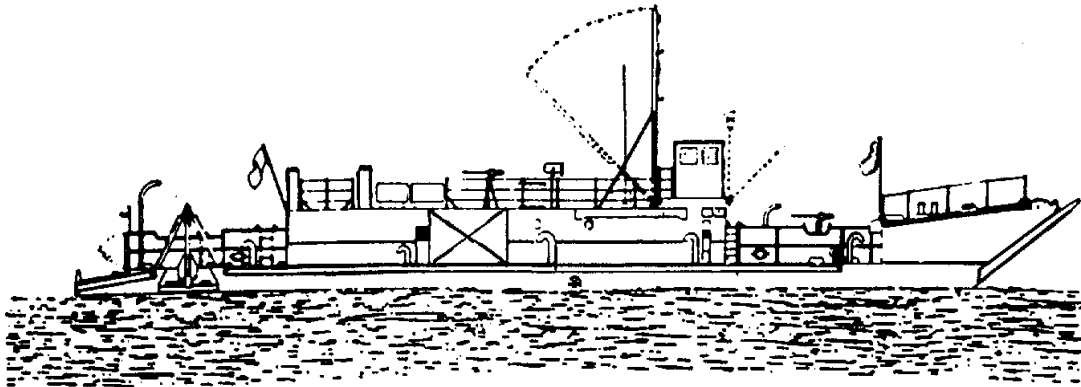


TECHNICAL MANUAL
OPERATOR'S, ORGANIZATIONAL,
DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE MANUAL

**DIRECT SUPPORT
MAINTENANCE
INSTRUCTION**

LANDING CRAFT UTILITY
LCU 1667-1670 Y
NSN 1905-00-168-5764

**GENERAL SUPPORT
MAINTENANCE
INSTRUCTIONS**



HEADQUARTERS, DEPARTMENT OF THE ARMY

8 APRIL 1985

CHANGE
NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 10 APRIL
1992

**Operator's, Organizational
Direct Support and General Support Maintenance Manual**

**LANDING CRAFT UTILITY
LCU 1667-1670
NSN 1905-)00-168-5764**

Approved for public release; distribution is unlimited

TM 55-1905-219-1411, 8 April 1985, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages

5-1099 through 5-1104
5-1117 through 5-1122
5-1123/5-1124
5-1167 through 5-1174
5-1175 through 5-1177
5-1189 and 5-1190
5-1239 through 5-1250
5-1407 and 5-1408
5-1471 through 5-1474
5-1475 and 5-1476
5-1477 through 5-1480
5-1535 through 5-1540
5-1543 and 5-1544
5-1555 through 5-1558
5-1583 and 5-1584
5-1587 through 5-1590
5-1593 through 5-1596
6-1 and 6-2

Index-1 and Index-2

FP-1 1/FP-12
FP-25/FP-26
FP-27/FP-28

Insert pages

5-1099 through 5-1104
5-1117 through 5-1122
5-1123/5-11 24
5-1167 through 5-1174

5-1189 and 5-1190
5-1239 through 5-1250
5-1407 and 5-1408
5-1471 through 5-1474
5-1475/5-1476

5-1535 through 5-1540
5-1543 and 5-1544
5-1555 through 5-1558
5-1583 and 5-1584
5-1587 through 5-1590
5-1593 through 5-1596
6-1 and 6-2
6-31 through 6-37/6-38
Index-1 and Index-2
FP-1 1/FP-12
FP-25/FP-26
FP-27/FP-28
FP-29/FP-30

2. Retain this sheet in front of manual 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
00902

DISTRIBUTION:

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WARNING**DEATH****OR SEVERE INJURY MAY RESULT IF PERSONNEL FAIL TO OBSERVE THE GENERAL SAFETY PRECAUTIONS-BELOW, AND THE SPECIFIC PRECAUTIONS CONTAINED IN THE TEXT.**

- Wear safety glasses, safety shoes, and a hard hat to provide adequate protection.
- Death or severe injury may result if personnel fail to use a lifting device that is adequate for the item to be lifted.
- Ear protection must be worn when-engines or machinery are in operation.
- Use care when using power tools.
- If cleaning agents are used, be sure area is adequately ventilated, and use protective gloves and goggles, or face shield and apron.
- Avoid excessive injection of ether into an engine during starting attempts. Follow the instructions on the container or by the manufacturer of the starting aid.
- Use the recommended air pressure when using compressed air to clean components. Too much air pressure can rupture, or in some way damage a component and create a hazardous situation that can lead to personal injury.
- When working on an engine that is running, accidental contact with the hot exhaust manifold can cause severe burns.
- Use extreme care when near rotating fans, belts, and pulleys.
- Avoid making contact across the terminals of the batteries, and do not spill the contents of the battery.

WARNING

(Continued)

- Keep clear of the Anchor Winch or Bow Ramp Winch while it is in operation.
- During any removal, disassembly, assembly, or installation of an electrical device, make sure all electrical power is disconnected and tagged. (Circuit breaker in the OFF position and tagged).
- Improper functioning of the Engine Exhaust System can cause injury or death.
- Personnel should know the location and operation of all equipment for emergency use .
- Before attempting to operate any equipment, read the instructions completely. Then, return to the appropriate section and follow the instructions.
- Do not enter the Winch Compartment alone.
- If the Halon Fire System is activated (horn sounds), leave the compartment immediately. Check that no one is left, and then close and dog the hatch.
- Use extreme care when handling gasoline for the Salvage Pump.
- Store all flammable materials in the Flammable Storage Compartment.

**OPERATOR'S ORGANIZATIONAL, DIRECT SUPPORT,
AND GENERAL SUPPORT MAINTENANCE MANUAL**

LANDING CRAFT UTILITY

LCU 1667-1670 NSN 1905-00-168-5764

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake 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 direct to: Commander, U. S. Army Troop Support Command, ATTN: AMSTR-MPS, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply will be furnished directly to you.

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CHAPTER 6. GENERAL SUPPORT MAINTENANCE INSTRUCTIONS	6-1
INDEX.....	Index-1

5-68. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS.

The following is an index to the Anchor Winch Engine maintenance instructions:

Description	Paragraph
Engine Assembly	5-69
Governor	5-70
Blower	5-71
Fuel Injector	5-72
Fresh Water Pump	5-73
Water Manifold.....	5-74
Thermostat and Housing.....	5-75
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Flywheel and Housing	5-77
Lube Oil Pump	5-78
Cylinder Block	5-79
Hydrostarter Piping	5-80
Hydrostarter Reservoir	5-81

The following is an index to the Hydrostarter Maintenance procedures.

Description	Paragraph
Hydrostarter	5-21
Accumulator	5-22
Engine Driven Pump	5-23
Solenoid	5-24

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Removal
- b. Engine Run-In Instructions
- c. Installation

INITIAL SETUP

Test Equipment

NONE

References

Vol-10 FO-1 Machinery/Vehicle Deck
Access

Special Tools

Cutting tools
Welding tools
Crane (10 ton)
Miscellaneous chains

Equipment

<u>Condition</u>	<u>Condition Description</u>
Paragraph	

5-65.1	Disconnect Clutch Assembly Removed
--------	---------------------------------------

5-66	Torque Converter Removed
------	--------------------------

Material/Parts

NONE

Special Environmental Conditions

Do not drain oil into bilges. Use oil/water separation and recovery system to collect oil.

Personnel Required

6

General Safety Instructions

Observe normal precautions when handling heavy equipment.

LOCATION

ITEM

ACTION

REMARKS

NOTE

Anchor Winch Engine weight is 2,880 lbs. (1306 kg) dry.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

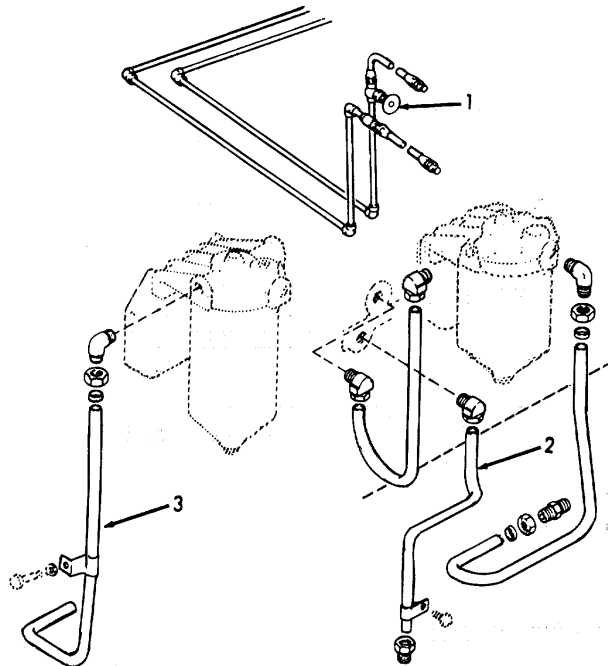
LOCATION	ITEM	ACTION	REMARKS
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WARNING

- To prevent the possibility of a fire when using cutting or welding equipment, place a crewman above and below the deck with a fire extinguisher.
- Keep clear of the area directly below the deck section being removed.

REMOVAL

1. Fuel Lines	a. Valve (1)	Close.	
	b. Fuel drain tube (2), and strainer to fuel pump tube (3)	Disconnect.	Drain fuel into a suitable container.

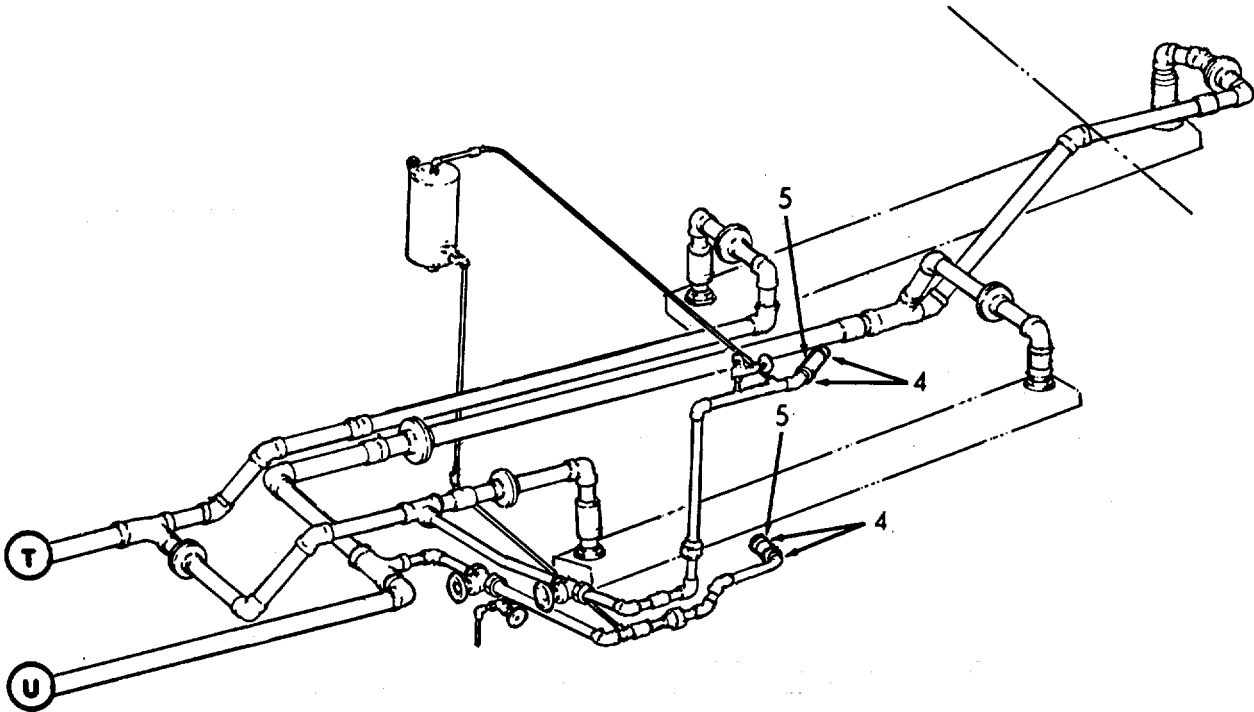


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|------------------|--------------------|---------|--|
| 2. Cooling Lines | a. Hose clamps (4) | Loosen. | |
| | b. Hoses (5) | Remove. | |

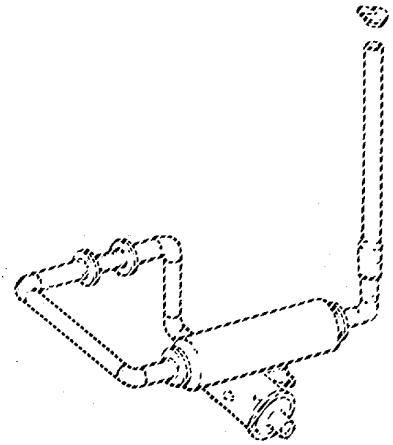
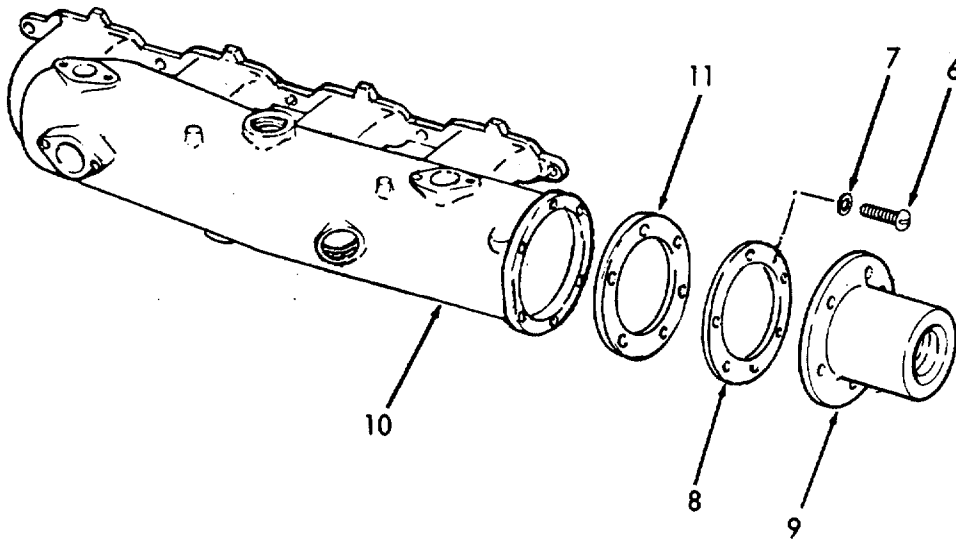


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | |
|-------------------|--|-----------|
| 3. Exhaust Piping | a. Screws (6), and lock-washers (7) | Remove. |
| | b. Flange (8) m nipple (9) and manifold (10) | Separate. |
| | c. Gasket (11) | Remove. |

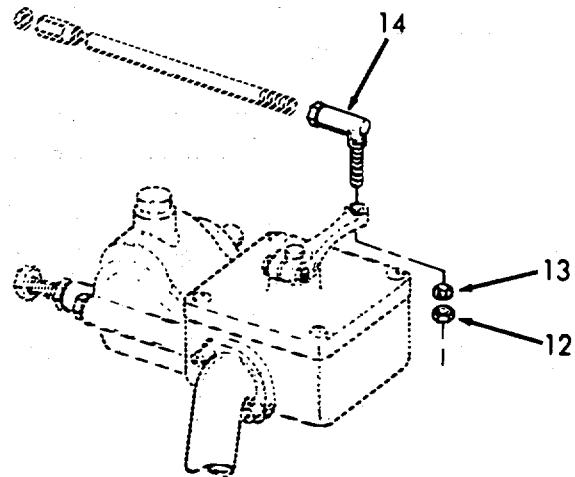
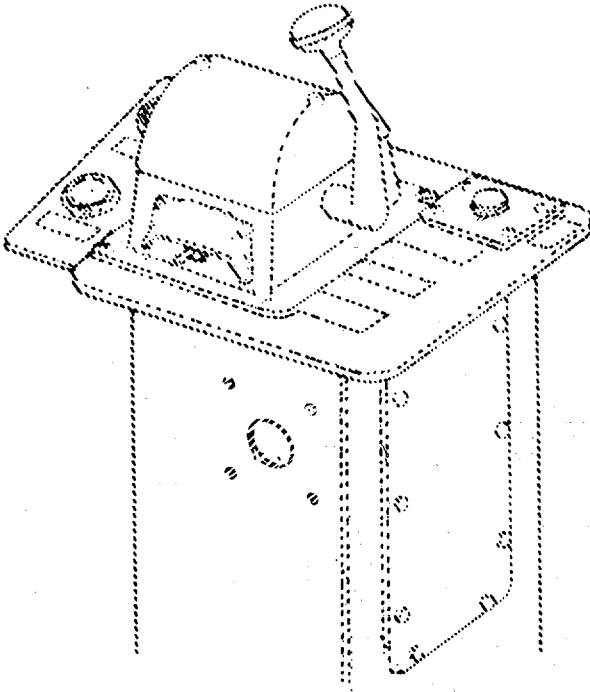


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|---------------|-----------------------------------|---------|--|
| 4. Stop Cable | a. Nut (12), and lock-washer (13) | Remove. | |
| | b. Ball joint (14) | Remove. | |

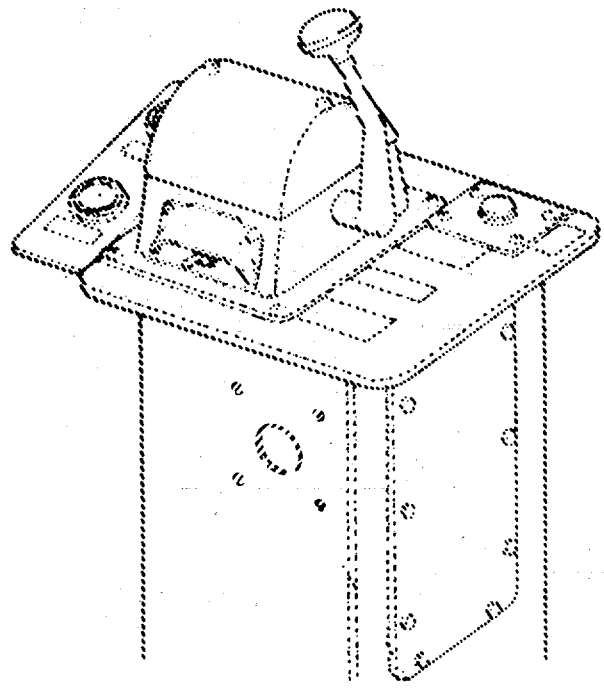
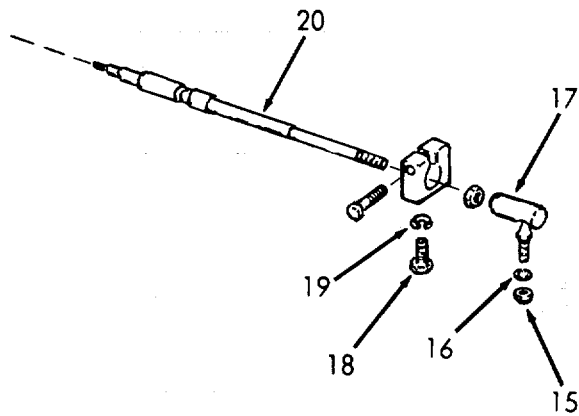


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----------------------|--|---------|--|
| 5. Shutdown
Lever | a. Nut
(15),
and
lock-
washer
(16) | Remove. | |
| | b. Ball
joint
(17) | Remove. | |
| | c. Screws
(18)
and
lock-
washers
(19) | Remove. | |
| | d. Control
cable
(20) | Remove. | |



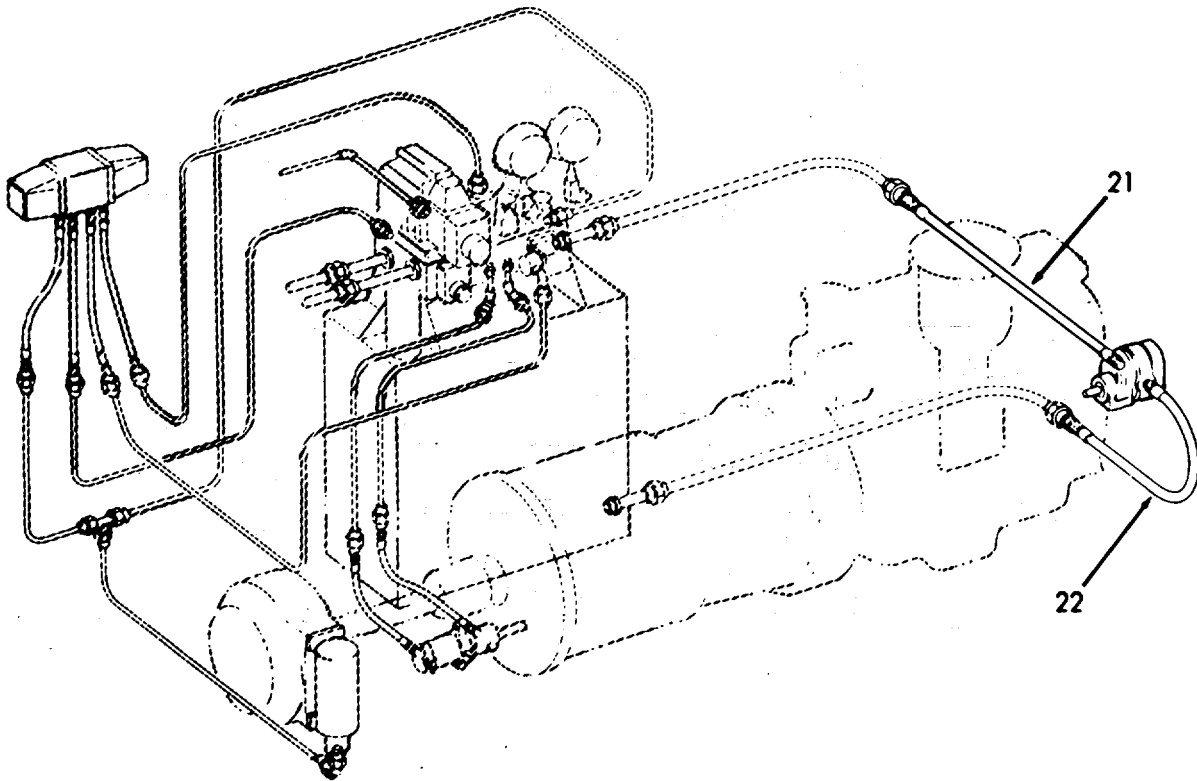
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

6. Control Pedestal Wiring	Wiring	Tag and disconnect.	
----------------------------	--------	---------------------	--

7. Hydraulic Piping	a. Flexible hose (21) to top of hydraulic tank		
	b. Flexible hose (22) to bottom of hydraulic tank	Remove.	

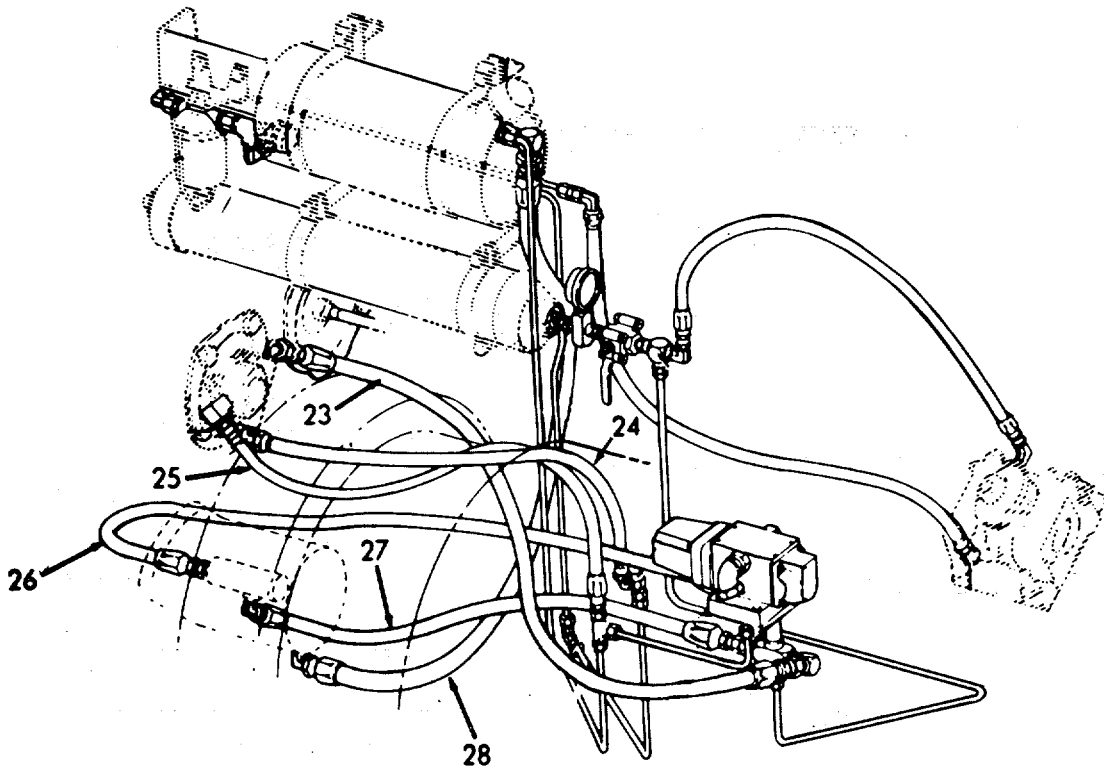


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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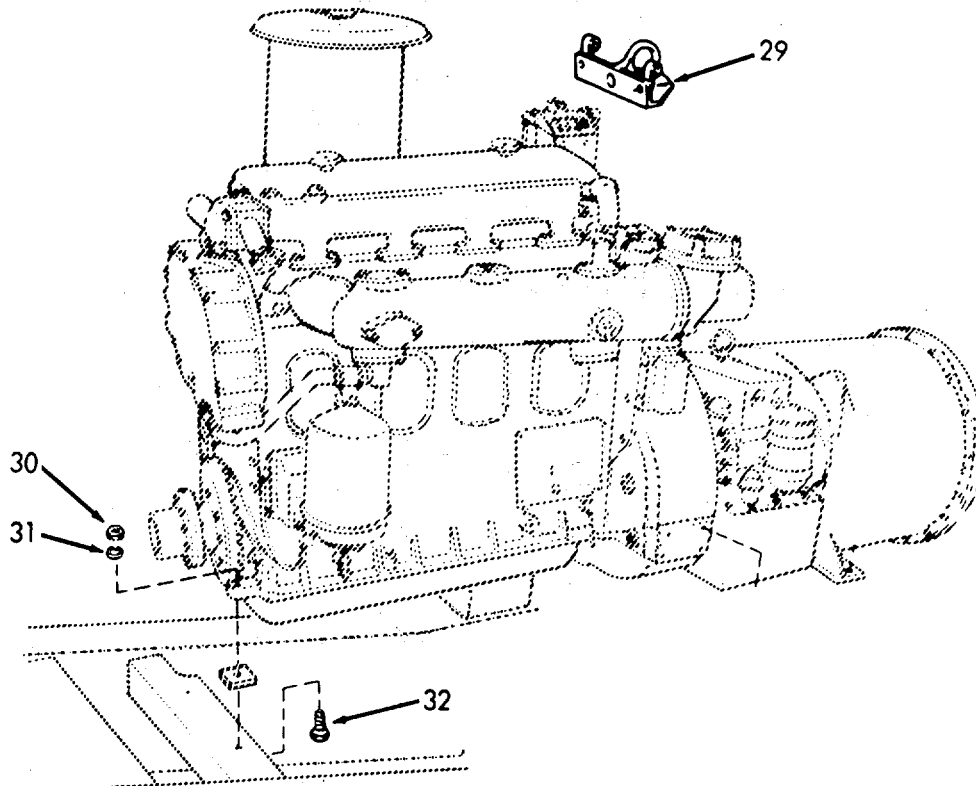
REMOVAL (Cont)

- | | | | |
|-------------------------|---------------------------------------|------------------------------------|--------------------------------------|
| 8. Hydro-starter Piping | a. Hand pump relief valve | Open to reduce pressure in system. | |
| | b. Hoses (23, 24, 25, 26, 27, and 28) | Remove. | Drain oil into a suitable container. |



5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
9. Dis-connect Clutch and Torque Converter	a. Clutch	Remove.	Refer to paragraph 5-65.1.
	b. Torque converter	Remove.	Refer to paragraph 5-66.
10. Vehicle Deck	Deck plate	Remove.	Refer to FO-1 in Volume 10.
11. Engine Room	a. Lifting brackets (29)	Attach chains.	
	b. Nuts (30), lockwashers (31), and screws (32)	Remove.	



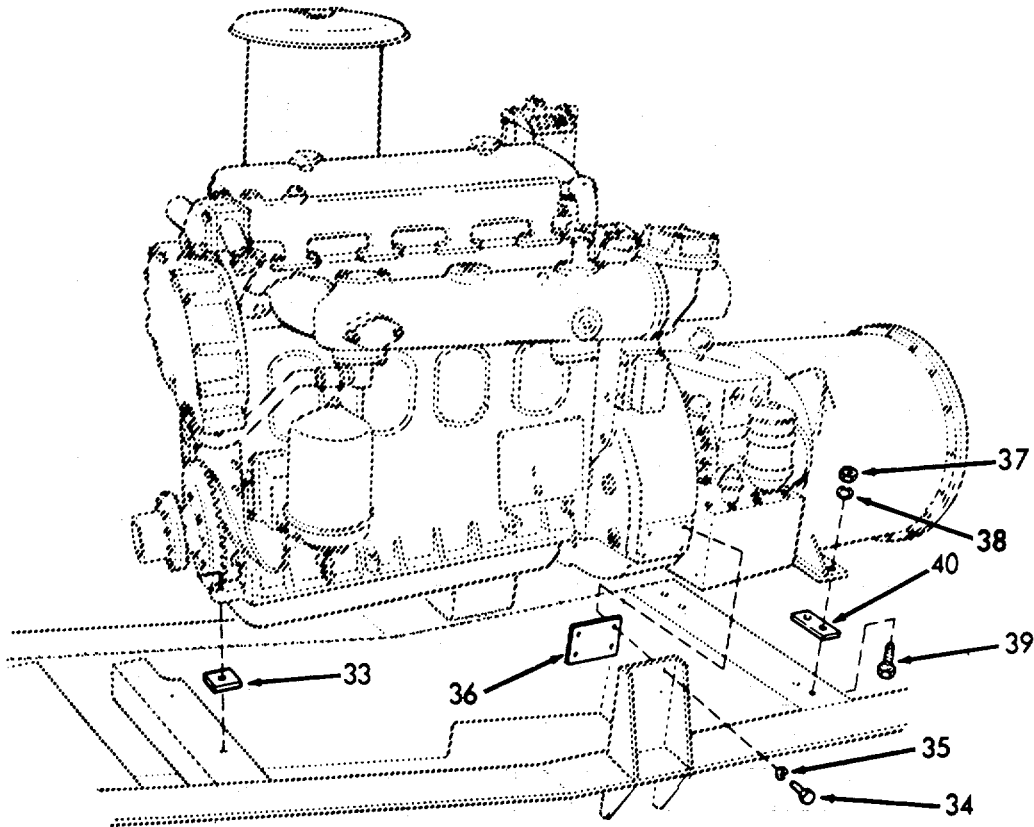
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	c. Steel chocks (33)	Remove.	
	d. Screws (34), and lock-washers (35)	Remove.	
	e. Steel chocks (36)	Remove.	
	f. Nuts (37) , lock-washers (38) and screws (39)	Remove.	
	g. Steel chock s (40)	Remove.	
12. Vehicle Deck	Engine	Lift.	

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



ENGINE RUN-IN INSTRUCTIONS

13. Anchor Winch Engine

- a. Following a complete overhaul or any major repair job involving the installation of piston rings, pistons, cylinder liners or bearings, the engine should be "run-in" on a dynamometer prior to release for service.
- b. The dynamometer is a device for applying specific loads to an engine. It permits the serviceman to physically and visually inspect and check the engine while it is operating. It is an excellent method of detecting improper tune-up, misfiring injectors, low compression and other malfunctions, and may save an engine from damage at a later date.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

- c. The operating temperature within the engine affects the operating clearances between the various moving parts of the engine and determines to a degree how the parts will wear. Normal coolant temperature (160° - 185° F.) should be maintained throughout the run-in.
- d. The rate of water circulation through the engine on a dynamometer should be sufficient to avoid having the engine outlet water temperature more than 10° F. higher than the water inlet temperature. Though a 10° rise across an engine is recommended, it has been found that a 15° temperature rise maximum can be permitted.
- e. A thermostat is used in the engine to control the coolant flow; therefore, be sure it is in place and fully operative or the engine will overheat during the run-in. However, if the dynamometer has a water standpipe with a temperature control regulator, such as a Taylor valve or equivalent, the engine should be tested without thermostats.
- f. The Basic Run-In Horsepower Schedule is shown in the Table. The horsepower shown in the table is at SAE conditions: dry air density .0705 lb/cu. ft., air temperature of 85° F., and 500 ft. elevation.
- g. Dynamometer Test and Run-In Procedures.
 - (1) The Basic Engine.
 - (a) A basic engine includes only those items actually required to run the engine. The addition of any engine driven accessories will result in a brake horsepower figure less than the values shown in the Basic Engine Run-In Horsepower Schedule. The following items are included on the basic engine: blower, fuel pump, fresh water pump, and governor.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

BASIC RUN-IN HORSEPOWER SCHEDULE

Speed RPM	Time Minutes	Horsepower
1200	10	28
1800	30	90
*1800	30	110
*2100	30	118
*2300	30	128

*Run at only one of the speeds shown, whichever is at or nearest to the governed speed and reset governor after final run, if necessary.

- (b) In situations where other than basic engine equipment is used during the test, proper record of this fact should be made on the Engine Test Report (see page 5-924.) The effects of this additional equipment on engine performance should be considered when evaluating test results.
- (2) Dynamometer
 - (a) The function of the dynamometer is to absorb and measure the engine output. Its basic components are a frame, engine mounts, the absorption unit, a heat exchanger, and a torque loading and measuring device.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

(b) The engine is connected through a universal coupling to the absorption unit. The load on the engine may be varied from zero to maximum by decreasing or increasing the resistance in the unit. The amount of power absorbed in a water brake type dynamometer, as an example, is governed by the volume of fluid within the working system. The fluid offers resistance to a rotating motion. By controlling the volume of water in the absorption unit, the load may be increased or decreased as required.

(c) The power absorbed is generally measured in torque (lb. ft.) on a suitable scale. This value for a given engine speed will show the brake horsepower developed in the engine by the following formula:

$$\text{BHP} = (\text{T} \times \text{RPM}) / 5250$$

Where:

BHP = brake horsepower

T = torque in lb. - ft.

RPM = revolutions per minute

(d) Some dynamometers indicate direct brake horsepower readings. Therefore, the use of the formula is not required when using these units.

(e) During the actual operation, all data taken should be recorded immediately on an Engine Test Report.

(3) Instrumentation

(a) Certain instrumentation is necessary so that data required to complete the Engine Test Report may be obtained. The following List contains both the minimum amount of instruments and the proper location of the fittings on the engine so that the readings represent a true evaluation of engine conditions.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

1. Oil pressure gage installed in one of the engine main oil galleries.
 2. Oil temperature gage installed in the oil pan, or thermometer installed in the dipstick hole in the oil pan.
 3. Adapter for connecting a pressure gage or mercury manometer to the engine air box.
 4. Water temperature gage installed in the water outlet manifold.
 5. Adapter for connecting a pressure gage or water manometer to the crankcase.
 6. Adapter for connecting a pressure gage or mercury manometer to the exhaust manifold at the flange.
 7. Adapter for connecting a vacuum gage or water manometer to the blower inlet.
 8. Adapter for connecting a fuel pressure gage to the fuel manifold inlet passage.
- (b) In some cases, gages reading in pounds per square inch are used for determining pressure while standard characteristics are given in inches of mercury or inches of water. It is extremely important that the scale of such a gage be of low range and finely divided if accuracy is desired. This is especially true of a gage reading in psi, the reading of which is to be converted to inches of water. The following conversion factors may be helpful:

Inches of water	=	psi x 27.7 inches
Inches of mercury	=	psi x 2.04 inches

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

(4) Run-In Procedure

The procedure outlined below will follow the order of the sample Engine Test Report (see page 5-924) .

(a) Pre-Starting

1. Fill the lubrication system.
2. Prime the fuel system.
3. A preliminary valve clearance adjustment must be made before the engine is started.
4. A preliminary injector timing check must be made before starting the engine.
5. Preliminary governor adjustments must be made.
6. Preliminary injector rack adjustment must be made.

(b) Basic Engine Run-In

1. The operator should be observant at all times, so that any malfunction which may develop will be detected. Since the engine has just been reconditioned, this run-in will be a test of the workmanship of the serviceman who performed the overhaul. Minor difficulties should be detected and corrected so that a major problem will not develop.
2. After performing the preliminary steps, be sure all water valves, fuel valves, etc. are open. Also inspect the exhaust system, being sure that it is properly connected to the engine. Always start the engine with minimum dynamometer resistance.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

3. After the engine starts, if using a water brake-type dynamometer, allow sufficient water, by means of the control loading valves, into the dynamometer absorption unit to show a reading of approximately 5 lb. ft. on the torque gage (or 10-15 HP on a horsepower gage). This is necessary, on some units, to lubricate the absorption unit seals and to protect them from damage.
4. Set the engine throttle at idle speed, check the lubricating oil pressure and check all connections to be sure there are no leaks.
5. Refer to the Engine Test Report sample (see page 5-924) which establishes the sequence of events for the test and run-in, and to the Basic Run-In Horsepower Schedule on page 5-917 which indicates the speed (rpm), length of time and the brake horsepower required for each phase of the test. Also, refer to the Operating Conditions in Chapter 3 which presents the engine operating characteristics. These characteristics will be a guide for tracing faulty operation or lack of power.
6. Engine governors in most cases must be reset at the maximum full-load speed designed for the run-in. If a governor is encountered which cannot be adjusted to this speed, a stock governor should be installed for the run-in .
7. After checking the engine performance at idle speed and being certain the engine and dynamometer are operating properly, increase the engine speed to half speed and apply the load indicated on the Basic Run-In Horsepower Schedule on page 5-917.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

8. The engine should be run at this speed and load for 10 minutes to allow sufficient time for the coolant temperature to reach the normal operating range. Record length of time, speed, brake horsepower, coolant temperature and lubricating oil pressure on the Engine Test Report (see page 5-924).

9. Run the engine at each speed and rating for the length of time indicated in the Basic Run-In Horsepower Schedule on page 5-917. This is the Basic Run-In. During this time engine performance will improve as new parts begin to "seat in". Record all required data.

(c) Basic Run-In Inspection

1. While the engine is undergoing the Basic Run-In, check each item indicated in Section "C" of the Engine Test Report. Check for fuel oil or water leaks in the rocker arm compartment.
2. During the final portion of the Basic Run-In, the engine should be inspected for fuel oil, lubricating oil and water leaks.
3. Upon completion of the Basic Run-In and Inspection, remove the load from the dynamometer, and reduce the engine speed gradually to idle and then stop the engine.

(d) Inspection After Basic Run-In

The primary purpose of this inspection is to provide a fine engine tune-up. First, tighten the cylinder head and rocker arm shaft bolts to the proper torque. Next, complete the applicable tune-up procedure.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

(e) Final Run-In

1. After all of the tests have been made and the Engine Test Report (see page 5-924) is completed through Section (d), the engine is ready for final testing. This portion of the test and run-in procedure will assure the engine user that the engine has been rebuilt to deliver factory-rated performance at the same maximum speed and load which will be experienced in the installation.
2. If the engine has been shut-down for one hour or longer, it will be necessary to have a warm-up period of 10 minutes at the same speed and load used for warm-up in the Basic Run-In. If piston rings, cylinder liners or bearings have been replaced as a result of findings in the Basic Run-In, the entire Basic Run-In must be repeated as though the run-in and test procedure were started anew.
3. All readings observed during the Final Run-In should fall within the range specified in the Operating Conditions, and should be taken at full load unless otherwise specified. Following is a brief discussion of each condition to be observed.
4. The engine water temperature should be taken during the last portion of the Basic Run-In at full load. It should be recorded and should be within the specified range.
5. The lubricating oil temperature reading must be taken while the engine is operating at full load and after it has been operating long enough for the temperature to stabilize. This temperature should be recorded and should be within the specified range.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

6. The lubricating oil pressure should be recorded in psi after being taken at engine speeds indicated in the Operating Conditions, Chapter 3.
7. The -fuel oil pressure at the fuel manifold inlet passage should be recorded and should fall within the specified range. Fuel pressure should be recorded at maximum engine rpm during the Final Run-In.
8. Check the air box pressure while the engine is operating at maximum speed and load. This check may be made by attaching a suitable gage (0-15 psi) or manometer (15-0-15) to an air box drain or to a hand hole plate prepared for this purpose. If an air box drain is used as a source for this check, it must be clean. The air box pressure should be recorded in inches of mercury.
9. Check the crankcase pressure while the engine is operating at maximum run-in speed. Attach a manometer, calibrated to read in inches of water, to the oil level dipstick opening. Normally, crankcase pressure should decrease during the run-in indicating that new rings are beginning to "seat-in".
10. Check the air inlet restriction with a water manometer connected to a fitting in the air inlet ducting located 2 inches above the air inlet housing. When practicability prevents the insertion of a fitting at this point, the manometer may be connected to a fitting installed in the 1/4 inch pipe tapped hole in the engine air inlet housing. If a hole is not provided, a stock housing should be drilled, tapped, and kept on hand for future use.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

11. The restriction at this point should be checked at a specific engine speed. The air cleaner and ducting should be removed from the air inlet housing and the engine again operated at the same speed while noting the manometer reading. The difference between the two readings, with and without the air cleaner and ducting, is the actual restriction caused by the air cleaner and ducting.
12. Check the normal air intake vacuum at various speeds (at no-load) and compare the results with the Engine Operating Conditions in Chapter 3. Record these readings on the Engine Test Report (see page 5-924).
13. Check the exhaust back pressure at the exhaust manifold companion flange or within one inch of this location. This check should be made with a mercury manometer through a tube adapter installed at the tapped hole. If the exhaust manifold does not provide a 1/8 inch pipe tapped hole, such a hole can be incorporated by reworking the exhaust manifold. Install a fitting for a pressure gage or manometer in this hole. Care should be taken so that the fitting does not protrude into the stack. The manometer check should produce a reading in inches that is below the Maximum Exhaust Back Pressure for the engine.
14. Refer to the Basic Run-In Horsepower Schedule (see page 5-917.), and determine the maximum rated brake horsepower and the full-load speed to be used during the Final Run-In. Apply the load thus determined to the dynamometer. If a hydraulic governor is used, the droop may be adjusted at this time by following the prescribed procedure. The engine should be run at this speed and load for 1/2 hour.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ENGINE RUN-IN INSTRUCTIONS (Cont)

While making the Final Run-In, the engine should develop, within 5%, the maximum rated brake horsepower indicated for the speed at which it is operating. If this brake horsepower is not developed, the cause should be determined and corrections made.

15. When the above conditions have been met, adjust the maximum no-load speed to conform with that specified for the particular engine. This speed may be either higher or lower than the maximum speed used during the Basic Run-In. This will ordinarily require a governor adjustment.

16. All information required in Section "E", Final Run-In, of the Engine Test Report (see page 5-924.), should be determined and filled in. After the prescribed time for the Final Run-In has elapsed, remove the load from the dynamometer and reduce the engine speed gradually to idle speed and then stop the engine. The Final Run-In is complete.

(f) Inspection After Final Run-In

After the Final Run-In and before the Engine Test Report is completed, a final inspection must be made. This inspection will provide final assurance that the engine is in proper working order. During this inspection the engine is also made ready for any brief delay in delivery or installation which may occur. This is accomplished by rust-proofing the fuel system. Also, a rust inhibitor should be introduced into the cooling system.

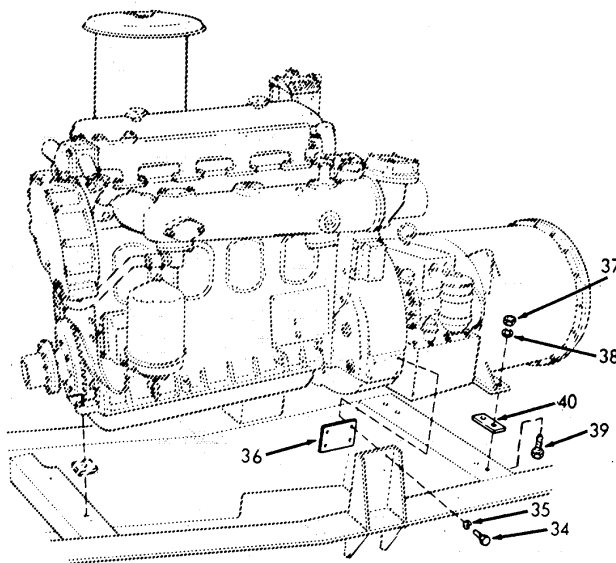
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION

14. Vehicle Deck	Engine	Lower into hull.	
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15. Engine Room	a.	Screws (39), steel chocks (40), lock-washers (38)X and nuts (37)	Install.
	b.	Screws (34), lock-washers (35), and steel chocks (36)	Install.

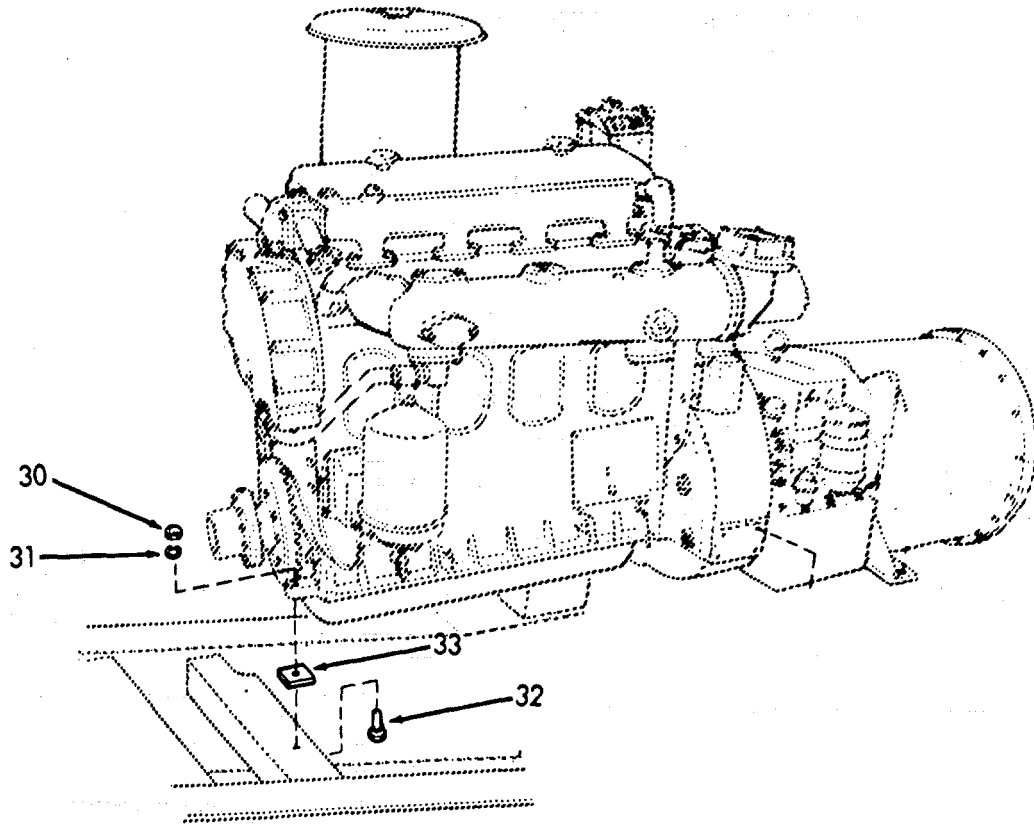


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

- | | | | |
|----|--|----------------|--|
| c. | Screws (32), steel chocks (33), lock-washers (31), and nuts (30) | Install. | |
| d. | Lifting brackets | Remove chains. | |



16. Vehicle Deck

Deck plate

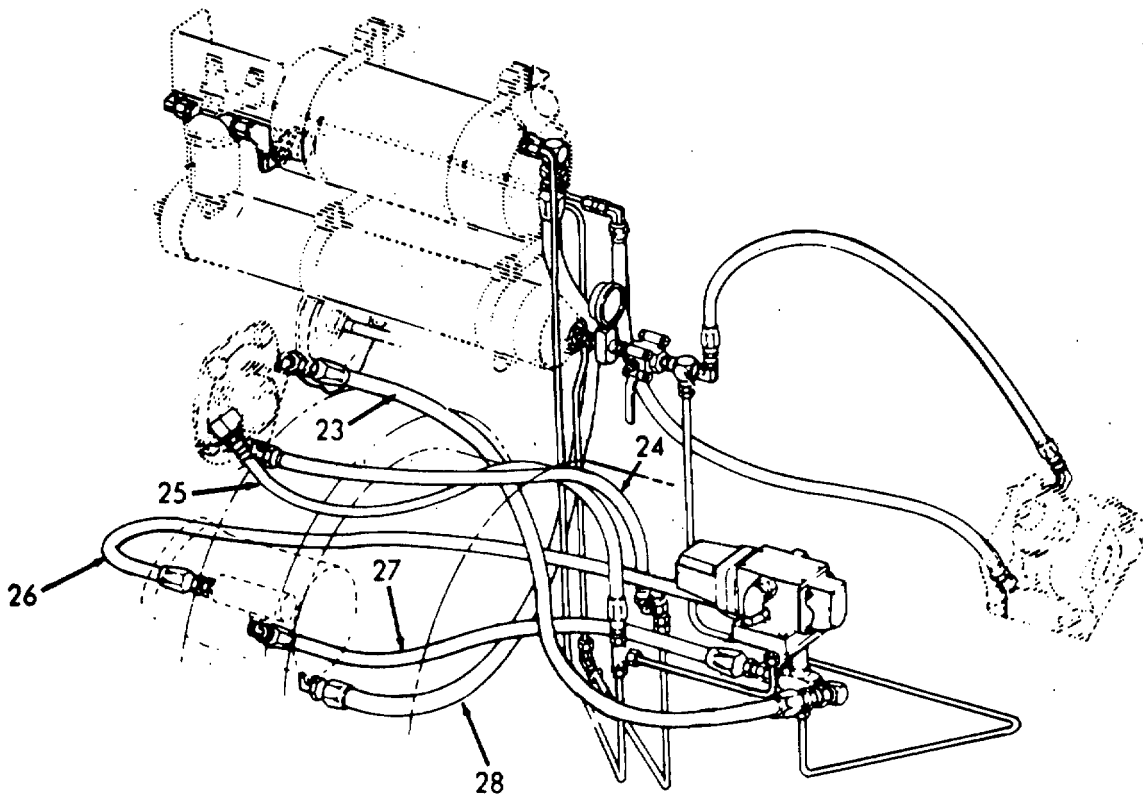
Install.

5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

17. Disconnect Clutch and Torque Converter	a. Torque converter	Install.	Refer to paragraph 5-66.
	b. Disconnect clutch	Install.	Refer to paragraph 5-65.1.
18. Hydro-starter Piping	a. Hoses (23, 24, 25, 26, 27, 28)	Install.	Install.
	b. Hand pump, relief valve	Close relief valve, and operate pump to build up pressure.	

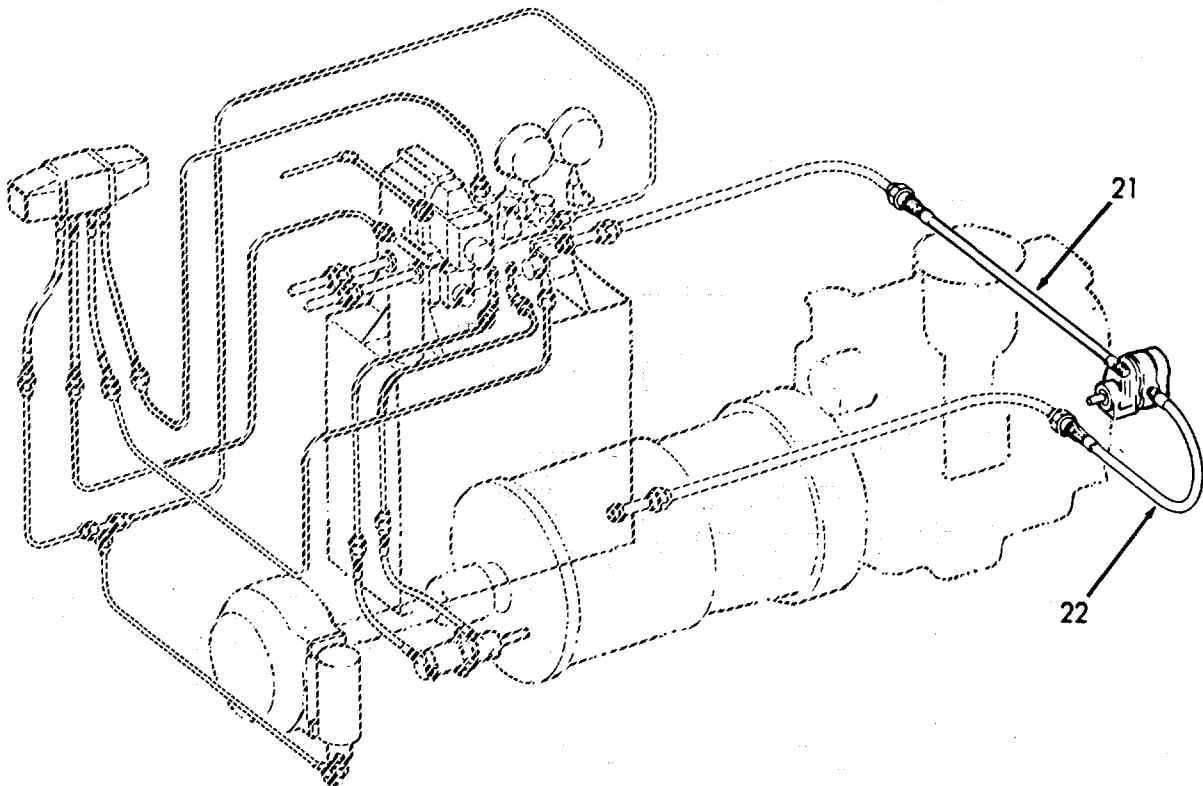


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

- | | | |
|----------------------|---|----------|
| 19. Hydraulic Piping | a. Flexible hose (22) to bottom of hydraulic tank | Install. |
| | b. Flexible hose (21) to top of hydraulic tank | Install. |

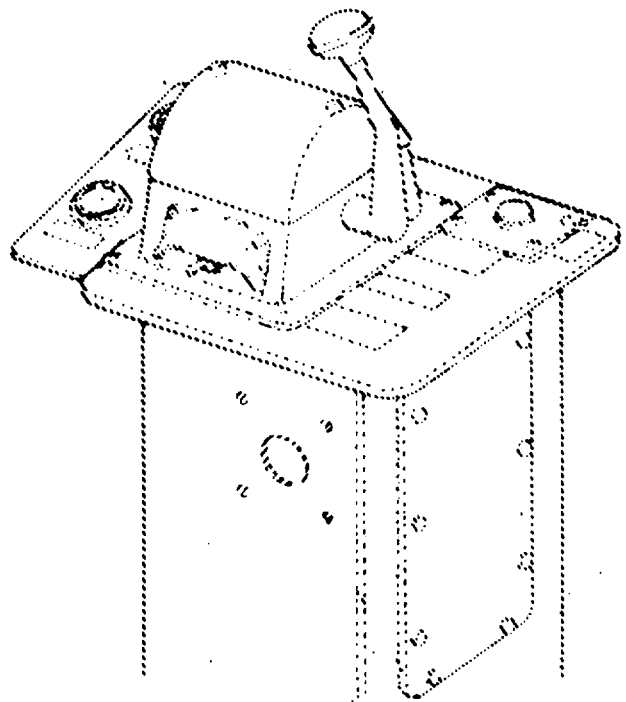
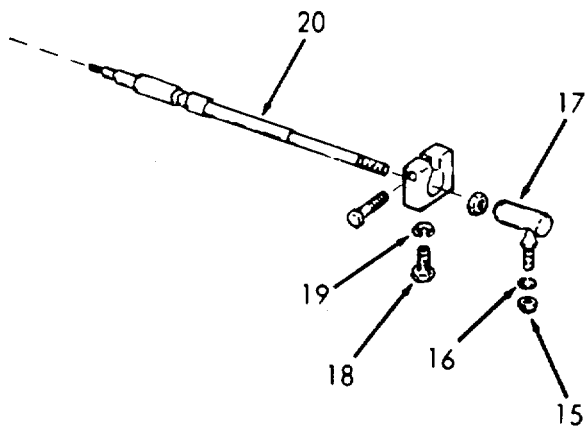


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

20. Control Pedestal Wiring	Wiring	Tag and disconnect.	
21. Shutdown Lever	a. Control cable (20)	Install.	
	b. Screws (18) and lock-washers (19)	Install.	
	c. Ball joint (17)	Install.	
	d. Nut (15), and lock-washer (16)	Install.	



5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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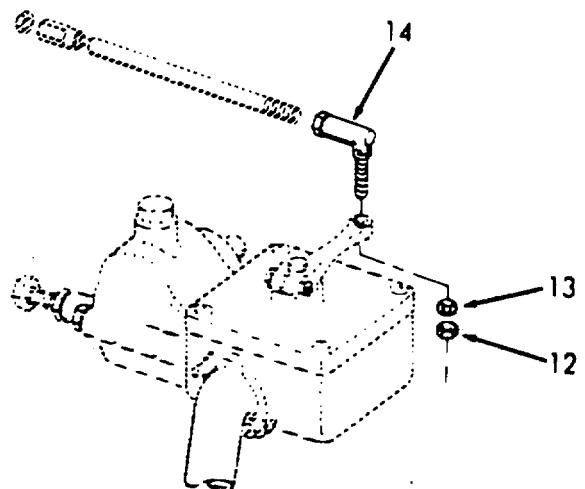
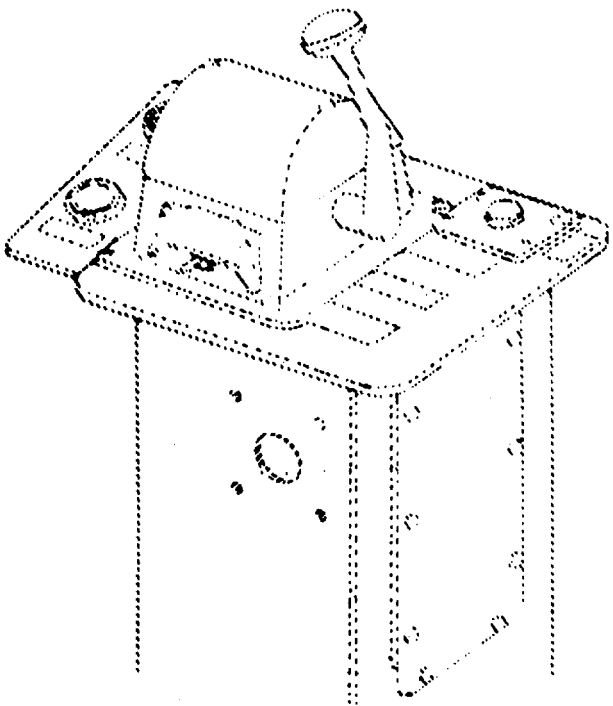
INSTALLATION (Cont)

22. Stop
Cable

- a. Ball joint (14)
- b. Nut (12), and lock-washer (13)

Install.

Install.



5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

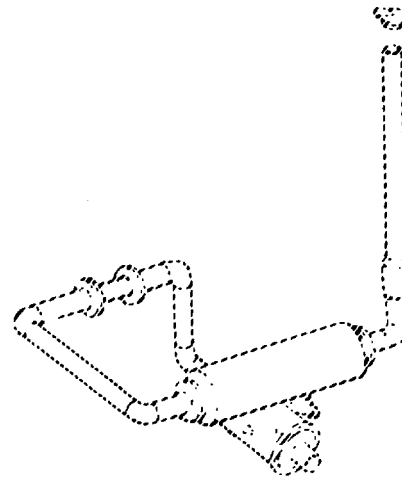
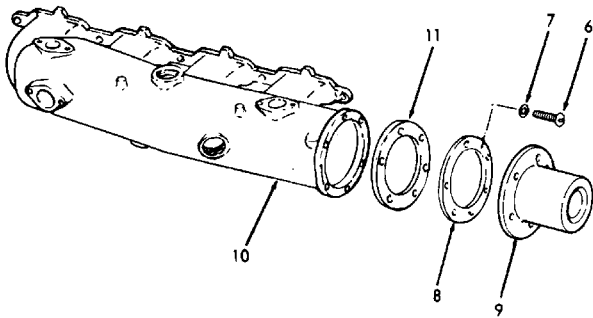
23. Exhaust Piping

- a. Gasket (11)
- b. Manifold (10), nipple, (9), and flange (8)
- c. Screws (6), and lock-washers (7)

Replace.

Align holes.

Install.

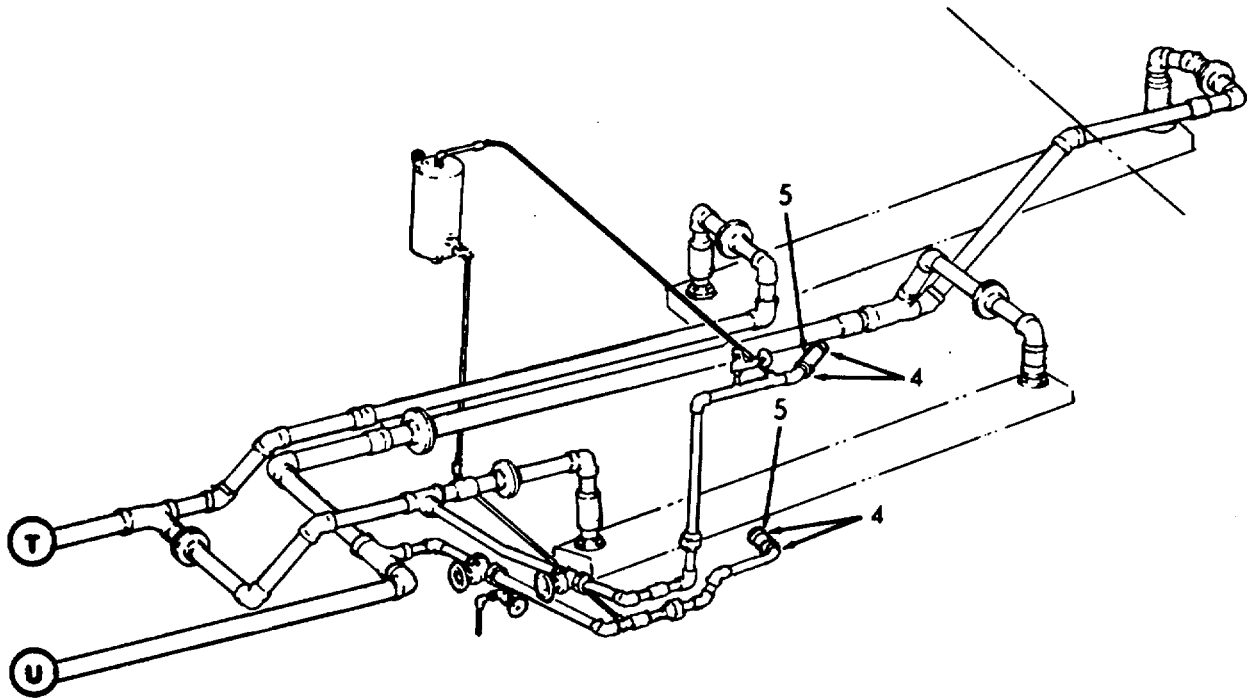


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

24. Cooling Lines	a. Hoses (5)	Install.	
	b. Hose clamps (4)	Tighten.	

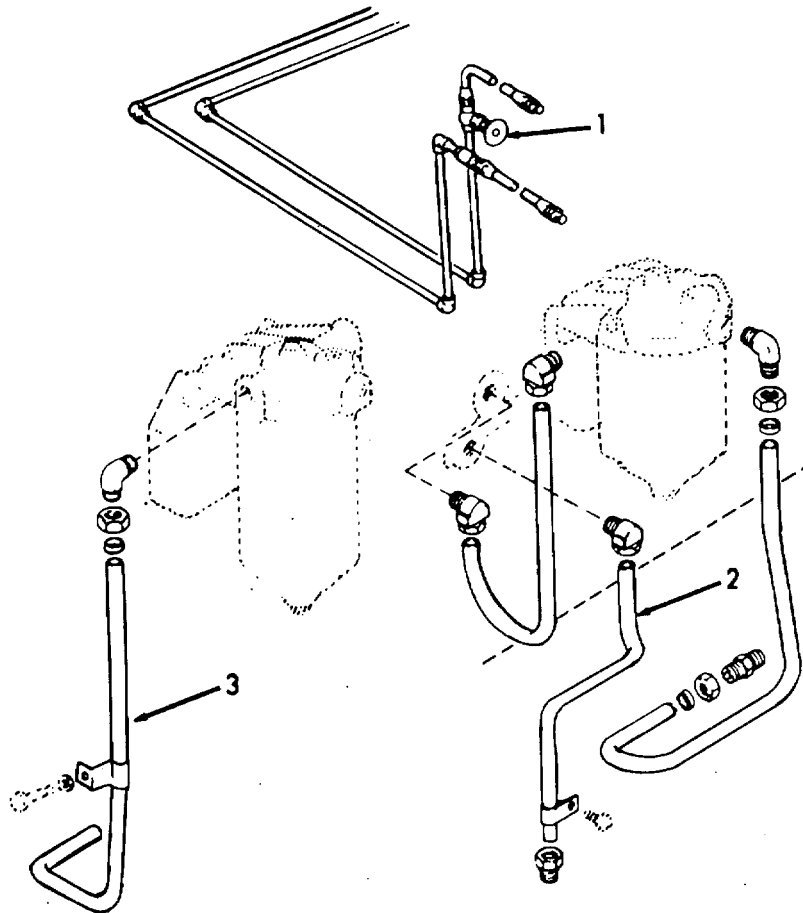


5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

25. Fuel Lines	a.	Strainer to fuel pump tube (3)	Reconnect.
	b.	Fuel drain tube (2)	Reconnect.
	c.	Valve (1)	Open.
	d.	Fuel filter and strainers	Remove the fill plug and fill with diesel fuel.



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS.

a. Operation

- (1) Two manual controls are provided on the variable speed governor: a stop lever for starting and stopping, and a speed control lever. For starting, the stop lever is moved to the RUN position, which holds the injector control racks near the full fuel position. Upon starting, the governor moves the injector racks toward the idle speed position. The engine speed is then controlled manually by moving the speed control lever.
- (2) The centrifugal force of the revolving governor weights is converted into linear motion, which is transmitted through the riser and operating shaft to the operating shaft lever. One end of the operating lever bears against the variable speed spring plunger, while the other end provides a changing fulcrum on which the differential lever pivots.
- (3) The centrifugal force of the governor weights is opposed by the variable speed spring. Load changes or movement of the speed control lever momentarily creates an unbalanced force between the revolving governor weights and tension on the variable speed spring. When the forces reach a balanced condition again, the engine speed will be stabilized for the new speed setting or new load.
- (4) A fuel rod, connected to the differential lever and injector control tube lever, provides a means for the governor to change the fuel settings of the injector control racks.
- (5) The engine idle speed is determined by the centrifugal force required to balance out the tension on the variable speed spring in the low speed range.
- (6) Adjustment of the engine idle speed is accomplished by changing the tension on the variable speed spring by means of the idle speed adjusting screw.
- (7) Adjustment of the maximum no-load speed is accomplished by varying the tension on the variable speed spring by the installation or removal of stops and shims as required.

b. Lubrication

- (1) Surplus oil returning from the cylinder head provides lubrication for the parts in the governor control housing, the riser thrust bearings, and the weight shaft end bearing. Oil, picked up from a reservoir in the blower front end plate by a slinger attached to the lower rotor shaft, provides lubrication for the governor weights and weight carrier.

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS. (Continued)

(2) Pressure lubrication has been provided for the weight housing bearings on current engines. The oil tube is attached between the oil gallery in the cylinder block and the governor weight housing.

This task covers:

- | | | | |
|----|-------------|----|------------|
| a. | Disassembly | c. | Reassembly |
| b. | Inspection | d. | Test |

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

- Arbor press
- Brass rods
- Bearing installer

Equipment

<u>Condition</u>	<u>Condition Description</u>
------------------	------------------------------

NONE

Material/Parts

- Grease - Shell Alvania #2
or equivalent
- Loctite HV or equivalent

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNING in this procedure.

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY

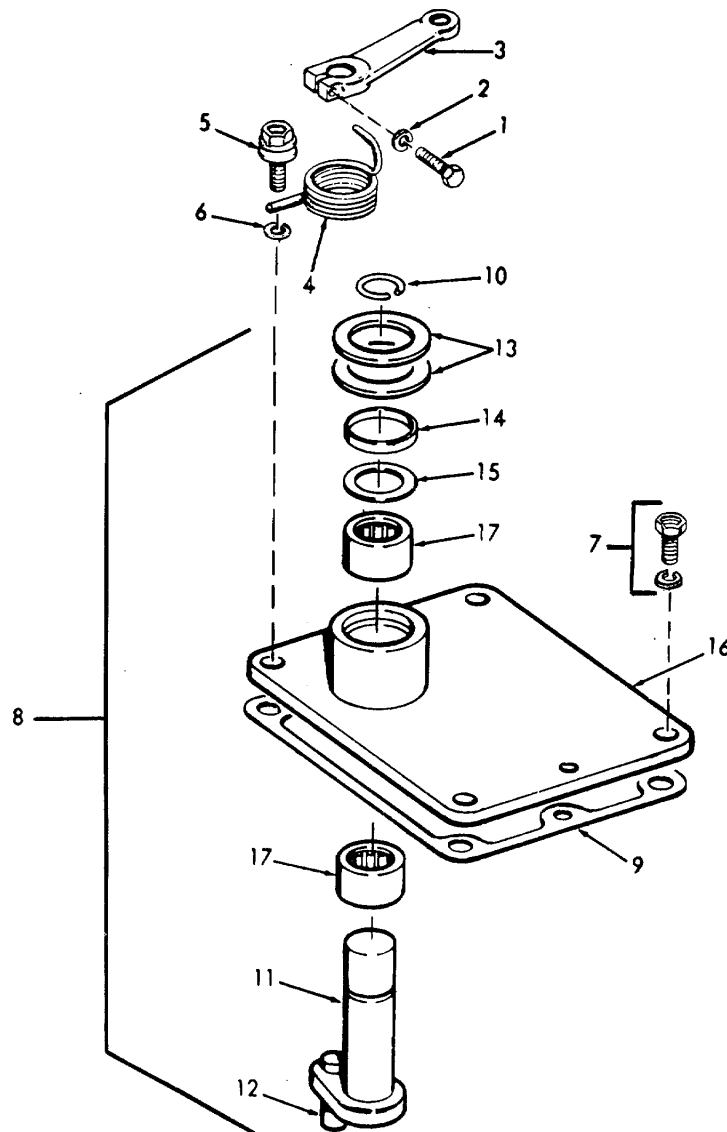
1. Cover	a. Screw (1), and lock-washers (2)	Loosen.	
	b. Throttle shaft lever (3)	Remove.	
	c. Return spring (4)	Remove.	
	d. Screw assembly (5), and lockwasher (6)	Remove.	
	e. Screw assembly (7)	Remove.	
	f. Cover assembly (8)	Remove.	
	g. Gasket (9)	Remove.	
	h. Retaining ring (10)	Remove.	
	i. Shaft (11)	Remove.	
	j. Fulcrum lever pin (12)	Remove.	If necessary.
	k. Shaft retainers (13), seal ring (14), and washer (15)	Remove from cover (16).	

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | |
|----|--|-------------------------|--|
| 1. | Cover assembly (16), including bearings (17) | Wash in clean fuel oil. | |
|----|--|-------------------------|--|



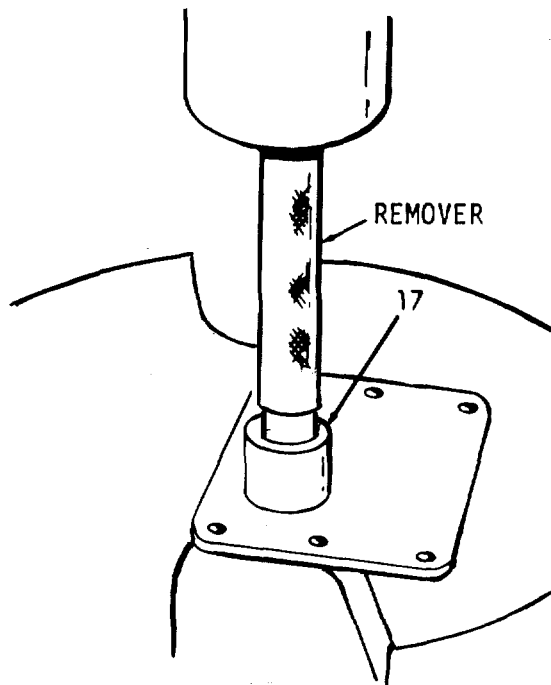
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

m. Bearings
(17)

1. Inspect for wear or damage.
2. Place inner face of cover over opening in bed of press.
3. Place remover on top of bearings and under ram of press.
4. Press out both bearings.

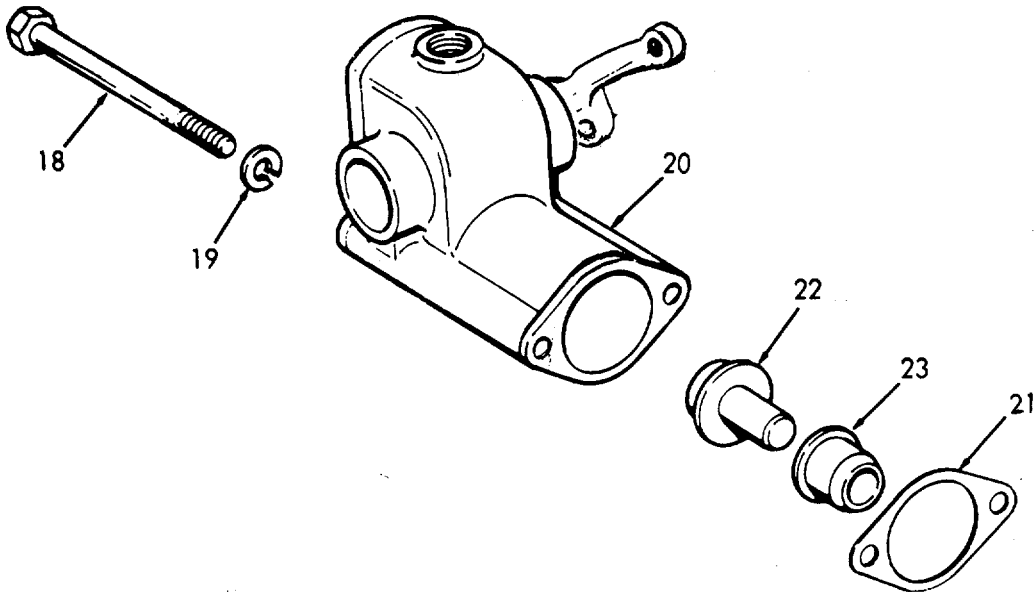


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | | |
|-----------------------------|----|------------------------------------|---------------------------------|----------|
| 2. Governor Control Housing | a. | Housing assembly | Place in vice with soft jaws. | |
| | b. | Screws (18), and lock-washers (19) | Remove. | |
| | c. | Variable speed spring housing (20) | Remove. | |
| | d. | Gasket (21) | Remove. | Discard. |
| | e. | Spring plunger (22) | Remove from plunger guide (23). | |



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

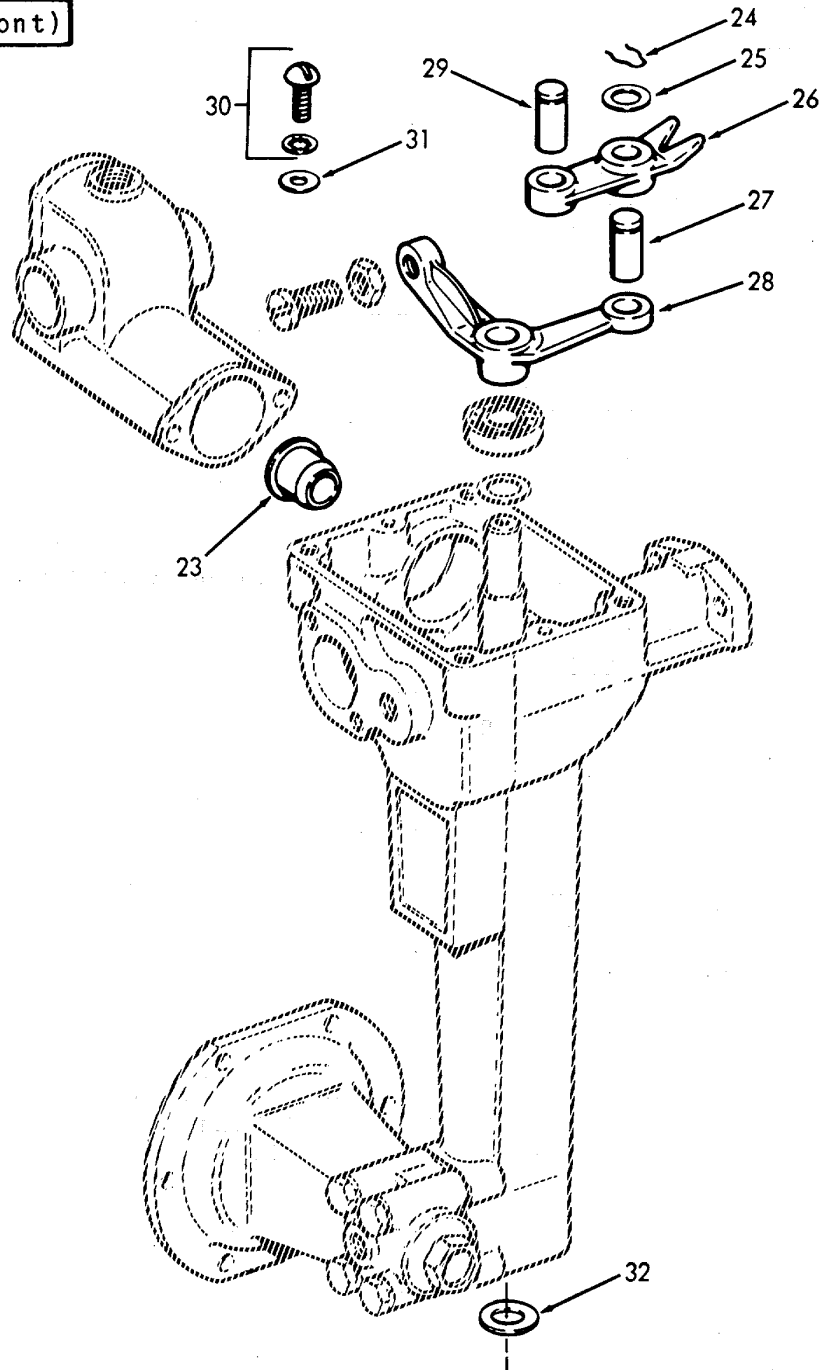
- | | | | |
|----|---|---|--|
| f. | Spring retainer (24), and washer (25) | Remove. | |
| g. | Differential lever (26) | Lift off of pin (27) on operating lever (28). | |
| h. | Differential pin (29) | Press out of differential lever (26). | |
| i. | Variable speed spring plunger guide (23) | Remove. | |
| j. | Screw assembly (30), and flat washer (31) | Remove. | |
| k. | Expansion plug (32) | Remove. | |

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

DISASSEMBLY (Cont)



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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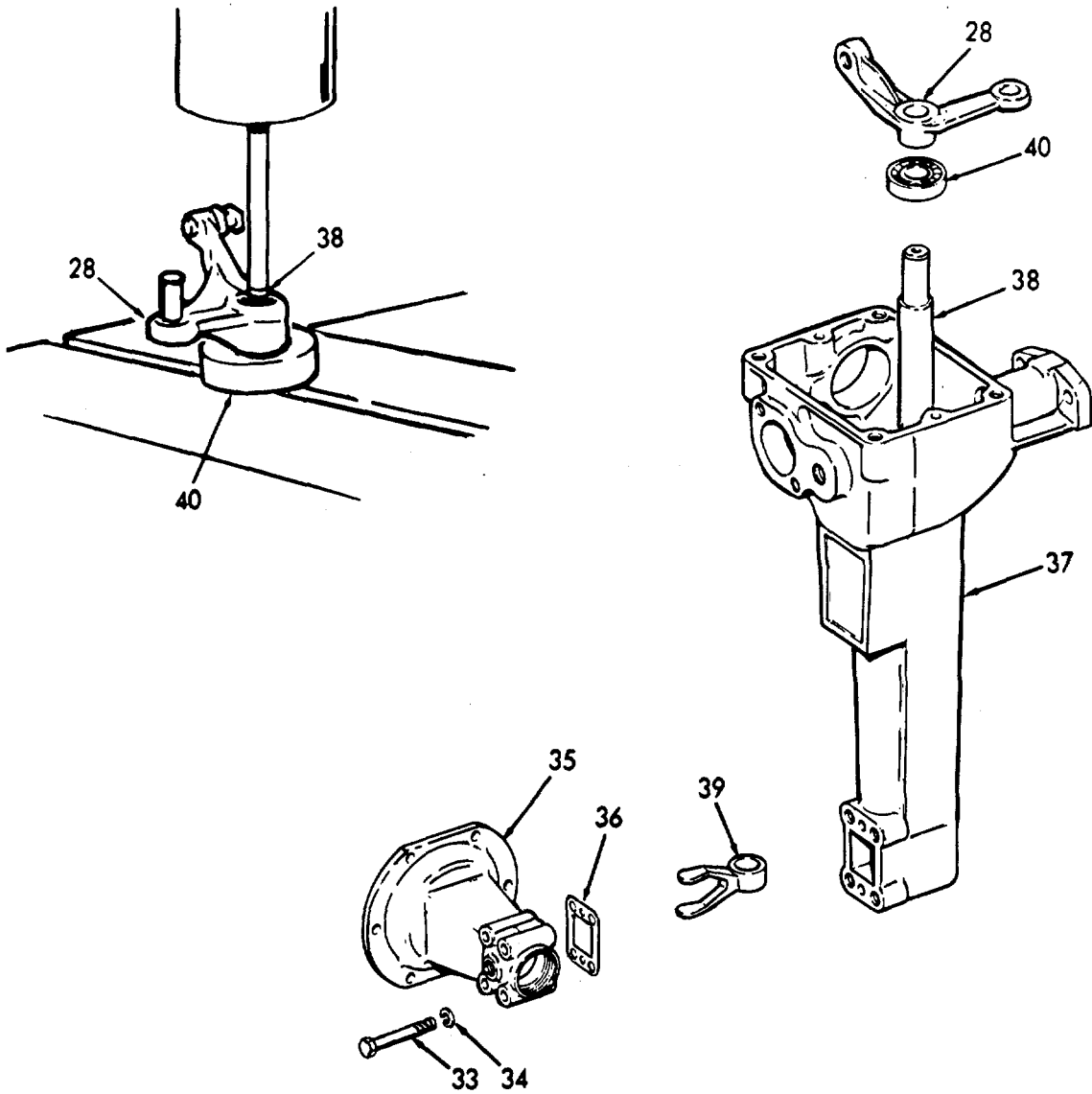
DISASSEMBLY (Cont)

- | | | | |
|--|--|---|--|
| | l. Screws (33), and lock-washers (34) | Remove. | |
| | m. Governor weight housing assembly, (35), and gasket (36) | Remove. | |
| | n. Control housing assembly (37) | Support bottom side up on bed of press. | |
| | o. Operating shaft (38), and operating lever assembly (28) | <ol style="list-style-type: none"> 1. Use a brass rod to press shaft from operating fork (39). 2. Remove assembly from housing (37). | |
| | p. Operating shaft (38) and operating lever assembly (28) | <ol style="list-style-type: none"> 1. Support on bed of press. 2. Use a brass rod to press operating lever (28), and bearing (40), from shaft (38). | |

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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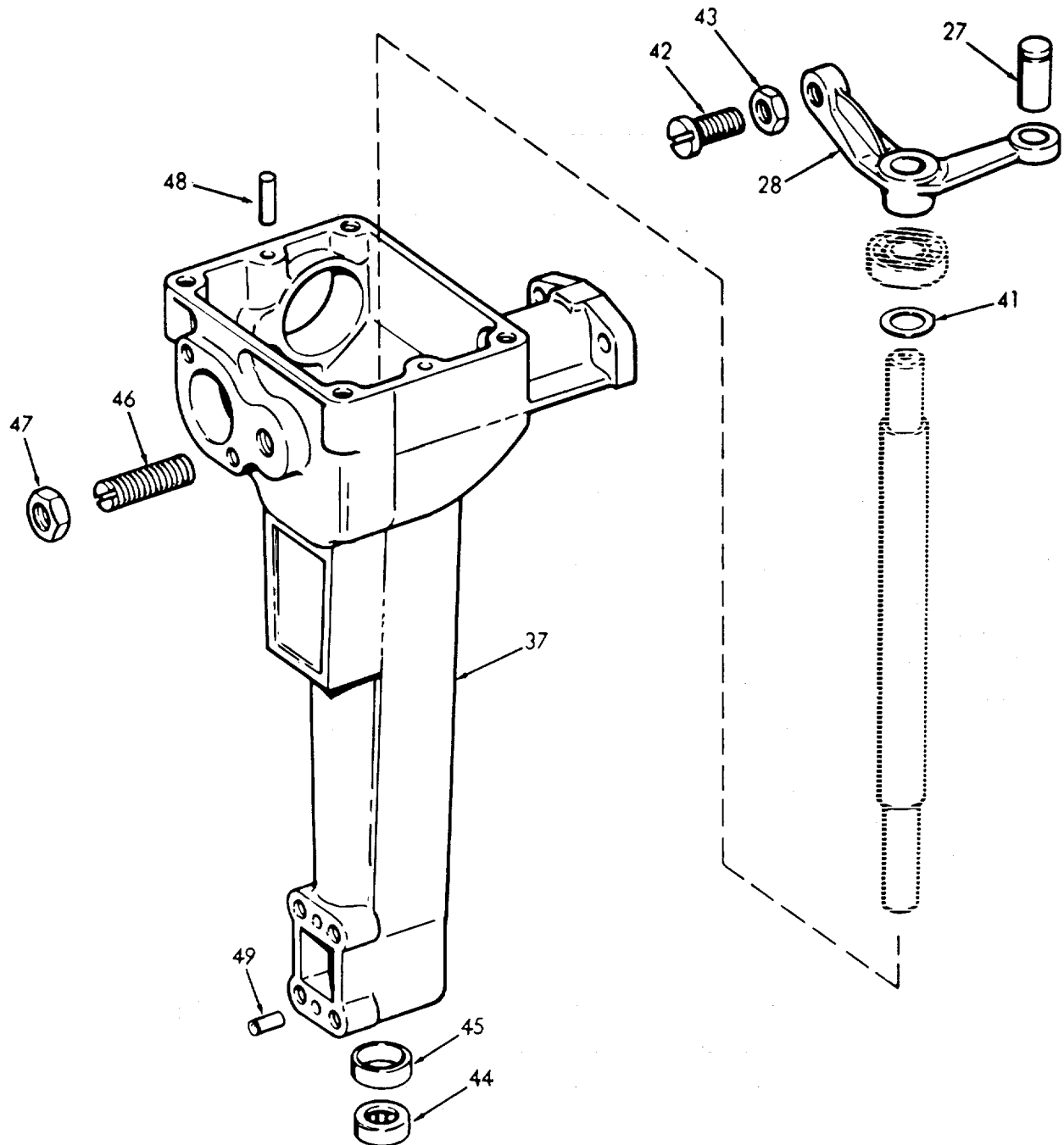
DISASSEMBLY (Cont)

	q. Washer (41)	Remove.	
	r. Screw (42), and locknut (43)	Remove.	If necessary.
	s. Pin (27)	Press from operating lever (28).	If necessary.
	t. Bearing (44), and bushing (45)	Press from housing (37).	
	u. Buffer screw (46)X and locknut (47)	Remove.	
	v. Dowel pins (48 and 49)	Remove.	If necessary.

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

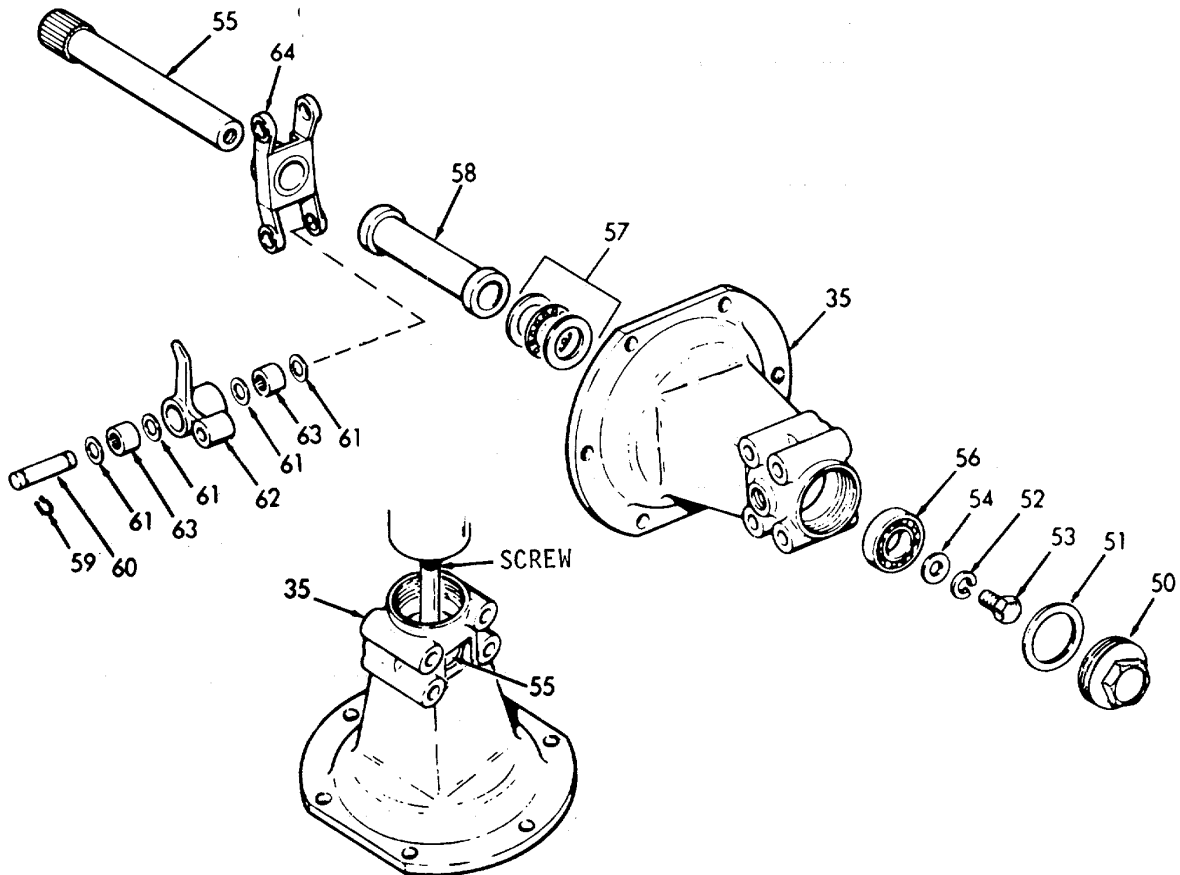
LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
3. Governor Weight Housing	a. Housing (35)	Place in vise with soft jaws.	
	b. Housing cap (50), and gasket (51)	Remove.	
	c. Lockwasher (52), and screw (53)	1. Bend tand on lock-washer.	
		2. Remove screw and lockwasher.	
	d. Washer (54)	Remove.	
	e. Weight shaft (55)	Install screw into tapped end of shaft.	Screw is 5/16-24 x 3 inch.
	f. Housing assembly (35) (56) screw.	Support housing on bed of a press, and press shaft (55) from bearing Then remove	
	g. Riser thrust bearing (57), and governor riser (58) parts does not indicate excessive wear.	Slide from shaft (55).	This bearing is specially designed to absorb thrust load. Looseness between mating
	h. Bearing (56)	Remove from housing (35).	
i. Lockrings (59)	Remove one from each weight pin (60).		

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | |
|----|---|-----------------------------------|--|
| j. | Weight pins (60), flatwashers (61), and governor weights (62) | Remove. | |
| k. | Needle bearings (63) | Press from governor weights (62). | |
| l. | Weight carrier (64) | Press from weight shaft (55). | |



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

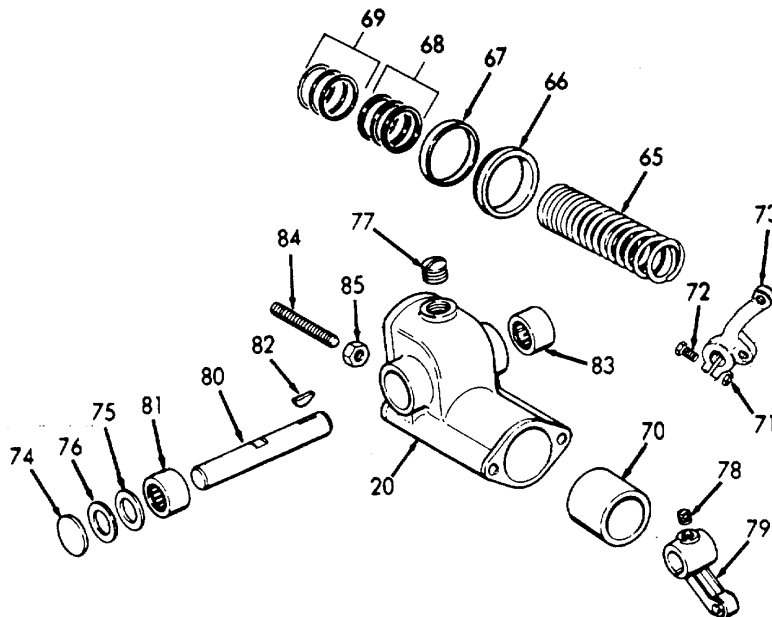
4. Governor Variable Speed Spring Housing	a.	Variable speed spring (65), stops (66 and 67) , shims (68 and 69) , and spring retainer (70)	Remove from housing (20).
	b.	Nut (71), and screw (72)	Loosen.
	c.	Speed control lever (73)	Remove.
	d.	Expansion plug (74), packing retaining washer (75) and pre formed packing (76)	Remove.
	e.	Pipe plug (77)	1. Remove. 2. Working through opening, remove set screw (78) from spring lever (79).
	f.	Housing (20)	1. Support on bed of press.

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | |
|----|---------------------------------------|---|--|
| | | 2. Use brass rod to press shaft (80), and bearing assembly (81) from housing. | |
| g. | Spring lever (79), and key (82) | Remove from housing. | |
| h. | Shaft (80), and bearing (81) | Press from shaft. | |
| i. | Bearing (83) | Press from housing. | |
| j. | Adjusting screw (84) and locknut (85) | Remove. | |



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

5. Governor

WARNING

Wear eye protection when using compressed air.

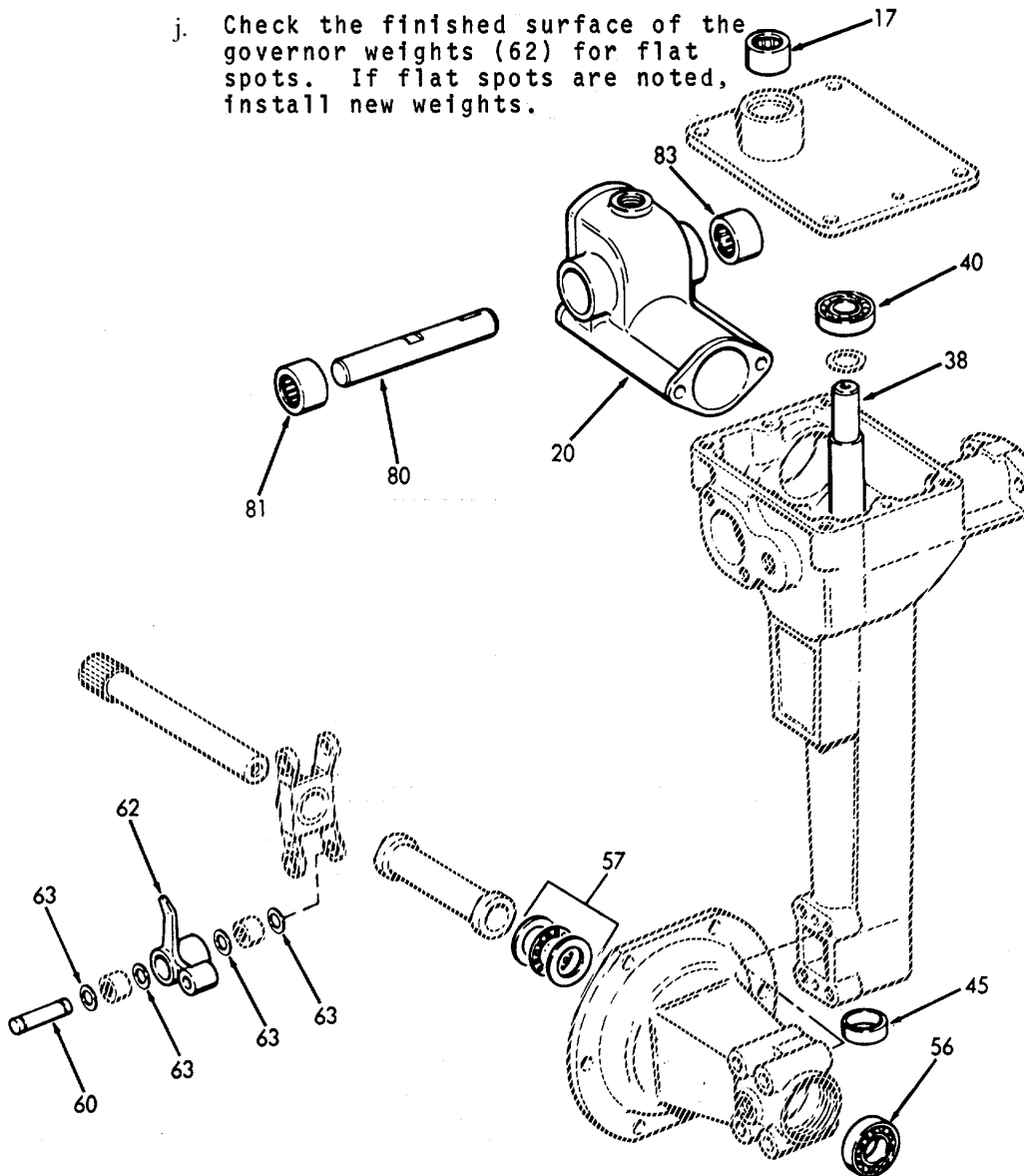
- a. Clean all parts with fuel oil and dry with compressed air.
- b. Inspect all governor components and replace worn or damaged parts.
- c. Revolve the operating shaft bearing (40) and the governor weight shaft bearing (56) slowly by hand; replace bearings if rough or tight spots are detected.
- d. Inspect the operating shaft (38) and shaft bushing (45) for excessive wear, and replace if necessary.
- e. Examine the riser thrust bearing (57) for excessive wear, flat spots or corrosion. If any of these conditions exist, install a new thrust bearing assembly.
- f. Inspect the needle bearings (17), bushing (45) and operating shaft for excessive wear or flat spots. If one or both conditions exist, install new bearings and control shaft.
- g. Inspect the spring lever shaft (80) and bearings (81 and 83) for excessive wear or flat spots at bearing surface. If one or both conditions exist, install a new shaft and bearing.
- h. When installing a new bearing in the spring housing assembly (20), note that the roller type bearing rides on a hardened bearing pin and is a press-fit in the spring housing assembly. When installing the roller type bearing, the pressed-in pin is to have equal protrusion on both sides of the lever.
- i. Examine the weight carrier pins (60) and bearings (63) for excessive wear and flat spots. If either of these conditions exist, install new parts.

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)

- j. Check the finished surface of the governor weights (62) for flat spots. If flat spots are noted, install new weights.



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY

6.	Governor Cover	a.	Cover assembly (16)	Place on bed of arbor press.	
		b.	Needle bearings (17)	1.	Start bearing into bearing bore of cover, with the number on bearing face up. Use new bearings.
				2.	Insert bearing installer in bearing.
				3.	Press bearing in until shoulder of the tool contacts the cover.
				4.	Reverse cover (inner face of cover turned up) .
				5.	Start bearing into bore of cover with bearing number up.
				6.	Press the bearing in flush to the cover, with the bearing installer.
				7.	Pack both bearings with grease.
		c.	Shaft (11)	Insert through bearings.	
		d.	Washer (15), seal ring (14), and shaft retainer (13)	Install.	

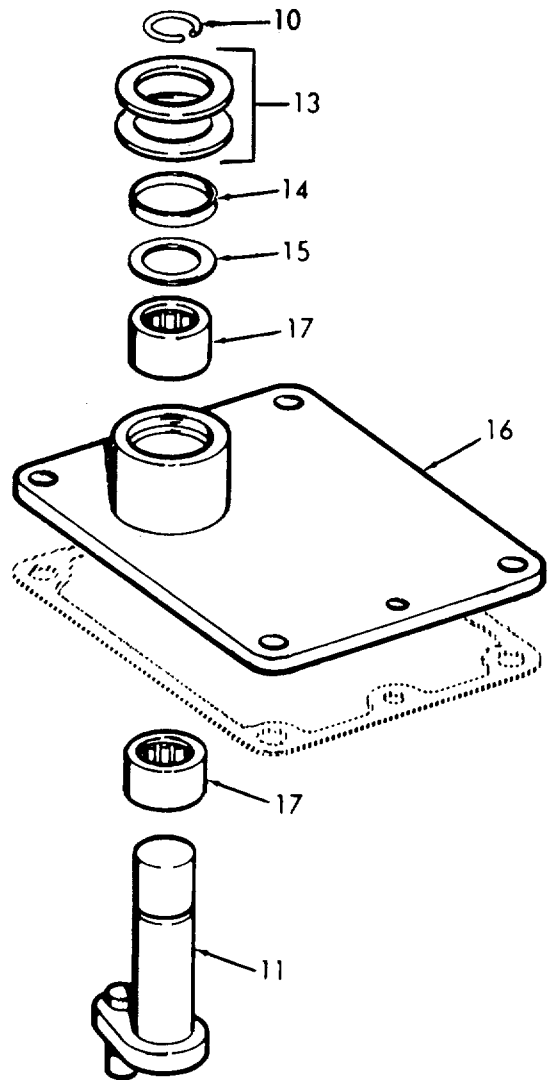
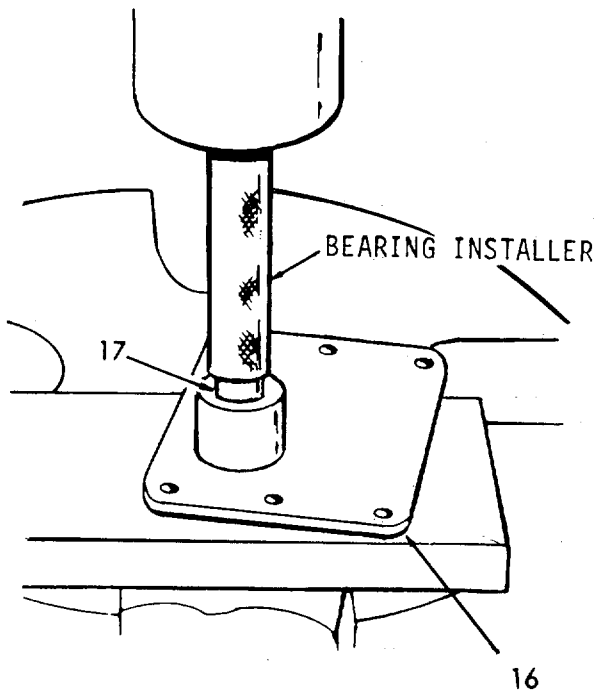
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

e. Retaining ring (10)

Install.

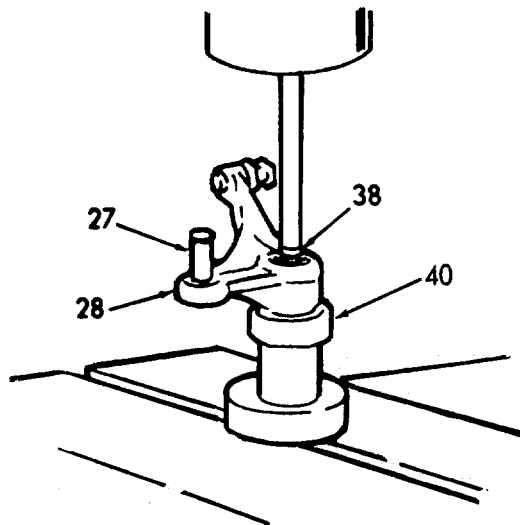


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | |
|-----------------------------|-------------------------|---|
| 7. Governor Control Housing | a. Washer (41) | Place over short, finished end of the operating shaft (38). |
| | b. Bearing (40) | <ol style="list-style-type: none"> 1. Start over end of shaft (38). 2. Support end of shaft on bed of press. 3. Use a sleeve with same diameter as the bearing inner race. Press bearing tightly against the washer. |
| | c. Operating lever (28) | <ol style="list-style-type: none"> 1. Place pivot pin (27) into the UP position. |



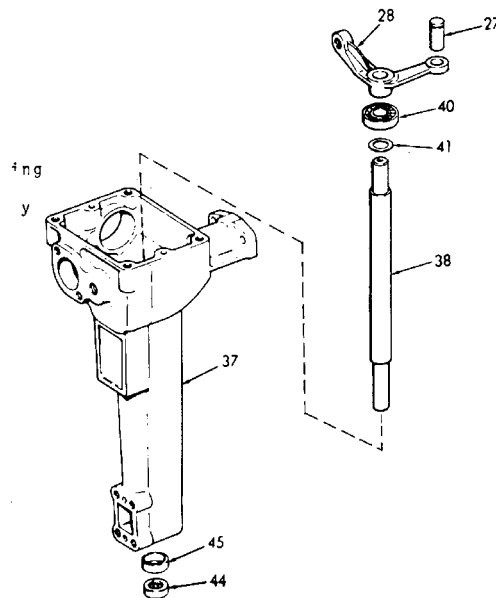
2. Start lever over end of the shaft (38), with the flat on shaft registering with the flat surface in lever.

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY Cont)

- | | | | |
|----|---|---|--|
| | | 3. Press lever on shaft tightly against bearing (40). | |
| d. | Bushing (45), and bearing (44) | Press into end of housing (37). | |
| e. | Bushing (45), and bearings (40 and 44) | Lubricate with clean engine oil. | |
| f. | Lever (28), and operating shaft assembly (38) | Insert into housing (37). | |



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

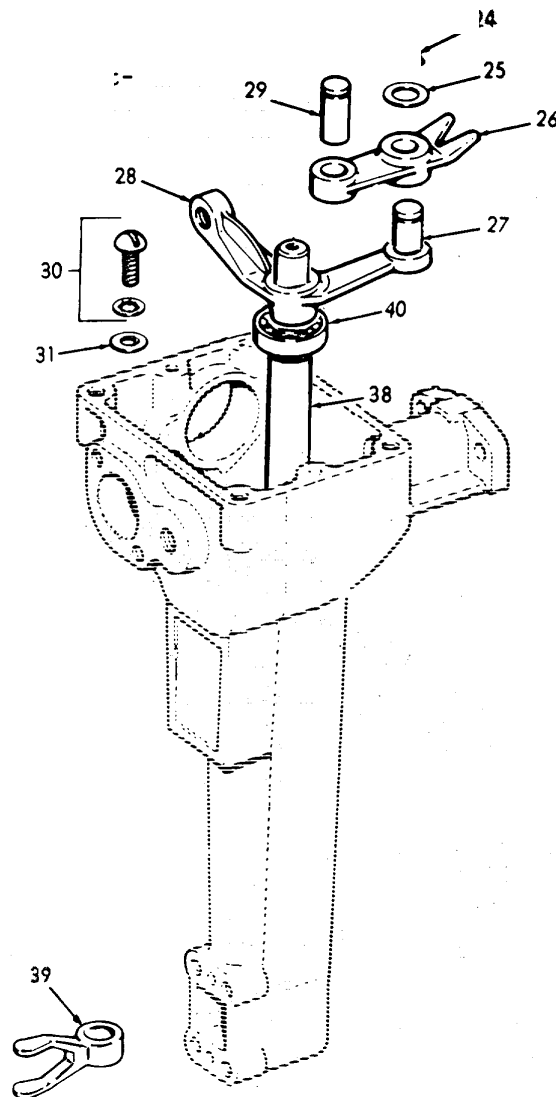
- | | | | |
|-----|---------------------------------------|---|--|
| g. | Operating fork (39) | <ol style="list-style-type: none"> 1. Position over lower end of operating shaft (38) so that the finished side of fork points outward. 2. Support the operating shaft and control housing on the bed of an arbor press with the upper end of the shaft resting on a steel block. 3. Align flat in operating fork with flat on shaft. Place sleeve over end of shaft and rest on fork . 4. Bring ram of press down on sleeve and press fork straight down tightly against the, shoulder on the shaft. | |
| h. | Differential lever (26) | <ol style="list-style-type: none"> 1. Press in pin (29). 2. Place over pivot pin (27) on operating lever (28). | |
| i . | Washer (25), and spring retainer (24) | Install. | |

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | |
|----|--|---------------------------------|
| j. | Screw assembly (30), and flat-washers (31) | Install to secure bearing (40). |
|----|--|---------------------------------|

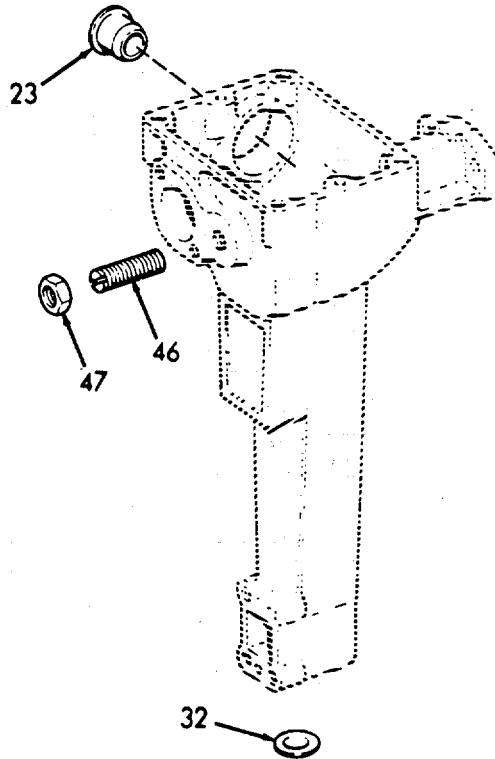


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|------------------------------------|---|--|
| k. | Spring plunger guide (23) | Install. | |
| l. | Expansion plug (32) | 1. Apply sealant around outer edge.
2. Tap plug into lower end of housing. | |
| m. | Buffer screw (46) and locknut (47) | Install. | |

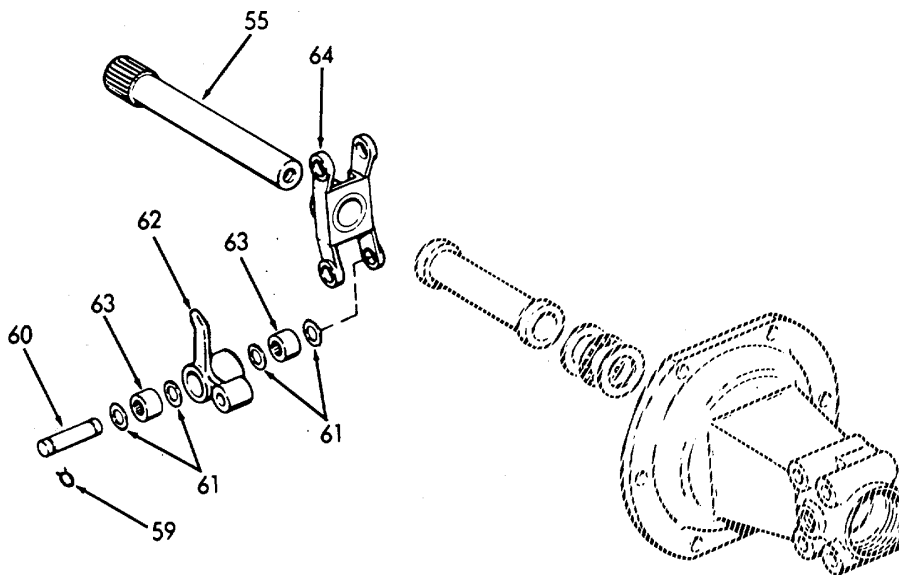


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----------------------------|----|----------------------|---|
| 8. Governor Weight Housing | a. | Weight carrier (64) | Press onto weight shaft (55). |
| | b. | Needle bearings (63) | Press into governor weights (62). |
| | c. | Lock ring (59) | Install on weight pins (60). |
| | d. | Flat-washers (61) | Place over weight pin (60) and against lock-ring (59). |
| | e. | Weight pin (60) | <ol style="list-style-type: none"> 1. Start pin through opening in weight carrier (64). 2. Place second washer (61) over pin and against projecting arm of weight carrier (64). |



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)			
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- | | | | |
|----|------------|--|--|
| | | 3. Position governor weight (62) between projecting arms of weight carrier (64), and push pin (60) through weight (62). | |
| | | 4. Place third washer (61) over pin (60) and against weight (62), and push pin (60) completely thru weight carrier. | |
| | | 5. Place fourth washer (61) over pin (60), and against projecting arm of weight carrier (64) | |
| | | 6. Install second locking ring (59). | |
| f. | Riser (58) | Slide over shaft (55), and against the burnished surfaces of the governor weights (64). | |

CAUTION

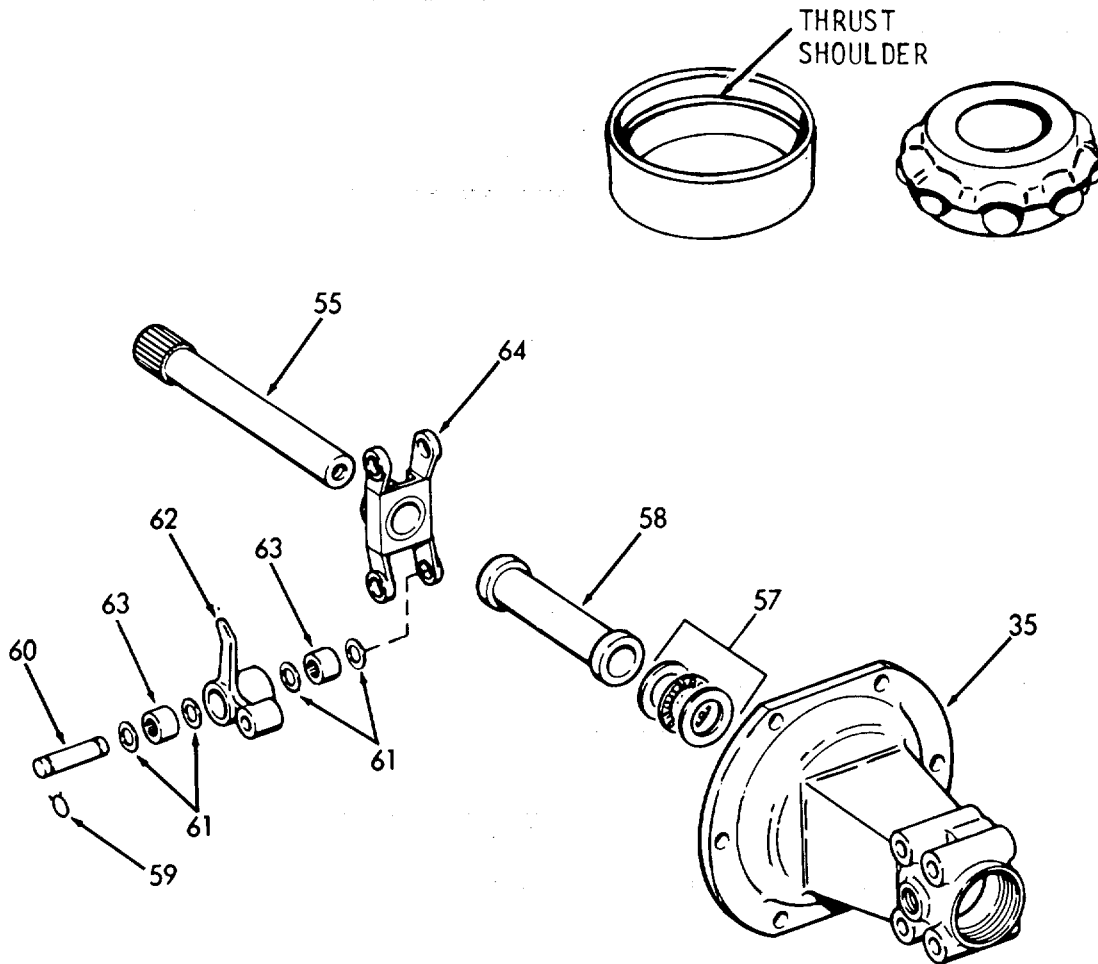
This bearing has thrust capacity in one direction only. Be sure to install the bearing so that the thrust shoulder is toward the governor weights. Otherwise, the force exerted by the weights will pull the inner race and ball assembly away from the outer race and result in damage to bearing and erratic governor operation.

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|-----------------------------------|---|---|
| g. | Riser thrust bearing (57) | Place on weight shaft (55), with the bearing having the smaller inside diameter against the thrust riser. | Incorrect installation of the bearing will result in erratic operation of the governor. |
| h. | Weight carrier and shaft assembly | Insert in housing (35). | |

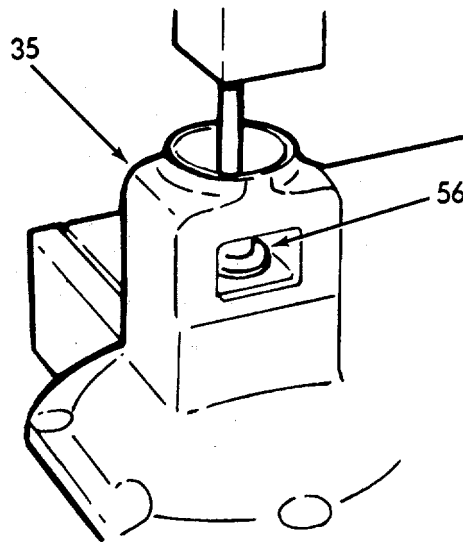


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|------------------------|--|--|
| i. | Housing assembled (35) | <ol style="list-style-type: none"> 1. Support splined end of shaft on bed of an arbor press. 2. Start the shaft end bearing (56) in the housing, and over the end of the shaft with the numbered side of the bearing facing away from the shaft. 3. Press the bearing in place with a sleeve that bears against the inner race. | |
|----|------------------------|--|--|



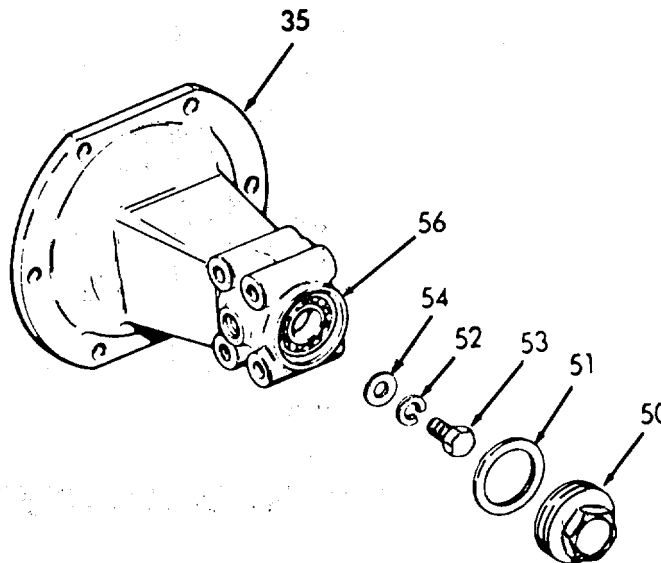
5-966

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|---|---|---|
| j. | Screw (53), lock-washer (52), and washer (54) | <ol style="list-style-type: none"> 1. Install. 2. Bend tang of washer against head of bolt. | |
| k. | Gasket (51) | Place in housing and against bearing. | |
| l. | Housing cap (50) | <ol style="list-style-type: none"> 1. Apply sealant to full circumference of cap. | Use Loctite HV or equivalent. |
| | | <ol style="list-style-type: none"> 2. Install. | |
| | | <ol style="list-style-type: none"> 3. Tighten to 30-60 lb. ft. (40.7-81.3 Nm). | Torque to flat or point of head on a horizontal line. |



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

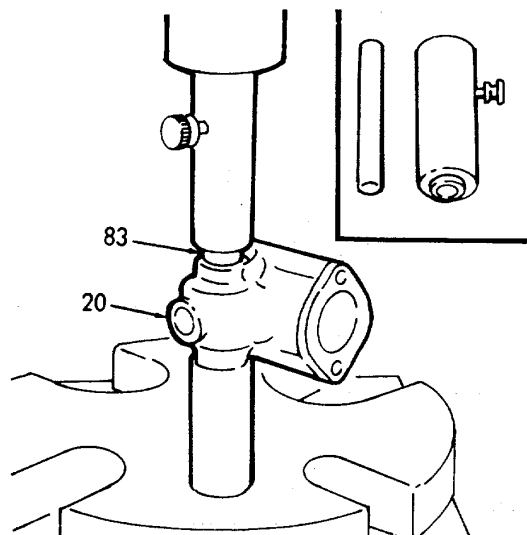
LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

9.	Variable Speed Spring Housing	a. Bearing (83), and housing (20)	1.	Lubricate with grease.	Use Shel1 Alvania #2 grease or equivalent.
			2.	Start, numbered end up, straight into the bearing bore.	
			3.	Place pilot rod end of a bearing installer assembly in the bear- ing. Support spring housing, bearing and installer on a short sleeve on the bed of an arbor press. Press bearing into housing until shoulder contacts the housing.	

NOTE

When the shoulder on the installer body contacts the housing, the bearing will be properly positioned in the housing.

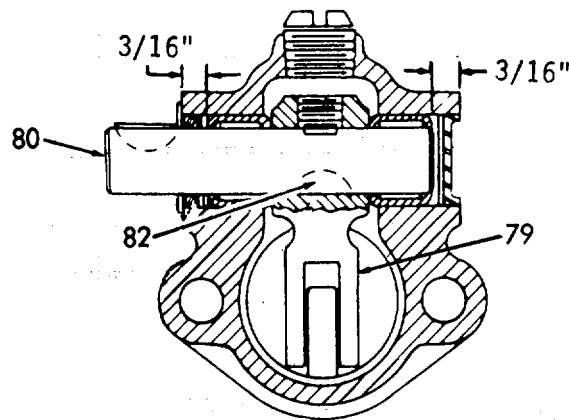


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | |
|----|--|--|
| b. | Woodruff key (82) | Place in center keyway in speed control lever shaft (80). |
| c. | Spring lever (79) | Place the spring lever assembly between bearing bores inside the spring housing with arm (roller end) of lever facing out. |
| d. | Speed control shaft (80), and key (82) | <ol style="list-style-type: none"> 1. Insert the end of the speed control lever shaft thru the bearing bore in the side of the spring housing, opposite the bearing previously installed. 2. Align the key in the shaft with keyway in the spring lever, and push the shaft through the lever and in the bearing until the flat on top of the shaft is centered under the set-screw hole in lever. |

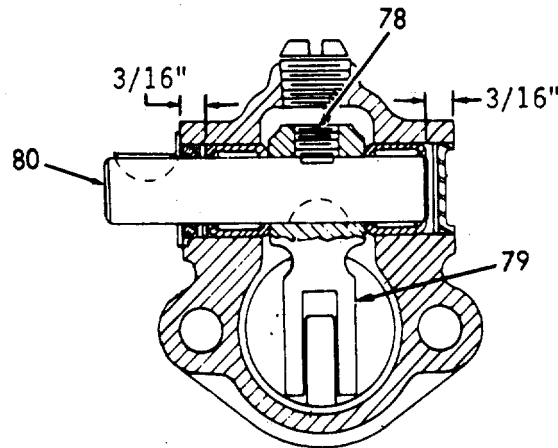


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|---------------|-------------------------------|--|
| e. | Setscrew (78) | Install in spring lever (79). | Make sure the point of the setscrew is seated in the flat on the shaft (80). |
|----|---------------|-------------------------------|--|



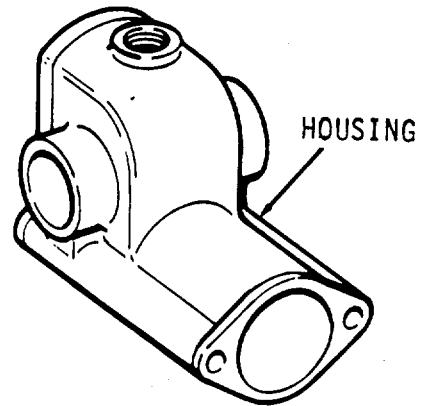
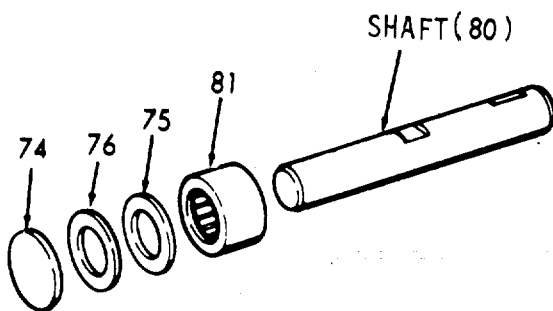
- | | | | |
|----|--------------|--|--|
| f. | Bearing (81) | <ol style="list-style-type: none"> 1. Lubricate with grease. 2. Place bearing numbered end up, over the protruding end of shaft and start it straight into bore of housing. 3. Support the spring housing, bearings and installer on a short sleeve on the bed of an arbor press. Then press the bearing in the housing until the shoulder on the installer contacts the housing. | Use Shell Alvania #2 grease or equivalent. |
|----|--------------|--|--|

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|--|---|--|
| g. | Pre-formed packing (76), and retaining washer (75) | Install. | |
| h. | Expansion plug (74) | <ol style="list-style-type: none"> 1. Apply a thin coat of sealing compound to the outside diameter of the plug. 2. Start plug straight in the bearing bore in the housing. Support the spring housing, bearings and shaft assembly on a sleeve on the bed of an arbor press, and press plug in flush with the outside face of housing. | |



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

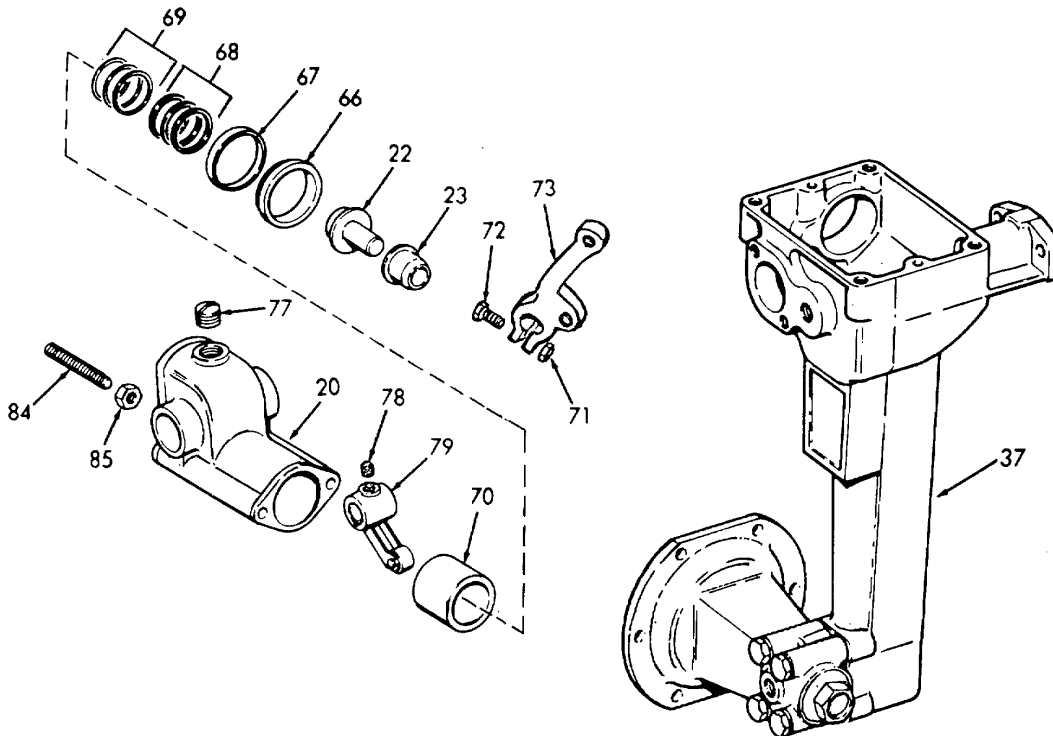
- | | | | |
|----|---|---|--|
| i. | Setscrew
(78) | <ol style="list-style-type: none"> 1. Clamp the spring housing assembly in a bench vise equipped with soft jaws. 2. Tighten the spring lever retaining set screw to 12-15 lb. ft. (16.3-20.3 Nm) torque. 3. Stake the edge of the spring lever setscrew hole with a small center punch and hammer to retain the setscrew in the lever. | |
| j. | Pipe plug
(77) | Install. | |
| k. | Speed control lever
(73), nut
(71), and screw
(72) | <ol style="list-style-type: none"> 1. Install lever. 2. Tighten nut and screw. | |
| l. | Adjusting screw
(84), and locknut
(85) | Thread into housing approximately one inch. | |
| m. | Spring plunger
(22) | Install small end in plunger guide (23). | |

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|---------------------------|--|-----------------------|
| n. | Spring retainer stop (66) | Place in governor control housing (37). | This is a solid stop. |
| o. | Spring retainer (70) | Install in housing (20) with closed end of retainer against spring lever (79). | |
| p. | Shims (68 and 69) | Place in spring retainer (70). | |
| q. | Stop (67) | Insert in housing (20), and against the spring retainer (70). | This is a split stop. |



5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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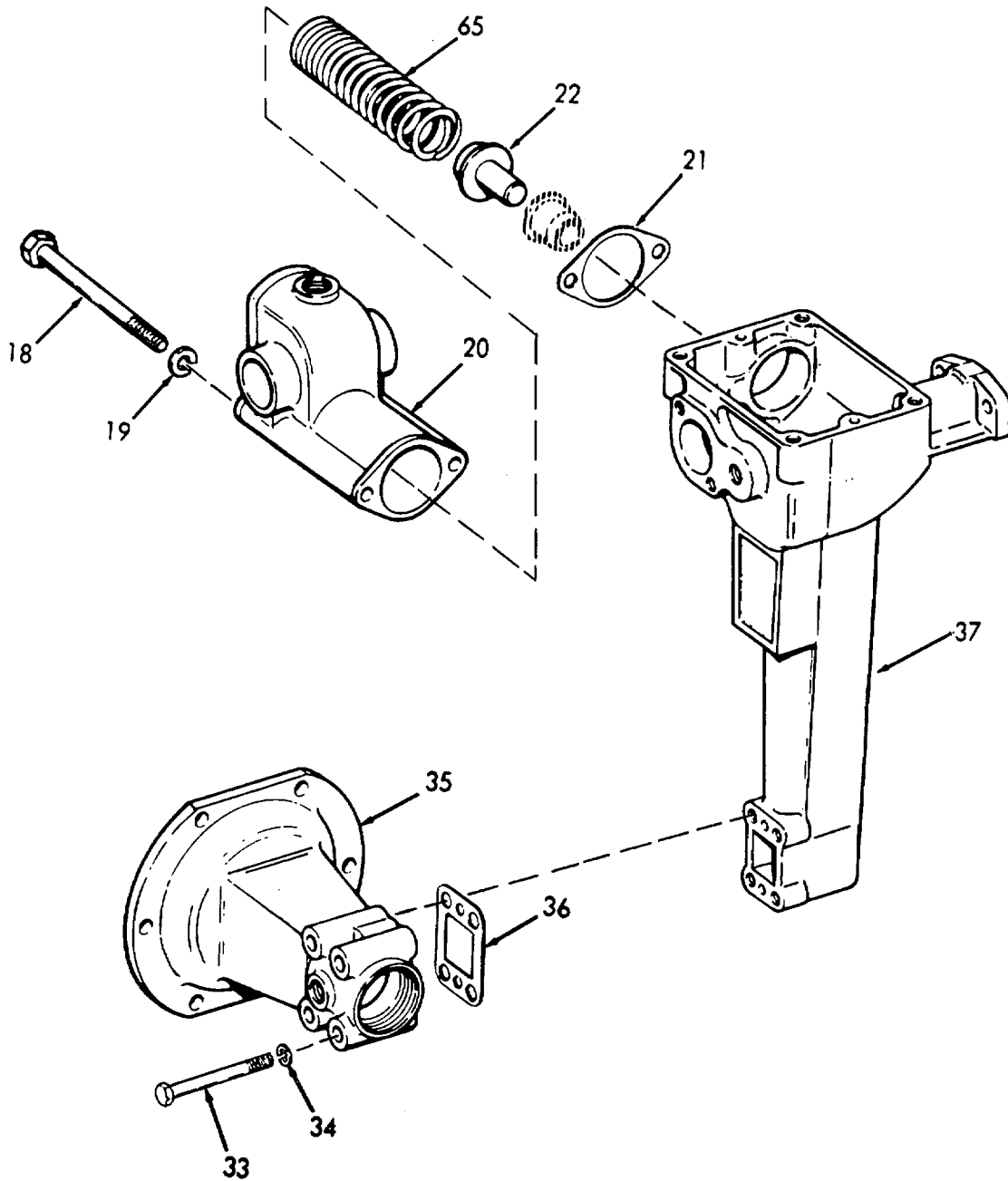
REASSEMBLY (Cont)

- | | | | |
|----|--|--|-----------------|
| r. | Spring
(65) | Insert in spring
plunger (22) with the
tightly wound end of
spring against shims. | |
| s. | Housing
(20),
and
gasket
(21) | Align holes with
governor control
housing (37). | Use new gasket. |
| t. | Screws
(18)
and
lock-
washers
(19) | Install. | |
| u. | Governor
weight
housing
(35)
and
gasket
(36) | Align holes with
governor control
housing (37). | |
| v. | Screws
(33)
and
lock-
washers
(34) | Install | |

5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

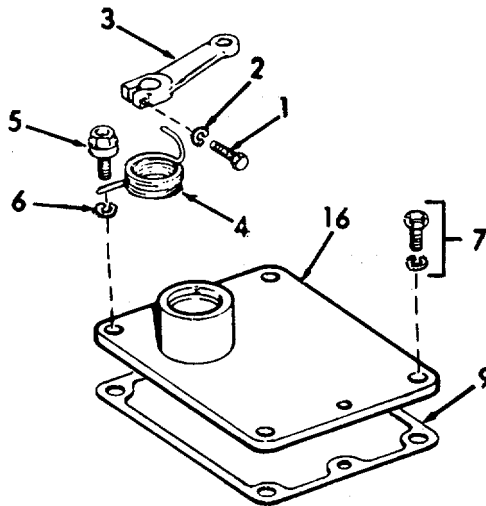


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | | | |
|-----|--------------------------|----|--|-------------------------|----------------|
| 10. | Governor Control Housing | a. | Cover (16), | Install. and gasket (9) | Use new gasket |
| | | b. | Screw assemblies | Install. (7) | |
| | | c. | Screw assembly (5), and lockwasher (6) | Install. | |
| | | d. | Throttle shaft lever (3), and spring (4) | Install. | |
| | | e. | Screw (1), and lock-washer (2) | Tighten. | |



TEST

- | | | |
|-----|--------------------------|---|
| 11. | Governor Control Housing | Perform the operation procedure in paragraph 5-70a. |
|-----|--------------------------|---|

5-71. BLOWER - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

Feeler gage
(1/2 inch wide)
Micrometer

References
Paragraph

3-144 Blower Organizational
Maintenance

Special Tools

Arbor press
Slide hammer
Tool set J6270
Vise (soft-jaws)

Equipment
Condition

Condition Description

NONE

Material/Parts

Hub blower repair kit
P/N 5192751
Blower repair kit
P/N 5192796

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions



Wear eye protection when
using compressed air.

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

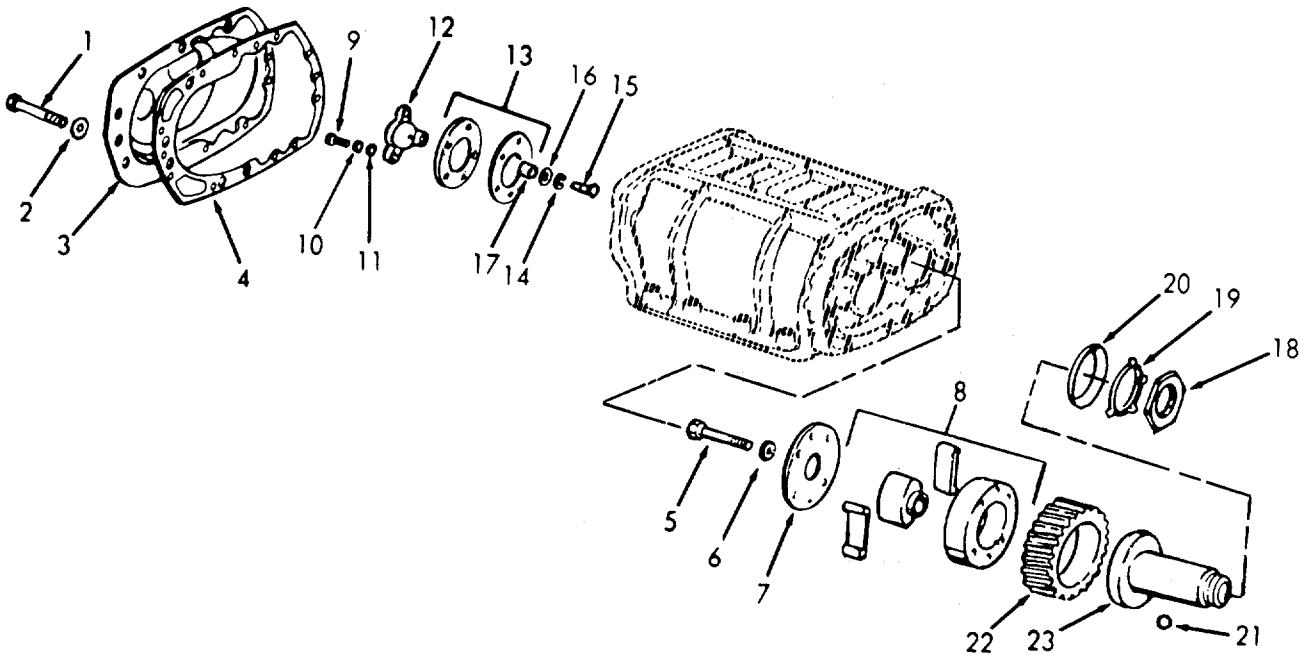
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY			
1. Rear Blower Cover and Drive Coupling	a. Machine bolts (1), and lock-washers (2)	Remove.	
	b. End plate cover (3), and gasket (4)	Remove.	
	c. Drive coupling machine bolts (5), and lock-washers (6)	Remove.	
	d. Retainer (7), and rear blower coupling (8)	Remove from right hand blower rotor gear.	
2. Blower Drive	a. Screws (9), flat-washers (10), and lock-washers (11)	Remove from housing.	
	b. Hub (12), and spring plates (13)	Remove.	

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY

- | | | | |
|----|--|------------------------|---------------|
| c. | Screws (14), flatwashers (15), and lockwasher (16) | Remove. | |
| d. | Spacers (17) | Remove. | |
| e. | Hub nut (18), and lockwasher (19) | Remove. | |
| f. | Thrust washer (20), and ball (21) | Remove. | |
| g. | Gear (22), and drive shaft (23) | Remove.
hand helix. | Gear is left- |



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY

3. Front Blower Cover and Water Pump Drive Coupling	a. Machine bolts (24), and lock-washers (25)	Remove.	
	b. Front cover (26) and gasket (27)	Remove.	
	c. Screw (28), and water pump coupling (29)	<ol style="list-style-type: none"> 1. Place a clean folded cloth between the rotors. 2. Pull the drive coupling from the blower rotor shaft. 	Use a slide hammer.
4. Blower	a. Screw (30), lock-washer (31), and coupling disc spacers (32)	<ol style="list-style-type: none"> 1. Place a clean folded cloth between the rotors. 2. Remove. 	
	b. Screws (33), lock-washers (34) and retaining washer (35)	Remove.	

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

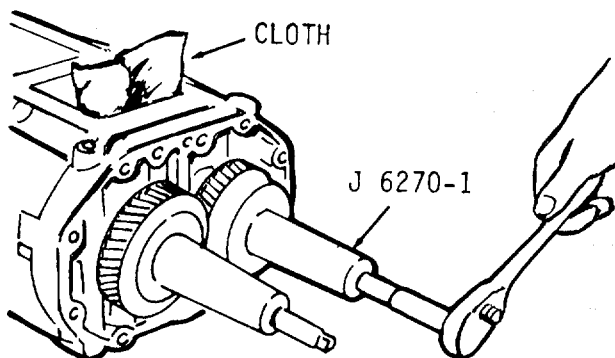
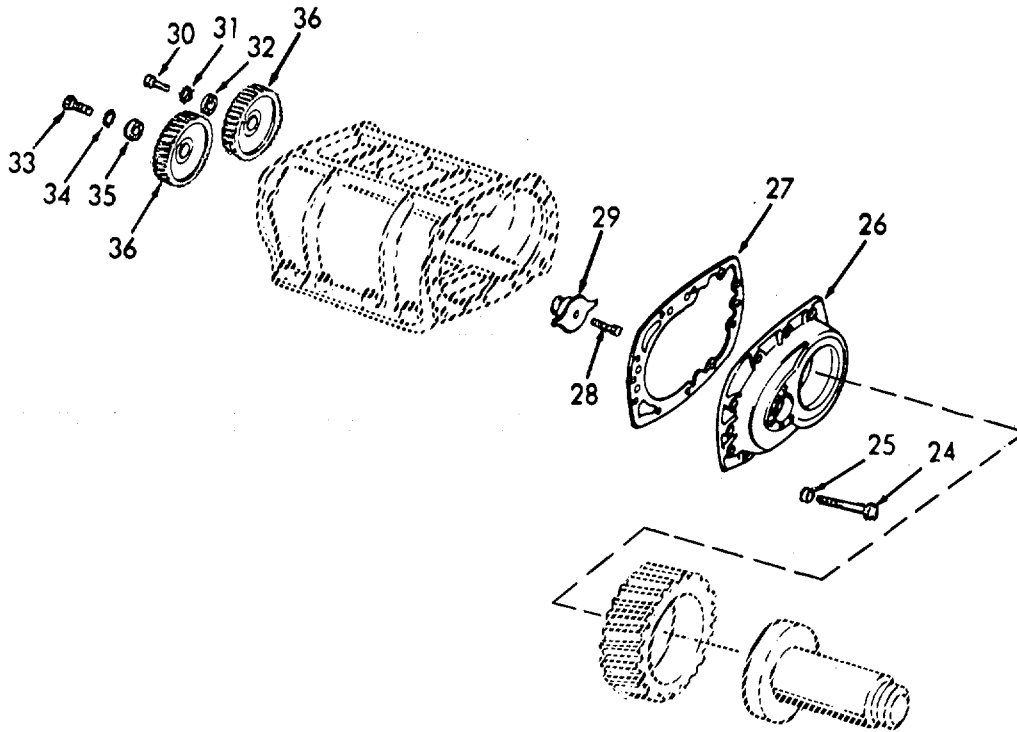
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY

c. Timing gears (36)

1. Remove both gears as follows:

Use two pullers J6270-1.



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

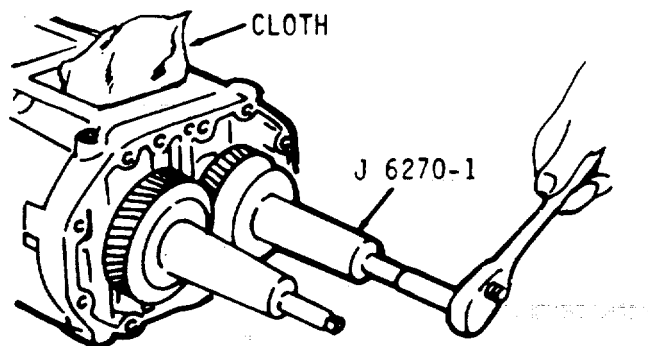
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY

2. Back out the center screws of both pullers and place the flanges against the gear faces, aligning the flange holes with the tapped holes in the gears. Secure the pullers to the gears with 5/16"-24x1-1/2" bolts (two bolts on the L.H. helix gear, and three bolts on the R.H. helix gear).

3. With a clean cloth placed between the rotors to prevent their turning, turn the two puller screws uniformly clockwise, and withdraw the gears from the rotor shafts as shown below.

Use puller J6270-1



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY (Cont)			
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d. Shims
(37)

1. Note the number and thickness of shims on each rotor shaft.

This will ensure identical replacement when reassembling the blower.

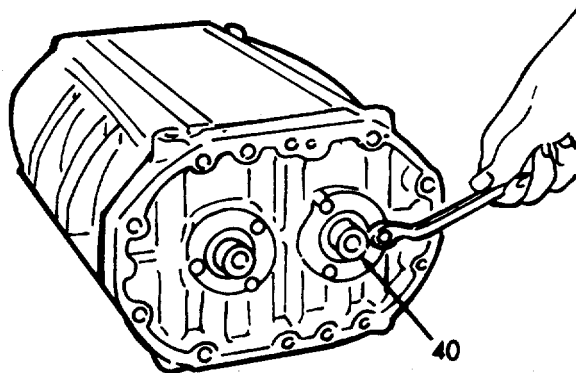
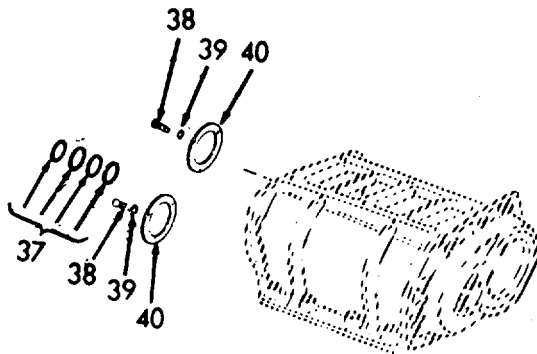
2. Remove.

e. Screws
(38),
and
lock-
washers
(39)

Remove six places.

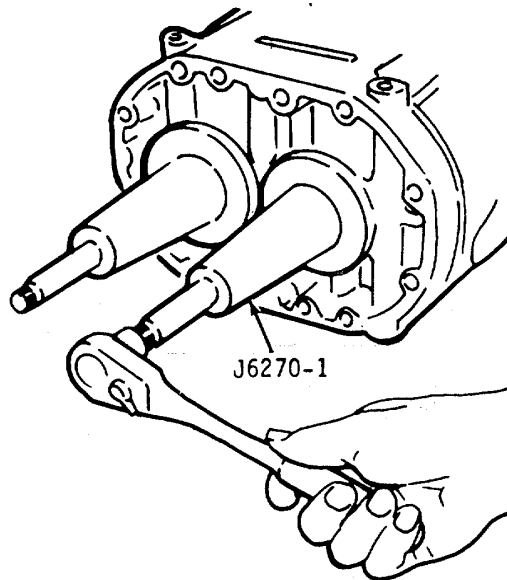
f. Bearing
retainers
(40)

Remove two places.



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)		
	g. Screws (41), and lock - washers (42)	Remove six places.
	h. Bearing retainers (43)	Remove two places.
	i. Screws (44)	Remove.
	j. Screws (45)	Loosen. Approximately three turns.
	k. Rear end plate (46)	1. Back out the center screws of pullers far enough to permit the flange of each puller to lay flat on the face of the end late. Use two pullers J6270-1.



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY (Cont)

- Align holes in each puller flange with the tapped holes in the end plate and secure pullers to the end plate with six 1/4"-20x1-1/4" or longer screws.

NOTE

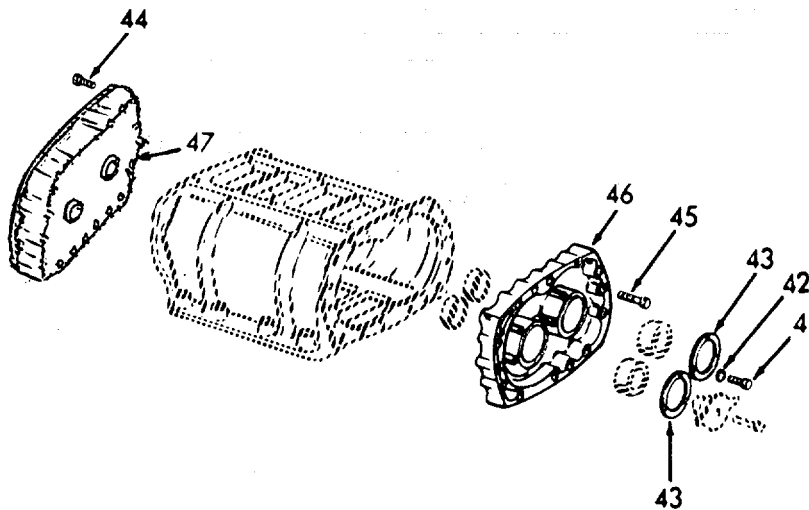
Be sure that the 1/4"-20 screws are threaded all the way into the tapped holes in the end plate to provide maximum anchorage for the pullers and to eliminate possible damage to the end plate.

- Turn the two puller screws uniformly clockwise and withdraw end plate and bearings from blower housing and rotors as shown.

- Front endplate (47)

Remove.

Refer to step k above.



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY (Cont)

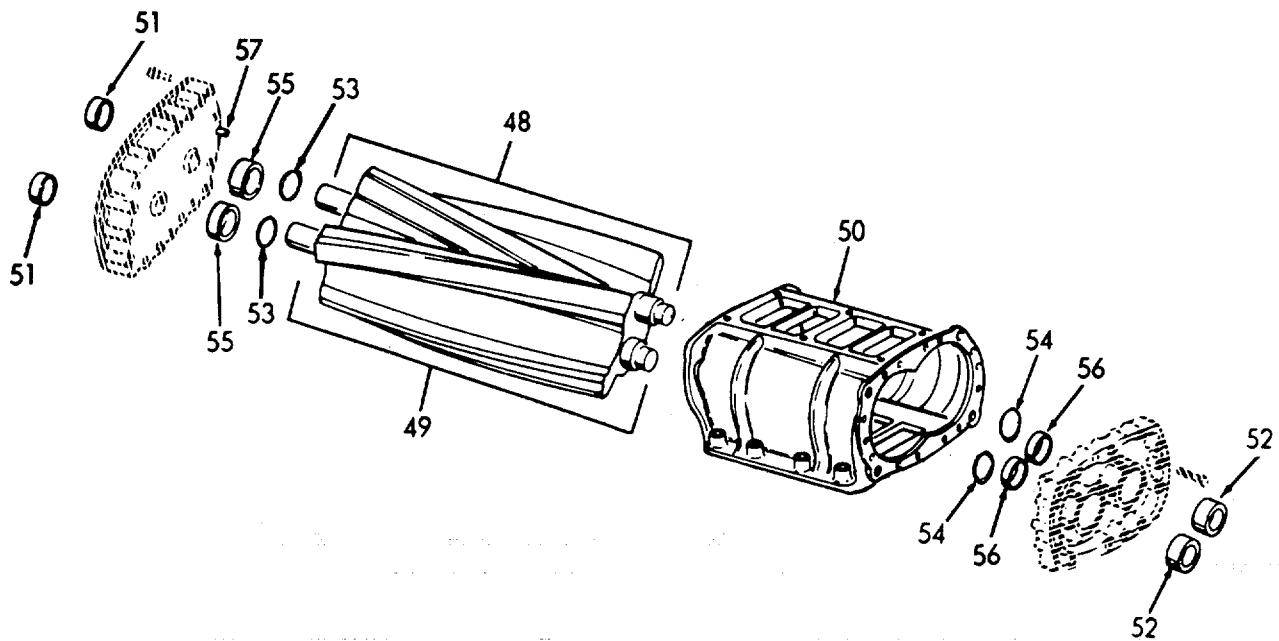
m. Rotors (48) and (49)

Remove from housing (50).

n. Bearings (51 and 52), seals (53 and 54), and spacer sleeves (55 and 56)

1. Inspect the oil seals and spacers. If the seals are scored, charred or hardened so that a tight seal around the shafts is impossible, new seals should be installed.
2. Support the outer face of the end plate on wood blocks on the bed of the arbor press.

1. Discard seals and spacers.
2. If necessary, the seals may be removed from the end plates at the same time as the individual bearings are removed.



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

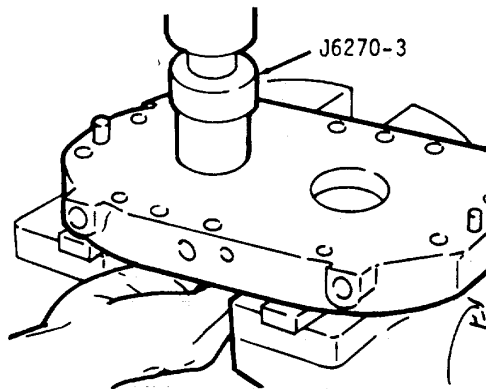
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY (Cont)

3. Place the long end of the oil seal remover and installer down through the oil seal and into the bearing, with the opposite end of remover under the, ram of the press. Then, press bearing and oil seal out of the end plate.

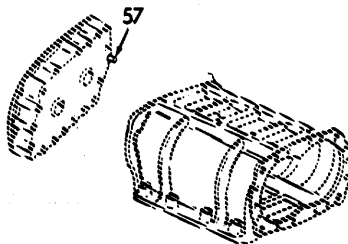
Use tool J6270-3.

4. Remove the remaining bearings and oil seals from end plates in the same manner.



- o. Dowel pins Remove. (57)

If necessary.



LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY (Cont)

5. Blower

WARNINGS

Wear eye protection when using compressed air.

- a. Wash all blower parts in clean fuel oil and dry with compressed air.
- b. Examine the bearings for any indications of corrosion or pitting. Lubricate each bearing with light engine oil; then, while holding the bearing inner race from turning, revolve the outer race slowly by hand and check for rough spots.
- c. The double-row ball bearings are pre-loaded and have no end play. A new double-row bearing will seem to have considerable resistance to motion when revolved by hand.
- d. Check the oil seal rings, carriers and collars for wear and scoring. If worn excessively, they must be replaced. Inspection of the lip type oil seal is covered in step 4n.
- e. Inspect the blower rotor lobes, especially the sealing ribs, for burrs and scoring. Rotors must be smooth for efficient operation of the blower. If the rotors are slightly scored or burred, they may be cleaned up with emery cloth.
- f. Examine the rotor shaft serrations for wear, burrs or peening. Also, inspect the bearing and oil seal contact surfaces of the shafts for wear and scoring.

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY INSPECTION (Cont)

- g. Inspect the inside surface of the blower housing for burrs and scoring. The inside surface must be smooth for efficient operation of the blower. If the inside surface of the housing is slightly scored or burred, it may be cleaned up with emery cloth.
- h. Check the finished ends of the blower housing for flatness and burrs. The end plates must sit flat against the blower housing.
- i. The finished inside face of each end plate must be smooth and flat. If the finished face is slightly scored or burred, it may be cleaned up with emery cloth.
- j. Examine the serrations in the blower timing gears for wear and peening. Also check the teeth for wear, chipping or damage. If the gears are worn to the point where the backlash between the gear teeth exceeds .004", or if they are damaged sufficiently to require replacement, both gears must be replaced as a set.
- k. Check the blower drive shaft serrations for wear or peening. Replace the shaft if it is bent.
- l. Inspect the blower drive coupling springs (pack) and the cam for wear. Replace all worn or excessively damaged blower parts.
- m. Clean oil strainer in the vertical oil passage at the bottom of each blower end plate, and blow out all oil passages with compressed air.

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY

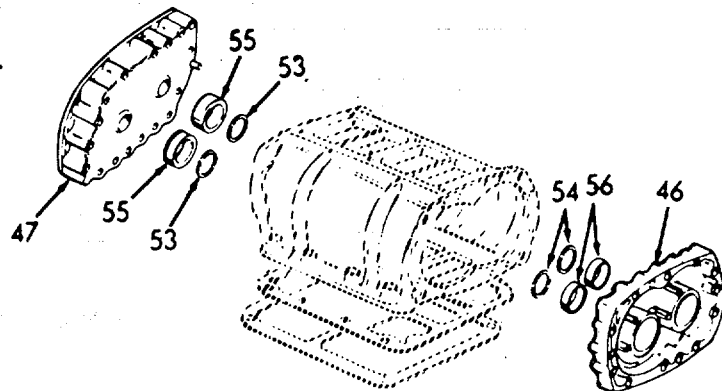
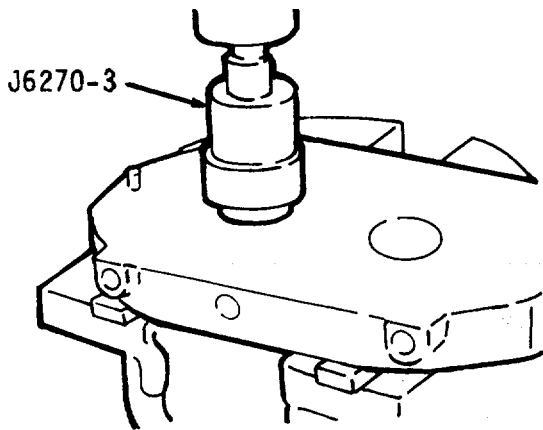
- | | | | |
|-----------|---|---|--|
| 6. Blower | <p>a. Several precautions are given below to assure the proper assembly of the rotors and gears for correct blower timing.</p> <ol style="list-style-type: none"> 1. The lobes on the DRIVING blower rotor and the teeth on the gear form a right-hand helix while the lobes and teeth of the DRIVEN rotor and gear form a left-hand helix. Hence, a rotor with right-hand helix lobes must be used with a gear having right-hand helix teeth and vice-versa. 2. One serration is omitted on the drive end of each blower rotor shaft and a corresponding serration is omitted in each gear. Assemble the gears on the rotor shafts with the serrations in alignment. 3. The rotors must be assembled in the blower housing with the omitted serrations in the rotor shafts aligned as shown in step 6f. | <ol style="list-style-type: none"> 1. Support the blower end plate, finished surface facing up, on wood blocks on the bed of an arbor press. | <p>Use new oil seals and spacer sleeves.</p> |
| | <p>b Blower end plates (46 and 47), spacer sleeves (55 and 56), and oil seals (53 and 54)</p> | | |

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)			
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2. Start the oil seal straight into the bore in the end plate with the sealing edge facing down (toward the bearing bore).
3. Place the short end of oil seal remover and installer in the oil seal and under the ram of the press. Then, press the oil seal into the end plate until the shoulder on the installer contacts the end plate.



5-71. .BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY(Cont)			
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NOTE

A step under the shoulder of the installer will position the oil seal approximately .005" below the finished face of the end plate. This is within the .002" to .008" specified.

- | | |
|--------------------------------|--|
| c. Blower front end plate (47) | <ol style="list-style-type: none"> 4. Install remaining oil seals in end plates in the same manner 1. The top of the end plate is identified by three bolt holes and one oil hole. The bottom side of the end plate has three bolt holes and three oil holes. The dowel pins (57) extend on both sides of front end plate. |
|--------------------------------|--|

CAUTION

The horizontal oil passage in the top front face of the front end plate that intersects the vertical oil passage is plugged. Do not install this end plate on the rear end, of the blower housing (50).

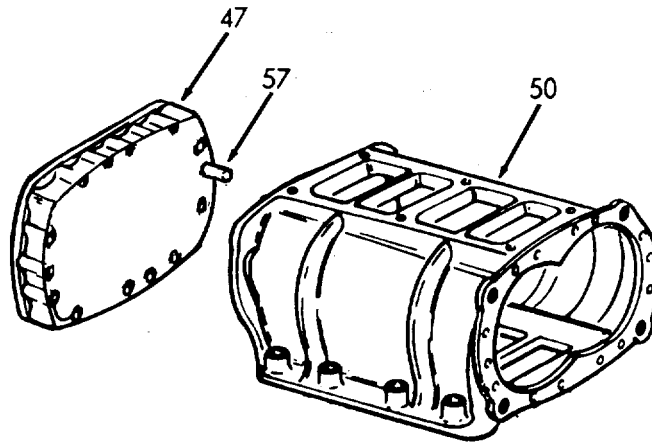
2. Attach front end plate to the front end of blower housing first. Attach rear end plate to the blower housing after rotors are in place. Then, attach the front endplate to blower housing.

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

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| d. | Dowel pins (57) | Check the dowel pins. The dowel pins must project .380" from the flat inner face of the front end plate to assure proper alignment of the end plate with the housing. | |
| e. | Blower housing (50), and end front plate (47) | <ol style="list-style-type: none"> 1. Place blower housing on a bench with top side of the housing up, and the front end of the housing facing the outside of the bench. 2. Position end plate (47) in front of the blower housing with the top side of end plate facing up. Then, start the dowel pins straight into the dowel pin holes in the housing. Push or tap the end plate against housing. | |



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

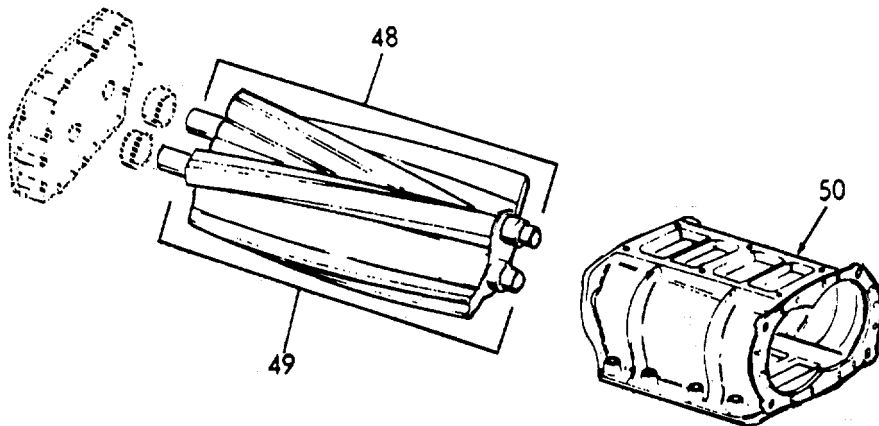
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

NOTE

Gaskets are not used between end plates and housing. The mating surfaces must be perfectly flat and smooth.

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| f. Blower housing (50), and rotors (48 and 49) | <ol style="list-style-type: none"> 3. Insert the screws through the end plate and thread them into the housing. Tighten the screws securely. Do not use lockwashers on these screws. 1. Reverse the blower housing on the bench (rear end of housing facing the outside of the bench). 2. Place rotors in mesh with the omitted serrations in the rotor shafts in a horizontal position and facing to the left as viewed from the rear end. |
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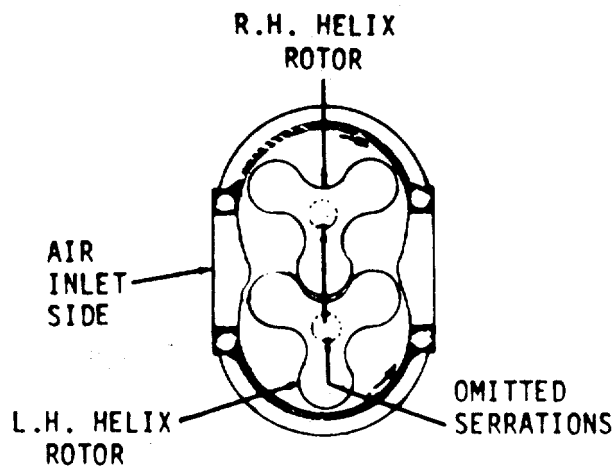
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)			
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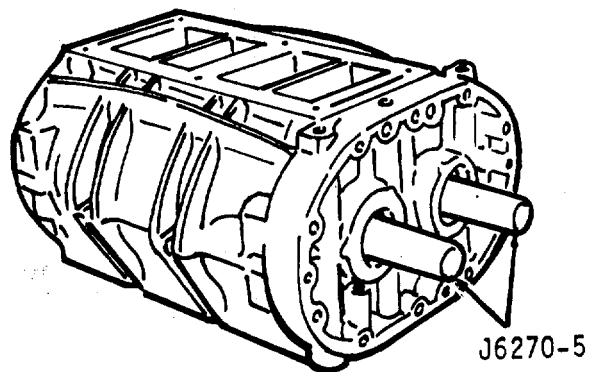
NOTE

The right-hand helix rotor is marked "GEAR END" on one end. The gear end of the left-hand rotor is that end which has the serrated shaft.



VIEW FROM GEAR END OF BLOWER

3. Install an oil seal pilot J6270-5 over the opposite end of each rotor shaft.



5-71. .BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

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|------------------------------|---|
| g Blower rear end plate (46) | 4. Insert rotors straight into the housing and thru the front blower end plate. |
| | 5 Remove the oil seal pilots from the rotor shafts. |
| | 1. Install oil seal pilot J6270-5 over the serrated end of each rotor shaft. |
| | 2 Check the dowel pins. The dowel pins must project .270" from the flat inner face of the rear end plate to assure the proper alignment of the end plate with the housing. |
| | 3. With the top of the end plate identified as in step 6a and its flat finished face towards the blower housing, slide the end plate straight over the oil seal pilots and start the dowel pins straight into the dowel pin holes in the housing. Then, n , push or tap the end plate against the housing . |
| | |

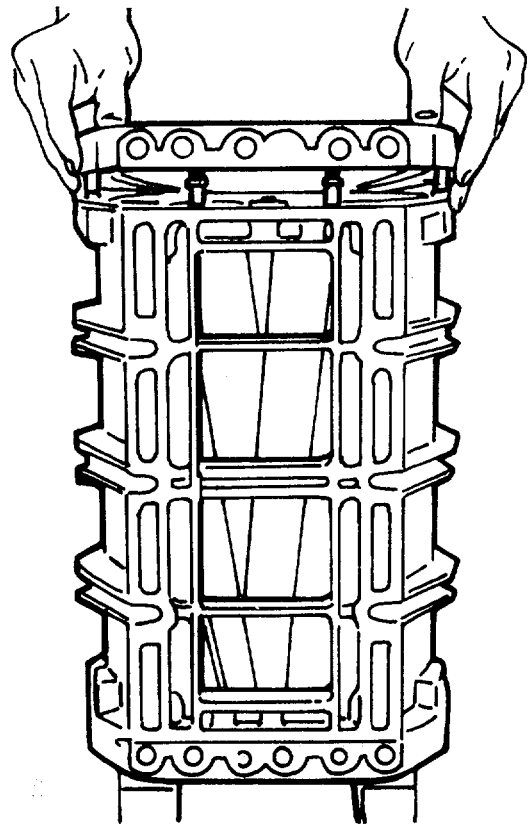
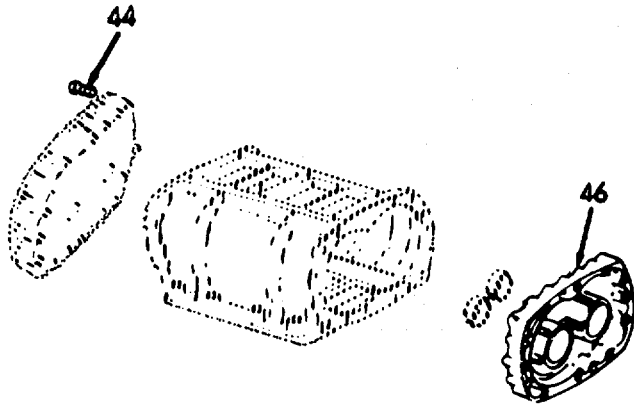
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

4. Insert two screws (44) thru the end plate and thread them into housing. Tighten screws securely. Do not use lockwashers on these screws.

5. Remove the oil seal pilots from the rotor shafts.



5-71. .BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

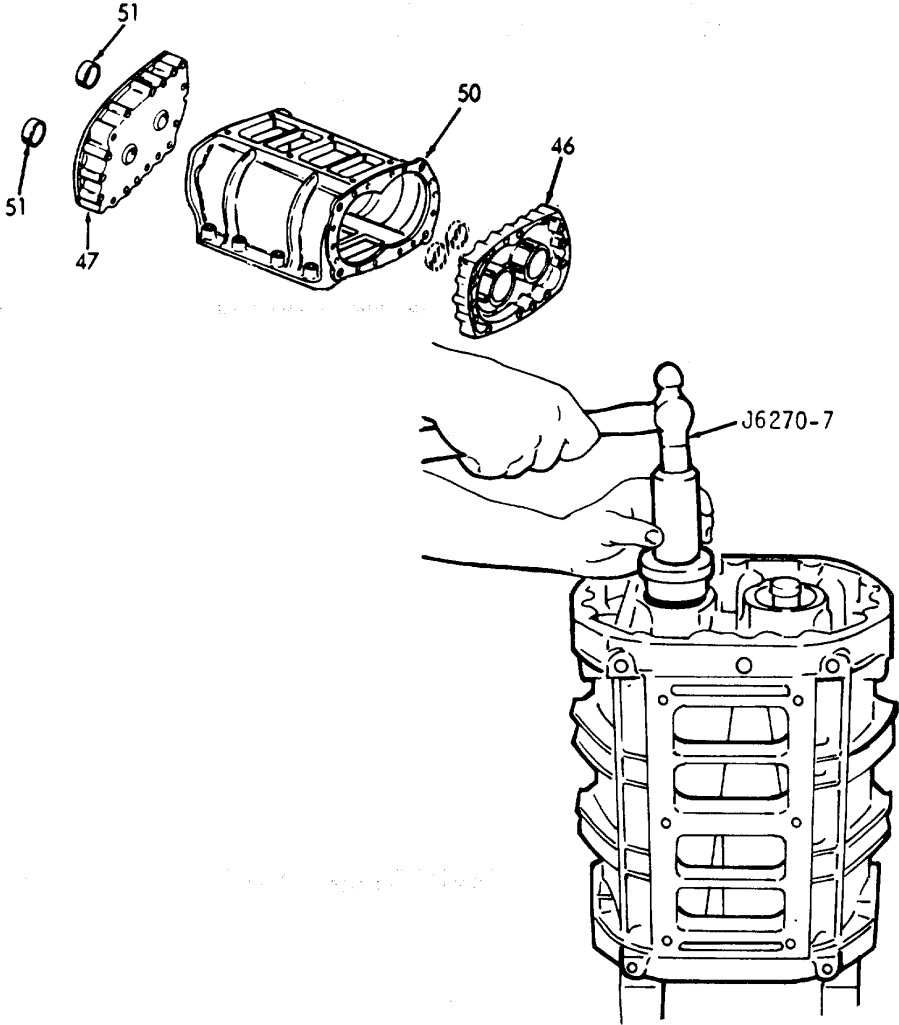
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| h. Blower housing (50), and end plates (46 and 47) | <p>Check the relationship of the blower end plates to the housing at the cylinder block side of the blower assembly. The protrusion of the housing with respect to the end plates should not be more than .0015". Excessive protrusion could distort the housing when the end plate to the cylinder block bolts are tightened and cause rotor-to housing interference.</p> | Use tool J6270-7 |
| i. Bearings (51) | <ol style="list-style-type: none"> 1. With the blower housing rotors and end plates still supported in a vertical position on the two wood blocks, install the ball bearings on the rotor shafts and in the rear end plate as follows: 2. Lubricate one ball bearing with light engine oil. Start bearing, numbered end up, straight on one of the rotor shafts. 3. Place installer on top of the bearing and tap the bearing straight on the shaft and into the rear end plate as shown. | Use tool J6270-7 |

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

- 4. Install the second ball bearing on the remaining rotor shaft in the same manner.



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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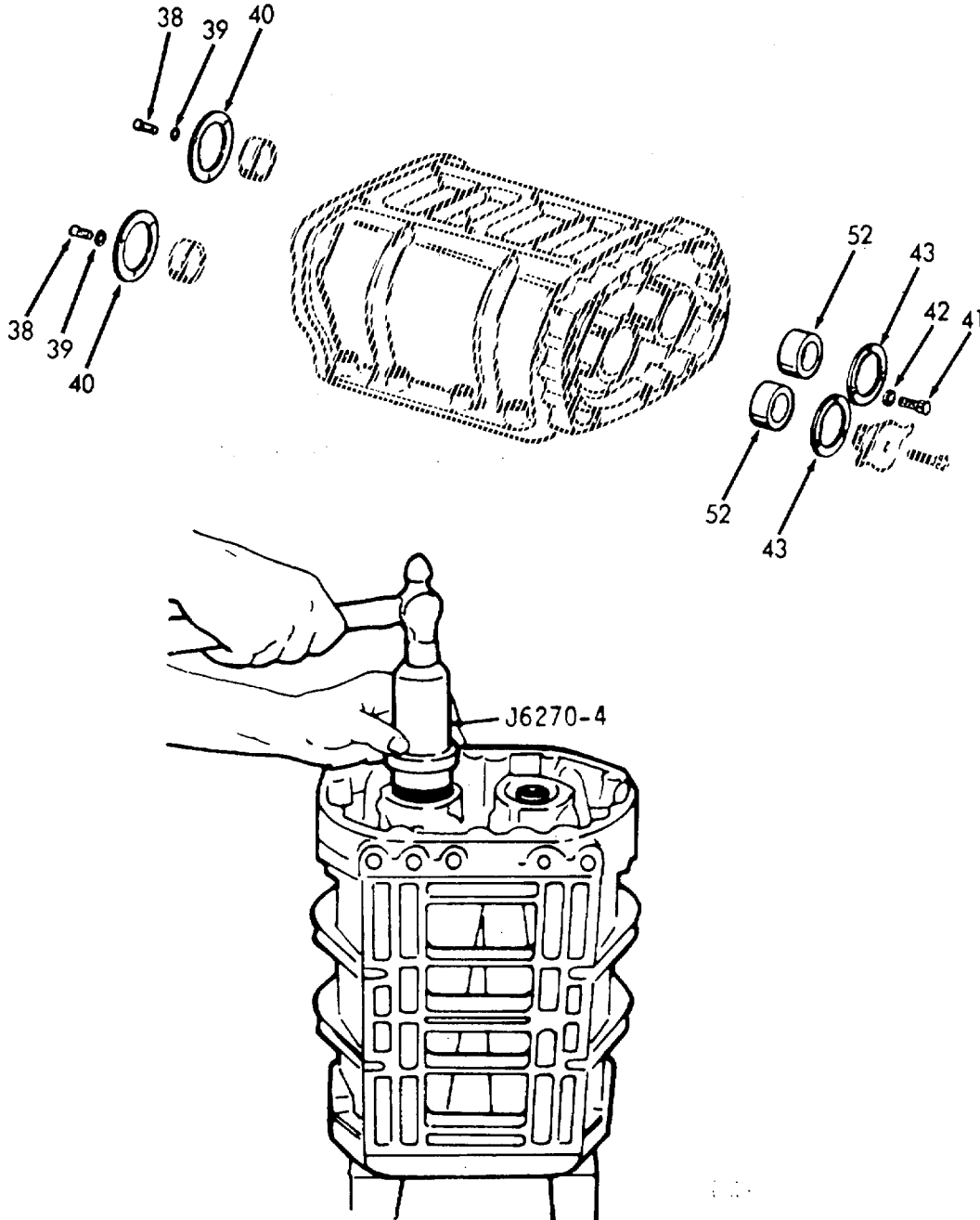
OVERHAUL-ASSEMBLY (Cont)

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| | j. Bearing retainers (40), screws (38), and lock-washers (39) | <ol style="list-style-type: none"> 1. Install. 2. Tighten screws to 7-9 lb-ft (9.5-12.2 Nm) torque. | |
| | k. Bearings (52) | <ol style="list-style-type: none"> 1. Reverse position of blower housing on the two wood blocks. 2. Lubricate one of the roller bearings with light engine oil. Start the bearing, numbered end up, straight on one of the rotor shafts. 3. Place installer J6270-4 on top of bearing and tap the bearing straight on the shaft and into the front end plate as shown. 4. Install second roller bearing on other rotor shaft in the same manner. | |
| 1. | Bearing retainers (43), screws (41), and lock-washers (42) | <ol style="list-style-type: none"> 1. Install. 2. Tighten screws to 7-9 lb-ft (9.5-12.2 Nm) torque. | |

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)



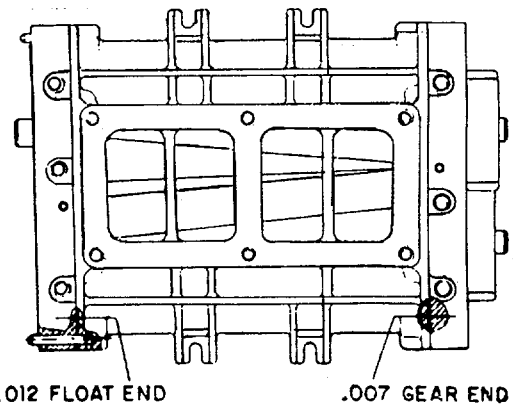
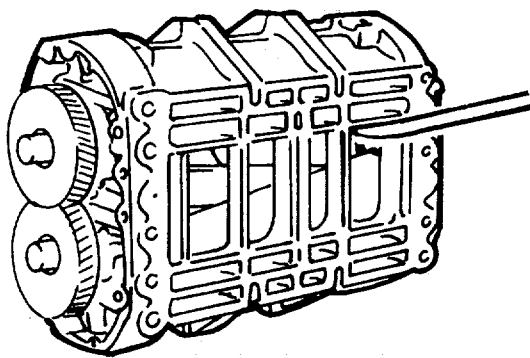
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

m. Blower housing assembled

Make a preliminary check of the rotor-to-end plate and rotor-to-housing clearances at this time with a feeler gage for minimum blower clearances.



n. Shims (37)

Replace shims in their original positions.

Refer to step 4c.

o. Blower housing assembly and gears (36)

1. Before installing the blower rotor timing gears on the rotor shafts, note precautions in step 6a 2 and 3 relative to the rotor shaft and timing gear alignment.

5-71. .BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)			
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2. The center punch mark in the end of each rotor shaft at the omitted serration will assist in aligning the gears on the shafts.
3. Place the blower assembly on the bench with the top of the housing facing up, and the rear end (serrated end of rotor shafts) of the blower facing the outside of the bench.
4. Rotate the rotors to bring the omitted serrations on the shafts into alignment and facing to the left.
5. Lubricate the serrations of the rotor shafts with light engine oil .
6. Place the teeth of the rotor gears in mesh so that the omitted serrations inside the gears are in alignment and facing the same direction as the serrations on the shafts.

5-71. .BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

7. Start both rotor gears straight on the rotor shafts with the right-hand helix gear on the right-hand helix rotor and the left-hand helix gear on the left-hand helix rotor, with the omitted serrations in the gears in line with the omitted serrations on the rotor shafts.
8. Thread a 1/2"-20x 1-1/4" bolt with a large plain washer into the end of each rotor shaft. Place a clean folded cloth between the lobes of the rotors to prevent the gears from turning. Draw the gears into position tight against the shims and the bearing inner races.
9. Remove the two bolts and washers that were used to draw the gears into position on the rotor shafts.

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

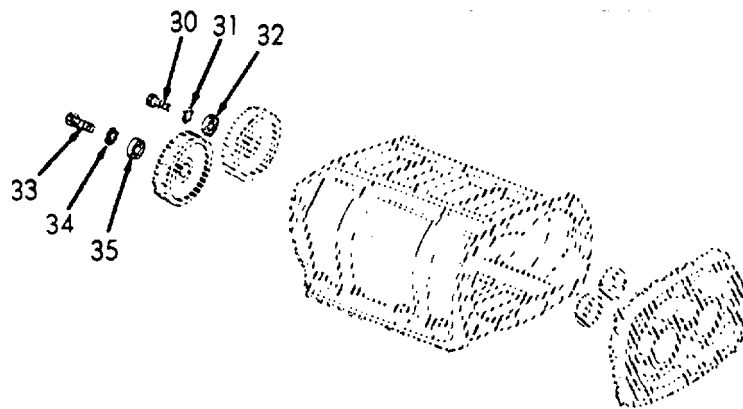
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

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|----|---|---|--|
| p. | Screw (30), lock-washer (31), and coupling disc (32) | <ol style="list-style-type: none"> 1. Lubricate the threads of the screw with engine oil. 2. Thread them into the rotor shafts. 3. Tighten the screw to 55-65 lb-ft (74.6 Nmr) torque. | |
| q. | Screw (33), lock-washer (34), and retaining washer (35) | <ol style="list-style-type: none"> 1. Lubricate the threads of the screw with engine oil. 2. Thread into the rotor shafts. 3. Tighten the screw to 55-65 lb-ft (74.6 Nm) torque. | |

NOTE

The blower timing gear retaining screws incorporate a special nylon insert and must be lubricated before installation into the rotor shafts.



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

- | | |
|-----------|---|
| 7. Blower | a. After the blower rotors and timing gears are installed, the blower rotors must be timed. |
|-----------|---|

NOTE

Before timing the blower, install four 5/16"-18x1-7/8"bolts with flat washers through four bolt holes in each end plate (top and bottom) and thread them into the blower housing. Tighten the bolts to 13-17 lb-ft (17.6-23.0 Nm) torque. This will hold the end plates against the blower housing so the proper clearance between the rotors and the end plate can be obtained.

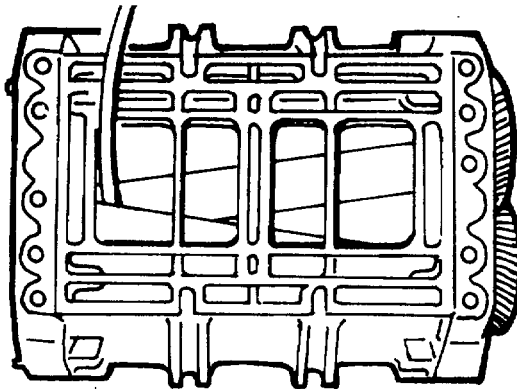
- b. The blower rotors, when properly positioned in the housing, run with a slight clearance between the lobes. This clearance may be varied by moving one of the helical gears in or out on the shaft relative to the other gear.
- c. If the right-hand helix gear is moved out, the right-hand helix rotor will turn counter-clockwise when viewed from the gear end. If the left-hand helix gear is moved out, the left-hand helix rotor will turn clockwise when viewed from the gear end. This positioning of the gear, to obtain the proper clearance between the rotor lobes, is known as blower timing.
- d. Moving the gears OUT or IN on the rotor shafts is accomplished by adding or removing shims between the gears and the bearings.

5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

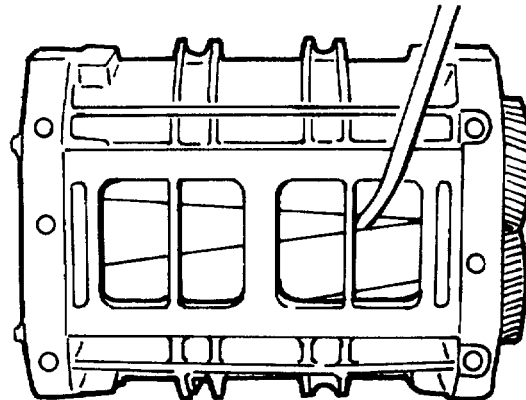
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

- e. The clearance between the rotor lobes may be checked with 1/2" wide feeler gages in the manner shown below. When measuring clearances of more the .005", laminated feeler gages that are made up of .002", .003" or .005" feeler stock are more practical and suitable than a single feeler gage. Clearances should be measured from both the inlet and outlet sides of the blower.



AIR OUTLET SIDE SHOWN



AIR INLET SIDE SHOWN

- f. TIME THE ROTORS AS FOLLOWS:

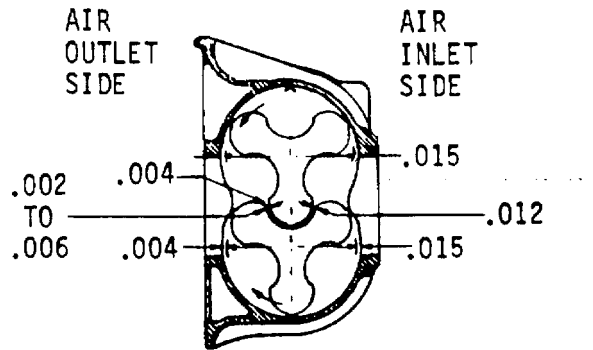
Time the rotors to have from .002" to .006" clearance between the TRAILING edge of the right-hand helix rotor and the LEADING edge of the left-hand helix rotor measured from both inlet and outlet sides as shown above.

5-71. .BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

If possible, keep this clearance to the minimum (.002"). Then, check the clearance between the LEADING edge of the right-hand helix rotor and the TRAILING edge of the left-hand helix rotor for the minimum clearance of (.012"). Rotor-to-rotor measurements should be taken 1" from each end, and at the center of the blower.



NOTE

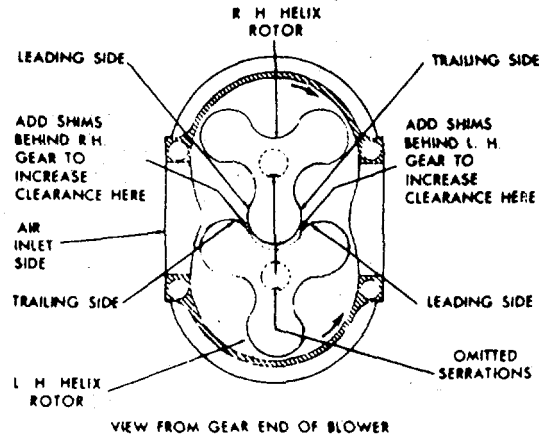
If the proper clearances cannot be obtained between the rotors, a mix of the former and current rotors, which have a different helix angle, may have occurred.

- g. After determining the amount one Rotor must be revolved to obtain the proper clearance, add shims back to the proper gear as shown below to produce the desired result. When more or less shims are required, both gears must be removed from the rotors. Placing a .003" shim in back of a rotor gear will revolve the rotor .001".

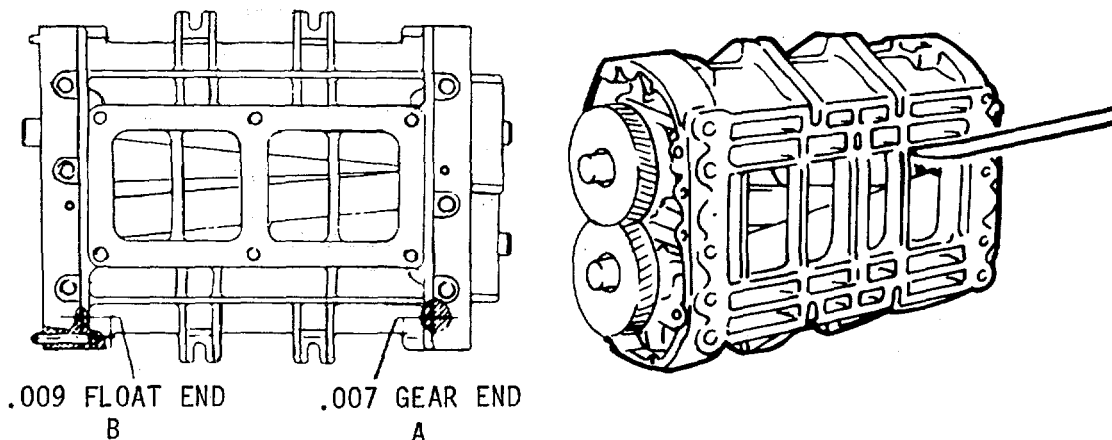
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)



- h. Install the required thickness of shims back of the proper gear and next to the bearing inner race and reinstall both gears. Recheck the clearances between the rotor lobes.
- i. Determine the minimum clearances at points "A" and "B". Insert the feeler gages between the end plates and the ends of the rotors. This operation must be performed at the ends of each lobe, making 12 measurements in all. See below for minimum clearances.



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

- j. Check the clearance between each rotor lobe and the blower housing at both the inlet and outlet side; 12 measurements in all.

OVERHAUL-ASSEMBLY

- | | | | |
|-------------------------|--|--|--|
| 8. Rear Blower Coupling | a. Support (58), spring pack (59), spring seat (60), and coupling cam (61) | <ol style="list-style-type: none"> 1. Place on two wooden blocks. 2. Apply a light coat of grease to the back of the spring seats. Place the half round spring seats in the grooves inside the support, and the flat spring seats inside the support at each end of the opening. 3. Lubricate the springs with light engine oil. Then, place spring packs, consisting of 21 leaves per pack, into the support with the spring seats in position as shown. 4. Place the blower drive cam over the end of the installer J1471 with the large chamfered inside diameter end of the cam facing up. | |
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5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

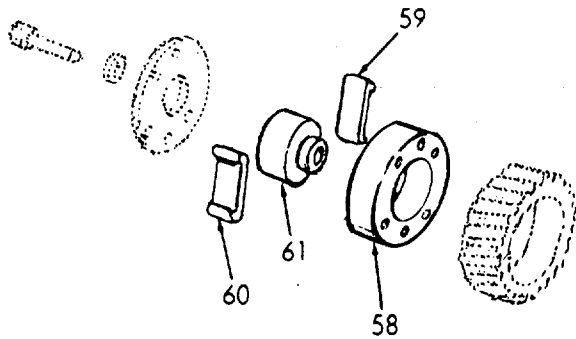
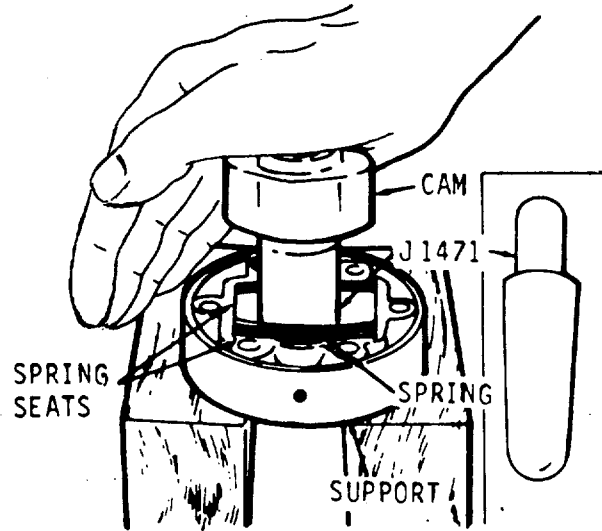
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)			
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Insert the tapered end of the installer between the spring packs until the drive cam is centered between the spring packs. Remove the installer from the drive cam.

b. Blower assembly

Place blower assembly on end on two wood blocks with rotor gears up.



5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

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|--|--|--|--|
| | c. Rear blower coupling (8), retainer (7), bolts (5) and washers (6) | <ol style="list-style-type: none"> Place blower coupling assembly and retainer on the right-hand helix gear, align the holes, and start the six bolts and lockwashers. Tap drive coupling cam with a plastic hammer to seat it on the rotor gear (22). | |
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| | d. Gear (22), and hub (23) | Assemble. | |
|--|----------------------------|-----------|--|

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| | e. Ball (21), thrust washer (20) X lock-washer (19), and hub nut (18) | Install. | |
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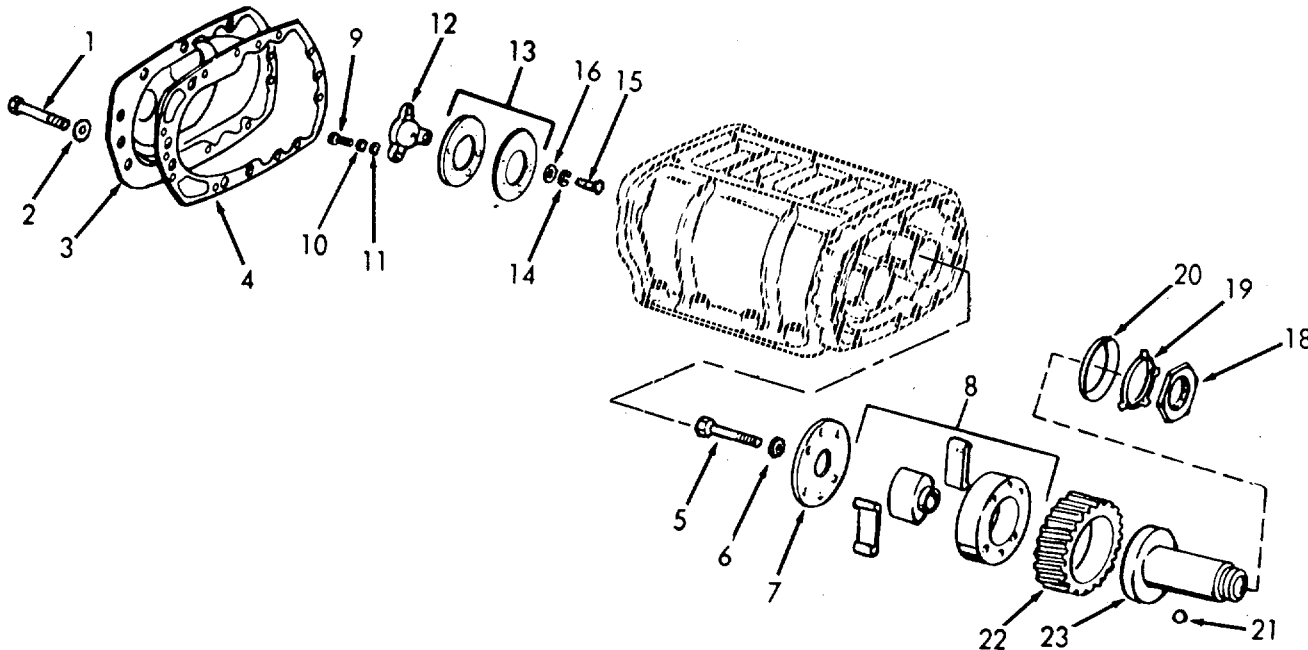
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|---------------|---|----------------------|--|
| 9. Blower Hub | a. Screws (14), lock-washers (15) and flat-washers (16) | Install in hub (13). | |
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5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

- | | | | |
|---------------|---|------------------------------------|--|
| | b. Screws (9), lock-washers (10), and flat-washers (11) | Install gear hub (12) to hub (13). | |
| 10. End Cover | a. Gasket (4), and end cover (3) | Install. | |
| | b. Bolts (1), and lock-washers (2) | Install. | |



5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

3-15 Fuel Injector Organizational Maintenance.

Special Tools

Injector body reamer
J21089
Injector service set
J23435
Lapping block J22090
Magnifying glass

Equipment
Condition Condition Description

NONE

Material/Parts

Service kit 5228701
Parts kit 5228769
Methylethylketone (MEK)

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions



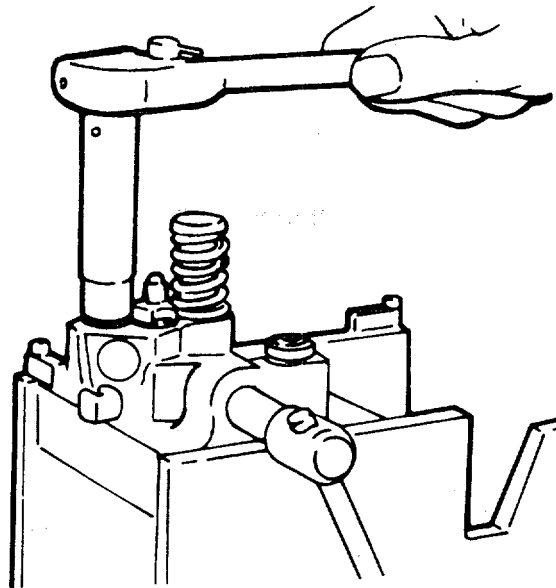
Wear protective eye goggles when using compressed air.

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY

- | | | |
|---|---|------------------------------------|
| <p>1. Injector</p> <p>a. Filter cap (1), gasket (2), and filter element (3)</p> | <p>1. Place in holding fixture.</p> <p>2. Remove cap.</p> | <p>Discard gasket and element.</p> |
|---|---|------------------------------------|

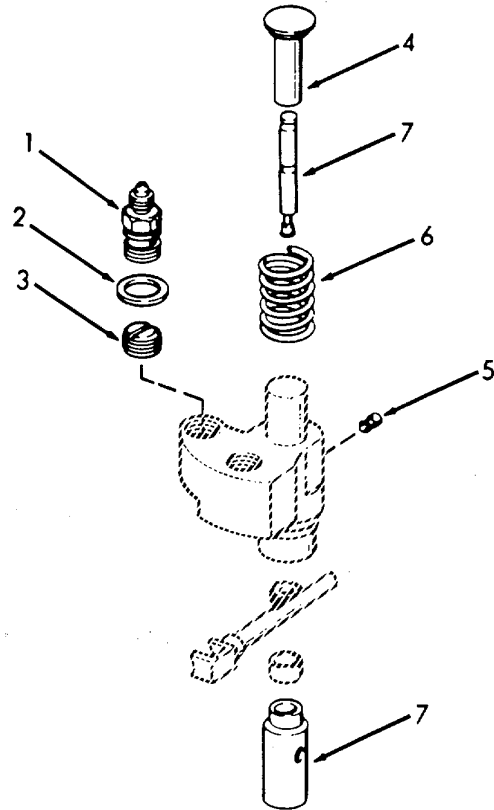
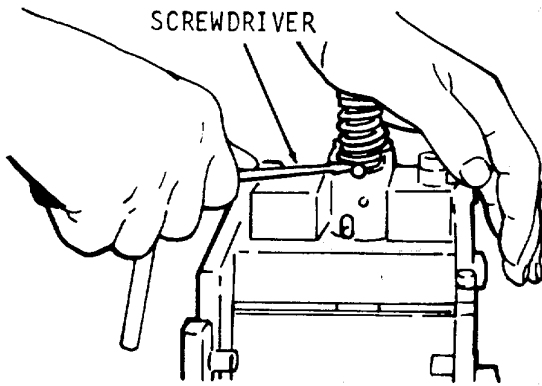


- | | |
|---|---|
| <p>b. Injector follower (4), and stop pin (5)</p> | <p>1. Compress the follower spring (6) .</p> <p>2. Raise the spring above the stop pin (5) with a screwdriver and withdraw the pin. Allow the spring to rise gradually.</p> |
|---|---|

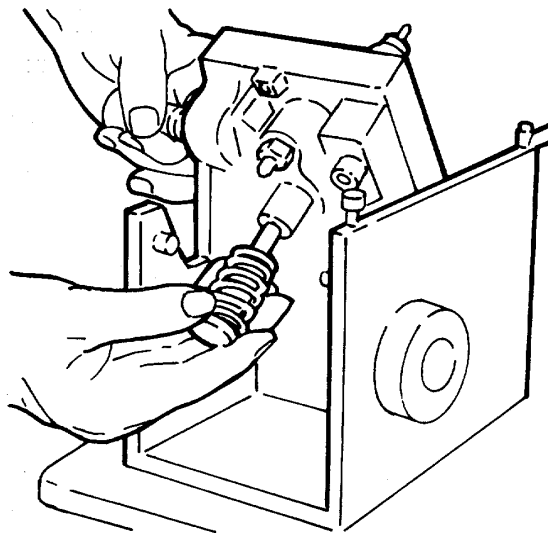
5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)



- c. Injector Remove follower (4), plunger (7) and spring (6)

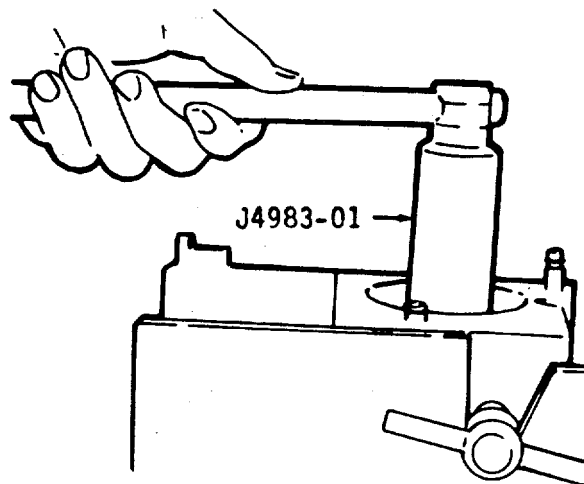


5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

- | | | |
|---------------------------|---|--------------------|
| d. Injector valve Nut (8) | <ol style="list-style-type: none"> 1. Loosen. 2. Lift injector nut straight up. Be careful not to dislodge the spray tip and valve parts. | Use tool J4983-01. |
|---------------------------|---|--------------------|



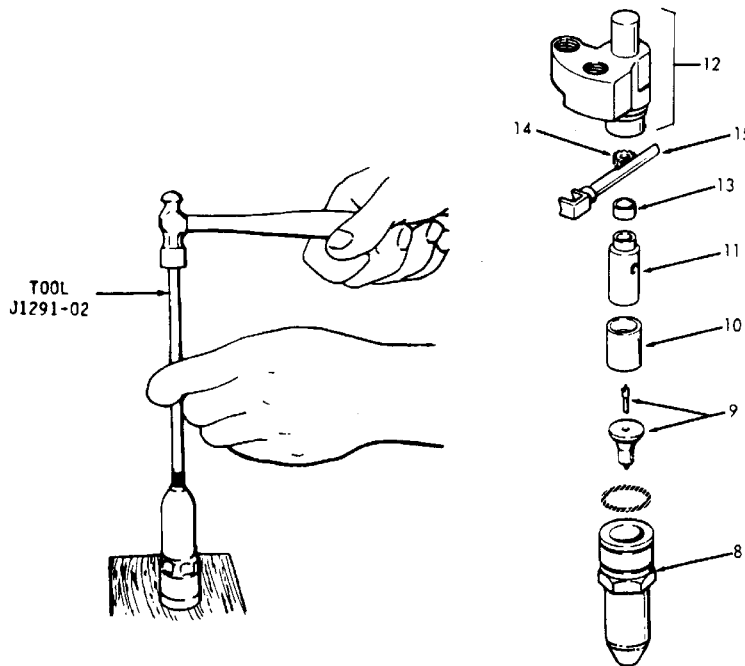
- | | | |
|----------------------------------|---|--------------------|
| e. Spray tip (9) and valve parts | <ol style="list-style-type: none"> 1. Remove the spray tip and valve parts from the bushing and place them in a clean receptacle until ready for assembly. 2. When an injector has been in use for some time, the spray tip, even though clean on the outside, may not be pushed readily from the nut with the fingers. In this event, support the nut on a wood block and drive the tip down thru the nut. | Use tool J1291-02. |
|----------------------------------|---|--------------------|

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

- | | | | |
|----|--|--|--|
| f. | Spill deflector (10), and bushing (11) | 1. Remove spill detector.
2. Lift bushing straight out of injector body (12). | |
| g. | Injector body (12) | 1. Remove from holding fixture, turn over and catch gear retainer (13), and gear (14) in your hand as they fall out of the body. | |
| h. | Injector control rack (15) | Remove from body. | |



5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - CLEANING

- | | | | |
|-------------|---|--|--|
| 2. Injector | a. Since most injector difficulties are the result of dirt particles, it is essential that a clean area be provided on which to place the injector parts after cleaning and inspection. | | |
|-------------|---|--|--|

WARNING

Wear protective eye goggles when using compressed air.

- | | | | |
|--|--|--|--|
| | b. Wash all of the parts with clean fuel oil or a suitable cleaning solvent and dry them with clean, filtered compressed air. Do not use waste or rags for cleaning purposes. Clean out all of the passages, drilled holes and slots in all of the injector parts. | | |
| | c. Carbon on the inside of the spray tip may be loosened for easy removal by soaking for approximately 15 minutes in a suitable solution prior to the external cleaning and buffing operation. Methyl Ethyl Ketone solution is recommended for this purpose. | | |

WARNING

Care must be exercised when inserting the carbon remover J9464-01 in the spray tip to avoid contacting the needle valve seat in the tip.

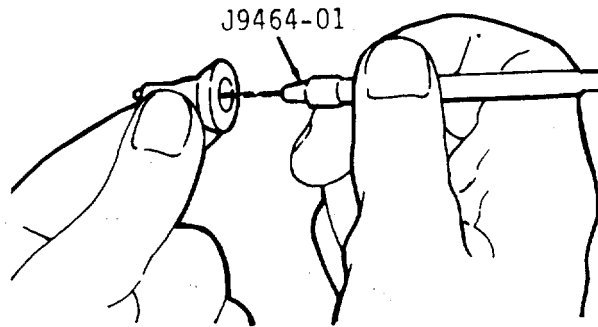
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|--|-------------------------|--|--|
| | d. Clean the spray tip. | | |
|--|-------------------------|--|--|

Use tool
J9464-01.

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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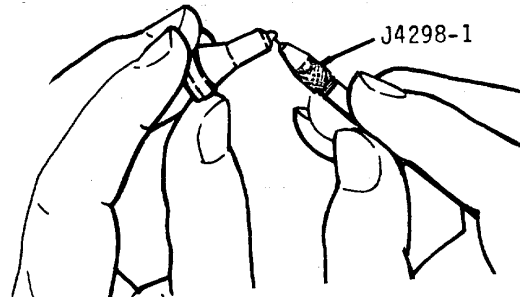
OVERHAUL - CLEANING (Cont)			
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WARNING

Use eye protection when using compressed air.

- e. Wash the tip in fuel oil and dry it with compressed air. Clean spray tip orifices with pin vise J4298-1 and the proper size spray tip cleaning wire. Use wire J21460 to clean .0055" diameter holes and wire J21461 to clean .006" diameter holes.
- f. Before using the wire, hone the end until it is smooth and free of burrs and taper the end a distance of 1/16" with stone J8170. Allow the wire to extend 1/8" from tool J4298-1.



5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-CLEANING (Cont)

CAUTION

Do not buff excessively. Do not use a steel wire buffing wheel or the spray tip holes may be distorted.

- g. The exterior surface of an injector spray tip may be cleaned by using a brass wire buffing wheel. To obtain a good polishing effect and longer brush life, the buffing wheel should be installed on a motor that turns the wheel at approximately 3000 rpm. A convenient method of holding the spray tip while cleaning and polishing is to place the tip over the drill end of the spray tip cleaner tool J1243 and hold the body of the tip against the buffing wheel. In this way, the spray tip is rotated while being buffed.
- h. When the body of the spray tip is clean, lightly buff the tip end in the same manner. This cleans the spray tip orifice area and will not plug the orifices.

WARNING

Use protective eye goggles when using compressed air.

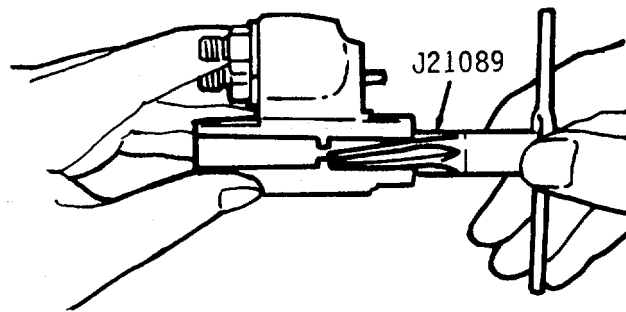
- i. Wash the spray tip in clean fuel oil and dry it with compressed air.
- j. Clean and brush all of the passages in the injector body, using fuel hole cleaning brush J8152 and rack hole cleaning brush J8150. Blow out the passages and dry them with compressed air.

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

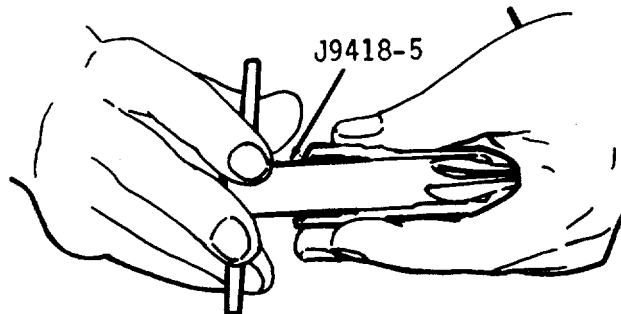
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - CLEANING (Cont)			
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- k. Carefully insert reamer J21089 in the injector body. Turn it in a clockwise direction a few times. Then, remove the reamer and check the entire-face of the ring for reamer contact. If necessary, repeat the procedure until the reamer makes contact with the entire face of the ring. Clean up the opposite side of the ring in the same manner.



- l. Carefully insert a .375" diameter fluted reamer straight inside the ring bore in the injector body. Turn the reamer in a clockwise direction and remove any burrs inside the ring bore. Then wash the injector body in clean fuel oil and dry with compressed air.
- m. Carefully insert carbon remover tool J9418-5 in the injector nut.



5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-CLEANING (Cont)			
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Turn it in a clockwise direction to remove the carbon deposits on the flat spray tip seat as shown above. Remove the carbon deposits from the lower end of the injector nut with carbon remover J9418-5, in the same manner. Use care not to remove any metal or to set up burrs on the spray tip seat.

- n. Wash the injector nut in clean fuel oil and dry it with compressed air. Carbon deposits on the spray tip-seating surfaces of the injector nut will result in poor sealing and consequent fuel leakage around the spray tip.
- o. When handling the injector plunger, do not touch the finished plunger surfaces with your fingers. Wash the plunger and bushing with clean fuel oil and dry them with compressed air. Be sure the high pressure bleed hole is not plugged. If this hole is plugged, fuel leakage will occur at the upper end of the bushing where it will drain out of the injector body vent and rack holes, during engine operation, causing a serious oil dilution problem. Keep the plunger and bushing together as they are mated parts .
- p. After washing, submerge the parts in a clean receptacle containing clean fuel oil. Keep the parts of each injector assembly together.

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-INSPECTION

- | | | | |
|-------------|--|--|--|
| 3. Injector | <ul style="list-style-type: none"> a. Inspect the teeth on the control rack gear for excessive wear or damage. Also check for excessive wear in the bore of the gear and inspect the gear retainer. Replace damaged or worn parts. b. Inspect the injector follower and pin for wear. c. Inspect both ends of the spill deflector for sharp edges or burrs which could create burrs on the injector body or injector nut and cause particles of metal to be introduced into the spray tip and valve parts. Remove burrs with a 500 grit stone. d. Inspect the follower spring for visual defects. Then check the spring with spring tester and an accurate torque wrench. e. The injector follower spring (.142" diameter wire) has a free length of approximately 1.504" and should be replaced when a load, of less than 70 lbs. will compress it to 1.028". f. It is recommended that at the time of overhaul, all injectors in an engine be converted to spring (.142" diameter wire) which will provide improved cam roller to shaft follow. However, in the event that one or two injectors are changed, the remaining injectors need not be reworked to incorporate the current spring. | | |
|-------------|--|--|--|

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - INSPECTION (Cont)

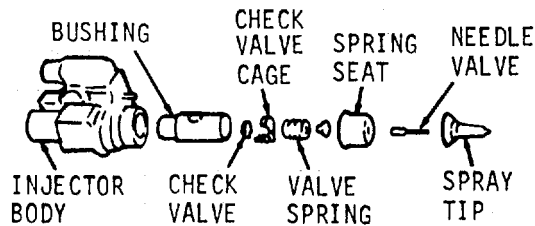
- g. Check the seal ring area on the injector body for burrs or scratches. Also check the surface which contacts the injector bushing for scratches, scuff marks or other damage. If necessary, lap this surface. A faulty sealing surface at this point will result in high fuel consumption and contamination of the lubricating oil. Replace any loose injector body plugs or a loose dowel pin. Install the proper number tag on a service replacement injector body.
- h. Inspect the injector plunger and bushing for scoring, erosion, chipping or wear. Check for sharp edges on that portion of the plunger which rides in the gear. Remove any sharp edges with a 500 grit stone. Wash the plunger after stoning it. Injector Bushing Inspectalite can be used to check the port holes in the inner diameter of the bushing for cracks or chipping. Slip the plunger into the bushing and check for free movement. Replace the plunger and bushing as an assembly if any of the above damage is noted, since they are mated parts. Use new mated factory parts to assure the best performance from the injector.
- i. Injector plungers cannot be reworked to change the output. Grinding will destroy the hardened case at the helix and result in chipping and seizure or scoring of the plunger.

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

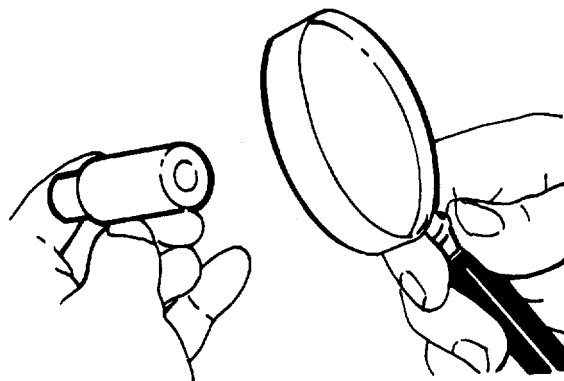
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-INSPECTION (Cont)

- j. Examine the spray tip seating surface of the injector nut and spray tip for nicks, burrs, erosion or brinelling. Reseat the surface or replace the nut or tip if it is severely damaged.
- k. The injector valve spring plays an important part in establishing the valve opening pressure of the injector assembly. Replace the worn or broken spring. Inspect the sealing surfaces of the injector parts indicated by arrows below.



- l. Examine the sealing surfaces with a magnifying glass as shown below for even the slightest imperfections will prevent the injector from operating properly. Check for burrs, nicks, erosion, cracks, chipping and excessive wear.



5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-INSPECTION (Cont)

Check for enlarged orifices in the spray tip. Replace damaged or excessively worn parts. Check the minimum thickness of the lapped parts as noted in the chart.

- m. Examine the seating area of the needle valve for wear or damage. Also examine the needle quill and its contact point with the valve spring seat. Replace damaged or excessively worn parts.
- n. Examine the needle valve seat area in the spray tip for foreign material. The smallest particle of such material can prevent the needle valve from seating properly. Polish the seat area with polishing stick. Coat only the tapered end of the stick with polishing compound and insert it directly into the center of the spray tip until it bottoms. Rotate the stick 6 to 12 times, applying a light pressure with the thumb and forefinger.

CAUTION

Be sure no compound is accidentally placed on the lapped surfaces located higher up in the spray tip. The slightest lapping action on these surfaces can alter the near-perfect fit between needle valve and tip.

- o. Before reinstalling used injector parts, lap all sealing surfaces indicated by the arrows in step k. It is also good practice to lightly lap the sealing surfaces of new injector parts which may become burred or nicked during handling.

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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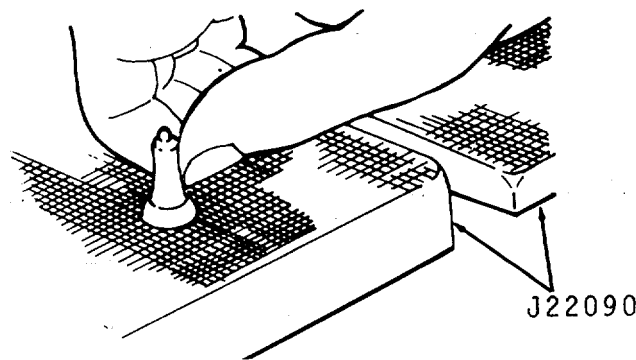
OVERHAUL - LAPPING

- | | | | |
|-------------|--|--|--|
| 4. Injector | Lap the sealing surfaces indicated in the figure in step 3 k and the chart as follows: | | |
|-------------|--|--|--|

WARNING

Use eye protection when using compressed air.

- a. Clean the lapping blocks J22090 with compressed air. Do not use a cloth or any other material for this purpose.
- b. Spread a good quality 600 grit dry lapping powder on one of the lapping blocks .
- c. Place the part to be lapped flat on the block as shown below and, using a figure eight motion, move it back and forth across the block. Do not press on the part, but use just enough pressure to keep the part flat on the block. It is important that the part be kept flat on the block at all times.



5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-LAPPING (Cont)

- d. After each four or five passes, clean the lapping powder from the part by drawing it across a clean piece of tissue placed on a flat surface and inspect the part. Do not lap excessively. Refer to the chart below.

PART NAME	MINIMUM THICKNESS
Tip, Spray (shoulder)	.199
Cage, Check Valve	.165 -.163
Valve, Check	.022
Cage, Valve Spring	.602

- e. When the part is flat, wash it in cleaning solvent and dry it with compressed air.
- f. Place the dry part on the second block. After applying lapping powder, move part lightly across the block in a figure eight motion several times to give it a smooth finish. Do not lap excessively. Again wash the part in cleaning solvent and dry with compressed air.
- g. Place the dry part on the third block. Do not use lapping powder on this block. Keep the part flat and move it across the block several times, using the figure eight motion. Lapping the dry part in this manner gives it the "mirror" finish required for perfect sealing.
- h. Wash all of the lapped parts in clean fuel oil and dry them with compressed air.

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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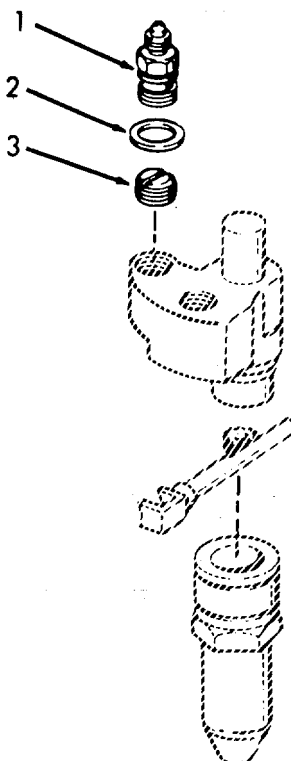
OVERHAUL - ASSEMBLY

5. Injector Filters

NOTE

Use an extremely clean bench to work on and to place the parts when assembling an injector. Be sure all injector parts, both new and used, are clean.

- | | | |
|--|--|-------------------|
| a. Filters
(3) | Insert filter, dimple end down, slotted end up, in each of the fuel cavities in the top of the injector body. | Use a new filter. |
| b. Gaskets
(2),
and
filter
caps
(1) | <ol style="list-style-type: none"> 1. Install gasket on each filter cap. 2. Lubricate cap threads and install. | Use new gaskets. |



5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

3. Tighten caps to 65-75 Use 9/16 inch lb-ft (88.1-101.7 Nm) deep socket. torque.

WARNING

Wear protective eye goggles when using compressed air.

- | | |
|------------|---|
| c. Filters | <ol style="list-style-type: none"> 1. Purge filters after installation by blowing compressed air or fuel thru the filter caps . 2. Install clean shipping caps on the filter caps to prevent dirt from entering the injector. |
|------------|---|

6. Rack and Gear

NOTE

Note the drill spot marks on control rack and gear.

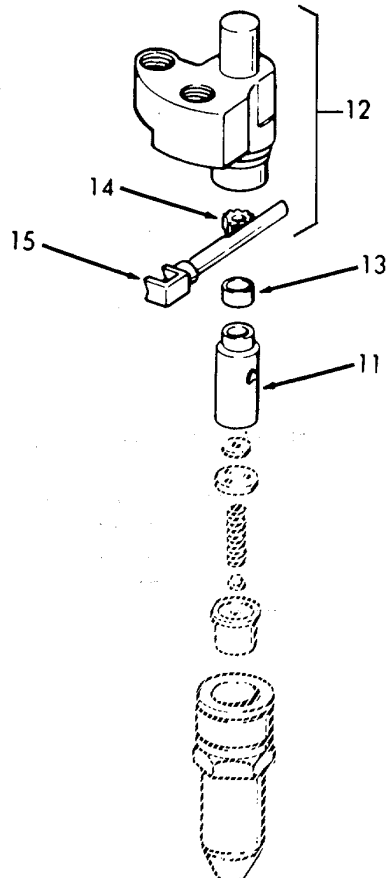
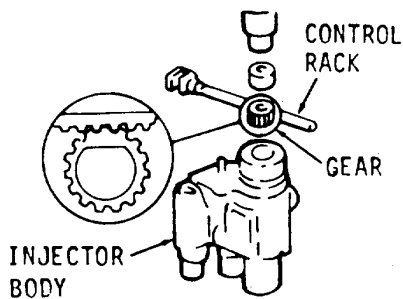
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|-------------------------------------|--|
| a. Injector body (12) and rack (15) | <p>Hold the injector body, bottom end up and slide the rack through the hole in the body. Look into the body bore and move the rack until you can see the drill marks. Hold the rack in this position.</p> |
|-------------------------------------|--|

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ASSEMBLY (Cont)

- | | | |
|----|-----------------------|--|
| b. | Gear
(14) | Place the gear in the injector body so that the marked tooth is engaged between the two marked teeth on the rack. |
| c. | Gear retainer
(13) | Place on top of gear. |
| d. | Bushing
(11) | Align the locating pin in the bushing with the slot in the injector body. Then slide the end of the bushing into place . |



5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			
7. Spray Tip, Spring Cage, and Check Valve	a. Injector body (12)	Support bottom end up in holding fixture.	
	b. Seal ring (16)	Place on shoulder of body.	
	c. Spill deflector (10)	Place over barrel of body.	
	d. Check valve (17), and valve cage (18)	1. Place the check valve (without the .010" hole) centrally onto the top of the bushing.	
		2. Place the check valve cage over the check valve and against the bushing .	
e. Spring seat (19), spring (20), and spring cage (21)	1. Insert the spring seat in the valve spring and insert the assembly in the spring cage with the spring seat first.		

CAUTION

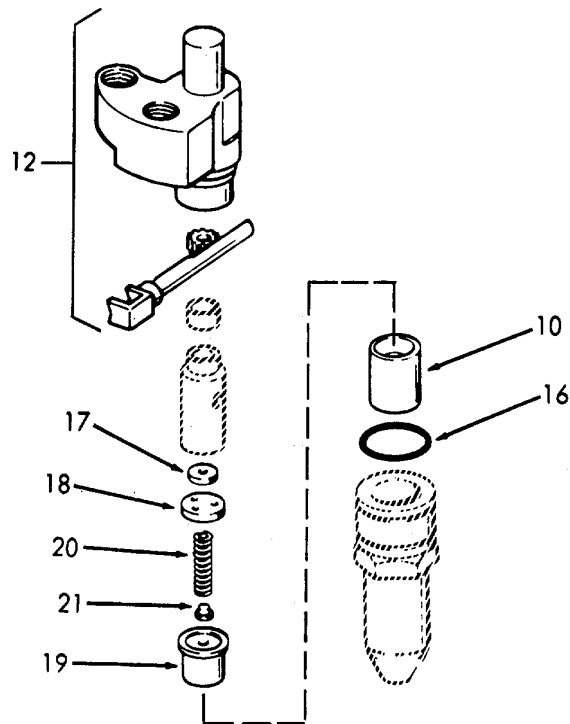
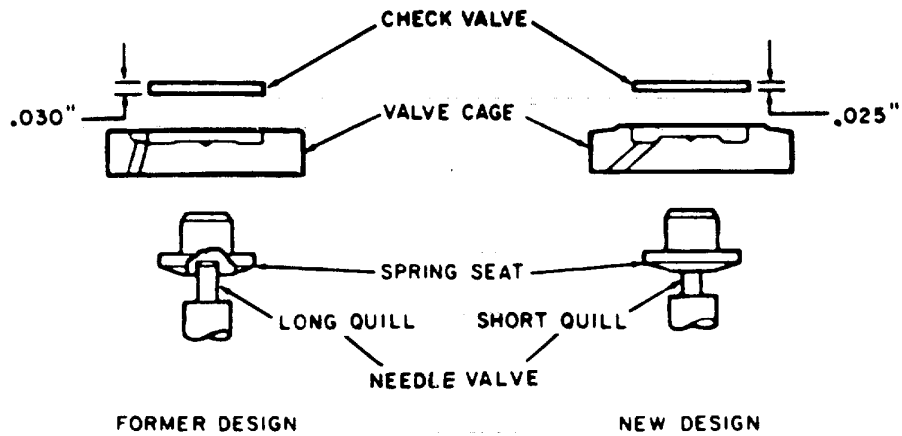
Install a new spring seat in a former injector if a new design spray tip assembly is used.

2. Place the spring cage, spring seat and valve spring assembly (valve spring down) on top of the check valve cage.

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - ASSEMBLY (Cont)



5-1035

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - ASSEMBLY (Cont)

CAUTION

When installing a new spray tip assembly in a former injector, a new valve spring seat must be installed. The current needle valve has a shorter quill.

- | | |
|---------------------|--|
| f. Needle valve (9) | <ol style="list-style-type: none"> 1. Insert needle valve, tapered end down, inside the spray tip. 2. Then, place the spray tip and needle valve on top of the spring cage with the quill end of the needle valve in the hole in the spring cage. |
| g. Injector nut (8) | <ol style="list-style-type: none"> 1. Lubricate the threads in the injector nut. Carefully thread the nut on the injector body by hand. Rotate the spray tip between your thumb and first finger while threading the nut on the injector body. Tighten the nut as tight as possible by hand. At this point there should be sufficient force on the spray tip to make it impossible to turn with your fingers. 2. Use socket J4983-01 and a torque wrench to tighten the injector nut to 75-85 lb-ft (101.7-115.2 Nm) torque. |

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

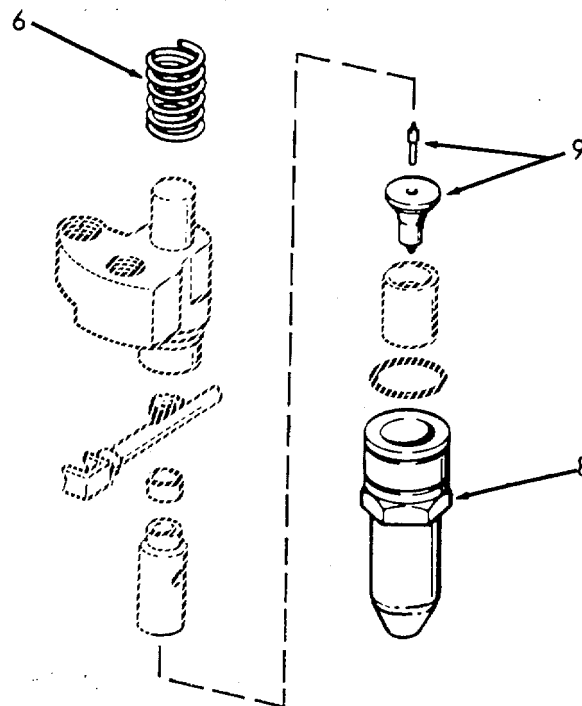
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - ASSEMBLY (Cont)			
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NOTE

Do not exceed the specified torque, as the nut may be stretched and result in improper sealing of the lapped surfaces in a subsequent injector overhaul.

8. Plunger and Follower	a. Injector and spring (6)	Invert injector in assembly fixture (filter cap end up), and push rack all the way in. Place follower spring on the injector body.	
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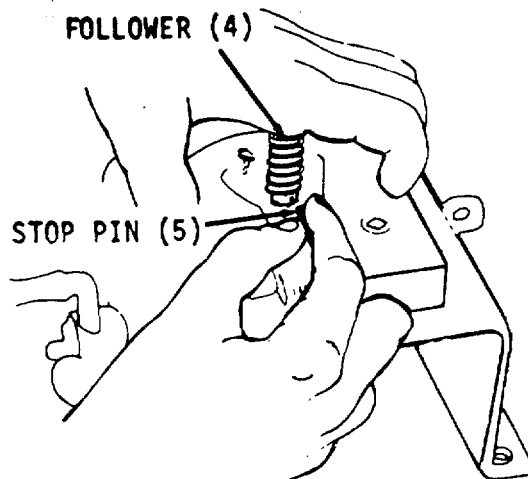


5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - ASSEMBLY (Cont)

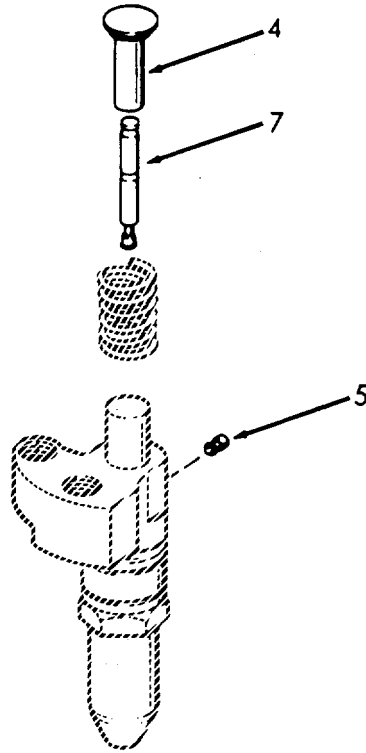
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|----|--------------------------------|---|--|
| b. | Stop pin (5), and follower (4) | <ol style="list-style-type: none"> 1. Place stop pin on injector body so that the follower spring rests on the narrow flange of the stop pin. 2. Align slot in follower with the stop pin hole in the injector body. 3. Align the flat side of the plunger (7) with the slot in follower. 4. Insert the free end of the plunger in the injector body. 5. Press down on the follower and at the same time press the stop pin in position. When in place, the spring will hold the stop pin in position. | |
|----|--------------------------------|---|--|



5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - ASSEMBLY (Cont)



OVERHAUL - TESTING

- | | |
|-------------|--|
| 9. Injector | Before placing an overhauled injector in service, perform those tests that can be performed at the Direct Support Maintenance Level. |
|-------------|--|

5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Disassembly

b. Inspection

c. Reassembly

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

3-150 Fresh Water Pump

Special Tools

Arbor press
Coupling and oil
seal remover J1930
Torque wrench

Equipment
Condition

Condition Description

NONE

Material/Parts

Cleaning fluid
Reconditioning kit
P/N 5198307 or
Replacement kit
P/N 5193605

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

DISASSEMBLY

- | | | | |
|----|------------------|-----------------------------------|---------|
| 1. | Fresh Water Pump | a. Nuts (1), and lock-washers (2) | Remove. |
|----|------------------|-----------------------------------|---------|

5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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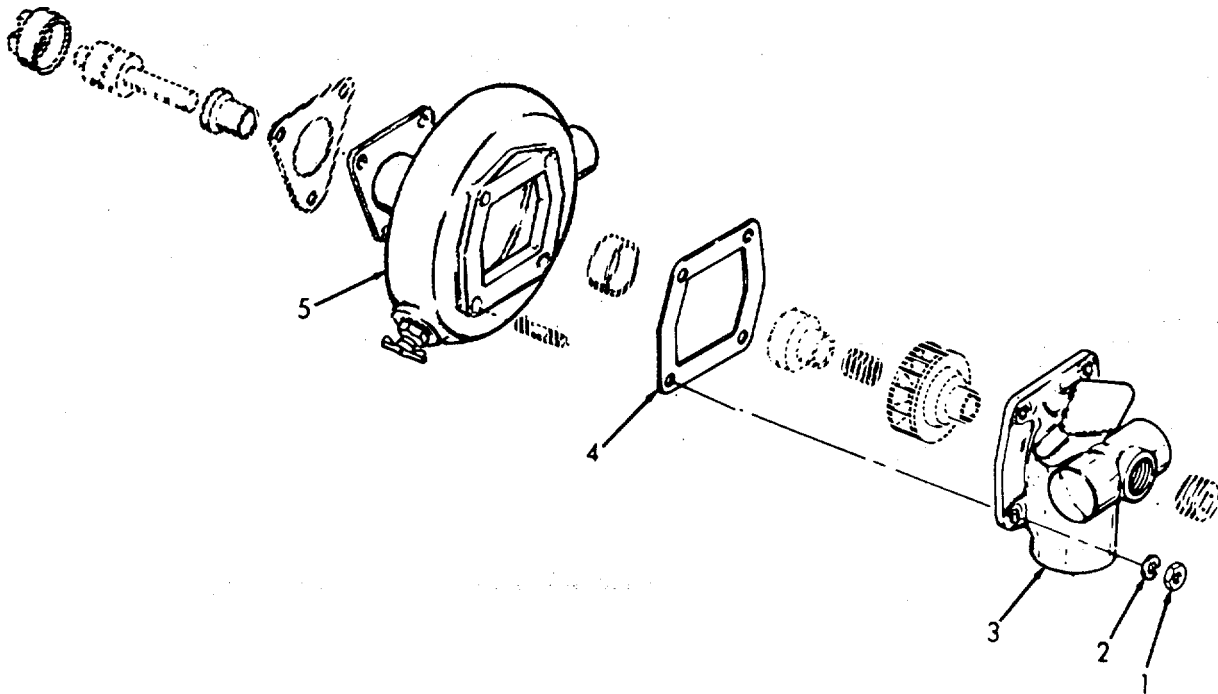
DISASSEMBLY (Cont)

- | | | | |
|----|--------------------------------|---------|-----------------|
| b. | Pump cover (3), and gasket (4) | Remove. | Discard gasket. |
|----|--------------------------------|---------|-----------------|

NOTE

Clean the corrosion from around the impeller and shaft before separating the shaft and bearing assembly from the impeller, seal and water pump body.

- | | | | |
|----|---------------|--|--|
| c. | Pump body (5) | <ol style="list-style-type: none"> 1. Support on mounting flange in an arbor press. 2. Place a short steel rod on the shaft. | |
|----|---------------|--|--|



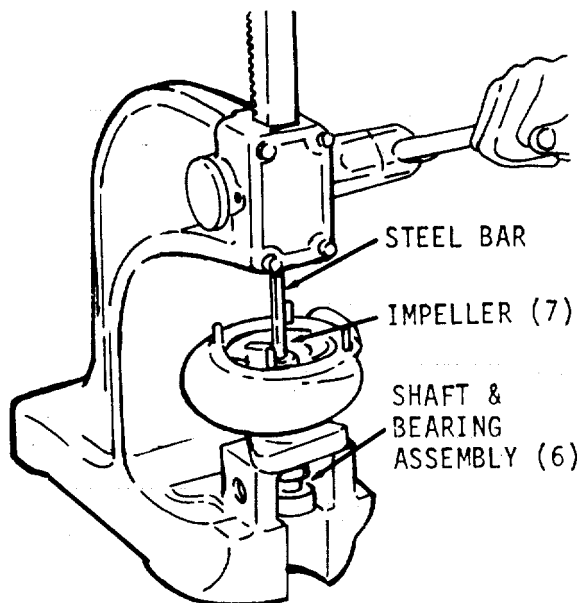
5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

3. Press out shaft and bearing assembly (6) from impeller (7), and seal assembly (8).

Discard shaft and bearing assembly.



- d. Impeller (7), and seal assembly (8)

Remove from pump body.

- a. Discard impeller if reconditioning pump.

- e. Steel insert (9)

1. Inspect for scratches or excessive wear.
2. Tap or press it out.

- b. Discard seal assembly. Discard if necessary.

NOTE

Perform the following step only if reconditioning the pump.

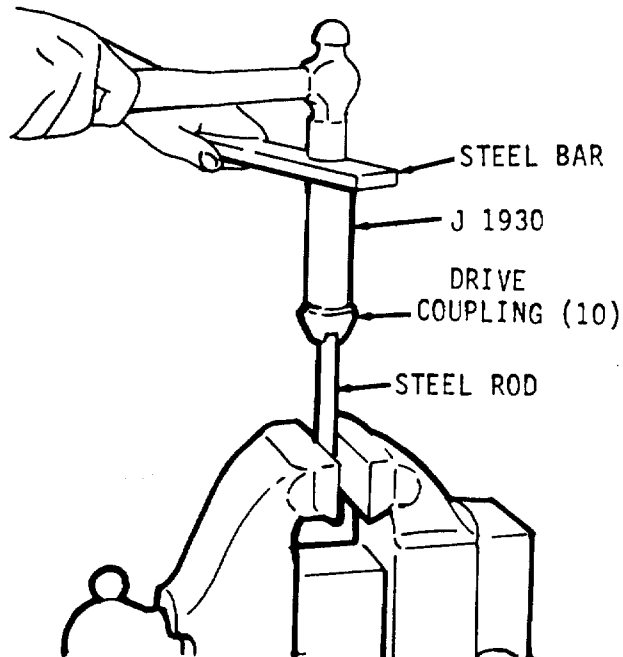
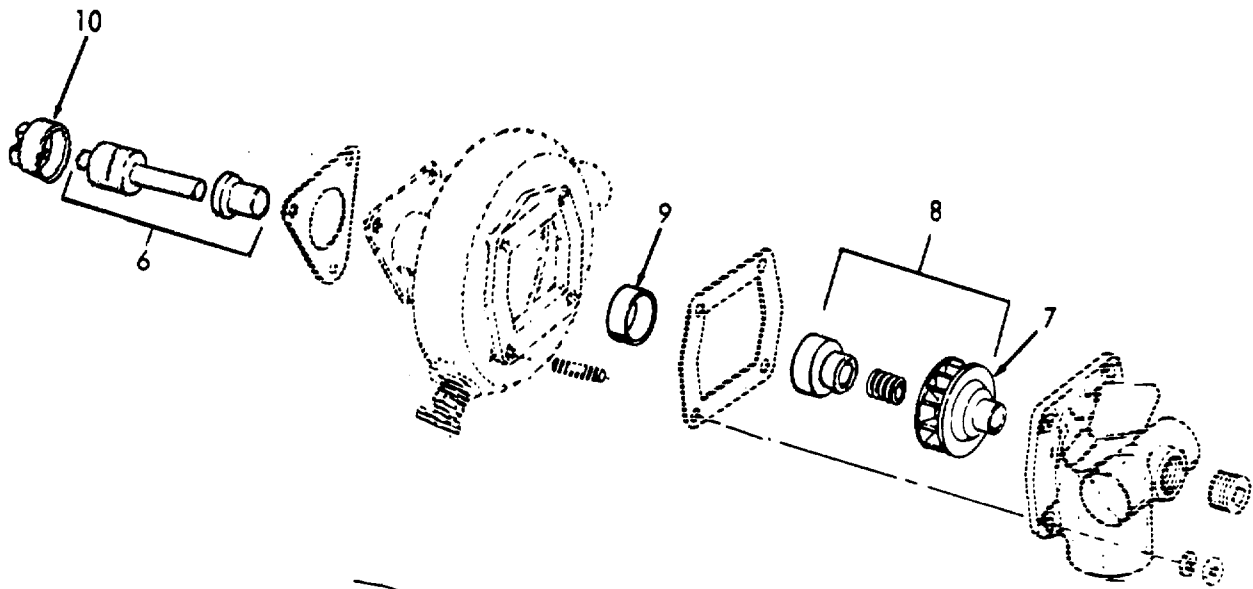
5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)

f. Pump drive coupling (thrower) (10)

1. Place steel rod in a vise.
2. Place drive coupling

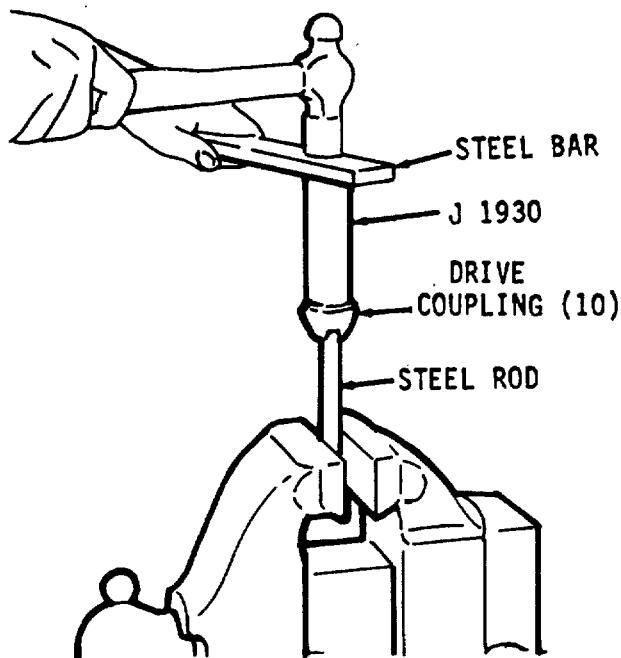


5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)

3. Using tool J1930 and a steel bar, remove coupling (10).

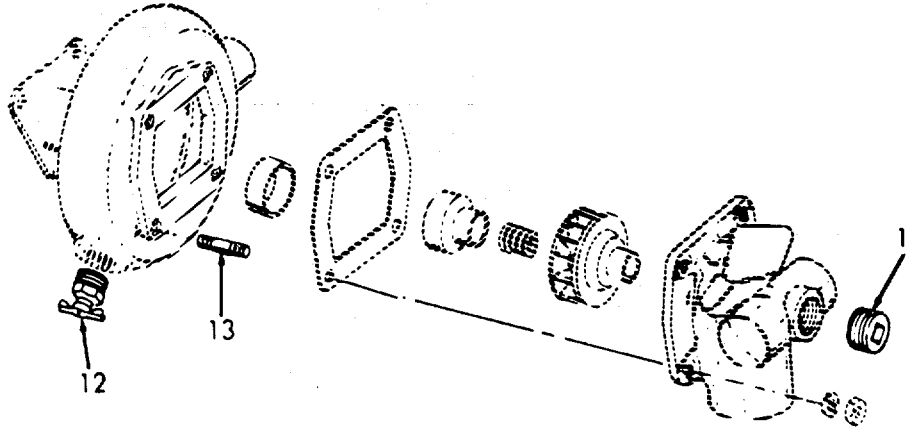


- | | | |
|-------------------|--|---------------|
| g. Pipe plug (11) | Remove. | If necessary. |
| h. Draincock (12) | Remove. | If necessary. |
| i. Studs (13) | <ol style="list-style-type: none"> 1. Remove. 2. Examine the studs in the pump body. If it is necessary to replace a stud, use a good grade of sealant on the threads and drive the stud in to 6-8 lb-ft (8.1-10.8 Nm) torque. | |

5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)



INSPECTION

2.
 - a. Clean all of the parts except the shaft and bearing assembly. The sealed-type pump shaft bearing must not be immersed in a cleaning fluid since dirt may be washed in and the fluid cannot be entirely removed.
 - b. Revolve the pump shaft bearing slowly by hand. If rough spots are detected, replace the shaft and bearing assembly and the seal assembly. A seal replacement kit includes a shaft, bearing assembly, cover, mounting gaskets, packing and seal assembly.
 - c. Examine the impeller for wear, and replace it if necessary.

5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY

- | | | | |
|----|---------------------|--|--|
| 3. | a. Steel insert (9) | <p>If a new steel insert is to be used in the pump body, make sure the counterbore in the pump body is thoroughly clean before installing a new insert. Dirt in the counterbore can cause misalignment between the insert and the carbon washer and result in a leak at this point. Start the counterbored end of the insert into the pump body. Press the insert in until it contacts the shoulder in the pump body. The insert has a .0015 inch-.0035 inch press fit in the pump body.</p> | |
|----|---------------------|--|--|

CAUTION

Do not mar the highly finished seal contact surface of the insert when pressing it into the pump body.

- | | | | |
|--|---------------------------------|--|--|
| | b. Slinger (14), and shaft (15) | <p>Install slinger on the pump shaft with the flange of the slinger approximately 3/16 inch from the end of outer race of the bearing.</p> | |
| | c. Pump body (5) | <p>1. Support the impeller end of the pump body on an arbor press, and insert the coupling end of the new shaft and bearing assembly (6) into the pump body.</p> | |

5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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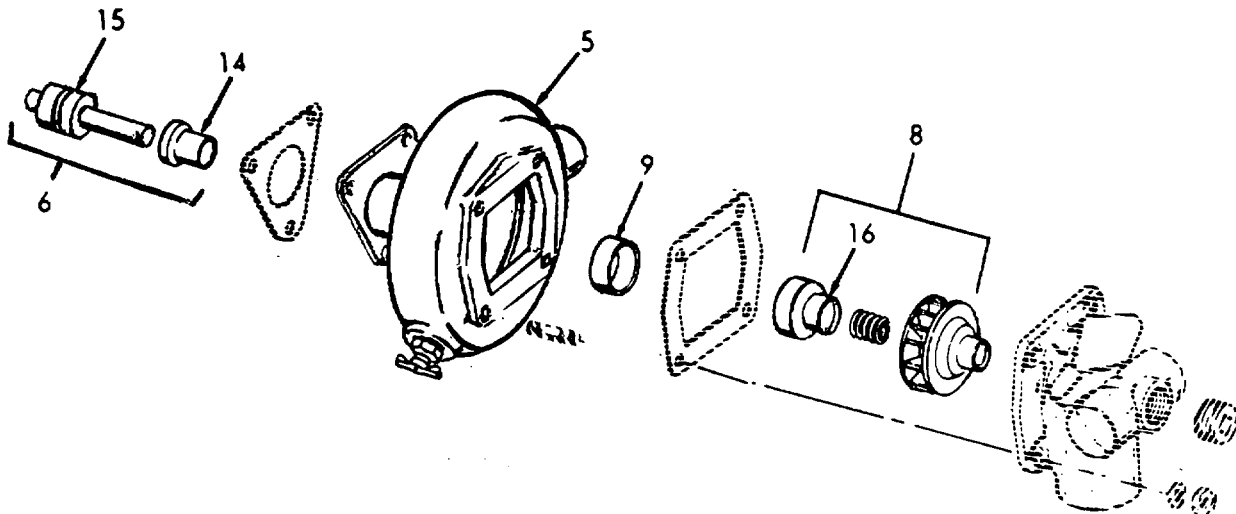
REASSEMBLY (Cont)

2. Press against the outer race of the bearing until the bearing contacts the shoulder in the pump body.
3. Stake the end of the pump body in three places to prevent the bearing from moving endwise.

d. Seal assembly (8)

1. With the surface of the water pump seal clean and free from dirt and metallic particles, apply a thin coat of liquid soap on the inside diameter of the rubber carbon washer seal (16).

Do not scratch or mar the surface of the carbon seal washer.



5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

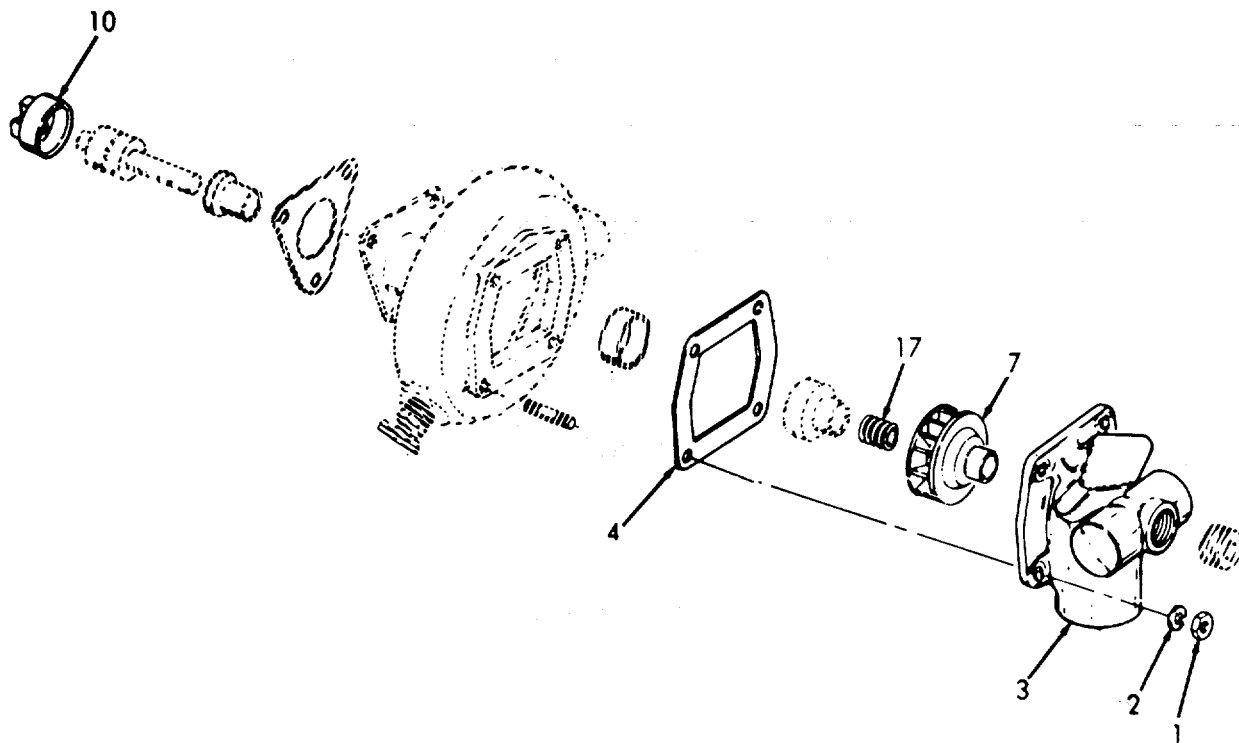
- | | |
|--|--|
| e. Impeller
(7) | <ol style="list-style-type: none"> 2. Slide the new seal assembly on the pump shaft until the carbon seal washer is seated firmly against the pump body insert. 3. Install the spring (17) with the small end toward the seal. 1. Support the bearing end of the shaft (not the drive coupling) on the bed of an arbor press . 2. Press the impeller onto the shaft. The end of the shaft must be flush with the face of the impeller hub with the bearing being held against the shoulder in the water pump body. |
| f. Drive coupling
(thrower)
(10) | <p>Support the impeller end of the pump shaft on a suitable arbor and press the coupling onto the shaft. The drive coupling must be flush with the end of the shaft. Make sure the drive coupling is tight on the shaft.</p> |

5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|--------------------------------|--|-------------------|
| g. | Pump assembly | Rotate shaft by hand to be sure the rear face of the impeller blades do not rub the pump body. | |
| h. | Cover (3), and gasket (4) | Install. | Use a new gasket. |
| i. | Nuts (1), and lock-washers (2) | Install. | |



5-74. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS.

This task covers:

Welding

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
1

General Safety Instructions
Observe precautions when welding.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WELDING

The only maintenance at this level is welding.
Weld in accordance with existing procedures.

5-75. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS.

This task covers:

Welding

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe precautions when welding.

LOCATION

ITEM

ACTION

REMARKS

WELDING

The only maintenance at this level is welding.
Weld in accordance with existing procedures.

5-76. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS.

This task covers:

Welding

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe precautions when welding.

LOCATION

ITEM

ACTION

REMARKS

WELDING

The only maintenance at this level is welding.
Weld in accordance with existing procedures.

5-77. FLYWHEEL AND HOUSING - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Removal

b. Installation

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

Drift
Hammer
Acetylene torch

Equipment

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

Observe precautions when using acetylene torch.

LOCATION

ITEM

ACTION

REMARKS

REMOVAL

1. Flywheel
Ring
Gear
 - Check whether or not the ring gear teeth are chamfered. The replacement gear must be installed so that the chamfer on the teeth faces the same direction with relationship to the flywheel as on the gear that is to be removed. Then remove the ring gear as follows:
 - a. Support the flywheel, crankshaft side down, on a solid flat surface or hardwood block which is slightly smaller than the inside diameter of the ring gear.
 - b. Drive the ring gear off the flywheel with a suitable drift and hammer. Work around the circumference of the gear to avoid binding the gear on the flywheel.

5-77. FLYWHEEL AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | |
|-----------------------------|--|
| 2. Flywheel
Ring
Gear | <ul style="list-style-type: none"> a. Support the flywheel - ring gear side up - on a solid flat surface. b. Rest ring gear on a flat, metal surface and heat the gear uniformly with an acetylene torch, keeping the torch moving around the gear to avoid hot spots. |
|-----------------------------|--|

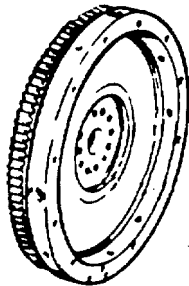


Do not, under any circumstances, heat the gear over 400°F (204° C), as excessive heat may destroy the original heat treatment.

NOTE

Heat indicating "crayons", which are placed on the ring gear and melt at a predetermined temperature, may be obtained from most tool vendors. Use of these "crayons" will ensure against over-heating the gear.

- c. Use a pair of tongs to place the gear on the flywheel with the chamfer facing the same direction as on the gear just removed.
- d. Tap the gear in place against the shoulder on the flywheel. If the gear cannot be tapped into place readily, remove it and apply additional heat, noting the above caution.



5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Disassembly b. Inspection c. Reassembly

INITIAL SETUP

Test Equipment

Micrometer
Feeler ribbon

References
Paragraph

3-149 Lube Oil Pump

Special Tools

Gear puller
Arbor press

Equipment
Condition Condition Description

NONE

Material/Parts

Kit P/N 5194800

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe all WARNINGS in this procedure.

5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

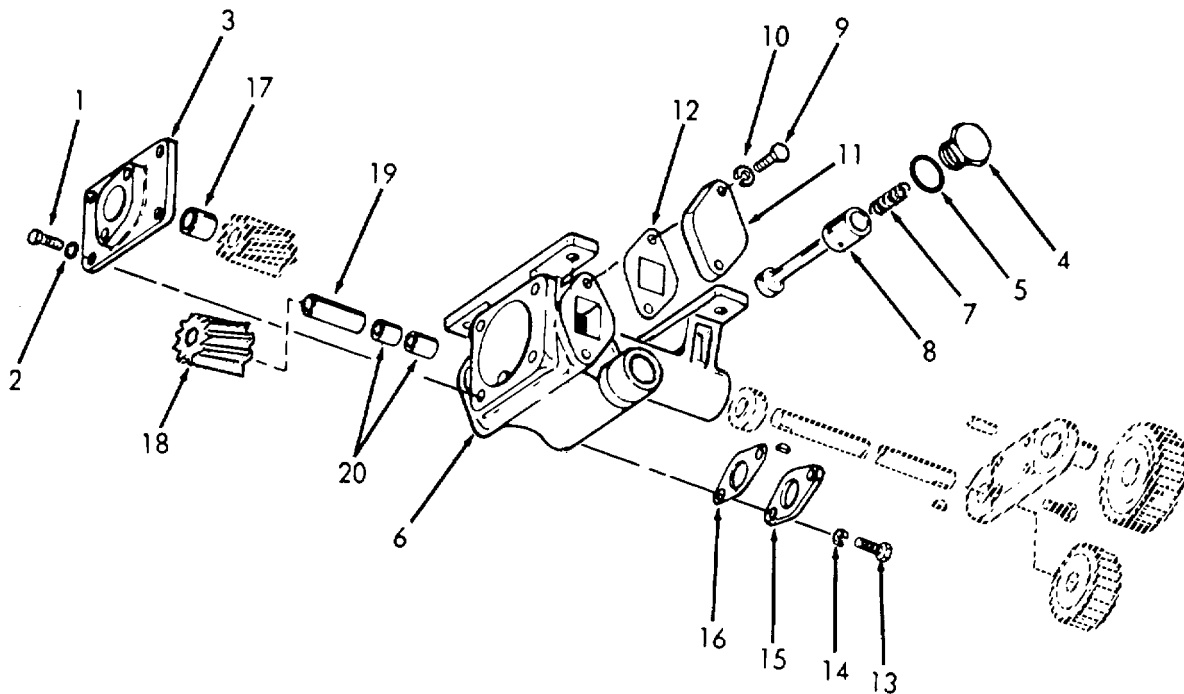
LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY(Cont)			
1. Lube Oil Pump	a. Screws (1), and lock-washers (2)	Remove.	
	b. Cover (3)	Remove.	
	c. Valve plug (4), and copper gasket (5)	Remove from both sides.	Discard gaskets.
	d. Pump body (6)	Jar body to loosen spring (7) and valve (8).	Discard spring.
	e. Screws (9) and lock-washers (10)	Remove.	
	f. Pad cover (11) and gasket (12)	Remove.	Discard gasket.
	g. Screws (13) and lock-washers (14)	Remove.	

5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | |
|----|---------------------------------|-------------------------|----------------------|
| h. | Pad cover (15), and gasket (16) | Remove. | Discard gasket. |
| i. | Bushing (17) | Remove from cover (3). | Discard. |
| j. | Driven Gear (18) | Remove from shaft (19). | Discard if damaged. |
| k. | Shaft (19), and bushings (20) | Remove. | Discard, if damaged. |



5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

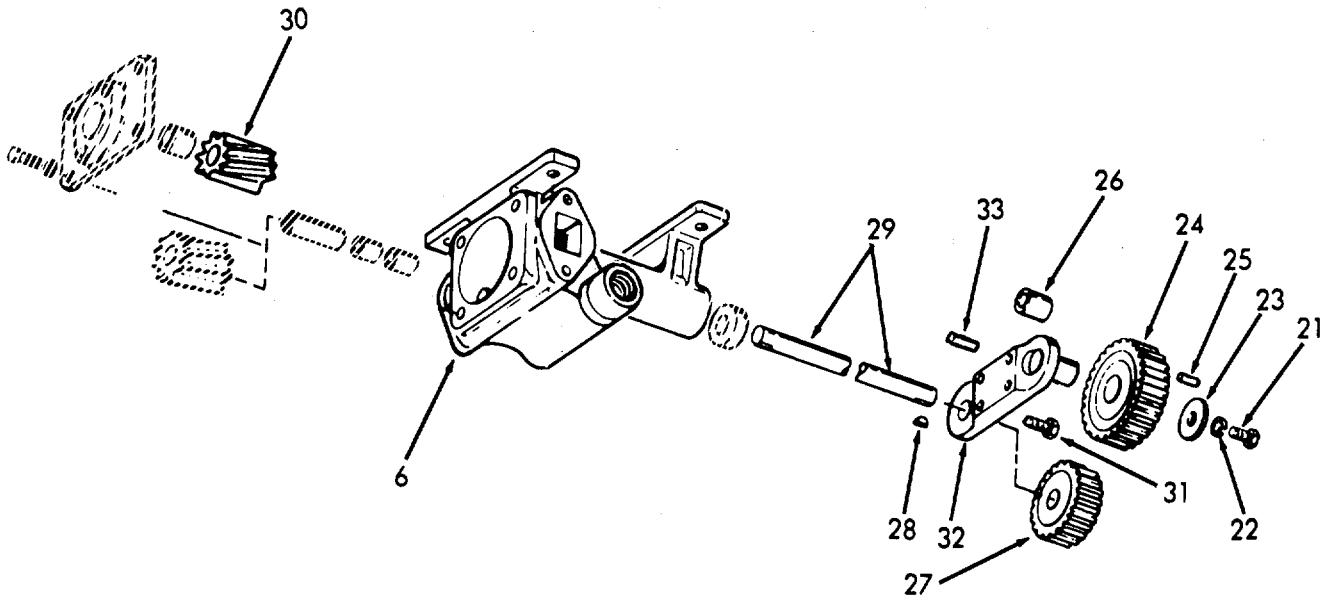
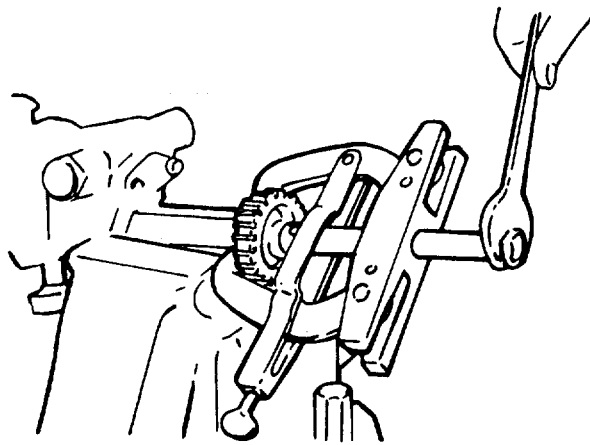
- | | | | |
|--|--|---|-------------------------------------|
| | l. Screw (21) lock-washer (22), and idler gear washer (23) | Remove. | |
| | m. Idler gear (24) | Remove. damaged. | Discard, if |
| | n. Headless pin (25) | Remove. | If necessary. |
| | o. Bushing (26) | Remove. | Discard. |
| | p. Pump body (6) | 1. Clamp in vise.
2. Pull driven gear (27), Woodruff key (28), and shaft (29). | Use gear puller. |
| | q. Shaft (29), and drive gear (30) | Remove from body (6) as an assembly. | Refer to step "t" for dis-assembly. |
| | r. Screw (31), and idler gear support (32) | Remove. | |

5-78. LIJBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY(Cont)

- | | | | |
|----|-------------------|---------|--|
| s. | Dowel pin
(33) | Remove. | |
|----|-------------------|---------|--|

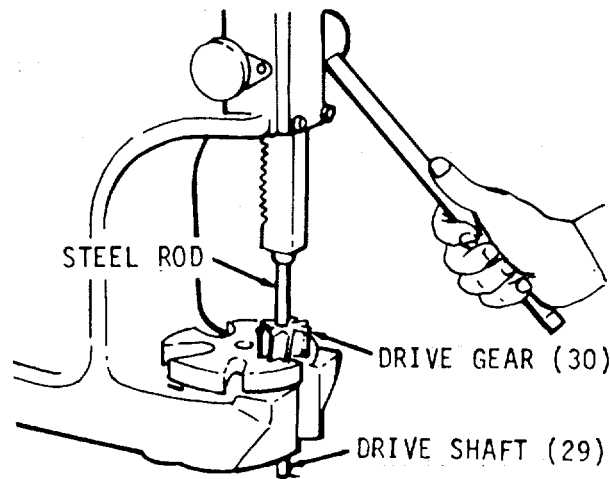


5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)

- | | | | |
|----|--|---|--|
| t. | Drive gear (30), shaft (29), and Woodruff key (34) | 1. Position on the bed of an arbor press with the long end of the shaft extending down through the slot in the bed plate, and with the face of the gear resting on the plate. | The drive gear and the shaft are part of the overhaul kit. |
|----|--|---|--|

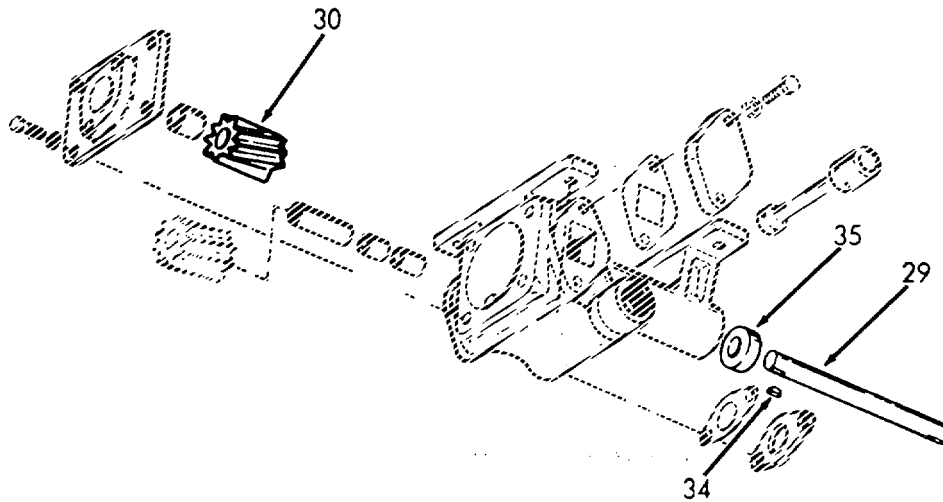


- | | | | |
|----|---------------|--|----------|
| | | 2. Place a short, 112 inch round steel rod on end of the shaft.
3. Press the shaft from the gear. | |
| u. | Bushings (35) | Remove. | Discard. |

5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)



INSPECTION

WARNING

Wear protective eye goggles when using compressed air.

2.
 - a. Wash all the parts in clean fuel oil and dry them with compressed air.
 - b. Examine the gear cavity in the pump body and the drive shaft bushings. If the driven gear bushings are worn, replace the bushings. Service replacement bushings in the driven gears must be reamed after assembly. Bushings used with the .499 inch diameter driven gear shaft must be reamed to .500 inch + .0005 inch and bushings used with the .623 inch diameter shaft must be reamed to .625 inch + .0005 inch.

5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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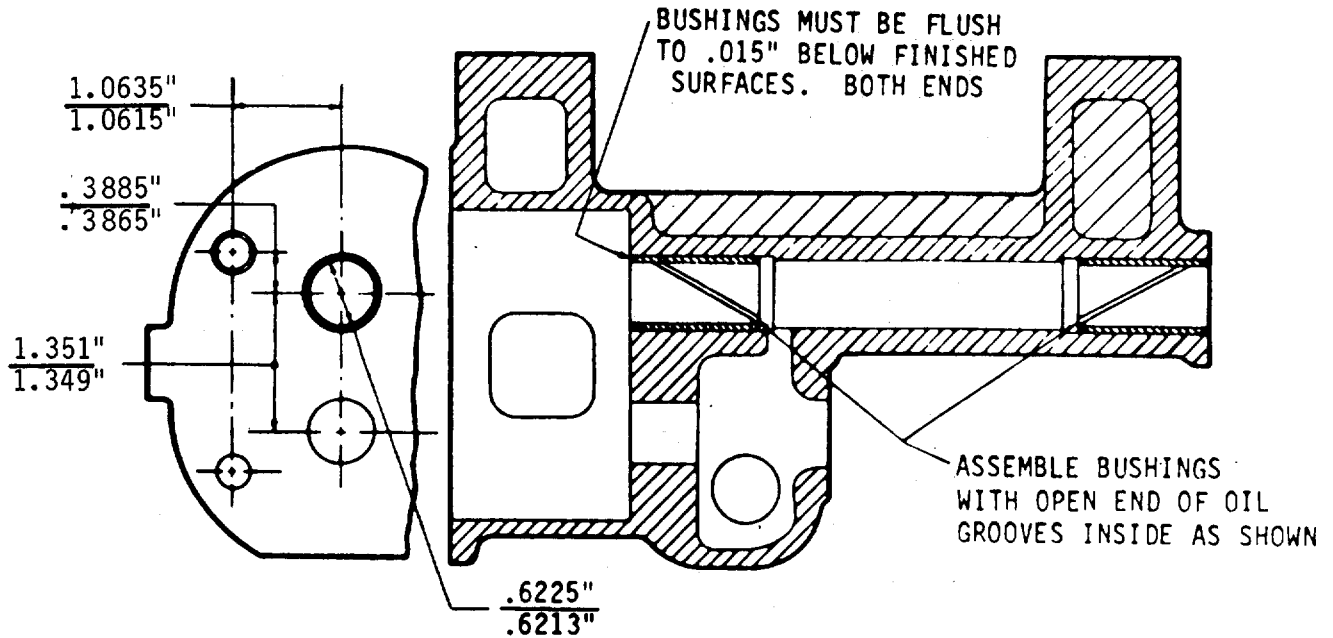
INSPECTION (Cont)

- c. Inspect the bushings in the pump body and cover. If the bushings are worn excessively, replace the pump and cover assemblies unless suitable boring equipment is available for finishing the new bushings. When installing the new bushings, replace all of the bushings. The bushings must be located and positioned as shown. Also, the gear bore and the bushing bore in both the pump body and the cover must be concentric within .001 inch. The shaft-to-pump body and the bushing clearance with new parts is .0008 inch to .0025 inch. The shaft-to-pump cover bushing clearance with new parts is .0010 inch to .0027 inch.
- d. In an efficient oil pump, the gears should have a free-running fit (with no perceptible looseness) in the pump housing. If the gear teeth are worn, install new gears. The use of excessively worn gears will result in low engine oil pressure which in turn, may lead to serious damage throughout the engine.
- e. Inspect the pressure relief valve and its seat in the pump body. If necessary, install new parts.

5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

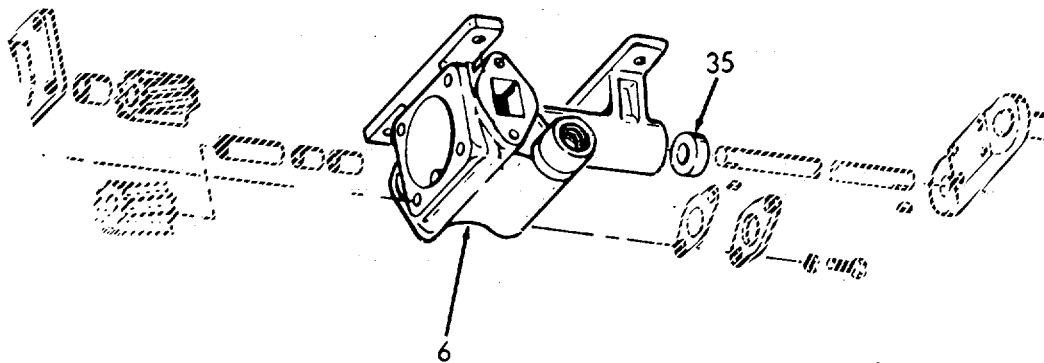
LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)



REASSEMBLY

- | | | | |
|----|------------------|----------------------|---|
| 3. | a. Bushings (35) | Press into body (6). | Use new bushing, if removed previously. |
|----|------------------|----------------------|---|



5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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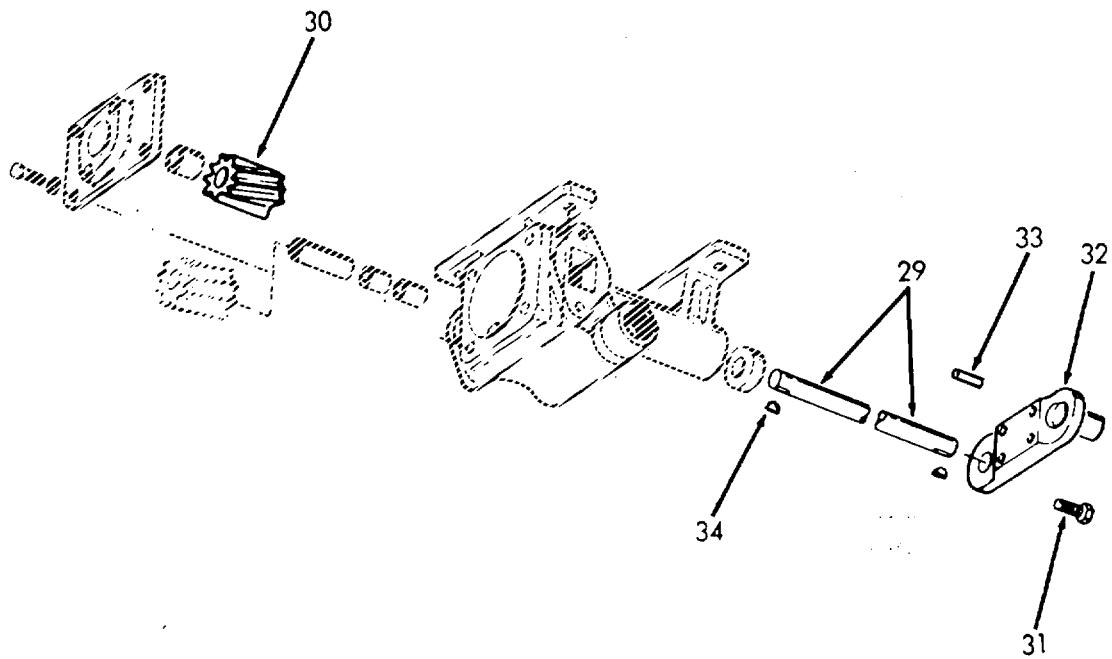
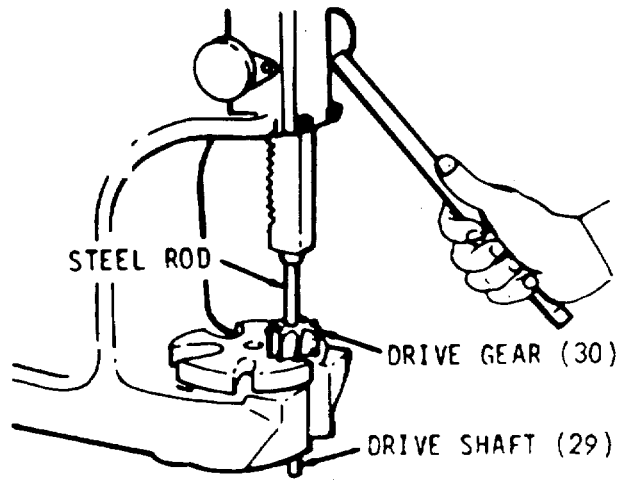
REASSEMBLY (Cont)

- | | | | |
|----|--|--|---|
| b. | Drive gear (30), shaft (29), and Woodruff key (34) | <ol style="list-style-type: none"> 1. Insert key in shaft. 2. Apply a light coat of engine oil to the shaft. 3. Start the shaft squarely into the bore of the gear. 4. Press shaft into gear. 5. The gear must be 6-15/16 inches from the key way end of the shaft. | <p>Use new gear and shaft, if removed previously .</p> <p>Use an arbor press.</p> |
| c. | Dowel pin (33) | Install . | |
| d. | Idler gear support (32) and screw (31) | Install. | |
| e. | Drive gear (30), and shaft (29) assembled | Install in body. | |

5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)



5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

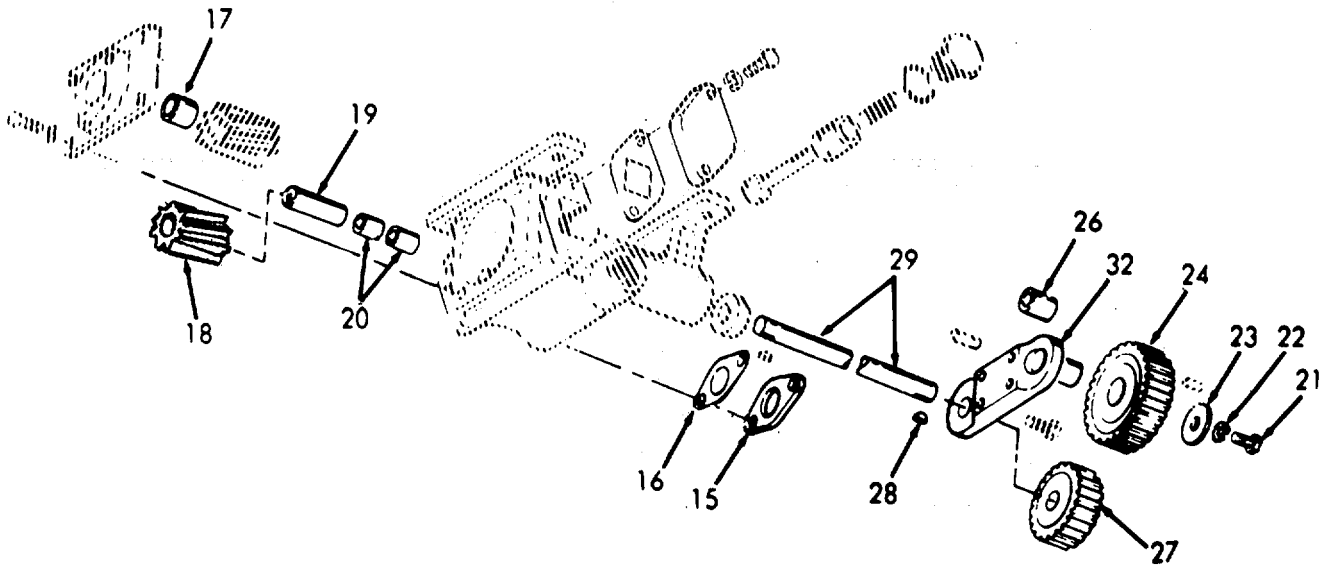
LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	f. Shaft (29), Woodruff key (28), and drive driven gear (27)	<ol style="list-style-type: none"> 1. Position gear on the end of the shaft with the extended hub side up away from the body. 2. Insert a .005 feeler ribbon between the gear and the body. 3. Press the gear on the shaft until the clearance is .005 between the body and the gear. 	Use new shaft and gear, if previously replaced.
	g. Bushings (26)	Install.	Use a new bushing.
	h. Idler gear (24)	<ol style="list-style-type: none"> 1. Lubricate with engine oil. 2. Install with flat side facing the support (32). 	Use a new gear, if replaced
	i. Idler gear washer (23), lock-washer (22), and screw (21)	<ol style="list-style-type: none"> 1. Rotate washer and lockwasher so that the slot in each washer engages the headless pin. 2. Install. 	
	j. Bushings (20), and shaft (19)	Install.	Use new bushing and shaft, if necessary.

5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|----------------------------------|----------|------------------------------|
| k. | Driven gear (18) | Install. | Use a new gear, if replaced. |
| l. | Bushing (17) | Install. | Use a new bushing . |
| n. | Pad cover (15), and gasket (16) | Install. | Use a new gasket. |



5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	n. Screws (13), and lock-washers (14)	Install.	
	o. Pad cover (11), and gasket (12)	Install.	Use a new gasket.
	p. Screws (9) and lock-washers (10)	Install.	
	q. Valve plug (4), and gasket (5)	Install in body on side opposite the inlet opening.	Use a new gasket.
	r. Valve (8) and spring (7)	1. Place in body. 2. Install second valve plug (4), and copper gasket (5).	Use a new gasket.
	s. Cover (3), screws (1), and lock-washers (2)	Install.	

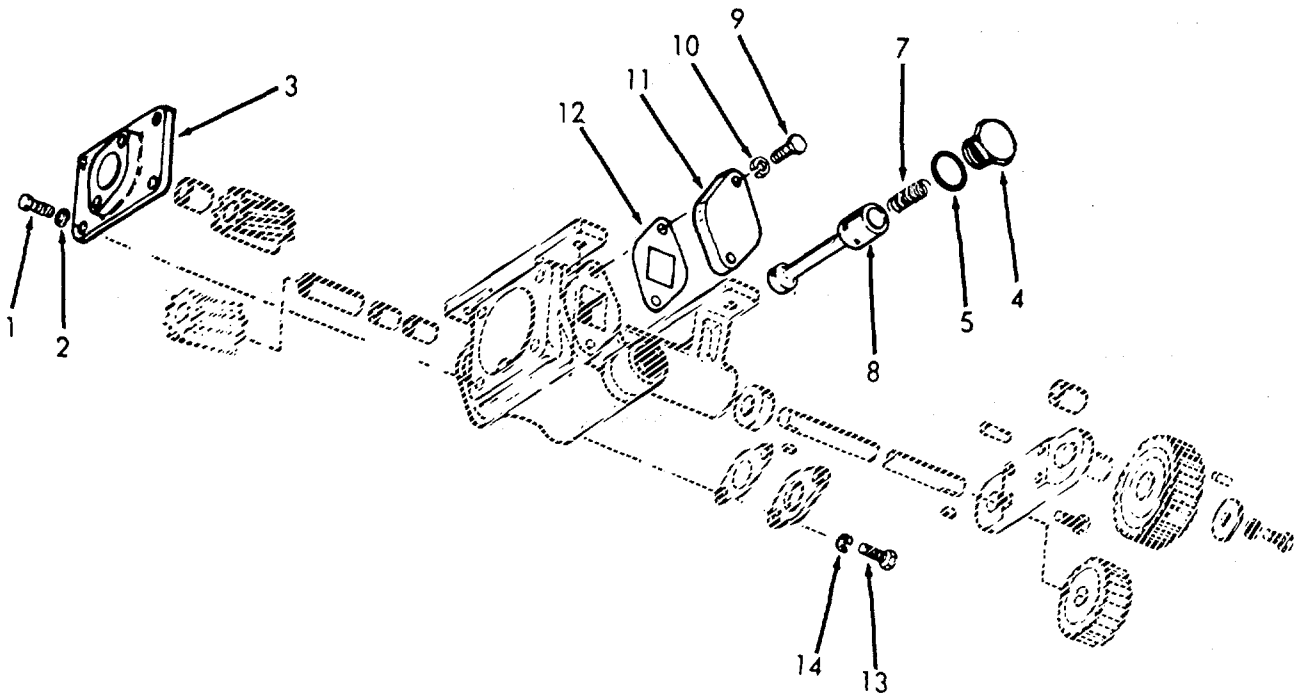
5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

t. Pump

1. The oil pump must turn freely after assembly.
2. Any bind in the pump must be removed prior to installation.



5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Repair
- b. Cleaning
- c. Pressure Test
- d. Inspect

INITIAL SETUP

Test Equipment

Feeler gage
 Straight edge
 Depth gage
 Equip ment

Special Tools

Drift 3/4 inch
 Hammer, 1 pound
 Hone
 120 grit hones

Material/Parts

Pickling acid
 Alkaline solution
 (Heavy duty)
 Permatex
 International compound
 #2 or equivalent
 Rust preventive

Personnel Required

2

References

Chapter 3 (volume 4) - Removal of
 all parts
 Chapter 5 - Removal of all parts

Condition Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

Observe all WARNINGS in this
 procedure.

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

1.	Cylinder block	All components	Remove.	Refer to Chapter 3 and 5.
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5-1070

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING

2.
 - a. Scrape all gasket material from the cylinder block. Then remove all oil gallery plugs and core hole plugs (except cup plugs) to allow the cleaning solution to contact the inside of the oil and water passages. This permits more efficient cleaning and eliminates the possibility of the cleaning solution attacking the aluminum core hole plug gaskets (if used) .
 - b. If a core hole plug is difficult to remove, hold a 3/4 inch drift against the plug and give it a few sharp blows with a one pound hammer. With a 1/2 inch flexible handle and a short extension placed in the countersunk hole in the plug, turn the plug slightly in the direction of tightening. Then turn it in the opposite direction and back the plug out. To remove the special plugs in the water-below-port cylinder block:
 - c. Clean the cylinder block as follows:
 - (1) Remove the grease by agitating the cylinder block in a hot bath of commercial heavy-duty alkaline solution.
 - (2) Wash the block in hot water or steam clean it to remove the alkaline solution.
 - (3) If the water jackets are heavily scaled, proceed as follows:
 - (a) Agitate the block in a bath of inhibited commercial pickling acid.
 - (b) Allow the block to remain in the acid bath until the bubbling stops (approximately 30 minutes).
 - (c) Lift the block, drain it and re-immerses it in the same acid solution for 10 minutes.
 - (d) Repeat step (c) until all scale is removed.

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING(Cont)			
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- (e) Rinse the block in clear hot water to remove the acid solution.
- (f) Neutralize the acid that may cling to the casting by immersing the block in an alkaline bath.
- (g) Wash the block in clean water or steam clean it.

WARNING

Wear protective eye goggles when using compressed air.

- (4) Dry the cylinder block with compressed air.
- (5) Make certain that all water passages, oil galleries and air box drain openings have been thoroughly cleaned.

NOTE

The above cleaning procedure may be used on all ordinary cast iron and steel parts of the engine. Mention will be made of special cleaning procedures whenever necessary.

- (6) After the block has been cleaned and dried, coat the threads of the plugs with sealant and, using new gaskets, reinstall the core hole plugs. Tighten the 1-3/4 inch - 16 plugs to 150-180 lb-ft (203.4 - 244.0 Nm) torque and the 2-1/2 inch - 16 plugs to 230-270 lb-ft (311.8 - 366.1 Nm) torque.

CAUTION

Excessive torque applied to the core hole plugs may result in cracks in the water jacket.

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

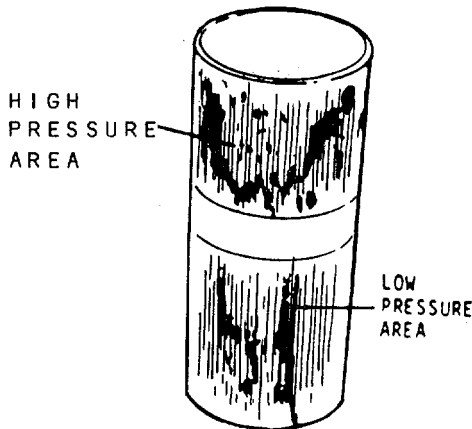
LOCATION	ITEM	ACTION	REMARKS
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CLEANING (Cont)

- d. If the cup plugs in the water jackets were removed, install new plugs as follows:
 - (1) Clean cup plug holes and apply Permatex No.1 sealant or equivalent to outer plug diameter.
 - (2) Drive plugs in place with handle and adapter.

PRESSURE TEST

- 3. After the cylinder block has been cleaned, it must be pressure tested for cracks or leaks by either one of two methods:
 - (a) This method may be used when a large water tank is available and the cylinder block is completely stripped of all parts.
 - (1) Seal the water inlet and outlet holes airtight. This can be done by using steel plates and suitable rubber gaskets held in place by bolts. Drill and tap one cover plate to provide a connection for an air line.
 - (2) Immerse the block for twenty minutes in a tank of water heated to 180°-200°F (82.2 - 93.3° C).
 - (3) Apply 40 psi (275.8 kPa) air pressure to the water jacket, and observe the water in the tank for bubbles which indicate the presence of cracks or leaks in the block. A cracked cylinder block must be replaced by a new block.



5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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PRESSURE TEST(Cont)

WARNING

Wear protective eye goggles when using compressed air.

- (4) After pressure test is completed, remove the block from the water tank. Remove plates and gaskets and dry with compressed air.
- b. This method may be used when a large tank is unavailable, or when it is desired to check the block for cracks without removing the engine from the equipment which it powers. However, it is necessary to remove the cylinder heads, blower, oil cooler, air box covers and oil pan.
 - (1) Attach sealing plates and gaskets as in method "a". Before attaching the last sealing plate, fill water jacket with a mixture of water and one gal 1 on of anti freeze. The antifreeze will penetrate small cracks and its color will aid in detecting their presence.
 - (2) Install the remaining sealing plate and tighten securely.
 - (3) Apply 40 psi (275.8 kPa) air pressure to the water jacket and maintain this pressure for at least two hours to give the water and antifreeze mixture ample time to work its way thru any cracks which may exist.
 - (4) At the end of the test period, examine the cylinder bores, air box, oil passages, crankcase and exterior of the block for presence of the water and anti-freeze mixture which will indicate the presence of cracks.

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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PRESSURE TEST (Cont)

A cracked cylinder block must be replaced by a new block.

- (5) After the test is completed, remove the plates, drain the water jacket and blow out all of the passages in the block with compressed air.

INSPECT

- 4.
- a. After cleaning and pressure-testing inspect the cylinder block.
 - b. Since most of the engine cooling is accomplished by heat transfer through the cylinder liners to the water jacket, a good liner-to-block contact must exist when the engine is operating. Whenever the cylinder liners are removed from an engine, the block bores must be inspected.

NOTE

Before attempting to check the block bores, hone them throughout their entire length until about 75% of the area above the ports has been cleaned-up.

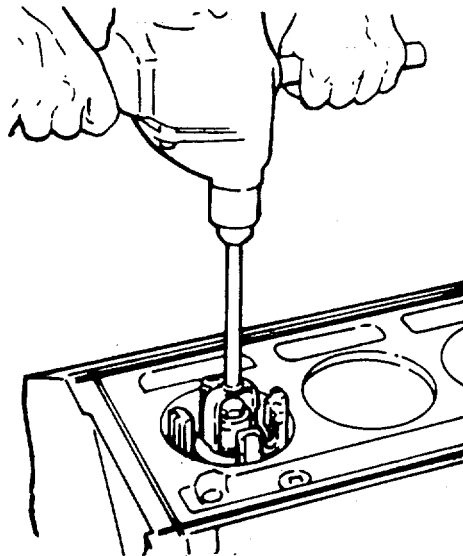
- c. Hone the block bores as follows:
 - (1) Use a hone in which the cutting radius of the stones can be set in a fixed position to remove irregularities in the bore rather than following the irregularities as with a spring-loaded hone. Clean stones frequently with a wire brush to prevent stone loading. Follow the manufacturer's instructions regarding the use of oil or kerosene on the stones. Do not use cutting agents with a dry hone. Use 120 grit stones.

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)

- (2) Insert the hone in the bore and adjust the stones snugly to the narrowest section. When correctly adjusted, the hone will not shake in the bore, but will drag freely up and down the bore when the hone is not running.
- (3) Start hone and "feel out" bore for high spots which will cause an increased drag on the stones. Move hone up and down the bore with short, overlapping strokes about 1 inch (2.54 cm) long. Concentrate on the high spots in the first cut. As these are removed, drag on the hone will be lighter and smoother. Do not hone as long at the air inlet port area as in the rest of the bore because this area, as a rule, cuts away more rapidly. Feed lightly to avoid an excessive increase in bore diameter. Some stones cut rapidly even under low tension.



- (4) When the bore is fairly clean, remove the hone, inspect the stones, and measure the bore. Determine which spots must be honed most. Moving the hone from the top to the bottom of the bore will not correct an out-of-round condition. To remain in one spot

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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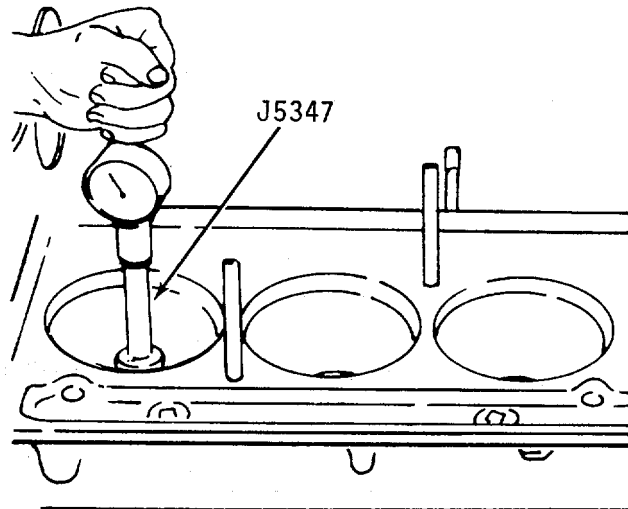
INSPECT (Cont)

too long will cause the bore to become irregular. Where and how much to hone can be judged by feel. A heavy cut in a distorted bore produces a steady drag on the hone and makes it difficult to feel the high spots. Therefore, use a light cut with frequent stone adjustments.

- (5) Wash the cylinder block thoroughly after the honing operation is completed.

d. Check the cylinder block bores:

- (1) Visually check contact area as revealed by the honed surface. There must not be any low spots which are larger in area than a half dollar.
- (2) Measure the entire bore of each cylinder with cylinder bore gage J5347 which has a dial indicator calibrated in .0001 inch increments. The standard block bore is 4.6260 inch to 4.6270 inch.

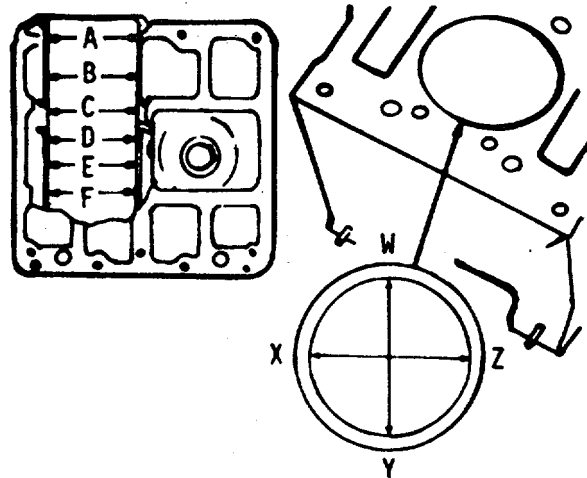


5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)

- (3) First, place the bore gage in the master ring gage J8386-01 which has an I.D. of 4.6270 inch and set the dial to zero. Rotate the dial clockwise .0005 inch to give a zero dial indicator setting of 4.627 inch. Take measurements on the cleaned-up surface only at positions A, B, C, D, E, and F in the bore on axes 45° apart. Read the measurements from the zero mark on the gage.



- (4) The cylinder liner is alternately expanding and contracting during engine operation, due to temperature variations. This may result in irregularities in the block bores (out-of-round and taper), the effects of which will be seen as high pressure areas on the outside of the cylinder liner.
- (5) If a new liner and piston is installed in the block without properly fitting the liner, galling and seizing of the piston may result. This is caused by the new piston having to travel over the irregularities without time to conform to the particular shape of the block bore.

e. Fit the liner to the cylinder block:

The liner-to-block clearance with new parts is zero to .002 inch. With used parts, maximum liner-to-

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)

block clearance is .0025 inch. Examine the block bore measurements to determine if standard or .001 inch oversize O.D. liners can be used, or if the cylinder block should be bored oversize. A light push fit between liner and block is desirable. However, a good fit between the cylinder liner and block may be obtained by comparing average bore sizes in Table below.

For Average Block Bore I.D. Size of	Use Liner O.D. Size	To Give A Liner-to-Block Clearance of
<u>4.6260 inches</u> 4.6275 inches	Standard	.000 inch to .0025 inch
<u>4.6270 inches</u> 4.6285 inches	.001 inch Oversize	.000 inch to .0025 inch

f. If necessary, bore the cylinder block as follows:

- (1) Each bore in a used block must not be out-of-round or tapered more than .002 inch. If the average block bore is over 4.6285 inches, the block should be bored oversize as shown below.

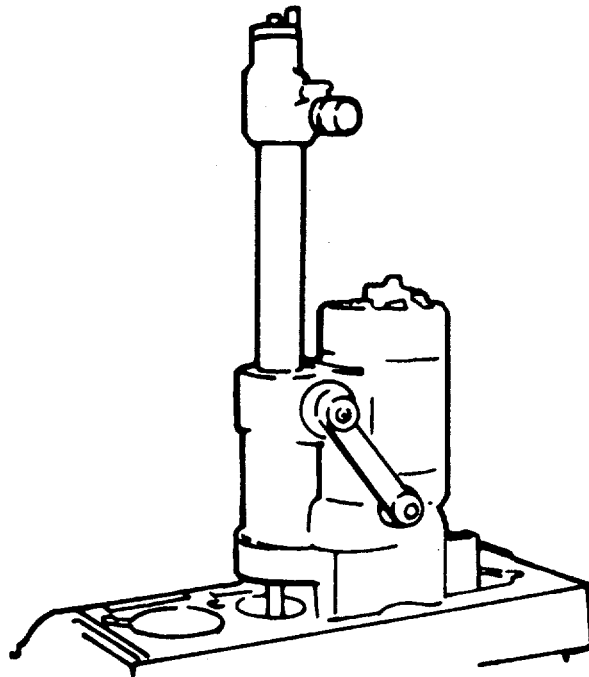
Block Boring Dimensions	Liner O.D. Size	Maximum Block Bore I.D. on a Used Block
<u>4.631 inches</u> 4.632 inches	.005 inch Oversize	4.6325 inches
<u>4.636 inches</u> 4.637 inches	.010 inch Oversize	4.6375 inches
<u>4.646 inches</u> 4.647 inches	.020 inch Oversize	4.6475 inches
<u>4.656 inches</u> 4.657 inches	.030 inch Oversize	4.6575 inches

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (CONT)

- (2) A typical commercially available portable boring bar is illustrated below. Instructions on the correct use of the boring bar are provided by the manufacturer.
- (3) After boring the block for an oversize cylinder liner, check the bore finish to be sure it is smooth (120 RMS). Heat transfer from cylinder liner to block will be adversely affected if the block isn't smooth.
- (4) Wash the block thoroughly after the boring operation.
- (5) When an oversized liner is used, stamp the size of liner on the top deck of the block adjacent to the liner counterbore. An oversized liner insert must be installed whenever an oversized ~ liner is used.

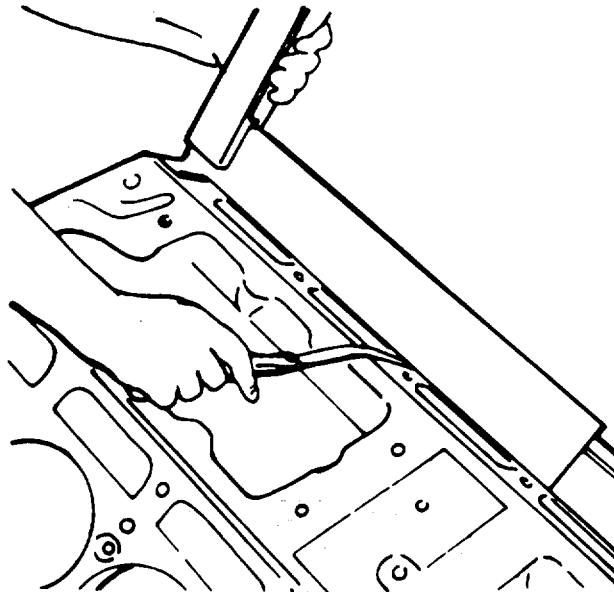


5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)

- g. Check the top of the block (cylinder head contact surfaces) for flatness with an accurate straight edge and a feeler gage.
- (1) The top surface of the block must not vary more than .003 inch transversely and not over .007 inch longitudinally. It will be difficult to prevent water, oil, and compression leaks if the top surface of the block exceeds these tolerances.
 - (2) If it is necessary to machine these surfaces to correct for the above conditions, do not remove more than .008 inch of metal. Stamp the amount of stock removed on the face of the block. The distance from the centerline of the crankshaft to the top of the cylinder head surface of the block must not be less than 16.176 inches.

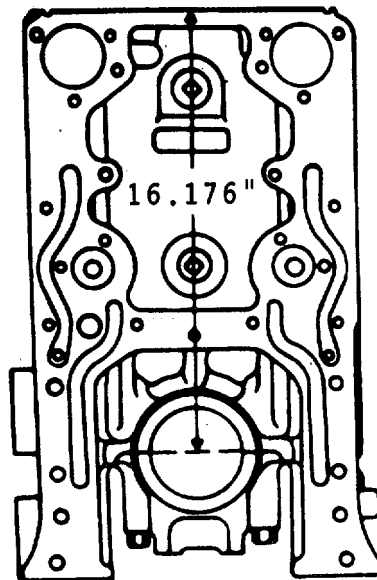


5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)

- (3) If stock is removed from the cylinder head contact surfaces of the block, check the depth of the seal ring grooves and counterbores. The cylinder head seal strip grooves must be .092 inch - .107 inch deep. The large water hole counterbores (between the cylinders) must be .109 inches - .120 inches deep, and the combination water and oil hole counterbores and small waterhole counterbores must be .087 inches - .098 inches deep. If necessary, deepen the grooves or counterbores to the specified limits to retain the proper "c-rush" on the seal rings. It is not necessary to deepen the counterbores for the cylinder liners since .004 inch and .008 inch under-size thickness inserts are available for adjusting the liner position as outlined in Chapter 3, paragraph 3-98, under Fitting Cylinder Liner in Block Bore.

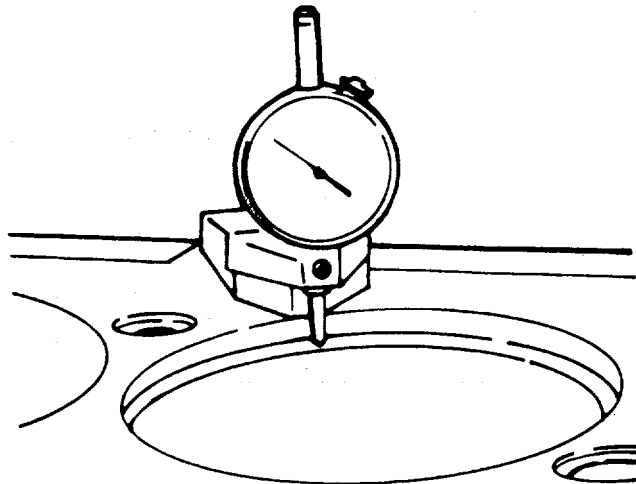


5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)

- h. Make sure the cylinder liner counterbores in the block are clean and free of dirt. Then check the depth. The depth must be .4770 inch to .4795 inch and must not vary more than .0015 inch throughout the entire circumference. The counterbored surfaces must be smooth and square with the cylinder bore within .001 inch total indicator reading. There must not be over .001 inch difference between any two adjacent cylinder counterbores when measured along the cylinder longitudinal center-line of the cylinder block.



- i. Check the main bearing bores as follows:
- (1) Check the bore diameters with the main bearing caps in their original positions. Lubricate the bolt threads and bolt head contact areas with a small quantity of International Compound No. 2, or equivalent. Then install and tighten the bolts to 165-175 lb-ft (223.7-237.3 Nm) torque. When making this check, do not install the main bearing cap stabilizers. The specified bore diameter is 4.812 inch to 4.813 inch. If the bores do not fall within these limits, the cylinder block must be rejected.

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)			
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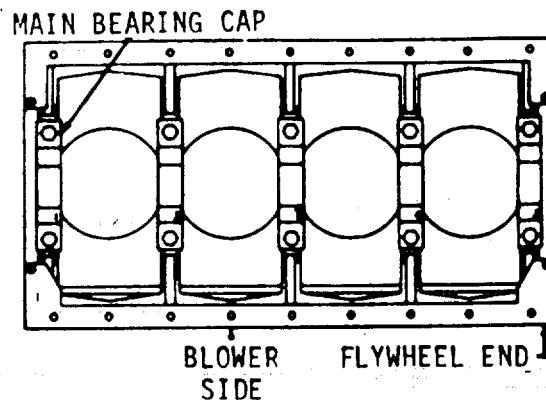
CAUTION

Main bearing cap bolts are especially designed for this purpose and must not be replaced by ordinary bolts.

NOTE

Bearing caps are numbered to correspond with their respective positions in the cylinder block. It is imperative that the bearing caps are reinstalled in their original positions to maintain the main bearing bore alignment. The number of the front main bearing cap is also stamped on the face of the oil pan mounting flange of the cylinder block, adjacent to its permanent location in the engine as established at the time of manufacture. The No. 1 main bearing cap is always located at the end opposite the flywheel end of the cylinder block.

- (2) Finished and unfinished main bearing caps are available for replacing broken or damaged caps. When fitting a finished replacement bearing cap, it may be necessary to try several caps before one will be found to provide the correct bore diameter and bore alignment. If a replacement bearing cap is installed, be sure to stamp the correct bearing position number on the cap.



5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)

NOTE

Use the unfinished bearing caps for the front and intermediate bearing positions. The finished bearing caps, machined for the crankshaft thrust washers, are to be used in the rear bearing position.

- (3) Main bearing bores are line-bored with the bearing caps in place and thus are in longitudinal alignment. Bearing bores may be considered properly aligned with one another if the crankshaft can be rotated freely by hand after new bearing shells have been installed and lubricated and the bearing caps have been secured in place and the bolts tightened to 180-190 lb. ft. (244.0-257.6 Nm) torque. If a main bearing bore is more than .001 inch out of alignment, the block must be line-bored or scrapped. Misalignment may be caused by a broken crankshaft, excessive heat or other damage.
 - (4) If the main bearing bores are not in alignment or a replacement bearing cap is used, the block must be line-bored. Install the bearing caps in their original positions (without the bearing cap stabilizers) and tighten the bolts to 165-175 lb. ft. (223.7-237.3 Nm) torque. Line-bore the block, but do not remove more than .001 inch stock. After boring, all bores must be within the specified limits 3.812 inch to 3.813 inch.
- j. Replace loose or damaged dowel pins. The dowels at the ends of the cylinder block must extend .630 inch from the cylinder blocks. The dowels used to retain the crankshaft thrust washers on the rear main bearing cap must extend .110 inch to .120 inch from the surface of the bearing cap.

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)

- k. If used, replace damaged or broken cylinder head studs. Drive new studs to a height of 4 3/8 inch + 1/32 inch above the block at a minimum of 75 lb. ft. (101.7 Nm) torque. Also, examine the cylinder head retaining bolt holes. If the threads are damaged, use a tap to "clean-up" the threads or install an helical thread insert.
- l. The tapped holes in the cylinder blocks may be tapped with a 5/8 inch-11 UNC3B thread tap. The stud holes and unplugged bolt holes must have the thread extending 1.84 inches below the block surface.
- m. Check the remaining cylinder block surfaces and threaded holes. Check all of the mating surfaces, or mounting pads, for flatness, nicks and burrs. Clean-up damaged threads in tapped holes with a tap or install helical thread inserts if necessary.
- n. After inspection, if the cylinder block is not to be used immediately, spray the machined surfaces with engine oil. If the block is to be stored for an extended period of time, spray or dip it in a polar-type rust preventive such as Valvoline Oil Company's "Tectyl 502-C", or equivalent. Castings free of grease or oil will rust when exposed to the atmosphere.

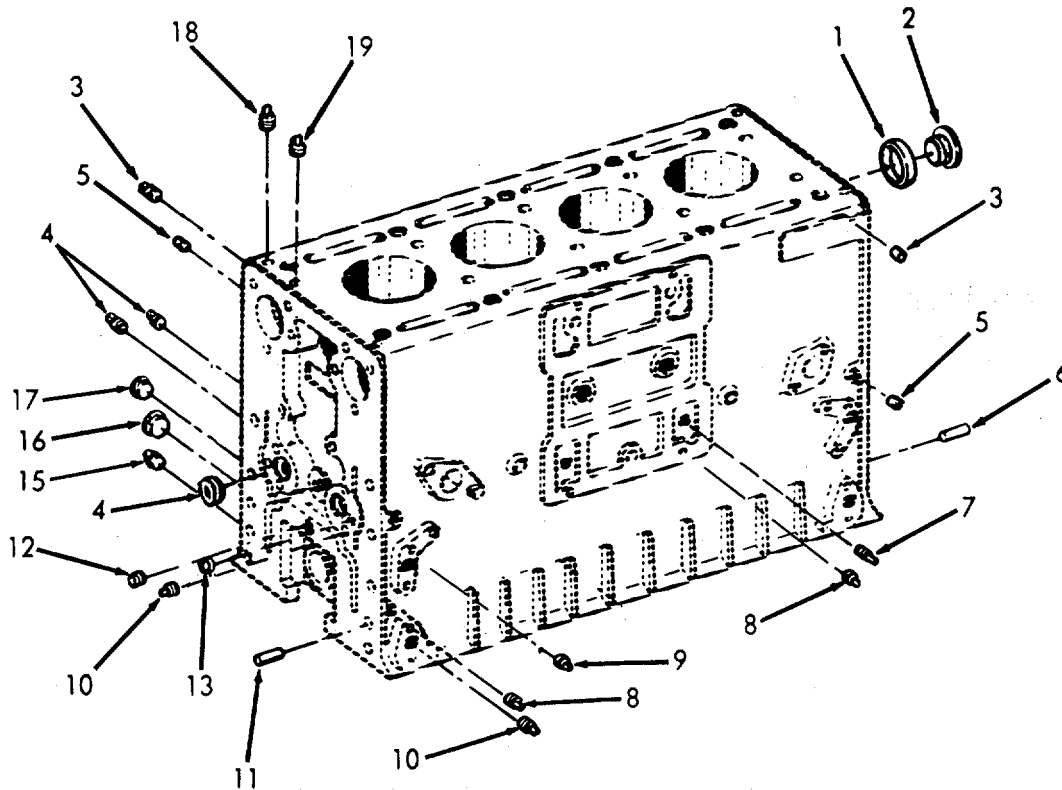
NOTE

Before a reconditioned or new service replacement cylinder block is used, steam clean it to remove the rust preventive and blow out the oil galleries with compressed air.

5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECT (Cont)



- 1. Gasket 1 3/4 - 16 plug
- 2. Plug
- 3. Pipe plug 1/8 steel
- 4. Plug 0.346 diameter x 7/32 long
- 5. Headless pipe plug
- 6. Dowel pin
- 7. Pipe plug 3/8 steel
- 8. Pipe plug
- 9. Plug cup 5/8
- 10. Pipe plug headless 1/2-
- 14. NPTF

- 11. Dowel pin
- 12. Plug special 1/4 x 5/16
- 13. Plug cup
- 14. Pipe plug
- 15. Pipe plug 3/4 steel
- 16. Plug 'cup
- 17. Plug cup
- 18. Special plug
- 19. Pipe plug headless 3/8-18 NPTF

5-80. HYDRAULIC FILTER AND PIPING - ANCHOR WINCH - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNING.

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

WARNING

To avoid possible injury bleed the system at the hand pump.

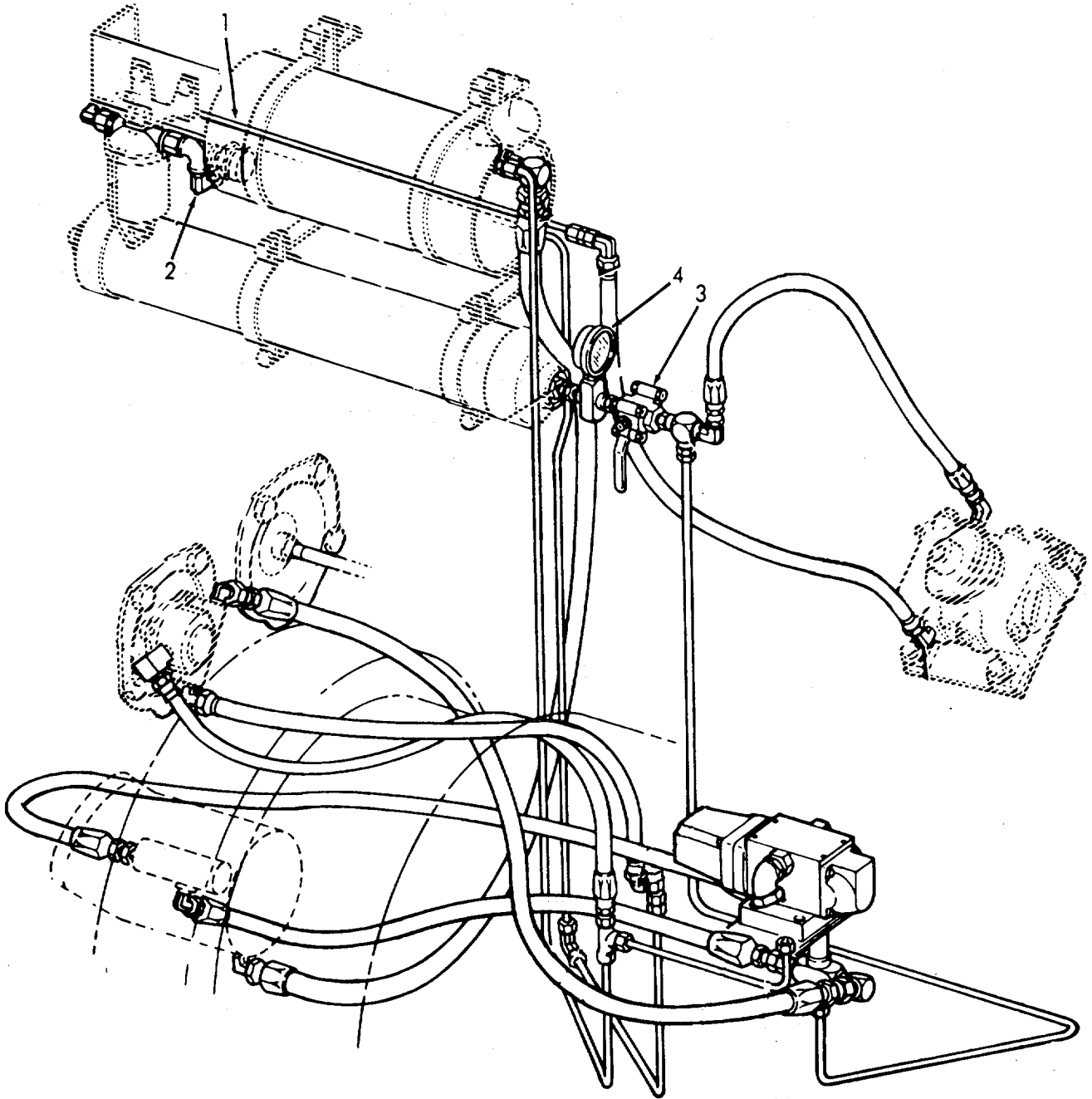
- | | | |
|-----------|-----------------------------|--------------------|
| 1. Piping | a. Hydraulic tubing (1) | Repair or replace. |
| | b. 90° male elbow (2) | Repair or replace. |
| | c. 3000 lbs. ball valve (3) | Repair or replace. |
| | d. Pressure gage (4) | Repair or replace. |

5-1088

5-80. HYDRAULIC FILTER AND PIPING - ANCHOR WINCH - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



 5-80. HYDRAULIC FILTER AND PIPING - ANCHOR WINCH - MAINTENANCE
 INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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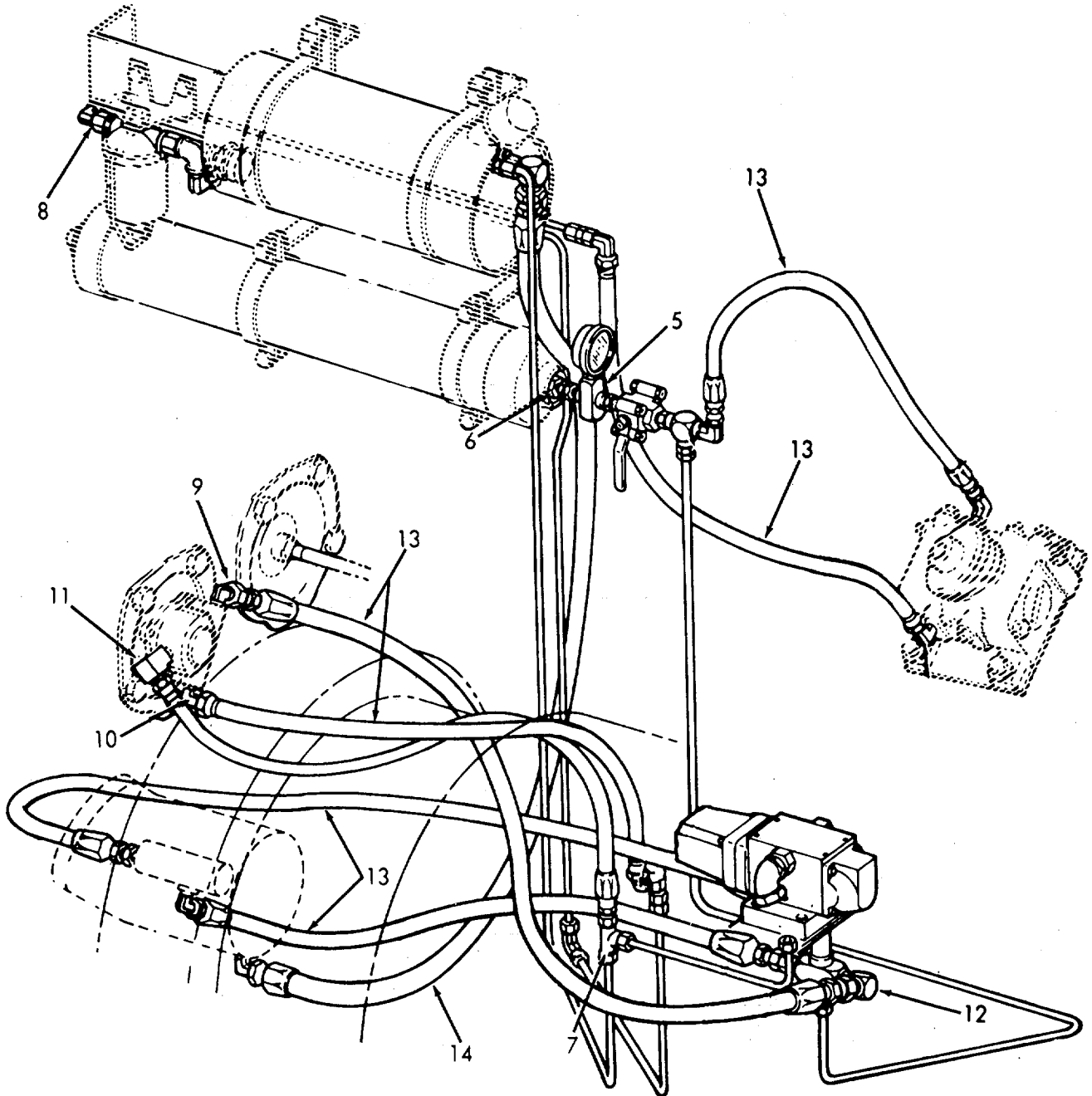
REPAIR (Cont)

e.	Male run tee (5)	Repair or replace.	
f.	Nipple (6)	Repair or replace.	
g.	Female run tee (7)	Repair or replace.	
h.	90° male elbow (8)	Repair or replace.	
i.	90° male elbow (9)	Repair or replace.	
j.	45° male elbow (10)	Repair or replace.	
k.	90° male elbow (11)	Repair or replace.	
l.	90° male elbow (12)	Repair or replace.	
m.	Two wire braid rubber hoses (13)	Repair or replace.	
n.	Two wire braid rubber hose (14)	Repair or replace.	

5-80. HYDRAULIC FILTER AND PIPING - ANCHOR WINCH - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



 5-80. HYDRAULIC FILTER AND PIPING - ANCHOR WINCH - MAINTENANCE
 INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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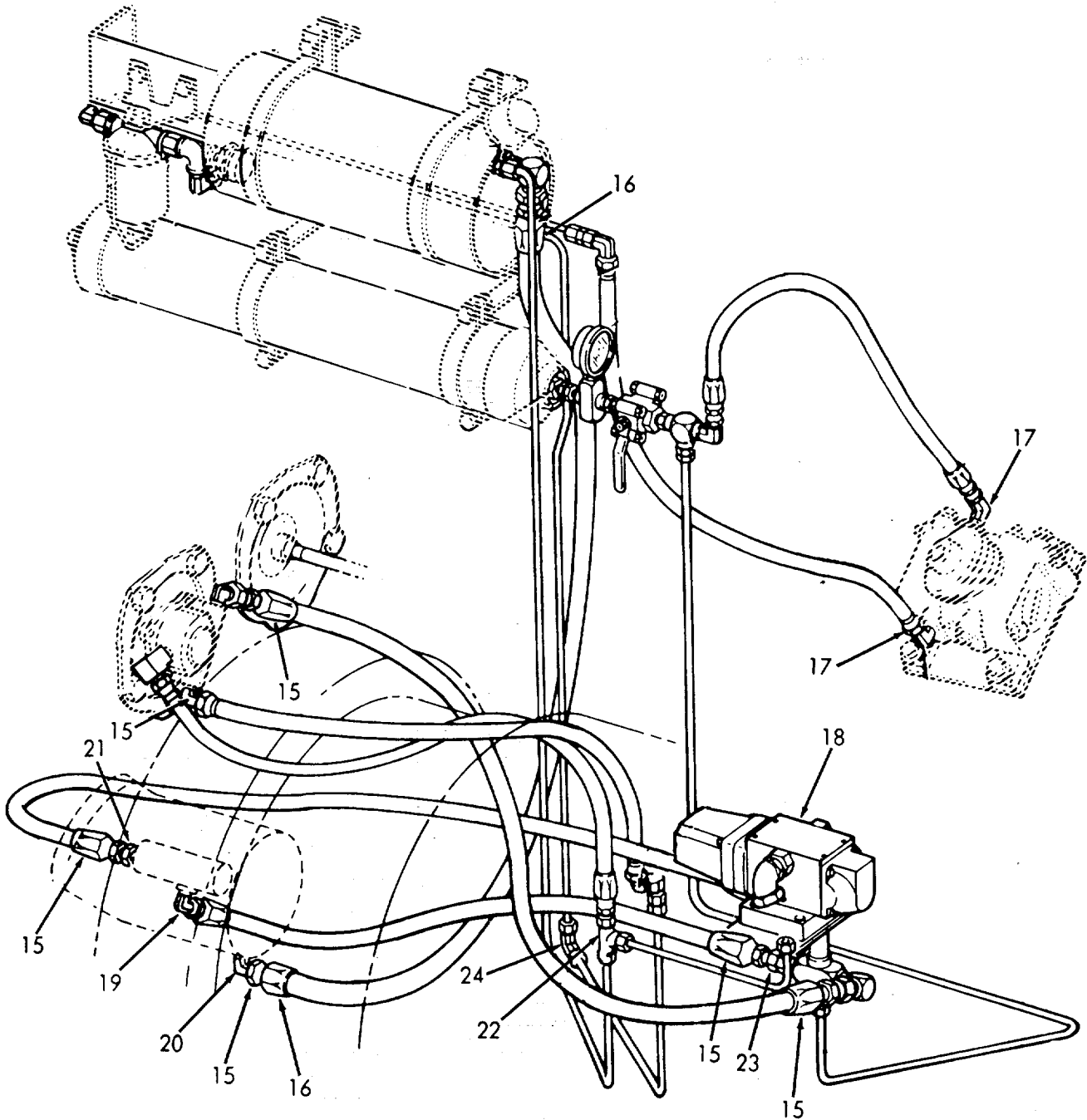
REPAIR (Cont)

- | | |
|-----------------------------|--------------------|
| o. Swivel fitting hose (15) | Repair or replace. |
| p. Swivel fitting hose (16) | Repair or replace. |
| q. 90° male elbow (17) | Repair or replace. |
| r. Solenoid valve (18) | Repair or replace. |
| s. 90° male elbow (19) | Repair or replace. |
| t. Male elbow (20) | Repair or replace. |
| u. Male connector (21) | Repair or replace. |
| v. Man run tee (22) | Repair or replace. |
| w. Male connector (23) | Repair or replace. |
| x. Union elbow (24) | Repair or replace. |

5-80. HYDRAULIC FILTER AND PIPING - ANCHOR WINCH - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

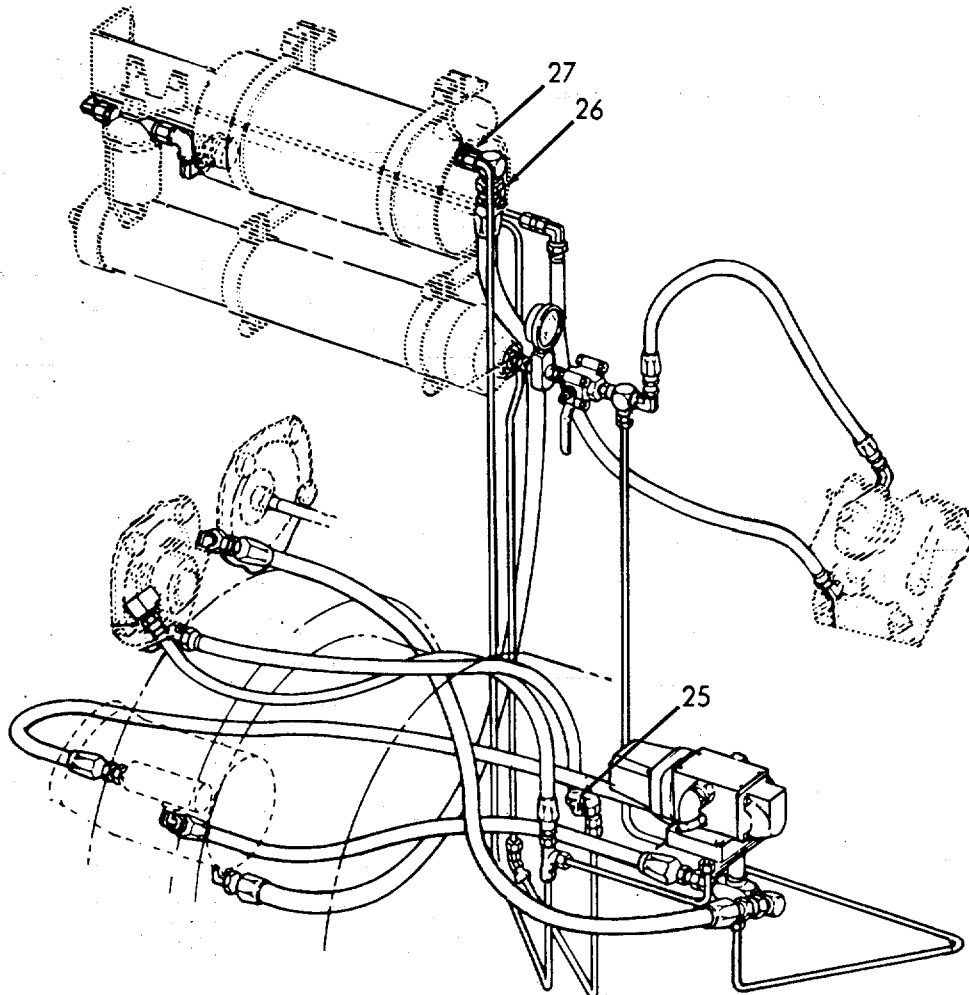


5-80. HYDRAULIC FILTER AND PIPING - ANCHOR WINCH - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|-----|--------------------------|--------------------|--|
| y. | 90° female elbow
(25) | Repair or replace. | |
| z. | 90° male elbow
(26) | Repair or replace. | |
| aa. | Male connector
(27) | Repair or replace. | |



5-81. HYDRAULIC RESERVOIR - ANCHOR WINCH - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

3-137 Reservoir

Special Tools

Welding equipment

Equipment

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe standard safety procedures.

LOCATION

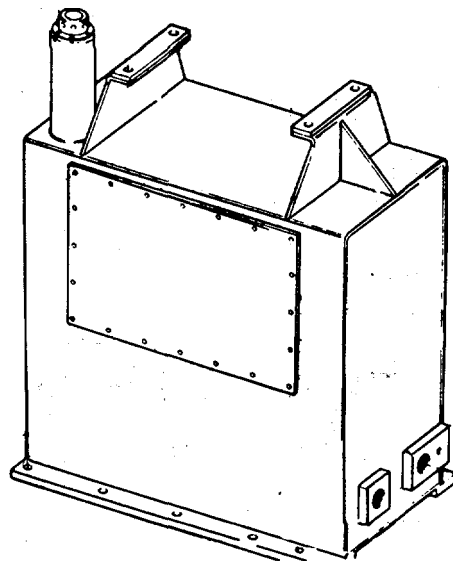
ITEM

ACTION

REMARKS

REPAIR

The maintenance of the Reservoir at this level is restricted to welding.



5-82. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Removal

b. Repair

c. Installation

INITIAL SETUP

Test Equipment

NONE

References

3-182 Anchor "A" Frame
5-83 Fairleader Removal

Special Tools

Crane and slings
Welding tool

Equipment

Condition Condition Description

NONE

Material/Parts

Grease MIL-G-10924
Type GAA

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

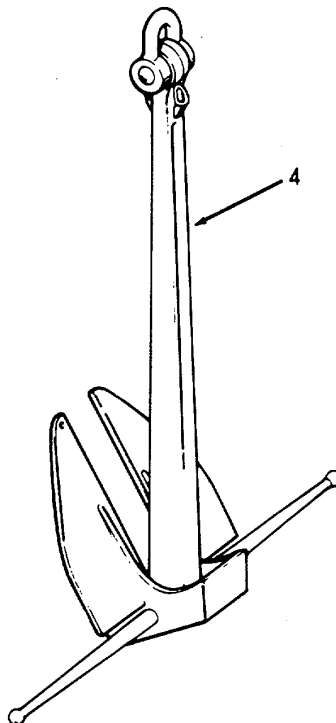
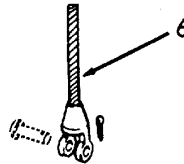
- Observe standard safety procedure when lifting heavy equipment.
- Observe standard safety procedure when welding.

5-82. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

- | | | | |
|--------------|---------------------------|-----------------------------------|-------------------------|
| 1. "A" Frame | a. Anchor (4) | Remove. | |
| | b. Anchor cable (6) | Remove from anchor and "A" frame. | |
| | c. Fair-leader | Remove. | If necessary. See 5-83. |
| | d. Miscellaneous hardware | Remove. | |



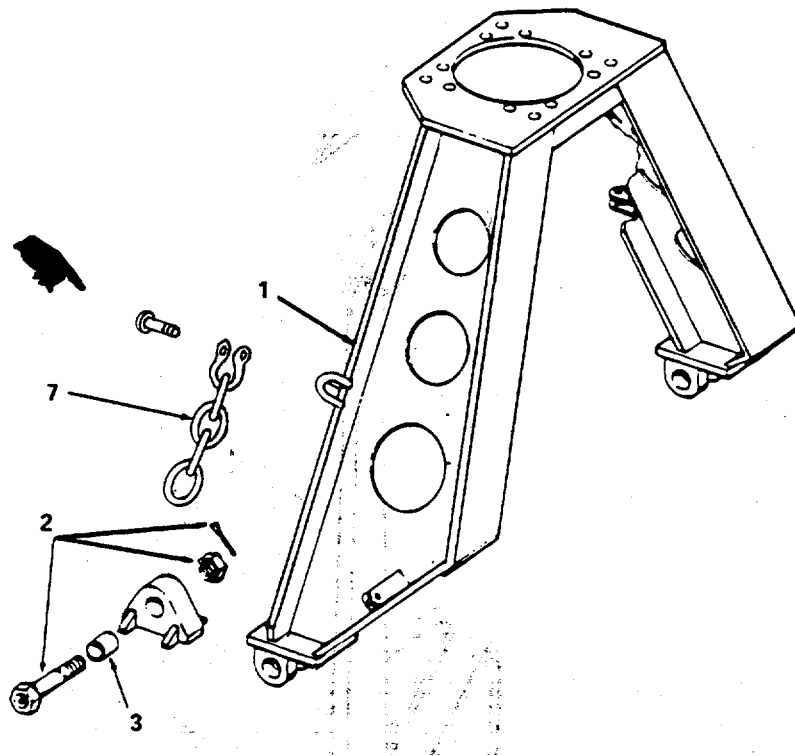
5-1098

5-82. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | | |
|----|---------------------------------|--------------------------|--|
| e. | Safety chain (7) | Remove. | |
| f. | "A" frame (1) | Attach slings and crane. | |
| g. | Cotter pins bolts, and nuts (2) | Remove. | |
| h. | "A" frame (1) | Lift and remove. | |
| i. | Bushings (3) | Remove. | |

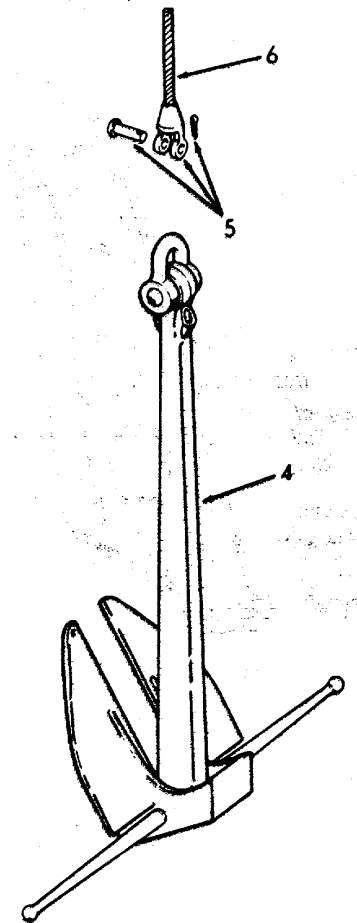


5-82. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

- | | | | |
|----|----------------------------------|---------------------|--|
| 2. | a. Anchor
(4) | Repair or replace.. | |
| | b. Wire
rope
socket
(5) | Repair or replace. | |
| | c. Anchor
cable
(6) | Repair or replace. | |

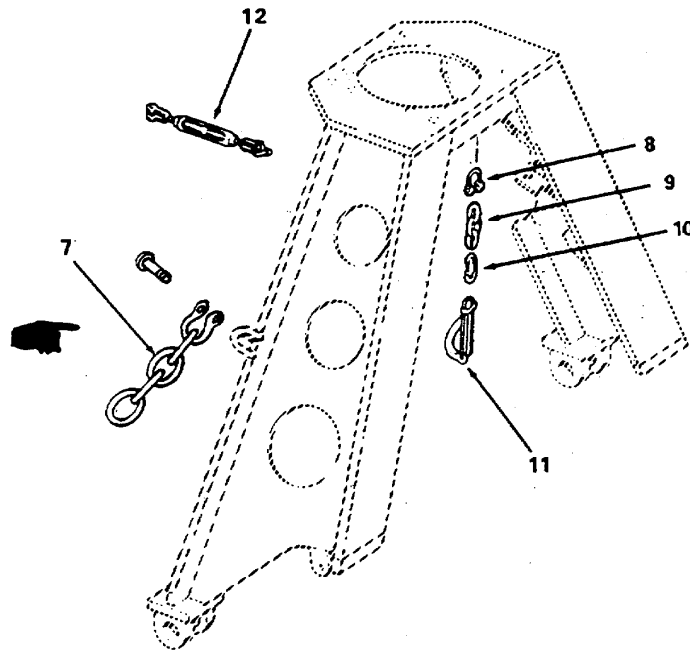


5-82. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | |
|----|---------------------------|--------------------|
| d. | Safety chain (7) | Repair or replace. |
| e. | A-frame chain shackle (8) | Repair or replace. |
| f. | Coil chain (9) | Repair or replace. |
| g. | Link (10) | Repair or replace. |
| h. | A-frame Pelican hook (11) | Repair or replace. |
| i. | Turnbuckle (12) | Repair or replace. |



5-82. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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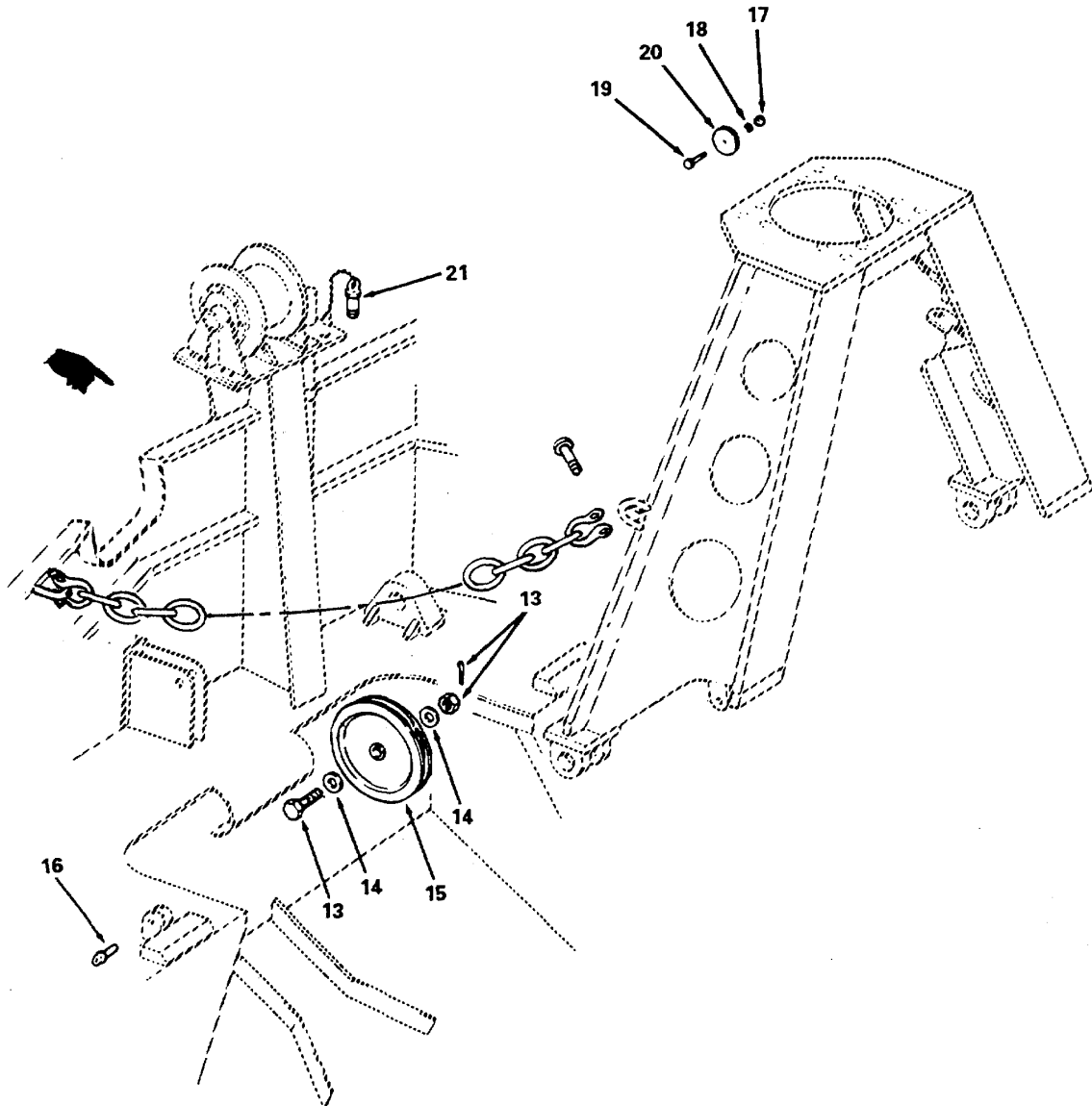
REPAIR (Cont)

- | | | | |
|--|---|---------------------|--|
| | i. Cotter pin
nut, and
sheave
pin (13) | Repair or replace., | |
| | j. Brass
washer
(14) | Repair or replace. | |
| | k. Ball
bearing
guide
sheave
(15) | Repair or replace. | |
| | l. Toggle
pin (16) | Repair or replace. | |
| | m. Plain
hex nut
(17) j | Repair or-replace. | |
| | n. Lockwasher
(18) - | Repair or replace, | |
| | o. Hex
head
capscrew
(19) | Repair or replace. | |
| | p. Wire
rope
sheave
(20) M | Repair or replace. | |
| | q. Toggle
pin
(21) | Repair or replace. | |

5-82. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



4951-188

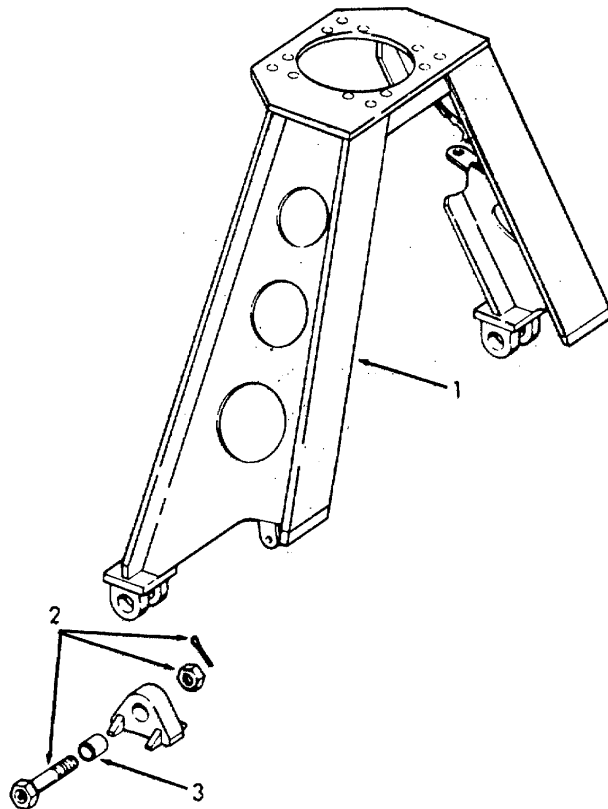
5-82. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | | | |
|----|--|---|--|
| 3. | a. Bushings
(3) | Install, | |
| | b. A-frame
(1) | Lower into position. | |
| | c. Bolts,
nuts,
and
cotter
pins
(2) | 1. Install.

2. Lubricate at grease
fitting. | Use grease
MIL-G-10924 type
GAA. |
| | d. All
removed
parts | Reinstall. | |



5-83. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Removal b. Repair c. Installation
-

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
Crane

Equipment
Condition Condition Description
NONE

Material/Parts
Grease MIL-G-10924
Type GAA

Special Environmental Conditions
NONE

Personnel Required
1

General Safety Instructions
Observe standard safety precautions
when lifting heavy equipment.

5-83. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS
(Continued).

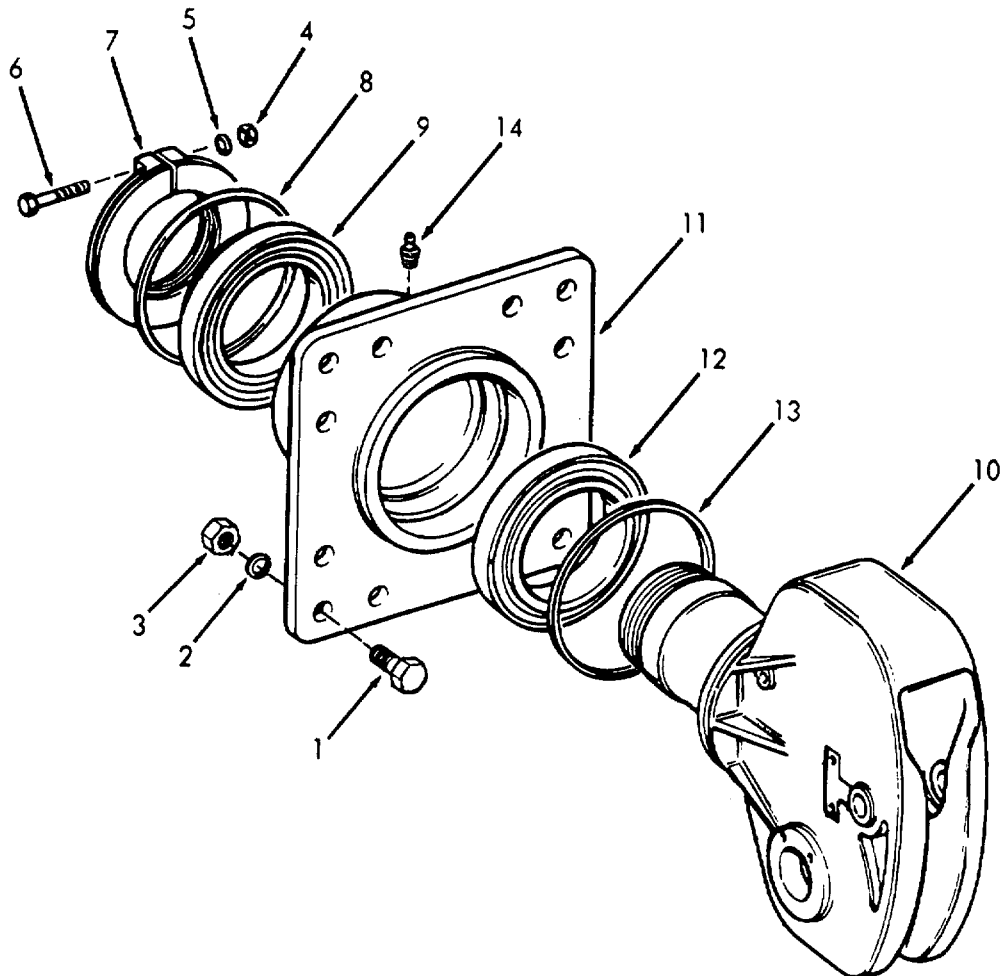
LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. Fair leader	a. Anchor cable	Remove.	
	b. Nuts (1), lock-washers (2), and screws (3)	Remove 12 places.	
	c. Fair-leader assembly	1. Attach sling and crane. 2. Lift up and remove.	
2. Flange and Hub	a. Nut (4), lock-washer (5), and screw (6)	Remove.	
	b. Shank collar (7)	Unscrew and remove.	
	c. Felt seal (8)	Remove.	
	d. Lower roller bearing (9)	Remove.	
	e. Swivel head (11)	Lift and remove from hub and flange (11).	

5-83. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | | |
|----|---------------------------|---------|---------------|
| f. | Upper roller bearing (12) | Remove. | |
| g. | Felt seal (13) | Remove. | |
| h. | Grease fitting (14) | Remove. | If necessary. |



5-83. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
3. Flange and Hub	a. All parts	Clean.	
	b. Bearings (9 and 12)	Pack with grease.	Use grease MIL-G-10924 Type GAA.
	c. Upper roller bearing (12)	Install into flange (11).	
	d. Felt seal (13)	Install.	
	e. Lower roller bearing (9)	Install into flange (11).	
	f. Felt seal (8)	Install.	
	g. Swivel head (10)	Lower into hub and flange (11).	
	h. Shank collar (7)	Install.	
	i. Screw (6) , lock-washer (5), and nut (4)	Install.	
	j. Grease fitting (14)	Grease.	Use grease MIL-G-10924 Type GAA.

5-83. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)			
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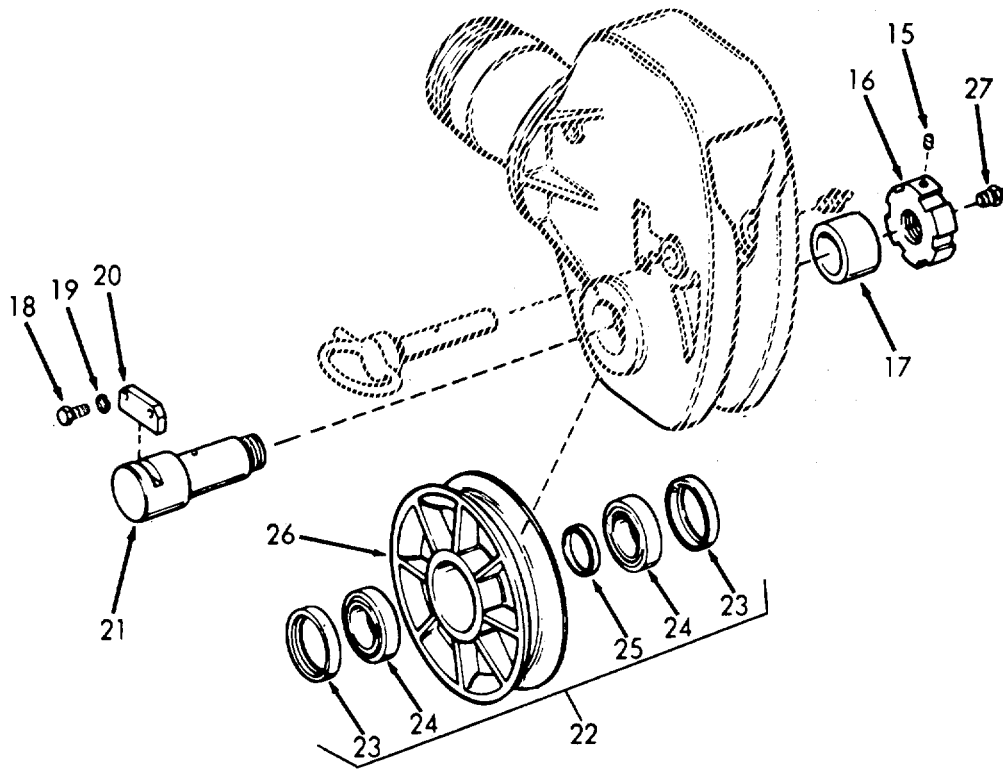
	d. Screws (18), and lock-washers (19)	Remove.	
	e. Pin lock plate (20)	Remove.	
	f. Sheave pin (21)	Withdraw slowly.	
	g. Sheave assembly (22)	Remove.	
	h. Grease retainers (23), roller bearings (24)s, and spacer (25)	<ol style="list-style-type: none"> 1. Remove from sheave (26). 2. Clean. 3. Repack bearings. 4. Reassemble. 	Use grease MIL-G-10924 Type GAA.
	i. Sheave assembly (22)	Install.	
	j. Sheave pin (21)	Install.	
	k. Pin lock plate (20)	Install.	
	l. Screws (18), and lock-washers (19)	Install.	

5-83. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

m.	Spacer (17)	Install.	
n.	Sheave nut (16)	Loosen.	
o.	Setscrew (15)	Tighten.	
p.	Grease fitting (27)	1. Replace. 2. Grease.	If necessary. Use grease MIL- G-10924 Type GAA.



5-83. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS
(Continued).

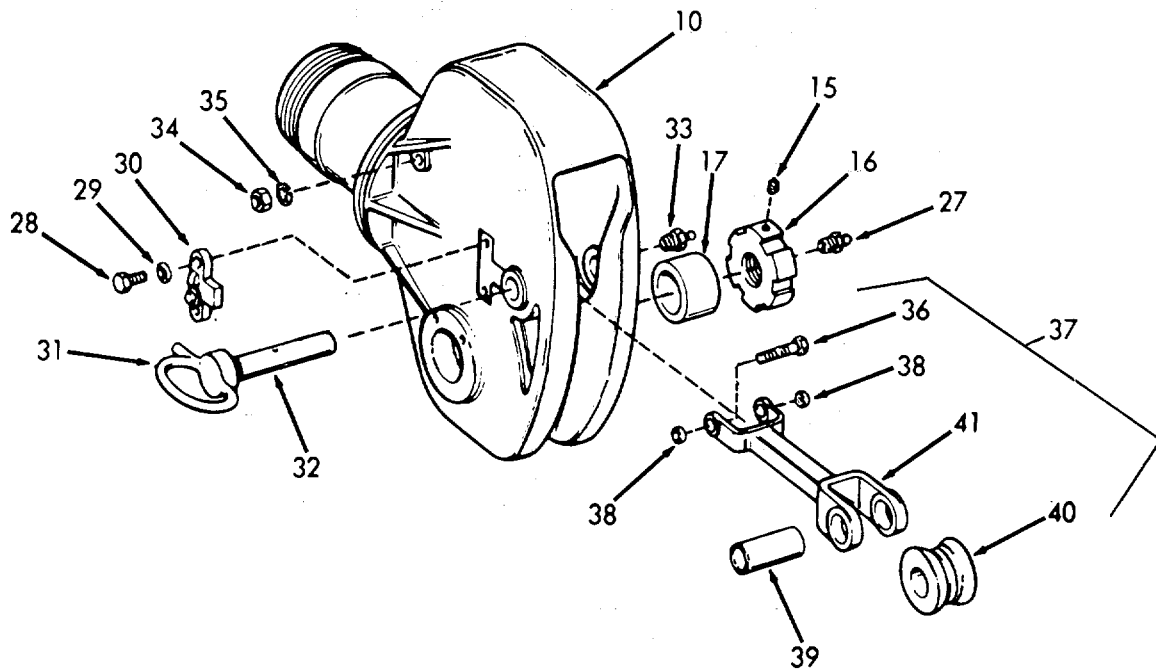
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
5. Guide Roller	a. Screws (28), and lock- washers (29)	Remove.	
	b. Roller pin key plate keeper spring (30)	Remove.	
	c. Keeper button (31), and pin (32)	Remove.	
	d. Grease fitting (33)	Remove.	If necessary.
	e. Nuts (34), lock- washers (35), and screws (36)	Remove.	
	f. Roller guide assembly (37)	Remove.	
	g. Hinge bushing (38), roller sleeve (39), and guide roller (40)	<ol style="list-style-type: none"> 1. Remove from roller frame (41). 2. Replace defective parts. 3. Reassemble. 	

5-83. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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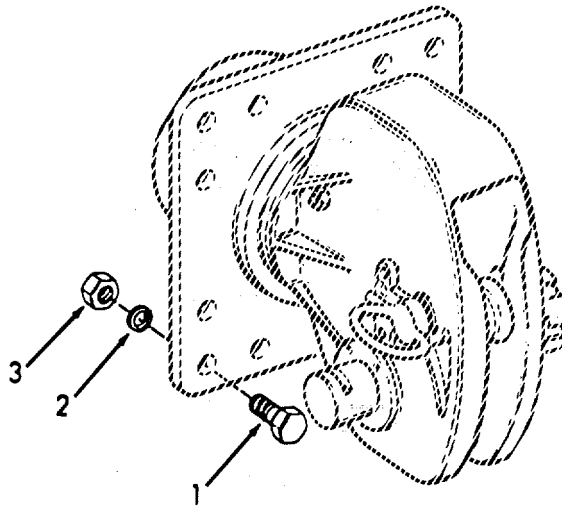
REPAIR (Cont)

- h. Roller guide assembly (37) Install in swivel head (10).
- i. Screws (36), lock washers (35), and nuts (34) Install.
- j. Keeper button (31) and pin (32) Install.
- k. Keeper (30), screws (28) and lock-washers (29) Install.



5-83. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
6. Fairleader	a. Fairlead assembly	1. Attach sling and crane.	
		2. Lift and put in place.	
	b. Screws (3), lock-washers (2), and nuts (1)	Install.	
	c. Anchor cable	Install.	



5-84. MAST - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Removal b. Repair c. Installation

INITIAL SETUP

Test Equipment
NONE

References
Paragraph

3-185 Mast Operators' Maintenance Instructions

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
4

General Safety Instructions
Observe WARNING in this procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------



In order to avoid shock and serious injury, place all switches and circuit breakers in the OFF position, and tag.

REMOVAL

- | | | |
|---------|--------------------|---------------------|
| 1. Mast | a. Wiring | Tag and disconnect. |
| | b. Signal halyards | Remove. |

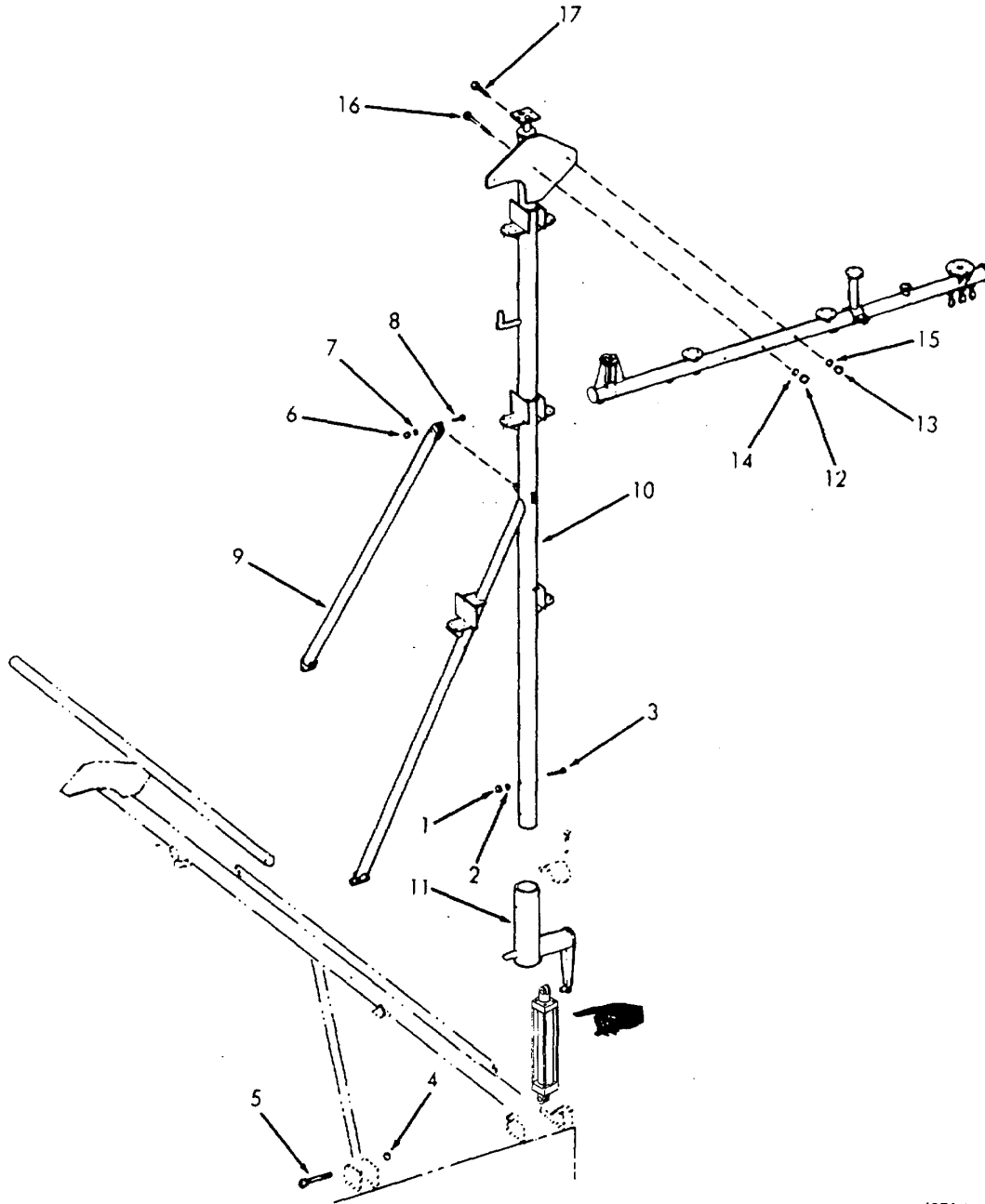
5-84. MAST - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS	
REMOVAL (Cont)	c. Mast	1. Place in vertical position . 2. Attach slings and crane .		
	d. Nuts (1), lock-washers (2) , and screws (3)	Remove.		
	e. Nut (4), and screw (5)	Remove.		
	f. Nuts (6), lock-washers (7) , and screws (8)	Remove.		
	g. Aft strut (9)	Remove.		
	h. Mast (10)	Remove from pivot (11).		
	2. Yardarm	a. Nuts (12 and 13), lock-washers (14 and 15), and screws (16 and 17)	Remove.	

5-84. MAST - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



4954-215

Change 1

5-1117

5-84. MAST - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	b. Yardarm (18)	Remove.	
	c. Yardarm pivot assembly y (19)	Remove.	
3. Pivot	a. Hydraulic Assembly and clevis ,attaching parts	Remove. ram (20),	
	b. Screws (21), and lock- washers (22)	Remove.	
	c. Saddle clamps (23)	Remove.	
	d. Pivot assembly (11)	Remove.	

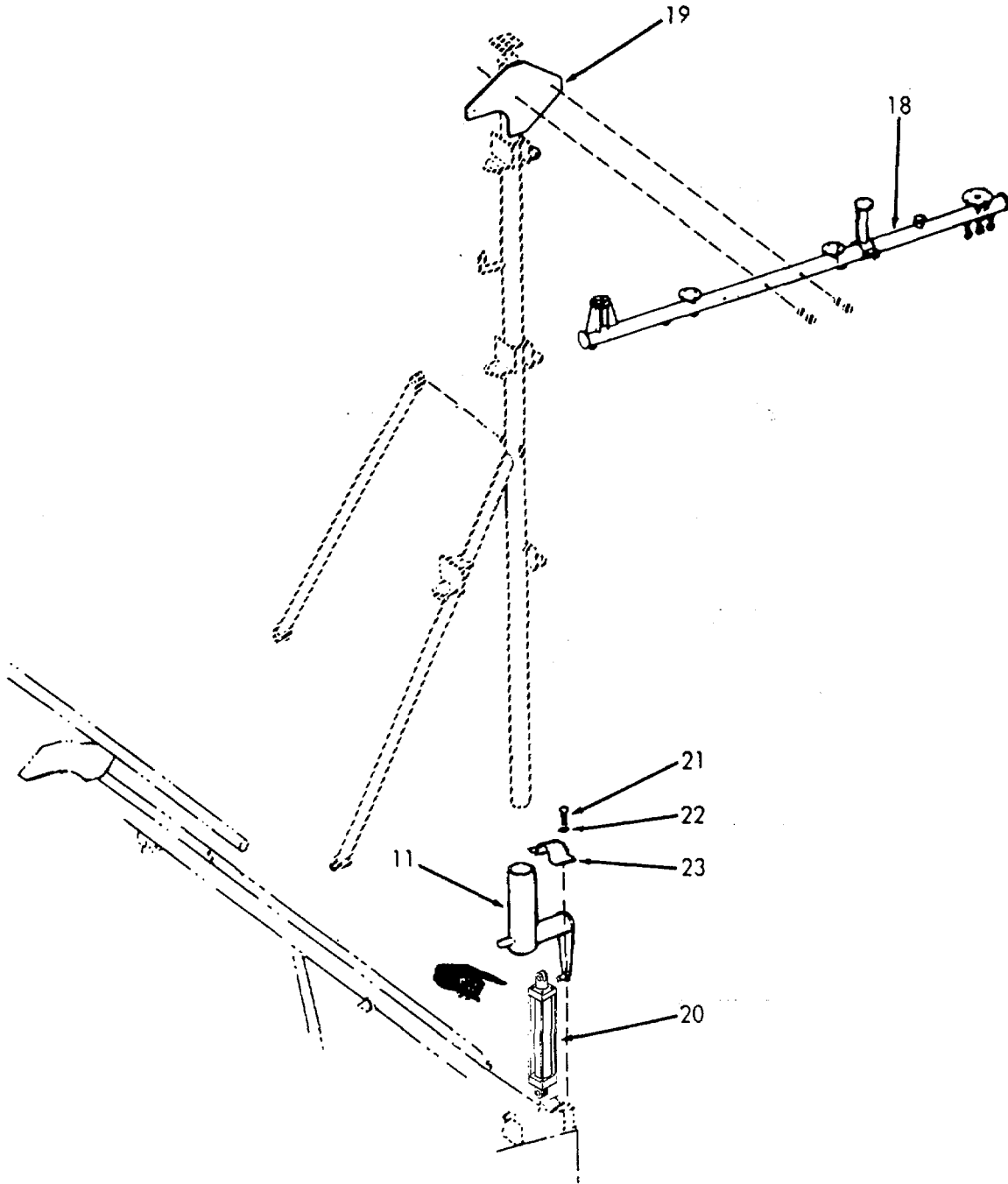
REPAIR

4. Mast and Yardarm Repair the mast, yardarm, and struts in accordance with standard procedures.

5-84. MAST - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)			
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4954-216

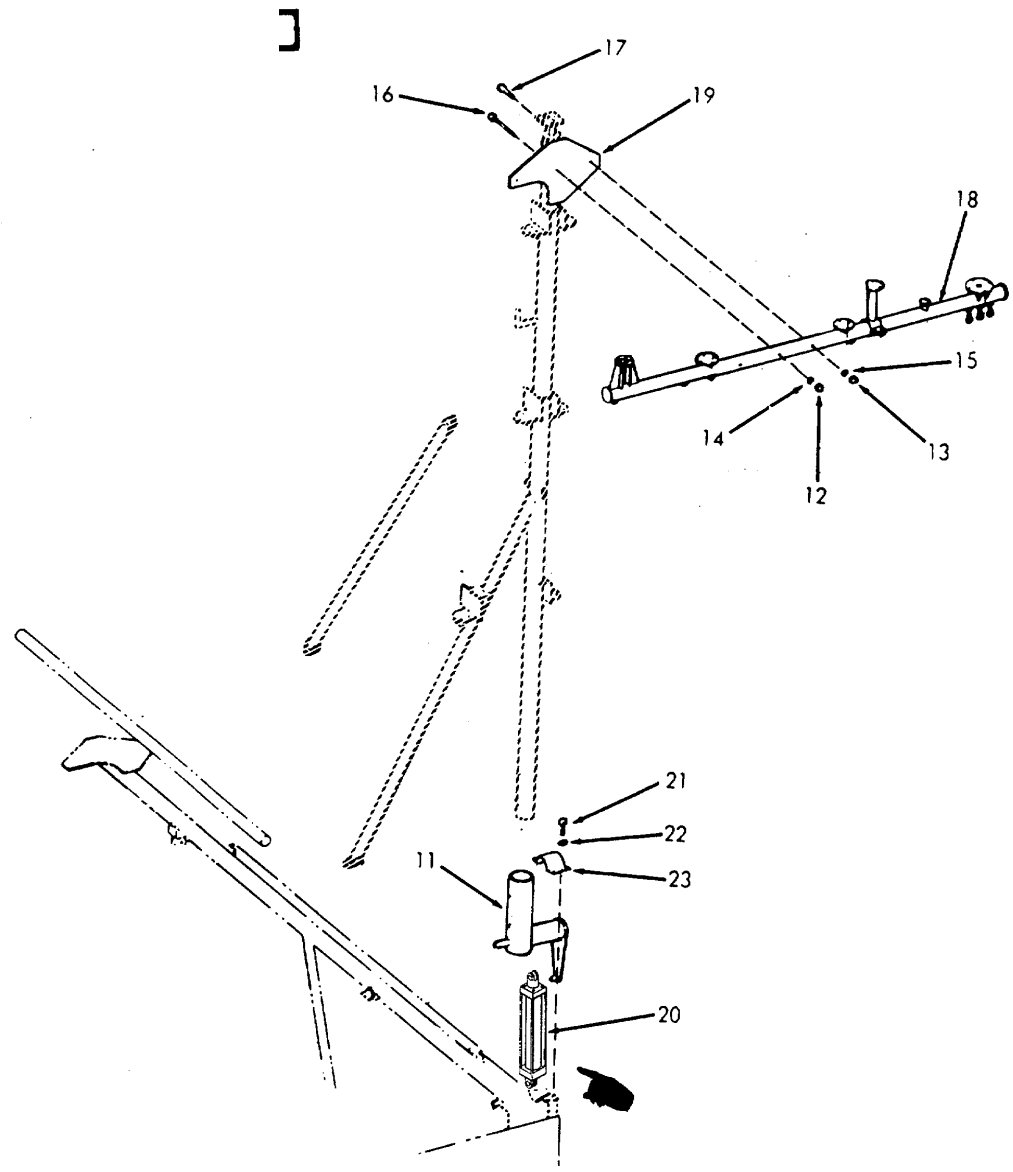
5-84. MAST - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
5. Pivot Assembly	a. Pivot assembly (11)	Install,	
	b. Saddle clamps (23)	Install.	
	c. Screws (21) and lock-washers (22)	Install.	
	d. Hydraulic ram (20), clevis attaching parts	Install,	
6. Yardarm	a. Yardarm pivot assembly (19)	Install.	
	b. Yardarm (18)	Install.	
	c. Screws (16 and 17), lock-washers (14 and 15), and nuts (12 and 13)	Install.	

5-84. MAST - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



4954-217

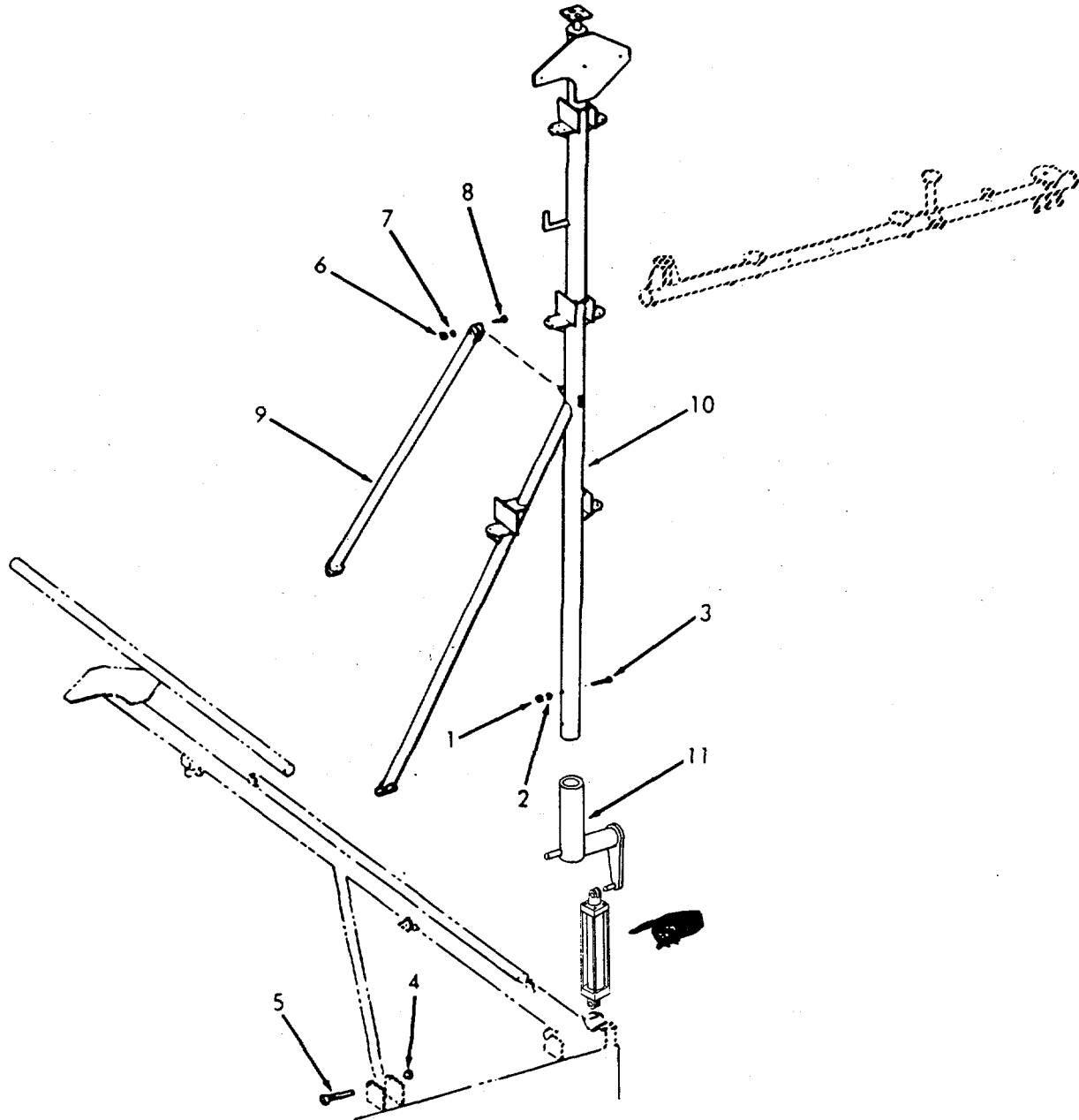
5-84. MAST - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
7. Mast	a. Mast (10)	1. Attach slings and crane.	
	b. Aft strut (9)	2. Lower onto pivot (11). Install.	
	c. Screws (8), lock-washers (7), and nuts (6)	Install.	
	d. Screw and nut (4)	Install.	
	e. Screws (3), lock-washers (2), and nuts (1)	Install.	
	f. Mast	Lower.	
	g. Signal halyards	Install,	
	h. Wiring	Reconnect.	

5-84. MAST - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)



4954-218

Change 1

5-1123/(5-1124 Blank)

5-85. SHIP'S HYDRAULIC SYSTEM - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance procedures.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Electric Motor	5-86
Hydraulic Pump	5-87
Hydraulic Reservoir	5-88
Controller	5-89
Starter (Nema, size D, 3 pole)	5-89.1
Gages	5-90
Pushbutton Switch	5-91

5-86. ELECTRIC MOTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

Bearing puller

Equipment

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNING in this procedure.

5-86. ELECTRIC MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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WARNING

In order to avoid shock and serious injury, place and tag all switches and circuit breakers in the OFF position.

REPAIR

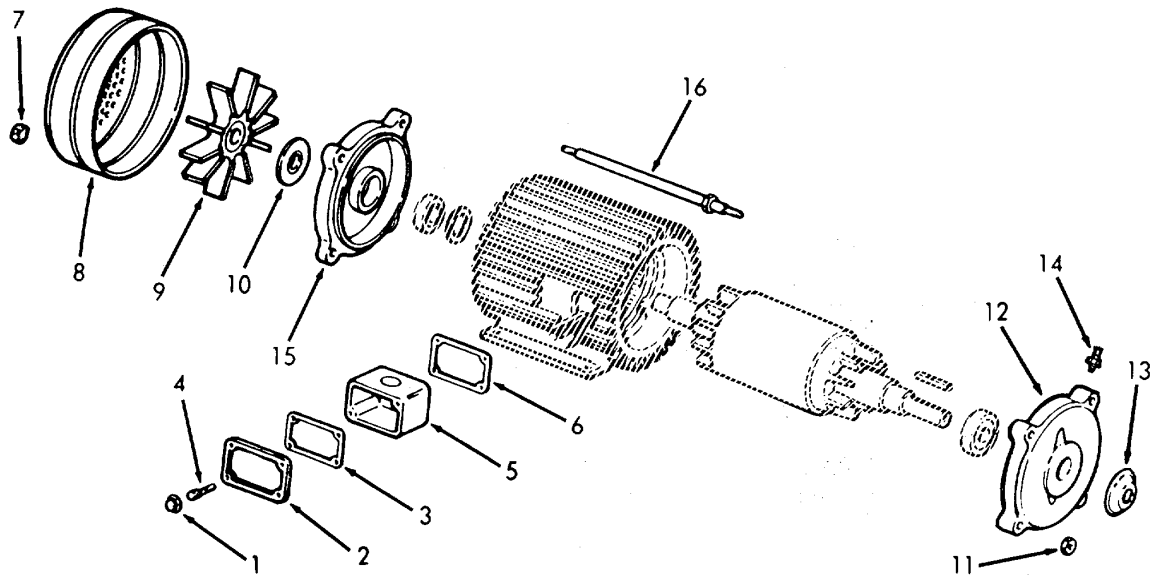
- | | | | |
|----|-------|--|-------------|
| 1. | Motor | a. Acorn nuts (1) | Remove. |
| | | b. Conduit box cover (2), and gasket (3) | Remove. |
| | | c. Wiring | Disconnect. |
| | | d. Studs (4) | Remove. |
| | | e. Conduit box (5), and gasket (6) | Remove. |
| | | f. Nuts (7) | Remove. |
| | | g. Fan shroud (8) | Remove. |
| | | h. Fan (9) | Remove. |
| | | i. Rubber slinger (10) | Remove. |

5-86. ELECTRIC MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- j. Nuts (11) Remove.
- k. Shaft end bracket (12) Remove.
- l. Rubber slinger (13) Remove.
- m. Grease fitting (14) Remove. If necessary.
- n. Blind end bracket (15) Remove.
- o. Through bolts (16) Remove.



5-86. ELECTRIC MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- z Conduit box gasket (6) and box (5)
- aa. Studs (4)
- ab. Wiring
- ac. Conduit box gasket (3) and cover (2)
- ad. Acorn nuts (1)

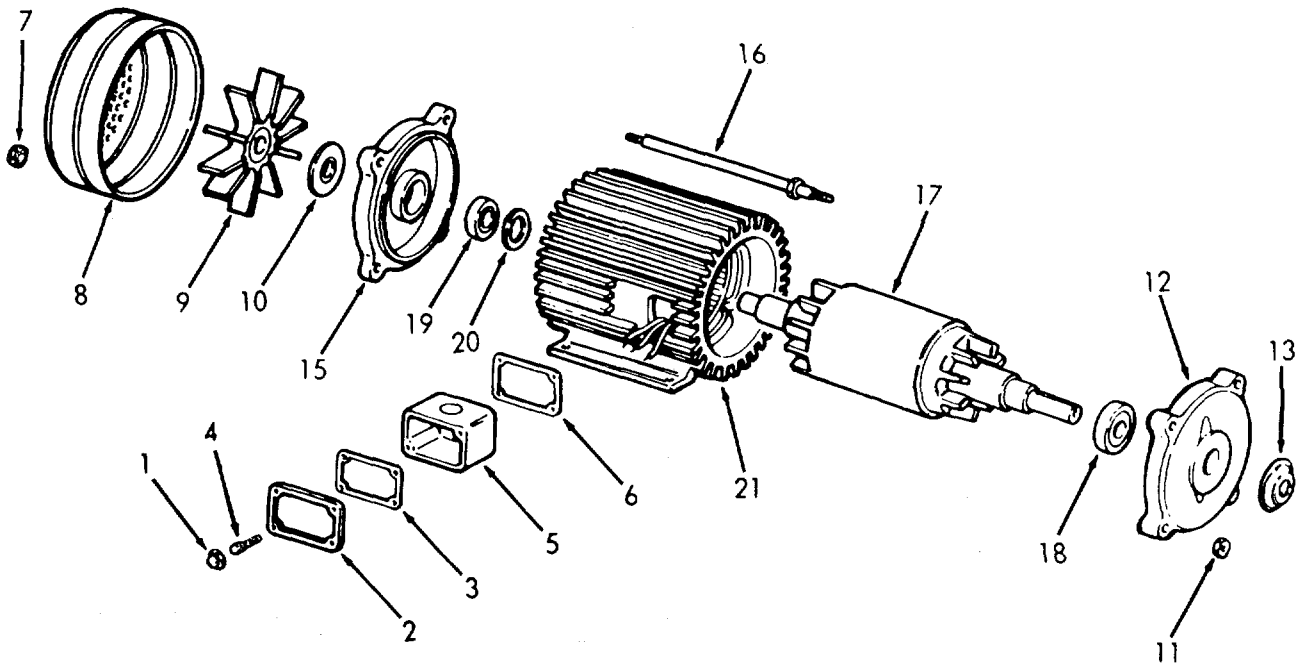
Install.

Install.

Reconnect.

Install.

Install.



5-87. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

Soft hammer
Torque wrench
Vice (soft jaws)

Equipment
Condition Condition Description
Paragraph

3-206 Hydraulic Cub Pump Removal

Material/Parts

Cartridge kit P/N 923470
Gasket kit P/N 923548
Hydraulic fluid
Petroleum jelly

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNINGS in procedure.

5-87. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY			
1. Pump	a. Bolts (1), and pump bracket (2)	Remove.	
	b. Pump	Clamp in a vise with soft jaws with the cover (3) up.	
	c. Screws (4), and cover (3)	Remove.	
	d. Preformed packing (5), spring (6), and pressure plate (7)	Remove.	Discard packing.
	e. Ring (8)	Remove.	Discard. Note position of ring for later reassembly.
	f. Pre- formed packing (9)	Remove.	Discard.
	g. Locating pins (10)	Remove.	
	h. Vanes (11), and rotor (12)	Separate.	Discard.
	i. Rotor (12)	Remove.	
	j. Body (13)	Turn over.	

5-87. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

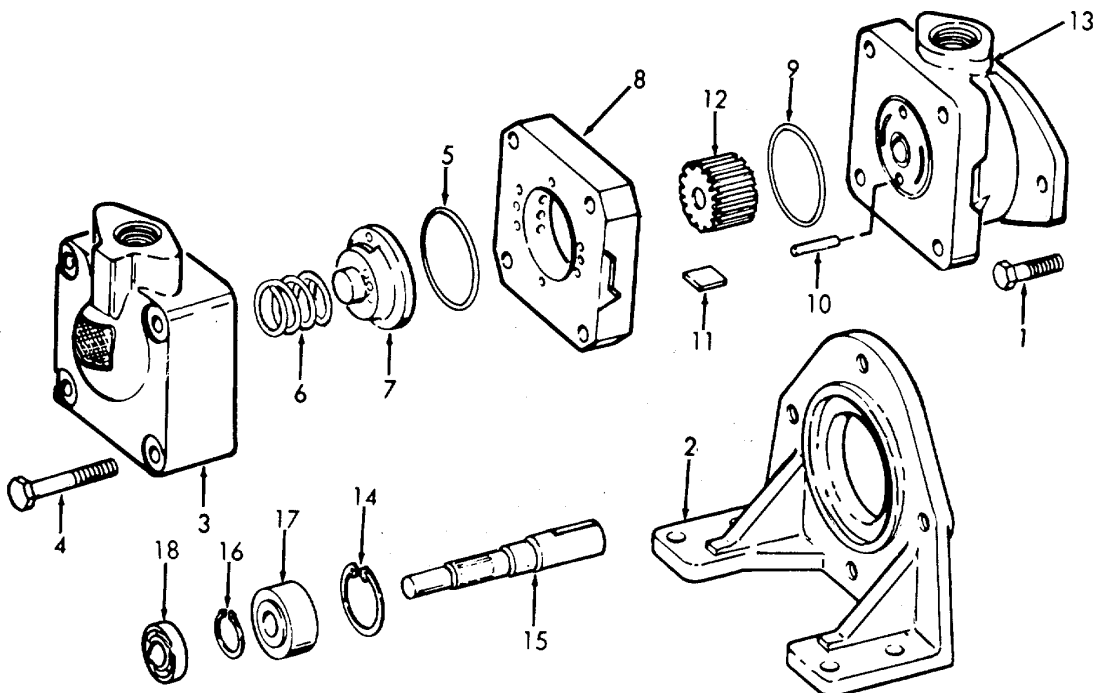
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL-DISASSEMBLY (Cont)

- | | | | |
|----|-------------------------|--|---|
| k. | Snapring
(14) | Remove. | |
| l. | Shaft
(15) | Tap on the splined
end to force the shaft
out of the body. | Use soft hammer. |
| m. | Small snap
ring (16) | Remove. | |
| n. | Bearing
(17) | 1. Support inner race.

2. Press shaft (15) out
of bearing. | |
| o. | Shaft
seal
(18) | Pull out. | a. Use hooked
tool.

b. Discard. |



5-87. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued),.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL-CLEANING-INSPECTION			
------------------------------	--	--	--

2.

WARNING

Wear protective eye goggles when using compressed air.

All parts must be thoroughly cleaned and kept clean during inspection and assembly. The close tolerance of the parts makes this requirement more stringent than usual. Clean all removed parts, using a commercial solvent that is compatible with the system fluid. Compressed air may be used for cleaning, but it must be filtered to remove water and contamination. Clean compressed air is particularly useful in cleaning spools, orifices, and cover passages.

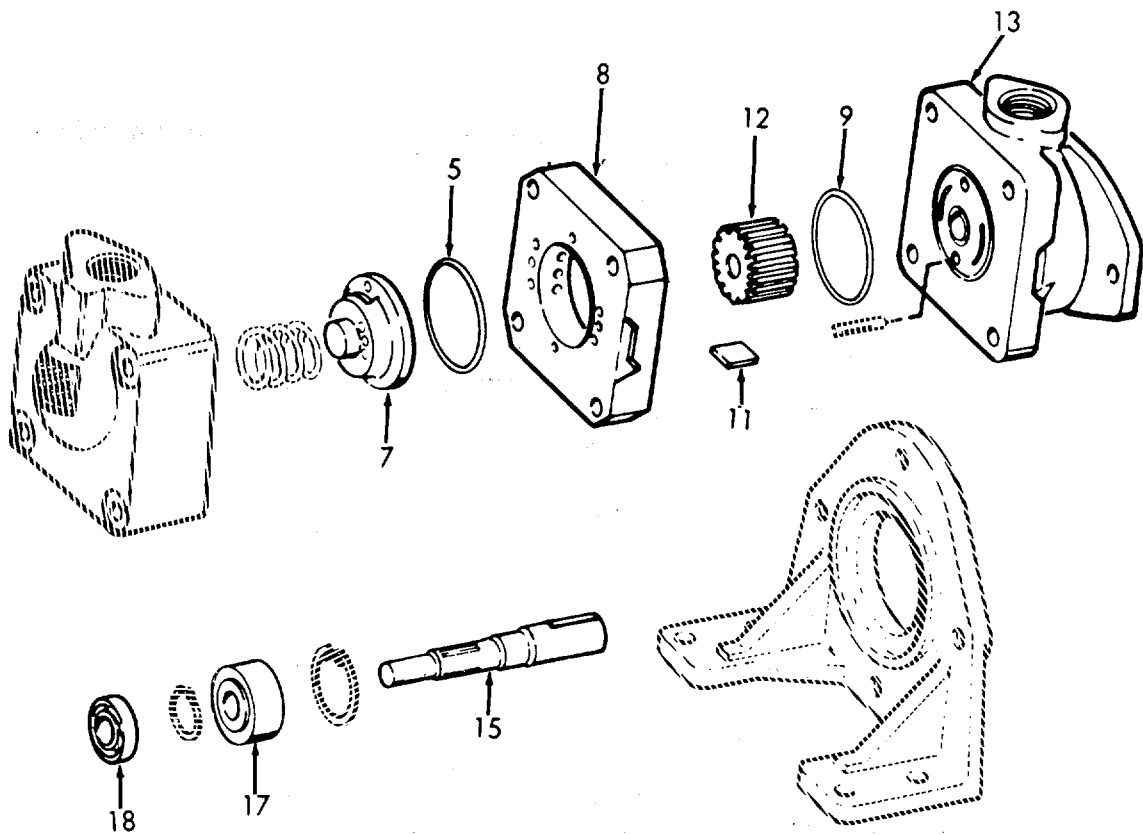
1. Discard the used shaft seal (18) and all preformed packings (5 and 9). Wash the metal parts in a solvent, blow them dry with filtered, compressed air and place them on a clean surface for inspection.
2. Check the wearing surfaces of the body (13), pressure plate (7), ring (8), and rotor (12) for scoring and excessive wear. Remove light score marks by lapping. Replace any heavily scored or badly worn parts.
3. Inspect the vanes (11) for burrs, wear and excessive play in the rotor slots. Replace the vanes (11) and rotor (12) if the slots are worn.

5-87. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL-CLEANING-INSPECTION (Cont)

4. Check the bearing (17) for wear and looseness. Rotate the bearings while applying pressure to check for pitted or cracked races.
5. Inspect the oil seal (18) mating surface on the shaft (15) for scoring or wear. If marks on the shaft cannot be removed by light polishing, replace the shaft.



5-87. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL/REASSEMBLY			
3.	NOTE		
Coat all parts with hydraulic fluid to facilitate assembly and provide initial lubrication. Use small amounts of petroleum jelly to hold preformed packing in place during assembly.			
	a. Shaft (15)	Press into bearing.	Support the bearing inner race.
	b. Small snap ring (14)	Install on shaft (15).	
	c. Shaft seal (18)	1. Press into body (13). 2. Lubricate lip with petroleum jelly.	Seals are assembled with the garter spring towards the pump body.
	d. Shaft (15)	Slide into body (13) until the bearing is seated.	Tap lightly on end of shaft if necessary.
	e. Snap ring (14)	Install.	
	f. Preformed packing (9), and locating pins (10)	Install in body.	
	g. Ring (8)	Install onto body.	Make sure arrow on perimeter points in direction of rotation

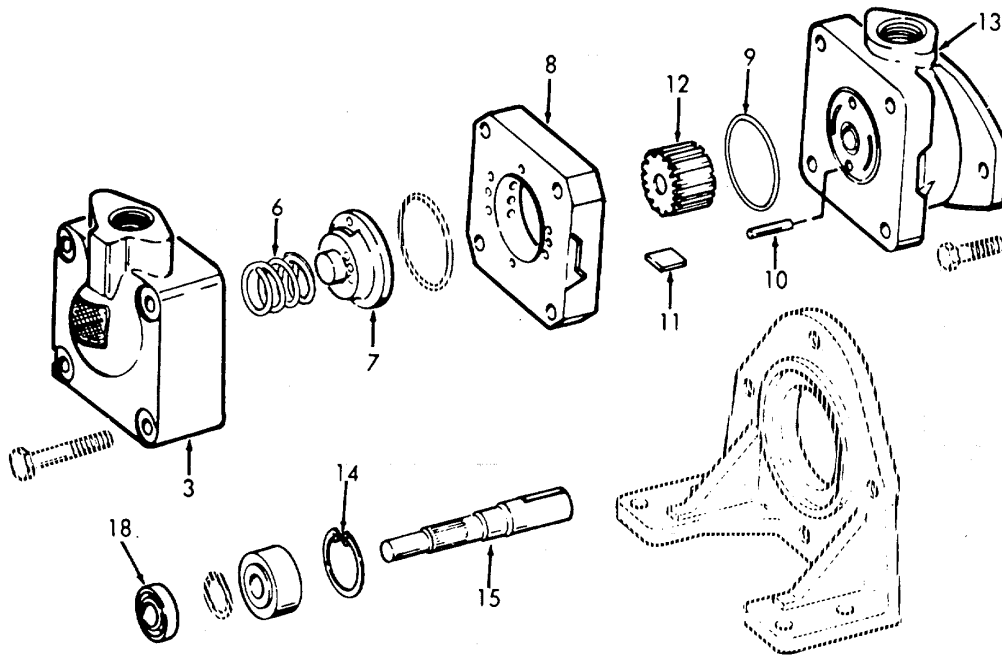
5-87. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL/REASSEMBLY (Cont)

- | | | | |
|----|-----------------------|---|--|
| h. | Rotor
(12) | Place on shaft (15). | |
| i. | Vanes
(11) | 1. Insert in rotor slots.

2. Be sure the radius edges of the vanes are toward the cam ring . | |
| j. | Pressure plate
(7) | Place on locating pins (10) and against the ring (8) . | |
| k. | Spring
(6) | Install. | |
| l. | Cover
(3) | Install. | |



5-87. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).-

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL/REASSEMBLY (Cont)

m. Screws
(4)

1. Install.

2. Tighten to 35-45
lb-ft (47.5-61.0 Nm)
torque.

n. Shaft
(15)

Rotate.

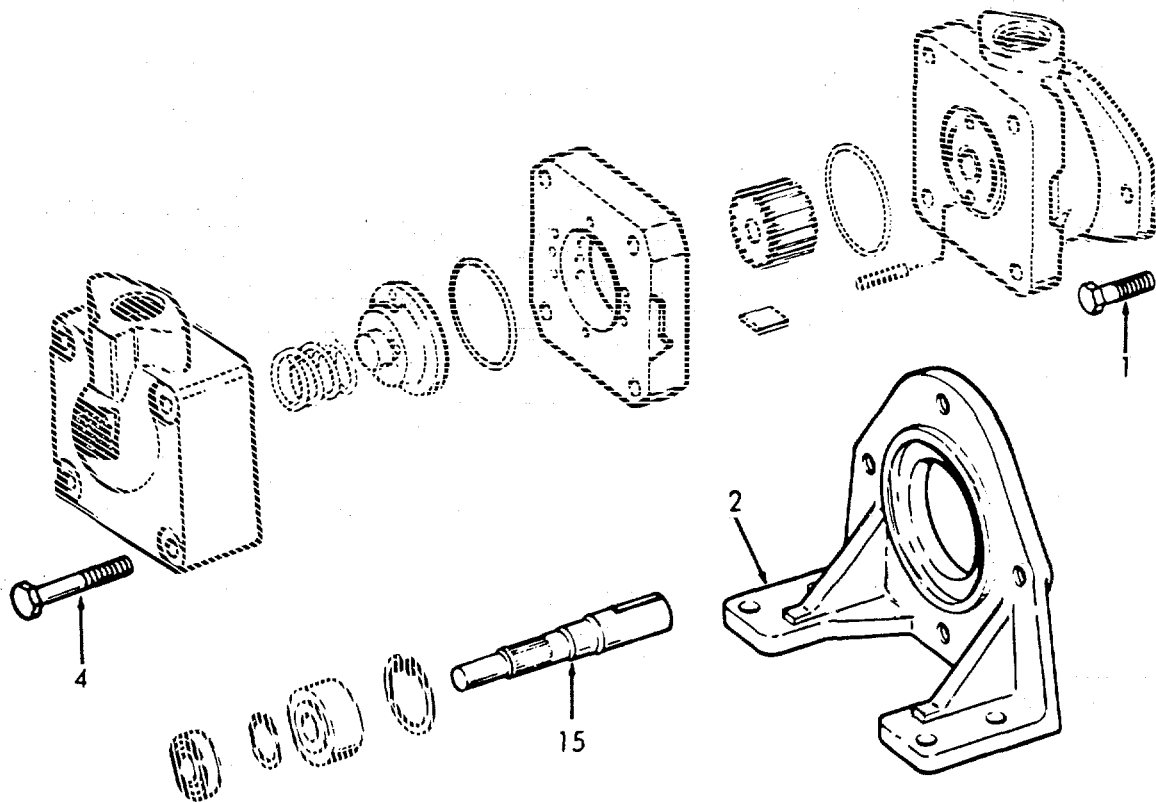
Make sure there
is no internal
binding .

o. Pump
bracket
(2)

Assemble.

p. Bolts
(1)

Install.



5-88. HYDRAULIC RESERVOIR - MAINTENANCE INSTRUCTIONS.

This task covers:

Replacement

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description
Paragraph

3-180 Hydraulic Reservoir

Material/Parts

NONE

Special Environmental Conditions

Do not drain oil into bilge.
Use the oil/water separation
and recovery system to collect
used oil .

Personnel Required

4

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

REPLACEMENT

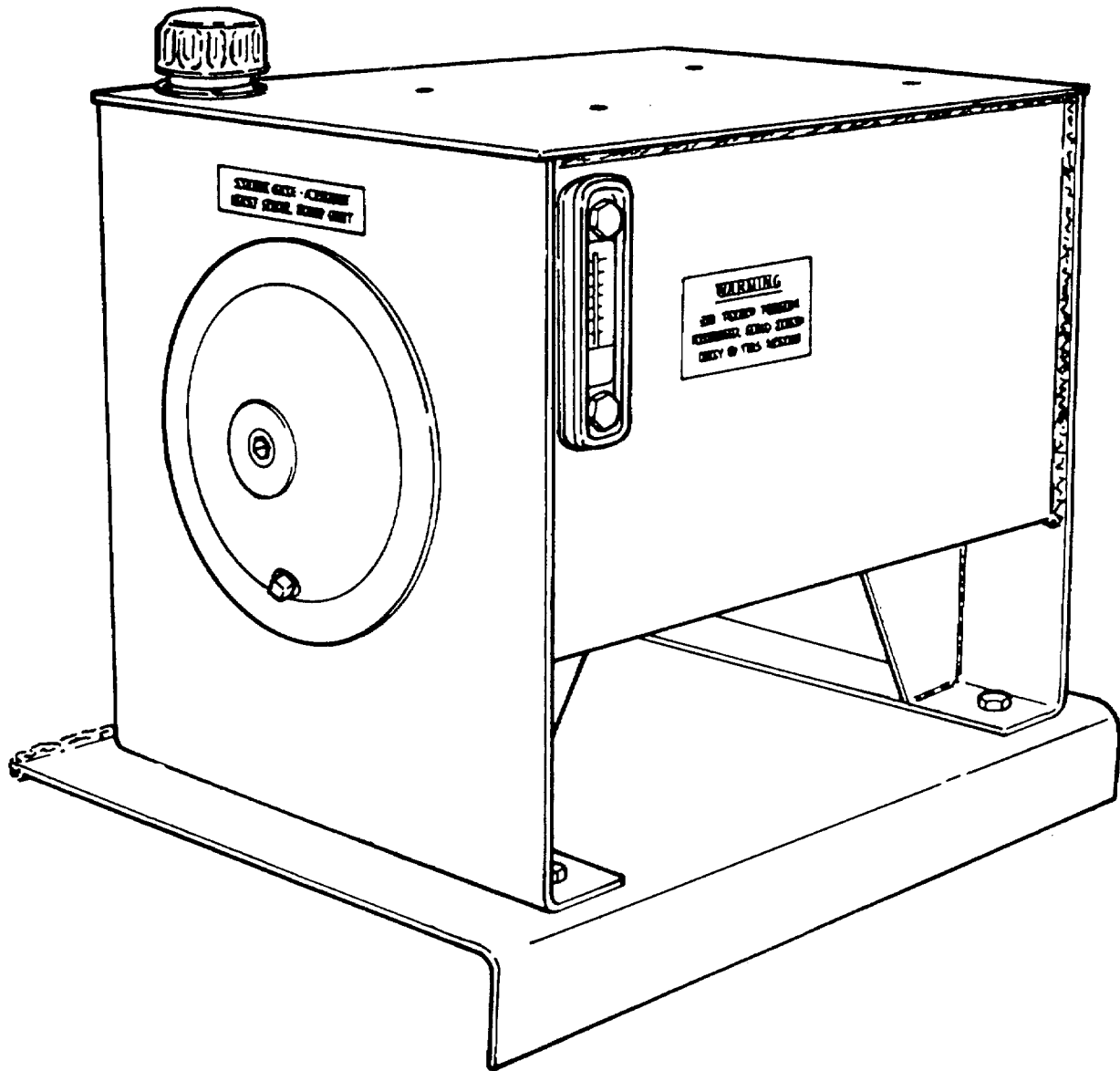
Reservoir

- a. Drain hydraulic fluid into a suitable container.
- b. Disconnect hydraulic fluid lines.
- c. Remove mounting hardware.
- d. Replace hydraulic reservoir.
- e. Reconnect hydraulic fluid lines.
- f. Fill reservoir with hydraulic fluid.

5-88. HYDRAULIC RESERVOIR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE (Cont)



5-89. CONTROLLER - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

References
Paragraph

4-89.1 Starter Maintenance
Instructions

Special Tools

Equipment
Condition Condition Description

NONE

NONE

Material/Parts

Special Environmental Conditions

NONE

NONE

Personnel Required

General Safety Instructions

1

Observe WARNING in procedure.

LOCATION

ITEM

ACTION

REMARKS

REPAIR

WARNING

In order to avoid shock and possible injury, tag and place circuit breaker in the OFF position.

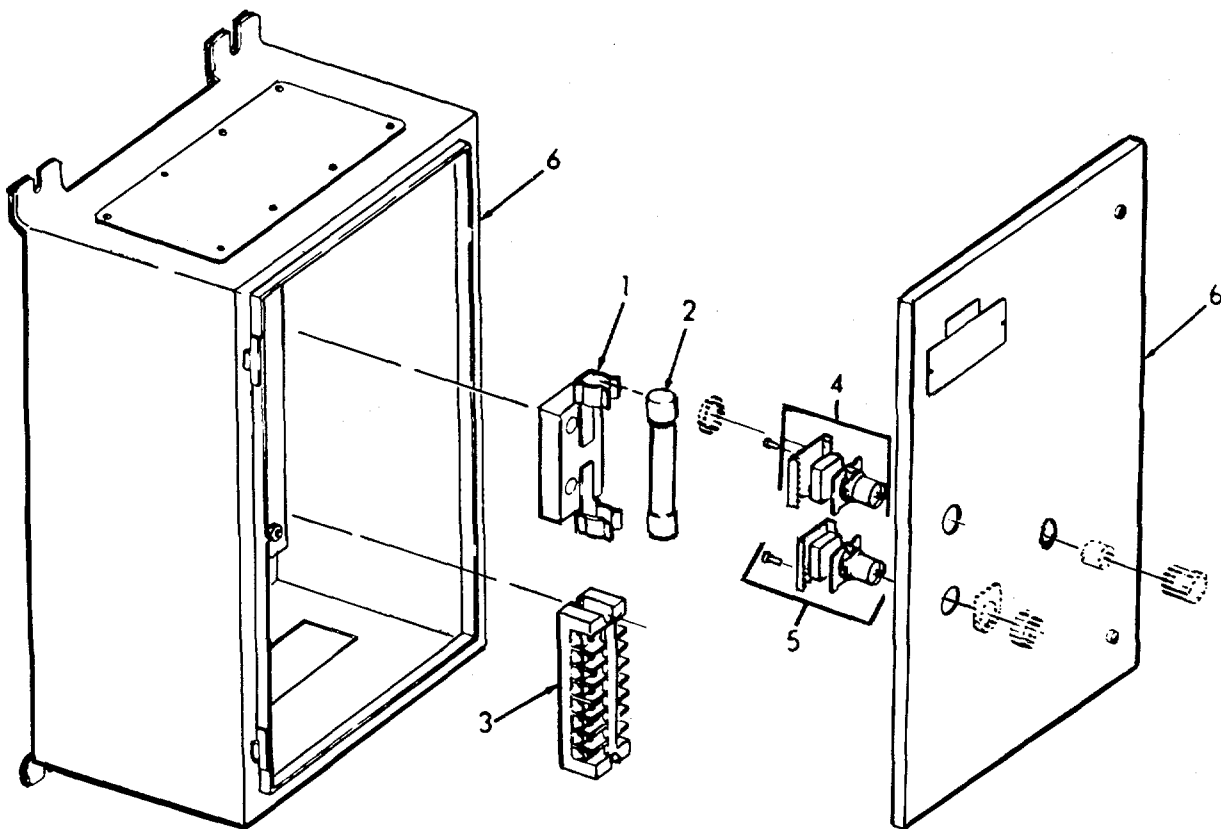
- | | | |
|---------------|-------------------|----------|
| 1. Controller | a. Fuse block (1) | Replace. |
| | b. Fuses (2) | Replace. |

5-89. CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

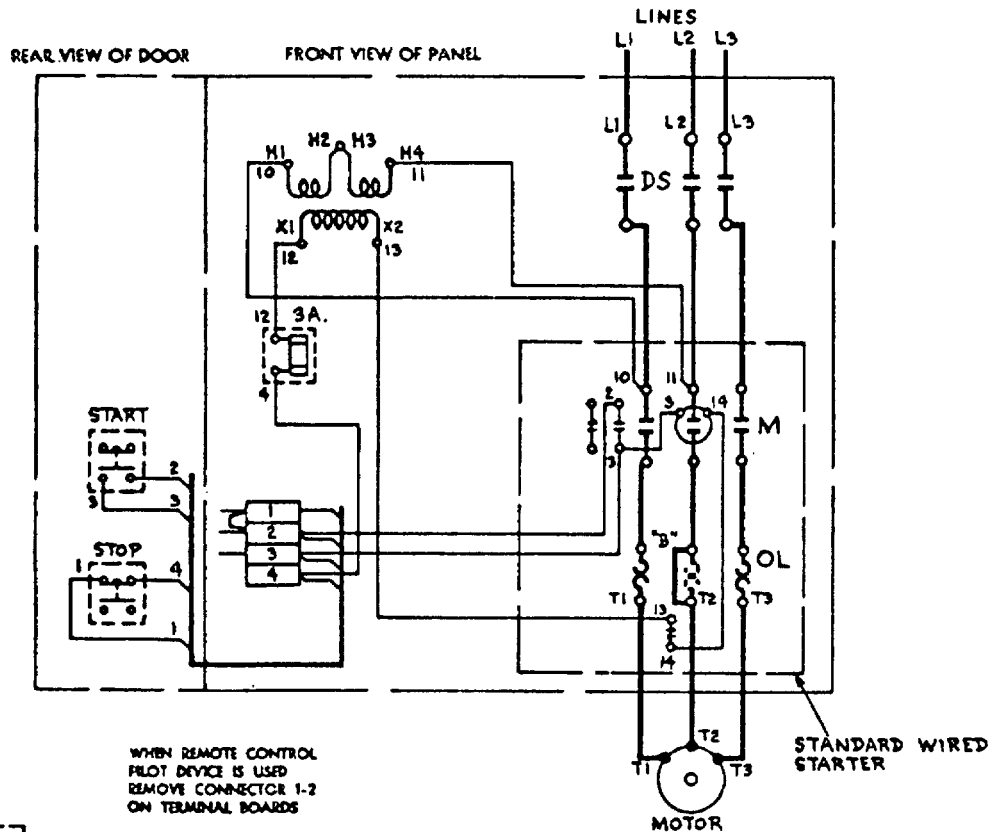
REPAIR (Cont)

- | | |
|--------------------------|------------------------------|
| c. Terminal block (3) | 1. Tag and disconnect wires. |
| | 2. Replace . |
| d. Start push-button (4) | Replace. |
| e. Stop push-button (5) | Replace. |
| f. Wall Enclosure (6) | Replace. |



5-89. CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR (Cont)



WHEN REMOTE CONTROL PILOT DEVICE IS USED REMOVE CONNECTOR 1-2 ON TERMINAL BOARDS

STANDARD WIRED STARTER

MOTOR

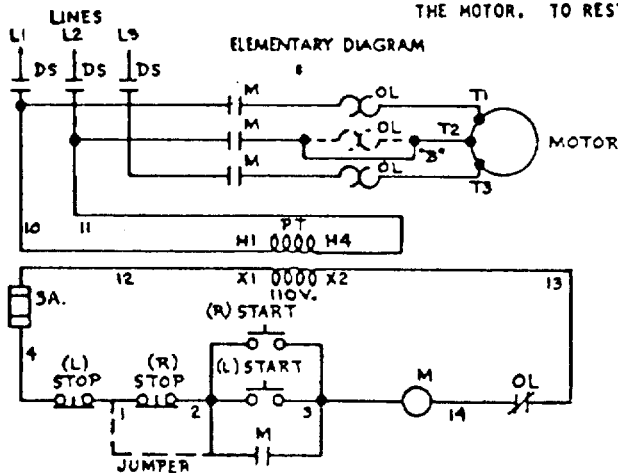
OMIT CONNECTOR "B" WHEN 3 COIL OVERLOAD IS USED.



WHEN MORE THAN ONE PUSH BUTTON STATION IS USED CONNECT PER DOTTED LINES OMITTING CONNECTOR "A"

DESCRIPTION OF OPERATION

TO START THE MOTOR PRESS THE START BUTTON. THIS ENERGIZES CONTACTOR M CONNECTING THE MOTOR ACROSS THE LINE. M MAINTAINS ITSELF THROUGH ITS OWN AUXILIARY CONTACT. TO STOP THE MOTOR PRESS THE STOP BUTTON. A VOLTAGE FAILURE WILL CAUSE M TO OPEN, STOPPING THE MOTOR. TO RESTART, WHEN VOLTAGE IS RESTORED, PRESS THE START BUTTON (LOW VOLTAGE PROTECTION). AN OVERLOAD WILL CAUSE THE OL CONTACTS TO OPEN CAUSING M TO OPEN STOPPING THE MOTOR. TO RESTART, PRESS THE STOP-RESET BUTTON AND THEN THE START BUTTON.



(L) = LOCAL
(R) = REMOTE

5-89.1. STARTER (NEMA, SIZE D, 3 POLE) - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

Renewal set controls
P/N 6-22-2

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNINGS.

LOCATION

ITEM

ACTION

REMARKS

REPAIR

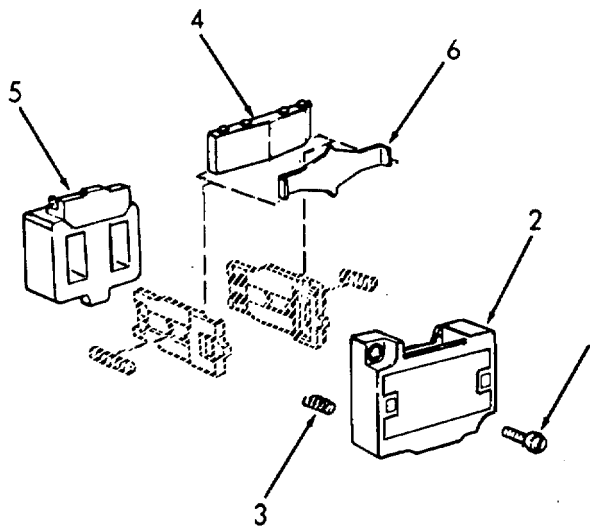
WARNING

In order to avoid shock and possible injury, place and tag disconnect switch and circuit breaker in the OFF position.

1. Operating coil
 - a. Two Remove. screws (1), and cover (2)
 - b. Four Remove. springs (3)

5-89.1. STARTER (NEMA, SIZE D, 3 POLE) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
c.	Armature (4)	1. Tilt the top away from coil (5). 2. Slide armature up and out.	
d.	Spring plate (6)	Remove.	
e.	Coil (5)	1. Pull straight out. 2. Replace.	Coil terminal blades must engage coil terminal clips.
f.	Spring plate (6)	Install and seal.	



5-89.1. STARTER (NEMA, SIZE D, 3 POLE) - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	g. Armature (4)	Slide (narrow end to the right) into its seated operating position .	
	h. Spring (3)	Install.	
	i. Cover (2), and screws (1)	Install.	
2. Power Unit	a. Screws (7)	Remove.	
	b. Power unit (8)	Replace.	
	c. Screw (7)	Install.	

NOTE

- It is advisable to install new stationary contacts when the power unit is replaced (see step 2), particularly if visual inspection indicates that both the movable and stationary contacts need replacement.
- If the power unit requires replacement of parts continue:

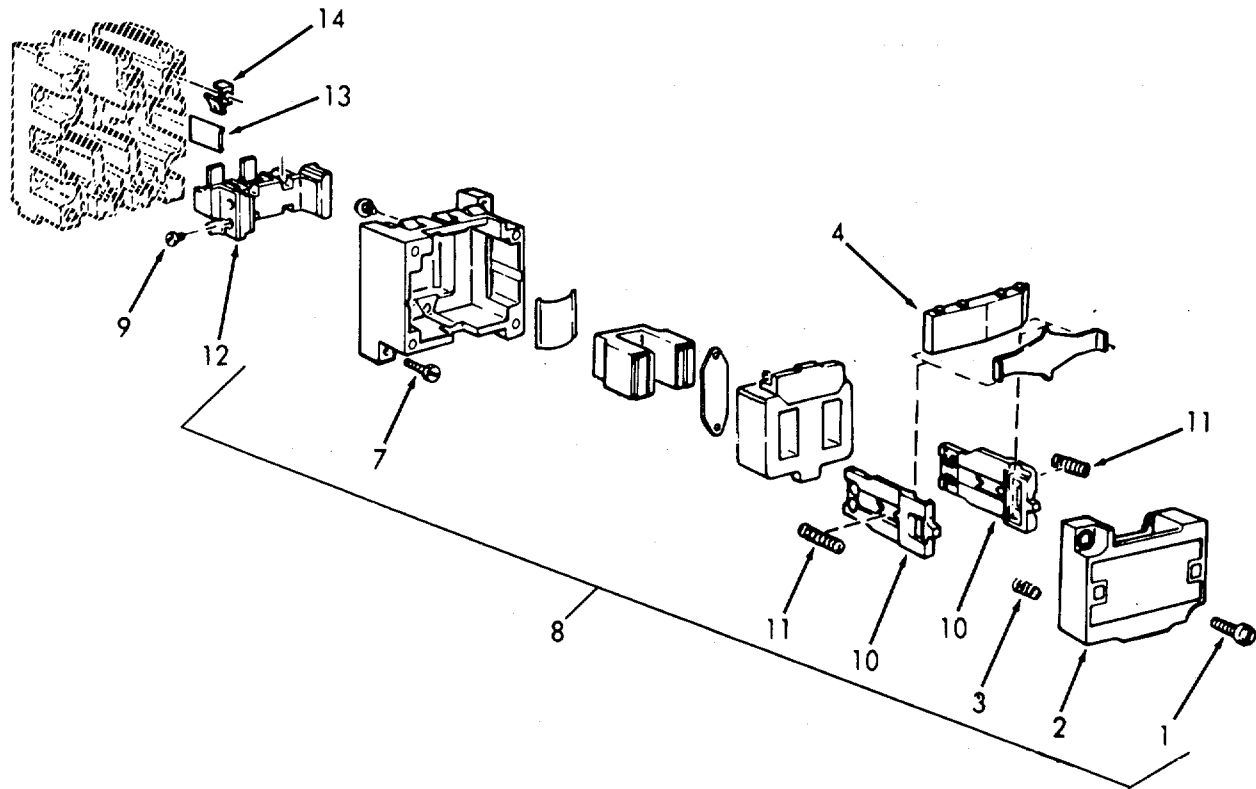
d. Screws (9)	Remove.
------------------	---------

5-89.1. STARTER (NEMA, SIZE D, 3 POLE) - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

e.	Pushbar set (10), springs (11), contac bar (12), insulators (13), and clips (14)	Remove.	
----	--	---------	--



5-89.1. STARTER (NEM-A, SIZE D, 3 POLE) - MAINTENANCE INSTRUCTIONS (Continued) .

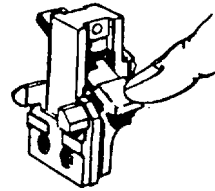
LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REPAIR (cont)</div>	f. Screws (15) and strap (16)	Remove.	
	g. Magnet frame (17), spring (18) , and magnet housing (19)	1. Disassemble. 2. Replace defective parts. 3. Reassemble.	
	h. Strap (16) and screws (15)	Install .	
	i. Coil1 clips (14) , insulator (13) , contact bar (12) springs (11), and pushbar set (10)	Install1.	
	j. Screws (9)	Install.	
	3. Movable Contacts	a. Screws (7)	Remove.

5-89.1. STARTER (NEMA, SIZE D, 3 POLE) - MAINTENANCE INSTRUCTIONS (Continued).

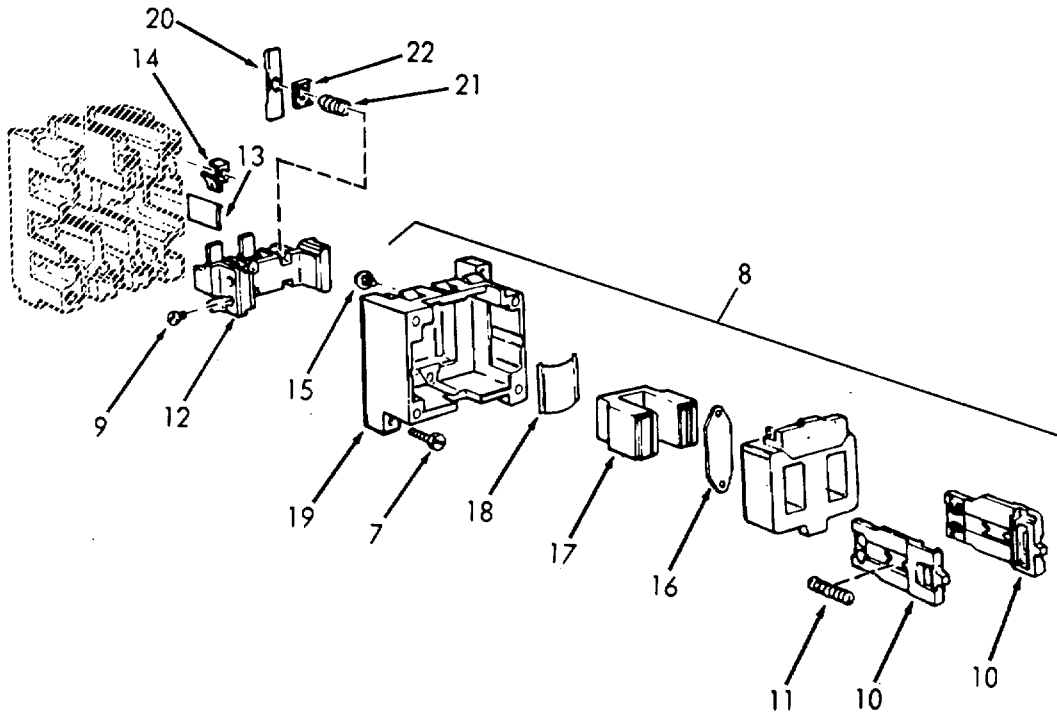
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|----|-----------------------|---------------------------------------|----------|
| b. | Power unit (8) | Remove. | |
| c. | Movable contacts (20) | Depress one end and push contact out. | Discard. |



- | | | | |
|----|--------------------------------|---------|----------|
| d. | Spring (21), and retainer (22) | Remove. | Discard. |
|----|--------------------------------|---------|----------|



5-89.1. STARTER (NEMA, SIZE D, 3 POLE) - MAINTENANCE INSTRUCTIONS (Continued).

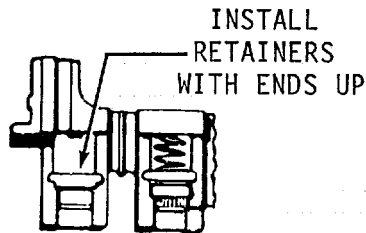
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

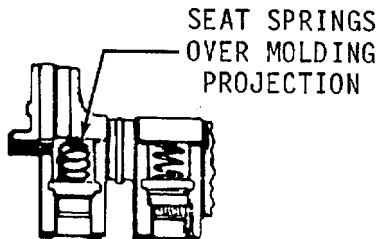
e. Retainer (22)	Install with ends up.	Use new retainer.
---------------------	-----------------------	-------------------

NOTE

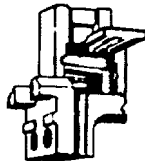
The retainer must be installed so the springs will seat over the extruded hole, with the retainer ends extending away from the contacts.



f. Spring (2 1)	Install.	Use new spring.
--------------------	----------	-----------------



g. Contact (20) in to seat.	Insert contact, raise end slightly and push	Use new contact.
-----------------------------------	--	------------------



5-89.1. STARTER (NEMA, SIZE D, 3 POLE) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

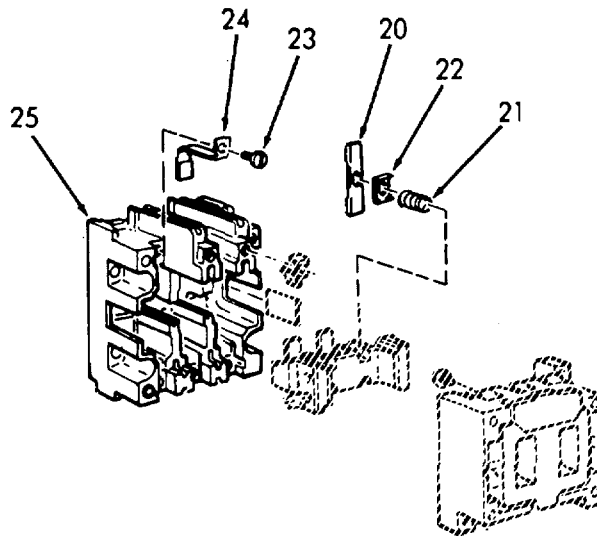
REPAIR (Cont)

4. Stationary Contacts

NOTE

It is not necessary to disconnect any wiring.

- | | | |
|---|---|--------------------------------|
| a. Screws (23) | Remove. | Discard. |
| b. Contact (24) in the molded base (25). removal with | 1. Slide the contact out of the groove is provided for convenient | a. A hole in the contact plate |
| a. screwdriver. | | |
| b. Discard. | | |



5-89.1. STARTER (NEMA, SIZE D, 3 POLE) - MAINTENANCE INSTRUCTIONS (Continued).

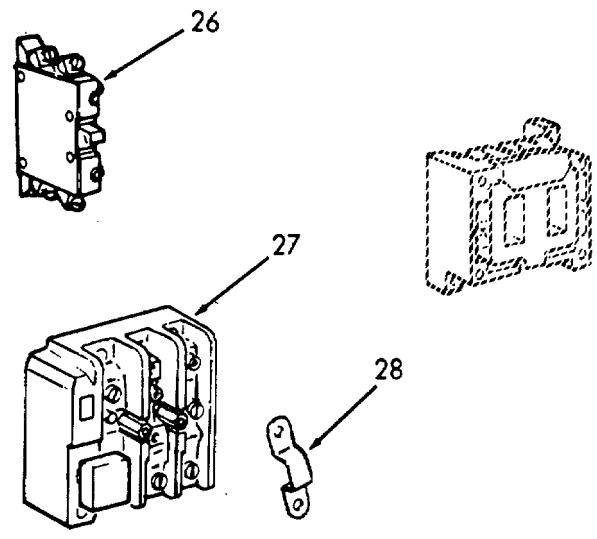
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

CAUTION

The stationary contacts must be installed so they seat on top of the terminal plates.

5. Electrical Interlock	Interlock (26)	2 Install.	Use new contact.
6. Overload Relay	Relay (27) and strap (28)	Replace.	



5-90. GAGES - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

NONE

Personnel Required

1

References

NONE

Equipment

Condition Condition Description

NONE

Special Environmental Conditions

NONE

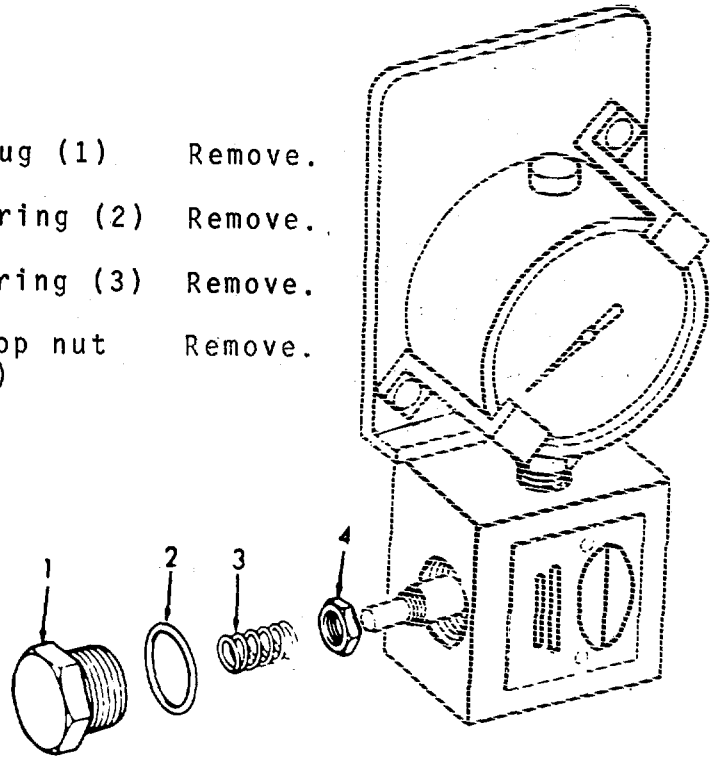
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

- | | | |
|----------------------|-----------------|---------|
| 1. Gage and Isolator | a. Plug (1) | Remove. |
| | b. O-ring (2) | Remove. |
| | c. Spring (3) | Remove. |
| | d. Stop nut (4) | Remove. |



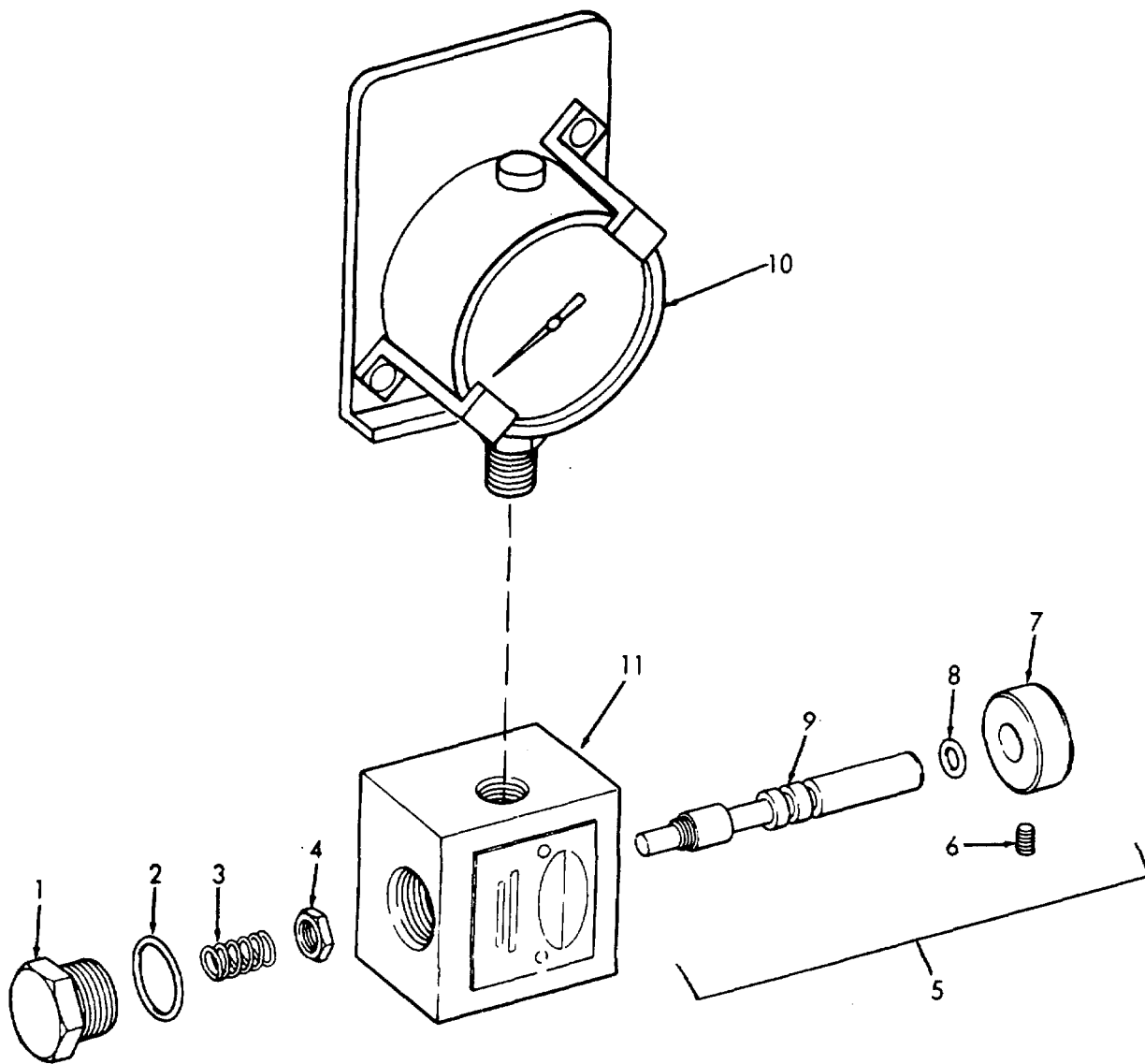
5-90. GAGES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
	REPAIR (Cont)		
	e. Spool and knob assembly (5)	Remove.	
	f. Setscrew (6)	Loosen.	
	g. Knob (7)	Remove.	
	h. O-ring (8)	Remove.	
	. Spool (9)	Remove.	
	j. Gage (10)	Replace in body (11).	
	k. Spool (9), Oring (8), knob (7), and setscrew (6)	Assemble.	
	l. Spool assembly (5)	Install in body (11).	
	m . Stop nut (4)	Install.	
	n. O-ring (2)	Install in body (11).	
	o. Spring (3), and Plug (1)	Install.	

5-90. GAGES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)



5-91. PUSHBUTTON SWITCH - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

- | | | | |
|----------------------|--------------------|----------------------------|--|
| 1. Pushbutton Switch | a. Dia-phragm (1) | Remove. | |
| | b. Screws (2) | Remove from diaphragm (1). | |
| | c. Gasket (3) | Remove. | |
| | d. Push-button (4) | Remove. | |
| | e. Spring ring (5) | Remove. | |

5-91. PUSHBUTTON SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

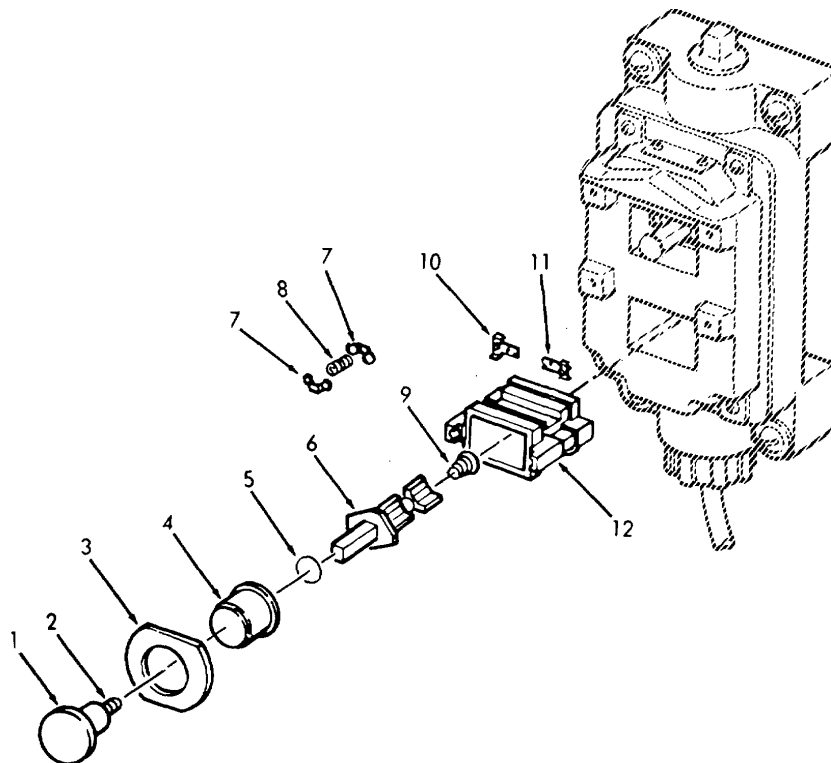
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|----|--|--|--|
| f. | Plunger (6) | 1. Remove.

2. Disassemble movable contacts (7), and spring (8). | |
| g. | Spring (9) | Remove. | |
| h. | Stationary contact (left) (10), and contact (right) (11) | 1. Remove from base (12).

2. Replace. | |
| i. | Spring (9) | Install. | |



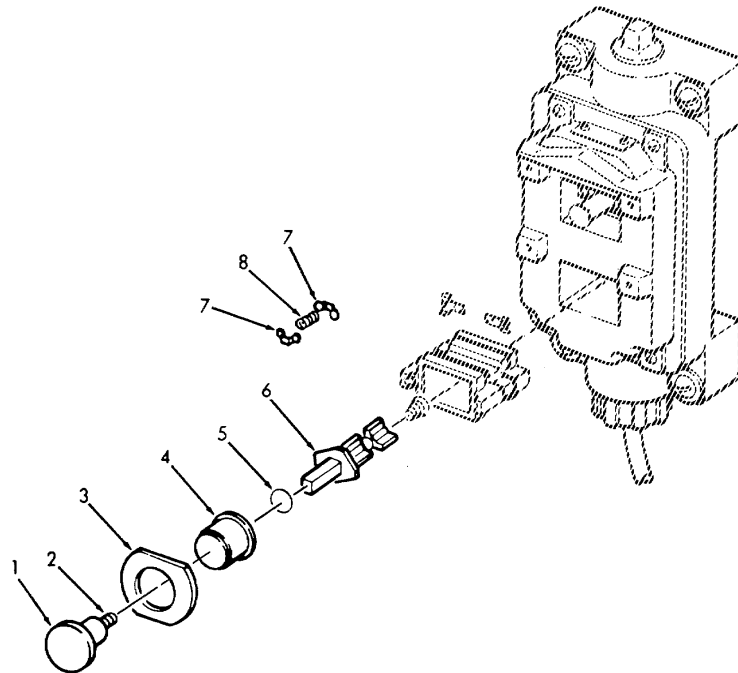
5-91. PUSHBUTTON SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|----|--------------------|--|--|
| j. | Plunger
(6) | 1. Reassemble movable contacts (7), and spring (8).

2. Install. | |
| k. | Spring ring
(5) | Install. | |
| l. | Push-button
(4) | Install. | |
| m. | Gasket
(3) | Install. | |
| n. | Screw
(2) | Install in diaphragm
(1). | |
| o. | Diaphragm | Install. | |



5-92. STERN GATE HYDRAULIC SYSTEM - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance procedures.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Hydraulic Control	5-93
Hose, Fittings, and Piping	5-94
Hydraulic Cylinder	5-95

5-93. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

Valve repair kit
P/N 4-2475-2-2

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

5-93. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
1. Hydraulic Control	a. Screw assembly (1)	Remove.	
	b. Handle (2)	1. Remove. 2. Remove plastic handle (3).	If necessary.
	c. Round head screws (4)	Remove.	
	d. Name-plate (5), and gasket (6)	Remove.	
	e. Retaining ring (7), and stop plate (8)	Remove.	
	f. Stop pin (9), detent ball (10), and spring (11)	Remove.	
	g. Screws (12)	Remove.	

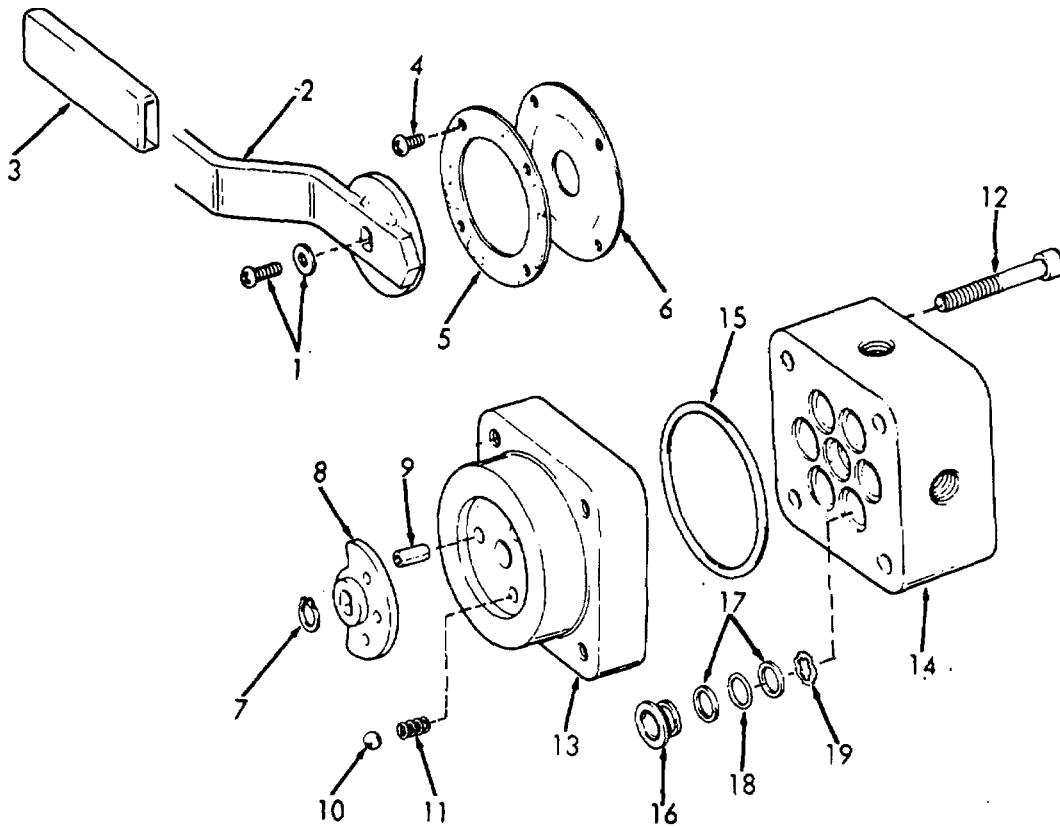
5-93. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

h.	Cap (13), body (14), and O- ring (15)	Separate.	Discard O-ring.
----	--	-----------	-----------------

i.	Seals (16), back-up rings (17), O-ring (18), and seal springs (19)	Remove six places. and O-rings.	Discard seals, and O-rings.
----	---	------------------------------------	--------------------------------



5-93. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|----|---|------------------------------------|------------------|
| j. | Shaft back-up rings (20), O-rings (21), shaft washers (22), disc (23) and shaft (24) | Disassemble. | Discard O-rings. |
| k. | All parts | Clean. or defective parts. | Inspect for worn |
| l. | Shaft (24), disc (23), shaft washers (22), O-rings (21), and shaft back-up rings (20) | Reassemble. | Use new O-rings. |
| m. | Seal springs (19), O-rings (18), back-up rings (17) and seals (16) | Install in body (14). and O-rings. | Use new seals, |

5-93. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

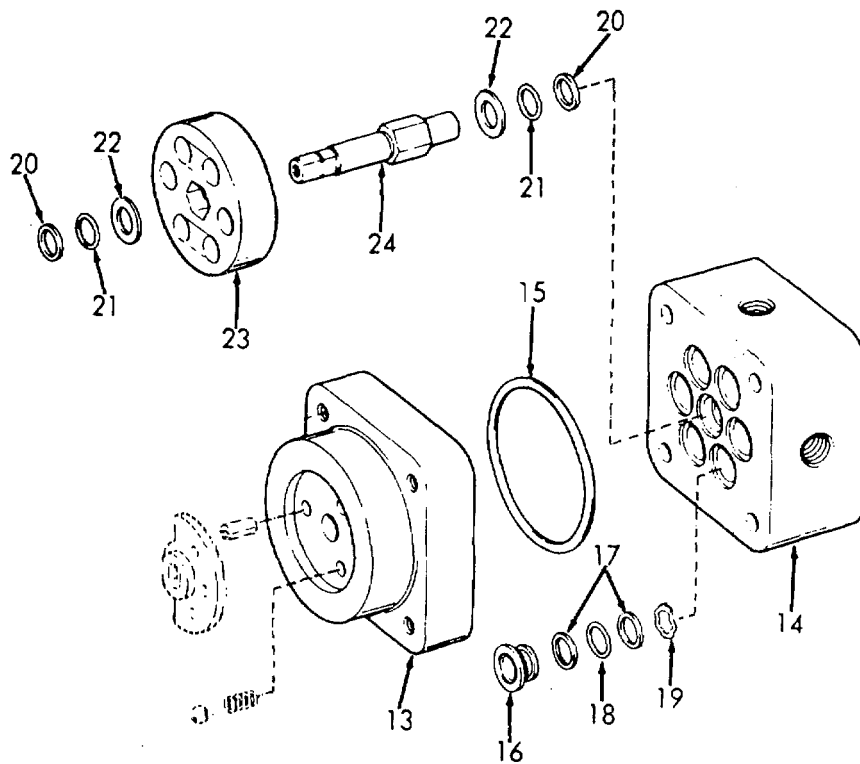
n. Shaft (24), and assembled parts

Install in body (14).

o. Body (14), O-ring (15), and cap (13)

Assemble.

Use new O-ring.

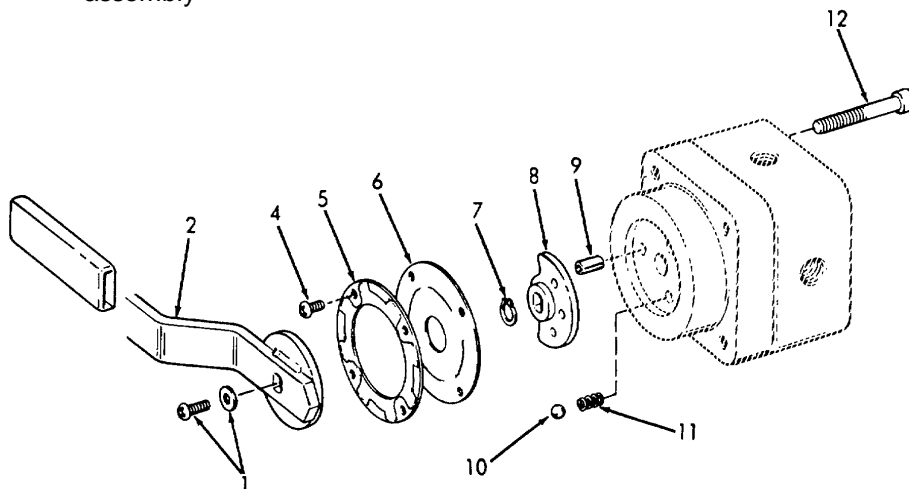


5-93. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | |
|----|---|-----------|
| p. | Screws
(12) | Install. |
| q. | Spring
(11),
ball
(10),
and stop
pin (9) | Assemble. |
| r. | Stop plate
(8), and
retaining
ring (7) | Install. |
| s. | Gasket
(6), and
nameplate
(5) | Install. |
| t. | Round
head
screws
(4) | Install. |
| u. | Handle
(2), and
screw
assembly | Install. |



5-94. HOSES, FITTINGS AND PIPING - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

Make sure the hydraulic system is tagged and unoperative. Bleed oil lines prior to opening.

5-94. HOSES, FITTINGS AND PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

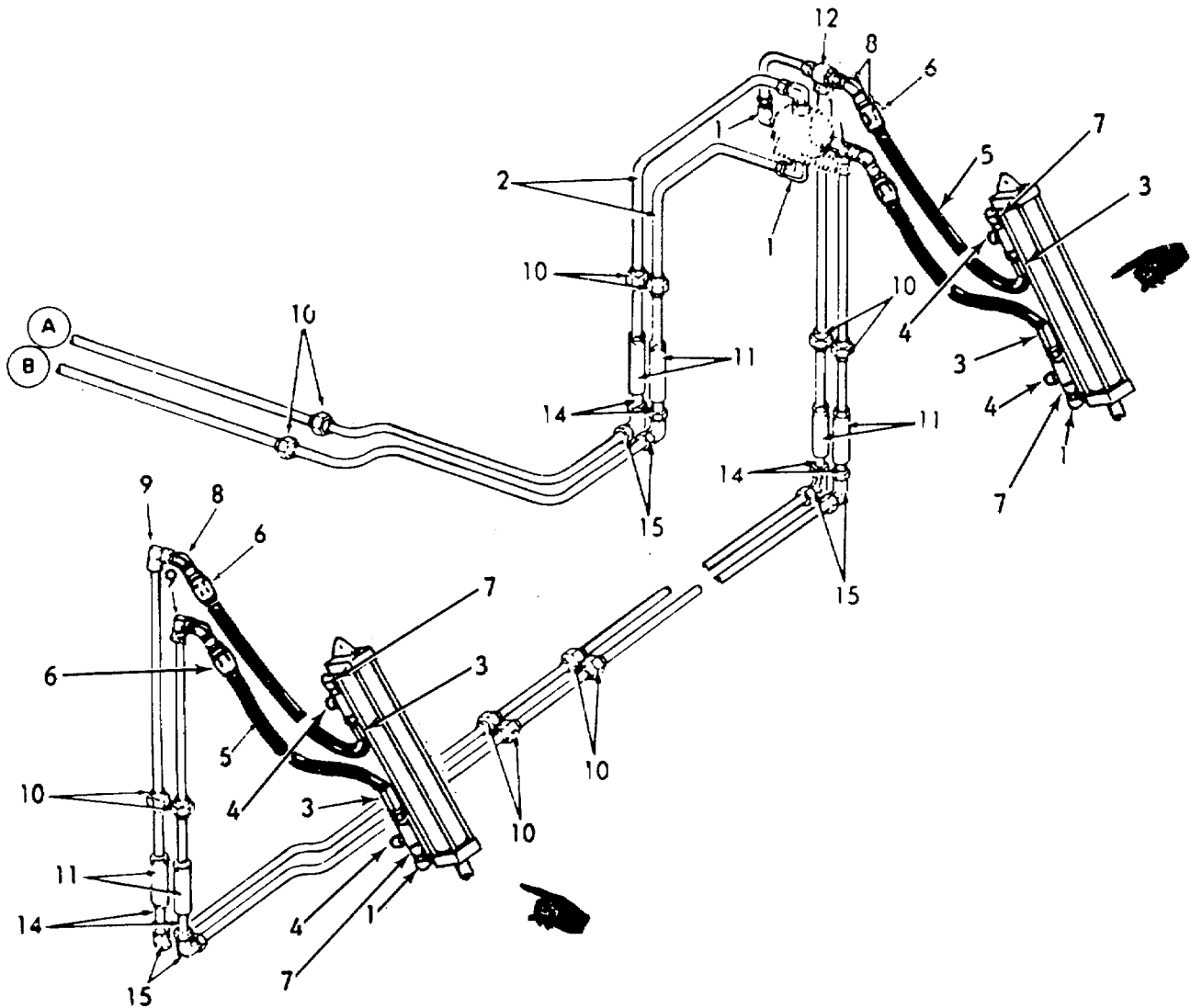
1. Hoses, Fittings, and Piping	a. Elbow (1)	Replace as needed.
	b. Hydraulic tube (2)	Replace as needed.
	c. Male connector (3)	Replace as needed.
	d. Flow control valve (4)	Replace as needed.
	e. Non-metallic hose (5)	Replace as needed.
	f. Straight connector (6)	Replace as needed.
	g. Pipe nipple (7)	Replace as needed.
	h. Connector (8)	Replace as needed.
	i. Elbow (9)	Replace as needed.
	j. Union (10)	Replace as needed.
	k. Stuffing tube (11)	Replace as needed.
	l. Union tee (12)	Replace as needed.
	m. Male tee (13)	Replace as needed.

5-94. HOSES, FITTINGS AND PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|----|-----------------|--------------------|--|
| n. | Steel pipe (14) | Replace as needed. | |
| o. | Elbow (15) | Replace as needed. | |



5-95. HYDRAULIC CYLINDER - STERN GATE- MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Spanner wrench (pin type or equivalent)
Strap wrench
Vise (soft jaws and copper pads)

Equipment Condition

Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

2

General Safety Instructions

WARNING

Wear protective eye goggles when using compressed air.

LOCATION

ITEM

ACTION

REMARKS

WARNING

Wear protective eye goggles when using compressed air.

REPAIR

1. Hydraulic Cylinder

Disassemble the hydraulic cylinder in the following order. Use care not to scuff or damage components.

a. Piston Move to fully retracted position.

b. Hydraulic Cylinder Remove. Refer to paragraph 3-196.

5-95. HYDRAULIC CYLINDER - STERN GATE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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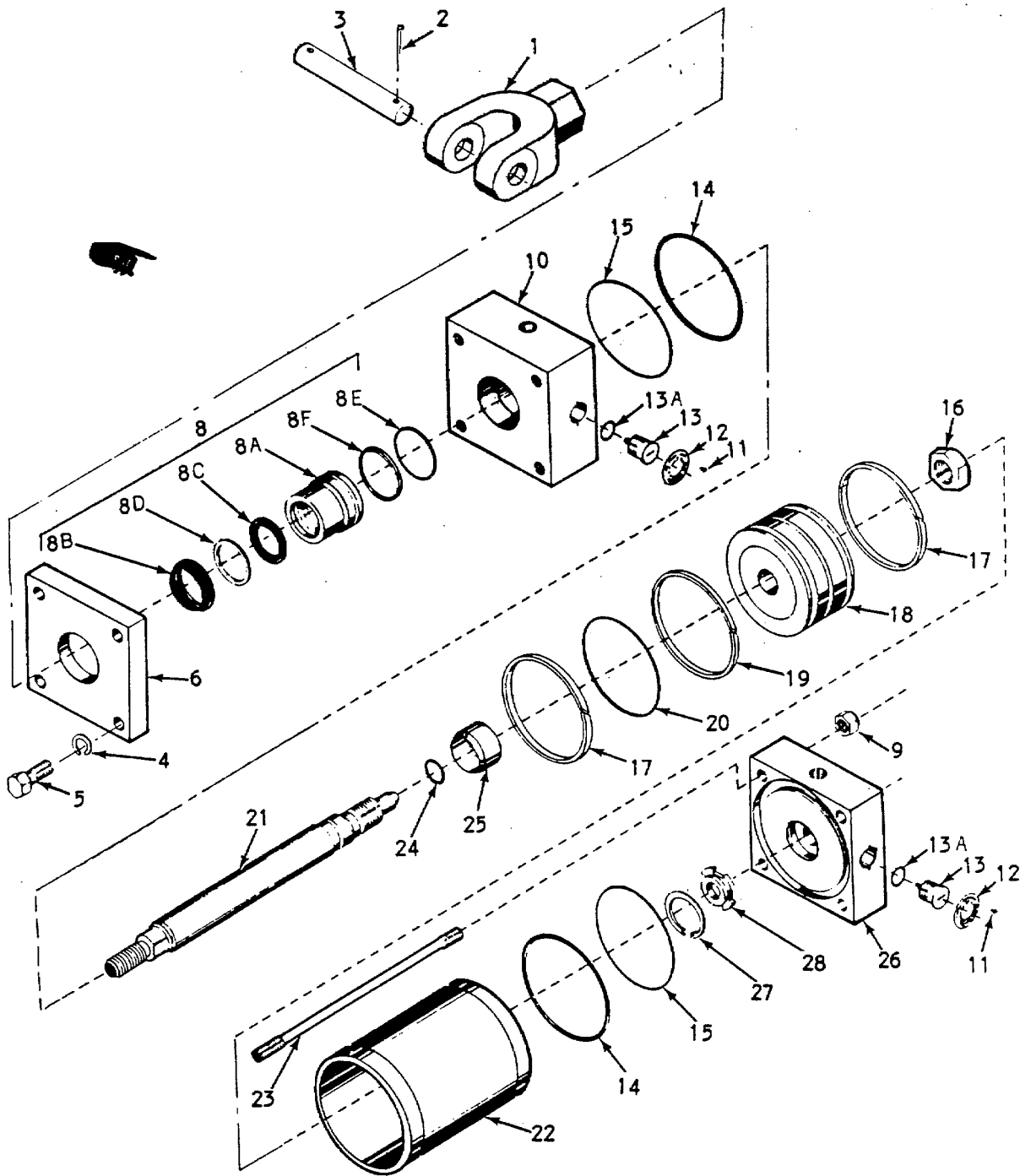
REPAIR (Cont)

- | | | | |
|--|--|--|---|
| | c. Cylinder cycling cylinder. | Drain fluid by manually | Compressed air may be used to remove hydraulic fluid, if above warning is followed. |
| | d. Clevis (1), cotter pin (2), and pivot pin (3) | Remove from piston rod (21). | |
| | e. Capscrews (5) and lockwashers (4) | Unscrew and remove retainer plate (6). | |
| | f. Rod cartridge (8) | Remove from head (10). | |
| | g. Rod bearing (8A), rod wiper (8B), "O" ring/"U" cup packing (8C), rod backup ring (8D), "O" ring (8E), back-up ring (8F) | Disassemble cartridge. | |
| | h. Tie rod lock nuts (9) | Remove from tie rod (23). | |
| | i. Head (10) and cap (26) | Remove from cylinder (22). | |
| | j. Exactajust drive screw (11), cover (12), needle and check valve (13), and needle valve ring (13A) | Remove. Do not damage components. | |
| | k. Tie rods (23) | Remove | |
| | l. End cover "O" ring (14) and backup ring (15) | Remove from head (10) and cap (26). | |

5-95. HYDRAULIC CYLINDER - STERN GATE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



5-95. HYDRAULIC CYLINDER - STERN GATE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|--|--|--|--|
| | m. Piston rod (21), piston bearing (18), and assembly. | Remove as a unit from cylinder tube (22). | |
| | n. Cylinder tube (22) | Remove. | |
| | o. Piston bearing retaining nut (16) | Remove from piston rod (21). | |
| | p. Piston bearing seal ring (19), "O" ring (20), and guide ring (17) | Remove from piston bearing (18). | |
| | q. Piston bearing "O" ring (24) and head cushion bushing (25) | Remove from piston rod (21). | |
| | r. Cap cushion retaining ring (27) and cap cushion insert (28) | Remove from cap (26). | |
| | s. All parts | <ol style="list-style-type: none"> 1. Clean 2. Inspect for wear and damage, especially piston bearing (18), associated "O" rings, ring seals, and guides. 3. Lightly lubricate before installing. | |

INSTALLATION

- | | | | |
|--|--|------------------------------------|--|
| | a. Cap cushion insert (28) and cap cushion retaining ring (27) | Install on cap (26). | |
| | b. End cover "O" ring (14) and backup ring (15) | Install on head (10) and cap (26). | |
| | c. Piston bearing seal ring (19), piston bearing - "O" ring (20), and piston bearing guide ring (17) | Install on piston bearing (18). | |

5-95. HYDRAULIC CYLINDER - STERN GATE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | | |
|--|---|---|--|
| | d. Piston bearing "O" ring (24) and head cushion bushing (25) | Install on piston rod (21). | |
| | e. Assembled piston bearing (18) | Install on piston rod (21). | |
| | f. Piston bearing retaining nut (16) | Install on piston rod (21). | |
| | g. Exactajust drive screw (11), cover (12), needle and check valve (13), and needle valve ring (13A) | Install in head (10), and cap (26). | |
| | h. Rod wiper (8B), "O" ring "U" cup packing (8C), rod backup ring (8D), "O" ring(8E), and back up ring (8F) | Assemble into rod bearing (8A) creating rod cartridge (8). Then install cartridge into head (10). | |
| | i. Piston rod (21), and piston bearing (18) and assembly | Install in cylinder tube (22). | |
| | j. Tie rods (23), and tie rod lock nuts (9) | Tie cylinder tube (22), head (10) and cap (26), into single unit with tie rods and lock nuts. | |
| | k. Retainer plate (6), lock washers (4), and cap screws (5) | Attach retainer plate to head (10) using lock washers and cap screws. | |
| | l. Clevis (1) | Attach clevis to piston rod (21) using cotter-pin (2) and pivot pin (3). | Make necessary adjustment to exactajust valves when mounting cylinder onto stern gate. |

5-96. MAST HYDRAULIC SYSTEM - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance procedures.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Hydraulic Control	5-93
Hydraulic Cylinder	5-97
Hoses and Fittings	5-98

5-97. MAST HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment

<u>Condition</u>	<u>Condition Description</u>
NONE	

NONE

Material/Parts

Piston seal kit
 P/N MPU3-H2 1/2-25-1-3H-P
 Rod seal kit
 P/N MPU3-H2 1/2-25-1-3H-RS
 Cylinder repair kit
 P/N MPU3-H2 1/2-25-1-3H-HC

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions



Wear eye protection when using compressed air.

1

5-97. MAST HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
1. Hydraulic Cylinder	a. Piston position.	Move to fully retracted	
	b. Hose fittings	Remove.	
	c. Cylinder	Drain fluid by manually cycling cylinder	Compressed air can be used on large cylinders.
	d. Bracket (1)	Unweld from bulkhead.	If necessary.
	e. Universal eye (2)	Remove. piston rod.	Use flat on
	f. Lubrication fitting (3)	Remove.	If necessary.
	g. Ball check plug (4), O-ring (5), and check ball (6)	Remove.	Discard O-ring, and check ball.
	h. Cushion needle screw (7), and O-ring (8)	Remove.	Discard O-ring.
	i. Tie rod nuts (9)	Remove.	

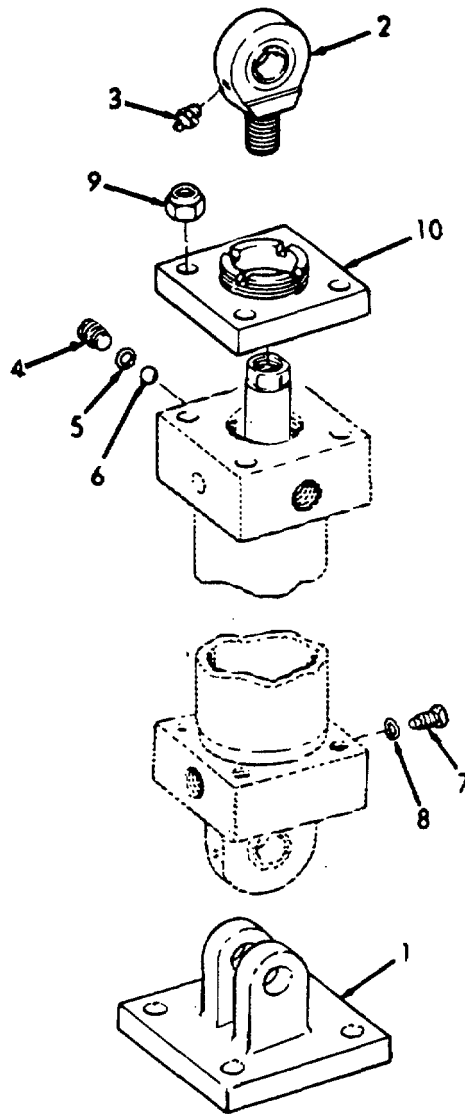
5-97. MAST HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

j. Filler plate (10) and attached parts

Remove.



5-97. MAST HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued).

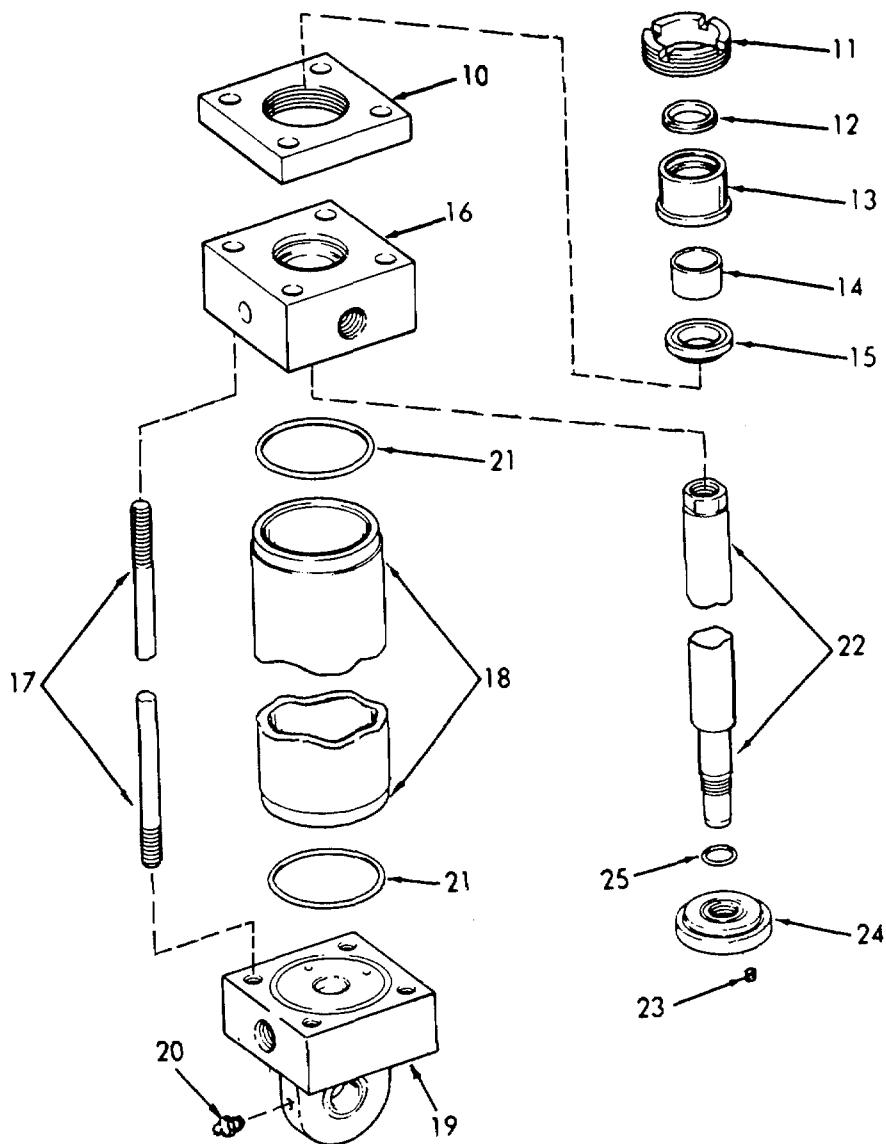
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	k. Gland retainer (11), rod wiper (12), cylinder gland (13), rod bearing (14), and rod seal (15)	Remove from filler plate (10).	Discard rod wiper (12), rod bearing (14), and rod seal (15).
	l. Mounting head (16)	Remove.	
	m. Tie rods (17)	Remove.	
	n. Cylinder (18), and assembled parts	Remove from basic cap (19).	
	o. Lubrication fitting (20)	Remove.	If necessary.
	p. O-ring (21)	Remove.	Discard.
	q. Piston rod (22), and associated parts	Remove from cylinder (18).	
	r. Setscrew (23)	Remove.	

5-97. MAST HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

s.	Cap follower (24), and O-ring (25)	Remove.	Discard O-ring.
----	------------------------------------	---------	-----------------



5-97. MAST HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

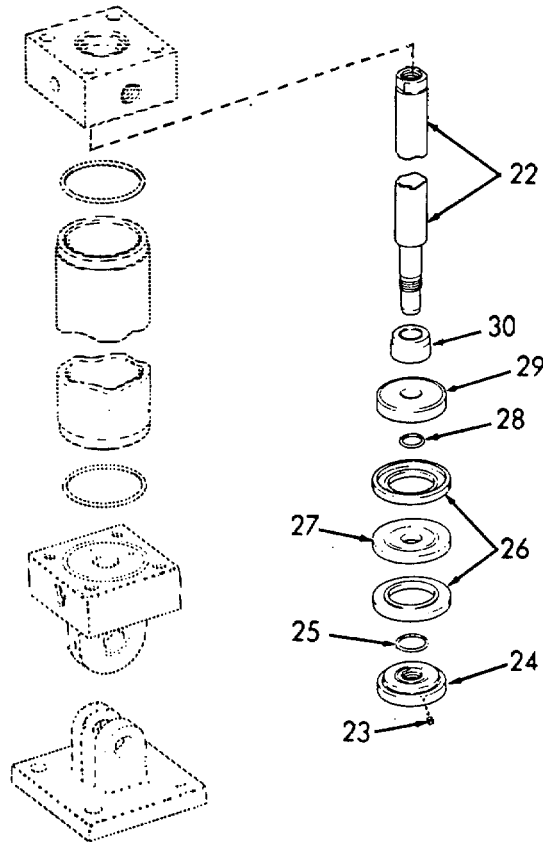
- | | | | |
|----|---|---|---------------------|
| t. | Piston cups (26), and bearing (27) | Remove from piston rod (22). | Discard piston cup. |
| u. | Follower O-ring (28) and head follower (29) | Remove from piston rod (22). | Discard O-ring. |
| v. | Head bushing (30) | Remove from piston rod (22). | |
| w. | All metal parts | <ol style="list-style-type: none"> Clean. Inspect for damage or wear especially the piston rod and inside diameter of the body. | |
| x. | All parts | Lightly lubricate before installation. | |
| y. | Head bushing (30) | Install on piston rod (22). | |
| z. | Head follower (29), and O-ring (28) | Install on piston rod (22). | Use new O-ring. |

5-97. MAST HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|-----|-------------------------------------|-----------------------------|----------------------|
| aa. | Piston cups (26) and bearing (27) | Install on piston rod (22). | Use new piston cups. |
| ab. | O-ring (25), and cap followers (24) | Install on piston rod (22). | Use new O-ring. |
| ac. | Setscrew (23) | Install. | |



5-97. MAST HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued).

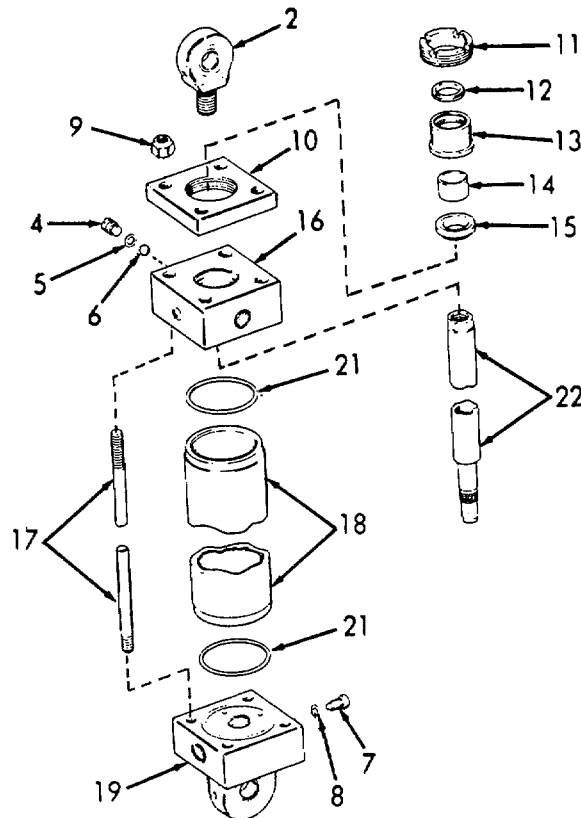
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	ad. Piston rod (22), and attached parts	Place in cylinder (18).	
	ae. O-ring (21) head (16).	Install in basic cap (19), and mounting	Use new O-ring.
	af. Cylinder (18) and associated parts	Install in basic cap (19).	
	ag. Tie rods (17)	Install in basic cap (19).	
	ah. Mounting head (16)	Install.	
	ai. Rod seal (15), rod bearing (14), Cylinder gland (13), rod wiper (12), and gland retainer (11)	Reassemble in filler plate (10).	Use new rod seal, rod bearing and rod wiper.
	aj. Filler plate (10)	Assemble to mounting head (16).	

5-97. MAST HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|-----|--|----------|--------------------------------|
| ak. | Tie Rod nuts (9) | Install. | |
| al. | O-ring (8) and cushion needle screw (7) | Install. | Use new O-ring. |
| am. | Check ball (6), O-ring (5) and ball check plug (4) | Install. | Use new O-ring and check ball. |
| an. | Universal eye (2) | Install. | Use flats on piston rod. |



5-1187

5-98. MAST HOSES AND FITTINGS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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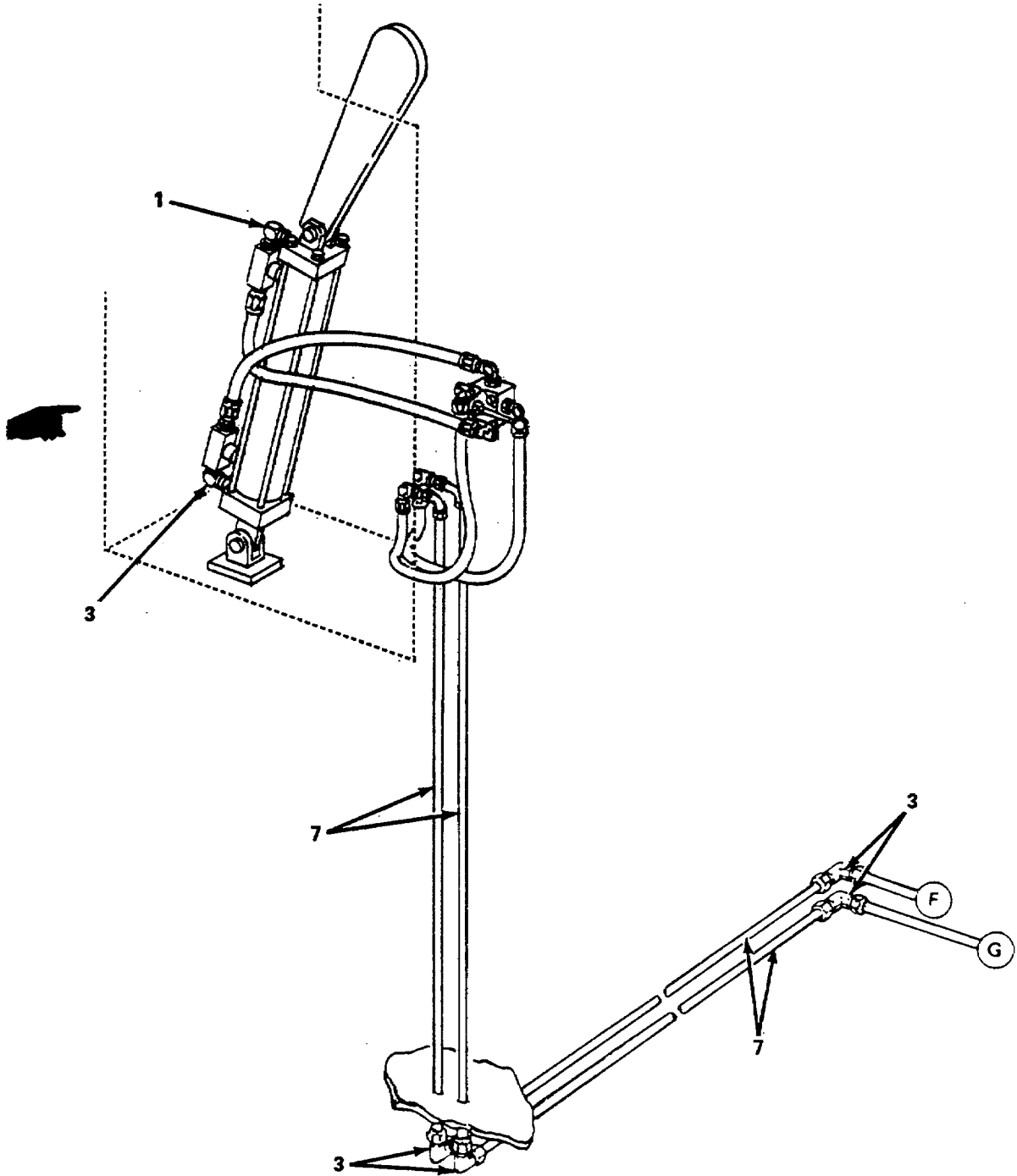
REPAIR

- | | | |
|-----------------------|-----------------------|-------------------|
| 1. Hoses and Fittings | a. Elbow (1) | Repair as needed. |
| | b. Male connector (2) | Repair as needed. |
| | c. Elbow (3) | Repair as needed. |
| | d. Stuffing tube (4) | Repair as needed. |
| | e. Union (5) | Repair as needed. |
| | f. Elbow (6) | Repair as needed. |
| | g. Hydraulic tube (7) | Repair as needed. |

5-98. MAST HOSES AND FITTINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



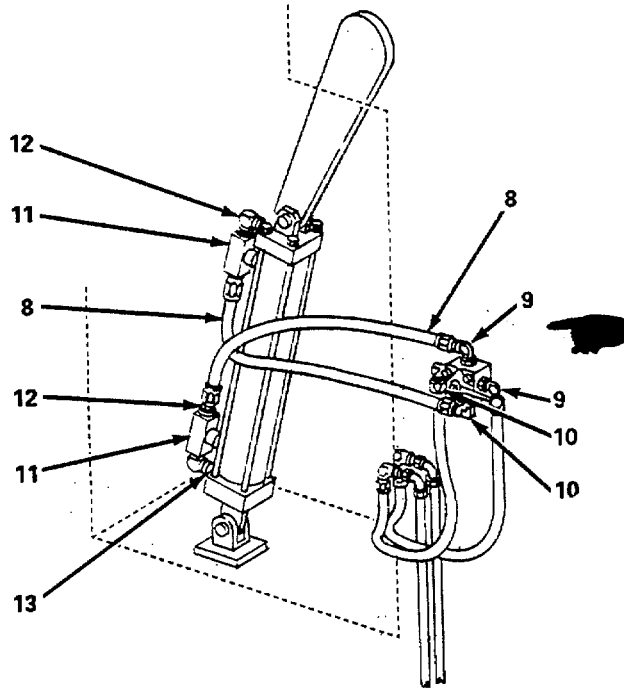
Change 1 5-1189

5-98. MAST HOSES AND FITTINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|--|----------------------------|--------------------|--|
| | h. Non-metallic hose (8) | Replace as needed. | |
| | i. Elbows (9 and 10) | Replace as needed. | |
| | j. Flow control valve (11) | Replace as needed. | |
| | k. Pipe nipple (12) | Replace as needed. | |
| | l. Bushing male (13) | Replace as needed. | |



4951-067

5-99. STERN ANCHOR HYDRAULIC SYSTEM - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance procedures.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Hydraulic Control	5-93
Hydraulic Winch	5-100
Hoses and Fittings	5-101

5-100. STERN ANCHOR HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

5-100. STERN ANCHOR HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS
(Continued).

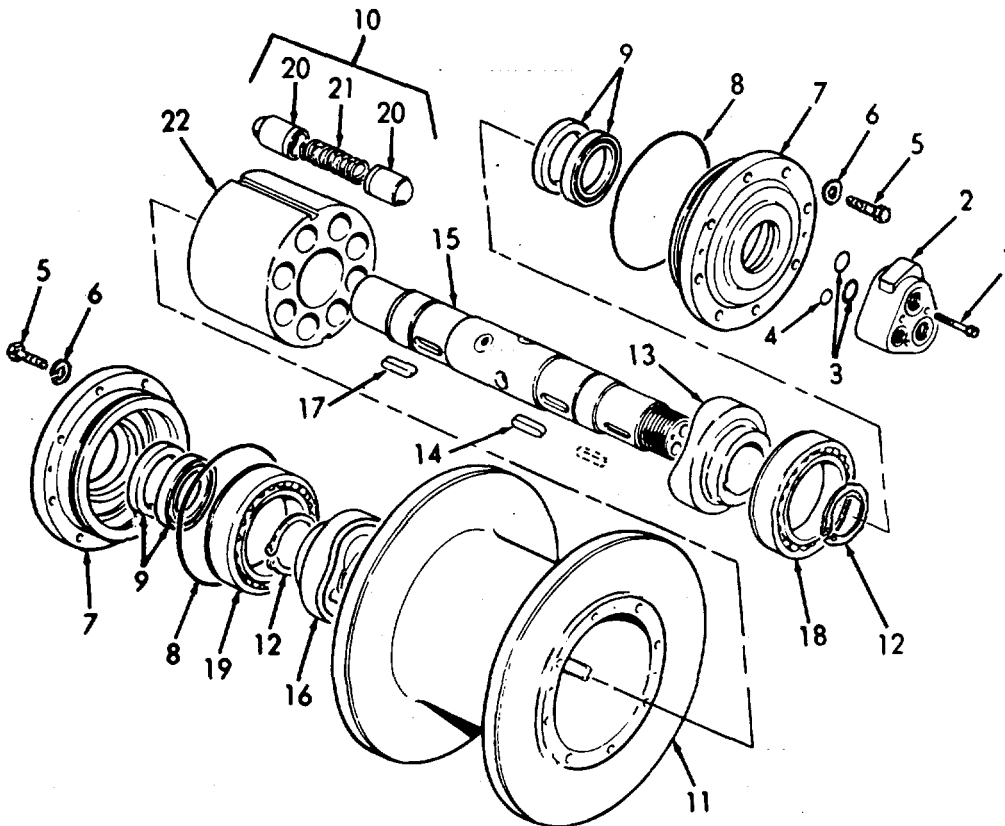
LOCATION	ITEM	ACTION	REMARKS
REPAIR			
1. Winch	a. Hydraulic hoses and fittings	Remove.	
	b. Screws (1)	Remove.	
	c. Feed port block (2)	Remove.	
	d. Preformed packings (3 and 4)	Remove.	
	e. Screws (5), and lock-washers (6)	Remove.	
	f. Bearing housing (7) , and preformed packings (8)	Remove.	
	g. Oil seals (9)	Remove from bearing housing (7).	
	h. Shaft (10) and assembled parts	Remove from casing (11).	
	i. Retaining rings (12)	Remove.	
	j. Outboard cam (13), and key (14)	Remove from shaft (15).	

5-100. STERN ANCHOR HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | |
|----|------------------------------------|-------------------------------|
| k. | Inboard cam (16), and key (17) | Remove from shaft (15). |
| l. | Bearings (18 and 19) | Remove from cams (13 and 16). |
| m. | Piston balls (20) and springs (21) | Remove from rotor (22). |
| n. | Rotor (22) | Remove from shaft (15). |



5-100. STERN ANCHOR HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

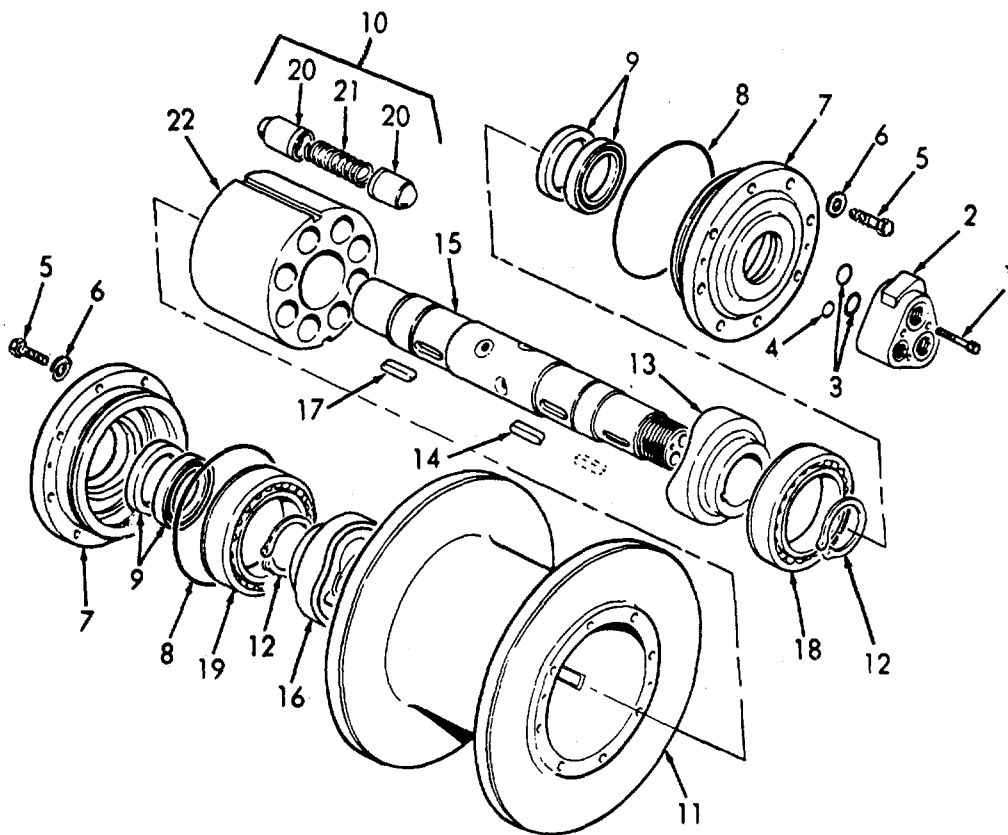
- | | | | |
|--|--------------------------------------|--|--|
| | o. All ports | <ol style="list-style-type: none"> 1. Clean. 2. Inspect for wear or damage. 3. Lightly lubricate before reassembly. | |
| | p. Rotor (22) | Install on shaft (15). | |
| | q. Bearings (18 and 19) | Install on cams (13 and 16). | |
| | r. Piston balls (20) and spring (21) | Install in rotor (22). | |
| | s. Inboard cam (16), and key (17) | Install on shaft (15). | |
| | t. Outboard cam (13) and key (14) | Install on shaft (15). | |
| | u. Retaining rings (12) | Install. | |
| | v. Shaft (10) and assembled parts | Install in casing (11). | |
| | w. Oil seals (9) | Install in bearing housings (7). | |
| | x. Preformed packing (8) | Install in bearing housings (7). | |
| | y. Bearing housings (7) | Align with holes in casing (11). | |

5-100. STERN ANCHOR HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|-----|---------------------------------|---------------------------------|--|
| z. | Screws (5) and lock-washers (6) | Install. | |
| aa. | Preformed packings (3 and 4) | Install in feed port block (2). | |
| ab. | Feed port block (2) | Align holes with shaft (15). | |
| ac. | Screws (1) | Install. | |
| ad. | All ports | Seal. | |



5-101. HOSES AND FITTINGS - MAINTENANCE INSTRUCTIONS

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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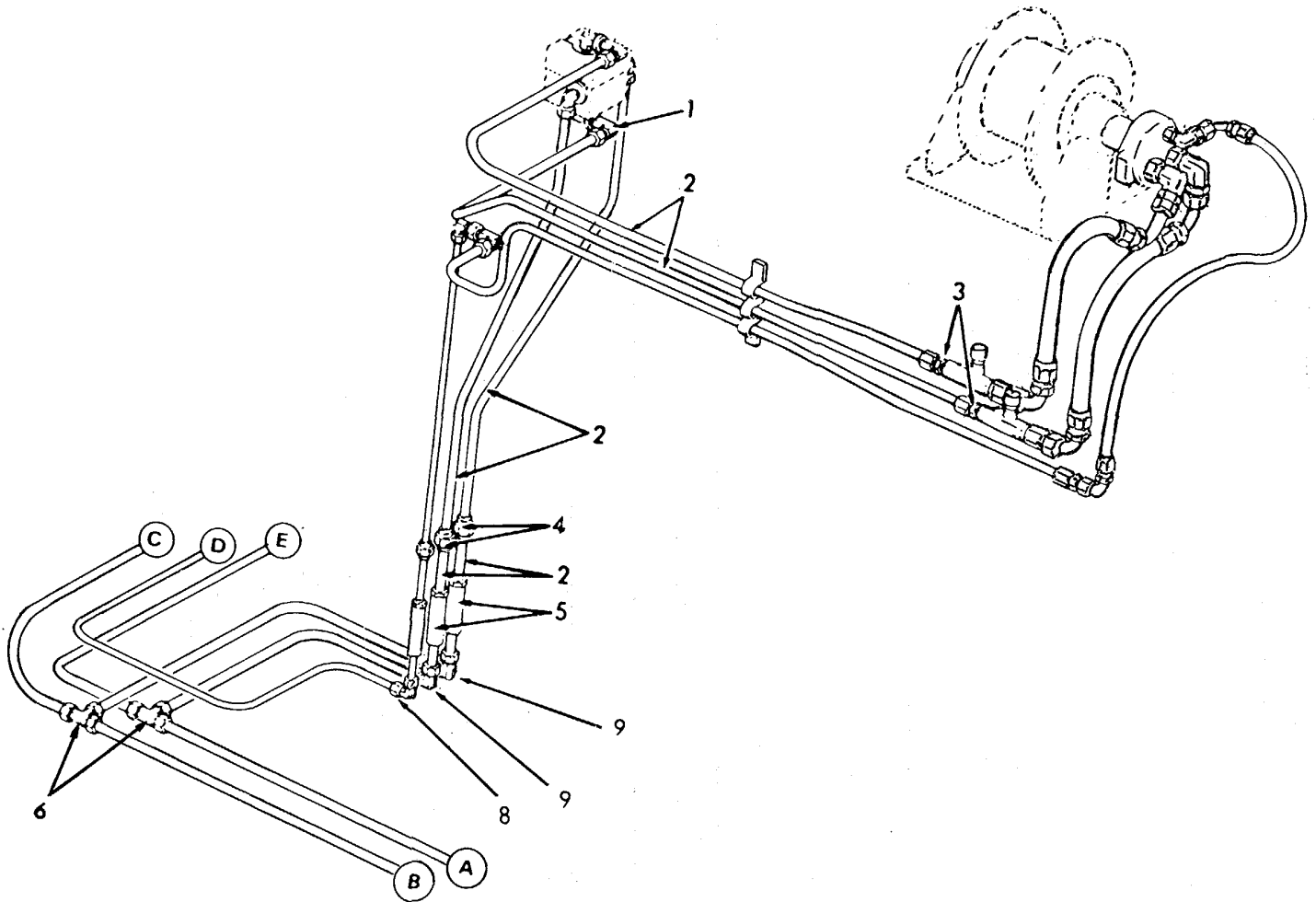
REPAIR

- | | | |
|-----------------------|---|---------|
| 1. Hoses and Fittings | a. Elbow (1), and hydraulic tube (2) | Repair. |
| | b. Male connector (3), and union (4) | Repair. |
| | c. Stuffing tube (5), and union tee (6) | Repair. |
| | d. Elbows (7 and 8) | Repair. |

5-101. HOSES AND FITTINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



5-101. HOSES AND FITTINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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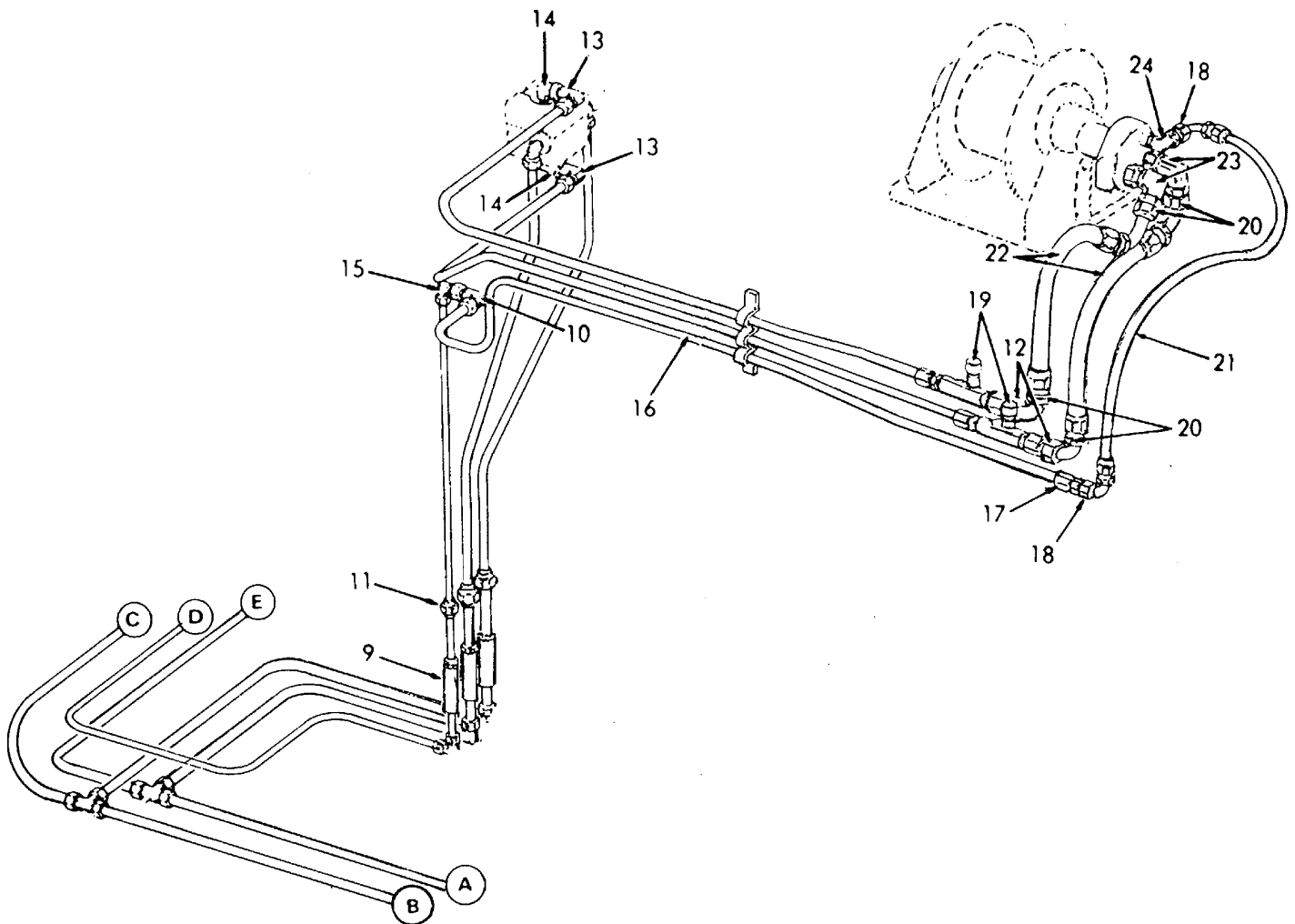
REPAIR (Cont)

- | | | | |
|----|--|---------|--|
| e. | Stuffing tube (9) elbow (10), and union (11) | Repair. | |
| f. | Female adapter (12), and elbows (13, 14, and 15) | Repair. | |
| g. | Hydraulic tube (16), and male connector (17) | Repair. | |
| h. | Swivel connector (18), and control flow valve (19) | Repair. | |
| i. | Swivel connector (20), and non-metallic hose (21) | Repair. | |
| j. | Non-metallic hose (22), and elbows (23 and 24) | Repair. | |

5-101. HOSES AND FITTINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

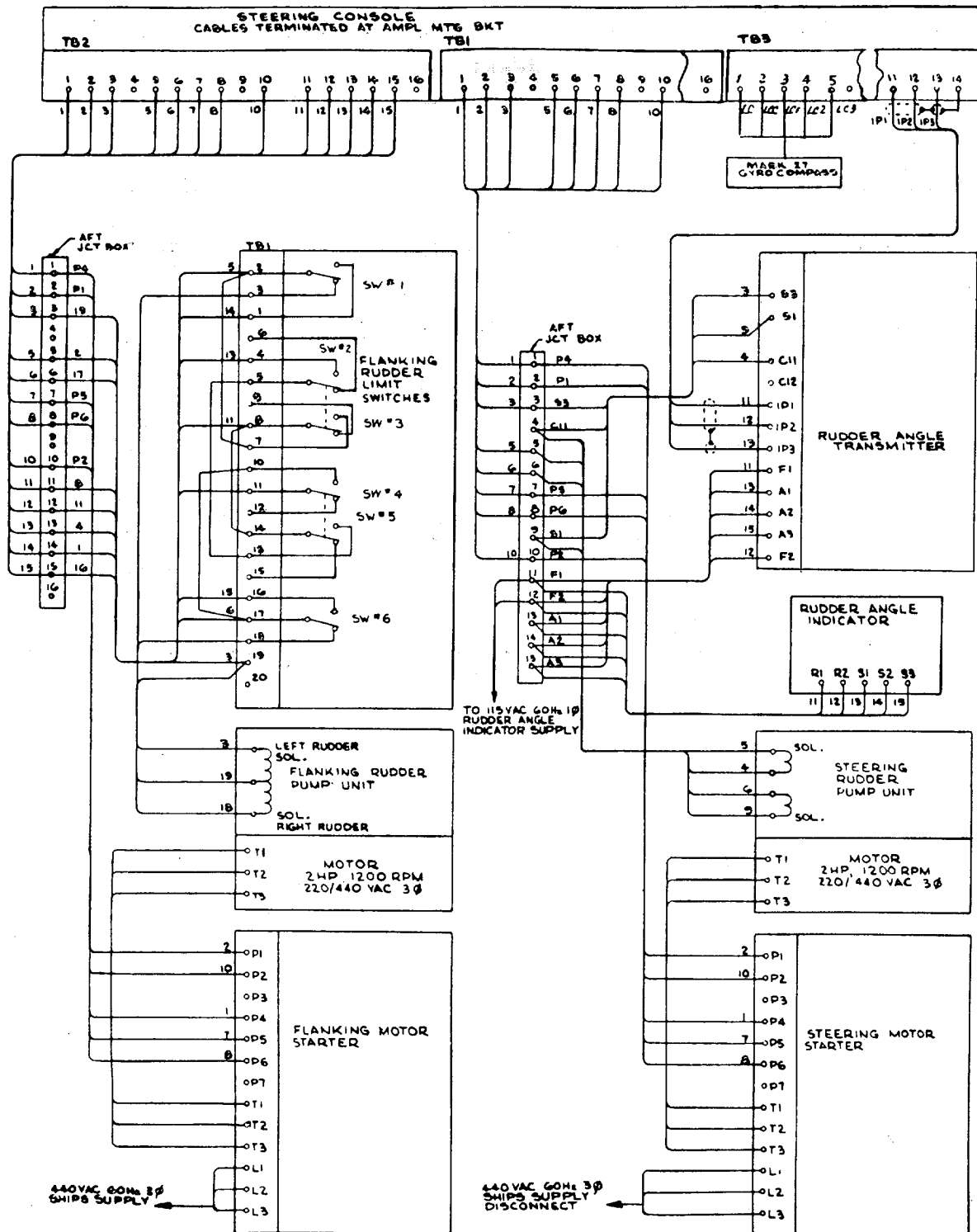


5-102. STEERING SYSTEMS - MAINTENANCE INSTRUCTIONS.

The following is an index to the steering systems' maintenance procedures.
Refer to schematic for overall component configuration.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Hydraulic Cub Pump Unit - Motor	5-103
Hydraulic Cub Pump Unit - Controller	5-104
Hydraulic Cub Pump Unit - Pump	5-105
Hydraulic Cub Pump Unit - Brake Valve	5-106
Hydraulic Cub Pump Unit - Reservoir, Tank and Strainer	5-107
Hydraulic Cub Pump Unit - Cylinder and Linkage	5-108
Hydraulic Cub Pump Unit - Hoses, Piping and Valves	5-109
Main and Flanking Rudders	5-110
Rudder Angle Indicator	5-111
Rudder Angle Transmitter	5-112
Flanking Rudder Limit Switch	5-113
Steering Control Panel and Gyro Computer	5-114
Heading Selector	5-115
Remote Magnetic Heading Compass	5-116
Ship's Course Indicator	5-117

5-102. STEERING SYSTEMS - MAINTENANCE INSTRUCTIONS. (Continued).



5-103. HYDRAULIC CUB PUMP UNIT - MOTOR - MAINTENANCE INSTRUCTIONS

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

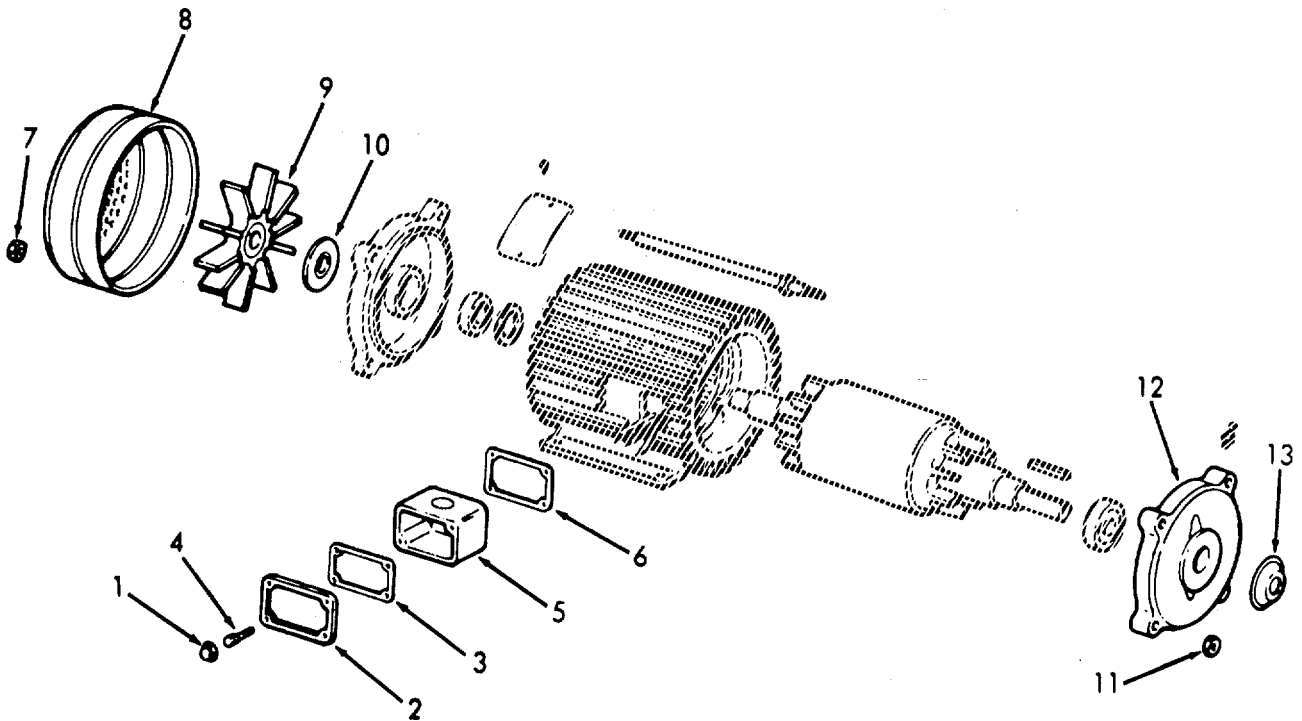
- | | | | |
|-----------------|--|-------------|--|
| 1. Motor
(1) | a. Acorn nuts | Remove. | |
| | b. Conduit box cover (2), and gasket (3) | Remove. | |
| | c. Wiring | Disconnect. | |
| | d. Studs (4) | Remove. | |
| | e. Conduit box (5), and gasket (6) | Remove. | |
| | f. Nuts (7) | Remove. | |

5-103. HYDRAULIC CUB PUMP UNIT - MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | |
|----|------------------------|---------|
| g. | Fan shroud (8) | Remove. |
| h. | Fan (9) | Remove. |
| i. | Rubber slinger (10) | Remove. |
| j. | Nuts (11) | Remove. |
| k. | Shaft end bracket (12) | Remove. |
| l. | Rubber slinger (13) | Remove. |



5-103. HYDRAULIC CUB PUMP UNIT - MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

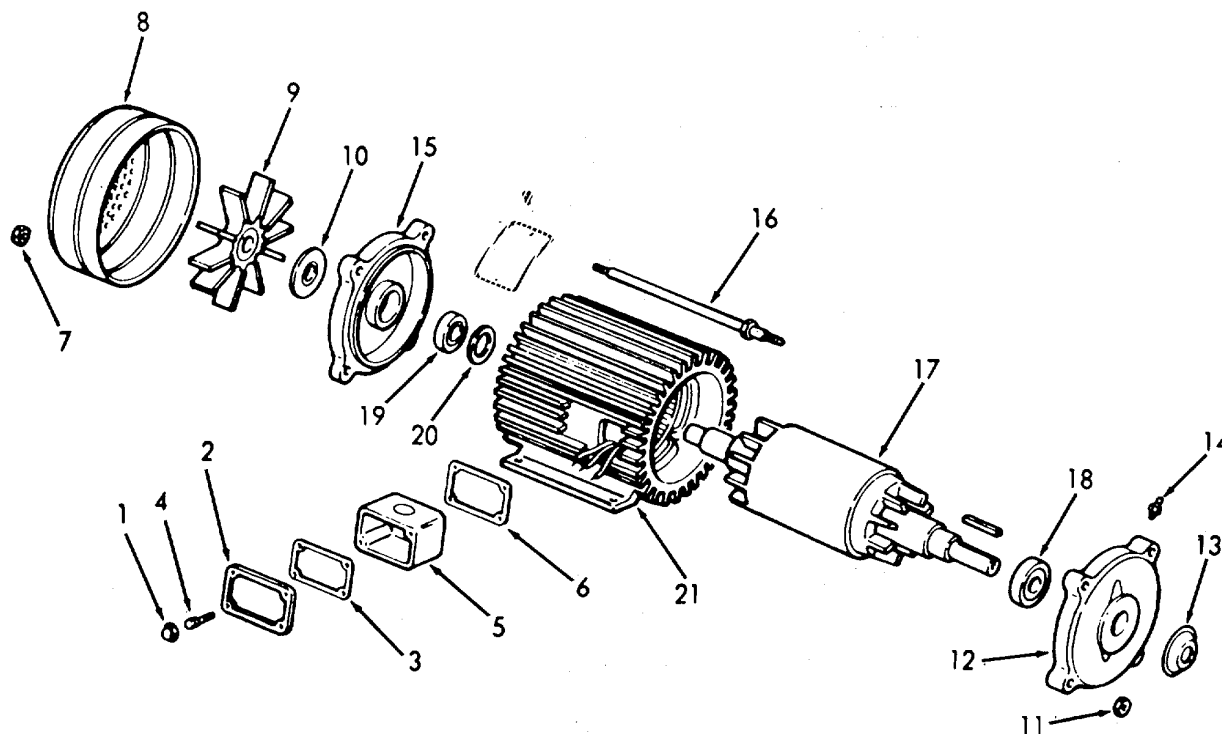
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	m. Grease fitting (14)	Remove.	If necessary.
	n. Blind end bracket (15)	Remove.	
	o. Through bolts (16)	Remove.	
	p. Rotor and shaft (17), bearings (18 and 19), and spring washer assembly (20) -	<ol style="list-style-type: none"> 1. Remove from stator (21). 2. Disassemble. 3. Replace defective parts. 4. Reassemble. 5. Install in stator (21). 	Use bearing puller.
	q. Through bolts (16)	Install.	
	r. Blind end bracket (15)	Install.	
	s. Shaft end bracket (12)	Install.	
	t. Rubber slinger (13)	Install.	
	u. Nuts (11)	Install.	
	v. Rubber singer (10)	Install.	

5-103. HYDRAULIC CUB PUMP UNIT - MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|-----|---|------------|--|
| w. | Fan (9), fan shroud (8), and nuts (7) | Install. | |
| x. | Conduit box gasket (6), box (5) and studs (4) | Install. | |
| y. | Wiring | Reconnect. | |
| z. | Conduit box gasket (3), and cover (2) | Install | |
| aa. | Acorn nuts (1) | Install. | |



5-104. HYDRAULIC CUB PUMP UNIT CONTROLLER - MAINTENANCE INSTRUCTIONS

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

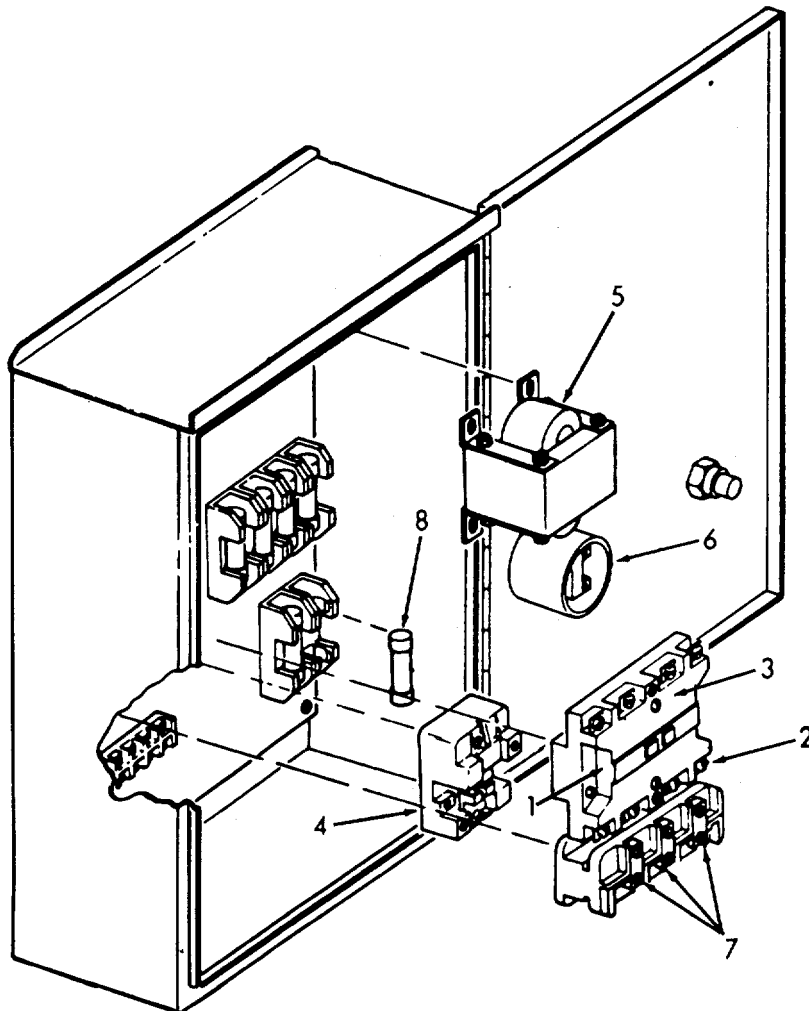
- | | | |
|---------------|--|--------------------|
| 1. Controller | a. Magnetic starter (1), and contacts (2) | Repair or replace. |
| | b. Starter coil (3), and control relay (4) | Repair or replace. |
| | c. Control transformer (5) | Repair or replace. |

5-104. HYDRAULIC CUB PUMP UNIT CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

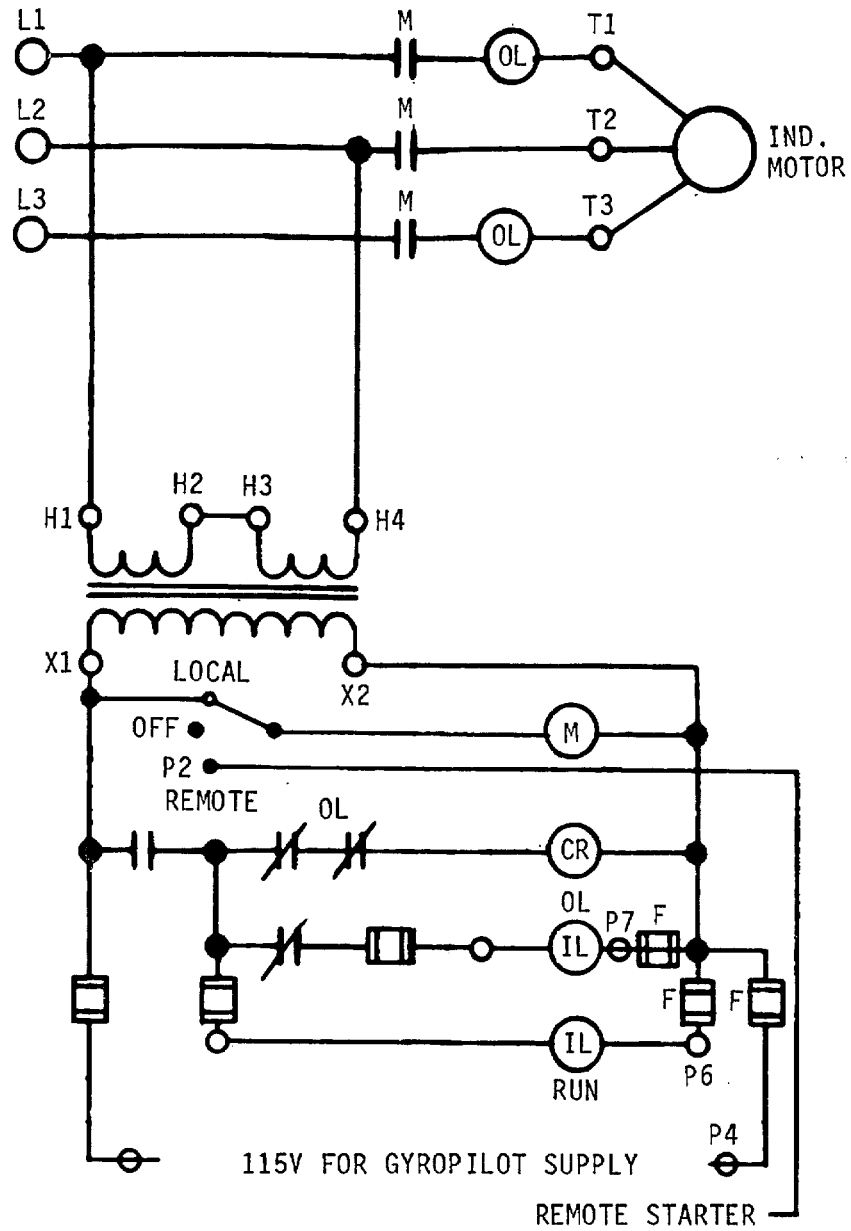
- | | | | |
|----|--|--------------------|--|
| d. | Selector switch (6), and overload heater (7) | Repair or replace. | |
| e. | Fuse (30 amps) (8) | Repair or replace. | |



5-104. HYDRAULIC CUB PUMP UNIT CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



SCHEMATIC DIAGRAM FOR 440VOLT

5-105. HYDRAULIC CUB PUMP UNIT - PUMP MAINTENANCE INSTRUCTIONS

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

Soft hammer
Torque wrench
Vise (soft jaws)
NONE

<u>Equipment Condition</u>	<u>Condition Description</u>
Paragraph	

3-206 Hydraulic Cub Pump

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

5-105. HYDRAULIC CUB PUMP UNIT - PUMP MAINTENANCE INSTRUCTIONS (Continued).

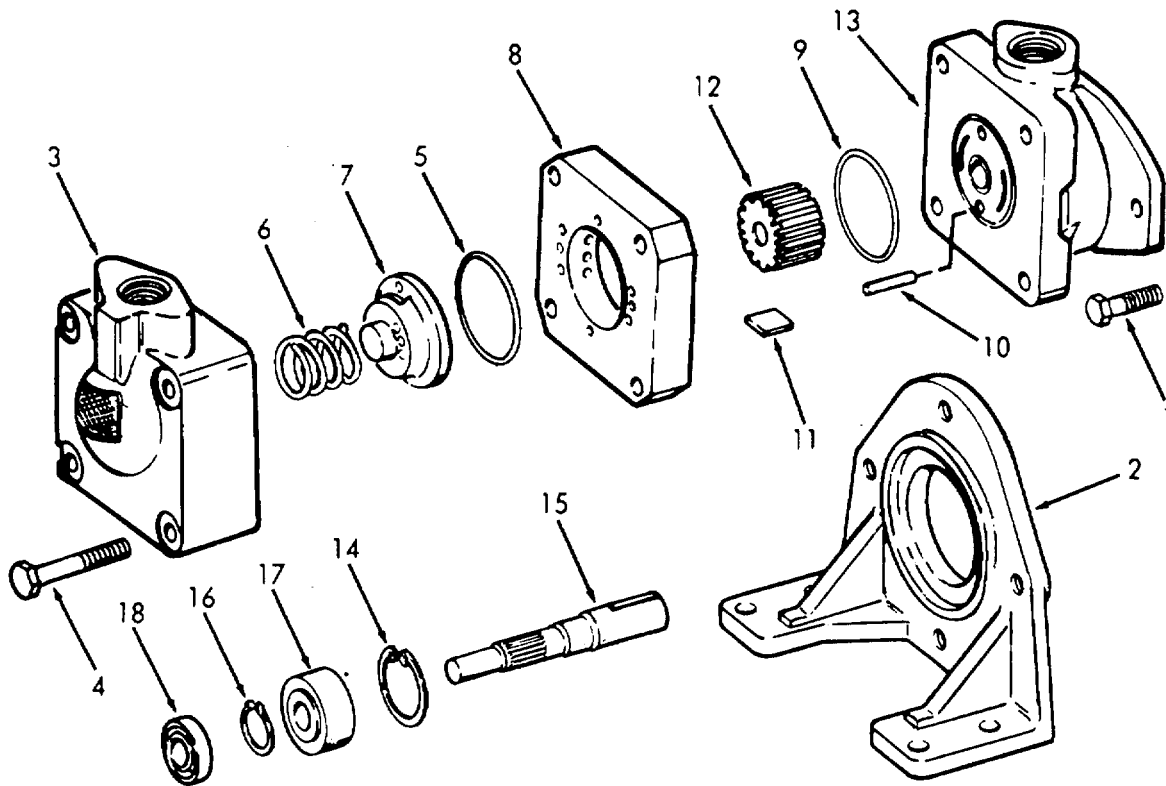
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY			
1. Pump	a. Bolts (1)	Remove.	
	b. Pump bracket (2)	Remove.	
	c. Pump	Clamp in a vise with soft jaws with the cover (3) up.	
	d. Screws (4)	Remove.	
	e. Cover (3)	Remove.	
	f. Preformed packing (5)	Remove.	Discard.
	g. Spring (6), and pressure plate (7)	Remove.	
	h. Ring (8)	Remove.	a. Note position of ring for reassembly. b. Discard.
	i. Preformed packing (9)	Remove.	Discard.
	j. Locating pins (10)	Remove.	
	k. Vanes (11) and rotor (12)	Separate.	Discard.
	l. Rotor (12)	Remove.	
	m. Body (13)	Turn over.	

5-105. HYDRAULIC CUB PUMP UNIT - PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY (Cont)

(14)	n. Snap ring	Remove.	
	o. Shaft (15)	Tap on the splined end to force the shaft out of the body.	Use soft hammer.
	p. Small snap ring (16)	Remove.	
	q. Bearing (17)	1. Support inner race. 2. Press shaft (15) out of bearing.	
	r. Shaft seal (18)	Pull out.	Discard. Use a hooked tool.



5-105. HYDRAULIC CUB PUMP UNIT - PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-CLEANING-INSPECTION

2.

WARNING

Wear protective eye goggles when using compressed air.

All parts must be thoroughly cleaned and kept clean during inspection and assembly. The close tolerance of the parts makes this requirement more stringent than usual. Clean all removed parts, using a commercial solvent that is compatible with the system fluid. Compressed air may be used for cleaning, but it must be filtered to remove water and contamination. Clean compressed air is particularly useful in cleaning spools, orifices, and cover passages.

1. Discard the used shaft seal (18) and all preformed packings (5 and 9). Wash the metal parts in a solvent, blow them dry with filtered compressed air and place them on a clean surface for inspection.
2. Check the wearing surfaces of the body (13), pressure plate (7), ring (8), and rotor (12) for scoring and excessive wear. Remove light score marks by lapping. Replace any heavily scored or badly worn parts.
3. Inspect the vanes (11) for burrs, wear and excessive play in the rotor slots. Replace the vanes (11) and rotor (12) if the slots are worn.

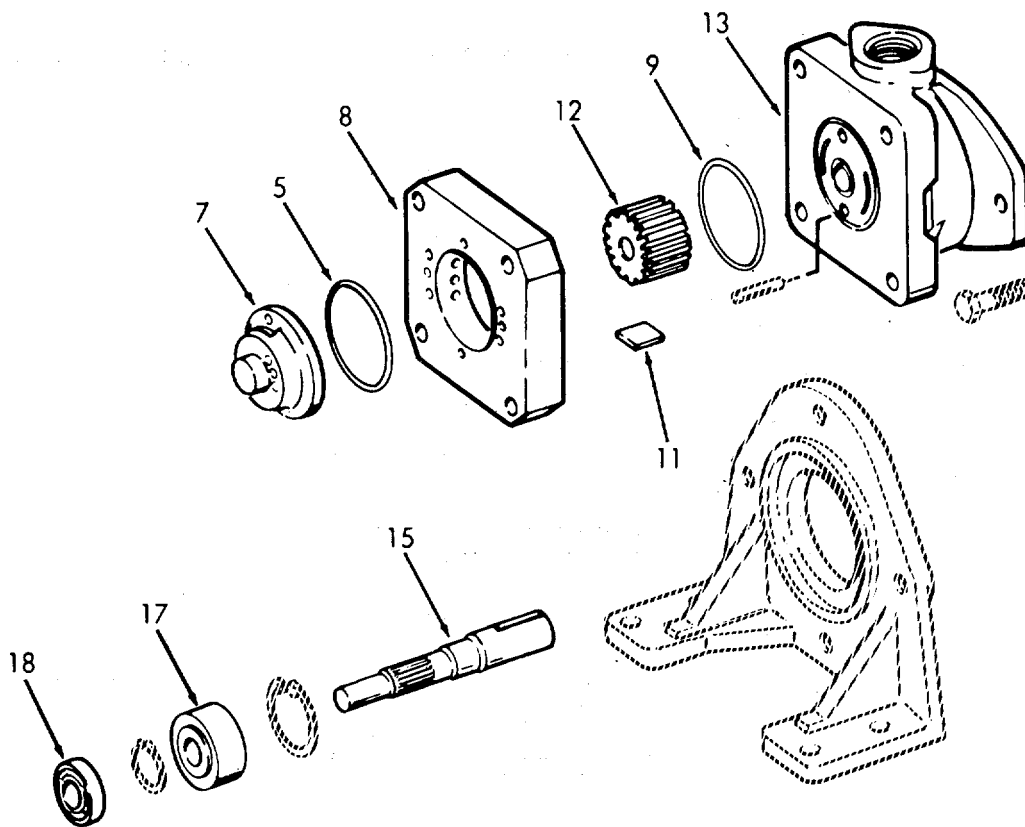
5-105. HYDRAULIC CUB PUMP UNIT - PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-CLEANING-INSPECTION (Cont)

4. Check the bearing (17) for wear and looseness. Rotate the bearings while applying pressure to check for pitted or cracked races.

5. Inspect the oil seal (18) mating surface on the shaft (15) for scoring or wear. If marks on the shaft cannot be removed by light polishing, replace the shaft.



5-105. HYDRAULIC CUB PUMP UNIT - PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL-REASSEMBLY

3.

NOTE

Coat all parts with hydraulic fluid to facilitate assembly and provide initial lubrication. Use small amounts of petroleum jelly to hold preformed packing in place during assembly.

- | | | | |
|----|--------------------------------|--|---|
| a. | Shaft (15)
ring inner race. | Press into bearing. | Support the bearing. |
| b. | Small snap ring (16) | Install on shaft (15). | |
| c. | Shaft seal (18) | 1. Press into body (13).

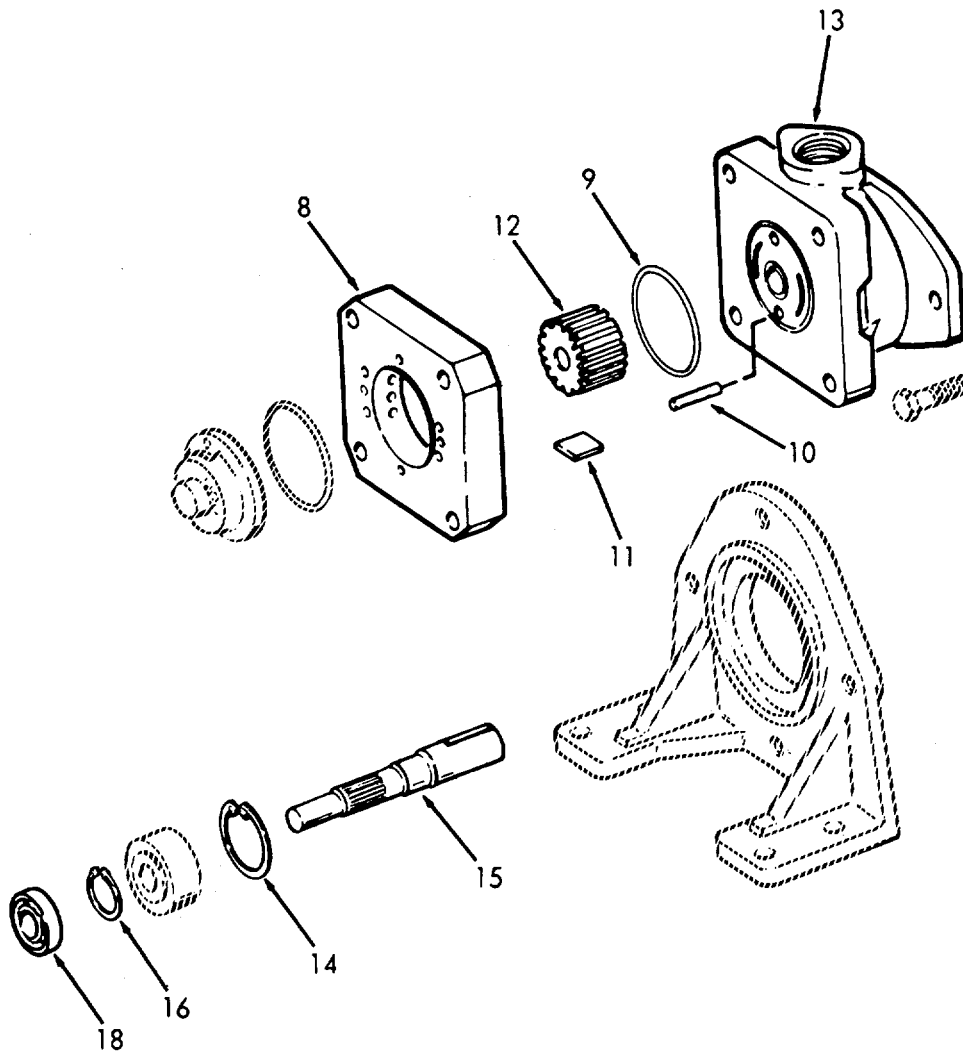
2. Lubricate lip with petroleum jelly. | Seals are assembled with the garter spring towards the pump body. |
| d. | Shaft (15) | Slide into body (13) until the bearing is seated. | Tap lightly on end of shaft if necessary. |
| e. | Snap ring (14) | Install. | |
| f. | Preformed packing (9) | Install in body. | |
| g. | Locating pins (10) | Install in body. | |
| h. | Ring (8) | Install onto body. | Make sure arrow on perimeter points in the direction of rotation. |
| i. | Rotor (12) | Place on shaft (15). | |

5-105. HYDRAULIC CUB PUMP UNIT - PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL-REASSEMBLY (Cont)

- | | | | |
|----|------------|--|--|
| j. | Vanes (11) | <ol style="list-style-type: none"> 1. Insert in rotor slots. 2. Be sure the radius edges of the vanes are toward the cam ring. | |
|----|------------|--|--|

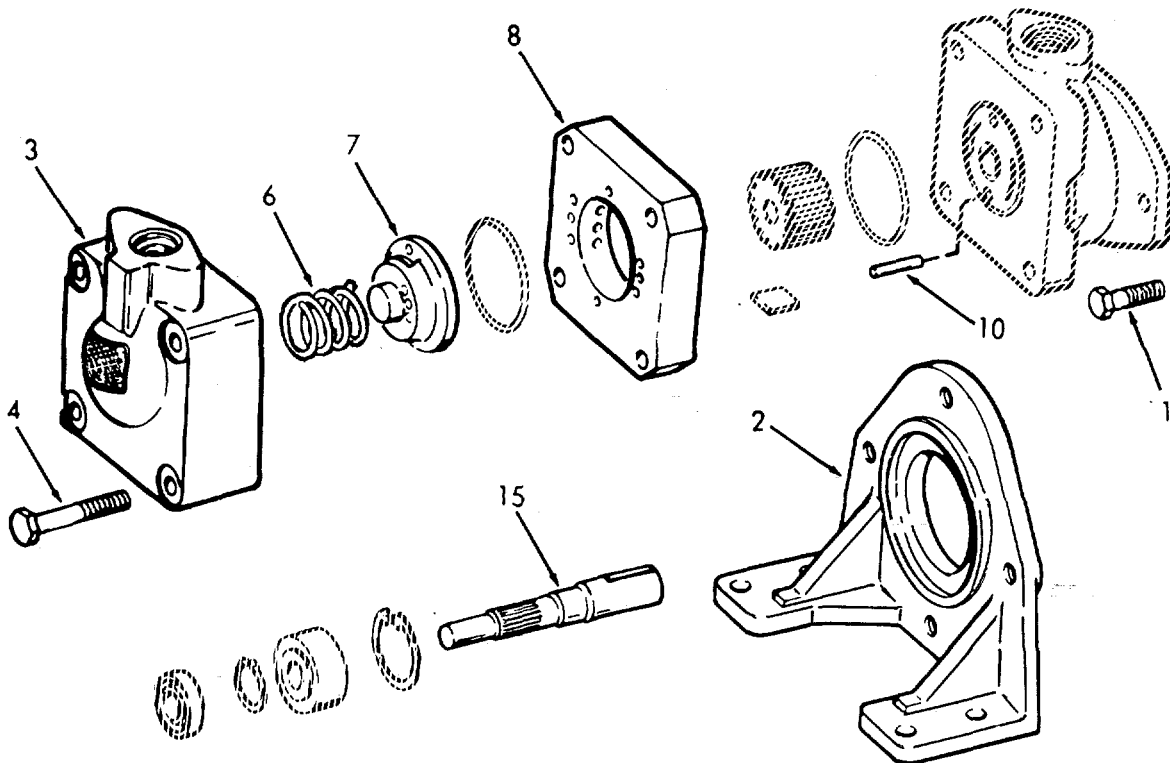


5-105. HYDRAULIC CUB PUMP UNIT - PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-REASSEMBLY (Cont)

- | | | | |
|----|---------------------------------------|---|--|
| k. | Pressure plate (7) | Place on locating pins (10) and against ring (8). | |
| l. | Spring (6), cover (3), and screws (4) | Install. | Tighten to 35-45 lb. ft (47.5 to 61. Nm) torque. |
| m. | Shaft (15) is no internal binding. | Rotate. | Make sure there |
| n. | Pump bracket (2) | Assemble. | |
| o. | Bolts (1) | Install. | |



5-106. HYDRAULIC CUB PUMP UNIT - BRAKE VALVE - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

Gasket kit P/N 919328

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

5-106. HYDRAULIC CUB PUMP UNIT - BRAKE VALVE MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

1. Brake Valve

WARNING

Before breaking any circuit connections, be certain the electrical power is off and all branches of the circuit are relieved of trapped pressures. Block any load whose movement could cause injury to personnel or damage to the equipment.

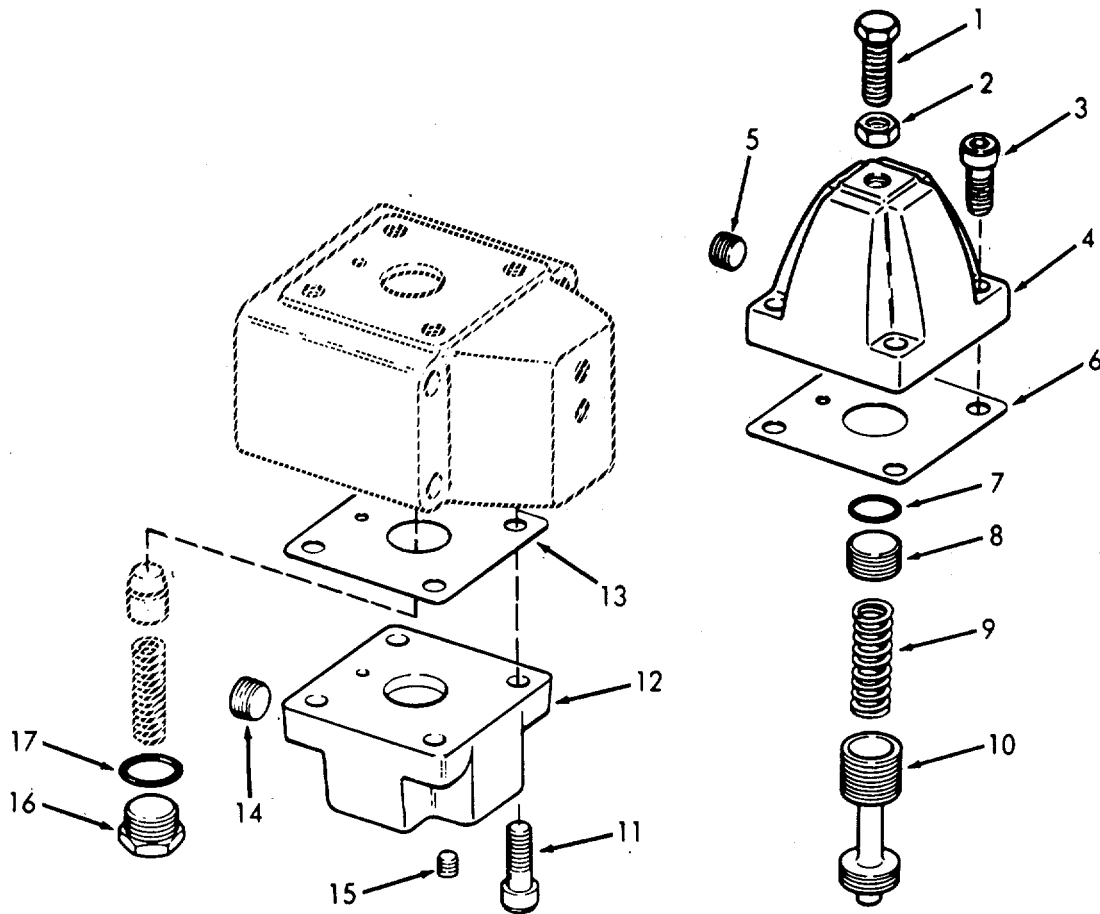
a.	Adjusting screw (1)	<ol style="list-style-type: none"> 1. Loosen locknut (2). 2. Back off screw to its full length. 3. Remove. 	Relieves spring compression.
b.	Screws (3)	Remove.	
c.	Top cover (4), and cover plug (5)	Remove.	
d.	Gasket (6)	Remove.	Discard.
e.	Preformed packing (7)	Remove.	Discard.
f.	Spring plug (8), spring (9), and spool (10)	<ol style="list-style-type: none"> 1. Remove. 2. Inspect spool for binding or excessive clearance. 	
g.	Screws (11)	Remove.	Discard.

5-106. HYDRAULIC CUB PUMP UNIT - BRAKE VALVE MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|----|----------------------------------|---------|----------|
| h. | Cover (12)
and gasket
(13) | Remove. | Discard. |
| i. | Cover plugs
(14 and 15) | Remove. | |
| j. | Plug (16) | Remove. | |
| k. | Preformed
packing
(17) | Remove. | Discard. |



5-106. HYDRAULIC CUB PUMP UNIT - BRAKE VALVE MAINTENANCE INSTRUCTIONS (Continued).

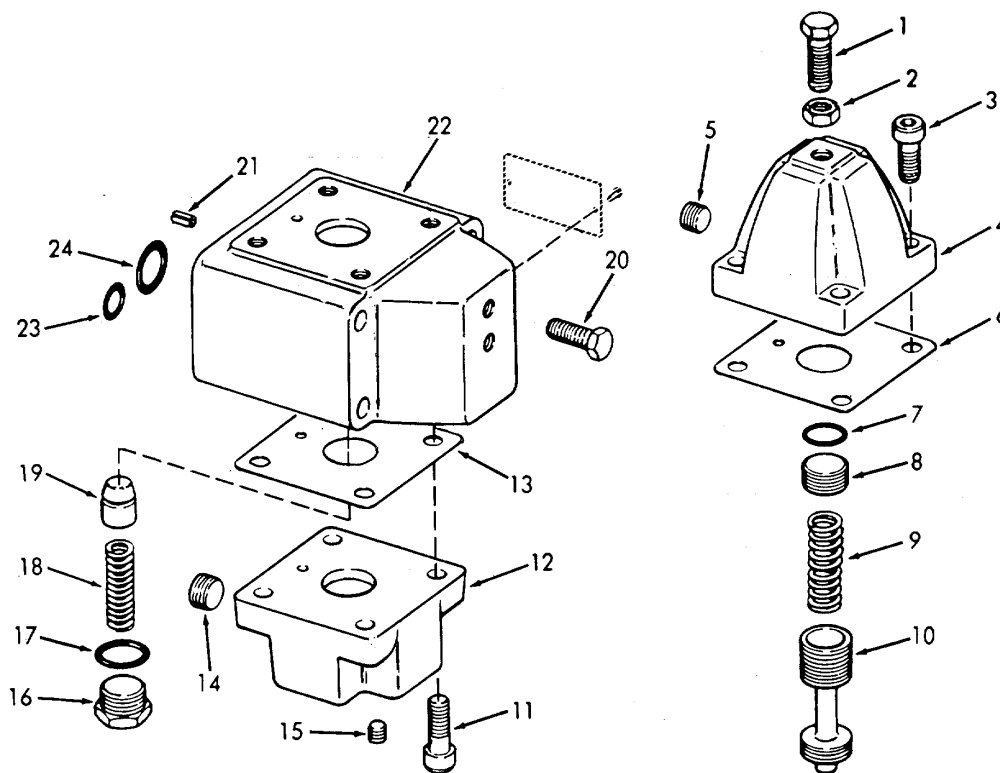
LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REPAIR (Cont)</div>	l. Spring (18), and poppet (19)	1. Remove. 2. Inspect poppet for binding or excessive clearance.	
	m. Plugs (20), and roll pin (21)	Remove from body (22). If necessary.	
	n. Preformed packings (23 and 24)	1. Remove from body (22). Discard.	Use new packings.
	o. Preformed packing (17)	2. Replace	Use new packing. X
	p. Poppet (19) and spring (18)	Install.	
	q. Plug (16), and cover plugs (14 and 15)	Install.	
	r. Gasket (13), and cover (12)	1. Align holes. 2. Install.	Use new gasket.
	s. Screws (11)	Install.	
	t. Preformed packing (7)	Install.	

5-106. HYDRAULIC CUB PUMP UNIT - BRAKE VALVE MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|----|---|--------------------------------|-----------------|
| u. | Spool (10),
spring (9)
and spring
plug (8) | Install. | |
| v. | Cover plug
(5) | Install. | |
| w. | Gasket (6),
and top
cover (4) | 1. Align holes.
2. Install. | Use new gasket. |
| x. | Screws (3) | Install. | |
| y. | Adjusting
screw (1),
and locknut
(2) | Adjust and tighten. | |



5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER MAINTENANCE INSTRUCTIONS

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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NOTE

Repair or replace the following parts as needed.

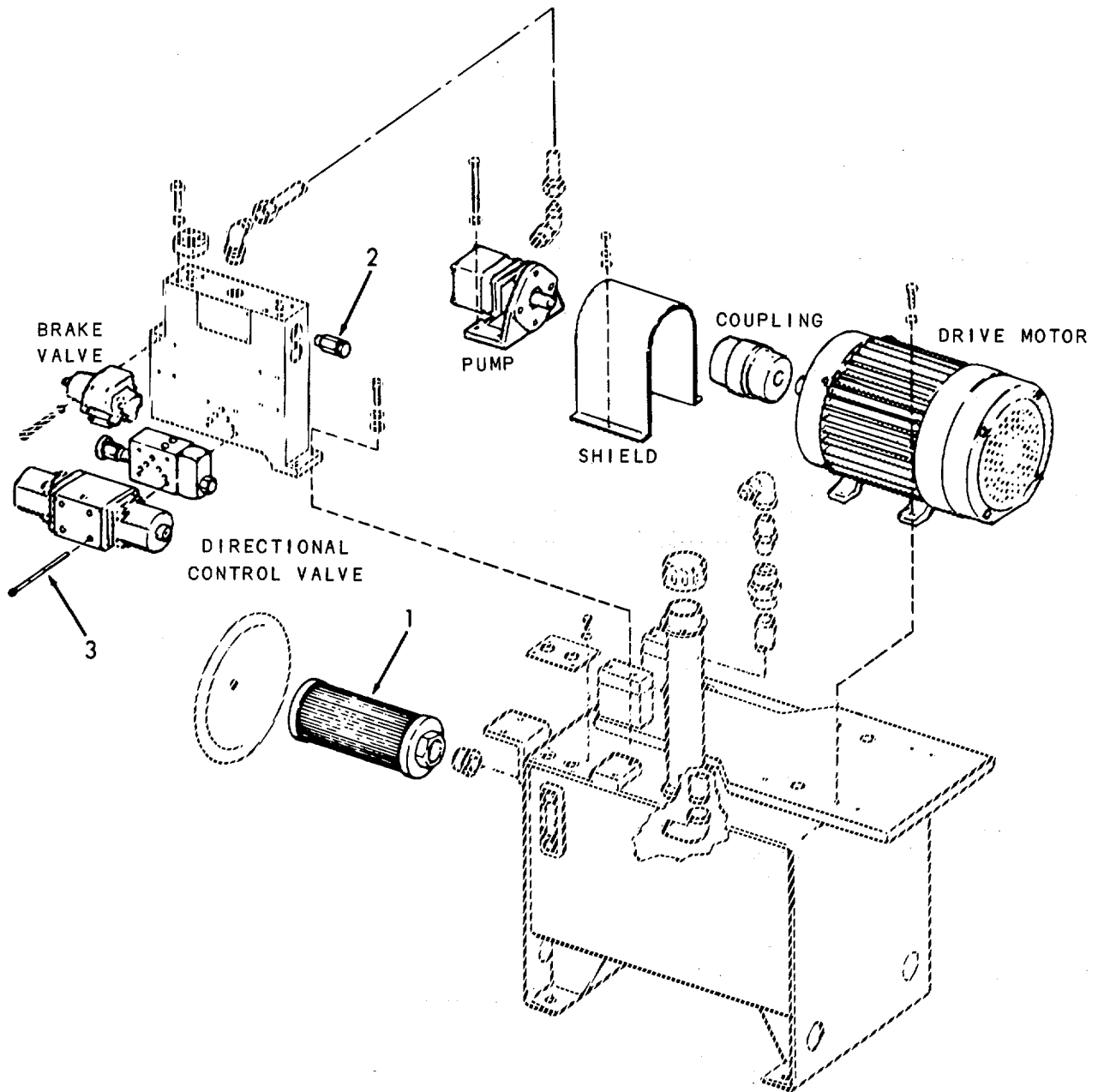
REPAIR

1. Reservoir, Tank, and Strainer
 - a. Hydraulic strainer (1)
 - b. Relief cylinder pressure valve (2)
 - c. Socket screw (3)

5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

NOTE

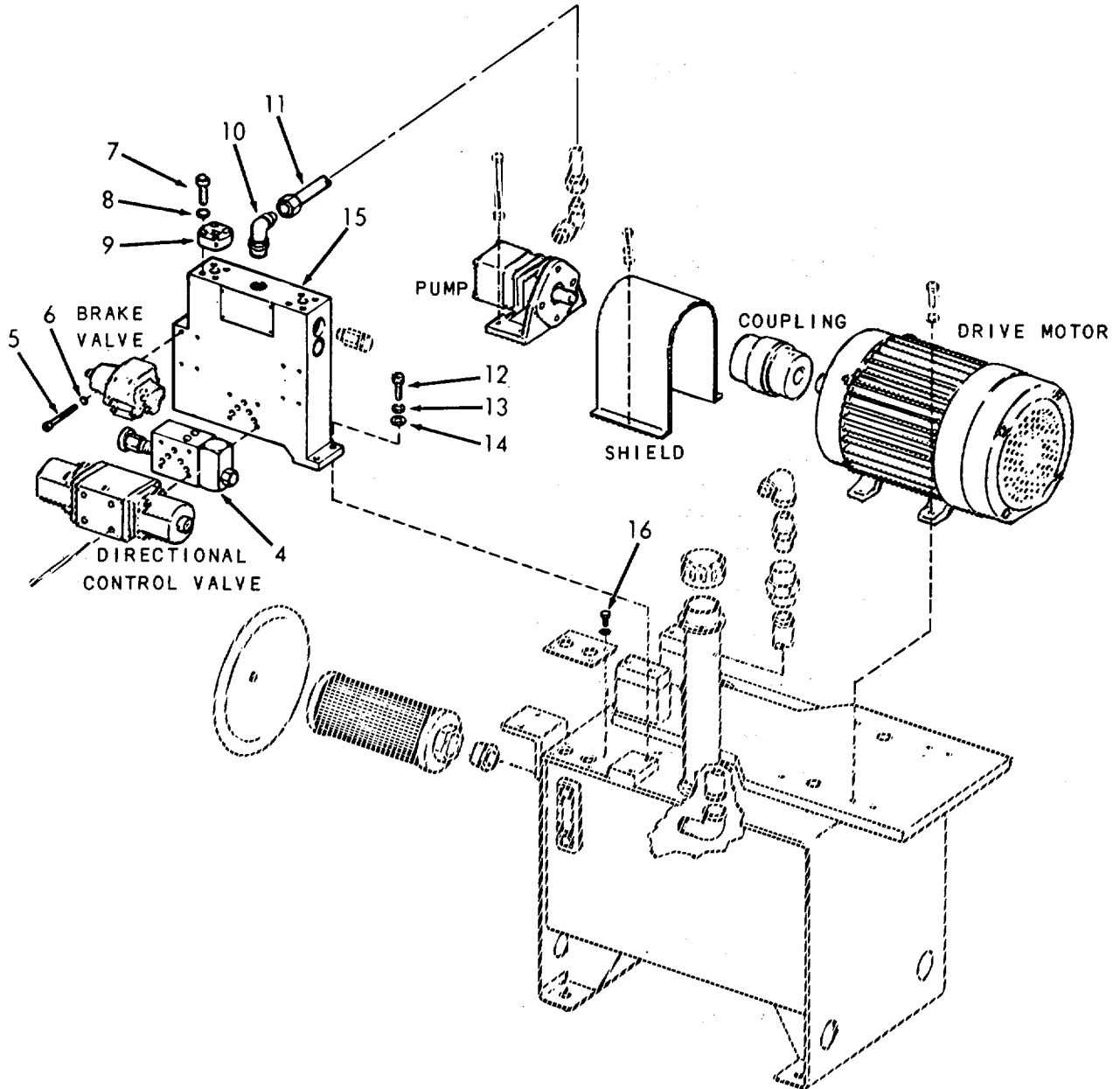
Repair or replace the following parts as needed.

- d. Relief pump pressure valve (4)
- e. Socket head capscrew (5)
- f. Lockwasher (6)
- g. Socket head capscrew (7)
- h. Lockwasher (8)
- i. Manifold fitting (9)
- j. Steel tubing (10)
- k. Elbow (11)
- l. Hex head capscrew (12)
- m. Lockwasher (13)
- n. Flatwasher (14)
- o. Aluminum manifold (15)
- p. Hex head capscrew (16)

5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

NOTE

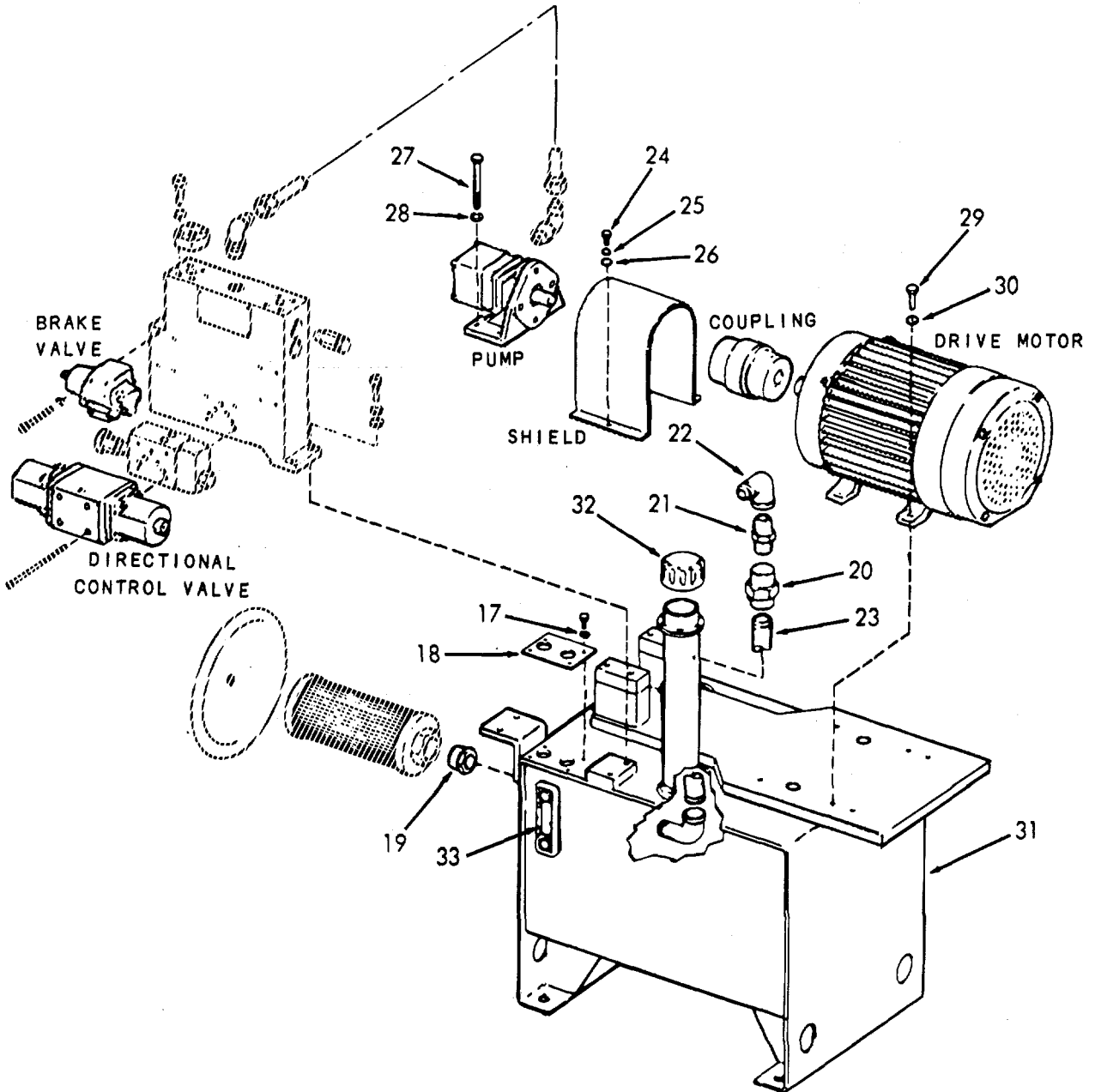
Repair or replace the following parts as needed.

- q. Lockwasher (17), and plate (18)
- r. Bushing (19)
- s. Pipe union (20), and nipple (21)
- t. Elbow (22), and pipe (23)
- u. Hex head capscrew (24), and lockwasher (25)
- v. Flatwasher (26), and capscrew (27)
- w. Lockwasher (28), and hex head capscrew (29)
- x. Lockwasher (30), and reservoir (31)
- y. Filler breather (32), and reservoir sight gage (33)

5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER MAINTENANCE INSTRUCTIONS

This task covers:

- a. Removal
- b. Repair
- c. Installation

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

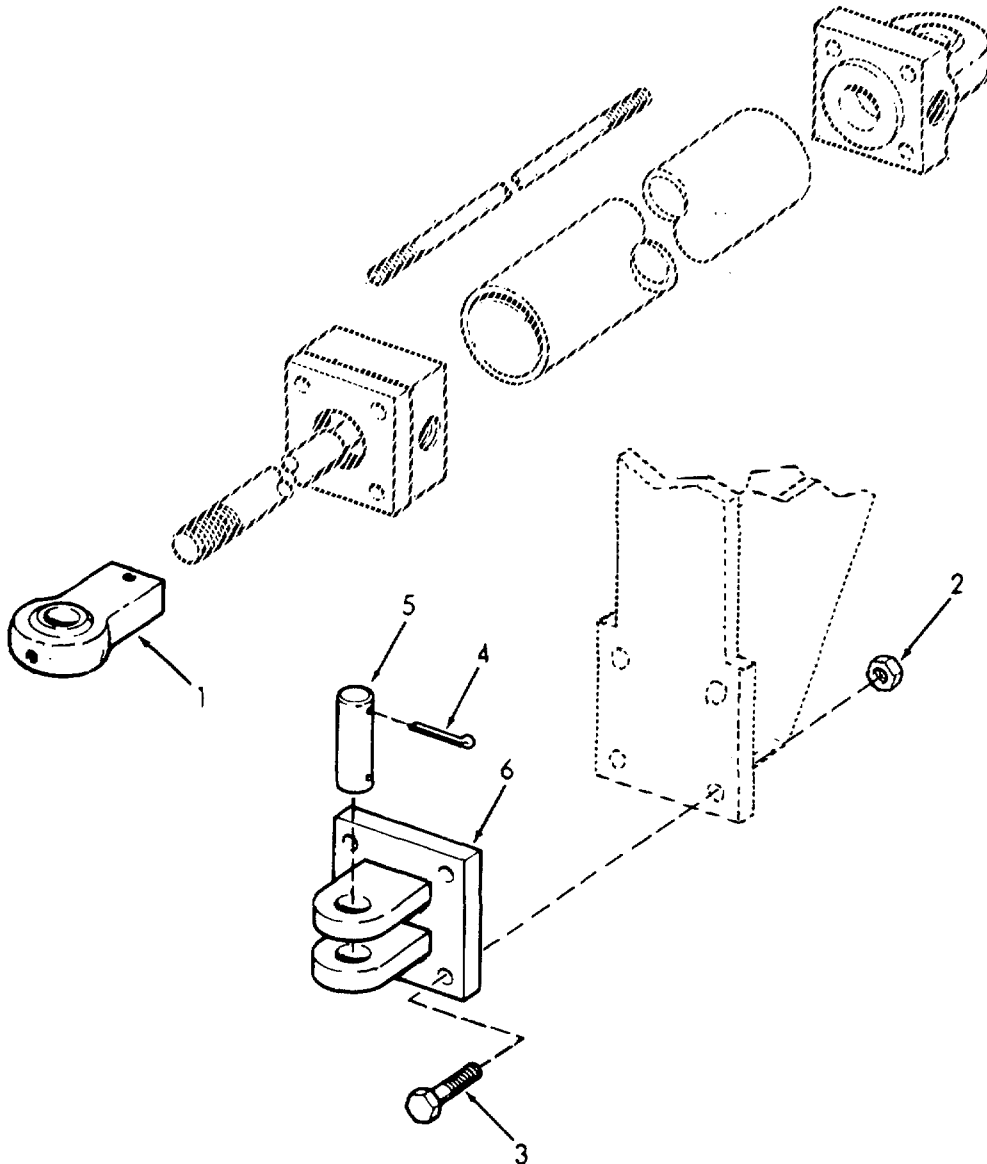
- | | | | |
|-----------------------|----|--------------------------|----------------------------|
| 1. Hydraulic Cylinder | a. | Rod eye end (1) | Remove attaching hardware. |
| | b. | Nuts (2), and screws (3) | Remove. |
| | c. | Cylinder assembly | Remove. |
| | d. | Cotter pins (4) | Remove. |
| | e. | Pivot pin (5) | Remove. |

5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----|--------------------------|-------------------------|--|
| f. | Clevis
bracket
(6) | Separate from cylinder. | |
|----|--------------------------|-------------------------|--|



5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE MAINTENANCE
INSTRUCTIONS (Continued).

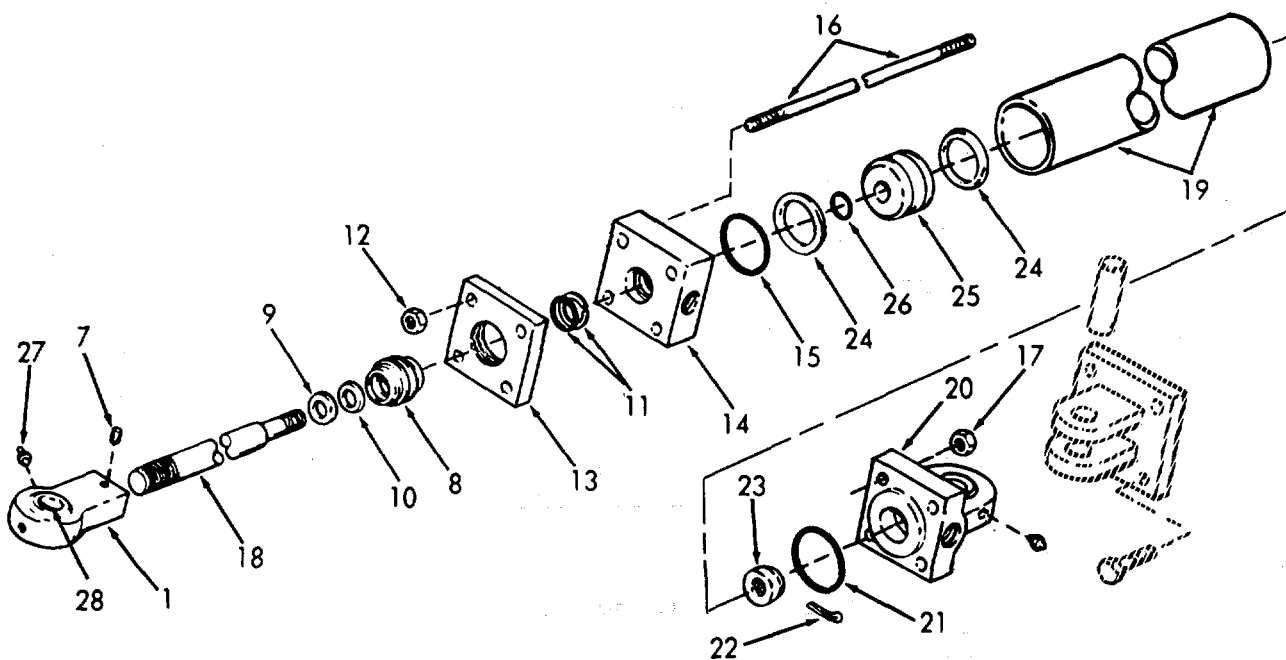
LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
2. Seals, Seal Rings, and Cups	a. Setscrew (7)	Remove.	
	b. Rod eye end (1)	Unscrew and remove.	
	c. Rod cartridge (8)	Remove.	Use spanner wrench.
	d. Scraper (9), rod seal cup (10), and back-up seal ring (11)	Remove.	
	e. Tie rod nuts (12), and retaining plate (13)	Remove.	
	f. Rod end head (14), and seal ring (15)	Remove.	
	g. Tie rods (16), and nuts (17)	Remove and disassemble.	
	h. Piston rod (18) and attached parts	Remove from cylinder barrel (19).	
	i. Blank end plate (20), and seal ring (21)	Remove.	

5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----|--|---|---------------|
| j. | Cotter pin (22), and blank end cushion sleeve (23) | Remove. | |
| k. | Seal cups (24), piston (25), and seal ring (26) | Remove. | |
| l. | Rod end eye (1) | Remove lubrication fittings (27), and self-aligning bearing (28). | If necessary. |



5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

m.	Blank end head (20), and seal ring (21)	Remove lubrication fittings (27), and self aligning bearing (28). NOTE	If necessary.
----	---	---	---------------

Lubricate all seal rings, seals, and seal cups with hydraulic fluid before installing.

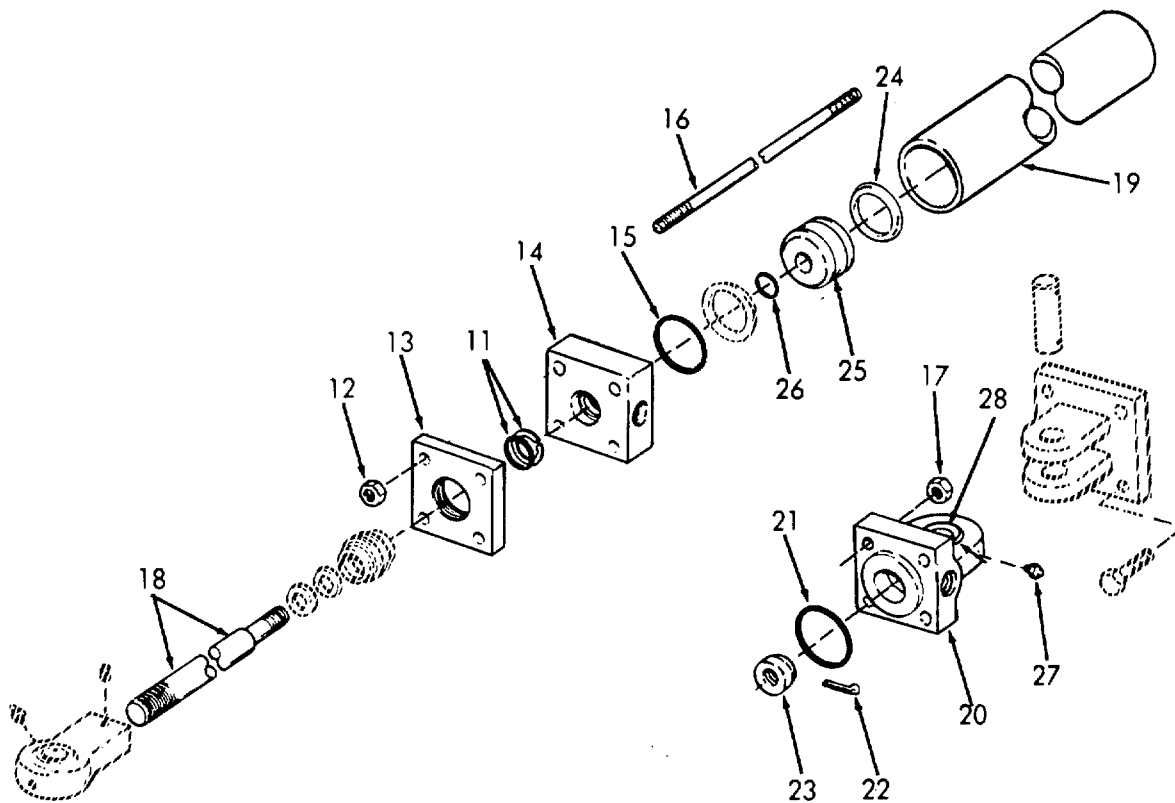
n.	Seal ring (26), and piston (25)	Install on piston rod (18).
o.	Seal cups (24)	Install.
p.	Blank end cushion sleeve (23)	Install.
q.	Cotter pin (22)	Install.
r.	Blank end head (20), and seal ring (21)	Assemble.
s.	Piston rod (18), and attached parts	Insert in cylinder barrel (19).
t.	Blank end	Install on cylinder
u.	Tie rods - (16), and nuts (17)	Insert in blank end head (20).

5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | | |
|----|---------------------------------------|----------|---------------------------------------|
| v. | Rod end head (14), and seal ring (15) | Install. | |
| w. | Retaining plate (13) | Install. | |
| x. | Tie rod nuts (12) | Install. | Tighten to 30 lb-ft (40.7 Nm) torque. |
| y. | Back-up seal ring | Install. | |

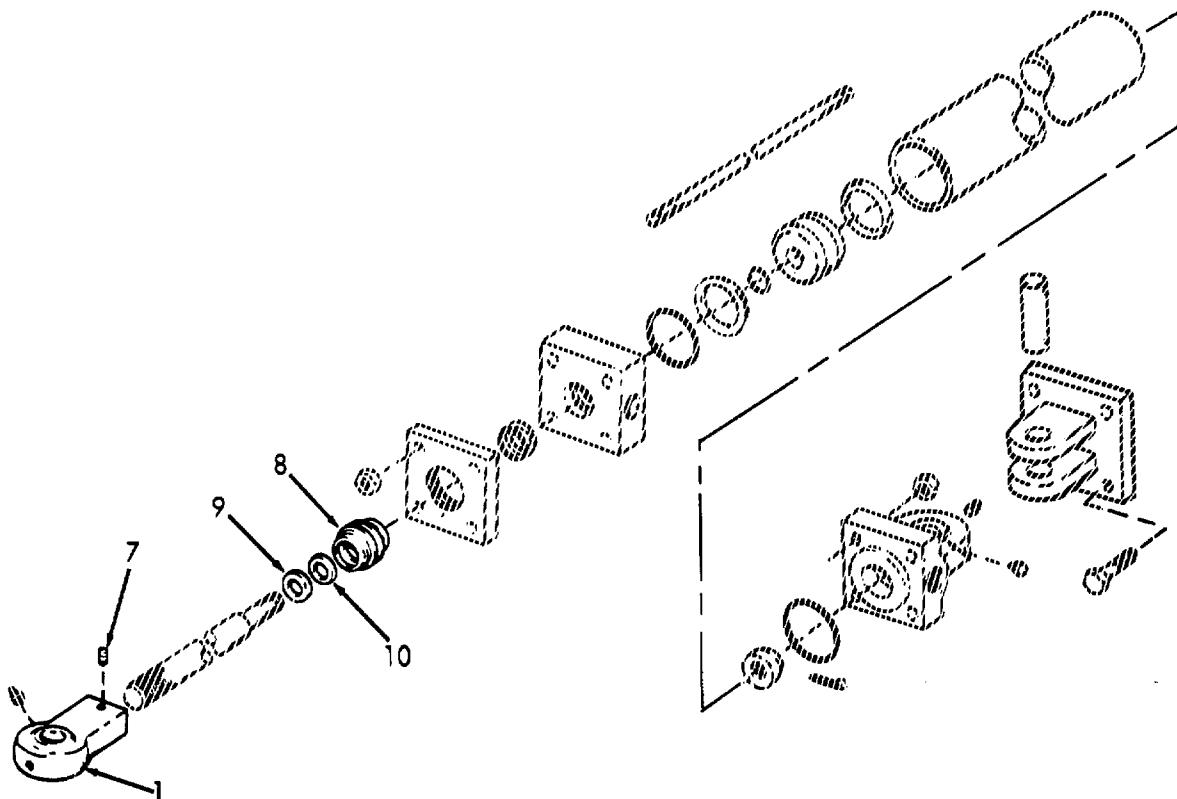


5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | |
|-----|-----------------------------------|----------|
| z. | Rod seal cup (10) and scraper (9) | Install. |
| aa. | Rod cartridge (8) | Install. |
| ab. | Rod eye end (1) | Install. |
| ac. | Setscrew (7) | Install. |

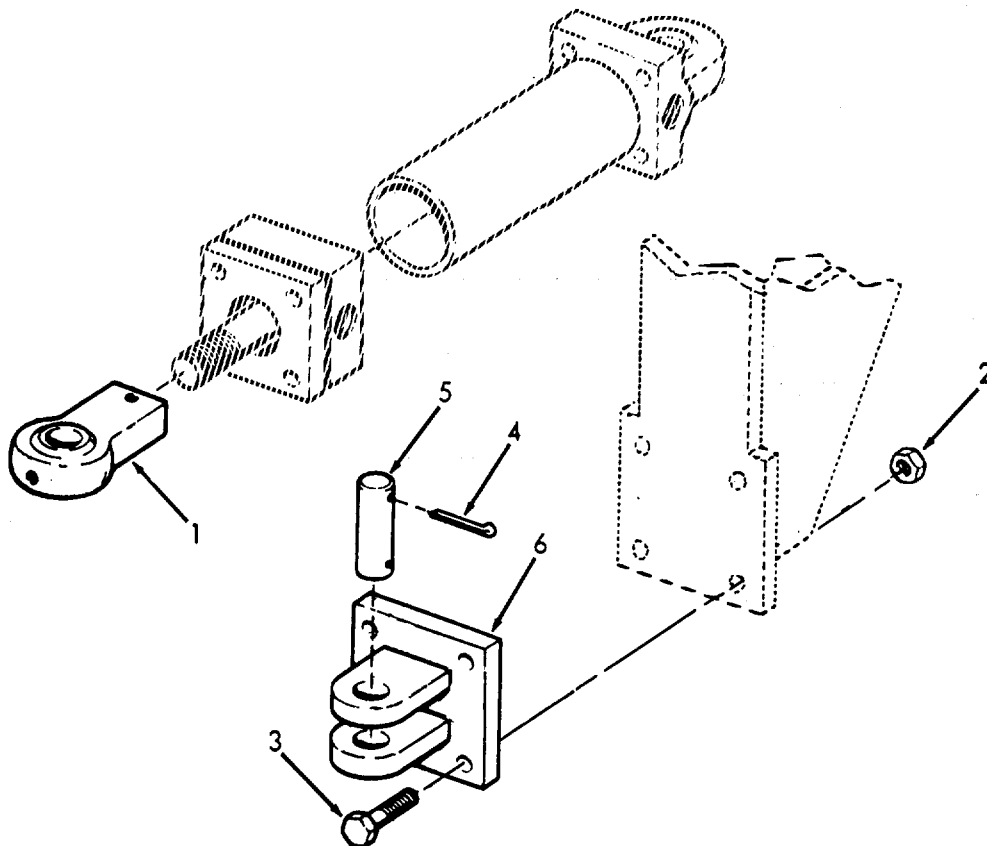


5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | |
|----|---------------------------------------|----------------------|
| 3. | a. Clevis bracket (6) | Install in cylinder. |
| | b. Pivot pin (5), and cotter-pins (4) | Install. |
| | c. Cylinder assembly | Install. |
| | d. Screws (3), and | Install. |
| | e. Rod eye end (1) | Reattach |



5-109. HYDRAULIC CUB PUMP UNIT - HOSES, PIPING, AND VALVES -
MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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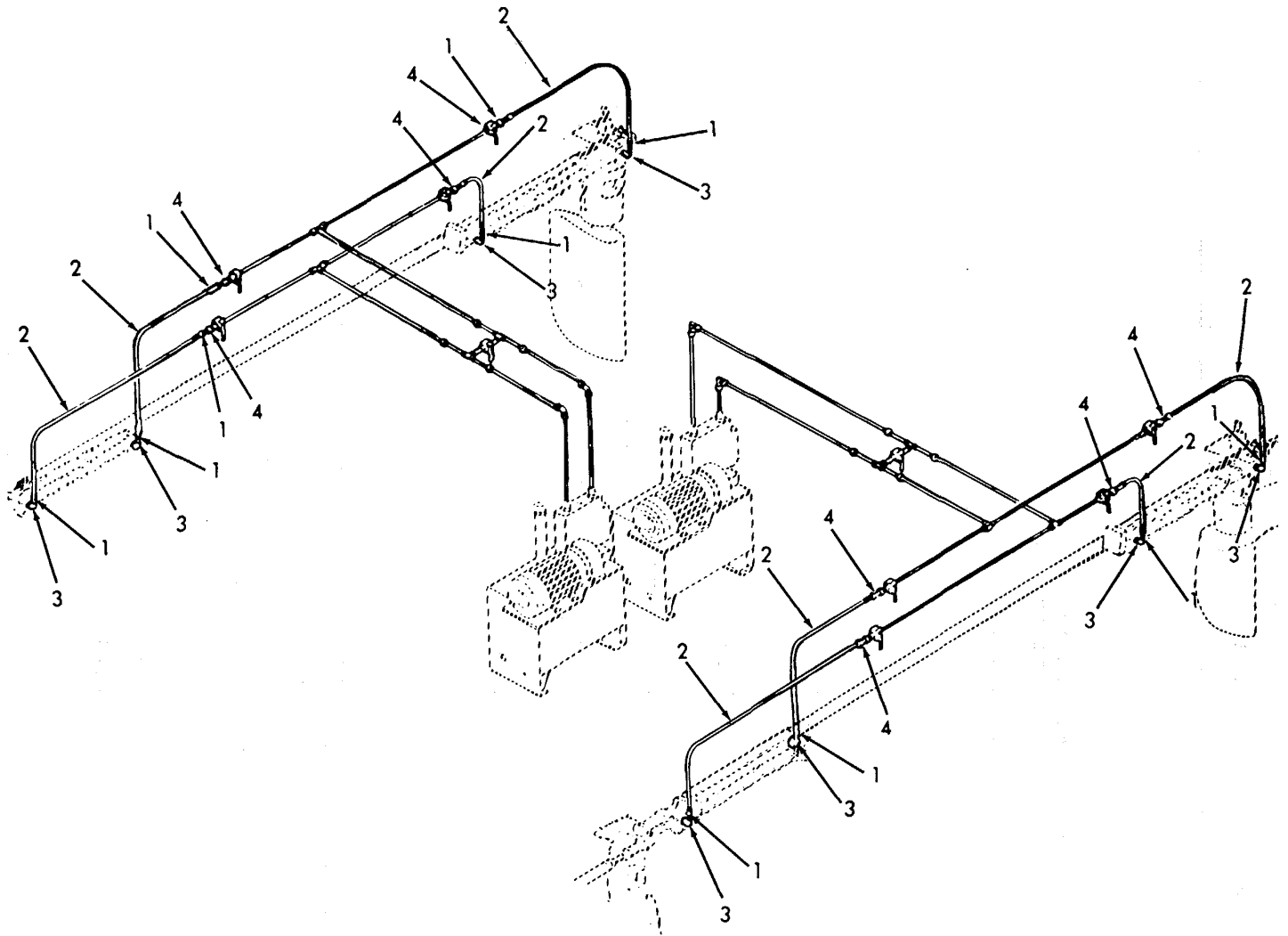
NOTE

Repair or replace the following parts as needed.

REPAIR OR REPLACE

- | | |
|---|--|
| <p>1. Hoses,
Piping,
and
Valves
rubber
hose (2)</p> | <p>a. Hose fitting
(1)</p> <p>b. Hydraulic</p> <p>c. Elbow (3)</p> <p>d. Union nut
(4)</p> |
|---|--|

5-109. HYDRAULIC CUB PUMP UNIT - HOSES, PIPING, AND VALVES -
MAINTENANCE INSTRUCTIONS (Continued).



5-109. HYDRAULIC CUB PUMP UNIT - HOSES, PIPING, AND VALVES -
 MAINTENANCE INSTRUCTIONS (Continued).

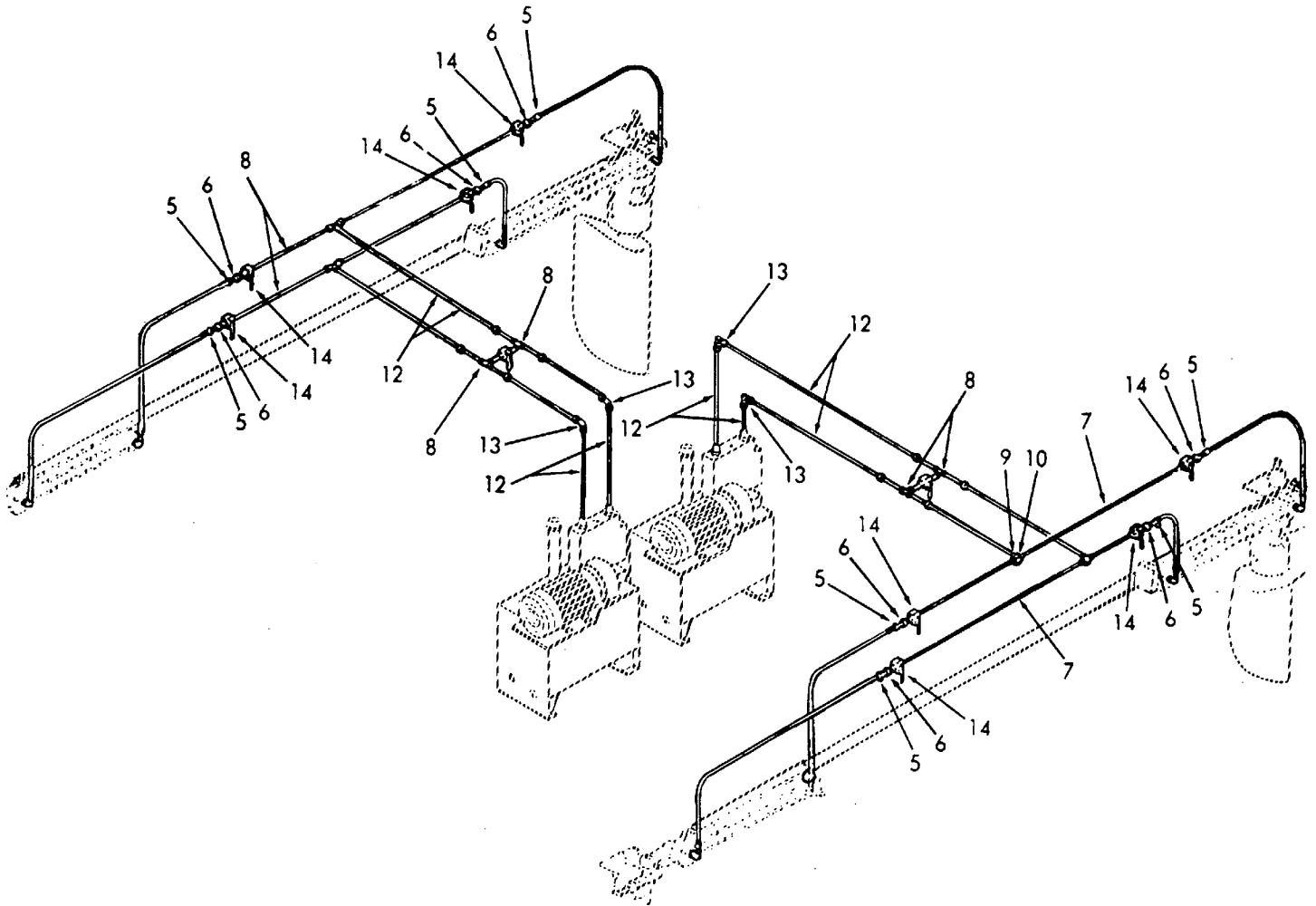
LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

- e. Female pipe fitting (5)
- f. O-ring tailpiece (6)
- g. Steel pipe (7)
- h. Pipe tee (8)
- i. Union nut (9)
- j. Pipe fitting (10)
- k. O-ring tailpiece (11)
- l. Pipe (12)
- m. Elbow (13)
- n. Gear system ball valve (14)

5-109. HYDRAULIC CUB PUMP UNIT - HOSES, PIPING, AND VALVES -
MAINTENANCE INSTRUCTIONS (Continued).

REPAIR OR REPLACE (Cont)



5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
DRYDOCKED

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required

4

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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NOTE

Repair or replace the following parts as needed.

REPAIR OR REPLACE

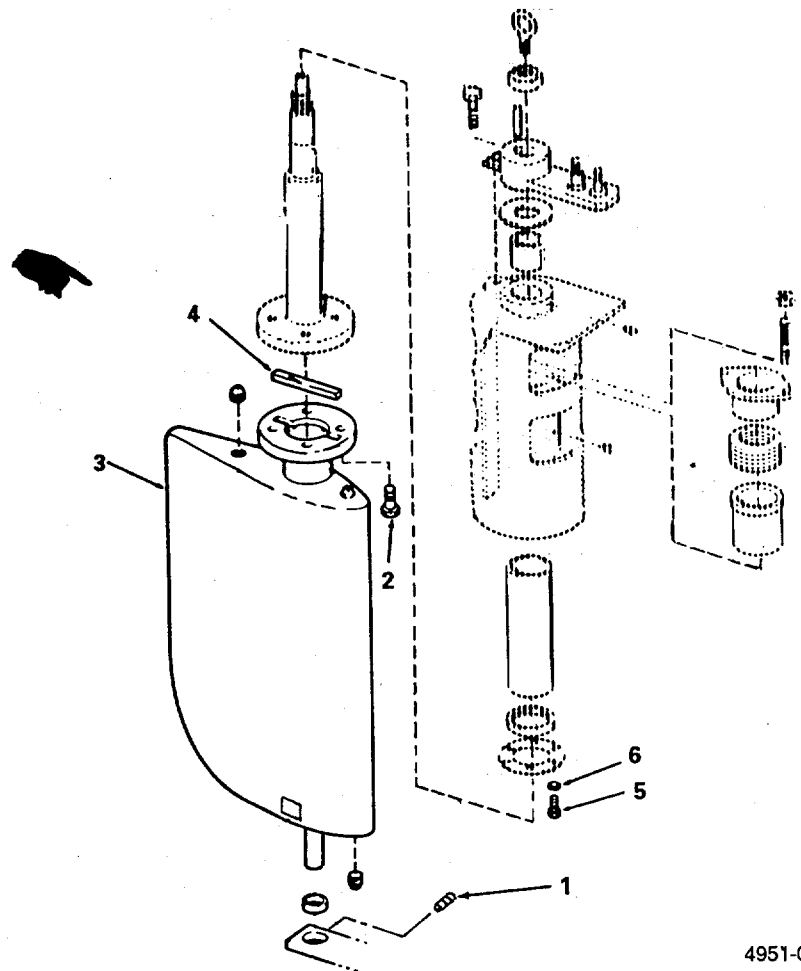
- | | | | |
|----|-----------------|----|------------------------|
| 1. | Flanking Rudder | a. | Cup paint setscrew (1) |
| | | b. | Hex head capscrew (2) |

5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

- c. Flanking rudder (3)
- d. Square rudder key (4)
- e. Hex head capscrew (5)
- f. Lockwashers (6:



Change 1 5-1241

4951-041

5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

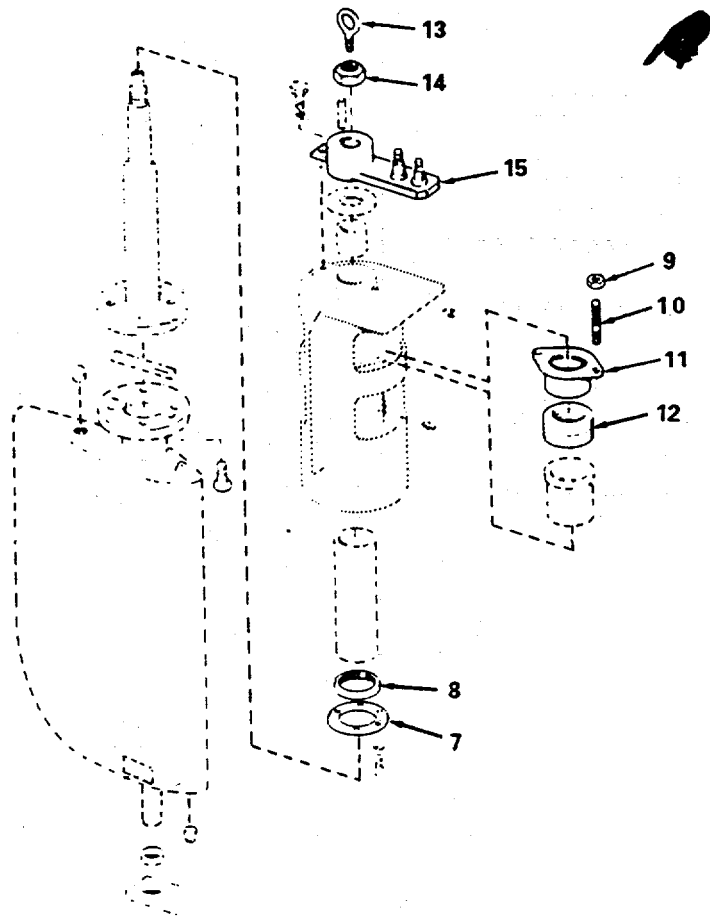
- g. Flanking rudder retaining plate (7)
- h. Flanking rudder lower rudder seal (8)
- i. Plain hex nut (9)
- j. Packing gland stud (10)
- k. Flanking rudder packing gland (11)
- l. Packing (12)
- m. Shoulder eyebolt (13)
- n. Hex nut (14) (self-locking)
- o. Starboard flanking rudder tiller arm (15)

5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

- p. Inboard port flanking rudder arm (15)
- q. Outboard starboard flanking rudder tiller arm (15)



5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

	r. Outboard port flanking rudder tiller arm (15)		
--	---	--	--

	s. Flanking rudder steel tiller square key (16)-		
--	---	--	--

	t. Flanking rudder stock (17)		
--	-------------------------------------	--	--

	u. Flanking stock rudder sleeve (18)		
--	--	--	--

	v. Flanking stock rudder floating ring (19)		
--	---	--	--

	w. Lubrica- tion fitting 20)		
--	---------------------------------------	--	--

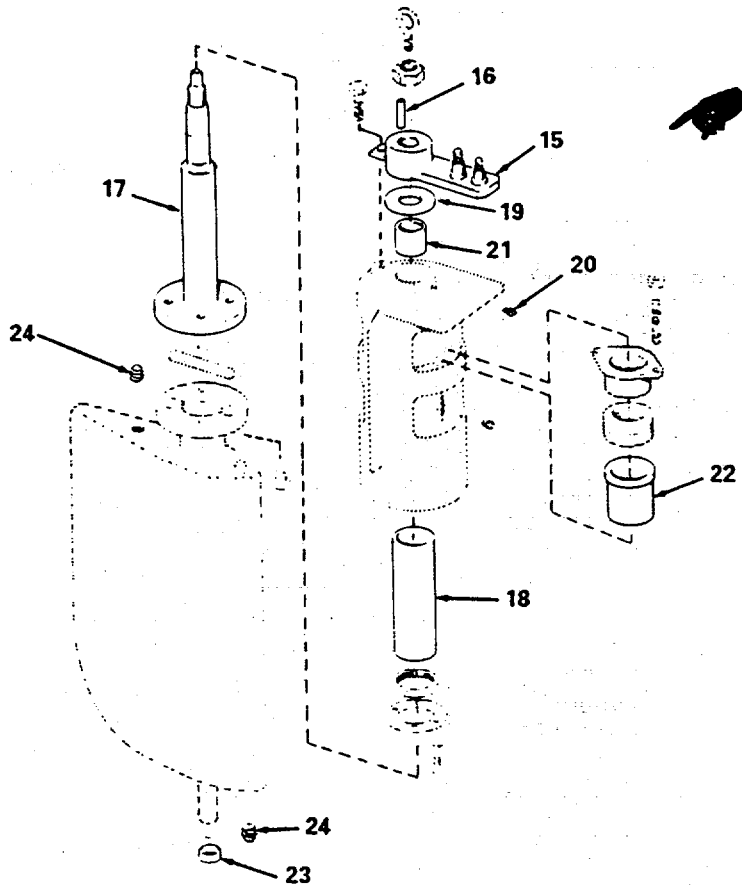
	x. Upper stock flanking rudder bushing (21)		
--	---	--	--

5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

- y. Lower stock flanking rudder bushing (22)
- z. Pintle bushing (23)
- aa. Pipe plug (24)



5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

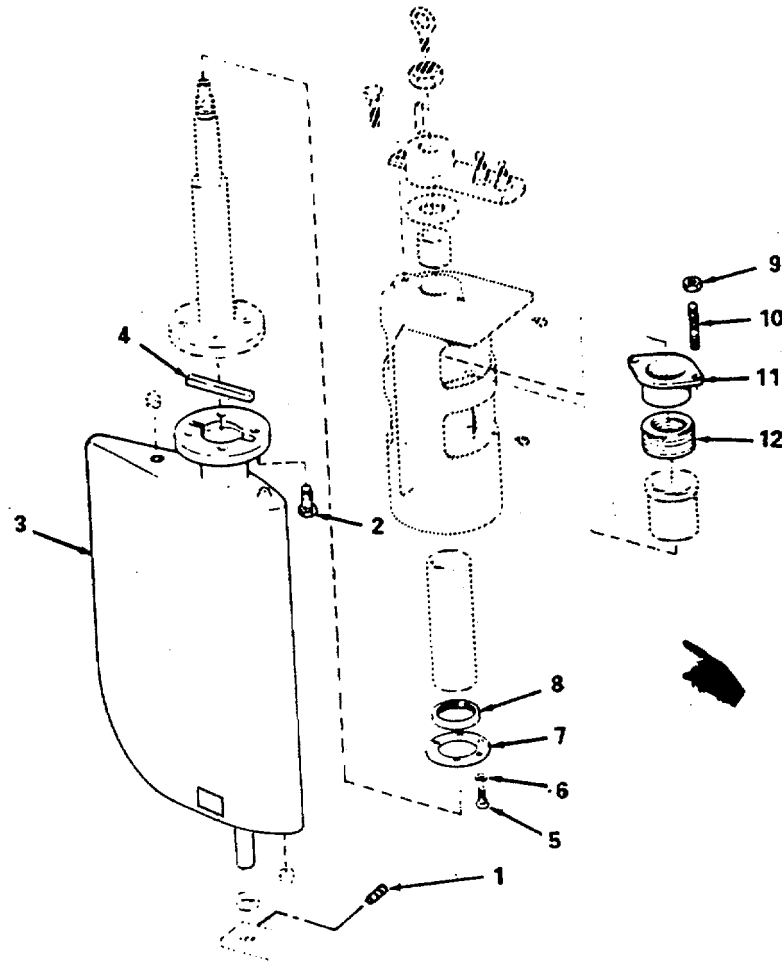
- | | | | |
|----------------|---------------------------------|--|--|
| 2. Main Rudder | a. Cup point setscrew (1) | | |
| | b. Hex head capscrew (2) | | |
| | c. Main rudder (3) | | |
| | d. Square rudder key (4) | | |
| | e. Hex head capscrew (5) | | |
| | f. Lockwasher (6) | | |
| | g. Rudder Retaining plate (7) | | |
| | h. Lower rudder rubber seal (8) | | |
| | i. Plain hex nut (9) | | |

5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

- j. Packing gland stud (10)
- k. Rudder packing (11)
- l. Packing (12)



5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

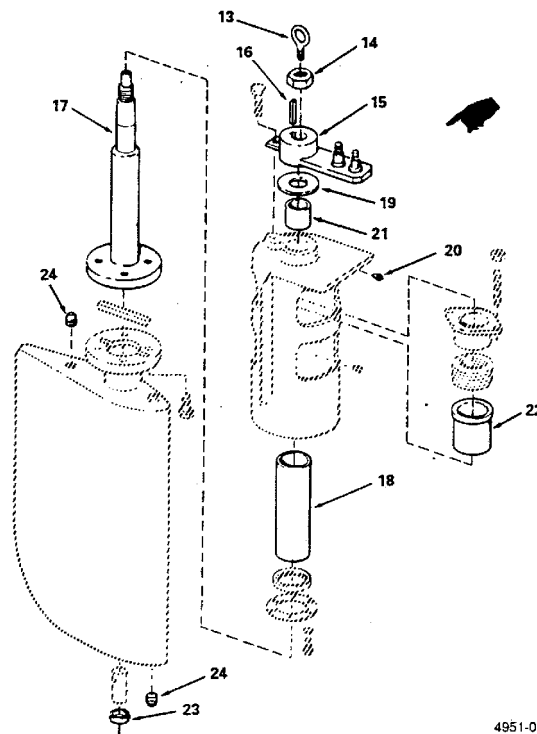
- m. Shoulder eyebolt (13)
- n. Hex nut (14) (self-locking)
- o. Steering rudder tiller arm (15)
- p. Square key (16)
- q. Main rudder stock (17)
- r. Main rudder stock sleeve (18)
- s. Main rudder floating-ring (19)
- t. Lubrication fitting (20)

5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

- u. Upper main rudder stock bushing (21)
- v. Lower main rudder bushing (22)
- w. Pintle bushing1 (23)
- x. Pipe plug (24)



4951-045

5-111. RUDDER ANGLE INDICATOR - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

References
Paragraph
3-212 Rudder Angle Indicator

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL

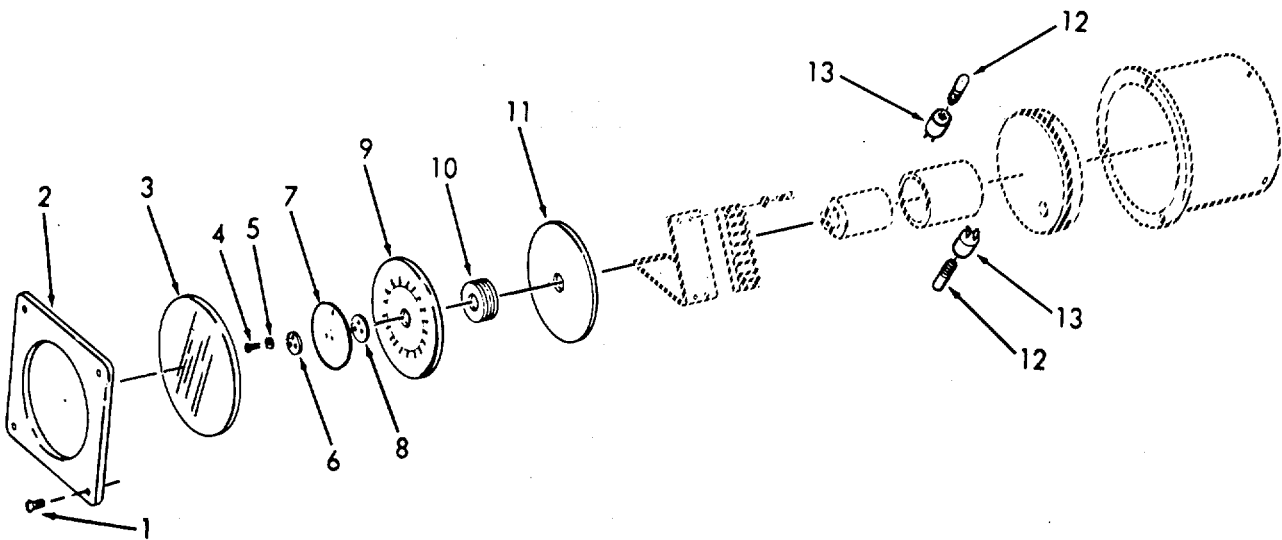
- | | | | |
|----------------------------|---|---------|--|
| 1. Rudder Angle Indicator" | a. Four screws (1), cover (2), and window (3) | Remove. | |
| | b. Three screws (4) and lock-washers (5) | Remove. | |

5-111. RUDDER ANGLE INDICATOR - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

- | | | | |
|--|--|----------------------------|---------------------|
| | c. Clamp (6), and pointer disc (7) | Remove. | |
| | d. Pointer hub (8), dial indicator (9), dial spacer (10), and light defuser (11) | Remove. | |
| | e. Lamps (12) | Remove. | |
| | f. Lamp sockets (13) | Unsolder wires and remove. | Refer to schematic. |



LOCATION

ITEM

ACTION

REMARKS

OVERHAUL (Cont)

- | | | | |
|----|---|---|---|
| g. | Screws
(14) | Remove. | |
| h. | Cover
(15) | Remove. | |
| i. | Screws
(16)
and
flat-
washers
(17) | Remove. | |
| j. | Back
casting
(18) and
preformed
packing
(19) | Move away from cover
(15) for access to
terminal strip. | Slide wiring
thru stuffing
tube (20). |
| k. | Terminal
strip
(21) | Tag and disconnect
wires. | Refer to
schematic. |
| l. | Terminal
strip
(21) | Reconnect wires and
remove tags. | Refer to
schematic. |
| m. | Preformed
packing
(19),
back
casting
(18),
cover
(15),
screws
(16) and
flat-
washers
(17) | Reassemble. | |

LOCATION

ITEM

ACTION

REMARKS

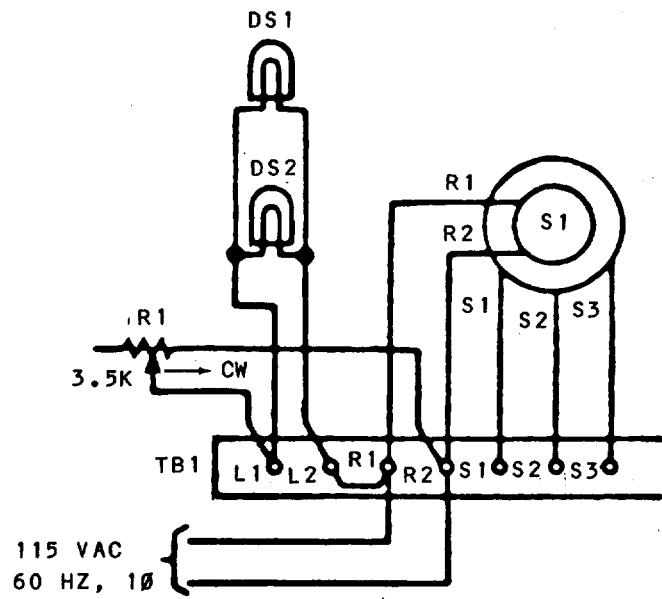
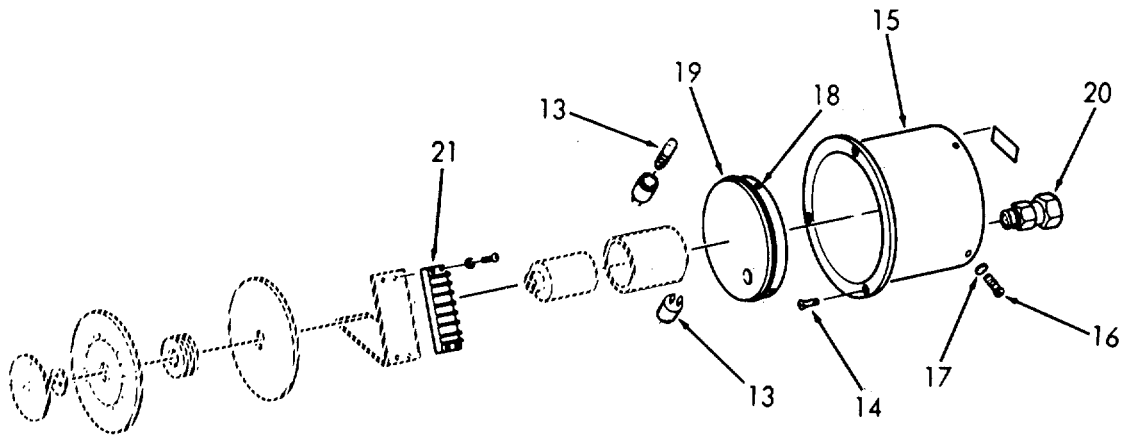
OVERHAUL (Cont)

n. Cover (15)
and screws
(14)

Install in panel.

o. Lamp
sockets
(13)

Install and resolder.



LOCATION

ITEM

ACTION

REMARKS

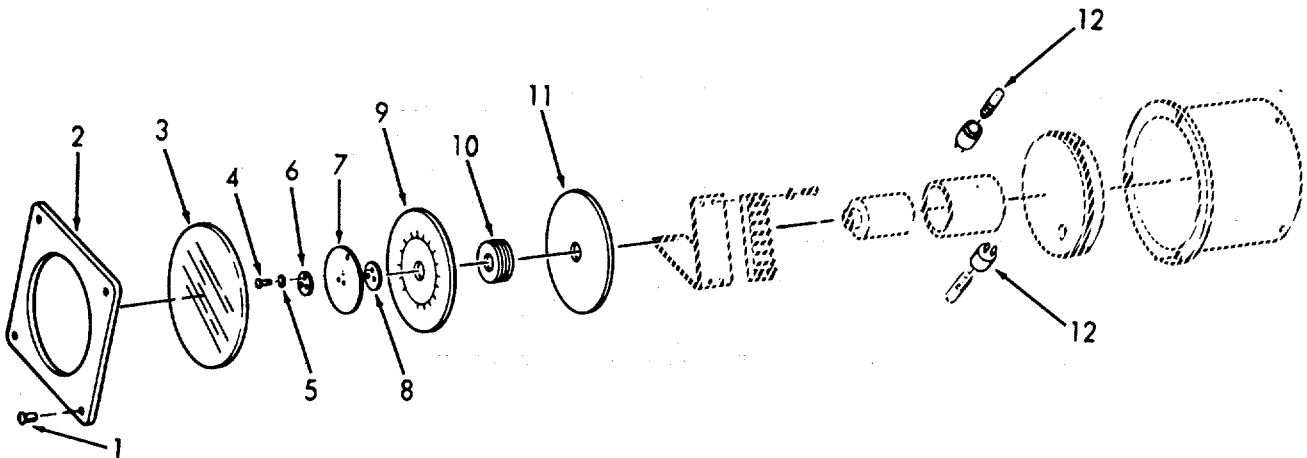
OVERHAUL (Cont)

- p. Lamps (12)
- q. Light defuser (11), dial spacer (10), dial indicator (9), and pointer hub (8)
- r. Pointer disc (7), clamps (6), lock-washers (5), and screws (4)
- s. Window (3), cover (2), and screws (1)

Install.
Assemble.

Install.

Install.



LOCATION

ITEM

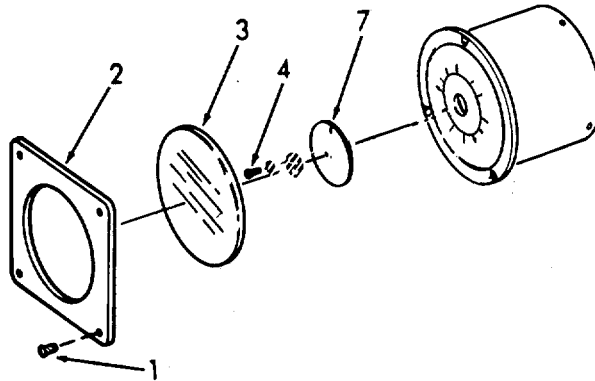
ACTION

REMARKS

ADJUSTMENT

2. Dial
Zeroing

- a. Screws
(1),
cover
(2),
and
window
(3). Remove.
- b. Screws
(4) Loosen.
- c. Pointer
disc
(7) Rotate until pointer
indicates zero.
- d. Screws
(4) Tighten.
- e. Window
(3),
cover
(2),
and
screws
(1) Install.



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Overhaul
- b. Adjustment

INITIAL SETUP

Test Equipment
Ohmmeter

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
Grease MIL-G-10924-
Type GAA

Special Environmental Conditions
NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL

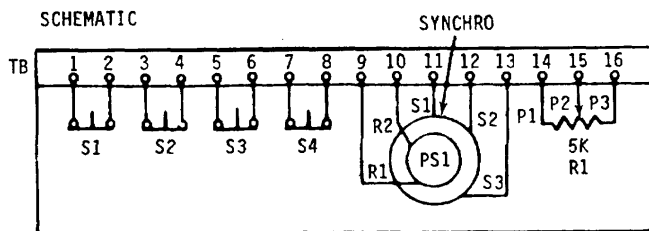
- | | | | |
|------------|---|---------|--|
| 1. Synchro | a. Screws
(1),
lock-
washers
(2),
and
flat-
washers
(3) | Remove. | |
| | b. Cover
(4),
and
gasket
(5) | Remove. | |

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS.
(Continued)

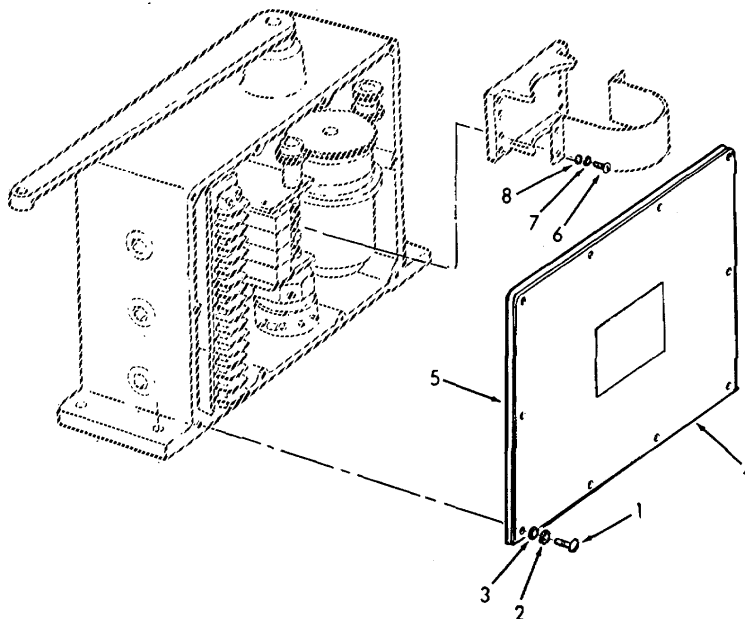
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

c.	Synchro wiring	Tag and disconnect	S1 to TB11 S2 to TB12 S3 to TB13 R1 to TB9 R2 to TB10
----	----------------	--------------------	---



d. Screws (6), lock-washers (7), and flat-washers (8) Remove.



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS.
(Continued)

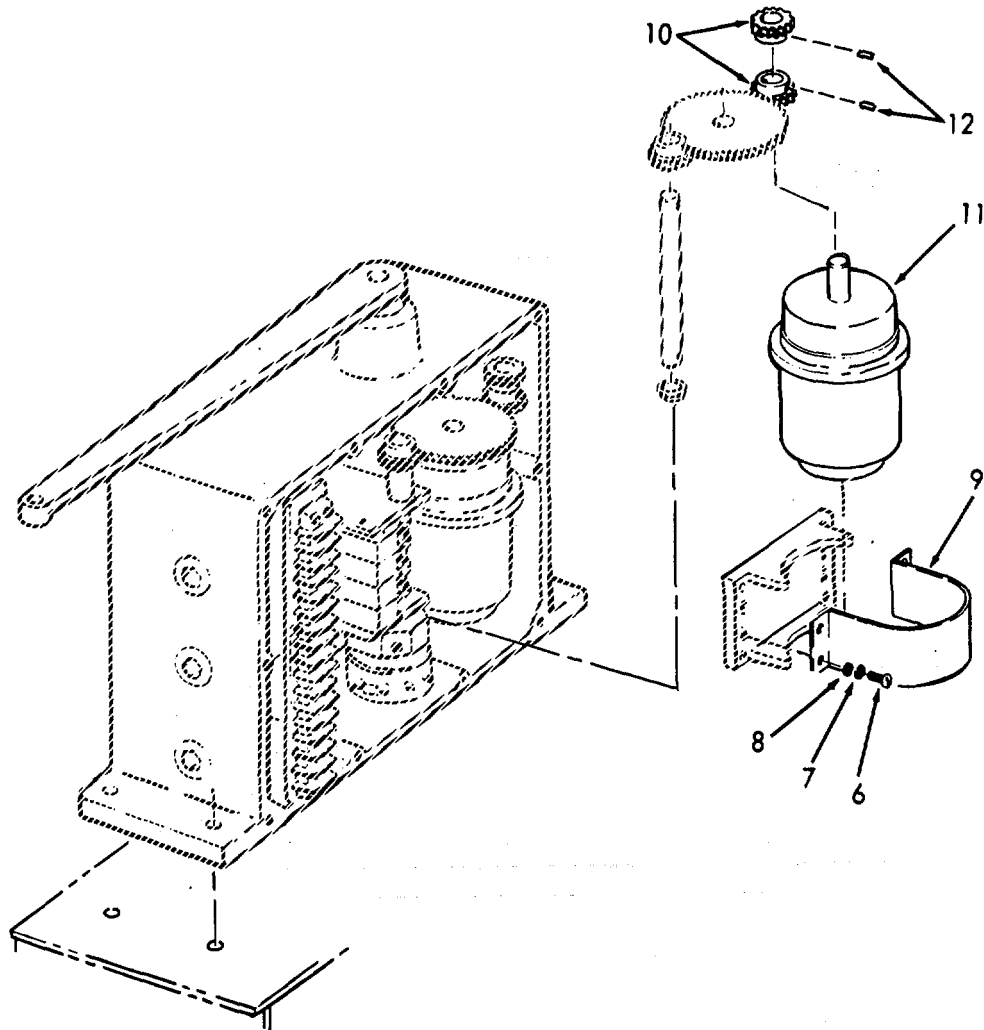
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

- | | | | |
|----|--|--|--|
| e. | Synchro clamp (9) | Remove. | |
| f. | Spur gears (10), and synchro - assembly (11) | Gently disengage gears and remove assembly. | |
| g. | Setscrews (12), and spur gears (10) | <ol style="list-style-type: none"> 1. Loosen setscrews. 2. Remove gears. 3. Replace gears, and tighten setscrews. | |
| h. | Synchro (11), and spur gears (10) assembled | Gently engage gears. | |
| i. | Synchro clamp (9) | Install. | |
| j. | Screws (6), lock-washers (7), and flat-washers (8) | Install. | |

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	k. Wiring	Reconnect.	Refer to wiring in step 1c and schematic.
	l. Synchro	Zero.	Refer to adjustment in step 8.



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

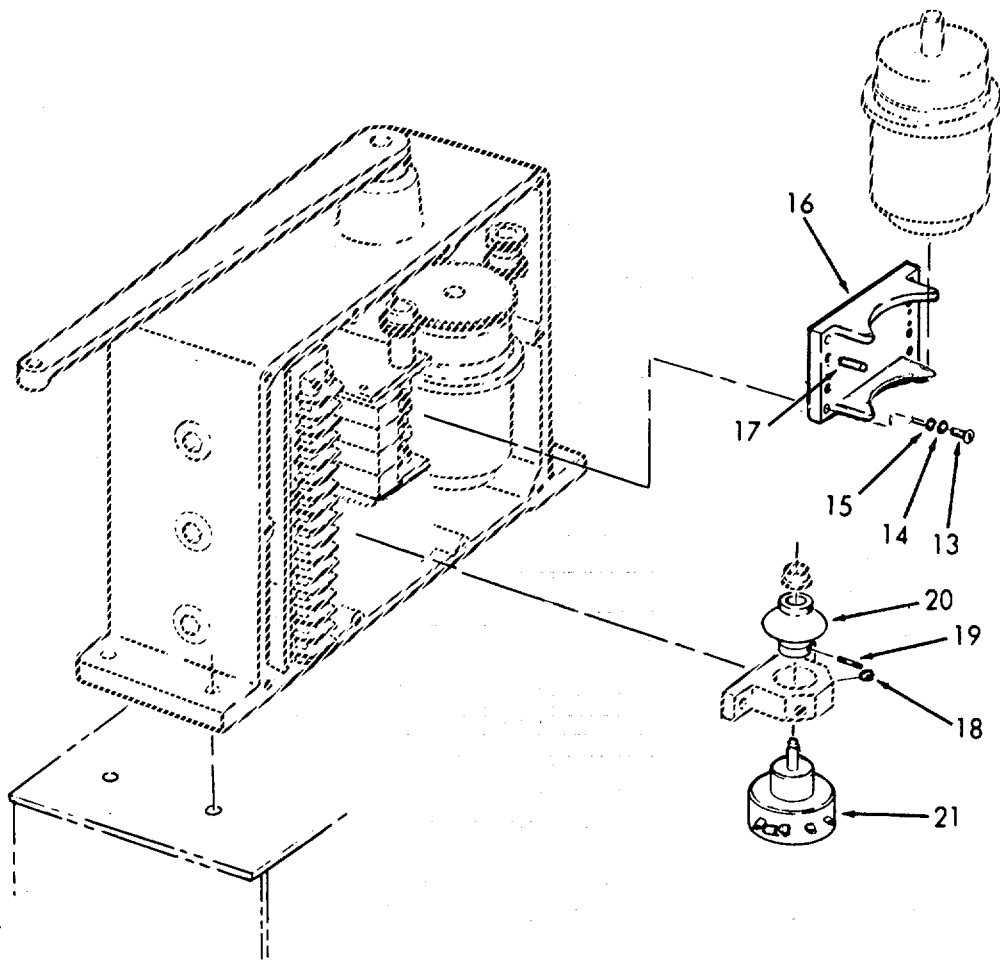
2. Synchro Mounting Bracket	a. Screws (13), lock-washers (14), and flat-washers (15)	Remove.	
	b. Bracket (16)	Remove.	
	c. Spring pins (17)	Replace.	If necessary.
	d. Bracket (16)	Install.	
	e. Screws (13), lock-washers (14), and flat-washers (15)	Install.	
3. Repeat-back Potentiometer	a. Wiring	Tag and unsolder three leads connected to pot.	
	b. Setscrews (18)	Loosen.	
	c. Spring pin (19)	Remove from flexible shaft coupling (20).	
	d. Potentiometer (21)	1. Remove.	

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

2. Set replacement potentiometer to approximately zero.



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

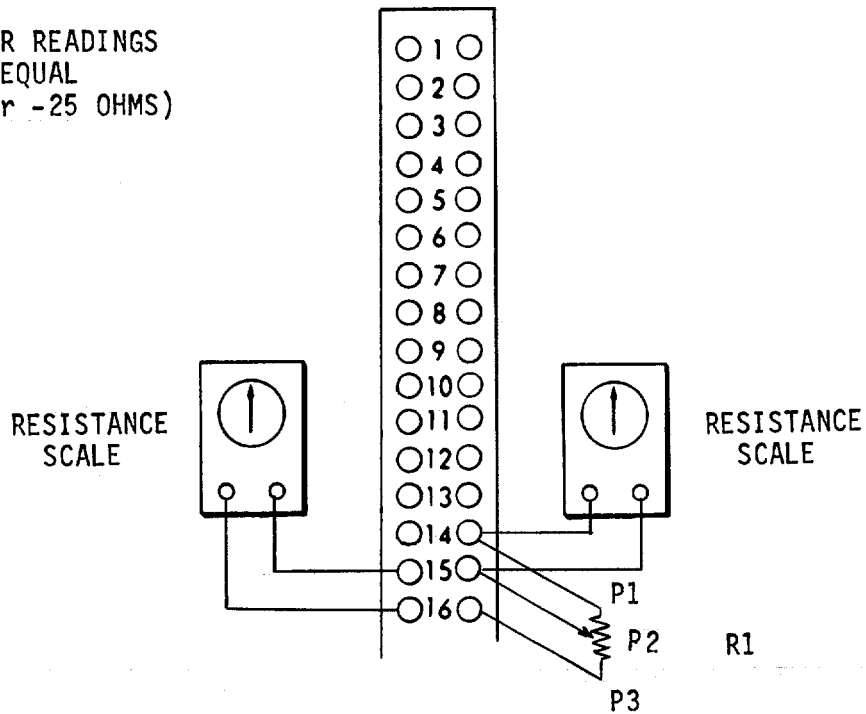
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)			
-----------------	--	--	--

3. Turn shaft until the resistance between wiper (P2) and terminal (P1 and P3) are within ± 25 ohms of the same value.
4. Insert into bracket (22) and flexible shaft coupling (20).

Do not move the potentiometer shaft with respect to the potentiometer.

METER READINGS
EQUAL
(+ or -25 OHMS)

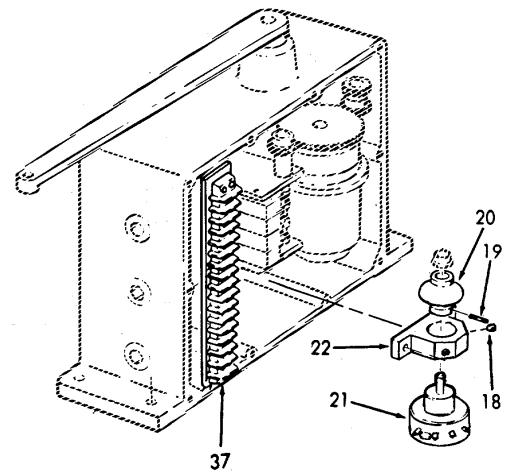


5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

- | | | | |
|----|---------------------------------------|---|---|
| e. | Spring pin (19) | Install. | |
| f. | Setscrew (20) | Tighten. | |
| g. | Rudder | Position to amidships. | |
| h. | Ohmmeter | <ol style="list-style-type: none"> 1. Connect to terminal strip (37), terminals 14 (P1), and 15 (P2). 2. Connect to terminals 15 (P2), and 16 (P3), and compare readings. | Observe reading. Readings should be equal (within 25 ohms). |
| i. | Setscrew (18), and potentiometer (21) | Loosen setscrew and rotate potentiometer. | If necessary to obtain an equal reading on ohmmeter. |
| j. | Setscrew (18) | Tighten. | |
| k. | Ohmmeter | Remove. | |



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

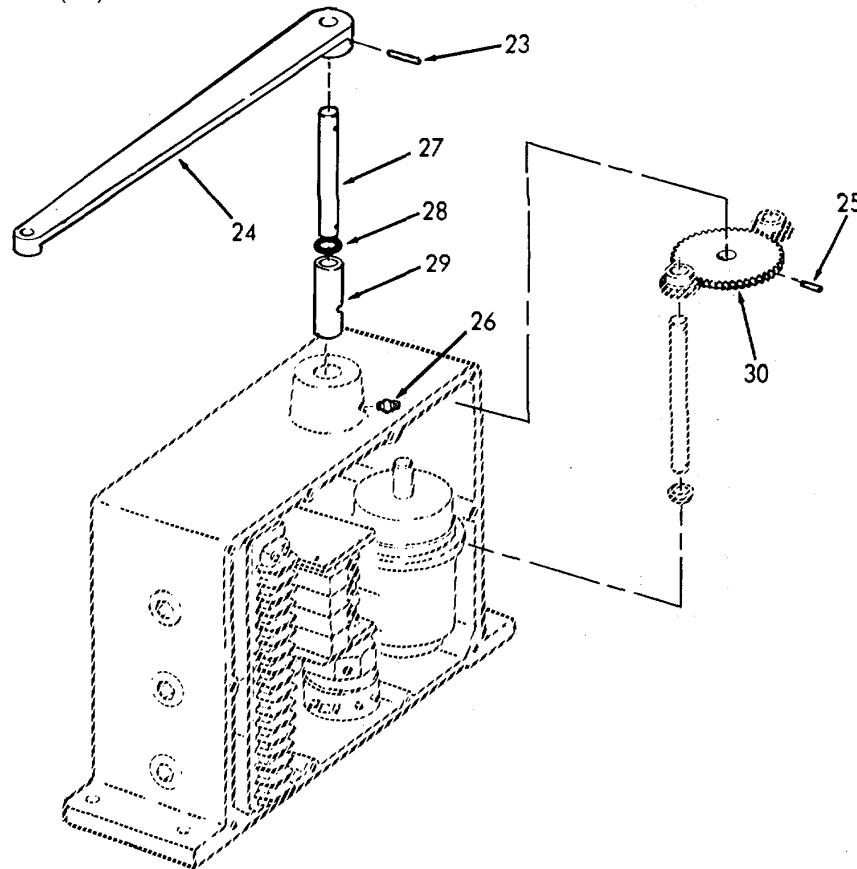
- | | | | |
|---|---|----------|--|
| 4. Trans-
Mitter
Arm and
Associated
Parts | a. Spring
pin (23),
trans-
mitter
arm (24),
and
spring
pin (25) | Remove. | |
| | b. Lubri-
cation
fitting
(26),
lever
shaft
(27)
grease
seal
(28)
and
Oilite
bushing
(29) | Remove. | |
| | c. Spur gear
(30) | Replace. | |
| | d. Oilite
bushing
(29),
grease
seal
(28),
and
lever
shaft
(27) | Install. | |
| | e. Lubri-
cation
fitting
(26) | Install. | |

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

- | | | | |
|----|--------------------------|----------|----------------------------------|
| f. | Spring pin (25) | Install. | |
| g. | Transmitter arm (24) | Install. | |
| h. | Spring pin (23) | Install. | |
| i. | Lubrication fitting (26) | Grease. | Use grease MIL-G-10924 Type GAA. |



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

5. Limit Switches (outside-inside)	a. Wiring	Disconnect wires to defective switch.	
	b. Nuts (31), lock-washers (32), and threaded rods (33)	Remove top nuts on both threaded rods (33), and remove two rods.	
	c. Switch (34)	Replace defective switch.	
	d. Threaded rods (33), lockwashers (32) and nuts (31)	Install.	
	e. Wiring	Reconnect.	
	f. Switches	Adjust.	Refer to Step 9.
6. Terminal Strip	a. Wiring	Tag and disconnect.	
	b. Screws (35), and lockwasher (36)	Remove.	
	c. Terminal strip (37) and identification strip (38)	Replace.	

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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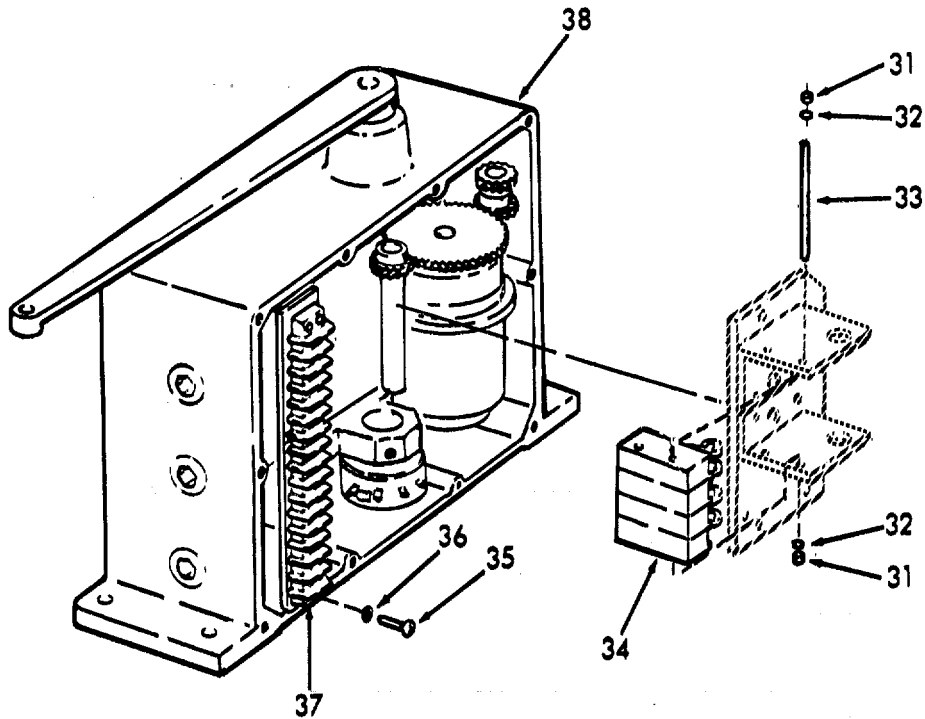
OVERHAUL (Cont)

d. Screws
(35),
and
lockwashers
(36)

Install.

e. Wiring

Reconnect and remove
tags.



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

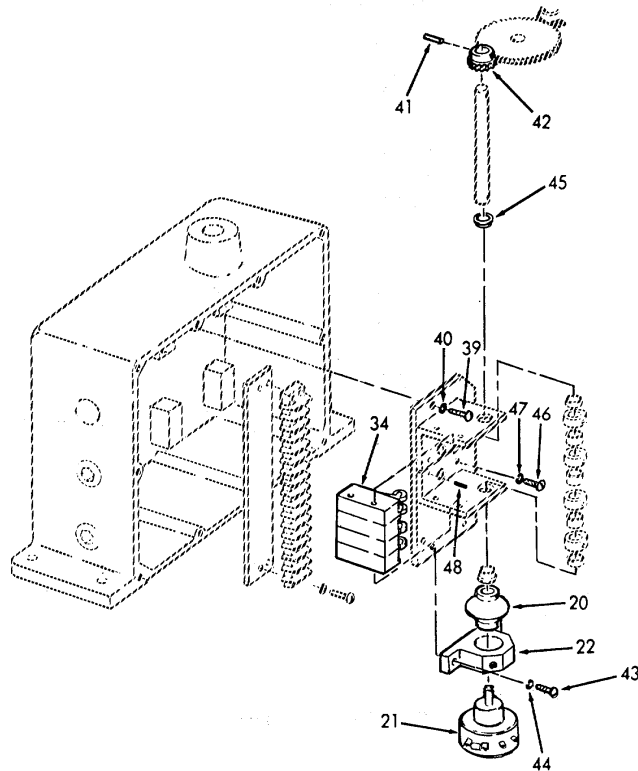
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
7. Limit Switch Cams	a. Potentiometer (21)	Remove wiring.	Refer to step 3.
	b. Limit switches (34)	Remove.	Refer to step 5.
	c. Screws (39), and lockwashers (40)	Remove.	
	d. Camshaft, cams, brackets, and associated parts	Remove as an assembly.	
	e. Spring pin (41)	Remove.	
	f. Spur gear (42)	Remove.	
	g. Potentiometer (21)	Remove.	Refer to step 3.
	h. Potentiometer mounting bracket (22)	Remove screws (43) and lockwashers (44).	
	i. Flexible coupling (20)	Remove.	

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

- | | | | |
|----|--|-------------------------------|--|
| j. | Bushings (45) | Remove top and bottom. | |
| k. | Screws (46),
- and
lock-washers (47) | Remove. | |
| l. | Camshaft, cams, brackets, and associated parts | Lift off of spring pins (48). | |



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

	m. Angle brackets (49)	Remove from both ends of cam shaft.	
--	------------------------	-------------------------------------	--

n. Setscrews (50)	Loosen.		
-------------------	---------	--	--

	o. Camshaft (51), spacers (52), switch actuator cams (53), and spacers (54)	<ol style="list-style-type: none"> 1. Disassemble. 2. Replace defective parts. 3. Reassemble. 4. Tighten setscrews (50) 	Observe position of all cam lobes.
--	---	---	------------------------------------

	p. Angle brackets (49)	Install.	
--	------------------------	----------	--

	q. Camshaft, cams, brackets, and associated parts	Relocate on spring pins (48).	
--	---	-------------------------------	--

	r. Screws (46), and lock-washers (47)	Install.	
--	---------------------------------------	----------	--

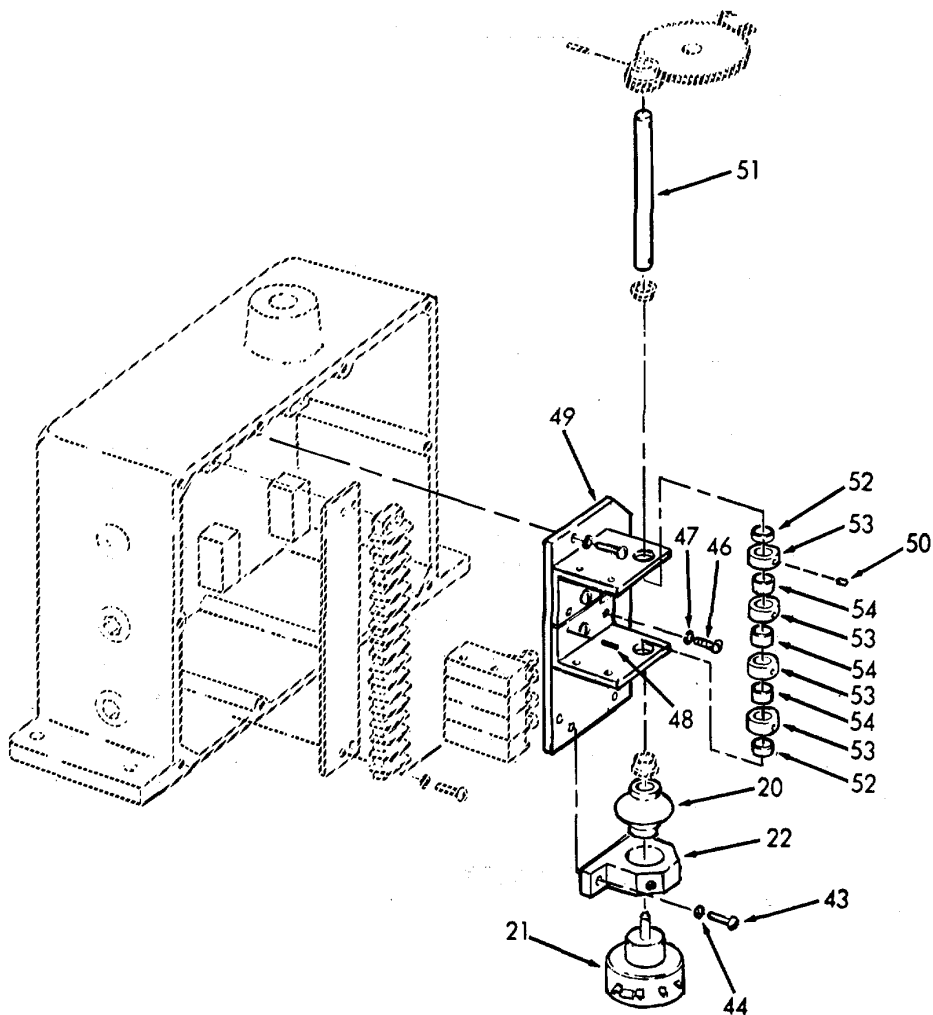
	s. Flexible coupling (20)	Install.	
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5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL (Cont)

- | | | | |
|----|-------------------------------------|---|------------------|
| t. | Potentiometer mounting bracket (22) | Install using screws (43) and lockwashers (44). | |
| u. | Potentiometer (21) | Install. | Refer to step 3. |



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL (Cont)

- | | | | |
|-----|--|-------------------|------------------|
| v. | Spur gear (42), and spring pin (41) | Install. | |
| w. | Camshaft, cams, brackets, and associated parts | Install. | |
| x. | Screws (39) and lock-washers (40) | Install. | |
| y. | Limit switches (34) | Install. | Refer to step 5. |
| z. | Potentiometer wiring | Install. | Refer to step 3. |
| aa. | Limit switch adjustment | Install 9 and 10. | Refer to steps |
| ab. | Synchro adjustment | | Refer to step 8. |
| ac. | Cover (4), and gasket (5) | Install. | |

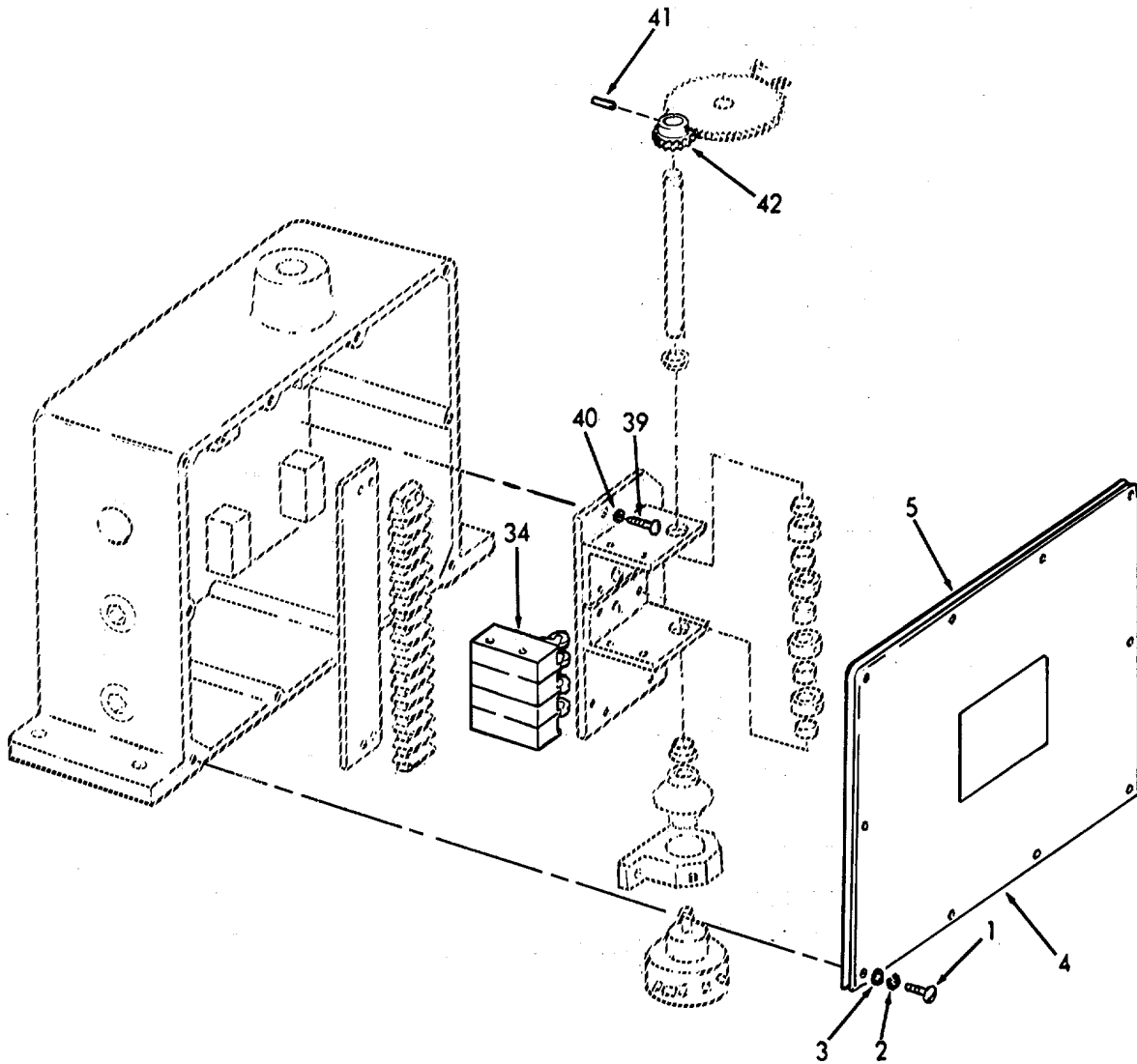
5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL (Cont)

ad. Screws
(1), lock-
washers
(2), and
flat-washers
(3)

Install.



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT

8. Zeroing Synchro

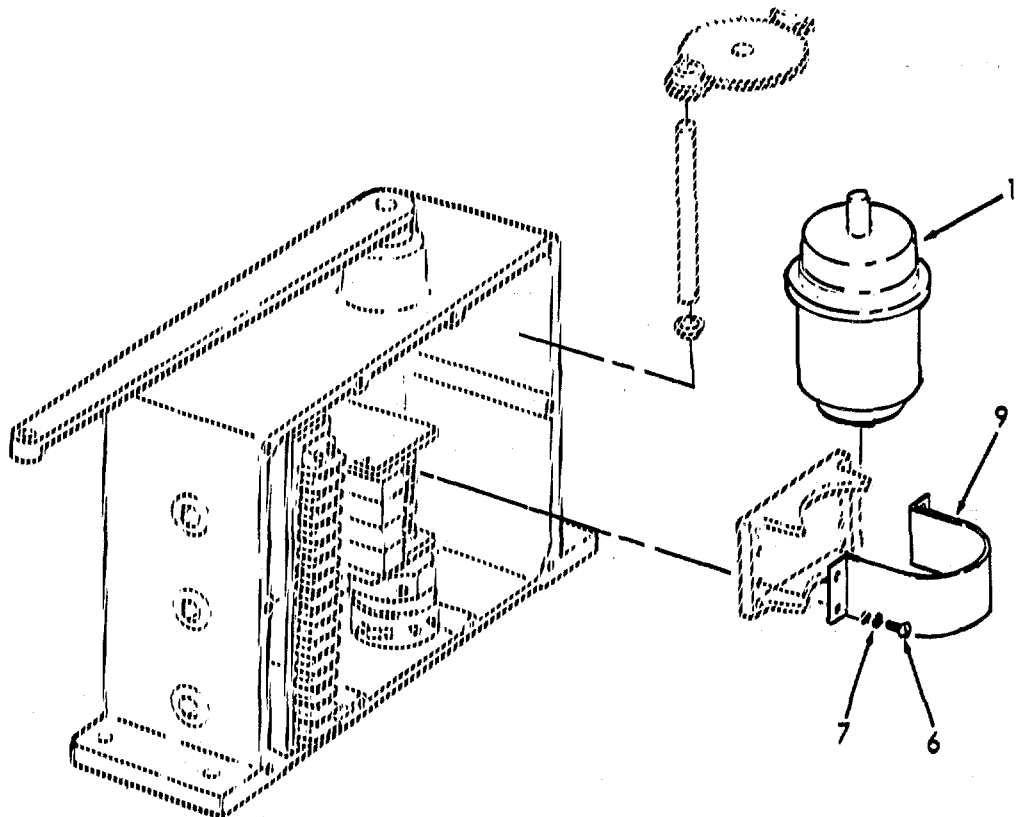
CAUTION

While performing the following procedure, make certain that the rudder is positioned amidships at all times.

- a. Screws (6), and lock-washers (7)

Loosen clamp (9) to allow synchro (11) to be rotated.

Do not remove.

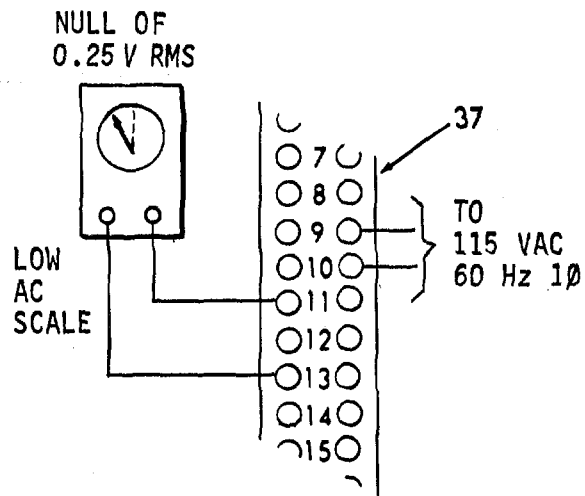
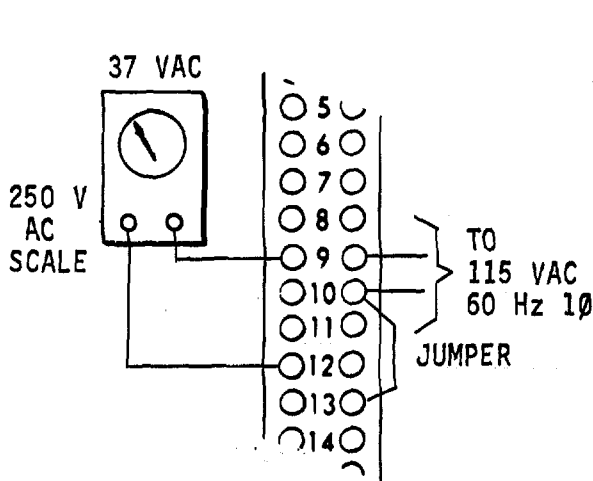


5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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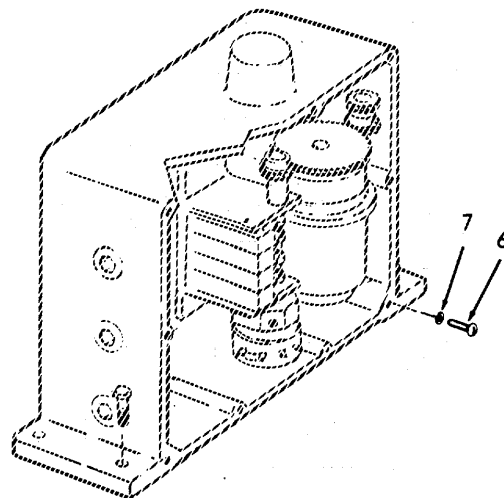
ADJUSTMENT (Cont)

b. Wiring	Tag and disconnect all wires to terminal strip (37) - Terminals 9 (R1), 10 (R2), 11 (S1), 12 (S2) and 13 (S3).	Refer to schematic.
c. Power source 115 VAC	Connect to terminals 9 and 10.	
d. Jumper wire	Place between terminals 10 and 13.	
e. Voltmeter	<ol style="list-style-type: none"> Place on 250 VAC scale. Connect to terminals 9 and 12. 	
f. Power	Turn on at source.	



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENT (Cont)			
	g. Synchro	Rotate in either direction until meter reads approximately 37 VAC.	This is the approximate zero setting.
	h. Power	Turn off at source.	
	i. Jumper wire	Remove from terminals 10 and 13.	
	j. Voltmeter	<ol style="list-style-type: none"> 1. Disconnect. 2. Reconnect to terminals 11 and 13. 3. Place on low AC scale. 	
	k. Power	Turn on at source.	
	l. Synchro	Turn slowly until a null (minimum reading) is indicated on meter.	Null should be less than 0.25 volt Rms.
	m. Power	Turn off.	
	n. Screws (6) and lock-washers (7)	Tighten.	

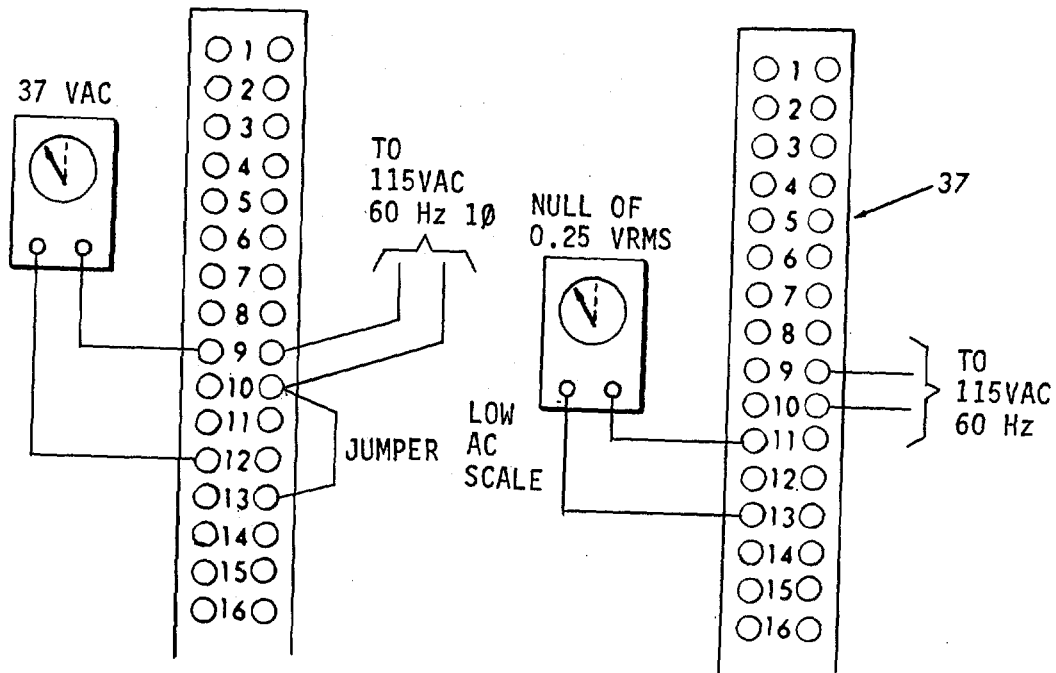


5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

ADJUSTMENT (Cont)

- | | | |
|--------------|--|---|
| o. Power | 1. Turn on, and recheck null. | Null should be less than 0.25 volt Rms. |
| | 2. Turn off, and remove wire from terminals 9 and 10. | |
| p. Voltmeter | Disconnect. | |
| q. Wiring | Reconnect wires to terminal strip (37), terminals 9 (R1), 10 (R2), 11 (S1), 12 (S2) and 13 (S3). | |



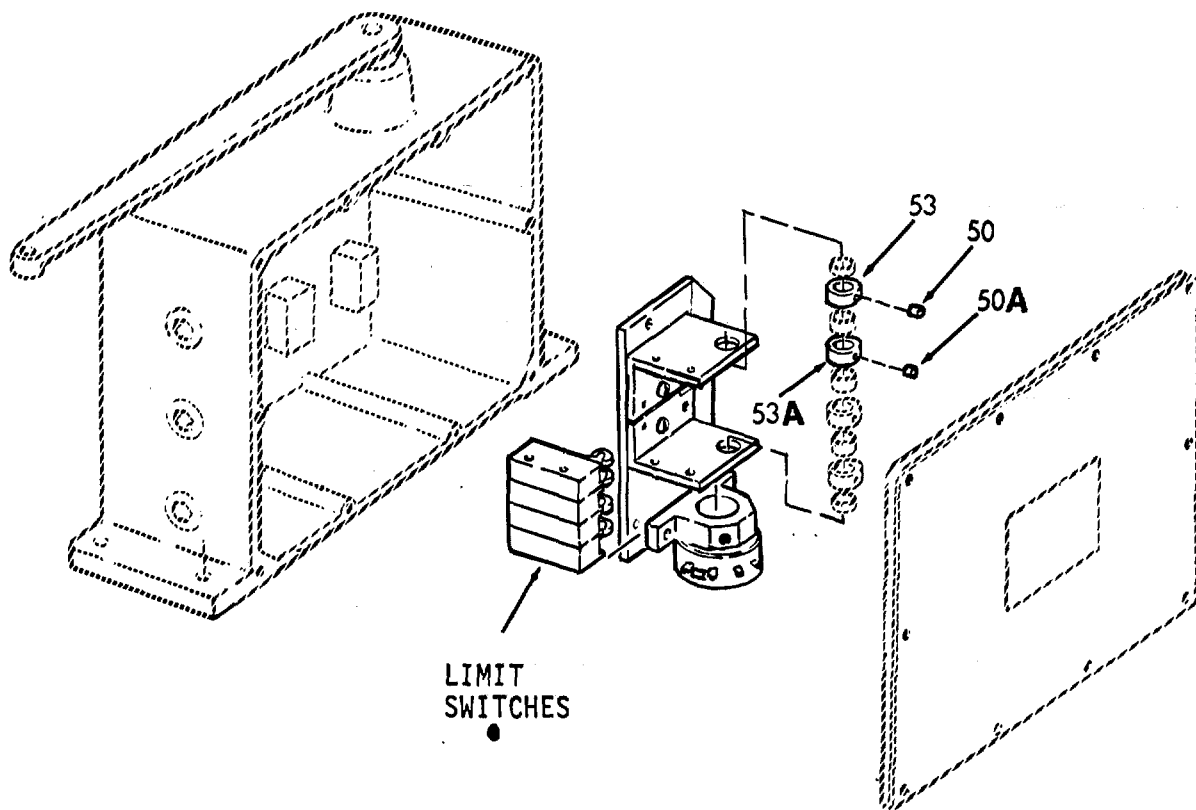
5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENT (Cont)			
9. Outside Limit Switch Adjustment	a. Rudder	Place in desired outside limit.	
	b. Setscrews (50)	Loosen on cam (53).	
	c. Cam (53)	Rotate until limit switch opens at slightly before the rudder setting.	
	d. Setscrews (50)	Tighten.	
10. Inside Limit Switch Adjustment	a. Rudder	Set at the desired maximum limit for automatic steering, usually 10 to 15 degrees in either direction).	
	b. Setscrews (50A)	Loosen on cam (53A).	
	c. Cam (53A)	Rotate until limit switch opens at exactly this rudder section.	
	d. Setscrews (50A)	Tighten.	

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT (Cont)



5-113. FLANKING RUDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS.

This Limit Switch Assembly contains 6 limit switches to provide for controlling flanking rudders to 3 discrete positions - Midships, Hard Left or Hard Right.

SW1 - For controlling hard left and indicating hard left.

SW6 - For controlling hard right and indicating hard right

SW3 - For driving rudder back to midships when rudder is between 1° right and hard right.

SW4 - For driving rudder back to midships when rudder is between 1° left and hard left.

SW2 - For operating midships indicator light.

SW5 - For operating midships indicator light.

This task covers:

- a. Replacement
- b. Alignment
- c. Testing

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

Switch MS24523-27

<u>Equipment Condition</u>	<u>Condition Description</u>
----------------------------	------------------------------

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

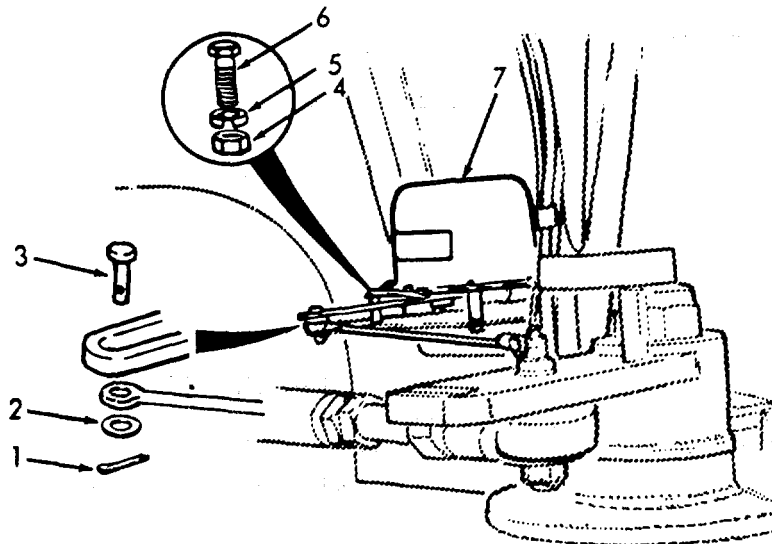
Observe safety precautions when working with electricity.

5-113. FLANKING RUDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT

- | | | |
|---------------------------------|---|---------------------|
| 1. Flanking Rudder Limit Switch | a. Wiring | Tag and disconnect. |
| | b. Cotter pin (1) | Remove. |
| | c. Washer (2), pin (3), nuts (4) lockwashers (5), and screws (6) | Remove. |
| | d. Limit switch (7) | Replace. |
| | e. Screws (6), washers (5), nuts (4), pin (3), washer (2), and cotter pin (1) | Install. |
| | f. Wiring | Reconnect. |

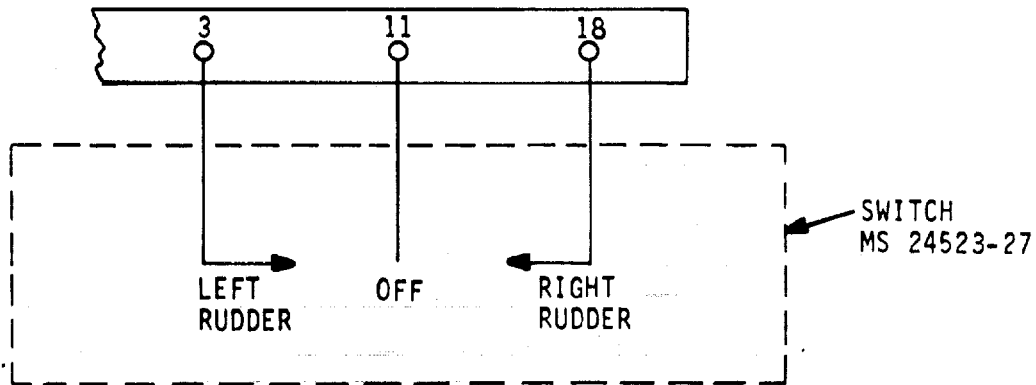


5-113. FLANKING RUDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ALIGNMENT

2.
 - a. PRELIMINARY: Check that the limit switch arm is parallel to tiller (with rudder at midship), and that connecting arm is perpendicular to both.
 - b. LIMIT SWITCHES: To set the limit switches, it is necessary to move the rudder. The convenient way is to disconnect the internal wiring on the limit switch terminal board connections - terminals 3 and 18 (insulate the lugs as they will be energized). Connect a single pole - double throw - spring centered switch (MS24523-27) to the limit switch assembly.



- c. Set flanking control on wheelhouse control panel to MIDSHP. Start flanking pump using local start on motor starter. Move rudder positioning spring-centered switch in either direction.

 5-113. FLANKING RUDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS
 (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ALIGNMENT (Cont)

CAUTION

Limit switches will not be in circuit, and care should be exercised when approaching hard-over rudder.

1. SW1 - position rudder to 40° left.
Set cam to open SW1 (between terminals 2 and 3) at 40° left.

NOTE

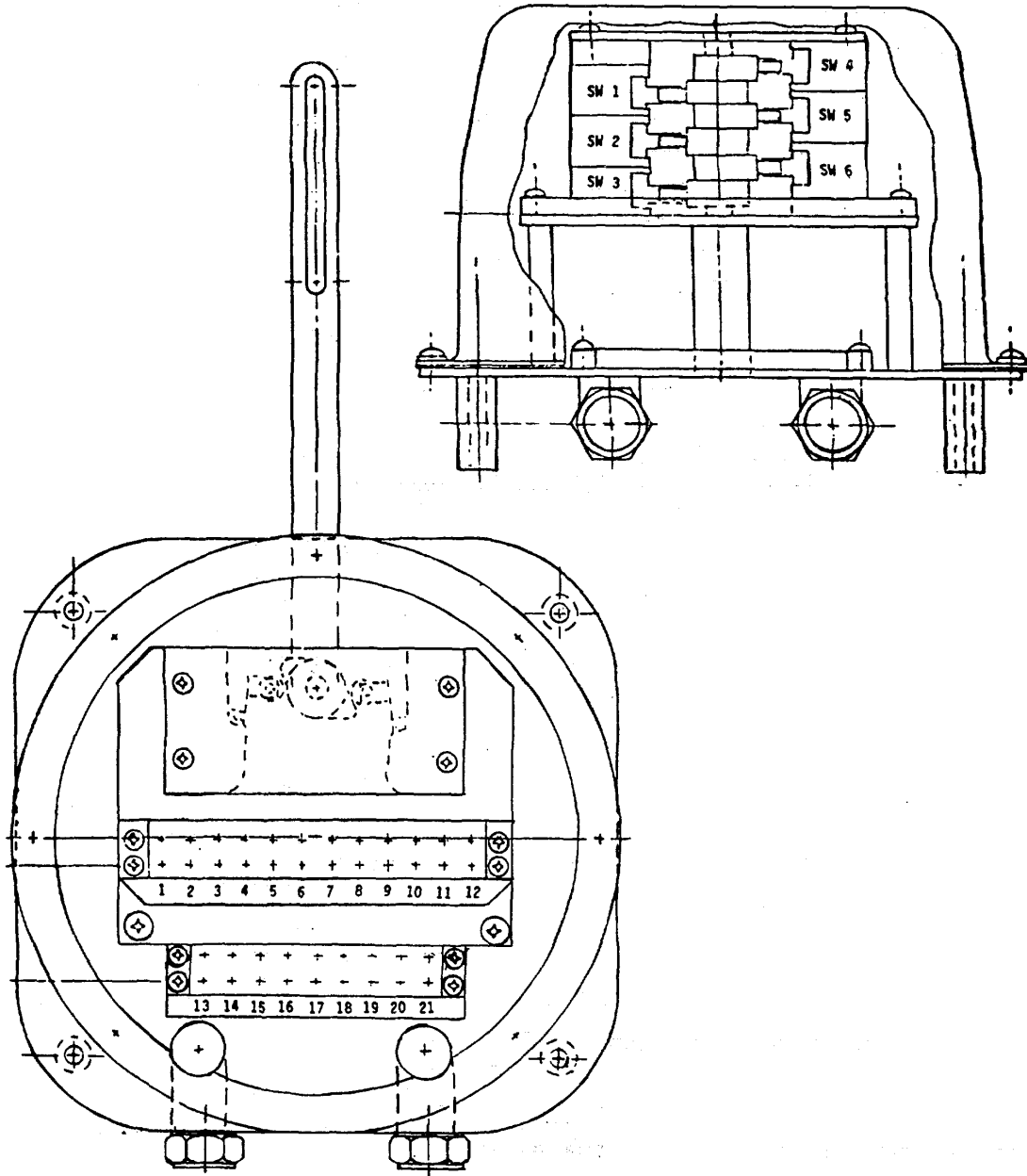
Move cam in same direction that it would travel in going from midships to hard-over position.

2. SW6 - Position rudder to 40° right.
Set cam to open SW6 (between terminals 17 and 18).
3. SW3 - Position rudder to 1° right.
Set cam to close (between terminals 7 and 8) as cam is rotated in direction it would move from midships to 1° right.
4. SW4 - Position rudder to 1° left.
Set cam to close (between terminals 10 and 11) as cam is rotated in direction it would move from midships to 1° left.
5. SW5 - Position rudder to 20° right.
Set cam to close (between terminals 14 and 15) as cam is rotated from hard right back towards 2° right rudder.
6. SW2 - Position rudder to 20° left.
Set cam to close (between terminals 5 and 6) as cam is rotated from hard left back towards 2° left rudder.

5-113. FLANKING RUDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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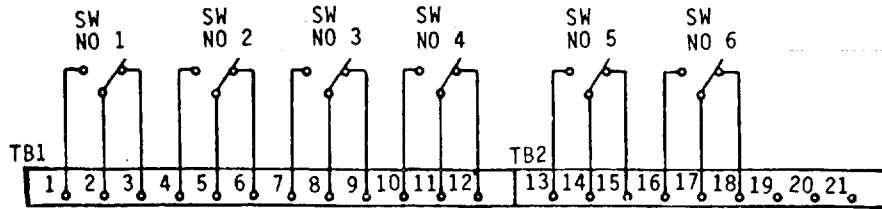
ALIGNMENT (Cont)



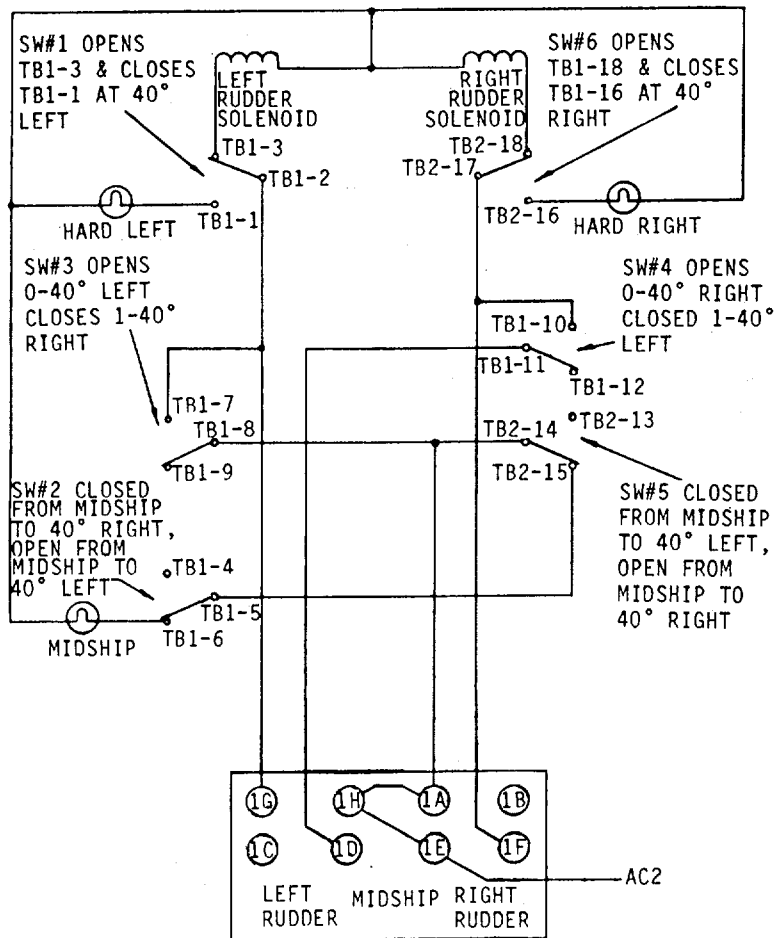
5-113. FLANKING RUDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ALIGNMENT



SCHEMATIC DIAGRAM



FLANKING RUDDER

5-114. STEERING CONTROL PANEL AND GYRQ -C.COMPUTER - MAINTENANCE INSTRUCTIONS.

This task covers:

OVERHAUL

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

3-125 Steering Control Panel
Organization
Maintenance

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

u

NONE

Personnel Required

NONE

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

OVERHAUL

NOTE

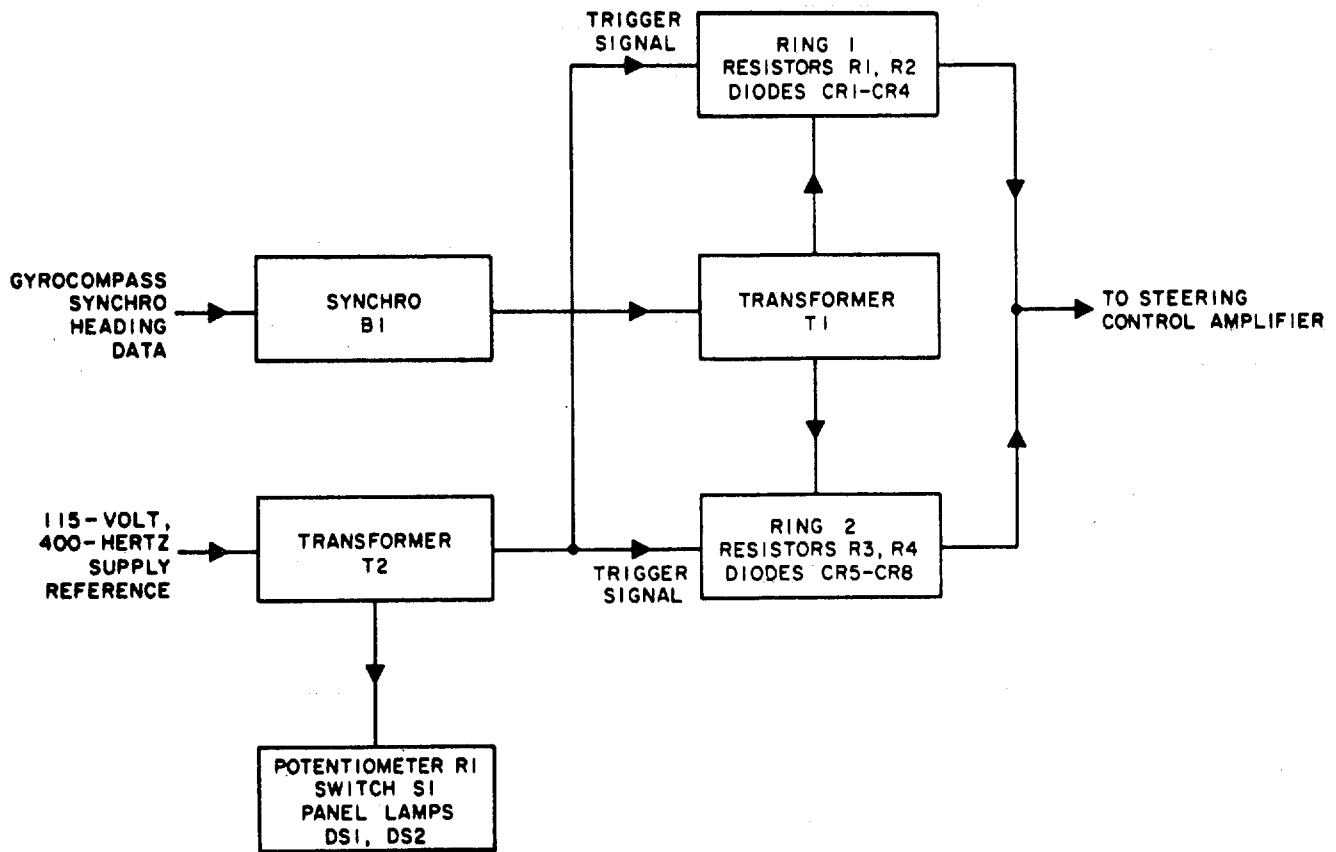
The overhaul procedure must be performed at the manufacturers' repair facility.

5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS

The Heading Selector is used as an interface between a gyrocompass and steering control panel to select the desired heading of the vessel. The gyrocompass transmits actual heading data to the Heading Selector for comparing the actual heading data with the ordered heading data. If the actual heading and the ordered heading are the same, there is no signal output from the Heading Selector. If the actual heading and the ordered heading differ, the Heading Selector will produce a signal that will cause the rudder positioning equipment to change the vessel's actual heading to its ordered heading.

Three-wire synchro data from the gyrocompass provides the heading information, and the same 115-volt, 400-hertz supply that powers the gyrocompass is needed for reference and illumination requirements.

The gyrocompass card is connected to a synchro which is excited by a 115-volt, 400-hertz supply. Three-wire heading data is transmitted by this synchro to synchro B1 of the Heading Selector. The heading selector card is connected to synchro B1 rotor so that for any reading of the gyrocompass card, the voltage induced in synchro B1 rotor will be zero when the heading selector card is set to the same heading. When the heading selector card and the gyrocompass card are on different headings, an error voltage is induced in synchro B2 rotor.



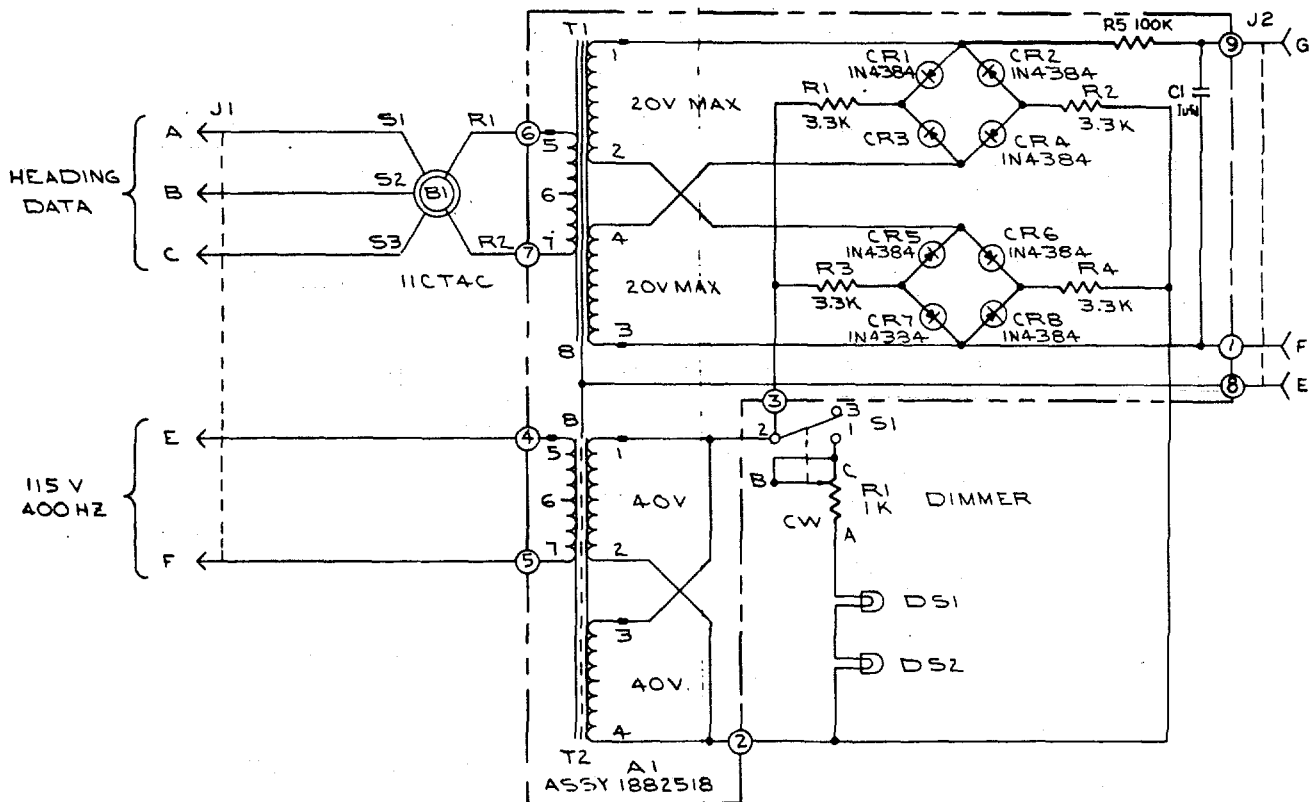
5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS

Any voltage that is induced in synchro B1 rotor is applied to the primary of transformer T1. A demodulator ring is connected in series with a leg of each secondary winding of transformer T1.

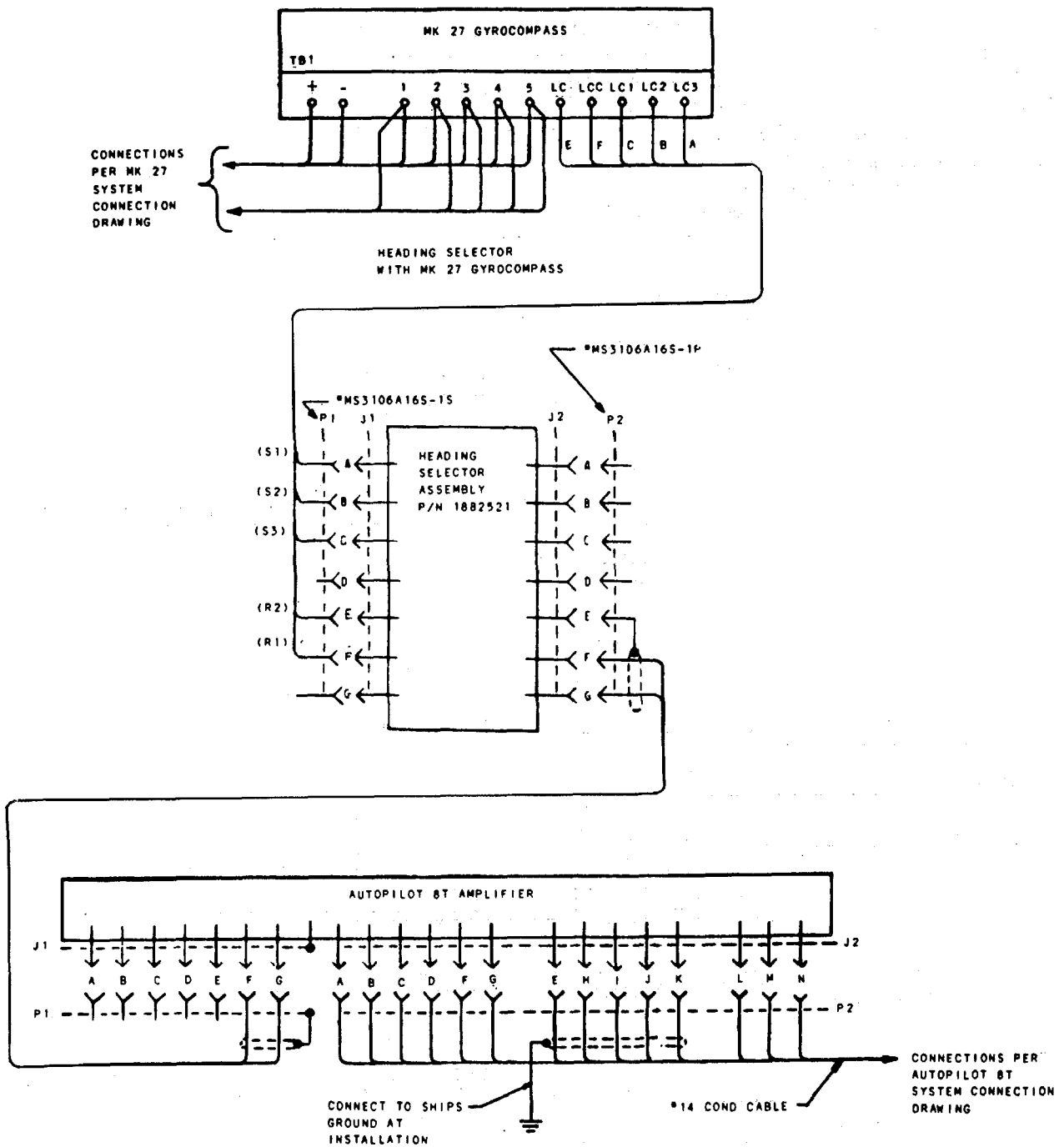
The same 115-volt, 400-hertz supply that excites the gyrocompass synchro must also be used for reference purposes in the Heading Selector. This reference voltage is applied to the primary of transformer T2. The output from transformer T2 secondaries is applied across the demodulator rings. This voltage serves as a trigger to turn the demodulator rings on or off. Ring 1 (resistors R1, R2; diodes CR1-CR4) conducts during the negative portions of each reference voltage cycle, and ring 2 (resistors R3, R4; diodes CR5-CR8) conducts only when the reference (trigger) signal is positive.

When there is any induced voltage across synchro B1 rotor, it will appear across both secondaries of transformer T1. This voltage can be either positive or negative with respect to the reference voltage at any given instant. The reference voltage is alternating continuously, and the output from the Heading Selector must be a direct current.

The reference voltage, in effect, switches the demodulator rings on and off in step with its cycles. This forces the proper transformer T2 secondary to be connected to the output at the right time. The net result is a pulsating d-c voltage that is proportional to the difference between the actual heading and the ordered heading. Resistor R5 and capacitor C1 provide filtering for the output.



5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS



5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

3-126 Heading Selector Organ-
izational Maintenance
Equipment

Special Tools

Soldering iron
(25 watt max)

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

OVERHAUL

CAUTION

Use a soldering iron with a rating of 25 watts maximum on all electrical connections.

1. Heading

- a. Knobs (1)
- b. Three nuts (2), screws (3), spacers (4), and lock-washers (5)

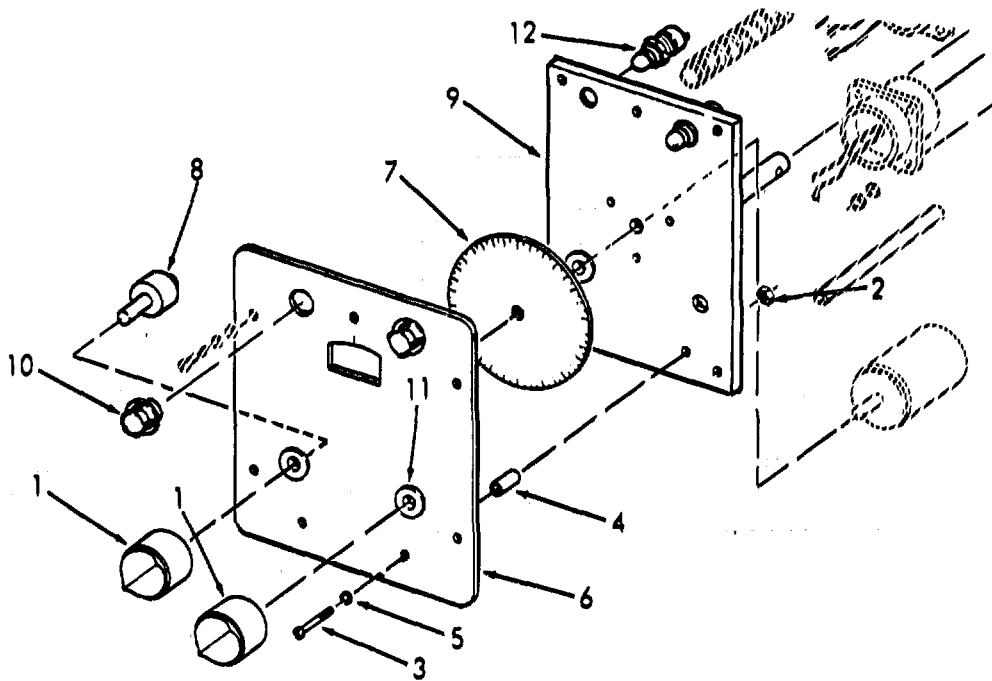
Remove.
Remove from control panel (6).

5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL (Cont)

- | | | | |
|--|-------------------------|------------------------------|---|
| | c. Control panel (6) | Remove. | |
| | d. Dial (7) | Remove. | Before removal, mark orientation of dial. |
| | e. Control shaft (8) | Remove from front plate (9). | |
| | f. Panel light (10) | Remove. | If necessary. |
| | g. Sleeve bearings (11) | Remove. | If necessary. |
| | h. Lamp (12) | Press and rotate to remove. | |



5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL (Cont)

- | | | | |
|--|--|---|--|
| | i. Wiring | Tag and disconnect. | |
| | j. Nut (13),
and
lamp-
holder
(14) | Remove. | |
| | k. Screws
(15),
and
lock-
washers
(16) | Remove. | |
| | l. Screws
(17) | Remove. | |
| | m. Mounting
posts
(18),
and
posts
(19)
and
assembled
parts | Remove. | |
| | n. Screws
(20),
lock-
washers
(21),
and
flat-
washers
(22) | Remove to separate
posts (19), and circuit
card (23). | |
| | o. Circuit
card
wiring
(23) | Tag and disconnect. | |

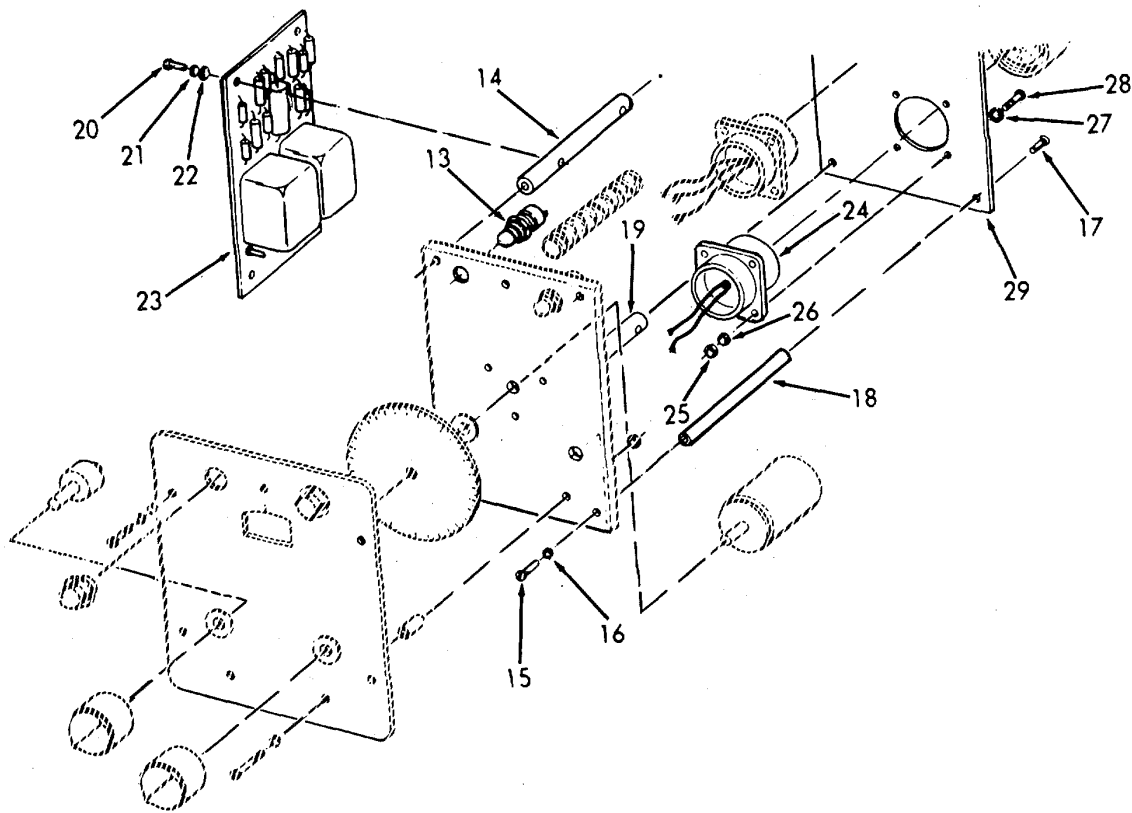
5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

p. Connector
(P1) (24)

1. Remove nuts (25), flatwashers (26), lockwashers (27), and screws (28) from back panel (29).
2. Unsolder wiring.
3. Replace connector.
4. Resolder wires.
5. Install screws (28), lockwashers (27), flatwashers (26), and nuts (25) in back panel (29).



5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS (Continued).

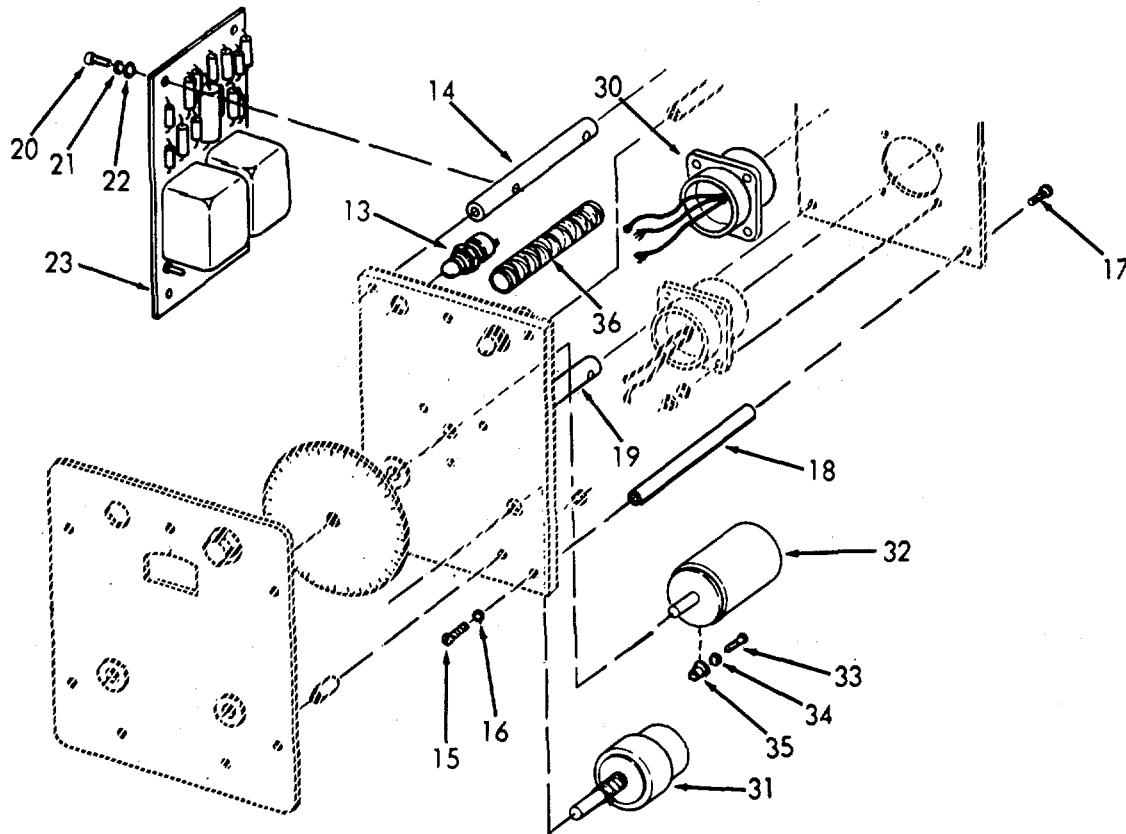
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	q. Connector (P2) (30)	Same as step p. above.	
	r. Variable resistor (31)	Unsolder and remove.	
	s. Synchro wiring (32)	Unsolder, tag, and remove.	
	t. Screws (33), lock-washers (34), and rim mounting clamps (35)	1. Remove. 2. Replace synchro (32). 3. Install.	
	u. Synchro wiring (32),	Resolder.	
	v. Wiring harness (36)	Replace.	If necessary.
	w. Variable resistor (31)	1. Install. 2. Resolder.	
	x. Circuit card (23) wiring	Reconnect.	
	y. Screws (20), and lock-washers (21)	Reassemble.	

5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL (Cont)

- | | | | |
|-----|--|---|--|
| z. | Flat-washers (22), circuit card (23), and posts (19) | Reassemble. | |
| aa. | Mounting posts (18 and 19) and assembled parts | <ol style="list-style-type: none"> 1. Align with holes in front plate and back plate. 2. Install screws (15 and 17), and lock-washers (16). | |



5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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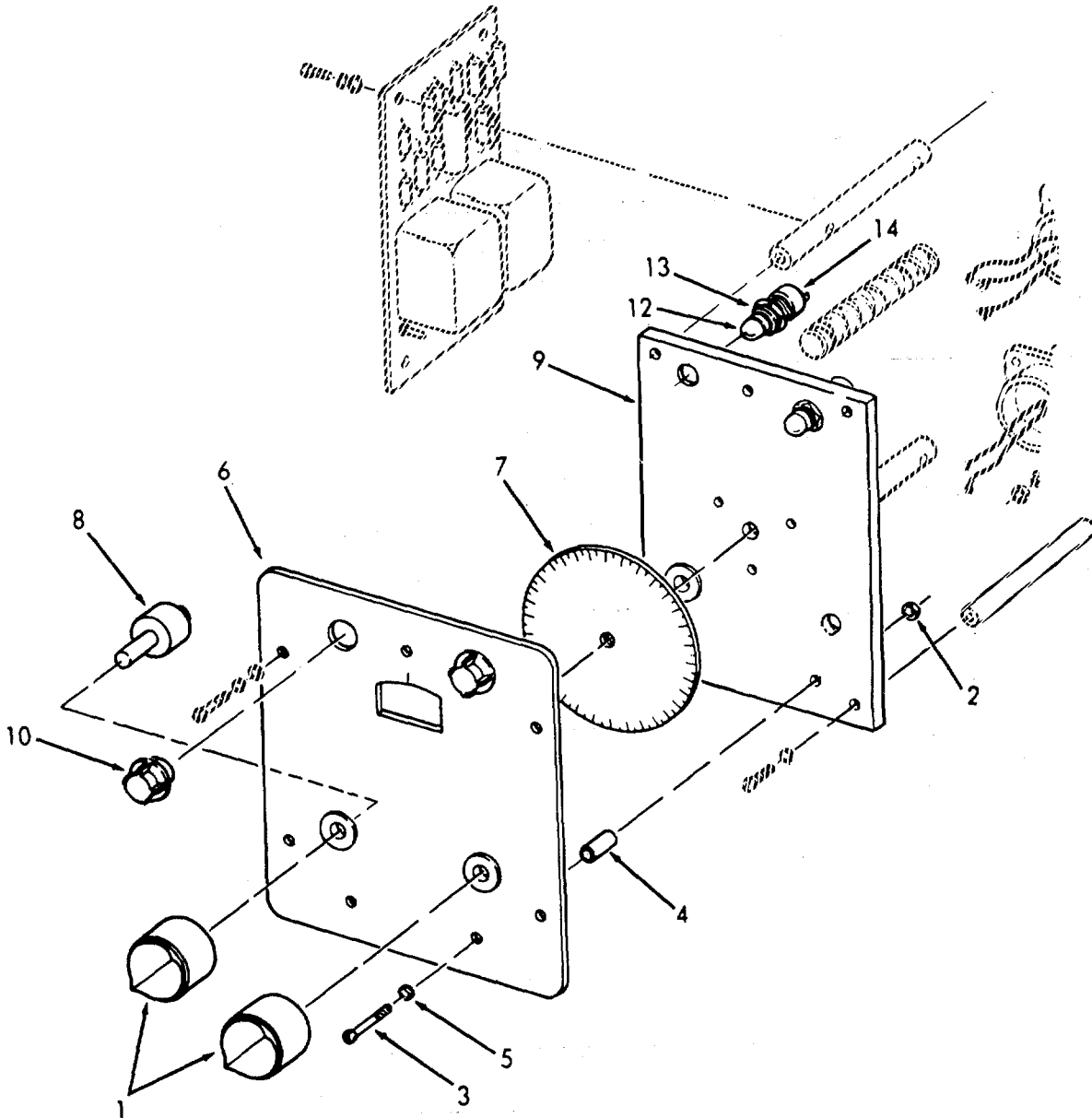
OVERHAUL (Cont)

	ab. Lampholder (14), and nut (13)	Install.	
	ac. Wiring	Reconnect.	
	ad. Lamp (12)	Press and rotate clockwise to install.	Use lamp type 327 or 387.
	ae. Panel light (10)	Install.	
	af. Control shaft (8)	Insert in control plate (6).	
	ag. Dial (7)	Re-orient and install.	
	ah. Control panel (6)	Install.	
	ai. Screws (3), lock-washers (5), spacers (4), and nuts (2)	Install.	
	aj. Knobs (1)	Install.	
	ak. Heading selector	Perform initial check-out and/or alignment.	

5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)



5-116. REMOTE MAGNETIC HEADING COMPASS (RMHS) - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Adjust/Calibration

b. Replace

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

3-217 Remote Magnetic Heading
Compass Organizational
Maintenance

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNING in this procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

ADJUST-CALIBRATION

1. Index Error.

A periodic vehicle swing is used to check calibration of the RMHS. The vehicle swing is recommended at 1-year intervals or sooner if the RMHS calibration is suspect. Refer to publication, H.O.226 Handbook of Magnetic Compass Adjustment, for additional information.

NOTE

All readings are relative to the magnetic North pole.

(a) Align the vehicle to a magnetic 000-degree heading. Subtract heading of vehicle from Heading Indicator reading. Record difference.

(b) Repeat step (a) for 090-, 180-, and 270 degree headings.

5-116. REMOTE MAGNETIC HEADING COMPASS (RMHS) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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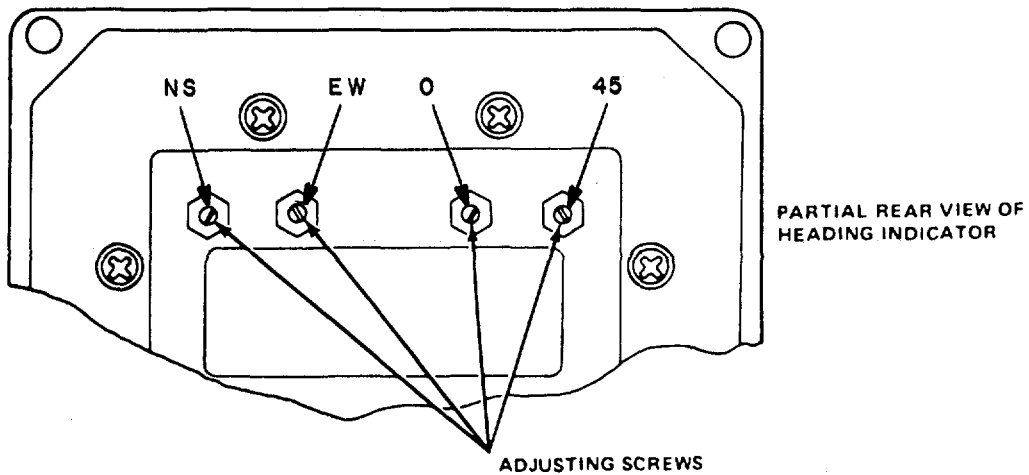
ADJUST-CALIBRATION (Cont)

- (c) Algebraically add sums from steps (a) and (b) and divide total by 4. Record the quotient as index error.
 - (d) Align the vehicle to magnetic 000-degree heading and record indication of Heading Indicator.
 - (e) Remove all magnetic material from person adjusting the compass transmitter case. Loosen three nuts securing Induction Compass Transmitter case for the support. Rotate Induction Compass Transmitter so that new heading on Heading Indicator is equal to heading recorded in step (d), minus the index error (magnitude and sign, calculated in step (c)).
2. Cyclic Error.

NOTE

If calibration cannot be accomplished by the following adjustments, substitute known good components, Induction Compass Transmitter or Heading Indicator to obtain a calibratable RMHS.

- (a) Secure transmitter case with three mounting nuts, insuring that position does not shift.
- (b) Remove 4 screws, securing the Heading Indicator. Pull the indicator out and position so that both the rear and front of indicator case are accessible and visible.



5-116. REMOTE MAGNETIC HEADING COMPASS (RMHS) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUST-CALIBRATION (Cont)

(c) With a vehicle aligned to magnetic 000-degree heading, adjust the NS adjustment screw, to obtain 000-degree indication on the Heading Indicator.

(d) Align the vehicle to magnetic 090-degree heading and adjust FW adjustment screw to obtain 090-degree indication on the Heading Indicator.

(e) Align the vehicle to magnetic 180-degree heading and adjust NS adjustment screw to remove one-half of the error indicated by the Heading Indicator.

(f) Align the vehicle to magnetic 270-degree heading and adjust EW adjustment screw to remove one-half of the error indicated by the Heading Indicator.

(g) Align the vehicle to magnetic 000-degree heading and adjust 0 adjustment screw to obtain 000-degree reading on the Heading Indicator.

(h) Align the vehicle to magnetic 180-degree heading and adjust 0 adjustment screw to remove one-half the error indicated by the
Heading Indicator.

(i) Align the vehicle to magnetic 45-degree heading and adjust the 45-degree adjustment screw to obtain a 045-degree indication on the Heading Indicator.

(j) Align the vehicle to magnetic 225-degree heading and adjust the 45-degree adjustment screw to remove one-half of the error indicated by Heading Indicator.

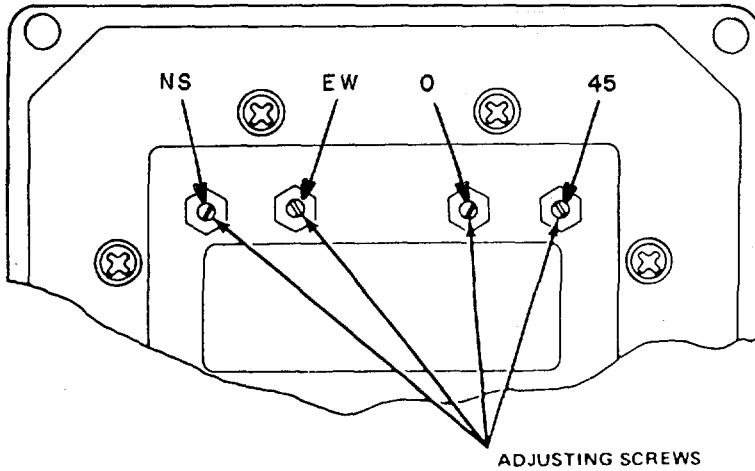
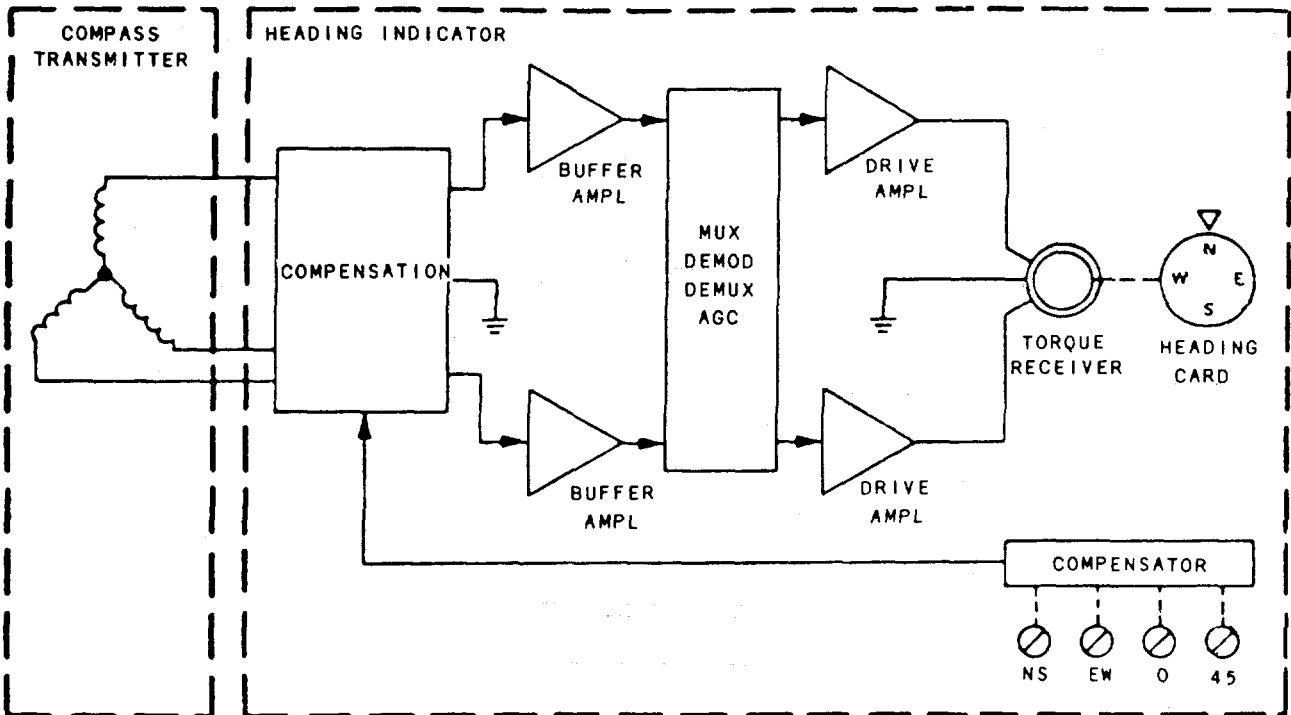
(k) Repeat steps (c) thru (j) as necessary to optimize the adjustment.

(l) Install the Heading Indicator and secure with 4 screws.

5-116. REMOTE MAGNETIC HEADING COMPASS (RMHS) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUST-CALIBRATION (Cont)



PARTIAL REAR VIEW OF HEADING INDICATOR

5-116. REMOTE MAGNETIC HEADING COMPASS (RMHS) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

- | | | | |
|--------------|----------------------------------|--|--|
| 3. Indicator | a. Screws (1), and indicator (2) | Remove. | |
| | b. Cable connector (3) | 1. Disconnect.
2. Reconnect to new indicator. | |
| | c. Indicator (2), and screws (1) | Install. | |

4. Transmitter

WARNING

In order to avoid electrical shock, make sure all electrical devices on the mast are secured.

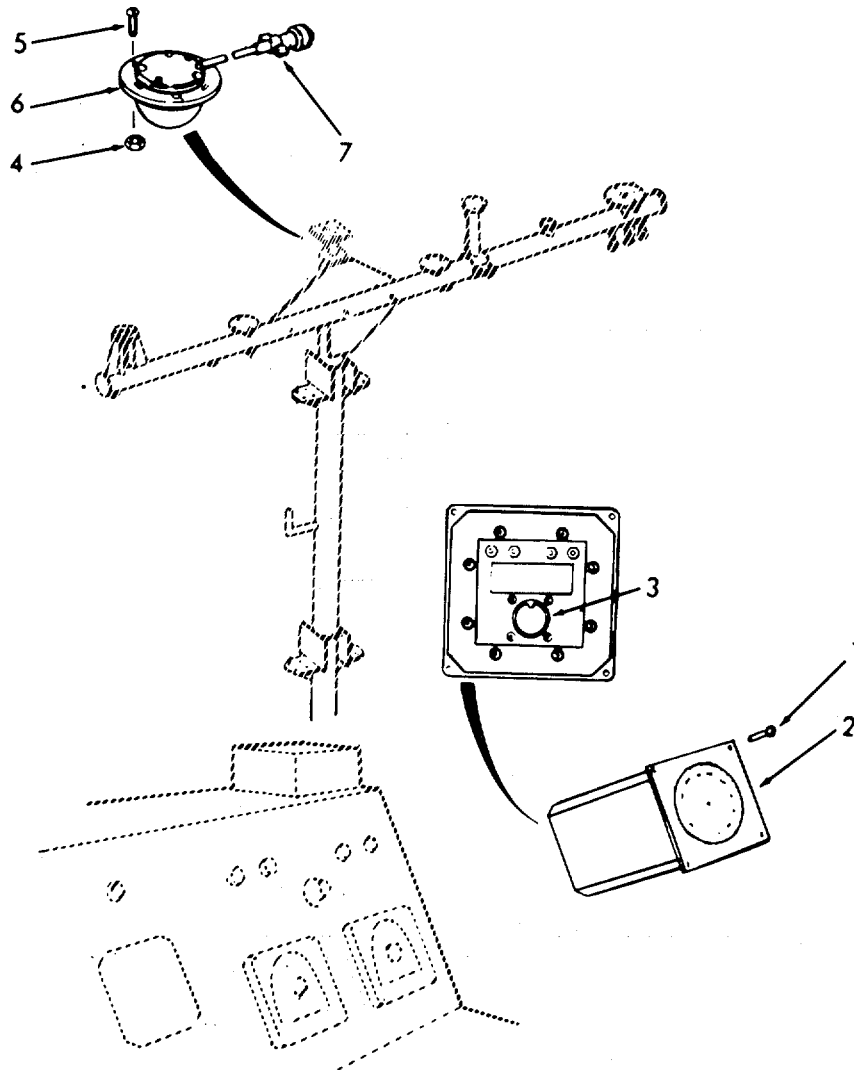
- | | | |
|--|---|--|
| a. Nuts (4), screws (5), and transmitter (6) | Remove. | |
| b. Cable connector (7) | 1. Disconnect
2. Reconnect to new transmitter. | |

5-116. REMOTE MAGNETIC HEADING COMPASS (RMHS) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | |
|--|-----------------|--|
| <p>c. Transmitter (6) screws (5), and nuts (4)</p> | <p>Install.</p> | |
|--|-----------------|--|



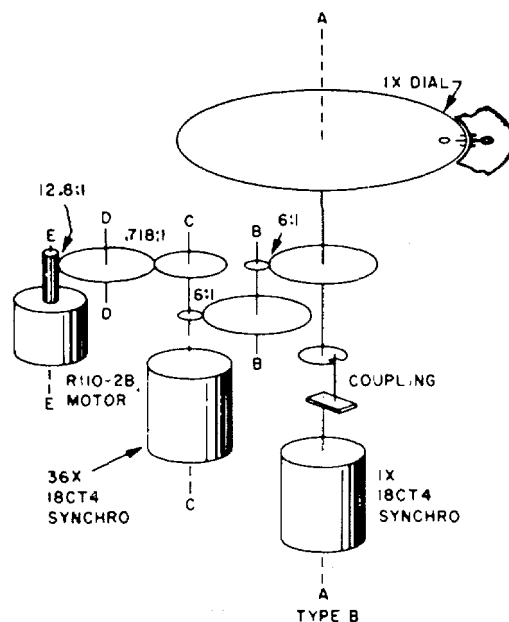
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS.

a. General.

(1) The ship's course indicator is a servo-driven remote repeater that indicates the ship's heading. The indicator receives heading data from the ship's gyrocompass. The indicator also receives reference power from the ship's supply. The gyrocompass signals and reference power actuate the indicator to position-graduated dials that show the ship's heading.

(2) The ship's course indicator is designated a Mark 2, Mod 6 and it a 400-cps two-speed single dial type. There are two synchro's geared together in a 36:1 ratio (1X and 36X). The 1X synchro provides coarse control of the dial and the 36X synchro provides fine control.

(3) The configuration of the servo gear train is shown below:



b. Principles of Operation.

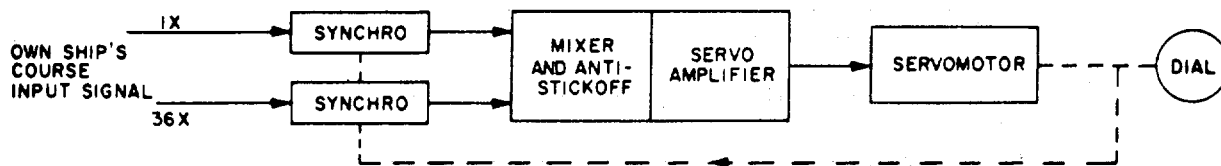
(1) Ship's Course Indicators (SCI) are basically compass repeaters. They receive electrical three-wire synchro data from a gyrocompass, and convert the data to a compass-card display. The 1X-36X complex indicator contains a servo system that is described herein.

(a) Basic servo systems in ship's course indicators.

- 1 A SCI receives a two-speed synchro signal of the ship's heading from a master gyrocompass. This signal is impressed on the stators of a control transformers.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

- 2 Inherent inaccuracies in the synchro result in shaft errors. Although small, these errors may be excessive for some applications and are, therefore, reduced by means of two-speed data system. In a two-speed SCI one data channel rotates 36 times (36X) while the other channel rotates once (1X) for one complete turn of the ship. Inside the SCI the two channels are accurately geared together in the ratio of 36:1. The 1X channel provides coarse dial position to near correspondence with the compass 1X transmitter. The 36X channel provides fine dial position to accurate correspondence with the compass 36X transmitter. Overall error is appreciably less in a two-speed indicator than in a one-speed indicator built with similar components.
- 3 Two-speed synchro signals feed two control transformers, the outputs of which are mixed and applied to a servo amplifier as shown below. In other respects a two-speed indicator is similar to a one-speed indicator.
- 4 So that the dial of a two-speed indicator can be readily read to the full accuracy capability of the servo system, a mechanically driven vernier dial is provided in the SCI. The vernier dial rotates by a gear drive from the main dial, the gearing rotating the vernier six times faster than the 1X dial. The vernier dial is graduated in divisions that correspond to degrees and half degrees with interpolations of tenths of a degree possible within ± 0.05 degree.



(b) Control transformer.

- 1 The control transformer converts electrical data into rotational position. The stator of a control transformer receives, from an external synchro transmitter, a voltage that depends on the angular position of the transmitter rotor. A three-section synchro capacitor connected in parallel with the stator windings provides power factor correction. When the rotor of the control transformer is in position alignment with the compass transmitter rotor, no voltage is induced in the control transformer rotor. If the control transformer rotor differs from this

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

aligned or null position by an amount other than 180 electrical degrees, a voltage is induced in the (control transformer) rotor such that the phase of the voltage indicates the direction of rotation from the aligned position. The magnitude of the voltage is, for small angular rotations from the aligned position, proportional to the extent of angular misalignment.

- 2 In the two-speed system the 36X control transformer passes through 72 nulls during a revolution of the 1X dial. The servo circuit is controlled by the 1X speed synchro signal until the control transformer signal is within ± 2.5 electrical degrees of position alignment. At this condition, the servo circuit must switch to operate from the 36X synchro to provide fine position alignment.

(c) Anti-stickoff bias voltage.

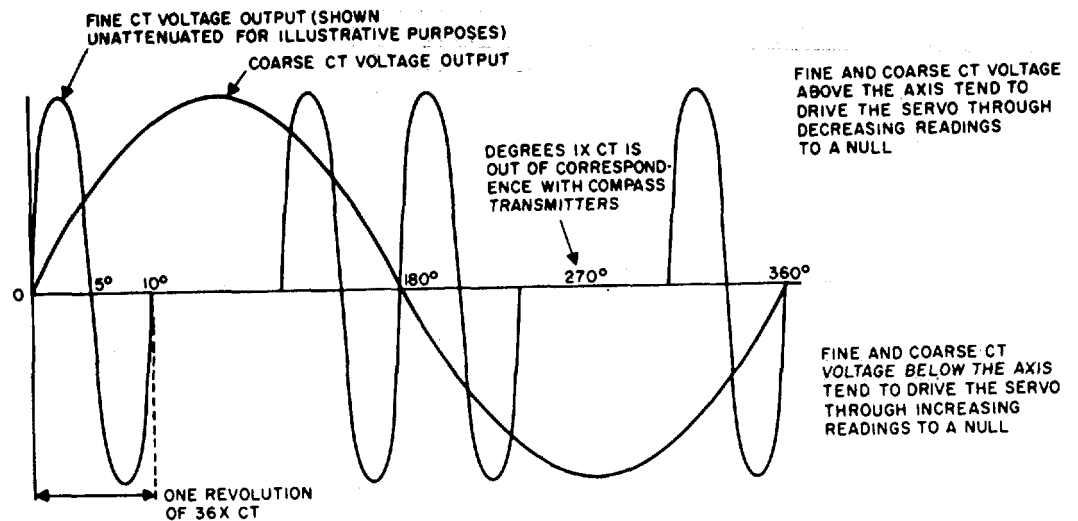
- 1 The 36X control transformer determines the accuracy of the indicator, but because this synchro has 72 null positions for one revolution of the 1X indicator dial, the 1X synchro is used to determine the proper null. The two synchro rotors are connected in shunt through a mixing network consisting of pairs of diodes and two resistors. The mixing network performs three functions. First, it effectively opens the 1X synchro rotor signal circuit whenever the indicator dial is within ± 2.5 degrees of null and effectively closes the 36X synchro rotor signal circuits. Second, it limits or attenuates the 36X synchro signal whenever the 36X synchro is more than ± 2.5 degrees from its null. Third, it keeps synchro loading to its minimum allowable level.
- 2 The use of the mixing network and anti-stickoff voltage eliminates every false null as an input signal to the servo amplifier including the one at the 180-degree point out of correspondence of the 1X synchro control transformer. This null is eliminated by the effect of adding a 2.5-volt 400-cps anti-stickoff voltage in series with the 1X synchro rotor voltage and shifting the phase of the 1X synchro voltage by 2.5 degrees to bring the indicator null back to a true reading. The above procedure converts the 180-degree out of correspondence null point to an unstable (or decentering) null. If the coarse (1X) and fine (36X) control transformers were adjusted to the same electrical zero as the electrical zero position of the compass transmitters, there would be a position of the coarse control transformer shaft 180-degrees out of correspondence with the compass transmitter at which the rotor voltages of

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

both the coarse and fine control transformers would again both equal zero (figure A). Thus the coarse synchro system provides two null points in a complete cycle. Regarding the coarse control transformer (1XCT), its null at the 180-degree point is an unstable null, because if the shaft were on either side of that point, by an infinitesimal angle, the servo would drive toward the correct null, 180 degrees away. The fine synchro has 72 null positions or 36 times as many as the coarse synchro system. If only the fine control transformer (36XCT) were connected in the system, there would be 36 positions of the transmitter shaft that would produce a stable null error voltage. Only one of these 36 positions is desired, that position being the point where the 1XCT also provides a stable null.

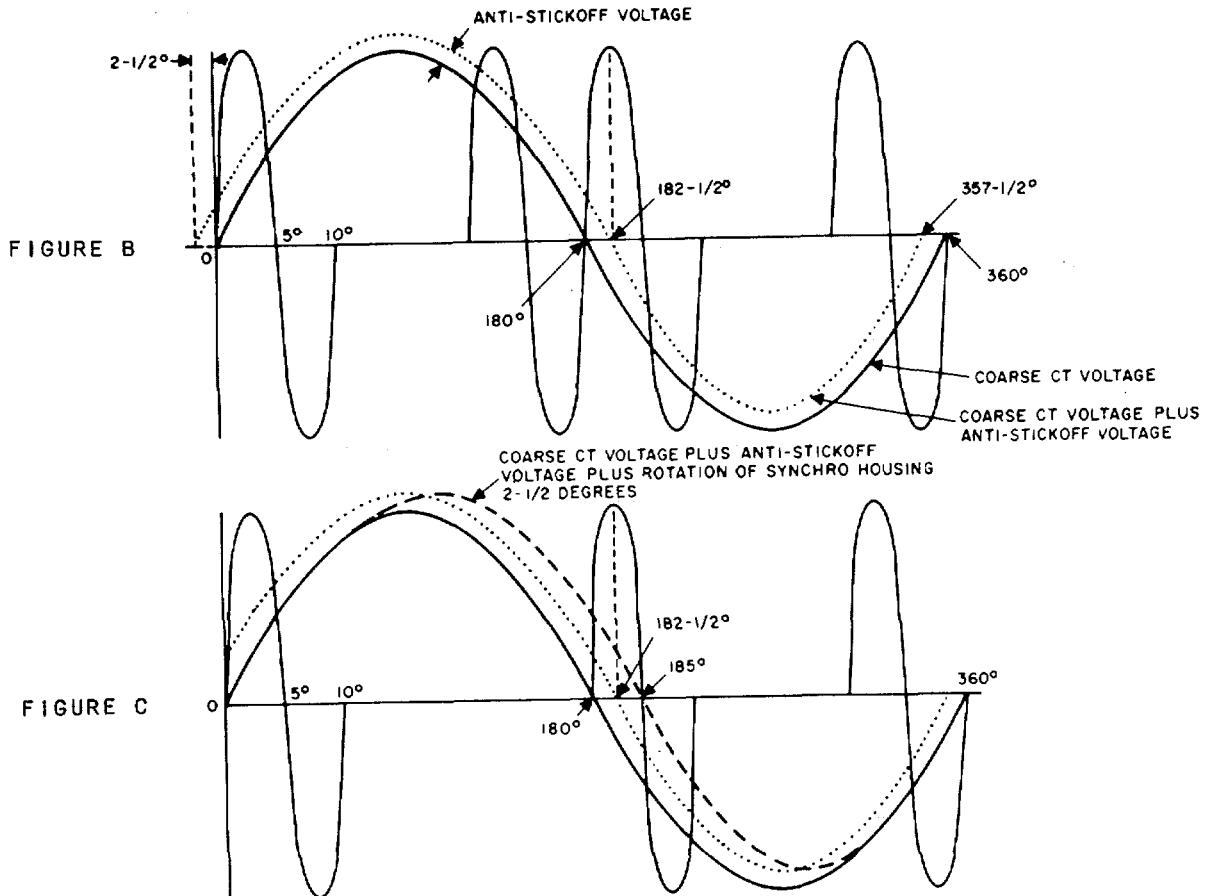
- 3 The mixing network switches into the servo amplifier the fine error signal when the error is small (output of the coarse synchro is small) and introduces to the amplifier the coarse error signal when the error is large (output of the coarse synchro is large). The coarse error signal can be small enough at the 180-degree point to result in the fine error signal being fed into the servo, through the action of the mixing network. If only the 1X error voltage were applied at the 180 degree point, the servo would drive away from this false null. But, because the 36X voltage has control, it drives the servo toward this 180 degree null point. The 36X error voltage negative between 175 degrees and 180 degrees tends to drive the servo to an increased angle (180 degrees); where positive between 180 degrees and 185 degrees it tends to drive the servo to a decrease angle 180 degrees - the same point. In other words, if this condition were tolerated the servo would lock in at a false null.

FIGURE A



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

- 4 To remove this condition (false null), an anti-stickoff voltage of 2.5 volts is obtained from a transformer in the amplifier unit and applied to the coarse error voltage. This voltage is applied either in phase or 180 degrees out of phase with the 1X error voltage and is sufficient to shift the 1X error signal null points 2.5 degrees. The resultant voltage does not pass thru the zero reference position of the 36XCT voltage (figure B). To restore the resultant voltage to the zero reference position, the 1XCT stator is shifted a total of 5 degrees which corresponds to 180 degrees rotation (36 times the 1X) of the 36X synchro (figure C).



- 5 With anti-stickoff bias, the false null at the 180 degree point cannot be attained by virtue of either the 36X or 1X error signal on either side of this point both being of such polarity as to drive in the same direction to the real null at zero degrees. The 36X error signal drives

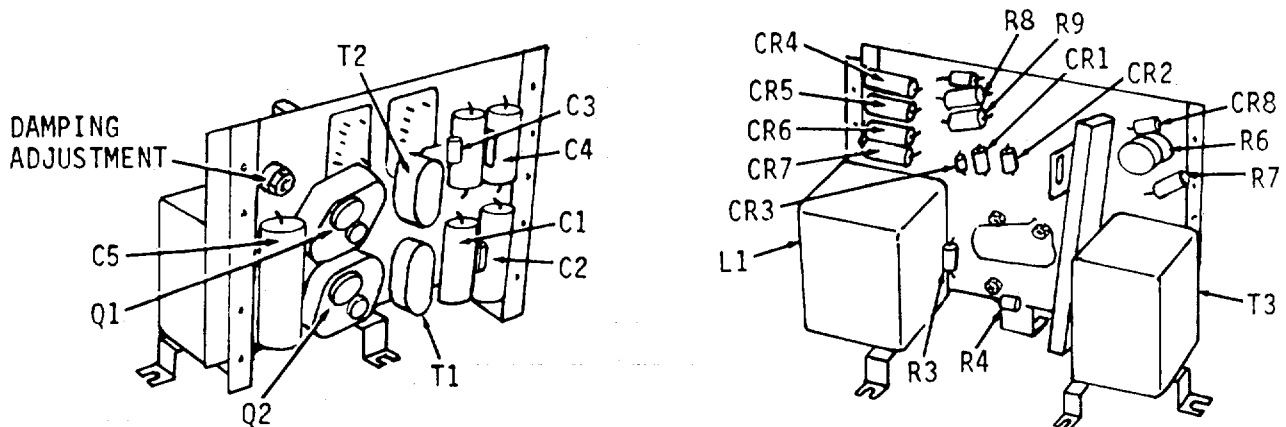
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

2.5 degrees toward the correct null, and the mixing network switches to the 1X error signal, which drives to 2.5 degrees from the zero degree null position.

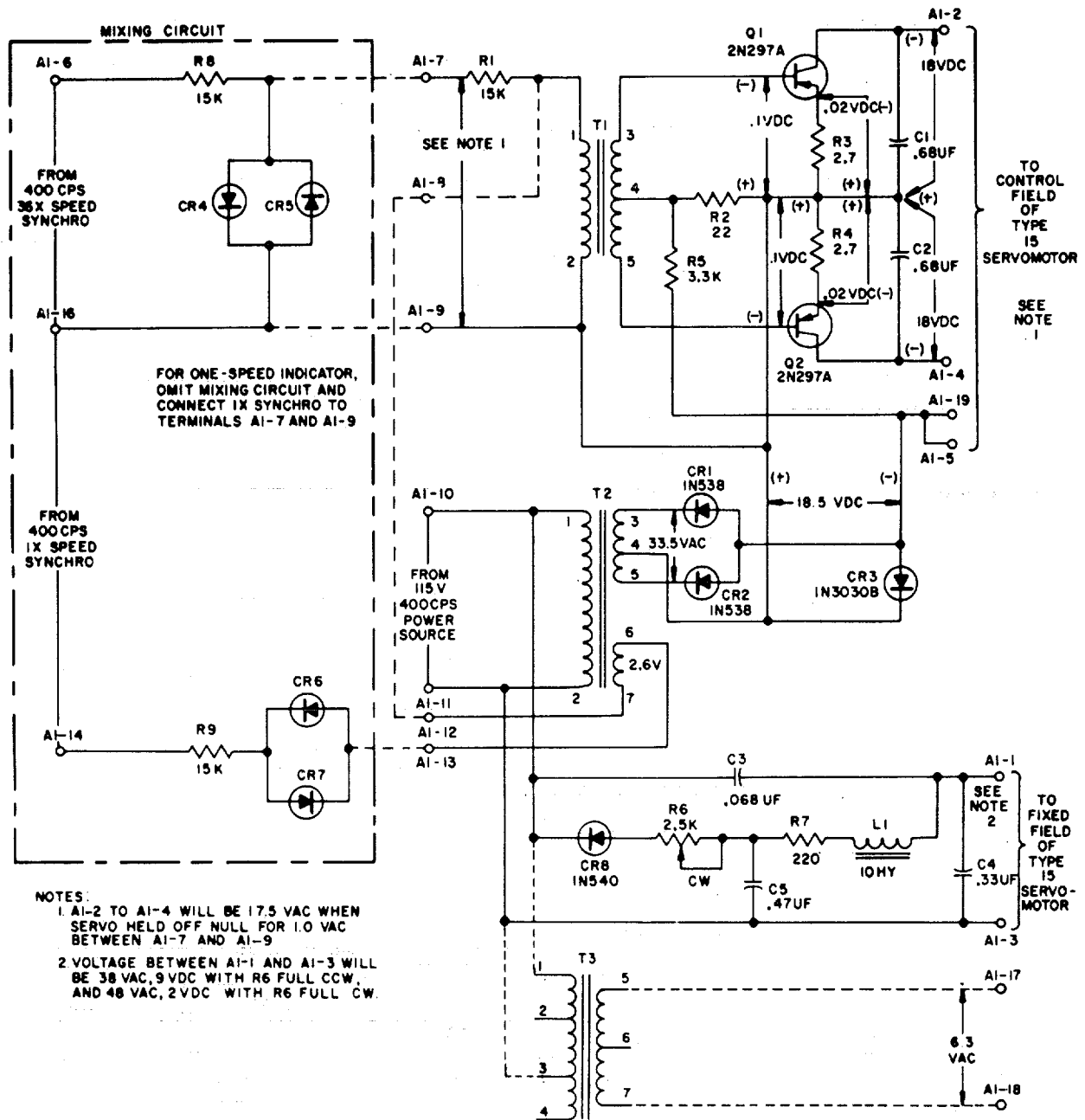
- 6 As the 2.5 degree point is reached, the mixing circuit automatically shifts the amplifier input signal from 1X synchro to 36X synchro. This signal, with amplifier output and motor torque reacting accordingly, is reduced as the servo approaches null. The final null position is reached at the point of minimum 36X synchro rotor voltage. Because the synchro voltage is very low, the amplifier output and motor torque are reduced substantially to zero.
- 7 Mixing networks and anti-stickoff voltages are unnecessary in one-speed systems. Although synchro voltage (and thus motor torque) go to zero at the 180-degree point, this point is an unstable (decentering) null. If the servo approaches this false null with slight overshoot, the servo will not come to rest at the null, instead the servo will continue to rotate toward the true null where it will come to final rest.

(d) 400-CPS servo amplifier.

- 1 The 400-cps servo amplifier receives electrical position data from one or two synchro control transformers and delivers electrical power to the servomotor.
- 2 A subchassis within the indicator housing carries the amplifier chassis. All components of the amplifier are mounted on this chassis including adjustable rheostat R6, which is part of the damping network. The amplifier contains its own power supply; a separate step-down transformer furnishes power to the dial lamps.



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

- 3 Push-pull transistor Q1 and Q2, mounted on heat sinks, provide power to control winding of the Type 15 servomotor. Transformer T1 couples the input signal to the transistor bases. Output signal flows directly from the collectors to the control field of the servomotor. Transformer T2 and diodes CR1 and CR2 provide bias for the common-emitter amplifier circuit, resistor R2 forward biases the transistors.
- 4 Reliability of the transistor amplifier is enhanced in several ways. In the emitter circuit, R2 minimizes current spikes. The collector circuit, C1 and C2 prevent voltage spikes. In addition, zener diode CR3 limits excess voltage spikes that might enter the amplifier from the power line.
- 5 Several circuit elements contribute to the stability of the servo loop of which the amplifier is a part. Capacitors C1 and C2 serve the additional function of converting the reactive load of the motor control field to a resistive load across the transistors. Capacitors C3 and C4 shift the phase of the current through the fixed field winding of the servomotor to be in quadrature with the current through the control winding. These capacitors also serve to decrease the voltage across the fixed field to about 38 rms volts so that the motor can be damped magnetically. Diode CR8, rheostat R6, and the associated L-C filter provide an adjustable direct current through the fixed field. This current serves to magnetically damp the servomotor for stable operation. Rheostat R6 is adjusted at the factory and normally needs no further adjustment unless the indicator is extensively overhauled.
- 6 As described under anti-stickoff voltage, two identical synchros provide input signals to the amplifier. In the vicinity of the one true null position the more sensitive 36X data is the dominant signal by virtue of the anti-stickoff voltage described above. Away from the null the 1X data is the dominant signal. The mixing circuit selects the more dominant signal.
- 7 Near null both signals are small. The 36X signal is applied across diodes CR4 and CR5 which present a high impedance at low voltage. The 36X signal thus passes through input transformer T1. The 1X signal is applied in series with another pair of diodes CR6 and CR7; these diodes also present a high impedance at low voltage. The 1X signal is thus blocked.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

- 8** Away from null the 36X signal may be large or small, and the 1X signal is always large. When the 36X signal is large, the diodes in parallel with it present a low impedance and bypass the signal around transformer T1. In the presence of a large 1X signal (in excess of about one volt) the diodes in series present a low impedance and thus pass the 1X signal to input transformer T1.
- 9** In addition, the anti-stickoff voltage is added in series with the 1X signal by the 2.5-volt secondary winding of power transformer T2. Series resistors R8 and R9 prevent the amplifier from excessively loading the synchros.

(e) Servomotor.

The servomotor is a conventional two-phase type. A capacitor in series with the motor reference winding produces a phase displacement relative to the control winding. This displacement results in a revolving magnetic field, when both windings are excited, which causes the armature to rotate. The servo motor is a closed assembly with lubricated and sealed bearings.

c. Maintenance Instructions.

(1) Care and cleanliness in the handling of ship's course indicators will do much to minimize their need for maintenance. Never use excessive force to get parts apart or together. The only test equipment required to work on the indicator is an electronic or precision a-c voltmeter, used for resistance and voltage measurements, and for zeroing the synchros.

CAUTION

When the SCI is disassembled for repair or lubrication, protect gear train including teeth, shafts, and bearings from scratches and other damage. Keep the gear train clean, preferably by preventing dust and dirt from entering the indicator mechanism.

(2) Lubrication.

- (a) The instrument gear trains are precision assemblies that operate to position the balanced dials. As a on sequence, the gears need transmit little power. Keep them clean, as dust may collect between the teeth with resulting binding. Keep synthetic gears clean and free of lubricants.
- (b) The metal gears should be cleaned and lightly coated with MIL-G-3278 or MIL-G-23827 grease during the yearly inspection or when the indicator is disassembled for repair.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

(c) All bearings are factory lubricated and shielded. Accessible bearings may be lubricated yearly with the same grease as used on the gear train. Since the bearings will operate for many years on the factory lubrication, the gear train should not be disassembled to lubricate bearings. If a bearing shows signs of looseness or binding, the bearing should be replaced.

(3) Periodic inspection.

(a) If excessive condensation appears on the underside of the dial window, remove the drain plug and let condensation escape. Indicators exposed to the weather are likely to have some condensation. If excessive condensation persists, the cover window gasket is not sealing properly and should be tightened or replaced as necessary.

(b) All gears should be inspected yearly for signs of dirt or corrosion. Check the gear train for binding or excessive backlash. Clean all gears with varsol and an air hose, and lubricate with MIL-G-3278 or MIL-G-23827 grease. Replace any worn gears or bearings. Instructions for disassembling the gear train are presented in step 1.

(c) When the SCI is disassembled for lubrication or repairs, check that all electrical connections, synchros and motor clamps, and all screws are secure. Inspect for visible defects and repair or replace as necessary; otherwise there are no regular preventive maintenance measures to be taken. If all is well, reassemble the indicator, re-energize it and observe it for proper response (static error 0.2 and dynamic error 0.5). Familiarity with a properly operating indicator gained during the first few periodic inspections will enable you to recognize more readily the symptoms of malfunctions should any develop later.

(4) Troubleshooting procedure.

(a) If the indication of a dial differs significantly from that of the master compass or other equipment that supplies data to a ship's course indicator, or if the dial holds a fixed position during course changes, moves abruptly to another position, or if the indicator otherwise behaves abnormally, inspect the indicator promptly to correct any defect. The cause of malfunction may, if uncorrected, cause rapid deterioration of the indicator.

(b) First determine that the trouble is in the indicator rather than in the transmitting equipment. This can be done on an installation with several ship's course indicators by comparing the behavior of all indicators. If they all behave in the same manner the cause of trouble is in the transmitting equipment.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

(c) Check power and synchro voltages 115VAC 400 cycles at the terminal board inside the base of the indicator housing and verify that these voltages are reaching the internal assembly through the cable that connects to the terminal board.

(d) When SCI dial and the synchro data source are at 0 degrees, the following voltages should be measured.

1 Synchro torque receivers:

S1 - S3,	0	volts a-c
S2 - S3,	78	volts a-c
S1 - S2,	78	volts a-c
R1 - R2,	115	volts a-c

2 Synchro control transformers.

R-1 - R-2,	0	volts a-c
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(e) Use an a-c voltmeter with a sensitivity of 1000 ohms per volt and a full-scale range of 150 rms volts. Similarly, measure the primary and secondary voltages of power transformer T2 and a lamp transformer T3.

(f) If these tests do not indicate the proper voltages, then the cause of trouble is in the external wiring or transmitting equipment. If proper voltages are present, proceed to make the following tests. The indicator may be repaired at its installed location. A clean area with appropriate power and synchro signals for energizing indicator is preferred if available.

(5) Mechanical or electrical trouble.

(a) No indicator contains a fuse. Fuses in the power circuit to the indicator will be on a switchboard.

(b) The following table gives several symptoms of trouble. To verify and correct any of these troubles, refer to the text that follows for more detailed instructions.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

Troubleshooting Procedures for Fault Isolation

Symptom	Probable cause	Verification and Remedy
Indicator inoperative Dial does not respond Dial lamps are out	No power	Check 115V reference voltage supply, check fuses between indicator and power source. If fuse is blown, disconnect and check ship's wiring to terminals LC and LCC. Check for shorted power or illumination transformer. Resistance looking into an indicator at terminals LC and LCC should be within 20% of 16 ohms .
Dial response is meaningless Lamps are lit	Improper power phase	Terminal LC in indicator must connect to same line of ship's power supply as R1 of synchro transmitter. Similarly, LCC must connect to same line as R2. Check that power is actually present.
No response	Gear train fouled	Inspect and clear gear train (paragraph c(3))
	Burned out rotary components	Check continuity of synchros and motors. Synchro - stator 838 ohms - rotor 413 ohms servo motor - fixed phase 120 ohms - control phase 60 ohms.
	No power to servo-motor	Check voltages out of amplifier and phasing network.

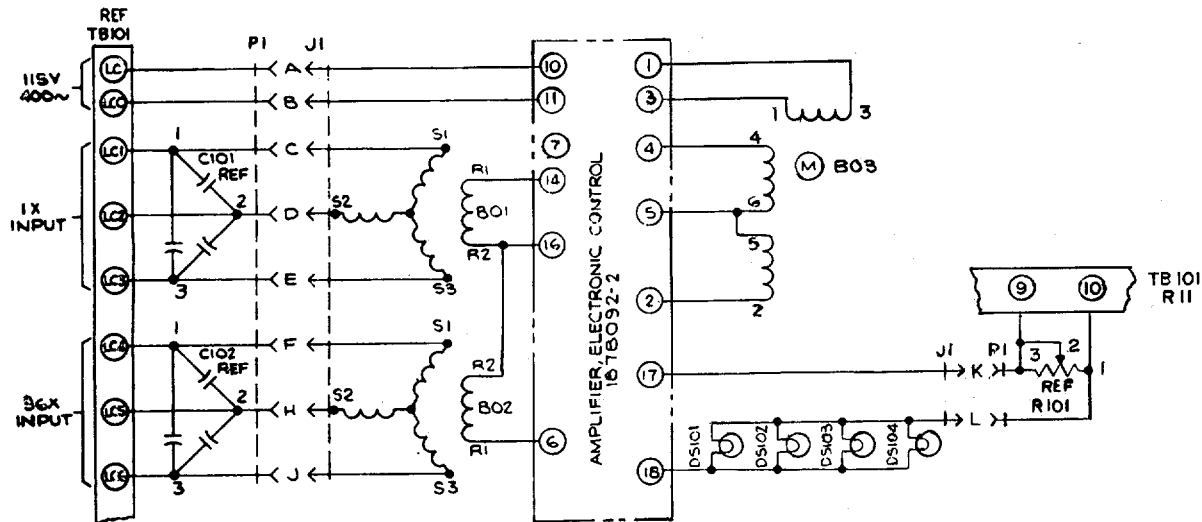
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

Troubleshooting Procedures for Fault Isolation

Symptom	Probable cause	Verification and Remedy
Dial of two-speed unit rotates continuously in an increasing direction drives servo.	No signal from control transformers to amplifier; anti-stickoff voltage	Check synchro circuits for signal transmission from external transmitters through to control transformers in indicator.
Dial travels slowly in one direction only	Amplifier is unbalanced or open circuited.	Check amplifier circuits with attention to symmetry.
Dial moves sluggishly	Dirt in gear train	Inspect and clean gear train (paragraph c(3)).
	Damping is excessive	Adjust damping rheostat as in step 4.
	Amplifier is unbalanced or lacking in gain	Check amplifier circuits.
Dial of two-speed indicator moves alternately fast and slow and may lock occasionally	No signal from 1X.	Check 1X synchro.
	1X and '36X synchros not set at proper electrical position	Readjust anti-stickoff positions of synchros (step 4).

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

- (c) De-energize the indicator servo and dial assembly by disconnecting the plug with its cable from the case. Inspect assembly S' for excessive gear train or bearing friction, loose clamps, loose terminal connections, loose screws, and for any signs of defective electronic components or wiring. If the gear train is binding, clean the gears or disassemble the gear train and clean all gears and lubricate all bearings. Replace any defective bearing or gears.
- (d) Gear train disassembly instructions are presented in step 1.
- (e) If inspection and mechanical tests show the rotating components to be mechanically operative proceed as follows to check that they are electrically operative. Reconnect the electrical plug to its other half in the case.
- (f) In all servo-driven indicators, under normal operation when the indicator is at rest the control field voltage across terminals 2 and 4 of the indicator servomotor should be below 2 rms volts. Fixed-field excitation (terminals 1 and 3) to 60-cps motors to 90 rms volts and to 400-cps motors is 45 rms volts.
- (g) Check continuity of each winding in a rotating component as follows. First remove all power and synchro signals from the indicator. Disconnect leads to a winding, and then measuring the resistance of the winding on a scale indicating in the 100's of ohms. Replace any unit with a shorted or open winding. (See step 4).



5-1317

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

Volt Ohmmeter

References
Paragraph

3-219 Ship's Course Indicator
Organizational Maintenance
Instructions

Special Tools

Solder iron (25 watt max)

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-DISASSEMBLY

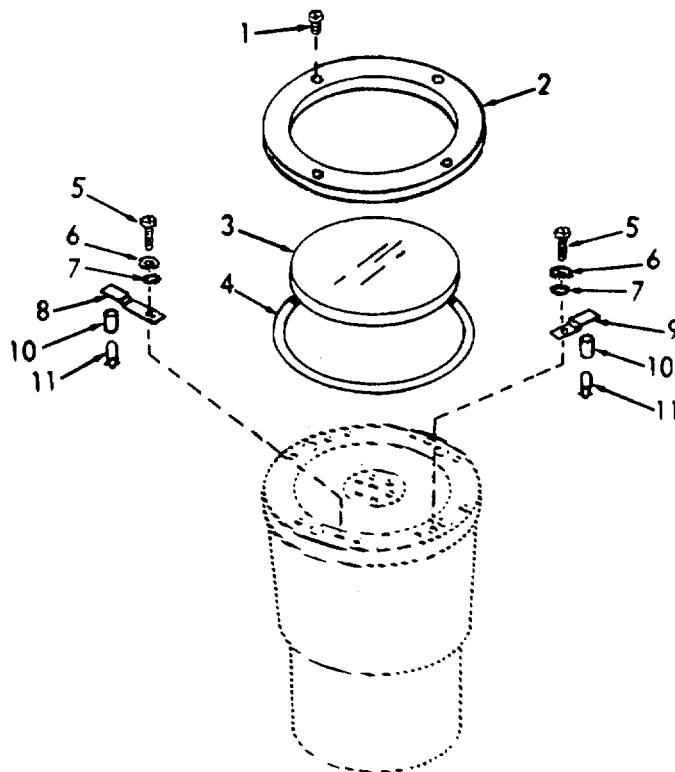
- | | | | |
|------------------|---|---------|--|
| 1. Dial
Light | a. Eight
screws
(1),
cover
(2),
and
lens
(3) | Remove. | |
| | b. preformed
packing
(4) | | |

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

- | | | | |
|----|--|--|--|
| c. | Screws (5)
lock-washers (6),
flat-washers (7),
retainers (8 and 9)
and filter (10) | Remove four places. | |
| d. | Dial light (11) | Push in and turn slightly counter-clockwise to remove. | |

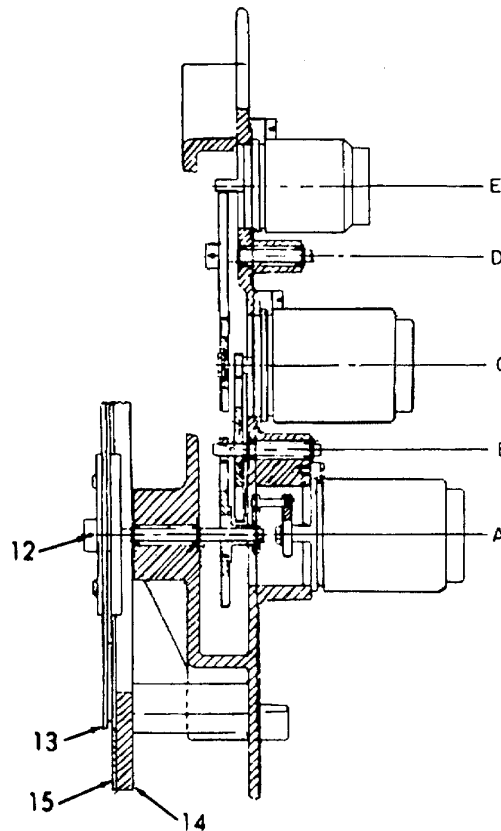


5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

- | | | | |
|---------------|--|---------|--|
| 2. Gear Train | a. Spring pin (12), dial assembly and hub (13) | Remove. | |
| | b. Light conducting panel (14) and dial (15) | Remove. | |



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

NOTE

- The gears of the synchro gear train are fastened to gear shafts with spring pins. The gear shafts are shimmed for end play and held in place with retaining rings.
- When disassembling the gear train, to avoid damaging the bearings, remove the gear along with its gear shaft and then drive the spring pin from the gear to remove the gear from the shaft.
- If a shaft is pinned at both ends such that a pin must be driven out while the shaft is inserted through its bearings, back the gear with a piece of hard wood or soft aluminum while the pin is being removed.
- When replacing any gear, if the old shaft is retained the gear and shaft should be assembled and drilled for the appropriate size pin. Turn the shaft so that the new hole is drilled through the shaft approximately perpendicular to the original hole. If the shaft has been previously redrilled, discard it and replace it with a new one.
- To gain access to the gear train for disassembly, remove the servo and dial assembly from the SCI. Remove all servo amplifier leads from the synchros and servomotor and tag for replacement. Remove the five screws which attach the servo amplifier to servo and dial assembly and remove the amplifier.
- When disassembling the gear train, tag all shims and spacers so they may be replaced on the proper end of the shaft from which they were removed. These spacers are selected to adjust shaft end play to prevent excessive gear backlash or bearing preloading.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

- | | | | |
|--|---|---|---------------|
| | c. Screws (16), lock-washers (17), and clamp (18) | Remove. | |
| | d. Motor B03 (19) | 1. Tag and disconnect wiring at axis E.

2. Remove. | |
| | e. Retaining ring (20) | Remove from shaft (axis D). | |
| | f. Gear (21), and shaft (22)
Assembled | 1. Remove.

2. Disassemble spring pin (23), gear (21), retaining ring (24), and shaft (22).

3. Reassemble. | If necessary. |
| | g. Retaining nut (25) | Remove at (axis C). | |
| | h. Gear (26) | Lift off of synchro B02. | |
| | i. Screws (27), lock-washers (28), and clamp (29) | Remove. | |
| | j. Synchro B02 (30) | 1. At axis C, tag and disconnect wiring.

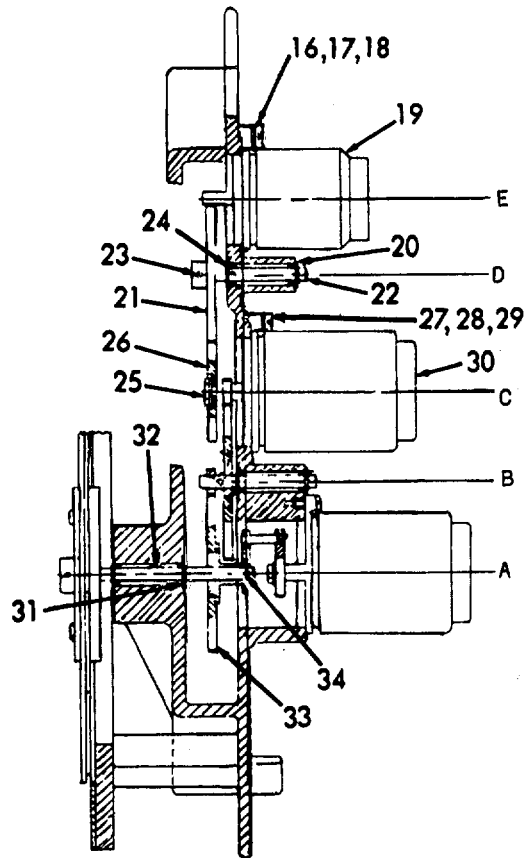
2. Remove. | |

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

- | | | | |
|----|-------------------------------------|--|--|
| k. | Lower retaining ring (31) | Remove from shaft (32) (axis A). | |
| l. | Shaft (32), and gear (33) assembled | <ol style="list-style-type: none"> 1. Lift up far enough to remove spring pin (34). 2. Pull shaft and gear assembly out the top. | |



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

- | | | | |
|--|---|---|--|
| | m. Spacers (35) | Remove. | |
| | n. Spring pin (36) | Remove from gear (37) at axis B. | |
| | o. Gear (37) | Remove from shaft (38). | |
| | p. Shaft (38) | Remove from bottom. | |
| | q. Spacers (39) | Remove. | |
| | r. Part (40), and coupling arm (41) | Remove. | |
| | s. Screws (42), lock-washers (43), and clamp (44) | Remove. | |
| | t. Synchro B01 (45) | At axis A.
1. Tag and disconnect wiring.
2. Remove. | |
| | u. Spacer (46) | Remove. | |
| | v. Pin (47) | Remove from pin (48) and coupling arm (49). | |

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

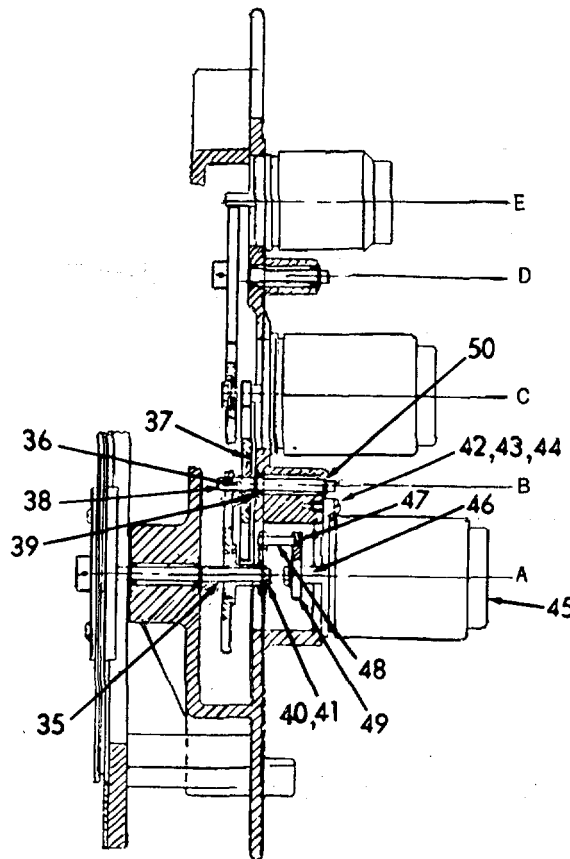
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

w. Bearings
(50)

Remove six places.

As required.

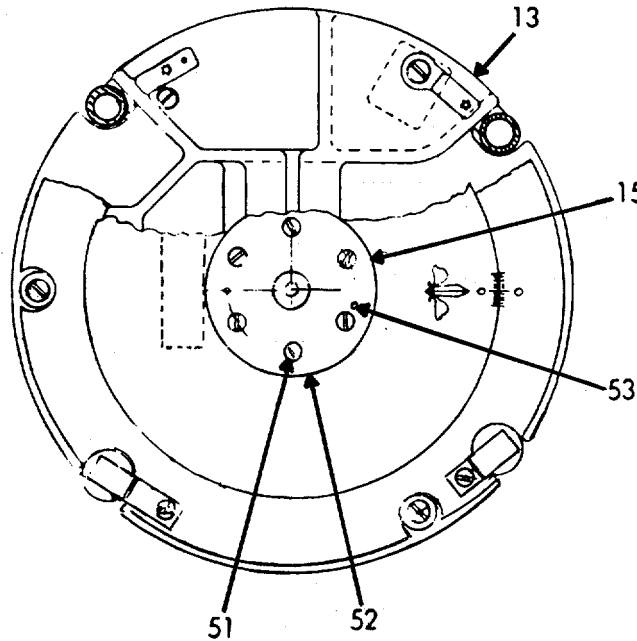


5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - DISASSEMBLY (Cont)

- | | | | |
|----|----------------------------------|--|---------------|
| x. | Dial (15), and hub Assembly (13) | <ol style="list-style-type: none"> 1. Remove screws (51), and disc clamp (52). 2. Remove straight pins (53). | If necessary. |
|----|----------------------------------|--|---------------|



OVERHAUL-REASSEMBLY

- | | | | | | |
|----|------------|----|----------------------------------|--|-----------------------|
| 3. | Gear Train | a. | Dial (15), and hub assembly (13) | <ol style="list-style-type: none"> 1. Install straight pins (53), and disc clamp (52). 2. Install screws (51). | Use staking compound. |
|----|------------|----|----------------------------------|--|-----------------------|

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - REASSEMBLY (Cont)

NOTE

When replacing the dial on hub, the dial must be carefully aligned before repinning. To align and pin the dial, proceed as follows:

1. Stack hub, new dial and retaining ring so that the screw holes are aligned but the original pinning holes in the retaining ring and hub are not aligned.
2. Center dial such that a line drawn through the 0 degree - 180 degree marks and the 90 degree - 270 degree marks will pass through the exact center of the hub.
3. Carefully tighten screws to clamp the hub, dial, and retaining ring together.
4. Drill two slightly undersized holes through the dial and hub using each of the original pinning holes in the retaining ring as a guide.
5. Use a reamer to enlarge the hole to exact size of the aligning pins.
6. Press in the aligning pins and replace the dial and hub assembly on the indicator in the reverse order of disassembly.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - REASSEMBLY (Cont)

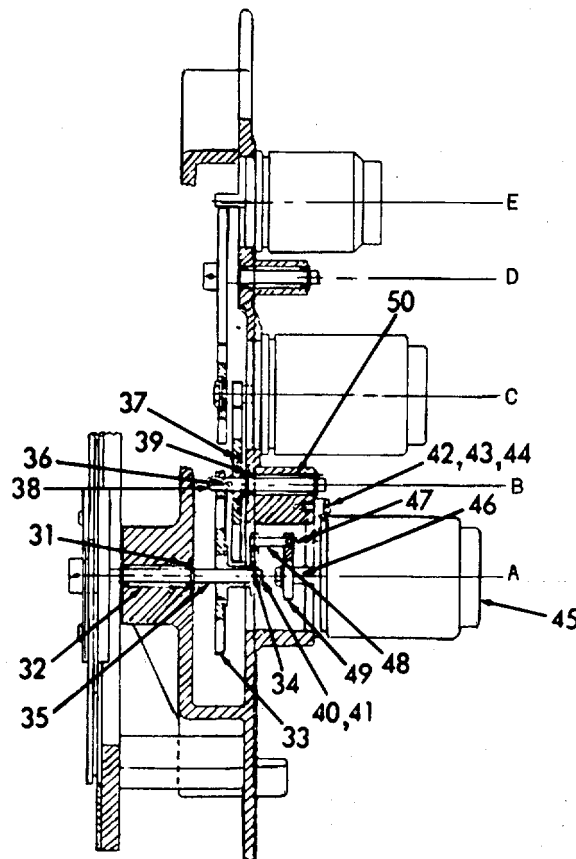
	b. Bearing	Install. (50)	
	c. Coupling arm (49), and pins (48 and 47)	Install.	
	d. Spacer (46)	Install.	
	e. Synchro B01 (45)	1. Install. 2. Reconnect wiring.	
	f. Clamp (44), lock-washers (43), and screws (42)	Install.	
	g. Coupling arm (41), and part (40)	Install.	
	h. Spacer (39)	Install.	
	i. Shaft (38)	Install from the bottom.	
	j. Gear (37)	Install on shaft (38).	
	k. Spring pin (36)	Install in gear (37). Axis B.	
	l. Spacers (35)	Install.	

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - REASSEMBLY (Cont)

- | | | | |
|----|------------------------------------|--|--|
| m. | Gear assembly (33), and shaft (32) | 1. Install through top.
2. Install spring pin (34). | |
| n. | Lower retaining pin (31) | Install on shaft (32). Axis A. | |



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - REASSEMBLY (Cont)

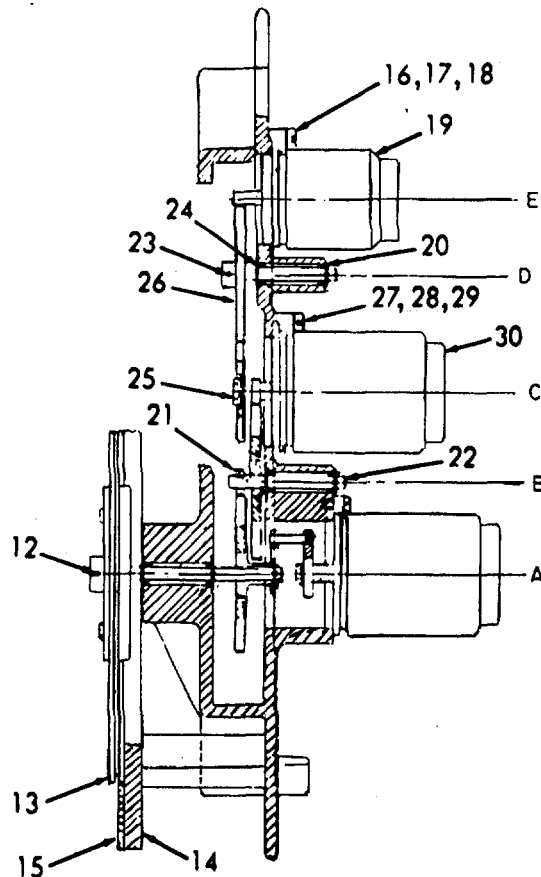
- | | | | |
|--|---|--------------------------|---------------|
| | o. Synchro B02 (30) | Install wiring. | Axis C. |
| | p. Clamp (29), lockwasher (28) and screws (27) | Install. | |
| | q. Gear (26) | Install on synchro (30). | |
| | r. Retaining nut (25) retaining ring (24) and spring pin (23) | Install. | If necessary. |
| | s. Assembled shaft (22), and gear (21) | Install. | |
| | t. Retaining ring (20) | Install on shaft. | Axis D. |
| | u. Motor B03 (19) | Install wiring. | |
| | v. Clamp (18), screws (16) and lockwashe (17) | Install. | |

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - REASSEMBLY (Cont)

- | | | | |
|----|--|----------|--|
| w. | Light conducting panel (14), and dial (15) | Install. | |
| x. | Dial and hub assembly (13) | Install. | |
| y. | Spring pin (12) | Install. | |

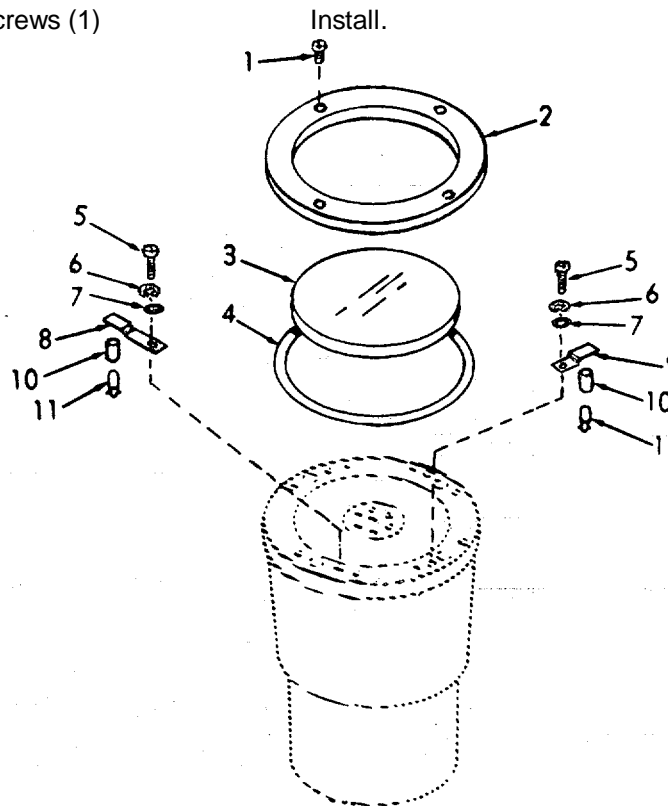


5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - REASSEMBLY (Cont)

- | | | |
|---------------|---|--------------------------------------|
| 4. Dial Light | a. Dial light (11) | Push in and turn slightly clockwise. |
| | b. Filter (10), retainer (9 or 8), flatwasher (7), lockwasher (6), and screws (5) | Install. |
| | c. Preformed packing (4), lens (3), and cover (2) | Assemble. |
| | d. Screws (1) | Install. |



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-TEST

5. Electrical Test

CAUTION

Do not measure resistances between circuit points. Ohmmeter test voltages can damage semiconductor devices such as the diodes and transistors used in ship's course indicators.

a. Remove all power and synchro signals at a point external to the indicator.

b. All circuits are isolated from the metal frame of the indicator. Ohmmeter tests, made with a multimeter-type ohmmeter, between all terminals, and the metal amplifier chassis and between any circuit point including lamp circuit and metal chassis should show resistance in excess of 10 megohms. (Similarly, all terminals on the terminal block at the base of the indicator housing are insulated from the case and should test at least 10 megohms from terminal to case.) If less than 10 megohms is measured, check for frayed insulation or evidence of a shorted lead at the terminal board or in the cable external to the indicator.

c. Troubleshooting the amplifier.

(1) If, with the ship's course indicator deenergized, the rotating components turn freely through a complete rotation of the dial, and if the rotating components check for continuity, the next step is to check the amplifier.

CAUTION

Apply power only at the rated frequency for the indicator under test.

(2) First examine the amplifier for outward signs of failure: loose connections, broken leads, overheated components. If the amplifier appears satisfactory, apply 115-volts at the specified frequency (Table 1-1) to the ship's course indicator and, with an AC voltmeter with a sensitivity of at least 1000 ohms per volt, check measured voltages against normal voltages (see table). A difference

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL-TEST

between the measured and tabulated voltages greater than ten percent indicates possible trouble as outlined in the table. In general, no voltage indicates an open circuit between the test points and the power source; a low voltage indicates an open circuit between the test points and the power source; a low voltage indicates an excessive load, such as a short circuit, further along in the circuits. Repair any fault located by these tests.

(3) If the transistor stage appears at fault, energize the amplifier and, with a d-c voltmeter with a sensitivity of at least 1000 ohms per volt, check measured voltages against normal voltages. Less than a ten-percent difference between measured and tabulated voltages indicates satisfactory DC circuit conditions; a greater difference indicates a possible cause of trouble.

d. Replacement of semiconductor device.

(1) If the fault appears to lie in a diode or transistor, or a component connected to a semiconductor device, observe the following precautions.

(2) All small electronic components are limited in their ability to withstand the temperature necessary for a properly soldered joint. Semiconductor components are especially susceptible to damage from high temperature.

(3) For this reason protect a diode or transistor from heat by firmly grasping the lead midway between component and soldered joint with a pair of pliers. The nibs of the pliers must be free from dirt, grease, and other coatings that would interfere with the rapid flow of heat into the pliers. Use the largest pliers that will fit. The pliers serve as a heat sink to protect the semiconductor device. Continue to grasp the lead with the pliers throughout the soldering operation and until the joint has cooled afterward.

(4) Use as small a soldering iron as will satisfactorily heat the junction to the melting point of solder; keep the tip brightly tinned. Clean a terminal or eyelet of excess solder from a previous connection before starting to connect a replacement part to it. Use only rosin-core solder and apply only enough solder to wet the joint.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-TEST

AC VOLTAGES IN 400-CPS AMPLIFIER.

Terminals	Normal Voltage (RMS)	Possible Trouble If Voltage Is Not Normal
A1, 10-11	115	Defective wiring to indicators and from terminal strip in indicator base to amplifier chassis.
A1, 1-3	38 (R6 CCW) 48 (R6 CW)	Defective damping rheostat R6, or other components of motor damping and phase-shift network.
T2, 6-7	2.6	Defective mixing circuit.
T2, 3-5	33.5	Defective transformer T2 or following rectifier and amplifier circuits.
T3, 1-3	115	Defective wiring to transformer T3.
A1, 17-18	6.3	Defective dimmer control and illumination circuit.

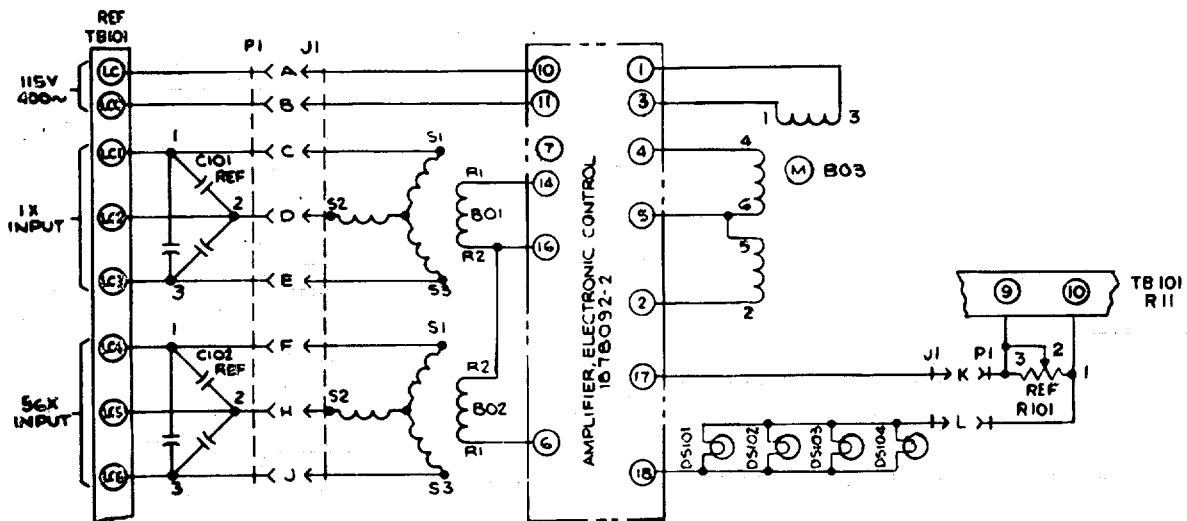
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-TEST- (Cont)

DC VOLTAGES IN 400-CPS AMPLIFIER.

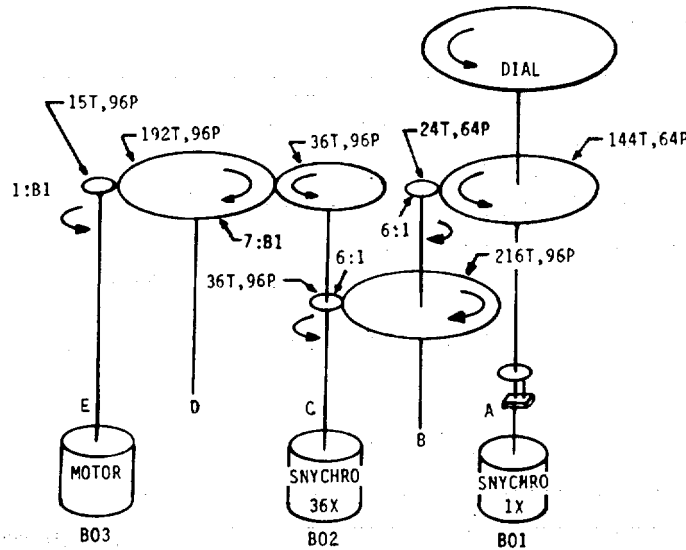
Terminals	Normal Voltage (DC)	Possible Trouble If Voltage Is Not Normal
A1, 9-5	18.5	Measured voltage should be within 10% of tabulated value; terminal A1-9 is positive. Check for 33.5 VAC on T2, 3-5. If not correct, T2 is defective. If A1, 9-5 voltage is very low, CR1 or CR2 is open. If heavy 400 cps ripple CR1 or CR2 shorted.
A1, 9-2	18	If voltage differs from the voltage A1, 9-4, check transistor Q1, resistor R3, and capacitor C1. If voltages across both halves of the transistor stage are substantially the same, check common components R2 and R5.
A1, 9-4	18	See above; check Q2, R4 and C2.



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-TEST (Cont)



GEARING SCHEMATIC
ARROWS SHOW ROTATIONS FOR INCREASING HEADING.

OVERHAUL-ADJUSTMENT

6. Zeroing of Synchro Control Transformers and Torque Receivers.

- Energize the indicator equipment. Check to see if the reading on the indicator dials correspond to that indicated on the synchro amplifier.
- If it does not, deenergize the indicator, remove the cover and servo and dial assembly, re-energize, and let the servo drive to null.
- Measure the voltages across the R1, R2 terminals of the 1X control transformer and 36X control transformer. They should be 2.5v (plus or minus 0.1v) and 100mv maximum, respectively. These measurements are obtained on a voltmeter with an a-c sensitivity of 1000 ohms per volt. With a clean soft lint-free cloth or plastic against the accessible teeth of the gear train, rotate the gears to drive the servo off null. It should return to null smoothly, without evidence of friction or binding. If the gear train functions properly, but the voltages are out of line, the electrical zero adjustment is at fault.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ADJUSTMENT (Cont)

d. Before proceeding with the zeroing of the synchros, observe that the indicator returns to rest promptly after being driven off null. If the indicator response is sluggish or oscillatory, adjust damping rheostat R6 for rapid response with up to four overshoots.

e. Connect the indicator to a two-speed synchro data source and connect power to proper terminals. Set the 1X and 36X synchro data source to null position.

f. Remove power from the indicator and loosen the clamps holding both single and 36X speed synchros in the unit. Remove the R1 lead from the 36X speed synchro (B02).

g. Turn power back ON and let the unit drive to a null on the one-speed data only.

h. If the servo oscillates adjust the damping control (R6) on the amplifier to correct this condition.

i. Rotate the single speed synchro stator allowing the servo to follow until the zero of the inner dial is aligned with ± 1.0 degrees with the zero of the outer dial. Clamp B01 stator while maintaining alignment. Turn power OFF. Replace the R1 lead on 36X speed synchro and remove the R1 lead from the one-speed synchro.

j. Turn power back ON and let the servo drive to null on the 36X speed data only. It may be necessary to adjust the damping control (R6) to eliminate dial oscillations.

k. Rotate the 36X speed synchro stator until the zeros of the inner and outer dials are aligned within ± 0.1 degree. Clamp the synchro stator while maintaining this alignment. Replace R1 lead to the 1X synchro.

7. System Damping.

a. If a synchro is removed for test or is replaced, zero it to the indicator dial zero by means of the preceding procedure. To complete the alignment, you will need a signal input to the indicator from a source of synchro data that can be held fixed at one angle while you check a synchro and that can be changed to another angle while you observe the indicator in operation. You will also need a source of power to energize the amplifier and servomotor if the indicator is a servo type. BE SURE TO USE POWER OF THE PROPER FREQUENCY.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTION (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL-ADJUSTMENT (Cont)

b. Connect the indicator to a source of 115-volt 400-cps power and connect the 2.5 volt secondary (amplifier terminals A1-12 and A1-13) in series with the R leads of the one-speed synchro. Complete the zeroing of the synchros of the indicator by following the procedure of OP 1303 while this anti-stickoff voltage is applied. With the synchros in their zeroed positions, set the synchro data source accurately to zero, and observe that the indicator synchros do not move, and that the control field (amplifier terminals 2 and 4) of the servo-motor is below 2-volts rms.

RESISTANCE DATA FOR ROTATING COMPONENTS.

Winding Resistance (Ohms)		400 Cps Synchro
Stator	(S1 - S2)	838
	(S2 - S3)	838
	(S3 - S1)	838
Rotor	(R1-R2)	413
Winding Resistance (Ohms)		400-cps Servomotor
Fixed Phase	1-3	120
	Control Phase	
	2-5	60
	4-6	60

c. Observe that the indicator smoothly follows rotation of the J synchro data source. Return the data source to zero, de-energize the servo amplifier, rotate the data source to 180 degrees, reenergize the servo and observe that the indicator dial moves to its new position with up to four overshoots. If the dial overshoots its final position more than four times, adjust the damping control. If the dial does not overshoot, clean the gear train and adjust the damping control.

5-118. PUMP SETS - MAINTENANCE INSTRUCTIONS.

The following is an index to the Pump Sets maintenance procedures.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Fire Pump	5-119
Fire Pump Motor	5-120
Fire Pump Controller	5-121
Bilge Pump	5-122
Lube Oil Pump Motor	5-123
Lube Oil Pump Controller	5-124
Fresh Water Pump Motor	5-125
Fresh Water Pump Controller	5-126
Air Conditioning Water Circulation Pump Motor	5-127
Air Conditioning Water Circulation Pump Controller	5-128
Diesel Oil Cooling Pump Motor	5-129

5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

4-8 Fire Pump Organizational
Maintenance Procedures

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

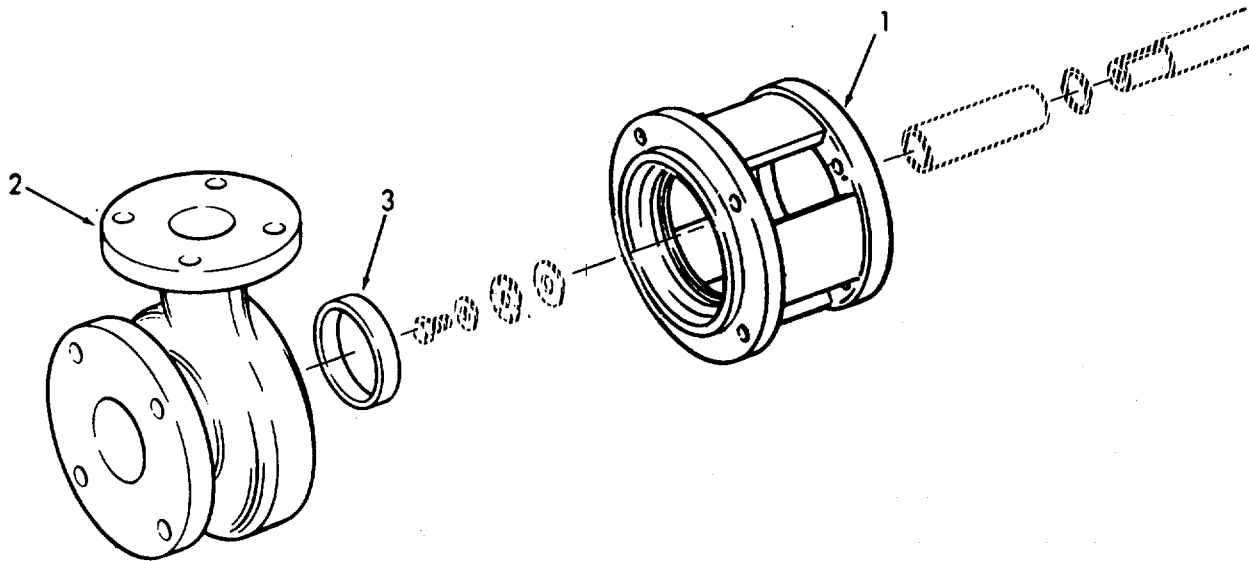
NONE

5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

1. Fire Pump	a. Pump	Remove and disassemble.	Refer to paragraph 4-8.
	b. Adapter (1)	Repair in accordance with standard procedures.	
	c. Pump Casing (2)	1. Press out casing wear ring (3).	Discard.
		2. Install new wear ring (3).	Repair in accordance with standard procedures.
	d. Pump	Reassemble.	Refer to paragraph 4-8.



5-120. FIRE PUMP MOTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

Paragraph

4-8 Fire Pump Motor

Special Tools

NONE

Equipment

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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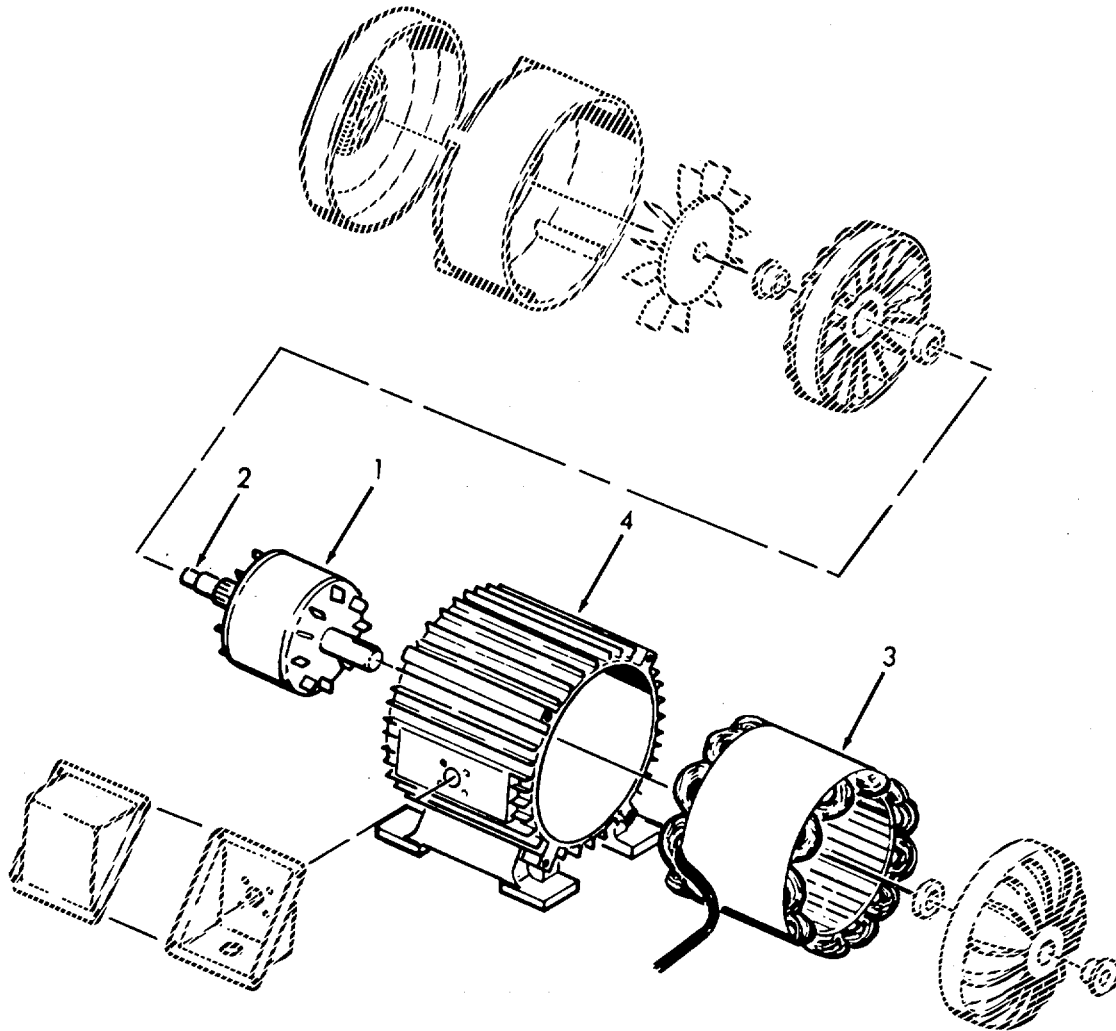
REPAIR

- | | | | |
|----------|---------------------------|--------------------|--|
| 1. Motor | a. Rotor
(1) | Repair or replace. | |
| | b. Shaft
(2) | Repair or replace. | |
| | c. Stator
core
(3) | Repair or replace. | |
| | d. Stator
frame
(4) | Repair or replace. | |

5-120. FIRE PUMP MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



5-121. FIRE PUMP CONTROLLER - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance procedures of the major internal components.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Contactator	5-121.1
Starter	5-121.2
M Type Relay	5-121.3

5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS.

This task covers:

REPAIR

INITIAL SETUP

Test Equipment

NONE

References

Paragraph

4-8.4 Fire Pump Controller
Maintenance Instructions

Special Tools

NONE

Equipment

Condition Condition Description

NONE

Material/Parts

Renewal set contacts
6-25-2

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNING in this procedure.

5-121.1 CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

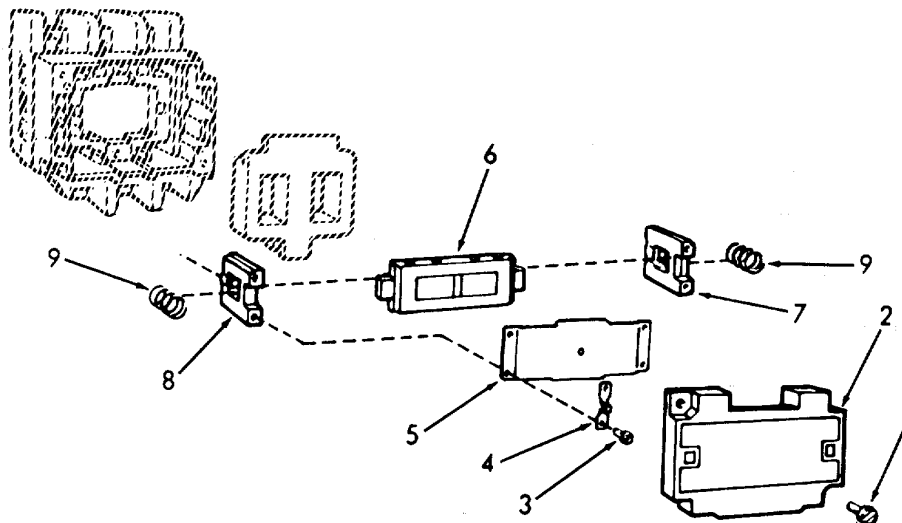
LOCATION	ITEM	ACTION	REMARKS
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WARNING

To prevent accidental shock and possible injury, tag and place disconnect switch in the OFF position, and pull fuses as an added precaution.

REPAIR

- | | | | |
|-------------------|---|---------|----------------------------------|
| 1. Operating Coil | a. Two screws (1), and cover (2) | Remove. | |
| | b. Four screws (3), two indicating plates (4), and clamp plate (5) | Remove. | |
| | c. Armature (6), right pushbar (7), left pushbar (8), and springs (9) | Remove. | There is no need to disassemble. |



5-121.1 CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

	d. Coil (10)	Pull straight out.	
--	--------------	--------------------	--

NOTE

If the magnet or armature requires replacement, proceed as follows (if not proceed to step f.).

	e. Magnet frame clamp (11), magnet frame (12), and spring (13)	Replace.	Replace armature (6), and magnet frame (12) as an assembly.
--	--	----------	---

	f. Coil (10)	Install new coil with terminal blades engaging the coil terminal clips .	
--	--------------	--	--

	g. Armature (6), right pushbar (7) , left pushbar (8), and springs (9)	Install narrow end to the left into its seated operating position.	
--	--	--	--

	h. Clamp plate (5), indicating plates (4), and screws (3)	Install.	
--	---	----------	--

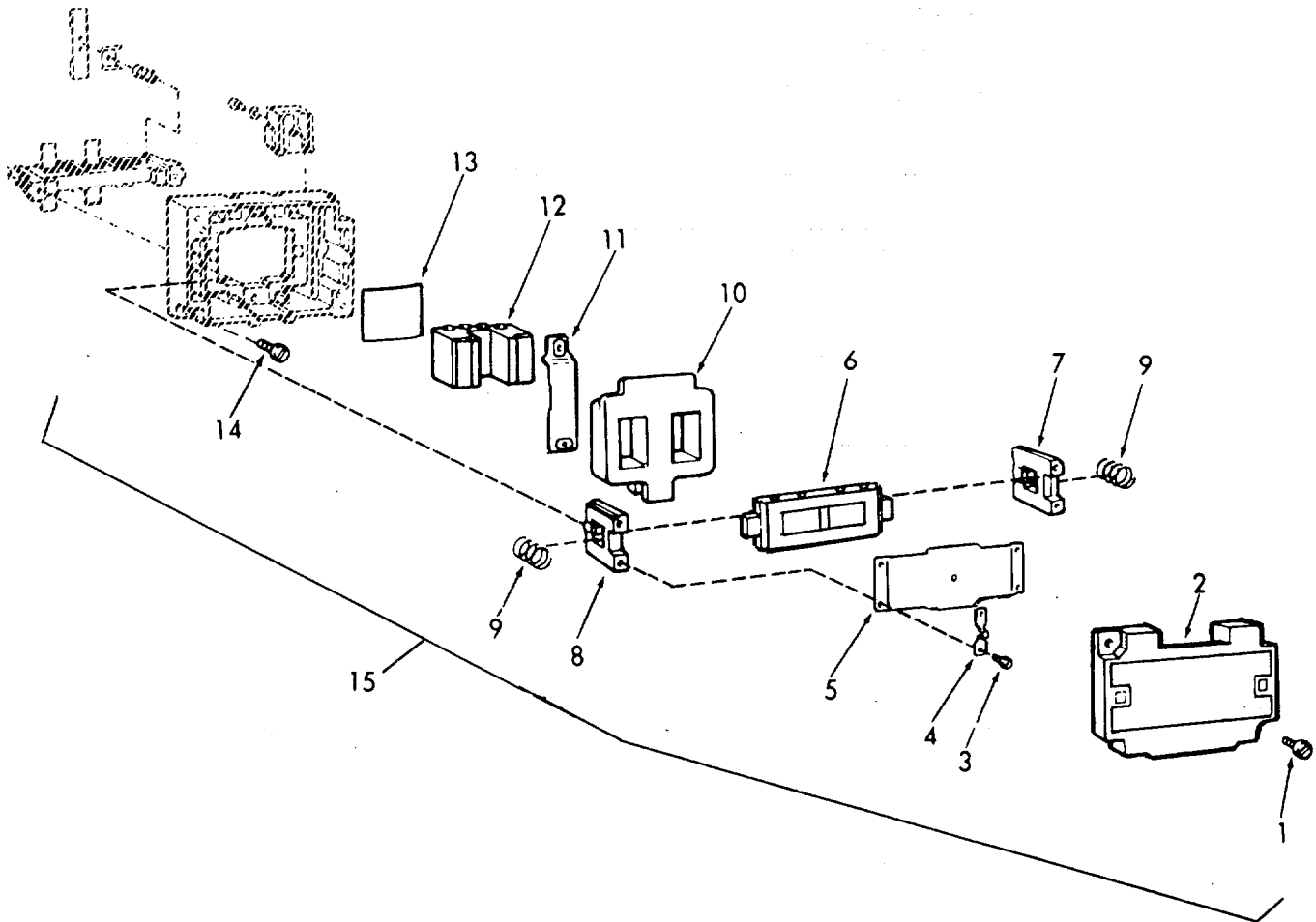
	i. Cover (2) and screws (1)	Install.	
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5-121.1 CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|---------------|--------------------|-------------------|--------------------------------|
| 2. Power Unit | a. Two screws (14) | Remove. | These screws are gold colored. |
| | b. Power unit (15) | Pull out. | |
| | c. Power unit (15) | Plug in new unit. | |
| | d. Screws (14) | Install. | |



5-121.1 CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

NOTE

It is advisable to replace the stationary contacts when the power unit is replaced.

3. Stationary Contacts	a. Six screws (16), and lugs (17)	Remove.	
	b. Two screws (18), terminal clamps (19), and control terminals (20)	Remove.	
	c. Two screws (21), and one screw (22)	Remove three per contact total 18 screws.	Discard screws.
	d. Six stationary contacts (23), and terminal plates (24)	Remove.	Discard stationary contacts.
	e. Six terminal plates (24), six stationary contacts (23), and screws (21 and 22)	Replace.	Use new stationary contacts and screws.

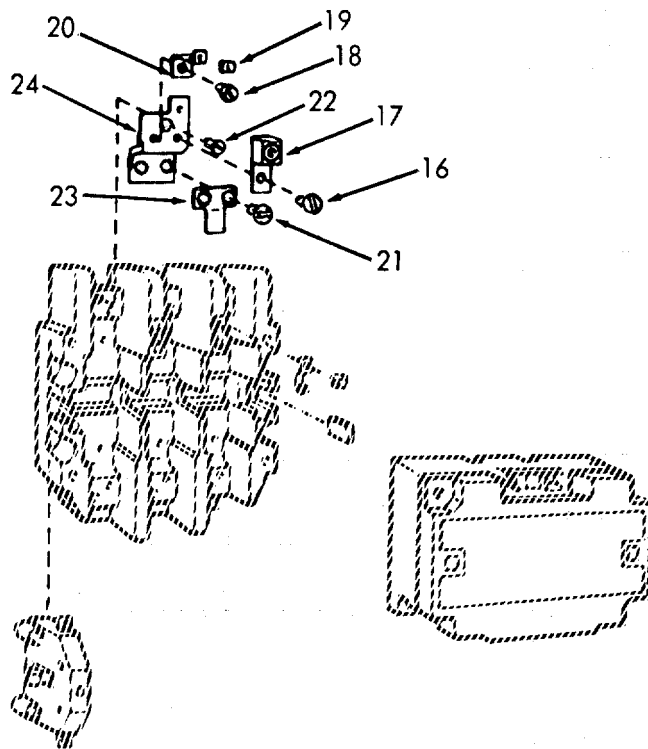
5-121.1 CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

f.	Two control terminals (20), terminal clamps (19), and screws (18)	Replace.	
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g.	Six lugs (17), and screws (16)	Replace.	
----	--------------------------------	----------	--



5-121.1 CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

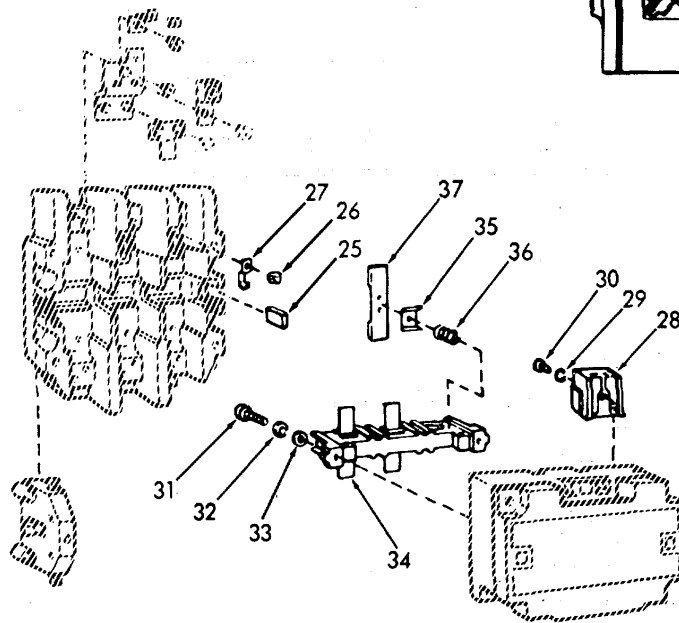
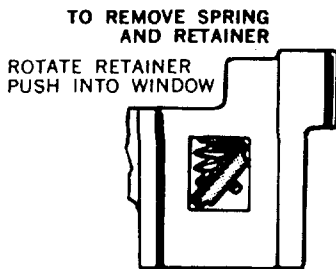
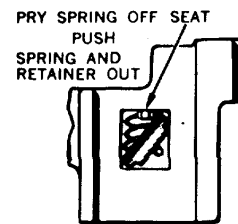
4. Miscellaneous	a. Insulator (25)	Replace.	If necessary.
	b. Two terminal clamps (26), and coil terminal clips (27)	Replace.	If necessary.
	c. Six screws (28), lock-washers (29), and blowouts (30)	Replace.	If necessary.
5. Movable Contacts	a. Four screws (31), lock-washers (32), and flat-washers (33)	Remove.	
	b. Contact bar (34)	Remove.	
	c. Retainer (35), spring (36) and movable contact (37)	<ol style="list-style-type: none"> 1. Raise retainer against spring (36) to free the movable contact (37). 2. Rotate retainer into position shown. 	Movable contact will drop out.

5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC)-MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)			
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- | | | | |
|--|--|--|--|
| | | 3. Push it into window to hold it. | |
| | | 4. Lift spring (36) off the seat with a small screwdriver. | |
| | | 5. Push spring (36), and retainer (35) thru the window. | Discard spring, retainer, and movable contact. |



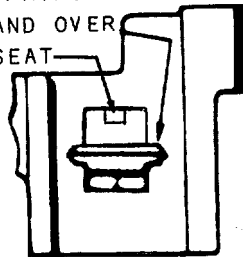
5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC)-MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)			
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- | | | | |
|--|--|---|--|
| | | 6. Place and hold retainer (35), in the position shown. | Use new spring, retainer, and movable contact. |
|--|--|---|--|

INSERT COMPRESSED
SPRING HERE
AND OVER
SEAT



- | | | | |
|--|--|---|--|
| | | 7. Compress spring (36) with thumb and index finger, and insert and seat in the cavity above the retainer (35). | |
| | | 8. Raise the retainer (35) against the spring (36), insert and position the movable contact (37). | Contact tips must face away from the retainer. |

- | | | | |
|----|--|----------|--|
| d. | Contact bar (34), screws (31), lock-washers (32) and flat-washers (33) | Install. | |
|----|--|----------|--|

5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC)-MAINTENANCE
INSTRUCTIONS (Continued).

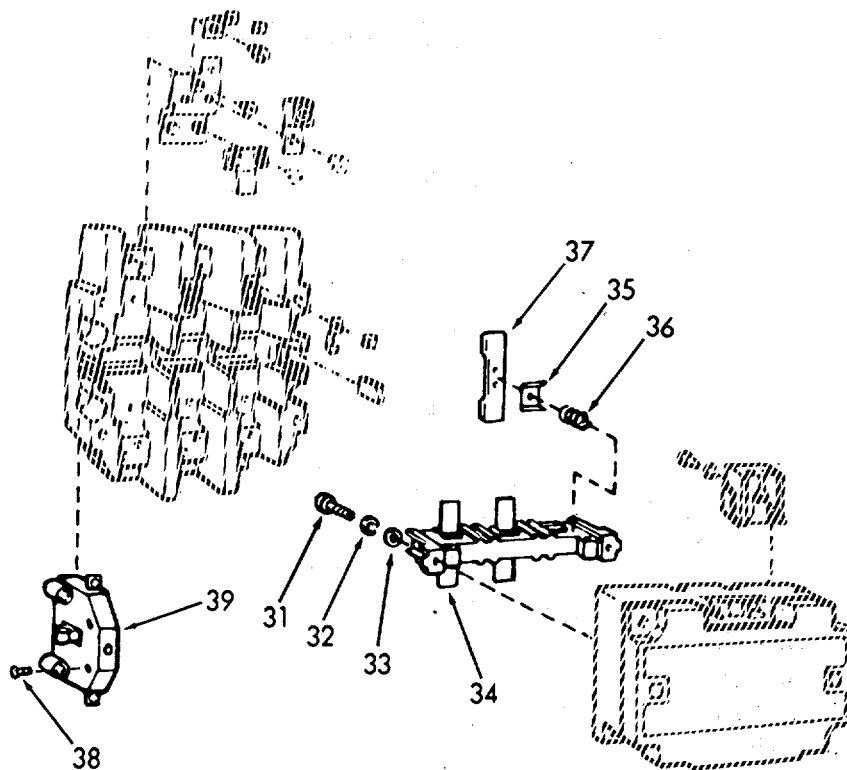
LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

NOTE

The contact bar is not reversible. Match the ends of the contact bar to fit the raised projections on the push bars.

- | | | | |
|----|-----------|-------------------|---------------------|
| 6. | Interlock | a. Screws (38) | Remove. |
| | | b. Interlock (39) | Remove and replace. |
| | | c. Screws (38) | Replace. |



5-1353/(5-1354 blank)

5-121.2. CONTACTOR (NEMA SIZE 3, 3 POLE REVERSING)-MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

Paragraph

- 4-8.1 Contactor
- 4-8.4 Fire Pump Controller

Special Tools

NONE

Equipment

Condition Condition Description

NONE

Material/Parts

Renewal set contacts
6-25-2

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNING in this procedure.

LOCATION

ITEM

ACTION

REMARKS

WARNING

To prevent accidental shock and possible injury, tag and place disconnect switch in the OFF position, and pull fuses as an added precaution.

REPAIR

NOTE

This starter is similar to the contactor in paragraph 4-8.1. The power unit in this starter is identical to the power unit in contactor in paragraph 4-8.1.

5-121.2. CONTACTOR (NEMA SIZE 3, 3 POLE REVERSING)-MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

1.	Power Unit (1)	a. Two screws	Remove.	These screws are gold colored.
		b. Power unit (2)	Pull out.	
		c. Power unit (2)	Plug in new unit.	
		d. Screws (1)	Install.	

NOTE

It is advisable to replace the stationary contacts when the power unit is replaced.

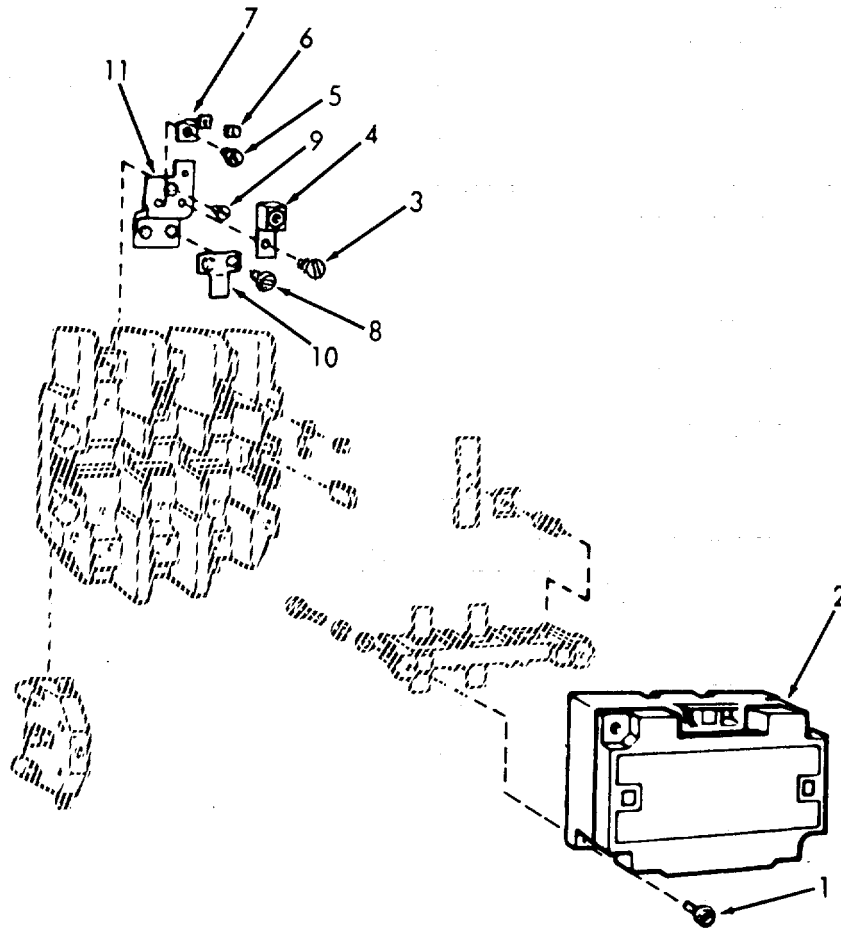
2.	Stationary Contacts	a. Six screws (3), and lugs (4)	Remove.	
		b. Two screws (5), terminal clamps (6), and control terminals (7)	Remove.	
		c. Two screws (8), and one screw (9)	Remove three per contact; total 18 screws.	Discard screws.
		d. Six stationary contacts (10), and terminal plates	Remove.	Discard stationary contacts.

5-121.2. CONTACTOR (NEMA SIZE 3, 3 POLE REVERSING)-MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)			
---------------	--	--	--

e.	Six terminal plates (11), six stationary contacts (10), and screws (8 and 9)	Replace.	Use new stationary contacts and screws.
----	--	----------	---



5-121.2. CONTACTOR (NEMA SIZE 3, 3 POLE REVERSING)-MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

	f. Two contact terminals (7), terminal clamps (6), and screws (5)	Replace.		
	g. Six lugs (4), and screws (3)	Replace.		
3.	Miscellaneous	a. Insulator (12)	Replace.	If necessary.
		b. Two terminal clamps (13), and coil terminal clips (14)	Replace.	If necessary.
4.	Movable Contacts	a. Four screws (15), lockwasher (16), and flatwasher (17)	Remove.	
		b. Contact bar (18)	Remove.	

5-121.2. CONTACTOR (NEMA SIZE 3, 3 POLE REVERSING)-MAINTENANCE
INSTRUCTIONS (Continued).

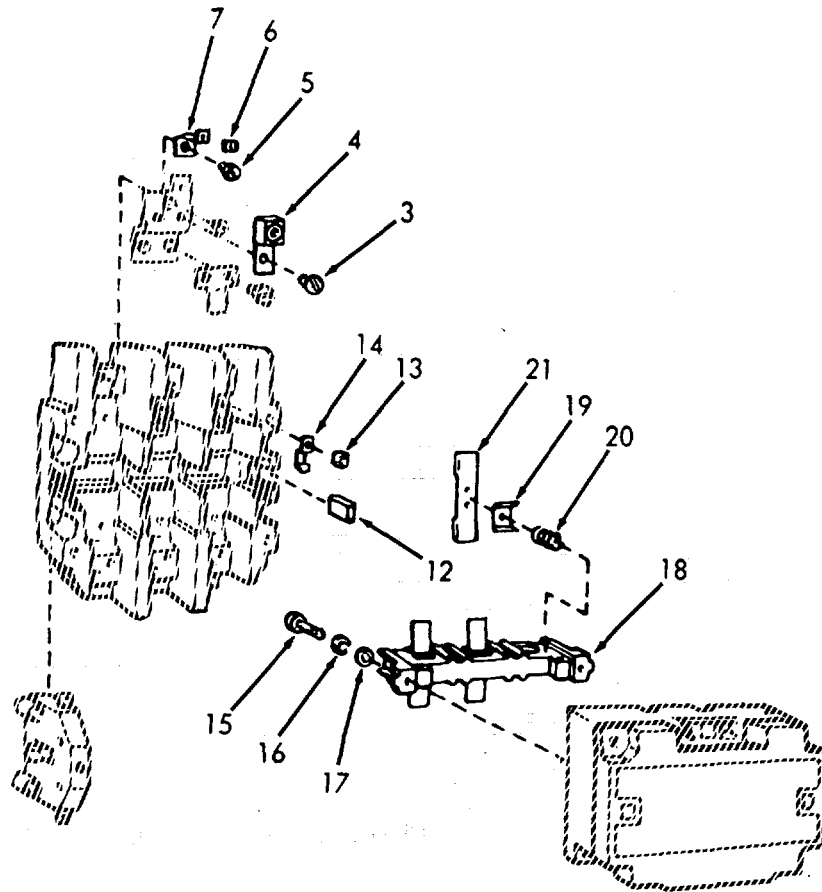
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)			
---------------	--	--	--

c.	Retainer (19), spring (20) and movable contact (21)		
----	---	--	--

1.	Raise retainer against spring to free the movable contact.		
----	--	--	--

			Movable contact will drop out.
--	--	--	--------------------------------

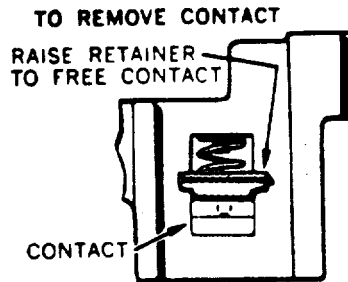


5-121.2. CONTACTOR (NEMA SIZE 3, 3 POLE REVERSING)-MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

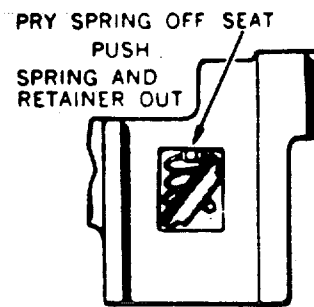
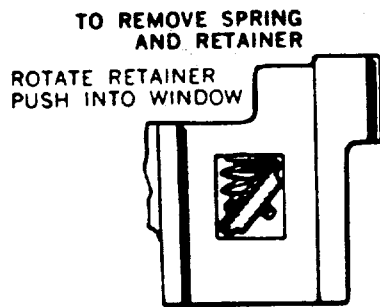
REPAIR (Cont)

2. Rotate retainer into position shown.



3. Push it into window to hold it.
4. Lift spring (20) off the seat with a small screwdriver.
5. Push spring (20), and retainer (19) thru the window.

Discard spring, retainer, and movable contact.



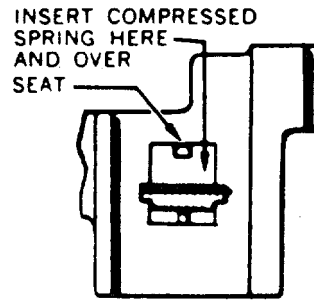
6. Place and hold the retainer (19) in the position shown.

Use new spring, retainer, and movable contact.

5-121.2. CONTACTOR (NEMA SIZE 3, 3 POLE REVERSING)-MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

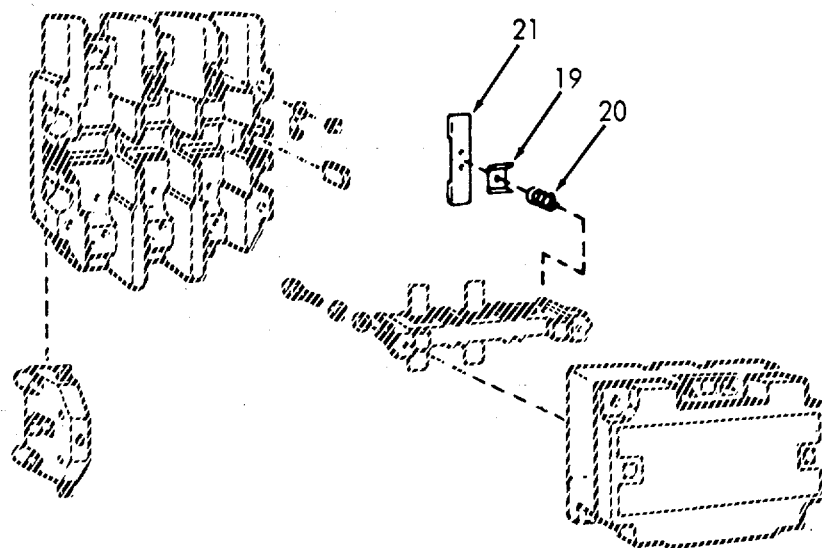
REPAIR (Cont)



7. Compress spring (20) with thumb and index finger, and insert and seat in the cavity above the retainer (19).

8. Raise the retainer (19) against the spring (20), insert and position the movable contact (21).

Contact tips must face away from retainer.



5-121.2. CONTACTOR (NEMA SIZE 3, 3 POLE AC)-MAINTENANCE
INSTRUCTIONS (Continued).

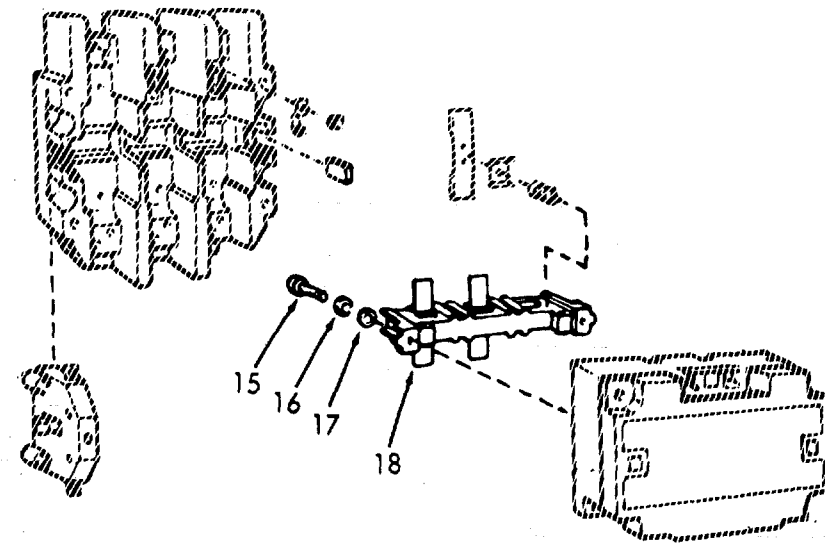
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)			
---------------	--	--	--

d.	Contact bar (18), screws (15), lock-washers (16), and flat-washers (17)	Install.	
----	---	----------	--

NOTE

The contact bar is not reversible. Match the ends of the contact bar to fit the raised projections on the push bars.



5-121.3. "M" TYPE RELAY-MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNING in this procedure.

LOCATION

ITEM

ACTION

REMARKS

WARNING

To prevent accidental shock and possible injury, tag and place disconnect switch in the OFF position, and pull fuses as an added precaution.

REPAIR

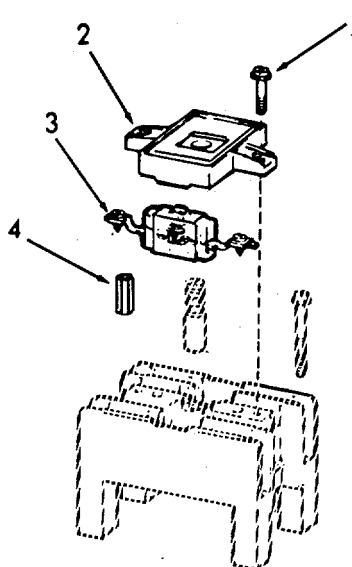
- | | | | | |
|----|----------|----|-------------------------------------|---------|
| 1. | Contacts | a. | Two screws (1), and cover plate (2) | Remove. |
|----|----------|----|-------------------------------------|---------|

5-121.3. "M" TYPE RELAY-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|----|--------------------------------------|------------|--|
| b. | Four contact poles (3) | Remove. | One of the screws on one of the contact poles must be loosened to release it from connector (4). |
| c. | Contact poles (3), and connector (4) | Reinstall. | |
| d. | Cover plate (2), and screws (1) | Replace. | |



5-121.3. "M" TYPE RELAY-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

2. Pushbar

NOTE

The following repair can be performed without removing the cover plate.

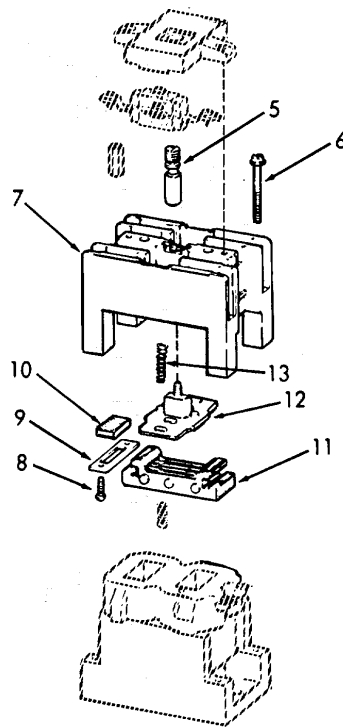
- | | | |
|----|---|------------------------------|
| a. | Manual operator (5) | Unscrew. |
| b. | Four screws (6) | Remove. |
| c. | Rear deck (7) | Lift up carefully to remove. |
| d. | Four screws (8), two magnetic retaining clamps (9), and cushions (10) | Remove. |
| e. | Magnet (11), pushbar (12), and two springs (13) | Remove. |

5-121.3. "M" TYPE RELAY-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | |
|----|---|----------|
| f. | Two springs (13) pushbar (12), and magnet (11) | Install. |
| g. | Two cushions (10), two magnetic retaining clamps (9), and four screws (8) | Install. |

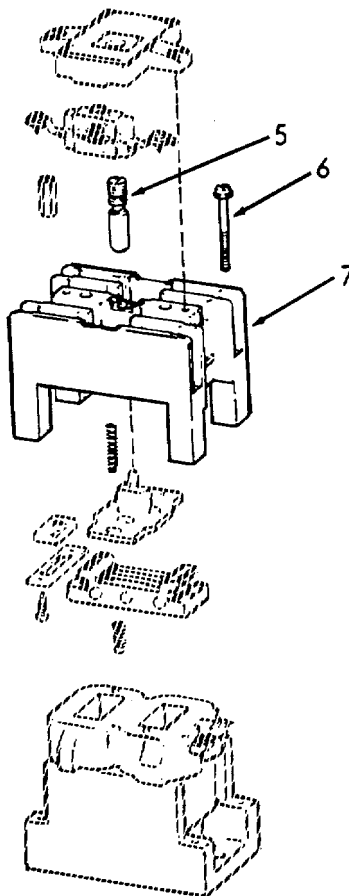


5-121.3. "M" TYPE RELAY-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | |
|----|------------------------------------|----------------------|
| h. | Rear deck (7), and four screws (6) | Install. |
| i. | Manual operator (5) | Screw into push bar. |



5-122. BILGE PUMP-MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

NONE

Personnel Required

2

References

4-9 Bilge Pump

Equipment

<u>Condition</u>	<u>Condition Description</u>
NONE	

NONE

Special Environmental Conditions

NONE

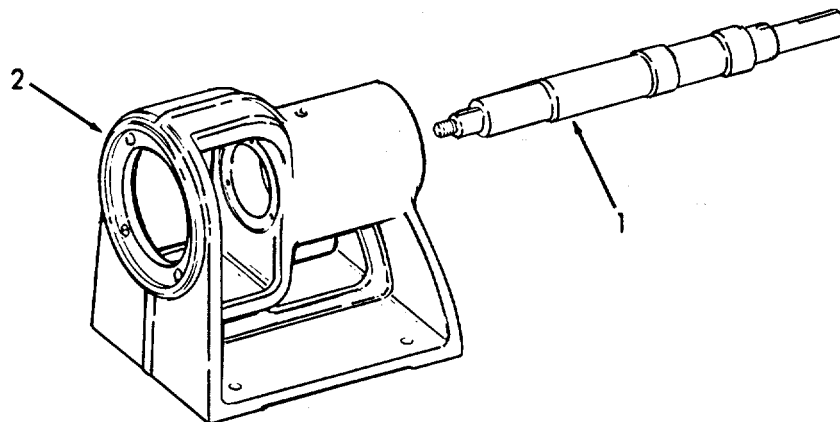
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

OVERHAUL

- | | | | | |
|----|------------|----|----------------------|--------------------|
| 1. | Bilge Pump | a. | Pump shaft (1) | Repair or replace. |
| | | b. | Bilge pump frame (2) | Repair or replace. |



5-1369

5-123. LUBE OIL PUMP MOTOR-MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References

4-10.3 Lube Oil Pump Motor

Special Tools

NONE

Equipment

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

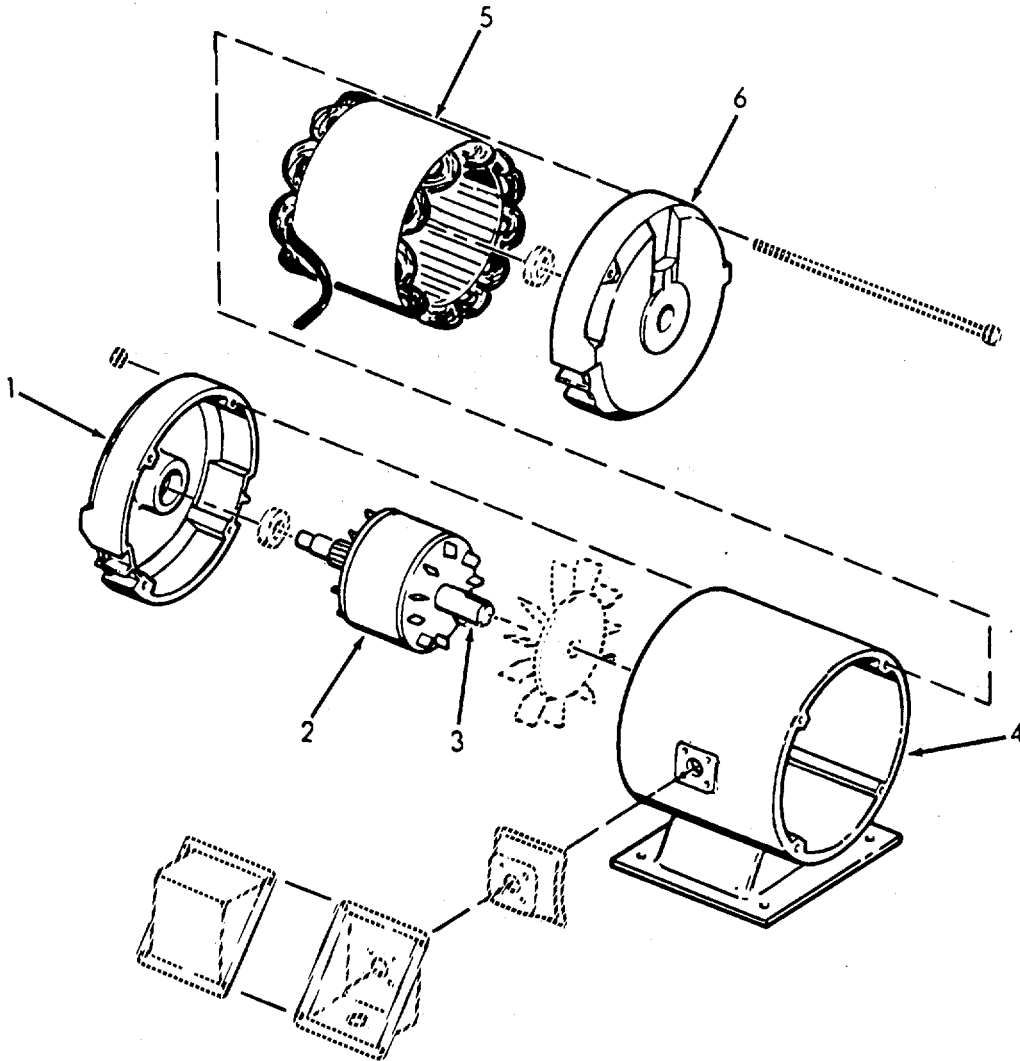
REPAIR

- | | | | | |
|----|-------|----|---------------------|--------------------|
| 1. | Motor | a. | Bracket
(1) | Repair or replace. |
| | | b. | Rotor (2) | Repair or replace. |
| | | c. | Shaft (3) | Repair or replace. |
| | | d. | Stator
frame (4) | Repair or replace. |
| | | e. | Stator
core (5) | Repair or replace. |
| | | f. | Bracket
(6) | Repair or replace. |

5-123. LUBE OIL PUMP MOTOR-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)



5-124. LUBE OIL PUMP CONTROLLER-MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for Controller maintenance instructions.

5-125. FRESH WATER PUMP MOTOR-MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

4-11.3 Fresh Water Pump Motor

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

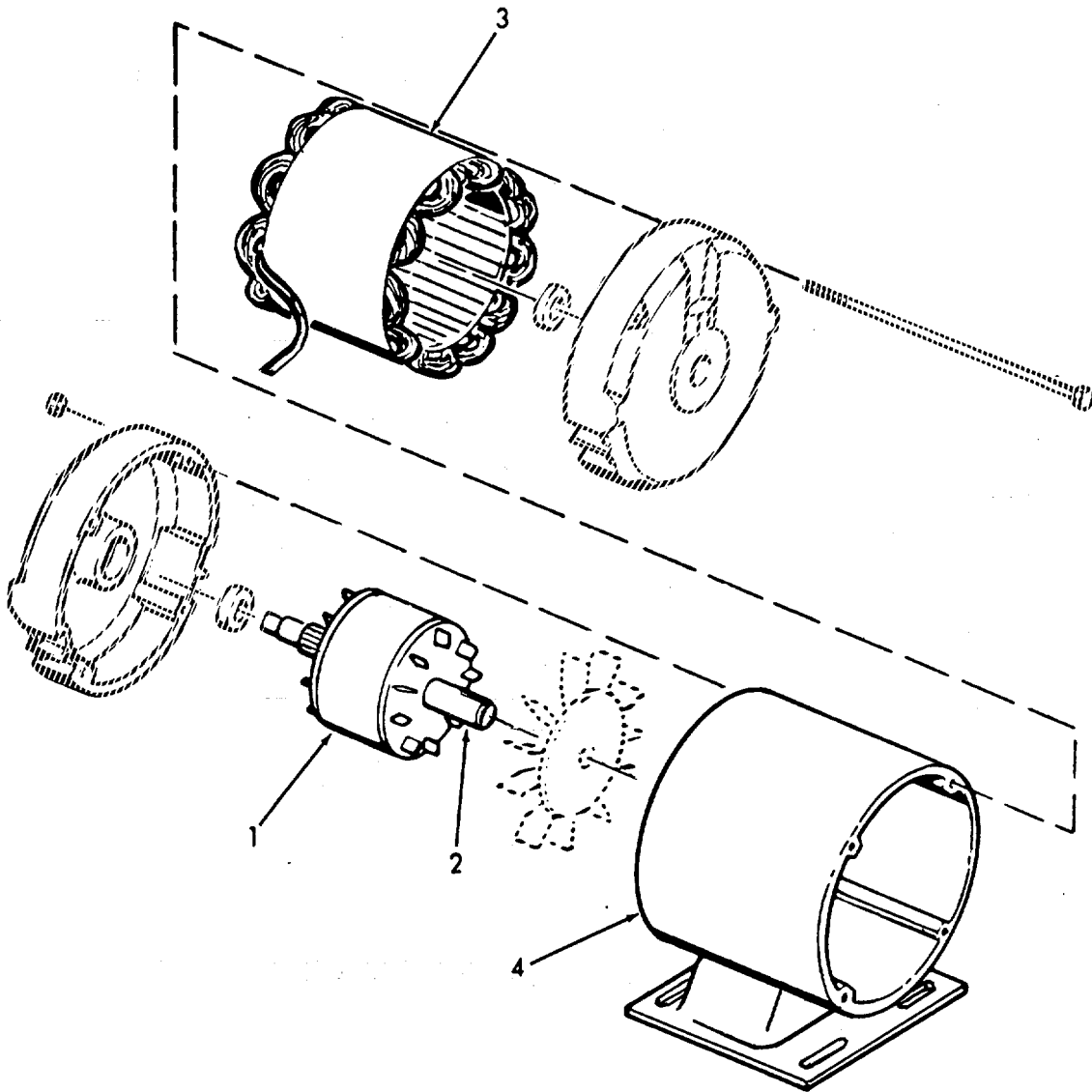
REPAIR

- | | | |
|----------|---------------------|--------------------|
| 1. Motor | a. Rotor (1) | Repair or replace. |
| | b. Shaft (2) | Repair or replace. |
| | c. Stator core (3) | Repair or replace. |
| | d. Stator frame (4) | Repair or replace. |

5-125. FRESH WATER PUMP MOTOR-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)



5-126. FRESH WATER PUMP CONTROLLER-MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for Controller maintenance instructions.

5-127. AIR CONDITIONING WATER CIRCULATION PUMP MOTOR-MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

4-12.3 Air Conditioning Water

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

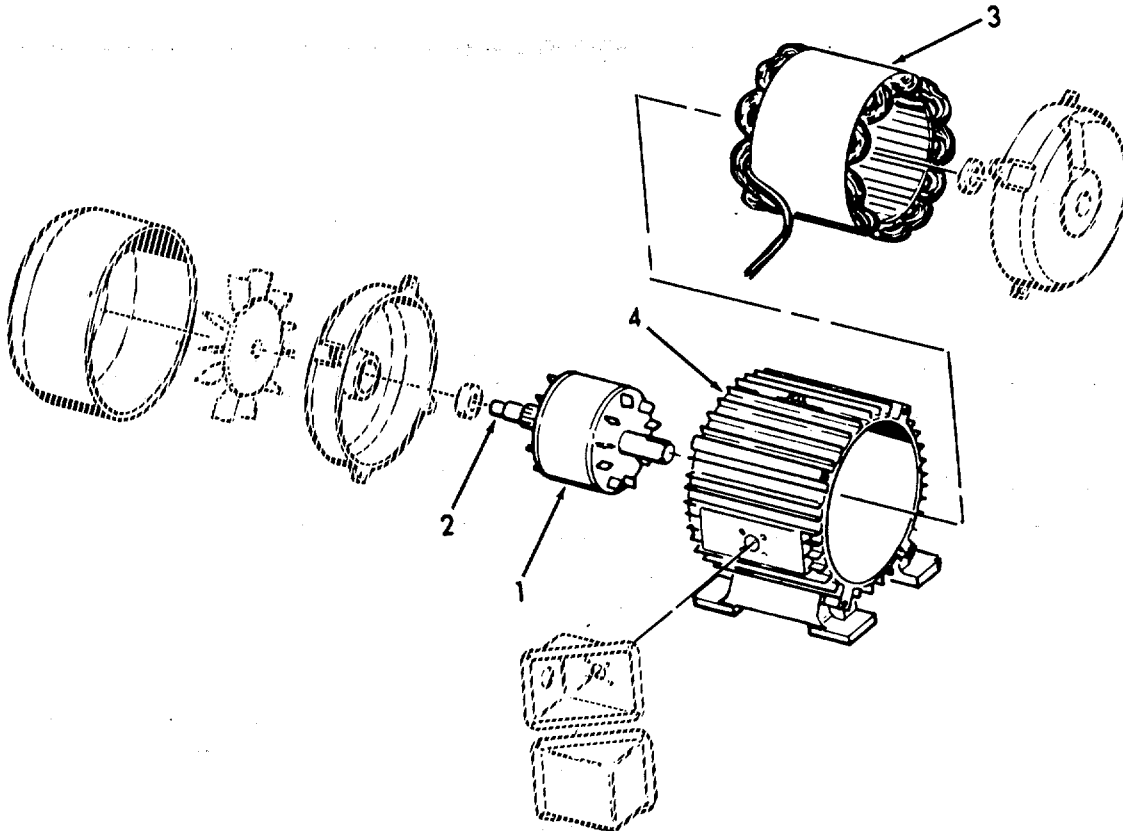
NONE

5-127. AIR CONDITIONING WATER CIRCULATION PUMP MOTOR-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

- | | | |
|----------|---------------------|--------------------|
| 1. Motor | a. Rotor (1) | Repair or replace. |
| | b. Shaft (2) | Repair or replace. |
| | c. Stator core (3) | Repair or replace. |
| | d. Stator frame (4) | Repair or replace. |



5-128. AIR CONDITIONING CIRCULATION PUMP CONTROLLER - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for the Pump Controller maintenance procedures.

5-129. DIESEL OIL COOLING PUMP MOTOR-MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References Paragraph

4-13.3 Diesel Oil Cooling Pump Motor

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

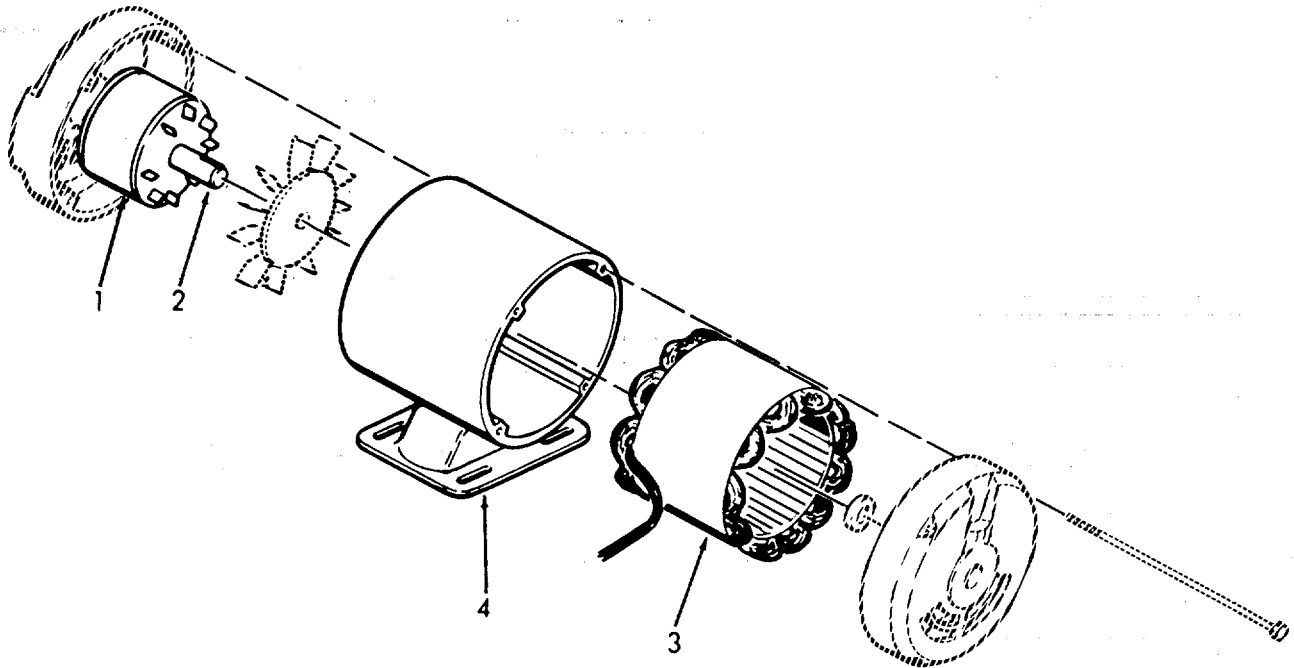
NONE

5-129. DIESEL OIL COOLING PUMP MOTOR-MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

- | | | |
|----------|--------------------------|--------------------|
| 1. Motor | a. Rotor
(1) | Repair or replace. |
| | b. Shaft
(2) | Repair or replace. |
| | c. Stator
core
(3) | Repair or replace. |
| | d. Frame
(4) | Repair or replace. |



5-130. SEWAGE SYSTEM-MAINTENANCE INSTRUCTIONS.

The following is an index to the Sewage System maintenance procedures.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Sewage System Discharge Piping	5-131
Sewage Sanitary Drain Piping	5-132
Sewage Tank	5-133

5-131. SEWAGE SYSTEM DISCHARGE PIPING-MAINTENANCE INSTRUCTIONS.

This task covers:

Repair and Repair

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

NONE

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

5-131. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

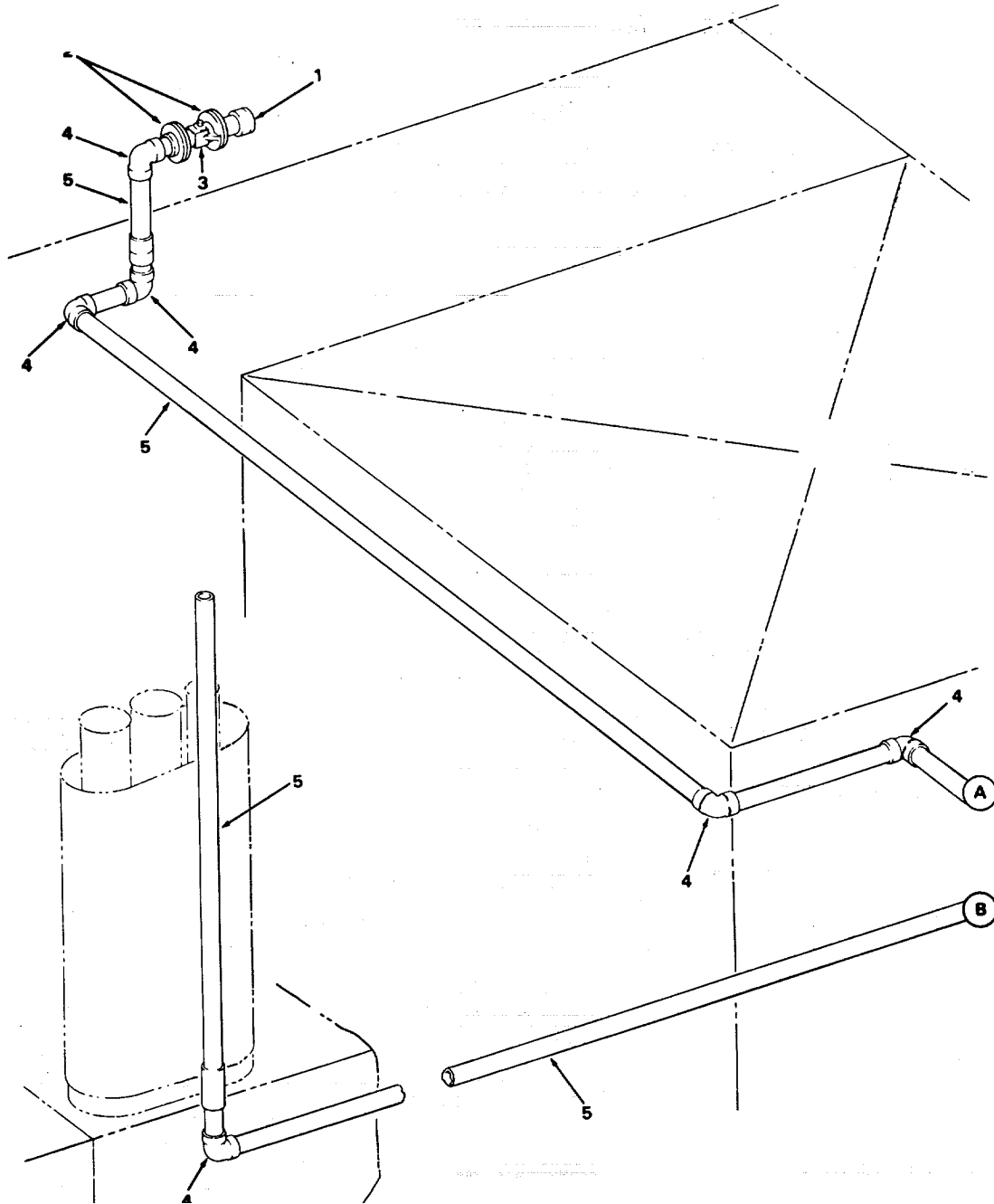
REPLACE AND REPAIR

- | | | | |
|---------------------|----|---|--------------------|
| 1. Discharge Piping | a. | Camlock (1), and bronze flange (2) | Repair or replace. |
| | b. | Ball valve (3), and 90° bronze elbow (4) | Repair or replace. |
| | c. | 90-10 tubing (5), and adapter (6) | Repair or replace. |
| | d. | 90° elbow (7), and swing check valve (8) | Repair or replace. |
| | e. | 1-1/2x2x 1-1/2" tee (9), and 1-1/2" tubing (10) | Repair or replace. |
| | f. | Bronze tee (11), and bronze union (12) | Repair or replace. |
| | g. | Bronze flange (13), ball valve (14), and 45° elbow (15) | Repair or replace. |

5-131. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE AND REPAIR (Cont)

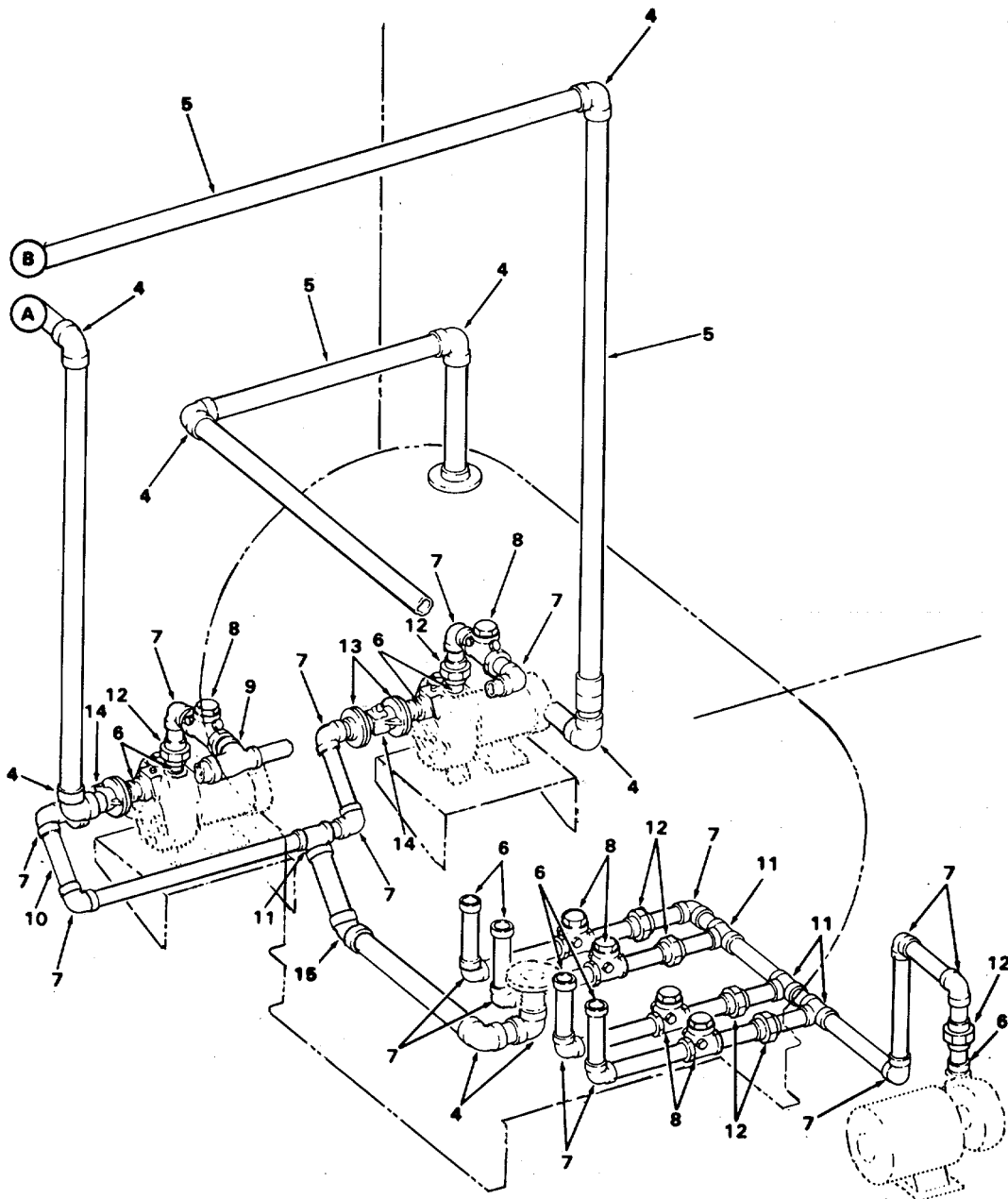


5-1380

5-131. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE AND REPAIR			
--------------------	--	--	--



5-1381

5-132. SEWAGE SANITARY DRAINS PIPING-MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

REPLACE AND REPAIR

- | | | | |
|----|----|--|--------------------|
| 1. | a. | Straight tee (1), 2-1/2" pipe (2), and 2 inch copper-nickel pipe (3) | Repair or replace. |
| | b. | 2" pipe plug (4), adapter (5), and 45° "Y" branch (6) | Repair or replace. |

5-132. SEWAGE SANITARY DRAINS PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE AND REPAIR (Cont)			
	c. Straight tee (7), adapter (8), and straight tee (9)	Repair or replace.	
	d. 1-1/2" copper-nickel pipe straight tee (11), and 90° elbow (12)	Repair or replace.	
	e. Adapter (13), and deck drain with trap (14)	Repair or replace.	
	f. Straight tee (15), and 450 elbow (16)	Repair or replace.	
	g. 45° "Y" branch (17), straight tee (18) and 3" flange (19)	Repair or replace.	

5-132. SEWAGE SANITARY DRAINS PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE AND REPAIR (Cont)			
	h. 3" ball valve (20), 3" pipe (21) and 1-1/4" funnel (22)	Repair or replace.	
	i. 90° elbow (23), and 1-1/4" copper-nickel pipe (24)	Repair or replace.	
	j. 45° elbow (25) 90° elbow (26), and 3"1 flange (27)	Repair or replace.	
	k. Deck drain with trap (28) 900 elbow (29), and bushing (30)	Repair or replace.	

5-132. SEWAGE SANITARY DRAINS PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE AND REPAIR (Cont)

- | | |
|---|--------------------|
| l. Flange (31), and scupper valve with control (32) | Repair or replace. |
| m. Slip-on flange (33), and tee (34) | |
| n. Scupper valve with control (35), flange (36), and bushing (37) | Repair or replace. |
| o. Flange (38), ball valve (39), and 4 inch copper-nickel pipe (40) | Repair or replace. |

5-132. SEWAGE SANITARY DRAINS PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE AND REPAIR (Cont)

- | | | | |
|----|---|--------------------|--|
| p. | Reducer coupling (41), pipe plug (42), and bushing (43) | Repair or replace. | |
| q. | 3" sweep tee (44), 90° long radius elbow (45) , and 3" long turn sweep tee (46) | Repair or replace. | |
| r. | 3 " flange (47), 90 11 reducing elbow (48), and 45° elbow (49) | Repair or replace. | |
| s. | 2" copper-nickel pipe (50), and 90 ° elbow (51) | Repair or replace. | |

5-132. SEWAGE SANITARY DRAINS PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE AND REPAIR (Cont)

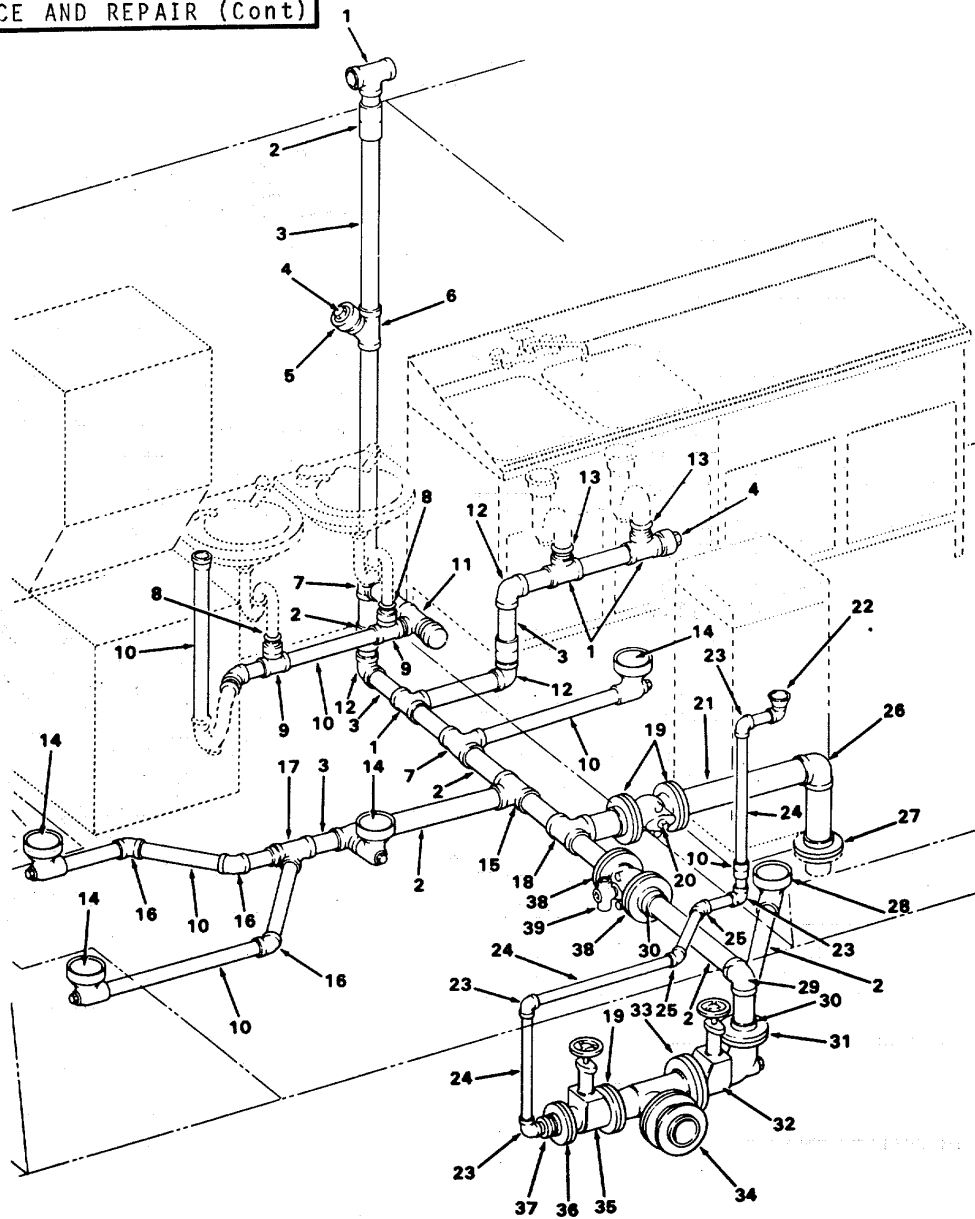
- | | | | |
|----|---|--------------------|--|
| t. | 1-1/4" copper-nickel pipe (52), and 900 reducing elbow (53) | Repair or replace. | |
| u. | 2" double sweep tee (54), and 2" adapter (55) | Repair or replace. | |
| v. | 2" ball valve (56), and 1-14" check valve (57) | Repair or replace. | |
| w | Scupper valve with control (58), and 90° long radius elbow (59) | Repair or replace. | |

5-132. SEWAGE SANITARY DRAINS PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE AND REPAIR (Cont)			
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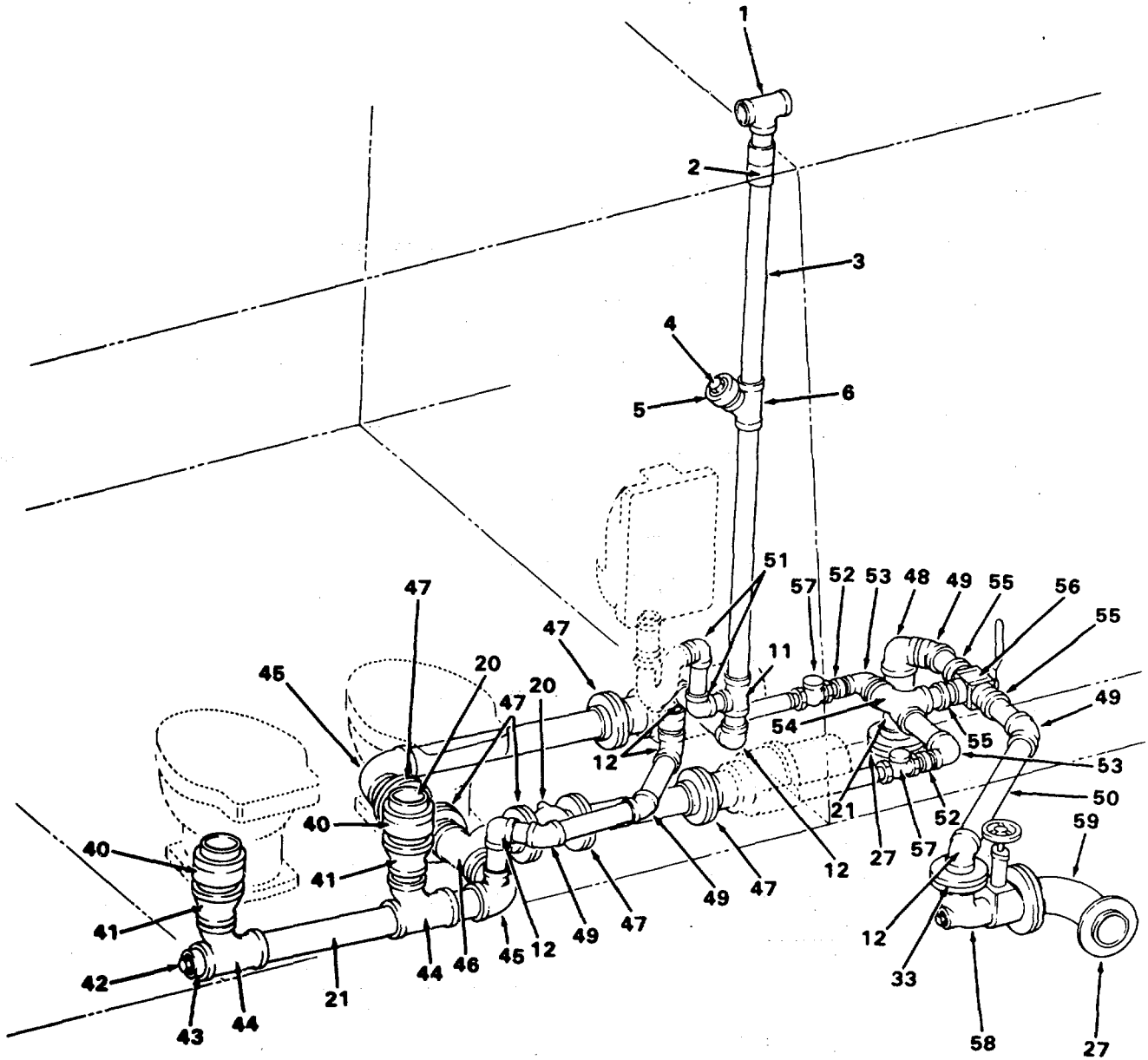
REPLACE AND REPAIR (Cont)			
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5-132. SEWAGE SANITARY DRAINS PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE AND REPAIR (Cont)			
---------------------------	--	--	--



5-133. SEWAGE TANK - MAINTENANCE INSTRUCTIONS

This task covers:

Replace

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
1

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE

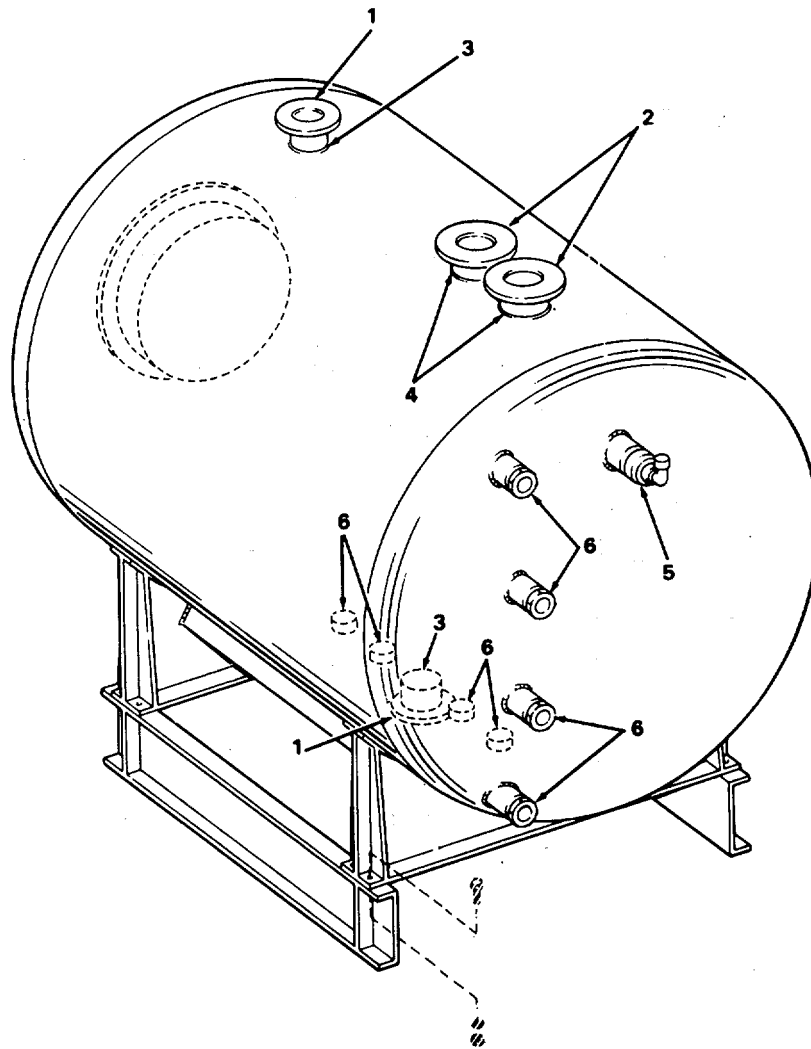
- | | | | |
|----------------|---|--------------------|--|
| 1. Sewage Tank | a. 4 inch stainless slip on flange (1) | Repair or replace. | |
| | b. 3 inch stainless slip on flange (2) | Repair or replace. | |
| | c. 2 inch stainless pipe (3) | Repair or replace. | |

5-133. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE (Cont)

- | | | | |
|----|-------------------------------|--------------------|--|
| d. | 3 inch stainless pipe (4) | Repair or replace. | |
| e. | 2 inch stainless coupling (5) | Repair or replace. | |
| f. | 1-1/2 inch | Repair or replace. | |



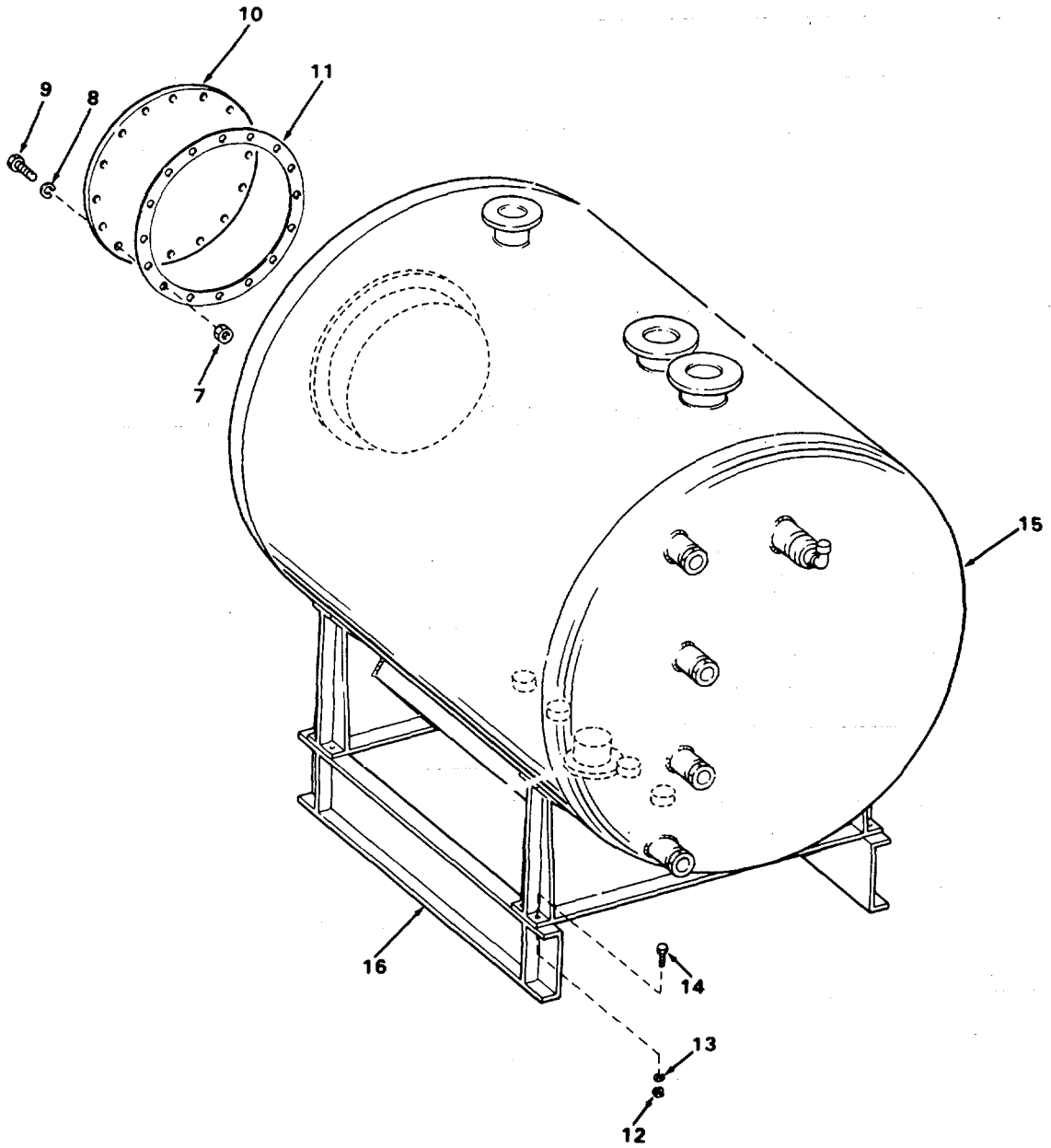
5-133. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	g. Plain hex nut (7), and lock-washer (8)	Repair or replace.	
	h. Hex head capscrew (9), and 19-1/2 inch OD stainless plate (10)	Repair or replace.	
	i. Rubber gasket (11), and plain hex nut (12)	Repair or replace.	
	j. Lockwasher (13), and hex head capscrew (14)	Repair or replace.	
	k. Sewage tank (15)	Repair or replace.	
	l. Tank support (16)	Repair or replace.	

5-133. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACE (Cont)



5-134. HEATING, VENTILATION AND AIR CONDITIONING SYSTEM.

The following is an index to the HVAC System maintenance procedures.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Recirculating Fan Controller	5-135
Recirculating Fan Motor	5-136
HYAC Ducting	5-137
Exhaust Fan Controller	5-138
Exhaust Fan Motor	5-139
Compressor	5-140
Compressor Motor	5-141
Compressor Controller	5-142

5-135. RECIRCULATING FAN CONTROLLER - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for Controller maintenance instructions.

5-136. RECIRCULATING FAN MOTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
1

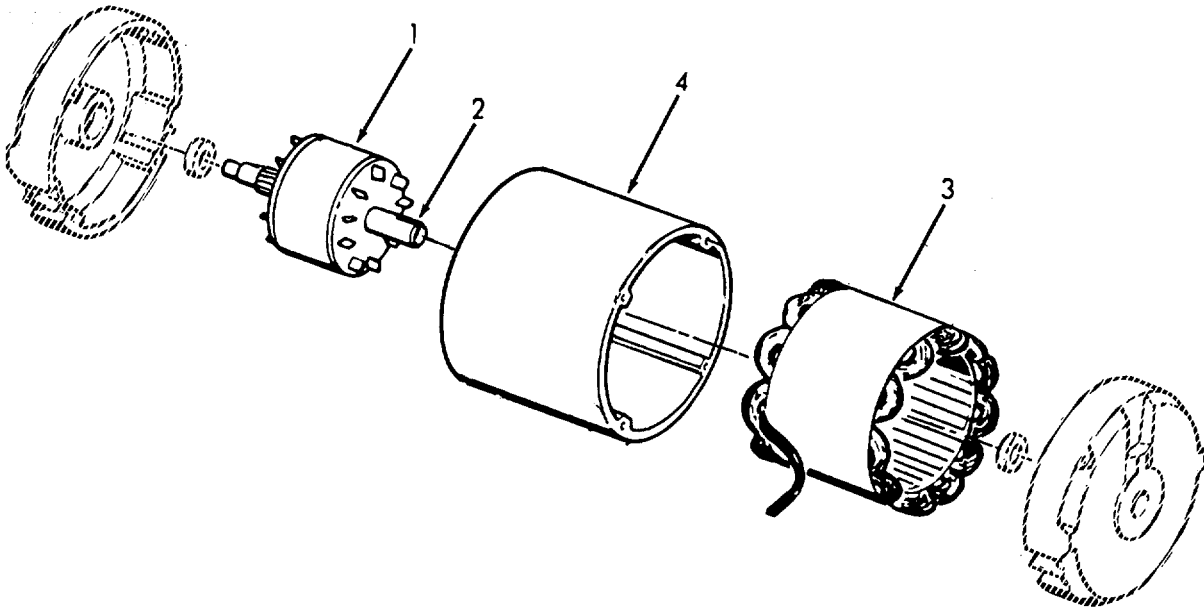
General Safety Instructions
NONE

5-136. RECIRCULATING FAN MOTOR - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

- | | | | |
|----------|------------------------|--------------------|--|
| 1. Motor | a. Rotor assembly (1) | Repair or replace. | |
| | b. Shaft (2) | Repair or replace. | |
| | c. Stator assembly (3) | Repair or replace. | |
| | d. Frame (4) | Repair or replace. | |



5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
1

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
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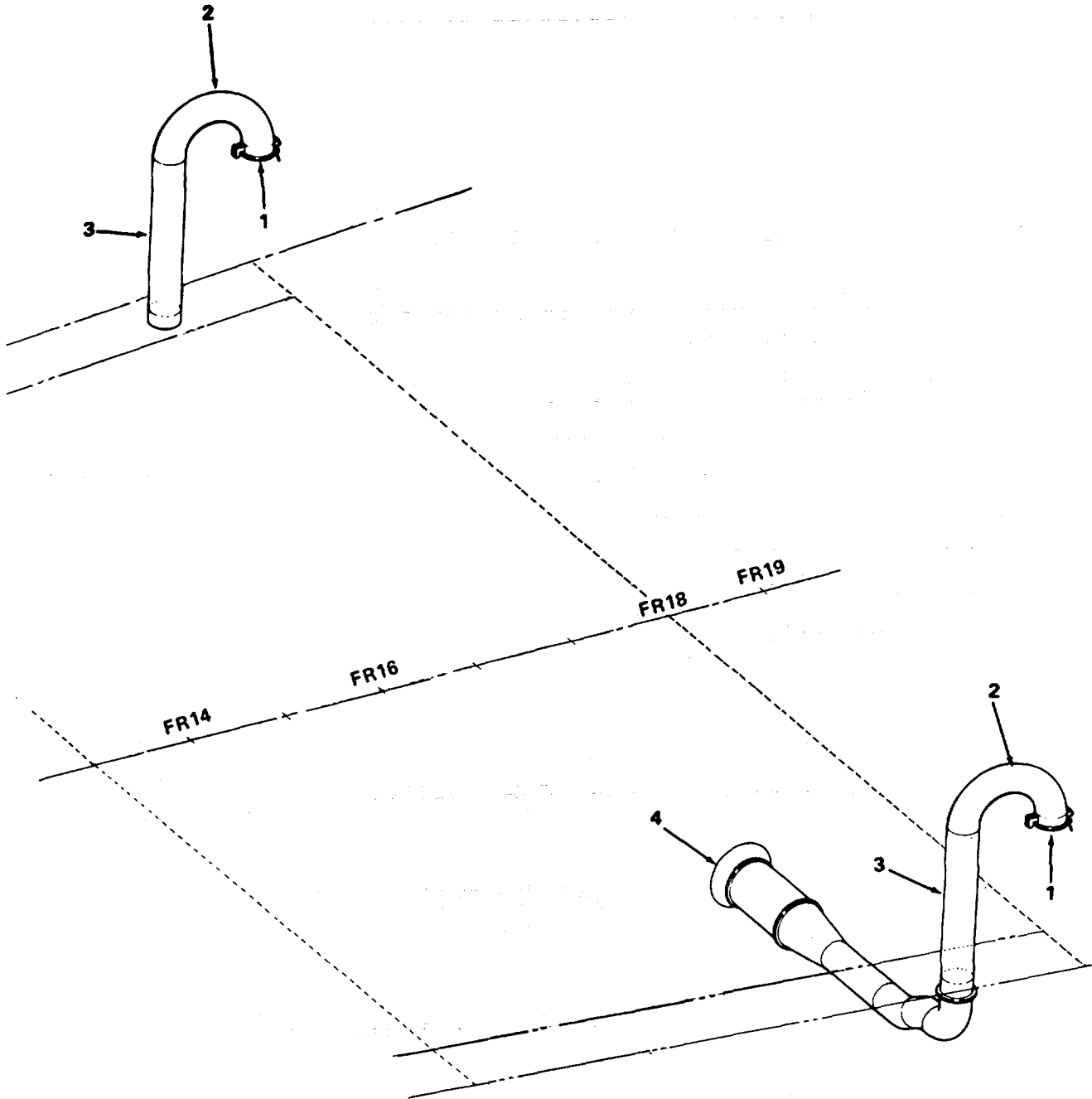
REPAIR OR REPLACE

- | | | | |
|------------|----------------------------------|--------------------|--|
| 1. Ducting | a. Water-tight closure (1) | Repair or replace. | |
| | b. 1800 return bend (2) | Repair or replace. | |
| | c. 6 inch steel pipe (3) | Repair or replace. | |
| | d. 1-1/2 wire mesh bellmouth (4) | Repair or replace. | |

5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)



5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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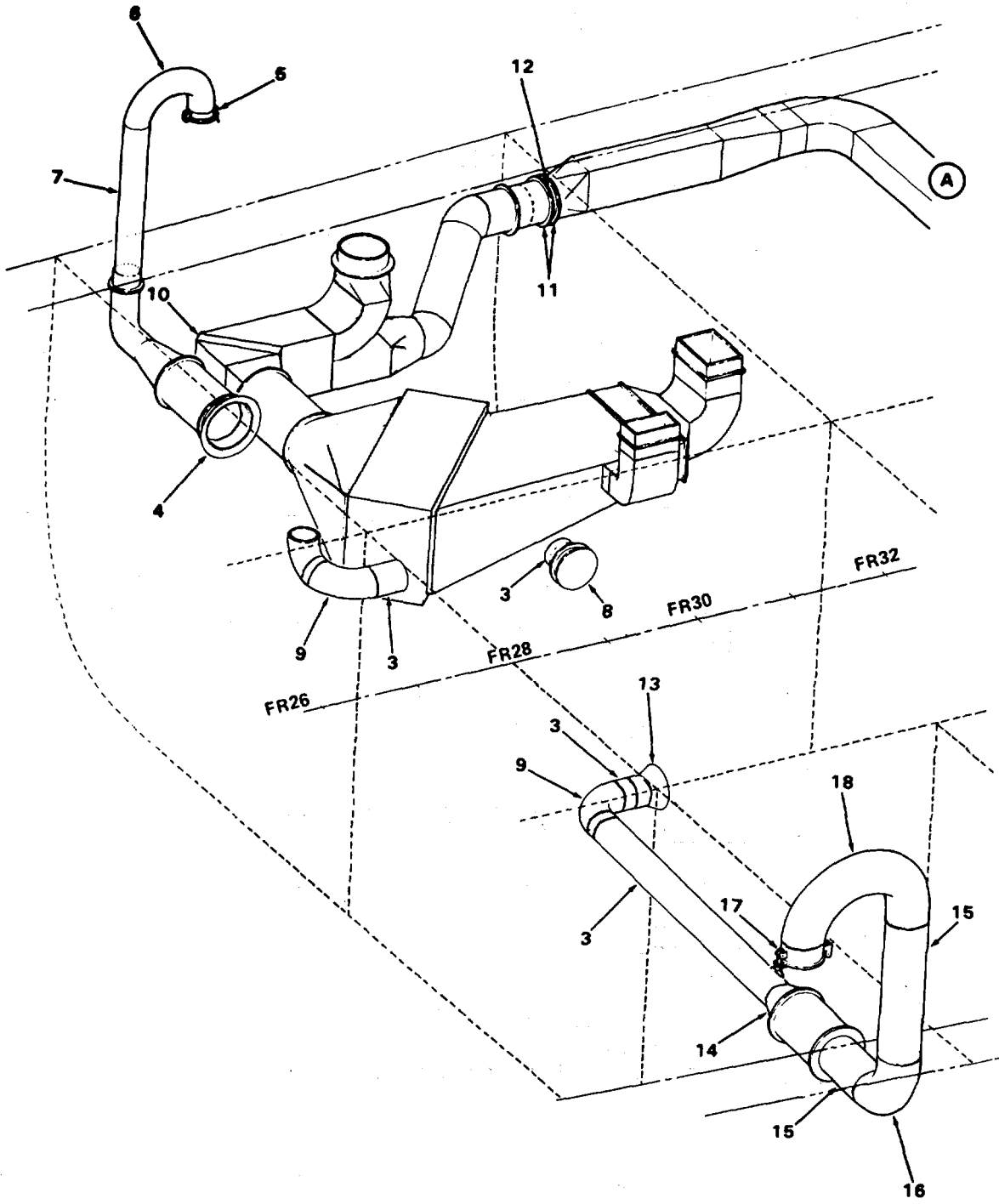
REPAIR OR REPLACE (Cont)			
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- | | | | |
|--|----------------------------------|--------------------|--|
| | e. Watertight closure (5) | Repair or replace. | |
| | f. 1800 return bend (6) | Repair or replace. | |
| | g. Steel pipe (7) | Repair or replace. | |
| | h. Butterfly valve (8) | Repair or replace. | |
| | i. 90° elbow (9) | Repair or replace. | |
| | j. 90° range turn (10) | Repair or replace. | |
| | k. 6 inch slip on flange (1 1) | Repair or replace. | |
| | l. Butterfly valve (12) | Repair or replace. | |
| | m. Terminal exhaust (13) | Repair or replace. | |
| | n. 6 inch access cover (14) | Repair or replace. | |
| | o. Steel pipe (15) | Repair or replace. | |
| | p. 8 inch 90° elbow (16) | Repair or replace. | |

5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)



5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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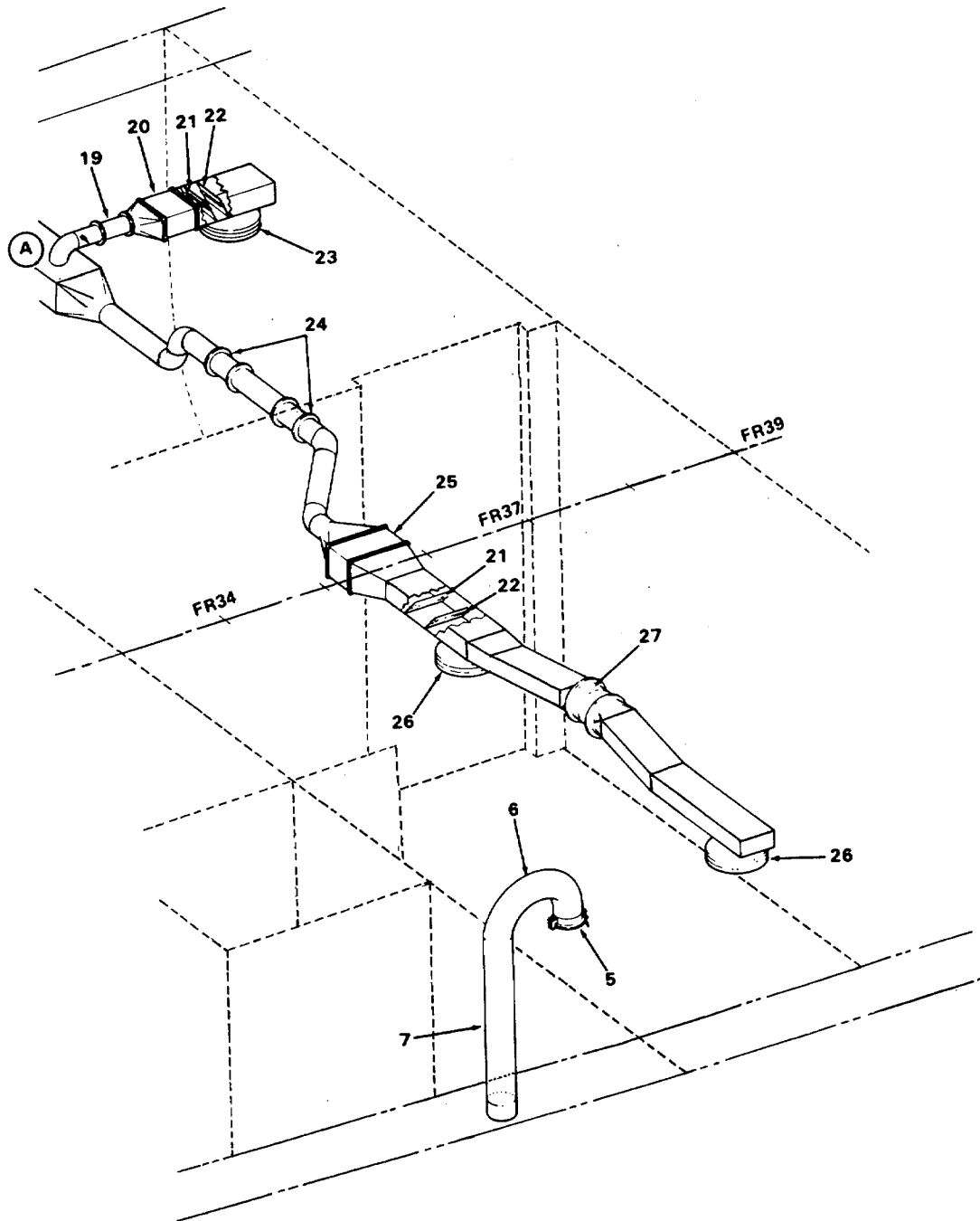
REPAIR OR REPLACE (Cont)

	q. Watertight closure (17)	Repair or replace,	
	r. 1800 return bend (18)	Repair or replace.	
	s. Steel spool (19)	Repair or replace.	
	t. Duct-type heater (20)	Repair or replace.	
	u. Balancing damper (21)	Repair or replace.	
	v. Manual damper (22)	Repair or replace,	
	w. Diffuser terminal (23)	Repair or replace.	
	x. 5 inch compression ring (24)	Repair or replace.	
	y. Duct-type heater (25)	Repair or replace.	
	z. Navy std diffuser terminal (26)	Repair or replace,	
	aa. Compression ring (27)	Repair or replace.	
	ab. Exhaust terminal (28)	Repair or replace.	

5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)			
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5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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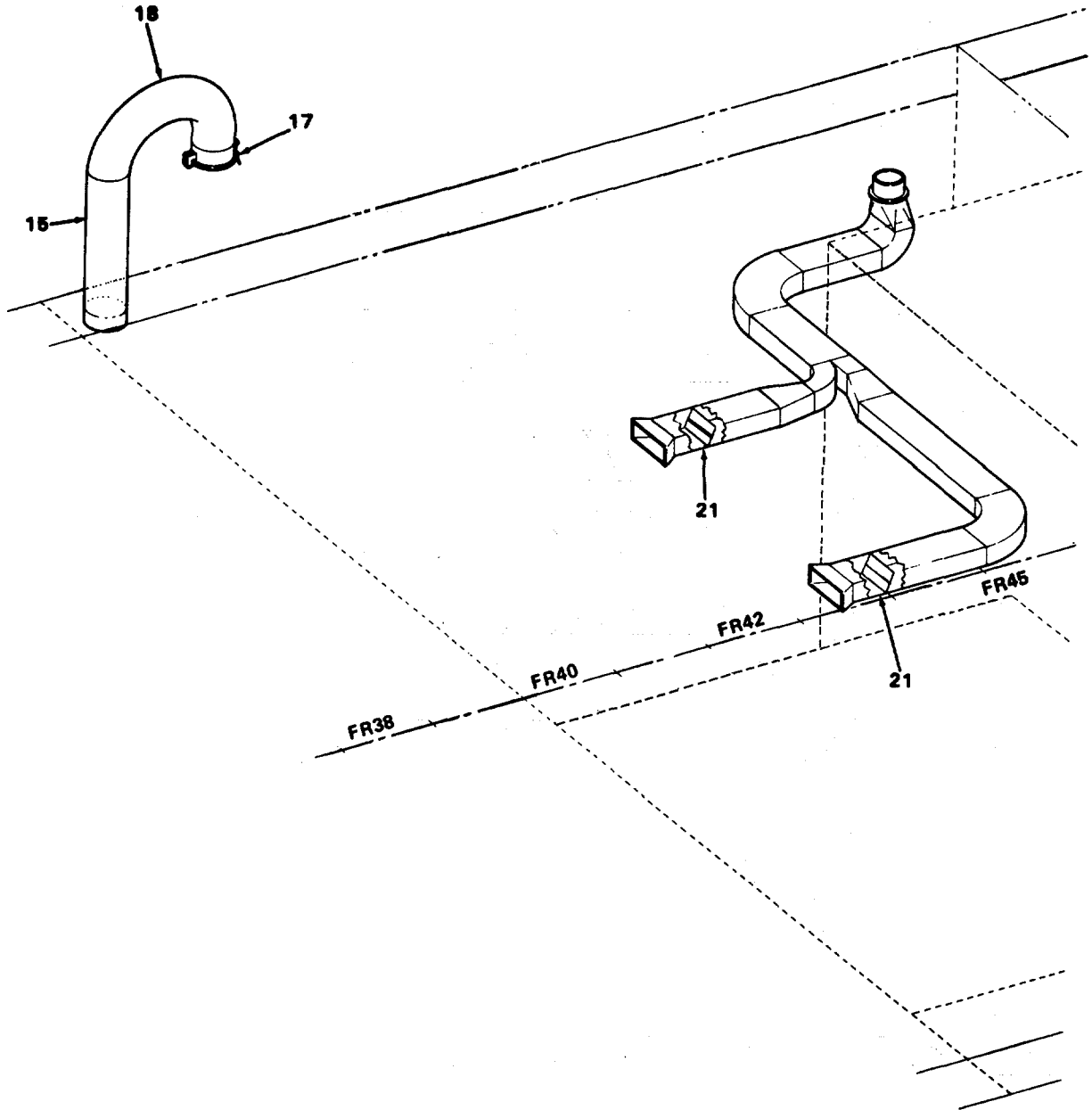
REPAIR OR REPLACE (Cont)

ac.	1-1/2 wire mesh exhaust terminal (29)	Repair or replace.	
ad.	7 inch compression ring (30)	Repair or replace.	
ae.	Duct-type heater (31)	Repair or replace.	
af.	Duct-type heater (32)	Repair or replace.	
ag.	Diffuser terminal (33)	Repair or replace.	
ah.	Steel bell- mouth (34)	Repair or replace.	
ai.	Compression ring (35)	Repair or replace.	
aj.	Compression ring (36)	Repair or replace.	
ak.	10 inch steel pipe (37)	Repair or replace.	
al.	10 inch rectangular spool (38)	Repair or replace.	
am.	Compression ring (39)	Repair or replace.	
an.	Compression ring (40)	Repair or replace.	

5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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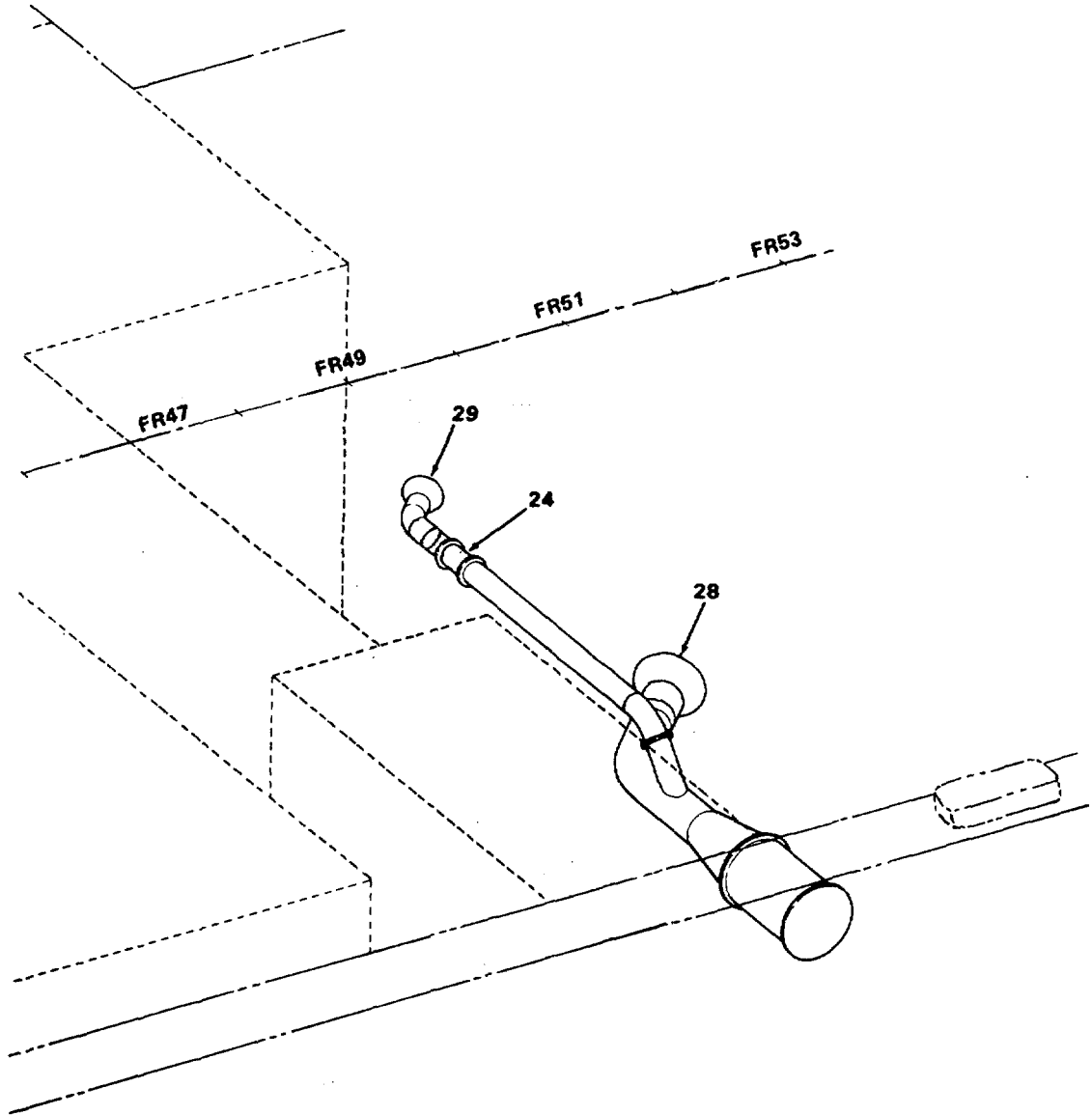
REPAIR OR REPLACE (Cont)			
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5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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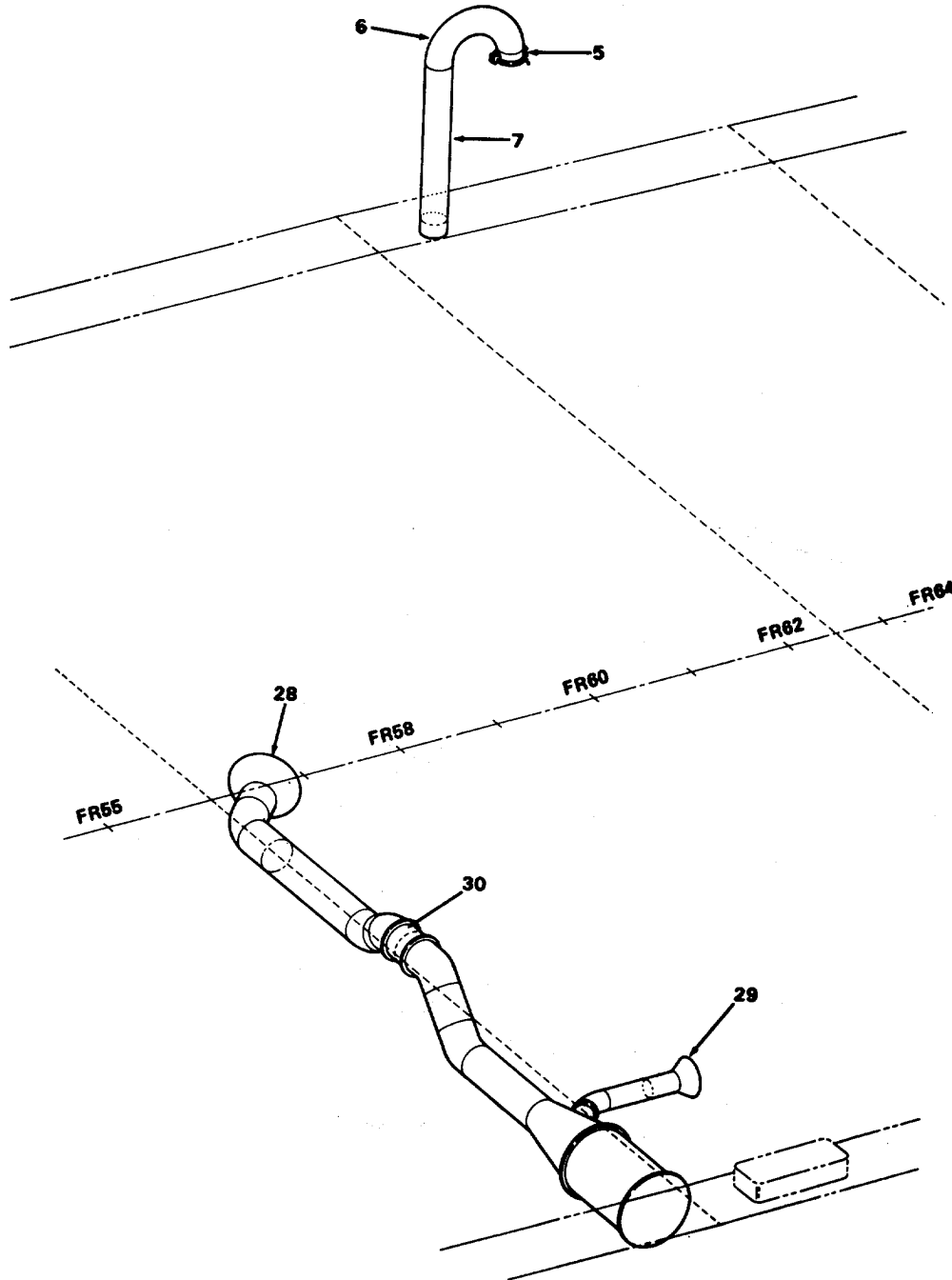
REPAIR OR REPLACE (Cont)			
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5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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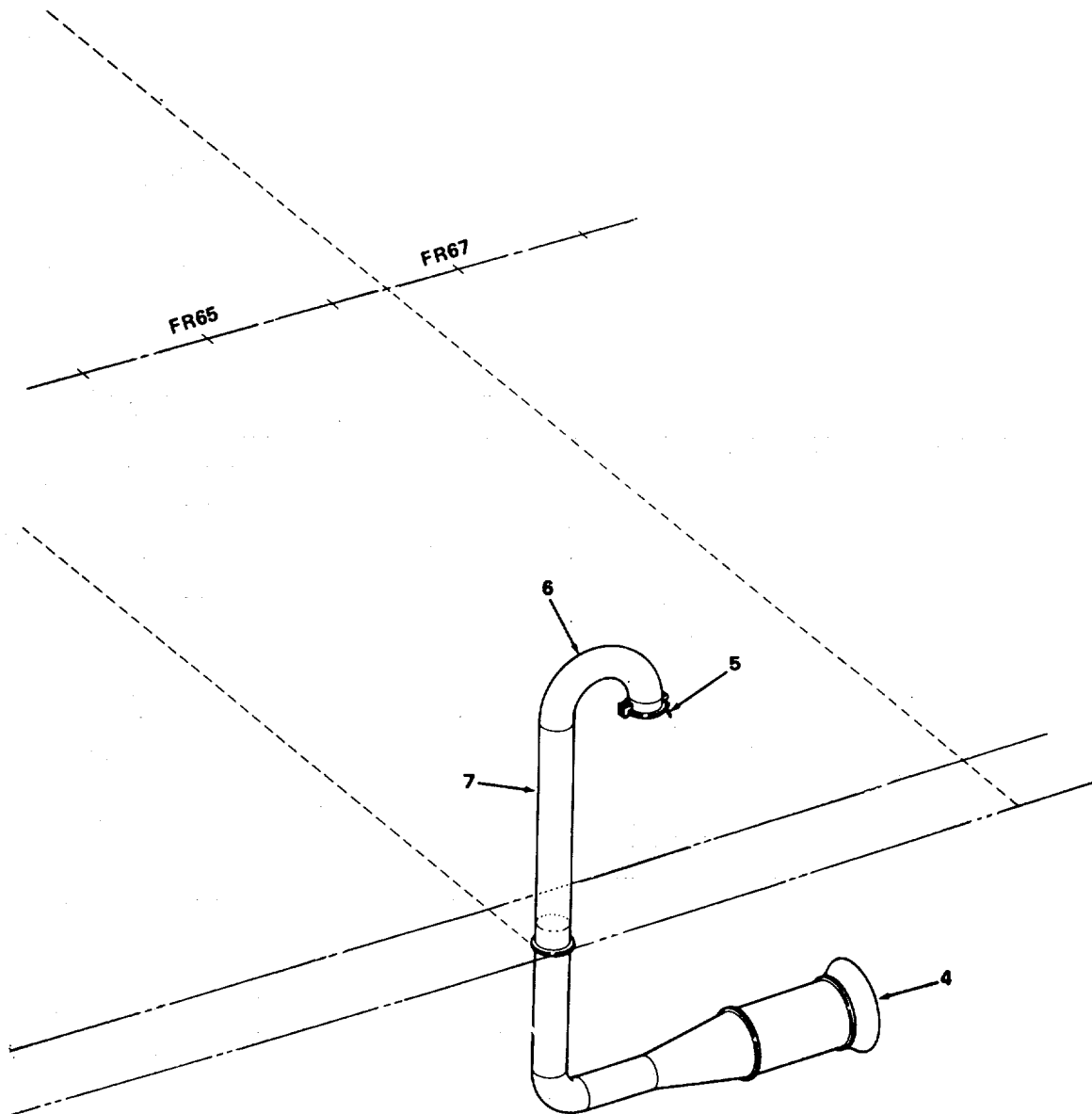
REPAIR OR REPLACE (Cont)



5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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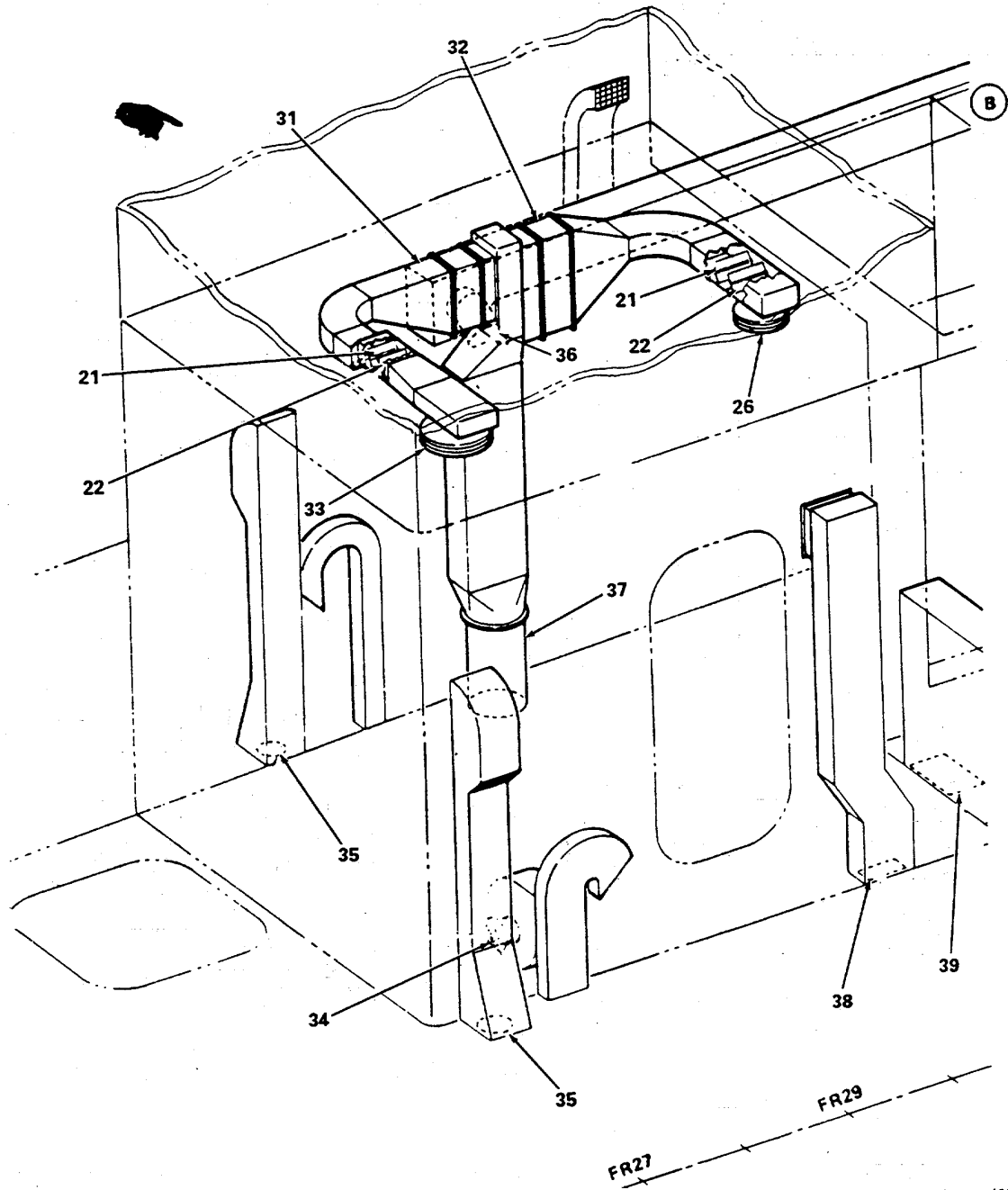
REPAIR OR REPLACE (Cont)



5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

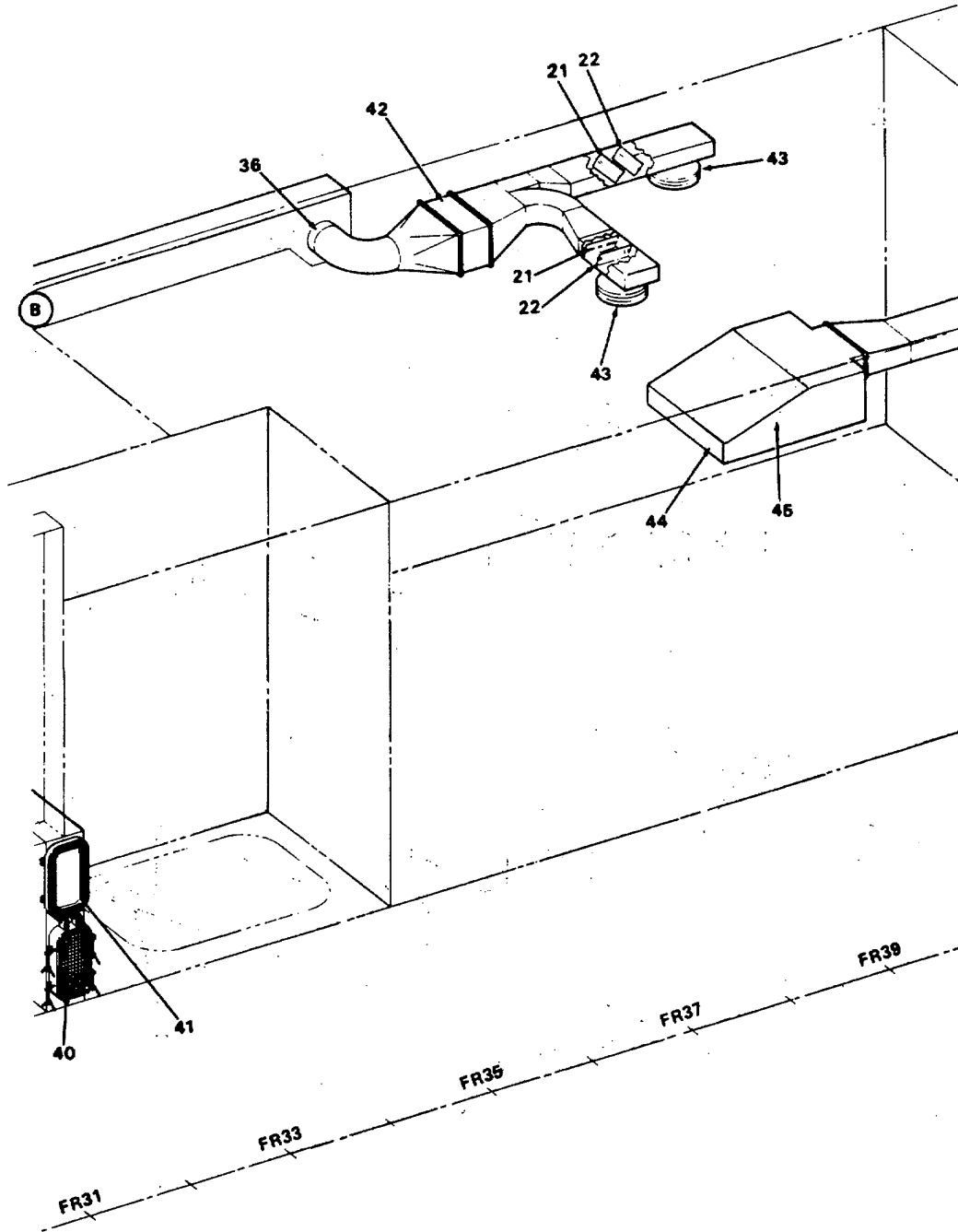


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5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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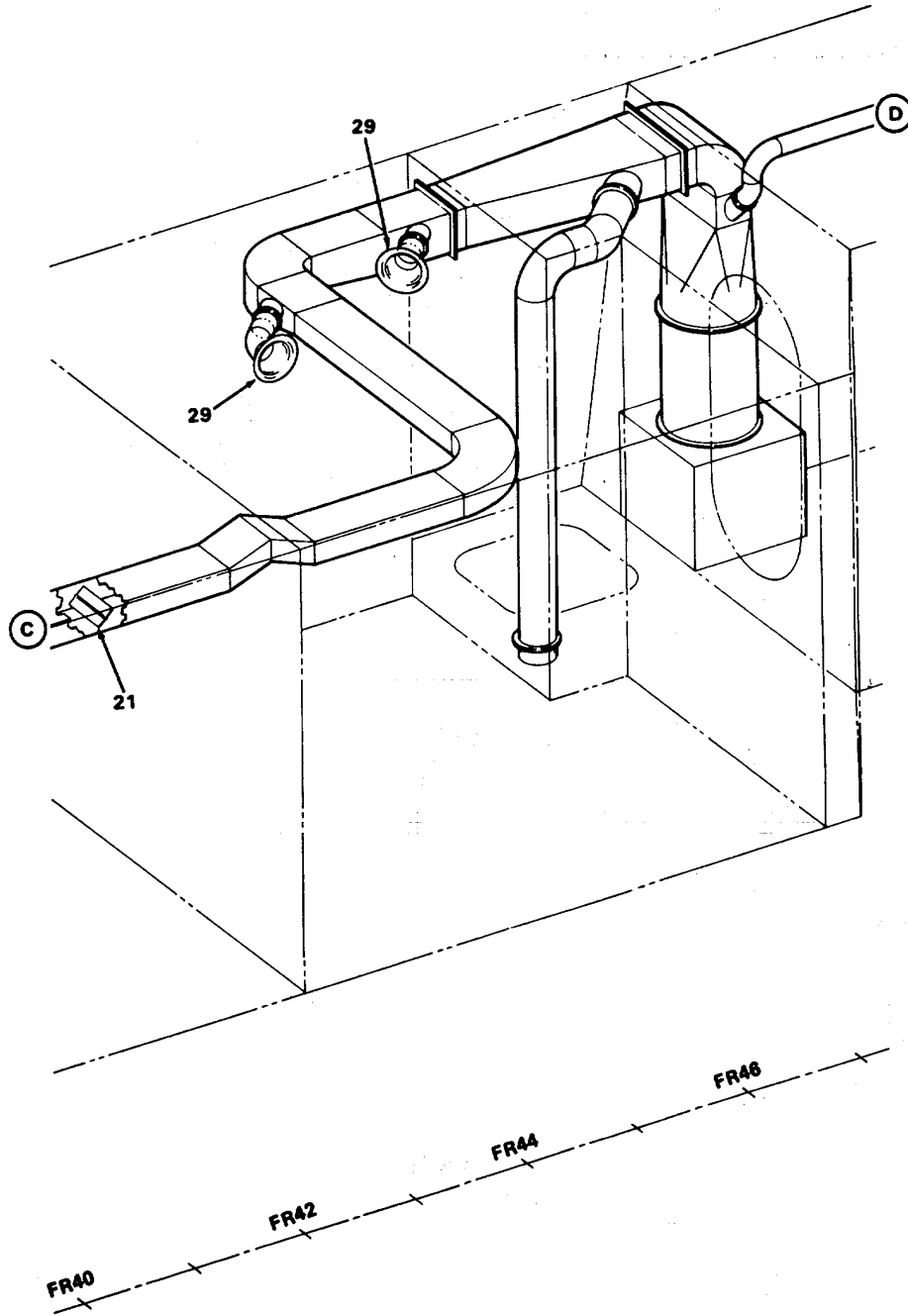
REPAIR OR REPLACE (Cont)



5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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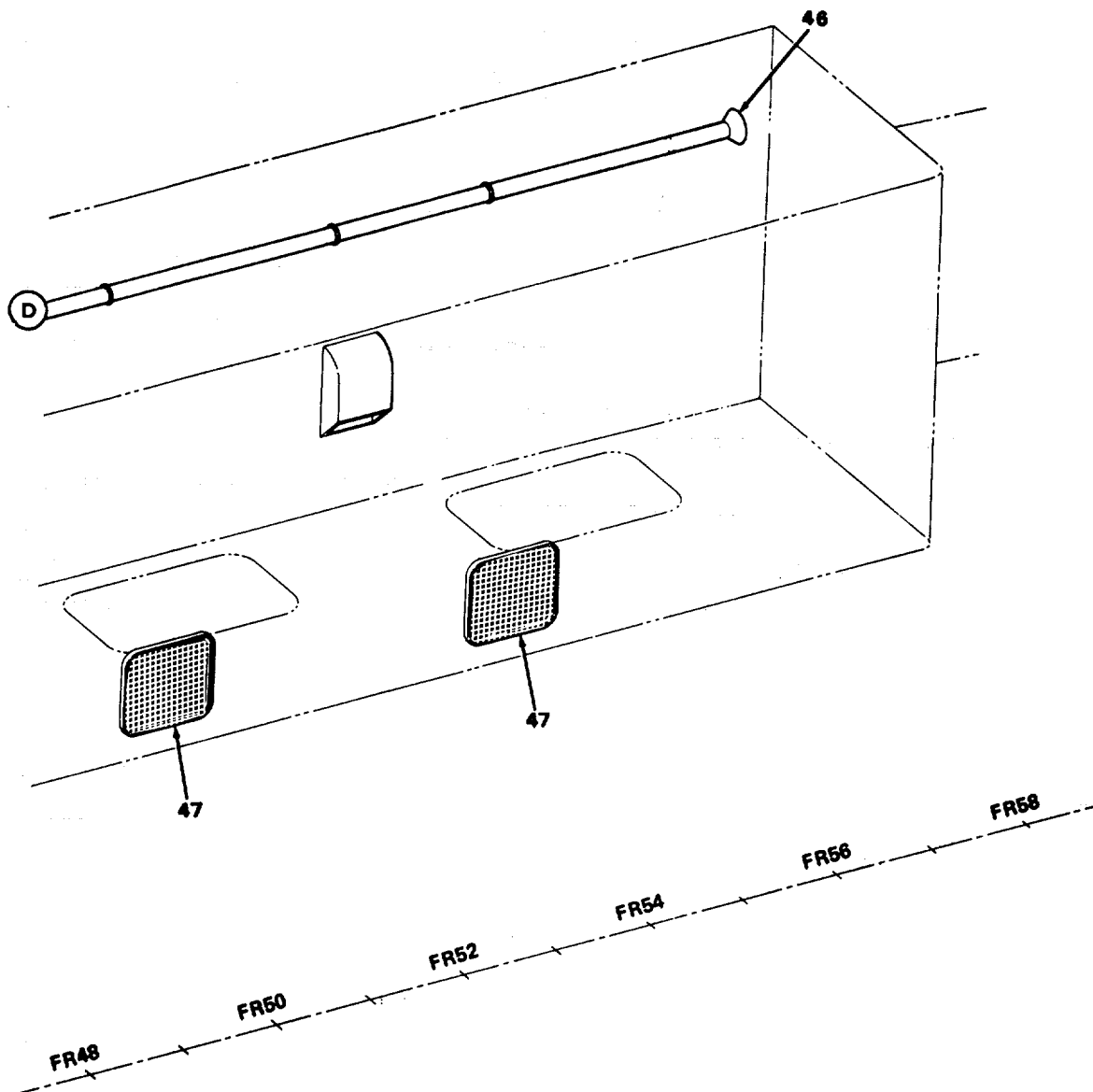
REPAIR OR REPLACE (Cont)			
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5-137. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)



5-138. EXHAUST FAN CONTROLLER - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for Controller maintenance instructions.

5-139. EXHAUST FAN MOTOR - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-136 for Motor maintenance instructions.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References

Paragraph

4-29

Compressor

Equipment

Condition

NONE

Condition Description

Special Tools

NONE

Special Environmental Conditions

NONE

Material/Parts

Gasket set 5330-01-040-7867

General Safety Instructions

Observe WARNING and safety precautions

Personnel Required

1

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - SAFETY PRECAUTIONS

WARNING

Wear goggles to prevent liquid R-12 from getting into the eyes when charging, purging or opening the system for repairs.

1. Operating.

a. Never start a compressor without making sure that any shutoff valve between the compressor and the condenser is open.

b. Do not jack or turn the compressor by hand when power is on.

c. Whenever the compressor motor is first started, the operator should stand by the switch and start the motor in short, intermittent spurts until it is certain that the compressor is operating properly. If possible, the compressor should be turned over several times by hand, to clear the cylinders of any oil that may have collected there during shipment or erection. When starting up the compressor, avoid rapid pumping down of the low side pressure. The operator should also be certain that liquid refrigerant is not being returned to the compressor. Liquid return will be indicated by the crankcase and cylinder being relatively cold, sweating or frosted.

d. In case of severe vibration or unusual noise, stop the unit and investigate.

e. When isolating any part of the system in which there is liquid refrigerant, close the cut-out valve on inlet side of the part to be isolated and allow the compressor to remove all liquid refrigerant. This will be indicated by a sudden chilling of the part being isolated. When the part begins to get warm again it may be considered devoid of liquid refrigerant. Close valve on outlet side of isolated part before opening bypass valves, if provided.

f. Never open any part of the system which is under a vacuum. If this is done, air and moisture will be drawn into the system and are almost certain to cause trouble at some later date. The section to be opened should be under 1 - 2 psig (6.9 - 13.8 kPa) pressure to prevent the admission of air and moisture into the system.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - SAFETY PRECAUTIONS (Cont)

g. During the shutdown period of any condenser. if there is a possibility of obtaining freezing temperatures in the machinery. room, drain the condenser and connecting piping to prevent a freeze-up and damage to condenser tubes.

h. After an inspection or repairs have been made, always be sure to expel all the air from the part of the system that has been opened by admitting a small amount of refrigerant gas into that part of the system.

2. Handling Refrigerant-12.

a. Refrigerant-12 is practically odorless and non-toxic. It is not necessary to wear a gas mask when servicing equipment in which it is contained unless the conditions necessary for the decomposition of -> R-12 to phosgene gas exist. Refer to item b. below.

b. Never use a torch or attempt a repair on a line containing R-12 until it is certain that all gas has been pumped out of the section of pipe to be repaired, the area is well ventilated and the line has been valved off. Refrigerant-12 in contact with an open flame of high temperature (about 1,000°F (557.8°C)) decomposes into phosgene, a highly toxic gas.

c. Always wear goggles when handling R-12, or servicing equipment in which it is contained, to avoid the possibility of liquid refrigerant coming in contact with the eyes.

d. If liquid R-12 accidentally comes in contact with the eyes, take person suffering the injury to the medical officer at once. Do not rub or irritate the eyes and give the following first aid treatment immediately:

(1) Introduce drops of sterile mineral oil into the eyes as an irrigant.

(2) If irritation continues at all, wash the eyes with a weak boric acid solution, or a sterile salt solution not to exceed 2% sodium chloride.

e. Should liquid R-12 come in contact with the skin, treat the injury the same as though the skin had been frost bitten or frozen.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - SAFETY PRECAUTIONS (Cont)

f. Do not work in a closed space where R-12 may be leaking unless adequate ventilation is provided.

g. Should a person be overcome in a space which lacks oxygen because of high concentrations of R-12 being present, treat such person the same as for suffocation, i.e., through artificial respiration.



- To prevent accidental shock and possible injury, tag and place disconnect switch in the OFF position.
- Tag starting switch to warn against starting compressor with discharge stop valve closed - Pull fuses so that compressor cannot be started. Serious compressor damage (and possible injury to personnel) will result if discharge stop valve is not opened before compressor is started.

OVERHAUL

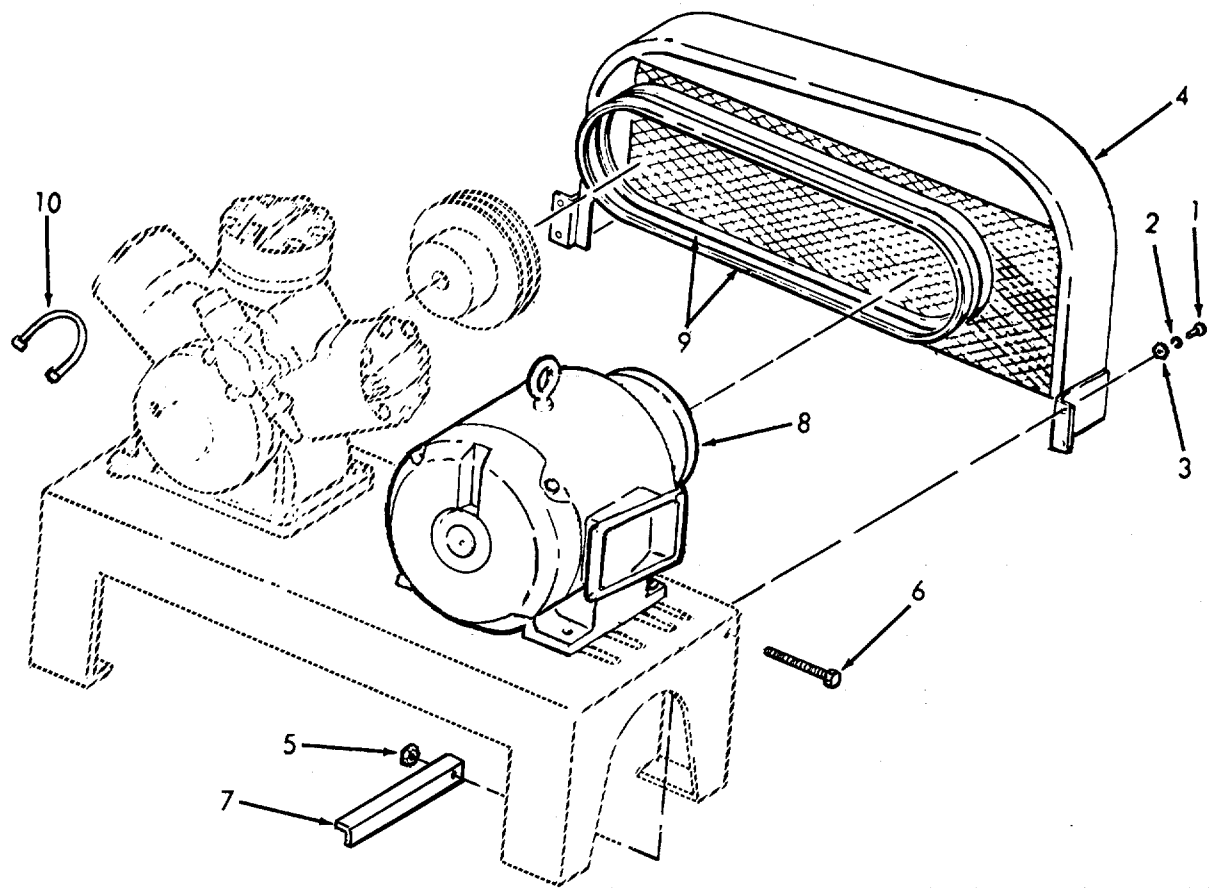
- | | | |
|---------------|--|---------|
| 3. Compressor | a. Screws
(1),
lock-
washers
(2), and
flat-
washers
(3) | Remove. |
| | b. Belt guard
(4) | Remove. |
| | c. Nut (5),
and bolt
(6) | Loosen. |

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)

- | | | | |
|----|--|--|---------------------|
| d. | Motor adjusting angle (7), and motor (8) | Move to loosen belts (9). | |
| e. | Belts (9) | Remove. | |
| f. | Compressor | Drain oil. | |
| g. | Capacity control valve inlet tubing (10) | 1. Unscrew flair nuts.
2. Carefully move copper tubing to one side. | Avoid kinking tube. |



5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

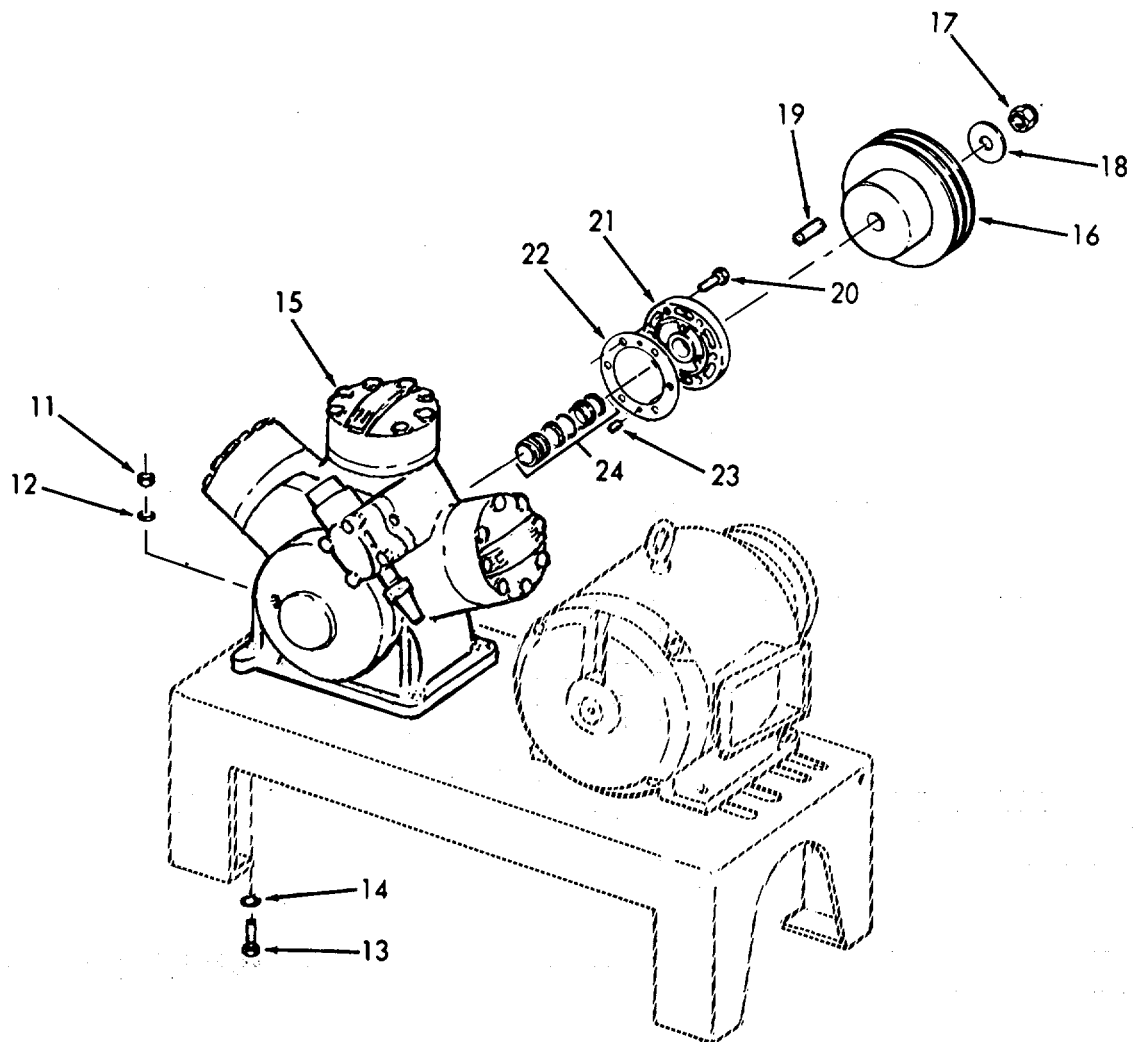
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - (Cont)			
	h. Discharge service valve tubing	Remove.	
	i. Suction service valve tubing	Remove.	
	j. Nuts (11), flat-washers (12), screws (13) and lock-washers (14)	Remove.	
	k. Compressor (15)	Remove.	
	l. Flywheel (16)	1. Remove nut (17), and flatwasher (18). 2. Remove flywheel (16), and key (19).	
4. External Parts		Remove and repair as needed.	Refer to paragraph 4-29.
5. Seal End Main Bearing	a. Screws (20)	Remove.	
	b. Cover plate (21), and gasket (22)	Remove.	Discard gasket.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)

- | | | | |
|----|--------------------------|---------|---------------------|
| c. | Dowel pins (23) | Remove. | If necessary. |
| d. | Shaft seal assembly (24) | Remove. | a. Use seal puller. |

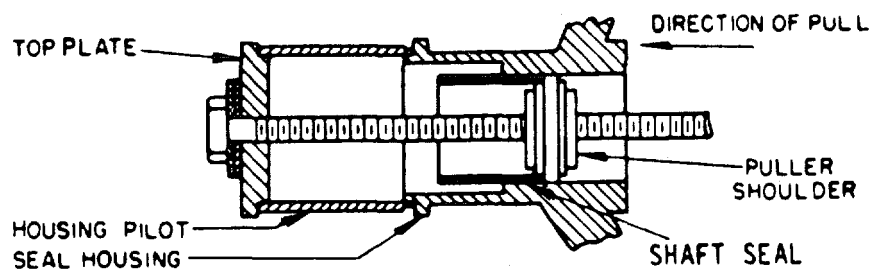


5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)

b. The puller shoulder is threaded and acts as a traveling nut. The friction will keep the puller shoulder from turning with the bolt unless the threads are damaged. If they are damaged, use a 3/4"-16 nut between the thrust washer and bolt head. Hold bolt head stationary and turn nut.



e. Cover plate (21)

Inspect.

If a burr or a sharp edge is in the cover, remove it and clean.

f. Shaft seal assembly (24)

1. Lubricate.

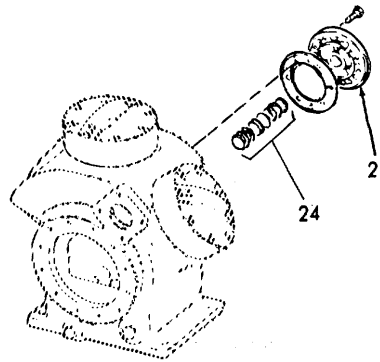
Use heavy grease,

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

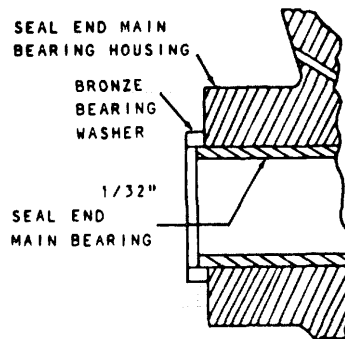
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)

2. Install.



- a. Position bearing so that chamfered edge (notched edge) enters bearing housing first and oil holes in bearing and housing are in line.
- b. Using puller, pull bearing into housing until positioned as shown below. Edge of bearing is 1/32" (0.794 cm) below surface of bronze bearing washer.
- c. Look through oil pressure regulator opening in crankcase to see that oil passage to bearing is not blocked.
- d. Check to see that relief groove in bearing is at the top.



5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 5px; display: inline-block;">OVERHAUL - (Cont)</div>			
<div style="border: 2px solid black; padding: 10px; display: inline-block; background-color: #f0f0f0;">WARNING</div>			
Wear protective eye goggles when using compressed air.			
			e. Blow out oil groove in bearing housing. Use new gasket.
	g. Cover plate (21), and gasket (22)	Install.	
	h. Screws (20)	Install.	Torque to 30 to 35 lb ft (40.67 to 47.45 N•m).
6. Cylinder Heads	a. Screws (25)	Remove.	
	b. Cylinder head (26)	Remove.	Do not drop or damage gasket sealing surfaces.
	c. Gasket (27)	Remove.	Discard.
	d. Cylinder head (26)	1. Clean. 2. Inspect.	Remove gasket material. Inspect for cracks, and satisfactory gasket sealing' surfaces.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)

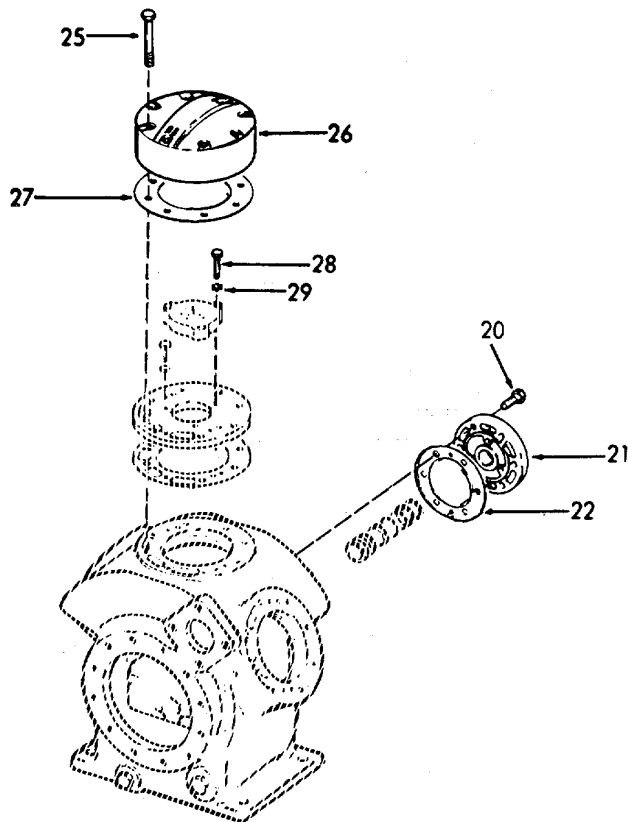
	e. Cylinder head (26), gasket (27), and screws (25)	Reinstall.	Torque screws to 30 to 35 lbft (40.67 to 47.45 Nm).
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NOTE

This procedure should NOT be performed without the use of valve retainer clips.

7. Discharge Valve

a. Screws (28), and lock-washers (29)	Loosen.
---------------------------------------	---------



5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

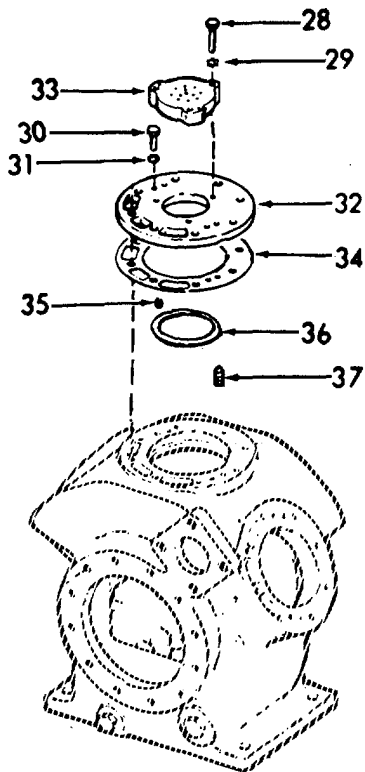
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - (Cont)			
	b. Screws (30), and screw gaskets (31)	Remove.	Discard gasket.
	c. Valve plate (32)	Remove from cylinder block.	
	d. Screws (28), and lock-washers (29)	Remove.	
	e. Valve guide (33) and valve plate (32)	Separate.	
	f. Gasket (34)	Remove.	Discard.
	g. Suction valve springs (35)	Remove.	Six places.
	h. Suction valve (36)	1. Remove. 2. Inspect.	Inspect for cracks or wear. Limits .005 inch (0.013 cm).
	i. Valve lift springs (37)	Remove.	Four places.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)

- | | | | |
|----|---|---------------------------------------|--|
| j. | Suction valve springs (35), and valve lift springs (37) | Inspect for signs of failure. | Replace any broken or distorted springs. |
| k. | Suction valve springs (35) | Place in valve plate (32).
bottom. | Large coil in contact with |



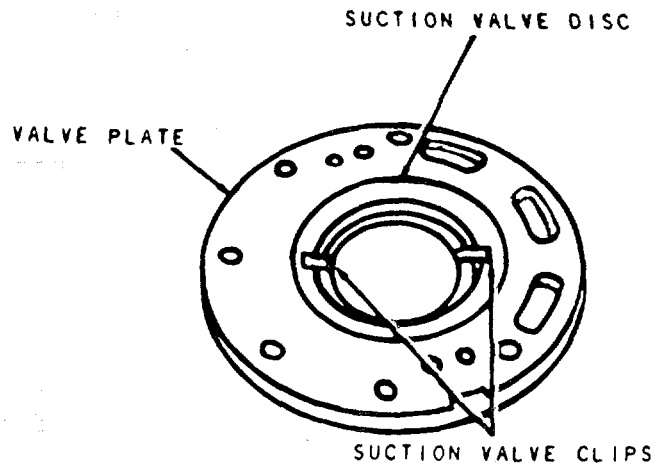
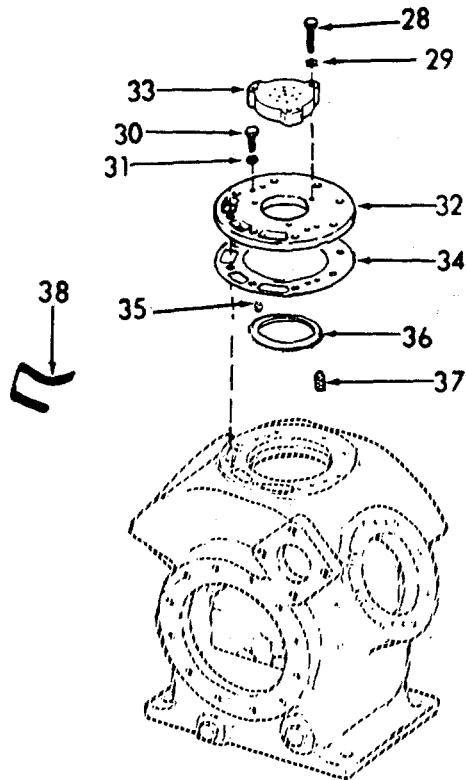
5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - (Cont)			
	1. Suction valve (36)	1. Place on valve spring (35). 2. Press down in valve plate recess. 3. Install slide retainer clips (38) as shown. lift pins and springs (37).	Locate clips so they do not cover any valve
	m. Valve plate (32), and gasket (34)	Align holes with cylinder block.	Use new gasket.
	n. Screws (30), and screw gaskets (31)	Install.	a. Use new gaskets. b. Torque to 6-10 lb.ft. (8.135 to 13.56 Nm).
	o. Retainer clips (38)	Remove.	Furnished with onboard spares for valve plate (32).
	p. Discharge valve guide (33), screws (28) and lock-washers (29)	Install.	Torque screws to 6 to 10 lb. ft. (8.135 to 13.56 Nm).
	q. Cylinder head	Install.	Refer to step 6.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)



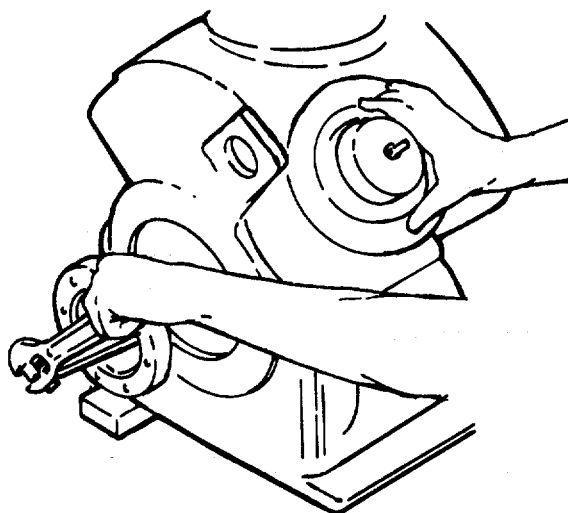
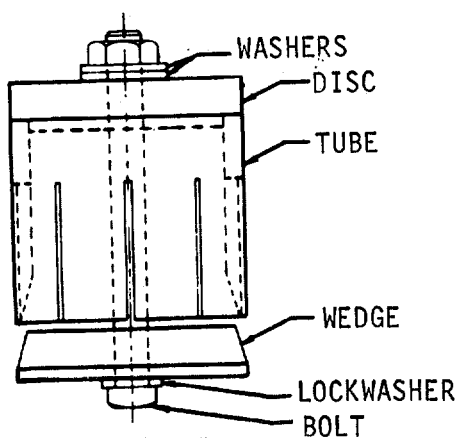
8. Cylinder And Unloader Sleeves	a. Cylinder head	Remove.	Refer to step 6.
	b. Discharge valve	Remove.	Refer to step 7.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)

- | | | |
|---------------------------------|---|--|
| c. Valve lift springs (39) | <ol style="list-style-type: none"> 1. Remove. 2. Inspect for wear. 3. Install. | Discard if damaged. |
| d. Crankshaft and sleeve puller | <ol style="list-style-type: none"> 1. Rotate crankshaft until piston is in mid-position. 2. Insert sleeve puller into cylinder. 3. Push sleeve puller down onto top of piston. 4. Tighten nut on top of sleeve puller to expand puller into sleeves. 5. Turn crankshaft by hand. | This forces the cylinder sleeve (40), and the unloader sleeve (41) up until it can be removed. |

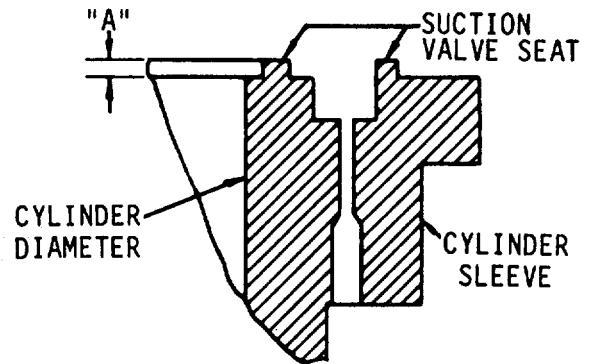
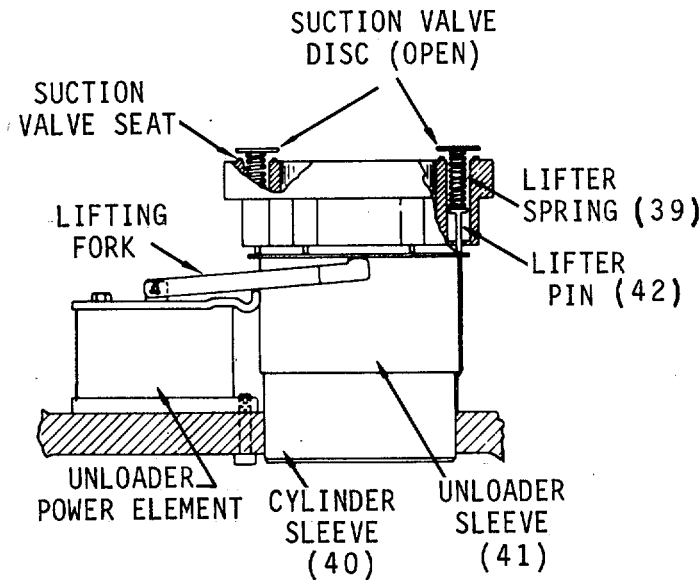


5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)

- | | |
|---|---|
| e. Lifter valve pin (42) | 1. Remove. |
| freedom of movement. | 2. Inspect for wear and |
| f. Unloader sleeve (41), and cylinder sleeve (40) | 1. Inspect bore of sleeve for wear. |
| | 2. Inspect suction valve seats for scratches or wear. |
| | 3. Inspect for wear limits. |



Factory
Minimum

Maximum Wear
Before Repair

SUCTION VALVE
Suction Valve Disc.
(Depth of Wear Below Face)
Suction Valve Seat
(for Dim. "A")
Minimum Height of "A" Before
Replacing Cylinder Sleeve (.010)

.012

.005

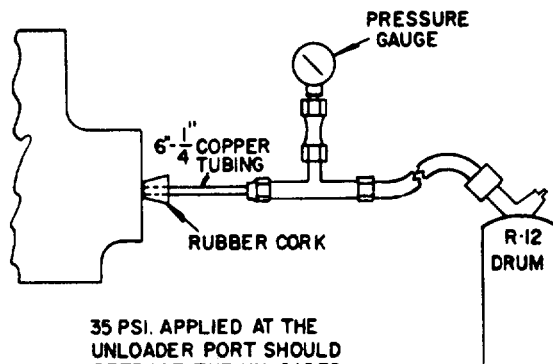
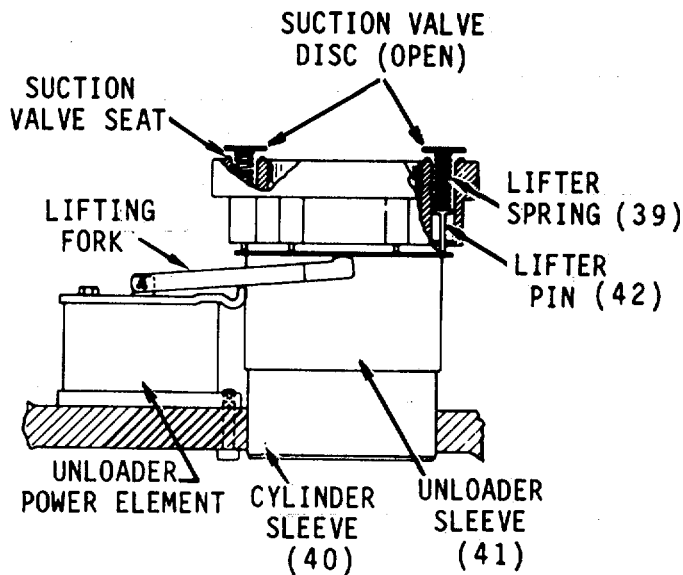
5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - (Cont)			
	g. Crank-shaft and piston	<ol style="list-style-type: none"> 1. Rotate so that piston is at top center. 2. Oil piston rings. 	
	h. Cylinder sleeve (40)	Oil beveled surface at lower edge.	
	i. Unloader sleeve (41), valve lifter pins (42), and cylinder sleeve (40)	With a turning motion, work sleeves over piston and rings.	
	j. Cylinder sleeve (40)	<p>Rotate so that any two valve lifter pins (42) are an equal distance from the longitudinal axis of the compressor. prevent undue stress on valve disc.</p>	<p>Valve lifter pins (42) should line up with suction valve springs and</p>
	k. Valve lifter pins (42)	<ol style="list-style-type: none"> 1. Make sure they operate freely. 2. Check unloader operation using the externally mounted capacity control valve. 	

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)



35 PSI. APPLIED AT THE UNLOADER PORT SHOULD RETRACT THE UNLOADER PINS OR SPRINGS

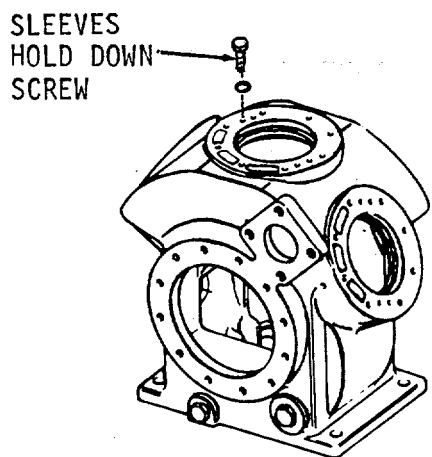
5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL - (Cont)

CAUTION

Never operate a compressor with a valve plate off unless cylinder sleeves are fastened in place. Cylinder sleeves can be held in place by capscrews and washers. Screw capscrews into tapped holes normally used to hold valve plate in place. Use plate washers large enough to extend well over faces of both sleeves or make up steel plates for this purpose. Two washers or plates should be used on each cylinder deck.



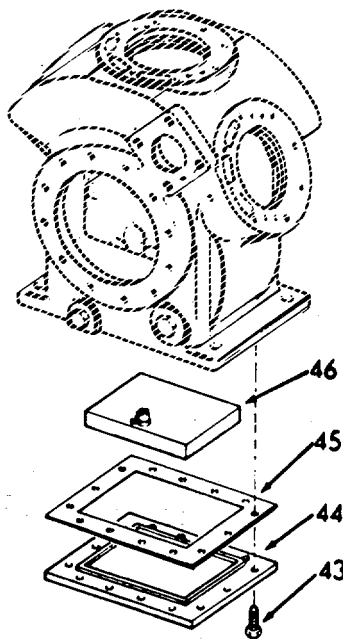
NOTE

Whenever a cylinder sleeve or valve plate is replaced, the suction valve disc should also be replaced, or turned over if reverse side is unused.

1. Discharge valve	Replace.	Refer to step 7.
--------------------	----------	------------------

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - (Cont)			
9. Bottom Plate	a. Screws (43)	Remove.	
	b. Bottom plate (44), and gasket (45)	Remove.	Discard gasket.
	c. Oil screen filter (46)	<ol style="list-style-type: none"> 1. Remove. 2. Clean. 3. Reinstall. 	
	d. Gasket (45), and bottom plate (44)	<ol style="list-style-type: none"> 1. Remove. 2. Clean. 3. Reinstall. Install using screws (43). 	Use new gasket.



5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - (Cont)			
10. Connecting Rods, Connecting Rod Bearing Inserts, Piston and Piston Pins	a. Cylinder head	Remove.	Refer to step 6.
	b. Valve plate	Remove.	Refer to step 7.
	c. Bottom plate nuts (47)	Remove.	Refer to step 9.
	d. Connecting rod caps (48)	Remove.	

NOTE

Label caps and rods so that caps can be put back on their respective rods and each rod reinstalled in same place on crankshaft.

- | | |
|---|------------------------|
| e. Cylinder sleeve (40), connecting rod (49), and piston (50) | Remove as an assembly. |
|---|------------------------|



Take care that piston does not come through top of sleeve. Connecting rod will not pass through sleeve and it is difficult to get rings back into cylinder without breaking them or damaging suction valve seats.

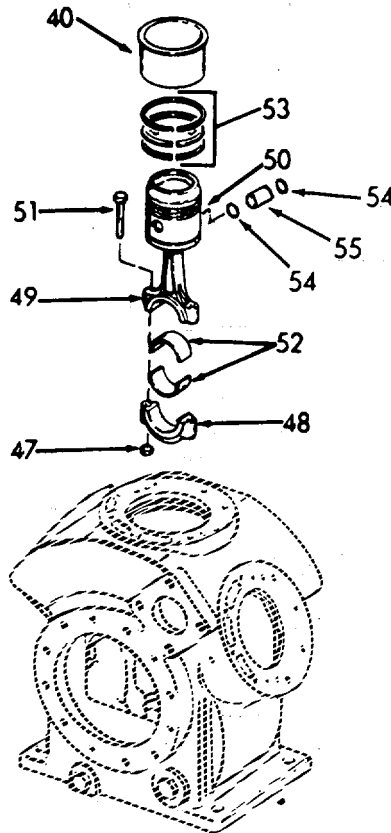
- | | |
|------------------------------|---------|
| f. Connecting rod bolts (51) | Remove. |
|------------------------------|---------|

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

- | | | | |
|--|--|--|--|
| | g. Connecting rod bearings (52) | Remove. | |
| | h. Rings (53) | Remove. | |
| | i. Piston pin retaining clips (54) | Remove. | |
| | j. Piston wrist pin (55), and associated parts | Press out of piston (50). | |
| | k. All parts | Inspect for worn parts, and for wear limits. | |



5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

PART NAME	FACTORY Maximum		FACTORY Minimum		MAXIMUM WEAR Before Repair	
	inches	cm	inches	cm	inches	cm
Connecting Rod Bearing dia.. (after assembly)	1.6255	4.1287			.002	.005
Bearing thickness			.06225	.15812	.001	.003
Crankpin dia.			1.6233	4.1232	.003	.008
Cylinders Bore	2.501	6.352			.003	.008
Piston (dia.)			2.4980	6.3449	.003	.008
Wrist Pin (dia.)			.7498	1.9045	.001	.003
Wrist Pin Bushing	.7507	1.9068			.001	.003
Piston Ring End Gap (comp. and oil)	.017	.043	.007	.018	.030	.076
Piston Ring Side Clearance (comp. and oil)	.0025	.0064	.001	.003	.003	.008

NOTE

If bearing inserts are damaged, but crankshaft is not worn, it is only necessary to replace inserts. Do not file bearing caps. Place inserts in the connecting rod and cap so that toeing knobs on inserts fit into notches on rod and cap. Lubricate insert bearings and crankpin freely before installing caps.

I. Piston pins (55)

Pushfit into place.

Pressure for a dry pin is 10 to 25 lb (44.5 to 111.2 N).

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

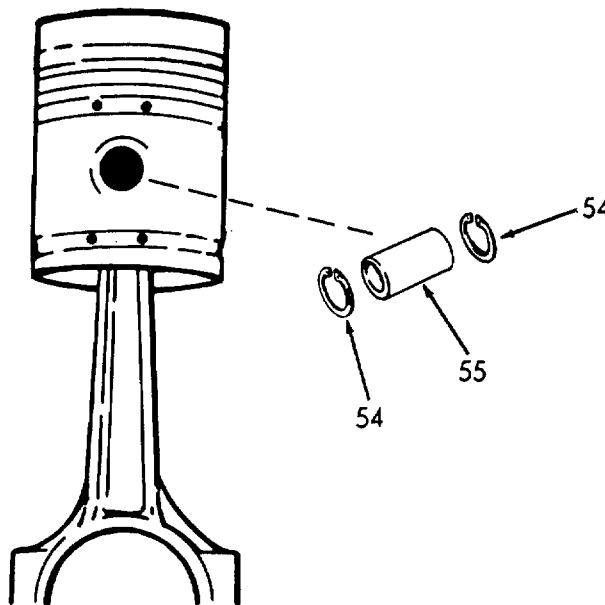
NOTE

Always reassemble pins in the pistons from which they were removed.

m. Piston
pin
retaining
clips
(54)

Install with gap on the
side.

The clips should
be tight enough
so they cannot
be rotated by
finger pressure.



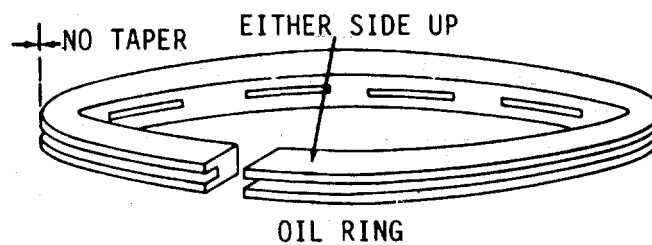
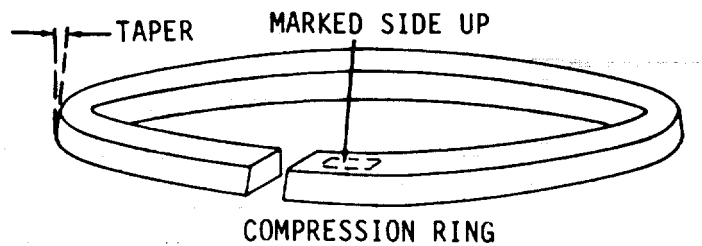
5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

n. Rings	Install two compression rings (plain), an oil ring (vented), and a second oil ring on the piston skirt, as follows:
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1. Insert each ring in cylinder about 3/8" from top and check ring gap. It should be between .007 and .017 inch (.018 and .043 cm).



2. Install compression rings on the piston with the side -marked "Top" toward the head of the piston. Install oil rings with either side up. (They have no taper).
3. Stagger ring gaps around piston.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

4. Check rings for free action and measure side clearance between ring and piston with a feeler gauge. It should be about .001 inch (.003 cm).

o. Sleeves

Install on piston.

Refer to step 8.

p. Sleeves, connecting rod, and piston assembly

Install in cylinder at the same time.

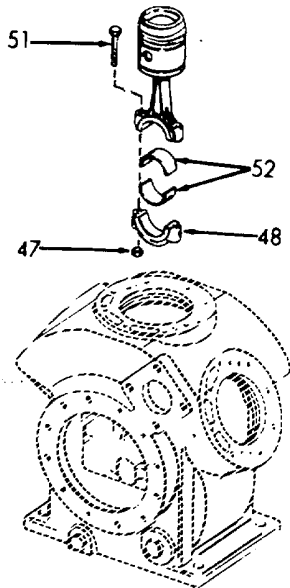
Make sure piston does not come out through top of sleeve.

q. Connecting rod bearings (52), cap (48), bolts (51), and nuts (47)

1. Turn connecting rod and install bearings and cap so that the chamfered sides are against the radius of the crankpins.

2. The small knobs on the rod and cap end must be on the same side of the journal.

3. Install bolts and nuts.



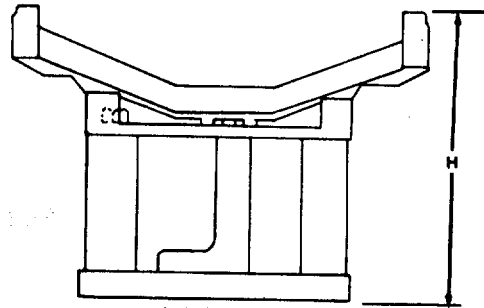
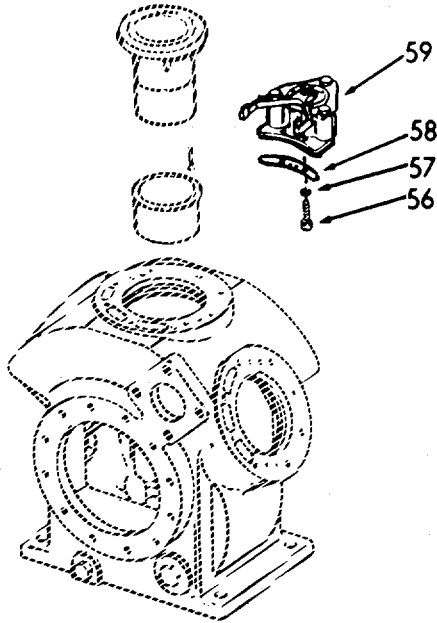
5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
11. Unloader Power Assembly	a. Cylinder head	Remove.	Refer to step 6.
	b. Discharge valve	Remove.	Refer to step 7.
	c. Bottom plate	Remove.	Refer to step 9.
	d. Connecting rod, piston, and cylinder sleeve	Remove.	Refer to step 10.
	e. Allen head screws (56), and lock-washers (57)	<ol style="list-style-type: none"> 1. Reach into crank-case through bottom plate. 2. Remove. 	
	f. Gasket (58), and unloader-power assembly (59)	Remove.	Discard.
	g. Unloader power assembly (59)	<ol style="list-style-type: none"> 1. Check unloader fork height of a new unloader power element. 2. Install power element gasket (58), with screws (56), and lockwashers (57). 	<p>Take measurement from base to highest point on fork arms. This will ensure even contact with unloader sleeve.</p> <p>Use new gasket.</p>

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)



$$H = 2 \frac{15}{32} + \frac{1}{64} - 0$$

- | | | | |
|----|---|----------|-------------------|
| h. | Connecting rod, piston, and cylinder sleeve | Install. | Refer to step 10. |
| i. | Bottom plate | Install. | Refer to step 9. |
| j. | Discharge valve | Install. | Refer to step 7. |
| k. | Cylinder head | Install. | Refer to step 6. |

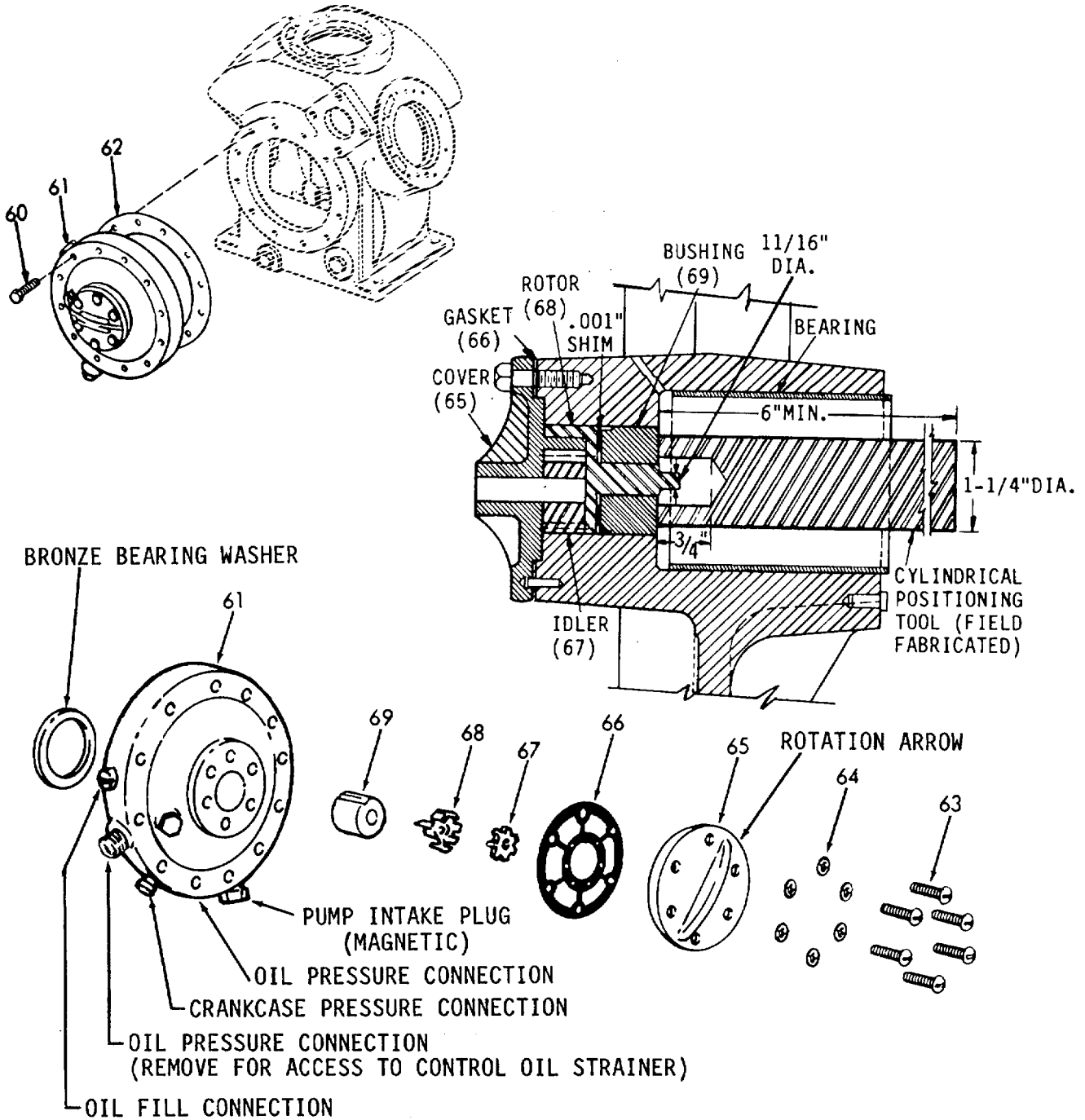
5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
12. Bearing Head	a. Screws (60)	Remove.	
	b. Bearing head assembly (61), and gasket (62)	1. Remove.	Discard gasket.
		2. Replace.	Use new gasket.
13. Oil Pump	c. Screws (60)	Install.	
	a. Bearing head	Remove.	Refer to step 12.
	b. Screws (63) , and lock-washers (64)	Remove.	
	c. Oil pump cover (65) and gasket (66)	1. Remove.	
		2. Inspect gasket for damage.	Replace if necessary.
d. Idler (67), and rotor (68)	1. Remove.		
	2. Inspect for burrs.		
e. Bushing (69), and bearing head assembly (61)	Inspect for scoring.	a. If bushing is scored replace when reassembling pump.	
		b. Replace complete bearing head and oil pump assembly if head is scored.	

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)



5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

NOTE

Attempting to clean a lightly scored bearing head can seriously affect pump operation and cause failure of a new pump.

CAUTION

End play is critical for proper pump operation. Take extreme care to insure proper end play.

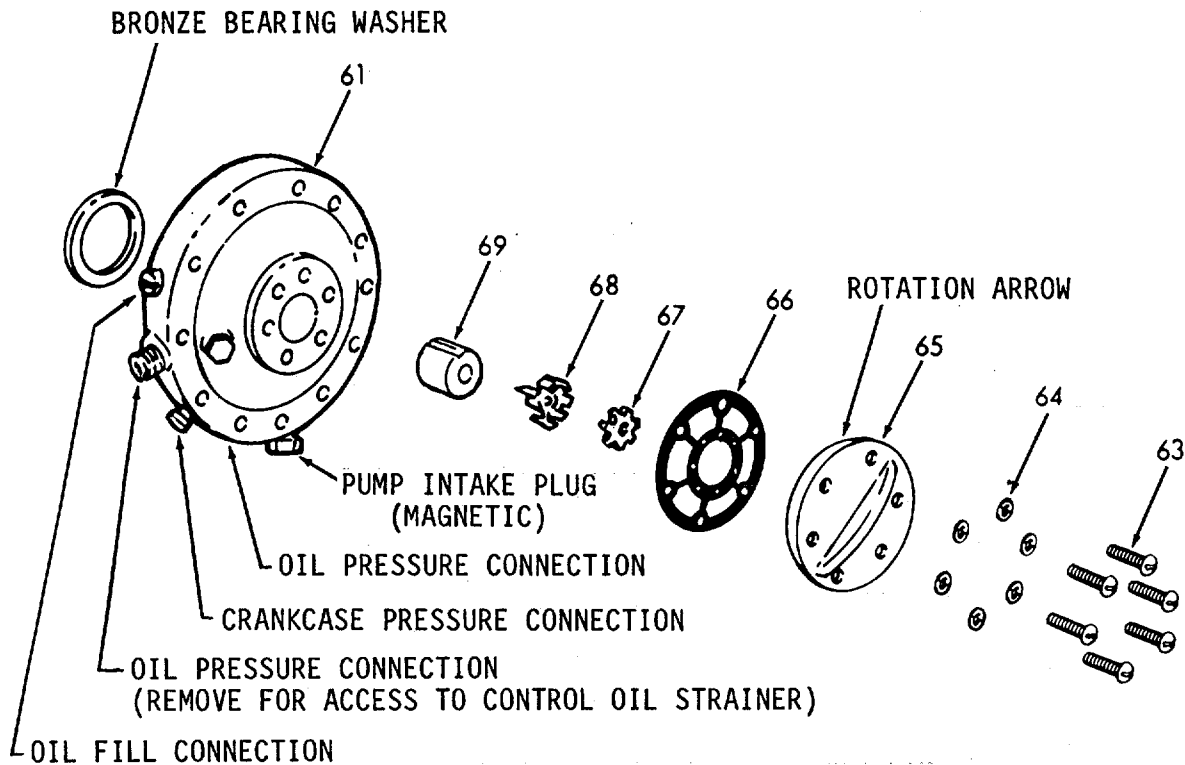
f. Bushing (69)	<ol style="list-style-type: none"> 1. Install new bushing by pressing bushing into bearing head (61) from bearing end with small end toward pump. 2. Insure sufficient clearance for pump by tapping bushing lightly toward bearing end of bearing head. 3. Place a .001 inch circular shim against bushing. 	Bushing oil groove must be located at top of bearing head.
g. Idler (67), and rotor (68)	Install.	
h. Oil pump cover (65), and gasket (66)	<ol style="list-style-type: none"> 1. Assemble. 2. Install screws (63), and lockwashers (64). 3. Tighten to 12 to 16 lb. ft. (16.3 to 21.7 Nm) torque. 	Use new gasket.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

- | | | | |
|----|--|--|-------------------------------|
| i. | Bushing (69) tool. | Tap towards pump until it seats against shim. | Use a cylindrical positioning |
| j. | Screws (63), lockwashers (64), cover (65), gasket (66), rotor (68), idler (67), and shim | <ol style="list-style-type: none"> Disassemble. Remove shim. | |



5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

- | | | | |
|--|---|---|-------------------|
| | k. Bushing (69) | Make sure it is square Use a depth gage. in bore. | |
| | l. All internal parts | Apply oil liberally. | |
| | m. Idler (67), rotor (68), gasket (66), cover (65), lock-washers (64) and screws (63) | 1. Reassemble.
2. Retorque. | Refer to h above. |
| | n. Pump | Check to see if pump does not bind in operation. | |

NOTE

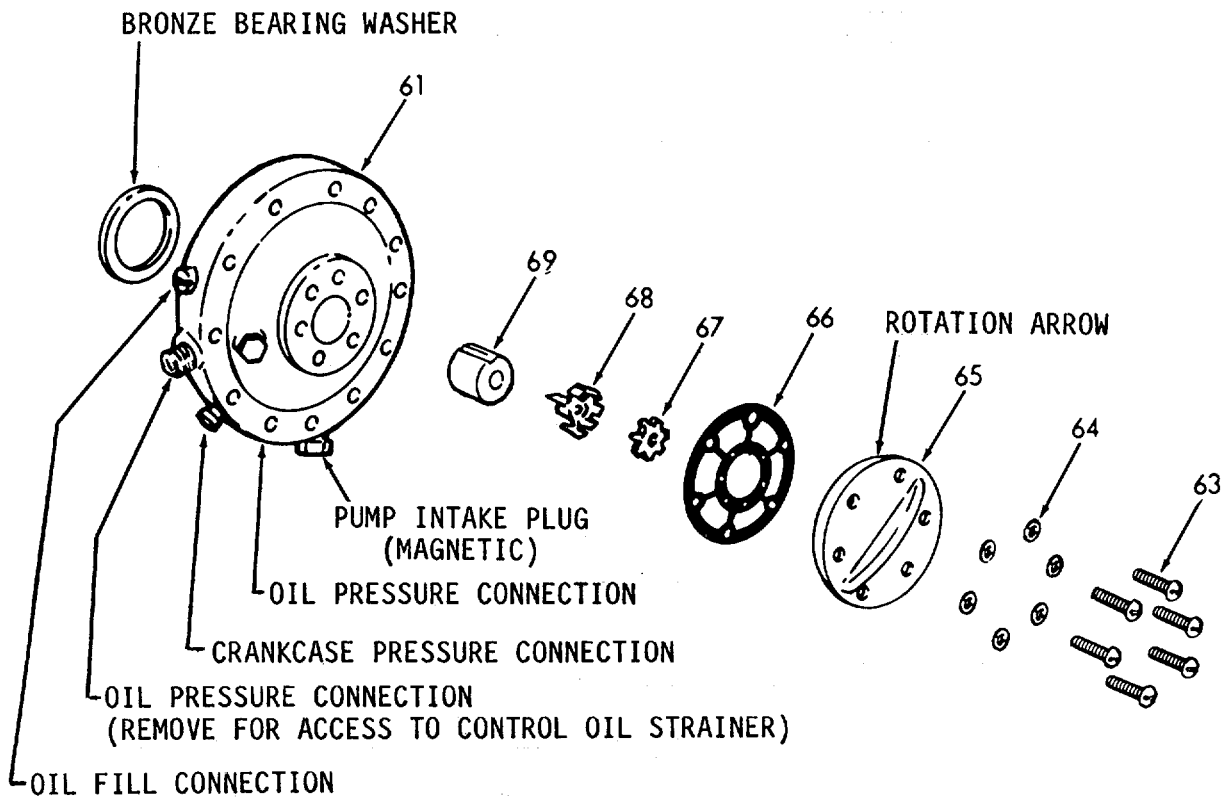
To check for proper clearance of oil pump bushing, grasp tang of oil pump shaft with a pair of pliers and try to move it in or out. If any end play can be felt, bushing is not properly positioned and there is too much clearance. If no axial movement is felt and if oil pump shaft rotates freely without binding, position of oil pump bushing is correct.

- | | | | |
|------------------------------|--------------------------|----------|-------------------|
| | o. Bearing head (61) | Install. | Refer to-step 12. |
| 14. Crank-shaft and Bearings | a. Seal and main bearing | Remove. | Refer to step 5. |

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)



- | | | |
|-----------------------------------|---------|------------------|
| b. Cylinder heads | Remove. | Refer to step 6. |
| c. Discharge valve | Remove. | Refer to step 7. |
| d. Cylinder and un-loader sleeves | Remove. | Refer to step 8. |
| e. Bottom plate | Remove. | Refer to step 9. |

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	f. Connecting rods, bearings, etc.	Remove.	Refer to step 10.
	g. Bearing head	Remove.	Refer to step 12.
	h. Crankshaft (70), thrust seal washer (71), and bearing washers (72)	Remove.	
	i. Pump end bearing (73)	<ol style="list-style-type: none"> <li>1. Chisel out. <li>2. Inspect bearing housing for burrs, <li>3. Clean surfaces. <li>4. Lubricate outside with heavy grease. <li>5. Line up hole in bearing with oil port in housing. Using puller shoulder and a jackscrew or press, press bearing in place. Let bearing protrude above housing $3/32" \pm 1/64"$ so that it will sup- 	<p>Be careful not to damage pump drive or bearing housing.</p> <p>Wipe away the filings.</p>

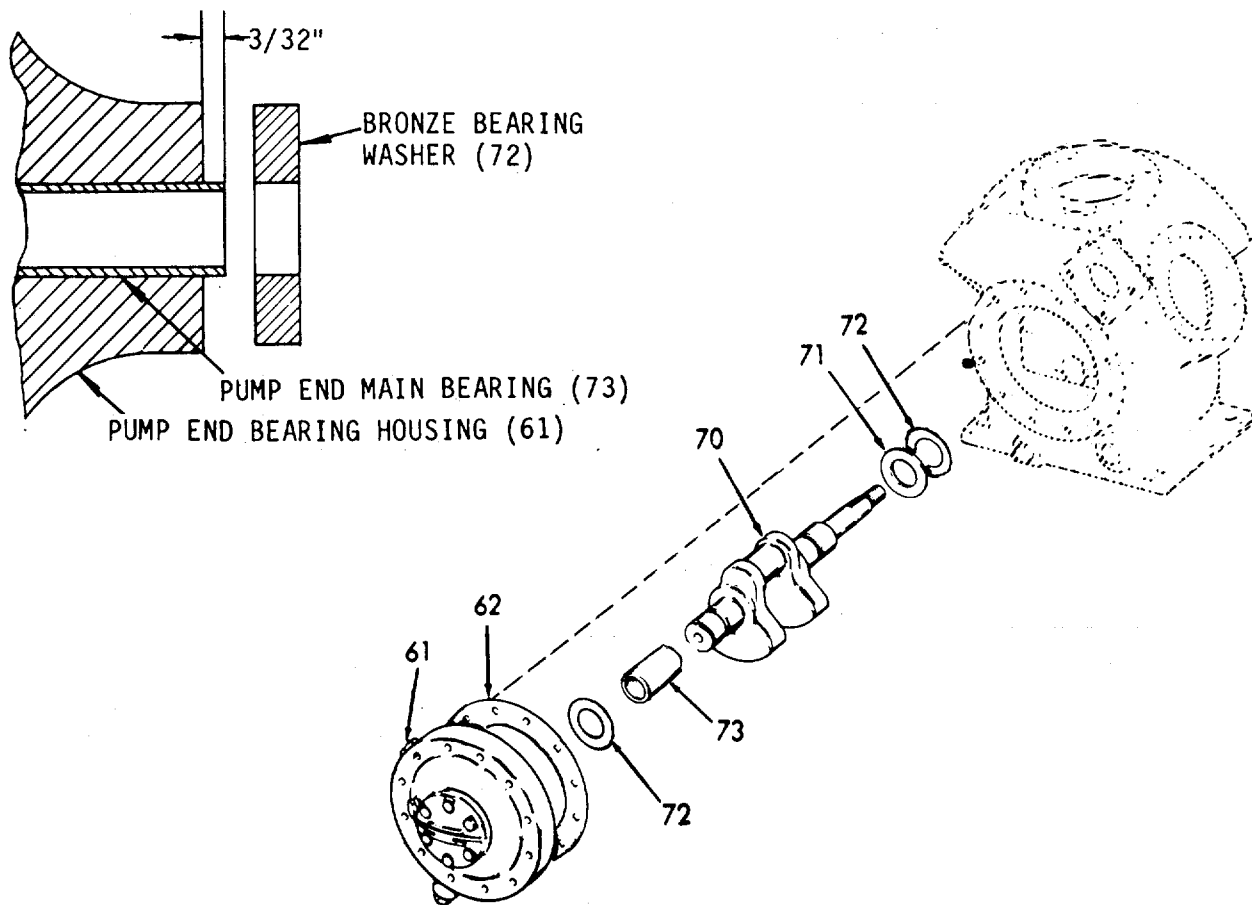
5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

port bronze bearing washer (72).

6. Install new gaskets (62) along with pump end bearing head (61). Be sure that notch in the bronze bearing washer is properly positioned around dowel pin.



5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

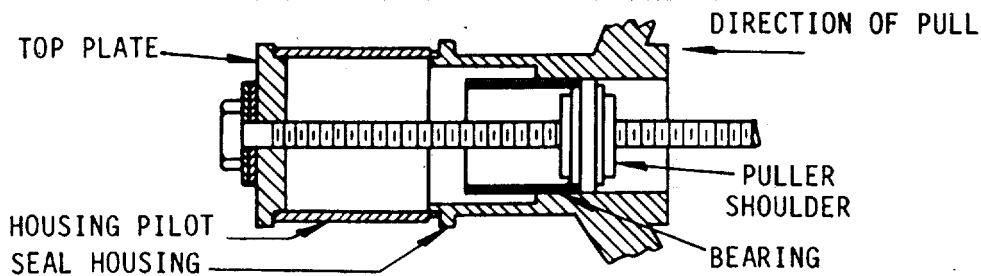
LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

j. Seal end bearing (74)

1. Install bearing puller.

The puller shoulder is threaded and acts as a traveling nut. Friction will keep the puller shoulder from turning with the bolt unless the threads are damaged. If they are damaged, use a 3/4"-16 nut between the thrust washer and bolt head. Hold bolt head stationary and turn nut.



2. Remove bearing.

3. Inspect.

If a burr or sharp edge is accidentally formed in bearing housing, remove it and clean housing before replacing bearing.

4. Lubricate outside of bearing with heavy grease.

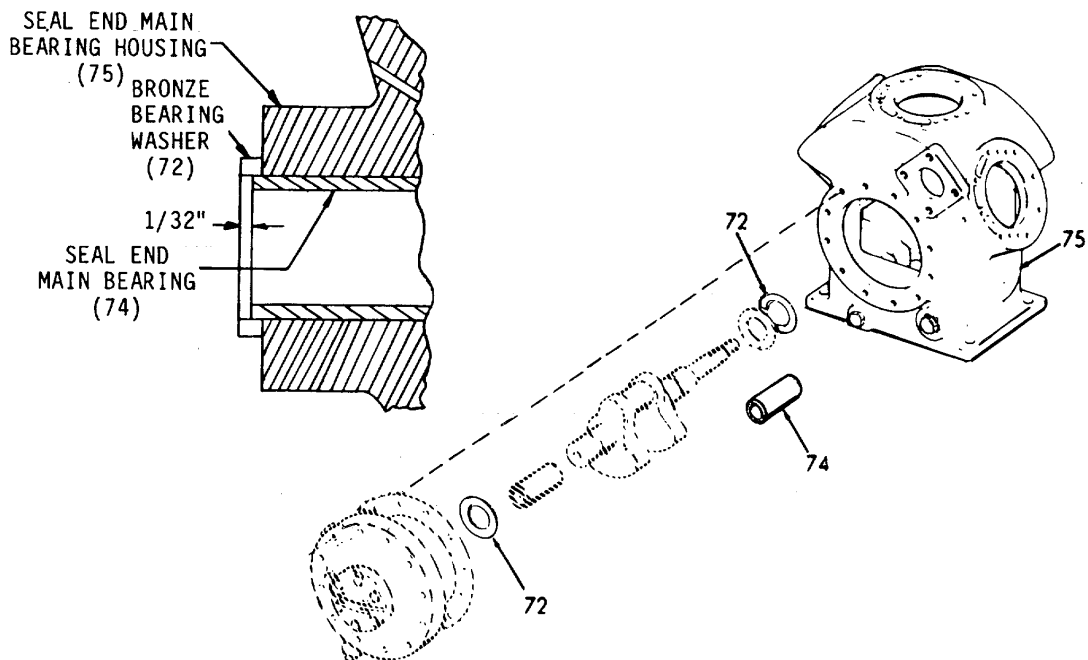
5. Position bearing so that the chamfered edge (notched edge) enters bearing housing first and oil holes in bearing and housing are lined up.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

6. Using puller, pull bearing into housing (75) until positioned as shown. Edge of bearing is 1/32" below surface of bronze bearing washer (72).
7. Look through oil pressure regulator opening to crankcase to see that oil passage to bearing is not blocked.
8. Check to see that relief groove in bearing is at top.
9. Blow out oil groove in bearing housing, and oil line to it.



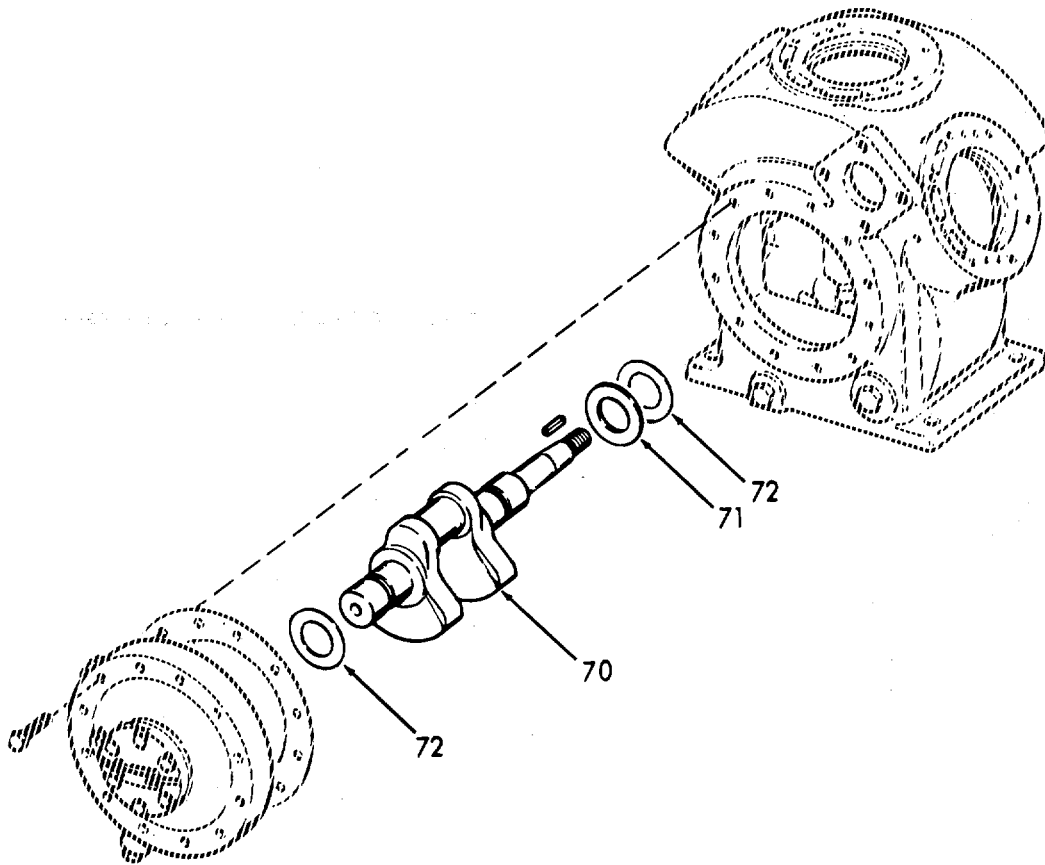
5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)	k. Crankshaft (70), thrust seal washer (71), and bearing washer (72)	Install.	
	l. Bearing head	Install.	Refer to step 12.
	m. Connecting rods, bearings, etc.	Install.	Refer to step 10.
	n. Bottom plate	Install.	Refer to step 9.
	o. Cylinder and unloader sleeves	Install.	Refer to step 8.
	p. Discharge valve	Install.	Refer to step 7.
	q. Cylinder head	Install.	Refer to step 6.
	r. Seal and main bearing	Install.	Refer to step 5.

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)



5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)

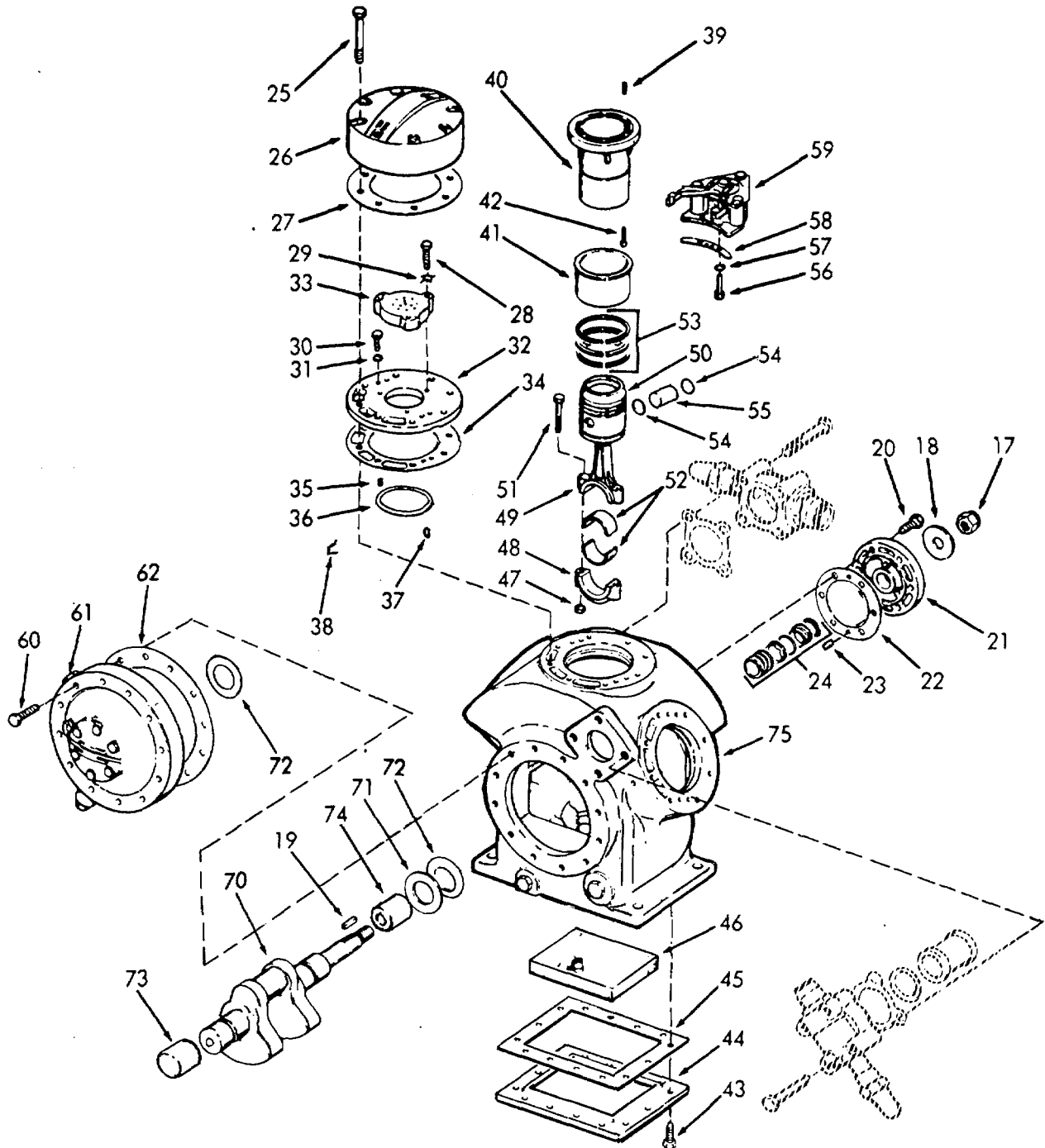
FREON COMPRESSOR LEGEND

- | | | | |
|-----|-----------------------|-----|----------------------------|
| 17. | Nut | 43. | Screws |
| 18. | Flatwasher | 44. | Bottom plate |
| 19. | Key | 45. | Gasket |
| 20. | Screws | 46. | Oil screen filter |
| 21. | Coverplate | 47. | Nuts |
| 22. | Gasket | 48. | Connecting rod caps |
| 23. | Dowel pins | 49. | Connecting rod |
| 24. | Shaft seal assembly | 50. | Piston |
| 25. | Screws | 51. | Connecting rod bolts |
| 26. | Cylinder head | 52. | Connecting rod bearings |
| 27. | Gasket | 53. | Rings |
| 28. | Screws | 54. | Piston pin retaining clips |
| 29. | Lockwashers | 55. | Piston wrist pin |
| 30. | Screws | 56. | Allen head screws |
| 31. | Screw Gaskets | 57. | Lockwashers |
| 32. | Valve plate | 58. | Gasket |
| 33. | Valve guide | 59. | Unloader power assembly |
| 34. | Gasket | 60. | Screws |
| 35. | Suction valve springs | 61. | Bearing head assembly |
| 36. | Suction valve | 62. | Gasket |
| 37. | Valve lift springs | 70. | Crankshaft |
| 38. | Retainer clips | 71. | Thrust seal washer |
| 39. | Valve lift clips | 72. | Bearing washers |
| 40. | Cylinder sleeve | 73. | Pump end bearing |
| 41. | Unloader sleeve | 74. | Seal end bearing |
| 42. | Lift valve pins | 75. | Housing |

5-140. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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OVERHAUL (Cont)



5-141. COMPRESSOR MPTOR - HVAC - MAINTENANCE INSTRUCTIONS

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

<u>Equipment Condition</u>	<u>Condition Description</u>
----------------------------	------------------------------

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

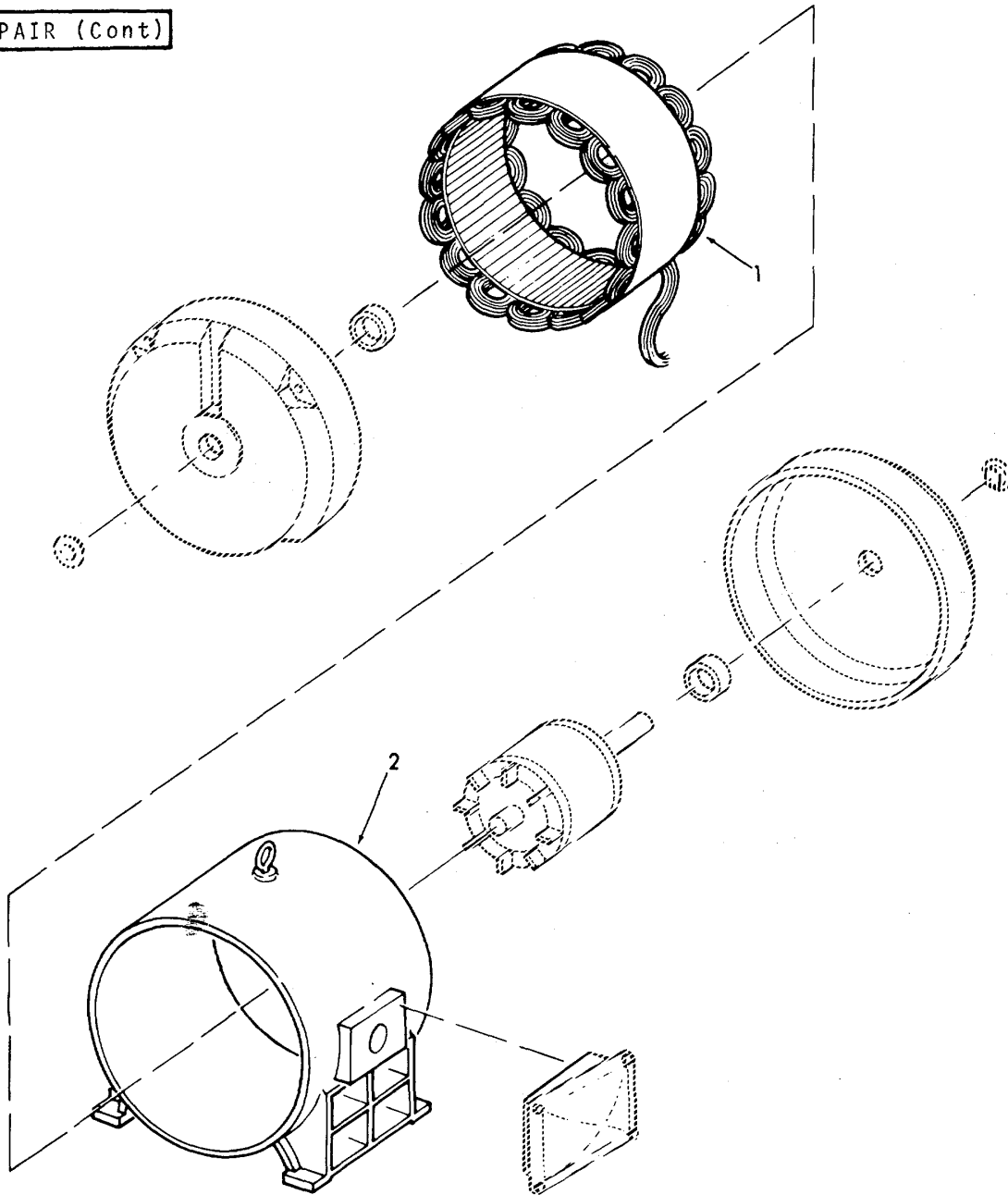
- | | | | |
|----------|------------------------|--------------------|--|
| 1. Motor | a. Stator core
(1) | Repair or replace. | |
| | b. Stator frame
(2) | Repair or replace. | |

5-141. COMPRESSOR MOTOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION ITEM ACTION REMARKS

REPAIR (Cont)

REPAIR (Cont)



5-142. COMPRESSOR MOTOR - HVAC - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for Controller maintenance instructions.

5-143. COMMISSARY SPACE EQUIPMENT - MAINTENANCE INSTRUCTIONS.

The following is an index to the Commissary Space Equipment maintenance instructions.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Refrigerator/Freezer	5-144
Milk Dispenser	5-145

5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS.

This task covers:

- | | | | |
|----|----------------------|----|---------|
| a. | Repair | b. | Service |
| c. | Test and Adjustments | d. | Replace |

INITIAL SETUP

Test Equipment

Halide leak detector
Refrigeration gauges

References
Paragraph

4-37 Refrigerator/Freezer

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

Freon FE12

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

Observe WARNING in this procedure.

5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

- REFRIGERANT UNDER PRESSURE is used in operation of this equipment.
- DEATH or severe injury may result if you fail to observe safety precautions.
- Avoid prolonged breathing of Freon gas.
- If gas leaks develop, avoid direct skin contact. Wear thermal protective gloves and goggles in any situation where skin-eye contact is possible.
- Prevent contact of refrigerant gas with flame or hot surfaces. Heat causes refrigerant to break down and form a highly toxic and corrosive gas.

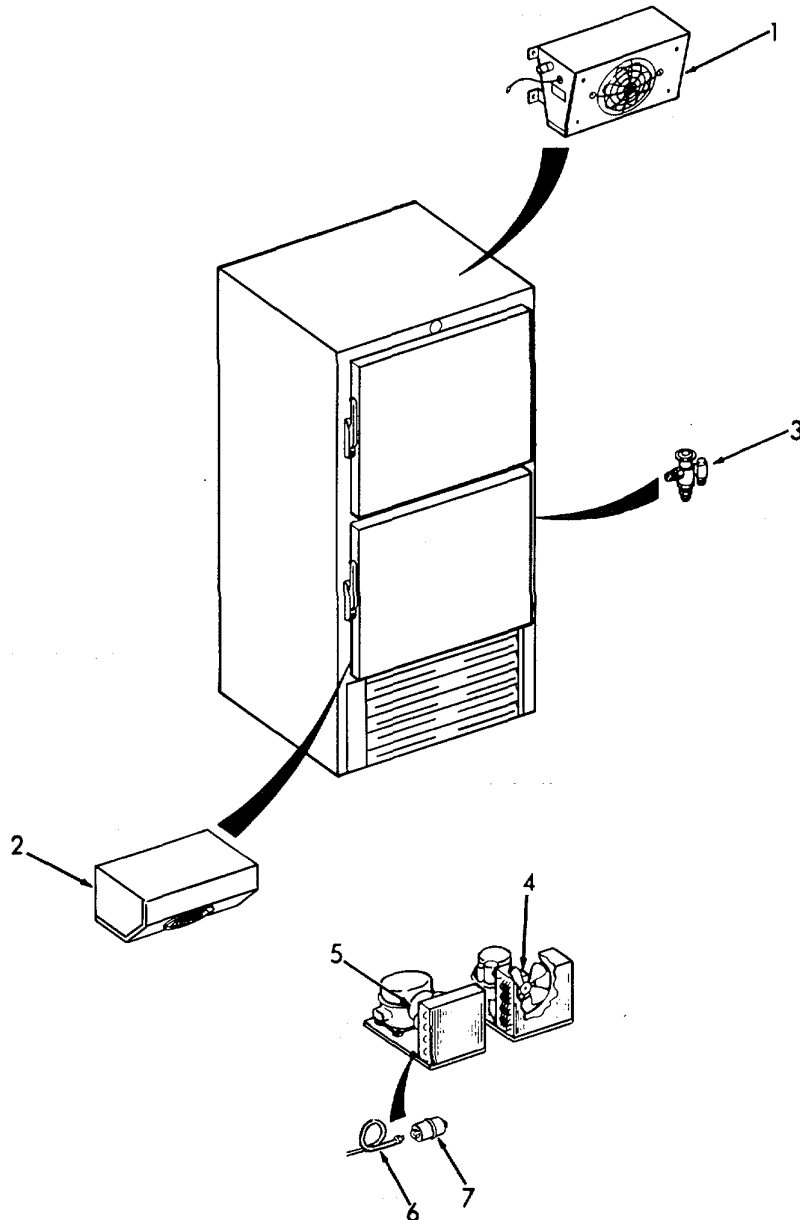
REPAIR

- | | | |
|-------------------------|-------------------------------------|---------|
| 1. Refrigerator/Freezer | a. Refrigerator evaporator (1) | Repair. |
| | b. Freezer evaporator (2) | Repair. |
| | c. Expansion valve (3) | Repair. |
| | d. Freezer condensing unit (4) | Repair. |
| | e. Refrigerator condensing unit (5) | Repair. |
| | f. Capillary (6) | Repair. |
| | g. Strainer dehydrator (7) | Repair. |

5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



SERVICE

2. Pressure settings.
 - a. All back pressure controls are factory set at 17 psi cut-out and 34 psi cut-in. These control settings will result in a cabinet temperature average of 40°F under normal conditions. If it becomes necessary to adjust the control, the cut-in point must never be set lower than 34 psi or the evaporator will not defrost during the off cycle. To lower the temperature, lower the cut-out point only. When the control is properly set, defrosting will be automatic.

5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

- b. To increase or decrease the pressure setting refer to back pressure control instruction sheet.

3. Refrigerant.

NOTE

Freon 12 refrigerant is used.

- a. Low refrigerant in the system.

(1) Should a compressor operate for too long a period, or too often, it is generally due to the refrigerant supply being low, even though the temperature may be cold enough.

(2) When the refrigerant is a little low, the head pressure may be below normal with the machine running; when the supply is very low, the pressure may drop considerably within 10 or 15 minutes after the compressor stops. The suction or back pressure may be higher than normal, while the machine is idle and drops more quickly than it -should when the compressor starts, and may continue to be lower than normal with the apparatus in operation.

(3) In case of low refrigerant, first locate the cause which is almost certain to be a leak. Do not add any refrigerant until the leak has been found and repaired.

- b. How to add refrigerant.

(1) Weigh the service cylinder before and after adding refrigerant, as this is the only way to determine how much refrigerant has been added.

(2) Be sure the low side suction valve is turned all the way to the left to close the gauge port. Install a compound gauge hose on one end, and connect the center hose from the manifold to the refrigerant cylinder. Before finally tightening the connection, crack the service valve to purge air in the regular way. Attach the pressure gauge to the high-side valve.

(3) Warm the refrigerant service cylinder by putting it into a pail of warm water, or by using hot cloths. Do not use a blow torch. Place cylinder in an upright position with valve at top to admit refrigerant vapor. Do not allow liquid to enter compressor crankcase.

5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

(4) Turn the low-side valve inward, so that the compressor crankcase is opened to the compound gauge and to the hose which leads to the cylinder for fresh refrigerant. Start the compressor; watch the compound gauge, and then open the valve on the service cylinder. A competent serviceman should add the proper amount of refrigerant to the corresponding temperature and pressure of the system.

c. How to pump refrigerant back into the receiver.

(1) When it is necessary to open, or remove for repairs, the expansion valve, expansion coil, or the suction line, all the refrigerant must be pumped back into the receiver and condenser - if it is to be used again after the repairs are complete. The receiver and condenser will hold the entire charge of refrigerant.

(2) Attach a compound gauge to the low-side or suction valve, and a pressure gauge to the high-side or discharge shut-off valve, purging the connections in the usual way. After the gauges are attached, turn both valves back one turn for reading; now close the receiver valve to shut-off the receiver from the liquid line going to the expansion valve.

(3) Then, start the compressor and run it until the compound gauge shows approximately 5 lbs. This operation pulls the refrigerant all the way around through the system in the direction of the arrows shown on master drawing and forces it into the condenser and receiver. When the 5 lb. pressure is reached, it is almost certain that all the refrigerant is pumped back into the condenser and receiver. At this point, the unit can be stopped, and the high-side shut-off valve closed to prevent any refrigerant vapor going back into the compressor should the compressor valves leak.

CAUTION

Never open a vacuum system as air will rush in to replace the vacuum and will probably draw some moisture into the system.

(4) With the refrigerant back into the condenser and receiver, any part can be removed from the unit with the exception of the high-side shut-off valve, the condenser and the receiver. These parts still have refrigerant in them.

5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

d. How to discharge excess refrigerant.

(1) Too much or too little refrigerant will result in improper operation.

(2) System with too much refrigerant is similar to one with air in system.

(3) If the operating head pressure is too high, stop the machine, and allow the unit to cool to room temperature. If the off head pressure is still higher than the corresponding room temperature, air is in the system. If the off pressure drops to normal, there is too much refrigerant. This excess liquid reaches the condenser area and overloads the machine causing it to run excessively. The overload protection may trip. The condenser will be hotter than normal near the top and cooler than normal near the bottom. In any case, refrigerant will not be satisfactory and the charge must be reduced to the correct amount by discharging excess refrigerant.

(4) Excess refrigerant is released through the high-side service valve. The high pressure gauge must be attached to the high-side valve in the regular way to observe the drop in pressure as the refrigerant is removed. The gauge connection of the high-side cylinder valve may be opened a little, two or three times in succession until the pressure comes down to a normal corresponding value of the condensating gas pressure and the room temperature in which the cooler is operating.

(5) Open the discharge service valve to release some of the refrigerant. Do not let too much refrigerant out at a time, as this may discharge more refrigerant than necessary and result in improper operation of the cooler.

e. Testing for leaks.

(1) If a leak is suspected in the system, check entire system including all tubing connections, valves, receiver, condenser, evaporator and compressor.

(2) Sometimes oil may be visible where leaks occur. The method for testing for leaks is two-fold, depending on whether or not leak occurs on the high-side or on the low-side.

5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

(3) The low-side refers to that part of the refrigeration system consisting of:

- Evaporator
- Suction Line
- Crankcase up to the intake valve located in the valve
- Plate

(4) The high-side refers to that part of the system extending from the cylinder head, condenser, receiver tank and liquid line up to the expansion valve.

(5) It is evident that before testing for leaks on the low-side, it is necessary to build up a pressure on the low-side. This is done by attaching the pressure gauge at the suction service valve and charging the system to about 30 lbs.

f. Halide torch leak test.

A halide torch is used to detect a leak in the freon 12 refrigerant. A change of color in the flame from blue to green indicates a leak around the joint being tested.

g. Air in the system may be caused by one of two reasons:

(1) By carelessness in servicing or charging methods.

(2) By a leak in the low-side when all refrigerant leaks out allowing air to be drawn into the system when operating under a vacuum.

(3) Air is non-condensable under the temperature and pressure conditions existing in refrigerating compressors. Therefore, the air becomes an inert substance which remains in the compressor head and condenser, resulting in increased discharge pressures and reduced condenser efficiency.

(4) If sufficient air is present, the discharge pressure will become so high that the compressor operation will be overworked forcing the motor overload device to cut out.

(5) To distinguish whether air in system or an overcharge of the refrigerant is causing the trouble will be relatively easy to determine by shutting off the unit and allowing it to cool to room

5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

temperature. In the case of a refrigerant overcharge, the discharge pressure will return to the normal figure which corresponds to the pressure, that is normal for the existing room temperature. However, if air is present, it will be seen that the head pressure does not return to the normal figure when the unit has cooled down to the existing room temperature.

h. Purging air.

(1) An excess of refrigerant or the presence of air in the system will require a purging operation. This operation is done as follows:

(a) Disconnect the pressure gauge at the discharge service valve and open the discharge valve so that air is allowed to escape slowly.

(b) At this point, the service man can purge the required amount.

TEST AND ADJUSTMENTS

4. Refrigerator/Freezer.

a. When the chill box is first installed, place a thermometer inside. Let the chill box run for three hours, Within one half hour, the temperature should be 45° above zero.

b. If the proper temperature is not obtained, install a gauge on the low-side of the condensing unit. The back pressure must show 3 to 6 lb. pressure. The head pressure gauge must show 85 to 90 pound pressure. If the low-side gauge shows a deep vacuum, then this is evidence of a gas leak and moisture in the system. In this case, the leak must be located and silver soldered. The proper way to locate a leak is with a Halide torch. When using a torch, use a small flame and be sure reactor plate is in good condition. After repairing leak, the system must be recharged. In order to recharge the system, the following must be done:

(1) Front-seat liquid line service valves.

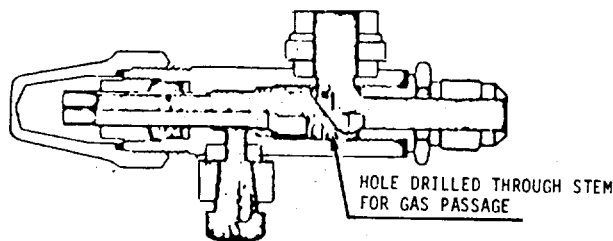
5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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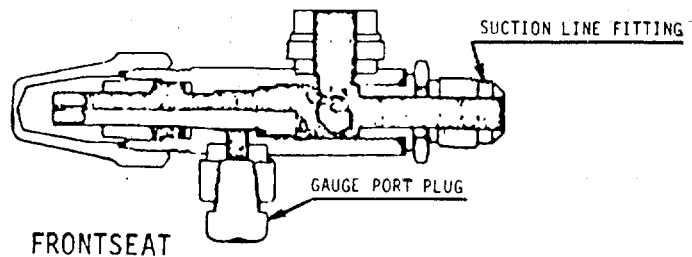
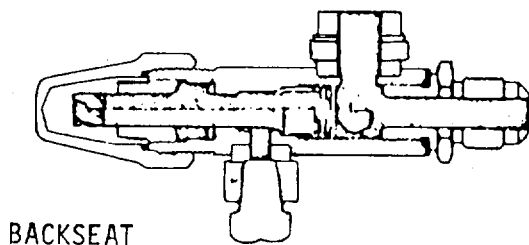
TEST AND ADJUSTMENTS (Cont)

- (2) Install low-side gauges, purge the connecting hose and crack the service valve.
- (3) Pump the system down until gauge shows zero pound pressure.
- (4) Remove dehydrator, replace with new one and be sure inlet and outlet are on proper ends.
- (5) Recharge system through suction line service valves. (Refer to step 5).
- (6) Backseat all service valves and run the system. Allow enough time for refrigerator to pull down to proper temperature.
- (7) Be sure all flared connections are tight.

c. The exact charge for this system varies. The approximate charge will be two (2) pounds. This charge will give the best results. Any large variation from this charge will affect the performance. If an exact two pounds cannot be put in the system, the correct charge is that quantity of Freon 12, which will refrigerate all of the evaporator coil, and at the same time will not cause frosting or sweating of the suction line. If the system is badly over-charged, open liquid line service valve and purge gas off. See below for service valve positions.



FRONTSEAT



FRONTSEAT

5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TEST AND ADJUSTMENTS (Cont)

5. Compressor.

a. Testing the compressor.

If for any reason the compressor is not pumping sufficient gas, it is obvious that poor performance is the result. This can be caused by leaky valves. To determine whether the valves are leaking, test as follows:

b. Vacuum test.

(1) A compound gauge is installed at the suction service valve. Shut off the suction line after having started the compressor. A hammering sound, coming from the cylinder head, indicates that an excessive amount of oil is being pumped through the compressor. Oil is incompressible and its presence in the cylinder and passing through the valves caused the hammering. The valves are designed to stand this abuse. It nevertheless is undesirable because the oil is gradually be transferred to the condenser and receiver, which means that insufficient oil remains in the crankcase to lubricate the compressor. As soon as the compressor starts to pump oil, the motor should be shut-off for a short period of time, and then restarted and stopped until quiet operation of the compressor is secured.

(2) All during this time, the compound gauge should be given careful attention and when the compressor pumps a 24 inch to 26 inch vacuum or more, it is operating properly. When a 24 inch - 26 inch vacuum is reached, the motor should be shut-off, and the compound gauge carefully watched. In event the loss of vacuum is pronounced, that is, the back pressure readings advance to a pressure within a short period of time, it is a very good indication of a leaky discharge valve.

REPLACE

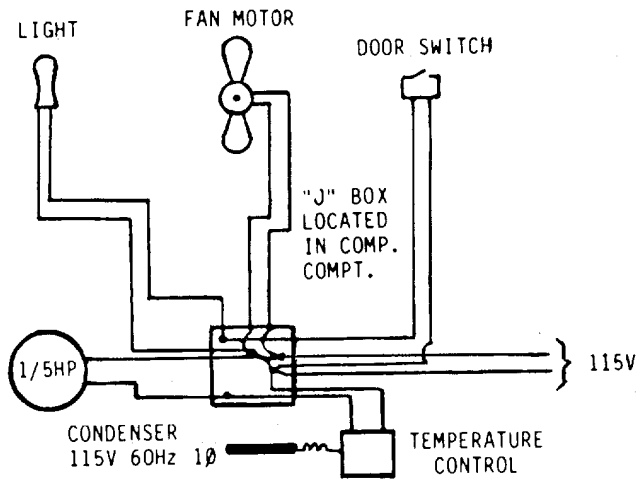
6. Refrigerator/
Freezer

Replace defective or damaged unit, if necessary.

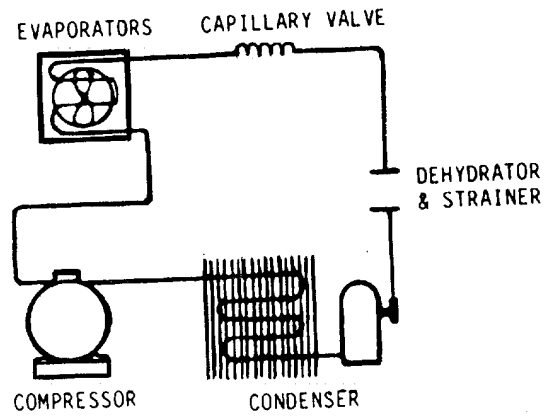
5-144. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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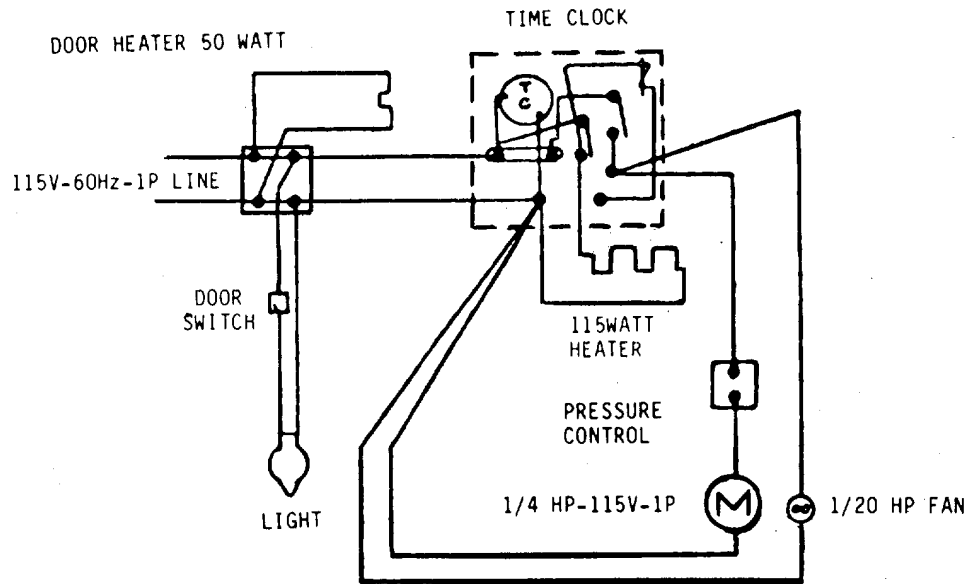
TEST AND ADJUSTMENTS (Cont)



SCHEMATIC WIRING DIAGRAM FOR REFRIGERATOR



TYPICAL SCHEMATIC REFRIGERATION DIAGRAM



FREEZER SCHEMATIC WIRING DIAGRAM

5-145. MILK DISPENSER - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

References
Paragraph

Test Lamp

4-39

M-ilk Dispenser

Special Tools

Equipment
Condition

Condition Description

NONE

NONE

Material/Parts

Special Environmental Conditions

NONE

NONE

Personnel Required

General Safety Instructions

1

Observe WARNING in this procedure.

LOCATION

ITEM

ACTION

REMARKS

NOTE

The following instructions pertain to electrical problems.

REPAIR

WARNING

In order to avoid electrical shock and possible injury, tag and place disconnect switch in the OFF position and pull fuses as an added precaution. Exercise caution when working with electrical equipment.

5-145. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

1. Milk Dispenser.

a. The electrical system on the compressor can be checked with an ordinary test lamp as follows:

(1) With compressor plugged into test lamp. The following must light:

(a) L1 and L2. If no light, check power source.

(b) L and 3. If no light, make sure control contacts are closed.

(c) M and 3. If no light, relay circuit is open. Replace relay.

(d) M and 1. If no light, overload may be tripped off. Wait 10 minutes. If no light, replace defective overload.

(2) Remove wires from L and 3 and insert test lamp in series with L1 and 3. Momentarily touch L2 to following points in sequence:

(a) S - If no light, start winding is open. Replace compressor.

(b) R - If no light, run winding is open. Replace compressor.

(c) S1 - If no light, Lead SI-S should be replaced.

(d) M - If no light, lead M-R should be replaced.

(e) L - If no light, replace relay.

(3) Remove lead M-R and insert test lamp in series with L1 and 3. If light shows when L2 is touched to L1 relay should be replaced. A new relay will eliminate any faulty electrical characteristics, such as improper pickup or drop out, which cannot be determined with a test lamp.

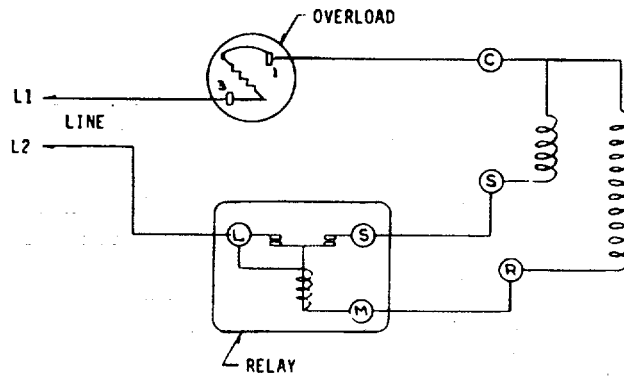
b. If all above tests prove satisfactory, and there is no capillary restriction, and unit still fails to operate properly with a good relay, compressor should be replaced.

5-145. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

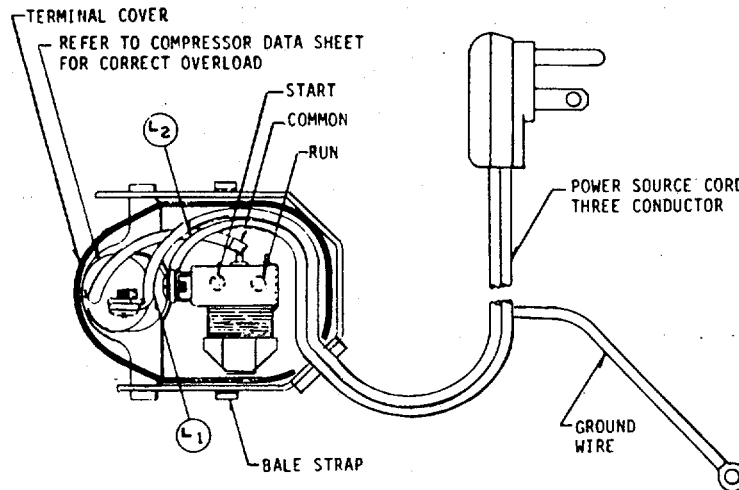
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

CHECKING
ELECTRICAL
SYSTEM



COMPRESSOR SCHEMATIC WIRING DIAGRAM



COMPRESSOR TERMINAL BOX

5-146. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENENCE INSTRUCTIONS.

This task covers:

a. Test

b. Replace

c. Repair

INITIAL SETUP

Test Equipment

None

References
Paragraph

4-45 Fire Detection/ Extinguishing System

F0-2 Fire Detection and Halon Alarm System

Special Tools

None

Equipment

Condition

Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

2

General Safety Instructions

Observe WARNING in procedure.

LOCATION

ITEM

ACTION

REMARKS

WARNING

Fire extinguishing agent is hazardous and toxic to humans.

TEST

1. System

Refer to paragraph-4-45 for complete information.

REPLACE

2. System

Replace any damaged components in accordance with standard pipe procedures.-

5-146. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS
(Continued).

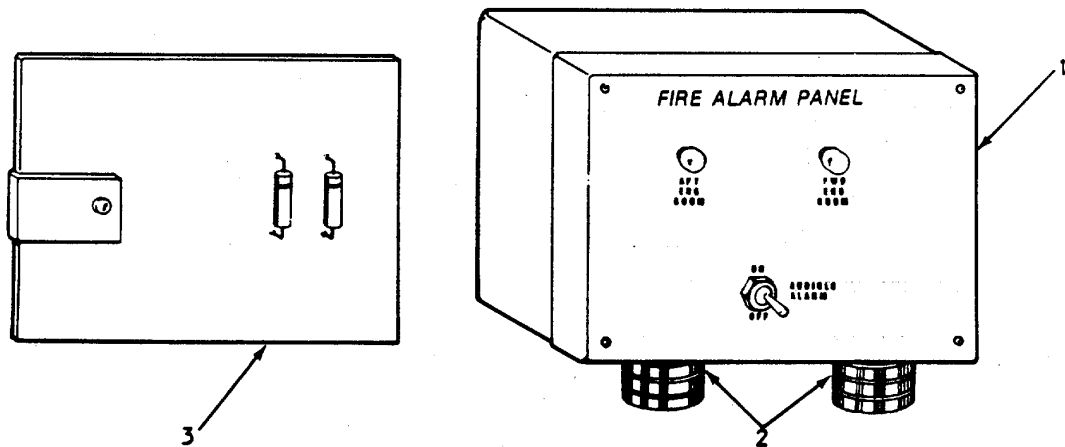
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE (Cont)

3. Fire Alarm	a. Cables	Tag and disconnect.	
	b. Hardware	Remove.	
	c. Fire Alarm panel	Replace.	
	d. Hardware	Reinstall.	
	e. Cables	Reconnect.	
4. Cylinder Assemblies	Refer to paragraph 4-45.		
5. All other Components	Refer to paragraph 4-45.1		

REPAIR

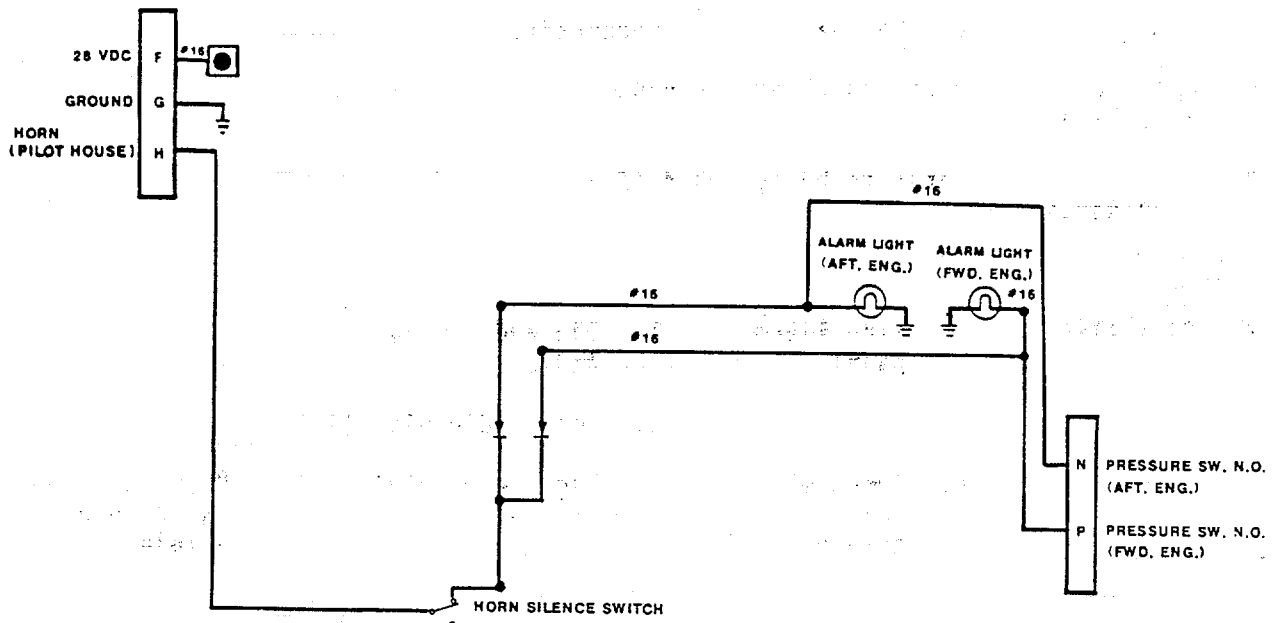
6. Fire Alarm panel	a. Fire Alarm panel	1. Tag and remove cables (2). 2. Remove cabinet (1).	
	b. Component board assembly (3)	1. Tag and unsolder wiring.	Refer to schematic, page 5-1474



5-146. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE (Cont)



NOTE: ALL WIRING IS #20 AWG, EXCEPT WHERE MARKED #16.

5-146. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

2. Remove nut (2), screw (3), and lockwasher (4) from bracket (5).

3. Remove board assembly (1).

Use new board.

4. Reinstall screw (3), lockwasher (4), and nut (2).

5. Reconnect wiring.

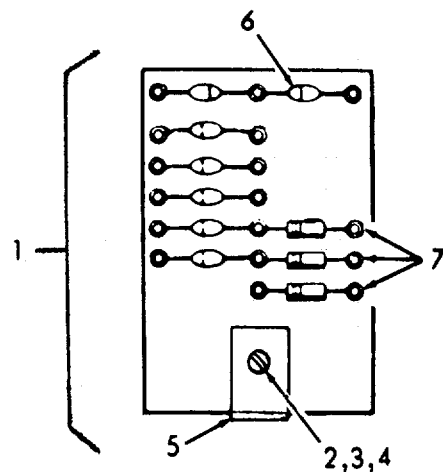
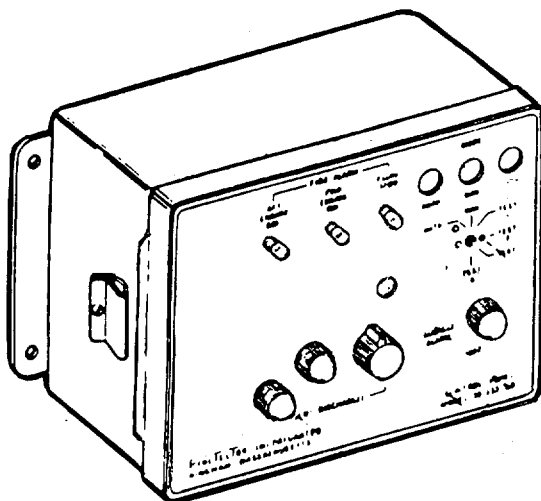
b. Diodes (6)

Replace.

Observe position of solid band on diode. Install new diode with solid band in same position.

c. Resistors (7)

Install.



5-146. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

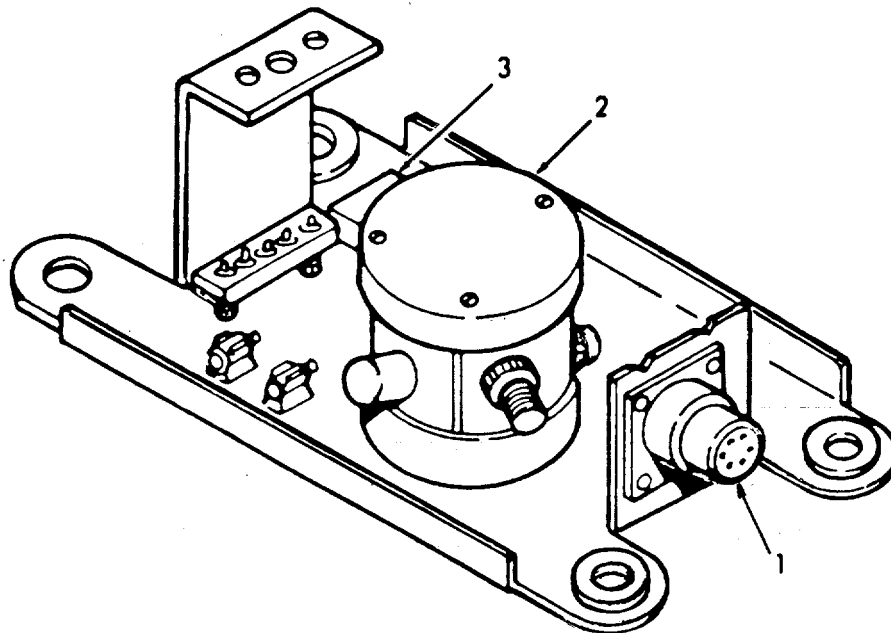
8. Smoke
Detector

a. Connector
(1)

1. Tag and disconnect wiring.
2. Remove mounting hardware, and connector.
3. Reinstall mounting hardware, and connector.
4. Reconnect wiring.

b. Labyrinth assembly (2), and relay (3)

Replace.



5-146. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

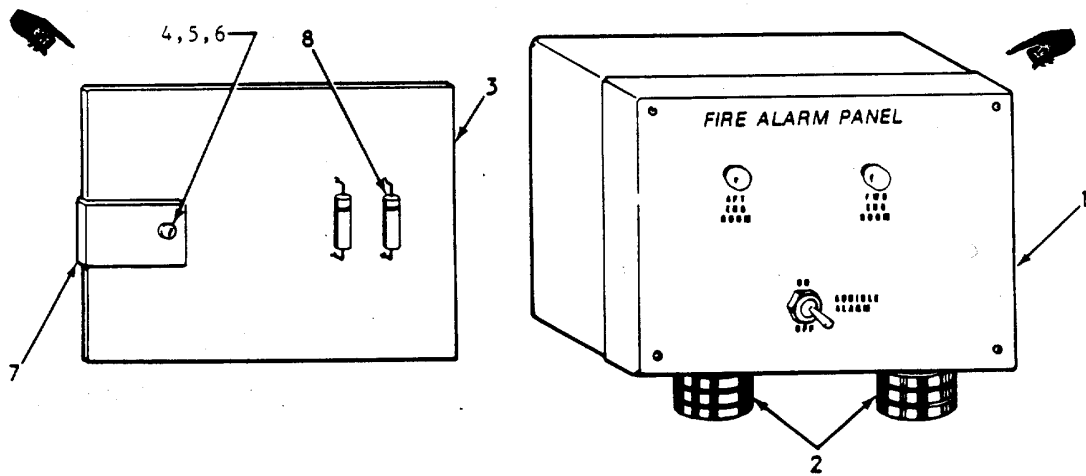
2. Remove nut (4), screw (5), and lockwasher (6) from bracket (7).
3. Remove board assembly (3). Use new board
4. Reinstall screw (5), lockwasher (6), and nut (4).
5. Reconnect wiring.

c. Diodes (8)

- Replace.
- Observe position of solid band on diode. Install new diode with solid band in same position.

d. Fire Alarm Panel

1. Replace cabinet (1)
2. Replace cables (2)



5-147. INTERIOR COMMUNICATION SYSTEMS - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

The following is an index to the Interior Communication System maintenance procedures.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Interior Communication Systems	5-148
Alarm Switchboard	5-149
Thermostat Switch and Magazine Alarm	5-150
Amplifier/Loudspeaker	5-151
Loudhailer	5-152

5-148. INTERIOR COMMUNICATION SYSTEMS'- MAINTENANCE INSTRUCTIONS.

This task covers:

Replace or Repair

INITIAL SETUP

Test Equipment

NONE

References

FO-1 Interior Communication System, One Line and Plan

FO-2 Fire Detection and Halon Alarm System

Special Tools

NONE

Equipment

<u>Condition</u>	<u>Condition Description</u>
------------------	------------------------------

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNING in this procedure.

5-147. INTERIOR COMMUNICATION SYSTEMS - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

In order to avoid possible shock and injury, tag and place all circuit breakers in the OFF position.

<u>CIRCUIT</u>	<u>DESCRIPTION</u>
E	Sound Powered Telephone Call Bell System
NH	Navigation Horn
1 JV	Sound Powered Phone System
KM	Propulsion Engine RPM Indicating System.
LC	MK27 Gyro Compass System.
-	Anchor Winch Alarm System.
-	Alarm Switch Board.
SE	Ship's Entertainment Receiver.
-	Remote Magnetic Heading System
-	Cease Fire
-	Steering Control and Rudder Angle Indicating System
TL	Remote Tank Level Indicating System

5-149. ALARM SWITCHBOARD - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair and Replace

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

4-49 Alarm Switchboard
FO-7 Alarm Switchboard Wiring Diagram

Special Tools

Soldering tools

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

REPLACE

1. Alarm Switch-board	a. Wiring	Tag and disconnect.	Refer to FO-7 for wiring diagram.
	b. Mounting hardware	Remove.	
	c. Switch-board	Replace.	
	d. Mounting hardware	Install.	
	e. Wiring	Reconnect.	

5-149. ALARM SWITCHBOARD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

NOTE

Refer to wiring diagram when replacing components.

- | | | | |
|----|--|--|--|
| 2. | a. Resistors
51K ohm 1W
(1), 53K
ohm 1W (2)
and 750K
ohm 2W (3) | Replace. | |
| | b. Power
transformer
(4) | 1. Remove nuts (5),
lockwashers (6),
and flatwashers (7).

2. Tag and disconnect
wiring.

3. Replace transformer.

4. Install flatwashers
(7), lockwashers (6),
and nuts (5) and
reconnect wiring. | |
| | c. Extension
signal
relay (8) | 1. Remove nuts (9),
lockwashers (10),
and flatwashers (11).

2. Tag and disconnect
wiring.

3. Replace relay (8) on
base (12).

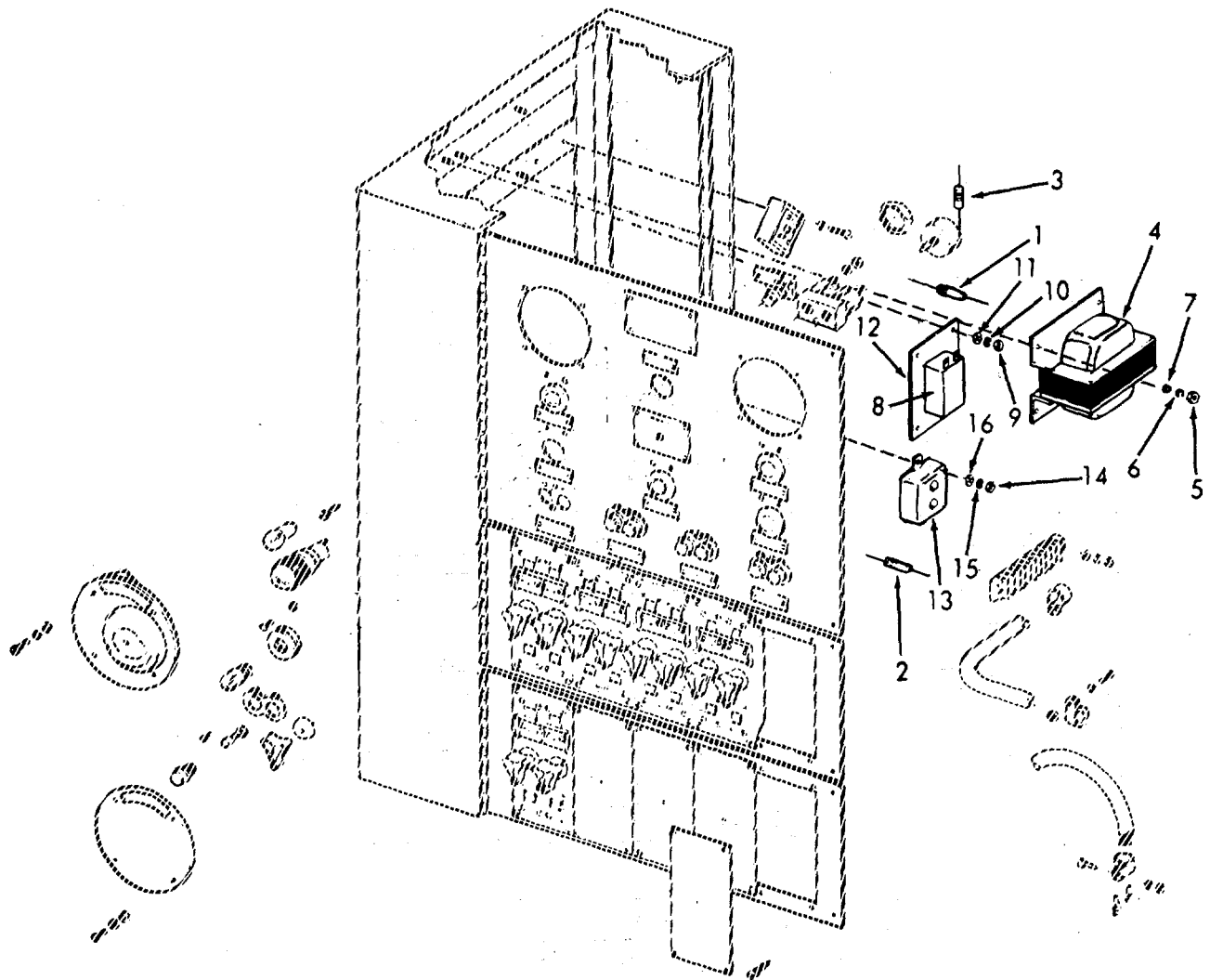
4. Install flatwashers
(11), lockwashers
(10), and nuts (9)
and reconnect wiring. | |
| | d. Capacitor
(13) (Elec-
trolytic
2UF 600V) | 1. Remove nuts (14),
lockwashers (15),
and flatwashers
(16). | |

5-149. ALARM SWITCHBOARD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

2. Tag and disconnect wiring.
3. Replace capacitor (13).
4. Install flatwashers (16), lockwashers (15), and nuts (14) and reconnect wiring.



5-149. ALARM SWITCHBOARD - MAINTENANCE INSTRUCTIONS (Continued).

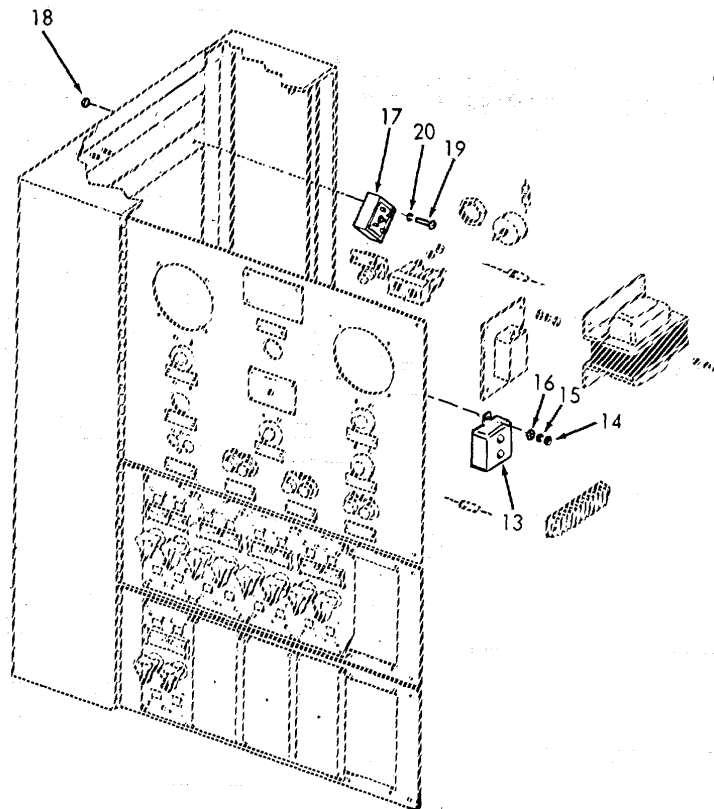
LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

e. Rectifier (17)

1. Remove nuts (18), screws (19), and flatwashers (20).
2. Tag and disconnect wiring.
3. Replace rectifier (17).
4. Install flatwashers (20), screws (19), and nuts (18).
5. Reconnect wiring.

See FO-7 for wiring diagram.



5-150. THERMOSTAT SWITCH AND MAGAZINE ALARM - MAINTENANCE INSTRUCTIONS.

This task covers:

Replace

INITIAL SETUP

Test Equipment

NONE

References

FO-1	Interior Communication System
FO-7	Alarm Switchboard Schematic

Special Tools

NONE

Equipment Condition

Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

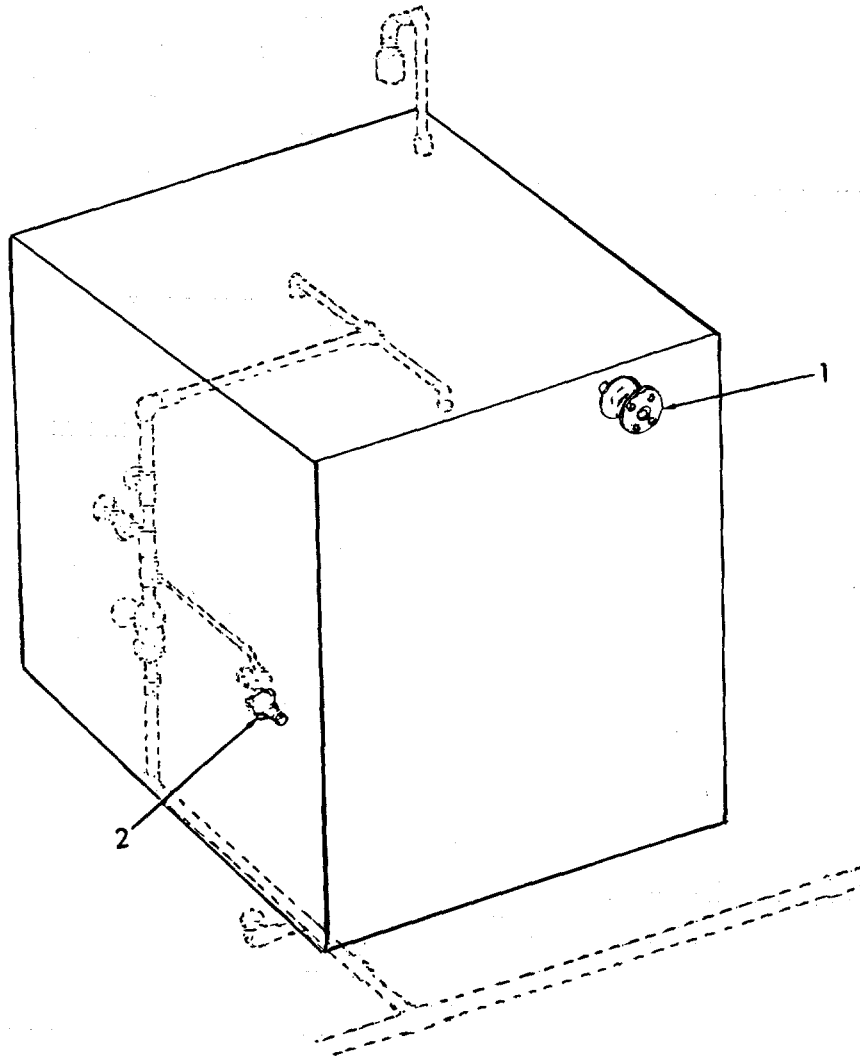
NONE

5-150. THERMOSTAT SWITCH AND MAGAZINE ALARM - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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REPLACE (Cont)

- | | | | |
|-------------|---|----------|--|
| 1. Magazine | a. Thermo-
static
switch
(1) | Replace. | |
| | b. Sprinkling
alarm
switch
(2) | Replace. | |



5-151. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

Soldering tools

Equipment Condition

Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

REPAIR

1. Amplifier/
Loudspeaker

a. Power switch (1), and pilot Light assembly (2)

Replace.

b. Incandescent lamp (3), and fuse holder (4)

Replace.

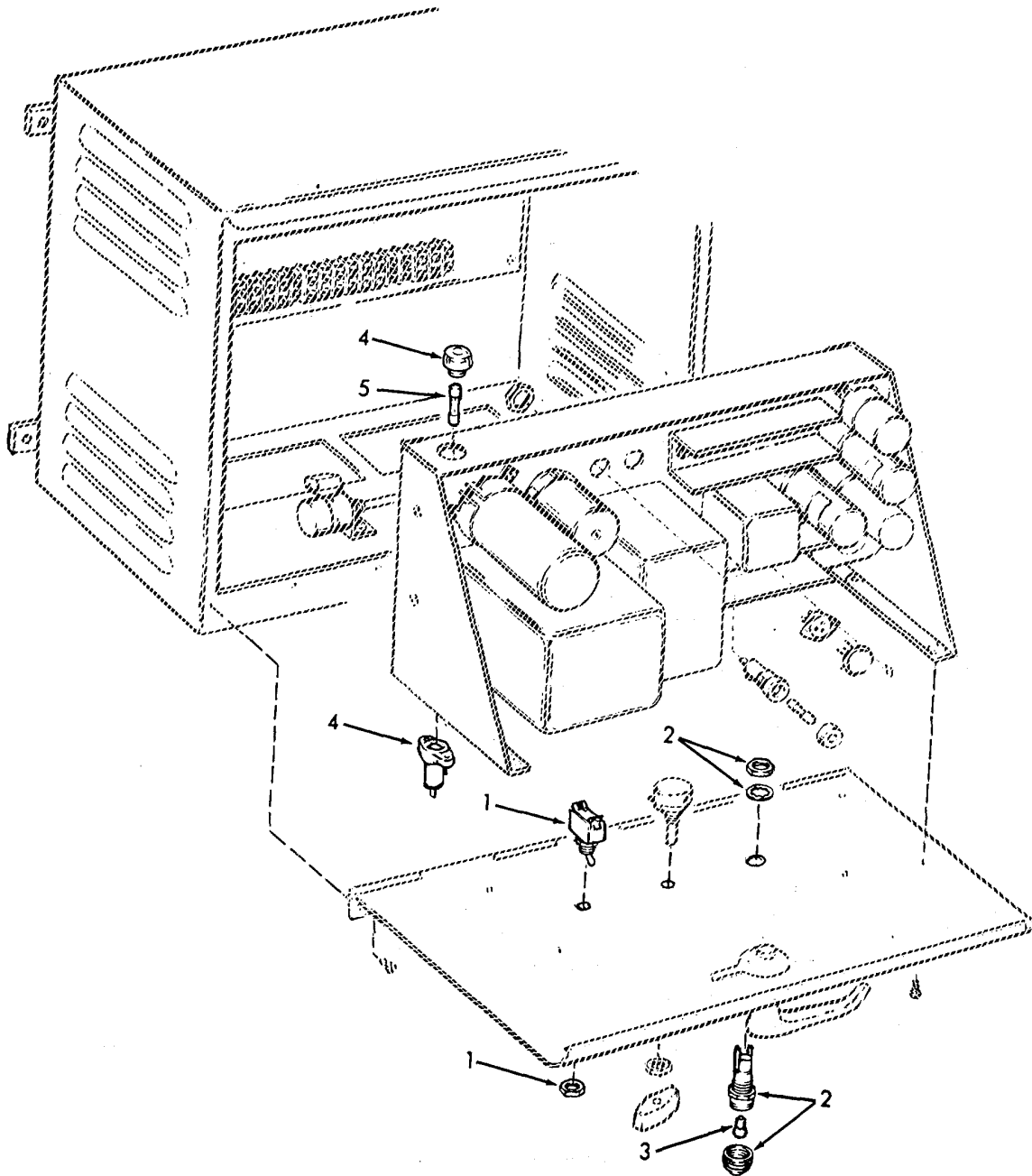
c. 2 ampere indicating fuse (5)

Replace.

5-151. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



5-151. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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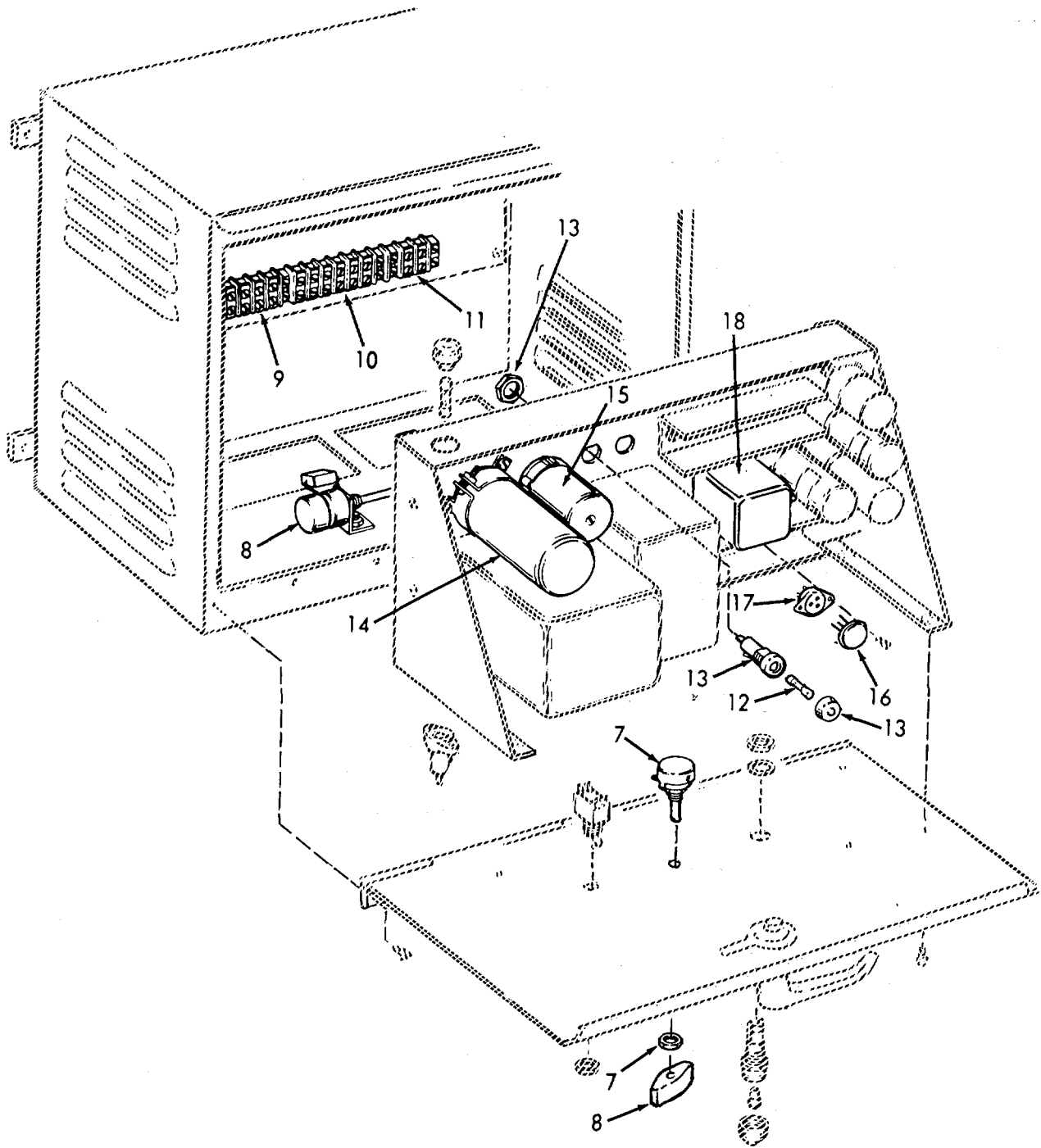
REPAIR (Cont)

- | | | | |
|--|---|----------|--|
| | d. Control knob (6) and 35k volume control (7) | Replace. | |
| | e. Line control (8), and terminal strip (9) | Replace. | |
| | f. Terminal strip (10) a and terminal strip (11) | Replace. | |
| | g. 4 ampere cartridge fuse (12), and fuse holder (13) | Replace. | |
| | h. Filter capacitor (14), and voltage regulator (15) | Replace. | |
| | i. PC power transistor (16), and transistor socket (17) | Replace. | |
| | j. Driver transformer (18) | Replace. | |

5-151. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



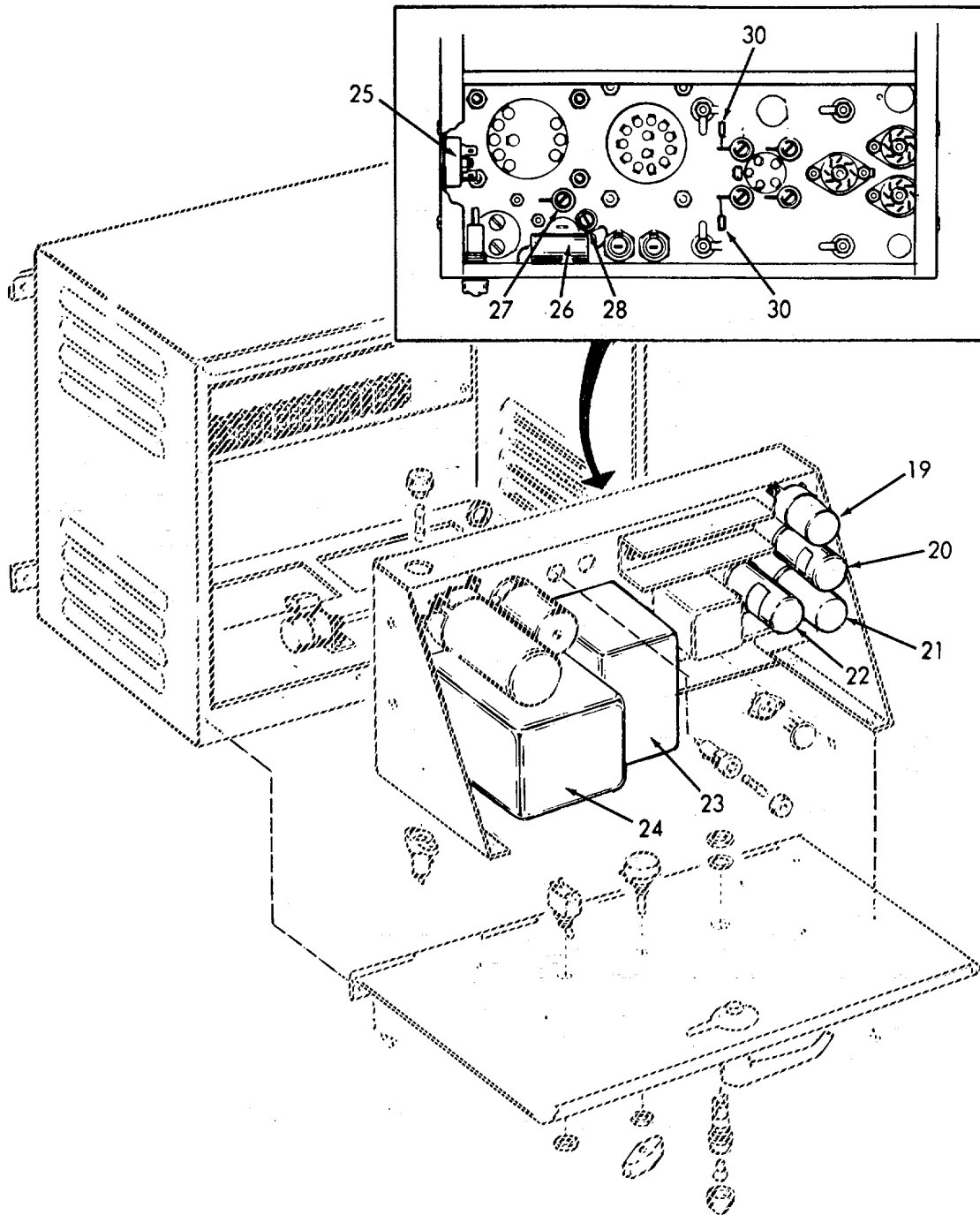
5-151. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)	k. Input transformer (19), and electronic switch (20)	Replace.	
	l. 500 UF electrolytic capacitor (21)	Replace.	
	m. Amplifier (22), and *output transformer (23)	Replace.	
	n. Power transformer (24), and bridge rectifier (25)	Replace.	
	o. PC filter capacitor (26)	Replace.	
	p. Bleeder resistor (27), and 30 ohm IIW resistor (28)	Replace.	
	q. DC bias diode (29), and DC blocking diode (30)	Replace.	

5-151. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



5-151. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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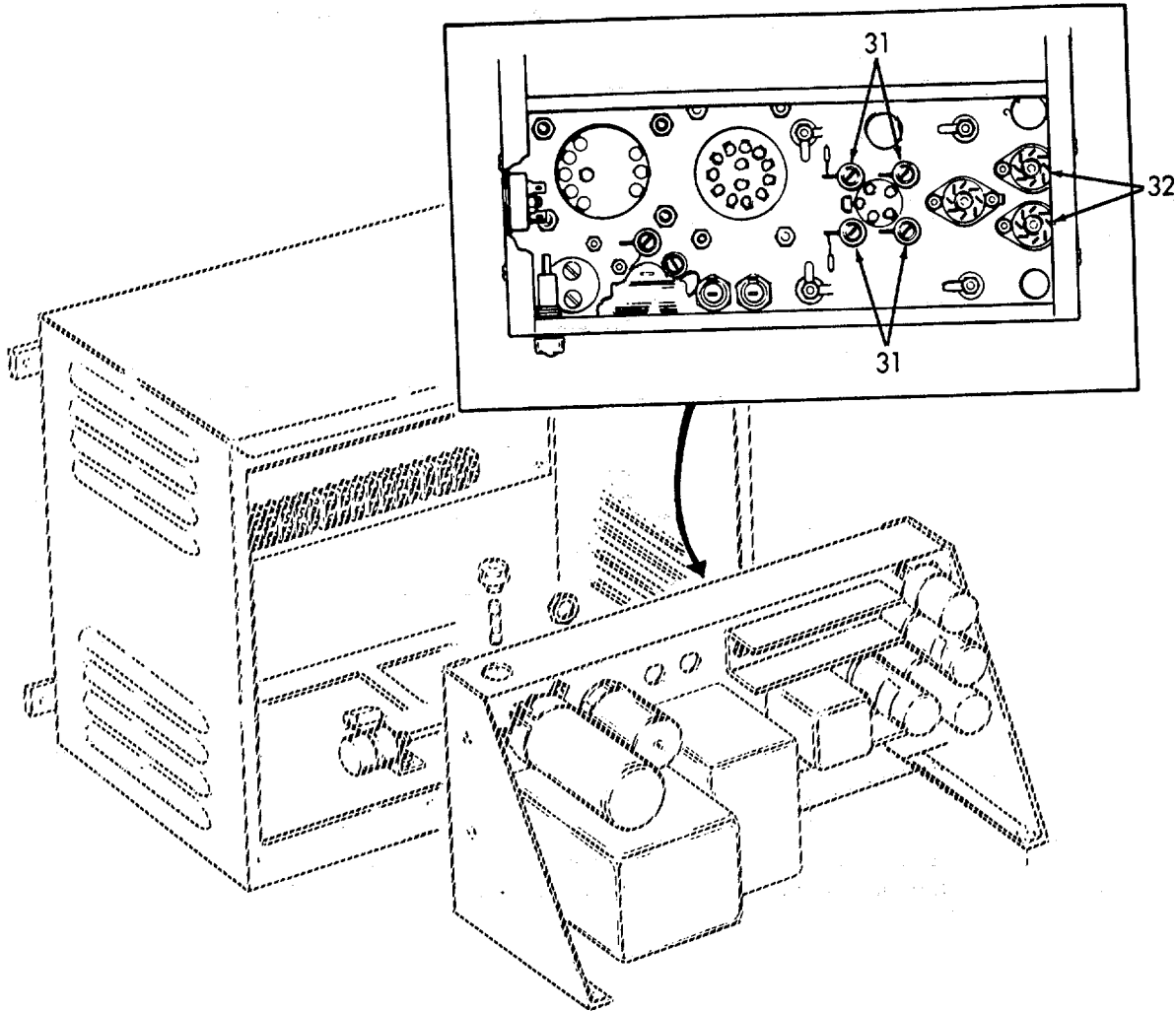
REPAIR (Cont)

r. Feedback resistor (31)

Replace.

s. 8 pin octal socket (32)

Replace,



5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Repair

b. Tests

INITIAL SETUP

Test Equipment

Audio signal generator
(1000 cycles)
Oscilloscope
Volt-Ohmmeter
(20,000 Ohm-volt)

References
Paragraph

4-47.3 Loudhailer Maintenance
FO-3 Loudhailer Wiring Diagram
FO-4 Loudhailer Schematic

Special Tools

Soldering tools

Equipment
Condition

Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe CAUTION in procedure.

LOCATION

ITEM

ACTION

REMARKS

REPAIR

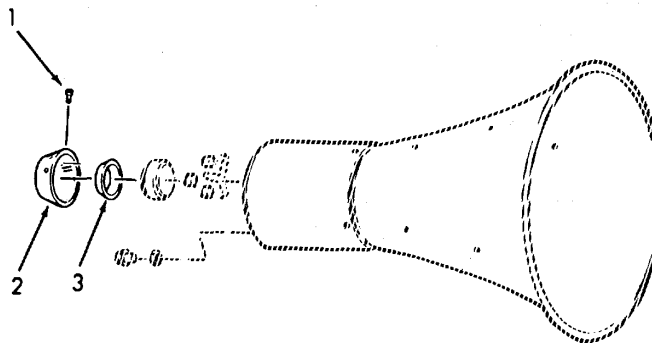
1. Microphone

a. Screws (1)

Remove.

b. Microphone cover (2)

Remove cover (2), and If damaged, rubber mouthpiece (3).



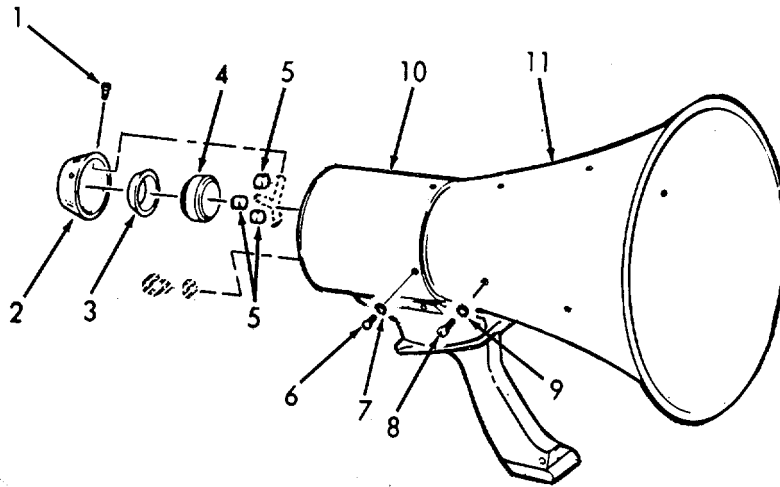
5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	c. Micro- phone (4) lugged leads.	1. Remove electrical wiring by removing two screws, and 2. Replace microphone by reinstalling two screws and lugged leads.	The other end of the wires are soldered to the two press-fit terminals on the amplifier housing.
	d. Neoprene bumpers (5)	Replace.	If damaged.
	e. Micro- phone cover (2)	Install rubber mouth- piece (3), using screws (1).	
2. Amplifier Housing Assembly	a. Screws (6), and lock- washers (7)	Remove three places.	
	b. Screws (8), and lock- washers (9)	Remove the rear screw on each side.	
	c. Amplifier housing assembly (10)	Slide off of horn (11).	

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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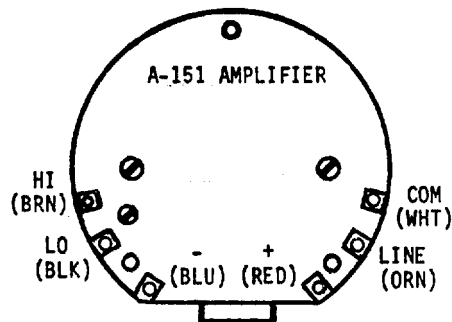
REPAIR (Cont)



d. Wiring

Disconnect wires.

- COM - white
- LINE - orange
- + - red
- - blue
- HI - brown
- LO - black



5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

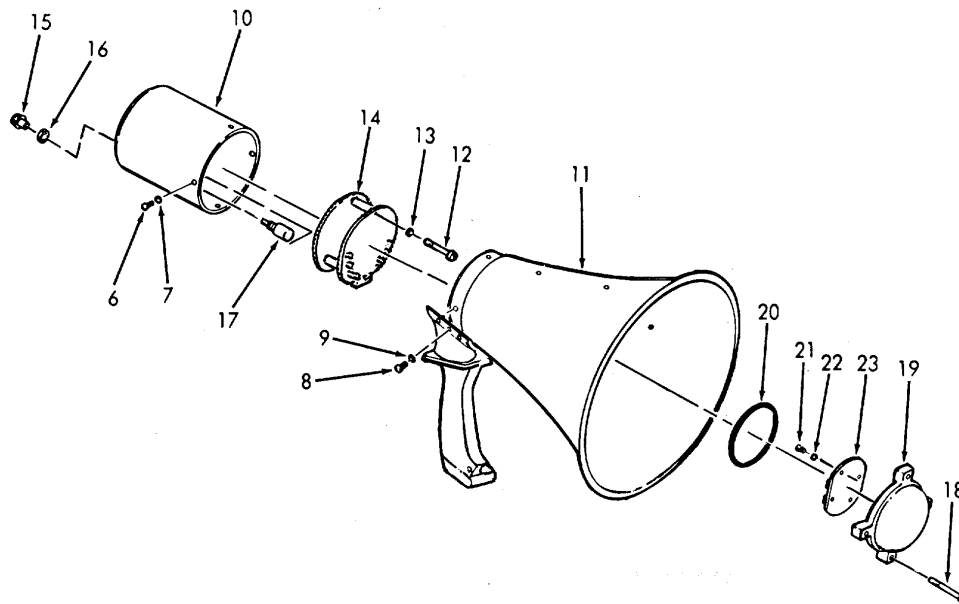
	e. Screws (12), and flat-washers (13)	Remove.	
	f. Amplifier (14)	Remove.	Refer to step 6 for repairs.
	9. Volume control	<ol style="list-style-type: none"> 1. Remove knob (15), seal nut (16), and variable resistor (17). 2. Disconnect wiring. 3. Replace variable resistor (17). 4. Reconnect wiring. 5. Install seal nut (16), and knob (15). 	Refer to schematic.
	h. Amplifier (14)	<ol style="list-style-type: none"> 1. Install using screws (12), and flatwashers (13). 2. Reconnect wiring. 	Refer to step 2d.
	i. Amplifier housing assembly (10)	<ol style="list-style-type: none"> 1. Slide onto horn (11). 2. Install screws (8), and lockwashers (9). 3. Install screws (6), and lockwashers (7). 	

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

3. Loud-speaker Assembly	a. Screws (18)	Remove.	
	b. Cover (19), and pre-formed packing (20)	Remove.	
	c. Screws (21), lockwashers (22), and contact boards (23)	<ol style="list-style-type: none"> 1. Disassemble. 2. Inspect springs on the contact boards to make certain they have not become deformed. 3. Inspect contacts for corrosion. 	<p>If necessary.</p> <p>Blackening of silver plate is normal. It is not necessary to remove it. Clean with metal polish.</p>



5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	d. Batteries (24), and separator (25)	Remove.	Discard batteries.
	e. Screws (26), and lock-washers (27)	Remove.	
	f. Contact board (28)	Remove.	If badly pitted, discard.
	g. Screws (29)	Remove.	
	h. Screws (30), flat-washers (31), lock-washers (32), and pre-formed packings (33)	Remove.	
	i. Battery cartridge lung (34)	Remove.	
	j. Screws (35), and lung supports (36)	Remove.	If necessary.
	k. Screws (6), and lock-washers (7)	Remove.	

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

l. Housing assembly (10)

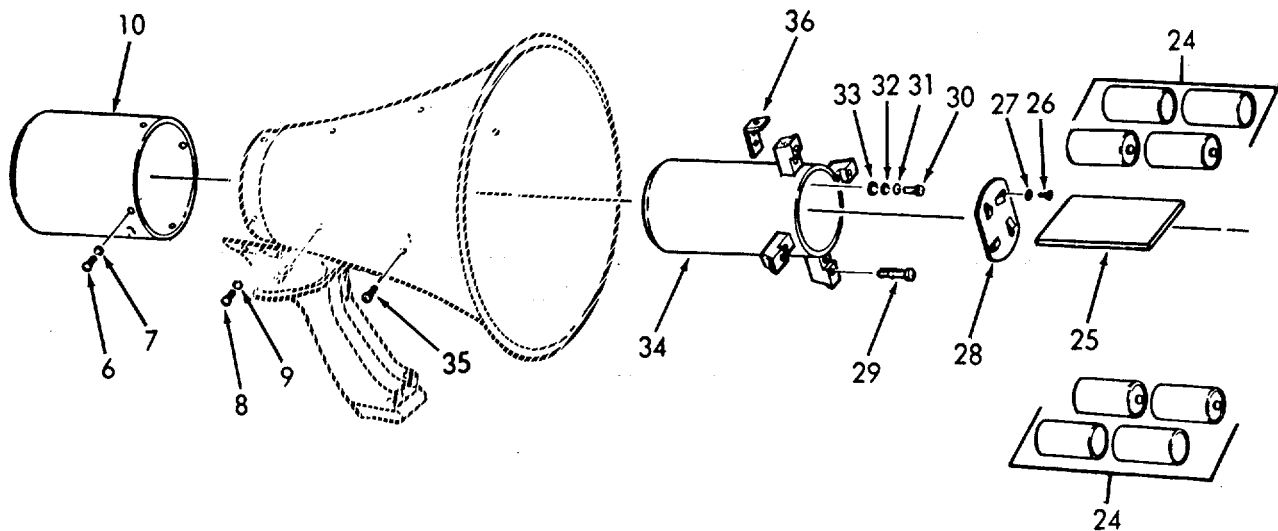
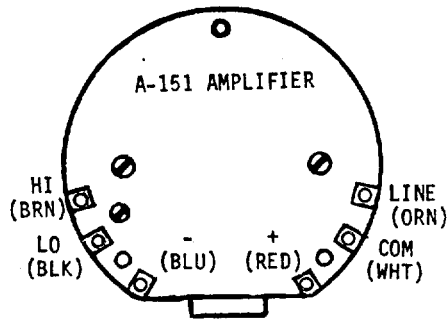
Remove.

If necessary, remove rear screws (8), and lockwasher (9) on each side.

m. Wiring

Disconnect wires to loudspeaker.

COM - white
 Line - orange
 + - red
 - - blue



5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

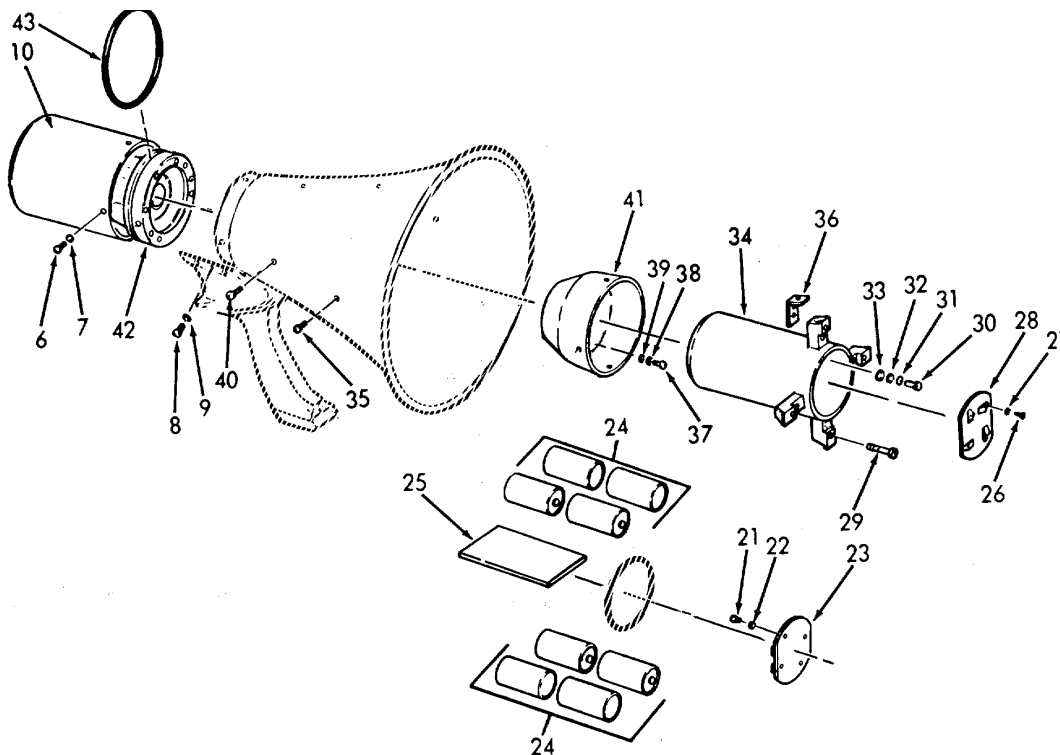
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	n. Screws (37), flat-washers (38) and lock-washers (39)	Remove.	
	o. Screws (40)	Remove.	
	p. Horn shell (41)	Remove.	
	q. Loudhailer (42)	Remove.	
	r. O-ring (43)	Remove.	
	s. O-ring (43), and loudhailer (42)	Reassemble.	Use light petroleum jelly on O-ring.
	t. Horn shell (41)	Install using screws (40 and 37), lock-washers (39), flat-washers (38).	
	u. Wiring	Reconnect.	Refer to step 3m.
	v. Housing assembly (10)	Install, using screws (6), and lockwashers (7).	Install rear screws (8), and lockwasher (9), if removed.
	w. Screws (35), and lung support (36)	Install.	

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | |
|-----|------------------------------------|---|
| x. | Battery cartridge lung (34) | Install using preformed packings (33), lock-washers (32), flat-washers (31), and screws (30). |
| y. | Screws (29) | Install. |
| z. | Contact board (28) | Install using screws (26), and lockwashers (27). |
| aa. | Batteries (24), and separator (25) | Install new batteries in accordance with outline on separator (25). |
| ab. | Contact board (23) | Install with screws (21), and lockwasher (22). |



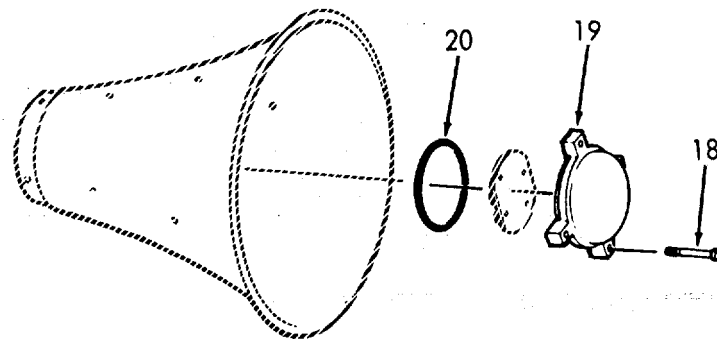
5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

ac.	Cover (19), and preformed packing (20)	Install.	<ol style="list-style-type: none"> 1. Align upper leg of cover and top leg of lung TOP markings. This will orientate the cover contact springs and the battery terminals correctly. 2. The upper leg on cover is longer than the other three legs to ease orientation.
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ad.	Screws (18)	Install.	
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5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS

4. Microphone.

The microphone unit can be given a preliminary check by removing the microphone cover (step 1), making the insulated feed thru terminals accessible. Turn the volume control to high and check the resistance across these terminals. A normal microphone unit will give a reading close to 30 ohms and in addition a click will be heard in the microphone.

5. Loudspeaker

The loudspeaker driver unit can be given a preliminary test before tests are initiated on the amplifier module. Remove the rear housing from the driver unit head as described in step 2. Setting the horn on its bell permits easy access to the driver unit with the housing hanging alongside by the connecting wires, as shown. Remove the snap on connectors from the amplifier output tabs marked "LINE" and "COM". Check the driver unit resistance across the "LINE" and "COM" terminals for a normal reading close to 10 ohms. A click should be heard in the loudspeaker at the same time. If no trouble has been found up to this point further tests must be made on the amplifier.

6. Amplifier

a. Refer to the electrical schematic of the Loudhailer.

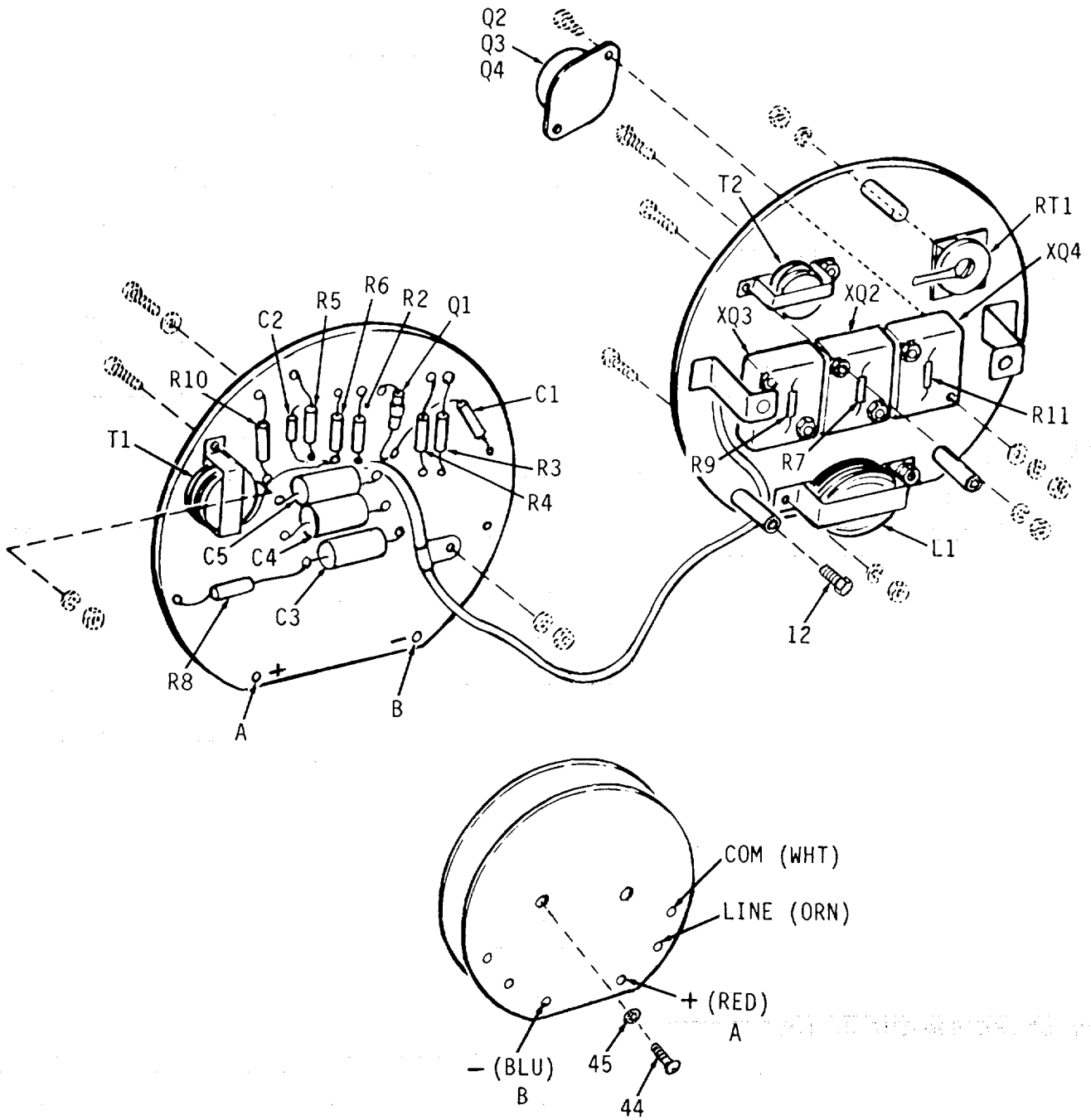
b. Positive and negative buses are designated test points, as either one or the other are used in checking the normal voltages or resistances of the circuit.

(1) Preliminary. In order to troubleshoot the amplifier, the module must be removed from the rear housing. First disconnect the six wires by removing the snap-on connectors from the tabs on the chassis. Remove the three amplifier mounting screws (12). Slide out the amplifier module from the housing and place on a working surface, with the power transistors down.- Remove the two screws (44), and flatwashers (45) which secure the phenolic board to the assembly. This board can now be hinged up and put on its cable and lid flat as shown in the illustration.

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)



5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)			
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CAUTION

Remove transistors from circuit before making resistance measurements; use a heat sink in soldering and unsoldering transistor leads.

(2) Resistance measurements.

(a) Most causes of malfunctioning are due to a faulty component, open or shorted wiring, or a loose or cold soldered joint which may have developed. These defects can usually be localized by conventional resistance measurements when these vary markedly from the normal values that should be obtained. Table 1 lists the normal resistance readings to be obtained across all points in the circuit necessary to localize defects, and in addition lists the possible J faults indicated by abnormal resistance reading. Test point A is the positive bus of the circuit, and test point B is the negative bus. All readings are in ohms and are measured with any standard 20,000 ohm per volt ohmmeter. Transistors Q2, Q3, and Q4 are removed for this test and at least two leads of Q1 are unsoldered from their lugs. Use a hot iron and hold the leads with a long nose plier to conduct heat away from Q1 and unsolder quickly.

(b) Note that the nominal resistance of the particular component is not measured in all cases, in as much as there are other components forming a network shunting the component. The median readings are given in each case for the combination of shunting effects - for instance in measuring R2 a reading of 1300 ohms nominal is obtained, instead of 27K. Here R2 is shunted by R3 in series with RT1 and the combination of T2 terminals 4-5, R9, L1 terminals 2-3 in parallel with T2 terminals 3-4, R11, L1 terminals 1-2. Confirmation of a defective transformer winding can be checked against the values given in the transformer table 2 after unsoldering the connections to this transformer.

(c) Attention is called to the tantalytic capacitors which y have a different resistance in either direction of polarity. For this reason, ohmmeter test prods must be used as table 1 indicates - use the plus test prod on test point A and the negative prod on test point B as called for in column 1. Be sure the ohmmeter used actually shows the polarity indicated by the test prod jacks or terminals as there are some meters which have reverse polarity on the ohmmeter range from that on the d.c. volts range.

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)

Table 1. Public Address Set Type AN/PIC-2, Troubleshooting - Resistance Measurements.

From Test Point	Component Symbol	Normal Indication	Cause of Abnormal Indication
B	Thru R3	470	R3 defective
B	Thru R4	220	R4 defective
A	Thru R2	1300	R2 or shunted components defective
A	Thru R5	950	R5, C2 or shunted components defective
A	Thru R6	10	R6 defective
A	From T1-1	700	T1 primary defective
B	From T1-4	1900	R7, T2 primary, or shunted components defective
A	From T2-3 or T2 -3	11	T2 secondary defective
A	Thru R10	0.3	R10 defective
A	From C1 neg.	100,000 Min	C1 defective
B	Thru R8	7,000	R8 defective
A	From L1-2	1,000	L1, R9, R11, T2 secondary or RT1 defective
A	From T1-4	1,000	T1 secondary or shunted components defective

Condition of Test

Meter: Any standard 20,000 ohm/volt V.O.M.
 Test Point A - Positive bus
 Test Point B - Negative bus
 Transistors removed from circuit
 All readings are in ohms

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)

Table 2. Transformer Table.

T1

Winding	400 Cycle Impedance	DC Resistance	Wire Size	No. of Turns	Tap
1-2	30000	700	43	3500	
3-4	500	30	37	420	

T2

1-2	250	22	34	502	
3-4-5	80	3.2 EA. Half	32	142 EA. Half Center	

L1

1-2-3	150	0.4 EA. Half	23	198	Center
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5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)

Table 3. Public Address Set Type AN/PIC-2, Troubleshooting - Voltage Measurements.

From Test Point	Component Symbol	Normal Indication No Signal	D.C. Volts Full Signal
B	ACROSS R1	0	0
B	ACROSS R3	+ 0.2	+ 0.2
B	ACROSS R4	+ 0.08	+ 0.08
A	ACROSS R2	- 12	- 11.5
A	ACROSS R5	- 0.45	- 0.45
A	ACROSS R6	- 0.35-	- 0.35
A	To T1-1	- 0.25-	-0.25
A	To T1-4	- 0.45	- 0.45
A	To T2-3	- 0.1	+ 0.15
A	To T2-5	- 0.1	+ 0.15
B	To L1-1	Below 0.05	+ 0.3
B	To L1-3	Below 0.05	+ 0.3

Conditions of Test

Meter: Any standard 20,000 ohm/volt V.O.M.
 Test Point A - Positive bus
 Test Point B - Negative bus
 Transistors in circuit
 Test set-up see illustration below
 All readings are in volts

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)

(3) Voltage measurements.

(a) Table 3 shows the nominal DC voltage measurements, which are obtained with a normally functioning amplifier. These are made with a 20,000 ohm per volt ohmmeter from either test point A or B as indicated, polarity of the test prod being observed accordingly. The values given are those obtained with a battery supply of 12 volts, so it is best to use a storage battery for these tests. The battery circuit should be fused, - to avoid damage due to accidental shorts.

(b) The values in the NO SIGNAL column are those obtained with transistors in circuit, the amplifier terminated normally and the battery circuit closed. The FULL SIGNAL column shows the normal d.c. voltages obtained with the amplifier is driven by a test signal to produce 10 watts output. Although it is possible to make amplifier tests with the amplifier module removed from the rear housing and opened up, and a 1000 c.p.s. test signal fed into the "HI" and "LO" terminals it is more convenient and conducive to careful testing to set it up for a bench test.

(c) To set up for a bench test, disconnect all six wires with snap-on connectors from chassis and remove the amplifier module entirely from the rear housing. Provide a 1000 c.p.s. adjustable signal source of any available impedance between 100 and 1000 ohms, to connect to terminals "HI" and "LO". Use a 16 ohm power resistor (25 to 50 watt rating) to terminate the output across terminals "LINE" and "COM". For test power use a 12 volt storage battery connected to the plus and minus terminals of the amplifier, through a 2 ampere fuse and a 2 ampere d.c. meter. The figure shows the amplifier connected in this manner ready for testing. Spring test clips are convenient means of making connection to the terminal tabs. The module is of course opened up as described above to permit access to all terminals.

(d) For the NO SIGNAL tests, shutoff the oscillator, but operate the switch S1. Observe the DC ammeter reading. This will be on the order of 100 m.a. if there are no defective components-or wiring in the amplifier. Proceed with the NO SIGNAL measurements in table 3.

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)

(e) If normal indications are obtained in the above test, energize the oscillator with the volume control turned down. Bridge a standard vacuum tube voltmeter (VTVM) across the output load terminals. Select a scale to read 12.65 volts, and advance the oscillator volume control until this output voltage is obtained. The d.c. ammeter will read between 1.2 and 1.4 amperes with a reading of 11.5 to 12 volts on the DC voltmeter. Proceed with the Full Signal series of measurements shown in table 3.

(f) Any appreciable departure in either test from the median values shown in table 3 indicates defects in the components or wiring, not evidenced in the Resistance Measurements made per table 1. Conventional methods of isolating, removing, and checking or replacing suspected defective parts are followed from this point on.

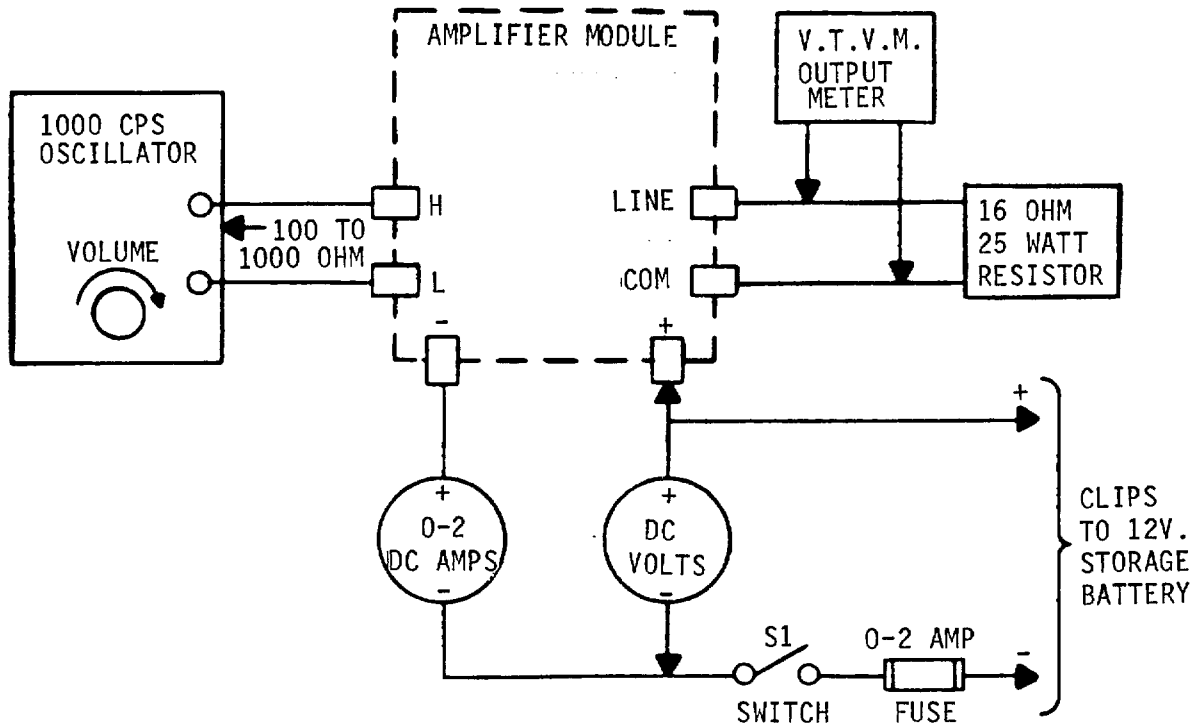
(g) Gain, frequency response, and distortion are measured in accordance with standard test practices. The same test set-up as shown is suitable for this purpose with a variable audio frequency oscillator as a source, and the VTVM used to set the input signal voltage. An oscilloscope may be used across the output to check distortion content. Frequency response and gain of an average amplifier are shown on the schematic.

(h) Other than conventional tests on electronic circuits and those described above, testing a transistor amplifier requires making sure that undamaged transistors are in circuit and that base bias voltages are correct. Note that the bias networks of both the driver and output stages includes the DC resistance of their respective transformer secondaries, and that the feedback resistors R7, R9, and R11 are also part of these bias networks. It is also good practice to check catalytic capacitors to make sure that their resistive value has not fallen to a low value, that is that their leakage is not excessive. If it becomes necessary to replace a driver transformer, be sure the phasing of the circuit has not been reversed, as the negative feedback link μ , R8 and C3 is connected in a degenerative sense. Transformer winding reversal will cause R8 and C3 to give positive feedback and the amplifier will oscillate strongly.

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)



(i) The oscilloscope is convenient for spotting unbalance in the push-pull output circuit. If one half of the output sine wave is flattened or appreciably distorted compared to the loop on the other half, this can mean one of the output transistors has gone bad. It can also indicate one half of the driver secondary is open, or that one of the collector to base resistors is defective. Further checks for amplifier transmission troubles ahead to the output stage follow standard electronic amplifier testing procedures.

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)

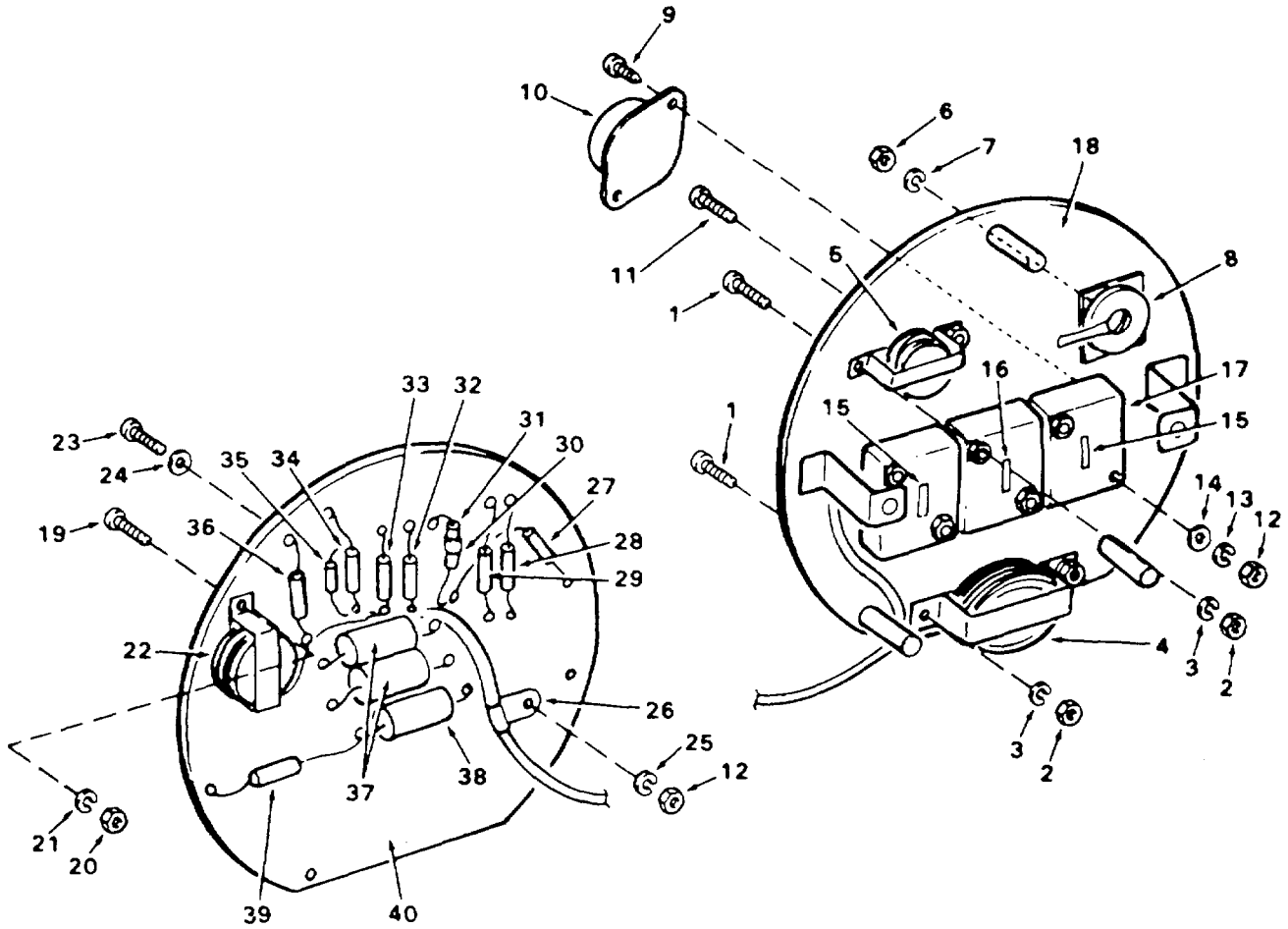
AMPLIFIER ASSEMBLY

ITEM NUMBER	DESCRIPTION
1.	Machine Screw
2.	Plain Hex Nut
3.	Lockwasher
4.	Audio Frequency Inductor
5.	Audio Frequency Transformer
6.	Plain Hex Nut
7.	Lockwasher
8.	Thermistor Assembly
9.	Tapping Screw
10.	Power Transistor
11.	Machine Screw
12.	Plain Hex Nut
13.	Lockwasher
14.	Flatwasher
15.	Fixed Composition Resistor
16.	Fixed Composition Resistor
17.	Transistor Socket
18.	Transistor Chassis Assembly
19.	Machine Screw
20.	Plain Hex Nut
21.	Lockwasher
22.	Input Transformer
23.	Machine Screw
24.	Flatwasher
25.	Lockwasher
26.	3/16ID Nylon Cable Clamp
27.	Fixed Capacitor
28.	Fixed Resistor
29.	Fixed Resistor
30.	Transistor Clip
31.	Low Noise Transistor
32.	27K 1/2 Watt 10 Percent Fixed Composition Resistor
33.	Fixed Composition Resistor
34.	Fixed Composition Resistor
35.	0.5mfd 20OVDC 20 Percent Fixed Paper Capacitor
36.	0.27 Ohms 1/2 Watt Wire Wound Resistor
37.	Fixed Capacitor
38.	Fixed Paper Capacitor
39.	Fixed Composition Resistor
40.	Resistor Board Assembly

5-152. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTS (Cont)



5-153. RADIO AND RADAR COMMUNICATION SYSTEMS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair and Replace

INITIAL SETUP

Test Equipment

NONE

References

FO-5 Radio Communication System
 FO-6 Radar System
 5-154 Radio Antenna

Special Tools

NONE

Equipment

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

General Safety Instructions

NONE

LOCATION/ITEM

ACTION

REMARKS

REPAIR/REPLACE

Refer to FO-5, and FO-6 for maintenance instructions for the Radio and Radar Communication Systems.

5-154. VHF ANTENNA - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair and Replace

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Make sure all transmitting devices are tagged and secured.

LOCATION	ITEM	ACTION	REMARKS
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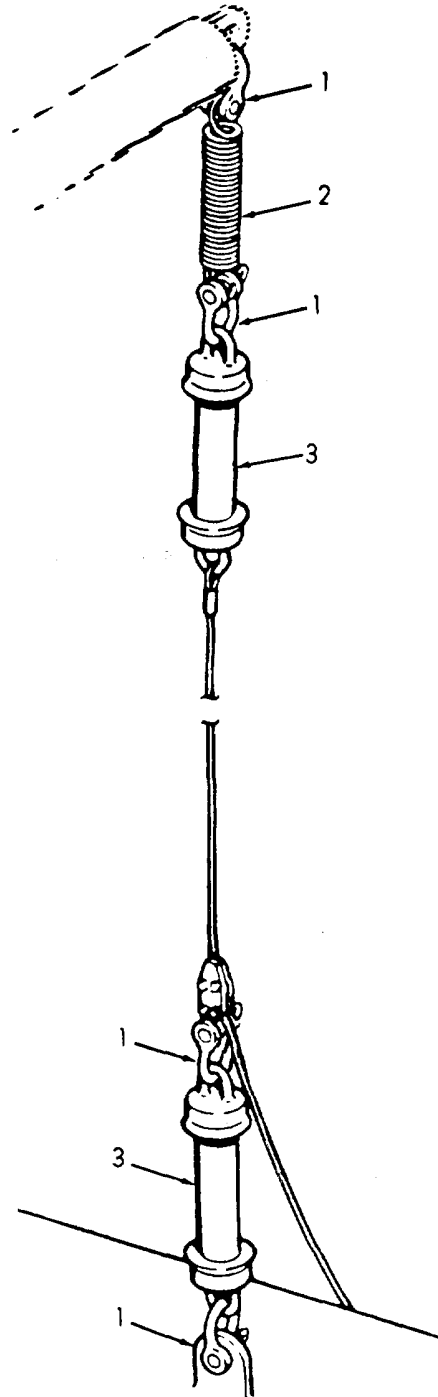
REPAIR/REPLACE

- | | | | |
|------------|--|--------------------|--|
| 1. Antenna | a. R-390A (URR) antenna shackle (1) | Repair or replace. | |
| | b. R-390A (URR) antenna spring (2) | Repair or replace. | |
| | c. Type IL-26/U 6 / R-390A (URR) antenna insulator (3) | Repair or replace. | |

5-154. VHF ANTENNA - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR/REPLACE (Cont)



5-154. VHF ANTENNA - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMAPKS
----------	------	--------	---------

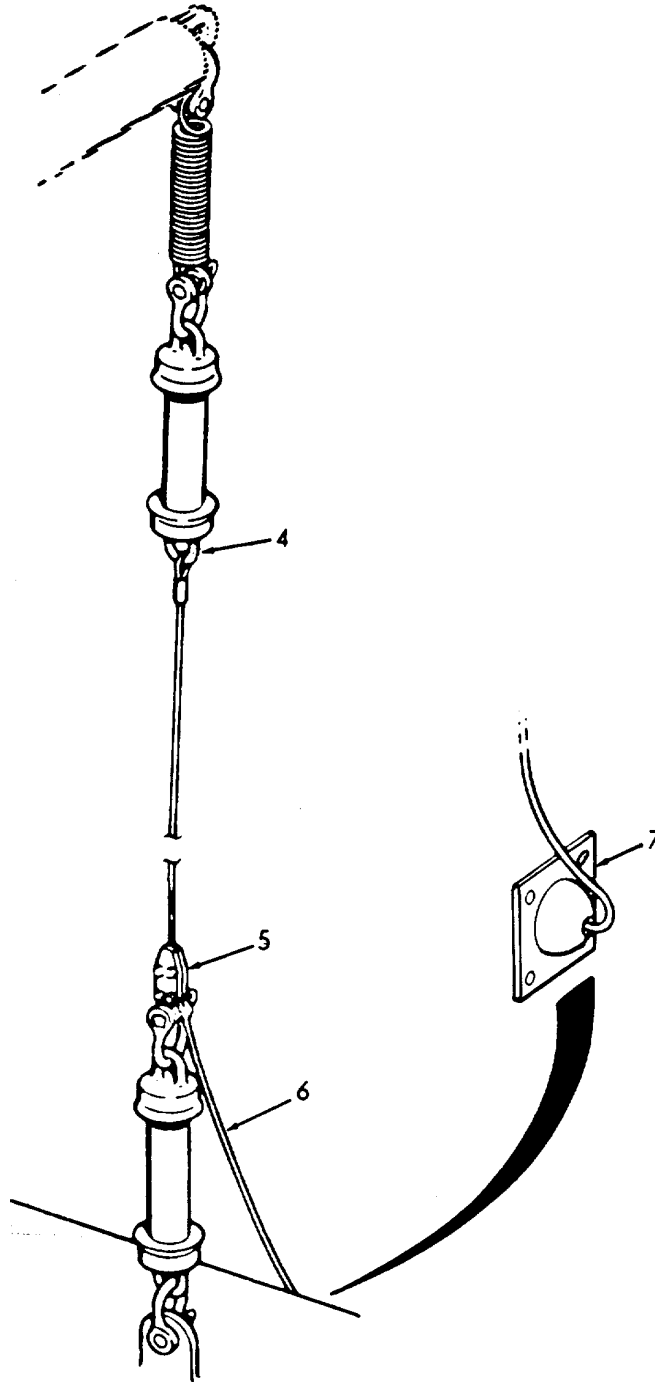
REPAIR/REPLACE (Cont)

- | | |
|--|--------------------|
| d. Type
MX1177/U
R-390
(URR)
antenna
connector
(4) | Repair or replace. |
| e. R-390A
(URR)
antenna
type
10678
clamp
(5) | Repair or replace. |
| f. 7-18
bronze
R-390A
(URR)
antenna
wire
(6) | Repair or replace. |
| g. Entrance
type
IL-21/U
R-390A
(URR)
antenna
insulator
(7) | Repair or replace. |

5-154. VHF ANTENNA - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMAPKS
----------	------	--------	---------

REPAIR/REPLACE (Cont)



5-155. OIL/WATER SEPARATION SYSTEM - MAINTENANCE INSTRUCTIONS.

Refer to TM 55-2090-201-14P for maintenance instructions.

5-156. PIPING SYSTEMS - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance instructions.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Exhaust Pipe Hangers	5-157
Fire, Ballast, and Bilge Piping	5-158
Machinery and Keel Coolers	5-159
Lube Oil Piping	5-160
Diesel Oil Piping	5-161
Engine Exhaust Piping	5-162
Fresh and Flush Water Piping	5-163
Deck Fittings	5-164

5-157. EXHAUST PIPE HANGERS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment

Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

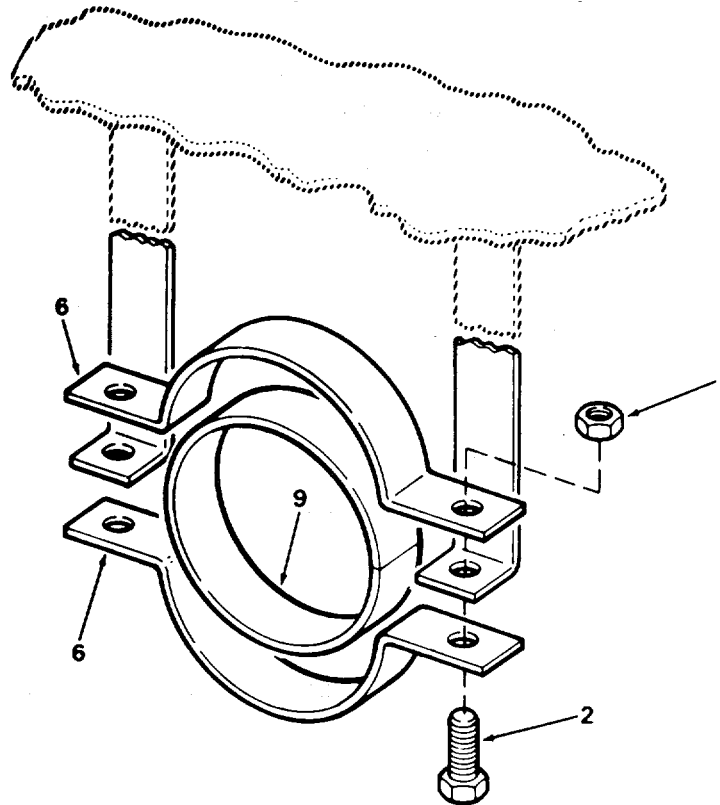
5-157. EXHAUST PIPE HANGERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE			
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ITEM NUMBER	DESCRIPTION
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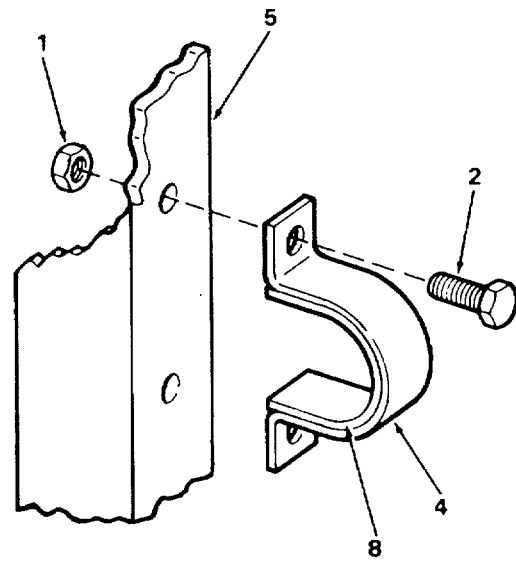
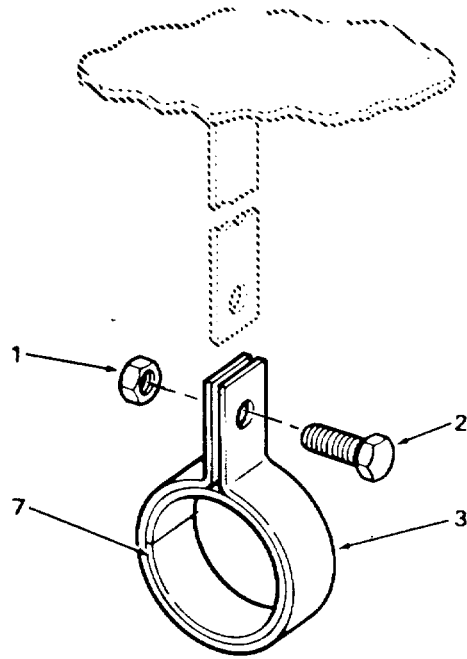
- | | |
|----|--------------------------------------|
| 1. | Plain hex nut |
| 2. | Hex head capscrew |
| 3. | Pipe clips |
| 4. | Hanger coil support clip |
| 5. | Hanger clip angle |
| 6. | Hanger clips |
| 7. | Oil resist rubber liner |
| 8. | Oil resist coil support rubber liner |
| 9. | Oil resist rubber liners |



5-157. EXHAUST PIPE HANGERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE



5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

Observe WARNING in procedure

LOCATION

ITEM

ACTION

REMARKS

REPAIR OR REPLACE



In order to avoid the possibility of scuttling the craft - make sure all thru the hull fittings are closed.

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

1. Fire, Ballast, and Bilge Piping Legend.

Item Number	Description
-------------	-------------

- | | |
|-----|--|
| 1. | Fog applicator bracket |
| 2. | Fog applicator |
| 3. | Spanner wrench bracket |
| 4. | Belt clip |
| 5. | Quick release belt |
| 6. | Double jacketed fire hose with couplings |
| 7. | Three position nozzle |
| 8. | Marine strainer with valve |
| 9. | Angle hose valve |
| 10. | Gate hose valve |
| 11. | Bronze adapter |
| 12. | 90° elbow |
| 13. | 45° elbow |
| 14. | Reducing tee |
| 15. | Bulkhead sleeve |
| 16. | Copper-nickel pipe |
| 17. | 900 elbow |
| 18. | Copper-nickel1 pipe |
| 19. | Butterfly valve |
| 20. | 90° elbow |
| 21. | Coupling |
| 22. | 90° elbow |
| 23. | Gate valve |
| 24. | Copper-nickel pipe |
| 25. | Bulkhead sleeve |
| 26. | 45° elbow |
| 27. | Copper-nickel pipe |
| 28. | 90°reducing elbow |
| 29. | Tee |
| 30. | Bushing |
| 31. | Copper-nickel pipe |
| 32. | Plain hex nut |
| 33. | Hex head capscrew |
| 34. | Flange |
| 35. | Full face gasket |

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

1. Fire, Ballast, and Bilge Piping Legend (Cont).

Item Number	Description
36.	Flanged sprinkler valve
37.	Gate valve
38.	Gate valve
39.	Reducing tee
40.	End cap
41.	45° elbow
42.	Gate valve
43.	Brass tube
44.	Brass tee
45.	Gate valve
46.	Bulkhead sleeve
47.	Reducing coupling
48.	Coupling
49.	Brass connection
50.	Adapter
51.	Plain hexagon nut
52.	Hex head capscrew
53.	Flange
54.	Male flange
55.	Full face gasket
56.	90° elbow
57.	Bulkhead sleeve
58.	Copper-nickel pipe
59.	Plain hex nut
60.	Hex head capscrew
61.	Male flange
62.	Flange
63.	Full face gasket
64.	Gate valve
65.	Tee
66.	Lift check valve
67.	45° elbow
68.	Stop check valve
69.	Flange
70.	Full face gasket

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

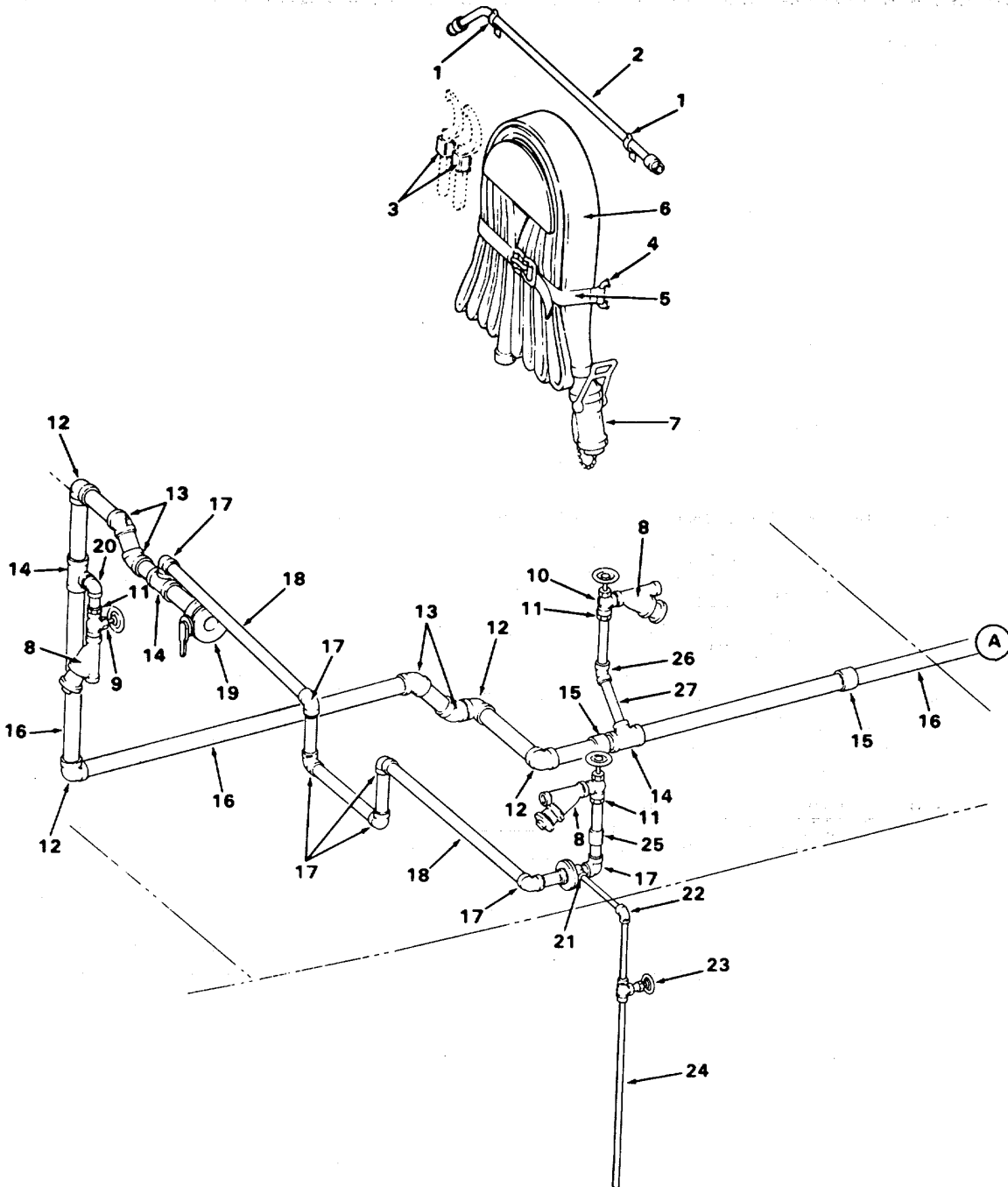
1. Fire, Ballast, and Bilge Piping Legend (Cont).

Item Number	Description
71.	Stop cock
72.	Simplex strainer
73.	Reducing tee
74.	Gate valve
75.	45° elbow
76.	Male flange
77.	Flange
78.	Slip-on flange
79.	180° bend return
80.	Globe valve
81.	Relief valve
82.	Bushing
83.	Union
84.	Tee
85.	Plain hex nut
86.	Hex head capscrew
87.	Bilge suction strainer
88.	Swing check valve
89.	Stop check valve
90.	Stop check valve
91.	Hose cap with chain
92.	Full face gasket
93.	Male flange
94.	Globe stop/check valve
95.	90° elbow
96.	Copper-nickel pipe
97.	45° elbow
98.	Hose clamp
99.	Suction hose
100.	Discharge hose
101.	Hose nipple
102.	Hose plug with chain
103.	90° street elbow
104.	Bilge eductor
105.	Globe stop/check valve

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)			
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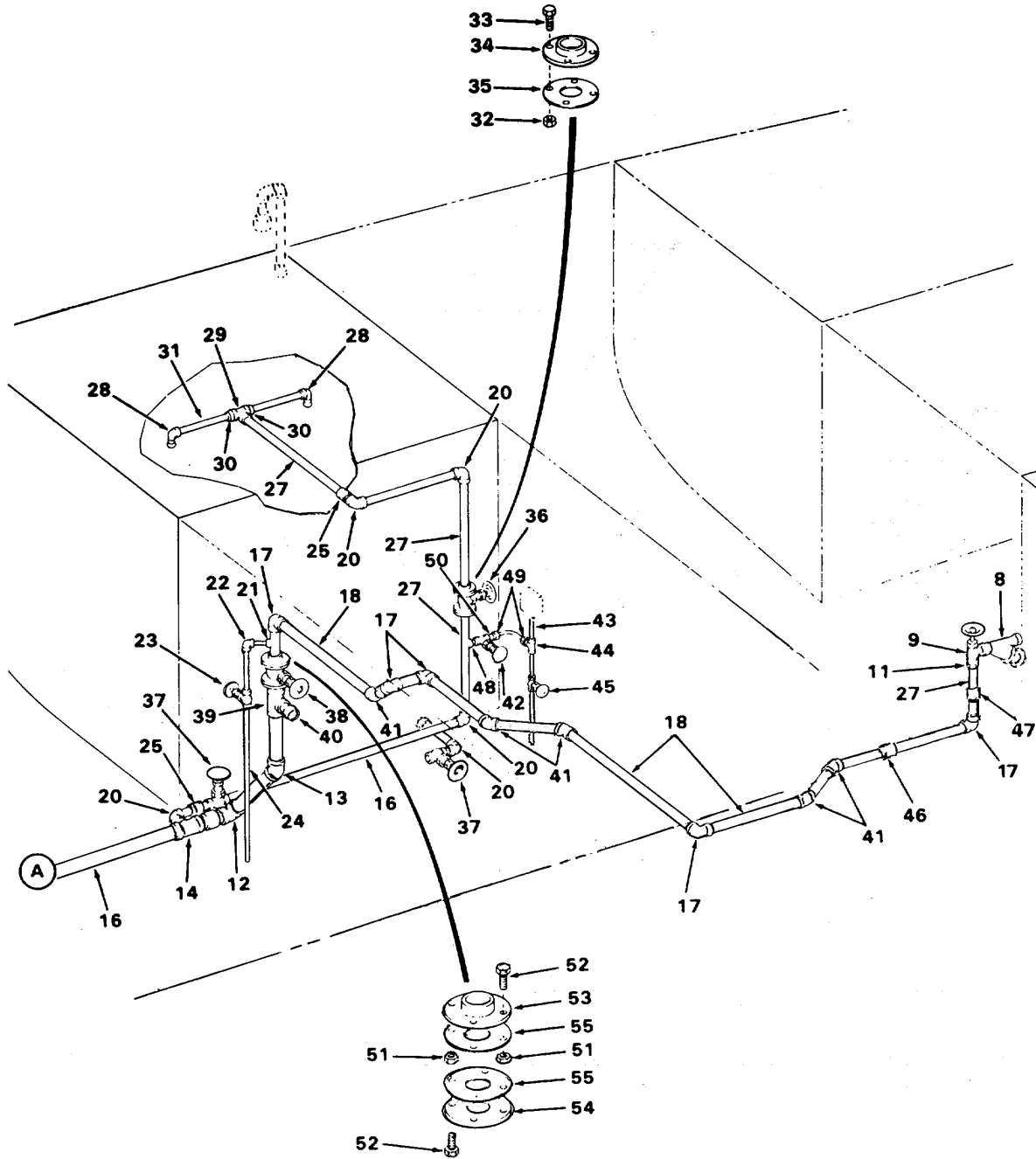


Fire, Ballast and Bilge Piping Systems (Sheet 1 of 7).

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)			
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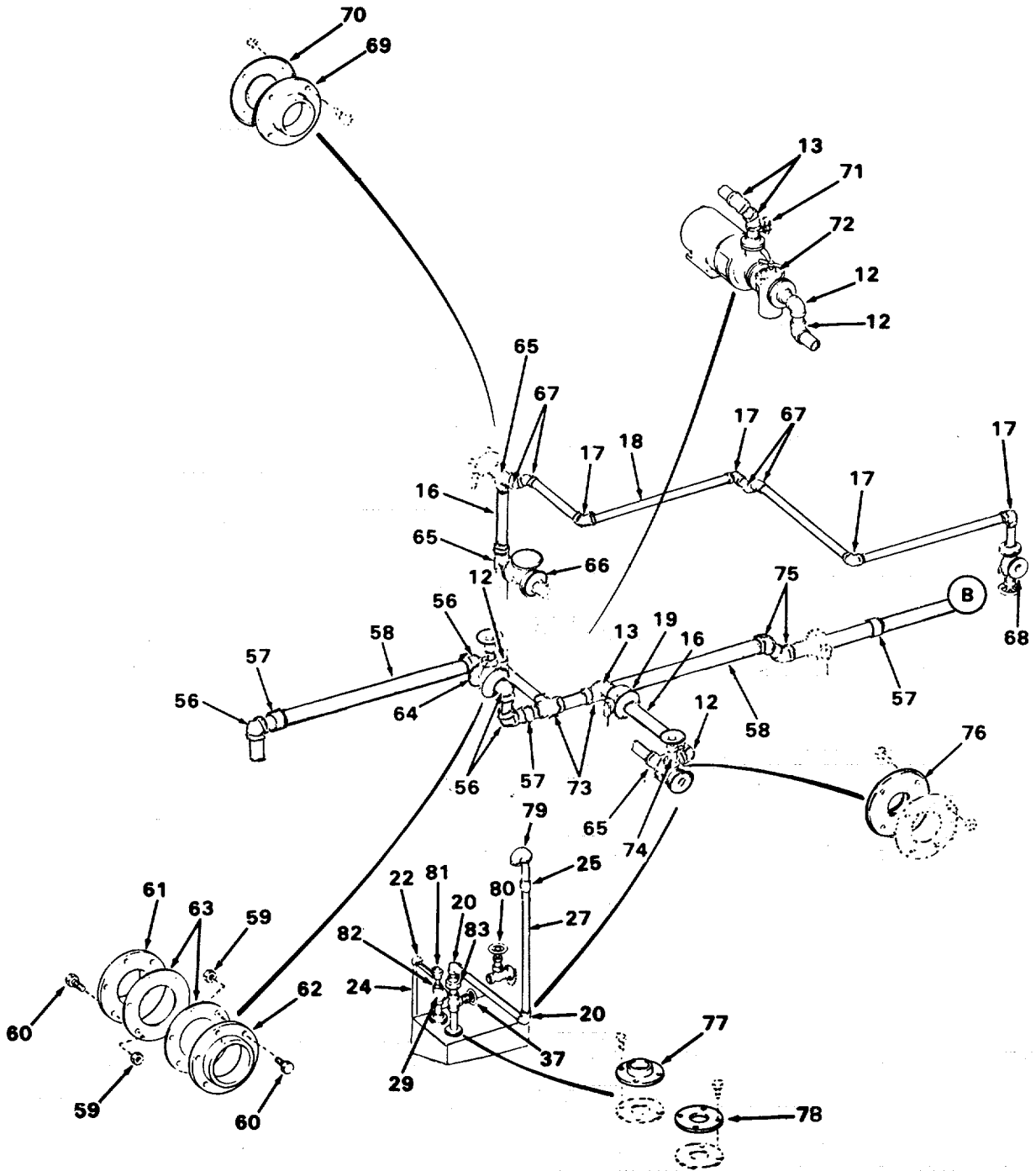


Fire, Ballast and Bilge Piping Systems (Sheet 2 of 7).

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)			
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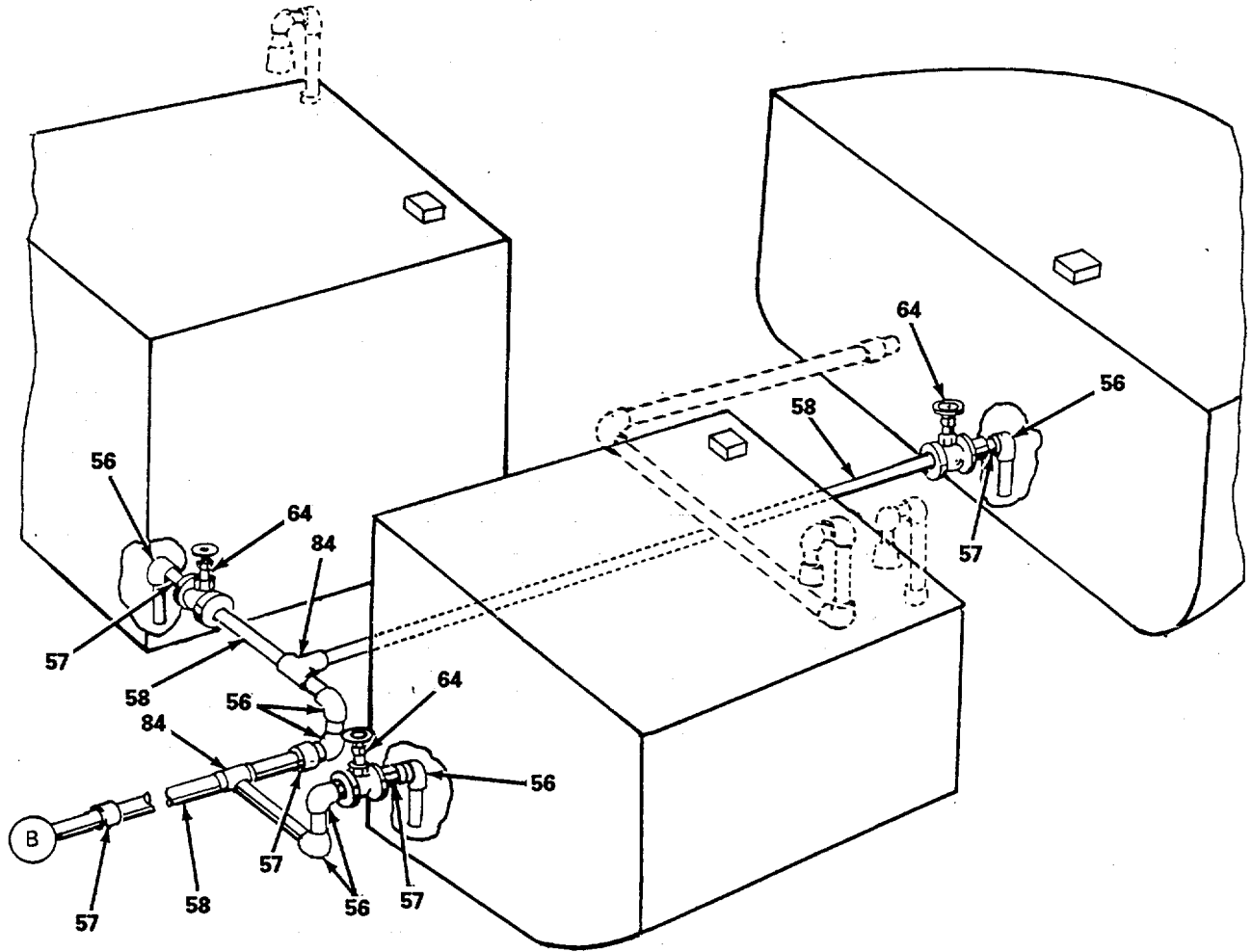


Fire, Ballast and Bilge Piping Systems (Sheet 3 of 7).
5-1534

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

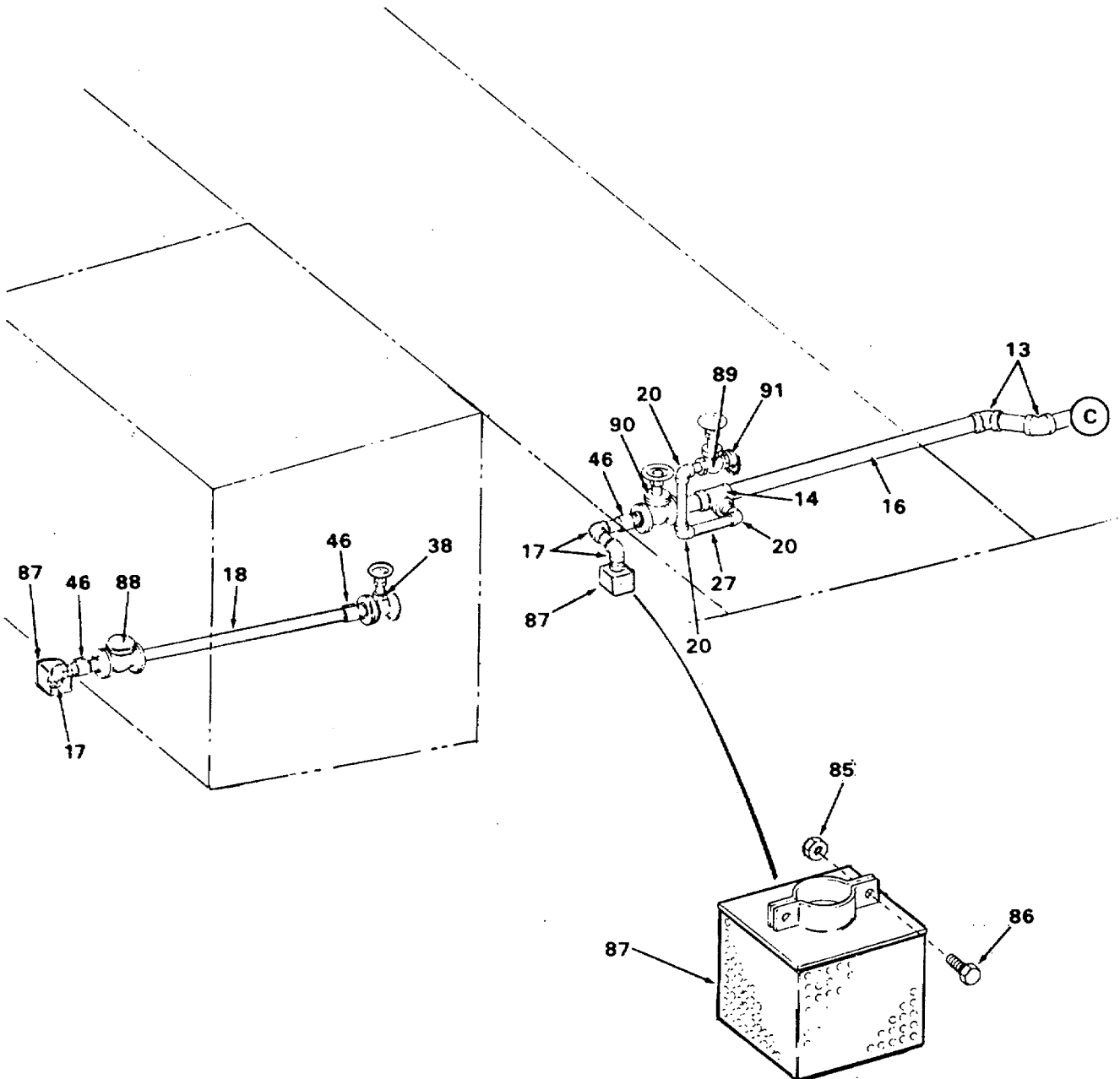


Fire, Ballast and Bilge Piping Systems (Sheet 4 of 7).

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)			
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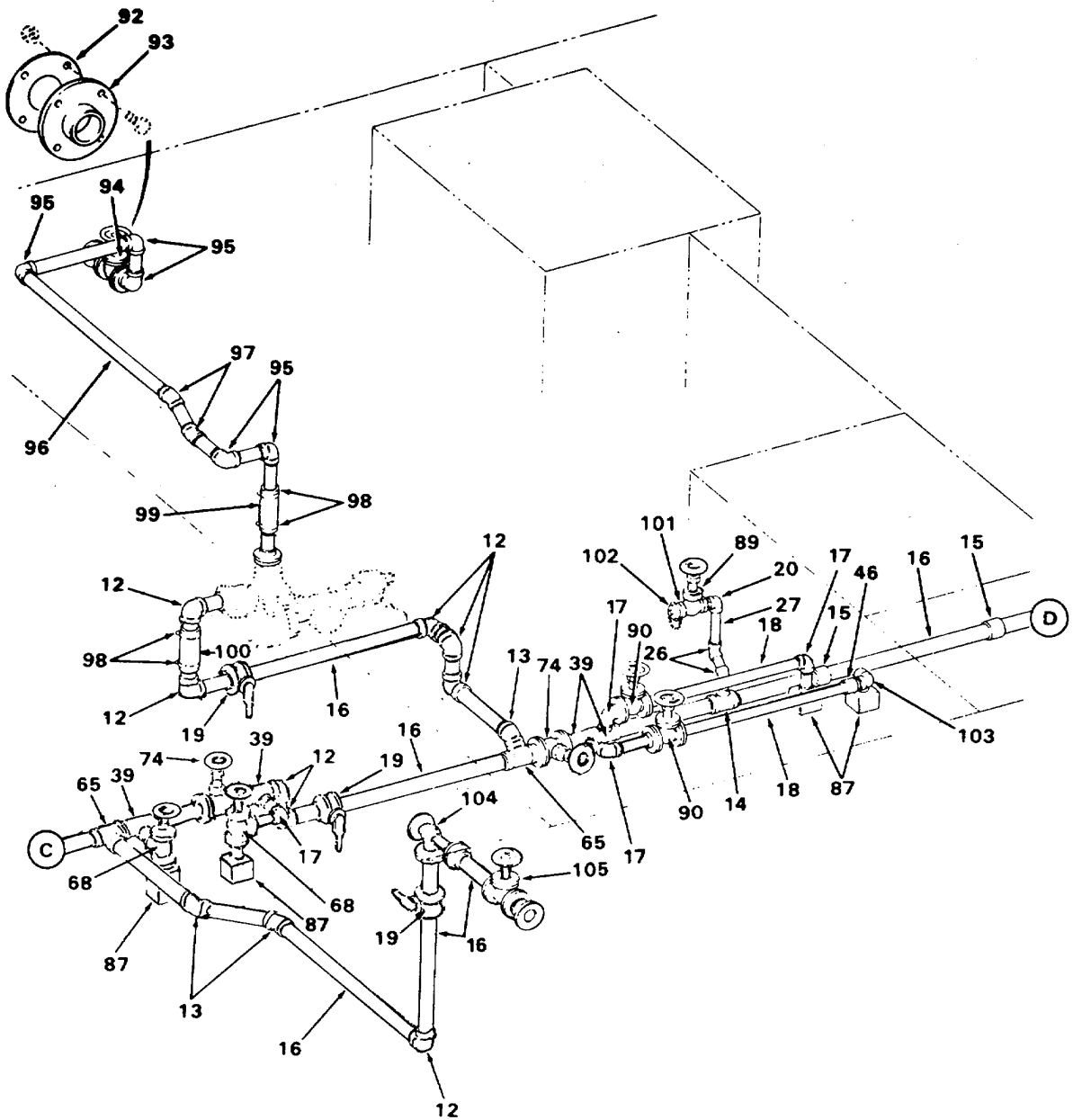


Fire, Ballast and Bilge Piping Systems (Sheet 5 of 7).

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

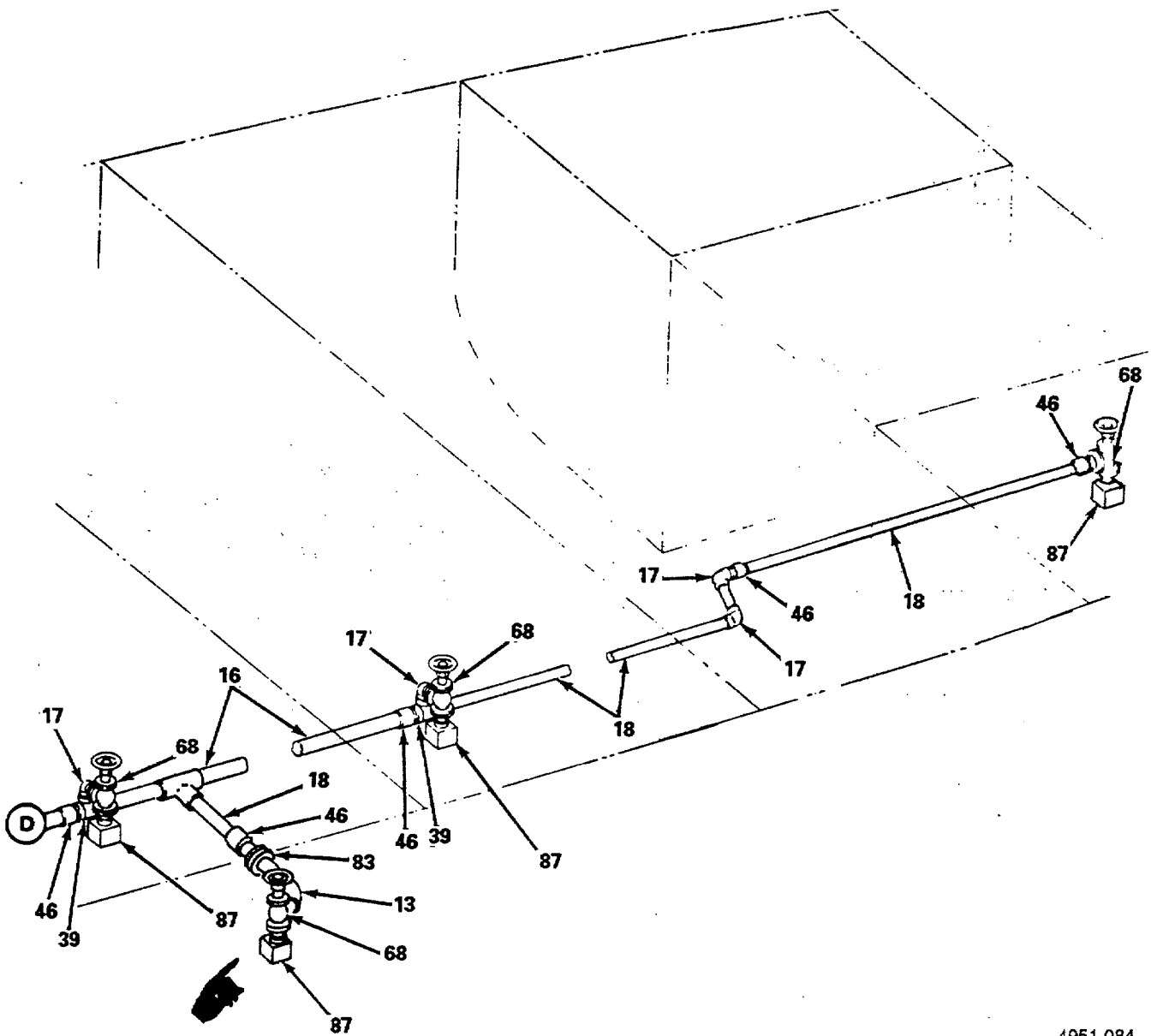


Fire, Ballast and Bilge Piping Systems (Sheet 6 of 7).

5-158. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)



4951-084

Fire, Ballast and Bilge Piping Systems (Sheet 7 of 7).

5-159. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE

1. Machinery Cooler Legend

<u>Item</u>	<u>Description</u>	<u>Item</u>	<u>Description</u>
1.	Steel bulkhead sleeve	18.	Hose clamp
2.	Union	19.	90° elbow
3.	Bronze tee	20.	Copper-nickel tubing
4.	Copper-nickel pipe	21.	Copper-nickel tubing
5.	90° elbow	22.	Brass pipe
6.	Copper tubing	23.	Reducing bushing
7.	Copper 90° elbow	24.	Bronze plug
8.	Copper tee	25.	Bronze 90° street elbow
9.	Copper bushing	26.	Bronze coupling half
10.	Copper union	27.	90° elbow
11.	Gate valve	28.	Close nipple
12.	Gate valve	29.	Coupling half
13.	Bronze tee	30.	Water gage
14.	DELETED	31.	Drain plug
15.	DELETED	32.	Close nipple
16.	DELETED	33.	Bronze coupling
17.	Rubber hose	34.	5 gallon expansion tank

5-159. MACHINERY AND KEEL COOLERS- - MAINTENANCE INSTRUCTIQNS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

Machinery Cooler Legend (Cont)

<u>Item</u>	<u>Description</u>	<u>Item</u>	<u>Description</u>
35.	Hose clamp	47.	Copper-nickel pipe
36.	90° elbow	48.	Bronze sweep tee
37.	Copper-nickel pipe	49.	45° elbow
38.	Plain hexagon nut	50.	Steel bulkhead sleeve
39.	Hex head capscrew	51.	Plain hexagon nut
40.	Flange gasket	52.	Hex head capscrew
41.	Flange	53.	Flange gasket
42.	Bulkhead sleeve	54.	Flange
43.	Hose	55.	Steel bulkhead sleeve
44.	Hose	56.	Bronze sweep tee
45.	Hose clamp	57.	Steel bulkhead sleeve
46.	90° elbow	58.	1 gallon expansion tank

2. Hull Coolers Legend

<u>Item Number</u>	<u>Description</u>
1.	Plain hex nut
2.	Hex head capscrew
3.	Cooler hanger
4.	Sup-port bolt nut
5.	Plain flatwasher
6.	Support bolt gasket
7.	Support bolt spacer
8.	Support plate tube gasket
9.	Special nut
10.	Nipple washer
11.	Nipple gasket
12.	Nipple sleeve
13.	Nipple washer
14.	Nipple spacer
15.	Drain plug
16.	Hull water cooler
17.	Support bolt nut
18.	Support bolt washer

5-159. MACHINERY AND KEEL COOLERS- - MAINTENANCE INSTRUCTIQNS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

Hull Coolers Legend (Cont)

<u>Item Number</u>	<u>Description</u>
19.	Support bolt gasket
20.	Support bolt sleeve
21 .	Support plate tube gasket
22.	Nipple nut
23.	Nipple washer
24.	Nipple gasket
25.	Nipple sleeve
26.	Nipple washer
27.	Nipple spacer
28.	Drain plug
29.	Hull water cooler

a. Damaged Keel Cooler: In the event of accidental damage in use, it is recommended that the following materials and steps be taken to make minor shipyard repairs.

(1) Brazing: Drain the keel cooler before brazing. Make certain that the joint or area to be brazed is thoroughly cleaned, using a good degreasing solvent followed by wire brushing. The silver alloy used in the manufacture of keel coolers is "Handy & Harman", 3/32" diameter Easy Flow No. 4 wire, having a melting point of 11600F. Use "Handy & Harman" Flux, low temperature brazing type. Source of brazing wire and flux is HANDY & HARMAN, 850 third Avenue, New York, New York 10022 U.S.A. who have many distributor outlets.

(2) In the event the tubes are accidentally bent and out of alignment, they can be straightened by using a hard, wood block and mallet. Keel coolers are constructed of ductile material s not subject to fracture.

b. Temporary repair:

(1) For temporary repairs, an epoxy compound similar to Devcon UW for above and under water repairs or Red Hand for above water repairs may be used when liberally applied.

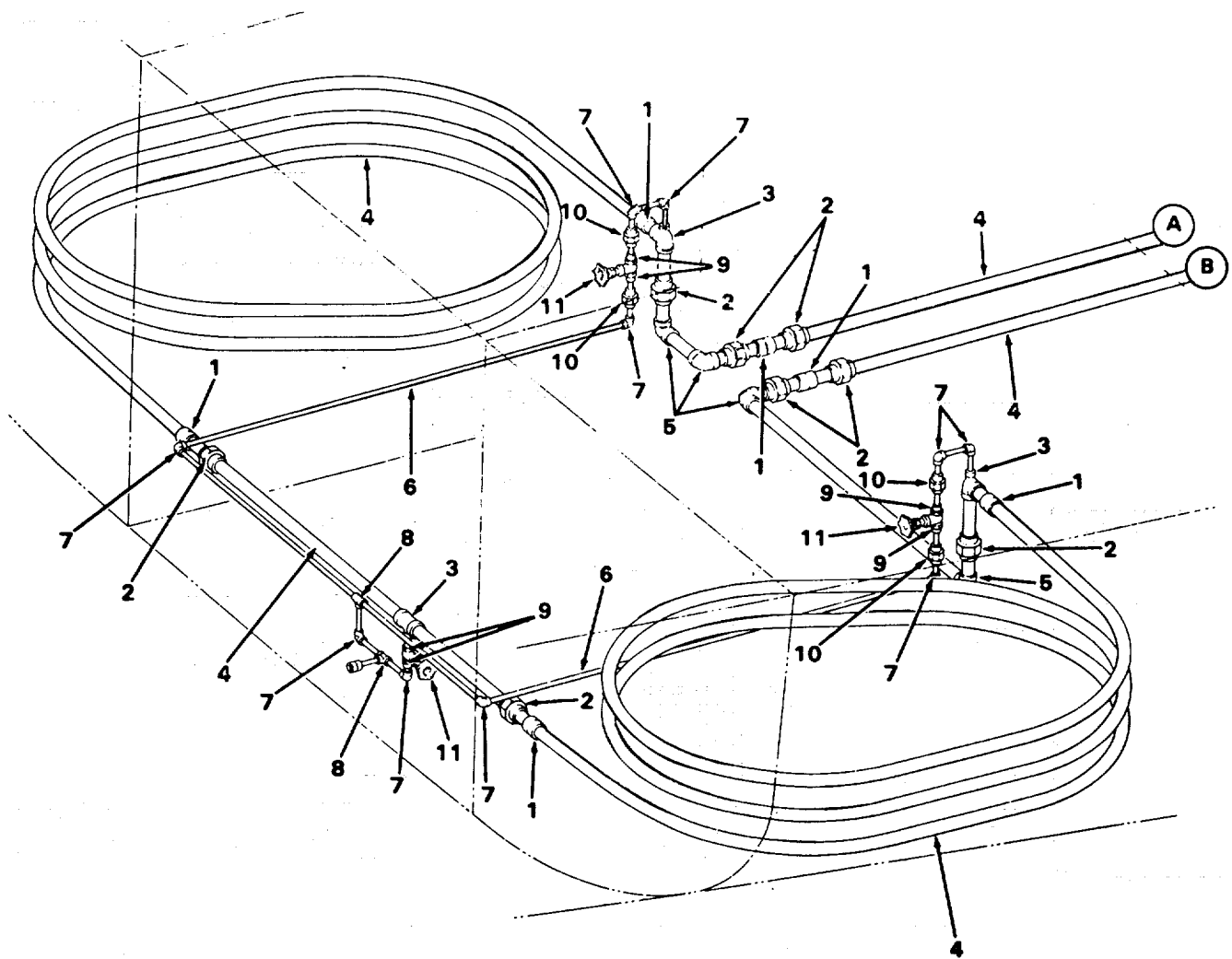
5-159. MACHINERY AND KEEL COOLERS- - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

(2) Before applying the epoxy compound, the surface must be clean and any internal pressure on the keel cooler must be removed.

(3) Devcon UW is available from Devon Corporation, Danvers, Massachusetts 01923. Red Hand is available from International Paint Company, New York, New York.

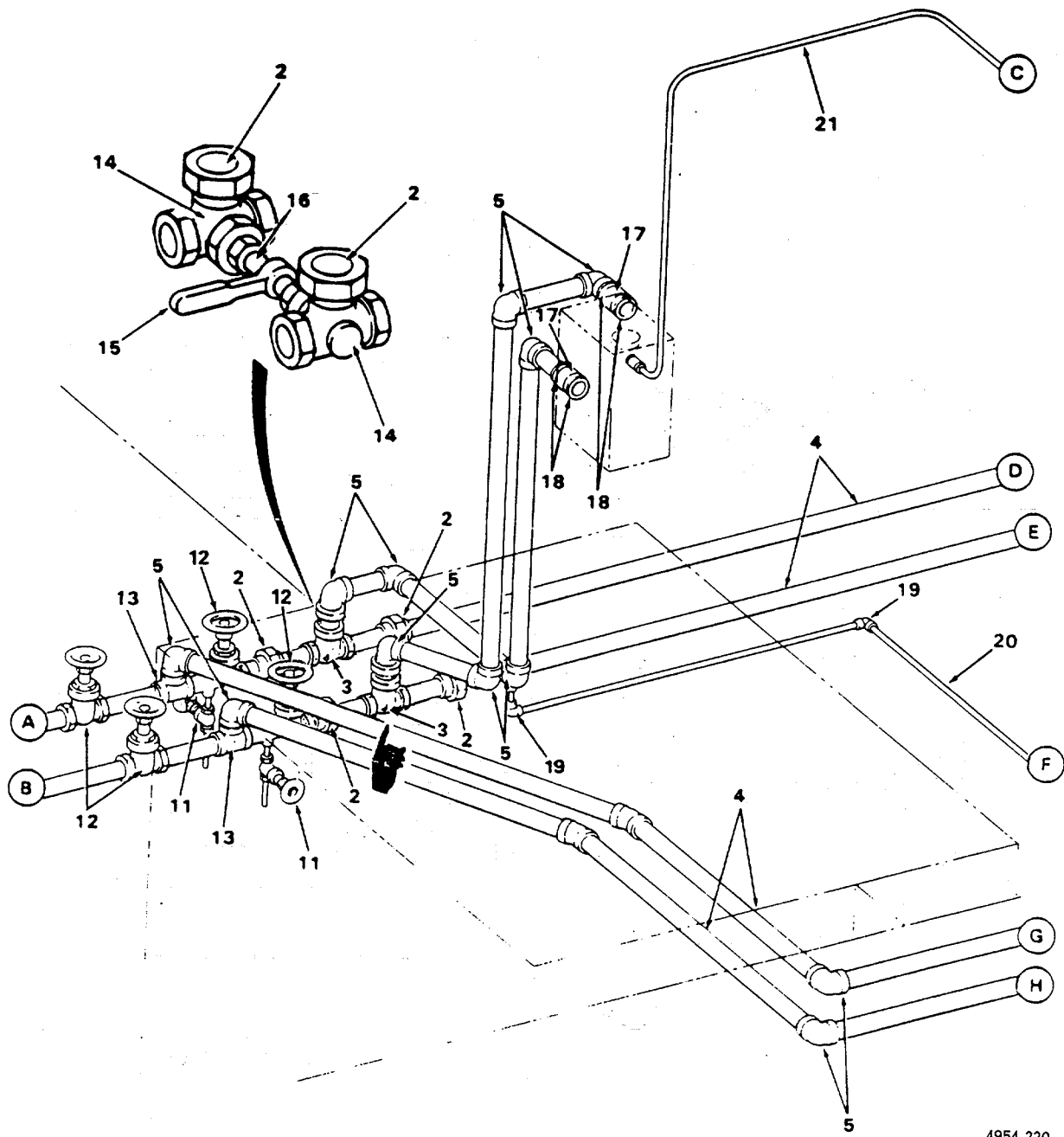


Diesel Engines Cooling System (Sheet 1 of 7).

5-159. MACHINERY AND KEEL COOLERS- - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)



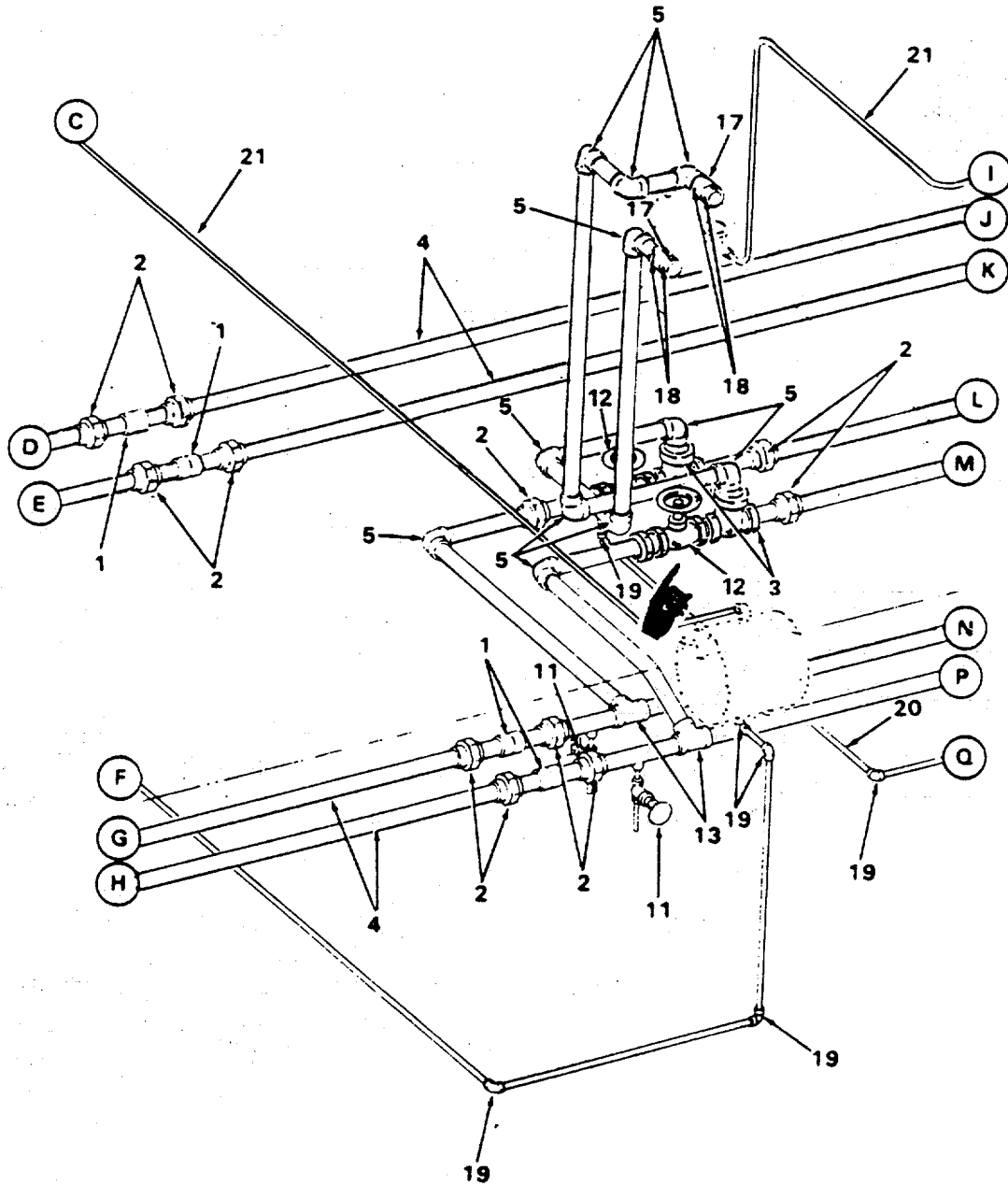
4954-220

Diesel Engines Cooling System (Sheet 2 of 7).

5-159. MACHINERY AND KEEL COOLERS- - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

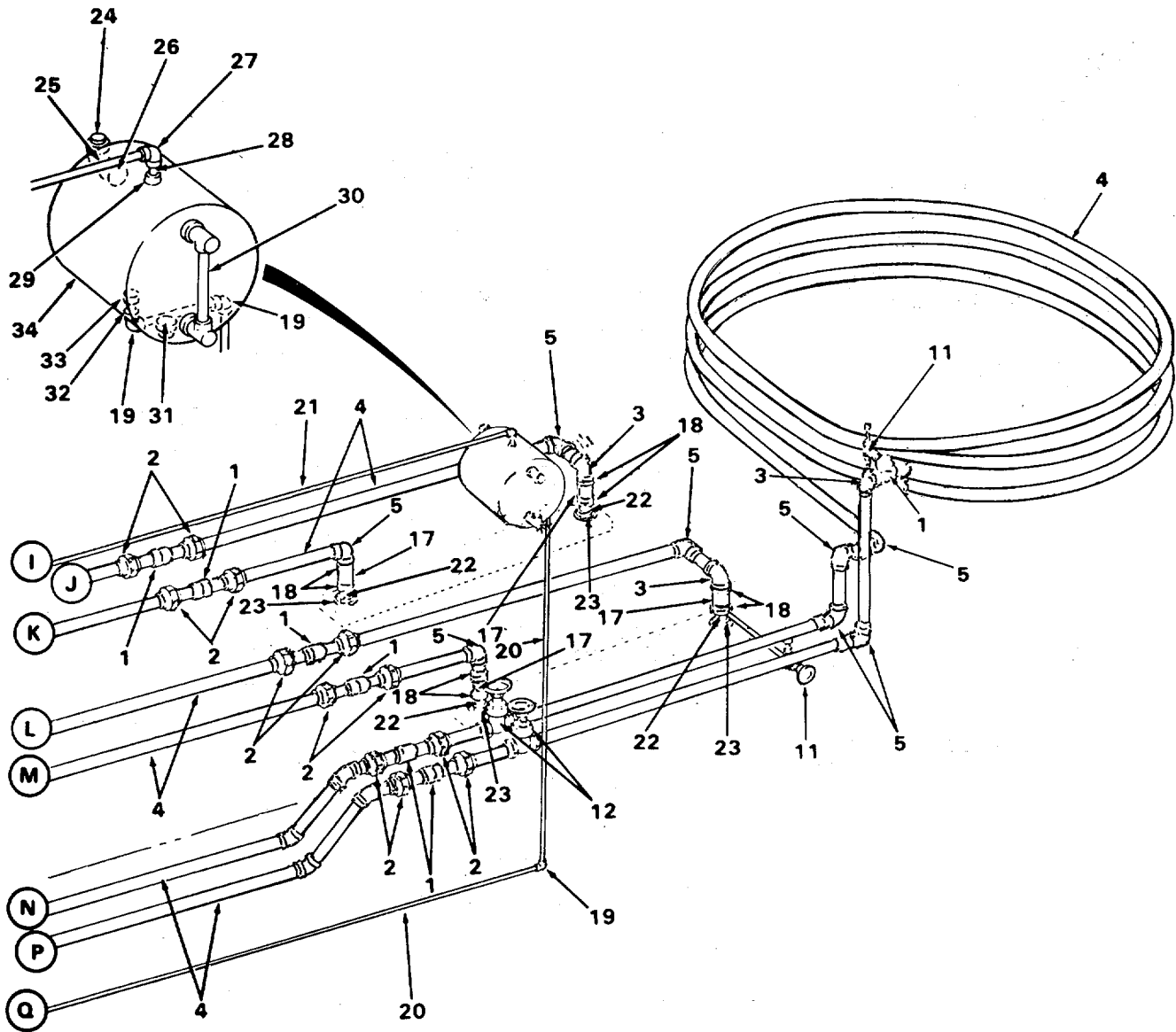


Diesel Engines Cooling System (Sheet 3 of 7).

5-159. MACHINERY AND KEEL COOLERS- - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)			
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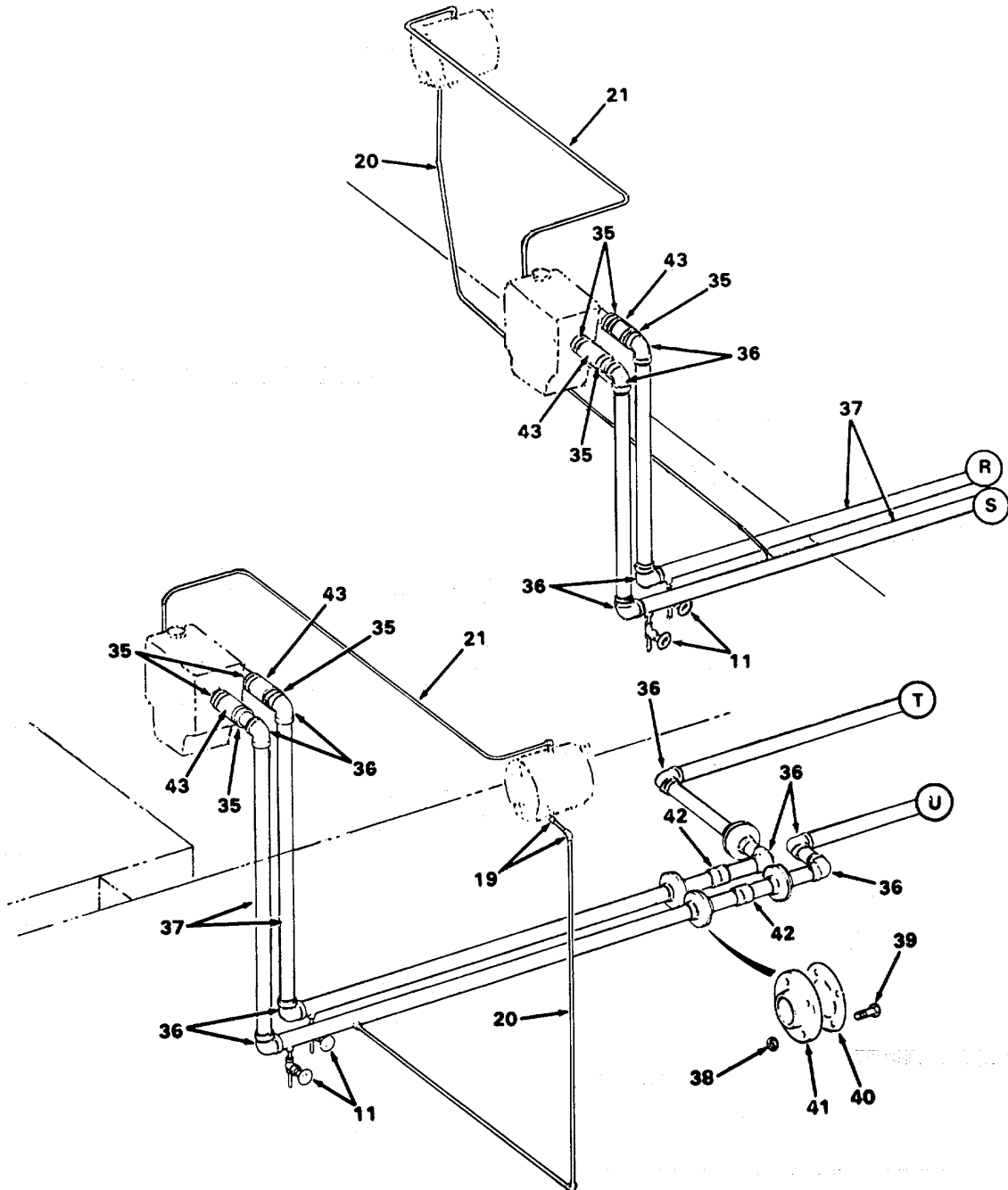


Diesel Engines Cooling System (Sheet 4 of 7).

5-159. MACHINERY AND KEEL COOLERS- - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)

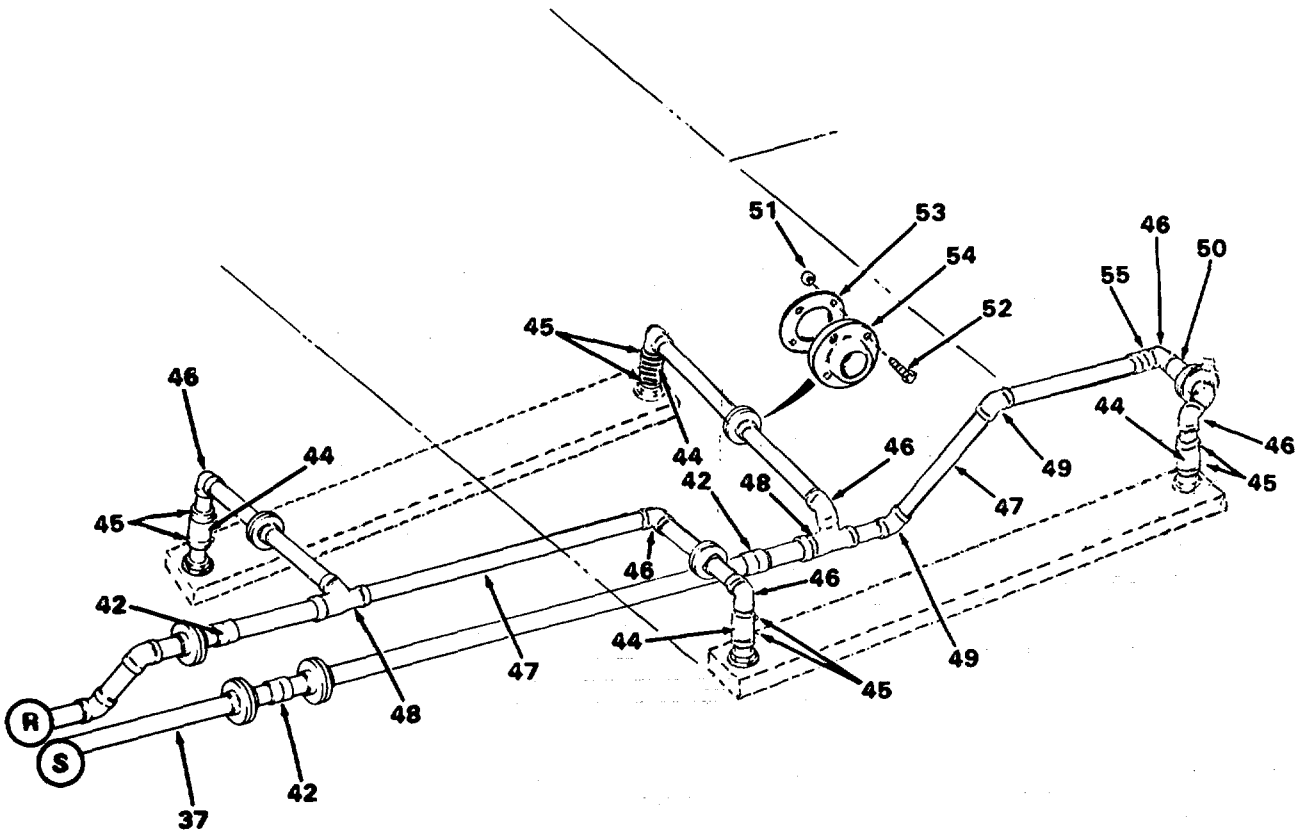


Diesel Engines Cooling System (Sheet 5 of 7).

5-159. MACHINERY AND KEEL COOLERS- - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

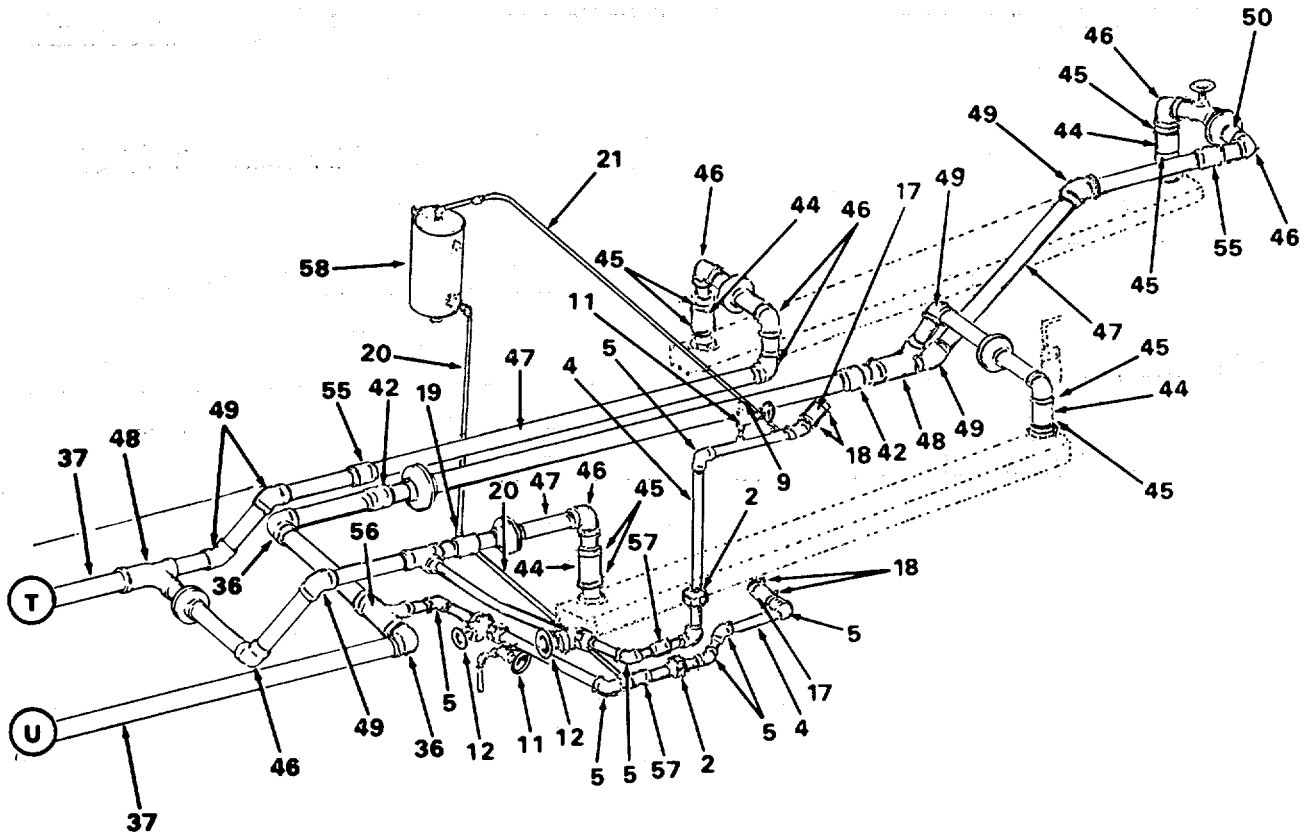


Diesel Engines Cooling System (Sheet 6 of 7).

5-159. MACHINERY AND KEEL COOLERS- - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)



Diesel Engines Cooling System (Sheet 7 of 7).

5-160. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE

1. Lube Oil Piping Legend.

Item Number

Description

- | | |
|----|------------------------|
| 1 | Angle valve |
| 2 | Brass nipple |
| 3 | 90° elbow |
| 4 | Oil resistant hose |
| 5 | Tee |
| 6 | Tee |
| 7 | Black steel pipe |
| 8 | Black steel pipe |
| 9 | Extra heavy steel pipe |
| 10 | Gate valve |
| 11 | Wye strainer |
| 12 | 90° elbow |

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5-160. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

1. Lube Oil Piping Legend (Cont)

<u>Item Number</u>	<u>Description</u>
13	Stop check valve
14	Black steel pipe
15	Flexible hose
16	Union
17	90° elbow
18	Check valve
19	Union
20	Lube oil transfer hand pump
21	Gate valve
22	Tee
23	Black steel pipe
24	Brass pipe cap
25	Angle valve

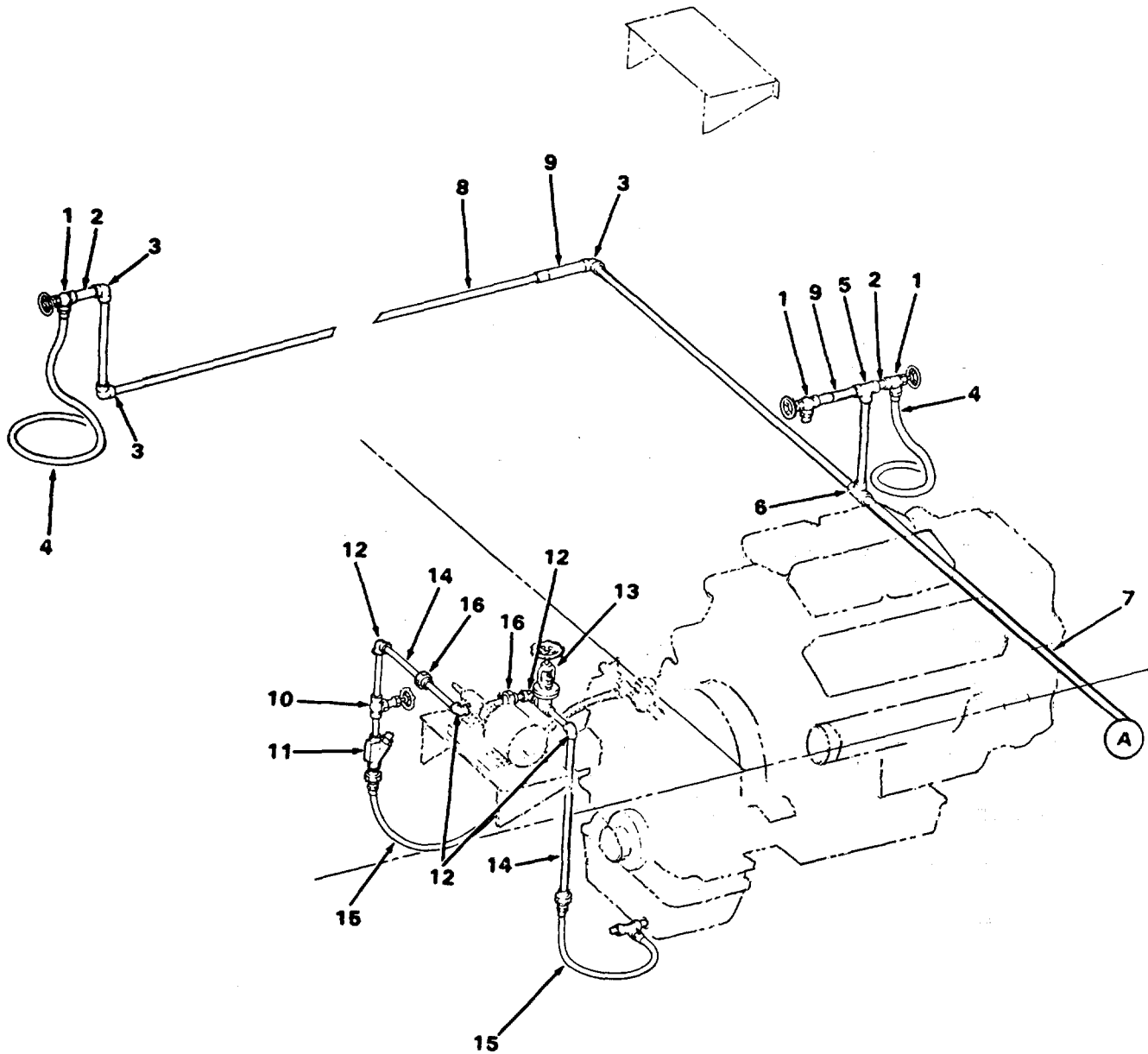
2. Lube Oil Tank Legend.

<u>Item Number</u>	<u>Description</u>
1	Plain hex nut
2	Flatwasher
3	Manhole cover
4	Neoprene gasket
5	Welded stud
6	Coupling half
7	Slip-on flange
8	Tank flange
9	Steel pipe

5-160. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

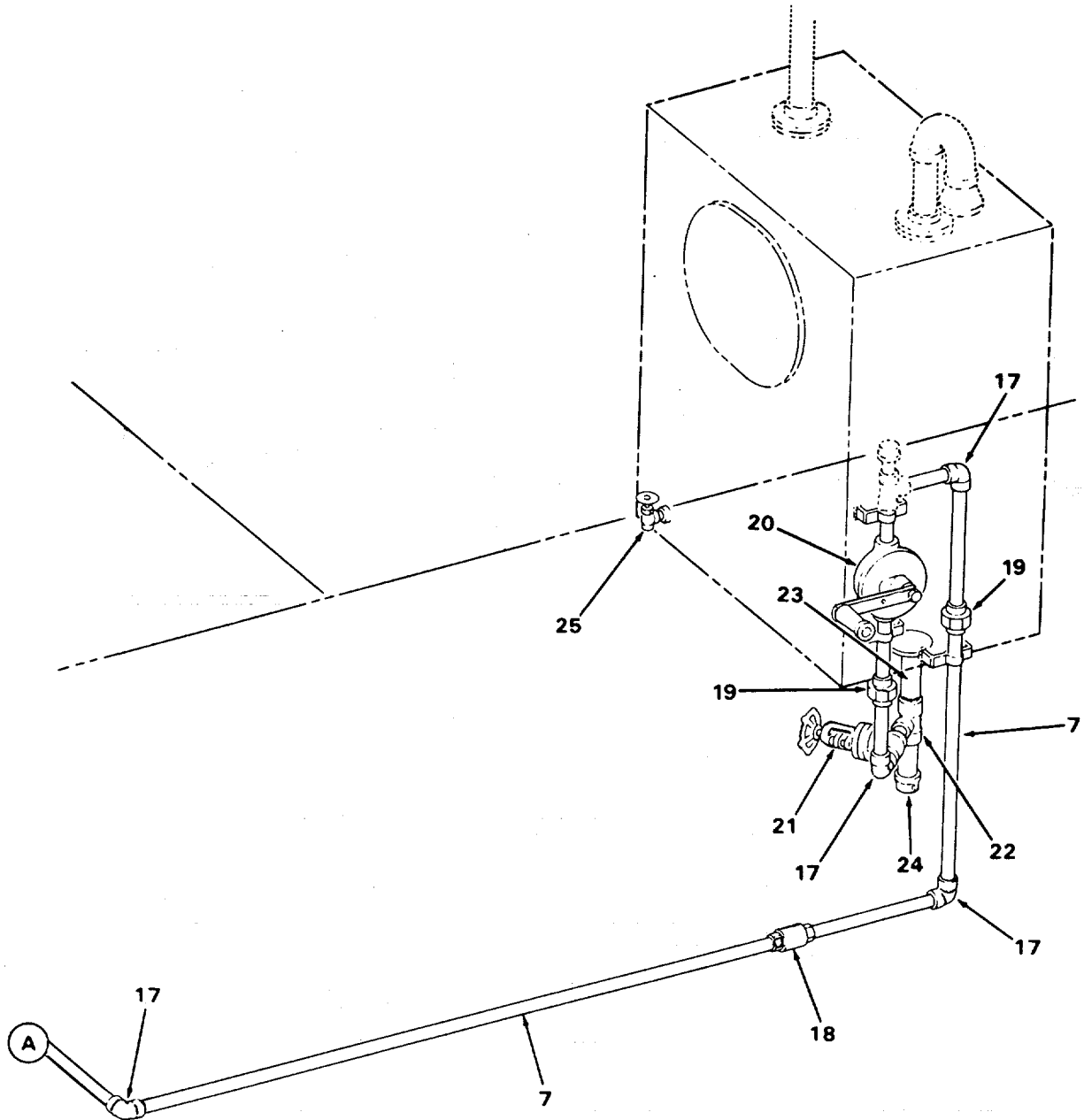


Lube Oil Piping (Sheet 1 of 2).

5-160. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)			
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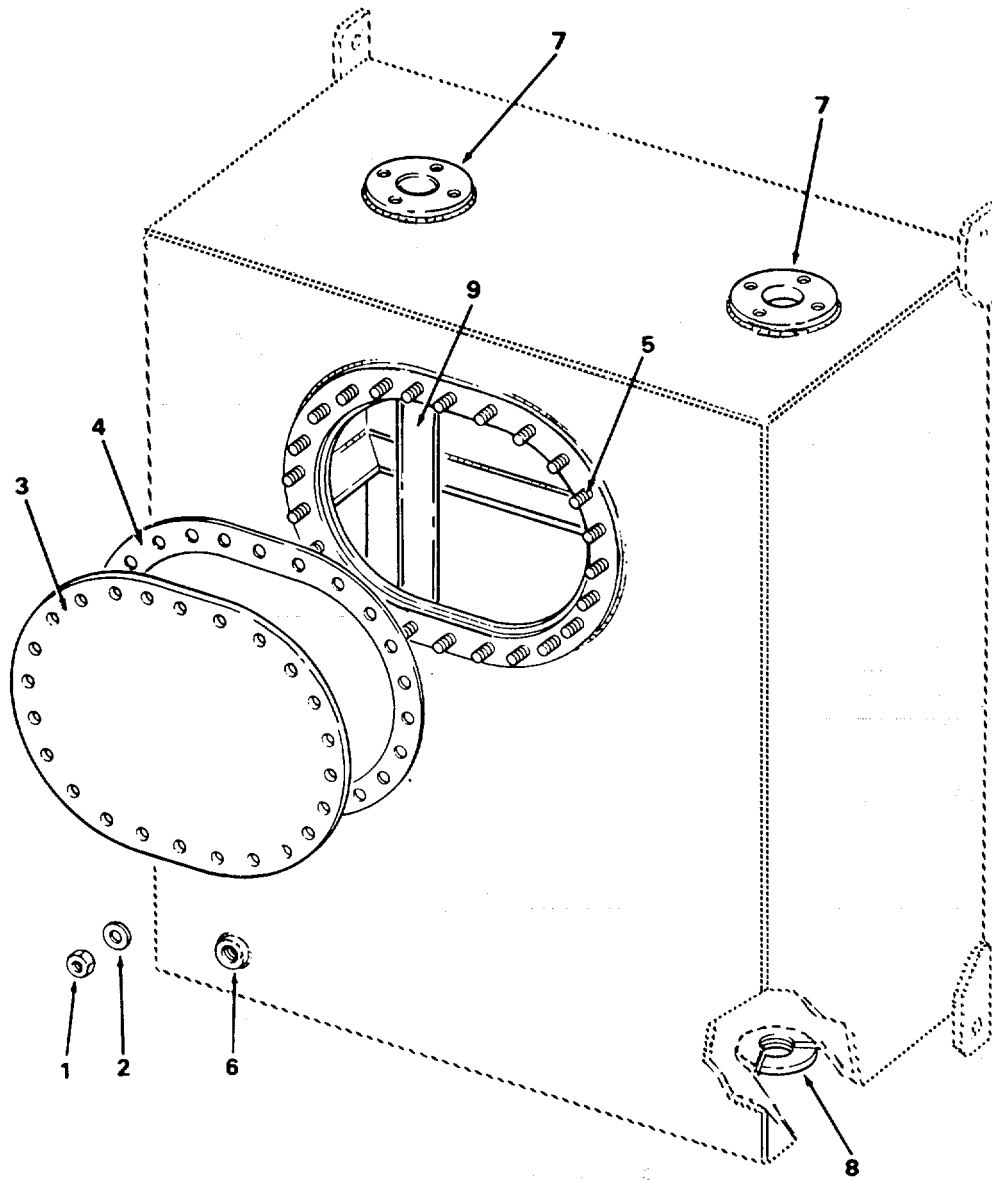


Lube Oil Piping (Sheet 2 of 2).

5-160. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)



Lube Oil Tank

5-1553

5-161. DIESEL OIL PIPING - MAINTENANCE INSTRUCTIONS

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE

1. Diesel Oil Piping Legend.

Item Number

Description

- | | |
|-----|---------------|
| 1. | Flexible hose |
| 2. | Flexible hose |
| 3. | Globe valve |
| 4. | Globe valve |
| 5. | Lift valve |
| 6. | Lift valve |
| 7. | Elbow |
| 8. | Elbow |
| 9. | Steel pipe |
| 10. | Steel pipe |
| 11. | Tee |
| 12. | Tee |

5-1554

5-161. DIESEL OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

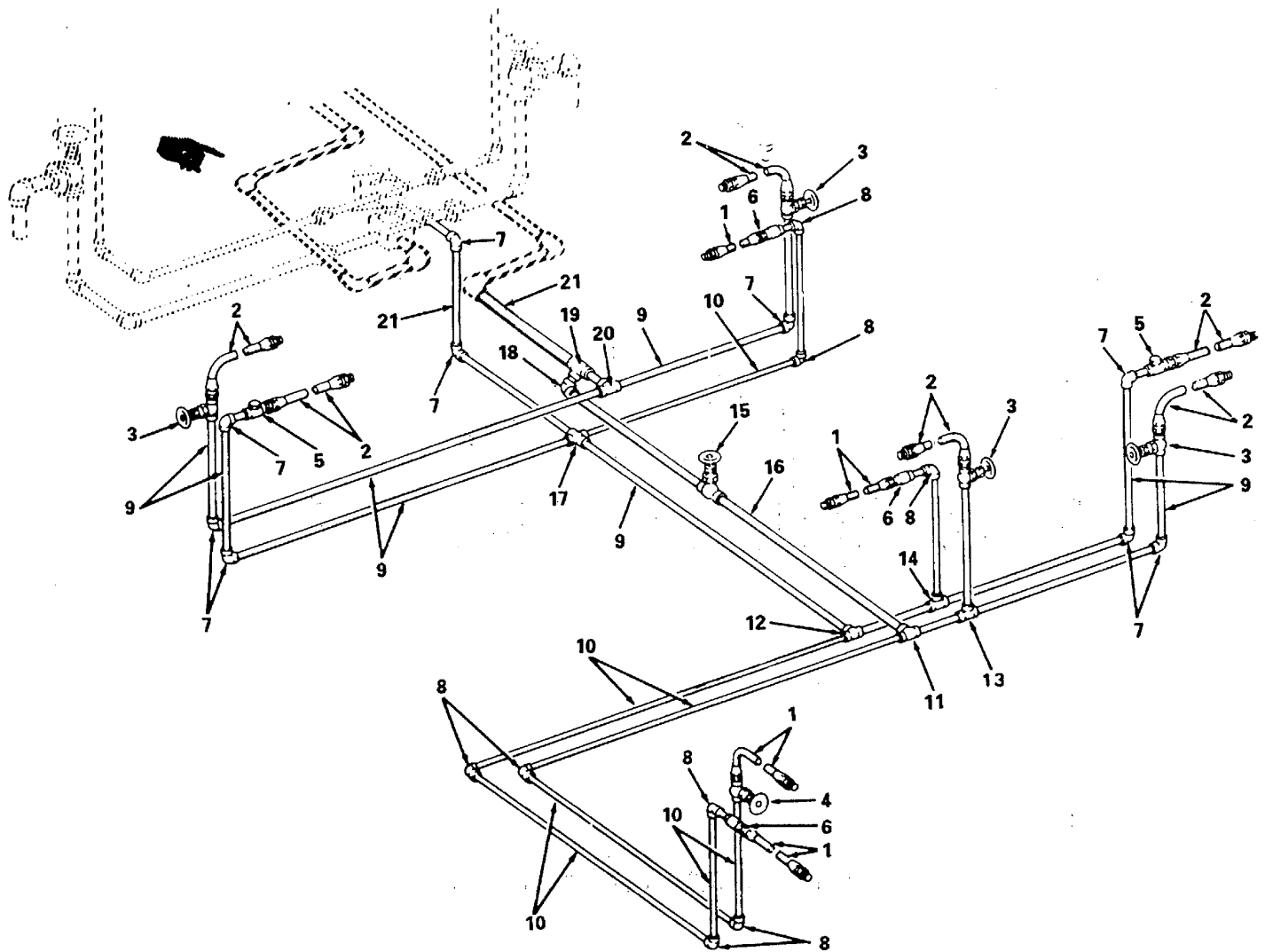
1. Diesel Oil Piping Legend (Cont)

<u>Item Number</u>	<u>Description</u>
13.	Tee
14.	Tee
15.	Globe valve
16.	Steel pipe
17.	Cross
18.	Elbow
19.	Tee
20.	Tee
21.	Steel pipe
22.	Union
23.	Union
24.	Selector valve
25.	Selector valve
26.	Elbow
27.	Angle valve
28.	Reducing flange
29.	Flange
30.	Elbow
31.	Steel pipe
32.	Steel pipe
33.	Gate valve
34.	Ball valve
35.	Tee
36.	Angle valve
37.	Pipe w/chain
38.	Coupling
39.	Coupling
40.	Reducer

5-161. DIESEL OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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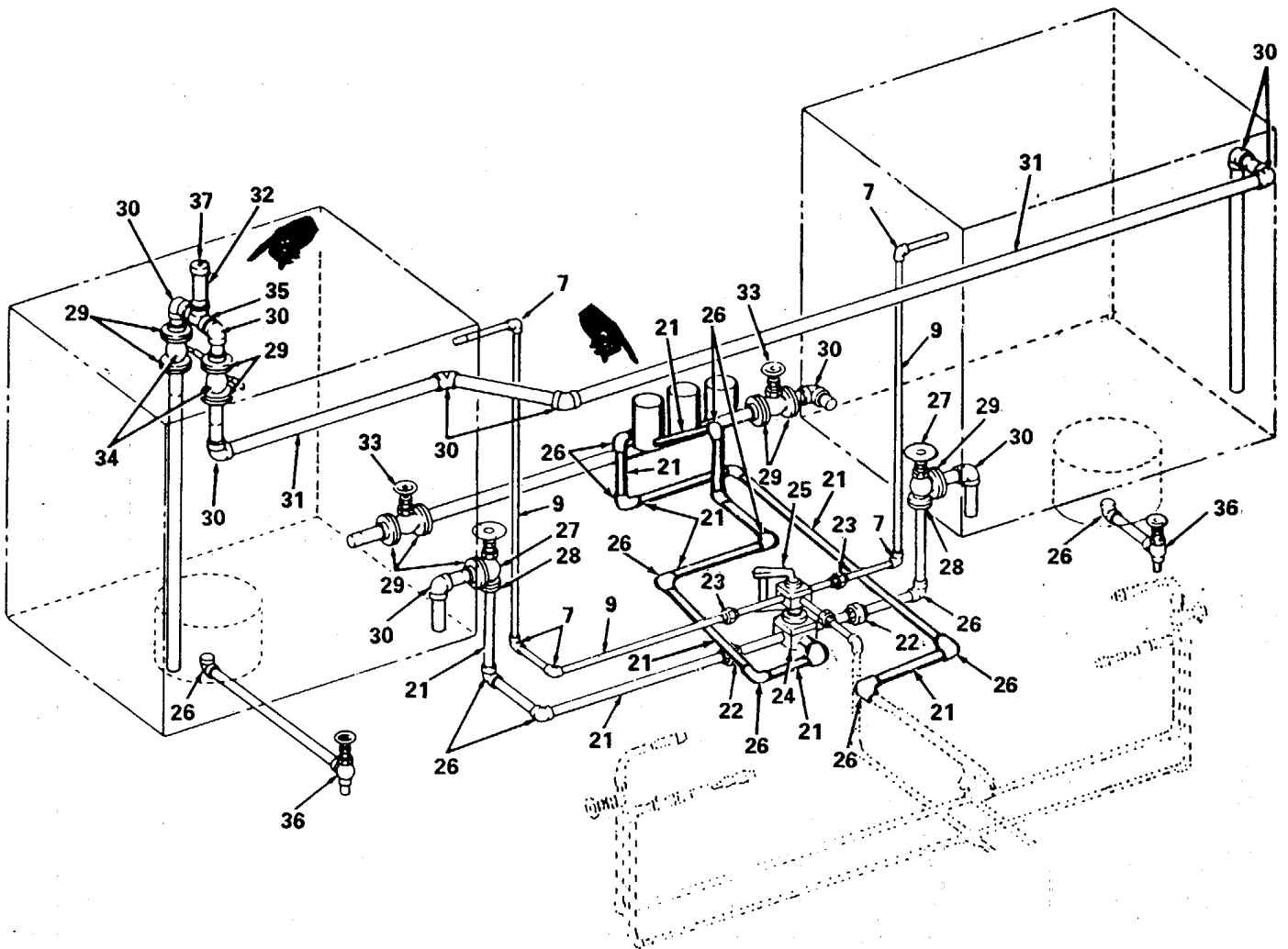
REPAIR OR REPLACE (Cont)



5-161. DIESEL OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)



Change 1 5-1557

5-162. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE

1. Engine Exhaust Piping Legend.

Item Number

Description

- | | |
|-----|--------------------|
| 1. | Plain hex nut |
| 2. | Lockwasher |
| 3. | Hex head capscrew |
| 4. | Exhaust guard |
| 5. | Steel pipe |
| 6. | 90° elbow |
| 7. | Reducing elbow |
| 8. | Steel flange |
| 9. | Exhaust muffler |
| 10. | Flexible connector |
| 11. | Weather cap |
| 12. | Weather cap |
| 13. | Weather cap |

5-1558

5-162. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

1. Engine Exhaust Piping Legend (Cont).

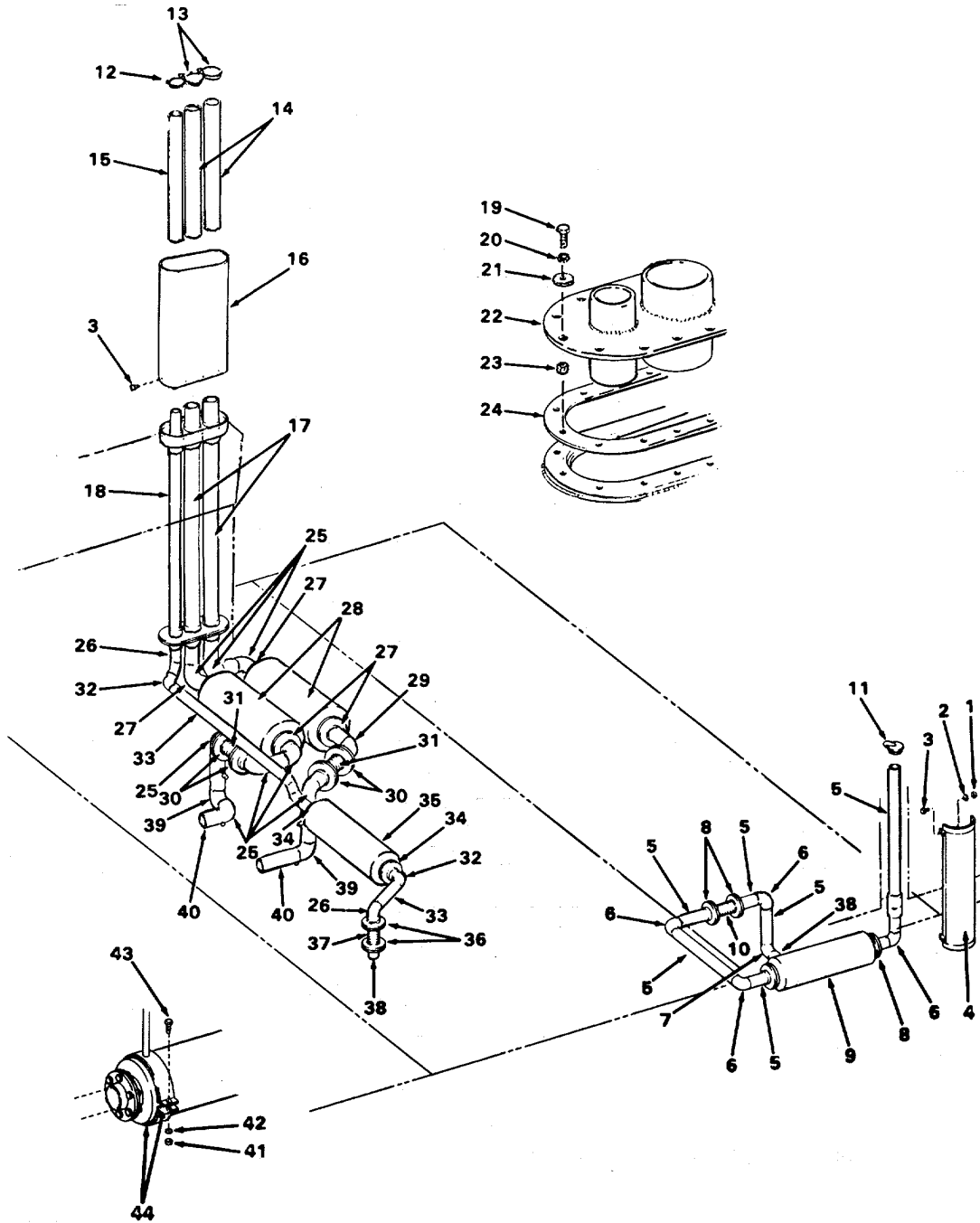
<u>Item Number</u>	<u>Description</u>
14.	Aluminum pipe
15.	Aluminum pipe
16.	Stack extension
17.	Steel pipe
18.	Steel pipe
19.	Hex head capscrew
20.	Lockwasher
21.	Asbestos washer
22.	Pipe and plate assembly
23.	Packing grommet
24.	Asbestos gasket
25.	Steel 90° elbow
26.	Steel 90° elbow
27.	Steel reducing flange
28.	Exhaust muffler
29.	Steel 45° elbow
30.	Steel flange
31.	Flexible connector
32.	Steel 45° elbow
33.	Steel pipe
34.	Steel reducing flange
35.	Exhaust muffler
36.	Steel flange
37.	Flexible connector
38.	Ball nipple
39.	90° elbow
40.	Steel ball nipple
41.	Plain hex nut
42.	Lockwasher
43.	Hex head capscrew
44.	Muffler hanger
45.	Plain hex nut
46.	Lockwasher
47.	Hex head capscrew
48.	Muffler hanger

5-1559

5-162. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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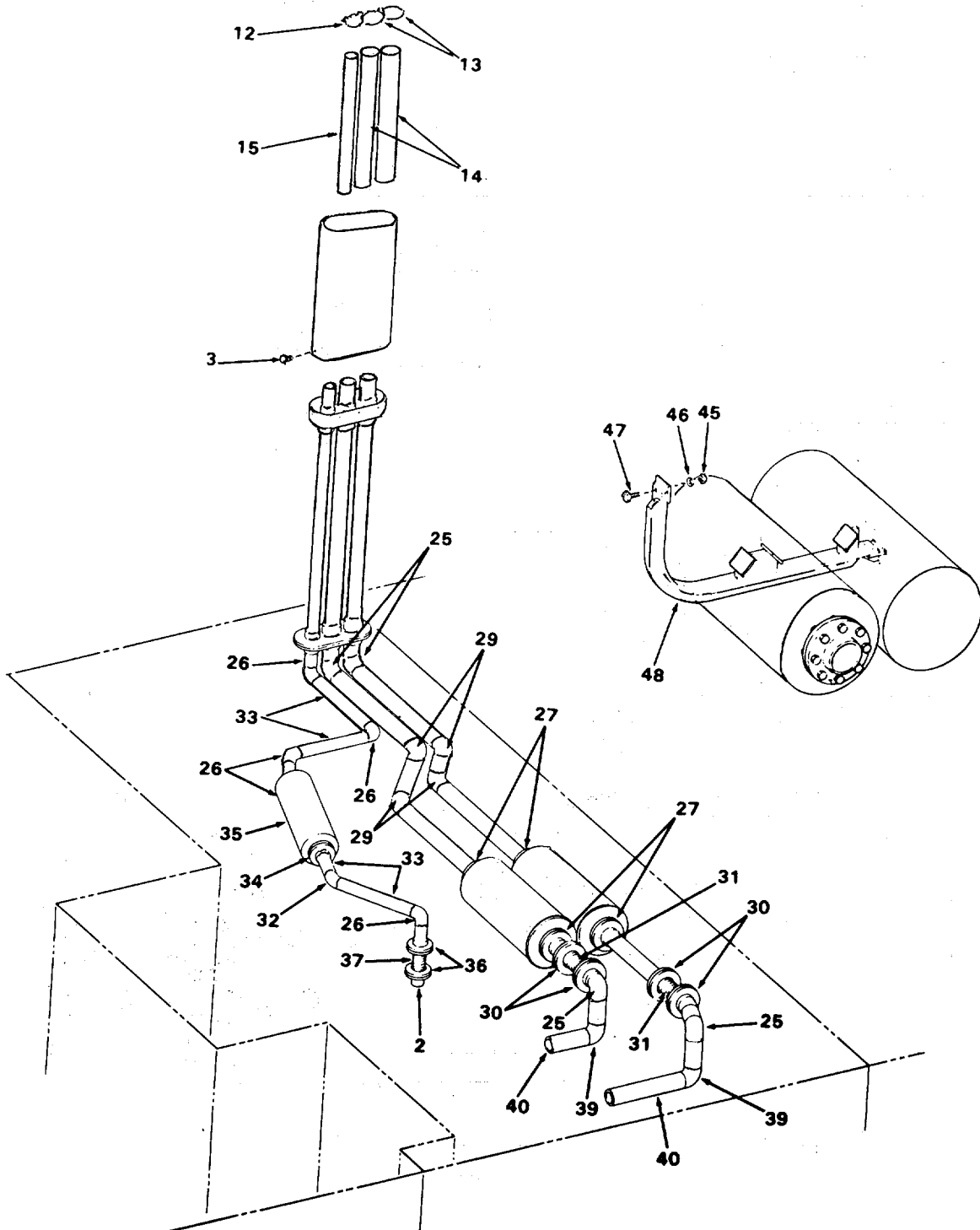
REPAIR OR REPLACE (Cont)



5-162. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)



5-163. FRESH WATER FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS

This task covers:

- a. Repair or Replace

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE

1. Fresh and Flush Water Piping Legend.

Item Number

Description

- | | |
|-----|----------------------|
| 1. | Hose valve |
| 2. | 90° reducer elbow |
| 3. | Bronze 90° elbow |
| 4. | Hose valve |
| 5. | Copper tubing |
| 6. | Bronze tee |
| 7. | Gate valve |
| 8. | Bronze 90° elbow |
| 9. | Copper tubing |
| 10. | Brass solenoid valve |
| 11. | Bronze adapter |
| 12. | Brass nipple |
| 13. | Bronze tee |

5-1562

5-163. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

1. Fresh and Flush Water Piping Legend (Cont).

<u>Item Number</u>	<u>Description</u>
14.	Bronze Union
15.	Gate valve
16.	Bronze tee
17.	Bronze tee
18.	Bronze 90° elbow
19.	Bronze union
20.	Bronze tee
21.	Bronze 90° elbow
22.	Y-strainer
23.	Gate valve
24.	Bronze union
25.	Bronze check valve
26.	Gate valve
27.	Hose valve
28.	Bronze tee
29.	Anti-syphon vacuum breaker
30.	Bronze tee
31.	Copper tubing
32.	Bronze tee
33.	Bronze globe valve
34.	Bronze 90° elbow
35.	Back-flow preventer
36.	Bronze stop/check hose valve
37.	Hose valve
38.	Bronze flange
39.	Bronze 90°0 elbow
40.	Copper tubing
41.	Bronze tee
42.	Gate valve
43.	Relif valve set at 5 psi
44.	Bronze reducer
45.	Copper tubing
46.	Swing check valve
47.	Copper tubing
48.	Bronze coupler
49.	Bronze tee

5-1563

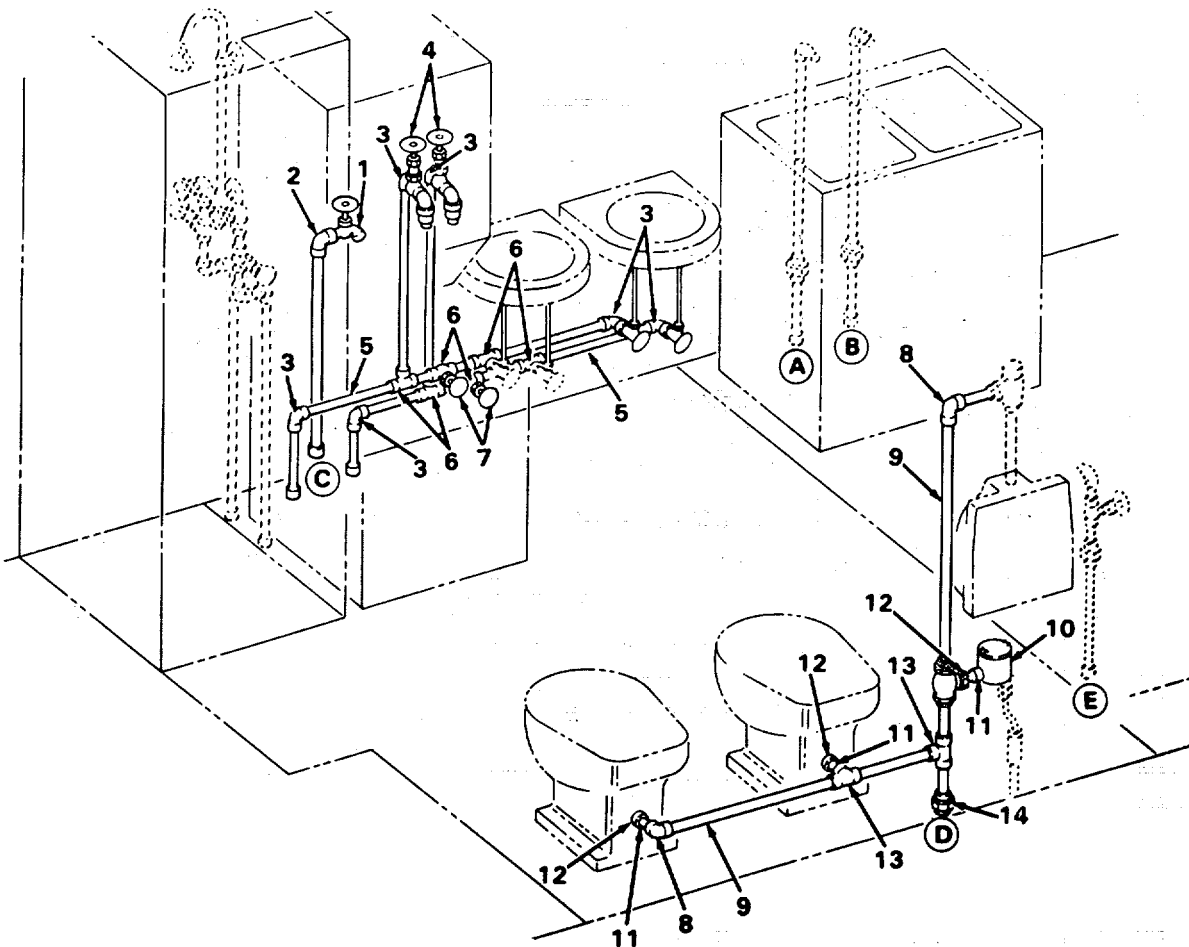
5-163. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)

1. Fresh and Flush Water Piping Legend (Cont).

<u>Item Number</u>	<u>Description</u>
50.	Brass pipe
51.	Bronze tee
52.	Bronze gate valve
53.	Vacuum breaker
54.	Bronze tee

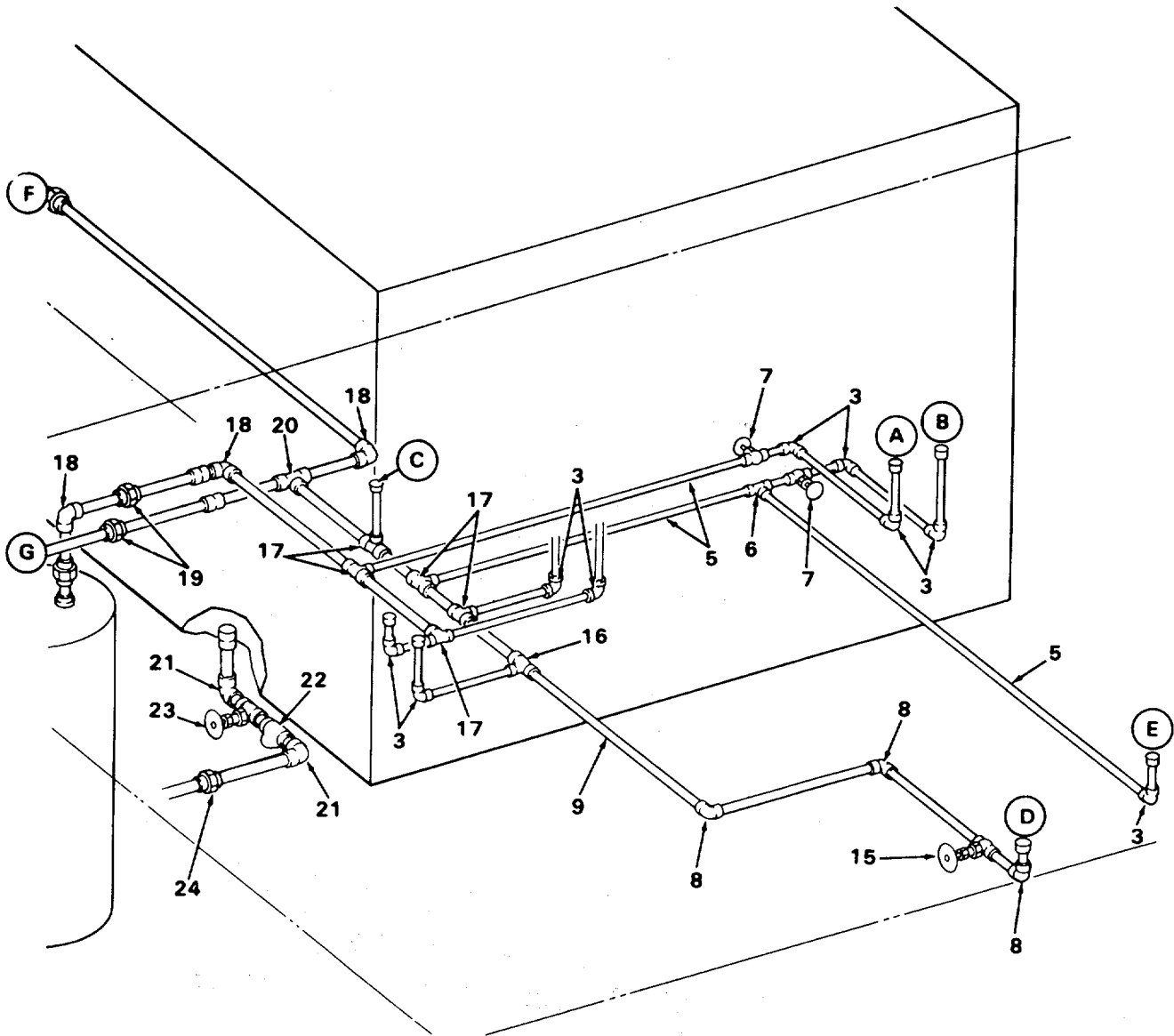


Fresh and Flush Water Piping (Sheet 1 of 5).

5-163. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)			
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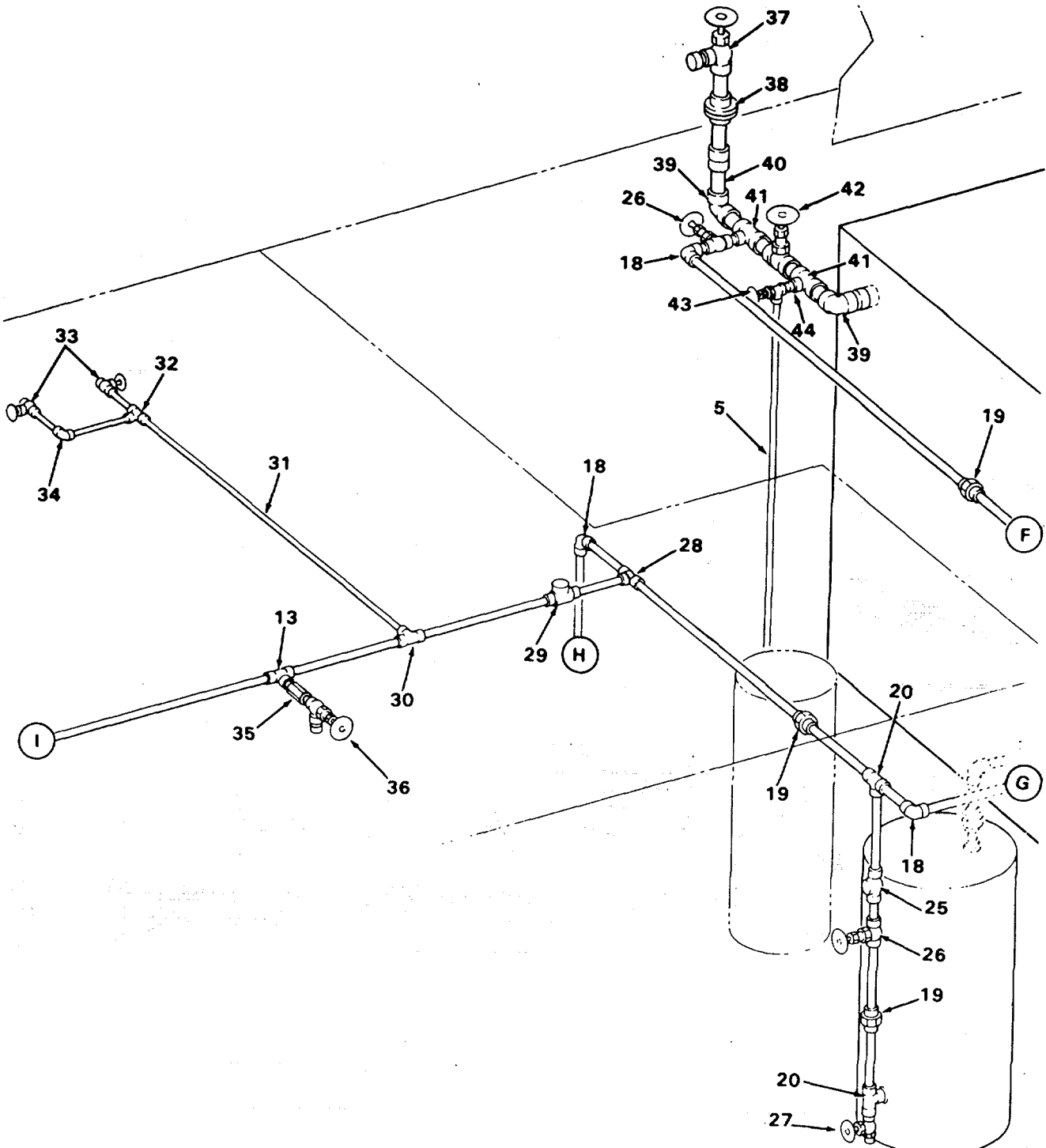


Fresh and Flush Water Piping (Sheet 2 of 5).

5-163. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)			
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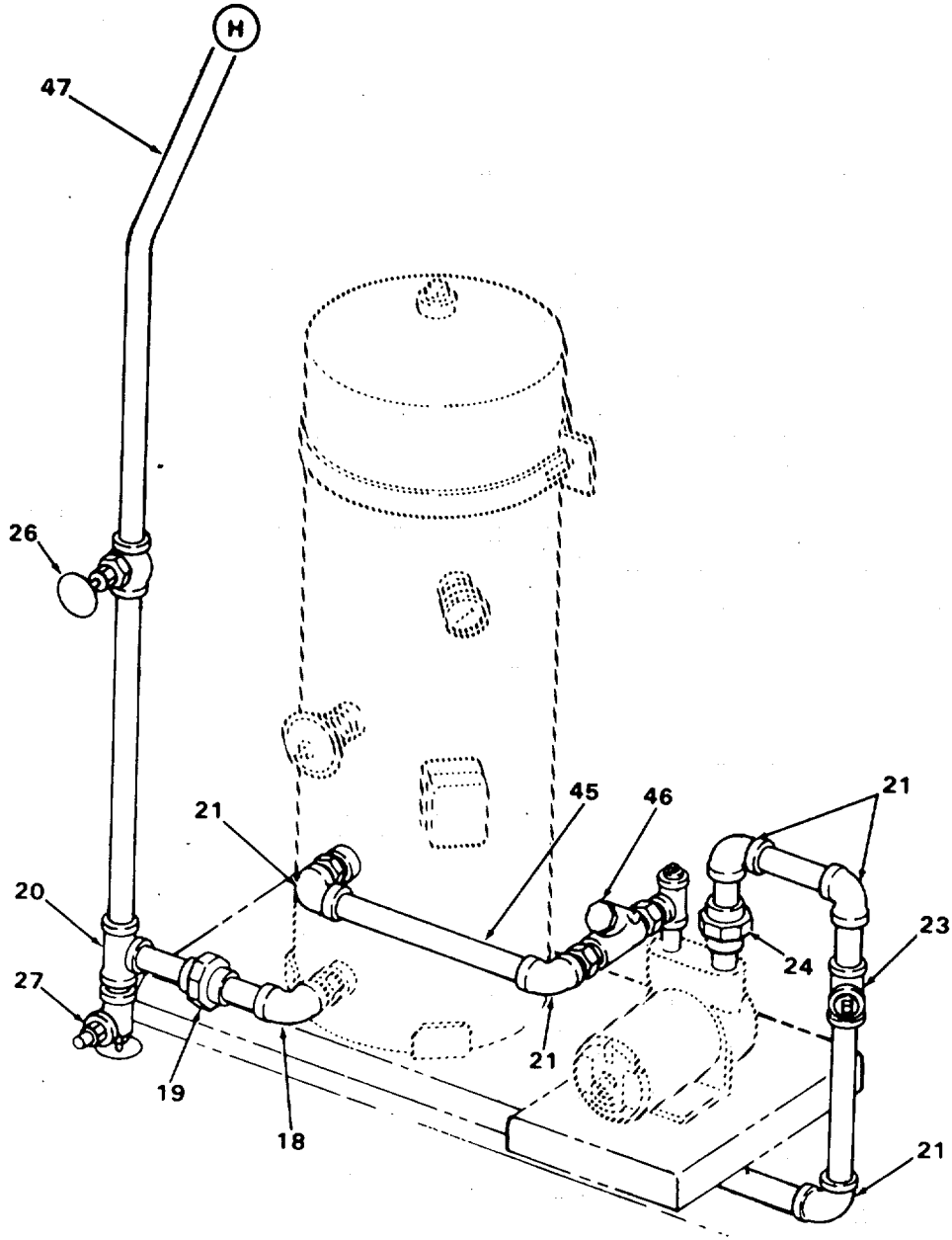


Fresh and Flush Water Piping (Sheet 3 of 5).

5-163. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR OR REPLACE (Cont)			
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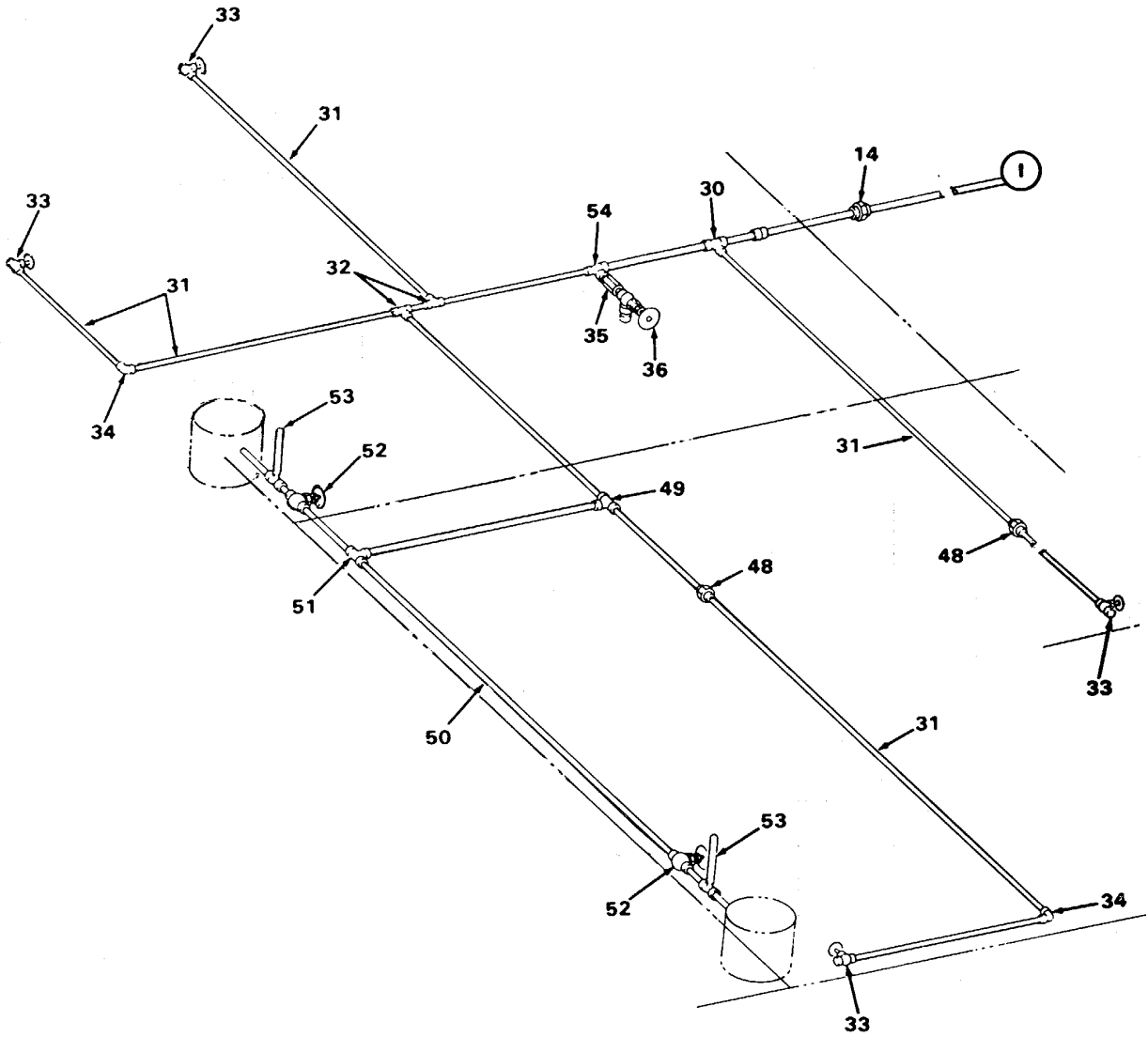


Fresh and Flush Water Piping (Sheet 4 of 5).

5-163. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)



Fresh and Flush Water Piping (Sheet 5 of 5).

5-164. DECK FITTINGS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
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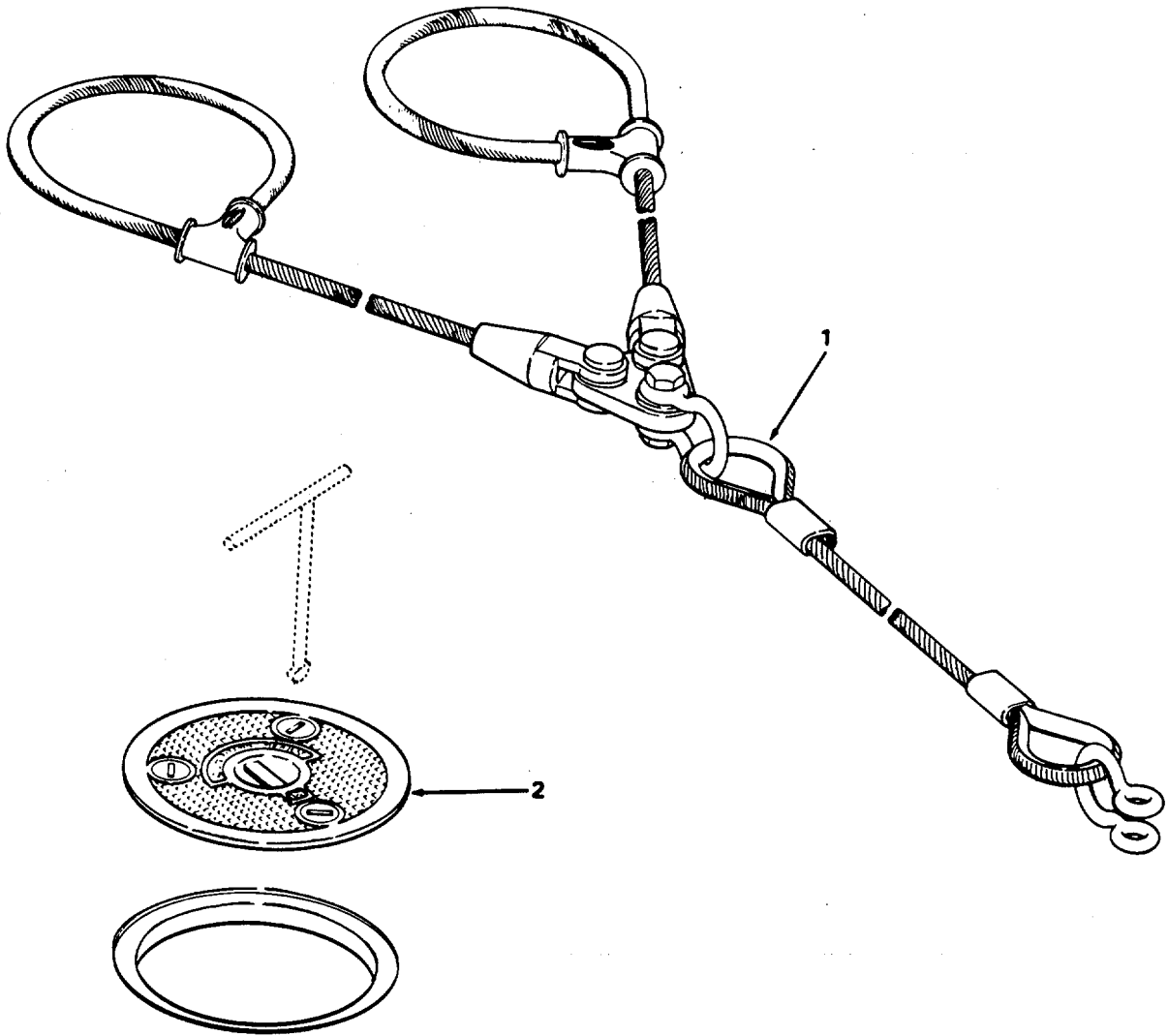
REPAIR OR REPLACE

- | | | | |
|----|------------------|-------------------------|---------------------|
| 1. | Towing
Bridle | Towing
bridle
(1) | Repair or Replace . |
| 2. | Deck
Cover | Deck cover
(2) | Repair or Replace . |

5-164. DECK FITTINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR OR REPLACE (Cont)			
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5-165. TANK LEVEL INDICATION RECEIVER - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

References
Paragraph

4-65.1 Tank level Indication Receiver

Special Tools
NONE

Equipment Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

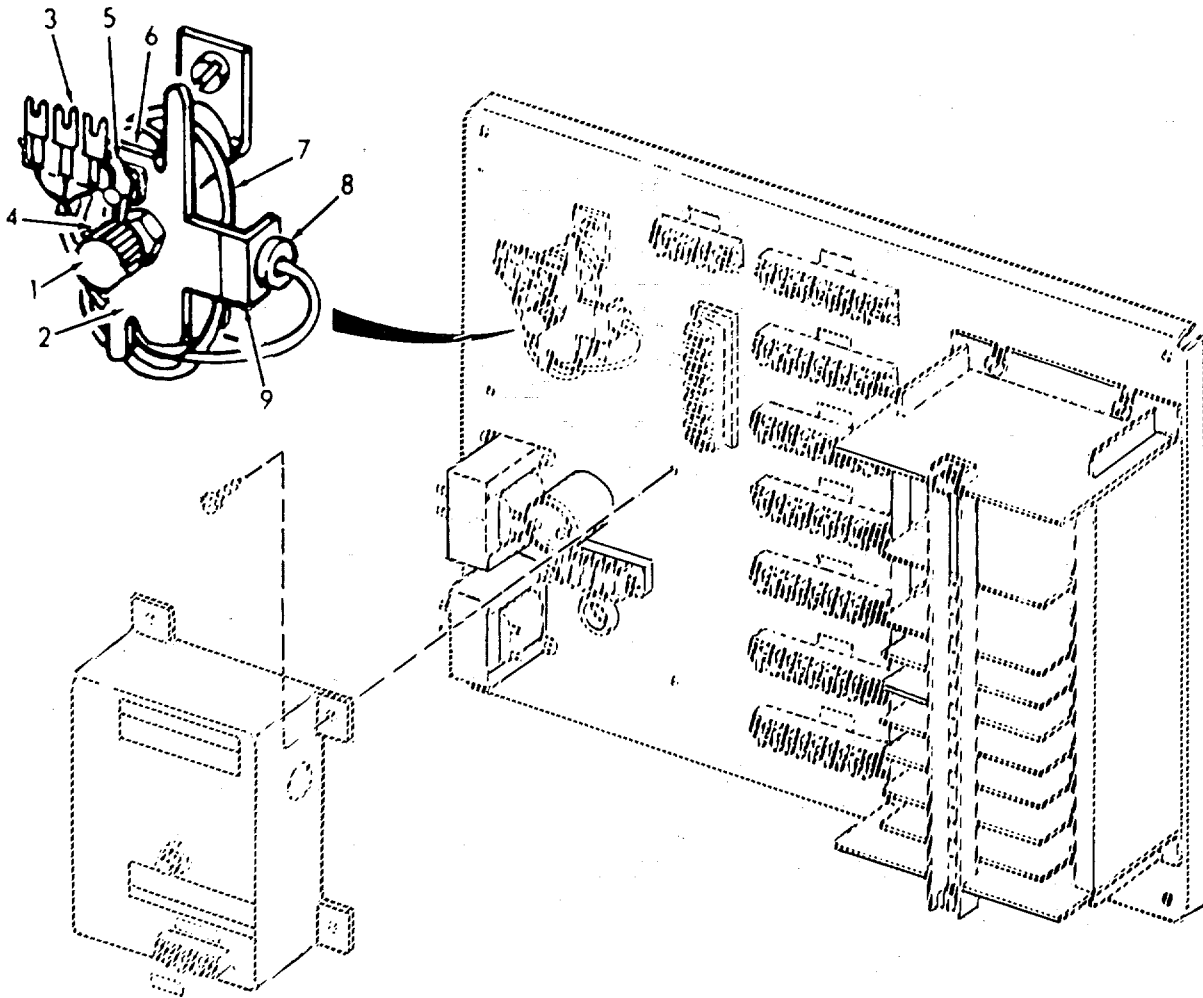
- | | | | |
|--------------------|---------------------------|----------|---------------------|
| 1. Float Simulator | a. Potent-ometer 2.5K (1) | Replace. | Refer to schematic. |
| | b. Float simulator (2) | Replace. | |
| | c. Connecting strip (3) | Replace. | |
| | d. Knob (4) | Replace. | |
| | e. Wing nut (5) | Replace. | |

5-165. TANK LEVEL INDICATION RECEIVER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|----|------------------|----------|--|
| f. | Wire cushion (6) | Replace. | |
| g. | Cable (7) | Replace. | |
| h. | Snub bushing (8) | Replace | |
| i. | Plate (9) | Replace. | |

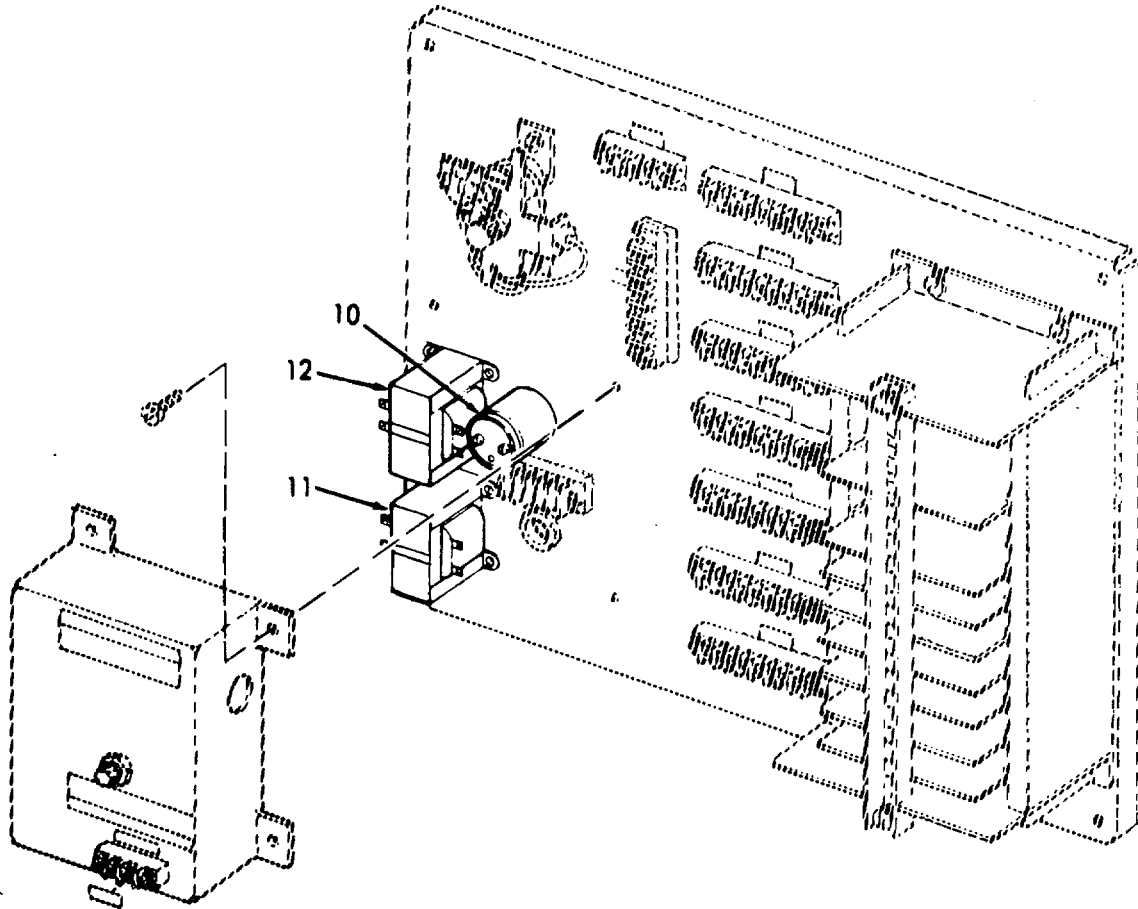


5-165. TANK LEVEL INDICATION RECEIVER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

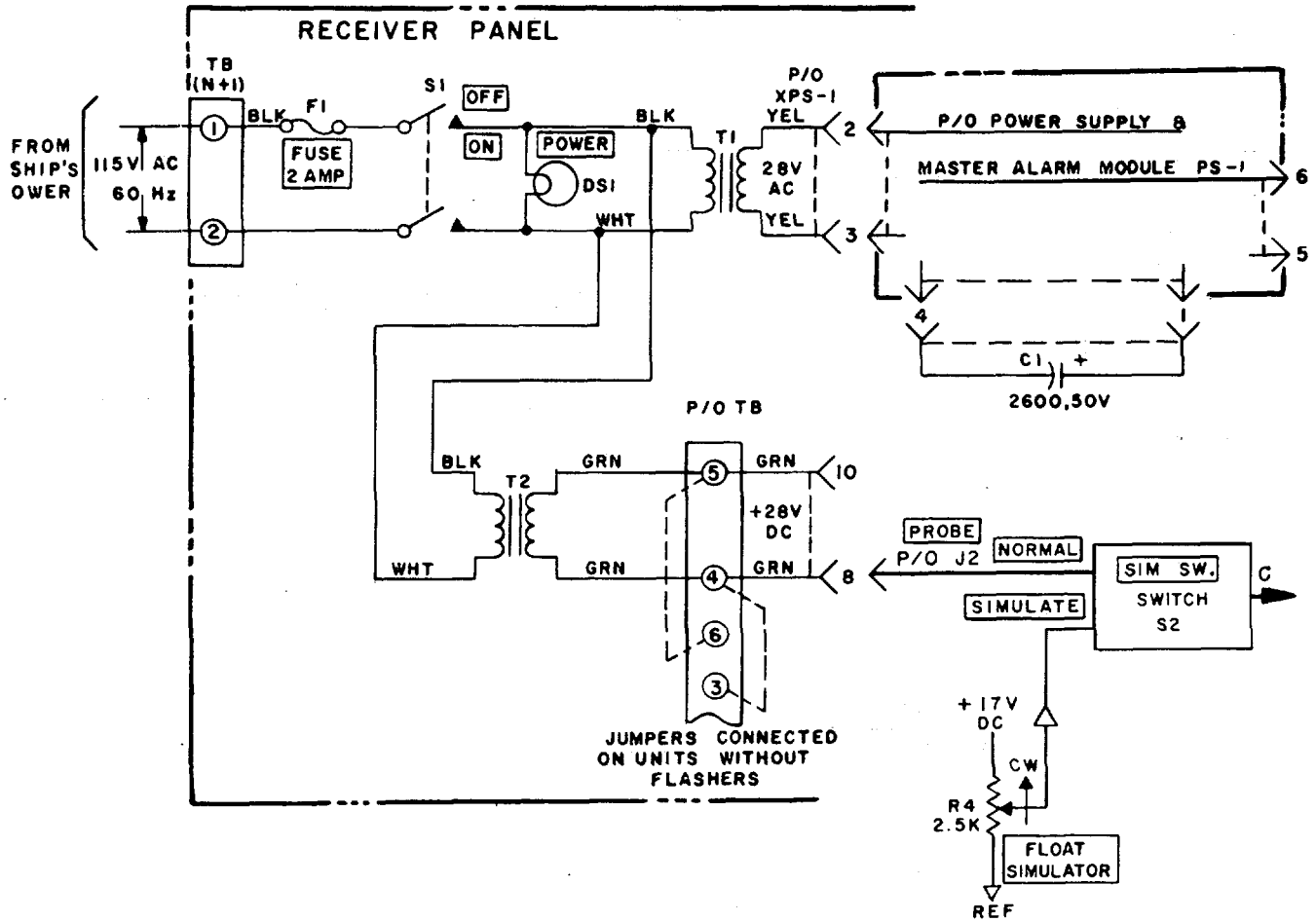
2. Power Supply	a. Capacitor 2600 mf (10)	Replace.	
	b. Trans- former (11)	Replace.	
	c. Trans- former (12)	Replace.	



5-165. TANK LEVEL INDICATION RECEIVER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)



5-166. HOT WATER HEATER - MAINTENANCE INSTRUCTIONS.

This task covers:

Replace

INITIAL SETUP

Test Equipment
NONE

References
Paragraph

5-163 Fresh Water Piping

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE

NOTE

Refer to Fresh Water Piping paragraph 5-163 for location of piping.

5-167. DECK AND SANITARY DRAINS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE

1. Deck and Sanitary Drains Legend.

<u>Item Number</u>	<u>Description</u>
1.	Straight tee
2.	Pipe
3.	Copper-nickel pipe
4.	Pipe plug
5.	Adapter
6.	450 Y-branch
7.	Straight tee
8.	Adapter
9.	Straight tee
10.	Copper-nickel pipe

5-167. DECK AND SANITARY DRAINS - MAINTENANCE INSTRUCTIONS.

(Cont)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE (Cont)

Deck and Sanitary Drains Legend (Cont).

<u>Item Number</u>	<u>Description</u>
11 .	Straight tee
12.	90° elbow
13.	Adapter
14.	Deck drain with trap
15.	Straight tee
16.	450 elbow
17.	45° Y-branch
18.	Straight tee
19.	Range
20.	Ball valve
21 .	Pipe
22.	Funnel
23.	90° elbow
24.	Copper-nickel pipe
25.	45° elbow
26.	90° elbow
27.	Deck drain with trap
29.	90° elbow
30.	Bushing
31 .	Range
32.	Scupper valve with control
33.	Slip on flange
34.	Tee
35.	Scupper valve with control
36.	Flange
37.	Bushing
38.	Flange
39.	Ball valve
40.	Copper-nickel pipe
41.	Reducer coupling
42.	Pipe plug
43.	Bushing
44.	Sweep tee
45.	90° long radius elbow
46.	Long turn sweep tee

5-167. DECK AND SANITARY DRAINS - MAINTENANCE INSTRUCTIONS.

(Cont)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE (Cont)

Deck and Sanitary Drains Legend (Cont).

<u>Item Number</u>	<u>Description</u>
47.	Range
48.	90° reducing elbow
49.	45° elbow
50.	Copper-nickel pipe
51.	90° elbow
52.	Copper-nickel pipe
53.	90° reducing elbow
54.	Double sweep tee
55.	Adapter
56.	Ball valve
57.	Check valve
58.	Scupper valve with control
59.	90° long radius elbow

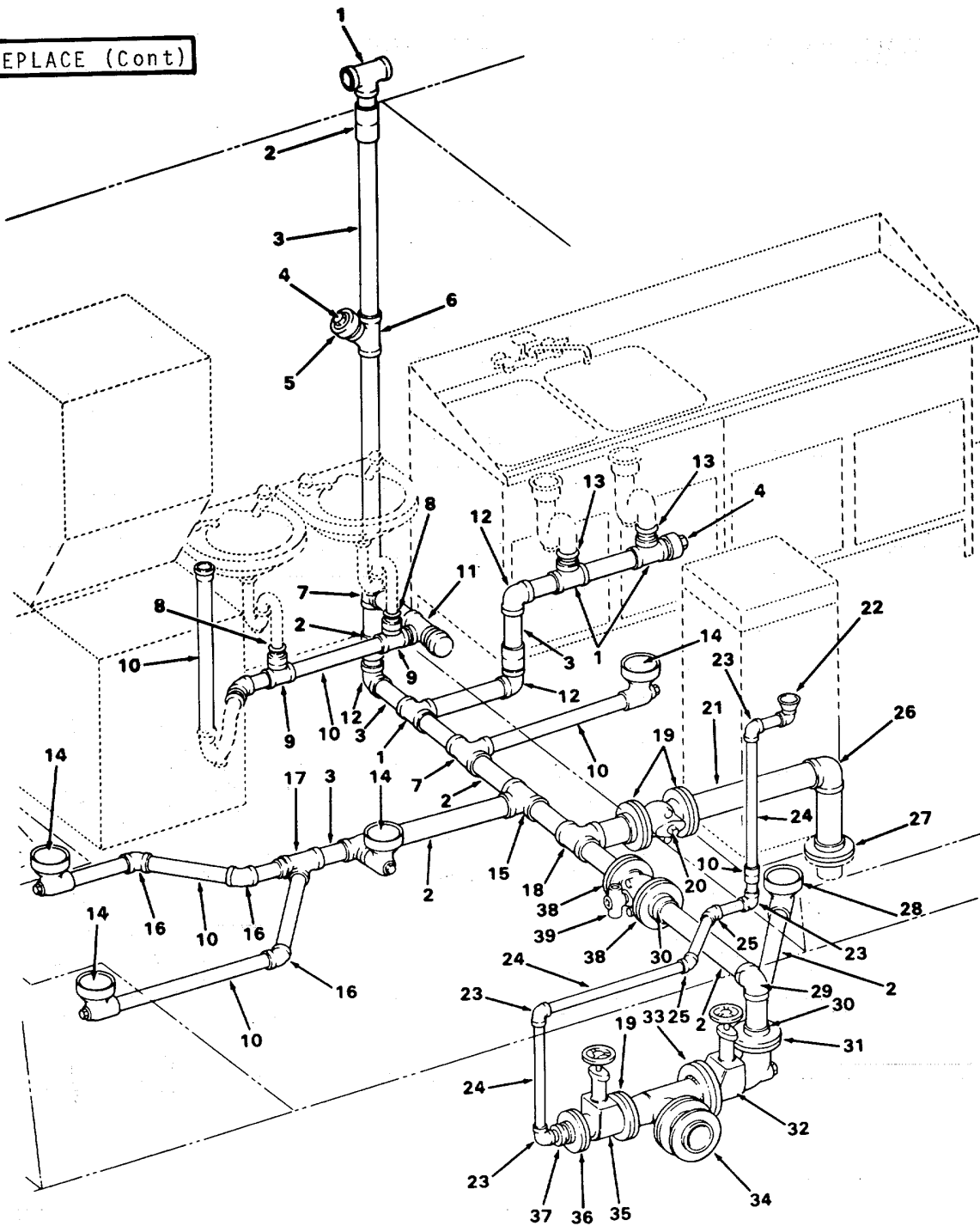
5-167. DECK AND SANITARY DRAINS - MAINTENANCE INSTRUCTIONS.

(Cont)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE (Cont)

REPLACE (Cont)

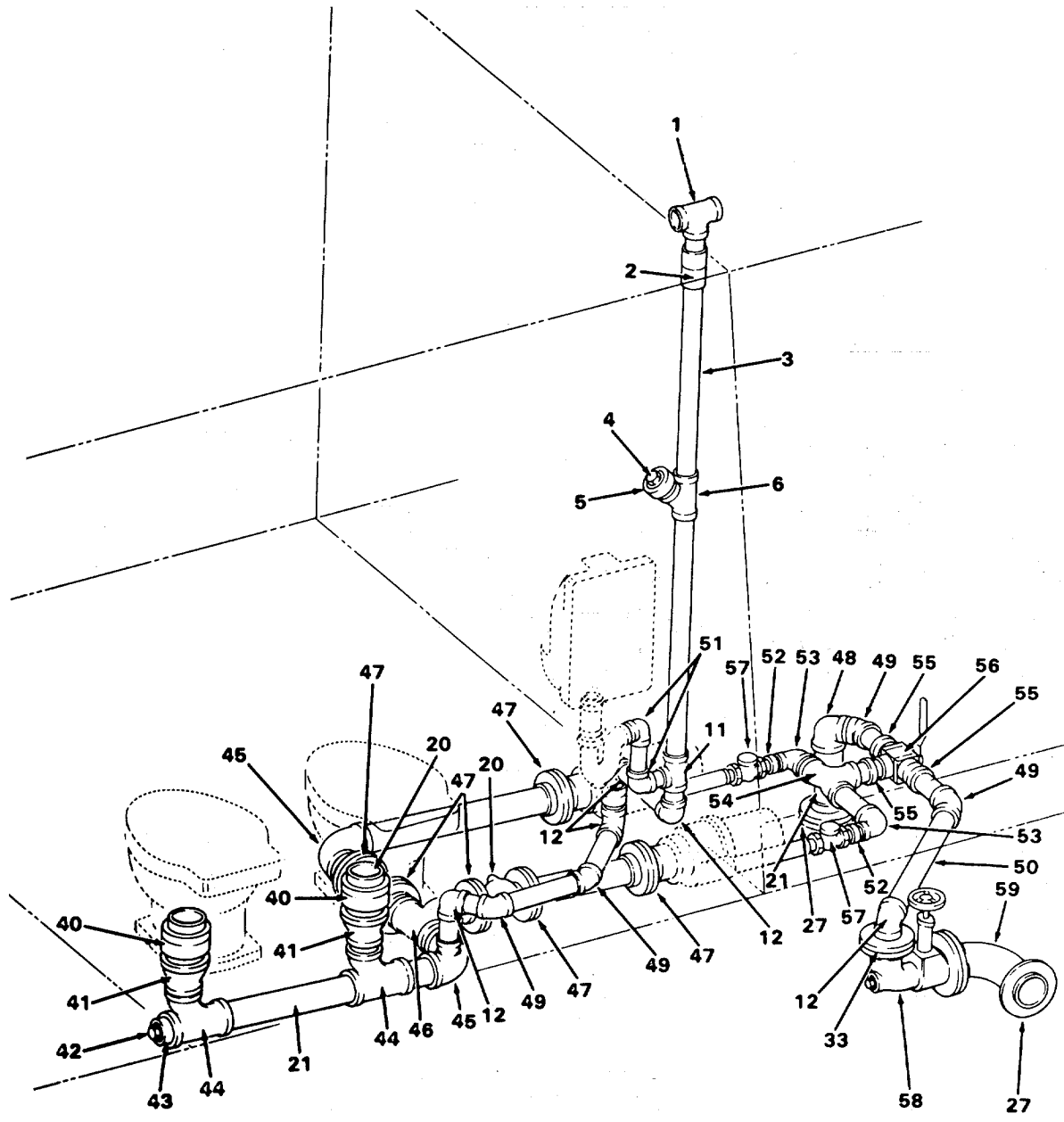


5-167. DECK AND SANITARY DRAINS - MAINTENANCE INSTRUCTIONS.

(Cont)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACE (Cont)



5-168. VENTS AND SOUNDING TUBES - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

Vents and Sounding Tubes Legend.

<u>Item Number</u>	<u>Description</u>
1.	Reducer
2.	Return bend elbow
3.	Black steel pipe
4.	Steel pipe
5.	Deck plate
6.	Adapter
7.	Steel elbow
8.	Steel tee
9.	Nose cap
10.	Black steel pipe
11.	Steel flange

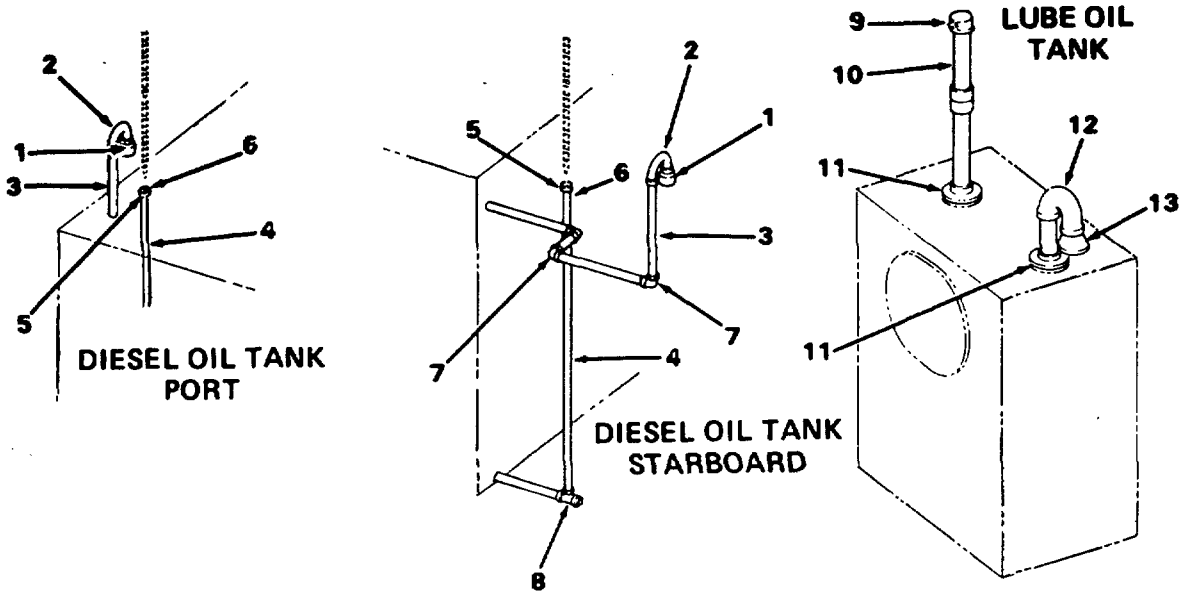
5-168. VENTS AND SOUNDING TUBES - MAINTENANCE INSTRUCTIONS.
(Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

Vents and Sounding Tubes Legend(Cont).

Item Number	Description
12.	Return elbow
13.	Terminal vent with flame screen
14.	Copper tubing
15.	90° elbow
16.	Return bend elbow
17.	Inverted check vent
18.	Brass pipe
19.	90° elbow
20.	Copper-nickel pipe
21.	Sleeve
22.	Inverted check vent
23.	90° elbow
24.	Brass pipe
25.	Copper-nickel pipe
26.	Sleeve

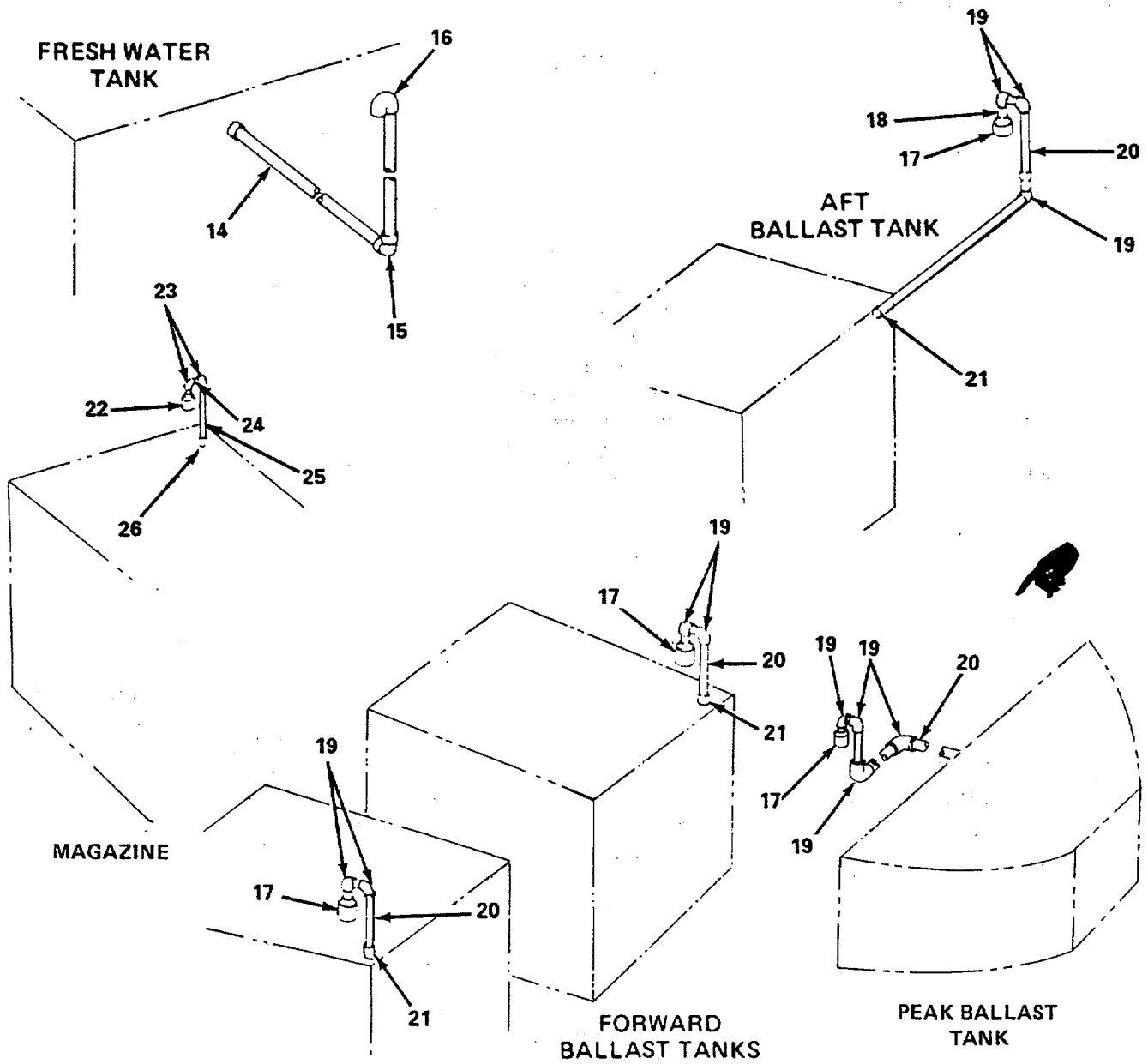


Vents and Sounding Tubes.

5-168. VENTS AND SOUNDING TUBES - MAINTENANCE INSTRUCTIONS.
(Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)



4954-076

Vents and Sounding Tubes.

5-169. FURNITURE AND MISCELLANEOUS FURNISHINGS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

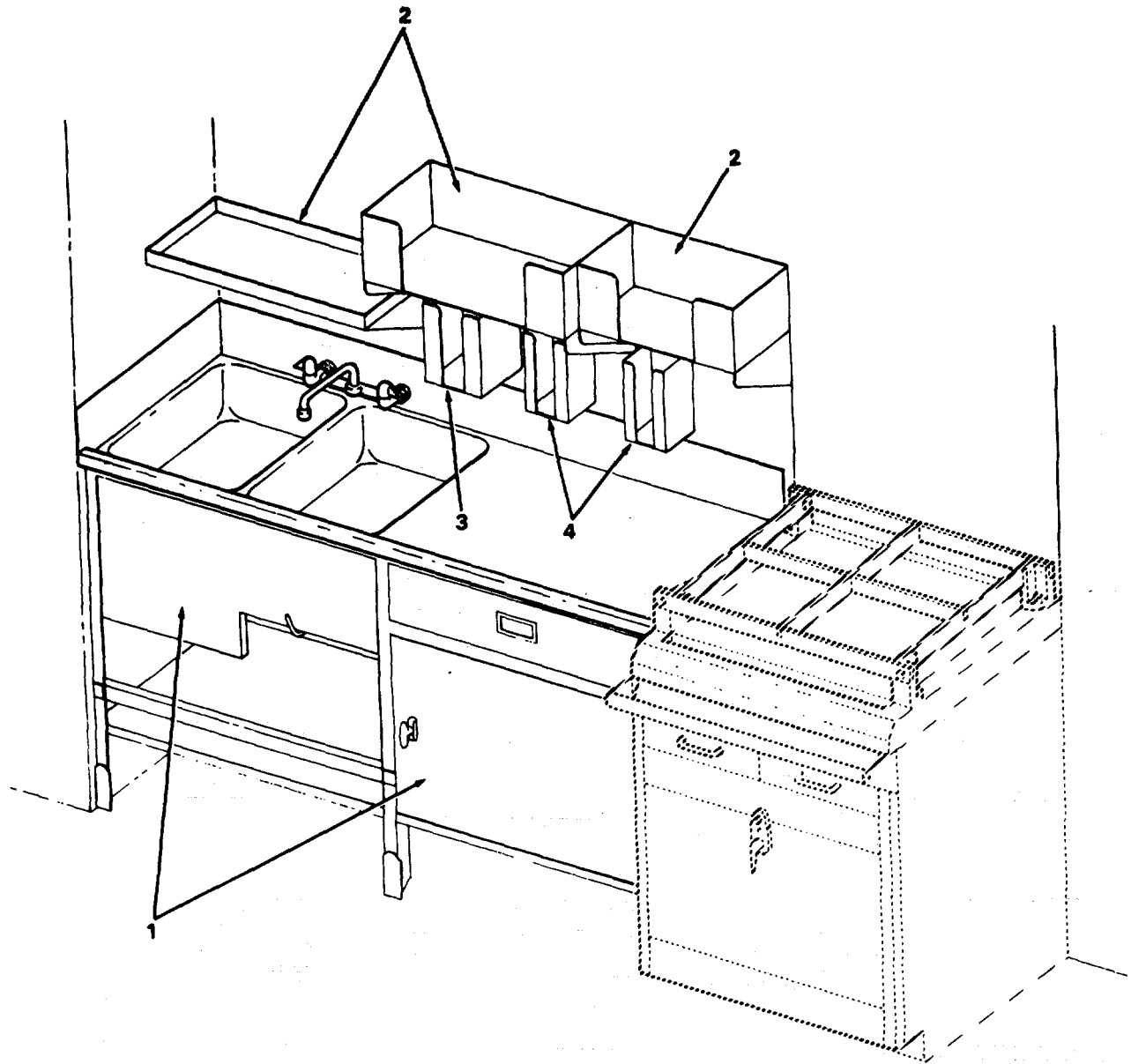
Furniture and Miscellaneous Furnishings Legend.

<u>Item Number</u>	<u>Description</u>
1.	Sink dresser
2.	Galley shelf set
3.	Galley bowl stowage rack
4.	Galley cup stowage rack
5.	Commissary stowage dresser
6.	Cabinet
7.	Condiment tray
8.	Mess counter
9.	Mess seat

5-169. FURNITURE AND MISCELLANEOUS FURNISHINGS - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

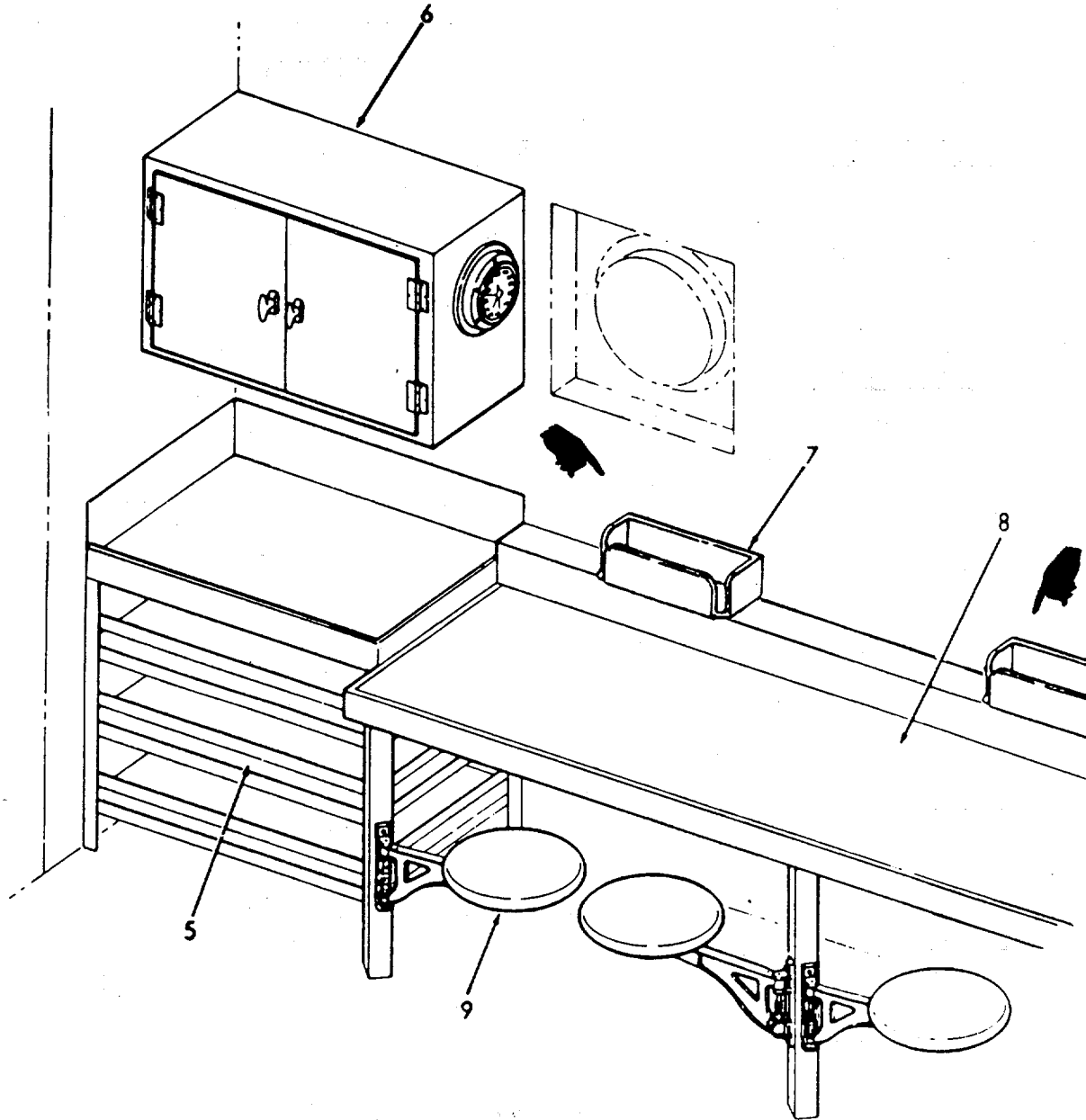


Furniture - Galley and Mess Room (Sheet 1 of 2).

5-169. FURNITURE AND MISCELLANEOUS FURNISHINGS - MAINTENANCE
INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)



4951-192

Furniture - Galley and Mess Room (Sheet 2 of 2).

5-170. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment
Condition Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
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REPLACE OR REPAIR

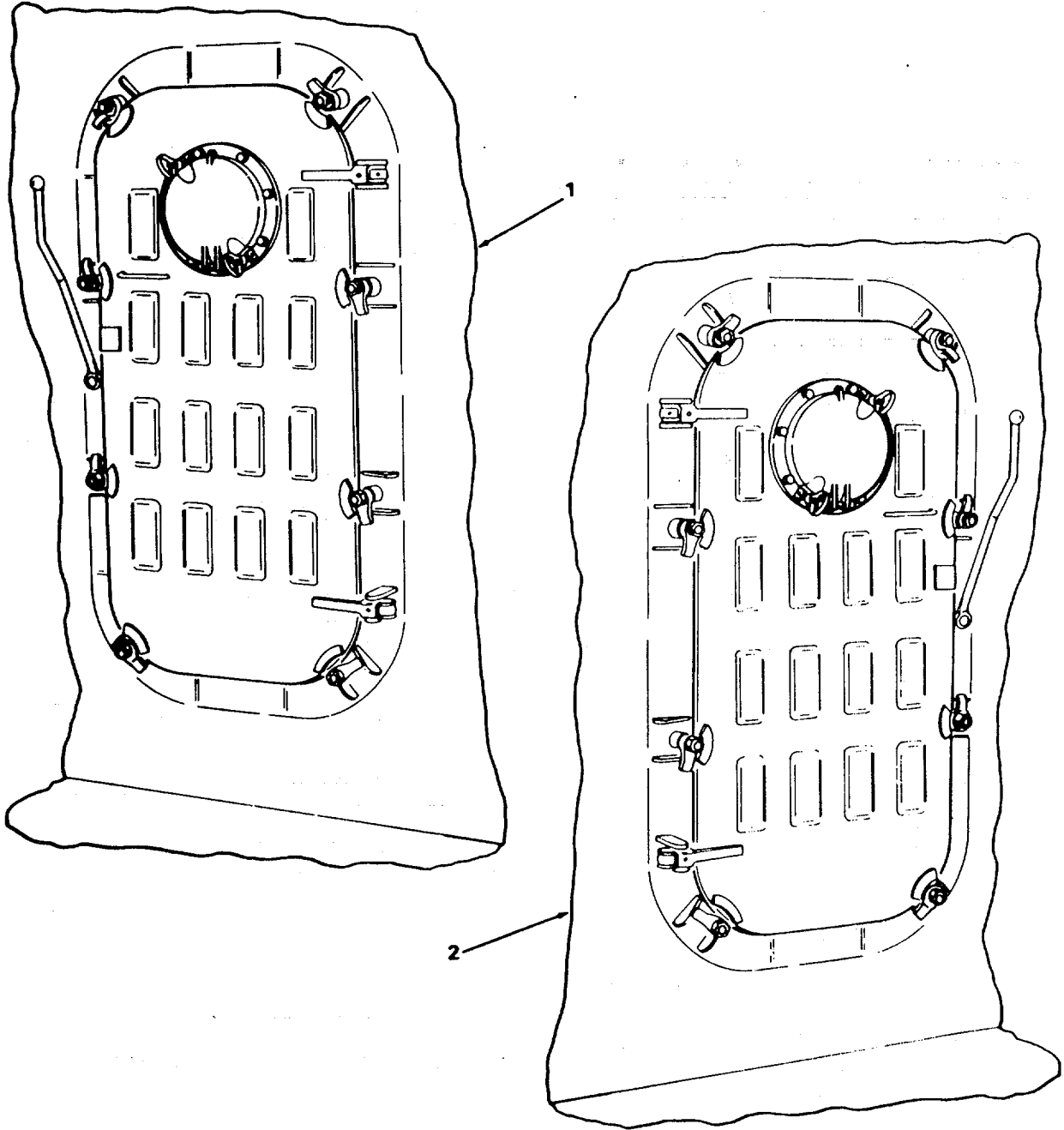
1. Doors Legend.

<u>Item Number</u>	<u>Description</u>
1.	26 x 54 door
2.	26 x 57 door
3.	26 x 45 door
4.	36 x 45 door
5.	26 x 45 door
6.	26 x 45 door
7.	18 x 36 door
8.	18 x 36 door
9.	26 x 45 door
10.	Sliding door

5-170. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACE OR REPAIR (Cont)

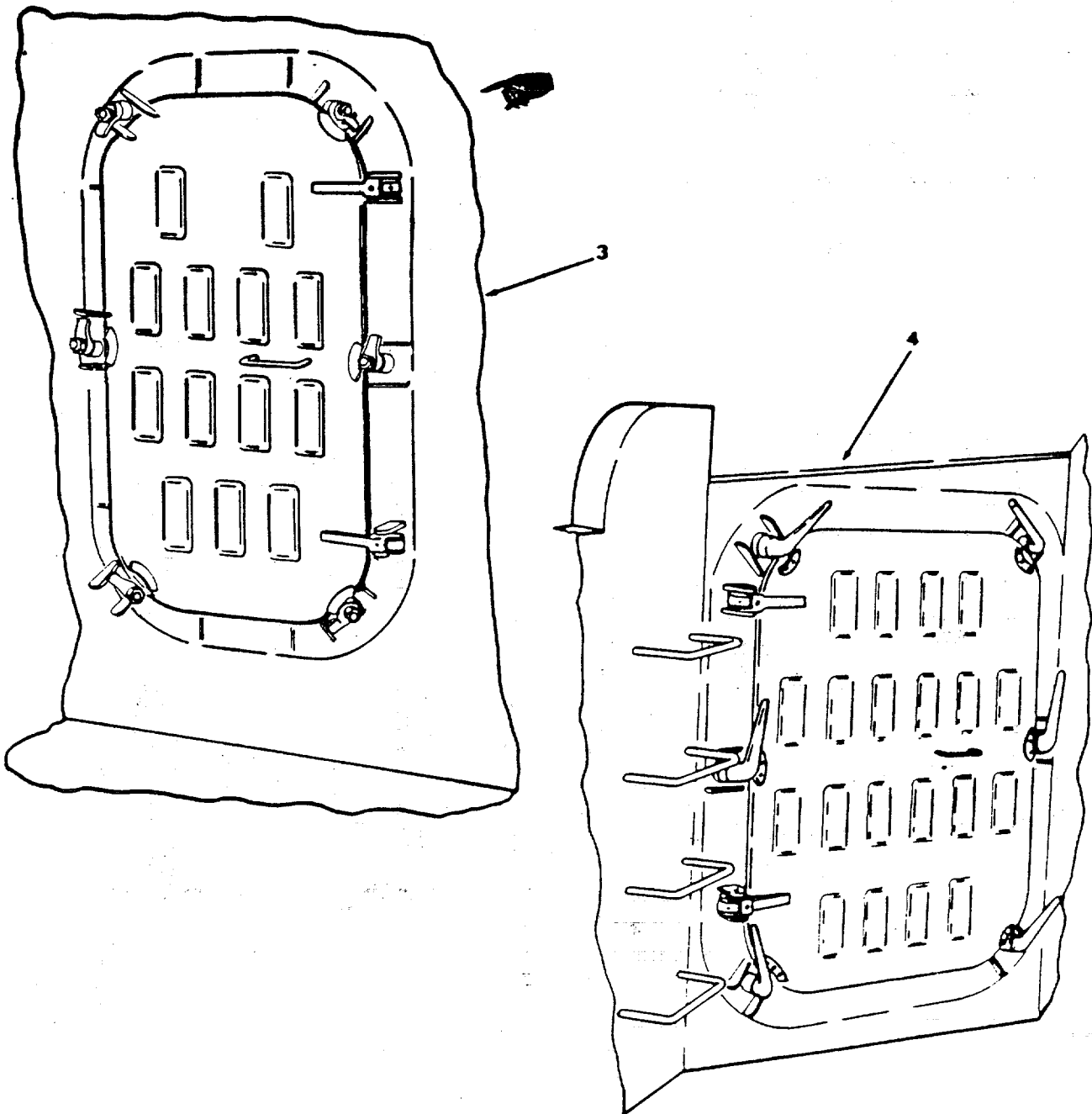


Doors - (Sheet 1 of 5).

5-170. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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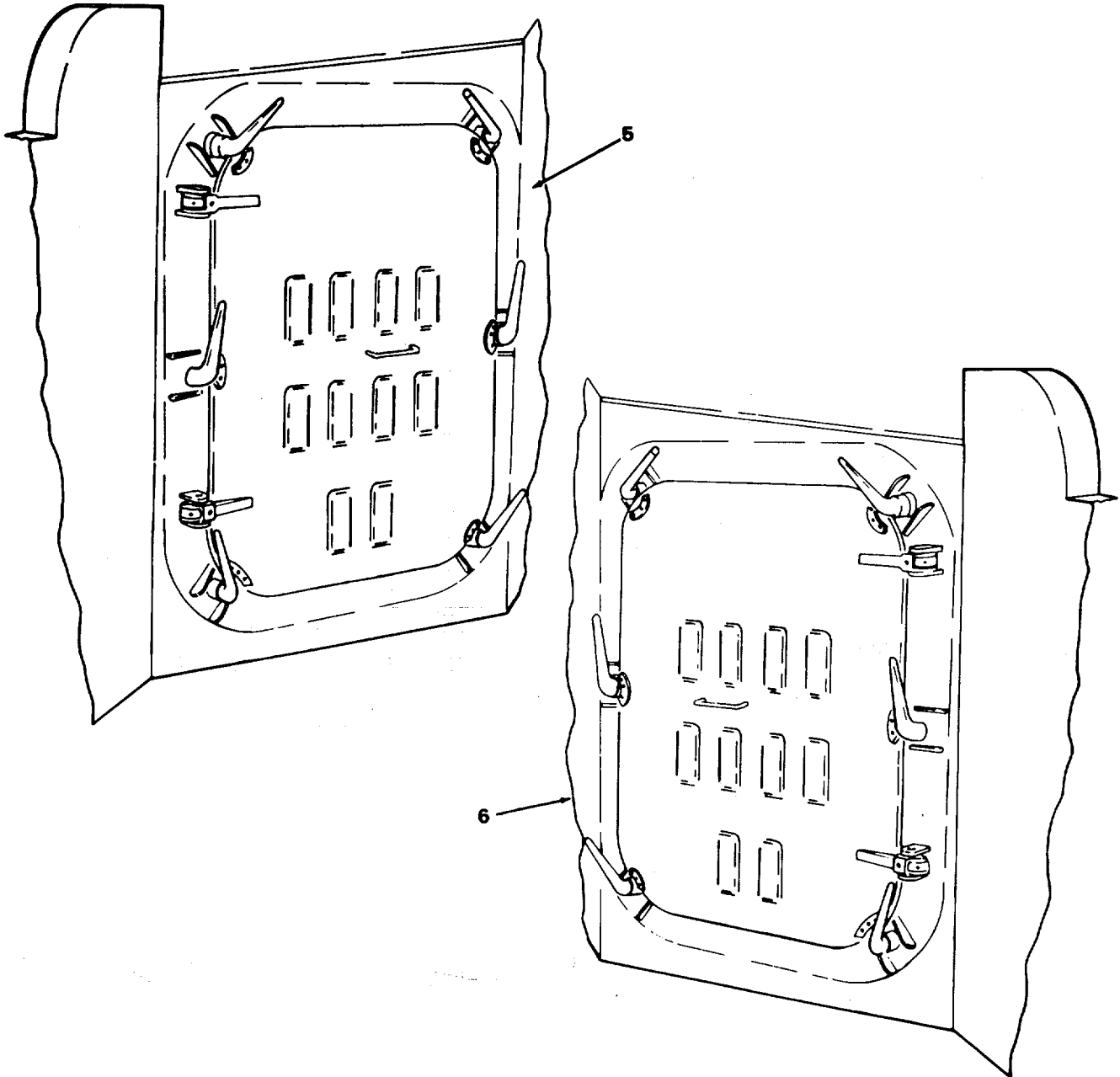
REPLACE OR REPAIR (Cont)



5-170. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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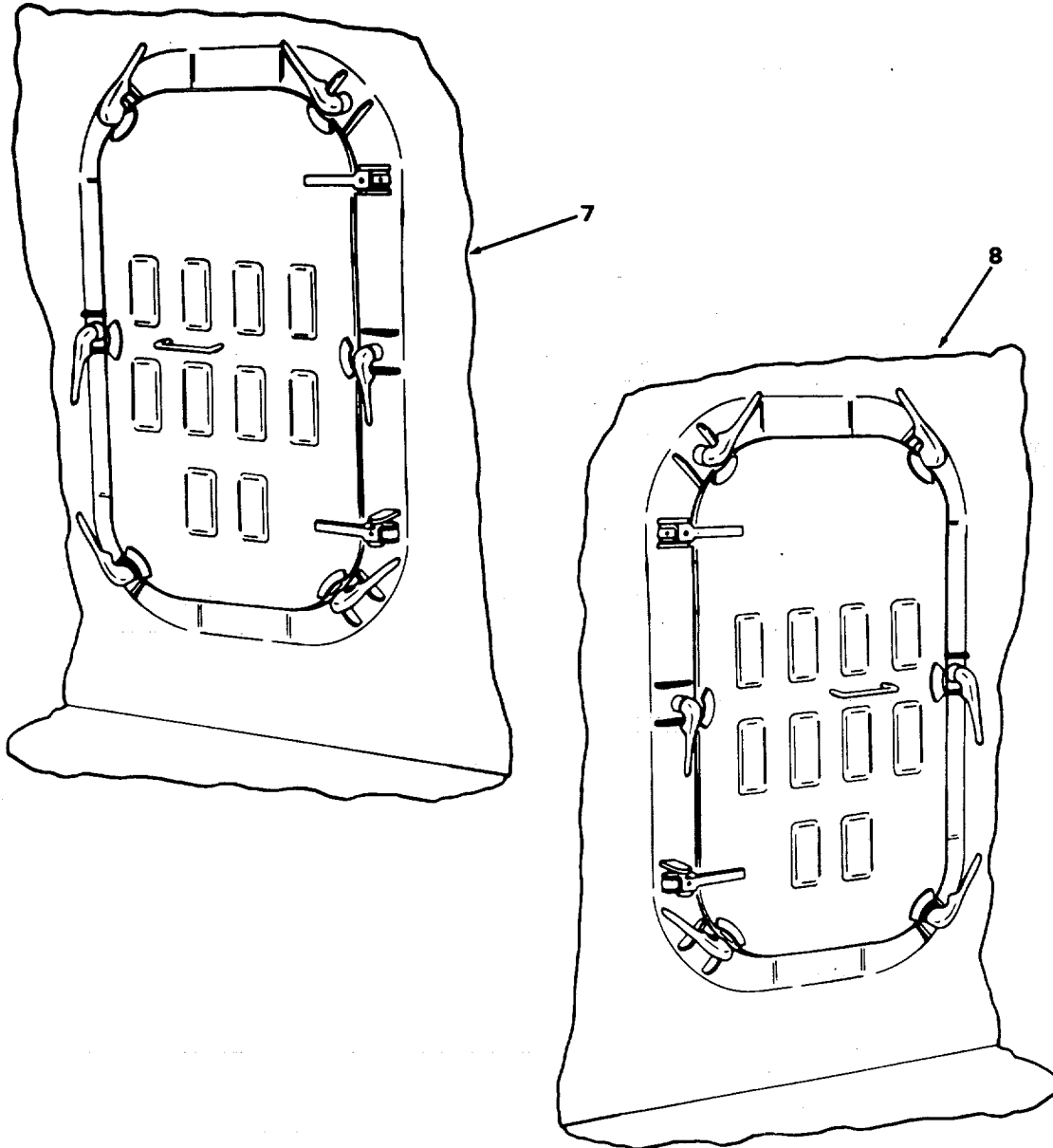
REPLACE OR REPAIR (Cont)



5-170. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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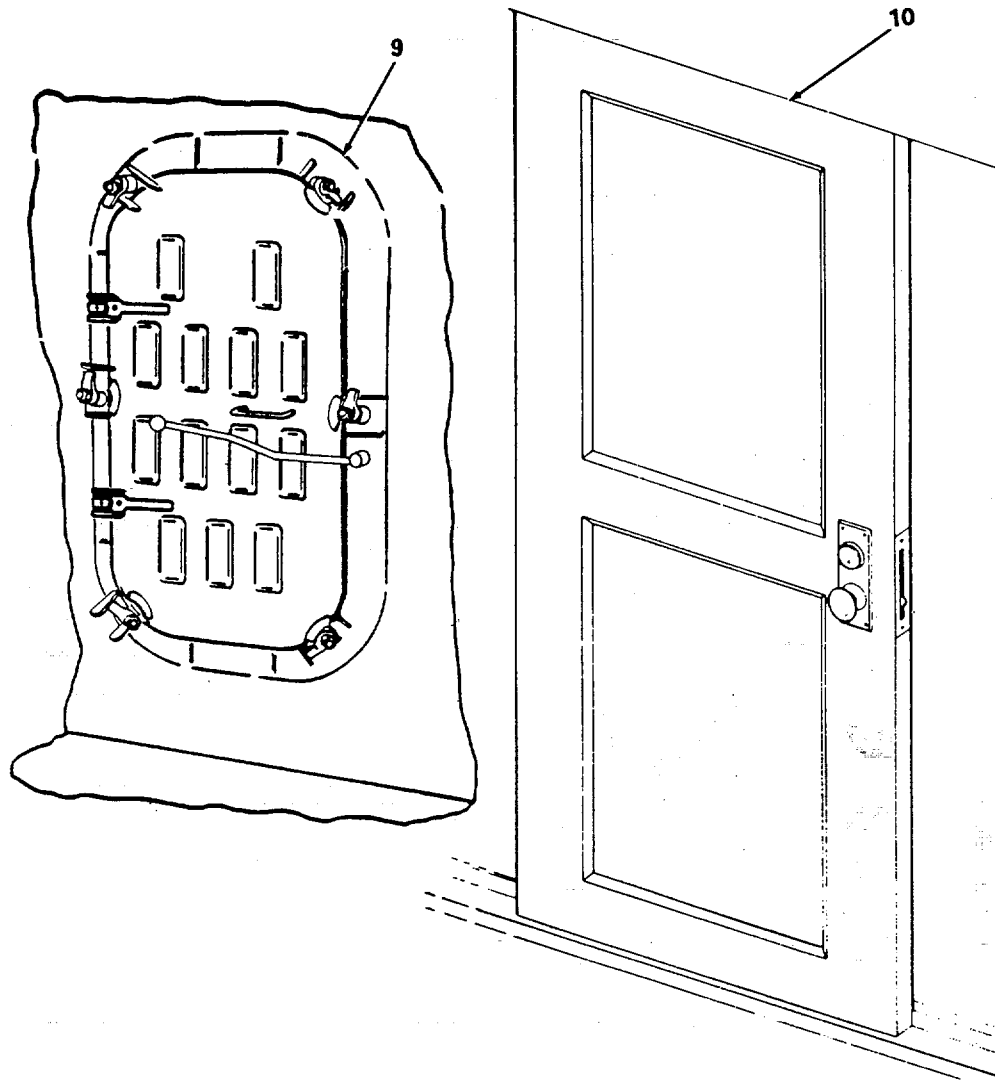
REPLACE OR REPAIR (Cont)



5-170. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS
 (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACE OR REPAIR (Cont)



4951-047

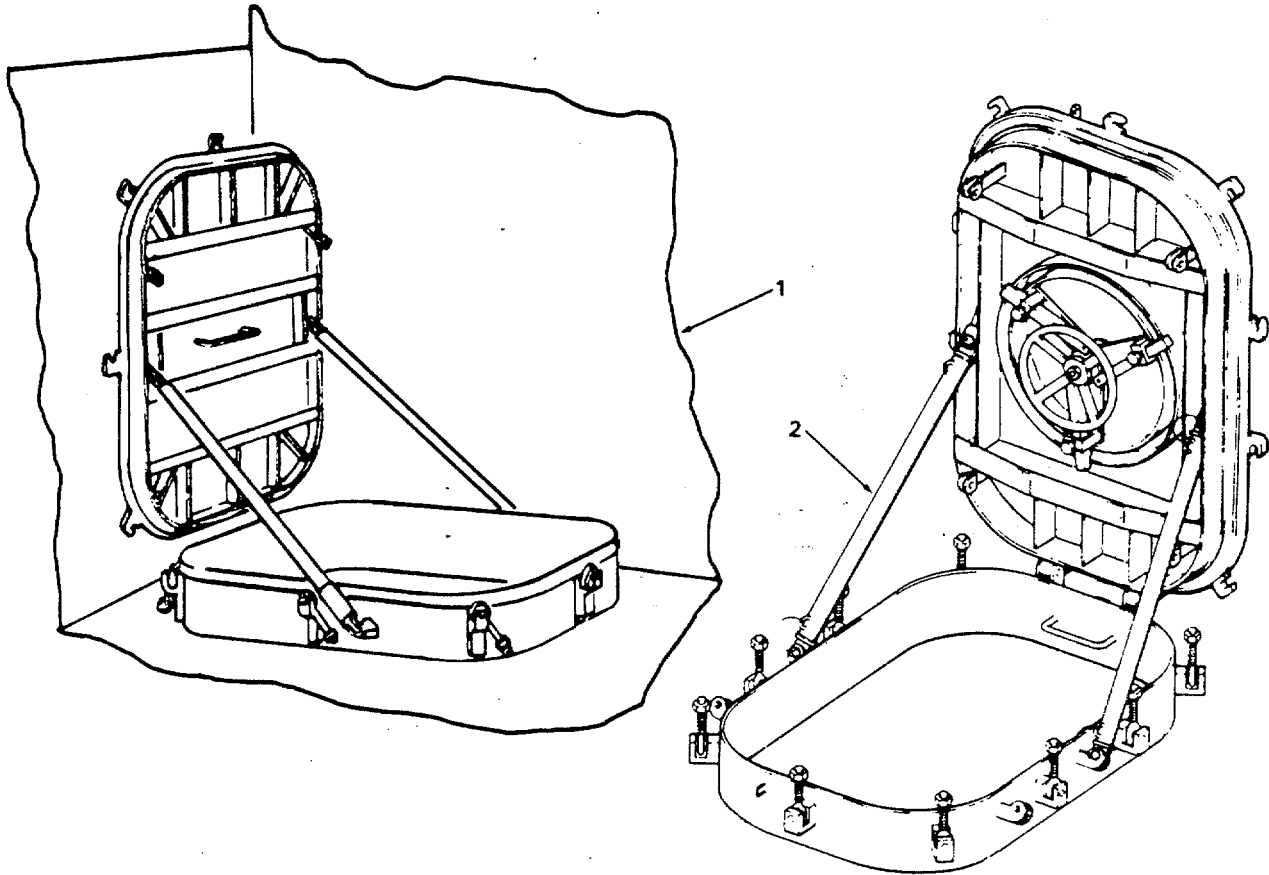
5-170. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACE OR REPAIR (Cont)

2. Hatches Legend.

<u>Item Number</u>	<u>Description</u>
1.	36 x 36 hatch
2.	24 x 42 hatch
3.	27 x 42 hatch
4.	24 x 24 hatch
5.	15 x 23 hatch



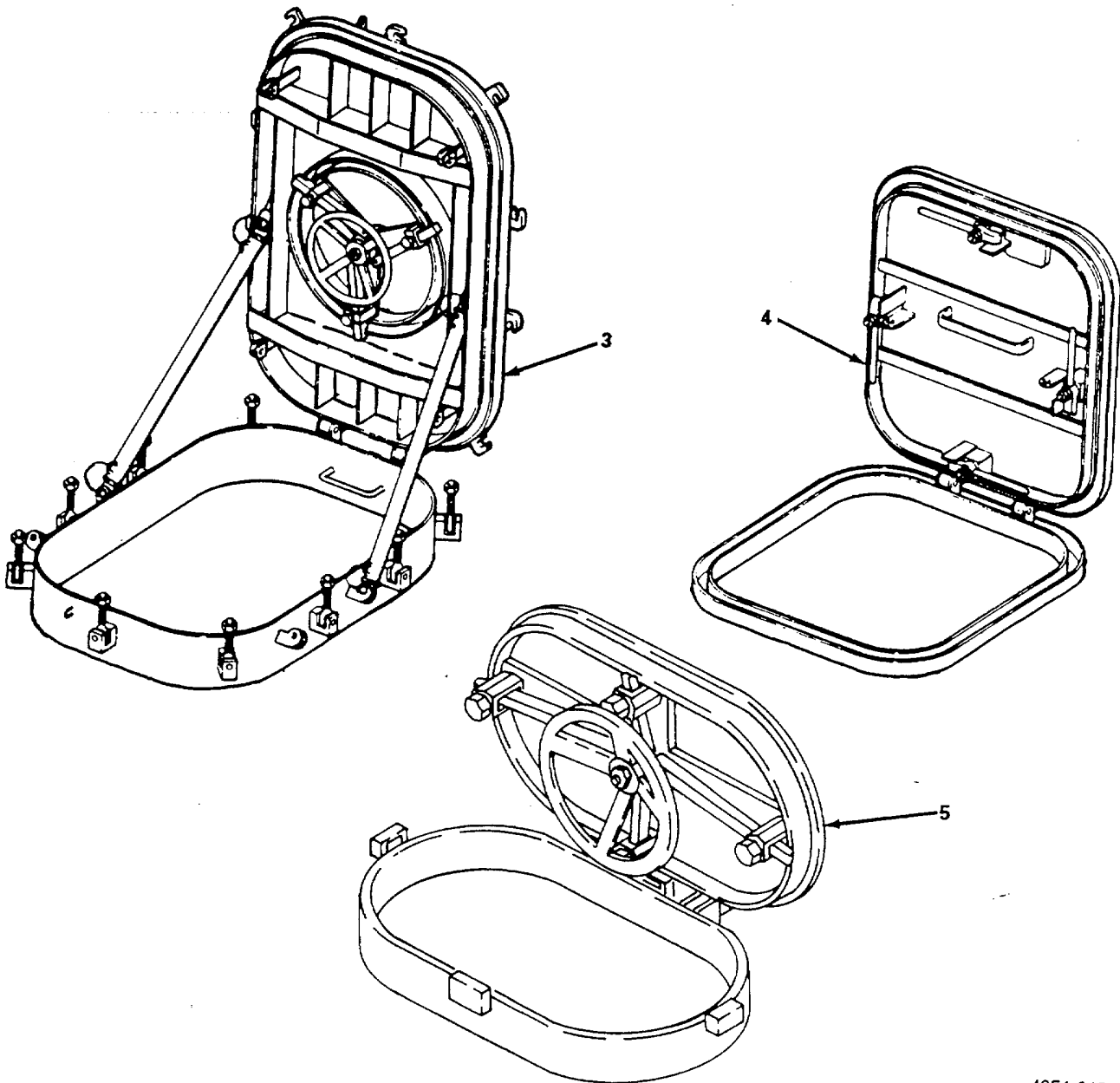
Hatches - (Sheet 1 of 2).

Change 1 5-1594

5-170. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACE OR REPAIR (Cont)



4951-013

Hatches (Sheet 2 of 2).

Change 1 5 -1 595

5-170. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS
(Continued).

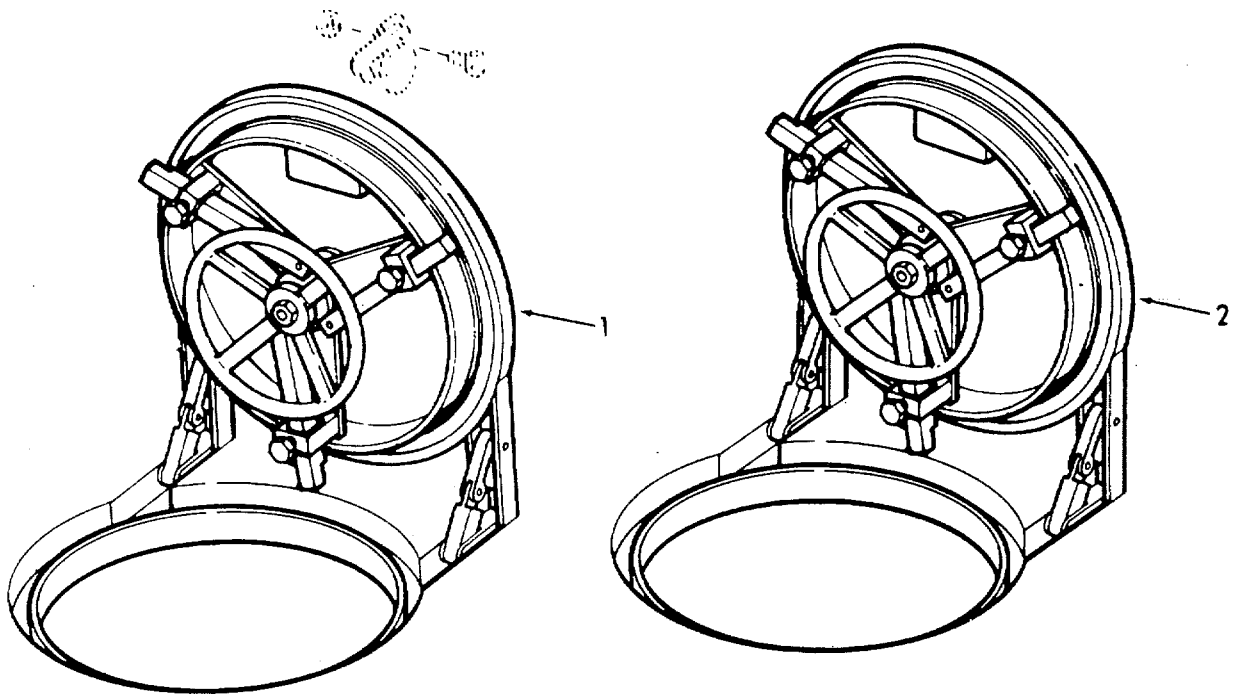
LOCATION	ITEM	ACTION	REMARKS
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REPLACE OR REPAIR (Cont)

3 Scuttles Legend.

Item Number	Description
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1. Quick-acting flush watertight 18 inch scuttle
2. Quick-acting flush watertight 20 inch scuttle



Scuttles.

CHAPTER 6
GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

OVERVIEW

The General Support maintenance instructions in this chapter apply to the following:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Propeller Shaft and Bearings	6-1
Shaft Seals	6-2
Steering Control Panel and Gyro Computer	6-3
Remote Magnetic Heading Compass	6-4
Corrosion Prevention Anodes	6-5
Elastomeric Compensating Winch	6-6

Chapter 3 contains the operator maintenance instructions for all Major Equipment.

Chapter 4 contains the operator maintenance instructions for all Auxiliary Equipment.

Chapter 5 contains the Direct Support maintenance instructions.

 6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS.

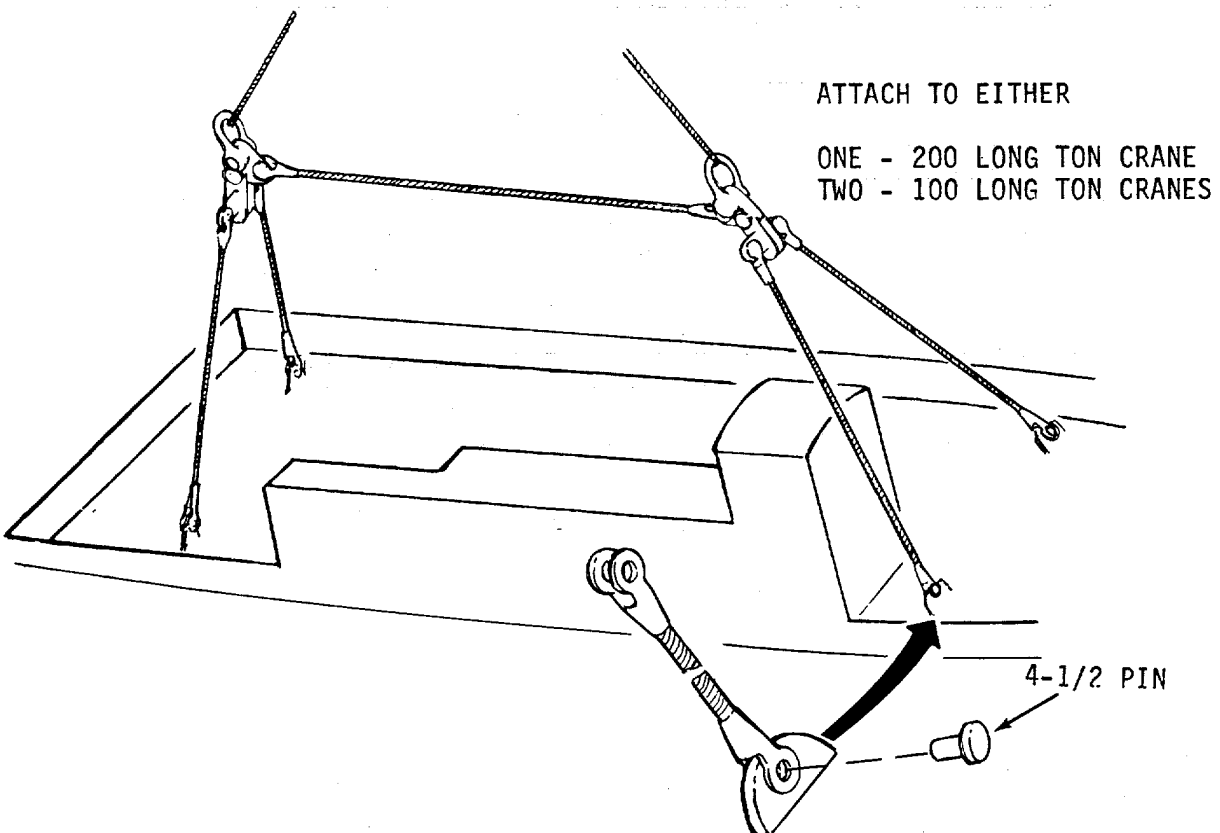
a. Prior to propeller shaft and bearing maintenance the landing craft must be either lifted from the water, or drydocked.

(1) Lifting of the landing craft.

(a) Lifting of the landing craft can be done by either:

- A 200 long ton (203 metric ton) crane.
- Two 100 long ton (101.5 metric ton) cranes.

(b) Attach lifting sling as shown-using 4-1/2 diameter pins in the deck lifting pads.



(2) Drydocking.

Refer to Foldout (FO-8) for the Drydock plan.

(3) Docking in an LSD.

The landing craft is designed to be docked in an LSD. The height limitation is 17 feet 9 inches (5.41 m). The height is from the bottom of the keel and skegs and a projection of that line. All items above this line are to be removed and stowed.

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

All equipment removed or stowed for LSD docking must be replaced after removal of the LCU from the LSD. The following is an index to the procedures:

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
1.	Main Mast	2-66
2.	Radar Mast	2-155
3.	Whip Antennas	2-156
4.	Voice Tube	2-157
5.	Lifeboats	2-158
6.	Windscreen and Railings	2-159
7.	Machine Gun Tri-Pod Mount	2-160
8.	Ready Service Locker	2-161
9.	Aircraft Float Light	2-162
10.	Searchlight	2-163
11.	Ship's Course Indicator and Peloris	2-164
12.	Stern Gate Davits	2-165
13.	Jack and Ensign Staff, Signal Flag	2-166
14.	Floodlight	2-167
15.	Exhaust Stacks	2-168

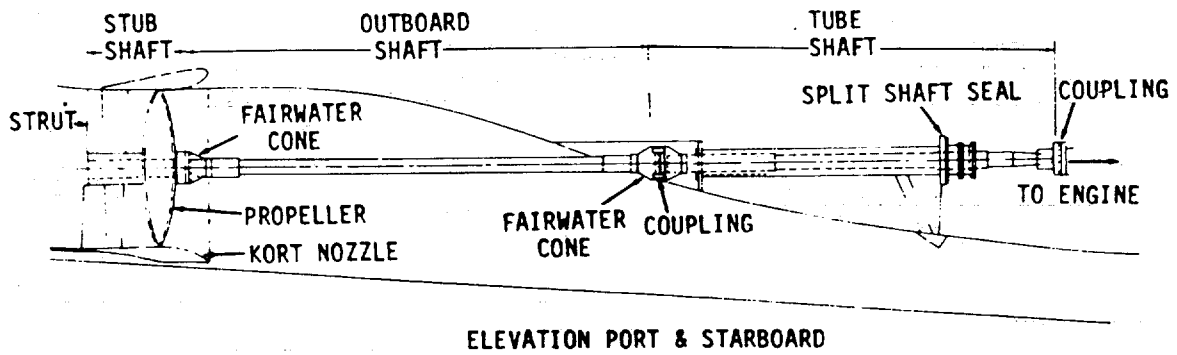
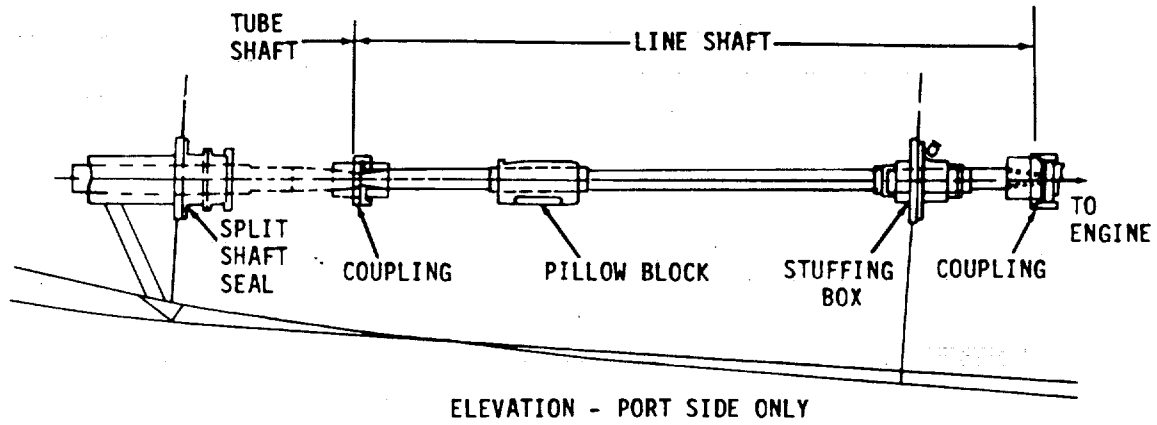
b. The propeller shafts are:

- Stub shaft (port and starboard)
- Outboard shaft (port and starboard)
- Life shaft (port only) (Refer to paragraph 3-54.)
- Stern tube shaft (port and starboard)

c. Each landing craft carries the following spare parts related to the Propulsion Shafting.

<u>Item</u>	<u>Qty</u>	<u>Location</u>
Line shaft	1	Bulwark, Port, Frame 41-48
Tube shaft	1	Bulwark, Port, Frame 41-48
Outboard shaft	1	Bulwark, Port, Frame 41-48
Stub Shaft	1	Aft engine room, Port Frame 62
Stub shaft sleeve	1	On spare shaft
Stub shaft cap	1	On spare shaft
Tube shaft sleeve (16 inches)	1	On spare shaft
Tube shaft sleeve (34 inches)	1	On spare shaft
Outboard shaft sleeves	2	On spare shaft

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
 (Continued).



6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

This task covers:

- a. Inspection
- b. Removal
- c. Installation
- d. Adjustment

INITIAL SETUP

Test Equipment

Chain hoists (850 lb min.)
Welding torch
Cutting torch

References
Paragraph

3-54

Line Shaft (Port Side)
Operators Maintenance
Instructions

FO-8
Equipment
Condition

Drydock Plan

Special Tools

Lifting pad eyes (3 each)
Lockwire
Tallow

Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

10

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

- | | | | |
|------------------------------|---------------------|--|---------------------------|
| 1. Propeller
And
Shaft | a. Coupling
half | <ul style="list-style-type: none"> 1. Check for cracks. 2. Check nuts and bolts. 3. Check cotter pins for wear or breaks. 4. Check for wear. | Make sure they are tight. |
|------------------------------|---------------------|--|---------------------------|

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

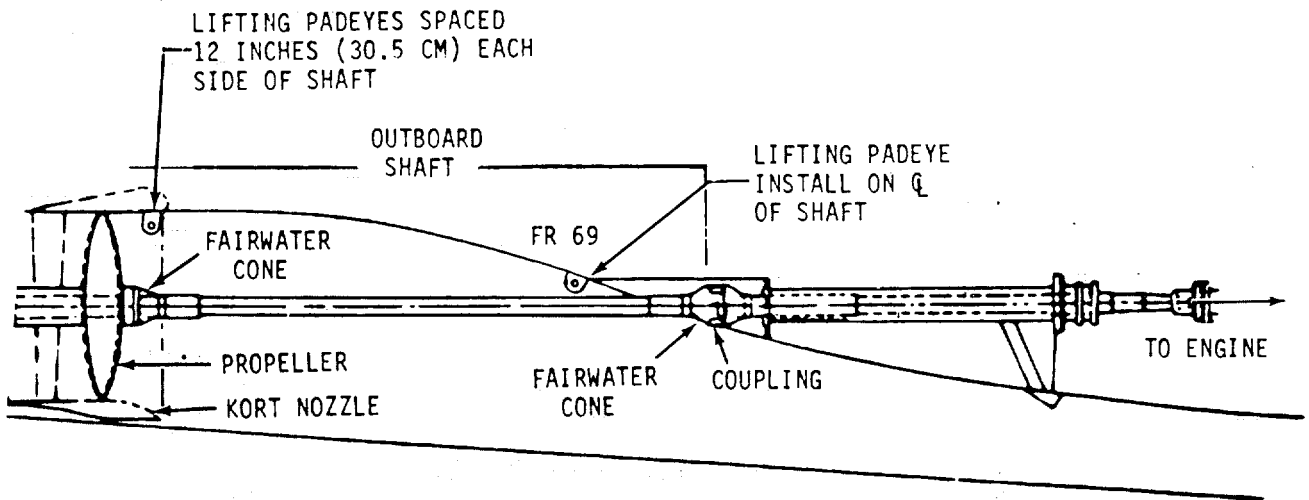
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION (Cont)

- | | | | |
|--|---------------|---|--|
| | | 5. Check for broken lockwires. | |
| | b. Line shaft | 1. Check for cracks.
2. Check for motion of coupling at shaft and indication of worn keys.
3. Check for wear. | |
| | c. Propeller | Check for damage, dents, bends, rough edges, and chunks missing. | |

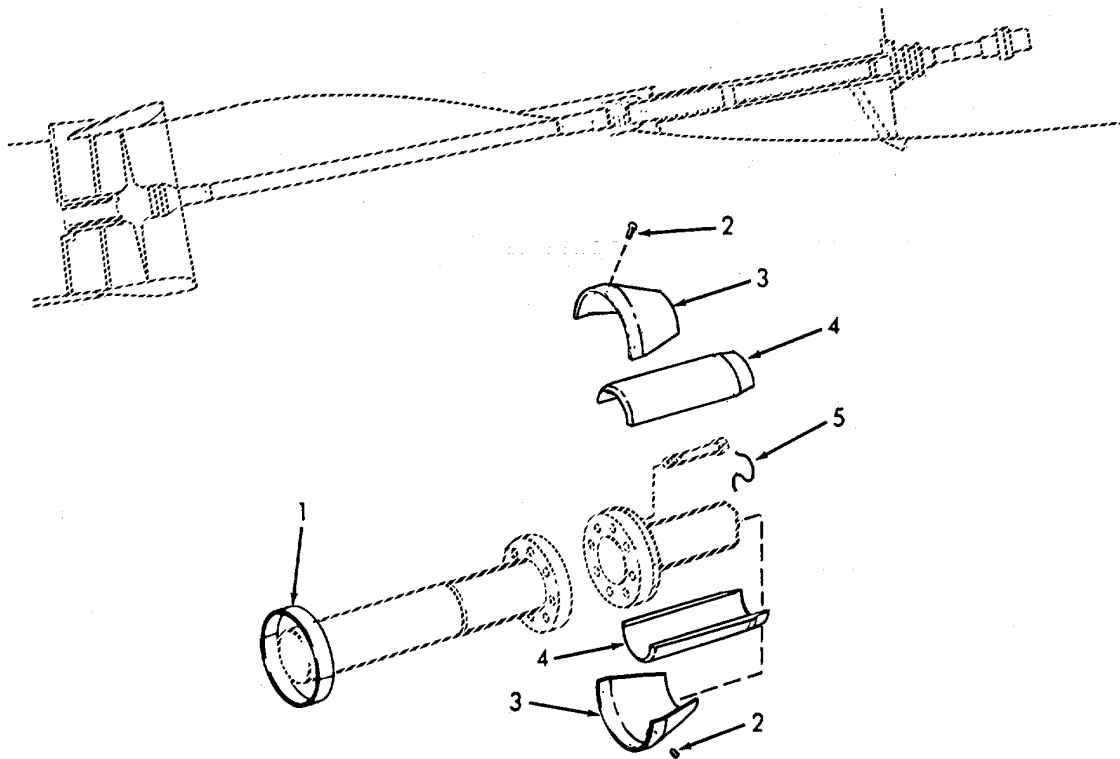
REMOVAL

- | | | |
|---------------------------------|---------------------|--|
| 2. Outboard Shaft (under craft) | a. Lifting pad eyes | Weld to hull at locations shown below. |
|---------------------------------|---------------------|--|



6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	b. Rope guard (1)	Chip, weld and remove.	
	c. Screws (2), and fairwater cones (3)	Remove.	
	d. Chain hoists shaft.	Install chain hoists in pad eyes and to	Minimum weight 850 lb. (1874 kg).
	e. Outboard shaft sleeves (4)	Remove.	
	f. Lockwire (5)	Remove.	



 6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
 (Continued).

LOCATION	ITEM	ACTION	REMARKS
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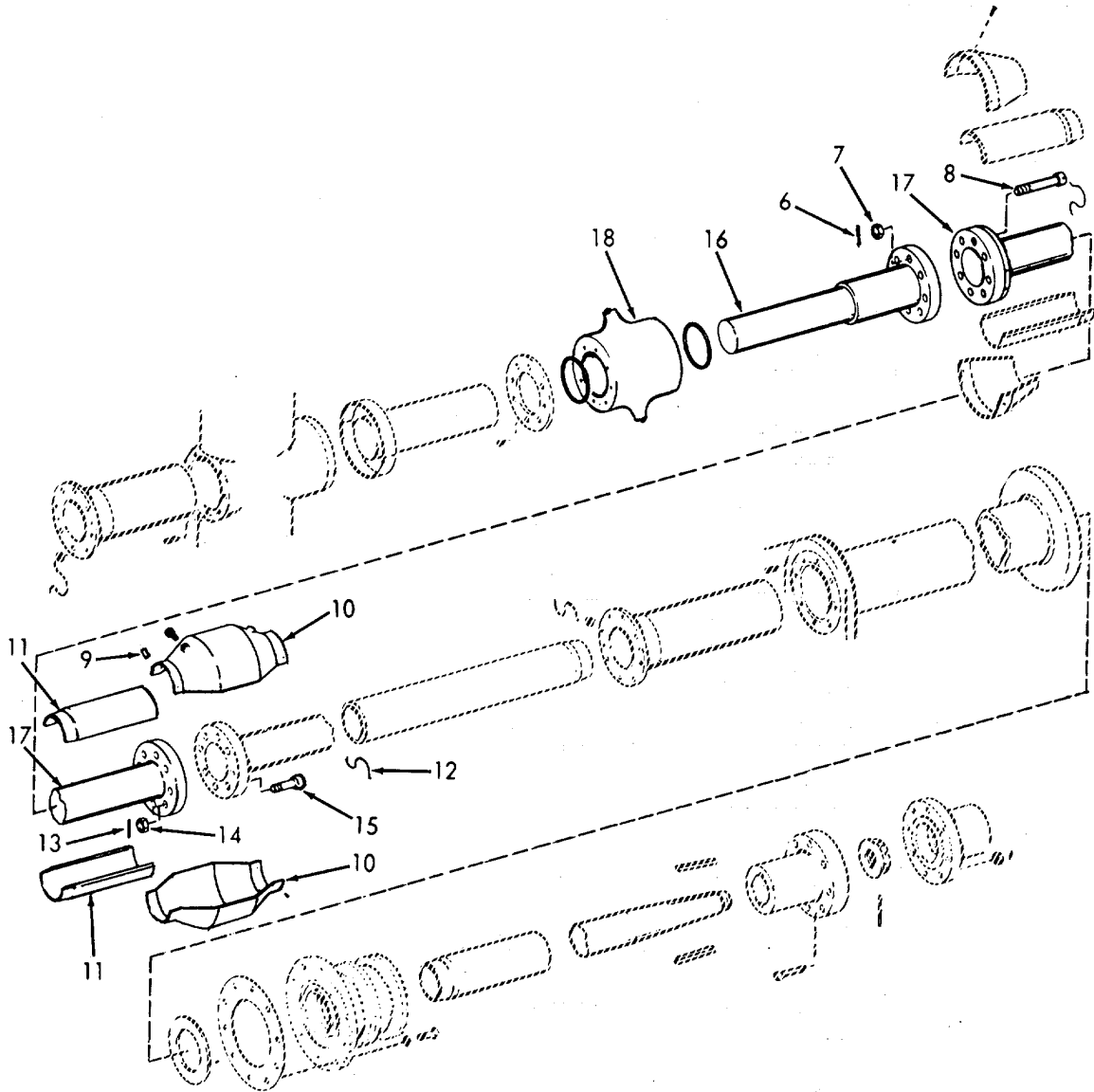
REMOVAL (Cont)

- | | | | |
|--|--|---------------------------------|--|
| | g. Cotter pins (6), nuts (7), and bolts (8) | Remove. | |
| | h. Screws (9), and fairwater cones (10) | 1. Remove.
2. Remove tallow. | |
| | i. Outboard shaft sleeves (11) | Remove. | |
| | j. Lockwire (12) | Remove. | |
| | k. Cotter pins (13), nuts (14), and bolts (15) | Remove. | |
| | l. Stub shaft (16), and outboard shaft (17) | Separate. | |
| | m. Propeller (18), and stub shaft (16) | Force aft. | |
| | n. Outboard shaft (17) | Remove. | |

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

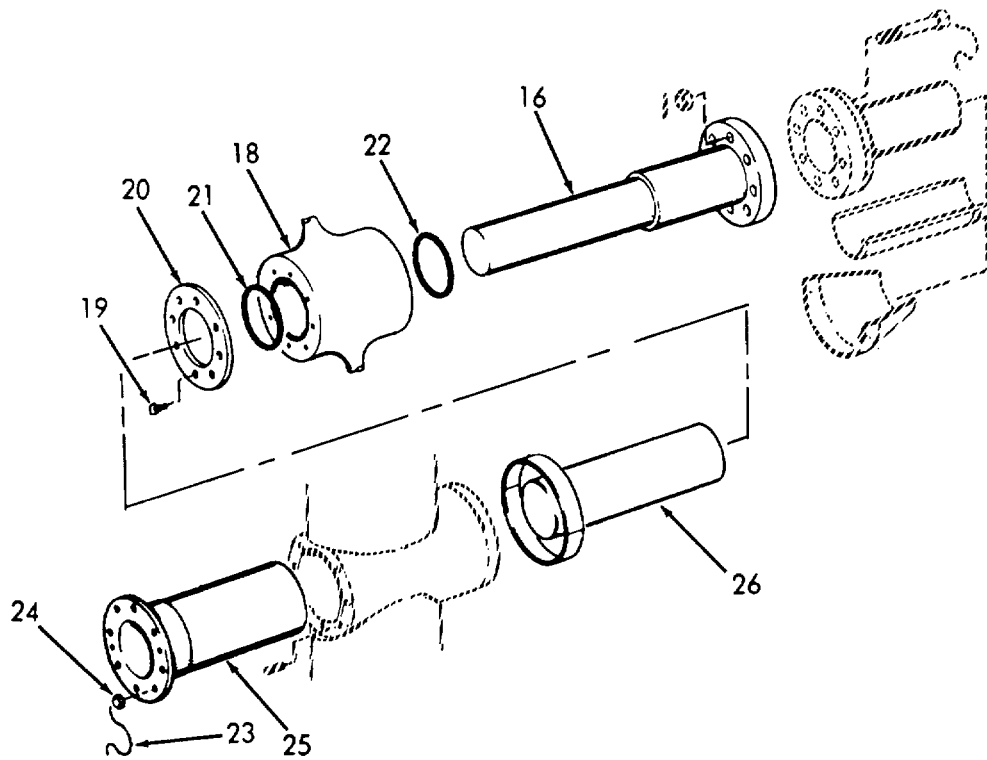
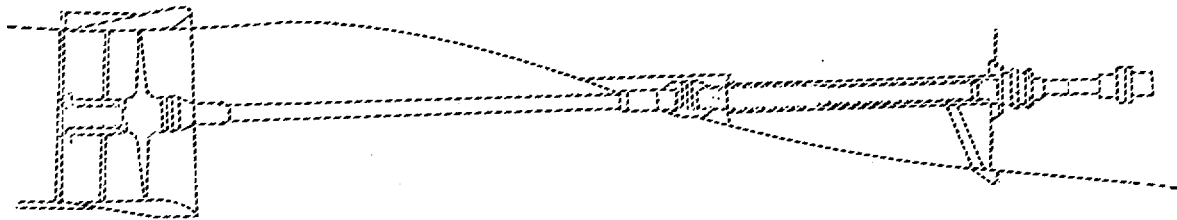
LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
3. Propeller and Stub Shaft (under craft)	a. Propeller (18), and stub shaft (16)	Remove by pulling from strut.	Propeller weighs 400+lbs (181.4 kg) and the stub shaft 215 lb. (97.5 kg)
	b. Screws (19), seal ring (20), and seal (21)	Remove.	
	c. Jacking screws and flange of stub shaft (16)	<ol style="list-style-type: none"> 1. Install screws in tapped holes of flange. 2. Tighten evenly. 3. Remove propeller. 	Screws are 3/4-16 NF thread.
	d. Seal (22)	Remove.	
4. Bearing Strut	a. Lockwire (23)	Remove.	
	b. Nuts (24)	Remove.	
	c. Jacking screws, and flange of bearing strut (25)	<ol style="list-style-type: none"> 1. Install jack screws into tapped holes of flange. 2. Remove bearing strut. 	

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | |
|---|---------|
| d. Bearing strut (25), and stub shaft sleeve (26) | Remove. |
|---|---------|



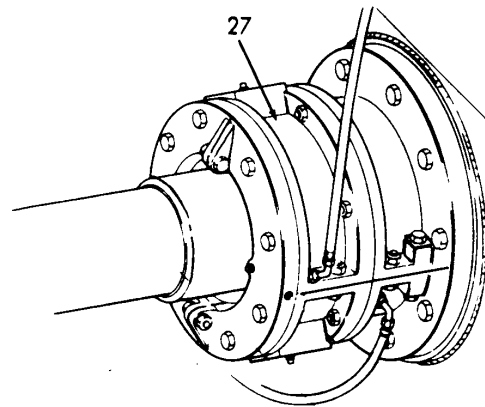
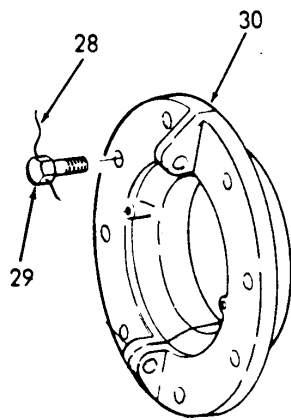
6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | | |
|-------------------------------|--------------------------|--|--|
| 5. Propeller
Tube
Shaft | a. Shaft
seal
(27) | 1. Remove lockwire (28),
and bolts (29).

2. Slack off glands (30). | |
|-------------------------------|--------------------------|--|--|



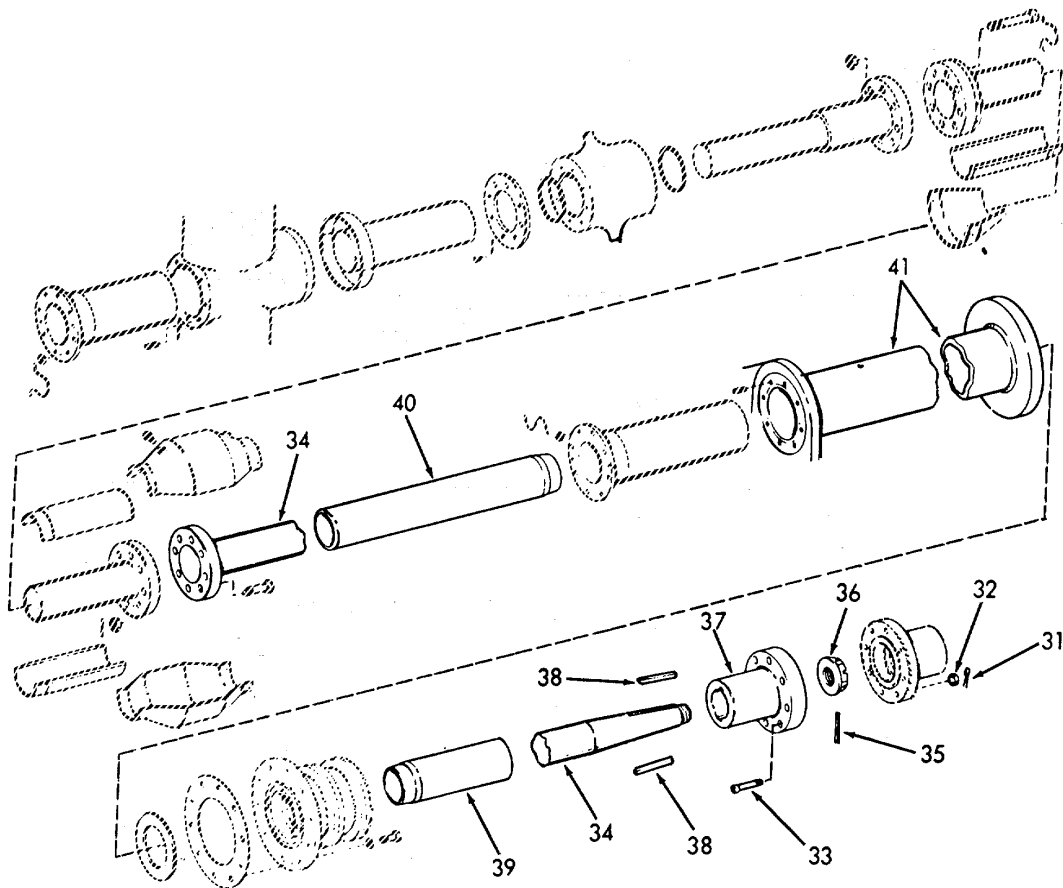
- | | | | |
|--|--|--|--|
| | b. Cotter
pins (31)
nuts (32),
and bolts
(33) | Remove. | |
| | c. Tube shaft
(34) | Force aft approximately
6 inches (15 cm). | |
| | d. Cotter
pin (35),
and nut
(36) | Remove. | |
| | e. Female
tube shaft
half coup-
ling (37)
and shaft
keys (38) | Remove. | |

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----|---|--------------------------------------|--|
| f. | Shaft tube (34) | Pull aft and remove from stern tube. | Shaft weighs approximately 626 lb. (284 kg). |
| 6. | Stern Tube (aft) (39) and shaft sleeve (40) (fwd) | a. Shaft sleeve (41) | Remove from stern tube (41). |



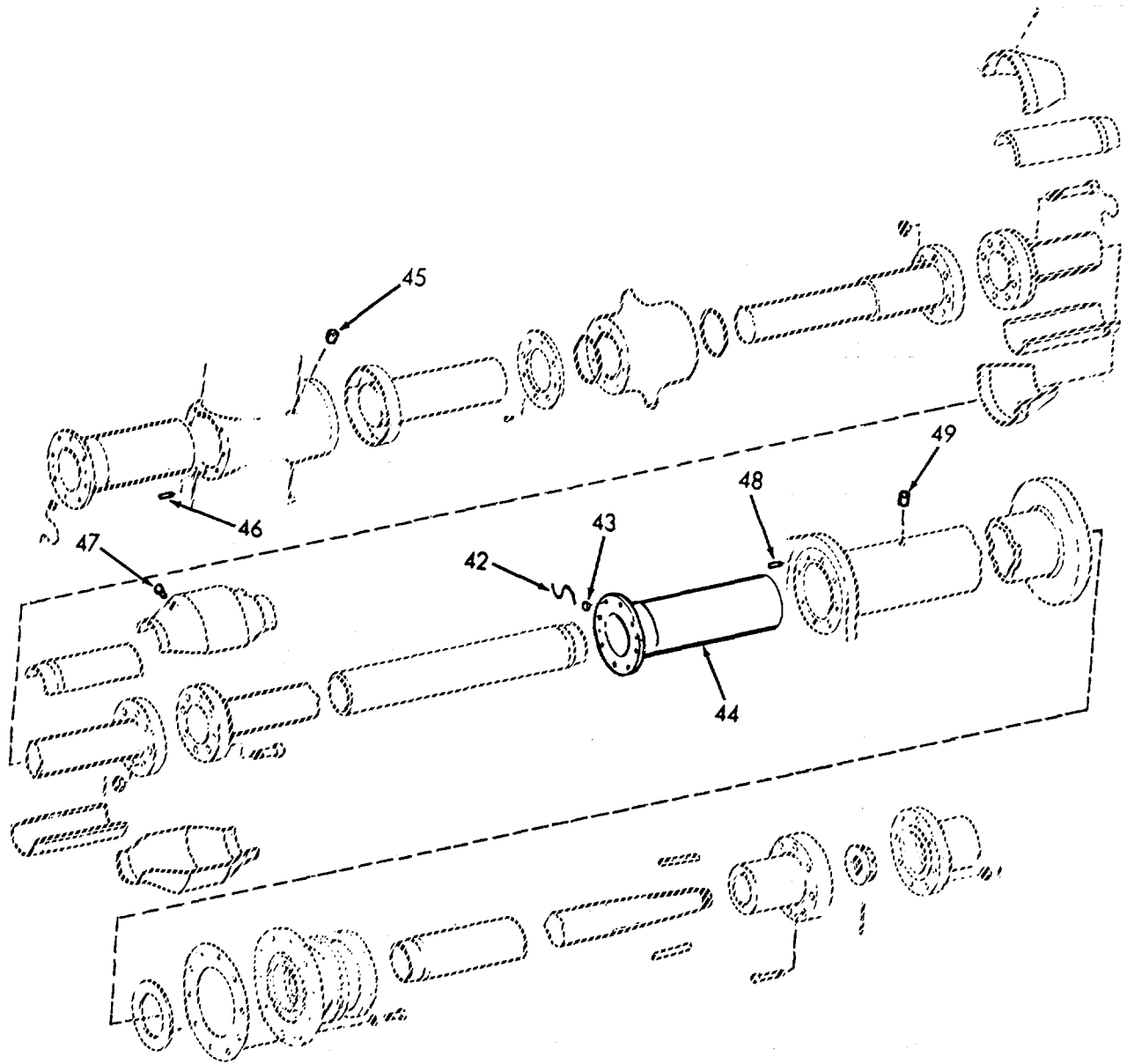
6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	b. Lockwire (42), and slotted hex nuts (43)	Remove.	
	c. Jacking screws and flange of stern tube bearing (44)	<ol style="list-style-type: none"> 1. Insert jack screws in tapped holes in bearing flange. 2. Tighten evenly to force the bearing out of the seat. 	
7. Miscel-lanes	a. Pipe plug (45)	Remove	If necessary.
	b. Studs (46)	Remove	If necessary.
	c. Plug (47)	Remove	If necessary.
	d. Studs (48)	Remove	If necessary.
	e. Pipe plug (49)	Remove	If necessary.

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
8 Stern Tube	a. Stern tube bearing (44)	Align holes and install.	
	b. Slotted hex nuts (43), and lockwire (42)	Install.	
	c. Shaft sleeve (aft) (39) and shaft sleeve (fwd) (40)	Install in stern tube (41).	
9. Propeller Tube Shaft	a. Shaft tube (34)	Slide all but 6 inches (15 cm) into stern tube.	
	b. Female tube shaft half coupling (37), and shaft keys (38)	Install.	
	c. Nut (36), and cotter pin (35)	Install.	
	d. Tube shaft (34)	Slide all the way in.	

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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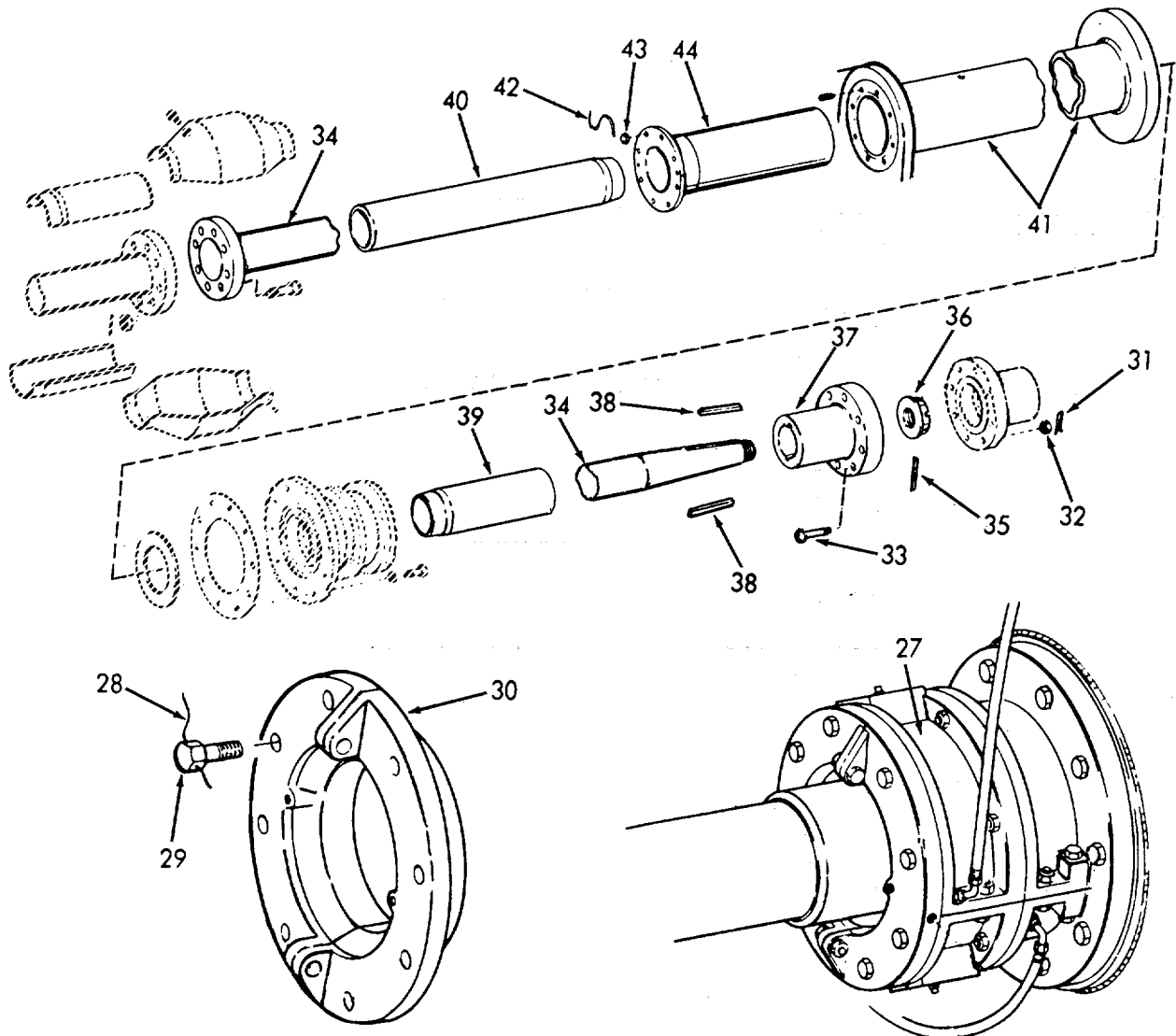
INSTALLATION (Cont)

e. Bolts (33), nuts (32), and cotter pins (31)

Install.

f. Shaft seal (27)

Install glands (30), bolts (29), and lock-wire (28).



6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

10. Bearing Strut	a. Stub shaft sleeve (26)	Install.	
	b. Bearing strut (25)	Align holes and install.	
	c. Nuts (24) and lockwire (23)	Install.	
11. Propeller and Stub Shaft	a. Seal (22)	Install in propeller.	
	b. Propeller (18)	Install on stub shaft.	
	c. Seal (21), seal ring (20) and screws (19)	Install.	
	d. Propeller (18), and stub shaft (16)	Install on strut.	
12. Outboard Shaft	a. Outboard shaft (17)	Install.	

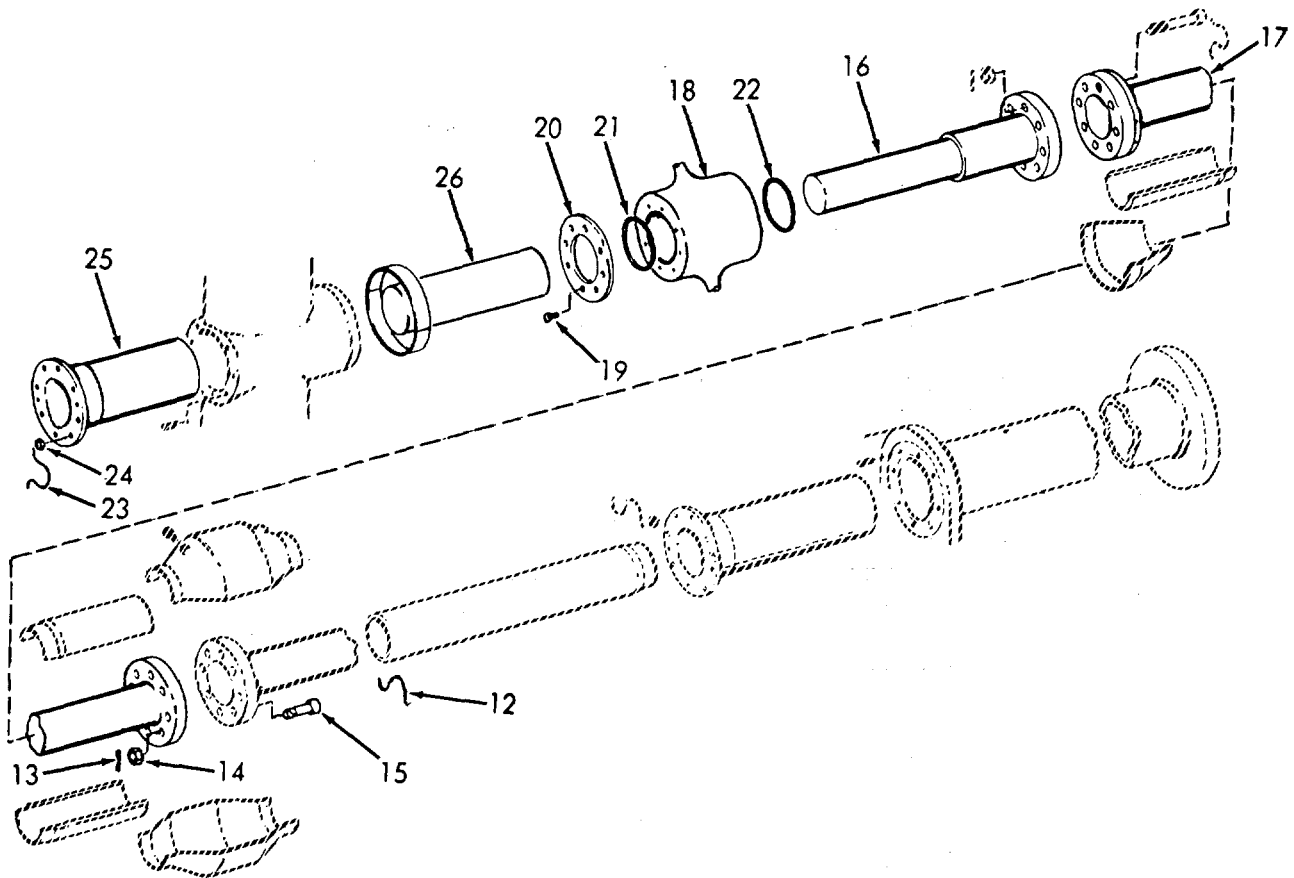
6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

b.	Bolts (15), nuts (14), and cotter pins- (13)	Draw flange together and install.	
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c.	Lockwire (12)	Install.	
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6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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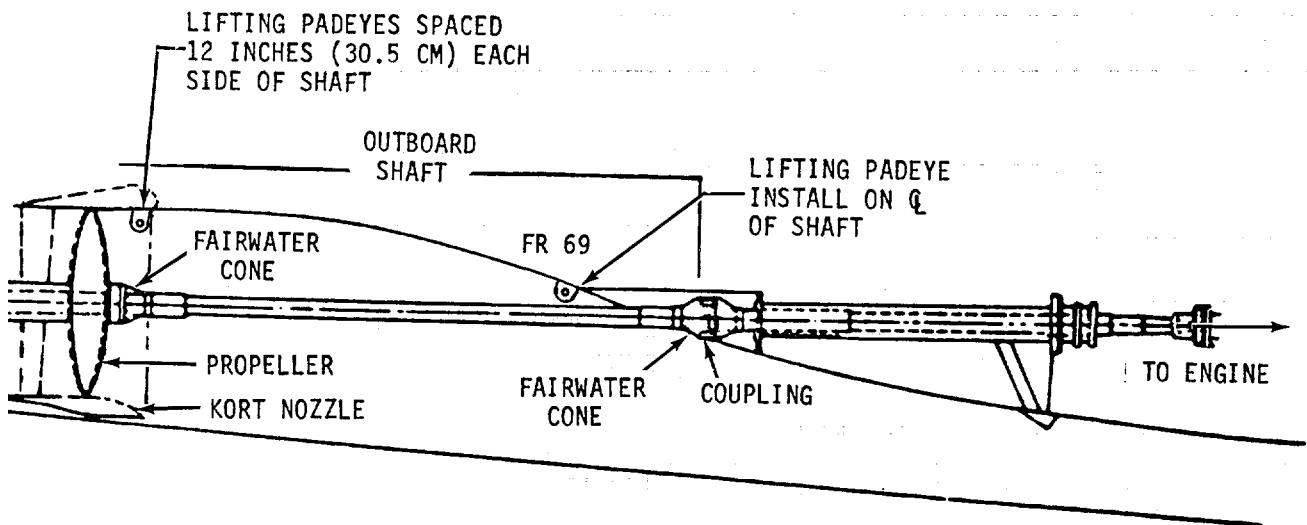
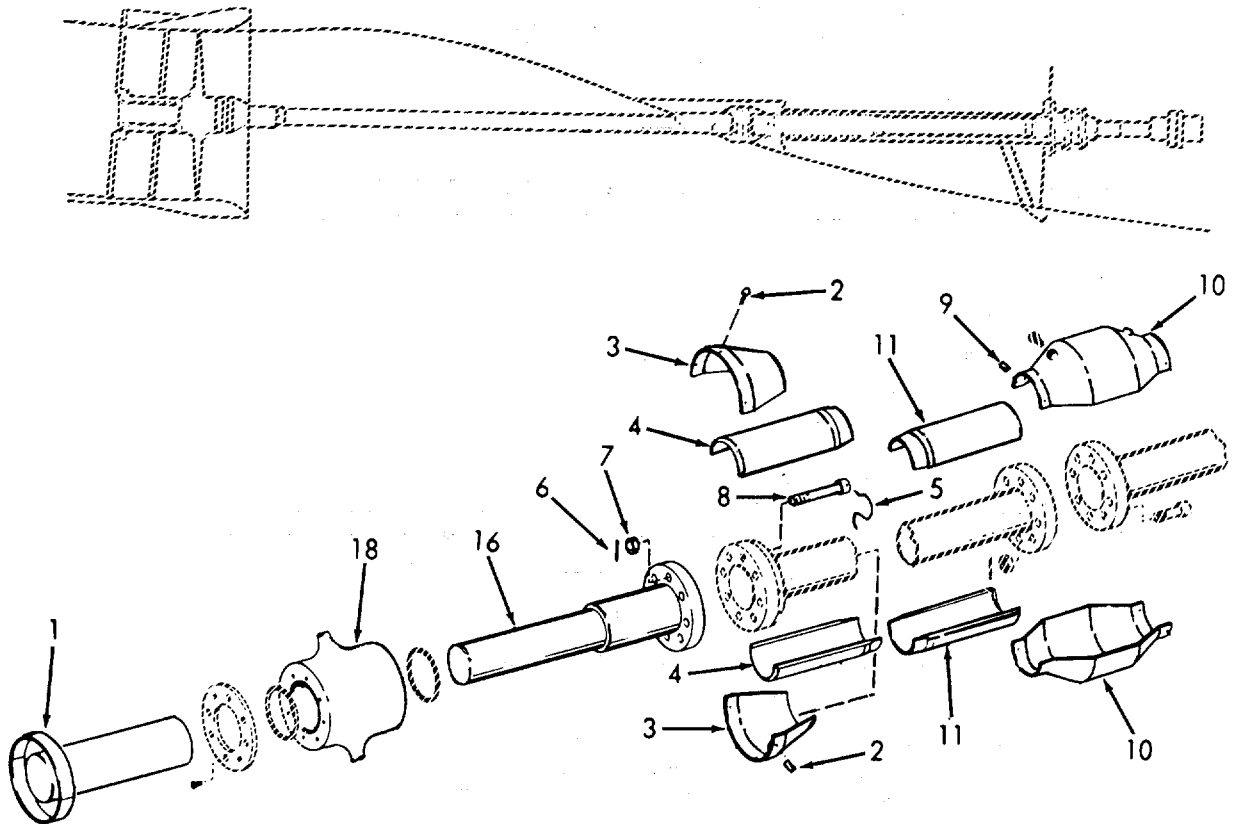
INSTALLATION (Cont)

- | | | | |
|--|---|---------------------|--|
| | d. Propeller (18), and stub shaft (16) | Draw together. | |
| | e. Bolts (8), nuts (7) and cotter pins (6) | Install. | |
| | f. Lockwire (5) , and outboard shaft sleeves (11) | Install. | |
| | g. Fairwater cones (10) and screws (9) | Install. | |
| | h. Outboard shaft sleeves (4) | Install. | |
| | i. Chain hoists | Remove. | |
| | j. Fairwater cones (3), and screws (2) | Install. | |
| | k. Rope guard (1) | Install. | |
| | l. Lifting | Remove.
eye pads | |

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT

13. Engine and Marine Gear Alignment to Propeller Shaft.

NOTE

It is important to align the engine and gear only when the boat is afloat, and NOT in drydock. During this alignment period, it is also advisable to fill the fuel tanks and add any other ballast that will be used when boat is in service. With the engine and gear in position on the engine bed, arrangements must be made to have a controlled lifting or lowering of each of the four corners of the engine. If threaded holes are provided in each of the engine mounts, jacking screws can be used in them. The engine can be raised by screwing down, or lowered by backing off the desired amount. Steel plates must be inserted under the jacking screws so that the jacking screws will not damage the engine bed. Lifting can also be accomplished by the use of properly placed jacks. Adjustable shims also are available and can simplify the whole procedure particularly for future realignment.

a. It will also be necessary to move the engine and gear from one side or the other on bed to obtain horizontal alignment. This can be done with a jack placed horizontally between the engine and the foundation. At the same time, a straight edge is laid across the edges of the flanges at the top and side to check the parallel alignment of the coupling edges.

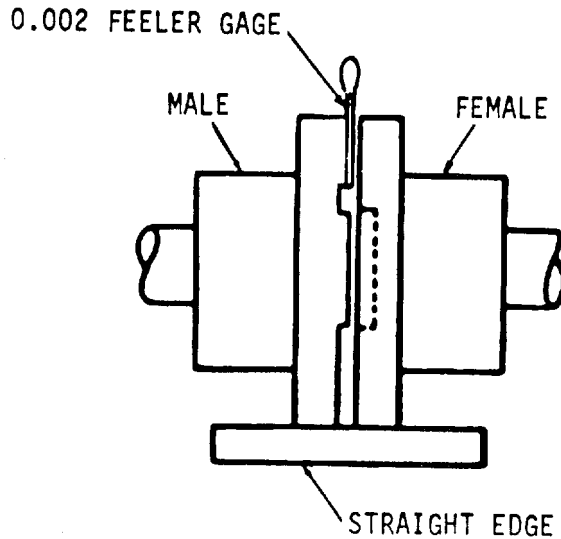
b. As the engine and marine gear comes into its aligned position, it will be possible to match the male and female halves of the output flange and propeller coupling, and prepare for bolting together. Care should be taken not to burr or mar this connection because the fit is very critical. Place a 0.002 inch (0.005 cm) feeler gauge between the flanges of the coupling. The feeler gauge is moved (slid) completely around the coupling.

c. Rotate the marine gear flange coupling 90, 180, and 270 degrees with the feeler blade being moved around the flange again in each successive position. If the alignment is correct, the feeler gauge will fit snugly, with the same tension, all around the flange coupling.

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT



- d. If the alignment varies during rotation, further alignment is necessary, or the marine gear and shaft couplings could be checked for improper face runout. Face runout on the marine gear output flange can usually be corrected by repositioning the coupling on its spline. Shaft coupling runout is usually due to an inaccuracy of taper fit, or key interference.
- e. Some boats are not structurally rigid and some carry their load in such a way that they will "hog" or go out of normal shape with every loading and unloading. Where this condition exists, it may be necessary to make a compromise between the top and bottom coupling clearance by leaving a greater clearance at the bottom of the marine gear output flange and propeller coupling. This clearance might be 0.005 to 0.007 inch (0.013 to 0.018 cm) while the top would maintain the standard 0.002 inch (0.005 cm).
- f. During the process of securing final alignment, it may be necessary to shift the engine many times. When the final alignment is secured, the necessary steel or hardwood shims are made up and the engine and gear is fastened in place. The alignment is then again rechecked, and if satisfactory, the coupling is bolted together.
- g. When a heavy boat is drydocked, it naturally undergoes some bending. Therefore, it is always good practice to unbolt the marine gear coupling and prevent bending of the shaft.

6-2. SHAFT SEAL - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Removal b. Installation

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

- 3-55 Shaft Inflatable Seal
3-56 Shaft Seal

Special Tools

NONE

Equipment
Condition Condition Description
Paragraph

- 6-1 Propeller Shaft and
 Bearings - Removal

Material/Parts

NONE

Special Environmental Conditions

Personnel Required

2

NONE
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

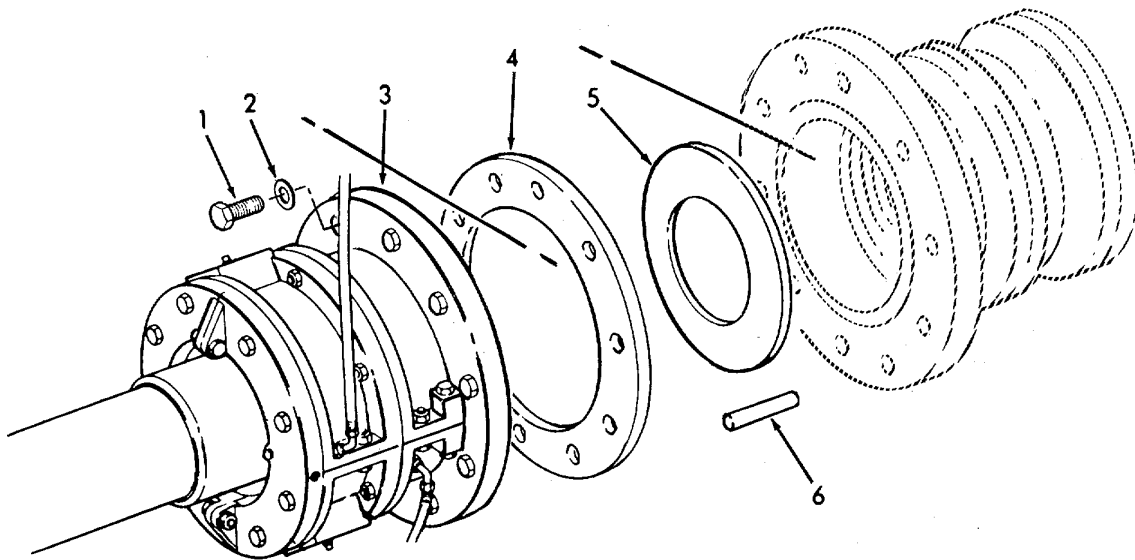
- | | | | |
|---------------|-------------------------------------|---------|--|
| 1. Shaft Seal | a. Screws (1), and lock-washers (2) | Remove. | |
| | b. Shaft seal (3) | Remove. | |

6-2. SHAFT SEAL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | | |
|----|-------------------------------------|---------|-----------------|
| c. | Seal plate (4), and gasket seal (5) | Remove. | Discard gasket. |
| d. | Headless pin (6) | Remove. | If necessary. |

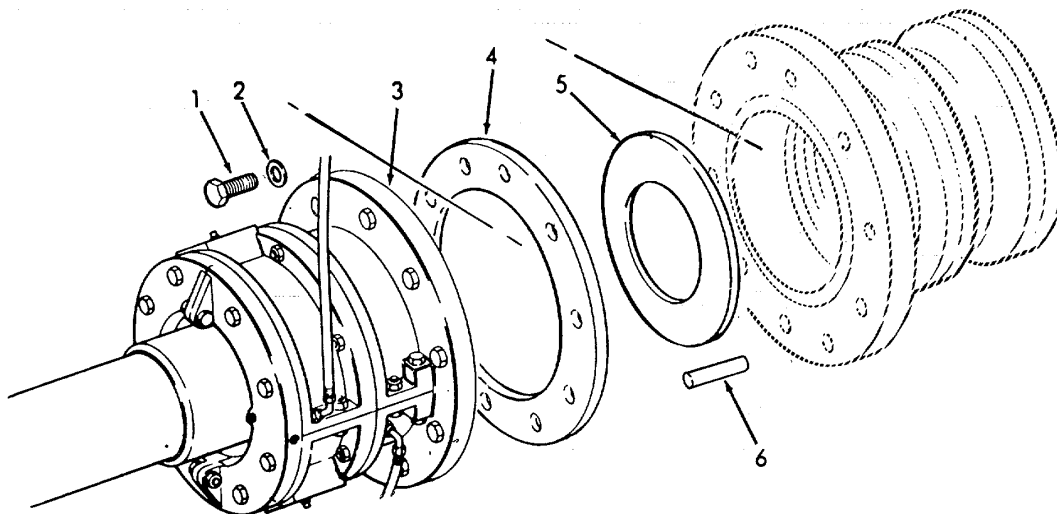


6-2. SHAFT SEAL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | | | |
|----|---------------------------------------|----------|-------------------|
| 2. | a. Headless pin (6) | Install. | |
| | b. Gasket seal (5) and seal plate (4) | Install. | Use a new gasket. |
| | b. Shaft seal (3) | Install. | |
| | c. Screws (1) and lock-washers (2) | Install. | |



6-3. STEERING CONTROL PANEL AND GYRO COMPUTER.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment
Condition Condition Description
NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

NONE

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

OVERHAUL

NOTE

The maintenance at this level must be performed at the manufacturers' repair facility.

6-4. REMOTE MAGNETIC HEADING COMPASS - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment
Condition Condition Description
NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

NONE

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

OVERHAUL

NOTE

The maintenance at this level must be performed at the manufacturers' repair facility.

6-5. CORROSION PREVENTION ANODES - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References

NONE

Special Tools

NONE

Equipment
Condition Condition Description
 NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

NONE

LOCATION

ITEM

ACTION

REMARKS

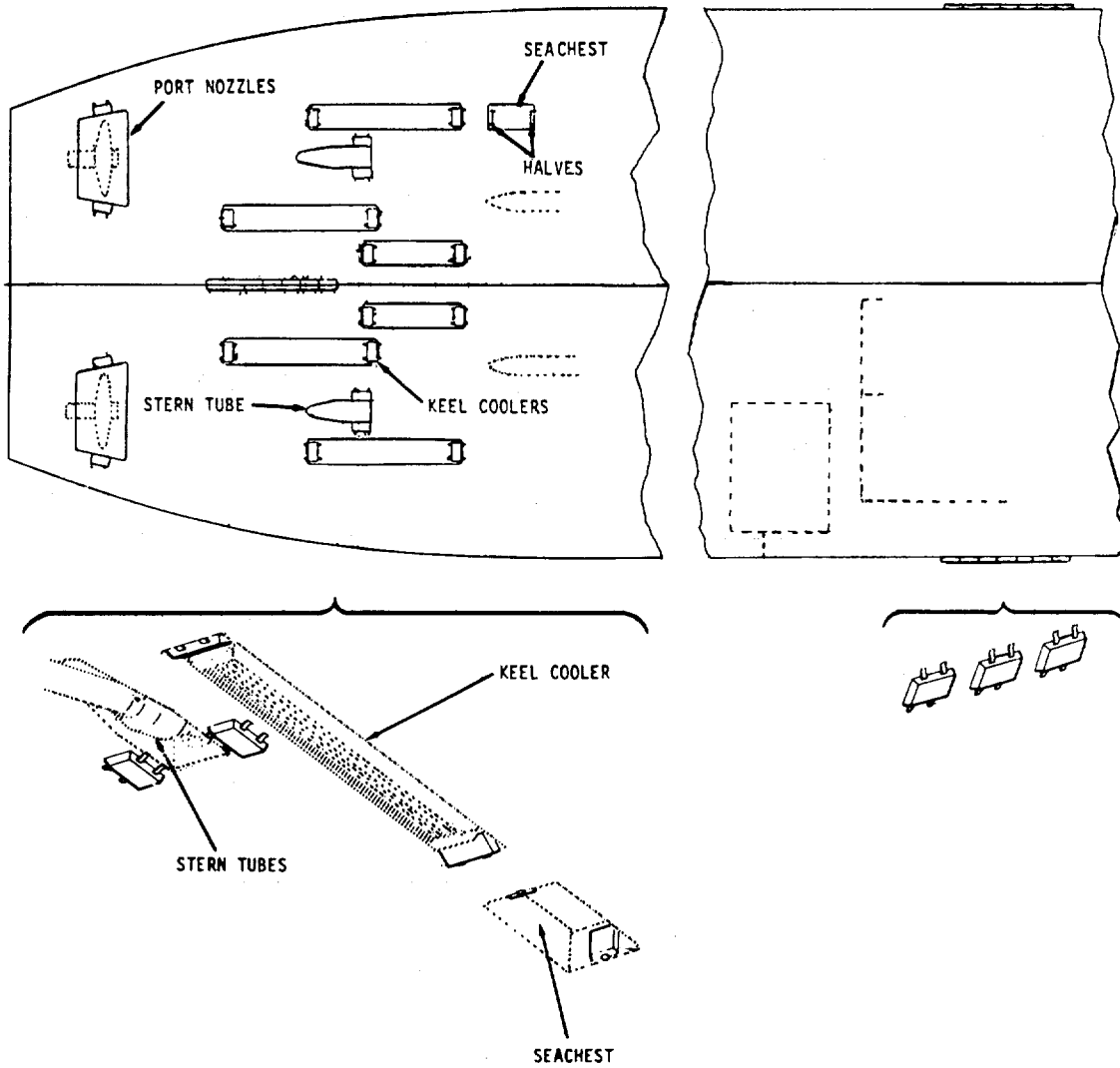
REPLACE

NOTE

Replace anodes if badly pitted or deteriorated.

6-5. CORROSION PREVENTION ANODES - MAINTENANCE INSTRUCTIONS
(Continued).

REPLACE (Cont)



6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENENCE INSTRUCTIONS

This task covers:

- a. Disassembly
- b. Reassembly
- c. Inspection

INITIAL SETUP

Test Equipment

NONE

References

- 5-48
- 5-49
- 5-50

Special Tools

Equipment
Condition Condition Description
 NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

4

General Safety Instructions

Observe WARNINGS in paragraph 5-49 and all normal precautions when handling heavy equipment.

LOCATION

ITEM

ACTION

REMARKS

DISASSEMBLY

NOTE

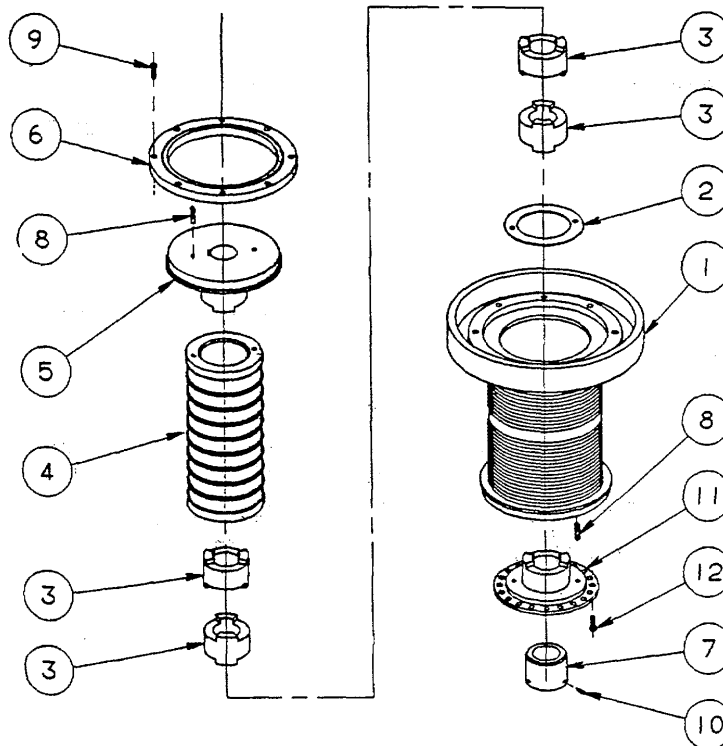
The elastomeric compensating component of the bow ramp winch is an integral part of the winch drum and as such has no user maintenance requirements. To remove the drum from the winch, follow the instructions in paragraph 5-48, 5-49, and 5-50.

6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY

- | | | |
|---------------------------|-------------------------|--|
| 1. Bow Ramp
Winch Drum | a. Drum weldment
(1) | Stand drum weldment on a wood pallet with small diameter in the up position. |
| | b. Set screws
(10) | Remove. |
| | c. Bushing (7) | Remove. |
| | d. Drum weldment
(1) | Turn drum weldment (1) over to place large diameter in the up position. |



Change 1

6-32

6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENENCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY

- | | | | |
|--|------------------------------|--|--------------------------------|
| | e. Screws (9) | Remove. | |
| | f. Bearing (6) | Remove. | |
| | g. Inner mounting plate (5) | Remove. | |
| | h. Dowels (8) | Remove. | Use new dowels for reassembly. |
| | i. Torsional Spring (4) | Remove. | |
| | j. Cogs (3) | Remove. | |
| | k. Shim(s) (2) | Remove. | |
| | l. Drum weldment (1) | Reverse drum to place small diameter in the up position. | |
| | m. Screws (12) | Remove. | |
| | n. Outer mounting plate (11) | Remove. | |

INSPECTION

2. a. Inspect the Torsional spring for cracks, cuts, or voids in the elastomer on both inside and outside diameters. If any are detected that measure longer than one inch or with depths greater than .25 inch notify a technical representative for corrective action.

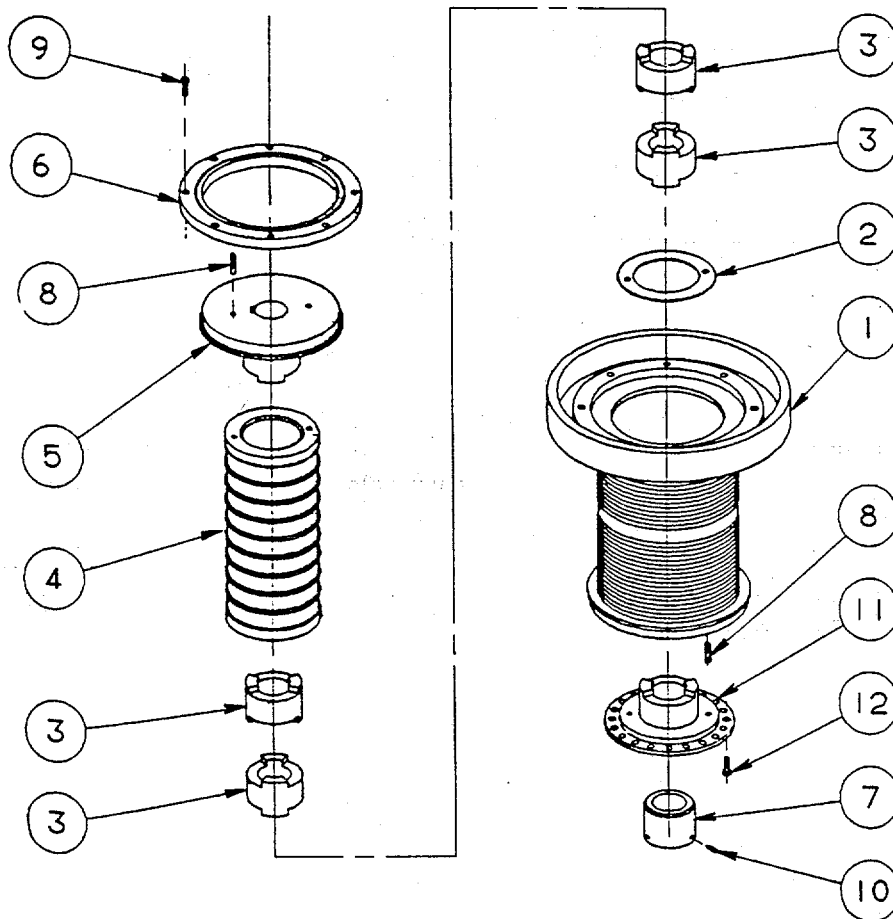
b. Inspect the cogs for gouges or worn surfaces. Gouges greater than .015 inch deep x .12 inch long and worn surface greater than .25 inch x .25 inch shall be cause for replacement.

6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY

- | | | | |
|----|------------------------------|--|------------------------------------|
| 3. | a. Dowel pins (8) | Press into outer mounting plate (11) 1.75 inches deep | Use new dowel pins for reassembly. |
| | b. Drum weldment (1) | Stand drum weldment on a wood pallet with small diameter in the up position. | |
| | c. Outer mounting plate (11) | <ol style="list-style-type: none"> 1. Install screws (12). 2. Torque screws to 75 ft-lbs in an alternating sequence. | |

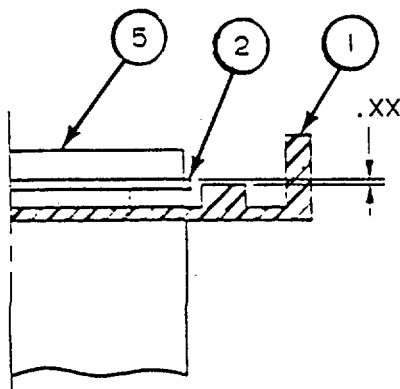


6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Con't)

- | | |
|---|--|
| c. Drum weldment (1) | Turn large end of drum to the up position. |
| d. Shim (2) | Insert shim into bore of the drum with clearance holes fitting over the exposed dowels. |
| e. Cogs (3) | Stack cogs on top of each other in the center of the drum. Rotate each cog clockwise until the teeth on all cogs engage with each other. |
| f. Torsional Spring (4)
the end plate of the spring fit over dowel pins. Seat the end plate of the spring against the shim (2). | Place springover cogs until clearance holes in |
| g. Inner mounting plate (5)
measure the distance between the top surface of the lip and top surface of the bearing mounting surface. | Place mounting plate(11) onto torsional spring and |



IF .xx IS	INSTALL AMITTONAL SHIMS
A) .32 THRU .43	0
B) .20 THRU .31	1
C) .08 THRU .19	2
D) .00 THRU .07	3

SHIM ADJUSTMENT

Figure 1.

6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENENCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Con't)

- | | |
|-----------------------------|--|
| h. Shim (2) | <ol style="list-style-type: none"> 1. Install the number of shims required in Figure 1. - 2. Remove the inner mounting assembly. 3. Place the additional shim(s) over the dowels at the bottom of the drum. |
| i. Torsional Spring (4) | <ol style="list-style-type: none"> 1. Place the torsional spring (4) over the cogs until clearance holes in the end plate of the torsional spring fit over the dowel pins. 2. Seat the end plate of the torsional spring against the shim. |
| j. Dowels (8) | <p>Press the dowels (8) through the inner mounting plate (5) 1.62 inches deep.</p> |
| k. Inner mounting plate (5) | <p>Place the inner mounting plate (5) on top of the torsional spring and rotate it until the dowels seat into the clearance holes in the torsional spring(4).</p> |
| l. Bearing (6) | <p>Install the bearing (6) over the inner mounting plate.</p> |

6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENENCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Con't)

- | | | | |
|--|----------------|--|--|
| | m. Screws (9) | <ol style="list-style-type: none"> 1. Tighten the screws (9) opposite each other until the bearing face has seated on the mounting surface. 2. Torque the screws to 30 ft-lbs. | |
| | n. Bushing (7) | Install the bushing (7) over the output shaft of gear box, chamfer end first. | |
| | o. Set screws | Install and tighten set (10) screws (10) to 24 ft-lbs after the bushing has seated inside the outer mounting plate. | |

NOTE

Refer to paragraphs 5-48, 5-49, 5-50 to reassemble winch drum to the speed reducer and place bow ramp winch back into operation.

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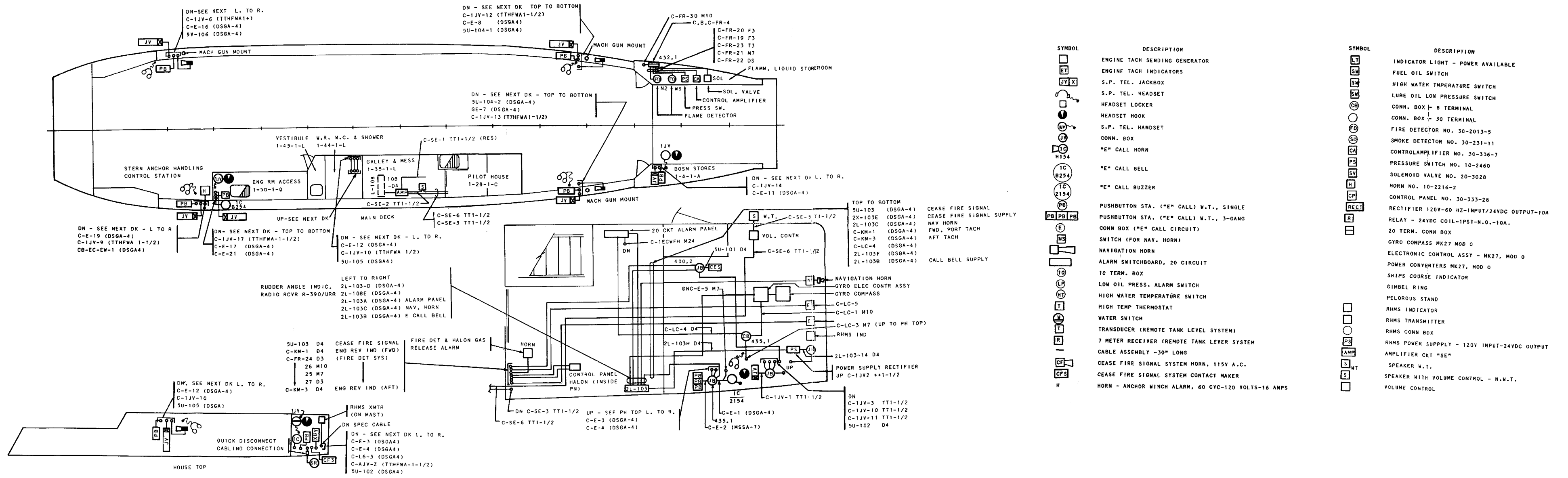
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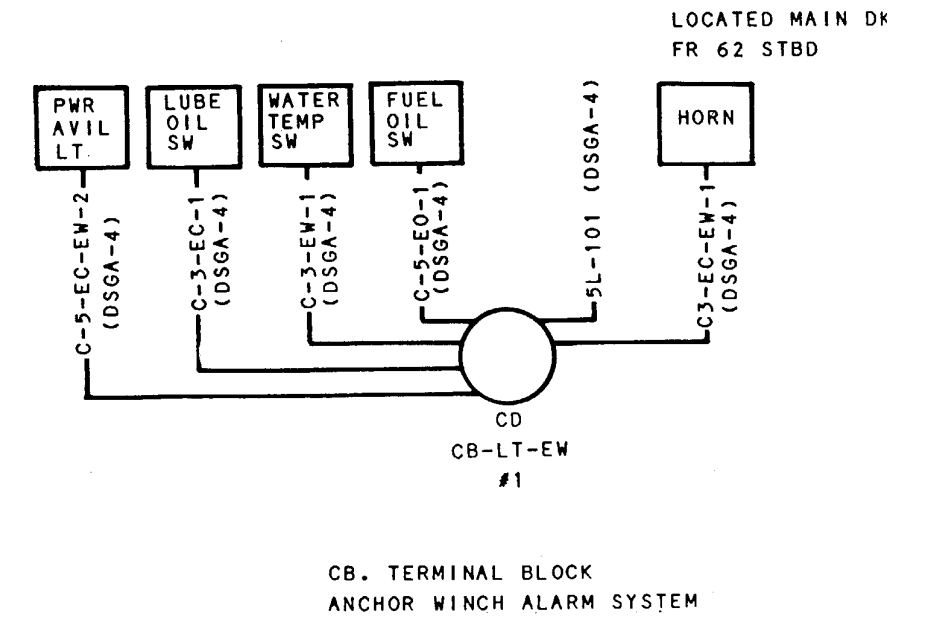
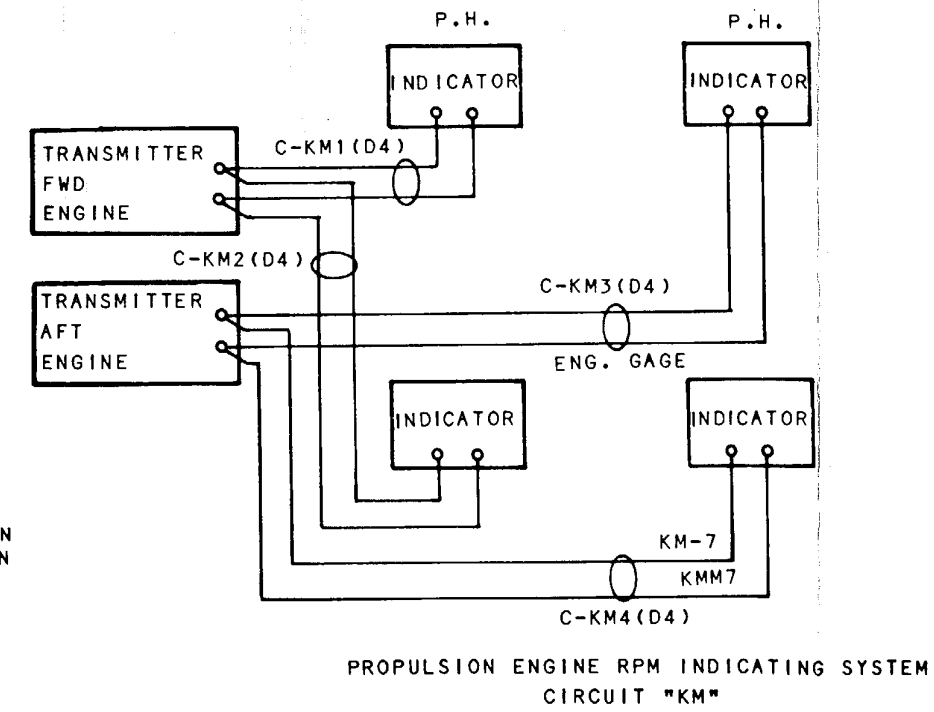
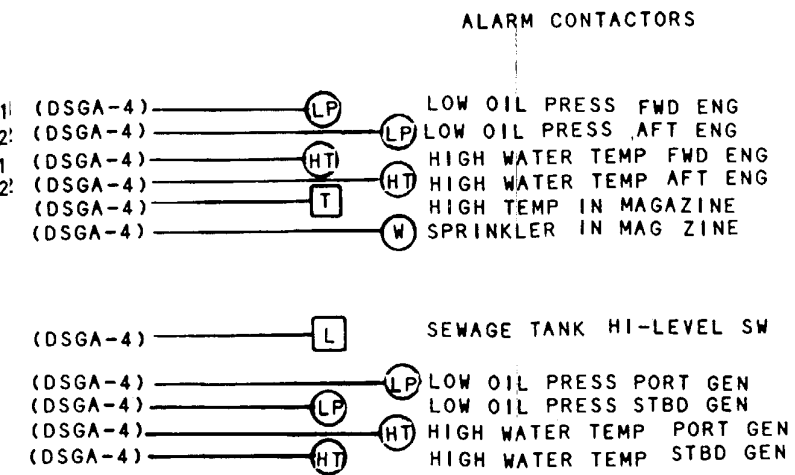
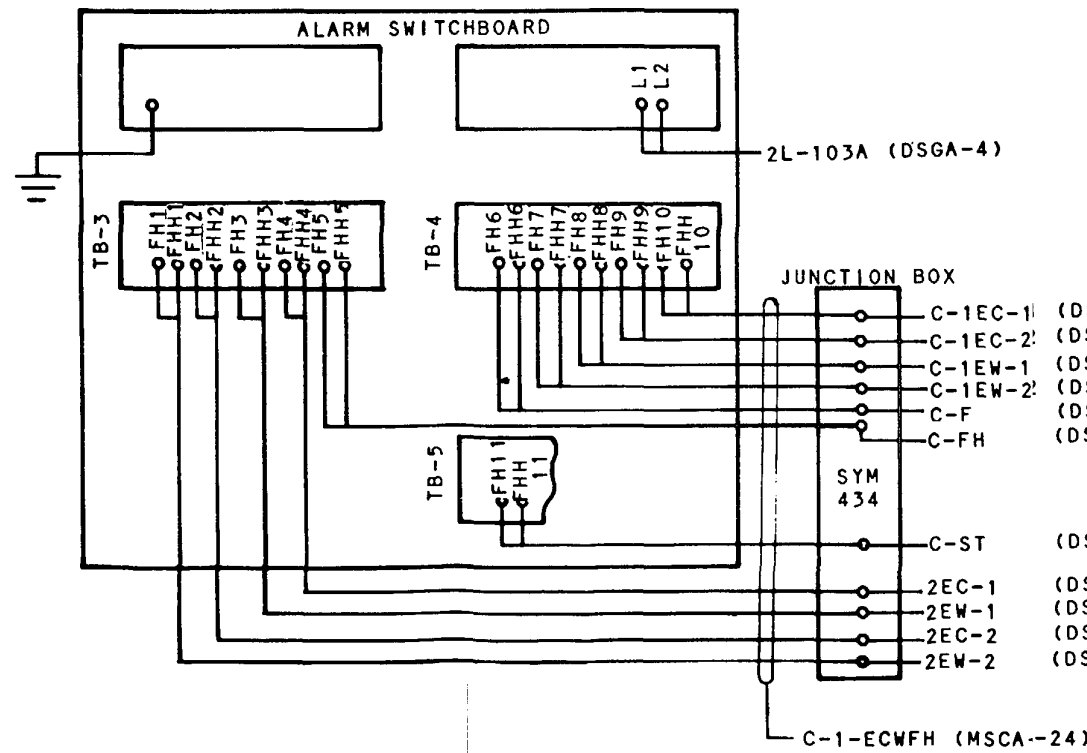
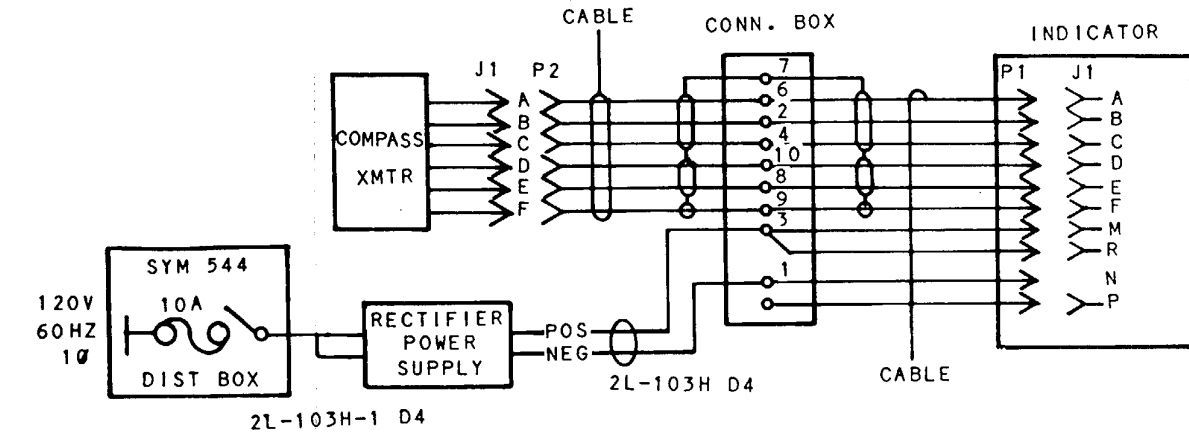
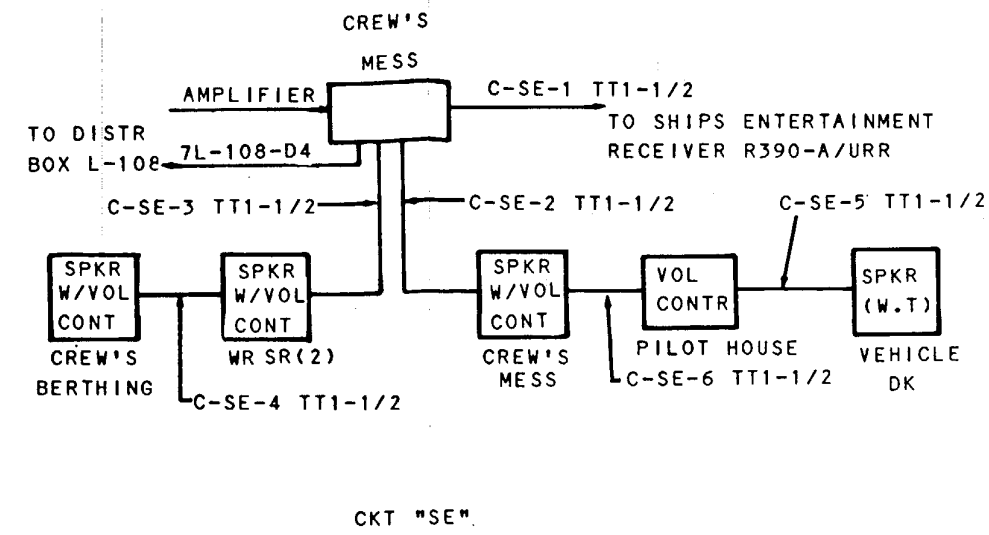
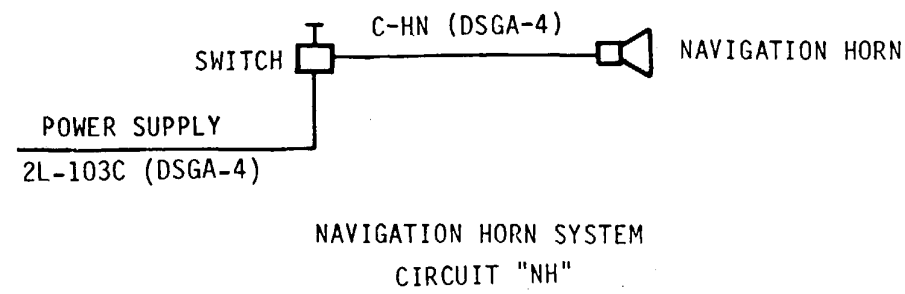


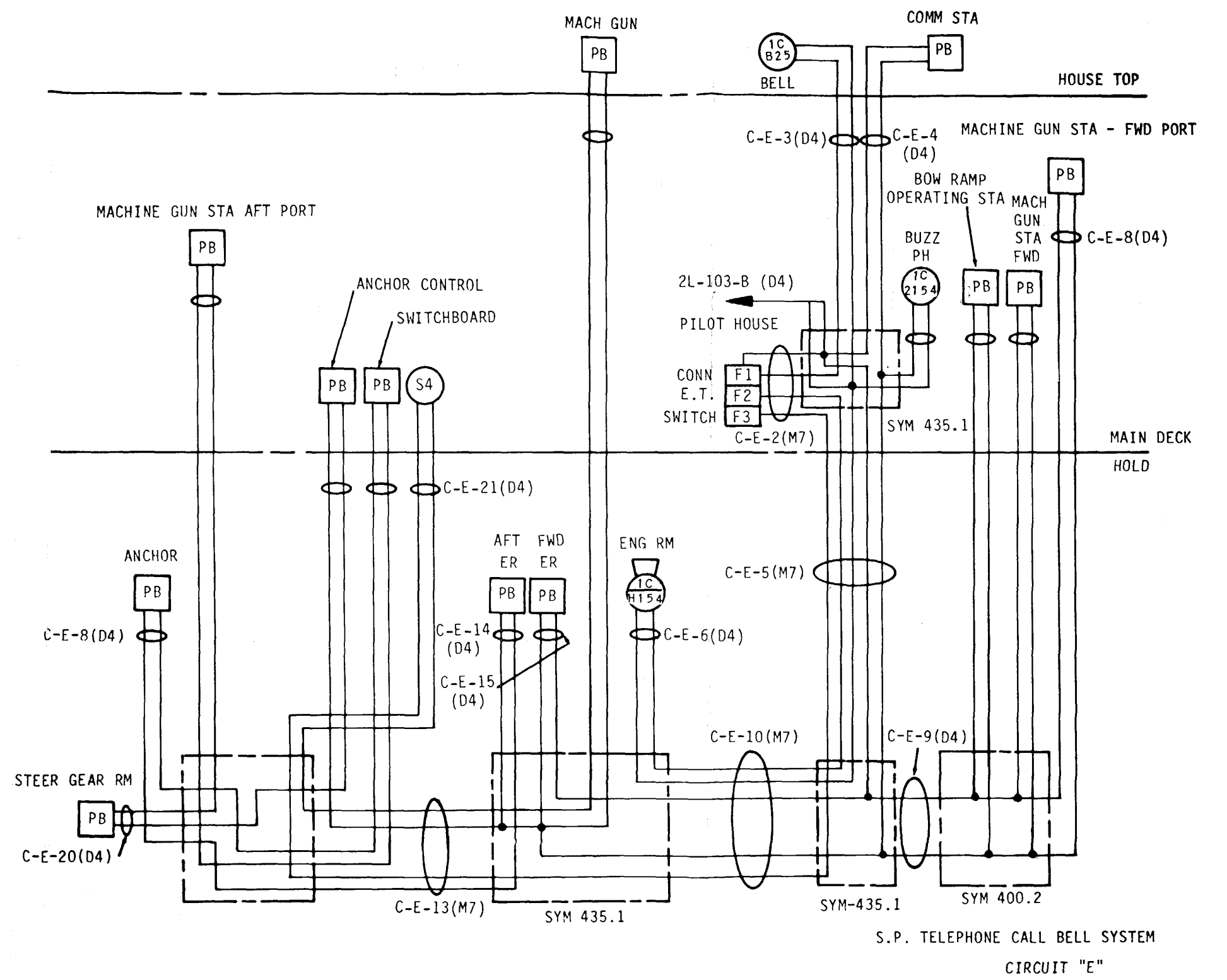
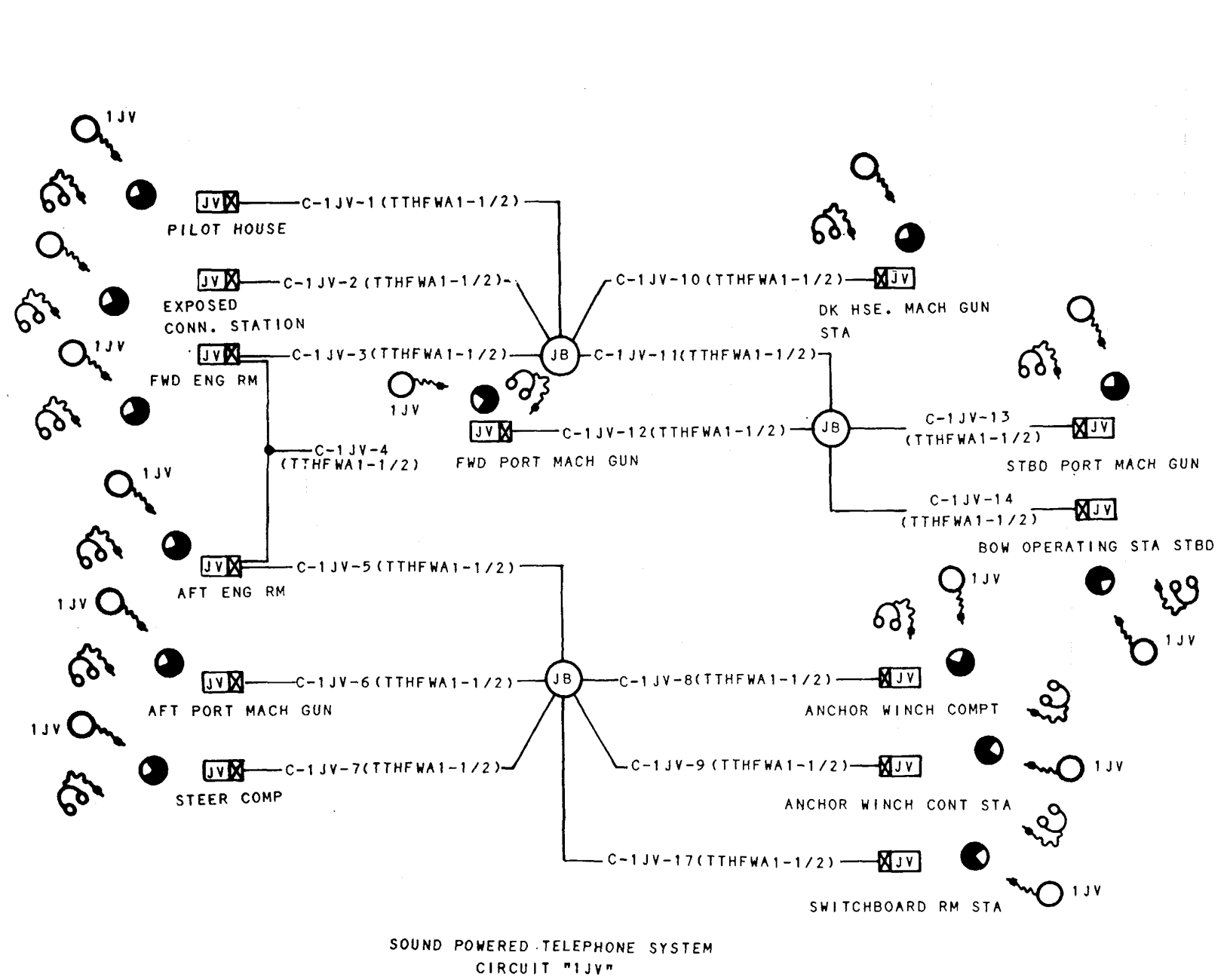
SYMBOL	DESCRIPTION
[Symbol]	ENGINE TACH SENDING GENERATOR
[Symbol]	ENGINE TACH INDICATORS
[Symbol]	S.P. TEL. JACKBOX
[Symbol]	S.P. TEL. HEADSET
[Symbol]	HEADSET LOCKER
[Symbol]	HEADSET HOOK
[Symbol]	S.P. TEL. HANDSET
[Symbol]	CONN. BOX
[Symbol]	"E" CALL HORN
[Symbol]	"E" CALL BELL
[Symbol]	"E" CALL BUZZER
[Symbol]	PUSHBUTTON STA. ("E" CALL) W.T., SINGLE
[Symbol]	PUSHBUTTON STA. ("E" CALL) W.T., 3-GANG
[Symbol]	CONN BOX ("E" CALL CIRCUIT)
[Symbol]	SWITCH (FOR NAV. HORN)
[Symbol]	NAVIGATION HORN
[Symbol]	ALARM SWITCHBOARD, 20 CIRCUIT
[Symbol]	10 TERM. BOX
[Symbol]	LOW OIL PRESS. ALARM SWITCH
[Symbol]	HIGH WATER TEMPERATURE SWITCH
[Symbol]	HIGH TEMP THERMOSTAT
[Symbol]	WATER SWITCH
[Symbol]	TRANSDUCER (REMOTE TANK LEVEL SYSTEM)
[Symbol]	7 METER RECEIVER (REMOTE TANK LEVEL SYSTEM)
[Symbol]	CABLE ASSEMBLY -30" LONG
[Symbol]	CEASE FIRE SIGNAL SYSTEM HORN, 115V A.C.
[Symbol]	CEASE FIRE SIGNAL SYSTEM CONTACT MAKER
[Symbol]	HORN - ANCHOR WINCH ALARM, 60 CYC-120 VOLTS-16 AMPS

SYMBOL	DESCRIPTION
[Symbol]	INDICATOR LIGHT - POWER AVAILABLE
[Symbol]	FUEL OIL SWITCH
[Symbol]	HIGH WATER TEMPERATURE SWITCH
[Symbol]	LUBE OIL LOW PRESSURE SWITCH
[Symbol]	CONN. BOX - 8 TERMINAL
[Symbol]	CONN. BOX - 30 TERMINAL
[Symbol]	FIRE DETECTOR NO. 30-2013-5
[Symbol]	SMOKE DETECTOR NO. 30-231-11
[Symbol]	CONTROL AMPLIFIER NO. 30-336-7
[Symbol]	PRESSURE SWITCH NO. 10-2460
[Symbol]	SOLENOID VALVE NO. 20-3028
[Symbol]	HORN NO. 10-2216-2
[Symbol]	CONTROL PANEL NO. 30-333-28
[Symbol]	RECTIFIER 120V-60 HZ-INPUT/24VDC OUTPUT-10A
[Symbol]	RELAY - 24VDC COIL-1PST-N.O.-10A.
[Symbol]	20 TERM. CONN BOX
[Symbol]	GYRO COMPASS MK27 MOD 0
[Symbol]	ELECTRONIC CONTROL ASSY - MK27, MOD 0
[Symbol]	POWER CONVERTERS MK27, MOD 0
[Symbol]	SHIPS COURSE INDICATOR
[Symbol]	GIMBEL RING
[Symbol]	PELOROUS STAND
[Symbol]	RHMS INDICATOR
[Symbol]	WATER SWITCH
[Symbol]	RHMS TRANSMITTER
[Symbol]	RHMS CONN BOX
[Symbol]	RHMS POWER SUPPLY - 120V INPUT-24VDC OUTPUT
[Symbol]	AMPLIFIER CKT "SE"
[Symbol]	SPEAKER W.T.
[Symbol]	SPEAKER WITH VOLUME CONTROL - N.W.T.
[Symbol]	VOLUME CONTROL

FO-1. Interior Communications System (Sheet 1 of 6)

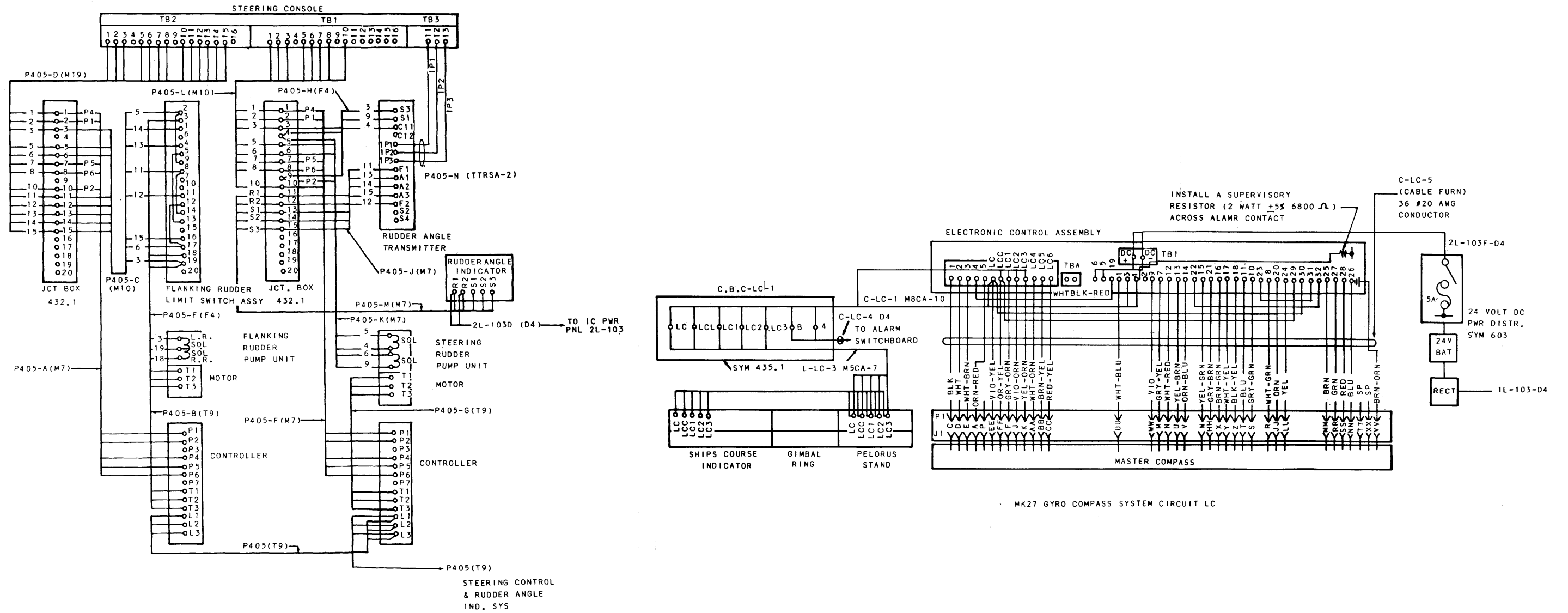
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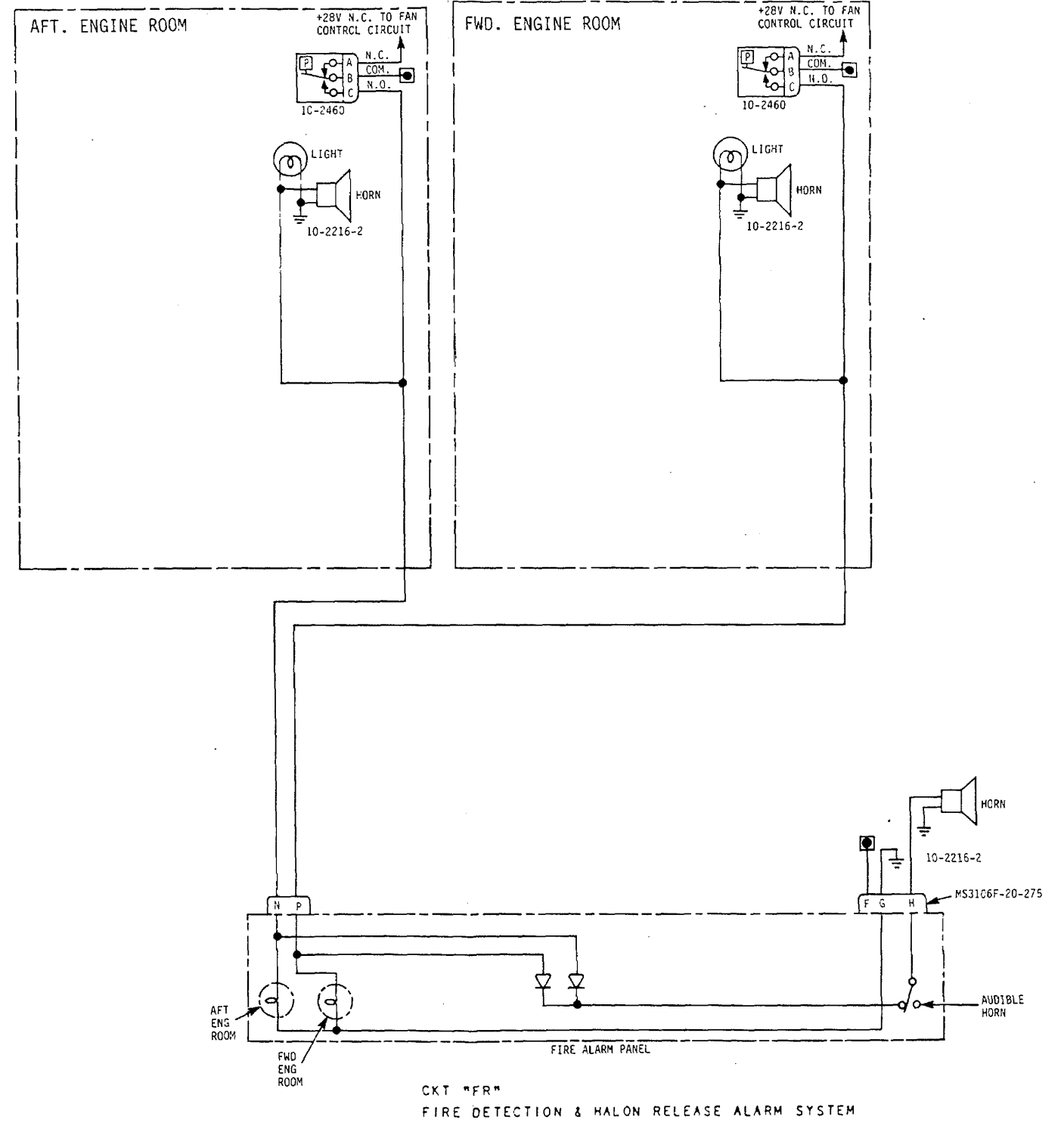
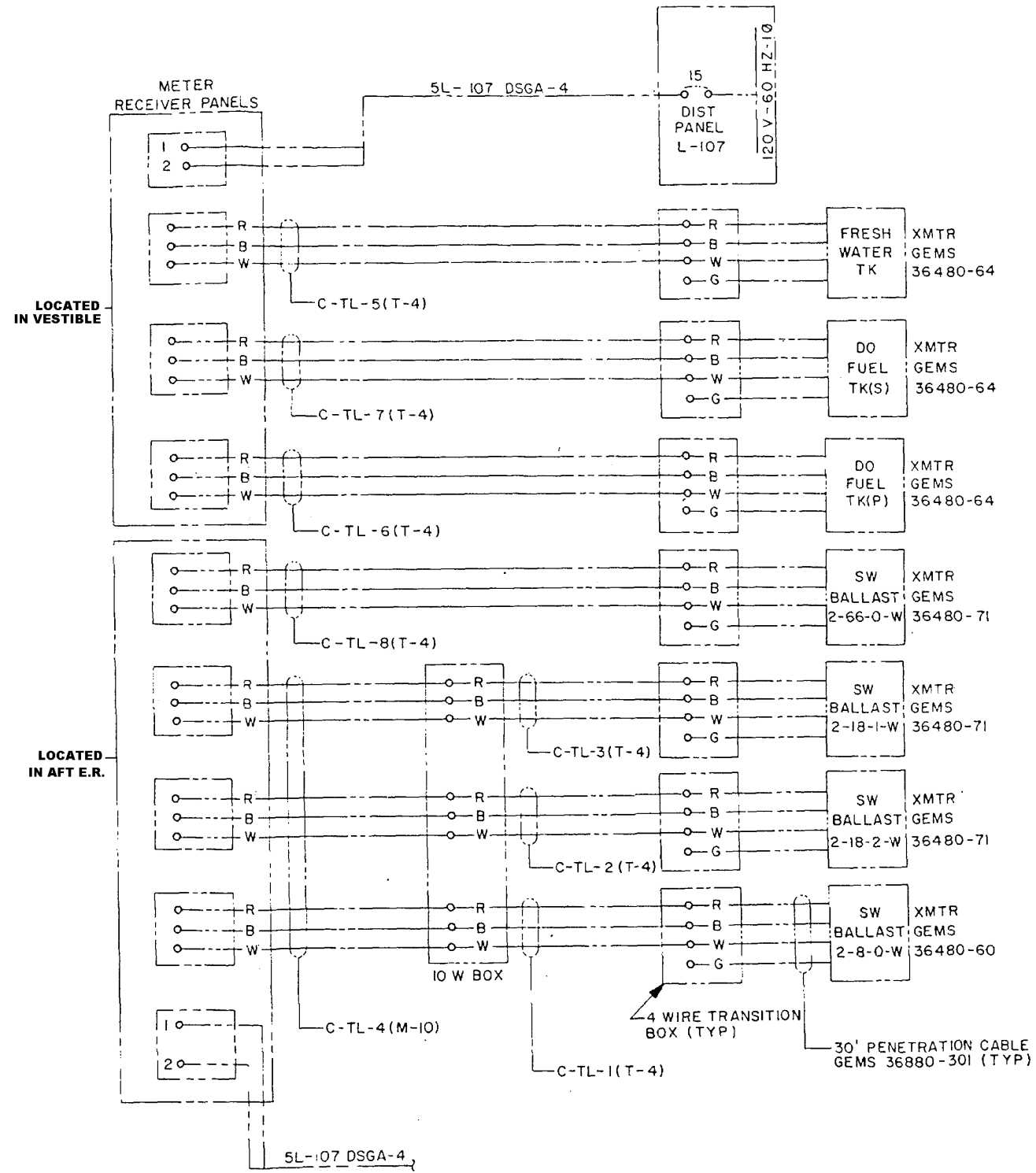


FO-1. Interior Communications System (Sheet 4 of 6)

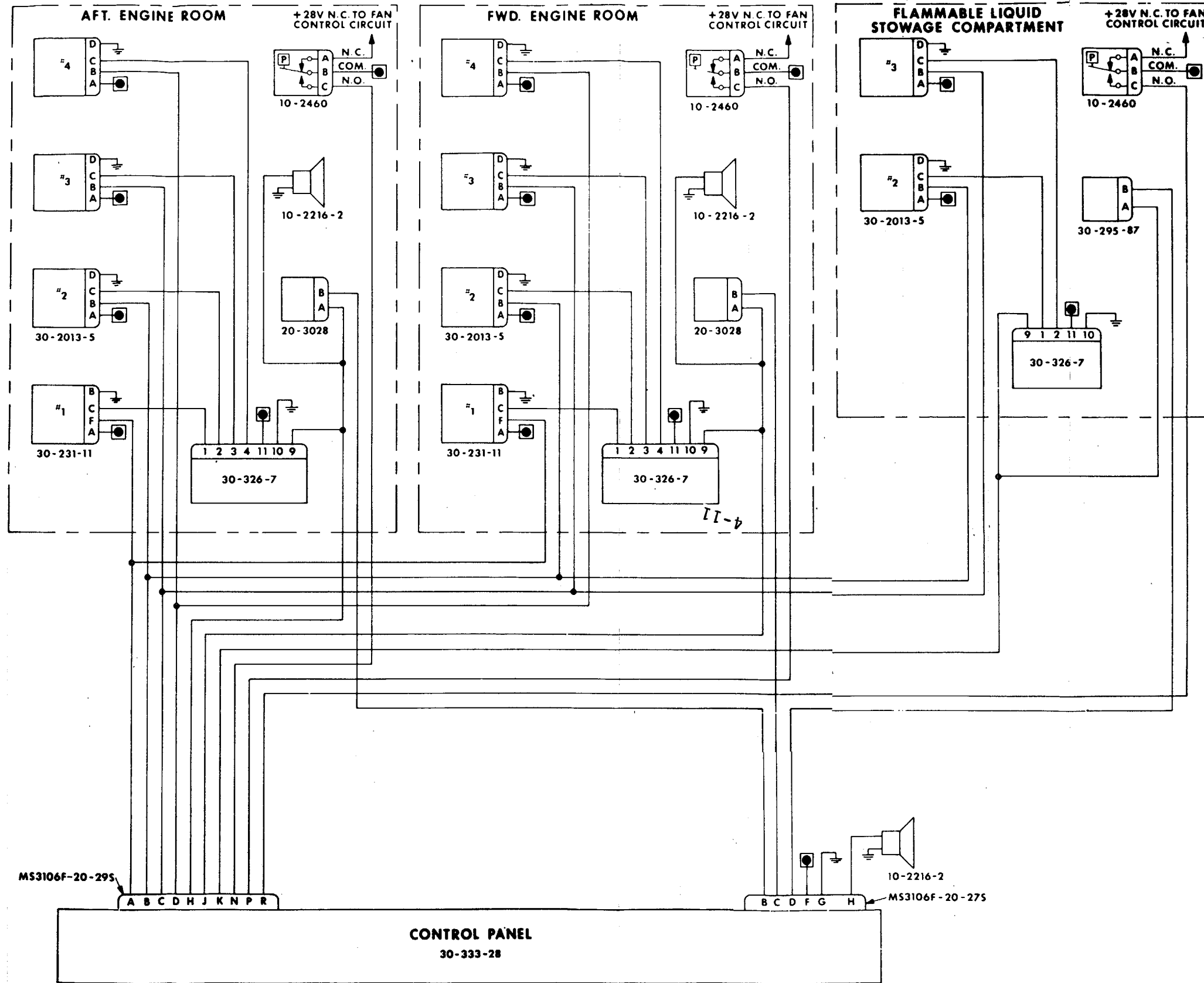
FP-7/(FP-8 Blank)

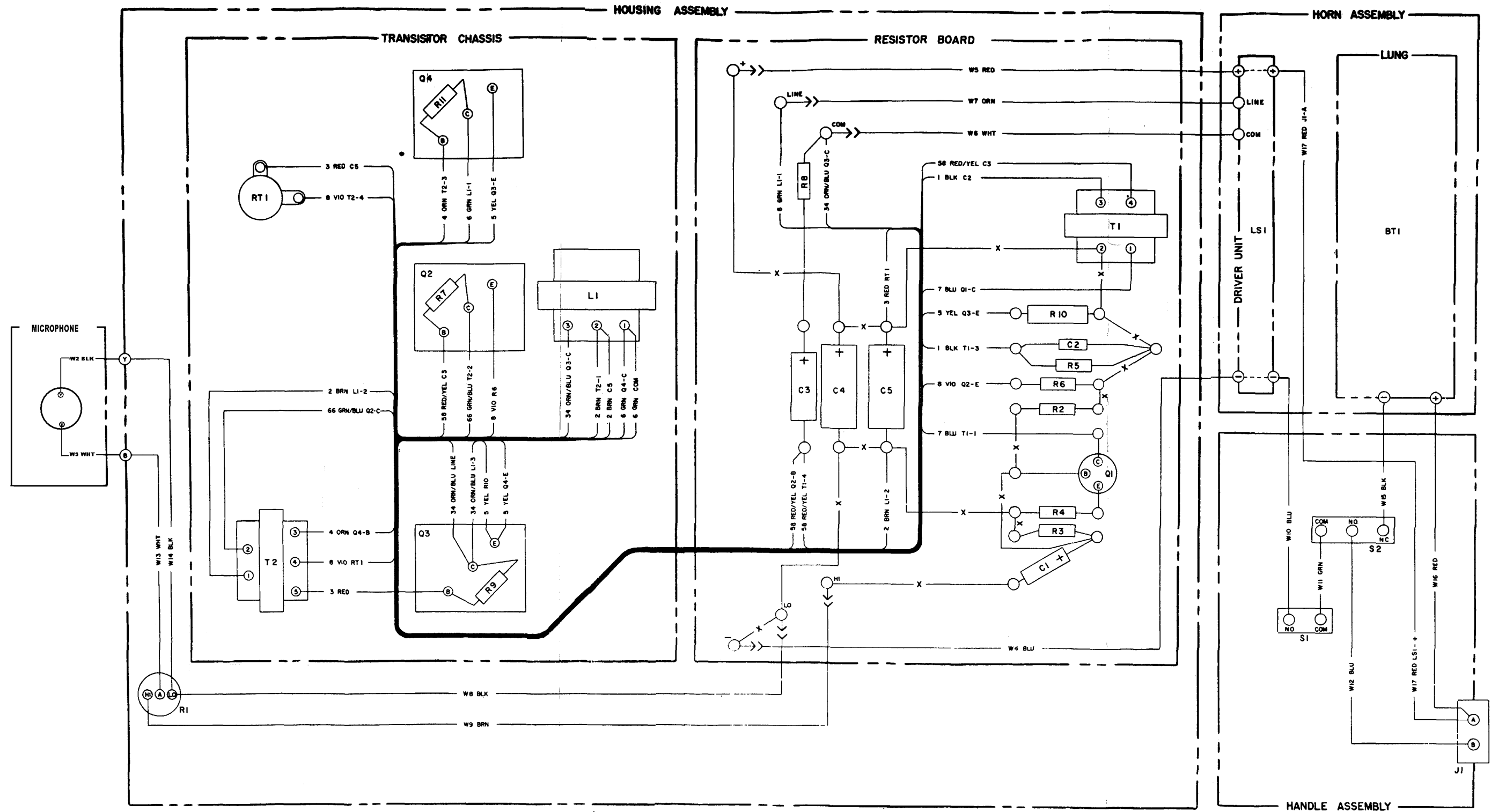


FO-1. Interior Communication System (Sheet 5 of 6).

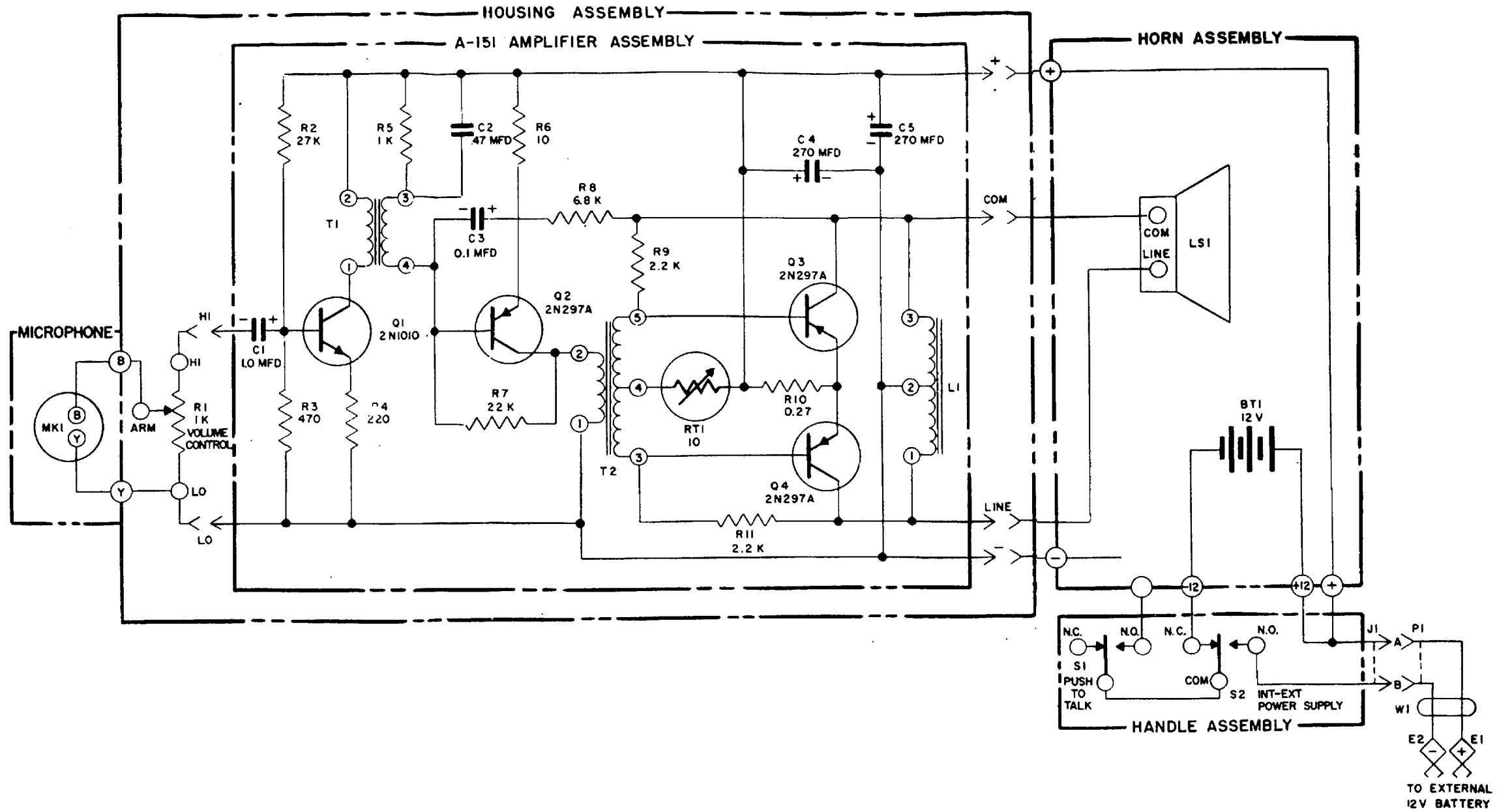


FO-1. Interior Communication System (Sheet 6 of 6)



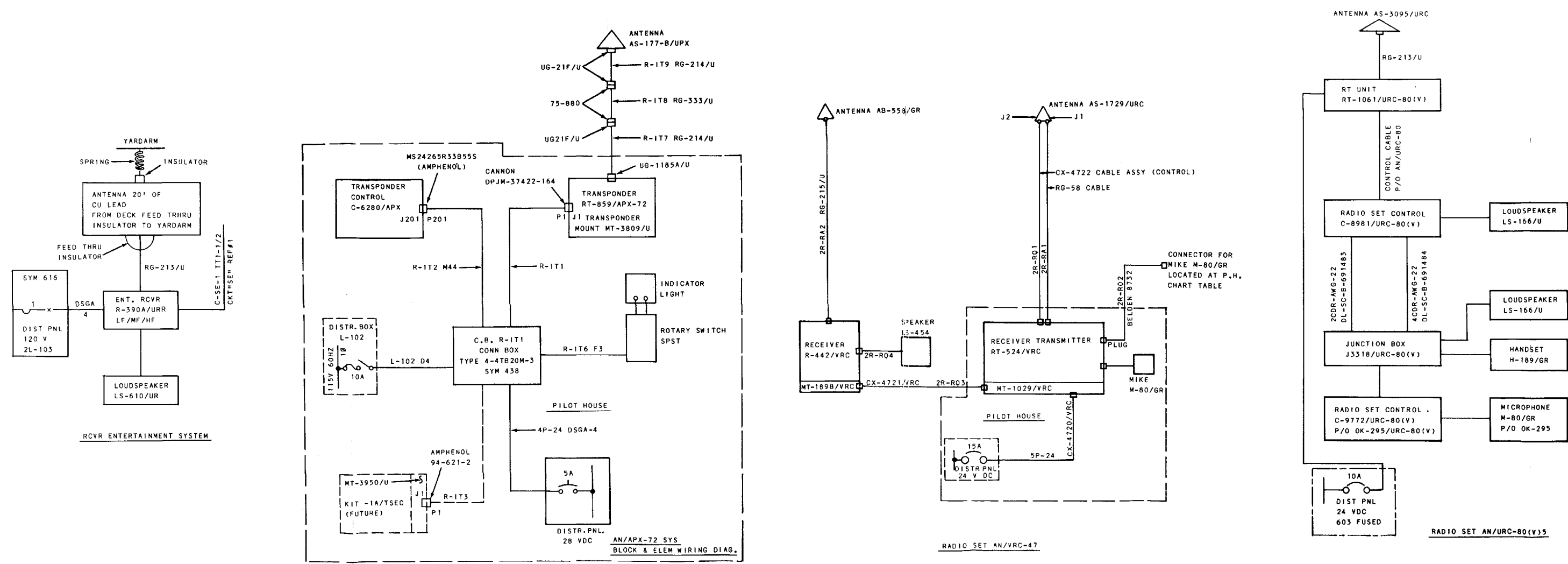


FO-3. Loudhailer - Wiring Diagram.



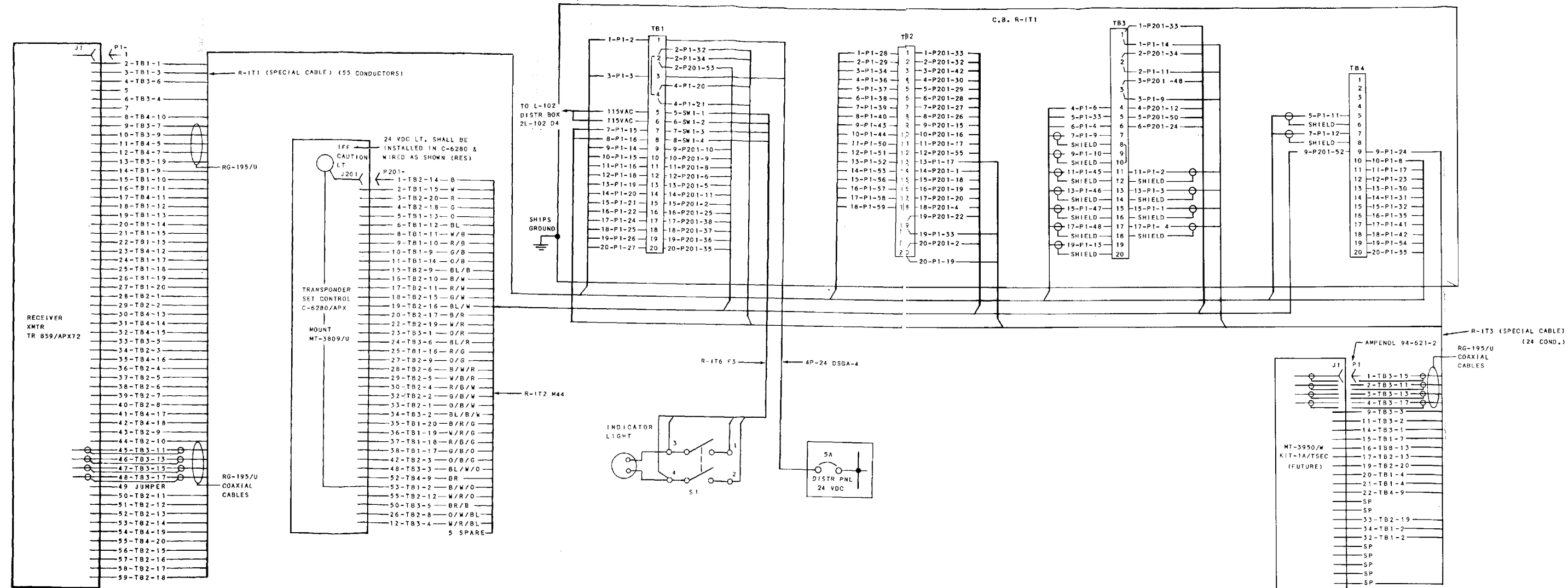
- NOTES:
- EXTERNAL SUPPLY: 12 V STORAGE BATTERY.
 - INPUT POWER:
 - NO SIGNAL: 1.5 WATTS
 - FULL OUTPUT: 20 WATTS
 - OUTPUT POWER: 10 WATTS
 - DO NOT APPLY BATTERY POWER WITH OUTPUT LOAD DISCONNECTED
 - ALL RESISTORS 1/2 WATT, UNLESS MARKED OTHERWISE
 - RESISTANCE VALUE IN OHMS K=1,000 M=1,000,000

FO-4. Loudhailer - Schematic.



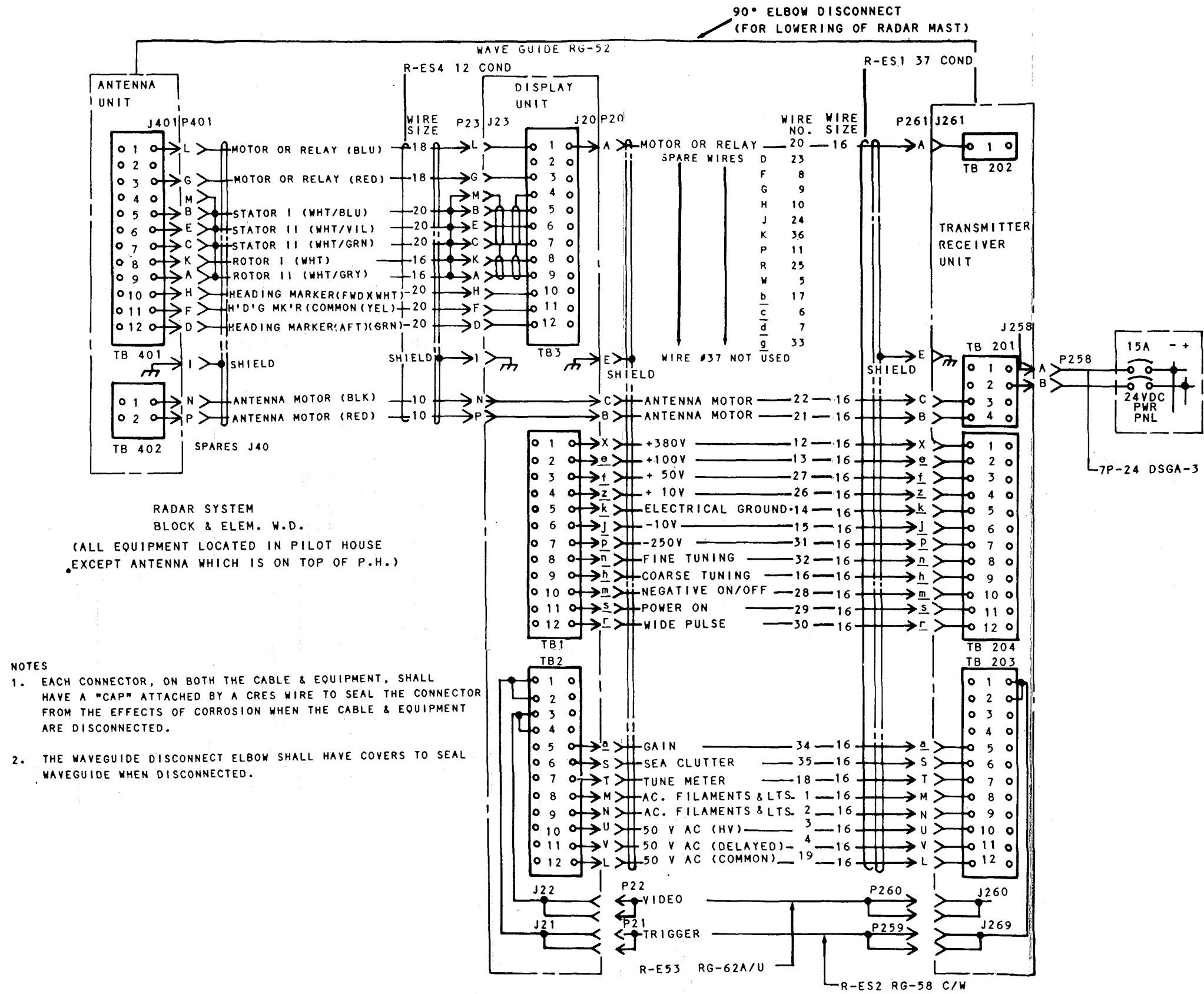
FO-5. Radio Communication System (Sheet 1 of 2).

FP-19/(FP-20 Blank)



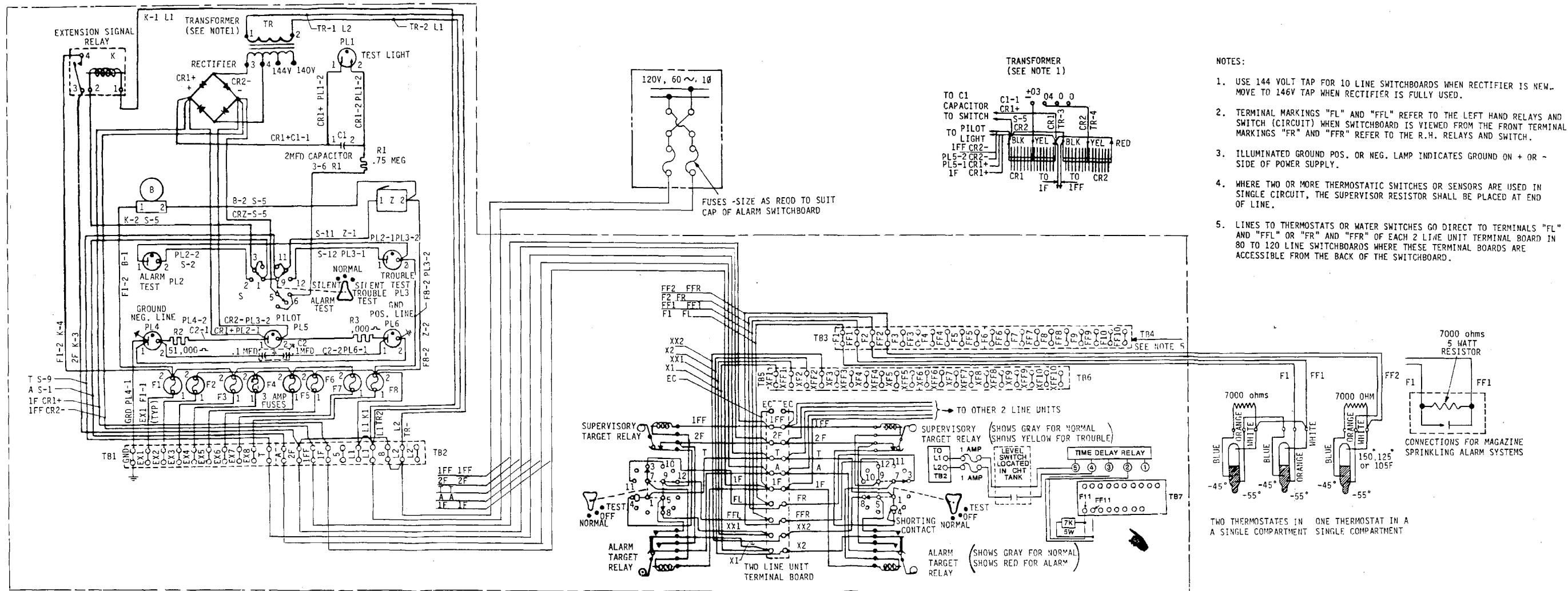
FO-5. Radio Communication System (Sheet 2 of 2).

FP-21/(FP-22 Blank)



FO-6. Radar System.

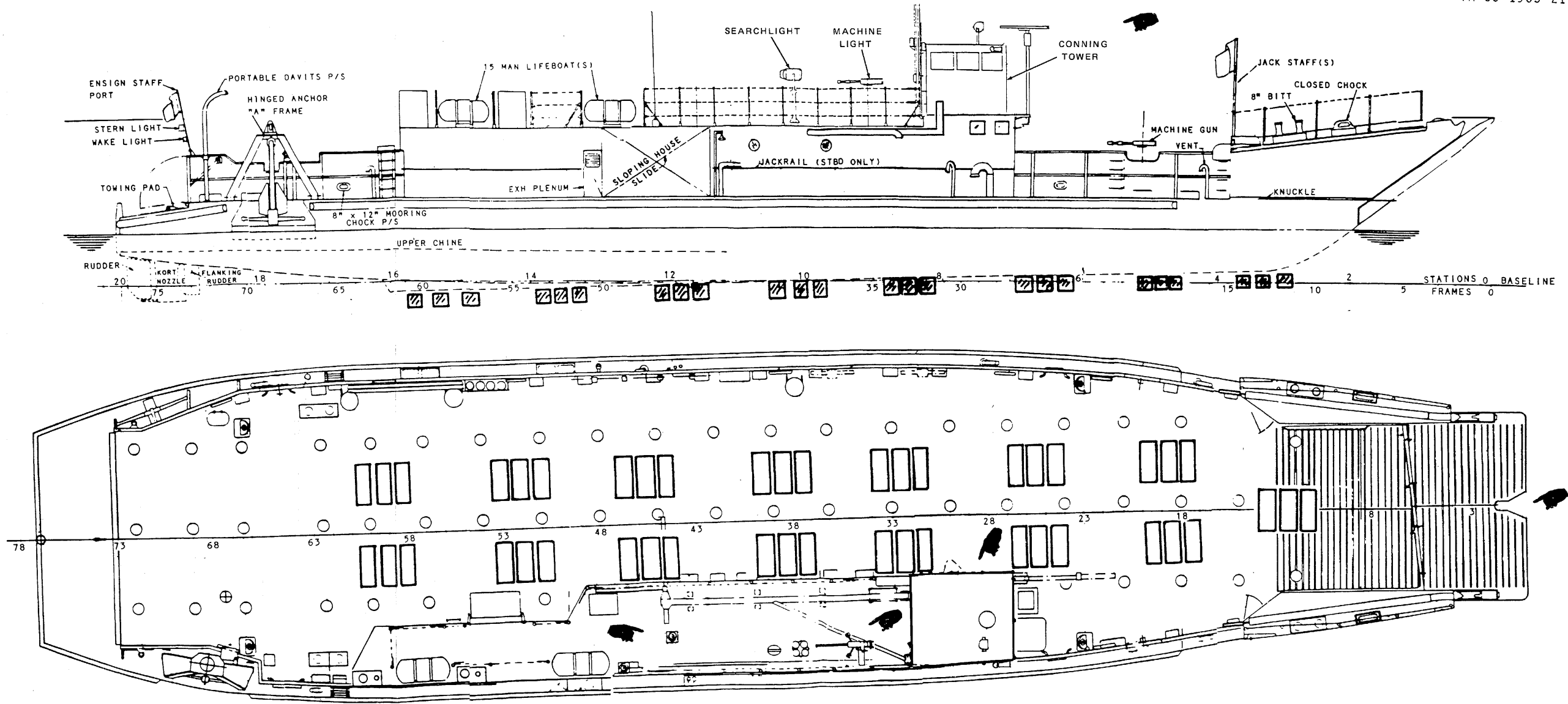
FP-23/(FP-24 Blank)



- NOTES:
1. USE 144 VOLT TAP FOR 10 LINE SWITCHBOARDS WHEN RECTIFIER IS NEW. MOVE TO 146V TAP WHEN RECTIFIER IS FULLY USED.
 2. TERMINAL MARKINGS "FL" AND "FFL" REFER TO THE LEFT HAND RELAYS AND SWITCH (CIRCUIT) WHEN SWITCHBOARD IS VIEWED FROM THE FRONT. TERMINAL MARKINGS "FR" AND "FFR" REFER TO THE R.H. RELAYS AND SWITCH.
 3. ILLUMINATED GROUND POS. OR NEG. LAMP INDICATES GROUND ON + OR - SIDE OF POWER SUPPLY.
 4. WHERE TWO OR MORE THERMOSTATIC SWITCHES OR SENSORS ARE USED IN SINGLE CIRCUIT, THE SUPERVISOR RESISTOR SHALL BE PLACED AT END OF LINE.
 5. LINES TO THERMOSTATS OR WATER SWITCHES GO DIRECT TO TERMINALS "FL" AND "FFL" OR "FR" AND "FFR" OF EACH 2 LINE UNIT TERMINAL BOARD IN 80 TO 120 LINE SWITCHBOARDS WHERE THESE TERMINAL BOARDS ARE ACCESSIBLE FROM THE BACK OF THE SWITCHBOARD.

FO-7. Alarm Switchboard.

Change 1 FP-25/(FP-26 Blank)



NOTE

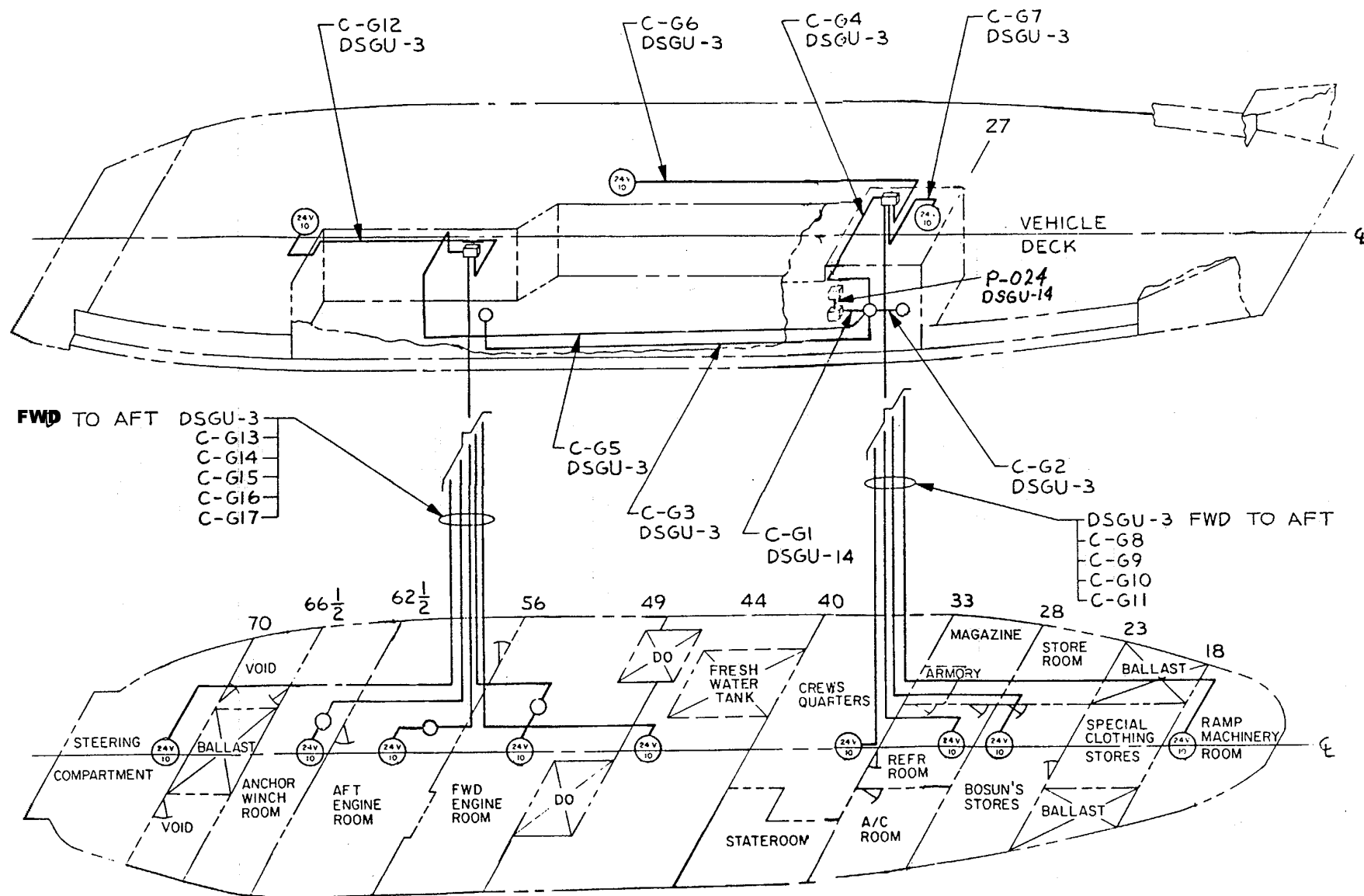
REFER TO NAVESEA PLAN NUMBER
LCU 1667 thru 1670-845-4661629
FOR DETAILS -

4954-014

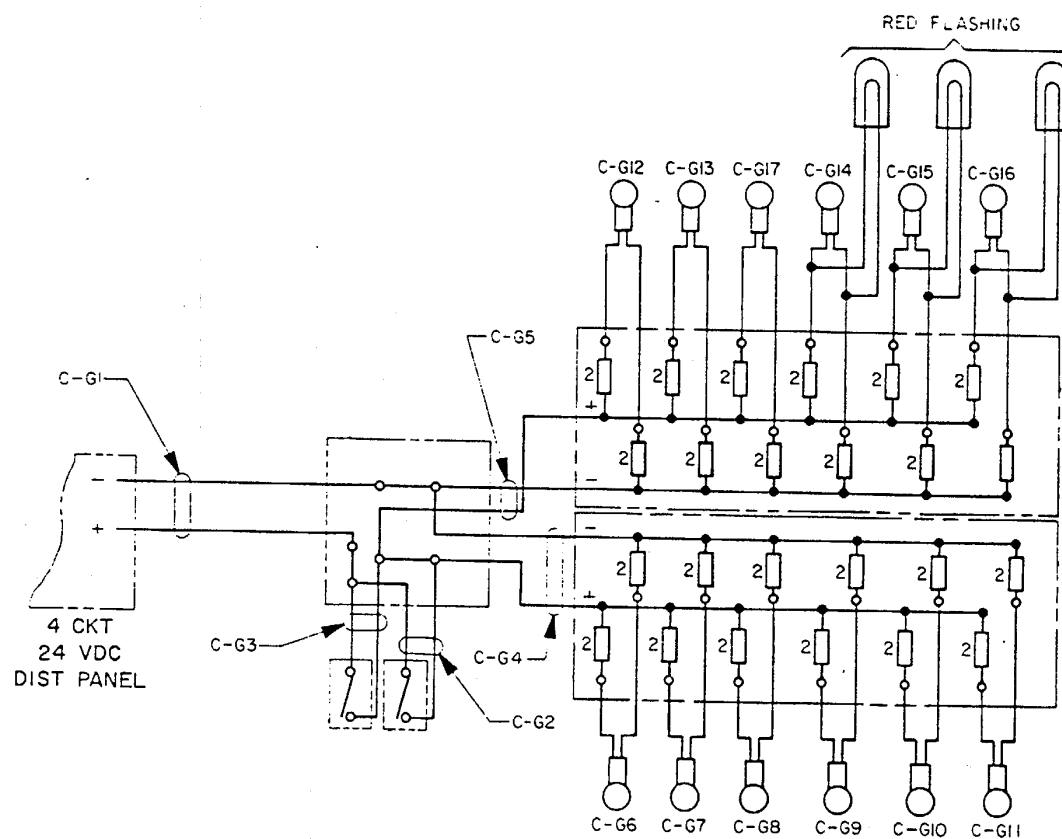
FO-8. Docking Plan.

FO-8. Docking Plan.

Change 1 FP-27/(FP-28 Blank)



GENERAL ALARM



SCHEMATIC DIAGRAM
CIRCUIT G

FO-9 GENERAL ALARM WIRING DIAGRAM

Change 1 FP-29/(FP-30) BLANK

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

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FIGURE NO.

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The Adjutant General

DISTRIBUTION:

To be distributed in accordance with DA Form 12-25D, Operator, Organizational, Direct and General Support Maintenance Requirements for Marine Equipment, All.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
 1 decimeter = 10 centimeters = 3.94 inches
 1 meter = 10 decimeters = 39.37 inches
 1 dekameter = 10 meters = 32.8 feet
 1 hectometer = 10 dekameters = 328.08 feet
 1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
 1 decigram = 10 centigrams = 1.54 grains
 1 gram = 10 decigram = .035 ounce
 1 dekagram = 10 grams = .35 ounce
 1 hectogram = 10 dekagrams = 3.52 ounces
 1 kilogram = 10 hectograms = 2.2 pounds
 1 quintal = 100 kilograms = 220.46 pounds
 1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
 1 deciliter = 10 centiliters = 3.38 fl. ounces
 1 liter = 10 deciliters = 33.81 fl. ounces
 1 dekaliter = 10 liters = 2.64 gallons
 1 hectoliter = 10 dekaliters = 26.42 gallons
 1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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