6-22.1).
B. Replace adapter and shaft assembly seal rings (page 6-22.5).
C. Install forward engine module (page 5-18).
D. Verify problem is solved.

11 **CAUTION**

Do not lean or hang anything on shaft (1). Damage to bearing or seals may result.

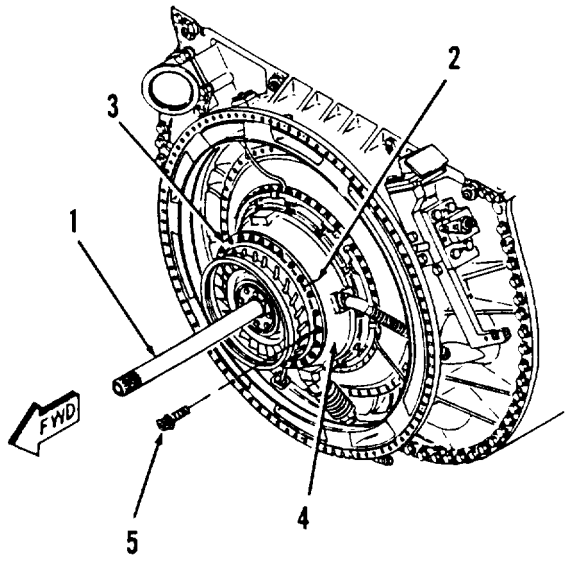
A. Using marker, place line (2) on nozzle (3) and power turbine housing (4).
B. Soak 24 bolts (5) with penetrating oil.

WARNING

Turbine rotor shaft (1) and turbine nozzle (3) must be supported when removing bolts (5) to prevent damage to parts and injury to personnel.

C. Support shaft (1) and nozzle (3). Cut lockwire and remove 24 bolts (5).
D. Check to see if nozzle (3) separated from housing (4).

Did nozzle separate from housing?



CONTINUED ON NEXT PAGE

3-2. TROUBLESOOTING - CONTINUED

d. ENGINE - CONTINUED	(6) ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY. OK DURING START AND SHUTDOWN. - CONTINUED

CONTINUED FROM STEP 11

NO — YES

Go to step 13.

12 **NOTE**

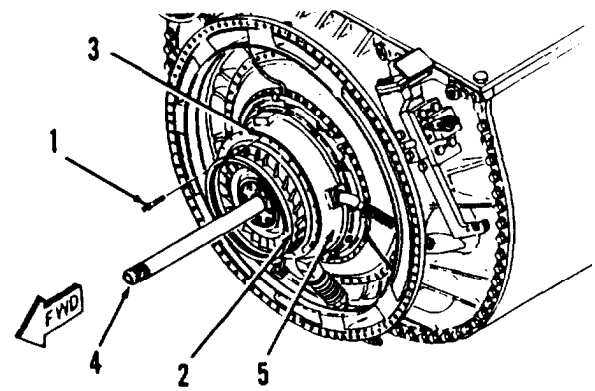
Three jackscrews (1) must be tightened evenly to prevent cocking of nozzle (2).

A. Using three bolts (1) as jackscrews, install bolts into three threaded holes (3) in nozzle (2).

WARNING

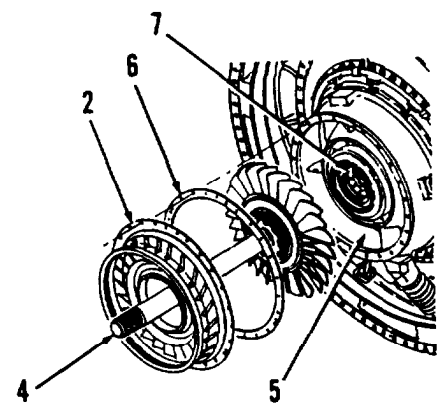
Shaft (4) and nozzle (2) must be supported when tightening jackscrews (1).

B. Support nozzle (2) and shaft (4) and tighten bolts (1) evenly until nozzle (2) is away from housing (5). Remove three bolts (1).



13 A. Remove shaft (4), nozzle (2) and spacer ring (6).
B. Check for evidence of oil leakage from No. 5 seal and diaphragm area (7).

Is there evidence of oil leakage at No. 5 seal and diaphragm?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

d. ENGINE - CONTINUED	(6) ES-22. ENGINE SMOKES (BLUE SMOKE) DURING OPERATION ONLY OK DURING START AND SHUTDOWN. - CONTINUED

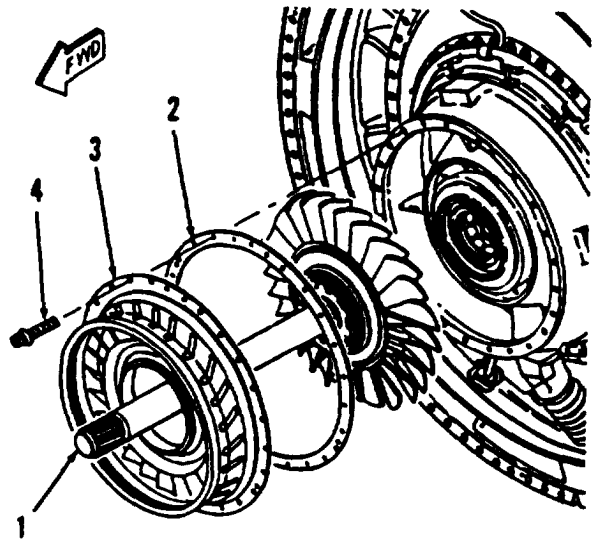
CONTINUED FORM STEP 13

NO

A. Install shaft (1), spacer ring (2), turbine nozzle (3) and 24 bolts (4). Tighten bolts (4).
B. Salvage Gas Turbine Power Unit (page 6-63).
C. Verity problem is solved.

YES

A. Replace No. 5 seal and diaphragm assembly (page 6-45).
B. Install RGB assembly (page 6-19).
C. Verify problem is solved.

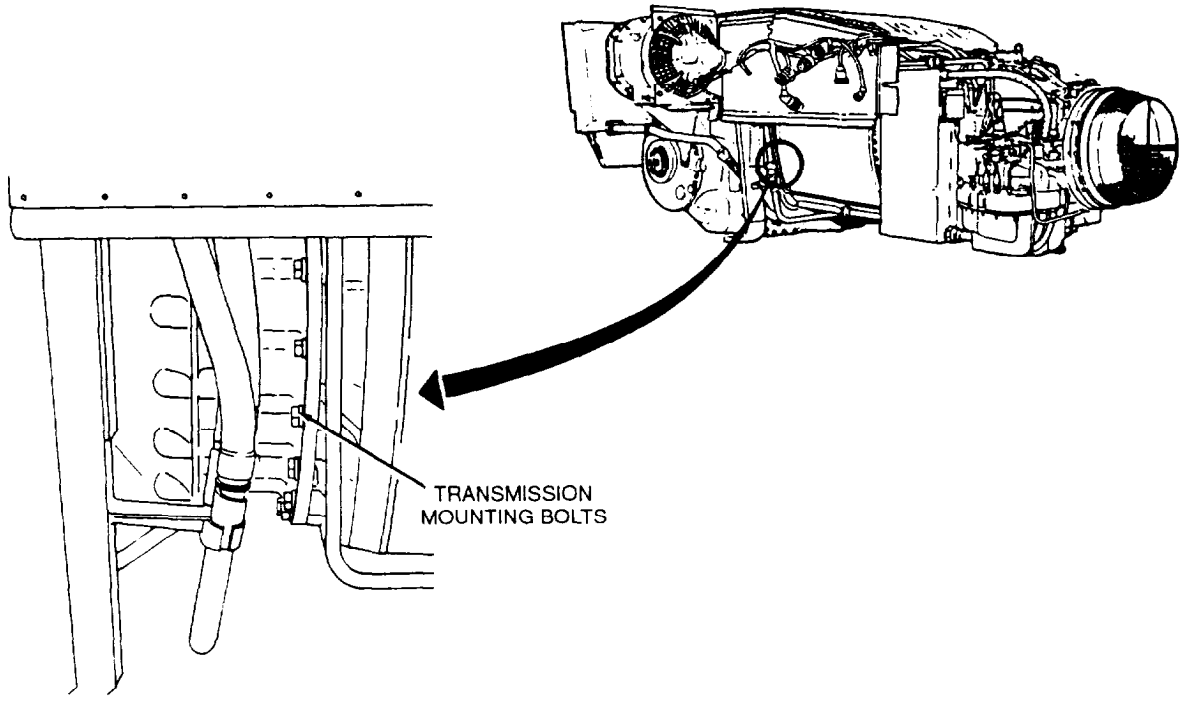


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

e. ENGINE/TRANSMISSION	(1) ES-23. 25 PERCENT OR MORE OF TRANSMISSION MOUNTING BOLTS AND WASHERS ARE LOOSE OR MISSING.

This section contains troubleshooting to try to determine why 25 percent or more of transmission mounting bolts were loose or missing. This is an indication that a module, the engine or transmission may have been swapped. The art on this page provides a complete overview of the engine and transmission interface. Use this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

e. ENGINE/TRANSMISSION - CONTINUED	(1) ES-23.25 PERCENT OR MORE OF TRANSMISSION MOUNTING BOLTS AND WASHERS ARE LOOSE OR MISSING. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
Inspection mirror (Item 92, Appendix D)

Supplies:
Wiping rag (Item 14, Appendix B)

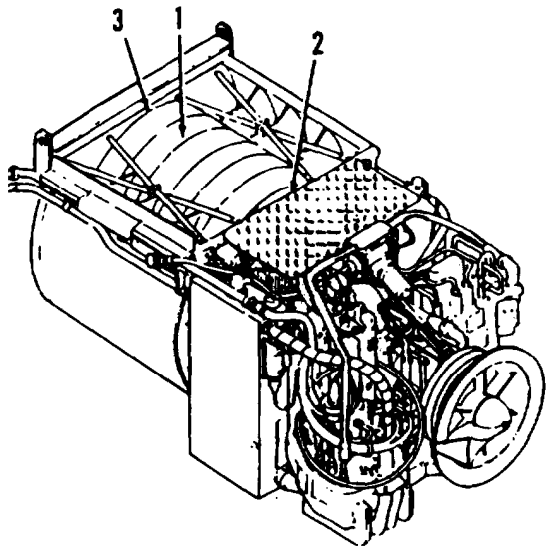
References:
TM 34-1

1 A. Disconnect engine assembly from transmission assembly (TM 34-1).
B. Inspect outside diameter of regenreator matrix (1), especially near the forward header (2) and rear header (3) all the way around for holes, cracks, buckling or separation of plates.

Is matrix outside diameter OK?

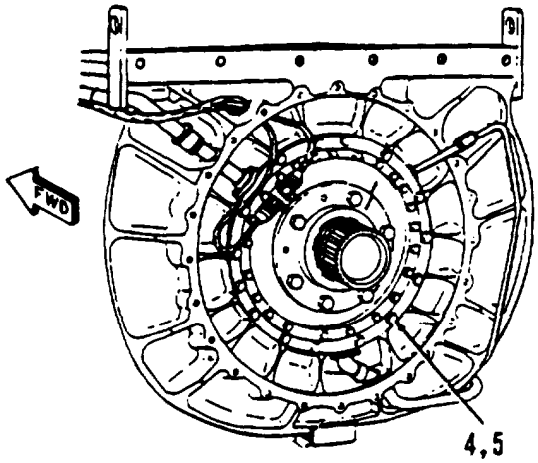
YES — NO

A . Salvage Gas Turbine Power Unit (page 6-63).
B . Verify problem is solved.



2 Check to see if all 15 reduction gearbox (RGB) mounting bolts (4) and washers (5) are installed.

Are all RGB mounting bolts and washers installed? .



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

e. ENGINE/TRANSMISSION - CONTINUED	(1) ES-23. 25 PERCENT OR MORE OF TRANSMISSION MOUNTING BOLTS AND WASHERS ARE LOOSE OR MISSING. - CONTINUED

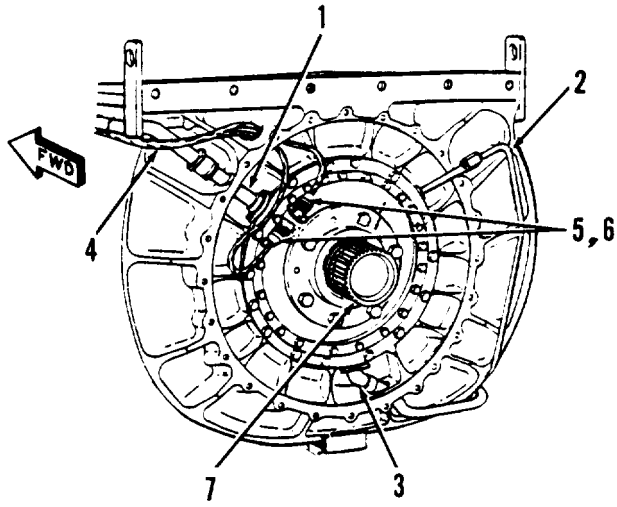
CONTINUED FROM STEP 2

YES — NO

NO: Go to step 4.

3. Check for installation and proper mounting of parts and assemblies listed below:
   - RGB air tube assembly - short (1).
   - RGB feed tube assembly (2).
   - RGB scavenge tube assembly - rear (3).
   - Speed wiring harness (4).
   - Speedometer adapters (5, 6).
   - Splined shaft (7).

Are all of the above parts and assemblies properly installed?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

e. ENGINE/TRANSMISSION - CONTINUED	(1) ES-23. 25 PERCENT OR MORE OF TRANSMISSION MOUNTING BOLTS AND WASHERS ARE LOOSE OR MISSING. - CONTINUED

CONTINUED FROM STEP 3

YES — NO

A. Replace missing or install loose parts and assemblies listed below:
- For RGB air tube assembly - short (page 6-5).
- For RGB feed tube assembly (page 6-7).
- For RGB scavenge tube assembly - rear (page 6-8).
- For speed wiring harness (page 6-4).
- For speedometer adapters (page 6-3).
- For splined shaft (page 6-2).

B. Connect engine assembly to transmission assembly (TM 34-1).
C. Verify problem is solved.

A. Connect engine assembly to transmission assembly (TM 34-1).
B. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

e. ENGINE/TRANSMISSION - CONTINUED

(1) ES-23.25 PERCENT OR MORE OF TRANSMISSION MOUNTING BOLTS AND WASHERS ARE LOOSE OR MISSING. - CONTINUED

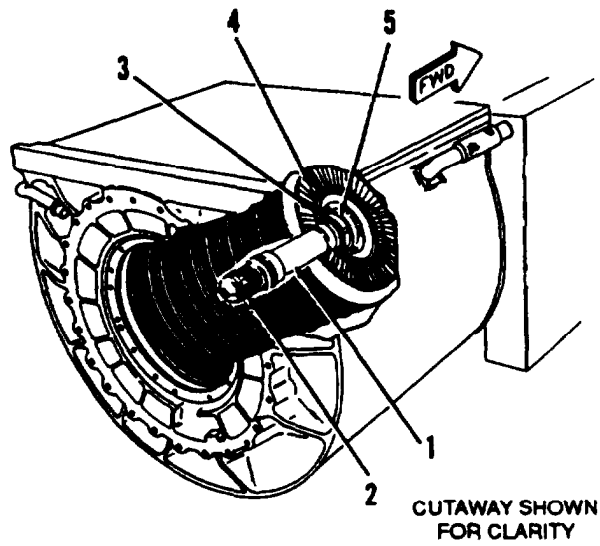
FROM STEP 2

4 A . Remove RGB assembly (page 6-17).
B . Check shaft assembly (1) for damage to splines (2).

Is there spline damage?

NO — YES

A . Salvage Gas Turbine Power Unit (page 6-63).
B . Verify problem is solved.



5 Check fourth turbine rotor (3) for damage or oil stains on blades (4).

Is turbine rotor damaged or are blades oil stained?

NO — YES

A . Salvage Gas Turbine Power Unit (page 6-63).
B . Verify problem is solved.

6 Check fourth turbine rotor (3) for oil stains in hub area (5).

Is turbine rotor stained in hub area?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

e. ENGINE/TRANSMISSION - CONTINUED	(1) ES-23. 25 PERCENT OR MORE OF TRANSMISSION MOUNTING BOLTS AND WASHERS ARE LOOSE OR MISSING. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

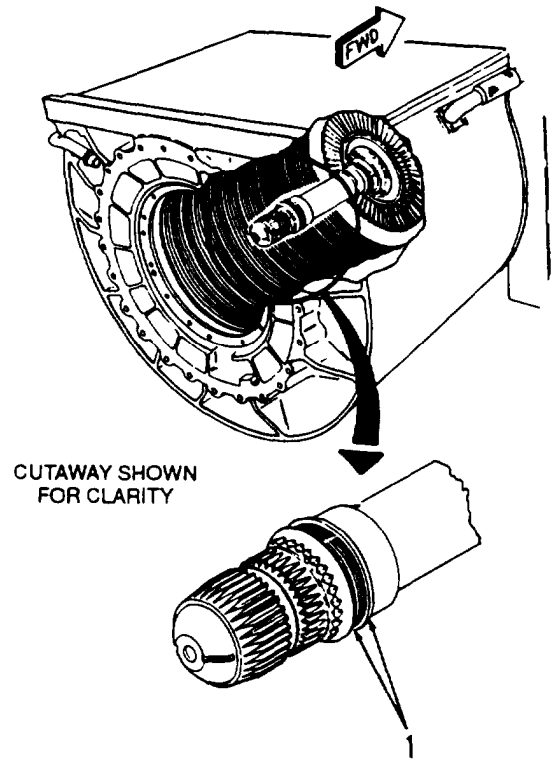
A. Repair adapter and shaft assembly (page 6-37).
B. Verify problem is solved.

7	Check to see if adapter and shaft seal rings (1) are missing or damaged.
Are seal rings missing or damaged?	

NO — YES

A. Replace adapter and shaft seal rings (page 6-22.5).
B. Verify-problem is solved.

A. install RGB assembly (page 6-19).
B . Verify problem is solved.

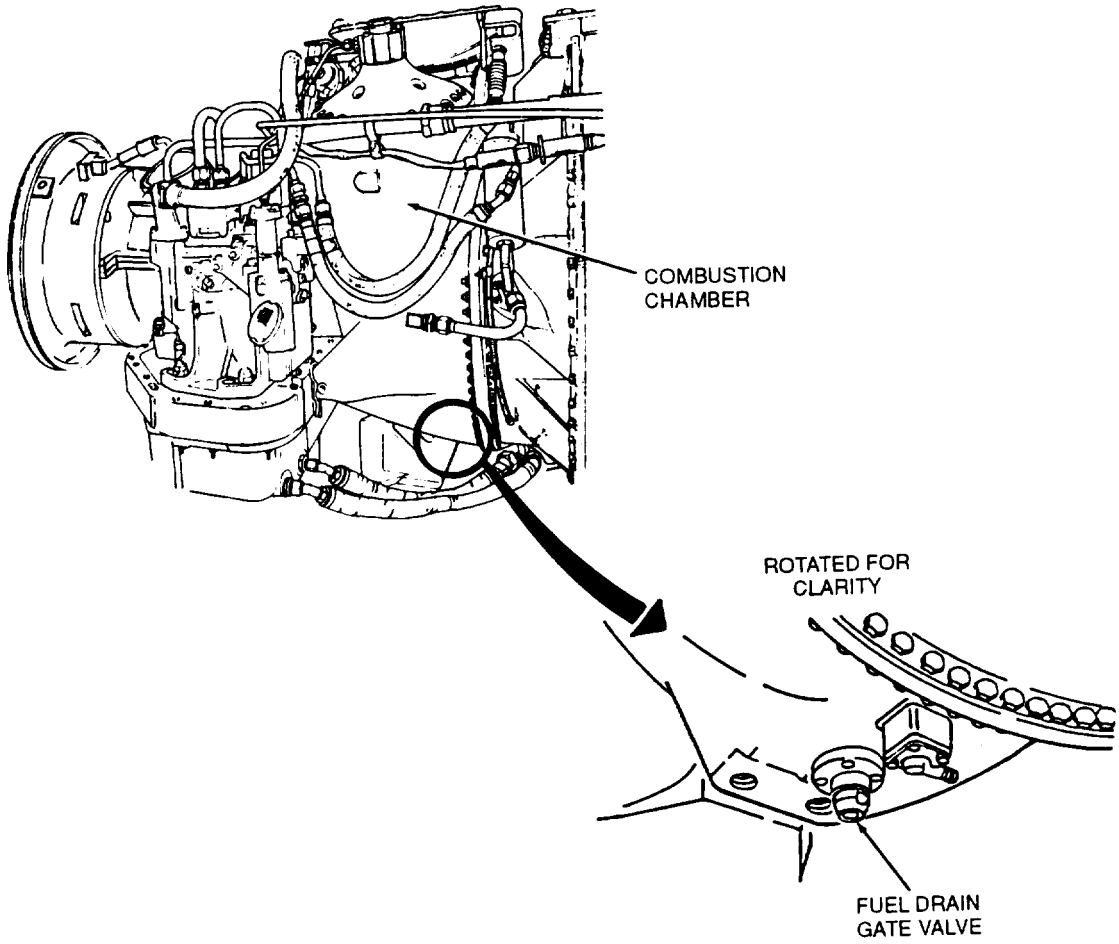


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

f. FORWARD MODULE/POWER TURBINE OIL TUBE ASSEMBLIES	(1) ES-24. OIL LEAKAGE FROM FUEL DRAIN GATE VALVE.

This section contains troubleshooting to determine and correct the cause(s) of oil leakage from the fuel drain gate valve. The art on this page provides an overview of the combustor section where Oil may leak, causing the above condition. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

f. FORWARD MODULE/POWER TURBINE OIL TUBE ASSEMBLIES - CONTINUED	(1) ES-24. OIL LEAKAGE FROM FUEL DRAIN GATE VALVE. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26)	Supplies: Wiping rag (Item 14, Appendix B)

1. A. Remove forward engine module (page 5-13).

CAUTION

Do not lean or hang anvthing on shaft (1). Damage to bearing or seal may result.

B. Check for evidence of oil leakage from No. 5 and 6 bearing oil feed tube assembly (2) and oil scavenge tube assembly (3)

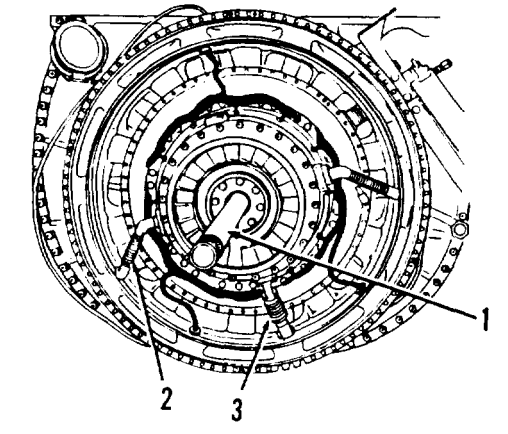
Is there evidence of oil leakage at either tube assembly?

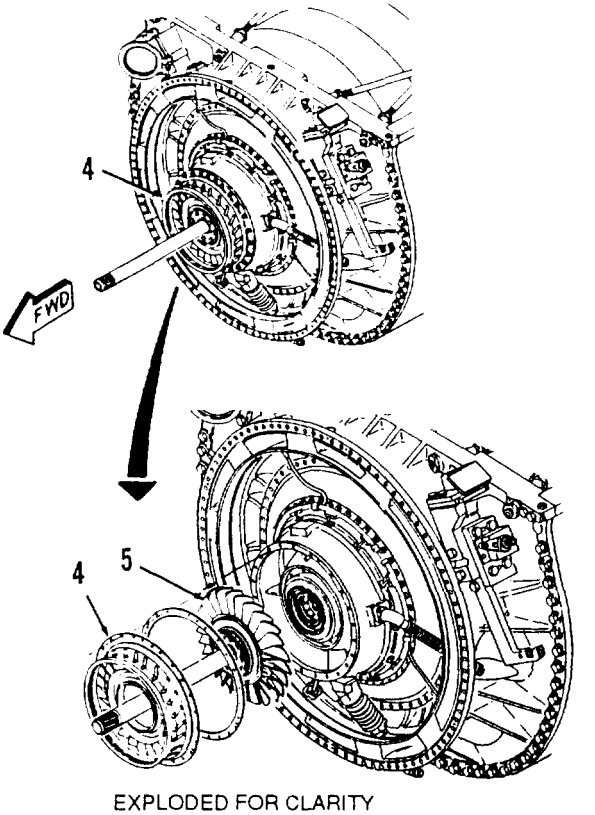
NO — YES

Replace leaking tube assembly and internal pressure special seals:
For oil feed tube assembly (page 6-12).
For oil scavenge tube assembly (page 6-10).

2 Check power turbine nozzle (4) and turbine rotor blades (5) for evidence of oil.

Is there evidence of oil on nozzle or blades?





EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

f. FORWARD MODULE/POWER TURBINE OIL TUBE ASSEMBLIES - CONTINUED	(1) ES-24. OIL LEAKAGE FROM FUEL DRAIN GATE VALVE. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Replace forward engine module (page 5-18).
B. Verify problem is solved

3 Check between air diffuser (1) and diffuser liner (2) for evidence of oil leakage.

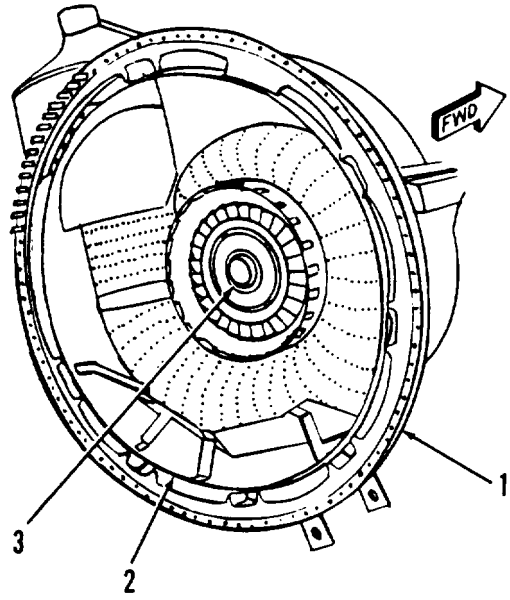
Is there evidence of oil leakage between diffuser and liner?

NO — YES

A. Replace forward engine module (page 5-18).
B. Verify problem is solved.

4 Check for evidence of oil leakage from compressor shaft (3).

Is there evidence of oil leakage from compressor shaft?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

f. FORWARD MODULE/POWER TURBINE OIL TUBE ASSEMBLIES - CONTINUED	(1) ES-24. OIL LEAKAGE FROM FUEL DRAIN GATE VALVE. - CONTINUED

CONTINUED FROM STEP 3

NO

A. Install forward engine module (page 5-18).
B. Verify problem is solved.

YES

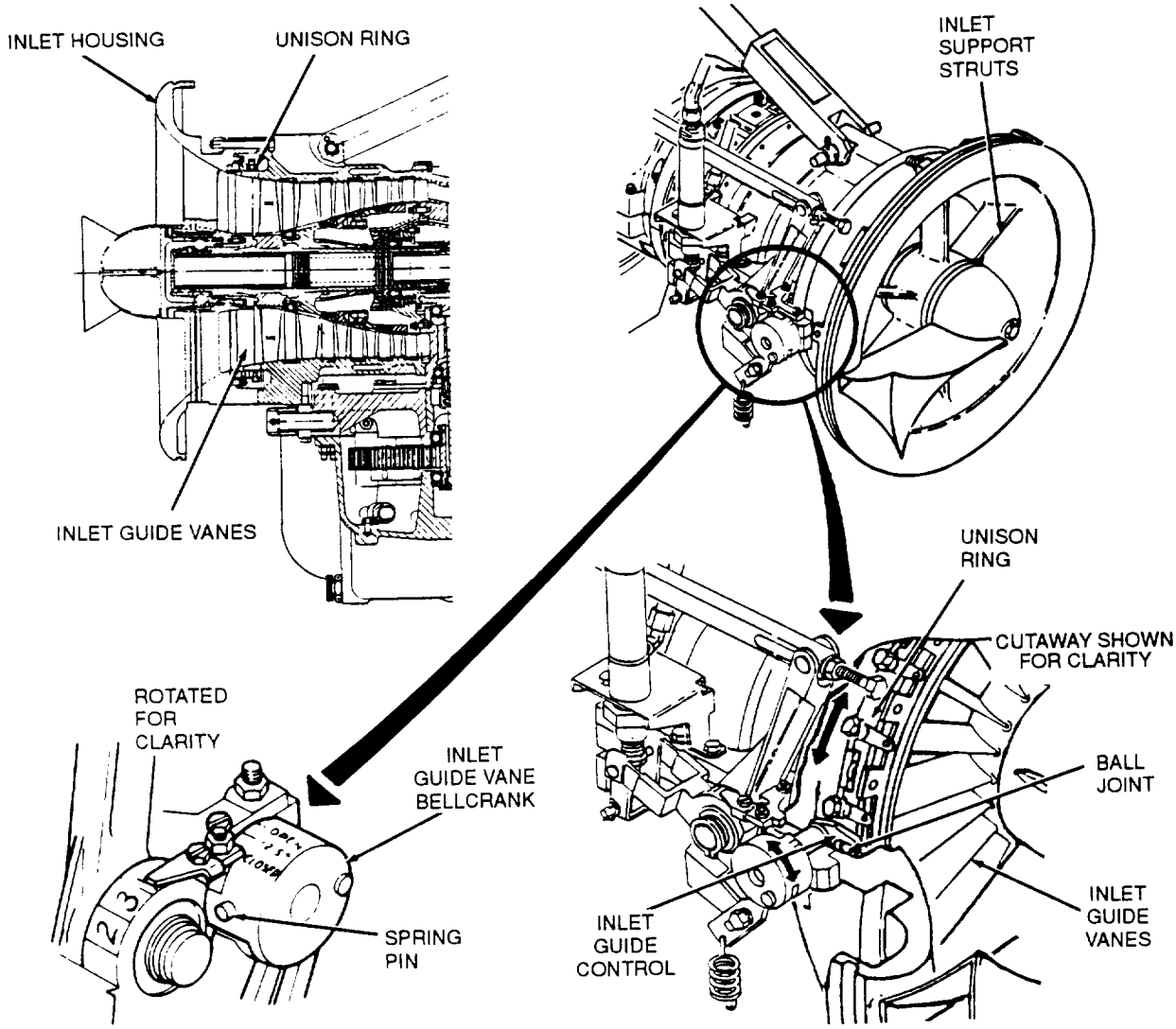
A. Replace foreward engine module (page 5-18).
B. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM	(1) ES-25. INLET GUIDE VANES (IGVs) DO NOT MOVE WHEN IGV BELLCRANK IS TURNED BY HAND.

This section contains troubleshooting to determine why the IGVs do not move when the IGV bellcrank is turned. The IGVs are located in the inlet housing behind the inlet support struts. The individual vanes are coupled together and controlled by a unison ring which is connected to the bellcrank outside the engine through an inlet guide control. The bellcrank is secured to the inlet guide control with a spring pin. If the spring pin is loose or missing or if the forked area of the inlet guide control is worn or not engaged on the ball joint, the unison ring will not activate and the IGVs will not move. If the unison ring and/or the IGVs are damaged or disconnected, the IGVs will not move when the bellcrank is turned. The art on this page provides an overview of the bellcrank and inlet guide vane parts. Refer to this page along with in-text art while doing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(1) ES-25. INLET GUIDE VANES (IGVs) DO NOT MOVE WHEN IGV BELLCRANK IS TURNED BY HAND. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26) Punch (Item 102, Appendix D)	Supplies: Spring pin (Item 113, Appendix E) Self-locking nut (Item 3, Appendix E)

1 Check to see if IGV bellcrank spring pin (1) is loose or missing.

NOTE

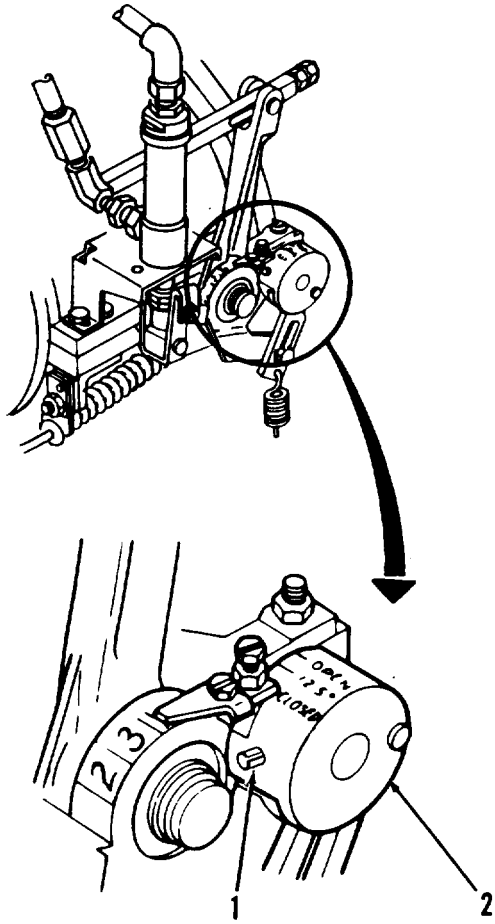
Under normal operation, pin may extend up to 1/4-inch out of bellcrank (2).

Is pin loose or missing?

NO — YES

1

A. Replace IGV bellcrank spring pin (page 5-32).
B. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(1) ES-25. INLET GUIDE VANES (IGVs) DO NOT MOVE WHEN IGV BELLCRANK IS TURNED BY HAND. - CONTINED

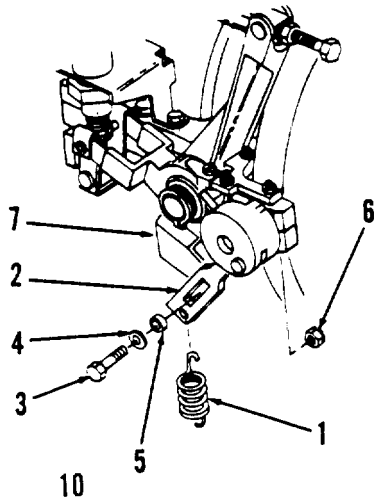
CONTINUED FROM STEP 1

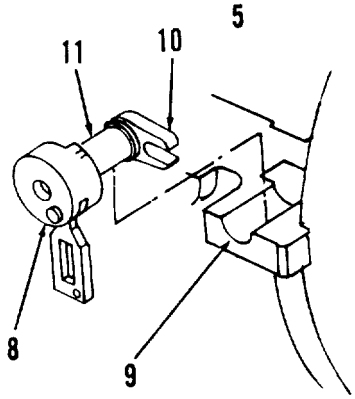
2 A. Unhook spring (1) from link (2).
B. Remove bolt (3), washer (4), spacer (5) and self-locklng nut (6) from link (2) and lever (7).
C. Remove top half of low pressure compressor housing assembly (page 5-6).
D. Remove bellcrank, link and control (8) from lower housing (9).
E. Inspect fork (10) on inlet guide control (11) for wear.

Is fork worn?

YES — NO

A. Install bellcrank, link, and control (8) in lower housing (9).
B. Install top half of low pressure compressor housing assembly (page 5-8).
C. Replace forward engine module (page 5-13).
D. Verify problem is solved.





CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(1) ES-25. INLET GUIDE VANES (IGVs) DO NOT MOVE WHEN IGV BELLCRANK IS TURNED BY HAND. - CONTINUED

CONTINUED FROM STEP 2

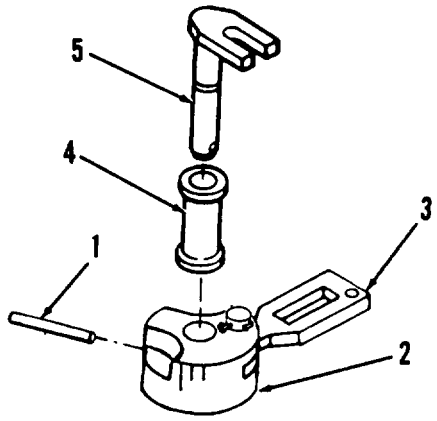
A. Remove spring pin (1). If more than 1/4-inch is exposed, use diagonal pllers. If less than 1/4-inch, use 3/32-inch punch.
B. Remove bellcrank (2) with link (3) attached, and bushing (4) from inlet guide control (5).

A. Place bellcrank (2), with link (3) attached, on flat surface. Start new spring pin (1) into bellcrank (2).
B. Put bushing 14) on new inlet guide control (5), and place inlet guide control (5) into bellcrank (2).

NOTE

When seated, spring pin (1) should extend about 1/4-inch out of bellcrank (2).

C. Use 3\32-inch punch to install spring pin (1) in bellcrank (2) and inlet guide control (5) until seated.



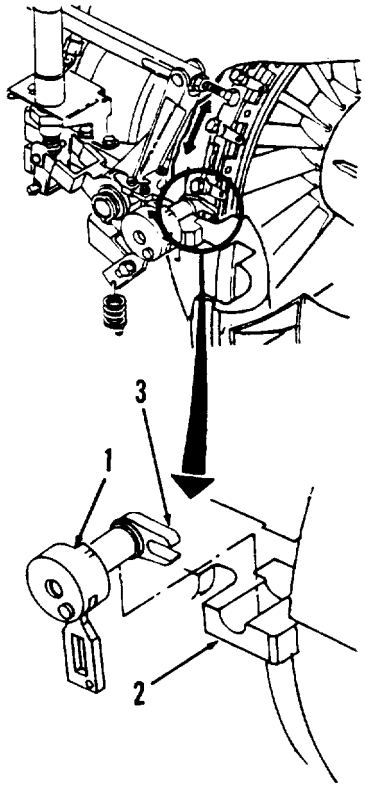
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

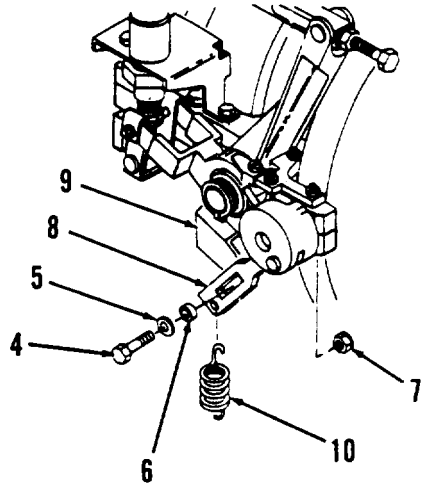
g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(1) ES-25. INLET GUIDE VANES (IGVS) DO NOT MOVE WHEN IGV BELLCRANK IS TURNED BY HAND. - CONTINUED

CONTINUED FROM STEP 2

A. Install bellcrank, link and control (1) in lower housing (2) making sure that fork (3) is positioned around ball joint on IGV unison ring.
B. Install top half of low pressure compressor housing assembly (page 5-8).
C. Install bolt (4), washer (5), spacer (6) and new self-locking nut (7) in link (8) and lever (9). Hook spring (10) on link (8).
D. Verify problem is solved.



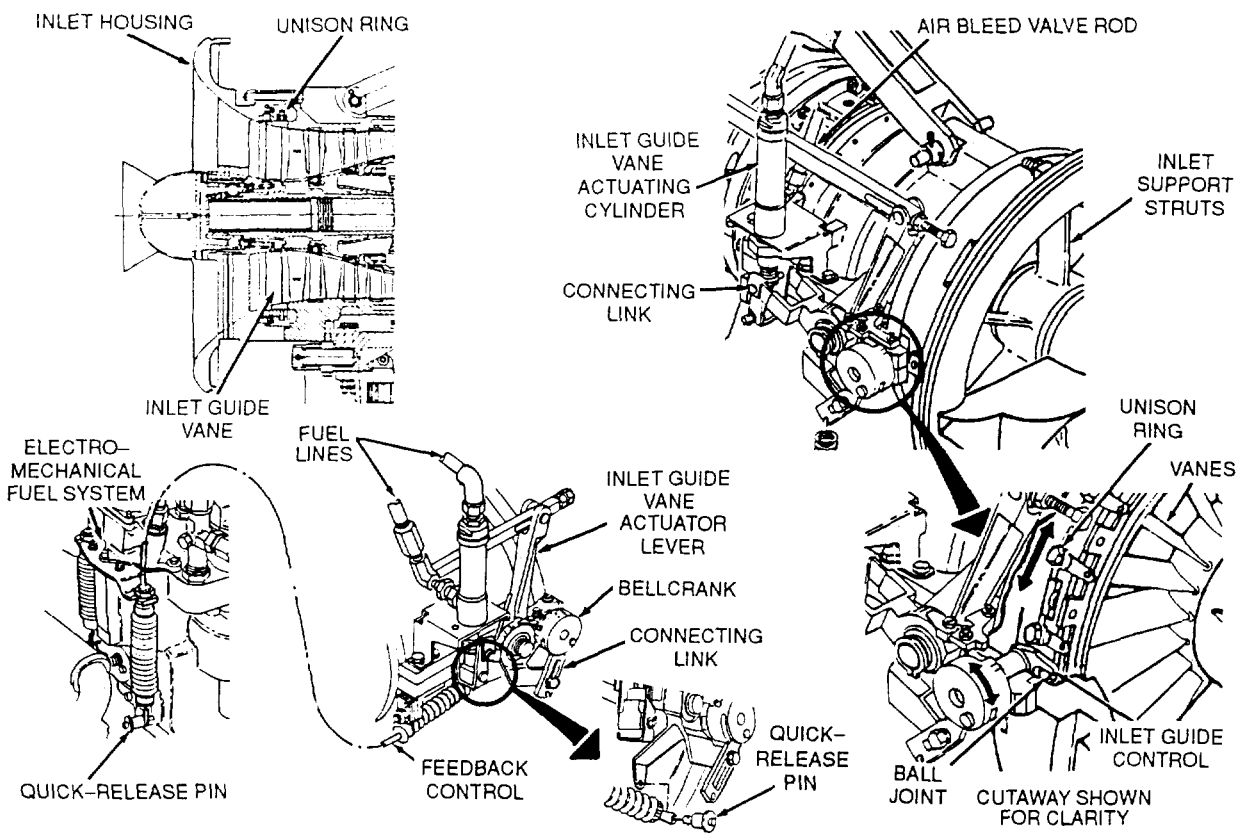
END OF TASK



3-2. TROUBLESHOOTING - CONTINUED

g.INLET GUIDE VANE (IGV) - CONTINUED	(2) ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND.

This section contains troubleshooting to determine why binding is felt when the IGV actuator lever is moved by hand. Variable inlet guide vanes (IGVs) are located in the inlet housing behind the inlet support struts. The individual vanes are coupled together and controlled by a unison ring which is connected to a bellcrank outside the engine through an inlet guide control. The bellcrank is attached to a connecting link which attaches to the IGV actuator lever. The IGV actuator lever is coupled to the IGV actuating cylinder piston through a connecting link. The air bleed butterfly valve control rod is also coupled to the IGV actuator lever. Movement of the IGV actuating cylinder causes the IGV actuator lever to move and turn the bellcrank to reposition the IGVS and also move the rod to reset the butterfly valve. The cylinder piston is controlled by fuel flow from the electro-mechanical fuel system (EMFS) which is regulated by the electronic control unit (ECU) .A feedback control (cable) is connected, by quick-release pins, between the EMFS and the IGV actuator lever. This reflects the actual setting of the IGVs back to the EMFS and ECU for reference. A faulty air bleed valve, IGV actuating cylinder, IGV feedback control, or EMFS could cause binding. Clogged fuel lines at the actuating cylinder, damage or wear on the IGV actuator lever and bushing, bellcrank, inlet guide control, connecting links and connecting hardware could also cause binding. The art on this page provides an overview of the IGV system. Refer to this along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED

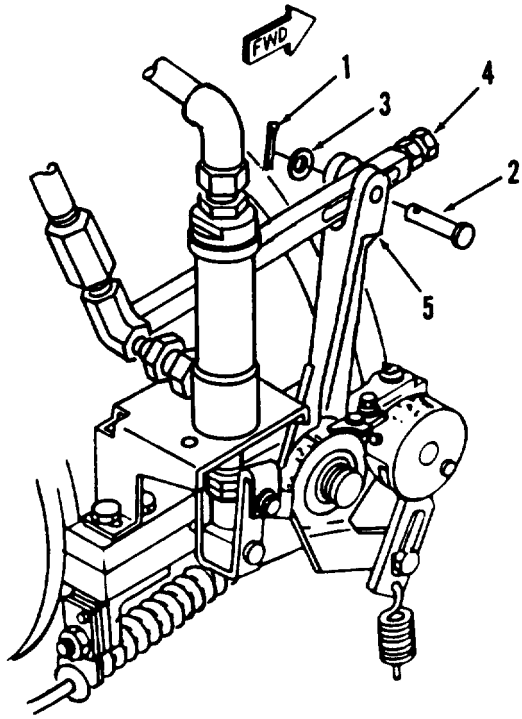
Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
Punch (Item 102, Appendix D)

References:
TM 20-1

Supplies:
Cotter pin (Item 5, Appendix E)
Cotter pin (Item 11, Appendix E)
Cotter pin (Item 114, Appendix E)
Spring pin (Item 113, Appendix E)
Wiping rag (Item 14, Appendix B)

1 A. Remove cotter pin (1) from pin (2).
B. Remove washer (3) and pin (2).
C. Move air bleed valve rod (4) forward and rearward while feeling for binding.

Does air bleed valve rod move back and forth without binding?



YES — A. Replace air bleed butterfly valve (TM 20-1).
B. Verify problem is solved.

NO

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(2) ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. CONTINUED.

CONTINUED FROM STEP 1

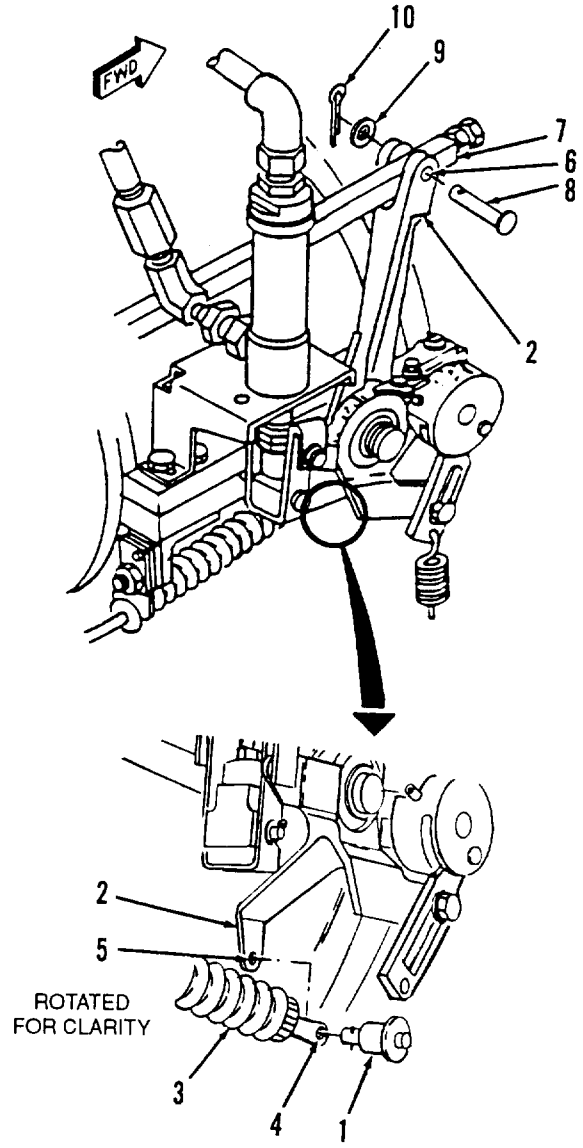
2. A. Remove quick-release pin (1) from lever (2) and feedback control (3).
   B. Check quick-release pin (1) for damage or wear. Replace damaged or worn pin (1).
   C. Check for binding of IGV system by moving IGV actuator lever (2) forward and rearward.

Does IGV actuator lever move back and forth without binding?

YES — NO

Go to step 4.

A. Line up hole (4) in feedback control (3) with hole (5) in actuator lever (2). Put quick-release pin (1) in feedback control (3) and actuator lever (2).
B. Line up hole (6) in actuator lever (2) with slot in rod (7). Put pin (8) in actuator lever (2) and rod (7).
C. Put washer (9) on pin (8), and put new cotter pin (10) in pin (8).



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED

CONTINUED FROM STEP 2

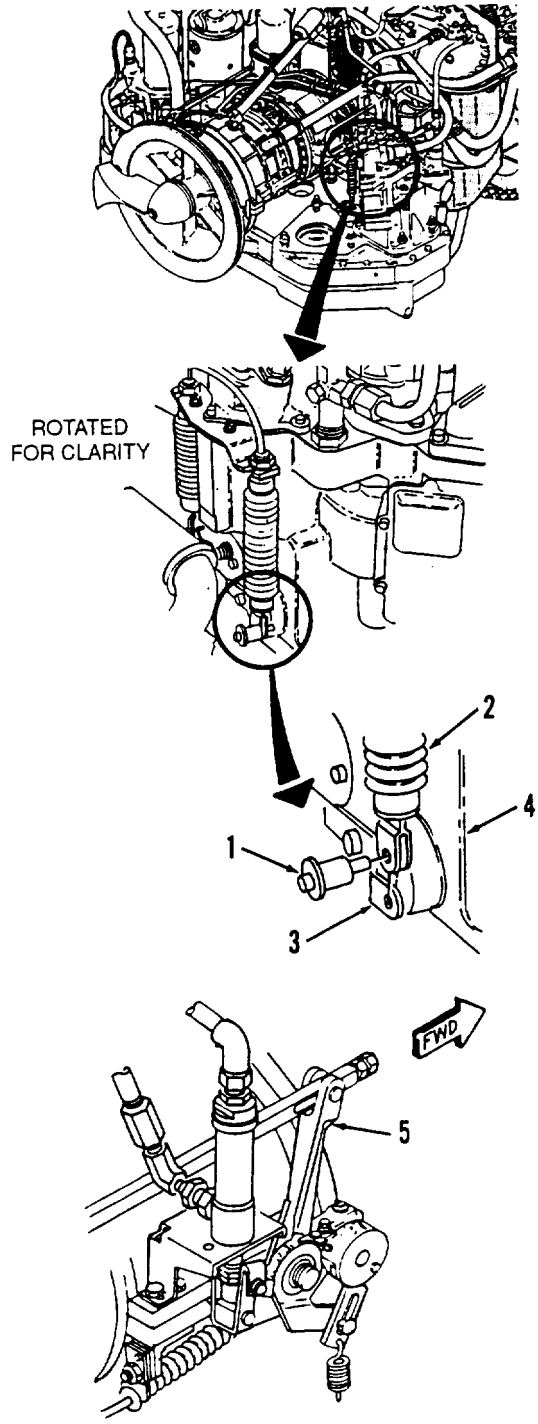
3 A. Remove quick-release pin (1) from feedback control (2) and lever (3) on EMFS (4).
B. Check quick-release pin (1) for damage or wear. Replace pin (1) If damaged or worn.
c. Check to see if feedback control (2) moves freely up and down when actuator level (5) is moved forward and rearward.

Does feedback control move freely?

YES — NO

A. Replace IGV feedback control assembly (TM 20-1).
B. Verify problem is solved.

CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTIN(3 - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(2) ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED.

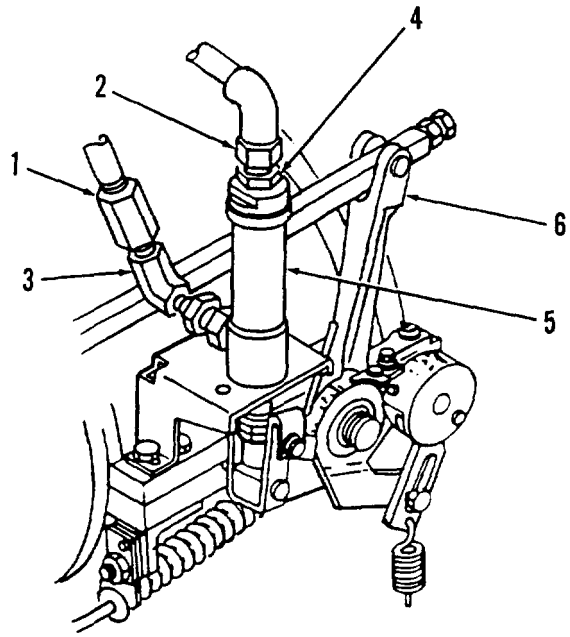
CONTINUED FROM STEP 3

4 . A. Disconnect tube nuts (1, 2) from fittings (3, 4) on IGV actuating cylinder (5).

WARNING

Actuating cylinder contains fuel. Fuel will squirt from fittings with strong force if IGV actuator lever is moved too fast. Hold rags over fittings and move IGV actuator lever slowly. Failure to do this may cause fuel to be splashed on personnel or eguipment.

B. Hold rags over fittings (3, 4), and move IGV actuator lever (6) slowly foward and rearward. While moving lever, check for binding.



Does IGV actuator lever move back and forth without binding?

YES — Go to step 7.

NO

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED

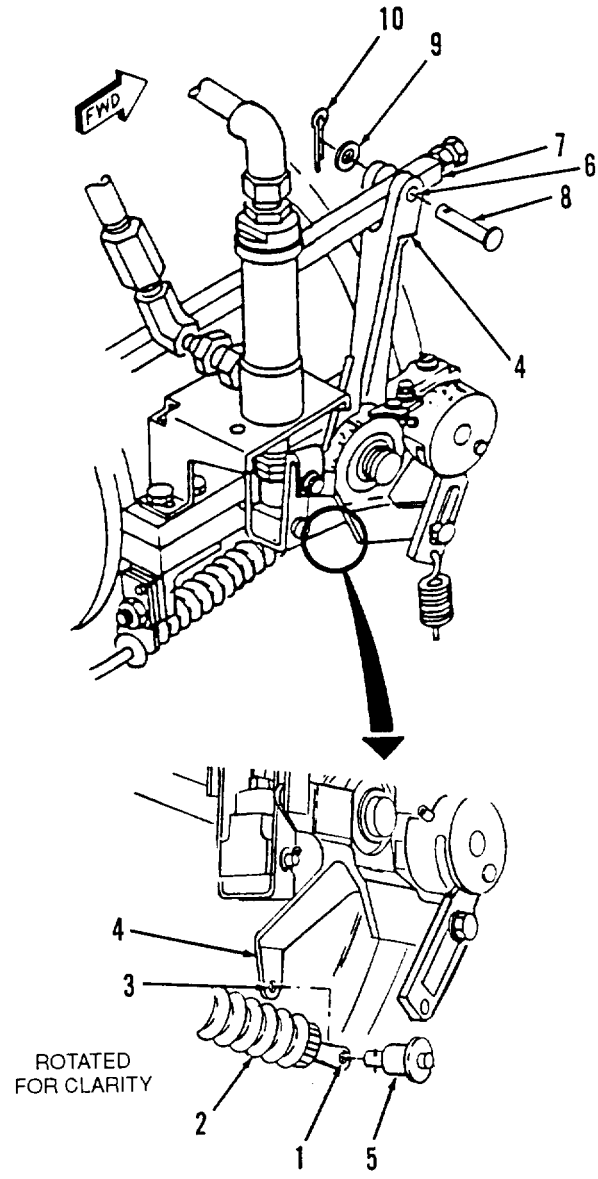
CONTINUED FROM STEP 4

5 A. Remove tube assembly (bottom of IGV actuating cylinder) (TM 20-1).
B. Remove tube assembly (top of IGV actuating cylinder (TM 20-1).
C. Check tube assemblies for clogging.

Are tube assemblies clogged?

YES — NO

A. Line up hole (1) in feedback control (2) with hole (3) in actuator lever (4). Put quick-release pin (5) in feedback control (2) and actuator lever (4).
B. Line up hole (6) in actuator lever (4) with slot in rod (7). Put pin (8) in actuator lever (4) and rod (7).
C. Put washer (9) on pin (8), and put new cotter pin (10) In pin (8).
D. Replace EMFS (TM 20-1).
E. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED

(2) ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED.

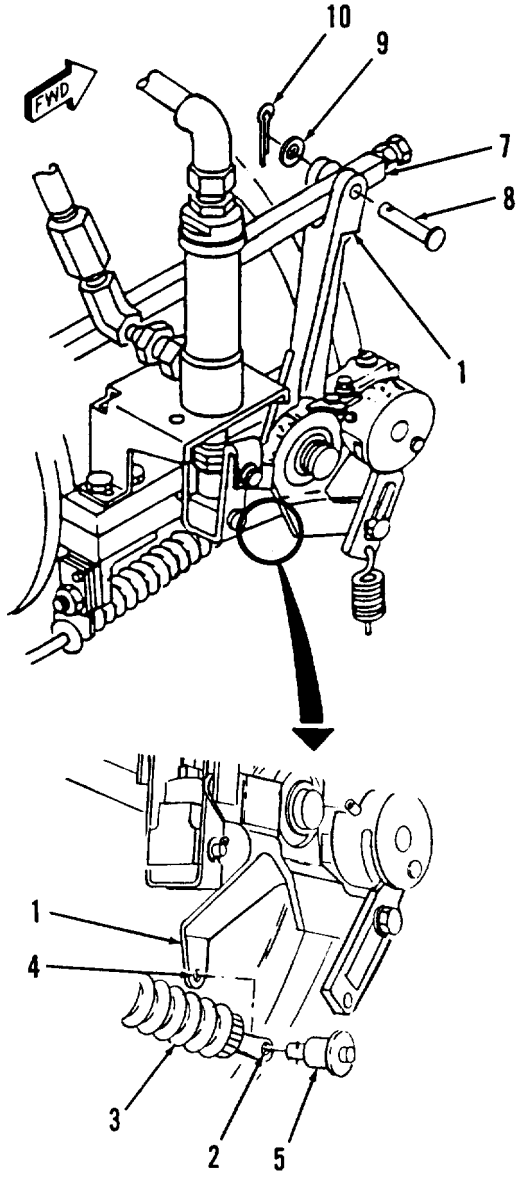
CONTINUED FROM STEP 5

6 A. Clean and install tube assembly (bottom of IGV actuator cylinder (TM 20-1).
B. Clean and Install tube assembly (top of IGV actuator cyllnder (TM 20-1).
C. Move IGV actuator lever (1) forward and rearward and feel for binding.

Does IGV actuator lever move back and forth without binding?

YES — NO

A. Line up hole (2) in feedback controi (3) with hole (4) in actuator lever (1). Put quick-release pln (5) in feedback control (3) and actuator lever (1).
B. Line up hole (6) in actuator lever (1) with slot in rod (7). Put pin (8) in actuator lever (1) and rod (7).
C. Put washer (9) on pin (8), and put new cotter pin (10) n pin (8). Replace EMFS (TM 20-1).
: : Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED

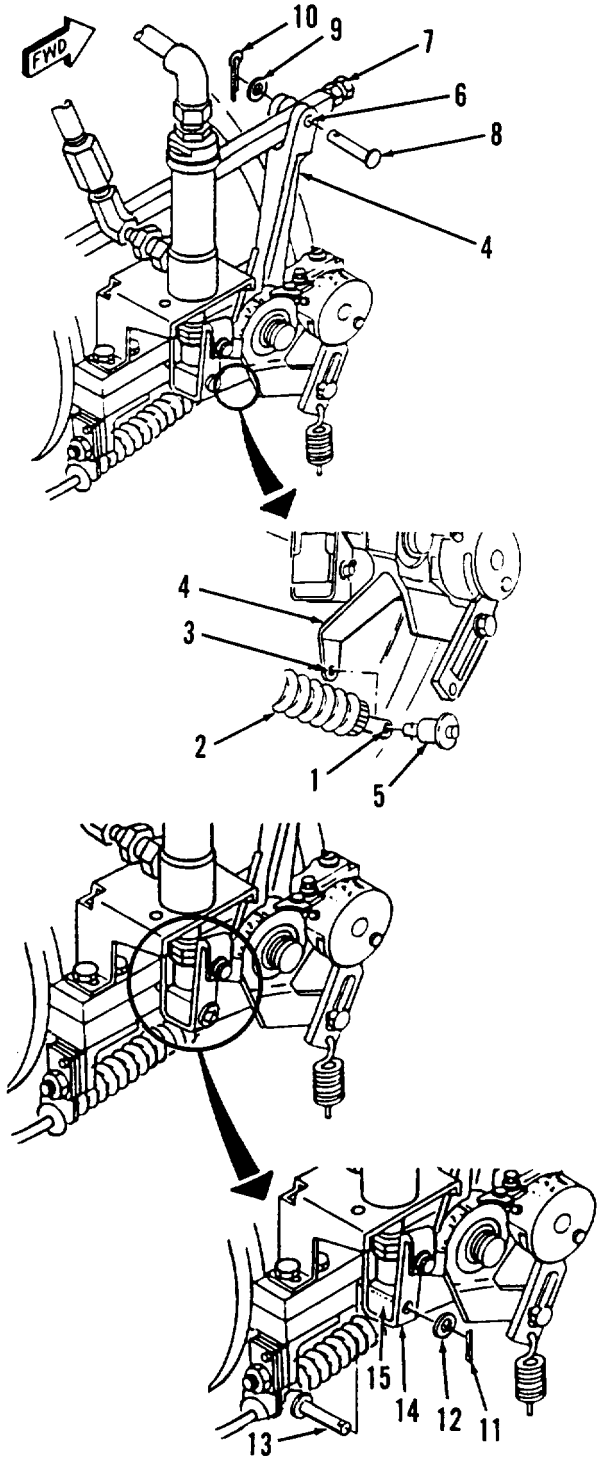
CONTINUED FROM STEP 6

A. Line up hole (1) in feedback control (2) with hole (3) in actuator lever f4). Put quick-release pm (5) in feedback control (2) and actuator lever (4).
B. Line up hole (6) in actuator lever (4) with slot in rod (7). Put pin (8) in actuator lever (4) and rod (7).
C. Put washer (9) on pin (8), and put new cotter pin (10) In pin (8).

7. Remove cotter pin (11), washer (12), and pm (13).
   B. Swing bracket (14) up and away from connector rod end (15).
   C. Move IGV actuator lever (4) forward and rearward and feel for binding.

Does IGV actuator lever move back and forth without binding?

CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(2) ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED.

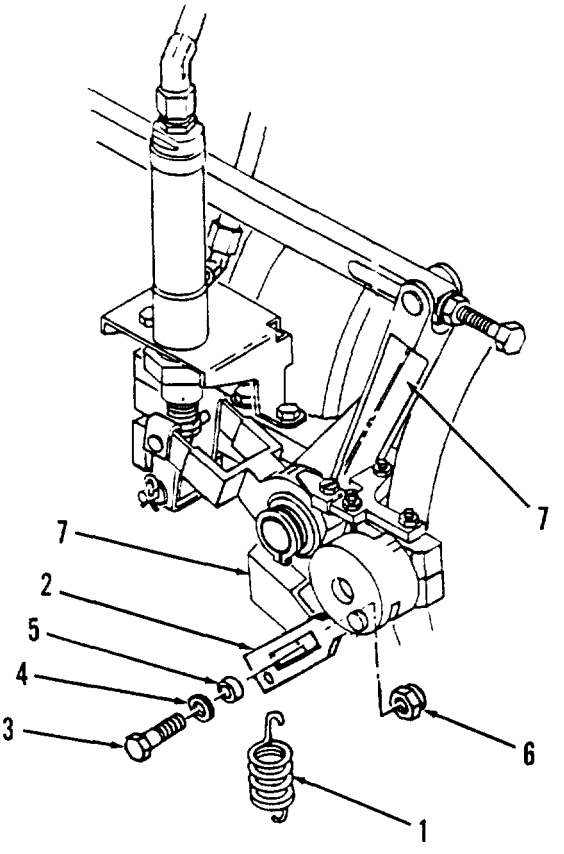
CONTINUED FROM STEP 7

NO — YES

YES:
A. Replace IGV actuator cylinder (TM 20-1).
B. Verify problem is solved.

8 A. Unhook spring (1) from link (2).
B. Remove bolt (3), washer (4), spacer (5) and self-locking nut (6) from link (2) and lever (7).
C. Move lever (7) forward and rearward, and feel for binding.

Does IGV actuator lever move back and forth without binding?



CONTINUED ON NEXT PAGE

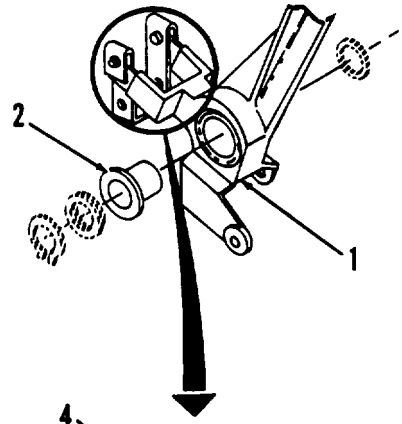
3-2. TROUBLESHOOTING - CONTINUED

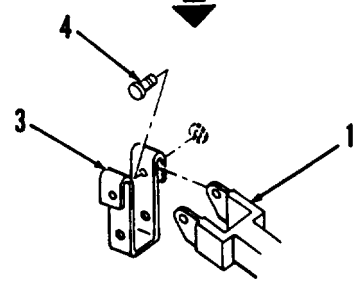
g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED

CONTINUED FROM STEP 8

YES — NO

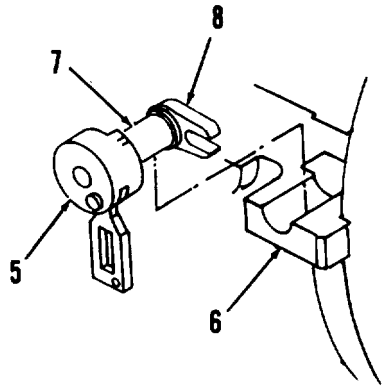
A. Remove bleed actuator assembly and IGV actuator link (TM 20-1).
B. Inspect IGV actuator lever (1) and bearing (2) for cracks, corrosion or wear. Replace faulty parts.
C. Inspect bracket (3) for bends, corrosion or worn holes. Replace bracket if faulty.
D. Inspect two pins (4) for wear. Replace pins (4) if faulty.
E. Install bleed actuator lever assembly and IGV actuator link (TM 20-1).
F. Verify problem is solved.





9 A. Remove low pressure compressor housing assembly (top half) (page 5-6).
B. Remove bellcrank, link and control (5) from lower housing (6).
C. Check to see if bushing (7) turns smoothly on inlet guide control (8).

Does bushing bind on control?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

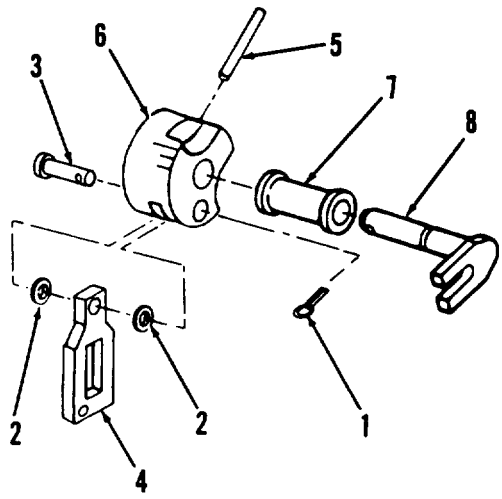
g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(2) ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED.

CONTINUED FROM STEP 9

YES — NO

A. Replace forward engine module (page 5-13).
B. Verify problem is solved.

Remove cotter pin (1), two washers (2), pin (3) and link (4).
Remove spring pin (5). If more than l/4-inch is exposed, use diagonal pliers. If less than 1/4-inch, use 3/32-inch punch.
Remove bellcrank (6), and bushing (7) from inlet guide control (8).
Inspect bellcrank (6), inlet guide control (8), and link (4) for worn holes, bends, or other. damage.
Replace faulty parts.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	ES-26. IGV SYSTEM BINDS WHEN IGV ACTUATOR LEVER IS MOVED BY HAND. - CONTINUED

CONTINUED FROM STEP 9

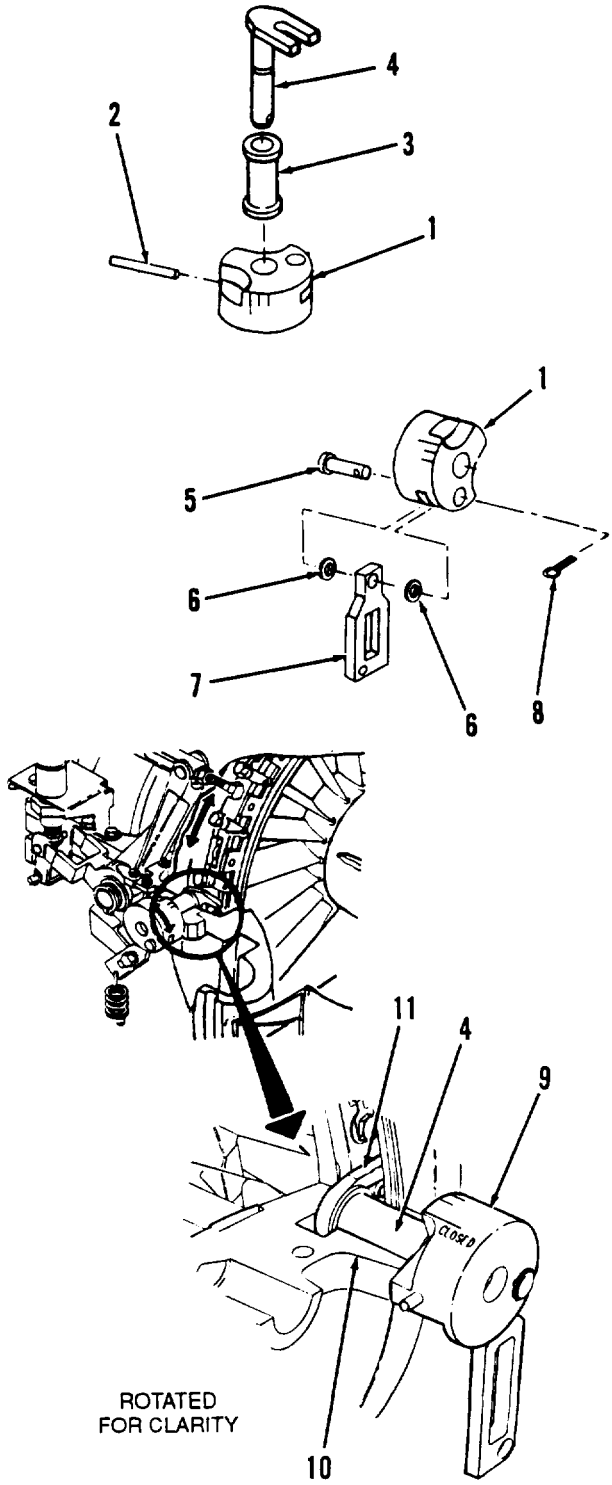
A. Place bellcrank (1) on flat surface. Start new spring pin (2) into bellcrank (1).
B. Put bushing (3) on inlet guide control (4), and place inlet guide control (4) Into bellcrank (1).

NOTE

When seated, spring pin (2) should extend about 1/4-inch out of bellcrank (1).

C. Use 3\32-inch punch to install spring pin (2) in bellcrank (1) and inlet guide control (4) until seated.
D. Install pin (5), two washers (6), link (7), and new cotter pin (8).
E. Install bellcrank, link and control (9) in lower housing (10), making sure that fork (11) of inlet guide control (4) is positioned around ball joint on IGV unison ring.
F. Install low pressure compressor housing assembly (top half) (page 5-8).
G. Verify problem is solved.

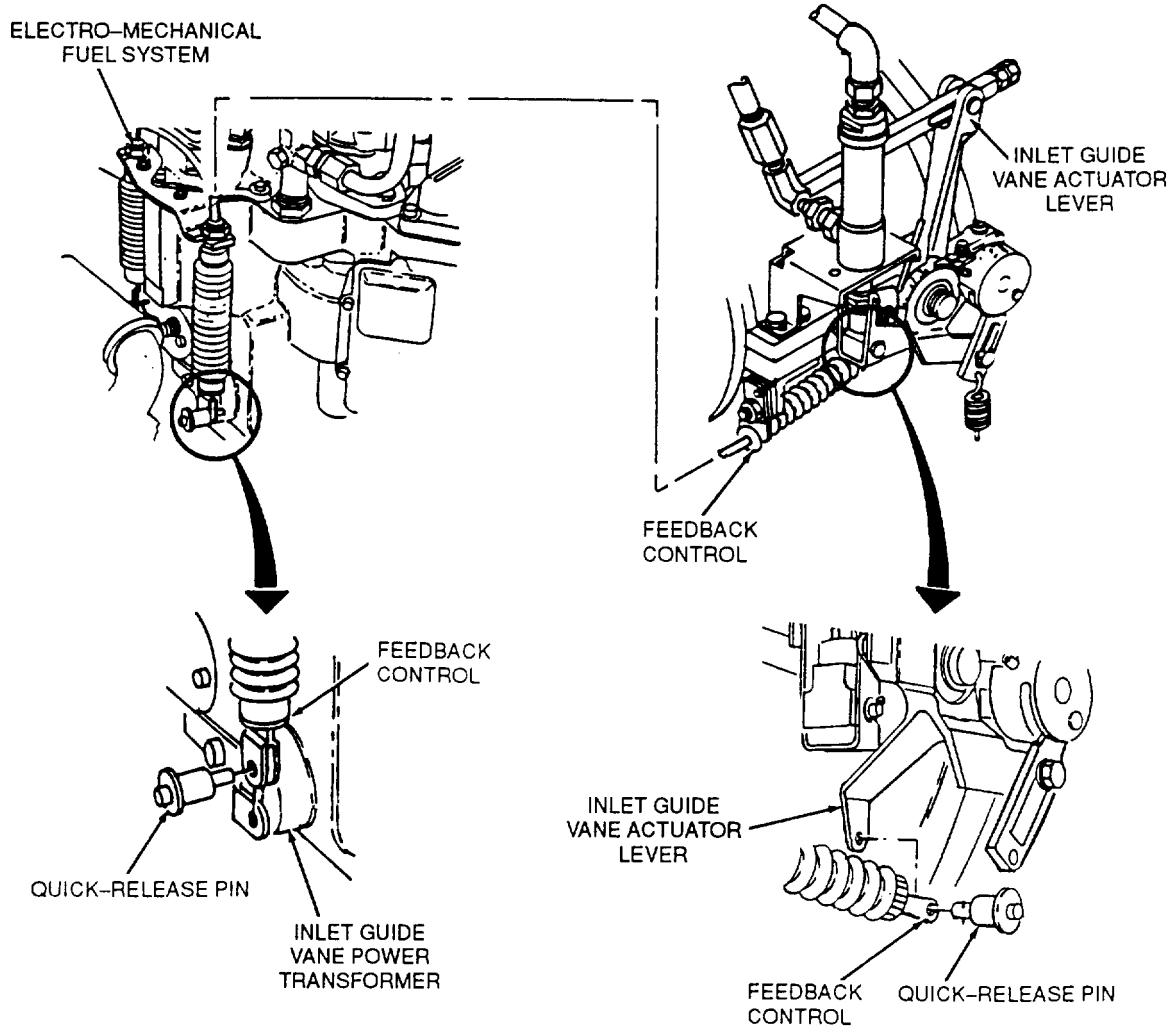
END OF TASK



3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(3) ES-27. LEVER ON ELECTRO-unmechanical FUEL SYSTEM (EMFS) DOES NOT MOVE WHEN IGV ACTUATOR LEVER IS MOVED.

This section contains troubleshooting to determine the reason the feedback lever on the EMFS does not move when the IGV actuator lever is moved. The IGV actuator lever is connected to the EMFS feedback lever through a feedback control (cable). The feedback control is connected to both levers with quick-release pins. Missing or improperly installed quick-release pins, a damaged or faulty feedback control, or a faulty IGV power transformer on the EMFS could be the reason the EMFS lever does not move when the IGV actuator lever is moved. The art on this page provides an overview of the affected parts. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(3) ES-27. LEVER ON ELECTRO-MECHANICAL FUEL SYSTEM (EMFS) DOES NOT MOVE WHEN IGV ACTUATOR LEVER IS MOVED. - CONTINUED

Tools:	References:
General mechanic's tool kit: automotive: (SC 5180-90-N26)	TM 20-1

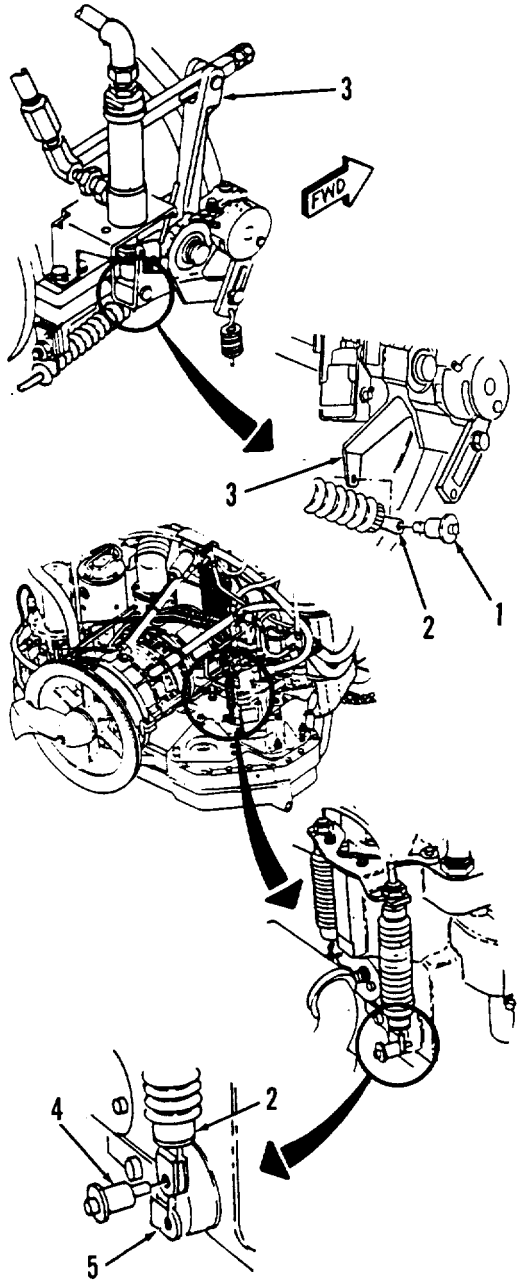
1 A. Check to see if quick-release pin (1) is installed in feedback control (2) and IGV actuator lever (3).
B. Check to see if quick-release pin (4) is installed in feedback control (2) and EMFS lever (5).

Are quick-release pins installed?

YES — NO

A. Install quick-release pins (1, 4).
B. Move IGV actuator lever (3) forward and rearward, and check if EMFS lever (5) moves.
C. If lever moves, verify problem is solved. If lever doesn't move, go to step 2.

CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTING - CONTINUED

g. INLET GUIDE VANE (IGV) SYSTEM - CONTINUED	(3) ES-27. LEVER ON ELECTRO-MECHANICAL FUEL SYSTEM (EMFS) DOES NOT MOVE WHEN IGV ACTUATOR LEVER IS MOVED. - CONTINUED

CONTINUED FROM STEP 1

2	A. Remove quick-release pin (1). B. Move IGV actuator lever (2) forward and rearward. and check if feedback control (3) moves freely up and down.

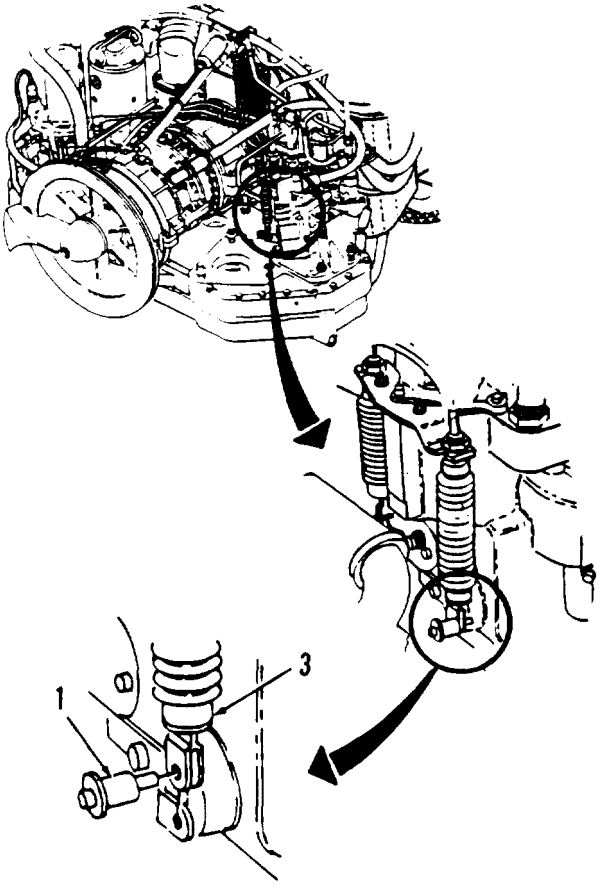
Does feedback control move freely up and down?

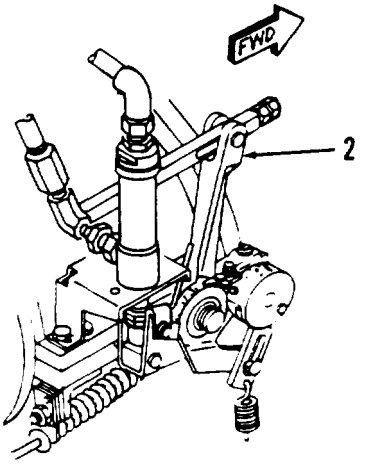
YES — NO

A. Replace IGV feedback control assembly (TM 20-1). B. Verify problem is solved.

Verify problem is solved.

END OF TASK

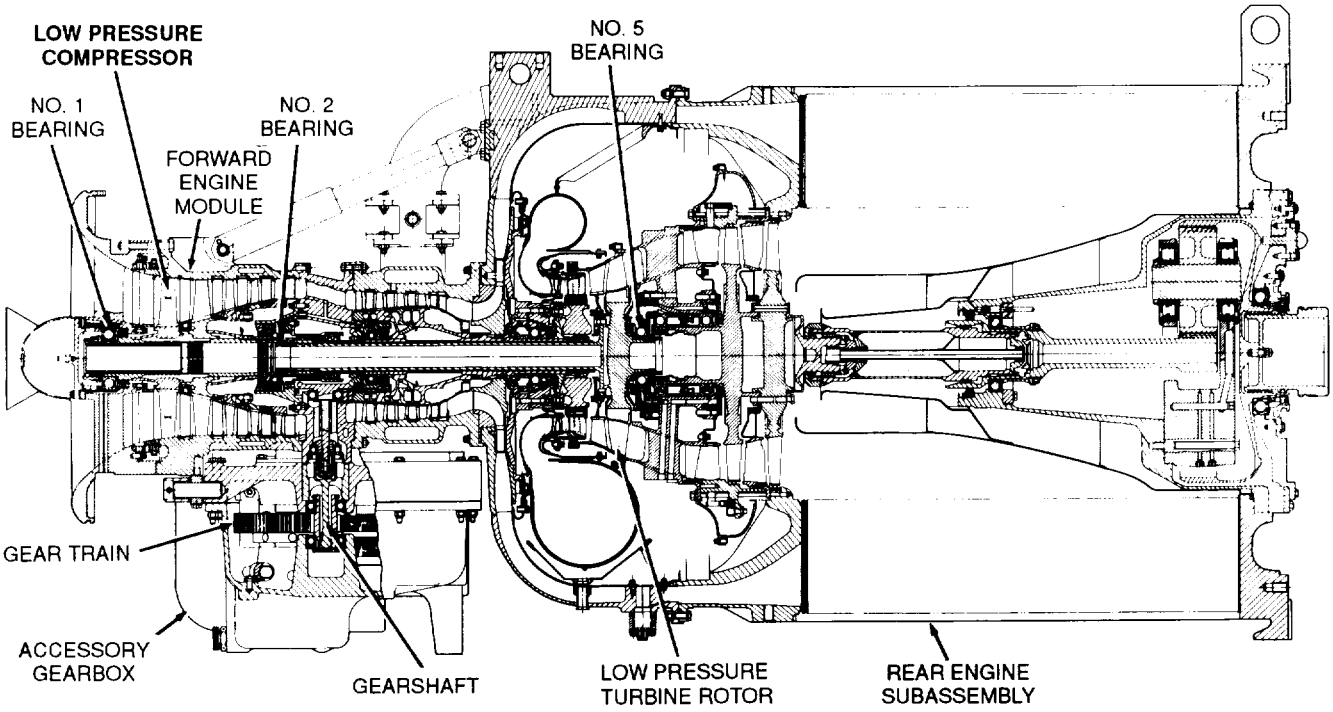




3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR	(1)	ES-28. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED.

This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearings in the forward engine module, or to the low pressure turbine rotor or position No 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The art on this page provides an overview of the low pressure compressor and low pressure turbine rotor system. Refer to this page along with in-text art while performing troubleshooting.



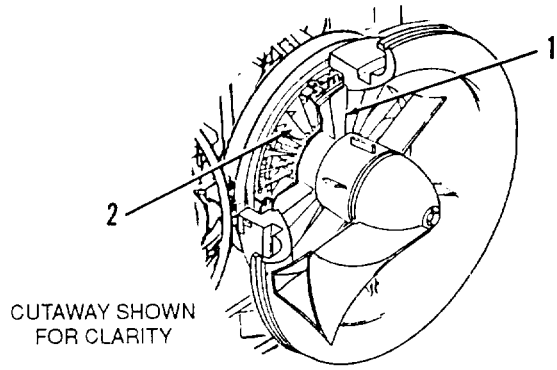
3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(1) ES-28. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

Tools:	Supplies:
General mechanic's tool kit: automotive (SC 5180-90-N26)	Wiping rag (Item 14, Appendix B)

1 Check inlet guide vanes (IGVs) (1) and first stage low pressure compressor blades (2) for foreign object damage (FOD), bends or damage that might cause rubbing or binding.

Are IGVs and first stage blades damaged enough to cause rubbing or binding?



NO — Go to step 4.

YES

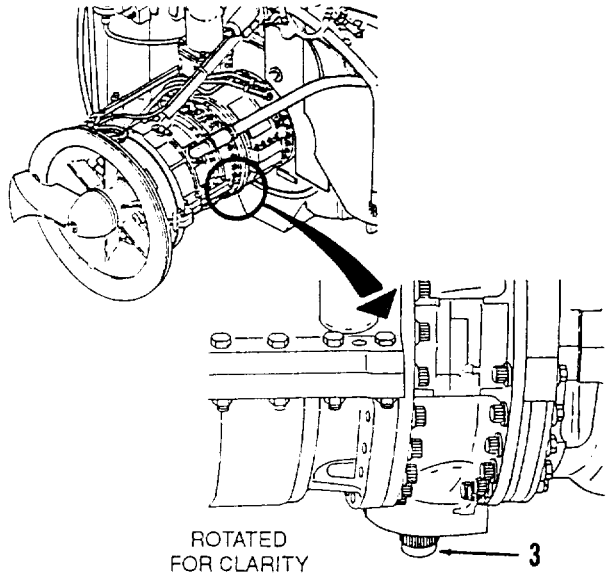
2 . A. Remove forward engine module (page 5-13).

WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

B. Turn low pressure compressor blades (2) by hand and high pressure compressor blades by turning spline coupling (3). Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(1)	ES-28. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Verify problem is solved.

3 **CAUTION**

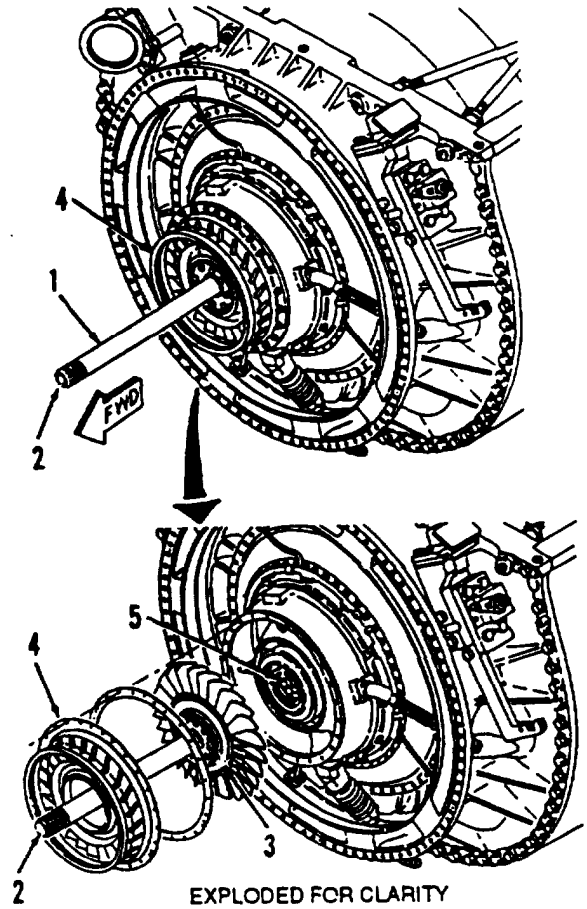
Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

A. Lift end (2) of shaft (1) slightly to center shaft (1). then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
B. Turn shaft (1), listen and feel for rubbing or binding.

Does shaft turn smoothly with no unusual noises?

NO — YES

A. Replace forward engine module (page 5-13).
B. Verify problem is solved.



EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(1)	ES-28. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 3

A. Salvage Gas Turbine Power Unit (page 6- 83).
B. Replace forward engine module (page 5-13).
C. Verify problem is solved.

FROM STEP 1

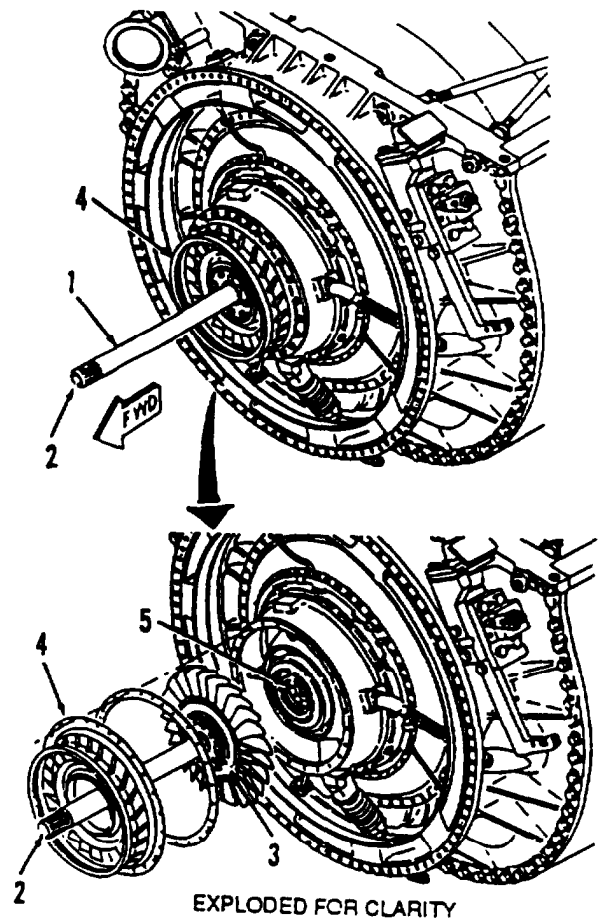
4 A. Remove forward engine module (page 5-13).

CAUTION

Extreme care should be taken when handling low pressure turbine rotors aft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

B. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
C. Turn shaft (1) listen and feel for rubbing or binding.

Does shaft turn smoothly with no unusual noises?

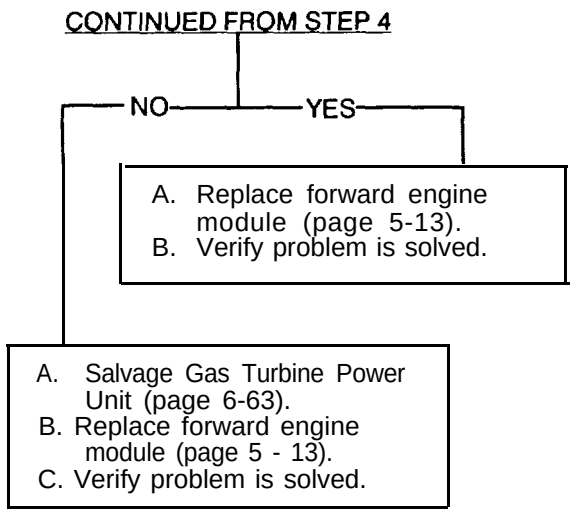


EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(1)	ES-28. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

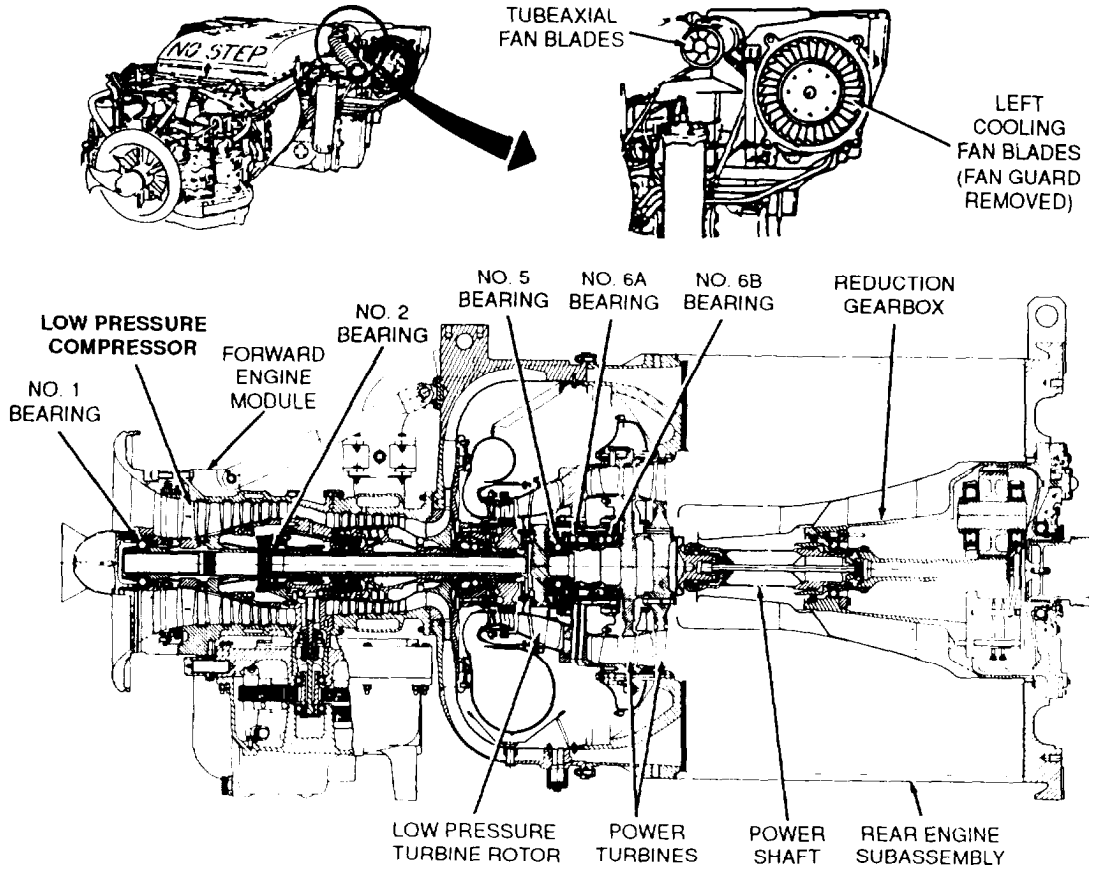


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(2) ES-29. LOW PRESSURE COMPRESSOR RUBS OR BINDS WREN TURNED BY RAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY BAND.

This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand, when rubbing or binding is also felt as the tubeaxial fan blades or left cooling fan blades are turned by hand. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The power turbine and reduction gearbox (RGB) are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing or RGB bearings and/or gears, binding will be felt when the tubeaxial fan blades or, left cooling, fan blades are turned by hand. The art on this page provides an overview of the systems described above. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(2) ES-29. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
AGB gear train handle (Item 42, Appendix D)

Supplies:
Wiping rag (Item 14, Appendix B)

References:
TM 20-1
TM 34-1

1. A. Remove accessory gearbox (AGB) module (page 7-6).
   B. Remove forward engine module (page 5-13).
   C. Remove RGB assembly (page 6-17).

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(2) ES-29. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

CONTINUED FROM STEP 1

2 **CAUTION**

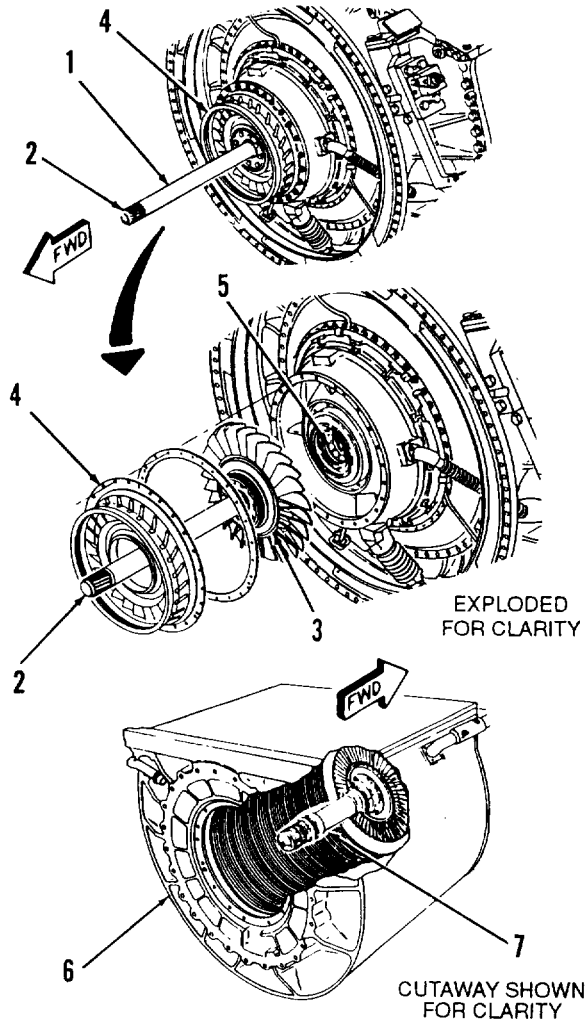
Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
B. Turn shaft (1), llsten and feel for rubbing or binding.
C. Check rotation of power turbine in rear engine subassembly (6) by turning shouldered shaft (7) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Do both shafts turn smoothly with no unusual noises?

NO — YES

Go to step 5



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

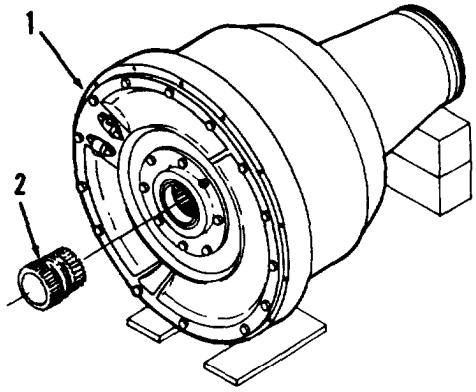
h. LOW PRESSURE COMPRESSOR - CONTINUED	(2) ES-29. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND: - CONTINUED

CONTINUED FROM STEP 2

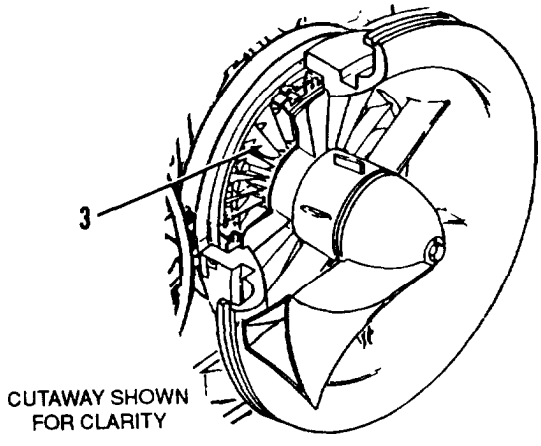
3	Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.
	Does shaft turn smoothly with no unusual noises?

NO — Go to step 7.

YES



4	**WARNING** Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor. Turn low pressure compressor blades (3) by hand. Listen and feel for rubbing or binding.
	Does low pressure compressor turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

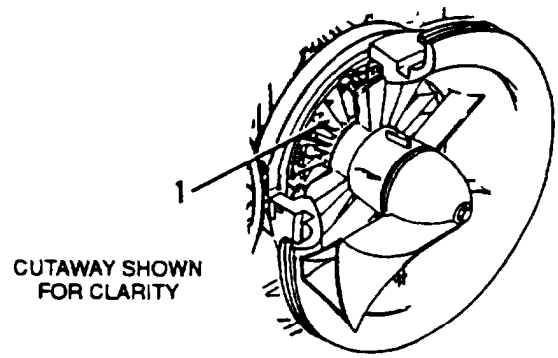
h. LOW PRESSURE COMPRESSOR - CONTINUED	(2)	ES-29. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

CONTINUED FROM STEP 4

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Replace engine oil pump (TM 20-1).
D. Verify problem is solved.

A. Replace engine assembly (TM 34-1).
B. Verify problem is solved.



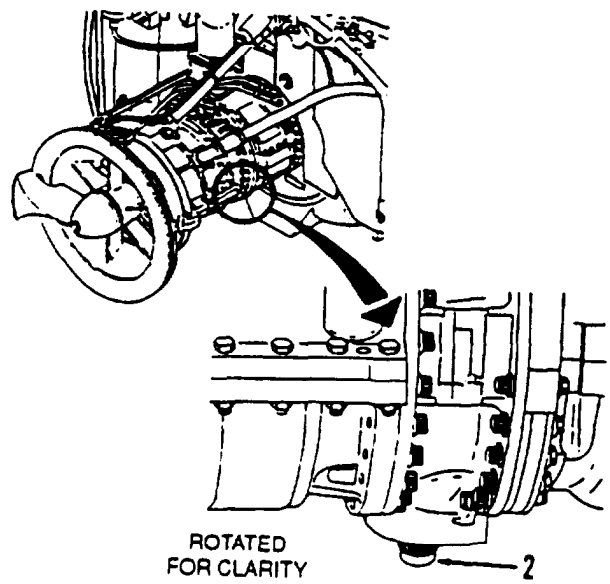
FROM STEP 2

5 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning splined coupling (2) in both directions. Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(2)	ES-29. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

CONTINUED FROM STEP 5

NO — YES

Go to step 8.

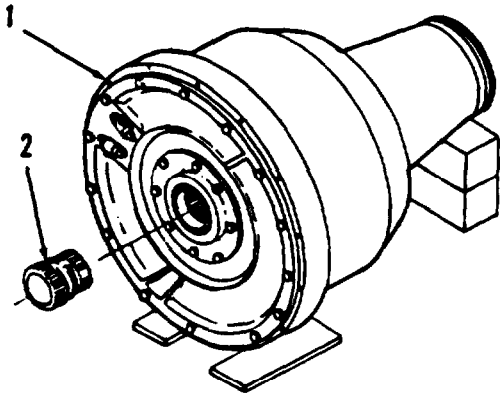
6 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

NO — YES

A. Replace forward engine module (page 5-13).
B. Replace engine oil pump (TM 20-1).
C. Install RGB assembly (page 6-19).
D. Verify problem is solved.

A. Replace number 10 bearing (page 6-52).
B. Replace forward engine module (page 5-13).
C. Replace engine oil pump (TM 20-1).
D. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(2)	ES-29. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

FROM STEP 3

7 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

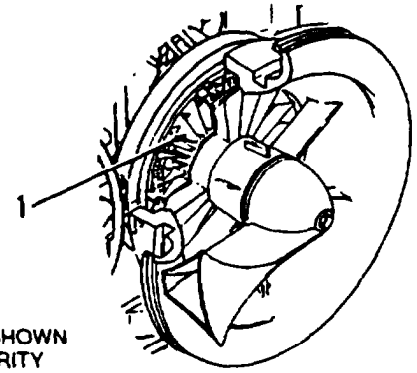
Turn low pressure compressor blades (1) by hand and high pressure compressor blades b turning splined coupling (2) in both directions. Listen and feel for rubbing or binding.

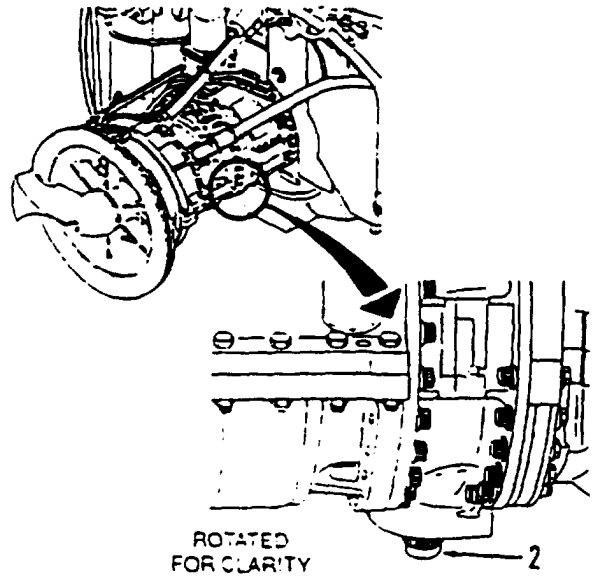
Do compressors turn smoothly with no unusual noises?

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace engine oil pump (TM 20-1).
C. Verify problem is solved.

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace forward engine module (page 5 - 13).
C. Replace engine oil pump (TM 20-1).
D. Verify problem is solved.





CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(2)	ES-29. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. - CONTINUED

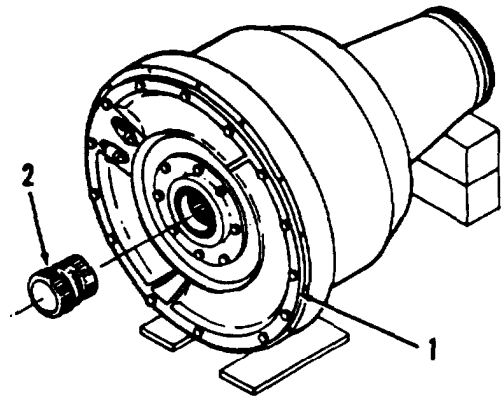
FROM STEP 5

8 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

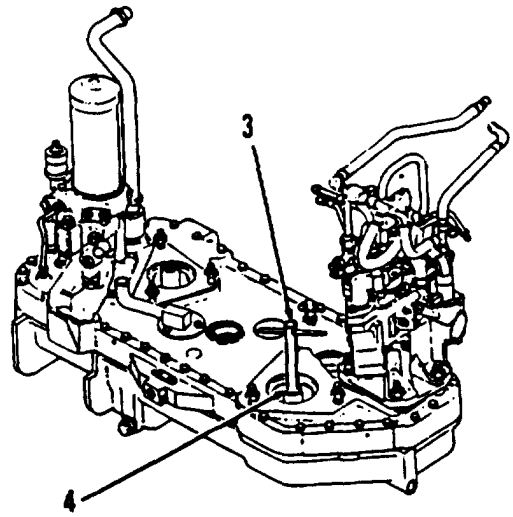
NO — YES

A. Replace number 10 bearing (page 6-52).
B. Replace engine oil pump (TM 20-1).
C. Verify problem is solved.



9 A. Put handle (3) in main hydraulic pump drive gear assembly (4).
B. Check rotation of AGB gears by turning handle (3) clockwise. Handle should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does handle turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(2) ES-29. LOW PRESSURE COMPRESSOR RUBS OR BINDS WREN TURNED BY RAND AND RUBBING OR BINDING IS FELT WREN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY BAND. --CONTINUED

CONTINUED FROM STEP 9

YES

A. Install RGB assembly (page 6-19).
B. Install forward engine module (page 5-18).
C. Install AGB module (page 7-12).
D. Verify problem is solved.

NO

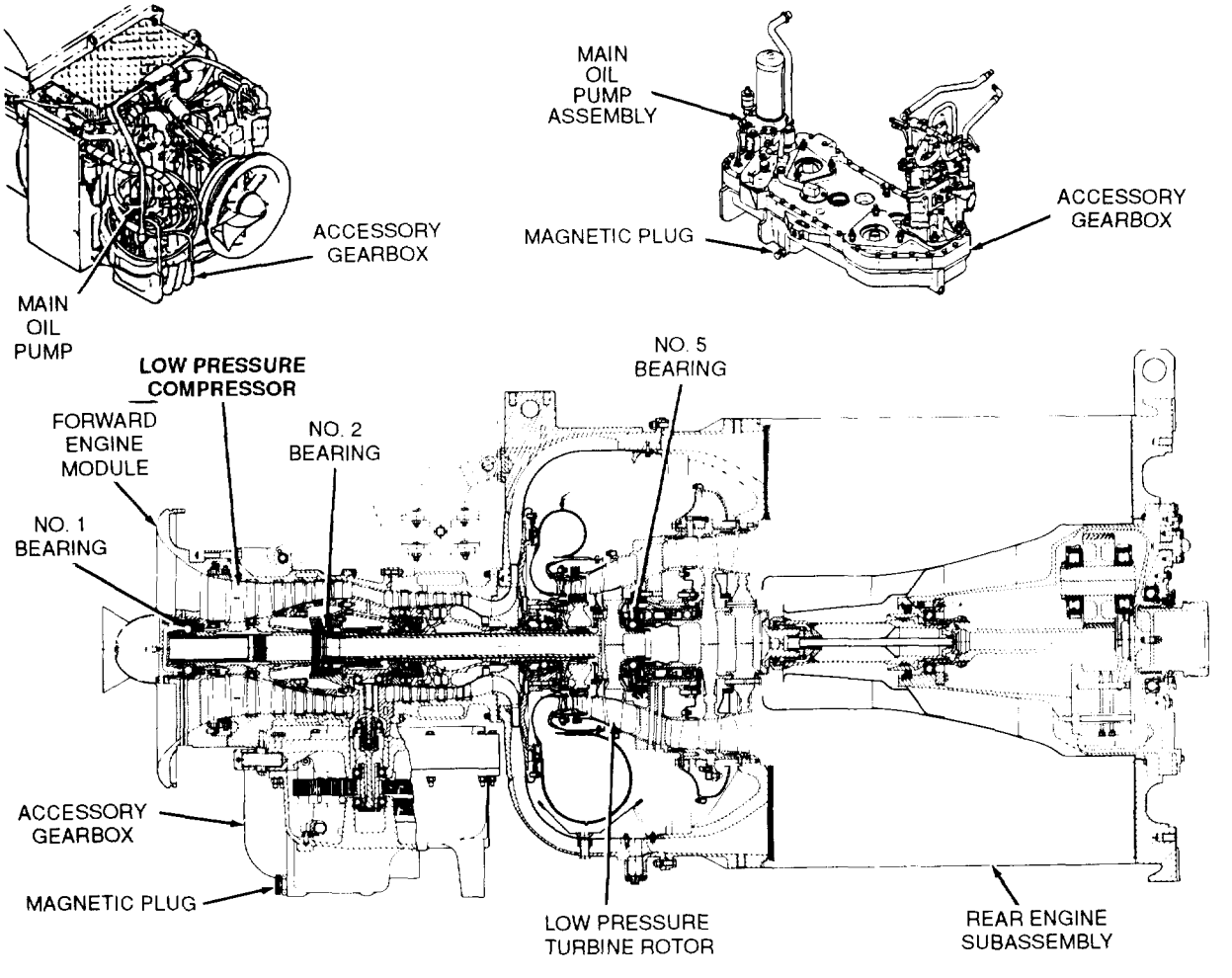
A. Clean AGB (page 7-46).
B. Replace engine oil pump (TM 20-1).
C. Install RGB assembly (page 6-19).
D. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

h.	LOW PRESSURE COMPRESSOR - CONTINUED	(3) ES-30. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF THE ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand, when more than one half of the AGB magnetic plug 1s covered with metal chips. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The AGB acts as an oil sump to collect oil which is scavenged from bearings in the forward engine module and rear engine subassembly. The main oil pump pumps the hot oil from the sump to the engine oil cooler. The art on this page provides an overview of the *system* described above. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(3) ES-30. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF THE ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26)	Supplies: Wiping rag (Item 14, Appendix B) References: TM 20-1

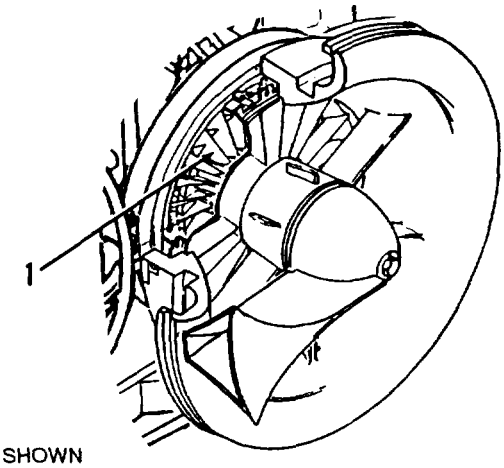
1 A. Remove forward engine module (page 5-13).

WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

B. Turn low pressure compressor blades (1) by hand. Listen and feel for rubbing or binding.

Does low pressure compressor turn smoothly with no unusual noises?



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(3)	ES-30. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF THE ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean AGB (page 7-46).
C. Replace oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

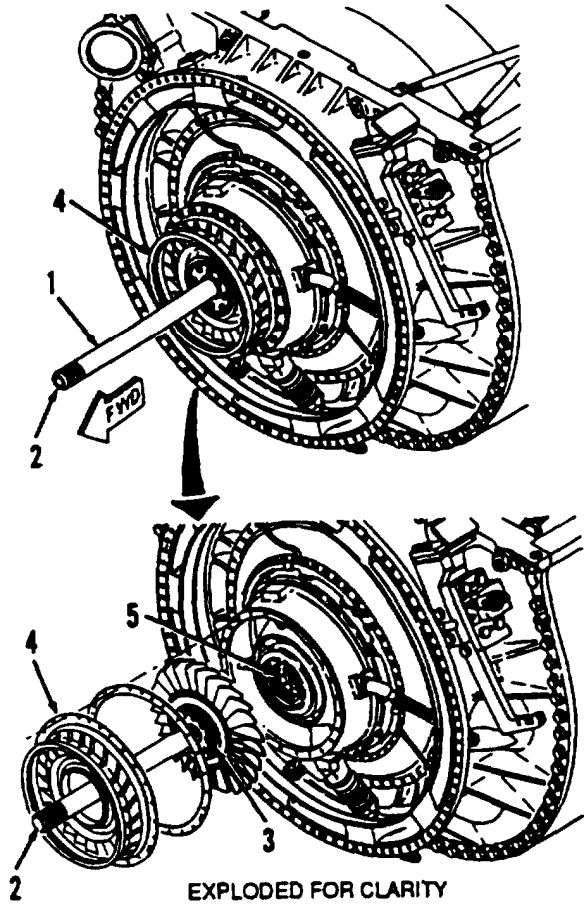
2

CAUTION

Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
B. Turn shaft (1), listen and feel for rubbing or binding.

Does shaft turn smoothly with no unusual noises?



EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(3)	ES-30 LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF THE ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

NO

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace forward engine module (page 5-13).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

YES

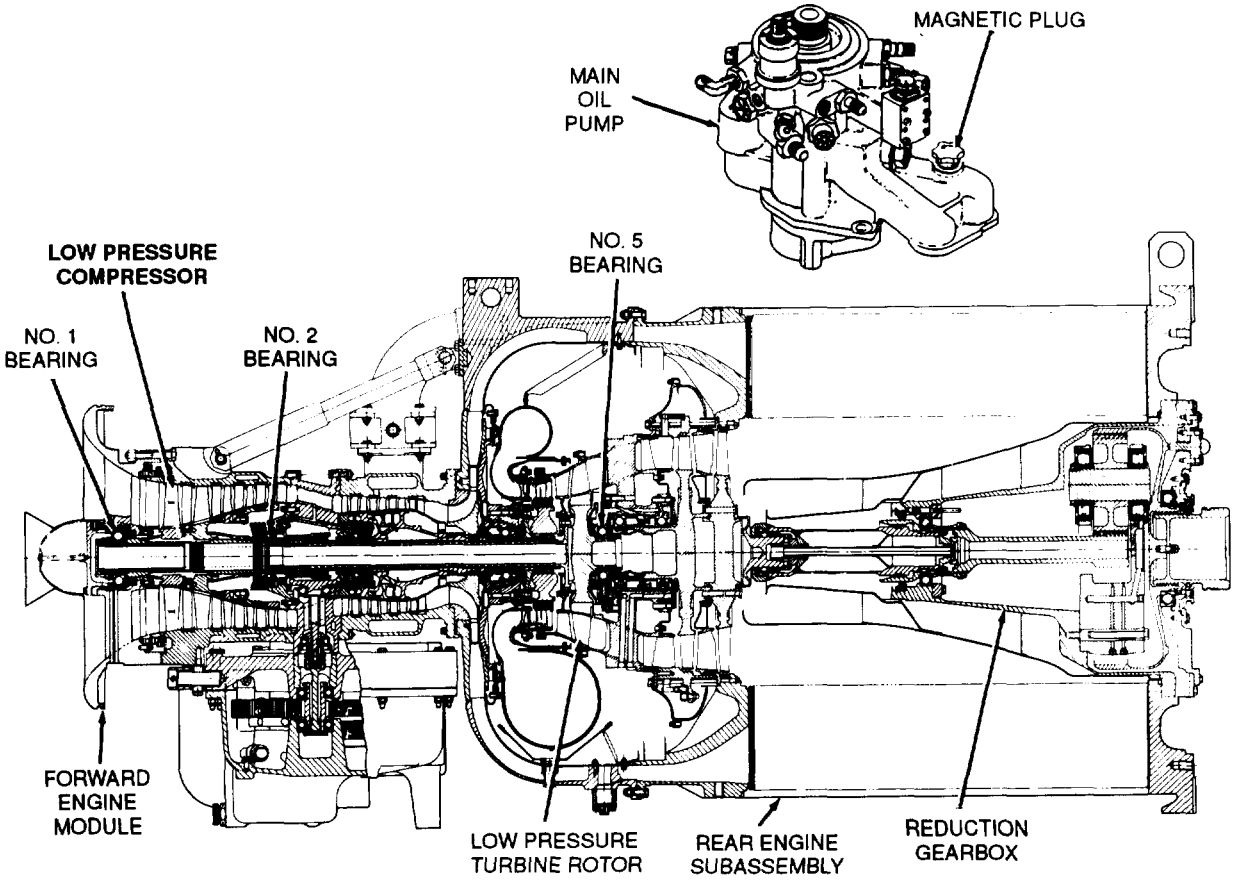
A. Replace forward engine module (page 5-13).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(4) ES-31. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand, when more than one half of the main oil pump magnetic plug is covered with metal chips. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The reduction gearbox (RGB) oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. These two systems are totally independent of each other. The symptoms described above indicate two separate failures. The art on this page provides an overview of the systems described above. Refer to this page along with in-text art while performing troubleshooting.



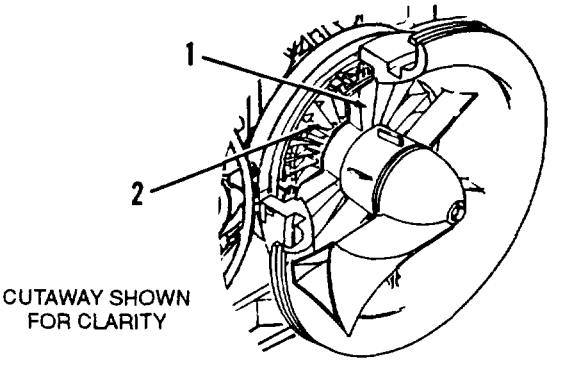
3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(4) ES-31. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26)	Supplies: Wiping rag (Item 14, Appendjx B) References: TM 20-1 TM 34-1

1 Check inlet guide vanes (IGVs) (1) and first stage compressor blades (2) for foreign object damage (FOD), bends or other damage that might cause rubbing or binding.

Are IGVs and first stage blades damaged enough to cause rubbing or binding?



NO

Go to step 4.

YES

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(4)	ES-31. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

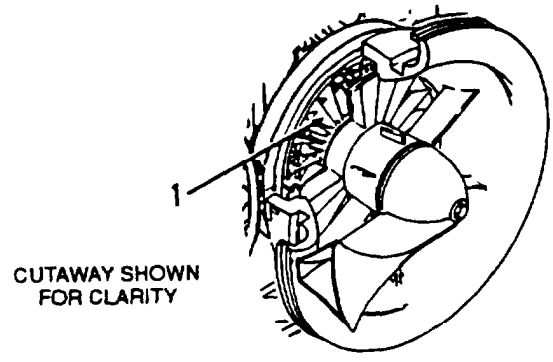
2 A. Remove forward engine module (page 5-13).

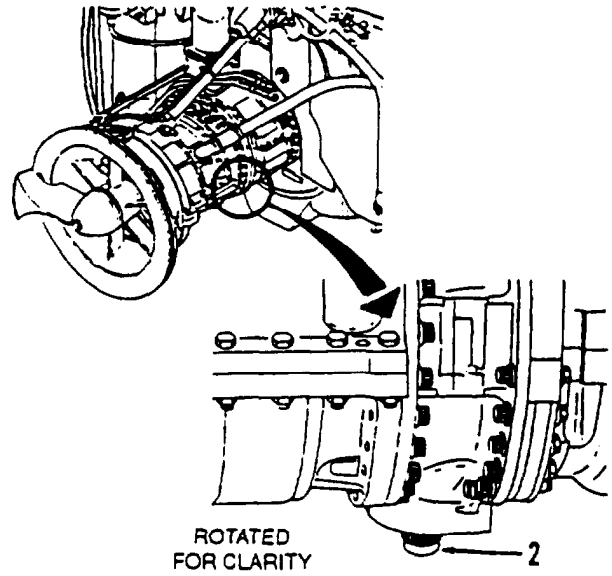
WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

B. Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning splined coupling (2) in both directions. Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?





NO — YES

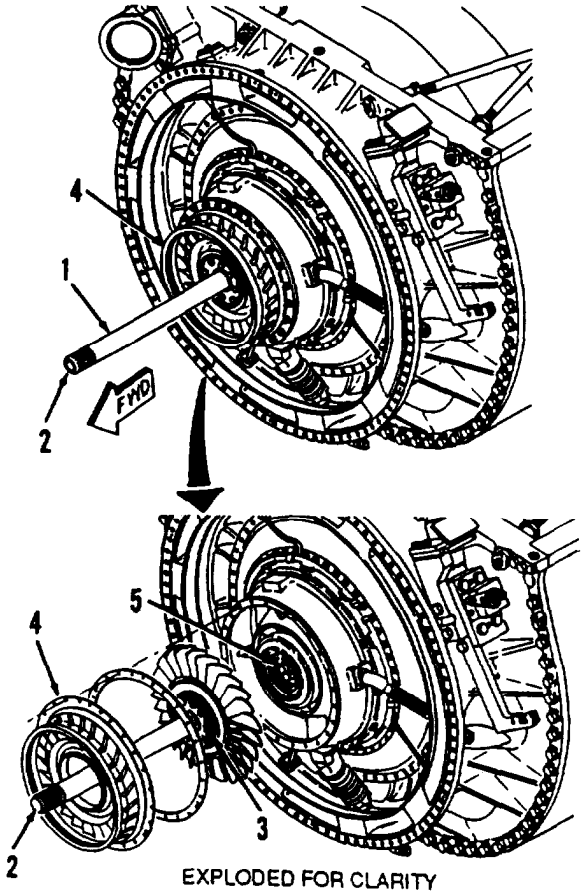
A. Salvage Gas Turbine Power Unit (pa e 6-63).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED	
h . LOW PRESSURE COMPRESSOR - CONTINUED	(4) ES-31. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF RAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

3	CAUTION
	Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal. A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle 4) and to load No. 5 bearing (5). B. Turn shaft (1), listen and feel for rubbing or binding.
Does shaft turn smoothly with no unusual noises?	



EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(4) ES-31. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 3

NO — YES

A. Replace forward engine module (page 5-13).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. cooler and generator lines (TM 20-1).
E. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(4) ES-31. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

FROM STEP 1

4 A. Remove forward engine module (page 5-13).

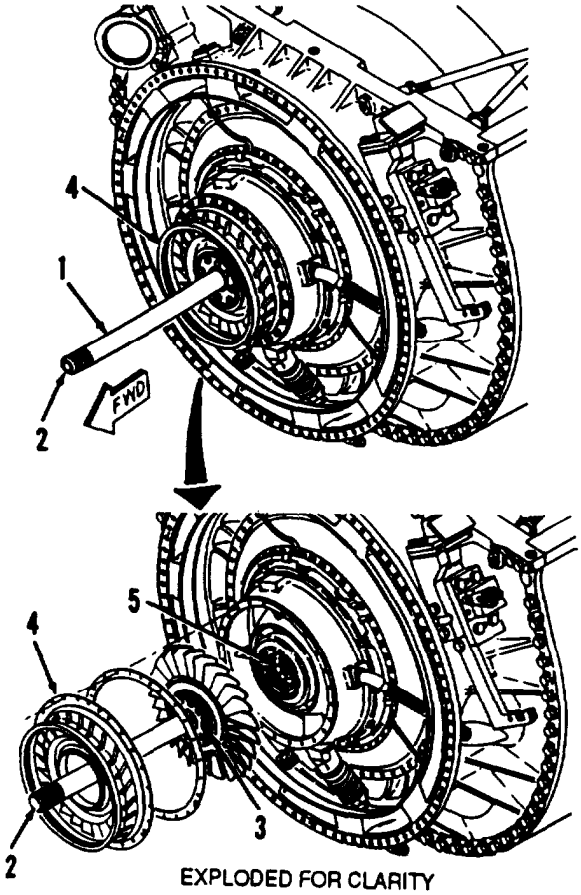
CAUTION

Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

B. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).

C. Turn shaft (1), listen and feel for rubbing or binding.

Does shaft turn smoothly with no unusual noises?



EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED		
h. LOW PRESSURE COMPRESSOR - CONTINUED	(4)	ES-31. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 4

NO — YES

A. Replace forward engine module page 5-13).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

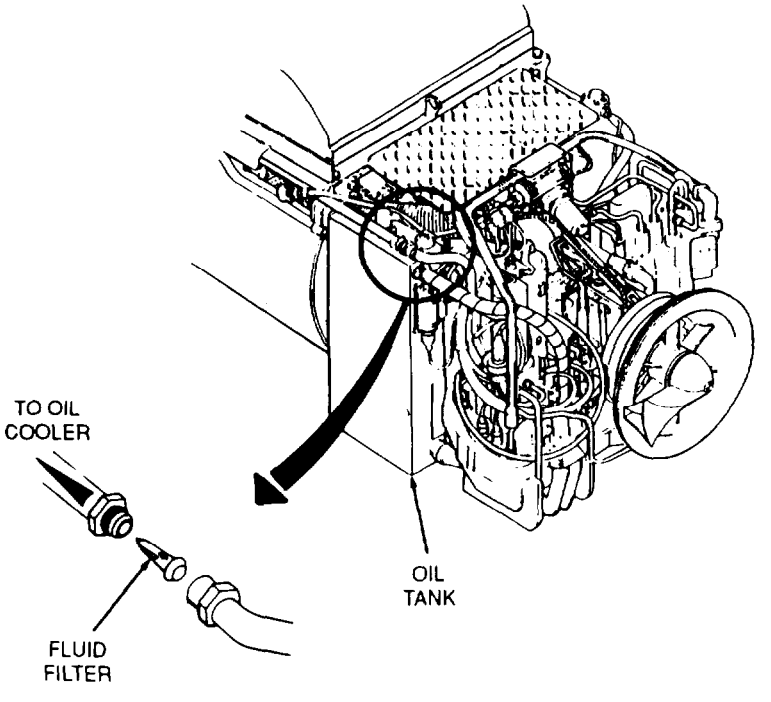
A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. lean cooler and generator lines (TM 20-1).
E. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

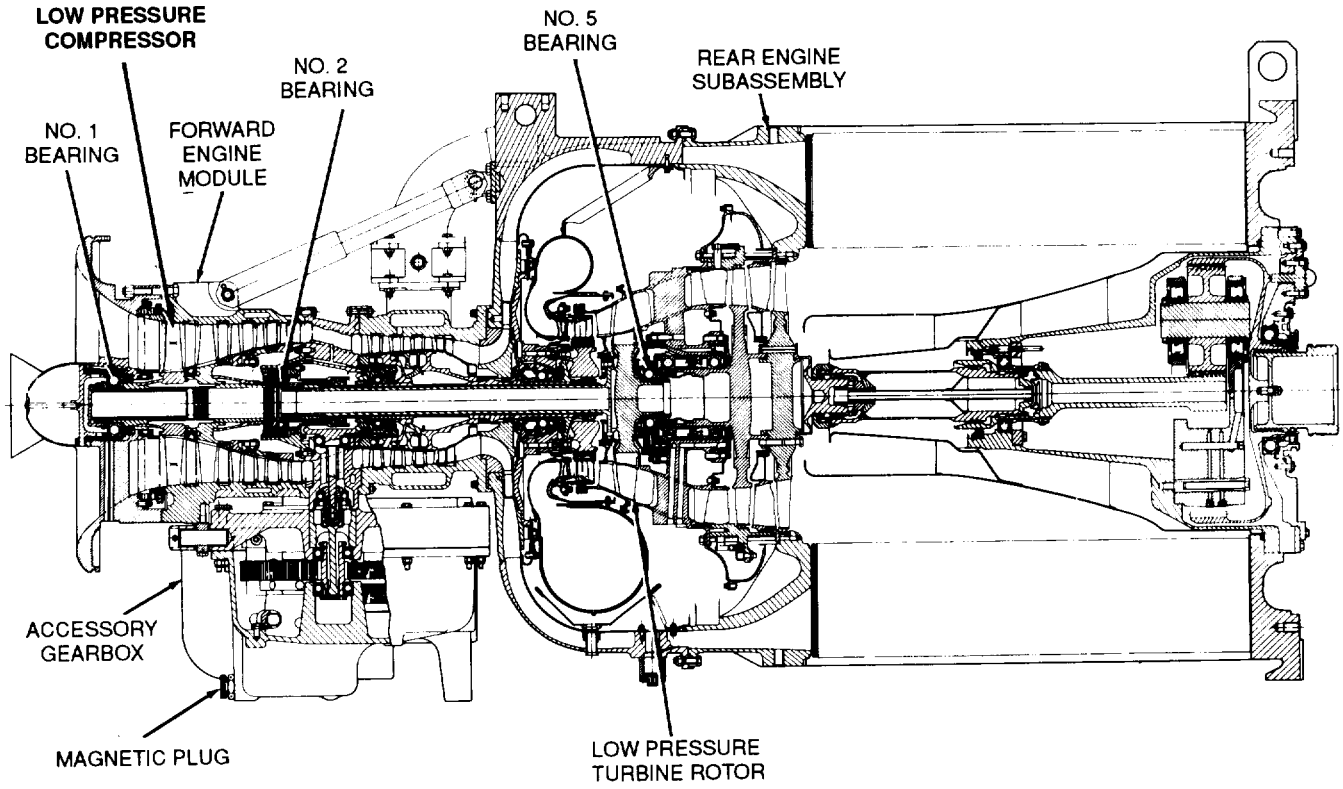
h . LOW PRESSURE COMPRESSOR - CONTINUED	(5) ES-32. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.

This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand, when there are metal chips in the oil pump to oil cooler fluid filter. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The lubrication system delivers hot oil, which is scavenged from bearing packages throughout the engine, through a fluid filter to the engine oil cooler. The cooled oil is then returned to the oil tank. Whenever metal chips are generated, the fluid filter will catch and retain most of the chips. Based on the above description, it would be logical to assume that position number 1, 2 or 5 bearings may be faulty. The accessory gearbox (AGB) magnetic plug should also be more than one half covered with metal chips unless it was previously wiped clean. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(5) ES-32. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

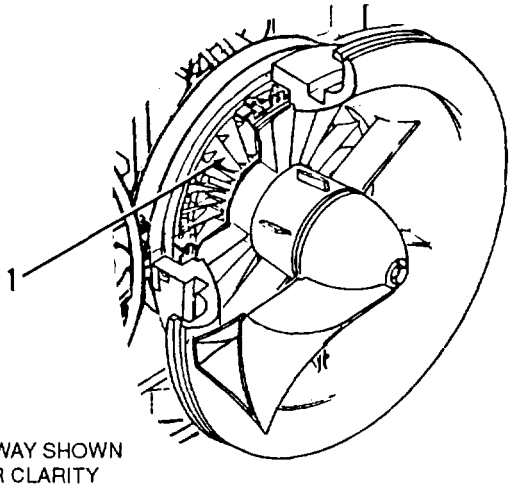


3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(5) ES-32. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26)	Supplies: Wiping rag (Item 14, Appendix B) References: TM 20-1

1	A. Remove forward engine module (page 5-13). **WARNING** Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor. B. Turn low pressure compressor blades (1) by hand. Listen and feel for rubbing or binding.
Does low pressure compressor turn smoothly with no unusual noises?	



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(5) ES-32. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 1

NO — YES

A. Salvage Gas Turbine Power Unit (pa e 6-63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

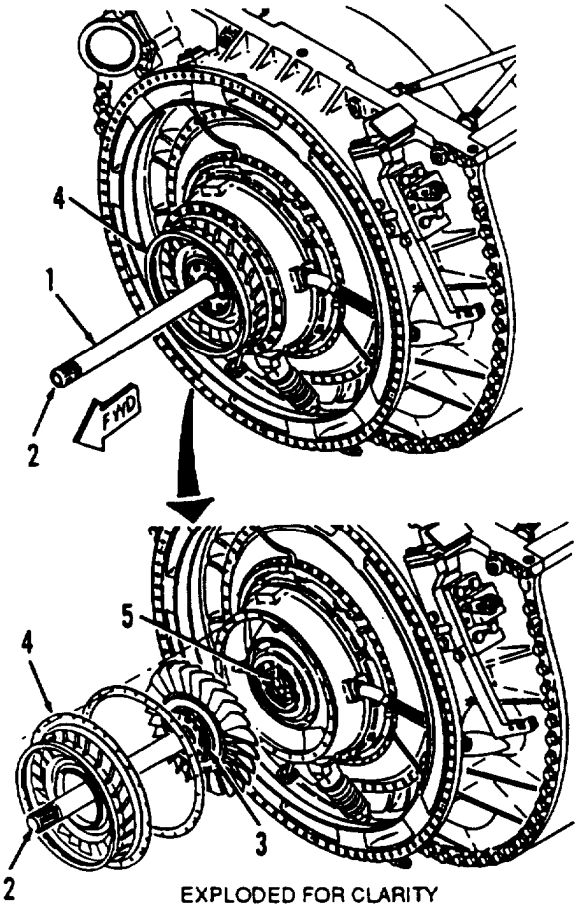
2

CAUTION

Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
B. Turn shaft (1), listen and eel for rubbing or binding.

Does shaft turn smoothly with no unusual noises?



EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(5)	ES-32. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Replace foward engine module (page 5-13).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

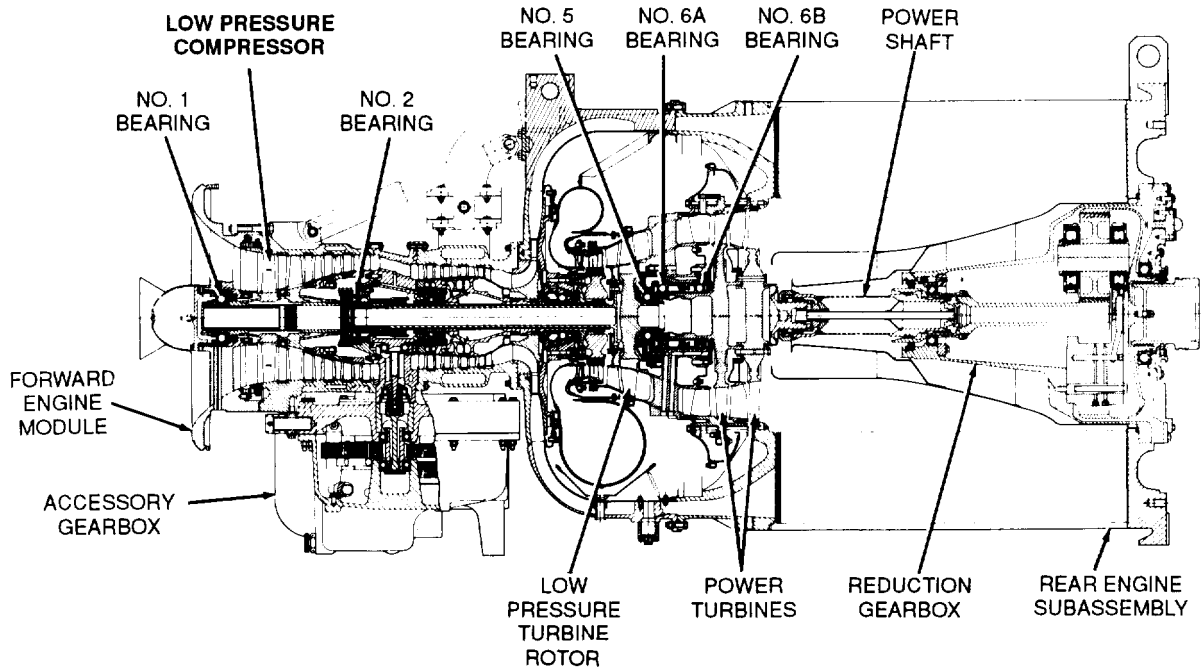
A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace forward engine module (page 5-13).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator TM 20-1)
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

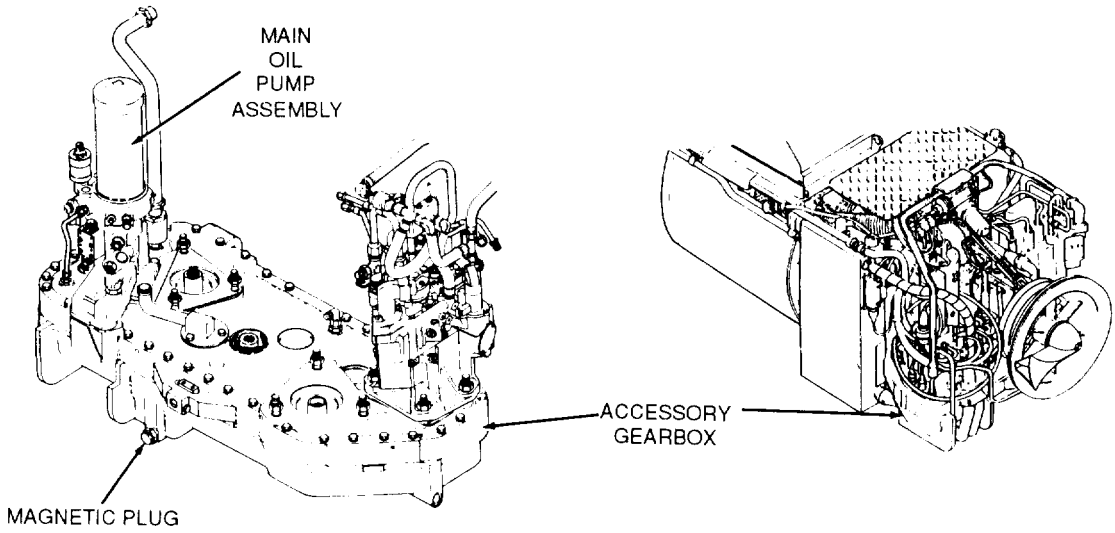
h. LOW PRESSURE COMPRESSOR - CONTINUED	(6) ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF THE ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

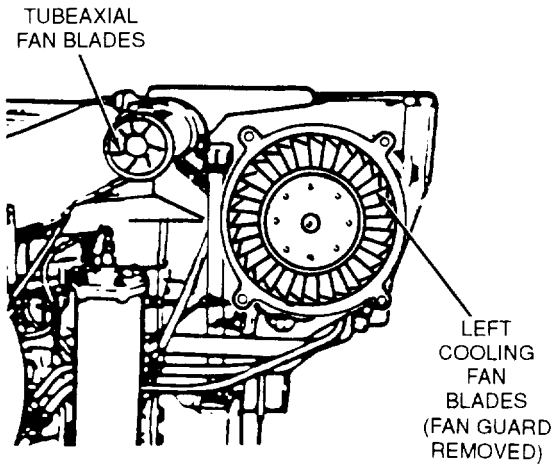
This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand, when rubbing or binding is also felt when the tubeaxial fan blades or left cooling fan blades are turned by hand, and more than one half of the AGB magnetic plug is covered with metal chips. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The power turbine and reduction gearbox (RGB) are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB gearbox bearings and/or gears, bindng will be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The AGB acts as an oil sump to collect oil which is scavenged from bearings in the forward engine module and rear engine subassembly. The main oil pump pumps the hot oil from the sump to the engine oil cooler. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(6) ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED





3-3. TROUBLESHOOTING - CONTINUED

h.	LOW PRESSURE COMPRESSOR - CONTINUED	(6) ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
AGB gear train handle (Item 42, Appendix D)

Supplies:
Wiping rag (Item 14, Appendix B)

References:
TM 20-1
TM 34-1

1 A. Remove AGB module (page 7-6).
B. Remove forward engine module (page 5-13).
C. Remove RGB assembly (page 6-17).

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(6) ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

2 **CAUTION**

Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

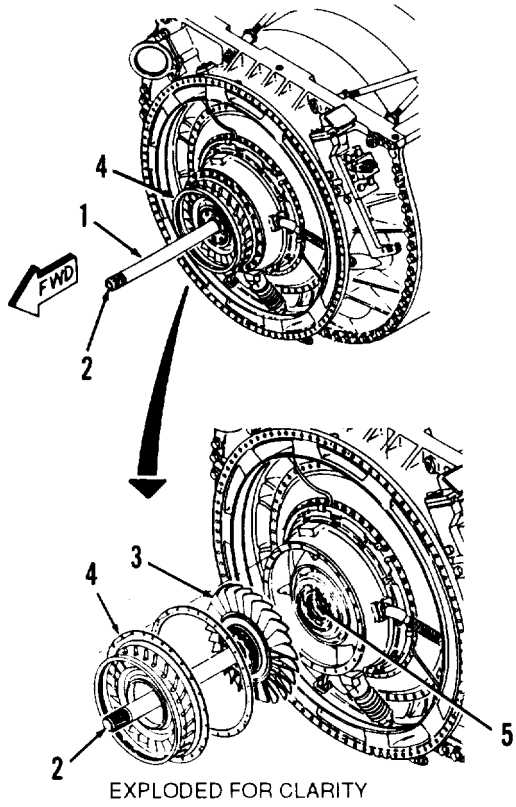
A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
B. Turn shaft (1), listen and feel for rubbing or binding.
C. Check rotation of power turbine in rear engine subassembly (6) by turning shouldered shaft (7) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Do both shafts turn smoothly with no unusual noises?

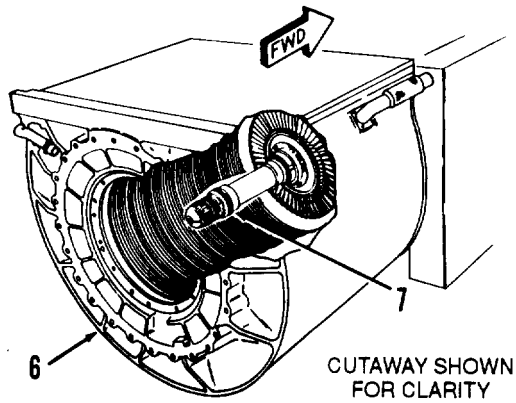
NO — YES

Go to step 5.

CONTINUED ON NEXT PAGE



EXPLODED FOR CLARITY



CUTAWAY SHOWN FOR CLARITY

3-3. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(6) ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

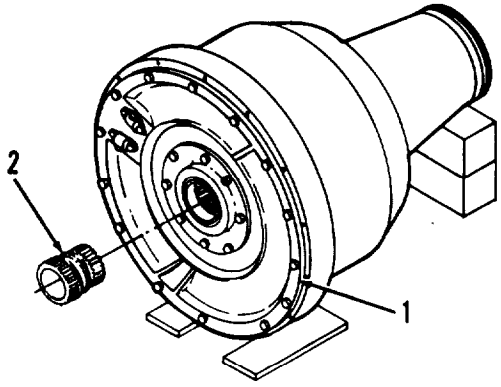
CONTINUED FROM STEP 2

3 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

NO — YES

Go to step 7.

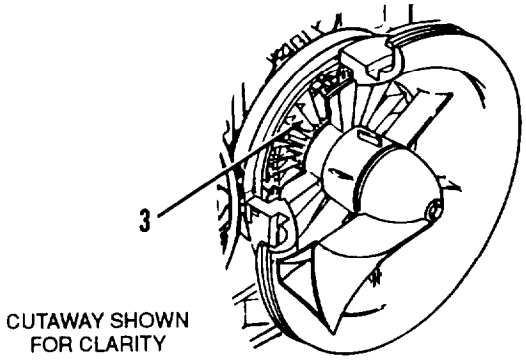


4 WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Turn low pressure compressor blades (3) by hand. Listen and feel for rubbing or binding.

Does low pressure compressor turn smoothly with no unusual noises?



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(6)	ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 4

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verity problem is solved.

A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. Clean cooler and AC generator lines (TM 20-1).
E. Verity problem is solved.

CONTINUED ON NEXT PAGE

3-3. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(6)	ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

FROM STEP 2

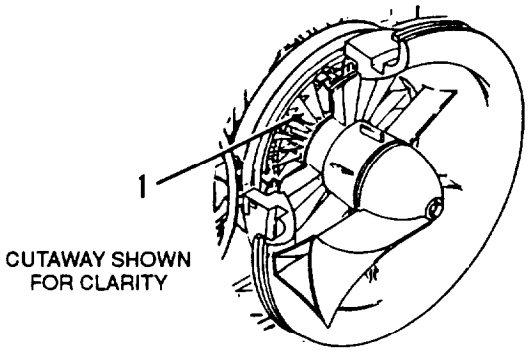
5	**WARNING** Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor. Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning spline coupling (2). Listen and feel for rubbing or binding.
Do compressors turn smoothly with no unusual noises?	

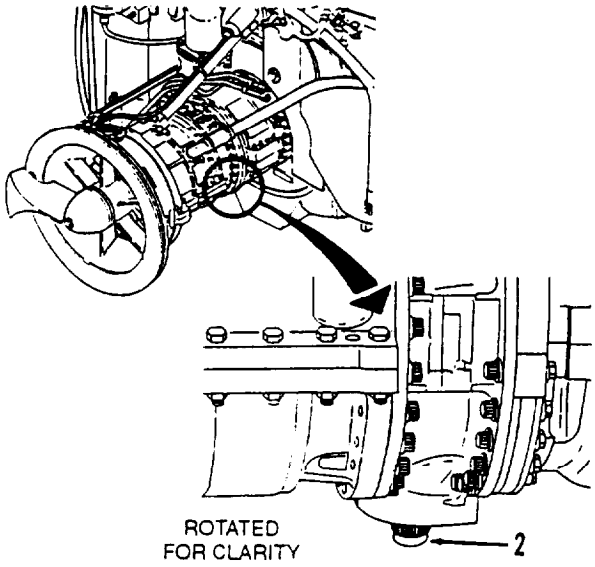
NO — YES

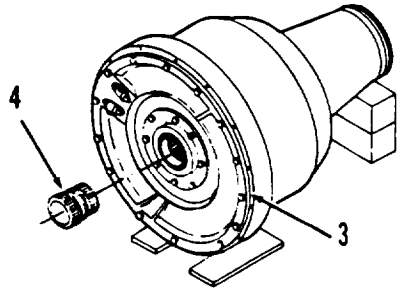
Go to step 8.

6	Check rotation of RGB assembly (3) by putting splined shaft (4) in RGB assembly and turning shaft (4) clockwise. Shaft should turn smoothly and no unusual noises should be heard.
Does shaft turn smoothly with no unusual noises?	

CONTINUED ON NEXT PAGE







3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(6)	ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

A. Replace forward engine module (page 5-13).
B. Clean AGB (page 7-46).
C. Replace engineoil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

A. Replace number 10 bearing (page 6-52).
B. Replace forward engine module (page 5-13).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h.	LOW PRESSURE COMPRESSOR - CONTINUED	(6) ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

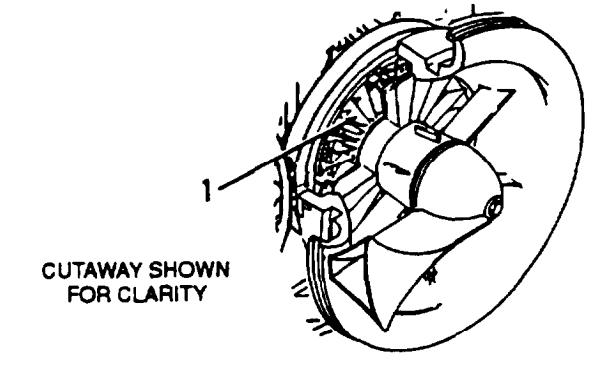
FROM STEP 3

7 **WARNING**

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

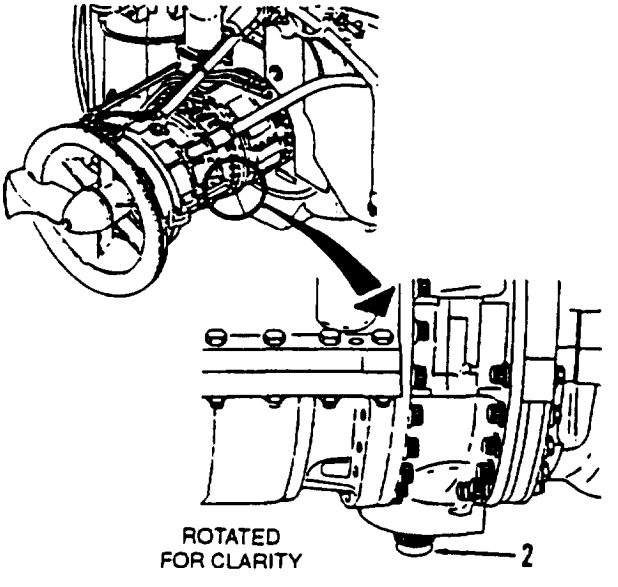
Turn low pressure compressor blades (1) by hand and high pressure compressor blades b turning splined coupling (2) in both directions. Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?



NO — YES

A. Salvage Gas Turbine Power Unit (pa e 6-63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h.	LOW PRESSURE COMPRESSOR - CONTINUED	(6) ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

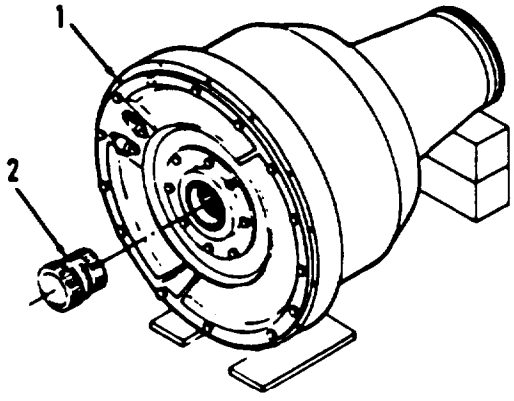
CONTINUED FROM STEP 7

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace forward engine module (page 5-13).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

FROM STEP 5

8 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

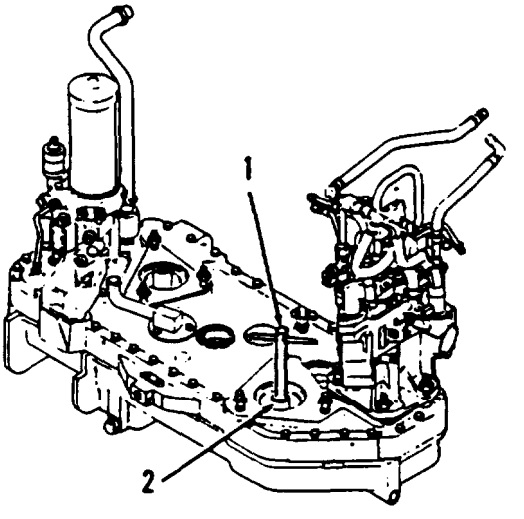
3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(6)	ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 8

YES — NO

A. Replace number 10 bearing (page 6-52).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.



9 A. Put handle (1) in main hydraulic pump drive gear assembly (2).
B. Check rotation of AGB gears by turning handle (1) clockwise. Handle should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.

Does handle turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h.	LOW PRESSURE COMPRESSOR - CONTINUED	(6) ES-33. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 9

YES

A. Install RGB assembly (page 6-19).
B. Install forward engine module (page 5-18).
C. Install AGB module (page 7-12).
D. Verify problem is solved.

NO

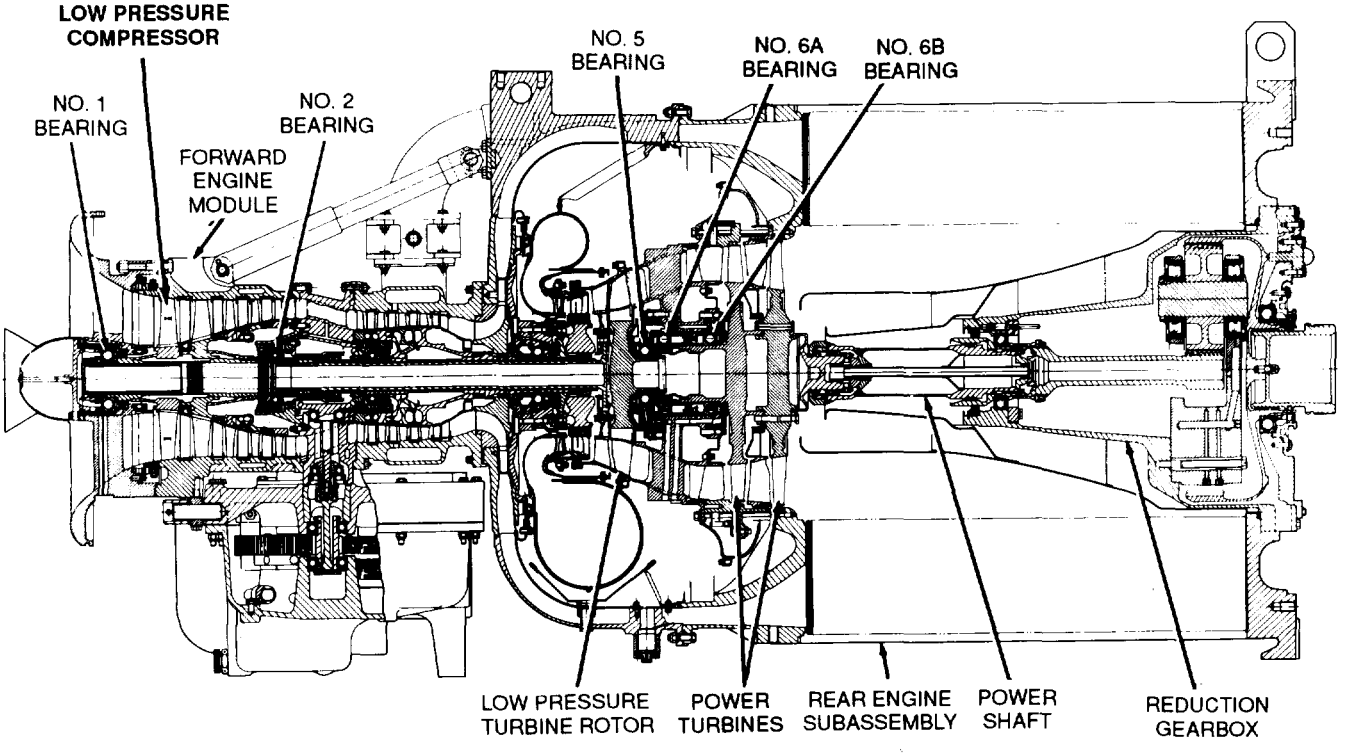
A. Clean AGB (page 7-46).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED'

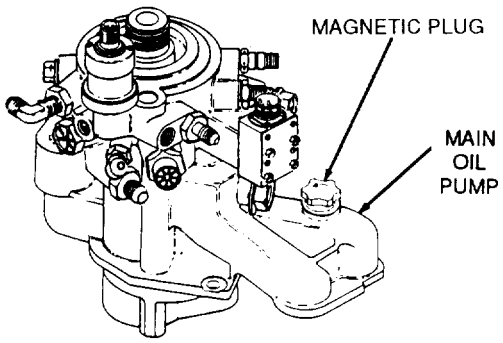
h.	LOW PRESSURE COMPRESSOR - CONTINUED	(7) ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

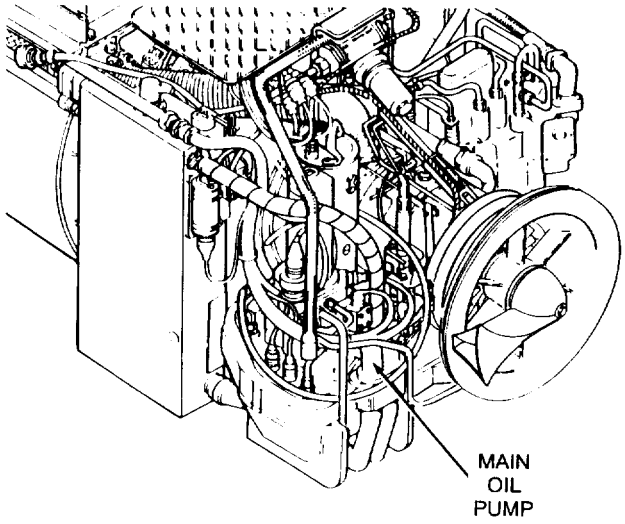
This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand, and rubbing or binding when the tubeaxial fan blades or left cooling fan blades are turned by hand, when more than one half of the main oil pump magnetic plug is covered with metal chips. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The power turbine and reduction gearbox (RGB) are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearings, or RGB bearings and/or gears, binding w1ll be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The RGB oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. The symptoms described above indicate two separate failures. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.

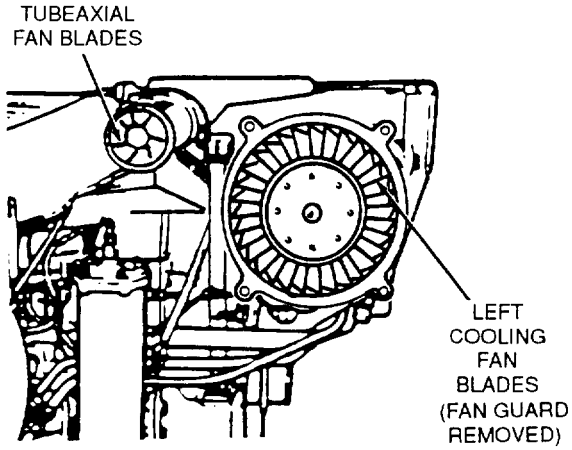


3-2. TROUBLESHOOTING - CONTINUED

. LOW PRESSURE COMPRESSOR - CONTINUED	(7) ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THEN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED







3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(7) ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THEN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

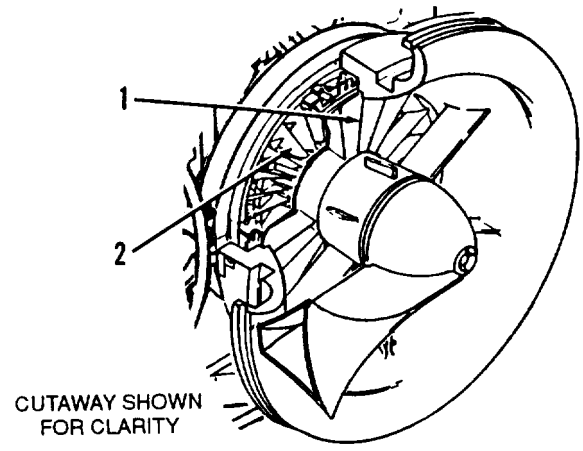
Tools: General mechanic's tool kit: automotive (SC 5180-90-N26)	Supplies: Wiping rag (Item 14, Appendix B) References: TM 20-1 TM 34-1

1 Check inlet guide vanes (IGVs) (1) and first stage compressor blades (2) for foreign object damage (FOD) that might cause rubbing or binding.

Are IGVs and first stage blades damaged enough to cause rubbing or binding?

NO — Go to step 5.

YES



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(7) ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THEN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. CONTINUED

CONTINUED FROM STEP 1

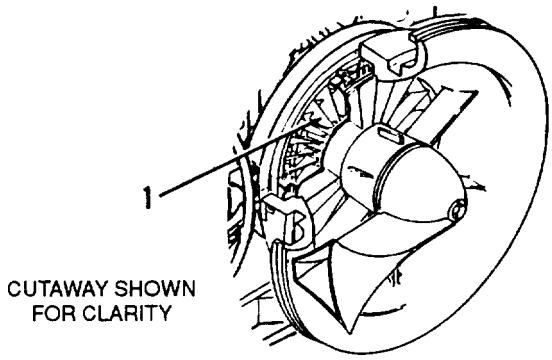
2 A. Remove forward engine module (page 5-13).

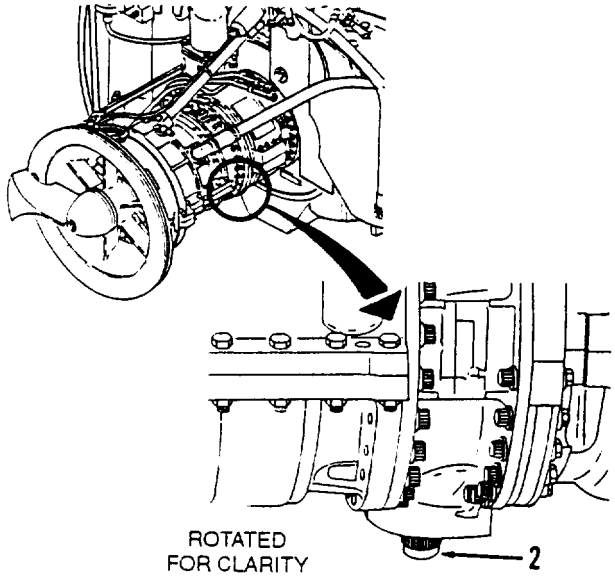
WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

B. Turn low pressure compressor blades (1) by hand and high pressure compressor blades by turning spline coupling (2). Listen and feel for rubbing or binding.

Do compressors turn smoothly with no unusual noises?





CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED		
h. LOW PRESSURE COMPRESSOR - CONTINUED	(7)	ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Salvage Gas Turbine Power Unit (pa e 6-63).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

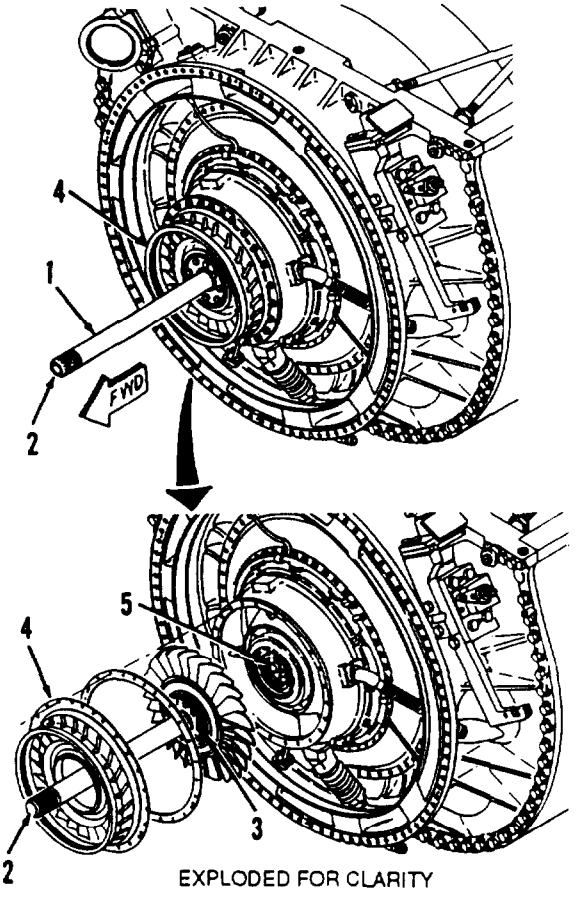
CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(7) ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THEN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

3	**CAUTION**
	Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal. A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5). B. Turn shaft (1), listen and feel for rubbing or binding.
Does shaft turn smoothly with no unusual noises?	



EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(7) ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THEN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

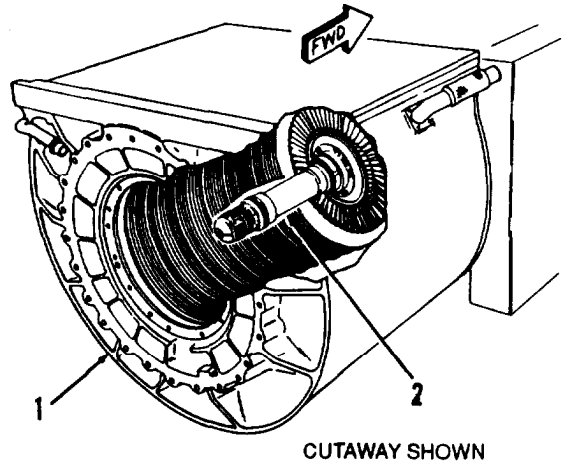
CONTINUED FROM STEP 3

YES — NO

A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. Clean cooler and generator lines (TM 20-1).
E. Verify problem is solved.

4 A. Remove RGB assembly (page 6-17).
B. Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(7)	ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 4

NO — YES

A. Replace forward engine module (page 5-13).
B. Replace number 10 bearing (page 6-52).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. Clean cooler and generator lines (TM 20-1).
E. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. IOW PRESSURE COMPRESSOR - CONTINUED	(7) ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THEN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

FROM STEP 1

5 A. Remove forward engine module (page 5-13).

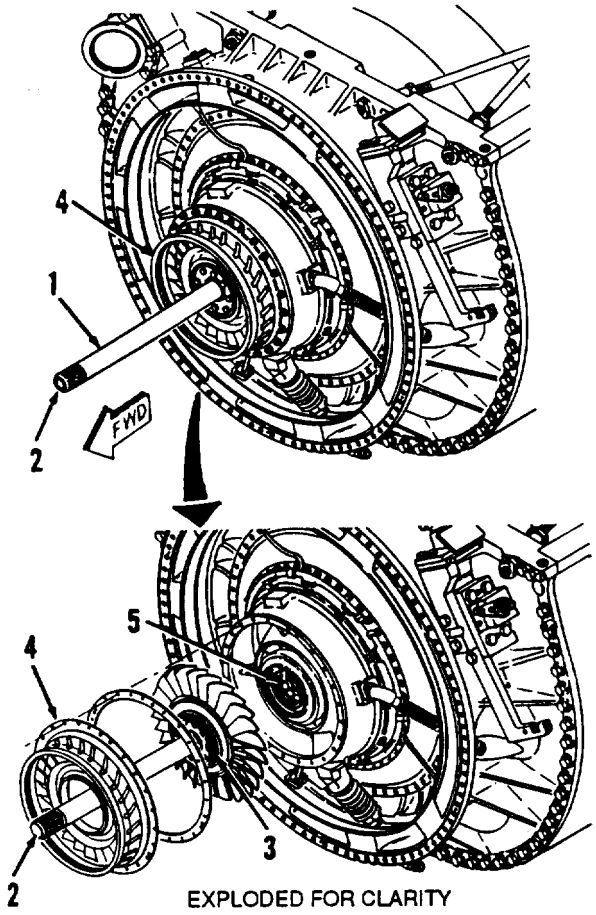
CAUTION

Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

B. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).

C. Turn shaft (1), listen and feel for rubbing or binding.

Does shaft turn smoothlY with no unusual noises?



EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(7) ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THEN ONE HALF OF MAIN OIL PUMP MAGNETIc PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

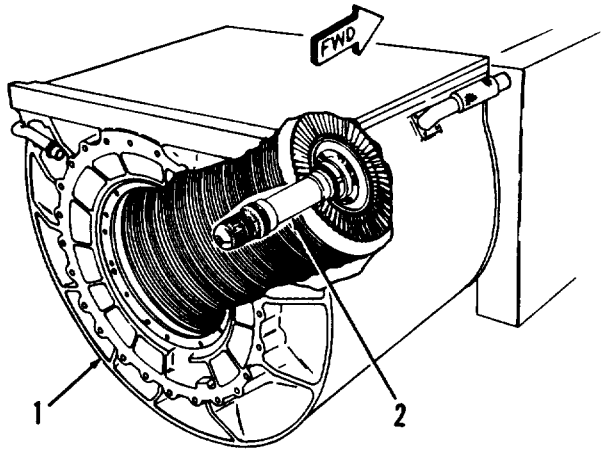
CONTINUED FROM STEP 5

YES NO

A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. Clean cooler and generator lines (TM 20-1).
E. Verify problem is solved.

6 A. Remove RGB assembly (page 6-17).
B. Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(7)	ES-34. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 6

NO — YES

A. Replace forward engine module (page 5-18).
B. Replace number 10 bearing (page 6-52).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

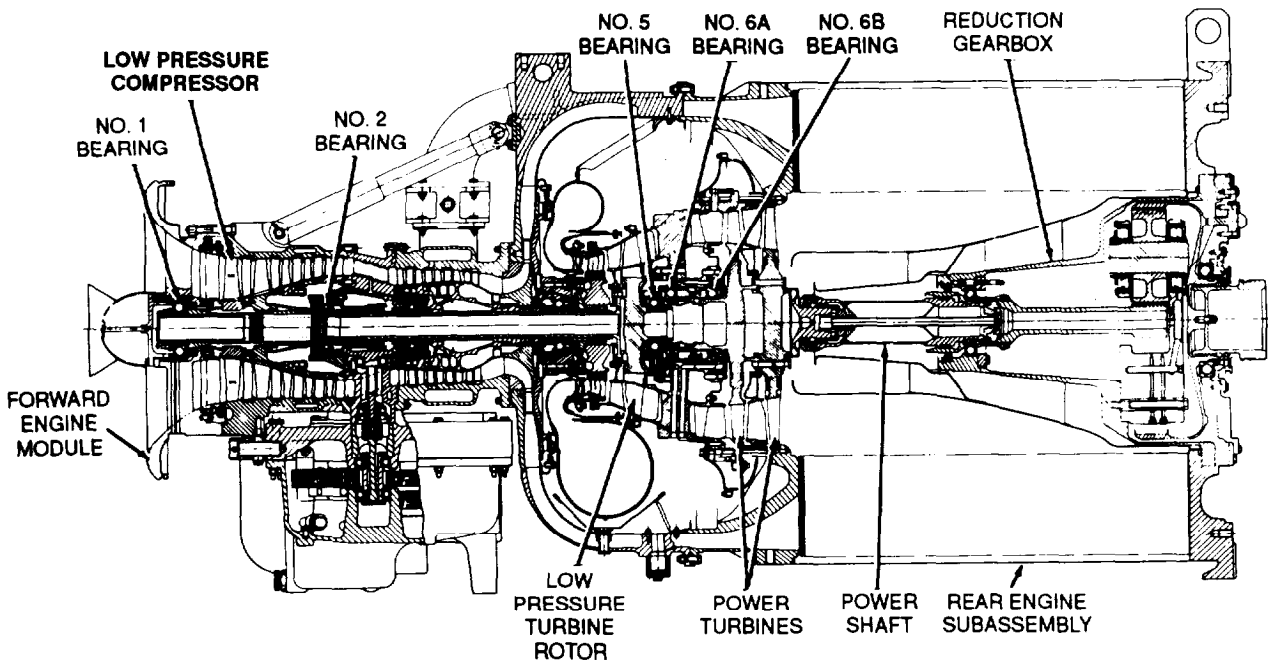
A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1)
D. Clean cooler and generator lines (TM 20-1).
E. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

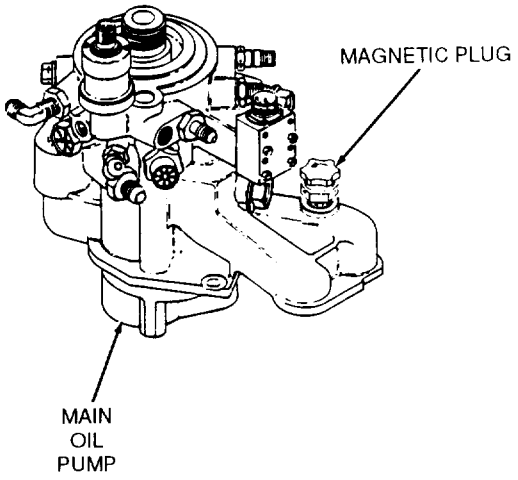
h. LOW PRESSURE COMPRESSOR - CONTINUED	(8) ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.

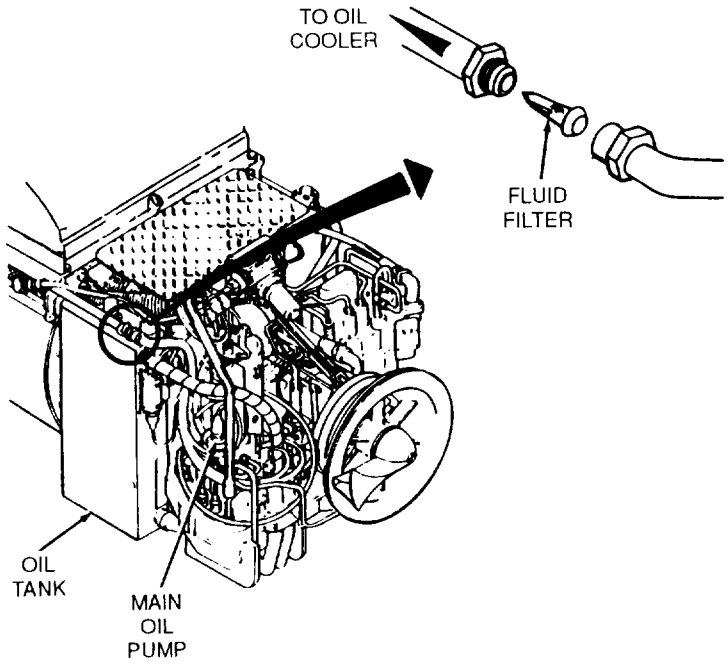
This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand, and rubbing or binding when the tubeaxial fan blades or left cooling fan blades are turned by hand, when there are metal chips in the oil pump to oil cooler fluid filter. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The power turbine and reduction gearbox (RGB) are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB bearings and/or gears, binding will be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The RGB oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. The lubrication system delivers hot oil, scavenged from bearing packages throughout the engine, through a fluid filter to the engine oil cooler. The cooled oil is then returned to the oil tank. Whenever metal chips are generated, the fluid filter will catch and retain most of the chips. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.

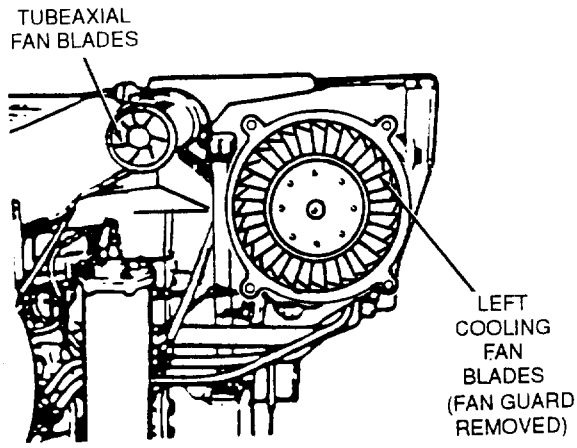


3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(8) ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED







3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(8) ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

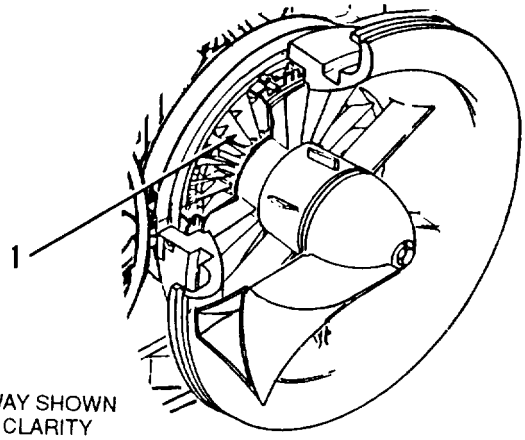
Tools: General mechanic's tool kit: automotive (SC 5180-90-N26) Metal pail (Item 136, Appendix D)	Supplies: Dry cleaning solvent (Item 7, Appendix B) Wiping rag (Item 14, Appendix B) References: TM 20-I TM 34-1

1 A. Remove forward engine module (page 5-13).
B. Remove RGB assembly (page 6-17).

WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

C. Turn low pressure compressor blades (1) by hand. Listen and feel for rubbing or binding.



CUTAWAY SHOWN FOR CLARITY

Does low pressure compressor turn smoothly with no unusual noises?

NO YES

Go to step 5.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(8) ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLINGFAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 1

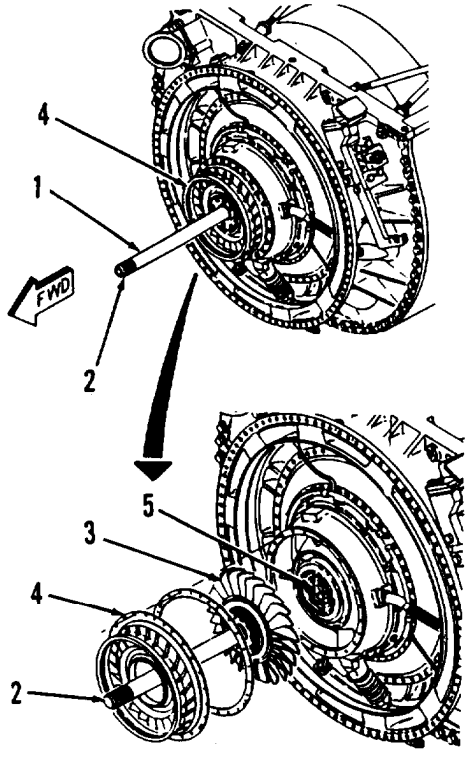
2 **CAUTION**

Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

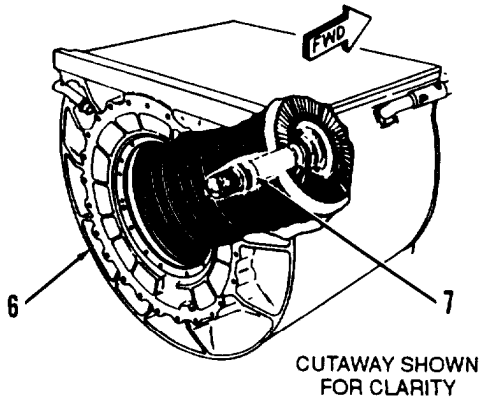
A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
B. Turn shaft (1), listen and feel for rubbing or binding.
C. Check rotation of power turbine in rear engine subassembly (6) by turning shouldered shaft (7) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Do both shafts rotate smoothly with no unusual noises?

CONTINUED ON NEXT PAGE



EXPLODED FOR CLARITY



CUTAWAY SHOWN FOR CLARITY

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(8) ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Replace forward engine module (page 5-13).
B. Replace number 10 bearing (page 8-52).
C. Clean RGB lubrication system (page 8-1).
D. Clean accessory gearbox (AGB) (page 7-46).
E. Replace engine oil pump (TM 20-1).
F. Replace engine oil cooler (TM 20-1).
G. Replace engine AC generator (TM 20-1).
H. Clean cooler and generator lines (TM 20-1).
I. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(8) ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

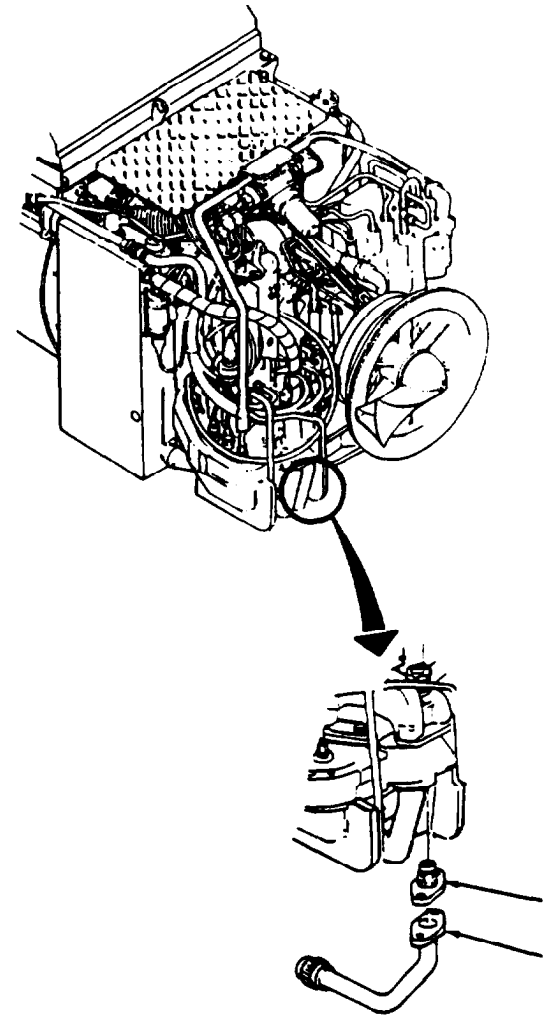
CONTINUED FROM STEP 2

3 A. Remove forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).

WARNING

B. Pour one quart of dry cleaning solvent through scavenge tube assembly (1) and into clean pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(8)	ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

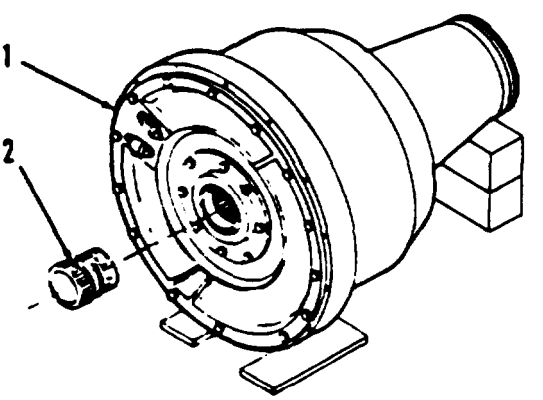
CONTINUED FROM STEP 3

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace forward engine module (page 5-13).
C. Clean accessory gearbox (AGB) (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace en line AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

4 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(8)	ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 4

NO — YES

A. Replace forward engine module (page 5-13).
B. Salvage Gas Turbine Power Unit (page 6-63).
C. Clean accessory gearbox (AGB) (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. Clean cooler and generator lines (TM 20-1).
E. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(8) ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

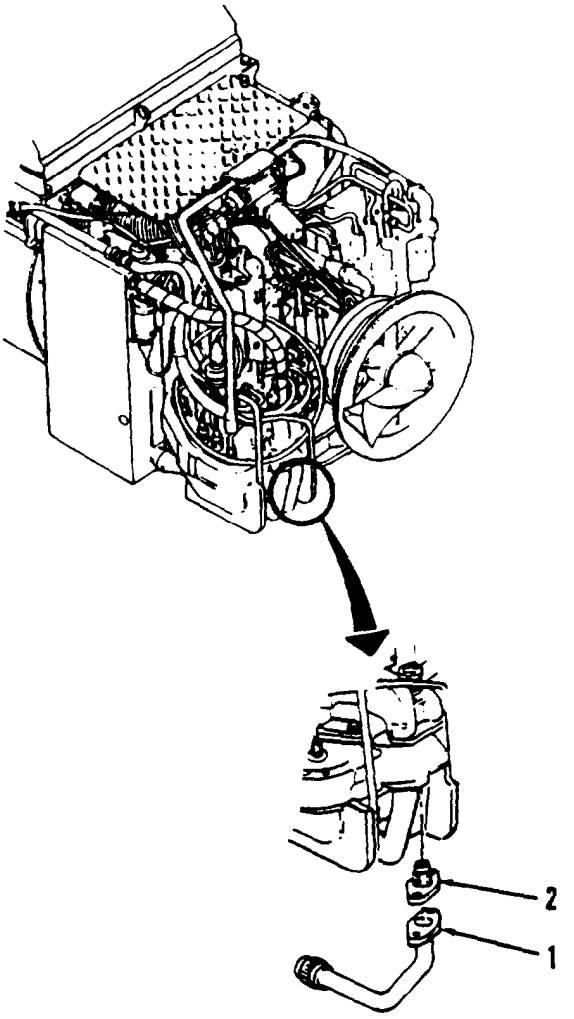
FROM STEP 1

5 A. Remove forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).

WARNING

B. Pour one quart of dry cleaning solvent through scavenge tube assembly (1) and into clean pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?



CONTINUED ON NEXT PAGE

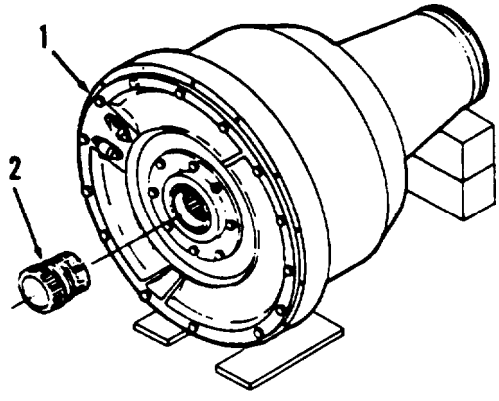
3-2. TROUBLESHOOTING - CONTINUED

h.	LOW PRESSURE COMPRESSOR - CONTINUED	(8) ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 5

NO — YES

A. Salvage Gas Turbine Power Unit (pa e 6-63).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Clean accessory gearbox (AGB) (page 7-46).
E. Replace engine oil pump (TM 20-1).
F. Replace engine oil cooler (TM 20-1).
G. Replace engine AC generator (TM 20-1).
H. Clean cooler and generator lines (TM 20-1).
I. Verify problem is solved.



6 Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(8)	ES-35. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STFP 8

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean accessory gearbox (AGB) (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

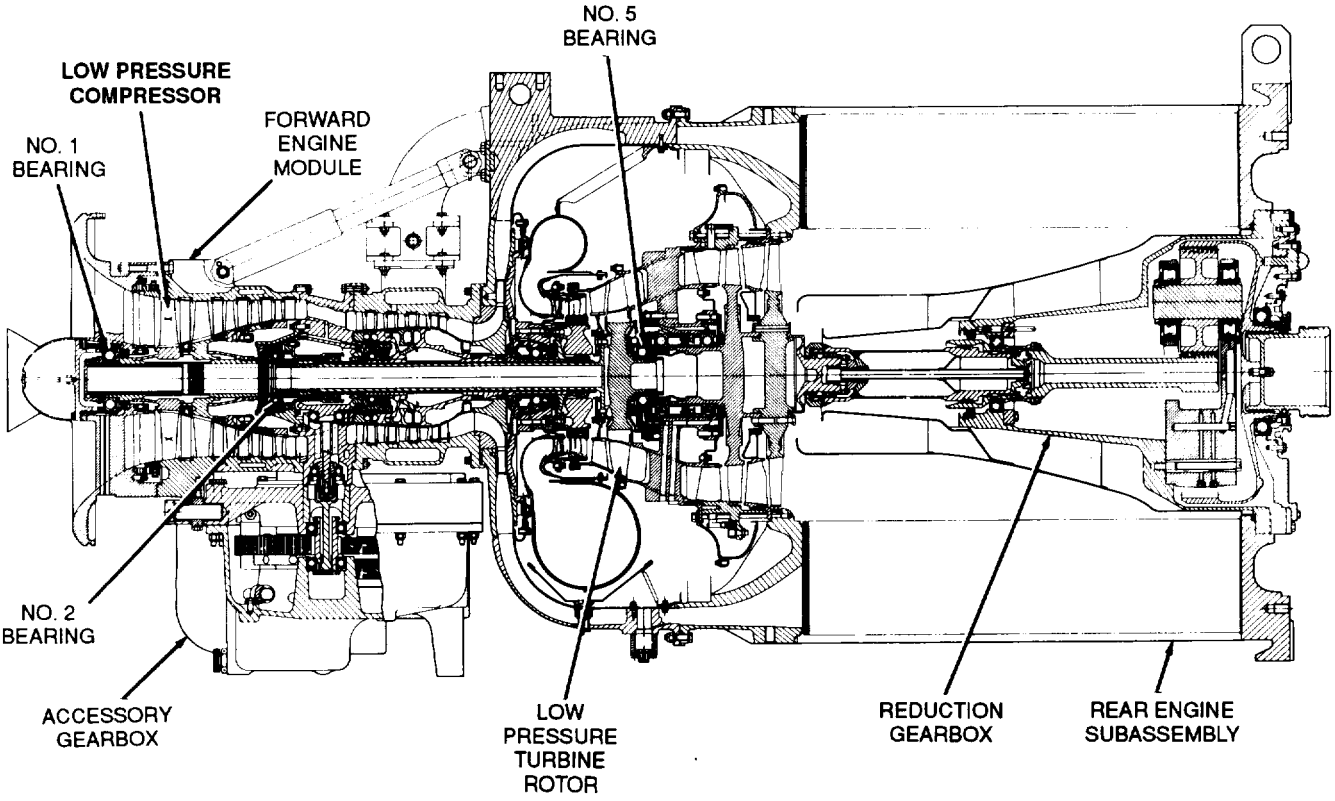
A. Salvage Gas Turbine Power Unit (pa e 6-63).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Clean accessory gearbox (AGB) (page 7-46).
E. Replace engine oil pump (TM 20-1).
F. Replace engine oil cooler (TM 20-1).
G. Replace engine AC generator (TM 20-1).
H. Clean cooler and generator lines (TM 20-1).
I. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

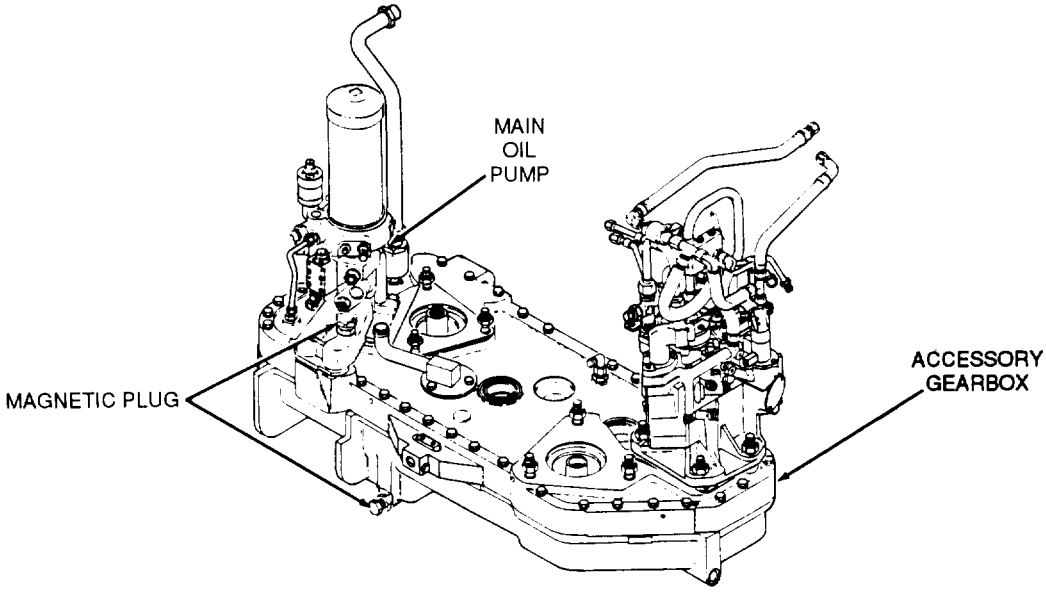
h. LOW PRESSURE COMPRESSOR - CONTINUED	(9) ES-36. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand, when more than one half of the AGB and main oil pump magnetic plugs are covered with metal chips. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward enqine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The AGB acts as an oil sump to collect oil scavenged from bearings in the forward engine module and rear engine subassembly. The main oil pump pumps the hot oil from the sump to the engine oil cooler. The reduction gearbox (RGB) oil return line feeds dlrectly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. The symptoms described above indicate two separate failures. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(9)	ES-36. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED



3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(9) ES-36. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26)	Supplies: Wiping rag (Item 14, Appendix B) References: TM 20-1 TM 34-1

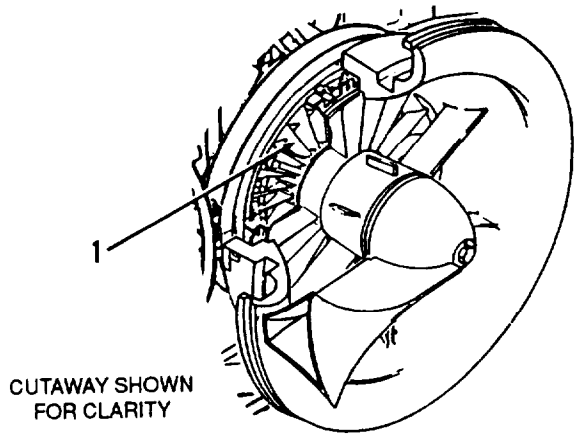
1 A. Remove forward engine module (page 5-13).

WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

B. Turn low pressure compressor blades (1) by hand. Listen and feel for rubbing or binding.

Does low pressure compressor turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(9)	ES-36. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Clean AGB (page 7-46).
E. Replace engine oil pump (TM 20-1).
F. Replace engine oil cooler (TM 20-1).
G. Replace engine AC generator (TM 20-1).
H. Clean cooler and generator lines (TM 20-1).
I. Verity problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(9) ES-36. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

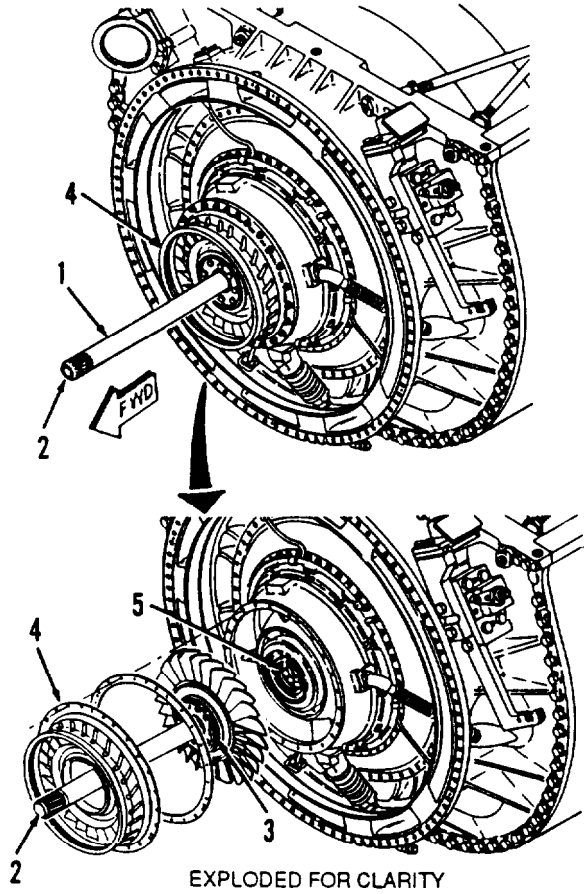
CONTINUED FROM STEP 1

2 **CAUTION**

Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No. 5 bearing carbon seal.

A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle (4) and to load No. 5 bearing (5).
B. Turn shaft (1), listen and feel for rubbing or binding.

Does shaft turn smoothly with no unusual noises?



EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(9)	ES-36. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Replace forward engine module (page 5-13).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Clean AGB (page 7-46).
E. Replace engine oil pump (TM 20-1).
F. Replace engine oil cooler (TM 20-1).
G. Replace engine AC generator (TM 20-1).
H. Clean cooler and generator lines (TM 20-1).
I. Verify problem is solved.

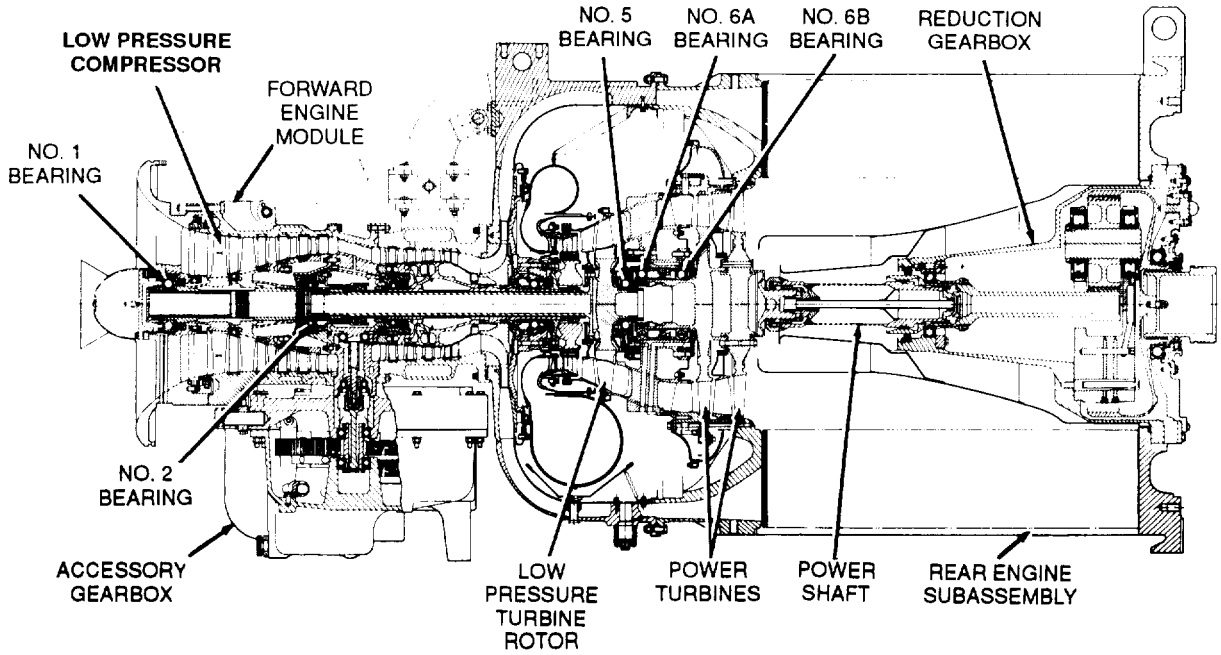
A. Replace engine assembly (TM 34-1).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1).
D. Clean cooler and generator lines (TM 20-1).
E. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

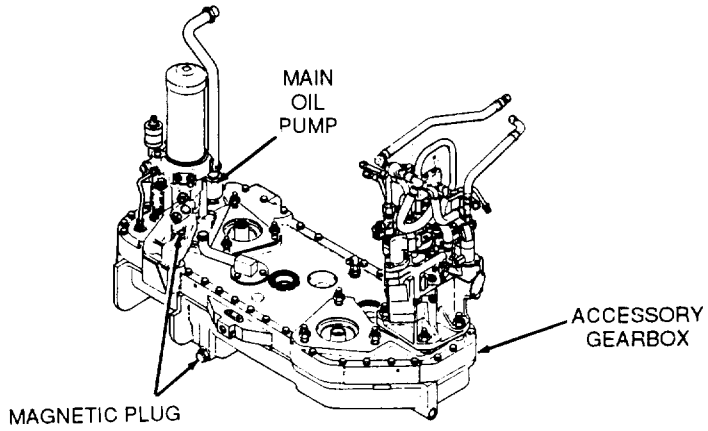
h. LOW PRESSURE COMPRESSOR - CONTINUED	(10)	ES-37. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.

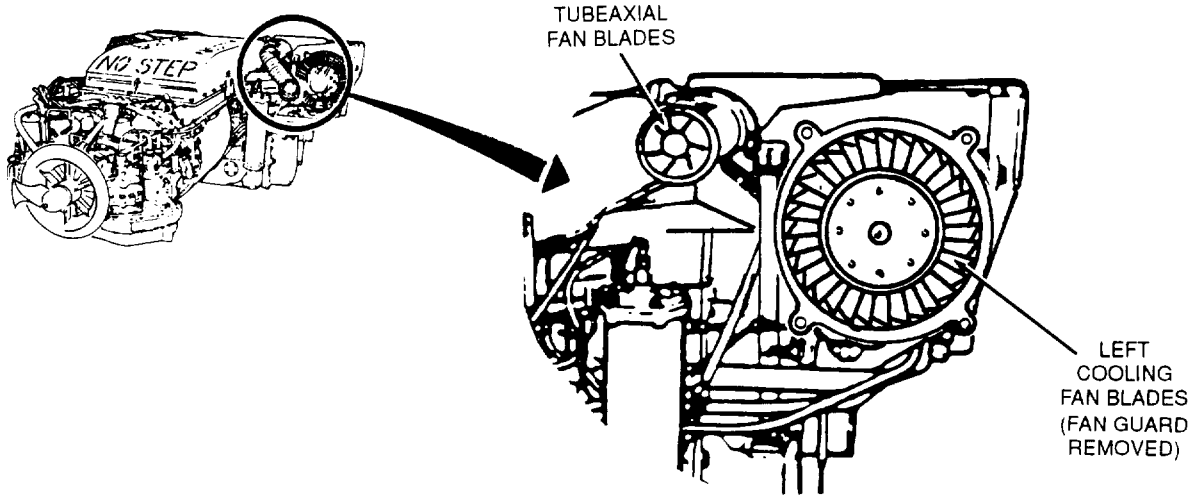
This section contains troubleshooting to locate and correct the cause(s) of low pressure compressor rubbing or binding when turned by hand, and rubbing or binding when the tubeaxial fan blades or left cooling fan blades are turned by hand, when more than one half of the AGB and main oil pump magnetic plugs are covered with metal chips. The low pressure compressor is mechanically coupled to the low pressure turbine rotor in the rear engine subassembly. If there is damage to the low pressure compressor or position No. 1 or 2 bearing in the forward engine module, or to the low pressure turbine rotor or position No. 5 bearing in the rear engine subassembly, binding will be felt when the low pressure compressor is turned by hand. The power turbine and reduction gearbox (RGB) are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB bearings and/or gears, binding w1ll be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The AGB acts as an oil sump to collect oil scavenged from bearings in the forward engine module and rear engine subassembly. The main oil pump pumps the hot oil from the sump to the engine oil cooler. The RGB oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. The symptoms described above indicate at least two separate failures. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(10) ES-37 . LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED





3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(10)	ES-37. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY BAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)

Supplies:
Wiping rag (Item 14, Appendix B)

References:
TM 20-1
TM 34-1

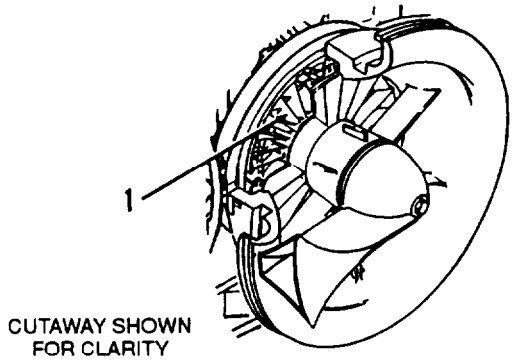
1 A. Remove forward engine module (page 5-13).

WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

B. Turn low pressure compressor blades (1) by hand. Listen and feel for rubbing or binding.

Does low pressure compressor turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(10) ES-37. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Clean AGB (page 7-46).
E. Replace engine oil pump (TM 20-1).
F. Replace engine oil cooler (TM 20-1).
G. Replace engine AC generator (TM 20-1).
H. Clean cooler and generator lines (TM 20-1).
I. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(10)	ES-37. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

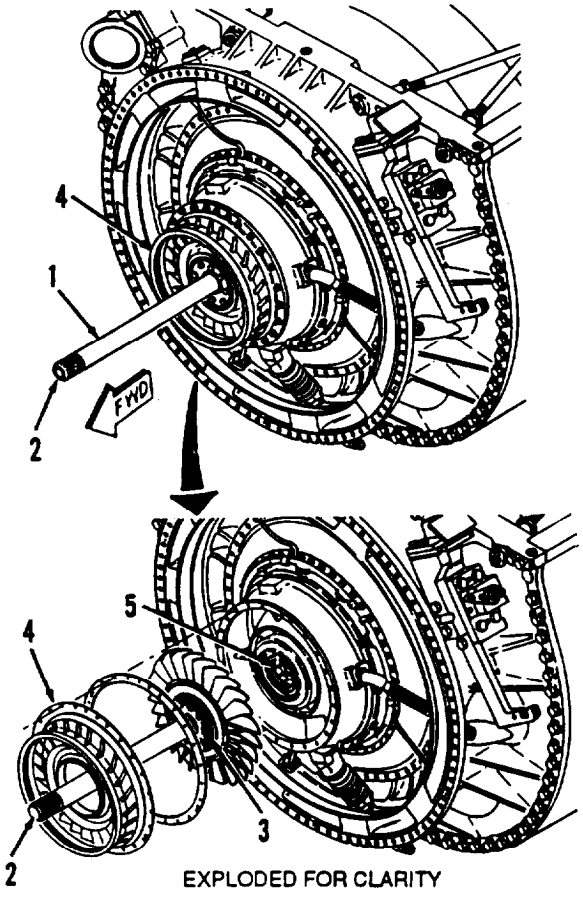
CONTINUED FROM STEP 1

2 **CAUTION**

Extreme care should be taken when handling low pressure turbine rotor shaft (1). Banging, jarring or rough handling will cause damage to No 5 bearing carbon seal.

A. Lift end (2) of shaft (1) slightly to center shaft (1), then push shaft (1) in to establish clearance between power turbine disc (3) and nozzle 4) and to load No. 5 bearing (5).
B. Turn shaft (1), listen and feel for rubbing or binding.

Does shaft turn smoothly with no unusual noises?

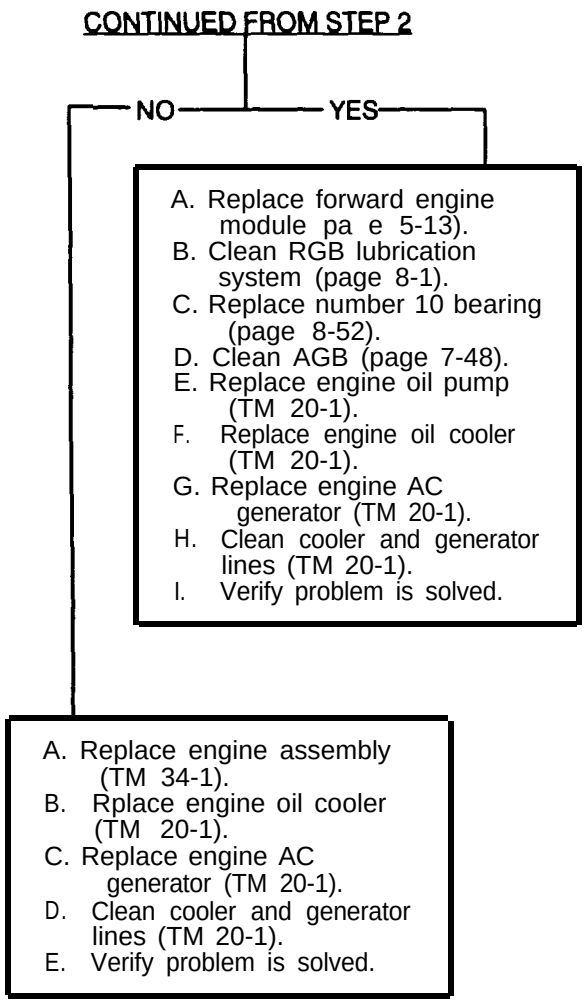


EXPLODED FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

h. LOW PRESSURE COMPRESSOR - CONTINUED	(10) ES-37. LOW PRESSURE COMPRESSOR RUBS OR BINDS WHEN TURNED BY HAND, RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

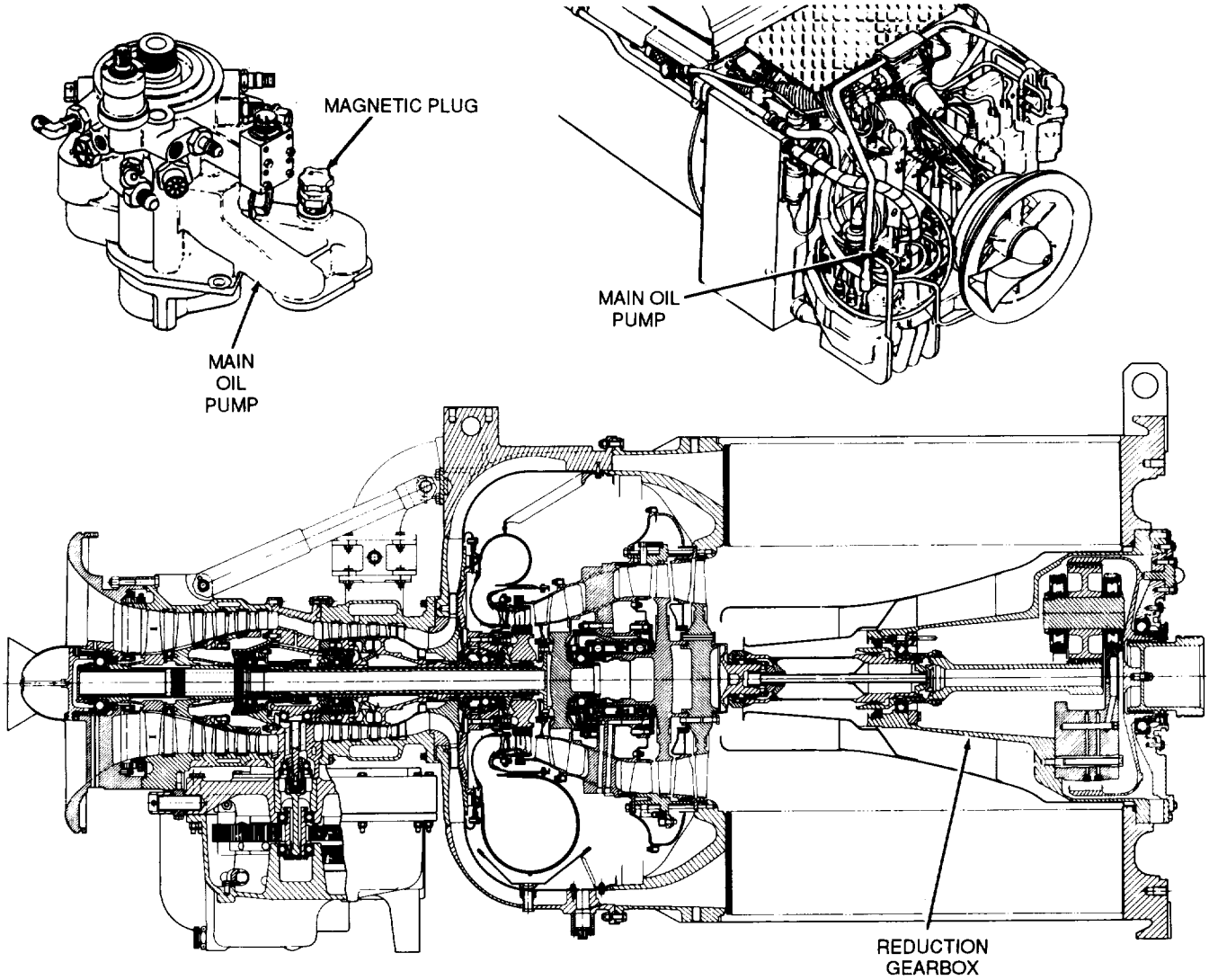


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

i.	MAIN OIL PUMP MAGNETIC PLUG	(1) ES-38. MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. NO OTHER ROTATION OR METAL CHIPS NOTED.

This section contains troubleshooting to locate and correct the cause(s) of more than one half of the main oil pump magnetic plug being covered with metal chips when no other rotation or metal chips were noted. The reduction gearbox (RGB) oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. The art on this page provides an overview of the systems described above. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

i. MAIN OIL PUMP MAGNETIC PLUG - CONTINUED	(1) ES-38. MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26) Metal pail (Item 136, Appendix D)	Supplies: Dry cleaning solvent (Item 7, Appendix B) Wiping rag (Item 14, Appendix B) References: TM 20-1

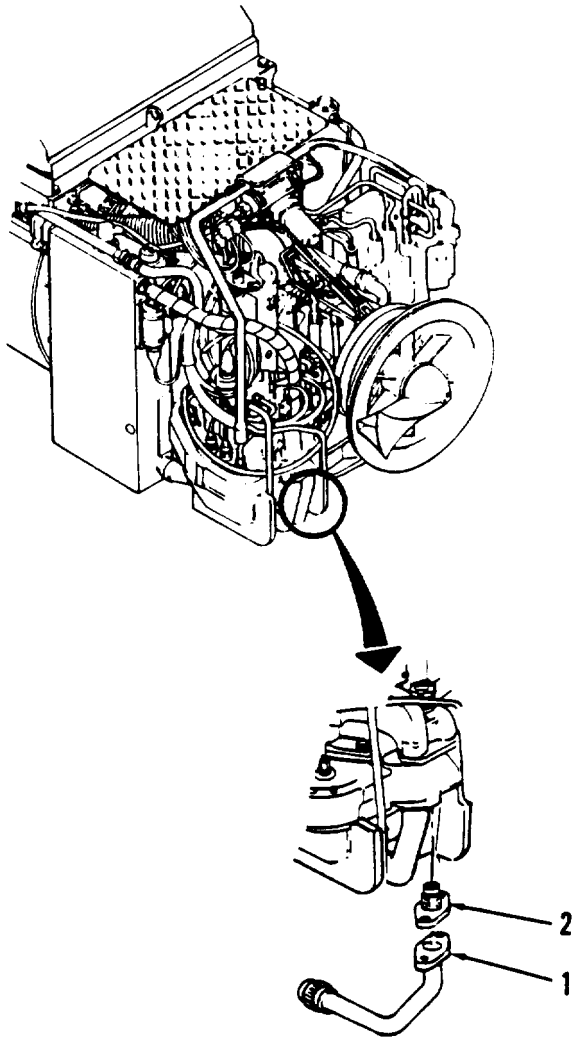
1 A. Remove forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).

WARNING

B. Pour one quart of dry cleaning solvent through scavenge tube assembly (1) and into clean pail.

C. Check solvent in pail for metal chips.

Are there metal chips in solvent?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

i.	MAIN OIL PUMP MAGNETIC PLUG - CONTINUED	(1)	ES-38. MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 1

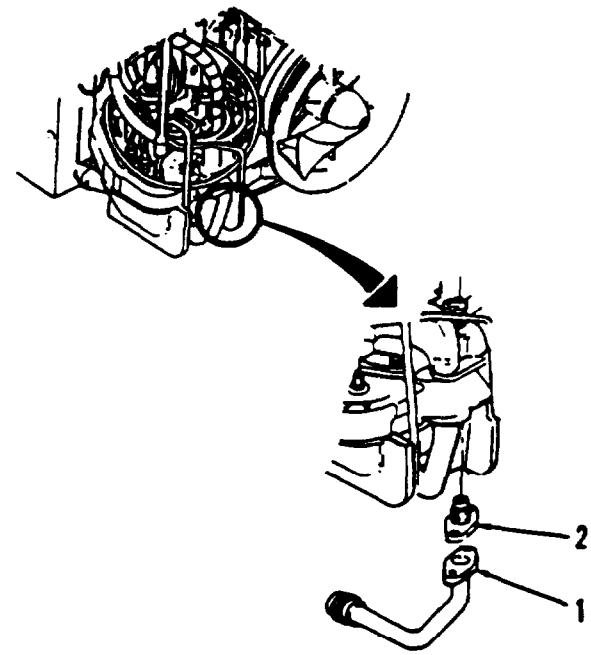
NO — YES

A. Clean RGB lubrication system (page 8-1).
B. Replace number 10 bearing (page 6-52).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

2

WARNING

A. Clean forward RGB scavenge tube assembly (1) and screen (2) with dry cleaning solvent and wiping rag.
B. Install forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).
C. Verify problem is solved.

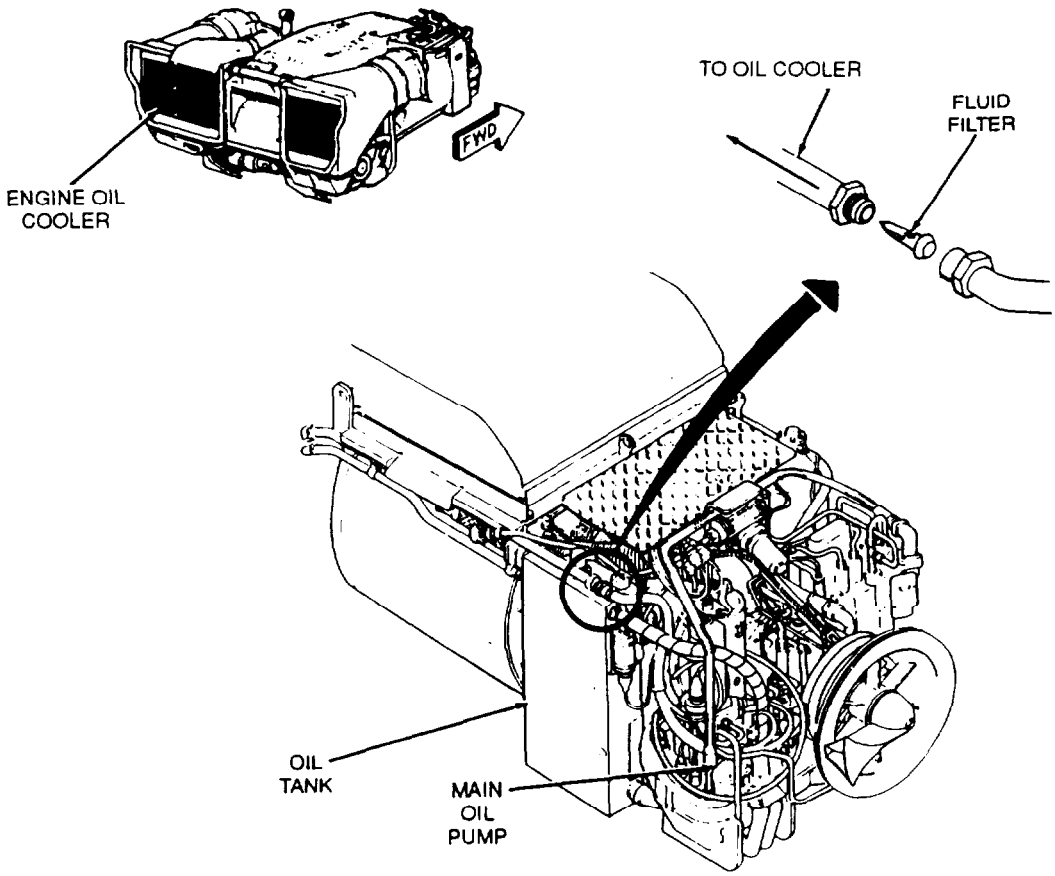


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

j. OIL PUMP TO OIL COOLER FLUID FILTER	(1) ES-39. METAL CHIPS ARE PRESENT IN THE OIL PUMP TO OIL COOLER FLUID FILTER. NO OTHER ROTATION OR METAL CHIPS NOTED.

This section contains troubleshooting to locate and correct the cause(s) of metal chips in the oil pump to oil cooler fluid filter, when no other rotation or metal chips were noted. The lubrication system delivers hot oil scavenged from bearing packages throughout the engine, to the engine oil cooler. The cooled oil is then returned to the oil tank. Whenever metal chips are generated{ the fluid filter will catch and retain most of the chips. Further investigation will be required to fault isolate the discrepant module(s) causing the symptom. The art on this page provides an overview of the system described above. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

j. OIL PUMP TO OIL COOLER FLUID FILTER - CONTINUED	(1) ES-39. METAL CHIPS ARE PRESENT IN THE OIL PUMP TO OIL COOLER FLUID FILTER. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
Metal pail (Item 136, Appendix D)

supplies:
Dry cleaning solvent (Item 7, Appendix B)
Wiping rag (Item 14, Appendix B)

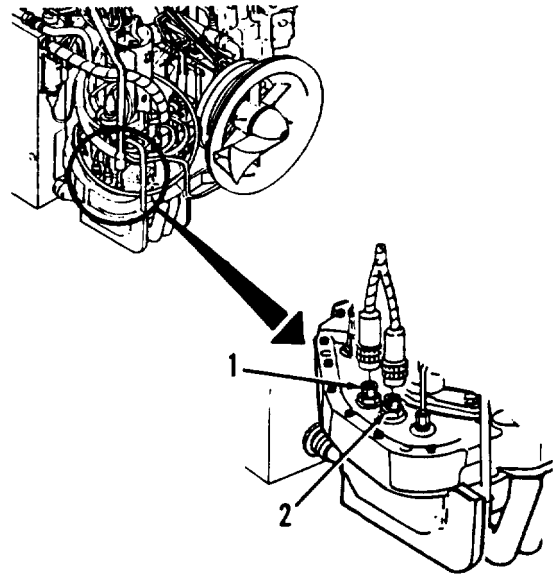
References:
TM 20-1

1 A. Remove electrical speed pickups No. 1 (1) and No. 2 (2) (TM 20-1).
B. Check pickups (1, 2) for metal chips.

Are there metal chips on pickups?

NO — Go to step 3.

YES



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

j. OIL PUMP TO OIL COOLER FLUID FILTER - CONTINUED	(1) ES-39. METAL CHIPS ARE PRESENT IN THE OIL PUMP TO OIL COOLER FLUID FILTER. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 1

2 A. Remove No. 5 and 6A bearing scavenge hose assembly (1) and No. 6B scavenge hose assembly (2).

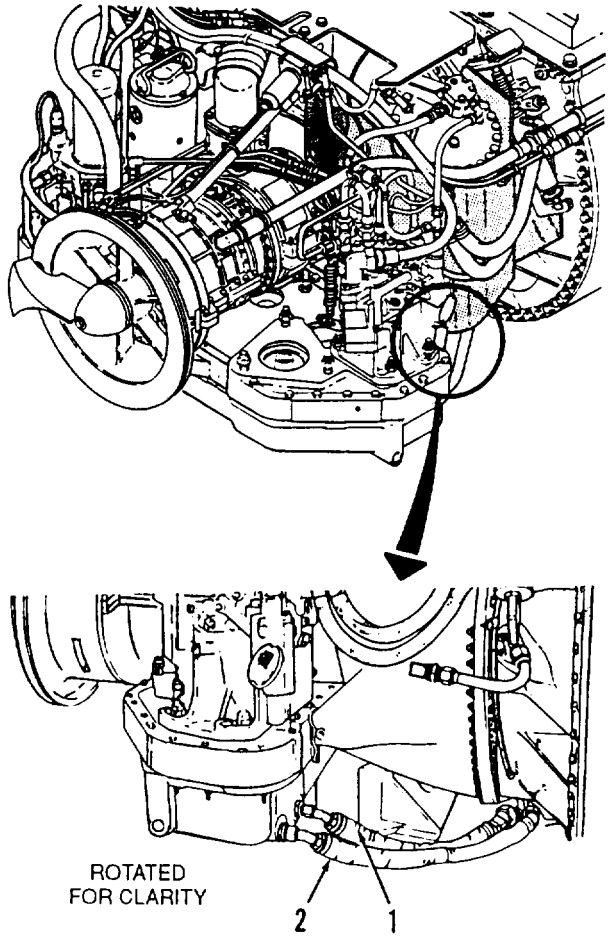
WARNING

B. Pour one quart of dry cleaning solvent through each hose (1, 2) and into clean pail.
c. Check solvent in pail for metal chips.

Are there metal chips in solvent?

YES — A. Replace engine oil pump (TM 20-1).
B. Verify problem is solved.

NO



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

j.	OIL PUMP TO OIL COOLER FLUID FILTER - CONTINUED	(1)	ES-39. METAL CHIPS ARE PRESENT IN THE OIL PUMP TO OIL COOLER FLUID FILTER. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 2

A. Salvage Gas Turbine Power Unit (page 6-63).
6. Clean accessory gearbox (AGB) (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

FROM STEP 1

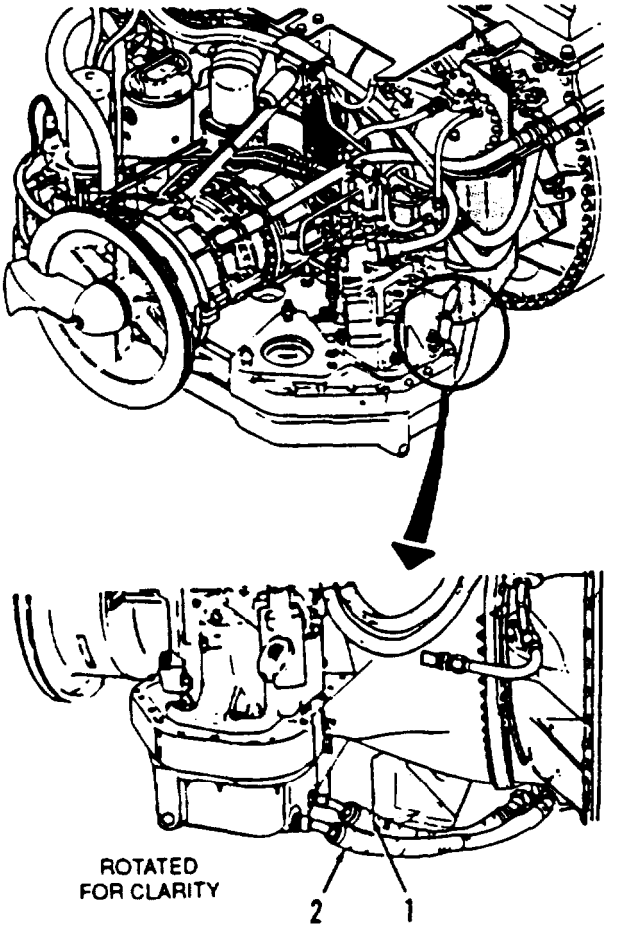
3 A. Remove No. 5 and 6A bearing scavenge hose assembly (1) and No. 6B scavenge hose assembly (2).

WARNING

B. Pour one quart of dry cleaning solvent through each hose (1, 2) and into clean pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?

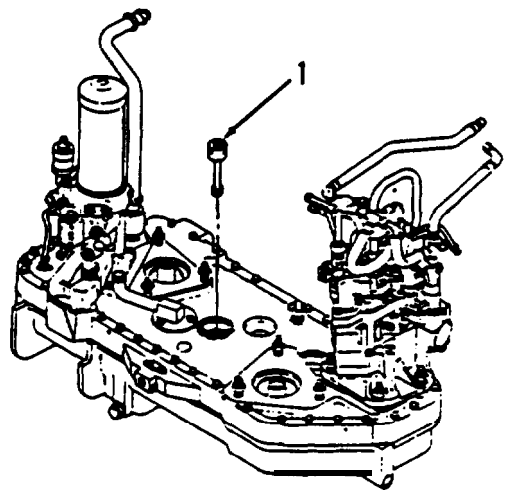
CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTING - CONTINUED

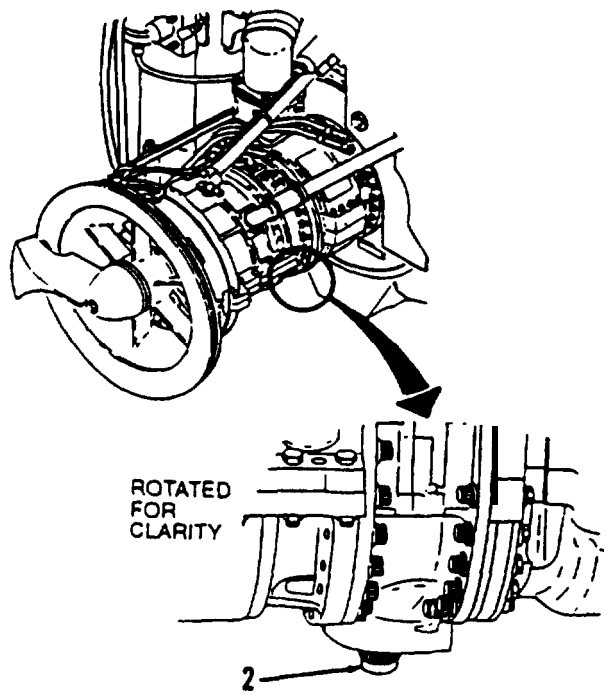
j.	OIL PUMP TO OIL COOLER FLUID FILTER - CONTINUED	(1) ES-39. METAL CHIPS ARE PRESENT IN THE OIL PUMP TO OIL COOLER FLUID FILTER. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean accessory gearbox (AGB) (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.



4 A. Remove accessory gearbox (AGB) (page 7-21).
B. Remove spur gearshaft (1).
C. Check to see if spur gearshaft (1) is broken or damaged.
D. Check splined coupling (2) for damage to splines.

Is spur gearshaft broken or damaged or is splined coupling damaged?



CONTINUED ON NEXT PAGE

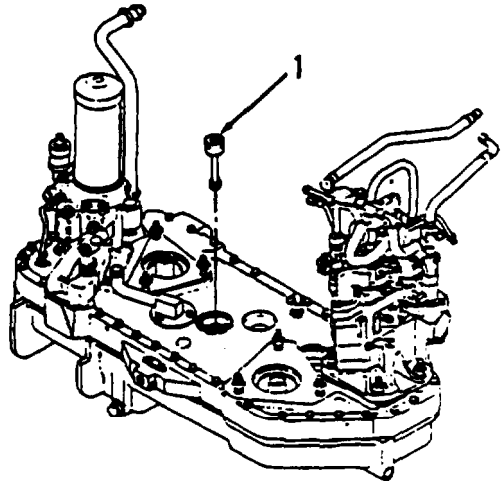
3-2. TROUBLESHOOTING - CONTINUED

j.	OIL PUMP TO OIL COOLER FLUID FILTER - CONTINUED	(1)	ES-39. METAL CHIPS ARE PRESENT IN THE OIL PUMP TO OIL COOLER FLUID FILTER. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

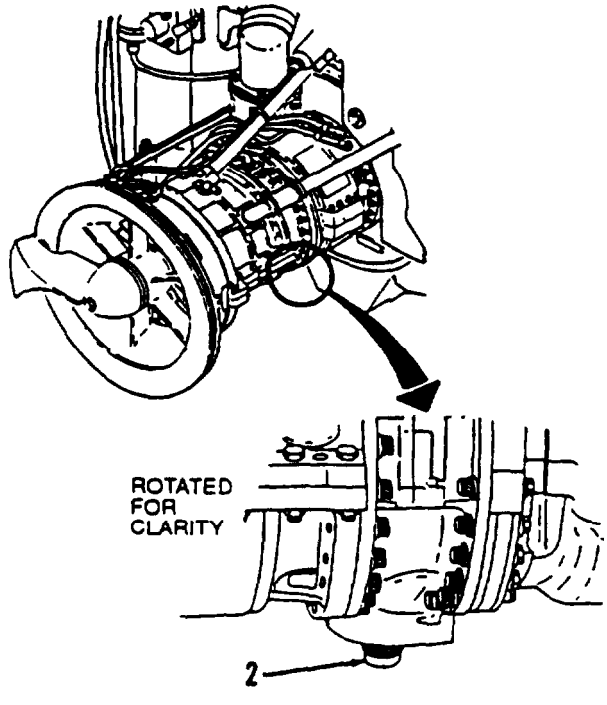
CONTINUED FROM STEP 4

NO — YES

A. If spur gearshaft (1) is damaged, replace spur gearshaft (1) (page 7-63).
B. If splined coupling (2) is damaged, replace No. 12 bearing and splined coupling (2) (page 7-86).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.



A. Clean AGB (page 7-46).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.

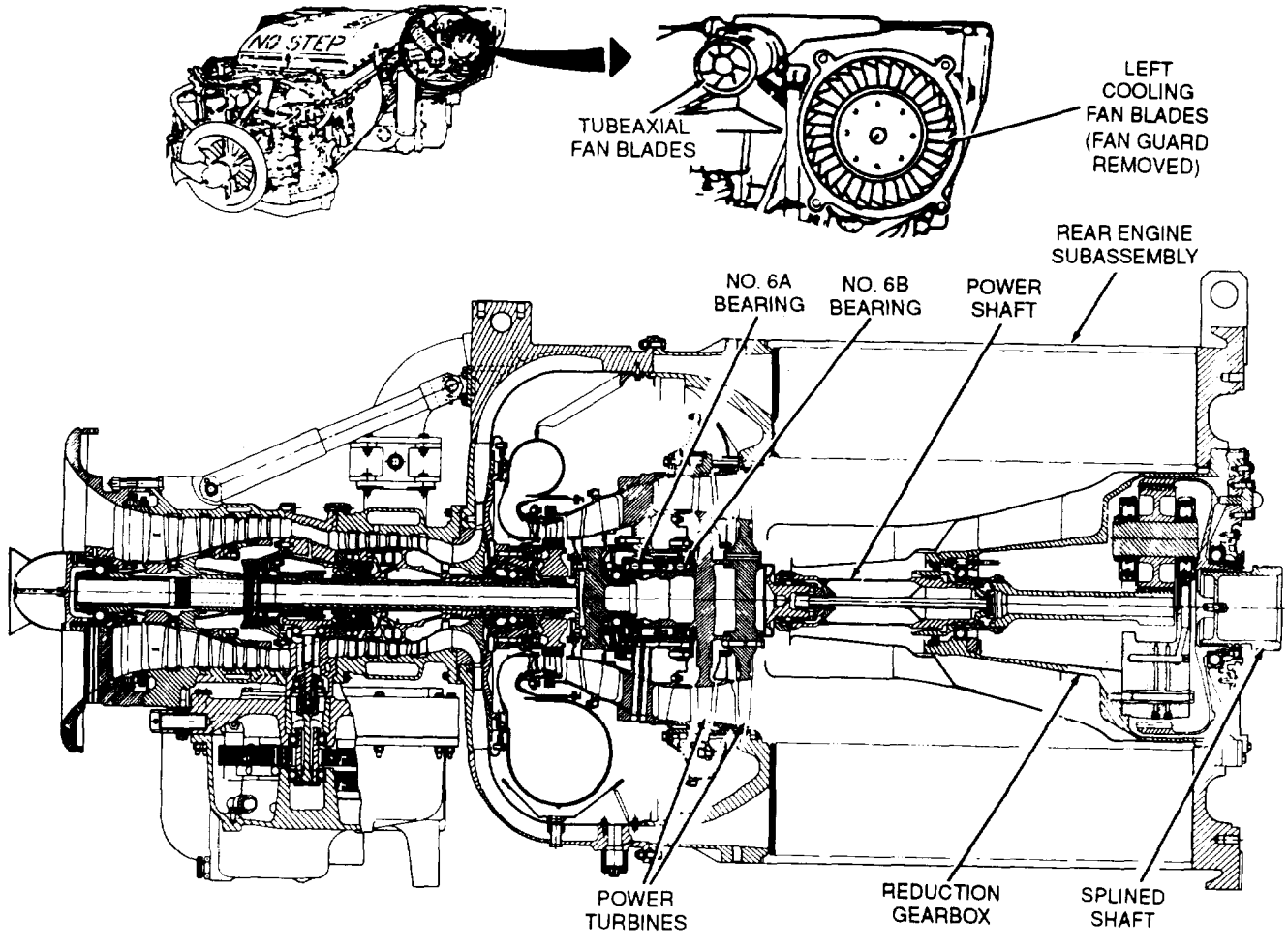


END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB)	(1) ES-40. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED.

This section contains troubleshooting to locate and correct the cause(s) of rubbing or binding when the tubeaxial fan blades or left cooling fan blades are turned by hand when no other rotation or metal chips were noted. The power turbine and RGB are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB bearings and/or gears, binding will be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The transmission is mechanically coupled to the RGB through a splined shaft. If there is internal transmission damage, binding will be felt when turning the tubeaxial fan blades or left cooling fan blades by hand. The art on this page provides an overview of the engine power turbine, RGB and transmission. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

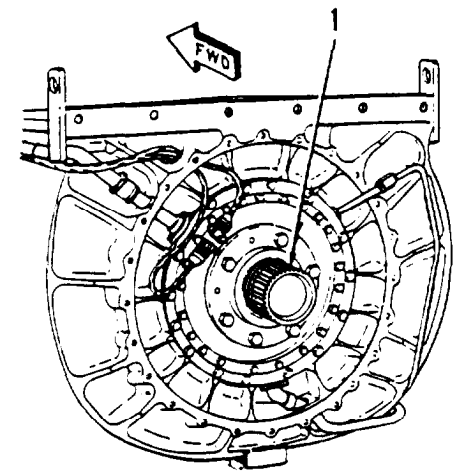
k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(1) ES-40. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED -

Tools: General mechanic's tool kit: automotive (SC 5180-90-N26)	Supplies: Wiping rag (Item 14, Appendix B) References: TM 34-1

1 A. Disconnect engine assembly from transmission assembly (TM 34-1).

NOTE
Splined shaft (1) does not turn easily. You may have to use both hands and some force.

B. Check rotation of splined shaft (1) by turning shaft (1) clockwise. Shaft should turn smoothly. No rubs or binds should be felt and no unusual noises should be heard.



Does shaft turn smoothly with no unusual noises?

NO — YES

A. Troubleshoot transmission (TM 34-1).
B. Install engine assembly on transmission assembly (TM 34-1).
C. Verify problem is solved.

CONTINUED ON NEXT PAGE

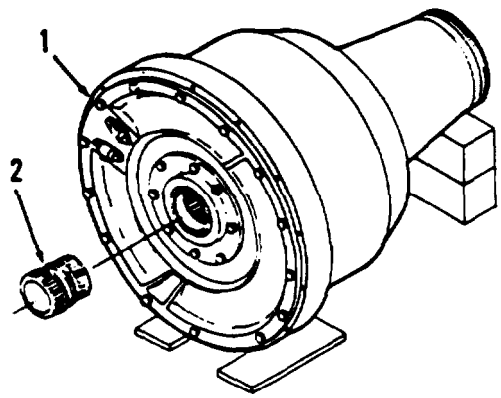
3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (1) GEARBOX (RGB) - CONTINUED	ES-40 RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

CONTINUED FROM STEP 1

2 A. Remove RGB assembly (page 6-17).
B. Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

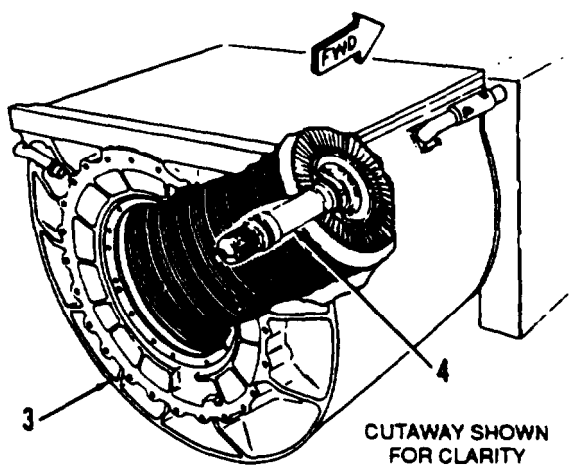


NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Verify problem is solved.

3 Check rotation of power turbine in rear engine subassemby (3) by turning shouldered shaft (4) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

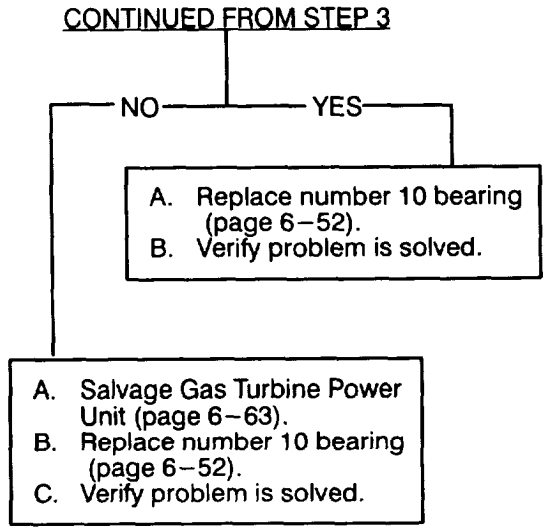
Does shaft turn smoothly with no unusual noises?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (1) GEARBOX (RGB) - CONTINUED	ES-40. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND. NO OTHER ROTATION OR METAL CHIPS NOTED. - CONTINUED

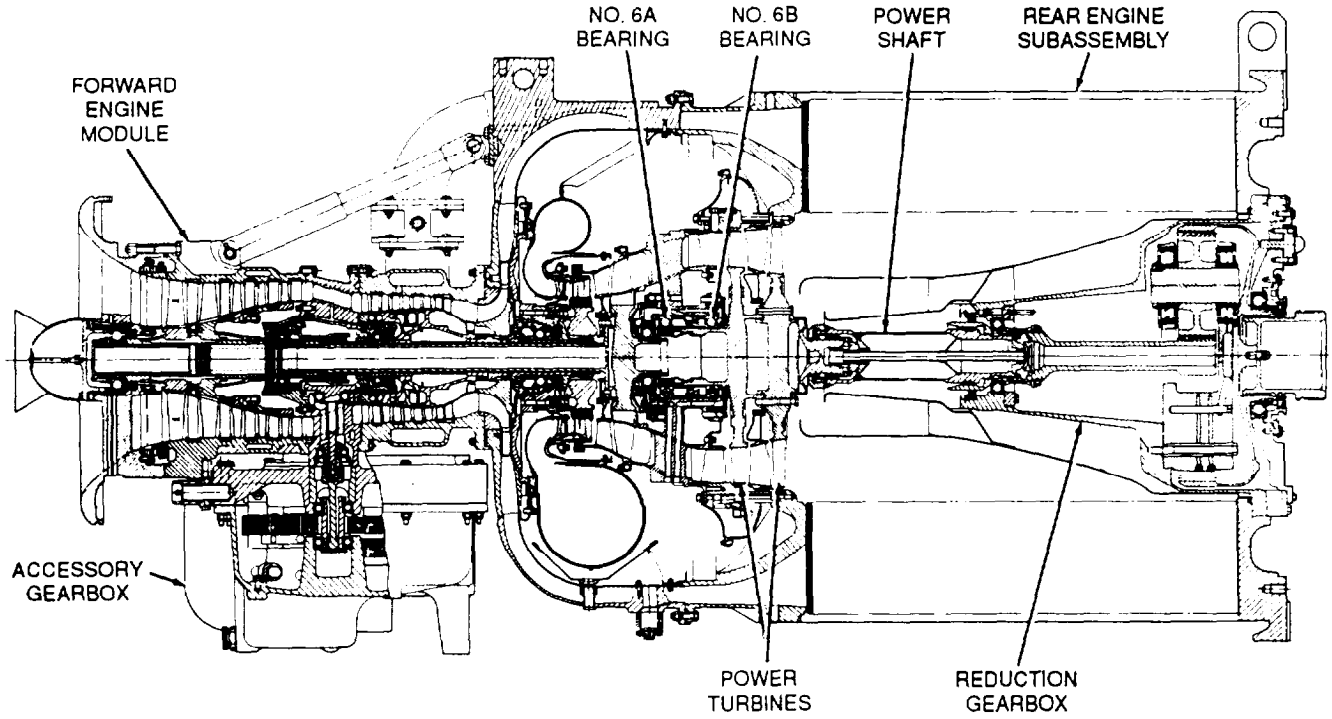


END OF TASK

3-2. TROUBLESBOOTING - CONTINUED

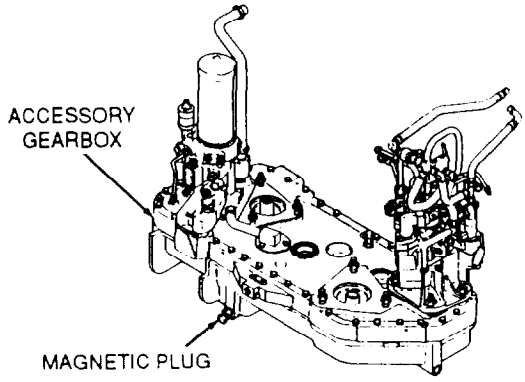
k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(2) ES-41. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

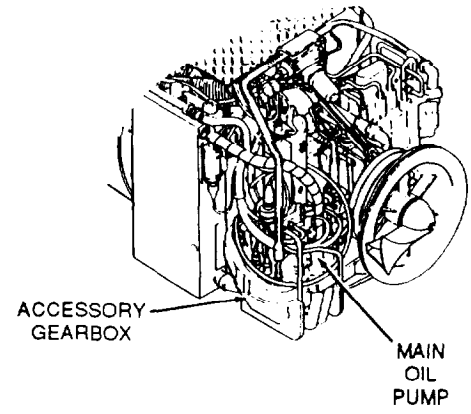
This section contains troubleshooting to locate and correct the cause(s) of binding when the tubeaxial fan blades or left cooling fan blades are turned by hand and more than one half of the AGB magnetic plug is covered with metal chips. The power turbine and RGB are coupled mechanically through the power shaft. If there is damage to-the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB bearings and/or gears, binding will be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The AGB acts as an oil sump to collect oil scavenged from bearings in the forward engine module and rear engine subassembly. The main oil pump pumps the hot oil from the sump to the engine oil cooler. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.

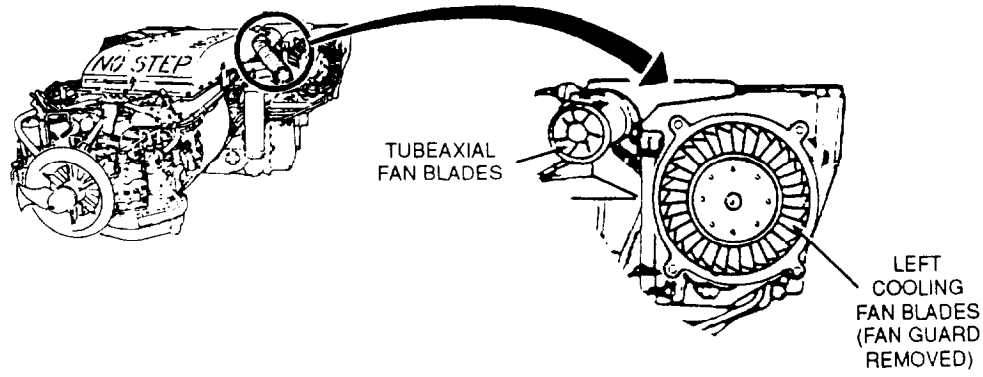


3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(2) ES-41. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED







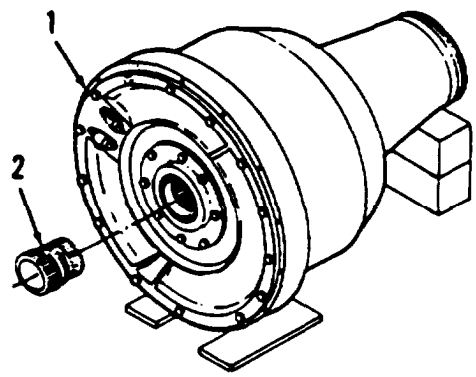
3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (2) GEARBOX (RGB) - CONTINUED	ES-41. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

Tools: General mechanic's tool kit: automotive (SC 5160-90-N26)	Supplies: Wiping rag (Item 14, Appendix B) References: TM 20-1

1 A. Remove RGB assembly (page 6-17).
B. Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



NO — YES

A. Salvage Gas Turbine Power Unit (pa e 6-63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (2) GEARBOX (RGB) - CONTINUED	ES-41. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

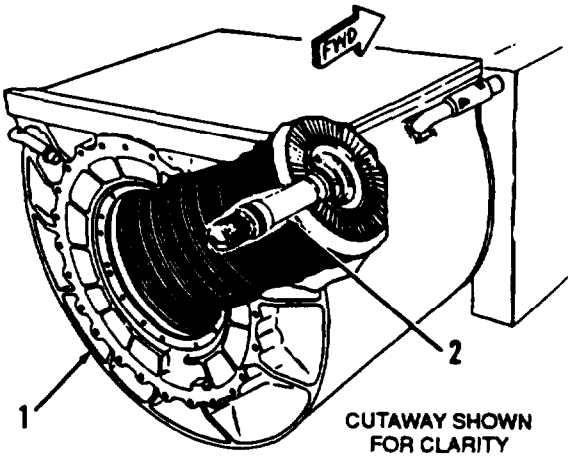
CONTINUED FROM STEP 1

Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

NO — YES

A. Replace number 10 bearing (page 6-52).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (2) GEARBOX (RGB) - CONTINUED	ES-41. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

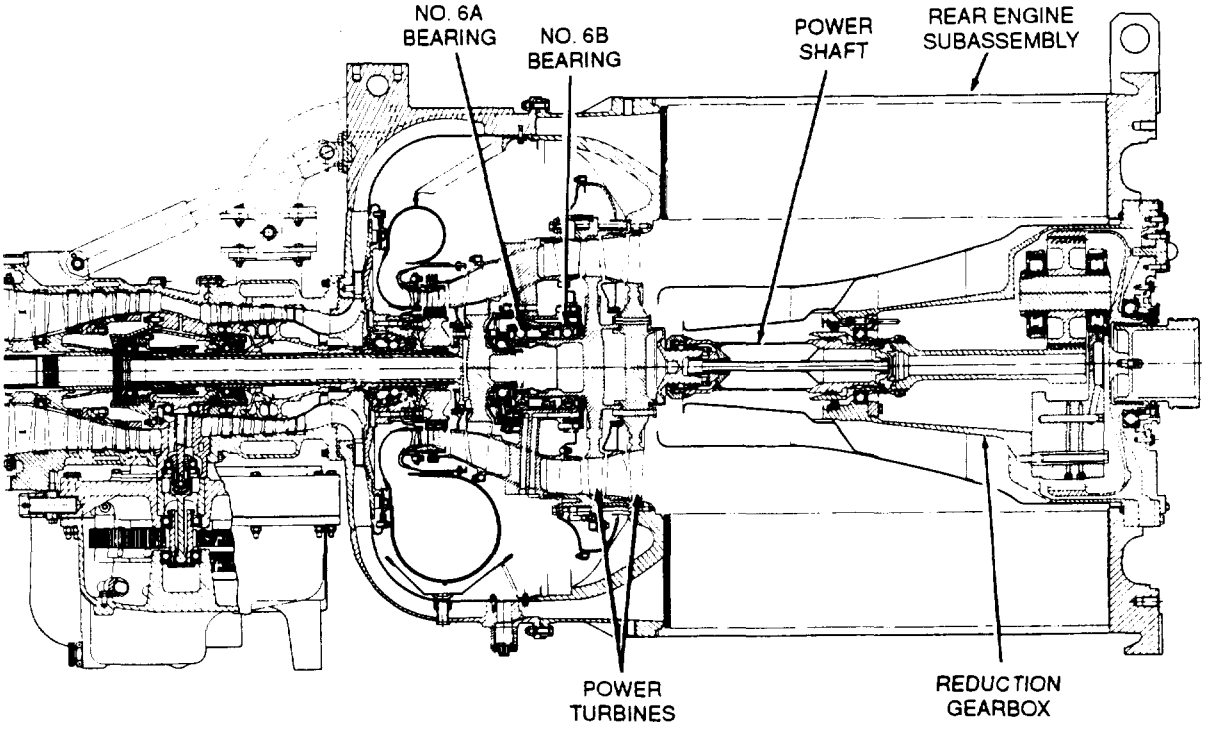
A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

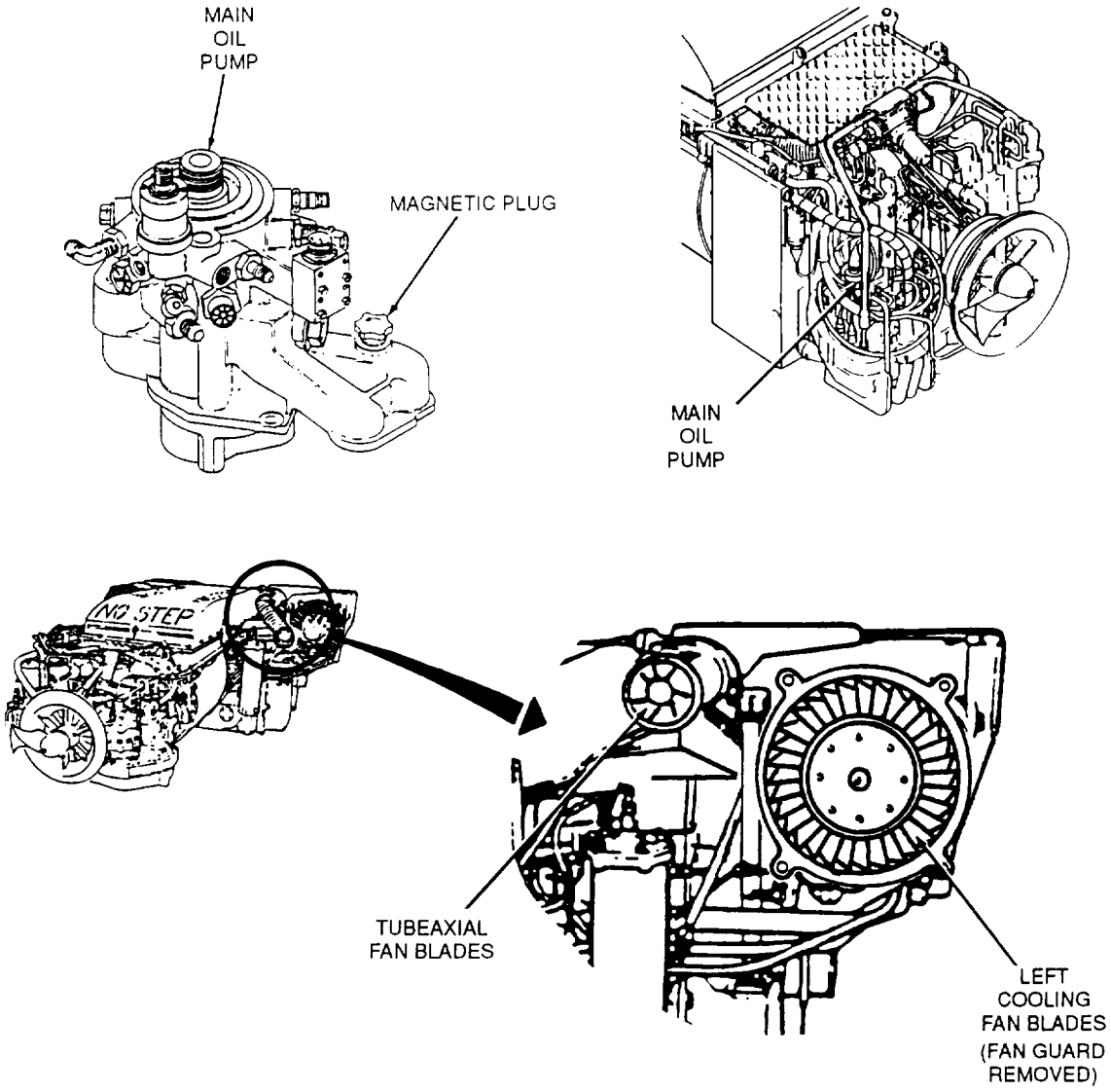
k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(3) ES-42. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS.

This section contains troubleshooting to locate and correct the cause(s) of rubbing or binding when the tubeaxial fan blades or left cooling fan blades are turned by hand, and more than one half of the main oil pump magnetic plug is covered with metal chips. The power turbine and RGB are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB bearings and/or gears, binding will be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The RGB oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. The art on this page provides an overview of the systems described above. Refer to this page along with in-text art while performing troubleshooting.



3-2. TROUBLESHOOTING - CONTINUED

k.	POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(3) ES-42. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED



3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(3) ES-42. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
Metal pail (Item 136, Appendix D)

Supplies:
Dry cleaning solvent (Item 7, Appendix B)
Wiping rag (Item 14, Appendix B)

References:
TM 20-1

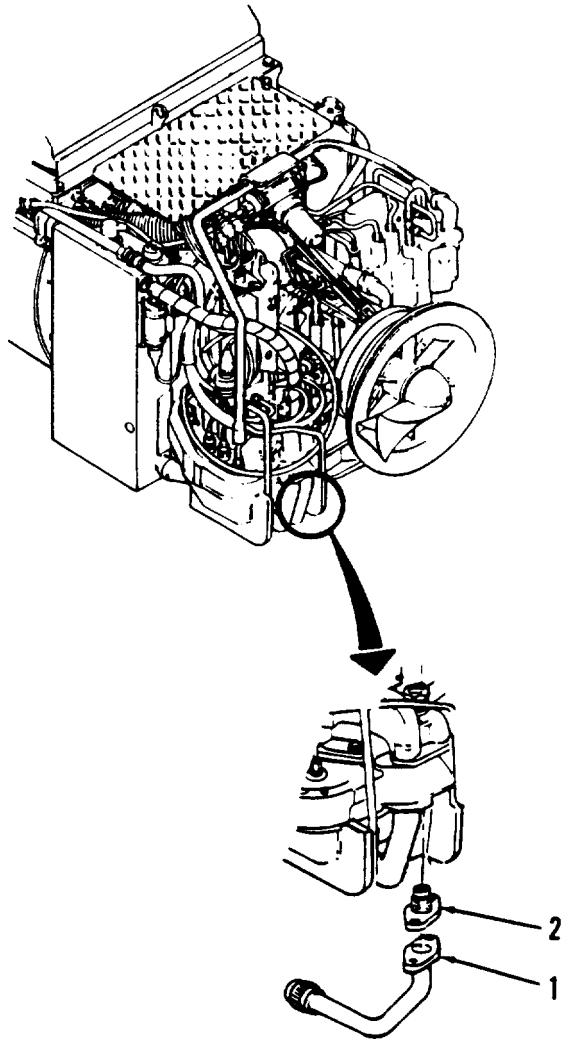
1 A. Remove forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).

WARNING

B. Pour one quart of dry cleaning solvent through scavenge tube assembly (1) and into clean pail.
C. Check solvent in pail for metal chips.

Are there metal chips in solvent?

CONTINUED ON NEXT PAGE



3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(3) ES-42. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

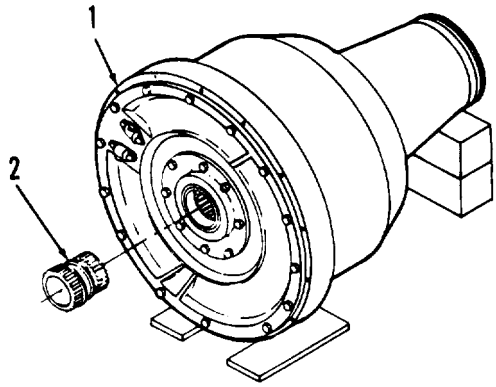
2 A. Remove RGB assembly (page 6-17).
B. Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft [2) clockwise. Shaft should turn smoothly and no unusual noises shduld be heard.

Does shaft turn smoothly with no unusual noises?

NO

A. Clean RGB lubrication system (page 8-1).
B. Replace RGB assembly (page 6-17).
C. Replace engine oil pump (TM 20-1).
D. Verify problem is solved.

YES



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (3) GEARBOX (RGB) - CONTINUED	ES-42. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

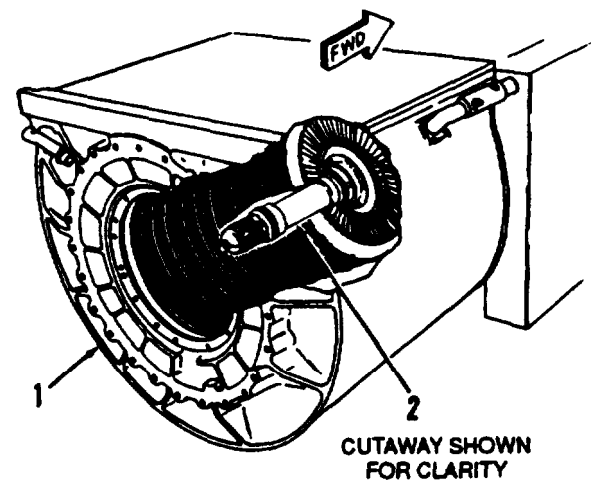
CONTINUED FROM STEP 2

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.

3 Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (3) GEARBOX (RGB) - CONTINUED	ES-42. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF MAIN OIL PUMP MAGNETIC PLUG IS COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 3

NO — YES

A. Replace number 10 bearing (page 6-52).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.

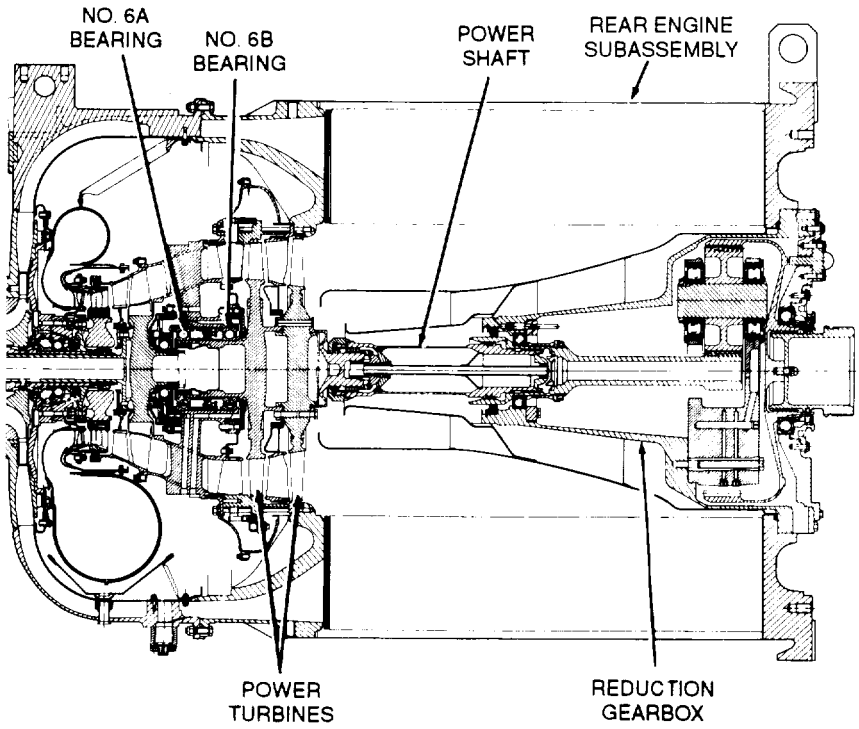
A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

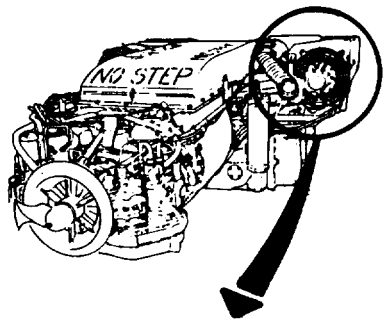
END OF TASK

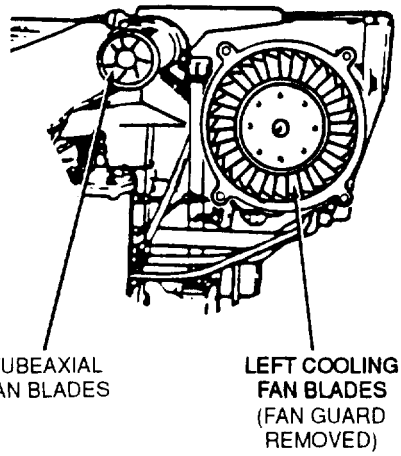
3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(4)	ES-43. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER.

This section contains troubleshooting to locate and correct the cause(s) of rubbing or binding when the tubeaxial fan blades or left cooling fan blades are turned by hand, and metal chips are found in the oil pump to oil cooler fluid filter. The power turbine and RGB are coupled mechanically through the power shaft. If there is damage to the power turbine, rear engine subassembly position No 6A or 6B bearing, or RGB bearings and/or gears, binding will be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. Whenever metal chips are generated, the fluid filter will catch most of the chips. It can be assumed, for this symptom, that the magnetic plug on either the accessory gearbox (AGB) or main oil pump has been wiped clean. Further fault isolation is required to determine which module is faulty. The art on the following pages provides an overview of the above described system. Refer to these pages along with in-text art while performing troubleshooting.

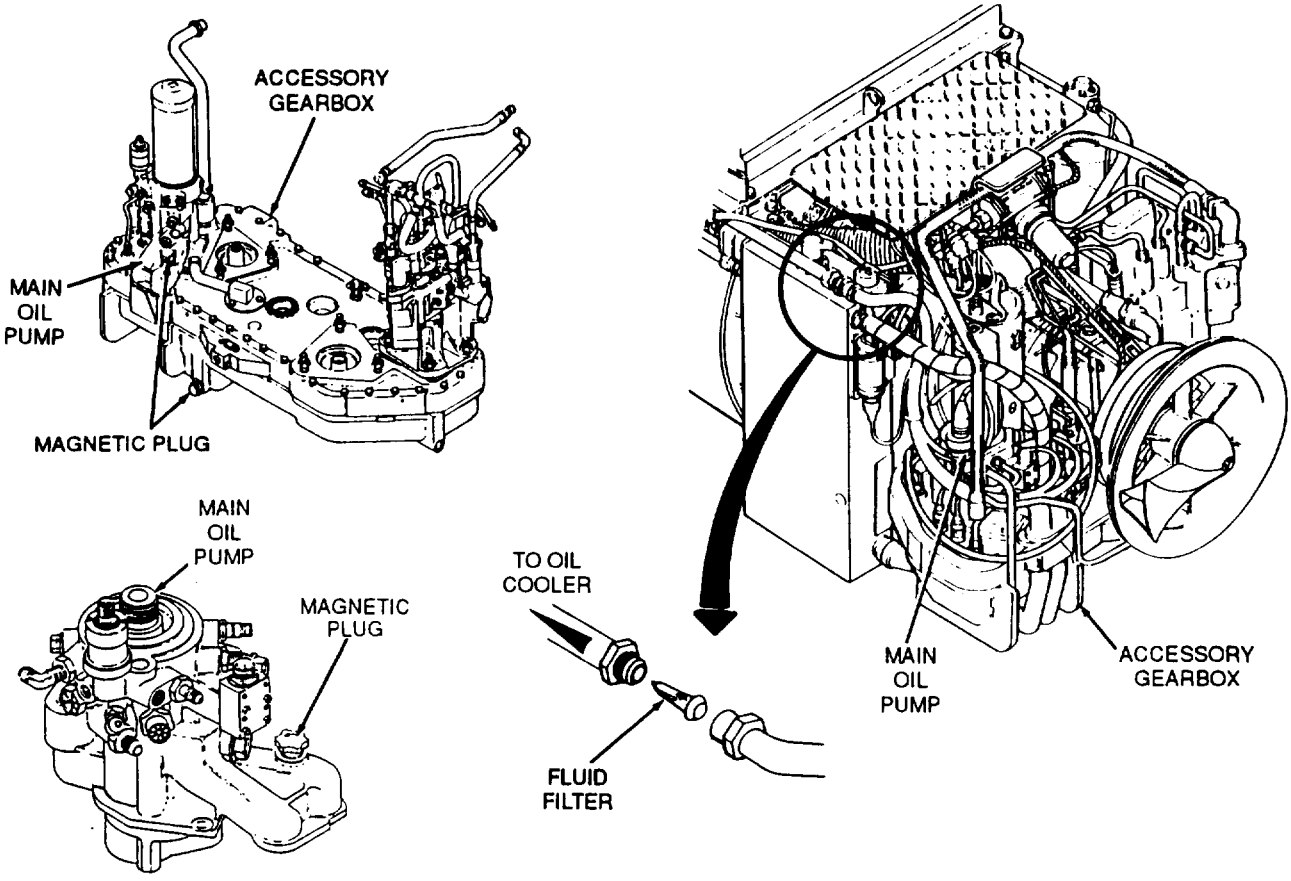






3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(4) ES-43. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED



3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(4) ES-43. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
Vernier depth gage (Item 139, Appendix D)

References:
TM 20-1

Supplies:
Wiping rag (Item 14, Appendix B)
Writing paper (Item 41, Appendix B)
Writing pencil (Item 27, Appendix B)

1	A. Remove RGB assembly (page 6-17). B. Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

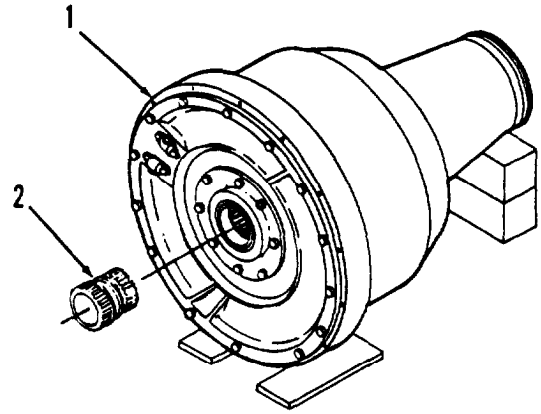
NO — YES

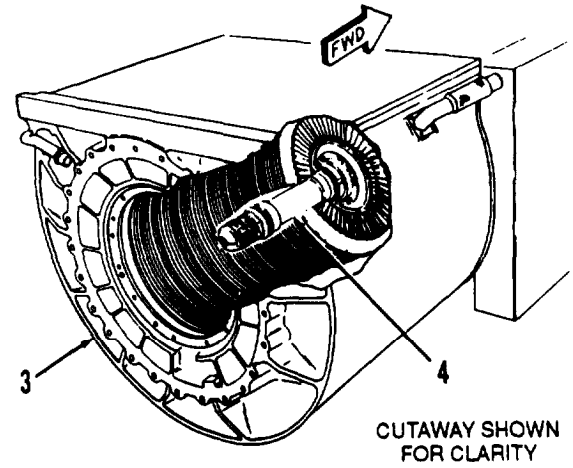
Go to step 3.

2	Check rotation of power turbine in rear engine subassembly (3) by turning shouldered shaft (4) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

CONTINUED ON NEXT PAGE





3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (4) GEARBOX (RGB) - CONTINUED	ES-43. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. Replace number 10 bearing (page 6-52).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Clean cooler and generator lines (TM 20-1).
H. Verify problem is solved.

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (4) GEARBOX (RGB) - CONTINUED	ES-43. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

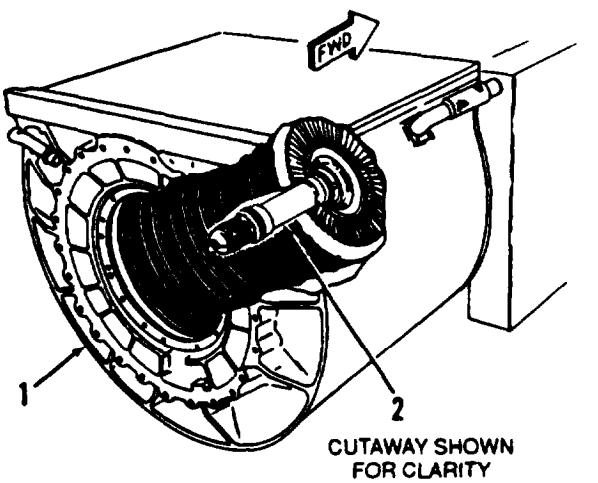
FROM STEP 1

Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

NO — YES

A. Replace number 10 bearing (page 6-52).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1).
F. Verify problem is solved.



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (4) GEARBOX (RGB) - CONTINUED	ES-43. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 3

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(4) ES-43. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND THERE ARE METAL CHIPS IN THE OIL PUMP TO OIL COOLER FLUID FILTER. - CONTINUED

CONTINUED FROM STEP 4

YES — NO

A. Replace RGB assembly (page 6-19).
B. Replace engine oil pump (TM 20-1).
C. Replace engine oil cooler (TM 20-1).
D. Replace engine AC generator (TM 20-1).
E. Clean cooler and generator lines (TM 20-1) .
F. Verify problem is solved.

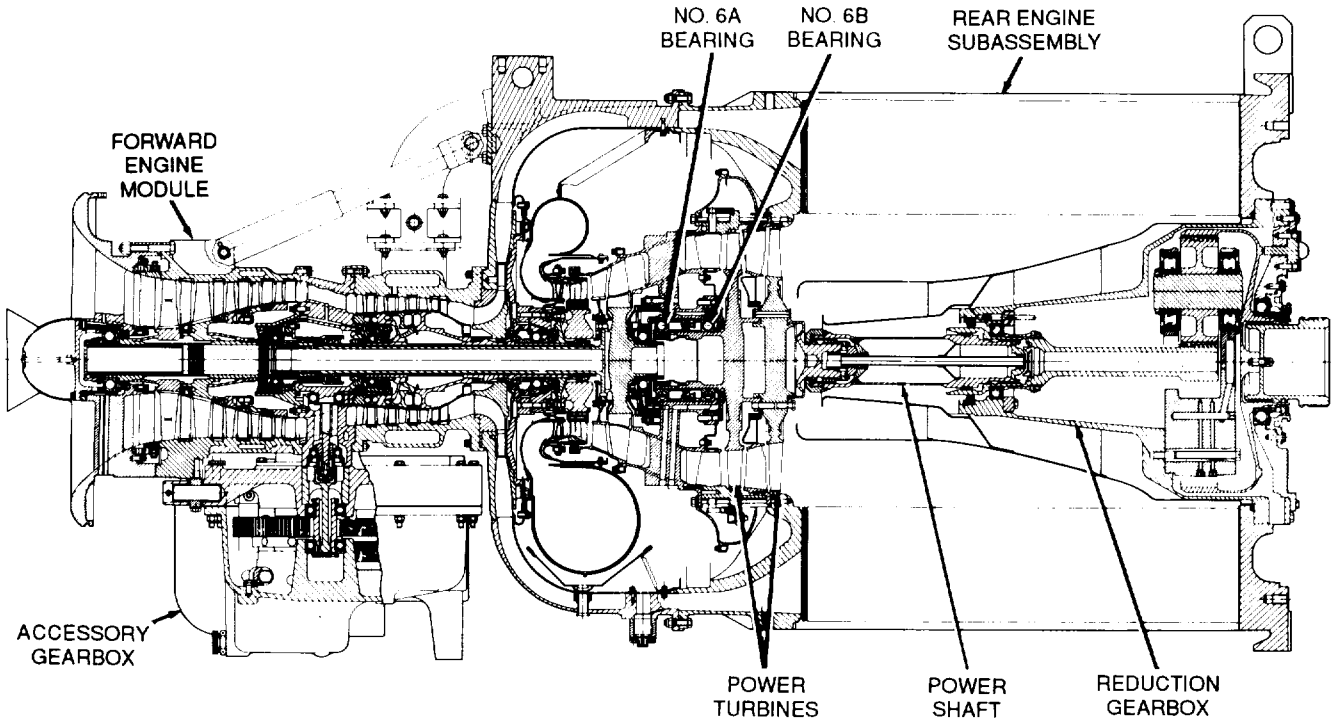
A. Replace rear engine subassembly (page 6-28).
B. Replace engine oil cooler (TM 20-1).
C. Replace engine AC generator (TM 20-1) .
D. Replace engine oil pump (TM 20-1).
E. Clean AGB (page 7-46).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

END *OF* TASK

3-2. TROUBLESHOOTING - CONTINUED

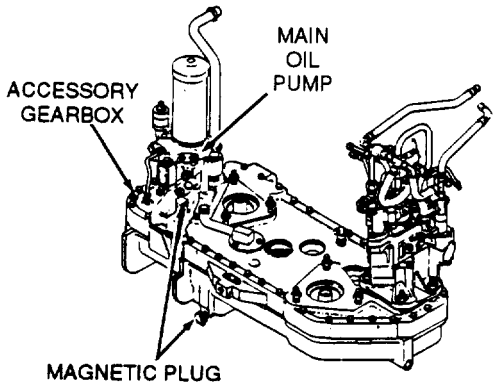
k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(5)	ES-44. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS.

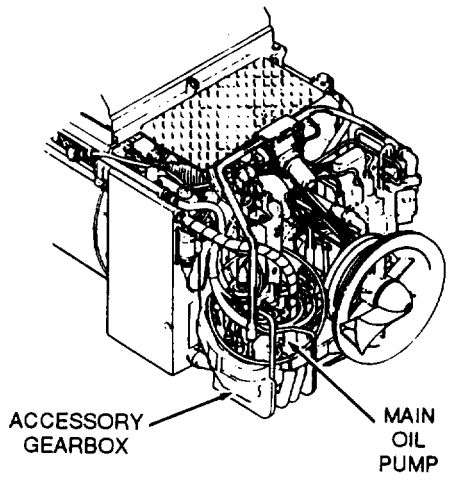
thls section contalns troubleshootng to locate and correct the cause(s) of rubbing or binding when the tubeaxial fan blades or left cooling fan blades are turned by hand, when more than one half of the AGB and main oil pump magnetic plugs, are covered with metal chips. The power turbine and RGB are coupled mechanically through the power shaft. lf there is damage to the power turbine, rear engine subassembly position No. 6A or 6B bearing, or RGB bearings and/or gears, binding w1ll be felt when the tubeaxial fan blades or left cooling fan blades are turned by hand. The AGB acts as an oil sump to collect oil scavenged from bearings in the forward engine module and rear engine subassembly. The main oil pump pumps the hot oil from the sump to the engine oil cooler. The RGB oil return line feeds directly into the oil pump passage that houses the magnetic plug. The only possible source of metal chips on the oil pump magnetic plug is the RGB. The symptoms described above indicate a damaged rear engine subassembly and RGB. The art on the following pages provides an overview of the systems described above. Refer to these pages along with in-text art while performing troubleshooting.

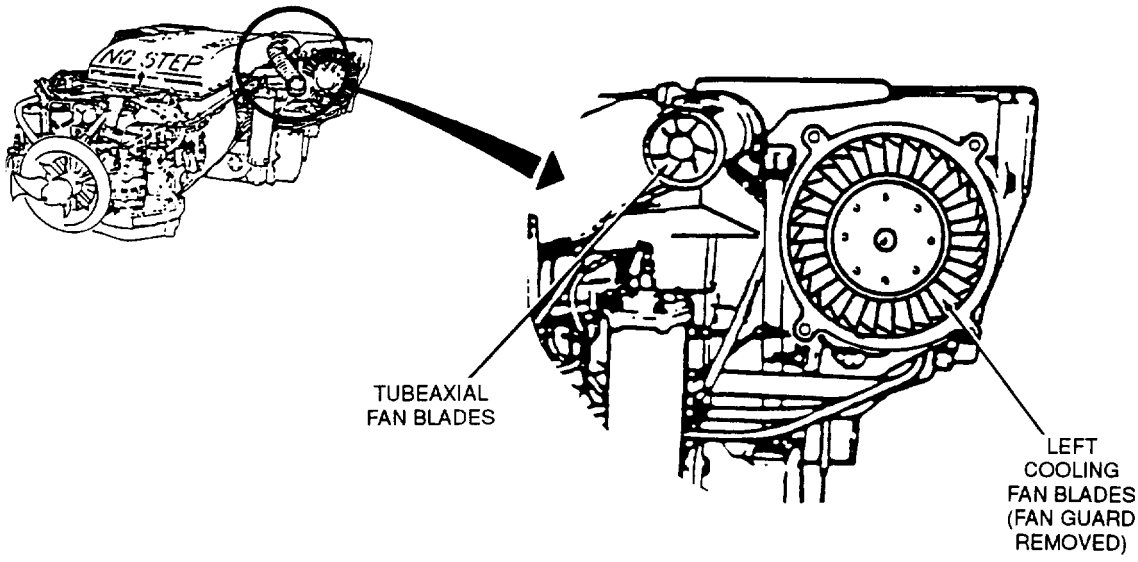


3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(5) ES-44. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED







3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(5) ES-44. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

Tools:
General mechanic's tool kit: automotive (SC 5180-90-N26)
Metal pail (Item 136, Appendix D)

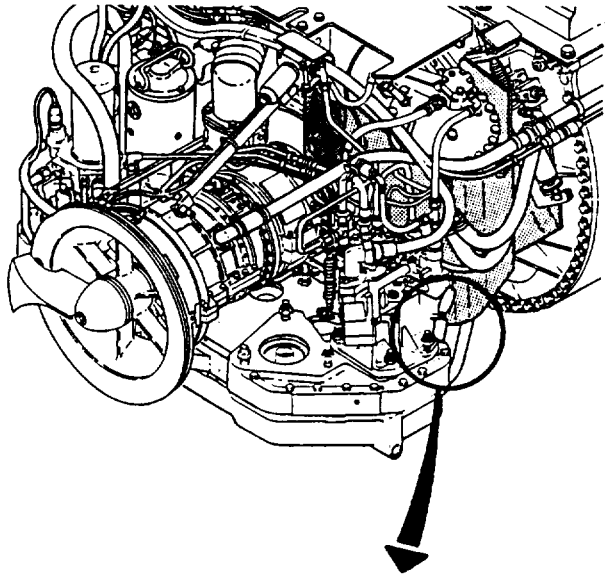
Supplies:
Dry cleaning solvent (Item 7, Appendix B)
Wiping rag (Item 14, Appendix B)

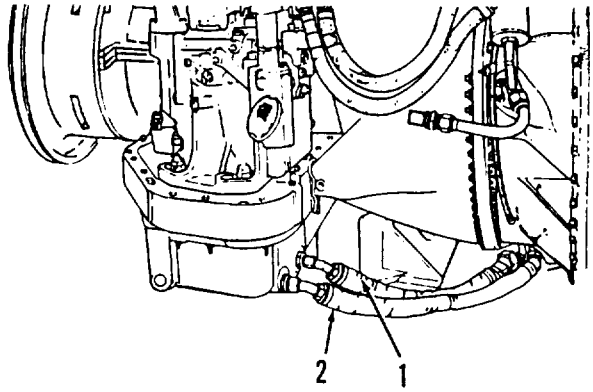
References:
TM 20-1

1 A. Remove No. 5 and 6A bearing scavenge hose assembly (1) and No. 6B scavenge hose assembly (2).

WARNING

B. Pour one quart of dry cleaning solvent through each hose (1, 2) and into clean pail.
C. Check solvent in pail for metal chips .





Are there metal chips in solvent?

CONTINUED ON NEXT PAGE

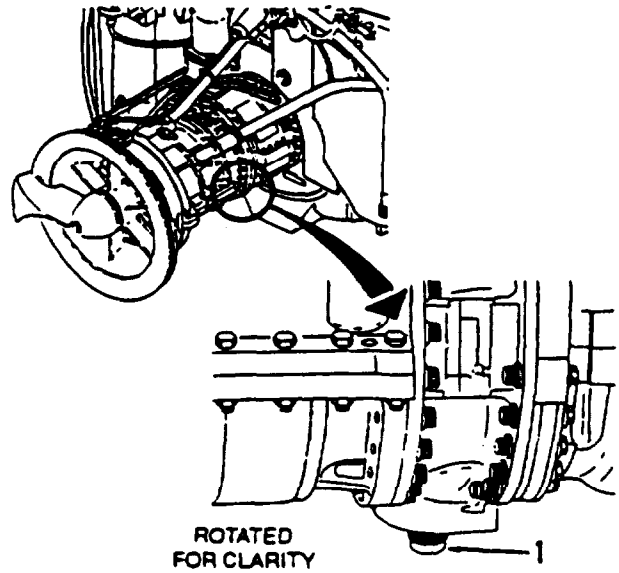
3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (5) GEARBOX (RGB) - CONTINUED	ES-44. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 1

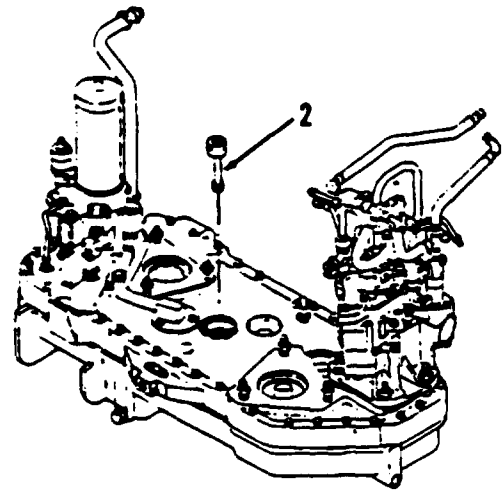
NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean RGB lubrication system (page 8-1).
C. Replace number 10 bearing (page 6-52).
D. Clean AGB (page 7-46).
E. Replace engine oil pump (TM 20-1).
F. Replace engine oil cooler (TM 20-1).
G. Replace engine AC generator (TM 20-1).
H. Clean cooler and generator lines (TM 20-1).
I. Verity problem is solved.



2 A. Remove AGB (page 7-21).
B. Check splined coupling (1) and spur gearshaft (2) for cracks, spine damage or breakage.

Is splined coupling or gearshaft damaged?



CONTINUED ON NEXT PAGE

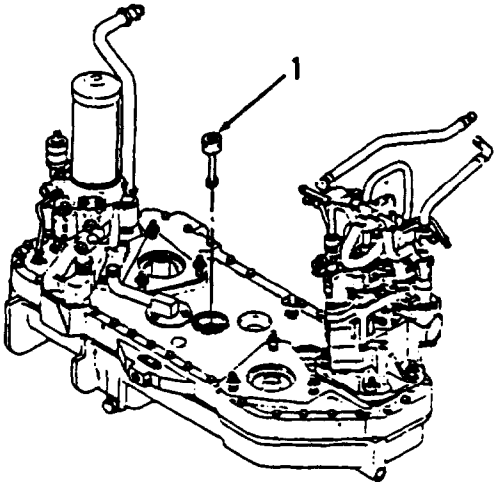
3-2. TROUBLESHOOTING - CONTINUED

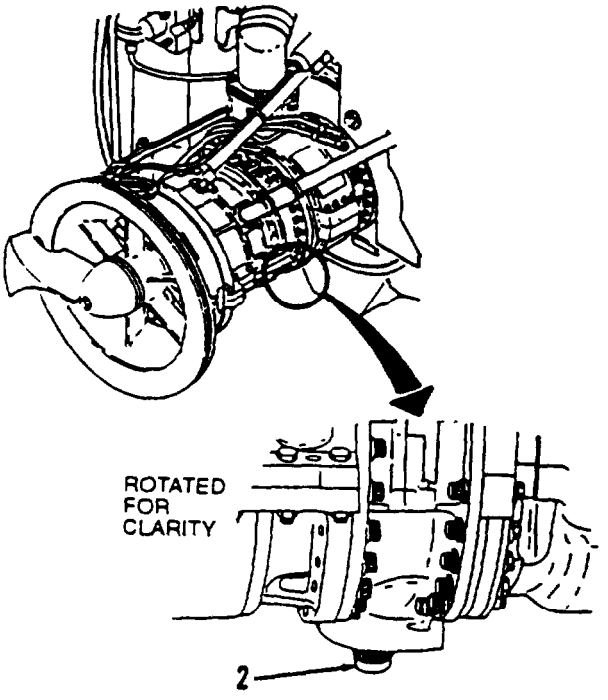
k. POWER TURBINE AND REDUCTION (5) GEARBOX (RGB) - CONTINUED	ES-44. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 2

NO — YES

A. If spur gearshaft (1) is damaged, replace spur gearshaft (1) (page 7-63).
B. If splined coupling (2) is damaged, replace No. 12 bearing and splined coupling (2) (page 7-86).
C. Replace number 10 bearing (page 6-52).
D. Clean RGB lubrication system (page 8-1).
E. Clean AGB (page 7-46).
F. Replace engine oil pump (TM 20-1).
G. Replace engine oil cooler (TM 20-1).
H. Replace engine AC generator (TM 20-1).
I. Clean cooler and generator lines (TM 20-1).
J. Verify problem is solved.





CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(5) ES-44. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

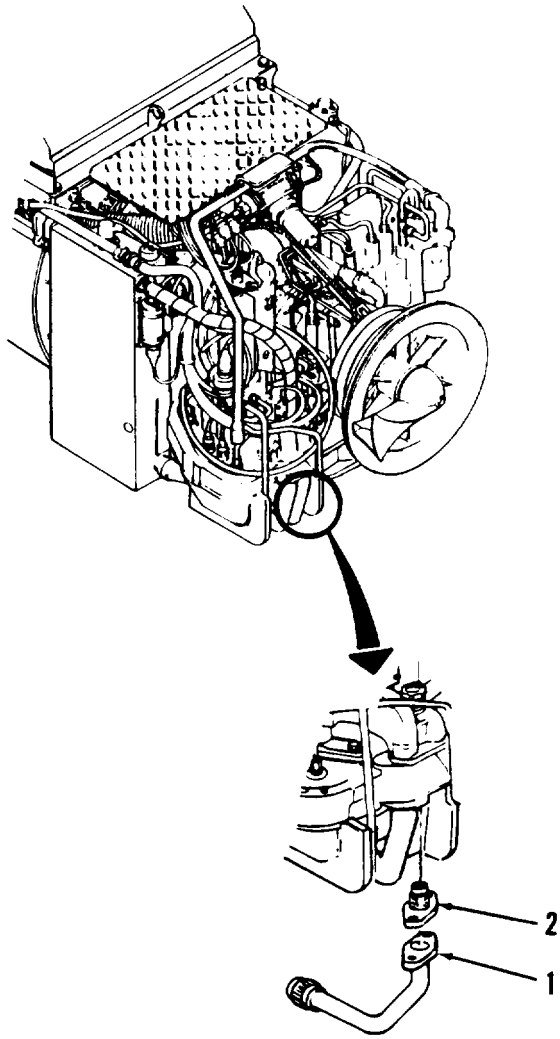
CONTINUED FROM STEP 2

3 A. Remove forward RGB scavenge tube assembly (1) and screen (2) (TM 20-1).

WARNING

B. Pour one quart of dry cleaning solvent through scavenge tube assembly (1) and into clean pail.
C. Check solvent in pail for metal chips.

Is there metal chips in solvent?



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION GEARBOX (RGB) - CONTINUED	(5) ES-44. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNET PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

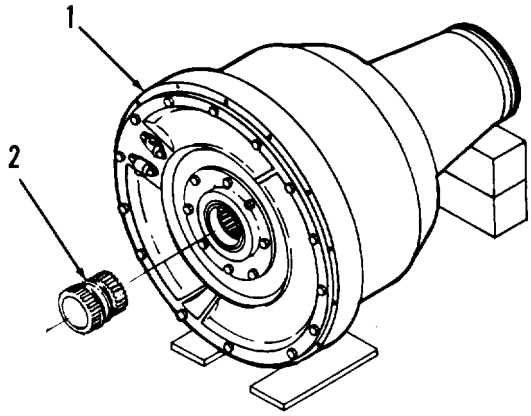
CONTINUED FROM STEP 3

4 A. Remove RGB assembly (page 6-17).
B. Check rotation of RGB assembly (1) by putting splined shaft (2) in RGB assembly and turning shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?

NO ——— YES

A. Clean RGB lubrication system (page 8-1).
B. Replace RGB assembly (page 6-17).
C. Clean AGB (page 7-46).
D. Replace engine oil pump (TM 20-1).
E. Replace engine oil cooler (TM 20-1).
F. Replace engine AC generator (TM 20-1).
G. Verify problem is solved.



CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (5) GEARBOX (RGB) - CONTINUED	ES-44. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

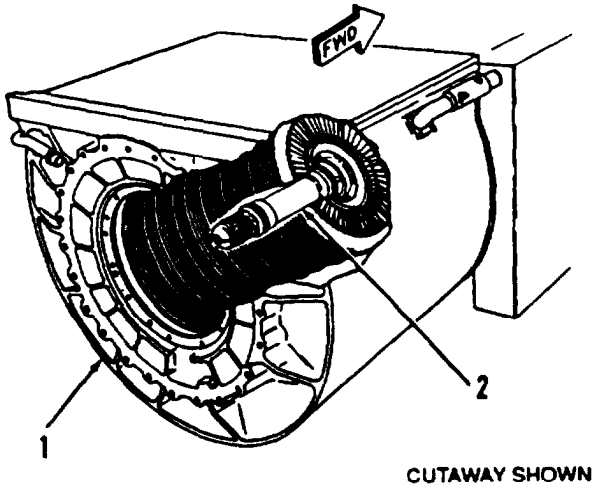
CONTINUED FROM STEP 4

NO — YES

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verity problem is solved.

Check rotation of power turbine in rear engine subassembly (1) by turning shouldered shaft (2) clockwise. Shaft should turn smoothly and no unusual noises should be heard.

Does shaft turn smoothly with no unusual noises?



CUTAWAY SHOWN FOR CLARITY

CONTINUED ON NEXT PAGE

3-2. TROUBLESHOOTING - CONTINUED

k. POWER TURBINE AND REDUCTION (5) GEARBOX (RGB) - CONTINUED	ES-44. RUBBING OR BINDING IS FELT WHEN TUBEAXIAL FAN BLADES OR LEFT COOLING FAN BLADES ARE TURNED BY HAND AND MORE THAN ONE HALF OF ACCESSORY GEARBOX (AGB) AND MAIN OIL PUMP MAGNETIC PLUGS ARE COVERED WITH METAL CHIPS. - CONTINUED

CONTINUED FROM STEP 5

NO

A. Salvage Gas Turbine Power Unit (page 6-63).
B. Replace number 10 bearing (page 6-52).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verity problem is solved.

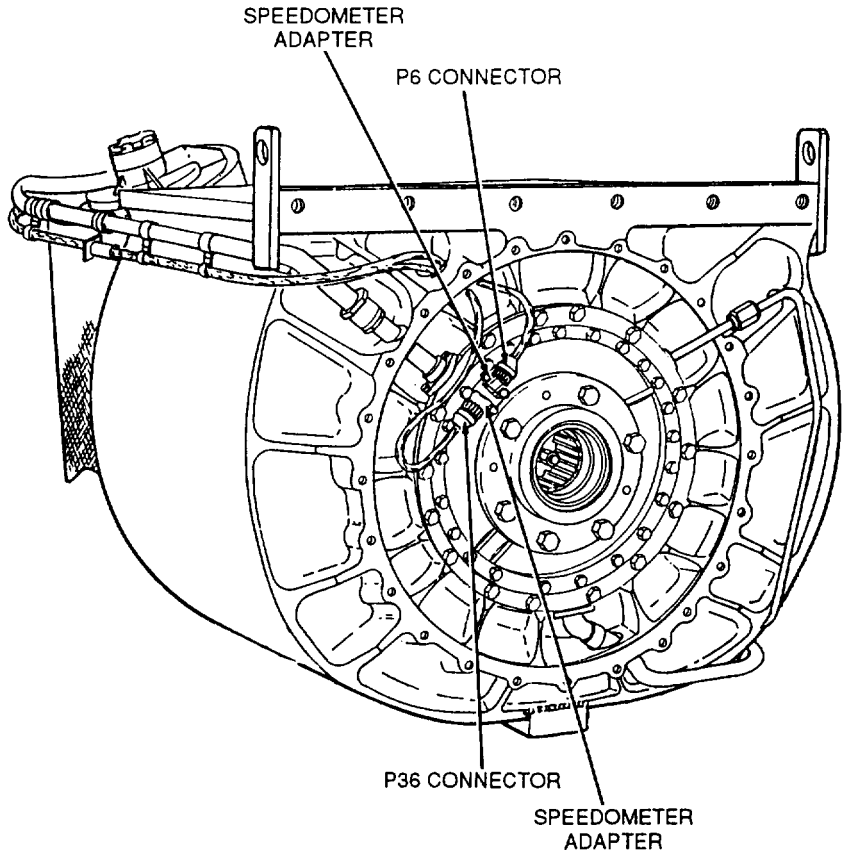
YES

A. Replace number 10 bearing (page 6-52).
B. Clean AGB (page 7-46).
C. Replace engine oil pump (TM 20-1).
D. Replace engine oil cooler (TM 20-1).
E. Replace engine AC generator (TM 20-1).
F. Clean cooler and generator lines (TM 20-1).
G. Verify problem is solved.

END OF TASK

3-2. TROUBLESHOOTING - CONTINUED	
1. SPEED CIRCUIT	(1) ES-45. ENGINE SPEED CIRCUIT FAULTY.

This section contains troubleshooting to determine and correct the cause(s) of a faulty engine speed circuit. The engine output speed is sensed by two independent speedometer adapters located on the rear cover of the reduction gearbox (RGB) and coupled to the electronic control unit (ECU) by an electrical cable. If both speedometer adapter circuits are faulty, engine output RPM will not be indicated and the ECU will induce a protective mode of operation. The art on this page provides an overview of the engine output speed circuit described above. Refer to this page along with in-text art while doing troubleshooting.



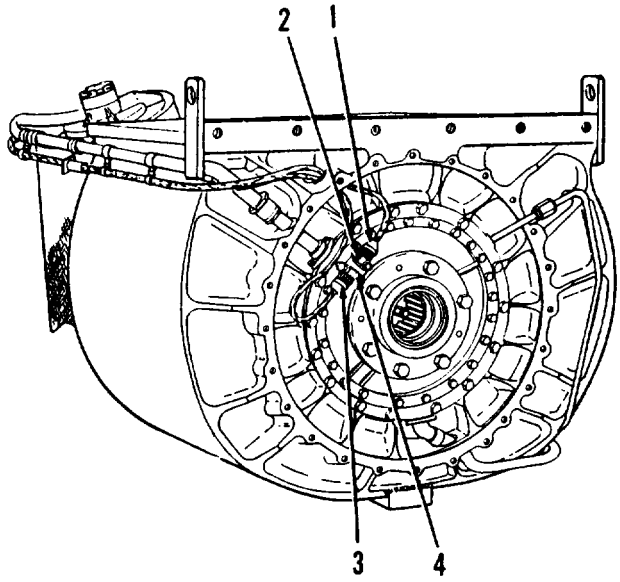
3-2. TROUBLESHOOTING - CONTINUED

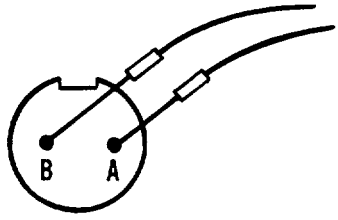
1. SPEED CIRCUIT - CONTINUED	(1) ES-45. ENGINE SPEED CIRCUIT FAULTY. - CONTINUED

Tools:	References:
Multimeter (Item 49, Appendix D)	TM 34-1

1 A. Disconnect engine assembly from transmission assembly (TM 34-1).
B. Remove P6 connector (1) from speedometer adapter (2) and P36 connector (3) from speedometer adapter (4).
C. Prepare multimeter for ohms test.
D. Test for 80 to 460 ohms between pins A and B of speedometer adapters (2, 4).

Does multimeter show 80 to 460 ohms?





YES

A. Replace speedometer adapter (page 6-3).
B. Verify problem is solved.

NO

A. Replace speed wiring harness (page 6-3).
B. Verify problem is solved.

END OF TASK

CHAPTER 4

PACK AND UNPACK ENGINE

CHAPTER INDEX

TOP WELDMENT REMOVAL AND INSTALLATION (Sheet 1 of 4)

TOOLS: Automotive fuel and electrical system repair toolkit (SC5l8O-95-CL-BO8)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Deep style socket, l/2-inch drive, 3/4 inch (Item 43, Appendix D)
Hoist, 1000-pound minimum capacity (Item 11, Appendix D)
Lifting sling, 4-point, 1000-lb (item 89, Appendix D)
Pinch bar (Item 85, Appendix D)

PERSONNEL: Three

NOTE

Use this task to remove and install any top weldment (1). Engine shipping container (2) is shown.

REMOVAL:

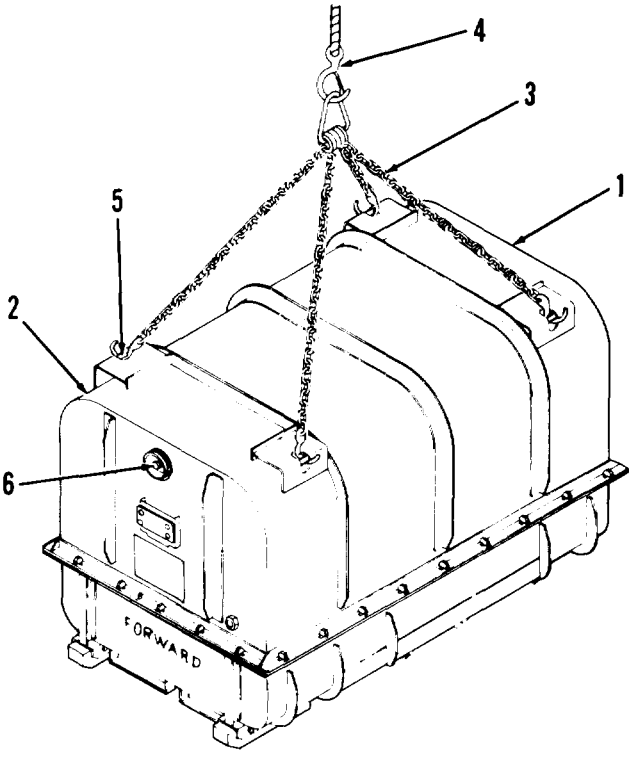
1. ATTACH SLING (3) AND RELEASE AIR PRESSURE.

   a. Attach sling (3) to hoist hook (4),

   b. Place sling (3) over container (2).

   c. Attach sling (3) to four corner lifting rods (5).

   d. Press air release button (6) and hold until no escaping air can be heard.



Go on to Sheet 2

TOP WELDMENT REMOVAL AND INSTALLATION (Sheet 2 of 4)

NOTE

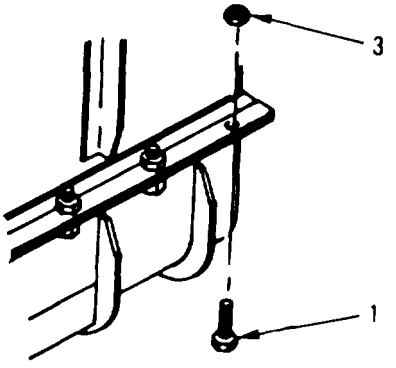
- Containers may have bolts (1) or T-bolts (2). If bolts (1) are used, do step 2a.
- Quantities of bolts (1) or T-bolts (2) are different for each container. Quantities required for each container are as follows:
  - AGB module shipping container (20 required).
  - Engine shipping container (28 required).
  - Forward engine module shipping container (22 required).
  - Rear engine module shipping container (26 required).
  - Reduction gearbox assembly shipping container (14 required).

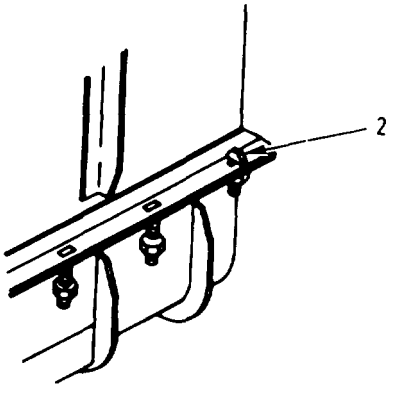
2. REMOVE 28 BOLTS (1) OR 28 T-BOLTS (2).

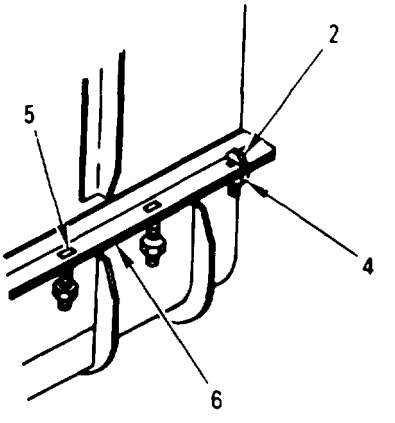
   a. Remove bolts (1) and nuts (3).

   b. Loosen 28 nuts (4).

   c. Turn T-bolts (2) l/4-turn until they drop through slots (5) in top weldment flange (6).







Go on to Sheet 3

TOP WELDMENT REMOVAL AND INSTALLATION (Sheet 3 of 4)

WARNING

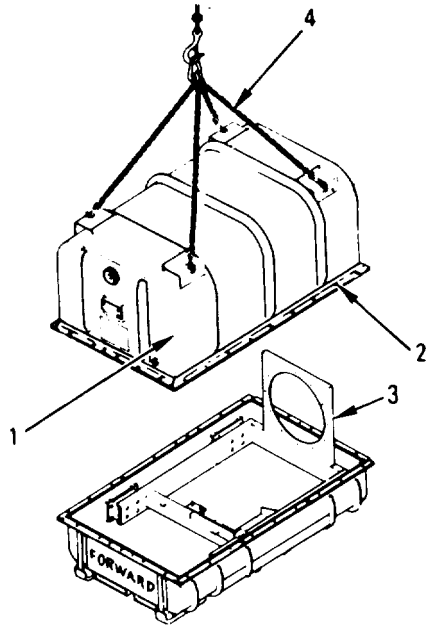
CAUTION

Use care when taking off top weldment (1). Hold top weldment (1) steady as it is lifted so it does not hit and damage engine parts.

3. LIFT TOP WELDMENT (1) STRAIGHT UP, UNTIL FLANGE (2) IS ABOUT 12 INCHES (30.48 CM) ABOVE AFW MOUNTING FLANGE (3). PUT TOP WELDMENT (1) NEARBY ON A CLEAN SURFACE.

4. INSPECT TOP WELDMENT (1) FOR CRACKS, BREAKS, OR WARPS. REPLACE AS REQUIRED.

5. UNHOOK AND STOW SLING (4).



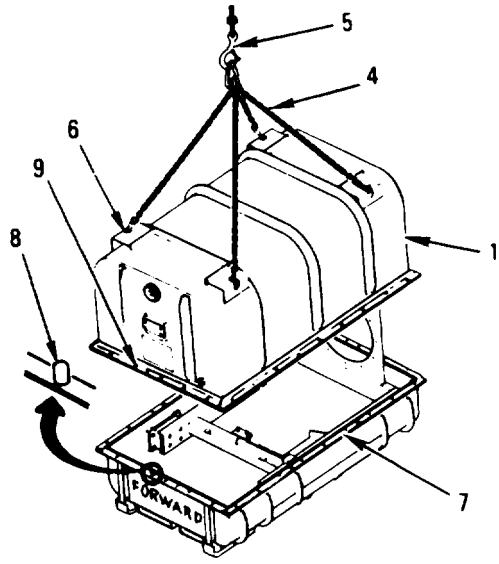
INSTALLATION:

1. ATTACH SLING (4) AND POSITION TOP WELDMENT (1).

   a. Lower hoist hook (5) over top weldment (1). Hook sling (4) to hoist hook (5).

   b. Hook sling (4) to four rods (6) of top weldment (1).

   c. Place top weldment (1) over bottom weldment (7). Lower top weldment (1) and mate with bottom weldment (7) so that pin (8) goes through hole (9).



Go on to Sheet 4

TOP WELDMENT REMOVAL AND INSTALLATION (Sheet 4 of 4)

2. SECURE TOP WELDMENT (1).

NOTE

If container has T-bolts (2), go to step c.

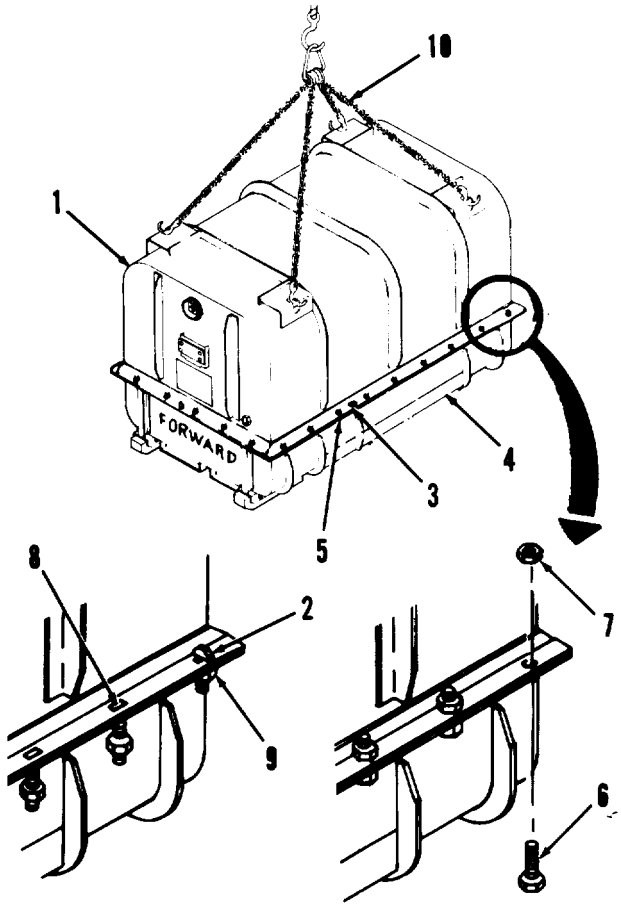
a. Put bar in hole (3) and move bottom weldment (4) until holes (5) aline.

b, Install 28 bolts (6) and nuts (7).

c. Put bar in hole (3) and move bottom weldment (4) until slots (8) aline.

d. Push 28 T-bolts (2) up through slot (8) and turn them l/4-turn. Tighten 28 nuts (9).

3. UNHOOK AND STOW SLING (10).



End of Task

ENGINE/REAR MODULE LIFTING SLING INSTALLATION AND REMOVAL (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-N26)
Engine/Rear module lifting sling (Item 32, Appendix D)
Hoist, 2-ton minimum capacity (item 36, Appendix D)

PERSONNEL: Two

INSTALLATION:

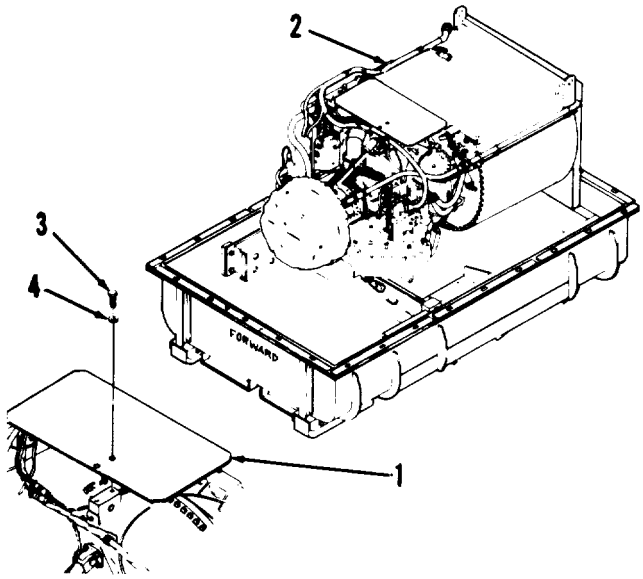
NOTE

If step plate (1) is on engine (2), do step 1.

1. REMOVE PLATE (1).

a. Remove two bolts (3) and lock-washers (4).

b. Remove plate (1).



Go on to Sheet 2

ENGINE/REAR MODULE LIFTING SLING INSTALLATION AND REMOVAL (Sheet 2 of 2)

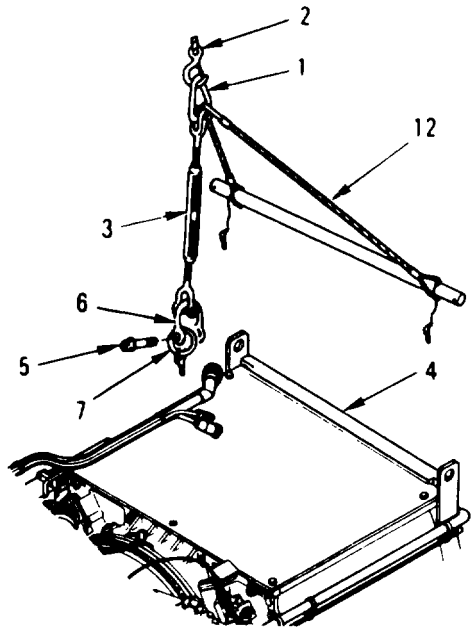
2. INSTALL SLING (1).

a. Hook sling (1) on hoist hook (2). Set turnbuckle (3) to its shortest length.

b. Place sling (1) over engine (4). Remove pin (5) from shackle (6). Remove ring (7) from shackle (6).

c. Put shackle (6) on mounting block (8) and screw in pin (5).

d. Put bar (9) through two rear engine lifting points (10). Put locking pin (11) in each end of bar (9).



REMOVAL:

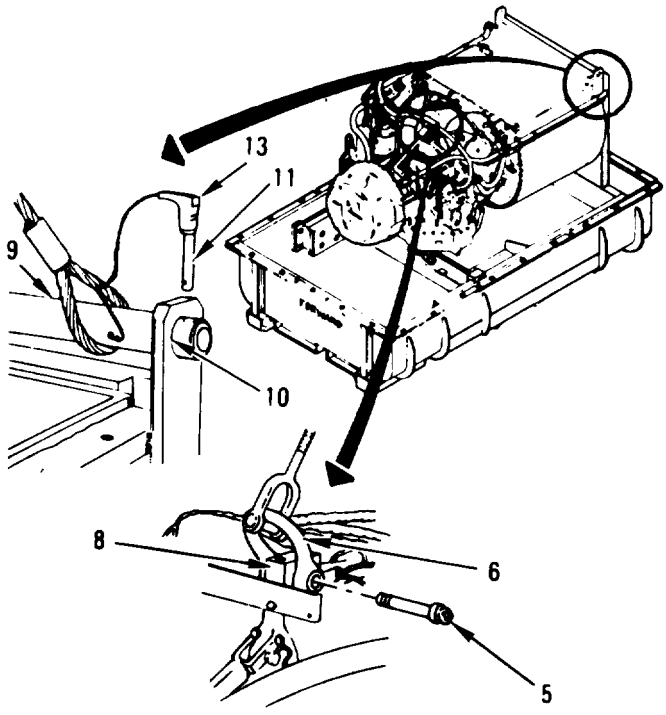
REMOVE SLING (1).

a. Lower hoist hook (2) until cables (12) are slack.

b. Push in and hold button (13) and lift out pin (11) from each end of bar (9). Remove bar (9) from engine (4).

c. Remove pin (5) and shackle (6).

d. Put ring (7) in shackle (6) and screw in pin (5). Unhook sling (1) from hoist hook (2). Stow sling (1).



End of Task

ENGINE REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 1 of 4)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-N26)
Combination wrench, 3/4-inch (Item 72, Appendix D)
Combination wrench, 1-5/16 inch (Item 19, Appendix D)
Deep style socket, l/2-inch drive, 3/4-inch (Item 43, Appendix D)
Hoist, 2-ton minimum capacity (Item 36, Appendix D)

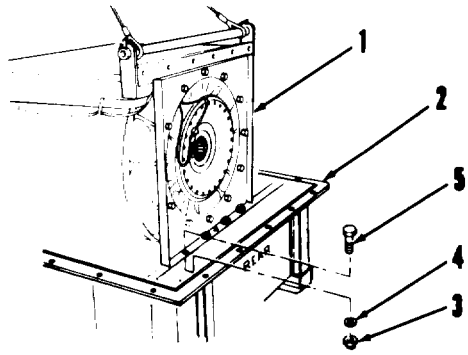
SUPPLIES: Self-locking nut (Item 17, Appendix E) (8 required)
Wood block (Item 23, Appendix B) (3 required)

PERSONNEL: Three

EQUIPMENT CONDITION: Top weldment removed (page 4-1)
Engine/rear module lifting sling installed on engine (page 4-4)

REMOVAL:

WARNING

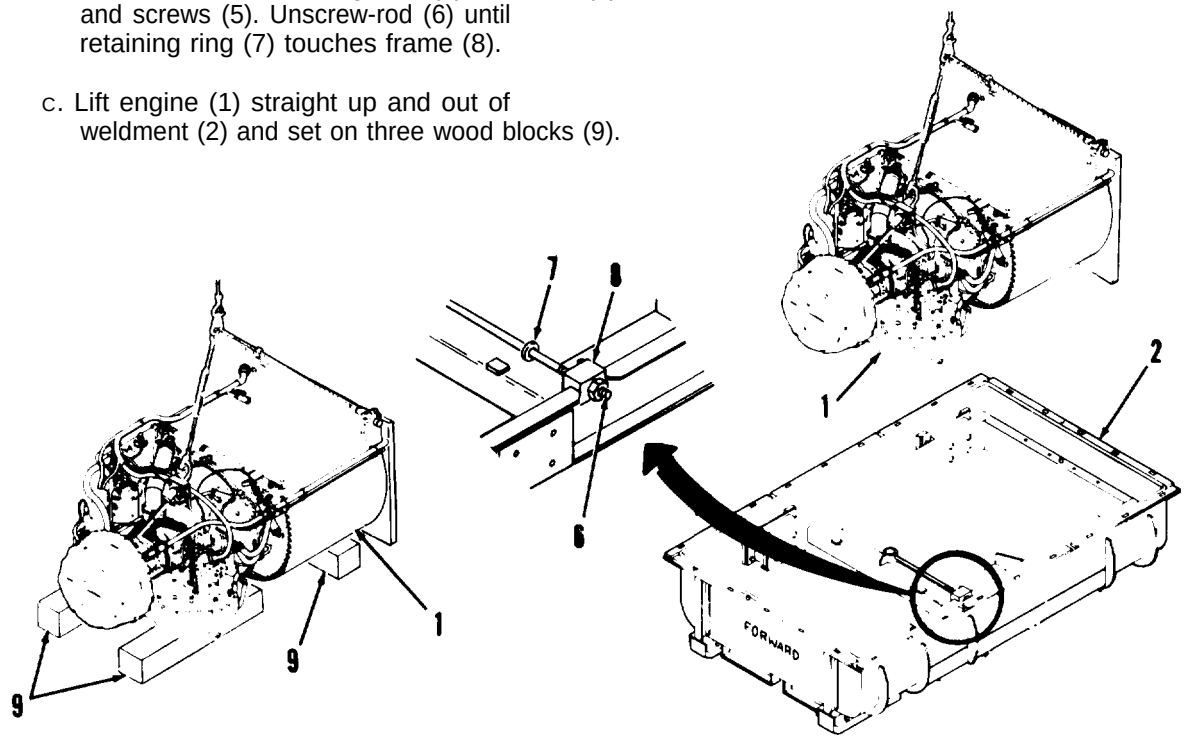


1. REMOVE ENGINE (1) FROM BOTTOM WELDMENT(2).

   a. Lift engine (1) just enough to take engine weight off weldment (2).

   b. Remove four self-locking nuts (3), washers (4), and screws (5). Unscrew-rod (6) until retaining ring (7) touches frame (8).

   c. Lift engine (1) straight up and out of weldment (2) and set on three wood blocks (9).



Go on to Sheet 2

ENGINE REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 2 of 4)

2. REMOVE AFT MOUNTING FLANGE (1) AND MOUNTING PIN (2) FROM ENGINE (3), AND THEN INSTALL FLANGE (1) AND PIN (2) IN CONTAINER (4).

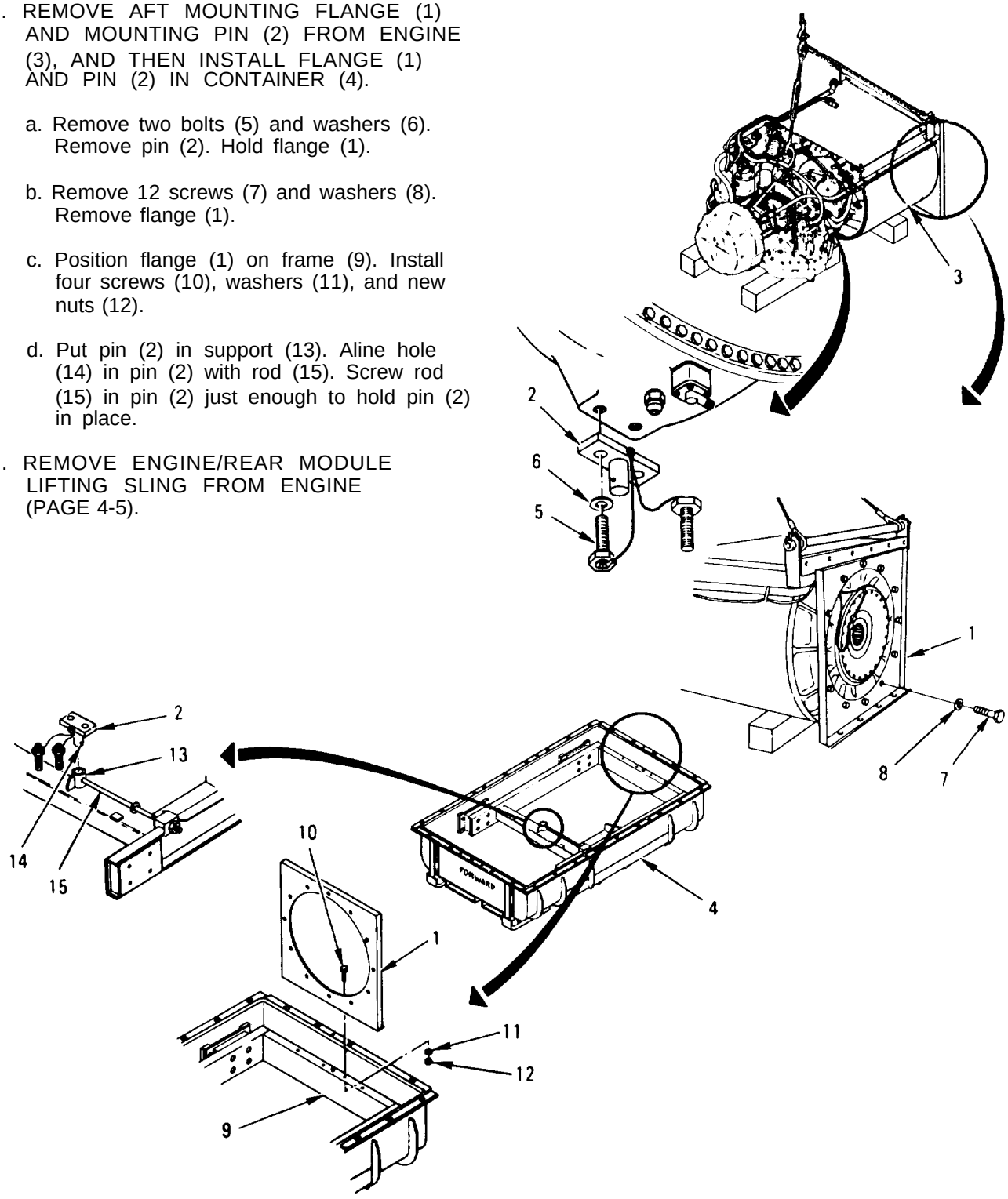
   a. Remove two bolts (5) and washers (6). Remove pin (2). Hold flange (1).

   b. Remove 12 screws (7) and washers (8). Remove flange (1).

   c. Position flange (1) on frame (9). Install four screws (10), washers (11), and new nuts (12).

   d. Put pin (2) in support (13). Aline hole (14) in pin (2) with rod (15). Screw rod (15) in pin (2) just enough to hold pin (2) in place.

3. REMOVE ENGINE/REAR MODULE LIFTING SLING FROM ENGINE (PAGE 4-5).



Go on to Sheet 3

ENGINE REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 3 of 4)

INSTALLATION:

1. REMOVE PIN (1) AND FLANGE (2) FROM CONTAINER (3).

   a. Loosen rod (4) until retaining ring (5) touches frame (6). Lift pin (1) out of support (7).

   b. Hold flange (2). Remove four self-locking nuts (8), washers (9), and screws (10).

   c. Remove flange (2).

2. INSTALL ENGINE/REAR MODULE LIFTING SLING ON ENGINE (PAGE 4-4).

3. INSTALL FLANGE (2) AND PIN (1) ON ENGINE (11).

   a. Position flange (2) on engine (11). Aline holes in flange (2) with holes in engine (11). Install 12 screws (12) and washers (13).

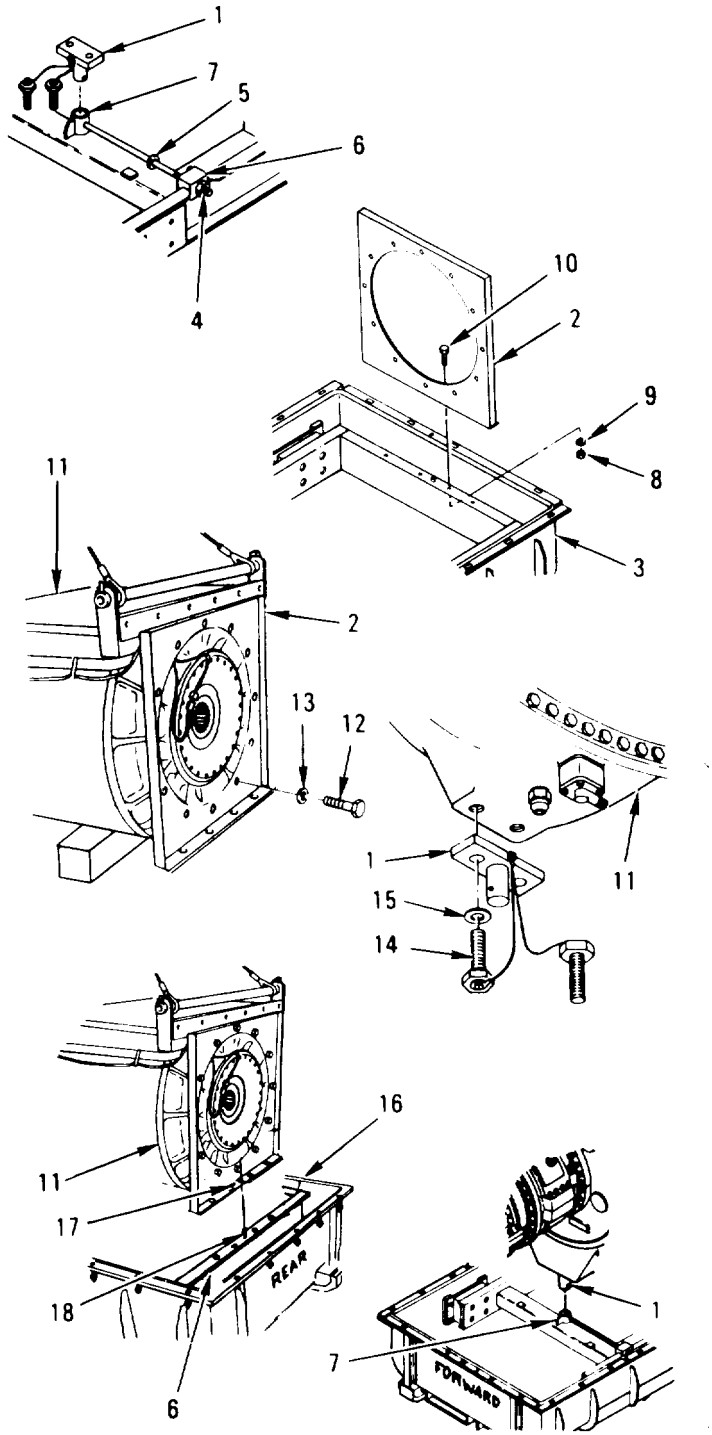
   b. Position pin (1) on engine (11). Aline two holes in pin (1) with holes in engine (11), and install two bolts (14) and washers (15).

WARNING

4. INSTALL ENGINE (11) IN WELDMENT (16).

   a. Position engine (11) over weldment (16). Guide engine (11) to aline pin (1) with support (7) and hole (17) with pin (18) in frame (6).

   b. Lower engine (11) in weldment (16).



Go on to Sheet 4

ENGINE REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 4 of 4)

c. Install four screws (1), washers (2), and new nuts (3).

d. Screw in rod (4) until lockwasher (5) is flattened against frame (6).

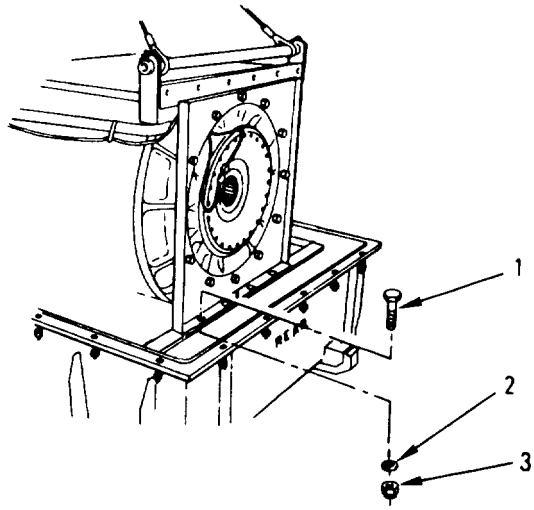
5. REMOVE ENGINE/REAR MODULE LIFTING SLING FROM ENGINE (PAGE 4-5).

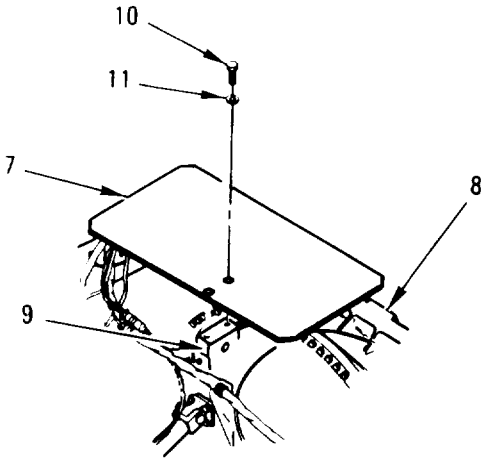
NOTE

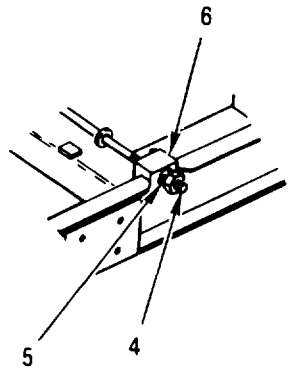
If step plate (7) was on engine (8), do step 6.

6. POSITION PLATE (7) ON ENGINE FORWARD LIFTING BLOCK (9). INSTALL TWO BOLTS (10) AND NEW LOCKWASHERS (11).

7. INSTALL TOP WELDMENT (PAGE 4-3).







End of Task

CHAPTER 5

FORWARD ENGINE MODULE MAINTENANCE

CHAPTER INDEX

TURBINE AXIAL COMPRESSOR (HIGH PRESSURE) HOUSING (TOP HALF) REPLACEMENT (Sheet I of 5)

TOOLS:

General mechanic's tool kit: automotive (SC5180-90-N26)
Inserted hammer face (Item 1, Appendix D)
Inserted hammer face holder (Item 2, Appendix D)

PERSONNEL: Two

SUPPLIES:

Antiseize compound (Item 2, Appendix B)
Cotter pin (Item 5, Appendix E)
Gasket (Item 1, Appendix E) (2 required)
Lockwasher (Item 2, Appendix E) (16 required)
Self-locking nut (Item 3, Appendix E) (14 required)
Self-locking nut (Item 4, Appendix E) (14 required)
Shortening compound (Item 20, Appendix B)
Technical beeswax (Item 3, Appendix B)
Wiping rag (Item 14, Appendix B)

Go on to Sheet 2

TURBINE AXIAL COMPRESSOR (HIGH PRESSURE) HOUSING (TOP HALF) REPLACEMENT (Sheet 2 of 5)

EQUIPMENT CONDITION: Engine starter motor removed (TM 20-1)
Pressure fluid filter double angle bracket removed (TM 20-1)
Transmission pressure velocity modulator tube assembly removed (TM 20-1)
Tube assembly (top of inlet guide vane actuating cylinder) removed (TM 20-1).
Tube assembly (bottom of inlet guide vane actuating cylinder) removed (TM 20-1)
Tube assembly (forward reduction gearbox) removed (TM 20-1)
Tube assembly (No. 5 and 6 bearings) removed (TM 20-1)
Tube assembly (No. 2 and 3 bearings) removed (TM 20-1)
Tube assembly (No. 2 and 3 bearing feed) removed (TM 20-1)
Inlet guide vane feedback control assembly removed (TM 20-1)
Compressed air tube assembly removed (TM 20-1)
Tube assembly (electro-mechanical fuel system to fuel nozzle) removed (TM 20-1)
Ignition electrical lead removed (TM 20-1)

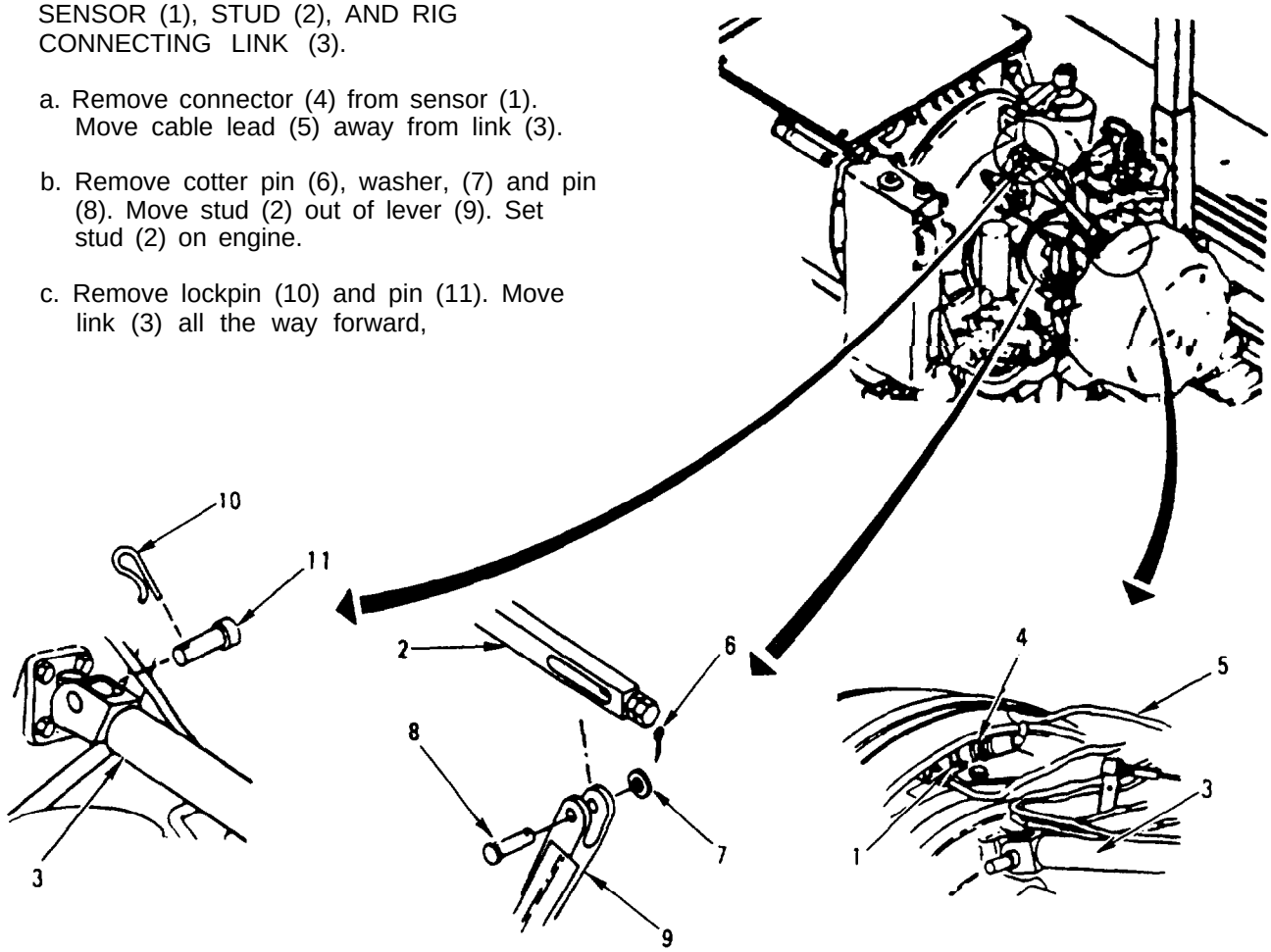
REMOVAL:

1. DISCONNECT ROTOR TEMPERATURE SENSOR (1), STUD (2), AND RIG CONNECTING LINK (3).

   a. Remove connector (4) from sensor (1). Move cable lead (5) away from link (3).

   b. Remove cotter pin (6), washer, (7) and pin (8). Move stud (2) out of lever (9). Set stud (2) on engine.

   c. Remove lockpin (10) and pin (11). Move link (3) all the way forward,



Go on to Sheet 3

TURBINE AXIAL COMPRESSOR (HIGH PRESSURE) HOUSING (TOP HALF) REPLACEMENT (Sheet 3 of 5)

CAUTION

- Be careful not to damage air seal (1) when removing housing (2).
- When working on internal parts of engine, make sure dirt or any objects do not get in engine.

2. REMOVE TWO COVERS (3) AND HOUSING (2).

   a. Remove two bolts (4), covers (3), and gaskets (5).

   b. Remove 14 self-locking nuts (6) and bolts (7). Remove 16 bolts (8) and lockwashers (9).

NOTE

If anv vane assemblies (10) come loose, set them aside.

   c. Remove 14 bolts (11) and self-locking nuts (12). Remove housing (2).

3. INSPECT SEAL (1) FOR DAMAGE. IF DAMAGED, CUT SEAL (1) EVEN WITH FLANGE (13) ON BOTH SIDES OF ENGINE. REMOVE SEAL (1) AND WIPE SPACER HALF (14). USE RAG.

4. INSPECT ALL OTHER PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

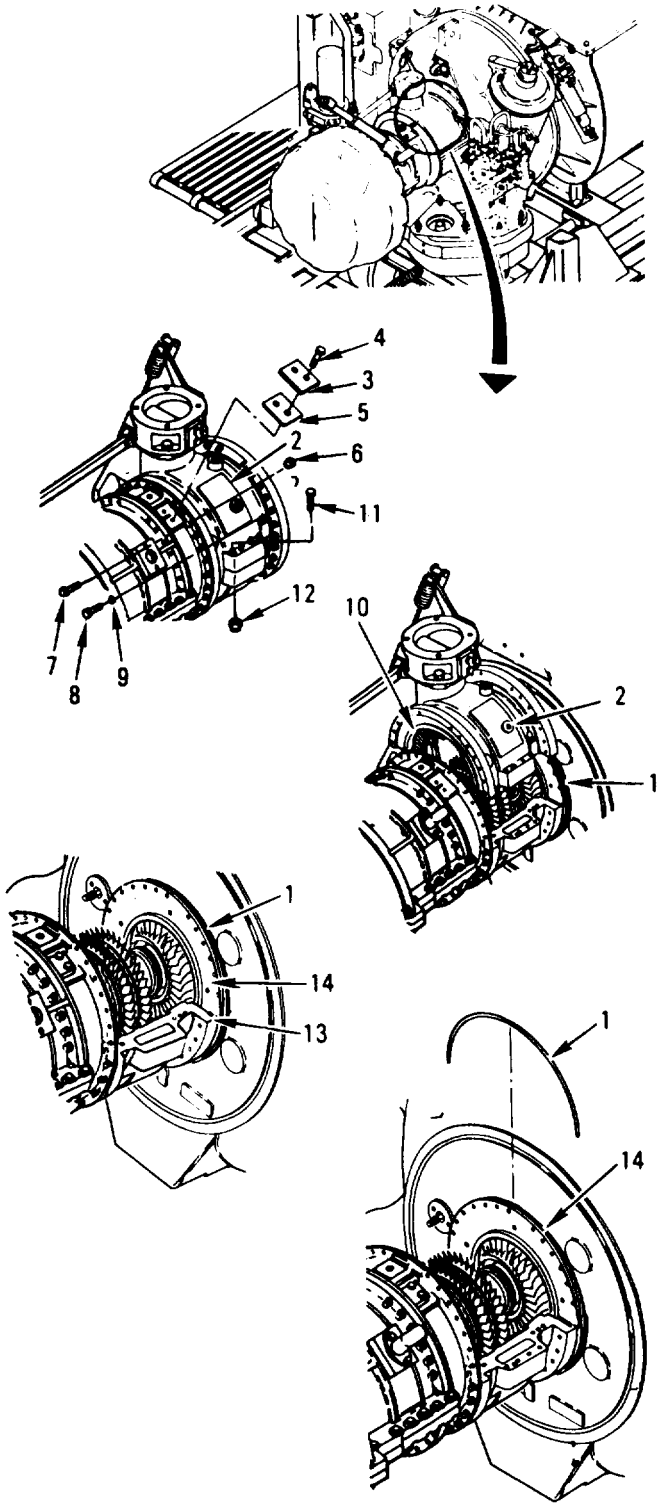
NOTE

If seal (1) was removed, do step 1.

1. INSTALL NEW SEAL (1).

   a. Cut seal (1) even with flange (13) on both sides of engine. Remove seal (1) and wipe spacer half (14). Use rag.

   b. Apply shortening to seal (1) and install on spacer half (14).



Go on to Sheet 4

TURBINE AXIAL COMPRESSOR (HIGH PRESSURE) HOUSING (TOP HALF) REPLACEMENT (Sheet 4 of 5)

CAUTION

When working on internal parts of engine, make sure dirt or any objects do not get in engine.

NOTE

If any vanes (1) came loose during removal of housing (2), do step 2.

2. APPLY A SMALL AMOUNT OF BEESWAX ON CROWN (3) OF VANE (1) TO HOLD IN PLACE.

3. ALINE HOLE IN VANE END (4) WITH PIN (5) AND INSTALL VANE ASSEMBLY (1) IN HOUSING (2).

CAUTION

Be careful not to damage seal (6) when installing housing (2). If seal (6) is damaged, repeat removal step 3 and installation step 1 to replace seal (6).

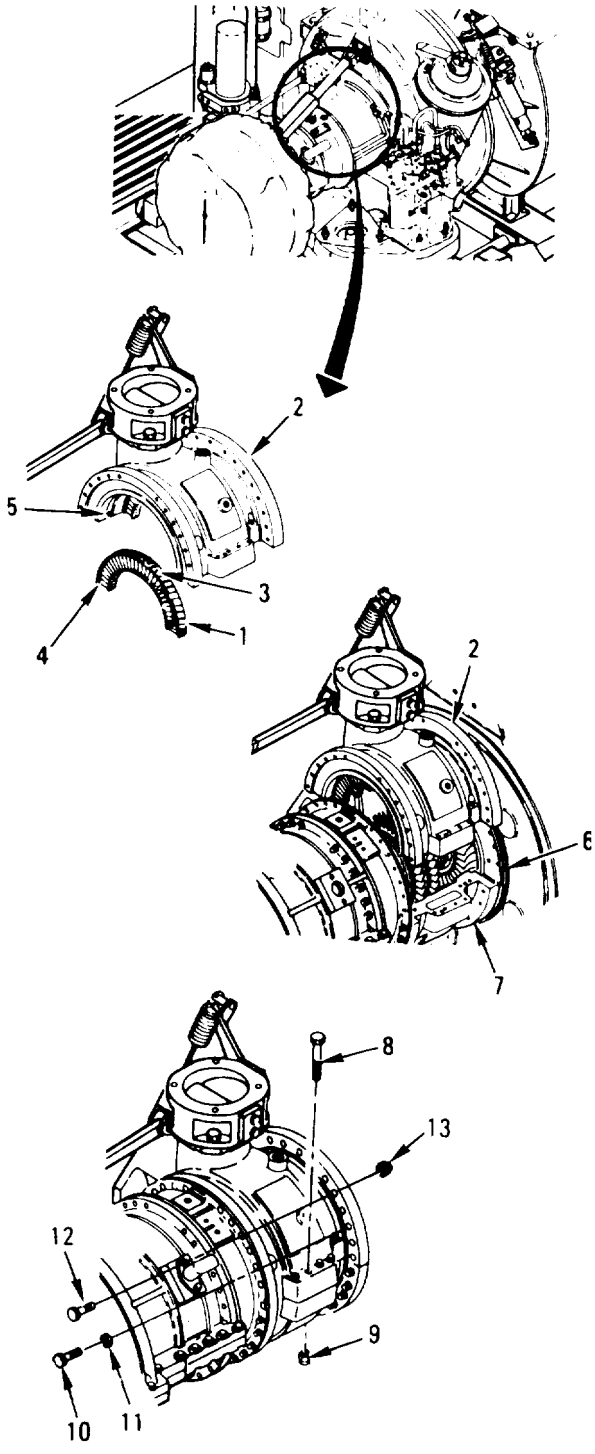
4. INSTALL HOUSING (2).

   a. Position housing (2) on engine (7).

   b. Apply antiseize compound to 14 bolts (8). Install bolts (8) and new nuts (9).

   c. Apply antiseize compound to 16 bolts (lo). Install bolts (10) and new lockwashers (11).

   d. Apply antiseize compound to 14 bolts (12). Install bolts (12) and new nuts (13).



Go on to Sheet 5

TURBINE AXIAL COMPRESSOR (HIGH PRESSURE) HOUSING (Top HALF) REPLACEMENT (Sheet 5 of 5)

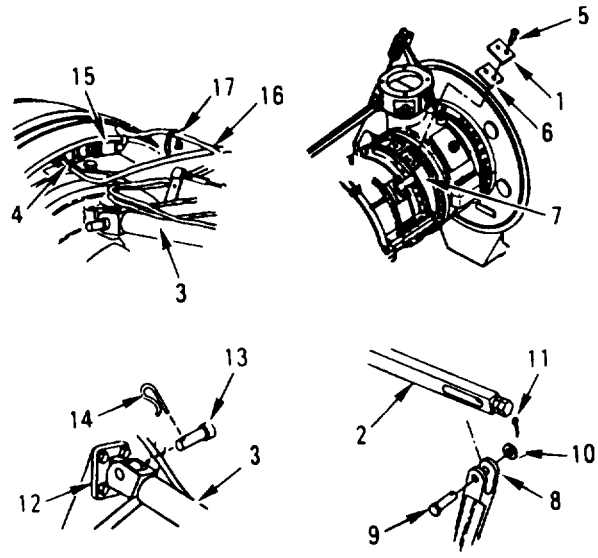
5. INSTALL TWO COVERS (1). CONNECT STUD (2), LINK (3), AND SENSOR (4).

   a. Apply antiseize compound to four bolts (5). Position covers (1) and new gaskets (6) on housing (7). Install two bolts (5) in each cover (1).

   b. Position stud (2) in lever (8). Install pin (9) through lever (8) and stud (2). Install washer (10). Install new cotter pin (11).

   c. Position link (3) on eye bracket (12). Install pin (13) and lockpin (14).

   d Install connector (15) on sensor (4). Place lead (16) on link (3) and install tiedown strap (17).



6. INSTALL IGNITION ELECTRICAL LEAD (TM 20-1).
7. INSTALL TUBE ASSEMBLY (ELECTRO-MECHANICAL FUEL SYSTEM TO FUEL NOZZLE) (TM 20-1).
8. [NSTALL COMPRESSED AIR TUBE ASSEMBLY (TM 20-1).
9. [NSTALL INLET GUIDE VANE FEEDBACK CONTROL ASSEMBLY (TM 20-1).
10. INSTALL TUBE ASSEMBLY (NO. 2 AND 3 BEARING FEED) (TM 20-1).
11. INSTALL TUBE ASSEMBLY (NO. 2 AND 3 BEARINGS) (TM 20-1).
12, INSTALL TUBE ASSEMBLY (NO. 5 AND 6 BEARINGS) (TM 20-1).
13, INSTALL TUBE ASSEMBLY (FORWARD REDUCTION GEARBOX) (TM 20-1).
14, INSTALL TUBE ASSEMBLY (BOTTOM OF INLET GUIDE VANE ACTUATING CYLINDER) (TM 20-1).
15. INSTALL TUBE ASSEMBLY (TOP OF INLET GUIDE VANE ACTUATING CYLINDER) (TM 20-1).
16. INSTALL TRANSMISSION PRESSURE VELOCITY MODULATOR TUBE ASSEMBLY (TM 20-1).
17. INSTALL PRESSURE FLUID FILTER DOUBLE ANGLE BRACKET (TM 20-1).
18. INSTALL ENGINE STARTER MOTOR (TM 20-1).
19. PERFORM INLET GUIDE VANE/POWER TURBINE STATOR (IGV/PTS) ADJUSTMENTS (TM 20-1).

End of Task

INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) REPLACEMENT (sheet 1 of 6)

TOOLS: General mechanic's tool kit: automotive (SC 5l8O-9O-N26)
Inserted hammer face (Item 1, Appendix D)
Inserted hammer face holder (Item 2, Appendix D)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Cotter pin (Item 10, Appendix E)
Cotter pin (Item 11, Appendix E)
Gasket (Item 1, Appendix E) (2 required)
Keywasher (Item 6, Appendix E)
Lockwasher (Item 2, Appendix E) (14 required)
Lockwasher (Item 7, Appendix E)(2 required)
Self-locking nut (Item 9, Appendix E) (12 Required)
Self-locking nut (Item 3, Appendix E) (5 Required)
Self-locking nut (Item 8, Appendix E) (2 Required)
Shortening compound (Item 20, Appendix B)
Technical beeswax (Item 3, Appendix B)

EQUIPMENT CONDITION: Engine starter motor removed (TM 20-1)
Plenum-to-engine plain seal removed (TM 20-1)
Screen assembly (engine air inlet) removed (TM 20-1)
Pressure fluid filter double angle bracket removed (TM 20-1)
Tube assembly (top of inlet guide vane actuating cylinder) removed (TM 20-1)
Tube assembly (bottom of inlet guide vane actuating cylinder) removed (TM 20-1)
Tube assembly (No. 5 and 6 bearings) removed (TM 20-1)
Tube assembly (No. 2 and 3 bearings) removed (TM 20-1)
Tube assembly (forward reduction gearbox) removed (TM 20-1)
Inlet guide vane feedback control assembly removed (TM 20-1)
Tube assembly (No. 2 and 3 bearing feed) removed (TM 20-1)
Tube assembly (No. 1 bearing feed) removed (TM 20-1)
Ignition electrical lead removed (TM 20-1)
Bleed valve rod removed (TM 20-1)

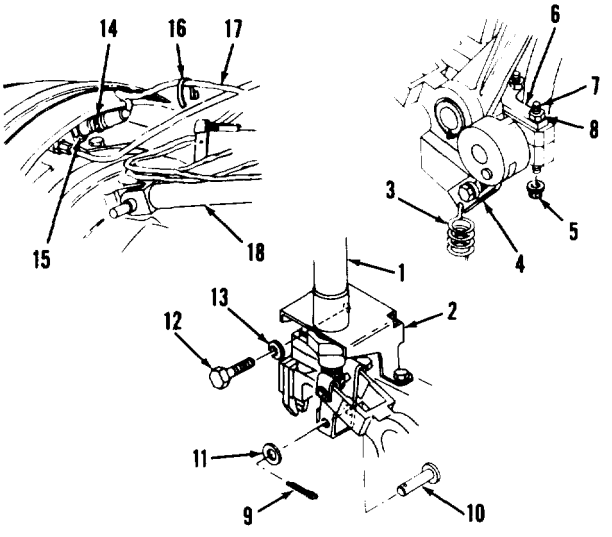
REMOVAL:

1. REMOVE ASSEMBLED ACTUATING CYLINDER (l) AND BRACKET(2).

   a. Unhook spring (3) from connecting link (4). Remove two selflocking nuts (5). Lift off assembled stop plate (6) with studs (7) and nuts (8) attached.

   b. Remove cotter pin (9), pin (10), and washer (11). Remove two bolts (12) and lockwashers (13).

   c. Remove connector (14) from sensor (15). Remove tiedown strap (16). Move cable lead (17) away from link (18).



Go on to Sheet 2

INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) REPLACEMENT (Sheet 2 of 6)

d. Bend tab on keywasher (l). Remove bolt (2), keywasher (l), and spacer (3).

e. Remove bolt (4) and self-locking nut (5).

f. Lift bracket (6) and shaft (7) and remove spacer (8).

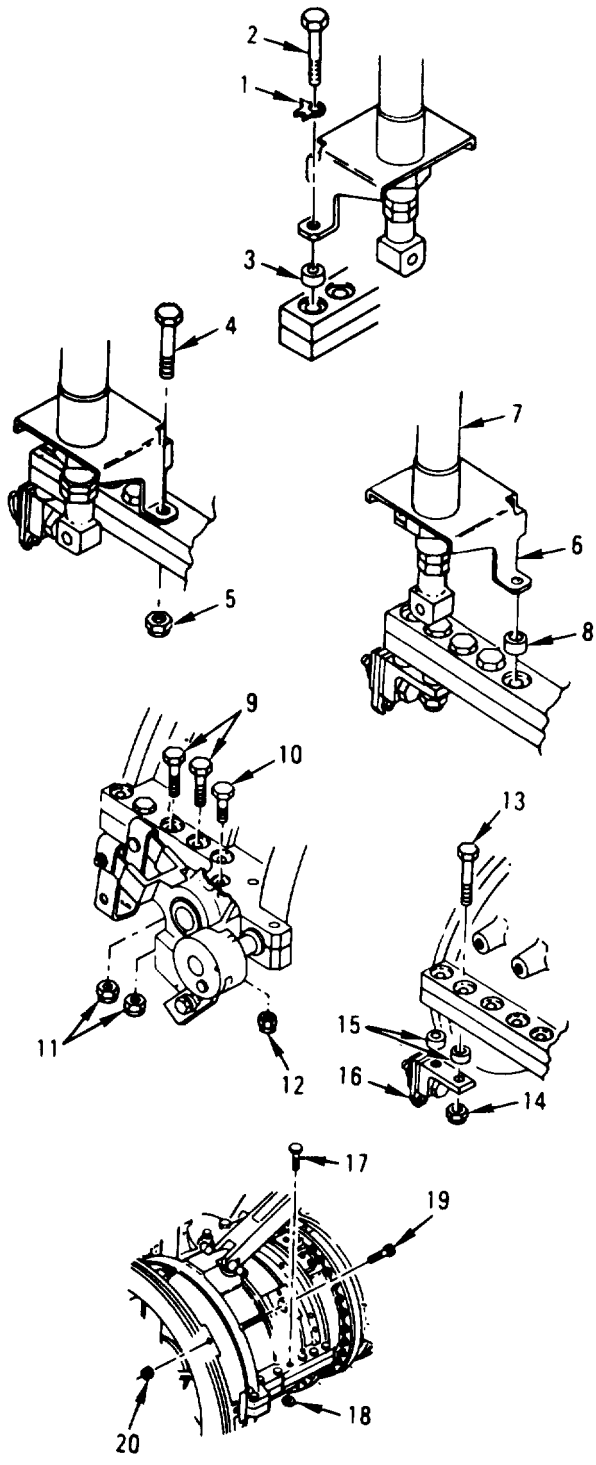
2. REMOVE ATTACHING HARDWARE (9 THRU 20).

a. Remove two bolts (9), bolt (10), and three self-locking nuts (11, 12).

b. Remove bolt (13), self-locking nut (14), two spacers (15), and bracket (16).

c. Remove seven bolts (17) and self-locking nuts (18).

d. Remove two screws (19) and self locking-nuts (20).



Go on to Sheet 3

INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) REPLACEMENT (Sheet 3 of 6)

3. REMOVE LINK (1) AND TWO COVERS (2).

a. Remove lockpin (3) and pin (4). Move link (1) all the way forward.

b. Remove two bolts (5). Remove covers (2) and gaskets (6).

CAUTION

- Be careful not to damage preformed packing(7) while removing housing (8).
- When working on internal parts of engine, make sure dirt or any objects do not get in engine.

4. REMOVE HOUSING(8).

a. Remove 14 bolts (9) and washers (10).

b. Turn bellcrank (11) all the way left or right.

NOTE

If any vanes (12) came loose, set them aside.

c. Remove housing (8) from engine (13).

5. INSPECT PACKING (7) FOR DAMAGE IF DAMAGED, CUT PACKING(7) EVEN WITH FLANGE (14) ON BOTH SIDES OF ENGINE. REMOVE PACKING (7).

6. INSPECT ALL OTHER PARTS FOR DAMAGE.
REPLACE AS REQUIRED.

INSTALLATION:

CAUTION

Do not stretch new packing(7) when fitting it in groove (15).

NOTE

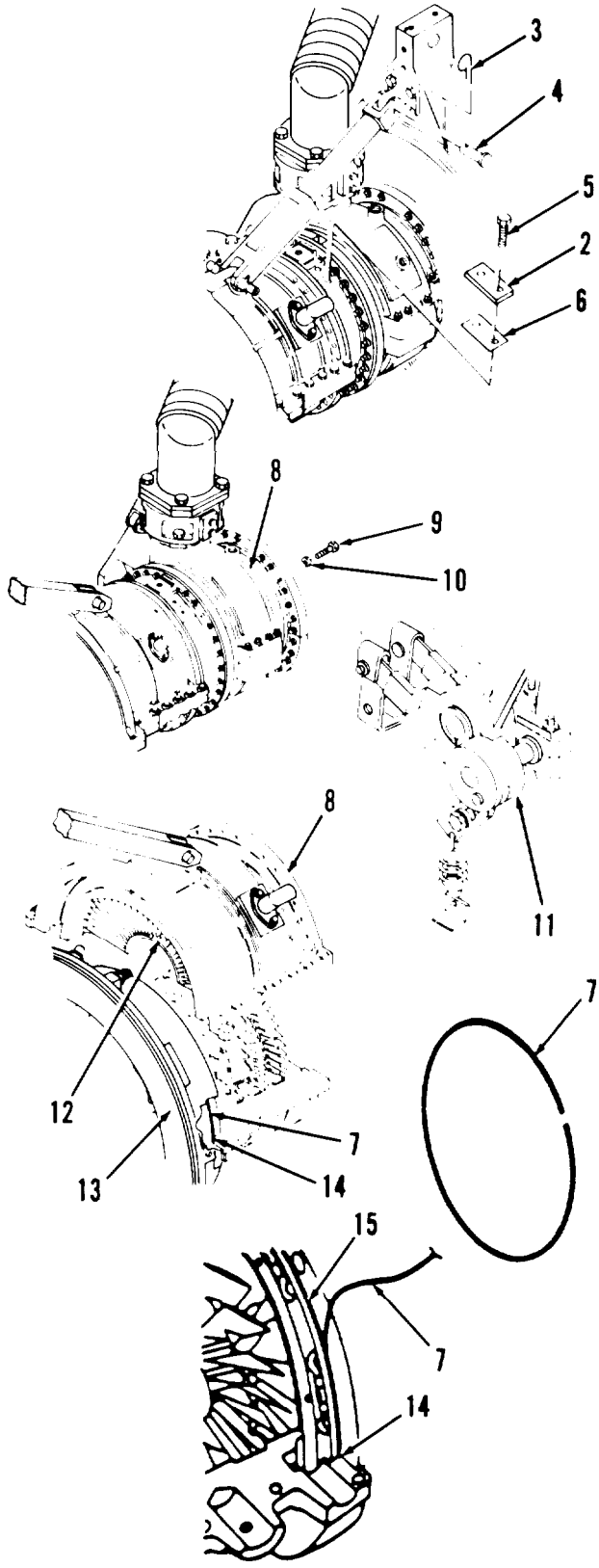
If packing(7) was removed, do step 1.

1. INSTALL NEW PACKING(7).

a. Cut packing(7) so it becomes one length.

b. Cut packing(7) to fit in groove(15) so both ends butt against flanges (14).

c. Apply shortening to packing (7) and install in groove (15).



Go on to Sheet 4

INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) REPLACEMENT (Sheet 4 of 6)

CAUTION

When working on internal parts of engine, make sure dirt or any objects do not get in engine.

NOTE

If any vanes (1) came loose during removal, do step 2.

2. APPLY SMALL AMOUNT OF BEESWAX ON CROWN (2) OF VANE (1) TO HOLD IN PLACE.

3. ALINE HOLE IN VANE END (3) WITH PIN (4) AND PRESS VANE (1) IN HOUSING (5).

4. INSTALL HOUSING (5), TWO COVERS (6), AND ATTACH LINK (7).

   a. Turn bellcrank (8) all the way to the left or right.

   b. Position housing (5) on engine. Do not damage or move packing (9) out of groove (10).

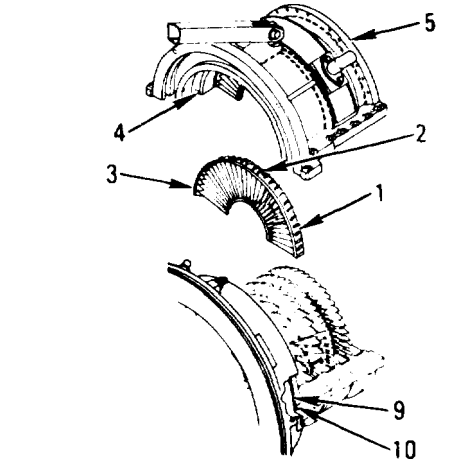
   c. Apply antiseize compound to two screws (11) and seven bolts (12). Loosely install screws (11) and new nuts (13). Loosely install bolts (12) and new nuta (14).

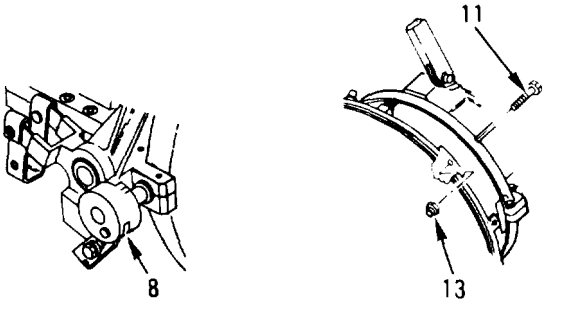
   d. Apply antiseize compound to 14 bolts (15 Install bolts (15) and new lockwashers (16).

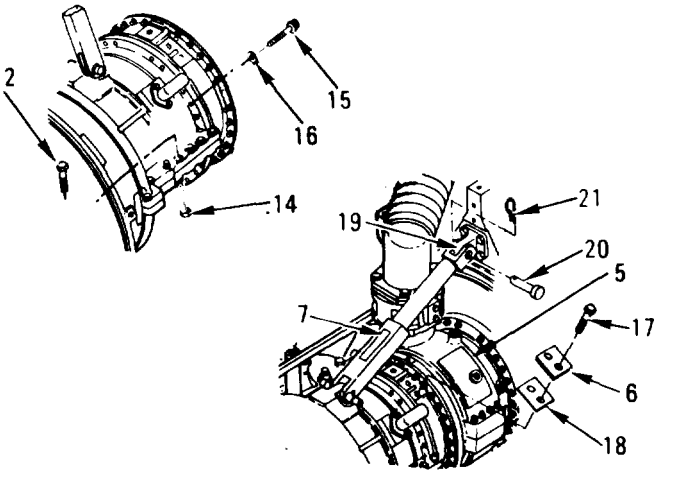
   e. Tighten screws (11) and nuts (13). Tighten bolts (12) and nuts (14).

   f. Apply antiseize compound to four bolts (17). Install covers (6) and new gaskets (18) on housing (5) with bolts (17).

   g. Aline link (7) on bracket (19). Install pin (20) and lockpin (21).







Go on to Sheet 5

INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) REPLACEMENT (Sheet 5 of 6)

5. INSTALL BRACKET (1) AND LEVER (2).

a. Apply antiseize compound to bolt (3). Aline bracket (1) and two spacers (4) under flange (5), Loosely install bolt (3) and new nut (6).

b. Apply antiseize compound to short bolt (7). Aline hole in lever pin (8) with hole in housing (9). Install bolt (7) and new nut (10).

c. Apply antiseize compound to two bolts (11). Install bolts (11) and new nuts (12).

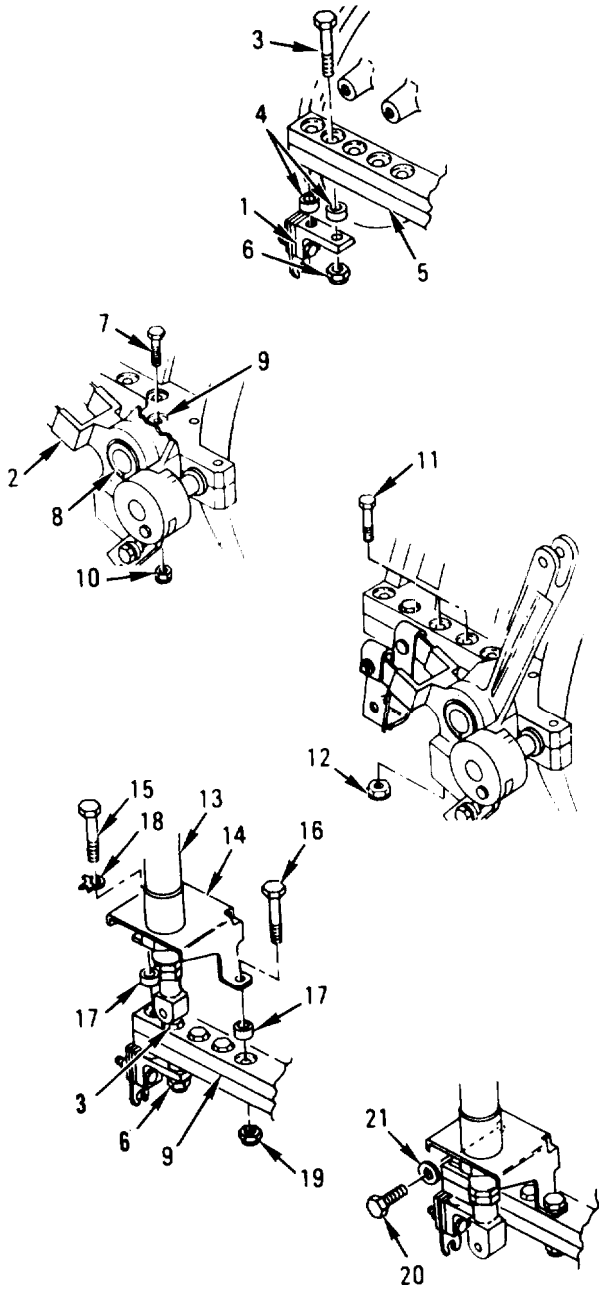
d. Tighten bolt (3) and nut (6).

6. INSTALL ASSEMBLED CYLINDER (13) AND BRACKET (14).

a. Apply antiseize compound to long bolt (15) and short bolt (16). Position bracket (14), cylinder (13), and two spacers (17) on housing (9). Loosely install long bolt (15) and new keywasher (18).

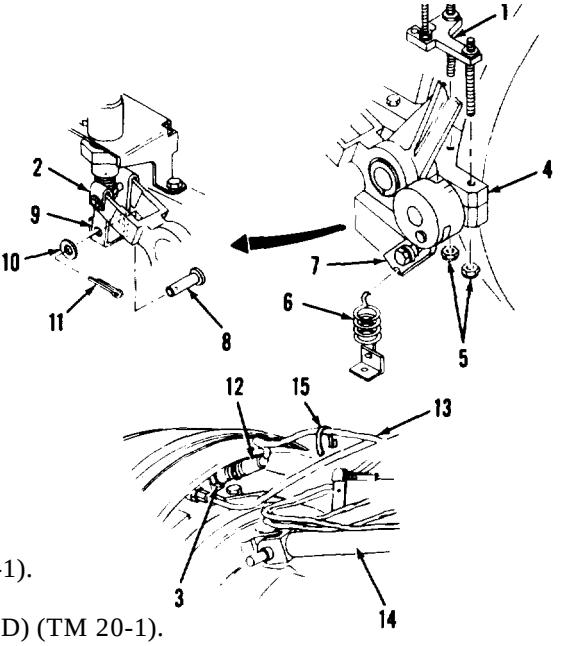
b. Loosely install short bolt (16) and new nut (19). Tighten bolts (15, 16) and nut (19). Bend tabs on keywasher (18).

c. Apply antiseize compound to two bolts (20). Install bolts (20) and new lockwashers (21).



Go on to Sheet 6

INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) REPLACEMENT (Sheet 6 of 6)



7. INSTALL PLATE (l), CONNECT CONNECTOR (2) AND SENSOR (3).

   a, Aline plate (1) with flange (4). Install two new nuts (5).

   b. Hook spring (6) to link (7).

   c. Install pin (8) through link (9) and connector (2).}nstall washer (10) and new cotter pin (11).

   d. Install connector (12) on sensor (3). Place cable lead (13) on link (14) and install new tiedown strap (15).

8. INSTALL BLEED VALVE ROD (TM 20-1).

9. INSTALL IGNITION ELECTRICAL LEAD (TM 20-1).

10. INSTALL TUBE ASSEMBLY (NO. 1 BEARING FEED) (TM 20-1).

11. INSTALL TUBE ASSEMBLY (NO. 2 AND 3 BEARING FEED)(TM 20-1).

12. INSTALL INLET GUIDE VANE FEEDBACK CONTROL ASSEMBLY (TM 20-1).

13. INSTALL TUBE ASSEMBLY (FORWARD REDUCTION GEARBOX) (TM 20-1).

14. [NSTALL TUBE ASSEMBLY (NO. 2 AND 3 BEARINGS) (TM 20-1).

15. INSTALL TUBE ASSEMBLY (NO. 5 AND 6 BEARINGS (TM 20-1).

16. INSTALL TUBE ASSEMBLY (BOTTOM OF INLET GUIDE VANE ACTUATING CYLINDER) (TM 20-1).

17. INSTALL TUBE ASSEMBLY (TOP OF INLET GUIDE VANE ACTUATING CYLINDER) (TM 20-1).

18. INSTALL PRESSURE FLUID FILTER DOUBLE ANGLE BRACKET (TM 20-1).

19. INSTALL SCREEN ASSEMBLY (ENGINE AIR INLET) TM 20-1).

20. INSTALL PLENUM-TO-ENGINE PLAIN SEAL (TM 20-1).

21. INSTALL ENGINE STARTER MOTOR (TM 20-1).

22. PERFORM INLET GUIDE VANE/POWER TURBINE STATOR (IGV/PTS) ADJUSTMENTS (TM 20-1).

End of task

FORWARD ENGINE MODULE LIFTING SLING INSTALLATION AND REMOVAL (Sheet 1 of 1)

TOOLS: Hoist, 1000-pound minimum capacity (Item 11, Appendix D)
Lifting sling (Item 7, Appendix D)

PERSONNEL: Two

INSTALLATION:

1. POSITION SHACKLE (1) AND HOOK SLING (2) TO HOIST HOOK (3).

NOTE

If moving forward module (4), do steps a and c. If moving forward module (4) with gearbox module (5), do steps b and c.

a. Install shackle (1) in second hole (6) from short cable (7).

b. Install shackle (1) in fourth hole (8) from short cable (7).

c. Hook sling (2) to hoist hook (3).

2. INSTALL SLING (2).

a. Aline sling (2) with module (4).

b. Remove pin (9) from shackle (10). Aline shackle (10) with block (11) and install pin (9).

c. Install hook (12) on pin (13) and take slack out of sling (2).

REMOVAL:

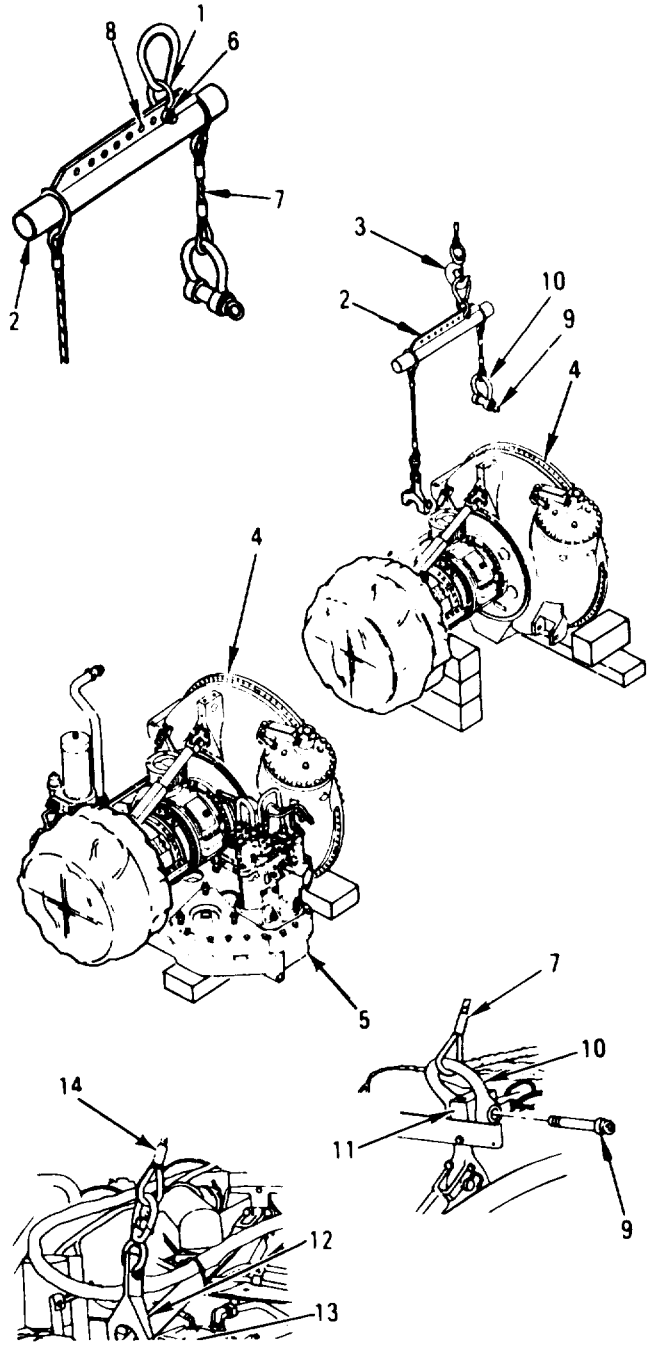
REMOVE SLING (2).

a. Lower sling (2) until cables (7, 14) are slack.

b. Remove hook (12) from pin (13).

c. Remove pin (9) from shackle (10). Remove shackle (10) and install pin (9) in shackle (10).

d. Remove sling (2) from hoist hook (3).



End of Task

FORWARD ENGINE MODULE REPLACEMENT (Sheet 1 of 10)

TOOLS: General mechanic's tool kit: automotive (SC 5l8O-9O-N26)
Bottoming tap, 1/4-28 (Item 15, Appendix D)
Chain-fall hoist, 1000-pound minimum capacity (Item 10, Appendix D)
Combination wrench, 1-1/4 inch (Item 16, Appendix D)
Extension, 3/8-inch drive, 6-inch (Item 8, Appendix D)
Forward engine module lifting sling (Item 7, Appendix D)
Hoist, 1000-pound minimum capacity (Item 11, Appendix D)
Inserted hammer face (Item 1, Appendix D)
Inserted hammer face holder (Item 2, Appendix D)
Jackscrew (Item 18, Appendix D) (4 required)
Ratchet handle, 3/8-inch drive (Item 9, Appendix D) (2 required)
Socket, 3/8-inch drive, l/2-inch (Item 12, Appendix D) (2 required)
Socket, 3/8-inch drive, 9/16-inch (Item 13, Appendix D)
Socket, 3/8-inch drive, 3/4-inch (Item 14, Appendix D)
Torque adapter (Figure 7, Appendix C)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)

PERSONNEL: Two

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Cotter pin (Item 14, Appendix E) (2 required)
Gasket (Item 15, Appendix E)
Laminated shim (Item 13, Appendix E)
Lubricating oil (Item 11, or 12, Appendix B)
Self-locking nut (Item 16, Appendix E) (96 required))
Shortening compound (Item 20, Appendix B)
Wood block (Item 22, Appendix B)
Wood block (Item 23, Appendix B) (2 required)
Wood block (Item 31, Appendix B) (3 required)

EQUIPMENT CONDITION: Forward engine overhead support installed (page 7-4)
Gearbox module removed from engine (page 7-7)
Thermocouple branched wiring harness 3W106 removed (TM 20-1)
Maintenance indicator branched wiring harness SW107 removed (TM 20-1)
Fuel management system branched wiring harness 3W105 removed (TM 20-1)
Pressure fluid filter double angle bracket removed (TM 20-1)
Forward reduction gearbox tube assembly removed (TM 20-1)
Reduction gearbox hose removed (TM 20-1)
Flange to hose elbow (reduction gearbox) removed (TM 20-1)
Ignition electrical lead removed (TM 20-1)
Tube assembly (No. 5 and 6 bearings) removed (TM 20-1)
Tube assembly (No. 2 and 3 bearings) removed (TM 20-1)
Power turbine stator cylinder assembly removed (TM 20-1)

Go on to Sheet 2

FORWARD ENGINE MODULE REPLACEMENT (Sheet 2 of 10)

REMOVAL:

1. POSITION FORWARD DOLLY (1) AND REMOVE BRACKET (2).

   a. Turn handle (3) clockwise until dolly (1) is all the way in.

   b. Unhook two latches (4).

   c. Remove three bolts (5). Remove bracket (2).

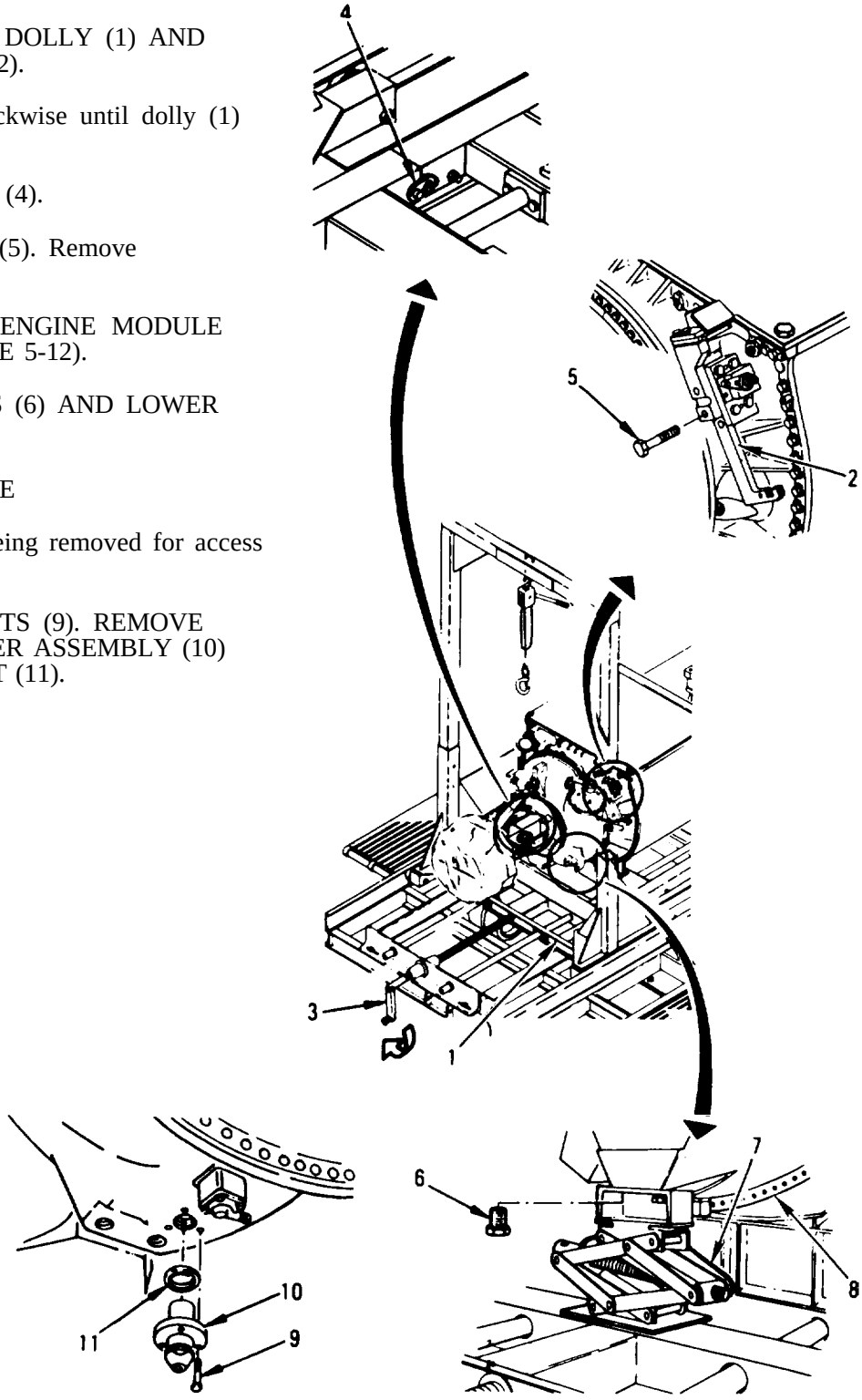
2, INSTALL FORWARD ENGINE MODULE LIFTING SLING (PAGE 5-12).

3. REMOVE TWO BOLTS (6) AND LOWER STAND JACK (7).

NOTE

If forward module (8) is being removed for access only, go to step 5.

4. REMOVE THREE BOLTS (9). REMOVE VALVE AND ADAPTER ASSEMBLY (10) AND V-SEAL GASKET (11).



Go on to Sheet 3

FORWARD ENGINE MODULE REPLACEMENT (Sheet 3 of 10)

CAUTION

Do not lean on, or hang anything on shaft (l). Damage to bearing seal or air seal may result.

5. REMOVE FORWARD MODULE (2) FROM REAR MODULE (3) AND CLEAN FOUR JACKSCREW HOLES (4).

   a. Remove 81 bolts (5) and self-locking nuts (6).

   b. Remove 15 self-locking nuta (7) from studs (8).

   c. Apply oil to tap and clean out holes (4 located at 12, 3, 6, and 9 o'clock positions.

   d. Apply oil to four jackscrews (9). Install jackcrews (9) in holes (4).

NOTE

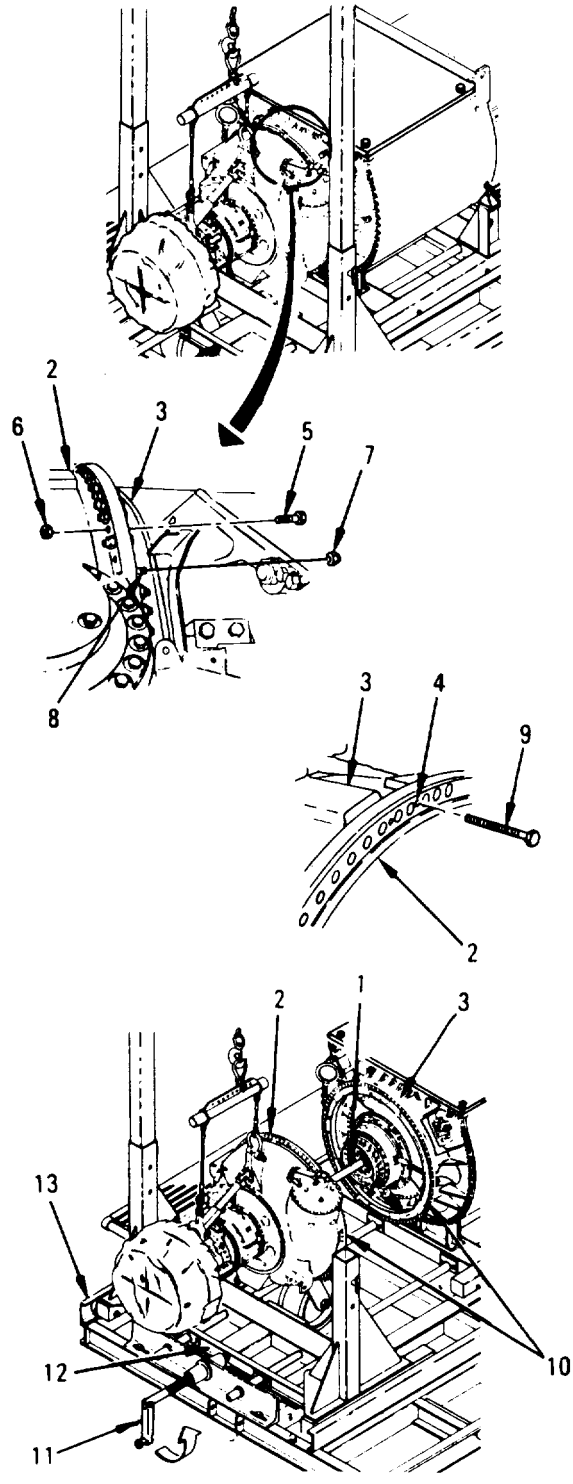
Tighten jackscrews (9) evenly opposite each other.

   e. Install jackscrews (9) evenly until forward module (2) moves away from rear module (3). Remove jackscrews (9).

NOTE

Make sure module flanges (10) are alined before moving.

   f. Turn handle (11) counterclockwise until forward dolly (12) stops at end of stand (13).



Go on to Sheet 4

FORWARD ENGINE MODULE REPLACEMENT (Sheet 4 of 10)

NOTE

Transfer sling (1) is part of maintenance stand (2).

6. ATTACH SLING (1) TO HOIST HOOK (3) AND FORWARD MODULE (4).

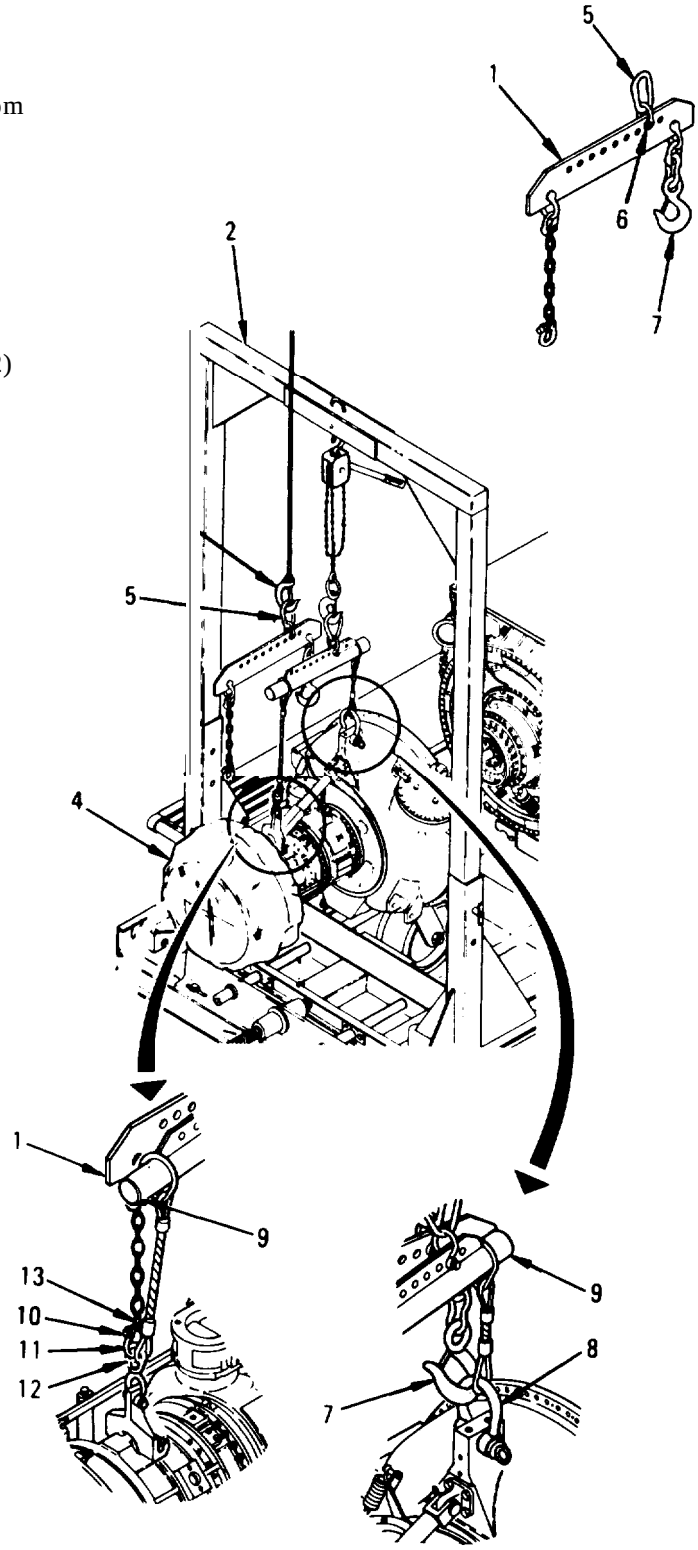
   a. Install shackle (5) in second hole (6) from sling hook (7).

   b. Hook shackle (5) on hoist hook (3).

   c. Install sling hook (7) to shackle (8) of module sling (9).

   d. Remove pin (10) from shackle (11) on sling (l). Install shackle (11) on ring (12) of module sling (9).

   e. Install shackle (11) on first chain link (13) and install pin (10).



Go on to Sheet 5

FORWARD ENGINE MODULE REPLACEMENT (Sheet 5 of 10)

WARNING

7. REMOVE MODULE (1) FROM STAND (2).

   a. Raise hoist hook (3) until cables (4) are slack.

   b. Remove module sling (5) from chain (6). Hook sling (5) to hoist hook (3).

   c. Hold module (1) steady when being moved.

   d. Move module (1) away from stand (2) and set on six wood block: (7).

8. REMOVE GASKET (8) FROM REAR MODULE (9).

NOTE

If module (1) was removed for access only, go to installation step 1.

9. REMOVE SLINGS (5, 10) FROM MODULE (l).

   a. Lower hoist hook (3) until transfer sling (10) is slack.

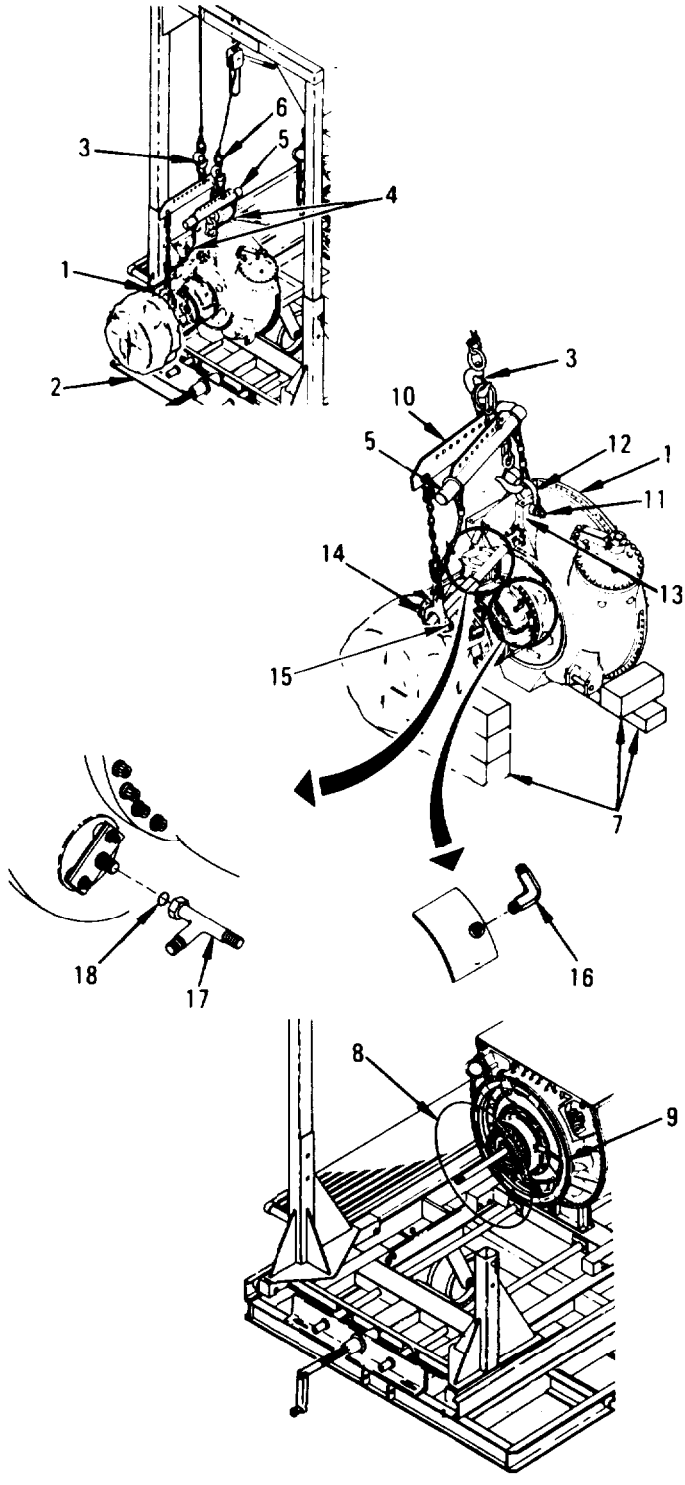
   b. Remove pin (11). Remove shackle (12) from block (13). Install pin (11) in shackle (12).

   c. Remove sling hook (14) from pin (15).

10. REMOVE ELBOW (16), TUBE TEE (17), AND SEAL (18).

11. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

12. REMOVE NEW ENGINE FROM SHIPPING CONTAINER (PAGE 4-6).



Go on to Sheet 6

FORWARD ENGINE MODULE REPLACEMENT (Sheet 6 of 10)

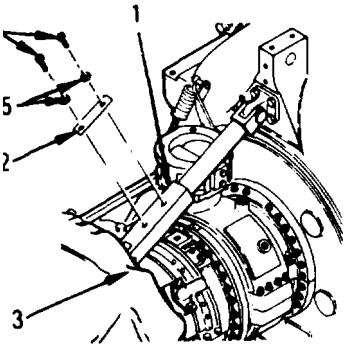
NOTE

If link (1) has an identification plate (2), do step 13.

13. TRANSFER PLATE (2) FROM OLD MODULE (3) TO NEW MODULE (3).

    a. Remove two screws (4) and lockwashers (5). Remove plate (2)

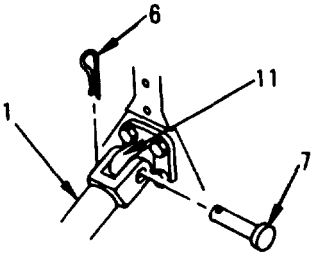
    b. Install plate (2) on link (1) of new module (3) with two screws (4) and new lockwashers (5).



14. REMOVE LINK (1) FROM OLD MODULE.

    a. Remove lockpin (6) and pin (7).

    b. Remove two cotter pins (8) and pin (9). Remove link (l).

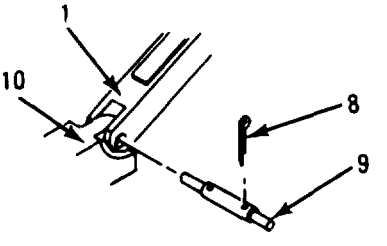


15. REPEAT STEP 14 FOR NEW MODULE (3).

INSTALLATION:

1. INSTALL NEW LINK (1) WITH PLATE (2) ON NEW MODULE (3). INSTALL OLD LINK (1) WITHOUT PLATE (2) ON OLD MODULE (3).

    a. Aline hole in mount (10) with hole in link (l). Install pin (9) and two new cotter pins (8).

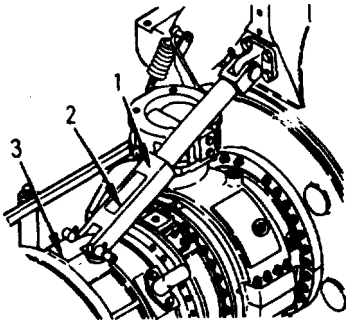


    b. Aline link (1) with hole in bracket (11).

NOTE

If link (1) does not aline with bracket (11), go to step 2.

    c. Install pin (7) and lockpin (6).



Go on to Sheet 7

FORWARD ENGINE MODULE REPLACEMENT (Sheet 7 of 10)

2. REPLACE SHIM (1) AND TORQUE FOUR BOLTS (2) BETWEEN 250-325 LB-IN (27-35 NŽm).

   a. Move link (3) forward. Remove bolts (2), eye bracket (4), and shim (l).

   b. Apply antiseize compound to bolts (2). Install new shim (1) and bracket (4) on front module (5) with bolts (2). Torque bolts (2) between 250-325 lb-in (27-35 NŽm).

   c. Aline hole in link (3) with hole in bracket (4). If holes do not aline, repeat steps a, b, and c, peeling off shim (1) until holes aline.

   d. Install pin (6) and lockpin (7).

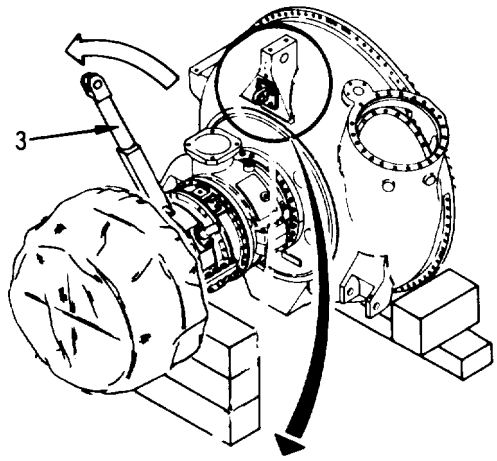
3. REPLACE SEAL RINGS AND EXPANDER SPRINGS (PAGE 6-33).

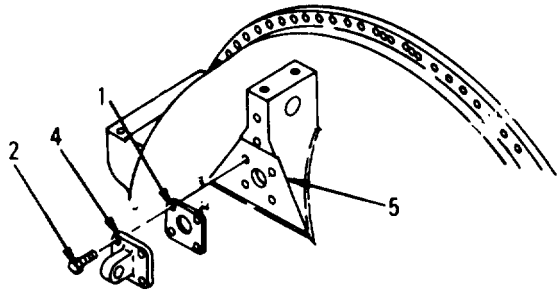
4. INSTALL NEW GASKET (8).

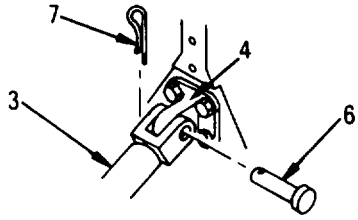
   Apply shortening to gasket (8) and install gasket (8) in groove (9) on module (10).

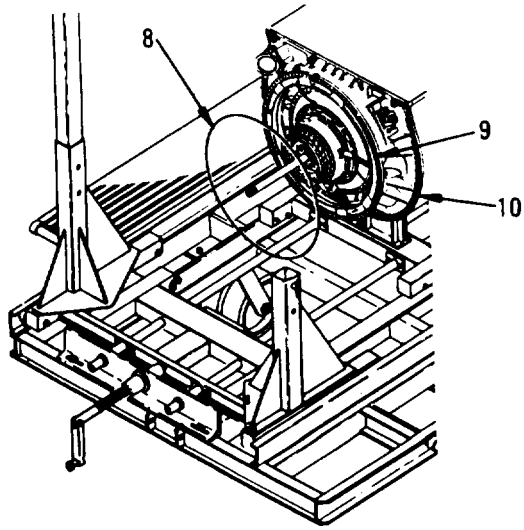
NOTE

If module (5) was removed for access only, do step 5.









Go on to Sheet 8

FORWARD ENGINE MODULE REPLACEMENT (Sheet 8 of 10)

5. INSTALL ELBOW (1) AND TEE (2).

a. Install elbow (1) in housing (3).

b. Install new flared conical seal (4) on nipple (5). Install tee (2) on nipple (5) and tighten nut (6).

6. INSTALL LIFTING SLINGS (7, 8) ON FORWARD MODULE (9).

a. Remove pin (10) from shackle (11), aline shackle (11) with hole in block (12), and install pin (10) in shackle (11).

b. Install sling hook (13) on pin (14).

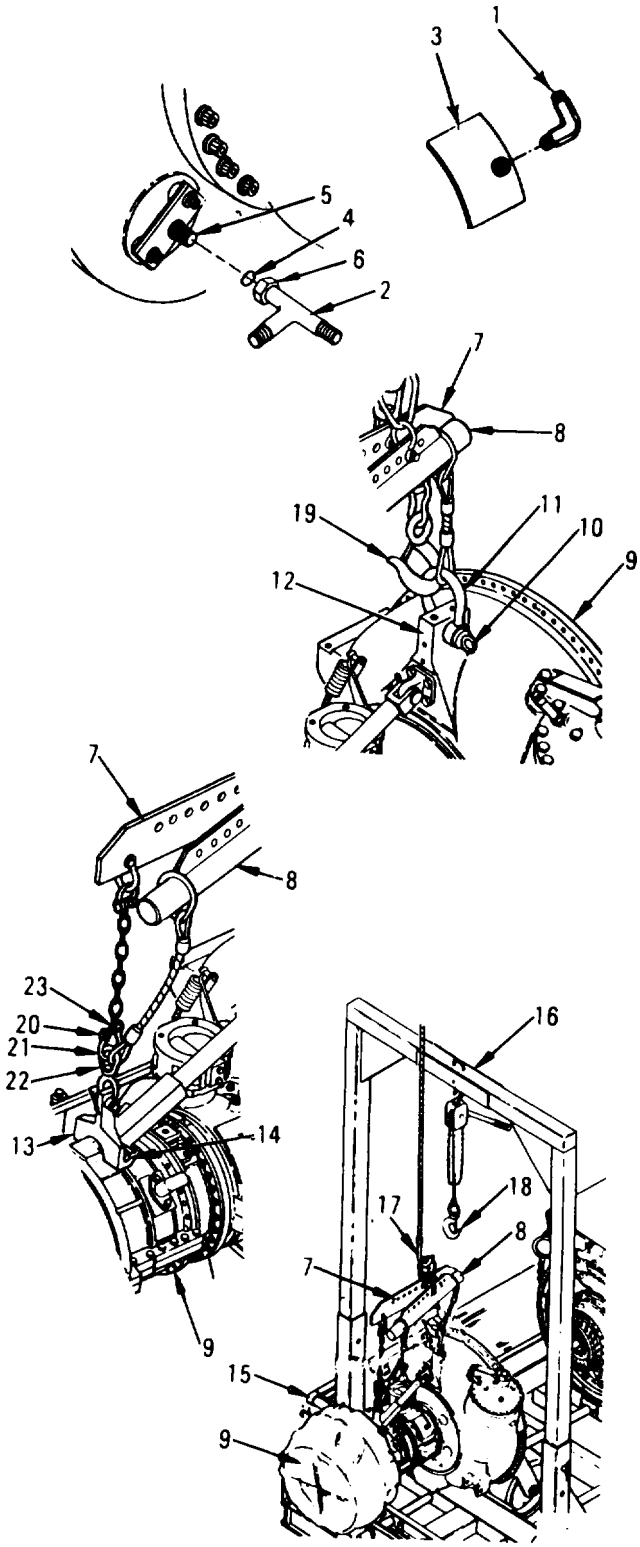
WARNING

7. INSTALL MODULE (9) ON STAND (15).

a. Move module (9) under support (16) until hoist hook (17) is near chain hook (18). Remove sling (8) from hoist hook (17). Hook sling (8) to chain hook (18).

b. Lower module (9) until sling (7) is slack. Remove sling hook (19) from shackle (11) on sling (8).

c. Remove pin (20) from shackle (21). Remove shackle (21) from ring (22) and put on first chain link (23). Install pin (20).



Go on to Sheet 9

FORWARD ENGINE MODULE REPLACEMENT (Sheet 9 of 10)

8. INSTALL FORWARD MODULE (1) ON REAR MODULE (2).

   a. Turn handle (3) clockwise until forward module (1) is close to shaft (4).

   b. Aline forward module (1) with shaft (4).

   c. Turn handle (3) clockwise until forward module (1) is close to rear module (2). Aline pin (5) in forward module (1) with small hole (6) in rear module (2).

   d. Turn handle (3) clockwise until modules (1, 2) are mated.

NOTE

Tighten bolts (7) and nuts (8) at the top, bottom, and each side of engine first to seat modules (1, 2).

   e. Apply antiseize compound to 81 bolts (7). Install bolts (7) and new nuts (8).

   f. Apply antiseize compound to 15 studs (9). Install 15 new nuts (10) on studs (9).

9. TORQUE BOLTS (7) AND NUTS (8, 10) BETWEEN 170-190 LB-IN (19-22 **NZm)**

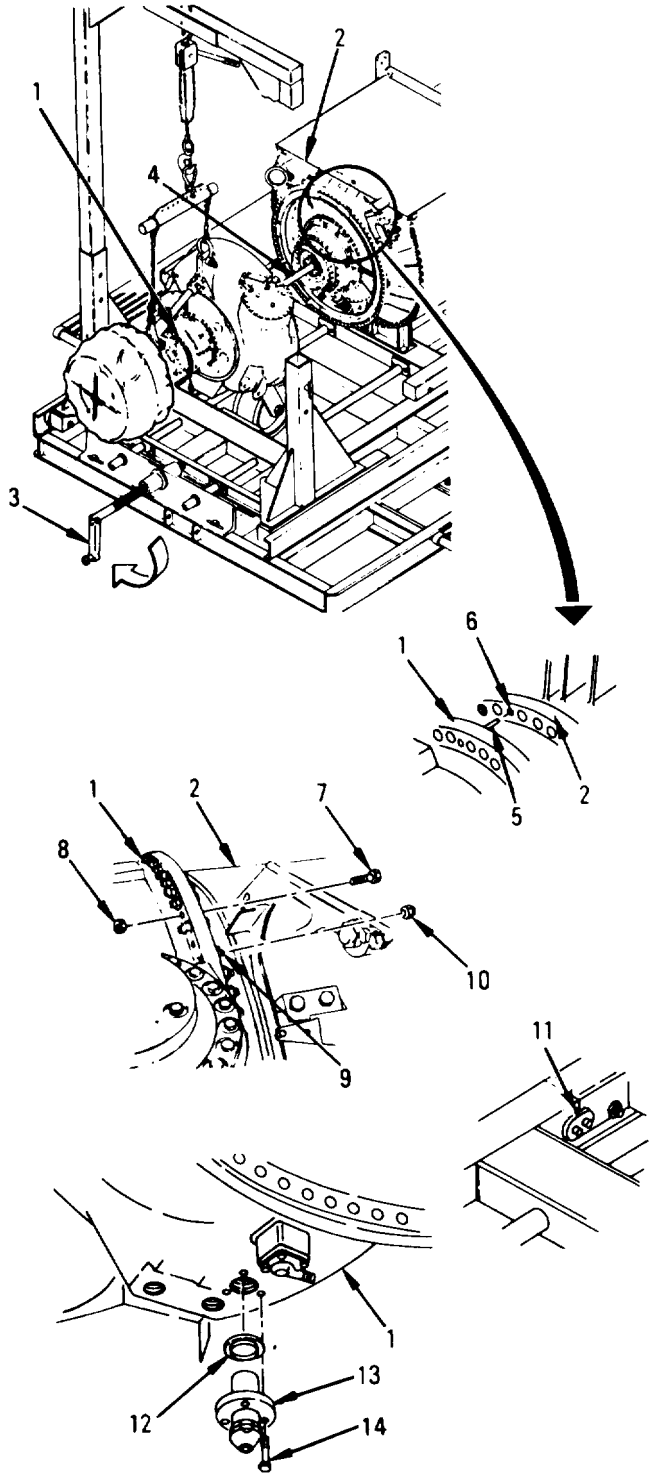
10. HOOK TWO LATCHES (11).

NOTE

If forward module (1) was removed for access only, go to step 13.

11. INSTALL NEW GASKET (12) AND VALVE AND ADAPTER (13).

    Apply antiseize compound to three bolts (14). Install gasket (12) and valve and adapter (13) in forward module (1). Install bolts (14).



Go on to Sheet 10

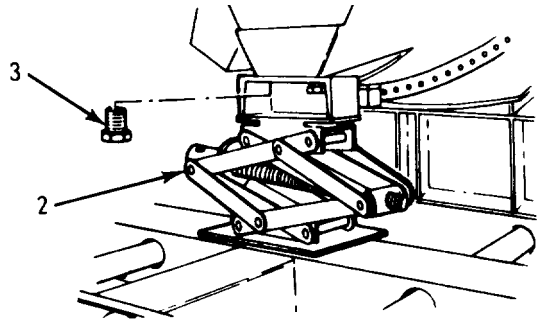
FORWARD ENGINE MODULE REPLACEMENT (Sheet 10 of 10)

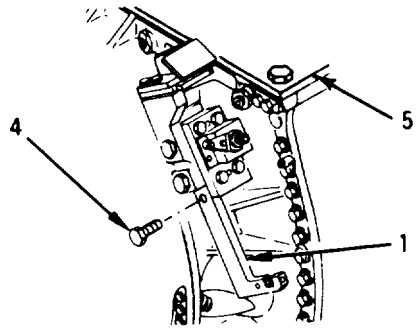
12. INSTALL BRACKET (l).

    a. Raise jack (2) and install two bolts (3).

    b. Remove forward engine module lifting sling (page 5-12).

    c. Apply antiseize compound to threads of three bolts (4). Install bracket (1) on engine (5). Install bolts (4).





13. INSTALL POWER TURBINE STATOR CYLINDER ASSEMBLY (TM 20-1).

14. INSTALL COMPRESSED AIR TUBE ASSEMBLY (TM 20-1).

15. INSTALL TUBE ASSEMBLY (NO. 2 AND 3 BEARINGS) (TM 20-1).

16, INSTALL TUBE ASSEMBLY (NO. 5 AND 6 BEARINGS) (TM 20-1).

17. INSTALL IGNITION ELECTRICAL LEAD (TM 20-1).

18. INSTALL FLANGE TO HOSE ELBOW (REDUCTION GEARBOX) (TM 20-1).

19. INSTALL REDUCTION GEARBOX HOSE (TM 20-1).

20 INSTALL FORWARD REDUCTION GEARBOX TUBE ASSEMBLY (TM 20-1).

21. INSTALL PRESSURE FLUID FILTER DOUBLE ANGLE BRACKET (TM 20-1).

22. INSTALL FUEL MANAGEMENT SYSTEM BRANCHED WIRING HARNESS 3W105 (TM 20-1).

23. INSTALL MAINTENANCE INDICATOR BRANCHED WIRING HARNESS 3W107 (TM 20-1).

24. INSTALL THERMOCOUPLE BRANCHED WIRING HARNESS 3W106 (TM 20-1).

25. INSTALL GEARBOX MODULE ON ENGINE (PAGE 7-12).

26. REMOVE FORWARD ENGINE OVERHEAD SUPPORT (PAGE 7-4).

End of Task

FORWARD ENGINE MODULE REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Combination wrench, 1-5/16 inch (Item 19, Appendix D)
Torque wrench, 0-150 ft-lb (Item 24, Appendix D)

SUPPLIES: Lockwasher (Item 18, Appendix E) (2 required)
Lockwasher (Item 19, Appendix E) (2 required)
Self-locking nut (Item 17, Appendix E) (6 required)
Wood block (Item 22, Appendix B)
Wood block (Item 23, Appendix B) (2 required)
Wood block (Item 31, Appendix B) (3 required)

PERSONNEL: Two

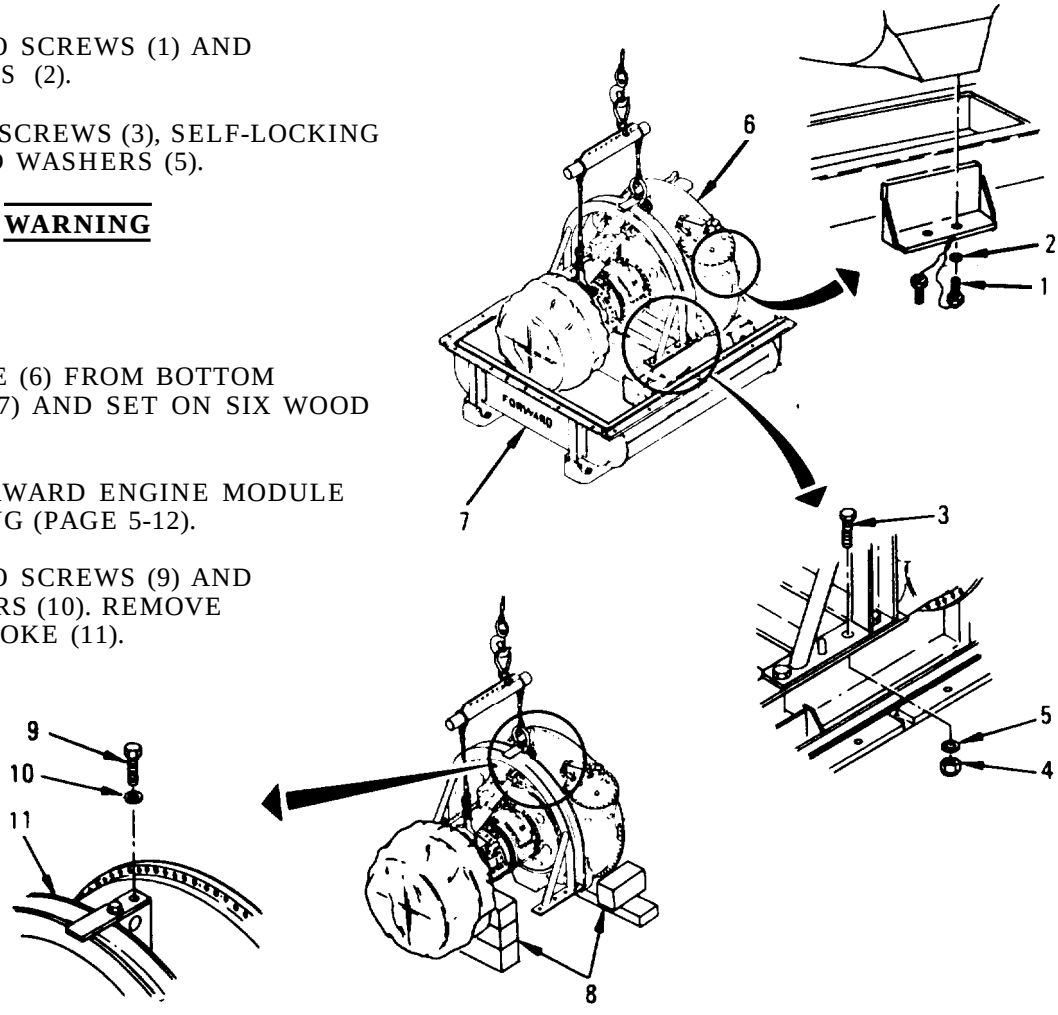
EQUIPMENT CONDITION: Top weldment removed (page 4-1)
Forward engine module lifting sling installed (page 5-12)

REMOVAL:

1. REMOVE TWO SCREWS (1) AND LOCKWASHERS (2).
2. REMOVE SIX SCREWS (3), SELF-LOCKING NUTS (4) AND WASHERS (5).

WARNING

3. LIFT MODULE (6) FROM BOTTOM WELDMENT (7) AND SET ON SIX WOOD BLOCKS (8).
4. REMOVE FORWARD ENGINE MODULE LIFTING SLING (PAGE 5-12).
5. REMOVE TWO SCREWS (9) AND LOCKWASHERS (10). REMOVE MOUNTING YOKE (11).



Go on to Sheet 2

FORWARD ENGINE MODULE REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 2 of 2)

INSTALLATION:

1. INSTALL YOKE (1) ON MODULE (2).

   Aline yoke (1) on module (2), and loosely install two screws (3) and new lockwashers (4),

2. INSTALL FORWARD ENGINE MODULE LIFTING SLING (PAGE 5-12).

WARNING

3. INSTALL MODULE (2) IN WELDMENT (5).

   a. Move module (2) over weldment (5). Aline two holes (6) with pins (7) and lower module (2) on frame (8).

   b. Aline two holes in bottom of module (2) with two holes (9) in bracket (10). Loosely install two screws (11) and new lockwashers (12).

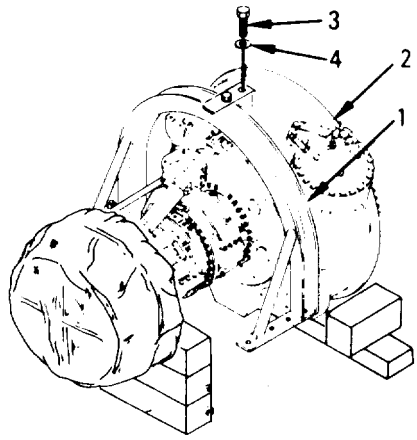
4. INSTALL SIX SCREWS (13), WASHERS (14), AND NEW NUTS (15). TORQUE SCREWS (13) AND NUTS (15) BETWEEN 52-60 LB-FT (71-81 N•m).

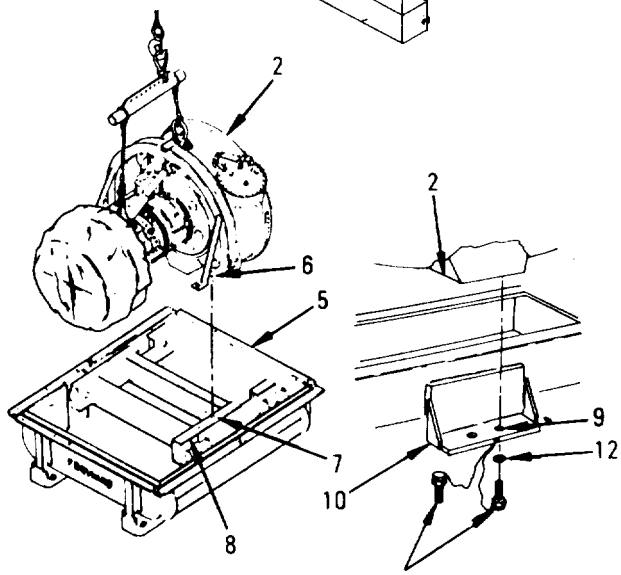
5. TIGHTEN SCREWS (11).

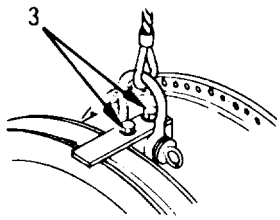
6. TORQUE SCREWS (3) BETWEEN 39-43 LB-FT (53-58 N•m).

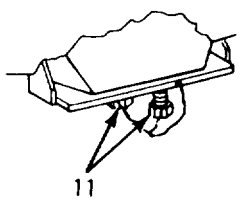
7. REMOVE FORWARD ENGINE MODULE LIFTING SLING (PAGE 5-12).

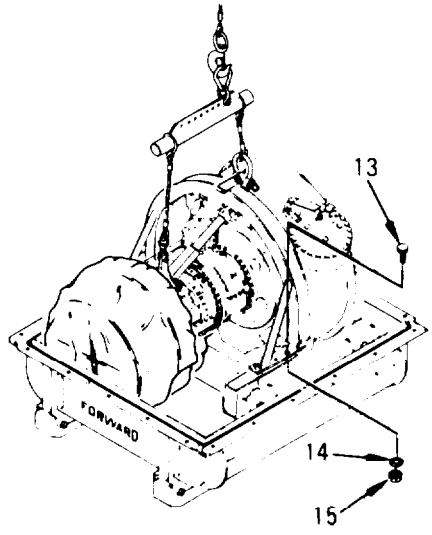
8. INSTALL TOP WELDMENT (PAGE 4-3).











End of Task

FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) REMOVAL AND INSTALLATION (Sheet 1 of 7)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Bottoming tap, 1/4-28 (Item 15, Appendix D)
Chain hoist, 1-ton minimum capacity (Item 20, Appendix D)
Combination wrench, 1-1/4 inch (Item 16, Appendix D)
Extension, 3/8-inch drive, 6-inch (Item 8, Appendix D)
Forward engine module lifting sling (Item 7, Appendix D)
Hoist, l-ton minimum capacity (Item 21, Appendix D)
Jackscrew (Item 18, Appendix D) (4 required)
Ratchet handle, 3/8-inch drive (Item 9, Appendix D)
Socket, 3/8-inch drive, l/2-inch (Item 12, Appendix D)
Socket, 3/8-inch drive, 11/16-inch (Item 22, Appendix D)
Socket, 3/8-inch drive, 3/4-inch (Item 14, Appendix D)
Torque adapter (Item 23, Appendix D)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Gasket (Item 15, Appendix E)
Lubricating oil (Item 11 or 12, Appendix B)
Self-locking nut (Item 16, Appendix E) (96 required)
Shortening compound (Item 20, Appendix B)
Wood block (Item 32, Appendix B) (3 required)

PERSONNEL: Two

EQUIPMENT CONDITION: Oil tank and gearbox module drained (TM 20-1)
Lubricating oil tank assembly removed (TM 20-1)
Thermocouple branched wiring harness 3W106 removed (TM 20-1)
Power turbine stator cylinder assembly removed (TM 20-1)
Power turbine stator feedback control assembly removed (TM 20-1)
Hose assembly (No. 6A and 6B bearing scavenge) removed (TM 20-1)
Hose assembly (No. 5 inner bearing scavenge) removed (TM 20-1)
Forward reduction gearbox tube assembly removed (TM 20-1)
Tube assembly (No. 5 and 6 bearings) removed (TM 20-1)
Compressed air tube assembly removed (TM 20-1)
Tube assembly (reduction gearbox oil feed - forward) removed (TM 20-1)
Tube assemblies (forward reduction gearbox scavenge) removed (TM 20-1)
Tube assembly (No. 5 and 6 bearing feed) removed (TM 20-1)
Fuel management system branched wiring harness 3W105 removed (TM 20-1)
Maintenance indicator branched wiring harness 3W107 removed (TM 20-1)
Pressure fluid filter double angle bracket removed (TM 20-1)
Ignition electrical lead removed (TM 20-1)
Forward engine overhead support installed (page 7-4)

Go on to Sheet 2

FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) REMOVAL AND INSTALLATION (Sheet 2 of 7)

REMOVAL:

1. REMOVE BRACKET (l).
   a. Position forward dolly (2). Turn handle (3) clockwise until dolly (2) is all the way in.
   b. Unhook two latches (4).
   c. Remove three bolts (5). Remove bracket (l).
2. REMOVE TWO BOLTS (6). LOWER JACK (7).
3. INSTALL FORWARD ENGINE MODULE LIFTING SLING (PAGE 5-12).

CAUTION

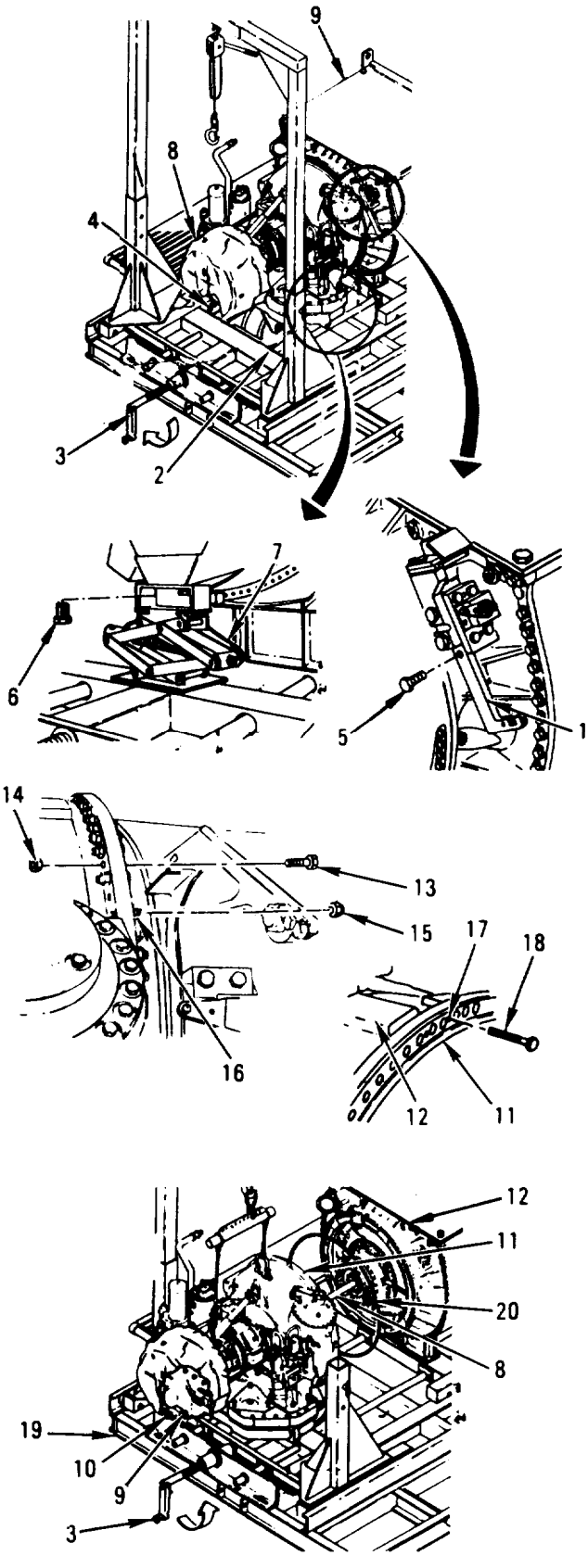
- Do not lean on, or hang anything on shaft (8). Damage to bearing seal or air seal may result.
- Make sure plug (9) does not hit front plate (10) when forward module (11) is moved.

4. REMOVE FORWARD MODULE (11) FROM REAR MODULE (12).
   a. Remove 81 bolts (13) and self-locking nuts (14).
   b. Remove 15 self-locking nuts (15) from studs (16).
   c. Apply oil to tap and clean out four jackscrew holes (17), located at the 12, 3, 6, and 9 o'clock positions.
   d. Apply oil to four .iackscrews (18), Install jacksrews (18) in-holes (17).

NOTE

Tighten jackscrews (18) opposite each other.

   e. Tighten jackscrews (18) evenly until forward module (11) moves away from rear module (12). Remove jackscrews (18).
   f. Turn handle (3) counterclockwise until forward module (11) stops at end of stand (19).
   g. Remove gasket (20).



Go on to Sheet 3

FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) REMOVAL AND INSTALLATION (Sheet 3 of 7)

NOTE

Transfer sling (1) is part of maintenance stand (2).

5. INSTALL SLING (1) TO HOIST HOOK (3) AND FORWARD MODULE (4).

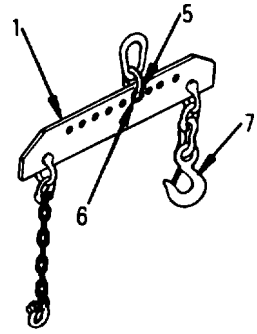
   a. Install shackle (5) in fourth hole (6) from sling hook (7).

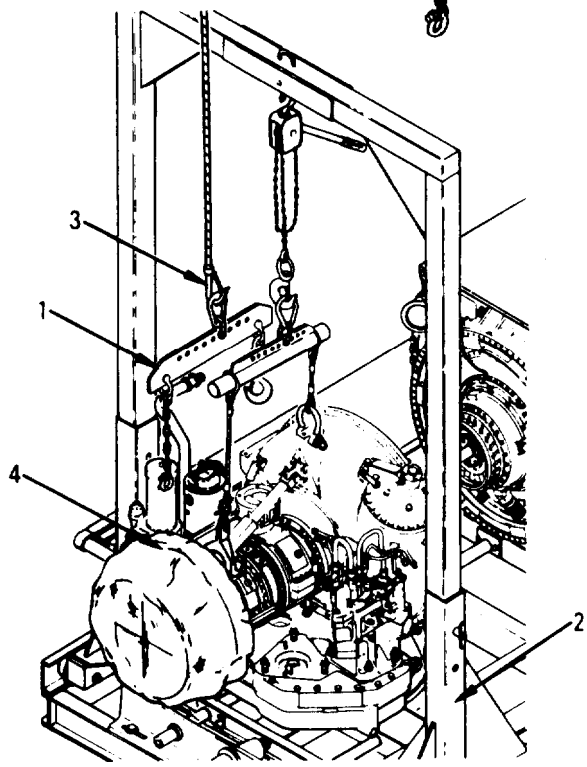
   b. Lower hoist hook (3) over forward module (4) and install sling (1) on hoist hook (3).

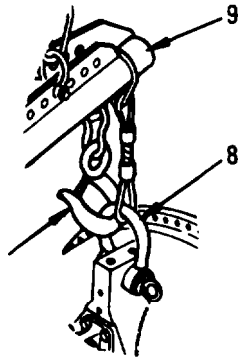
   c. Install sling hook (7) to shackle (8) of module sling (9).

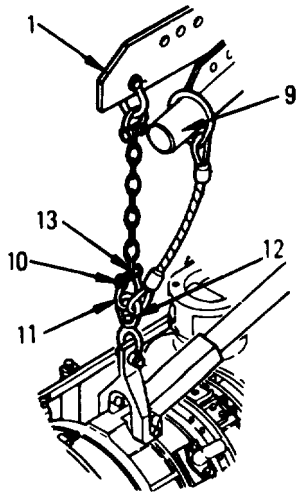
   d. Remove pin (10) from shackle (11) on sling (l). Install shackle (11) on ring (12) of module sling (9).

   e. Install shackle (11) on first chain link (13) and install pin (10).









Go on to Sheet 4

FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) REMOVAL AND INSTALLATION (Sheet 4 of 7)

WARNING

6. REMOVE MODULE (1) FROM STAND (2).

   a. Remove sling (3) from chain hoist hook (4). Install sling (3) on hoist hook (5).

   b. Move module (1) away from stand (2) and set on three wood blocks (6).

NOTE

If rear module (7) is being replaced, go to installation step 1.

7. REPLACE SEAL RINGS AND EXPANDER SPRINGS (PAGE 6-33).

INSTALLATION:

1. INSTALL MODULE (1) ON STAND (2).

   a. Install sling (3) on chain hoist hook (4).

   b. Operate hoist until there is tension on chain hoist hook (4).

   c. Lower module (1) until sling (8) is slack. Remove sling hook (9) from shackle (10) on sling (3).

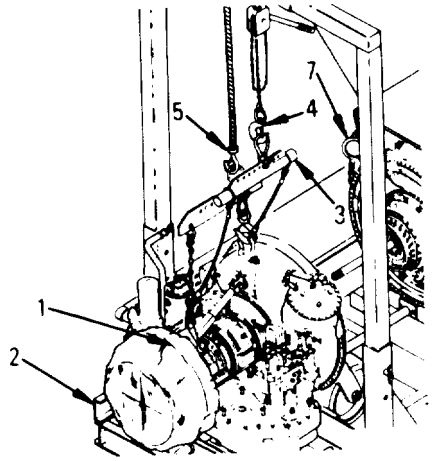
CAUTION

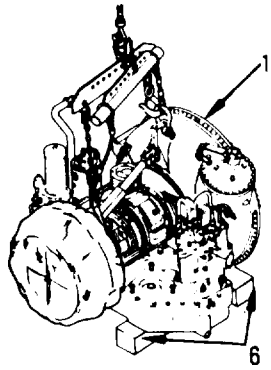
Do not lean on, or hang anything on shaft (11). Damage to bearing seal or air seal may result.

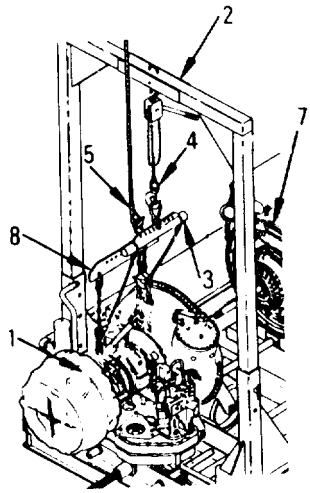
2. REMOVE TRANSFER SLING (8).

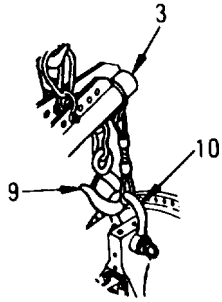
   a. Remove pin (12) from shackle (13). Remove shackle (13) from ring (14) and install on first chain link (15). Install pin (12).

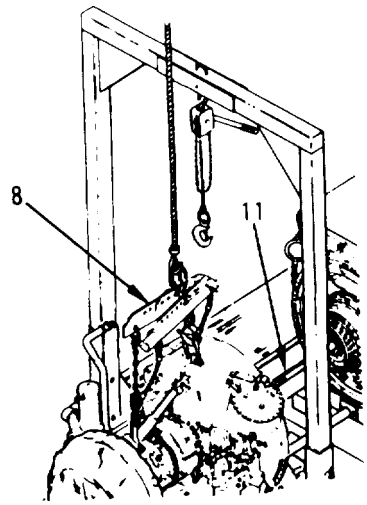
   b. Remove and stow sling (8).

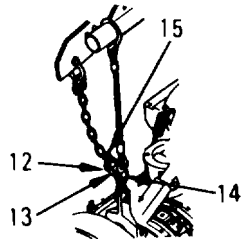












Go on to Sheet 5

FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) REMOVAL AND INSTALLATION (Sheet 5 of 7)

3. INSTALL NEW GASKET (l).

   a. Apply shortening to gasket (1), three rings (2), and shaft (3).

   b. Install gasket (1) in groove (4) on rear module (5).

4. INSTALL FORWARD MODULE (6) ON REAR MODULE (5).

   a. Turn handle (7) clockwise until forward module (6) is close to shaft (3).

   b. Aline forward module (6) with shaft (3). Turn handle (7) until forward module (6) is close to rear module (5).

   c. Using alinement pin (8) in forward module (6) and small holes (9) in rear module (5) as reference to 12 o'clock position, aline studs (10) to mating holes (11).

   d. Turn handle (7) clockwise until forward module (6) is mated to rear module (5).

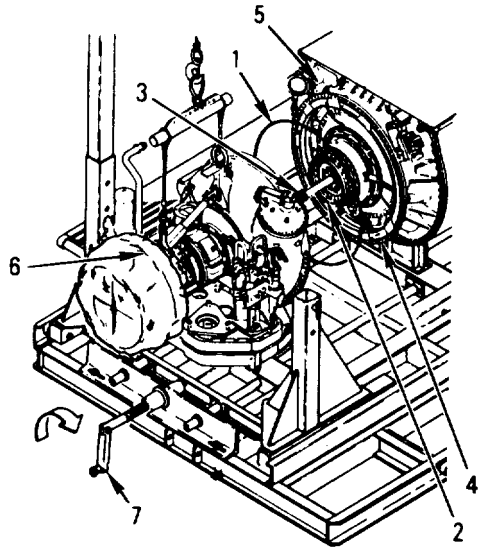
NOTE

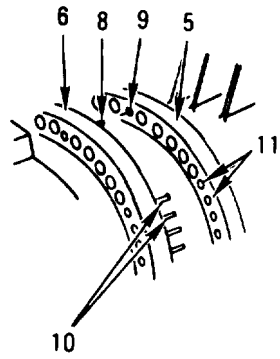
Tighten bolts (12) and nuts (13) at top, bottom, and each side of engine first to seat forward module (6) on rear module (5).

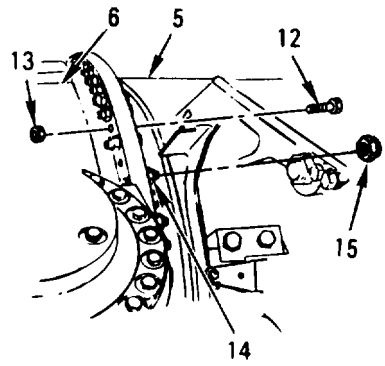
   e. Apply antiseize compound to 81 bolta (12). Install bolts (12) and new nuts (13).

   f. Apply antiseize compound to 15 studs (14). Install 15 new nuts (15) on studs (14).

5. TORQUE BOLTS (12) AND NUTS (13, 15) BETWEEN 170-190 LB-IN (19-22 N•m).





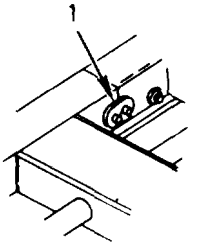


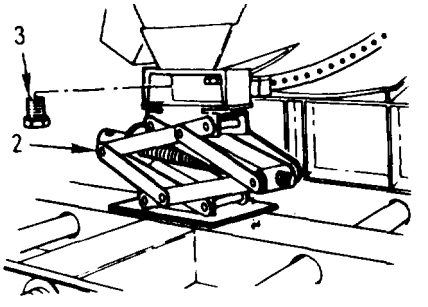
Go on to Sheet 6

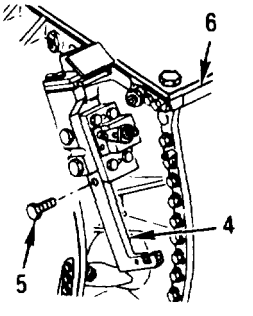
FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) REMOVAL AND INSTALLATION (Sheet 6 of 7)

6. HOOK TWO LATCHES (l), RAISE JACK (2) AND INSTALL TWO BOLTS (3).
7. REMOVE FORWARD ENGINE MODULE LIFTING SLING (PAGE 5-12).
8. INSTALL BRACKET (4).

   Apply antiseize compound to three bolts (5). Install bracket (4) on engine (6) with bolts (5).
9. REMOVE FORWARD ENGINE OVERHEAD SUPPORT (PAGE 7-4).
10. INSTALL IGNITION ELECTRICAL LEAD (TM 20-1).
11. INSTALL PRESSURE FLUID FILTER DOUBLE ANGLE BRACKET (TM 20-1).
12. INSTALL MAINTENANCE INDICATOR BRANCHED WIRING HARNESS 3W107 (TM 20-1).
13. INSTALL FUEL MANAGEMENT SYSTEM BRANCHED WIRING HARNESS 3W105 (TM 20-1).
14. INSTALL TUBE ASSEMBLY (NO. 5 AND 6 BEARING FEED) (TM 20-1).
15. INSTALL TUBE ASSEMBLIES (FORWARD REDUCTION GEARBOX SCAVENGE) (TM 20-1).
16. INSTALL TUBE ASSEMBLY (REDUCTION GEARBOX OIL FEED - FORWARD) (TM 20-1).
17. INSTALL COMPRESSED AIR TUBE ASSEMBLY (TM 20-1).
18. INSTALL TUBE ASSEMBLY (NO. 5 AND 6 BEARINGS) (TM 20-1).
19. INSTALL FORWARD REDUCTION GEARBOX TUBE ASSEMBLY (TM 20-1).
20. INSTALL HOSE ASSEMBLY (NO. 5 INNER BEARING SCAVENGE) (TM 20-1).
21. INSTALL HOSE ASSEMBLY (NO. 6A AND 6B BEARING SCAVENGE) (TM 20-1).







Go on to Sheet 7

FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) REMOVAL AND INSTALLATION (Sheet 7 of 7)

22. INSTALL POWER TURBINE STATOR FEEDBACK CONTROL ASSEMBLY (TM 20-1).
23. INSTALL POWER TURBINE STATOR CYLINDER ASSEMBLY (TM 20-1).
24. INSTALL THERMOCOUPLE BRANCHED WIRING HARNESS 3W106 (TM 20-1).
25. INSTALL LUBRICATING OIL TANK ASSEMBLY (TM 20-1).
26. FILL OIL TANK AND GEARBOX MODULE (LO -12)

End of Task

SCREEN ASSEMBLY REPAIR (Sheet 1 of 1)

TOOLS: Rubber mallet (Item 26, Appendix D)
Torch outfit (Item 25, Appendix D)

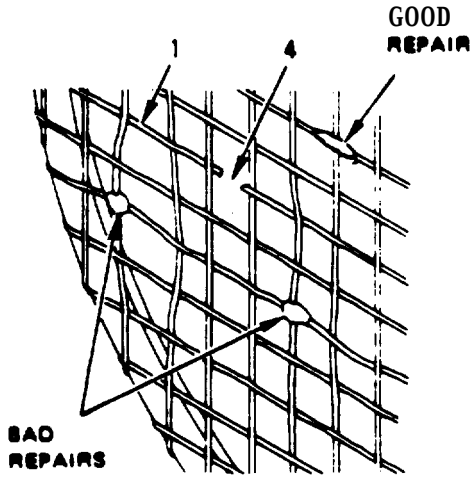
SUPPLIES: Brazing alloy (Item 4, Appendix B)
Brazing alloy (Item 5, Appendix B)
Flux (Item 8, Appendix B)

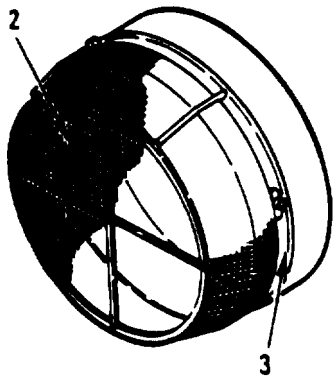
REPAIR:

CAUTION

- Do not bend wire (1) more than 90° when making repairs. Sharp bending of wire (1) may cause it to become weak or crack, If wire (1) is sucked into engine, it will cause compressor damage.
- Do not allow large amounts of filler metal to form. They could break off and be sucked into engine, causing compressor damage.

1. REPAIR DEFORMED SCREEN (2) BY PLACING IT AGAINST SOMETHING HARD. GENTLY TAP UNTIL SHAPE IS RESTORED.
2. TORCH SILVER BRAZE BROKEN OR SEPARATED WIRES (1) AT THE Attachment BAND (3). USE BRAZING ALLOY (ITEM 5, APPENDIX B) AND FLUX.
3. LOOK AT ALL OTHER WIRES (1) FOR BREAKS. IF GAP (4) IS GREATER THAN 0.030-INCH (0.762 MM), REPLACE SCREEN (2). OTHERWISE TORCH SILVER BRAZE BROKEN WIRE (l). USE BRAZING ALLOY (ITEM 4 OR 5 APPENDIX B) AND FLUX.





End of Task

IGV BELLCRANK SPRING PIN REPLACEMENT (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-N26)
Drive pin punch, 3/32-inch (Item 102, Appendix D)

SUPPLIES: Cotter pin (Item 114, Appendix E)
Spring pin (Item 113, Appendix E)

REMOVAL:

NOTE

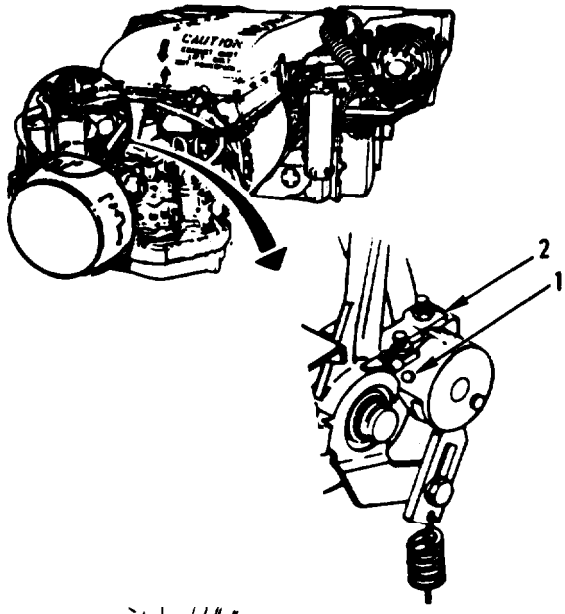
Try steps 1 thru 6 first to remove spring pin (l). If pin (1) cannot be removed go to step 7.

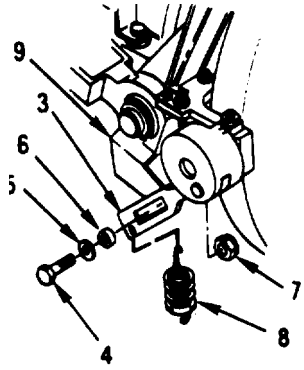
1. REMOVE SCREEN ASSEMBLY (ENGINE AIR INLET) (TM 20-1).
2. REMOVE TUBE ASSEMBLY (NUMBER 1 BEARING FEED) (TM 20-1).
3. REMOVE INLET GUIDE VANE ACTUATING CYLINDER (TM 20-1).
4. REMOVE IGV STOP BRACKET (2).
5. REMOVE CONNECTING LINK (3).
   a. Remove screw (4), washer (5), spacer (6), nut (7), and spring (8) from link (3) and lever assembly (9).
   b. Remove cotter pin (10), two washers (11), and pin (12).
   c. Remove link (3).

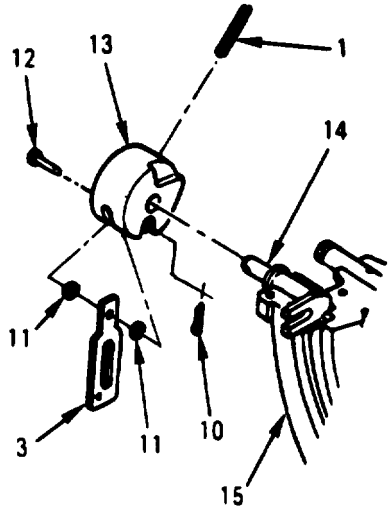
NOTE

If pin (1) is exposed more than l/4-inch, remove with diagonal pliers. If not, use 3/32-inch punch and hammer.

6. REMOVE PIN (1) FROM BELLCRANK (13) AND SHAFT ASSEMBLY (14). GO TO STEP 10.
7. REMOVE INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) (PAGE 5-6).
8. REMOVE BELLCRANK (13) AND SHAFT (14) FROM LOWER HOUSING (15).
9. REMOVE PIN (1) FROM BELLCRANK (13) AND SHAFT (14).
10. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.







Go on to Sheet 2

IGV BE1.LCRANK SPRING PIN REPLACEMENT (Sheet 2 of 2)

INSTALLATION:

1. PLACE BELLCRANK (1) ON FLAT SURFACE. START NEW PIN (2) INTO BELLCRANK (1) WITH SLIT OF PIN (2) FACING INWARD NOTCH.

NOTE

- If pin (2) was removed with intermediate (low pressure) housing (top half) installed, do steps 2 thru 7 only. lf not, go to step 8.
- Use 3/32-inch punch to assist in alining pin (2) until it seats. When fully seated, pin (2) should extend about l/4-inch out of bellcrank (1).

2. INSTALL PIN (2) IN BELLCRANK (1) AND SHAFT (3).

3. INSTALL CONNECTING LINK (4).

   a. Install pin (5), two washers (6), and new cotter pin (7) in link (4) and bellcrank (1).

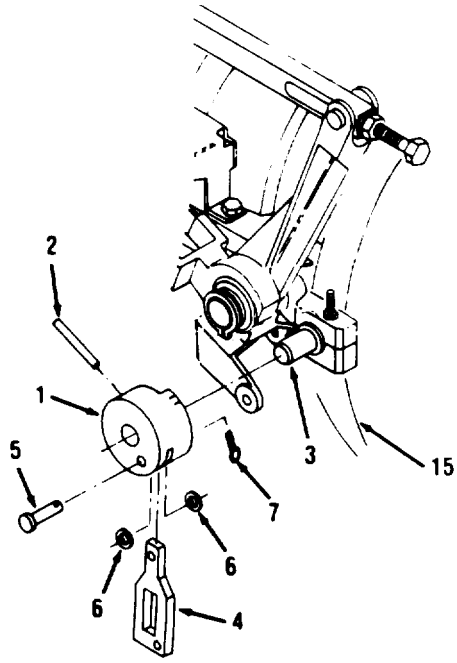
   b. Install screw (8), washer (9), spacer (10), nut (11), and spring (12) in link (4) and lever assembly (13).

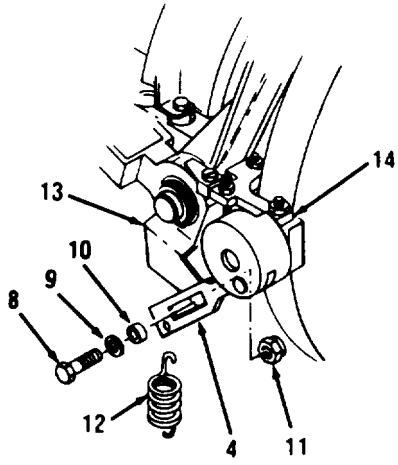
4. INSTALL IGV STOP BRACKET (14).

5. INSTALL INLET GUIDE VANE ACTUATING CYLINDER (TM 20-l).

6. INSTALL TUBE ASSEMBLY (NUMBER 1 BEARING FEED) (TM 20-1).

7. INSTALL SCREEN ASSEMBLY (ENGINE AIR INLET) (TM 20-l).





NOTE

Use 3/32- inch punch to assist in alining pin (2) until it seats. When fully seated, pin (2) should extend about 1/4-inch out of bellcrank (1).

8. [NSTALL PIN (2) IN BELLCRANK (1) AND SHAFT (3).

9. INSTALL BELLCRANK (1) AND SIIAFT (3) IN I.OWER HOUSING (15).

10. INSTALL INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) (PAGE 5-8).

End of Task

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 1 of 21)

TOOLS: General mechanic's tool kit: automotive (SC5180-90-N26)
Chemical and oil protective gloves (Item 87, Appendix D)
Feeler gage (Item 142, Appendix D)
Industrial goggles (Item 58, Appendix D)
[nserted h,ammer face (Item 1, Appendix D)
Inserted hammer face holder (Item 2, Appendix D)
Metal pail (five gallon capacity) (Item 136, Appendix D)
Open end wrench (Item 30, Appendix D)
Pocket knife (Item 137, Appendix D)
Torque adapter (Item 138, Appendix D)
Torque wrench (Item 27, Appendix D)

SUPPLIES: Alkaline descaler compound (Item 49, Appendix B)
Antiseize compound (Item 2, Appendix B)
Conical seal (Itcm 157. Appendix E)
Cotter pin (Item 14, Appendix E) (2 required)
Cotter pin (Item 5, Appendix E) (2 required)
Gasket (Item 1, Appendix E) (2 required)
Gasket (ltem 124, Appendix E)
Keywasher (Item 6, Appendix E)
Lockwasher (Item 120. Appendix E) (60 required)
Lockwasher (Item 7, Appendix E) (2 required)
Oven cleaner (Item 43. Appendix B)
Preformed packing (Item 129, Appendix E)
Self-locking nut (Item 128, Appendix E (14 required)
Self-locking nut (Item 3, Appendix E (32 required)
Self- 1ocking nut (Item 8, Appendix E (4 required)
Self -1ocking nut (Item 9, Appendix E (14 required)
Shortening compound (Item 20, Appendix B)
Technical beeswax (Item 3, Appendix B)
Toothbrush (Item 47, Appendix B)
Wiping Rag (Item 14, Appendix B)

PERSONNEL: Two

EQUIPMENT CONDITION: Gearbox module removed (page 7-6)
Turbine axial compressor (high pressure) housing (top half) removed (page 5-2)
Intermediate (low pressure) housing (top half) removed (page 5-6)

Go on to Sheet 2

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 2 of 21)

CLEANING:

CAUTION

Upper and lower housing and upper and lower stators are matched sets. Do not break up sets.

NOTE

If damage is found in steps 1 and 2, install upper case and stator assemblies using old (not new) supplies.

1. CHECK ALL LOW PRESSURE STATOR VANE ASSEMBLIES (1) AND ALL HIGH PRESSURE STATOR VANE ASSEMBLIES (2) FOR CRACKS, BENDS, EROSION OR OTHER MAJOR DAMAGE. IF DAMAGED, INSTALL INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) (PAGE 5-8) AND TURBINE AXIAL COMPRESSOR (HIGH PRESSURE) HOUSING (TOP HALF) (PAGE 5-3), AND REPLACE FORWARD MODULE (PAGE 5-25). IF OK, GO TO STEP 2.

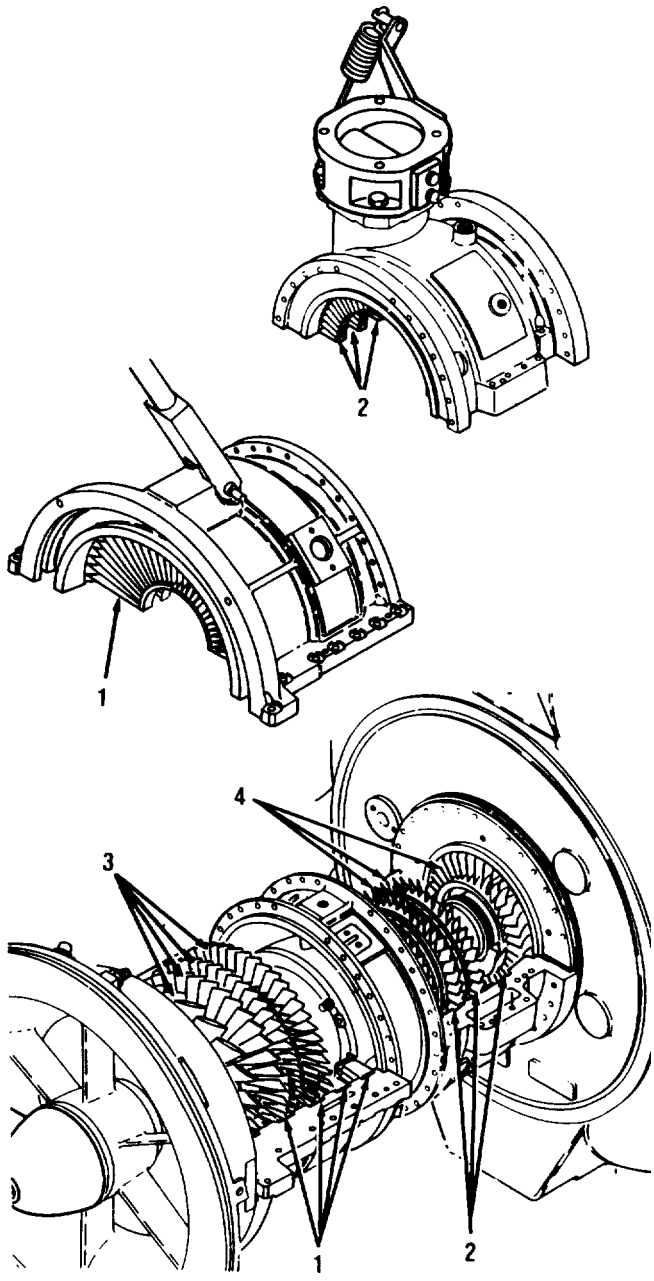
2. CHECK ALL LOW PRESSURE COMPRESSOR BLADES (3) AND ALL HIGH COMPRESSOR BLADES (4) FOR FOREIGN OBJECT DAMAGE. IF DAMAGE IS FOUND, INSTALL INTERMEDIATE (LOW PRESSURE) HOUSING (TOP HALF) (PAGE 5-8) AND TURBINE AXIAL COMPRESSOR (HIGH PRESSURE) HOUSING (TOP HALF) (PAGE 5-3), AND REPLACE FORWARD MODULE (PAGE 5-25). IF OK, GO TO STEP 3.

a. Inspect for cracks, bends or distortion.

b. Inspect for sharp nicks and dents that are longer than 3/32-inch (2.38 mm).

c. Inspect for any nicks and dents that are within 3/4-inch (19.05 mm) of blade root.

d, If damage is found in steps a. through c., install intermediate (low-pressure) housing (top half) (page 5-8) and turbine axial compressor (high pressure) housing (top half) (page 5-3), and replace forward module (page 5-25). If ok, go to step 3.



Go on to Sheet 3

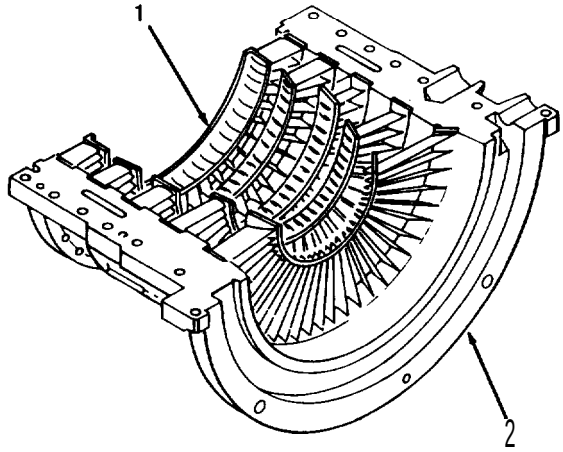
LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 3 of 21)

WARNING

NOTE

The cleaning procedure in steps 3 through **7** is the same for all case and stator assembly halves. The low pressure case and stator (top half is shown being cleaned.

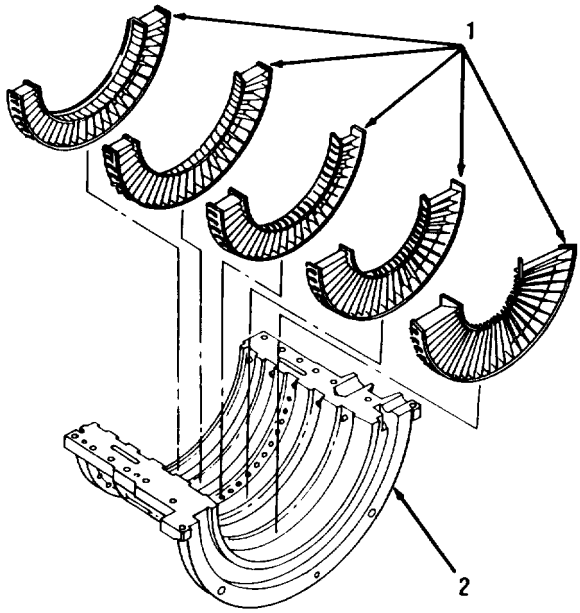
3. PREPARE CLEANING SOLUTION BY MIXING ONE PART OF ALKALINE DE-SCALER COMPOUND TO FOUR PARTS OF FRESH HOT WATER.



NOTE

When removing vanes (l), ensure vanes are kept in order of disassembly.

4. REMOVE AND CLEAN VANE ASSEMBLIES (1) OF LOW PRESSURE CASE AND STATOR (TOP HALF) (2) W1TH TOOTHBRUSH AND PREMIXED CLEANING SOLUTION.



   a. Remove each vane assembly (1) from case (2).

   b. Clean vane assemblies (1) with toothbrush and premixed cleaning solution.

   c. Check to see if vane assemblies (1) have been cleaned. If not clean, soak vane assemblies in the premixed solution for 30 minutes, then scrub with tooth brush.

   d. Recheck to see if vane assemblies are clean. If clean, go to step 6. If not clean, go to step 5.

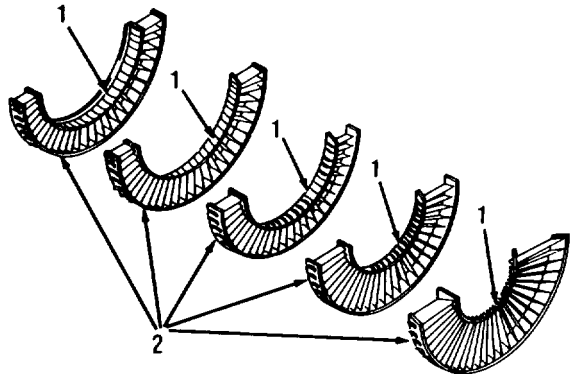
Go on to Sheet 4

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING **(Sheet 4 of 21)**

WARNING

CAUTION

Oven cleaner contains solvents that may dissolve nonmetallic materials. Do not allow oven cleaner to contact abradable seal (1) at inner diameter of vane assemblies (2).



5. CLEAN VANE ASSEMBLIES (2) WITH OVEN CLEANER, TOOTHBRUSH AND PREMIXED CLEANING SOLUTION.

a. Spray vane assemblies (2) with oven cleaner, being careful not to get any on the abradable seal (1) at inner diameters. Let cleaner work for 45 minutes.

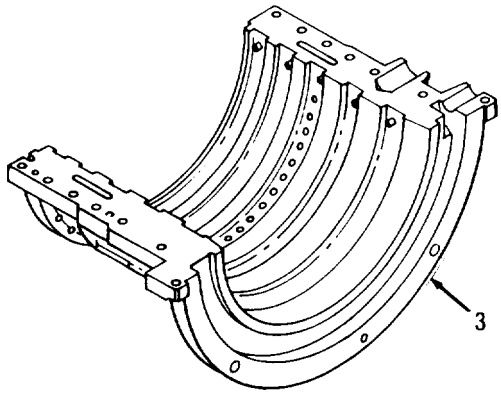
b. Scrub vane assemblies (2) with toothbrush, and rinse in premixed cleaning solution.

c. Rinse vane assemblies in fresh clean hot tap water bath.

d. Check to see if vane assemblies (2) are clean. Repeat steps a. through c. as needed.

WARNING

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



6. CLEAN CASE (3) WITH TOOTHBRUSH AND PREMIXED CLEANING SOLUTION.

a. Clean case (3) with toothbrush and premixed cleaning solvent.

b. Flush case (3) with hot tap water, and dry using shop air.

Go on to Sheet 5

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL (COMPRESSOR AND ROTOR CLEANING (Sheet 5 of 21)

7. INSTALL VANE ASSEMBLIES (1) IN CASE **(2)** IN SAME ORDER THEY WERE REMOVED.

   a. Apply small amount of beeswax on crown (3) of each vane assembly (1) to hold vane assemblies in place in case (2).

   b. Aline hole in each vane assembly end (4) with respective pin (5), and press vane assemblies (1) in case (2).

8. REPEAT STEPS 3. THROUGH 7. AND CLEAN HIGH PRESSURE CASE AND STATOR ASSEMBLY (TOP HALF) (6).

WARNING

9. PREPARE NEW BATCH OF CLEANING SOLUTION BY MIXING ONE PART OF ALKALINE DESCALER COMPOUND TO FOIIR PARTS OF FRESH HOT WATER.

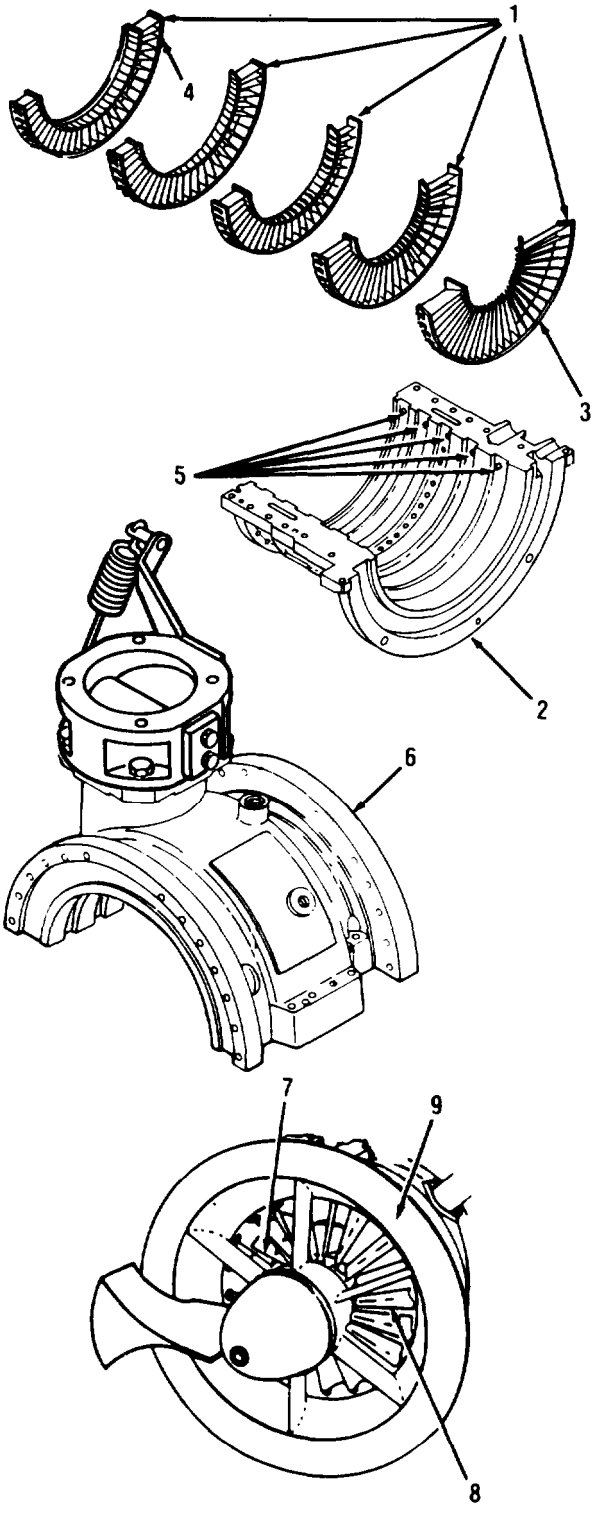
WARNING

Be careful not to get fingers caught between compressor blades (7) and inlet guide vanes (8). Blades (7) ,are sharp and can cut you.

10. CLEAN INLET HOUSING (9) AND INLET GUJDE VANES (8) WITH TOOTHBRUSH, PREMJXED CLEANING SOLUTION AND RAG.

   a. Clean inlet housing (9) with rag dipped in premixed cleaning solution.

   b. Scrub inlet guide vanes (8) with brush and premixed cleaning solution. Wipe with clean rag.



Goon to Sheet 6

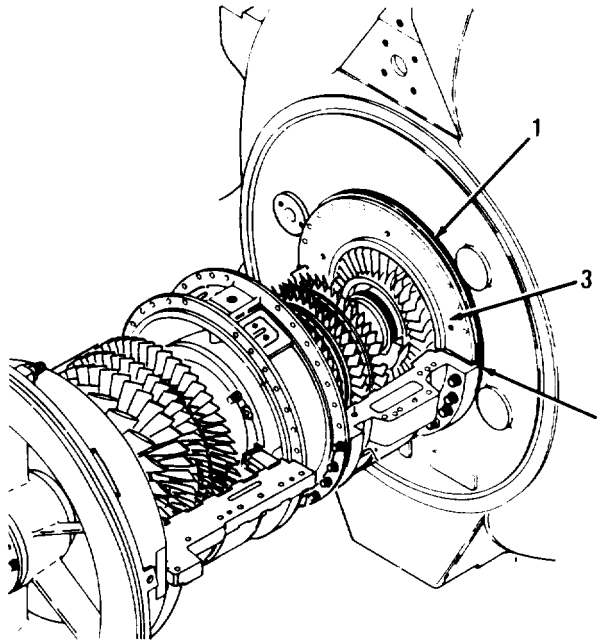
LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 6 of 21)

11. INSPECT GASKET (l) FOR DAMAGE THAT MIGHT CAUSE AN AIR LEAK. IF DAMAGED, CUT AND REMOVE UPPER HALF OF GASKET (l).

    a. Inspect gasket (1) for gouges, nicks or cuts that could cause an air leak.

    b. If damaged, cut gasket even with split line flange (2) on both sides of engine, and remove cut portion of gasket (1). Save removed portion for use in step 12.

    c. Wipe spacer half (3) with rag.



Go on to Sheet **7**

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRItSSOR AND ROTOR CLEANING (Sheet 7 of 21)

NOTE

Do step 12. only if upper half of gasket (1) was removed.

12. CUT AND INSTALL NEW GASKET (l).

a. Using removed portion of gasket (1), measure and cut a new gasket to the same length.

b. Apply shortening compound to new gasket (1) and install on spacer half (2).

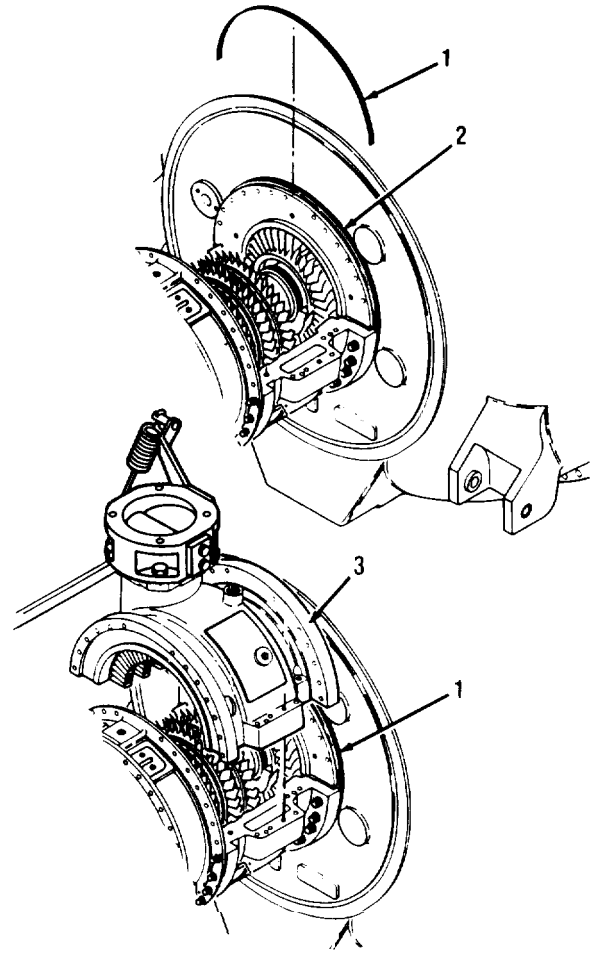
CAUTION

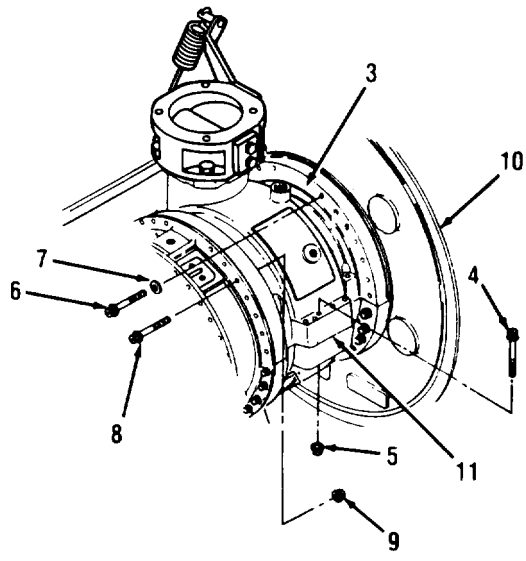
Be careful not to damage gasket (1) when installing case and stator assembly (3). If seal (1) is damaged, remove case and stator assembly and repeat step 12.

13. INSTALL HIGH PRESSURE VANE AND STATOR ASSEMBLY (TOP HALF) (3), FOUR BOLTS (4), NUTS (5), 12 BOLTS (6), NEW WASHERS (7), 14 BOLTS (8) AND NEW NUTS (9). TIGHTEN BOLTS (4) AND NUTS (5). TORQUE BOLTS (6 BETWEEN 100-110 LB-IN (11-12 N•m). TORQUE BOLTS (8) BETWEEN 68-75 LB-IN (7-9 N•m).

a. Position high pressure case and stator assembly (top half) (3) on engine (10).

b. Install two bolts (4) and nuts (5) on both sides of case and stator assembly (3), at split line flange (11). Tighten bolts (4) and nuts (5).





Go on to Sheet 8

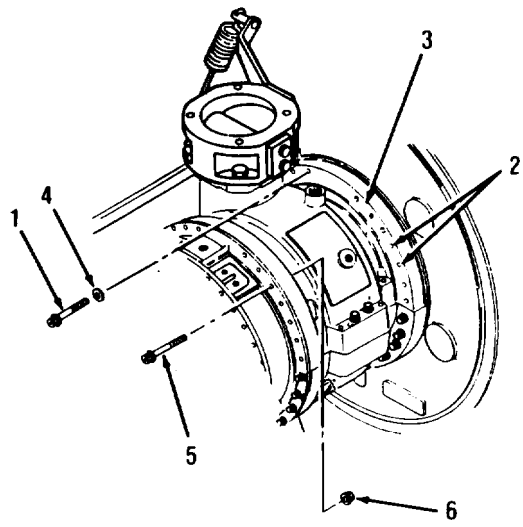
LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 8 of 21)

NOTE

Only 12 of the 16 bolts (1) required are to be installed at this time. Do not install bolts in third and fourth holes (2) from split line on both sides of case and stator assembly (3). They will be installed later on in this task.

c. Apply antiseize compound to 12 bolts (l). Install 12 bolts (1) and new Iockwashers (4). Do not install bolts in third and fourth holes (2) from split line on both sides of case and stator assembly (3). Torque bolts (1) between 100-110 lb-in (ll-12 N• m).

d. Install 14 bolts (5) and new nuts (6). Torque bolts (5) and nuts (6) between 68-75 lb-in (7-9 N•m).



CAUTION

Do not stretch new packing (7) when fitting it in groove (8).

NOTE

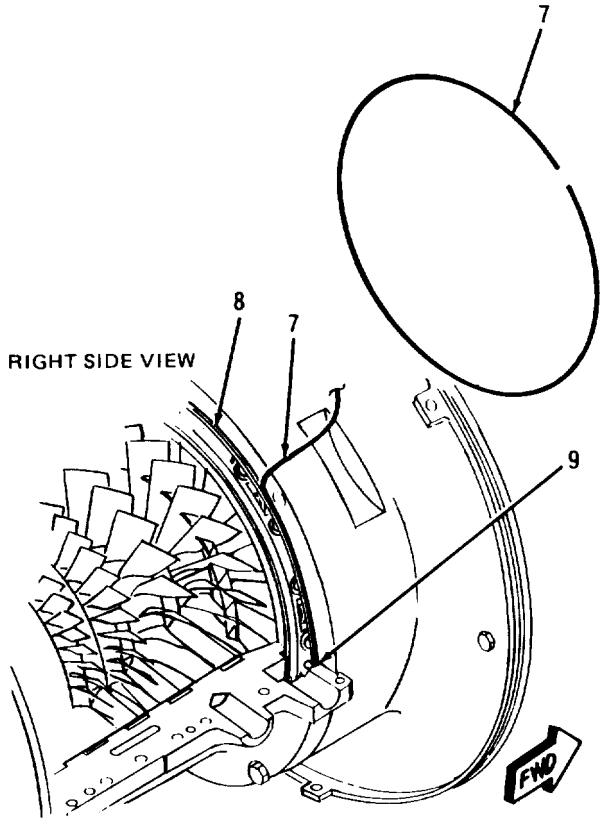
Do step 14. only if packing (7) was removed.

14. INSTALL NEW PACKING (7).

a. Cut packing (7) so it becomes one length.

b. Cut packing (7) to fit in groove (8) so both ends but against flanges (9)

c. Apply shortening compound to packing (7) and install in groove (8).



Go on to Sheet 9

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 9 of 21)

15. MOVE INLET GUIDE VANES (1) ALL THE WAY CLOSED, AND INSTALL LOW PRESSURE VANE AND STATOR ASSEMBLY (TOP HALF) (2). INSTALL TWO CAP SCREWS (3), NEW NUTS (4), FOUR BOLTS (5), AND NUTS (6), FOURTEEN BOLTS (7) AND NEW WASHERS (8). TIGHTEN BOLTS (5) AND NUTS (6). TORQUE BOLTS (7) BETWEEN 68-75 LB-IN (7-9 N•m).

    a. Move inlet guide vanes (1) by hand all the way to the closed position.

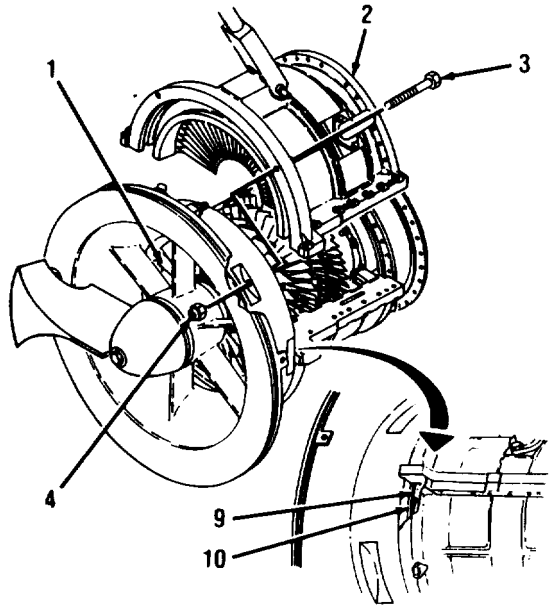
    b. Position vane and stator assembly (top half) (2) on engine. Do not damage or move packing (9) out of groove (10).

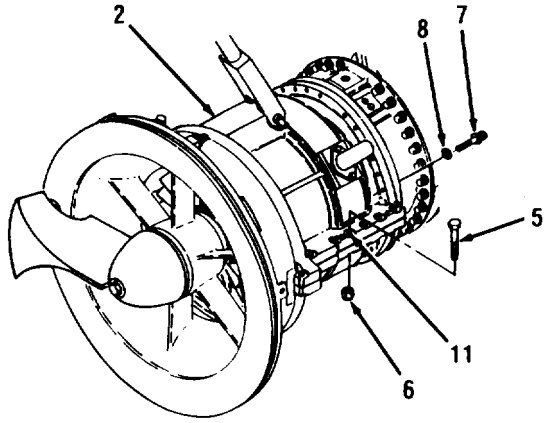
    c. Install two cap screws (3) and new nuts (4).

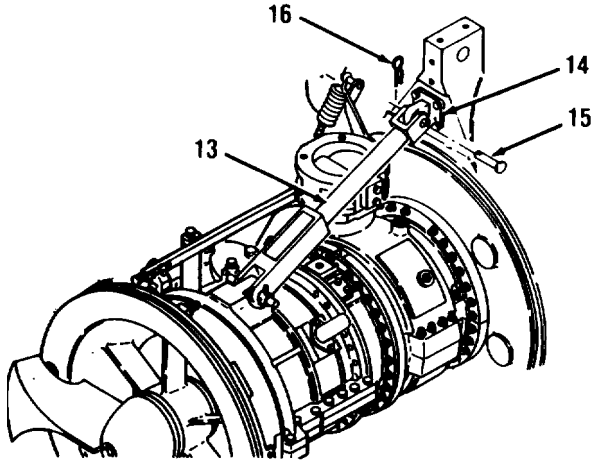
    d. Install two bolts (5) and nuts (6) on both sides of case and stator assembly (2), in two holes (11) of split line flange (12). Tighten bolts (5) and nuts (6).

    e. Apply antiseize compound to 15 bolts (7). Install 14 bolts (7) and new washers (8). Torque bolts (7) between 68-75 lb-in (7-9 N•m).

16. ATTACH CONNECTING LINK (13) TO BRACKET (14). INSTALL PIN (15) AND LOCKPIN (16).







Go on to Sheet 10

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 10 of 21)

17. REMOVE TUBE TEE (l), FLARED CONICAL SEAL (2), TWO BOLTS (3), MENDING PLATES (4), AND SPACERS (5).

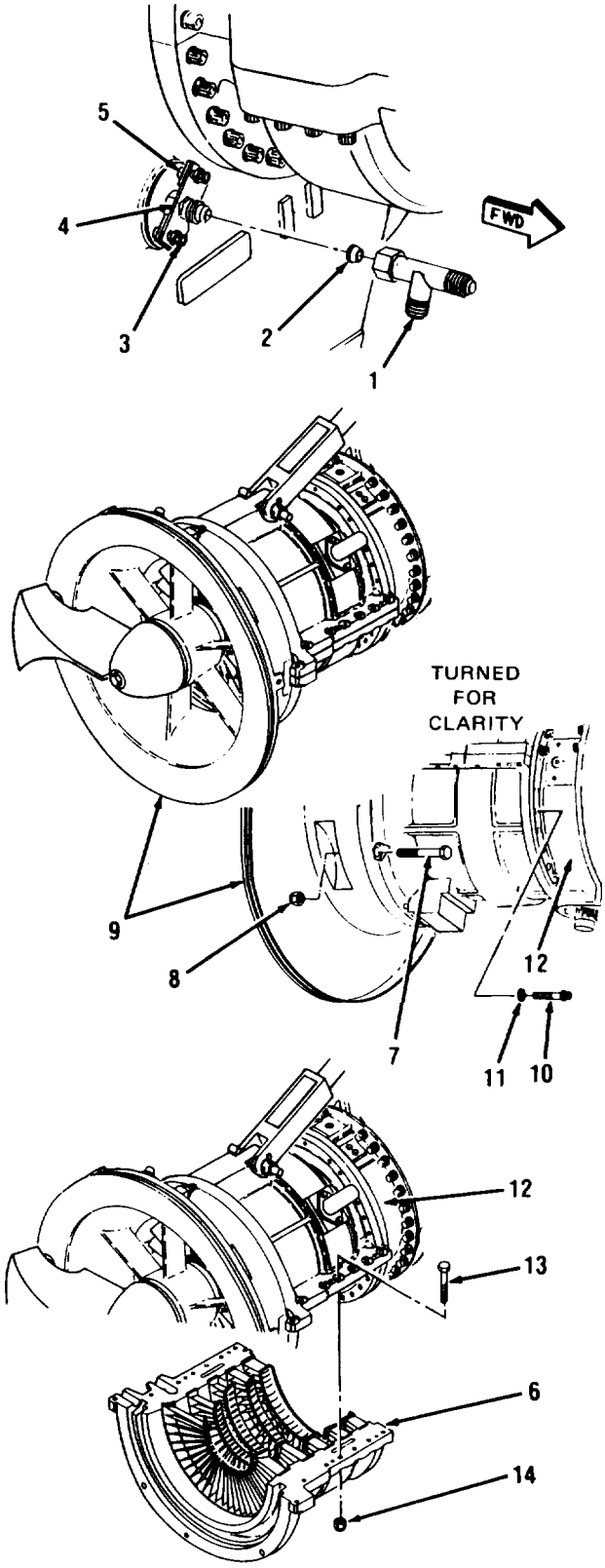
18. REMOVE LOW PRESSURE CASE AND STATOR ASSEMBLY (BOTTOM HALF) (6).

a. Remove two screws (7) and nuts (8) from inlet housing (9).

b. Remove 14 bolts (10) and lockwashers (11) from housing (12).

c. Have assistant support low pressure case and stator assembly (bottom half) (6), and remove two bolts (13) and nuts (14) from each side.

d. Remove low pressure case and stator assembly (bottom half (6).



Goon to Sheet 11

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANLNG (Sheet 11 of 21)

19. REMOVE HIGH PRESSURE CASE AND STATOR ASSEMBLY (BOTTOM HALF) (1).

    a. Remove 16 bolts (2) and lock washers (3) from air diffuser (4).

    b. Remove 14 bolts (5) and nuts (6) from housing (7).

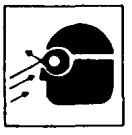
    c. Have assistant support high pressure case and stator assembly (bottom hall) (1), and remove two bolts (8) and nuts (9) from each side.

    d. Remove high pressure case and stator assembly (bottom half) (1) from engine.

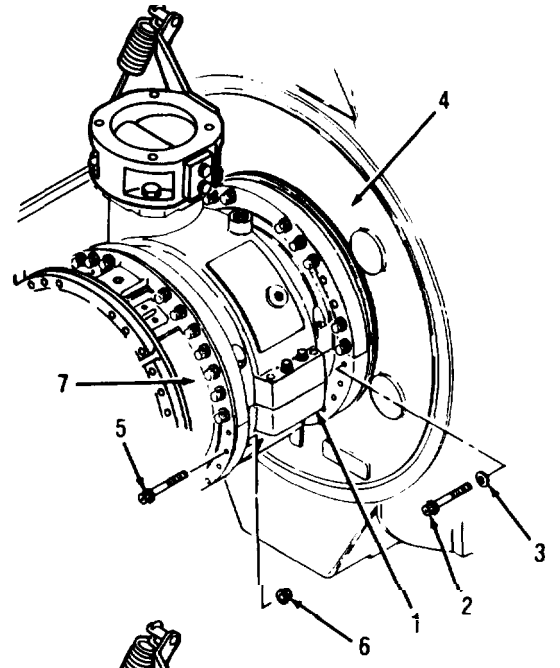
20. REPEAT STEPS 3 THROUGH 7. AND CLEAN LOW PRESSURE CASE AND STATOR ASSEMBLY (BOTTOM HALF) (1).

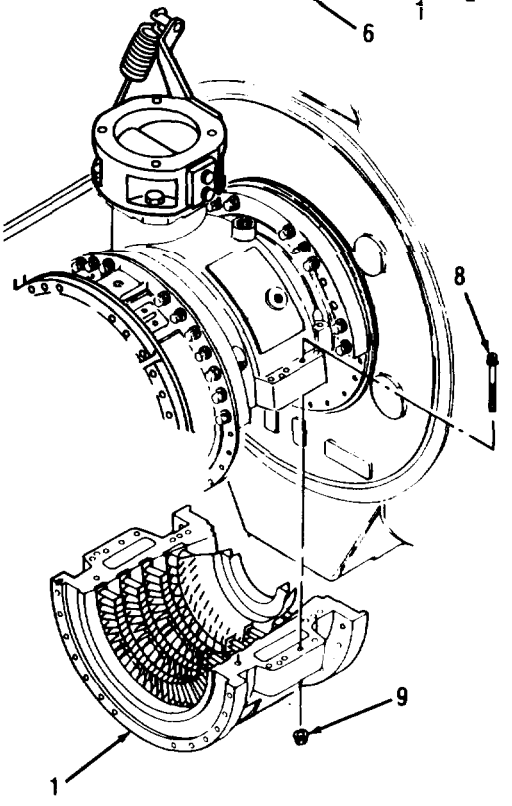
21. REPEAT STEPS 3 THROUGH 7. AND CLEAN HIGH PRESSURE CASE AND STATOR ASSEMBLY (BOTTOM HALF) (1),

WARNING



22. PREPARE NEW BATCH OF CLEANING SO1.UTION BY MIXING ONE PART OF ALKALINE DESCALER COMPOUND TO FOUR PARTS OF FRESH HOT WATER.





Go on to Sheet 12

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 12 of 21)

WARNING

CAUTION

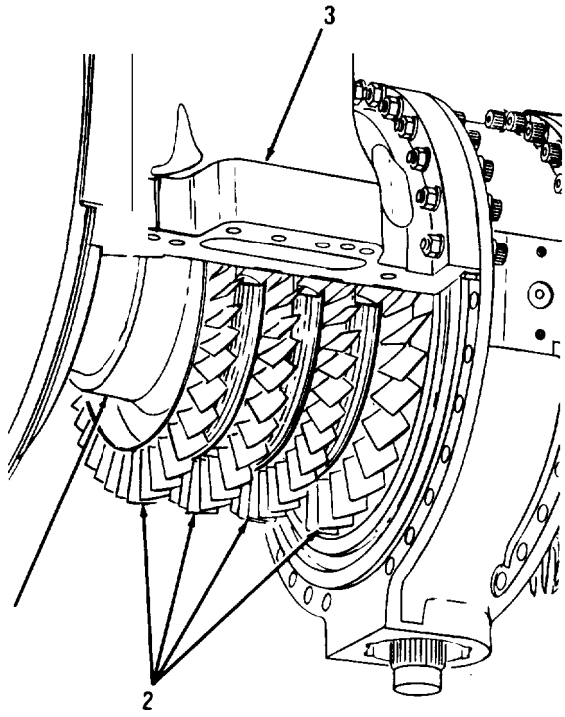
Oven cleaner contains solvents that may dissolve nonmetallic materials. Do not allow oven cleaner to splash up into case and stator assembly (top half-) when cleaning rotor. Damage to case and stator assembly will occur.

23. CLEAN HIGH PRESSURE AXIAL COMPRESSOR ROTOR (1). USE OVEN CLEANER. RINSE WITH PREMIXED CLEANING SOLUTION.

    a. Hand coat each exposed rotor blade (2) with oven cleaner and hand scrub until clean. Be careful that oven cleaner does not splash Up into case and stator assembly (top half) (3).

    b. Rinse oven cleaner from blades (2) with premixed cleaning solution before rotating rotor (1) to expose remaining blades (2).

    c. Rotate rotor (1) to expose blades (2) that have not been cleaned, and repeat steps a. and b. until all blades have been cleaned.



Go on to Sheet 13

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 13 of 21)

WARNING

CAUTION

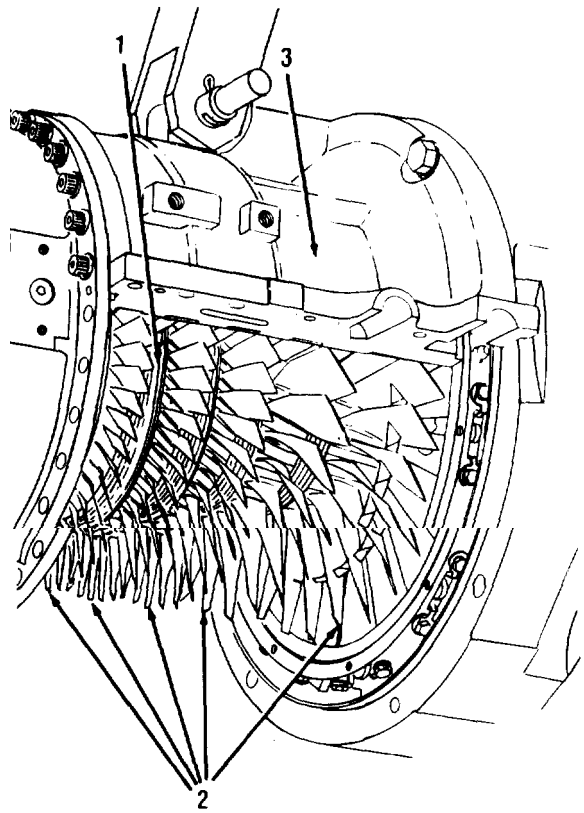
Oven cleaner contains solvents that may dissolve nonmetallic materials. Do nol allow oven cleaner to splash up into case and slator assembly (top half) when cleaning rotor. Damage to case and staler assembly will occur.

24. CLEAN LOW PRESSURE COMPRESSOR ROTOR (1) USING OVEN CLEANER. RINSE WITH PREMIXED CLEANING S0LUTION.

    a. Hand coat each exposed rotor blade (2) with oven cleaner and hand scrub until clean. Be careful that oven cleaner does not splash up into case and stator assembly (top half) (3).

    b. Rinse oven cleaner from blades (2) with premixed cleaning solution before rotating rotor (1) to expose remaining blades (2).

    c. Rotate rotor (1) to expose blades (2) that have not been cleaned, and repeat steps a. and b. until all blades have been cleaned.



Go on to Sheet 14

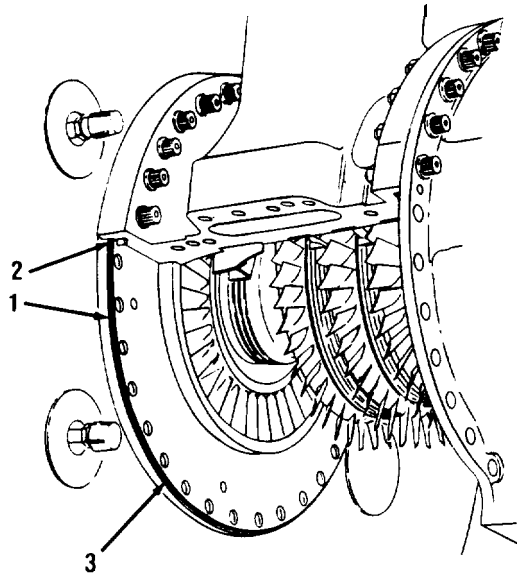
LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 14 of 21)

25. INSPECT GASKET (1) FOR DAMAGE THAT MIGHT CAUSE AN AIR LEAK. CUT AND REMOVE LOWER HALF OF GASKET (1) IF DAMAGED.

a. Inspect gasket (1) for gouges, nicks or cuts that could cause an air leak,

b. If damaged, cut gasket even with split line flange (2) on both sides of engine, and remove cut portion of gasket (l). Save removed portion for use in step 26.

c. Wipe spacer half (3) with rag.



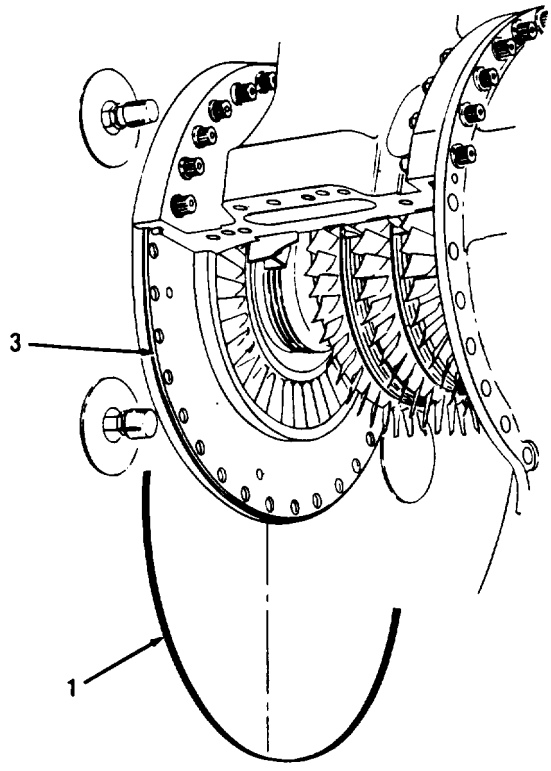
NOTE

Do step 26 only if lower half of gasket (1) was removed.

26. CUT AND INSTALL NEW GASKET (l).

a. Using removed portion of gasket (1), measure and cut a new gasket to the same length.

b. Apply shortening compound to new gasket (1) and install on spacer half(3).



Go on to Sheet 15

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 15 of 21)

CAUTION

Be careful not to damage gasket (3) when installing case and stator assembly (bottom half) (l). If gasket is damaged, remove case and stator assembly and repeat steps 25 and 26.

27. INSTALL HIGH PRESSURE CASE AND STATOR (BOTTOM HALF) (l).

    a. Carefully position high pressure case and stator (bottom half) (1) on engine (2) and hold in place. Do not damage or move gasket (3).

    b. Apply antiseize compound to 12 bolts (4) and two bolts (5). Install bolts (4,5) and 14 new nuts (6).

    c. Apply antiseize compound to 16 bolts (7), Install bolts (7) and new lockwashers (8).

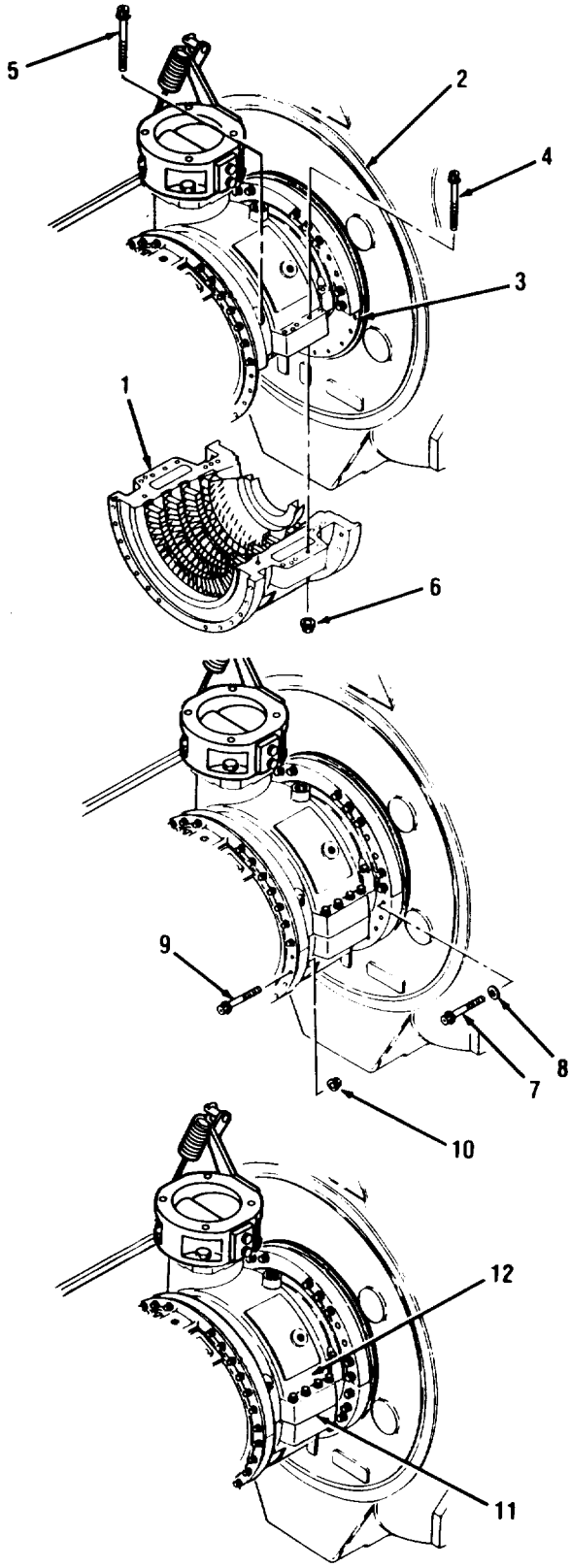
    d. Apply antiseize compound to 14 bolts (9). Install bolts (9) and new nuts (10).

28. TORQUE BOLTS (4,5) AND NUTS (6) BETWEEN 100-110 LB-IN (10-11 N• m). THEN TORQUE BOLTS (7) BETWEEN" 100-110 LB-IN (10-11 N•m). TORQUE BOLTS (9 AND NUTS (10) BETWEEN 68-75 LB-IN (7-9 N•m)) LAST.

NOTE

Gaps larger than 0.001 inch (0.025 mm) at split line edges are ok if they do not extend into case through split line.

29. USE FEELER GAGE, AND CHECK GAP AT SPLIT LINE (11) ON BOTH SIDES OF HIGH PRESSURE AXIAL COMPRESSOR (12). THE GAP SHALL BE NO LARGER THAN 0.001 INCH (0.025 MM). IF GAP IS GREATER THAN 0.001 INCH, REMOVE HOUSING, CLEAN SPLIT LINE SURFACE AND INSTALL HOUSING.



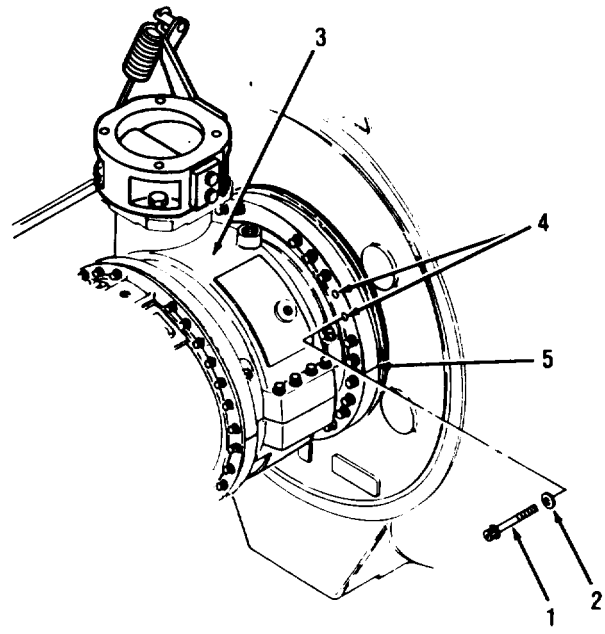
Go on to Sheet 16

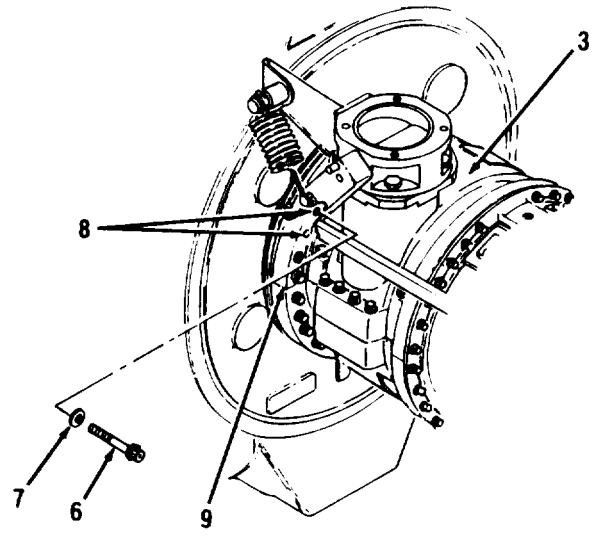
LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL (COMPRESSOR AND ROTOR CLEANING (Sheet **16** of **21)**

30. INSTALL TWO BOLTS (1) AND NEW WASHERS (2) ON LEFT SIDE OF HIGH PRESSURE CASE AND STATOR (TOP HAI.F) (3) IN THIRD AND FOURTH HO1.ES (4) FROM SPLIT LINE FLANGE (5).

31. INSTALL TWO BOLTS (6) AND NEW WASHERS (7) ON RIGHT SIDE OF HIGH PRESSURE CASE AND STATOR (TOP HALF) (3) IN THIRD AND FOURTH HOLES (8) FROM SPLIT LINE FLANGE (9).

32. TORQUE BOLTS (1) AND (6) BETWEEN 100-110 LB-IN (10-11 N-m).





Go on to Sheet 17

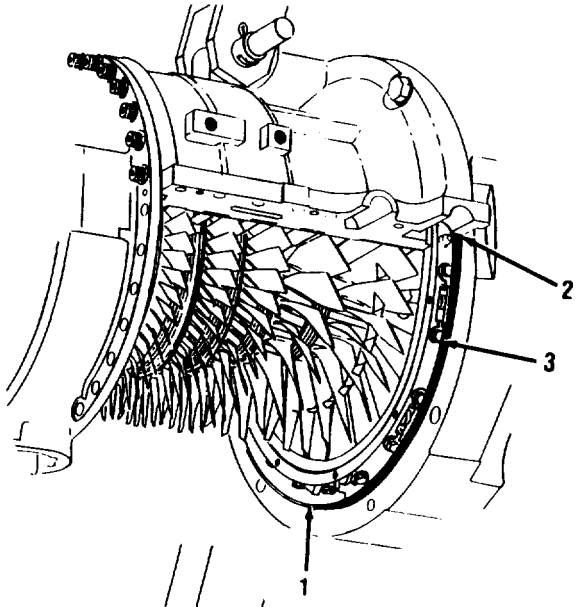
LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 17 of 21)

33. INSPECT PACKING (l) FOR DAMAGE THAT MIGHT CAUSE AN AIR LEAK. IF DAMAGED, CUT AND REMOVE LOWER HALF OF PACKING (l).

a. Inspect packing (1) for gouges, nicks or cuts that could cause an air leak.

b. If damaged, cut packing even with split line flange (2) on both sides of engine, and remove cut portion of packing (l). Save removed portion for use in step 34.

c. Wipe groove (3) clean with rag.



CAUTION

Do not stretch new packing (1) when fitting it in groove (3).

NOTE

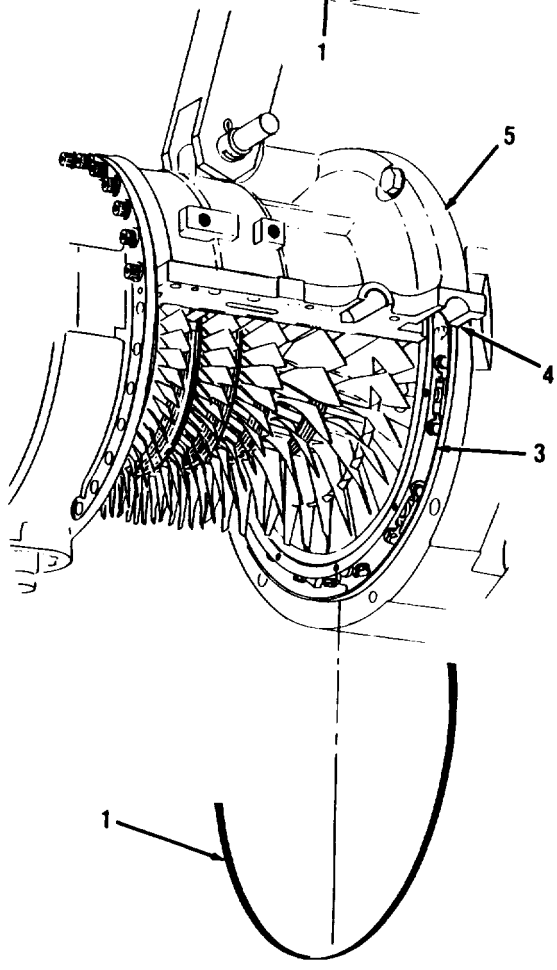
Do step 34 only if packing (1) was removed.

34. INSTALL NEW PACKING (l).

a. Using removed portion of packing, measure and cut a new packing (1) to the same length.

b. Cut packing (1) to fit in groove (3) so both ends butt against flange (4) on both sides of upper case (5).

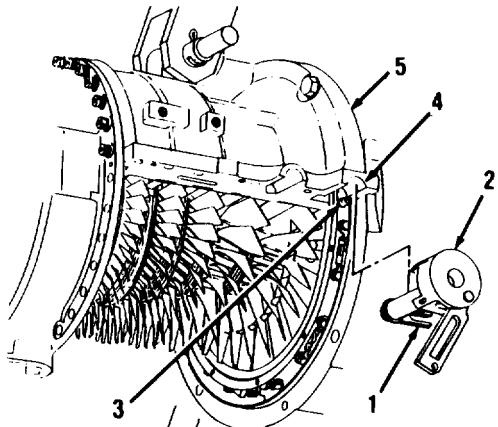
c. Apply shortening compound to new packing (1) and install in groove (3).



Go on to Sheet 18

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 18 of 21)

35. POSITION FORK END (1) OF BELLCRANK AND SHAFT (2) AROUUND BALL JOINT (3), AND HOLD BELLCRANK AND SHAFT (2) IN CUTOUT (4) OF LOW PRESSURE CASE (TOP HALF) (5).



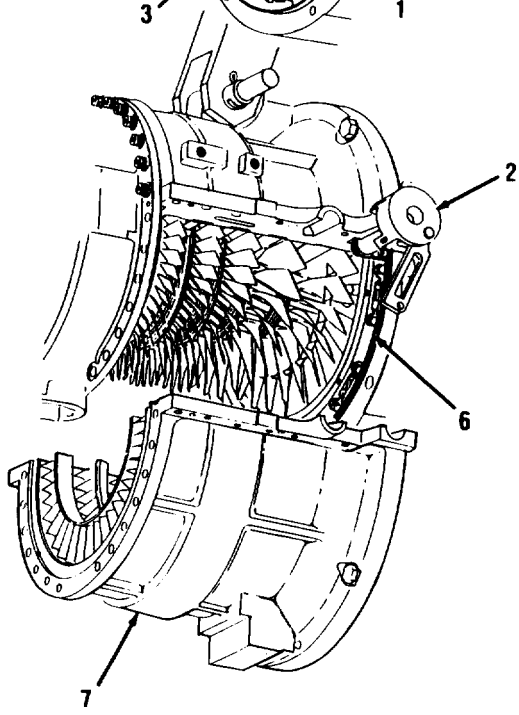
CAUTION

Packing (6) could get moved and pinched. Use care when installing case and stator (bottom half (7) not to move or pinch packing (6).

NOTE

Do not move bellcrank and shaft (2) when housing (7) is installed. Fork end (1) will disconnect from balljoint (3).

36. TURN BELLCRANK AND SHAFT (2) ALL THE WAY TO THE RIGHT, AND INSTALL LOW PRESSURE VANE AND STATOR ASSEMBLY (BOTTOM HALF) (7). INSTALL NINE BOLTS (8) AND NINE NEW NUTS (9).

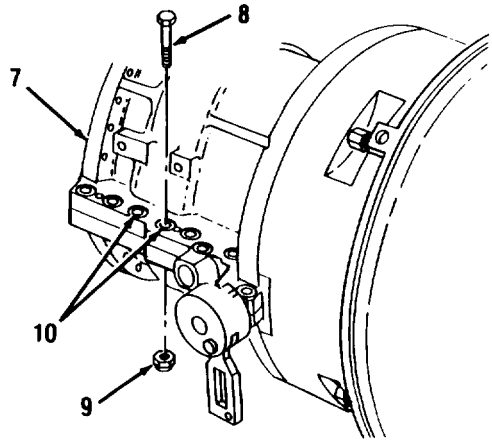


a. Turn bellcrank and shaft (2) all the way to the right.

b. Position vane and stator assembly (bottom half) (7) on engine. Do not damage or move packing (6).

NOTE

Only 9 of the 12 bolts (8) required are to be installed at this time. Install bolts in two holes (10) only on right side of case and stator assembly (7),



c. Apply antiseize compound to nine bolts (8). Install nine bolts (8) and new nuts (9).

37. TORQ UE BOLTS (8) AND NUTS (9) BETWEEN 100-110 LB-IN (11-12 N-m).

Go on to Sheet 19

LOW PRESSURE *ROTOR AND* HOUSING ASSEMBLY (COMPRESSOR AND HIGH PRESSURE AXIAL COMPRFSSOR AND ROTOR CLEANING (Sheet 19 of 21)

NOTE

Gaps larger than 0.001 inch (0.025 mm) at split line edges are ok if they do not extend into case through split line.

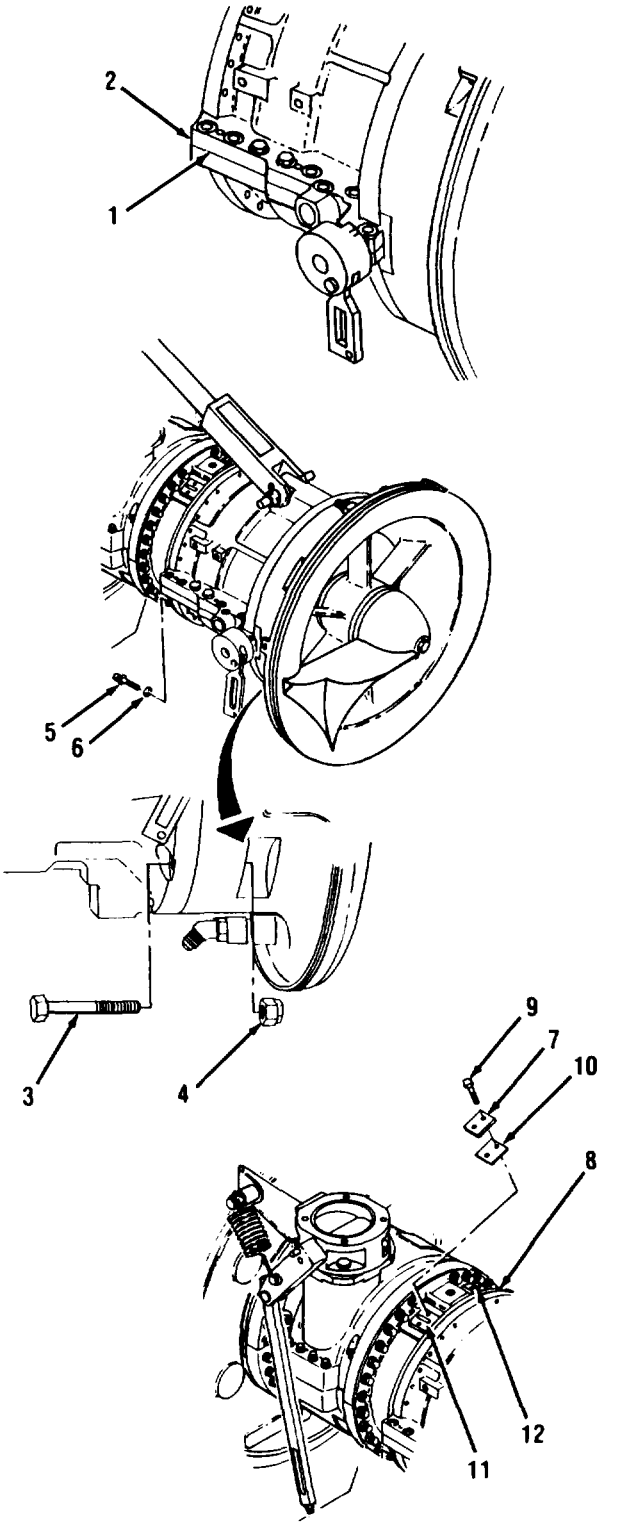
38. USE FEELER GAGE, AND CHECK GAP AT SPLIT LINE (1) ON BOTH SIDES OF LOW PRESSURE HOUSING ASSEMBLY (2). THE GAP SHALL BE NO LARGER THAN 0.001 INCH (0.025 MM). IF GAP IS GREATER THAN 0.001 INCH (0.025 MM), REMOVE HOUSING, CLEAN SPLIT LINE SURFACE AND REINSTALL HOUSING.

39. INSTALL TWO CAP SCREWS (3) AND NEW NUTS (4).

40. APPLY ANTISEIZE COMPOUND TO 14 BOLTS (5). INSTALL 14 BOLTS (5) AND NEW WASHERS (6). TORQUE BOLTS (5) BETWEEN 68-75 LB-IN (7-9 N·m).

41. INSTALL TWO MOUNTING PLATES (7) ON MECHANICAL HOUSING (8).

    a. Apply antiseize compound to four bolts (9). Install new gasket (10), plate (7) and two bolts (9) on each pad (11,12) of housing (8).



Go on to Sheet 20

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 20 of 21)

42. INSTALL LEVER AND SHAFT (1) ON LOW PRESSURE CASE AND STATOR ASSEMBLY (2).

    a. Position shaft (3) in hole (4) in case and stator assembly (2).

    b. Aline hole (5) in shaft (3) with hole (6) in case and stator assembly (2). Install bolt (7) and new nut (8).

43. TORQUE BOLT (7) AND NUT (8) BETWEEN 100-110 LB-IN (11-12 N•m).

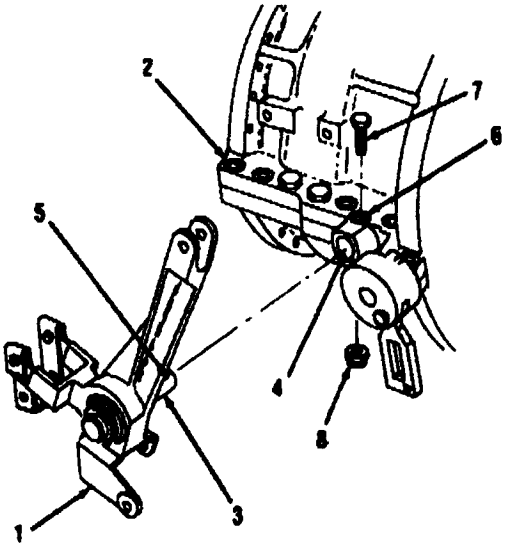
44. INSTALL BRACKET (9) AND CYLINDER AND BRACKET (10).

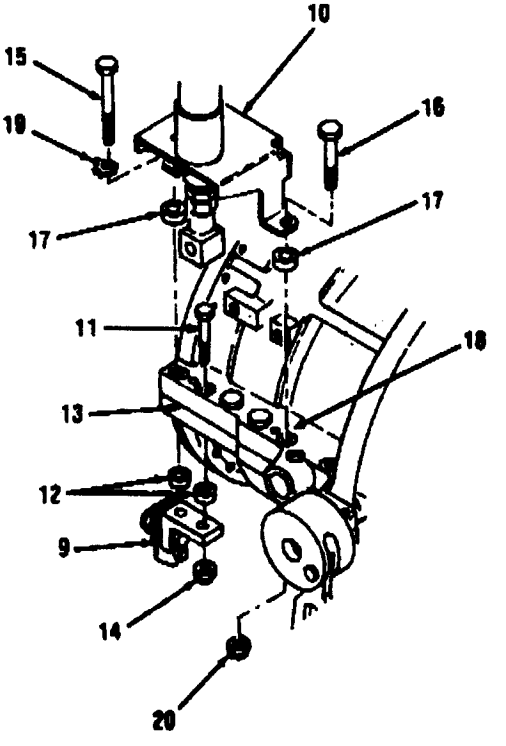
    a. Apply antiseize compound to bolt (11). **Aline bracket (9) and two** spacers **(12)** under flange (13). Install bolt (11) and new nut (14).

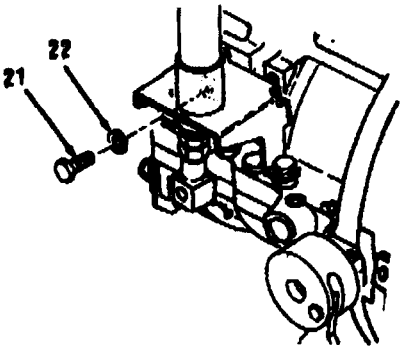
    b. Apply antiseize compound to long bolt (15) and short bolt (16). Position cylinder and bracket (10) and two spacers (17) on flange (18). Loosely install long bolt (15) and new key washer (19).

    c. Loosely install short bolt (16) and new nut (20).

    d. Apply antiseize compound to two bolts (21). Install bolts (21) and new lock washers (22). Tighten bolts (15,16) and nut (20). Bend tabs on keywasher (19).







Go on to Sheet 21

LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (COMPRESSOR) AND HIGH PRESSURE AXIAL COMPRESSOR AND ROTOR CLEANING (Sheet 21 of 21)

45. ALINE HOLE IN LEVER (1) WITH SLOT IN LINK (2) AND INSTALL BOLT (3), WASHER (4), SPACER (5) AND NEW NUT (6).

46. POSITION STOP PLATE (7) ON FLANGE (8) AND INSTALL TWO NEW NUTS (9). TORQUE NUTS (9) BETWEEN 100-110 IN-LB (11-12 N.m).

NOTE

Make sure mending plates (10) are positoned on flats of union fitting (11).

47. INSTALL TWO SPACERS (12), TWO MENDING PLATES (10), AND TWO BOLTS (13) ON HOUSING (14).

48. INSTALL NEW FLARED CONICAL SEAL (15) ON FI'IT'ING (11). INSTALL TEE (16) ON FITTlNG (11) AND TIGHTEN NUT (17).

49. INSTALL TEMPERATURE ROTOR SENSOR PLUG (TM 20-1).

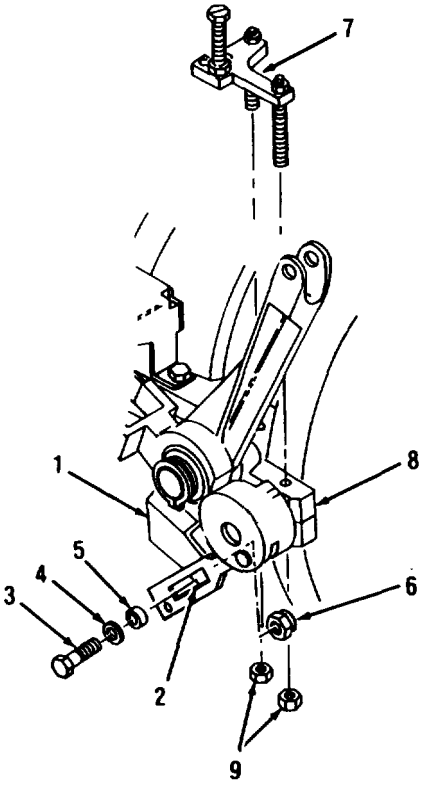
50. INSTALL BLEED VALVE ROD (TM 20-1).

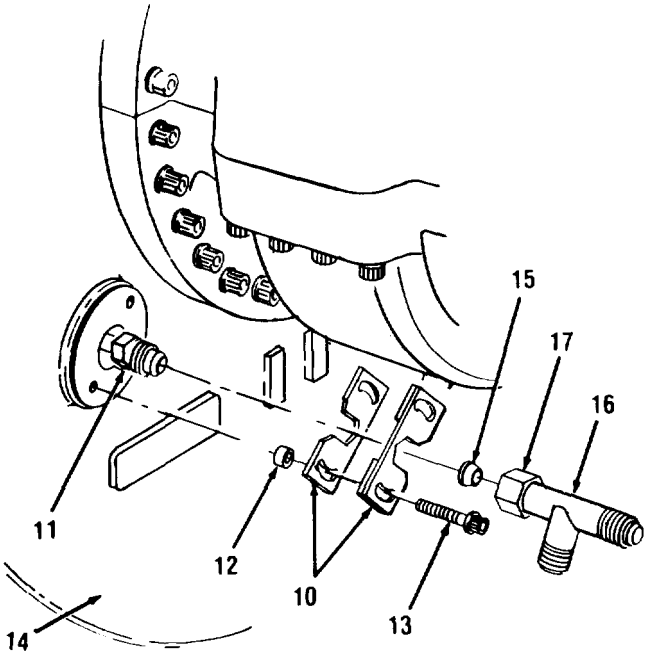
51. INSTALL ACCESSORY GEARBOX MODULE (PAGE 7-6).

52. INSTALL IGN1TION ELECTRICAL LEAD (TM 20-1).

53. INSTALL TUBE ASSEMBLY (NO. 2 AND 3 BEARINGS) (TM 20-1).

54. INSTALL PRESSURE FLUID FILTER DOUBLE ANGLE BRACKET (TM 20-1).





End of Task

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 1 of 21)

TOOLS:

General mechanic's tool kit: automotive (SC5180-90-N26)
Adapter, socket wrench, 3/4 inch male, 1/2 inch female (Item 120, Appendix D)
Arbor press (Item 37, Appendix D)
Holding fixture (Item 146, Appendix D)
Industrial goggles (Item 58, Appendix D)
Installer tool (Item 147, Appendix D)
Micrometer, 1 inch (Item 128, Appendix D)
Micrometer, depth gage (Item 205, Appendix D)
Puller (Item 148, Appendix D)
Socket, 3/8-inch drive, 1/4-inch, 12 point (Item 190, Appendix D)
Socket, 3/8-inch drive, 7/32-inch, 12 point (Item 191, Appendix D)
Spanner wrench (Item 119, Appendix D)
Tool kit (Item 149, Appendix D)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)
Torque wrench, 0-250 ft-lb (Item 151, Appendix D)

PERSONNEL: Two

SUPPLIES:

Antiseize compound (Item 2, Appendix B)
Cotton gloves (Item 52, Appendix B)
Dry cleaning solvent (Item 7, Appendix B)
Dry molycote (lubricant, solid film) type "z" (Item 53, Appendix B)
Marker (Item 25, Appendix B)
Non-electric safety wire (Item 15, Appendix B)
Nut (Item 198, Appendix E) (3 required)
Packing retainer (face seal) (Item 161, Appendix E)
Packing retainer (locking cup) (Item 162, Appendix E)
Preformed packing (Item 163, Appendix E) (2 required)
Preformed packing (Item 164, Appendix E)
Preformed packing (Item 165, Appendix E)
Preformed packing (Item 166, Appendix E)
Preformed packing (Item 129, Appendix E)
Protector caps (Item 167, Appendix E)
Ring spacer (shim) (Item 168, Appendix E)
Self-locking nuts (Item 8, Appendix E) (4 required)
Shortening compound (Item 20, Appendix B)
Slave bolts (Item 196, Appendix E) (3 required)
Sleeve, flared (Item 169, Appendix E)
Sleeve, compression (Item 170, Appendix E)
Spacer ring (Item 171, Appendix E)
Washer (Item 197, Appendix E) (3 required)
Wiping rag (Item 14, Appendix B)

Go on to Sheet 2

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 2 of 21)

EQUIPMENT CONDITION:

No. 2 and 3 bearing air pressurization tube removed (TM 20-1)
Power pack/engine on maintenance stand (TM 20-1)
Splitter assembly removed (TM 20-1)

REFERENCES: TM 20-1

Go on to Sheet 3

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 3 of 21)

REMOVAL:

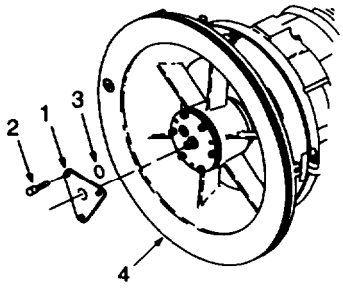
1. REMOVE ACCESS COVER (1).

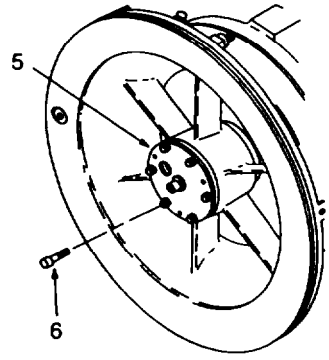
   a. Cut safety wire and remove three bolts (2), access cover (1), and preformed packing (3) from inlet housing (4). Discard packing (3).

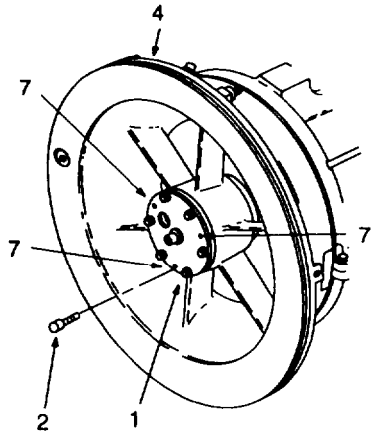
2. REMOVE NO. 1 BEARING HOUSING (5).

   a. Cut safety wire and remove six bolts (6) from bearing housing (5).

   b. Using three bolts (2) removed from access cover (1) as jacking screws, install bolts (2) into three threaded holes (7). Tighten bolts (2) evenly and opposite each other until bearing housing (5) is away from inlet housing (4).







LE552

Go on to Sheet 4

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 4 of 21)

c. Remove jacking screws (1), bearing housing (2) and ring spacer (3) from inlet housing (4). Retain ring spacer (3) for further use.

d. Remove and discard two preformed packings (5) from bearing housing (2).

3. REMOVE PLAIN ROUND NUT (6), PACKING RETAINER (7) AND SLEEVE SPACER (8) FROM INLET HOUSING (4).

a. Using suitable tool, uncrimp packing retainer (7).

NOTE

Locking cup holding fixture (9) has an "offset hole" which shall be at 7 o'clock position when properly installed.

b. Place locking cup holding fixture (9) on inlet housing (4) and make sure tangs of holding fixture (9) engage packing retainer (7).

c. Align offset holes of holding fixture (9) on inlet housing (4) at the 7 o'clock position.

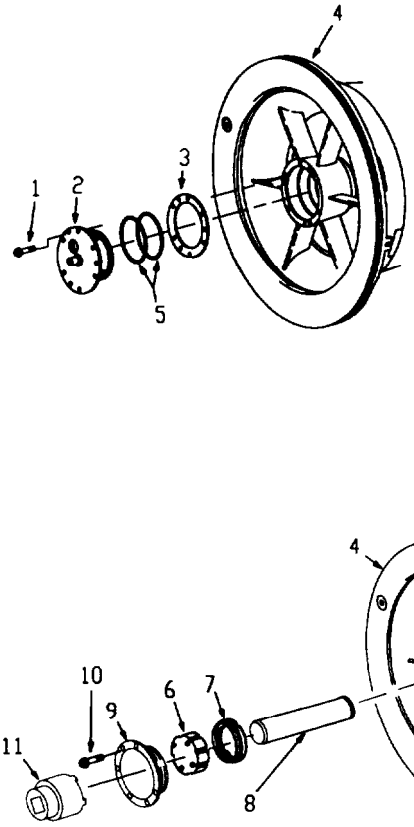
d. Secure holding fixture (9) to inlet housing (4) with six bolts (10).

e. Using spanner wrench (11), remove plain round nut (6).

f. Remove and discard packing retainer (7).

g. Remove holding fixture (9).

h. Remove sleeve spacer (8) and set aside.



LE553

Go on to Sheet 5

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 5 of 21)

4. REMOVE NO. 1 BEARING AND SLEEVE BUSHING (1) FROM INLET HOUSING (2).

a. Using three bolts (3) as jacking screws, install bolts (3) into three threaded holes (4) of sleeve bushing (1).

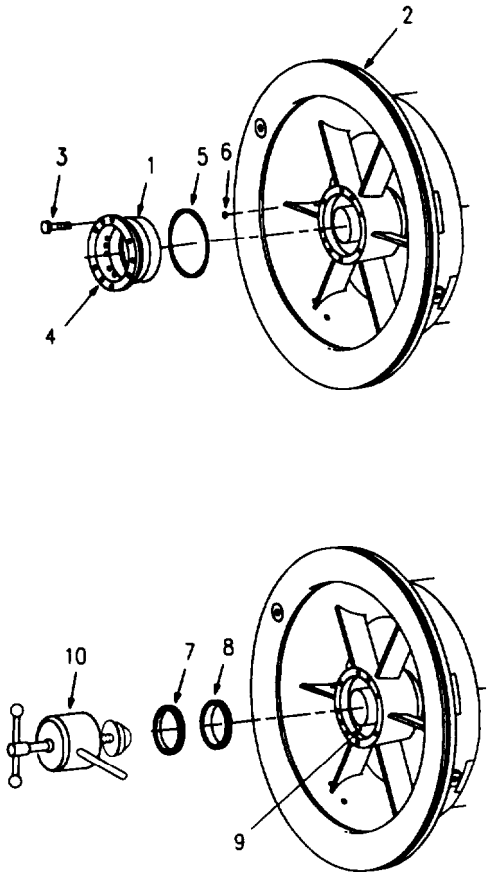
CAUTION

The No. 1 bearing is comprised of four separate pieces which will fall apart. Do not handle bearing parts with bare hands. Damage to bearing may result. Use clean cotton gloves.

b. Tighten bolts (3) evenly opposite each other until sleeve bushing (1) is away from inlet housing (2).

c. Remove and discard preformed packings (5) and (6).

5. REMOVE NO. 1 BEARING INNER RACE HALF (7) WITH RING SPACER (8) FROM LOW PRESSURE COMPRESSOR SHAFT (9) USING BEARING PULLER (10).



LE554

Go on to Sheet 6

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 6 of 21)

CAUTION

The No. 1 bearing (1) is comprised of four separate pieces which will fall apart. Do not handle bearing parts with bare hands. Damage to bearing may result. Use clean cotton gloves.

6. REMOVE NO. 1 BEARING (1) FROM SLEEVE BUSHING (2).

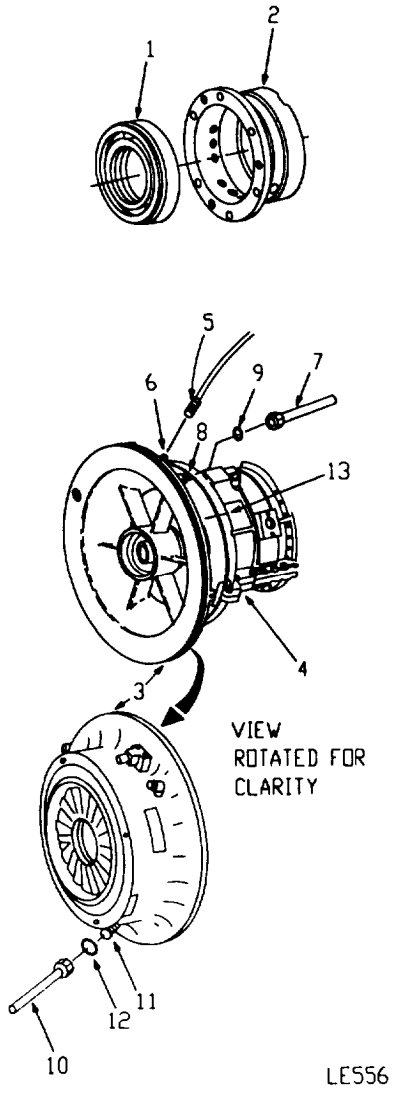
7. REMOVE INLET HOUSING (3) FROM LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (4).

a. Disconnect plug connector 3W105-P34 (5) from temperature rotor sensor receptacle connector J34 (6).

b. Disconnect No. 1 bearing oil feed tube (7) from fitting (8). Remove and discard flared sleeve (9). Disconnect scavenge tube (10) from fitting (11). Remove and discard compression sleeve (12).

c. Install protector caps on all open ends of fittings.

d. Using marker, place a match mark line (13) on inlet housing (3) and forward flange of low pressure rotor and housing assembly (4).



Go on to Sheet 7

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 7 of 21)

e. Remove four self-locking nuts (1) and four cap screws (2).

f. Ensure inlet guide vane (IGV) bellcrank (3) is in full closed position.

NOTE

Inlet guide vanes must be closed.

WARNING

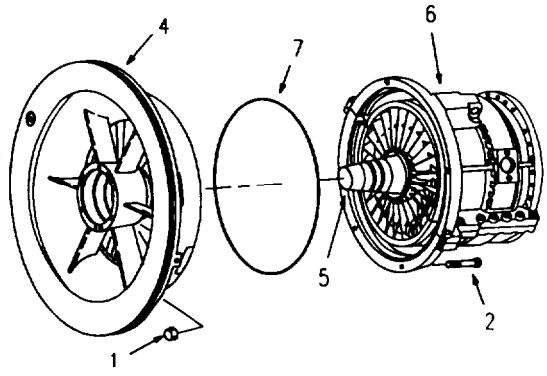
Inlet housing (4) is heavy and may require two persons to lift. Damage to components or injury to personnel may result if dropped or mishandled. Use firm grip while lifting.

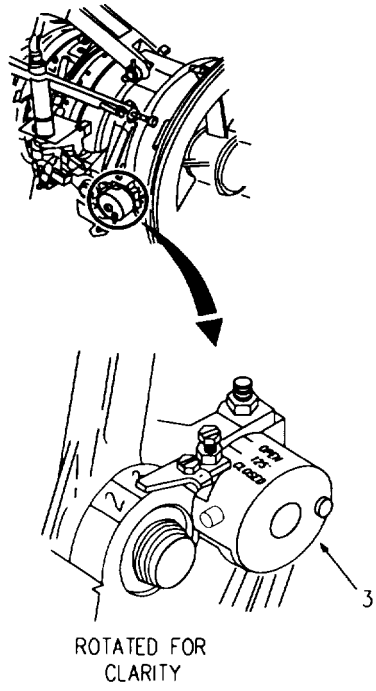
CAUTION

Use care not to bump low pressure compressor shaft (5) when removing inlet housing (4). Damage to shaft may result.

g. Firmly grasp inlet housing (4) with both hands . and pull straight off low pressure rotor and housing assembly (6). Place inlet housing (4) nose down on clean work surface.

h. Remove and discard preformed packing (7) from inlet housing (4).





LE557

Go on to Sheet 8

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 8 of 21)

WARNING

Use caution when using arbor press. Improper tools, or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

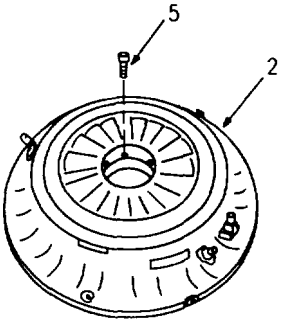
8. REMOVE PACKING RETAINER (1) FROM INLET HOUSING (2) USING POSITION NO. 1 SEAL REMOVAL TOOL (3) AND ARBOR PRESS.

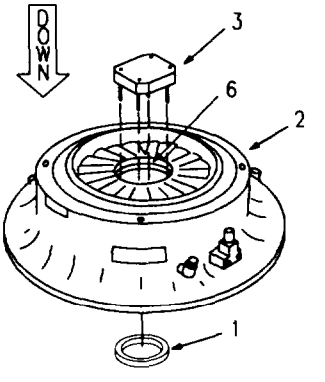
a. Cut safety wire and remove four bolts (5) from inlet housing (2).

b. Position inlet housing (2) nose down on base of arbor press.

c. Insert four legs of position No. 1 seal removal tool (3) into four bolt hole (6).

d. Carefully press packing retainer (1) from inlet housing (2).





LE558

Go on to Sheet 9

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 9 of 21)

9. CLEAN ALL PARTS REMOVED.

WARNING

CAUTION

Do not handle bearing or bearing races with bare hands. Damage to bearing or bearing races may result. Use clean cotton gloves.

10. INSPECT BEARING AND RACES FOR SCORING, SPALLING, GALLING AND CRACKS.

NOTE

If any of these conditions exist, reassemble bearing package with original hardware and replace forward engine module (PAGE 5-13).

Go on to Sheet 10

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 10 of 21)

INSTALLATION:

1. INSTALL NEW PACKING RETAINER (1) IN INLET HOUSING (2) USING ARBOR PRESS AND INSTALLER TOOL (3). CHECK THAT NO GAP EXISTS BETWEEN PACKING RETAINER (1) AND INLET HOUSING (2).

WARNING

Use caution when using arbor press. Improper tools, or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

a. Place inlet housing (2), with nose facing up, on arbor press table.

b. Lubricate packing retainer (1) with lubricating oil.

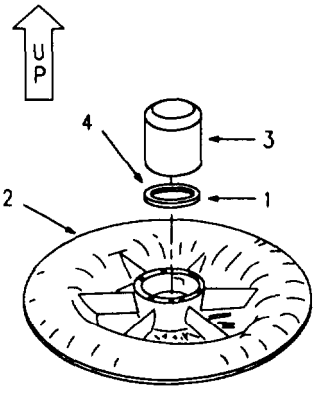
CAUTION

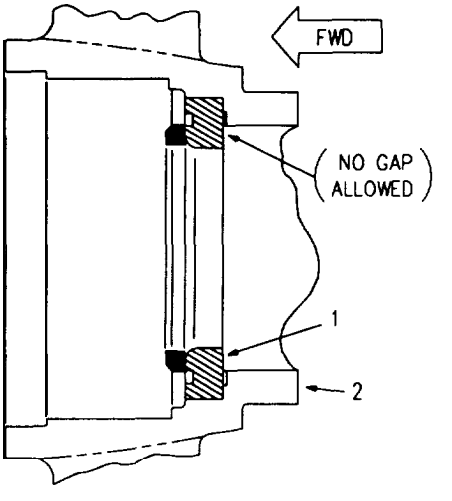
Be very careful not to damage new packing retainer (1) when pressing into inlet housing (2). Do not jerk press when installing packing retainer (1).

c. Using arbor press and installer tool (3) install new packing retainer (1), with carbon element side (4) facing up, into inlet housing (2).

d. Using 0.001 inch (0.025 mm) feeler gage, check for gap between packing retainer (1) and inlet housing (2). NO GAP ALLOWED.

e. If gap is present, remove packing retainer (1), clean and inspect inlet housing (2) for debris or burrs. Remove debris or burrs and reinstall packing retainer (1). Repeat step d.. If problem persists, replace packing retainer (1) and repeat step d. again.





LE559

Go on to Sheet 11

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 11 of 21)

2. POSITION INLET HOUSING (1) NOSE DOWN ON WORK SURFACE AND INSTALL FOUR BOLTS (2).

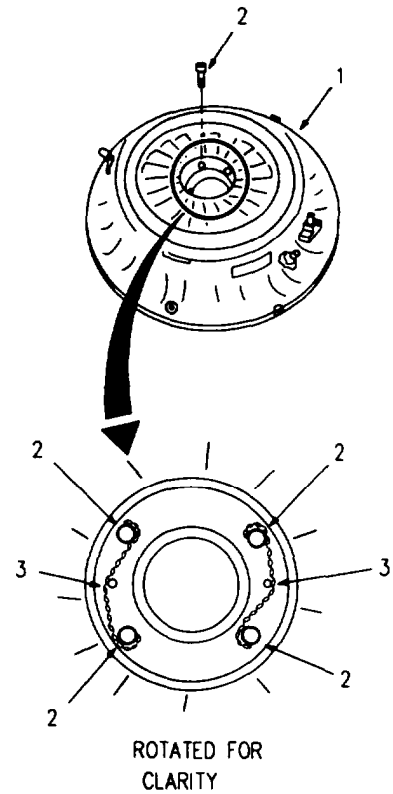
a. Apply antiseize compound to four bolts (2). Install and torque bolts (2) evenly between 40-45 lb-in (0.45-0.51 N•m).

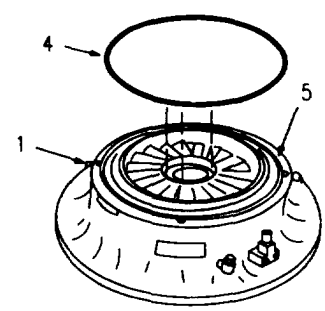
CAUTION

Safety wire must be routed around outside of spring pin (3) to prevent contact with rotor.

b. Using double twist method, install new safety wire to two bolts (2) at 8 o'clock and 10 o'clock positions. install new safety wire to two bolts (2) at 2 o'clock and 4 o'clock positions. Run safety wire around outside of interceding spring pin (3).

3. APPLY SHORTENING COMPOUND TO NEW PREFORMED PACKING (4) AND INSTALL INTO GROOVE (5) AT REAR OF INLET HOUSING (1).





LE5510

Go on to Sheet 12

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 12 of 21)

4. INSTALL INLET HOUSING (1) ONTO LOW PRESSURE ROTOR AND HOUSING ASSEMBLY (2).

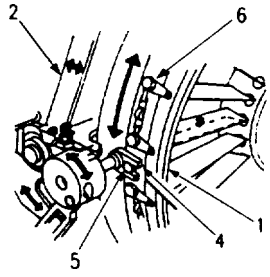
WARNING

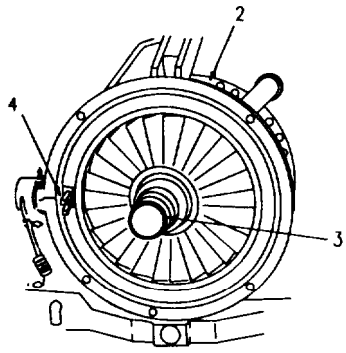
Inlet housing (2) is heavy and may require two persons to lift. Damage to components or injury to personnel may result if dropped or mishandled. Use firm grip while lifting.

CAUTION

Use care not to bump low pressure compressor rotor shaft (3) during installation. Damage to shaft may result.

a. Firmly grasp inlet housing (1) with both hands and align IGV bellcrank and fork assembly (4) on low pressure rotor and housing assembly **(2)** with ball (5) attached to unison ring (6).





LE5511

Go on to Sheet 13

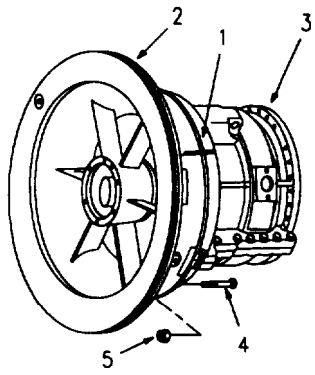
NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 13 of 21)

b. Align match marks (1) on inlet housing (2) and low pressure rotor and housing assembly (3).

c. Install four cap screws (4) and four new self-locking nuts (5).

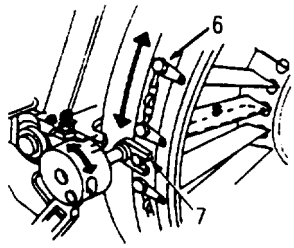
d. Torque cap screws (4) between 300-350 lb-in (34-40 N•m).

e. Check for normal operation of IGV mechanism. If IGV does not function properly, unison ring (6) and fork (7) are not aligned. Remove inlet housing (2) and repeat step 4.



5. INSTALL NO. 1 BEARING OUTER RACE (8) ONTO SLEEVE BUSHING (9) USING ARBOR PRESS AND INSTALLER TOOL (10).

a. Lightly coat inner diameter of sleeve bushing (9) with lubricating oil.



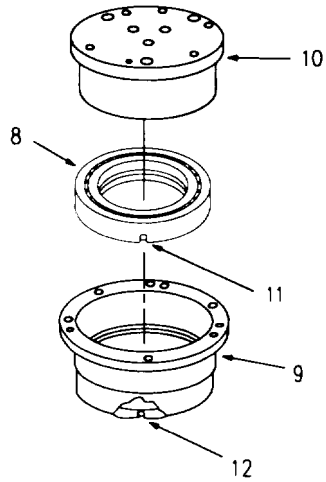
WARNING

Use caution when using arbor press. Improper tools, or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

CAUTION

Make sure slot (11) in bearing outer race (8) is positioned to engage anti-rotation pin (12) in sleeve bushing (9) to prevent damage to parts.

b. Using arbor press and installer tool (10), use light pressure to install No. 1 bearing outer race (8) into sleeve bushing (9). Make sure slot (11) in bearing outer race (8) is aligned with anti-rotation pin (12) in sleeve bushing (9).



LE5512

Go on to Sheet 14

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 14 of 21)

6. DETERMINE REQUIRED THICKNESS OF RING SPACER (1) TO PRODUCE A 0.001-0.003 INCH (0.025-0.076 MM) GAP (2) UNDER BEARING OUTER RACE (3).

a. Using a depth gage micrometer, measure and record dimension (A) of bearing housing (4).

A = _____

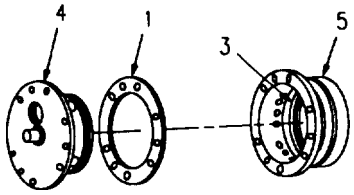
b. Using a depth gage micrometer, measure and record dimension (B) of sleeve bushing (5) to No. 1 bearing outer race (3).

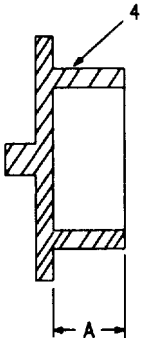
B = _____

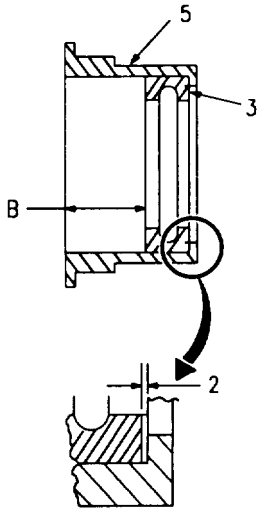
c. Determine required thickness of shim (1) using following formula:

Shim size = (A - B = C) + GAP (2)

Where: GAP = 0.001-0.003 inch (0.025-0.076 mm)







LE5513

Go on to Sheet 15

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 15 of 21)

NOTE

Layers of laminated ring spacer (1) can be peeled away until desired thickness is achieved. If too thin, replace with a new ring spacer (1).

7. TEMPORARILY INSTALL BEARING HOUSING (2) ONTO SLEEVE BUSHING (3) TO CHECK FOR CORRECT GAP (4) UNDER BEARING OUTER RACE (5).

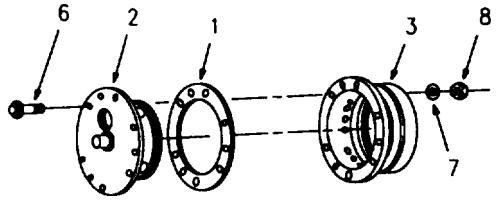
a. Install bearing housing (2) (without preformed packings) and predetermined ring spacer (1) onto sleeve bushing.

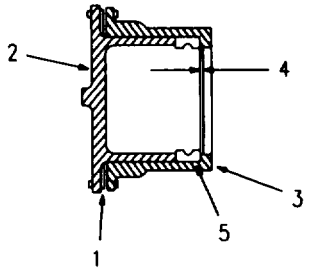
b. Install three slave bolts (6), washers (7) and nuts (8) and tighten securely.

c. Using feeler gage, check for actual gap (4) of 0.001-0.003 inch (0.025-0.076 mm) between bearing race (5) and sleeve bushing (3) for a full 360 degrees.

d. If actual gap (4) is not 0.001-0.003 inch (0.025-0.076 mm), recalculate ring spacer size and repeat steps 7.a through 7.c.

8. REMOVE BEARING HOUSING (2) RING SPACER (1) AND BEARING RACE (5) FROM SLEEVE BUSHING (3).





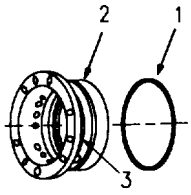
LE5514

Go on to Sheet 16

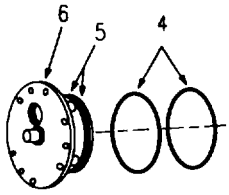
NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 16 of 21)

CAUTION

Larger preformed packing (1) must be installed in groove (2) of sleeve bushing (3). Smaller preformed packings (4) must be installed in grooves (5) of bearing housing (6). Installing wrong packings in grooves will result in oil leakage at inlet housing (7).

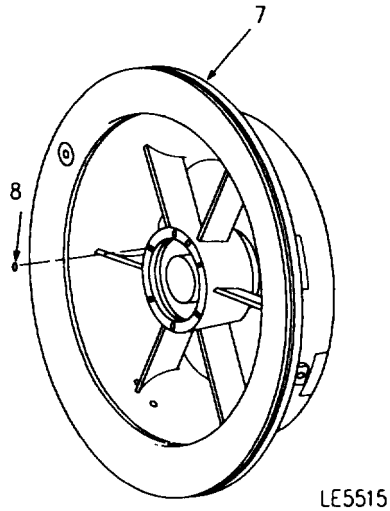


9. APPLY SHORTENING COMPOUND TO NEW PREFORMED PACKING (1) AND INSTALL IN GROOVE (2) OF SLEEVE BUSHING (3).



10. APPLY SHORTENING COMPOUND TO TWO NEW PREFORMED PACKINGS (4) AND INSTALL INTO GROOVES (5) OF BEARING HOUSING (6).

11. APPLY SHORTENING COMPOUND TO NEW PREFORMED PACKING (8) AND INSTALL ONTO FORWARD FACE OF INLET HOUSING (7).



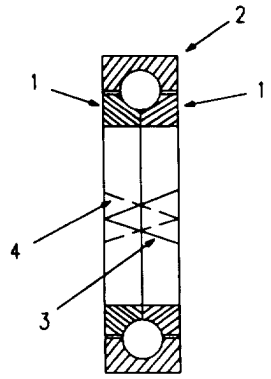
Go on to Sheet 17

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 17 of 21)

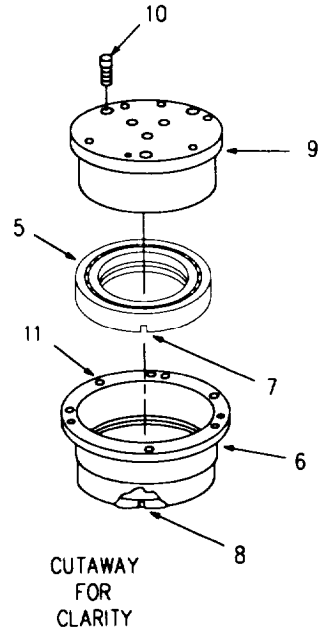
CAUTION

- Do not handle bearing or bearing races with bare hands. Damage to bearing or bearing races may result. Use clean cotton gloves.
- Bearing failure will occur if thrust marks are not correct.

12. PACK BEARING BALL AND CAGE WITH CLEAN SHORTENING COMPOUND. ASSEMBLE BALL AND CAGE AND INNER RACES (1) TO OUTER RACE (2) WITH "V" THRUST MARK (3) ON INNER RACES (1) POINTING OPPOSITE TO "V" THRUST MARK (4) ON OUTER RACE (2).



13. INSTALL ASSEMBLED BEARING (5) INTO SLEEVE BUSHING (6) WITH SLOT (7) IN BEARING OUTER RACE POSITIONED TO ENGAGE ANTI-ROTATION PIN (8). HOLD BEARING (5) IN SLEEVE BUSHING (6) WITH INSTALLER TOOL (9). SECURE WITH THREE SLAVE BOLTS (10) GOING INTO THREADED HOLES (11) OF SLEEVE BUSHING (6).



LE5516

Go on to Sheet 18

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 18 of 21)

14. INSTALL RING SPACER (1) WITH LARGE DIAMETER FACING TOWARD REAR OF ENGINE, ONTO LOW PRESSURE ROTOR SHAFT (2).

15. APPLY A LIGHT COATING OF SHORTENING COMPOUND TO OUTER DIAMETER OF LOW PRESSURE ROTOR SHAFT (2) AND SLEEVE BUSHING (3).

NOTE

Sleeve bushing (3) has one mounting hole offset to ensure alignment of oil feed hole when secured to inlet housing (4).

16. INSTALL SLEEVE BUSHING (3) ONTO INLET HOUSING (4) WITH ALL MOUNTING HOLES ALIGNED. SECURE WITH THREE KNURLED KNOB SLAVE BOLTS (5) TIGHTENED EVENLY TO SEAT SLEEVE BUSHING (3) IN INLET HOUSING (4).

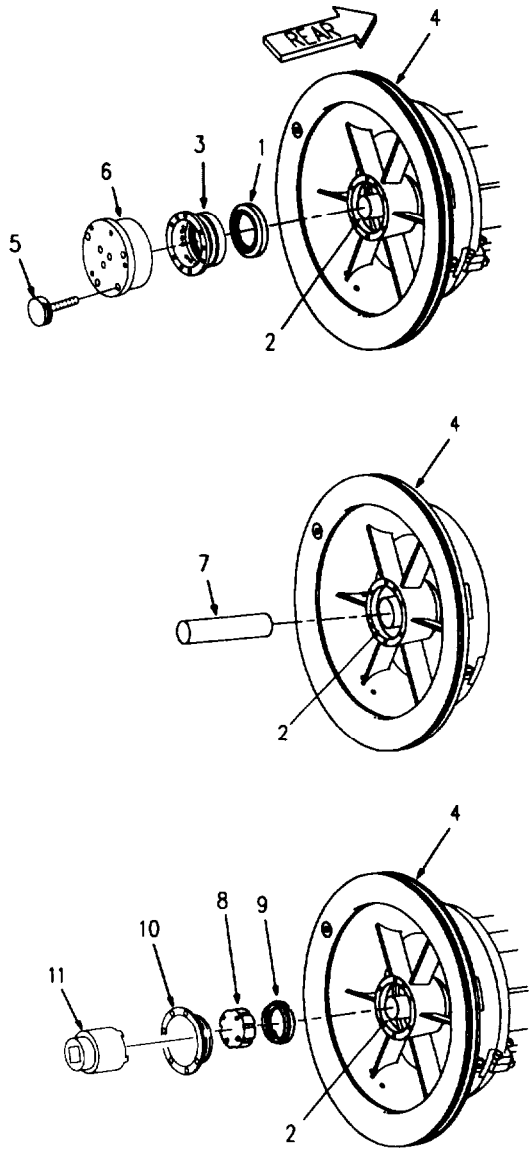
17. REMOVE INSTALLER TOOL (6).

18. INSTALL SLEEVE SPACER (7) INTO LOW PRESSURE ROTOR SHAFT (2).

19. APPLY DRY LUBRICANT TO THREADS OF PLAIN ROUND NUT (8). INSTALL NEW PACKING RETAINER (9) AND PLAIN ROUND NUT (8) ONTO LOW PRESSURE ROTOR SHAFT (2).

20. USING HOLDING FIXTURE (10) AND SPANNER WRENCH (11) TIGHTEN PLAIN ROUND NUT (8) BETWEEN 150-175 LB-FT (203-237 N-M) TORQUE.

21. REMOVE SPANNER WRENCH (11) AND HOLDING FIXTURE (10).



LE5517

Go on to Sheet 19

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 19 of 21)

CAUTION

Make sure packing retainer (1) does not shear or crack while deforming. If packing retainer (1) shears or cracks, replace.

22. DEFORM PACKING RETAINER (1) INTO PLAIN ROUND NUT (2) AT TWO PLACES, 160 DEGREES APART VISUALLY INSPECT DEFORMED PACKING RETAINER (1) FOR SHEARING OR CRACKS.

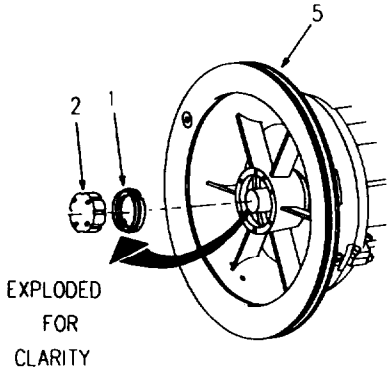
23. INSTALL PREDETERMINED RING SPACER (3) AND BEARING HOUSING (4) ONTO INLET HOUSING (5).

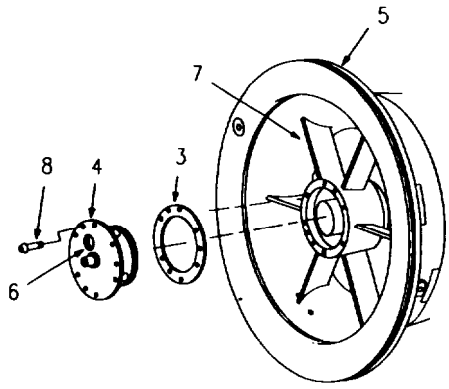
a. Install predetermined ring spacer (3) onto bearing housing (4) and align all holes.

NOTE

Low pressure compressor speed pickup hole (6) in bearing housing (4) is identified for reference only.

b. Align low pressure compressor speed pickup hole (6) in bearing housing (4) with 10 o'clock strut (7) on inlet housing (5) and install bearing housing (4) onto inlet housing (5). Secure with six bolts (8) tightened between 40-45 lb-in (4.52-5.08 N•m) torque in a staggered sequence.





LE5518

WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

Go on to Sheet 20

NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 20 of 21)

c. Using care, turn low pressure compressor blades (1) by hand and listen and feel for rubbing or binding. No rubs or binds should be felt and no unusual noises should be heard.

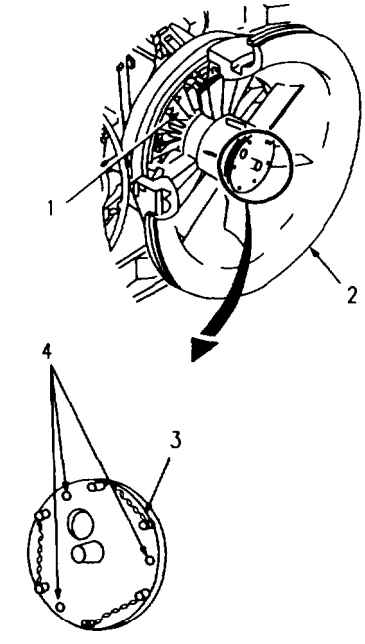
NOTE

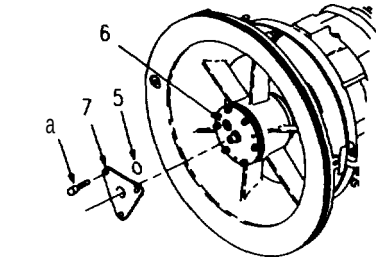
If any of these conditions exist, inlet housing (2) should be disassembled as required to locate and correct problem.

d. Safety wire six bolts (3) making sure not to run safety wire over three access cover bolt holes (4). Use double twist method.

24. APPLY SHORTENING COMPOUND TO PREFORMED PACKING (5) AND INSTALL IN BEARING HOUSING LOW PRESSURE COMPRESSOR SPEED PICKUP HOLE (6).

25. INSTALL ACCESS COVER PLATE (7) AND SECURE WITH THREE BOLTS (8). TIGHTEN BOLTS (8) BETWEEN 40-45 LB-IN (4.5-5.1 N•M) TORQUE. SAFETY WIRE BOLTS (8) USING SINGLE WIRE METHOD.





LE5519

Go on to Sheet 21

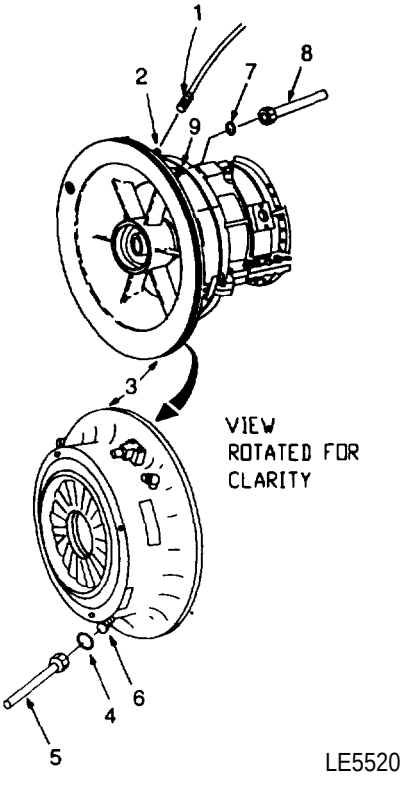
NO. 1 BEARING SEAL/PACKING RETAINER REPLACEMENT (Sheet 21 of 21)

26. CONNECT PLUG CONNECTOR 3W105-P34 (1) TO TEMPERATURE ROTOR SENSOR RECEPTACLE CONNECTOR (2) ON INLET HOUSING (3).

27. INSTALL NEW COMPRESSION SLEEVE (4) AND CONNECT NO. 1 BEARING OIL SCAVENGE TUBE (5) TO FITTING (6) ON INLET HOUSING (3).

26. INSTALL NEW FLARED SLEEVE (7) AND CONNECT OIL FEED TUBE (8) TO FITTING (9) ON INLET HOUSING (3).

29. INSTALL INLET AIR SPLITTER ASSEMBLY (TM 20-1).



End of Task

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 1 of 49)

TOOLS:

General mechanic's tool kit: automotive (SC5180-90-N26)
Adapter, socket wrench, 3/4 inch male, 1/2 inch female (Item 120, Appendix D)
Arbor Press (Item 37, Appendix D)
Chain-fall hoist, 1000 pound min. capacity (Item 10, Appendix D)
Clamp, type "C" (Item 159, Appendix D)
Cotton gloves (Item 52, Appendix 6)
Crowsfoot, 1/4-inch drive, 5/16-inch (Item 206, Appendix D)
Holding fixture (Item 146, Appendix D)
Hoist, 1000 pound min. capacity (Item 11, Appendix D)
Holding fixture (Item 157, Appendix D)
Lifting sling (Item 7, Appendix D)
Micrometer, depth gage (Item 205, Appendix D)
Remover/installer tool, #2 & 3 seals (Item 160, Appendix D)
Puller, #2 bearing housing (Item 204, Appendix D)
Puller, No. 3 brg hsg (Item 161, Appendix D)
Puller, bevel gear (Item 153, Appendix D)
Sleeve set (Item 162, Appendix D)
Sling (Item 163, Appendix D)
Socket, 3/8-inch drive, 7/32-inch, 12 point (Item 191, Appendix D)
Spanner wrench (Item 164, Appendix D)
Spanner wrench (Item 165, Appendix D)
Torque wrench, 0- 150 lb-in (Item 27, Appendix D)
Torque wrench, 0-200 lb-ft (Item 166, Appendix D)

PERSONNEL: Two or three

SUPPLIES:

Antiseize compound (Item 2, Appendix B)
Cotter pin (Item 5, Appendix E)
Dry cleaning solvent (Item 7, Appendix B)
Dry Moly Kote "Z" (Item 53, Appendix B)
Gasket (Item 1, Appendix E) (2 required)
Locking cup (No. 3 bearing) (Item 172, Appendix E)
Lockwasher (Item 120, Appendix E) (28 required)
Lubricating oil (Item 11 or 12, Appendix B)
Marker (grease) pencil (Item 54, Appendix B)
Non electric wire (Item 15, Appendix B)
Plastic sheet (Item 55, Appendix B) (approx. 4 ft square)

Go on to Sheet 2

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 2 of 49)

Preformed packings:
(Item 163, Appendix E) (2 required)
(item 166, Appendix E)
(Item 164, Appendix E) (2 required)
(Item 176, Appendix E)
(Item 177, Appendix E) (2 required)
(Item 63, Appendix E)
(Item 165, Appendix E) (2 required)
(Item 179, Appendix E)
Retaining ring (Item 180, Appendix E)
Seal (fuel tube) (Item 170, Appendix E) (2 required)
Self locking nut (Item 3, Appendix E) (28 required)
Shortening compound (Item 20, Appendix B)
Wiping rag (Item 14, Appendix B)
Wood block (Item 22, Appendix B) (2 required)

EQUIPMENT CONDITION:

Forward engine module removed (Page 5-13)
Air splitter removed (Page 5-114)
No. 2 and 3 bearing air pressurization tube removed (TM 20-1)

Go on to Sheet 2

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (SHEET 3 of 49)

REMOVAL:

1. PLACE FORWARD ENGINE MODULE (1) ONTO WOOD BLOCKS (2,3) ON FLOOR IN VERTICAL POSITION (NOSE (4) UP) USING HOISTS AND LIFTING SLING (5).

NOTE

Forward engine module (1) may drip engine oil onto floor when placed on wood blocks (2,3).

a. Place two wooden blocks (2,3) on plastic sheet or suitable material on level floor or surface.

WARNING

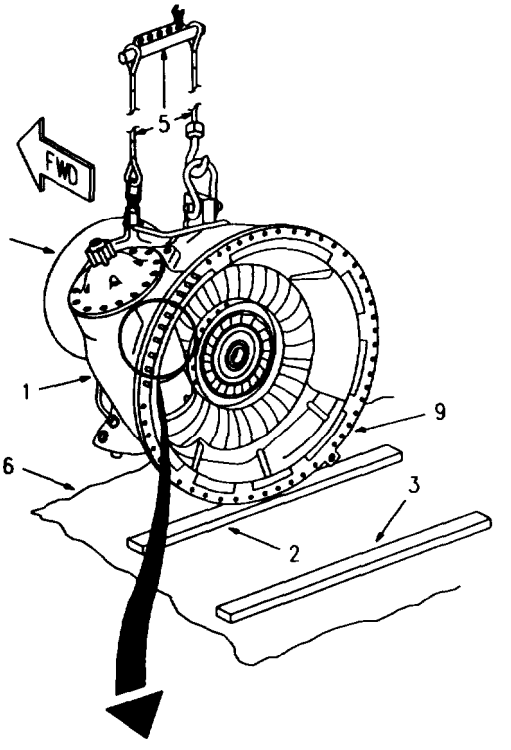
Forward engine module (1) is heavy. To avoid injury, use hoists when lifting. Keep hands and feet out from under module (1). Use helpers as required.

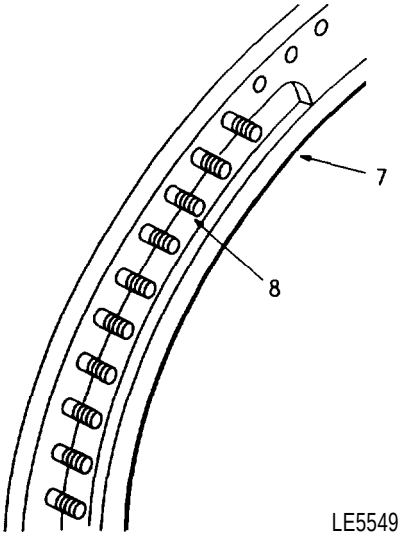
CAUTION

Do not allow air diffuser liner (7) or studs (8) to rest on blocks (2,3). Damage to parts may result.

b. Using hoist and lifting sling (5), carefully lower forward engine module (1) until aft end (9) rests lightly on wood block (2).

c. Position wood block (2) so air diffuser liner (7) will not rest on wood block (2) when forward engine module nose (4) is raised.





Go on to Sheet 4

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL)
(Sheet 4 of 49)

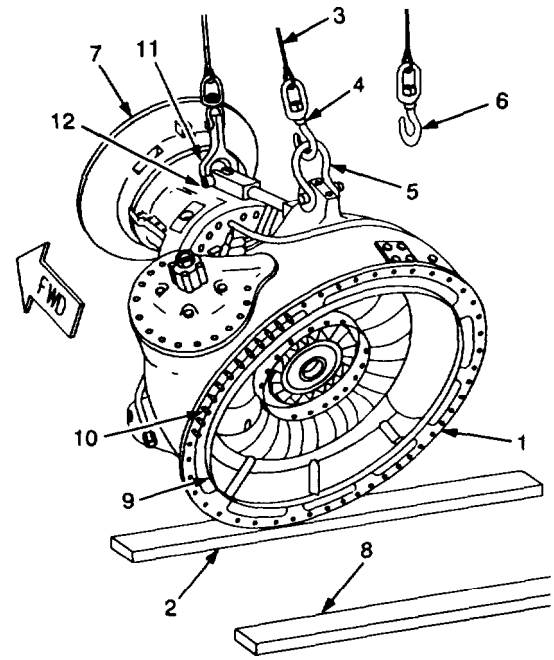
d. Lower aft end (1) onto wood block (2) until slack in sling cable (3) allows removal of hook (4) from shackle (5). Remove hook (4).

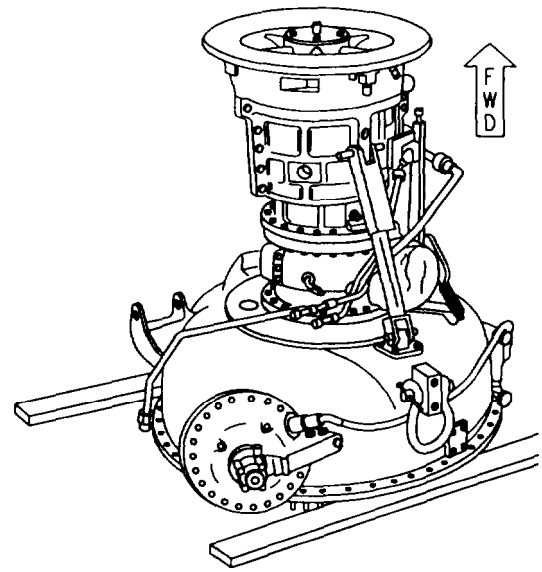
e. Attach hook (6) of another hoist to shackle (5) and take up slack, but do not raise aft end (1) off wood block (2).

f. Using sling hoist, slowly raise nose end (7) while simultaneously lowering aft end (1) toward wood block (8).

g. Position wood block (8) so diffuser liner (9) and studs (10) clear wood block (8) when aft end (1) is on wood block (8).

h. Continue lowering aft end (1) until hoist cables are slack. Remove hook (6) from shackle (5) and hook (11) from pin (12).





LE5550

Go on to Sheet 5

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 5 of 49)

CAUTION

With inlet housing (2) facing up, make sure dirt or any foreign objects do not fall into forward engine module. Damage to components may result.

2. REMOVE ACCESS COVER (1) AND PACKING (4).

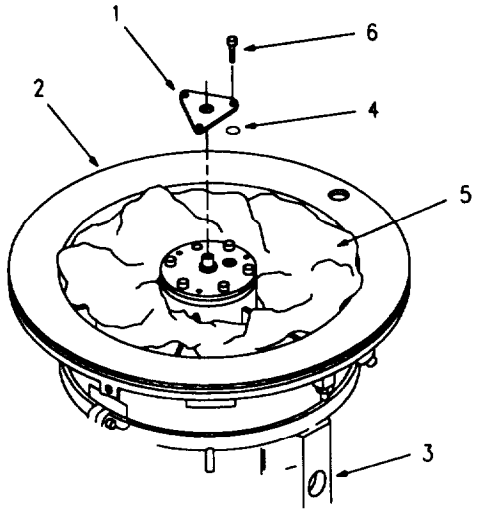
   a. Block inlet housing (2) with clean rags (5) to prevent dirt or objects from falling into forward engine module (3).

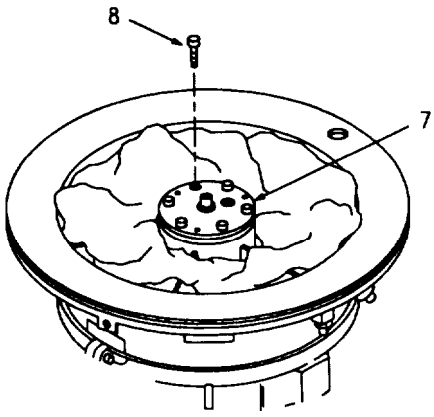
   b. Cut safety wire and remove three bolts (6), access cover (1) and preformed packing (4) from inlet housing (2). Discard packing (4).

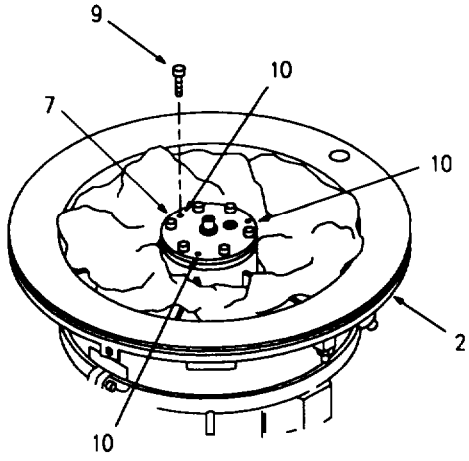
3. REMOVE NO.1 BEARING HOUSING (7).

   a. Cut safety wire and remove six bolts (8) from bearing housing (7).

   b. Using three bolts (9), removed from access cover in step 2 as jacking screws, install bolts (9) into three threaded holes (10). Tighten bolts (9) evenly opposite each other until bearing housing (7) is away from inlet housing (2).







LE5551

Go on to Sheet 6

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 8 of 49)

c. Remove jacking screws (1), bearing housing (2) and ring spacer (3) from inlet housing (4). Retain ring spacer (3) for further use.

d. Remove and discard two preformed packings (5) from bearing housing (2).

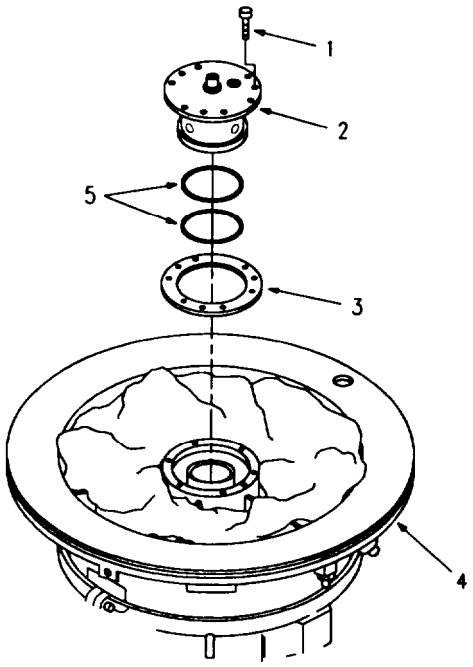
4. INSTALL LOCKING CUP HOLDING FIXTURE (6) ON INLET HOUSING (4).

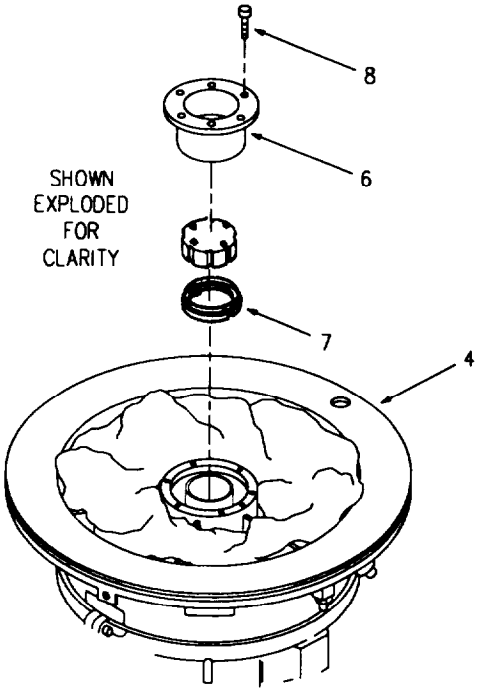
NOTE

Locking cup holding fixture (6) has an "offset hole" which will be at 7 o'clock position when properly installed on inlet housing (4).

a. Place locking cup holding fixture (6) onto inlet housing (4) and ensure tangs of holding fixture (6) engage packing retainer (7).

b. Secure fixture (6) to inlet housing (4) with six bolts (8) removed in step 3.a.





LE5552

Go on to Sheet 7

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 7 of 49)

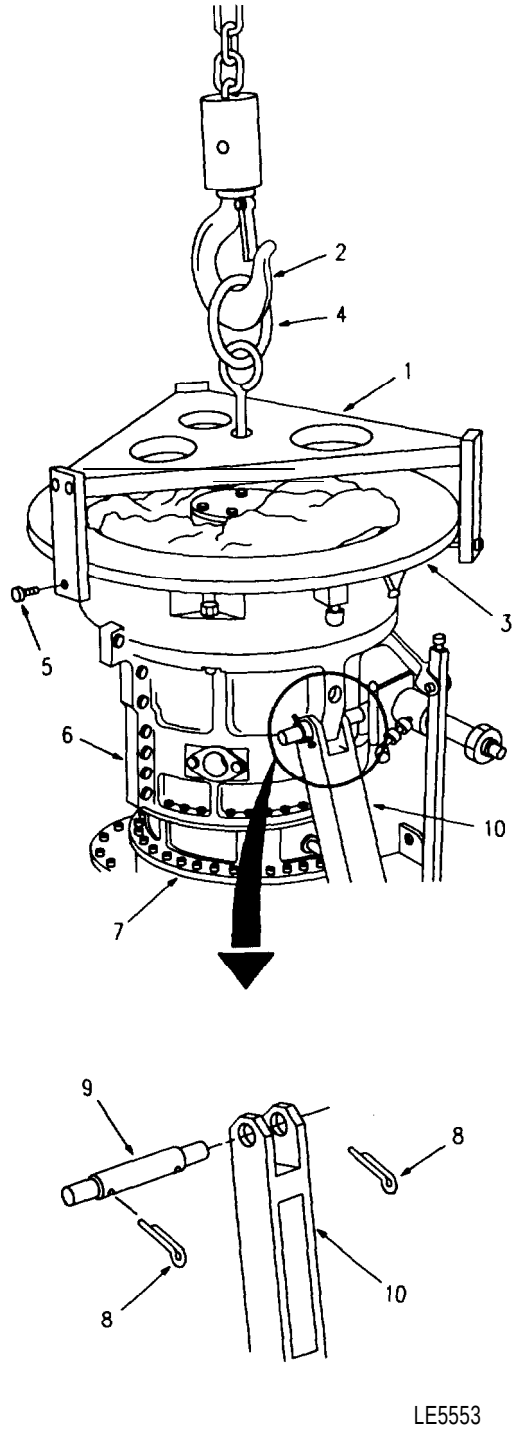
5. ATTACH LIFTING SLING (1) TO HOIST HOOK (2) AND INLET HOUSING (3).

a. Attach hoist hook (2) to ring (4) of lifting sling (1).

b. Secure lifting sling (1) to inlet housing (3) with three bolts (5). Secure bolts (5) with nuts.

6. REMOVE INLET HOUSING (3) AND LOW PRESSURE COMPRESSOR (6) FROM INTERMEDIATE MECHANICAL HOUSING (7).

a. Remove cotter pins (6) and shoulder pin (9). Swing structural support (10) away. Discard cotter pins (8).



Go on to Sheet 8

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 8 of 49)

b. Remove cotter pin (1) washer (2) and pin (3). Swing bleed valve rod (4) out of control lever (5).

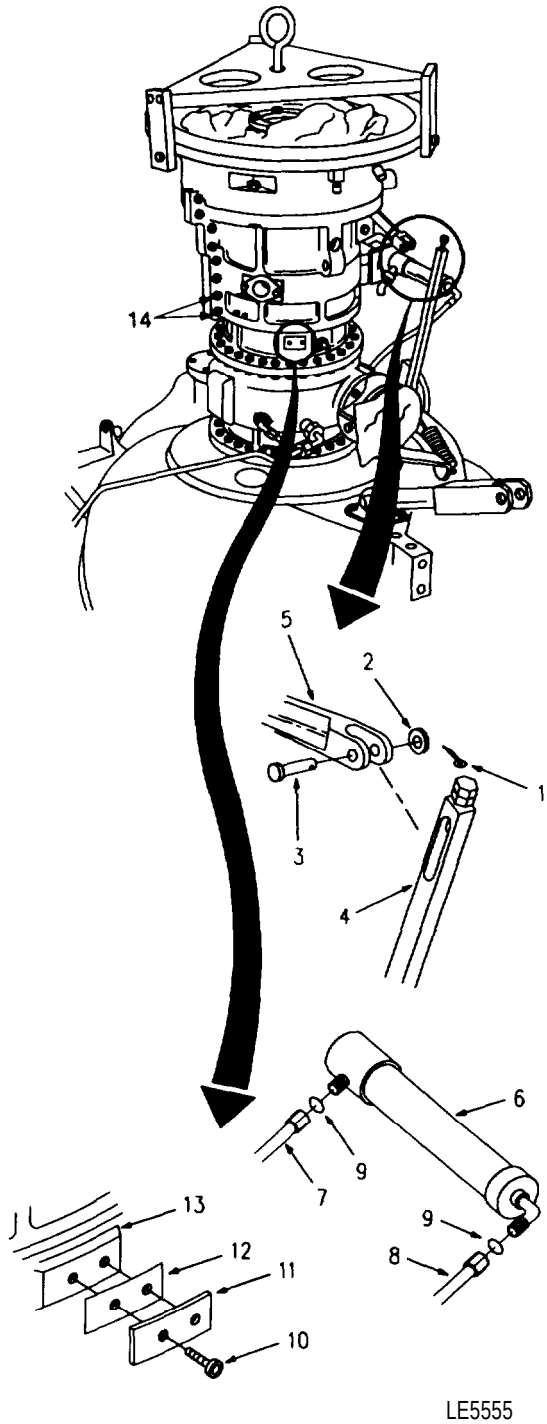
CAUTION

Do not actuate cylinder (6). Fuel under pressure will leak.

c. Disconnect IGV actuator fuel tubes (7,8) from actuating cylinder (6). Discard seals (9).

d. Remove four bolts (10), two mounting plates (11) and two gaskets (12) from intermediate housing (13). Discard gaskets (12).

e. Loosen lower two bolts (14) on each side of low pressure compressor housing split line.



Go on to Sheet 9

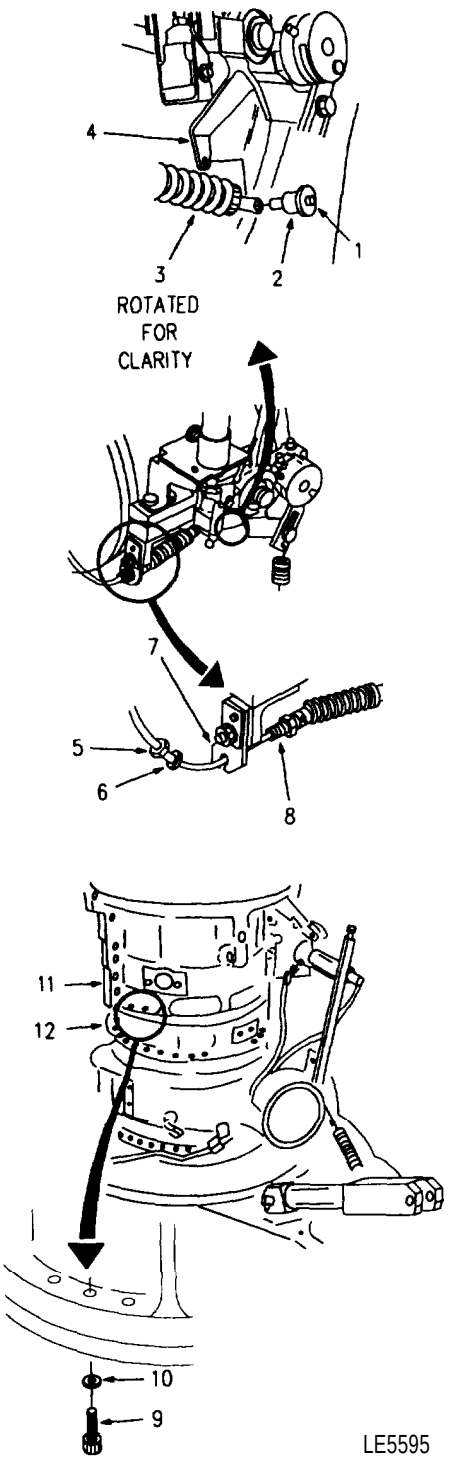
NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 9 of 49)

f. Push in button (1) on quick-release pin (2) and remove pin (2) from control assembly (3) and control lever (4). Remove control assembly (3) from control lever (4) and install pin (2) into control lever (4).

g. Loosen nut (5) on control assembly (3). Unscrew and slide nut (5) and lockwasher (6) away from angle bracket (7).

h. Pull threaded end (8) of control assembly (3) through hole in angle bracket (7). Slide control assembly (3) down and out of angle bracket (7) and remove from forward module to avoid possibility of damage to control assembly (3).

i. Remove 28 bolts (9) and lockwashers (10) securing low pressure compressor housing (11) to intermediate housing (12). Discard lockwashers (10).



Go on to Sheet 10

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 10 of 49)

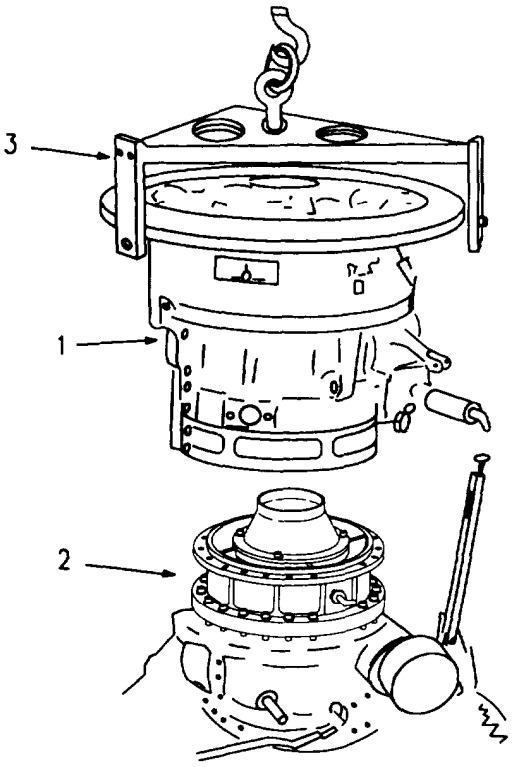
CAUTION

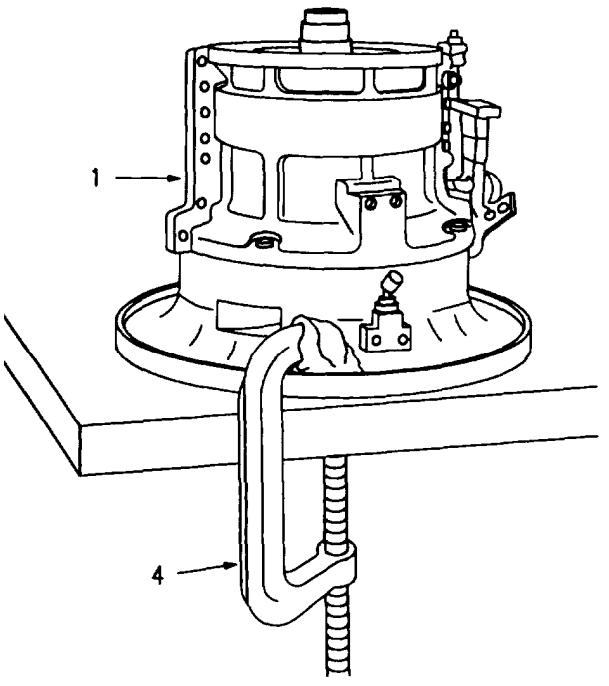
Use two personnel, one as a guide, when lifting inlet housing/low pressure compressor assembly (1) from intermediate housing (2). Damage to components or injury to personnel may result if dropped or mishandled.

j. Using hoist, carefully raise inlet housing/low pressure compressor assembly (1) from intermediate housing (2) and place horizontally on work surface.

k. Remove lifting sling (3).

7. POSITION INLET HOUSING/LOW PRESSURE COMPRESSOR ASSEMBLY (1) NOSE DOWN ONTO WORK SURFACE AND SECURE WITH LARGE C-CLAMP (4).





LE5556

Go on to Sheet 11

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 11 of 49)

8. REMOVE PLAIN ROUND NUT (1) USING SPANNER WRENCH (2). REMOVE RETAINING RING (3) AND BEARING LOCKING SPACER (4).

a. Using suitable tool, uncrimp retaining ring (3) from plain round nut (1).

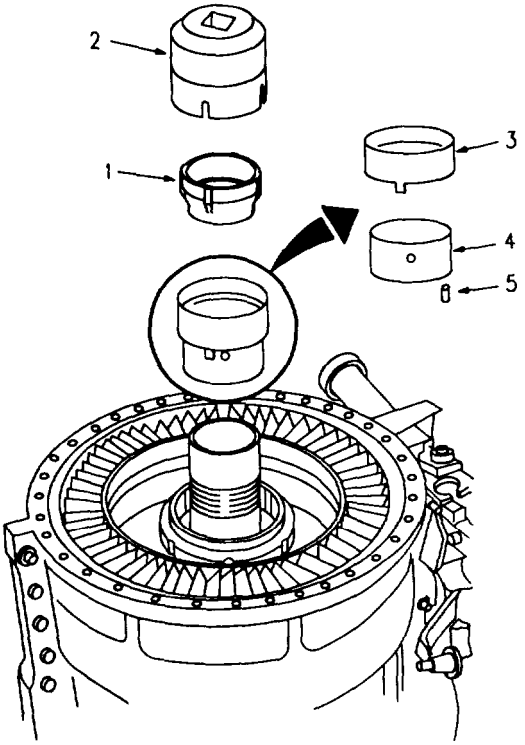
b. Remove plain round nut (1) using spanner wrench (2).

CAUTION

When removing bearing locking spacer (4), do not lose straight pin (5). Damage may result.

c. Remove retaining ring (3), bearing locking spacer (4) and straight pin (5).

d. Remove retaining ring (3) from bearing locking spacer (4). Discard retaining ring (3).



LE5557

Go on to Sheet 12

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 12 of 49)

9. REMOVE NO. 2 BEARING HOUSING (1) FROM LOW PRESSURE COMPRESSOR HOUSING (2) USING PULLER (3).

a. Install puller (3) to engage No. 2 bearing housing (1) and rotor shaft (4).

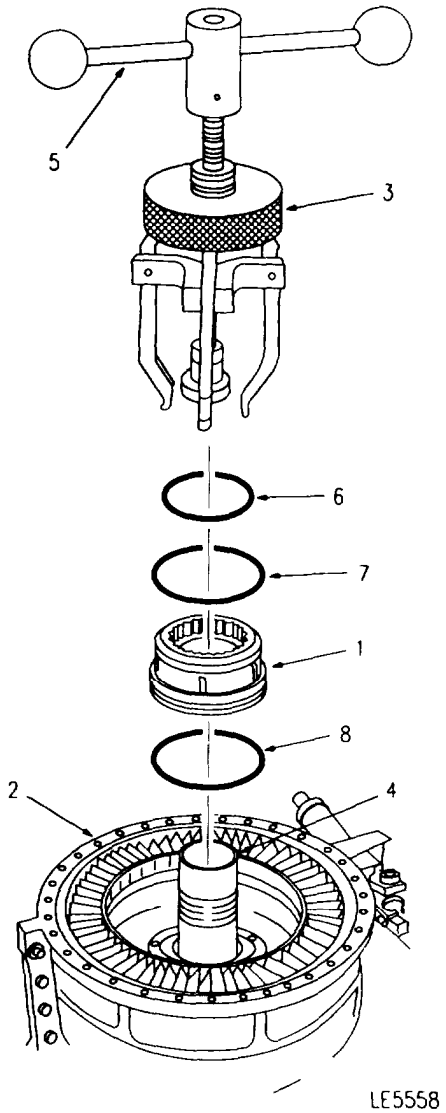
b. Turn handle (5) of puller (3) clockwise to free and remove No. 2 bearing housing (1).

c. Remove and discard preformed packings (6,7,8).

10. INSPECT LUGS ON NO. 2 BEARING HOUSING (1) FOR SCORING, CRACKS, OR FRETTING.

NOTE

If any of these conditions exist, the forward engine module is not repairable at DS level of maintenance. Reassemble forward engine module with original hardware and replace forward engine module (Page 5-13).



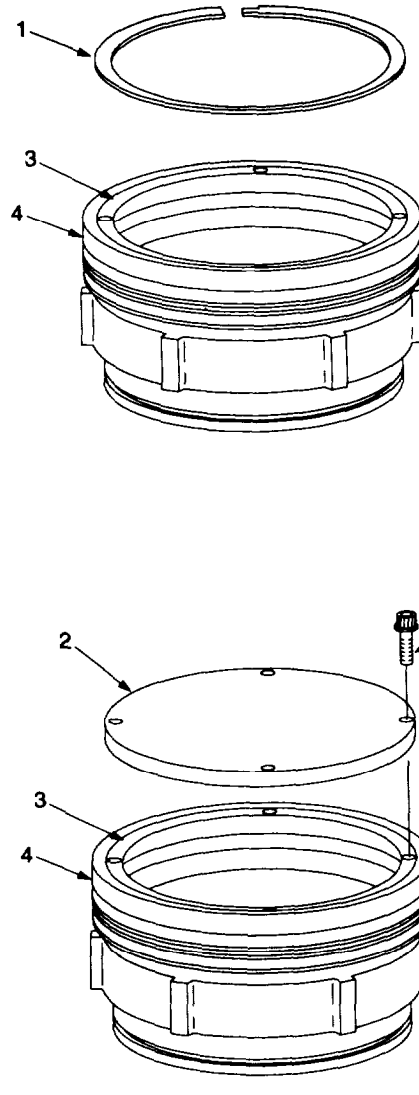
Go on to Sheet 13

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 13 of 49)

11. REMOVE RETAINING RING (1). USING SEAL REMOVAL TOOL (2), REMOVE PACKING RETAINER (3) FROM NO. 2 BEARING HOUSING (4).

a. Using suitable tool, pry retaining ring (1) from No. 2 bearing housing (4). Discard retaining ring (1).

b. Install seal removal tool (2) onto forward end of No. 2 bearing housing (4) and secure to packing retainer (3) with four bolts (5).



Go on to Sheet 14

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 14 of 49)

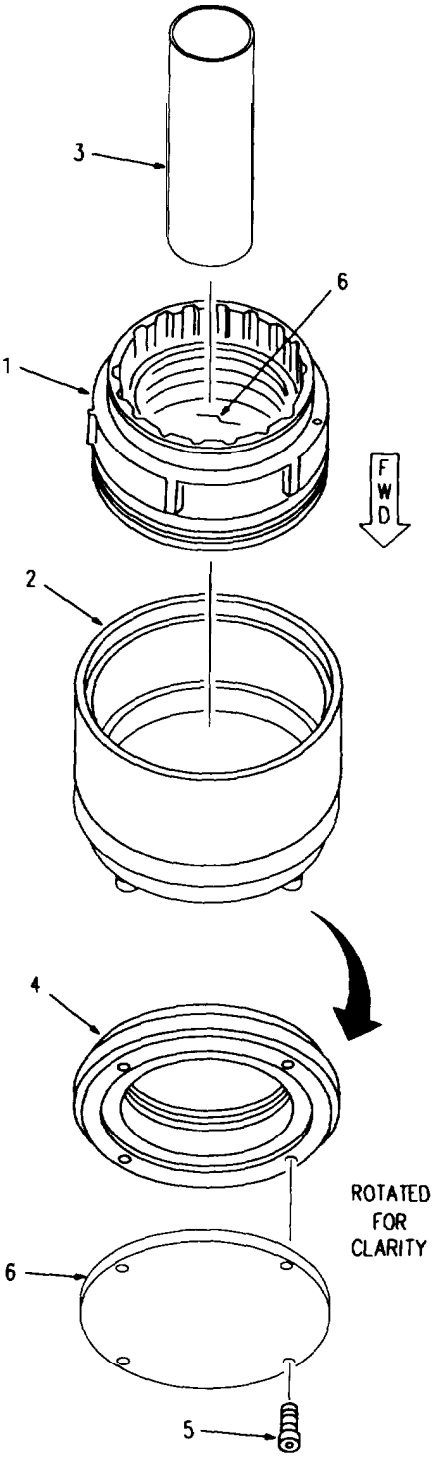
c. Place forward end of No. 2 bearing housing (1) onto sleeve (2).

WARNING

Use caution when using press. Improper tools, or tools not properly aligned, may cause injury to personnel or damage to parts or equipment.

d. Using arbor press and pusher sleeve (3). press packing retainer (4) from No. 2 bearing housing (1).

e. Remove four bolts (5) and seal removal tool (6) from packing retainer (4).



LE5560

Go on to Sheet 15

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 15 of 49)

CAUTION

Do not handle bearing or bearing races with bare hands. Damage to parts may result. Use clean cotton gloves.

12. REMOVE RING SPACER (1), RING SPACER (2) AND BEARING (3) FROM NO. 2 BEARING HOUSING (4).

13. CLEAN ALL HARDWARE REMOVED.

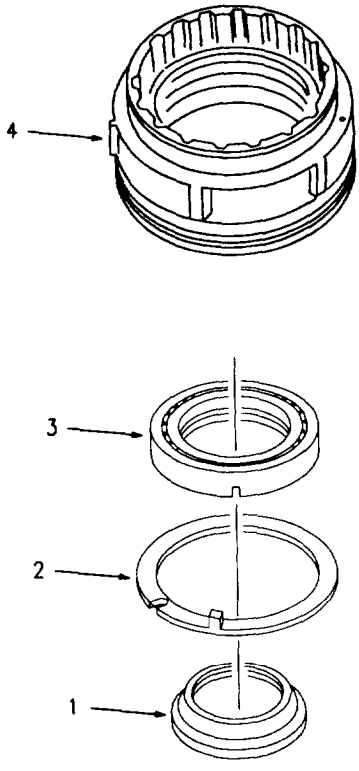
WARNING

CAUTION

Do not allow bearing to rotate when air drying with shop air. Damage to bearing may result.

a. Clean all hardware removed with dry cleaning solvent and air dry using shop air.

b. Secure bearing package hardware in clean plastic bag once cleaned and lubricated with lubricating oil.



LE5561

Go on to Sheet 16

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 16 of 49)

NOTE

Performing the slip fit check of step 14 may not be necessary when using original hardware. This slip fit check is required when new or different hardware is used.

14. PERFORM A SLIP FIT CHECK OF NO. 2 BEARING HOUSING (1) INTO NO. 2 BEARING SEAL HOUSING (2).

CAUTION

Do not allow debris or foreign objects to fall into high pressure compressor area. Damage to components may result. Cover opening of high pressure compressor with wiping rags as required.

a. Insert No. 2 bearing housing (1) into No. 2 bearing seal housing (2), slip lugs into slots and seat No. 2 bearing housing (1) onto No. 2 bearing seal housing. Check for binding.

b. Lift No. 2 bearing housing (1),turn approximately 60 degrees clockwise and repeat step a.

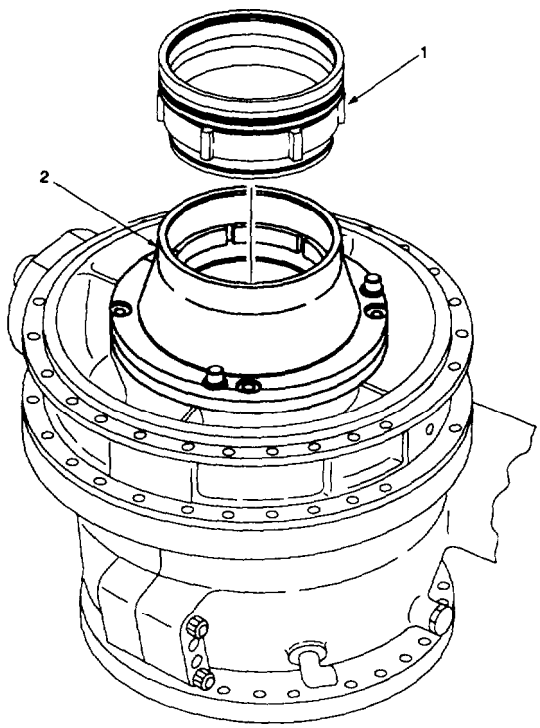
c. Repeat step b. five times, turning No. 2 bearing housing (1) 60 degrees clockwise each time.

NOTE

If any binding is felt, forward engine module is not repairable at DS level of maintenance. Reassemble forward engine module with original hardware and replace forward engine module (Page 5-13).

CAUTION

Do not handle bearing or bearing races with bare hands. Damage to parts may result. Use clean cotton gloves.



LE5562

Go on to Sheet 17

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 17 of 49)

15. INSPECT NO. 2 BEARING (1) PARTS AND LOW PRESSURE COMPRESSOR ROTOR SHAFT (2) FOR DAMAGE.

a. Inspect bearing (1) and raceways (3) for scoring, spalling, galling and cracks.

CAUTION

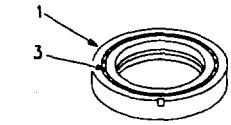
Do not rotate bearing while dry. Damage to part may result.

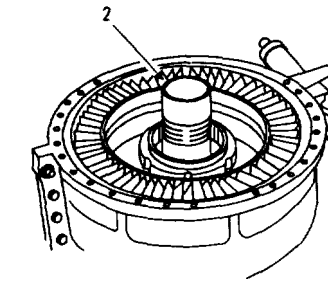
b. Lubricate bearing (1) with lubricating oil. Rotate bearing (1) by hand and feel for any binding or rough rotation.

c. Inspect low pressure compressor rotor shaft (2) for scoring, spalling, galling, cracks and damaged threads.

NOTE

If any of the above conditions exist, forward engine module is not repairable at DS level of maintenance. Reassemble forward engine module with original hardware and replace forward engine module (Page 5-13).





LE5563

Go on to Sheet 18

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 18 of 49)

16. REMOVE NO. 2 BEARING SEAL HOUSING (1) AND PREFORMED PACKING (2) FROM INTERMEDIATE MECHANICAL HOUSING (3).

CAUTION

Do not allow debris or foreign objects to fall into high pressure compressor area. Damage to components may result. Cover opening of high pressure compressor with wiping rags as required.

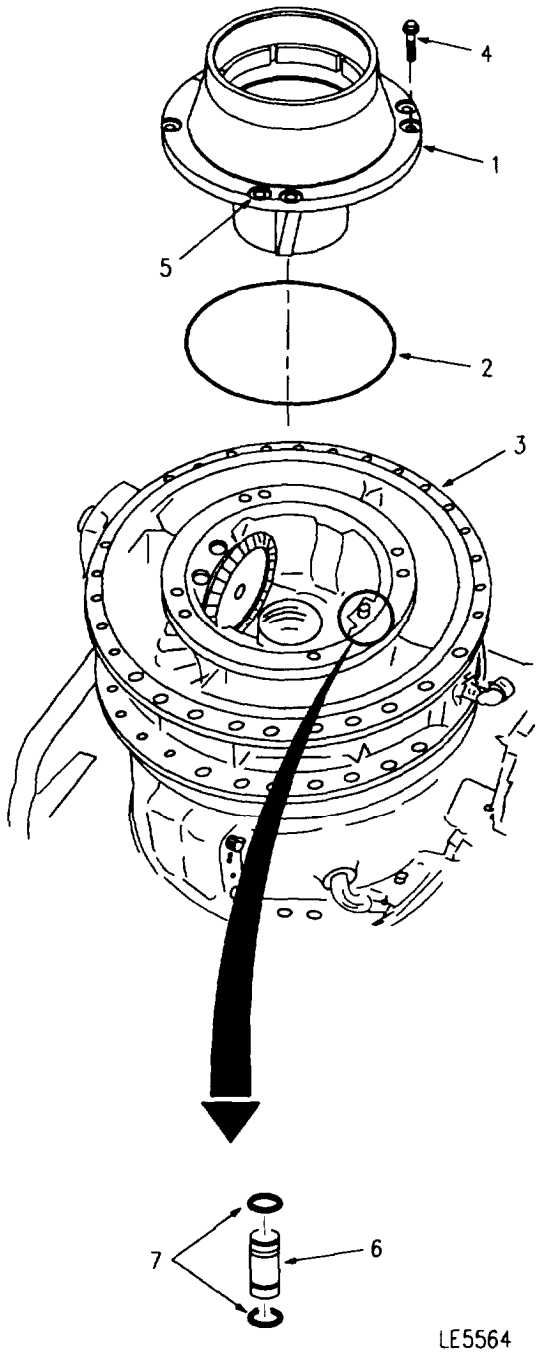
a. Cut safety wire and remove four bolts (4) securing No. 2 bearing seal housing (1) to intermediate housing (3).

b. Using three of bolts (4), removed in step a., as jacking screws, install bolts (4) into three threaded holes (5) of No. 2 bearing seal housing.

c. Tighten bolts (4) evenly opposite each other until No. 2 bearing seal housing (1) is away from intermediate housing (3). Remove No. 2 bearing seal housing (1).

d. Remove and discard preformed packing (2) from No. 2 bearing seal housing (1).

17. REMOVE OIL TRANSFER SLEEVE (6). REMOVE AND DISCARD TWO PREFORMED PACKINGS (7) FROM OIL TRANSFER SLEEVE (6).



Go on to Sheet 19

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 19 of 49)

18. INSPECT NO. 2 BEARING SEAL HOUSING (1) FOR SCORING, CRACKS, GALLING OR PITTING. INSPECT LUGS (2) ON NO. 2 BEARING SEAL HOUSING (1) FOR SCORING, CRACKS OR FRETTING.

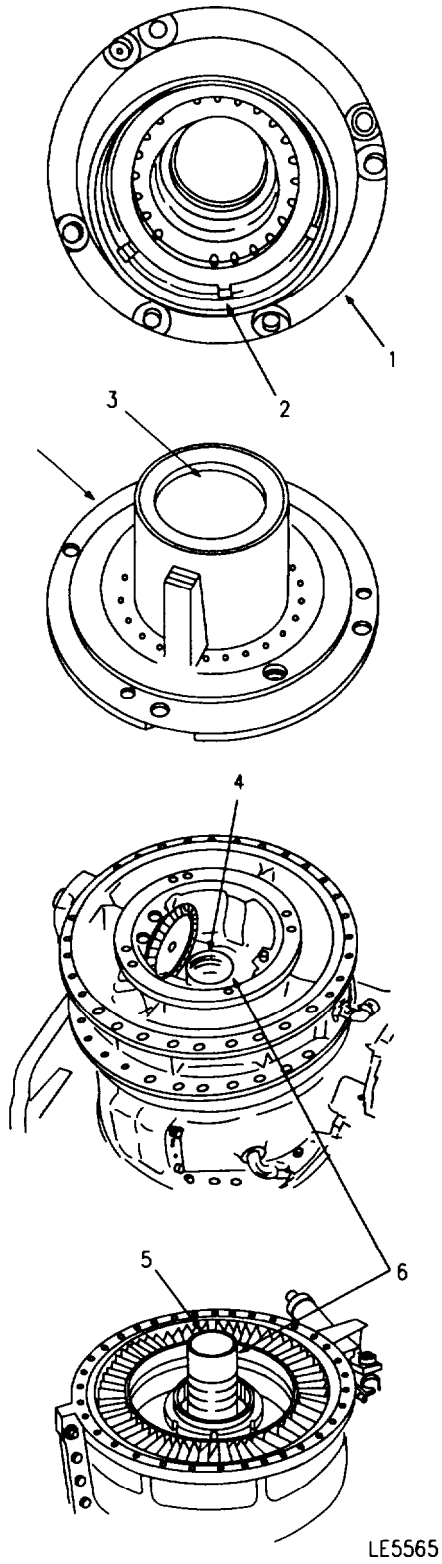
NOTE

If any of these conditions exist, the forward engine module is not repairable at DS level of maintenance. Reassemble forward engine module with original hardware and replace forward engine module (Page 5-13).

19. INSPECT PLAIN ENCASED SEAL CARBON ELEMENTS (3) FOR CHIPS AND CRACKS. IF CHIPS AND/OR CRACKS EXIST, INSPECT OUTSIDE DIAMETER OF AXIAL COMPRESSOR ROTOR SHAFT (4) AND LOW PRESSURE COMPRESSOR SHAFT (5) IN AREA (6) WHERE SEAL CARBON ELEMENTS (3) RIDE. INSPECT FOR SCORING, CRACKS AND/OR PURPLE COLOR.

NOTE

If any of these conditions exist, the forward engine module is not repairable at DS level of maintenance. Reassemble forward engine module with original hardware and replace forward engine module (Page 5-13).



Go on to Sheet 20

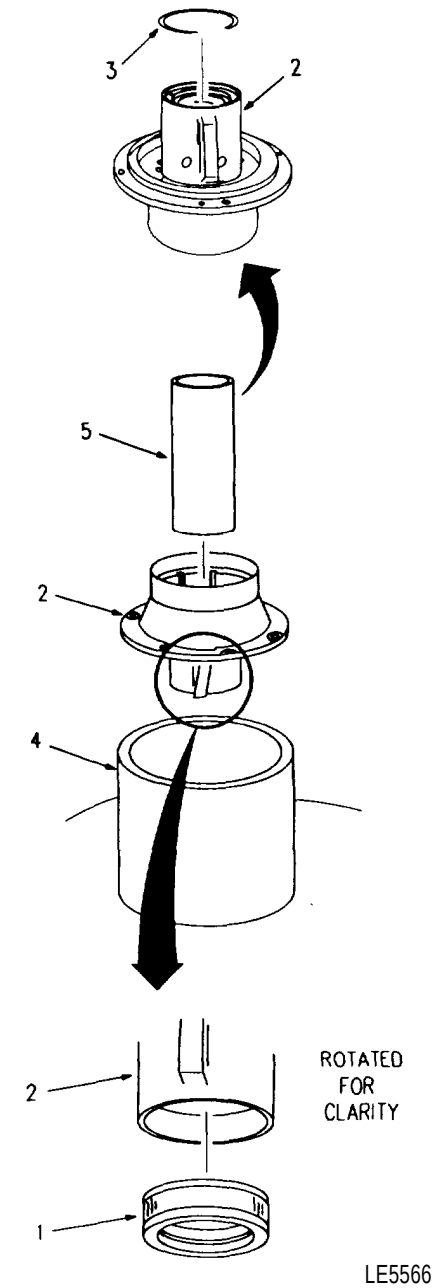
NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 20 of 49)

20. IF INSPECTION STEP 19 REVEALS NO DISCREPANT ITEMS, REMOVE PLAIN ENCASED SEAL (1) FROM NO. 2 BEARING SEAL HOUSING (2).

a. Using suitable tool, pry out retaining ring (3) from No. 2 bearing seal housing (2).

b. Place No. 2 bearing seal housing (2) seal end into sleeve (4).

c. Using arbor press and pusher sleeve (5), press out plain encased seal (1) from No. 2 bearing seal housing (2).



Go on to Sheet 21

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 21 of 49)

21. REMOVE INTERMEDIATE HOUSING (1) FROM AXIAL COMPRESSOR HOUSING (2).

a. Remove 28 self-locking nuts (3) and bolts (4).

b. Loosen but do not remove two upper bolts (5) on each side of axial compressor housing (2).

c. Using a soft head mallet, tap on intermediate housing (1) to dislodge it from axial compressor housing (2). Carefully lift intermediate housing (1) and place on work surface.

22. REMOVE PLAIN ROUND NUT (6) AND LOCKING CUP (7) FROM AXIAL COMPRESSOR ROTOR SHAFT (8).

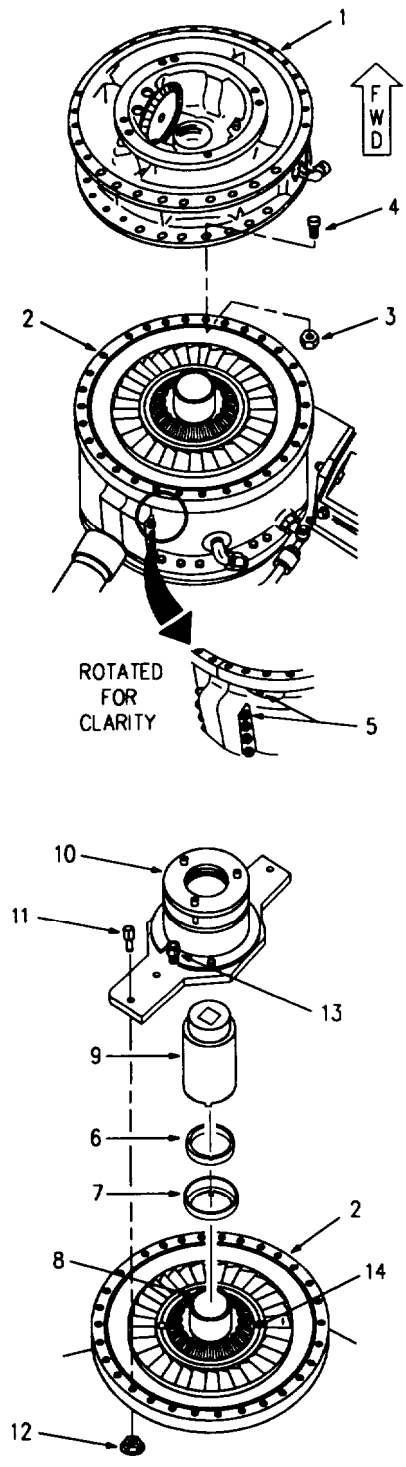
a. Uncrimp locking cup (7) from plain round nut (6) using suitable tool.

b. Install spanner wrench (9) with adapter over axial compressor rotor shaft (6) to engage plain round nut (6).

c. Install and adjust holding fixture (10) until it is flush with compressor housing flange. Secure holding fixture (10) to axial compressor housing (2) with two bolts (11) and nuts (12). Ensure locking bolts (13) are engaged with cutouts (14) on high pressure rotor (8).

d. Using spanner wrench (9) with adapter, loosen plain round nut (6).

e. Remove holding fixture (10), spanner wrench (9) with adapter, plain round nut (6) and locking cup (7) from rotor shaft (8). Discard locking cup (7).



LE5567

Go on to Sheet 22

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 22 of 49)

23. REMOVE BEVEL GEAR (1) AND SHIM (2) FROM AXIAL COMPRESSOR HOUSING (3) USING PULLER (4).

a. Install gear puller (4) onto bevel gear (1).

b. Remove bevel gear (1) and gear puller (4).

CAUTION

If shim (2) is replaced, the replacement shim must be of equal thickness.

c. Remove shim (2) and inspect for hangers, nicks, burrs and raised edges. Use honing stone to remove burrs. Replace damaged shim (2).

d. Inspect bevel gear teeth (1) for heavy wear, corrosion, medium to heavy pitting, cracking, heavy frosting, medium to heavy scoring, spalling or blue or purple heat discoloration. Also, inspect anti-rotation slot for excessive wear, cracks or chips.

NOTE

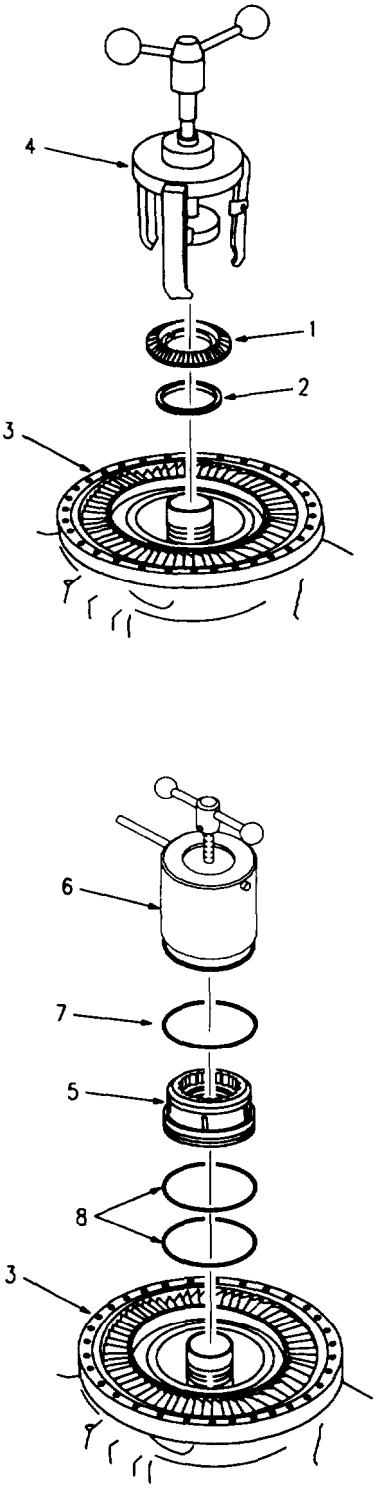
If any of these conditions exist, the forward module is not repairable at DS level of maintenance. Reassemble forward module with original hardware and replace forward module (page 5-13).

24. REMOVE NO. 3 BEARING HOUSING (5) FROM AXIAL COMPRESSOR HOUSING (3) USING PULLER (6).

a. Install puller (6) onto No. 3 bearing housing (5) and remove from axial compressor housing (3).

b. Remove puller (6) from No. 3 bearing housing (5).

c. Remove and discard preformed packings (7,8).



LE5568

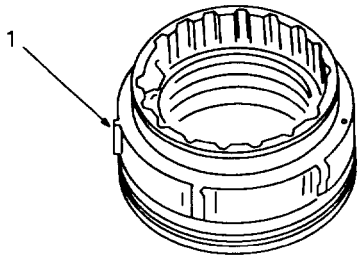
Go on to Sheet 23

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 23 of 49)

25. INSPECT LUGS ON NO. 3 BEARING HOUSING (1) FOR SCORING, CRACKS, FRETTING.

NOTE

If any of these conditions exist, the forward engine module is not repairable at DS level of maintenance. Reassemble forward engine module with original hardware and replace forward engine module (Page 5-13).



NOTE

Performing the slip fit check of step 26. may not be necessary when using original hardware. This slip fit check is required when new or different hardware is used.

26. PERFORM SLIP-FIT CHECK OF NO. 3 BEARING HOUSING (1) INTO INTERMEDIATE MECHANICAL HOUSING (2).

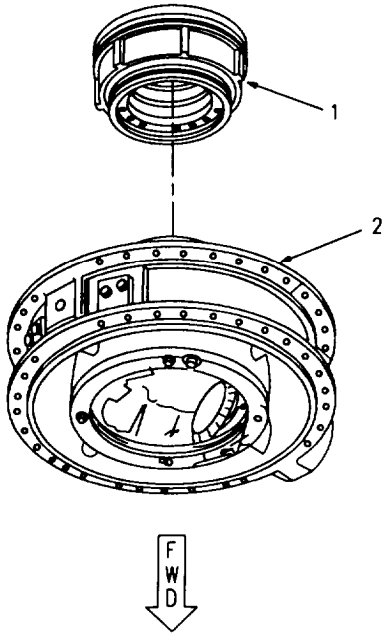
a. Position intermediate mechanical housing (2) on work surface so forward end faces down.

b. Slip fit No. 3 bearing housing (1) into intermediate mechanical housing (2). Weight of No. 3 bearing housing (1) must cause it to bottom in intermediate mechanical housing (2) without binding.

c. Repeat step b. five times, turning No. 3 bearing housing (1) 60 degrees in same direction each time.

NOTE

If any of these conditions exist, the forward engine module is not repairable at DS level of maintenance. Reassemble forward engine module with original hardware and replace forward engine module (Page 5-13).



LE5569

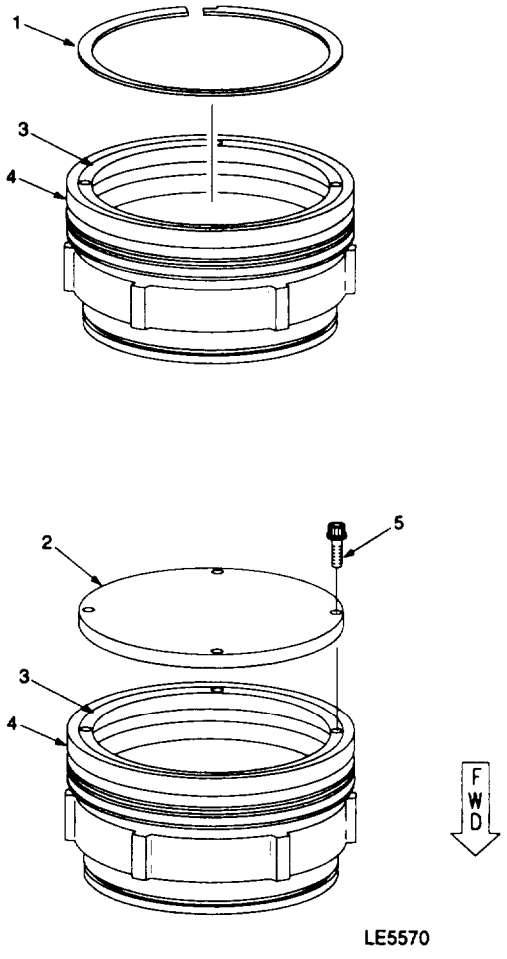
Go on to Sheet 24

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 24 of 49)

27. REMOVE RETAINING RING (1). USING SEAL REMOVAL TOOL (2) REMOVE PACKING RETAINER (3) FROM NO. 3 BEARING HOUSING (4).

a. Using suitable tool, pry retaining ring (1) from No. 3 bearing housing (4).

b. Install seal removal tool (2) onto rearward end of No. 3 bearing housing (4) and secure to packing retainer (3) with four bolts (5).



Go on to Sheet 25

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 25 of 49)

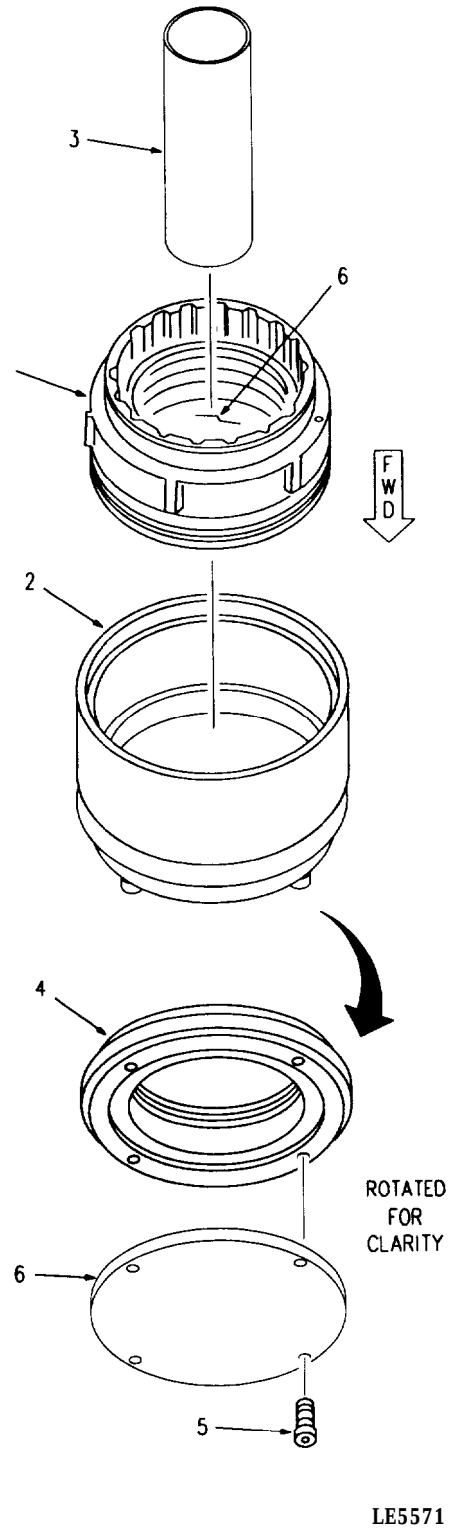
c. Place rearward end of No. 3 bearing housing (1) onto sleeve (2).

WARNING

Use caution when using press. Improper tools, or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

d. Using arbor press and pusher sleeve (3) press packing retainer (4) from No. 3 bearing housing (1).

e. Remove four bolts (5) and seal removal tool (6) from packing retainer (4).



LE5571

Go on to Sheet 26

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 28 of 49)

CAUTION

Do not handle bearing or bearing races with bare hands. Damage to parts may result. Use clean cotton gloves.

28. REMOVE RING SPACER (1) RING SPACER (2) AND BEARING (3) FROM NO. 3 BEARING HOUSING (4).

CAUTION

Do not allow bearing to rotate when air drying with shop air. Damage to part may result.

29. CLEAN ALL HARDWARE REMOVED.

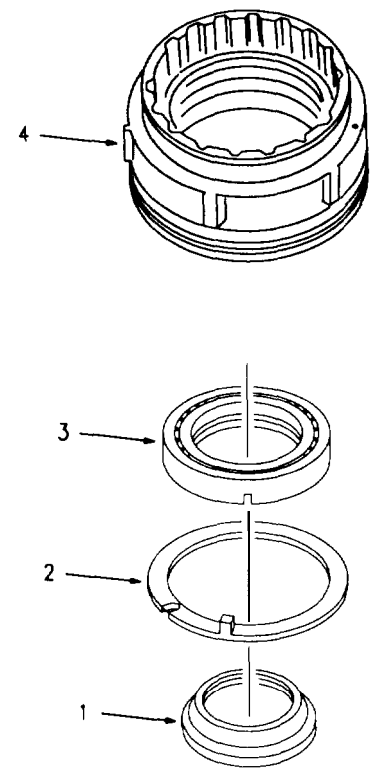
WARNING

a. Clean all hardware removed with dry cleaning solvent and air dry using shop air. Do not immerse bearing parts in solvent.

CAUTION

Do not handle bearing or bearing races with bare hands. Damage to parts may result. Use clean cotton gloves.

b. Secure bearing package hardware in clean plastic bag once cleaned and lubricated with lubricating oil.



LE5572

Go on to Sheet 27

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 27 of 49)

30. INSPECT NO. 3 BEARING (1) PARTS AND AXIAL COMPRESSOR ROTOR SHAFT (2) FOR DAMAGE.

a. Inspect bearing (1) and races (3) for scoring, spalling, galling, cracks and fretting heat discoloration (purple).

CAUTION

Do not rotate bearing while dry. Damage to part may result.

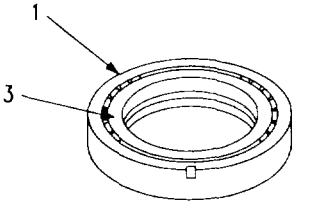
b. Lubricate bearing (1) with lubricating oil. Rotate bearing (1) by hand and feel for any binding or rough rotation.

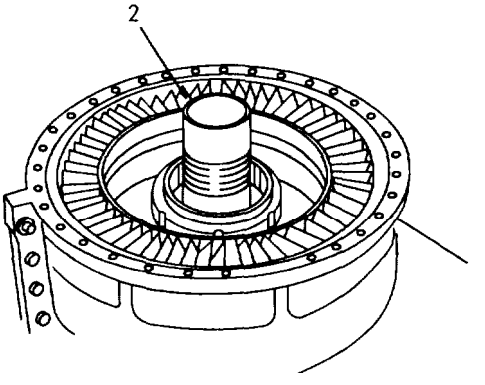
c. Inspect axial compressor rotor shaft (2) for scoring, spalling, galling, cracks and damaged threads.

NOTE

If any of these conditions exist, the forward engine module is not repairable at DS level of maintenance. Reassemble forward engine module with original hardware and replace forward engine module (Page 5-13).

d. Secure bearing package hardware in clean plastic bag once cleaned and lubricated with lubricating oil.





LE5573

Go on to Sheet 28

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 28 of 49)

INSTALLATION:

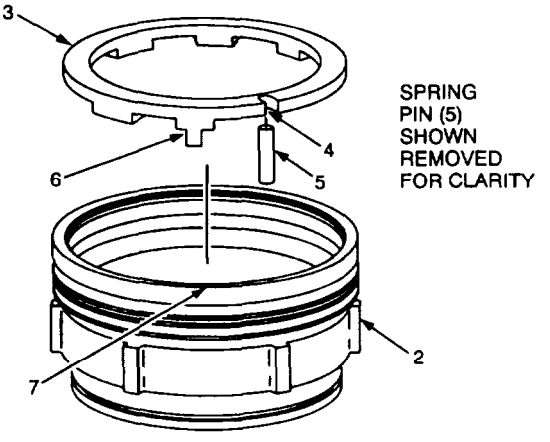
1. INSTALL BEARING (1) INTO NO. 3 BEARING HOUSING (2).

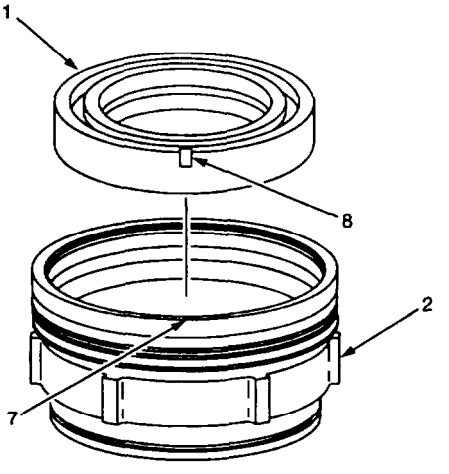
   a. Install spacer (3), with slot (4) in line with spring pin (5), and tang (6) down, into No. 3 bearing housing (2).

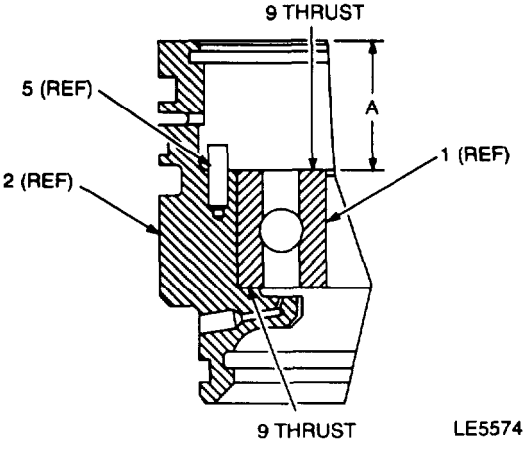
   b. Using marker pencil, place a mark (7) on No. 3 bearing housing (2) relative to position of spacer tang (6). Remove spacer (3).

   c. Lightly lubricate inner diameter of No. 3 bearing housing (2) with shortening compound. Install bearing (1) into No. 3 bearing housing (2) with bearing slot (8) in line with mark (7) on No. 3 bearing housing (2). Verify bearing thrust marks (9) are at proper position in No. 3 bearing housing (2).

   d. Using depth gage micrometer, check for proper seating of bearing (1) in No. 3 bearing housing (2). Measure distance (A) from aft end of housing (2) to top of outer race of bearing (1) at three places equally spaced. Measurements at all three locations shall be between 0.748-0.763 inches (18.999-19.380 mm) and equal to each other.







Go on to Sheet 29

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 29 of 49)

2. INSTALL RING SPACER (1) IN NO. 3 BEARING HOUSING (2).

a. Align slot (3) of ring spacer (1) with spring pin (4) in No. 3 bearing housing (2).

NOTE

Tang (5) of ring spacer **(1)** should be aligned with slot (6) in bearing (7) outer race.

b. Install ring spacer (1) into No. 3 bearing Housing (2).

WARNING

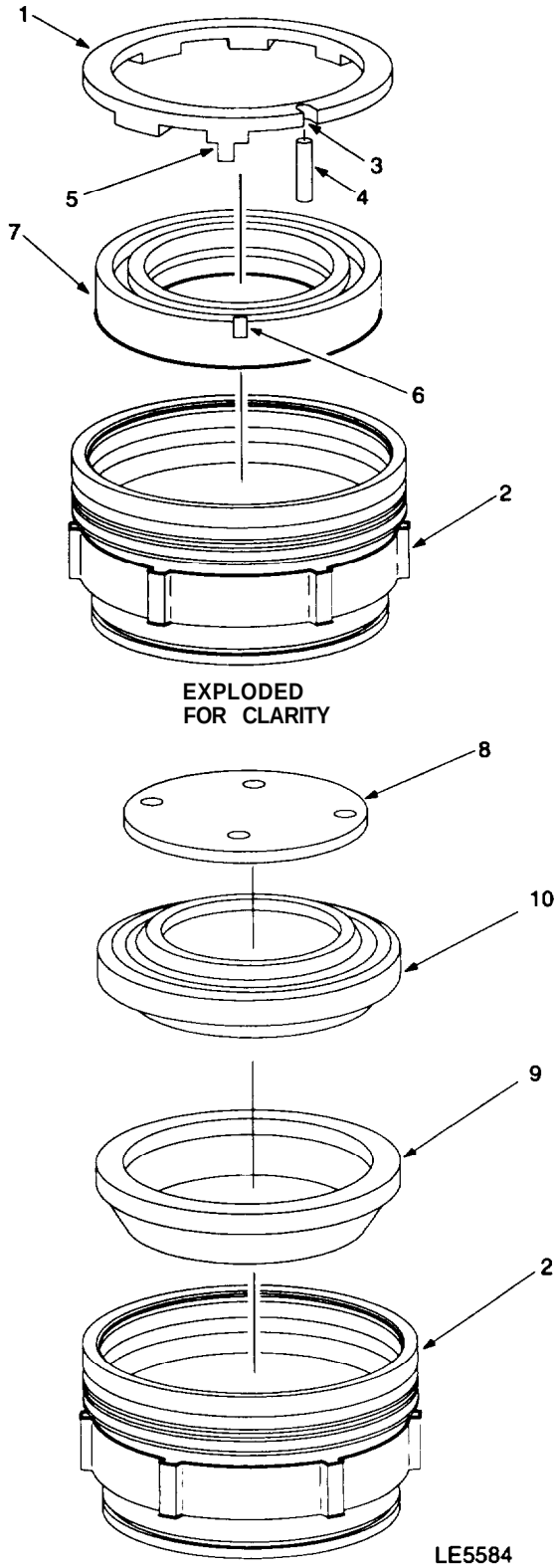
Use caution when using press. Improper tools, or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

3. USING PUSHER TOOL (8) AND ARBOR PRESS, INSTALL RING SPACER (9) AND PACKING RETAINER (10) INTO NO. 3 BEARING HOUSING (2).

a. Lightly lubricate large diameter side of ring spacer (9) with lubricating oil. Place ring spacer (9) into No. 3 bearing housing (2) with large diameter side up.

b. Lightly lubricate face seal of packing retainer (10) with lubricating oil. Install packing retainer (10) into No. 3 bearing housing (2) with carbon element facing down.

c. Using seal installer tool (8) and arbor press, press ring spacer (9) and packing retainer (10) into No. 3 bearing housing (2).



Go on to Sheet 30

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 30 of 49)

d. Using depth gage micrometer, check dimension (A), from aft end (1) of No. 3 bearing housing (2) to packing retainer (3) at two places 180 degrees apart. Dimension (A) shall be between 0.125-0.115 inches (3.175-2.921 mm) at both places and shall be within 0.002 inch (0.051 mm) of each other.

4. INSTALL RETAINING RING (4) INTO NO. 3 BEARING HOUSING (2).

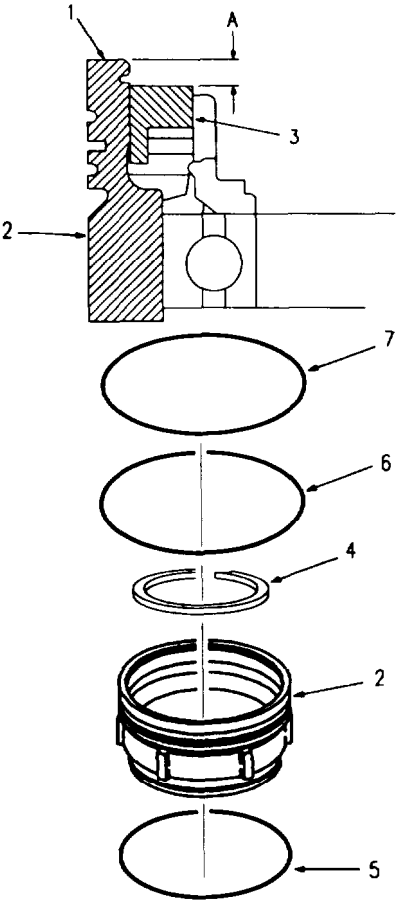
5. LUBRICATE NEW PREFORMED PACKINGS (5,6,7) WITH SHORTENING COMPOUND AND INSTALL ONTO NO. 3 BEARING HOUSING (2).

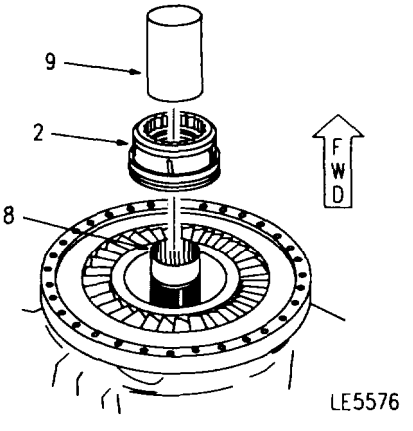
6. INSTALL NO. 3 BEARING HOUSING (2) ONTO AXIAL COMPRESSOR ROTOR (8).

a. Lightly lubricate axial compressor rotor shaft (8) with shortening compound.

b. Install No. 3 bearing housing (2) onto axial compressor rotor shaft (8).

c. Using sleeve (9) and mallet, push bearing housing (2) down on shaft (8) until seated.





Go on to Sheet 31

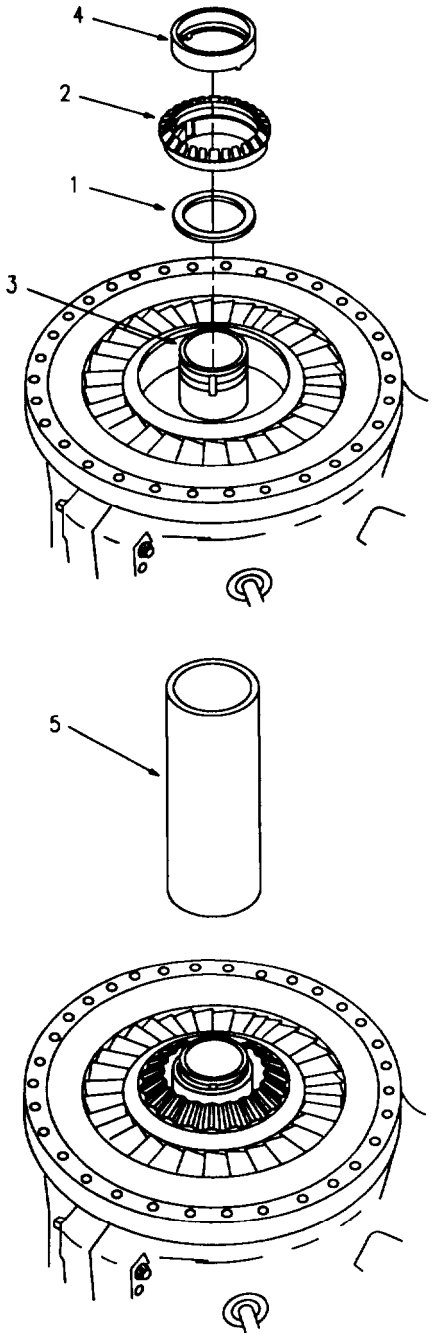
NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 31 of 49)

7. INSTALL SHIM (1) AND BEVEL GEAR (2) ONTO AXIAL COMPRESSOR ROTOR (3). ALIGN ANTI-ROTATION SLOTS IN BEVEL GEAR (2) AND AXIAL COMPRESSOR ROTOR (3).

8. INSTALL NEW LOCKING CUP (4) ONTO AXIAL COMPRESSOR ROTOR (3).

a. Install new locking cup (4) with tangs engaged in anti-rotation slots of bevel gear (2) and axial compressor rotor (3).

b. Using sleeve tool (5) and mallet, seat locking cup (4) against face of bevel gear (2).



LE5577

Go on to Sheet 32

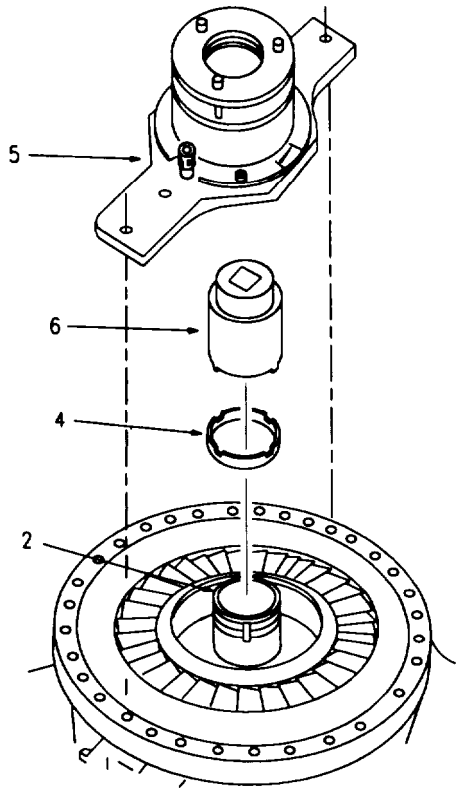
NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 32 of 49)

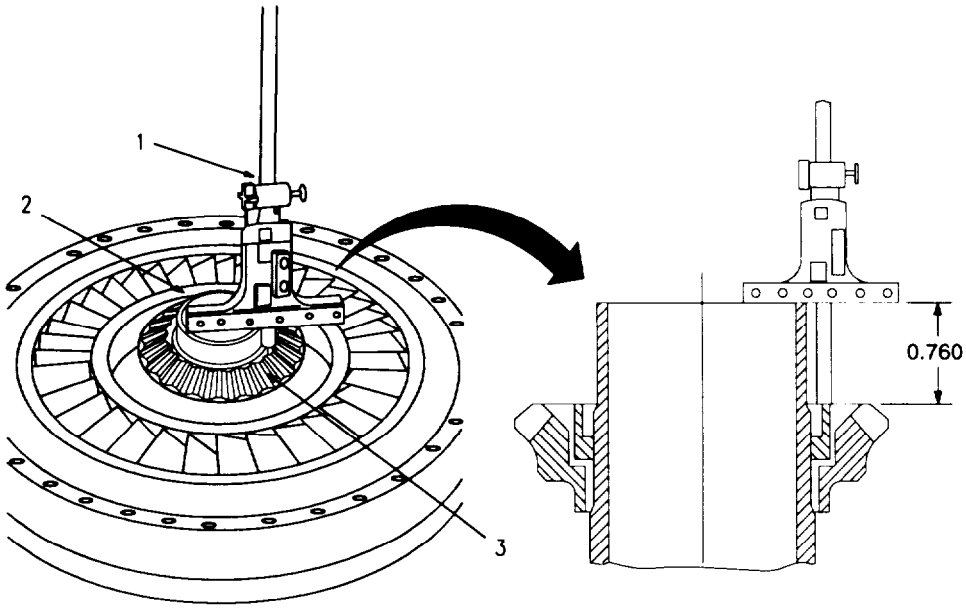
9. USING DEPTH GAGE MICROMETER (1) CHECK DISTANCE FROM END OF AXIAL COMPRESSOR ROTOR (2) TO OUTER RIM OF LOCKING CUP (3) IS 0.760 INCH (19.364 MM) MINIMUM. IF MINIMUM DISTANCE IS NOT ACHIEVED, REMOVE LOCKING CUP (3). INSPECT, CLEAN AND RESEAT LOCKING CUP (3). AFTER THREE Al-TEMPTS, REPLACE FORWARD ENGINE MODULE (Page 5-13).

10. INSTALL PLAIN ROUND NUT (4) ONTO AXIAL COMPRESSOR ROTOR (2). TIGHTEN NUT (4) BETWEEN 170-180 LB-FT (230-244 N.M) TORQUE.

a. Lubricate plain round nut (4) with dry molykote "z" mixed with a small amount of lubricating oil. Install plain round nut (4) onto rotor shaft (2) and hand tighten with spanner wrench (6).

b. Using torquing fixture (5) and spanner wrench (6), tighten plain round nut (4) between 170-180 lb-ft (230-244 N.m) torque. Wait five minutes and retorque.





LE5578

Go on to Sheet 33

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 33 of 49)

11. DEFORM LOCKING CUP (1) INTO TWO OF THE FOUR CASTELLATIONS OF THE PLAIN ROUND NUT (2) 180 DEGREES APART USING A BALL PEEN HAMMER AND BRASS DRIFT

CAUTION

Do not substitute the brass drift for any tool made from a metal that is harder than brass. Tool damage to the bevel gear or compressor shaft is unacceptable and will result in replacement of the entire forward module.

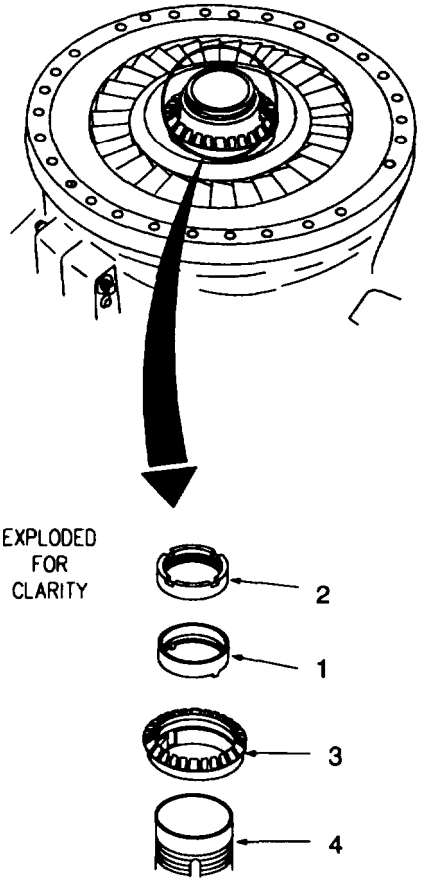
a. Lightly deform locking cup (1) into two castellations of the plain round nut (2) 180 degrees apart by placing the end of the brass drift against the side of the locking cup (1) and striking the brass drift lightly with a ball peen hammer. Deform locking cup (1) enough to engage the two castellations of the plain round nut (2) without shearing or cracking the locking cup (1).

b. Inspect locking cup (1) for shears or cracks. No shears or cracks are acceptable. If any shears or cracks are present, replace locking cup (1).

c. Inspect bevel gear (3) and compressor shaft (4) for tooling marks.

NOTE

If tooling marks exist, the forward module is not repairable at DS level of maintenance. Reassemble forward module with original hardware and replace forward module (page 5-13).



LE5579

Go on to Sheet 34

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 34 of 49)

12. ALIGN AND INSTALL INTERMEDIATE HOUSING (1) ONTO AXIAL COMPRESSOR HOUSING (2). SECURE WITH 28 BOLTS (3) AND 28 NEW SELF-LOCKING NUTS (4). TIGHTEN BOLTS (3) USING TORQUE WRENCH WITH CROWSFOOT (REFERENCE: TB 43-0218). (NORMAL TORQUE VALUE, NOT CORRECTED FOR CROWSFOOT, IS BETWEEN 68-75 LB-IN (7.68-8.47 N.m) TORQUE.)

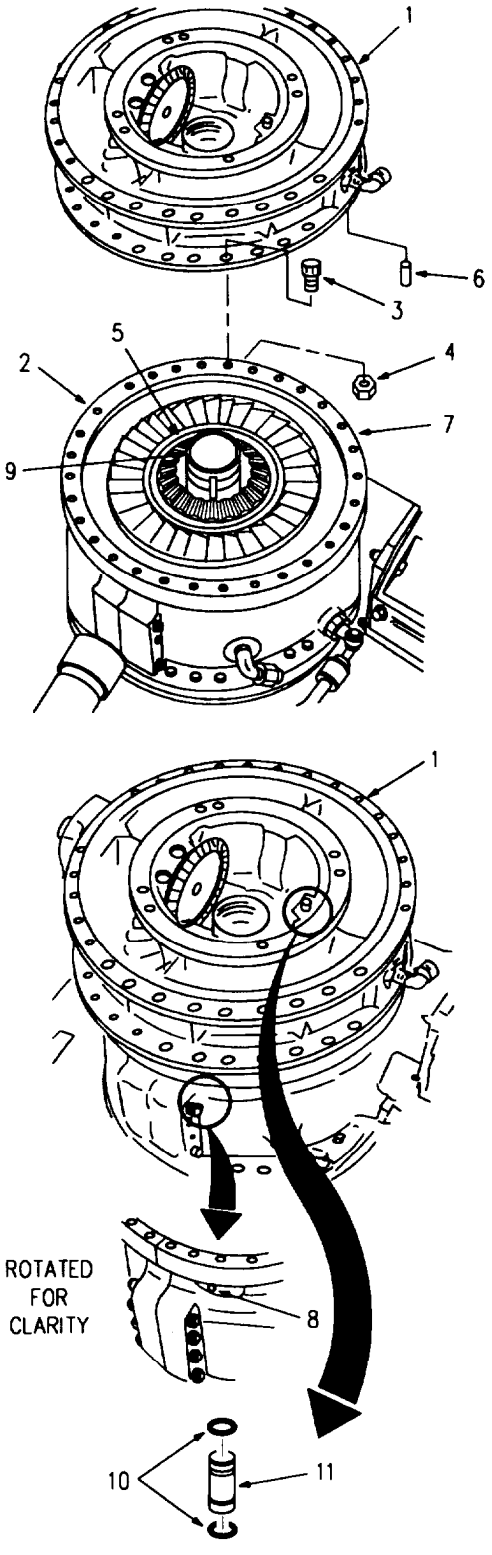
a. Lightly coat inner diameter of intermediate housing (1) with shortening compound. Carefully align slots of intermediate housing (1) with lugs on No. 3 bearing housing (5) and align spring pin (6) with hole (7) in axial compressor housing (2). Install intermediate housing (1) onto axial compressor housing (2).

b. Secure intermediate housing (1) to axial compressor housing (2) with 28 bolts (3) and 28 new self-locking nuts (4). Tighten bolts (3) using torque wrench with crowsfoot (Reference: TB 43-0218). (Normal torque value, not corrected for crowsfoot, is between 68-75 lb-in (7.88-8.47 N.m) torque.)

c. Tighten two upper bolts (8) on each side of axial compressor housing (1) between 70-95 lb-in (7.91-10.73 N.m) torque.)

d. Rotate axial compressor rotor (9) and check for rubs or unusual noises. No rubs or unusual noises allowed.

13. LIGHTLY LUBRICATE TWO NEW PREFORMED PACKINGS (10) WITH SHORTENING COMPOUND AND INSTALL ONTO TRANSFER TUBE (11). INSTALL TRANSFER TUBE (11) INTO INTERMEDIATE HOUSING (1).



LE5580

Go on to Sheet 35

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL)
(Sheet 35 of 49)

14. INSTALL NEW PLAIN ENCASED SEAL (1) INTO NO. 2 BEARING SEAL HOUSING (2) USING SLEEVE (3) AND ARBOR PRESS.

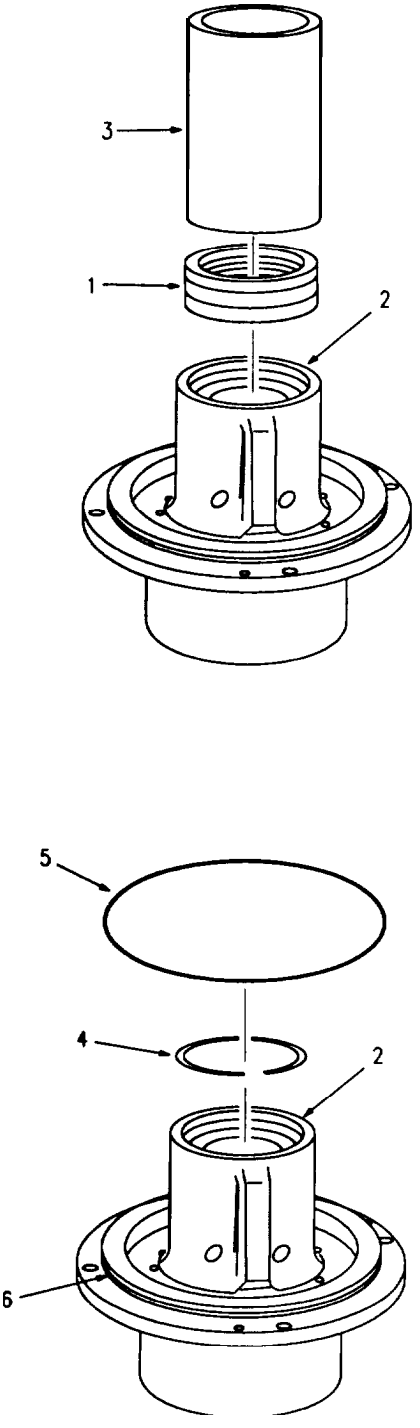
CAUTION

Make sure all screws in plain encased seal (1) are covered when retaining ring (4) is installed.

15. INSTALL RETAINING RING (4) INTO GROOVE OF NO. 2 BEARING SEAL HOUSING (2) TO SECURE PLAIN ENCASED SEAL (1).

16. INSTALL NEW PREFORMED PACKING (5) ONTO NO. 2 BEARING SEAL HOUSING (2).

a. Lubricate new preformed packing (5) with shortening compound and install into groove (6) of No. 2 bearing seal housing (2).



LE5581

Go on to Sheet 36

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 36 of 49)

CAUTION

Use extreme caution when sliding plain encased seal (1) over axial compressor rotor shaft (2). Damage to parts may result.

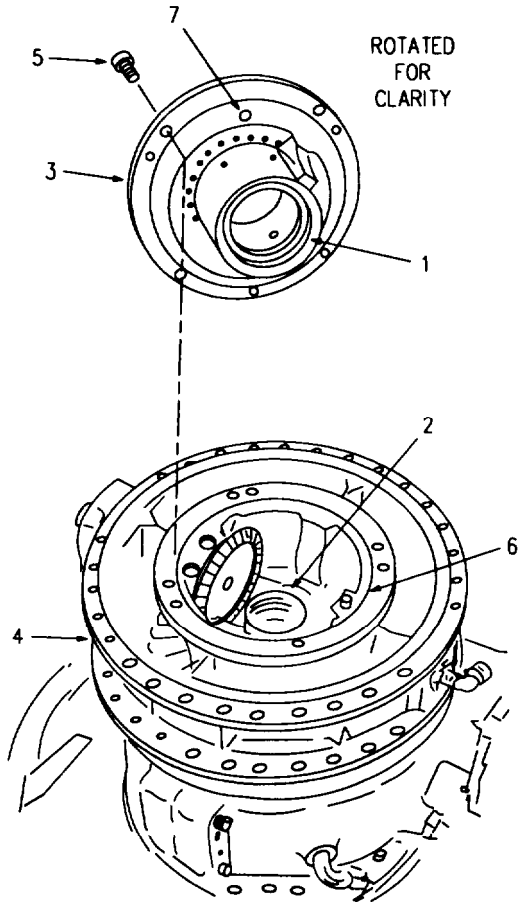
17. LUBRICATE PLAIN ENCASED SEAL (1) WITH LUBRICATING OIL AND INSTALL NO. 2 BEARING SEAL HOUSING (3) ONTO INTERMEDIATE HOUSING (4). SECURE WITH FOUR BOLTS (5). TIGHTEN BOLTS (5) BETWEEN 75-95 LB-IN (6-11 N.M) TORQUE. SAFETY WIRE BOLTS (5).

a. Lubricate plain encased seal (1) with lubricating oil.

b. Align oil transfer tube (6) with hole (7) in bottom of No. 2 bearing seal housing (3).

c. Carefully lower No. 2 bearing seal housing (3) over axial compressor rotor shaft (2) and onto intermediate housing (4). Apply an even downward pressure to seat No. 2 bearing seal housing (3) onto intermediate housing (4).

d. Apply antiseize compound to four bolts (5). Install bolts (5) and tighten evenly and opposite each other between 70-95 lb in (8-11 N.m) torque. Safety wire bolts (5) using single wire method.



LE5582

Go on to Sheet 37

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 37 of 49)

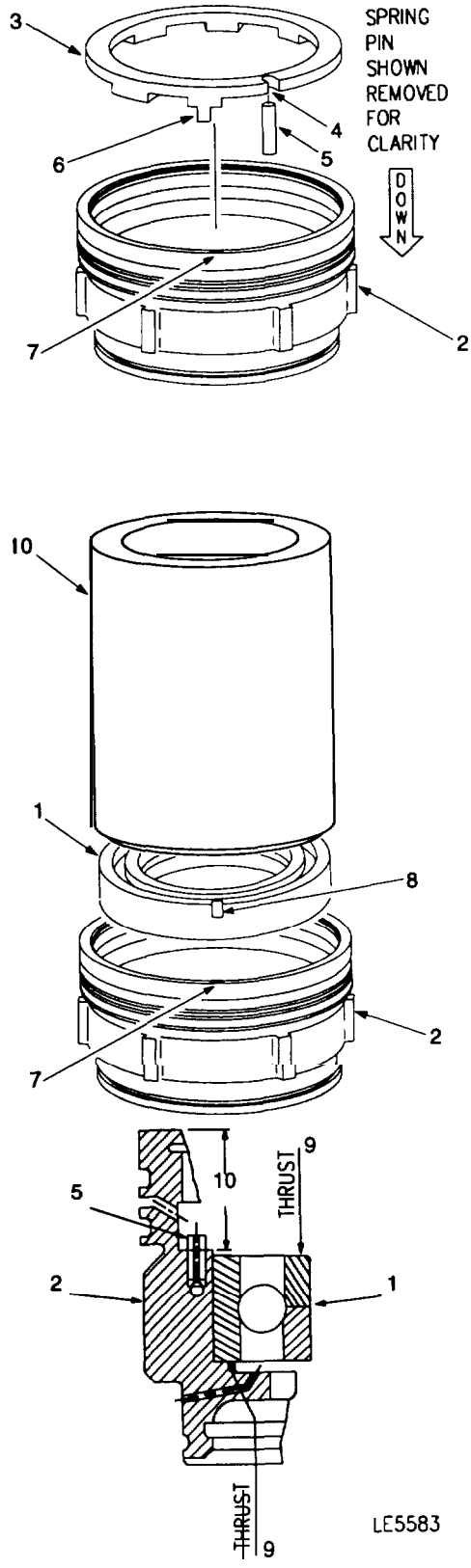
18. INSTALL BEARING (1) INTO NO. 2 BEARING HOUSING (2).

a. Install spacer (3) with slot (4) in line with spring pin (5), and tang (6) facing down, into No. 2 bearing housing (2).

b. Using suitable marker pencil, place a mark (7) on No. 2 bearing housing (2) relative to position of spacer tang (8). Remove spacer (3).

c. Lubricate inside diameter of No. 2 bearing housing (2) with shortening compound.

d. Install bearing (1) into No. 2 bearing housing (2) with bearing slot (8) in line with mark (7) on No. 3 bearing housing (2). Check bearing thrust marks (9) are at proper position in No. 2 bearing housing (2). Using installer tool (10), press bearing (1) into No. 2 bearing housing (2).



Go on to Sheet 38

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 38 of 49)

19. INSTALL RING SPACER (1) INTO NO. 2 BEARING HOUSING (2).

a. Align slot (3) of ring spacer (1) with spring pin (4) in No. 2 bearing housing (2).

NOTE

Tang (5) of ring spacer (1) should be aligned with slot (6) in bearing (7) outer race.

b. Install ring spacer (1) into No. 2 bearing housing (2).

20. USING PUSHER TOOL (8) AND ARBOR PRESS, INSTALL RING SPACER (9) AND PACKING RETAINER (10) INTO NO. 2 BEARING HOUSING (2).

a. Lightly lubricate seal contact side of ring spacer (9) with lubricating oil. Install ring spacer (9), with small diameter down, onto bearing (7) inner race.

b. Lightly lubricate face seal of packing retainer (10) with lubricating oil. Install packing retainer (10) into No. 2 bearing housing (2) with carbon element facing down.

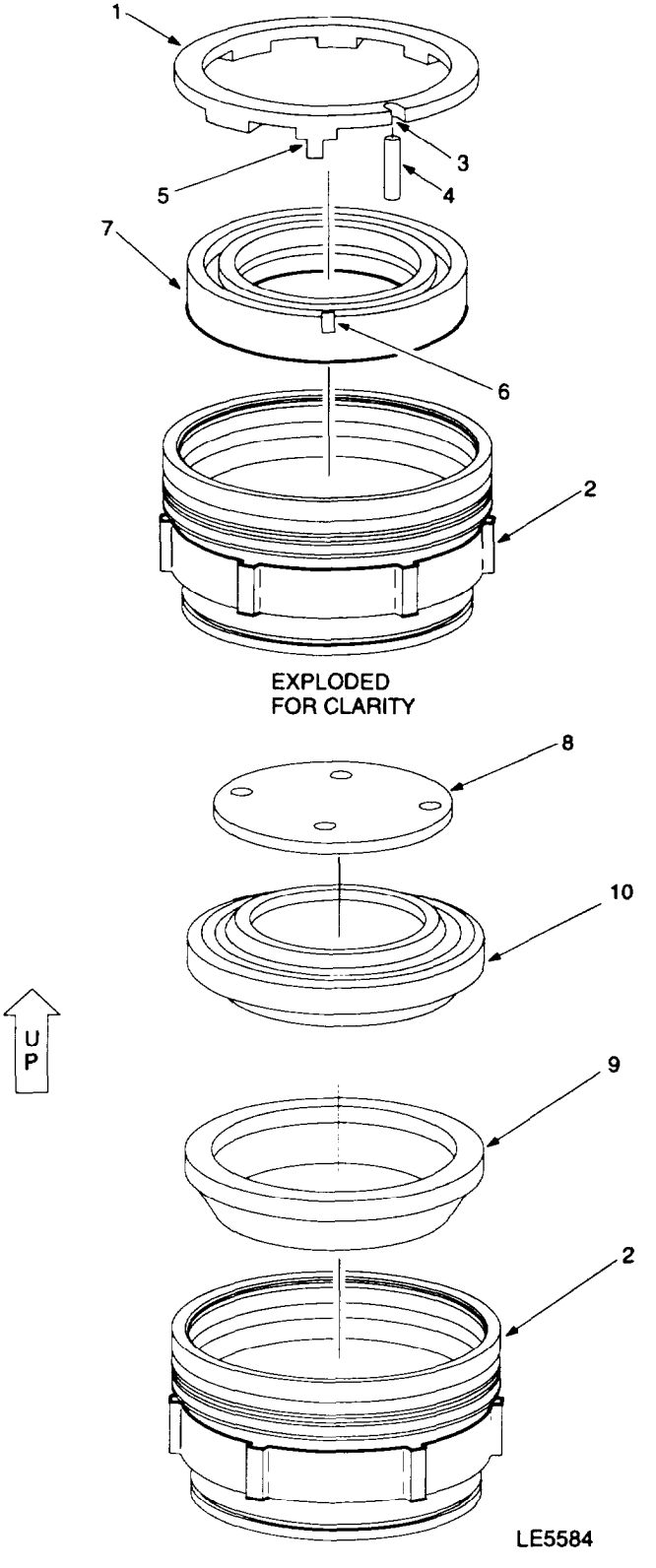
CAUTION

Press packing retainer (10) into No. 2 bearing housing (2) smoothly. Do not shock packing retainer (10). Damage to parts may result.

WARNING

Use caution when using press. Improper tools, or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

c. Using seal installer tool (8) and arbor press, press ring spacer (9) and packing retainer (10) into No. 2 bearing housing (2).



Go on to Sheet 39

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 39 of 49)

d. Using depth gage micrometer, check distance (A) from forward end (1) of No. 2 bearing seal housing (2) to top face of packing retainer (3) at two places 180 degrees apart. Dimension (A), measured at both places, shall be within 0.002 inch (0.0508 mm) of each other.

21. INSTALL RETAINING RING (4) IN NO. 2 BEARING HOUSING (2).

22. LUBRICATE NEW PREFORMED PACKINGS (5,6) WITH SHORTENING COMPOUND AND INSTALL ONTO NO. 2 BEARING HOUSING (2).

CAUTION

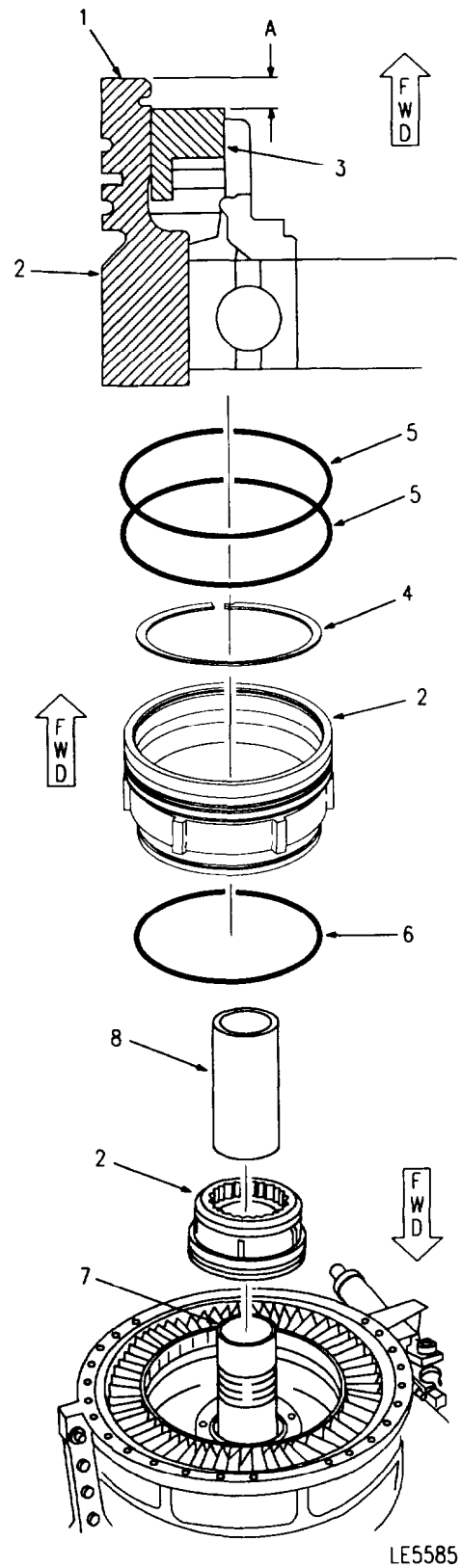
Use extreme caution during installation of No. 2 bearing housing (2) not to damage packing retainer (3).

23. INSTALL NO. 2 BEARING HOUSING (2) ONTO LOW PRESSURE COMPRESSOR ROTOR SHAFT (7) USING PUSHER SLEEVE (8).

a. Lubricate low pressure compressor rotor shaft (7) with lubricating oil.

b. Install No. 2 bearing housing (2), with seal end facing down, onto aft end of low pressure compressor rotor shaft (7).

c. Install pusher sleeve (8) against inner bearing race in No. 2 bearing housing (2) and tap sleeve (8) until No. 2 bearing housing (2) is seated.



Go on to Sheet 40

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 40 of 49)

24. INSTALL LOCKING SPACER (1) AND RETAINING RING (2) ONTO LOW PRESSURE COMPRESSOR ROTOR SHAFT (3).

a. Apply shortening compound to low pressure compressor rotor shaft (3) and place pin (4) onto shaft (3).

CAUTION

Make sure pin (4) is not dislodged during installation of locking spacer (1). Damage to parts may result.

b. Install locking spacer (1) onto low pressure compressor rotor shaft (3).

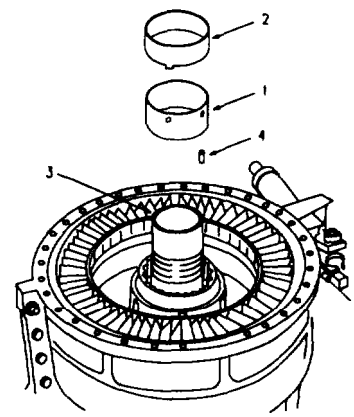
NOTE

Holes in locking spacer (1) should be up.

c. Try rotating locking spacer (1) in place. If locking spacer (1) rotates, remove and reinstall until locked in place.

d. Install retaining ring (2). with tangs down, onto low pressure compressor rotor shaft (3).

e. Align tangs of retaining ring (2) with holes of locking spacer (1). Bend tangs into holes at three locations.



LE5586

Go on to Sheet 41

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 41 of 49)

25. INSTALL PLAIN ROUND NUT (1) ONTO LOW PRESSURE COMPRESSOR ROTOR SHAFT (2) AND TIGHTEN BETWEEN 150-175 LB-FT (203-237 N.M) TORQUE.

a. Coat threads of plain round nut (1) with a paste consisting of dry molykote type “z” and lubricating oil.

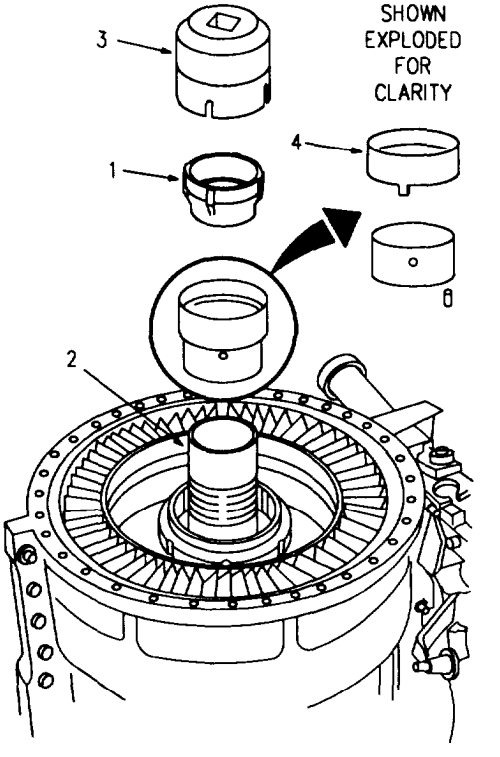
b. Install plain round nut (1), with threads down and lugs up, onto low pressure compressor rotor shaft (2).

c. Using spanner wrench (3), tighten plain round nut (1) between 150-175 lb-ft (203-237 N.m) torque.

CAUTION

Do not shear retaining ring (4) during dimple procedure. If cracks develop, replace retaining ring (4) and repeat step d.

d. Using brass drift or suitable crimping tool, dimple retaining ring (4) into plain round nut (1) at two locations equally spaced.



LE5587

Go on to Sheet 42

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 42 of 49)

26. INSTALL LIFTING SLING (1) ONTO INLET HOUSING (2).

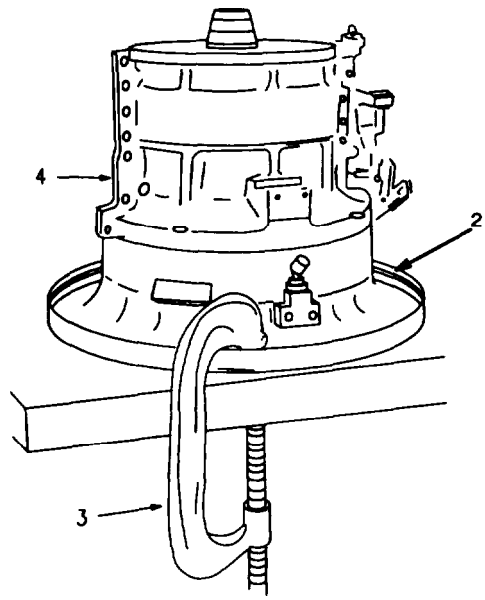
a. Remove c-clamp (3). Place inlet housing/low pressure compressor assembly (4) horizontally onto work surface.

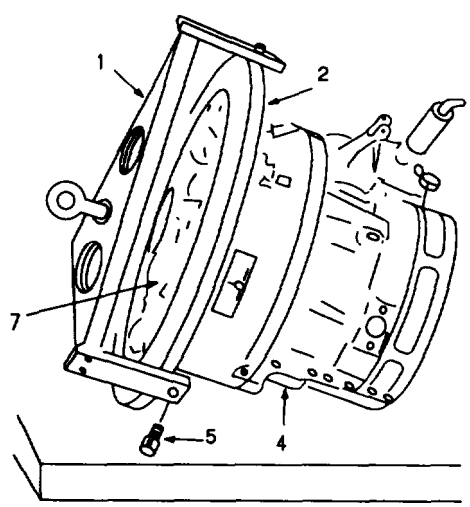
CAUTION

When inlet housing (2) is facing up, make sure debris or any objects do not fall into low pressure compressor (4). Damage to components may result.

b. Install lifting sling (1) onto inlet housing (2). Secure with three bolts (5). Secure bolts (5) with nuts.

27. ATTACH HOIST TO LIFTING SLING (1). RAISE INLET HOUSING/LOW PRESSURE COMPRESSOR ASSEMBLY (4).





LE5588

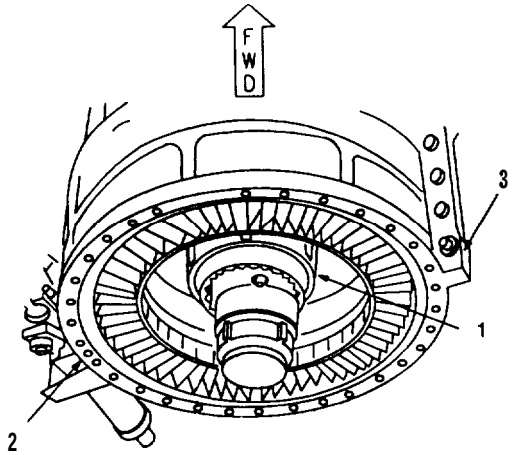
Go on to Sheet 43

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 43 of 49)

NOTE

Be careful not to disturb the position of the No. 2 bearing housing (1) once it has been alined.

28. ROTATE THE NO. 2 BEARING HOUSING (1) BY HAND UNTIL TWO TANGS ON NO. 2 BEARING HOUSING (1) ALINE WITH COMPRESSOR HOUSING (2) SPLIT LINE (3) 180 DEGREES APART.



Go on to Sheet 44

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 44 of 49)

CAUTION

Do not rock or bang low pressure compressor assembly (1) during installation. Damage to the carbon elements of the intershaft seal in the intermediate housing (2) will occur.

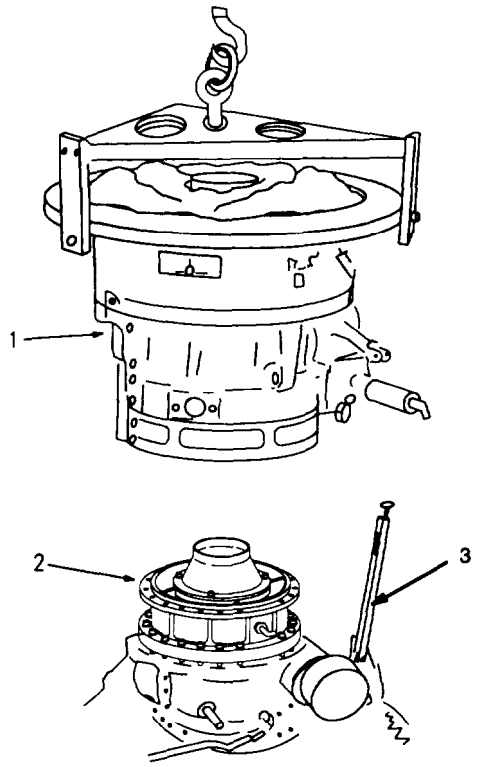
29. CAREFULLY LOWER LOW PRESSURE COMPRESSOR ASSEMBLY (1) ONTO INTERMEDIATE HOUSING (2).

NOTE

If low pressure compressor housing (1) does not mate with intermediate housing (2), slowly raise and turn low pressure compressor assembly (1) slightly until mating is achieved. If mating is still not achieved, raise compressor assembly (1) and check No. 2 bearing housing tang alignment with split line on compressor case. Realign if necessary.

NOTE

Make sure bleed valve rod (3) is positioned up.



LE5590

Go on to Sheet 45

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 45 of 49)

30. SECURE LOW PRESSURE COMPRESSOR HOUSING (1) TO INTERMEDIATE HOUSING (2) WITH 28 BOLTS (3). TIGHTEN BOLTS (3) USING TORQUEMETER WITH CROWSFOOT (TB 43-0218). (NORMAL TORQUE VALUE, NOT CORRECTED FOR CROWSFOOT, IS BETWEEN 88-75 LB-IN (7.88-8.47 NM) TORQUE.)

a. Apply antiseize compound to 28 bolts (3).

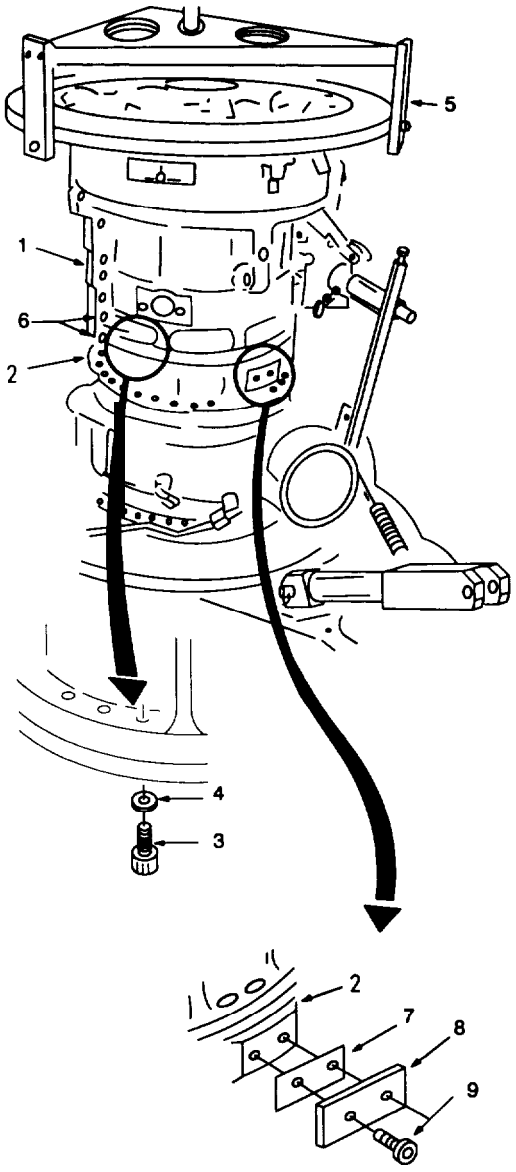
b. Secure low pressure compressor housing (1) to intermediate housing (2) with 28 bolts (3) and 28 new lockwashers (4).

c. Tighten bolts (3) using torque adapter with crowsfoot (TB 43-0218). (Normal torque value, not corrected for crowsfoot, is between 68-75 lb-in (7.68-8.47 N.m) torque.)

d. Remove lifting sling (5).

31. TIGHTEN LOWER TWO BOLTS (6), ON EACH SIDE OF LOW PRESSURE COMPRESSOR HOUSING (1) SPLIT LINE, BETWEEN 70-95 LB-IN (7.90-10.73 N.M) TORQUE.

32. INSTALL TWO NEW GASKETS (7) AND MOUNTING PLATES (8) AT TWO PLACES ON INTERMEDIATE HOUSING (2) USING FOUR BOLTS (9). TIGHTEN BOLTS (9) TO 45 LB-IN (5.08 N.M) TORQUE.



LE5591

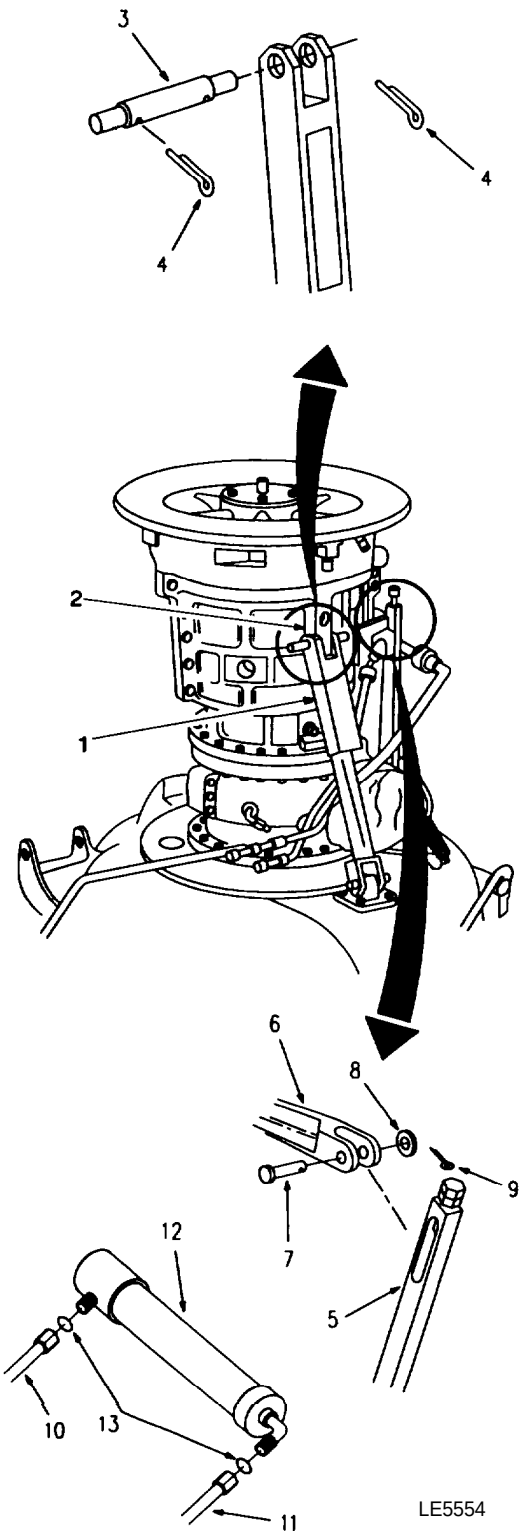
Go on to Sheet 46

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 46 of 49)

33. SWING STRUCTURAL SUPPORT (1) ONTO LOW PRESSURE COMPRESSOR BOSS (2) AND INSTALL SHOULDER PIN (3) AND COTTER PINS (4).

34. CONNECT BLEED VALVE ROD (5) TO CONTROL LEVER (6) WITH PIN (7), WASHER (8) AND NEW COTTER PIN (9).

35. CONNECT IGV ACTUATOR FUEL TUBES (10, 11) TO ACTUATING CYLINDER (12). USE NEW SEALS (13).



Go on to Sheet 47

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 47 of 49)

CAUTION

Make sure clean rags (1) are in inlet housing (2) to prevent debris or any objects from falling into the low pressure compressor (3).

36. REMOVE SIX BOLTS (4) AND HOLDING FIXTURE (5) FROM INLET HOUSING (2).

37. INSTALL TWO NEW PREFORMED PACKINGS (6) ONTO POSITION NO. 1 BEARING HOUSING (7). LUBRICATE PACKINGS (6) WITH SHORTENING COMPOUND.

38. INSTALL SPACER RING (8) AND BEARING HOUSING (7) ONTO INLET HOUSING (2).

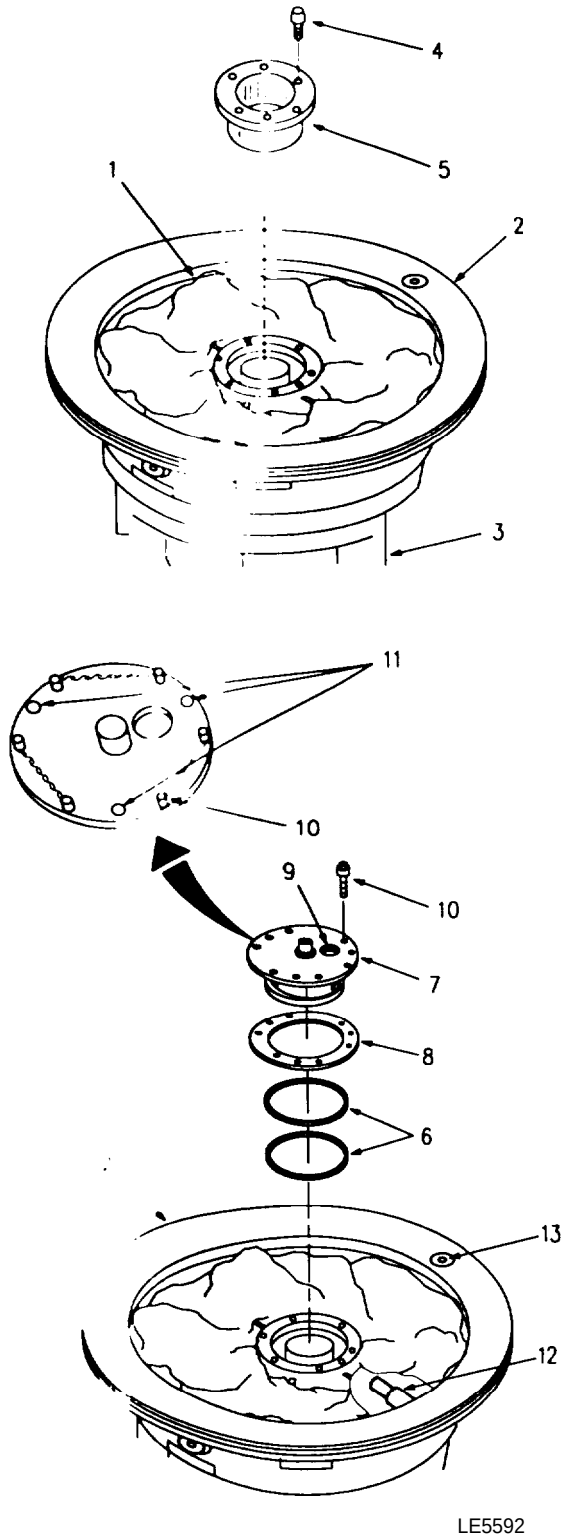
a. Install original spacer ring (8) onto bearing housing (7) and align all holes.

NOTE

Low pressure compressor speed pickup hole (9) in bearing housing (7) is identified for reference only.

b. Align low pressure compressor speed pickup hole (9) with inlet housing vane (strut) located between T-1 sensor (12) and air splitter hole (13) and install bearing housing (7) onto inlet housing (2). Secure with six bolts (10) tightened between 40-45 lb-in (4.52-5.08 N.m) torque in a staggered sequence.

c. Safety wire six bolts (10) making sure not to run safety wire over three access cover bolt holes (11). Use double twist method.



LE5592

Go on to Sheet 48

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL)
(Sheet 48 of 49)

39. APPLY SHORTENING COMPOUND TO PREFORMED PACKING (1) AND INSTALL INTO GROOVE OF BEARING HOUSING LOW PRESSURE COMPRESSOR SPEED PICKUP HOLE (2).

40. INSTALL ACCESS COVER PLATE (3) AND SECURE WITH THREE BOLTS (4) COATED WITH ANTI-SEIZE COMPOUND. TIGHTEN BOLTS (4) BETWEEN 40-45 LB-IN (4.52-5.08 N.M) TORQUE. SAFETY WIRE BOLTS (4) USING SINGLE WIRE METHOD. REMOVE RAGS FROM INLET

41. PERFORM A ROTATION CHECK OF LOW PRESSURE AND HIGH PRESSURE ASSEMBLIES TO ENSURE PROPER INSTALLATION.

WARNING

Compressor blades are sharp and can cut you. Be careful not to pinch fingers between blades and vanes when turning compressor.

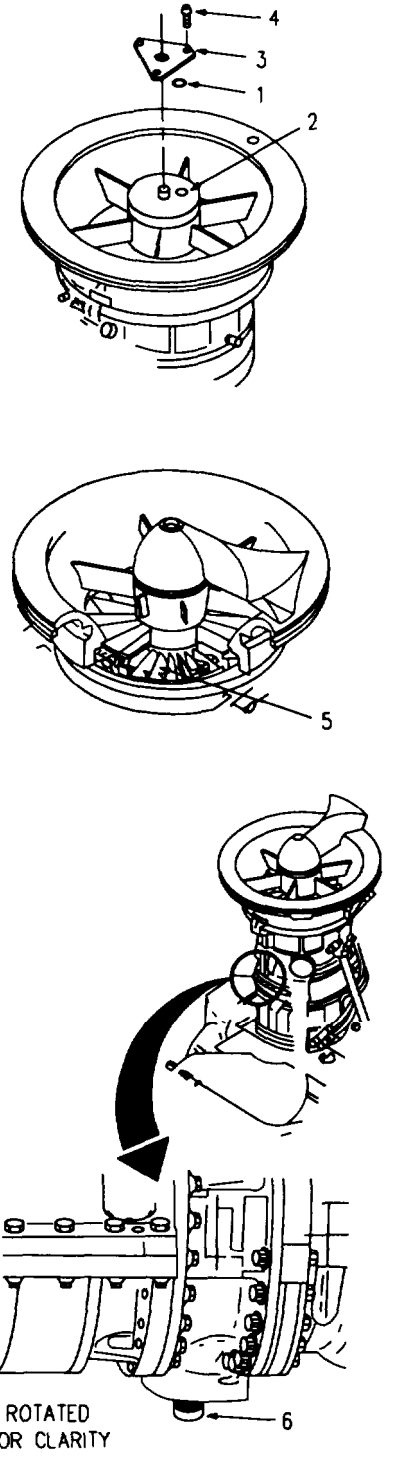
a. Turn low pressure compressor blades (5) by hand. Listen and feel for rubbing or binding.

b. Turn high pressure compressor blades by turning splined coupling (6) in both directions. Listen and feel for rubbing or binding.

NOTE

If any of these conditions exist, repeat this procedure as required to locate and correct problem.

42. INSTALL INLET AIR SPLITTER ASSEMBLY (TM20-1).



LE5593

Go on to Sheet 49

NO. 2 AND 3 BEARING SEAL/PACKING RETAINER REPLACEMENT (INCLUDING INTERSHAFT SEAL) (Sheet 49 of 49)

43. USING HOISTS AND LIFTING SLING (1), RAISE FORWARD ENGINE MODULE (2) FROM WOOD BLOCKS (3,4) ON FLOOR.

a. Attach chain fall hoist hook (5) to shackle (6) and take up slack.

b. Attach hook (7) of lifting sling (1) to pin (9) and take up slack.

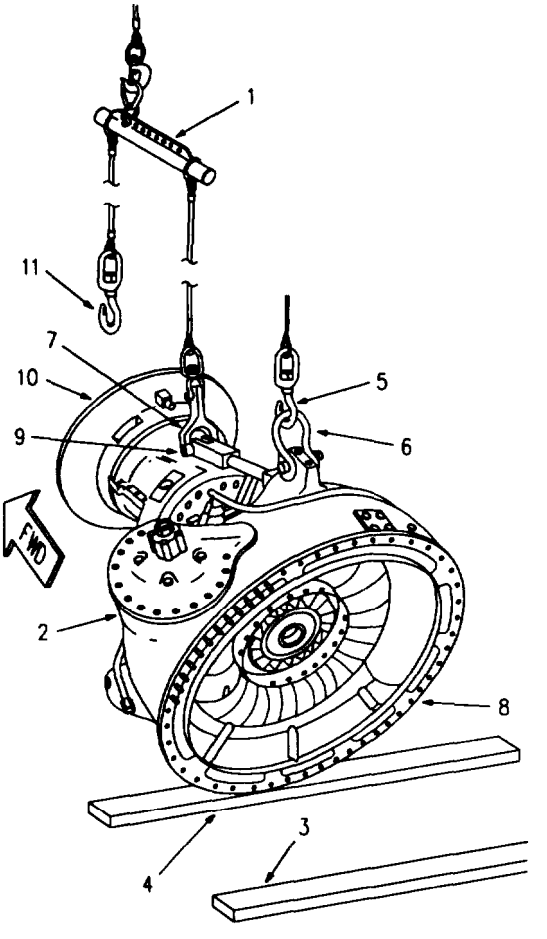
c. Slowly raise aft end (8) from wood block (3), but not from wood block (4), while simultaneously lowering forward end (10).

d. Continue raising aft end (8) until forward engine module (2) is tilted enough to allow replacing hoist hook (5) with sling hook (11) at shackle (6).

e. Remove hoist hook (5) from shackle (6) and connect sling hook (11) to shackle (6).

f. Raise forward engine module (2) to horizontal position.

44. INSTALL FORWARD MODULE (PAGE 5-13).



LE5594

End of Task

NO. 12 BEARING AND SPLINED COUPLING REPLACEMENT (Sheet 1 of 7)

TOOLS:

General mechanic's tool kit: automotive (SC 5180-90-N26)
Arbor press (Item 37, Appendix D)
Crimping tool (item 175, Appendix D)
Driver (Item 176, Appendix D)
Holding fixture (Item 177, Appendix D)
Puller (Item 180, Appendix D)
Rubber Mallet (Item 26, Appendix D)
Sleeve set (Item 162, Appendix D)
Vise, machinist's (Item 55, Appendix D)
Wrench (Item 181, Appendix D)
Wrench (Item 182, Appendix D)
Wrench, torque, 0-600 in-lb (Item 17, Appendix D)

PERSONNEL: Two

SUPPLIES:

Dry Cleaning Solvent (Item 7, Appendix B)
Key washer (Item 189, Appendix E)
Locking cup (Item 190, Appendix E)
Lubricating oil (Item 11 ,12, Appendix B)
Spring pin (Item 191, Appendix E)

EQUIPMENT CONDITION:

Accessory gearbox module removed from engine (PAGE 7-6)

Go on to Sheet 2

NO. 12 BEARING AND SPLINED COUPLING REPLACEMENT (Sheet 2 of 7)

REMOVAL:

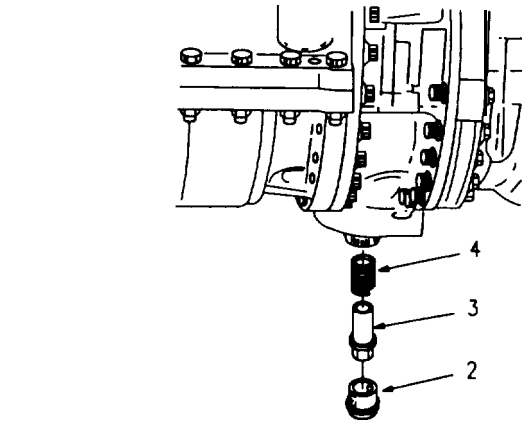
1. REMOVE SPRING PIN (1), DUST CAP (2), SPRING RETAINER (3), AND SPRING (4).

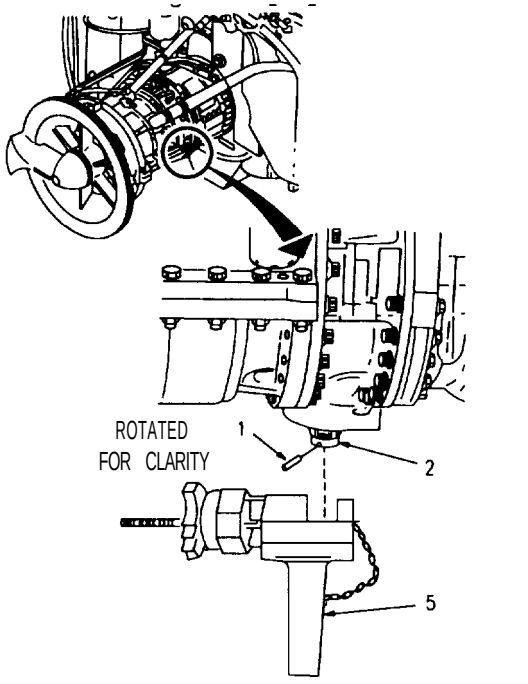
NOTE

Use care not to loose spring pin (1) during removal.

a. Using driver (5), remove spring pin (1).

b. Remove dust cap (2), spring retainer (3) and spring (4).





LE5522

Go on to Sheet 3

NO. 12 BEARING AND SPLINED COUPLING REPLACEMENT (Sheet 3 of 7)

2. REMOVE NUT (1) AND KEY WASHER (2). REMOVE BEARING AND COUPLING PACKAGE (3).

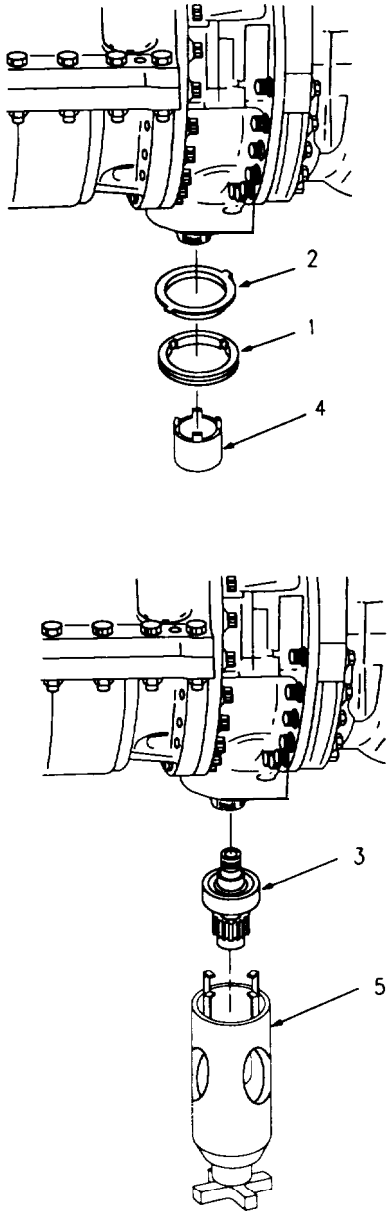
a. Uncrimp key washer (2). Using wrench (4), remove nut (1) and key washer (2).

b. Using puller (5), remove bearing and coupling package (3).

NOTE

The bevel gearshaft is located up inside the intermediate housing where the No. 12 bearing and splined coupling was removed from. To inspect, shine lignt directly up into the No. 12 bearing and splined coupling bore. If any of the conditions described below exist, the forward engine module is not repairable at DS level of maintenance. Reassemble forward engine module with original hardware and replace forward engine module (Page 5-13).

3. USING A FLASHLIGHT INSPECT BEVEL GEARSHAFT FOR SPLINE DAMAGE, SHEARED GEARSHAFT OR EXCESSIVE SPLINE WEAR.



LE5523

Go on to Sheet 4

NO. 12 BEARING AND SPLINED COUPLING REPLACEMENT (Sheet 4 of 7)

WARNING

Use caution when using press. Improper tools or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

NOTE

If inner race of No. 12 bearing comes apart during removal or installation, No. 12 bearing shall be replaced.

4. REMOVE NUT (1) AND LOCKING CUP (2). REMOVE NO. 12 BEARING (3) FROM SPLINED COUPLING (4).

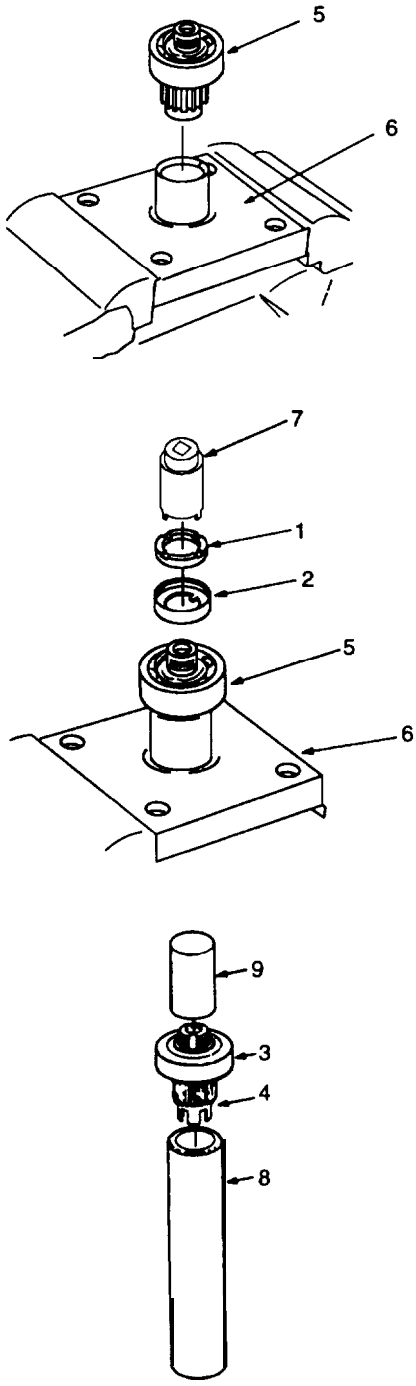
a. Place bearing and coupling package (5) in holding fixture (6).

b. Uncrimp locking cup (2). Using wrench (7), remove nut (1) and locking cup (2).

c. Remove bearing and coupling package (5) from holding fixture (6).

d. Using removal and installation tool (8) arbor press aid (9) and an arbor press, press No. 12 bearing (3) from splined coupling (4).

5. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.



LE5524

Go on to Sheet 5

NO. 12 BEARING AND SPLINED COUPLING REPLACEMENT (Sheet 5 of 7)

INSTALLATION:

WARNING

Use caution when using arbor press. Improper tools or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

CAUTION

All bearings that are not vacuum packed must be cleaned to prevent damage to parts. Work bench and tools shall be washed down with solvent prior to assembly.

NOTE

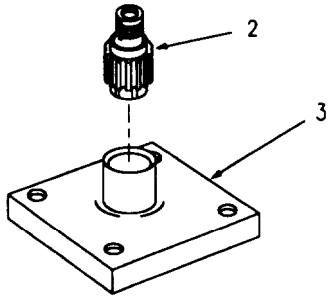
If inner race of No. 12 bearing comes apart during removal or installation, No. 12 bearing shall be replaced.

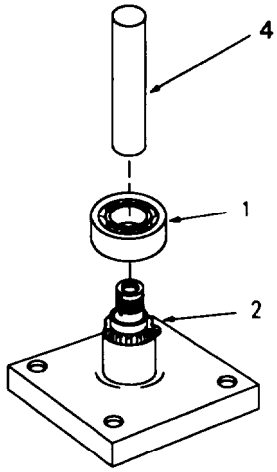
1. COAT NO. 12 BEARING (1) AND SPLINED COUPLING (2) WITH CLEAN LUBRICATING OIL. PRESS NO. 12 BEARING, THRUST MARK DOWN, ON SPLINED COUPLING (2).

a. Place splined coupling (2) in holding fixture (3) and place on arbor press.

b. Coat inner race of No. 12 bearing (1) and journal of splined coupling (2) with clean lubricating oil, and position No. 12 bearing (1) thrust mark down, on splined coupling (2).

c. Using installation and removal tool (4), press No. 12 bearing (1) on splined coupling (2).





LE5525

Go on to Sheet 6

NO. 12 BEARING AND SPLINED COUPLING REPLACEMENT (Sheet 6 of 7)

2. INSTALL NEW LOCKING CUP (1) AND NUT (2). TIGHTEN NUT (2) BETWEEN 230-250 LB-IN (25-28 N•M) TORQUE. BEND LOCKING CUP (1) INTO NUT (2) IN TWO PLACES. DO NOT SHEAR LOCKING CUP

a. Secure holding fixture (3) in vise or on work surface. Place splined coupling (4), with No. 12 bearing (5) installed, in holding fixture (3).

b. Install new locking cup (1) and nut (2). Using wrench (6) tighten nut (2) between 230-250 lb-in (25-28 N•m) torque. Bend locking cup (1) into nut (2) in two places. Replace locking cup (1) if it shears or cracks.

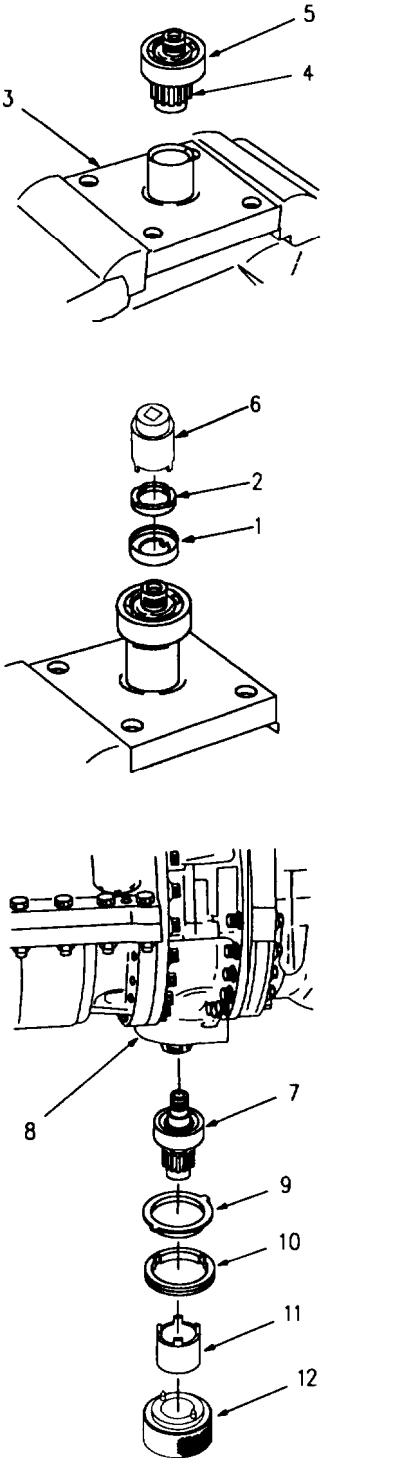
NOTE

It may be necessary to tap bearing and coupling package with rubber mallet to seat.

3. INSTALL BEARING AND COUPLING PACKAGE (7) IN INTERMEDIATE HOUSING (8) AND INSTALL NEW KEY WASHER (9) AND NUT (10). TIGHTEN NUT (10) BETWEEN 380-400 LB-IN (43-45 N•M) TORQUE. BEND KEY WASHER (9) INTO NUT (10) IN TWO PLACES. DO NOT SHEAR KEY WASHER.

a. Install bearing and coupling package (7) in intermediate housing (8). Tap with rubber hammer if necessary to seat. Install new key washer (9) and nut (10).

b. Using wrench (11), tighten nut (10) between 380-400 lb-in (43-45 N•m) torque. Mark housing (8) to align crimping tool (12) with slots of nut. Using crimping tool (12), crimp key washer (9) into nut (10) in two places. Replace key washer (9) if it shears or cracks.



LE5526

Go on to Sheet 7

NO. 12 BEARING AND SPLINED COUPLING REPLACEMENT (Sheet 7 of 7)

4. INSTALL SPRING (1) SPRING RETAINER (2) DUST CAP (3) AND SPRING PIN (4) IN SPLINED COUPLING (5).

CAUTION

Do not screw spring retainer (2) in beyond end of splined coupling (5) and then unscrew to set flushness. Damage to parts may result.

a. Install spring (1), into splined coupling (5). Screw spring retainer (2) into coupling (5) until end of retainer (2) is just flush with end of coupling (5); then line up slot (6) in retainer (2) with closest hole (7) in coupling (5).

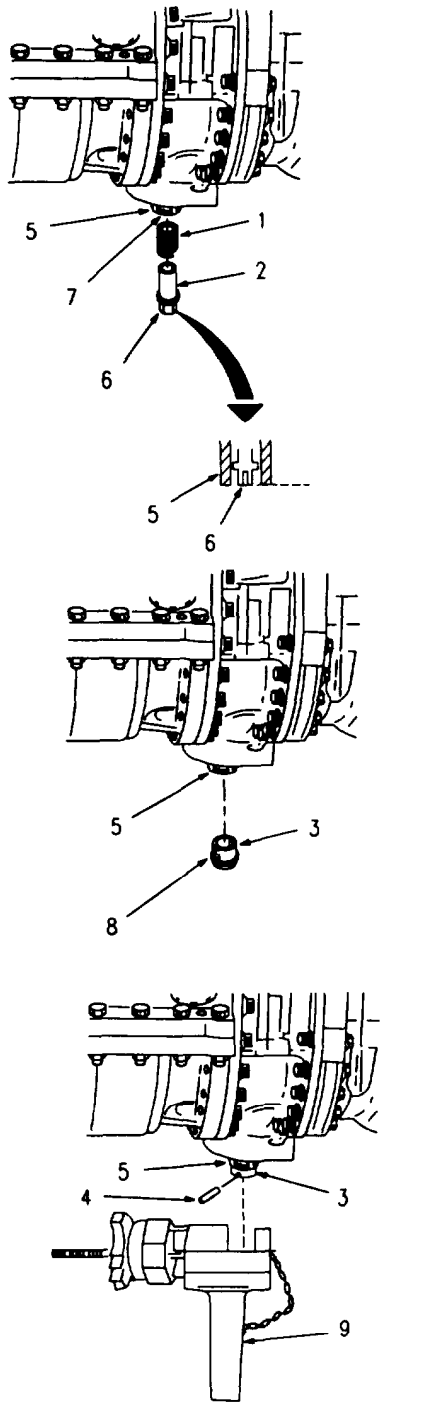
b. Line up holes (8) in dust cap (3) with holes in coupling (5), and install dust cap (3).

CAUTION

Spring pin must be installed so that both ends of pin do not stick out into coupling splines to prevent damage to parts.

c. Using driver (9). put spring pin (4) into driver (9), then install pin (4) into hole in coupling (5) and dust cap (3), so that both ends of pin (4) are within splines.

5. INSTALL ACCESSORY GEARBOX MODULE ON ENGINE (PAGE 7-12).



LE5527

End of Task

CHAPTER 6

REAR ENGINE MODULE MAINTENANCE

CHAPTER INDEX

SPLINED SHAFT REPLACEMENT (Sheet 1 of 2)

TOOLS:

General mechanic's tool kit: automotive (SC5180-90-N26)
Extension, 3/8-inch drive, 6-inch (Item 8, Appendix D)
Ratchet handle, 3/8-inch drive (Item 9, Appendix D)
Socket, 3/8-inch drive, 7/16-inch (Item 28, Appendix D)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES:

Antiseize compound (Item 2, Appendix B)
Preformed packing (Item 21, Appendix E)
Preformed packing (item 22, Appendix E)
Self-locking nut (Item 20, Appendix E)
Shortening compound (Item 20. Appendix B)

PERSONNEL: Two

EQUIPMENT CONDITION:

Engine disconnected from transmission (TM 34-1)

Go on to Sheet 2

SPLINED SHAFT REPLACEMENT (Sheet 2 of 2)

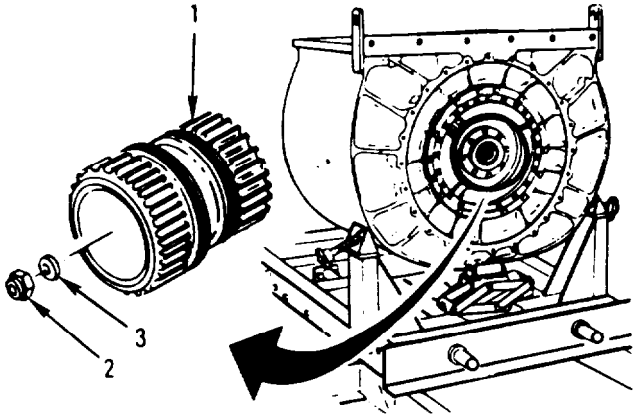
REMOVAL:

1. REMOVE SHAFT (1).

   a. Remove self-locking nut (2) and washer (3). Pull out shaft (1).

   b. Remove preformed packings (4,5) from shaft (1).

2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.



INSTALLATION:

1. INSTALL SHAFT (1) AND NEW PREFORMED PACKINGS (4, 5).

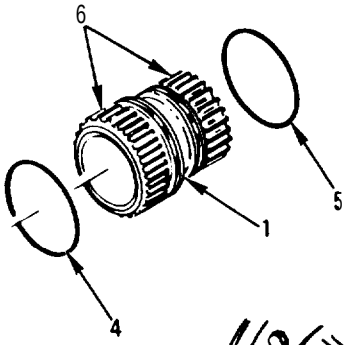
   a. Apply shortening to packings (4, 5) and install packings (4, 5) on shaft (1).

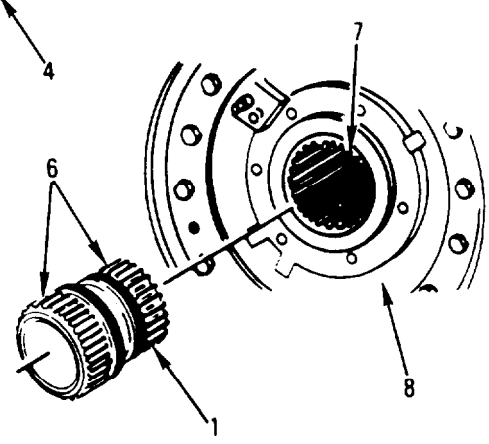
   b. Apply antiseize compound to splines (6) of shaft (1) and mating splines (7) of reduction gearbox assembly (8). Install shaft (1) in gearbox (8).

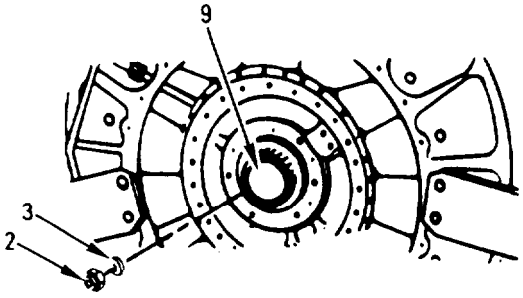
   c. Apply antiseize compound to stud (9). Install washer (3) and new nut (2).

2. HOLD SHAFT (1) TO PREVENT IT FROM TURNING AND TORQUE NUT (2) BETWEEN 25-40 LB-IN (3-5 N•m).

3. CONNECT ENGINE TO TRANSMISSION (TM 34-1).







End of Task

SPEEDOMETER ADAPTER REPLACEMENT (Sheet 1 of 1)

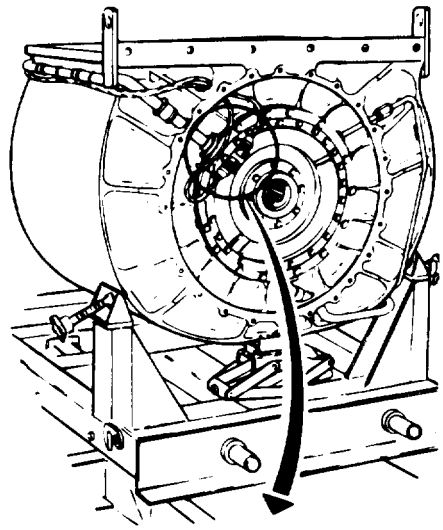
TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Extension, 3/8-inch drive, 6-inch (Item 8, Appendix D)
Ratchet handle, 3/8-inch drive (Item 9, Appendix D)
Socket, 3/8-inch drive, 7/16-inch (Item 28, Appendix D)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Gasket (Item 23, Appendix E)
Lockwasher (Item 2, Appendix E) (2 required)
Shortening compound (Item 20, Appendix B)

EQUIPMENT CONDITION: Engine disconnected from transmission (TM 34-1)

NOTE

Use this task to replace either adapter (1). One is shown.

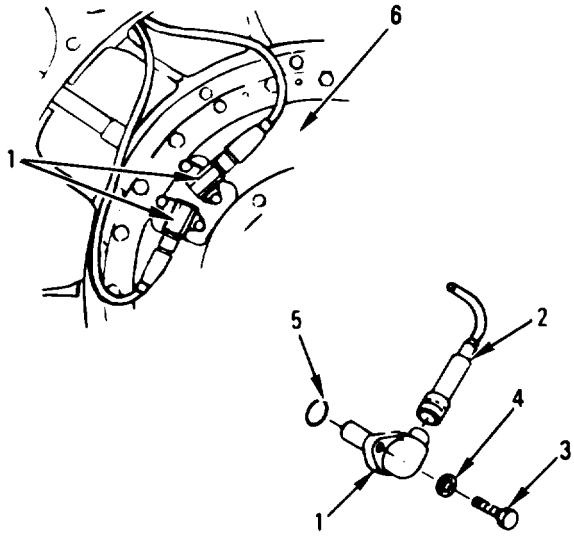


REMOVAL:

1. REMOVE ADAPTER (1).
   a. Remove connector (2) from adapter (1).
   b. Remove two screws (3) and lockwashers (4). Remove adapter (1) and gasket (5).
2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

1. INSTALL ADAPTER (1) AND NEW GASKET (5).
   a. Apply shortening to gasket (5) and install in groove on adapter (1). Put adapter (1) in reduction gearbox assembly (6).
   b. Apply antiseize compound to two screws (3) Install screws (3) and new lockwashers (4).
   c. Install connector (2).
2. TORQUE SCREWS (3) BETWEEN 100-110 LB-IN (11-12 N·m).
3. CONNECT ENGINE TO TRANSMISSION (TM 34-1).



End of Task

SPEED WIRING HARNESS REPLACEMENT (Sheet 1 of 1)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-N26)

SUPPLIES: Self-locking nut (Item 24, Appendix E) (2 required)

EQUIPMENT CONDITION: Engine disconnected from transmission (TM 34-1)

REMOVAL:

1. REMOVE HARNESS (1)

a. Remove P6 connector (2) from adapter (3) and P36 connector 4) from adapter (5).

b. Remove two harness leads (6) from hole in rear header (7).

c. Remove two screws (8) and selflocking nuts (9) from two clamps (10) and two clamps (11). Remove clamps (10) from harness (l).

d. Remove P37 connector **(12)** from harness).

2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

1. INSTALL HARNESS (1).

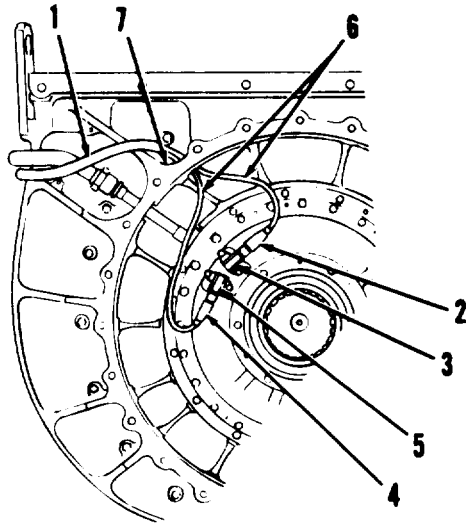
a. Guide two leads (6) through hole in header (7).

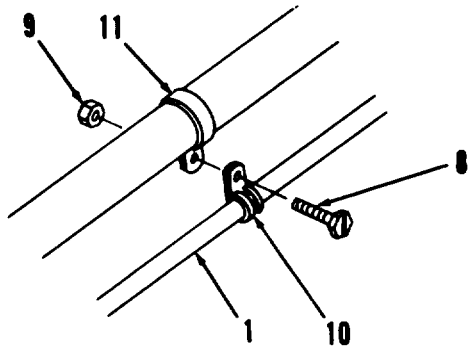
b. Install connector (2) to adapter (3) and connector (4) to adapter (5).

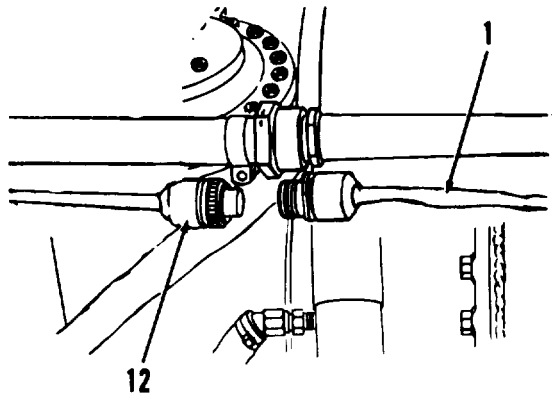
c. Install connector (12) to harness (1).

d. Put two clamps (10) on harness (1) near two clamps (11). Aline four clamps (10, 11) and install two screws (8) and new nuts (9).

2. CONNECT ENGINE ~TRANSMISSION (TM 34-l).







End of Task

All Data on page 6-5 deleted.

AIR TUBE ASSEMBLY (REDUCTION GEARBOX-SHORT) REPLACEMENT (Sheet 1 of 1)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-N26)
Open end wrench, 1-1/2 inch (Item 30, Appendix D)
SUPPLIES: Antiseize compound (item 2, Appendix B)
Flared conical seal (Item 25, Appendix E)
Gasket (Item 26, Appendix E)
Lockwasher (Item 2, Appendix E) (2 required)
Shortening compound (Item 20, Appendix B)

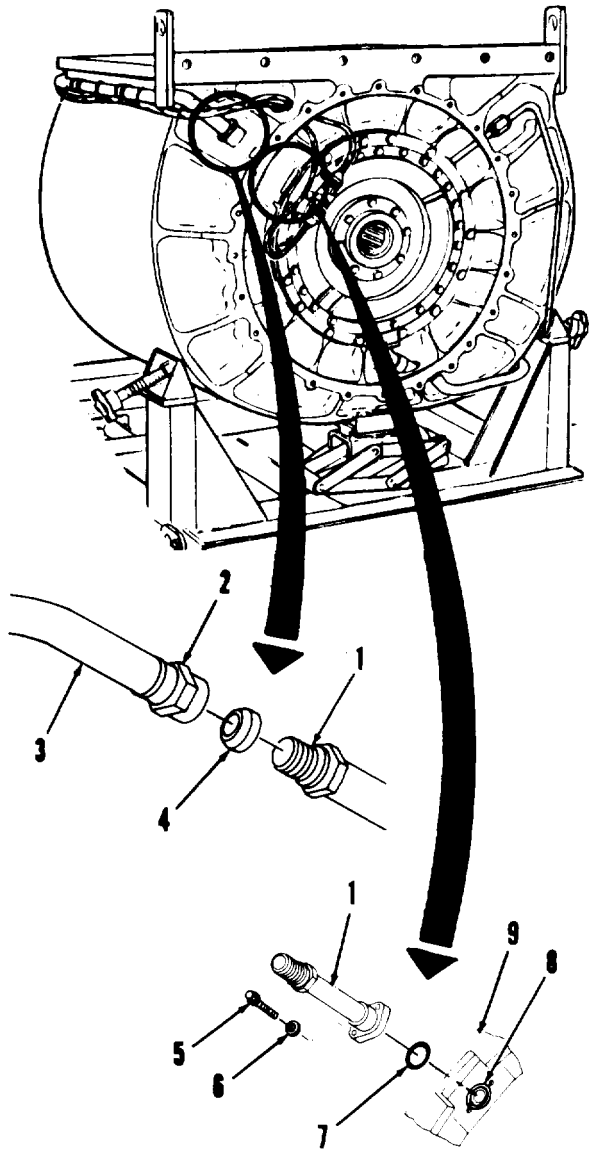
EQUIPMENT CONDITION: Engine disconnected from transmission (TM 34-1)

REMOVAL:

1. REMOVE TUBE (1).
   a. Loosen tube nut (2) and remove tube assembly (3) from tube (1). Remove flared conical seal (4).
   b. Remove two bolts (5) and lockwashers (6). Remove tube (1) and gasket (7).
2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

1. INSTALL TUBE (1) AND NEW GASKET (7).
   a. Apply shortening to gasket (7) and install in groove (8) of reduction gearbox housing (9).
   b. Apply antiseize compound to two bolts (5). Place tube (1) on housing (9). Install bolts (5) and new lockwashers (6).
   c. Install new seal (4) on tube (1). Aline tubes (1, 3) and tighten nut (2).
2. CONNECT ENGINE TO TRANSMISSION (TM 34-1).



End of Task

TUBE ASSEMBLY (REDUCTION GEARBOX FEED) REPLACEMENT (Sheet 1 of 1)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Flared conical seal (Item 25, Appendix E)
Gasket (Item 26, Appendix E)
Lockwasher (Item 2, Appendix E) (2 required)
Shortening compound (Item 20, Appendix B)

EQUIPMENT CONDITION: Engine disconnected from transmission (TM 34-1)

REMOVAL:

1. REMOVE TUBE (l).

   a. Loosen tube nut (2) and remove tube assembly (3) from tube (1). Remove flared conical seal (4).

   b. Remove two bolts (5) and lockwashers (6). Remove tube (1) and gasket (7).

2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

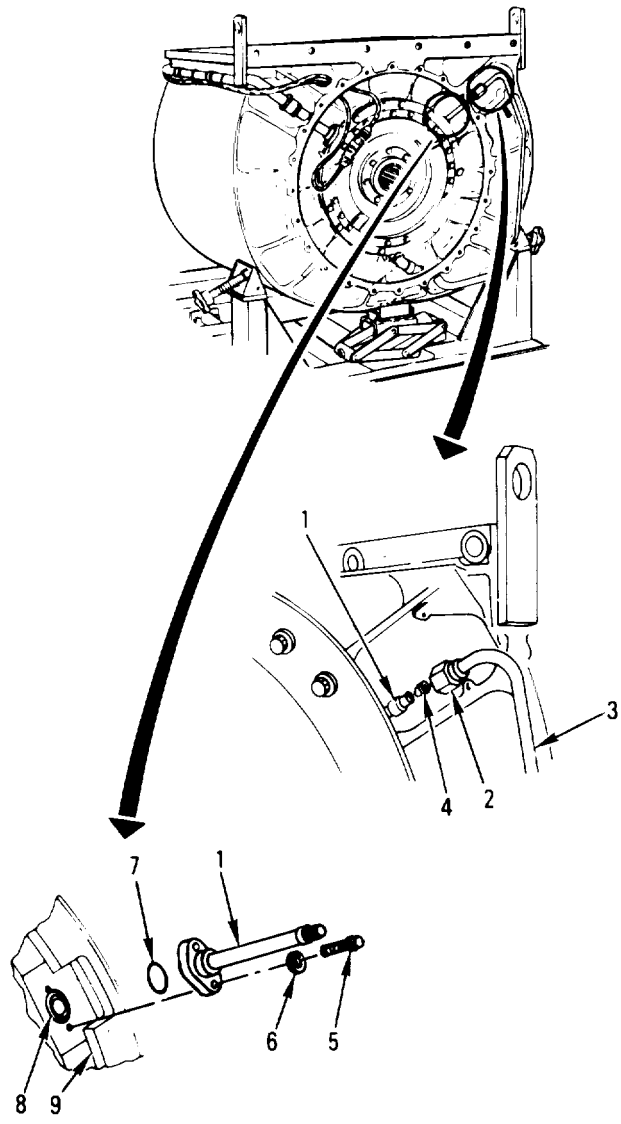
1. INSTALL TUBE (1) AND NEW GASKET (7).

   a. Apply shortening to gasket (7) and install in groove (8) of reduction gearbox housing (9).

   b. Apply antiseize compound to two bolts (5). Place tube (1) on housing (9) and install bolts (5) and new lockwashers (6).

   c. Install new seal (4) on tube (l). Aline tubes (1, 3) and tighten nut (2).

2. CONNECT ENGINE TO TRANSMISSION (TM 34-1).



TUBE ASSEMBLY (REDUCTION GEARBOX SCAVENGE - REAR) REPLACEMENT (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Conduit style slip joint pliers with plastic jaw inserts (Item 31, Appendix D)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Lockwasher (Item 29, Appendix E) (2 required)
Preformed packing (Item 28, Appendix E)
Preformed packing (Item 30, Appendix E) (2 required)
Self-locking nut (Item 24, Appendix E)
Shortening compound (Item 20, Appendix B)

PERSONNEL: Three

EQUIPMENT CONDITION: Engine disconnected from transmission (TM 34-1)
Engine/rear module lifting sling installed on engine (page 4-4)

REMOVAL:

1. DISCONNECT TUBE (l).

   a. Loosen tube fittings (2, 3) and remove tube (1) from tube assembly **(4).** Remove two preformed packings (5).

   b. Remove screw (6), self-locking nut **(7),** and clamp **(8).**

   c. Remove two bolts (9) and lockwashers (10). Move tube (1) down and remove preformed packing (11).

WARNING

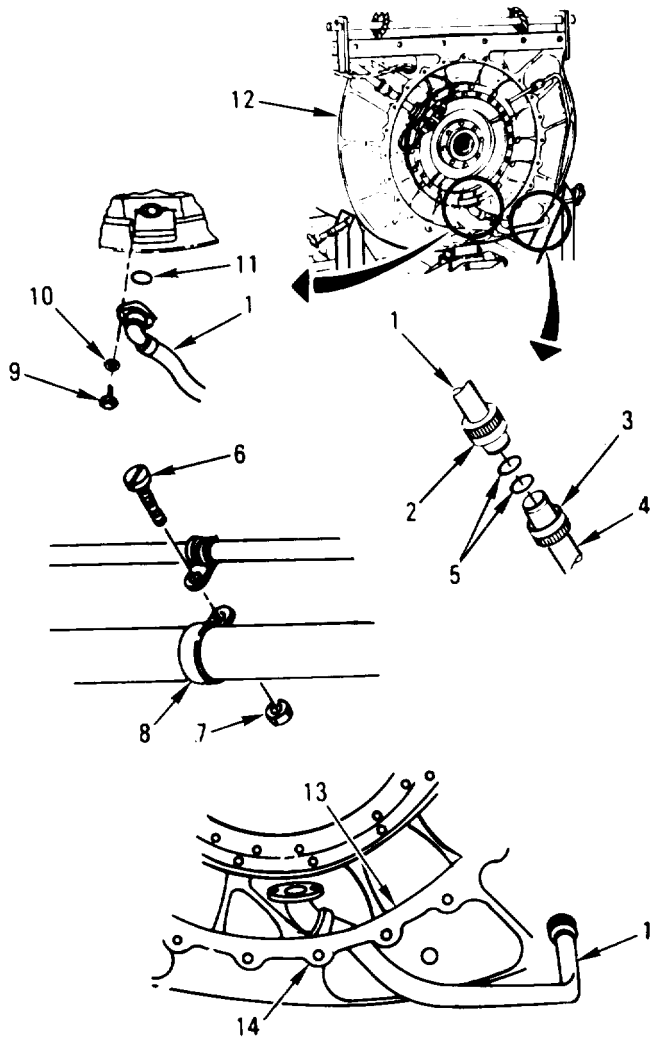
2. REMOVE TUBE (1).

   a. Lift engine (12) enough to allow tube (1) to be removed.

   b. Hold engine (12) steady and remove tube (1) through hole (13) in rear module (14).

   c. Set engine (12) on maintenance stand.

3. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.



Go on to Sheet 2

TUBE ASSEMBLY (REDUCTION GEARBOX SCAVENGE - REAR) REPLACEMENT (Sheet 2 of 2)

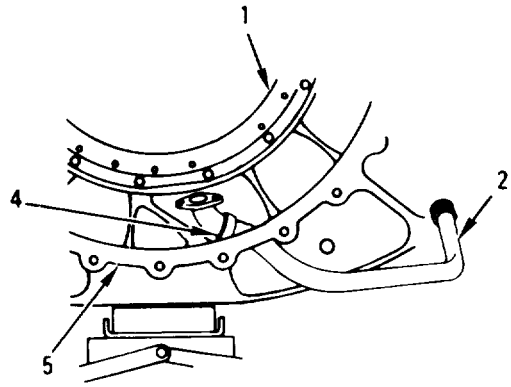
INSTALLATION:

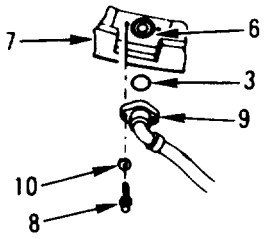
WARNING

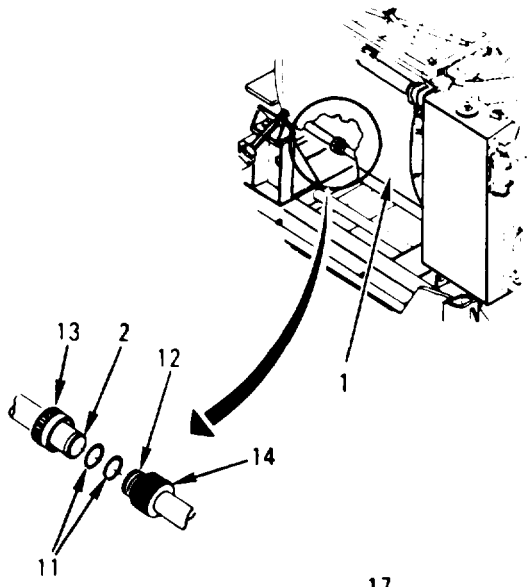
NOTE

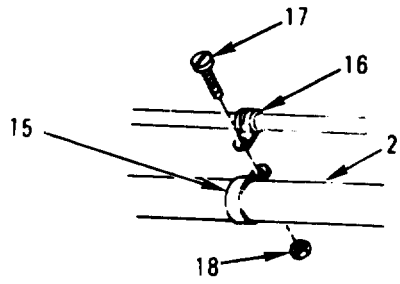
Lift and hold engine (1) steady when installing tube (2).

1. INSTALL TUBE (2) AND NEW PACKING (3).
   a. Lift engine (1) enough to allow tube (2) to be installed through hole (4) in rear module (5).
   b. Apply shortening to packing (3) and install in groove (6) in gearbox housing (7).
   c. Apply antiseize compound to two bolts (8). Aline tube flange (9) with gearbox (7) and install bolts (8) and new lockwashers (10).
2. INSTALL TWO NEW PACKINGS (11) AND CONNECT TUBE (2).
   a. Apply shortening to packings (11). Install one packing (11) on tube (2) and other packing (11) on tube (12).
   b. Move tube fitting (13) over tube (12). Loosely install fitting (14) against fitting (13).
   c. Set engine (1) back on stand.
   d. Install clamp (15) on tube (2) next to clamp (16). Put screw (17) through clamps (15, 16) and install new nut (18).
3. REMOVE ENGINE/REAR MODULE LIFTING SLING FROM ENGINE (PAGE 4-5).
4. CONNECT ENGINE TO TRANSMISSION (TM 34-1).









End of Task

TUBE ASSEMBLY AND INTERNAL PRESSURE SPECIAL SEALS (NO. 5 AND 6 BEARING OIL SCAVENGE) REPLACEMENT (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-N26)
Adapter, 3/8 inch to l/4-inch (Item 33, Appendix D)
Inserted hammer face (Item 1, Appendix D)
Inserted hammer face holder (Item 2, Appendix D)
Torque adapter (Figure 7, Appendix C)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES: Antiseize compound (Item2, Appendix B)
Lubricating oil (Item 11, Appendix B)
Nonelectric wire (Item 15, Appendix B)
Self-locking nut (item 24, Appendix E)
Shortening compound (Item 20, Appendix B)
Shoulder bolt (Item 31, Appendix E) (2 required)
Special seal (Item 32, Appendix E)
Special seal (Item 33, Appendix E) (2 required)
Special seal (Item 34, Appendix E)

EQUIPMENT CONDITION: Forward engine module (gearbox module attached) removed (page 5-26)

REMOVAL:

1. REMOVE TUBE (l), AND FOUR SPECIAL SEALS (2, 3, 4).

   a. Remove screw (5), self-locking nut (6), and two clamps (7) from two tubes (8).

   b. Cut safety wire and remove three bolts (9) and washers (10).

   c. Cut safety wire and remove two inner shoulder bolts (11). Use box end of torque adapter and remove tube (1).

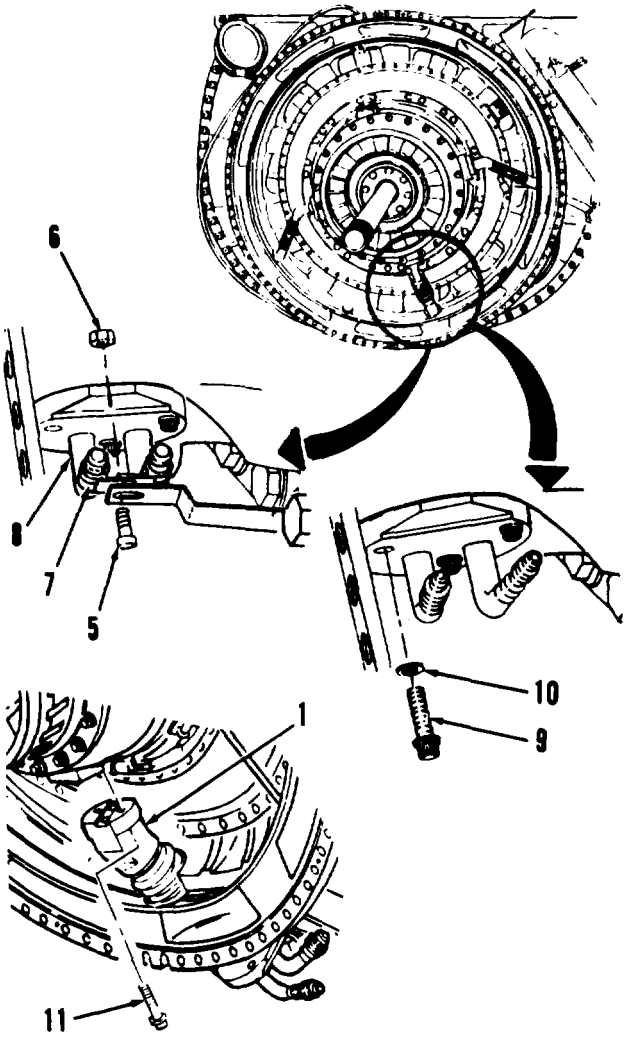
   d. Remove seals (2, 3, 4)

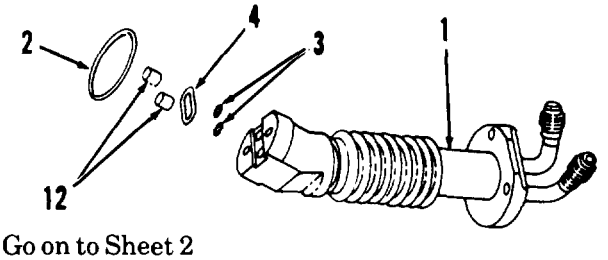
NOTE

Replace hollow pins (12) only if damaged, and set tube (1) aside.

2. INSPECT PINS (12) FORDAMAGE. REPLACE AS REQUIRED.

3. INSPECT PARTS FOR DAMAGE, REPLACE AS REQUIRED.



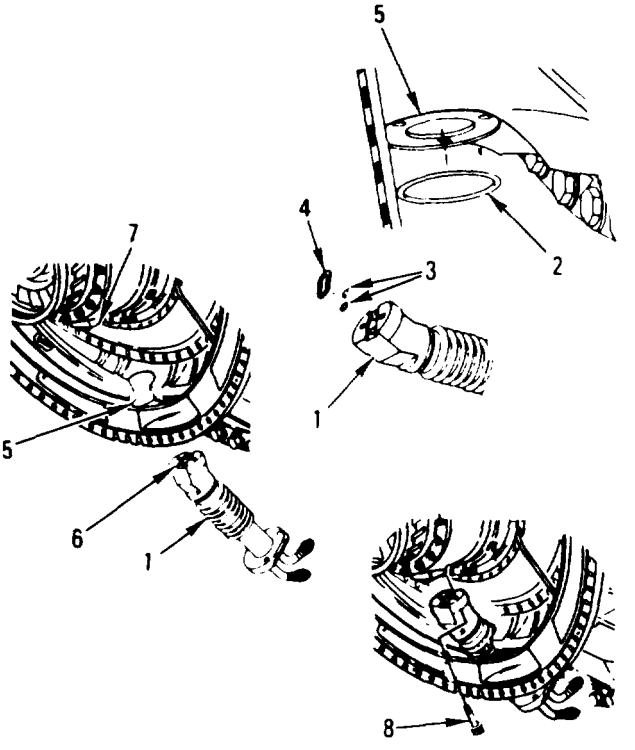


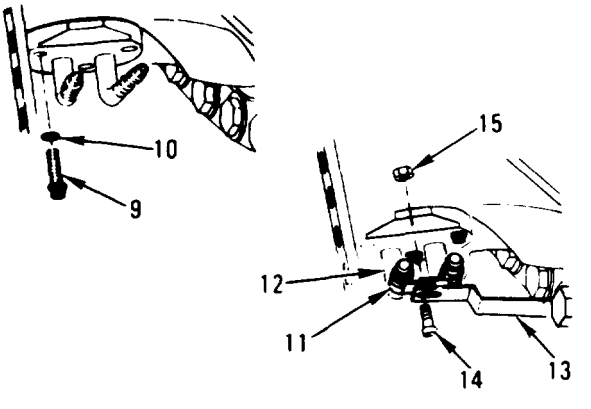
Go on to Sheet 2

TUBE ASSEMBLY AND INTERNAL PRESSURE SPECIAL SEALS (NO. 5 AND 6 BEARING OIL SCAVENGE) REPLACEMENT (Sheet 2 of 2)

INSTALLATION:

1. INSTALL TUBE (1) AND FOUR NEW SEALS (2, 3, 4).
   a. Apply shortening to seal (2) and install on header (5).
   b. Apply oil to three seals (3, 4). Install seals (3, 4) on tube (l).
   c. Put tube (1) through hole in header (5), position flange (6) on power turbine assembly (7). make sure four seals (2, 3, 4) are seated.
   d. **Apply** antiseize compound to two new bolts (8). Install bolts (8).
2. TORQUE BOLTS (8) BETWEEN 45-52 LB-IN (5-6 N-m). USE TORQUE ADAPTER.
3. WAIT 10 MINUTES AND TORQUE BOLTS (8) BETWEEN 45-52 LB-IN (5-6 N-m). USE TORQUE ADAPTER.
4. APPLY ANTISEIZE COMPOUND TO THREE BOLTS (9). INSTALL BOLTS (9) AND WASHERS (10). TORQUE BOLTS (9) BETWEEN 80-100 LB-IN (9-11 N-m). WIRE FIVE BOLTS (8, 9).
5. INSTALL TWO CLAMPS (11) ON TUBES (12). ALINE HOLES IN CLAMPS (11) WITH SLOT IN BRACKET (13). INSTALL SCREW (14) AND NEW NUT (15).
6. INSTALL, FORWARD ENGINE MODULE WITH GEARBOX MODULE ATTACHED (PAGE 5-28).





End of Task

TUBE ASSEMBLY AND INTERNAL PRESSURE SPECIAL SEALS AND PACKING (NO. 5 AND 6 BEARING OIL FEED) REPLACEMENT (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-N26)
Adapter, 3/8 inch to l/4-inch (Item 33, Appendix D)
Inserted hammer face (Item 1, Appendix D)
Inserted hammer face holder (Item 2, Appendix D)
Torque adapter (Item 23, Appendix D)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Lubricating oil (Item 11 or 12, Appendix B)
Nonelectric wire (Item 15, Appendix B)
Packing (Item 35, Appendix E)
Shortening compound (Item 20, Appendix B)
Shoulder bolt (Item 31, Appendix E) (2 required)
Special seal (Item 33, Appendix E)
Special seal (Item 36, Appendix E)

EQUIPMENT CONDITION: Forward engine module (gearbox module attached) removed page 5-26)

REMOVAL:

1. REMOVE TUBE (l), SPECIAL SEALS (2, 3) AND PACKING (4).

   a. Cut safety wire and remove four bolts (5) and washers (6).

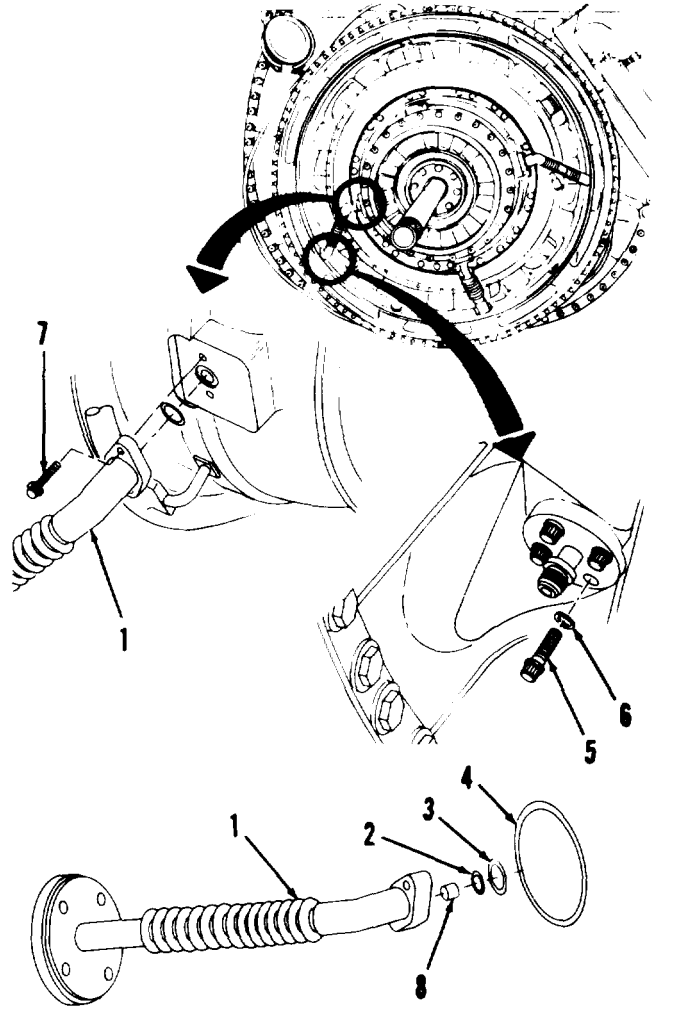
   b. Cut wire and remove two inner shoulder bolts (7). Use box end of torque adapter to remove tube (l).

   c. Remove seals (2, 3) and packing (4)

NOTE

Replace hollow pins (8) only if damaged, and set tube (1) aside.

2. INSPECT PIN (8) FOR DAMAGE. REPLACE AS REQUIRED.
3. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

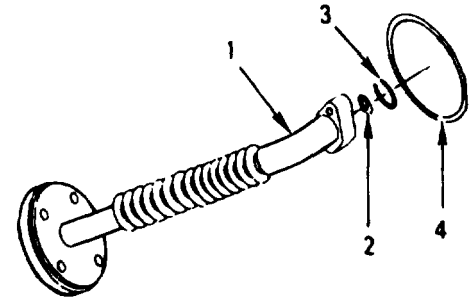


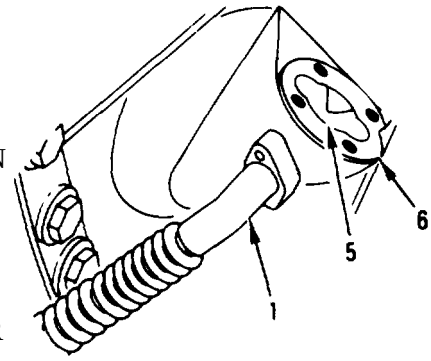
Go on to Sheet 2

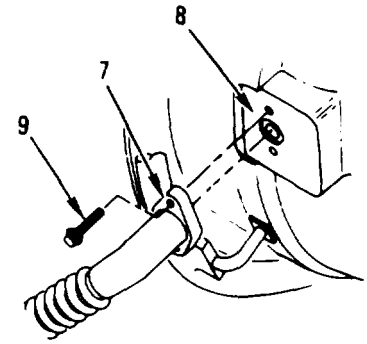
TUBE ASSEMBLY AND INTERNAL PRESSURE SPECIAL SEALS AND PACKING (NO. 5 AND 6 BEARING OIL FEED) REPLACEMENT (Sheet 2 of 2)

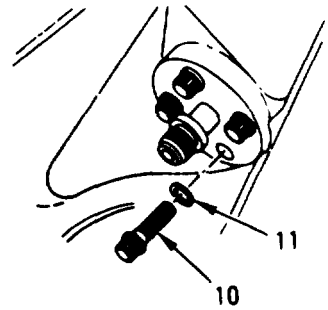
INSTALLATION:

1. INSTALL TUBE (1), NEW SEALS (2, 3), AND NEW PACKING (4).
   a. Apply shortening to packing **(4)** and oil to seals (2, 3). Install packing (4) and seals (2, 3) on tube (l).
   b. Put tube (1) through hole (5) in forward header (6) and position flange (7) on power turbine assembly (8). Make sure packing (4) and seals (2, 3) are seated.
   c. Apply antiseize compound to two new **bolts (9).** Install bolts (9).
2. TORQUE BOLTS (9) BETWEEN 45-52 LB-IN (5-6 N-m).
3. WAIT 10 MINUTES AND TORQUE BOLTS (9) BETWEEN 45-52 LB-IN (5-6 N-m).
4. APPLY ANTISEIZE COMPOUND TO FOUR BOLTS (10), INSTALL BOLTS (10) AND WASHERS (11). TORQUE BOLTS (10) BETWEEN 80-100 LB-IN (9-11 N-m). Wire six bolts (9, 10).
5. INSTALL FORWARD ENGINE MODULE WITH GEARBOX MODULE ATTACHED (PAGE 5-28).









End of Task

COOLING TUBE ASSEMBLY (NO. 5 AND 6 BEARING) REPLACEMENT

(Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180 -90-N26)
Adapter, 3/8 inch to l/4-inch (Item 33, Appendix D)
Torque adapter (Item 23, Appendix D)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Lubricating oil (Item 11, Appendix B)
Nonelectric wire (Item 15, Appendix B)
Packing (Item 35, Appendix E)
Shortening compound (Item 20, Appendix B)
Shoulder bolt (Item 31, Appendix E) (2 required)
Special seal (Item 37, Appendix E)

EQUIPMENT CONDITION: Forward engine module (gearbox module attached) removed page 5-26)

REMOVAL:

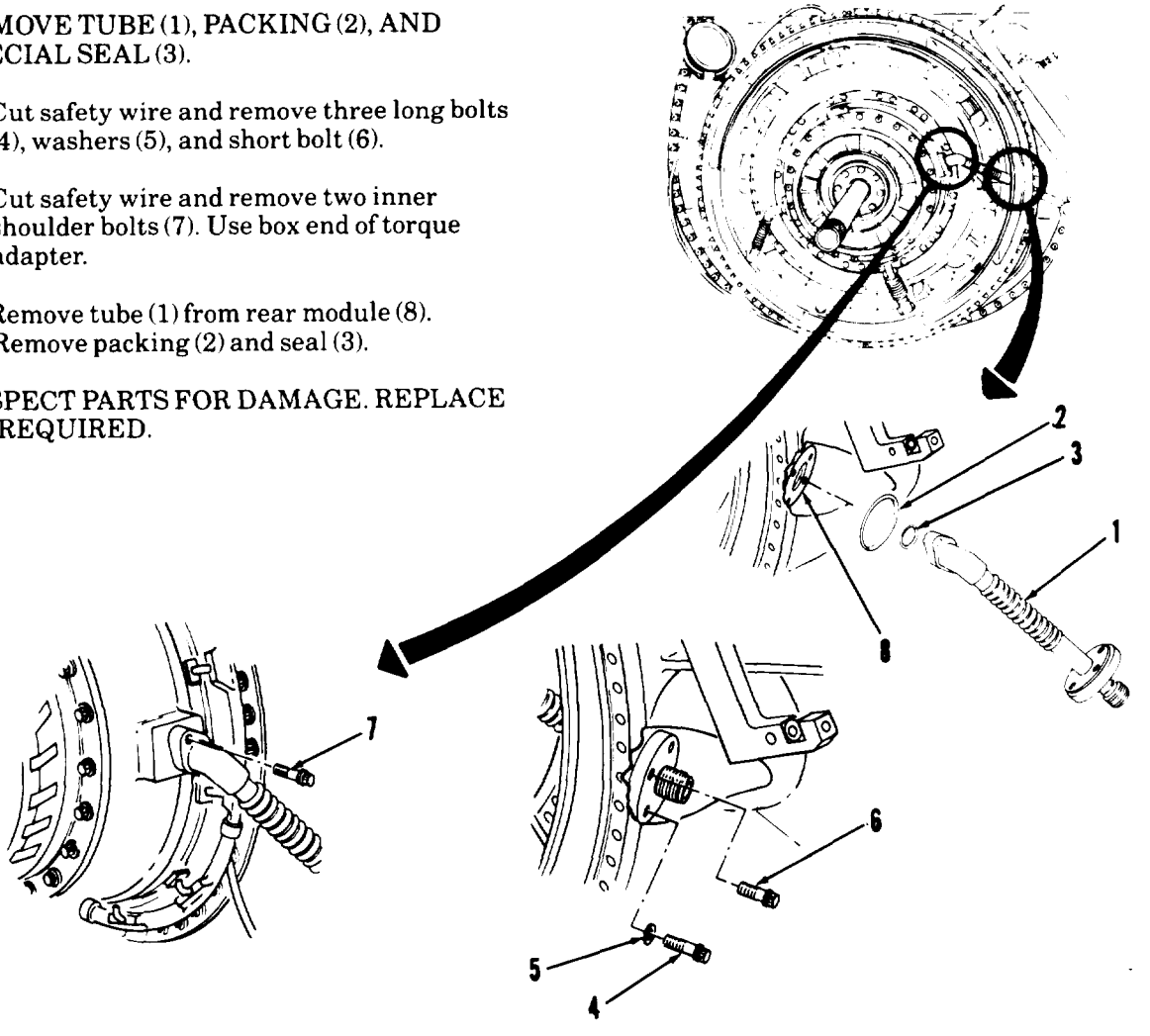
REMOVE TUBE (1), PACKING (2), AND SPECIAL SEAL (3).

a. Cut safety wire and remove three long bolts (4), washers (5), and short bolt (6).

b. Cut safety wire and remove two inner shoulder bolts (7). Use box end of torque adapter.

c. Remove tube (1) from rear module (8). Remove packing (2) and seal (3).

INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

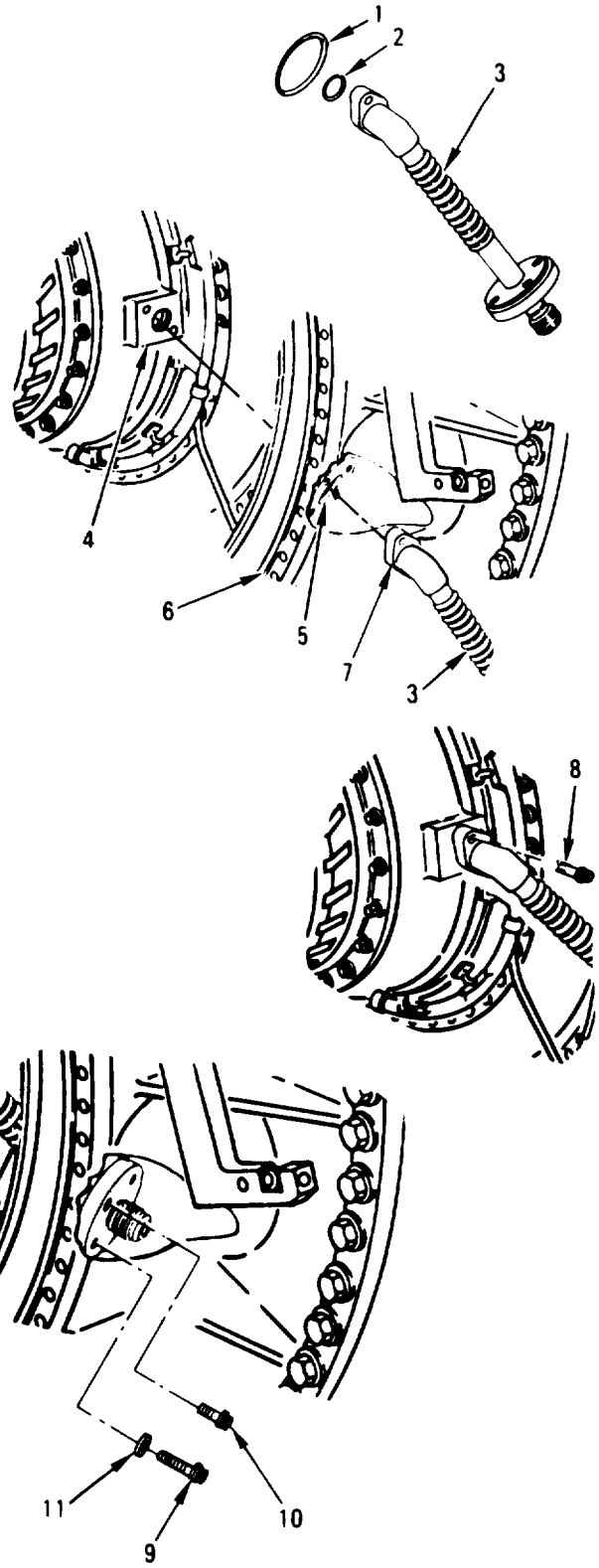


Go on to Sheet 2

COOLING TUBE ASSEMBLY (NO. 5 AND 6 BEARING) REPLACEMENT (Sheet 2 of 2)

INSTALLATION:

1. INSTALL NEW PACKING (1) AND NEW SEAL (2) ON TUBE (3) AND INSTALL TUBE (3) ON POWER TURBINE ASSEMBLY (4).
   a. Apply shortening to packing (1) and oil to seal (2). Install packing (1) and seal (2) on tube (3).
   b. Put tube (3) through hole (5) in forward header (6) and position flange (7) on turbine (4). Make sure packing (1) and seal (2) are seated.
   c. Apply antiseize compound to two new bolts (8). Install bolts (8).
2. TORQUE BOLTS (8) BETWEEN 45-52 LB-IN (9-11 N·m).
3. WAIT 10 MINUTES AND TORQUE BOLTS (8) BETWEEN 45-52 LB-IN (9-11 N·m).
4. APPLY ANTISEIZE COMPOUND TO FOUR BOLTS (9, 10). INSTALL THREE LONG BOLTS (9), WASHERS (11), AND SHORT BOLT (10). TORQUE BOLTS (9, 10) BETWEEN 80-100 LB-IN (9-11 N·m). Wire six bolts (8, 9, 10).
5. INSTALL FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) (PAGE 5-28).



End of Task

REDUCTION GEARBOX LIFTING SLING INSTALLATION AND REMOVAL (Sheet 1 of 1)

TOOLS: General mechanic's tool kit, automotive (SC5180-90-N26)
Hoist, 1000-pound minimum capacity (Item 11, Appendix D)
Reduction gearbox lifting sling (Item 35, Appendix D)

PERSONNEL: Two

INSTALLATION:

INSTALL LIFTING SLING (1).

a. Place shackle (2) in center hole (3) of sling (1). Hook sling (1) on hoist hook (4).

NOTE

If reduction gearbox assembly (5) is on engine, do step c.

b. Turn gearbox (5) until flange (6) is at 10 o'clock position.

c. Turn three screws (7) from threaded end all the way counterclockwise.

d. Aline three captive screws (8) with gearbox mounting holes (9). Install screws (8).

NOTE

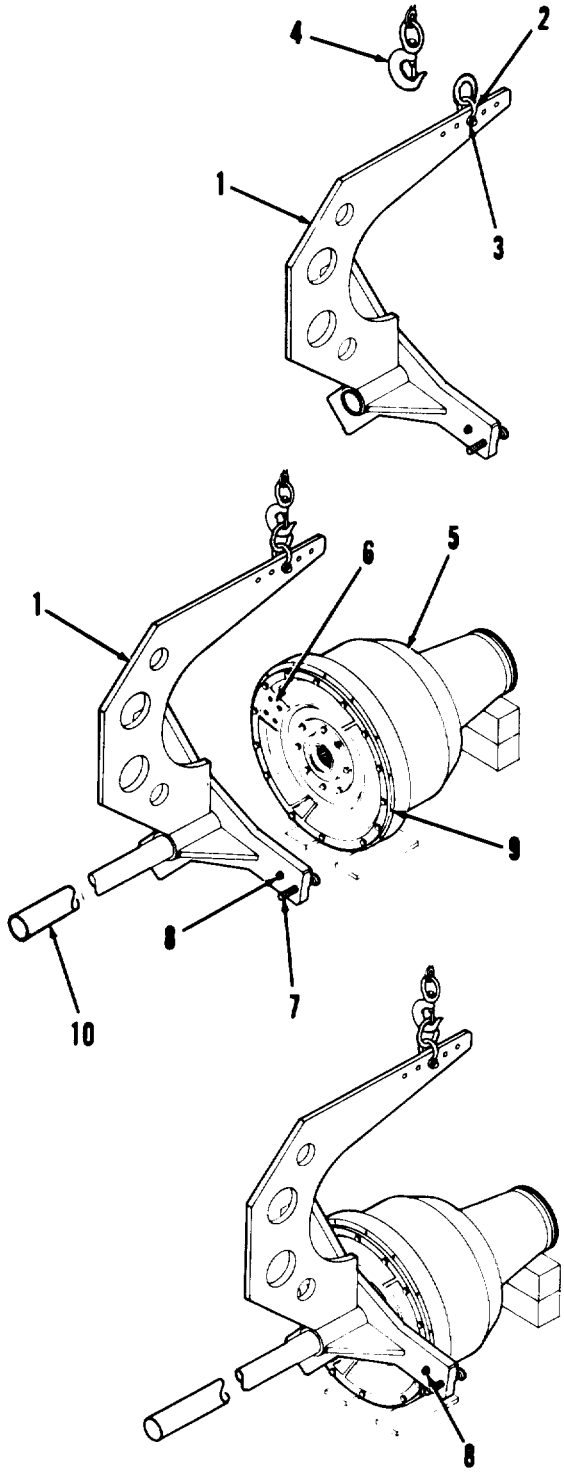
Bar (10) is part of sling (1) and is used to guide gearbox (5).

REMOVAL:

REMOVE SLING (1).

a. Remove three screws (8).

b. Remove sling (1) from hoist hook (4). Stow sling (1).



End of Task

REDUCTION GEARBOX ASSEMBLY REPLACEMENT (Sheet 1 of 4)

Tools:

General mechanic's tool kit: automotive (SC 5180-90-N26)
Chain-fall hoist, 1000-pound minimum capacity (item 10, Appendix D)
Extension, 3/8-inch drive, 6-inch (Item 8, Appendix D)
Guide pin (Figure 6, Appendix C)
Key, 5/16-inch (Item 34, Appendix D)
Ratchet handle, 3/8-inch drive (Item 9, Appendix D)
Socket, 3/8-inch drive, 1/2-inch (Item 12, Appendix D)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)

PERSONNEL: Two

SUPPLIES:

Antiseize compound (Item 2, Appendix B)
Gasket (Item 26, Appendix E)
Keywasher (item 38, Appendix E) (15 required)
Lockwasher (Item 29, Appendix E) (2 required)
Shortening compound (Item 20, Appendix B)
Wood block (Item 21, Appendix B) (2 required)
Wood block (Item 33. Appendix B) (2 required)

EQUIPMENT CONDITION:

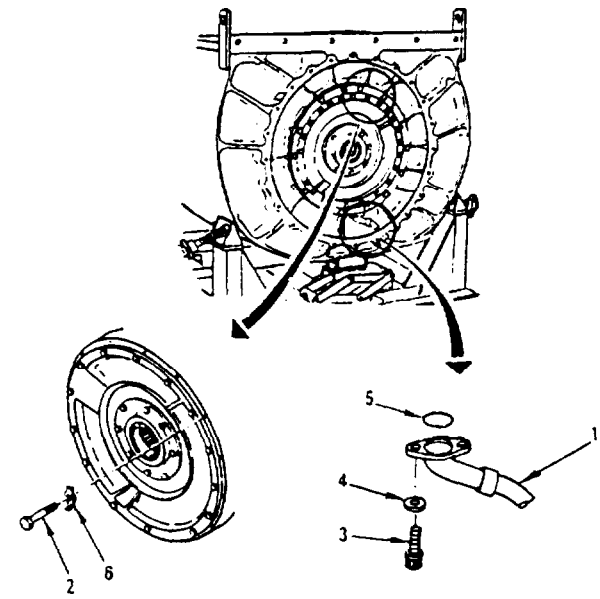
Transmission assembly removed (TM 34-1)
Splined shaft removed (page 6-2)
Speedometer adapter removed (page 6-3)
Air tube assembly (reduction gearbox - short) removed (page 6-6)
Tube assembly (reduction gearbox feed) removed (page 6-7)

REMOVAL:

1. DISCONNECT TUBE ASSEMBLY (1) AND REMOVE 15 BOLTS (2).

   a. Remove two bolts (3) and lockwashers (4). Move tube (1) down and remove gasket (5).

   b. Bend tabs of 15 keywashers (6). Remove bolts (2) and keywashers. (6)



Go on to Sheet 2

REDUCTION GEARBOX ASSEMBLY REPLACEMENT (Sheet 2 of 4)

2. INSTALL REDUCTION GEARBOX LIFTING SLING (PAGE 6-16).

WARNING

3. REMOVE GEARBOX (1).

   a. Install three jackscrews (2) until gearbox (1) is loose from rear engine subassembly (3).

   b. Remove gearbox (1) from rear engine (3).

   c. Slide deflector (4) off gearbox (1) or out of rear engine (3). Set gearbox (1) on four wood blocks (5).

4. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

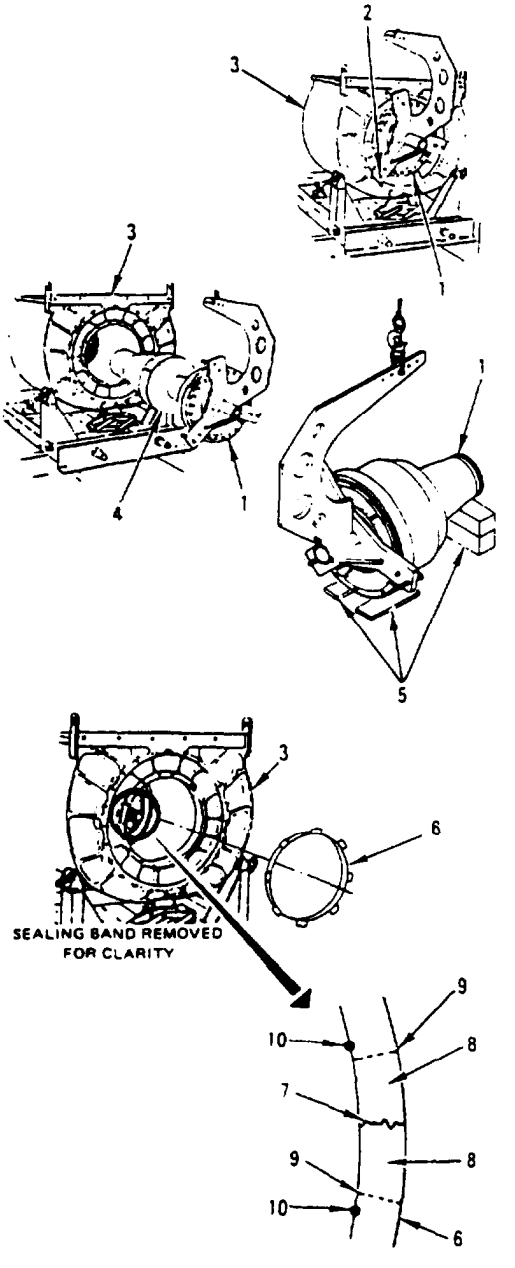
NOTE

If gearbox (1) was removed for access only go to step 6.

5. INSTALL REDUCTION GEARBOX ASSEMBLY IN SHIPPING CONTAINER (PAGE 6-22).

6. INSPECT INSIDE OF REAR ENGINE (3) FOR PIECES OF FORWARD SEALING BAND (6) THAT HAVE BROKEN OFF AND FALLEN INTO REAR ENGINE (3). TAKE OUT PIECES OF BAND (6).

7. INSPECT BAND (6) FOR CRACKS (7) THAT GO ALL THE WAY THROUGH WIDTH OF SHROUD OF BAND (6). IF CRACKS (7) EXIST, CUT OFF TWO PIECES (8). MAKE CUTS (9) AT NEAREST SPOT WELDS (10).



Go on to Sheet 3

REDUCTION GEARBOX ASSEMBLY REPLACEMENT (Sheet 3 of 4)

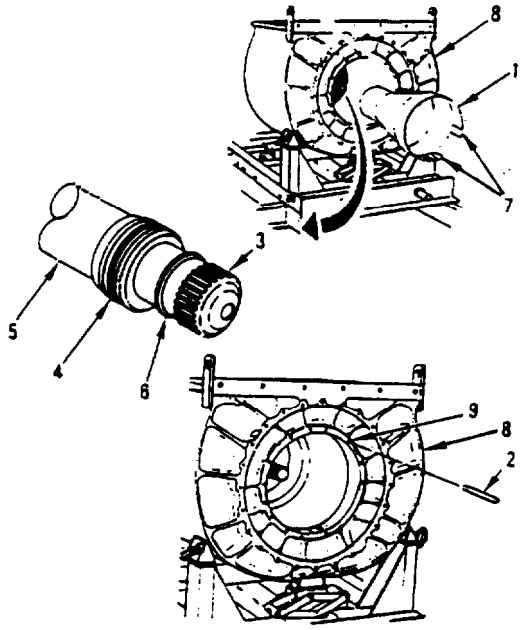
INSTALLATION:

1. INSTALL DEFLECTOR (1) AND GUIDE PIN (2).

   a. Apply a heavy amount of shortening to splines (3) and seal (4) of power turbine shaft (5). Center seal (4) and ring (6) on shaft (5).

   b. Align two cutouts (7) and slide deflector (1) in rear engine (8).

   c. Install pin (2) in hole (9) at 1 o'clock position in rear engine (8).



NOTE

If gearbox (10) was removed for access, go to step 3.

2. REMOVE NEW REDUCTION GEARBOX ASSEMBLY FROM SHIPPING CONTAINER (PAGE 6-21).

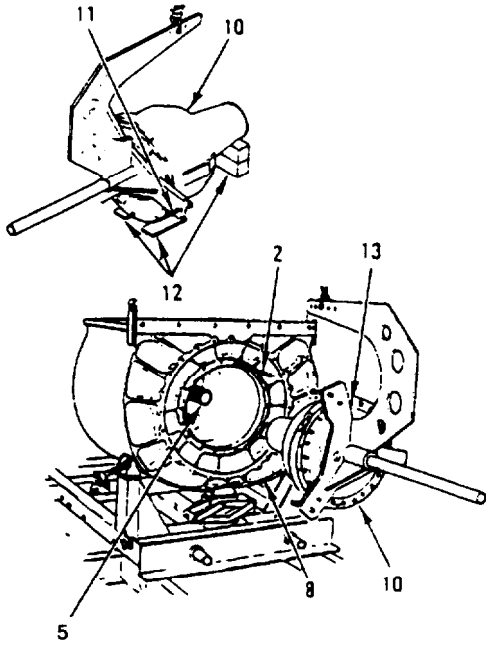
WARNING

3. INSTALL GEARBOX (10).

   a. Turn three screws (11) all the way counterclockwise.

   b. Raise gearbox (10) off wood blocks (12) and align hole (13) with guide pin (2).

   c. Seat gearbox (10) in rear engine (8).



NOTE

Rotate shaft (5) slowly while seating gearbox (10) to ensure the splines align. Failure to slowly rotate shaft (5) during installation may cause damage to ring (6).

Go on to Sheet 4

REDUCTION GEARBOX ASSEMBLY REPLACEMENT (Sheet 4 of 4)

4. APPLY ANTISEIZE COMPOUND TO THREE BOLTS (1). INSTALL BOLTS (1) AND NEW KEY WASHERS (2) IN HOLES (3) AT 2,6, AND 10 O'CLOCK POSITIONS. Torque bolts (1) be tween 210-250 Lb-In (24-28 N•m)

5. REMOVE REDUCTION GEARBOX LIFTING SLING (PAGE 6-16).

6. ROTATE GEARBOX AND LISTEN FOR UNUSUAL NOISES. IF UNUSUAL NOISE IS NOTED, *(A RUMBLING AND KNOCKING SOUND DURING ROTATION MAY BE AN INDICATION OF A DAMAGED OIL DAMMING RING).* REMOVE GEAR BOX ASSEMBLY AND INSPECT THE OIL DAMMING RING FOR VISIBLE DAMAGE (BENT EDGES WITH SPLINE IMPRESSIONS) . REPLACE OIL DAMMING RING AS REQUIRED.

7. REMOVE GUIDE PIN (4).

8. APPLY ANTISEIZE COMPOUND TO 12 BOLTS (1). INSTALL BOLTS (1) AND NEW KEYWASHERS (2). TORQUE BOLTS (1) BETWEEN 210-250 LB-IN (24-28 N-M). BEND TABS OF KEYWASHERS (2) AGAINST BOLTS (1).

9. APPLY SHORTENING To NEW GASKET (5) AND INSTALL GASKET (5) IN GROOVE (6) IN GEAR BOX (7).

10. APPLY ANTISEIZE COMPOUND TO TWO BOLTS (6). PUT. TUBE FLANGE (9) ON GEARBOX (7). INSTALL BOLTS (8) AND NEW LOCK WASHERS (10).

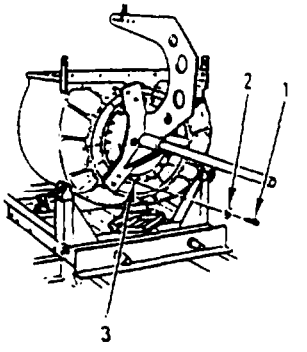
11. INSTALL TUBE ASSEMBLY (REDUCTION GEAR BOX FEED) (PAGE 6-7)

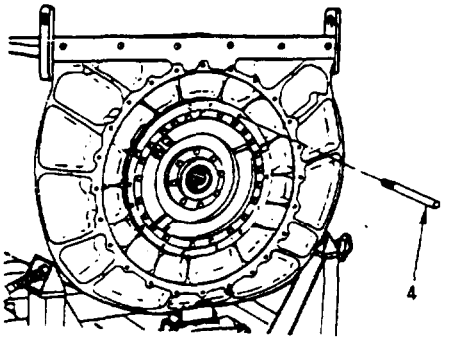
12. INSTALL AIR TUBE ASSEMBLY (REDUCTION GEARBOX SHORT) (PAGE 6-6).

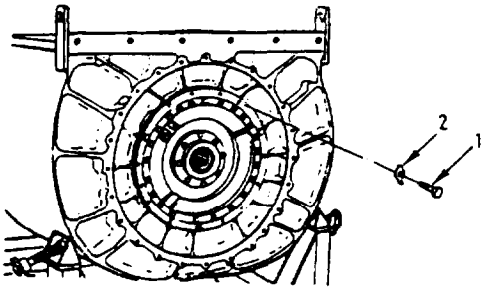
13. INSTALL SPEEDOMETER ADAPTER (PAGE 6-3).

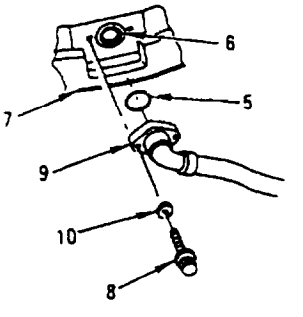
14. INSTALL SPLINED SHAFT (PAGE 6-2).

15. INSTALL TRANSMISSION ASSEMBLY (TM 34-1).









End of Task

REDUCTION GEARBOX ASSEMBLY REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Torque wrench, 0-150 ft-lb (Item 24, Appendix D)

SUPPLIES: Lockwasher (Item 39, Appendix E) (2 required)
Self-locking nut (Item 40, Appendix E) (2 required)
Wood block (Item 21, Appendix B) (2 required)
Wood block (Item 33, Appendix B) (2 required)

PERSONNEL: Two

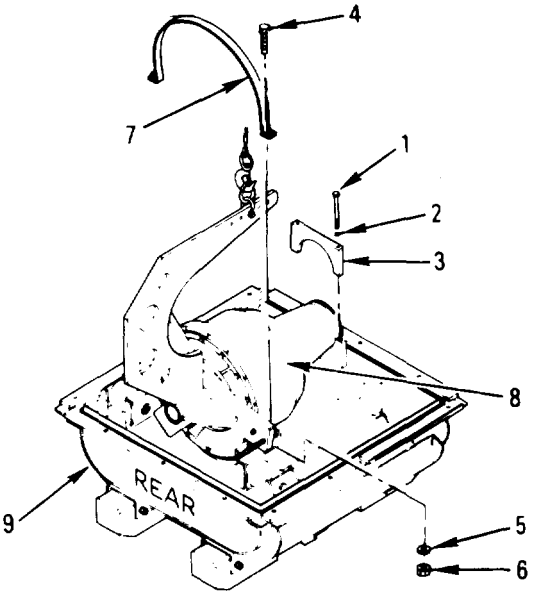
EQUIPMENT CONDITION: Top weldment removed (page 4-1)
Reduction gearbox lifting sling installed (page 6-16)

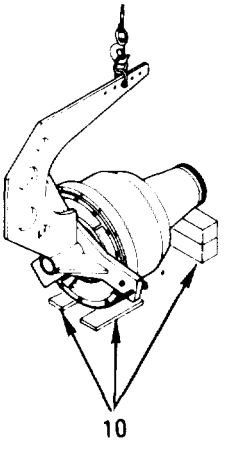
REMOVAL:

1. REMOVE TWO SCREWS (1), LOCKWASHERS (2), AND CAP (3).
2. REMOVE TWO SCREWS (4), WASHERS (5), SELF-LOCKING NUTS (6), AND MOUNTING STRAP (7).

WARNING

3. LIFT GEARBOX (8) STRAIGHT UP AND OUT OF BOTTOM WELDMENT (9). SET GEARBOX (8) ON FOUR WOOD BLOCKS (10).
4. REMOVE REDUCTION GEARBOX LIFTING SLING (PAGE 6-16).





Go on to Sheet 2

REDUCTION GEARBOX ASSEMBLY REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 2 of 2)

INSTALLATION:

1. **INSTALL** REDUCTION GEARBOX LIFTING SLING (PAGE 6-16).

2. TURN THREE JACKSCREWS (1) FROM THREADED END ALL THE WAY COUNTERCLOCKWISE.

WARNING

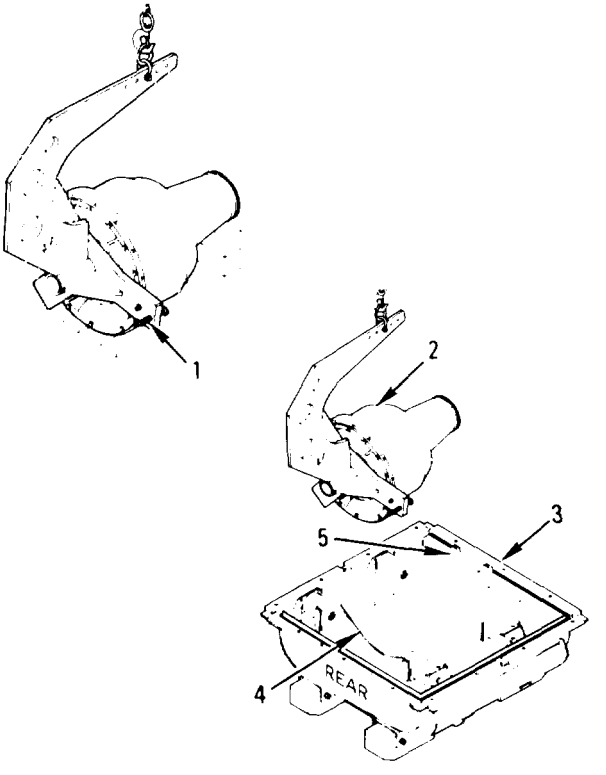
3. POSITION GEARBOX (2) OVER WELDMENT (3). LOWER GEARBOX (2) ON STRAP (4) AND PILLOW BLOCK BASE (5).

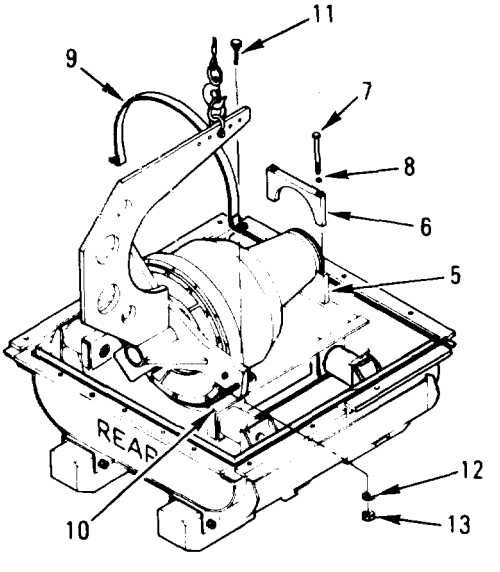
4. PLACE CAP (6) ON BASE (5). INSTALL TWO SCREWS (7) AND NEW LOCKWASHERS (8). TORQUE SCREWS (7) BETWEEN 20-24 LB-FT (27-33 N-m).

5. PLACE STRAP (9) ON FRAME (10). INSTALL TWO SCREWS (11), WASHERS (12), AND NEW NUTS (13). TORQUE SCREWS (11) AND NUTS (13) BETWEEN 20-24 LB-FT (27-33 N-m).

6. REMOVE REDUCTION GEARBOX LIFTING SLING (PAGE 6-16).

7. INSTALL TOP WELDMENT (PAGE 4-3).





End of Task

NO. 7 BEARING SEAL REPLACEMENT **(Sheet 1** of 4)

TOOLS: General mechanic's tool kit: automotive (SC5l8O-9O-N26)
Industrial goggles (Item 58, Appendix D)
Mechanical installer (Item 105, Appendix D)
Mechanical puller (Item 103, Appendix D)
Protective gloves (item 87, Appendix D)
Snap ring pliers (Item 104, Appendix D)

SUPPLIES: Oven cleaner (Item 43, Appendix B)
Plain encased seal (Item 119, Appendix E)
Shortening compound (Item 20, Appendix B)
Wiping rag (Item 14, Appendix B)

PERSONNEL: Two

EQUIPMENT CONDITION: Reduction gearbox removed and on blocks (page 6-17)

REMOVAL:

1. **CLEAN SPUR GEARSHAFT (1).**

WARNING

Make sure reduction gearbox is horizontal and blocked to prevent it from rolling.

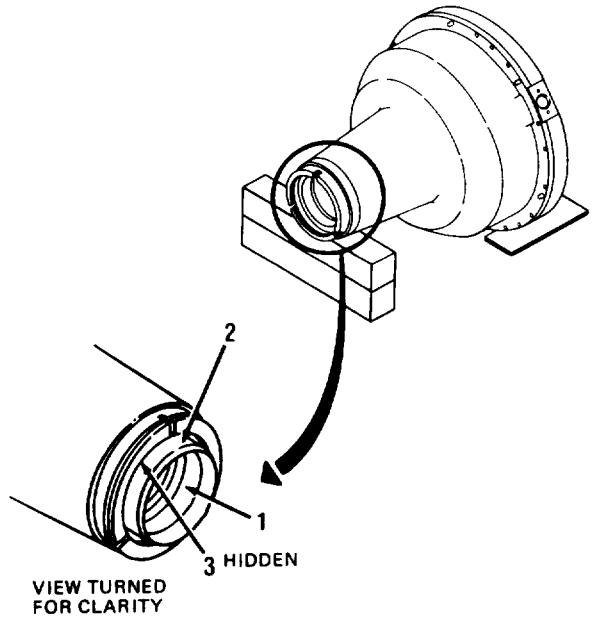
WARNING

CAUTION

Carbon residue (coking) left in the seal area will make removal of seal harder and may cause damage to removal tool. Ensure all carbon residue is removed.

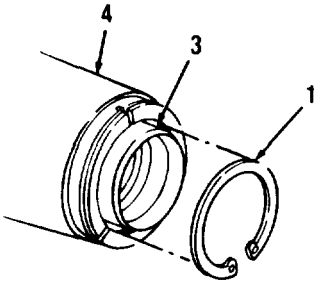
a. **Stuff a clean rag in gearshaft (1) to prevent dirt or foreign objects from entering gearshaft.**

b. **Spray oven cleaner on spur gearshaft outer surface (1) projecting beyond No. 7 bearing seal (2). Let stand for 45 minutes.**



Go on to Sheet 2

NO. 7 **BEARING SEAL REPLACEMENT** (Sheet **2 of 4)**



c. Remove oven cleaner and carbon residue by wiping with clean rag dampened with water.

d. Inspect area to make sure carbon residue has been removed. Repeat steps a. and b. if necessary.

2 REMOVE RETAINING RING (1) and NO. 7

WARNING

Retaining ring will be under high tension during removal. Use care when removing it.

a. **Remove retaining ring (1) from groove (3) in housing (4) using snap ring pliers.**

b. **Turn handle (5) of mechanical puller (6) all the way counterclockwise and position three legs (7) in slots (8) of housing (4).**

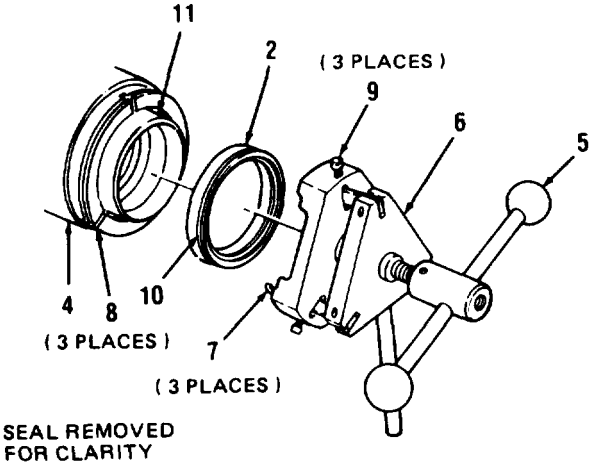
CAUTION

In following step, ensure that three legs (7) are firmly in position before turning handle (5), otherwise puller (6) will cock sideways and could be damaged.

c. **Adjust three screws (9) until three legs (7) are in position in groove (10) of seal (2). Turn handle (5) clockwise and pull seal (2) from housing (4).**

d. **Unscrew three screws (9) and remove seal (2) from puller (6).**

e. **Wipe remaining oven cleaner from gearshaft (11) with clean rag. Inspect gearshaft housing (4) and shaft (11) for cleanliness.**



Go on to Sheet 3

NO. 7 BEARING SEAL REPLACEMENT (Sheet 3 of 4)

INSTALLATION:

1. INSTALL NEW NO. 7 BEARING SEAL (1) on SHAFT (2). USE MECHANICAL INSTALLER (3).

CAUTION

In following step, make sure seal (1) is installed "air side" (4) out so groove (5) is away from gearbox housing (6). Failure to comply will make future removal of seal (1) impossible.

a. Coat outside diameter of gearshaft (2) and inside and outside diameter of new seal (1) with shortening compound or engine lubricating oil. Position seal "air side" (4) out on end of gearshaft (2).

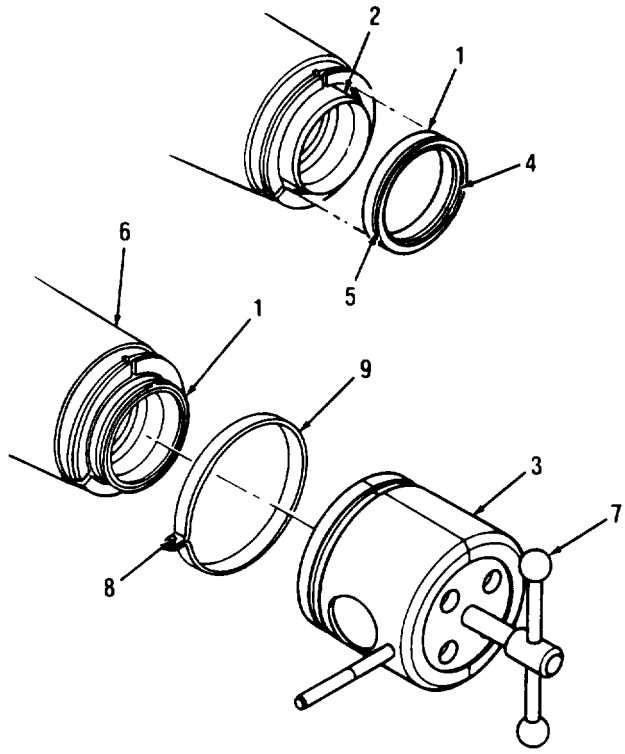
b. Turn handle (7) of mechanical installer (3) all the way counterclockwise. Loosen Clamp screw (8). Take ring (9) off installer (3) and loosely put on gearbox housing (6).

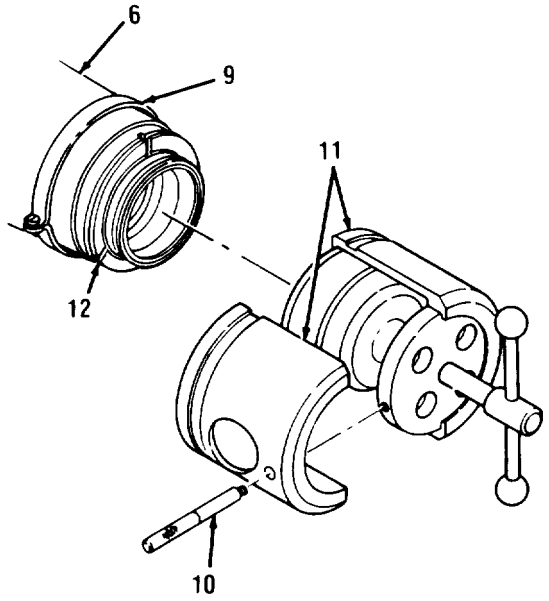
c. Remove handle (10) and separate halves (11). Put halves (11) around groove (12) in housing (6).

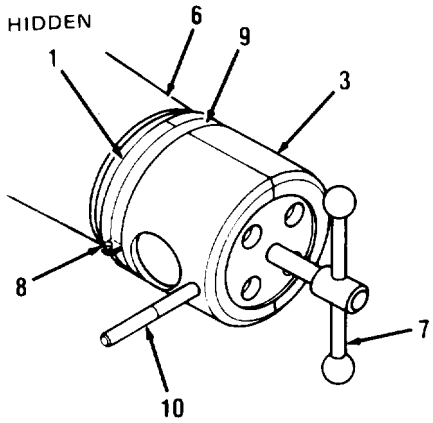
d. Screw in handle (10). Put ring **(9) around** halves (11) and tighten screw (8).

e. Hold handle (10) and turn handle (7) clockwise until seal (1) seats in housing (6).

f. Remove installer (3) from housing (6).





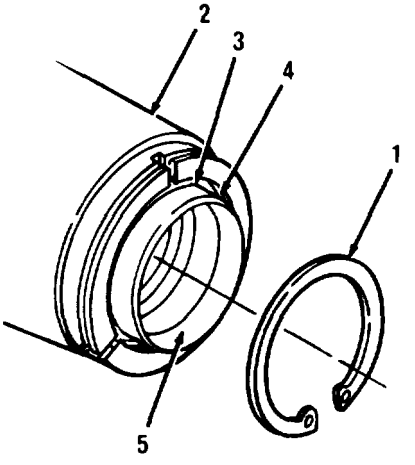


go on to Sheet 4

NO. 7 BEARING SEAL REPLACEMENT (Sheet 4 of 4)

WARNING

Retaining ring (1) will be under high tension during installation. Use care when installing it.



2. INSTALL RETAINING RING (l).

   a. Look into housing (2) and check to see if seal (3) has been pushed far enough back to allow retaining ring (1) to be installed in its groove (4). If not, repeat step 1.

   b. Compress retaining ring (l), and insert ring (1) into groove (4) of housing (2).

NOTE

Rag in following step acts as a shield in case ring (1) springs out of housing.

   c. Have assistant place rag over end of housing and retaining ring pliers, then help to guide retaining ring (1) into groove (4). Make sure retaining ring is properly seated in groove (4).

   d. Wipe interior of spur gearshaft (5) with clean, dry, wiping rag. Inspect for cleanliness.

3. INSTALL REDUCTION GEARBOX (PAGE 6-17).

End of Task

ADAPTER AND SHAFT ASSEMBLY SEAL RINGS REPLACEMENT (Sheet 1 of 4)

TOOLS: General mechanic's tool kit: automotive (SC5180-90-N26)
Mirror (Item 92, Appendix D)

SUPPLIES: Dry cleaning solvent (Item 7, Appendix B)
Expander spring (Item 118, Appendix E) (2 required)
Metal seal ring (Item 115, Appendix E) (2 required)
Retaining ring (Item 117, Appendix E)
Rubber mat (Item 42, Appendix B)
Scouring pad (Item 46, Appendix B)
Shortening compound (Item 20, Appendix B)
Turbine sealing ring (Item 116, Appendix E)
Wiping rag (Item 14, Appendix B)

EQUIPMENT CONDITION: Reduction gearbox removed (page 6-17)

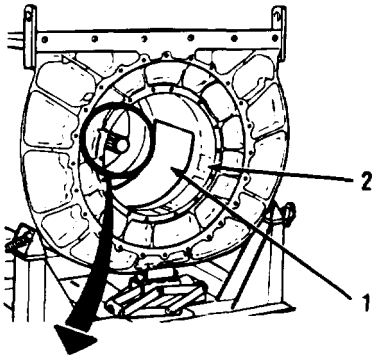
REMOVAL:

WARNING

Inner diameter of recuperator is sharp and maybe hot. IJse rubber mat to prevent injury or burns and also to prevent damage to recuperator from dropped tools or other objects.

1. PUT RUBBER MAT (1) IN LOWER HALF OF RECUPERATOR (2). REMOVE RETAINING RING (OIL DAM RING) (3), METAL SEAL RINGS (4,5), EXPANDER SPRINGS (6,7) AND TURBINE SEALING RING (8).

   a. Put rubber mat (1) in lower half of recuperator (2) to protect recuperator and catch dropped objects.



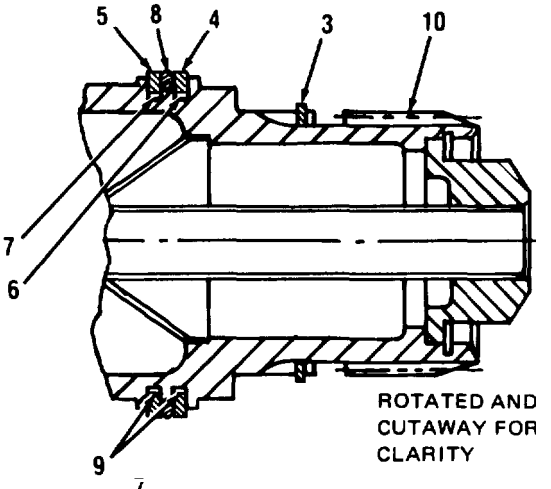
CAUTION

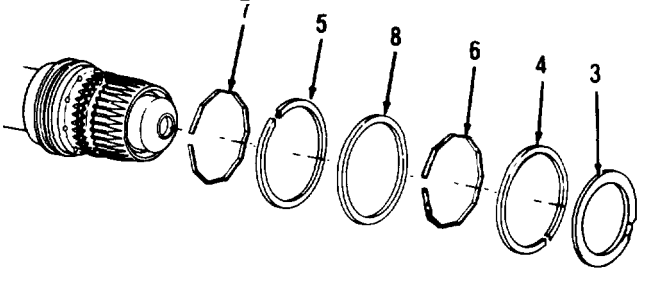
Do not damage ring grooves **(9)** in shaft (10). Damage to ring grooves will cause oil leakage.

NOTE

Retaining ring **(3)** spirals around shaft (10) and must be pried off from around shaft.

   b. Remove retaining ring (3), metal seal rings [4,5), expander springs (6,7) and turbine sealing ring (8). Discard ring (3), seal rings (4,5), expamder springs (6,7) and sealing ring (8).



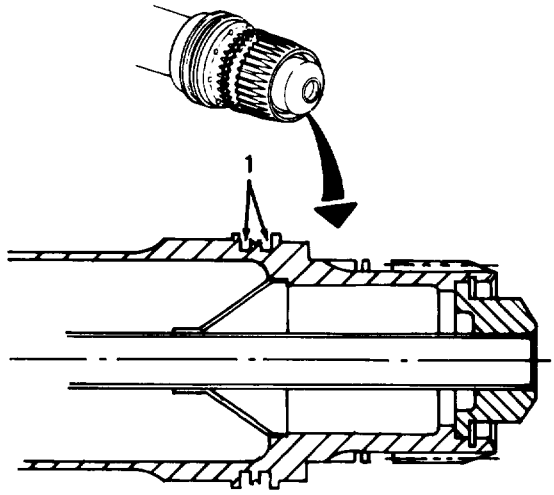


Go on to Sheet **2**

ADAPTER AND SHAFT ASSEMBLY SEAL RINGS REPLACEMENT (Sheet 2 of 4)

WARNING

2. CLEAN GROOVES (1) WITH CLEAN RAG, SCOURING PAD AND DRY CLEANING SOLVENT. MAKE SURE GROOVES ARE CLEAN.



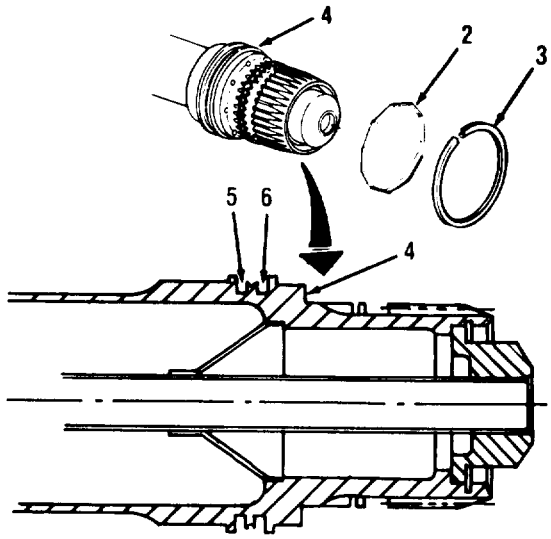
INSTALLATION:

1. INSTALL NEW EXPANDER SPRING (2) AND NEW METAL. SEAL RING (3).

NOTE

Expander springs are made straight and must be bent inlo a circle to install.

a. Preshape new expander spring (2) to form a circle. Install expander spring (2) over shaft (4) and into groove (5). Coat expander spring (2) with shortening compound.



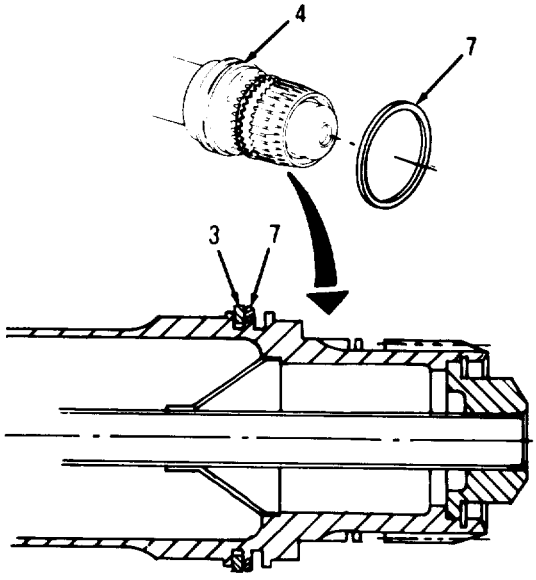
CAUTION

Do not overpand metal seal ring (3) when installing it.

b. Expand new seal ring (3) just enough to fit over shaft (4), and install seal ring (3) in groove (5) over expander spring (2). If seal ring (3) should slip into groove (6), gently pry it out and into groove (5).

c. Ensure spring (2) is seated properly by rotating seal ring (3) in groove (5).

2. **INSTALL NEW** TURBINE SEALING RING (7) *ON SHAFT (4)* AGAINST SEAL RING (3).



Go on to Sheet 3

ADAPTER AND SHAPT ASSEMBLY SEAL RINGS REPLACEMENT (Sheet 3 of 4)

3. INSTALL NEW EXPANDER SPRING (1) AND NEW METAL SEAL RING (2).

   a. Preshape new expander spring (1) to form a circle. Install expander spring (1) over shaft (3) and into groove (4).

CAUTION

Do not overexpand metal seal ring (2) when installing it.

   b. Expand new seal ring (2) just enough to fit over shaft (3), and install seal ring (2) in groove (4) over expander spring (1).

   c. Ensure spring (1) is seated properly by rotating seal ring (2) in groove (4).

   d. Adjust metal seal rings (2,5) until split line (6) of each seal ring is 180 degrees apart from the other.

4. **INSTALL NEW RETAINING RING (OIL DAM** RING) (7) ON SHAFT (3).

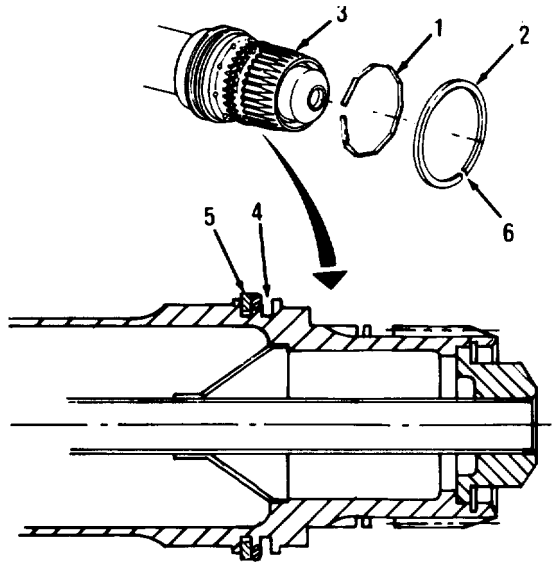
CAUTION

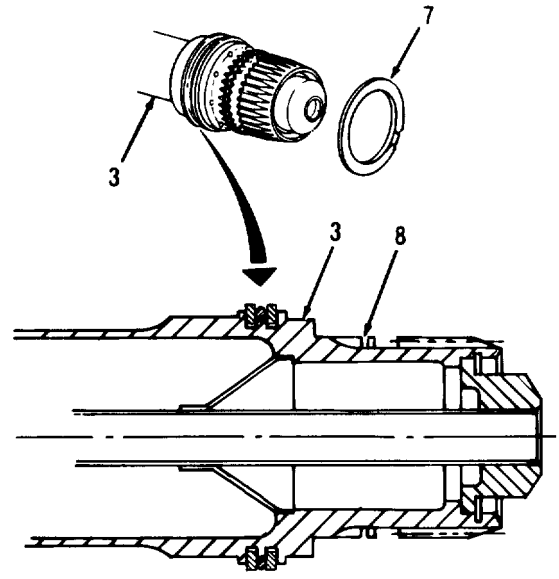
Do not bend retaining ring (7) during installation. Bends in ring will cause leakage.

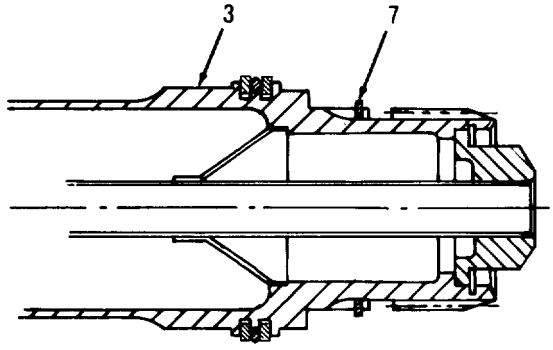
   a. Carefully feed retaining ring (7) into groove (8) of shaft (3).

   b. Adjust retaining ring (7) until it feels centered (approximate) around shaft (3).

   c. Pack retaining ring groove (8) with shortening compound.







Go on to Sheet **4**

ADAPTER AND SHAFT ASSEMBLY SEAL RINGS REPLACEMENT (Sheet 4 of 4)

5. CHECK SEAL RINGS (1 ,2) TO ENSURE THAT SPLIT LINES (GAPS) (3) ARE FACING 180 DEGREES AWAY FROM EACH OTHER.

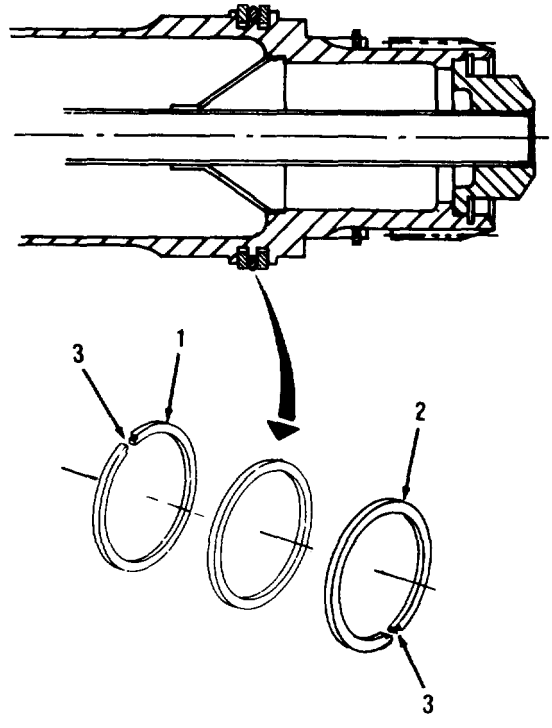
6. REMOVE RUBBER MAT FROM LOWER RECUPERATOR.

WARNING

NOTE

If reduction gearbox in step 7. is not new, seal ring mating surfaces in reduction gearbox gearshaft should be cleaned with dry cleaning solvent, scouring pad and rag.

7. INSTALL REDUCTION GEARBOX (PAGE 6- 17).



End of Task

ENGINE/REAR MODULE LIFTING SLING INSTALLATION ON AND REMOVAL FROM REAR ENGINE SUBASSEMBLY (Sheet 1 of 1)

TOOLS: Engine/rear module lifting sling (Item 32, Appendix D)
Hoist, 2-ton miniumum capacity (Item 36, Appendix D)

PERSONNEL: Two

INSTALLATION:

INSTALL SLING (1).

a. Hook sling (1) to hoist hook (2). Place sling (1) over rear engine (3).

b. Position bar (4) in two lifting plates (5). Put two locking pins (6) in holes (7) of bar (4).

c. Install link (8) in hole (9).

d. Remove pin (10) from shackle (11). Place shackle (11) on ring (12). Install pin (10).

REMOVAL:

REMOVE SLING (l).

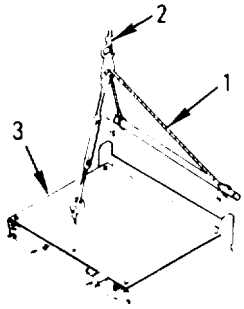
a. Lower hoist until cables of sling (1) are slack.

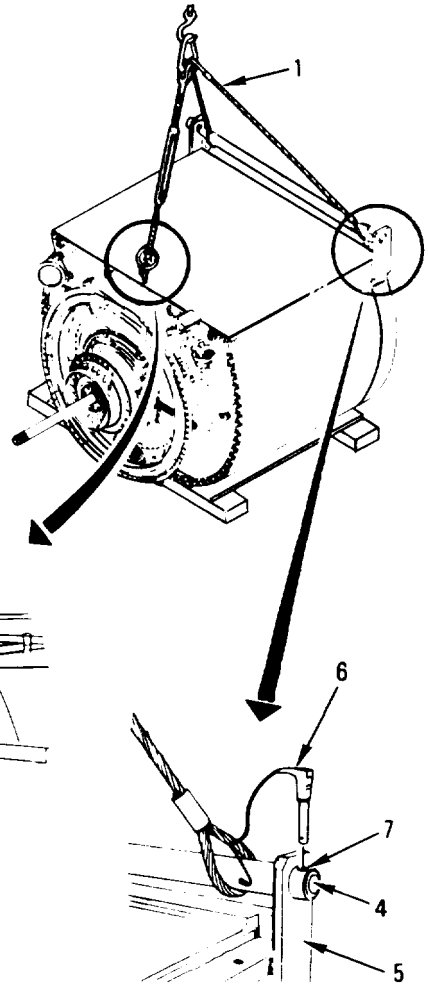
b. Remove pin (10) from shackle (11). Take shackle (11) off ring (12). Install pin (10) in shackle (11).

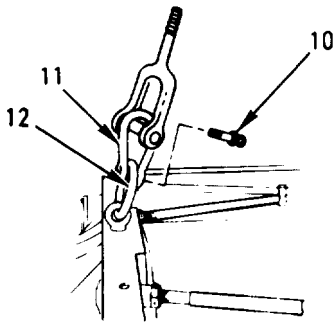
c. Remove link (8).

d. Remove two pins (6) from bar (4). Remove bar (4) from two plates (5).

e. Remove sling (1) from hoist hook (2) and stow sling (l).







End of Task

REAR ENGINE SUBASSEMBLY REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 1 of 4)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Torque adapter (Item 23, Appendix D)
Torque wrench, 0-150 ft-lb (Item 24, Appendix D)

SUPPLIES: Lockwasher (Item 7, Appendix E) (4 required)
Lockwasher (Item 39, Appendix E) (2 required)
Lockwasher (Item 41, Appendix E) (9 required)
Self-locking nut (Item 17, Appendix E) (8 required)
Self-locking nut (Item 42, Appendix E) (15 required)
Wood block (Item 34, Appendix B) (2 required)
Wood block (Item 35, Appendix B) (2 required)

PERSONNEL: Two

EQUIPMENT CONDITION: Top weldment removed (page 4-1)
Engine/rear module lifting sling installed on rear engine subassembly (page 6-23)

REMOVAL:

1. REMOVE ATTACHING HARDWARE AND ADJUST SLING (l).

   a. Remove four self-locking nuts (2), washers (3), and screws (4).

   b. Remove four self-locking nuts (5), washers (6), and screws (7).

   c. Hold eyebolt (8) from turning. Turn sling turnbuckle (9) to level rear engine (10).

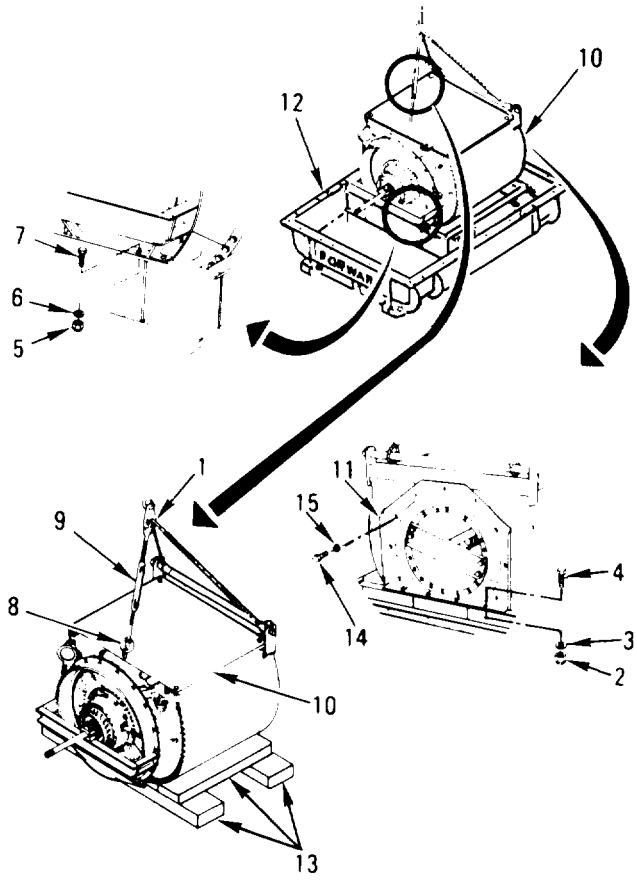
WARNING

2. REMOVE REAR ENGINE (10) AND MOUNTING FLANGE (11).

   a. Lift rear engine (10) straight up and out of bottom weldment (12). Set rear engine (10) on four wood blocks (13).

   b. Hold flange (11) and remove nine screws (14) and lockwashers (15).

   c. Remove flange (11).



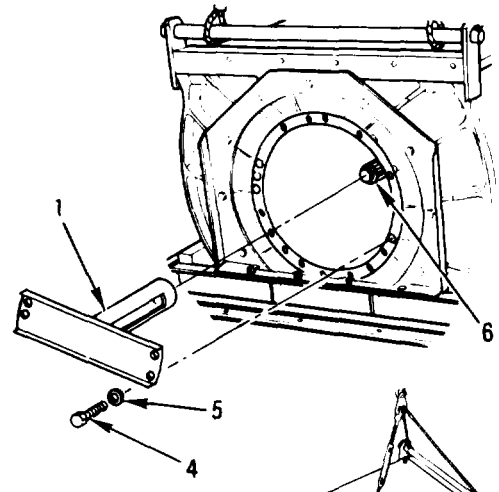
Go on to Sheet **2**

REAR ENGINE SUBASSEMBLY REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 2 of 4)

3. REMOVE POWER TURBINE SHAFT SUPPORT (1), CAP (2), AND TWO CUSHIONS (3).

   a. Remove four screws (4) and lockwashers (5). Slide support (1) off shaft (6).

   b. Remove two screws (7) and lockwashers (8). Lift off cap (2) and let it hang. Remove cushions (3).



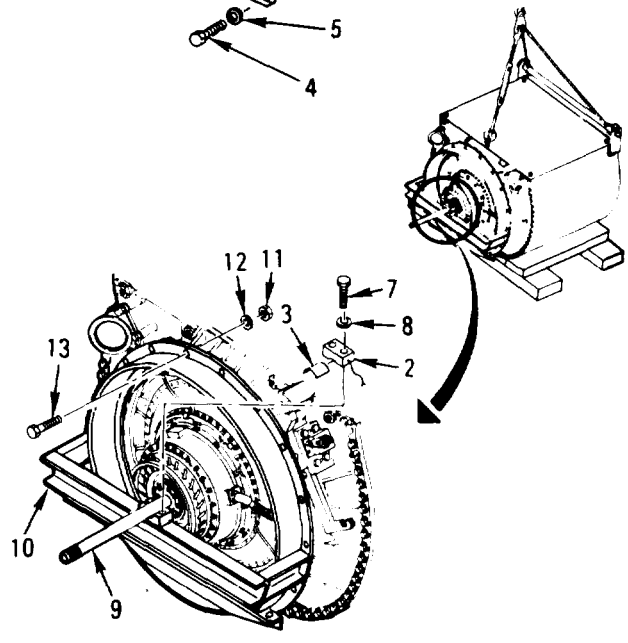
CAUTION

- Do not lean on or hang anything on shaft (9). Damage to bearing seal or air seal may result.
- To prevent forward mounting flange (10) from dropping, remove self-locking nut (11), washer (12), and screw (13) at the 12-o'clock position last.

4. REMOVE FLANGE (10).

   a. Remove 14 nuts (11), washers (12), and screws (13).

   b. Hold flange (10) and remove top nut (11), washer (12), and screw (13) at the 12 o'clock position. Remove flange (10).



5. REMOVE ENGINE/REAR MODULE LIFTING SLING FROM REAR ENGINE SUBASSEMBLY (PAGE 6-23).

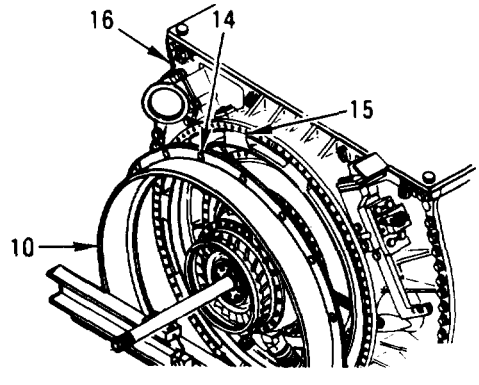
INSTALLATION:

1. INSTALL ENGINE/REAR MODULE LIFTING SLING ON REAR ENGINE SUBASSEMBLY (PAGE 6-23).

2. INSTALL FLANGE (10).

   a. Aline hole (14) in flange (10) with hole (15) in forward header (16). Position and hold flange (10) on header (16).

   b. Install 15 screws (13), washers (12), and new nuts (11).



3. TORQUE SCREWS (13) AND NUTS (11) BETWEEN 10-13 LB-FT (14-18 N·m).

Go on to Sheet 3

REAR ENGINE SUBASSEMBLY REMOVAL FROM AND SHIPPING CONTAINER (Sheet 3 of 4)

4. INSTALL CAP (1), TWO CUSHIONS (2), AND SUPPORT (3).

   a. Place cap (1) and cushions (2) on block (4). Install two screws (5) and new lockwashers (6).

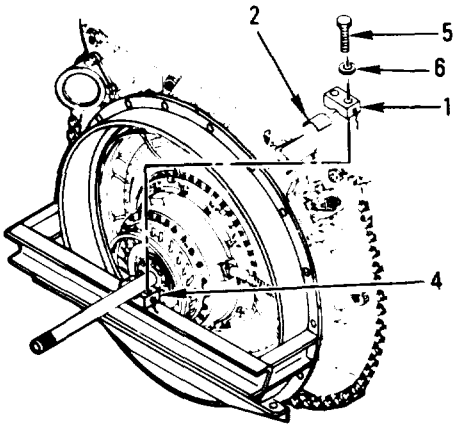
   b. Slide support (3) on shaft (7). Aline two short spaced holes (8) with holes (9) near harness access hole (10).

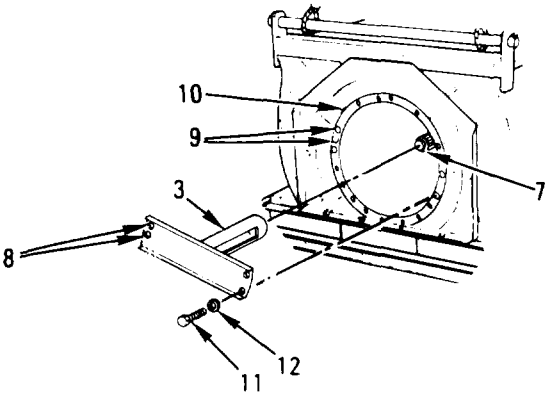
   c. Install four screws (11) and new lockwashers (12).

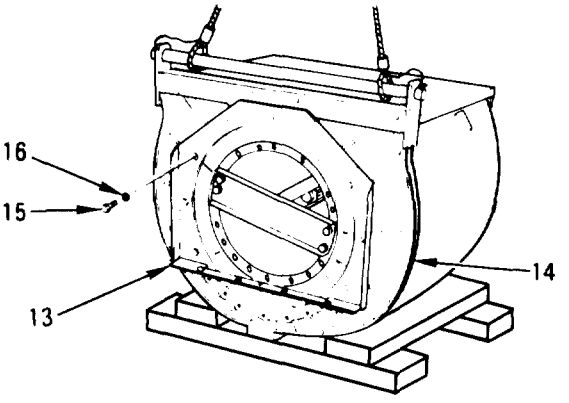
5. INSTALL FLANGE (13).

   Hold flange (13) on header (14) and install nine screws (15) and new lockwashers (16).

6. TORQUE SCREWS (15) BETWEEN 20-24 FT-LB (27-33 N·m).





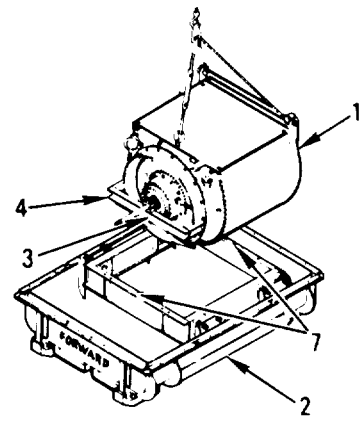


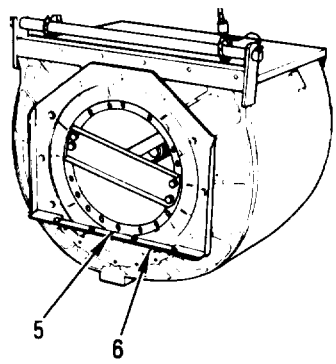
Go on to Sheet 4

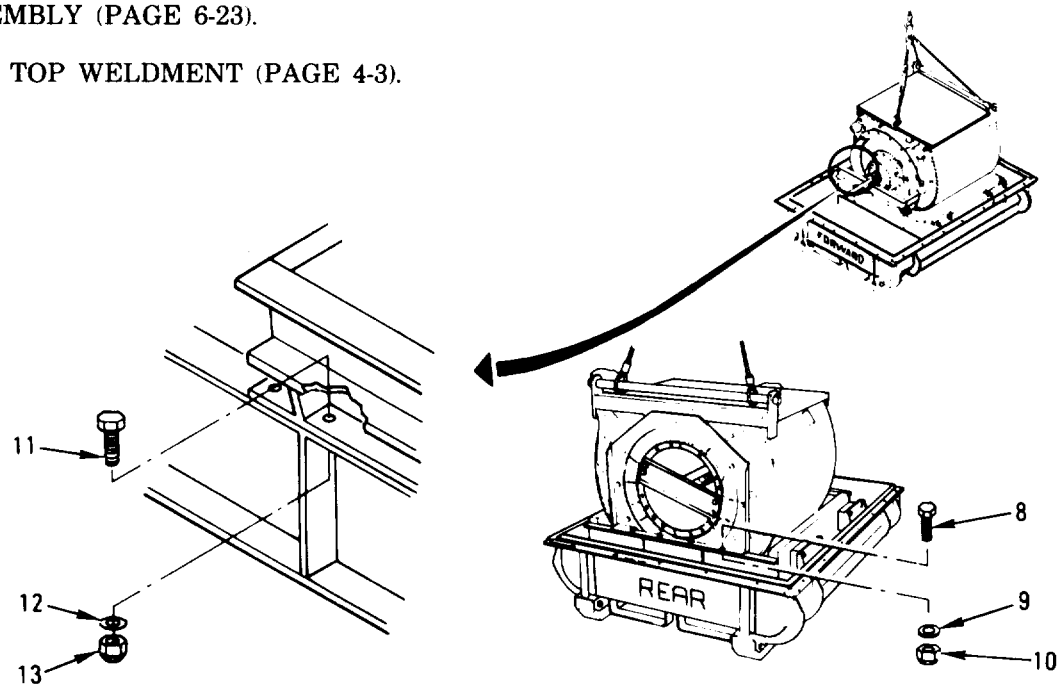
REAR ENGINE SUBASSEMBLY REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 4 of 4)

WARNING

7. INSTALL REAR ENGINE (1).
   a. Position rear engine (1) over weldment (2).
   b. Aline hole (3) in forward flange (4) and hole (5) in rear flange (6) with two pins (7) in weldment (2).
   c. Lower rear engine (1) in weldment (2).
8. INSTALL FOUR SCREWS (8), WASHERS (9), AND NEW NUTS (10). TORQUE SCREWS (8) AND NUTS (10) BETWEEN 52-60 LB-FT (71-81 N·m).
9. INSTALL FOUR SCREWS (11), WASHERS (12), AND NEW NUTS (13). TORQUE SCREWS (11) AND NUTS (13) BETWEEN 52-60 LB-FT (71-81 N·m).
10. REMOVE ENGINE/REAR MODULE LIFTING SLING FROM REAR ENGINE SUBASSEMBLY (PAGE 6-23).
11. INSTALL TOP WELDMENT (PAGE 4-3).







End of Task

REAR ENGINE SUBASSEMBLY REPLACEMENT (Sheet 1 of 3)

SUPPLIES: Rear engine subassembly (Item 43, 44, or 45, Appendix E)
Shortening compound (Item 20, Appendix B)
Wood block (Item 35, Appendix B) (2 required)
Wood block (Item 36, Appendix B) (2 required)

PERSONNEL: Three

EQUIPMENT CONDITION: Transmission assembly removed (TM 34-1)
Forward engine overhead support installed (page 7-4)
Forward engine module (gearbox module attached) removed (page 5-26)
Speed wiring harness removed (page 6-4)
Speedometer adapter removed (page 6-3)
Air tube assembly (reduction gearbox - long) removed (page 6-5)
Air tube assembly (reduction gearbox - short) removed (page 6-6)
Tube assembly (reduction gearbox feed) removed (page 6-7)
Power turbine stator cylinder assembly removed (TM 20-1)
Hose assembly (No. 6A and 6B bearing scavenge) removed (TM 20-1)
Hose assembly (No. 5 inner bearing scavenge) removed (TM 20-1)
Tube assembly (No. 5 and 6 bearings) removed (TM 20-1)
Reduction gearbox assembly removed (page 6-17)
Install engine/rear module lifting sling on rear engine subassembly (page 6-23)
Tube assembly (regenerator drain) removed (TM 20-1)
Tube assembly (outer regenerator drain) removed (TM 20-1)
Tube assembly (inner regenerator drain) removed (TM 20-1)

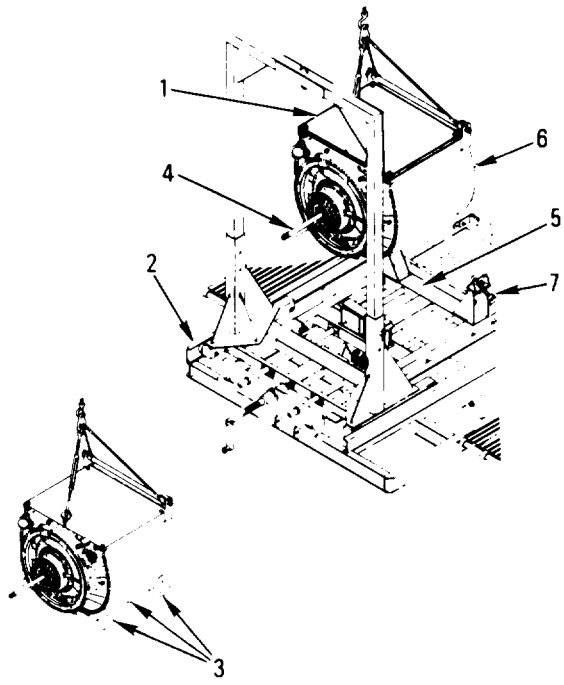
Go on to Sheet 2

REAR ENGINE SUBASSEMBLY REPLACEMENT (Sheet 2 of 3)

REMOVAL:

WARNING

1. MOVE REAR ENGINE (1) FROM MAINTENANCE STAND (2) AND SET ON FOUR WOOD BLOCKS (3).
2. REMOVE TUBE ASSEMBLY (REDUCTION GEARBOX SCAVENGE - REAR) (PAGE 6-8).
3. INSTALL REAR ENGINE SUBASSEMBLY IN SHIPPING CONTAINER (PAGE 6-25).



INSTALLATION:

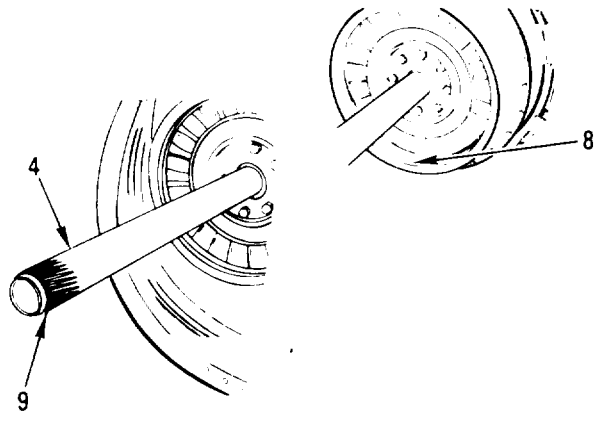
CAUTION

Do not lean on or hang anything on shaft (4) of new rear engine subassembly (1). Damage to bearing seal or air seal may result.

1. INSTALL TUBE ASSEMBLY (REDUCTION GEARBOX SCAVENGE - REAR) (PAGE 6-9).
2. INSTALL ENGINE/REAR MODULE LIFTING SLING ON REAR ENGINE SUBASSEMBLY (PAGE 6-23).

WARNING

3. MOVE NEW REAR ENGINE (1) OVER FRAME (5). ALINE REAR HEADER (6) WITH TWO ADJUSTING SCREWS (7) AND LOWER REAR ENGINE (1) ON FRAME (5).
4. APPLY SHORTENING TO THREE SEAL RINGS (8), SHAFT (4), AND SPLINES (9).



Go on to Sheet 3

REAR ENGINE REAR ENGINE REPLACEMENT (Sheet 3 of 3)

5. INSTALL TUBE ASSEMBLY (INNER REGENERATOR DRAIN) (TM 20-1).
6. INSTALL TUBE ASSEMBLY (OUTER REGENERATOR DRAIN) (TM 20-1).
7. INSTALL TUBE ASSEMBLY (REGENERATOR DRAIN) (TM 20-1).
8. REMOVE ENGINE/REAR MODULE LIFTING SLING FROM REAR ENGINE SUBASSEMBLY (PAGE 6-23).
9. INSTALL REDUCTION GEARBOX ASSEMBLY (PAGE 6-19).
10. INSTALL TUBE ASSEMBLY (NO. 5 AND 6 BEARINGS) (TM 20-1).
11. INSTALL HOSE ASSEMBLY (NO. 5 INNER BEARING SCAVENGE) (TM 20-1).
12. INSTALL HOSE ASSEMBLY (NO. 6A AND 6B BEARING SCAVENGE) (TM 20-1).
13. INSTALL POWER TURBINE STATOR CYLINDER ASSEMBLY (TM 20-1).
14. INSTALL TUBE ASSEMBLY (REDUCTION GEARBOX FEED) (TM 20-1).
15. INSTALL AIR TUBE ASSEMBLY (REDUCTION GEARBOX - SHORT) (PAGE 6-6).
16. INSTALL AIR TUBE ASSEMBLY (REDUCTION GEARBOX - LONG) (PAGE 6-5).
17. INSTALL SPEEDOMETER ADAPTER (PAGE 6-3).
18. INSTALL SPEED WIRING HARNESS (PAGE 6-4).
19. INSTALL FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) (PAGE 5-28).
20. REMOVE FORWARD ENGINE OVERHEAD SUPPORT (PAGE 7-4).
21. INSTALL TRANSMISSION ASSEMBLY (TM 34-l).

End of Task

NO. 10 BEARING SEAL REPLACEMENT (Sheet 1 of 6)

TOOLS: General mechanic's tool kit: automotive **(SC5180-90-N26)**
Arbor press (Item **37,** Appendix D)
Industrial goggles (Item 58, Appendix D)
No. 10 oil seal removal and installation tool (Item 127, Appendix D)
Protective gloves (Item 87, Appendix D)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES: Adhesive sealant (Item 28, Appendix B)
Antiseize compound (Item 2, Appendix B)
Dry cleaning solvent (Item 7, Appendix B)
Gasket (Item 46, Appendix E)
Lockwasher (Item 2, Appendix E) (6 required)
Marker (Item 25, Appendix B)
Plain encased seal (Item 47, Appendix E)
Preformed packing (Item 21, Appendix E)
Shortening compound (Item 20, Appendix B)
Wiping rag (Item 14, Appendix B)

EQUIPMENT COND1TION: Splined shaft removed (page 6-1)

REMOVAL:

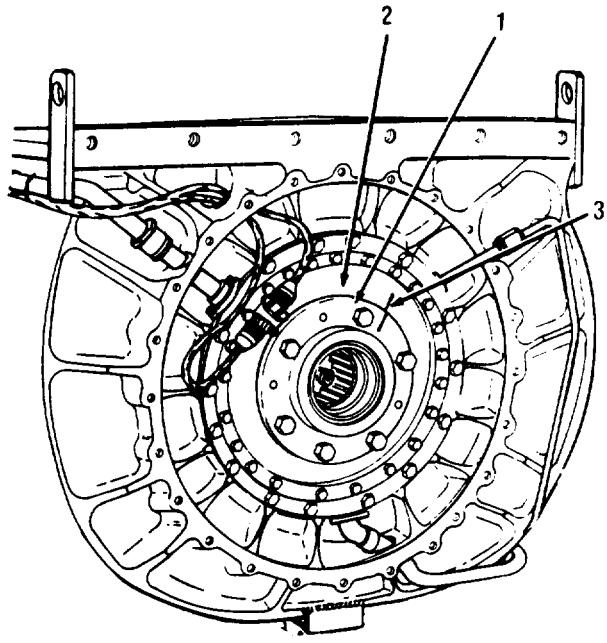
WARNING

CAUTION

Before removing retaining plate (1), plate (1) and area (2) around plate (1) must be clean. If not clean, sand or dirt sticking to parts may fall into bearing area and cause damage.

1. CLEAN PLATE (1) AND AREA (2) AROUND PLATE (1). USE SOLVENT AND RAG.

2. USING MARKER, PLACE A LINE (3) ACROSS THE PLATE AND ENGINE, AS A LOCATER.



Go on to Sheet 2

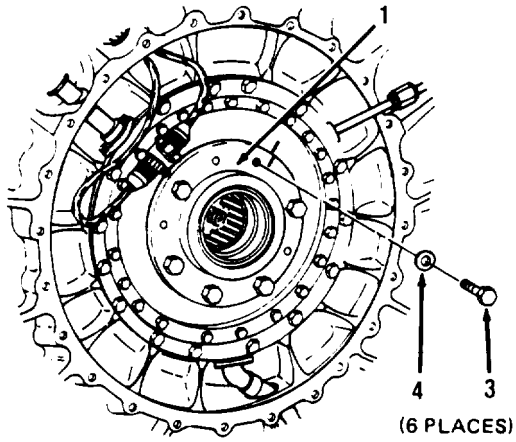
NO. 10 BEARING SEAL REPLACEMENT (Sheet 2 of 6)

1. **REMOVE BEARING RETAINING PLATE (I) /\ND METAL GASKET (2).**

   a. Remove six bolts (3) ,and lockwnshers **(4).**

   h. Install three bolts (3) in three jackscrew holes (5) and tighten evenly to remove plate (I). Remove bolts (3).

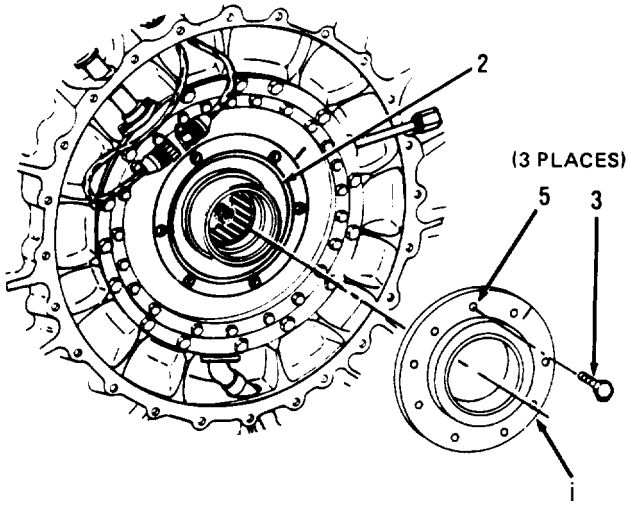
   (. Remove metal gasket (2) from groove (6).

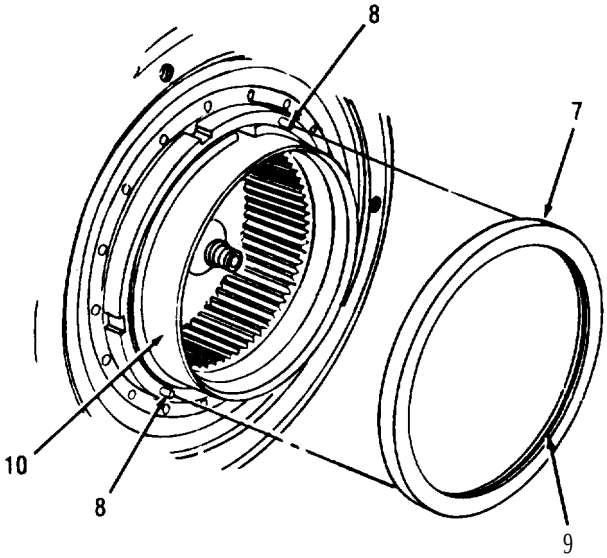


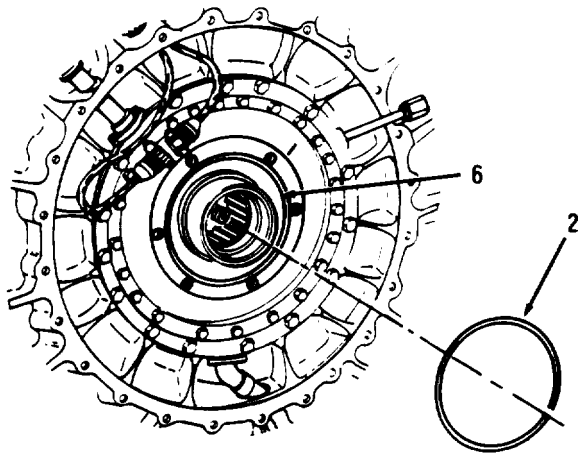
CAUTION

Seal face plate (7) is set on two alignment pins (8). Use care when prying plate (7) loose to prevent damage to alignment pins (8).

4. PRY SEAL FACE PLATE (7) LOOSE, AND SLIDE PLATE (7) AND PREFORMED PACKING (9) OFF SHAFT (10). REMOVE PACKING (9) **FROM PLATE (7).**







Go on to Shcet 3

NO. 10 BEARING SEAL REPLACEMENT (Sheet 3 of 6)

WARNING

Use caution when using press. Improper tools or tools not properly alined may cause injury to personnel or damage to parts or equipment.

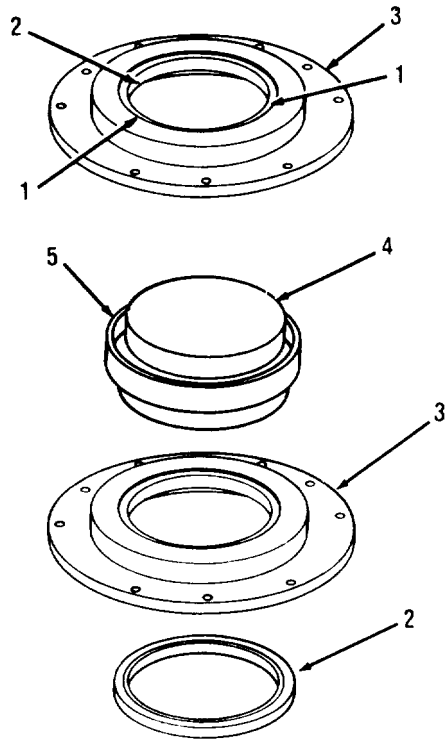
WARNING:

5 CLEAN EXCESS SEALANT (l) FROM SEAL (2). AND PRESS SEAL (2) FROM. PLATE (3). USE REMOVAL AND INSTALLATION TOOL (4).

a. Clean excess sealant (1) from seal (2) and plate (3). Use solvent and rag.

b. Position plate (3) on press. Position removal and installation tool (4), with lip (5) up, on plate (3). Press seal (2) from plate (3).

6. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.



Go on to Sheet 4

NO. 10 BEARING SEAL REPLACEMENT (Sheet 4 of 6)

INSTALLATION:

WARNING

Use **caution** when using press. Improper tools, or tools not properly alined may cause injury to personnel or damage to parts or equipment.

WARNING

1. CLEAN OLD SEALANT FROM PLATE (1) AND INSTALL NEW SEAL (2) IN PLATE (l). USE REMOVAL AND INSTALLATION TOOL (3).

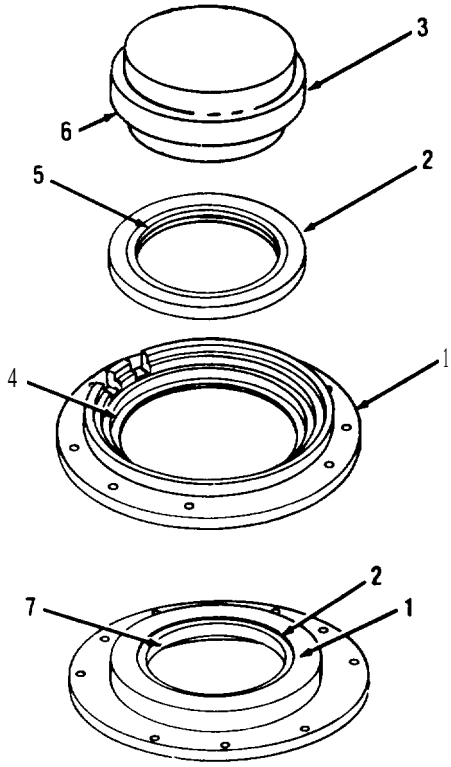
   a. Turn plate (1) over and clean old sealant from seal mating surface (4). Use solvent and rag.

   b. Position plate (1), rear side down, on press. Apply a thin coat of sealant on outside diameter of seal (2). Position seal (2) on plate (1) with carbon element lip (5) up.

   c. Press seal (2) in plate (l). Use tool (3) with lip (6) down.

   d. Using a 0.002 inch (0.051 mm) feeler **gage,** check gap between seal (2) and plate (i) No gap greater than 0.002 inch (0.051 mm) is allowed.

2. VISUALLY INSPECT CARBON ELEMENTS (7) (OF SEAL (2) FOR CHIPS OR CRACKS. IF DAMAGED, REPLACE SEAL (2).



Go on to Sheet 5

NO. 10 BEARING SEAL REPLACEMENT (Sheet 5 of 6)

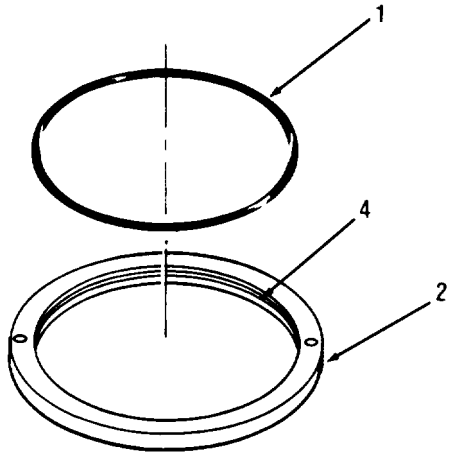
CAUTION

Use care wbcn installing packing (1). Improperly installed packing (1) will cause leakage.

3. INSTALL NEW PACKING (1) IN METAL SEAL RING (2), AND INSTALL METAL SEAL RING (2) ON SHAFT (3).

   a. Apply shortening compound to new packing (1) and install in groove (4) on inside diameter of metal seal ring (2).

   b. Mark and align two holes (5) in forward side of metal seal ring (2) with two pins (6). Slide metal seal ring (2) on shaft (3) until metal seal ring (2) seats against nut (7).

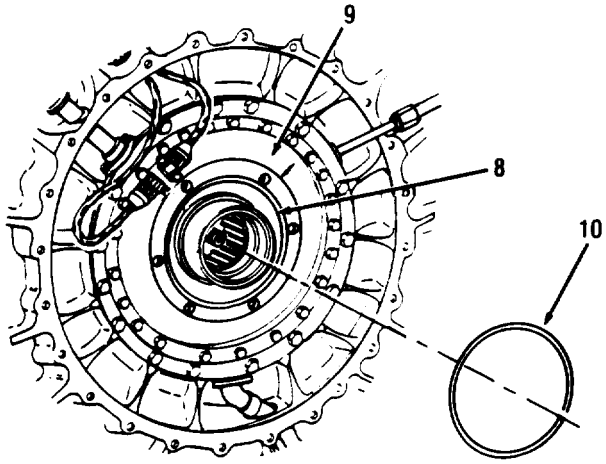


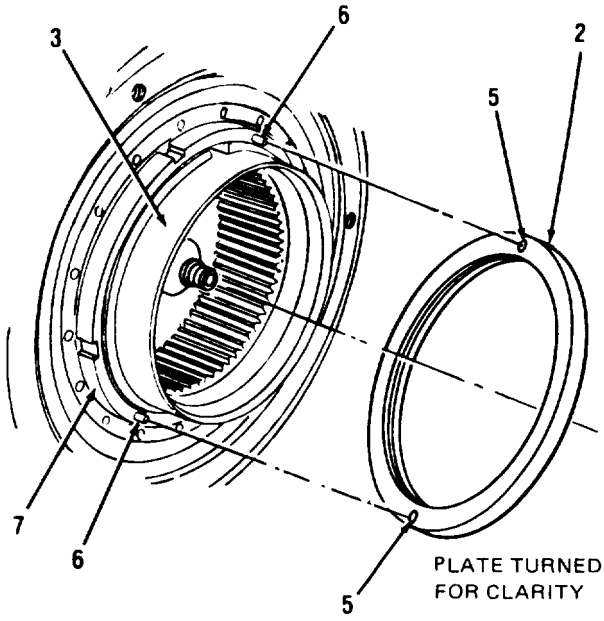
WARNING

4. CLEAN OUT GROOVE (8) IN HOUSING (9), AND SET NEW METAL GASKET (10) IN GROOVE (8).

   a. Clean groove (8) in housing (9). Use solvent and rag.

   b. Apply sealant in groove (8). Set new metal gasket (10) in groove (8).



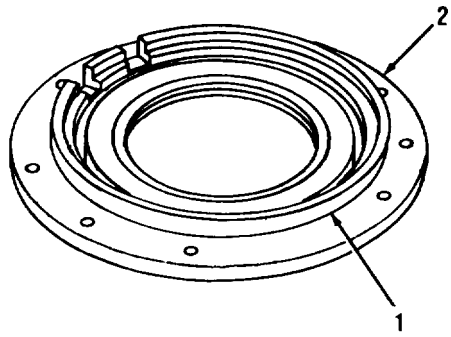


Go on to Sheet 6

NO. 10 BEARING SEAL REPLACEMENT (Sheet 6 of 6)

WARNING

5. CLEAN GASKET MATING AREA (1) OF BEARING RETAINING PLATE (2). USE SOLVENT AND RAG. INSTALL PLATE (2), SIX BOLTS (3) AND NEW LOCK-WASHERS (4). TORQUE BOLTS (3) IN CRISS-CROSS SEQUENCE BETWEEN 55-60 LB-IN (6-7 N-m) AND THEN RE-TORQUE BOLTS IN CRISS-CROSS SEQUENCE BETWEEN 100-110 LB-IN (11-12 N.m).



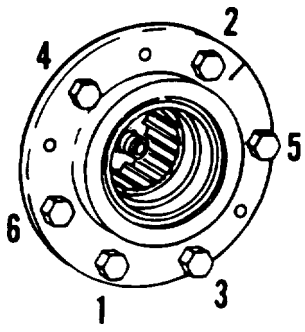
   a. Clean gasket mating area (1) of plate (2). Use solvent and rag.

   b. Apply antiseize compound to six bolts (3). Position plate (2) on housing (5), and install bolts (3) and new lockwashers (4).

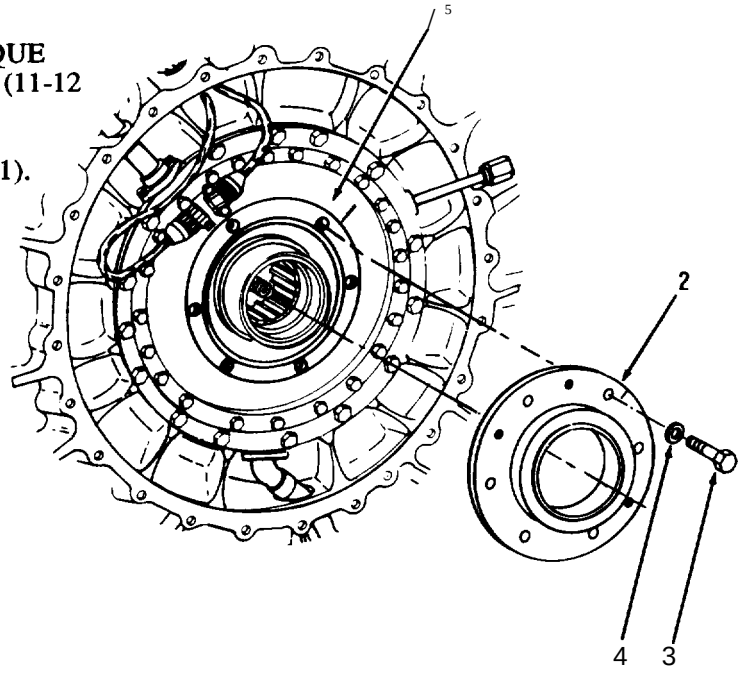
   c. Torque bolts (3) in criss-cross sequence between 55-60 lb-in (6-7 N•m) then retorque between 100-110 lb-in (11-12 N-m).

6. WAIT FIVE MINUTES AND **RETORQUE** BOLTS (3) BETWEEN 100-1**10 LB-IN (11-12** N-m).

7. INSTALL SPLINED SHAFT **(PAGE 6-1).**



TORQUE SEQUENCE



(6 PLACES)

End of Task

SEAL RINGS AND EXPANDER SPRINGS REPLACEMENT (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)

SUPPLIES: Expander spring (Item 49, Appendix E) (3 required)
Nonelectric wire (Item 15, Appendix B)
Seal ring (Item 48, Appendix E) (3 required)
Shortening compound (Item 20, Appendix B)

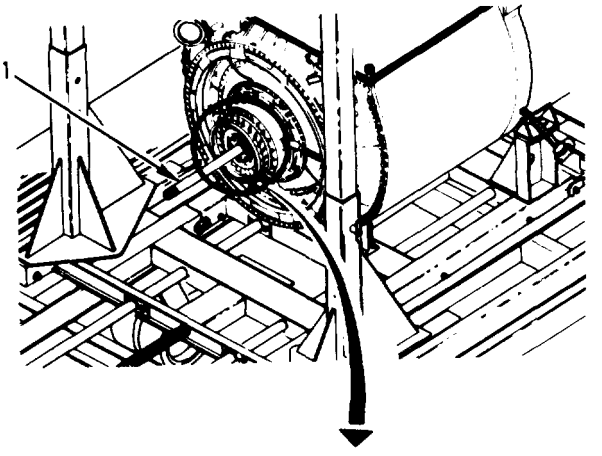
PERSONNEL: Two

EQUIPMENT CONDITION: Forward engine module (gearbox module attached) removed (page 5-26)

REMOVAL:

CAUTION

Do not lean on or hang anything on shaft (1). Damage to bearing seal or air seal may result.



1. REMOVE THREE SEAL RINGS (2).

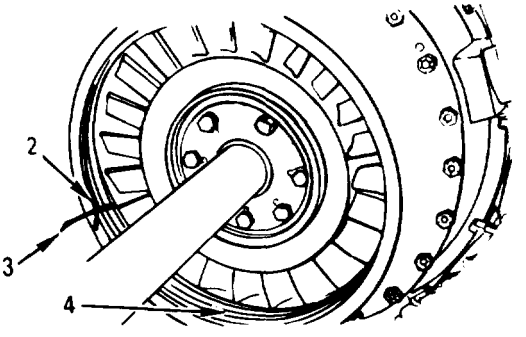
a. Push seal rings (2) in on opposite side of ring separation points.

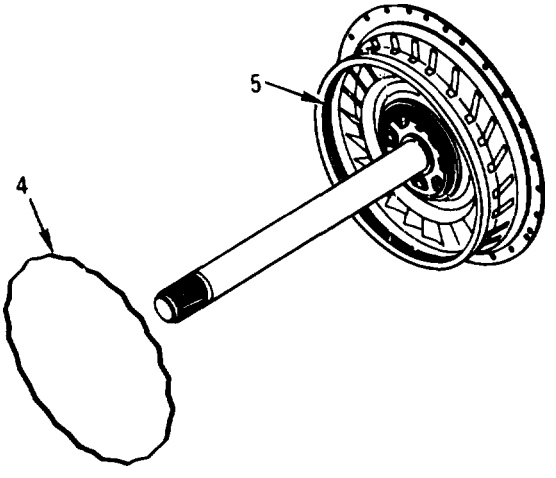
b. Pull out ends of seal rings (2). Slide piece of wire (3) under each seal ring (2).

c. Slide wire (3) all around seal rings (2). Remove rings (2).

2. REMOVE THREE SPRINGS (4).

. Turn springs (4) until springs (4) rise above groove (5) and then remove springs (4).





Go on to Sheet 2

SEAL RINGS AND EXPANDER SPRINGS REPLACEMENT (Sheet 2 of 2)

INSTALLATION:

1. INSTALL THREE NEW SPRINGS (1) AND NEW SEAL RINGS (2).

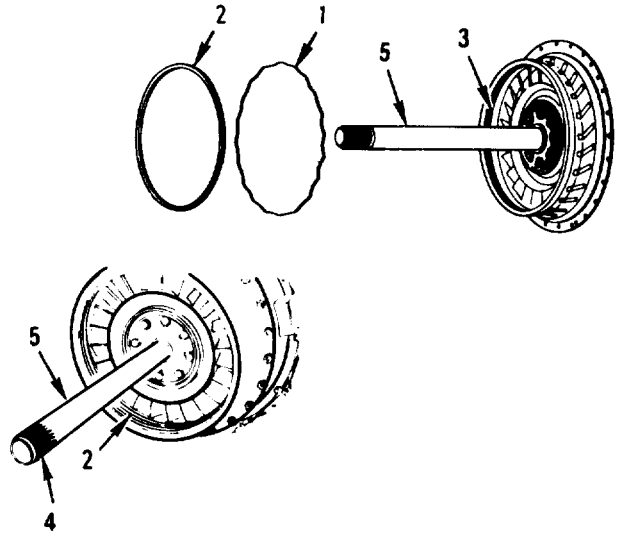
   a. Install springs (1) in grooves (3).

   b. Position seal rings (2) in grooves (3) over springs (l). Snap seal rings (2) in grooves (3).

   c. Apply shortening to seal rings (2) and splines (4) of shaft (5).

2. INSTALL FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) (PAGE 5-28).

End of Task



THERMOCOUPLE WIRING HARNESS REPLACEMENT (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Wire twister pliers (Item 101, Appendix D)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Marker (Item 25, Appendix B)
Nonelectric wire (Item 15, Appendix B)
Self-locking nut (Item 24, Appendix E) (4 required)

EQUIPMENT CONDITION: Forward engine module (gearbox module attached) removed (page 5-26)

Go on to Sheet 2

THERMOCOUPLE WIRING HARNESS REPLACEMENT (Sheet 2 of 2)

NOTE

Use this task to replace any harness (l). One harness (1) is shown.

REMOVAL:

1. REMOVE HARNESS (l).
   a. Cut safety wire and remove four bolts (2) and clamps (3).
   b. Mark location of clamps (4) on harness (1) and remove four bolts (5), self-locking nuts (6), clamps (4), and two brackets (7).
   c. Cut safety wire and remove plug (8).
   d Remove harness (1) from inside of rear module (9). Note location of marks.
2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

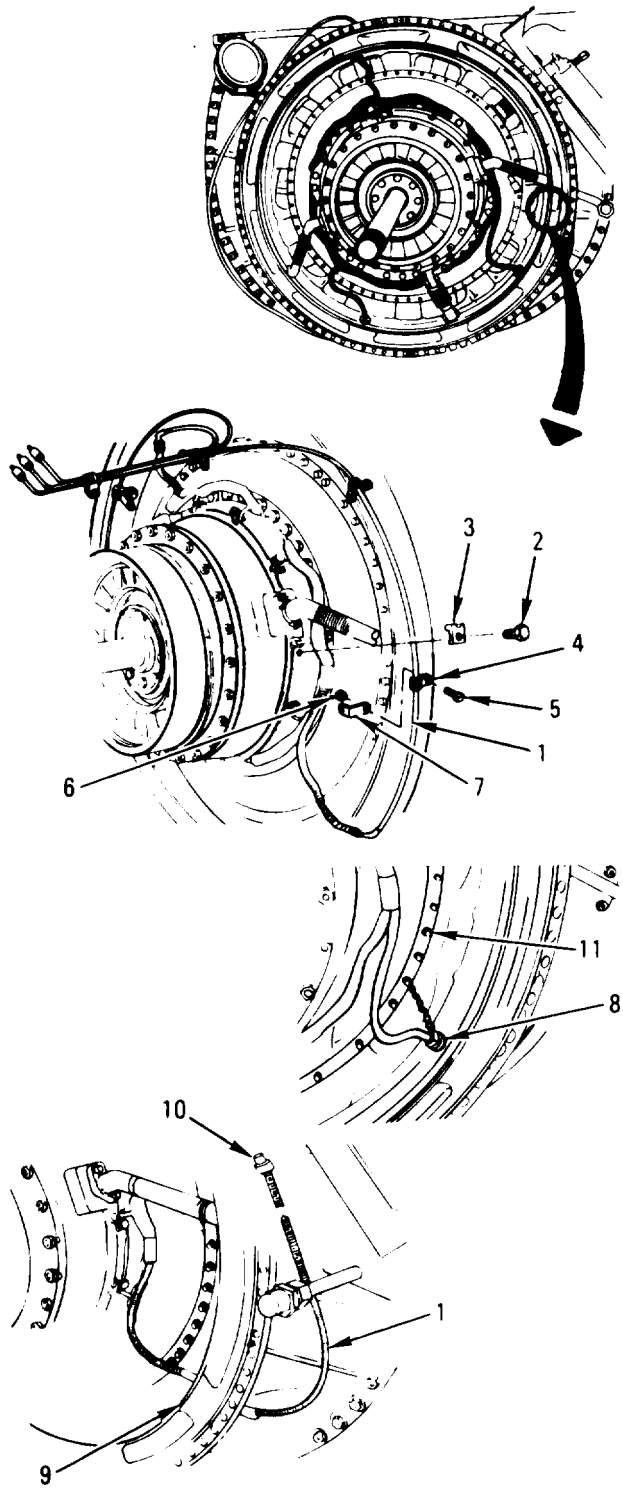
INSTALLATION:

1. INSTALL HARNESS (l).

NOTE

If harness (1) is new do step a.

   a. Transfer marks made during removal to same locations on new harness (l).
   b. Push connector end (10) of harness (1) through inside of rear module (9). Place harness (1) on engine.
   c. Apply antiseize compound to threads of plug (8), Install plug (8) and wire to one bolt (11).
   d. Apply antiseize compound to four bolts (2). Put on four clamps (3). Install and wire bolts (2).
   e. Put four clamps (4) and two brackets (7) on harness (1) at marked locations. Install four bolts (5) and new nuts (6).
2. INSTALL FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) (PAGE 5-28).



End of Task

ADAPTER AND SHAFT ASSEMBLY REPAIR (Sheet 1 of 8)

TOOLS: General mechanic's tool kit: automotive (SC5180-90-N26)
Adapter, 1/4-inch male, 3/8-inch female (Item 33, Appendix D)
Extension, 3/4-inch drive, 16-inch (Item 121, Appendix D)
Extension, 3/8-inch drive, 12-inch (Item 111, Appendix D) (2 required)
Feeler gage (Item 142, Appendix D)
Hinged handle 3/4-inch drive (Item 113, Appendix D)
Holding fixture (Item 110, Appendix D)
Holding fixture (Item 114, Appendix D)
Industrial goggles (Item 58, Appendix D)
Protective gloves (Item 87, Appendix D)
Puller (Item 115, Appendix D)
Puller (Item 116, Appendix D)
Ratchet handle 3/4-inch drive (Item 112, Appendix D)
Ratchet handle 3/8-inch drive (Item 9, Appendix D)
Socket wrench (Item 118, Appendix D)
Socket wrench adapter, 3/4-inch male, 1/2-inch female (Item 120, Appendix D)
Spanner wrench (Item 119, Appendix D)
Torque wrench 0-150 ft-lb (Item 24, Appendix D)
Torque wrench 0-600 ft-lb (Item 107, Appendix D)
Torque wrench 0-600 in-lb (Item 17, Appendix D)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Bumper stop (Item 201, Appendix E)
Gasket (Item 147, Appendix E)
Keywasher (Item 150, Appendix E) (9 required)
Lubrication oil (Item 11, Appendix B)
Marker (Item 25, Appendix B)
Nut, plain round (Item 148, Appendix E)
Oven cleaner (Item 43, Appendix B)
Ring, retaining (Item 202, Appendix E)
Seal ring assembly, metal (Item 149, Appendix E)
Sheet, rubber (Item 45, Appendix B)
Shortening compound (Item 20, Appendix B)
Toothbrush, adult (Item 47, Appendix B)
Washer, forward stop keylock (Item 151, Appendix E)
Wiping rag (Item 14, Appendix B)

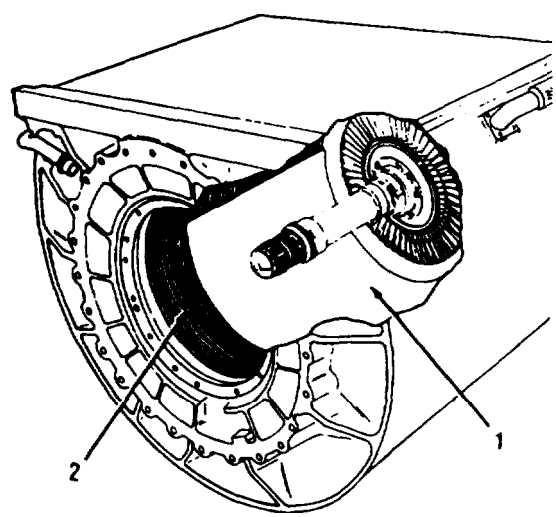
EQUIPMENT CONDITION: Reduction gearbox assembly removed (page 7-16)

REMOVAL:

WARNING

Inner diameter of recuperator is sharp and may be hot. Use rubber mat to prevent injury or burns and also to prevent damage to recuperator from dropped tools or other objects.

1. PLACE RUBBER MAT (1) IN LOWER HALF OF RECUPERATOR (2) TO PROTECT RECUPERATOR AND CATCH DROPPED OBJECTS.



Go on to Sheet 2

ADAPTER AND SHAFT ASSEMBLY REPAIR (Sheet 2 of 8)

2. USING FLASHLIGHT, LOCATE NUMBERED MATCHMARKS ON SPLINED ADAPTER (1) AND NINE BOLTS (2). WITH MARKER. PLACE A LINE (3) ACROSS BOLT NUMBERED 1 (2), SPLINED ADAPTER (1) AND TURBINE ROTOR (4).

3. INSTALL HOLDING FIXTURE (5) OVER END OF ADAPTER AND SHAFT ASSEMBLY (6) AND ATTACH TO RECUPERATOR WITH THREE BOLTS (7).

4. DISCONNECT ADAPTER AND SHAFT ASSEMBLY (6) FROM TURBINE ROTOR (4).

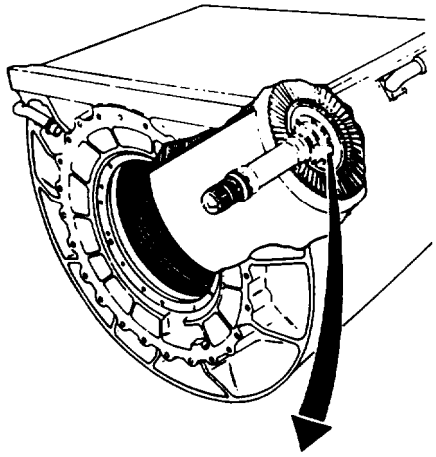
   a. Bend tabs of nine keywashers (8).

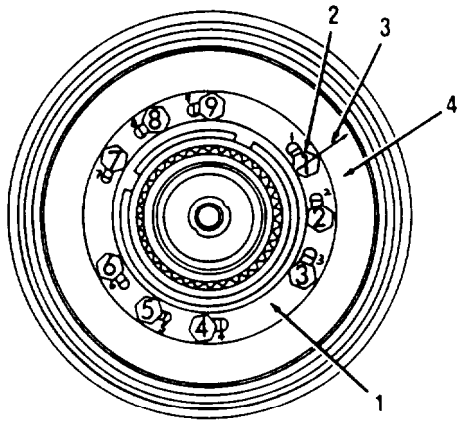
   b. Remove bolts (2) and keywashers (8). Discard keywashers (8). Remove holding fixture (5).

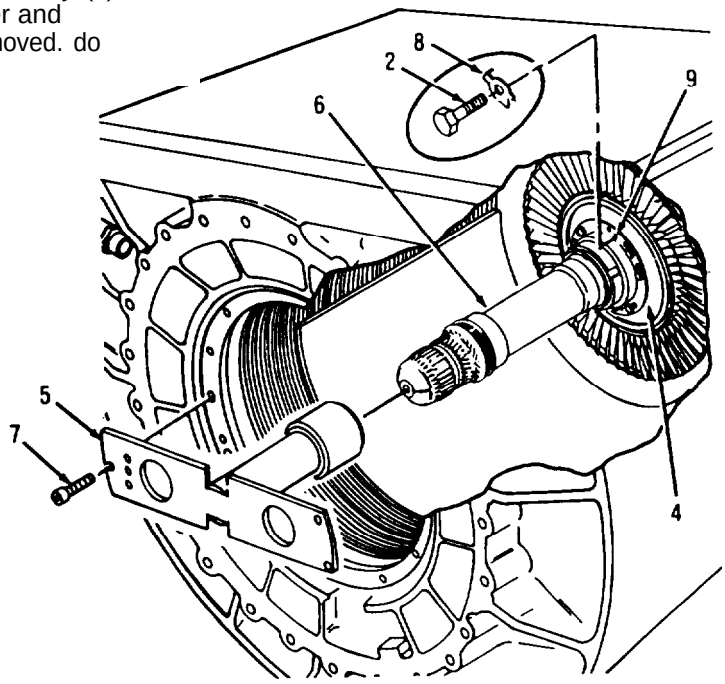
CAUTION

Do not damage or discard bolts (2). The nine bolts (2), and holes (9) in the splined adapter are numbered and matched. If bolts (2) are damaged. replace rear engine subassembly (page 6-28).

   c. Gently rock adapter and shaft assembly (6) off the turbine rotor (4). if adapter and shaft assembly (6) cannot be removed. do step 5. If removed, go to step 6.







Go on to Sheet 3

ADAPTER AND SHAFT ASSEMBLY REPAIR (Sheet 3 of 8)

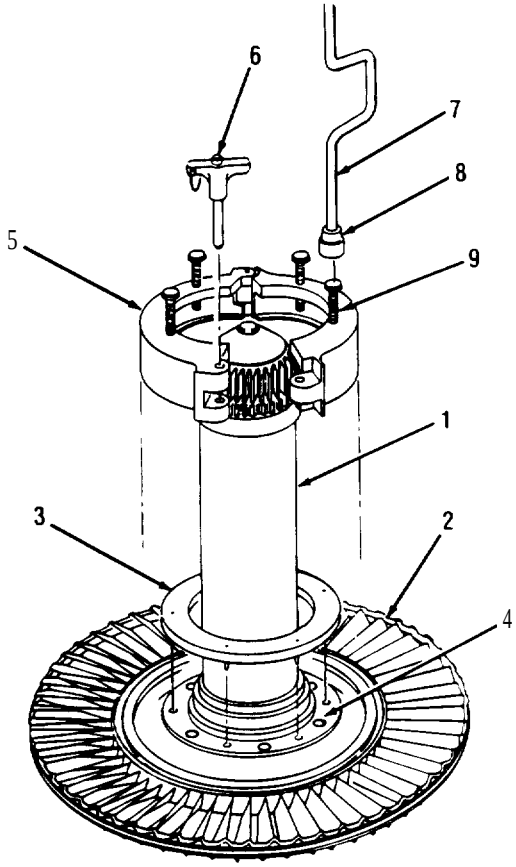
5. INSTALL PULLER AND REMOVE ADAPTER AND SHAFT ASSEMBLY (1) FROM TURBINE ROTOR (2).

   a. Install ring (3) over adapter and shaft assembly (1). Aline pins of ring with small holes in flange (4) of adapter and shalt assembly (1).

   b. install clamp (5) around flange (4). Make sure edge of clamp (5) is under edge of flange (4). Install locking pin (6).

   c. Using crank (7) and socket (8), tighten the four jackscrews (9) in a staggered sequence, one quarter turn at a time, until adapter and shaft assembly (1) is separated from turbine rotor (2).

   d. Remove puller from adapter and shaft assembly (1).

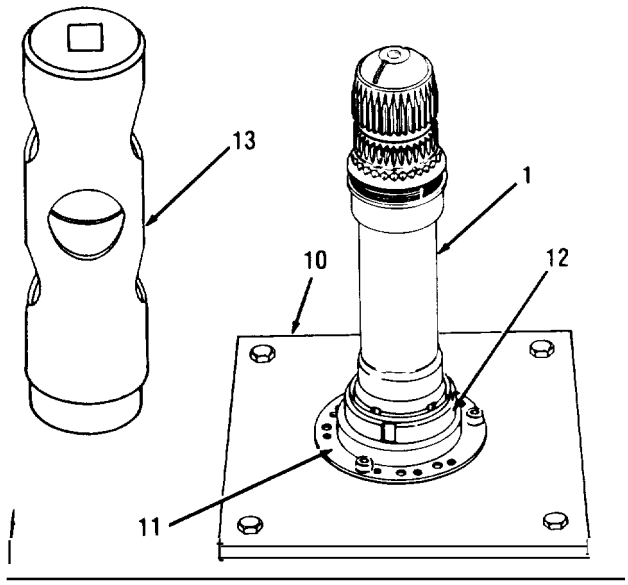


6. INSTALL AND SECURE ADAPTER AND SHAFT ASSEMBLY (1) ON HOLDING FIXTURE (10) WHICH IS SECURED ON WORK SURFACE.

7. DISCONNECT SHAFT FROM SPLINED ADAPTER (11).

   a. Straighten deformed portion of retaining nut (12) from shaft.

   b. Place spanner wrench (13) over shaft and engage retaining nut (12). Turn clockwise and loosen retaining nut (12) until shaft separates from adapter (11).



Go on to Sheet 4

ADAPTER AND SHAFT ASSEMBLY REPAIR (Sheet 4 of 8)

8. REMOVE THREADED STOP (1). KEY-LOCK WASHER (2), SPLINED GEAR (3), RETAINING NUT (4) AND METAL SEAL RING ASSEMBLY (5) FROM SPLINED ADAPTER (6).

a. Straighten edge of keylock washer (2).

b. Using socket wrench (7), turn counter-clockwise to remove threaded stop (1). Remove keylock washer (2) and discard.

NOTE

Splined gear (3) and splined adapter (6) should be installed in same position they were removed.

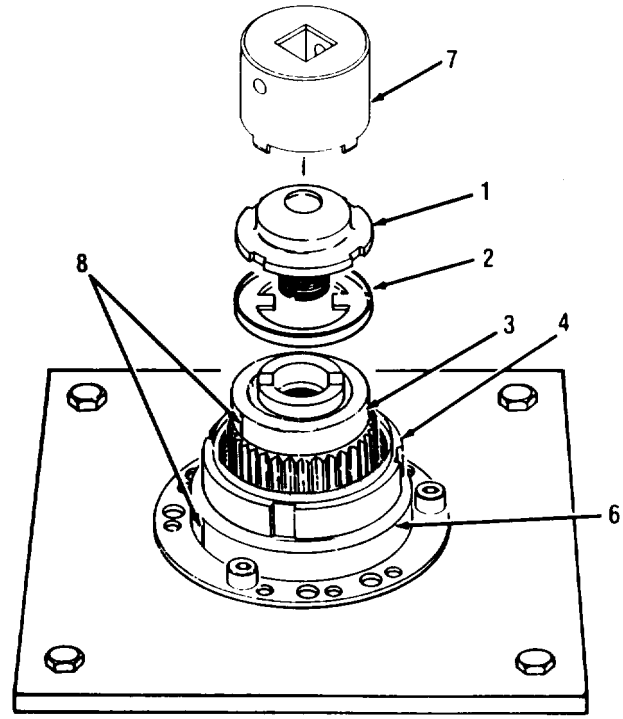
c. Look for matchmarks (8) on splined gear (3) and splined adapter (6). If not there use marker to place matctmmaks there.

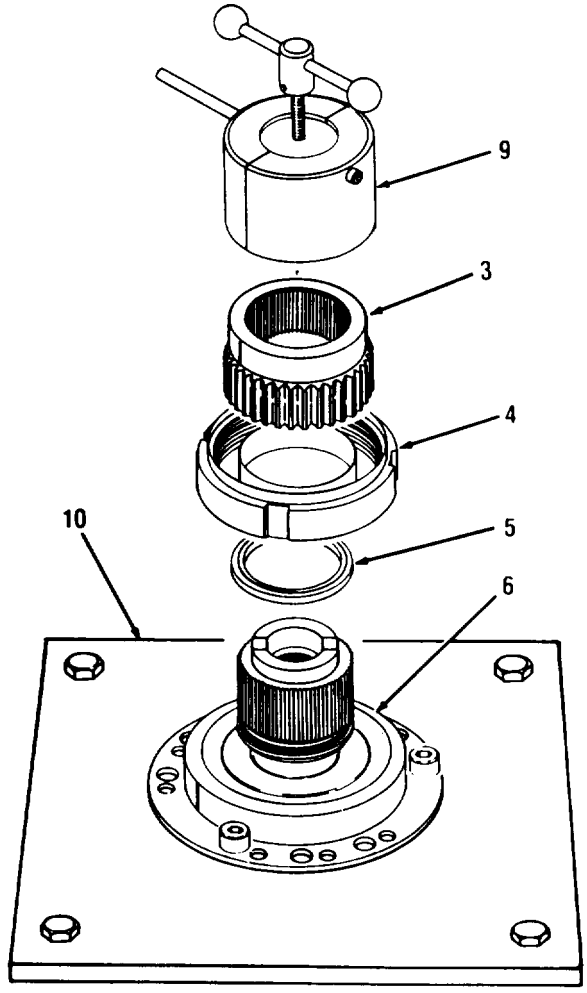
d. Install puller (9) and remove splined gear (3).

e. Remove retaining nut (4) and discard.

f. Remove metal seal ring assembly (5) from splined adapter (6) and discard.

g. **Remove** splined adapter (6) from fixture (10).





Go on to Sheet 5

ADAPTER AND SHAFT ASSEMBLY REPAIR (Sheet 5 of 8)

9. REMOVE METAL GASKET (1) FROM INSIDE OF SPLINED SHAFT (2). DISCARD GASKET.

10. REMOVE RETAINING AND SEALING RINGS (3) FROM SPLINED SHAFT (2) (PAGE 6-22.5).

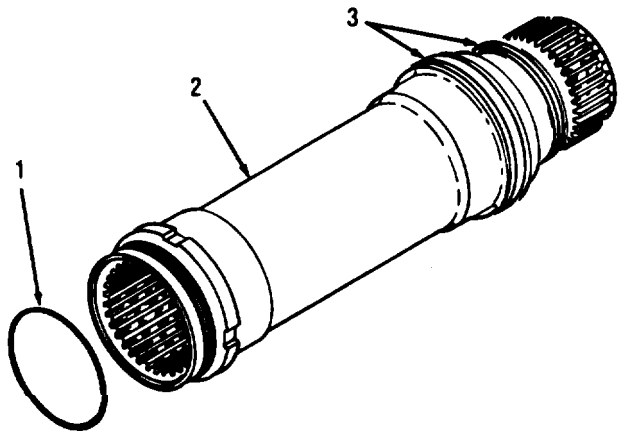
11. CLEAN SPLINED SHAFT (2), THREADED STOP (4), SPLINED SPUR GEAR (5) AND SPLINED ADAPTER (6).

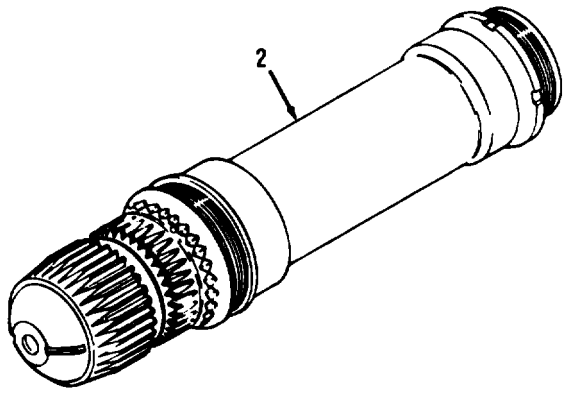
WARNING

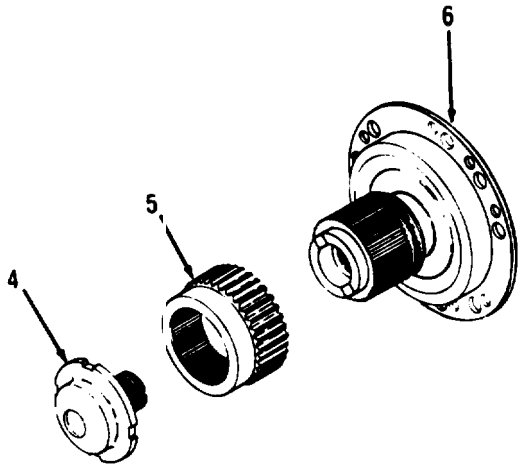
a. Spray oven cleaner on splined shaft (2), threaded stop (4), splined spur gear (5) and splined adapter (6). Let stand for 30 minutes.

b. Scrub with tooth brush and wipe clean wilh clean rag.

12. INSPECT ALL PARTS FOR DAMAGED THREADS AND OBVIOUS DAMAGE. IF FOUND, REPLACE REAR ENGINE SUBASSEMBLY (PAGE 6-28).







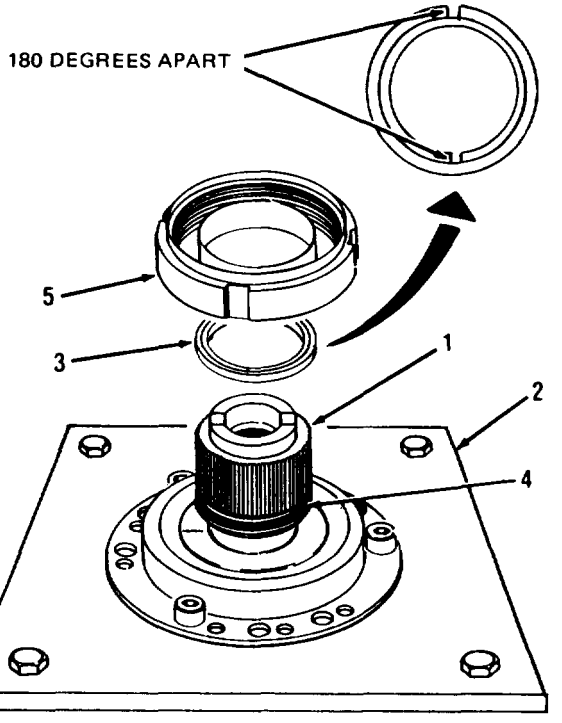
Go on to Sheet 6

ADAPTER AND SHAFT ASSEMBLY REPAIR (Sheet 6 of 8)

INSTALLATION:

1. INSTALL AND SECURE SPLINED ADAPTER (1) ON HOLDING FIXTURE (2).

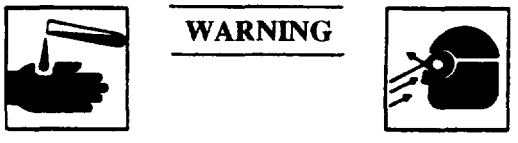
2. INSTALL NEW METAL SEAL RING ASSEMBLY (3) INTO GROOVE (4) OF SPLINED ADAPTER (l), AND CHECK THAT GAPS IN SEAL RING ASSEMBLY ARE 180 DEGREES APART.



NOTE

Depress installed seal ring assembly (3) to allow nut (5) to fit over seal ring assembly.

3. COAT THREADS OF NEW RETAINING NUT (5) WITH ANTISEIZE COMPOUND AND INSTALL ON SPLINED ADAPTER (l). WIPE OFF EXCESS COMPOUND WITH RAG.



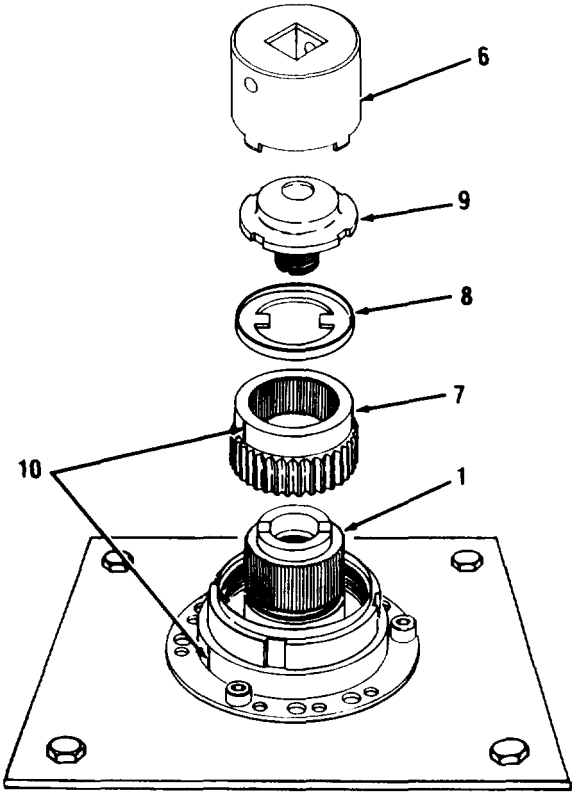
4. USING SOCKET WRENCH (6), INSTALL SPLINED SPUR GEAR (7), NEW KEYLOCK WASHER (8) AND THREADED STOP (9) ON SPLINED ADAPTER (l). TORQUE THREADED STOP TO 50-55 LB-FT (67.8-74.6 N-m).

   a. Aline existing match marks (10). Install splined spur gear (7) on splined adapter (1).

   b. Install new keylock washer (8) on splined spur gear (l).

   c. Lubricate threads of threaded stop (9) with lubricating oil. Use socket wrench (6) to install threaded stop (9) in splined adapter (l). Torque threaded stop to 50-55 Ib-ft (67.8-74.6 N-m).

   d. Deform keylock washer (8) into threaded stop (9) at two places, 180 degrees apart. Do not shear keylock washer.



Go on to Sheet 7

ADAPTER AND SHAFT ASSEMBLY REPAIR (Sheet 7 of 8)

5. INSTALL NEW METAL GASKET (1) ONTO GROOVE OF SPLINED SHAFT (2). COAT THREADS OF SPLINED SHAFT (2) WITH ANTI-SEIZE COMPOUND.

6. CAREFULLY INSTALL SPLINED SHAFT (2) ONTO SPLINED ADAPTER (3). TURN SHAFT RETAINING NUT (4) COUNTERCLOCKWISE BY HAND.

7. USING SPANNER WRENCH (5), TORQUE RETAINING NUT (4) TO 290-310 LB-FT (393-421 N.M). DEFORM LOCKING RING ON RETAINING NUT (4) AT TWO PLACES 180 DEGREES APART

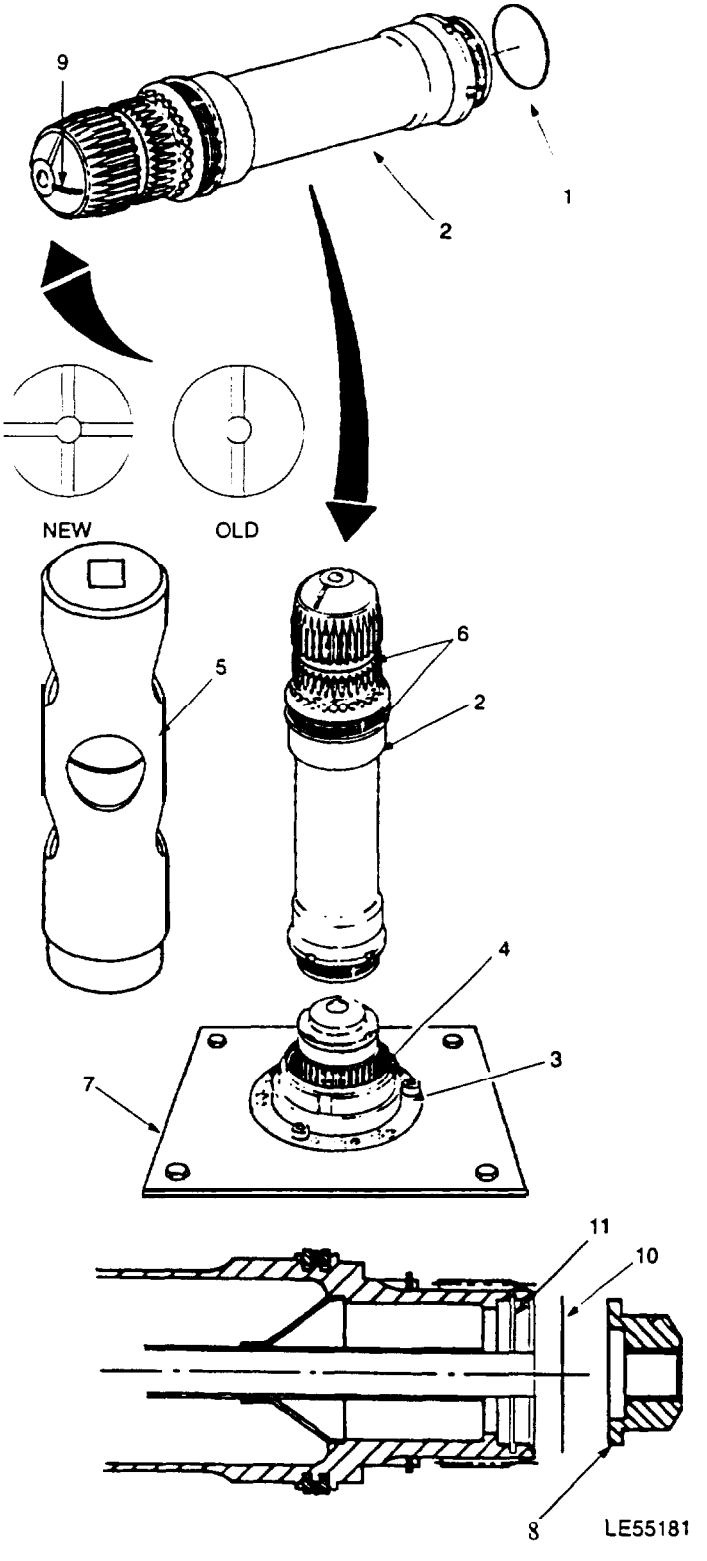
8. INSTALL NEW RETAINING AND SEALING RINGS (6) ON SPLINED SHAFT (2) (PAGE 6-22.5).

8.1 INSPECT BUMPER STOP (8) TO DETERMINE IF IT IS OF THE LATEST CONFIGURATION. IF THE BUMPER STOP END IS EQUIPPED WITH ONLY TWO OIL GROOVES (9), THEN A NEW BUMPER STOP EQUIPPED WITH FOUR OIL GROOVES MUST BE INSTALLED. THIS REQUIREMENT IS CRITICAL AND CANNOT BE DEFERRED. IF THE BUMPER STOP IS EQUIPPED WITH FOUR GROOVES CONTINUE TO STEP 9. IF THE BUMPER STOP IS EQUIPPED WITH TWO GROOVES, REPLACE STOP AS FOLLOWS:

   a. Using a suitable prying tool, remove retaining ring (10). Remove bumper stop (8).

   b. Install replacement bumper stop equipped with four oil grooves (9). Inspect retaining ring (10). If serviceable, reuse retaining ring by installing into groove (11) making sure it is properly seated. If original retaining ring was damaged, install a replacement retaining ring.

9. REMOVE SHAFT AND ADAPTER ASSEMBLY FROM FIXTURE (7).



Go on to Sheet 8

ADAPTER AND SHAFT ASSEMBLY REPAIR (Sheet 8 of 8)

NOTE

Bolts and holes are match numbered. Make sure to install bolts in holes with the same number.

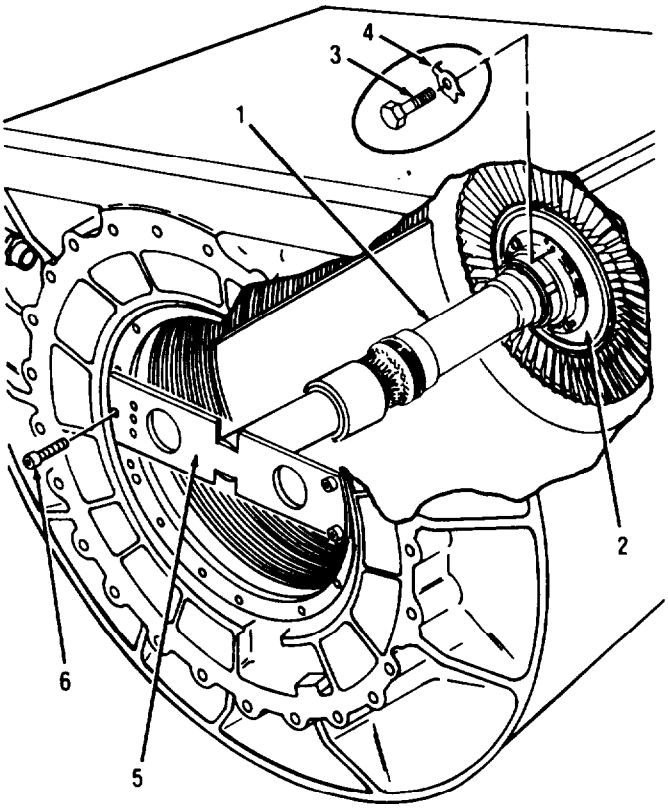
10. ALINE MATCH MARKS AND INSTALL ADAPTER AND SHAFT ASSEMBLY (1, ON TURBINE ROTOR (2) WITH NINE NUMBERED BOLTS (3) AND NINE NEW KEYWASHERS (4). BOLTS MUST BE PLACED IN ASSIGNED NUMBERED POSITION.

11. INSTALL HOLDING FIXTURE (5) WITH THREE BOLTS (6) TO PREVENT TURBINE ROTOR (2) FROM TURNING. TORQUE BOLTS 3) IN STAGGERED SEQUENCE TO 235-255 LB-IN (26.56-28.82 N•m). REMOVE HOLDING FIXTURE (5).

12. USING 0.001 INCH (0.025 MM) FEELER GAGE (7). CHECK GAP BETWEEN SPLINED ADAPTER (8) AND TURBINE ROTOR (2). NO GAP IS ALLOWED. IF THERE IS A GAP REMOVE, REINSTALL AND RETORQUE ADAPTER AND SHAFT ASSEMBLY (1).

13. BEND TABS ON KEYWASHERS (4). IF KEYWASHER (4) GETS DAMAGED OR SHEARED. REPLACE KEYWASHER (4).

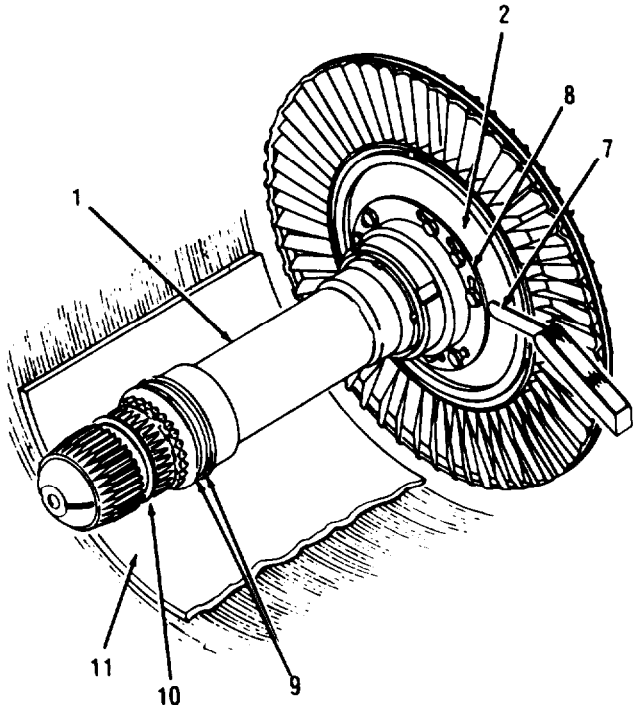
14. APPLY LIGHT COAT OF SHORTENING COMPOUND TO SEAL RINGS (9) AND OIL DAM RING (10) TO PREVENT MOVEMENT. REMOVE RUBBER MAT (11).



CAUTION

Before installation of reduction gearbox make sure split lines of seal rings (9) on adapter and shaft assembly are 180 degrees apart from each other.

15. INSTALL REDUCTION GEARBOX (PAGE 6-17).



End of Task

NO. 5 SEAL AND DIAPHRAGM ASSEMBLY REPLACEMENT (Sheet 1 of 7)

TOOLS: General mechanic's tool kit: automotive (SC5180-90-N26)
Industrial goggles (Item 58, Appendix D)
Press, arbor (Item 37, Appendix D)
Tool, No. 5 seal (Item 140, Appendix D)
Torque wrench, 0-150 lb-in (Item 27, Appendix D)

SUPPLIES: Antiseize compound (Item 2, Appendix B)
Diaphragm assembly (Item 155, Appendix E)
Marker (Item 25, Appendix B)
Non-electric wire (Item 15, Appendix B)
Penetrating oil (Item 44, Appendix B)
Ring, retaining (Item 154, Appendix E)
Seal, plain, No. 5 (Item 126, Appendix E)
Seal, special (Item 127, Appendix E)
Shortening compound (Item 20, Appendix B)

EQUJPMENT CONDITIONS: Forward engine module (gearbox module attached) removed (page 5-25)

PERSONNEL: Two

REMOVAL:

WARNING

Support turbine rotor shaft (1) and turbine nozzle (2) when removing to prevent damage to parts and injury to personnel.

CAUTION

Do not lean or hang anything on shaft (1). Damage to bearing or seals may result.

1. USING MARKER, PLACE A LINE (3) ON NOZZLE (2) AND POWER TURBINE HOUSING (4).

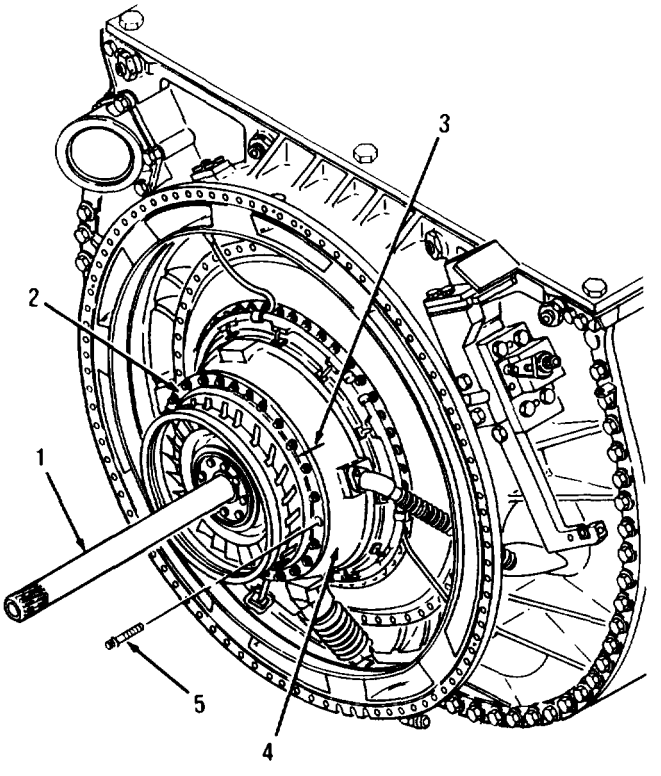
2. REMOVE SHAFT (1) AND NOZZLE (2) FROM POWER TURBINE HOUSING (4).

   a. Soak 24 bolts (5) with penetrating oil.

   b. Cut safety wire and remove 24 bolts (5).

NOTE

If nozzle (2) did not separate from turbine housing (4), go to step 3. If nozzle separated from power turbine housing (4). go to step 4.



Go on to Sheet 2

NO. 5 SEAL AND DIAPHRAGM ASSEMBLY REPLACEMENT (Sheet 2 of 7)

NOTE

Tighten three jackscrews (1) evenly opposite each other.

3. USING THREE BOLTS (1) AS JACK-SCREWS, INSTALL BOLTS INTO THREE THREADED HOLES (2). TIGHTEN EVENLY UNTIL NOZZLE (3) IS AWAY FROM POWER TURBINE HOUSING (4). REMOVE THREE BOLTS (l).

4. REMOVE SHAFT (5), NOZZLE (3) AND SPACER RING (6).

5. INSPECT NO. 5 BEARING (7) FOR CORROSION, PITTING OR FRACTURE. IF DAMAGE EXISTS, INSTALL SHAFT (5), NOZZLE (3) AND SPACER RING (6) USING OLD PARTS. REPLACE REAR ENGINE SUBASSEMBLY (PAGE 6-28).

6. REMOVE HOUSING ASSEMBLY (8) FROM NO. 5 SEAL AND DIAPHRAGM ASSEM-BLY (9).

   a. With marker place a line (10) on housing (8) and power turbine housing (4).

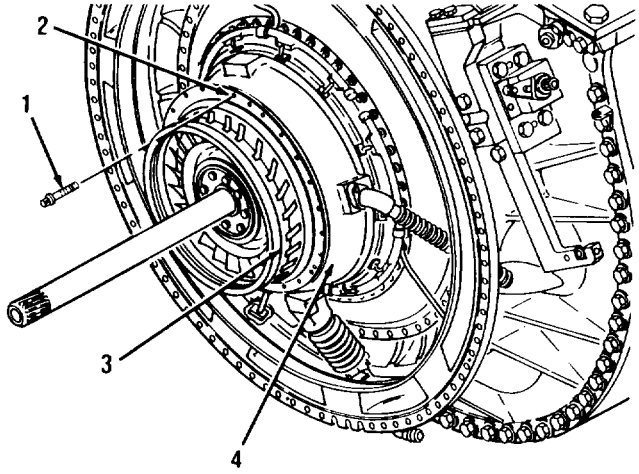
   b. Soak 12 bolts (11) with penetrating oil. Cut safety wire and remove 12 bolts.

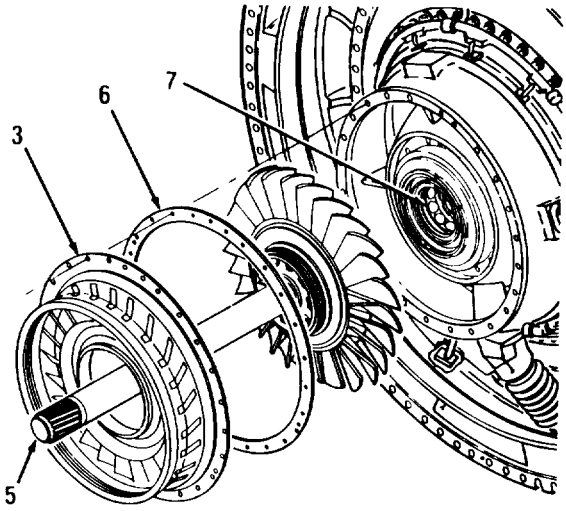
NOTE

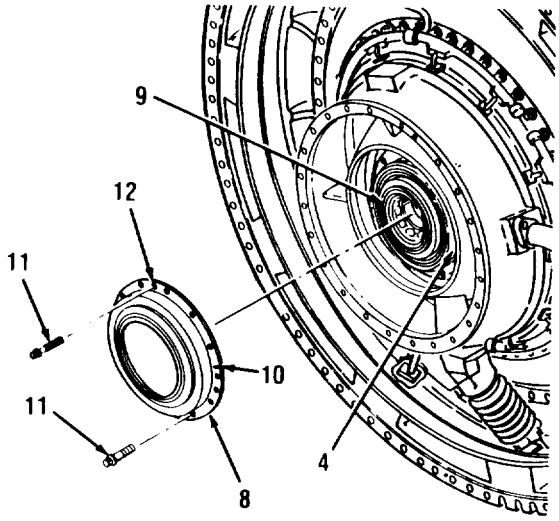
Tighten three jackscrews (11) evenly opposite each other.

   c. Using three bolts (11) as jackscrews, install into three threaded holes (12). Tighten evenly until housing (8) is away from diaphragm assembly (9).

   d. Remove housing (8). Remove three bolts (11).







Go on to Sheet 3

NO. 5 **SEAL AND DIAPHRAGM ASSEMBLY REPLACEMENT** (Sheet **3 of 7)**

CAUTION

Remove No. 5 seal and diaphragm assembly (1) only by using jackscrews. Otherwise, damage to seal will occur.

7. REMOVE NO. 5 SEAL AND DIAPHRAGM ASSEMBLY (1) FROM NO. 5 BEARING HOUSING ASSEMBLY (2).

   a. Using marker place a line (3) on diaphragm assembly (1) and power turbine housing (4).

NOTE

Tighten three jackscrews (5) evenly opposite each ottier.

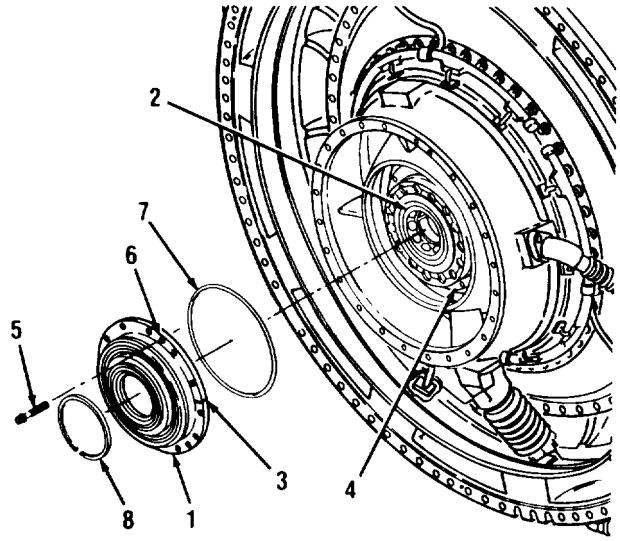
   b. Using three bolts (5) as jackscrews, install bolts into three threaded holes (6). Tighten evenly until diaphragm assembly (1) is away from bearing housing (2).

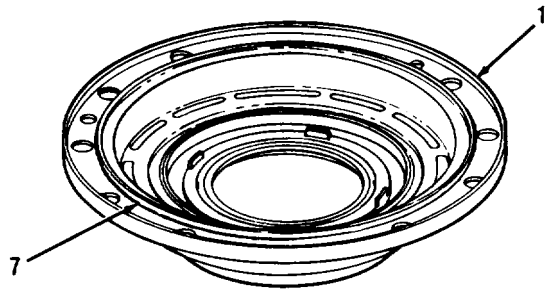
   c. Remove diaphragm assembly (1) from bearing housing assembly (2).

   d. Remove special seal (7) from diaphragm assembly (l).

   e. Remove retaining ring (8) from diaphragm assembly (l).

8. INSPECT DIAPHRAGM ASSEMBLY (1) FOR CRACKS. IF CRACKED, DO STEP 10. IF DIAPHRAGM ASSEMBLY(1) IS NOT CRACKED, DO STEP 9.





Go on to Sheet 4

NO. 5 **SEAL AND DIAPHRAGM ASSEMBLY REPLACEMENT (Sheet 4 of 7)**

WARNING

Use caution when using press. Improper tools, or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

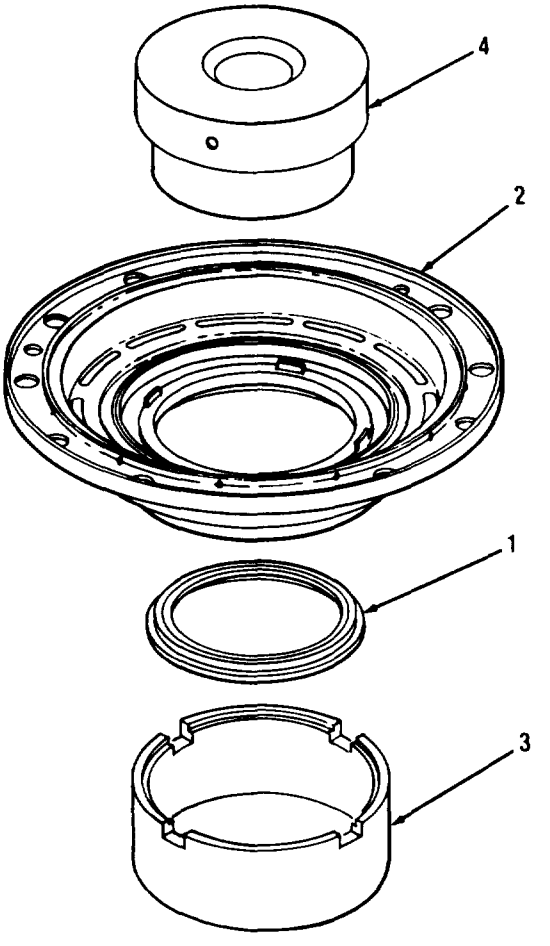
9. REMOVE NO. 5 PLAIN SEAL (1) FROM DIAPHRAGM ASSEMBLY (2), USING NO. 5 SEAL INSTALLATION AND REMOVING TOOL AND ARBOR PRESS.

   a. Position diaphragm assembly (2) onto nest (3) seal side down.

   b. Position plug (4) onto seal, small diameter side down.

   c. Position nest (3), diaphragm assembly (2), and plug (4) on press. Press seal (1) from diaphragm assembly (2).

10. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.



Go on to Sheet 5

No. 5 SEAL AND DIAPHRAGM ASSEMBLY REPLACEMENT (Sheet 5 of 7)

INSTALLATION:

WARNING

Use caution when using press. Improper tools, 01 tools not properly aligned may cause injury to personnel or damage to parts or equipment.

1. *INSTALL* NEW NO. 5 PLAIN SEAL (1) INTO DIAPHRAGM ASSEMBLY (2) USING NO. 5 SEAL INSTALLATION AND REMOVING TOOL AND ARBOR PRESS.

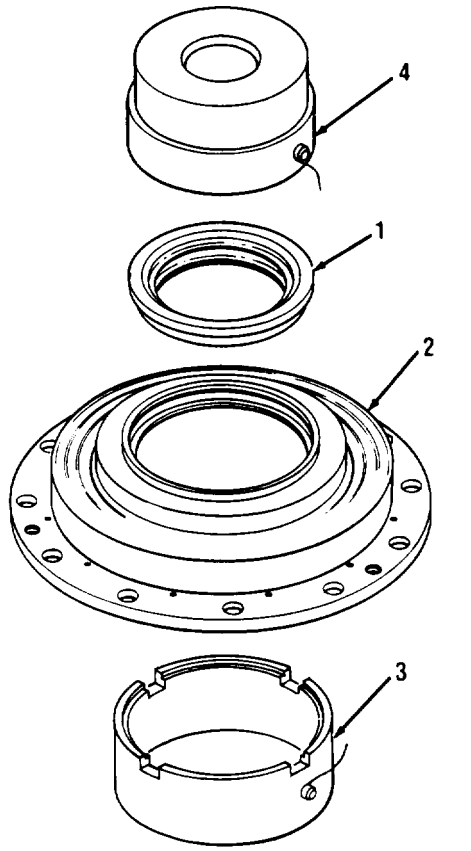
   a. Position diaphragm assembly (2) onto nest (3) with rear side down ,and notches in slots. Position new seal (1) in diaphragm assembly (2) with small diameter of seal down.

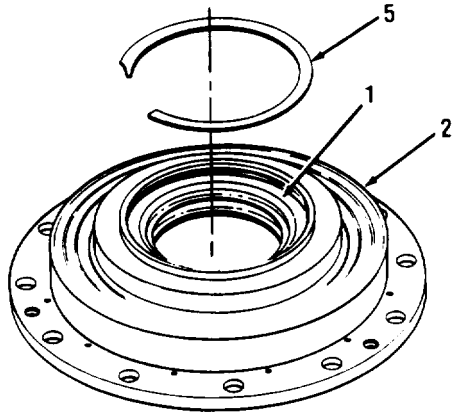
   b. Position plug (4) onto seal (1) large diameter side down.

   c. Position nest (3), diaphragm assembly (2), seal (1), and plug (4) on press. Press seal (1) into diaphragm assembly (2).

   d. Install new retaining ring (5) into diaphragm assembly (2).

2. INSPECT SEAL (1) TO ENSURE CARBON ELEMENT WAS NOT DAMAGED DURING INS INSTALLATION. IF SEAL (1)**WAS DAMAGED, REPLACE SEAL.**





Go on to Sheet **6**

NO. 5 SEAL AND DIAPHRAGM ASSEMBLY REPLACEMENT (Sheet 6 of 7)

3. INSTALL DIAPHRAGM ASSEMBLY (1) (WITH NO. 5 SEAL) ONTO NO. 5 BEARING HOUSING (2).

   a. Apply shortening compound to new special seal (3) and install into groove (4) on diaphragm assembly (1).

   b. Aline locating marks (5) on diaphragm assembly (1) and engine module (6) and install diaphragm assembly (1) onto bearing housing (2) and aline bolt holes.

NOTE

Tighten four bolts (7) evenly opposite each other.

   c. Apply antiseize compound to four bolts (7). Install bolts (7) evenly.

4. TORQUE BOLTS (7) BETWEEN 70-95 LB-IN (8-11 N·m).

5. WAIT 10 MINUTES AND TORQUE BOLTS (7) BETWEEN 70-95 LB-IN (8-11 N·m) TO CRUSH SEAL (3). REMOVE FOUR BOLTS (7).

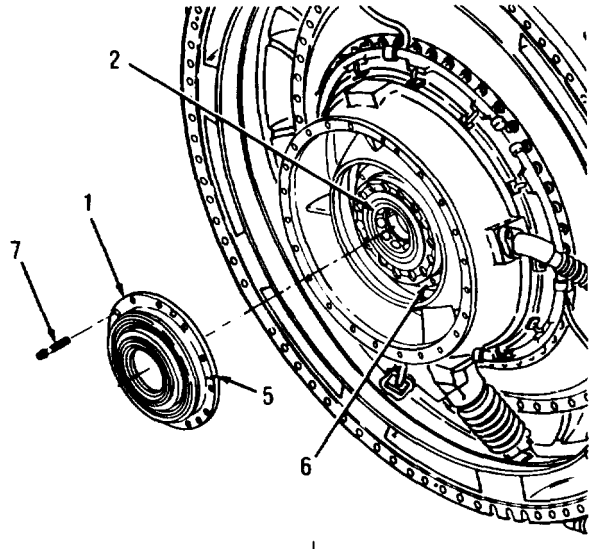
6. INSTALL HOUSING ASSEMBLY (8) AND 12 BOLTS (9). TORQUE 12 BOLTS (9) BETWEEN 70-95 LB-IN (8-11 N·m).

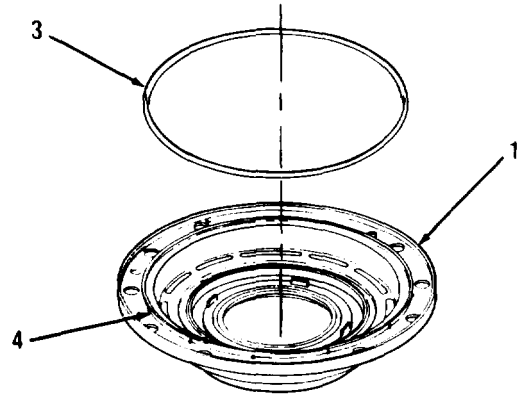
   a. Aline locating marks (10) on housing assembly (8) and engine module (6) and install housing assembly (8) onto diaphragm assembly (1) and aline bolt holes.

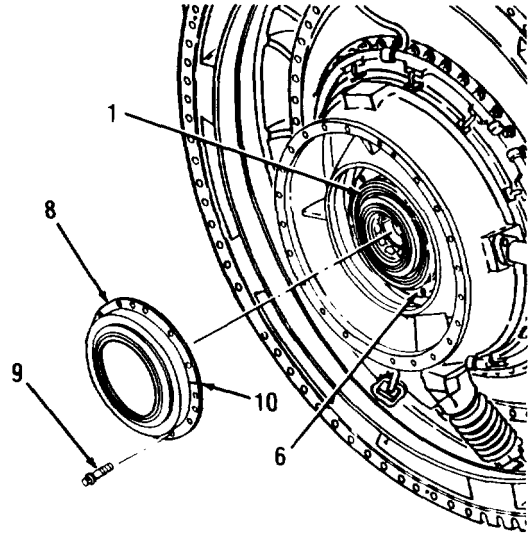
NOTE

Tighten 12 bolts (9) evenly opposite each other.

   b. Apply antiseize compound to 12 bolts (9). Install bolts (9) evenly and torque between 70-95 lb-in (8-11 N·m). Lockwire 12 bolts (9).







Go on to sheet 7

NO. 5 SEAL AND DIAPHRAGM ASSEMBLY REPLACEMENT (Sheet 7 of 7)

CAUTION

Use care during and after installation of turbine rotor shaft (1) to avoid damaging bearing seal or air seal.

7. INSPECT INSIDE OF POWER TURBINE HOUSING (2) FOR FOREIGN OBJECTS.

8. INSTALL SHAFT (1) SPACER RING (3) TURBINE NOZZLE (4) AND 24 BOLTS (5). TORQUE 24 BOLTS (5) BETWEEN 70-95 LB-IN (8-11 N.M).

a. Have assistant hold shaft (1) and scat in No. 5 bearing (8).

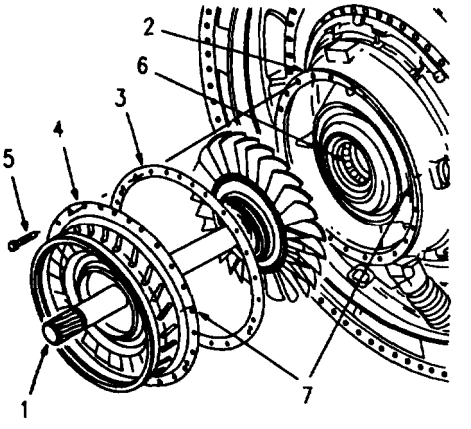
b. Install spacer ring (3), and nozzle (4) on power turbine housing (2). Align locating marks (7) on nozzle (4) and power turbine housing (2), and aline bolt holes.

NOTE

Tighten 24 bolts (5) evenly opposite each other.

c. Apply antiseize compound to 24 bolts (5). Install bolts (5) evenly and torque between 70-95 lb-in (8-11 N.m). Lockwire 24 bolts (5).

9. INSTALL FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) (PAGE 5-28).



End of Task

NO. 10 BEARING REPLACEMENT (Sheet 1 of 11)

TOOLS:

General mechanic's tool kit: automotive (SC5180-90-N26)
Arbor press (Item 37, Appendix D)
Breaker bar, 3/4-inch drive (Item 209, Appendix D)
Fixture, ring gear torque (Item 171, Appendix D)
Key, socket head screw, 5/16- inch (Item 172, Appendix D)
Micrometer, depth gage (Item 205, Appendix D)
Removal tool (Item 173, Appendix D)
Sleeve set (Item 162, Appendix D)
Spanner wrench (Item 174, Appendix D)
Torque wrench, 0-600 lb-ft (Item 107, Appendix D)

PERSONNEL: Two

SUPPLIES:

Antiseize compound (Item 2, Appendix B)
Bearing, ball, annular (Item 186, Appendix E)
Cup, locking (Item 169, Appendix E)
Dry cleaning solvent (Item 7, Appendix B)
Gasket, metal v-seal (Item 188, Appendix E)
Lockwasher (Item 159, Appendix E) (24 required)
Lubricating oil (Item 11 or 12, Appendix B)
Marker, tube type (Item 25, Appendix B)
Rag, wiping (Item 14, Appendix B)
Sealant (Item 28, Appendix B)
Shortening compound (Item 20, Appendix B)

EQUIPMENT CONDITION:

Reduction gearbox removed (page 6-17)
No. 10 bearing retaining plate, seal, and face plate removed (page 6-31)

Go on to Sheet 2

NO. 10 BEARING REPLACEMENT (Sheet 2 of 11)

1. CHECK SUNGEAR (1) END FLOAT MOVEMENT IN RGB ASSEMBLY (2).

   a. Install RGB lifting sling (5) (PAGE 6-16).

   b. Position RGB assembly (2) with front of sungear (1) facing down, and turn sungear (1) at least one turn.

   c. Measure from end (3) of sungear (1) to front (4) of RGB assembly (2). Mark as distance A.

   d. Remove RGB lifting sling (5) (PAGE 6-16).

WARNING

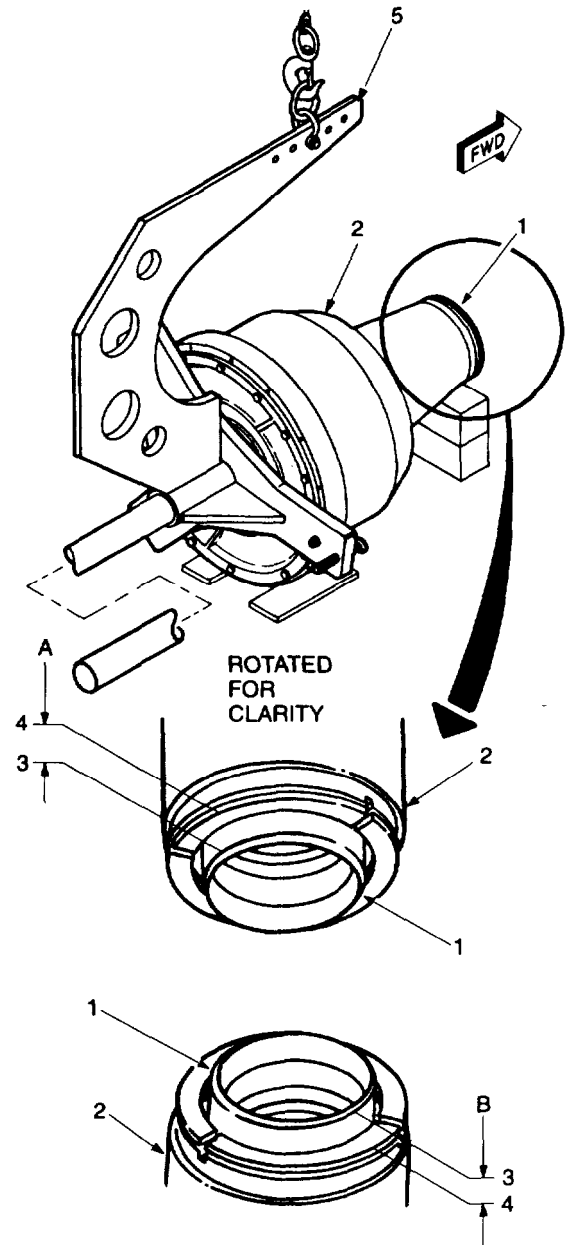
RGB assembly (2) is heavy. Damage to components or injury to personnel may result if dropped or mishandled. Use firm grip while positioning.

   e. Position RGB assembly (2) with front of sungear (1) facing up, and turn sungear (1) at least one turn.

   f. Measure from end (3) of sungear (1) to front (4) of RGB assembly (2). Mark as distance B.

   g. Subtract distance B from distance A. Result should be between 0.012 and 0.015 inch (0.305 to 0.381 mm).

   h. If sungear end float is not within tolerance replace RGB (PAGE 6-17).



LE5543

Go on to Sheet 3

NO. 10 BEARING REPLACEMENT (Sheet 3 of 11)

REMOVAL:

WARNING

Bearing housing, bearing and spur gearshaft (1) is heavy. Damage to components or injury to personnel may result if dropped or mishandled. Use firm grip while lifting.

1. REMOVE BEARING HOUSING, BEARING AND SPUR GEARSHAFT (1) FROM REDUCTION GEARBOX (2).

a. Using a marker, place alignment marks (3) on bearing housing outer flange (4) and reduction gearbox (2).

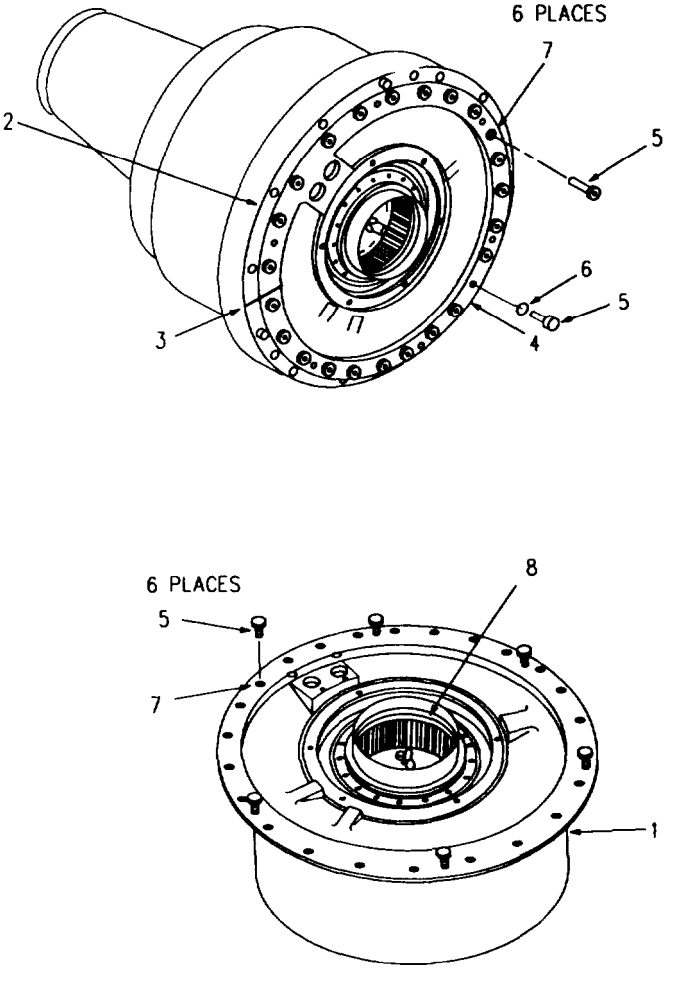
b. Remove 24 bolts (5) and lockwashers (6). Discard lockwashers (6).

c. Thoroughly clean six threaded jackscrew holes (7) around bearing housing outer flange (4).

d. Using six bolts (5) as jacking screws, screw in six bolts (5) into threaded holes (7) of bearing housing outer flange (4). Tighten bolts (5) evenly until bearing housing (4) is separated from reduction gearbox (2).

e. Using both hands, gently remove bearing housing, bearing and spur gearshaft (1) from reduction gearbox (2). Place on clean work surface with spur gearshaft (8) facing up.

f. Remove jacking bolts (5) from threaded holes (7).



LE55106

Go on to Sheet 4

NO. 10 BEARING REPLACEMENT (Sheet 4 of 11)

2. REMOVE GASKET (1) FROM FLANGE OF BEARING HOUSING (2). DISCARD GASKET (1).

3. INSPECT INTERNAL COMPONENTS OF REDUCTION GEARBOX (3). CHECK FOR EXCESSIVE WEAR OR DAMAGE TO GEAR TEETH. CHECK FOR DEBRIS IN GEARBOX CAVITY

NOTE

If any of these conditions exist, reassemble reduction gearbox with original components and replace reduction gearbox (page 6-17).

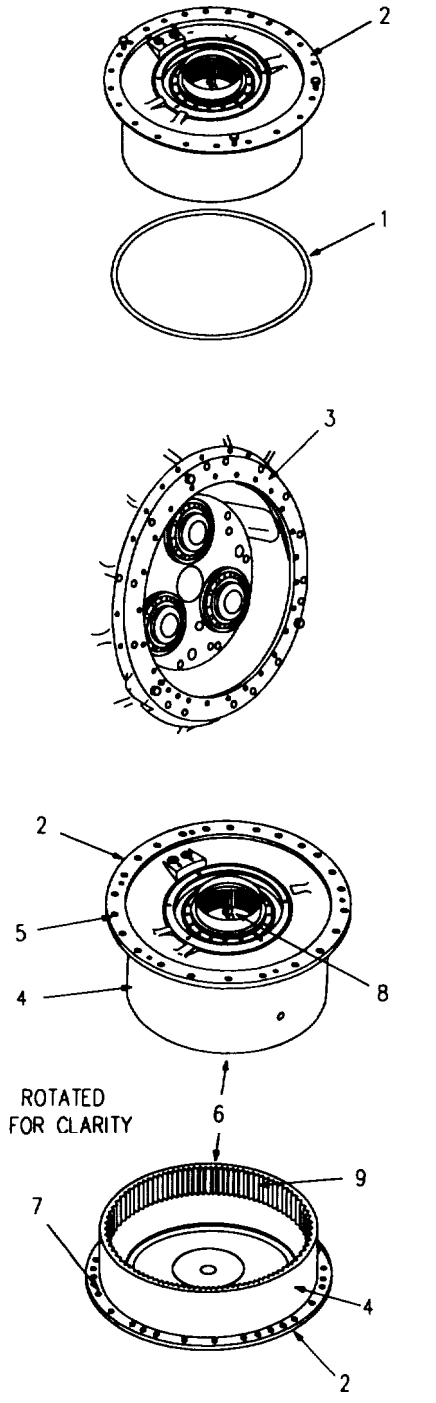
4. COVER REDUCTION GEARBOX (3) CAVITY TO PREVENT CONTAMINATION FROM DIRT OR OBJECTS.

5. INSPECT BEARING HOUSING (2), AND SPUR GEARSHAFT (4) FOR DAMAGE.

a. Inspect bearing housing (2) for cracks, damaged threads and elongated holes (5). Turn bearing housing, bearing and spur gearshaft (6) over and inspect gasket seating area (7) for damage.

b. Inspect spur gearshaft (4) for cracks, scratches, scoring, grooves in preformed packing seal surfaces, thread damage, and loose or damaged stud (8).

c. Inspect teeth (9) of spur gearshaft (4) for corrosion, cracking, spalling, and any red-purple, purple, or blue discoloration due to overheating. Check for heavy end loading wear, frosting, pitting, scoring, wear or fretting corrosion, and deep nicks and scratches on teeth (9).



LE55107

Go on to Sheet 5

NO. 10 BEARING REPLACEMENT (Sheet 5 of 11)

NOTE

If any of these conditions exist, reassemble reduction gearbox with original components and replace reduction gearbox (page 6-17).

6. INSTALL BEARING HOUSING, BEARING AND SPUR GEARSHAFT (1) IN TORQUE FIXTURE (2).

   a. Secure torque fixture (2) to work surface. Unscrew but do not remove three screws (3) from torque fixture (2).

   b. Place bearing housing, bearing and spur gearshaft (1) into torque fixture (2). Align three holes (4) with three screws (3). Screw in and tighten three screws (3).

7. UNCRIMP LOCKING CUP (5) USING SUITABLE TOOL.

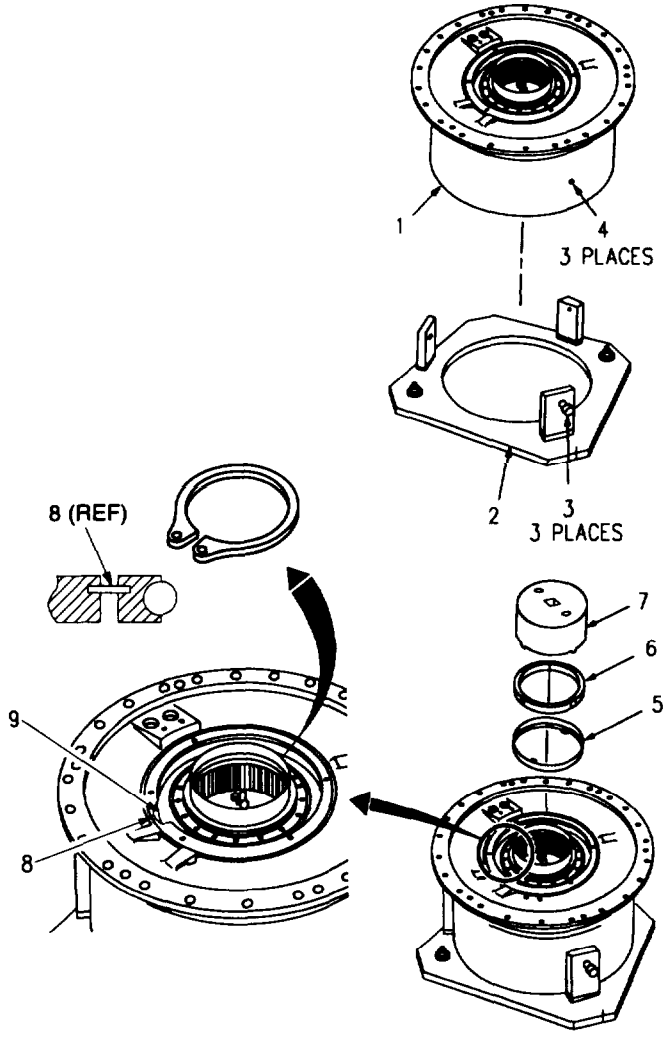
8. REMOVE AND INSPECT PLAIN ROUND NUT (6).

   a. Using spanner wrench (7) and breaker bar, remove plain round nut (6). Inspect plain round nut (6) for cracks, worn lug slots, and damaged internal threads. Replace plain round nut (6) if damaged.

9. REMOVE AND DISCARD LOCKING CUP (5).

10. REMOVE RETAINING RING (6).

    a. Pry retaining ring (8) from groove (9). Discard retaining ring (8).



LE55108

Go on to Sheet 6

NO. 10 BEARING REPLACEMENT (Sheet 8 of 11)

11. REMOVE BEARING HOUSING (1)

a. Using soft face mallet, gently tap up and around outer edge of bearing housing (1) until bearing housing (1) is free from bearing (2). Remove bearing housing (1) and set aside for later use.

12. REMOVE BEARING AND SPUR GEARSHAFT (3) FROM TORQUE FIXTURE (4).

a. Unscrew, but do not remove, three screws (5) from torque fixture (4) using socket head screw key. Remove bearing and spur gearshaft (3) from torque fixture (4).

WARNING

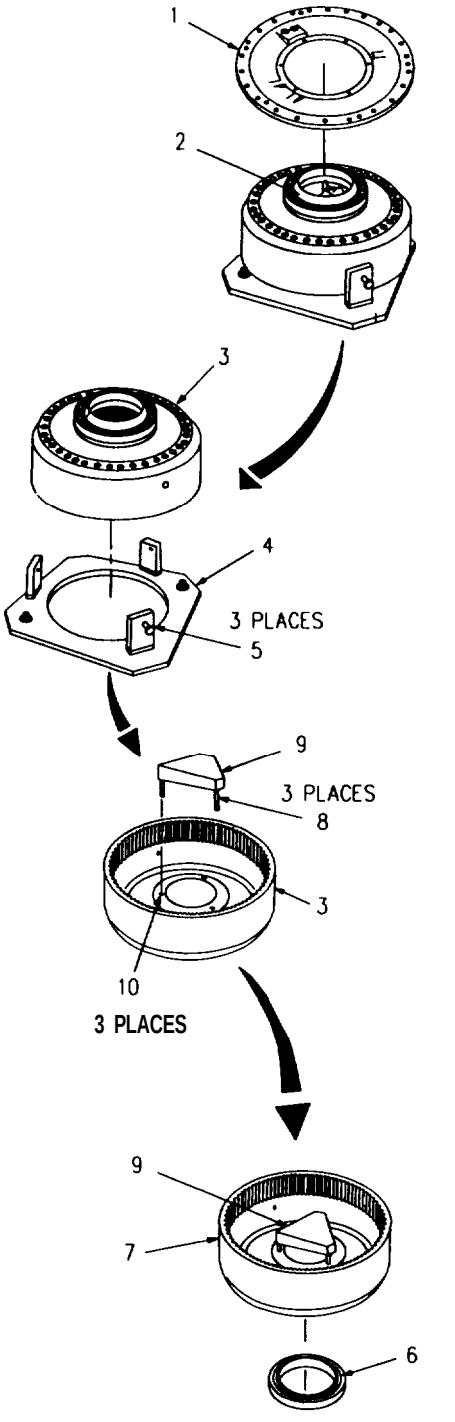
Use caution when using press. Improper tools or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

WARNING

13. REMOVE BEARING (6) FROM SPUR GEARSHAFT (7).

a. Place bearing and spur gearshaft (3), bearing side down, on arbor press.

b. Insert three pins (8) of bearing removal tool (9) into three holes (10) of bearing and spur gearshaft (3).



LE55109

Go on to Sheet 7

NO. 10 BEARING REPLACEMENT (Sheet 7 of 11)

c. Using arbor press and removal tool (1), press bearing (2) off spur gearshaft (3). Discard bearing (2).

14. INSPECT SPUR GEARSHAFT (3) FOR SCORING ON BEARING JOURNAL (4). CHECK FOR DAMAGED THREADS.

NOTE

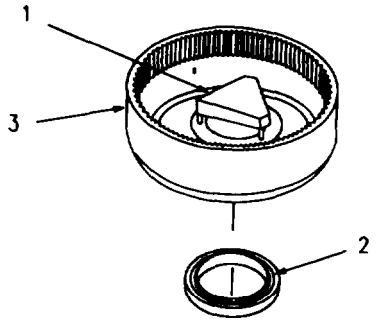
If any of these conditions exist, reassemble reduction gearbox with original components and replace reduction gearbox (page 6-17).

INSTALLATION:

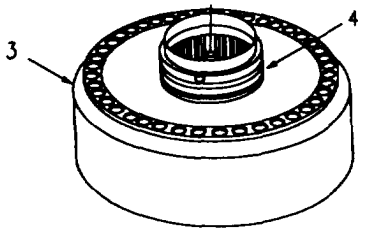
WARNING

Use caution when using press. Improper tools or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

WARNING



ROTATED FOR CLARITY



LE55110

Go on to Sheet 8

NO. 10 BEARING REPLACEMENT (Sheet 8 of 11)

1. INSTALL NEW BEARING (1) ON SPUR GEARSHAFT (2).

   a. Place spur gearshaft (2), with bearing journal (3) at top, on arbor press.

   b. Apply shortening compound to inner race (4) of new bearing (1). Place bearing (1), with retaining ring groove (5) up, on spur gearshaft (2).

   c. Place sleeve (6) on bearing (1). Press bearing (1) onto spur gearshaft (2) until seated. Remove sleeve (6) and bearing and spur gearshaft (7) from arbor press.

2. INSTALL BEARING AND SPUR GEARSHAFT (7) IN TORQUE FIXTURE (8).

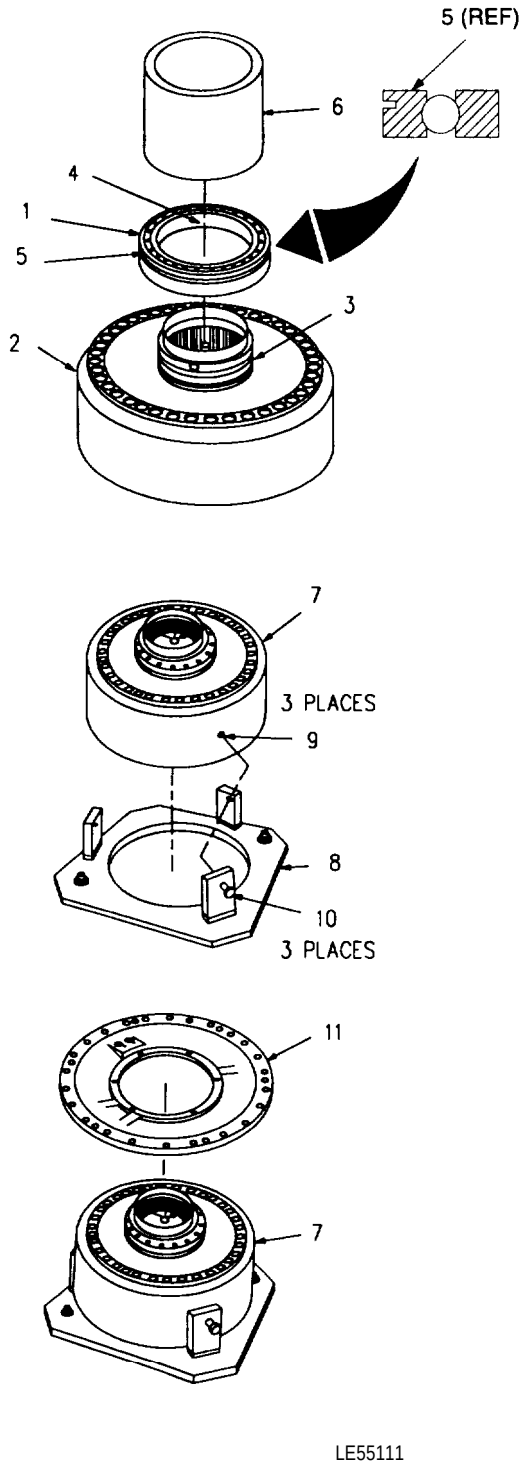
   a. Place bearing and spur gearshaft (7) in torque fixture (8).

   b. Align three holes (9) with three screws (10). Screw in and tighten screws (10) using socket head screw key.

3. INSTALL BEARING HOUSING (11) ON BEARING AND SPUR GEARSHAFT (7).

   a. Place bearing housing (11) on bearing and spur gearshaft (7).

   b. Using soft face mallet, tap bearing housing (11) down and evenly around housing outer diameter until seated.



Go on to Sheet 9

NO. 10 BEARING REPLACEMENT (Sheet 9 of 11)

4. INSTALL NEW RETAINING RING (1) IN GROOVE (2). MAKE SURE RETAINING RING (1) IS COMPLETELY SEATED IN GROOVE (2).

5. INSTALL LOCKING CUP (3) WITH INTERNAL TANGS FACING DOWN AND ALIGNED WITH GROOVES ON SPUR GEARSHAFT (4).

6. INSTALL PLAIN ROUND NUT (5). TIGHTEN BETWEEN 166-183 LB-FT (225-248 N.M) TORQUE.

a. Apply lubricating oil to threads of plain round nut (5).

b. Install plain round nut (5) on spur gearshaft (4). Using spanner wrench (6) and bar, tighten plain round nut (5) between 166-183 lb-ft (225-248 N.m) torque.

c. Crimp locking cup (3) into two slots (7) 180 degrees apart of plain round nut (5) using a suitable tool.

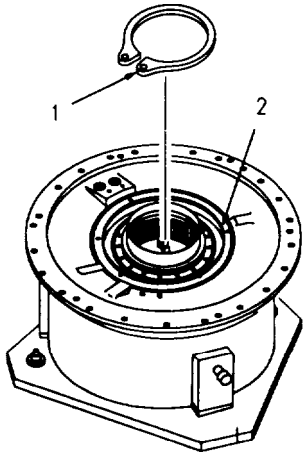
d. Inspect locking cup (3) for cracks. Replace locking cup (3) if cracked.

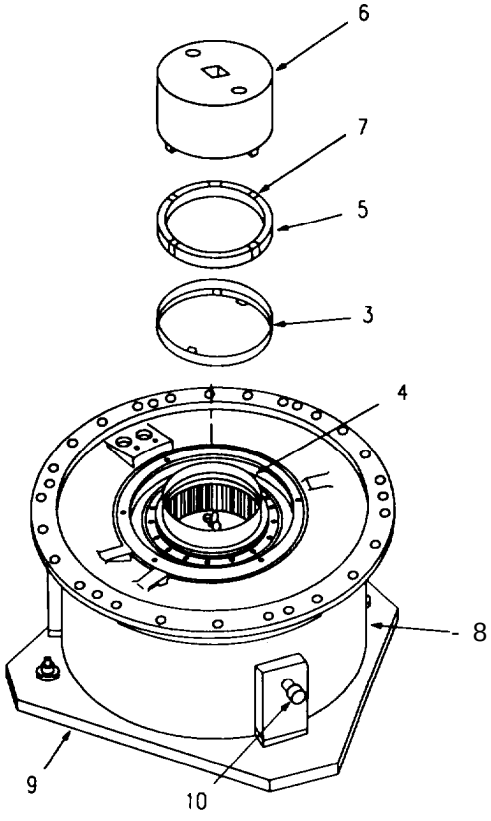
7. REMOVE BEARING HOUSING, BEARING AND SPUR GEARSHAFT (8) FROM TORQUE FIXTURE (9).

a. Unscrew but do not remove three screws (10) from torque fixture (9).

b. Remove bearing housing, bearing and spur gearshaft (8) from torque fixture (9).

c. Remove torque fixture (9) from work surface and stow.





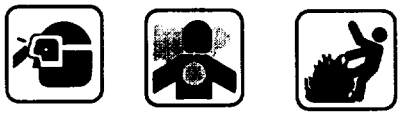
LE55112

Go on to Sheet 10

NO. 10 BEARING REPLACEMENT (Sheet 10 of 11)

8. INSTALL NEW GASKET (1) ON REDUCTION GEARBOX HOUSING (2).

WARNING



a. Using dry cleaning solvent and rag, clean groove (3) in reduction gearbox housing (2).

b. Apply a coat of sealant to groove (3) then install new gasket (1) in groove (3).

9. CLEAN GASKET MATING AREA OF BEARING HOUSING FLANGE (4).

a. Using dry cleaning solvent and rag, clean gasket mating area of bearing housing flange (4).

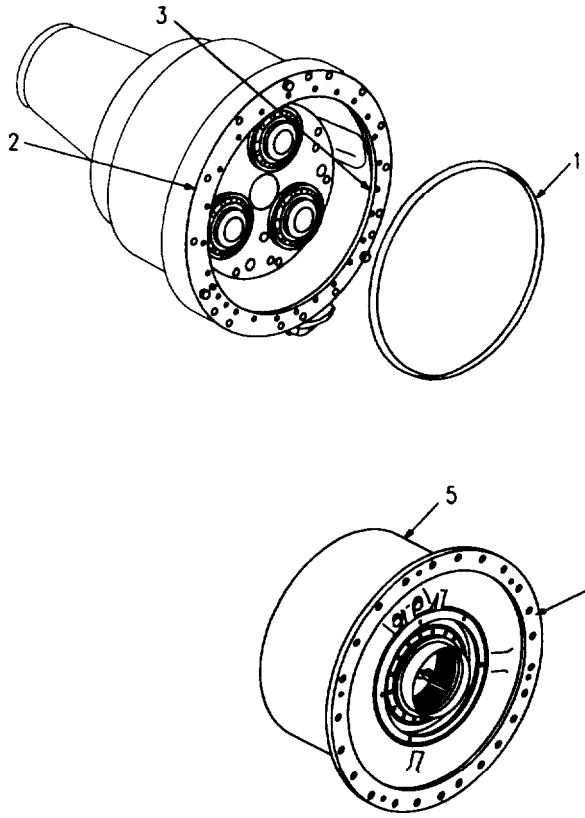
b. Apply a coat of sealant to gasket mating area of bearing housing flange (4).

WARNING

Bearing housing, bearing and spur gearshaft (5) is heavy. Damage to components or injury to personnel may result if dropped or mishandled. Use firm grip while lifting.

10. INSTALL BEARING HOUSING, BEARING AND SPUR GEARSHAFT (5) ONTO REDUCTION GEARBOX HOUSING (2).

a. Remove temporary cover from reduction gearbox (2) cavity. Make sure no foreign objects or dirt has entered and contaminated reduction gearbox (2) cavity.



LE55113

Go on to Sheet 11

NO. 10 BEARING REPLACEMENT (Sheet 11 of 11)

b. Turn sungear (10) by hand to engage ring gear (1) onto planetary gears (9).

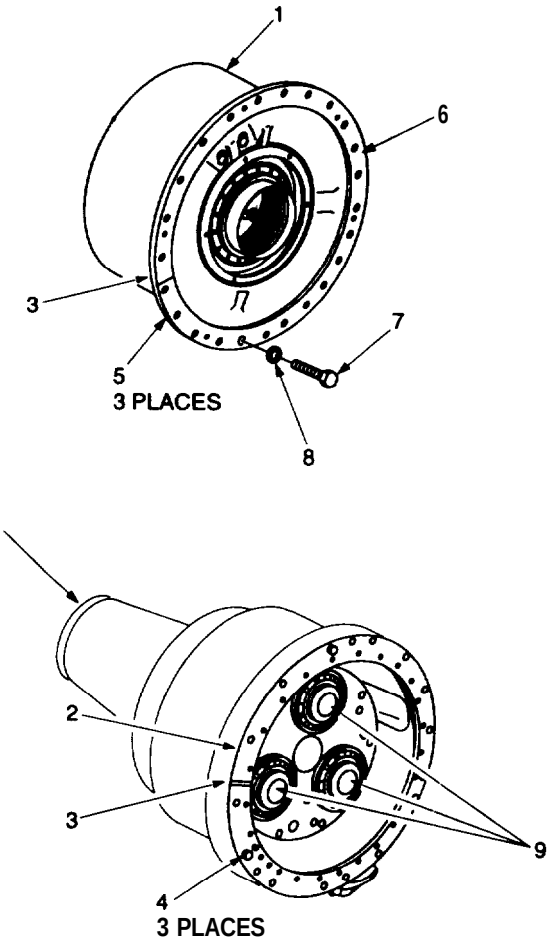
c. Firmly grasp bearing housing, bearing and spur gearshaft (1) with both hands. Lift and position against reduction gearbox housing (2) so that alignment marks (3) made during removal, line up. Three pins (4) on reduction gearbox housing (2) should align with three holes (5) in bearing housing flange (6).

d. Apply antiseize compound to threads of 24 bolts (7). Install 24 bolts (7) and new lock-washers (8). Tighten bolts (7) between 100-110 lb-in (11-12 N.m) torque in a criss-cross sequence. Retorque as required to retain torque.

11. INSTALL NO. 10 BEARING RETAINING PLATE, SEAL, AND FACE PLATE (PAGE 6-32.2).

12. INSTALL REDUCTION GEARBOX SPEEDOMETER CONNECTORS AND ADAPTERS (PAGE 6-3).

13. CONNECT ENGINE TO TRANSMISSION TM34-1).



LE55114

End of Task

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 1 of 30)

TOOLS:

General mechanic's tool kit: automotive (SC5180-90-N26)
Chain-fall hoist, 2000-lb capacity (Item 20, Appendix D)
Lifting sling (item 188, Appendix D)
Rigging pin (Item 189, Appendix D)
Socket, 3/8-inch drive, 1/4-inch, 12-point (Item 190, Appendix D)
Socket, 3/8-inch drive, 7/32-inch, 12-point (Item 191, Appendix D)
Socket, 3/8-inch drive, 5/16-inch, 12-point (Item 192, Appendix D)
Torque adapter, 3-inch (Item 207, Appendix D)
Torque wrench, 600 in-lb (Item 17, Appendix D)
Wire twister, plier (Item 101, Appendix D)

PERSONNEL: Two

SUPPLIES:

Antiseize compound (Item 2, Appendix B)
Gasket (Item 199, Appendix E)
Gasket (Item 33, Appendix E) (3 required)
Gasket (Item 34, Appendix E)
Marker (Item 25, Appendix B)
Nonelectric wire (Item 15, Appendix B)
Plastic bag, large garbage (Item 59, Appendix B)
Preformed packing (Item 35, Appendix E) (2 required)
Preformed packing (Item 37, Appendix E)
Seal ring (Item 32, Appendix E)
Seal ring (Item 36, Appendix E)
Self-locking nut (Item 24, Appendix E)
Shortening compound (Item 20, Appendix B)
Shoulder bolt (Item 31, Appendix E) (2 required)
Spacer (Item 200, Appendix E)
Ultrachem (Item 60, Appendix B)
Wood blocks (Item 32, Appendix B) (2 required)

EQUIPMENT CONDITION:

Engine disconnected from transmission (TM34-1)
Forward engine module (accessory gearbox module attached) removed (page 5-26)
Reduction gearbox removed (page 6-17)

Go on to Sheet 2

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 2 of 30)

NOTE

This task provides instructions for salvaging one of two unserviceable rear engine modules. Before proceeding, make sure the following conditions exist:

- All removed rear engine modules have been evaluated and determined unserviceable.
- At least one unserviceable rear engine module with a serviceable gas turbine power unit is available.
- At least one unserviceable rear engine module with a serviceable regenerator assembly is available.

NOTE

If salvaging one of two unserviceable rear engine modules is not possible, replace rear engine subassembly (page 6-28).

Go on to Sheet 3

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 3 of 30)

REMOVAL:

CAUTION

Do not lean on, hang anything on, bump or rock low pressure (LP) turbine rotor shaft (1). Damage to No. 5 bearing air and oil seals may result.

1. USING MARKER, PLACE MATCH MARKS (2) ON POWER TURBINE (PT) HOUSING (3), SPACER RING (4) AND LP TURBINE NOZZLE (5).

WARNING

Use caution when removing nozzle (5). Rotor (1) will fall free without nozzle (5) in place and could cause personnel injury or damage to equipment. Have helper support rotor shaft (1) at all times during removal of nozzle (5).

2. SUPPORT ROTOR SHAFT (1), CUT SAFETY WIRE AND REMOVE 24 BOLTS (6). RETAIN BOLTS FOR FURTHER USE.

NOTE

Penetrating oil can be used to soak 24 bolts (6) to facilitate their removal.

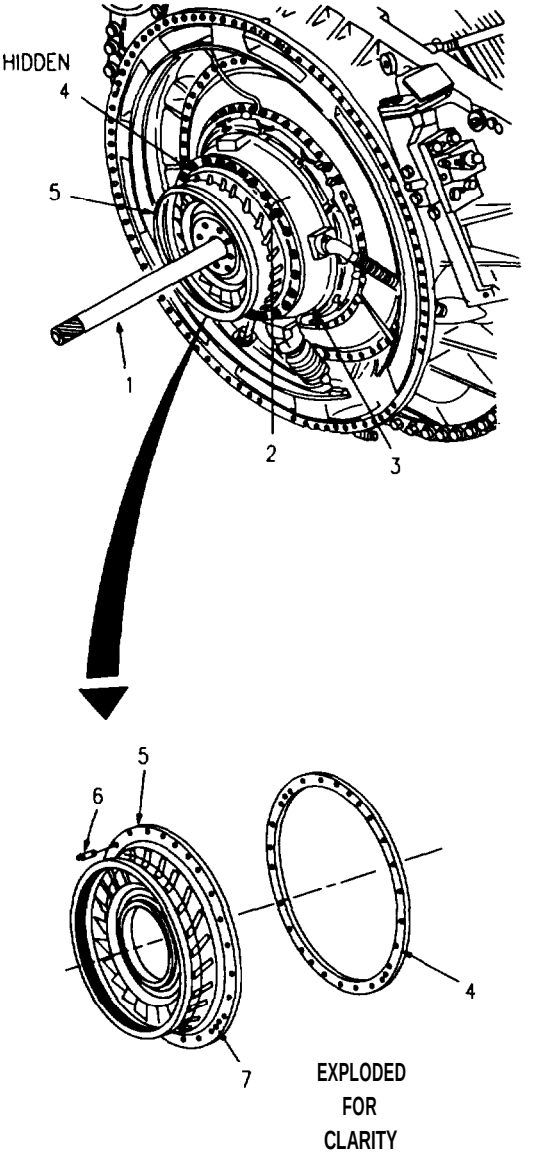
CAUTION

Do not use hammer to dislodge nozzle (5). Damage to nozzle could result. Use jacking bolts.

3. REMOVE NOZZLE (5) AND SPACER RING (4).

a. Using both hands, carefully remove nozzle (5). Then do step d. If unable to remove nozzle (5) by hand, do steps b. and c., then continue with step d.

b. Install three bolts (6) into three threaded holes (7) in nozzle (5).



LE55115

Go on to Sheet 4

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 4 of 30)

c. Tighten three jacking bolts (1) evenly until nozzle (2) is free of PT housing (3). Remove nozzle (2) and jacking bolts (1).

d. Remove spacer ring (4) and retain for further use.

CAUTION

Do not attempt to exchange, swap or replace LP turbine rotor (5). No. 5 bearing failure could result.

4. REMOVE AND VISUALLY INSPECT LP TURBINE ROTOR AND SHAFT (5).

a. Check rotor blades (6) for cracks and missing blade material.

b. Check rotor shaft (7) for scoring and wear on splines (8).

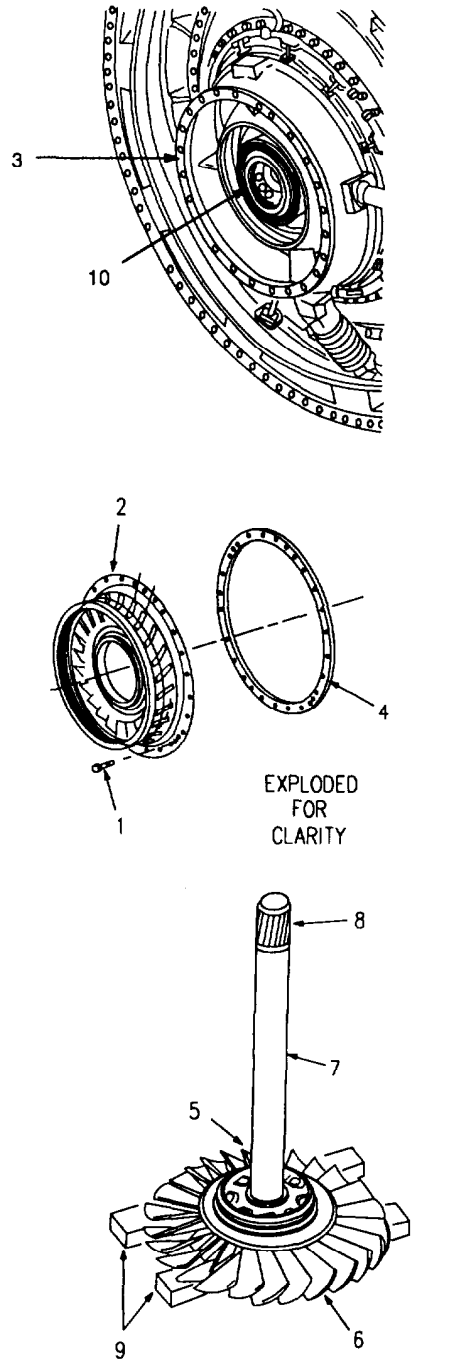
c. Inspect No. 5 bearing (10) for corrosion, pitting or fracture.

NOTE

If any of these conditions exist, reassemble power turbine assembly with original hardware and replace rear engine module.

d. Inspect inside of power turbine housing (3) for foreign objects or damage. Remove any foreign objects and repair minor nicks and burrs as necessary.

5. PLACE LP TURBINE ROTOR AND SHAFT (5) NOSE UP ON TWO WOOD BLOCKS (9) IN A CLEAN AND SECURE LOCATION.



Go on to Sheet 5

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 5 of 30)

6. REMOVE OIL SCAVENGE TUBE ASSEMBLY (1), METAL SEAL RING (2) AND GASKETS (3, 4).

a. Remove screw (5) and self-locking nut (6) from two clamps (7) and mounting bracket (8). Discard self-locking nut (6).

NOTE

Mounting bracket (8) does not have to be removed from rear module forward header bolt flange (9).

b. Cut safety wire and remove three outer bolts (10) and washers (11).

c. Cut safety wire from two inner bolts (12). Using box end of torque adapter (13), remove two bolts (12) and tube assembly (1). Discard bolts (12).

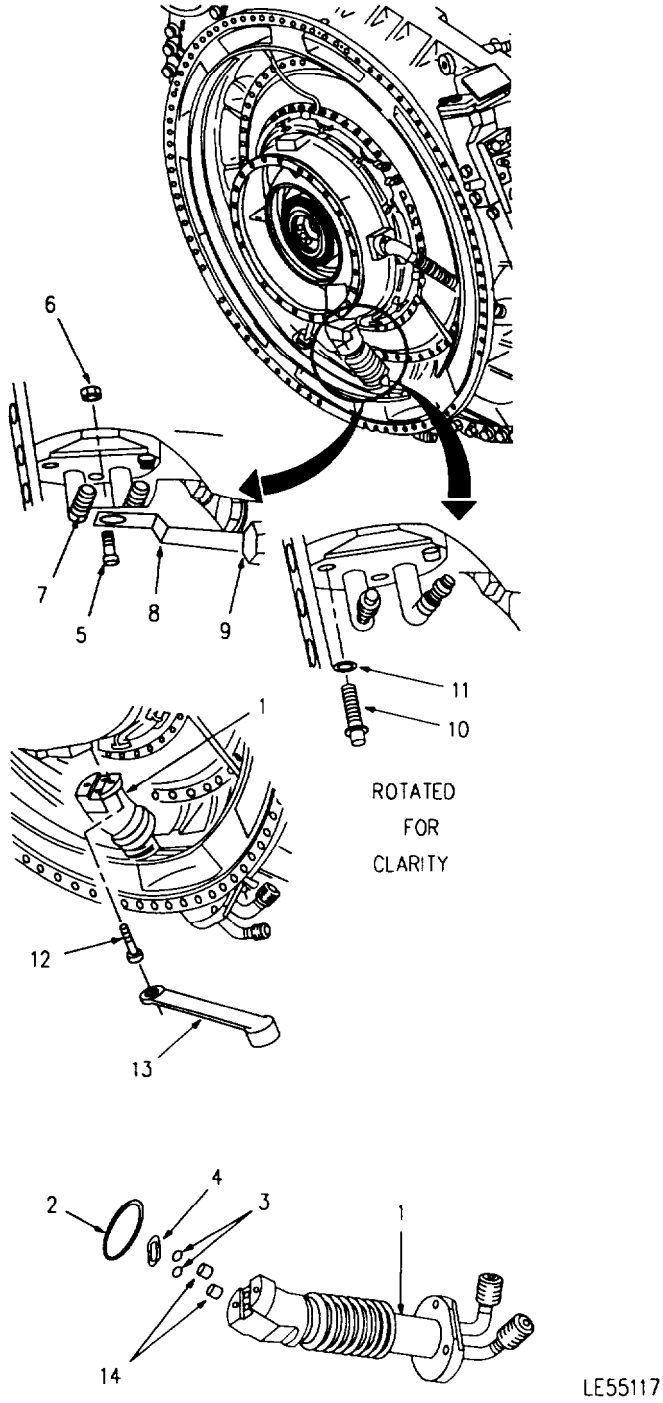
d. Remove and discard metal seal ring (2) and gaskets (3, 4).

NOTE

Replace hollow pins (14) only if damaged, and set tube assembly (1) aside.

7. INSPECT PINS (14) FOR CRACKS, DEFORMATION AND SCORING. REPLACE AS REQUIRED.

8. INSPECT ALL PARTS FOR DAMAGE. REPLACE AS REQUIRED.



Go on to Sheet 6

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 6 of 30)

9. REMOVE OIL FEED TUBE ASSEMBLY (1) GASKET (2) METAL SEAL RING (3) AND PACKING MATERIAL (4).

a. Cut safety wire and remove four outer bolts (5) and washers (6).

b. Cut safety wire from two inner bolts (7). Using box end of torque adapter (8) remove bolts (7) and tube assembly (1).

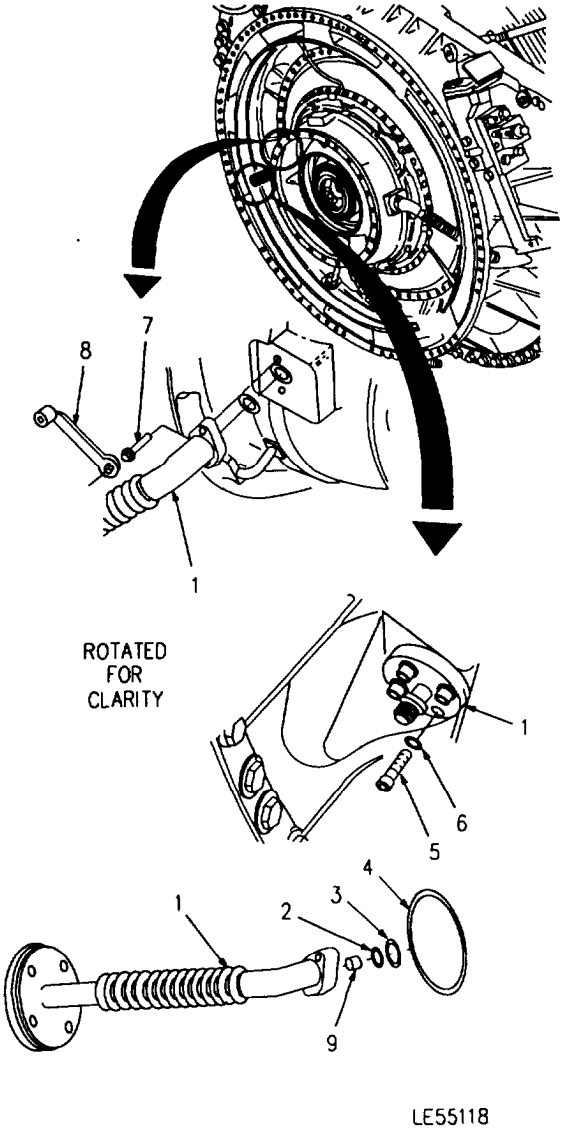
c. Remove and discard gasket (2), metal seal ring (3) and packing material (4).

NOTE

Replace hollow pin (9) only if damaged, and set tube assembly (1) aside.

10. INSPECT PIN (9) FOR CRACKS, DEFORMATION AND SCORING. REPLACE AS REQUIRED.

11. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.



Go on to Sheet 7

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 7 of 30)

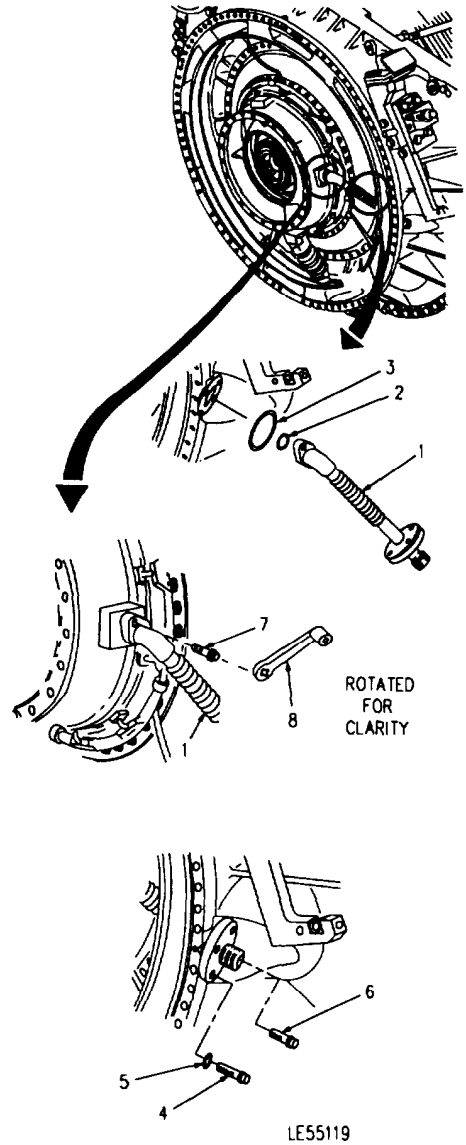
12. REMOVE COOLING TUBE ASSEMBLY (1), PREFORMED PACKING (2) AND PACKING MATERIAL (3).

a. Cut safety wire and remove three long bolts (4), washers (5) and one short bolt (6).

b. Cut safety wire from two bolts (7'). Using box end of torque adapter (8), remove bolts (7) and tube assembly (1).

c. Remove and discard preformed packing (2) and packing material (3).

13. INSPECT ALL PARTS FOR DAMAGE. REPLACE AS REQUIRED.



Go on to Sheet 8

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 8 of 30)

14. REMOVE THERMOCOUPLE WIRING HARNESSES (1, 2, 3).

a. Cut safety wire and remove 12 bolts (4) and 12 cable hangers (5).

b. Remove 12 probes (6) from gas turbine power unit (7).

NOTE

Wiring harnesses (1, 2, 3) do not have to be removed from forward header of rear module sub-assembly (8).

15. INSPECT WIRING HARNESSES (1, 2, 3) FOR FRAYING OR WORN OUTER SHEATH AND BURNED OR BROKEN PROBES (6). REPLACE AS REQUIRED (PAGE 6-35).

16. CAREFULLY BEND WIRING HARNESSES (1, 2, 3) BACK AND INSERT PROBES (6) INTO GAS TURBINE POWER UNIT THERMOCOUPLE PROBE BOSSES (8).

Go on to Sheet 90

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 9 of 30)

17. REMOVE MECHANICAL GUARD (1) FROM POWER UNIT (2) AND REGENERATOR (3).

a. Cut and remove safety wire from 45 bolts (4) and 60 bolts (5).

b. Remove 45 bolts (4), assess cover (6) and 60 bolts (5).

c. Remove mechanical guard (1).

18. INSPECT MECHANICAL GUARD (1) FOR ELONGATED BOLT HOLES, WARPAGE OR CRACKS. REPLACE AS REQUIRED.

CAUTION

Do not install four temporary bolts (7) without spacers (8). Bolts may extend beyond thread depth and become lodged in power unit housing.

NOTE

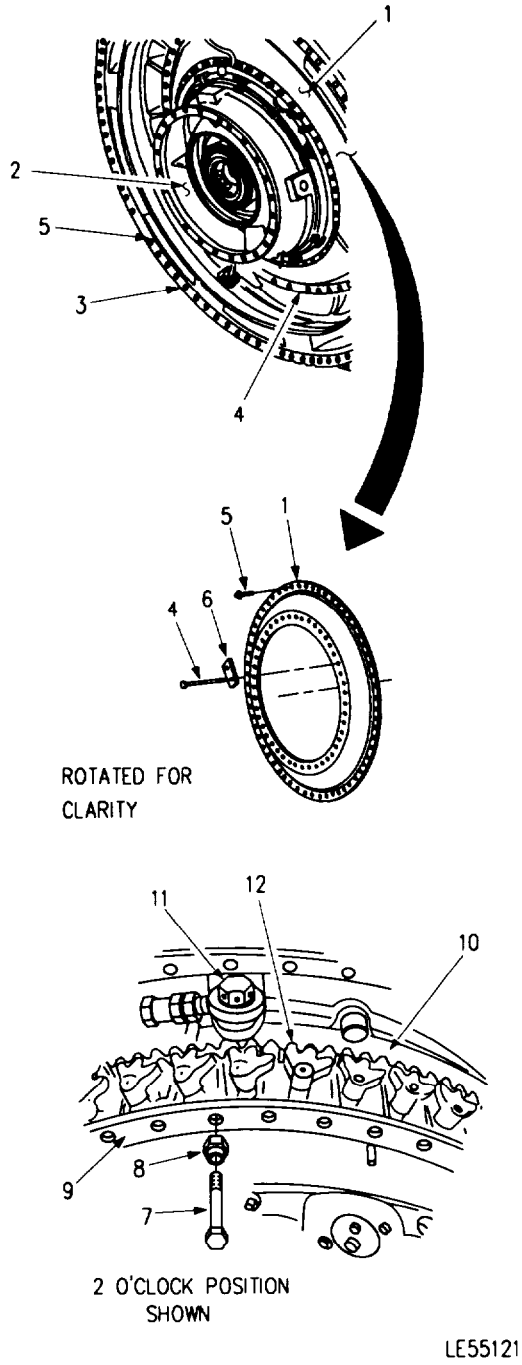
Use four of the 45 bolts removed in step 17.b. Use four nuts (callout 14, page 5-26), removed from forward and rear module flange, as spacers (8).

19. TEMPORARILY INSTALL FOUR BOLTS (7) AND SPACERS (8) WITH THE FIRST BOLT LOCATED IN A BOLT HOLE NEAR THE END OF TURNBUCKLE ROD BEARING ASSEMBLY (11). EVENLY SPACE OTHER 3 BOLTS 90 DEGREES APART (APPROXIMATELY 2, 4, 8 AND 10 O'CLOCK POSITIONS) ON MECHANICAL HOUSING OUTER FLANGE (9). TIGHTEN BOLTS SECURELY

CAUTION

Excessive rotation of spur gear (10), with turnbuckle rod bearing (11) disconnected, may cause vanes (12) to become unhinged from spur gear (10).

If vanes (12) become unhinged, reassemble turbine power unit with original parts and replace rear engine module.



Go on to Sheet 9

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 10 of 30)

20. ROTATE REMOTE CONTROL LEVER (1) UNTIL RIGGING PIN (2) CAN BE INSERTED THROUGH HOLE IN SPUR GEAR (3) AND INTO ALIGNMENT HOLE IN SHROUD (4). INSERT RIGGING PIN (2).

21. CUT SAFETY WIRE AND REMOVE FOUR BOLTS (5).

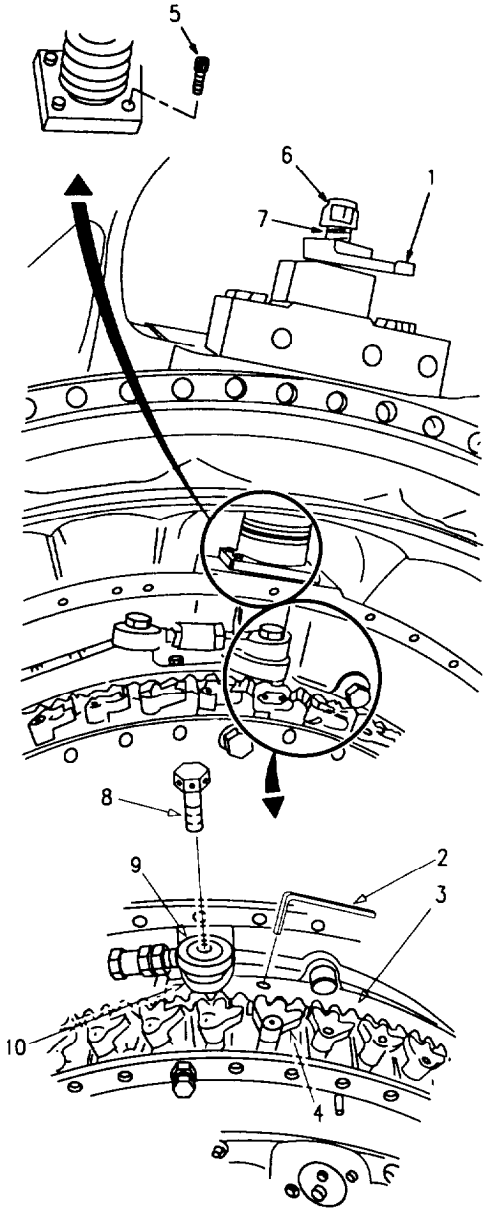
22. LOOSEN SELF-LOCKING NUT (6) TO WITHIN ONE THREAD OF END OF SHAFT (7). DO NOT REMOVE NUT (6).

23. PUSH DOWN ON SELF-LOCKING NUT (6) UNTIL SHAFT (7) IS SEATED.

24. CUT LOCKWIRE, REMOVE BOLT (8) AND SWING TURNBUCKLE ROD BEARING ASSEMBLY (9) AWAY FROM SPUR GEARSHAFT (10). RETAIN BOLT (8) FOR FURTHER USE.

CAUTION

Do not adjust turnbuckle rod bearing assembly (9). Alignment of vanes with turbine gearbox housing assembly is preset at the factory and must not be disturbed. Damage to internal parts may result which may not be readily apparent during visual inspection.



2 O'CLOCK POSITION SHOWN

LE55122

Go on to Sheet 11

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 11 of 30)

25. REMOVE FOUR BOLTS (1). REMOVE TURBINE GEARBOX HOUSING AND SPUR GEARSHAFT (2).

26. REMOVE AND DISCARD GASKET (3).

CAUTION

Use extreme care not to damage inside of regenerator assembly (4) while removing gas turbine power unit (5). Replace regenerator assembly (4) if damage such as cracks (except minor axial cracks) or holes in core is observed.

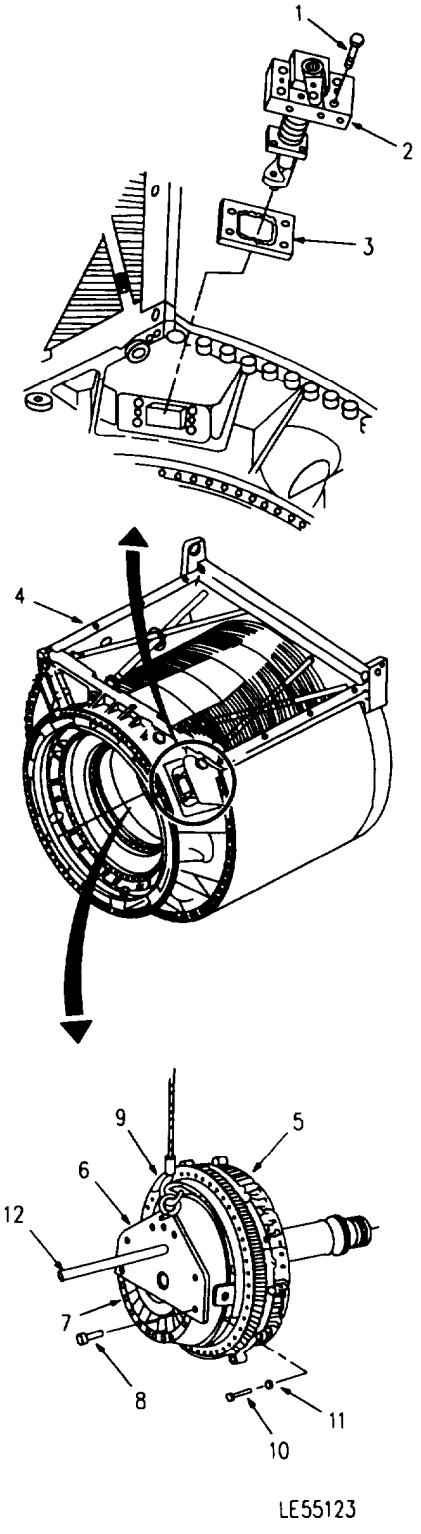
27. USING HOIST AND LIFTING SLING (6), REMOVE GAS TURBINE POWER UNIT (5) FROM REGENERATOR ASSEMBLY (4).

a. Install lifting sling (6) on LP turbine nozzle flange (7) using seven bolts (8) provided with sling.

b. Attach chain hoist hook (9) to lifting sling (6) and remove slack from chain.

C. Remove four temporary bolts (10) and spacers (11) and set aside for further use..

d. Gently remove gas turbine power unit (5) from regenerator assembly (4) by pulling and applying only enough downward pressure on lifting sling handle (12) to free and guide power unit (5).



LE55123

Go on to Sheet 12

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 12 of 30)

NOTE

Mechanical guard (1) and gas turbine power unit (2) should be kept together as a matched set whenever removed from regenerator assembly (3). Used serviceable units may be substituted, however. Whenever possible, keep guard (1) with, and positioned on, power unit (2) as removed.

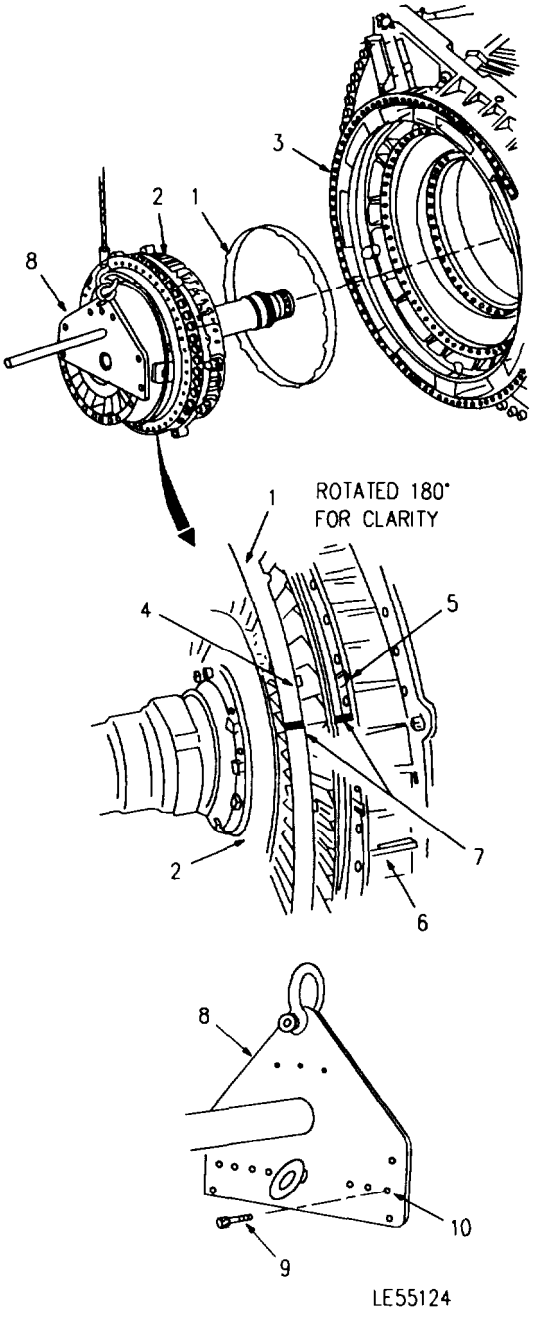
28. REMOVE MECHANICAL GUARD (1) FROM REGENERATOR ASSEMBLY (3).

29. ALIGN TABS (4) ON MECHANICAL GUARD (1) WITH GROOVES (5) IN GAS TURBINE POWER UNIT ASSEMBLY OUTER SHROUD (6) IN SAME POSITION AS BEFORE REMOVAL.

30. USING MARKER, MAKE MATCH MARKS (7) ON MECHANICAL GUARD (1) AND OUTER SHROUD (6). REMOVE MECHANICAL GUARD (1) AND SET ASIDE.

31. PLACE GAS TURBINE POWER UNIT (2) ON CLEAN, DRY WORK SURFACE AND REMOVE HOIST AND LIFTING SLING (8). COVER GAS TURBINE POWER UNIT (2) WITH A PLASTIC GARBAGE BAG.

32. INSTALL SEVEN BOLTS (9) IN THREADED HOLES (10) OF LIFTING SLING (8). SET LIFTING SLING (8) ASIDE FOR LATER USE.



Go on to Sheet 13

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 13 of 30)

INSTALLATION:

NOTE

Go to installation step No. 2 if gas turbine power unit is unserviceable and not being salvaged or control exchanged.

1. CHECK REPLACEMENT GAS TURBINE POWER UNIT (1) FOR PROPERLY INSTALLED RIGGING PIN (2) IN SPUR GEAR (3) AND SHROUD (4).

CAUTION

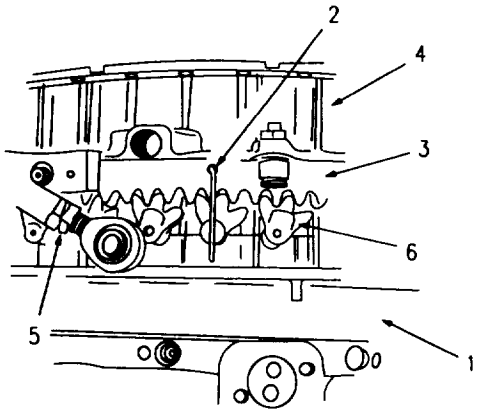
Excessive rotation of spur gear (3) with turnbuckle rod bearing (5) disconnected may cause vanes (6) to become unhinged from spur gear (3).

If vanes (6) become unhinged, reassemble gas turbine power unit (1) with original parts and replace with a serviceable unit.

a. If rigging pin (2) is not installed, rotate spur gear (3) in either direction until rigging pin (2) can be inserted through hole in spur gear (3) and into alignment hole in shroud (4). Avoid rotating spur gear excessively which could cause vanes (6) to unhinge. Insert rigging pin (2).

b. Check vanes (6) around circumference of gas turbine power unit (1) to ensure no vanes (6) are dislodged or unhinged from spur gear (3).

c. If one or more vanes (6) become unhinged, reassemble gas turbine power unit (1) and replace with a serviceable unit.



LE55125

Go on to Sheet 14

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 14 of 30)

NOTE

Proper orientation of lifting sling (1) on gas turbine power unit (2) will ensure alignment with regenerator assembly (3) during reassembly.

2. INSTALL LIFTING SLING (1) CHAIN HOIST HOOK (4) AND MECHANICAL GUARD (5) ON GAS TURBINE POWER UNIT (2).

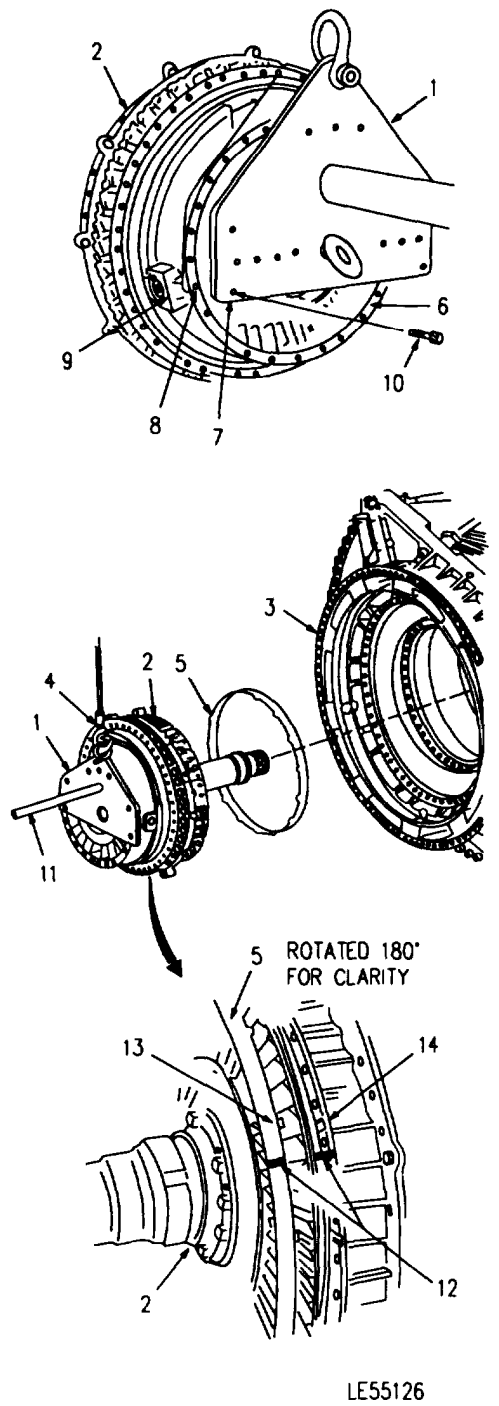
a. Position lifting sling (1) against mechanical housing flange (6) so that bottom left bolt hole (7) aligns with bolt hole (8) adjacent to oil feed mounting boss (9). Secure using seven bolts (10) provided with lifting sling (1).

b. Attach chain hoist hook (4) to lifting sling (1). Use lifting sling handle (11) to support gas turbine power unit (2) while lifting the assembly.

NOTE

Mechanical guard (5) and gas turbine power unit (2) must be retained as a matched set. During installation, make sure mechanical guard (5) is positioned on gas turbine power unit (2) with match marks (12), tabs (13) and grooves (14) aligned.

c. Gently raise gas turbine power unit (2) from work surface and install mechanical guard (5) using match marks (12) made during disassembly. Make sure tabs (13) are installed in grooves (14).



Go on to Sheet 15

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 15 of 30)

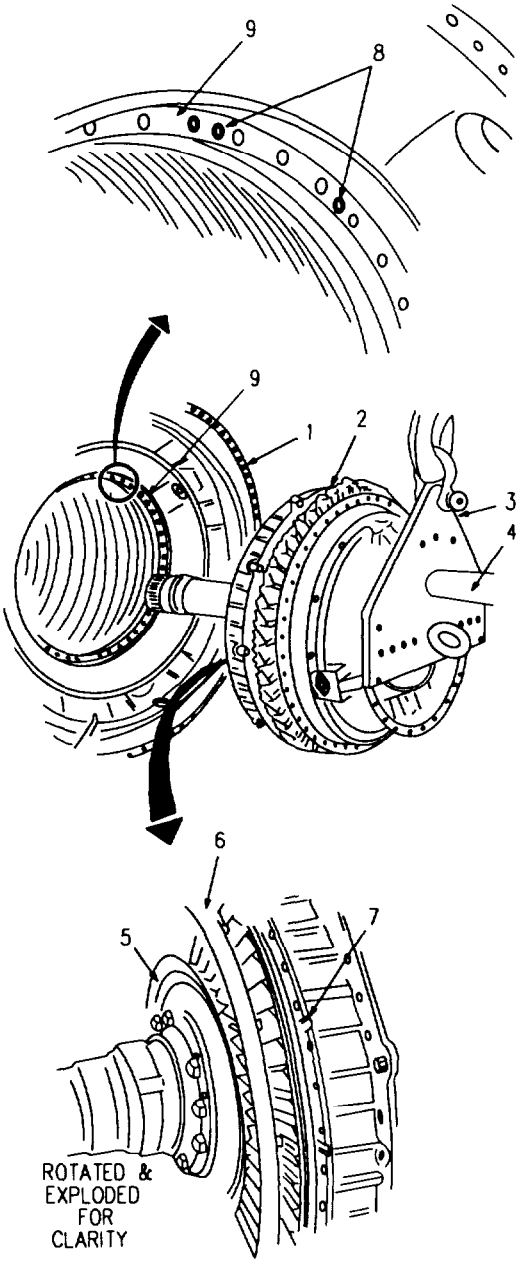
CAUTION

Use caution to prevent damage to turbine rotor (5), mechanical guard (6) or regenerator assembly (1). Use extreme care not to damage inside of regenerator assembly (1) while installing gas turbine power unit (2). Avoid excessive upward or downward movement of power unit (2) to prevent damage to inside of regenerator assembly (1). If damage occurs, replace regenerator with a serviceable assembly.

3. USING HOIST AND LIFTING SLING (3), GUIDE GAS TURBINE POWER UNIT (2) INTO POSITION IN REGENERATOR ASSEMBLY (1).

a. Carefully install gas turbine power unit (2) into regenerator assembly (1) by applying only enough downward pressure on lifting sling handle (4), in combination with hoist, to position and guide power unit (2) into regenerator assembly (1).

b. Align gas turbine power unit rear assembly 15 slots (7) with 15 spring pins (8) on mounting flange (9).



Go on to Sheet 16

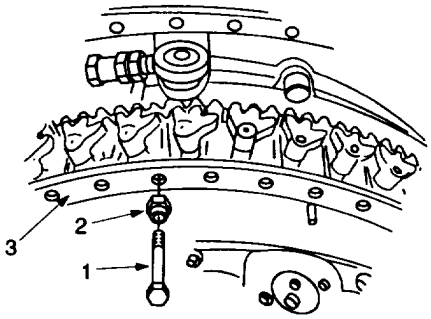
GAS TURBINE POWER UNIT REPLACEMENT (Sheet 18 of 30)

CAUTION

Do not install four temporary bolts (1) without spacers (2). Bolts may extend beyond thread depth and become lodged in power unit housing.

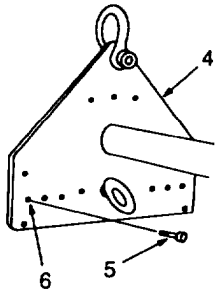
NOTE

Use four of the 45 bolts removed in step 17.b. Use four nuts (call out 14, page 5-26) removed from forward and rear module flange as spacers (2).



2 O'CLOCK POSITION SHOWN

4. TEMPORARILY INSTALL FOUR BOLTS (1) AND SPACERS (2) AT 2, 4, 8, AND 10 O'CLOCK POSITIONS OF MECHANICAL HOUSING OUTER FLANGE (3). TIGHTEN BOLTS SECURELY



5. REMOVE LIFTING SLING (4). INSTALL SEVEN MOUNTING BOLTS (5) IN THREADED HOLES (6) AND SET SLING ASIDE.

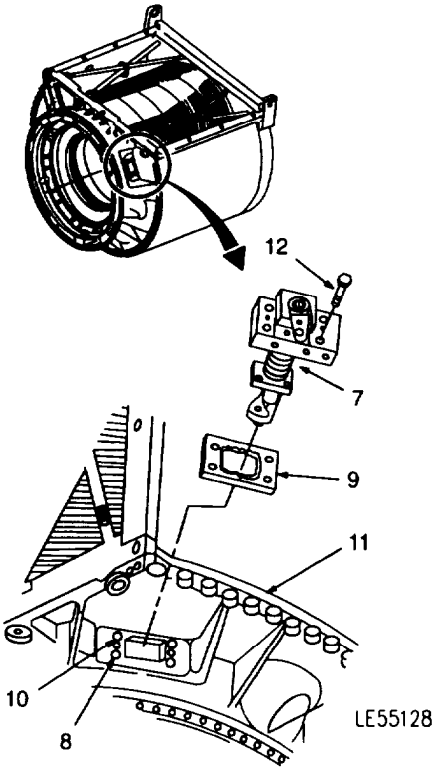
6. INSTALL TURBINE GEARBOX HOUSING AND SPUR GEARSHAFT (7).

a. Apply antiseize compound to four outer threaded mounting flange holes (8).

b. Install new gasket (9) over two spring pins (10) in regenerator (11).

c. Install turbine gearbox housing and spur gearshaft (7). Make sure housing is seated properly on spring pins (10) and is flush against gasket (9) and mounting surface.

d. Apply antiseize compound to four bolts (12). Install four bolts (12) and tighten between 250-325 lb-in (28-37 N•m) torque.



Go on to Sheet 17

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 17 of 30)

CAUTION

Do not adjust turnbuckle rod bearing assembly (1). Alinement of vanes with turbine gearbox housing assembly is preset at the factory and must not be disturbed.

7. INSTALL BOLT (2) IN TURNBUCKLE ROD BEARING ASSEMBLY (1) AND CONNECT TO TURBINE GEARBOX HOUSING SPUR GEARSHAFT (3). TIGHTEN BOLT (2) SECURELY

8. REMOVE RIGGING PIN (4).

9. TIGHTEN SELF-LOCKING NUT (5).

10. INSPECT ADAPTER AND SHAFT ASSEMBLY (6) AS FOLLOWS:

a. Rotate adapter and shaft assembly (6) from rear of regenerator (7) and check for rubs or binding. No rubs or binding is permitted during rotation check.

NOTE

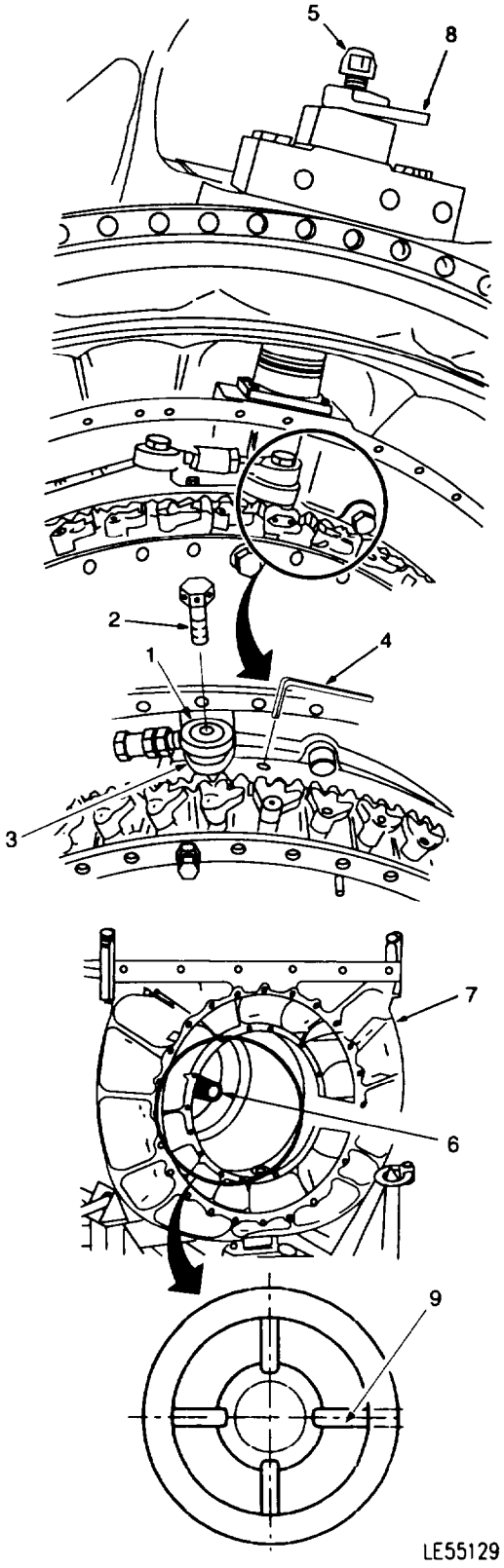
If a rub is detected, go to step 12.
If no rubs are detected, go to step 11.

b. Inspect adapter and shaft assembly (6) bumper stop to determine if it is the latest configuration. If the bumper stop end is equipped with only two oil grooves (9), then a new bumper stop equipped with four oil grooves must be installed. This requirement is critical and cannot be deferred. If the bumper stop is equipped with fourgrooves (9) continue to step 11. If the bumper stop is equipped with two grooves, perform adapter and shaft assembly repair procedure on page 6-37 first, then proceed to step 11.

11. ROTATE REMOTE CONTROL LEVER (8) UP AND DOWN TO CHECK FOR BINDING. NO EXCESSIVE BINDING IS PERMITTED.

NOTE

If remote control lever (8) moves freely when rotated by hand, go to step 13.
If remote control lever (8) cannot be rotated freely by hand, go to next step.



Go on to Sheet 18

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 18 of 30)

12. PERFORM THE FOLLOWING PROCEDURE IF A RUB OR BINDING OCCURS WHEN ROTATING REMOTE CONTROL LEVER (1):

CAUTION

Excessive rotation of spur gear (2) with turnbuckle rod bearing (3) disconnected may cause vanes (4) to become unhinged from spur gear (2).

If vanes (4) become unhinged, reassemble turbine power unit with original parts and replace rear engine module.

a. Rotate remote control lever (1) until rigging pin (5) can be inserted through hole in spur gear (2) and into alignment hole in shroud (6).

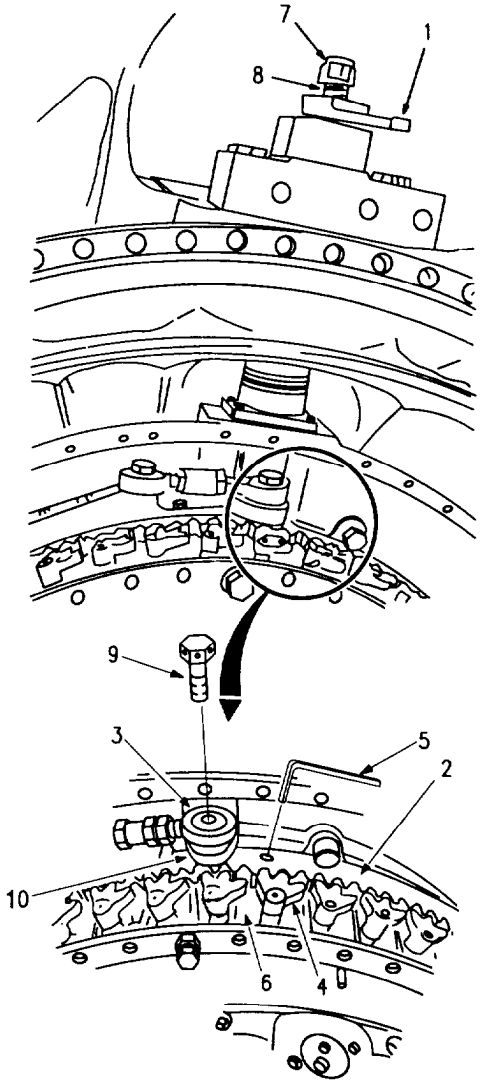
b. Loosen self-locking nut (7) to within one thread of end of shaft (8). Do not remove nut (7).

c. Push down on self-locking nut (7) until shaft (8) is seated.

d. Remove bolt (9) and swing turnbuckle rod bearing assembly (3) away from spur gear-shaft (10). Retain bolt (9) for further use.

CAUTION

Do not adjust turnbuckle rod bearing assembly (3). Alignment of vanes with turbine gearbox housing assembly is preset at the factory and must not be disturbed. Damage to parts may result.



2 O'CLOCK POSITION SHOWN

LE55130

Go on to Sheet 19

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 19 of 30)

e. Remove four bolts (1). Remove turbine gearbox housing and spur gearshaft (2) and gasket (3). Retain gasket (3) for further use.

CAUTION

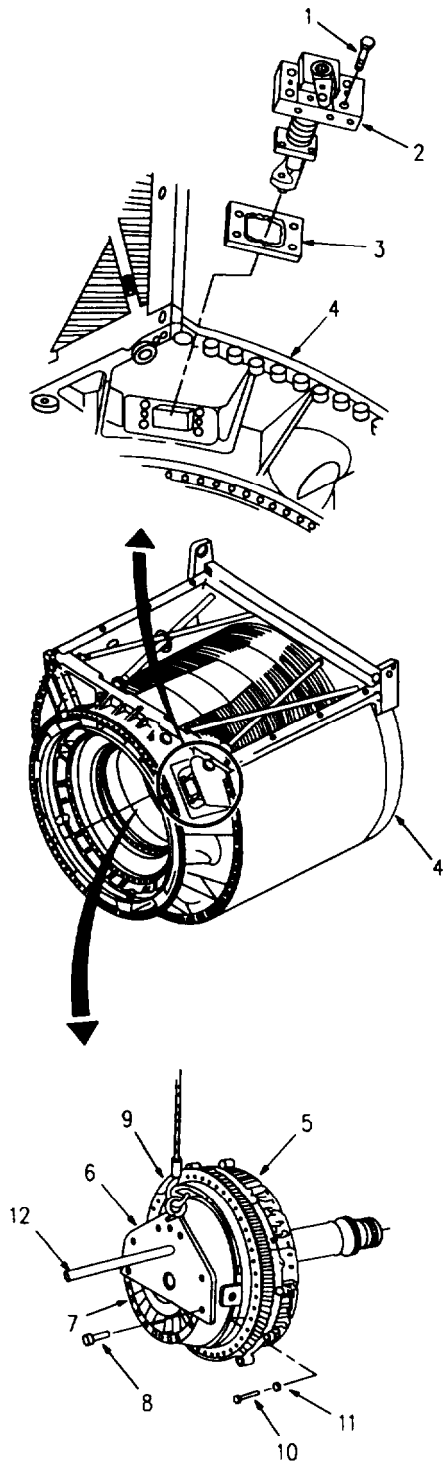
Use extreme care not to damage inside of regenerator assembly (4) while removing gas turbine power unit (5). Replace regenerator assembly (4) if damage such as cracks (except minor axial cracks) or holes in core is observed.

f. Install lifting sling (6) on LP turbine nozzle flange (7) using seven bolts (8) provided with lifting sling (6).

g. Attach chain hoist hook (9) to lifting sling (6) and remove slack from chain.

h. Remove four temporary bolts (10) and spacers (11) and set aside for further use.

i. Gently remove gas turbine power unit (5) from regenerator assembly (4) by pulling and applying only enough downward pressure on lifting sling handle (12) to free and guide power unit (5).



LE55131

Go on to Sheet 20

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 20 of 39)

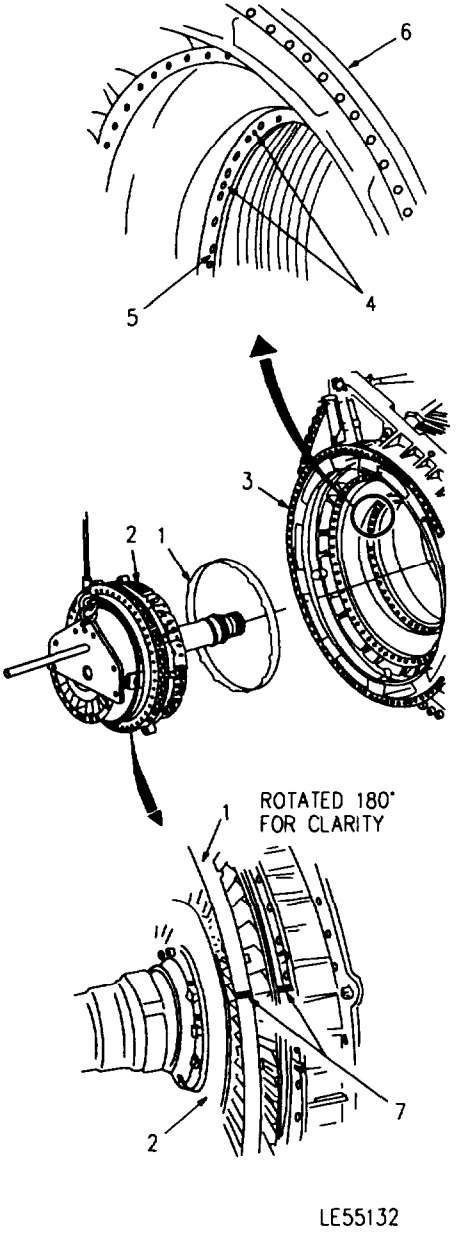
NOTE

Mechanical guard (1) and gas turbine power unit (2) should be kept together as a matched set whenever removed from regenerator assembly (3). Used serviceable units may be substituted, however. Whenever possible, keep mechanical guard (1) with, and positioned on, gas turbine power unit (2) as removed.

j Inspect mechanical guard (1) for warpage, bends or deformation. Replace as required with a used serviceable unit.

k. Inspect 15 spring pins (4) in mounting flange (5) of regenerator (6). Check for bent, misaligned or missing spring pins (4). Replace regenerator (6) if any of these conditions exist.

l. Install mechanical guard (1) on rear of gas turbine power unit (2) using alignment marks (7) made during disassembly.



Go on to Sheet 21

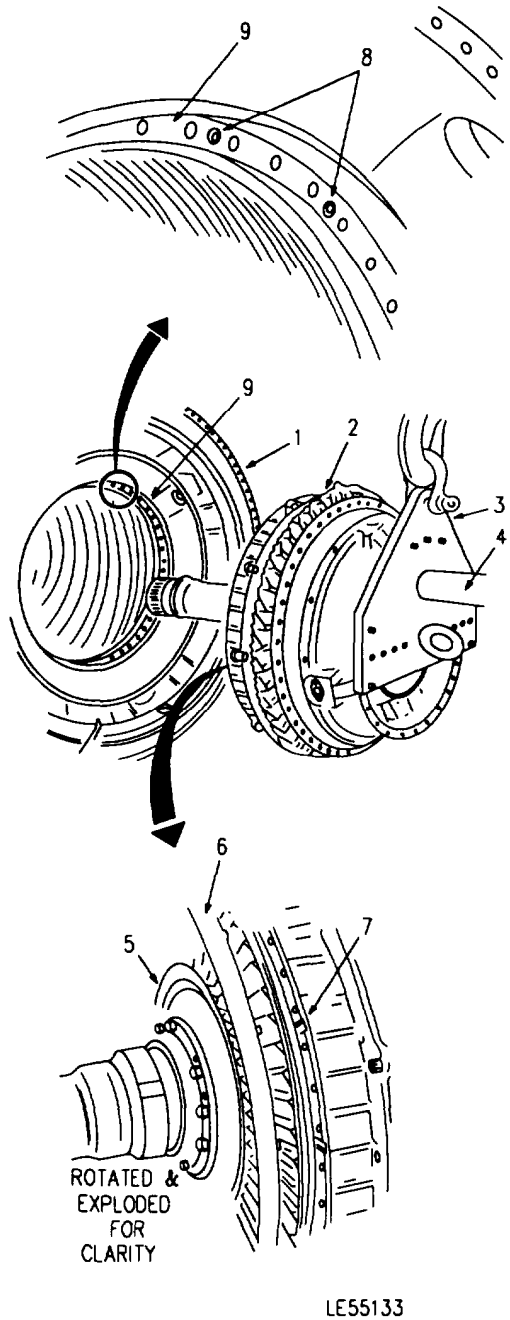
GAS TURBINE POWER UNIT REPLACEMENT (Sheet 21 of 30)

CAUTION

Use caution to prevent damage to turbine rotor (5), mechanical guard (6) or regenerator assembly (1). Use extreme care not to damage inside of regenerator assembly while installing gas turbine power unit (2). Avoid excessive upward or downward movement of power unit (2) to prevent damage to inside of regenerator assembly. If damage occurs, replace regenerator (1) with a serviceable assembly.

m. Using hoist and lifting sling (3), guide gas turbine power unit (2) into position in regenerator assembly (1). Apply only enough downward pressure on lifting sling handle (4), in combination with hoist, to position and guide power unit (2) into regenerator assembly (1).

n. Align gas turbine power unit rear assembly 15 slots (7) with 15 spring pins (8) on mounting flange (9).



Go on to Sheet 22

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 22 of 30)

CAUTION

Do not install four temporary bolts (1) without spacers (2). Bolts may extend beyond thread depth and become lodged in power unit housing.

NOTE

Use four of the 45 bolts removed in step 17.b. Use four nuts (callout 14, page 5-26) removed from forward and rear module flange as spacers (2).

o. Temporarily install four bolts (1) and spacers (2) with the first bolt located in a bolt hole near the end of turnbuckle rod bearing assembly (13). Evenly space other 3 bolts 90 degrees apart (approximately 2, 4, 8 and 10 o'clock positions) on mechanical housing outer flange (3). Tighten bolts securely.

p. Remove lifting sling (4). Install seven mounting bolts (5) in threaded holes (6) and set sling aside.

q. Apply antiseize compound to four outer threaded mounting flange holes (7).

r. Install new gasket (8) over two spring pins (9) in regenerator (10).

s. Install turbine gearbox housing and spur gear-shaft (11). Make sure housing is seated properly on spring pins (9) and is flush against gasket (8) and mounting surface.

t. Apply antiseize compound to four bolts (12). Install four bolts (12) and tighten between 250-325 lb-in (28-37 N•m) torque.

Go on to Sheet 23

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 23 of 30)

CAUTION

Do not adjust turnbuckle rod bearing assembly (1). Alignment of vanes with turbine gearbox housing assembly is preset at the factory and must not be disturbed. Damage to parts may result.

u. Install bolt (2) in turnbuckle rod bearing assembly (1) and connect to turbine gearbox housing spur gearshaft (3). Tighten bolt (2) securely.

v. Remove rigging pin (4).

w. Tighten self-locking nut (5).

x. Rotate adapter and shaft assembly (6) from rear of regenerator (7) and check for rubs or binding. No rubs or binding is permitted during rotation check.

NOTE

If a rub is detected, repeat Installation steps 12.a through x. If this is the third attempt to eliminate rubbing, assemble rear engine module with original parts and replace.

If no rubs are detected, go to next step.

y. Rotate remote control lever (8) up and down to check for binding. No excessive binding is permitted.

Go on to Sheet 24

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 24 of 30)

NOTE

If remote control lever (1) moves freely when rotated by hand, go to CAUTION before step 13.

If remote control lever (1) cannot be rotated freely by hand, repeat step 12.a. through y. If this is the third attempt to eliminate binding, assemble rear engine module with original parts and replace.

CAUTION

Retrieve any inner mounting bolts (2) that are dropped or fall out during assembly. Loose hardware will cause damage to engine during operation.

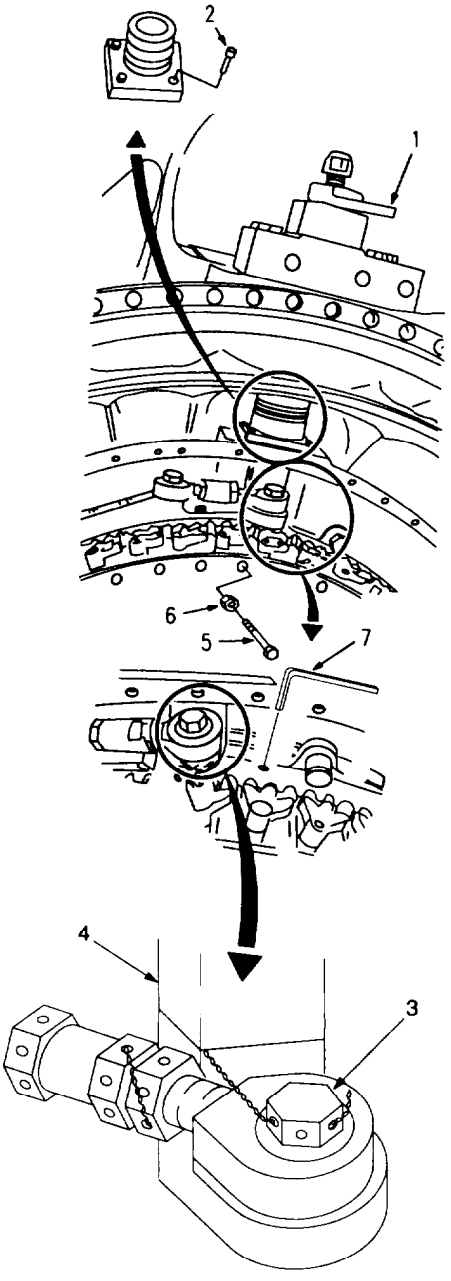
13. APPLY ANTISEIZE COMPOUND TO FOUR INNER MOUNTING BOLTS (2), INSTALL AND TIGHTEN SECURELY SAFETY WIRE BOLTS (2).

14. SAFETY WIRE TURNBUCKLE ROD BEARING ASSEMBLY RETAINING BOLT (3) TO SPUR GEARSHAFT (4).

15. REMOVE FOUR TEMPORARY BOLTS (5) AND SPACERS (6).

NOTE

Verify that rigging pin (7) has been removed and turbine gearbox housing inner mounting bolts (2) are safety wired.



LE55136

Go on to Sheet 25

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 25 of 30)

NOTE

Mechanical guard (1) has a small hole (2) located in the inner bolt hole circle. Hole (2) shall be at 1 o'clock position when mechanical guard (1) is properly installed.

16. APPLY ANTISEIZE COMPOUND TO 45 (LONG) MOUNTING BOLTS (3). PLACE MECHANICAL GUARD (1) AGAINST GAS TURBINE POWER UNIT MOUNTING FLANGE (4) AND REGENERATOR MOUNTING FLANGE (5) AND LINE UP ALL HOLES.

17. LOOSELY INSTALL 45 BOLTS (3) AND ACCESS COVER (6) OVER HOLE (2).

18. APPLY ANTISEIZE COMPOUND TO 60 (SHORT) MOUNTING BOLTS (7) AND LOOSELY INSTALL AT OUTER BOLT HOLE CIRCLE OF MECHANICAL GUARD (1).

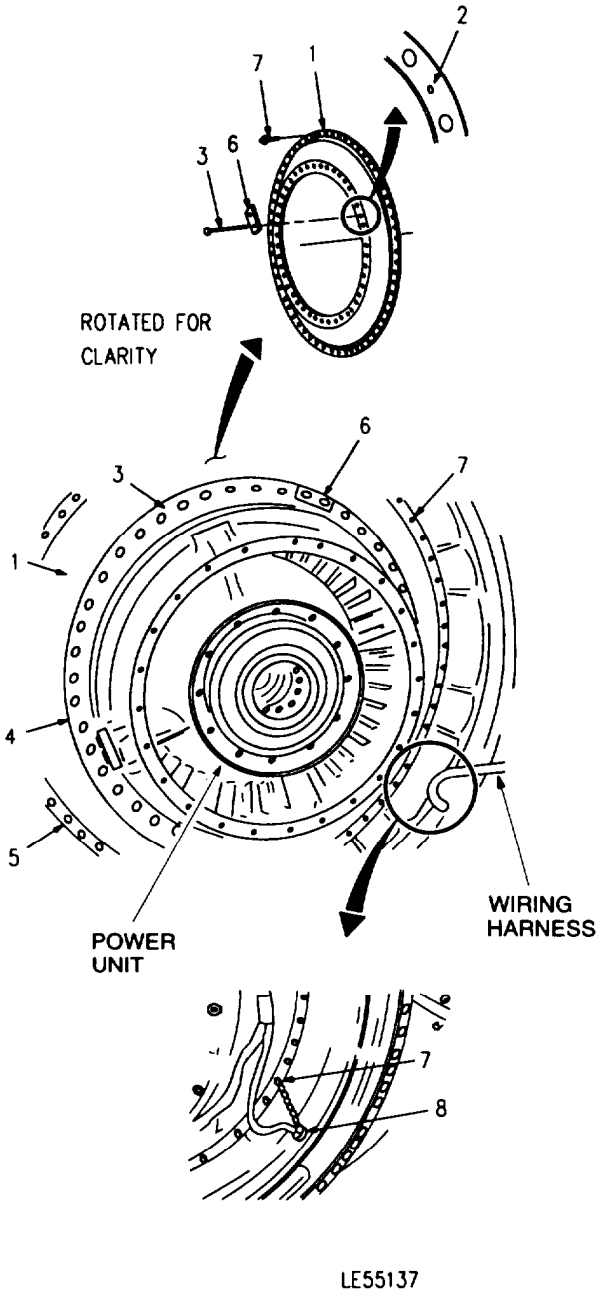
19. TIGHTEN 45 INNER BOLTS (3) BETWEEN 45-50 LB-IN (5-6 N•M) TORQUE IN A CRISS-CROSS PAT-TERN. RETORQUE BOLTS.

20. TIGHTEN 60 OUTER BOLTS (7) BETWEEN 45-50 LB-IN (5-6 N•M) TORQUE IN A CRISS-CROSS PATTERN. RETORQUE BOLTS.

21. SAFETY WIRE 45 INNER BOLTS (3) USING SINGLE WIRE METHOD.

22. .SAFETY WIRE THREE WIRING HARNESS PLUGS (8) TO ADJACENT OUTER MOUNTING BOLT (7).

23. SAFETY WIRE REMAINING 57 MOUNTING BOLTS (7) USING SINGLE WIRE METHOD.

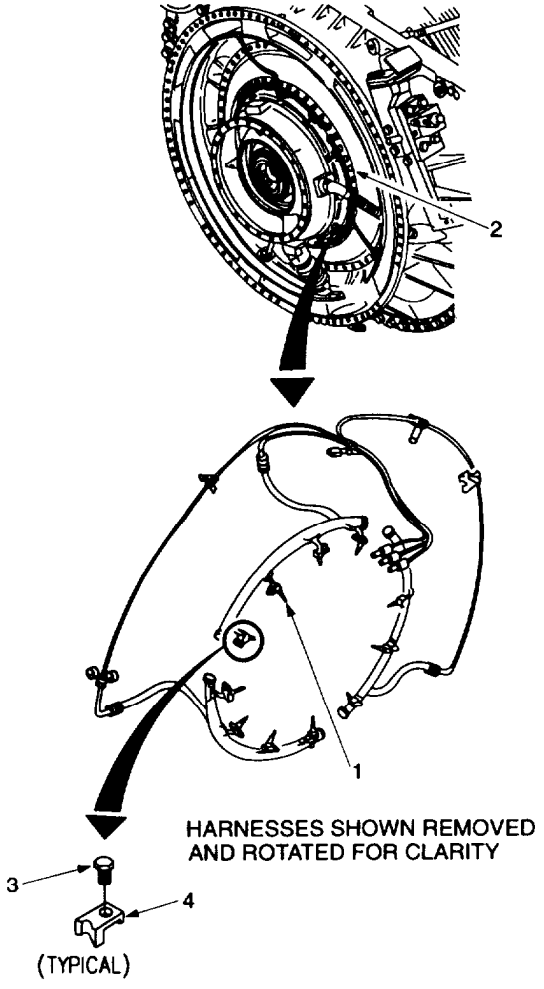


Go on to Sheet 28

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 26 of 30)

24. INSERT WIRING HARNESS PROBES (1) INTO GAS TURBINE POWER UNIT ASSEMBLY (2).

25. APPLY ANTISEIZE COMPOUND TO 12 BOLTS (3). SECURE PROBES (1) WITH 12 CABLE HANGERS (4) AND BOLTS (3). TIGHTEN BOLTS (3) BETWEEN 80-100 LB-IN (9-11 N•M) TORQUE. SAFETY WIRE BOLTS (3) USING SINGLE WIRE METHOD.



Go on to Sheet 27

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 27 of 30)

26. INSTALL COOLING TUBE ASSEMBLY (1), PACKING MATERIAL (2) AND PREFORMED PACKING (3).

a. Lightly coat packing material (2) with Ultrathem assembly fluid and install onto outer flange (4) of cooling tube (1).

b. Install preformed packing (3) onto gas turbine power unit housing (5).

c. Insert cooling tube (1) through regenerator (6) and onto gas turbine power unit housing (5).

d. Apply antiseize compound to two bolts (7). Install bolts (7) but do not torque.

e. Apply antiseize compound to three (long) bolts (8) and one (short) bolt (9). Loosely install bolts (8) with washers (10), and bolt (9).

NOTE

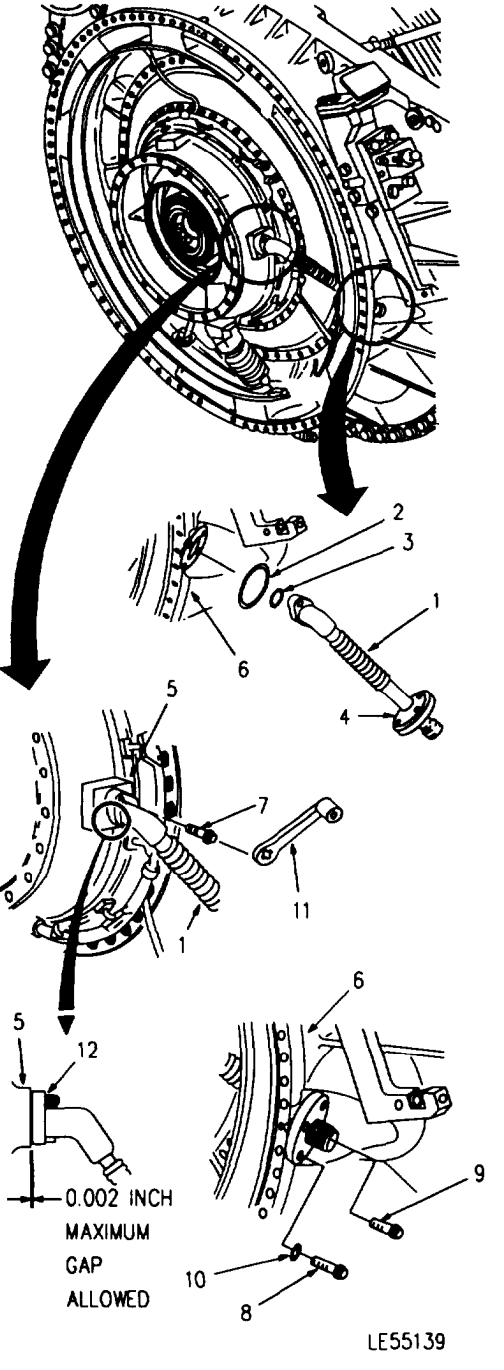
Torque two inner bolts (7) first, then torque outer bolts (8, 9).

27. USING TORQUE ADAPTER (11), TIGHTEN BOLTS (7) BETWEEN 49-57 LB-IN (5.5-6.5 N•M) TORQUE. WAIT 10 MINUTES AND RETORQUE.

28. TIGHTEN BOLTS (8, 9) BETWEEN 80-100 LB-IN (9-11 N•M) TORQUE.

29. USING FEELER GAGE, CHECK GAP BETWEEN FLANGE (12) AND GAS TURBINE POWER UNIT HOUSING (5). THE GAP SHALL BE NO LARGER THAN 0.002 INCH (0.051 MM). IF GAP IS GREATER THAN 0.002 INCH, REPLACE COOLING TUBE ASSEMBLY (1).

30. SAFETY WIRE BOLTS (7) USING TWO WIRE TWIST METHOD AND BOLTS (8, 9) USING SINGLE WIRE METHOD.



Go on to Sheet 28

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 28 of 30)

31. INSTALL OIL SCAVENGE TUBE ASSEMBLY (1), METAL SEAL RING (2) AND GASKETS (3, 4).

f. Lightly coat two gaskets (3) with Ultrachem assembly fluid and install over hollow pins (5).

g. Apply a light coat of Ultrachem assembly fluid to metal seal ring (2) and install onto outer flange (6).

h. Insert oil scavenge tube assembly (1) through regenerator (7). Install (oval) gasket (4), onto inner flange (8). Use Uttrachem assembly fluid to hold gasket.

i. Apply antiseize compound to two new bolts (9). Install bolts (9) but do not torque.

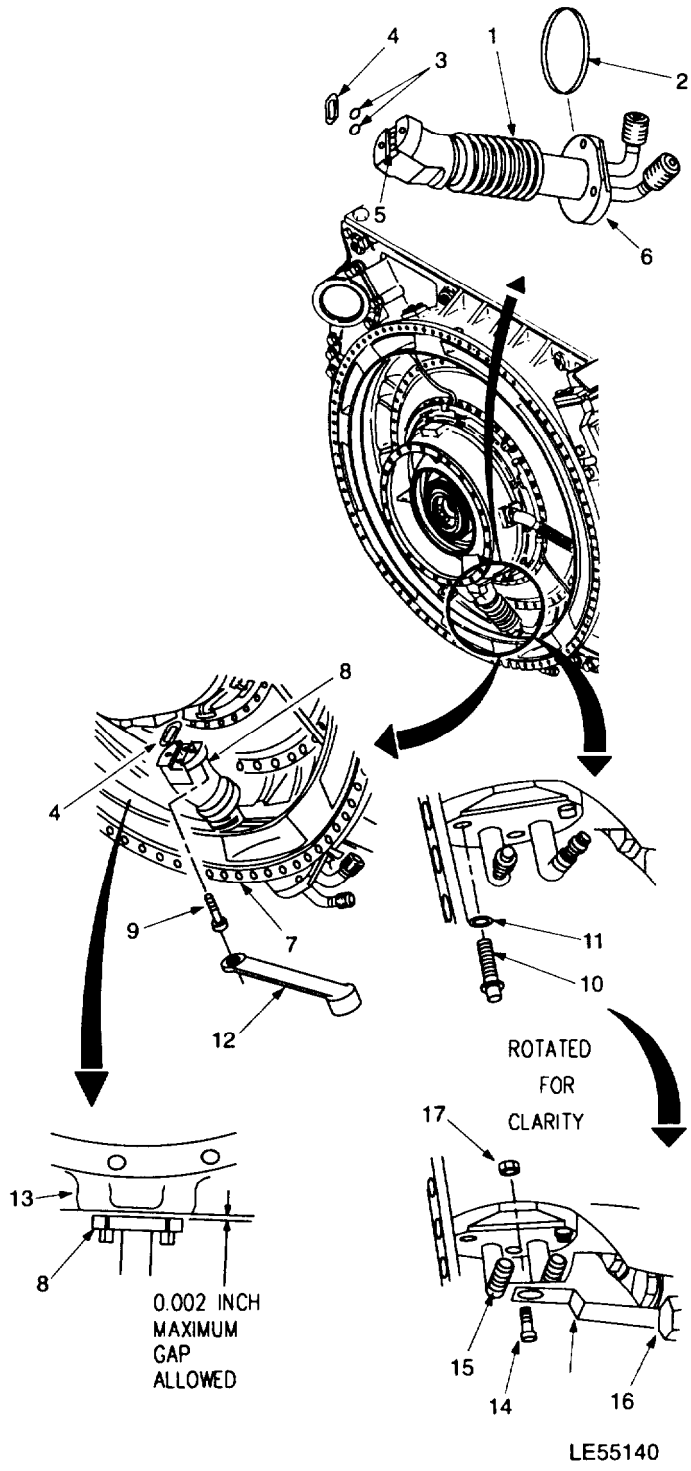
j. Apply antiseize compound to three bolts (10). Loosely install bolts (10) with washers (11).

32. USING TORQUE ADAPTER (12) TIGHTEN BOLTS (9) BETWEEN 49-57 LB-IN (5.5-6.5 N•M) TORQUE. WAIT 10 MINUTES AND RETORQUE. TIGHTEN BOLTS (10) BETWEEN 80-100 LB-IN (9-11 N•M) TORQUE.

33. USING FEELER GAGE, CHECK GAP BETWEEN FLANGE (8) AND GAS TURBINE POWER UNIT HOUSING (13). THE GAP SHALL BE NO LARGER THAN 0.002 INCH (0.051 MM). IF GAP IS GREATER THAN 0.002 INCH, REPLACE OIL SCAVENGE TUBE ASSEMBLY (1).

34. INSTALL SCREW (14) THROUGH CLAMPS (15) AND SUPPORT BRACKET (16) AND SECURE WITH NEW SELF-LOCKING NUT (17).

35. SAFETY WIRE BOLTS (9) USING TWO WIRE TWIST METHOD AND BOLTS (10) USING SINGLE WIRE METHOD.



Go on to Sheet 29

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 29 of 30)

36. INSTALL OIL FEED TUBE ASSEMBLY (1), GASKET (2) METAL SEAL RING (3) AND PACKING MATERIAL (4).

a. Apply Ultrachem assembly fluid to gasket (2) and metal seal ring (3). Install gasket (2) and seal ring (3) on tube inner flange (5).

b. Install packing material (4) on tube outer flange (6). Use Ultrachem assembly fluid to hold packing material (6) in place.

C. Insert oil feed tube assembly (1) through regenerator (7).

d. Apply antiseize compound to two bolts (8) and secure tube inner flange (5) to gas turbine power unit housing (9). Do not torque bolts (8).

e. Apply antiseize compound to four bolts (10). Loosely install bolts (10) and washers (11) into tube outer flange (6) and regenerator (7).

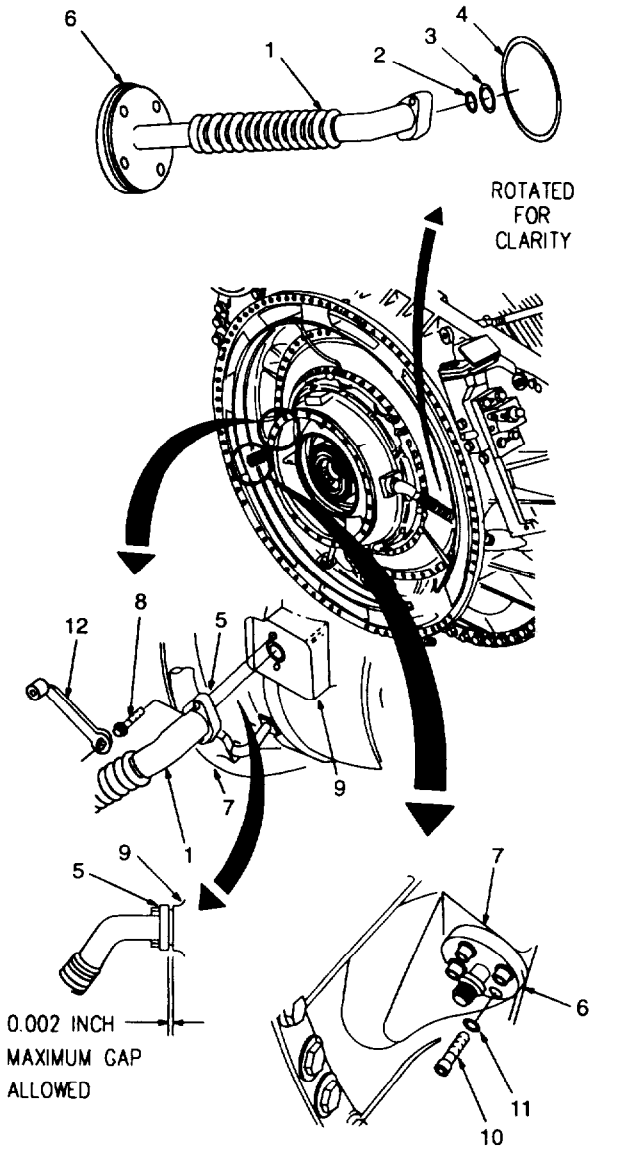
NOTE

Torque two inner bolts (8) first, then torque four outer bolts (10).

37. USING TORQUE ADAPTER (12), TIGHTEN BOLTS (8) BETWEEN 49-57 LB-IN (5.5-6.5 N•M) TORQUE. WAIT TEN MINUTES AND RETORQUE. TIGHTEN BOLTS (10) BETWEEN 80-100 LB-IN (9-11 N•M) TORQUE.

38. USE FEELER GAGE AND CHECK GAP BETWEEN FLANGE (5) AND GAS TURBINE POWER UNIT HOUSING (9). THE GAP SHALL BE NO LARGER THAN 0.002 INCH (0.051 MM). IF GAP IS GREATER THAN 0.002 INCH, REPLACE OIL SCAVENGE TUBE ASSEMBLY (1).

39. SAFETY WIRE BOLTS (8) USING TWO WIRE TWIST METHOD AND BOLTS (10) USING SINGLE WIRE METHOD.



LE55141

Go on to Sheet 30

GAS TURBINE POWER UNIT REPLACEMENT (Sheet 30 of 30)

CAUTION

Use care during and after installation of turbine rotor shaft (1) to avoid damaging bearing seal or air seal.

40. INSTALL SHAFT (1) SPACER RING (3), TURBINE NOZZLE (4) AND 24 BOLTS (5). TIGHTEN 24 BOLTS (5) BETWEEN 70-95 LB-IN (8-11 N•M) TORQUE.

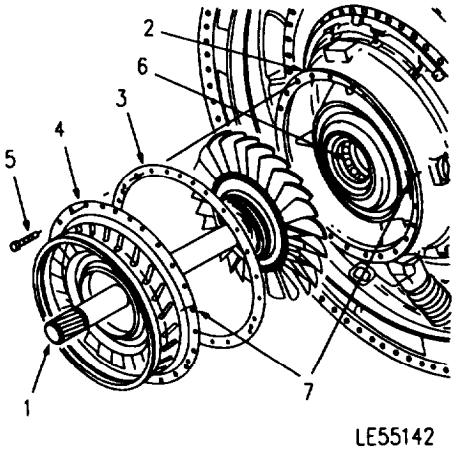
a. Have assistant hold shaft (1) and seat in No. 5 bearing (6).

b. Install spacer ring (3) and nozzle (4) on power turbine housing (2). Align locating marks (7) on nozzle (4) and power turbine housing (2), and align bolt holes.

NOTE

Tighten 24 bolts (5) evenly opposite each other.

c. Apply antiseize compound to 24 bolts (5). Install bolts (5) evenly and tighten between 70-95 lb-in (8-11 N•m) torque. Lockwire 24 bolts (5).



41. INSTALL REDUCTION GEARBOX (PAGE 6-19).

42. INSTALL FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) (PAGE 5-28).

43. CONNECT ENGINE TO TRANSMISSION (TM 34-1).

End of Task

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 1 of 11)

TOOLS:

General mechanic's tool kit: automotive (SC5180–90–N26)
Feeler Gage, 0.020 in. (Item 142, Appendix D)
G.P. Turbine Runouts Fixture (Item 157, Appendix D)
Micrometer, 1 inch (Item 128, Appendix D)
Micrometer, depth gage (Item 205, Appendix D)
Socket, 3/8-inch drive, 1/4-inch, 12 point (Item 190, Appendix D)
Torque Wrench, 150 in-lb (Item 27, Appendix D)

PERSONNEL: Two

SUPPLIES:

Antiseize Compound (Item 2, Appendix B)
Felt Marker, Tube Type (Item 25, Appendix B)
Lockwire, 0.032 in. (Item 15, Appendix B)
Ring Spacer, 0.038 in. (Item 182, Appendix E)
Ring Spacer, 0.048 in. (Item 183, Appendix E)
Ring Spacer, 0.058 in. (Item 184, Appendix E)
Ring Spacer, 0.068 in. (Item 185, Appendix E)
Wood Block (Item 21, Appendix B) (2 required)

EQUIPMENT CONDITION:

Powerpack removed (TM20–1)
Engine disconnected from transmission (TM34–1)
Forward engine module removed (page 5-26)

Go on to Sheet 2

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 2 of 11)

REMOVAL:

CAUTION

Do not lean against, hang anything on, bump or rock low pressure (LP) turbine rotor shaft (1). Damage to No. 5 bearing air and oil seals may result.

1. USING A MARKER, PLACE ALIGNMENT MARKS (2) ON POWER TURBINE (PT) HOUSING (3), SPACER RING (4) AND LP TURBINE NOZZLE (5).

WARNING

Use caution when removing nozzle (5). Rotor (1) will fall free without nozzle (5) in place and could cause personnel injury or damage to equipment. Have assistant support rotor shaft (1) at all times during removal of nozzle (5).

2. SUPPORT ROTOR SHAFT (1), CUT SAFE-I-Y WIRE AND REMOVE 24 BOLTS (6). RETAIN BOLTS (6) FOR FURTHER USE.

NOTE

Penetrating oil can be used to soak 24 bolts (6) to facilitate their removal.

CAUTION

Do not use a hammer to dislodge nozzle (5). Damage to nozzle could result. Use jacking bolts.

Go on to Sheet 3

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 3 of 11)

3. REMOVE NOZZLE (1) AND SPACER RING (2).

   a. Using both hands, carefully remove nozzle (1). Then do step d. If unable to remove nozzle (1) by hand, do steps b. and c., then continue with step d.

   b. Install three jacking bolts (3) into three threaded holes (4) in nozzle (1).

   c. Tighten three jacking bolts (3) evenly and op posite each other until nozzle (1) is free of PT housing (5). Remove nozzle (1) and jacking bolts (3).

   d. Remove spacer ring (2). Using a micrometer, measure spacer thickness. Record dimension on tag. Attach tag to spacer and retain for further use.

CAUTION

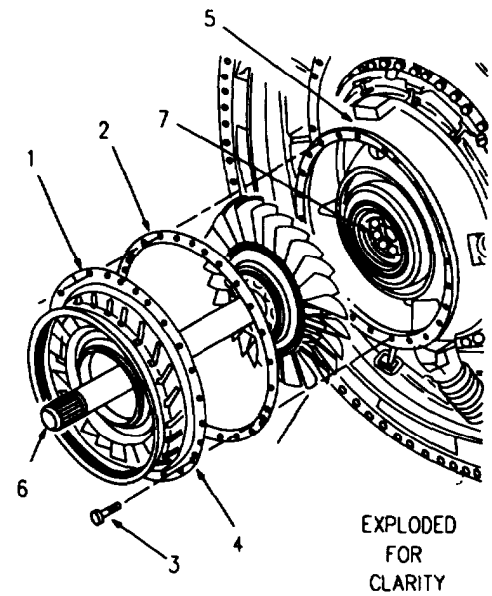
Do not attempt to exchange, swap or replace LP turbine rotor (6). Turbine bearing failure could result.

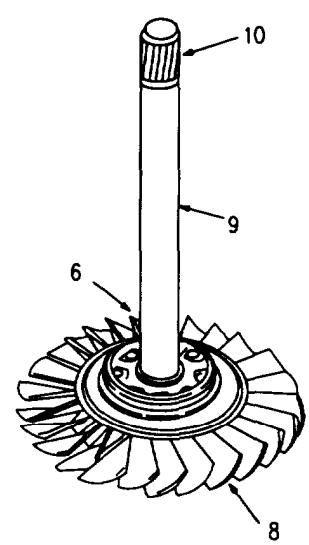
4. REMOVE AND VISUALLY INSPECT LP TURBINE ROTOR AND SHAFT (6). INSPECT NO. 5 BEARING (7).

   a. Check rotor blades (6) for cracks and missing blade material, bends or distortion and heat damage.

   b. Check rotor shaft (9) for scoring and wear on splines (10).

   c. Inspect No. 5 bearing (7) for corrosion, pitting or fracture.





LE5597

Go on to Sheet 4

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 4 of 11)

NOTE

If any of these conditions exist, reassemble power turbine assembly with original hardware and replace rear engine subassembly (page 6–28).

5. PLACE LP TURBINE ROTOR AND SHAFT (1) NOSE UP ON TWO WOOD BLOCKS (2) IN A CLEAN AND SECURE LOCATION.

6. INSPECT NO. 5 SEAL AND DIAPHRAGM (3) FOR DAMAGE (REFER TO PAGE 6–46 FOR REMOVAL INSTRUCTIONS). REPLACE AS REQUIRED.

7. INSPECT INSIDE OF PT HOUSING (4) FOR FOREIGN OBJECTS OR DAMAGE. REMOVE ANY FOREIGN OBJECTS. REPAIR MINOR BURRS, NICKS OR SCRATCHES AS NECESSARY IF SEVERE FOREIGN OBJECT DAMAGE OR CRACKING OF HOUSING IS PRESENT, REASSEMBLE POWER TURBINE ASSEMBLY WTH ORIGINAL HARDWARE AND SALVAGE GAS TURBINE POWER UNIT (PAGE 6-62).

INSTALLATION:

CAUTION

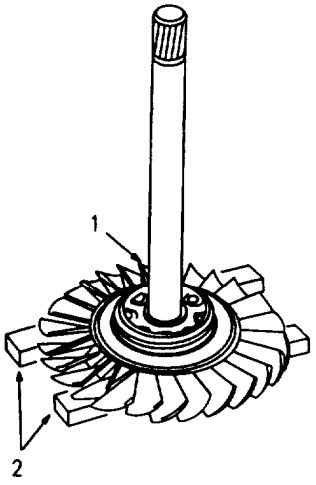
Use care during and after installation of turbine rotor shaft (1) to avoid damaging No. 5 bearing air and oil seals.

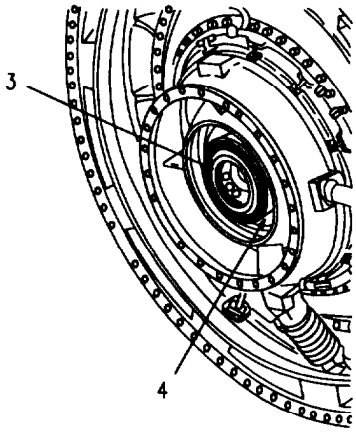
1. USING MARKER, PLACE AN ALIGNMENT MARK (5) ON NEW OR REPLACEMENT NOZZLE (6) AT SAME LOCATION AS MARK MADE ON REMOVED NOZZLE.

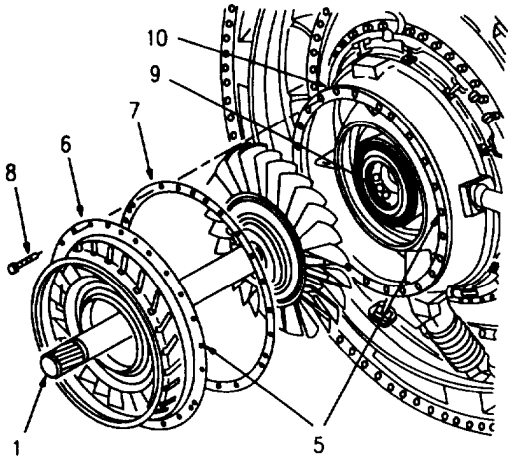
2. INSTALL TURBINE ROTOR SHAFT (1), SPACER RING (7), TURBINE NOZZLE (6) AND 6 BOLTS (8). TIGHTEN BOLTS (8) BETWEEN 70–5 LB-IN (8–1 N•M) TORQUE.

a. Have assistant hold shaft (1) and carefully seat in No. 5 bearing (9).

b. Install spacer ring (7) and nozzle (6) on PT housing (10). Align locating matchmarks (5) on nozzle (6) and PT housing (10), and align bolt holes.







LE5598

Go on to Sheet 5

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 5 of 11)

c. Insure low pressure turbine nozzle is fully seated by attempting to insert a 0.002 inch feeler gage at 3, 6, 9 and 12 o'clock positions at low pressure turbine nozzle to power turbine housing mating surface. If 0.002 inch feeler can be inserted remove low pressure turbine nozzle, inspect for minor nicks or burrs if necessary. Repeat step 2 on page 6-95.

d. Apply antiseize compound to 6 nozzle flange bolts (1). Evenly space and install bolts (1) in a criss–cross pattern and tighten between 70-95 lb-in (8-11 N•m) torque.

3. INSTALL G.P. RUNOUTS FIXTURE, (2) TO BOLT FLANGE (3) USING 4 BOLTS (4) AND NUTS (9).

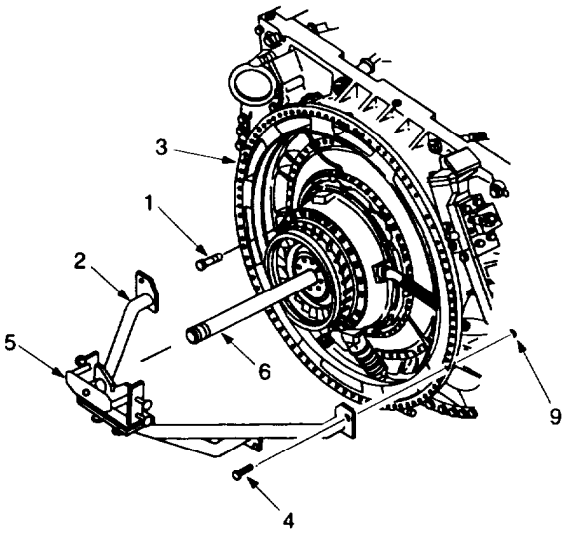
4. INSTALL DIAL INDICATOR ASSEMBLY (7) ON POWER TURBINE SHAFT (6).

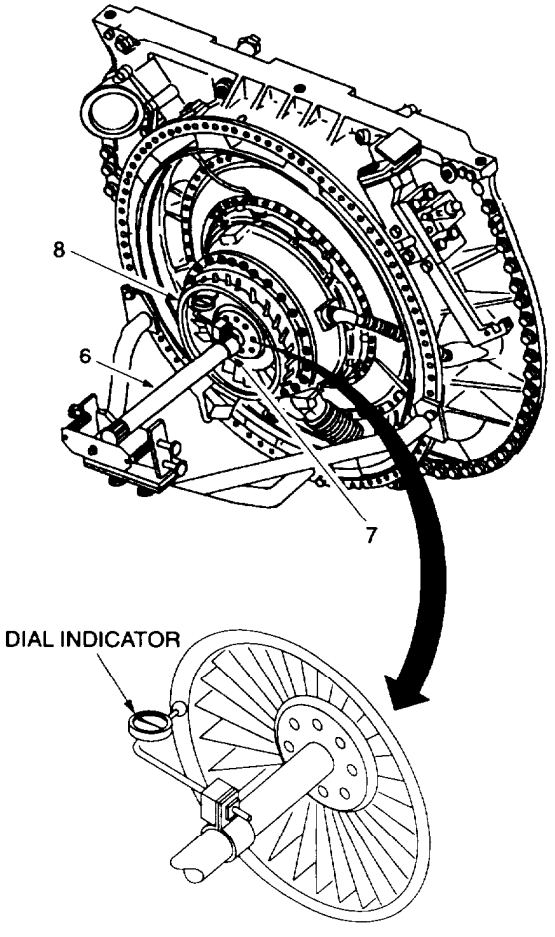
a. Install and loosely secure dial indicator assembly (7) on power turbine shaft (6) with screw clamp.

b. Slide dial indicator assembly (7) rearward to 12 o'clock position and allow indicator gauge plunger to contact low pressure turbine nozzle flange (8) and recess slightly in indicator housing.

c. Tighten dial indicator assembly screw clamp.

5. PULL BACK ON TOGGLE PAD (5) AND PLACE PLUG OVER FORWARD END OF POWER TURBINE SHAFT (6).





LE5599

Go on to Sheet 6

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 8 of 11)

6. CHECK VERTICAL RUNOUT OF POWER TURBINE SHAFT (1).

a. Set dial indicator gauge pointer to zero.

b. Rotate power turbine shaft (1) 180 degrees to 6 o'clock position and note direction of indicator gauge pointer travel as turbine shaft (1) is rotated. Record dial reading.

c. Rotate power turbine shaft (1) in reverse direction back to 12 o'clock position.

d. Adjust runout fixture bottom swivel head screws (2) to obtain a dial reading equal to one half the dial reading recorded in step b.

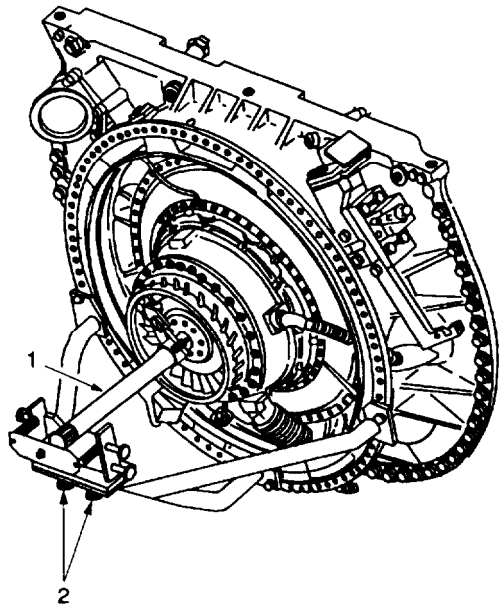
NOTE

Dial indicator gauge pointer must travel in same direction as noted in step b. when adjusting centering screws.

e. Reset indicator gauge pointer to zero at 12 o'clock position, then rotate power turbine shaft (1) 180 degrees to 6 o'clock position and note dial reading.

f. If zero reading is obtained at 6 o'clock position, go to step 7.

g. If zero reading is not obtained at 6 o'clock position, repeat steps c., d., and e.



LE55100

Go on to Sheet 7

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 7 of 11)

7. CHECK HORIZONTAL RUNOUT OF POWER TURBINE SHAFT (1).

a. Move dial indicator assembly (2) to 9 o'clock position and reset indicator gauge pointer to zero.

b. Rotate power turbine shaft (1) 180 degrees to 3 o'clock position and note direction of indicator gauge pointer travel as shaft is rotated. Record dial reading.

c. Rotate power turbine shaft (1) in reverse direction back to 9 o'clock position.

d. Adjust runout fixture left and right side swivel head screws (3) to obtain a dial reading equal to one half the dial reading recorded in step b.

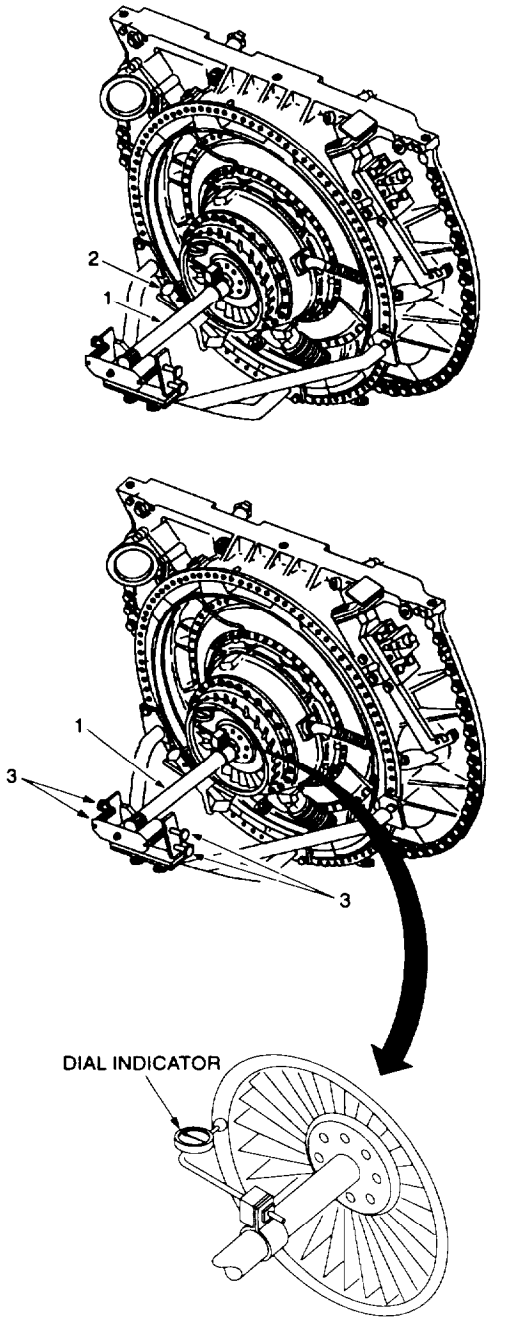
NOTE

Dial indicator gauge pointer must travel in same direction as noted in step b. when adjusting centering screws.

e. Reset indicator gauge pointer to zero at 9 o'clock position, then rotate power turbine shaft (1) 180 degrees to 3 o'clock position and note dial reading.

f. If zero reading is obtained at 3 o'clock position, go to step 8.

g. If zero reading is not obtained at 3 o'clock position, repeat steps c., d., and e.



LE55101

Go on to Sheet 8

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 8 of 11)

8. RECHECK VERTICAL AND HORIZONTAL RUN-OUT OF POWER TURBINE SHAFT (1).

a. Move dial indicator assembly (2) to 12 o'clock position and reset indicator gauge pointer to zero.

NOTE

In the following step, observe and record dial readings obtained at noted clock positions.

b. Rotate power turbine shaft (1) to 3 o'clock position, to 6 o'clock position, to 9 o'clock position and back to 12 o'clock position.

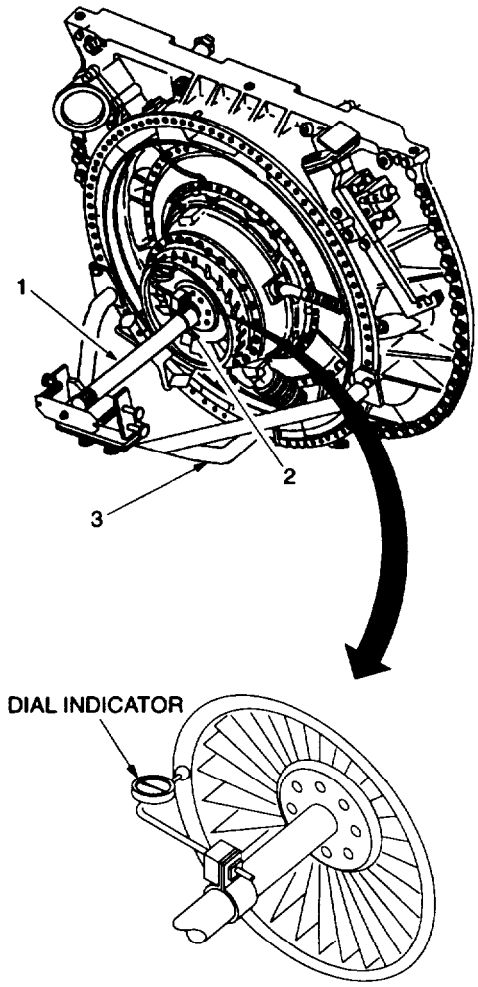
c. If dial reading is between 0-0.005 inch (0-0.127 mm) at any two opposing clock positions, go to step (9).

d. If dial reading is greater than 0.005 inch (0.127 mm) at any two opposing clock positions, repeat steps 6 through 8.c.

9. REMOVE DIAL INDICATOR ASSEMBLY (2) FROM POWER TURBINE SHAFT (1).

CAUTION

Do not remove G.P. turbine runouts fixture (3) or unload power turbine shaft by removing plug from forward end of power turbine shaft (1) (Ref. step 4.). Damage to parts may result.



LE55102

Go on to Sheet 9

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 9 of 11)

10. DETERMINE LONGEST BLADE OF LOW PRESSURE POWER TURBINE ROTOR (1).

a. Insert a 0.015 inch (0.381 mm) minimum feeler gage between top of power turbine rotor blades (2) and cylinder area (3) of turbine nozzle (4).

b. Slowly rotate power turbine rotor shaft (1) to determine longest rotor blade.

11. CHECK LOW PRESSURE POWER TURBINE ROTOR BLADE TIP CLEARANCE.

a. Measure power turbine rotor blade tip clearance by inserting feeler gage on top of longest rotor blade and rotating power turbine rotor shaft (1) one complete revolution (360 degrees).

b. Tip clearance gap shall be maintained between 0.018-0.020 inch (0.457-0.508 mm).

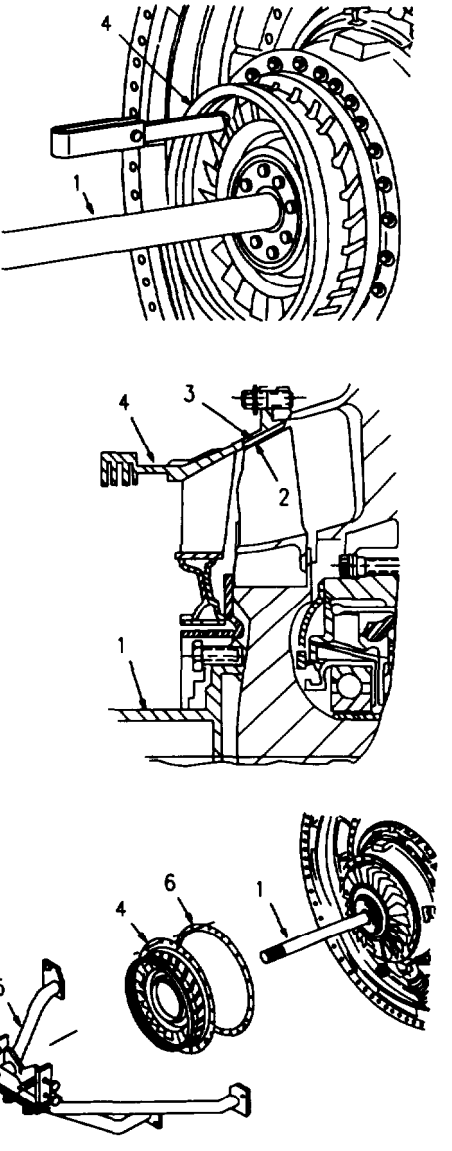
c. If tip clearance is within limits specified in step b., go to step 12.

NOTE

Thicker spacer ring will increase tip clearance. Thinner spacer ring will decrease tip clearance.

d. If tip clearance is not within limits specified in step b., remove G.P. runout fixture (5), LP turbine nozzle (4), and spacer ring (6). Replace spacer ring (6) as necessary to obtain required tip clearance. Then repeat INSTALLATION steps 1. through 11.

12. REMOVE G.P. RUNOUT FIXTURE (5).



LE55103

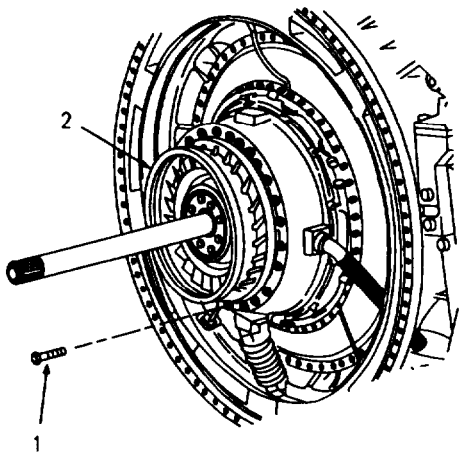
Go on to Sheet 10

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 10 of 11)

13. LOOSEN BUT DO NOT REMOVE 6 BOLTS (1) SECURING LP TURBINE NOZZLE (2).

14. APPLY ANTISEIZE COMPOUND TO REMAINING 18 BOLTS (1) AND INSTALL FINGER TIGHT IN LP TURBINE NOZZLE (2).

15. TIGHTEN ALL 24 BOLTS (1) BETWEEN 70 - 95 LB-IN (7.9 – 10.7 N•M) TORQUE IN A CRISS-CROSS PATTERN.



LE55104

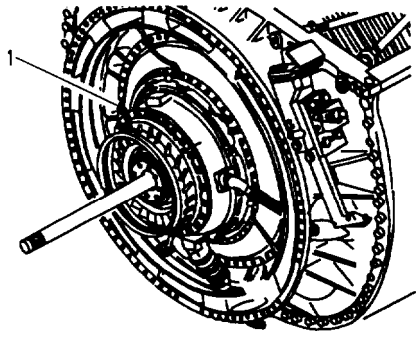
Go on to Sheet 11

LOW PRESSURE TURBINE NOZZLE REPLACEMENT (Sheet 11 of 11)

16. LOCKWIRE ALL 24 BOLTS (1) SECURING LP TURBINE NOZZLE USING SINGLE WIRE METHOD (REF. APPENDIX F).

17. INSTALL FORWARD ENGINE MODULE (GEARBOX MODULE ATTACHED) (PAGE 5-28).

18. CONNECT ENGINE TO TRANSMISSION (TM34-1).



LE55105

End of Task

CHAPTER 7

GEARBOX MODULE MAINTENANCE

CHAPTER INDEX

ACCESSORY SEAL ASSEMBLY REPLACEMENT (Sheet 1 of 7)

TOOLS:

General mechanic's tool kit: automotive (SC5180-90-N26)
Gearbox seal puller (Item 39, Appendix D)
Inserted hammer face (Item 1, Appendix D)
Inserted hammer face holder (Item 2, Appendix D)
AGB dust seal installer (item 117, Appendix D)
AGB face seal installer (Item 124, Appendix D)

PERSONNEL: Two

SUPPLIES:

Adhesive sealer (Item 29, Appendix B)
Nonelectric wire (Item 15, Appendix B)
Plain encased seal (Item 53, Appendix E).
Preformed packing (Item 50, Appendix E)
Preformed packing (Item 51, Appendix E)
Retainer oil seal (Item 54, Appendix E)
Retaining ring (Item 158, Appendix E)
Seal, plain encased (Item 52, Appendix E)
Shortening compound (Item 20, Appendix B)

Go on to Sheet 2

EQUIPMENT CONDITION:

For electromechanical fuel system seal:
Electromechanical fuel system removed (TM 20-1)
Main hydraulic centrifugal pump removed (TM 26-1)
For starter motor seal:
Starter motor removed (TM 20-1)
Engine oil pump removed (TM 20-1)
For main hydraulic centrifugal pump seal:
Main hydraulic centrifugal pump removed (TM 20-1)
Electromechanical fuel system removed (TM 20-l)

Go on to Sheet 3

ACCESSORY SEAL ASSEMBLY REPLACEMENT (Sheet 3 of 7)

NOTE

Use this task to replace seal for the starter, electromechanical fuel system, or main hydraulic pump. Pump seal (1) is shown.

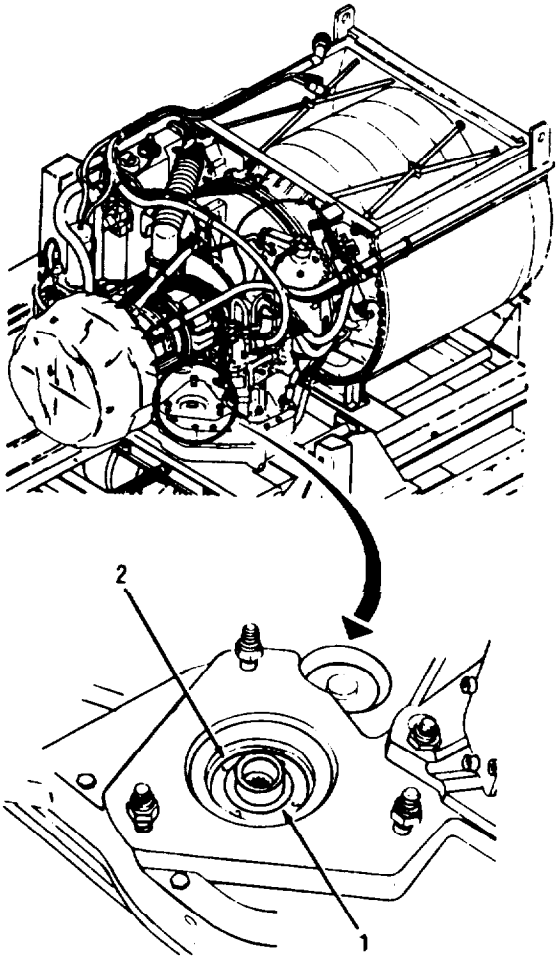
REMOVAL:

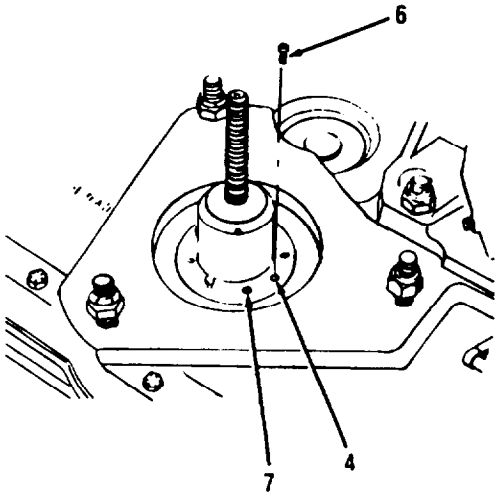
1. REMOVE RETAINING RING (2) AND INSTALL PULLER (3).

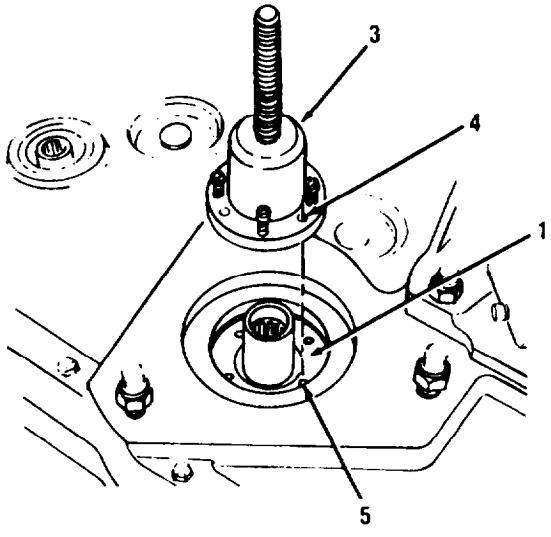
   a. Remove retaining ring (2) from groove.

   b. Install puller (3) on seal (1). Aline four holes (4) with holes (5).

   c. Remove four screws (6) from storage holes (7). Install screws (6) in holes (4).







Go on to Sheet 4

ACCESSORY SEAL ASSEMBLY REPLACEMENT (Sheet 4 of 7)

2. INSTALL PUSHER (1). REMOVE PLAIN ENCASED SEAL (2) OIL SEAL RETAINER (3) AND PREFORMED PACKING (4).

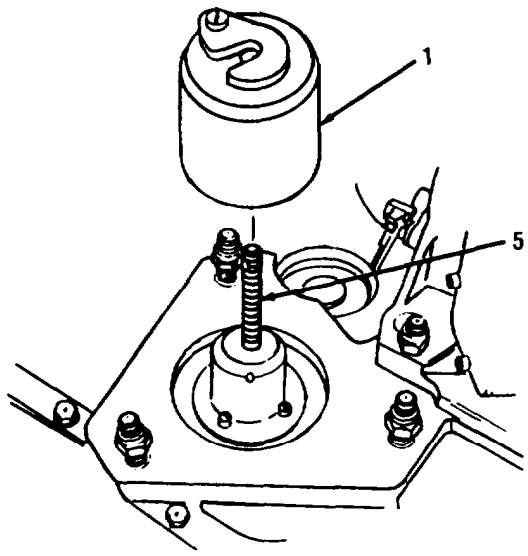
a. Place pusher (1) over stud (5).

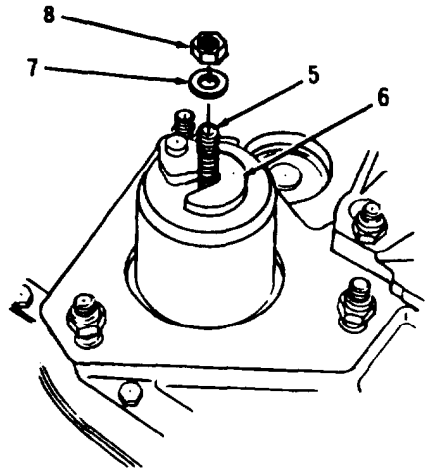
b. Place swing washer (6) around stud (5). Install washer (7) and nut (8) on stud (5).

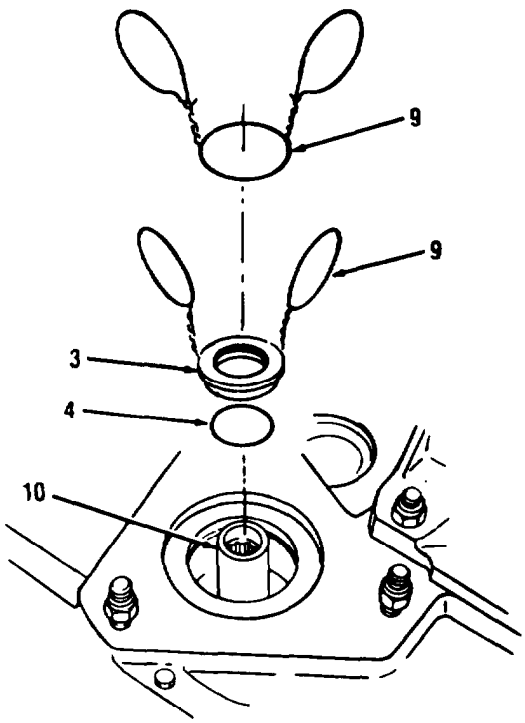
c. Tightem nut (8) until pusher (1) can be lifted.

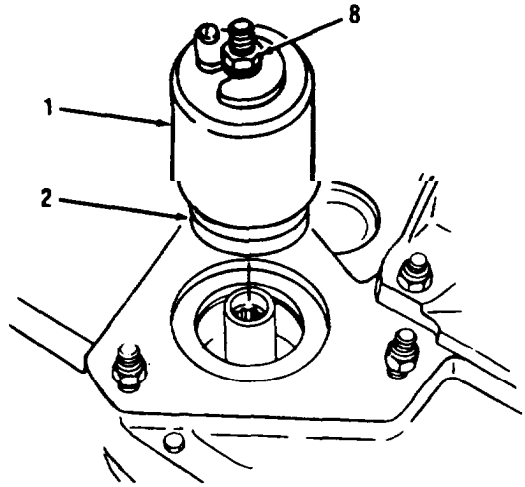
d. Lift pusher (1) and seal (2).

e. Form wire (9) as indicated and wrap under lip of retainer (3) and pull retainer (3) and packing (4) off shaft (10). Discard retainer (3) and packing (4).









Go on to Sheet 5

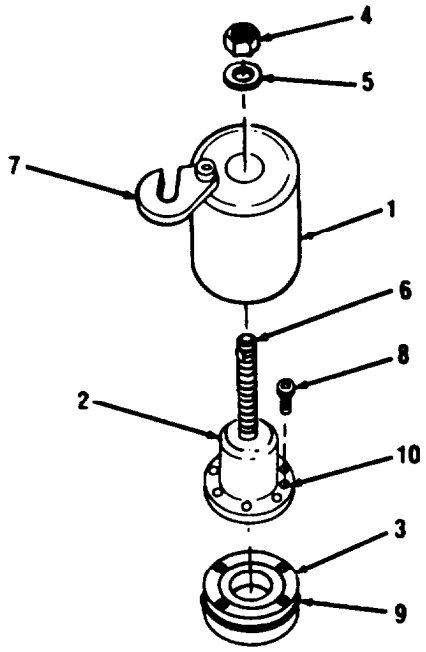
ACCESSORY SEAL ASSEMBLY REPLACEMENT (Sheet 5 of 7)

3. REMOVE PUSHER (1) FROM PULLER (2) AND REMOVE SEAL (3) NUT (4) AND WASHER (5) FROM STUD (6).

a. Move swing washer (7) away. Take puller (2) and seal (3) out of pusher (1).

b. Remove four screws (8). Remove and discard seal (3) and preformed packing (9).

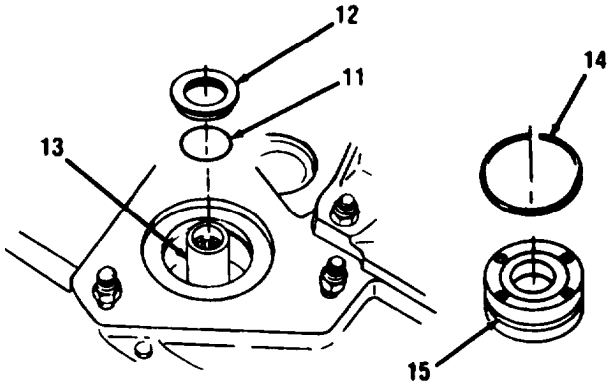
C. Install screws (8) in storage holes (10). Wipe gearshft and seal mating surface clean.



INSTALLATION:

1. APPLY SHORTENING COMPOUND ON NEW PREFORMED PACKING (11) AND INSTALL IN GROOVE OF NEW RETAINER (12). INSTALL RETAINER ALL THE WAY DOWN ON SHAFT (13).

2. APPLY SHORTENING COMPOUND ON NEW PREFORMED PACKING (14) AND INSTALL IN GROOVE (15) OF NEW SEAL.



Go on to Sheet 6

ACCESSORY SEAL ASSEMBLY REPLACEMENT (Sheet 6 of 7)

3. INSTALL NEW SEAL (1) IN GEARBOX (2).

   a. Apply shortening compound on outside of shaft (3) inner diameter of housing and outside diameter of seal (1).

   b. Place seal (1) on shaft (3) with four holes facing up. Push by hand to evenly snug the seal into bore prior to installing the pusher.

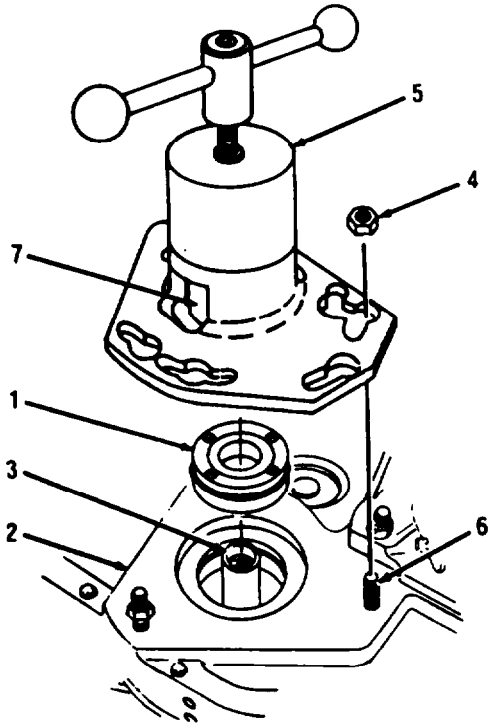
   c. Loosen three nuts (4) and install pusher (5) on gearbox (2). Aline holes with studs (6).

CAUTION

Ensure hub (7) is evenly seated on seal (1), to prevent damage to gearbox (2).

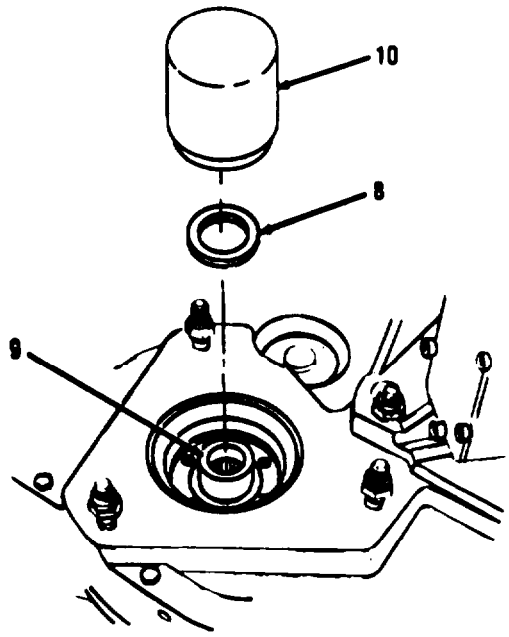
   d. Secure pusher (5) with three nuts (4). Slowly turn handle clockwise until hub (7) is evenly seated on seal (1).

   e. If hub (7) is evenly seated on seal (1), continue to turn handle slowly clockwise. When handle cannot be turned any further, seal is fully seated. Loosen three nuts (4) and remove pusher (5).



4. APPLY SEALER ON OUTSIDE EDGE OF NEW DUST SEAL (8).

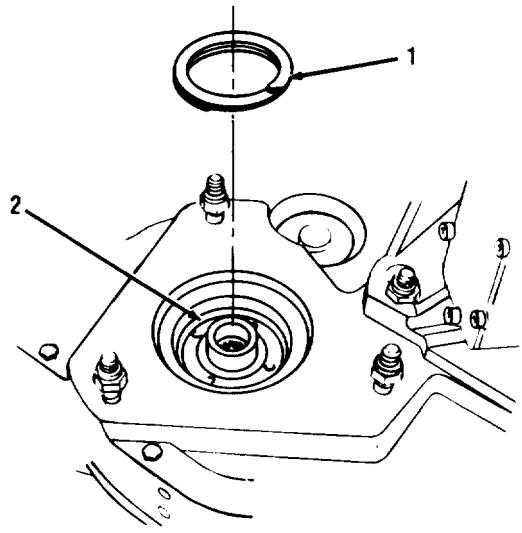
5. PLACE SEAL (8) ON SHAFT (9). PLACE INSTALLING TOOL (10) ON SEAL (8) AND TAP INSTALLING TOOL (10) UNTIL SEAL (8) IS SEATED.



Go on to Sheet 7

ACCESSORY SEAL ASSEMBLY REPLACEMENT (Sheet 6 of 6)

6. INSTALL NEW RETAINING RING (1) IN GROOVE (2).



NOTE

Do only steps necessary to install parts removed.

7. FOR ELECTROMECHANICAL FUEL SYSTEM SEAL.
   - INSTALL ELECTROMECHANICAL FUEL SYSTEM (TM 20-1).
   - [NSTALL MAIN HYDRAULIC CENTRIFUGAL PUMP (TM 20-1).

8. FOR STARTER MOTOR SEAL.
   - INSTALL STARTER MOTOR (TM 20-1).
   - INSTALL ENGINE OIL PUMP (TM 20-1).

9. FOR MAIN HYDRAULIC CENTRIFUIGAL PUMP SEAL.
   - INSTALL MAIN HYDRAULIC CENTRIFUGAL PUMP (TM 20-1).
   - INSTALL ELECTROMECHANICAL FUEL SYSTEM (TM 20-1).

End of Task

FORWARD ENGINE OVERHEAD SUPPORT INSTALLATION AND REMOVAL (Sheet 1 of 1)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Chain-fall hoist, 1000-pound minimum capacity (Item 10, Appendix D)
Hoist, 1000-pound minimum capacity (Item 11, Appendix D)

PERSONNEL: Three

INSTALLATION:

WARNING

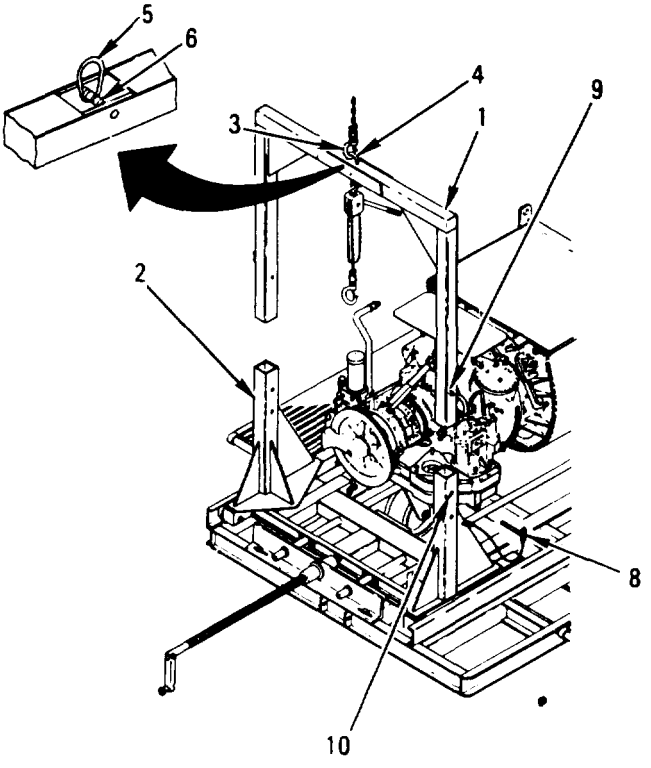
INSTALL SUPPORTS (1) IN SUPPORT MOUNTS (2).

a. Hook hoist hook (3) to link (4).

b. Slide link (5) to aft notch (6). Attach chain hoist (7) to link (5).

c. Remove two pins (8) from mounts (2).

d. Aline two holes (9) in support (1) with holes (10) in mounts (2). Install two pins (8).



REMOVAL:

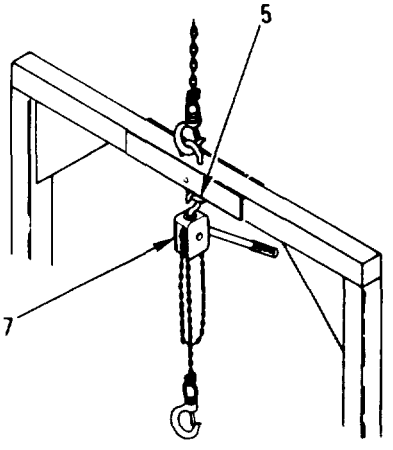
WARNING

REMOVE SUPPORT (1) FROM MOUNTS (2).

a. Remove two pins (8) and lift support (1) from mounts (2).

b. Remove chain hoist (7) from link (5).

c, Remove hoist hook (3) from link (4).



End of Task

AGB MODULE LIFTING SLING INSTALLATION AND REMOVAL (Sheet 1 of 1)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
AGB module lifting sling (Item 40, Appendix D)
Hoist, 1000-pound minimum capacity (Item 11, Appendix D)

PERSONNEL: Two

INSTALLATION:

INSTALL SLING (1) TO GEARBOX MODULE (2).

a. Install shackle (3) in fourth hole (4) from bar (5) of sling (l).

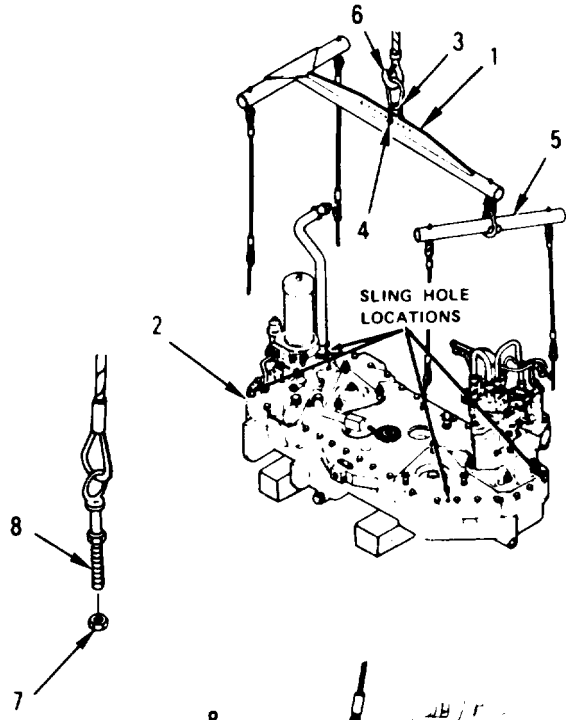
b. Hook sling (1) on hoist hook (6) so bar (5) will be on left side of engine.

c. Remove four nuts (7) from eyebolts (8).

d. Clean out four holes (9) in module (2) and install eyebolts (8).

e. Install nuts (7) about 1 inch (2.54 cm) up on eyebolts (8).

f Take slack out of sling (l).



REMOVAL:

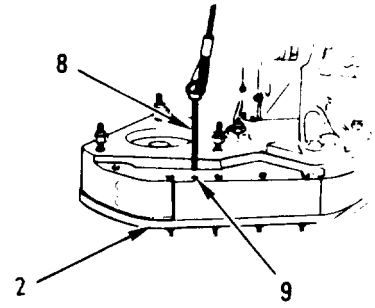
REMOVE SLING (1) FROM MODULE (2),

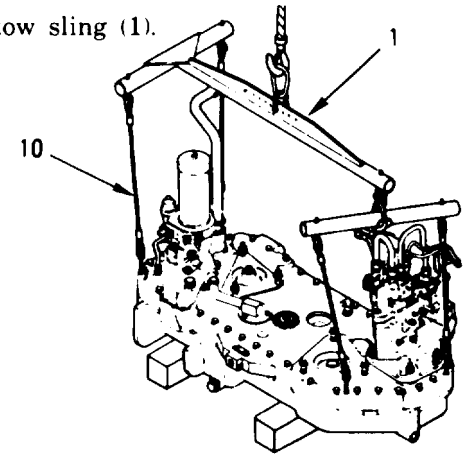
a. Lower sling (1) until four cables (10) are slack.

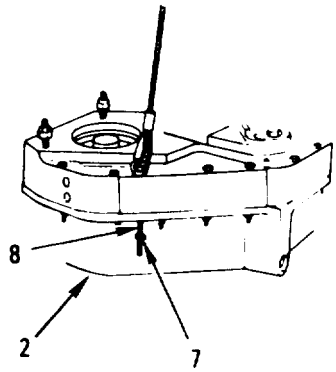
b. Remove four nuts (7) from eyebolts (8). Remove eyebolts (8) from module (2).

c. Install nuts (7) on eyebolts (8).

d. Stow sling (1).







End of Task

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 1 of 12)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-N26)
Combination wrench, 1-1/4 inch (Item 16, Appendix D)
Conduit style slip joint pliers with plastic jaw inserts (Item 31, Appendix D)
Gearbox dowel pin mechanical puller (Item 41, Appendix D)
Ratchet handle, 3/8-inch drive (Item 9, Appendix D)
Socket, 3/8-inch drive, l/2-inch (Item 12, Appendix D)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)
Wire twister pliers (Item 101, Appendix D)

SUPPLIES: Flared conical seal (Item27, Appendix E) (2 required)
Flared conical seal (Item 56, Appendix E)
Flared conical seal (Item 57, Appendix E)
Lubricating oil (Item 11 or 12, Appendix B)
Nonelectric wire (Item 15, Appendix B)
Preformed packing (Item 55, Appendix E)
Pressure sensitive tape (Item 30, Appendix B)
Shortening compound (Item 20, Appendix B)
Wood block (Item 23, Appendix B) (2 required)

PERSONNEL: Three

EQUIPMENT CONDITION: Oil tank and gear box module drained (LO-12)
Engine fireshield assembly removed (TM 20-1)
Oil cooler inlet and outlet tube assembly (right side) removed (TM 20-1)
Hose assembly (oil tank vent) removed (TM 20-1)
Engine starter removed (TM 20-1)
Compressed air tube assembly removed (TM 20-1)
Lubricating oil tank assembly removed (TM 20-1)
Tube assembly (electromechanical fuel system to fuel nozzle) removed (TM 20-1)
Tube assembly (in-line pressure fluid filter to electromechanical fuel system) removed (TM 20-1)
Power turbine stator feedback control assembly removed (TM 20-1)
Inlet guide vane feedback control assembly removed (TM 20-1)
Plenum-to-engine plain seal removed (TM 20-1)
Screen assembly (engine air inlet) removed (TM 20-1)
Tube assembly (top of inlet guide vane actuating cylinder) removed (TM 20-1)
Tube assembly (No. 2 and 3 bearing feed) removed (TM 20-1)
Tube assembly (No. 5 and 6 bearing feed) removed (TM 20-1)
Tube assembly (No. 4 bearing feed) removed (TM 20-1)
Tube assembly (No. 4 bearing scavenge-left hand) removed (TM 20-1)

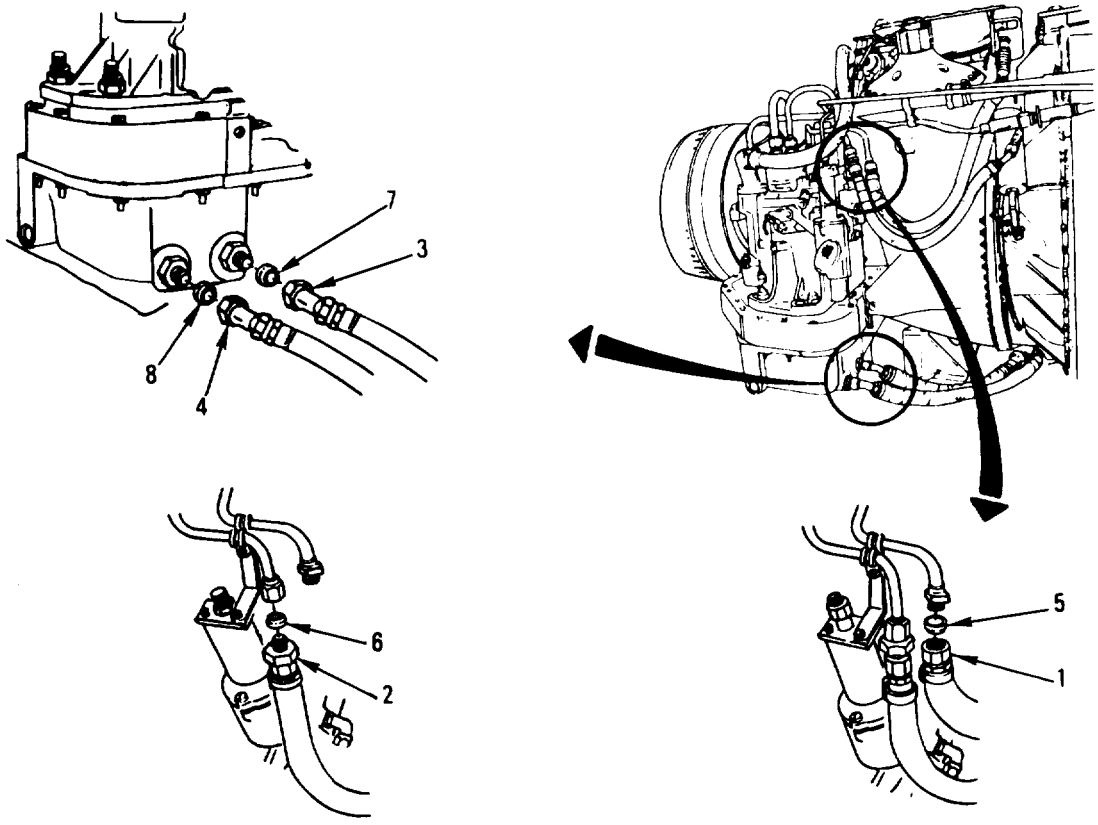
Go on to Sheet **2**

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 2 of 12)

Tube assembly (No. 4 bearing scavenge - right hand) removed (TM 20-1)
Accessory gearbox vent hose removed (TM 20-1)
Tube assembly (forward reduction gearbox oil feed) removed (TM 20-1)
Tube assembly (No. 1 bearing feed) removed (TM 20-1)
Tube assembly (No. 1 bearing scavenge) removed (TM 20-1)
Tube assemblies (oil tank to engine oil pump assembly) removed (TM 20-1)
Tube assemblies (forward reduction gearbox scavenge) removed (TM 20-1)
Tube assembly (oil pump return to oil cooler - forward) removed (TM 20-1)
Tube assembly (electromechanical fuel system to bottom of inlet guide vane actuating cylinder) removed (TM 20-1)
Tube assembly (electromechanical fuel system to top of inlet guide vane actuating cylinder) removed (TM 20-1)
Main hydraulic centrifugal pump removed (TM 20-1)
Forward engine overhead support installed (page 7-4)

REMOVAL:

1. DISCONNECT HOSE ASSEMBLIES (1 THRU 4) AND REMOVE FLARED CONICAL SEALS (5 THRU 8).



Go on to Sheet 3

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 3 of 12)

2. DISCONNECT CABLE ASSEMBLY (l).

   a. Remove P33 connector (2) from electromechanical fuel system (3).

   b. Remove P35 connector (4) from speed pickup (5).

   c. Remove P5 connector (6) from speed pickup (7).

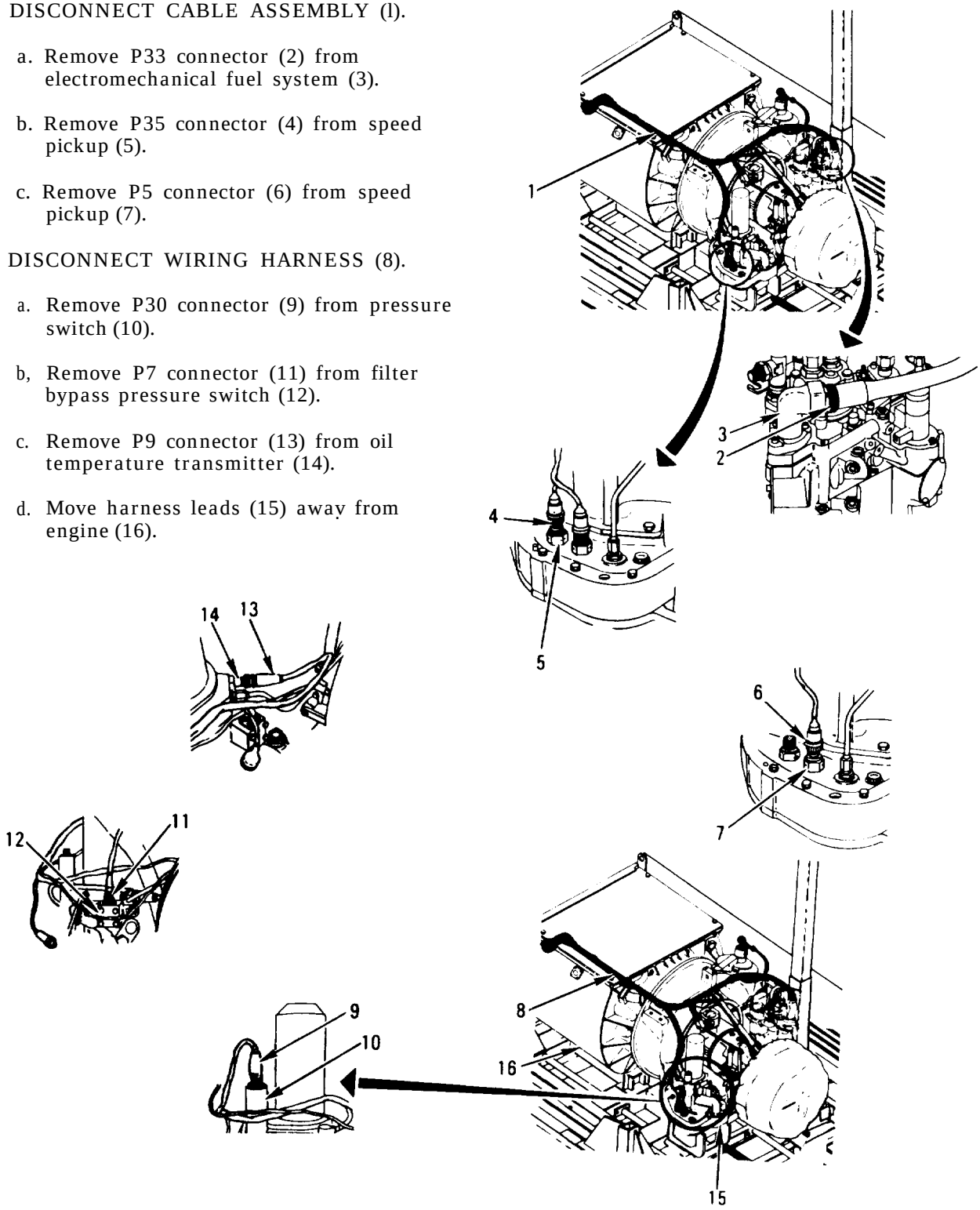
3. DISCONNECT WIRING HARNESS (8).

   a. Remove P30 connector (9) from pressure switch (10).

   b, Remove P7 connector (11) from filter bypass pressure switch (12).

   c. Remove P9 connector (13) from oil temperature transmitter (14).

   d. Move harness leads (15) away from engine (16).



Go on to Sheet 4

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 4 of 12)

4. INSTALL AGB MODULE LIFTING SLING (PAGE 7-5).

5. UNHOOK SPRING (1) FROM BRACKET (2). CUT SAFETY WIRE FROM TWO BOLTS (3) AND REMOVE BOLTS **(3).**

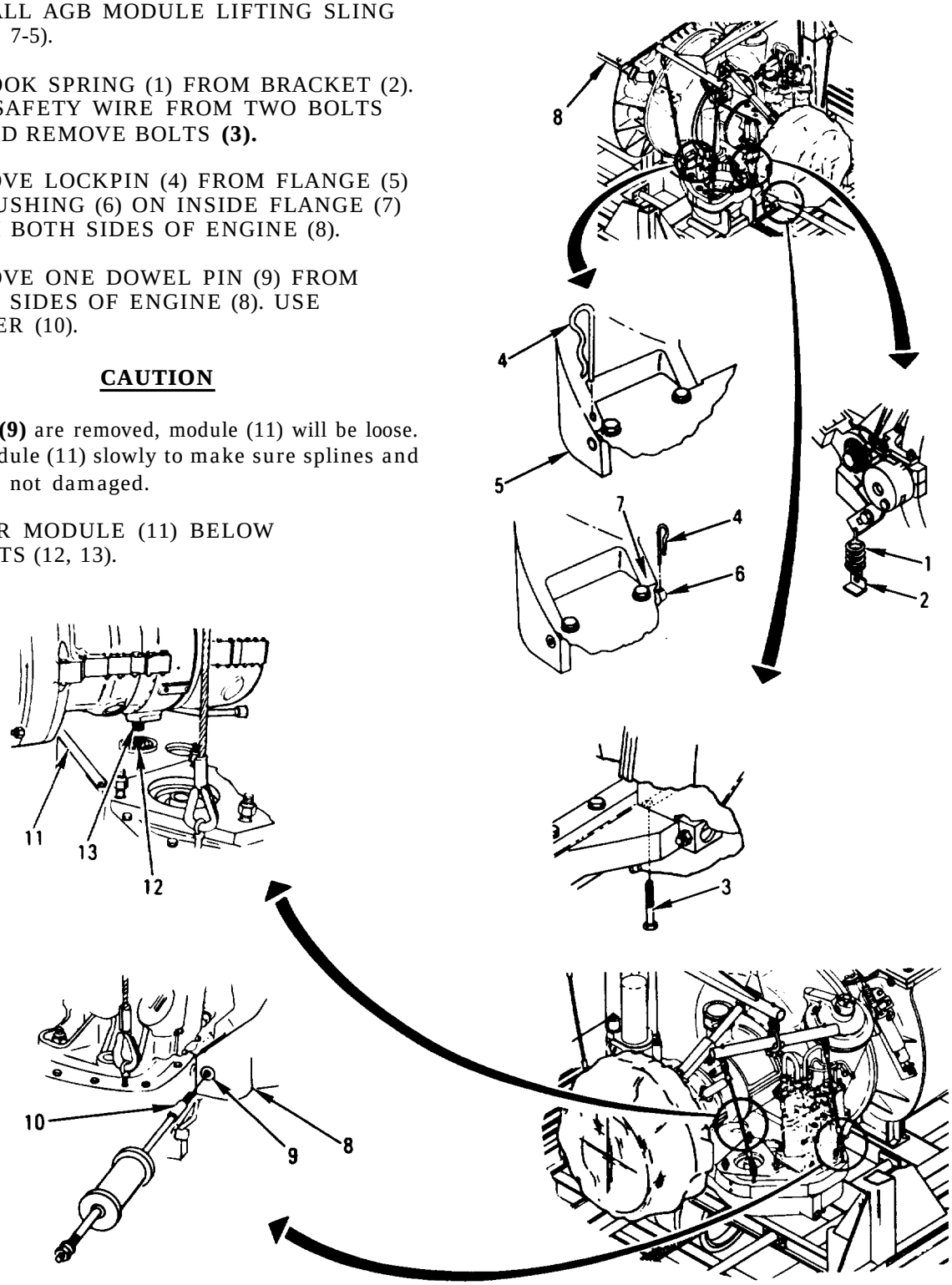
6. REMOVE LOCKPIN (4) FROM FLANGE (5) OR BUSHING (6) ON INSIDE FLANGE (7) FROM BOTH SIDES OF ENGINE (8).

7. REMOVE ONE DOWEL PIN (9) FROM BOTH SIDES OF ENGINE (8). USE PULLER (10).

CAUTION

Once pins **(9)** are removed, module (11) will be loose. Lower module (11) slowly to make sure splines and shafts are not damaged.

8. LOWER MODULE (11) BELOW SHAFTS (12, 13).



Go on to Sheet **5**

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 5 of 12)

9. REMOVE TWO BOLTS (l), LOWER JACK (2), AND UNHOOK TWO LATCHES (3).

WARNING

CAUTION

To prevent damage to plug (4), make sure plug (4) does not hit front plate (5) when module (6) is moved forward.

10. LOWER MODULE (6) FROM ENGINE.

    a. Lower module (6) enough to clear engine air inlet (7) when moved forward.

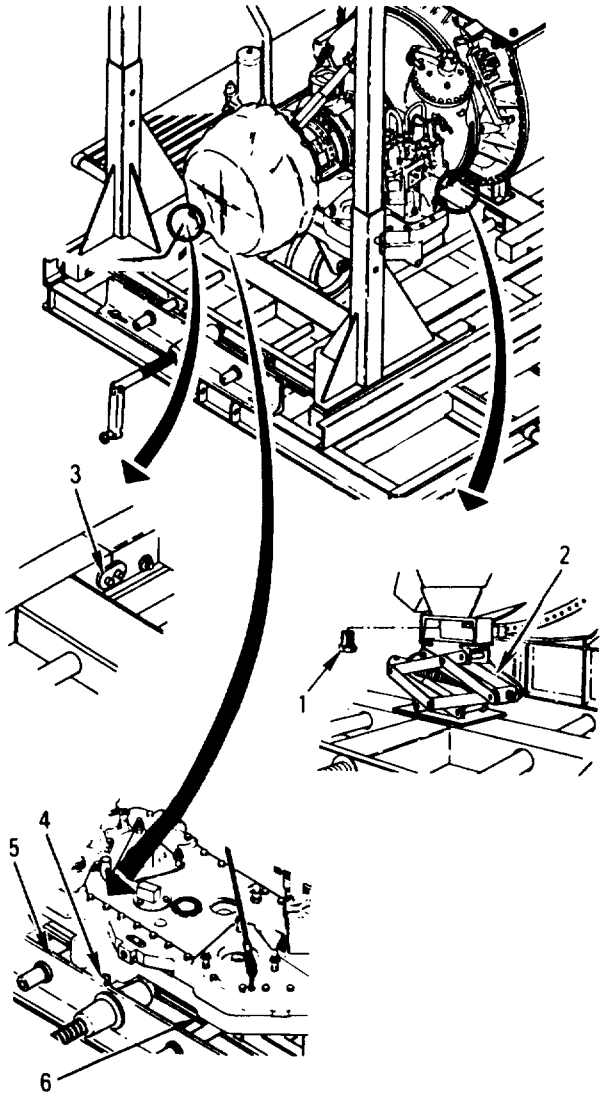
    b. Turn handle (8) counterclockwise until forward dolly (9) is all the way forward.

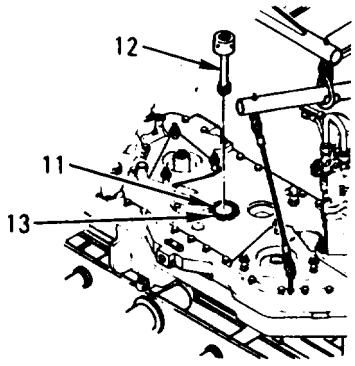
    c. Lower module (6) on dolly (9) until four cables (10) are slack.

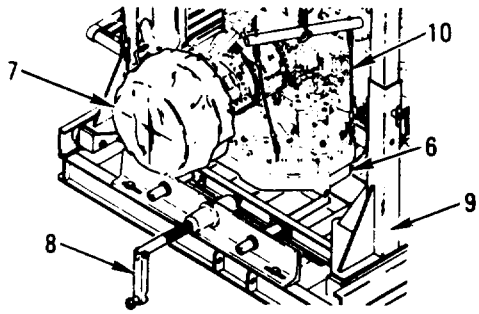
    d. Remove preformed packing (11) and gearshaft (12).

11. INSPECT GEARSHAFT (12) FOR DAMAGE. REPLACE AS REQUIRED.

12. INSTALL GEARSHAFT (12) IN GEARBOX DRIVE SPLINES (13).







Go on to Sheet 6

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 6 of 12)

WARNING

13. REMOVE MODULE (1) FROM MAINTENANCE STAND (2).

    a. Center hoist hook (3) over module (1).

    b. Unhook sling (4) from chain hoist hook (5). Hook sling (4) on hoist hook (3).

    c. Set module (1) on two wood blocks (6).

NOTE

If module (1) is being replaced, remove AGB lifting sling (page 7-5) and go to step 15.

14. UNHOOK SLING (4) FROM HOIST HOOK (3). LAY SLING (4) ALONG SIDE OF MODULE (1). COVER OPENINGS IN MODULE (1) WITH TAPE.

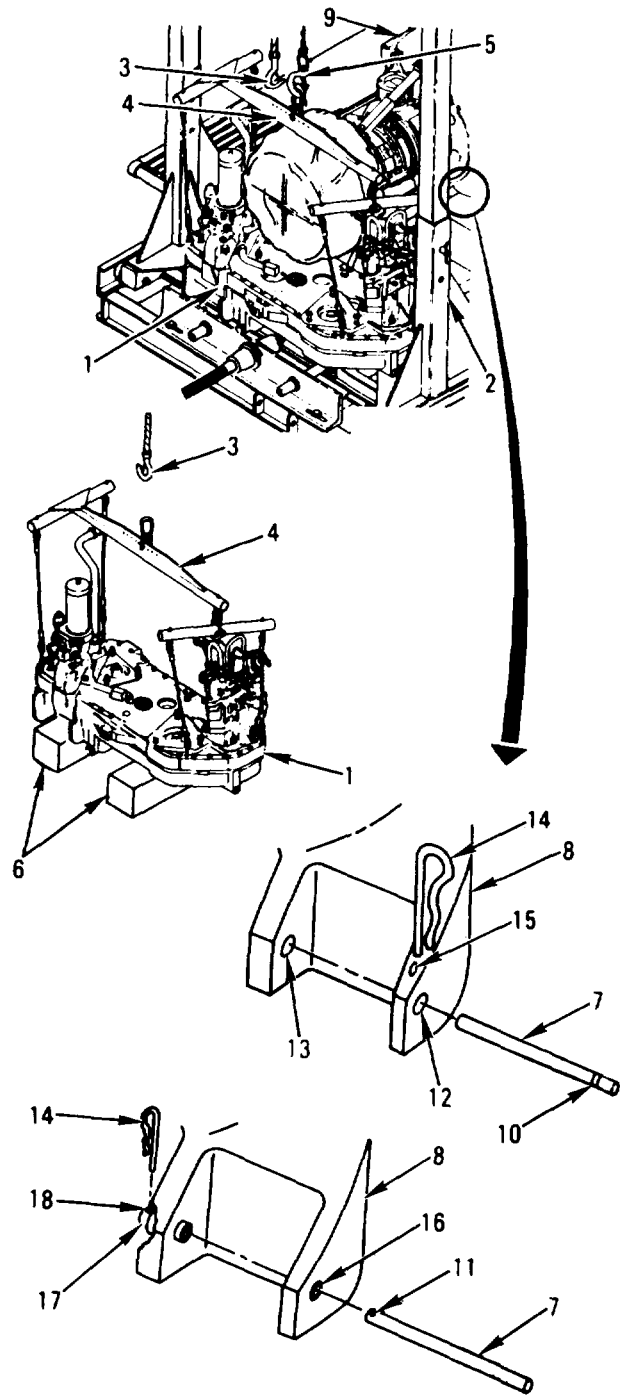
15. INSTALL TWO PINS (7) ON FORWARD MODULE (8) ON BOTH SIDES OF ENGINE (9).

NOTE

If pins (7) have grooves (10), do step a. If pins (7) have holes (11), do step b.

    a. Push one pin (7) in through hole (12) and part way through hole (13). Put one lock pin (14) through hole (15) until it touches pin (7). Push lightly on lock pin (14) and push in on pin (7) until lock pin (14) slides all the way down in groove (10). Repeat for other side of engine (9).

    b. Push one pin (7) in through bushings (16, 17). Aline hole (11) with two holes (18) in bushing (17). Push one lock pin (14) all the way down through hole (11) and holes (18). Repeat for other side of engine (9).



Go on to Sheet 7

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 7 of 12)

INSTALLATION:

WARNING

1. HOOK SLING (1) TO HOIST HOOK (2) AND REMOVE FOUR PINS (3) FROM FORWARD MODULE (4).

   a. Position hoist hook (2) over module (5).

   b. Hook sling (1) on hoist hook (2).

   c. Turn handle (6) counterclockwise until dolly (7) is all the way forward on stand (8).

   d. Remove four lockpins (9) from holes (10) or bushings (11) on both sides of forward module (4). Remove pins (3).

2. REMOVE GEARSHAFT (12). COAT SPLINES (13) WITH OIL. PUT GEARSHAFT (12) IN GEARBOX DRIVE SPLINES (14).

3. APPLY SHORTENING ON NEW PACKING (15) AND INSTALL IN GROOVE (16).

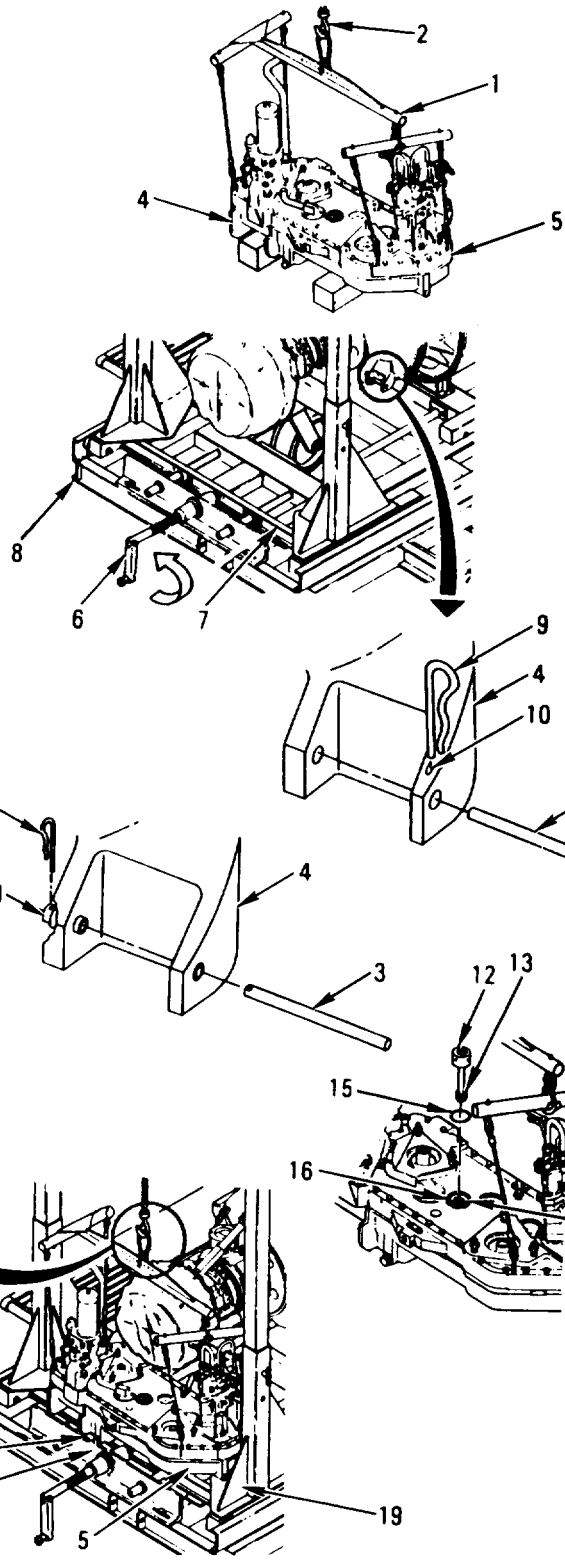
CAUTION

To prevent damage to plug (17), make sure plug (17) does not hit or rest on front plate (18) of stand (8).

4. INSTALL MODULE (5) ON STAND (8).

   a. Place module (5) on dolly (19).

   b. Place chain hoist hook (20) near hoist hook (2).



Go on to Sheet 8

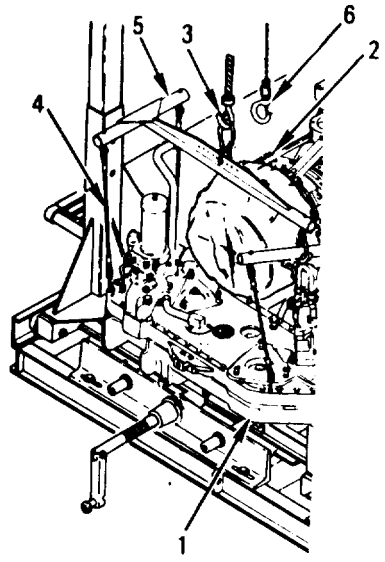
GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 8 of 12)

5. POSITION MODULE (1) UNDER FORWARD MODULE (2).

   a. Lower hoist hook (3) until four sling cables (4) are slack. Unhook sling (5) from hoist hook (3). Hook sling (5) on chain hoist hook (6).

   b. Raise module (1) enough so it can be moved under forward module (2) without hitting engine air inlet (7).

   c. Turn handle (8) clockwise until module (1) is under forward module (2).



CAUTION

To avoid damage, make sure module (1) is square with forward module (2) and splines (9, 10) are alined.

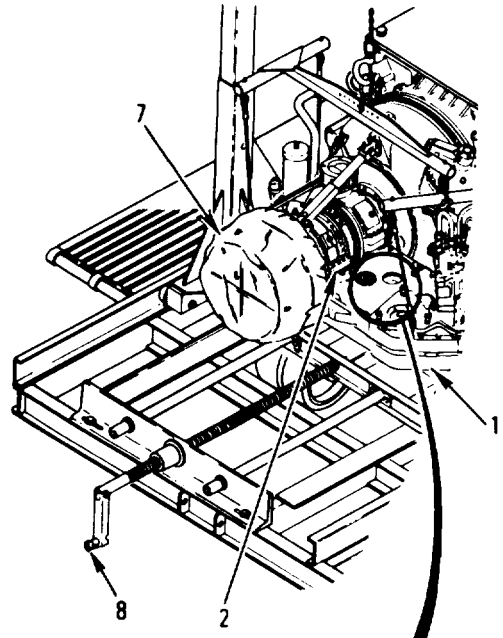
MATE MODULE (1) WITH FORWARD MODULE (2).

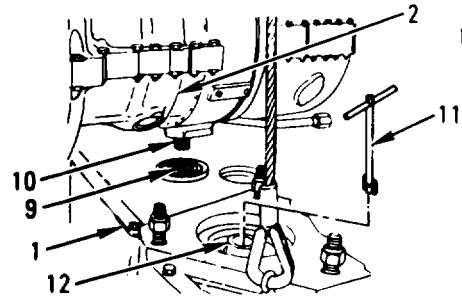
   a. Raise module (1) close to splines (10).

   b. Turn handle (8) clockwise or counterclockwise to aline splines (9, 10).

   c. Install handle (11) in shaft (12). Move handle (11) back and forth as splines (9, 10) begin to touch to make sure splines mate.

   d. Raise module (1) until mated with forward module (2).





Go on to Sheet 9

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 9 of 12)

7. INSTALL MODULE (1) TO FORWARD MODULE (2).

NOTE

- If outside flanges (3) have holes (4), do step a. If flanges (3) have bushings (5), do step b.
- In steps a and b, install pins (6 or 7) on each side of engine at the same time.

   a. Push two pins (6) partly in holes (8). Put lock pins (9) through holes (4) until it touches pins (6). Push lightly on lock pins (9) and push in on pins (6) until lock pins (9) slide all the way down in grooves (10).

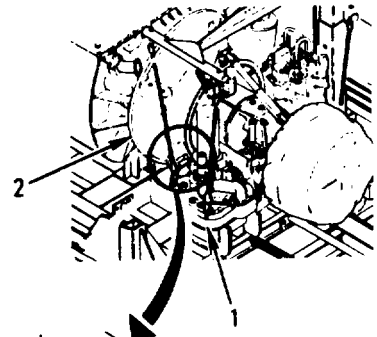
   b. Push two pins (7) through bushings (5). Aline holes (11) with holes (12) in bushings (13). Push two lock pins (14) all the way down through holes (11) and holes (12).

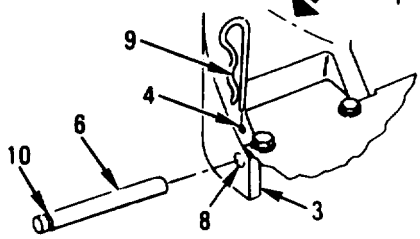
8. INSTALL TWO BOLTS (15). TORQUE BOLTS (15) BETWEEN 120-165 LB-IN (14-19 N·m). WIRE BOLTS (15).

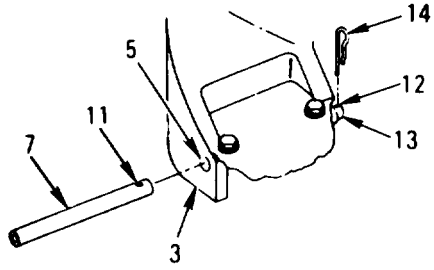
9. HOOK SPRING (16) TO BRACKET (17).

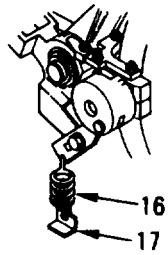
10. REMOVE AGB MODULE LIFTING SLING (PAGE 7-5).

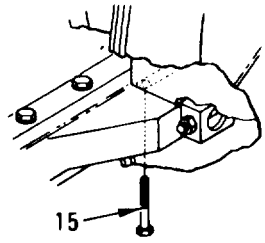
11. HOOK TWO LATCHES (18). RAISE JACK (19) AND INSTALL TWO BOLTS (20).

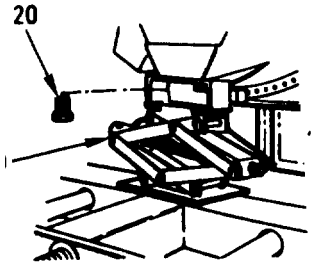


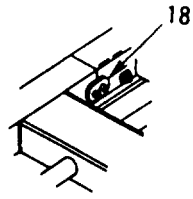












Go on to Sheet 10

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (sheet 10 of 12)

12. CONNECT HARNESS (l).

a. Connect P9 connector (2) to oil temperature transmitter (3).

b. Connect P7 connector (4) to filter bypass pressure switch (5).

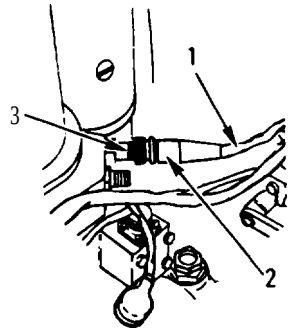
c. Connect P30 connector (6) to pressure switch (7).

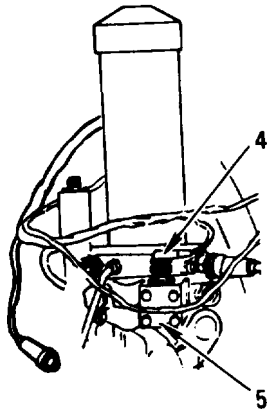
13. CONNECT CABLE (8).

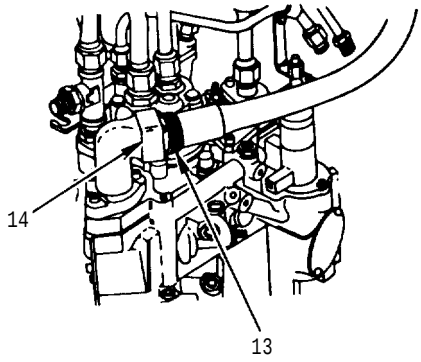
a, Install P5 connector (9) on speed pickup (l0).

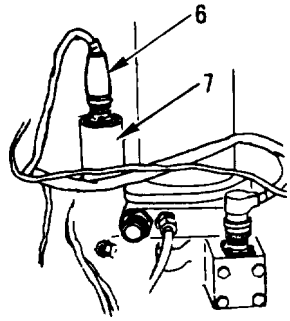
b. Install P35 connector (11) on speed pickup (12).

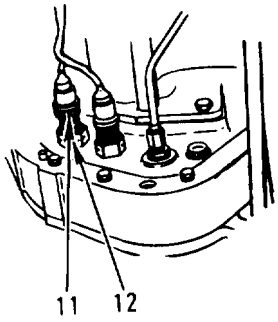
c. Install P33 connector (13) on electromechanical fuel system (14).

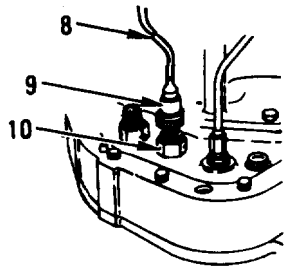








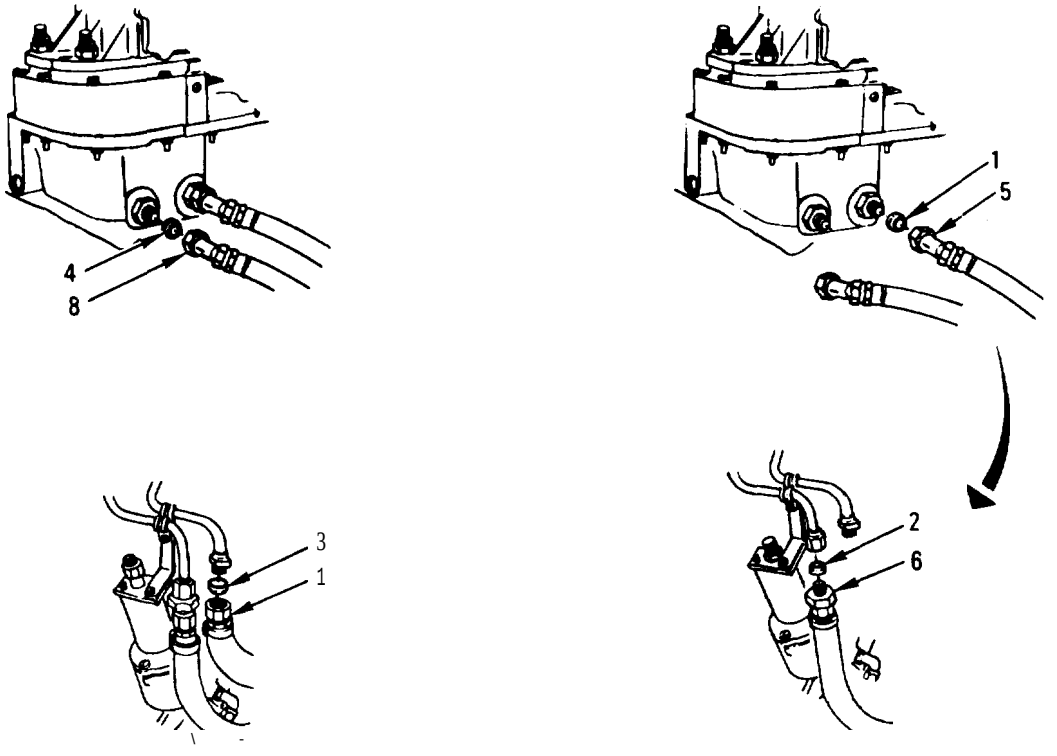




Go on to Sheet 11

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 11 of 12)

14. INSTALL NEW SEALS (1 THRU 4) AND CONNECT HOSES (5 THRU 8).



15, REMOVE FORWARD ENGINE OVERHEAD SUPPORT (PAGE 7-4).

16, INSTALL MAIN HYDRAULIC CENTRIFUGAL PUMP (TM 20-1).

17, INSTALL TUBE ASSEMBLY (ELECTROMECHANICAL FUEL SYSTEM TO TOP OF INLET GUIDE VANE ACTUATING CYLINDER) (TM 20-1).

18. INSTALL TUBE ASSEMBLY (ELECTROMECHANICAL FUEL SYSTEM TO BOTTOM OF INLET GUIDE VANE ACTUATING CYLINDER (TM 20-1).

19. INSTALL TUBE ASSEMBLY (OIL PUMP RETURN TO OIL COOLER - FORWARD) (TM 20-1).

20, INSTALL TUBE ASSEMBLIES (FORWARD REDUCTION GEARBOX SCAVENGE) (TM 20-1).

21, INSTALL TUBE ASSEMBLIES (OIL TANK TO ENGINE OIL PUMP ASSEMBLY) (TM 20-1).

22. INSTALL TUBE ASSEMBLY (NO. 1 BEARING SCAVENGE) (TM 20-1).

Go on to Sheet 11

GEARBOX MODULE REMOVAL FROM AND INSTALLATION ON ENGINE (Sheet 12 of 12)

23. INSTALL TUBE ASSEMBLY (NO. 1 BEARING FEED) (TM 20-1).
24. INSTALL TUBE ASSEMBLY (FORWARD REDUCTION GEAR BOX OIL FEED -)(TM 20-1).
25. INSTALL ACCESSORY GEARBOX VENT HOSE (TM 20-1).
26. INSTALL TUBE ASSEMBLY (NO. 4 BEARING SCAVENGE- RIGHT HAND) (TM 20-1).
27. INSTALL TUBE ASSEMBLY (NO. 4 BEARING SCAVENGE –LEFT HAND) (TM 20-1).
28. INSTALL TUBE ASSEMBLY (NO. 4 BEARING FEED) (TM 20-1).
29. INSTALL TUBE ASSEMBLY (NO. 5 AND 6 BEARING FEED) (TM 20-1).
30. INSTALL TUBE ASSEMBLY (NO. 2 AND 3 BEARING FEED) (TM 20-1).
31. INSTALL TUBE ASSEMBLY (BOTTOM OF INLET GUIDE VANE ACTUATING CYLINDER) (TM 20-1).
32. INSTALL TUBE ASSEMBLY (TOP OF INLET GUIDE VANE ACTUATING CYLINDER) (TM 20-1).
33. INSTALL SCREEN ASSEMBLY (ENGINE AIR INLET) (TM 20-1).
34. INSTAL P LENUM TO-ENGINE PLAIN SEAL (TM 20-1).
35. INSTALL INLET GUIDE VANE FEEDBACK CONTROL ASSEMBLY (TM 20-1).
36. INSTALL POWER TURBINE STATOR FEED BACK CONTROL ASSEMBLY TM 20-1).
37. INSTALL TUBE ASSEMBLY (IN-LINE PRESSURE FLUID FILTER TO ELECTROMECHANICAL FUEL SYSTEM (TM 20-1).
38. INSTALL TUBE ASSEMBLY ELECTROMECHANICAL FUEL SYSTEM TO FUEL NOZZLE) (TM 20-1).
39. INSTALL COMPRESSED AIR TUBE ASSEMBLY (TM 20-1).
40. INSTALL ENGINE STARTER (TM 20-1).
41. INSTALL LUBRICATING OIL TANK ASSEMBLY (TM 20-1).
42. INSTALL HOSE ASSEMBLY (OIL TANK VENT) (TM 20-1).
43. INSTALL COOLER INLET AND OUTLET TUBE ASSEMBLY (RIGHT SIDE) (TM 20-1).
44. INSTALL ENGINE FIRE SHIELD ASSEMBLY (TM 20-1).
45, FILL OIL TANK AND GEARBOX MODULE (2O-12).
46. PERFORM INLET GUIDE VANE/POWER TURBINE STATOR(IGV/PTS) ADJUSTMENTS (TM 20-1).

End of Task

ACCESSORY GEARBOX REMOVAL FROM AND INSTALLATION IN SHIPPING CONTAINER (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Deep style socket, l/2-inch drive, 3/4-inch (Item 43, Appendix D)
Torque wrench, 0-150 ft-lb (Item 24, Appendix D)

SUPPLIES: Self-locking nut (Item 40, Appendix E) (8 required)
Self-locking nut (Item 17, Appendix E) (6 required)
Wood block (Item 23, Appendix B) (2 required)

PERSONNEL: Two

EQUIPMENT CONDITION: Top weldment removed (page 4-1)
AGB module lifting sling installed (page 7-5)

REMOVAL:

WARNING

1. REMOVE GEARBOX (1) FROM BOTTOM WELDMENT (2).

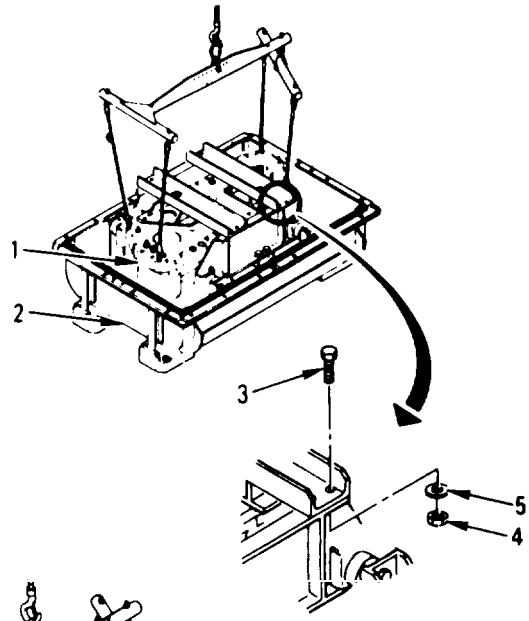
   a. Remove eight screws (3), self-locking nuts (4), and washers (5).

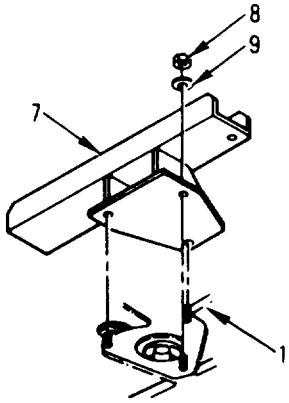
   b. Lift gearbox (1) straight up and out of weldment (2). Set gearbox (1) on two wood blocks (6).

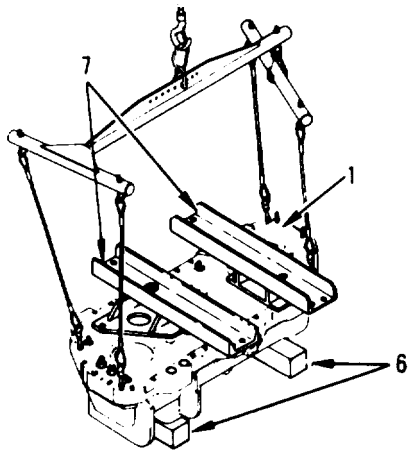
2. REMOVE TWO BRACKETS (7).

   Remove six self-locking nuts (8), washers (9), and two brackets (7) from gearbox (1).

3. REMOVE AGB MODULE LIFTING SLING (PAGE 7-5).







Go on to Sheet 2

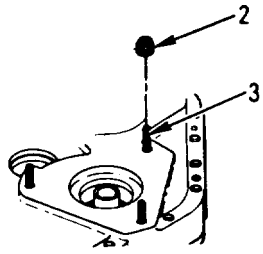
ACCESSORY GEARBOX REMOVAL AND INSTALLATION IN SHIPPING CONTAINER (Sheet 2 of 2)

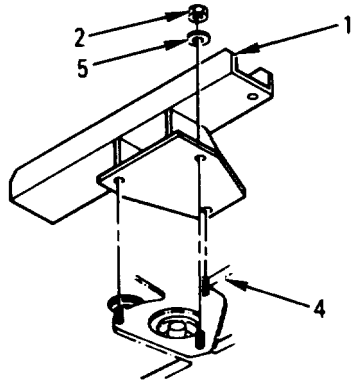
INSTALLATION:

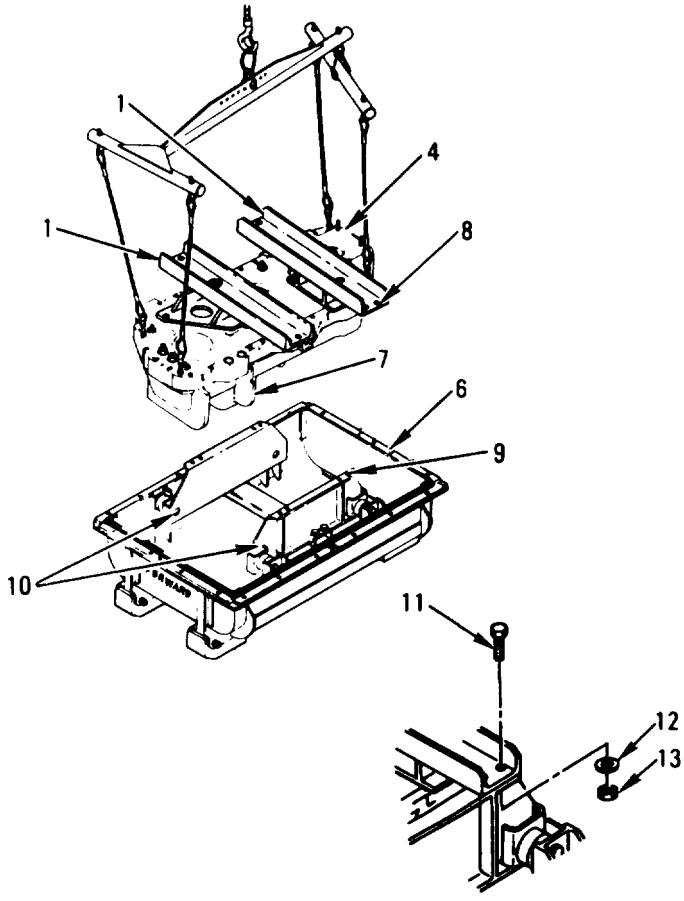
1. INSTALL TWO BRACKETS (1).
   a. Remove six nuts (2) from studs (3).
   b. Install brackets (1) on gearbox (4) with six new nuts (2) and washers (5).
2. TORQUE NUTS (2) BETWEEN 50-60 LB-FT (68-81 N·m).
3. INSTALL AGB MODULE LIFTING SLING (PAGE 7-5).

WARNING

4. INSTALL GEARBOX (4) IN WELDMENT (6).
   a. Place gearbox (4) over weldment (6) with oil sump (7) at forward end of weldment (6).
   b. Aline eight holes (8) in brackets (1) with holes (9) in two mounting bars (10).
   c. Set gearbox (4) on bars (10) and install eight screws (11), washers (12), and new nuts (13).
5. TORQUE NUTS (13) BETWEEN 20-24 LB-FT (27-32 N-m).
6. REMOVE AGB MODULE LIFTING SLING (PAGE 7-5).
7. INSTALL TOP WELDMENT (PAGE 4-3).







End of Task

FRONT ANGLE MOUNTING BRACKET REPLACEMENT (Sheet 1 of 1)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Gearbox dowel pin mechanical puller (Item 41, Appendix D)
Ratchet handle, 3/8-inch drive (Item 9, Appendix D)
Socket, 3/8-inch drive, 7/16-inch (Item 28, Appendix D)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES: Lockwasher (Item 58, Appendix E)
Lubricating oil (Item 11 or 12, Appendix B)

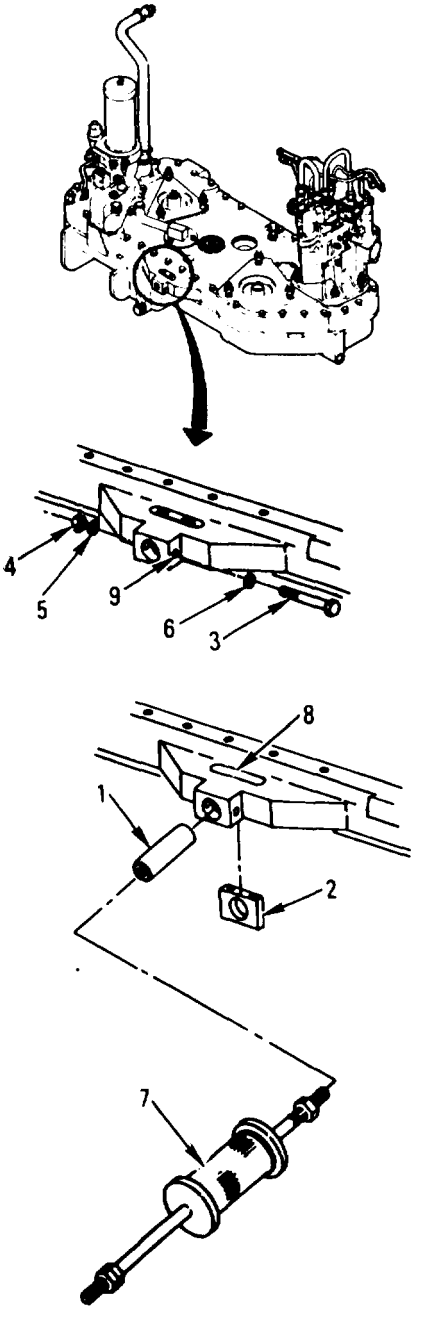
EQUIPMENT CONDITION; Gearbox module removed from engine (page 7-7)

REMOVAL:

1. REMOVE PIN (1) AND BRACKET (2).
   a. Remove bolt (3), nut (4), lockwasher (5), and washer (6).
   b. Remove pin (1) and bracket (2). Use puller (7).
2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

1. INSTALL BRACKET (2) AND PIN (l).
   a. Apply oil to bolt (3). Position bracket (2) in slot (8) and install bolt (3) and washer (6) through hole (9).
   b, Install new lockwasher (5) and nut (4).
2. TORQUE NUT (4) BETWEEN 70-95 LB-IN (8-11 Nom).
3. INSTALL GEARBOX MODULE ON ENGINE (PAGE 7-12).



End of Task

ACCESSORY GEARBOX REPLACEMENT (Sheet 1 of 3)

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-CL-N26)
Deep style socket, 1/2-inch drive, 3/4-inch (Item 43, Appendix D)
Torque wrench, 0-150 ft-lb (Item 24, Appendix D)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES: Accessory gearbox (Item 60 or 61, Appendix E)
Flared conical seal (Item 59, Appendix E) (2 required)
Grease (Item 10, Appendix B)
Lubricating oil (Item 11 or 12, Appendix B)
Preformed packing (Item 55, Appendix E)
Preformed packing (Item 63, Appendix E)
Preformed packing (Item 64, Appendix E)
Preformed packing (Item 65, Appendix E)
Preformed packing (Item 66, Appendix E)
Preformed packing (Item 67, Appendix E)
Self-locking nut (Item 62, Appendix E) (3 required)
Shortening compound (Item 20, Appendix B)

EQUIPMENT CONDITION: Gearbox module removed from engine (page 7-7)

REMOVAL:

1. REMOVE ELECTROMECHANICAL FUEL SYSTEM (1) AND PREFORMED PACKING (2).

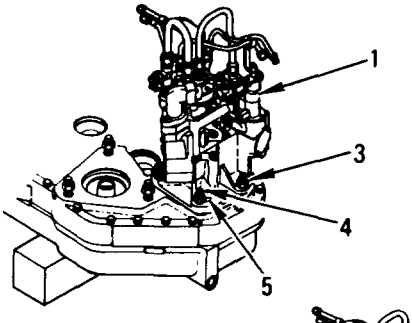
   a. Remove three self-locking nuts (3).

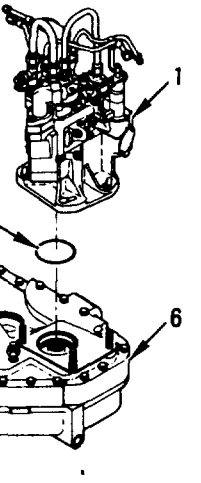
   b. Turn fuel system (1) counterclockwise until three studs (4) are in large holes of keyhole slots (5).

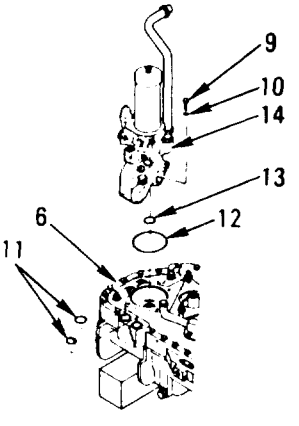
   c. Lift fuel system (1) from gearbox (6) and remove packing (2).

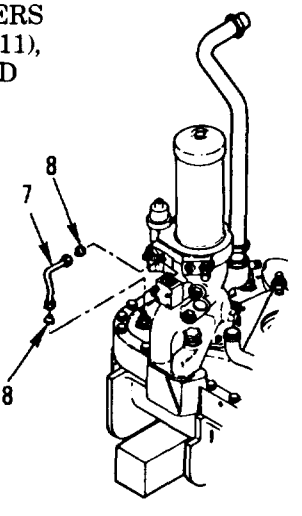
2. REMOVE TUBE ASSEMBLY (7) AND TWO FLARED CONICAL SEALS (8).

3. REMOVE FOUR SCREWS (9), WASHERS (10), TWO PREFORMED PACKINGS (11), PREFORMED PACKINGS (12, 13) AND ENGINE OIL PUMP (14).









Go on to Sheet 2

ACCESSORY GEARBOX REPLACEMENT (Sheet 2 of 3)

4. REMOVE GEARSHAFT (1) AND PREFORMED PACKING (2).

5. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

NOTE

If gearbox (3) is new, do steps 1 and 2.

1, REMOVE ACCESSORY GEARBOX FROM SHIPPING CONTAINER (PAGE 7-18).

2, INSTALL DEFECTIVE ACCESSORY GEARBOX IN SHIPPING CONTAINER (PAGE 7-19).

3. APPLY OIL TO SPLINES (4) OF GEARSHAFT (1) AND NEW PACKING (2). INSTALL GEARSHAFT (1) AND PACKING (2) IN DRIVE SPLINES (5) OF GEARBOX (3).

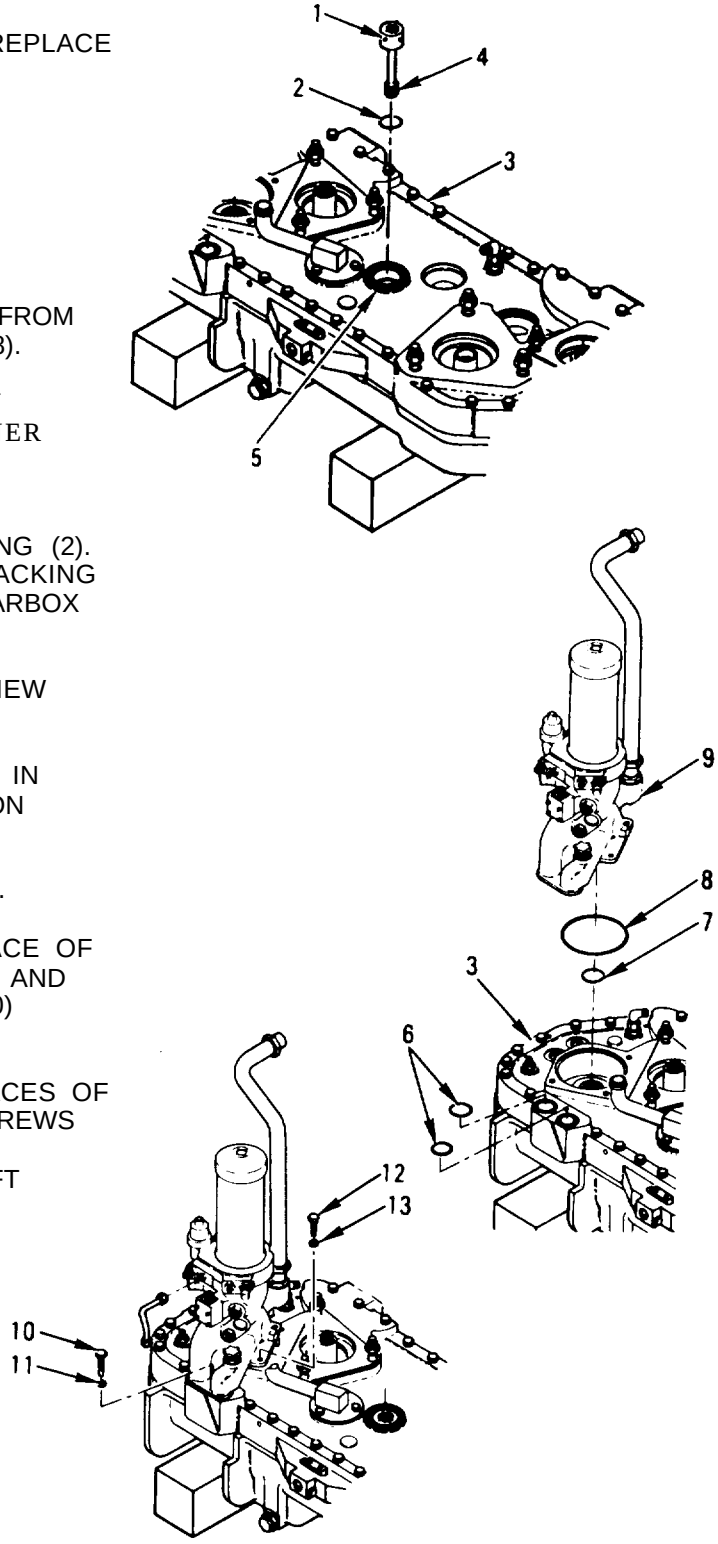
4. APPLY SHORTENING TO FOUR NEW PACKINGS (6, 7, 8).

5. INSTALL THREE PACKINGS (6, 7) IN GEARBOX (3) AND PACKING (8) ON BOTTOM OF PUMP (9).

6. ALINE PUMP (9) TO GEARBOX (3).

7, APPLY OIL TO THREADS AND FACE OF SCREW (10). INSTALL SCREW (10) AND WASHER (11). TORQUE SCREW (10) BETWEEN 70-95 LB-IN (8-11 N-m)

8. APPLY OIL TO THREADS AND FACES OF THREE SCREWS (12). INSTALL SCREWS (12) AND WASHERS (13). TORQUE SCREWS (12) BETWEEN 20-27 LB-FT (27-36 N“m).



Go on to Sheet 3

ACCESSORY GEARBOX REPLACEMENT (Sheet 3 of 3)

9. INSTALL TUBE (1) AND TWO NEW SEALS (2).

   a. Put one seal (2) on adapter (3) and other seal (2) on adapter (4).

   b. Put tube (1) in place on pump (5) and gearbox (6).

   c. Install tube nuts (7, 8) on pump (5) and gearbox (6).

10 INSTALL FUEL SYSTEM (9) AND NEW PACKING (10).

   a. Install three new nuts (11) on studs (12) two or three turns.

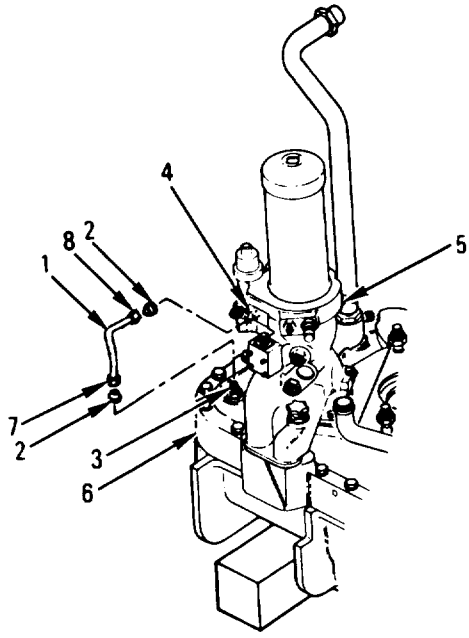
   b. Apply shortening to packing (10) and install in groove of gearbox (6).

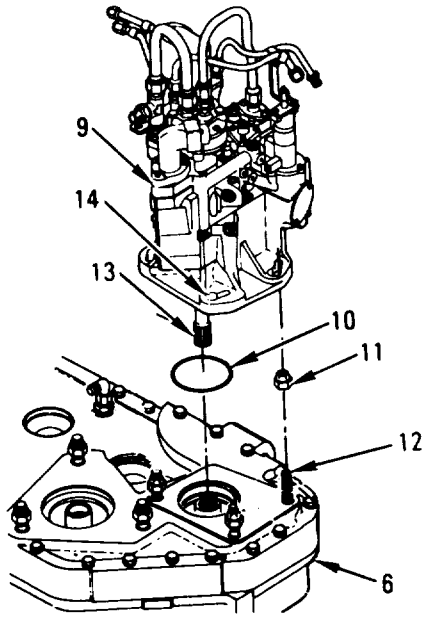
   c. Apply grease to splines of drive shaft (13).

   d. Aline large holes in three keyhole slots (14) of fuel system (9) with nuts (11). Place fuel system (9) on gearbox (6). .

   e. Turn fuel system (9) all the way clockwise and tighten nuts (11).

11 INSTALL GEARBOX MODULE ON ENGINE (PAGE 7-12).





GEAR ACCESS COVER ASSEMBLY REPLACEMENT (Sheet 1 of 1)

TOOLS: General mechanic's tool kit: automotive (SC5180-90-N26)
Socket, 3/8-inch drive, 7/16-inch (Item 28, Appendix D)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES: Cover, accessory gearbox (Item 142, Appendix E)
Lubricating oil (Item 11, Appendix B)
Preformed packing (Item 68, Appendix E)
Shortening compound (Item 20, Appendix B)

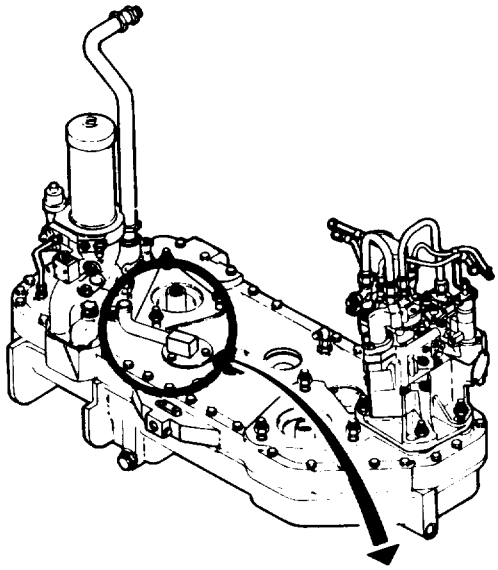
EQULPMENT CONDITION: Gearbox module removed from engine (page 7-'7)

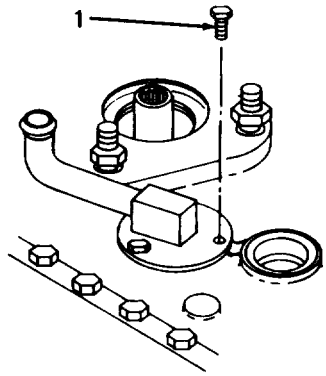
REMOVAL:

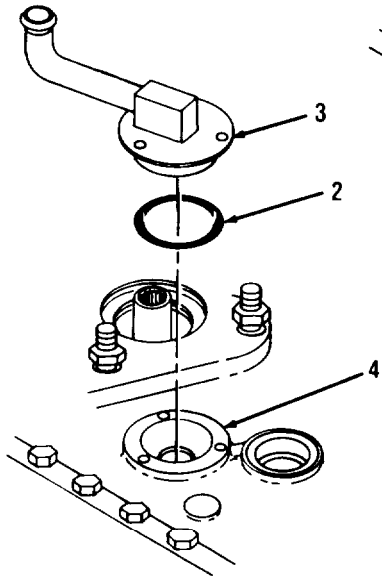
1. REMOVE THREE SCREWS (l), PRE-FORMED PACKING (2), AND COVER (3) FROM GEARBOX FLANGE (4).

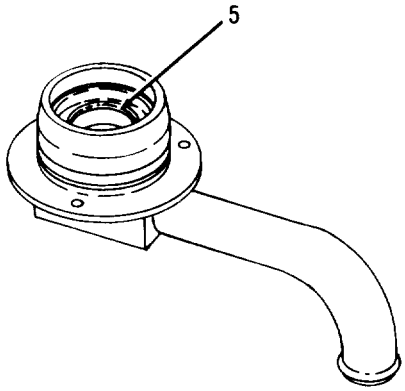
INSTALLATION:

1. APPLY OIL TO INSIDE DIAMETER OF SEAL (5).
2. APPLY SHORTENING COMPOUND T() NEW PACKING (2) AND INSTALL ON NEW COVER (3).
3. INSTALL COVER (3) ON FLANGE (4). INSTALL THREE SCREWS (1) AND TORQUE BETWEEN 70-95 LB-IN (8-1 1 N-m).
4. INSTALL GEARBOX MODULE ON ENGINE (PAGE 7-12).









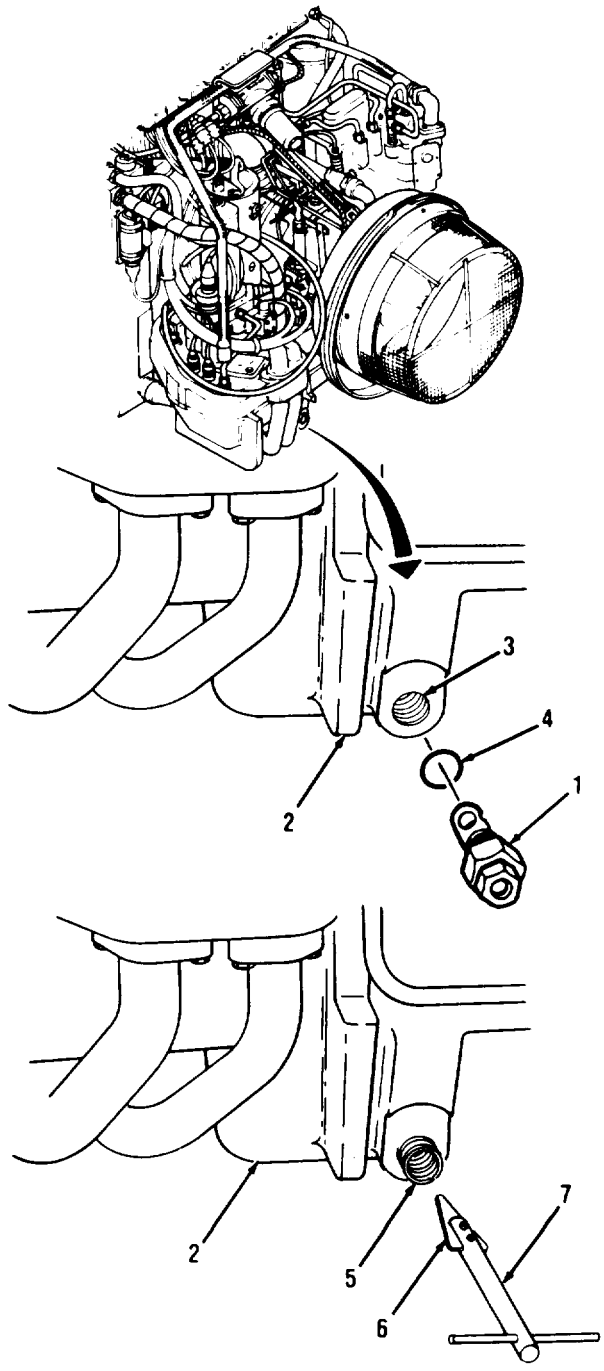
End of Task

SCREW THREAD INSERT REPLACEMENT (.MACHINE THREAD PLUG) (Sheet 1 of 3)

TOOLS: General mechanic's tool kit: automotive (SC5 l80-90-N26)
Combination wrench, 1-I/8 inch (Item 94, Appendix D)
Metal pail, 5-gallon (Item 136, Appendix D)
Tool kit, screw thead insert (Item 123. Appendix D)

SUPPLES: Insert, screw thread (Item 152, Appendix E)
Shortening compound (Item 20, Appendix B)
Preformed packing (Item 123. Appendix E)
Wiping rag (itcm 14, Appendix B)

EQUIPMENT CONDITION: None



REMOVAL:

1. REMOVE PLUG (1).

   a. Put pail under plug (1). Loosen plug (1) from accessory gearbox (2).

   b. Remove plug (1) from drain hole (3)- Let oil drain in pail. Remove preformed Packing (4).

2. REM0VE SCREW THREAD INSERT (5) FROM ACCESSORY GEARBOX (2) USING SCREW THREAD INSERT TOOL KIT.

   a. Place blade (6) of extracting tool (7) into insert (5).

   b. Tap head of extracting tool (7), with hammer to seal blade (6) into the top coil of hsert (5).

   c. With firm pressure, turn extracting tool (7) counterclockwise until insert (5) is half way out.

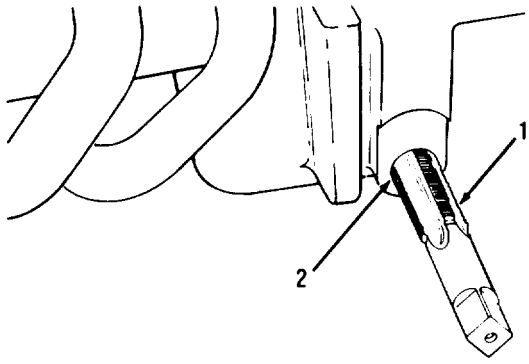
   d. Turn insert (5) all the way OUt

Go on to Sheet 2

SCREW THREAD INSERT REPLACEMENT (MACHINE THREAD PLUG) (Sheet 2 of 3)

3. COAT TAP (1) WITH SHORTENING COMPOUND TO CAPTURE ANY CHIPS. CHASE THREADS WITH TAP (1) TO REMOVE NICKS AND BURRS. CLEAN OUT HOLE (2) USING WIPING RAG.

4. USING FLASHLIGHT, INSPECT HOLE (2) FOR MISSING OR CROSSED THREADS. IF THREADS ARE MISSING OR CROSSED, REPLACE ACCESSORY GEARBOX (3) (PAGE 7-21).



INSTALLATION:

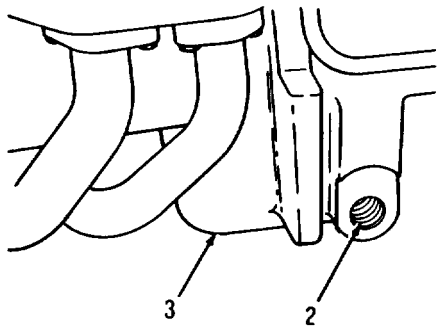
11. INSTALL NEW INSERT (4) INTO ACCESSORY GEARBOX (3) USING SCREW THREAD INSERT TOOL KIT.

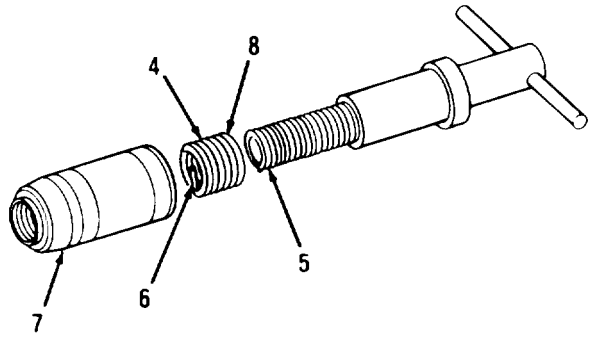
    a. Install insert (4) onto end of wrench (5) until tang (6) is seated against tip of wrench (5).

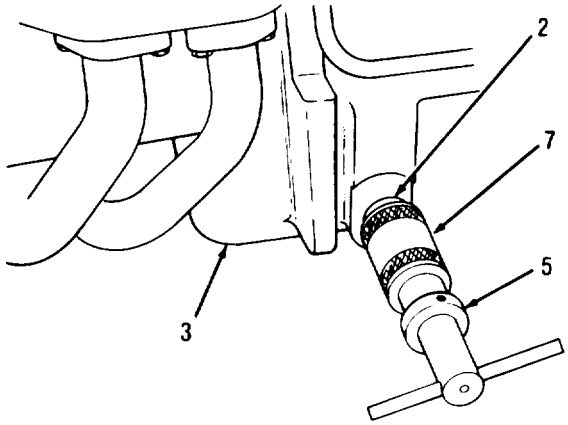
    b. Install wrench (5) with insert (4) attached into mandrel (7) until one thread of insert (4) is one thead past tip of mandrel (7).

    c. Place wrench (5), mandrel (7), with insert (4) attached, into hole (2). Holding mandrel (7), turn wrench (5) clockwise until top (8) of insert (4) is one and on-half turns below surface of hole (2).

    d. Remove wrench (5) and mandrel (7).







Go on to Sheet 3

SCREW THREAD INSERT REPLACEMENT (MACHINE THREAD PLUG) (Sheet 3 of 3)

CAUTION

Do not drop tang (1) into gearbox (2). If this happens, perform gearbox cleaning procedure (page 7-46) to remove tang.

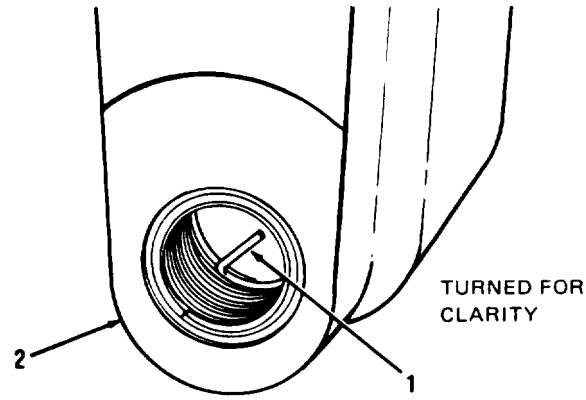
2. BREAK OFF TANG (1) BY BENDING IN AND OUT.

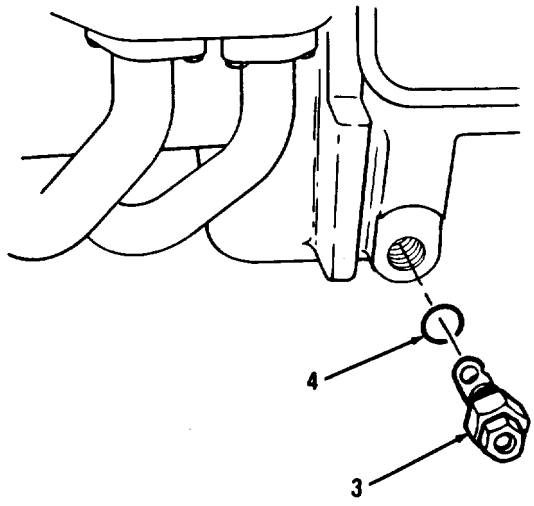
3. INSTALL PLUG (3) AND NEW PACKING (4).

   a. Put new packing (4) on plug (3).

   h. Install plug (3).

4. SERVICE OIL TANK (LO9-2350-255-12OR L09-2350-264-l2).





End of Task

SCREW THREAD INSERT REPLACEMENT (ENGINE ELECTRICAL MOTIONAL TRANSDUCER/SPEED PICKUP NO. 1 0R 2) (Sheet 1 of 2)

TOOLS: General mechanic's tool kit: automotive (SC5180-90-N26)
Tool kit, screw thread insert (Item 122, Appendix D)

SUPPLIES: Insert, screw thread (Item 153, Appendix E)
Shortening compound (Item 20, Appendix B)
Wiping rag (Item 14, Appendix B)

EQUIPMENT CONDITION:
Engine oil pump assembly removed (TM 20-1)

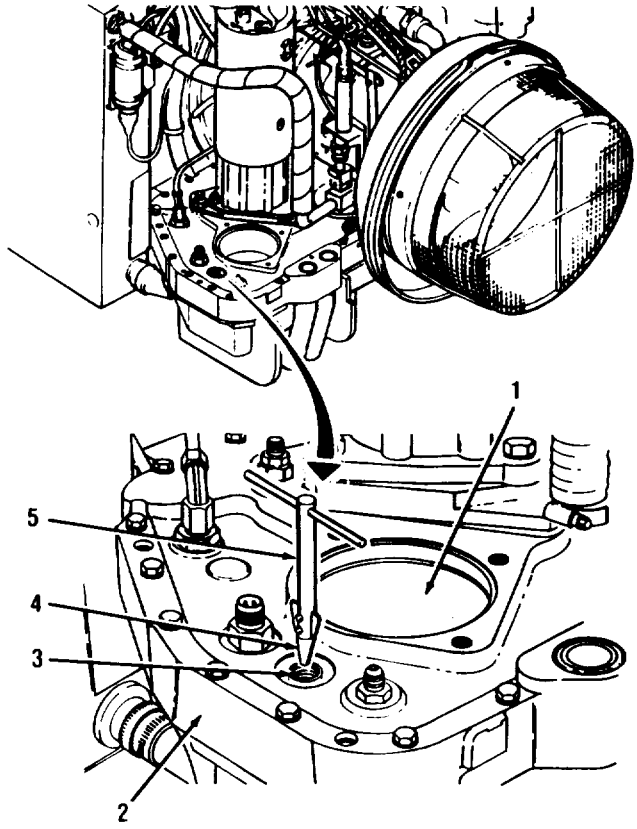
Engine electrical motional transducer/speed pickup No. 1 or 2 removed (TM 20-1)

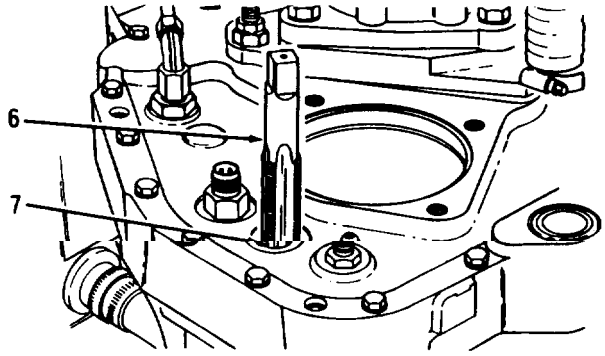
REMOVAL:

NOTE

- Cover oil pump mounting pad opening (1) with wiping rag to keep dirt out of accessory gearbox (2) while doing work.
- Use this task to replace No. 1 or 2 speed pickup insert. No. 1 is shown.

1. REMOVE SCREW THREAD INSERT (3) FROM GEARBOX (2) USING SCREW THREAD INSERT TOOL KIT.
   a. Place blade (4) of extracting tool (5) into insert (3).
   b. Tap head of extracting tool (5) with hammer to seat blade (4) into the top coil of insert (3).
   c. With firm pressure turn extracting tool (5) counterclockwise until insert (3) is half way out.
   d. Turn insert (3) all the way out.
2. COAT TAP (6) WITH SHORTENING COMPOUND TO CAPTURE ANY CHIPS. CHASE THREADS WITH TAP (6) TO REMOVE NICKS AND BURRS. CLEAN OUT HOLE (7), USING WIPING RAG.





Go on to Sheet **2**

SCREW THREAD INSERT REPLACEMENT (ENGINE ELECTRIC MOTIONAL TRANSDUCER/SPEED PICKUP NO. 1 OR 2) (Sheet 2 of 2)

3. USING FLASHLIGHT, INSPECT HOLE (1) FOR MISSING OR CROSSED THREADS. IF THREADS ARE MISSING OR CROSSED. REPLACE ACCESSORY GEARBOX (2) (PAGE 7-21).

INSTALLATION:

1. INSTALL NEW INSERT (3) INTO ACCESSORY GEARBOX (2) USING SCREW THREAD INSERT TOOL KIT.

   a. Install insert (3) onto end of wrench (4) until tang (5) is seated against tip of wrench (4).

   b. Install wrench (4) with insert (3) attached into mandrel (6) until one thread of insert (3) is one thread past tip of mandrel (6).

   c. Place wrench (4), mandrel (6), with insert (3) attached, into hole (1). Holding mandrel (6), turn wrench (4) clockwise until top (7) of insert (3) is one and one-half lures below surface of hole (1).

   d. Remove wrench (4) and mandrel (6).

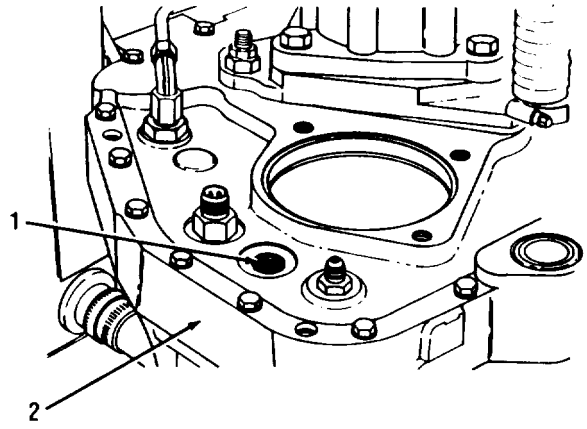
CAUTION

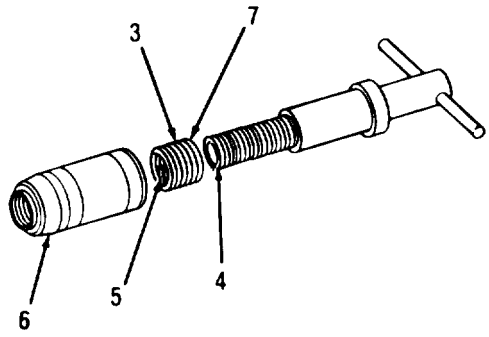
Do not drop tang (8) into gearbox (2). If this happens, perform gearbox cleaning procedure (page 7-46) to remove tang.

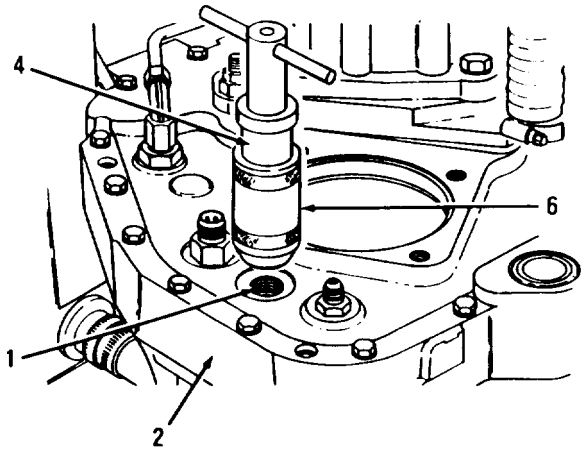
   e. Break off tang (8) by bending in and out.

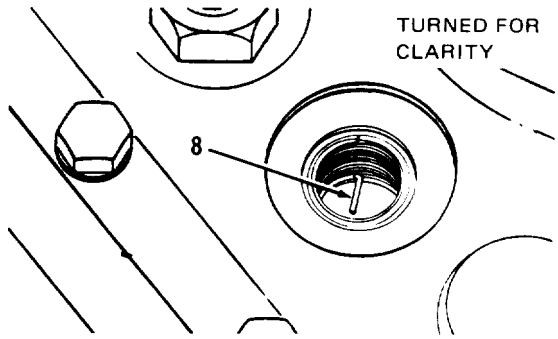
2. INSTALL ENGINE OIL PUMP ASSEMBLY (TM 20- 1).

3. INSTALL ENGINE ELECTRICAL MOTIONAL TRANSDUCER/SPEED PICKUP NO. I OR 2 (TM 20-I).









End of Task

POWER TURBINE STATOR (PTS) POWER TRANSFORMER REPLACEMENT (Sheet 1 of 5)

TOOLS: General mechanic's tool kit: automotive (SC5180-90-N26)
Handle, ratchet (Item 9, Appendix D)
Maintenance kit, electrical (Item 98, Appendix D)
Multimeter (Item 49, Appendix D)
Socket, 3/8-inch drive, 5/32-inch (Item 108, Appendix D)
Torque wrench, 0-150 in-lb (Item 27, Appendix D)

SUPPLIES: Bolt, self locking (Item 146, Appendix E) (4 required)
Flatwasher (Item 135, Appendix E) (10 required)
Gasket (Item 132, Appendix E)
Gasket (Item 133, Appendix E)
Non-electric wire (Item 15, Appendix B) (30 inch)
Power transformer (Item 130. Appendix E)
Screw. cap socket (Item 145, Appendix E) (2 required)
Screw. self locking (Item 134, Appendix E) (3 required)
Screw, self locking (Item 144, Appendix E (4 required)
Tape (Item 30, Appendk B)
Woodblock (Item 32, Appendix B) (2 required)

EQUIPMENT CONDITION: Electromechanical fuel system rcmovcd (TM 20-1)

REMOVAL:

1. SET ELECTROMECHANICAL FUEL SYSTEM (1) ON TWO BLOCKS OF WOOD (2) S0 THAT SPLINE (3) WILL NOT BE DAMAGED.

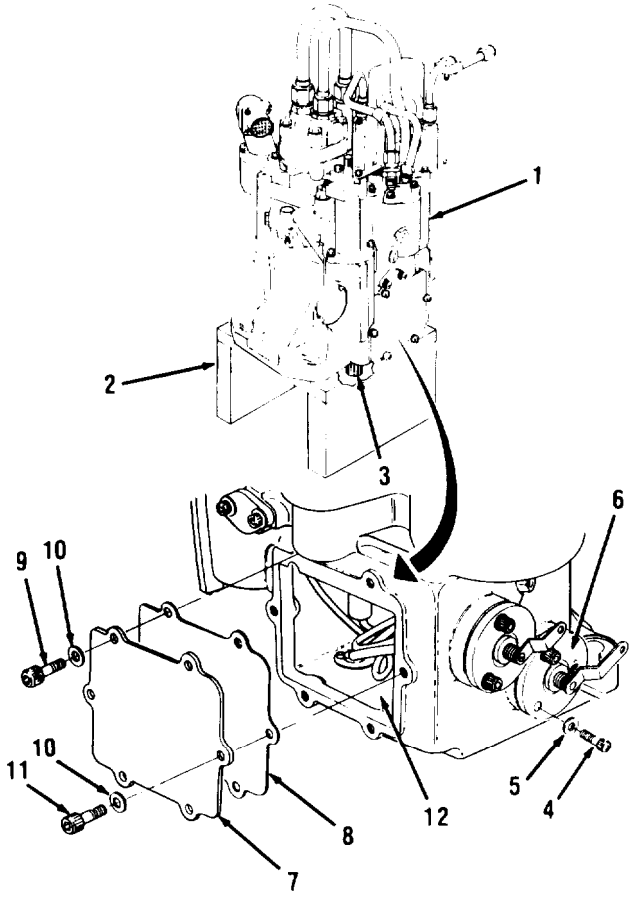
2. REMOVE THREE SCREWS (4) AND THREE WASHERS (5) FROM POWER TRANSFORMER (6).

3. REMOVE ACCESS COVER (7) AND GASKET (8).

   a. Cut safety wire and remove two screws (9) and washers (10).

   b. Remove four remaining screws (11) and washers (10). access cover (7) and gasket (8).

   c. Inspect electromechanical fuel System cavity (I2) for fuel. If fuel is present, assemble electromechanical fuel system using old parts, and replace electro-mechanical fuel system.



Go on to Sheet 2

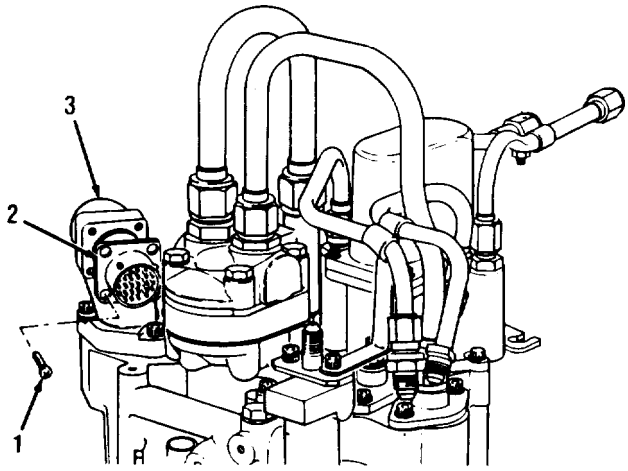
POWER TURBINE STATOR (PTS) POWER TRANSFORMER REPLACEMENT (Sheet 2 of 5)

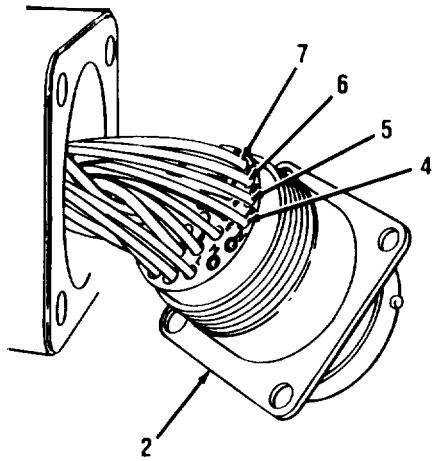
4. REMOVE FOUR BOLTS (1) AND SEPARATE CONNECTOR (2) FROM THE FLANGE CONNECTOR ELBOW (3).

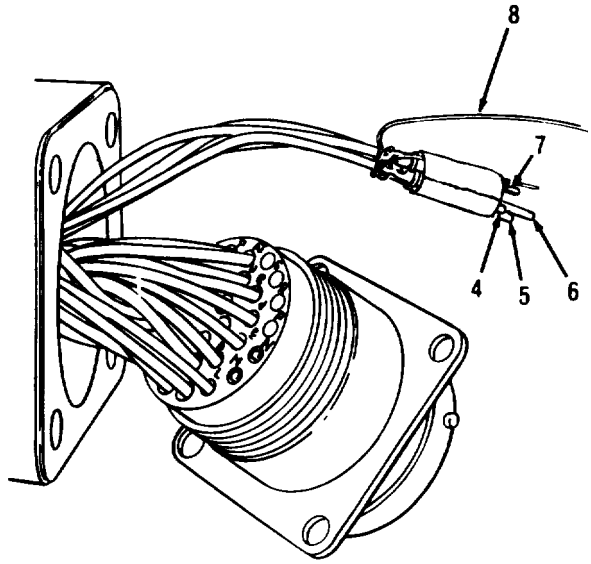
5. EXTRACT WIRES AND PINS (4,5.6.7) FROM CONNECTOR (2).

   a. Using pin extractor and installation tool. remove the following wires and pins from the backside of the connector (2): P (white/green) (4), R (white/grey) (5), S (white/yellow) (6) and T (white/blue) (7).

6. ATTACH A 30 INCH NONELECTRICAL. PULL THROUGH WIRE (8) WITH KNOT AROUND EXPOSED PINS (4,5,6,7) OF LOOSE WIRES. COVER KNOT AND WIRES WITH TAPE TO FORM SMOOTH SURFACE.





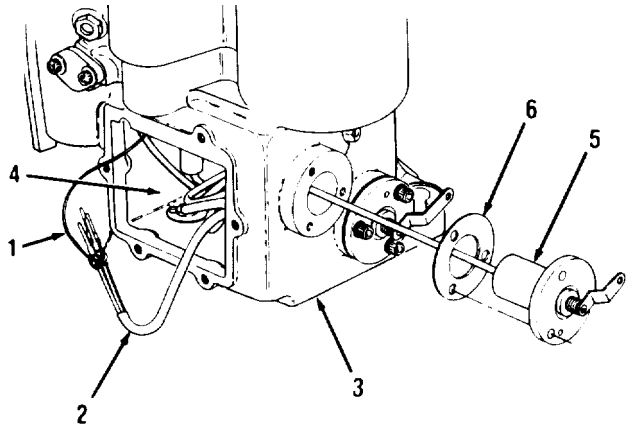


Go on to Sheet 3

POWER TURBINE STATOR (PTS POWER TRANSFORMER REPLACEMENT (Sheet 3 of 5)

NOTE

Do not pull nonelectrical wire (1) out of eleclro-mechanical fuel system. Keep wire routed for installation.



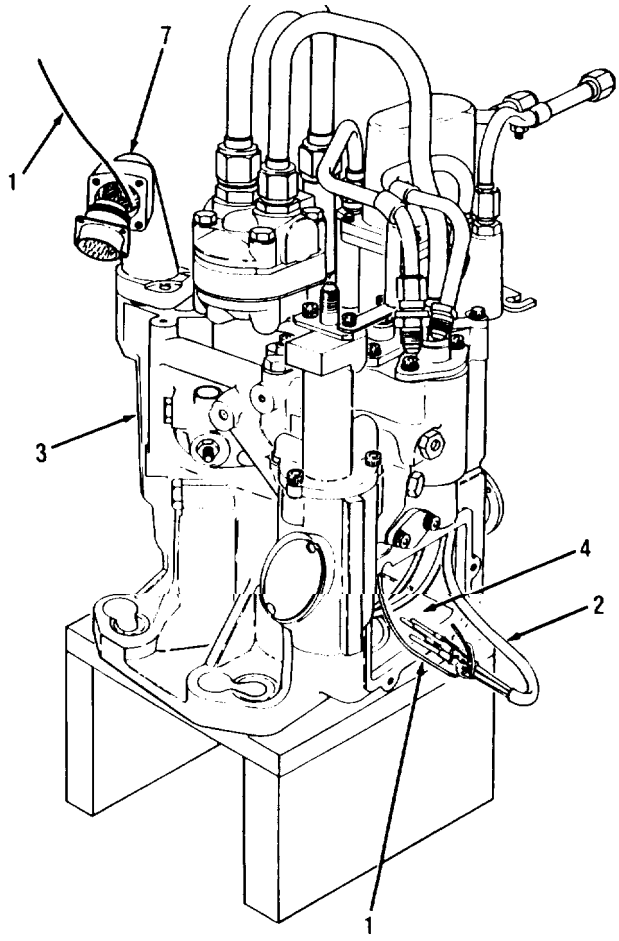
7. PULL THE POWER TRANSFORMER WIRE (GREEN) (2) OUT OF THE ELECTROMECHANICAL FUEL SYSTEM (3) THROUGH THE ACCESS CAVITY {4).

8. REMOVE TAPE AND DISCONNECT NONELECTRICAL WIRE FROM PINS.

9. REMOVE POWER TRANSFORMER (5) AND GASKET (6).

NOTE

If wires other than the wires you work on break or come out of the housing, assemble electro-mechanical fuel system using old part and replace electromechanical fuel system.



l0. INSPECT WASHERS FOR DAMAGE. REPLACE AS REQULRED.

INSTALLATION:

1. [NSTALL NEW GASKET (6) AND NEW POWER TRANSFORMER (5) ONTO ELECTROMECHANICAL FUEL SYSTEM (3).

NOTE

Do not put in new screws and washers in power transformer at this time.

2. ATTACH NONELECTRICAL WIRE (1) TO PINS AND ROUTE THROUGH ELECTRO-MECHANICAL FUEL SYSTEM (3).

   a. At access cavity (4), attach non- electrical wire (1) to pins with knot. Cover with tape to form smooth surface.

   b. Route power transformer wire (3) carefully out through connector elbow (7).

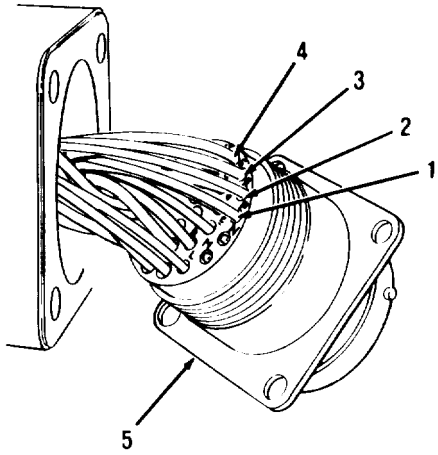
   c. Remove tape and nonelectrical wire from pins.

Go on to Sheet 4

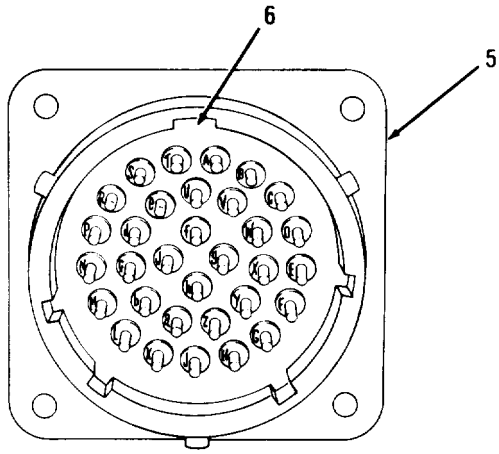
POWER TURBINE STATOR (PTS) POWER TRANSFORMER REPLACEMENT (sheet 4 of 5)

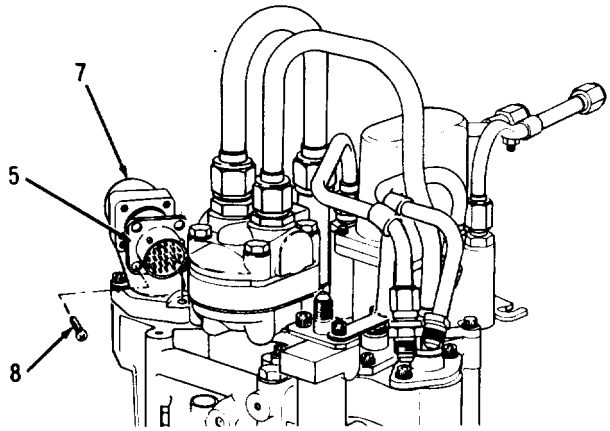
3. INSTALL PINS AND WIRES (1,2,3,4) ON CONNECTOR (5)

   a. Using pin extractor and installation tool, install wires and pins (1) (white/green) into P.(2) (white/grey) into **R.** (3) (white/yellow) into **S** and (4) (white/blue) into **T** in connector (5).



4. POSITION CONNECTOR (5). WITH SLOT (6) IN TWELVE O'CLOCK POSITION, ON FLANGE CONNECTOR ELBOW (7). INSTALL FOUR NEW BOLTS (8). TIGHTEN BOLTS IN STAGGERED SEQUENCE





Go on 10 Sheet 5

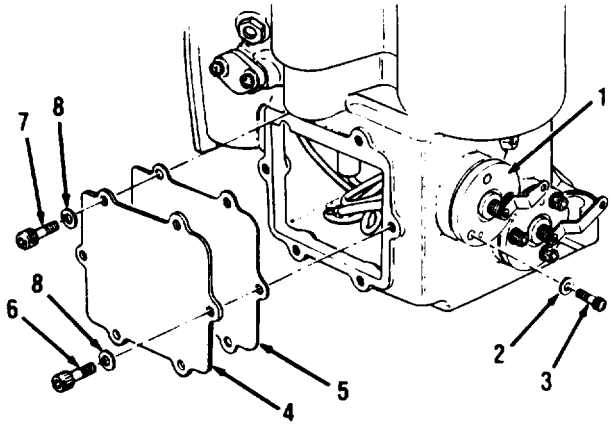
POWER TURBINE STATOR (PTS) POWER TRANSFORMER REPLACEMENT (Sheet 5 of 5)

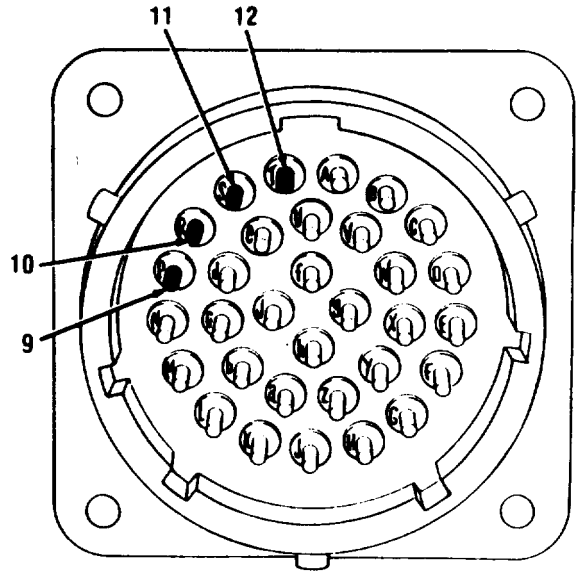
5. SECURE POWER TRANSFORMER (1) WITH THREE WASHERS (2) AND THREE NEW SCREWS (3). TORQUE SCREWS IN STAGGERED SEQUENCE TO 25-30 LB-IN (2.82-3.39 N.m).

6. INSTALL ACCESS COVER (4), NEW GASKET (5), SIX NEW SCREWS (6,7) AND SIX WASHERS (8). TORQUE SCREWS IN STAGGERED SEQUENCE BETWEEN 25-30 LB-IN (2.82-3.39 N m).

7. MEASURE RESISTANCE BETWEEN PINS P (9) and R (10). MULTIMETER SHOULD READ 5-50 OHMS.

8. MEASURE RESISTANCE BETWEEN PINS S (11) and T (12). MULTIMETER SHOULD READ 2-40 OHMS.





End of Task

INLET GUIDE VANE (IGV) POWER TRANSFORMER REPLACEMENT (Sheet 1 of 5)

TOOLS: General mechanic's (001 kit: automotive (SC5180-90-N26)
Handle, ratchet (Item 9, Appendix D)
Maintenance kit, electrical (Item 98. Appendix D)
Multimeter (Item 49, Appendix D)
Socket, .3/8 -inch drive, 5/32-inch (Item 108, Appendix D)
Torque wrench. 0-150 in-lb (Item 27. Appendix D)

SUPPLIES: Bolt, self locking (Item 146, Appendix E) (4 required)
Flatwasher (Item 135. Appendix E) (10 required)
Gasket (Item 132. Appendix E)
Gasket (Item 133, Appendix E)
Non-electric wire (Item 15, Appendix B) (30 inch)
Power transformer (Item 131. Appendix E)
Screw. cap socket (,Item 145, Appendix E) (2 required)
Screw, self locking (Item 134, Appendix E) (3 required)
Screw. self locking (Item 144. Appendix E (4 required)
Tape (Item 30, Appendix B)
Woodblock (Item 32, Appendix B) (2 required)

EQUIPMENT CONDITION: Electromechanical fuel system removed (TM 20-1)

REMOVAL:

1. SET ELECTROMECHANICAL FUEL SYSTEM (1) ON TWO BLOCKS OF WOOD (2) SO THAT SPLINE (3) WILL NOT BE DAMAGED.

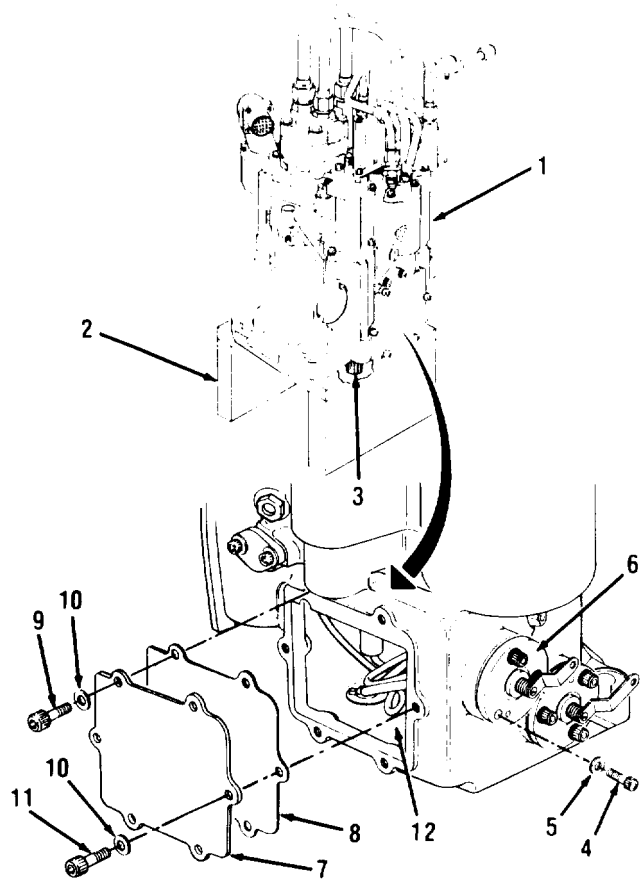
2. REMOVE THREE SCREWS (4) AND THREE WASHERS (5) FROM POWER TRANSFORMER (6).

   REMOVE ACCESS COVER (7) AND GASKET (8).

   a. Cut safety wire and remove two screws (9) and washers (10).

   b. Remove four remaining screws (11) and washers (10), access cover (7) and gasket (8).

   c. inspect electromechanical fuel system cavity (12) for f'uel. if fuel is present, assemble electromechanical fuel system using old parts. and replace electro-mechanical fuel system.



Go on to Sheet 2

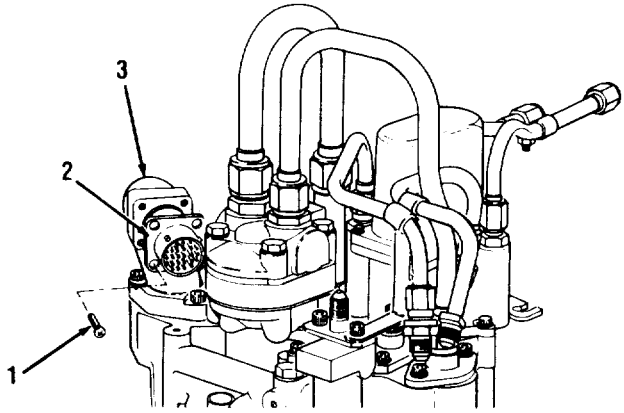
INLET GUIDE VANE (IGV) POWER TRANSFORIWER REPLACEMENT (Sheet 2 of 5)

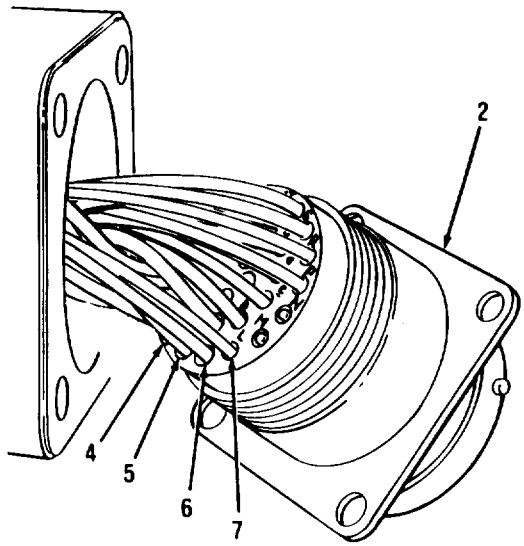
4. REMOVE FOUR BOLTS (1) AND SEPARATE CONNECTOR (2) FROM THE FLANGE CONNECTOR ELBOW (3).

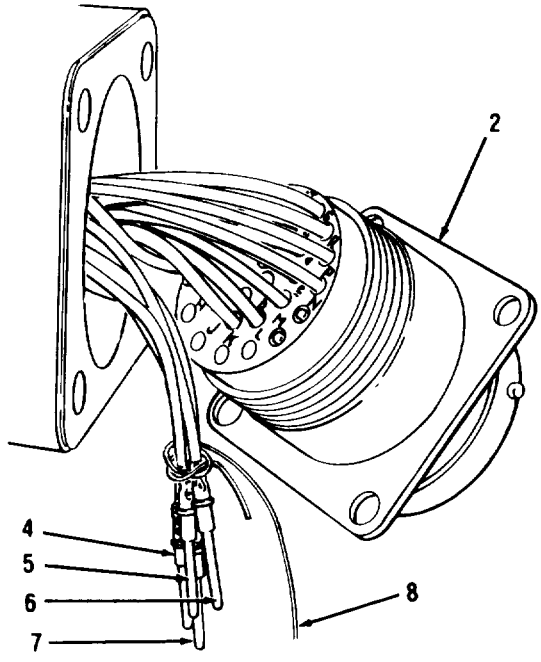
5. EXTRACT WIRES AND PINS (4,5.6.7) FROM CONNECTOR (2).

   a. Using pin extractor and installation tool, temove the following wires and pins from the backside of the connector (2): **H** (white/green) (4), **J** (white/grey) (5), **K** (white/yellow) **(6)** and **L** (white/blue) (7).

6. ATI"ACH A 30 INCH NONELECTRICAL PULL THROUCiH WIRE (8) WI[TH KNOT AROUND EXPOSED PINS (4,5,6,7) OF LOOSE WIRES. COVER KNOT AND WIRES WITH TAPE TO FORM SMOOTH SURFACE.







Go on to Sheet 3

INLET GUIDE VANE (IGV) POWER TRANSFORMER REPLACEMENT (Sheet 3 of 5)

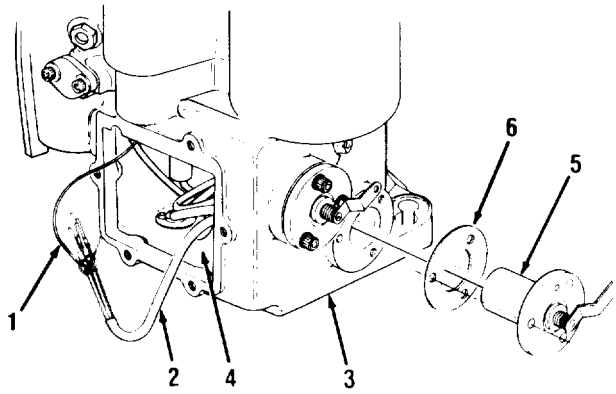
NOTE

IDo not pull nonelectrical wire (1) out of electro-mechanical fuel system. Keep wire routed for installation.

7. PULL THE POWER TRANSFORMER WIRE (RED) (2) OUT OF THE ELECTROMECHANICAL FUE.L SYSTEM (3) THROUGH THE ACCESS CAVITY (4).

8. REMOVE TAPE AND DISCONNECT NONELECTRICAL WIRE FROM PINS.

9. REMOVE POWER TRANSFORMER (5) AND GASKET (6).



NOTE

If wires other than the wires you work on break or come out of the housing. assemble electro-mechanicial f'uel system using old part and replace electromecharnical tuel syslem.

10. INSPECT WASHERS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

1. INSTALL NEW GASKET (6) AND NEW POWER TRANSFORMER (5) ONTO ELEC-TROMECHANICAL FUEL SYSTEM (3).

NOTE

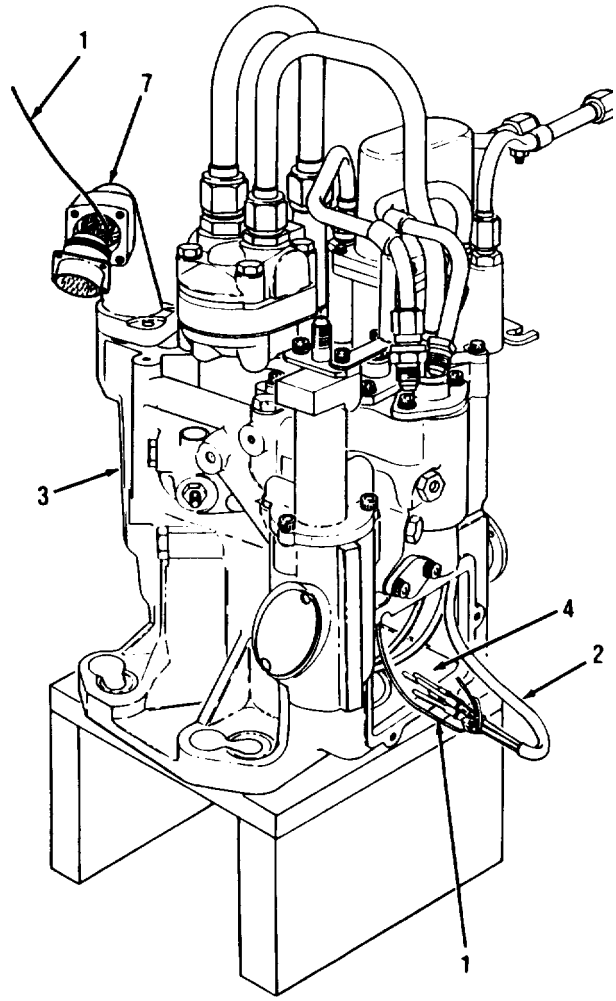
Do not put in new screws and washers in power translomer at this time.

2. ATTACI-I NONELECTRICAL WIRE **(I)** TO PINS AND ROUTE THROUGH ELECTRO-MECHANICAL FUEL SYSTEM **(4).**

   a At access cavity (4), attach non- electrical **wire** (1) to pins with knot. Cover with tape t0 form smooth surface.

   b. Route power trarnsforner wire (2) carefully out through. connector elbow (7).

   c. Remove Iape and nonelectrical wire from pins.



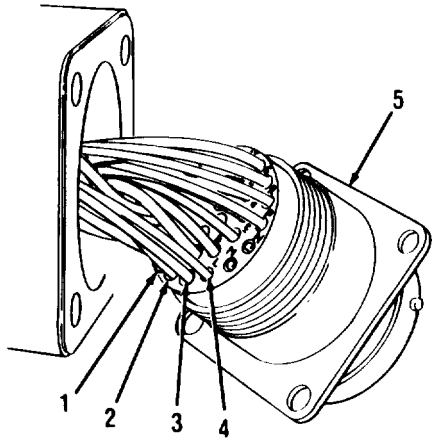
Go on to Sheet 4

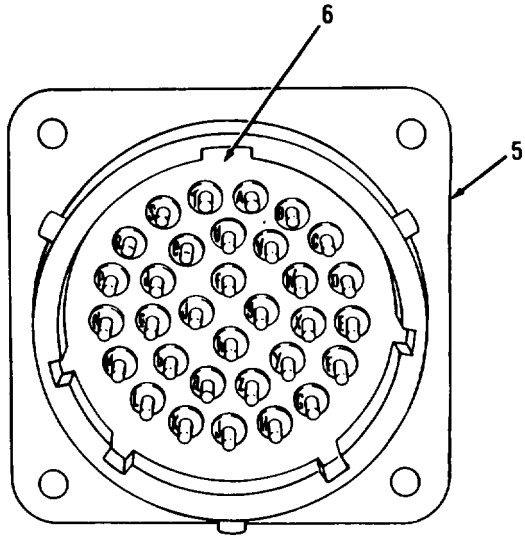
INLET GUIDE VANE (IGV) POWER TRANSFORMER REPLACEMENT (Sheet 4 of 5)

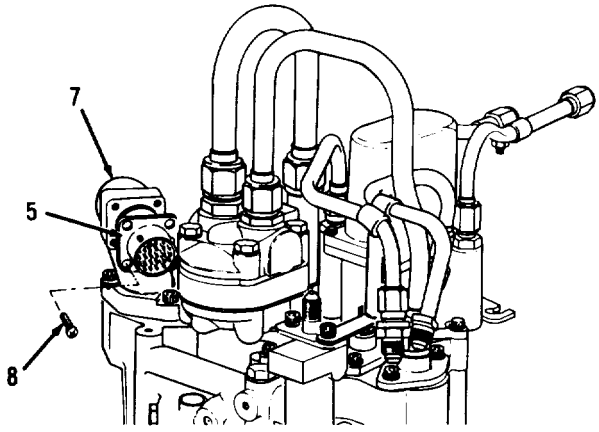
3. [NSTALL PINS AND WtRES (1,2,3,4) ON CONNECTOR (5).

   a. Using pin extractor and installation tool, install wires and pins (1) (white/green) into **H,** (2) (white/grey) into **J,** (3) (while/ yellow) into **K** and (4) (white/blue) into **L** in connector (5).

4. POSITION CONNECTOR (5), WITH SLOT (6) IN TWELVE O'CLOCK POSITION, ON FLANGE CONNECTOR ELBOW (7). [NSTALL FOUR NEW BOLTS (8).
   TIGHTEN BOLTS IN STAGGERED SEQUENCE.







Go on to Sheet 5

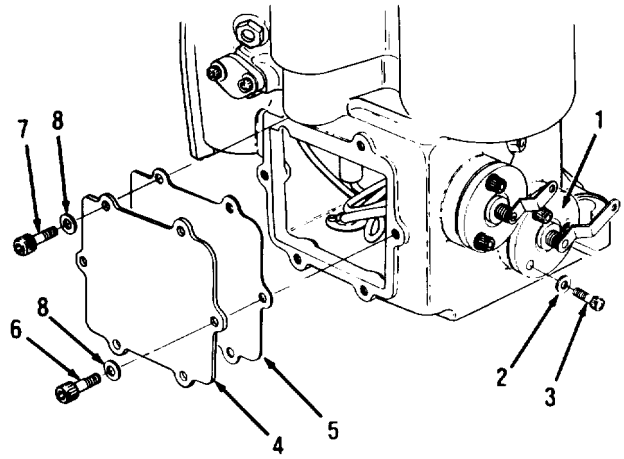
INLET GUIDE VANE (IGV) POWER TRANSFORMER REPLACEMENT (Sheet 5 of 5)

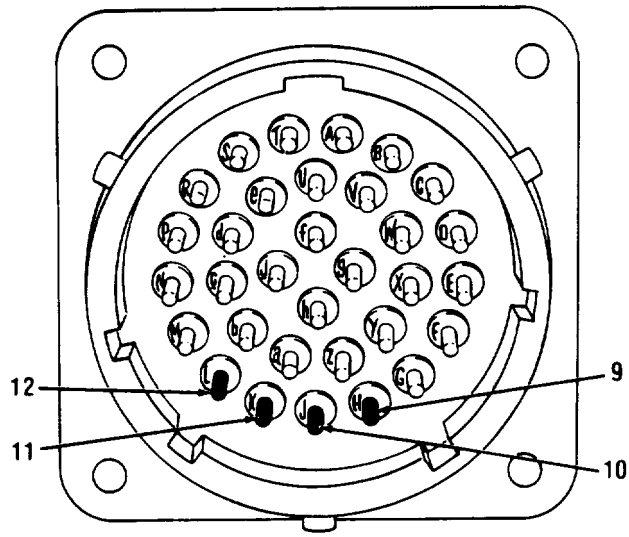
5. SECURE POWER TRANSFORMER (1) WITH THREE WASHERS (2) AND THREE NEW SCREWS (3). TORQUE SCREWS IN STAGGERED SEQUENCE TO 25-30 LB-IN (2.82-3.39 N.m).

6. INSTALL ACCESS COVER (4), NEW GASKET (5), SIX NEW SCREWS (6,7) AND SIX WASHERS (8). TORQUE SCREWS IN STAGGERED SEQUENCE BETWEEN 25-30 LB-IN (2.82-3.39 N m).

7. MEASURE RESISTANCE BETWEEN PINS **H** (9) and **J** (10). MULTIMETER SHOULD READ 5-50 OHMS.

8. MEASURE RESISTANCE BETWEEN PINS **K** (11) and **L** (12). MULTIMETER SHOULD READ 2-40 OHMS.





End **of Task**

DIRECT LINEAR VALVE REPLACEMENT (Sheet 1 of 6)

TOOLS: General mechanic's tool kit: automotive (SC5180-90-N26)
Extension, 3/8-inch drive, 6 inch (Item 8, Appendix D)
Handle, ratchet (Item 9, Appendix D)
Industrial goggles (Item 58, Appendix D)
Maintenance kit, electrical (Item 98, Appendix D)
Muitimeter (Item 49, Appendix D)
Pliers, wire twister (Item 101. Appendix D)
Socket, 3/8-inch drive, 5/32-inch (Item 108, Appendix D)
Socket, 3/8-inch drive, 3/16-inch (llem 109, Appendix D)
Torque wrench, 0-150 lb-in (Item 27, Appendix D)

SUPPLIES: Bolt, self-locking (Item 146, Appendix E) (4 required)
Direct linear valve (Item 137, Appendix E)
Flatwasher (Item 140, Appendix E) (3 required)
Flatwasher (Item 135, Appendix E) (6 required)
Gasket (Item 143, Appendix E)
Non-electric wire (item 15, Appendix B) (30 inch)
Non-electric wire (Item 50, Appendix B)
Preformed packing (Item 139, Appendix E)
Preformed packing (Item 141, Appendix E) (2 required)
Screw cap, socket (Item 145, Appendix E) (2 required)
Screw, self-locking (Item 138, Appendix E) (3 required)
Screw, self-locking (Item 144, Appendix E) (4 required)
Shortening compound (Item 20, Appendix B)
Tape (Item 30, Appendix B)
Woodblock (Item 32, Appendix B) (2 required)

EQUIPMENT CONDITION: Electromechanical fuel system removed **(TM 20-1)**

REMOVAL:

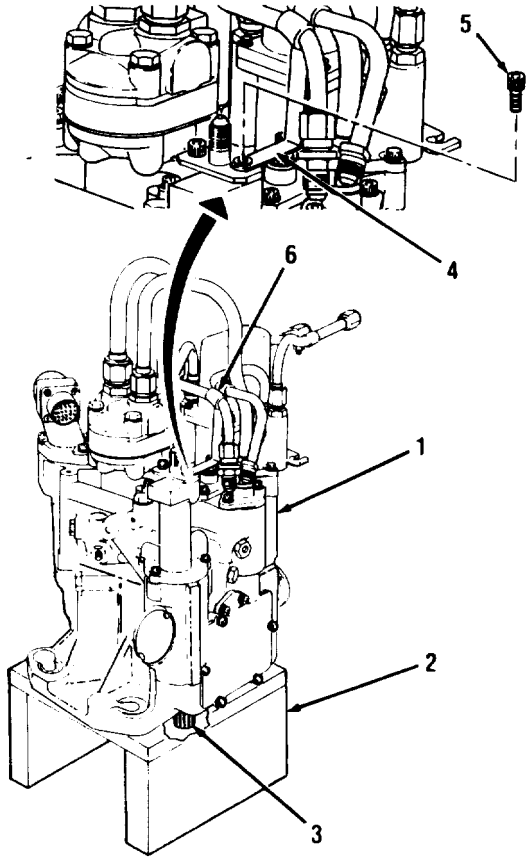
1. SET ELECTROMECHANICAL FUEL SYSTEM (1) ON TWO BLOCKS OF WOOD (2) SO THAT SPLINE (3) WILL NOT BE DAMAGED.

2. DISCONNECT BRACKET (4).

   a. Cut lockwire and remove screw (5).

   b. Loosen screw on champs (6) and swing bracket (4) to side.

   c. Put screw (5) back in fitting and tighten.



Go on to Sheet 2

DIRECT LINEAR VALVE REPLACEMENT (Sheet 2 of 6)

3. REMOVE THREE SCREWS (I) AND THREE WASHERS (2) THAT SECURE THE DIRECT LINEAR VALVE (3) TO ELECTROMECHANICAL FUEL SYSTEM (4).

4. REMOVE ACCESS COVER (5) AND GASKET (6).

a. Cut safety wire and remove two screws **(7)** and washers **(8).**

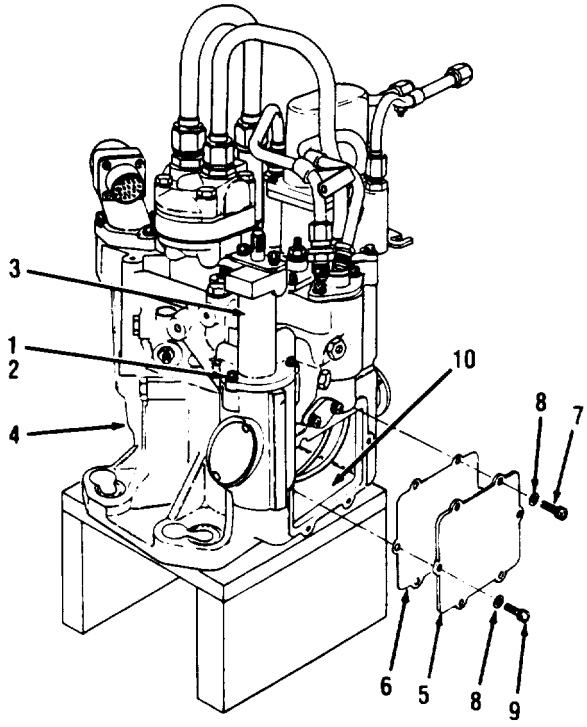
b. Remove four remaining screws (9), washers (8), access cover (5) and gaskel (9).

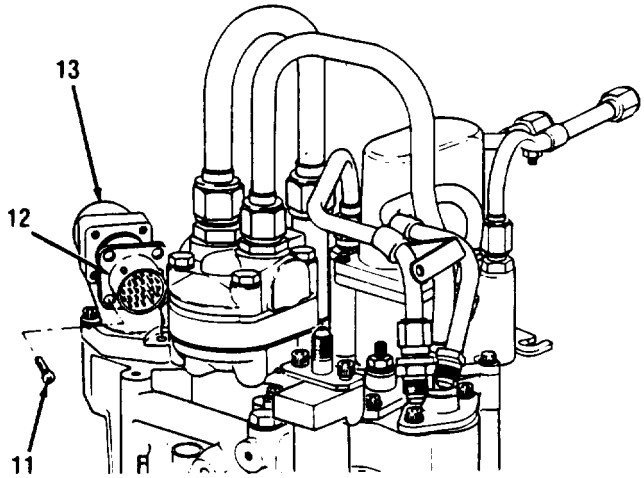
c. inspect electromechanical fuel system cavity (10) for fuel. If fuel is present, assemble electromechanical fuel system using old parts and replace electromechanical fuel system.

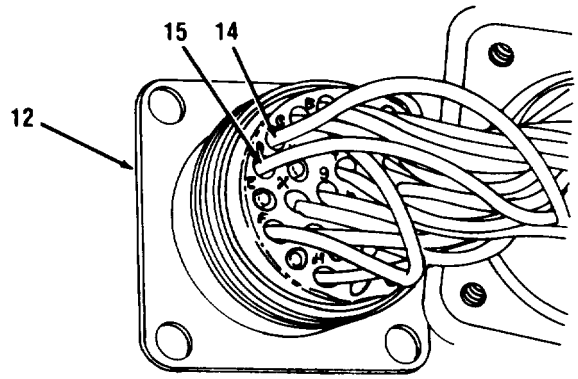
5. REMOVE FOUR BOLTS (11) AND SEPARATE CONNECTOR (12) FROM THE FLANGE CONNECTOR ELBOW (13).

6. EXTRACT WIRES AND PINS (14,15) FROM CONNECTOR (1 2).

a. Using a pin extractor and installation tool. remove wires and pins C (red) (14) and I) (blue) (15) from the backside of connector (12).



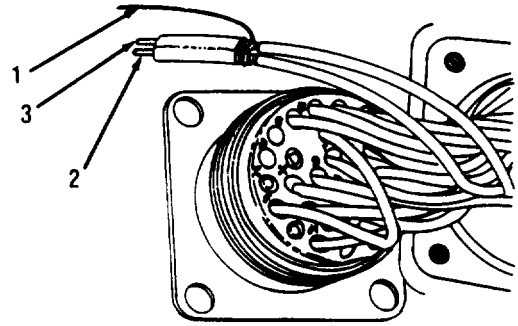




Go on to Sheet 3

DIRECT LINEAR VALVE REPLACEMENT (Sheet 3 of 6)

7. ATTACH 30 INCH NON-ELECTRICA.L PULL THROUGH WIRE (1), WITH KNOT AROUND EXPOSED PINS **(2,3),** TO LOOSE WIRES. COVER KNOT WITH TAPE TO FORM SMOOTH SURFACE.



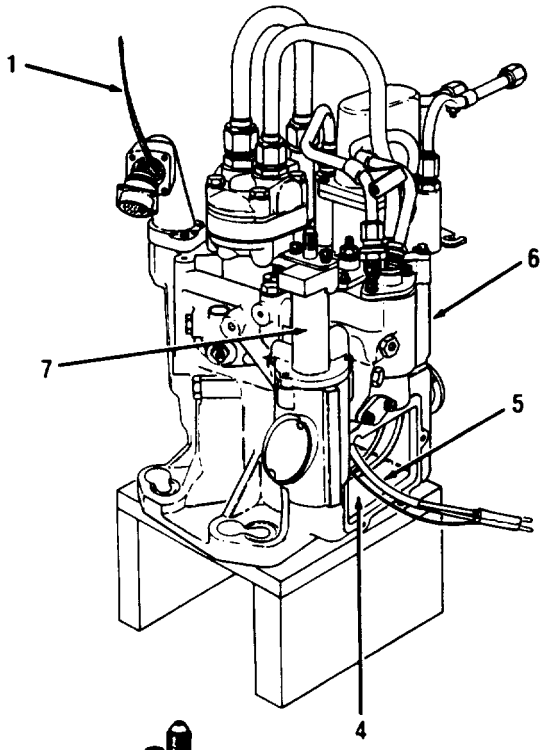
NOTE

Do not pull non-electrical wire (1) out of electro-mechanical fuel system. Keep wire routed for installation.

8. THROUGH THE ACCESS CAVITY (4), PULL THE DIRECT LINEAR VALVE WIRE (RED AND BLUE IN CLEAR SLEEVE) (.5) OUT OF THE ELECTROMECHANICAL FUEL SYSTEM (6).

9. REMOVE TAPE AND DISCONNECT NON-ELECTRICAL WIRE FROM PINS.

I(). REMOVE DIRECT LINEAR VALVE (7) FROM ELECTROMECHANICAL FUEL SYSTEM (6).



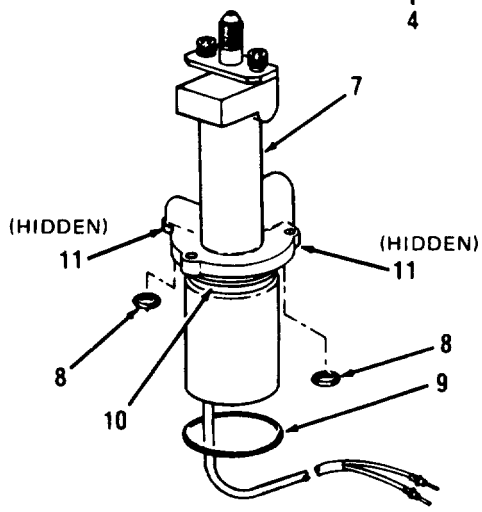
NOTE

if wires other than the wires you work on break or come out of the housing, assemble eleclro-mechanicnl fuel system using old parts and replace electromechanical fuel system.

11. [NSPECT WASHERS FOR DAMAGE. RE-PLACE AS REQUIRED.

INSTALLATION:

1. LUBRICATE NEW PREFORMED PACK-INGS (8 AND **9)** WITH SHORTENING COMPOUND AND SLIDE PACKING (9) UP THE NEW DIRECT LINEAR VALVE INTO GROOVE (10). PLACE PACK{NGS (8) IN GROOVES (11).



Go on to Sheet 4

DIRECT LINEAR VALVE REPLACEMENT (Sheet 4 of 6)

2. INSTALL NEW DIRECT LINEAR VALVE (1) INTO ELECTROMECHANICAL FUEL SYSTEM (2).

NOTE

Do not install screws and washers in direct linear valve at this time.

3. ATTACH NON-ELECTRICAL WIRE (3) TO PINS (4) AND ROUTE THROUGH ELECTROMECHANICAL FUEL SYSTEM (2).

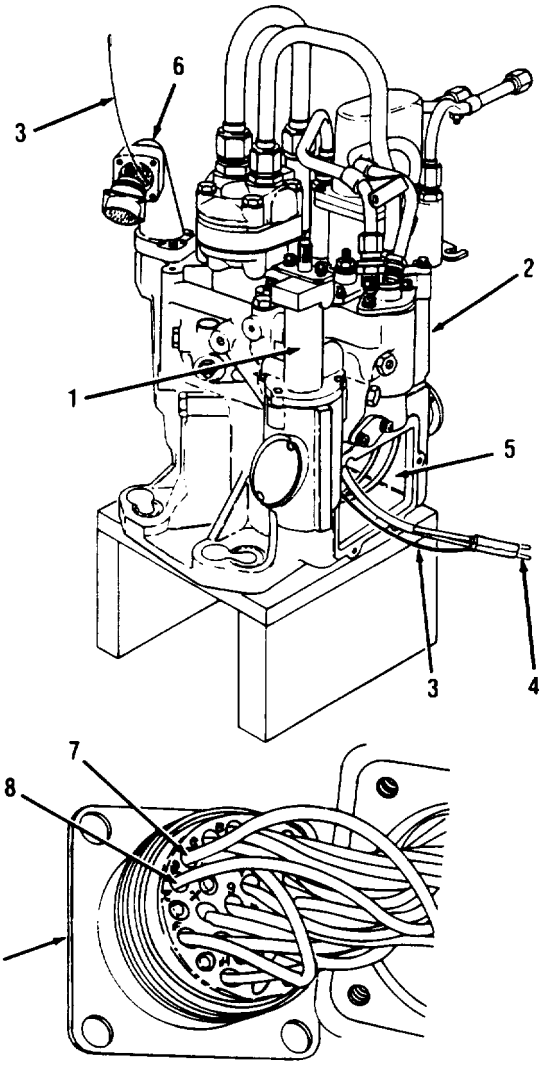
   a. At access cavity (5), attach non- electrical wire (3) to pins (4) with knot. Cover with tape to form smooth .surface.

   b. Route linear valve wires carefully out through connector elbow (6).

   c. Remove tape and non-electrical wire from pins,

4. INSTALL PINS AND WIRES (7,8) IN CONNECTOR (9).

   a. Using pin extractor and installation tool, install wire and pin (7) (red) into C and wire and pin (8) (blue) into D in connector (9).



Go on to Sheet 5

DIRECT LINEAR VALVE REPLACEMENT (Sheet 5 of 6)

5. POSITION CONNECTOR (1), WITH SLOT **(2) IN** TWELVE O'CLOCK POSITION, ON FLANGE CONNECTOR ELBOW (3). INSTALL FOUR NEW BOLTS (4). TIGHTEN BOLTS IN STAGGERED SEQUENCE.

6. SECURE DIRECT LINEAR VALVE (5) WITH THREE WASHERS (6) AND THREE NEW SCREWS (7). TORQUE IN 5 LB-.IN INCREMENTS TO 15-20 LB-IN (1 .69-2.26 **N.m).**

7. INSTALL ACCESS COVER (8) AND NEW GASKET (9). SIX NEW SCREWS (10,1l) AND) SIX WASHERS (12). TORQUE SCREWS IN STAGGERED SEQUENCE BETWEEN 25-30 LB-IN (2.82-3:39 N m).

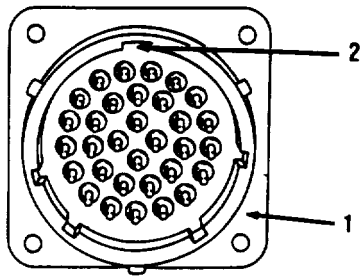
K. ATTACH BRACKET (13) TO LINEAR VALVE (5) WITH SCREW (14) AND TORQUE TO 40-45 LB-IN (4.52-5.08 N .111).

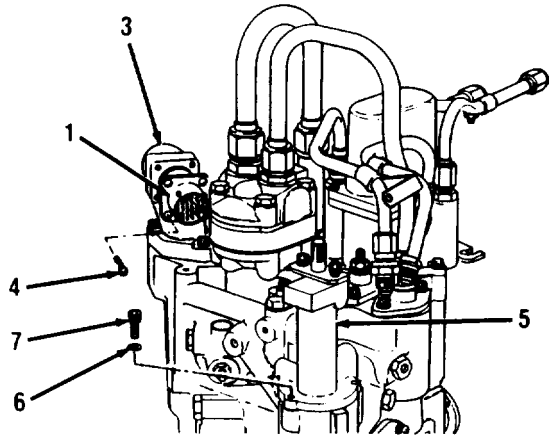
   a. Remove screw (14) and swing bracket (13) back in posit ion.

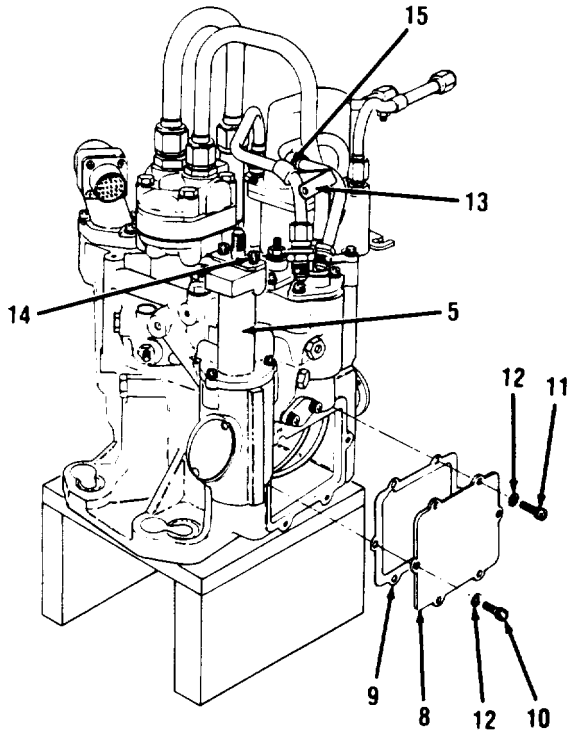
   b. Attach bracket (13) to linear valve (5) with screw (14) and torque to 40-45 lb-in (4.52-5.08 N.m).

   c. Tighten screw securing bracket (13) to clamps (15).

   dl. Lockwire two screws (14) on top of linear valve.





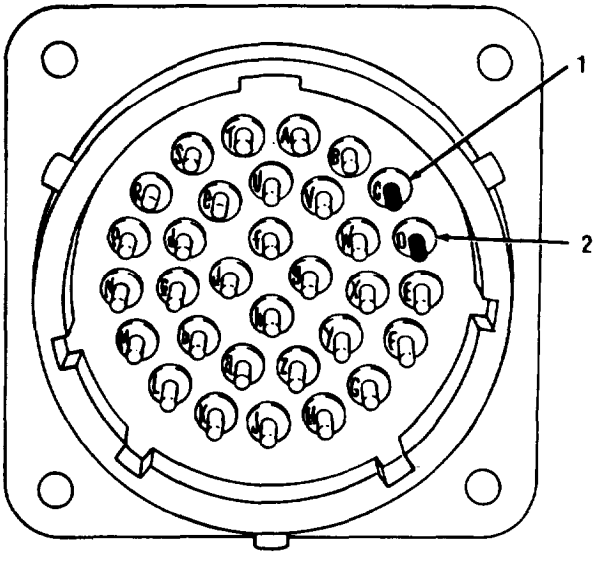


Go on to Sheet 6

DIRECT LINEAR VALVE REPLACEMENT (Sheet 6 of 6)

9. MEASURE RESISTANCE BETWEEN PINS C (1) AND D (2). MULTIMETER SHOULD READ 25-35 OHMS.

10. INSTALL ELECTROMECHANICAL FUEL SYSTEM (TM 20-1).



End of Task

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 1 of 40)

TOOLS:

General mechanic's tool kit, automotive (SC5180-90-N28)
Anti-torque plate (Item 193, Appendix D)
Arbor press (Item 37, Appendix D)
Bar, 1/2-inch square drive (Item 194, Appendix D)
Caliper, outside micrometer, 0-2-inch (0-25.4 mm) (Item 195, Appendix D)
Combination wrench, 1-1/8-inch (Item 94, Appendix D)
Combination wrench, 7/16-inch (item 133, Appendix D)
Dead- blow hammer (Item 132, Appendix D)
Deep style socket, 1/2-inch drive, 3/4-inch (Item 43, Appendix D)
Drill, twist No. 57 (0.043 inch diameter) (Item 197, Appendix D)
Drill, 7/64-inch (Item 125, Appendix D)
Extension, 3/8-inch drive, 6-inch (Item 8, Appendix D)
Faceshield (Item 88, Appendix D)
Gear train handle (Item 42, Appendix D)
Industrial goggles (Item 58, Appendix D)
Inserted hammer face (Item 130, Appendix D)
Inserted hammer face (Item 131, Appendix D)
Magnifying glass, 4 power (Item 199, Appendix D)
Measure bar (Item 141, Appendix D)
Metal pail, 5 gallon (Item 136, Appendix D)
Micrometer (Item 128, Appendix D)
Micrometer, depth gage (Item 205, Appendix D)
Paint brush, oval (Item 129, Appendix D)
Protective gloves (Item 87, Appendix D)
Puller (Item 200, Appendix D)
Puller, bearing, gearshaft (Item 201, Appendix D)
Punch, drive pin (Item 102, Appendix D)
Ratchet handle, 3/8-inch drive (Item 9, Appendix D)
Sharpening stone (Item 202, Appendix D)
Sleeve set (Item 162, Appendix D)
Sling, accessory gearbox cover lifting (Item 126, Appendix D)
Socket, 3/8-inch drive, 7/16-inch (Item 28, Appendix D)
Spanner wrench (Item 203, Appendix D)
Tap, 1/2-20NF (Item 135, Appendix D)
Torque wrench, 0-150 ft-lb (Item 24, Appendix D)
Torque wrench, 0-200 in-lb (Item 134, Appendix D)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)

SUPPLIES:

Dry cleaning solvent (Item 7, Appendix B)
Flared conical seal (Item 59, Appendix E) (2 required)
Gasket (Item 121, Appendix E)
Grease (Item 10, Appendix 8)

Go on to Sheet 2

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 2 of 40)

SUPPLIES - continued:

Locking cup (Item 173, Appendix E) (2 required)
Lubricating oil (Item 11 or 12, Appendix B)
Non-electrical safety wire (Item 15, Appendix B)
Plain round nut (Item 174, Appendix E) (2 required)
Plastic bag (Item 48, Appendix B) (as required)
Preformed packing (Item 123, Appendix E)
Preformed packing (Item 68, Appendix E) (2 required)
Preformed packing (Item 122, Appendix E) (2 required)
Rubber sheet (Item 45, Appendix B)
Scouring pad (Item 46, Appendix B)
Seal washer (packing with retainer) (Item 156, Appendix E)
Sealer, adhesive (Item 29, Appendix B)
Self-locking nut (Item 20, Appendix E) (33 required)
Self-locking nut (Item 62, Appendix E) (6 required)
Shortening compound (Item 20, Appendix B)
Spacer (Item 125, Appendix E)
Straight pin (Item 175, Appendix E)
Tape (Item 30, Appendix B)
Wiping rag (Item 14, Appendix B)
Writing paper (Item 41, Appendix B)
Writing pencil (Item 27, Appendix B)

PERSONNEL: Two

EQUIPMENT CONDITION:

Accessory gearbox (AGB) removed from engine (page 7-21)
Wash exterior of AGB with steam cleaner or other suitable method to remove contaminants.

Go on to Sheet 3

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 3 of 40)

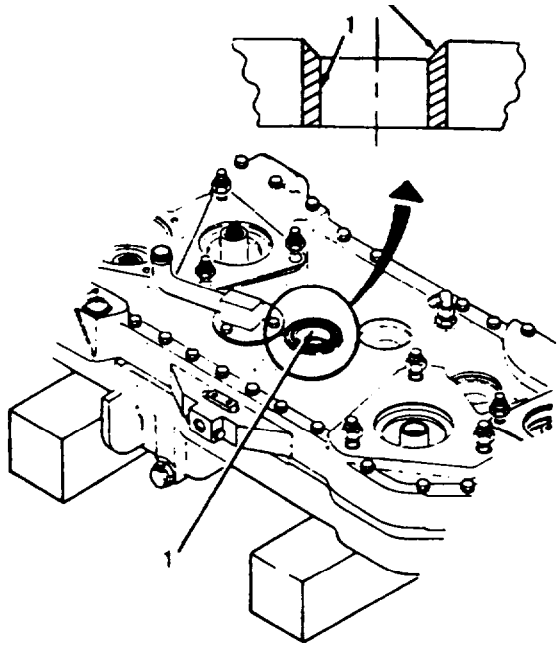
1. INSPECT SLEEVE BUSHING (1). IF 45 DEGREE BEVEL (2) EXISTS, REASSEMBLE USING OLD PARTS AND REPLACE ACCESSORY GEARBOX (PAGE 7-21). IF NO 45 DEGREE BEVEL EXISTS, GO TO STEP 2.

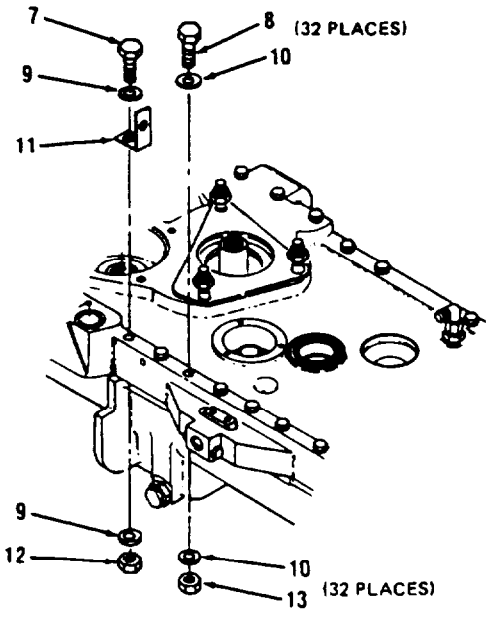
2. REMOVE THREE SCREWS (3), PREFORMED PACKING (4) AND COVER (5) FROM GEARBOX FLANGE (6).

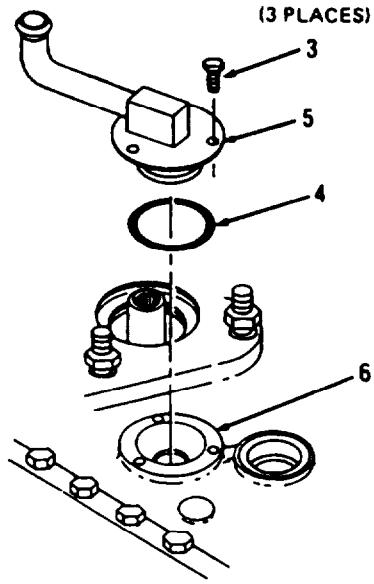
3. REMOVE SCREWS (7, 8), WASHERS (9, 10), BRACKET (11) AND NUTS (12, 13).

   a. Remove screw (7), two washers (9), bracket (11) and nut (12).

   b. Remove 32 screws (8), 64 washers (10) and 32 nuts (13).







Go on to Sheet 4

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 4 of 40)

CAUTION

Case and cover are a matched set. Do not mix with other gearboxes.

Cover may swing and strike other parts when lifting. Have assistant guide cover while lifting to prevent damage.

4. ATTACH SLING (1) AND REMOVE COVER (2) GASKET (3) AND PREFORMED PACKING (4) FROM HOUSING

a. Hook sling (1) on hoist hook (6) and place over gearbox (7).

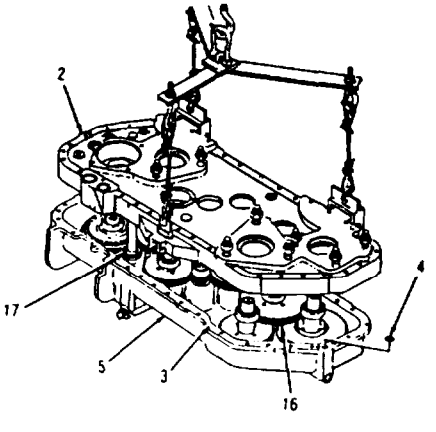
b. Remove two lockpins (8) from two pins (9). Remove two pins (9) and two bolts (10).

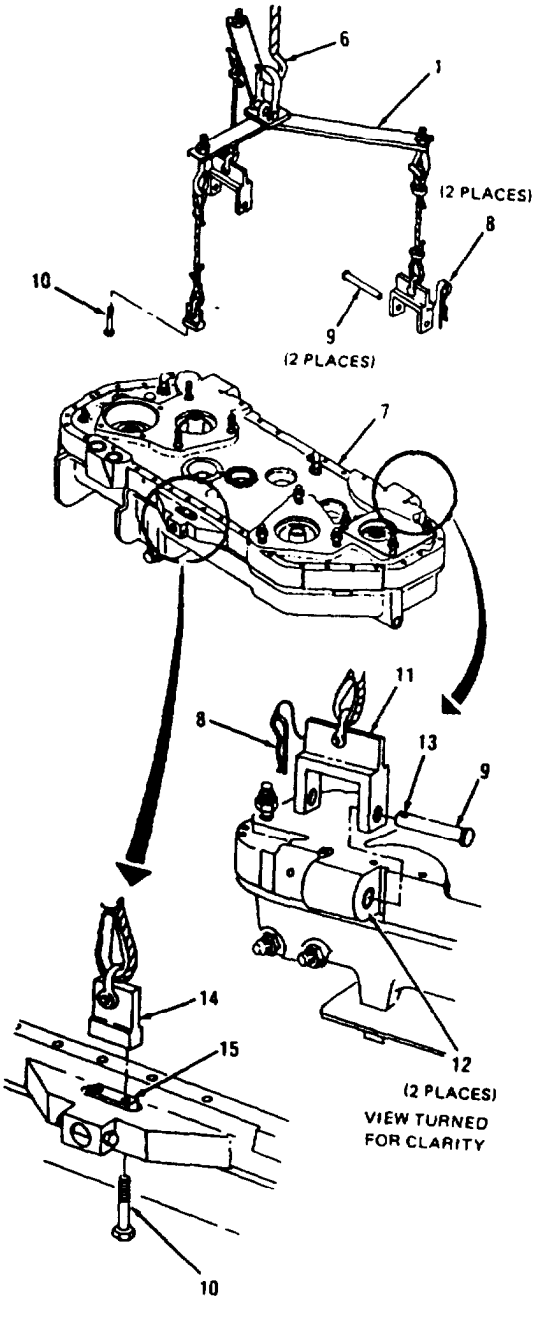
c. Place two lifter blocks (11) over two lift mounts (12) and install two pins (9). Install two lockpins (8) in holes (13) of two pins (9).

d. Place lifter block (14) on mounting block (15) and install two bolts (10).

e. Tap cover (2) lightly with hammer to prevent gears (16) from sticking in cover, and slowly lift cover (2) from housing (5). Guide cover (2), while lifting, to prevent oil scavenge tube (17) from hitting housing (5) or gears (16).

f. Remove cover (2) gasket (3) and packing (4) from housing (5).





Go on to Sheet 5

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 5 of 40)

5. PLACE COVER (1) ON WORK SURFACE (2) AND REMOVE SLING (3).

CAUTION

Do not rest cover (1) on oil scavenge tube (4) when placing cover on work surface (2). Resting cover on oil scavenge tube will damage oil scavenge tube.

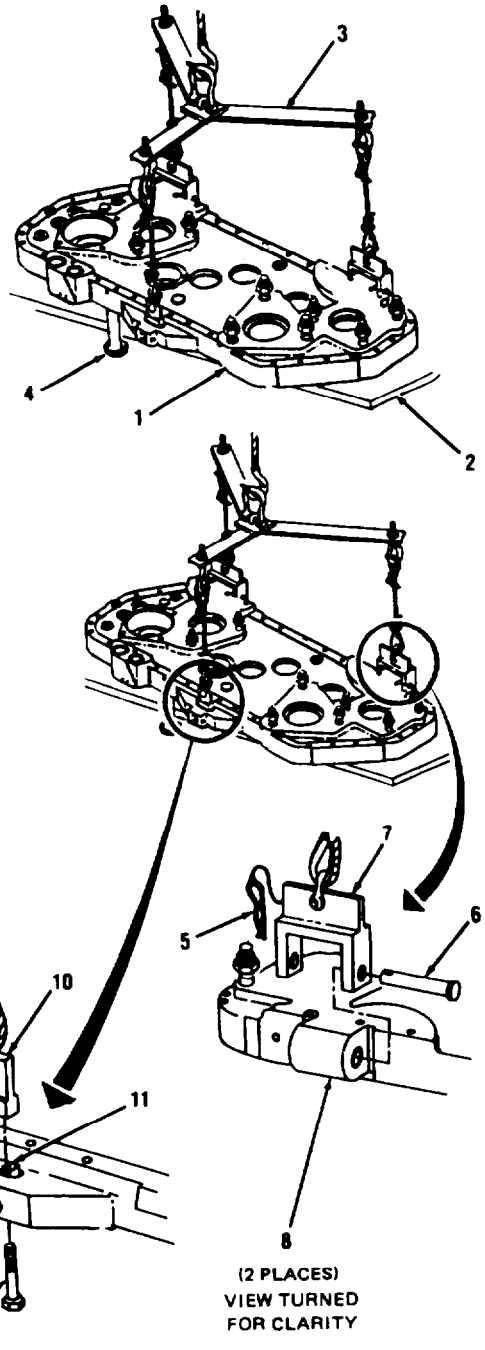
a. Place cover (1) on clean work surface (2). Do not allow cover (1) to rest on oil scavenge tube (4).

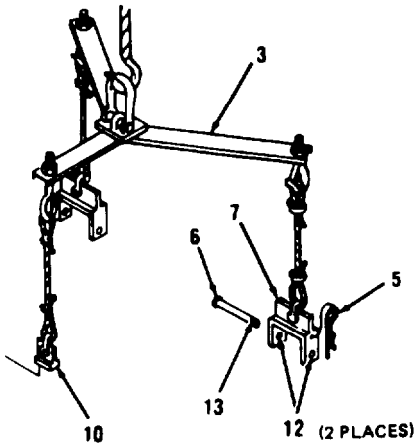
b. Remove two lockpins (5) from two pins (6) and remove pins (6). Remove two lifter blocks (7) from two mounting blocks (8).

c. Remove two bolts (9) and remove lifter-block (10) from mounting block (11).

d. Install two bolts (9) in lifter block (10). Install two pins (6) in holes (12) of two lifter blocks (7). Install two lockpins (5) in holes (13) of two pins (6).

e. Remove and stow sling (3).





Go on to Sheet 6

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 6 of 40)

6. TURN COVER (1) OVER AND CHECK EIGHT BEARING BORES (2) FOR SCORING. CHECK COVER (1) FOR CRACKS, BREAKS AND RUST OR CORROSION.

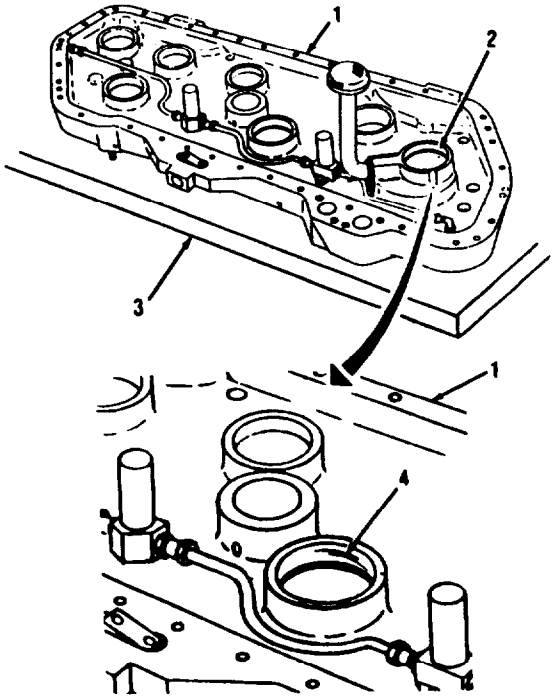
WARNING

Cover (1) is heavy. Do not let fingers get caught between work surface (3) and cover (1) when turning cover over. Injury to fingers will result.

a. Turn cover (1) over on clean work surface (3).

b. Check eight bearing bores (2) for scoring (4) caused by bearing turning in bores. If scoring (4) exists, install cover (1) (page 7-80) and replace accessory gearbox (page 7-21). If there is no scoring, go to step c.

c. Check cover (1) for cracks, breaks and rust or corrosion. If damage exists, install cover (1) (page 7-80) and replace accessory gearbox (page 7-21). If there is no damage, go to step 7.



CAUTION

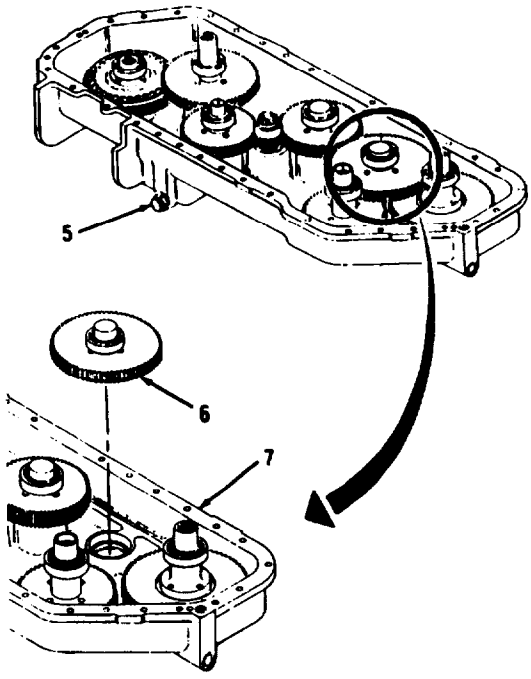
Gear assemblies may be slippery and are heavy. Use both hands when removing assemblies. Do not lift assemblies by bearings. Do not rotate or spin bearings by hand or with shop air. Damage to assemblies or bearings may occur.

7. REMOVE PLUG (5) AND DRAIN ANY OIL THAT WAS LEFT IN HOUSING INTO PAIL.

NOTE

During assembly, gears must he installed in same bores from which they were removed.

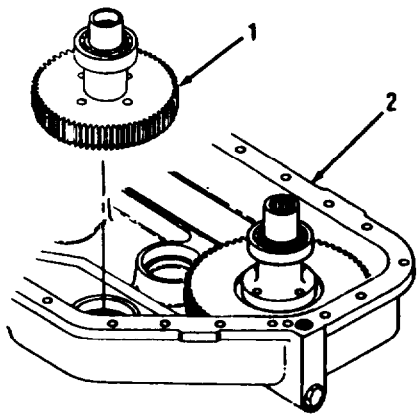
8. MARK SPUR GEARSHAFT NO. 5 AND 6 (6) IN ORDER TO RE-INSTALL INTO ORIGINAL POSITION. REMOVE SPUR GEARSHAFT (6) FROM HOUSING (7).



Go on to Sheet 7

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 7 of 40)

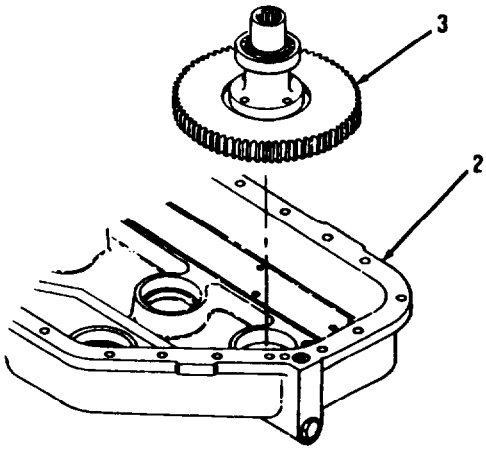
9. MARK SPUR GEARSHAFT NO. 7 (1) IN ORDER TO RE-INSTALL INTO ORIGINAL POSITION. REMOVE GEARSHAFT (1) FROM HOUSING (2).

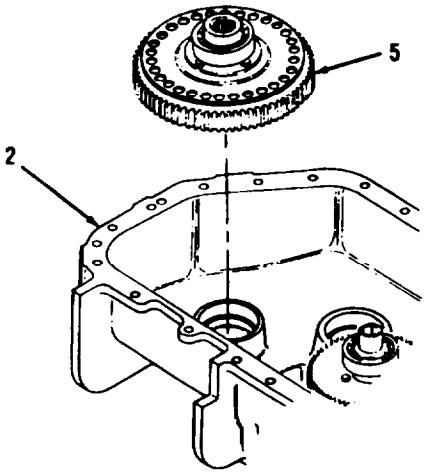


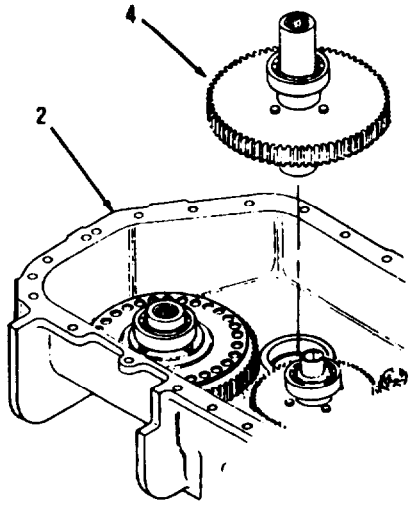
10. MARK SPUR GEARSHAFT NO. 8 (3) IN ORDER TO RE-INSTALL INTO ORIGINAL POSITION. REMOVE GEARSHAFT (3) FROM HOUSING (2).

11. MARK SPUR GEARSHAFT NO. 10 AND 11 (4) IN ORDER TO RE-INSTALL INTO ORIGINAL POSITION. REMOVE GEARSHAFT (4) FROM HOUSING (2).

12. MARK GEAR CLUSTER (5) IN ORDER TO RE-INSTALL INTO ORIGINAL POSITION. REMOVE GEAR CLUSTER (5) FROM HOUSING (2).







Go on to Sheet 8

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 8 of 40)

NOTE

Gears must be installed in same bores from which they were removed.

13. REMOVE SPUR GEARSHAFT NO. 4 (1), SPUR GEARSHAFT NO. 9 (2), SPUR GEARSHAFT ASSEMBLY (3) AND SPACER (4) FROM HOUSING (5).

a. Remove spur gearshaft No. 4 (1), spur gearshaft No. 9 (2) and spur gearshaft assembly (3) at the same time (as a unit) from housing (5).

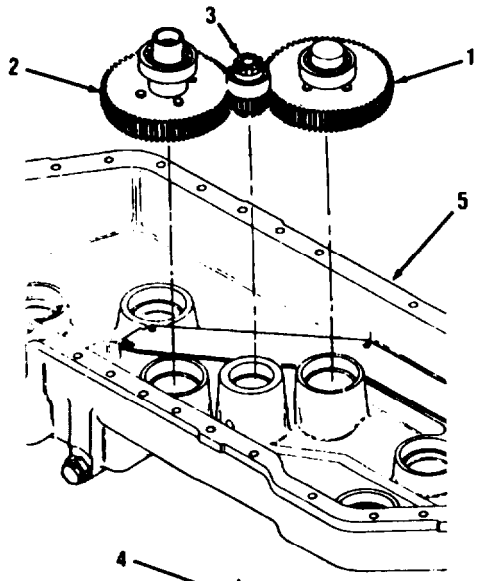
b. Remove spacer (4) from bearing bore (6) in housing (5).

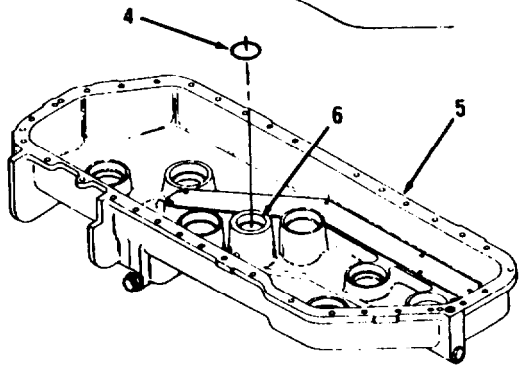
14. INSPECT EIGHT BEARING BORES (7) IN HOUSING (5) FOR SCORING.

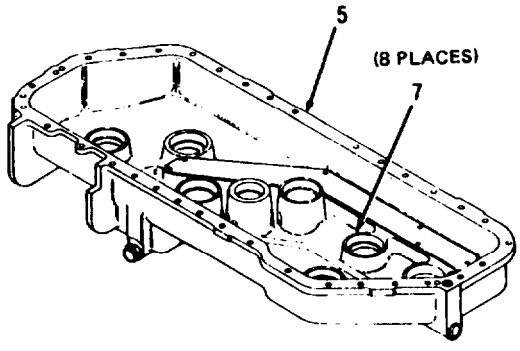
a. Inspect eight bearing bores (7) in housing (5) for scoring caused by bearing turning in bores.

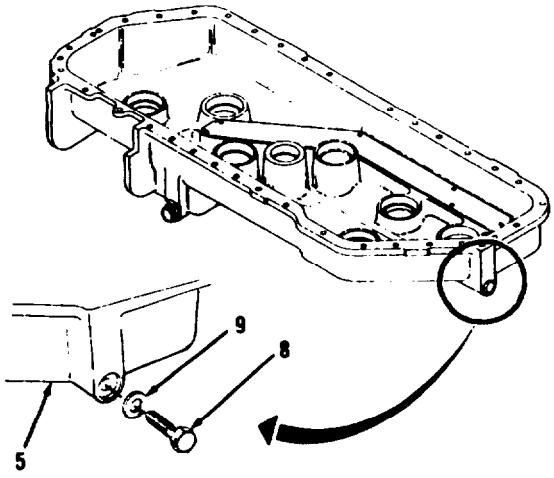
b. If scoring exists, assemble accessory gearbox using original parts (page 7-74), replace accessory gearbox (page 7-21). If there is no scoring, go to step 15.

15. CUT LOCKWIRE. REMOVE NOZZLE ASSEMBLY (8) AND SEAL WASHER (9) FROM HOUSING (5).









Go on to Sheet 9

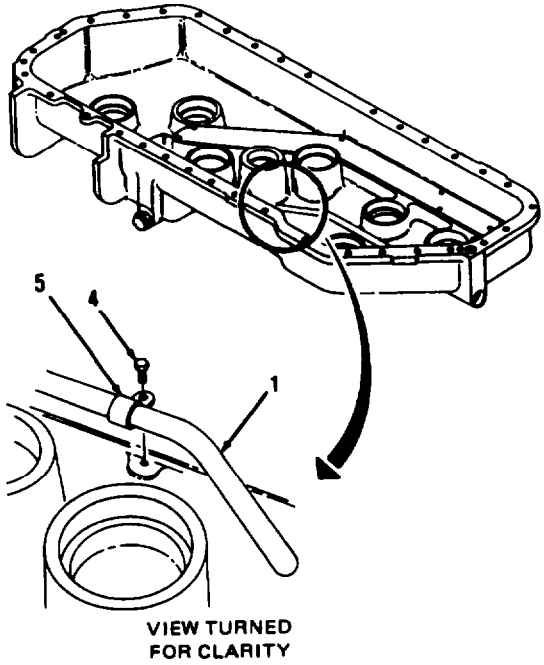
ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 9 of 40)

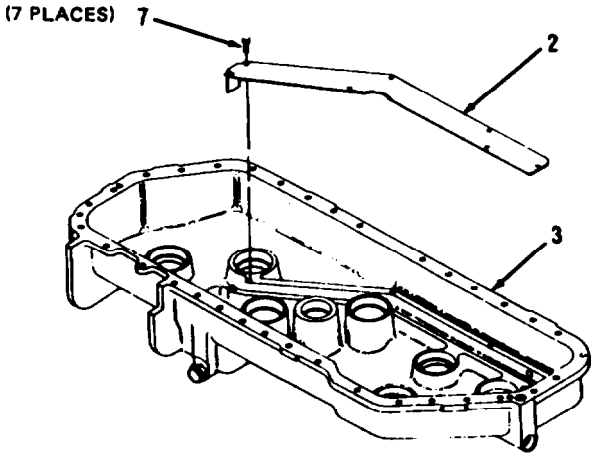
16. REMOVE TUBE ASSEMBLY (I) AND SUMP COVER (2) FROM HOUSING (3).

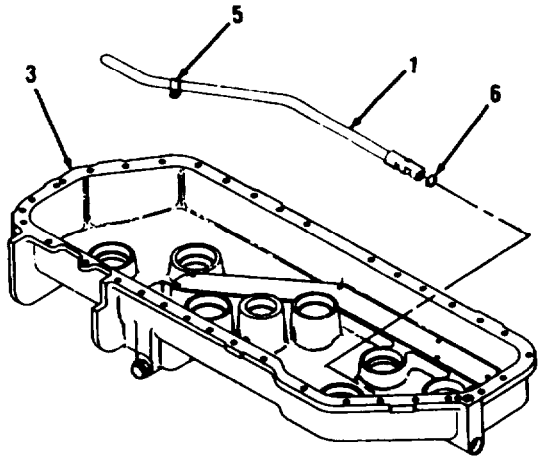
a. Remove screw (4) and tube assembly (1) with clamp (5) installed, and washer (6) from housing (3).

b. Remove clamp (5) from tube assembly (1).

c. Remove seven screws (7) and sump cover (2) from housing (3).





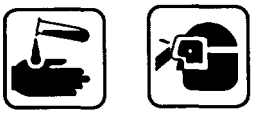


Go on to Sheet 10

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 10 of 40)

CLEANING:

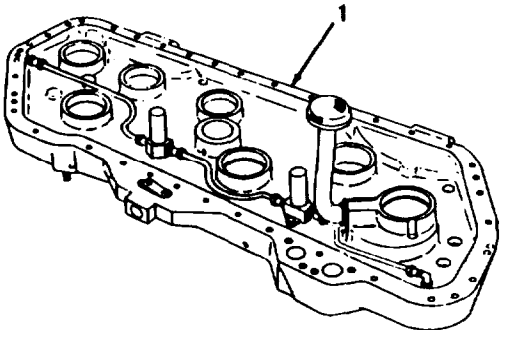
WARNING



1. CLEAN COVER (1).

   a. Clean cover (1) with soft bristle brush and cleaning solvent.

   b. Dry with shop air.



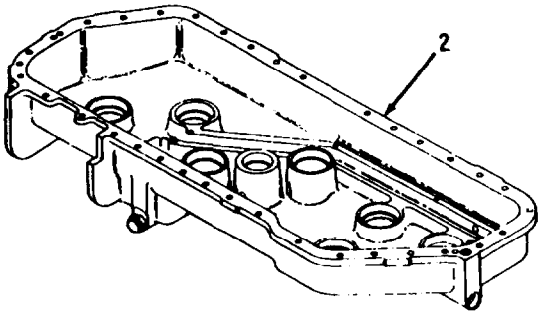
2. CLEAN HOUSING (2).

   a. Remove large amounts of dirt and oil from housing (2) with rag.

   b. Clean surface of housing with soft bristle brush and cleaning solvent.

   c. Dry with shop air.

3. CLEAN ALL GEAR ASSEMBLIES.



   a. Clean all gear assemblies by dunking in cleaning solvent two or three times. Allow solvent to soak into bearings on both ends.

   b. Allow gear assemblies to dry by evaporation and coat immediately with clean lubricating oil.

NOTE

If gears and bearings are not to be reinstalled within one hour, place lubricated gears and bearings in plastic bags.

Go on to Sheet 11

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 11 of 40)

4. CLEAN ALL OTHER PARTS WITH SOFT BRISTLE BRUSH AND CLEANING SOLVENT.

INSPECTION:

1. INSPECT COVER (1).

NOTE

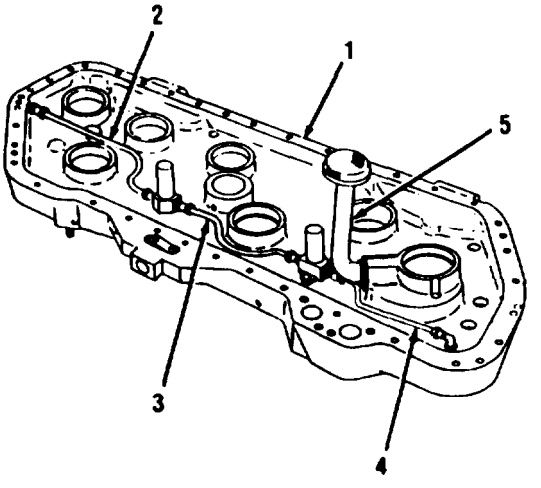
Damage found in steps a. through c. is not allowed. If any damage is found, go immediately to step d.

a. Look at cover (1) for cracks, breaks and rust or corrosion.

b. Look at tube assemblies (2, 3 and 4) for dents, cracks and evidence of leaks.

c. Look at tube assembly (5) for cracks, screen damage and evidence of leaks.

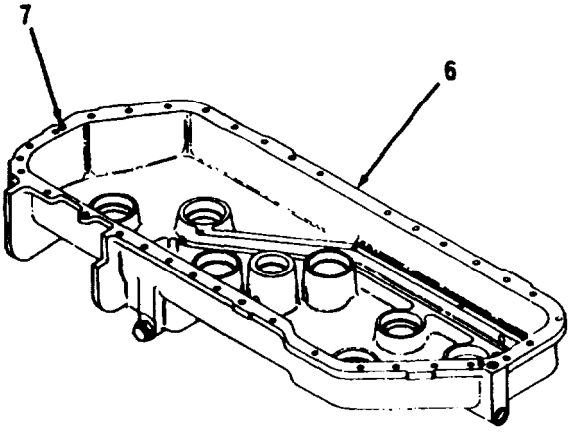
d. If any damage was found in steps a. through c., assemble accessory gearbox using original parts (page 7-74) and replace accessory gearbox (page 7-21).



2. INSPECT HOUSING (6).

a. Look at housing (6) for cracks, breaks, rust or corrosion, and damaged or loose dowel pins (7).

b. If damaged, assemble accessory gearbox using original parts (page 7-74) and replace accessory gearbox (page 7-21).



Go on to Sheet 12

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 12 of 40)

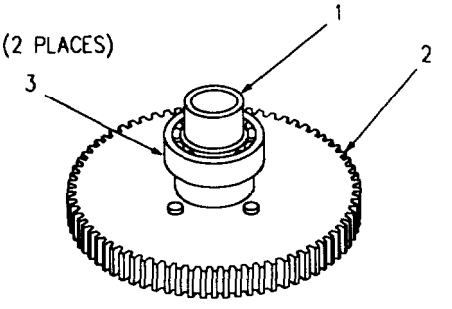
CAUTION

Gear assemblies are heavy and may be slippery. Use both hands when handling gear assemblies. Do not lift assemblies by bearings. Damage to assemblies may result.

3. INSPECT SPUR GEARSHAFT NO. 9 (1).

NOTE

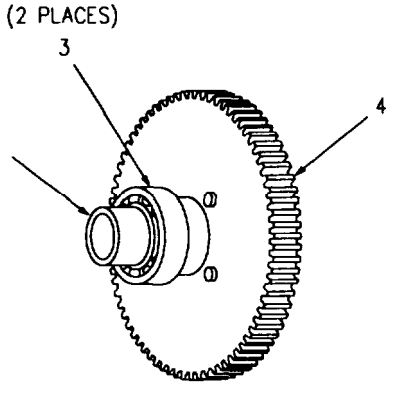
Damage found in steps a. through d. is not allowed. If any damage is found, replace AGB gears and bearings as required (page 7-60).



a. Look at spur gear (2) and two bearings (3) for cracks, chips or any red-purple, purple or blue discoloration.

b. Look at two bearings (3) for rust, broken parts, pitting, spalling or dirt.

c. Apply clean lubricating oil to bearings (3) and hold gearshaft (1) horizontal. Slowly rotate each bearing (3) by hand and feel for roughness.



d. Using four-power magnifying glass, check gear teeth (4) for wear and corrosion.

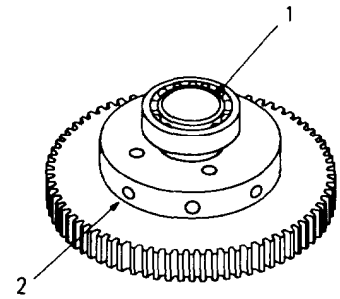
e. Clean minor corrosion on gear (2) by rubbing with scouring pad. If corrosion cannot be removed or if any other damage was found in steps a. through d., replace gear and bearings as required (page 7-60).

Go on to Sheet 13

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 13 of 40)

WARNING

f. Turn spur gearshaft No. 9 (1) over and look at air passages (2) for clogging. If clogged, clean air passages with cleaning solvent and shop air.



4. INSPECT ALL OTHER GEARSHAFTS.

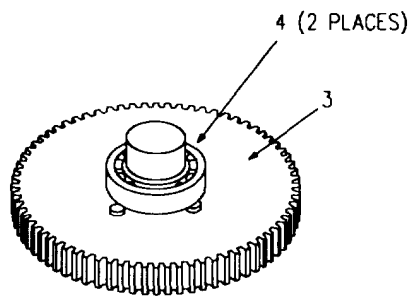
NOTE

Damage found in steps a. through e. is not allowed. If any damage is found, replace gears and bearings as required (page 7-60).

a. Look at gear (3) and two bearings (4) for cracks, chips or any red-purple, purple or blue discoloration.

b. Look at two bearings (4) for rust, broken parts, pitting, spalling or dirt.

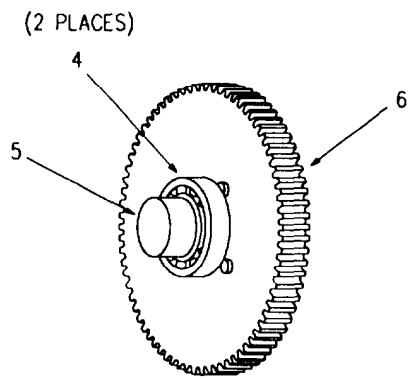
c. Apply clean lubricating oil to bearings (4) and hold gearshaft (5) horizontal. Slowly rotate each bearing (4) by hand and feel for roughness.



d. Using four-power magnifying glass, check gear teeth (6) for wear and corrosion.

e. Visually inspect for loose, damaged, or missing expansion plugs.

f. Clean minor corrosion on gears by rubbing with scouring pad. If corrosion cannot be removed, or if any other damage was found in steps a. through d., replace gears and bearings as required (page 7-60).



LE5544

Go on to Sheet 14

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 14 of 40)

5. INSPECT SPUR GEARSHAFT ASSEMBLY (1).

NOTE

Damage found in steps a. through d. is not allowed. Replace bearings and spur gear as required (Ref. pg 7-64).

a. Look at spur gear (2) and bearings (3) for cracks, chips or any red-purple, purple or blue discoloration.

b. Look at two bearings (3) for rust, broken parts, pitting, spalling or dirt.

c. Using four-power magnifying glass, check gear teeth (4) and accessory drive splines (5) for wear and corrosion.

d. Visually inspect spring pin inside spur gearshaft for cracks or deformation.

e. If any damage was found in steps a. through d., replace bearings spur gear and/or spring pin as required (Ref. pg 7-64).

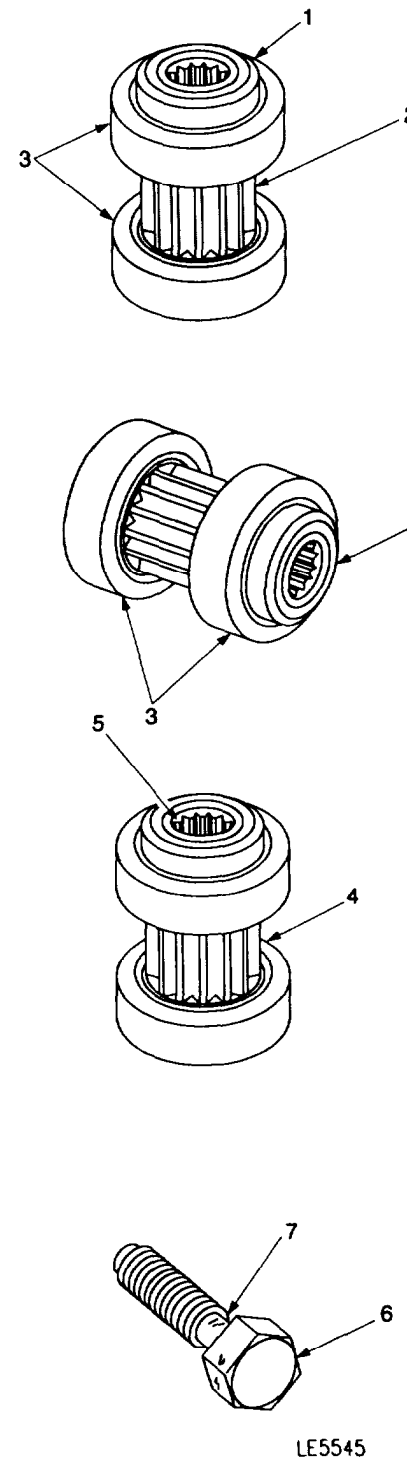
WARNING

6. INSPECT SCAVENGE PUMP NOZZLE (6).

a. Look at nozzle (6) for damaged threads and clogged oil jet hole (7).

b. Replace nozzle (6) if threads are damaged.

c. Clean out clogged hole (7) with twist drill and cleaning solvent.



Go on to Sheet 15

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 15 of 40)

AGB GEARS AND BEARINGS REPLACEMENT:

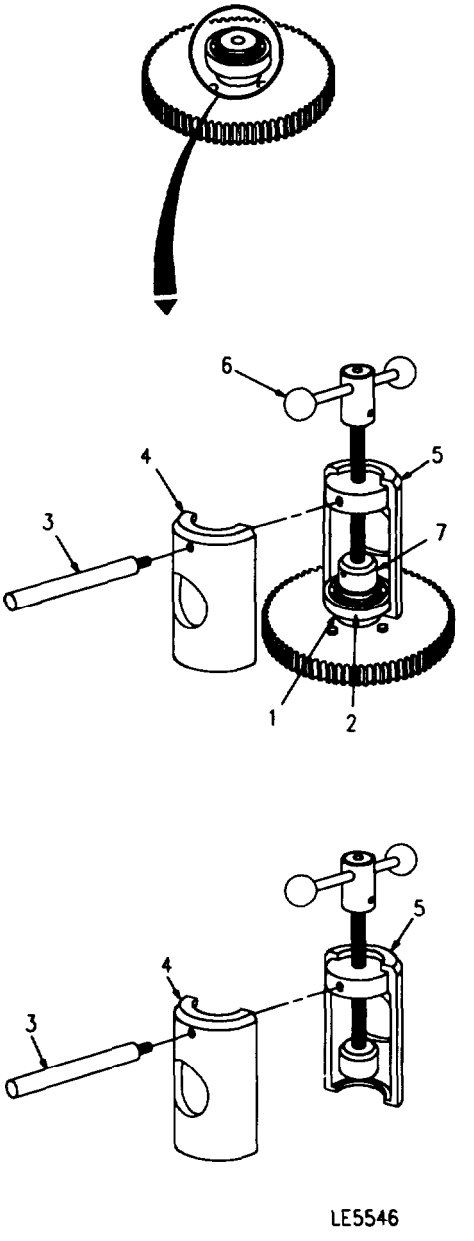
1. REMOVE BEARINGS (1) FROM ANY GEARSHAFT (2).

NOTE

The following steps apply to the removal of both bearings (1) from any gearshaft (2). No. 5 and 6 gearshaft (2) is shown.

a. Unscrew and take out handle (3) and body half (4) from puller (5).

b. Position puller (5) on bearing (1) and turn handle (6) clockwise until pusher (7) is snug against gearshaft (2). Put on body half (4) and screw in handle (3).



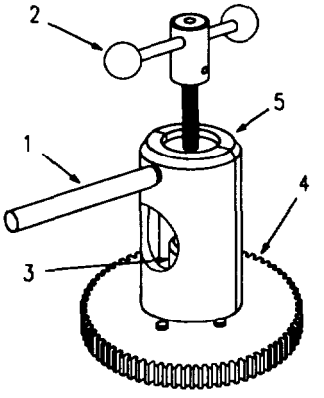
LE5546

Go on to Sheet 16

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 16 of 40)

c. Hold handle (1) and turn handle (2) clockwise until bearing (3) is pulled off gearshaft (4). Set puller (5) and bearing (3) onto clean work surface.

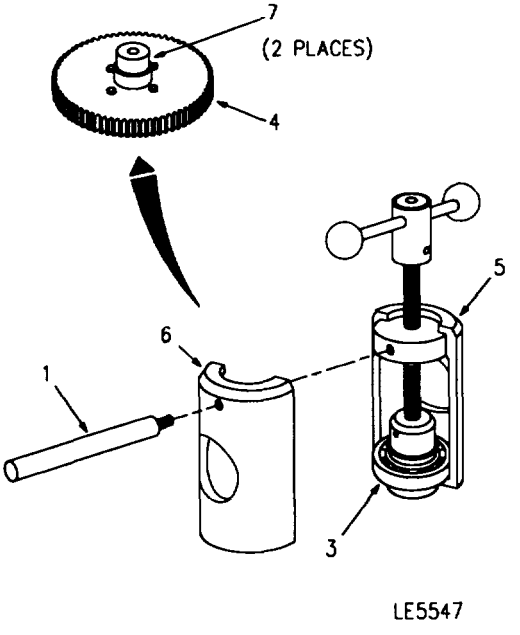
d. Unscrew and remove handle (1) and body half (6). Remove bearing (3) from puller (5). Put body half (6) on puller (5) and screw in handle (1). Stow assembled puller (5).



NOTE

If bearings were removed because gearshaft was bad, skip step e. and replace gearshaft.

e. Check for scoring at two bearing journals (7). Measure diameter of journals (7) with caliper. Check that diameters are 1.5747 to 1.5751 inch (39.997 to 40.007 mm). If bad, replace gearshaft. If good, set aside for later assembly.



Go on to Sheet 17

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 17 of 40)

2. INSTALL BEARINGS (1) ON ANY GEARSHAFT (2).

NOTE

The following steps apply to the installation of two bearings (1) on any gearshaft (2). No. 5 and 6 gearshaft (2) is shown.

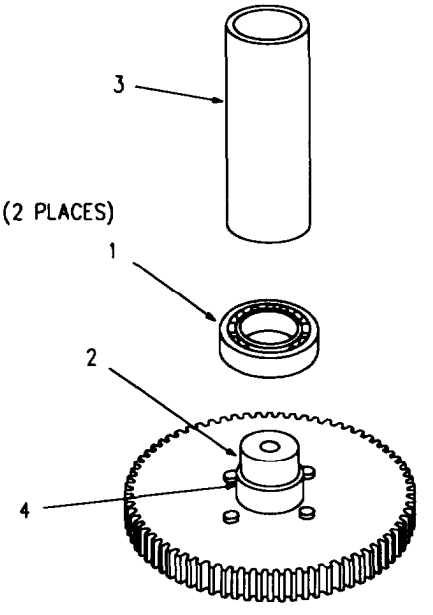
a. Position gear-shaft (2) on arbor press. Place bearing (1) on gearshaft (2).

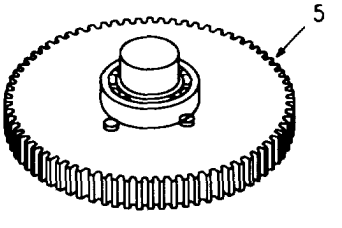
b. Place sleeve (3) on bearing (1). Press bearing (1) on gearshaft (2) until bearing (1) seats on gearshaft shoulder (4).

c. Remove and turn gearshaft (2) over on arbor press.

d. Repeat steps a. and b. to install other bearing (1).

e. Remove gearshaft assembly (5) from arbor press and set aside for later use.





LE5548

Go on to Sheet 18

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 18 of 40)

NO. 3 SPUR GEARSHAFT AND BEARINGS REPLACEMENT

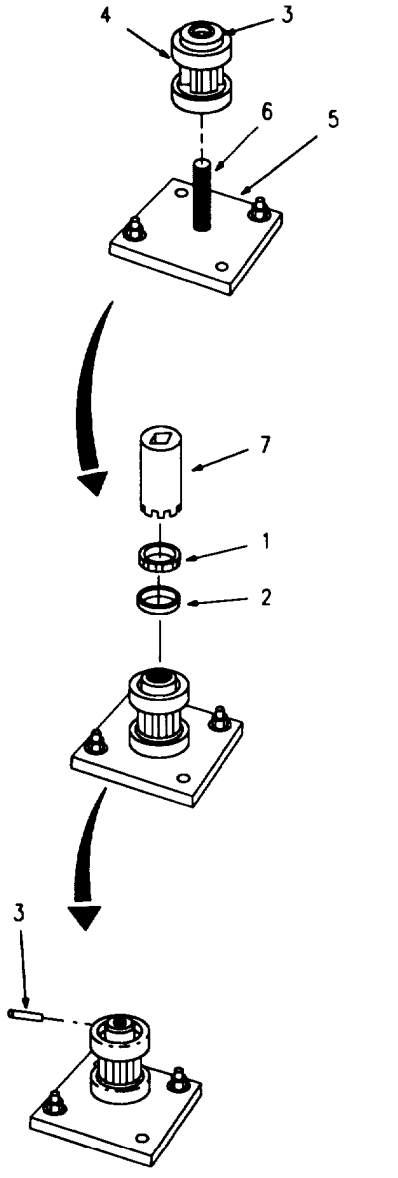
1. REMOVE PLAIN ROUND NUT (1), LOCKING CUP (2) AND STRAIGHT PIN (3) FROM SPUR GEARSHAFT ASSEMBLY (4).

a. Secure anti-torque plate (5) to clean work surface. Position spur gearshaft assembly (4) so that straight pin (3) is at top. Place spur gearshaft assembly (4) onto splined shaft (6) of anti-torque plate (5).

b. Using suitable tool, uncrimp locking cup (2).

c. Using spanner wrench (7) and bar, remove plain round nut (1). Inspect threads of plain round nut (1). If threads are stripped, replace plain round nut (1). Remove and discard locking cup (2).

d. Using punch and hammer, tap out straight pin (3). Discard straight pin (3).



LE5534

Go on to Sheet 19

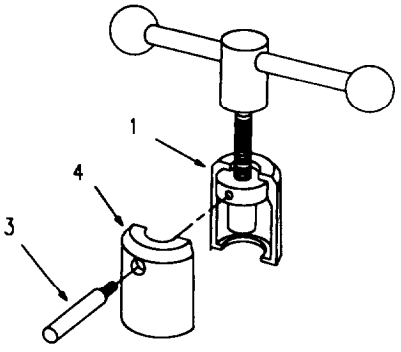
ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 19 of 40)

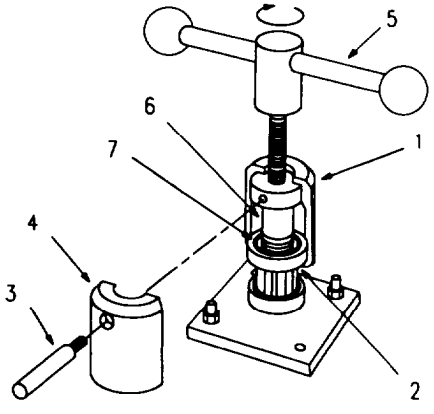
NO. 3 SPUR GEARSHAFT AND BEARINGS REPLACEMENT

2. INSTALL PULLER (1) ON BEARING (2).

   a. Unscrew handle (3) and remove body half (4) from puller (1).

   b. Position puller (1) on bearing (2) and turn handle (5) clockwise until pusher (6) is snug against end of gear (7). Put on body half (4) and screw in handle (3).





LE5535

Go on to Sheet 20

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 20 of 40)

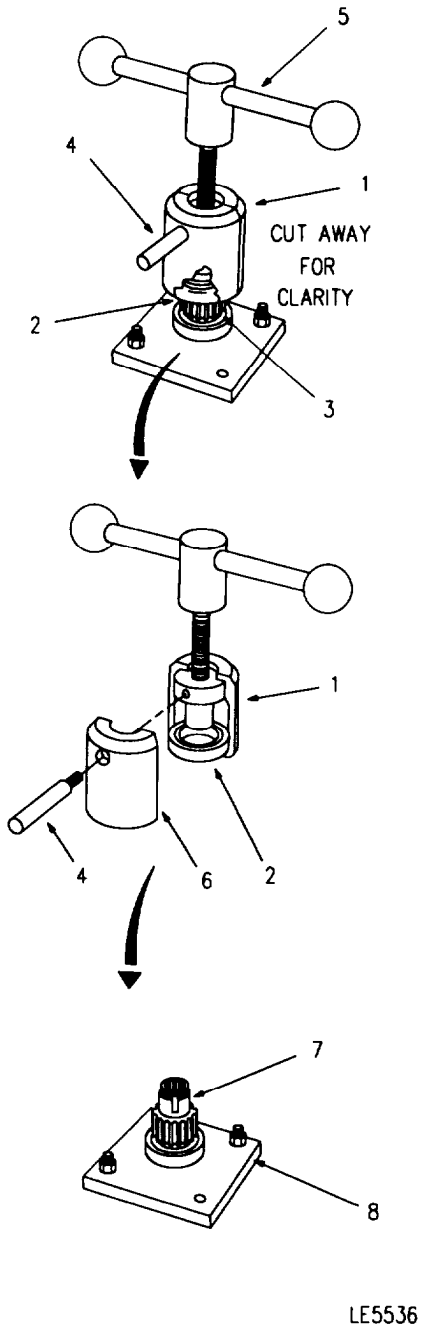
NO. 3 SPUR GEARSHAFT AND BEARINGS REPLACEMENT

3. USING PULLER (1), REMOVE BEARING (2) FROM SPUR GEARSHAFT ASSEMBLY (3).

a. Hold handle (4) and turn handle (5) of puller (1) clockwise until bearing (2) is pulled off spur gearshaft (3). Place puller (1) and bearing (2) onto clean work surface.

b. Unscrew handle (4) from puller (1) and remove body half (6). Remove bearing (2) from puller (1). Set aside puller (1), body half (6) and handle (4) for later use.

c. Remove bearing and spur gear (7) from anti-torque plate (8).



Go on to Sheet 21

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 21 of 40)

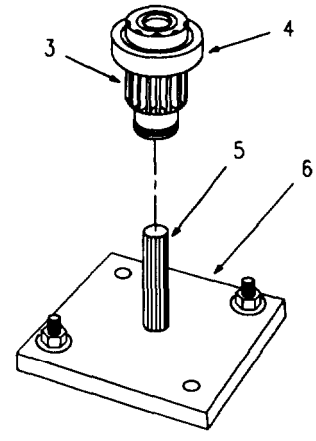
NO. 3 SPUR GEARSHAFT AND BEARINGS REPLACEMENT

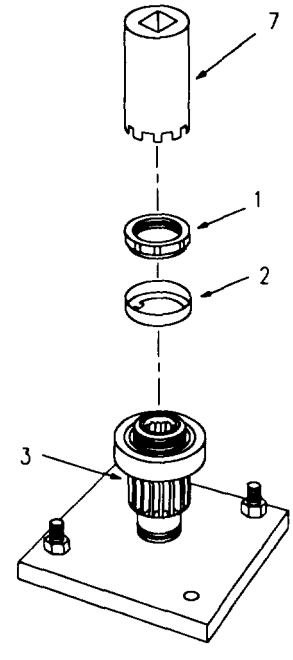
4. REMOVE PLAIN ROUND NUT (1) AND LOCKING CUP (2) FROM BEARING AND SPUR GEAR (3).

a. Position bearing and spur gear (3), with bearing (4) facing up, onto splined shaft (5) of anti-torque plate (6).

b. Using suitable tool, uncrimp locking cup (2).

c. Using spanner wrench (7) and bar, remove plain round nut (1). Inspect threads of plain round nut (1). If threads are stripped, replace plain round nut (1). Remove and discard locking cup (2).





LE5537

Go on to Sheet 22

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 22 of 40)

NO. 3 SPUR GEARSHAFT AND BEARINGS REPLACEMENT

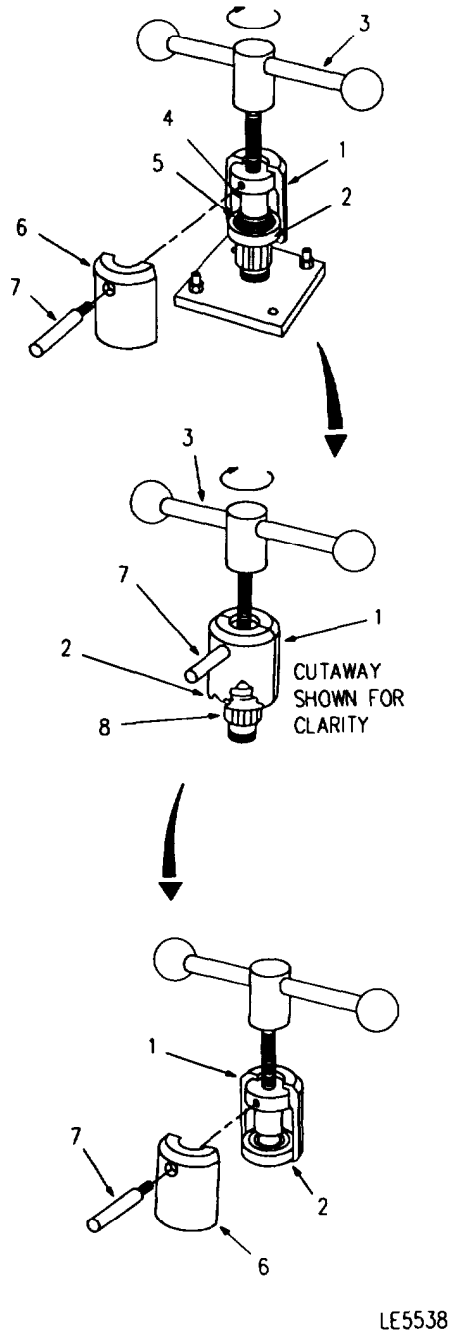
5. INSTALL PULLER (1) ON BEARING (2).

   a. Position puller (1) on bearing (2) and turn handle (3) clockwise until pusher (4) is snug against end of spur gear (5). Put on body half (6) and screw in handle (7).

6. USING PULLER (1) REMOVE BEARING (2) FROM SPUR GEAR (8).

   a. Hold handle (7) and turn handle (3) clockwise until bearing (2) is pulled off spur gear (8). Place puller (1) and bearing (2) onto clean work surface.

   b. Unscrew handle (7) and remove body half (6) from puller (1). Remove bearing (2) from puller (1). Put body half (6) on puller (1) and screw in handle (7). Stow puller (1).



Go on to Sheet 23

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 23 of 40)

NO. 3 SPUR GEARSHAFT AND BEARINGS REPLACEMENT

7. INSPECT SPUR GEAR (1).

a. Remove spur gear (1) from anti-torque plate (2).

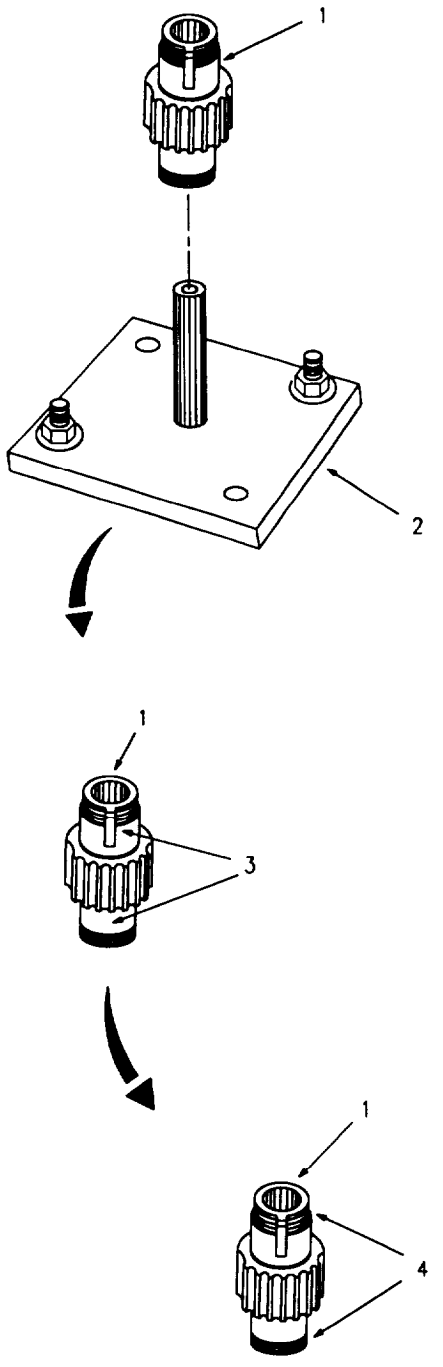
NOTE

If spur gear (1) was disassembled because of damage found while inspecting spur gearshaft assembly (page 7-59), skip steps b. and c. and replace spur gear (1).

b. Check two bearing journals (3) for scoring. Measure diameter of journals (3) with 0 to 2 inch (0 to 50.8 mm) outside micrometer caliper. Check that diameters are 0.9842 to 0.9844 inch (24.9987 to 25.0038 mm). If bearing journals are scored or out of tolerance, replace spur gear. If OK, go to step c.

c. Examine threads (4) of spur gear (1) for minor damage or stripped threads. Repair minor thread damage by blending with small sharpening stone. If threads are stripped, replace spur gear (1).

d. Visually inspect internal spur gearshaft splines for evidence of wear or damage. If wear or damage exists, replace spur gearshaft.



LE5539

Go on to Sheet 24

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 24 of 40)

NO. 3 SPUR GEARSHAFT AND BEARINGS REPLACEMENT

8. USING ARBOR PRESS AND INSTALLER SLEEVE (1), INSTALL BEARINGS (2, 3) ON SPUR GEAR (4).

WARNING

Use caution when using press. Improper tools or tools not properly aligned may cause injury to personnel or damage to parts or equipment.

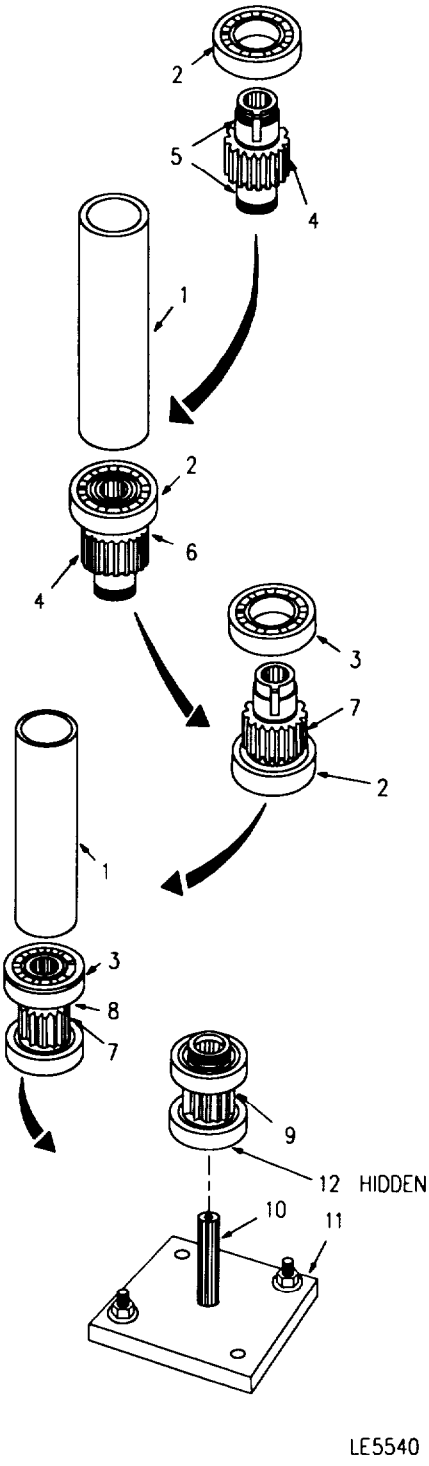
a. Coat two bearing journals (5) of spur gear (4) with lubricating oil. Position spur gear (4) on arbor press. Place bearing (2) on spur gear (4).

b. Place installer sleeve (1) on bearing (2). Press bearing (2) onto spur gear (4) until bearing (2) seats on gear shoulder (6). Remove installer sleeve (1).

c. Turn bearing and spur gear (7) over on arbor press. Place bearing (3) on bearing and spur gear (7).

d. Place installer sleeve (1) on bearing (3). Press bearing (3) onto bearing and spur gear (7) until bearing (3) seats on gear shoulder (8). Remove installer sleeve (1) and bearings and spur gear (9) from arbor press.

e. Position bearings and spur gear (9) onto splined shaft (10) of anti-torque plate (11) so that end with straight pin hole (12) is on bottom.



Go on to Sheet 25

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 25 of 40)

NO. 3 SPUR GEARSHAFT AND BEARINGS REPLACEMENT

9. INSTALL NEW LOCKING CUP (1) AND PLAIN ROUND NUT (2) ON BEARINGS AND SPUR GEAR (3). USING SPANNER WRENCH (4), TIGHTEN PLAIN ROUND NUT (2) BETWEEN 354-434 LB-IN (40-50 N•M) TORQUE.

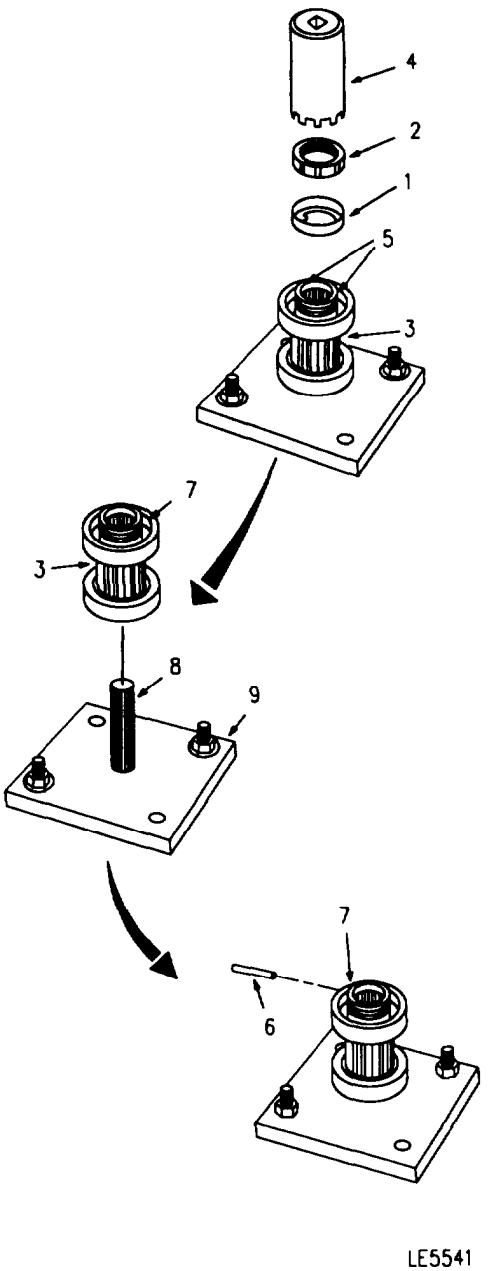
a. Lubricate threads with lubricating oil

b. Place new locking cup (1) on bearings and spur gear (3). Screw on and tighten plain round nut (2) using spanner wrench (4). Tighten plain round nut (2) between 354-434 lb-in (40-50 N•m) torque. Bend locking cup (1) into two slots (5) 180 degrees apart using brass drift and hammer. Do not shear locking cup (1). If sheared or cracked, replace locking cup (1).

10. INSTALL NEW STRAIGHT PIN (6) INTO SPUR GEAR HOLE (7) AND STAKE AT BOTH ENDS.

a. Turn bearings and spur gear (3) over on splined shaft (8) of anti-torque plate (9) so spur gear hole (7) is on top.

b. Insert new straight pin (8) into spur gear hole (7) and stake at both ends using punch and hammer.



LE5541

Go on to Sheet 26

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 26 of 40)

NO. 3 SPUR GEARSHAFT AND BEARINGS REPLACEMENT

11. INSTALL NEW LOCKING CUP (1) AND PLAIN ROUND NUT (2) ON BEARINGS AND SPUR GEAR (3). USING SPANNER WRENCH (4), TIGHTEN PLAIN ROUND NUT (2) BETWEEN 354-434 LB-IN (40-50 N•M) TORQUE.

a. Lubricate threads with lubricating oil.

b. Place new locking cup (1) on bearings and spur gear (3). Screw on and tighten plain round nut (2) using spanner wrench (4). Tighten plain round nut (2) between 354-434 lb-in (40-50 N•m) torque. Bend locking cup (1) into two slots (5) 180 degrees apart using brass drift and hammer. Do not shear locking cup (1). If sheared or cracked, replace locking cup (1).

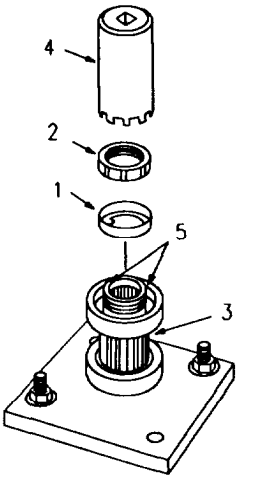
c. Remove spur gearshaft assembly (6) from anti-torque plate (7). Lubricate spur gearshaft assembly (6) with lubricating oil and place in clean plastic bag. Set aside for later use.

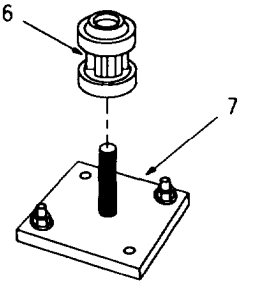
d. Remove anti-torque plate (7) from work surface and stow.

12. INSTALL SPUR GEARSHAFT ASSEMBLY (PAGE 7-76).

13. INSTALL AGB MECHANICAL COVER AND RELATED PARTS (PAGE 7-80).

14. INSTALL AGB ON ENGINE (PAGE 7-22).





LE5542

Go on to Sheet 27

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 27 of 40)

ACCESSORY GEARBOX COVER PLUG REPAIR

REMOVAL:

1. REMOVE AGB (ACCESSORY GEARBOX) COVER ASSEMBLY (1) (PAGE 7-49).

2. REMOVE RETAINING RING (2).

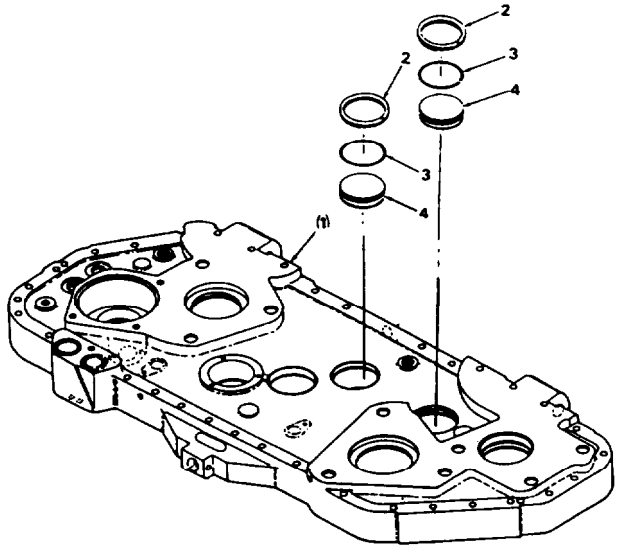
CAUTION

Cover (1) is heavy. Use caution when turning cover to prevent injury to fingers.

3. TURN COVER ASSEMBLY (1) UPSIDE DOWN ONTO TWO BLOCKS OF WOOD.

   a. Position blocks of wood between the work surface and the cover assembly (1) to prevent damage of hardware protruding from the cover assembly.

4. USING SLEEVE AND SOFT MALLET, PUSH METAL RING (4) FROM THE AGB COVER ASSEMBLY (1). DISCARD PACKING (3).



INSPECTION:

1. INSPECT METAL SEAL RING BORE AND RETAINING RING GROVE FOR EVIDENCE OF DAMAGE. IF DAMAGED, REASSEMBLE THE AGB USING ORIGINAL HARDWARE AND REPLACE AGB

2. INSPECT THE METAL SEAL RING (4) FOR SCORING, CRACKS OR DENTS. IF DAMAGED, REPLACE METAL SEAL RING (4).

Go on to Sheet 28

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 28 of 40)

ACCESSORY GEARBOX COVER PLUG REPAIR

INSTALLATION:

1. INSTALL RETAINING RING (2) INTO METAL SEAL RING BORE GROOVE IN THE AGB COVER ASSEMBLY (1). ENSURE THE RETAINING RING IS SEATED IN THE GROOVE.

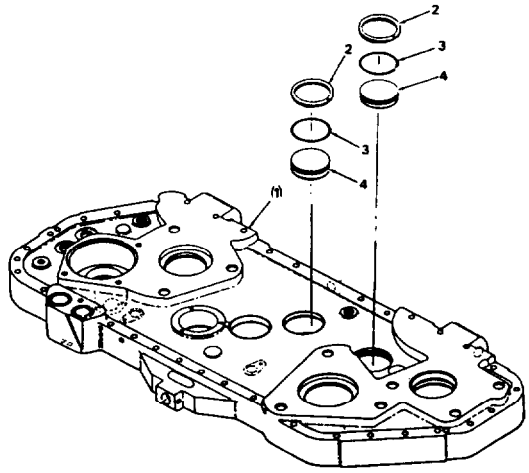
2. INSTALL NEW PACKING ONTO THE METAL SEAL RING (4).

3. LUBRICATE THE PACKING AND THE INSIDE DIAMETER OF THE METAL SEAL RING BORE IN THE AGB COVER ASSEMBLY (1) WITH SHORTENING COMPOUND.

4. USING SLEEVE AND SOFT MALLET, PRESS METAL SEAL RING (4) INTO COVER UNTIL SEATED AGAINSTTHE RETAINING RING (2).

5. REASSEMBLE THE AGB (PAGE 7-74).

6. APPLY SEALANT TO THE METAL SEAL RING CAVITY (PAGE 7-85).



Go on to Sheet 29

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 29 of 40)

ASSEMBLY:

1. INSTALL SUMP COVER (1) IN HOUSING (2).

   a. Place sump cover (1) in housing (2).

   b. Install seven screws (3).

2. INSTALL TUBE ASSEMBLY (4) AND NOZZLE (5). TORQUE NOZZLE (5) BETWEEN 145-160 LB-IN (16-18 N•m).

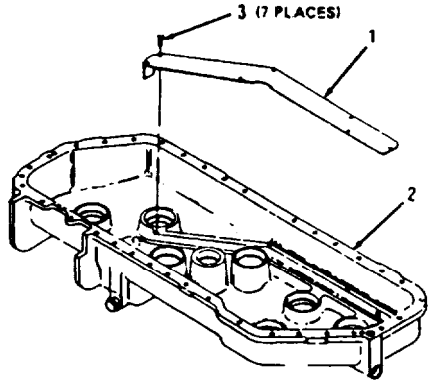
   a. Install clamp (6) on tube assembly (4) and place tube assembly (4) and washer (7) in housing (2).

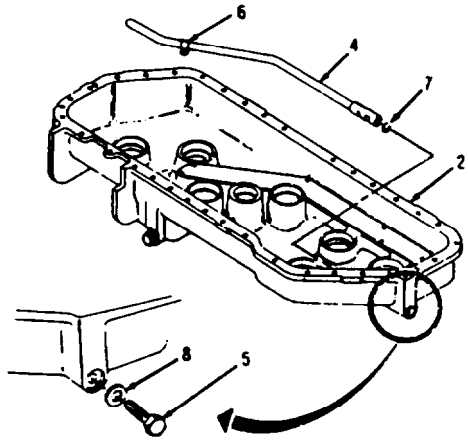
   b. Install nozzle (5) and new seal washer (8) into tube assembly (4). Torque nozzle (5) between 145-160 lb-in (16-18 N•m).

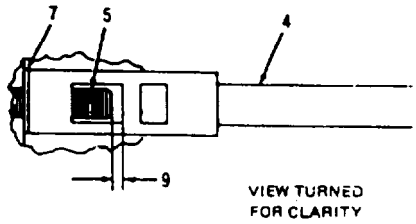
3. CHECK THAT GAP (9) BETWEEN NOZZLE (5) AND TUBE ASSEMBLY (4) IS BETWEEN 0.130-0.150 INCH (3.30-3.81 MM).

   a. Measure gap (9) between nozzle (5) and tube assembly (4) using thickness gage.

   b. If gap (9) is within 0.130-0.150 inch (3.30-3.81 mm), lockwire nozzle (5) and skip steps 4 and 5.





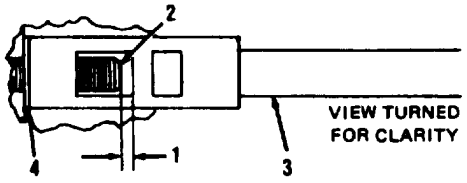


Go on to Sheet 30

4. IF GAP (1) IS NOT WITHIN 0.1 30-0.150 INCH (3.30-3.81 MM), REMOVE NOZZLE (2) AND TUBE ASSEMBLY (3) AND ADJUST (REPLACE) WASHER (4) TO CORRECT GAP (1).

   a. Remove nozzle (2) and seal washer (5).

   b. Remove tube assembly (3) and washer (4). Replace or add washer (4) as needed to correct gap (1).

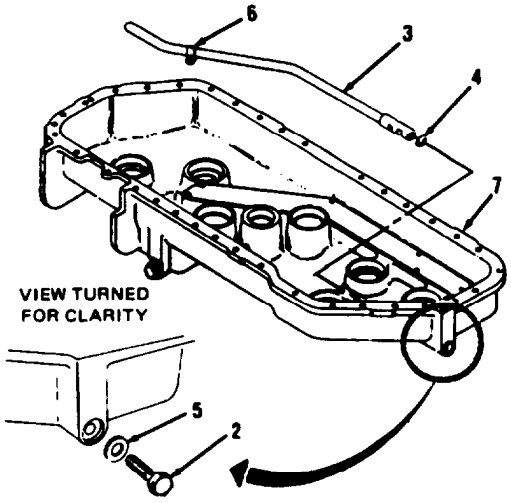


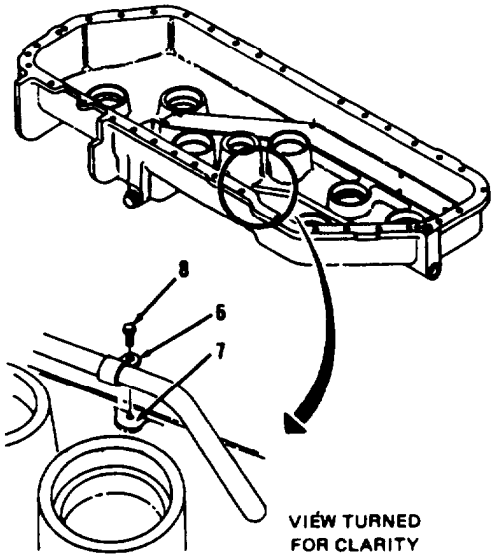
5. IF REMOVED, INSTALL TUBE ASSEMBLY (3) AND NOZZLE (2). TORQUE NOZZLE (2) BETWEEN 145-160 LB-IN (16-18 N•m).

   a. Place tube assembly (3) with clamp (6) installed and washer (4) in housing (7).

   b. Install nozzle (2) and new seal washer (5) into tube assembly (3). Torque nozzle (2) between 145-160 lb-in (16-18 N•m). Lockwire nozzle (2).

6. SECURE CLAMP (6) TO HOUSING (7) WITH SCREW (8).





Go on to Sheet 31

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 31 of 40)

NOTE

If gasket (1) or spacer (2) being installed are not the same that were removed, do steps 7 through 10. If the same gasket and spacer are being installed, skip steps 7 through 10 and go to step 11 (page 7-78).

7. MEASURE THICKNESS OF COVER (3) AT OIL PUMP PAD (4) AND RECORD AS DIMENSION A.

a. Turn cover (3) over on work surface (5) using care not to rest cover on oil scavenge tube (6).

b. Hold measuring bar (7) firmly against cover mating surface (8) under oil pump pad (4).

c. Measure from oil pump pad (4) to measuring bar (7) with depth gage. Record as dimension A.

d. Turn cover (3) over on work surface (5).

NOTE

Make sure spur gearshaft assembly is seated all the way in housing.

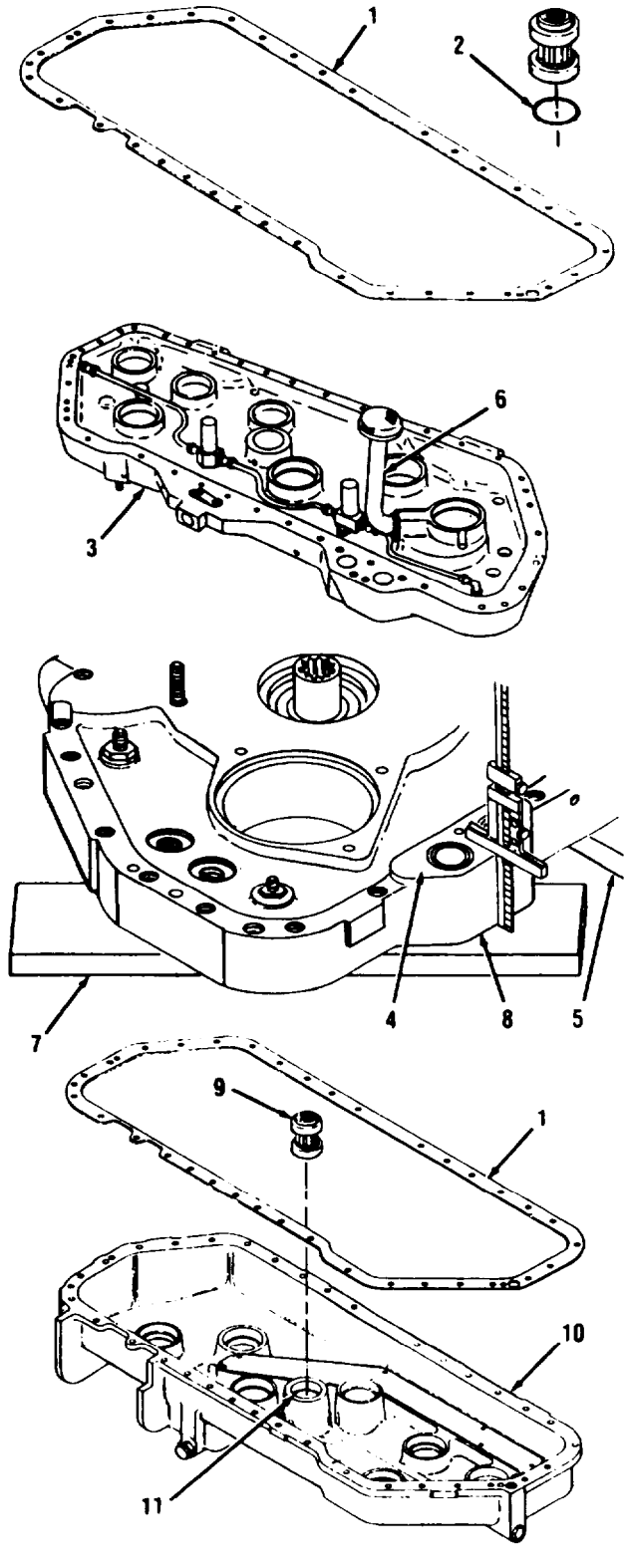
8. PLACE SPUR GEARSHAFT ASSEMBLY (9) IN HOUSING (10), MEASURE AND RECORD THICKNESS OF NEW GASKET (1), AND TAPE NEW GASKET (1) IN PLACE ON HOUSING (10).

a. Place spur gearshaft assembly (9). Pin end down, in bore (11) of housing (10).

NOTE

If gasket (1) should get damaged during assembly, use new gasket and go back to step 7.

b. Place gasket (1) on housing (10) and hold in place using tape.



Go on to Sheet 32

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 32 of 40)

9. CHECK TO SEE IF BEARING OUTER RACE (1) IS HIGHER OR LOWER THAN GASKET (2) AND MEASURE DISTANCE BETWEEN BEARING OUTER RACE (1) AND GASKET (2). RECORD DIFFERENCE AS DIMENSION B.

a. Place measuring bar (3) across housing (4), on gasket (2) and over spur gear (5).

b. Using depth gage, measure from top of bar (3) to outer race (1) and from top of bar (3) to gasket (2). Subtract the smaller from the larger. Record as dimension B.

c. Check and make note that outer race (1) is above or below gasket (2).

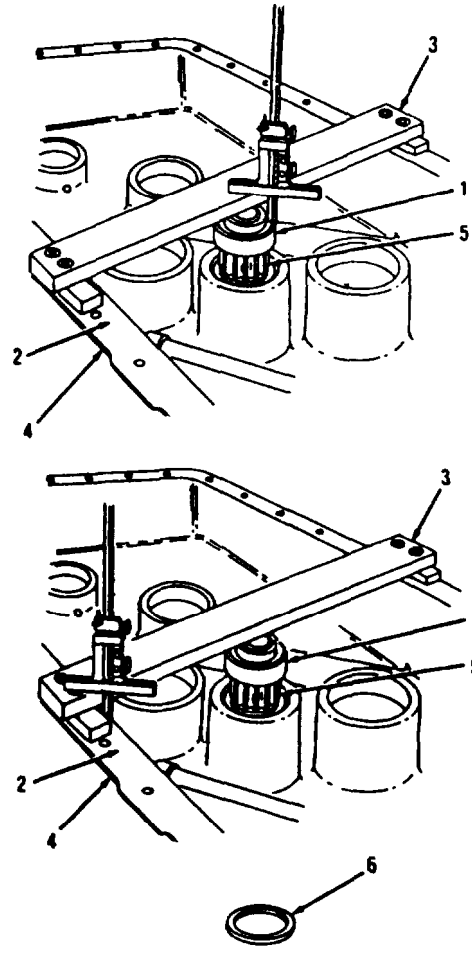
d. Remove measuring bar (3), spur gearshaft assembly (5) and gasket (2).

10. DETERMINE REQUIRED THICKNESS OF SPUR GEAR SPACER (6).

a. If bearing outer race (I) was below gasket (2). add dimensions A and B and record as dimension C.

b. If bearing outer race (1) was above gasket (2), subtract dimension B from dimension A and record as dimension C.

c. Subtract 2.425 from dimension C. Result is thickness of spacer (6) required. If original spacer (6) is not proper thickness, replace.



dimension A
+ dimension B
dimension C

dimension A
- dimension B
dimension C

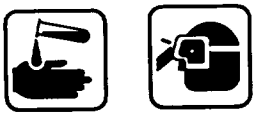
dimension C
-2.425
Spacer Thickness

Go on to Sheet 33

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 33 of 40)

11. INSTALL SPACER (1), WITH SMALLER DIAMETER DOWN, IN BORE (2) OF HOUSING (3).

WARNING



12. LUBRICATE ALL BEARING BORES (4) IN HOUSING (3) WITH CLEAN LUBRICATING OIL.

CAUTION

Gear assemblies may be slippery and are heavy. Use both hands when handling gear assemblies. Do not lift assemblies by bearings. Damage to assemblies may result.

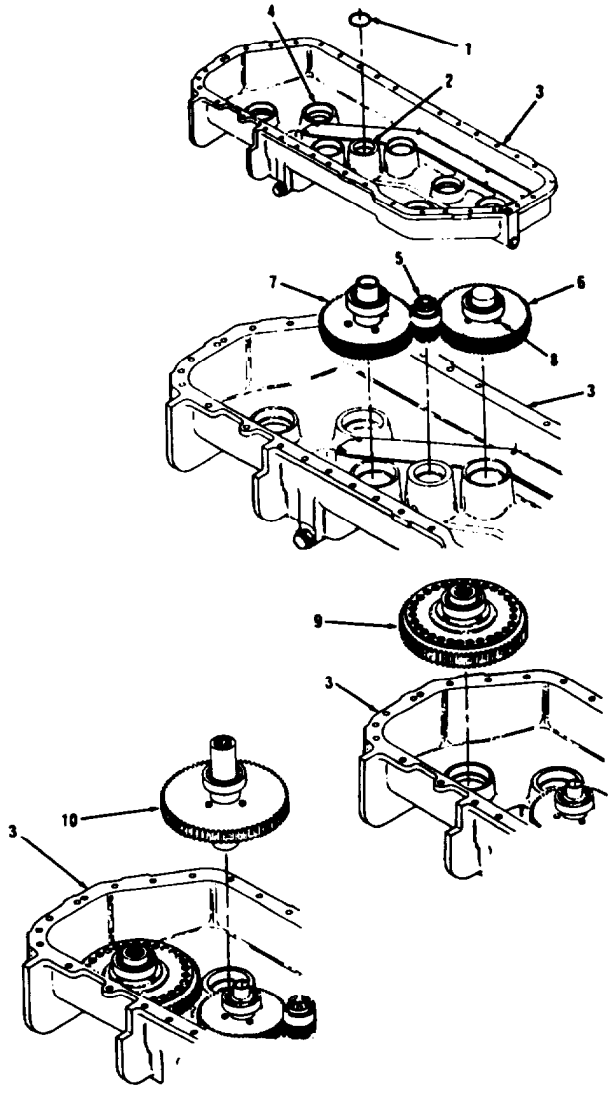
13. COAT SPUR GEARSHAFT ASSEMBLY (5). SPUR GEARSHAFT NO. 4 (6) AND SPUR GEARSHAFT NO. 9 (7) WITH CLEAN LUBRICATING OIL AND INSTALL IN HOUSING (3).

a. Coat spur gearshaft assembly (5), spur gearshaft No. 4 (6) and spur gearshaft No. 9 (7) with clean lubricating oil.

b. Install spur gearshaft assembly (5), pin end down, and gearshafts (6 and 7) with heads of rivets (8) down, into housing (3) as a unit (at the same time).

14. COAT GEARCLUSTER (9) WITH CLEAN LUBRICATING OIL AND INSTALL, WITH RIVET HEADS DOWN, INTO HOUSING (3).

15. COAT SPUR GEARSHAFT NO. 10 AND 11 (10) WITH CLEAN LUBRICATING OIL AND INSTALL, WITH RIVET HEADS DOWN, INTO HOUSING (3).

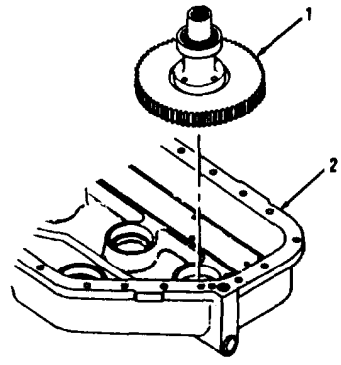


Go on to Sheet 34

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 34 of 40)

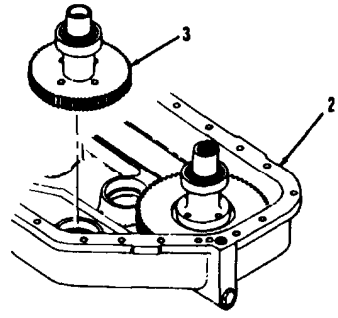
WARNING

16. COAT SPUR GEARSHAFT NO. 8 (1) WITH CLEAN LUBRICATING OIL AND INSTALL, WITH RIVET HEADS UP INTO HOUSING (2).



17. COAT SPUR GEARSHAFT NO. 7 (3) WITH CLEAN LUBRICATING OIL AND INSTALL, WITH RIVET HEADS UP INTO HOUSING (2).

18. COAT SPUR GEARSHAFT NO. 5 AND 6 (4) WITH CLEAN LUBRICATING OIL AND INSTALL, WITH RIVET HEADS DOWN, INTO HOUSING (2).

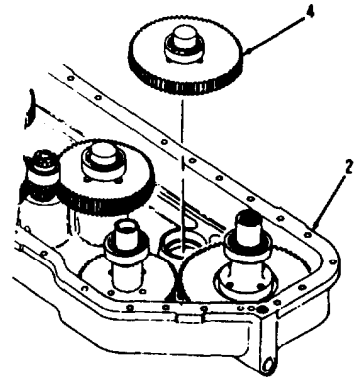


WARNING

Gears are sharp and fingers can get wedged between them. Use gear train handle to rotate gears.

19. ROTATE GEARS TO CHECK THAT THERE IS NO BINDING AND TO MAKE SURE GEARS ARE MESHING PROPERLY IF NOT, DISASSEMBLE AND CHECK PARTS.

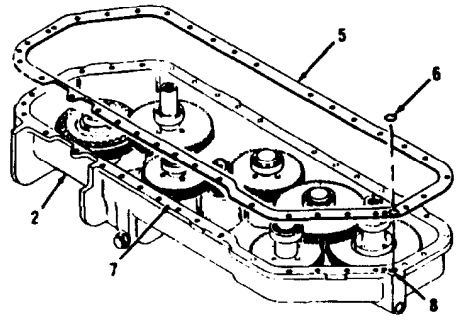
20. SLOWLY POUR ONE QUART OF CLEAN LUBRICATING OIL OVER ALL INSTALLED BEARINGS AND GEARS.



21. INSTALL GASKET (5) AND NEW PACKING, (6) ON HOUSING (2).

a. Coat both sides of gasket (5) with shortening compound. Install gasket (5) on mating surface (7) of housing (2).

b. Coat new packing (6) with shortening compound. Install new packing (6) in groove (8) of housing (2).



Go on to Sheet 35

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 35 of 40)

22. ATTACH SLING (1) TO COVER (2).

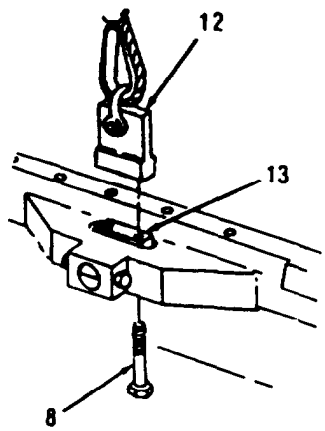
a. Turn cover (2) over on work surface (3) so it does not rest on oil scavenge tube (4)

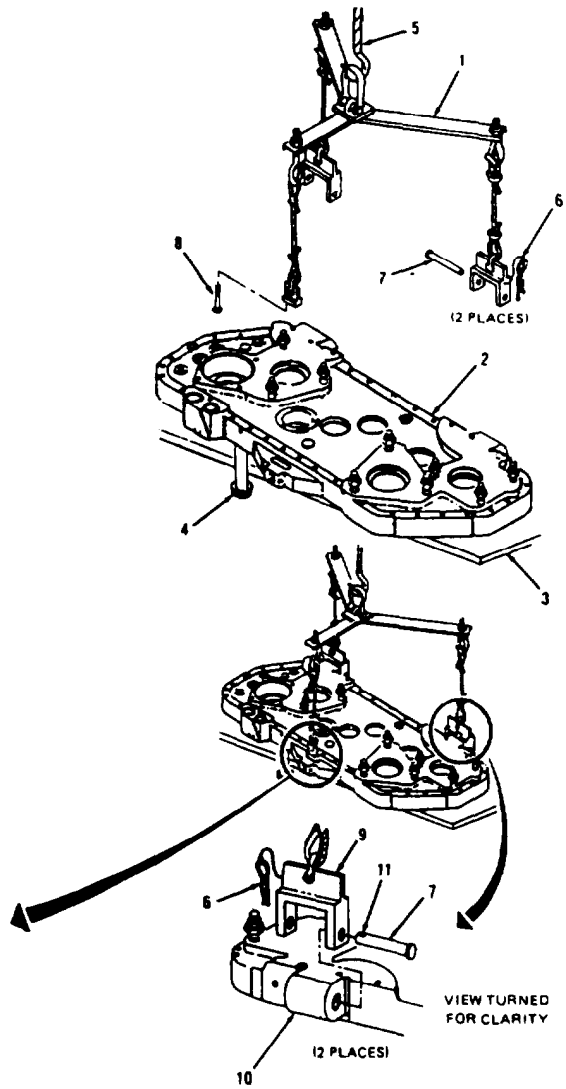
b. Hook sling (1) on hoist hook (5) and move sling (1) over cover (2).

c. Remove two lockpins (6) from two pins (7) and remove two pins (7). Remove two bolts (8).

d. Place two lifter blocks (9) over two lift mounts (10). mid install two pins (7). Install two lock-pins (6) in holes (11) of two pins (7).

e. Place lifter block (12) on mounting block (13) and install two bolts (8).





Go on to Sheet 36

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 36 of 40)

23. INSTALL COVER (1) ON HOUSING (2).

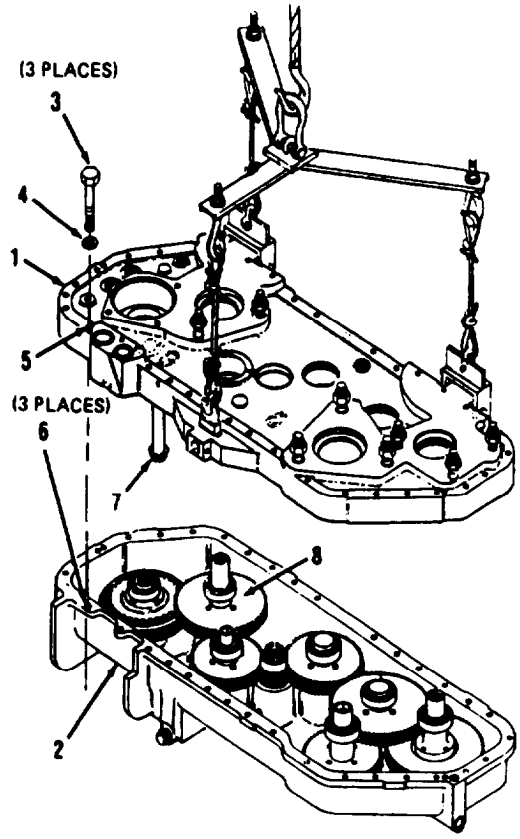
a. Lift and position cover (1) over housing (2).

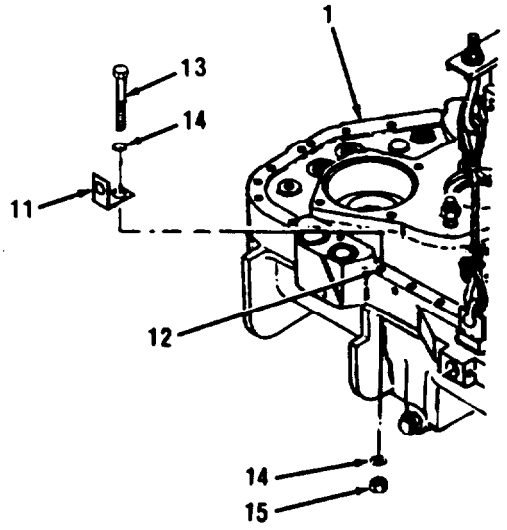
b. Insert three screws (3) and washers (4) in three holes (5). Use screws (3) to align related holes (6) in housing (2) when lowering cover (1).

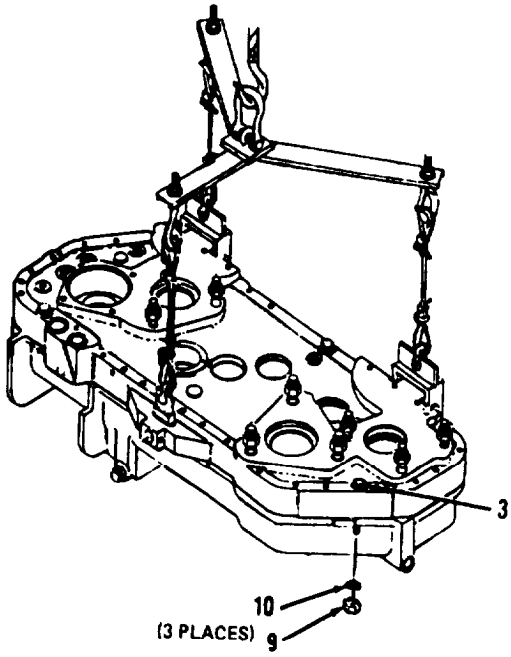
c. Guide cover (1) so oil scavenge tube (7) clears housing (2) and gears (8), and lower cover (1) onto housing (2).

d. Install three new self-locking nuts (9) and washers (10) on three screws (3).

e. Position bracket (11) at hole (12) in cover (1) and install screw (13). Two washers (14) and new self-locking nut (15).







Go on to Sheet 37

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 37 of 40)

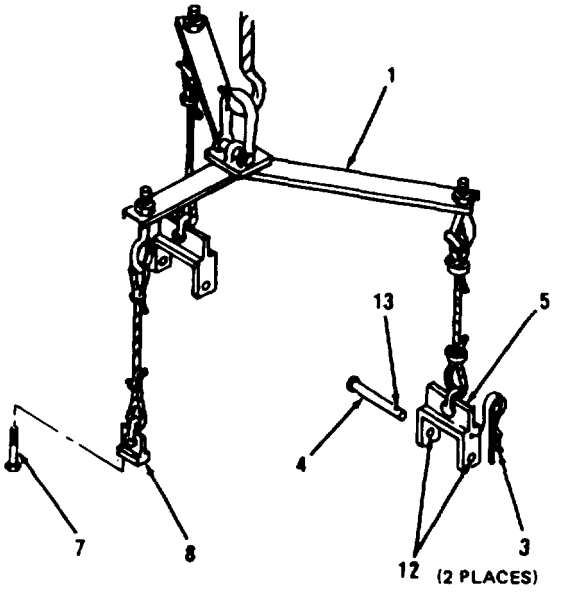
24. REMOVE SLING (1) FROM ACCESSORY GEARBOX (2).

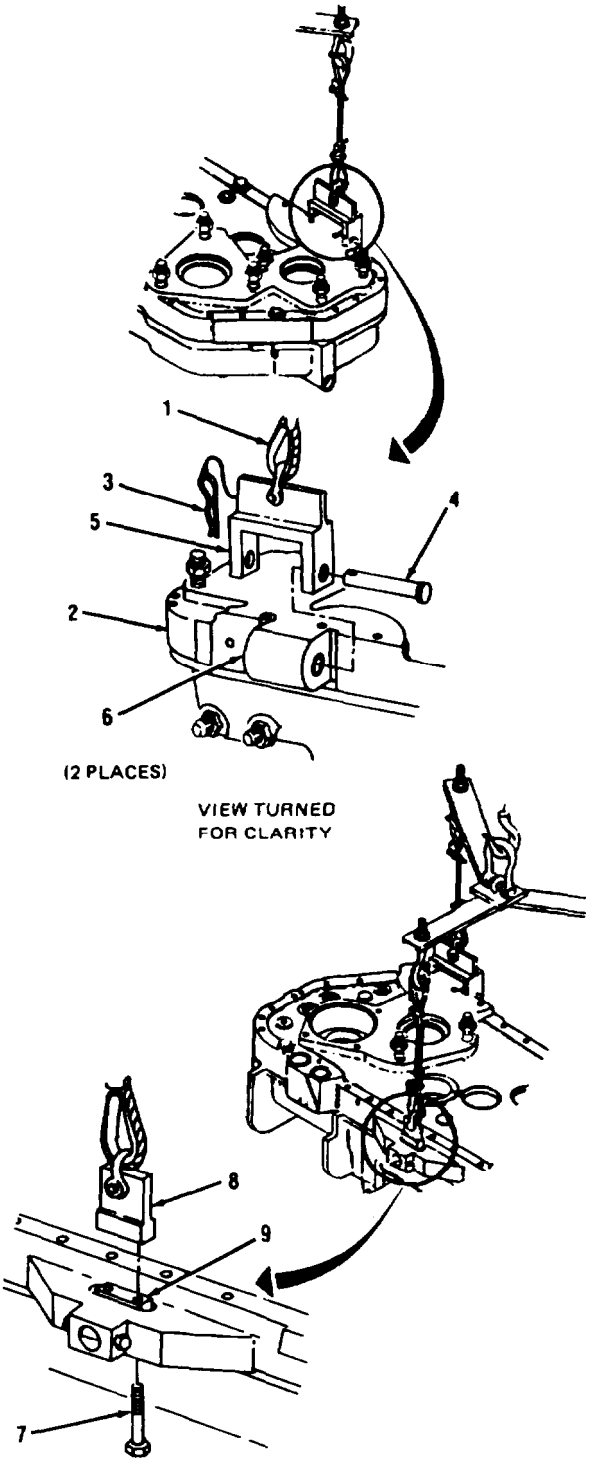
a. Remove two lockpins (3) from two pins (4) and remove pins (4). Remove two lifter blocks (5) from two mounting blocks (6).

b. Remove two bolts (7) and remove lifter block (8) from mounting block (9).

c. Install two bolts (7) in lifter block (8). Install two pins (4) in holes (12) of two lifter blocks (5). Install two lockpins (3) in hole (13) of two pins (4).

d. Remove and stow sling (1).





Go on to Sheet 38

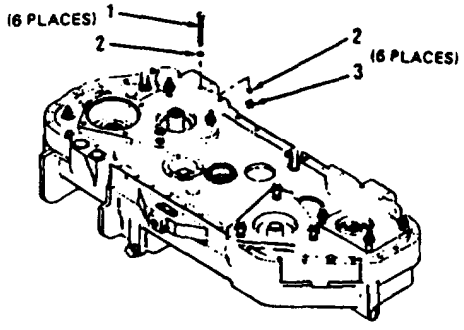
ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 38 of 40)

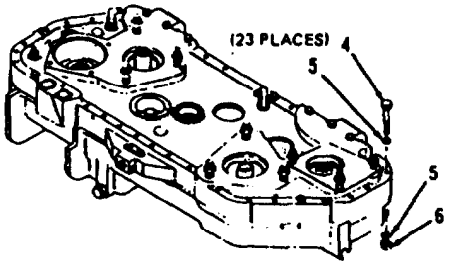
25. INSTALL REMAINING SCREWS, WASHERS AND NUTS. TORQUE ALL SCREWS BETWEEN 70-95 LB-IN (8-11 N•M).

a. Install six longer screws (1), 12 washers (2) and six new self-locking nuts(3).

b. Install 23 screws (4), 46 washers (5) and 23 new self-locking nuts (6).

c. Torque all screws between 70-95 lb-in (8 to 11 N•m) in sequence shown.



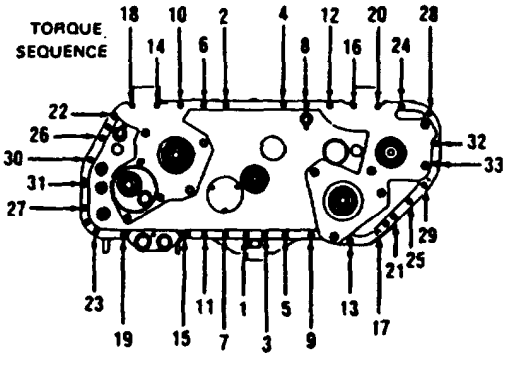


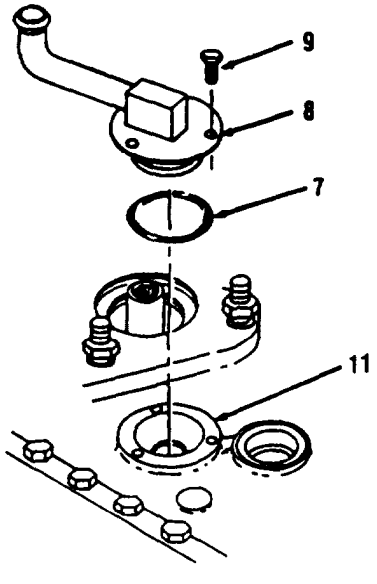
26. INSTALL PREFORMED PACKING (7), GEAR ACCESS COVER ASSEMBLY (8) AND THREE SCREWS (9). TORQUE SCREWS (9) BETWEEN 70-95 LB-IN (8-11 N•m).

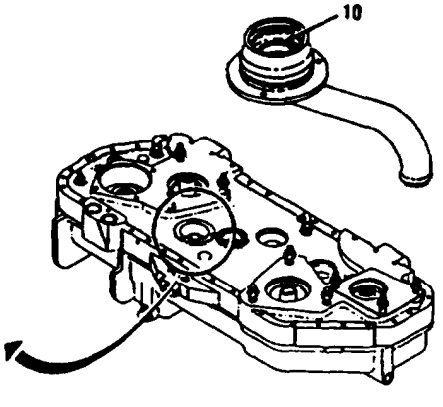
a. Apply oil to inside diameter of seal (10).

b. Apply shortening compound to new packing (7) and install on cover (8).

c. Install cover (8) on flange (11). Install three screws (9) and torque between 70-95 lb-in (8-11 N•m)







Go on to Sheet 39

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 39 of 40)

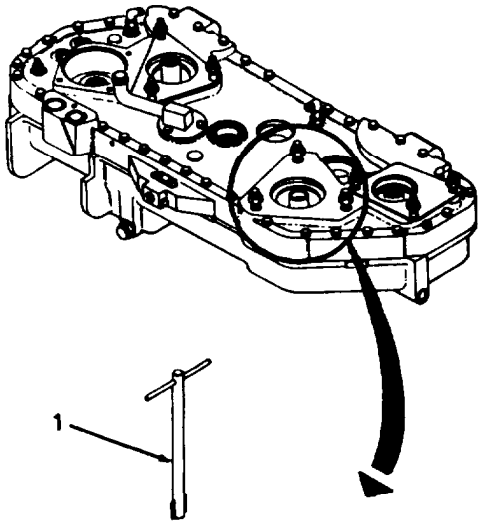
27. CHECK ROTATION OF GEARS FOR BINDING.

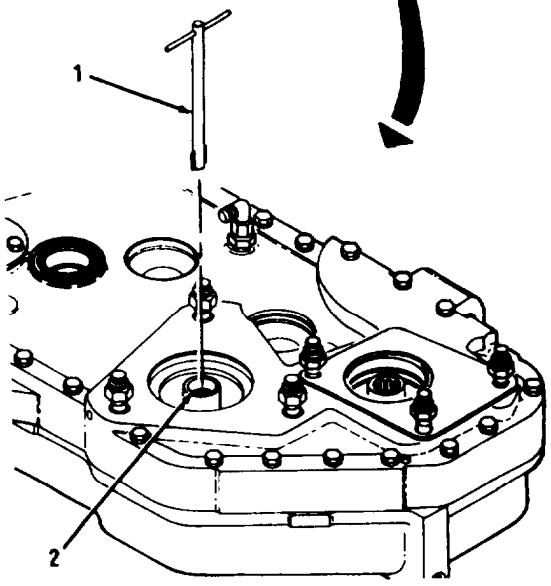
a. Insert handle (1) in No. 7 gearshaft (2).

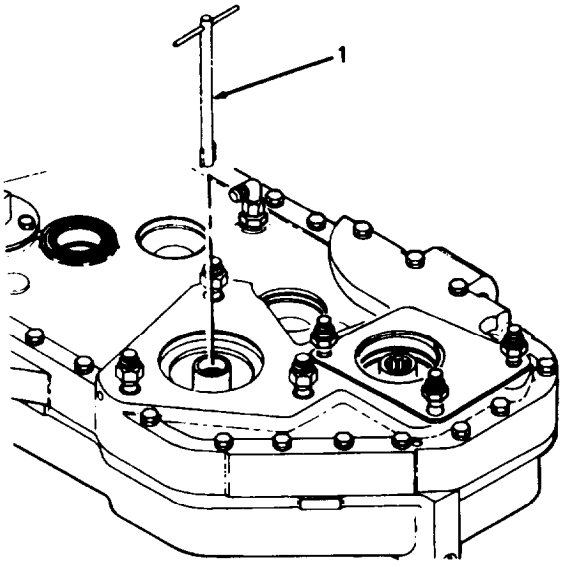
b. Turn handle (1) clockwise. Check for binding and listen for unusual noises.

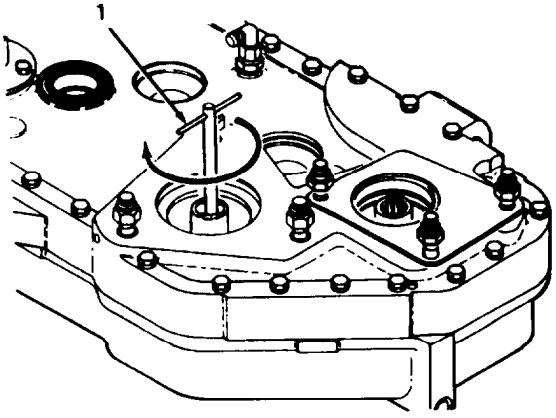
c. If binding occurs, or if unusual noises are heard, disassemble and reinspect accessory gearbox.

d. Remove handle (1).









Go on to Sheet 40

ACCESSORY GEARBOX CLEANING AND REPAIR (Sheet 40 of 40)

28. APPLY SEALANT TO METAL SEAL RING CAVITY

a. Inspect metal seal ring and retaining ring for proper installation (page 7-73).

b. If not properly installed, perform procedures beginning on (page 7-72).

c. If properly installed.

WARNING

(1) Seal metal seal ring cavity.

(a) Using solvent, thoroughly clean plug cavity. Allow to air dry

(b) Brush cavity with a thin uniform coating of primer. Allow to dry 1-3 hours.

(c) Fill cavity with RTV silicone rubber and allow to cure for 2-4 hours.

29. INSTALL ACCESSORY GEARBOX ON ENGINE (PAGE 7-22).

End of Task

CHAPTER 8

ENGINE LUBRICATION SYSTEM

CHAPTER INDEX

REDUCTION GEARBOX LUBRICATION SYSTEM CLEANING (Sheet I of 3)

TOOLS:

General mechanic's tool kit- automotive (SC5180-90-N26)
Industrial goggles (Item 58, Appendix D)
Metal pail (Item 96, Appendix D)
Gloves (Item 87, Appendix D)

PERSONNEL: Two

SUPPLIES:

Dry cleaning solvent (Item 7, Appendix B)
Lockwasher (Item 70, Appendix E) (4 required)
Preformed packing (Item 69, Appendix E)
Wiping rag (Item 14, Appendix B)

EQUIPMENT CONDITION:

Oil tank drained (LO -12)
Cooler inlet or outlet tube assembly (left side) removed (TM 20-1)
Cooler inlet or outlet tube assembly (crossover) removed (TM 20-1)
Cooler inlet and outlet tube assembly (right side) removed (TM 20-1)
Generator oil inlet how removed (TM 20-1)
Generator oil outlet home removed (TM 20-1)
Tube assemblies (oil tank to engine oil pump) removed (TM 20-1)
Tube assembly (oil pump return to cooler - forward) removed (TM 20-1)
Tube assemblies (forward reduction gearbox scavenge) removed (TM 20-1)
Tube assembly (reduction gearbox scavenge - rear) removed (page 6-8)
Tube assembly (reduction gearbox oil feed) removed (TM 20-1)
Tube assembly (reduction gearbox oil feed - forward) removed (TM 20-1)
Tube assembly (reduction gearbox feed) removed (page 6-7)
Oil tank filter assembly removed (TM 20-1)
Fluid filter element (engine oil pump to oil cooler) removed (TM 20-1)

Go on to Sheet 2

REDUCTION GEARBOX LUBRICATION SYSTEM CLEANING (Sheet 2 of 3)

CLEANING:

WARNING

NOTE

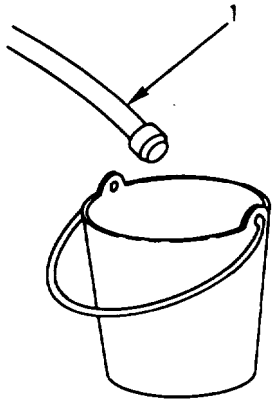
Do step 1 to clean all tubes or hoses. One hose (1) is shown.

1. CLEAN HOSE (1).

   a. Hold one end of hose (1) over pail to catch solvent.

   b. Pour approximately 1 quart of solvent in hose (1) to rinse out metal chips or dirt.

   c. Wipe hose (1) dry. Use rag.



CAUTION

Make sure screen (2) is not damaged when cleaning filter (3).

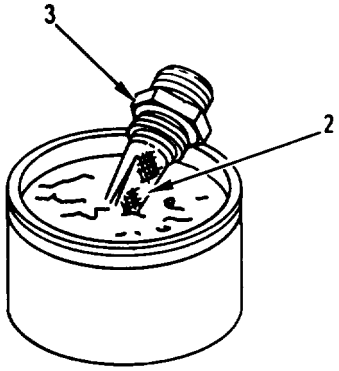
NOTE

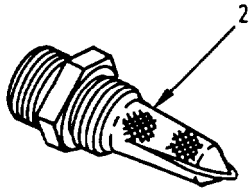
Do step 2 to clean screen, reduction gearbox scavenge, oil filter, oil pump to oil cooler, and oil tank filter. Oil tank filter (3) is shown.

2. CLEAN FILTER (3).

   a. Place filter (3) in solvent. Shake filter (3) in solvent to rinse out metal chips or dirt.

   b. Take filter (3) out of solvent and wipe dry. Use rag.





Go on to Sheet 3

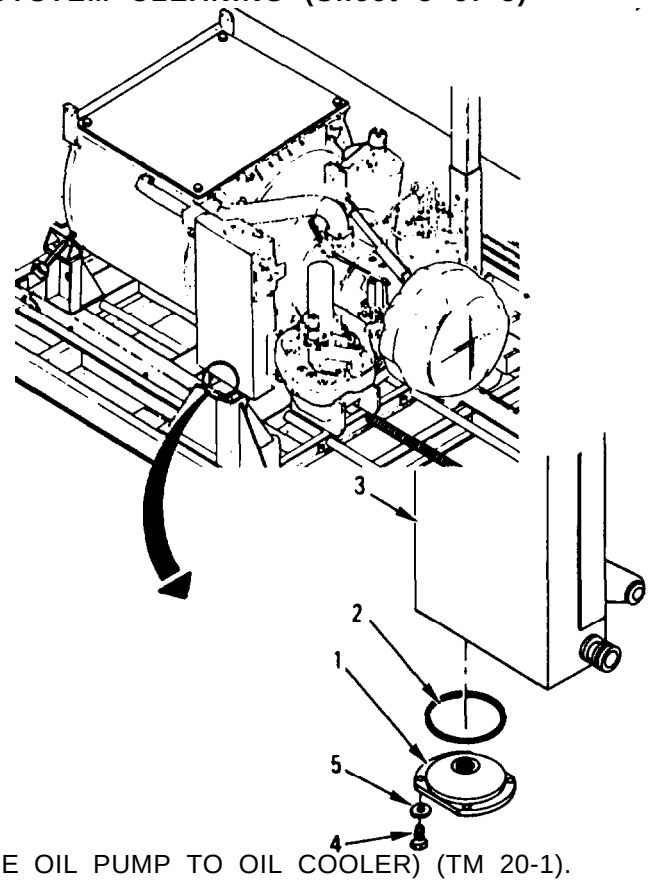
REDUCTION GEARBOX LUBRICATION SYSTEM CLEANING (Sheet 3 of 3)

3. REMOVE PORT COVER (1) AND PREFORMED PACKING (2). CLEAN OIL TANK (3).

   a. Remove four screws (4) and lockwashers (5). Remove cover (1) and packing (2).

   b. Rinse inside of oil tank (3) with solvent and wipe clean. Use rag.

4. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.



INSTALLATION:

1. INSTALL COVER (1) AND NEW PACKING (2).

   a. Install packing (2) on cover (1). Install cover (1) on oil tank (3).

   b. Install four screws (4) and new lockwashers (5).

2. INSTALL FLUID FILTER ELEMENT (ENGINE OIL PUMP TO OIL COOLER) (TM 20-1).
3. INSTALL OIL TANK FILTER ASSEMBLY (TM 20-1).
4. INSTALL TUBE ASSEMBLY (REDUCTION GEARBOX FEED) (PAGE 6-7).
5. INSTALL TUBE ASSEMBLY (REDUCTION GEARBOX OIL FEED - FORWARD) (TM 20-1).
6. INSTALL TUBE ASSEMBLY (REDUCTION GEARBOX OIL FEED) (TM 20-1).
7. INSTALL TUBE ASSEMBLY (REDUCTION GEARBOX SCAVENGE - REAR) (PAGE 6-9).
8. INSTALL TUBE ASSEMBLIES (FORWARD REDUCTION GEARBOX SCAVENGE) (TM 20-1).
9. INSTALL TUBE ASSEMBLY (OIL PUMP RETURN TO COOLER - FORWARD) (TM 20-1).
10. INSTALL TUBE ASSEMBLIES (OIL TANK TO ENGINE OIL PUMP) (TM 20-1).
11. INSTALL GENERATOR OIL OUTLET HOSE (TM 20-1).
12. INSTALL GENERATOR OIL INLET HOSE (TM 20-1).
13. INSTALL COOLER INLET AND OUTLET TUBE ASSEMBLY (RIGHT SIDE) (TM 20-1).
14. INSTALL COOLER INLET OR OUTLET TUBE ASSEMBLY (CROSSOVER) (TM 20-1).
15. INSTALL COOLER INLET OR OUTLET TUBE ASSEMBLY (LEFT SIDE) (TM 20-1).
16. FILL OIL TANK (LO -12).

End of Task

LUBRICATING OIL TANK REPAIR (Sheet 1 of 7)

TOOLS:

General mechanic's tool kit: automotive (SC5180-90-N26)
Automotive wrench (Item 208, Appendix D)
Faceshield (Item 88, Appendix D)
Hand Held Electric Router (Item 183, Appendix D)
Hand Held Electric Grinder (Item 184, Appendix D
Protective Gloves (Item 87, Appendix D)
Spanner Wrench (Item 185, Appendix D)
TIG Welder - Manual GTAW, 60-90 Amps DC (Item 186, Appendix D)
Wire Brush (Item 187, Appendix D)

PERSONNEL: Two

SUPPLIES:

Cleaning Solvent (Item 7, Appendix B)
Dye Penetrant/Developer (Item 56, Appendix B)
Flat Washer (Item 192, Appendix E) (Qty as Req'd)
Grinding Discs (Various Grits) (Item 57, Appendix B)
Preformed Packings:
(Item 193, Appendix E) (Qty as Req'd)
(Item 194, Appendix E) (Qty as Req'd)
(Item 69, Appendix E) (Qty as Req'd)
(Item 55, Appendix E) (Qty as Req'd)
Shortening Compound (Item 20, Appendix B)
Shoulder Bolts (Item 195, Appendix E) (Qty as Req'd)
Welding Rod, Size 0.035 (Item 58, Appendix B)
Wiping Rags (Item 14, Appendix B)

EQUIPMENT CONDITION:

Powerpack removed (TM20-1)
Lubricating oil tank assembly removed (TM20-1)

Go on to Sheet 2

LUBRICATING OIL TANK REPAIR (Sheet 2 of 7)

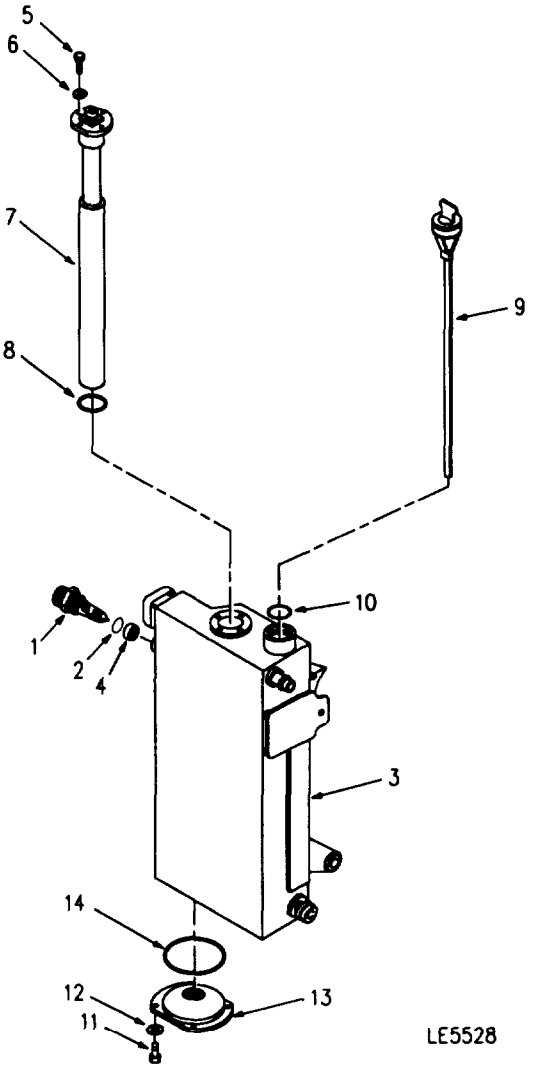
OIL TANK ASSEMBLY TEARDOWN:

1. REMOVE OIL FILTER (1) AND PREFORMED PACKING (2) FROM OIL TANK (3). DO NOT REMOVE BUSHING (4) AT THIS TIME.

2. REMOVE FOUR SCREWS (5), WASHERS (6), LIQUID LEVEL SWITCH (7) AND PREFORMED PACKING (8).

3. REMOVE FILLER CAP AND LIQUID LEVEL GAGE ROD ASSEMBLY (9), AND PREFORMED PACKING (10).

4. REMOVE FOUR SCREWS (11), WASHERS (12), WASH PORT COVER (13) AND PREFORMED PACKING (14).



Go on to Sheet 3

LUBRICATING OIL TANK REPAIR (Sheet 3 of 7)

CLEANING AND INSPECTION:

1. STEAM CLEAN OIL TANK ASSEMBLY (1) IN ACCORDANCE WITH TC 9-237 TO REMOVE ALL OIL FROM TANK INTERIOR.

2. VISUALLY INSPECT OIL TANK ASSEMBLY (1).

   a. Visually inspect oil tank (1) for severe damage and mutilation. Replace tank if these conditions exist.

   b. Visually inspect oil tank support flange (2).

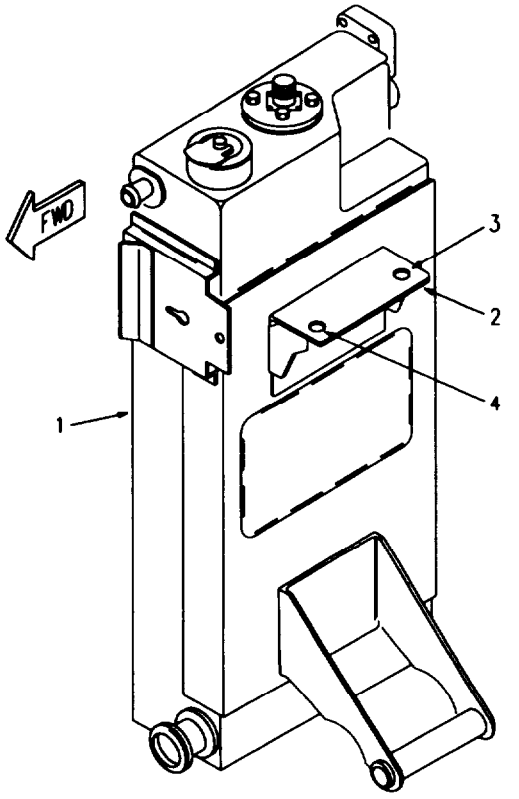
      (1) Inspect aft mounting bolt hole (3) for wear. Bolt hole diameter shall be 0.760 to 0.770 inch (19.30 to 19.56 mm).

NOTE

Bolt holes in support flange normally wear to one side only. Forward bolt hole (4) is purposely oval shaped.

      (2) Inspect forward mounting bolt hole (4) for wear. Bolt hole diameter shall be 0.760 to 0.770 inch (19.30 to 19.56 mm), and oval dimension shall be 0.820 to 0.850 inch (20.83 to 21.59 mm).

      (3) Inspect surrounding areas of two bolt holes (3,4) for cracks.



LE5529

Go on to Sheet 4

LUBRICATING OIL TANK REPAIR (Sheet 4 of 7)

c. Visually inspect oil tank support flange (1) for cracks in fusion welds and parent material.

d. Visually inspect for broken spot welds at ignition exciter mounting bracket (2).

e. Visually inspect for cracked fillet welds (3) and broken or cracked mounting plate (4) and bracket material.

f. Visually inspect bushing (7) for damage.

REPAIR:

CAUTION

BEFORE DOING WELD REPAIRS, MAKE SURE OIL TANK INTERIOR HAS BEEN THOROUGHLY CLEANED PER STEP 1 TO REMOVE ANY REMAINING OIL.

1. TIG WELD ANY CRACKED WELDS, OR CRACKS IN TWO BOLT HOLE AREAS (5, 6) OF SUPPORT FLANGE (1).

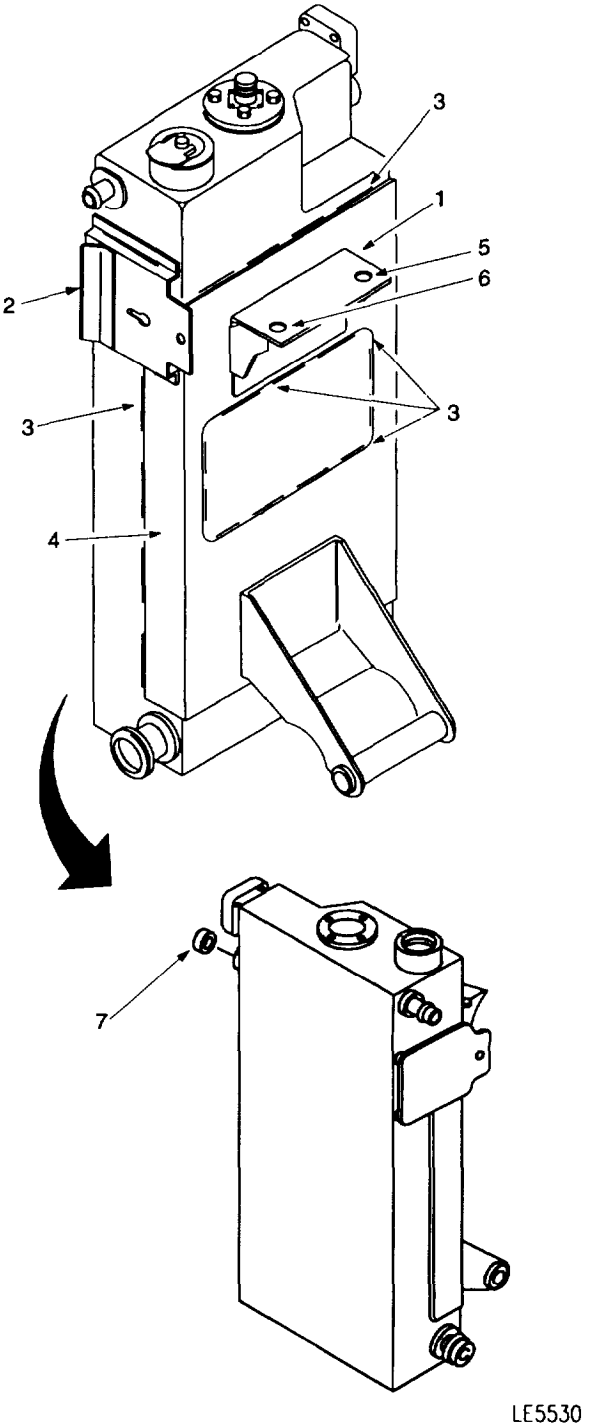
a. Route as required to remove cracks, raised or cracked metal.

b. Wirebrush area(s) to be weld repaired and clean with cleaning solvent.

c. Tig weld routed areas using AMS 5680 weld wire with gas tungsten arc welder (GTAW).

d. Blend top surface to original flatness and to remove weld spatter.

e. Using dye penetrant method, inspect repaired areas. No cracks allowed.



Go on to Sheet 5

LUBRICATING OIL TANK REPAIR (Sheet 5 of 7)

2. TACK FILLET WELD WASHERS (1) TO WORN BOLT HOLE AREAS (2) OF SUPPORT FLANGE (3).

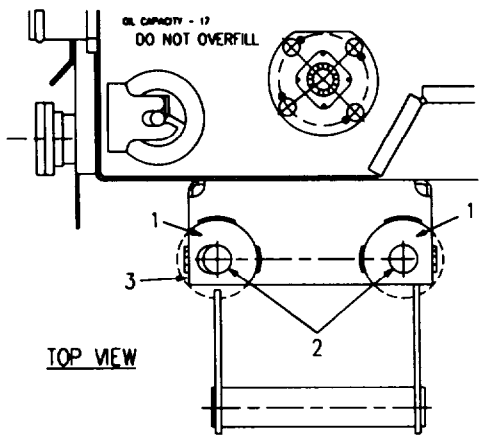
a. Tack fillet weld a flat washer MS9321-17 (1) around each worn mounting bolt hole (2) in at least three places using TIG welder and AMS 5680 weld wire.

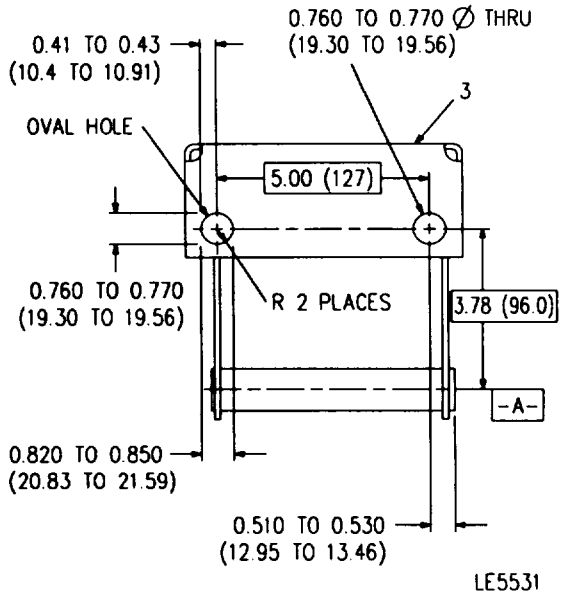
NOTE

Shoulder bolt P/N 12280582 may be used to align flat washer on support bracket bolt hole.

b. Grind off overlapping edges of washers (1) and blend to remove sharp edges.

c. Redrill, file or grind holes as necessary to obtain required bolt hole dimensions.





Go on to Sheet 6

LUBRICATING OIL TANK REPAIR (Sheet 6 of 7)

3. FUSION WELD REPAIR CRACKED FILLET WELD AREAS (1) AND BROKEN OR CRACKED MOUNTING PLATE (2) AND BRACKET MATERIAL OF MOUNTING SUPPORT (3) AND LOWER BRACKET (4).

a. Repair cracked fillet weld areas (1) by continuous fusion welding.

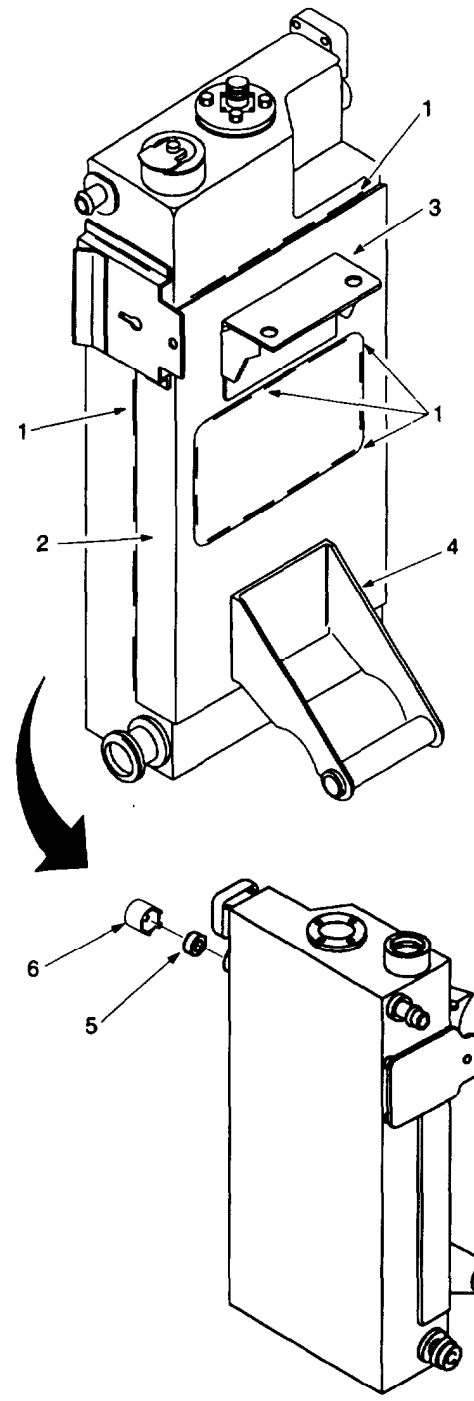
b. Repair cracks in parent metal of mounting support (3), lower bracket (4) and mounting plate (2) by fusion welding edges of mounting support (3) and lower bracket (4) to mounting plate (2).

WARNING

4. CLEAN ALL EXTERIOR WELD REPAIR AREAS USING WIRE BRUSH AND CLEANING SOLVENT

5. CHECK REPAIRED AREA(S) FOR CRACKS AND BAD WELDS. REPAIR AS REQUIRED. PERFORM DYE PENETRANT INSPECTION IF APPLICABLE.

6. USING SPANNER WRENCH (6), REMOVE DAMAGED BUSHING (5). INSTALL AND SECURELY TIGHTEN NEW BUSHING (5) USING SPANNER WRENCH (6).



LE5532

Go on to Sheet 7

LUBRICATING OIL TANK REPAIR (Sheet 7 of 7)

OIL TANK REASSEMBLY:

1. INSTALL WASH PORT COVER (1) AND NEW PACKING (2) ON OIL TANK (3) AND SECURE WITH FOUR SCREWS (4) AND WASHERS (5).

2. INSTALL FILLER CAP AND LIQUID LEVEL GAGE ROD ASSEMBLY (6), AND PREFORMED PACKING (7).

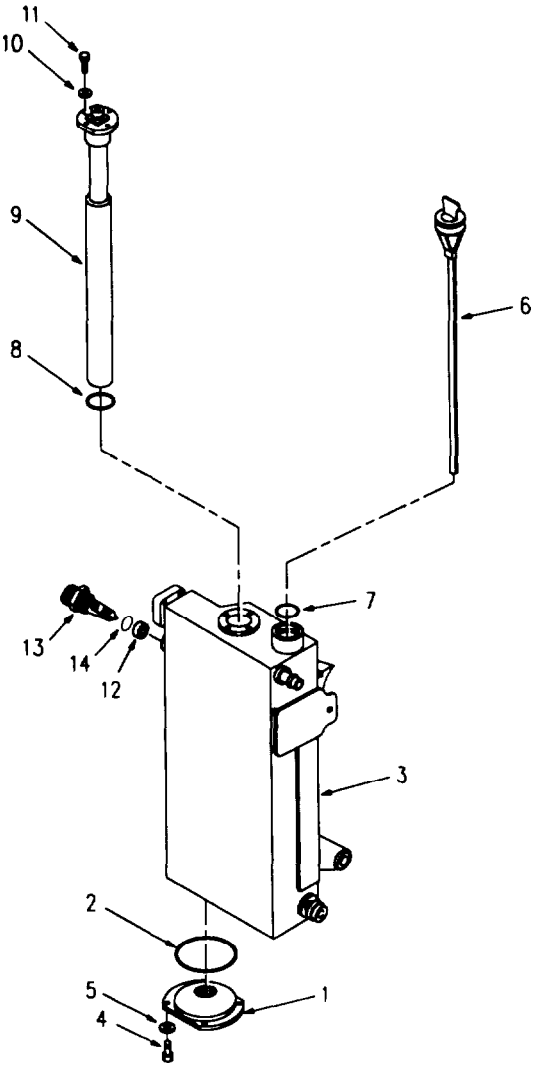
3. APPLY SHORTENING COMPOUND TO NEW PREFORMED PACKING (8). INSTALL LIQUID LEVEL SWITCH (9) AND PACKING (8) ON OIL TANK (3) AND SECURE WITH FOUR WASHERS (10) AND SCREWS (11).

4. INSURE THAT BUSHING (12) IS INSTALLED, THEN INSTALL CLEAN OIL FILTER (13) AND NEW PREFORMED PACKING (14).

INSTALLATION:

1. INSTALL LUBRICATING OIL TANK ASSEMBLY. (REF. TM20-1)

2. INSTALL POWERPACK. (REF. TM20-1)



End of Task

CHAPTER 9

STARTER MOTOR MAINTENANCE

CHAPTER INDEX

STARTER MOTOR TEST (Sheet 1of 3)

APPLICABILITY: Starter 1114673

TOOLS: Automotive fuel and electrical system repair tool kit (SC5180-95-CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Alternator and starter automotive generator test stand (Item 45, Appendix D)
Chemical and oil protective gloves (Item 87, Appendix D)
Cross tip screwdriver bit, l/2-inch drive (Item 46, Appendix D)
Electric impact wrench, l/2-inch drive (Item 44, Appendix D)
Flat tip screwdriver bit, 3/8 inch drive, 11/16-inch (Item 47, Appendix D)
Industrial goggles (Item 58, Appendix D)
Multimeter(Item 49, Appendix D)

SUPPLIES: Drycleaning solvent (Item7, Appendix B)
Gasket (Item 71, Appendix E) (2 required)
Wiping rag(Item 14, Appendix B)

REFERENCES: TM 9-4910-485-12

Go on to Sheet 2

STARTER MOTOR TEST (Sheet 2 of 3)

TEST:

WARNING

1. CLEAN MOTOR (1) AND CHECK ARMATURE ROTATION.

   a. Clean outside of motor (1) with solvent and rag.

   b. Turn starter housing collar (2) clockwise and counterclockwise. If collar (2) and armature shaft (3) do not turn freely, repair starter motor (page 9-6).

2. REMOVE TWO PLUGS (4) AND GASKETS (5). INSPECT PLUGS (4) FOR DAMAGE. REPLACE AS REQUIRED.

3, TEST ARMATURE CONTINUITY.

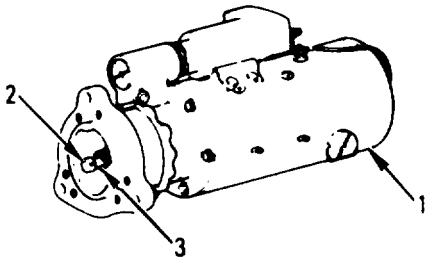
   a. Set multimeter to RX1 scale and check continuity between two brush terminals (6). If multimeter reads 10 ohms or more, replace motor (1).

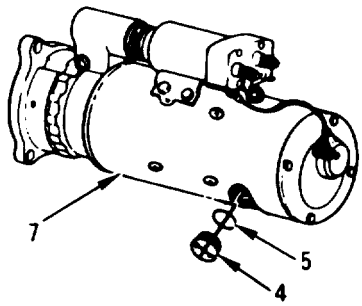
   b. Set multimeter to RX10,000 scale. Check continuity between each terminal (6) and housing (7). If multimeter reads any thing except infinity, replace motor (1).

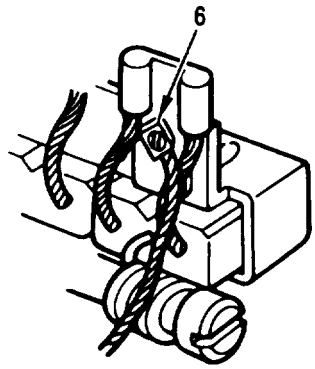
4. TEST SOLENOIID RESISTANCE.

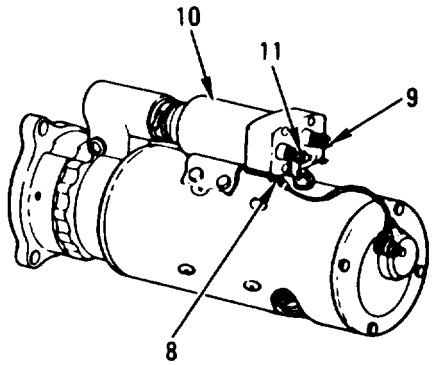
   a. Set multimeter to RX1 scale. Check continuity between terminal (8) and B terminal (9). If multimeter reads more than 10 ohms, replace starter motor solenoid switch (page 9-4).

   b. Set multimeter to RX10.000 scale. Check resistance between terminal (8) and switch case (10). Check resistance between M terminal (11) and case (10). Check resistance between B terminal (9) and case (10). If multimeter reads anything except infinity for any of three checks, replace starter motor solenoid switch (page 9-4).









Go on to Sheet 3

STARTER MOTOR TEST (Sheet 3 of 3)

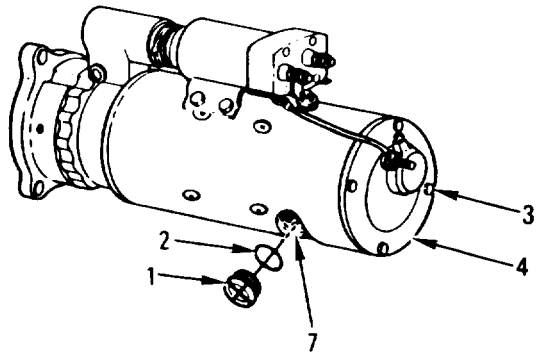
5. CHECK MOTOR CURRENT, SPEED, AND VOLTAGE (TABLE 9-1) AND (TM 9-4910-485-12).

Table 9-1. Current, Speed, end Voltage Accepted Values

Measurement	Accepted Values
Current	70 to 110 Amps dc
Speed	5500 to 9000 RPM
Voltage	20 V dc

6. IF CHECK DOES NOT GIVE THE ACCEPTED VALUES SHOWN IN TABLE 9-1, OR MOTOR VIBRATES AND NOISE IS HEARD, SKIP STEP 7.

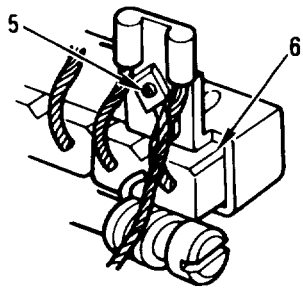
7. INSTALL TWO PLUGS (1) AND NEW GASKETS (2). GO TO INSPECTION STEP 6.



INSPECTION:

1. INSPECT FOUR SCREWS (3) IN COMMUTATOR END BELL (4) FOR TIGHTNESS. IF ANY SCREW (3) IS LOOSE, TIGHTEN IT.

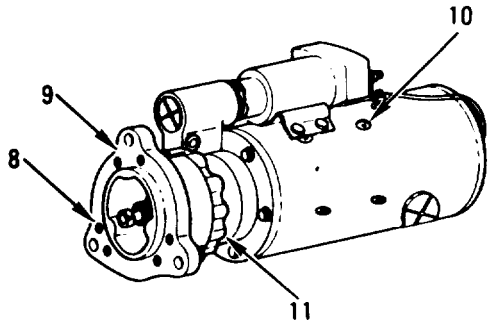
2. INSPECT TWO SCREWS (5) HOLDING BRUSHES (6) FOR TIGHTNESS. IF EITHER SCREW (5) IS LOOSE, TIGHTEN IT THROUGH OPENING (7). INSTALL TWO PLUGS (1) AND NEW GASKETS (2).



3. INSPECT SIX SCREWS (8) IN DRIVE HOUSING (9) AND EIGHT SHOE POLE SCREWS (10) FOR TIGHTNESS. IF ANY SCREW (8, 10) IS LOOSE, TIGHTEN IT.

4. INSPECT LEVER HOUSING (11) FOR TIGHTNESS. IF LOOSE, REPAIR STARTER MOTOR (PAGE 9-6).

5. REPEAT TEST STEPS 5 AND 6. IF MOTOR STILL DOES NOT GIVE ACCEPTED VALUES SHOWN IN TABLE 9-1 OR MOTOR VIBRATES AND NOISE IS STILL HEARD, REPAIR STARTER MOTOR (PAGE 9-6).



6. LUBRICATE STARTER MOTOR (PAGE 9-19).

End of Task

STARTER MOTOR SOLENOID SWITCH REPLACEMENT (Sheet 1 of 1)

APPLICABILITY: Starter 1114673

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CL-B08)

SUPPLIES: Lockwasher (Item 75, Appendix E) (2 required)

REMOVAL:

1. REMOVE SWITCH (1).
   a. Loosen screw (2). Remove electrical lead (3) from switch (1).
   b. Remove two nuts (4) and lockwashers (5). Loosen clamp (6).
   c. Remove four screws (7). Pull terminal connector (8) off motor (9) and switch (1).
   d. Rock switch (1) back and fourth and pull switch (1) up and out from motor (9).
2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

1. INSTALL SWITCH (1).

NOTE

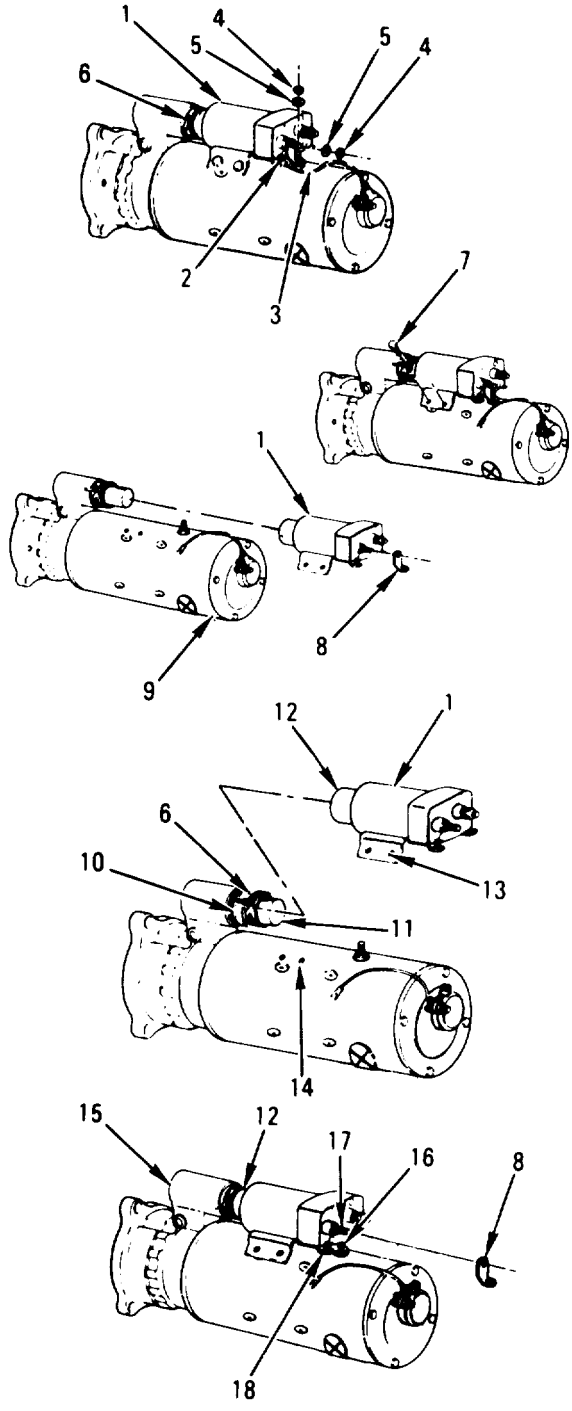
Make sure clamp (6) is centered over boot (10).

   a. Put plunger assembly (11) in plunger housing (12). Rock switch (1) until four mounting holes (13) line up with housing holes (14).

NOTE

Make sure that ridge of boot (10) is inside lever housing (15) and that smooth end of boot (10) is around plunger housing (12).

   b. Put connector (8) on stud (16) and terminal (17). Install four screws (7). Tighten clamp (6).
   c. Install two nuts (4) and new lockwashers (5) on stud (16) and terminal (17).
   d. Put lead (3) on terminal (18). Tighten screw (2).
2. LUBRICATE STARTER MOTOR (PAGE 9-19).
3. TEST STARTER MOTOR (PAGE 9-1).



End of Task

STARTER MOTOR SOLENOID SWITCH REPAIR (Sheet 1 of 1)

APPLICABILITY: Starter 1114673

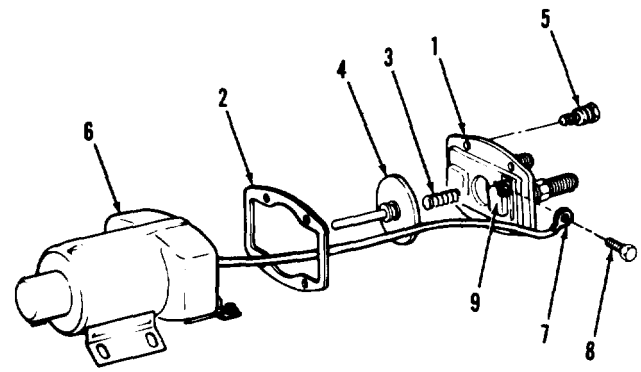
TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Multimeter (Item 49, Appendix D)

SUPPLIES: Gasket (Item 72, Appendix E)
Helical spring (Item 74, Appendix E)
Screw (Item 73, Appendix E) (4 required)

EQUIPMENT CONDITION: Starter motor solenoid switch removed (page 9-4)

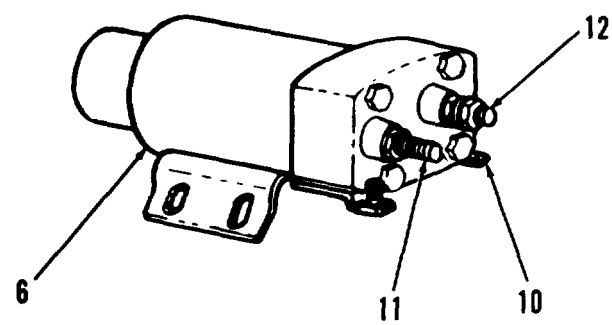
DISASSEMBLY:

1. REMOVE PLATE ASSEMBLY (1), GASKET (2), HELICAL SPRING (3),AND CONTACT ASSEMBLY (4).
   a. Remove four screws (5) from plate (1). Lift plate (1), spring (3), and contact (4) from switch case (6) as far as electrical lead (7) will allow.
   b. Remove screw (8) from lead (7). Remove gasket (2) from plate (1).
2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.



ASSEMBLY:

1. INSTALL PLATE (1), NEW GASKET (2), NEW SPRING (3), AND CONTACT (4).
   a. Install gasket (2) on plate (1). Install contact (4) and spring 3) in case (6).
   b. Install screw (8) through end of lead(7). Install screw (8) on terminal (9). Aline plate (1) to case (6).
   c. Install four new screws (5) through plate (1) and in case (6).
2. SET MULTIMETER TO RX10,000 SCALE. CHECK CONTINUITY BETWEEN TERMINAL (10) AND CASE (6) AND BETWEEN M TERMINAL (11) AND CASE (6). CHECK CONTINUITY BETWEEN B TERMINAL (12) AND CASE (6). IF MULTIMETER READS ANYTHING OTHER THAN INFINITY, REPLACE STARTER MOTOR SOLENOID SWITCH (PAGE 9-4).
3, INSTALL STARTER MOTOR SOLENOID SWITCH (PAGE 9-4).



End of Task

STARTER MOTOR REPAIR (Sheet 1 of 13)

APPLICABILITY: Starter 1114673

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Air blow gun (Item 59, Appendix D)
Armature test set (Item 64, Appendix D)
Armature undercutter (Item 65, Appendix D)
Chemical and oil protective gloves (Item 87, Appendix D)
Dial indicator (Item 62, Appendix D)
Engine lathe (Item 63, Appendix D)
Flat tip screwdriver bit, l/2-inch drive, 15/16-inch (Item 51, Appendix D)
Hacksaw blade (Item 56, Appendix D)
Industrial goggles (Item 58, Appendix D)
Inserted hammer face (Item 1, Appendix D)
Inserted hammer face holder (Item 2, Appendix D)
Machinist's vise (Item 55, Appendix D)
Multimeter (Item 49, Appendix D)
Nonmetallic hose assembly (Item 61, Appendix D)
Outside caliper (Item 57, Appendix D)
Reciprocating compressor unit (Item 60, Appendix D)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)
Vise jaw caps (Item 54, Appendix D)

SUPPLIES: Adhesive (Item 1, Appendix B)
Brush (Item 76, Appendix E) (8 required)
Dry cleaning solvent (Item 7, Appendix B)
Electrical parts kit (Item 82, Appendix E)
Gasket (Item 71, Appendix E)
Gasket (Item 88, Appendix E)
Grease (Item 9, Appendix B)
Helical spring (Item 86, Appendix E) (8 required)
Hose clamp (Item 77, Appendix E)
Insulator (Item 78, Appendix E)
Lockwasher (Item 39, Appendix E) (9 required)
Lockwasher (Item 75, Appendix E)
Pin (Item 90, Appendix E)
Preformed packing (Item 79, Appendix E)
Preformed packing (Item 80, Appendix E)
Preformed packing (Item 81, Appendix E)
Preformed packing (Item 89, Appendix E) (2 required)
Retaining ring (Item 83, Appendix E) (2 required)
Sandpaper (Item 16, Appendix B)
Screw (Item 84, Appendix E) (3 required)
Sealing compound (Item 18, Appendix B)
Sleeve spacer (Item 85, Appendix E)
Washer (Item 87, Appendix E)
Wiping rag (Item 14, Appendix B)

EQUIPMENT CONDITION: Starter motor tested (page 9-1)

Go on to Sheet 2

STARTER MOTOR REPAIR (Sheet 2 of 13)

DISASSEMBLY:

1. SCRIBE A STRAIGHT LINE (1) FROM COMMUTATOR END BELL (2) TO FIELD WINDING FRAME (3) IN LINE WITH OIL PLUG (4).

2. REMOVE ELECTRICAL LEAD (5), TWO PLUGS (6), AND GASKETS (7).

   a. Remove nut (8) and lockwasher (9). Lift lead (5) from terminal stud (10).

   b. Loosen screw (11) at side of solenoid switch (12). Take lead (5) off switch (12).

   c. Remove plugs (6). Remove gaskets (7).

3. INSPECT PLUGS (6) FOR DAMAGE. REPLACE AS REQUIRED.

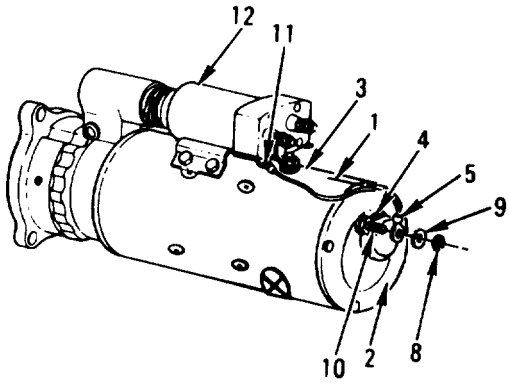
4. REMOVE END BELL (2) AND PREFORMED PACKING (13).

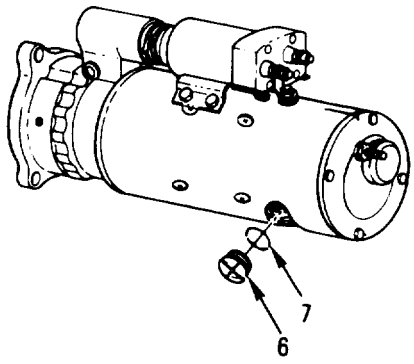
   a. Remove two screws (14) that hold field winding leads (15) to brushes (16).

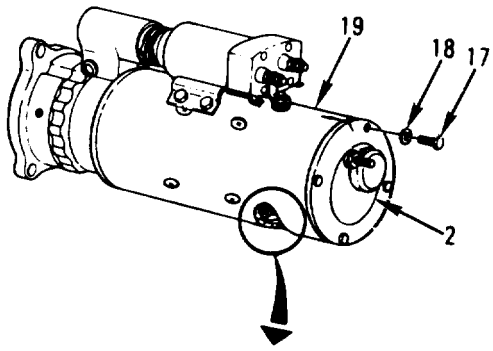
   b. Remove four screws (17) and lockwashers (18) from end bell (2).

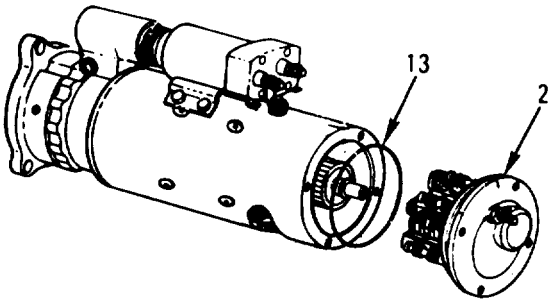
   c. Tap end bell (2). Pry end bell (2) off frame (19).

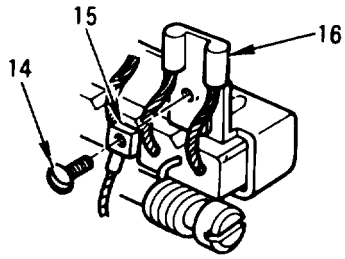
   d. Pull packing (13) off end bell (2).











Go on to Sheet 3

STARTER MOTOR REPAIR (Sheet 3 of 13)

5. SCRIBE A STRAIGHT LINE (1) ACROSS DRIVE HOUSING (2) AND LEVER HOUSING (3) AT PIPE PLUG (4).

6. REMOVE SIX SCREWS (5). TAP DRIVE HOUSING (2) FROM LEVER HOUSING (3). REMOVE GASKET (6).

7. REMOVE LEVER HOUSING (3), PREFORMED PACKING (7). OUTER THRUST BEARING RACE (8), NEEDLE BEARING (9), INNER BEARING RACE (10), AND WASHER (11),

   a. Tap out valve to shaft pin (12) from housing collar (13). Pull off collar (13).

   b. Remove five screws (14) and lockwashers (15) from lever housing (3). Loosen clamp (16).

NOTE

Clutch motor drive (17) may fall out of lever housing (3) when lever housing (3) is taken off winding frame (18).

   c. Pry lever housing (3) from frame (18) and solenoid switch (19).

   d. Remove packing (7) from lever housing (3).

   e. Remove outer race (8), bearing (9), inner race (10), and washer (11) from armature shaft (20).

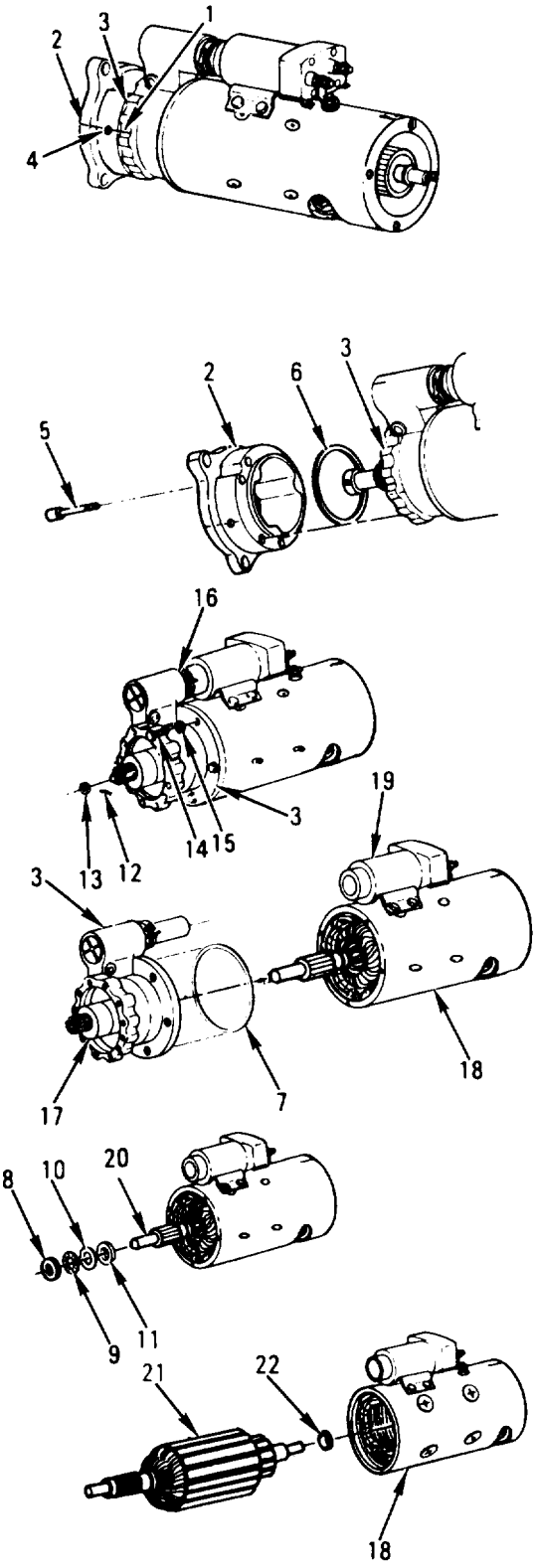
8 INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

9. REMOVE STARTER MOTOR ARMATURE (21) AND WASHER (22) FROM FRAME (18).

REPAIR:

NOTE

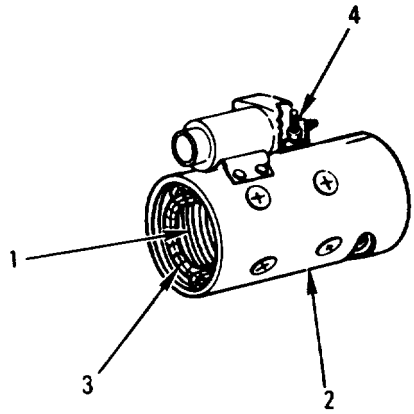
If motor is found to be damaged, assemble starter motor (page 9-16) and replace.



Go on to Sheet 4

STARTER MOTOR REPAIR (Sheet 4 of 13)

1. INSPECT FOUR SHOE POLES (1) AND FRAME (2) FOR CRACKS OR BREAKS. INSPECT MOTOR FIELD WINDING (3) FOR CRACKS, BREAKS, BURNED INSULATION, BROKEN WIRES, OR STRIPPED THREADS ON STUD (4). REPLACE AS REQUIRED.



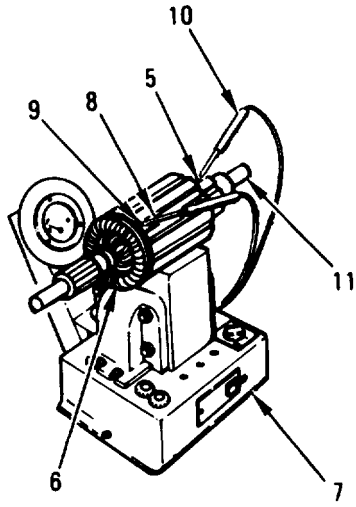
NOTE

Do steps 2 and 3 for each bar riser (5). If armature (6) is damaged, assemble starter motor (page 9-16) and replace as required.

2. PUT ARMATURE (6) IN GROWLER (7). PUT BLACK NEGATIVE PROBE (8) ON ARMATURE CORE (9). PUT RED PROBE (10) ON BAR RISER (5). IF LIGHT ON GROWLER (7) LIGHTS, ASSEMBLE STARTER MOTOR (PAGE 9-16) AND REPLACE.

3. PUT BLACK NEGATIVE PROBE (8) ON SHAFT (11) AND RED PROBE (10) ON BAR RISER (5). IF LIGHT ON GROWLER (7) LIGHTS, ASSEMBLE STARTER MOTOR (PAGE 9-16) AND REPLACE.

4. TEST ARMATURE (6) FOR SHORT CIRCUITS.



NOTE

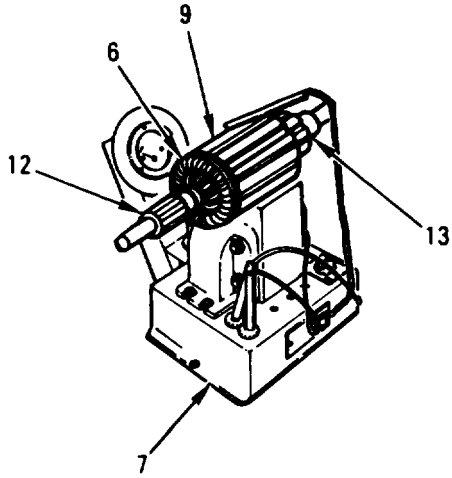
Short circuit in armature (6) will pull hacksaw blade against the core (9) and cause blade to vibrate.

a. With growler (7) turned on, hold blade about l/32-inch (0.794 mm) away from armature (6).

b. Turn armature (6) slowly. If blade is pulled against core (9), assemble starter motor (page 9-16) and replace.

5. INSPECT ARMATURE SHAFT SPLINES (12) FOR DAMAGE. IF DAMAGED, ASSEMBLE STARTER MOTOR (PAGE 9-16) AND REPLACE.

6. INSPECT CONTACT SURFACE (13) FOR ROUGH SURFACE, PITS, BURNS, OR HARD CARBON OR OIL COAT. IF DAMAGED DO STEPS 7, 8, AND 9.



Go on to Sheet 5

STARTER MOTOR REPAIR (Sheet 5 of 13)

7. INSPECT COMMUTATOR (1) FOR WEAR,

a. Measure diameter of commutator (1). Check for wear limits (table 9-2).

Table 9-2. Armature Wear Limits

Point of Measurement	Sizes and Fits of New Parts (inches)	Direct and General Support Wear Limits (inches)
Commutator Diameter	2.115 to 2.125 (5.372 cm to 5,397 cm)	
Commutator Minimum Turned Diameter		2.00 (5.08 cm)
Commutator Diameter Total Indicator Runout with Shaft Diameter at Bearings	0.0020 (0.0508 mm)	

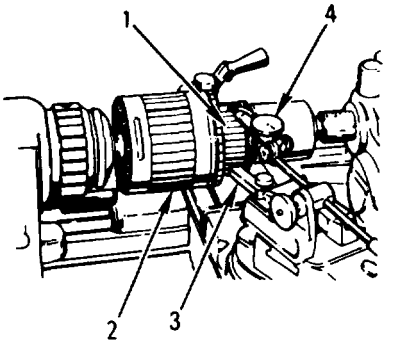
b. If armature (2) is worn beyond limits shown in table 9-2, assemble starter motor (page 9-16) and replace,

c. Put armature (2) in lathe and position cutting tool (3) and dial indicator (4) against commutator (1).

WARNING

Always wear eye protection when operating a lathe. Failure to wear eye protection could result in serious injury.

8. CUT OFF 0.007-INCH (0.0178 MM) AND UNDERCUT MICA (5) TO l/32-INCH (0.794 MM) DEEP AND l/32-INCH (0.794

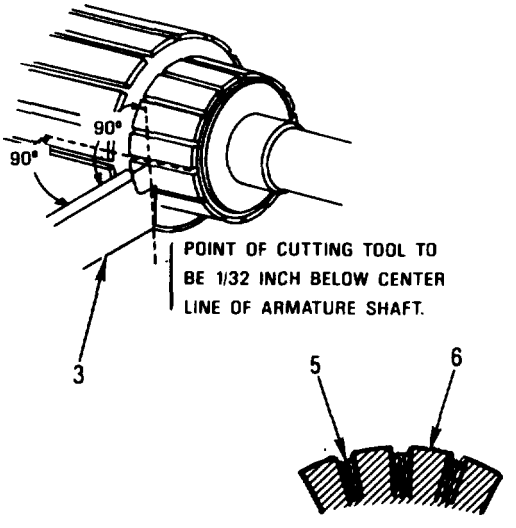


a, Turn lathe on. Watch indicator (4). Cut 0,005-inch (0.0127 mm) off commutator (1) with tool (3). Turn lathe off. Check commutator (1) for clean smooth surface.

b. Repeat step a and make final cut 0.002-inch (0.005 mm). Watch indicator (4) to make sure total indicator runout is within limits shown in table 9-2.

c. Turn off lathe. Pull tool (3) and indicator (4) away from commutator (1).

d. Start grooves in mica (5) with file. Undercut mica (5) with piece of hacksaw blade to l/32-inch (0.794 mm) deep and l/32-inch (0.794 mm) wide. Mica (5) must be cut away clean between segments (6) of commutator (1).



Go on to Sheet 6

STARTER MOTOR REPAIR (Sheet 6 of 13)

WARNING

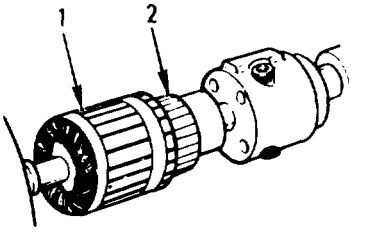
Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/faceshield, gloves, etc.).

9. CLEAN ARMATURE (1) AND CHECK DIAMETER OF COMMUTATOR (2).

   a. Blow off loose copper and mica particles from commutator (2) with low pressure air.

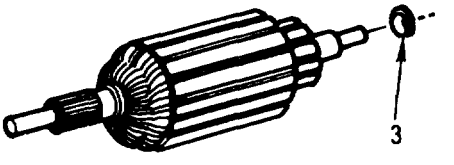
   b. Turn lathe on. Polish commutator (2) with sandpaper. Turn lathe off.

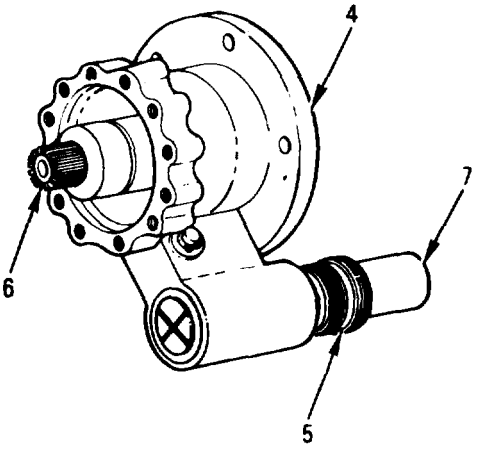
   c. Check diameter of commutator (2) to limits shown in table 9-2 (page 9-10). If commutator (2) is not within limits, assemble starter motor (page 9-16) and replace.



10. INSPECT SPACER WASHER (3) FOR DAMAGE. REPLACE AS REQUIRED.

11 INSPECT HOUSING (4) AND BOOT (5) FOR DAMAGE. PUSH AND PULL CLUTCH MOTOR DRIVE (6) AND LOOK FOR MOVEMENT OF PLUNGER (7). IF PLUNGER (7) DOES NOT MOVE OR ANY PART IS DAMAGED, DO STEPS 12 THRU 20.





Go on to Sheet 7

STARTER MOTOR REPAIR (Sheet 7 of 13)

12. REMOVE PLUG (1) FROM HOUSING (2). PULL GASKET (3) OFF PLUG (1). INSPECT PLUG (1) FOR DAMAGE. REPLACE AS REQUIRED.

13. REMOVE PLUNGER (4), RECESSED WASHERS (5, 6), HELICAL SPRING (7), BOOT (8), AND WASHER (9).

    a. Remove linkage nut (10). Remove plunger (4) from housing (2).

    b. Remove clamp (11) from plunger (4).

    c. Remove retaining ring (12) from plunger (4).

    d. Remove washer (5), spring (7), washer (6), boot (8), and washer (9) from plunger (4).

14. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

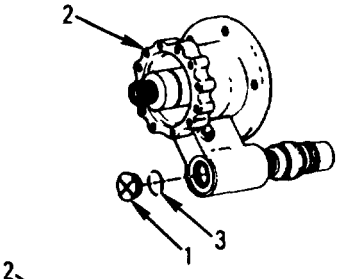
15. REMOVE MOTOR DRIVE (13), SHOULDERED SHAFT (14), TWO PREFORMED PACKINGS (15), AND LEVER ASSEMBLY (16).

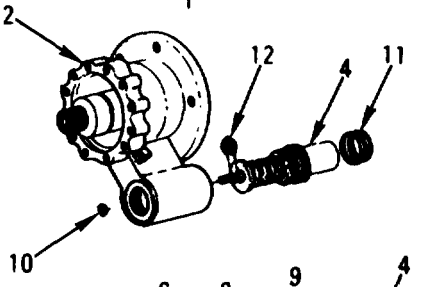
    a. Pull lever (16) toward opening in housing (2). Remove drive (13).

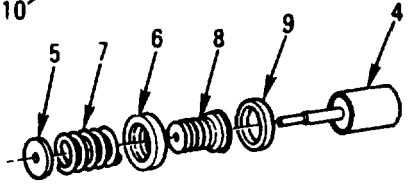
    b. Remove retaining ring (17) from shaft (14). Remove shaft (14). Remove packings (15) from shaft (14).

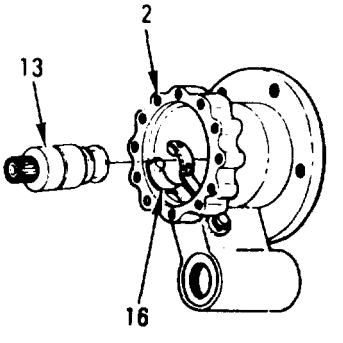
    c. Remove lever (16) from housing (2).

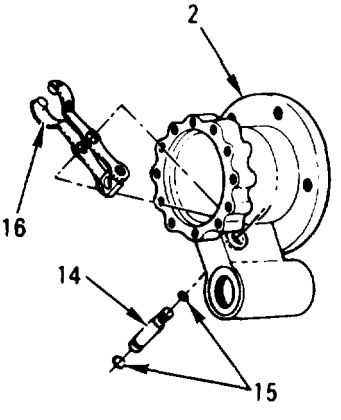
16. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

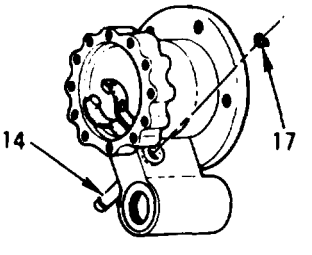












Go on to Sheet 8

STARTER MOTOR REPAIR (Sheet 8 of 13)

WARNING

17, REMOVE FIBER WASHER (1) FROM HOUSING (2) AND CLEAN HOUSING (2) AND WASHER (1) WITH SOLVENT AND RAG.

18, INSTALL WASHER (1), LEVER (3), TWO NEW PACKINGS (4), AND SHAFT (5).

a. Apply adhesive on back of washer (1). Put washer (1) in housing (2).

b. Put lever (3) in housing (2).

c. Coat packings (4) with grease. Put packings (4) on shaft (5). Put shaft (5) through housing (2) and lever (3).

d. Put new retaining ring (6) on shaft (5).

19. INSTALL WASHERS (7, 8, 9), SPRING (10), AND BOOT (11).

a. Install washer (7), boot (11), washer (8) spring (10), and washer (9) on plunger (12).

b. Install new retaining ring (13) on plunger (12).

c. Install new clamp. (14) on plunger (12) where boot (11) overlaps plunger (12). Do not tighten clamp (14) at this time.

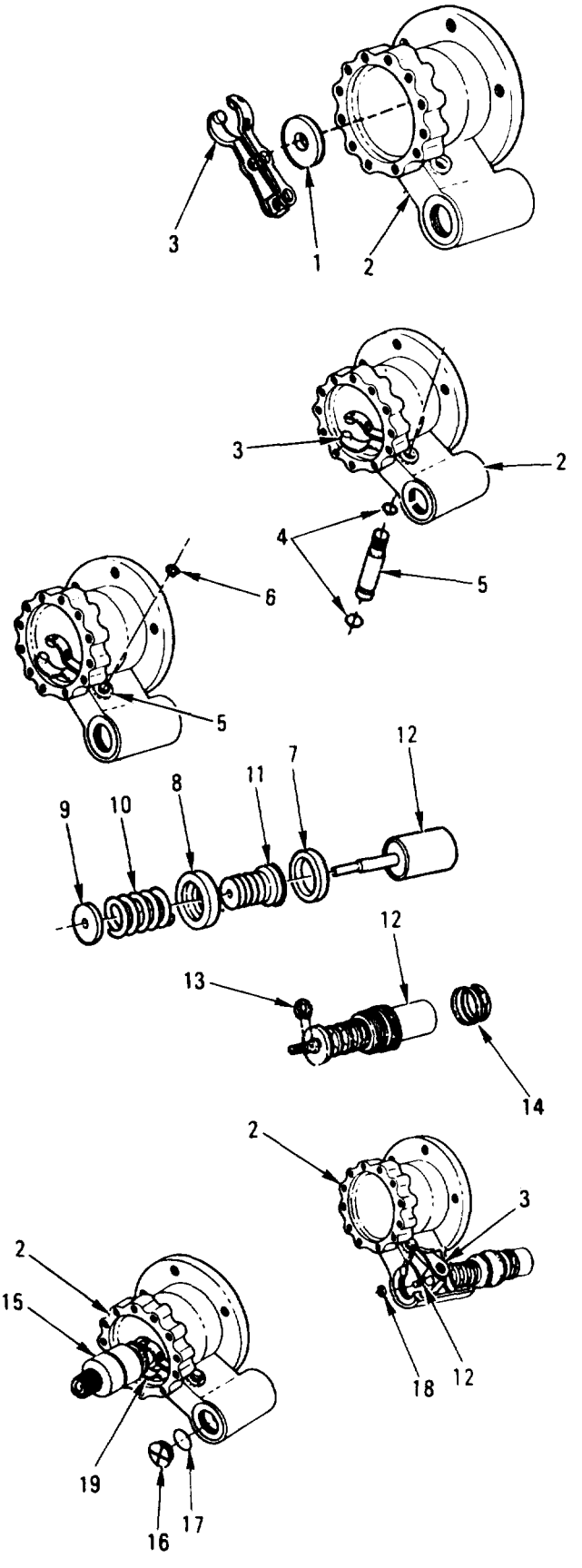
20. INSTALL PLUNGER (12), DRIVE (15), PLUG (16), AND NEW PACKING (17) IN HOUSING (2).

a. Put plunger (12) in housing (2) and through lever (3).

b. Install nut (18) on threads of plunger (12).

c. Pull lever ears (19) to front of housing (2). Put grease on ears (19). Put drive (15) between ears (19).

d. Push drive (15) in housing (2). Put packing (17) on plug (16). Install plug (16) on housing (2).



Go on to Sheet 9

STARTER MOTOR REPAIR (Sheet 9 of 13)

21. REMOVE EIGHT BRUSHES (1) AND HELICAL SPRINGS (2) FROM END BELL (3).

    a. Put end bell (3) in vise. Remove six screws (4) from six brush leads (5)

    b. Pull brushes (1) out of eight brush holders (6). Remove springs (2) from four spring holders (7).

22, SET MULTIMETER TO RX1 SCALE. CHECK CONTINUITY BETWEEN STUD (8) AND TWO GROUND BRUSH HOLDERS (9). IF CONTINUITY IS NOT FOUND FOR EITHER HOLDER (9), DO STEP 24 AND THEN GO TO STEP 31.

23, SET MULTIMETER TO RX1 SCALE. CHECK CONTINUITY BETWEEN STUD (8) AND TWO INSULATED BRUSH HOLDERS (10). IF A CONTINUITY IS FOUND, GO TO STEP 27.

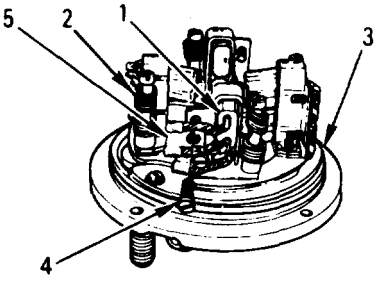
24, SEPARATE HOLDER ASSEMBLY (11) AND END BELL (3).

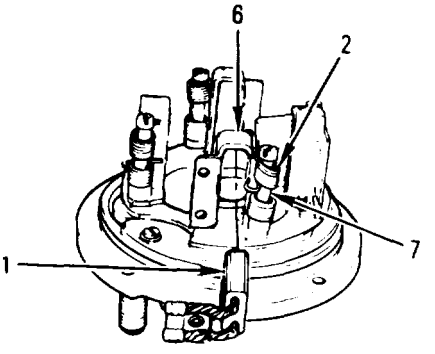
    a. Remove nut (12), lockwasher (13), washer (14), and insulator (15) from stud (8).

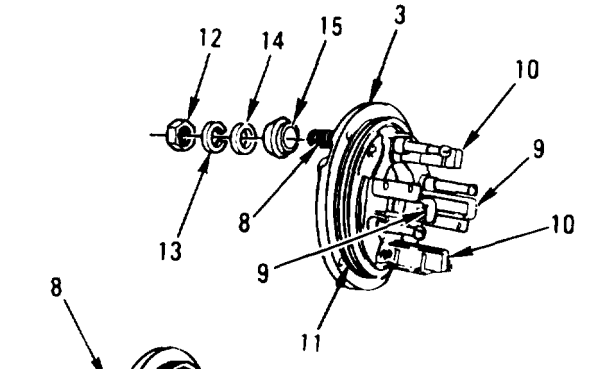
    b. Remove three screws (16) and washers (17) from holder (11). Tap stud (8) until holder (11) separates from end bell (3).

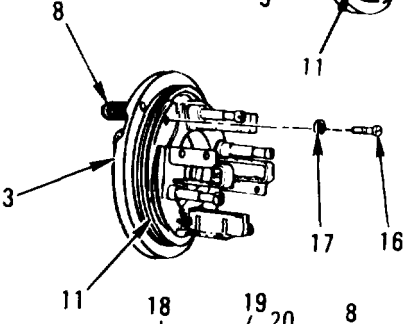
25. PULL SLEEVE SPACER (18) FROM END BELL (3). PULL PREFORMED PACKING (19) AND WASHER (20) FROM STUD (8).

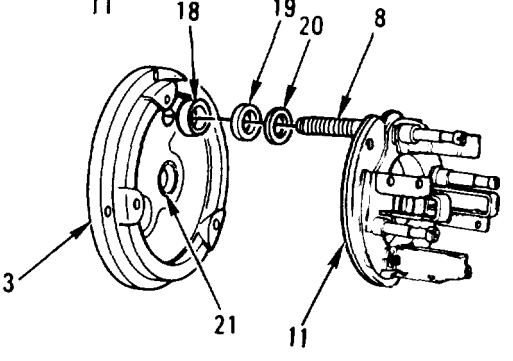
26. INSPECT END BELL (3) FOR CRACKS OR BREAKS. INSPECT BUSHING (21) FOR CRACKS, BREAKS, OF SCORE MARKS. REPLACE AS REQUIRED.











Go on to Sheet 10

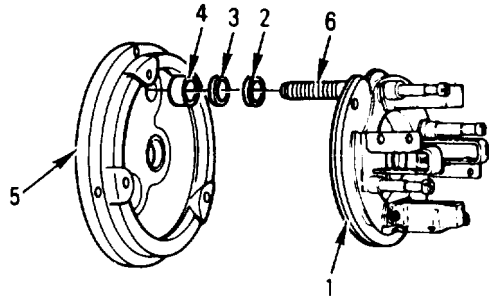
STARTER MOTOR REPAIR (sheet 10 Of 13)

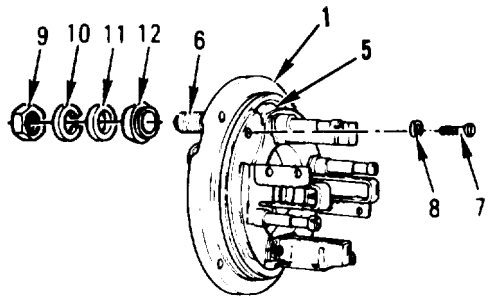
27. INSPECT HOLDER (1) FOR DAMAGE. REPLACE AS REQUIRED.
28. INSTALL NEW WASHER (2), NEW PACKING (3), NEW SPACER (4), AND CONNECT END BELL (5) AND HOLDER (1).
    a. Put washer (2) and packing (3) on stud (6). Put spacer (4) in end bell (5).
    b. Put sealing compound on back of holder (1). Put holder (1) on end bell (5).
29. ALINE HOLDER (1) WITH END BELL (5). INSTALL THREE NEW SCREWS (7) AND WASHERS (8).
30. INSTALL NUT (9), NEW LOCKWASHER (10), WASHER (11), AND NEW INSULATOR (12) ON STUD (6). SKIP STEPS 31 THRU 34.
31. PULL SPACER (4), PACKING (3), AND WASHER (2) FROM STUD (6). REPLACE HOLDER (1).
32. INSTALL NEW WASHER (2), NEW PACKING (3), NEW SPACER (4), AND CONNECT END BELL (5) WITH NEW HOLDER (1).
    a. Put washer (3), packing (2), and spacer (4) on stud (6) of holder (1).
    b. Put sealer on back of holder (1). Put holder (1) on end bell (5).
33. ALINE HOLDER (1) WITH END BELL (5). INSTALL THREE SCREWS (7) AND WASHERS (8).
34. INSTALL NUT (9), NEW LOCKWASHER (10), AND NEW INSULATOR (12) ON STUD (6).
35. INSTALL EIGHT NEW SPRINGS (13) AND NEW BRUSHES (14) ON END BELL (5).
    a. Put springs (13) on four holders (15). Put brushes (14) in holders (16) from center of holder (1).

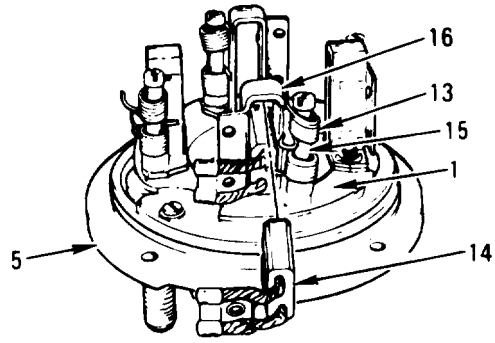
NOTE

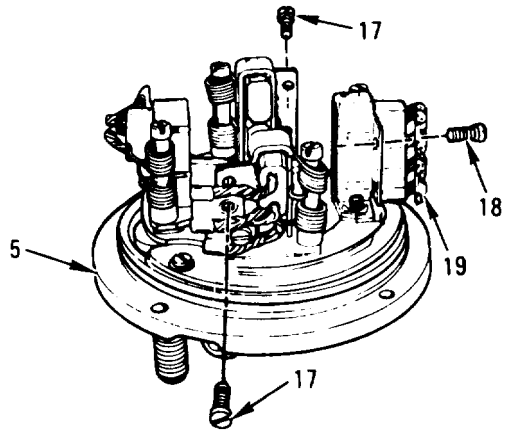
Two screws (17) are not installed until motor is assembled.

    b. Install six screws (18) that hold leads (19). Remove end bell (5) from vise.









Go on to Sheet 11

STARTER MOTOR REPAIR (Sheet 11 of 13)

ASSEMBLY:

1. INSTALL WASHER (1) ON SHAFT (2) AND INSTALL ARMATURE (3). IN FRAME (4).

2. INSTALL WASHER (5), RACES (6, 7), BEARING (8), NEW PACKING (9), AND HOUSING (10) ON FRAME (11).

   a. Fill grease cavity (12) with grease.

NOTE

Inner bearing race (6) is thinner than outer bearing race (7).

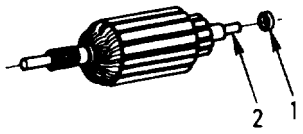
   b. Put washer (5), race (6), bearing (8), and race (7) on shaft (13).

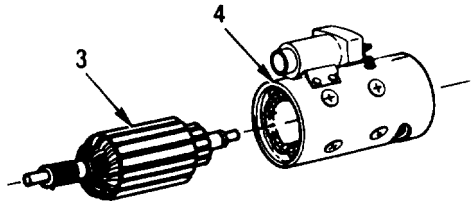
   c. Put packing (9) on housing (10). Slip housing (10) on shaft (13) and guide plunger (14) in switch (15).

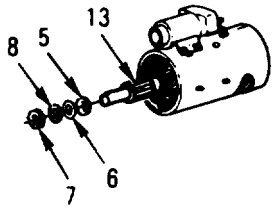
   d. Rock housing (10) gently to make contact with frame (11) and switch (15).

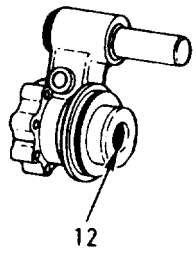
3, SECURE HOUSING (10) TO FRAME (11) WITH FIVE SCREWS (16) AND NEW LOCKWASHERS (17).

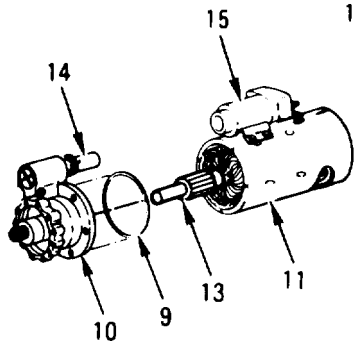
4, INSTALL COLLAR (18) AND NEW PIN (19) ON SHAFT (13). TIGHTEN CLAMP (20),

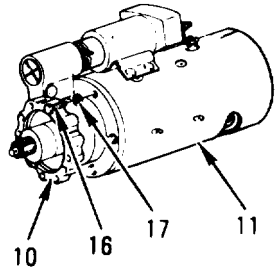


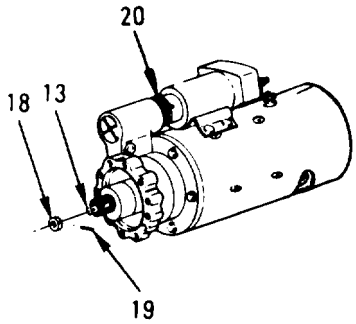












Go on to Sheet 12

STARTER MOTOR REPAIR (Sheet 12 of 13)

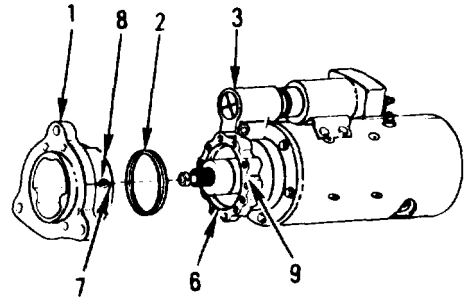
5. INSTALL DRIVE HOUSING (1) AND NEW GASKET (2) ON LEVER HOUSING (3). INSTALL AND TORQUE SIX SCREWS (4, 5) BETWEEN 155-200 LB-IN (18-23 N-m).

   a. Put new gasket (2) in seat (6) on lever housing (3).

   b. Line up scribe mark (7) at pipe plug (8) on drive housing (1) with scribe mark (9) on lever housing (3).

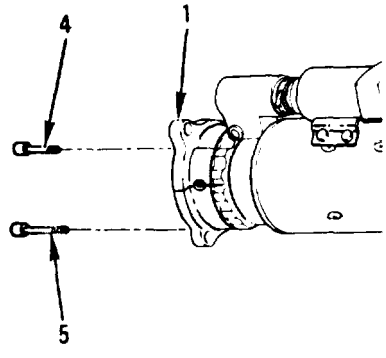
   c. Install short screw (4) in drive housing (1). Install five screws (5) in drive housing (1),

   d. Torque screws (4, 5) between 155-200 lb-in (18-23 N·m).



6. PUT NEW PACKING (10) IN GROOVE (11) ON END BELL (12). PUT END BELL (12) IN CAPPED VISE.

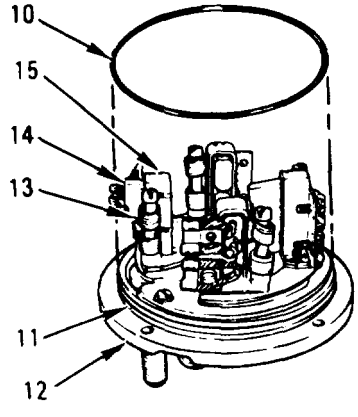
7. LIFT BRUSH SPRING (13) AWAY FROM BRUSH (14). SIDE BRUSH (14) OUT OF HOLDER (15) UNTIL YOU CAN LAY SPRING (13) AGAINST SIDE OF BRUSH (14).

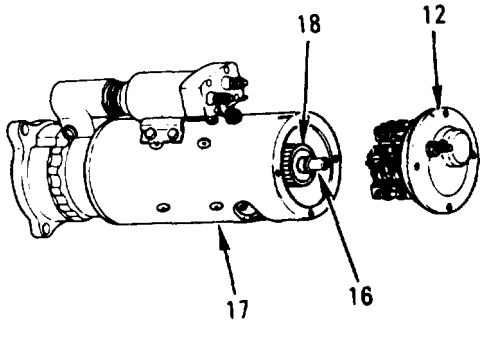


8. REPEAT STEP 7 FOR REMAINING SEVEN BRUSHES (14). THEN TAKE END BELL (12) OUT OF VISE.

9. PULL ARMATURE (16) OUT OF MOTOR (17) UNTIL BAR RISERS (18) STICK OUTSIDE OF MOTOR (17) AS FAR AS POSSIBLE.

10. PUT END BELL (12) IN MOTOR (17) UNTIL FIRST FOUR BRUSHES (14) ARE OVER BAR RISERS (18).





Go on to Sheet 13

STARTER MOTOR REPAIR (Sheet 13 of 13)

11. PRESS FOUR BRUSHES (1) ALL THE WAY IN HOLDERS (2) UNTIL EACH SPRING (3) SNAPS INTO PLACE.

12. PUT END BELL (4) IN MOTOR (5) UNTIL SECOND FOUR BRUSHES (1) ARE OVER BAR RISERS (6). PRESS SECOND FOUR BRUSHES (1) ALL THE WAY IN HOLDERS (2) UNTIL EACH SPRING (3) SNAPS INTO PLACE.

13. ALINE SCRIBE MARK (7) ON MOTOR (5) WITH SCRIBE (8) ON END BELL (4) OR WITH OIL PLUG (9) OF NEW END BELL (4). PUSH END BELL (4) DOWN ON MOTOR (5).

14. SECURE END BELL (4) TO MOTOR (5). ATTACH TWO WINDING LEADS (10) TO BRUSHES (1), AND INSTALL TWO PLUGS (11) AND NEW GASKETS (12).

    a. Install four screws (13) and new lockwashers (14).

    b. Install two screws (15) to hold leads (10) to brushes (1).

    c. Put two gaskets (12) on plugs (11). Install plugs (11).

15. INSTALL LEAD (16).

    a. Put lead (16) on stud (17).

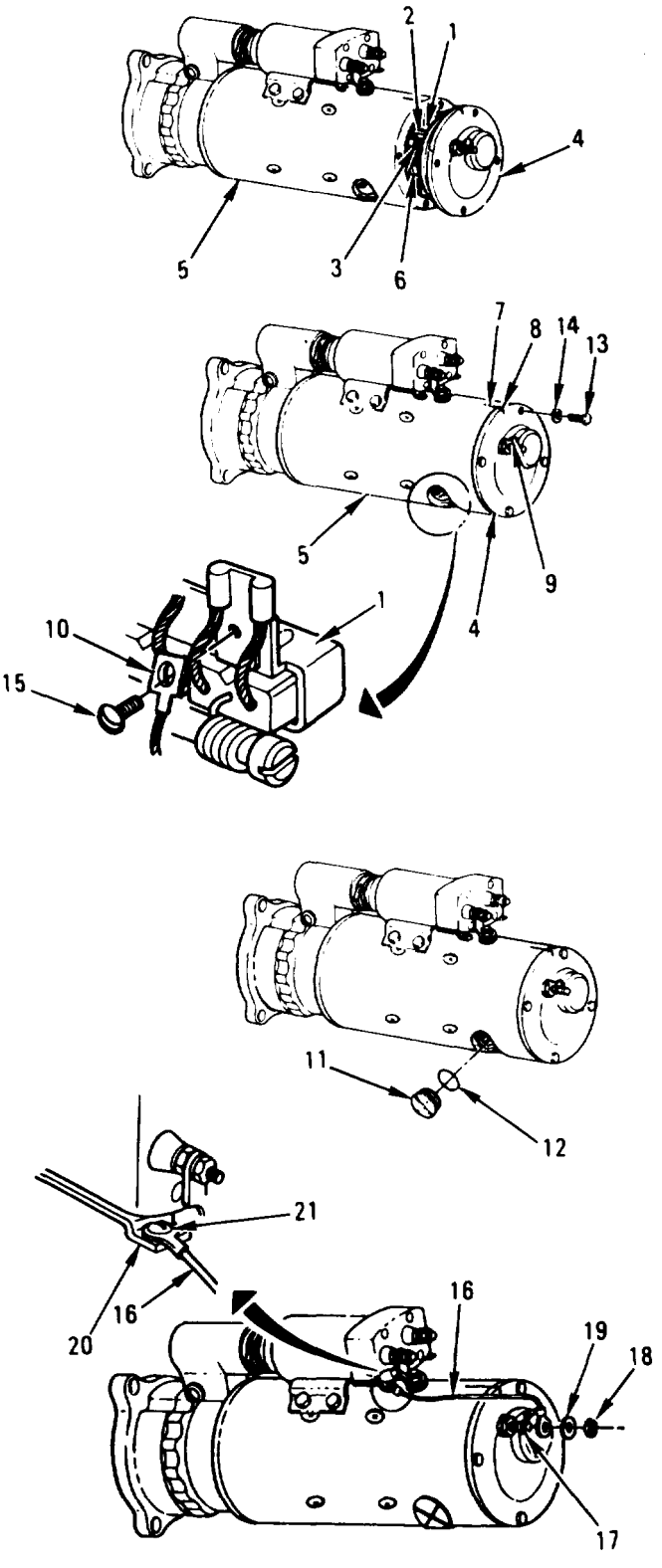
    b. Install nut (18) and new lockwasher (19).

    c. Put other end of lead (16) on terminal (20). Install screw (21).

16. ADJUST STARTER MOTOR END PLAY (PAGE 9-19).

17. LUBRICATE STARTER MOTOR [PAGE 9-19).

18. TEST STARTER MOTOR (PAGE 9-1).



End of Task

STARTER MOTOR LUBRICATION (Sheet 1 of 1)

APPLICABILITY: Starter 1114673

TOOLS: General mechanic's tool kit: automotive (SC 5180-90-N26)

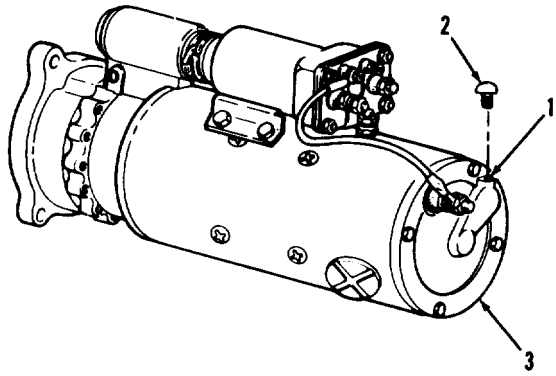
SUPPLIES: Lubricating oil (Item 13, Appendix B)
Wiping rag (Item 14, Appendix B)

LUBRICATION:

FILL MOTOR PIPE PLUG HOLE (1) WITH OIL.

a. Remove pipe plug (2) from commutator end bell (3).

b. Fill hole (1) to top with oil. Install plug (2). Wipe off excess oil with rag.



End of Task

STARTER MOTOR END PLAY ADJUSTMENT (sheet 1 of 3

APPLICABILITY: Starter 114673

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95 -CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Flat tip screwdriver bit, l/2-inch drive, 15/16-inch (Item 51, Appendix D)
Power supply unit (Item 69, Appendix D)
Test setup (Figure 1, Appendix C)

SUPPLIES: Gasket (Item 71, Appendix E)

Go onto Sheet 2

STARTER MOTOR END PLAY ADJUSTMENT (Sheet 2 of 3)

ADJUSTMENT:

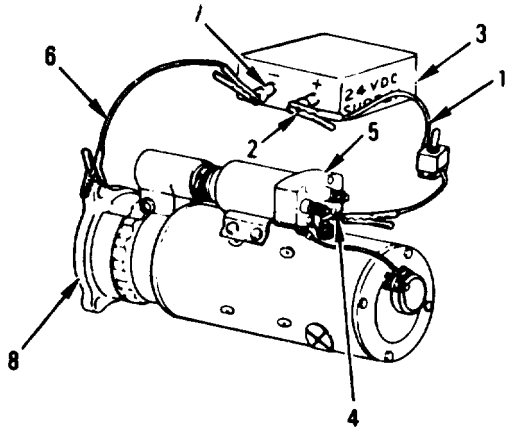
1. CONNECT TEST SETUP.

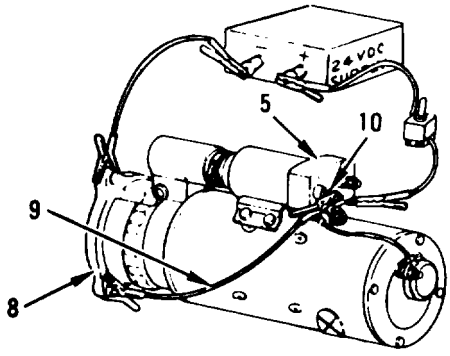
   a. Put cable (1) on positive terminal (2) of power supply (3). Put other end of cable (1) on SW terminal (4) of solenoid switch (5).

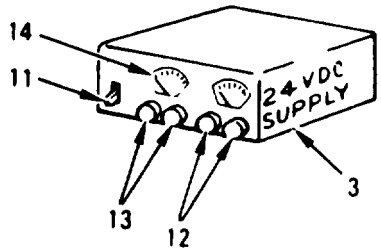
   b. Put cable (6) on negative terminal (7) of power supply (3). Put other end of cable (6) on housing (8).

   c. Put cable (9) on M terminal (10) of switch (5). Put other end of cable (9) on housing (8).

2. SET LINE SWITCH (11) ON POWER SUPPLY (3) TO ON. TURN TWO CURRENT KNOBS (12) CLOCKWISE 3/4-TURN. TURN TWO VOLTAGE KNOBS (13) CLOCKWISE UNTIL VOLTS INDICATOR (14) SHOWS 24 VOLTS.







Go on to Sheet 3

STARTER MOTOR END PLAY ADJUSTMENT (Sheet 3 of 3)

CAUTION

Holding switch (1) ON more than 30 seconds will damage switch (2). Hold switch (1) just long enough to drive clutch motor drive gear (3) against starter housing collar (4).

3. HOLD SWITCH (1) ON UNTIL SWITCH (2) PUSHES GEAR (3) AGAINST COLLAR (4).

4. PUSH GEAR (3) AWAY FROM COLLAR (4) AND TRY TO SLIP 0.040-INCH GAGE BETWEEN GEAR (3) AND COLLAR (4). IF GAGE SLIPS BETWEEN GEAR (3) AND COLLAR (4), SET SWITCH (1) TO OFF AND SKIP STEP 5.

5. PUT 0.030 INCH GAGE BETWEEN GEAR (3) AND COLLAR (4). IF GAGE WILL NOT FIT, OR IS VERY LOOSE, DO STEPS 6 THRU 9.

6. REMOVE PLUG (5). PULL GASKET (6) OFF PLUG (5).

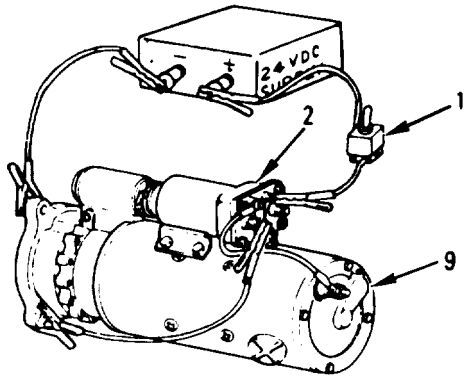
7. SET SWITCH (1) TO ON UNTIL SWITCH (2) PUSHES GEAR (3) AGAINST" COLLAR (4).

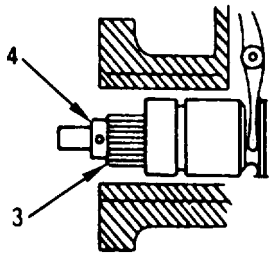
8. PUT 0.035-INCH GAGE BETWEEN GEAR (3) AND COLLAR (4) AND TURN LEVER NUT (7) TO POINT WHERE GAGE JUST SLIPS OUT. SET SWITCH (1) TO OFF AND TURN OFF POWER SUPPLY (8). IF END PLAY WILL NOT ADJUST, DO STEPS 9 AND 10 AND REPLACE MOTOR (9).

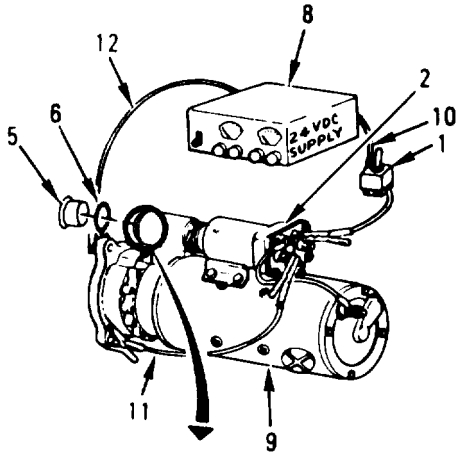
9, INSTALL PLUG (5) AND NEW GASKET (6).

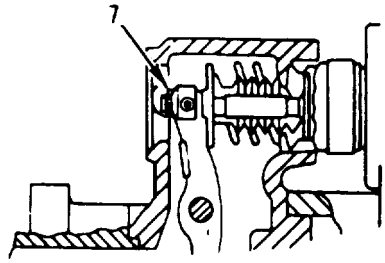
10. REMOVE CABLES (10, 11, 12) FROM POWER SUPPLY (8) AND MOTOR (9).

11. TEST STARTER MOTOR (PAGE 9-l).









End of Task

STARTER MOTOR TEST (Sheet 1 of 3)

APPLICABILITY: Starter 1114678

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Alternator and starter automotive generator test stand (Item 45, Appendix D)
Chemical and oil protective gloves (Item 87, Appendix D)
Cross tip screwdriver bit, l/2-inch drive (Item 46, Appendix D)
Electric impact wrench, l/2-inch drive (Item 44, Appendix D)
Flat tip screwdriver bit, 3/8-inch drive, 11/16-inch (Item 47, Appendix D)
Industrial goggles (Item 58, Appendix D)
Multimeter (Item 49, Appendix D)
Rubber mallet (Item 26, Appendix D)

SUPPLIES: Dry cleaning solvent (Item 7, Appendix B)
Gasket (Item 71, Appendix E) (2 required)
Wiping rag (Item 14, Appendix B)

REFERENCES: TM 9-4910-485-12

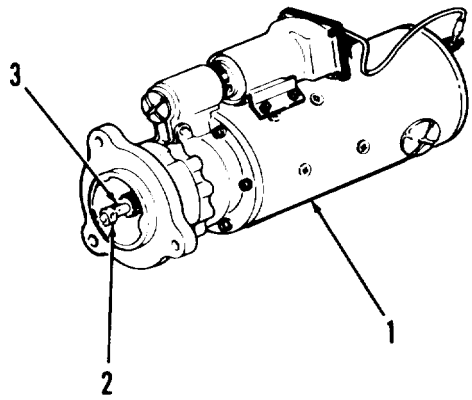
TEST:

WARNING

1. CLEAN MOTOR (1) AND CHECK ARMATURE ROTATION.

   a. Clean outside of motor (1) with solvent and rag.

   b. Turn starter housing collar (2)lockwise and counterclockwise. If collar (2) and armature shaft (3) do not turn freely, repair starter motor (page 9-28).



Goon to Sheet 2

STARTER MOTOR TEST (Sheet 2 of 3)

2. REMOVE TWO PLUGS (1) AND GASKETS (2). INSPECT PLUGS (1) FOR DAMAGE. REPLACE AS REQUIRED.

3. TEST ARMATURE CONTINUITY.

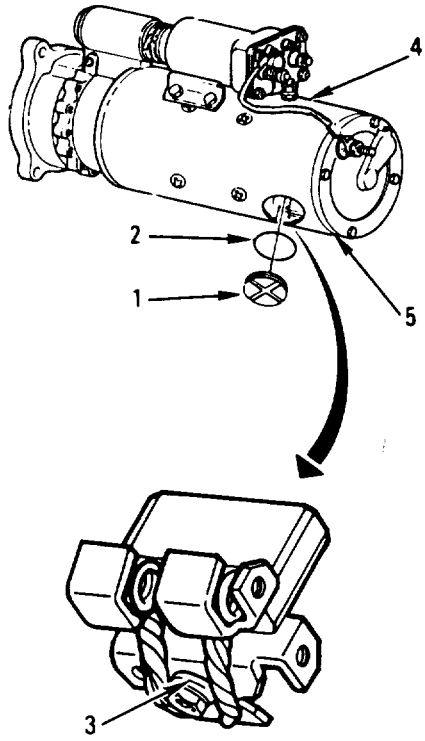
   a. Set multimeter to RX1 scale and check continuity between two brush terminals (3). If multimeter reads 10 ohms or more, replace motor (4).

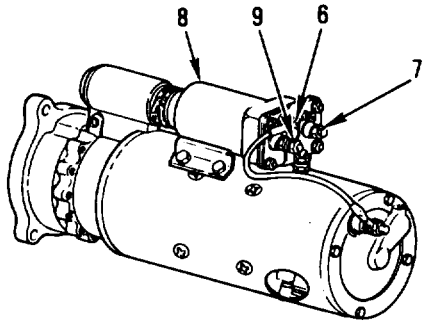
   b. Set multimeter to RX10,000 scale and check continuity between each terminal (3) and motor housing (5). If multimeter reads anything except infinity, replace motor (4).

4. TEST SOLENOID RESISTANCE.

   a. Set multimeter to RX1 scale and check resistance between switch terminal (6) and B terminal (7). If multimeter reads 10 ohms or less, go to step b. If multimeter reads more than 10 ohms, replace starter motor solenoid switch (page 9-25).

   b. Set multimeter to RX10,000 scale and check resistance between switch terminal (6) and case (8). Check resistance between M terminal (9) and case (8). Check resistance between B terminal (7) and case (8). If multimeter reads anything except infinity for any of three checks, replace starter motor solenoid switch (page 9-25).





Go on to Sheet 3

STARTER MOTOR TEST (Sheet 3 of 3)

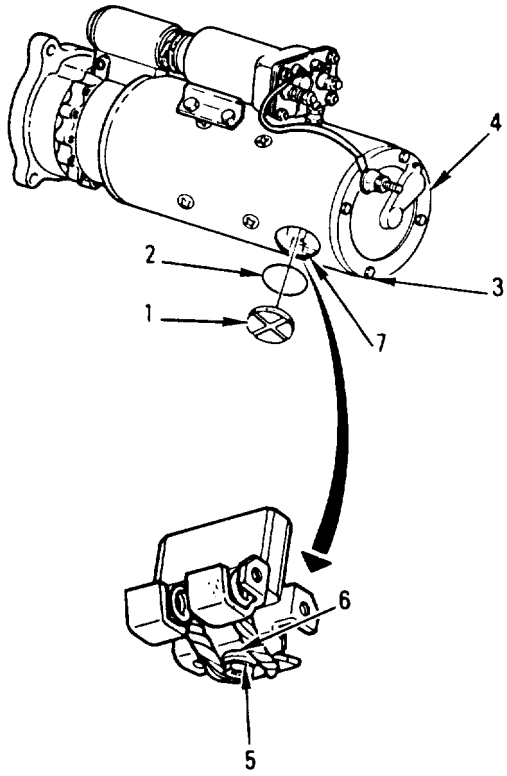
5. CHECK MOTOR CURRENT, SPEED, AND VOLTAGE WITH (TABLE 9-3) AND (TM 9-4910-485-12).

Table 9-3. Currant, Speed, and Voltege Accepted Values

Measurement	Accepted Values
Current	**70 to 110 Amps dc**
Speed	**5500 to 9000 RPM**
Voltage	**20 V dc**

6. IF CHECK DOES NOT GIVE THE ACCEPTED VALUES SHOWN IN TABLE 9-3, OR IF MOTOR VIBRATES AND NOISE IS HEARD, SKIP STEP 7.

7. INSTALL TWO PLUGS (1) AND NEW GASKETS (2). GO TO INSPECTION STEP 6.



INSPECTION:

1. INSPECT FOUR SCREWS (3) IN COMMUTATOR END BELL (4) FOR TIGHTNESS. IF ANY SCREW (3) IS LOOSE, TIGHTEN IT.

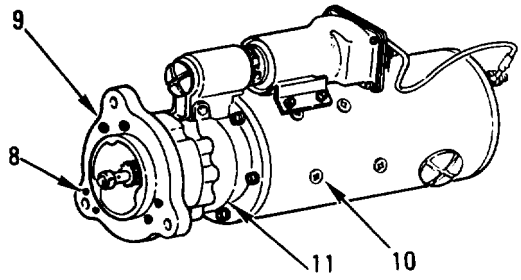
2. INSPECT TWO SCREWS (5) HOLDING BRUSH LEADS (6) FOR TIGHTNESS. IF EITHER SCREW (5) IS LOOSE, TIGHTEN IT THROUGH OPENING (7). INSTALL TWO PLUGS (1) AND NEW GASKETS (2).

3. INSPECT SIX SCREWS (8) IN DRIVE HOUSING (9) AND EIGHT POLE SHOE SCREWS (10) FOR TIGHTNESS. IF ANY SCREW (8, 10) IS LOOSE TIGHTEN IT.

4. INSPECT LEVER HOUSING (11) FOR TIGHTNESS. IF LOOSE, REPAIR STARTER MOTOR (PAGE 9-28).

5. REPEAT TEST STEPS 5 AND 6. IF MOTOR STILL DOES NOT GIVE ACCEPTED VALUES SHOWN IN TABLE 9-3 OR MOTOR VIBRATES AND NOISE IS STILL HEARD, REPAIR STARTER MOTOR (PAGE 9-28).

6. LUBRICATE STARTER MOTOR (PAGE 9-40).



End of Task

STARTER MOTOR SOLENOID SWITCH REPLACEMENT (Sheet 1 of 2)

APPLICABILITY: Starter 1114678

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CLB08)
Combination wrench, 3/8-inch (Item 71, Appendix D)
Combination wrench, 3/4-inch (Item 72, Appendix D)

SUPPLIES: Lockwasher (Item 75, Appendix E)

REMOVAL:

1. REMOVE SWITCH (1).

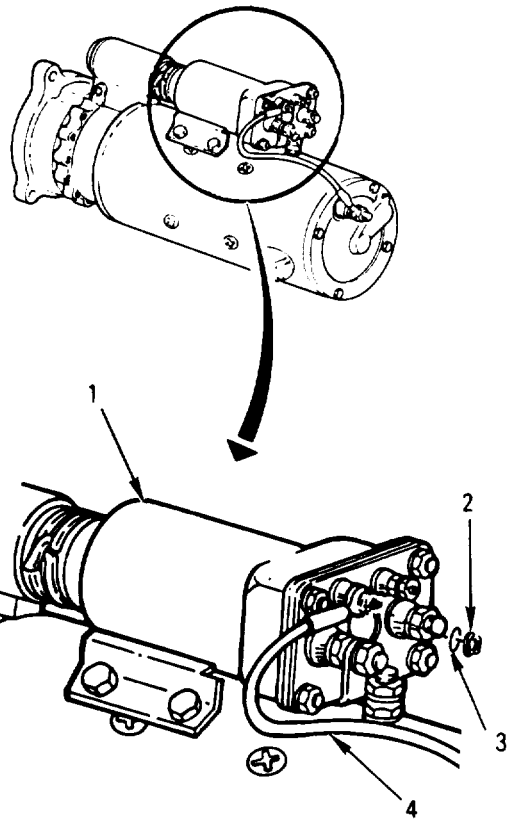
   a. Remove nut (2) and lockwasher (3). Remove electrical lead (4) from switch (1).

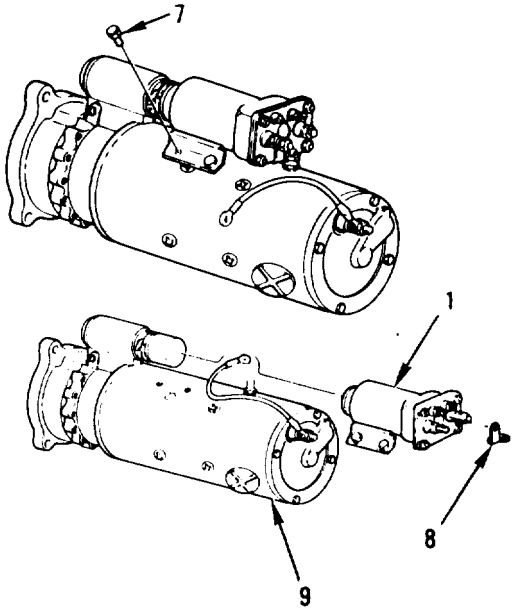
   b. Remove two nuts (5). Loosen clamp (6).

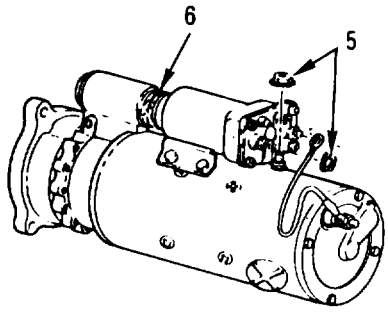
   c. Remove four screws (7). Pull terminal connector (8) off motor (9) and switch (1).

   d. Rock switch (1) back and fourth and pull switch (1) up and out from motor (9).

2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.







Go on to Sheet 2

STARTER MOTOR SOLENOID SWITCH REPLACEMENT (Sheet 2 of 2)

INSTALLATION:

1. INSTALL SWITCH (1).

NOTE

Make sure clamp (2) is centered over boot (3).

a. Put plunger assembly (4) in plunger (5). Rock switch (1) until four switch mounting holes (6) aline with housing holes (7).

NOTE

Make sure that ridge of boot (3) is inside lever housing (8) and that smooth end of boot (3) is around plunger (5).

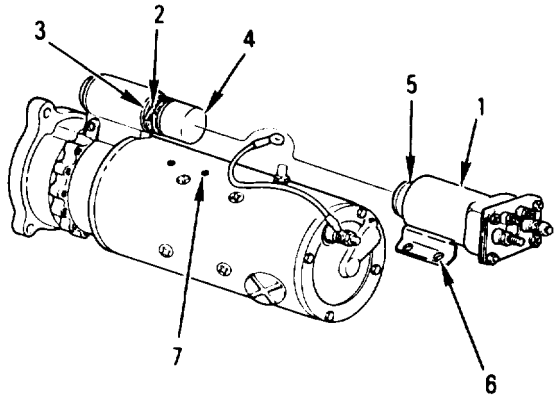
b. Put connector (9) on stud (10) and switch terminal (11). Install four screws (12). Tighten clamp (2).

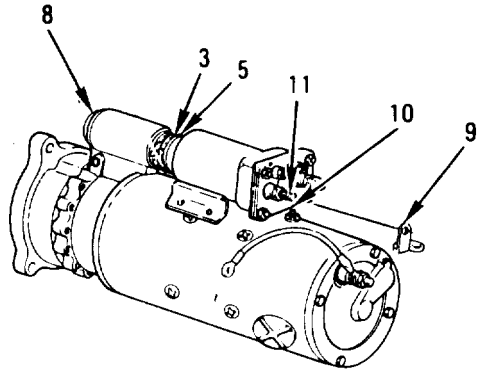
c, Install two nuts (13) on stud (10) and terminal (11).

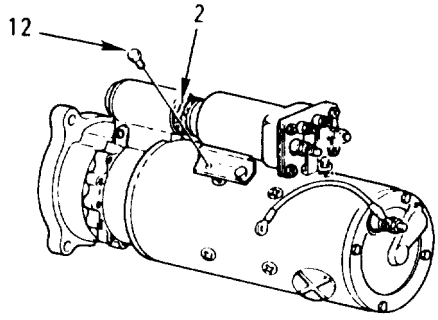
d. Put lead (14) on switch terminal (15), Install nut (16) and new lockwasher (17).

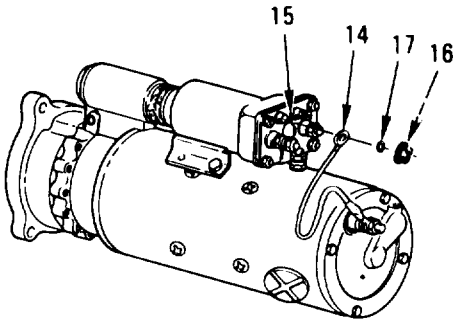
2. LUBRICATE STARTER MOTOR (PAGE 9-40).

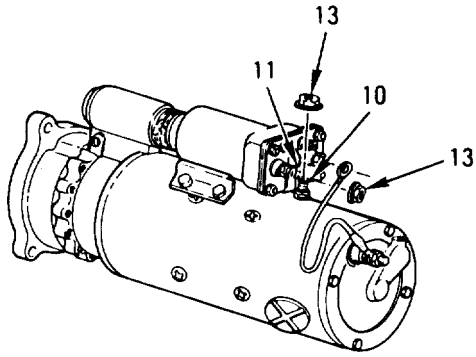
3. TEST STARTER MOTOR (PAGE 9-22).











End of Task

STARTER MOTOR SOLENOID SWITCH REPAIR (Sheet 1 of 1)

APPLICABILITY: Starter 1114678

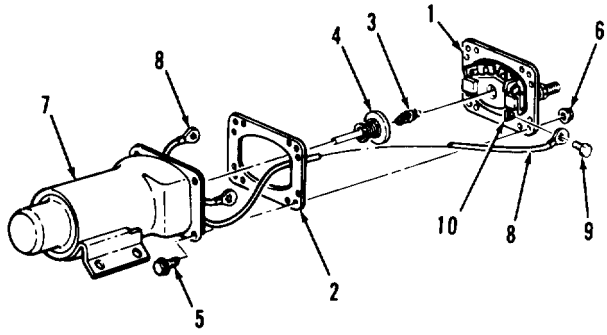
TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95 -CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Multimeter (Item 49, Appendix D)

SUPPLIES: Gasket (item 72, Appendix E)
Helical spring (Item 91, Appendix E)

EQUIPMENT CONDITION: Starter motor solenoid switch removed (page 9-25)

DISASSEMBLY:

1. REMOVE PLATE ASSEMBLY (1), GASKET (2), HELICAL SPRING (3), AND CONTACT ASSEMBLY (4).
   a. Remove four screws (5) and nuts (6) from plate (1).
   b. Lift plate (1), spring (3), and contact (4) from solenoid switch case (7) as far as electrical leads (8) will allow. Remove contact (4) and spring (3).
   c. Remove three screws (9) from leads (8).
   d. Remove gasket (2) from plate (1).
2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.



ASSEMBLY:

1. INSTALL PLATE (1), NEW GASKET (2), NEW SPRING (3), AND CONTACT (4).

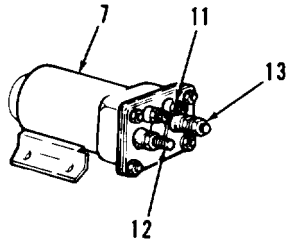
a. Install gasket (2) on plate (1). Install contact (4) and spring (3) in case (7).

b. Install three screws (9) through ends of leads (8). Install screws (9) on terminals (10). Aline plate (1) to case (7).

c. [nstall four screws (5) and nuts (6) through plate (1) and case (7).

2. SET MULTIMETER TO RX10,000 SCALE. CHECK CONTINUITY BETWEEN TERMINAL (11) AND CASE (7) AND BETWEEN M TERMINAL (12) AND CASE (7). CHECK CONTINUITY BETWEEN B TERMINAL (13) AND CASE (7). IF MULTIMETER READS ANYTHING OTHER THAN INFINITY, REPLACE STARTER MOTOR SOLENOID SWITCH (PAGE 9-25).

3. INSTALL STARTER MOTOR SOLENOID SWITCH (PAGE 9-26).



End of Task

STARTER MOTOR REPAIR (Sheet 1 of 12)

APPLICABILITY: Starter 1114678

TOOLS: Automotive fuel and electrical system repair tool kit(SC 5180-95-CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Air blow gun (Item 59, Appendix D)
Armature test set (Item 64, Appendix D)
Armature undercutter (Item 65, Appendix D)
Chemical and oil protective gloves (Item 87, Appendix D)
Combination wrench, 3/8 inch (Item 71, Appendix D)
Deep style socket, 3/8-inch drive, 3/4-inch (Item 53, Appendix D)
Dial indicator (Item 62, Appendix D)
Electric impact wrench, l/2-inch drive (Item 44, Appendix D)
Engine lathe (Item 63, Appendix D)
Faceshield (Item 88, Appendix D)
Flat tip screwdriver bit, 3/8-inch drive, 11/16-inch (Item 47, Appendix D)
Flat tip screwdriver bit, l/2-inch drive, 15/16-inch (Item 51, Appendix D)
Hacksaw blade (Item 56, Appendix D)
Industrial goggles (Item 58, Appendix D)
Machinist's vise (Item 55, Appendix D)
Multimeter (Item 49, Appendix D)
Nonmetallic hose assembly (Item 61, Appendix D)
Oil and water separator (Item 76, Appendix D)
Outside caliper (Item 57, Appendix D)
Reciprocating compressor unit (Item 60, Appendix D)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)
Vise jaw caps (Item 54, Appendix D)

SUPPLIES: Adhesive (Item 1, Appendix B)
Brush (Item 92, Appendix E)(4 required)
Dry cleaning solvent (Item 7, Appendix B)
Electrical parts kit (Item 82, Appendix E)
Gasket (Item 71, Appendix E) (2 required)
Gasket (Item 88, Appendix E)
Grease (Item 9, Appendix B)
Hose clamp (Item 77, Appendix E)
Insulator (Item 78, Appendix E)
Lockwasher (Item 39, Appendix E) (9 required)
Lockwasher (Item 75, Appendix E)
Pin (Item 90, Appendix E)
Preformed packing (Item 79, Appendix E)
Preformed packing (Item 80, Appendix E)
Preformed packing (Item 81, Appendix E)
Preformed packing (Item 89, Appendix E)(2 required)
Retaining ring (Item 83, Appendix E)(2 required)
Sandpaper (Item 17, Appendix B)
Sealing compound (Item 18, Appendix B)
Self-locking nut (Item 93, Appendix E)
Washer (Item 87, Appendix E) (2 required)
Wiping rag (Item 14, Appendix B)

EQUIPMENT CONDITION: Starter motor tested (page 9-22)

Go on to Sheet 2

STARTER MOTOR REPAIR (Sheet 2 of 12)

DISASSEMBLY:

1. SCRIBE A STRAIGHT LINE (1) FROM ELECTRICAL COMMUTATOR END BELL (2) TO MOTOR FIELD WINDING FRAME (3) IN LINE WITH OIL FILL PLUG (4).

2. REMOVE ELECTRICAL LEAD (5), TWO PLUGS (6), AND GASKETS (7).

   a. Remove nut (8) and lockwasher (9). Lift lead (5) from terminal stud (10).

   b. Remove nut (11) from terminal stud (12) and solenoid switch (13). Remove lead (5) from stud (12).

   c. Remove plugs (6) and gaskets (7).

3. INSPECT PLUGS (6) FOR DAMAGE. REPLACE AS REQUIRED.

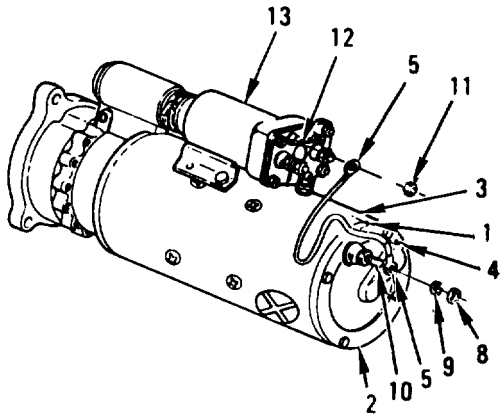
4. REMOVE END BELL (2) AND PREFORMED PACKING (14).

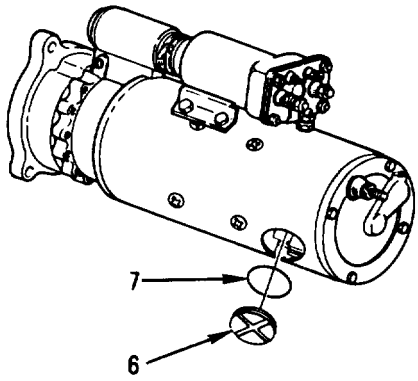
   a. Remove two screws (15) holding motor field winding leads (16) to brushes (17).

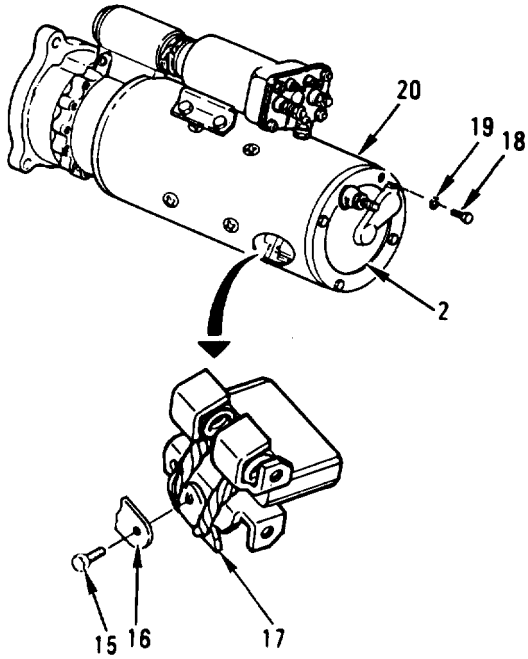
   b. Remove four screws (18) and lockwashera (19) from end bell (2).

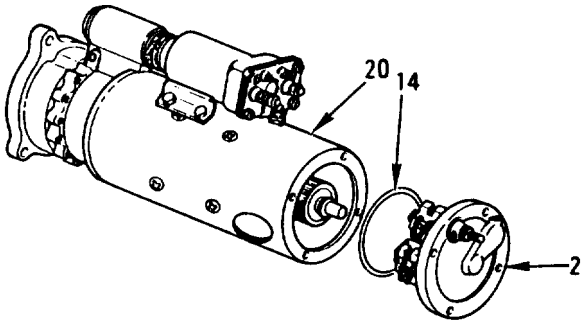
   c. Tap end bell (2). Pry end bell (2) off motor frame (20).

   d. Pull packing (14) off end bell (2).









Go on to Sheet 3

STARTER MOTOR REPAIR (Sheet 3 of 12)

5. SCRIBE A STRAIGHT LINE (1) ACROSS DRIVE HOUSING (2) AND LEVER HOUSING (3) AT PIPE PLUG (4).

6. REMOVE SIX SCREWS (5). TAP HOUSING (2) FROM HOUSING (3). REMOVE GASKET (6).

7. REMOVE HOUSING (3). PREFORMED PACKING (7), OUTER THRUST BEARING RACE (8), NEEDLE BEARING (9), INNER BEARING RACE (10), AND WASHER (11).

   a. Tap out valve to shaft pin (12) from housing collar (13). Pull off collar (13).

   b. Remove five screws (14) and lockwashers (15) from housing (3). Loosen clamp (16).

NOTE

Clutch motor drive (17) may fall out of housing (3) when housing (3) is removed from winding frame 18).

   c. Pry housing (2) from frame (18) and switch (19).

   d. Remove packing (7) from housing (3).

   e. Remove outer race (8), bearing (9), inner race (10), and washer (11) from armature shaft (20).

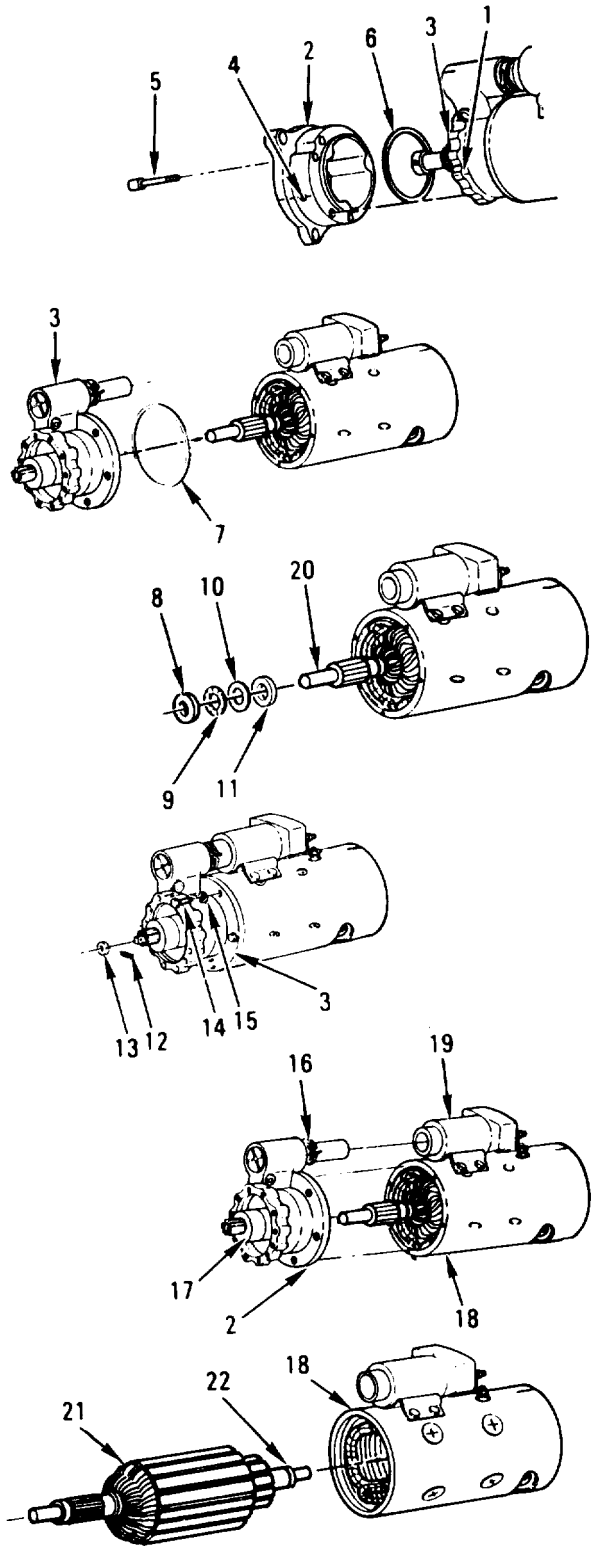
8. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

9. REMOVE STARTER MOTOR ARMATURE (21) AND WASHER (22) FROM FRAME (18).

REPAIR:

NOTE

If starter motor is found to be damaged, assemble starter motor (page 9-37) and replace.



Go on to Sheet 4

STARTER MOTOR REPAIR (Sheet 4 of 12)

1. INSPECT FOUR SHOE POLES (1) AND FRAME (2) FOR CRACKS OR BREAKS. INSPECI' WINDING (3) FOR CRACKS, BREAKS, BURNED INSULATION, BROKEN WIRES, OR STRIPPED THREADS ON STUD (4). REPLACE AS REQUIRED.

2 REMOVE AND INSPECT SPACER WASHER (5) FOR DAMAGE. REPLACE AS REQUIRED.

NOTE

Do steps 3 and 4 for each bar riser (6). If armature (7) is damaged, assemble starter motor (page 9-37) and replace.

3. PUT ARMATURE (7) IN GROWLER (8). PUT BLACK NEGATIVE PROBE (9) ON ARMATURE CORE (10) AND RED PROBE (11) ON RISER (6). IF LIGHT ON GROWLER (8) LIGHTS, ASSEMBLE STARTER MOTOR (PAGE 9-37) AND REPLACE.

4. PUT BLACK PROBE (9) ON SHAFT (12) AND RED PROBE (11) ON RISER (6). IF LIGHT ON GROWLER (8) LIGHTS, ASSEMBLE STARTER MOTOR (PAGE 9-37) MOTOR AND REPLACE.

5, TEST ARMATURE (7) FOR SHORT CIRCUITS.

NOTE

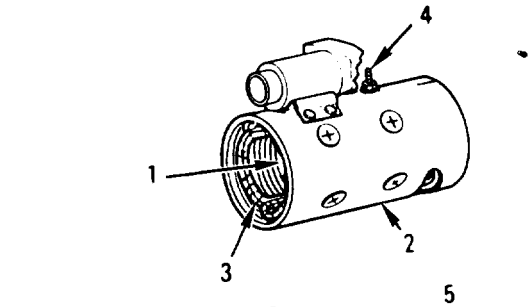
Short circuit in armature (7) will pull hacksaw blade against core (10) and cause blade to vibrate.

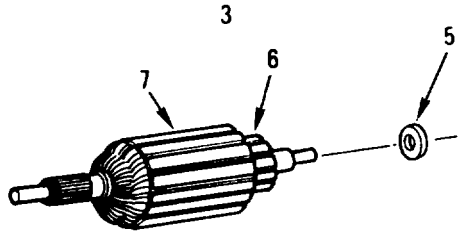
a, With growler (8) turned on, hold hacksaw blade about l/32-inch (0.794 mm) away from armature (7).

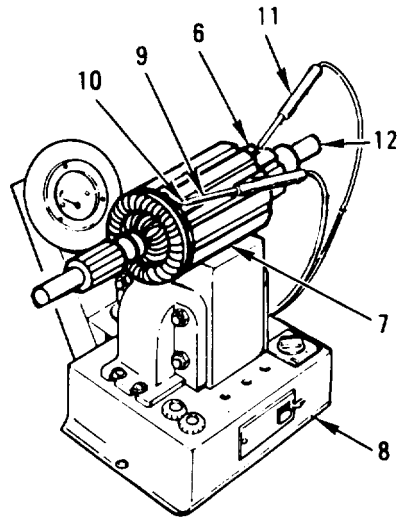
b. Turn armature (7) slowly. If blade is pulled against core (10), assemble starter motor (page 9-37) and replace.

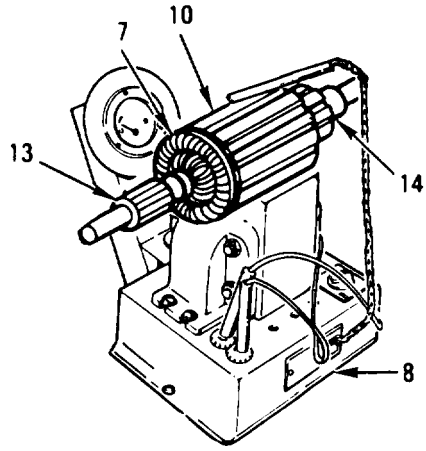
6 INSPECT SHAFT SPLINES (13) FOR DAMAGE. IF DAMAGED ASSEMBLE STARTER MOTOR (PAGE 9-37) AND REPLACE.

7 INSPECT CONTACT SURFACE (14) FOR ROUGH SURFACE, PITS, BURNS, OR HARD CARBON OR OIL COAT. IF DAMAGED, DO STEPS 8, 9, AND 10.









Go on to Sheet 5

STARTER MOTOR REPAIR (Sheet 5 of 12)

8. INSPECT COMMUTATOR (1) FOR WEAR.

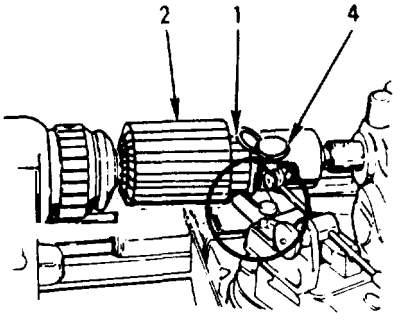
a. Measure diameter of commutator (1). Check wear limits (table 9-4).

Table 9-4. Armature Wear Limits

Point of Measurement	Sizes and Fits of New Parts	Direct and General Support Wear Limits
Commutator Diameter	2.1150 to 2.1250 (5.37 cm to 5.40 cm)	
Commutator Minimum Turned Diameter		2.000 (5.08 cm)
Commutator Diameter Total Indicator Runout with Shaft Diameter at Bearings	0.0020 (0.0508 mm)	

b. If armature (2) is worn beyond limits shown in table 9-4, assemble starter motor (page 9-37) and replace,

c. Put armature (2) in lathe and position cutting tool (3) and dial indicator (4) against commutator (1).



WARNING

Always wear eye protection when operating a lathe. Failure to wear eye protection could result in serious injury.

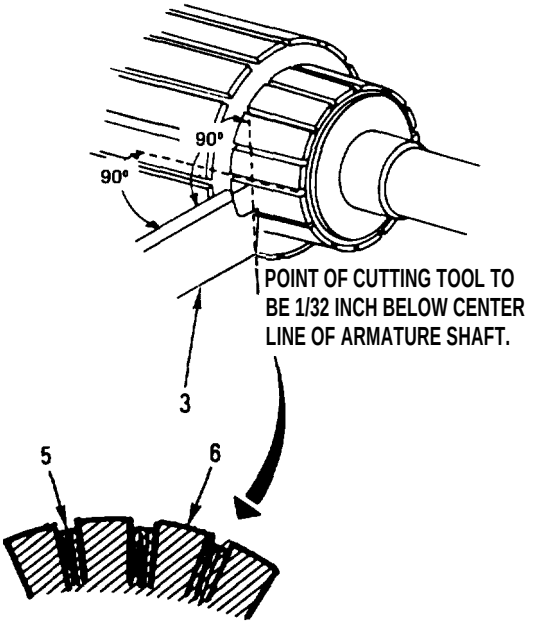
9. CUT 0.007-INCH (0.018 MM) OFF COMMUTATOR (1) AND UNDERCUT MICA (5) To l/32-INCH (0.794 MM) DEEP AND l/32-INCH (0.794 MM) WIDE.

a. Turn lathe on. Watch indicator (4). Cut 0,005-inch (0.013 mm) off commutator (1) with tool (3). Turn lathe off. Check commutator (1) for clean smooth surface.

b. Repeat step a and make final cut 0.002-inch (0.058 mm). Watch indicator (4) to make sure that total indicator runout is within the wear limits shown in table 9-4,

c. Turn off lathe. Pull tool (3) and indicator (4) away from commutator (1).

d Start grooves in mica (5) with file. Undercut mica (5) with piece of hacksaw blade to l/32-inch (0.794 mm) deep and l/32-inch (0.794 mm) wide. Mica (5) must be cut away clean between segments (6) of commutator (1).



Go on to Sheet 6

STARTER MOTOR REPAIR (Sheet 6 of 12)

WARNING

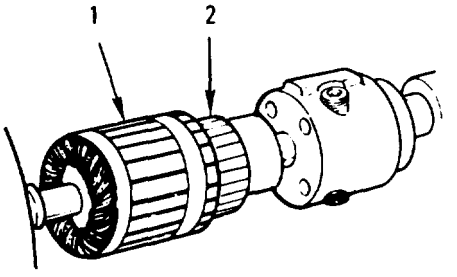
Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip-guarding and personal protective equipment (goggles/faceShield, gloves, etc.).

10. CLEAN ARMATURE (1) AND CHECK DIAMETER OF COMMUTATOR (2).

    a. Blow off loose copper and mica particles from commutator (2) with low pressure air.

    b. Turn lathe on. Polish commutator (2) with sandpaper. Turn lathe off.

    c. Check diameter of commutator (2) to limits shown in table 9-4 (page 9-32). If commutator (2), is not within limits, assemble starter motor (page 9-37) and replace.



Go on to Sheet 7

STARTER MOTOR REPAIR (Sheet 7 of 12)

11. REMOVE PLUG (1) FROM HOUSING (2). PULL GASKET (3) OFF PLUG (1). INSPECT PLUG (1) FOR DAMAGE. REPLACE AS REQUIRED.

12. REMOVE PLUNGER (4), RECESSED WASHERS (5, 6), HELICAL SPRING (7), BOOT (8), AND WASHER (9).

    a. Remove linkage nut (10). Remove plunger (4) from housing (2).

    b. Remove clamp (11) from plunger (4).

    c. Remove retaining ring (12) from plunger (4).

    d. Remove washer (5), spring (7), washer (6), boot (8), and washer (9) from plunger (4).

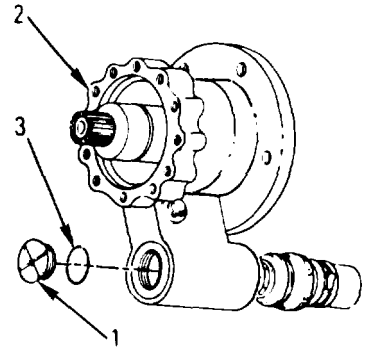
13. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

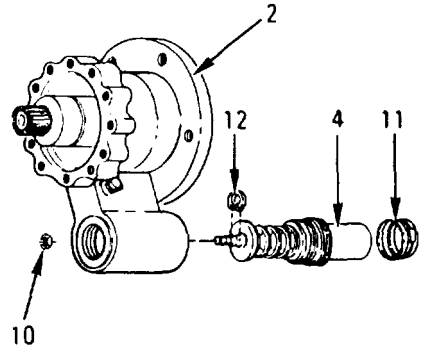
14. REMOVE MOTOR DRIVE (13), SHOULDERED SHAFT (14), TWO PREFORMED PACKINGS (15), AND LEVER ASSEMBLY (16).

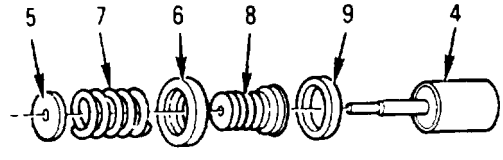
    a. Remove retaining ring (17) from shaft (14). Remove shaft (14). Remove packings (15) from shaft (14).

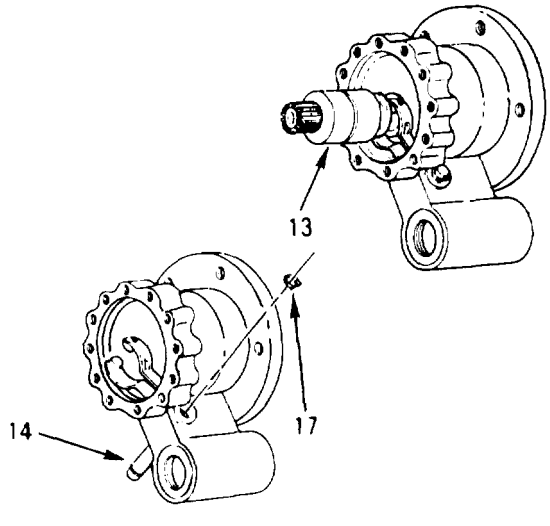
    b. Remove lever (16) from housing (18).

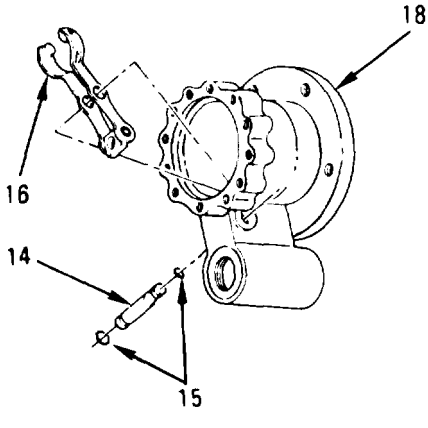
15. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.









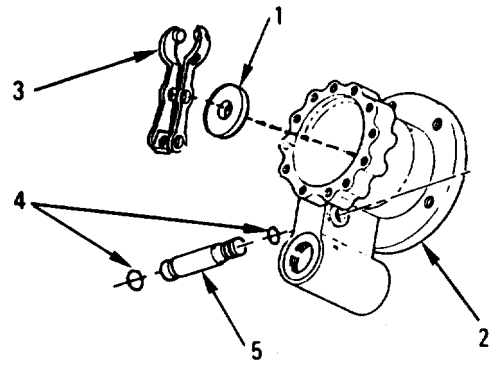


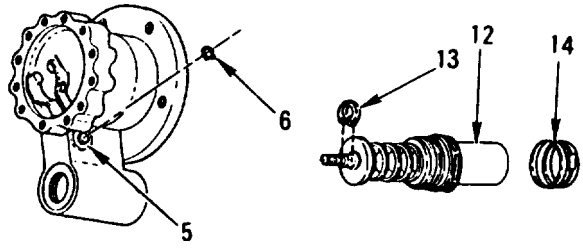
Go on to Sheet 8

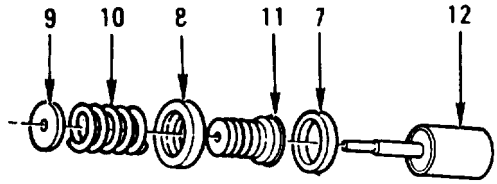
STARTER MOTOR REPAIR (Sheet 8 of 12

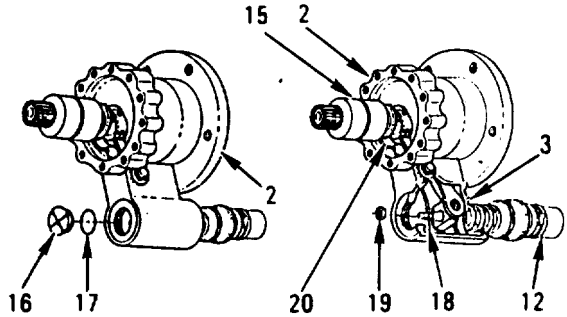
WARNING

16. REMOVE FIBER WASHER (1) FROM HOUSING (2) AND CLEAN HOUSING (2) AND WASHER (1) WITH SOLVENT AND RAG.
17. INSTALL WASHER (1), LEVER (3), TWO NEW PACKINGS (4), AND SHAFT (5).
    a. Apply adhesive on back of washer (1). Put washer (1) in housing (2).
    b. Put lever (3) in housing (2).
    c. Coat packings (4) with grease. Put packings (4) on shaft (5). Put shaft (5) through housing (2) and lever (3).
    d. Put new retaining ring (6) on shaft (5).
18. INSTALL WASHERS (7, 8, 9), SPRING (10), AND BOOT (11).
    a. Install washer (7), boot (11), washer (8), spring (10), and washer (9) on plunger (12).
    b. Install new retaining ring (13) on plunger (12).
    c. Loosely install new clamp (14) on plunger (12) where boot (11) overlaps plunger (12).
19 INSTALL PLUNGER (12), DRIVE (15), PLUG (16), AND NEW PACKING (17) IN HOUSING (2).
    a. Put plunger shaft (18) in housing (2) and through lever (3).
    b. Install new nut (19) on threads of shaft (18).
    c. Pull lever ears (20) to front of housing (2). Put grease on ears (20). Put drive (15) between ears (20).
    d. Push drive (15) in housing (2). Put packing (17) on plug (16). Install plug (16) on housing (2).









Go on to Sheet 9

STARTER MOTOR REPAIR (Sheet 9 of 12)

20, PUT END BELL (1) IN VISE. REMOVE FOUR SCREWS (2) FROM BRUSH LEADS [3). PULL FOUR BRUSHES (4) OUT OF BRUSH HOLDERS (5).

21. SET MULTIMETER TO RX1000 SCALE AND CHECK CONTINUITY BETWEEN TERMINAL STUD (6) AND TWO INSULATED BRUSH HOLDERS (7). IF MULTIMETER READS LESS THAN INFINITY FOR EITHER CHECK, SKIP STEP 22.

22. SET MULTIMETER TO RX1 SCALE. CHECK CONTINUITY BETWEEN STUD (6) AND TWO GROUND BRUSH HOLDERS (8). IF MULTIMETER READS 10 OHMS OR LESS, GO TO STEP 28.

23. SEPARATE HOLDER ASSEMBLY (9) AND END BELL (1).

    a. Remove nut (10), lockwasher (11), washer (12), and insulator (13) from stud (6).

    b. Remove three screws (14), lockwashers (15), and washers (16) from holder (9). Tap stud (6) until holder (9) separates from end bell (1).

24. PULL PREFORMED PACKING (17) AND TWO WASHERS (18) FROM STUD (6). REMOVE HOLDER (9).

25. INSPECT END BELL (1) FOR CRACKS OR BREAKS. INSPECT BUSHING (19) FOR CRACKS, BREAKS, OR SCORE MARKS. REPLACE AS REQUIRED.

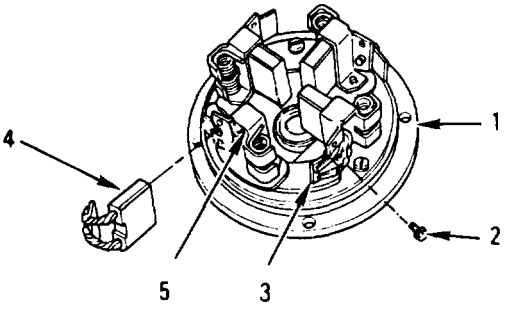
26. INSTALL TWO NEW WASHERS (18) AND NEW PACKING (17) ON HOLDER (9) AND END BELL (1)

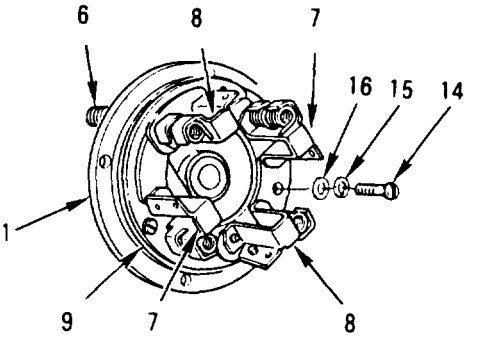
    a. Put washers (18) and packing (17) on stud (6) of holder (9).

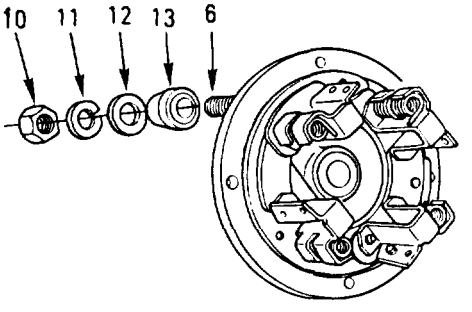
    b, Apply sealing compound to back of holder (9).

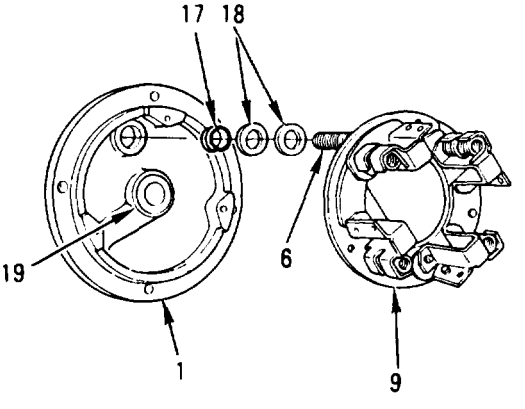
    c. Aline holder (9) with end bell (1). Install three screws (14), new lockwashers (15), and washers (16).

27. INSTALL NUT (10), NEW LOCKWASHER (11), WASHER (12), AND NEW INSULATOR (13) ON STUD (6).









Go on to Sheet 10

STARTER MOTOR REPAIR (Sheet 10 of 12)

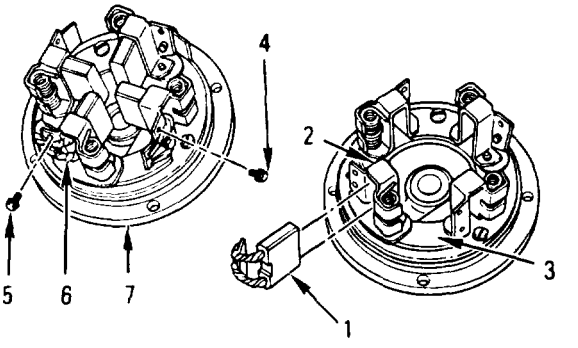
28. INSTALL FOUR NEW BRUSHES (1) IN HOLDERS (2).

    a. Put brushes (1) in holders (2) from center of brush holder assembly (3).

NOTE

Two screws (4) are not installed until motor is assembled.

    b. Install four screws (5) holding leads (6). Remove end bell (7) from vise.

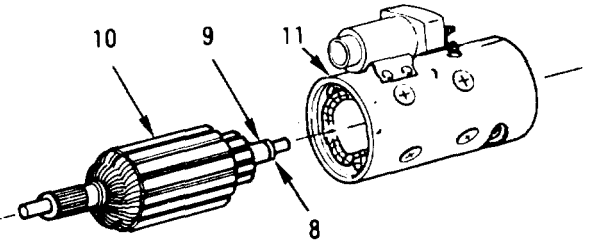


ASSEMBLY:

1. INSTALL WASHER (8) ON SHAFT (9) AND INSTALL ARMATURE (10) IN FRAME (11).

2. INSTALL WASHER (12), RACES (13, 14), BEARING (15), NEW PACKING (16), AND HOUSING (17) ON FRAME (11).

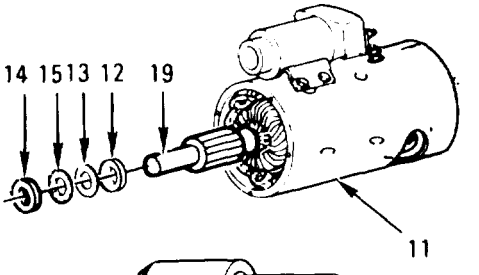
    a. Fill grease cavity (18) with grease.



NOTE

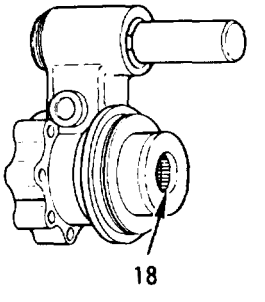
Inner bearing race (13) is thinner than outer bearing race (14).

    b. Put washer (12), race (13), bearing (15), and race (14) on shaft (19).



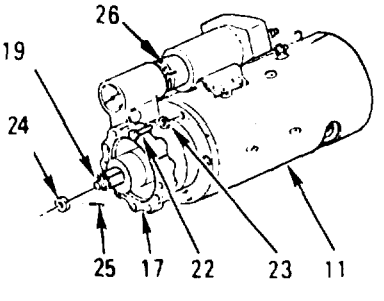
    c. Put packing (16) on housing (17). Slip housing (17) on shaft (19) and guide plunger (20) in body (21).

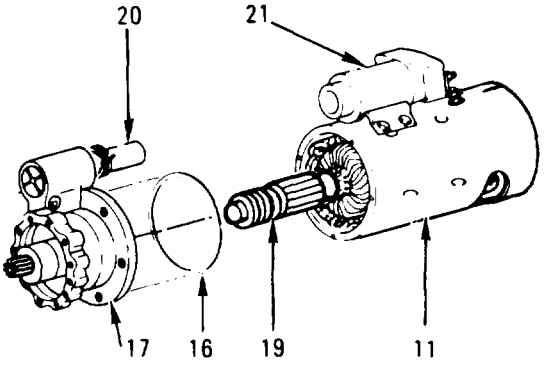
    d. Rock housing (17) gently to make contact with frame (11) and body (21).



3 SECURE HOUSING (17) TO FRAME (11) WITH FIVE SCREWS (22) AND NEW LOCKWASHERS (23).

4, INSTALL COLLAR (24) AND NEW PIN (25) ON SHAFT (19). TIGHTEN CLAMP (26).





Go on to Sheet 11

STARTER MOTOR REPAIR (Sheet 11 of 12)

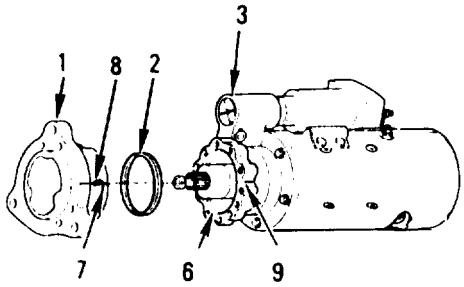
5. INSTALL DRIVE HOUSING (1) AND NEW GASKET (2) ON HOUSING (3). INSTALL AND TORQUE SIX SCREWS (4, 5) BETWEEN 155-200 LB-IN (18-23 N·m).

   a. Put gasket (2) in seat (6) on housing (3).

   b. Line up scribe mark (7) at plug (8) on housing (1) with scribe mark (9) on housing (3).

   c. Install short screw (4) in housing (1). Install five screws (5) in housing (1).

   d. Torque screws (4, 5) between 155-200 lb-in (18-23 N·m).



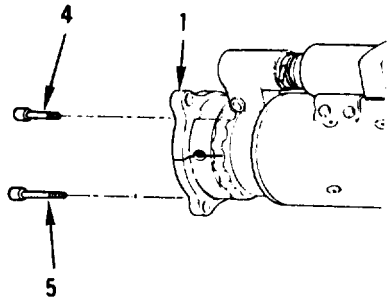
6. INSTALL NEW PACKING (10) AND POSITION END BELL (11) ON MOTOR (12).

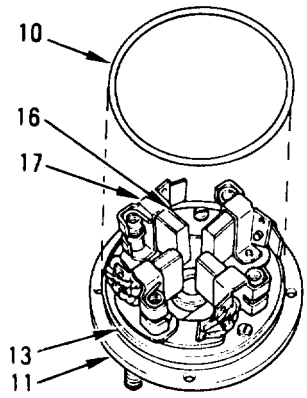
   a. Put packing (10) in groove (13) of end bell (11).

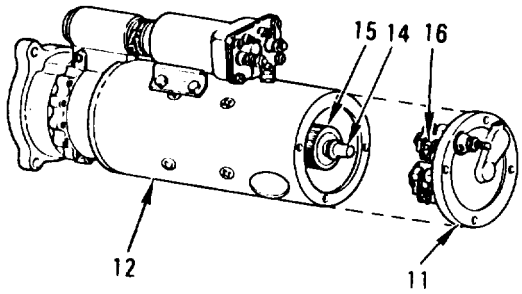
   b. Pull armature (14) out of motor (12) until bar risers (15) stick outside of motor (12) as far as possible.

   c. Put end bell (11) in motor (12) until first four brushes (16) are against bar risers (15).

   d. Push brushes (16) all the way in holders (17) until each brush (16) is over bar riser (15).







Go on to Sheet 12

STARTER MOTOR REPAIR (Sheet 12 of 12)

7. SECURE END BELL (1) TO MOTOR (2). INSTALL TWO PLUGS (3) AND TWO NEW GASKETS (4).

   a. Push end bell (1) against motor (2).

   b. Aline scribe mark (5) on motor (2) with scribe mark (6) on end bell (1).

   c. Install four screws (7) and new lockwashers (8).

   d. Install two screws (9) to hold leads (10) to brush holder assemblies (11).

   e. Put gaskets (4) on plugs (3). Install plugs (3).

8. INSTALL LEAD (12).

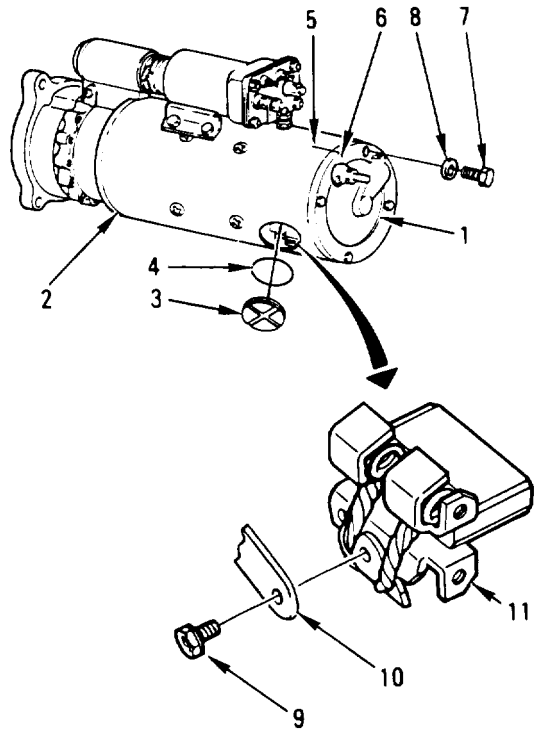
   a. Put lead (12) on terminal stud (13). Install nut (14) and new lockwasher (15).

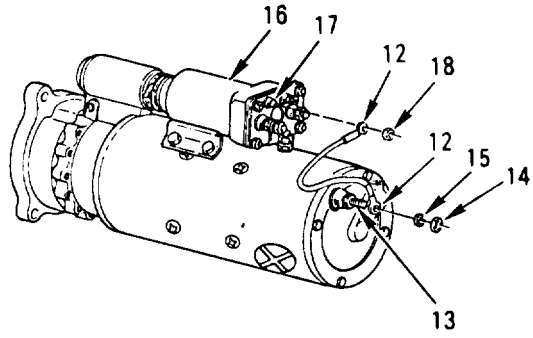
   b. Install other end of lead (12) on switch (16) and terminal (17). Install nut (18).

9. ADJUST STARTER MOTOR END PLAY (PAGE 9-40).

10 LUBRICATE STARTER MOTOR (PAGE 9-40).

11 TEST STARTER MOTOR (PAGE 9-22).





End of Task

STARTER MOTOR LUBRICATION (Sheet 1 of 1

APPLICABILITY: Starter 1114678

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CL-B08)

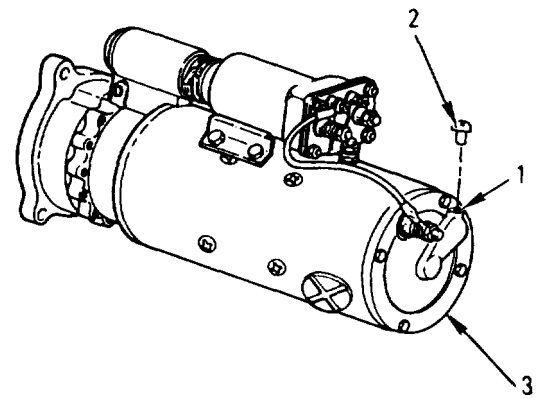
SUPPLIES: Lubricating oil (Item 13, Appendix B)
Pipe plug (Item 94, Appendix E)
Wiping rag (Item 14, Appendix B)

LUBRICATION:

FILL MOTOR PIPE PLUG HOLE (1) WITH OIL.

a. Remove pipe plug (2) from commutator end bell (3).

b. Fill hole (1) to top with oil. Install new plug (2). Wipe off excess oil with rag.



End of Task

STARTER MOTOR END PLAY ADJUSTMENT (Sheet 1 of 3)

APPLICABILITY: Starter 1114678

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CL-B08)
Flat tip screwdriver bit, l/2-inch drive, 15/16-inch (Item 51, Appendix D)
Power supply unit (Item 69, Appendix D)
Test setup (Figure 1, Appendix C)

SUPPLIES: Gasket (Item 71, Appendix E)

Go on to Sheet 2

STARTER MOTOR END PLAY ADJUSTMENT (Sheet 2 of 3)

ADJUSTMENT:

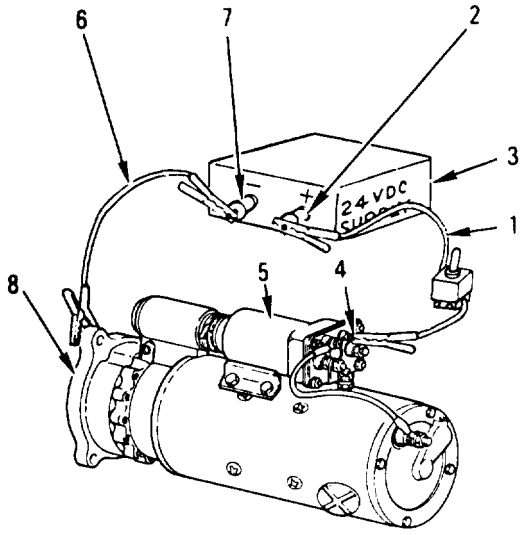
1. CONNECT TEST SETUP.

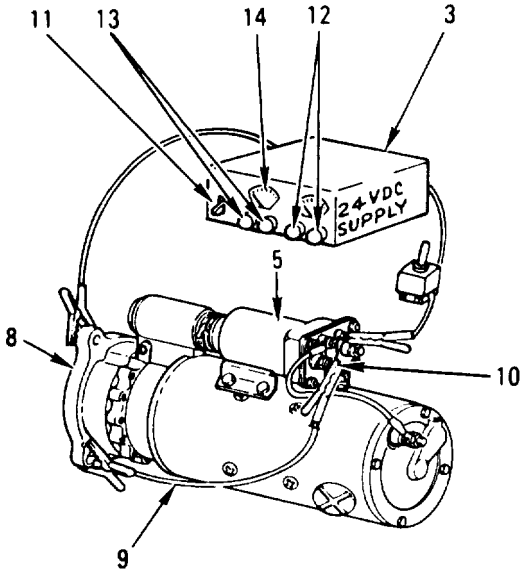
   a. Put cable (1) on positive terminal (2) of power supply (3). Put other end of cable (1) on SW terminal (4) of solenoid switch (5).

   b. Put cable (6) on negative terminal (7) of power supply (3). Put other end of cable (6) on housing (8).

   c. Put cable (9) on M terminal (10) of switch (5). Put other end of cable (9) on housing (8).

2. SET LINE SWITCH (11) ON POWER SUPPLY (3) TO ON. TURN TWO CURRENT KNOBS (12) CLOCKWISE 3/4-TURN. TURN TWO VOLTAGE KNOBS (13) CLOCKWISE UNTIL VOLTS INDICATOR (14) SHOWS 24 VOLTS.





Go on to Sheet 3

STARTER MOTOR END PLAY ADJUSTMENT (Sheet 3 of 3)

CAUTION

Holding switch (1) ON more than 30 seconds will damage switch (2). Hold switch (1) just long enough to drive clutch motor drive gear (3) against starter housing collar (4).

3. HOLD SWITCH (1) ON UNTIL SWITCH (2) PUSHES GEAR (3) AGAINST COLLAR (4).

4. PUSH GEAR (3) AWAY FROM COLLAR (4) AND TRY TO SLIP 0.040-INCH GAGE BETWEEN GEAR (3) AND COLLAR (4). IF GAGE SLIPS BETWEEN GEAR (3) AND COLLAR (4), SET SWITCH (1) TO OFF AND SKIP STEP 5.

5. PUT 0.030-GAGE BETWEEN GEAR (3) AND COLLAR (4). IF GAGE WILL NOT FIT, OR IS VERY LOOSE, DO STEPS 6 THRU 9.

6. REMOVE PLUG (5). PULL GASKET (6) OFF PLUG (5).

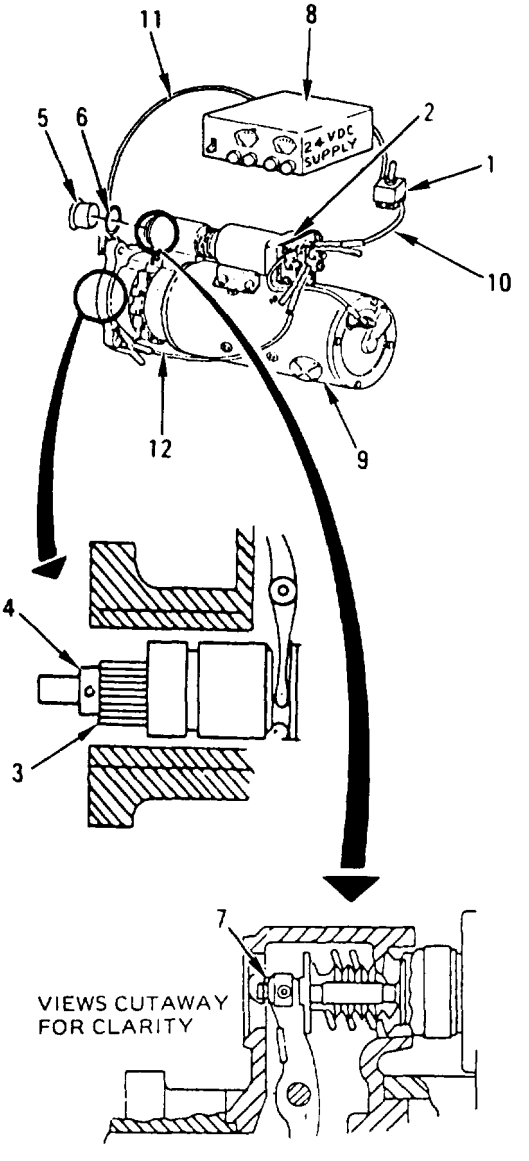
7. SET SWITCH (1) TO ON UNTIL SWITCH (2) PUSHES GEAR (3) AGAINST COLLAR (4).

8. PUT 0.035-INCH GAGE BETWEEN GEAR (3) AND COLLAR (4) AND TURN LEVER NUT (7) TO POINT WHERE GAGE JUST SLIPS OUT. SET SWITCH (1) TO OFF AND TURN OFF POWER SUPPLY. (8) IF END PLAY WILL NOT ADJUST, DO STEPS 9 AND 10 AND REPLACE MOTOR (9).

9. INSTALL PLUG (5) AND NEW GASKET (6).

10 REMOVE CABLES (10, 11, 12) FROM POWER SUPPLY (8) AND MOTOR (9).

11 TEST STARTER MOTOR (PAGE 9-22).



End of Task

STARTER MOTOR TEST (Sheet 1 of 5)

APPLICABILITY: Starter MO017414MA, MB, AND MC

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95 -CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Alternator and starter automotive generator test stand (Item 45, Appendix D)
Chemical and oil protective gloves (Item 87, Appendix D)
Cross tip screwdriver bit, 3/8-inch drive (Item 82, Appendix D)
Industrial goggles (Item 58, Appendix D)
Multimeter (Item 49, Appendix D)
Open end wrench, 7/8-inch and 13/16-inch (Item 83, Appendix D)

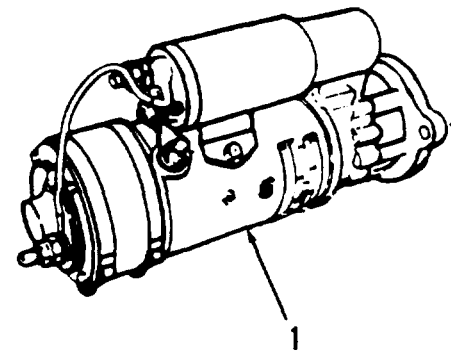
SUPPLIES: Dry cleaning solvent (Item 7, Appendix B)
Gasket (Item 95, Appendix E)
Sandpaper (Item 16, Appendix B)

REFERENCES: TM9-4910-485-12

TEST:

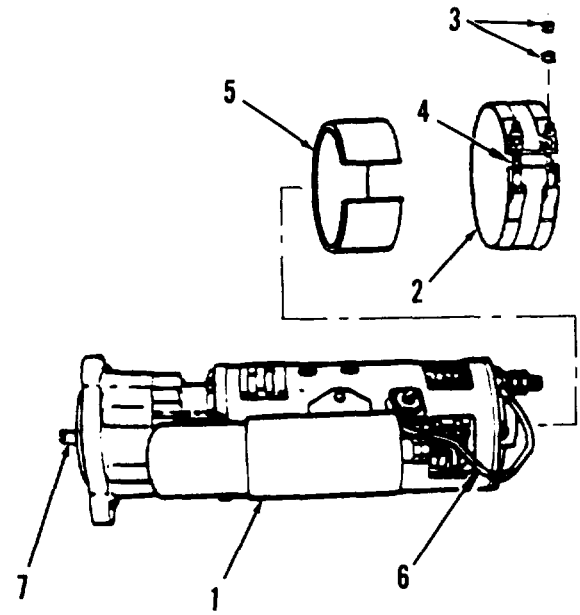
WARNING

1.



2.

3.



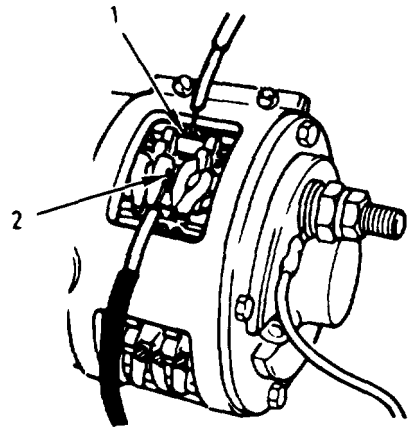
STARTER MOTOR TEST (Sheet 2 of 5)

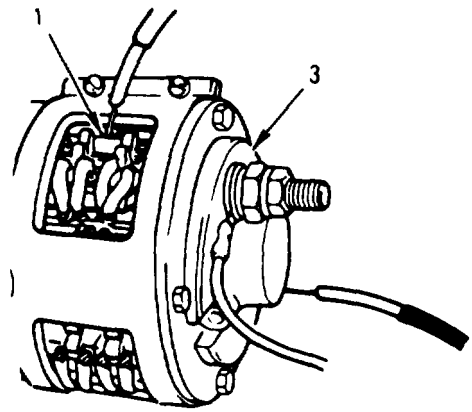
4. CHECK RESISTANCE BETWEEN TWO BRUSH SET TERMINALS BY PUTTING RED PROBE ON BRUSH SPRING HOLDER (1) AND BLACK PROBE ON BRUSH LOCKING PLATE SCREW (2), WITH MULTIMETER SET AT RX1 OHMS. RESISTANCE SHOULD BE LESS THAN 10 OHMS. IF RESISTANCE IS 10 OHMS OR MORE, SKIP STEPS 5 AND 6.

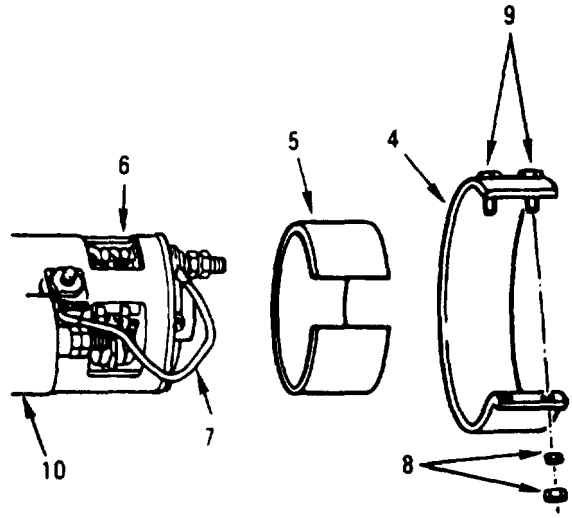
5. REPEAT STEP 4 FOR ALL BRUSH SETS.

6. CHECK RESISTANCE BETWEEN EACH HOLDER (1) AND END HOUSING (3) WITH MULTIMETER SET AT RX10,000 OHMS. IF MULTIMETER READS ANYTHING EXCEPT INFINITY, DO STEP 7.

7. POSITION COVER (4) AND NEW GASKET (5) IN PLACE OVER FOUR FIELD RING ASSEMBLY WINDOWS (6) WITHOUT DISTURBING WIRE (7). INSTALL FOUR NUTS (81 TO TWO T-SCREWS (9). REPLACE STARTER MOTOR (10).







Go on to Sheet 3

STARTER MOTOR TEST (Sheet 3 of 5)

8. CHECK RESISTANCE BETWEEN SOLENOID TERMINALS 1 (1), 2 (2), AND 3 (3), AND BETWEEN TERMINALS (1, 2, 3) AND SOLENOID HOUSING (4) WITH MULTIMETER SET ON RX10,000 OHMS. IF MULTIMETER READS ANYTHING BUT INFINITY, REPLACE SOLENOID SWITCH ASSEMBLY (PAGE 9-48).

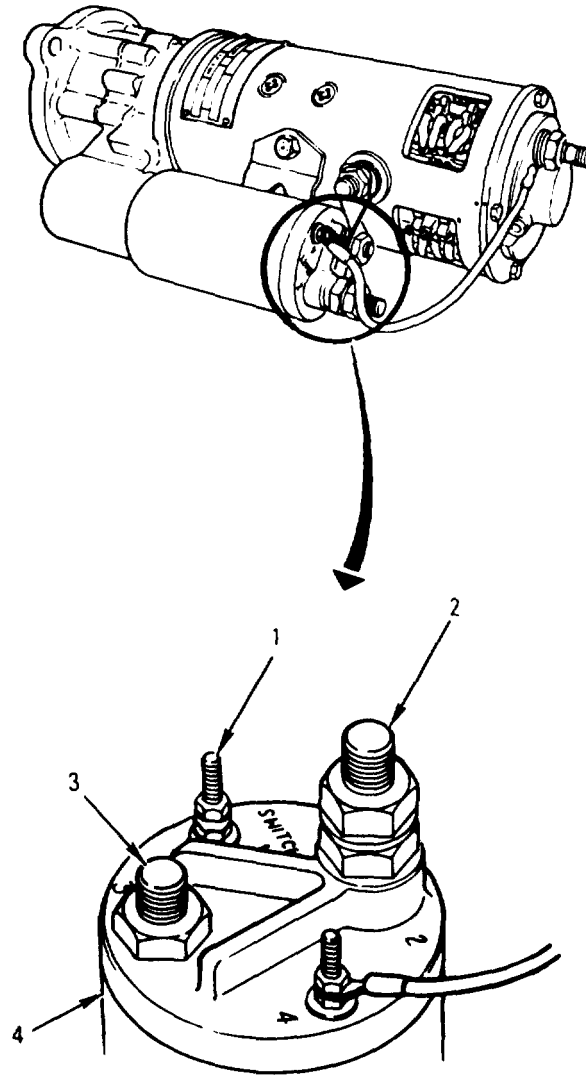
CAUTION

Motor should not be run for more than 15 seconds and should be cooled for 2 minutes after each run. Motor could be damaged if run longer than 15 seconds.

9. CHECK MOTOR CURRENT, SPEED, AND VOLTAGE (TABLE 9-5) AND (TM 9-4910-485-12).

Table 9-5. Current, Speed, and Voltage Accepted Values

Measurement	Accepted Values
Current	60 to 90 Amps
Speed	7000 to 8500 RPM
Voltage	18 to 20 V dc (specific gravity 1.25 minimum)



Go on to Sheet 4

STARTER MOTOR TEST (Sheet 4 of 5)

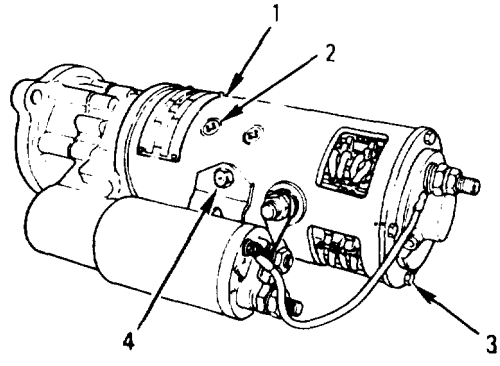
10. LISTEN TO MOTOR (1) FOR HIGH NOISE VIBRATION LEVEL.

NOTE

•. If noise and vibration levels are high, go to step 11.

- If motor (1) does not meet the accepted value in table 9-5 (page 9-45), but has an acceptable noise and vibration level, go to step 17.

- If motor (1) meets accepted values in table 9-5 and has an acceptable noise and vibration level go to step 20.



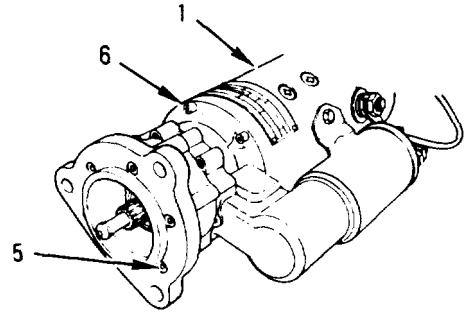
11. LUBRICATE STARTER MOTOR (PAGE 9-62).

12. REMOVE SOLENOID SWITCH (PAGE 9-48).

13. TIGHTEN EIGHT SHOE POLES (2).

14. INSTALL SOLENOID SWITCH (PAGE 9-49).

15. TIGHTEN TWO COMMUTATOR END HOUSING SCREWS (3), TWO SOLENOID SCREWS (4), SIX DRIVE HOUSING SCREWS (5), AND SIX SHIFT HOUSING SCREWS (6).



16. RUN MOTOR (1) AGAIN. IF NOISE OR VIBRATION LEVELS ARE STILL TOO HIGH, REPAIR STARTER MOTOR (PAGE 9-51).

Go on to Sheet 5

STARTER MOTOR TEST (Sheet 5 of 5)

NOTE

- If speed is low and current is high, do step 17.
- If speed is low and current is low, do step 18.
- If motor (1) gave accepted values in steps 8, 9, and 10, do steps 20 and 21.

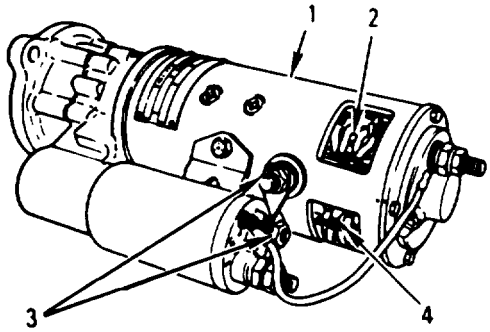
17 REPAIR STARTER MOTOR (PAGE 9-51).

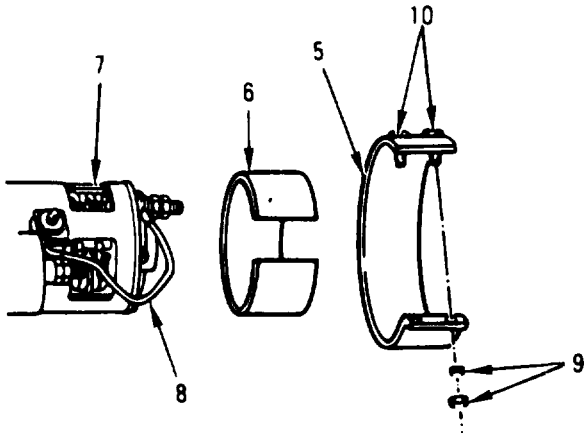
18. TIGHTEN EIGHT BRUSH TERMINAL SCREWS (2) AND TWO SOLENOID-TO-STARTER NUTS (3).

19, RUN MOTOR (1) AGAIN AND CHECK FOUR BRUSH AREAS (4) FOR ARCING IF ARCING, REPAIR STARTER MOTOR (PAGE 9-51).

20, PUT COVER (5) AND NEW GASKET (6) OVER FOUR FIELD RING ASSEMBLY WINDOWS (7) WITHOUT DISTURBING WIRE (8).

21, INSTALL FOUR NUTS (9) TO TWO T-SCREWS (10).





End of Task

STARTER MOTOR SOLENOID SWITCH REPLACEMENT (Sheet 1 of 3)

APPLICABILITY: Starters MO017414MA, MB, AND MC

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Chemical and oil protective gloves (Item 87, Appendix D)
Conduit style slip joint pliers with plastic jaw inserts (Item 31, Appendix D)
Deep style socket, 1/4-inch drive, l/4-inch (item 77, Appendix D)
Extension, l/4-inch drive, 6-inch (Item 80, Appendix D)
Industrial goggles (Item 58, Appendix D)
Machinist's vise (Item 55, Appendix D)
Plier wrench (Item 84, Appendix D)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)
Vise jaw caps (Item 54, Appendix D)

SUPPLIES: Cleaning compound (Item 24, Appendix B)
Grease (Item 9, Appendix B)
Lockwasher (Item 96, Appendix E)
Sealing compound (Item 19, Appendix B)
Wiping rag (Item 14, Appendix B)

EQUIPMENT CONDITION: Starter motor tested (page 9-43)

REMOVAL:

1. DISCONNECT GROUND JUMPER WIRE (1), JUMPER (2), AND SWITCH (3).

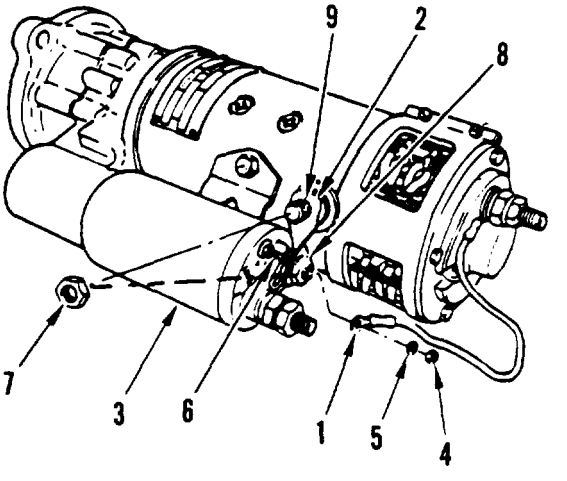
   a. Remove nut (4), lockwasher (5), and wire (1) from terminal 4(6).

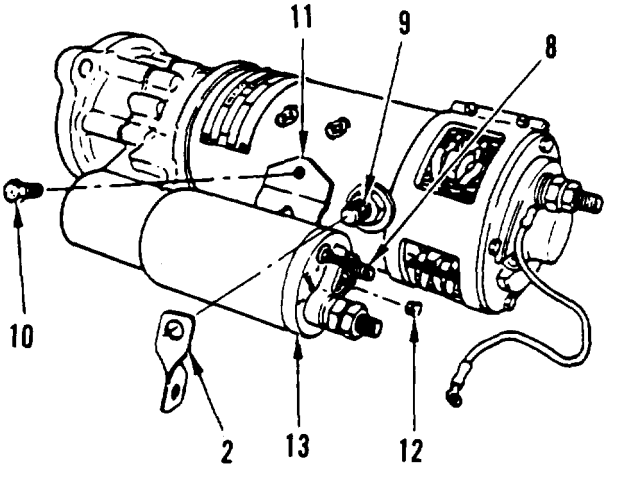
   b. Remove two nuts (7) from terminal 3 (8) and ring assembly stud (9).

   c. Remove two screws (10) from mounting bracket (11).

   d. Remove jumper (2) from terminal (8) and stud(9).

2. REMOVE PLUG (12) FROM SOLENOID CAP (13).





Goon to Sheet 2

STARTER MOTOR SOLENOID SWITCH REPLACEMENT (Sheet 2 of 3)

CAUTION

Sealing compound on threaded end of shaft (1) may make it necessary to use pliers to unscrew plunger (2) from shaft (1). Damage may occur to plunger (2), shaft (1), or arm link (3) if plunger (2) is difficult to turn. If plunger (2) is damaged, switch (4) must be replaced.

3. REMOVE SWITCH (4).

   a. Pull switch (4) out of shift housing assembly (5) as far as it will go.

NOTE

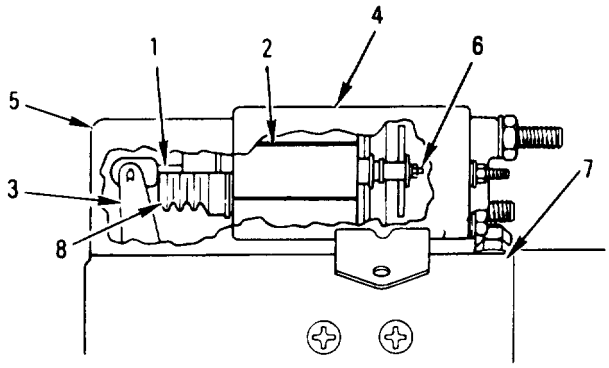
- Do not loosen plunger and shaft assembly nut (6) while turning it counterclockwise to unscrew plunger (2) from shaft (1).
- If plunger (2) does not turn when turning nut (6), do step c.

   b. Loosen plunger (2) from shaft (1) by turning nut (6) counterclockwise.

   c. Put rag over plunger (2) and unscrew plunger (2) from housing (5) counterclockwise. If shaft (1) comes out of link (3) instead of unscrewing from plunger (2), put plunger (2) in capped vise and unscrew shaft (1).

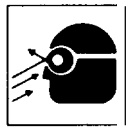
   d. Remove switch (4) from motor (7) by rocking to loosen plunger (2) from boot (8).

4. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED



INSTALLATION:

WARNING



NOTE

Shaft (1) must be free of dirt, grease, and oil.

1. CLEAN SHAFT (1). USE CLEANING COMPOUND AND RAG.

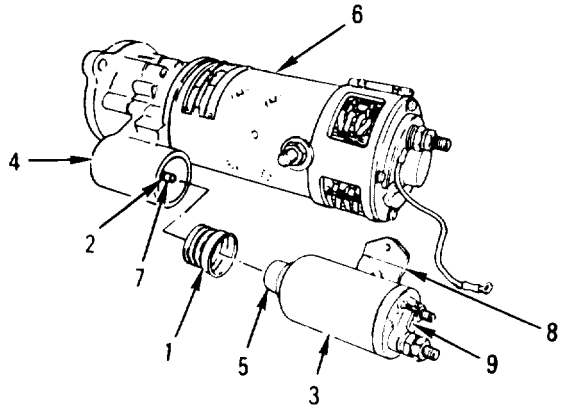
Go on to Sheet 3

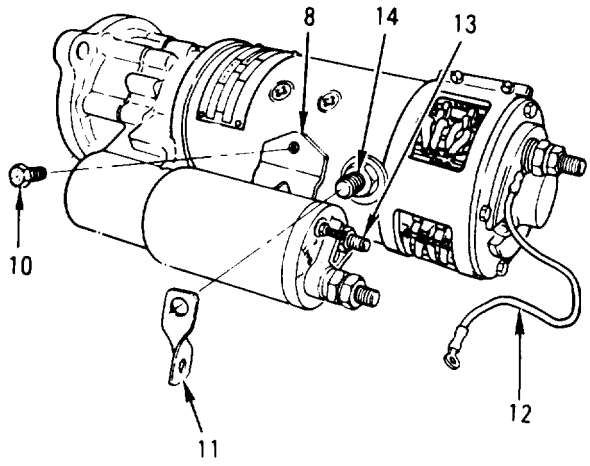
STARTER MOTOR SOLENOID SWITCH REPLACEMENT (Sheet 3 of 3)

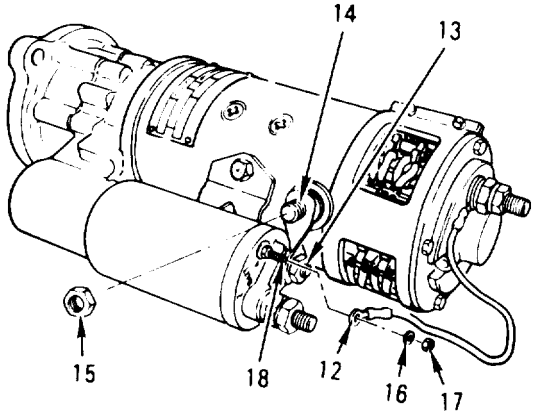
NOTE

- If boot (1) is new, do step 2.
- Do steps 3, 4, and 5 and adjust starter motor end play (page 9-63) within 20 minutes after doing step 3. If not done within 20 minutes, sealing compound on shaft threads (2) will set.

2. INSTALL NEW BOOT (1).
3. APPLY SMALL BEAD OF SEALING COMPOUND ON FIRST l/2-INCH (1.27 CM) OF SHAFT THREADS (2).
4. APPLY GREASE TO SWITCH (3) AND ON HOUSING (4) AROUND PLUNGER (5).
5. PUT SWITCH (3) ON MOTOR (6) AND ALINE PLUNGER (5) WITH SHAFT (7) AND HOLES IN BRACKET (8) AND MOTOR (6).
6. PUT l/4-INCH SOCKET IN ACCESS HOLE (9). INSTALL PLUNGER (5) ON SHAFT (7) BY TURNING PLUNGER (5) CLOCKWISE 10 FULL TURNS.
7. INSTALL SWITCH (3) IN HOUSING (4).
8. APPLY TWO BEADS OF SEALING COMPOUND ON THREADS OF TWO SCREWS (10). INSTALL SCREWS (10) THROUGH BRACKET (8). TORQUE SCREWS (10) BETWEEN 240-290 LB-IN (27-33 N·m).
9. INSTALL JUMPER (11) AND CONNECT WIRE (12).
   a. Put jumper (11) on terminal (13) and stud (14). Slotted side on jumper (11) goes over stud (14).
   b. Install two nuts (15) on terminal (13) and stud (14), Install wire (12), new lockwasher (16), and nut (17) on terminal (18).
10. ADJUST STARTER MOTOR END PLAY (PAGE 9-60).







End of Task

STARTER MOTOR REPAIR (Sheet 1 of 11)

APPLICABILITY: Starters M0017414MA, MB, and MC

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Air blow gun (Item 59, Appendix D)
Armature test set (Item 64, Appendix D)
Chemical and oil protective gloves (Item 87, Appendix D)
Dead blow hammer, 3-pound (Item 78, Appendix D)
Dial indicator (Item 62, Appendix D)
Driver shaft (Figure 3, Appendix C)
Engine lathe (Item 63, Appendix D)
Faceshield (Item 88, Appendix D)
Hacksaw blade (Item 56, Appendix D)
Industrial goggles (Item 58, Appendix D)
Machinist's scriber (Item 86, Appendix D)
Nonmetallic hose assembly (Item 61, Appendix D)
Outside caliper (Item 57, Appendix D)
Pinch bar(Item 85, Appendix D)
Reciprocating compressor unit (Item 60, Appendix D)
Spring resiliency tester (Item 79, Appendix D)
Spring tool (Figure 2, Appendix C)
Torque wrench, 0-600 in-lb (Item 17, Appendix D)

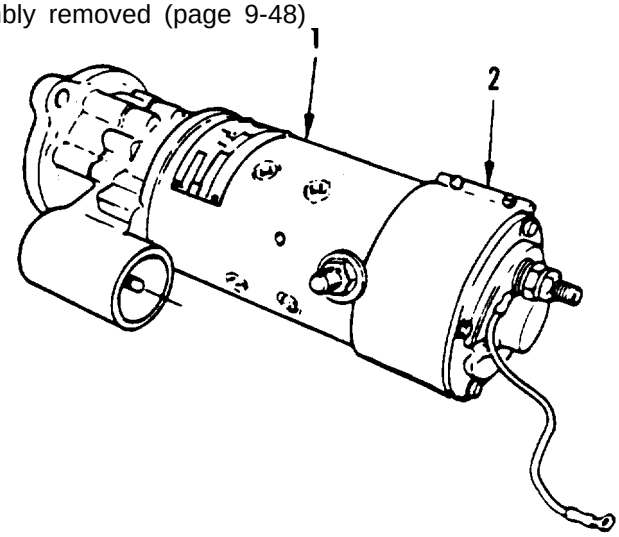
SUPPLIES: Brush kit (models MA and MB) (Item 102, Appendix E)
Brush kit (model MC) (Item 103, Appendix E)
Bushing (Item 98, Appendix E)
Dry cleaning solvent (Item 7, Appendix B)
Gasket (Item 95, Appendix E)
Grease (Item 9, Appendix B)
Lockwasher (Item 104, Appendix E) (9 required)
Lubricating oil (Item 13, Appendix B)
Plain seal (Item 100, Appendix E)
Preformed packing (Item 99, Appendix E)
Preformed packing (Item 105, Appendix E) (2 required)
Preformed packing (Item 106, Appendix E)
Sandpaper (Item 16, Appendix B)
Sealing compound (Item 19, Appendix B)
Washer (Item 101, Appendix E)
Wick (Item 97, Appendix E)

EQUIPMENT CONDITION: Starter motor tested (page 9-43)
Solenoid switch assembly removed (page 9-48)

DISASSEMBLY:

WARNING

1. CLEAN MOTOR (1) AND REMOVE ACCESS COVER (2).



a. Clean outside of motor (1). Use solvent.

Go on to Sheet 2

STARTER MOTOR REPAIR (Sheet 2 of 11)

b. Remove four nuts (1). Remove cover (2) and gasket (3).

2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

CAUTION

Do not pull brush lead (4) while brush (5) is being held by brush spring (6). Lead (4) may come out of brush (5}.

3. REMOVE EIGHT BRUSHES (5) AND FOUR LOCK PLATES (7).

   a. Pull spring (6) up enough to release brush (5). While holding spring (6) up, pull brush (5) out of holder (8), Allow spring (61 to return to rest.

   b. Repeat step a for second brush (5) in same window (9).

   c. Remove two screws (10), one plate (7), and two brushes (5).

   d. Repeat steps a, b, and c for three remaining 'pairs of brushes (5).

4. REMOVE END HOUSING ASSEMBLY (11), HANDLE (12), JUMPER (13), AND PREFORMED PACKING (14).

   a. Mark field ring assembly (15) and end housing (11) with scribe.

   b. Remove four screws (16), lockwashers (17), and handle (12) from end housing (11).

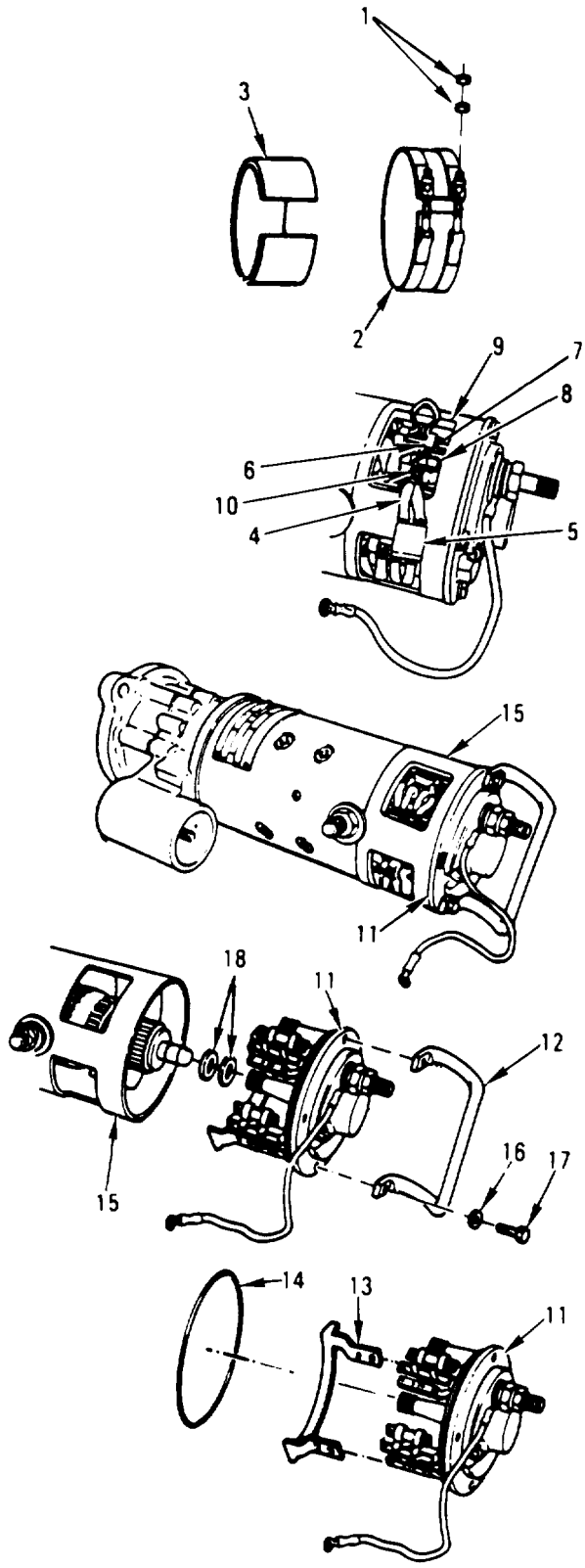
   c. Remove end housing (11) from ring (15). Remove two thrust washers (18).

NOTE

Model MC has built in jumper (13). If working on model MC, do step d.

   d. Note position of jumper (13) and remove from end housing (11).

   e. Remove packing (14) from end housing (11).



Go on to Sheet 3

STARTER MOTOR REPAIR (Sheet 3 of 11)

5. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

6. REMOVE DRIVE HOUSING ASSEMBLY (1) AND PREFORMED PACKING (2).

   a. Mark drive housing (1) and shift housing (3).

   b. Remove six screws (4) from drive housing (1).

   c. Remove drive housing (1) and packing (2).

7. INSPECT DRIVE HOUSING (1) FOR DAMAGE. IF DAMAGED, ASSEMBLE STARTER MOTOR (PAGE 9-59) AND REPLACE AS REQUIRED.

8. REMOVE SHIFT HOUSING (3) AND PREFORMED PACKING (5).

   a Remove screw (6) and thrust washer (7) from end of shaft (8). Mark shift housing (3) and ring (9).

   b Remove five screws (10) and lockwashers (11) from shift housing (3).

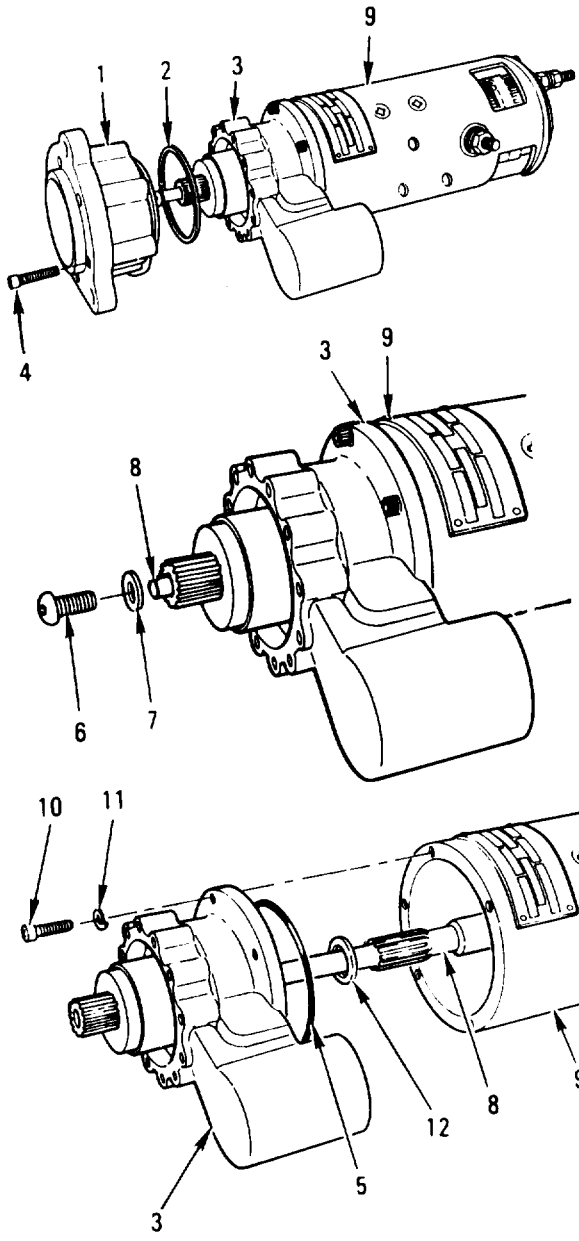
NOTE

If shaft (8) comes out with shift housing (3), set shaft (8) aside.

   c. Remove shift housing (3) from ring (9) and slide shift housing (3) off shaft (8). Remove packing (5) from shift housing (3).

9. REMOVE WASHER (12) FROM SHAFT (8). INSPECT WASHER (12) FOR DAMAGE. REPLACE AS REQUIRED.

10. REMOVE SHAFT (8) FROM RING (9)



Go on to Sheet 4

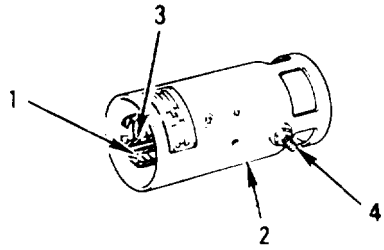
STARTER MOTOR REPAIR (Sheet 4 of 11)

REPAIR:

NOTE

If starter motor is damaged, assemble starter motor (page 9-59) and replace.

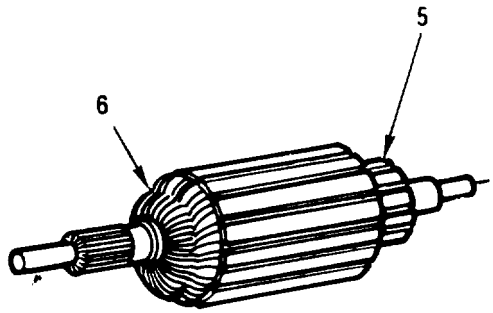
1. INSPECT FOUR SHOE POLES (1) AND RING ASSEMBLY (2) FOR CRACKS OR BREAKS. INSPECT MOTOR FIELD WINDINGS (3) FOR CRACKS, BREAKS, BURNED INSULATION, BROKEN WIRES, OR STRIPPED THREADS ON STUD (4). REPLACE AS REQUIRED.



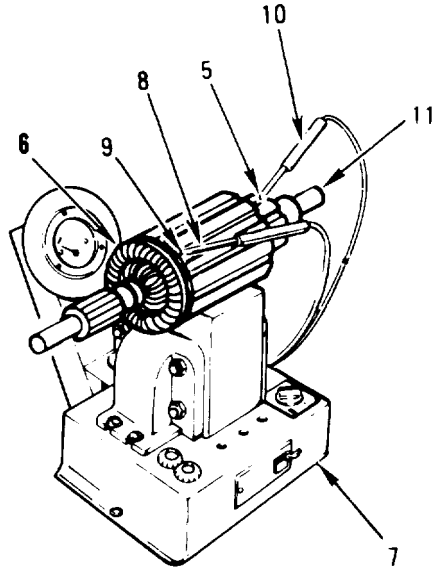
NOTE

Do steps 2 and 3 for each bar riser (5). If armature (6) is damaged, assemble starter motor (page 9-59) and replace.

2. PUT ARMATURE (6) IN GROWLER (7). PUT BLACK NEGATIVE PROBE (8) ON CORE (9) AND RED PROBE (10) ON RISER (5). IF LIGHT ON GROWLER (7) LIGHTS, ASSEMBLE STARTER MOTOR (PAGE 9-59) AND REPLACE.



3. PUT BLACK NEGATIVE PROBE (8) ON SHAFT (11) AND RED PROBE (10) ON RISER (5). IF LIGHT ON GROWLER (7) LIGHTS, ASSEMBLE STARTER MOTOR (PAGE 9-59) AND REPLACE.



Go on to Sheet 5

STARTER MOTOR REPAIR (Sheet 5 of 11)

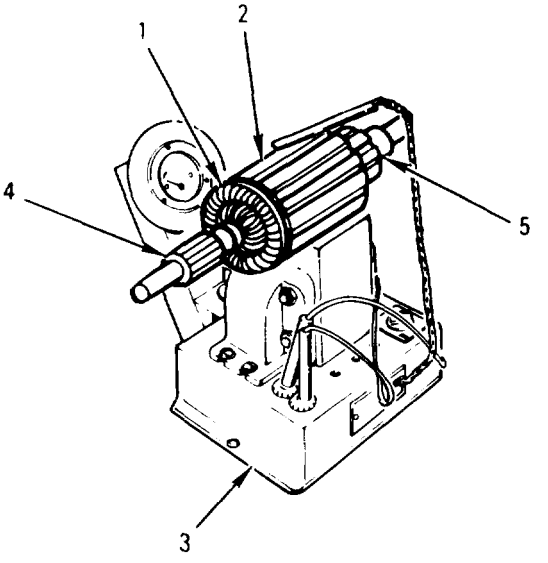
4. TEST ARMATURE (1) FOR SHORT CIRCUITS.

NOTE

Short circuit in armature (1) will pull hacksaw blade against armature core (2) and cause blade to vibrate.

a. With growler (3) turned on, hold blade about 1/32-inch (0.794 mm) away from armature (1).

b. Turn armature (1) slowly. If blade is pulled against core (2), assemble starter motor (page 9-59) and replace.



5. INSPECT ARMATURE SHAFT SPLINES (4) FOR DAMAGE, IF DAMAGED, ASSEMBLE STARTER MOTOR (PAGE 9-59) AND REPLACE.

6. INSPECT CONTACT SURFACE (5) FOR ROUGH SURFACE, PITS, BURNS, OR HARD CARBON OR OIL COAT, IF DAMAGED, DO STEPS 7, 8, AND 9.

Go on to Sheet 6

STARTER MOTOR REPAIR (Sheet 6 of 11)

7. INSPECT COMMUTATOR (1) FOR WEAR.

a. Measure diameter of commutator (1). Check for wear limits (table 9-6).

Table 9-6. Armature Wear Limits

Point of Measurement	Sizes and Fits of New Parts (Inches)	Direct and General Support Wear Limits (Inches)
Commutator Diameter	2,125 to 2.140 (5.397 cm to 5.435 cm)	
Commutator Minimum Turned Diameter		2.0625 (5.08 cm)
Commutator Diameter Total Indicator Runout with Shaft Diameter at Bearings	0.003 (5.2387 mm)	

b. If armature (2) is worn beyond limits shown in table 9-6, assemble starter motor (page 9-59) and replace.

c. Put armature (2) in lathe and Dosition cutting tool (3) and dial indicator (4) against commutator (1),

WARNING

Always wear eye protection when operating a lathe. Failure to wear eye protection could result in serious injury.

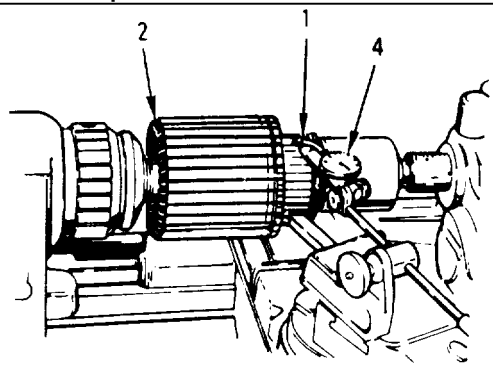
8. CUT 0.007-INCH (0.178 MM) OFF COMMUTATOR (1) AND UNDERCUT MICA (5) TO l/32-INCH (0.794 MM) DEEP AND l/32-INCH (0.794 MM) WIDE.

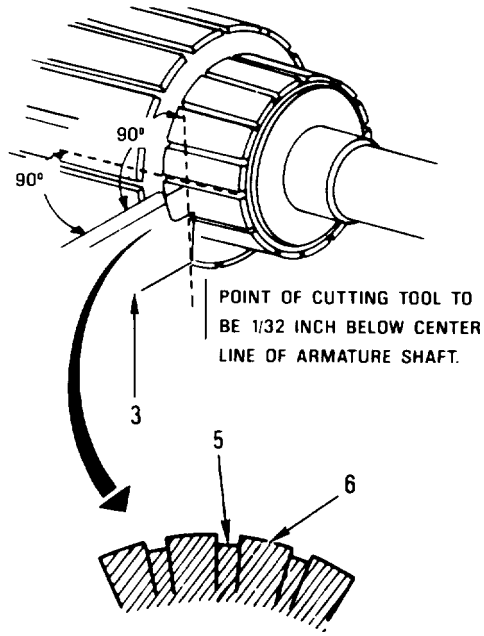
a. Turn lathe on. Watch indicator (4). Cut 0.005-inch (0.127 mm) off commutator (1) with tool (3). Turn lathe off, Check commutator (1) for clean smooth surface.

b. Repeat step a and make final cut 0.002-inch (0.051 mm). Watch indicator (4) to make sure that total indicator runout is within the wear limits of table 9-6.

c. Turn off lathe. Pull tool (3) and dial indicator (4) away from commutator (1).

d. Start grooves in mica (5) with file. Undercut mica (5) with piece of blade to l/32-inch (0.794 mm) deep and l/32-inch (0.794 mm) wide. Mica (5) must be cut away clean between segments (6) of commutator (1).





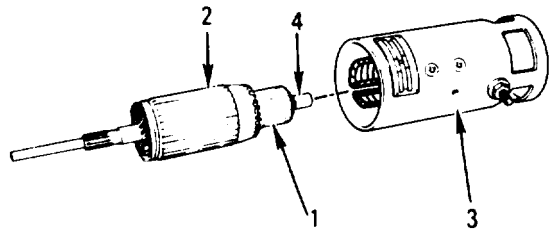
Go on to Sheet 7

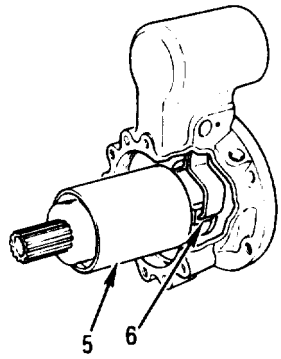
STARTER MOTOR REPAIR (Sheet 7 of 11)

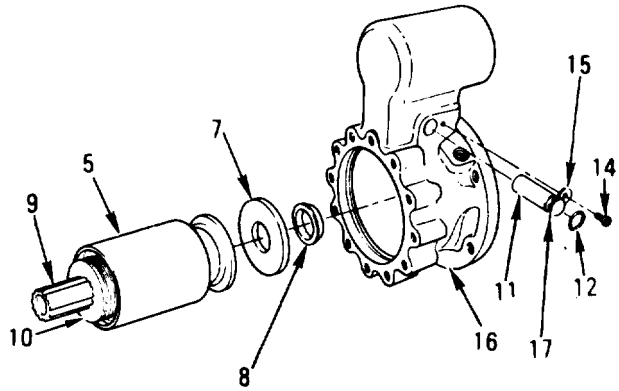
WARNING

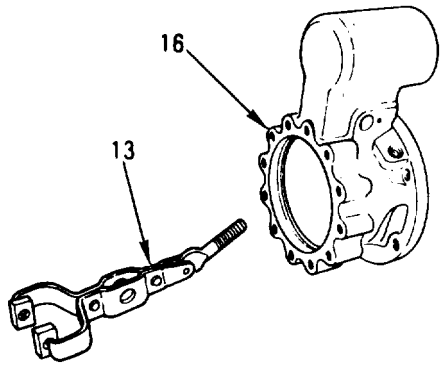
- Compressed air used for cleaning purposes will not exceed 30 psi. Use only effective chip-guarding and personal protective equipment (goggles/faceshield, gloves, etc.).
- Do not wrap sandpaper around commutator (1) while turning armature (2). Injury to hand or wrist may result.

9. CLEAN ARMATURE (2) AND CHECK DIAMETER OF COMMUTATOR (1).
   a. Blow off loose copper and mica particles from commutator (1) with low pressure air.
   b. Turn lathe on. Polish commutator (1) with sandpaper. Turn lathe off.
   c. Check diameter of commutator (1). If diameter is less than 2.0625 inches (5.239 cm), skip step 10.
10. SLIDE ARMATURE (2) IN RING (3) WITH COMMUTATOR END SHAFT (4) AT WINDOW END OF RING (3). ASSEMBLE STARTER MOTOR (PAGE 9-59) AND REPLACE.
11. SLIDE ARMATURE (2) IN RING (3) WITH SHAFT (4) AT WINDOW END OF RING (3).
12. SLIDE DRIVE ASSEMBLY (5) OUT FROM BETWEEN TWO SHHW LEVER ASSEMBLY CAMS (6) AND TAKE OUT DRIVE (5), WASHER (7), AND SEAL (8).
13. INSPECT SLOT (9) ON DRIVE (5) FOR DAMAGE. TRY TO TURN AND PUSH IN PINION (10). IF PINION (10) TURNS IN BOTH DIRECTIONS OR DOES NOT MOVE IN OR OUT FREELY, REPLACE DRIVE (5).
14. REMOVE SHIFT LEVER SHAFT (11), PREFORMED PACKING (12), AND SHIFT LEVER ARM AND LINK ASSEMBLY (13).
    a. Remove screw (14) and washer (15). Lift shaft (11) from housing (16) by prying up on slot (17). Remove packing (12) from









Go on to Sheet **8**

STARTER MOTOR REPAIR (Sheet 8 of 11)

15. REMOVE TWO CAMS (1). PLAIN SEAL (2). AND BUSHING (3).

    a. Take cams (1) off arm and link (4).

    b. Lift seal (2) from housing (5).

    c. Remove bushing (3) from housing (5).

16. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

17. INSTALL NEW BUSHING (3) AND NEW SEAL (2).

    a. Install bushing (3) in housing (5),

    b. Install seal (2) in housing (5) with rubber side of seal (2) facing toward bushing (3). Use l-inch end of driver shaft to seat seal (2) against bushing (3).

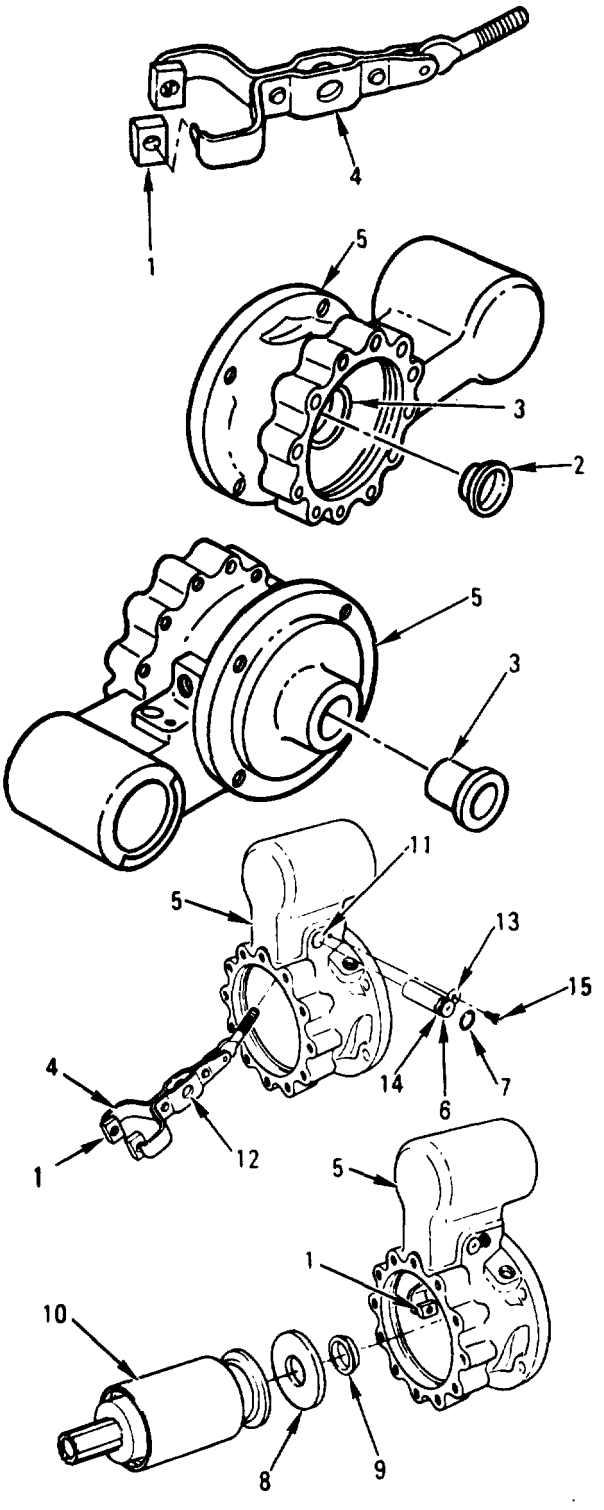
18. INSTALL TWO CAMS (1), ARM AND LINK (4), SHAFT (6), NEW PACKING (7), NEW WASHER (8), NEW SEAL (9), AND DRIVE (10),

    a. Apply a light coat of oil on cams (1). Put cams (1) on arm and link (4). Put arm and link (4) in housing (5).

    b. Put packing (7) on shaft (6). Install shaft (6) in housing port (11) and arm and link pivot hole (12).

    c. Put washer (13) in shaft slot (14) and install screw (15).

    d. Install seal (9) and washer (8) in housing (5). Slide drive (10) between cams (1).



Go on to Sheet 9

STARTER MOTOR REPAIR (Sheet 9 of 11)

19. INSPECT BUSHING (1) AND HOUSING (2) FOR CRACKS OR BREAKS. IF DAMAGED, REPLACE HOUSING (2) AND TRANSFER SCRIBE MARKS FROM OLD HOUSING (2) TO NEW HOUSING (2).
20. REMOVE LUBRICATION PLUG (3). REMOVE WICK (4) FROM BUSHING CAVITY (5). INSPECT PLUG (3) FOR DAMAGE. REPLACE AS REQUIRED.
21. LOOK AT FOUR BRUSH HOLDERS (6) FOR DISTORTED OR DISCOLORED SURFACES DUE TO BURNS OR HIGH TEMPERATURES. IF DAMAGED, REPLACE HOUSING (2) AND TRANSFER SCRIBE MARKS FROM OLD HOUSING (2) TO NEW HOUSING (2).
22. TEST TENSION ON EIGHT BRUSH SPRINGS (7). TENSION SHOULD BE BETWEEN 2.25-2.50 POUNDS (1.02-1.14 KG). IF DAMAGED, REPLACE HOUSING (2) AND TRANSFER SCRIBE MARKS FROM OLD HOUSING (2) TO NEW HOUSING (2).
23. LUBRICATE STARTER MOTOR (PAGE 9-62). PUT NEW WICK (4) IN CAVITY (5) AND INSTALL PLUG (3).

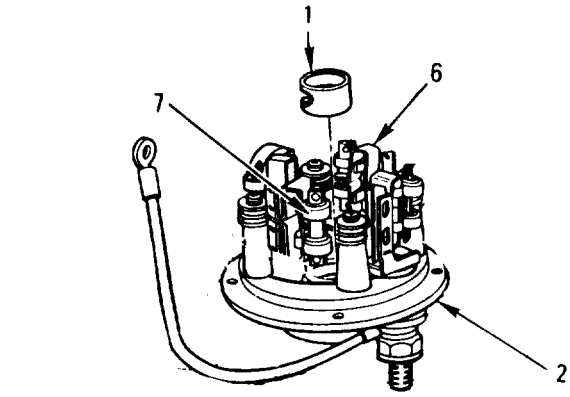
ASSEMBLY:

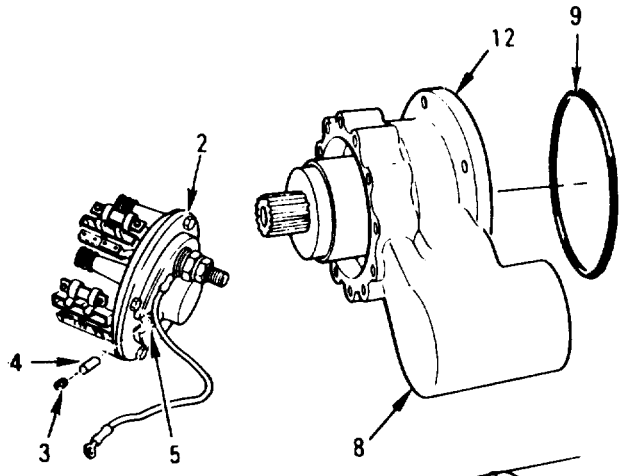
1. INSTALL HOUSING (8), NEW PACKING (9), WASHER (10), AND SCREW (11).
   a. Apply grease to packing (9) and install in housing groove (12).
   b. Slide washer (13) on shaft (14). Apply grease to shaft (14) and splines (15) where drive (16) slides.

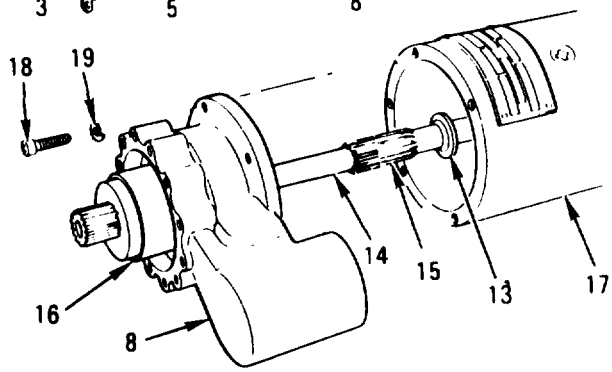
NOTE

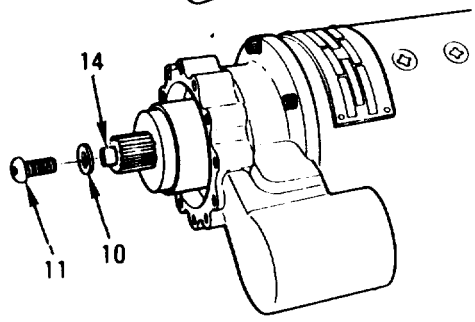
Make sure surfaces are grease-covered and wipe off excess grease while housing (8) and ring (17) are assembled.

   c. Aline housing (8) and ring (17) scribe marks and press together.
   d. Apply sealing compound to five screws (18). Install screws (18) and new lockwashers (19).
   e. Apply two drops of sealing compound to screw (11). Put washer (10) in end of shaft (14) and install screw (11).









Go on to Sheet 10

STARTER MOTOR REPAIR (Sheet 10 of 11)

2. INSTALL DRIVE HOUSING (1) AND NEW PACKING (2). INSTALL AND TORQUE SIX SCREWS (3) BETWEEN 156-180 LB-IN (18-23 NŽm).

   a. Apply grease to packing (2) and install in drive housing groove (4).

   b. Put motor (5) in vise.

   c. Aline scribe marks on housing (1) and shift housing (6) and push together.

   d. Apply sealing compound to screws (3) and install.

   e. Torque screws (3) between 156-180 lb-in (18-23 N•m).

3. INSTALL END HOUSING (7), NEW PACKING (8), JUMPER (9), AND HANDLE (10).

   a. Apply grease to packing (8) and install in groove (11).

NOTE

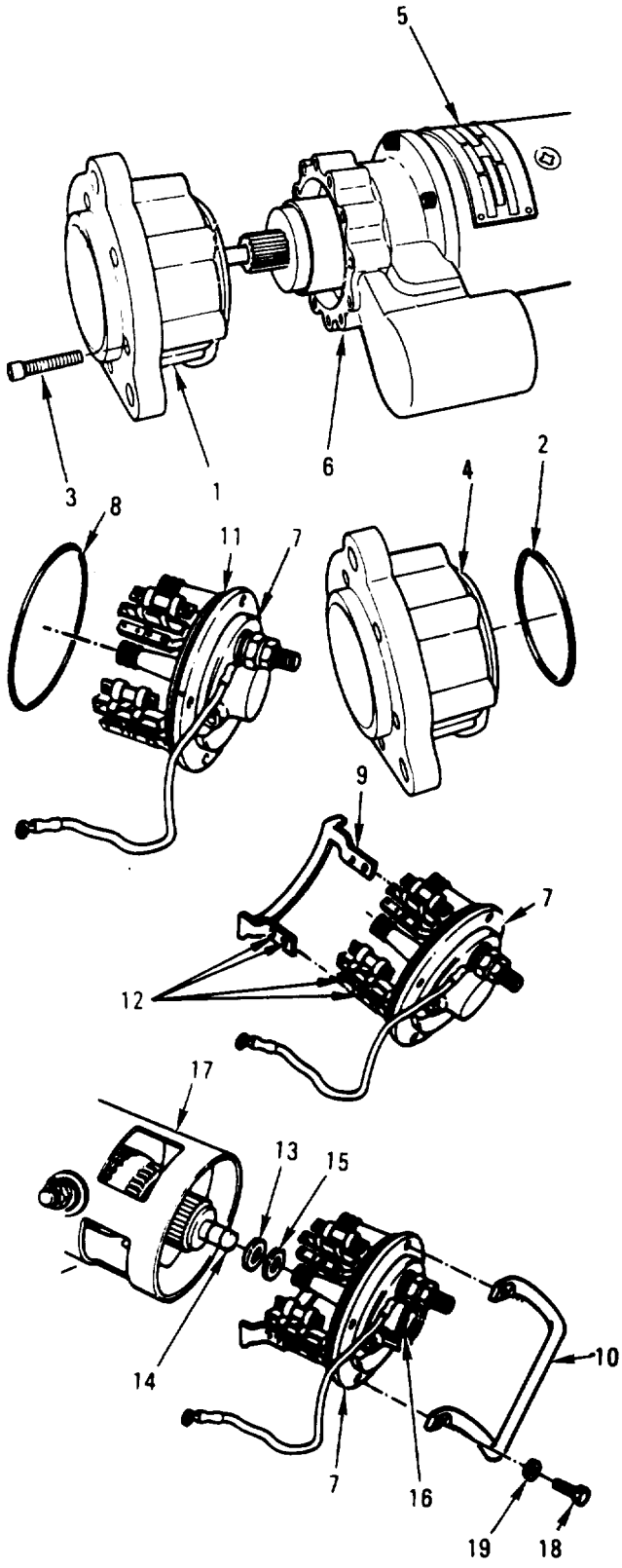
Model MC has built in jumper (9), If working on model MC, do step b.

   b. Aline eight holes (12) in jumper (9) and housing (7) and install jumper (9).

   c. Put washer (13) on shaft (14) and bearing (15) on bushing (16).

   d. Aline scribe marks on ring (17) and housing (7). Install housing (7) on shaft (14) and in ring (17).

   e. Apply sealing compound to four screws (18). Install screws (18), new lockwashers (19), and handle (10).

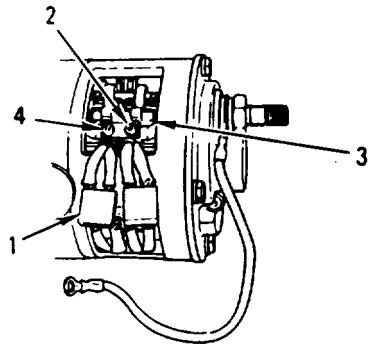


Go on to Sheet 11

STARTER MOTOR REPAIR (Sheet 11 of 11)

4. INSTALL EIGHT NEW BRUSHES (1) AND FOUR NEW PLATES (2) ON FOUR HOLDERS (3).

   a. Install two screws (4), plate (2), and two brushes (1) on holder (3).



NOTE

Put one brush (1) in holder (3) closest to ring (5) before putting second brush (1) in housing (6)

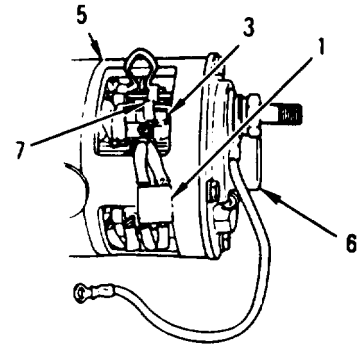
   b. Pull spring (7) up and install one brush (1) in holder (3). Release spring (7) slowly and put in second brush (1).

   c. Repeat steps a and b for three remaining pairs of brushes (1).

5. INSTALL COVER (8) AND NEW GASKET (9).

   a. Put cover (8) and gasket (9) over four ring windows (10).

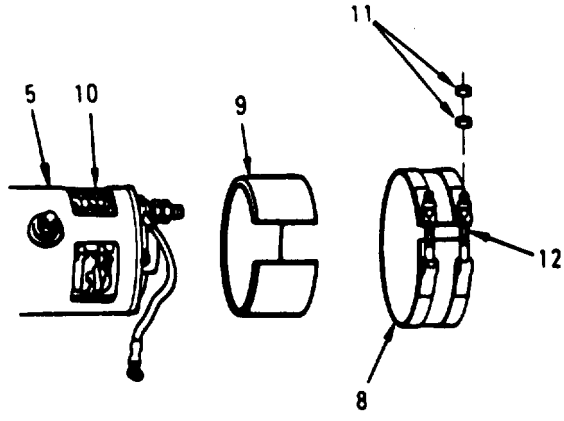
   b. Install four nuts (11) to two T-screws (12).



6. LUBRICATE STARTER MOTOR (PAGE 9-62).

7. INSTALL SOLENOID SWITCH ASSEMBLY (PAGE 9-50).

8. TEST STARTER MOTOR (PAGE 9-43).



End of Task

STARTER MOTOR LUBRICATION (Sheet 1 of 1)

APPLICABILITY: Starters M0017414MA, MB, and MC

TOOLS: Automotive fuel and electrical system repair tool kit (SC5180-95-CL-B08)
Hand oiler (Item 84, Appendix D)

SUPPLIES: Lubricating oil (Item 13, Appendix B)
Wiping rag (Item 14, Appendix B)

LUBRICATION:

1. REMOVE PLUB (1) FROM END HOUSING (2) AND PLUG (3) RO SHIFT HOUSING (4). LUBRICATE HOUSINGS (2,4).

   a. Remove plug (1) from end housing (2). Make sure wick (5) is in plug port (6).

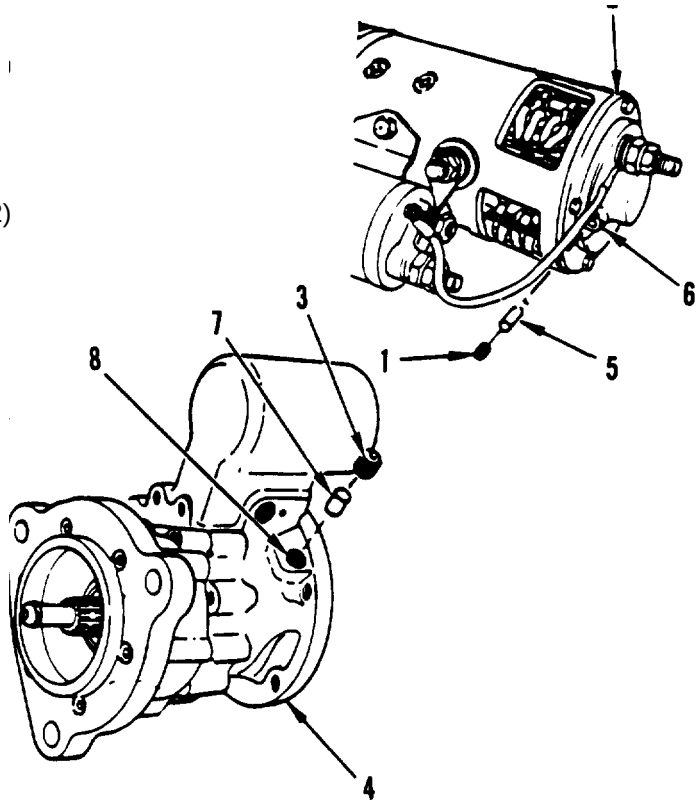
   b. Remove plug (3) from shift housing (4). Make sure wick (7) is in plug port (8).

2. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

3. ADD OIL TO WICKS (5,7) UNTIL SOAKED. WIPE OFF EXTRA OIL.

4. INSTALL PLUGS (1,3).

End of Task



STARTER MOTOR END PLAY ADJUSTMENT (Sheet 1 of 2)

APPLICABILITY: Starters M0017414MA, MB, and MC

TOOLS: Automotive fuel and electrical system repair tool kit (SC 5180-95-CL-B08)
General mechanic's tool kit: automotive (SC 5180-90-N26)
Deep style socket, 1/4-inch drive, 1/4-inch (Item 77, Appendix D)
Extension, 1/4-inch drive, 6-inch (Item 80, Appendix D)
Power supply unit (Item 69, Appendix D)

SUPPLIES: Protective plug (Item 107, Appendix E)
Test setup (Figure 5, Appendix C)
Timing gage (Figure 4, Appendix C)

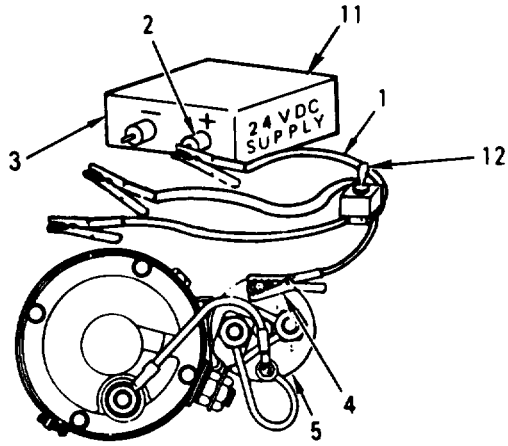
EQUIPMENT CONDITION: Starter motor tested (page 9-43)

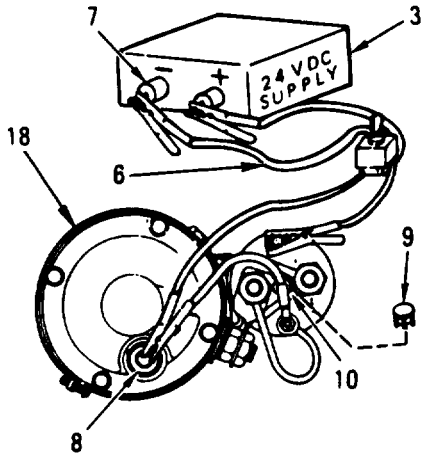
Go on to Sheet 2

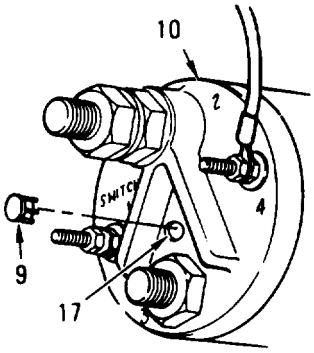
STARTER MOTOR END PLAY ADJUSTMENT (Sheet 2 of 2)

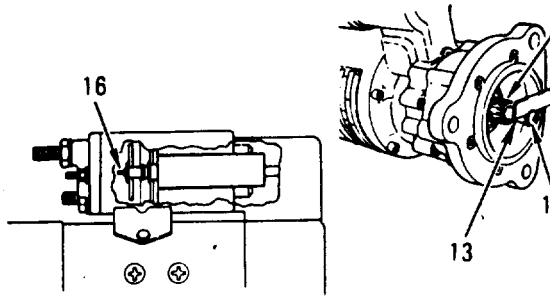
ADJUSTMENT:

1. CONNECT TEST SETUP.
   a. Put cable (1) on positive terminal (2) of power supply (3). Put other end of cable (1) on switch terminal 1 (4) of switch assembly (5).
   b. Put cable (6) on negative terminal (7) of power supply (3). Put other end of cable (6) on terminal stud (8).
   c. Remove plug (9) from solenoid cap (10).
   d. Turn power supply switch (11) to ON. Set switch assembly (12) of test cable to ON.
2. PUT TIMING GAGE (13) BETWEEN FACE OF PINION GEAR (14) AND THRUST WASHER (15) WHILE OPERATING SWITCH (12). IF GAGE (13) WILL NOT FIT OR IS LOOSE, DO STEP 3.
3. TURN PLUNGER (16) THROUGH ACCESS HOLE (17) OF CAP (10) IN OR OUT AS REQUIRED UNTIL GAGE (13) FITS BETWEEN GEAR (14) AND WASHER (15).
4. SET SWITCH (11) TO OFF. INSTALL NEW PLUG (9) IN CAP (10).
5. REMOVE CABLE (6) FROM POWER SUPPLY (3) AND MOTOR (18).
6. TEST STARTER MOTOR (PAGE 9-43).
7. LUBRICATE STARTER MOTOR (PAGE 9-62).









End of Task

APPENDIX A

REFERENCES

A-1 Maintenance Forms and Records

DA Form 2028	Recommended Changes to Publications and Blank Forms
DA Form 2402	Exchange Tag
DA Form 2404	Equipment Inspection and Maintenance Worksheet
DA Form 2407	Material Request
DA Form 2408-9	Equipment Control Record
DA Form 5504	Maintenance Request Form
DA PAM 738-750	The Army Maintenance Management System (TAMMS)
A-2 Regulations	
AR 750-58	Printing, Camouflage Painting, and Marking of Army Materiel
A-3 Technical Manuals	
TM 43-0139	Painting Instructions for Field Use
TM 5-200	Camouflage Materiels
TM 750-244-6	Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use: (U.S. Army Tank-Autonlotive Command)
TM 9-2350-255-10-1	Operator's Manual, Operator Controls, PMCS and Operation Under Unusual Conditions, Tank, Combat, Full-Tracked: 105-mm Gun, Ml (2350-01-061-2445), IPM1 (2350-01-136-8738) General Abrams
TM 9-2350-255-10-2	Operator's Manual, Operation Under Unusual Conditions, Maintenance and Ammunition, Tank Combat, Full-Tracked: 105-nlm Gun, Ml (2350-01-061-2445), IPMI (2350-01-136-8738) General Abrarns
TM 9-2350-264-10-1	Operator's Manual, Operator Controls, PMCS ,and Operation Under Unusual Conditions, Tank, Combat, Full-Tracked: 120-mm Gun, M1A1 Hull (2350-01-087-1095) General Abrams
TM 9-2350-264-10-2	Operator's Manual, Unusual Conditions, Troubleshooting and Maintenance. Tank. Combat. Full-Tracked: 120-mm Gun, M1A1 Hull (2350-01-087-1095) General Abram

A-3 Technical Manuals (Continued)

TM 9-2350-255-20- 1-1	Unit Maintenance Manual. Tank, Combat, Full-Tracked: 105-mm Gun, M1 (2350-01-061-2445) and Tank, Combat, Full-Tracked: 105-mm Gun, IPM1 (2350-01-136-8738) General Abrams
TM 9-2350-255-20- 1-2	Unit Maintenance Manual. Tank, Combat, Full-Tracked: 105-mm Gun, M1 (2350-01-061-2445) and Tank, Combat, Full-Tracked: 105-mm Gun, IPM1 (2350-01-136-8738) General Abrams
TM 9-2350-255-20- 1-3	Unit Maintenance Manual. Tank, Combat, Full-Tracked: 105-mm Gun, M1 (2350-01-061-2445) and Tank, Combat, Full-Tracked: 105-mm Gun, IPM1 (2350-01-136-8738) General Abrams
TM 9-2350-255-20- 1-4	Unit Maintenance Manual. Tank, Combat, Full-Tracked: 105-mm Gun, M1 (2350-01-061-2445) and Tank, Combat, Full-Tracked: 105-mm Gun, IPM1 (2350-01-136-8738) General Abrams
TM 9-2350-255-20- 1-5	Unit Maintenance Manual, Tank, Combat, Full-Tracked: 105-mm Gun, M1 (2350-01-061-2445) and Tank, Combat, Full-Tracked: 105-mm Gun, IPM1 (2350-01-136-8738) General Abrams
TM 9-2350-264-20- 1-1	Unit Maintenance Manual. Tank, Combat, Full-Tracked: 120-mm Gun, M1A1 Hull (2350-01-087-1095) General Abrams
TM 9-2350-264-20- 1-2	Unit Maintenance Manual. Tank, Combat, Full-Tracked: 120-mm Gun, M1A1 Hull (2350-01-087-1095) General Abrams
TM9-2350-264-20-1-3	Unit Maintenance Manual. Tank, Combat, Full-Tracked: 120-mm Gun, M1A1 Hull (2350-01-087-1095) General Abrams
TM9-2350-264-20-1-4	Unit Maintenance Manual. Tank, Combat, Full-Tracked: 120-mm Gun, M1A1 Hull (2350-01-087-1095) General Abrams
TM9-2350-264-20-1-5	Unit Maintenance Manual. Tank, Combat, Full-Tracked: 120-mm Gun, M1A1 Hull (2350-01-087-1095) General Abrams
TM9-2350-264-34-1	Direct Support and General Support Maintenance Manual, Tank, Combat, Full-Tracked: 120-mm Gun, M1A1 Hull (2350-01-087-1095) General Abrams
TM9-2350-255-24P-1	Unit, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts) for Tank, Combat, Full-Tracked: 105-mm Gun, M1 (2350-01-062-2445) and Tank, Combat, Full-Tracked: 105-mm Gun, IPM1 (2350-01-136-8738) General Abrams
TM9-2350-264-24P-1	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Parts) for Tank, Combat, Full-Tracked: 120-mm Gun, M1A1 Hull (2350-01-087-1095) General Abrams
TM9-2350-276-34	Direct Support and General Support Maintenance Manual, Transmission Assembly Model X1100-3B (P/N 12288200) and Transmission Assembly Model X1100-3B (P/N 12321700) and Transmission Assembly Model X100 -3B (P/N 12321800)
TM9-2835-255-34P	Direct Support and General Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts) for Turbine Engine, Field Service Model AGT1500 (M1/IPMl) (P/N 12887429) and Turbine Engine, Field Service Model AGT1500 (M1A1) (P/N 12324029) and Container (8145-00-112-6574)

A-3 Technical Manuals (Continued)

TM 9-2835-255-34P	Direct Support and General Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts) for Turbine Engine, Field Service Model AGT1500 (M1/IPM1) (P/N 12887429) and Turbine Engine, Field Service Model AGT1500 (M1A1) (P/N 12324029) and Container (8145-00-112-6574)
TM 9-4910-485-12	Test Stand Auto Generator Alternator Starter MDL AG
LO 9-2350-255-12	Lubrication Order - Tank, Combat, Full-Tracked: 105-mm Gun, M1 (2350-01-061-2445) and IPM1 (2350-01-136-8738) General Abrams
LO 9-2350-264-12	Lubrication Order - Tank, Combat, Full-Tracked: 120-mm Gun, M1A1 (2350-01-087-1095) General Abrams

A-4 Supply Catalogs

CTA 50-970	Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items)
SC 3470-95-CL-A02	Shop Equipment, Machine Shop; Field Maintenance, Basic, Less Power (3470-00-754-0708) (LIN T15644) and Shop Equipment, Machine Shop, Field Maintenance, Basic, Map only (3470-00-919-0068)
SC 4910-95-CL-A01	Shop Equipment, Fuel and Electrical System Engine: Field Maintenance, Basic, Less Power (4910-00-754-0714) (LIN T30414) (4910-00-919-0083) Map only
SC 4910-95-CL-A31	Shop Equipment, Automotive Maintenance and Repair: Field Maintenance, Basic, Less Power (4910-00-754-0705) (LIN T24660) (4910-00-919-0076) Map only
SC 4910-95-CL-A72	Shop Equipment, Automotive Maintenance and Repair: Organizational Maintenance Common No. 2, Less Power (4910-00-919-0082) (LIN W32730)
SC 4910-95-CL-A74	Shop Equipment, Automotive Maintenance and Repair (4910-00-754-0654) (LIN W32593)
SC 5180-90-N26	Tool Kit, General Mechanics Automotive (5180-00-177-7033) (LIN W33004)
SC 5180-95-CL-B08	Tool Kit, Automotive Fuel and Electrical System Repair (5180-00-754-0655) (LIN W32456)

A-5 Field Manuals

FM 21-11	First Aid for Soldiers

A-6 Technical Bulletins

TB 9-2835-255-12	AVCO AGT 1500 Engine Warranty
TB 43-021B	Inspection, Use And Tightening Of Metal Fasteners Used On Tank Automotive Equipment

A-7 Training Circulars

TC 9-237	Welding Theory And Application

APPENDIX B

EXPENDABLE SUPPLIES AND MATERIALS LIST

SECTION I. INTRODUCTION

B-1. SCOPE

This appendix lists expendable supplies and materials you will need to operate and maintain the turbine engine. 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 Heraldix Items).

B-2. EXPLANATION OF COLUMNS

a. Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced when required.

b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

F - Intermediate Direct Support Maintenance
H - Intermediate General Suport Maintenance

c. Column (3) - National Stock Number. This is the National Stock Number assigned to the item; use it to request or requisition the item.

d. Column (4) - Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by the part number.

e. Column (5) - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., EA, IN, PR). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

SECTION II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	F	8040-00-262-9025	Adhesive, Type I: (81348) MIL-A-5092	OZ
2	F	8030-00-251-3980	Antiseize Compound, 1600°F temperature rating, 1-pound Can: (05972) MIL-A-907E	LB
3	F	9160-00-253-1171	Beeswax, technical: Federal Specification C-B-191	LB/CK
4	F	3439-00-160-3524	Brazing Alloy, QQ-B-654, Grade VIII	RD
5	F	3439-00-262-4188	Brazing Alloy, QQ-B-654, Grade IV	RD
6	F	7930-01-045-3515	Detergent, laundry, liquid, 5-gallon can (81349) MIL-D-43966	GL
7	F	6850-00-285-8011	Dry Cleaning Solvent, Type II, 55-gallon drum: (81348) P-D-680	GL
8	F	3439 -00-350-1427	Flux: brazing, AMS3410	LB
9	F	9150-00-408-9635	Grease, aircraft (81349) MIL-G-81827	LB
10	F	9150-00-223-4004	Grease, molybednum, 1-pound can: (81349) MIL-G-21164	LB
11	F	9150-00-985-7099	Lubricating Oil, aircraft turbine engine, 1-quart can: (81349) MIL-L-23699	QT
12	F	9150-00-270-4057	Lubricating Oil, aircraft turbine engine: (81349) MIL-L-7808	GL
13	F	9150-00-186-6681	Lubricating Oil, engine, heavy duty OE/HDO-30, 1-quart can: (81349) MIL-L-2104	QT
14	F	7920-00-205-1711	Rag, wiping, 50-pound bale: (81348) A-A-531	LB
15	F	9505-00-295-4208	Wire, nonelectric (safety wire) 0.032-inch diameter, 1-pound roll: (96906) MS20995C32	RL
16	F	5350-00-264-3489	Sandpaper. No. 2/0): P-P-105	SH

SECTION II EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
17	F	5350-00-334-7207	Sandpaper, 320: P-P- 101	PG
18	F	8030-00-779-4700	Sealing Compound: EC1225	OZ
19	F	8030-01-025-1692	Sealing Compound, Type II, Grade N, 250-cubic centimeter bottle: (05972) MIL-S-46163	CC
20	F	8945-00-519-1440	Shortening Compound (81348) EE-S-321	LB
21	F		Wood Block 1x4x12-inch, make from lumber (Item 37)	BF
22	F		Wood Block, 2x4x36-inch, make from lumber (item 38)	BF
23	F		Wood Block, 4x4x18-inch, make from lumber (item 39)	BF
24	F	6850-00-105-3084	Cleaning Compound, solvent, 16-ounce can: (81349) MIL-C-81302	
25	F	7520-00-973-1059	Marker, tube type, felt: GG-M-114	EA
26	F	9905-00-537-9854	Tag, marker, 50 each: (81349) MIL-T-12755	EA
27	F	7510-00-189-7881	Pencil, writing, package of 12:(81349) SS-P-1605	EA
28	F	8030-00-551-1059	Sealant, Permatex, Form-A-Gasket, Type V: (80244)	OZ
29	F	8040-00-576-2014	Sealer, adhesive: EC1022	OZ
30	F	8135-00-551 -1245	Tape, pressure sensitive, olive, 60-yard roll: (81348) PPP-T-60	YD
31	F		Wood Block, 4x4x8-inch, make from lumber (Item 39)	BF
32	F		Wood Block, 2x4x12-inch, make from lumber (Item 38)	BF
33	F		Wood Block, 4x4x12-inch, make from lumber (Item 39)	BF

SECTION II EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
34	F		Wood Block, 1x4x28-inch, make from lumber {item 37)	BF
35	F		Wood Block, 2x4x28-inch, make from lumber (item 38)	BF
36	F		Wood Block, 1x4x28-inch, make from lumber (item 37)	BF
37	F	5510-00-220-6078	Lumber, softwood, 1x4-inch x 10-foot long	BF
38	F	5510-00-220-6194	Lumber, softwood, 2x4-inch x 10-foot long	BF
39	F	5510-00-220-6I78	Lumber, softwood, 4x4-inch x 10-foot long	BF
40	F	7920-00-165-7195	Cloth, cleaning 10 pound box: (81349) MIL-C-85043	LB
41	F	7530-00-285-5836	Paper, writing, package of 12: (81349) SS-P-1605	EA
42	F	5330-00-333-0313	Rubber mat	EA
43	F	7930-00-923-0254	Oven cleaner, P-C-1947	OZ
44	F	9150-00-261-7899	Penetrating Oil	PT
45	F	9320-00-171-6423	Sheet, Rubber	EA
46	F	7920-00-151-6120	Pad, scouring, polyester Type F, 10 sheets (27293) Scotchbrite Type T	EA
47	F	8530-00-080-6341	Toothbrush, adult	PG
48	F	8105-00-137-9133	Plastic bag, polyethylene clear (81348) PPP-B-26, 50 pkg.	EA
49	F	6850-01-213-8797	Alkaline descaler compound	LB
50	F	9505-00-221-2650	Wire, nonelectric (safety wire) 0,020 inch diameter, MS20995C20	RL
51	F	8040-00-865-8991	Adhesive, sealant, silicone	OZ

SECTION II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
52	F		Gloves, Cotton	PR
53	F		Molykote “Z”, Dry, (Lubricant, Solid Film)	PT
54	F		Marker, Pencil, Grease	EA
55	F		Plastic Sheet (4” - 0” square)	ROLL
56	F		Dye Penetrant/Developer	PT
57	F		Grinding Discs (Various Grits)	EA
58	F		Welding Rod - AMS 5680, Size 0.035"	LB
59	F		Plastic Bag, Large garbage, Polyethylene ( ) PPP-B-XX, XX pkg	BOX
50	F		Ultrchem	PT

APPENDIX C

ILLUSTRATED LIST OF MANUFACTURED ITEMS

This appendix contains complete instructions for making items authorized to be manufactured or fabricated at intermediate direct support and intermediate general support maintenance. All bulk materials needed for manufacture of an item are listed by part number or specification number in a tabular list on the illustration. All dimensions are in inches.

MATERIAL		
STOCK	**DESCRIPTION**	**FABRICATING REQUIREMENTS**
	Electrical clip, 50 amp (81348) WC-440B, Type PC4 (6 required) Switch (96906) MS35059-22 Terminal lug (96906) MS20659-106 (2 required) Wire, 12-gauge (81349) M81044/12-12-9 (12 feet 6-inches required)	1. Cut four 36-inch (91.44 cm) pieces of wire (1, 2). Strip l/2-inch (1.27 cm) insulation from both ends of four wires (1, 2). 2. Crimp two terminal lugs (3) on one end of two wires (1). 3. Crimp six clips (4) on remaining ends of four wires (1, 2). 4. Install two screws (5), lockwashers (6), and lugs (3) to switch (7).

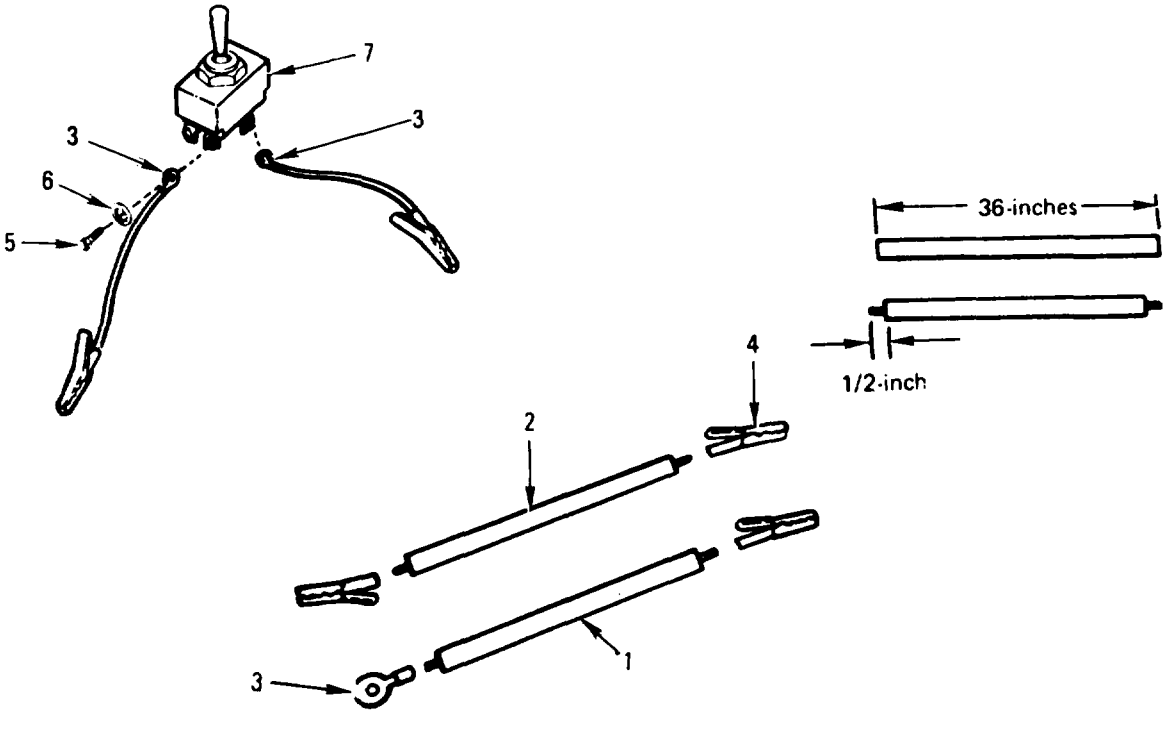


Figure 1. Test Setup

ILLUSTRATED LIST OF MANUFACTURED ITEMS (Continued)

MATERIAL		
STOCK	**DESCRIPTION**	**FABRICATING REQUIREMENTS**
	Wire -12 AWG	1. Measure and mark wire. 2. Place wire in vise and bend wire.

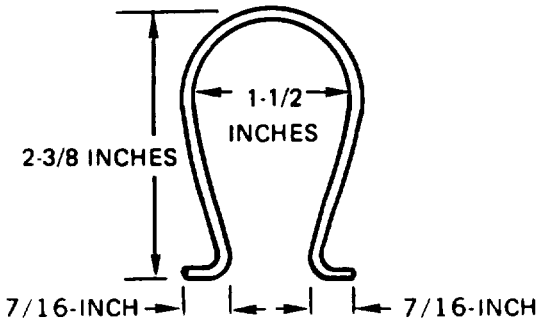


Figure 2. Starter Brush Spring Tool

MATERIAL		
STOCK	**DESCRIPTION**	**FABRICATING REQUIREMENTS**
	Aluminum Bar Stock, 1-1/2 inch diameter	1. Measure and mark aluminum bar stock with rule and scribe. 2. Cut to size shown. 3. Turn down end to size shown. 4. Grind off all burrs.

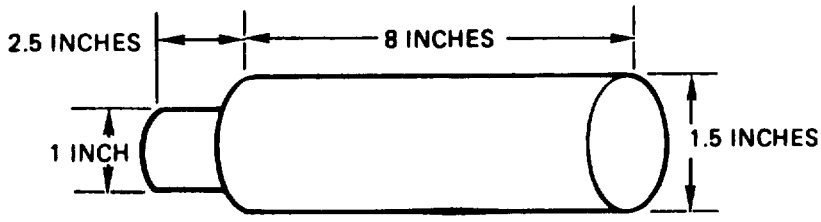


Figure 3. Starter Shift Housing Driver Shaft

ILLUSTRATED LIST OF MANUFACTURED ITEMS (Continued)

MATERIAL		
STOCK	DESCRIPTION	FABRICATING REQUIREMENTS
	Bar Stock, l/16-inch x 3/4-inch	1. Measure and mark bar stock with rule and scribe. 2. Cut to 6 inches (15.24 cm)long. 3. Grind off all burrs, but do not grind to less than l/16-inch (1.6 mm) thickness.

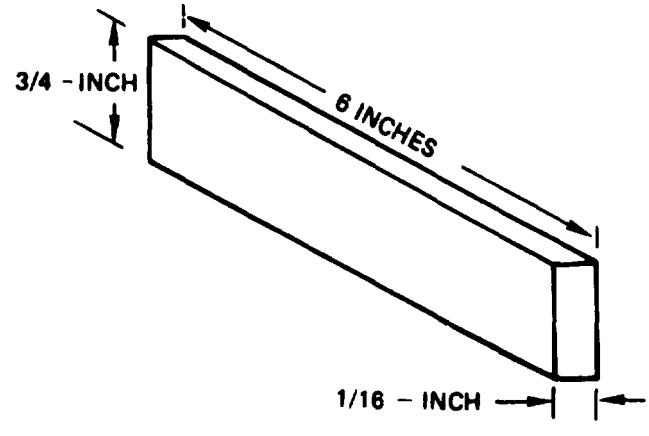


Figure 4. End Play Timing Gage

ILLUSTRATED LIST OF MANUFACTURED ITEMS (Continued)

MATERIAL		
STOCK	**DESCRIPTION**	**FABRICATING REQUIREMENTS**
	Electrical clip, 50 amp (81348) WC-440B, Type PC4 (6 required) Switch (96906) MS35059-22 Terminal lug (96906) MS20659-106 (4 required) Wire, 12-gauge (81349) M81044/12-12-9 (12 feet 6-inches required)	1. Cut four 36-inch (91.44 cm) pieces of wire (1) and one 6-inch (15.24 cm) piece of wire (2). Strip l/2-inch (1.27 cm) insulation from both ends of four wires (1, 2). 2. Crimp four terminal lugs (3) on one end of wires (l). 3. Crimp six clips (4) on remaining ends of wires (1, 2). 4. Install four screws (5), lockwashers (6), and lugs (3) to switch (7).

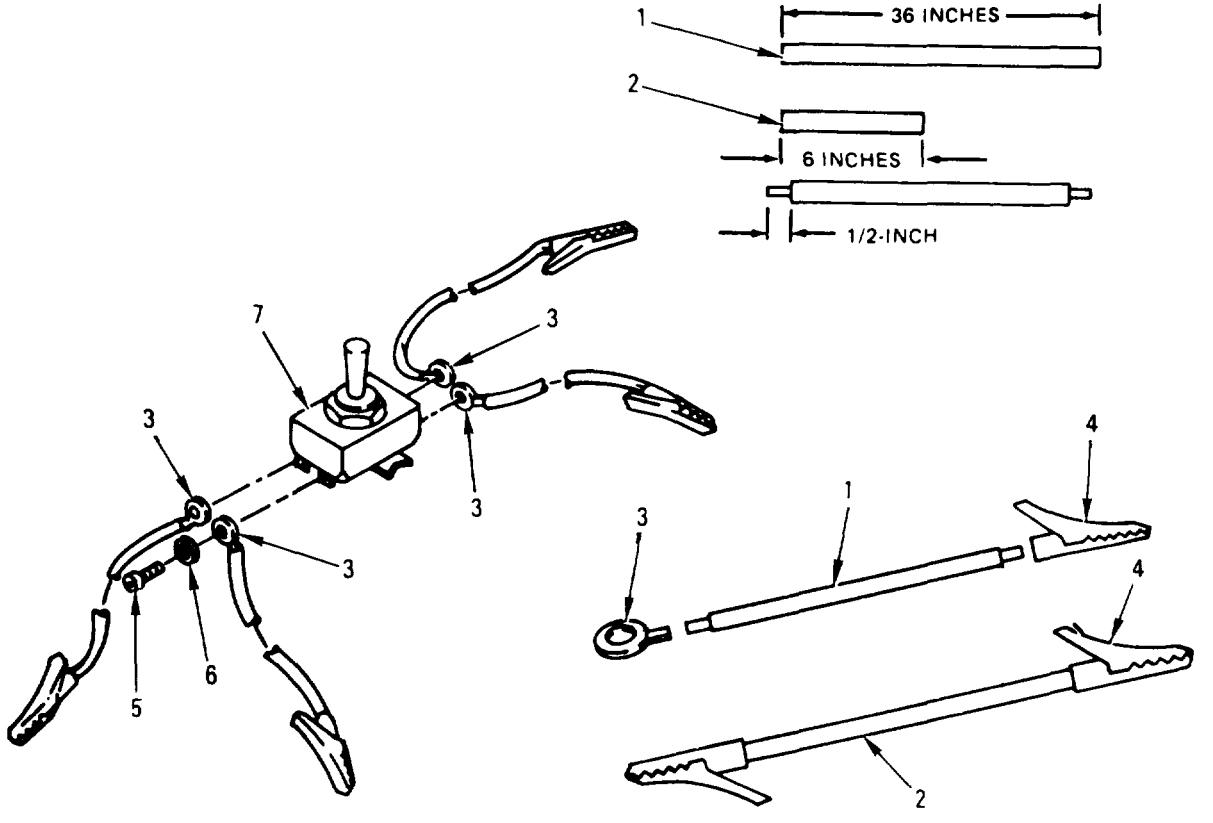


Figure 5. Test Setup

ILLUSTRATED LIST OF MANUFACTURED ITEMS (Continued)

MATERIAL		
STOCK	**DESCRIPTION**	**FABRICATING REQUIREMENTS**
	Steel Rod, 5/16-inch diameter	1. Measure and mark steel rod. 2. Cut to 8 inches (20.32 cm) long. 3. Thread one end to size shown. 4. Grind or file off all burrs.

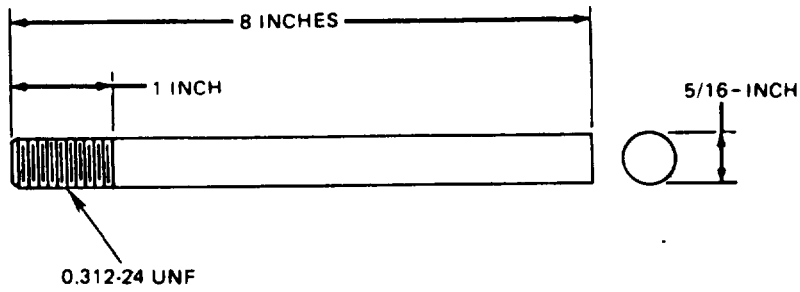


Figure 6. Reduction Gearbox Guide Pin

ILLUSTRATED LIST OF MANUFACTURED ITEMS (Continued)

MATERIAL		
STOCK	DESCRIPTION	FABRICATING REQUIREMENTS
	Socket Wrench Adapter, 1/4inch drive, 3/8-inch Combination Wrench, 1/4-inch, 12-point	1. Measure and mark wrench (1). 2. Cut open end of wrench (1) as shown. 3. Cut 1/4-inch square drive off adapter (2) as shown. 4. Weld adapter (2) to wrench (1) as shown.

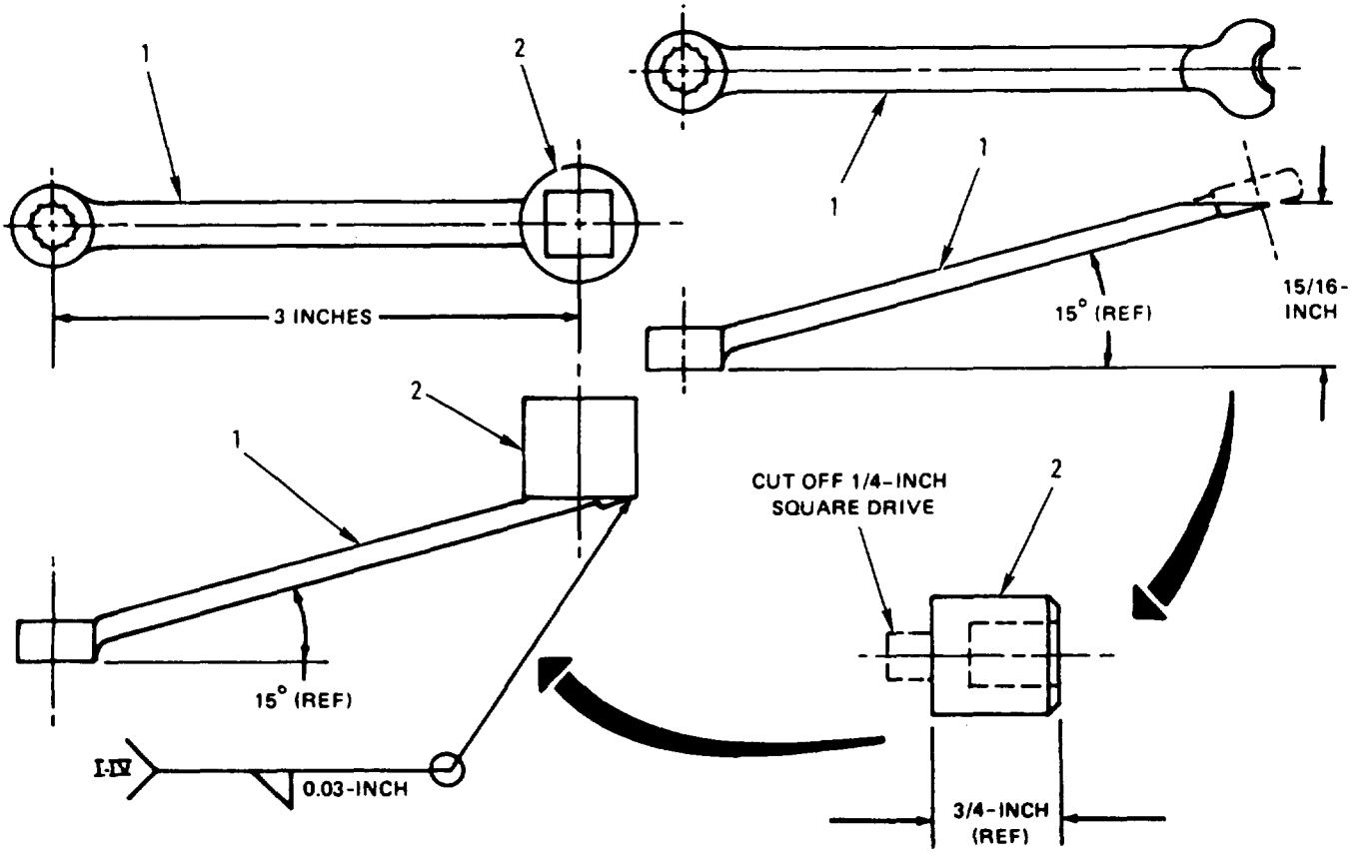


Figure 7. Torque Adapter

ILLUSTRATED LIST OF MANUFACTURED ITEMS (Continued)

MATERIAL		
STOCK	DESCRIPTION	FABRICATING REQUIREMENTS
	Aluminum, 6061-T6 (2.25 x 5.75-inch block)	1. Machine tool from aluminum stock as shown. 2. Break sharp edges 0.02-inch (0.51 mm) to 0.03 inch (0.76 mm) x 40° to 50° unless otherwise specified. 3. Anodize tool in accordance with specification AMS2470.

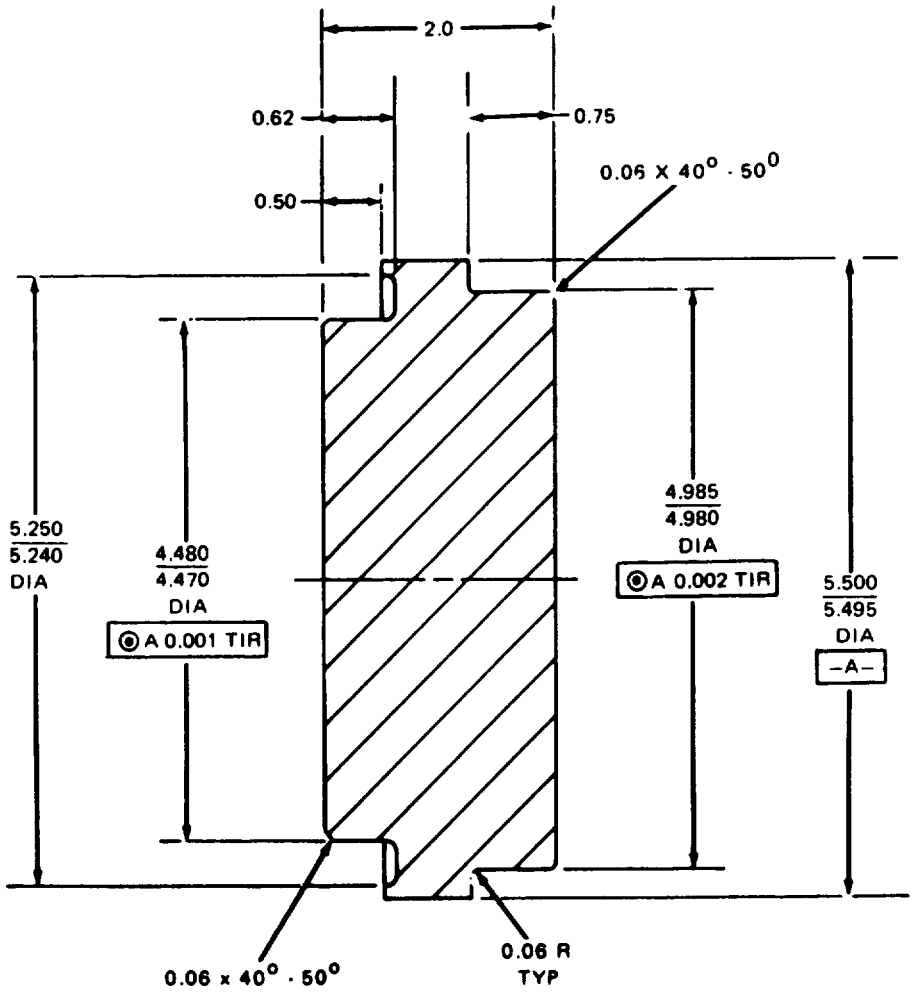


Figure 8. No. 10 Seal Removal and Installation Tool

APPENDIX D

TOOLS LIST

SECTION I. INTRODUCTION

D-1. SCOPE

This appendix is a cross-reference of item numbers to stock numbers and is included for that purpose only. Common tools are authorized in the supply catalogs listed in the "Reference" column. Special tools are also cross-referenced and the specific publication number is listed in the ‘Reference’ column.

D-2. EXPLANATION OF COLUMNS

a. Column (1) - Item number. This number is assigned to the entry in the listing for cross--referencing to the stock number.

b. Column (2) - Description. This column matches common tool nomenclature to the task nomenclature. Special tools are matched by part numbers, as nomenclature varies between tasks and tool list,

c. Column (3) - NSN. This is the national stock number assigned to the tool.

d. Column (4) - Reference, This column lists the supply catalog or publication number that contains complete description for the referenced tools.

SECTION II. TOOLS LIST

(1) Itern No.	(2) Description	(3) NSN	(4) Reference
1	Face, hammer, inserted, 1-1/2 inch	5120-00-596-1075	SC4910-95-CL-A31
2	Holder, inserted hammer face	5120-00-903-8555	SC 4910-95-CL-A3 1
3	Deleted		
4	Deleled		
5	Deleted		
6	Deleted		
7	Sling, beam type, forward engine module	3940-01-115-8159	TM 9-2835-255-34P
8	Extension. 3/8-inch drive, 6-inch	5120-00-227-8107	SC4910-95-CL-A31
9	Handle, ratchet, 3/8-inch drive	5120-00-240-5364	SC4910-95-CL-A31
10	Hoist, chain-fall type, 1000-pound minimum capacity		
11	Hoist. 1000-pound minimum capacity		
12	Socket, 3/8-inch drive, l/2-inch	5120-00-237-0977	SC 4910-95-CL-A31
13	Socket, 3/8-inch drive, 9/16-inch	5120-00-227-6704	SC 4910-95 -CL-A31
14	Socket, 3/8-inch drive, 3/4-inch	5120-00-227-6705	SC 4910-95-CL-A31
15	Tap. bottoming. 1/4-28	5136-00-227-8627	CTA 50-970
16	Wrench, combination, l-1/4-inch	5120-00-228-9517	CTA 50-970
17	Wrench, torque, 0-600 in-lb	5120-00-542-5681	CTA 50-970
18	Bolt, machine	5306-00-463-0350	TM 9-2835-255-34P
19	Wrench, combination, 1 -5/16-inch	5120-00-228-9518	CTA 50-970
20	Hoist, chain-type, 1-ton minimum capacity		
21	Hoist, l-ton minimum capacity		
22	Socket, 3/8-inch drive, 1 1/16-inch	5120-00-232-5706	SC49I0-95-CL-A31
23	Adapter. torque wrench	5120-00-867-5517	TM 9-2835-255-34P
24	Wrench, torque, 0-150 ft-lb	5120-00-247-2540	SC4910-95-CL-A31
25	Torch Outfit, cutting and welding	3433-00-357-8116	SC 3433 -90-CL-NO1
26	Mallet, rubber	5120-00-293-3399	CTA 50-970
27	Wrench, torque 0-150 in-lb	5120-00-230-6380	SC49I0-95-CL-A31
28	Socket, 3/8-inch drive, 7/16-inch	5120-00-227-6703	SC 4910-95 -CL-A31
29	Deleted		
30	Wrench, open end, 1-1/2 inch and 1-5/8 inch	5120-00-184-8439	SC 4910-95 -CL-A3 1

SECTION II TOOLS LIST (Continued)

(1) Itern No.	(,2) Description	(3) NSN	(4) Reference
31	Pliers, slip joint, conduit style with plastic jaw inserts	5120-00-624-8065	CTA 50-970
32	Sling, multiple leg, engine/rear module	3940-01-115-8117	TM 9-2835-255-34P
33	Adapter, l/4-inch male. 3/8-inch female	5120-00-227-8095	CTA 50-970
34	Deleted		
35	Sling. assembly. reduction gearbox	4910-01-127-2711	TM 9-2835-255-34P
36	Hoist, 2-ton minimum capacity		
37	Press, arbor	3444-00-449-7295	SC4910-95-CL-A31
38	Deleted		
39	Puller. mechanical gearbox seal	5120-01-115-8155	TM 9-2835-255-34P
40	Sling. beam type. AGB module	3940-01-115-8158	TM 9-2835-255-34P
41	Puller, mechanical. gearbox dowel pin	5120-01-115-8154	TM 9-2835-255-34P
42	Crank. handle, AGB gear train	5340-01-129-0463	TM 9-2835-255-34P
43	Socket, deep well. l/2-inch drive. 3/4-inch	5120-00-242-3349	SC 4910-95 -CL-A72
44	Wrench, impact, electric, l/2-inch drive	5130-00-221-0607	SC 4910-95 -CL-A01
45	Test Stand. automotive generator, alternator and starter	4910-00-767-0218	SC 4910-95 -CL-A01
46	Bit, screwdriver, cross tip, 1/2-inch drive	5130-00-240-5250	SC 4910-95 -CL-A01
47	Bit. screwdriver, flat tip, 3/8-inch drive, 1 l/16-inch	5120-00-243-7332	CTA 50-970
48	Deleted		
49	Multimeter	6625-00-999-6282	SC 4910-95 -CL-A01
50	Deleted		
51	Bit. screwdriver, flat tip, 1/2-inch drive, 15/16-inch	5120-00-277-3600	CTA 50-970
52	Deleted		
53	Socket, deep style, 3/8-inch drive, 3/4-inch	5120-00-235-5879	SC 4910-95 -CL-A31
54	Caps. vise jaw	5120-00-221-1506	SC 4910-95 -CL-A01
55	Vise, machinist's 6-inch jaw opening	5120-00-293-1439	SC 4910-95 -CL-A01
56	Blade, hand, hacksaw	5110-00-277-4591	SC 4910-95 -CL-A31
57	Caliper, outside	5210-00-221-1945	SC 3470-95 -CL-A02
58	Goggles. industrial	4240-00-269-7912	SC 4910-95 -CL-A31
59	Gun, air blow	4940-00-333-5541	SC4910-95-CL-A31
60	Compressor Unit, reciprocating, power driven	4310-00-542-4566	SC 4910-95 -CL-A31

SECTION II. TOOLS LIST (Continued)

(1) Item No.	(2) Description	(3) NSN	(4) Reference
61	Hose Assembly, nonmetallic	4720-00-356-8557	SC4910-95-CL-A31
62	Indicator, dial	5210-00-277-8840	SC3470-95-CL-A02
63	Lathe, engine	3416-01-030-8195	SC3470-95-CL-A02
64	Test Set, armature	6625-00-828-5810	SC4910-95-CL-A01
65	Undercutter, armature	4940-00-270-1594	SC3470-95-CL-A02
66	Deleted		
67	Deleted		
68	Deleted		
69	Power Supply, 14 Vdc, 30 amps	6130-00-249-2748	
70	Deleted		
71	Wrench, combination, 3/8-inch	5120-00-895-9567	SC 4910-95-CL-A31
72	Wrench, combination, 3/4-inch	5120-00-895-9573	SC 4910-95-CL-A31
73	Bit, screwdriver, hex tip, 1/2-inch drive, 7/32-inch	5130-00-242-0614	SC 4910-95-CL-A01
74	Deleted		
75	Deleted		
76	Separator, oil and water	4940-00-242-4101	SC 4910-95-CL-A31
77	Socket, deep style, 1/4-inch drive, 1/4-inch	5120-00-189-7918	CTA 50-970
78	Hammer, dead blow	5120-01-065-9037	CTA 50-970
79	Tester, spring resiliency	6635-00-641-7346	SC 4910-95-CL-A63
80	Extension, 1/4 inch drive, 6-inch	5120-00-243-7325	CTA 50-970
81	Oiler, hand	4930-00-274-5713	SC 4910-95-CL-A31
82	Bit, screwdriver, cross tip, 3/8-inch drive, No. 2	5120-00-293-0318	CTA 50-970
83	Wrench, open end, 7/8-inch and 13/16-inch	5120-00-277-2329	SC4910-95-CL-A31
84	Wrench, plier	5120-00-277-4244	SC4910-95-CL-A31
85	Bar, pinch	5120-00-224-1372	SC4910-95-CL-A62
86	Scriber, machinist's	5120-00-221-7063	SC3470-95-CL-A02
87	Gloves, chemical and oil protective	8415-00-6414601	SC4910-95-CL-A72
88	Faceshield, industrial	4240-00-202-9473	SC4910-95-CL-A31
89	Sling, lifting, 4-point minimum 1000 pound capacity		
90	Deleted		
91	Scraper, bearing	5110-00-240-7666	CTA 50-90
92	Mirror, inspection	5120-00-596-1098	CTA 50-970
93	Rule, machinist's	5120-00-234-5223	SC4940-95-CL-B04
94	Wrench, combination 1-1/8 inch	5120-00-895-9577	SC4910-95-CL-A31
95	Measure, liquid	7240-00-205-0810	CTA 50-970
96	Pail, metal 10 quart	7240-00-754-1298	CTA 50-970

SECTION II. TOOLS LIST

97	Deleted		
98	Maintenance kit, electrical	4931-01-119-7103	TM 9-2350-264-24-P1
99	Bruxh, bench	7920-00-165-7277	CTA 50-970
100	Gloves, leather	8415-00-268-7859	SC 4910-95-CL-A31
101	Pliers, wire twister	5120-00-542-4171	CTA 50-970
102	Punch, drive pin, 3/32-inch	5120-00-223-1010	CTA 50-970
103	Puller, No. 7 seal, LTCT5498		Tm 9-2835-255-34P
104	Pliers, retaining ring: internal 3.15 to 6.5 inches	5120-00-293-0186	SC 4910-95-CL-A31
105	Installer, No. 7 seal, LTCT5561		TM 9-2835-255-34P
106	Screwdriver, 12-inch	5120-00-227-7362	
107	Wrench, torque, 0-600 ft-lb	5120-00-221-7983	SC 4910-95-CL-A31
108	Socket, 3/8-inch drive, 5/32-inch	5120-00-555-2353	SC 5180-95-CL-A12
109	Socket, 3/8-inch drive, 3/16 6-inch	5120-00-583-8597	SC 5180-95-CL-A12
110	Holding fixture, LTCT5889		TM 9-2835-255-34P
111	Extension, 3/8-inch drive, 12-inch	5120-00-243-1691	SC 4910-95-CL-A31
112	Handle ratchet, 3/4-inch drive	5120-00-249-1076	SC 4910-95-CL-A31
113	Handle, hinged, 3/4-inch drive	5120-00-221-7959	SC 4910-95-CL-A31
114	Fixture, holding, LTCT7411		TM 9-2835-255-34P
115	Puller, splined coupling, LTCT5602		TM 9-2835-255-34P
116	Puller, adapter and shaft, LTCT5655		TM 9-2835-255-34P
117	AGB dust seal installer, LTCT5685		TM 9-2835-255-34P
118	Wrench, socket, threaded stop, LTCT5141		TM 9-2835-255-34P
119	Wrench, spanner, LTCT5990		TM 9-2835-255-34P
120	Adapter, socket wrench, 3/4-inch male, 1/2-inch female	5120-00-144-5207	SC 4910-95-CL-A31
121	Extension, 3/81994-inch drive, 16-inch	5120-00-227-8079	SC 4910-95-CL-A31
122	Tool kit, screw thread insert 3/4-16 UNF	5180-00-054-7513	TM 9-2835-255-34P
123	Tool kit, screw thread insert 7/8-14 UNF	5180-00-054-7519	TM 9-2835-255-34P
124	AGB face seal, installer, LTCT5563		TM 9-2835-255-34P
125	Drill twist, 7/64-inch	5133-00-227-9649	SC 4910-95-CL-A74
126	Sling, cover accessory gear box, LTCT7114		TM 9-2835-255-34P
127	Removal and installation tool, No. 10 seal, LTCT5247		TM 9-2835-255-34P
128	Caliper, micrometer	5210-00-242-6653	
129	Brush, paint oval 2-7/8-inch	8020-00-297-6657	SC 4910-95-CL-A31
130	Face, hammer, inserted flat 2-inch	5120-00-540-4273	SC 4910-95-CL-A31
131	Face, hammer, inserted, convex 2-inch	5120-00-585-8502	SC 4910-95-CL-A31
132	Face, hammer, deadblow 14-oz	5120-00-071-5356	SC 4910-95-CL-A31
133	Wrench, combination, 7/16-inch pr 5-1/2-inch L	5120-00-895-9568	SC 4910-95-CL-A31

SECTION II. TOOLS LIST (Continued)

134	Wrench, torque, 0-200 in-lb	5120-00-853-4538	SC 4910-95-CL-A72
135	Tap thread, CTG 1/2-20NF	5120-00-825-7096	SC 4910-95-CL-A72
136	Pail, metal 5-gallon	7240-00-575-2243	CTA 50-970
137	Pocket knife	5110-00-240-5943	
138	Torque adapter, wrench		TM9-2835-255-34P
139	Gage depth, vernier	5210-00-274-2861	TM 9-2835-255-34P
140	Installation and removing tool, No. 5 seal, LTCT5557		TM 9-2835-255-34P
141	Measure bar, LTCT7418		TM 9-2835-255-34P
142	Feeler gage, general use	5210-01-119-7601	
143	Test probe kit, TA1 continuity (P/N 12303622)	3625-01-102-6878	Authorized by TOE
144	Multimeter, digital	5625-01-139-2512	SC 4910-95-CL-A72
145	Set, test lead	5625-00-444-4041	CTA 50-970
146	Fixture, holding, LTCT5442		TM 9-2835-255-34P
147	Installing tool, bearing and housing No., LTCT130622-01		TM 9-2835-255-34P
148	Puller, seal No. 1, LTCT5443		TM 9-2835-255-34P
149	Tool kit, rem and inst seal No. 1, LTCT5545		TM 9-2835-255-34P
150	Deleted		
151	Wrench, torque, 0-250 ft-lb		
152	Deleted		
153	Puller, bevel gear, LTCT30303		TM 9-2835-255-34P
154	Deleted		
155	Deleted		
156	Fixture, LP turb runout, LTCT5612		TM 9-2835-255-34P
157	Fixture, torque, LTCT5136		TM 9-2835-255-34P
158	Installing tool		TM 9-2835-255-34P
159	Clamp, type "C"		
160	Remover/installer, seals No. 2 and 3, LTCT5568		TM 9-2835-255-34P
161	Puller, No. 3 bearing housing, LTCT5591		TM 9-2835-255-34P
162	Sleeve set, LTCT12967		TM 9-2835-255-34P
163	Lifting, LPC module, LTCT7102		TM 9-2835-255-34P
164	Wrench, spanner, bevel gear nut, LTCT5987		TM 9-2835-255-34P
165	Wrench, spanner, bearing No. 2, LTCT5401		TM 9-2835-255-34P
166	Wrench, torque, 0-200 lb-ft		
167	Gage kit assembly, axial clearance		TM 9-2835-255-34P
168	Deleted		
169	Micrometer, 7-inch maximum diameter		
170	Deleted		
171	Fixture, ring gear torque, LTCT5346		TM 9-2835-255-34P
172	Key, socket, 5/16-inch		
173	Remover tool, No. 10 bearing, LTCT5370		TM 9-2835-255-34P
174	Wrench, torquing, LTCT5081-06		TM 9-2835-255-34P
175	Crimping tool, lockcup lockwasher, LTCT5410		TM 9-2835-255-34P
176	Tool, rem/inst, intermediate housing pin, LTCT7189		TM 9-2835-255-34P
177	Fixture, holding, LTCT5527		TM 9-2835-255-34P

SECTION II. TOOLS LIST (Continued)

178	Deleted		
179	Deleted		
180	Puller, No. 12 bearing, LTCT5441		TM 9-2835-255-34P
181	Wrench, No. 12 bearing nut, LTCT5436		TM 9-2835-255-34P
182	Wrench, No. 12 bearing retaining nut, LTCT5503		TM 9-2835-255-34P
183	Router, hand held, electric		
184	Grinder, hand held, electric		
185	Wrench, spacer, lubricating oil tank, LTCI7370		TM 9-2835-255-34P
186	Welder, TIG - manual GTAW, 60-90 amps dc		
187	Brush, wire		
188	Lifting adapter (sling), PT assembly, LTCT5610		TM 9-2835-255-34P
189	Pin, rigging, LTCT7442		TM 9-2835-255-34P
190	Socket, 3/8-inch drive, 1/4-inch, 12-point	5120-00-288-8155	
191	Socket, 3/8-inch drive, 7/32-inch, 12-point	5120-00-935-7484	
192	Socket, 3/8-inch drive, 5/16-inch, 12-point	5120-00-232-5711	
193	Plate, anti-torque, LTCT5592		TM 9-2835-255-34P
194	Bar, 1/2-inch drive (breaker bar)		
195	Caliper, outside, 0-1 inch (0-25.4 mm)		
196	Crimping tool (brass drift)		
197	Drill, twist No. 57 (0.043-inch diameter) + B 1 1 4		
198	Deleted		
199	Magnifying glass, 4 power		
200	Puller, AGB bearings, LTCT5593		TM 9-2835-255-34P
201	Puller, universal AGB bearing, LTCT5562		TM 9-2835-255-34P
202	Sharpening stone		
203	Wrench, spanner, No. 3 spur gear, LTCT5531		TM 9-2835-255-34P
204	Puller, No. 2 bearing housing, LTCT5100		TM 9-2835-255-34P
205	Micrometer, depth gage		
206	Crowsfoot, 1/4-inch, 5/16-inch		
207	Torque adapter, 3-inch		
208	Automotive wrench		
209	Breaker bar, 3/4-inch drive		

APPENDIX E

REPLACEMENT PARTS LIST

SECTION I. INTRODUCTION

D-1. SCOPE

This appendix is a cross-reference of item numbers to part numbers and is included for that purpose only.

D-2. 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) - Description. This column identifies parts which appear on the first page of the task under the subheading "SUPPLIES."

c. Column (3) - 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, specifications, standards, and inspection requirements to identify any item or range of items.

NOTE: When you use National Stock Number (NSN) to requisition a part, the part you get may have a different part number from the part ordered, but go ahead and use or furnish it as the supply part.

SECTION II REPLACEMENT PARTS LIST (Continued)

(1) Item No.	(2) Description	(3) Part Number
1	Gasket	12286883
2	Lockwasher	MS35333-36
3	Nut, self-locking	MS21043-4
4	Nut, self-locking	12286996-1
5	Pin, cotter	MS24665-300
6	Keywasher	MS9582-10
7	Lockwasher	MS35333-75
8	Nut, self-locking	MS51943-35
9	Nut, self-locking	MS21042-4
10	Pin, cotter	MS24665-151
11	Pin, cotter	MS24665-300
12	Strap, tiedown	MS3367-3-9
13	Spacer	12286604
14	Pin, cotter	MS24665-370
15	Gasket	12271135
16	Nut, self-locking	MS20500-524
17	Nut, self-locking	MS51922-33
18	Lockwasher	MS35338-47
19	Lockwasher	MS35338-52
20	Nut, self-locking	MS51943-31
21	Packing, preformed	M83248/1-156
22	Packing, preformed	M83248/1-343
23	Packing, preformed	12284602
24	Nut, self-locking	MS51988-1
25	Seal. conical flared	VSF1015N16B
26	Gasket	12271185
27	Seal, conical flared	12284521
28	Packing, preformed	12284601
29	Deleted	
30	Packing. preformed	M83248/1-215
31	Bolt, shoulder	12284535
32	Seal ring	12284573
33	Gasket	12284579
34	Gasket	12284580
35	Packing	12284574
36	Seal ring	12284577
37	Packing, preformed	12284578
38	Keywasher	12286991-3
39	Lockwasher	MS35338-46
40	Nut, self-locking	MS51922-17
41	Lockwasher	MS35338-48
42	Nut, self-locking	MS51922-9
43	Deleted	
44	Deleted	
45	Deleted	
46	Gasket	12271128
47	Seal, plain encased	12284415

SECTION II REPLACEMENT PARTS LIST (Continued)

(1) Item No.	(2) Description	(3) Part Number
48	Seal Ring	12286353
49	Spring, expander	12286812
50	Packing, preformed	M8324811-129
51	Packing, preformed	M83248/1-150
52	Seal, plain encased	12284756
53	Seal, plain encased	12302043
54	Retainer, oil seal	12284757
35	Packing. preformed	M83248/1-226
56	Seal, conical. flared	12284519
57	Seal, conical flared	12284520
58	Lockwasher	MS35338-44
59	Seal. conical, flared	12284518
60	Accessory Gearbox	12284320
61	Accessory Gearbox	12284326
62	Nut, self-locking	12285856
63	Packing. preformed	M83248/1-047
64	Packing, preformed	M83248/1-123
65	Packing, preformed	M83248/1-216
66	Packing, preformed	M83248/1-220
67	Packing. preformed	M83248/1-245
68	Packing, preformed	M83248/1-037
69	Packing, preformed	M83248/1-243
70	Lockwasher	MS35333-40
71	Gasket	1894791
72	Gasket	1972748
73	Screw	1971106
74	Spring, helical	1945402
75	Lockwasher	11504248
76	Brush, electrical	1946407
77	Clamp, hose	801078
78	Insulator	1913027
79	Packing, preformed	1894785
80	Packing, preformed	1894786
81	Packing, preformed	1851604
82	Parts Kit, electrical	1851632
83	Ring. retaining	9415235
84	Screw	1847807
85	Spacer. sleeve	1851603
86	Spring, helical	1979391
87	Washer	1918689
88	Gasket	1894792
89	Packing, preformed	1894790
90	Pin. valve to shaft	273436
91	Spring, helical	1945402
92	.Brush, electrical	1832883
93	Nut. self-locking	9412305
94	Plug, pipe	10505779
95	Gasket	M042095305

SECTION II. REPLACEMENT PARTS LIST (Continued)

(1) Item No.	(2) Description	(3) Part Number
96	Lockwasher	2434
97	Wick	M091038406
98	Bushing, sleeve	95040
99	Packing, preformed	Z053095311
100	Seal, plain	M054225004
101	Washer, flat	71164
102	Brush Kit	71247
103	Brush Kit	M027296002
104	Lockwasher	2523
105	Packing, preformed	Z053095309
106	Packing, preformed	Z053095308
107	Plug. protective	Z777095358
108	Packing. preformed	M83248/1-112
109	Gasket, air bleed	12286920
110	Nut, self-locking	MS21046C4
111	Packing, preformed	M83248-1-029
112	Packing, preformed	M83248/1-014
113	Pin, spring	NAS561S5-22
114	Pin, cotter	MS24665-1012
115	Ring. seal	12286825
116	Ring, seal	12286824
117	Ring, retaining	M27426-3155D
118	Spring, expander	12286836
119	Seal, plain encased	12286859
120	Lockwasher	MS35333-36
121	Gasket	12286105
122	Packing, preformed	M83248/1-011
123	Packing, preformed	M83248/1-910
124	Gasket	12302400
125	Spacer, -1 thru -16	12302351
126	Seal, plain, No. 5	12286810
127	Seal, special	12284631
128	Nut, self-locking	12286996-1
129	Packing, preformed	12302369
130	Power transformer	2540572
131	Power transformer	2540566
132	Gasket	2540568
133	Gasket	2539796
134	Screw, self locking	NAS1352-3LE10P
135	Washer, flat	AN960C10L
136	Seal	328617
137	Direct linear valve	2718362
138	Screw, self locking	LP62U04J9HQM
139	Packing, preformed	953541-129
140	Flatwasher	AN960-10L
141	Packing, preformed	2666850-12

SECTION II. REPLACEMENT PARTS LIST (Continued)

(1) Item No.	(2) Description	(3) Part Number
142	Cover, accessory gearbox	12286142
143	Gasket	2539796
144	Screw, self- locking	2529390
145	Screw, cap socket	333-S-641
146	Bolt, machine	LP62U62J6HQM
147	Gasket	12271129
148	Nut, plain round	12286505
149	Seal ring assembly, metal	12286492
150	Keywasher	12286992
151	Keywasher, forward stop keylock	12266508
152	Insert screw thread	1191-14CNX7-8
153	Insert screw thread	12286975
154	Ring, retaining	12302271
155	Diaphragm assembly	12284403
156	Packing with retainer	NAS1523C8Y
157	Seal, conical, flared	12284519
158	Ring, retaining	M27426-3173A
159	Lockwasher	MS35333-74
160	Sleeve, compression	ST2001-08
161	Packing retainer (face seal)	12302426
162	Packing retainer (lockcup)	12286202
163	Packing, preformed	M83248/1-041
164	Packing, preformed	M83248/1-042
165	Packing, preformed	M83248/1-007
166	Packing, preformed	M83248/1-115
167	Protector caps	
168	Ring spacer (shim)	12286053
169	Sleeve, flaired	AS3075-04
170	Sleeve, flaired	AS3075-06
171	Spacer, ring	12302389
172	Lockcup, bearing No. 3	12286273
173	Lockcup, gearshaft, spur	12286074
174	Nut, plain, round, gearshaft, spur	MS172241
175	Pin, straight, headless	12286112
176	Packing, preformed	MB324811-038
177	Packing, preformed	M83248/1-152

SECTION II. REPLACEMENT PARTS LIST (Continued)

(1) Item No.	(2) Description	(3) Part Number
178	Deleted	
179	Packing, preformed	M83248/1-040
180	Ring, retaining	12286168
181	Deleted	
182	Spacer, ring, 0.038-inch	12271532-3
183	Spacer, ring, 0.048-inch	12271532-4
184	Spacer, ring, 0.058-inch	12271532-6
185	Spacer, ring, 0.068-inch	12271532-7
186	Bearing, ball, annular	12286800
187	Lockcup	12286006
188	Gasket, metal (v-seal)	12284386
189	Keywasher	12286277
190	Lockcup	12286278
191	Pin, spring	NAS561C3-13
192	Washer, flat	MS9321-17
193	Packing, preformed	M83248/1-132
194	Packing, preformed	M83248/1-916
195	Bolt	12286582
196	Bolt, slave	MS9490-10
197	Washer, flat	AN960C416
198	Nut, slave	AN315-4R
199	Gasket, metal	12286513
200	Spacer	12271587
201	Bumper stop	12325011
202	Ring, retaining	M27426-3145D

APPENDIX F

GENERAL MAINTENANCE INSTRUCTIONS

CLEANING MECHANICAL PARTS

TOOLS: Bench brush (Item 99, Appendix D)
Chemical and oil protective gloves (Item 87, Appendix D)
Industrial goggles\Item 58, Appendix D)
Scraper (Item 91, Appendix D)

SUPPLIES: Dry cleaning solvent (Item 7, Appendix B)
Wiping rag (Item 14, Appendix B)

WARNING

Use one of the following methods to remove dirt, grease, oil, etc., from all metal surfaces:

- Dip tank: Stir or shake fast for 1 minute in each tank.
- Vapor degreaser: Soak for 2 to 3 minutes.
- Wipe with rags: Dip rags in dry cleaning solvent.
- Stiff brush or scraper: Clean hard-to-get-at areas with a stiff-bristled brush or scraper.

PAINTING

Look in TM 43-0139 and AR 750-58 for ways to paint and what supplies to use. Look in TM 5-200 for ways to camouflage parts.

UNPACKING AND PACKING

WARNING

NOTE

New engines are packed with a cover on the engine air inlet and engine exhaust. New forward engine modules are packaged with a cover on the engine air inlet. New rear engine subassemblies are packaged with a cover on the engine exhaust. These covers may be used when working on the engine.

When unpacking engines, forward engine modules, and rear engine subassemblies, set engine air inlet cover or engine exhaust cover aside for use when working on the engine.

Remove all packing material (e.g. barrier paper, tape, plastic bags, covers) when unpacking items from shipping containers.

Cover engine inlet and exhaust, and openings in engine, modules, and subassemblies, when packing in shipping containers, This keeps dirt and other objects from getting in engine parts.

PROTECTING AND HANDLING ENGINE

CAUTION

- Do not use tubes, hoses, or electrical cables as hand holds when moving or working on engine, modules, or subassemblies. This could loosen or crack tubes, hoses or electrical connectors.

- Foreign objects can cause engine damage. Make sure air intake cover, 12310804 and exhaust duct cover, 12310812 are installed when doing maintenance on engine to prevent dirt and other objects from getting in engine.

- . Cap all fuel, oil, air, or engine component openings with protective covers. Do not use tape to seal fuel or oil openings. Tape adhesive can contaminate fuel oil.

CARE OF TUBES AND HOSES

TOOLS: Air blow gun (Item 59, Appendix D)
Metal pail (Item 96, Appendix D)

SUPPLIES: Dry cleaning solvent (Item 7, Appendix B)
Protective caps and plugs (as required)
Wiping rag (Item 14, Appendix B)

WARNING

Clean tubes and hose fittings with solvent and rag before removing.

CAUTION

Do not use tape to close off fuel or oil openings, the sticky surface of tape will mix with fuel or oil and will get into the engine fuel or lubrication system which could result in engine damage.

Cap open ends of tubes and hoses and plug openings in engine with protective caps and plugs to keep dirt from getting in engine.

When tubes and hoses are removed, a small amount of oil or fuel will drain out. Catch oil or fuel in a container.

WARNING

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

Clean tubes and hoses with a clean rag and solvent. Dry with low air pressure before installing.

Check oil in engine after removing and installing tubes and hoses.

REMOVING OR INSTALLING CONNECTORS

TOOLS: Electrical maintenance kit (Item 98, Appendix D)

SUPPLIES: Cleaning cloth (Item 40, Appendix B)
Protective caps and plugs (as required)

REMOVING OR INSTALLING CONNECTORS (Continued)

Dry the outside surface of electrical connectors and receptacles with a cloth before loosening them for disassembly. Moisture can be present from rain, snow, washing, or dew.

If connectors cannot be removed by hand, use conduit style slip joint pliers with plastic jaw inserts to loosen them. Finish removal by hand. Straighten any bent contacts with long round nose pliers. When installing connectors on larger harnesses, another soldier will be needed to help aline the mating ends of the cable. Make sure that contacts and keyways line up. Tighten twist-snap-type connectors until a click is heard. Tighten screw-on-type connectors until ratchet noise is heard to indicate that connectors are tight.

Put a protective cap or plug over any electrical connector that is left uncovered. Cover connectors on any item being moved to or from the tank. Remove covers when connectors are installed.

Look at connectors for broken, missing, or pushed in contacts before making any connections. If a connector is bad, repair it. Tighten connectors by hand whenever tools are not called out.

CARE OF REMOVED PARTS AND COMPONENTS

SUPPLIES: Writing pencil (Item 27, Appendix B)
Tag (Item 26, Appendix B) (as required)

Before removing any parts or components, check to see if the part or component and mounting area are identified. If not, write identification on tags and fasten tags to the part or component and the mounting area. If tag cannot be fastened to a part or component or mounting area, mark identification on the part or component and mounting area with pencil.

Look carefully at parts and components for signs of trouble while doing routine work. Replace damaged or cross threaded screws and nuts. Check for torn or stretched gaskets or leaks. Check mounting, parts, and shafts for alinement. Tighten loose parts. Straighten bent parts if possible and check for cracks. Replace damaged or missing parts.

CARE OF SLINGS

Check slings for damaged, worn, or cracked links in chain or breaks, cuts or signs of fraying cables. Replace damaged slings.

Check that safety hooks and latches are in good working order and are not damaged. Replace slings with damaged hooks or latches.

SILVER BRAZE INSPECTION

Check brazements after repair for cracks. Cracks are not allowed.

LOCKWIRING

TOOLS: General mechanic's tool kit: automotive (SC5180-90-N26)
Industrial goggles (Item 58. Appendix D)
Pliers, wire twister (Item 101, Appendix D) (for double twist method)

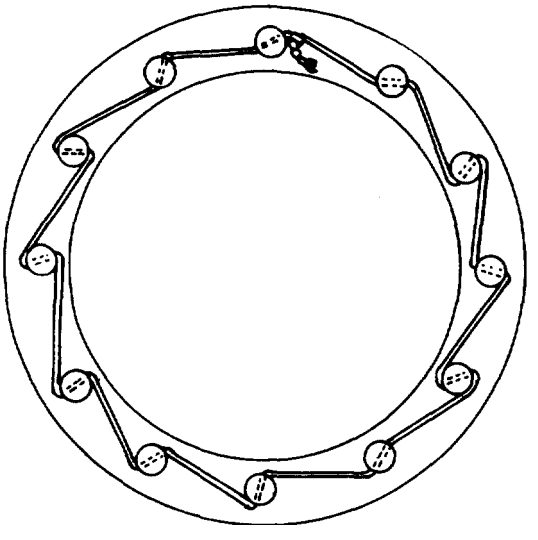
WARNING

When ends of Iockwire are cut, they may be propelled into the air and cause eye injury, Always wear eye protection when Iockwiring. Failure to comply could result in serious injury.

The double twist method of safety wiring shall be the common method. The single wire method may be used in closely spaced patterns (maximum of two inches between screw centers) or when space makes the single wire method more feasible. In areas where screws secure hydraulic or air seals, the double twist method shall he used.

Wire parts so that the wire will be put in tension when a screw tends to loosen. Always install and twist the wire so the loops around the heads stay down and do not lend to come up over the screw heads to form a slack loop.

Twist the ends of the lockwire to form a pigtail (approximately 3 to 5 twists). Bend the pigtail back or under to prevent it from becoming a snag.



SINGLE WIRE METHOD

DOUBLE TWIST METHOD

GLOSSARY

ABBREVIATIONS

The following abbreviations are used in this manual to help identify major components and reduce wording:

AGB . . . . . Accessory Gearbox
AMP . . . . . Ampere
AR . . . . . Army Regulations
ATTN: . . . . . Attention
BF . . . . . Board Feet
CC . . . . . Cubic Centimeter
CM or cm . . . . . Centimeter
DA . . . . . Department of the Army
DS . . . . . Direct Support
DS/GS . . . . . Direct Support/General Support
EA . . . . . Each
EIR . . . . . Equipment Improvement Recommendations
ECU . . . . . Electronic Control Unit
EMFS . . . . . Electro-mechanical Fuel System
ES . . . . . Engine Symptom
FM . . . . . Field Manual
FOD . . . . . Foreign Object Damage
FSCM . . . . . Federal Supply Code for Manufacturer
GL . . . . . Gallon
GMI . . . . . General Maintenance Instructions
IGV . . . . . Inlet Guide Vane
IGVS . . . . . Inlet Guide Vanes
LB-FT or lb-ft . . . . . Pound-Feet
LB-IN or lb-in . . . . . Pound-Inches
LO . . . . . Lubrication Order
MI . . . . . Michigan
MM or mm . . . . . Mllllmeter
MTOE . . . . . Modified Table of Organization and Equipment
NŽom . . . . . Newton Meters
No. . . . . Number
NSN . . . . . National Stock Number
OK . . . . . Okay
Oz . . . . . Ounce
PAM . . . . . Pamphlet
PR . . . . . Pair
PT . . . . . Pint
PTS . . . . . Power Turbine Stator
QT . . . . . Quart
RD . . . . . Rod
RGB . . . . . Reduction Gearbox
RL . . . . . Roll
RPM . . . . . Revolutions Per Minute
RPSTL . . . . . Repair Parts and Special Tools List
SC . . . . . Supply Catalog
SH . . . . . Sheet

TACOM . . . . . Tank Automotive Command
TB . . . . . Technical Bulletin
TM . . . . . Technical Manual
U.S. . . . . United States
U/M . . . . . Unit of Measure
YD . . . . . Yard

*U.S. GOVERNMENT PRINTING OFFICE: 1994-546-017/00175

ALPHABETICAL INDEX

Subject, Page

E

Subject, Page

E (Continued)

F

Subject, Page

G

Subject, Page

H

I

*U.S. GOVERNMENT PRINTING OFFICE:1998-546-039 60115

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

R. L. DILWORTH
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-37R, Intermediate Direct Support and Intermediate General Support Maintenance requirements for M1A1 General Abrams Tank.

*** U.S. GOVERNMENT PRINTINO OFFICE: 1994 300-421/03084**

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)
Your mailing address

DATE SENT
Date you fill out this form.

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 9-2835-255-34	28 Oct 87	Turbine Engine, Field Service, Model AGT 1500 and Container

BE EXACT PIN-POINT WHERE IT IS

PAGE NO	PARAGRAPH	FIGURE NO	TABLE NO	IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
3-21				Item 4 show packing removed from drain plug.
5-5				Callouts 16 and 17 should be reversed. Callout 17 should be a strap.
9-32			9-4	Commutator diameter change 2.1160 to 2-1150.
B-2				Change NSN from 9150-00-985-7098 to 9150-00-985-7099

SAMPLE

PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE
Jack Shiver PFC 343 6376	Jack Shiver

DA FORM 1 JUL 79 2028-2 PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 9-2835-255-34	28 Oct 87	Turbine Engine, Field Service, Model AGT 1500 and Container

BE EXACT PIN-POINT WHERE IT IS

PAGE NO	PARAGRAPH	FIGURE NO	TABLE NO

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

PRINTED NAME GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P S --IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

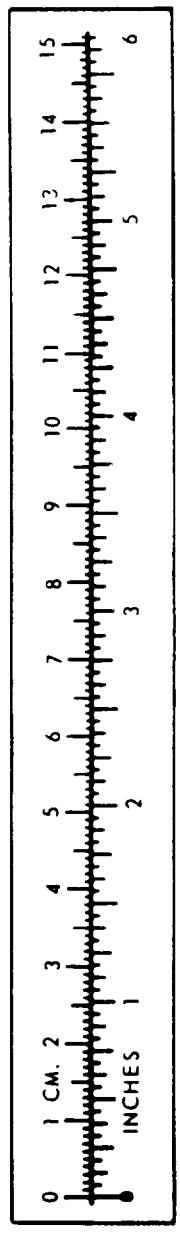
TEMPERATURE

$\frac{5}{9}(°F - 32) = °C$
212° Fahrenheit is equivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
$\frac{9}{5}\,°C + 32 = °F$

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	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
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	2.354
Kilometers per Hour	Miles per Hour	0.621



TA089991

PIN: 053039-006