TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL,

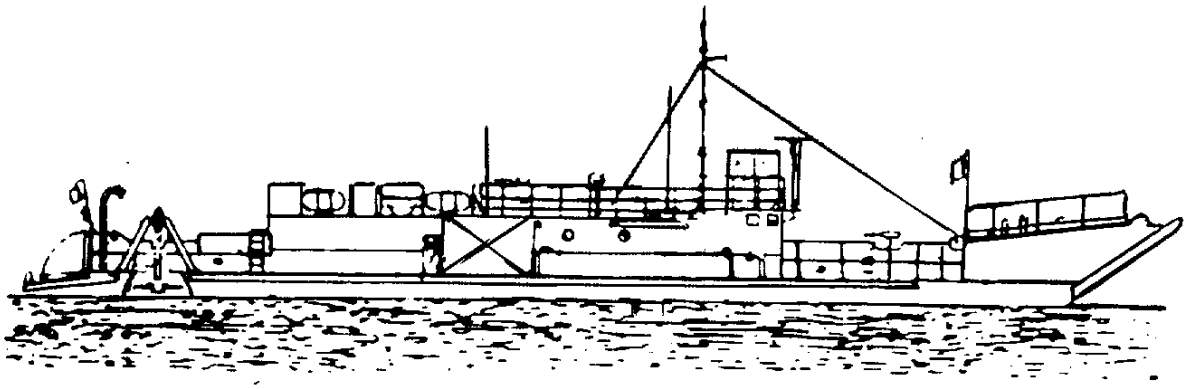
AND DIRECT SUPPORT

MAINTENANCE MANUAL

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

LANDING CRAFT UTILITY
LCU 1671-1679
NSN 1905-01-009-1056



HEADQUARTERS, DEPARTMENT OF THE ARMY

8 APRIL 1985

CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 27 APRIL 1992

Technical Manual
Operator's, Organizational
and Direct Support Maintenance Manual

LANDING CRAFT UTILITY
LCU 1671-1679
NSN 1905-01-009-1056

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TM 55-1905-220-14-11, 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	Insert pages
5-1095 and 5-1096	5-1095 and 5-1096
5-1099 and 5-1100	5-1099 and 5-1100
5-1145 through 5-1158	5-1145 through 5-1158
5-1159 through 5-1162	-----
5-1179 through 5-1182	5-1179 through 5-1182
5-1245 through 5-1250	5-1245 through 5-1250
5-1395 and 5-1396	5-1395 and 5-1396
5-1465 and 5-1466	5-1465 and 5-1466
-----	-5-1466.1/5-1466.2
5-1467 through 5-1470	5-1467 through 5-1470
5-1473 through 5-1478	5-1473 through 5-1478
5-1559/5-1560 through 5-1562	5-1559 through 5-1562
5-1625 through 5-1632	5-1625 through 5-1632
5-1635 through 5-1644	5-1635 through 5-1644
5-1657 and 5-1658	5-1657 and 5-1658
5-1663 through 5-1666	5-1663 through 5-1666
5-1685 through 5-1690	5-1685 through 5-1690
5-1693 through 5-1696	5-1693 through 5-1696
5-1709 through 5-1722	5-1709 through 5-1722
-----	6-1 and 6-2 6-1 and 6-2
6-31 through 6-37/6-38	
Index 1 and Index-2	Index-1 and Index-2
FP-3/FP-4	FP-3/FP-4
FP-7/FP-8	FP-7/FP-8
FP-9/FP-10	FP-9/FP-10
FP-15/FP-16	FP-15/FP-16
FP-29/FP-30	FP-29/FP-30
-----	FP-31/FP-32

2. Retain these sheets 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
01177

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25E, (qty rqr block No. 1060)

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.

Technical Manual
No. 55-1905-220-14-11

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 8 April 1985

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

LANDING CRAFT UTILITY

LCU 1671-1679 NSN 1905-01-009-1056

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: AMSTS-MPS, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply will be furnished directly to you.

TABLE OF CONTENTS

5-68. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS.

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

The following is an index to the Hydrostarter Maintenance procedures.

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

Special Tools

Cutting tools
Welding tools
Crane (10 ton)
Miscellaneous chains

Material/Parts

NONE

Personnel Required

6

References

Vol-10 F0-1 Machinery/Vehicle Deck Access

Equipment Condition Paragraph	Condition Description
5-65.1	Disconnect Clutch Assembly Removed
5-66	Torque Converter Removed

Special Environmental Conditions

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

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).

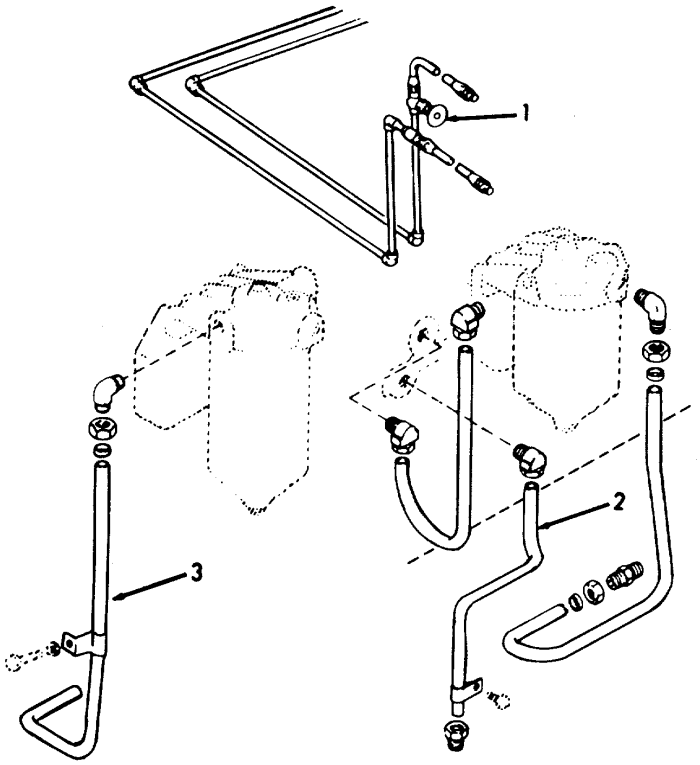
LOCATION	ITEM	ACTION	REMARKS

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.

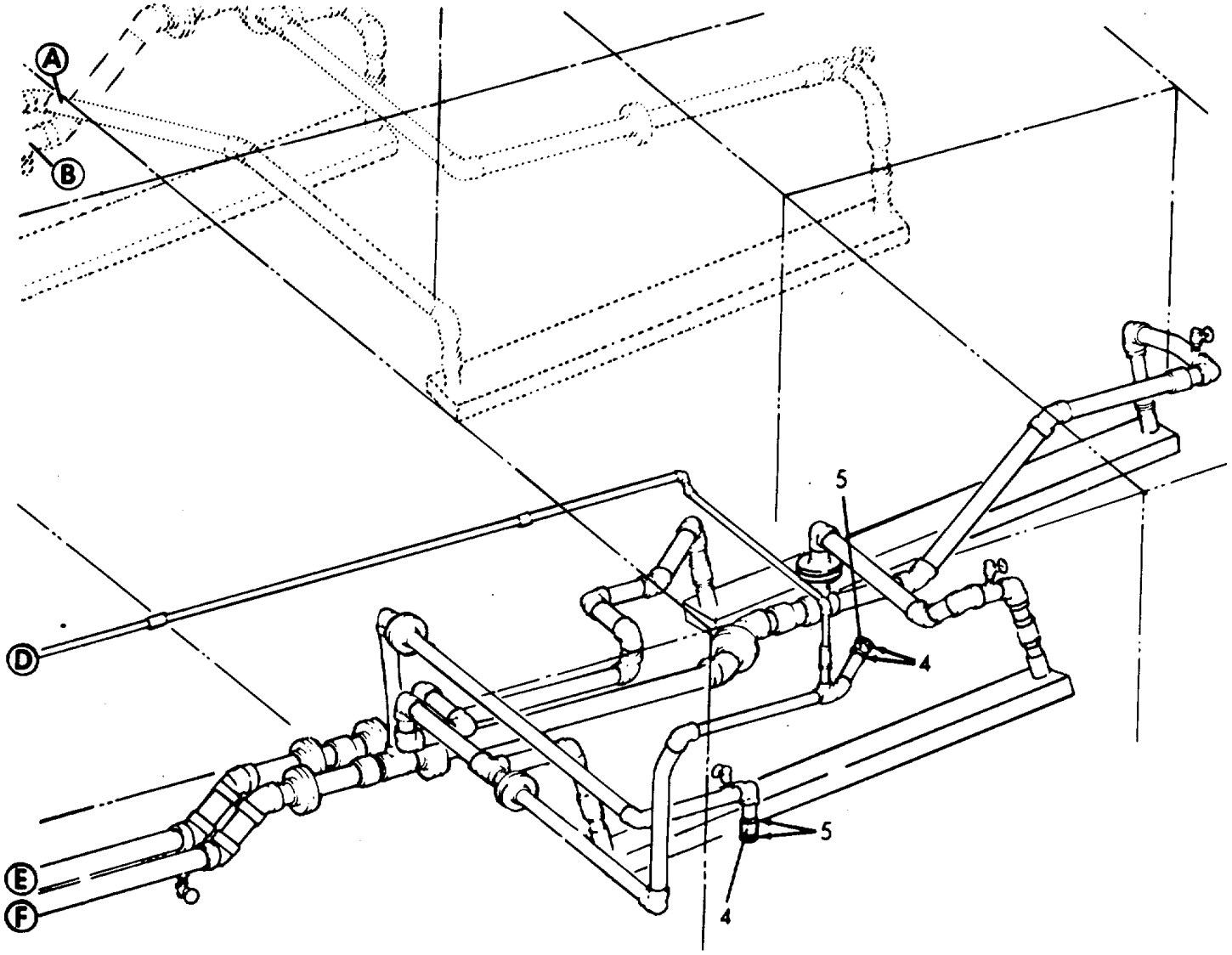
REMOVAL

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.



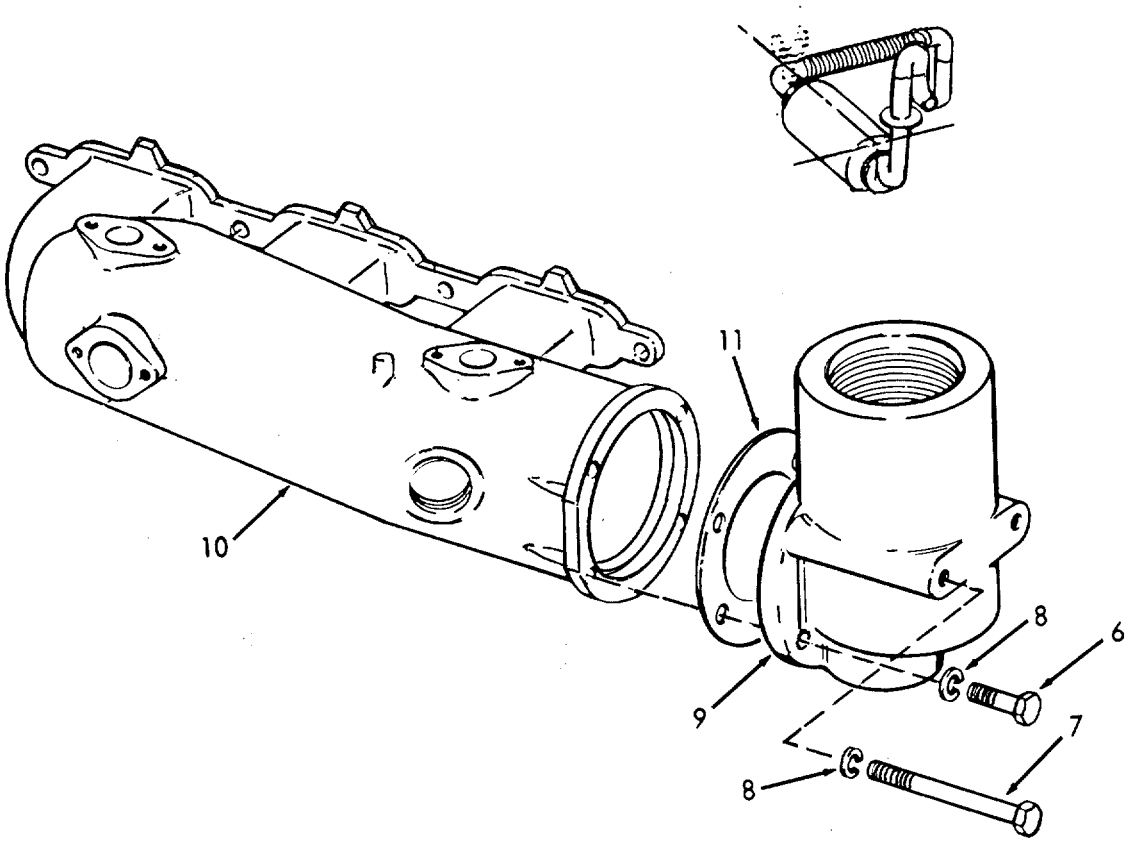
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
2. Cooling Lines	a. Hose clamps (4)	Loosen.	
	b. Hoses (5)	Remove.	



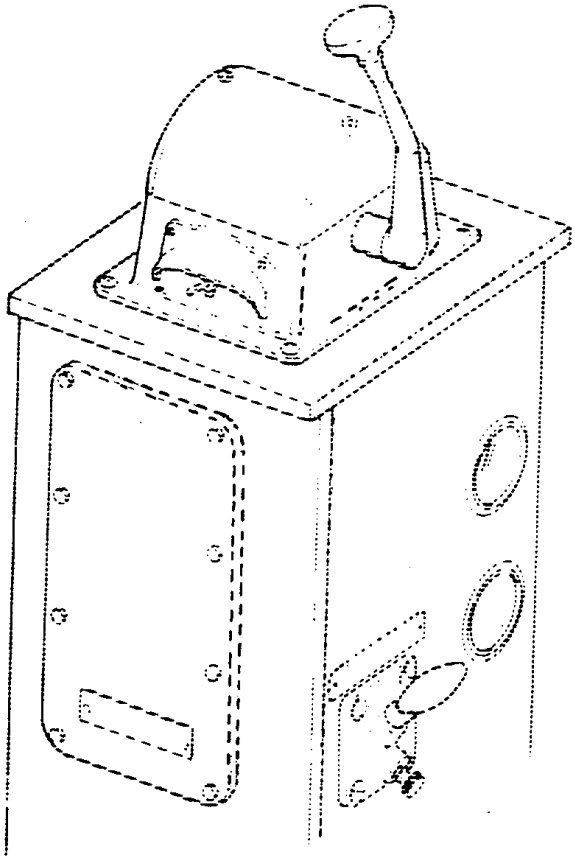
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

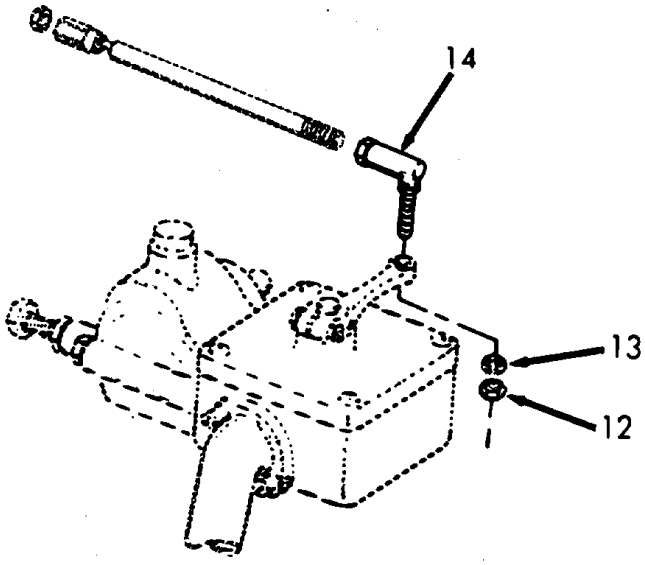
LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
3. Exhaust Piping	a. Screws (6 and 7), and lock-washers (8)	Remove.	
	b. Exhaust elbow (9), and manifold (10)	Separate.	
	c. Asbestos gasket (11)	Remove.	



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

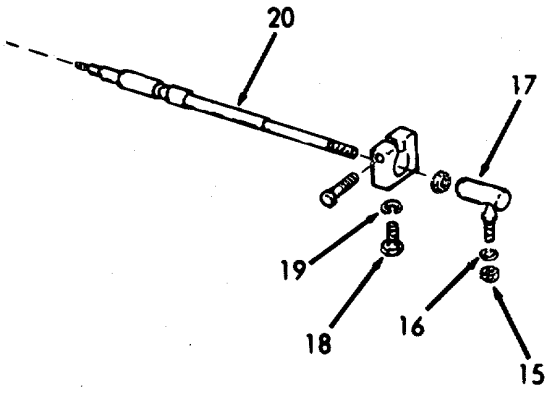
LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
4. Stop Cable	a. Nut (12), and lock-washer (13)	Remove.	
	b. Ball joint (14)	Remove.	

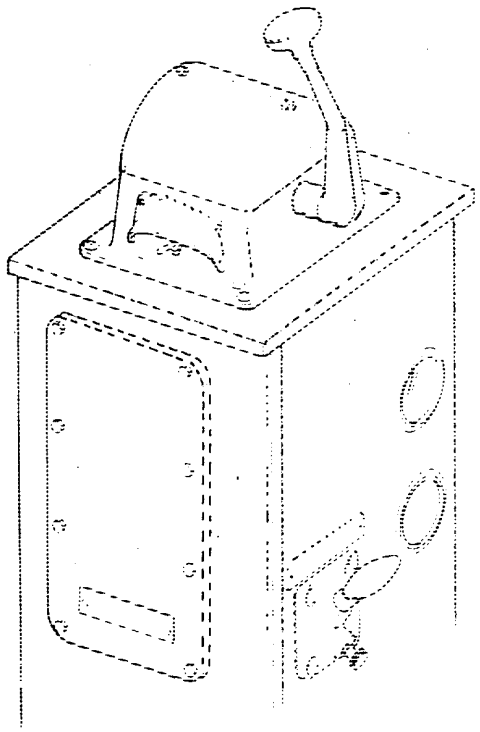




5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

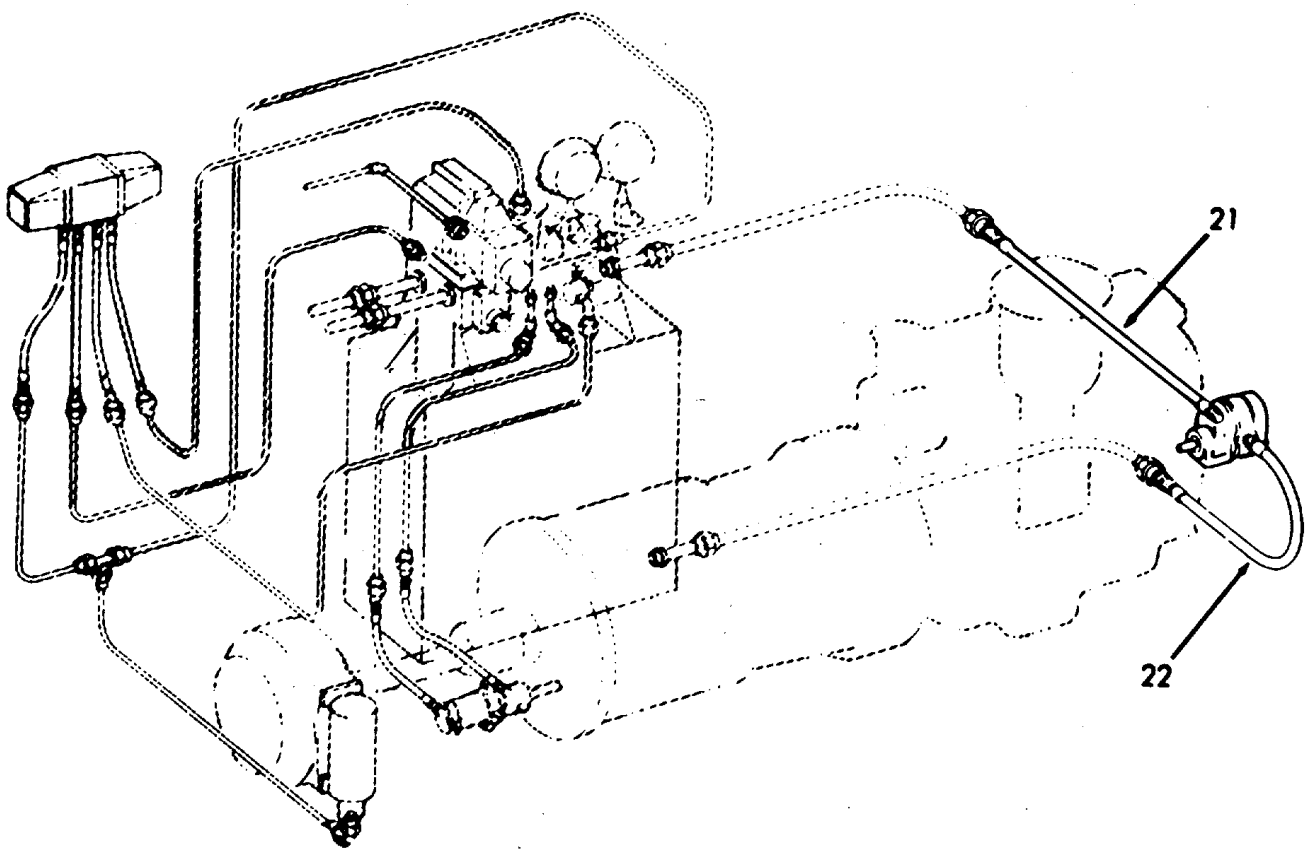
LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
5. Shutdown Lever	a. Nut (15), and lock-washer (16)	Remove.	
	b. Ball joint (17)	Remove.	
	c. Screws (18), and lock-washers (19)	Remove.	
	d. Control cable (20)	Remove.	





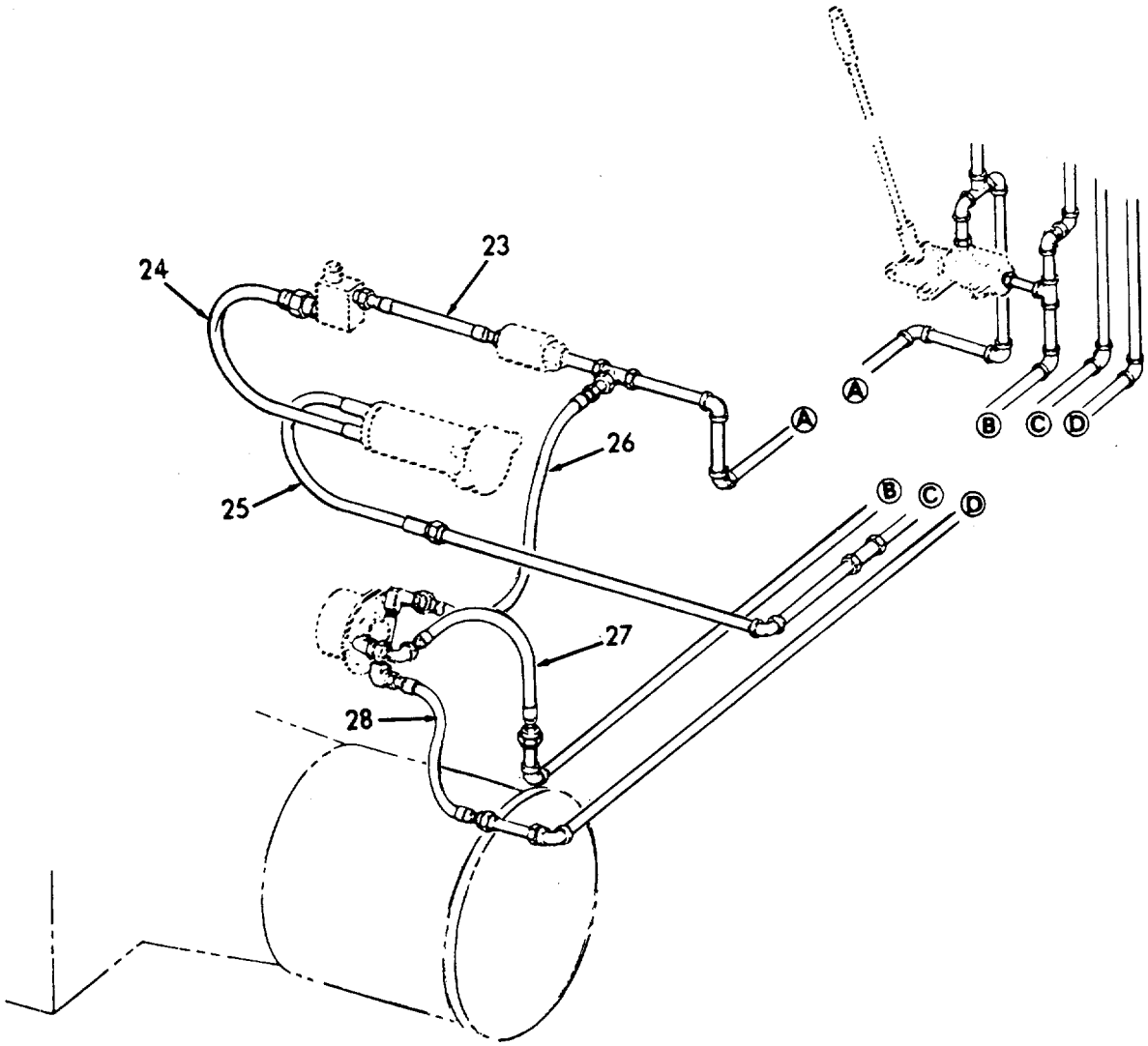
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
6. Control Pedestal Wiring	Wiring	Tag and disconnect.	
7. Hydraulic Piping	a. Flexible hose (21) to top of hydraulic tank	Remove.	
	b. Flexible hose (22) to bottom of hydraulic tank	Remove.	



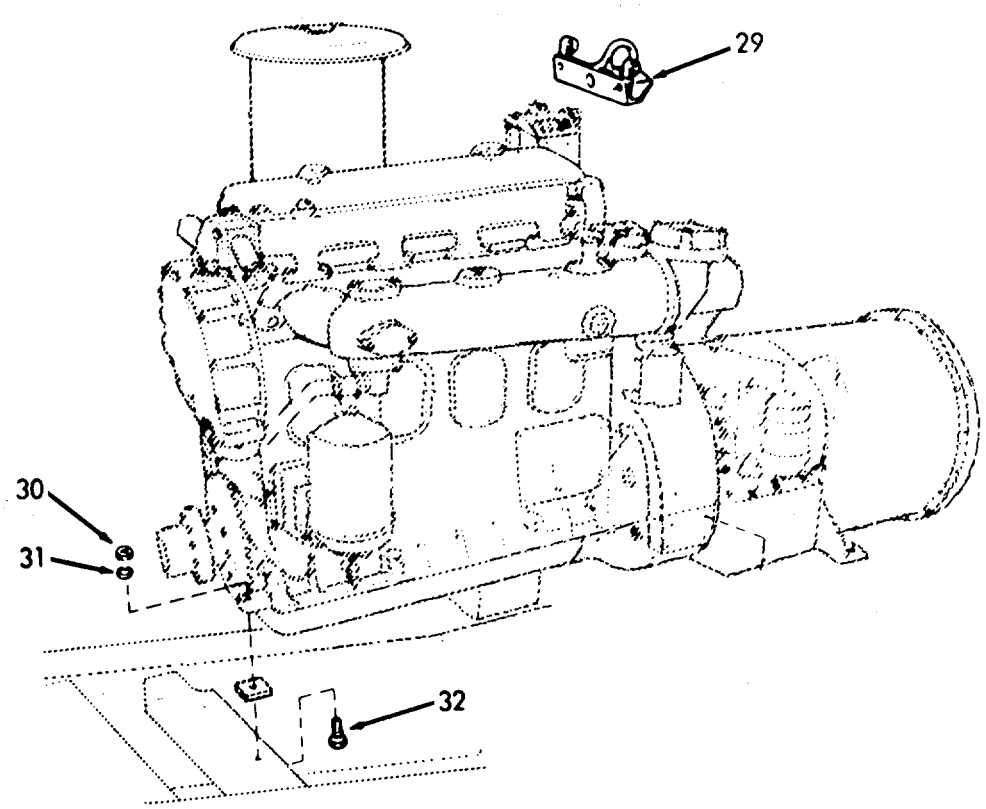
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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. Disconnect 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 F0-1 in Volume 10.
11. Engine Room (29)	a. Lifting rackets	Attach chains.	
	b. Nuts (30), lockwashers (31), and screws (32)	Remove.	



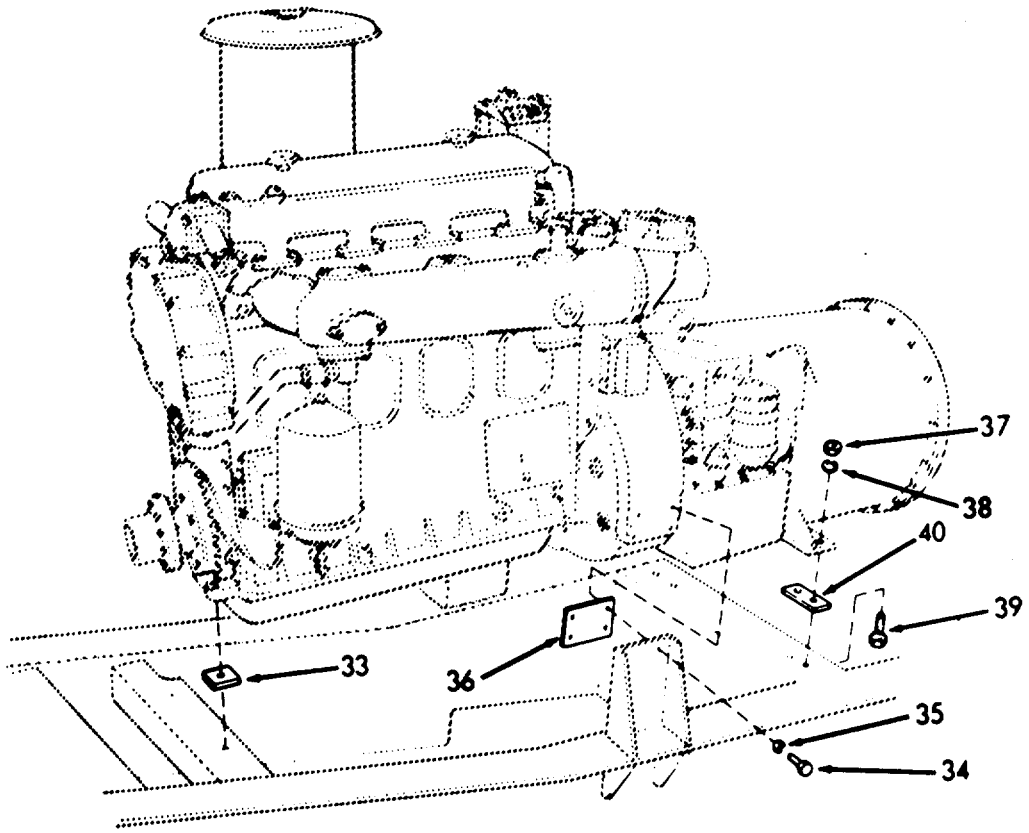
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

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 chocks (40)	Remove.	
12. Vehicle Deck	Engine	Lift.	

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

LOCATION	ITEM	ACTION	REMARKS

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

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 (1600 - 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 850 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

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 5-926). 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

ENGINE RUN-IN INSTRUCTIONS (Cont)

(b) The engine is connected through an 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:

BHP = (T x 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

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 dip- stick hole in the oil pan.
3. Adaptor for connecting a pressure gage or mercury manometer to the engine air box.
4. Water temperature gage installed in the water outlet manifold.
5. Adaptor for connecting a pressure gage or water manometer to the crankcase.
6. Adaptor for connecting a pressure gage or mercury manometer to the exhaust manifold at the flange.
7. Adaptor for connecting a vacuum gage or water manometer to the blower inlet.
8. Adaptor 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

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 5-926).

(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
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 5-926) which establishes the sequence of events for the test and run-in, and to the Basic Run-In Horsepower Schedule on page 5-919 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 5-919.

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

LOCATION	ITEM	ACTION	REMARKS

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 5-926).

9. Run the engine at each speed and rating for the length of time indicated in the Basic Run-In Horsepower Schedule on page 5-919. 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 1eaks 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
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 5-926) 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 emperature should be recorded and should be within the specified range.

t

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

LOCATION	ITEM	ACTION	REMARKS

ENGINE TEST REPORT

Date_____ Unit Number_____

Repair Order Number_____ Model Number_____

A	Pre-Starting				
Prime Lube 1. Oil System	Prime Fuel 2. System	Adjust Valves 3. And Bridges	Time 4. Injector	Adjust 5. Governor	Adjust 6. Injector Racks

B	Basic Engine Run-In					C	Basic Run-In Inspection
TIME AT SPEED	TIME START	STOP	RPM	BHP	WATER TEMP.	LUBE OIL PRESS.	1. Check oil at rocker mechanism
							2. Inspect for lube oil leaks
							3. Inspect for fuel oil leaks
							4. Inspect for water leaks
							5. Check and tighten all external bolts
							6.

D	INSPECTION AFTER BASIC RUN-IN			
1. Tighten Cylinder Head & Rocker Shaft Bolts			4. Adjust Governor Gap	
2. Adjust Valves (Hot)			5. Adjust Injector Racks	
3. Time Injectors			6.	

E	FINAL RUN-IN						
TIME		TOP RPM		BHP	AIR BOX PRESSURE FULL LOAD	EXHAUST BACK PRESSURE F/L	CRANKCASE PRESSURE F/L
START	STOP	NO LOAD	FULL LOAD				

BLOWER INTAKE RES. - F/L	FUEL OIL PRESSURE RET. MAN. F/L	WATER TEMP. FULL LOAD	LUBE OIL TEMP. F/L	LUBE OIL PRESSURE		IDLE SPEED
				FULL LOAD	IDLE	

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

LOCATION	ITEM	ACTION	REMARKS

F	INSPECTION AFTER FINAL RUN	
	1. Inspect Air Box, Pistons Liners, Rings	6. Inspect Oil Pump Drive
	2. Inspect Blower	7. Replace Lube Filter Elements
	3. Wash Oil Pan, Check Gasket	8. Tighten Flywheel Bolts
	4. Clean Oil Pump Screen	9. Rust Proof Cooling System
	5. Tighten Oil Pump Bolts	
REMARKS:		
Final Run OK'd_____Dynamometer Operator _____ Date _____		
NOTE: Operator must initial each check and sign this report.		

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

LOCATION	ITEM	ACTION	REMARKS
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
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 5-926).

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 adaptor 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 5-919.), 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

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.

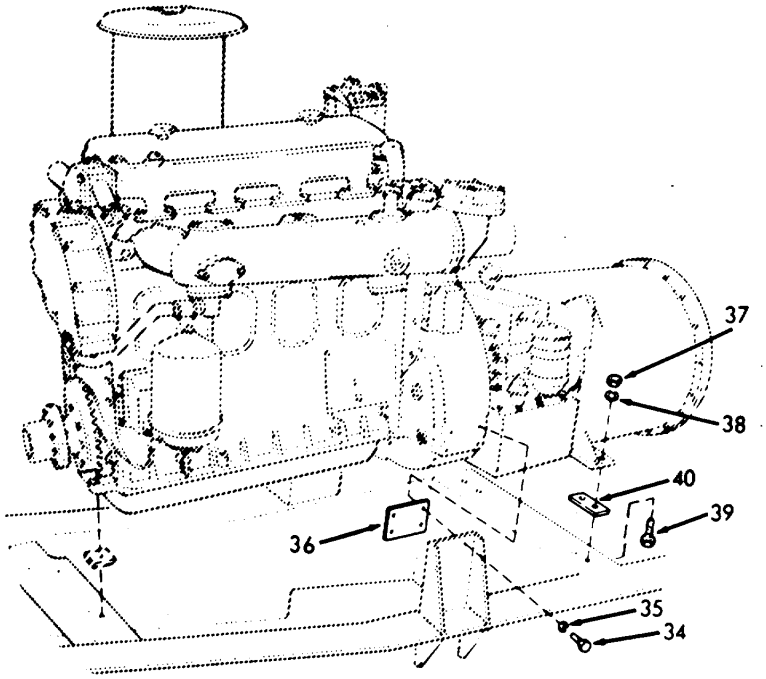
15. When the above conditions have been met, adjust the maximum no-load speed to conform with that specified for the particular engine. This speed may be either higher or lower than the maximum speed used during the Basic Run-In. This will ordinarily require a governor adjustment.

16. All information required in Section "E", Final Run-In, of the Engine Test Report (see page 5-926.), 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.

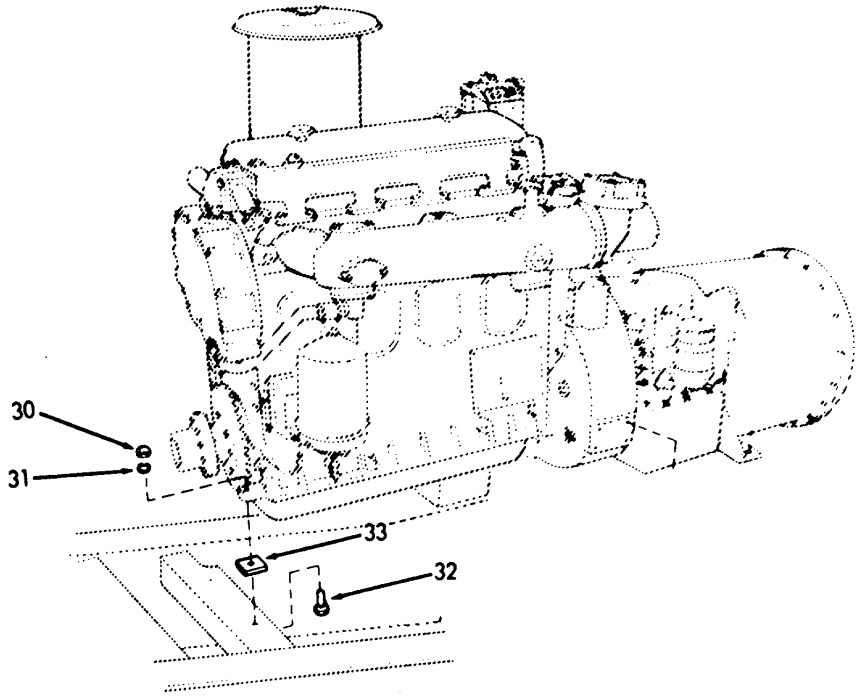
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
14. Vehicle Deck	Engine	Lower into hull.	
15. Engine Room	a. Screws (39), steel chocks (40), lock-washers (38), 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).

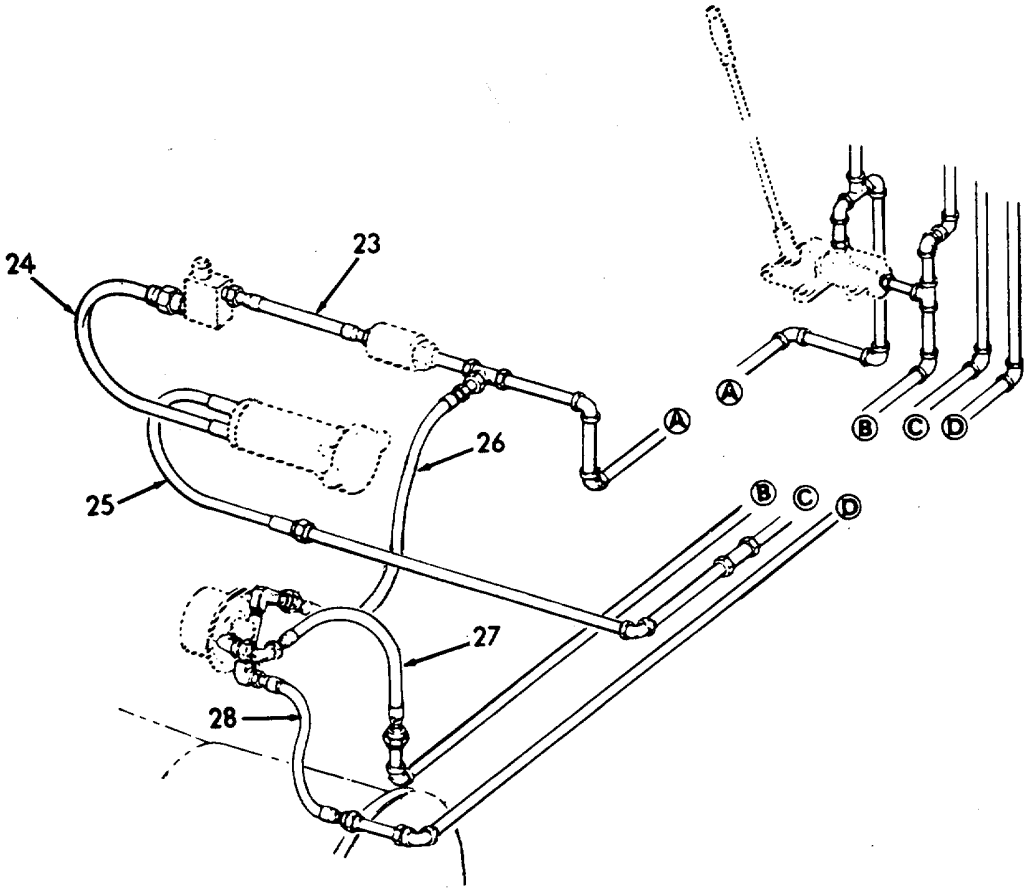
LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
	c. Screws (32), steel chocks (33), lock-washers (31), and nuts (30)	Install.	
	d. Lifting brackets	Remove chains.	



16.	Vehicle Deck	Deck plate	Install.	

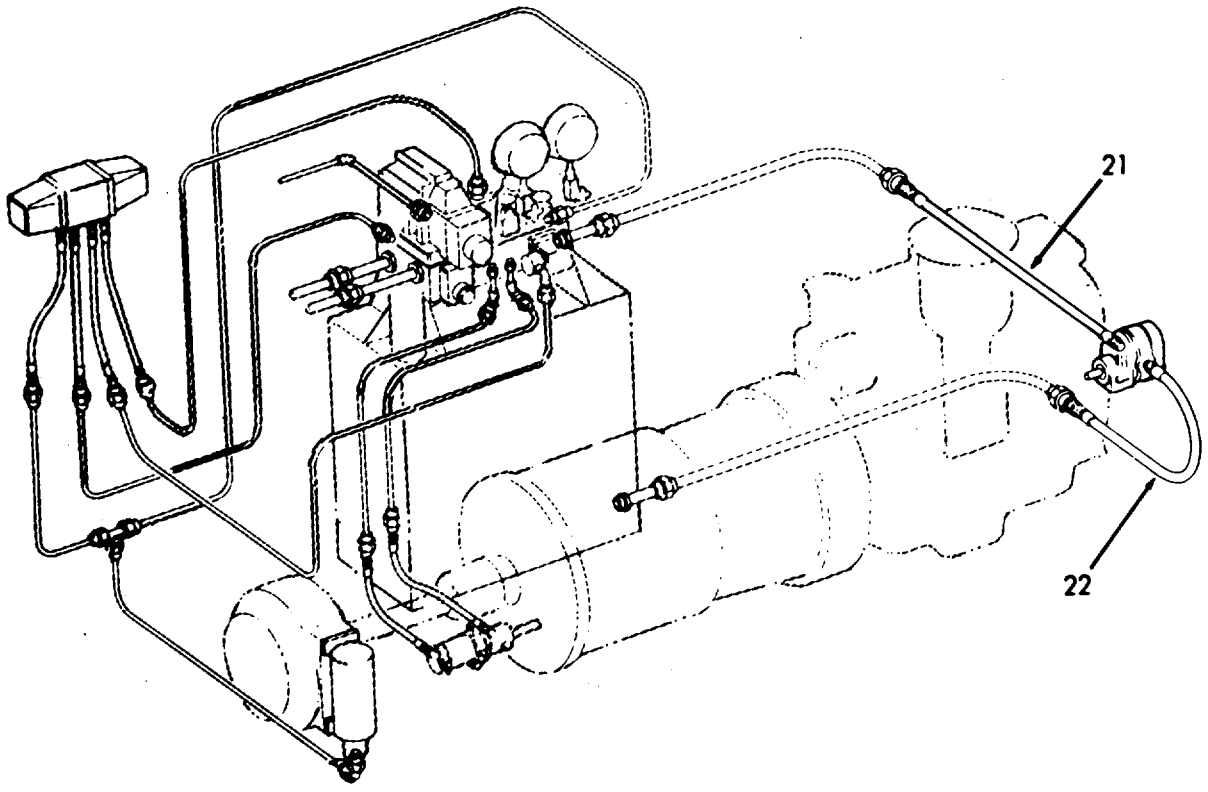
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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. Hydrostarter Piping	a. Hoses (23, 24, 25, 26, 27, 28)	Install.	
	b. Hand pump relief valve	Close relief valve, and operate pump to build up pressure.	



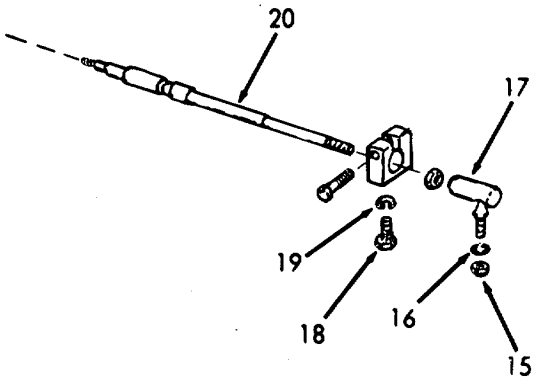
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

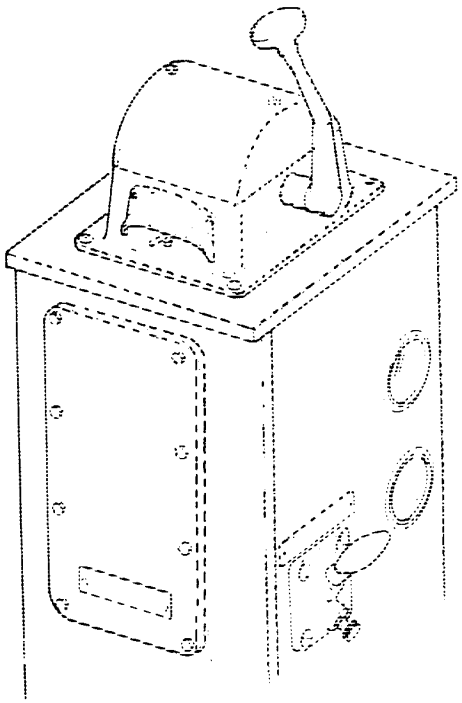
LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
19.	Hydraulic Piping	a. Flexible hose (22) to bottom of hydraulic tank	Install.
		b. Flexible hose (21) to top of hydraulic tank	Install.



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

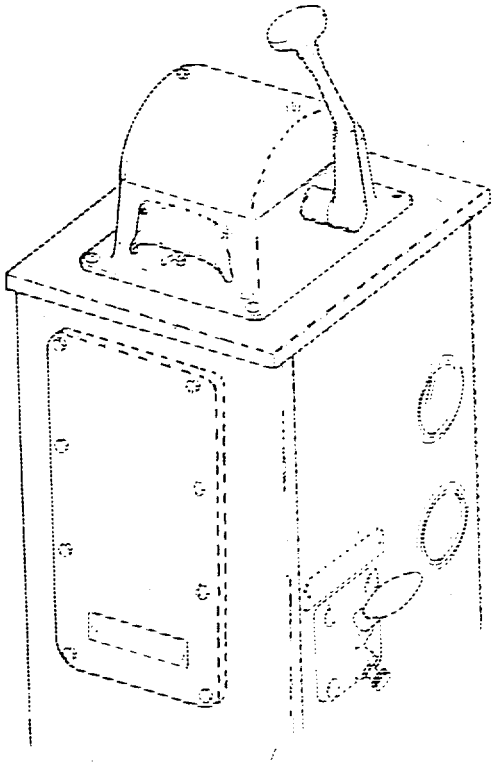
LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
20.	Control Pedestal Wiring	Wiring	Tag and disconnect.
21.	Shutdown Lever	a. Control cable (20)	Install.
		b. Screws (18), and lock-washers (19)	Install.
		c. Ball joint (17)	Install.
		d. Nut (15), and lock-washer (16)	Install.

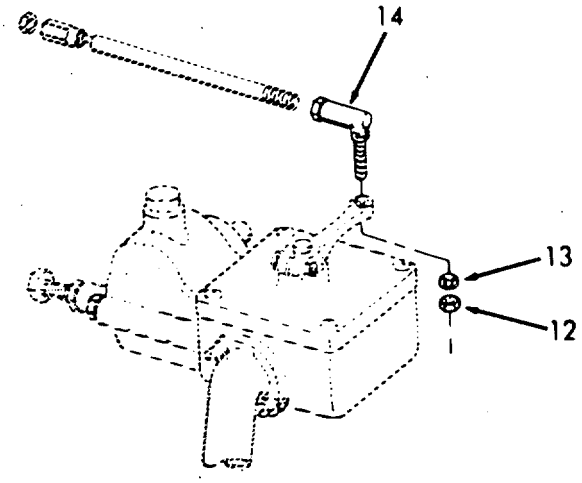




5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

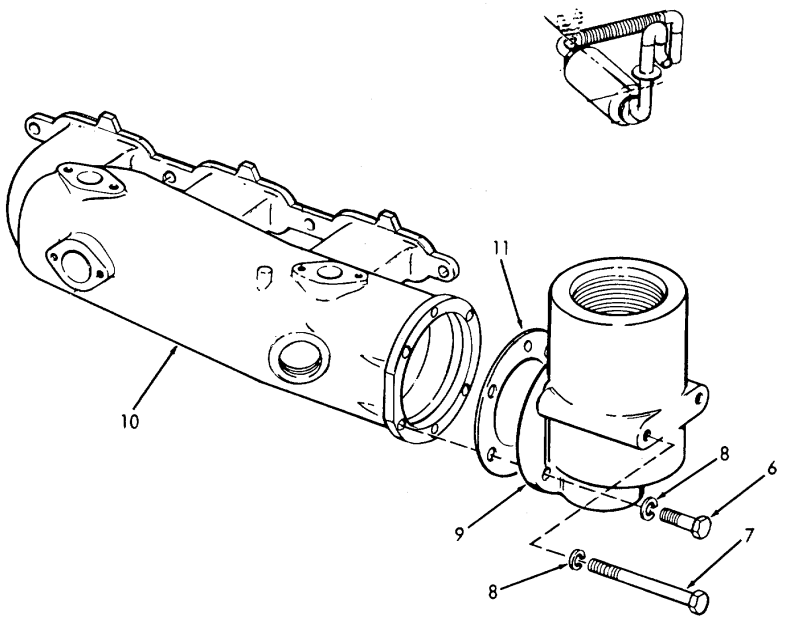
LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
22. Stop Cable	a. Ball joint (14)	Install.	
	b. Nut (12), and lock-washer (13)	Install.	





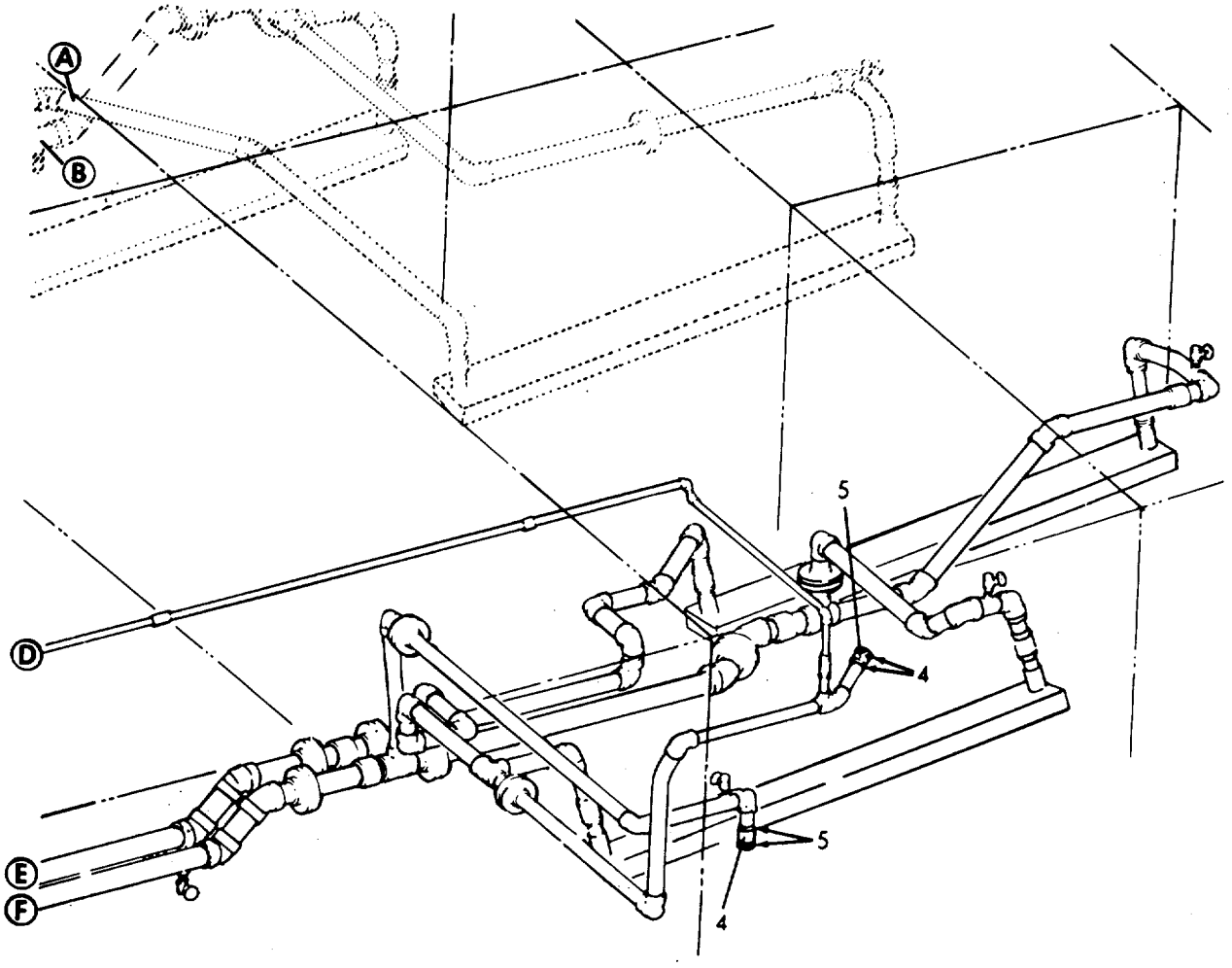
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
23. Exhaust Piping	a. Gasket (11)	Replace.	
	b. Manifold (10), and exhaust elbow (9)	Align holes.	
	c. Screws (6 and 7), and lock-washers	Install.	



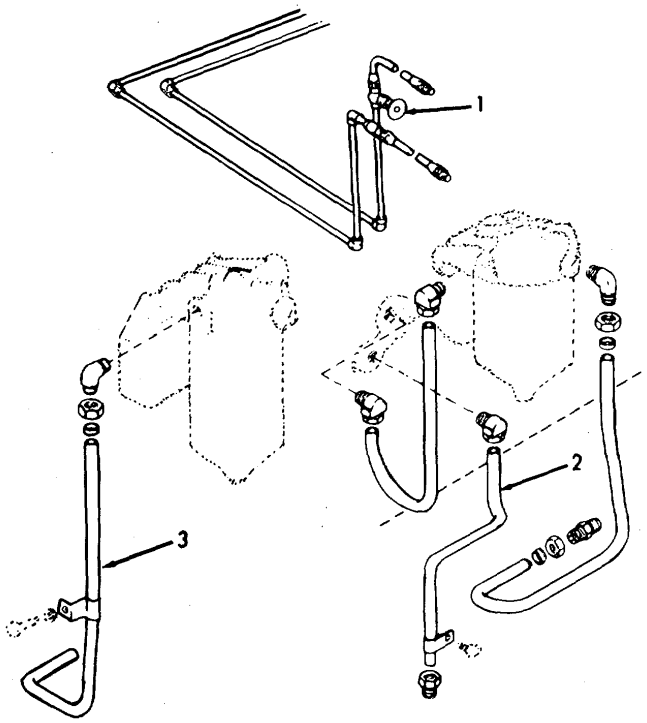
5-69. ENGINE ASSEMBLY - REMOVAL AND RUN-IN - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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
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
b. Inspection
c. Reassembly
d. Test

INITIAL SETUP

Test Equipment

NONE

Special Tools

Arbor press
Brass rods
Bearing installer

Material/Parts

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

Personnel Required

1

References

NONE

Equipment Condition: Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

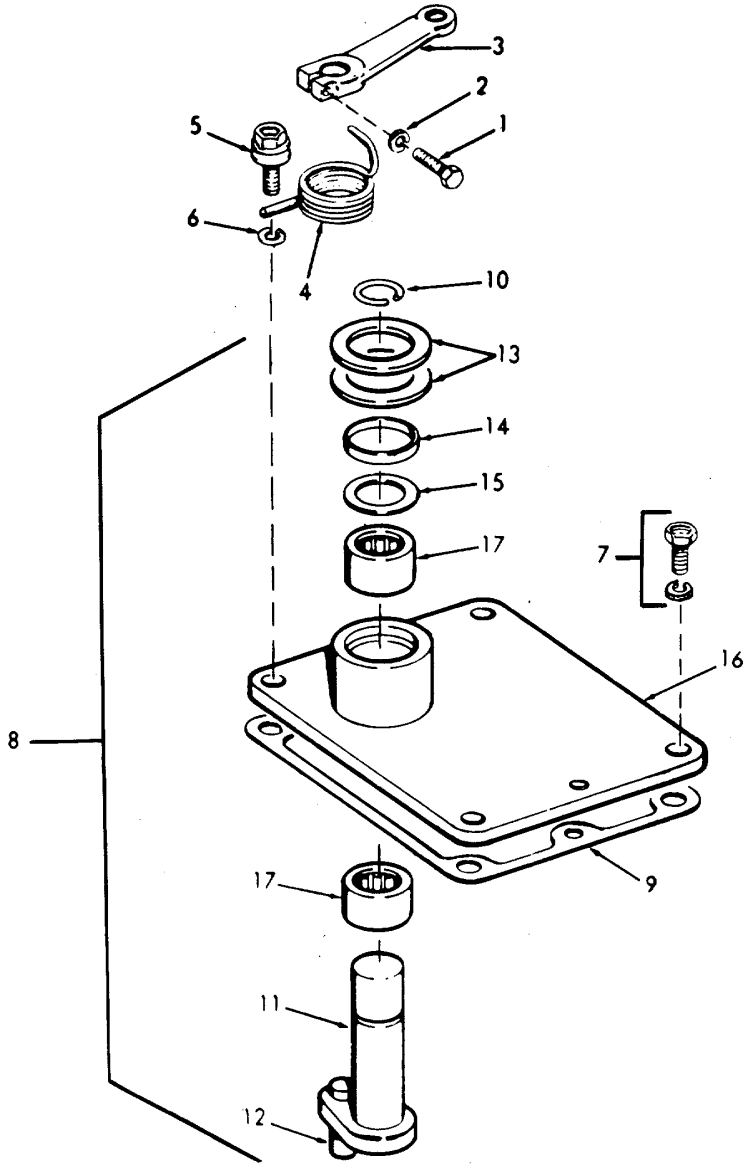
Observe WARNING in this procedure.

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

LOCATION	ITEM	ACTION	REMARKS
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).	

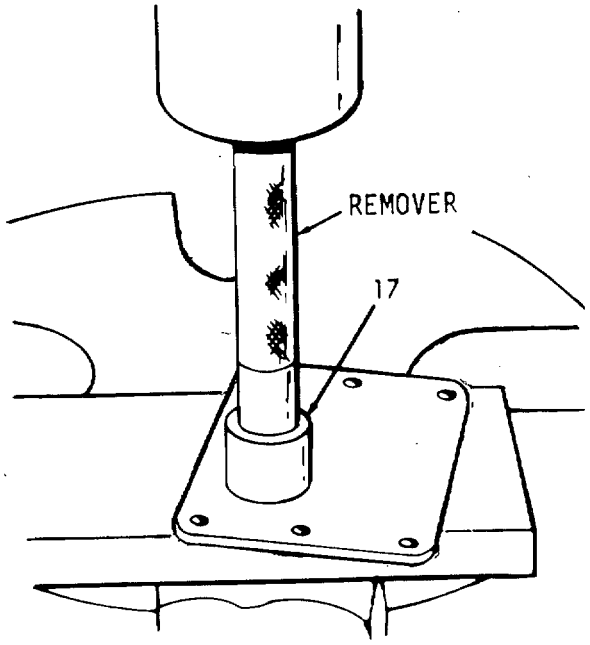
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
	1. Cover (16), including bearings (17)	Wash in clean fuel oil.	



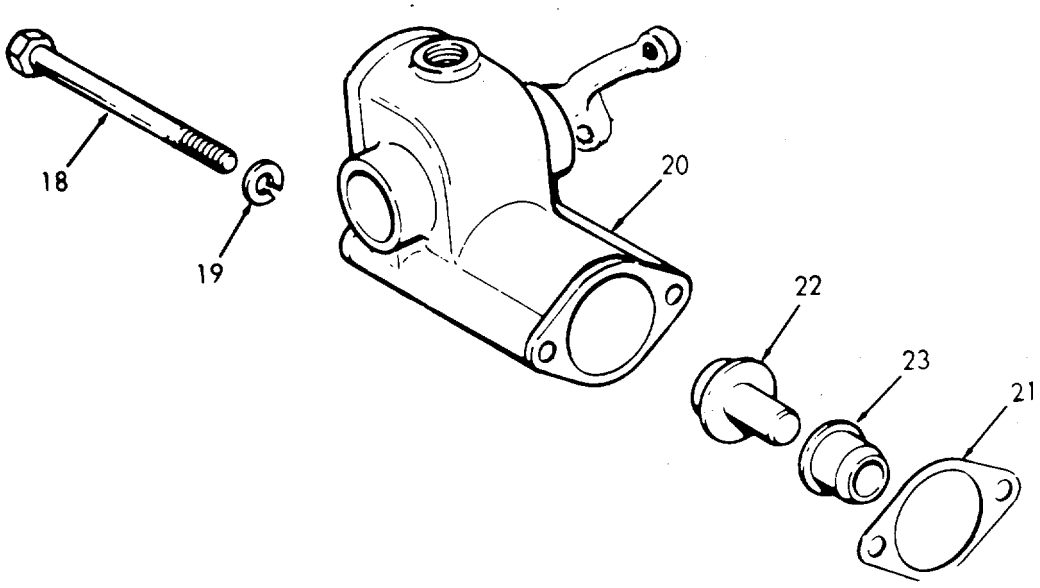
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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
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).	

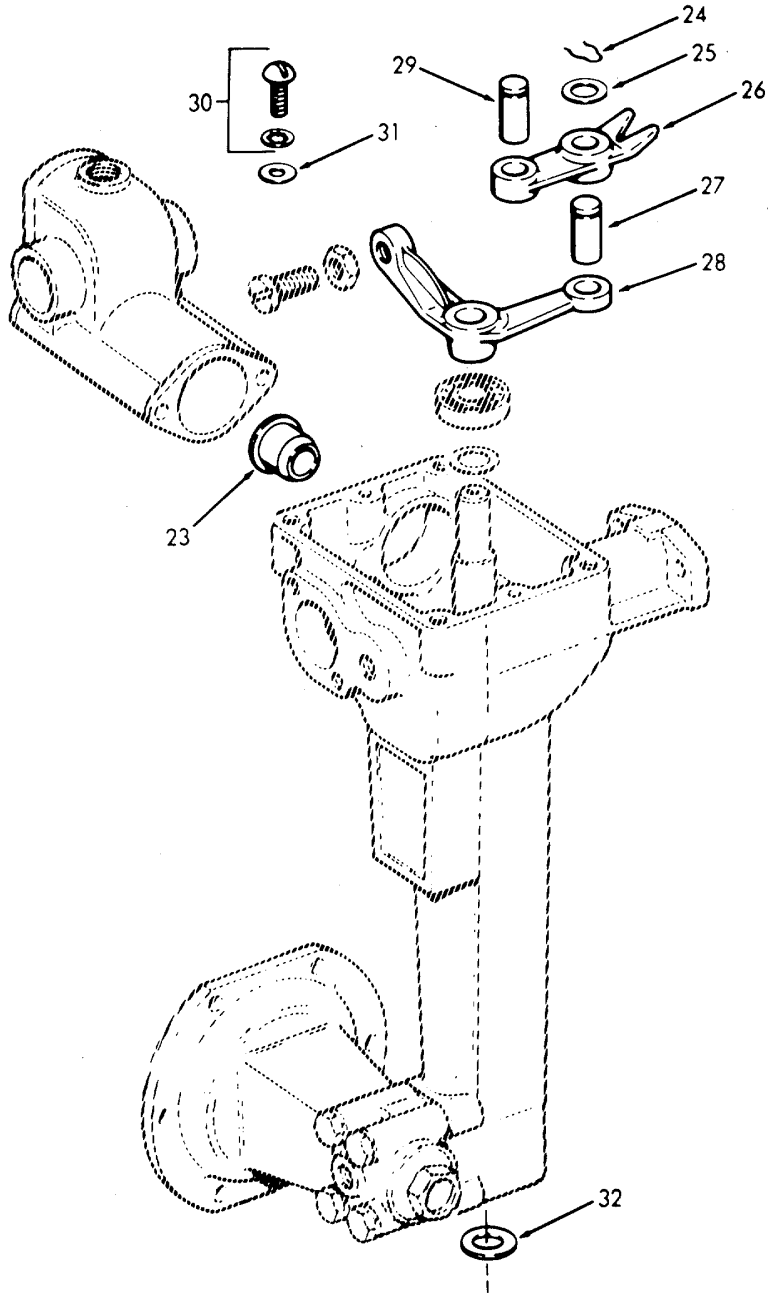


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.	

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

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			

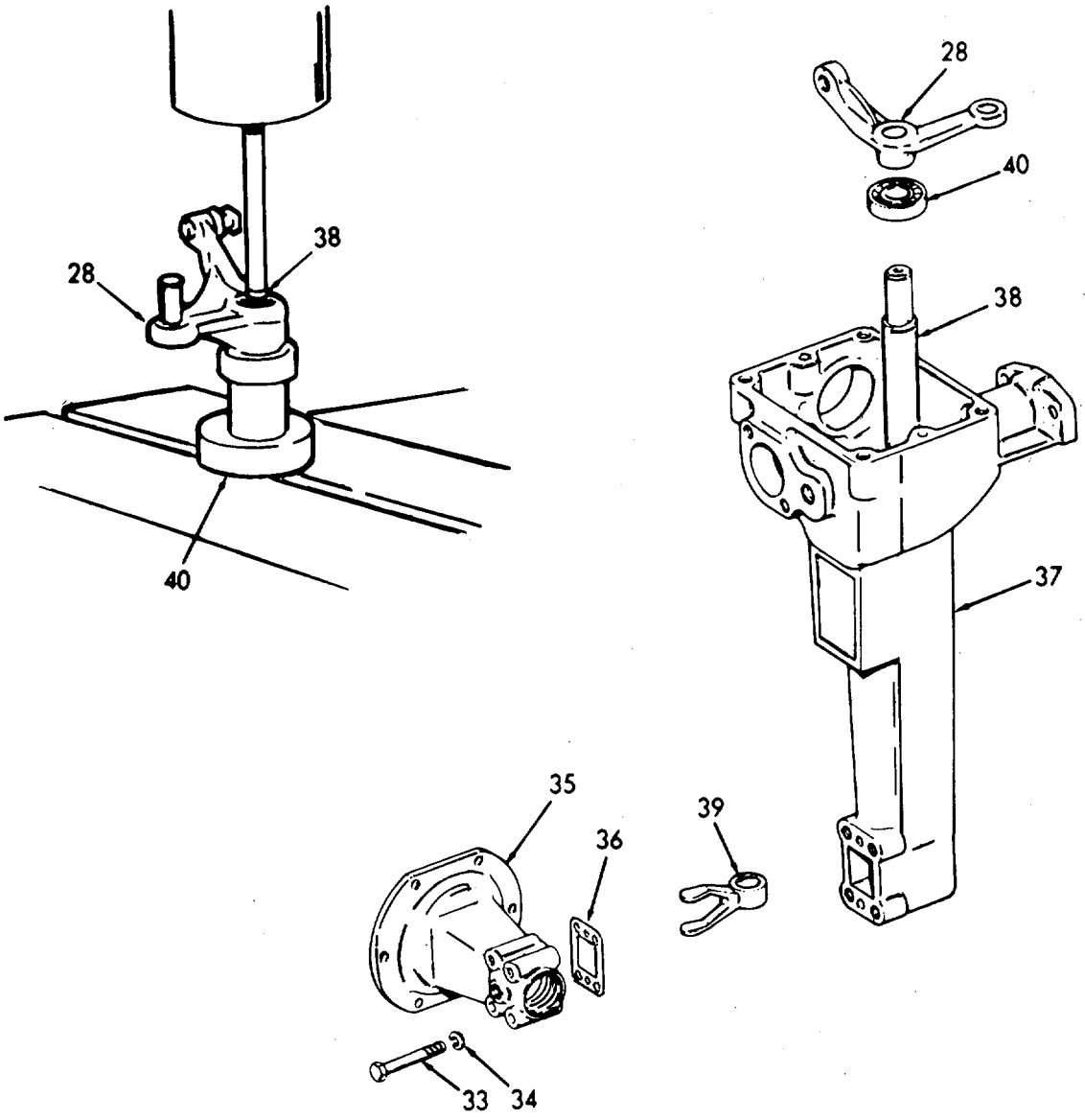


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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)	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)	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
DISASSEMBLY (Cont)			

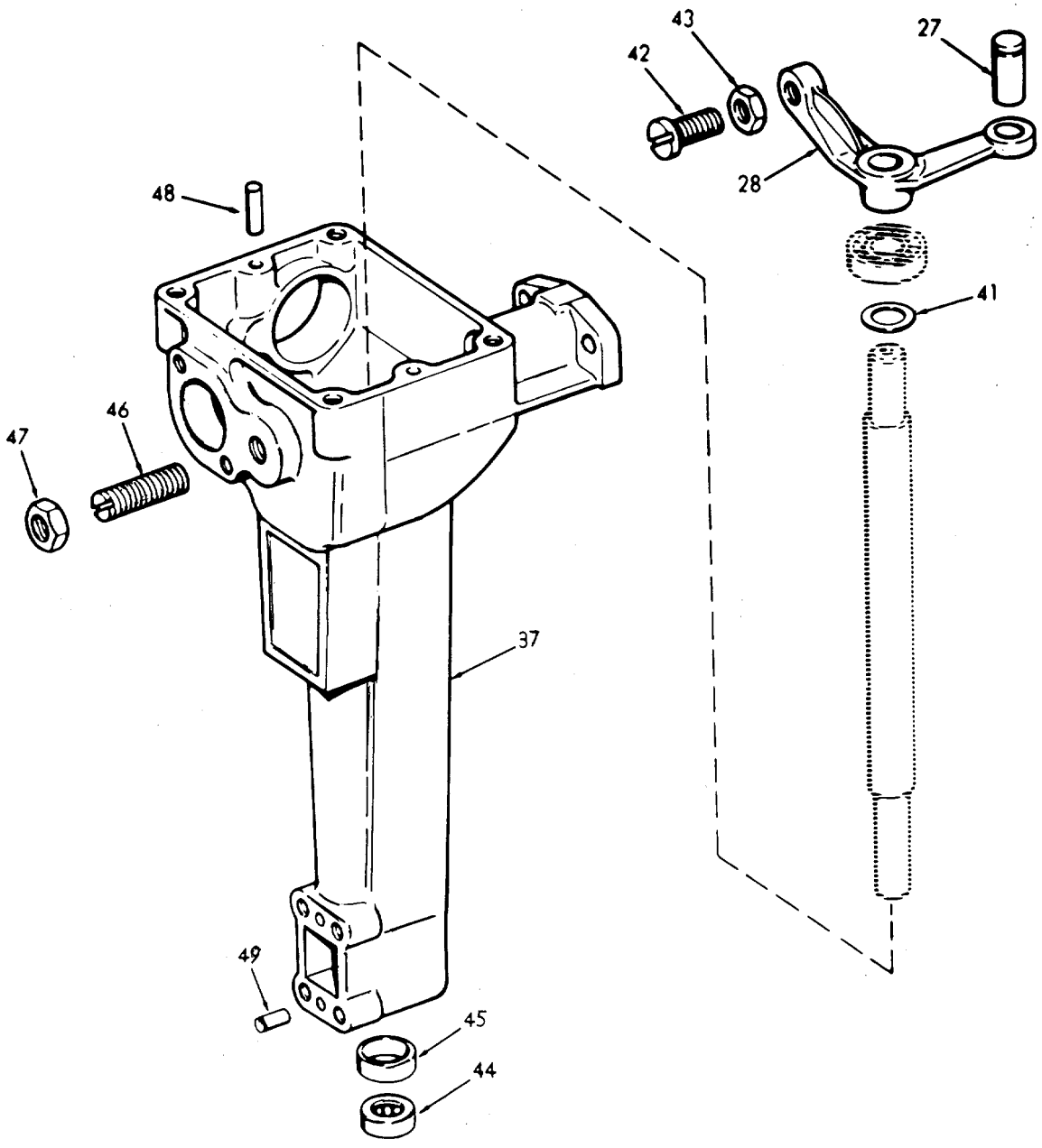


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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), and locknut (47)	Remove.	
	v. Dowel pins (48 and 49)	Remove.	If necessary.

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

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			

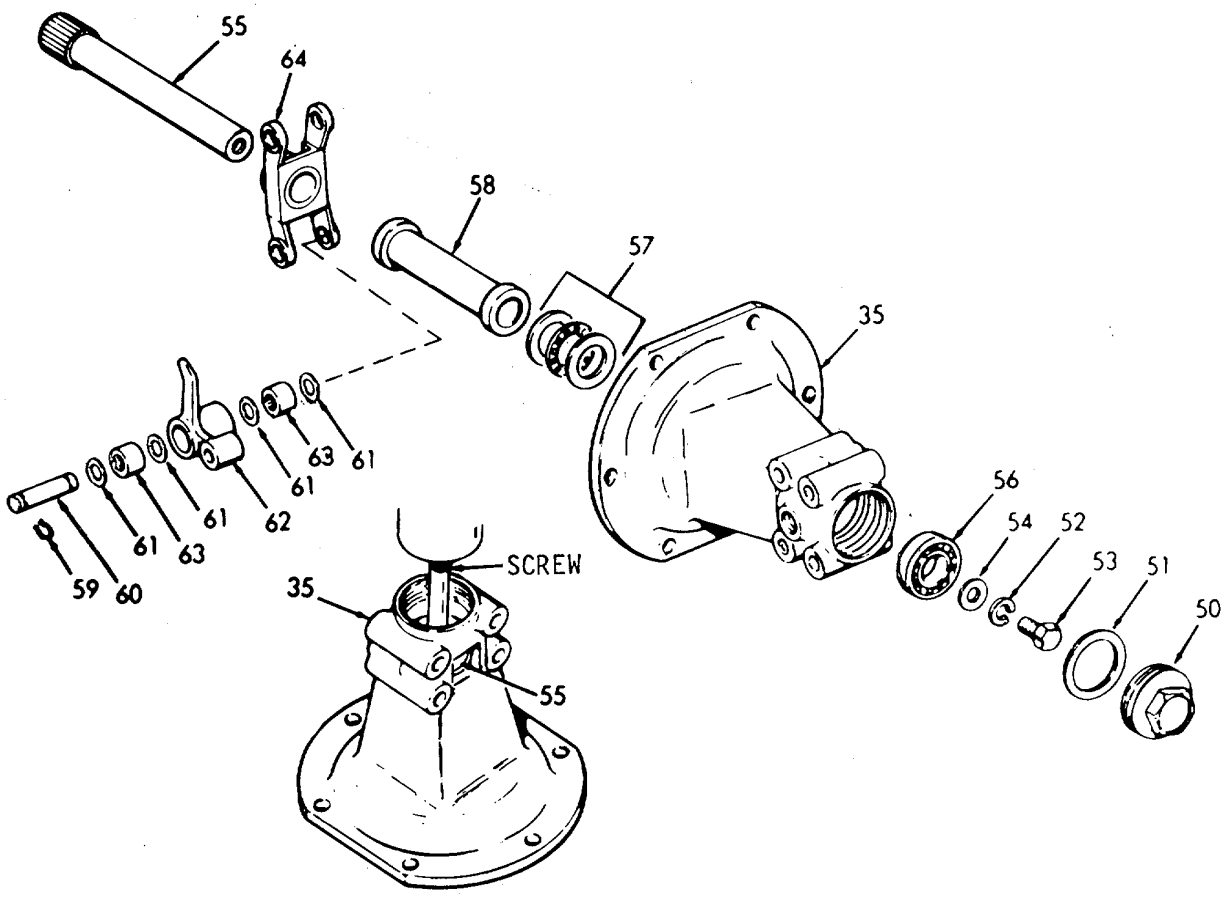


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

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. Lock-washer (52), and screw (53)	1. Bend tang 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 inches.
	f. Housing assembly (35) bearing (56).	Support housing on bed of a press, and press shaft (55) from	Remove screw from weight shaft.
	g. Riser thrust bearing (57), and governor riser (58)	Slide from shaft (55).	This bearing is specially designed to absorb thrust load. Looseness between mating parts does not indicate excessive wear.
	h. Bearing (56)	Remove from housing (35).	
	i. Lock-rings (59)	Remove one from each weight pin (60).	

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

LOCATION	ITEM	ACTION	REMARKS
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).	

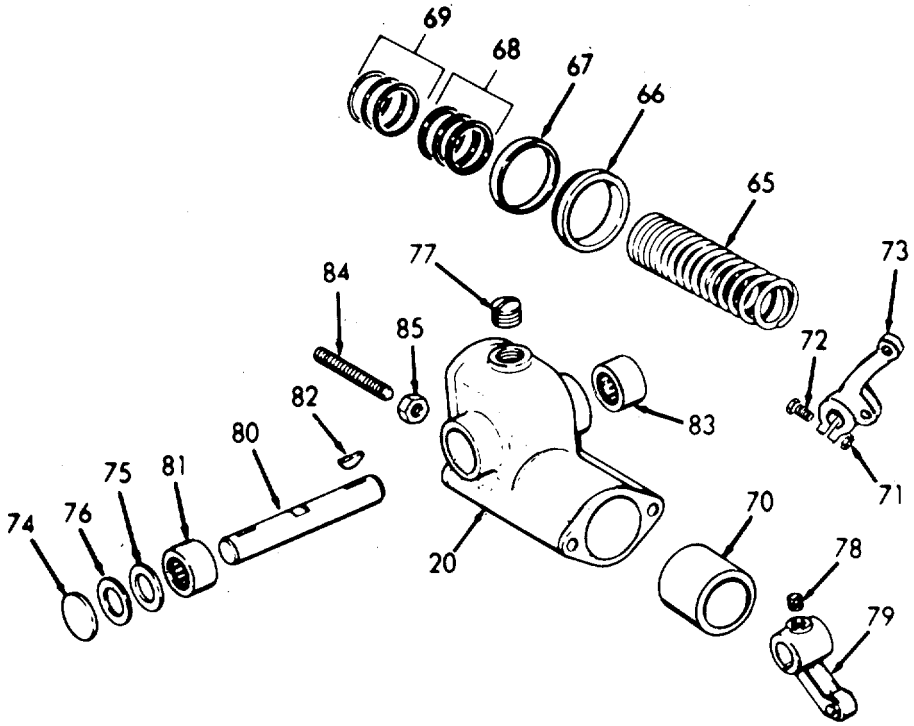


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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
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 lock-nut (85)	Remove.	



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

LOCATION	ITEM	ACTION	REMARKS
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.

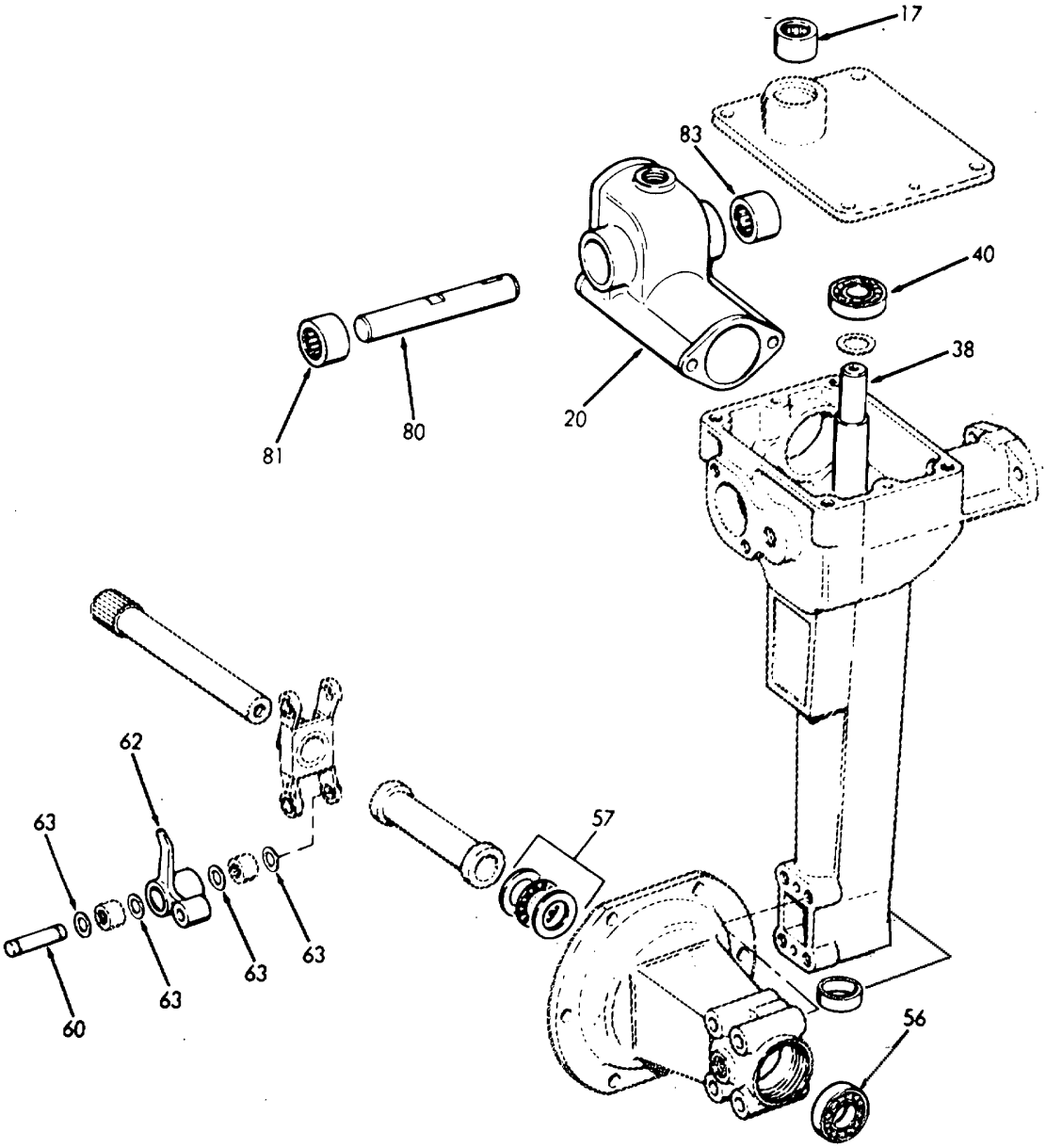
g. Inspect the spring lever shaft (80) and bearings 81 and 83) for excessive wear or flat spots at bearing surface. If one or both conditions exist, install a new shaft and bearing.

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).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
	j.	Check the finished surface of th, governor weights (62) for flat spots. If flat spots are noted, install new weights.	

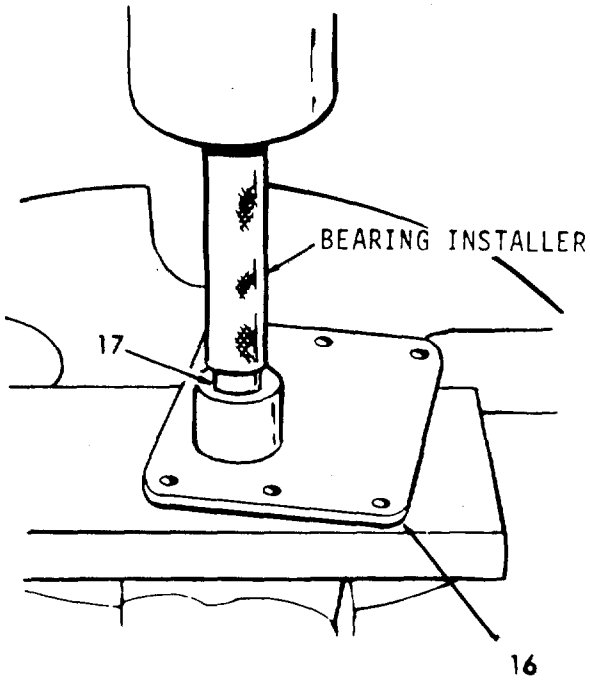


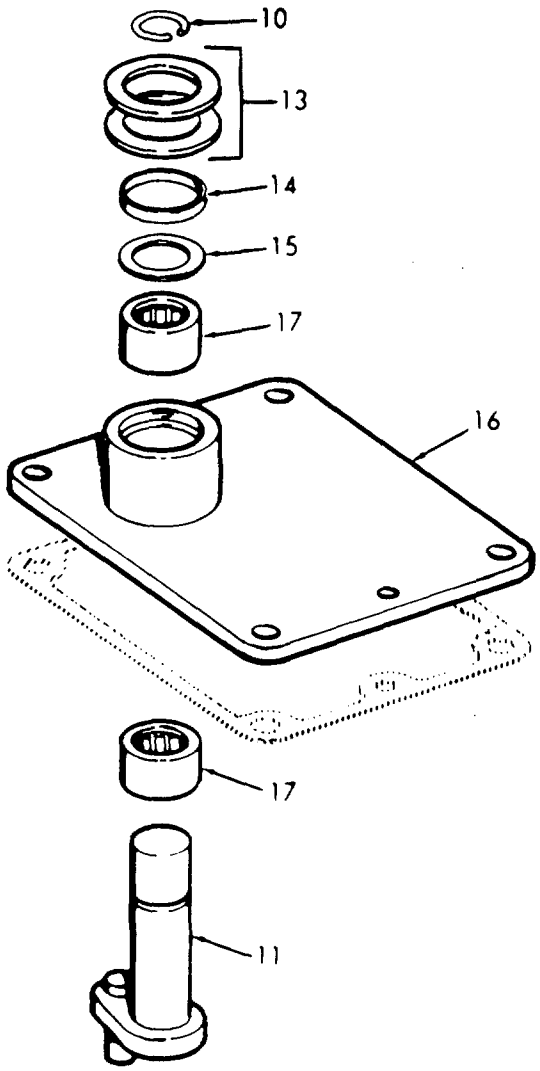
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 the bearing face up. 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 up). 5. Start bearing straight 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.	Use new bearings.
	c. Shaft (11) d. Washer (15), seal ring (14), and shaft retainer (13)	Insert through bearings. Install.	

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

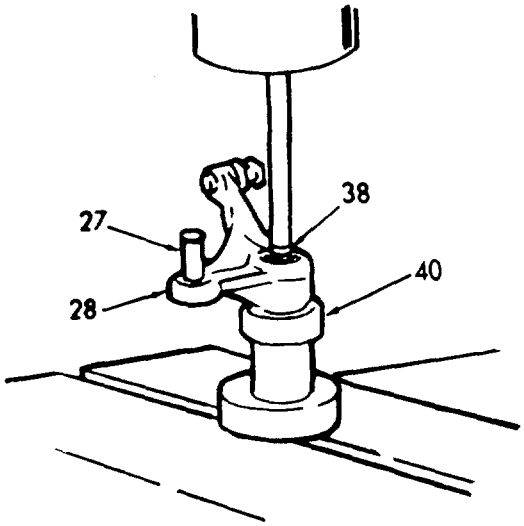
LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	e. Retaining ring (10)	Install.	





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

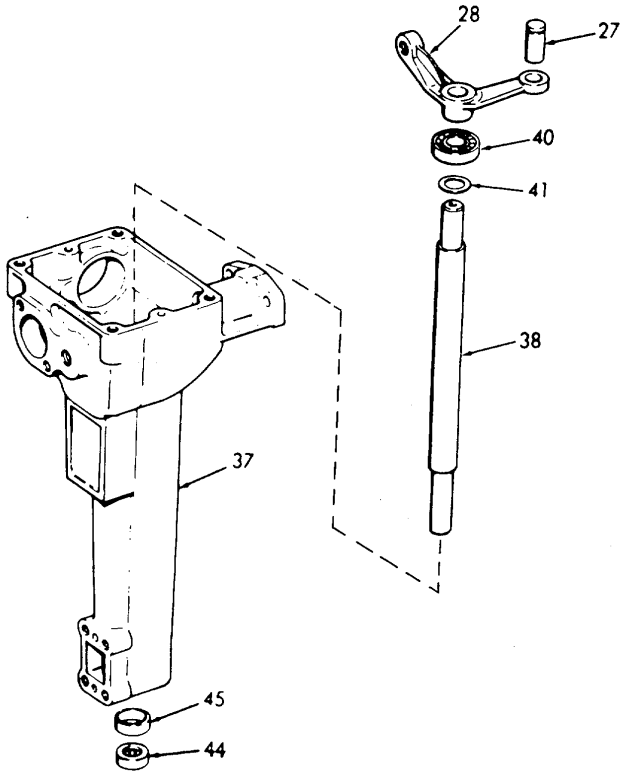
LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
7. Governor Control Housing	a. Washer (41)	Place over short finished end of the operating shaft (38).	
	b. Bearing (40)	1. Start over end of shaft (38). 2. Support end of shaft on bed of press. 3. Use a sleeve with same diameter as the bearing inner race. Press bearing tightly against the washer.	
	c. Operating lever (28)	1. Place pivot pin (27) into the UP position.	



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

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

LOCATION	ITEM	ACTION	REMARKS
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 (38) assembly	Insert into housing (37).	

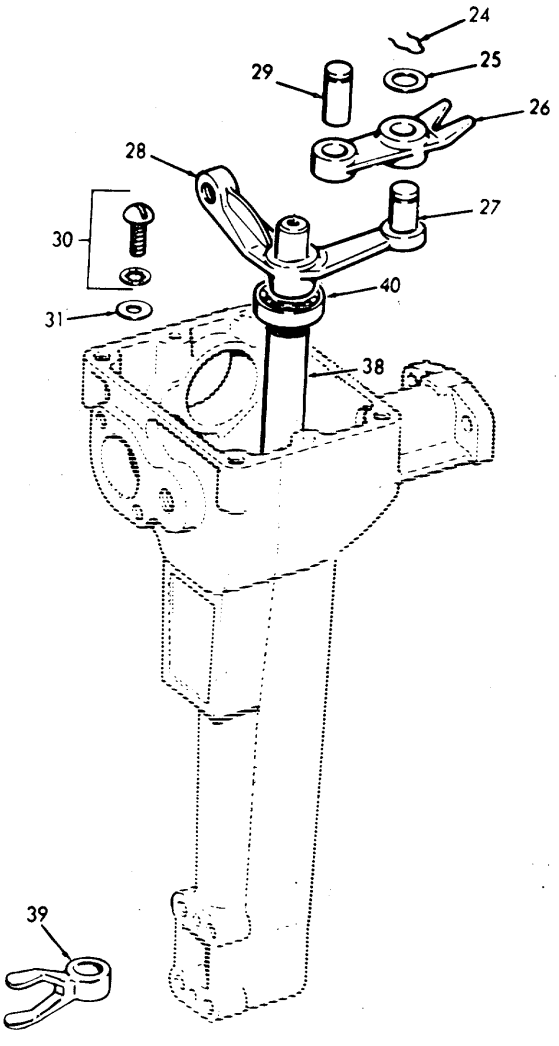


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	g. Operating fork (39)	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 shoulder on the shaft.	
	h. Differential lever (26)	1. Press in pin (29). 2. Place over pivot pin (27) on operating lever (28).	
	i. Washer (25), and spring retainer (24)	Install.	

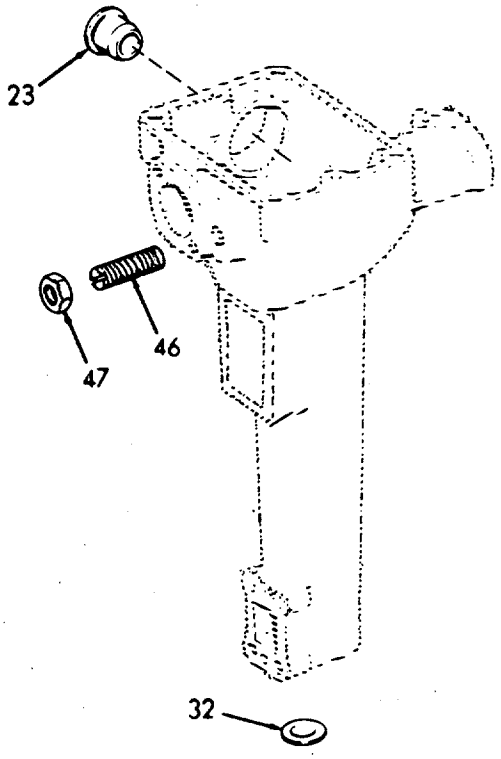
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	j. Screw assembly (30), and flat-washers (31)	Install to secure bearing (40).	



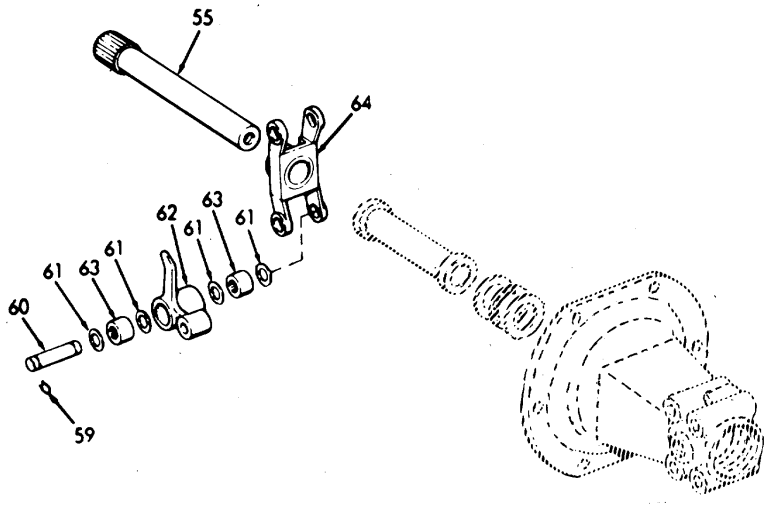
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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).

LOCATION	ITEM	ACTION	REMARKS
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. Lockring (59)	Install on weight pins (60).	
	d. Flat-washers (61)	Place over weight pin (60) and against lock-ring (59).	
	e. Weight pin (60)	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).

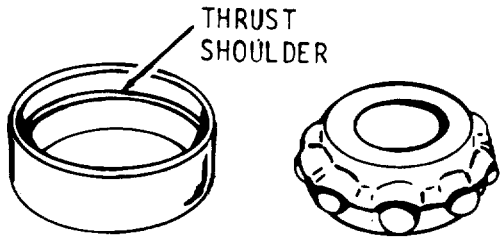
LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
		3. Position governor weight (62) between projecting arms of weight carrier (64), and push pin (60) through weight (62).	
		4. Place third washer (61) over pin (60) and against weight (62), and push pin (60) completely thru weight carrier.	
		5. Place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

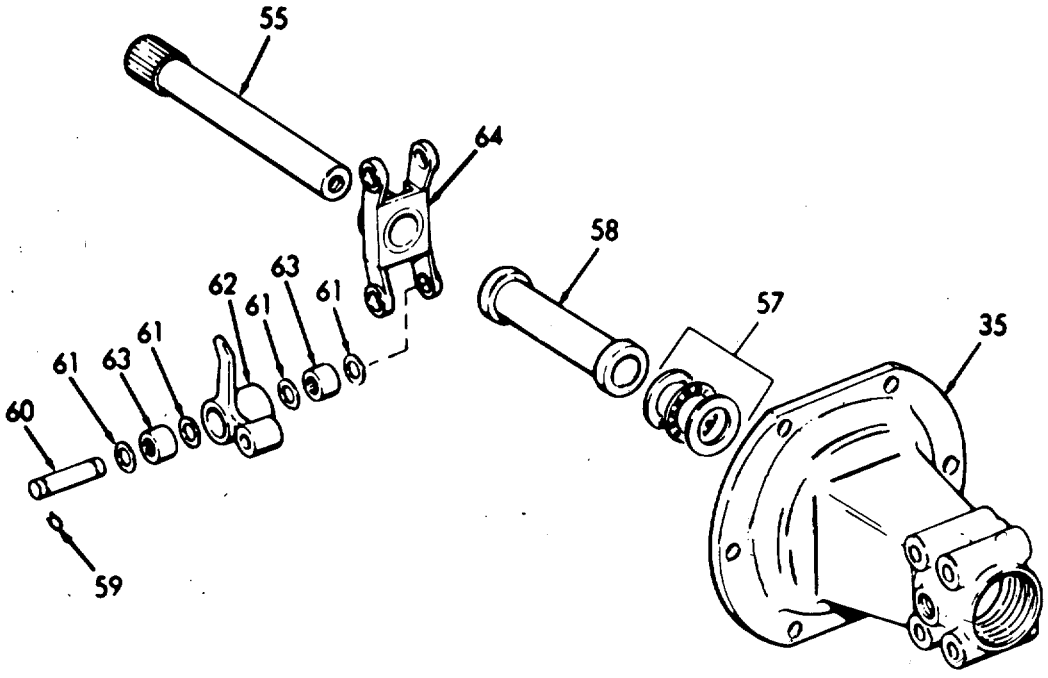
CAUTION

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).

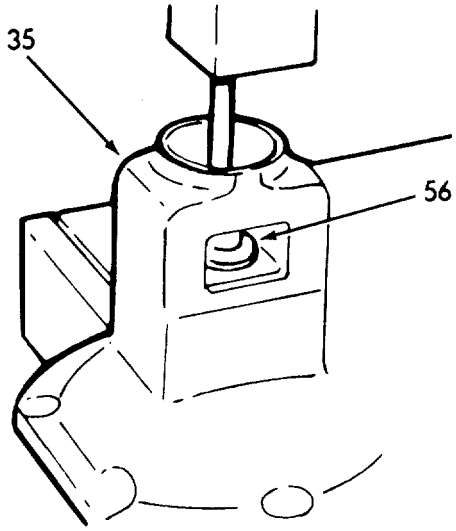
LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	g. Riser thrust bearing (57)	Place on weight shaft (55), with the bearing having the smaller inside diameter against the thrust riser.	Incorrect installation of the bearing will result in erratic operation of the governor.
	h. Weight carrier and shaft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





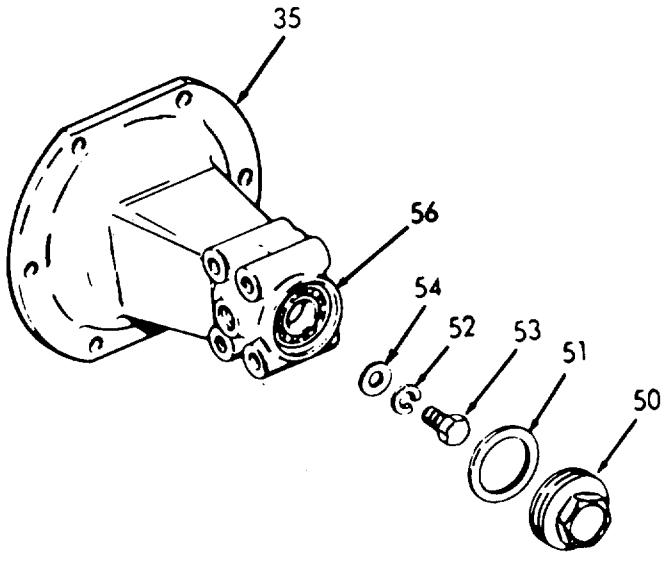
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	i. Housing assembled (35)	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.	



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

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	j. Screw (53), lock-washer (52) and washer (54)	1. Install. 2. Bend tang of washer against head of bolt.	
	k. Gasket (51)	Place in housing and against bearing.	
	l. Housing cap (50)	1. Apply sealant to full circumference of cap. 2. Install. 3. Tighten to 30-60 lb. ft. (40.7-81.3 Nm).	Use Locktite HV or equivalent. Torque to flat or point of head on a horizontal line.

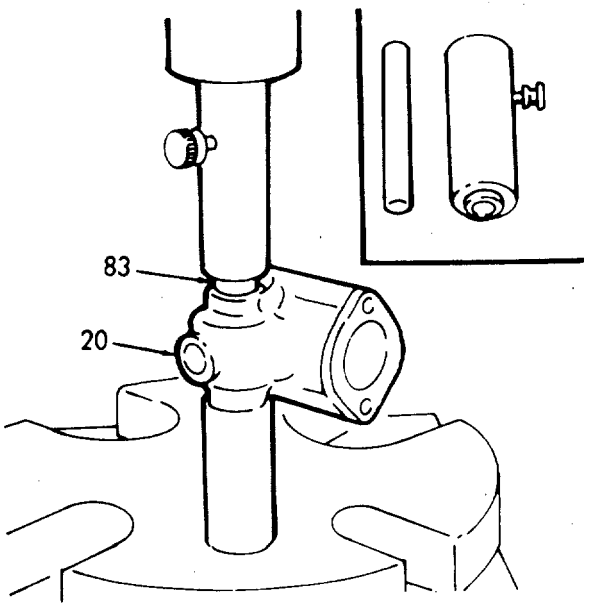


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
9. Variable Speed Spring Housing	a. Bearing (83), and housing (20)	1. Lubricate with grease.	Use Shell 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 bearing. 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.	

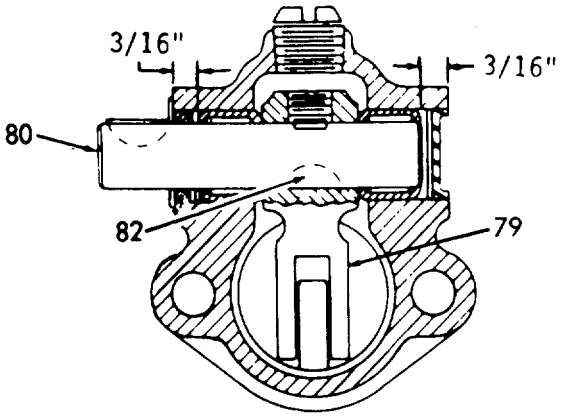
NOTE

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



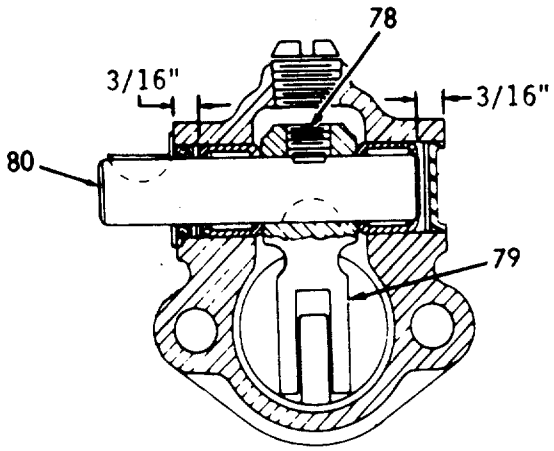
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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)	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.	



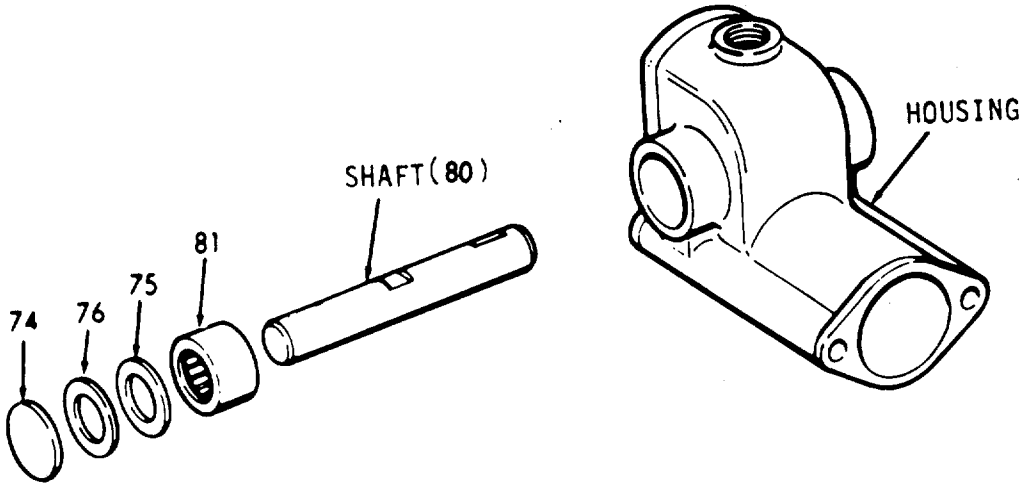
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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)	1. Lubricate with grease.	Use Shell Alvania #2 grease or equivalent.
		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.	



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

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	g. Preformed packing (76), and retaining washer (75)	Install.	
	h. Expansion plug (74)	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.	

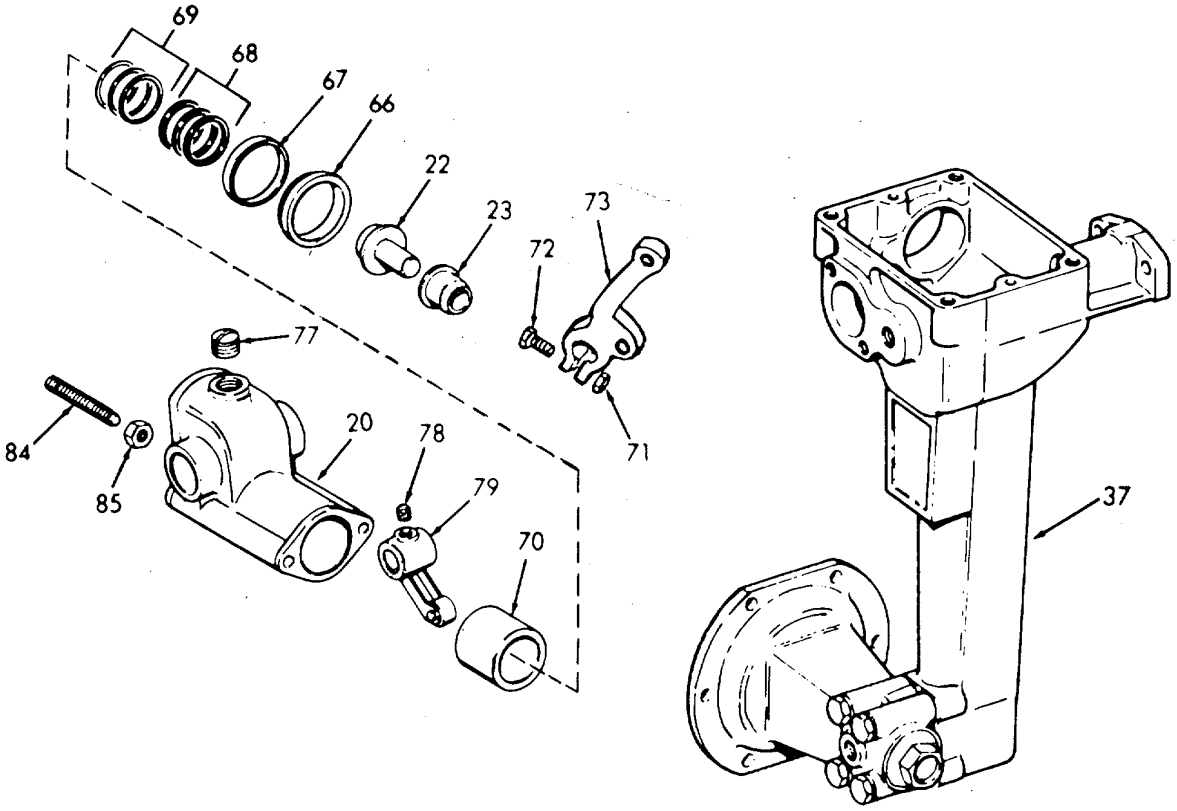


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	i. Setscrew (78)	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)	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).

LOCATION	ITEM	ACTION	REMARKS
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.

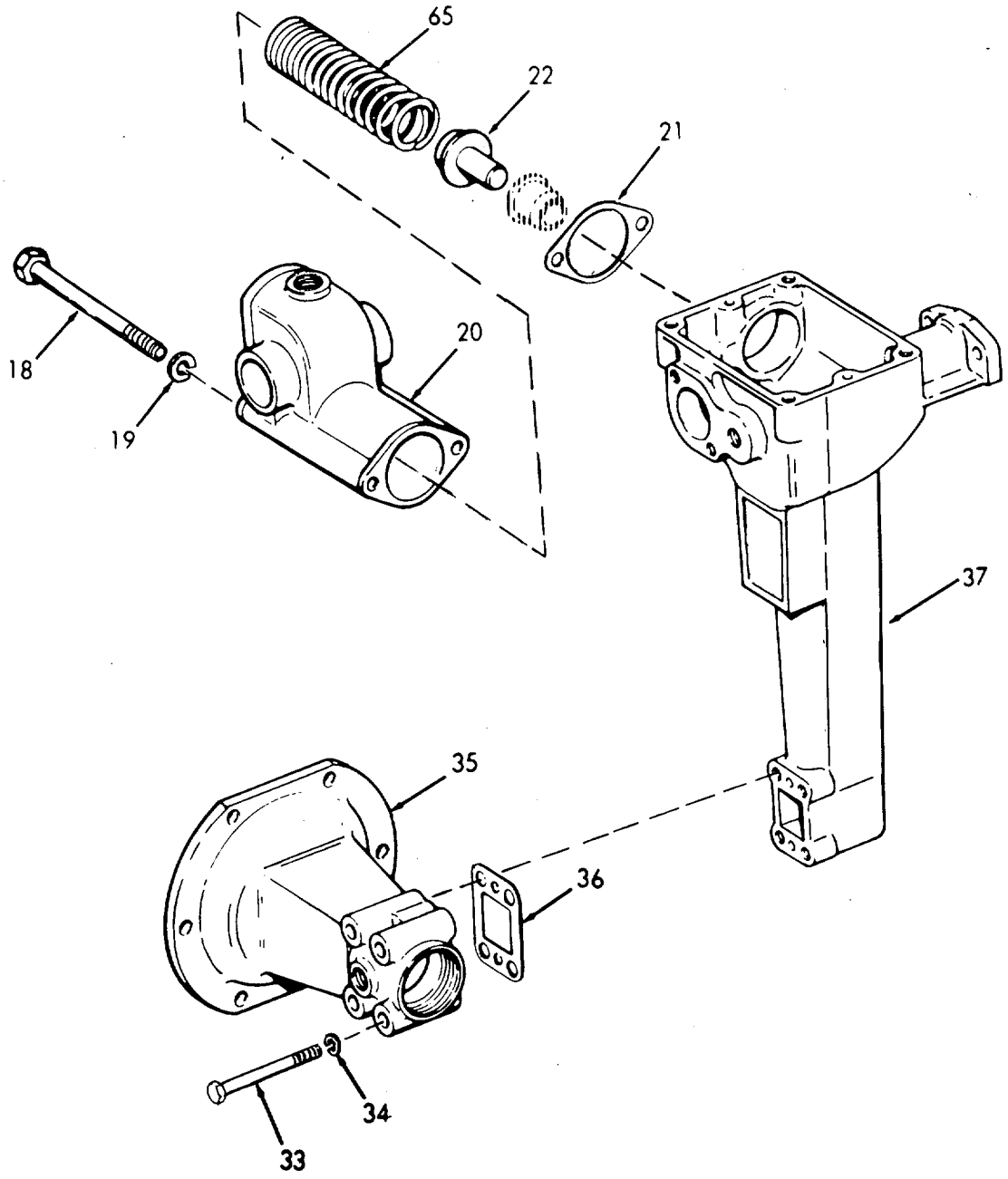


5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.	

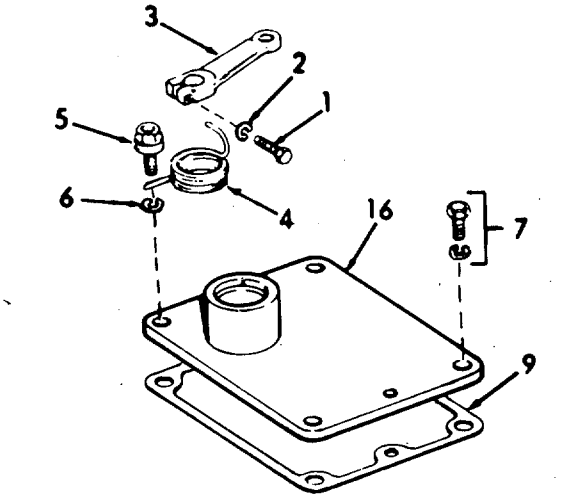
5-70. GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			



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

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
10. Governor Control Housing	a. Cover (16), and gasket (9)	Install.	Use new gasket.
	b. Screw assemblies (7)	Install.	
	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 Maintenance

Special Tools

Arbor press
Slide hammer
Tool set J6270-1
Vise (soft-jaws)

Material/Parts

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

Personnel Required

1

References

Paragraph	
3-144	Blower Organizational

Equipment

Condition	Condition Description
	NONE

Special Environmental Conditions

NONE

General Safety Instructions

WARNING

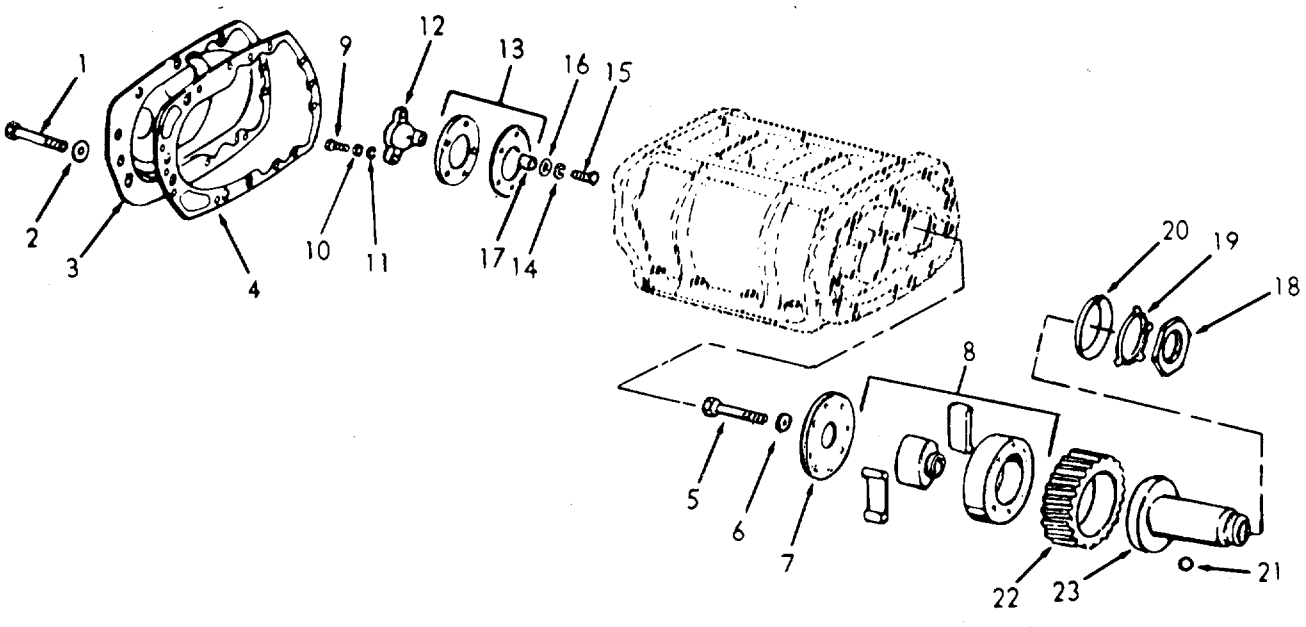
Wear eye protection when using compressed air.

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

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - DISASSEMBLY			
1. Rear Blower Cover and Drive Coupling (2)	a. Machine bolts (1), and lock-washers	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
OVERHAUL - DISASSEMBLY (Cont)			
	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.	Gear is left-hand helix.

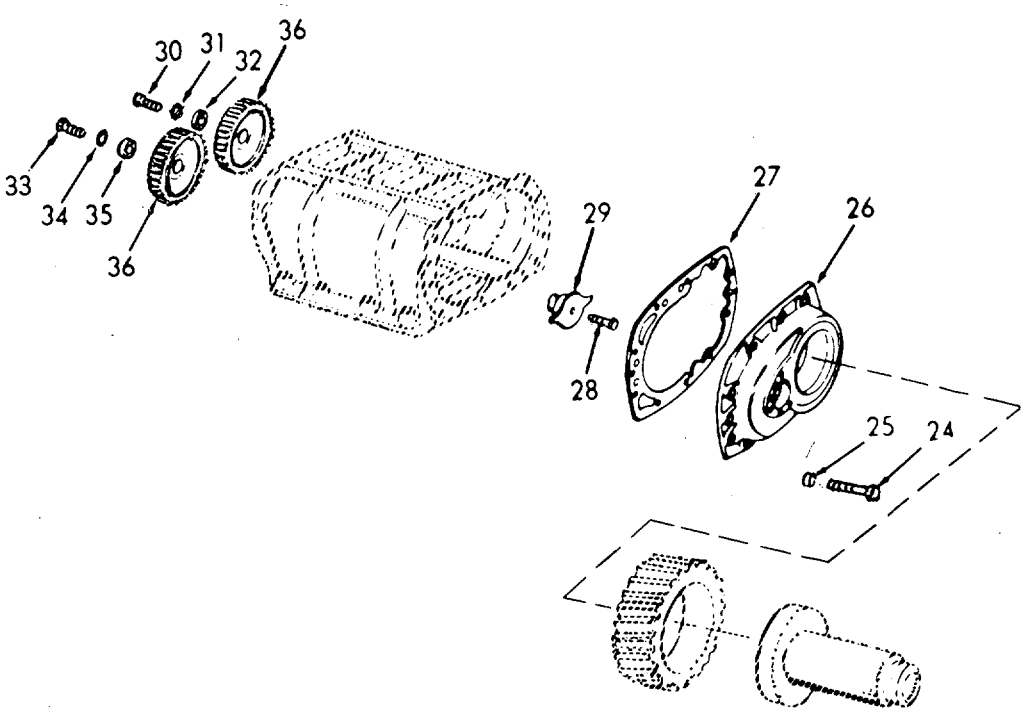


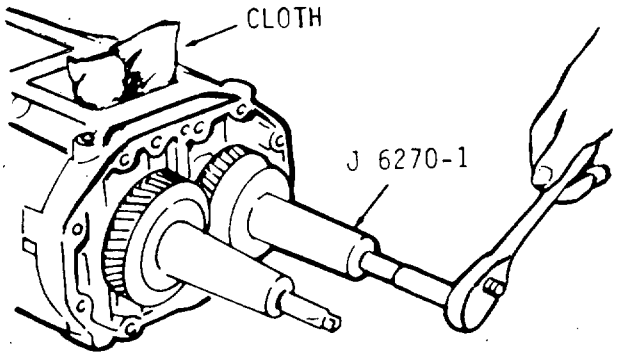
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - DISASSEMBLY (Cont)			
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)	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)	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).

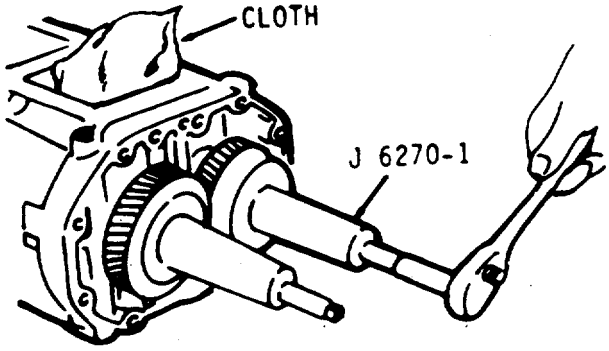
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - DISASSEMBLY (Cont)			
	c. Timing gears (36)	1. Remove both gears at the same time.	Use two pullers J6270-1.





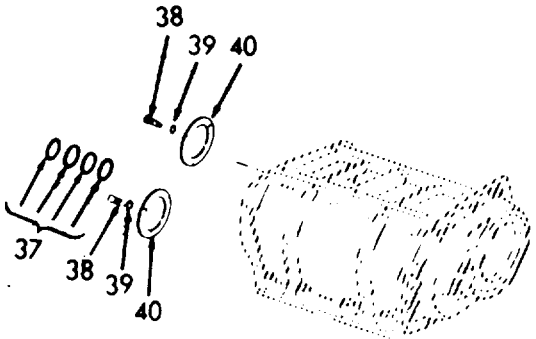
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

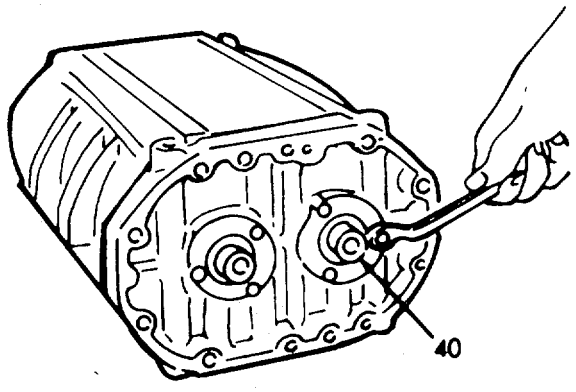
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - DISASSEMBLY (Cont)			
		2. Back out the center screws of both pullers and place the flanges against the gear faces, aligning the flange holes with the tapped holes in the gears. Secure the pullers to the gears with 5/16"-24xl-1/2" bolts (two bolts on the L.H. helix 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).

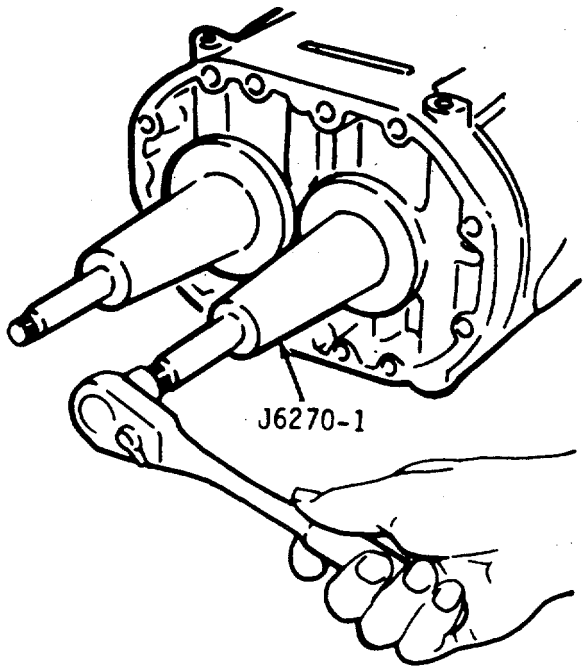
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - DISASSEMBLY (Cont)			
	d. Shims (37)	1. Note the number and thickness of shims on each rotor shaft.	This will ensure identical replacement when reassembling the blower.
		2. Remove.	
	e. Screws (38), and lock-washers (39)	Remove six places.	
	f. Bearing retainers (40)	Remove two places.	





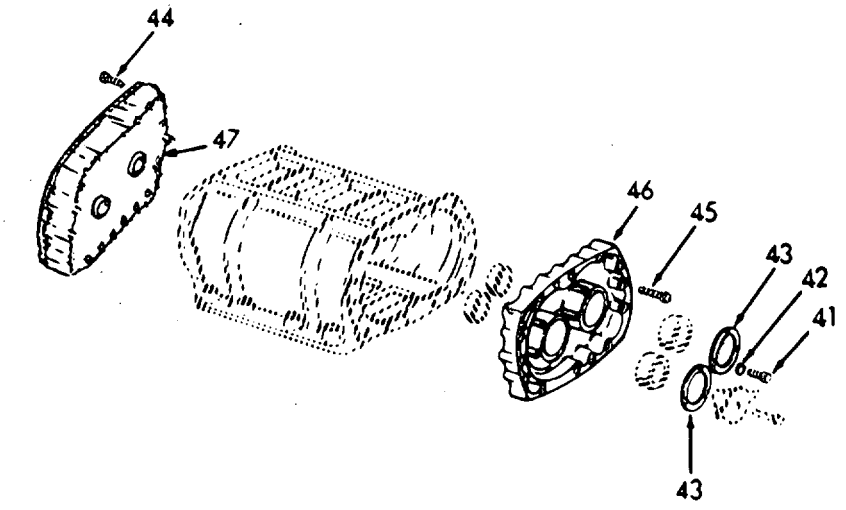
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

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 plate.	Use two pullers J6270-1.



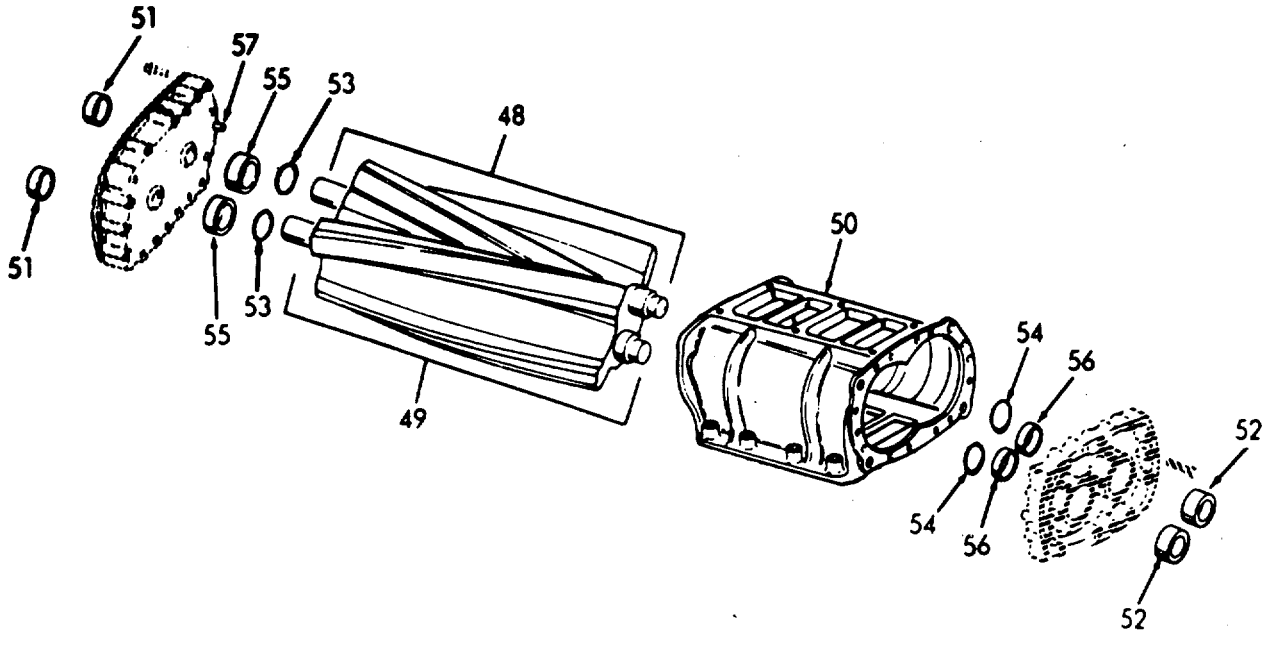
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - DISASSEMBLY (Cont)			
		2. 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.	
		3. Turn the two puller screws uniformly clockwise and withdraw end plate and bearings from blower housing and rotors as shown.	
l.	Front end plate (47)	Remove.	Refer to step k above.



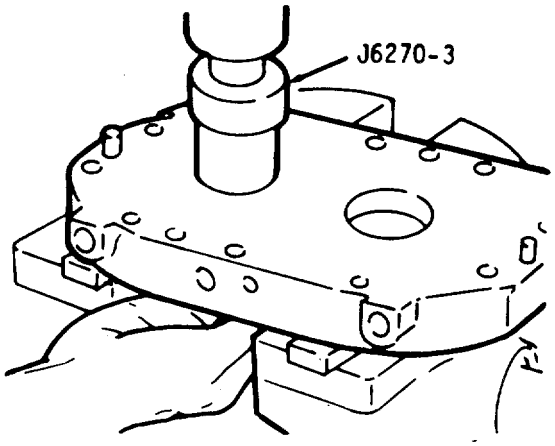
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.	1. Discard seals and spacers.
		2. Support the outer face of the end plate on wood blocks on the bed of the arbor press.	2. If necessary, the seals may be removed from the end plates at the same time as the individual bearings are removed.

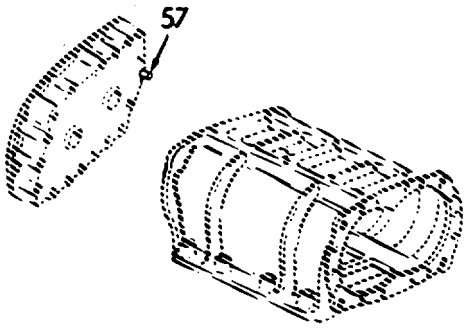


5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 (57)	Remove	If necessary



5-989

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

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL - INSPECTION

5. Blower

WARNING

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
OVERHAUL - 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.

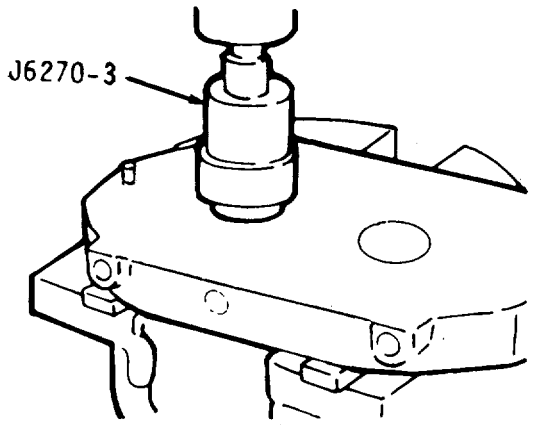
m. Clean oil strainer in the vertical oil passage at the bottom of each blower end plate, and blow out all oil passages with compressed air.

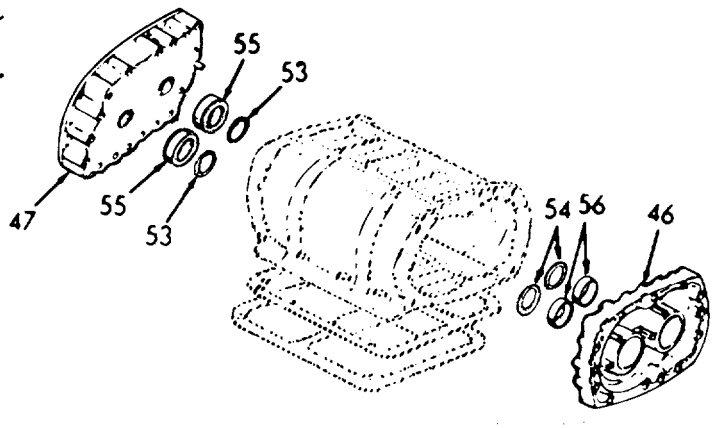
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - ASSEMBLY			
6. Blower	a. Several precautions are given below to assure the proper assembly of the rotors and gears for correct blower timing. 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.		
	b. Blower end plates (46 and 47), spacer sleeves (55 and 56), and oil seals (53 and 54)	1. Support the blower end plate, finished surface facing up, on wood blocks on the bed of an arbor press.	Use new oil seals and spacer sleeves.

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

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - ASSEMBLY (Cont)			
		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.	Use tool J6270-3.



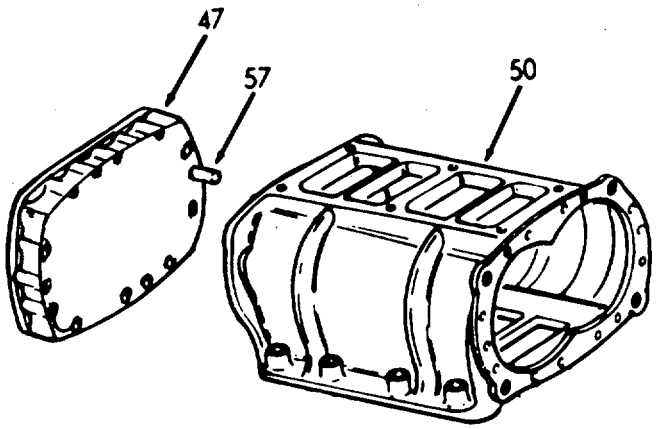


5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - ASSEMBLY (Cont)			
		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.	
		4. Install remaining oil seals in end plates in the same manner	
c.	Blower front end plate (47)	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 the 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 end plate to blower housing.	

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

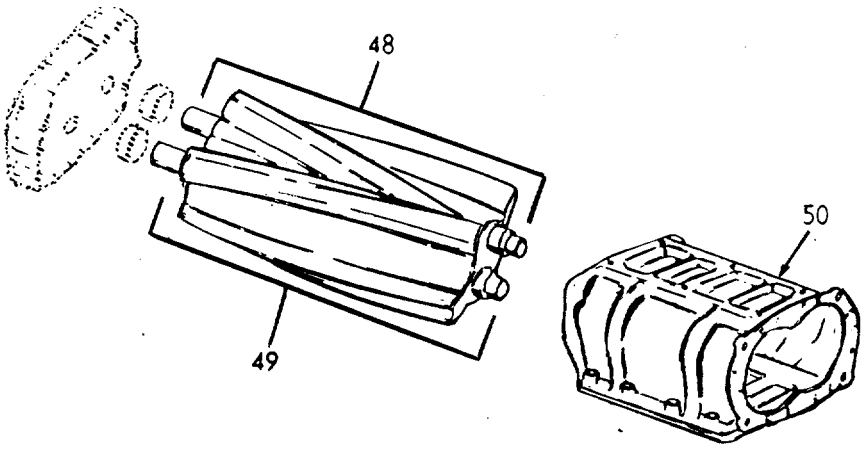
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - ASSEMBLY (Cont)			
	d. Dowel pins (57)	Check the dowel pins. The dowel pins must project .380" from the flat inner face of the front end plate to assure proper alignment of the end plate with the housing.	
	e. Blower housing (50), and end front plate (47)	1. Place 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.	



5-995

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

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - ASSEMBLY (Cont)			
		NOTE Gaskets are not used between the end plates and the housing; therefore, the mating surfaces must be perfectly flat and smooth.	
		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.	
f.	Blower housing (50), and rotors (48 and 49)	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.	

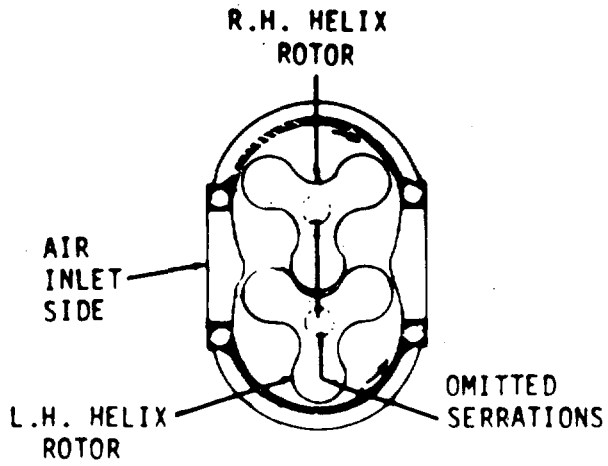


5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

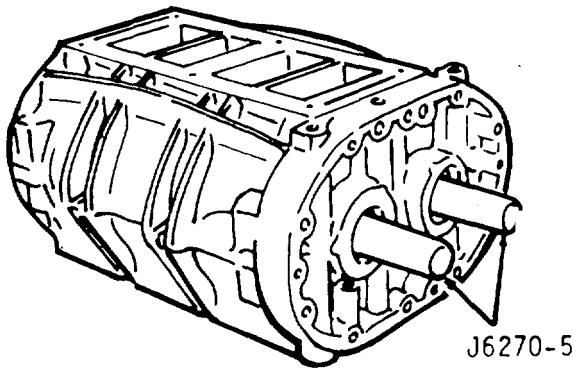
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - ASSEMBLY (Cont)			

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.



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

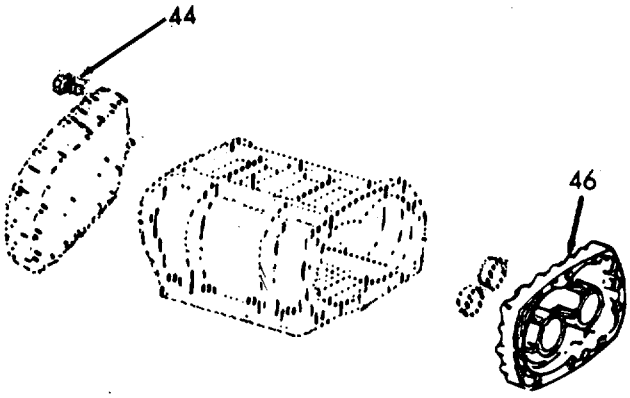


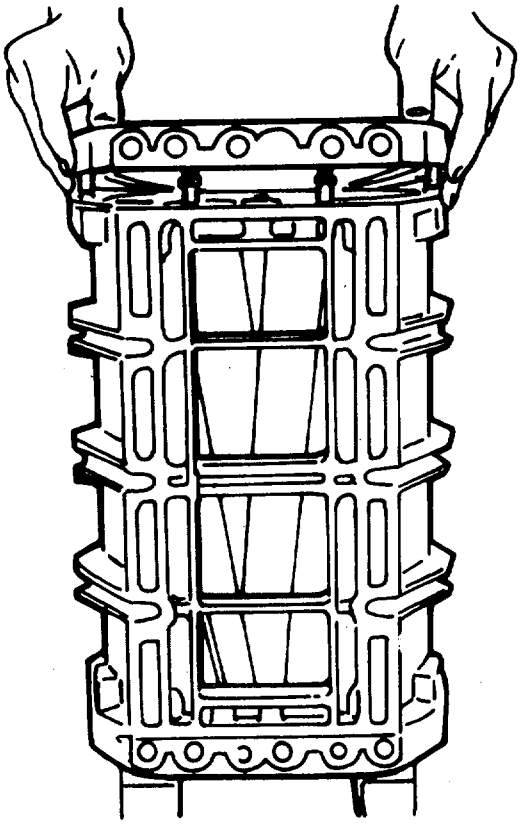
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - ASSEMBLY (Cont)			
		4. Insert rotors straight into the housing and thru the front blower end plate.	
		5. Remove the oil seal pilots from the rotor shafts.	
	g. Blower rear end plate (46)	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, push or tap the end plate against the housing.	

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

LOCATION	ITEM	ACTION	REMARKS
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.	



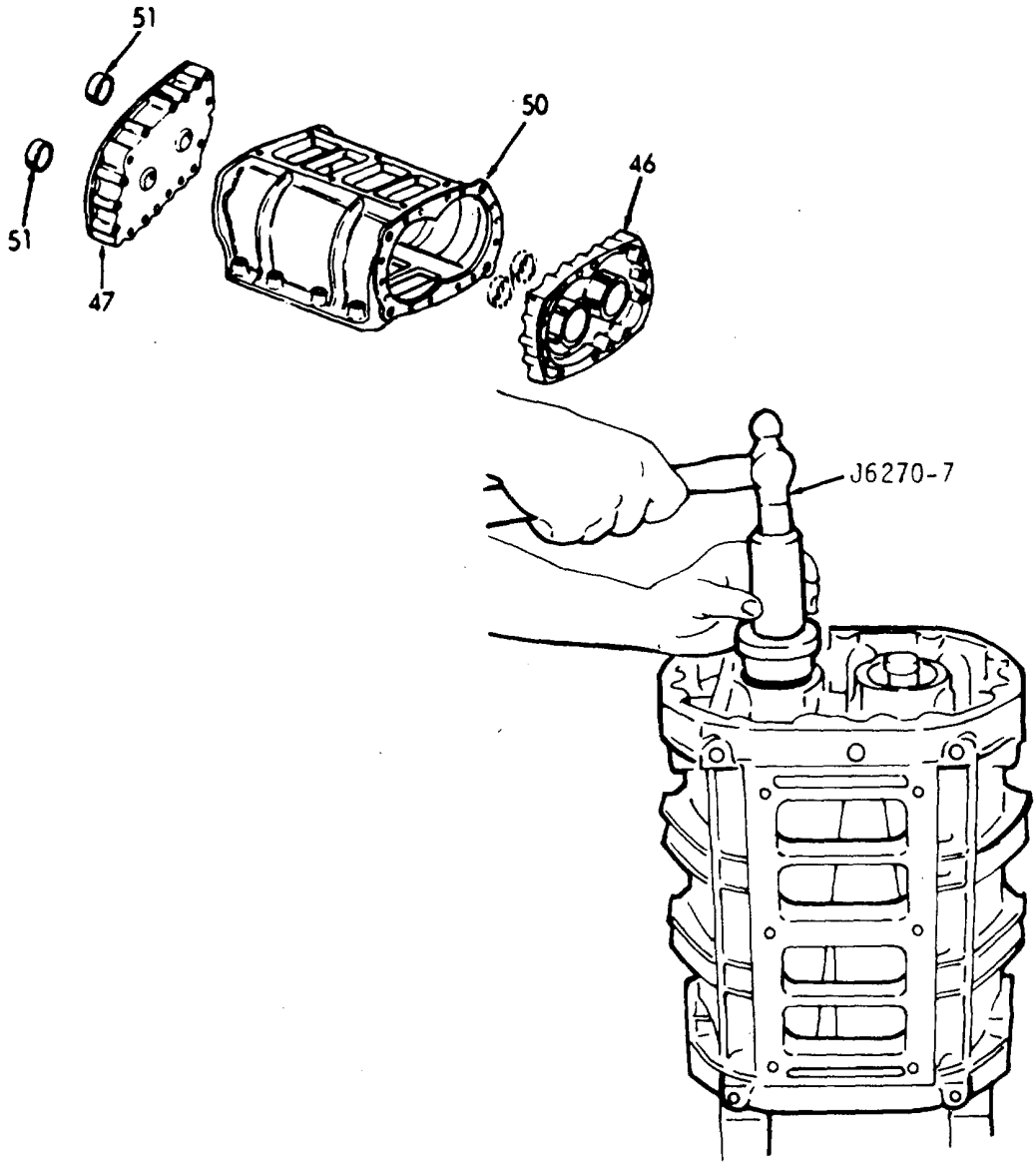


5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - ASSEMBLY (Cont)			
	h. Blower housing (50), and end plates (46 and 47)	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.	
	i. Bearings (51)	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 bearing and tap the bearing straight on the shaft and into rear end plate as shown.	Use tool J6270-7.

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

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)		4. Install the second ball bearing on the remaining rotor shaft in the same manner.	

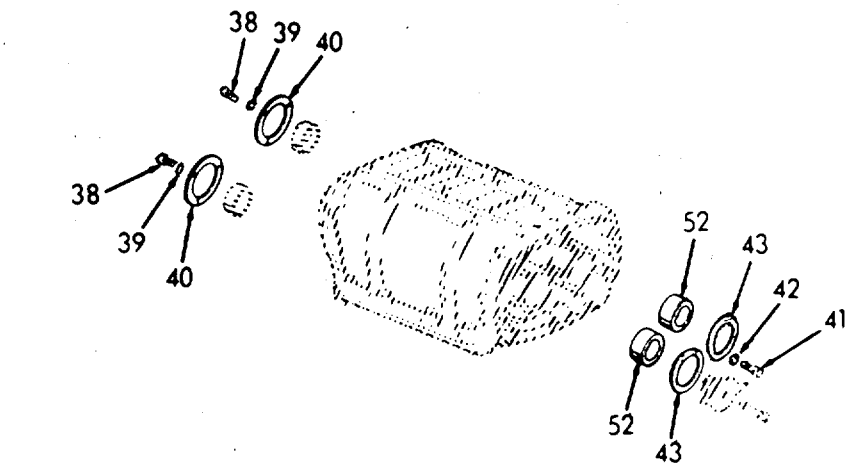


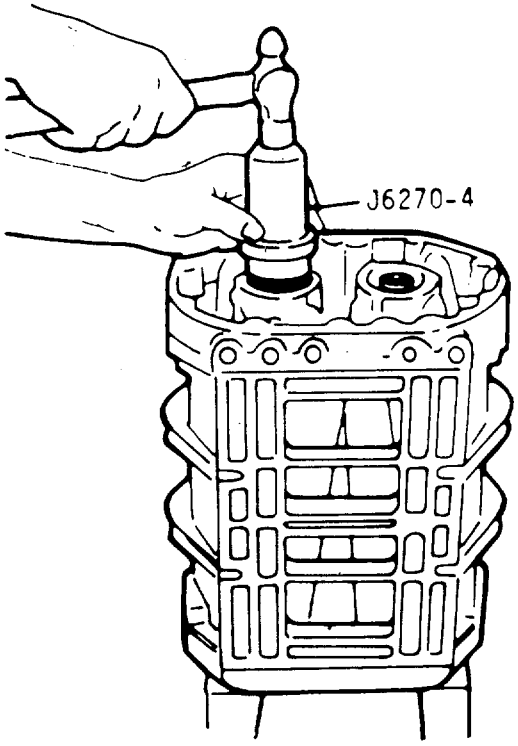
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			
	j. Bearing retainers (40), screws (38), and lock-washers (39)	1. Install. 2. Tighten screws to 7-9 lb-ft (9.5-12.2 Nm) torque.	
	k. Bearings (52)	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)	1. Install. 2. Tighten screws to 7-9 lb-ft (9.5-12.2 Nm) torque.	

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

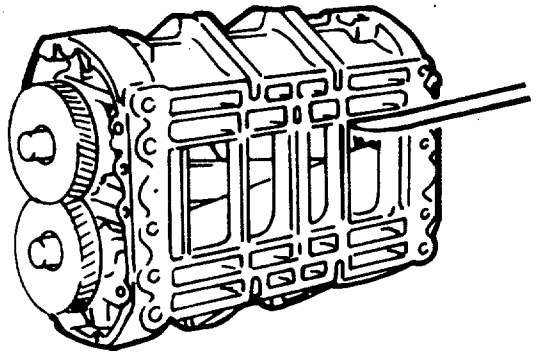
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			

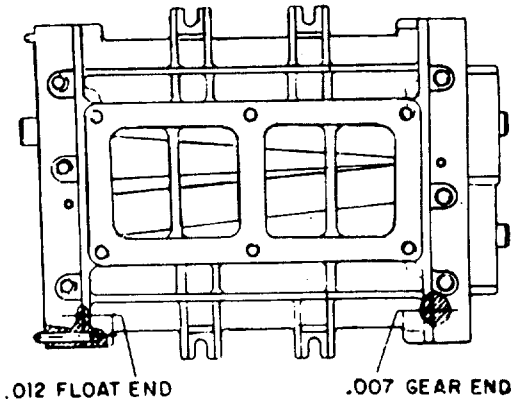




5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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) the rotor shaft and timing gear alignment.	1. Before installing the blower rotor timing gears on the rotor shafts, note the pre-cautions in steps 6a 2 and 3 relative to	





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

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			
		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 housing facing up, and the rear end (serrated end of rotor shafts) of the blower facing 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).

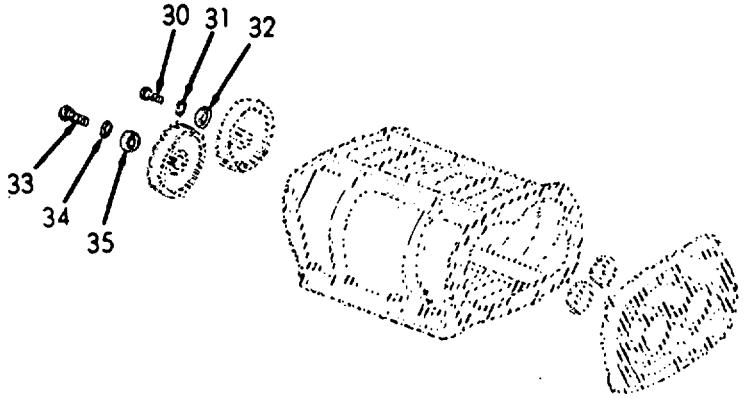
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			
		7. Start both rotor gears straight on the rotor shafts with the right-hand helix gear on the right-hand helix rotor and the left-hand helix gear on the left-hand helix rotor, with the omitted serrations in the gears in line with the omitted serrations 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
OVERHAUL-ASSEMBLY (Cont)			
	p. Screw (30), lock-washer (31), and coupling disc (32)	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 Nm) torque.	
	q. Screw (33), lock-washer (34), and retaining washer (35)	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.



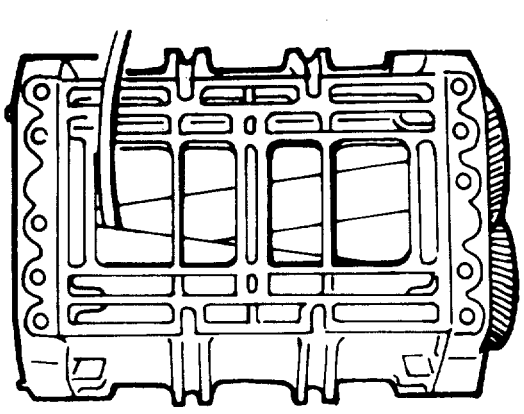
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-TIMING BLOWER ROTORS			
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.		

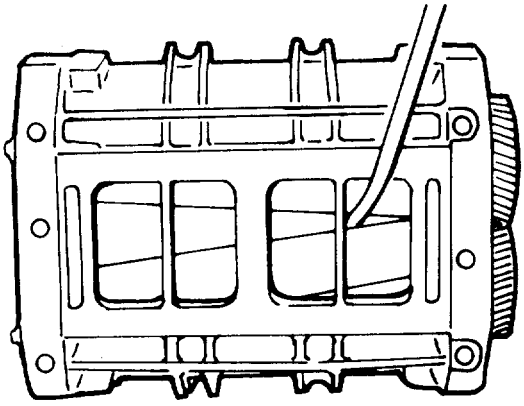
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-TIMING BLOWER ROTORS (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

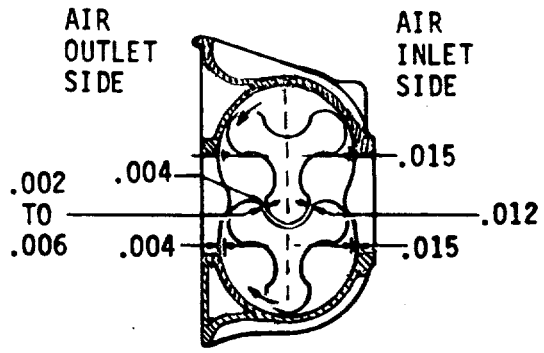
f. TIME THE ROTORS AS FOLLOWS:

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
OVERHAUL-TIMING BLOWER ROTORS (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

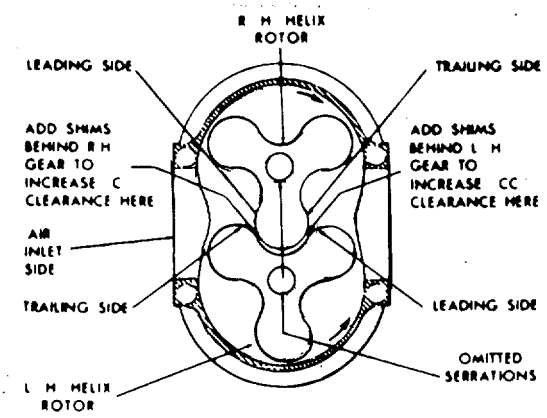
If the proper clearances cannot be obtained between the rotors, a mix of the former and current rotors, which have a different helix angle, may have occurred.

g. After determining the amount that one rotor must be revolved to obtain the proper clearance, add enough 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

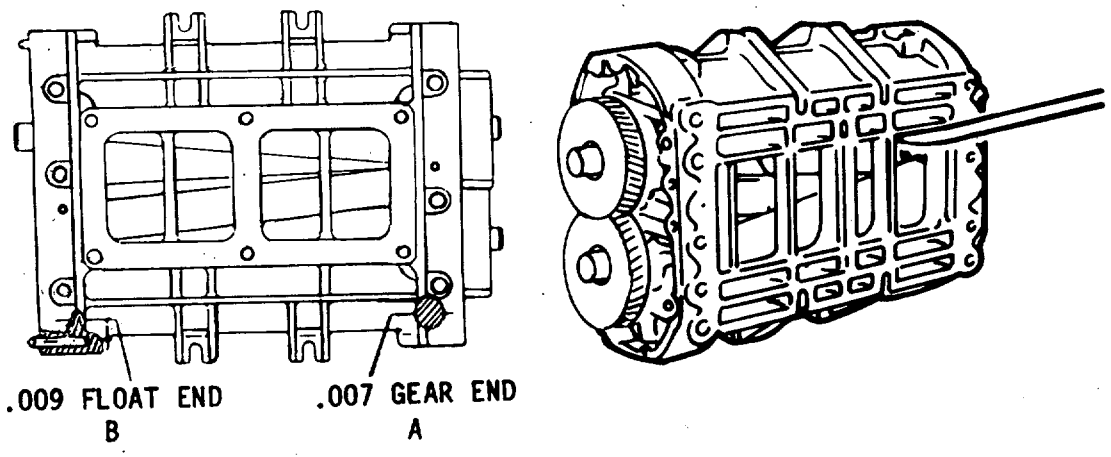
OVERHAUL-TIMING BLOWER ROTORS (Cont)



VIEW FROM GEAR END OF BLOWER.

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 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.

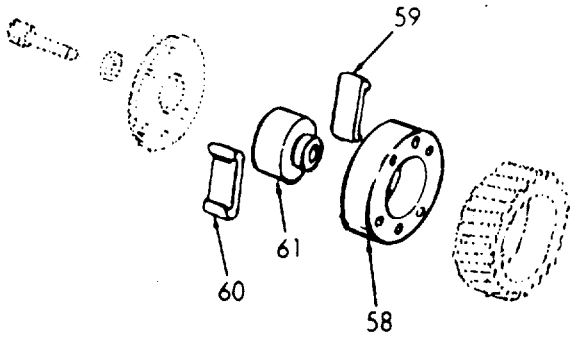


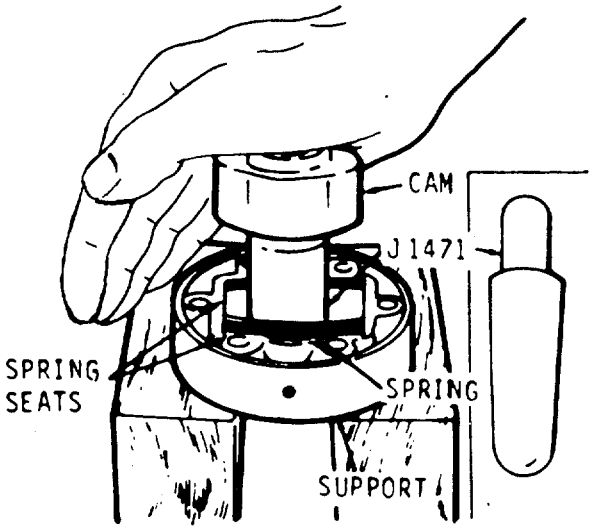
5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-TIMING BLOWER ROTORS (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)	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.	

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

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			
		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.	



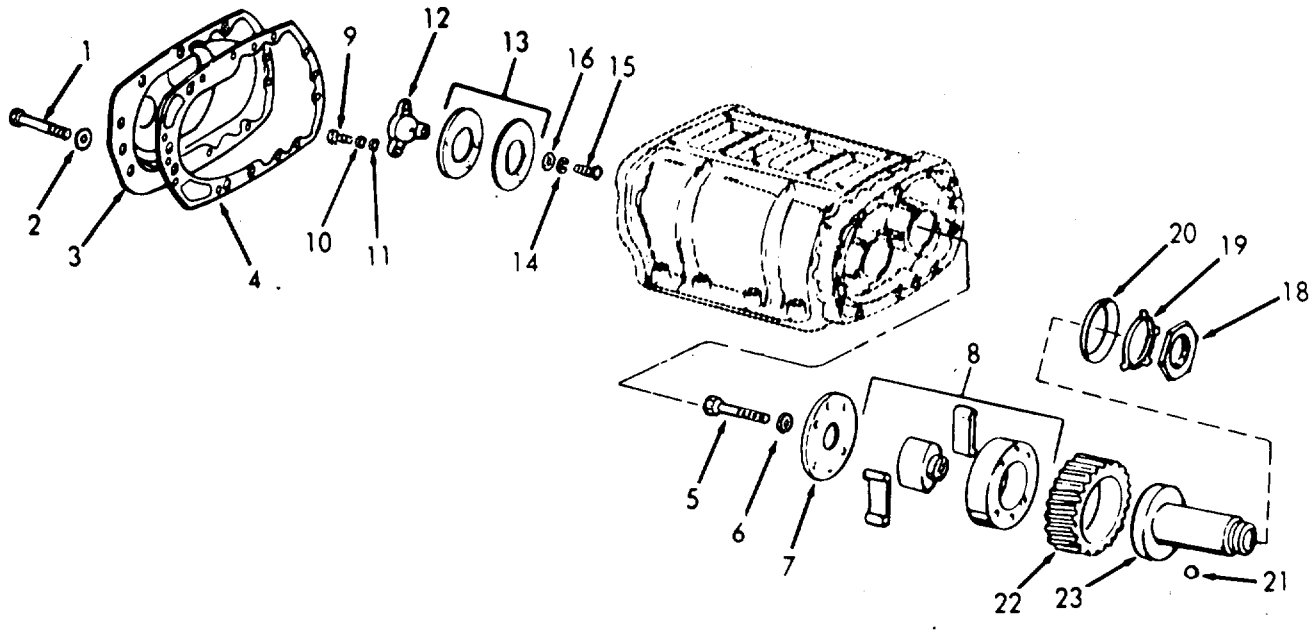


5-71. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			
	c. Rear blower coupling (8), retainer (7), bolts (5), and washers (6)	1. Place blower coupling assembly and retainer on the right-hand helix gear, align the holes, and start the six bolts and lockwashers. 2. Tap drive coupling cam with a plastic hammer to seat it on the rotor gear (22).	
	d. Gear (22), and hub (23)	Assemble.	
	e. Ball (21), thrust washer (20), lock-washer (19), and hub nut (18)	Install.	
9. Blower Hub	a. Screws (14), lock-washers (15), and flat-washers (16)	Install in hub (13).	

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

LOCATION	ITEM	ACTION	REMARKS
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

Special Tools

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

Material/Parts

Service kit 5228701
Parts kit 5228769
Methylethylketone (MEK)

Personnel Required

1

References
Paragraph

3-15 Fuel Injector Organizational Maintenance.

Equipment Condition: Condition Description

NONE

Special Environmental Conditions

NONE

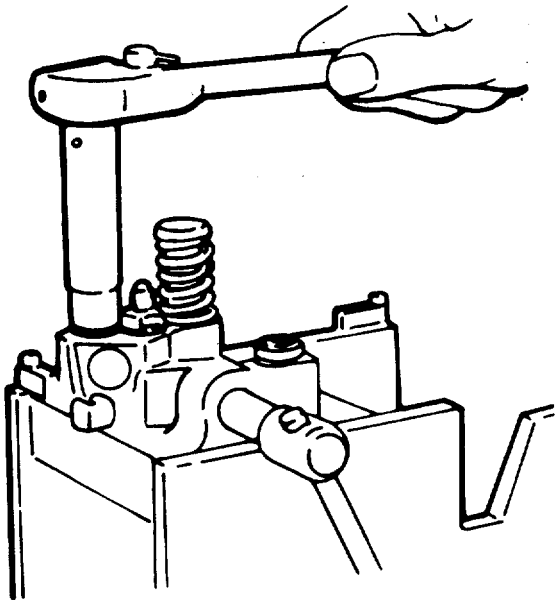
General Safety Instructions

WARNING

Wear protective eye goggles when using compressed air.

5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS.

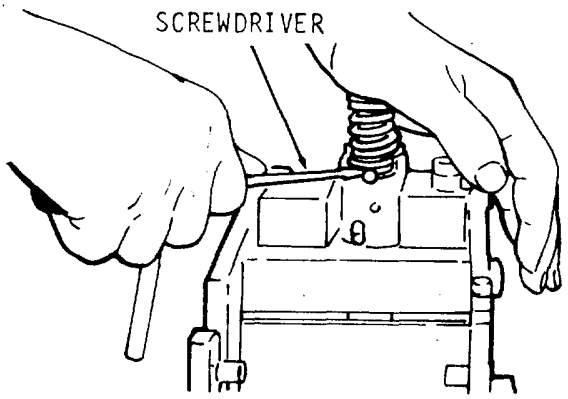
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY			
1. Injector	a. Filter cap (1), gasket (2), and filter element (3)	1. Place in holding fixture. 2. Remove cap.	Discard gasket and element.
	b. Injector follower (4), and stop pin (5)	1. Compress the follower spring (6). 2. Raise the spring above the stop pin (5) with a screwdriver and withdraw the pin. Allow the spring to rise gradually.	

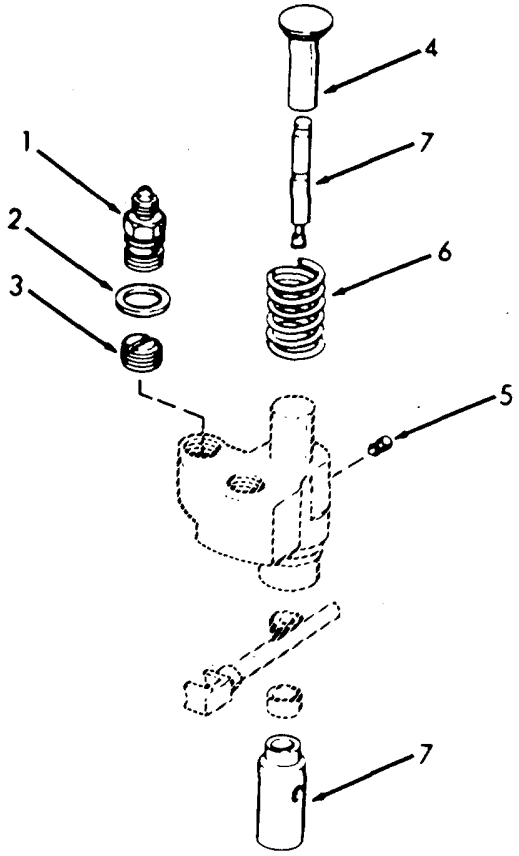


5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS.

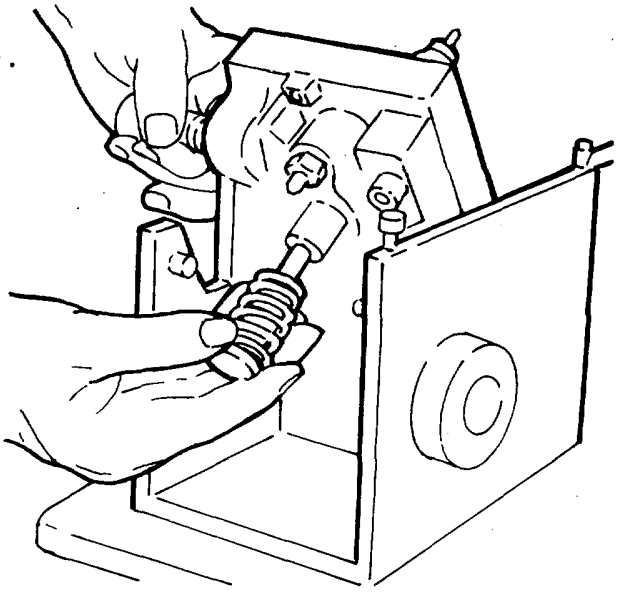
LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-DISASSEMBLY (Cont)



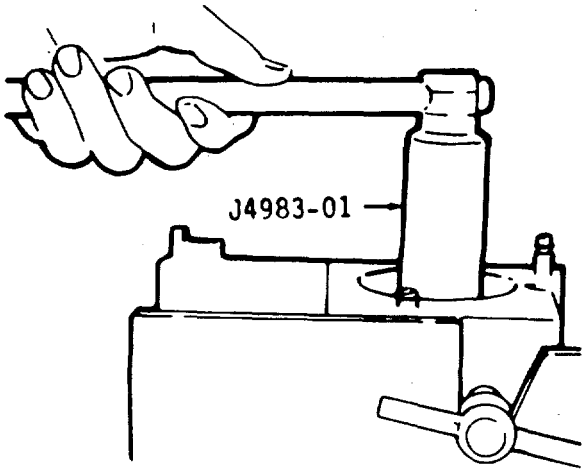


c. Injector follower (4), plunger (7) and spring (6) — Remove.



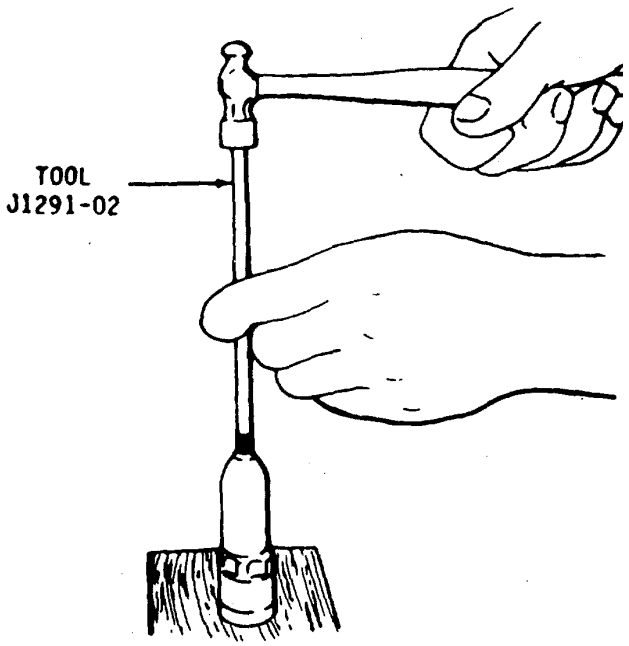
5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS.

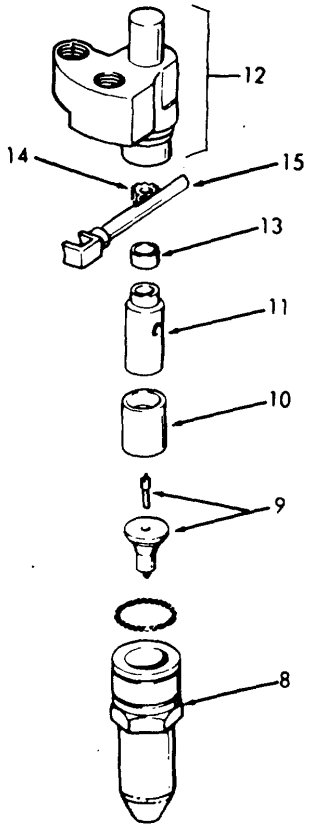
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
d.	Injector valve Nut (8)	1. Loosen. 2. Lift injector nut straight up. Be careful not to dislodge the spray tip and valve parts.	Use tool J4983-01.
e.	Spray tip (9) and valve parts	1. Remove the spray tip and valve parts from the bushing and 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
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) retainer (13), and gear (14) in your hand as they fall out of the body.	1. Remove from holding fixture, turn over and catch the gear	
	h. Injector control rack (15)	Remove from body.	





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

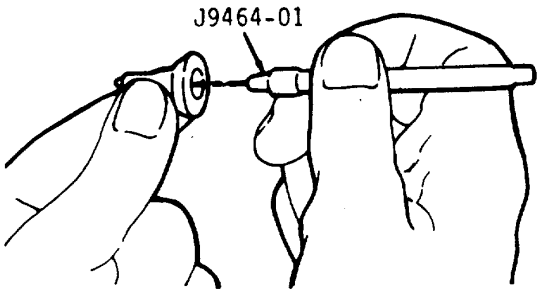
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-CLEANING			
2.	Injector	a. Since most injector difficulties are the result of dirt particles, it is essential that a clean area be provided on which to place the injector parts after cleaning and inspection.	
		WARNING Wear protective eye goggles when using compressed 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.	
		d. Clean the spray tip.	Use tool J9464-01.

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

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-CLEANING

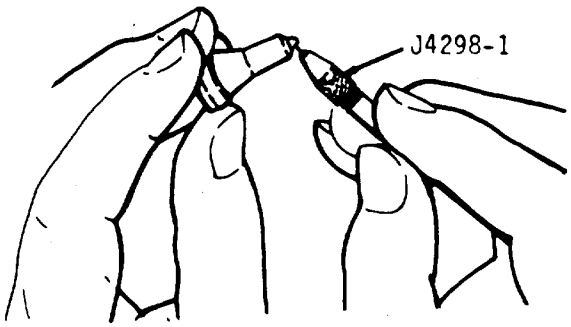
WARNING



Wear protective eye goggles 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).

LOCATION	ITEM	ACTION	REMARKS

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.

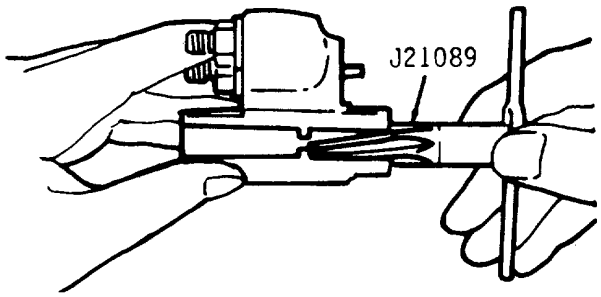
i. Wash the spray tip in clean fuel oil and dry it with compressed air.

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).

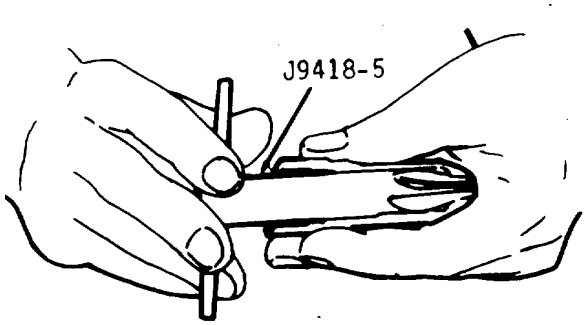
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-CLEANING (Cont)			

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

OVERHAUL-CLEANING (Cont)

Turn it in a clockwise direction to remove the carbon deposits on the flat spray tip seat as shown below. 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.

WARNING

Wear protective eye goggles when using compressed air.

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
OVERHAUL-INSPECTION			
3.	Injector	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).

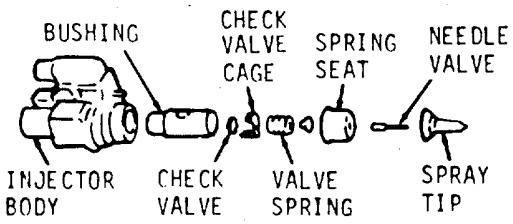
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-INSPECTION (Cont)			
	g. Check the seal ring area on the injector body for burrs or scratches. Also check the surface which contacts the injector bushing for scratches, scuff marks or other damage. If necessary, lap this surface. A faulty sealing surface at this 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).

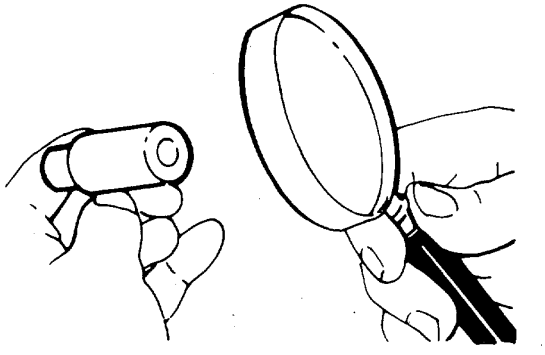
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-CLEANING (Cont)			

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
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).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-LAPPING			
4.	Injector	Lap the sealing surfaces indicated in the figure in step 3 k and the chart as follows:	

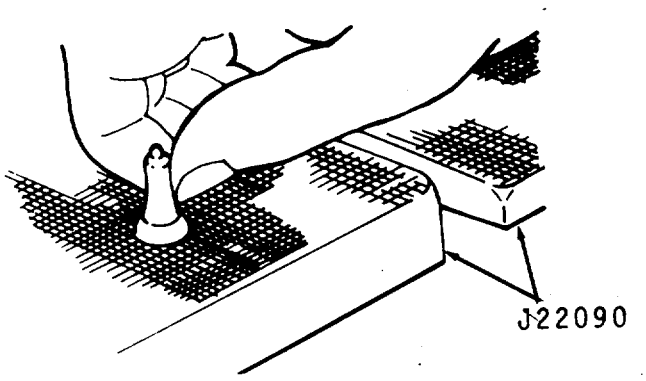
WARNING

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

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.

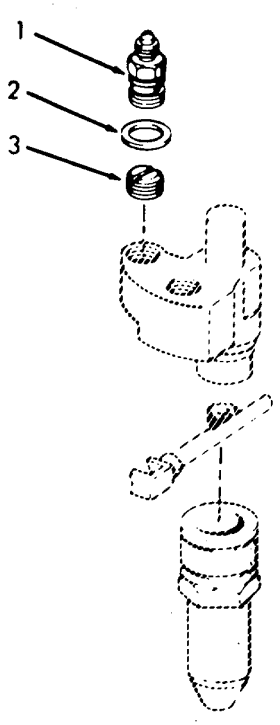
f. Place the dry part on the second block. After applying lapping powder, move part lightly across the block in a figure eight motion several times to give it a smooth finish. Do not lap excessively. Again wash the part in cleaning solvent and dry with compressed air.

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
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 a new 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)	1. Install gasket on each filter cap. 2. Lubricate cap threads and install.	Use new gaskets.

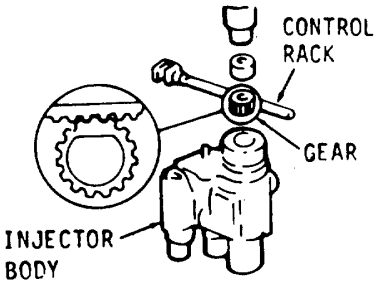


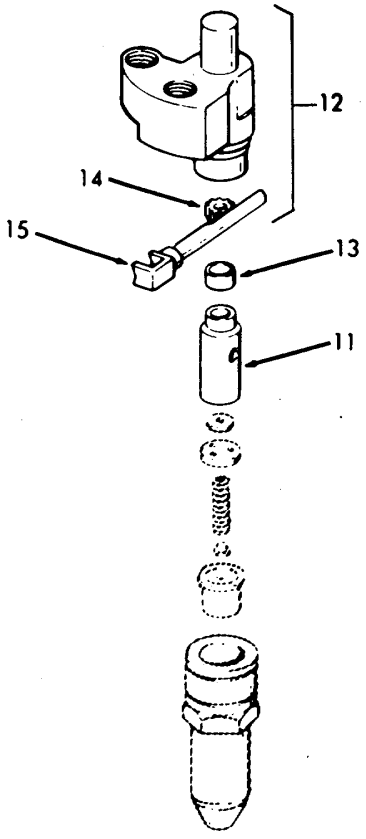
5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			
		3. Tighten caps to 65-75 lb-ft (88.1-101.7 Nm) torque.	Use 9/16 inch deep socket.
		WARNING	
		Wear protective eye goggles when using compressed air.	
	c. Filters	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.	
	a. Injector body (12) and rack (15)	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.	

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

LOCATION	ITEM	ACTION	REMARKS
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.	

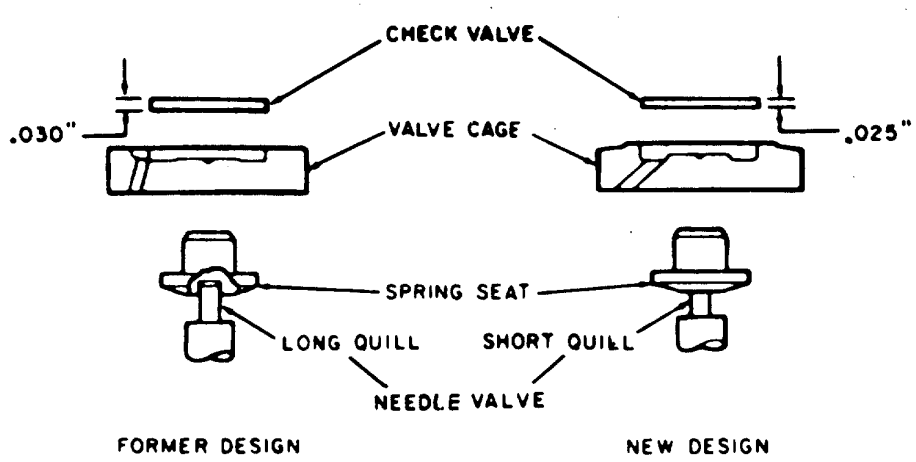
CAUTION

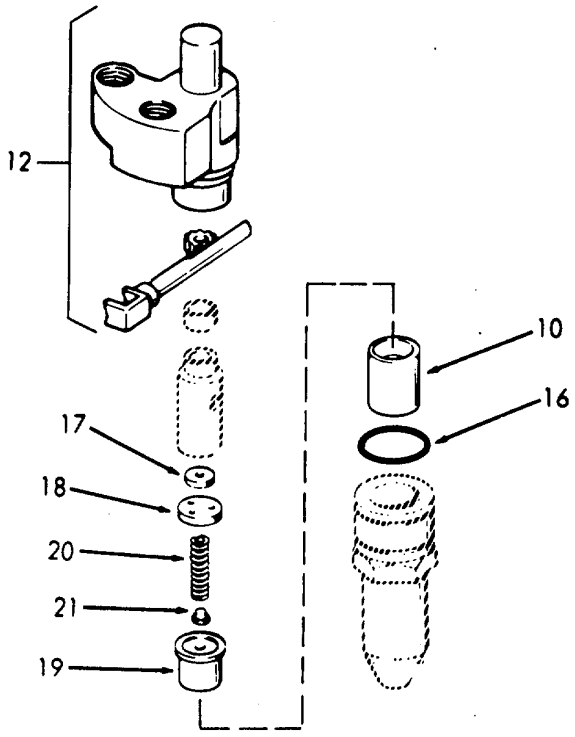
Install a new spring seat in a former injector if a new design spray tip assembly is used.

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
OVERHAUL-ASSEMBLY (Cont)			



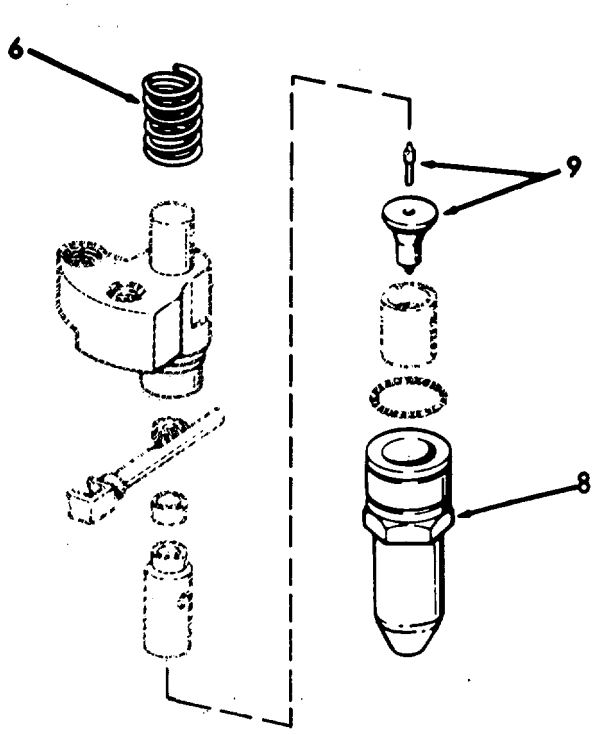


5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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)	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)	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.	

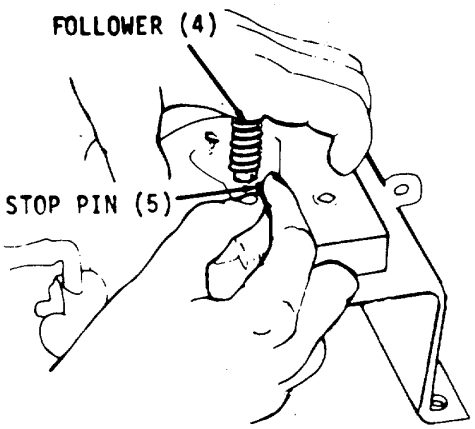
5-72. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			
		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	a. Injector and Follower (6)	Invert injector in the assembly fixture and (filter cap end up), and push the rack spring all the way in. Then, place the follower spring on the injector body.	



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

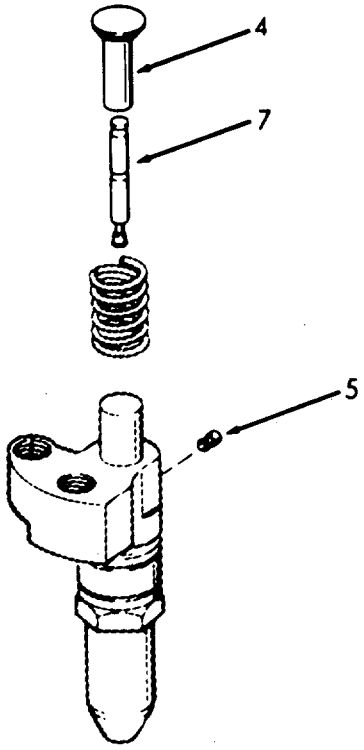
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-ASSEMBLY (Cont)			
	b. Stop pin (5), and follower (4)	1. Place stop pin on injector body so that the follower spring rests on the narrow flange of the stop pin.	
		2. Align slot in follower with the stop pin hole in the injector body.	
		3. Align the flat side of 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

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

Special Tools

Arbor press
Coupling and oil seal remover J1930
Torque wrench

Material/Parts

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

Personnel Required

1

References
Paragraph

3-150 Fresh Water Pump

Equipment Condition Condition Description

NONE

Special Environmental Conditions

NONE

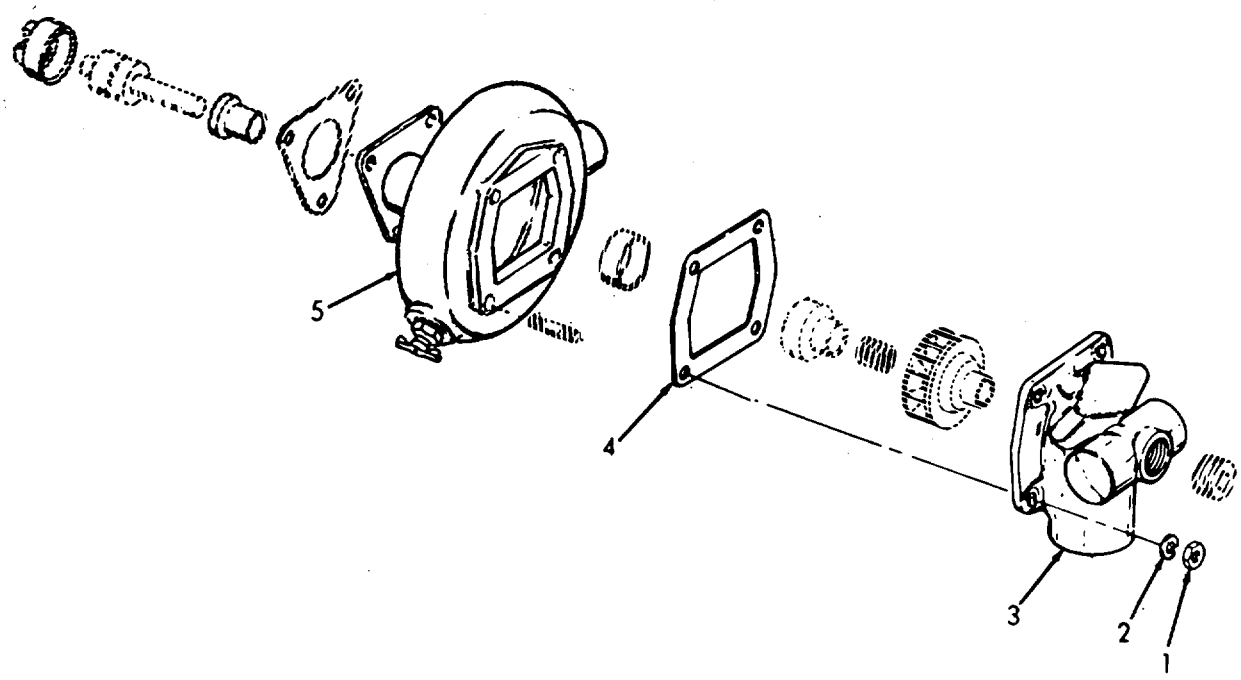
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
1. Fresh Water Pump	a. Nuts (1), and lock-washers (2)	Remove.	

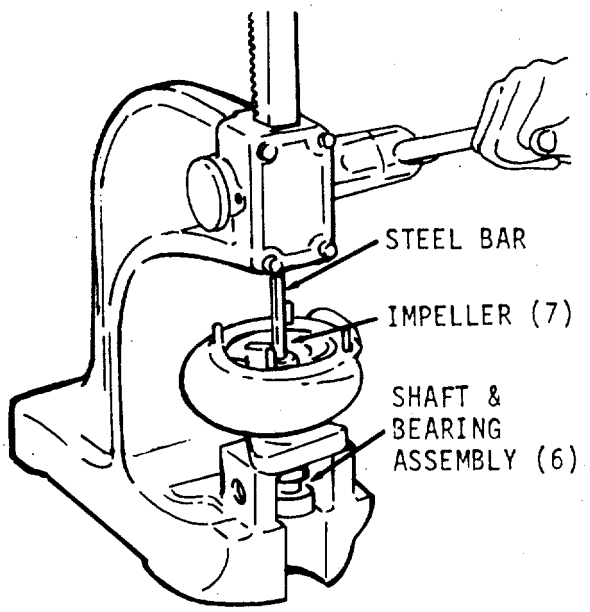
5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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)	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
DISASSEMBLY (Cont.)			
		3. Press out shaft and bearing assembly (6) from impeller (7), and seal assembly (8).	Discard shaft and bearing assembly.



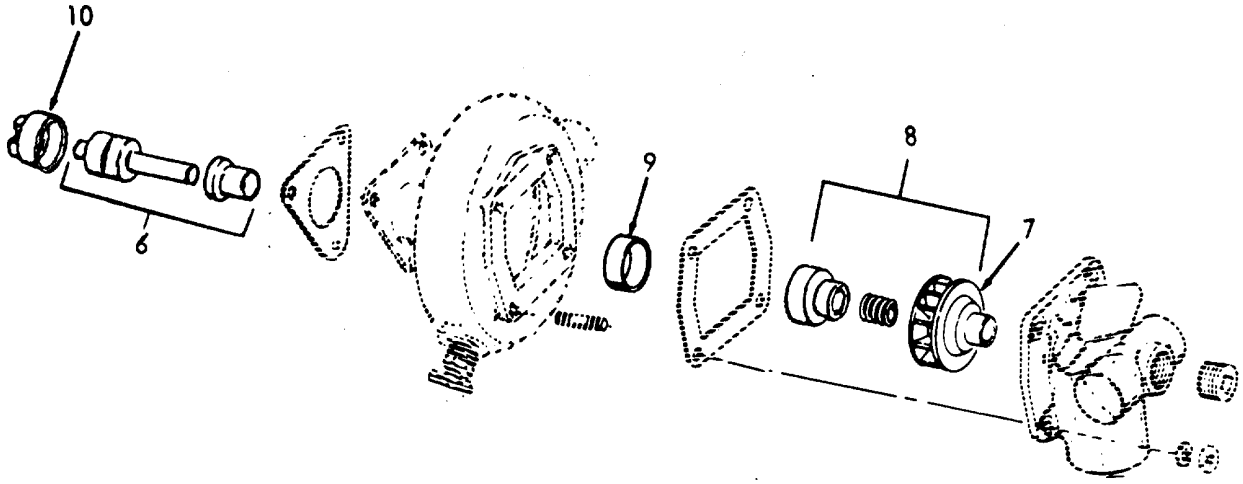
d. Impeller (7), and seal assembly (8) b. Discard seal assembly.	Remove from pump body.	a. Discard impeller if recondition-ing pump.
e. Steel insert (9)	1. Inspect for scratches or excessive wear. 2. Tap or press it out.	Discard if necessary.

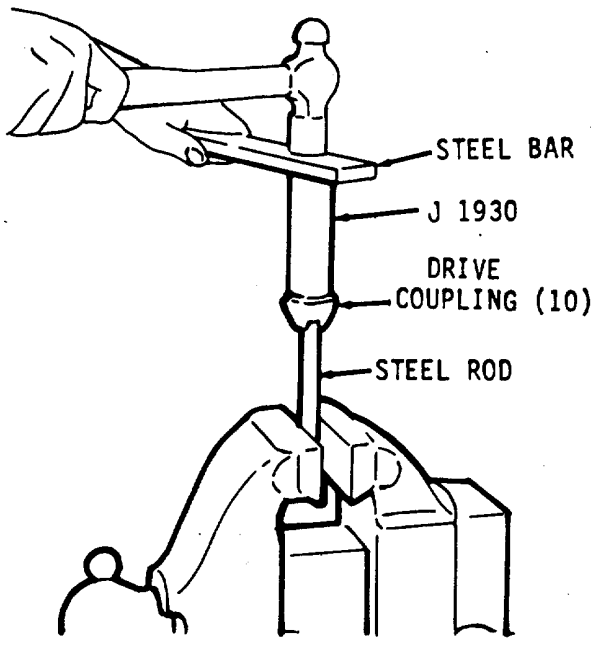
NOTE

Perform the following step only if reconditioning the pump.

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

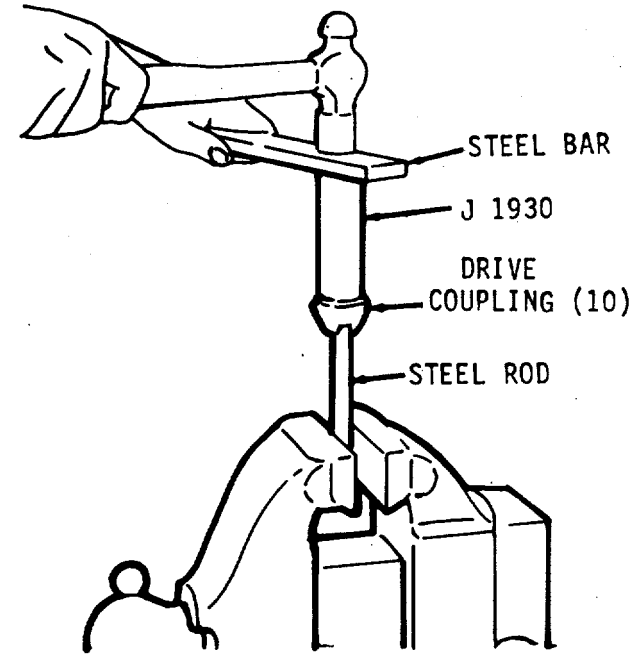
LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont.)			
	f. Pump drive coupling (thrower) (10) (10) on steel rod.	1. Place steel rod in a vise. 2. Place drive coupling	





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).	

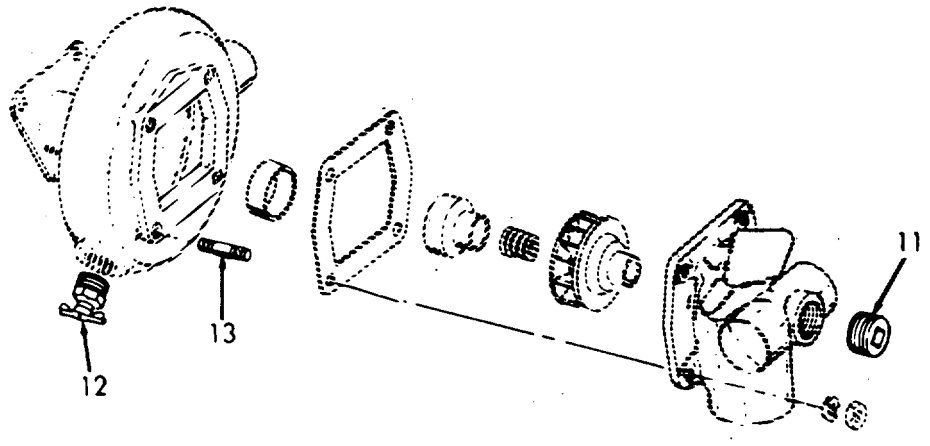


g.	Pipe plug (11)	Remove.	If necessary.
h.	Draincock (12)	Remove.	If necessary.
i.	Studs (13)	1. Remove. 2. Examine the studs in the pump body. If it is necessary to replace a stud, use a good grade of sealant on the threads and drive the stud in to 6-8 lb-ft (8.1-10.8 Nm) torque.	

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)	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.	

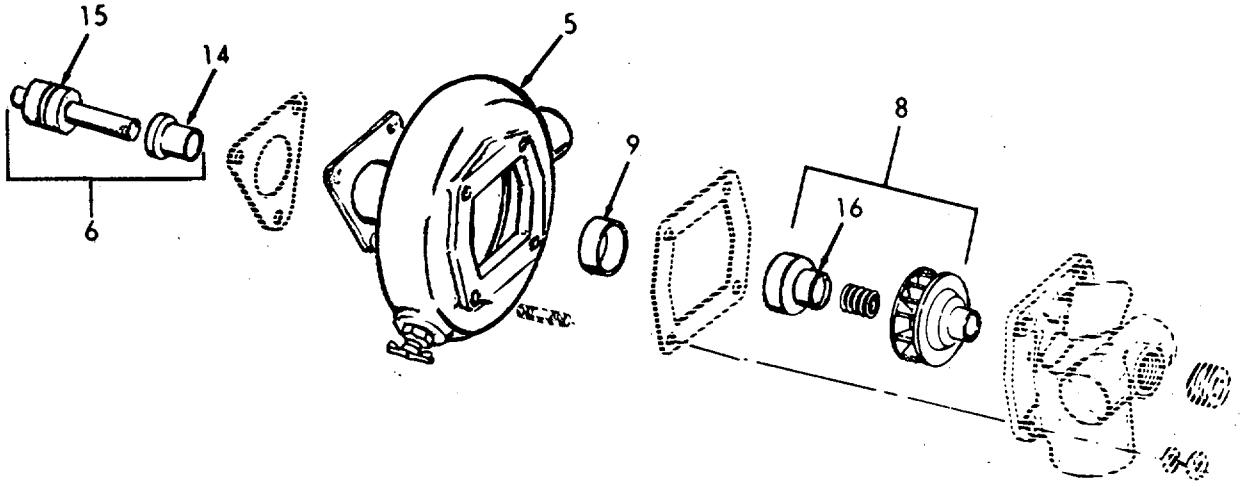
CAUTION

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)	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.	
	c. Pump body (5)	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.	

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

LOCATION	ITEM	ACTION	REMARKS
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.

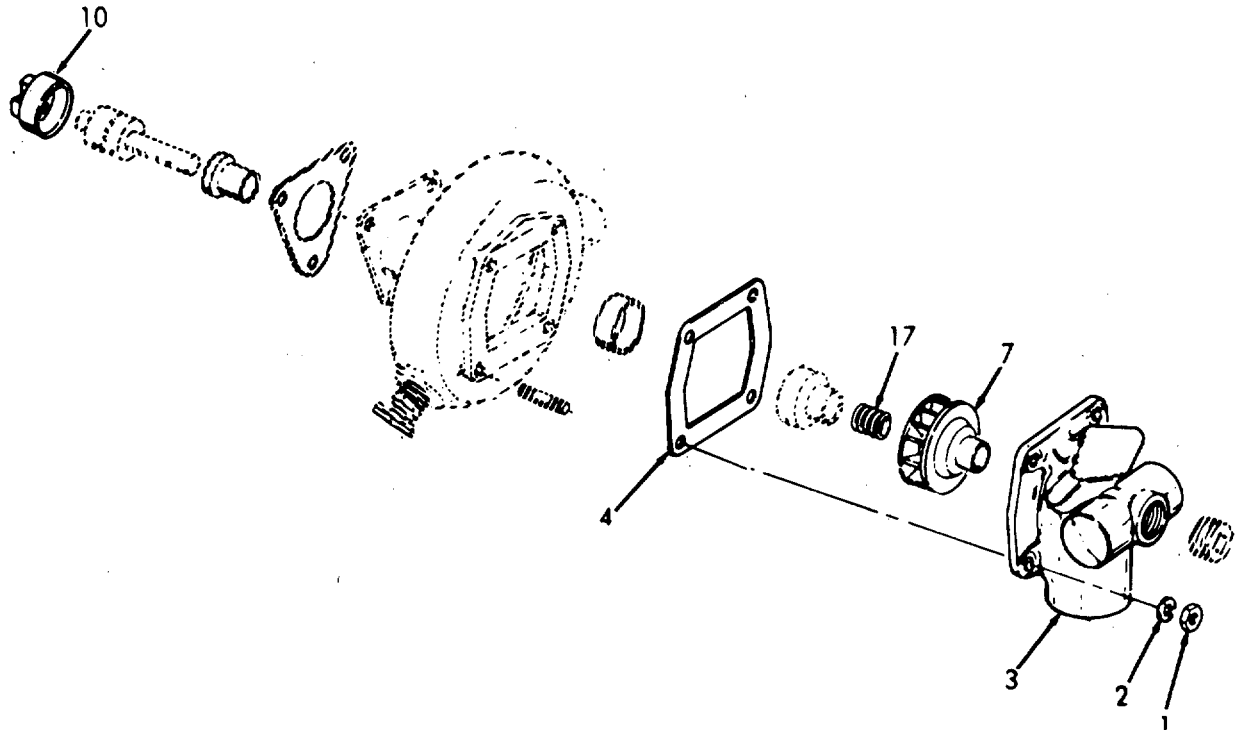


5-73. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont.)			
		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.	
	e. Impeller (7)	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)	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.	

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

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont.)			
	g. Pump assembly	Rotate the 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

Special Tools

NONE

Material/Parts

NONE

Personnel Required

1

References

NONE

Equipment Condition Condition Description

NONE

Special Environmental Conditions

NONE

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. 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

1

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

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.

CAUTION

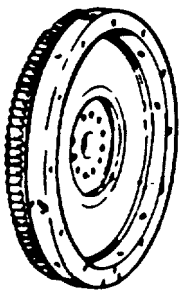
Do not, under any circumstances, heat the gear over 400°F (204°C), as excessive heat may destroy the original heat treatment.

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 gear in place against the flywheel shoulder. 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

Special Tools

Gear puller
Arbor press

Material/Parts

Kit P/N 5194800

Personnel Required

1

References
Paragraph

3-149 Lube Oil Pump

Equipment
Condition Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

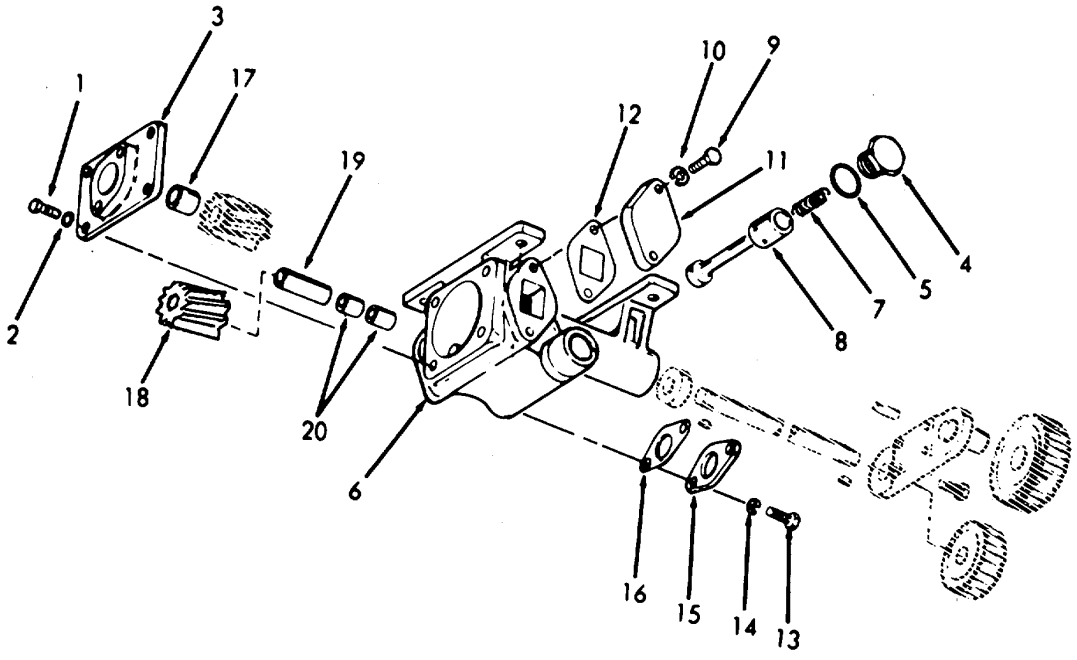
Observe all WARNINGS in this procedure.

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

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
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
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.

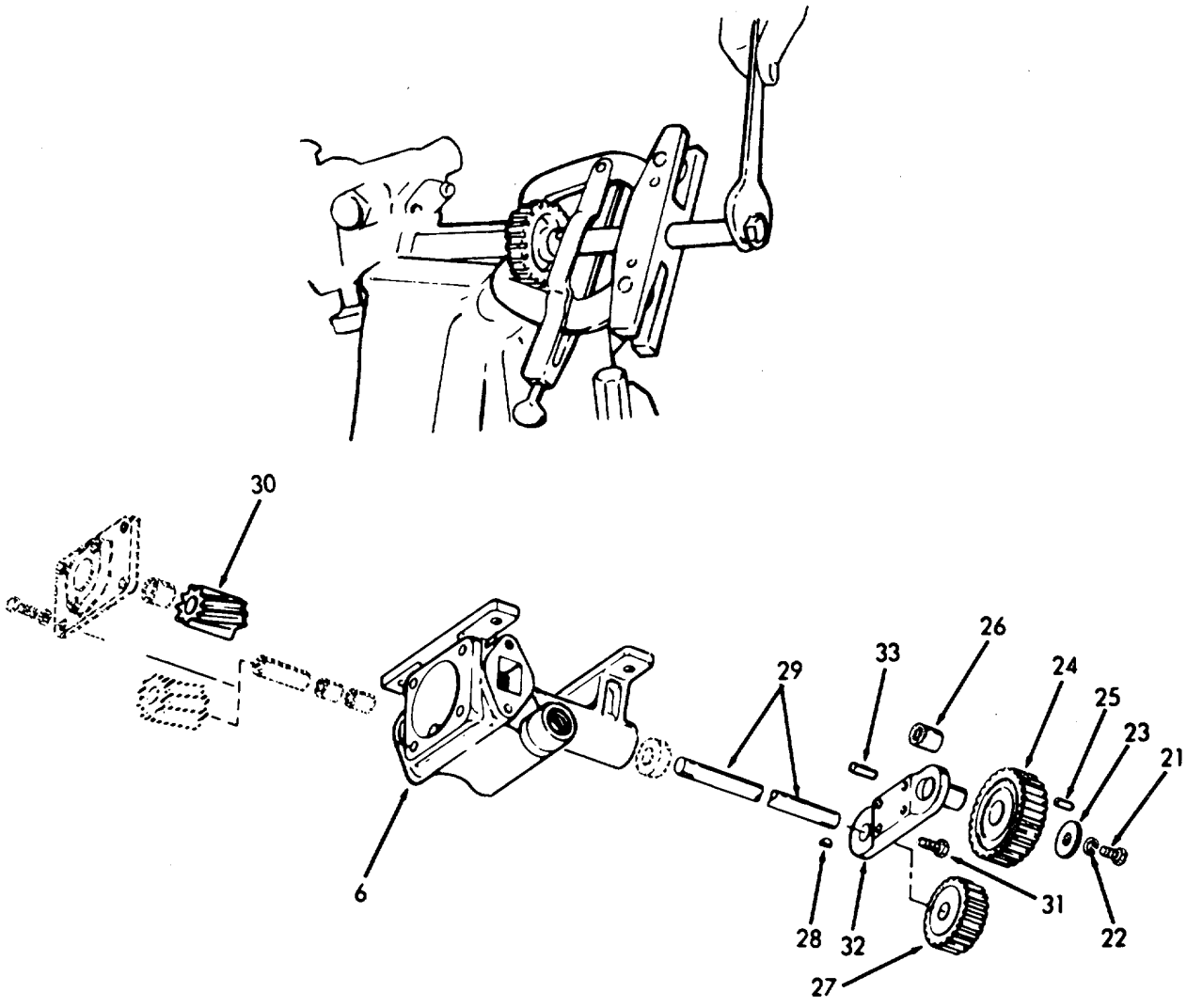


5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont).			
	1. Screw (21), lock-washer (22), and idler gear washer (23)	Remove.	
	m. Idler gear (24)	Remove.	Discard, if damaged.
	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 disassembly.
	r. Screw (31), and idler gear support (32)	Remove.	

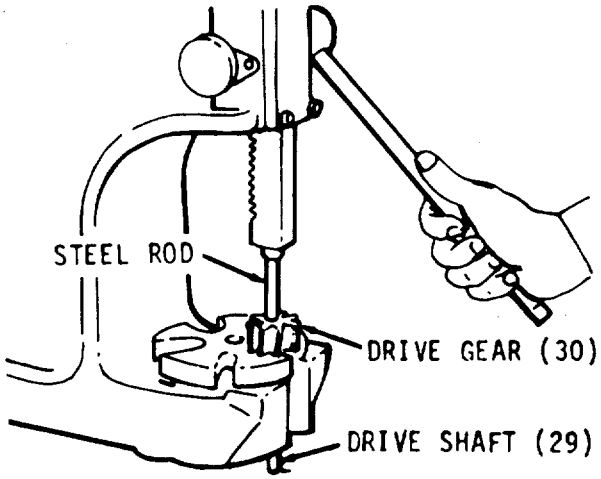
5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

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.

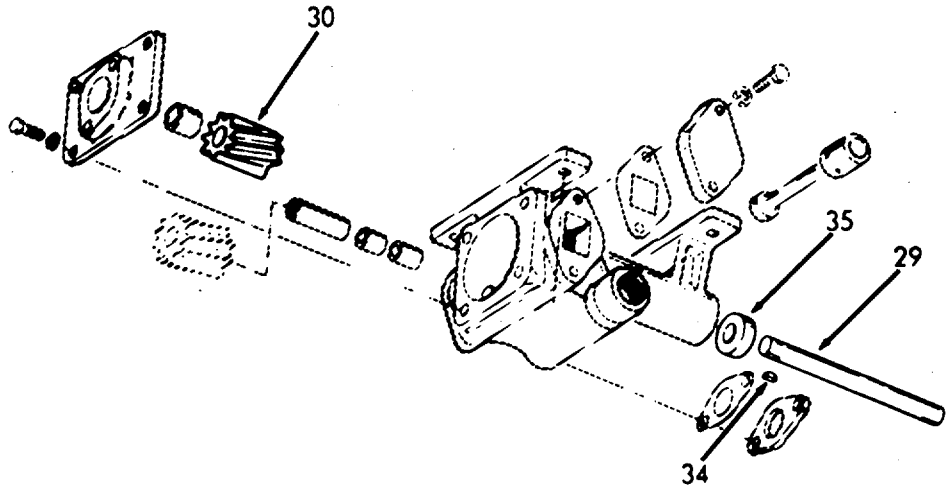


		2. Place a short 1/2 inch round steel rod on end of the shaft.	
		3. Press the shaft from the gear.	
	u. Bushings (35)	Remove.	Discard.

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

LOCATION	ITEM	ACTION	REMARKS

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.

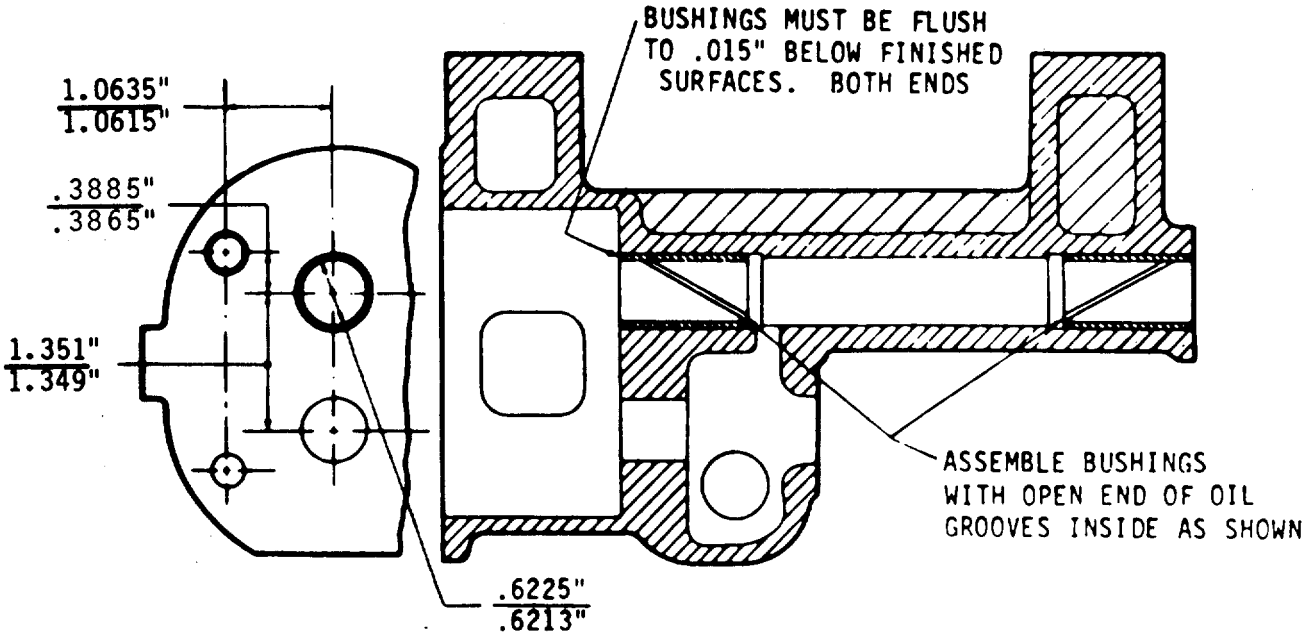
   b. Examine the gear cavity in the pump body and the drive shaft bushings. If the driven gear bushings are worn, replace the bushings. Service replacement bushings in the driven gears must be reamed after assembly. Bushings used with the .499 inch diameter driven gear shaft must be reamed to .500 inch $\pm$ .0005 inch and bushings used with the .623 inch diameter shaft must be reamed to .625 inch $\pm$ .0005 inch.

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

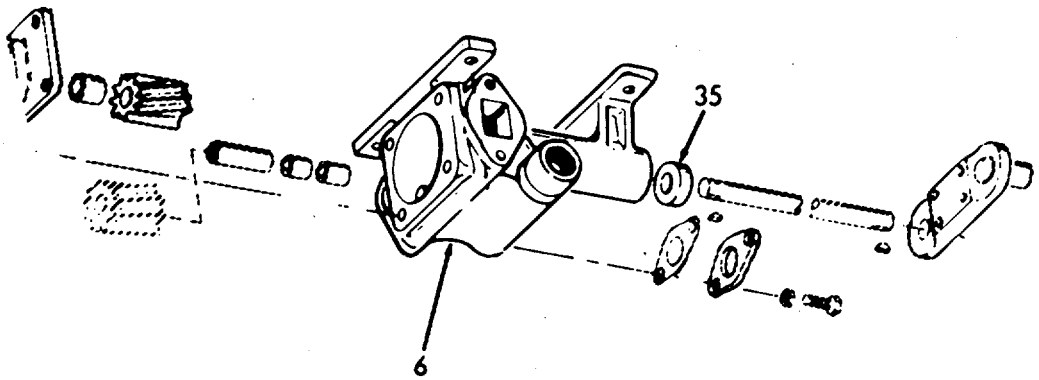
LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont.)			
	c. Inspect the bushings in the pump body and cover. If the bushings are worn excessively, replace the pump and cover assemblies unless suitable boring equipment is available for finishing the new bushings. When installing the new bushings, replace all 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
INSPECTION (Cont)			



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

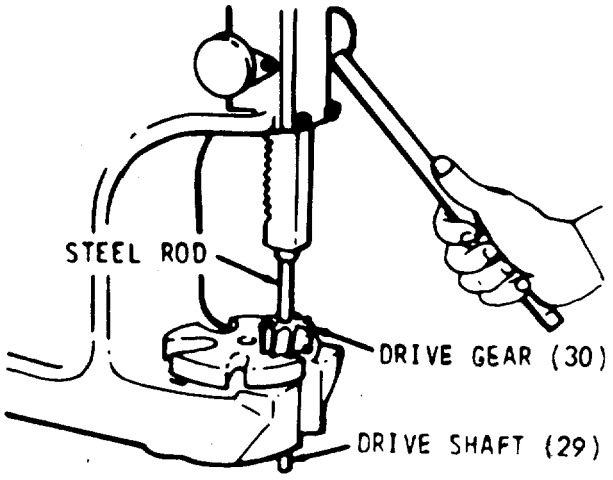


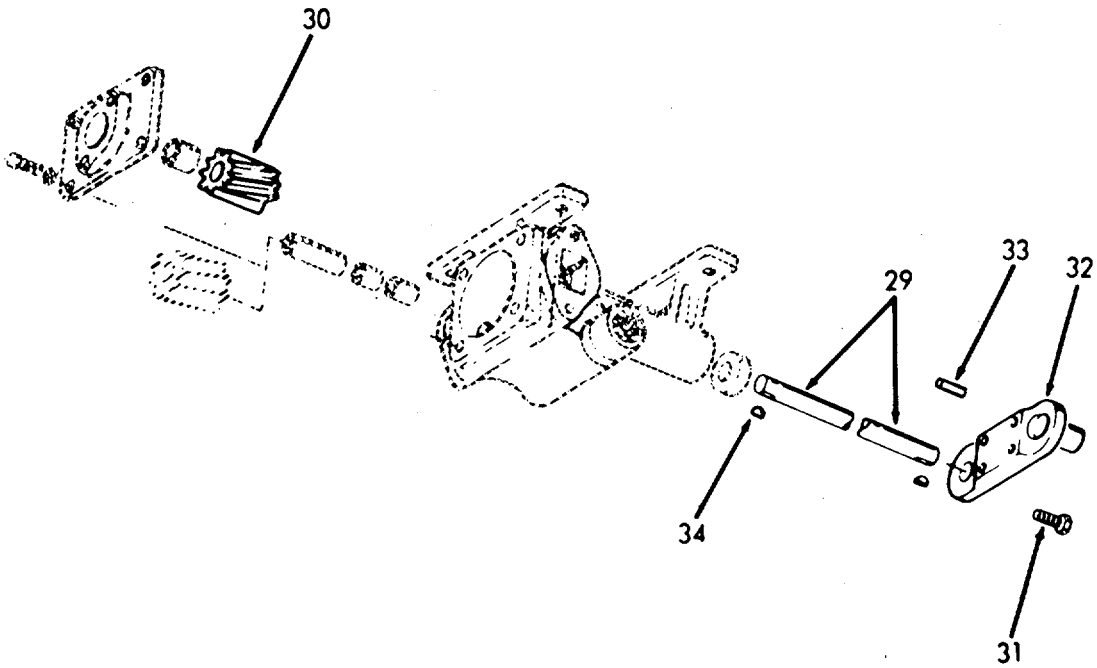
5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont) |			
	b. Drive gear (30), shaft (29), and Woodruff key (34)	1. Insert key in shaft.	Use new gear and shaft, if removed previously.
		2. Apply a light coat of engine oil to the shaft.	
		3. Start the shaft squarely into the bore of the gear.	Use an arbor press.
		4. Press shaft into gear.	
		5. The gear must be 6-15/16 inches from the keyway end of the shaft.	
	c. Dowel pin (33)	Install.	
	d. Idler gear support (32), and screw (31)	Install.	
	e. Drive gear (30), and shaft (29) assembly	Install in body.	

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

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			



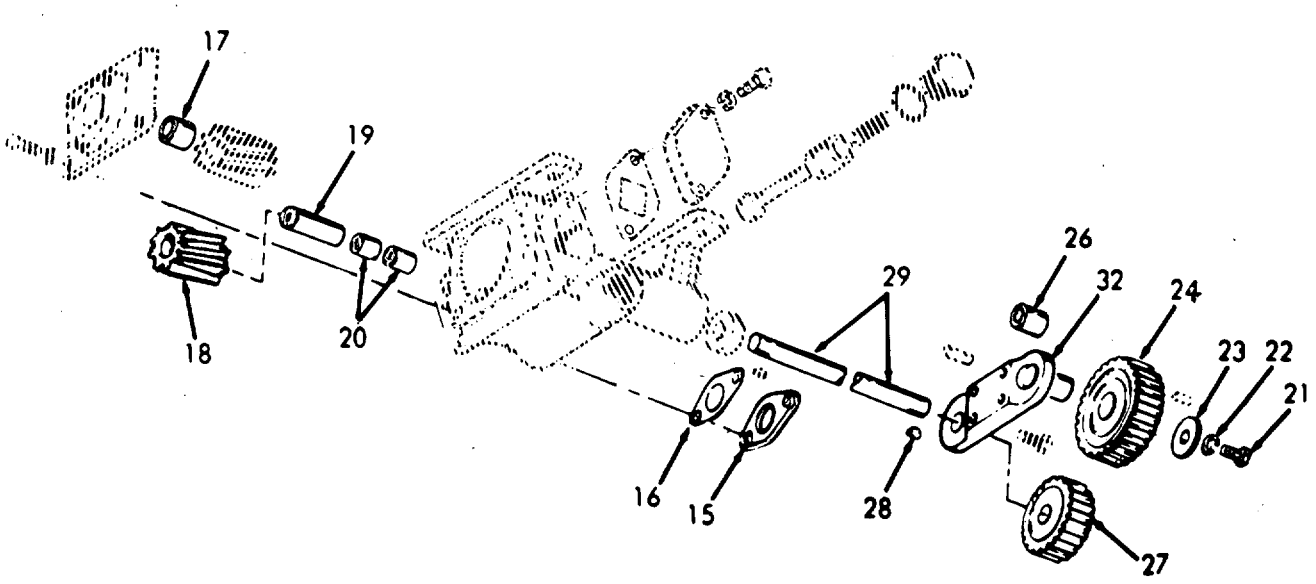


5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	f. Shaft (29), Woodruff key (28), and drive driven gear (27)	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)	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), lockwasher (22), and screw (21)	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
REASSEMBLY (Cont)			
	k. Driven gear (18)	Install.	Use a new gear, if replaced.
	l. Bushing (17)	Install.	Use a new bushing.
	m. Pad cover (15), and gasket (16)	Install.	Use a new gasket.



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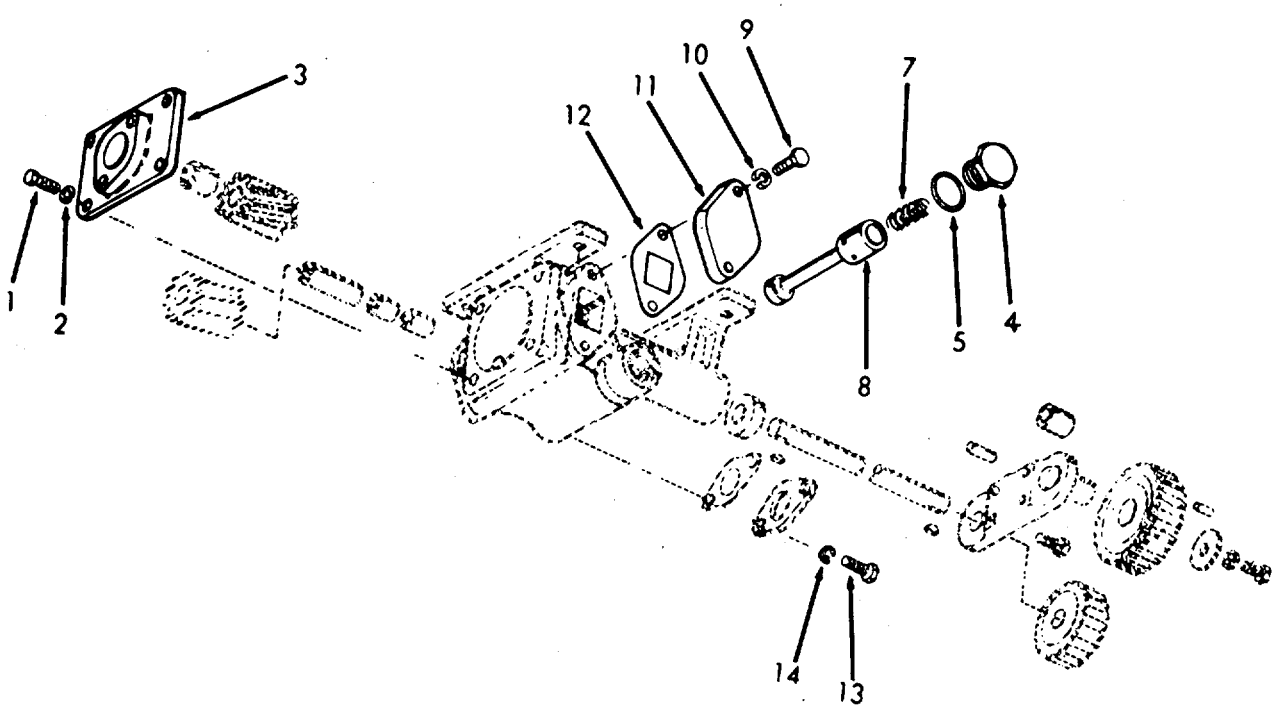
5-78. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

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
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	References
Feeler gage	Chapter 3 (volume 4) - Removal of all parts
Straight edge	Chapter 5 - Removal of all parts
Depth gage	

Special Tools	Equipment Condition	Condition Description
Drift 3/4 inch	NONE	
Hammer, 1 pound		
Hone		
120 grit hones		

Material/Parts	Special Environmental Conditions
Pickling acid	NONE
Alkaline solution (Heavy duty)	
Permatex International compound #2 or equivalent	
Rust preventive	

Personnel Required	General Safety Instructions
2	Observe all WARNINGS in this procedure.

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
1. Cylinder block	All components	Remove.	Refer to Chapter 3 and 5.

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

LOCATION	ITEM	ACTION	REMARKS
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-immerse 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

CLEANING (Cont)

(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

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

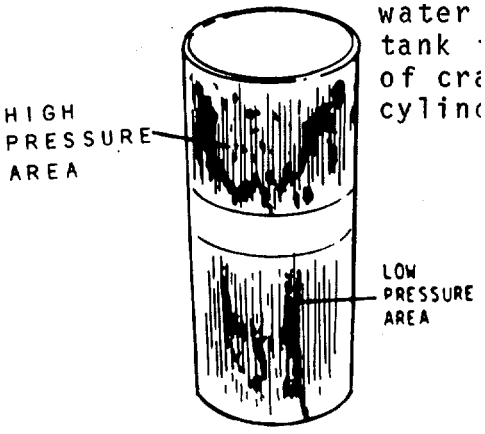
3. After the cylinder block has been cleaned, it must be pressure tested for cracks or leaks by either one of two methods:

(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 coverplate 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

PRESSURE TEST (Cont)l

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 gallon of antifreeze. 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 anti-freeze 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).

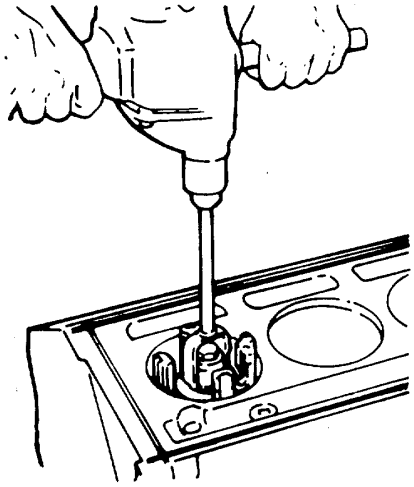
LOCATION	ITEM	ACTION	REMARKS
PRESSURE TEST (Cont)l			
		A cracked cylinder block must be replaced by a new block.	
		(5) After the test is completed, remove the plates, drain the water jacket and blow out all of the passages in the block with compressed air.	
INSPECT			
4.		a. After cleaning and pressure-testing 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
INSPECT (Cont)I			

(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 too long will cause the b-ore to become irregular. Where and how much to hone can

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

LOCATION	ITEM	ACTION	REMARKS
INSPECT (Cont)l			

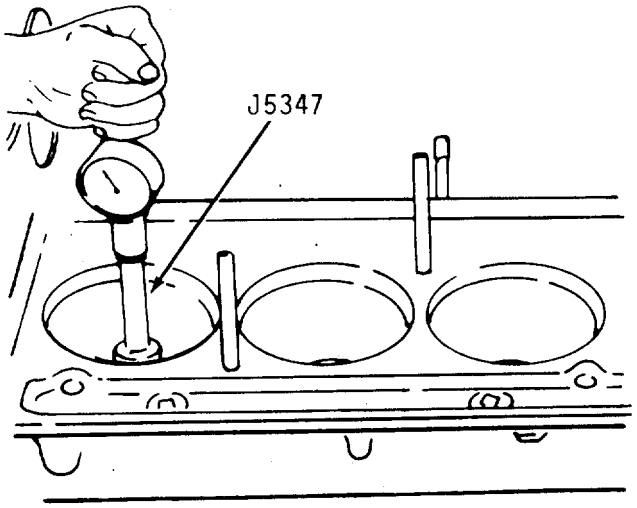
be judged by feel. A heavy cut in a distorted bore produces a steady drag on the hone and makes it difficult to feel the high spots. Therefore, use a light cut with frequent stone adjustments.

(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.

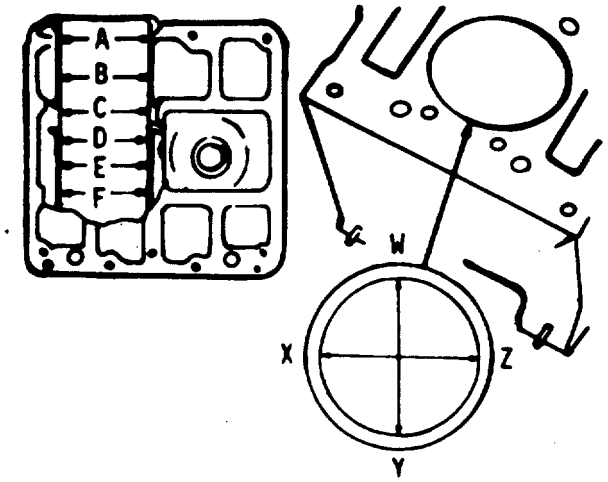
(2) Measure the entire bore of each cylinder with cylinder bore gage J5347 which has a dial indicator calibrated in .0001 inch increments. The standard block bore is 4.6260 inch to 4.6270 inch.



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

LOCATION	ITEM	ACTION	REMARKS
INSPECT (Cont)l			

(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
INSPECT (Cont)l			

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
4.6260 inches 4.6275 inches	Standard	.000 inch to .0025 inch
4.6270 inches 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
4.631 inches 4.632 inches	.005 inch Oversize	4.6325 inches
4.636 inches 4.637 inches	.010 inch Oversize	4.6375 inches
4.646 inches 4.647 inches	.020 inch Oversize	4.6475 inches
4.656 inches 4.657 inches	.030 inch Oversize	4.6575 inches

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

LOCATION	ITEM	ACTION	REMARKS

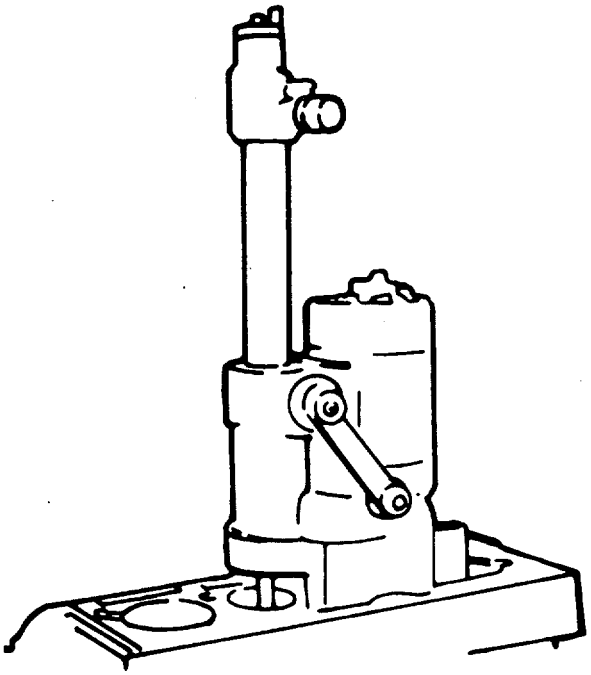
INSPECT (Cont)I

(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.



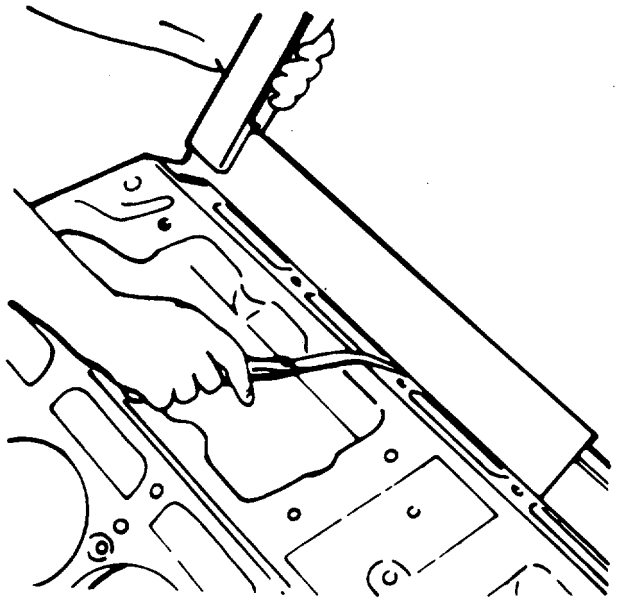
5-79. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECT (Cont)l			

g. Check the top of the block (cylinder head contact surfaces) for the 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.

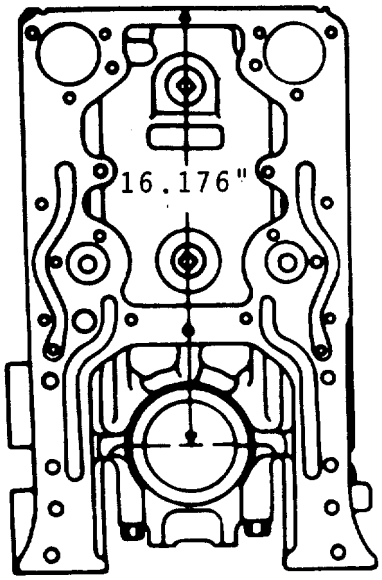
(2) If it is necessary to machine these surfaces to correct for the above conditions, do not remove more than .008 inch of metal. Stamp the amount of stock removed on the face of the block. The distance from the centerline of the crankshaft to the top of the cylinder head surface of the block must not he less than 16.176 inches.



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

LOCATION	ITEM	ACTION	REMARKS
INSPECT (Cont)I			

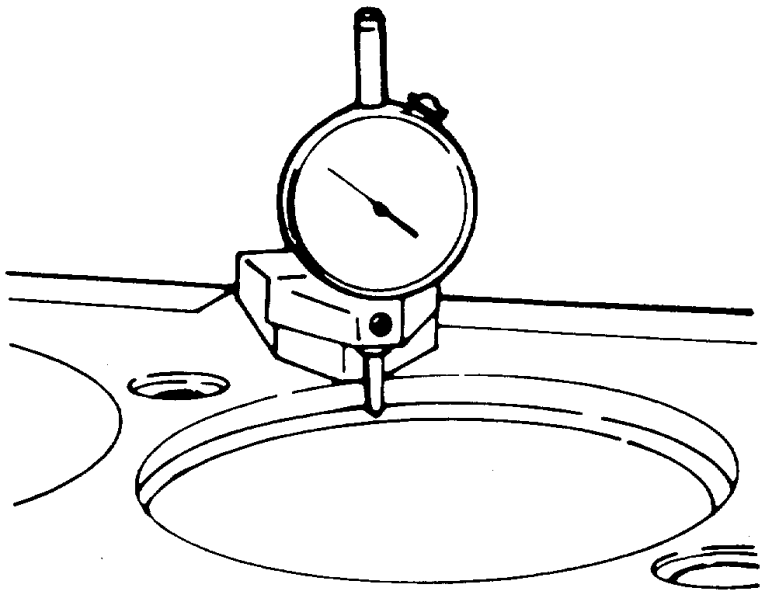
(3) If stock is removed from the cylinder head contact surfaces of the block, check the depth of the seal ring grooves and counter-bores. The cylinder head seal strip grooves must be .092 inch-.107 inch deep. The large water hole counterbores (between the cylinders) must be .109 inches-.120 inches deep, 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 "crush" on the seal rings. It is not necessary to deepen the counterbores for the cylinder liners since .004 inch and .008 inch undersize 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
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
INSPECT (Cont)			

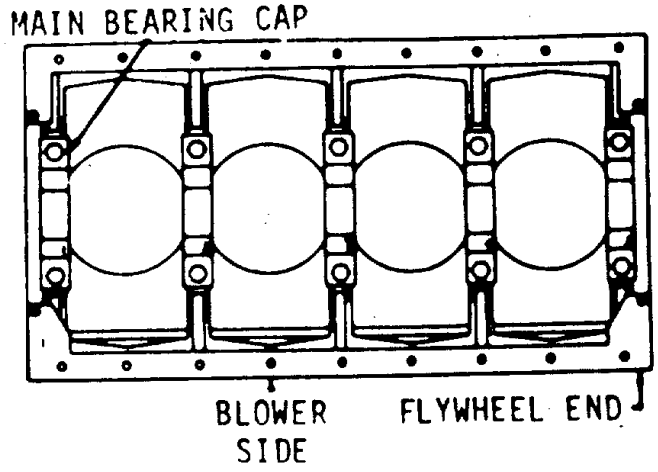
CAUTION

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

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 N•m) 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 N•m) 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
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 N•m) 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.

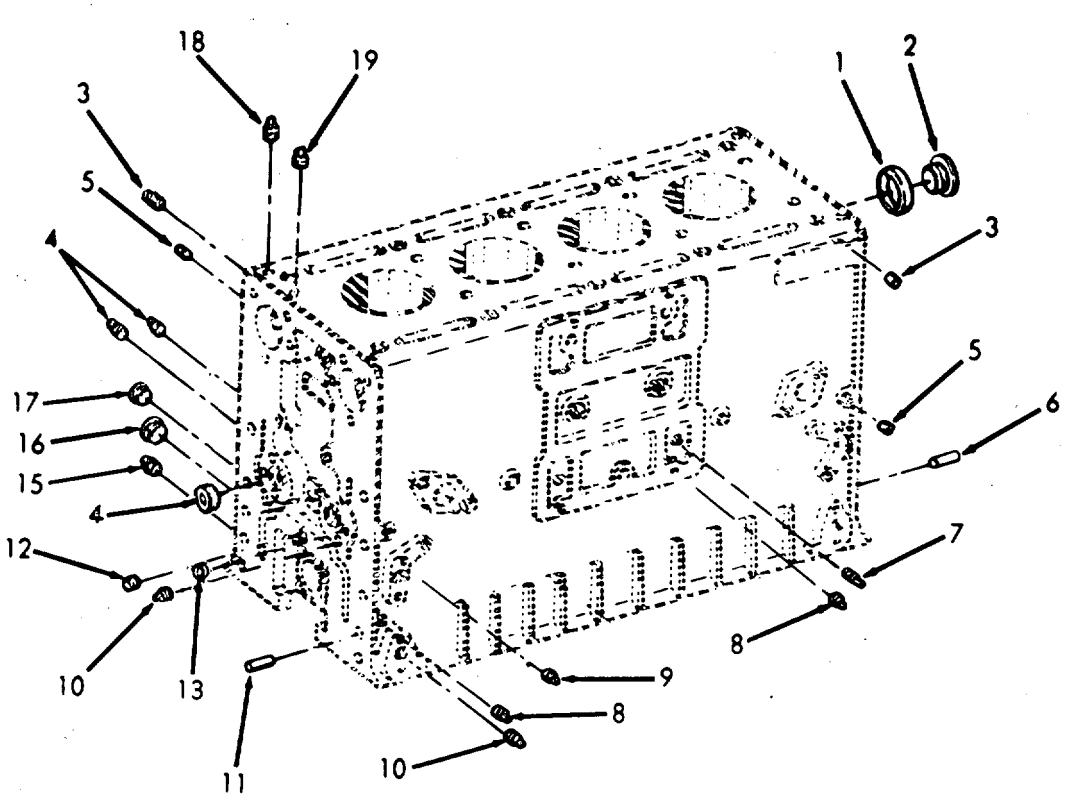
n. After inspection, if the cylinder block is not to be used immediately, spray the machined surfaces with engine oil. If the block is to be stored for an extended period of time, spray or dip it in a polar-type rust preventive such as Valvoline Oil Company's "Tectyl 502-C", or equivalent. Castings free 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
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, PIPING, and RESERVOIR - ANCHOR WINCH MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

Special Tools
Welding Equipment

Material/Parts
NONE

Personnel Required

1

References
NONE

Equipment
Condition Condition Description
NONE

Special Environmental Conditions
NONE

General Safety Instructions

Observe WARNING, and standard safety practices.

LOCATION	ITEM	ACTION	REMARKS

REPAIR

1. Piping

WARNING

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

2. Reservoir

The maintenance at this level is restricted to welding.

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

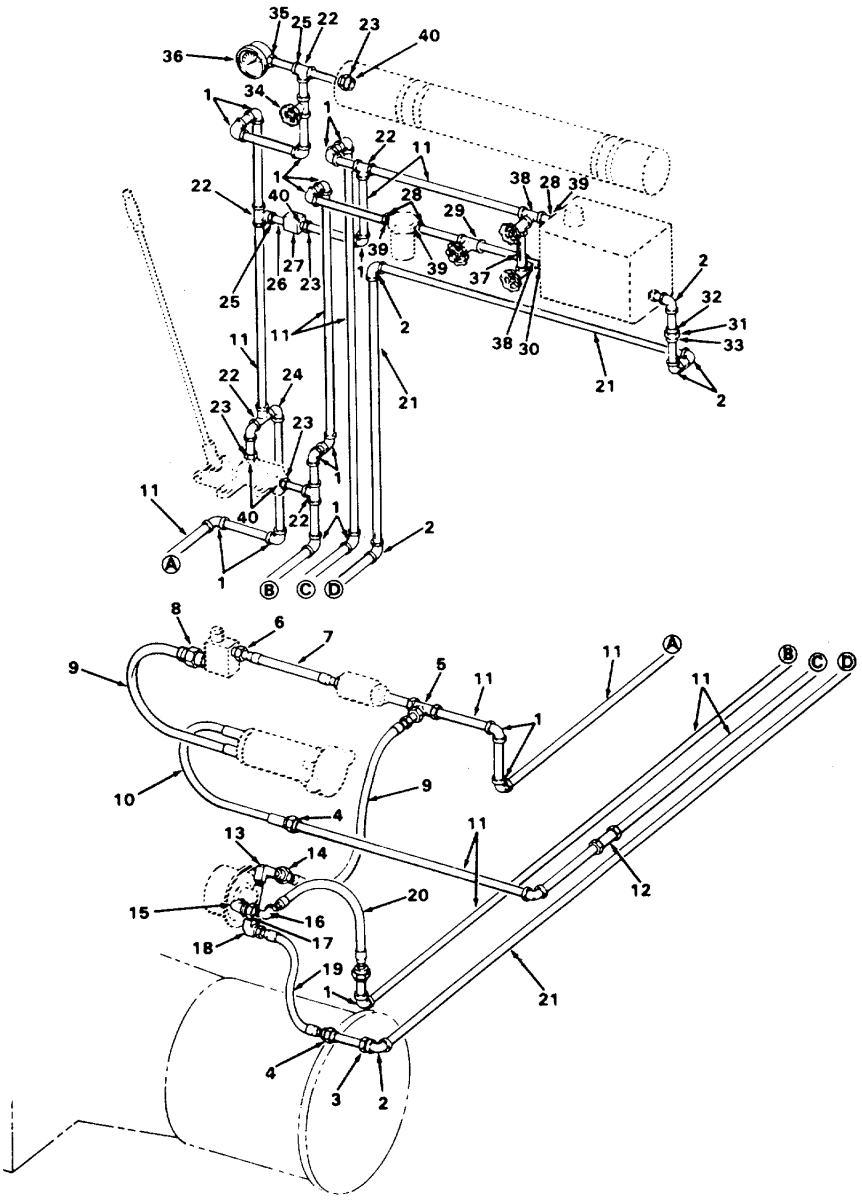
LOCATION	ITEM	ACTION	REMARKS

REPAIR (Cont)

ITEM NUMBER	DESCRIPTION
1.	Elbow Socket, 90°, 3/8 inch
2.	Elbow Socket, 90°, 1/2 inch
3.	Insert Reducing, 1/2x3/8 inch
4.	Union O-Ring
5.	Tee Union, 3/8 inch
6.	Union Reducer, 3/4 inch
7.	Hose Assembly
8.	Bushing
9.	Hose Assembly
10.	Hose Assembly
11.	Pipe, 3/8 inch
12.	Valve Check, 3/8 inch
13.	Elbow, 90°
14.	Union Reducer
15.	Elbow, Street
16.	Elbow Assembly, 90°
17.	Nipple, Pipe
18.	Elbow Assembly, 90°
19.	Hose Assembly
20.	Hose Assembly
21.	Pipe, 1/2 inch
22.	Tee Socket, 3/8 inch
23.	Connector, Male, Steel
24.	Elbow, Street Steel
25.	Insert Reducer
26.	Pipe, 1/4 inch
27.	Valve Relief
28.	Connector, Male Steel
29.	Valve Gate 3/8 inch
30.	Bushing
31.	Nut Union
32.	Tailpiece
33.	Threadpiece
34.	Valve Globe, 3/8 inch
35.	Coupling, Screwed 1/4 inch
36.	Gauge High Pressure
37.	Gauge Water
38.	Tee Street
39.	Adapter, Steel
40.	Adapter, Steel

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

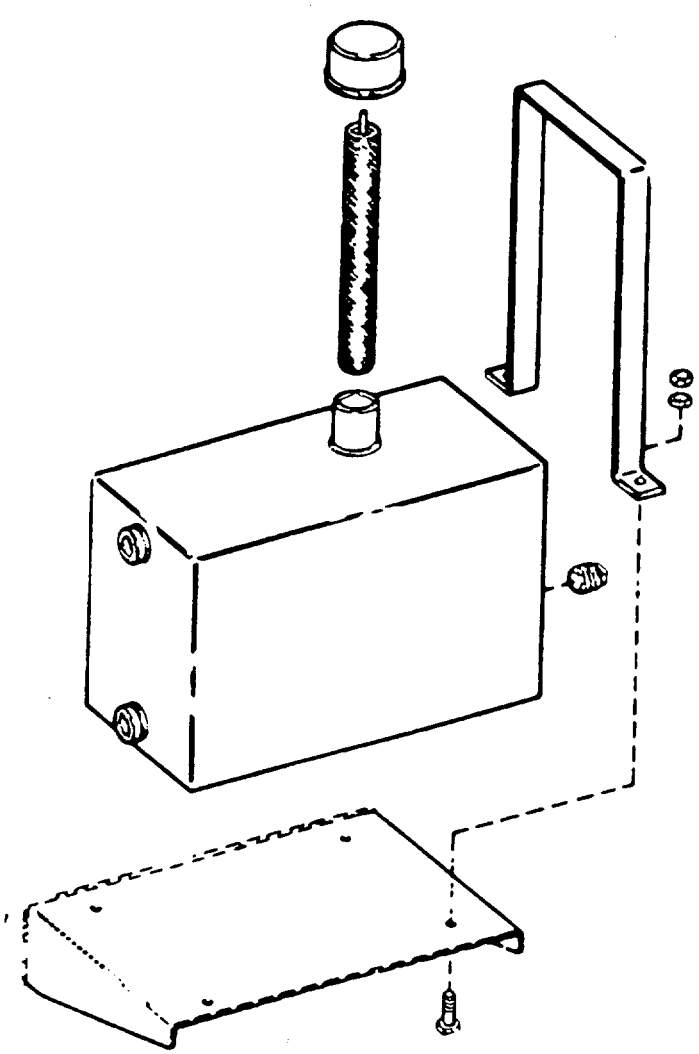
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



Hydraulic Starting System Piping.

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



Hydraulic Reservoir.

5-81. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Removal b. Repair c. Installation

INITIAL SETUP

Test Equipment

NONE

Special Tools

Crane and slings
Welding tool

Material/Parts

Grease MIL-G-10924
Type GAA

Personnel Required

1

References
Paragraph

3-181	Anchor "A" Frame
5-82	Fairleader Removal

Equipment

Condition	Condition Description
	NONE

Special Environmental Conditions

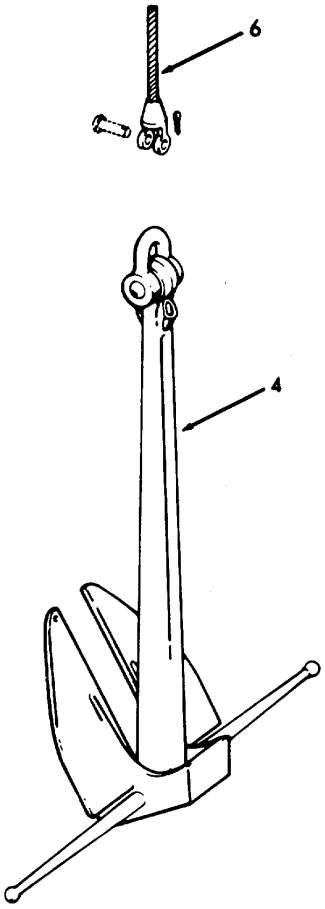
NONE

General Safety Instructions

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

5-81. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS.

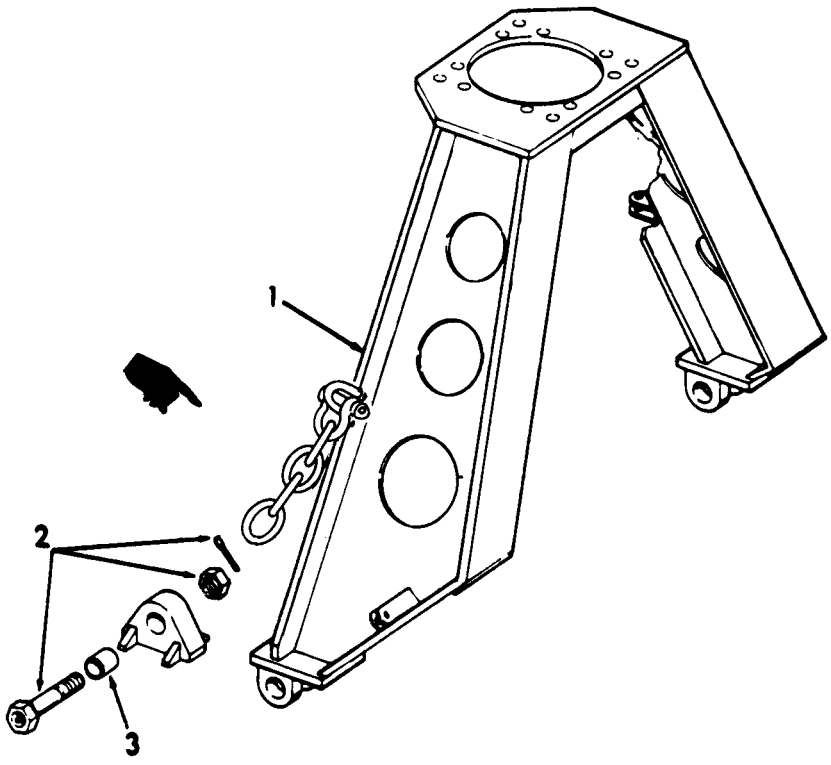
LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. "A" Frame	a. Anchor (4)	Remove.	
	b. Anchor cable (6)	Remove from anchor and "A" frame.	
	c. Fair-leader	Remove.	If necessary. See 5-82.
	d. Miscel-laneous hardware	Remove.	



5-1095

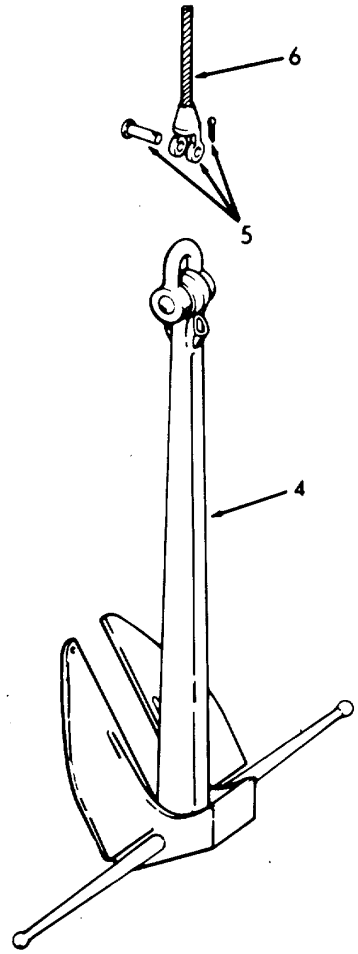
5-81. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
	e. "A" -frame (1)	Attach slings and crane.	
	f. Cotter pins, bolts, and nuts (2)	Remove.	
	g. "A" frame (1)	Lift and remove.	
	h. Bushings (3)	Remove.	



5-81. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
2.	a. Anchor (4)	Repair or replace.	
	b. Wire rope socket (5)	Repair or replace.	
	c. Wire anchor rope (6)	Repair or replace.	



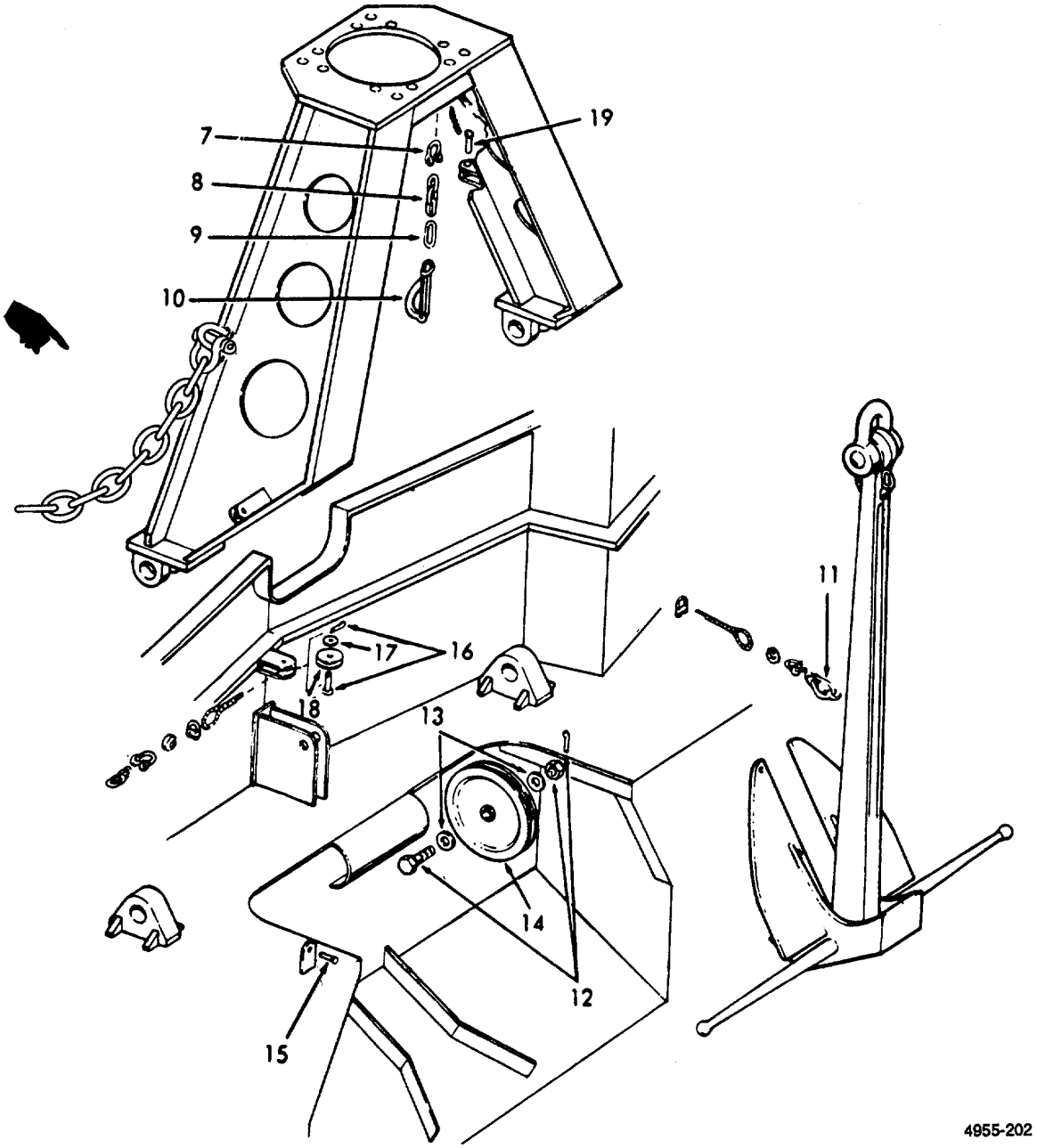
5-1097

5-81. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	d. A-Frame chain shackle (7)	Repair or replace.	
	e. Coil chain (8)	Repair or replace.	
	f. Link (9)	Repair or replace.	
	g. A-Frame Pelican hook (10)	Repair or replace.	
	h. Pelican hook (11)	Repair or replace.	
	i. Cotter pin, nut, and sheave pin (12)	Repair or replace.	
	j. Brass washer (13)	Repair or replace.	
	k. Ball bearing guide sheave (14)	Repair or replace.	
	l. Toggle pin (15)	Repair or replace.	
	m. Cotter pin and sheave pin (16)	Repair or replace.	
	n. Flatwasher (17)	Repair or replace.	
	o. Sheave (18)	Repair or replace.	
	p. Toggle pin (19)	Repair or replace.	

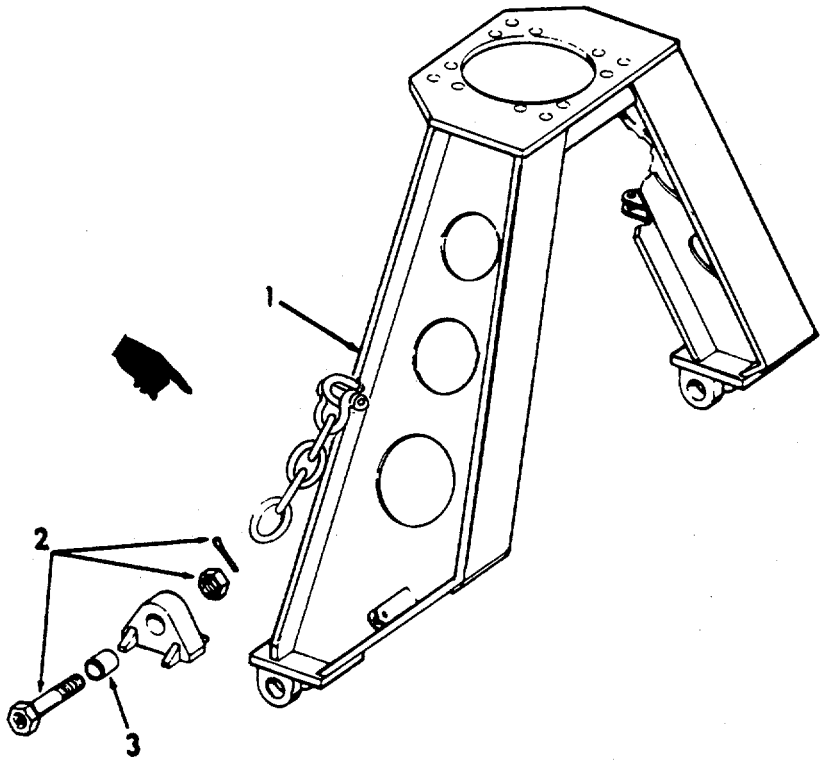
5-81. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



5-81. ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS.

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. Type GAA.	Use grease MIL-G-10924
	d. All removed parts	Reinstall.	



5-82. FAIRLEADER - ANCHOR “A” FRAME - MAINTENANCE INSTRUCTIONS.

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

INITIAL SETUP

Test Equipment
NONE

Special Tools
Crane

Material/Parts
Grease MIL-G-10924
Type GAA

Personnel Required
1

References
NONE

Equipment Condition: Condition Description
NONE

Special Environmental Conditions
NONE

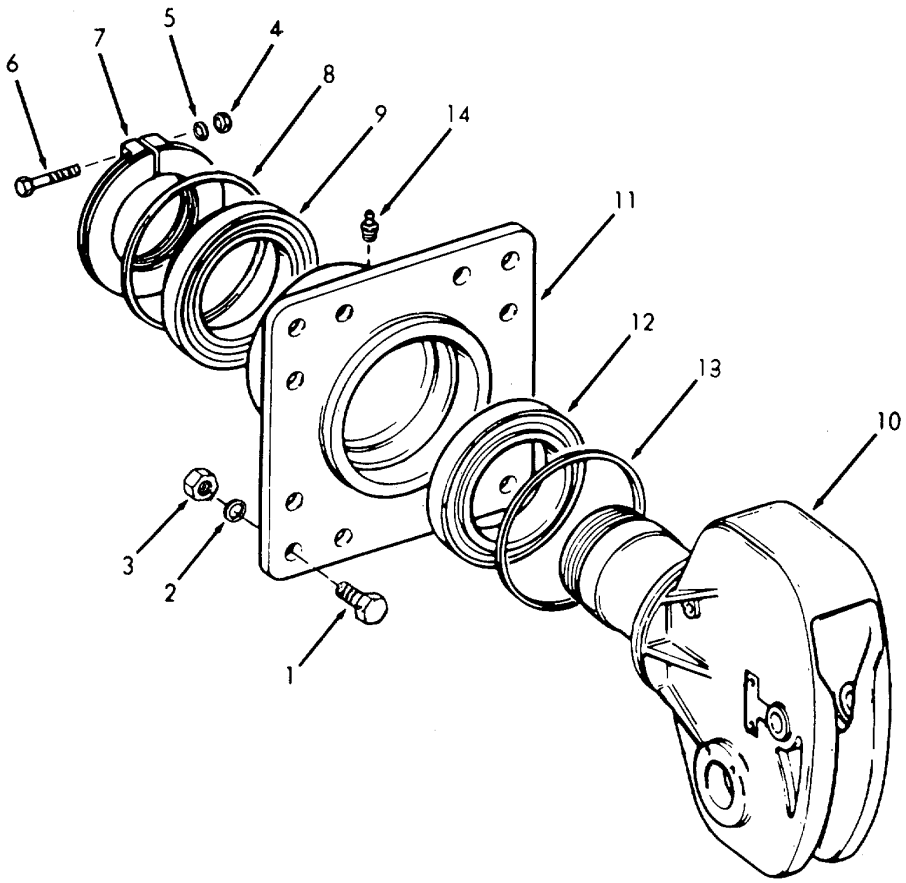
General Safety Instructions
Observe standard safety precautions when lifting heavy equipment.

5-82. FAIRLEADER - ANCHOR "A" FRAME AND CABLE - 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 (10)	Lift and remove from hub and flange (11).	

5-82. FAIRLEADER - ANCHOR "A" FRAME AND CABLE - 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.

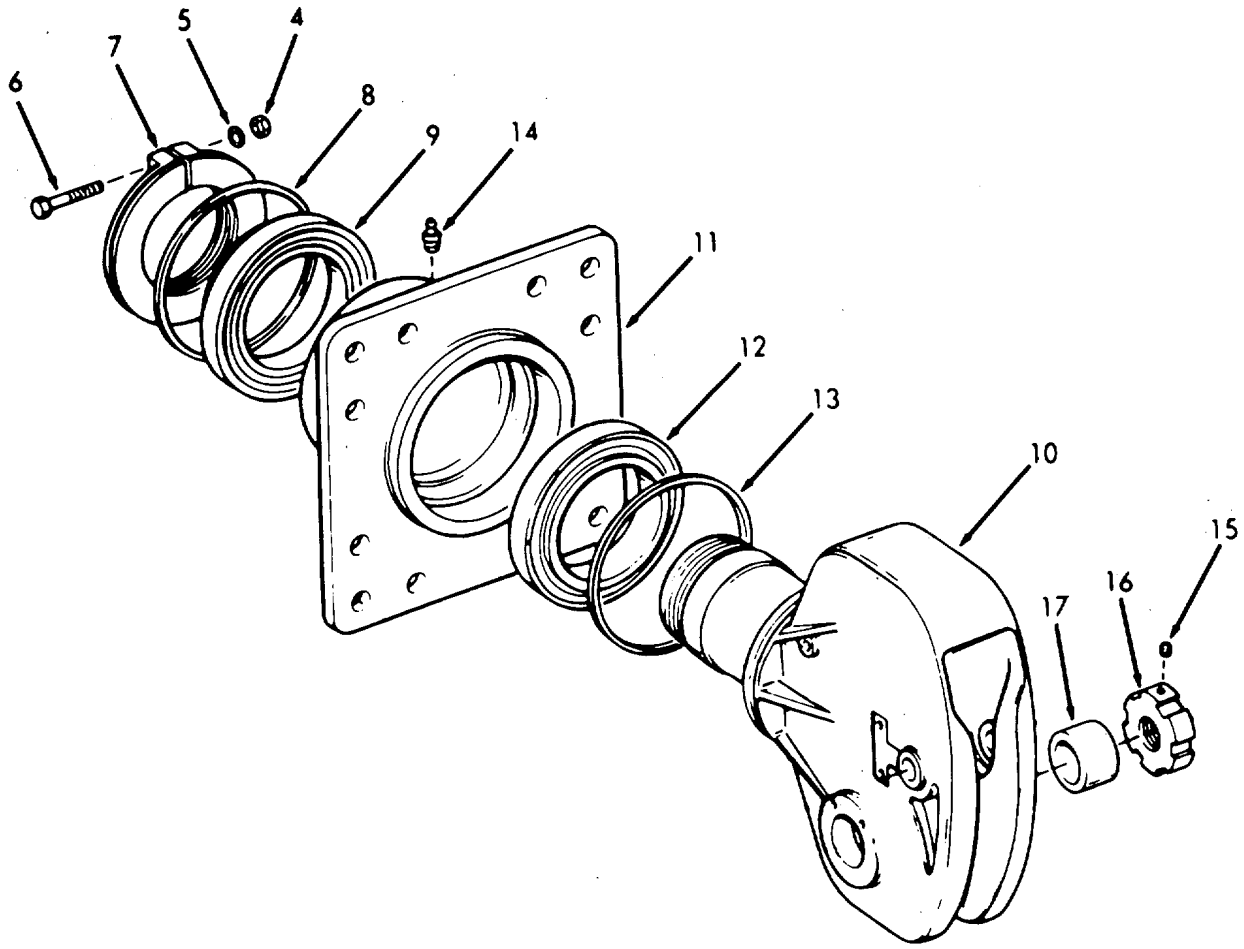


5-82. FAIRLEADER - ANCHOR "A" FRAME AND CABLE - MAINTENANCE INSTRUCTIONS. (Continued)

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. Type GAA.	Use grease MIL-G-10924

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
4. Fairlead Sheave	a. Setscrew (15)	Loosen.	
	b. Sheave nut (16)	Remove.	
	c. Spacer (17)	Remove.	

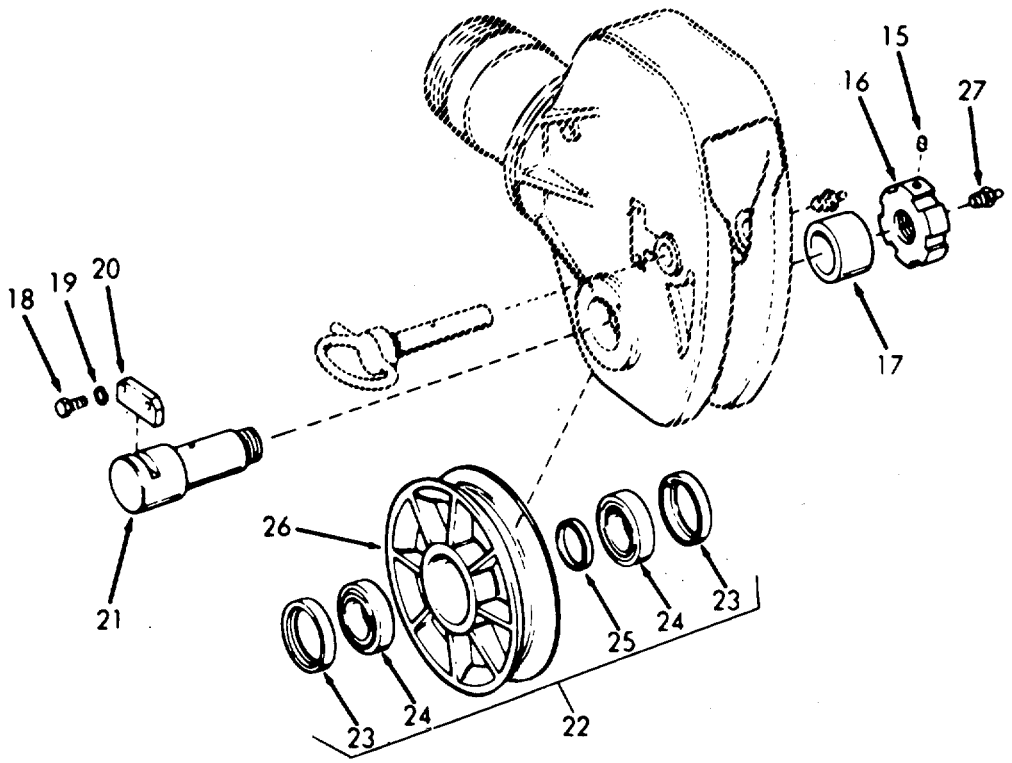


5-82. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	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), and spacer (25)	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.	

5-82. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	m. Spacer (17)	Install.	
	n. Sheave nut (16)	Install.	
	o. Setscrew (15)	Install.	
	p. Grease fitting (27)	1. Replace.	If necessary.
		2. Grease.	Use grease MIL-G-10924 Type GAA.

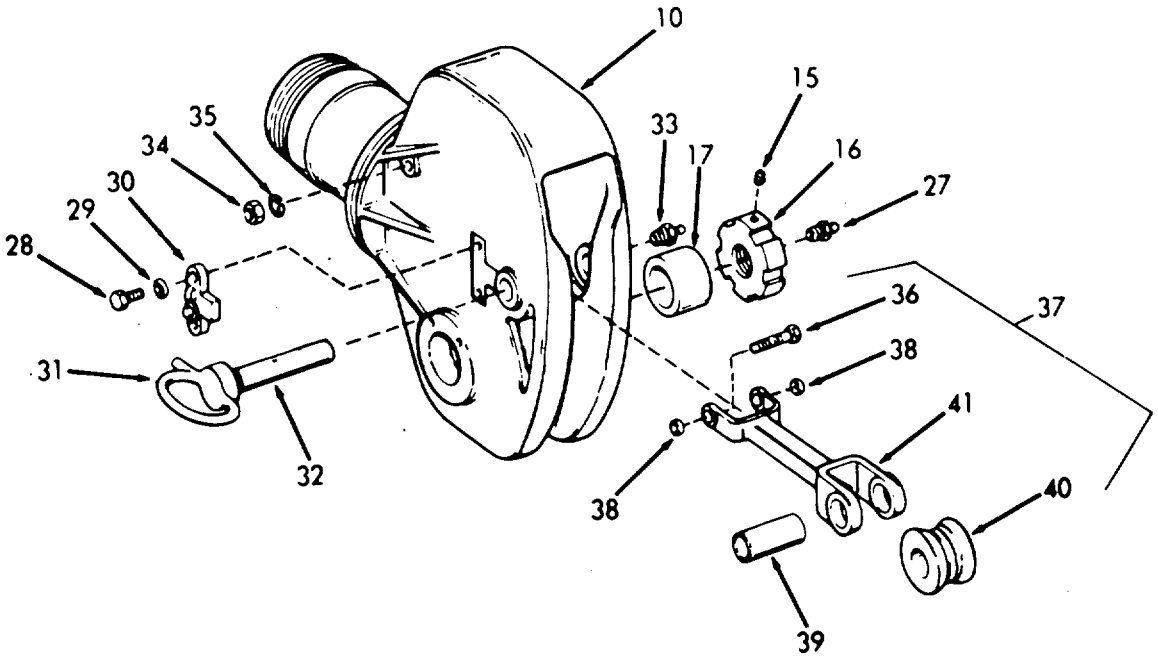


5-82. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
5. Guide Roller	a. Screws (28), lockwashers (29), and roller pin key plate keeper spring (30)	Remove.	
	b. Keeper button (31), pin (32), and grease fitting (33)	Remove.	Replace grease fitting, if necessary.
	c. Nuts (34), lock-washers (35), and screws (36)	Remove.	
	d. Roller guide assembly (37)	Remove.	
	e. Hinge bushing (38), roller sleeve (39), and guide roller (40)	1. Remove from roller frame (41). 2. Replace defective parts. 3. Reassemble.	

5-82. FAIRLEADER - ANCHOR "A" FRAME - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	f. Roller guide assembly (37)	Install in swivel head (10).	
	g. Screws (36), lockwashers (35) and nuts (34)	Install.	
	h. Keeper button (31), and pin (32)	Install.	
	i. Keeper (30), screws (28), and lockwashers (29)	Install.	



5-82. FAIRLEADER - ANCHOR “A” FRAME - MAINTENANCE INSTRUCTIONS

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.	

5-83. MAST - MAINTENANCE INSTRUCTIONS.

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

INITIAL SETUP

Test Equipment
NONE

References
Paragraph
3-185 Mast - 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
REMOVAL			

WARNING

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

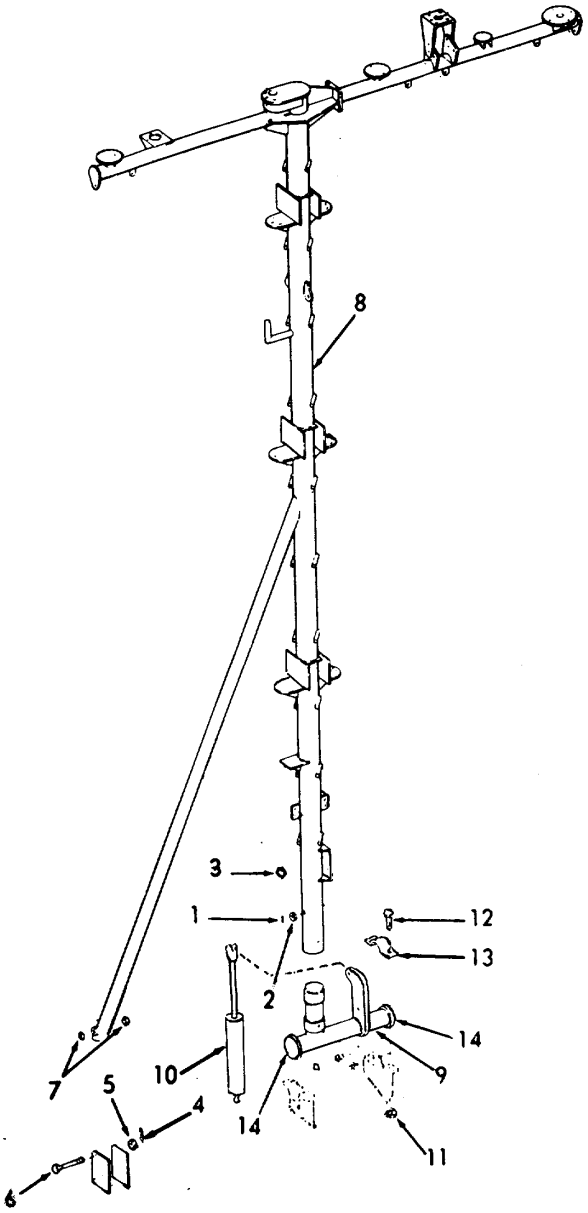
1.	Mast	a. Wiring	Tag and disconnect.
		b. Signal halyards	Remove.

5-83. MAST - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont.)			
	c. Mast	1. Place in vertical position. 2. Attach slings and crane.	
	d. Cotter pins (1), nuts (2), and bolts (3)	Remove.	
	e. Cotter pin (4), nut (5), and bolt (6)	Remove.	
	f. Teflon washers (7)	Remove.	
	g. Guy wires	Remove.	
	h. Mast (8)	Remove from pivot (9).	
2. Pivot Assembly	a. Hydraulic ram (10) and clevis attaching parts	Remove.	
	b. Nuts (11), and screws (12)	Remove.	
	c. Bearing clamps (13)	Remove.	
	d. Pivot assembly (9)	Remove.	

5-83. MAST - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont.)			
	e. Pivot caps (14)	Remove.	If necessary.



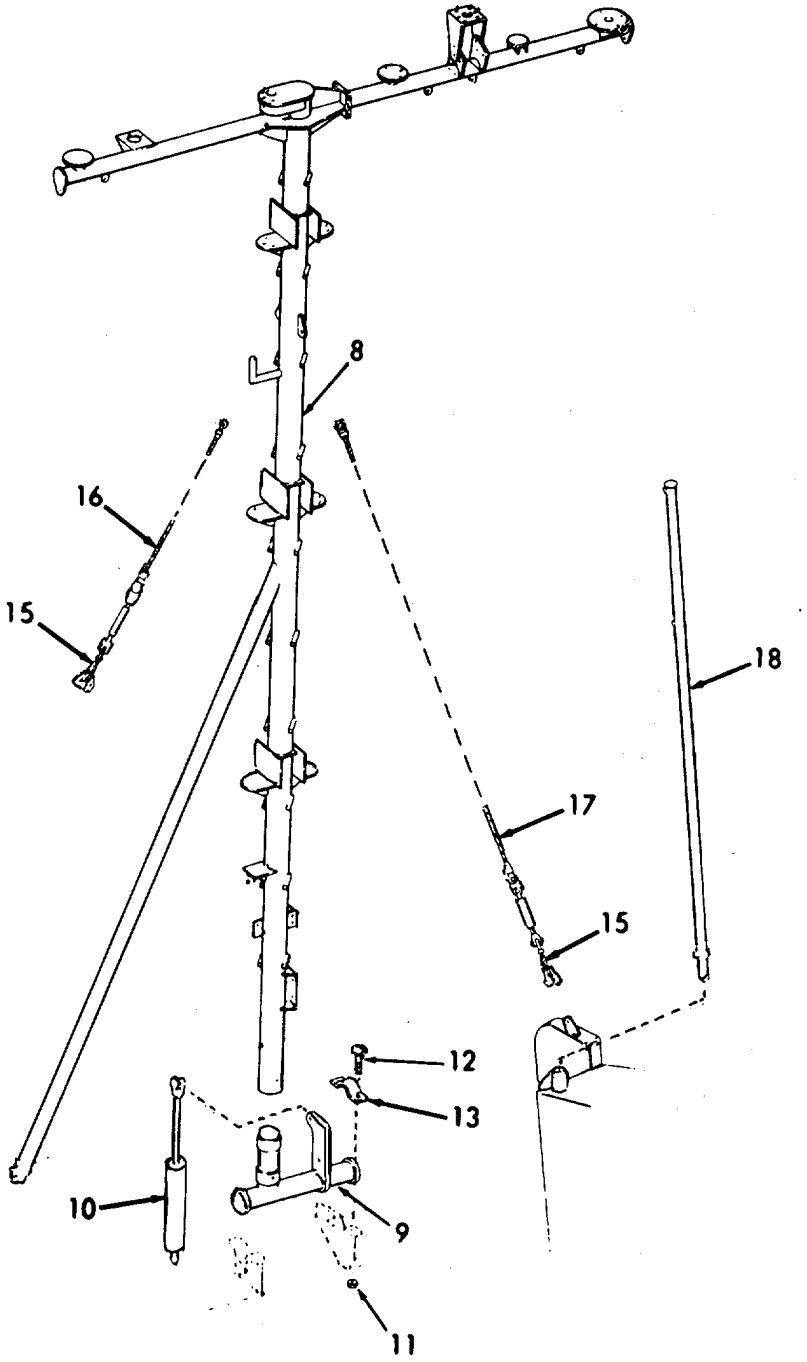
5-1113

5-83. MAST - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION		ITEM	ACTION	REMARKS
REPAIR				
3.	Guy Wire (Aft)	Socket (15), and wire rope (16)	Repair.	
4.	Guy Wire (Fwd)	Socket (15) and wire rope (17)	Repair.	
5.	Jackstaff (18)	Repair or replace as required.		
6.	Mast	Repair according to standard procedures.		
INSTALLATION				
7.	Pivot Assembly	a. Pivot assembly (9), and bearing clamp (13)	Install.	
		b. Screws (12), and nuts (11)	Install.	
		c. Hydraulic ram (10), clevis, and attaching parts	Install.	
8.	Mast (8)	a. Mast	Attach slings and cranes, and lower onto pivot assembly (9).	

5-83. MAST - MAINTENANCE INSTRUCTION. (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			

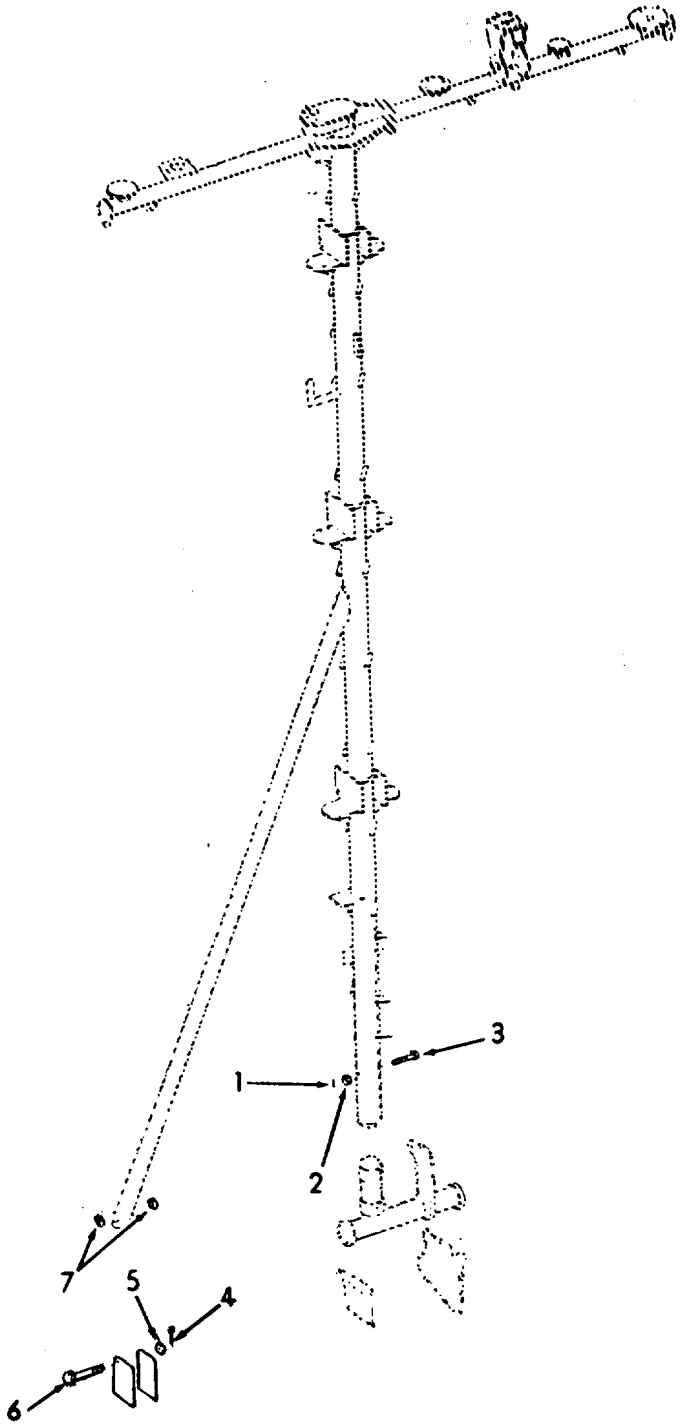


5-83. MAST - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
	b. Guy wires	Attach.	
	c. Washers (7), bolt (6), nut (5), and cotter pin (4)	Install.	
	d. Bolts (3), nuts (2), and cotter pins (1)	Install.	
	e. Signal halyards	Install.	
	f. Wiring	Reconnect.	

5-83. MAST - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			



5-84. SHIP'S HYDRAULIC SYSTEM - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance procedures.

5-85. ELECTRIC MOTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

Special Tools
Bearing puller

Material/Parts
NONE

Personnel Required
1

References
NONE

Equipment Condition
Condition Description
NONE

Special Environmental Conditions
NONE

General Safety Instructions
Observe WARNING in this procedure.

5-85. ELECTRIC MOTOR - MAINTENANCE INSTRUCTIONS (Continued.)

LOCATION	ITEM	ACTION	REMARKS

WARNING

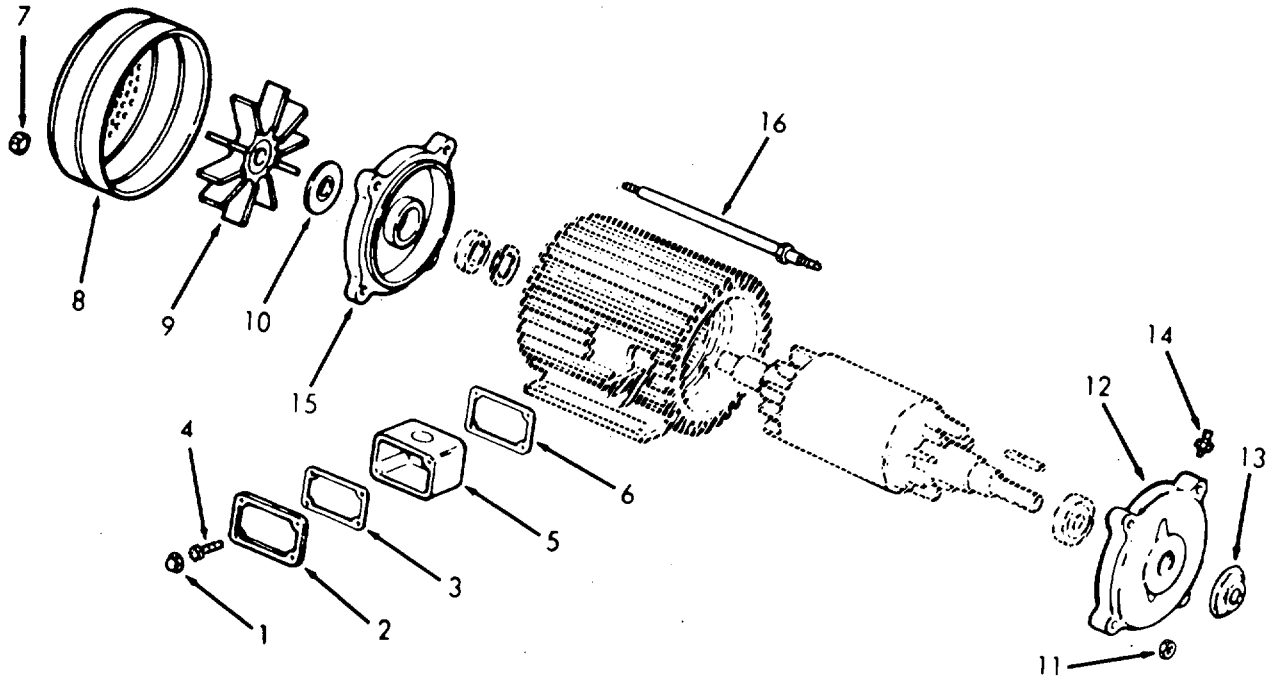
To avoid shock and serious injury, place all switches and circuit breakers in the OFF position and tag.

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.
	l.	Rubber Slinger (10)	Remove.

5-85. 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.	

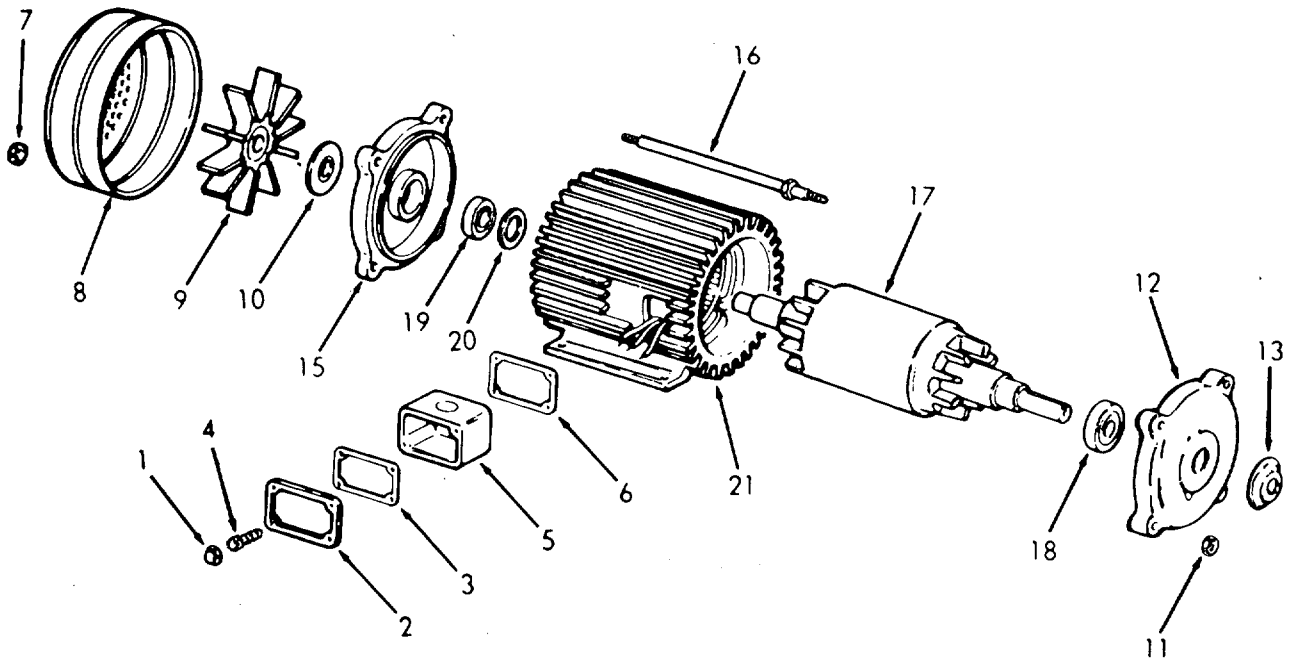


5-85. ELECTRIC MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont.)			
	p. Rotor and shaft (17), bearings (18 and 19), and spring washer (20)	1. Remove from stator (21). 2. Disassemble. 3. Replace defective parts. 4. Reassemble. 5. Install into stator (21).	Use bearing puller.
	q. Thru bolts (16)	Install.	
	r. Blind end bracket (15), and shaft end bracket (12)	Install.	
	s. Rubber slinger (13), and nuts (11)	Install.	
	t. Rubber slinger (10), and fan (9)	Install.	
	u. Fan shroud (8), and nuts (7)	Install	

5-85. ELECTRIC MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
	v. Conduit box gasket (6), and box (5)	Install.	
	w. Studs (4)	Install.	
	x. Wiring	Reconnect.	
	y. Conduit box gasket (3) and cover (2)	Install.	
	z. Acorn nuts (1)	Install.	



5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

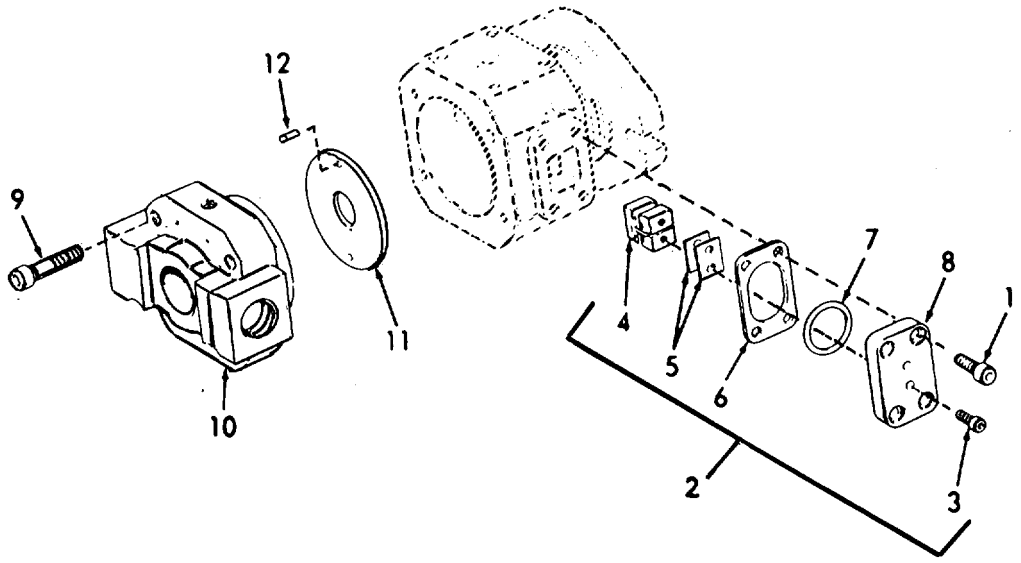
INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition / Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
Repair kit P/N 723200	NONE
Personnel Required	**General Safety Instructions**
1	Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL - DISASSEMBLY			
1. Pump	a. Screws (1)	Remove.	
	b. Thrust block assembly (2)	Remove.	
	c. Screws (3)	Remove.	
	d. Thrust block (4), and shims (5)	Remove.	Discard.

5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
	e. Seal plate (6)	Remove.	
	f. O-ring (7), and cap (8)	Disassmble.	Discard O-ring.
	g. Screws (9), and body (10)	Remove.	
	h. Body plate (11), and roll pin (12)	Remove.	Discard.

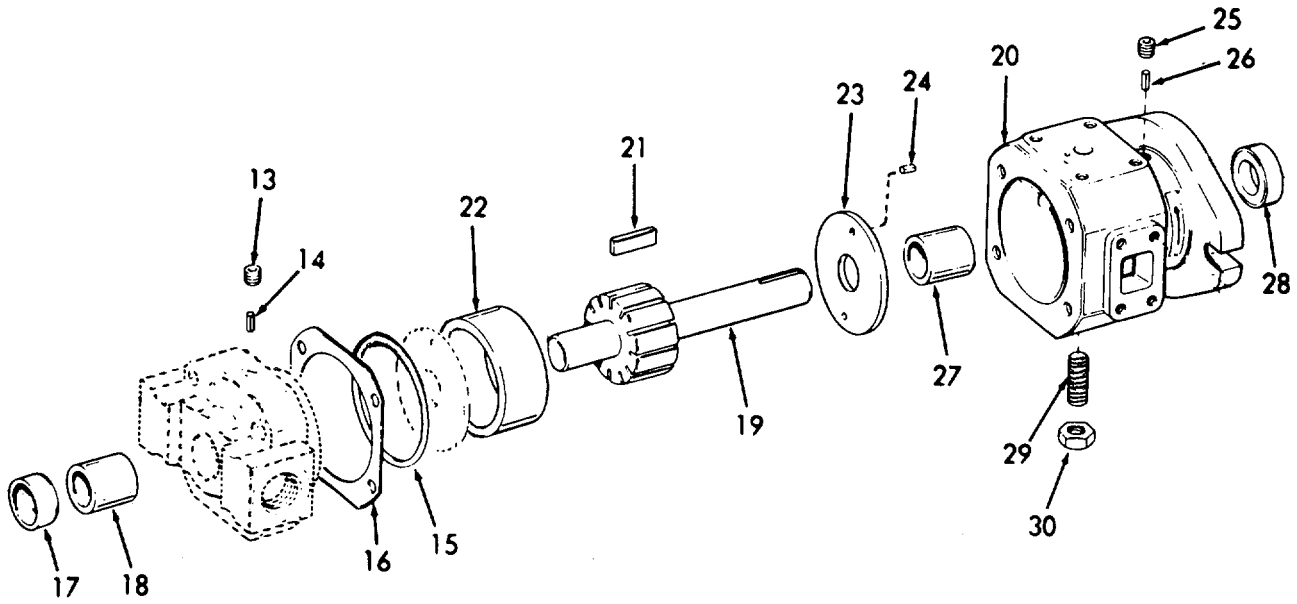


5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
	i. Pipe plug (13), and roll pin (14)	Remove if necessary.	Discard roll pin.
	j. O-ring seal (15), and shim (16)	Remove.	Discard shim.
	k. End cover plug (17)	Remove.	
	l. Journal bearing (18) ,	Remove.	Discard.
	m. Shaft (19)	Remove from cover (20).	
	n. Vanes (21), ring (22), plate cover (23), and roll pin (24)	Remove.	Discard.

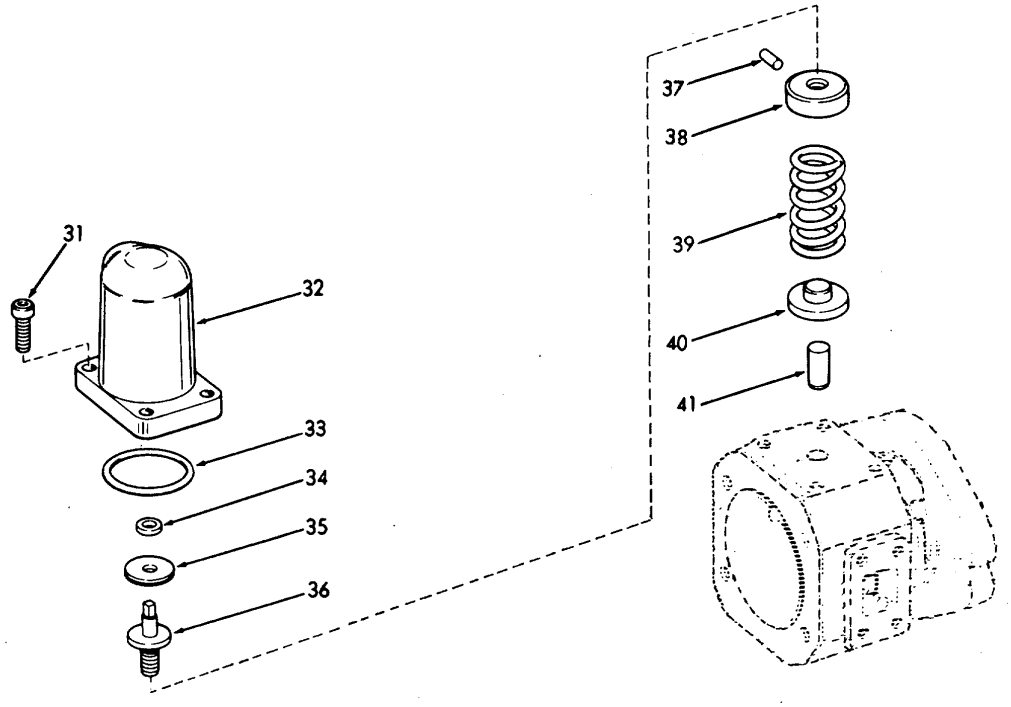
5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
	o. Pipe plug (25), and roll pin (26)	Remove if necessary.	Discard roll pin.
	p. Journal bearing (27), and shaft seal (28)	Remove.	Discard.
	q. Adjusting screw (29), and locknut (30)	Remove if necessary.	



5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
2. Relief Valve	a. Screws (31)	Remove.	
	b. Governor body (32)	Remove.	
	c. O-rings (33 and 34)	Remove.	Discard.
	d. Thrust washer (35), and adjusting screw (36)	Remove.	
	e. Roll pin (37)	Remove.	Discard.
	f. Spring seat (38), and spring (39)	Remove.	
	g. Spring seat (40), and dowel pin (41)	Remove.	



5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

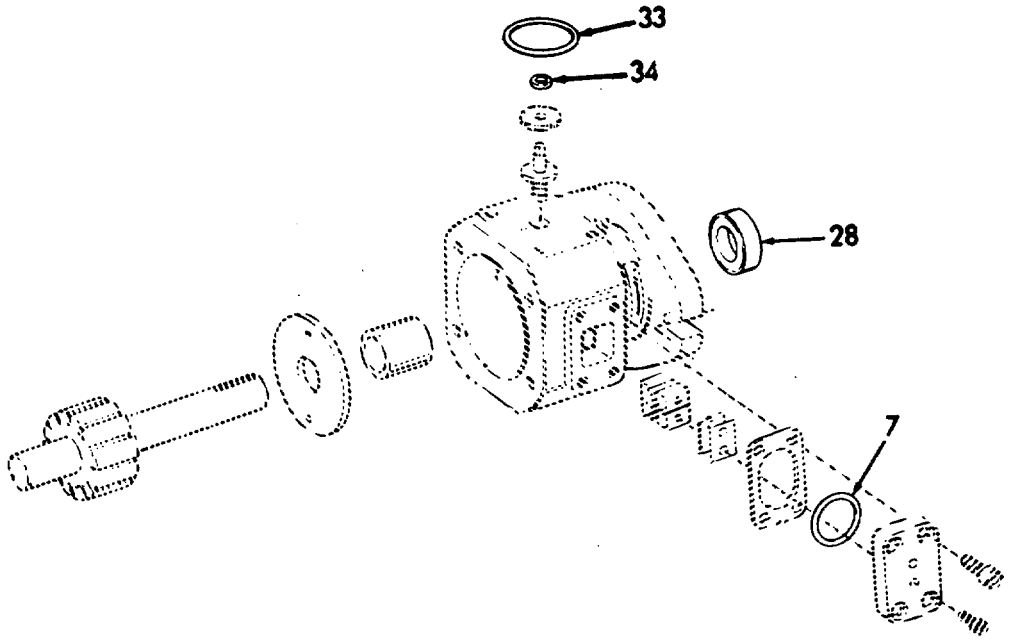
LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-CLEANING- INSPECTION (Cont)

WARNING

Wear protective eye goggles when using compressed air.

3.	Pump and Relief Valve	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 (28) and O-rings (7, 33, and 34). Wash the metal parts in a solvent, blow them dry with filtered compressed air and place them on a clean surface for inspection.	



5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

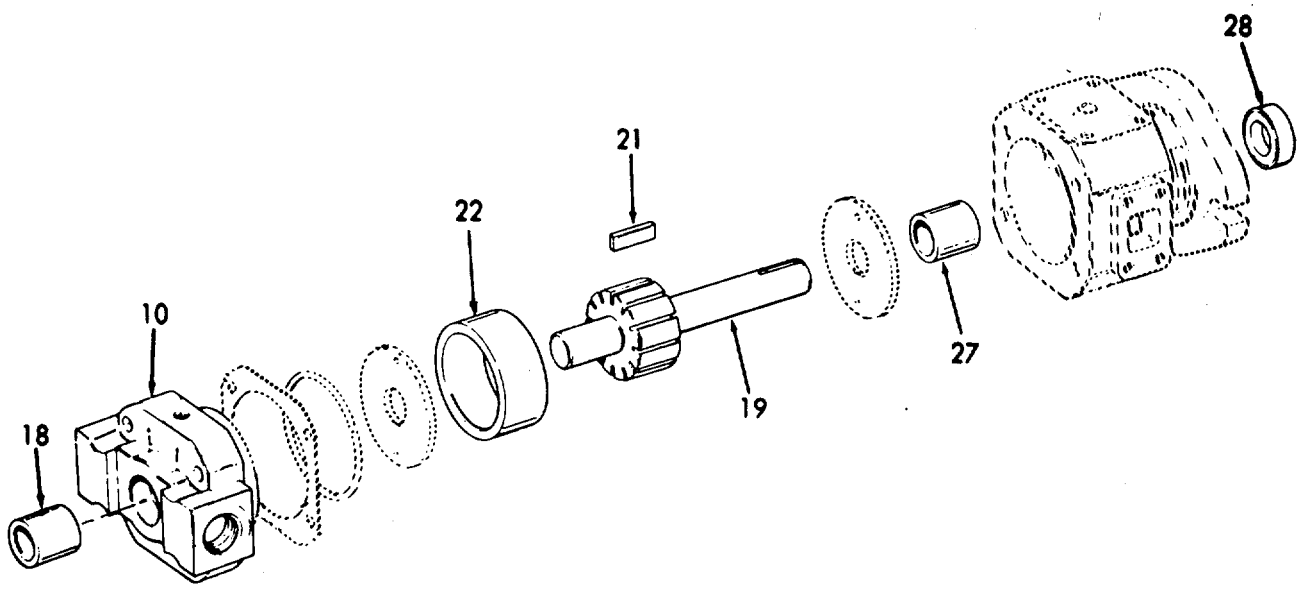
OVERHAUL-CLEANING- INSPECTION (Cont)

2. Check the wearing surfaces of the body (10), ring (22), and rotor (19) for scoring and excessive wear. Remove light score marks by lapping. Replace any heavily scored or badly worn parts.

3. Inspect the vanes (21) for burrs, wear and excessive play in the rotor slots. Replace the vanes (21) and rotor (19) if the slots are worn.

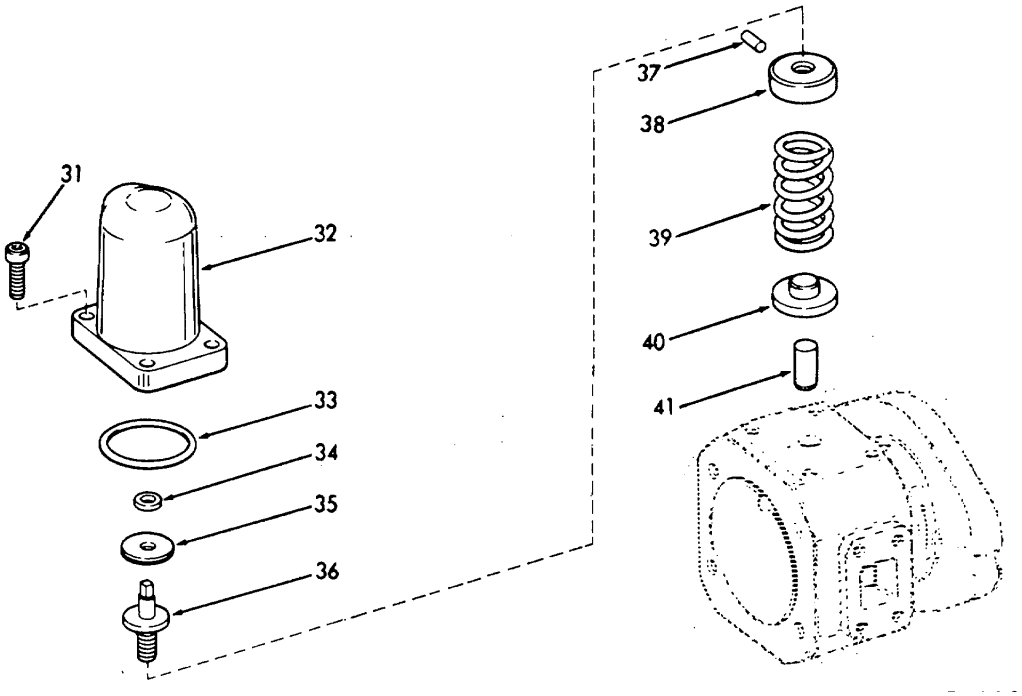
4. Check the bearing journals (18 and 27) for wear and looseness. Rotate the bearings while applying pressure to check for pitted or cracked races.

5. Inspect the oil seal (28) mating surface on shaft (19) for scoring or wear. If marks on shaft cannot be removed by light polishing, replace the shaft.



5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-REASSEMBLY			
4. Relief Valve	a. Dowel pin (41), and spring seat (40)	Install.	
	b. Spring (39), and spring seat (38)	Install.	
	c. Roll pin (37)	Install.	Use new pin.
	d. Adjusting screw (36), and thrust washer (35)	Install.	
	e. O-rings (33 and 34)	Install.	Use new O-rings.
	f. Governor body (32), and screws (31)	Install.	

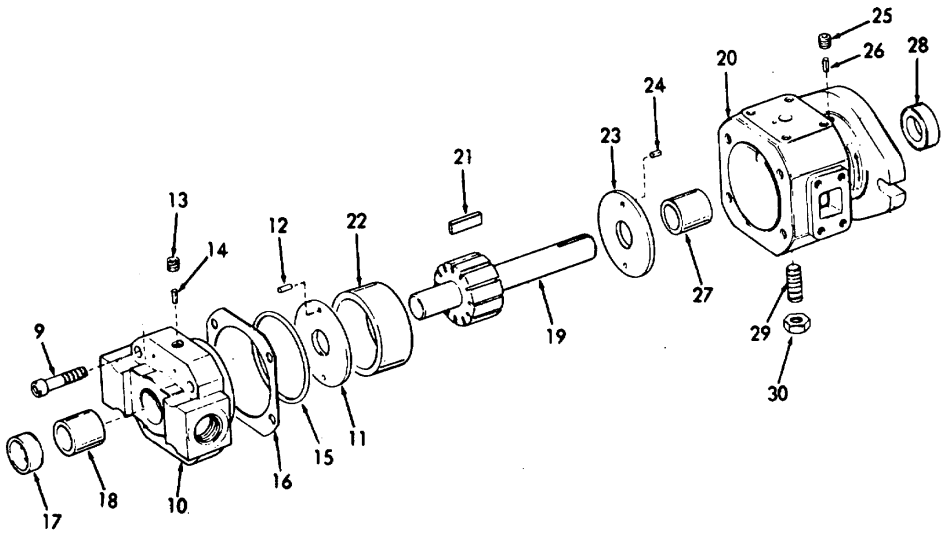


5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-REASSEMBLY (Cont)			
5. Pump	a. Adjusting screw (29), and locknut (30)	Install.	
	b. Shaft seal (28), and journal bearing (27)	Install.	Use new parts.
	c. Roll pin (26), and pipe plug (25)	Install.	Use new roll pin.
	d. Plate cover (23), and roll pin (24)	Install.	Use new parts.
	e. Ring (22)	Install.	Use new ring.
	f. Shaft (19)	Install in cover (20).	
	g. Vanes (21)	Install.	Use new vanes.
	h. Journal bearing (18), and end cover plug (17u	Install in body (10).	

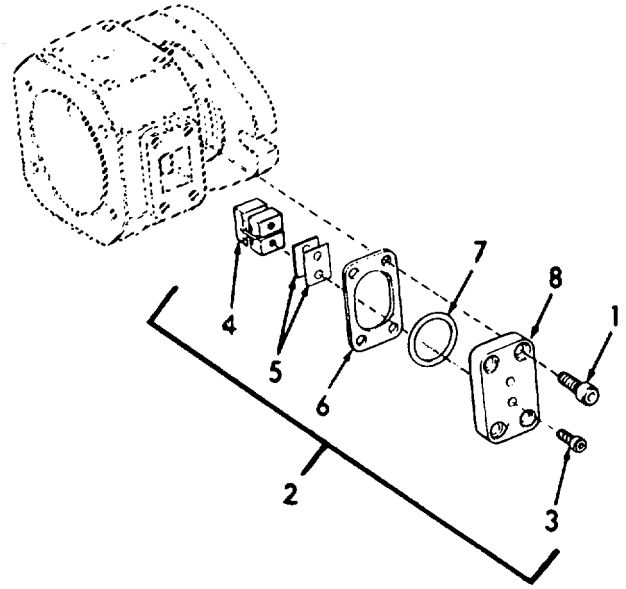
5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-REASSEMBLY (Cont)			
	i. Shims (16), and O-ring seal (15)	Install.	Use new shims with the same thickness of old.
	j. Roll pin (14), and pipe plug (13)	Install	Use new roll pin.
	k. Body plate (11), and roll pin (12)	Install.	Use new parts.
	l. Body (10), and screws (9)	Install.	



5-86. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-REASSEMBLY (Cont)			
	m. Cap (8), and "0" ring (7)	Assemble.	Use new O-ring.
	n. Seal plate (6)	Install.	
	o. Thrust block (4), and shims (5)	Install.	Use new shims with the same thickness as old.
	p. Screws (3)	Install.	
	q. Thrust block assembly (2), and screws (1)	Install.	



5-87. HYDRAULIC RESERVOIR - MAINTENANCE INSTRUCTIONS.

This task covers:

Replacement

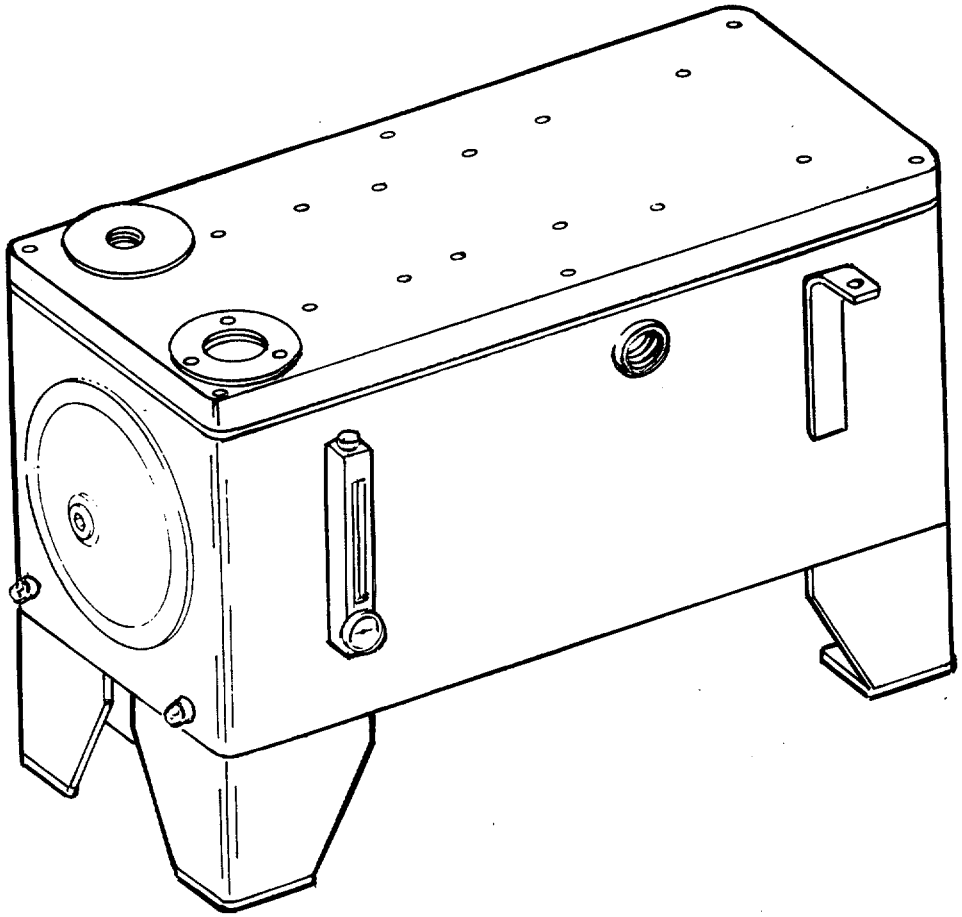
INITIAL SETUP

Test Equipment	References	
NONE	NONE	
Special Tools	Equipment Condition	Condition Description
NONE	Paragraph 3-180 Hydraulic Reservoir	
Material/Parts	Special Environmental Conditions	
NONE	Do not drain oil into bilge. Use the oil/water separation and recovery system to collect used oil.	
Personnel Required	General Safety Instructions	
4	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.	

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

LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont)			



. 5-88. CONTROLLER - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment Condition
NONE

Condition Description

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
1

General Safety Instructions
Observe WARNING in Procedure

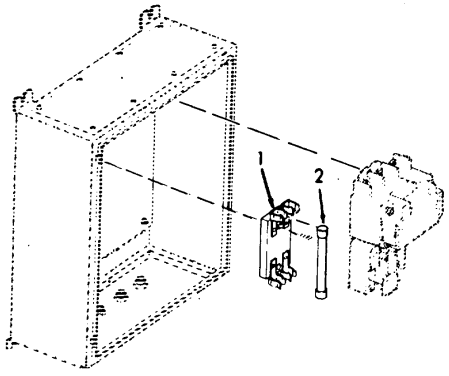
LOCATION	ITEM	ACTION	REMARKS

REPAIR

WARNING

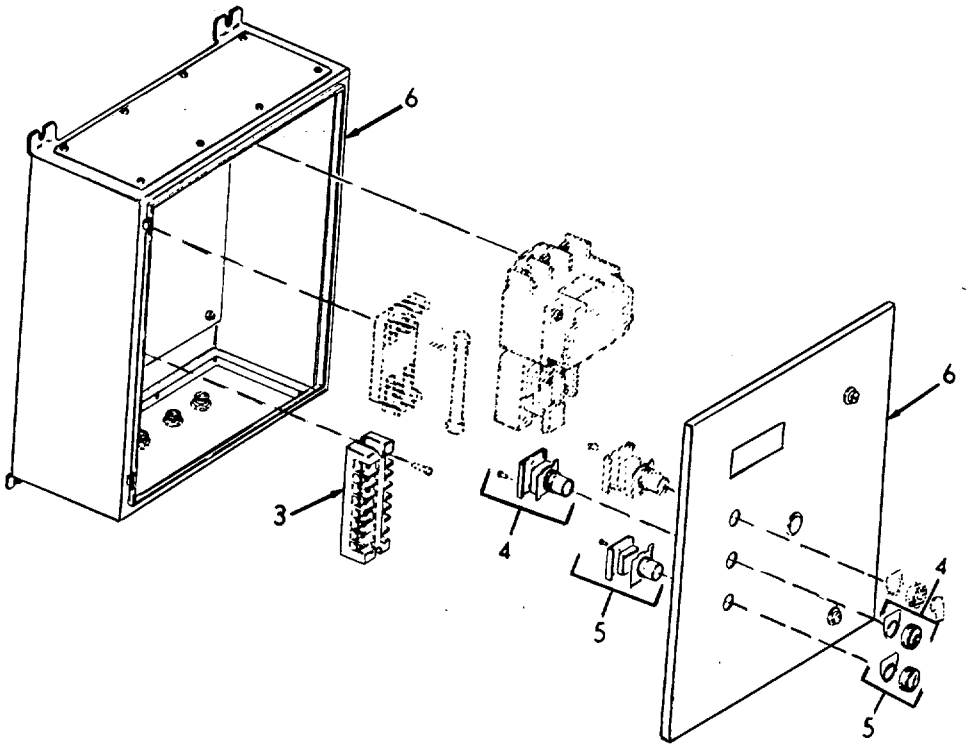
To avoid shock and possible injury, tag and place circuit breaker in the OFF position.

1.	Controller	a. Fuse block (1), and fuses (2)	Replace.



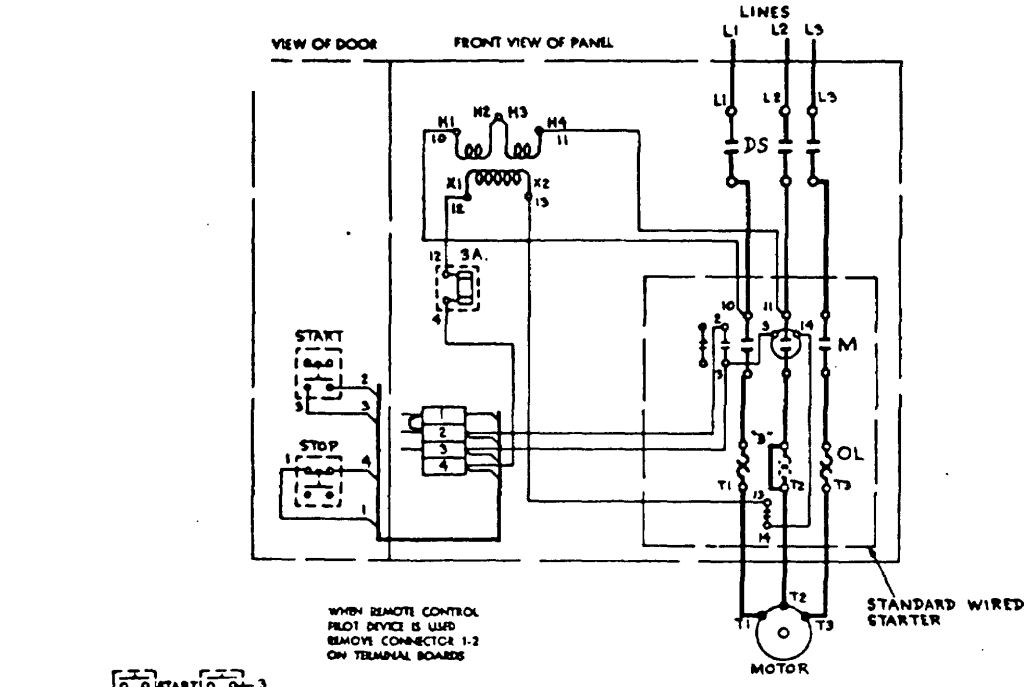
5-88. CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	b. Terminal block (3)	1. Tag and disconnect wires. 2. Replace.	
	c. Start pushbutton (4)	Replace.	
	e. Stop pushbutton (5)	Replace.	
	f. Wall Enclosure (6)	Replace.	



5-88. CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



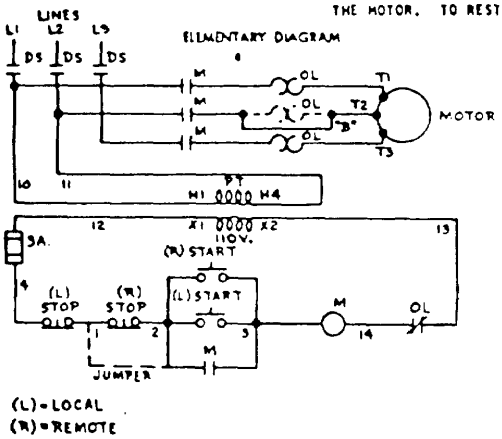
WHEN MORE THAN ONE PUSH BUTTON STATION IS USED CONNECT PER DOTTED LINES OMITTING CONNECTOR "A"

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 BUTTOM (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.



5-89. GAGES - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

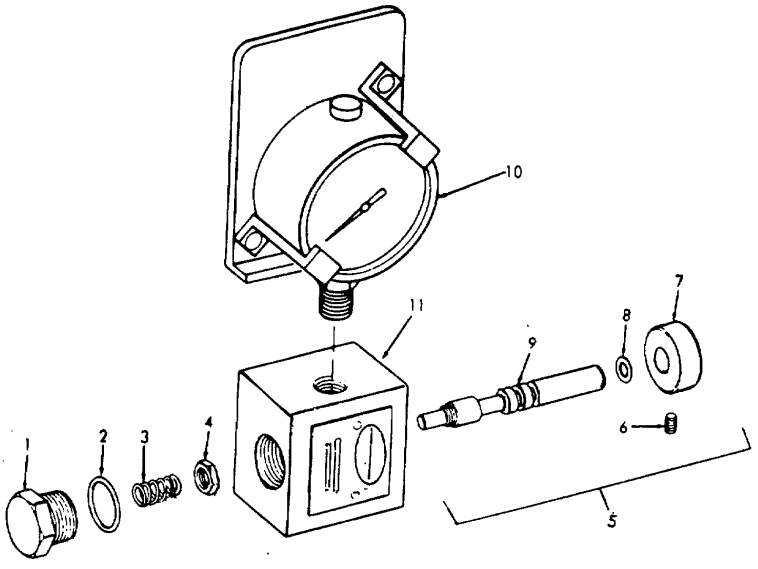
INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition** / **Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
1	NONE

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
Gage and Isolato	a. Plug (1), and "0" ring (2)	Remove.	
	b. Spring (3), and stop nut (4)	Remove.	
	c. Spool and knob assembly (5)	Remove.	
	d. Setscrew (6), and knob (7)	1. Loosen setscrew. 2. Remove knob.	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	e. O-ring (8), and spool (9)	Remove.	
	f. Gage (10)	Replace in body (11).	
	g. Spool (9), O-ring (8), knob (7), and setscrew (6)	Assemble.	
	h. Spool assembly (5)	Install in body (11).	
	i. Stop nut (4)	Install.	
	j. O-ring (2)	Install in body (11).	
	k. Spring (3), and plug (1)	Install.	



5-90. PUSHBUTTON SWITCH - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment Condition
NONE

Condition Description

Material/Parts
NONE

Special Environmental Conditions
NONE

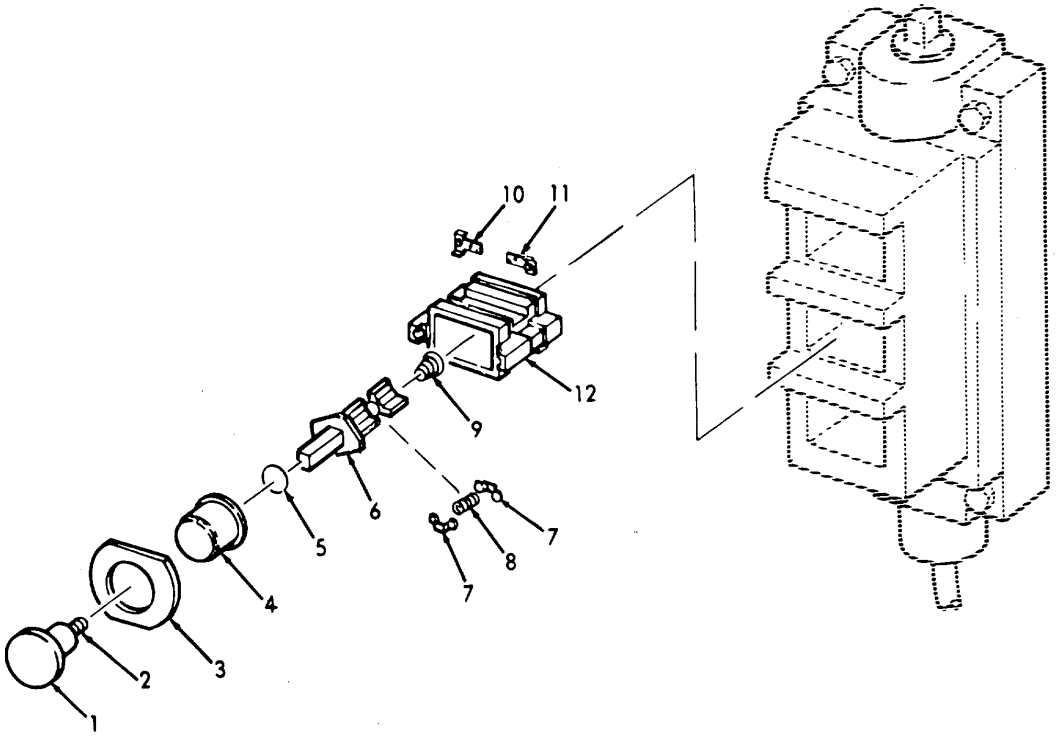
Personnel Required
1

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
1. Pushbutton Switch	a. Diaphragm (1)	Remove.	
	b. Screws (2)	Remove from diaphragm (1).	
	c. Gasket (3), and pushbutton (4)	Remove.	
	d. Spring ring (5)	Remove.	
	e. Plunger (6)	1. Remove. 2. Disassemble movable contacts (7) and spring (8).	

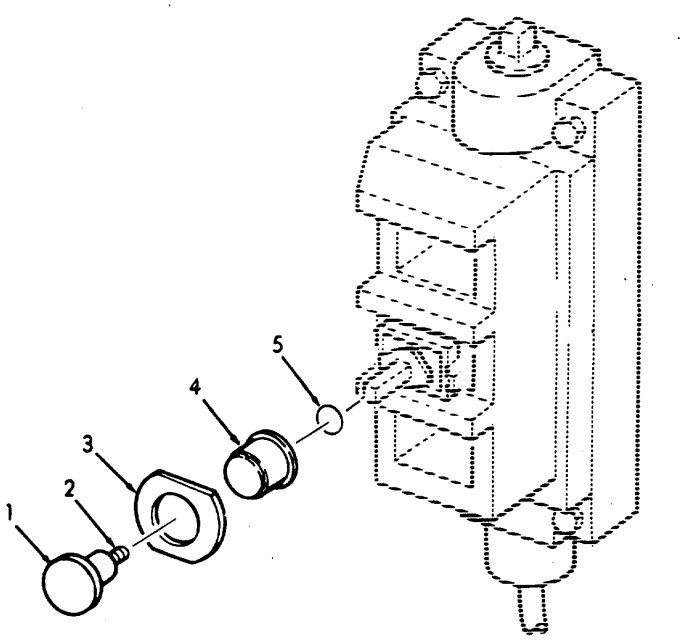
5-90. PUSHBUTTON SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	f. Spring (9)	Remove.	
	g. Stationary contact (left) (10), and contact (right) (11)	1. Remove from base (12). 2. Replace.	
	h. Spring (9) i. Plunger (6)	Install. 1. Reassemble movable contacts (7), and spring (8). 2. Install.	



5-90. PUSHBUTTON SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	j. Spring ring (5), push-button (4), and gasket (3)	Install.	
	k. Screw (2)	Install in diaphragm.	
	l. Diaphragm (1)	Install.	



5-91. STERN GATE HYDRAULIC SYSTEM - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance procedures.

5-92. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

Special Tools
NONE

Material/Parts
Seal kit P/N 723394

Personnel Required
1

References
NONE

Equipment Condition
Condition Description
NONE

Special Environmental Conditions
NONE

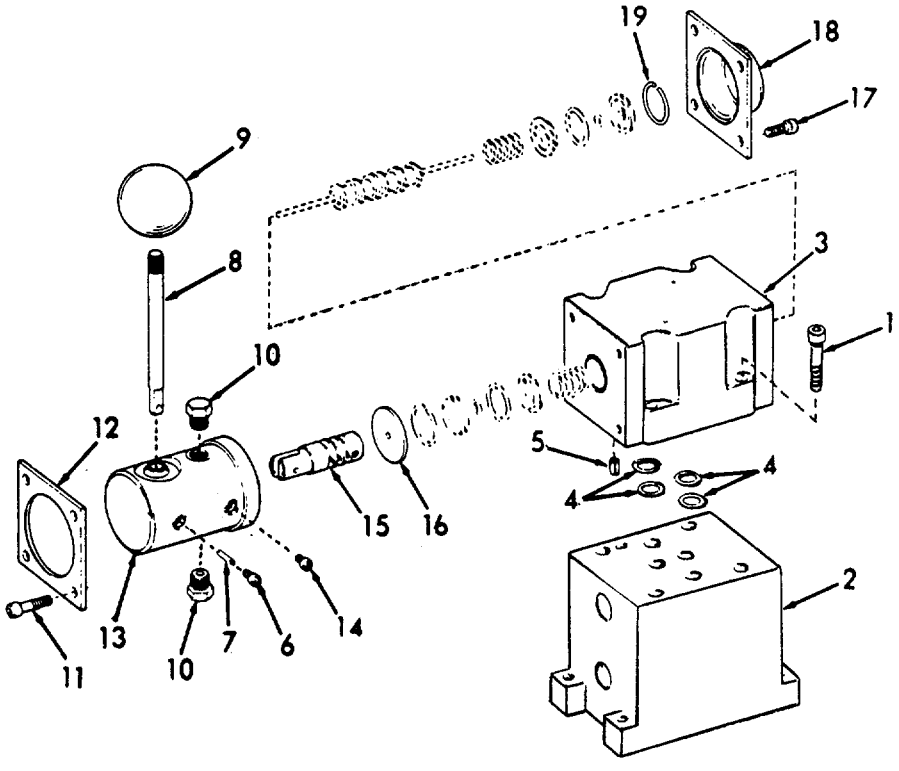
General Safety Instructions
NONE

5-92. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
		NOTE When reassembling all interior parts, coat lightly with hydraulic fluid.	
1. Directional - Control Valve	a. Screws (1)	Remove.	
	b. Subplate. (2), and body (3)	Remove.	
	c. O-ring seals (4)	Remove.	Discard.
	d. Spring pin (5), screw (6), and spring pin (7)	Remove.	If necessary.
	e. Control lever (8)	1. Remove. 2. Remove knob (9).	If necessary.
	f. Pipe plugs (10)	Remove.	If necessary.
	g. Screws (11), end cap clamp (12), and cap (13)	Remove.	

5-92. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	h. Screw (14), detent stem (15), and end cap flat washer (16)	Remove.	
	i. Screws (17), end cap (18), and retaining rings (19)	Remove.	

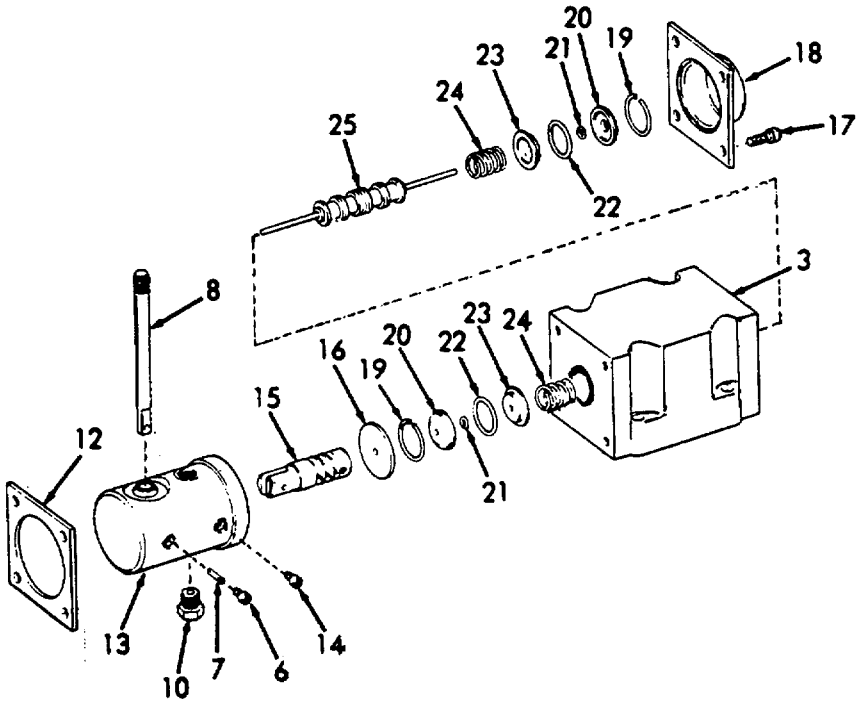


5-92. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	j. Retainer seal plugs (20), and O-ring seals (21 and 22)	1. Remove from body (3). 2. Replace defective parts. 3. Replace "O" ring seals.	Discard O-ring seals (21 and 22).
	k. Seal retainers (23), spool springs (24), and spool (25)	1. Reassemble 2. Insert in body (3).	
	l. Retaining rings (19), and end cap (18)	Install.	
	m. Screws (17), and end cap clamp (12)	1. Install. 2. Place over cap.	
	n. Control lever (8), spring pin- (7), and detent stem (15)	Align holes and insert spring pin.	

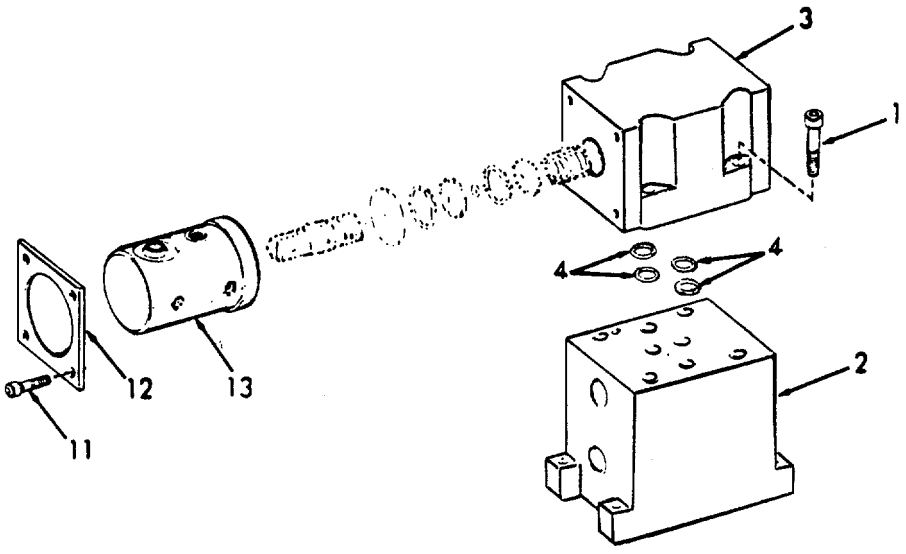
5-92. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	o. End cap (13), and screw (6)	Install.	
	p. Screw (14)	Insert.	Make sure the screw is in the detent stem (15).
	q. Pipe plugs (10)		Install.
	r. End cap flat washer 16)	Install.	



5-92. HYDRAULIC CONTROL - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)l			
	s. End cap (13), and assembled parts, and end cap clamp (12)	Align holes.	
	t. Screws (11)	Install.	
	u. O-ring seals (4), subplate (2), and body (3)	Assemble.	
	v. Screws (1)	Install.	



5-93. HOSES, FITTINGS AND PIPING - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment

None

Special Tools

None

Material/Parts

None

Personnel Required

2

References

None

Equipment

Condition	Condition Description
None	

Special Environmental Conditions

None

General Safety Instructions

Make sure the hydraulic system is tagged and inoperative.
Bleed all lines prior to opening.

5-93. HOSES, FITTINGS AND PIPING - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS

REPAIR - REPLACE

NOTE

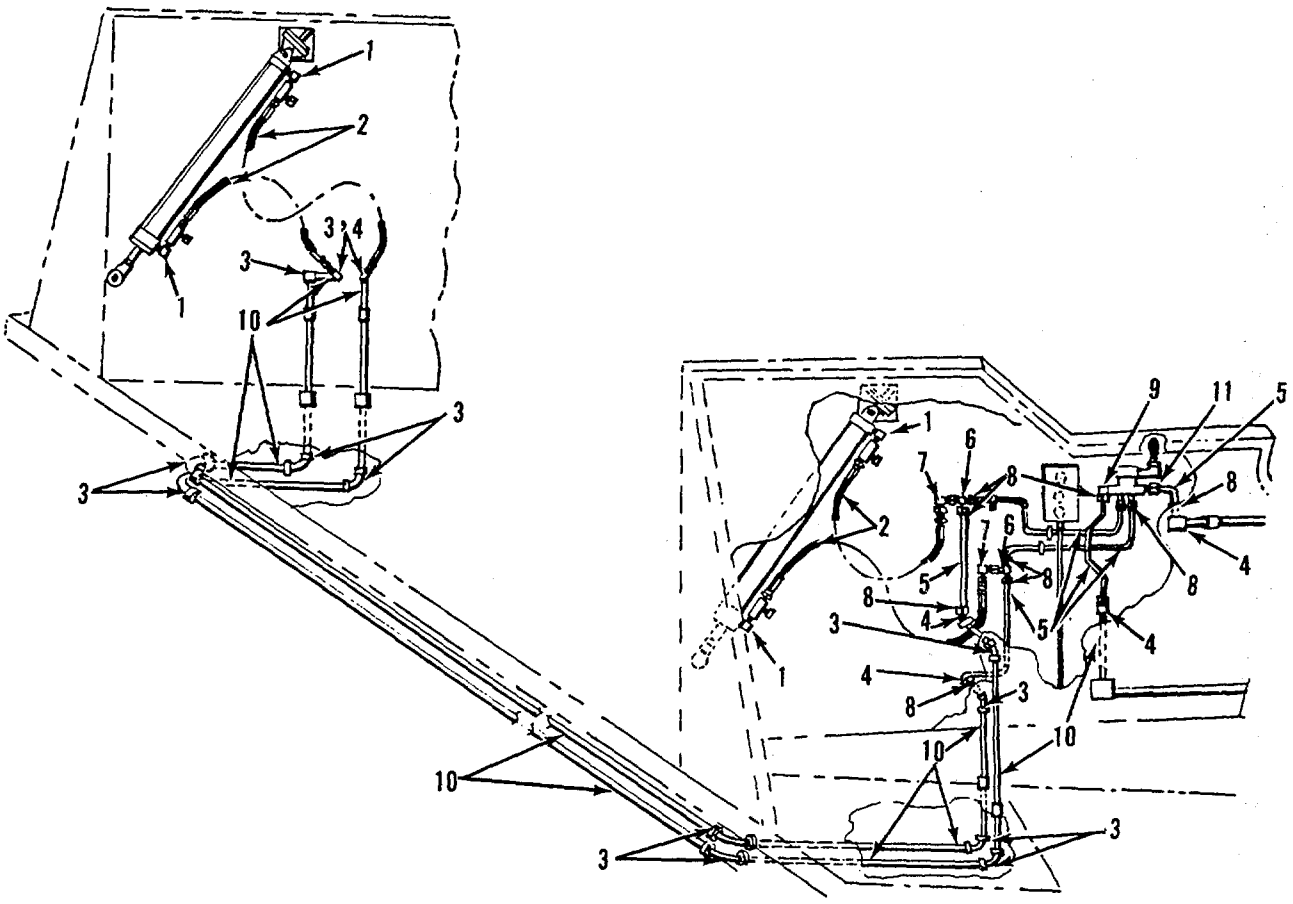
Repair or replace the following parts.

PART NUMBER	DESCRIPTION
1.	Elbow, 90°, male (3/4" x 1/2" pipe)
2.	Hose and Connectors
3.	Elbow, 90°, female (1/2" pipe)
4.	Elbow, 90°, female (1/2" tube x 1/2" pipe)
5.	Tubing (1/2")
6.	Tee Union (1/2" tube)
7.	Elbow, 90°, male (1/2" x 1/2" tube)
8.	Flare rube Nut and Ferrule
9.	Elbow, 90°, male (1/4" pipe x 1/2" tube)
10.	Pipe (1/2")
11.	Connector, male, straight

5-93. HOSES, FITTINGS AND PIPING - MAINTENANCE INSTRUCTIONS
(Continued)

LOCATION	ITEM	ACTION	REMARKS

REPAIR - REPLACE



5-94. HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS

This task covers:

Repair

INITIAL SETUP

Test Equipment	References
None	None
Special Tools	**Equipment Condition / Condition Description**
Spanner wrench (pin type or equivalent) Strap wrench Vise (soft jaws and copper pads)	None
Material/Parts	**Special Environmental Conditions**
None	None
Personnel Required	**General Safety Instructions**
2	**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 position.	Move to fully retracted	
	b. Hydraulic Cylinder	Remove.	Refer to paragraph 3-196.

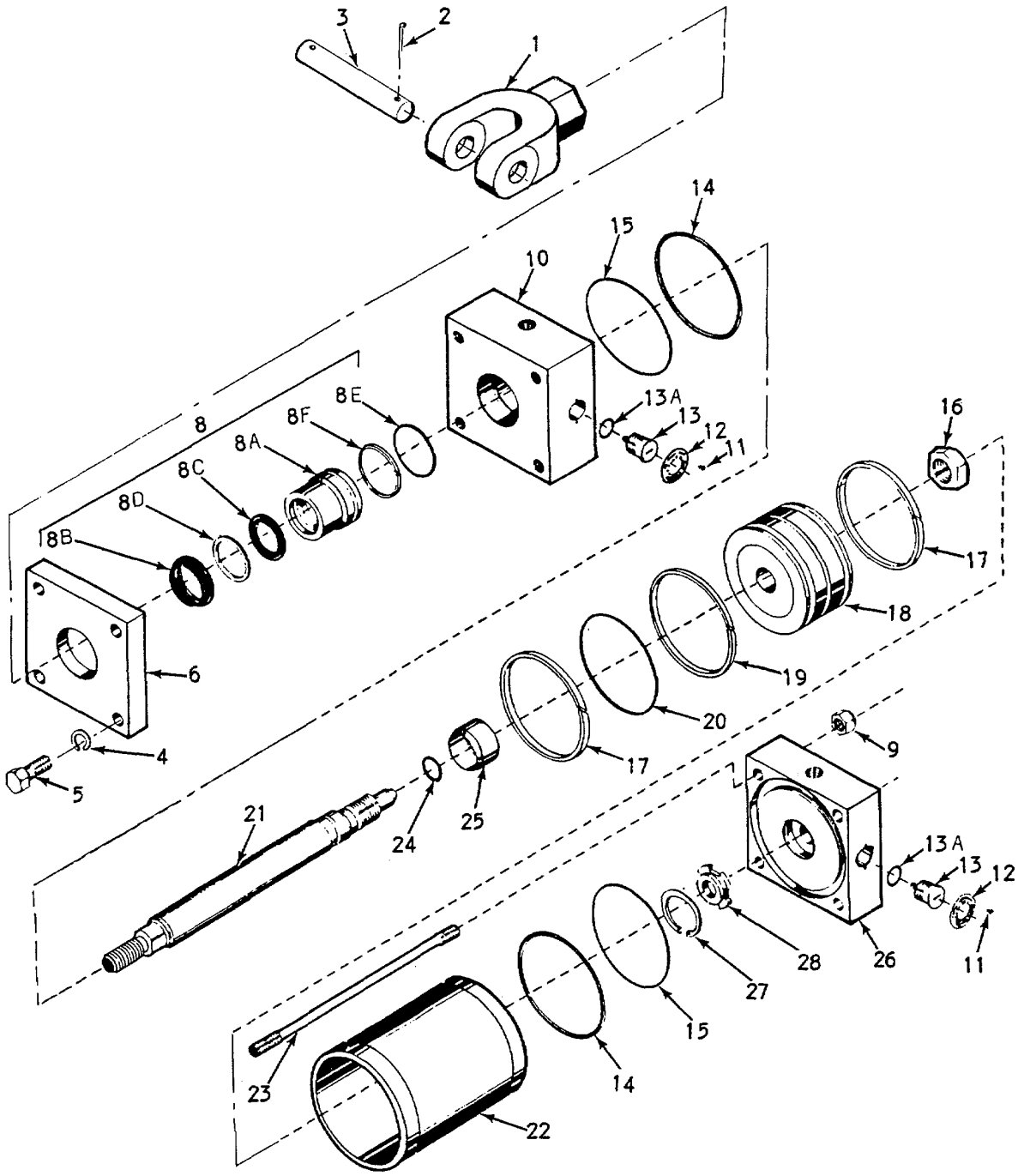
5-94. HYDRAULIC CYLINDER - STERN GATE - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR - (Cont)			
	c. Cylinder	Drain fluid by manually cycling cylinder.	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), "0" ring/ "U" cup packing (8C), rod backup ring (8D), "0" 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).	

5-94. HYDRAULIC CYLINDER - STERN GATE - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS

REPAIR - (Cont)



5-94. 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), "0" 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	1. Clean 2. Inspect for wear and damage, especially piston bearing (18), associated "0" 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).	

5-94. 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 (88), "O" ring/"U" cup packing (8C), rod backup ring (8D), "0" 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) (26), into single unit with tie rods and lock nuts.	Tie cylinder tube (22), head (10) and cap	
	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.

Change 1 5-1158 All data on pages 5-1159 thru 5-1162 deleted.

5-95. MAST HYDRAULIC - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS

The following is an index to the maintenance procedures.

5-96. HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

Special Tools

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

Material/Parts

NONE

Personnel Required

2

References

NONE

Equipment Condition: Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

WARNING

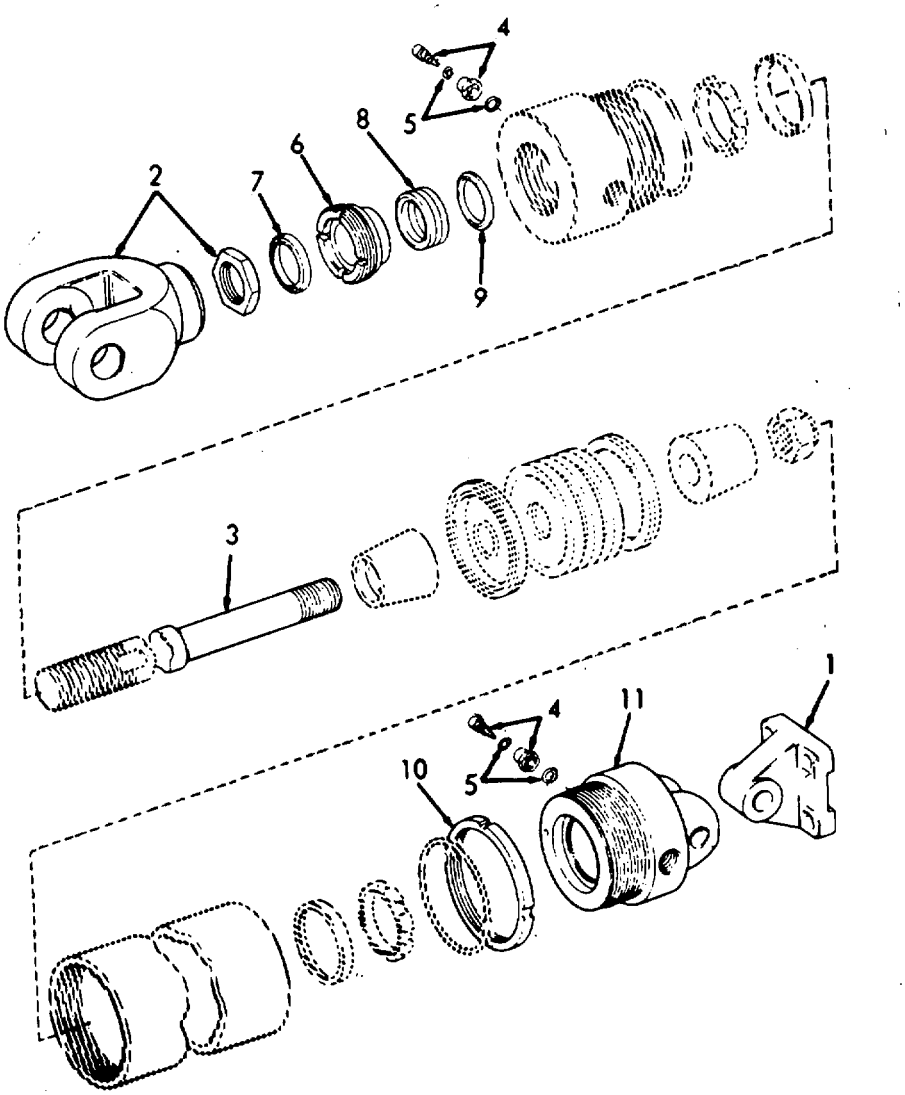
Wear protective eye goggles when using compressed air.

5-96. HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
Hydraulic Cylinder	a. Piston	Move to fully retracted position.	
	b. Hose fittings	Remove.	
	c. Cylinder	Drain fluid by manually cycling the cylinder.	Compressed air can be used on large cylinder.
	d. Mounting bracket (1)	Unweld and replace.	If necessary.
	e. Clevis and locknut (2)	Remove.	
	f. Piston rod (3)	Remove any burrs from the wrench flat area.	
	g. Adjusting screws (4), and O-rings (5)	Remove.	
	h. Packing nut (6), and scraper (7)	Remove.	Use a pin type spanner wrench.
	i. Packing (8), and adapter (9)	Remove.	Place thumb over rod end part and give a quick pull on piston rod (3). The same results can be obtained on large cylinders by using low air pressure in the rod end part.

5-96. HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
	j. Locknut (10)	Loosen.	Use pin type spanner wrench.
	k. Blank end head (11)	Remove from right-hand threaded body.	
	l. Locknut (10)	Remove.	

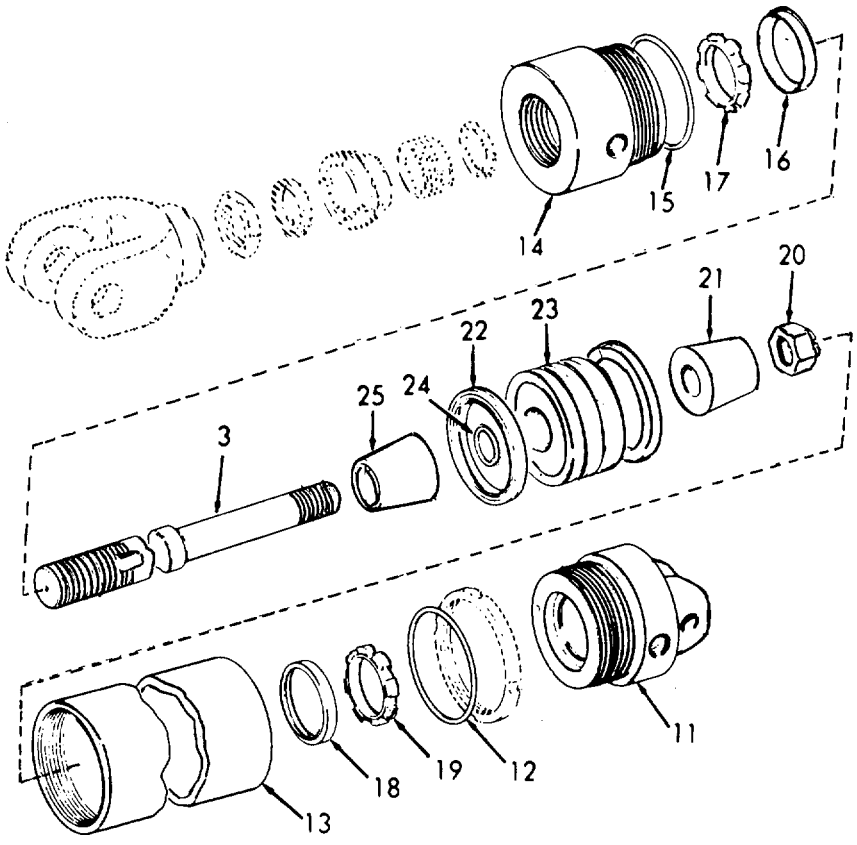


5-96. HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	m. O-ring (12)	Remove.	
	n. Piston rod (3), and assembled parts	Slide out of body (13).	
	o. Rod end head (14)	1. Place in vise with soft jaws.	
		2. Turn body (13) out.	Use strap wrench.
	p. O-ring (15)	Remove.	
	q. Cushion retainer (16), and cushion (17)	Remove from rod end (14).	
	r. Cushion retainer (18), and cushion (19)	Remove from blank end head (11).	
	s. Piston rod (3)	Place in vise.	Soft and copper jaws.
	t. Piston locknut (20)	Remove.	
	u. Blank end cushion collar (21)	Remove.	

5-96. HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	v. Packings (22), piston (23), O-ring (24), and rod end cushion collar (25)	Remove.	
	w. All metal parts	1. Clean.	



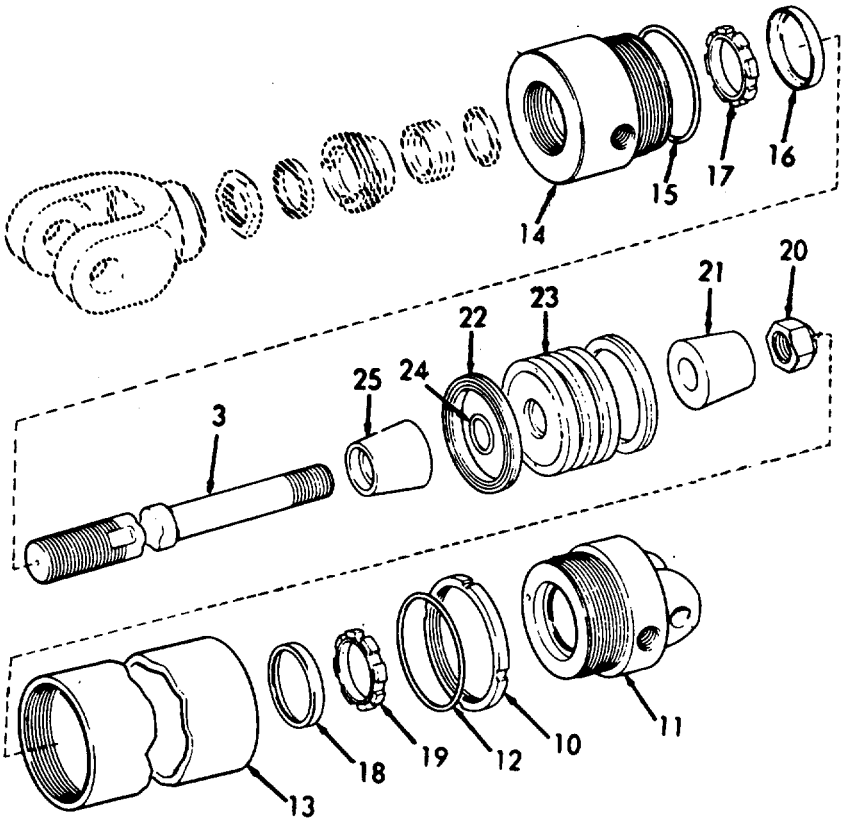
5-1167

5-96. HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
		2. Inspect for damage or wear on piston rod and inside diameter of body.	
	x. All parts	Lightly lubricate before installation.	
	y. Rod end cushion collar (25), O-ring (24), and piston (23)	Install.	
	z. Packings (22), blank end cushion collar (21), and piston locknut (20)	Install.	
	aa. Stationary rod (3)	Remove from vise.	
	ab. Cushion (19), and retainer (18)	Install in blank end head (11).	
	ac. Cushion (17), retainer (16), and O-ring (15)	Install in rod end (14).	

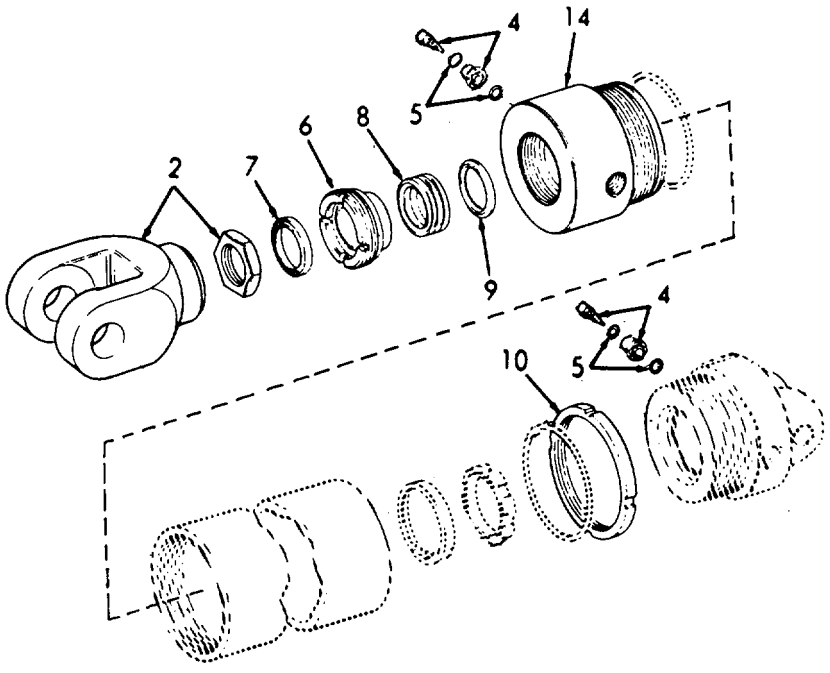
5-96. HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	ad. Rod end head (14)	1. Place in vise with soft jaws.	
		2. Turn body (13) on vise.	Use strap wrench.
	ae. Piston rod (3), and assembled parts	Slide into body (13).	
	af. Locknut (10), and O-ring (12)	Install on blank end head (11).	
	ag. Blank end head (11)	Install on body, with a right-hand thread.	



5-96. HYDRAULIC CYLINDER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	ah. Locknut (10)	Tighten.	Use pin type spanner wrench.
	ai. Adapter (9), and packing (8)	Install in rod end (14).	
	aj. Scraper (7)	Install in packing nut (6).	
	ak. Packing nut (6)	Install.	Use pin type spanner wrench.
	al. O-rings (5), and adjusting screws (4)	Install.	
	am. Clevis and locknut (2)	Install.	
	an. All parts	Seal.	



5-97. HYDRAULIC CONTROL AND FLOW CONTROL MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued)

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

References
NONE

Special Tools
NONE

Equipment Condition / Condition Description
NONE

Material/Parts
Seal kit P/N 723394

Special Environmental Conditions
NONE

Personnel Required
1

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR (Cont)

NOTE

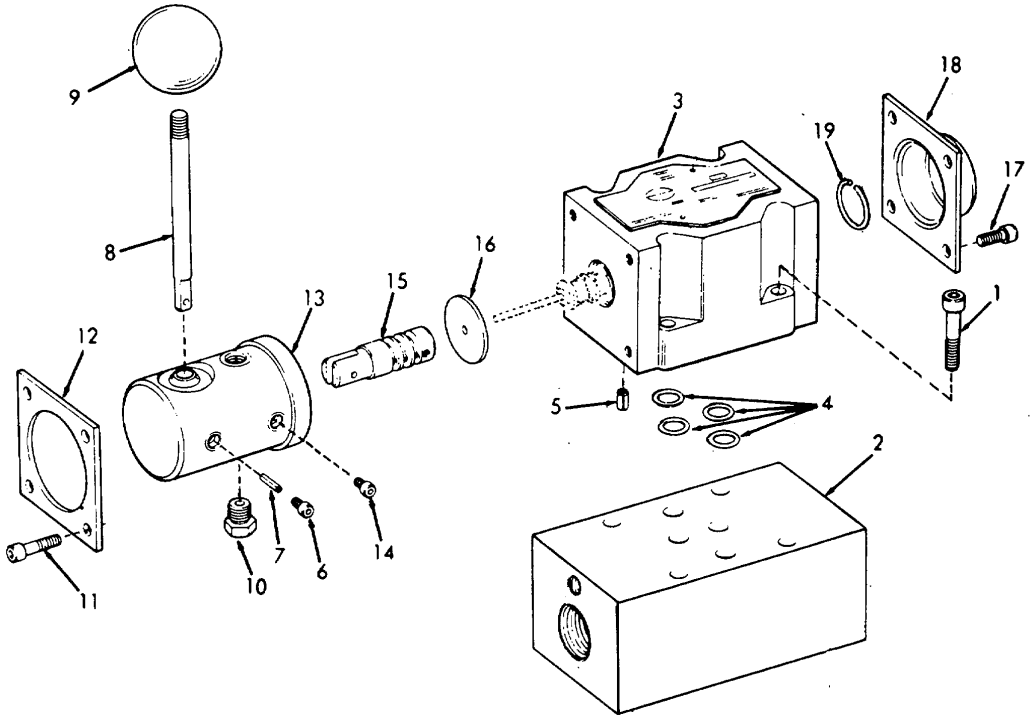
When reassembling all interior parts, coat lightly with hydraulic fluid.

5-97. HYDRAULIC CONTROL AND FLOW CONTROL MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
1. Directional Control Valve	a. Screws (1), and flow control manifold body (2)	Remove.	
	b. Body (3), and O-ring seals (4)	Remove.	Discard O-ring seals.
	c. Spring pin (5)	Remove.	If necessary.
	d. Screw (6), spring pin (7), and control lever (8)	Remove.	
	e. Knob (9), and pipe plugs (10)	Remove.	If necessary.
	f. Screws (11), end cap clamp (12), and cap (13)	Remove.	

5-97. HYDRAULIC CONTROL AND FLOW CONTROL MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	g. Screw (14), detent stem (15), and end cap flatwasher (16)	Remove.	
	h. Screws (17), end cap (18) and retaining rings (19)	Remove.	



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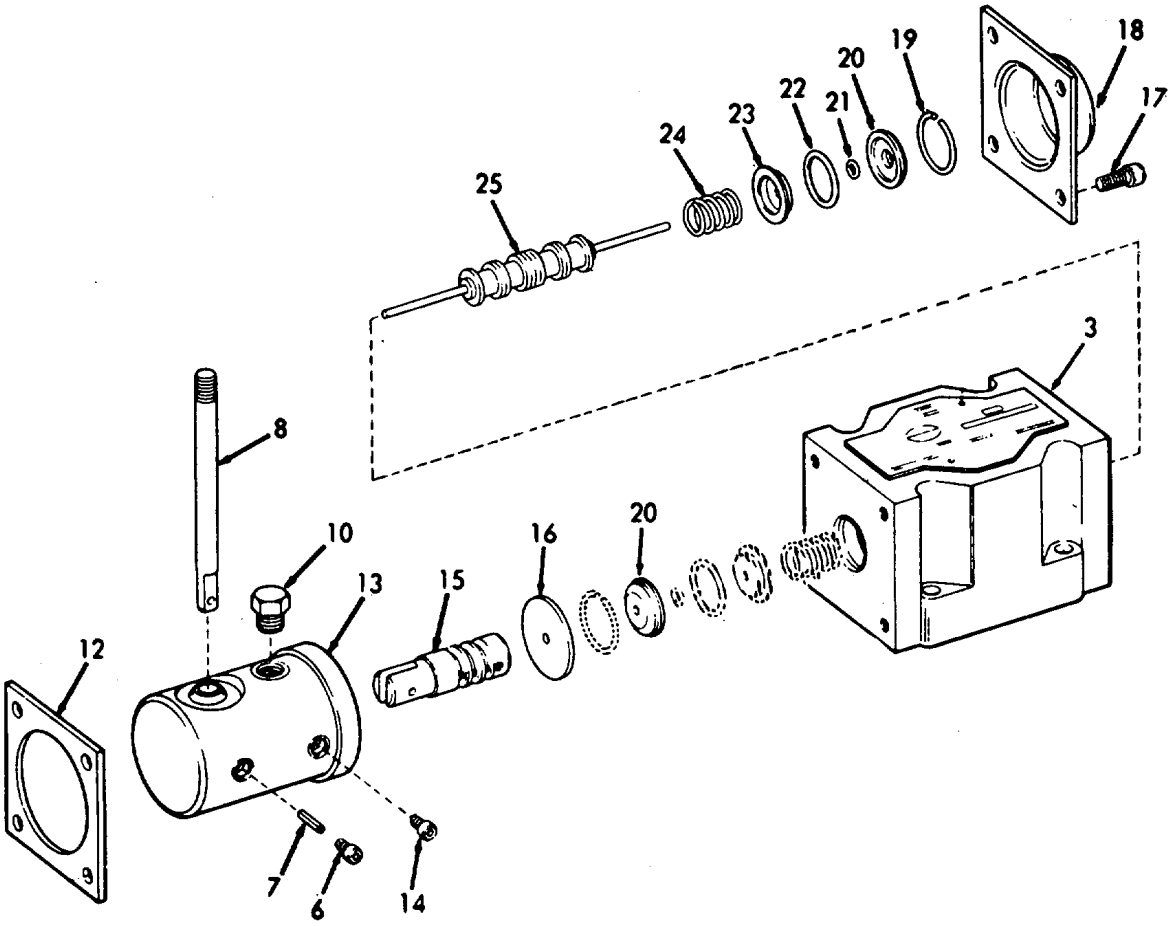
5-97. HYDRAULIC CONTROL AND FLOW CONTROL MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	i. Retainer seal. plugs (20), O-ring seals (21 and 22), seal retainers (23), spool springs (24), and spool (25)	1. Remove from body (3) 2. Replace defective parts. 3. Replace O-ring seals. 4. Reassemble. 5. Insert in body (3).	Discard O-ring seals (21 and 22).
	j. Retaining rings (19), end cap (18), and screws (17)	Install.	
	k. End cap clamp (12)	Place over cap.	
	l. Control lever (8), spring pin (7), detent stem (15), and end cap (13)	Align holes and insert spring pin.	

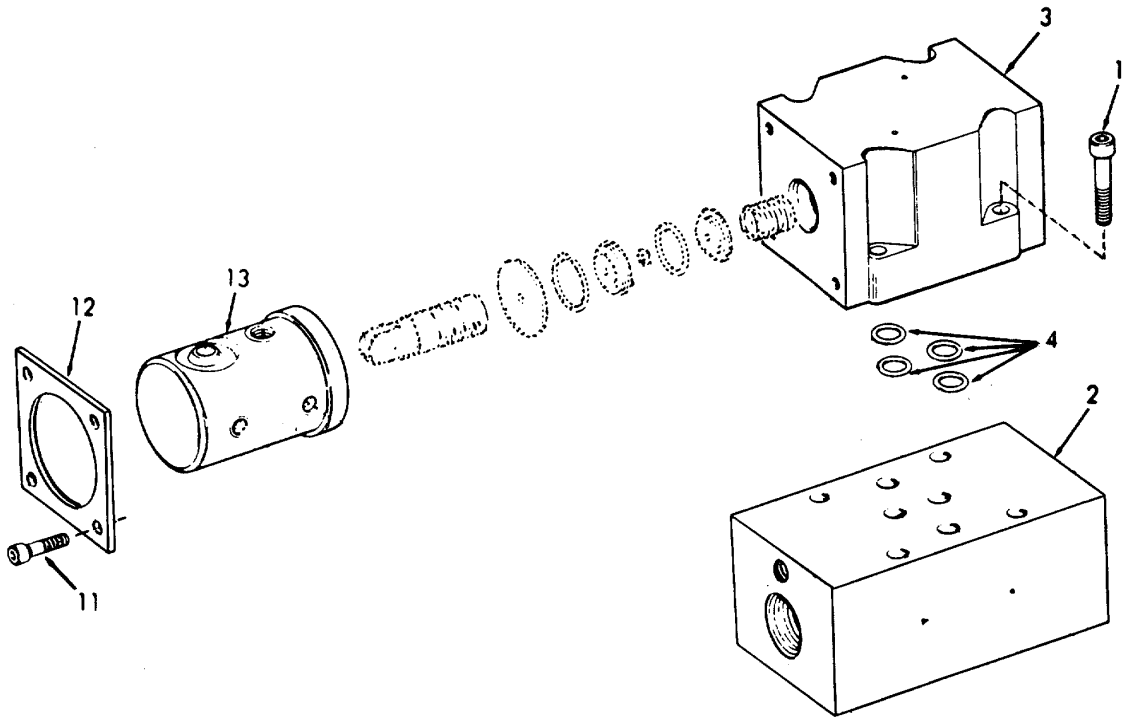
5-97. HYDRAULIC CONTROL AND FLOW CONTROL MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	m. Screw (6)	Install.	
	n. Screw (14) detent	Insert.	Make sure the screw is in the stem (15).
	o. Pipe plugs (10), and end cap flatwasher (16)	Install.	



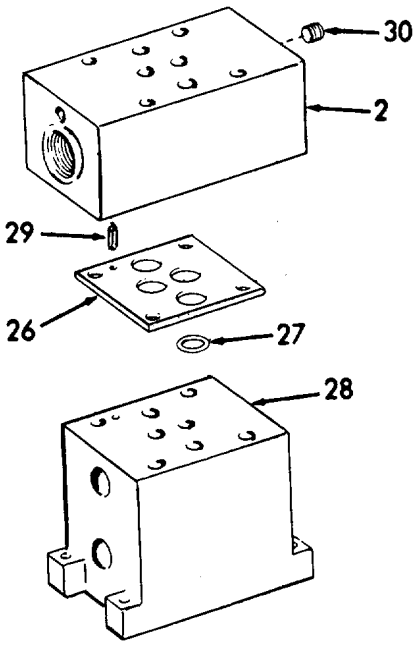
5-97. HYDRAULIC CONTROL AND FLOW CONTROL MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	p. End cap (13), assembled parts, and end cap clamp (12)	Align holes.	
	q. Screws (11)	Install.	
	r. O-ring seals (4), flow control manifold body (2), and body (3)	Assemble.	
	s. Screws (1)	Install.	



5-97. HYDRAULIC CONTROL AND FLOW CONTROL MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
2. Flow Control Manifold	a. Flow control manifold body (2), seal plate (26), O-ring seals (27), and sub-plate (28)	Separate.	
	b. Spring pin (29) and pipe plug (30)	Remove.	If necessary.

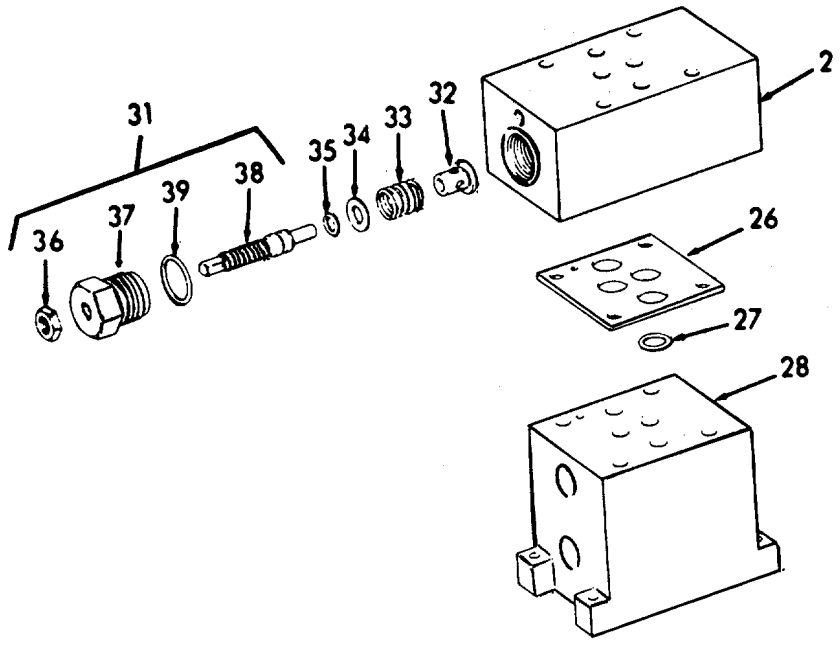


5-97. HYDRAULIC CONTROL AND FLOW CONTROL MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	c. Throttling stem assembly (31), and manifold valve poppet (32)	Remove.	
	d. Spring (33), spring washer (34), and O-ring (35)	Remove.	
	e. Jam nut (36), cap (37), and stem (38)	Disassemble.	
	f. O-ring (39)	Remove.	
	g. Stem (38), cap (37), and jam nut (36)	Reassemble.	
	h. O-ring (39)	Install on cap (37).	
	i. O-ring (35), spring washer (34), and spring (33)	Install.	

5-97. HYDRAULIC CONTROL AND FLOW CONTROL MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	j. Manifold valve poppet (32), and throttling stem assembly (31)	Install.	
	k. Subplate (28), O-ring seals (27), seal plate (26), and flow control manifold body (2)	Reassemble.	



5-98. HOSES AND FITTINGS - MAINTENANCE INSTRUCTIONS.

This task covers

Repair

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

NONE

Personnel Required

2

References

NONE

Equipment Condition: Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

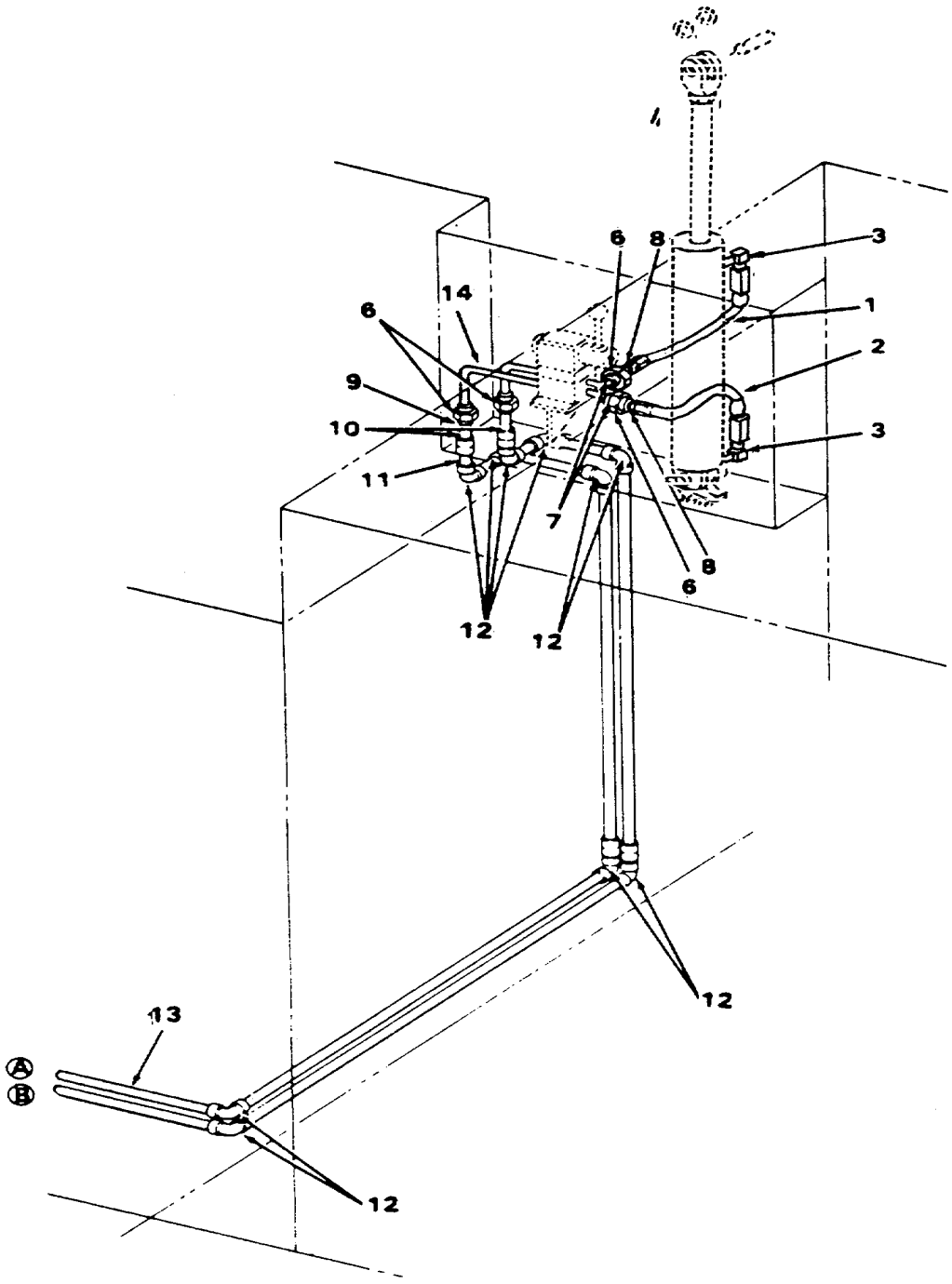
LOCATION	ITEM	ACTION	REMARKS
Repair			
Hoses and Fittings	a. Hose assembly, folding mast cylinder 18 inch (1)	Replace as needed.	
	b. Hose assembly, folding mast cylinder 26 inch (2)	Replace as needed.	

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

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	c. Elbow, street 900 (3)	Replace as needed.	
	d. Flow control valves (4)	Replace as needed.	
	e. Pipe nipple (5)	Replace as needed.	
	f. Union nut (6)	Replace as needed.	
	g. Reducer socket (7)	Replace as needed.	
	h. Threaded pipe piece (8)	Replace as needed.	
	i. Threaded pipe piece (9)	Replace as needed.	
	j. Pipe nipple (10)	Replace as needed.	
	k. Pipe nipple (11)	Replace as needed.	
	l. Elbow socket (12)	Replace as needed.	
	m. Steel pipe (13)	Replace as needed.	
	n. Steel pipe (14)	Replace as needed.	

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

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			



4955-204

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

The following is an index to the maintenance procedures.

DESCRIPTION	PARAGRAPH
Hydraulic Control	5-97
Hydraulic Winch	5-100
Hoses and Fittings	5-101

5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Disassembly b. Repair c. Reassembly

INITIAL SETUP

Test Equipment

NONE

Special Tools

Arbor press

Material/Parts

NONE

Personnel Required

2

References

NONE

Equipment Condition: Condition Description

NONE

Special Environmental Conditions

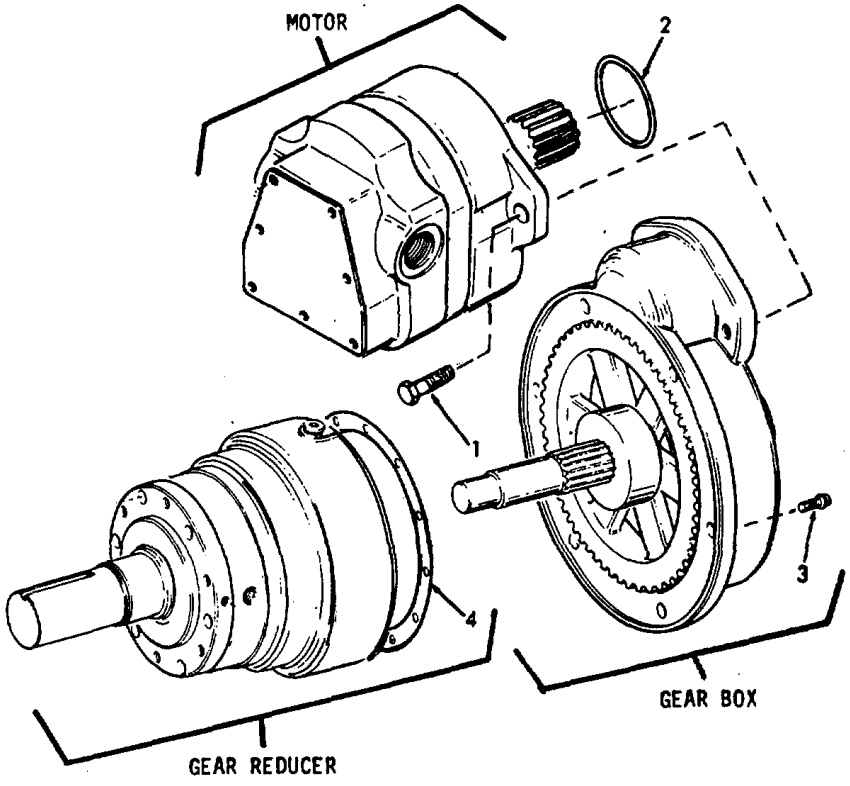
NONE

General Safety Instructions

NONE

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

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
1. Winch Assembly	a. All mounting hardware	Remove.	
	b. All hydraulic piping	Remove.	
	c. Screws (1)	Remove.	
	d. Motor	Remove from gear box.	
	e. O-ring (2)	Remove.	
	f. Screws (3)	Remove six places.	
	g. Gear box	Remove from gear reducer.	
	h. Gasket	Remove.	

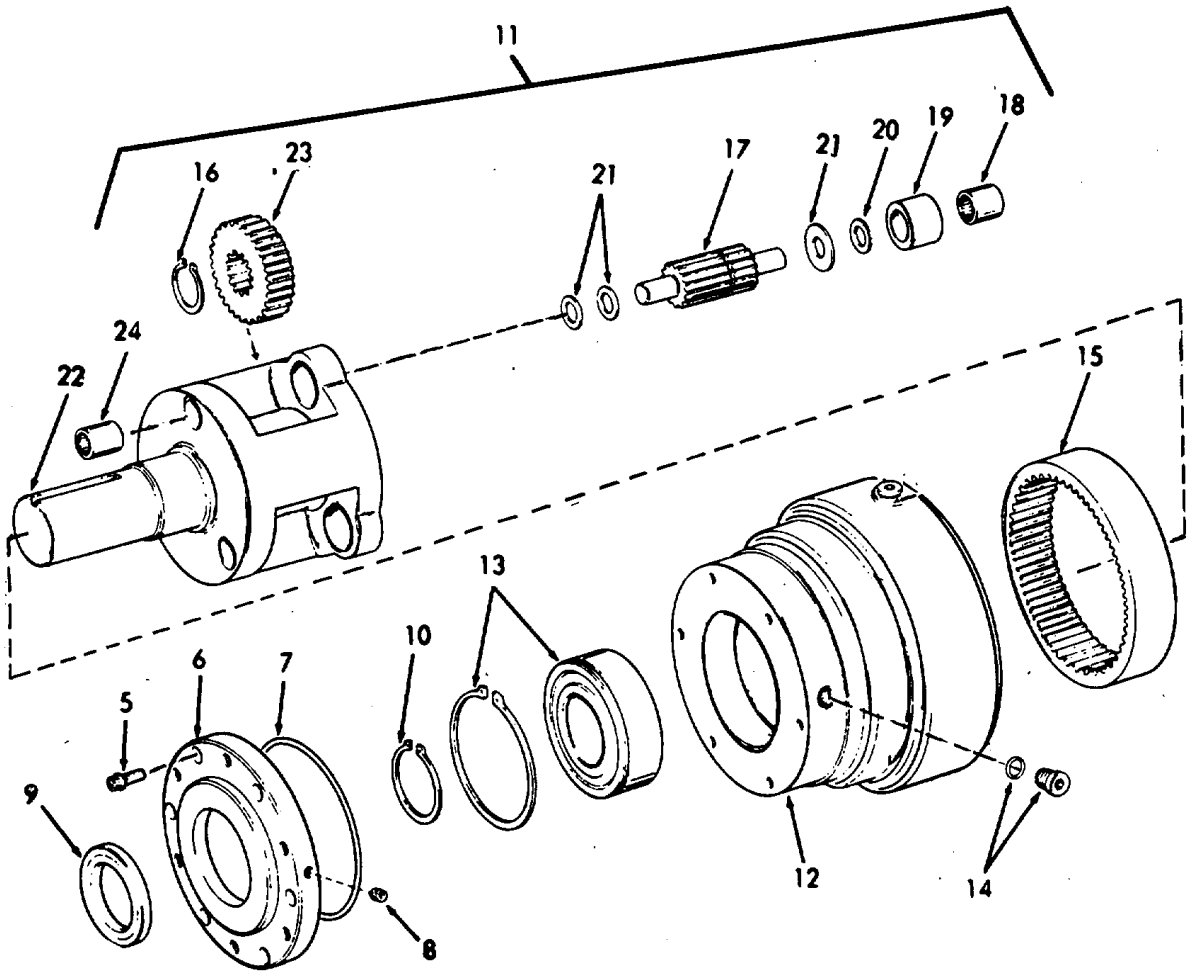


5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair			
2. Gear Reducer	a. Screws (5), housing cap (6), and 0-ring (7)	Remove.	
	b. Lubrication plug (8), and shaft seal (9)	Remove.	
	c. Retaining ring (10)	Remove.	
	d. Output shaft and planetary gear assembly (11)	Remove from housing (12).	
	e. Retaining ring and bearing (13)	1. Remove retaining ring. 2. Press bearing out of housing.	
	f. Seal caps with O-rings (14)	Remove two places.	
	g. Output shaft, and planetary gear assembly (11)	1. Remove reducer ring gear (15). 2. Move retaining ring (16) on reducer gear (17).	

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

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
		3. Press reducer gear (17), roller bearing (18), bushing (19), and thrust flat-washers (20 and 21) out of shaft (22).	Use arbor press.
		4. Remove planetary gear (23), and retaining ring (16).	
		5. Press roller bearing (24) from shaft (22).	
		6. Repeat two more times.	

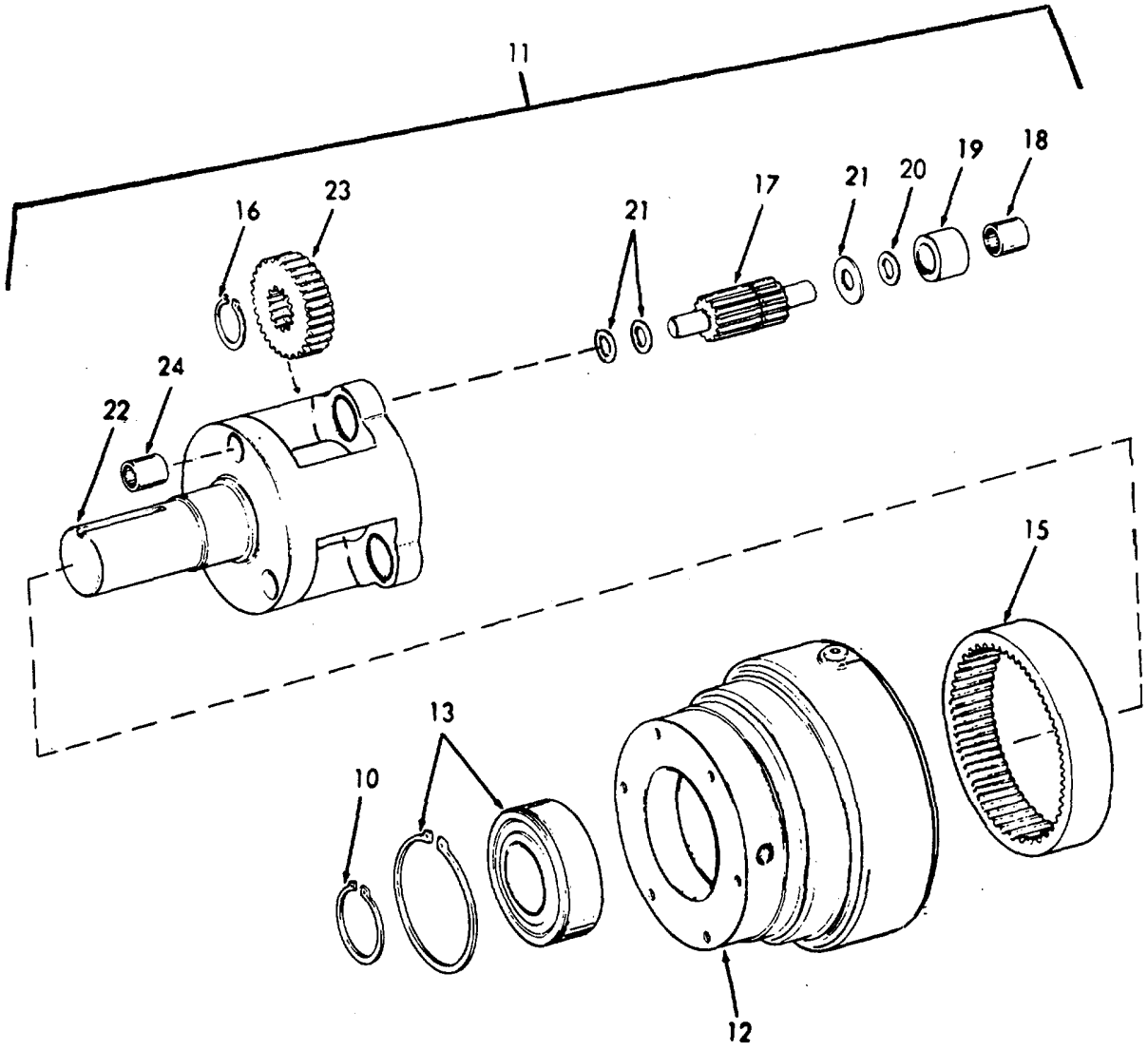


5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	h. All parts	1. Clean 2. Inspect for wear or damage. 3. Lubricate lightly before reassembly.	
	i. Roller bearings (24)	Press into shaft (22).	
	j. Planetary gears (23), and retaining rings (16)	Insert into shaft (22).	
	k. Thrust flat-washers (20 and 21), bushing (19), reducer gear (17), and roller bearing (18)	1. Press into planetary gear (23). 2. Press into shaft (22). 3. Place retaining ring (16) into its slot. 4. Repeat two times.	
	l. Reducer ring gear (15)	Install.	
	m. Retaining ring and bearing (13)	1. Press bearing into housing (12). 2. Install retaining ring.	

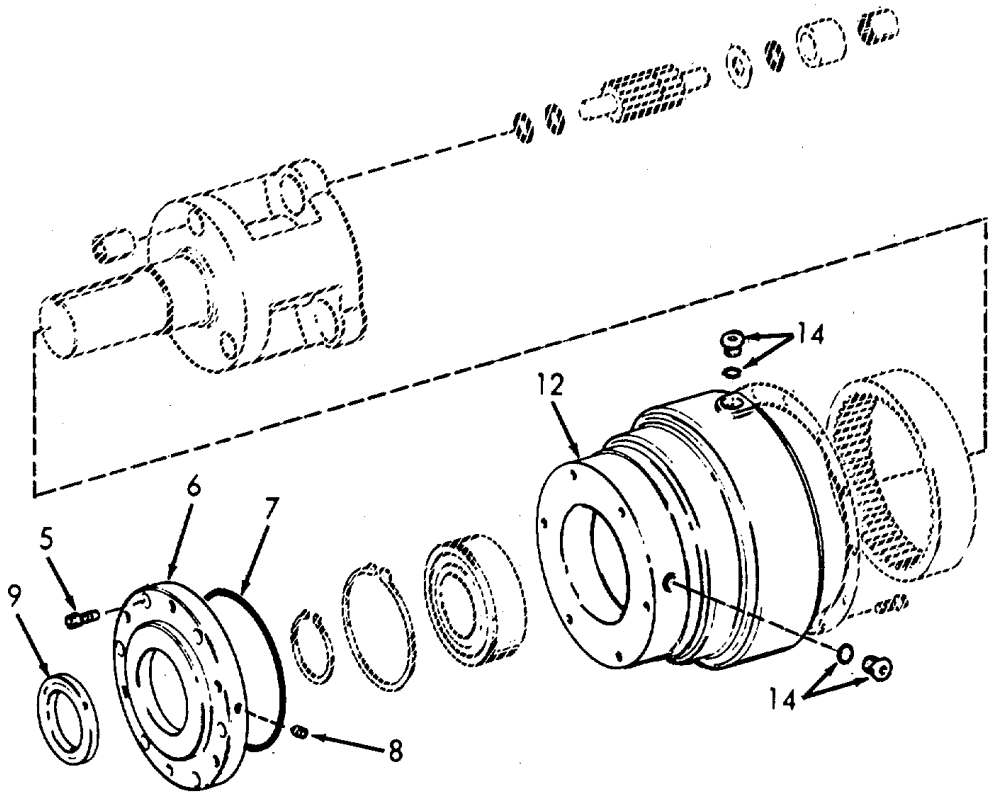
5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	n. Output shaft and planetary gear assembly (11)	Place in housing (12).	
	o. Retaining ring (10)	Install.	



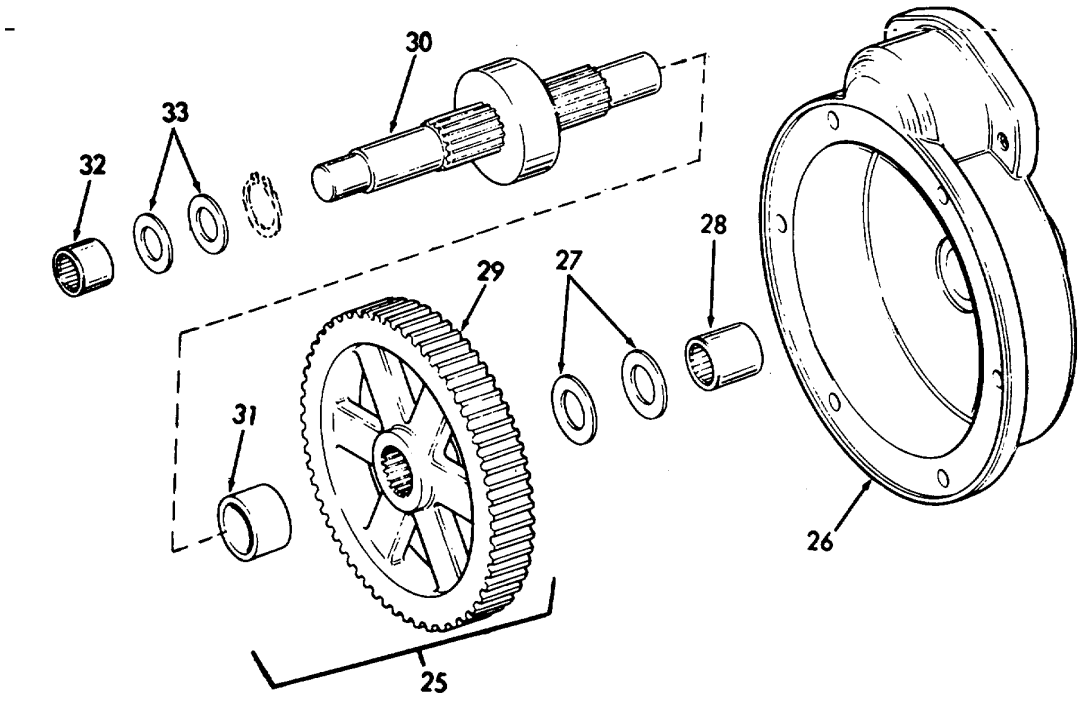
5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	p. Seal caps with O-rings (14)	Install two places.	
	q. Shaft seals (9), and O-ring (7)	Install in housing cap (6).	
	r. Housing cap (6)	Install on housing (12).	
	s. Screw (5)	Install in non-threaded holes.	
	t. Lubri-cation plug (8)	Install.	



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

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
3. Gear Box assembly (25)	a. Shaft and gear	Press out of housing (26).	
	b. Thrust washers (27)	Remove.	
	c. Needle bearing. (28)	Press out of housing (26)	
	d. Gear (29)	Press off of shaft (30).	
	e. Spacer (31)	Remove.	
	f. Needle bearing (32), and thrust washers (33)	Press off of shaft (30).	

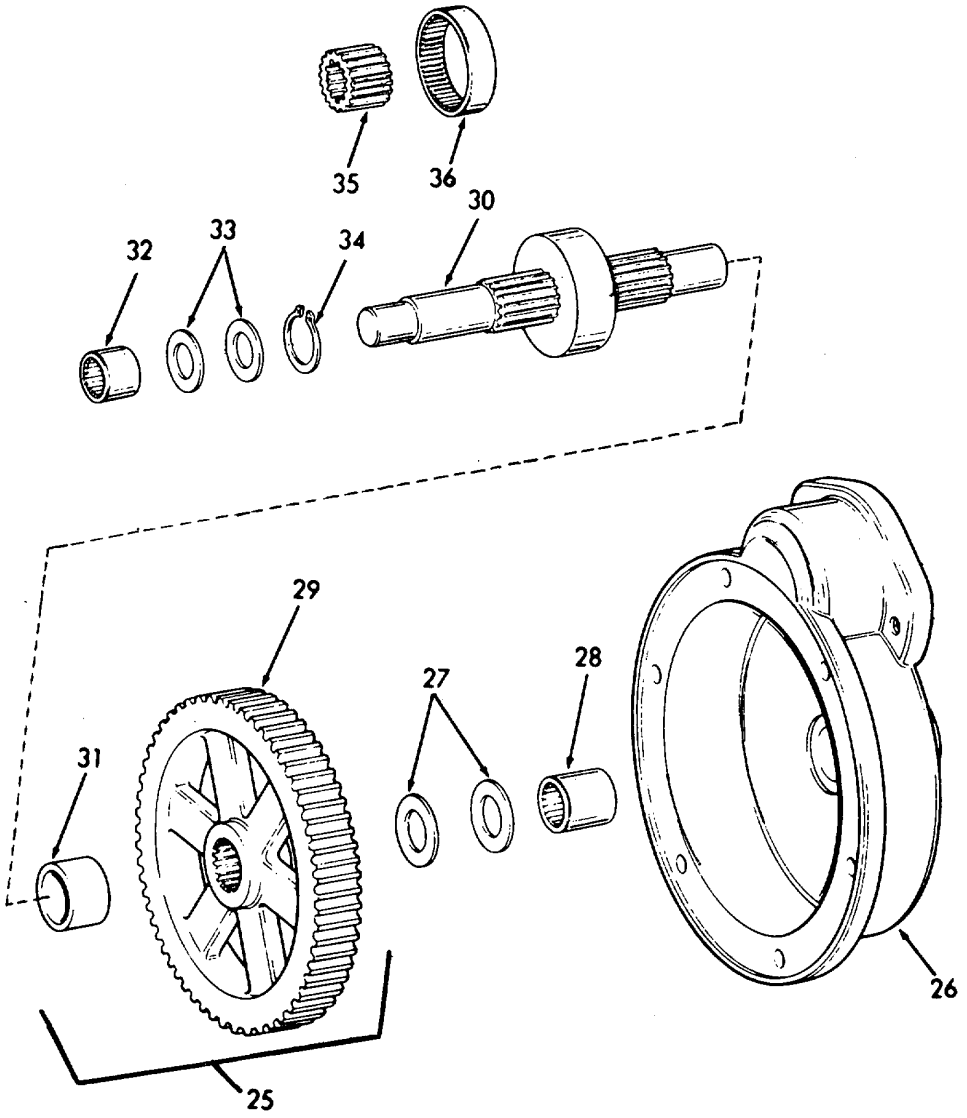


5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
	g. Retaining ring (34)	Remove.	
	h. Main reducer drive gear (35)	Remove.	
	i. Roller bearing (36)	1. Press off of shaft (30). 2. Replace.	
	j. Main reducer drive gear (35), and retaining ring (34)	Install on shaft (30).	
	k. Thrust washers (33), and needle bearing (32)	Install on shaft (30).	
	l. Spacer (31)	Install on shaft (30).	
	m. Gear (29)	Install on shaft (30).	
	n. Needle bearing (28)	Press into housing (26).	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	o. Thrust washers (27)	Install.	
	p. Shaft and gear assembly (25)	Press into housing (26).	

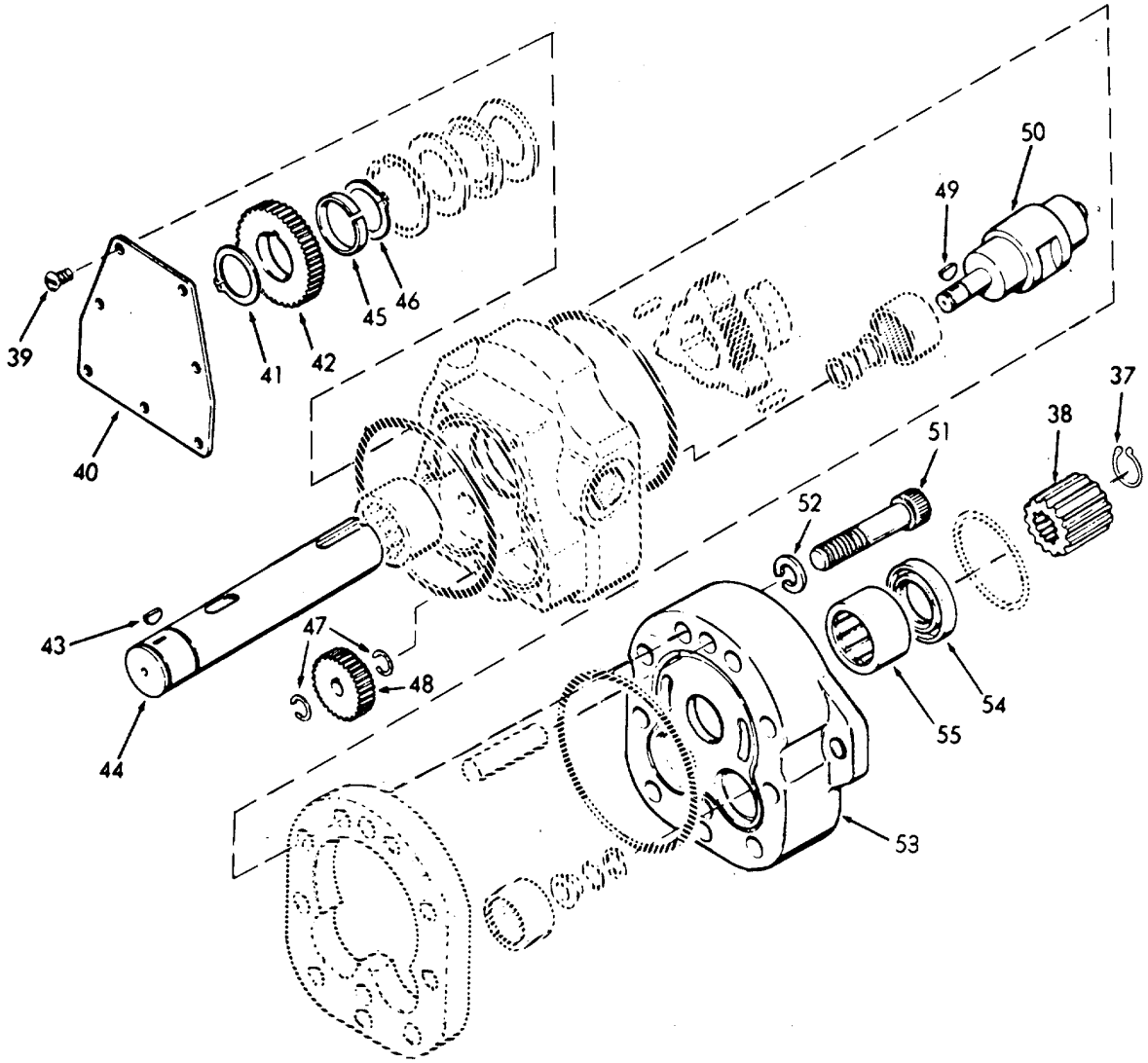


5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
4. Winch Motor	a. Retaining ring (37)	Remove.	
	b. Main reducer drive gear (38)	Remove.	Use gear puller.
	c. Screws (39), cover (40), and retaining ring (41)	Remove.	
	d. Drive gear (42), and Woodruff key (43)	Remove from shaft (44).	
	e. Washer (45)	Remove.	
	f. Retaining ring (46)	Remove from shaft (44).	
	g. Retaining rings (47), gears (48), and Woodruff keys (49)	Remove from abutment valve (50).	
	h. Screws (51), and lockwashers (52)	Remove.	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	i. Front end cap (53)	Remove.	
	j. Shaft seal (54), and needle bearing (55)	Press out of front end cap (53).	Use arbor press.

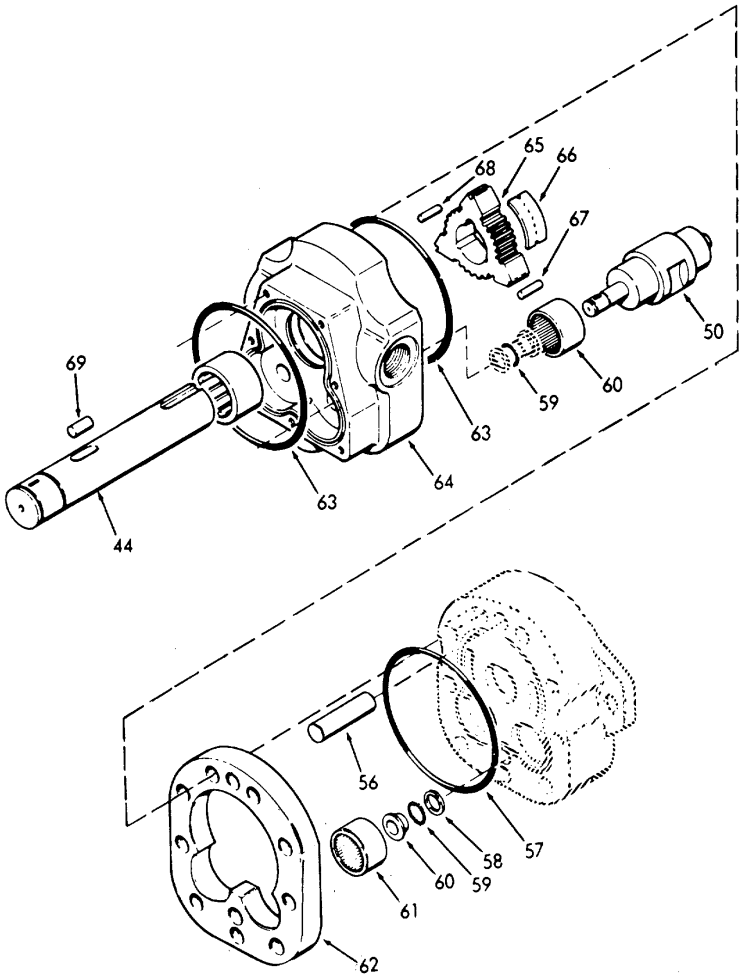


5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	k. Dowel pins (56)	Remove.	If necessary.
1. Oil seal (57)		Remove.	
	m. Abutment valves (50), and associated parts	1. Rotate shaft (44) to a position that the rotor is clear of the abutment valves. 2. Remove valves and associated parts.	
	n. Backup step bearing seal 1 rings (58), and 0-rings (59)	Remove from abutment valves (50).	
	o. Bearing steps (60) and needle bearings (61)	Remove from abutment valves (50).	
	p. Displace-ment housing (62), and oil seals (63)	Remove from rear end cap (64).	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	q. Rotor (65), vane shields (66), three rollers (67), eighteen rollers (68) and drive pin (69)	Disassemble.	

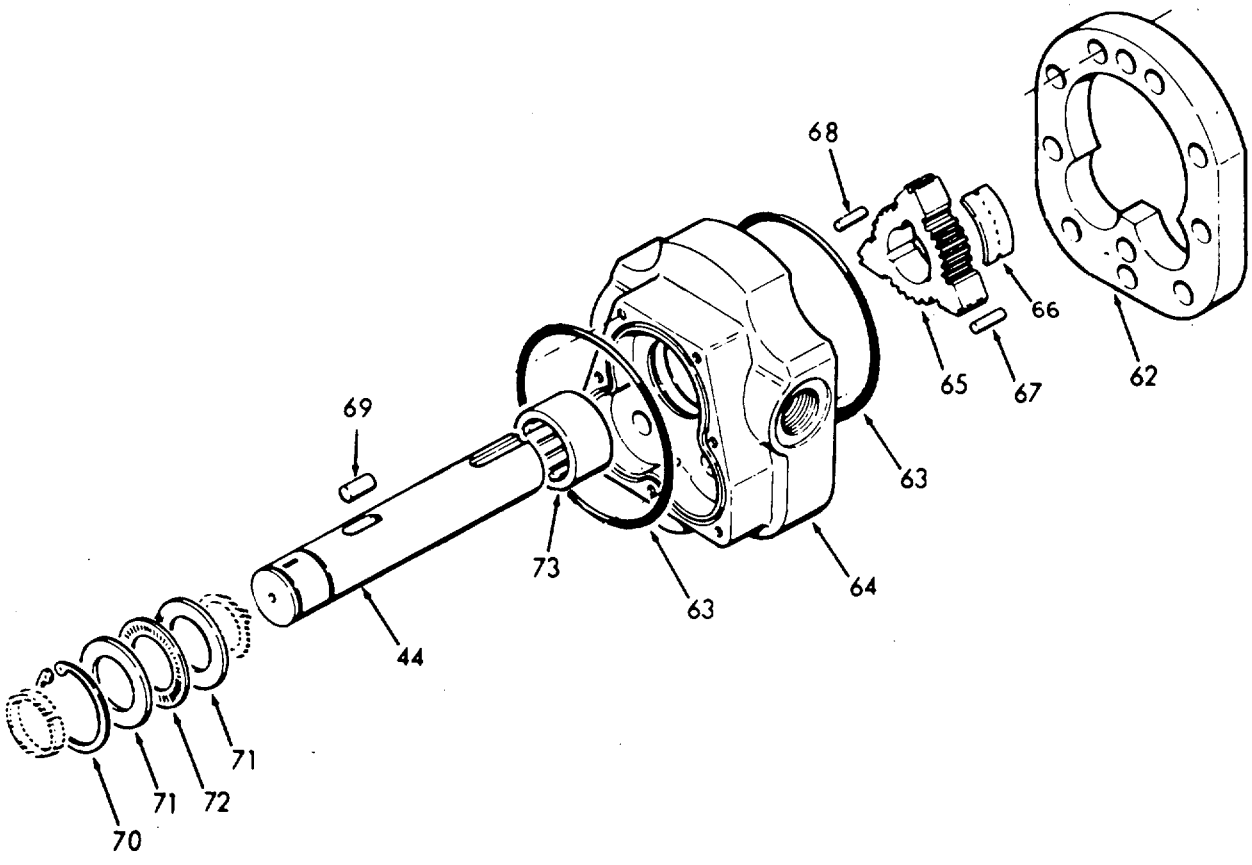


5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	r. Shaft (44)	Press out of rear end cap (64).	
	s. Retaining ring (70), bearing races (71), and thrust bearing (72)	Remove from rear end cap (64).	
	t. Needle bearing (73)	1. Press out of rear end cap (64). 2. Replace.	
	u. Bearing races (71), thrust bearing (72), and retaining ring (70)	Install in rear end cap (64).	
	v. Shaft (44), drive pin (69), and rotor (65)	Assemble.	
	w. Shaft (44)	Place in rear end cap (64).	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	x. Oil seals (63), and displacement housing (62)	Install.	
	y. Eighteen rollers (68), vane shields (66), and three rollers (67)	Install in rotor (65).	

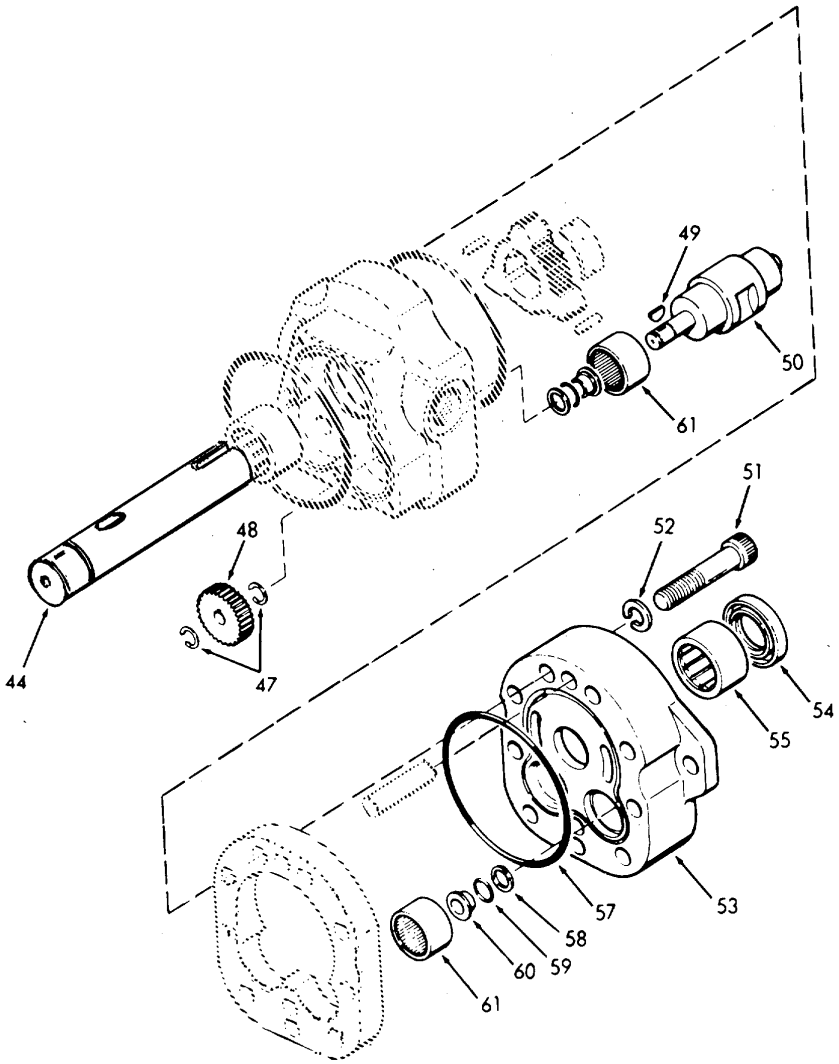


5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	z. Needle bearings (61)	Press onto abutment valves (50).	
	aa. Bearing steps (60), O-rings (59), and back-up step bearing seal rings (58)	Install on abutment valves (50).	
	ab. Abutment valves (50), and associated parts	1. Rotate shaft (44) to position that the rotor is clear of the abutment valves. 2. Install valve and associated parts.	
	ac. Needle bearing (55), and shaft seal (54)	Press into front end cap (53).	
	ad. Oil seal (57)	Install in front end cap (53).	
	ae. Screws (51), and lockwasher (52)	Install.	

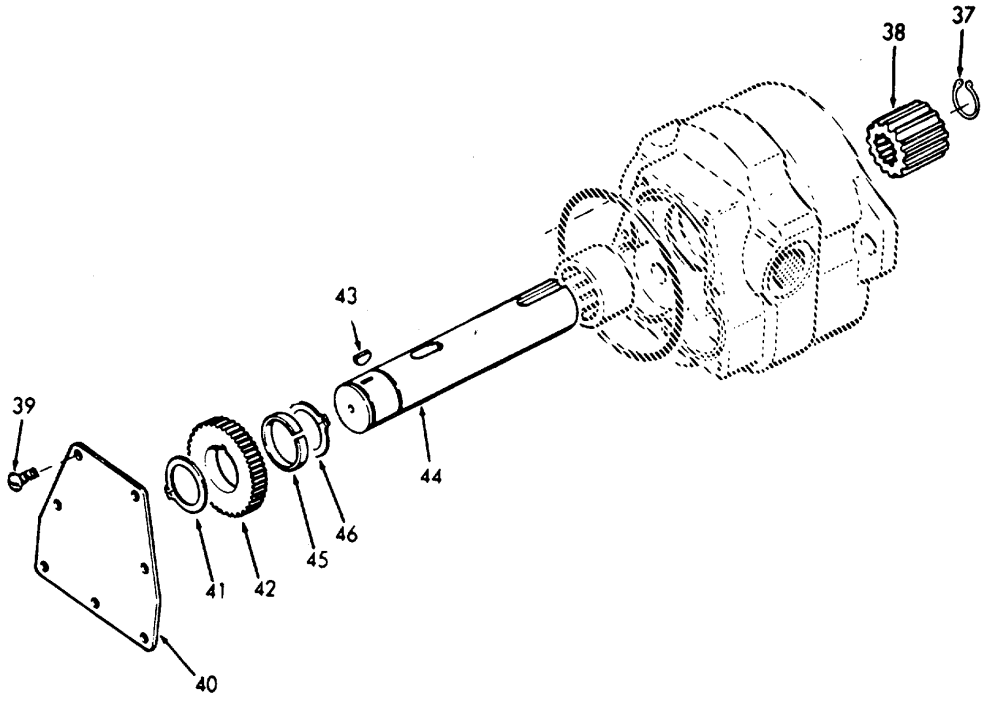
5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	af. Woodruff keys (49), retaining rings (47), and gears (48)	Install.	



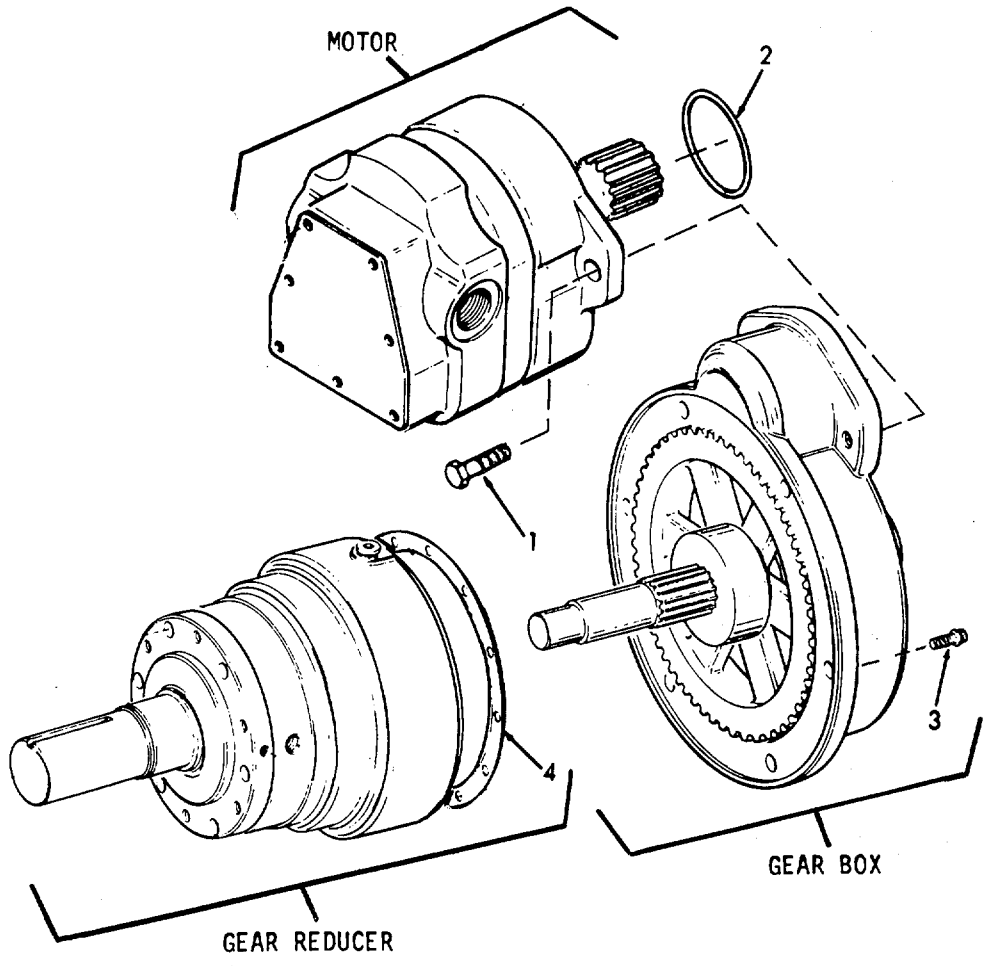
5-100. HYDRAULIC WINCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	ag. Retaining ring (46), washer (45), Woodruff key (43), and drive gear (42)	Install on shaft (44).	
	ah. Retaining ring (41)	Install on shaft (44).	
	ai. Cover (40)	Install.	
	aj. Screws (39)	Install.	
	ak. Main reducer drive gear (38)	Install.	
	al. Retaining ring (37)	Install.	



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

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY			
5. Winch Assembly	a. Gasket (4)	Install on gear box.	
	b. Gear box	Affix to gear reducer.	
	c. Screws (3)	Install six places.	
	d. O-ring (2)	Install on gear box.	
	e. Motor	Affix to gear box.	
	f. Screws (1)	Install.	
	g. All ports	Seal.	



5-101. HOSES AND FITTINGS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition** / **Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
2	NONE

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
1. Hoses and Fittings (1)	a. Hose assembly 17 inch	Replace or repair.	
	b. Hose assembly 8 inch (2)	Replace or repair.	
	c. Hose assembly 17 inch (3)	Replace or repair.	
	d. Elbow (4)	Replace or repair.	

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

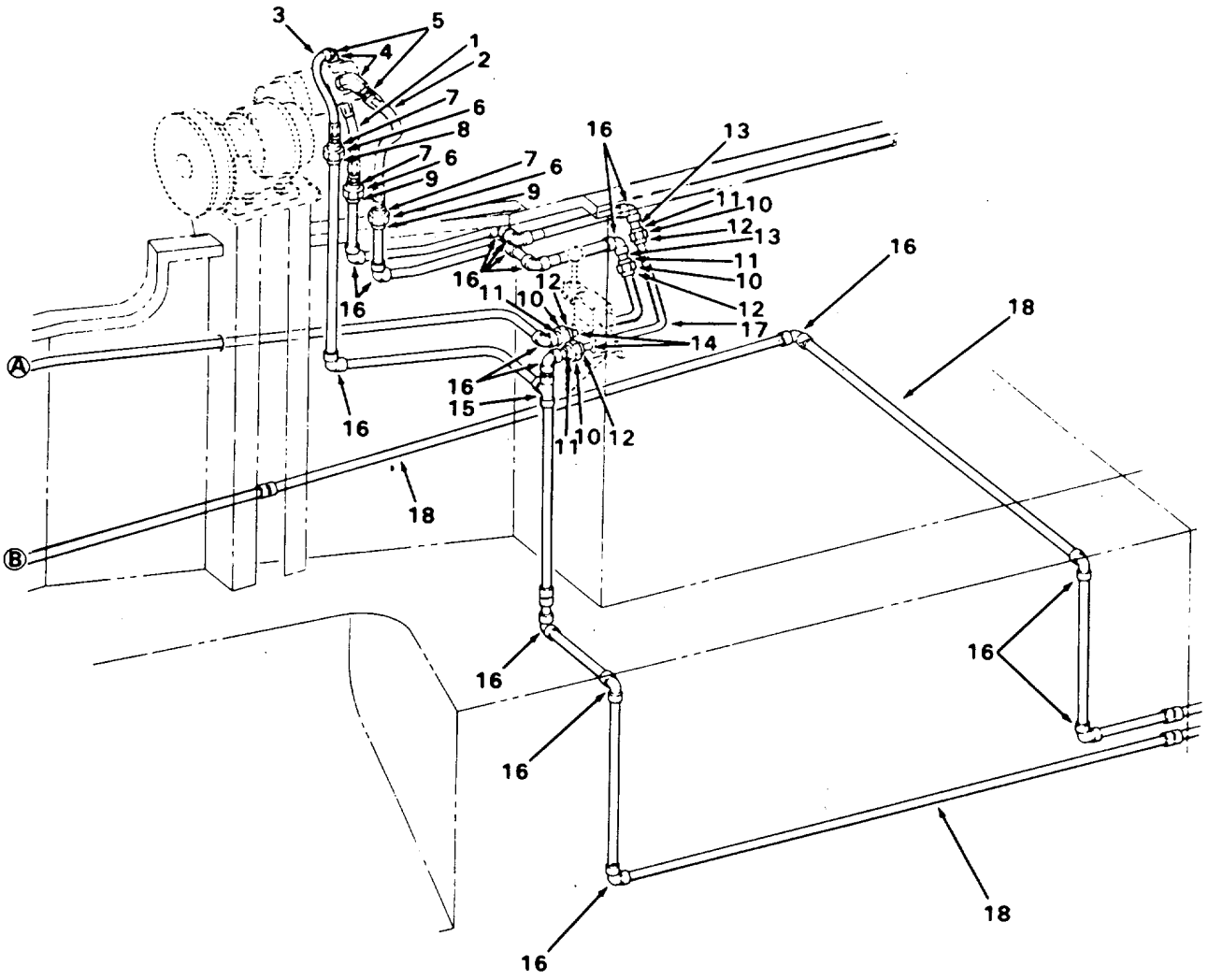
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	e. Pipe reducer bushing (5)	Replace or repair.	
	f. Union nut (6)	Replace or repair.	
	g. Weld steel socket tailpiece (7)	Replace or repair.	
	h. Pipe reducer (8)	Replace or repair.	
	i. Steel threaded piece (9)	Replace or repair.	
	j. Union nut (10)	Replace or repair.	
	k. Male threaded piece (11)	Replace or repair.	
	l. Steel socket reducer (12)	Replace or repair.	
	m. Pipe nipple 2 inches (13)	Replace or repair.	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	n. Pipe nipple 4 inches (14)	Replace or repair.	
	o. Socket tee (15)	Replace or repair.	
	p. 90° weld socket elbow (16)	Replace or repair.	
	q. 1/4 inch seamless steel pipe (17)	Replace or repair.	
	r. 1/2 inch seamless steel pipe (18)	Replace or repair.	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



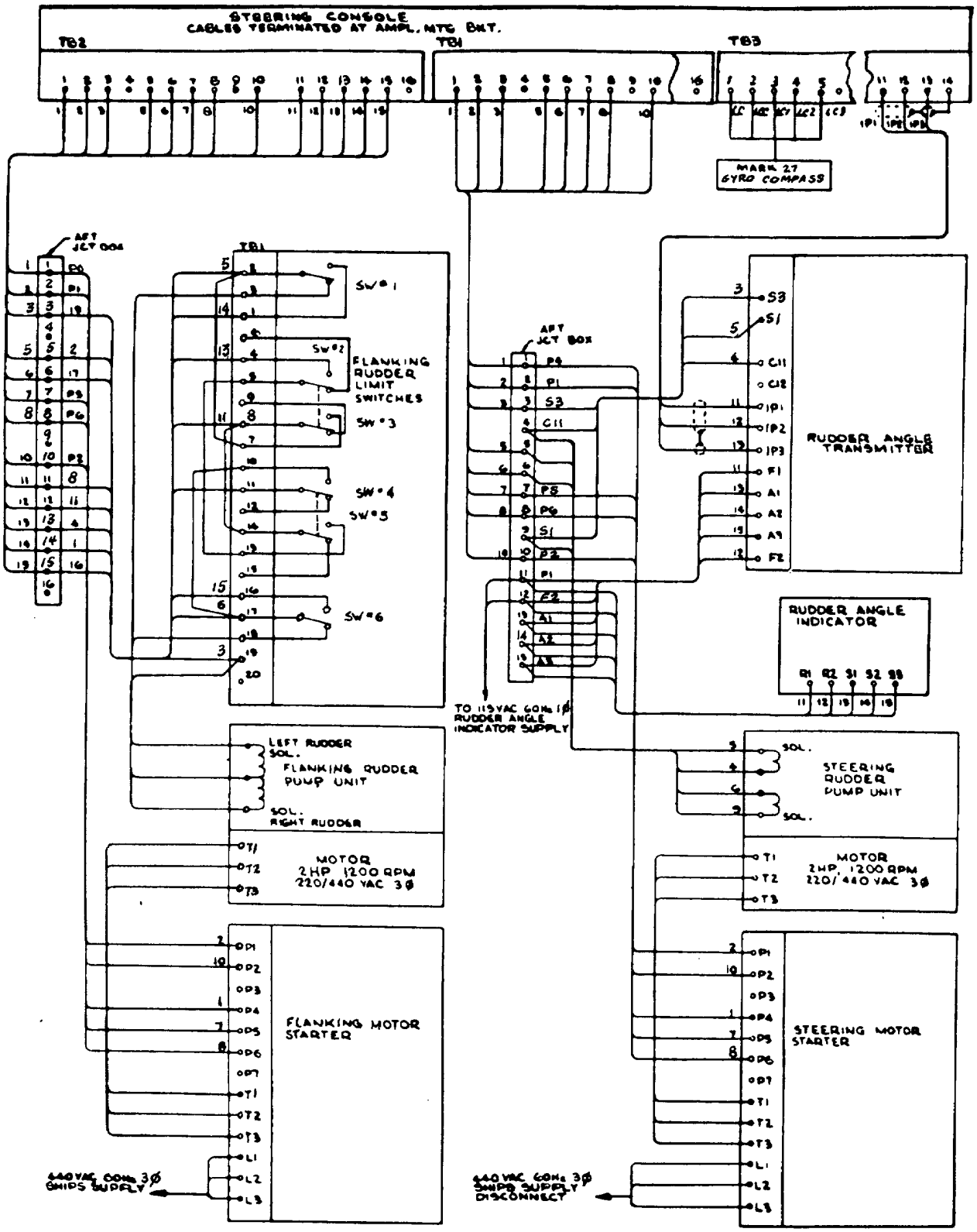
5-102. STEERING SYSTEMS - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS

The following is an index to the steering systems' maintenance procedures.

Refer to the schematic for overall component configuration.

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



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

This task covers:

Repair

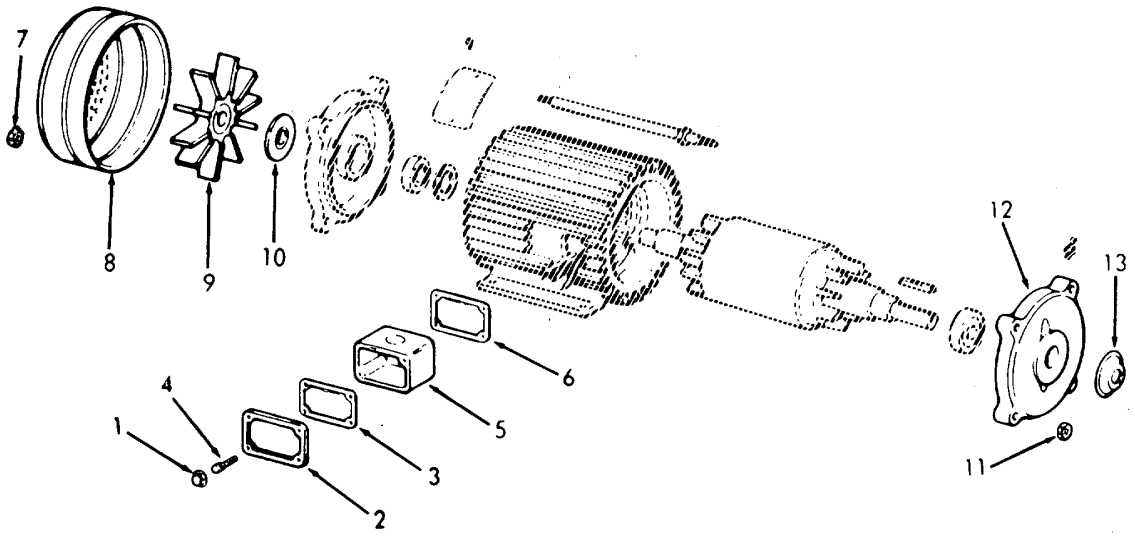
INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition** / **Condition Description**
Bearing Puller	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
1	NONE

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
Motor	a. Acorn nuts (1), conduit box cover (2), and gasket (3)	Remove.	
	b. Wiring	Disconnect.	
	c. Studs (4), and conduit box (5)	Remove.	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	d. Gasket (6), nuts (7), and fan shroud (8)	Remove.	
	e. Fan (9), rubber slinger (10), and nuts (11)	Remove.	
	f. Shaft end bracket (12), and rubber slinger (13)	Remove.	

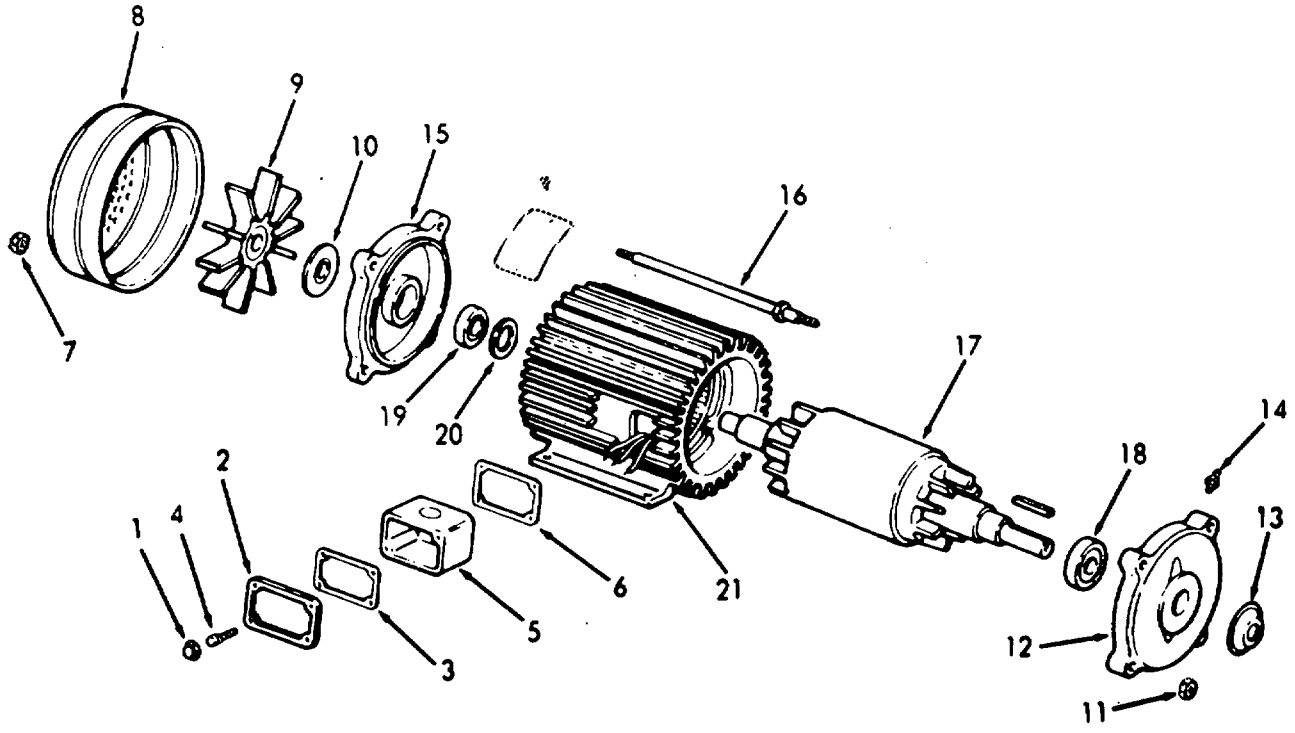


5-103. HYDRAULIC CUB PUMP UNIT - MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	g. Grease fitting (14), and blind end bracket (15)	Remove.	If necessary.
	h. Thru bolts (16)	Remove.	
	i. Rotor and shaft (17), bearings (18 and 19), and spring washer assembly (20)	1. Remove from stator (21). 2. Disassemble. 3. Replace defective parts. 4. Reassemble. 5. Install in stator (21).	Use bearing puller.
	j. Thru bolts (16), blind end bracket (15), and shaft end bracket (12)	Install.	

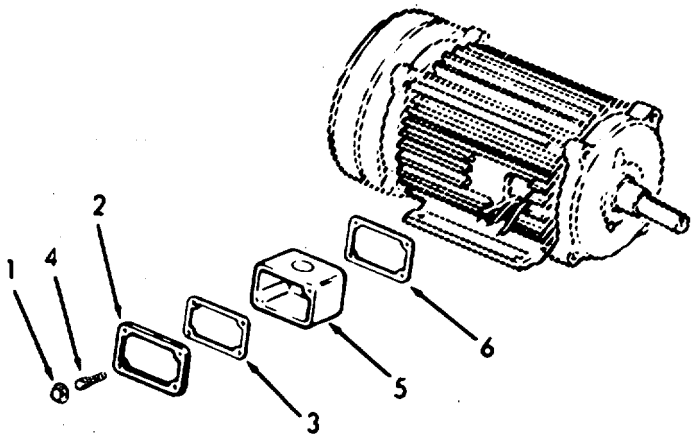
5-103. HYDRAULIC CUB PUMP UNIT - MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	k. Rubber slinger (13), and nuts (11)	Install.	
	l. Rubber slinger (10)	Install.	
	m. Fan (9), fan shroud (8), and nuts (7)	Install.	



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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	n. Conduit box gasket (6), box (5) and studs (4)	Install.	
	o. Wiring	Reconnect.	
	p. Conduit box gasket (3), and cover (2)	Install	
	q. Acorn nuts (1)	Install.	



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

This task covers:

Repair

INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	Equipment Condition / Condition Description
NONE	NONE
Material/Parts	Special Environmental Conditions
Replacement control kit 5480CR34	NONE
Personnel Required	General Safety Instructions
1	NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR

NOTE

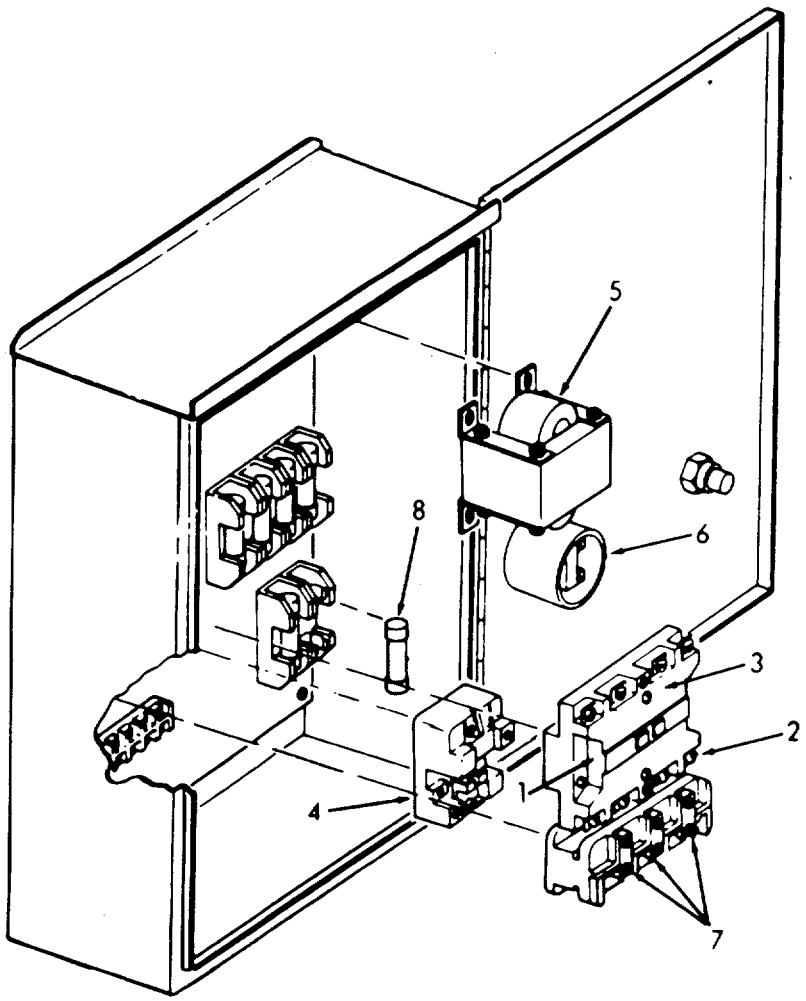
Repair or replace the following parts on the Controller.

ITEM NUMBER	DESCRIPTION
1.	Magnetic starter
2.	Contacts
3.	Starter coil
4.	Control relay
5.	Control transformer
6.	Selector switch
7.	Overload heater
8.	Fuse, 30 amps

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

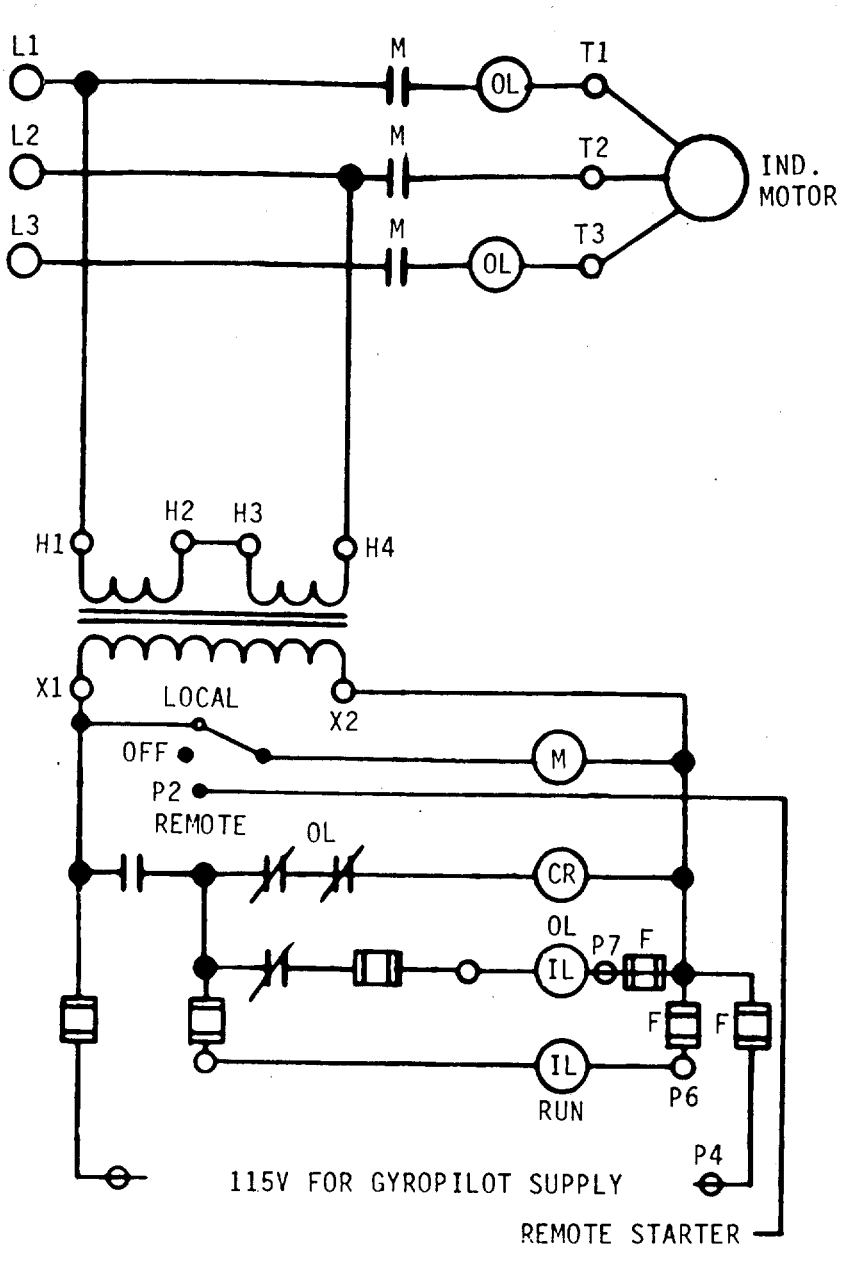
LOCATION	ITEM	ACTION	REMARKS

REPAIR (Cont)



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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



SCHEMATIC DIAGRAM FOR 440VOLT

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

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

Special Tools

Soft hammer
Torque wrench
Vise (soft jaws)

Material/Parts

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

Personnel Required

1

References

NONE

Equipment Condition — Condition Description Paragraph

3-206 Hydraulic Cub Pump

Special Environmental Conditions

NONE

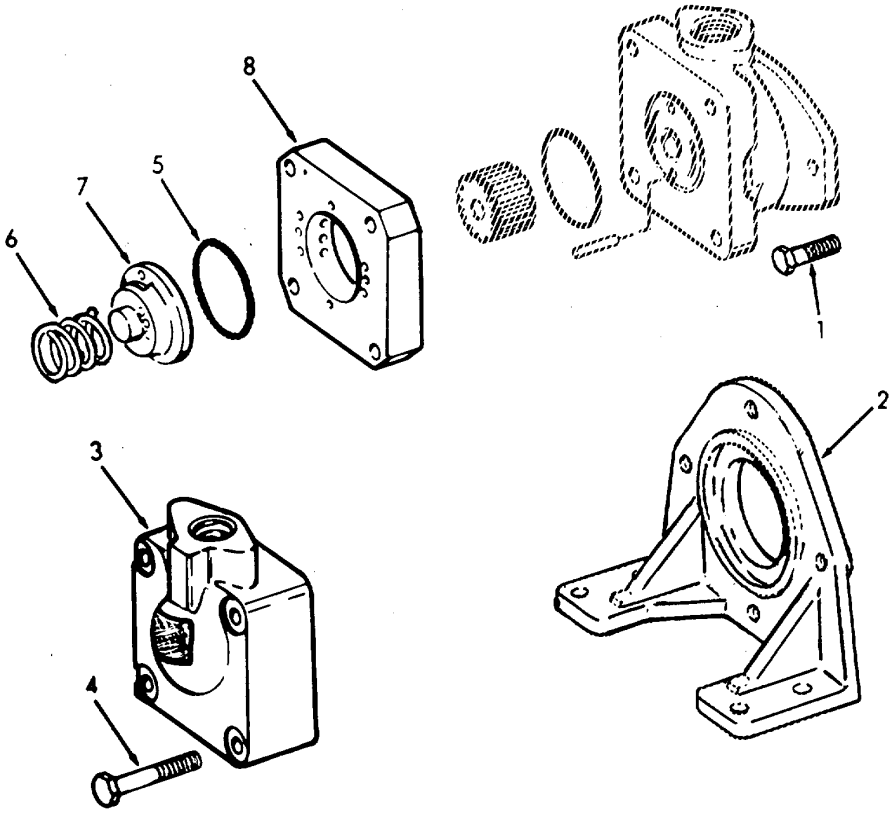
General Safety Instructions

Observe WARNING in procedure.

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.	

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

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
	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.



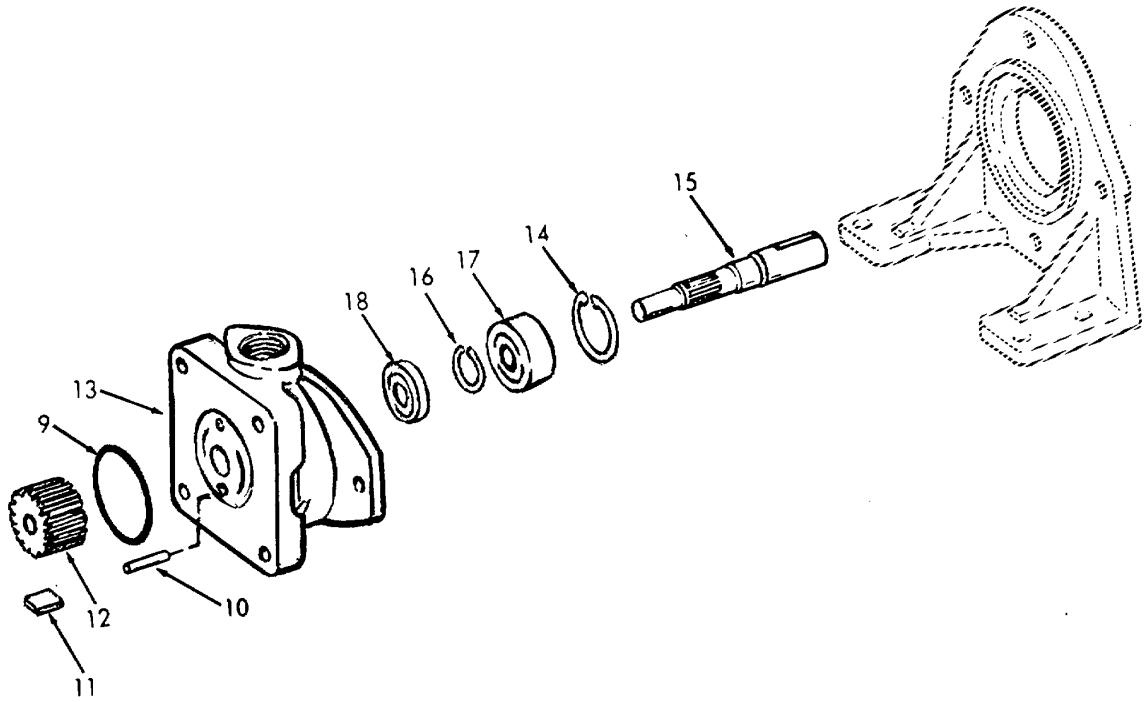
5-103. HYDRAULIC CUB PUMP UNIT - PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
	i. Preformed packing (9)	Remove.	Discard.
	j. Locating pins (10)	Remove.	
	k. Vanes (11) and rotor (12)	Separate.	Discard vanes.
	l. Rotor (12)	Remove.	
	m. Body (13)	Turn over.	
	n. Snap ring (14)	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.	a. Use a hooked tool. b. Discard.

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

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-DISASSEMBLY (Cont)



OVERHAUL-CLEANING-INSPECTION

WARNING

Wear protective eye goggles when using compressed air.

2. 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 compatible with 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.

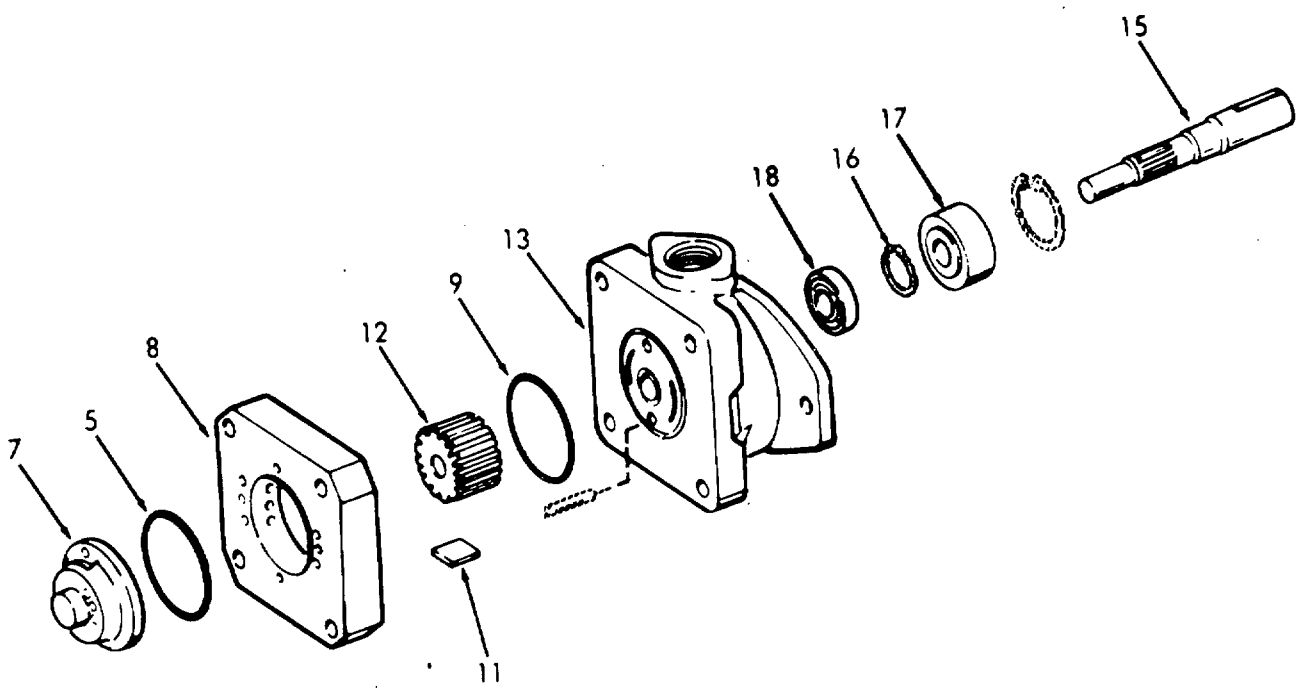
5-103. HYDRAULIC CUB PUMP UNIT - PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-CLEANING-INSPECTION (Cont)			
		1. Discard the used shaft seal (18) and all the 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 the rotor (12) for scoring and excessive wear. Remove any 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 slots are worn.	
		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.	

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

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-CLEANING-INSPECTION (Cont)



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.

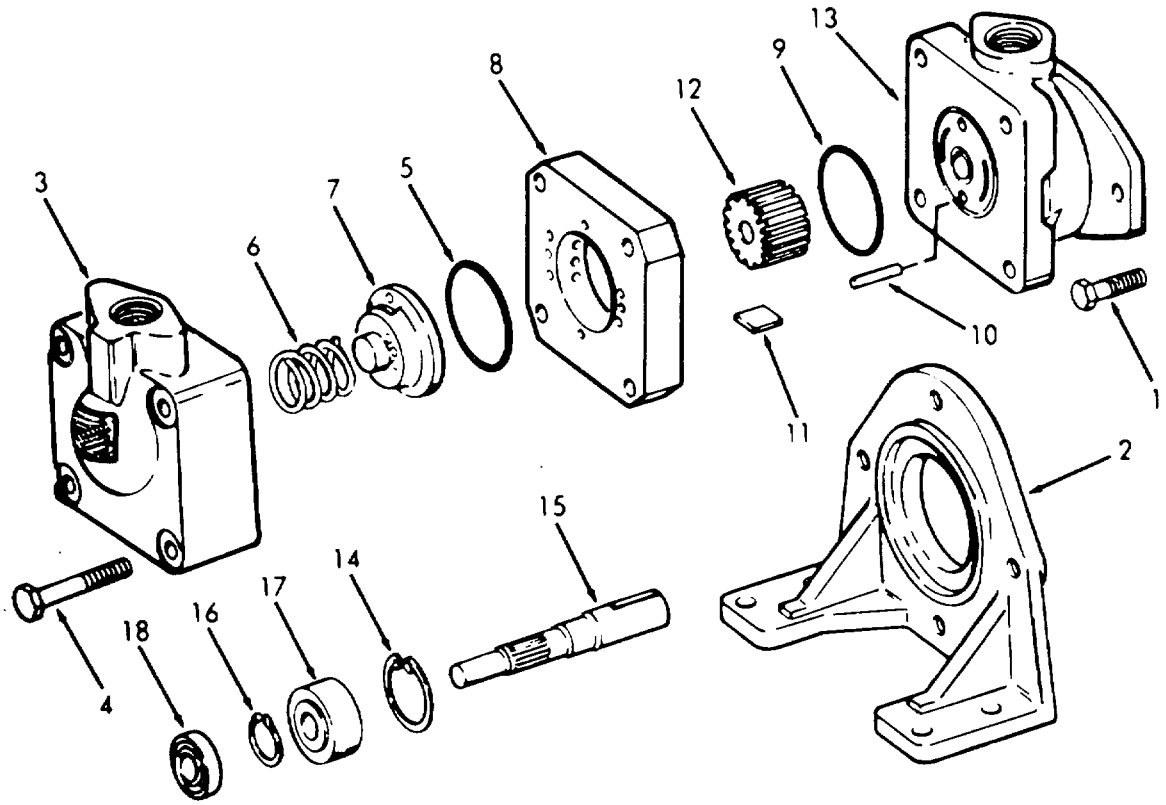
a.	Shaft (15)	Press into bearing.	Support bearing inner race.
b.	Small snap ring (16)	Install on shaft (15).	

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

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-CLEANING-INSPECTION (Cont)			
	c. Shaft seal (18)	1. Press into body (13).	Seals are assembled with the garter spring towards the pump body.
		2. Lubricate lip with petroleum jelly.	
	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 packings (5 and 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).	
	j. Vanes (11)	1. Insert in rotor slots.	
		2. Be sure radius edges of the vanes are toward the cam ring.	
	k. Pressure plate (7)	Place on locating pins (10) and against ring (8).	

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

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-CLEANING-INSPECTION (Cont)			
	l. Spring (6), cover (3), and screws (4)	Install.	Tighten to 35-45 lb. ft. (47.5 to 61 Nm) torque.
	m. Shaft (15)	Rotate.	Make sure there is no internal binding.
	n. Pump bracket (2)	Assemble.	
	o. Bolts (1)	Install.	



5-103. HYDRAULIC CUB PUMP UNIT - BRAKE VALVE - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	Equipment Condition / Condition Description
NONE	NONE
Material/Parts	Special Environmental Conditions
Gasket kit P/N 919328	NONE
Personnel Required	General Safety Instructions
1	Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS

REPAIR

1. Brake Valve

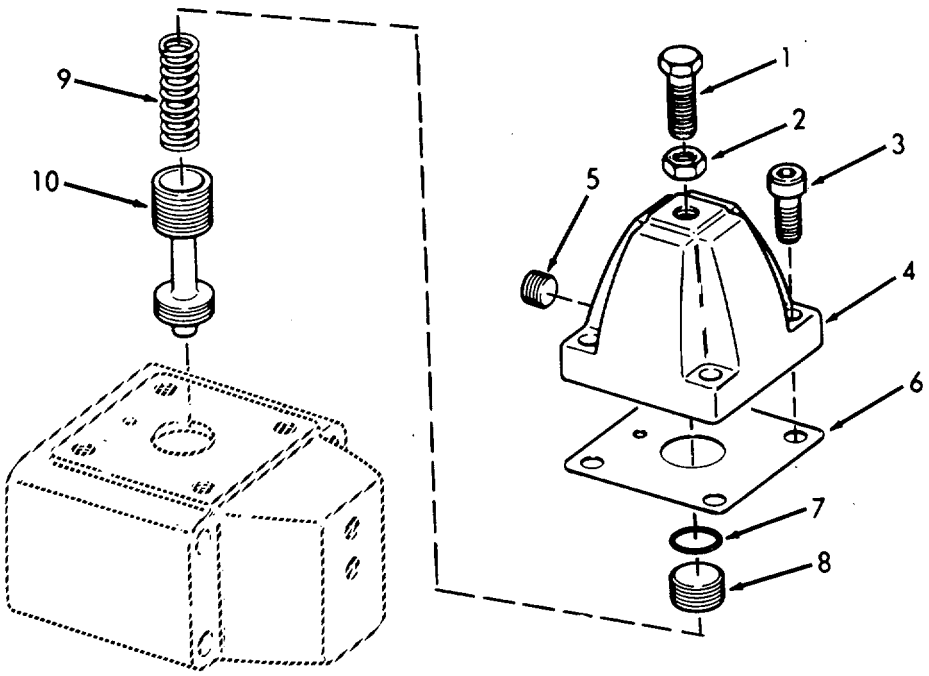
WARNING

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)	1. Loosen locknut (2).	Relieves spring compression.
		2. Back off screw to its full length.	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
		3. Remove.	
	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)	1. Remove. 2. Inspect spool for binding or excessive clearance.	

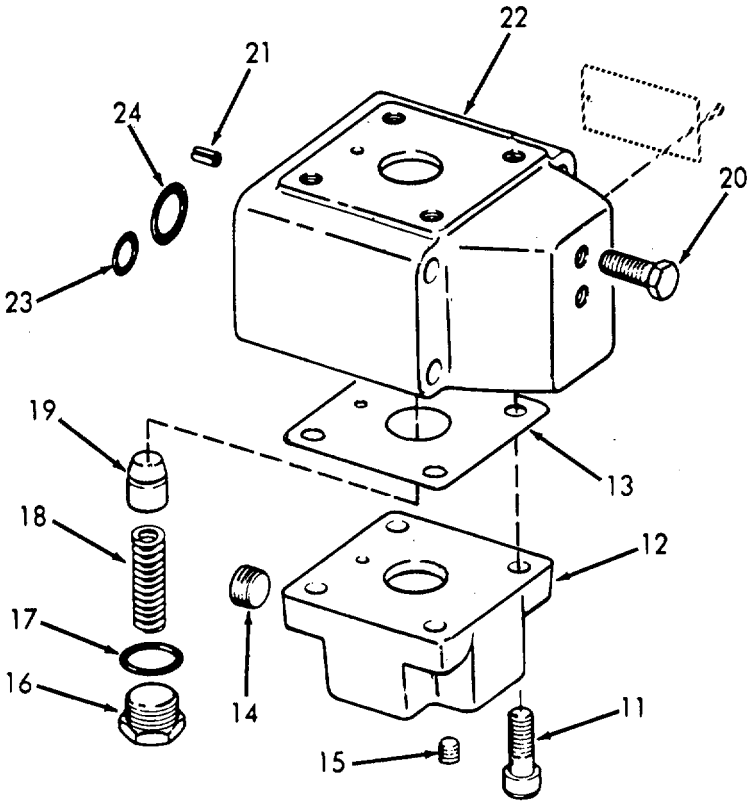


5-103. HYDRAULIC CUB PUMP UNIT - BRAKE VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	g. Screws (11)	Remove.	Discard.
	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.
	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). 2. Replace	Discard. Use new packings.

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	o. Preformed packing (17)	Install.	Use new packing.
	p. Poppet (19), and spring (18)	Install.	
	q. Plug (16), and cover plugs (14 and 15)	Install.	

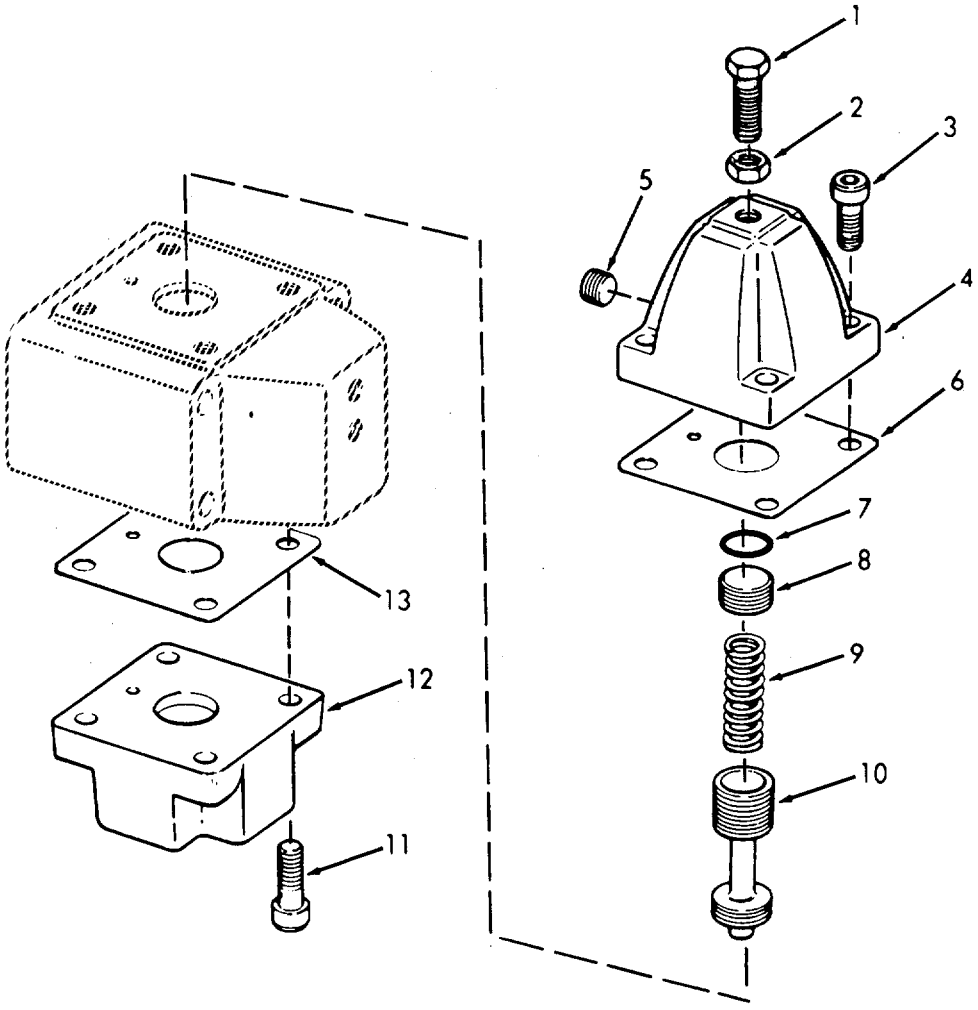


5-103. HYDRAULIC CUB PUMP UNIT - BRAKE VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	r. Gasket (13), and cover (12)	1. Align holes. 2. Install.	Use new gasket.
	s. Screws (11)	Install.	
	t. Preformed packing (7)	Install.	
	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.	

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

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	y. Locknut. (2), and adjusting screw (1)	Adjust and tighten.	



5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER - MAINTENANCE INSTRUCTIONS

This task covers:

Repair

INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition** / **Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
2	NONE

LOCATION	ITEM	ACTION	REMARKS

NOTE

Repair or replace the Reservoir, Tank or Strainer parts, as needed.

PART NUMBER	DESCRIPTION
1.	Hydraulic strainer
2.	Relief cylinder pressure valve
3.	Socket screw
4.	Relief pump pressure valve
5.	Socket head capscrew
6.	Lockwasher
7.	Socket head capscrew
8.	Lockwasher
9.	Manifold fitting
10.	Tubing

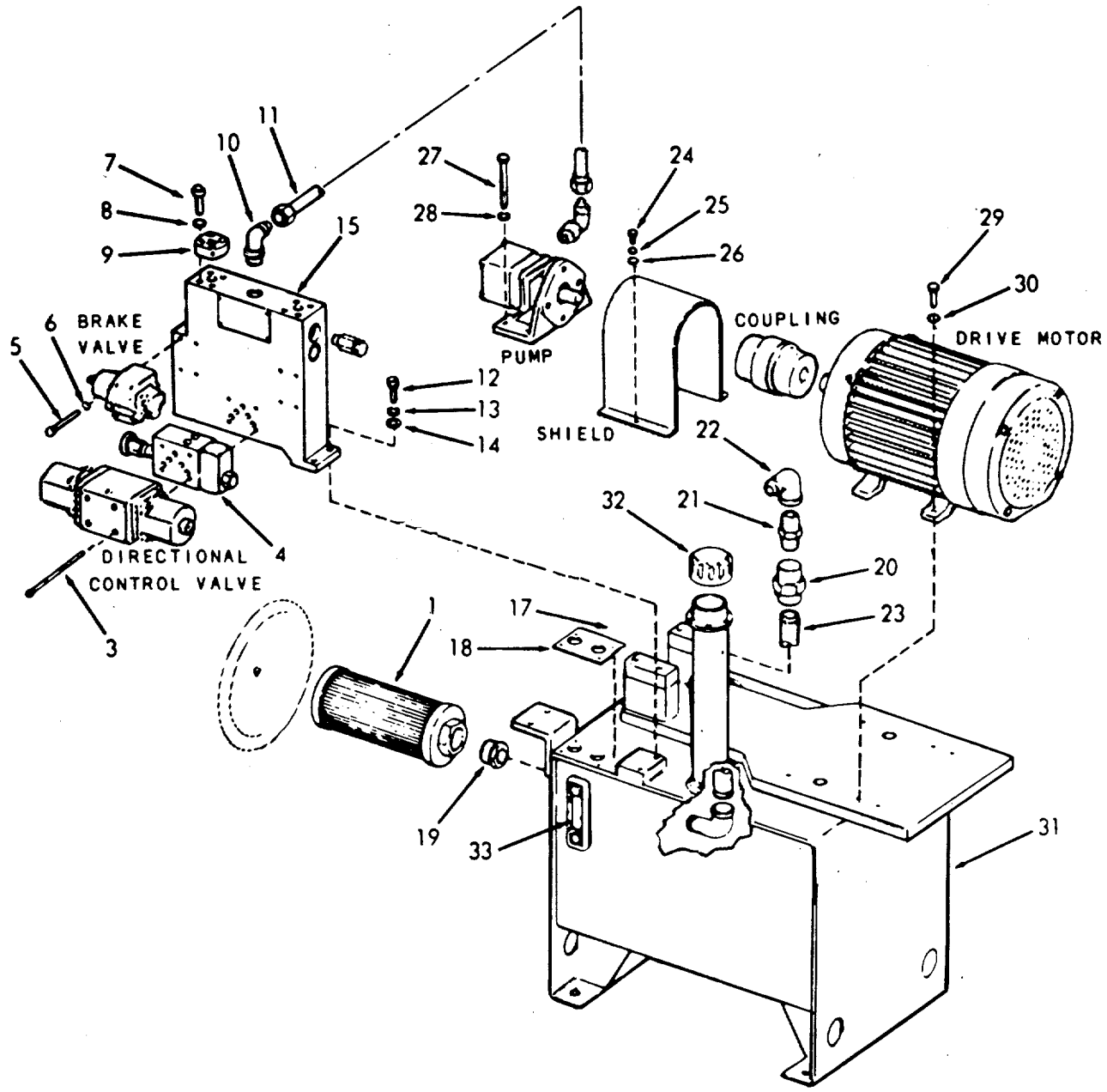
5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			

PART NUMBER	DESCRIPTION
11.	90° flared tube to boss elbow
12.	Hex head capscrew
13.	Lockwasher
14.	Flatwasher
15.	Aluminum manifold
16.	Hex head capscrew
17.	Lockwasher
18.	Steel plate
19.	Pipe bushing
20.	Pipe union
21.	Pipe nipple
22.	900 street elbow
23.	Pipe, 1 1/4 diameter
24.	Hex head capscrew
25.	Lockwasher
26.	Flatwasher
27.	Hex socket capscrew
28.	1/4 hi-collar lockwasher
29.	Hex head capscrew
30.	Lockwasher
31.	10 gallon hydraulic fluid reservoir
32.	Filler breather
33.	Hydraulic reservoir sight gauge

5-107. HYDRAULIC CUB PUMP UNIT - RESERVOIR, TANK AND STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



5-1234

5-108. HYDRAULIC CUB PUMP UNIT - SYLINDER AND LINKAGE - 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

Spanner wrench hooked

Special Environmental Conditions

NONE

Personnel Required

1

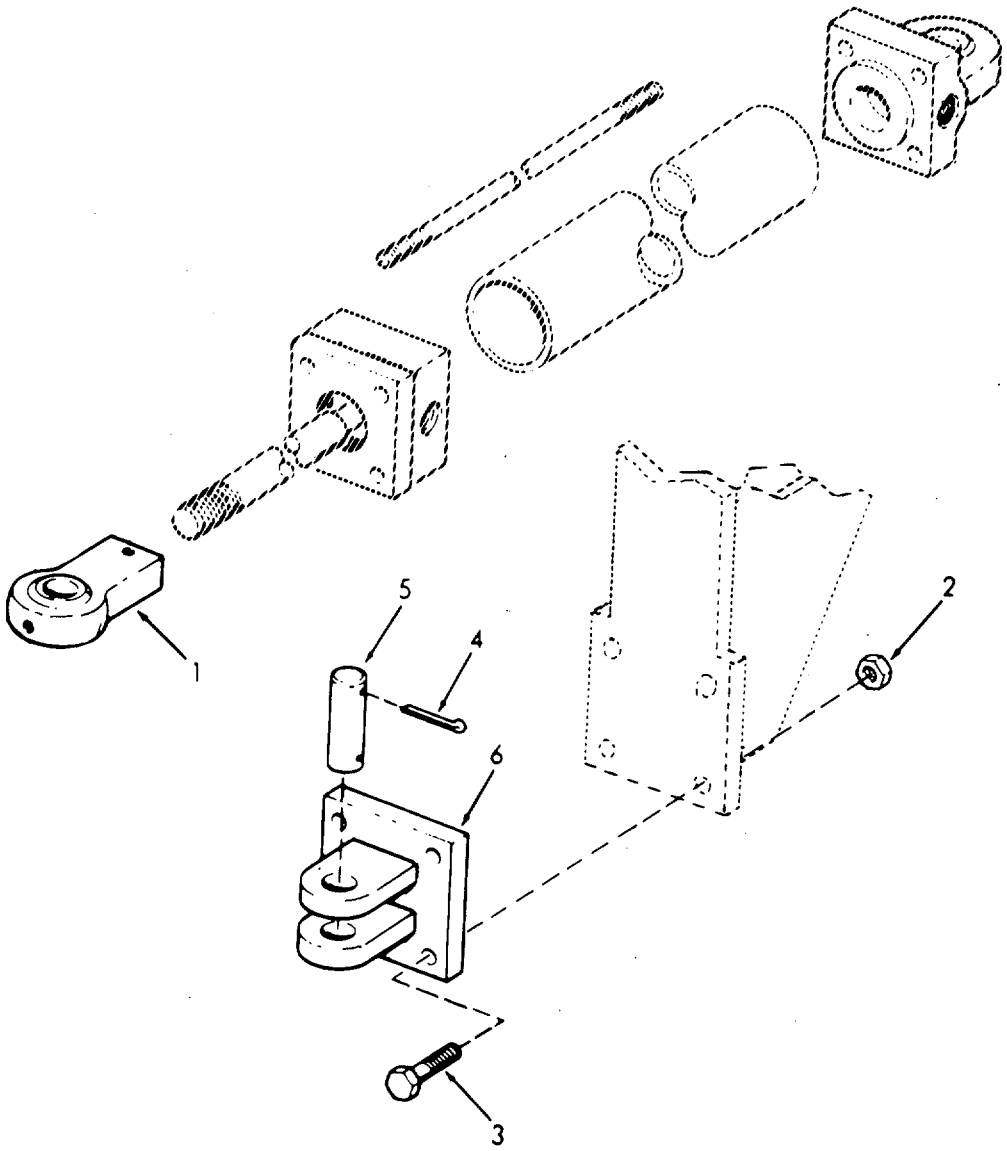
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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
REPAIR (Cont)			
	f. Clevis bracket (6)	Separate from cylinder.	



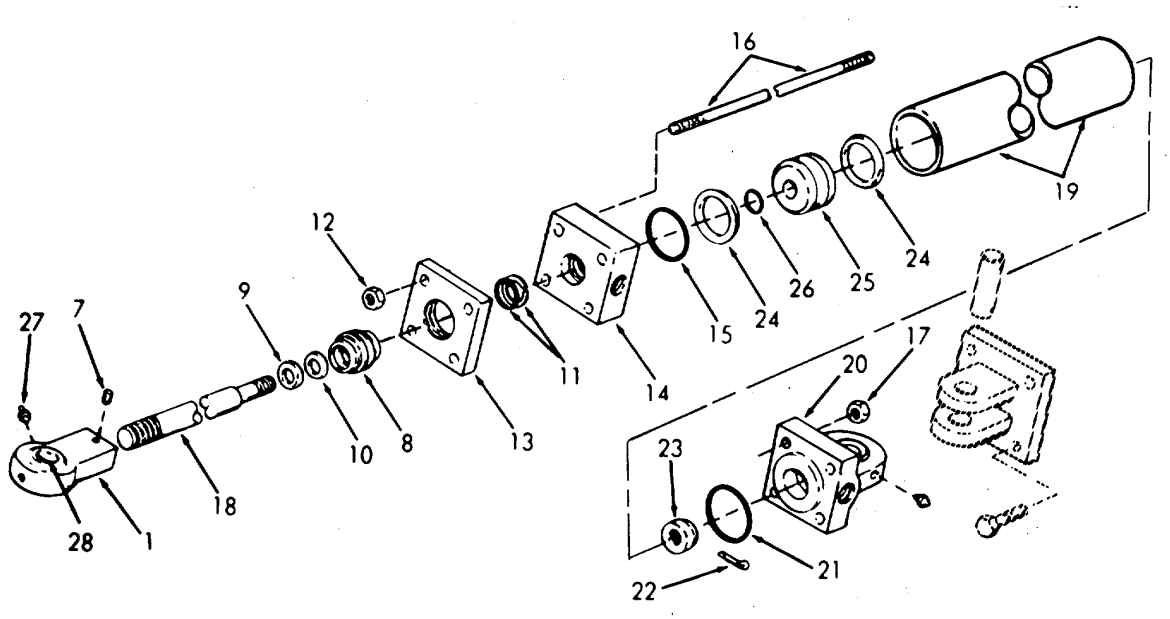
5-1237

5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (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 head (20), and seal ring (21)	Remove.	

5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (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.

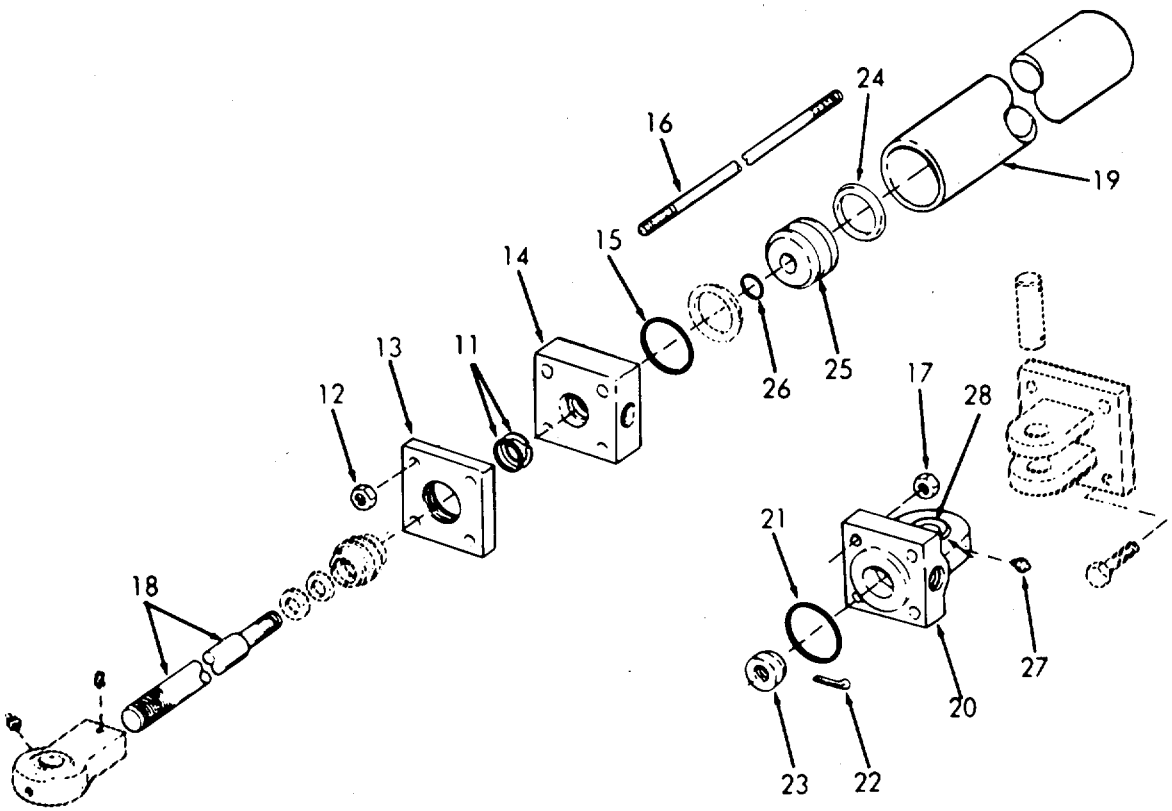


5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	m. Blank end head (20), and seal ring (21)	Remove lubrication fittings (27), and self-aligning bearing (28).	If necessary.
	NOTE Lubricate all seal rings, seals, and seal cups with hydraulic fluid before re-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 head (20)	Install on cylinder barrel (19).	
	u. Tie rods (16), and nuts (17)	Insert in blank end head (20).	

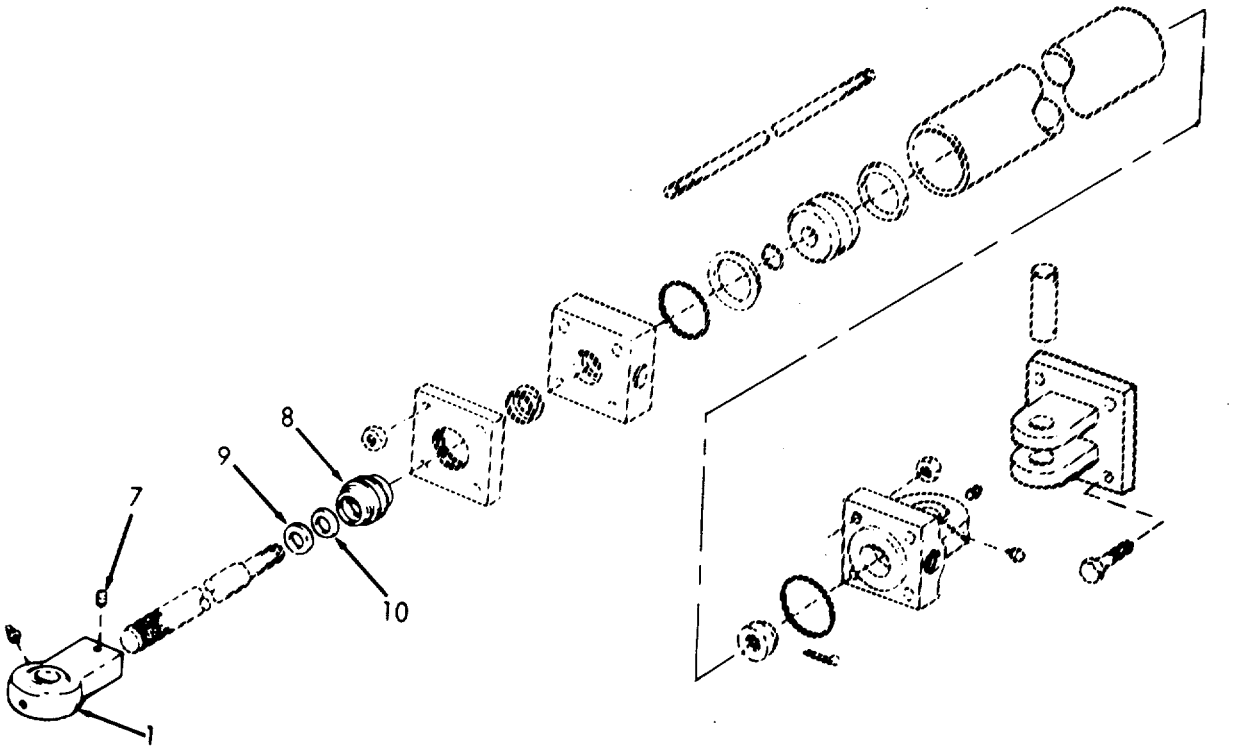
5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (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 (11)	Install.	



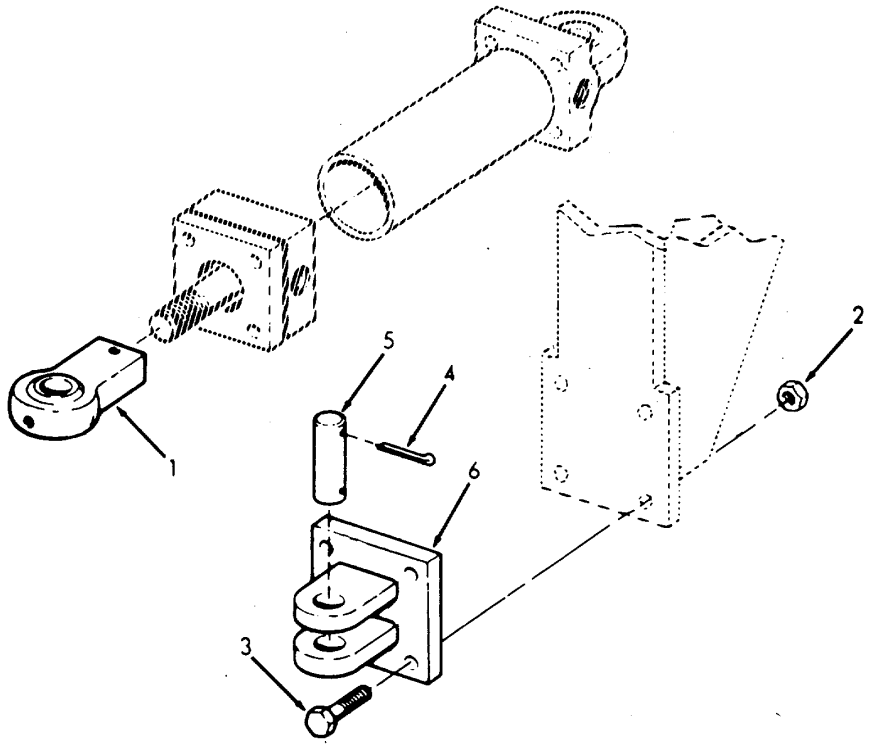
5-108. HYDRAULIC CUB PUMP UNIT - CYLINDER AND LINKAGE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (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
INSTALLATION			
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 nuts (2)	Install.	
	e. Rod eye end (1)	Re-attach.	



5-109. HYDRAULIC CUB PUMP UNIT - HOSES, PIPING, AND VALVES - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition** / **Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
2	NONE

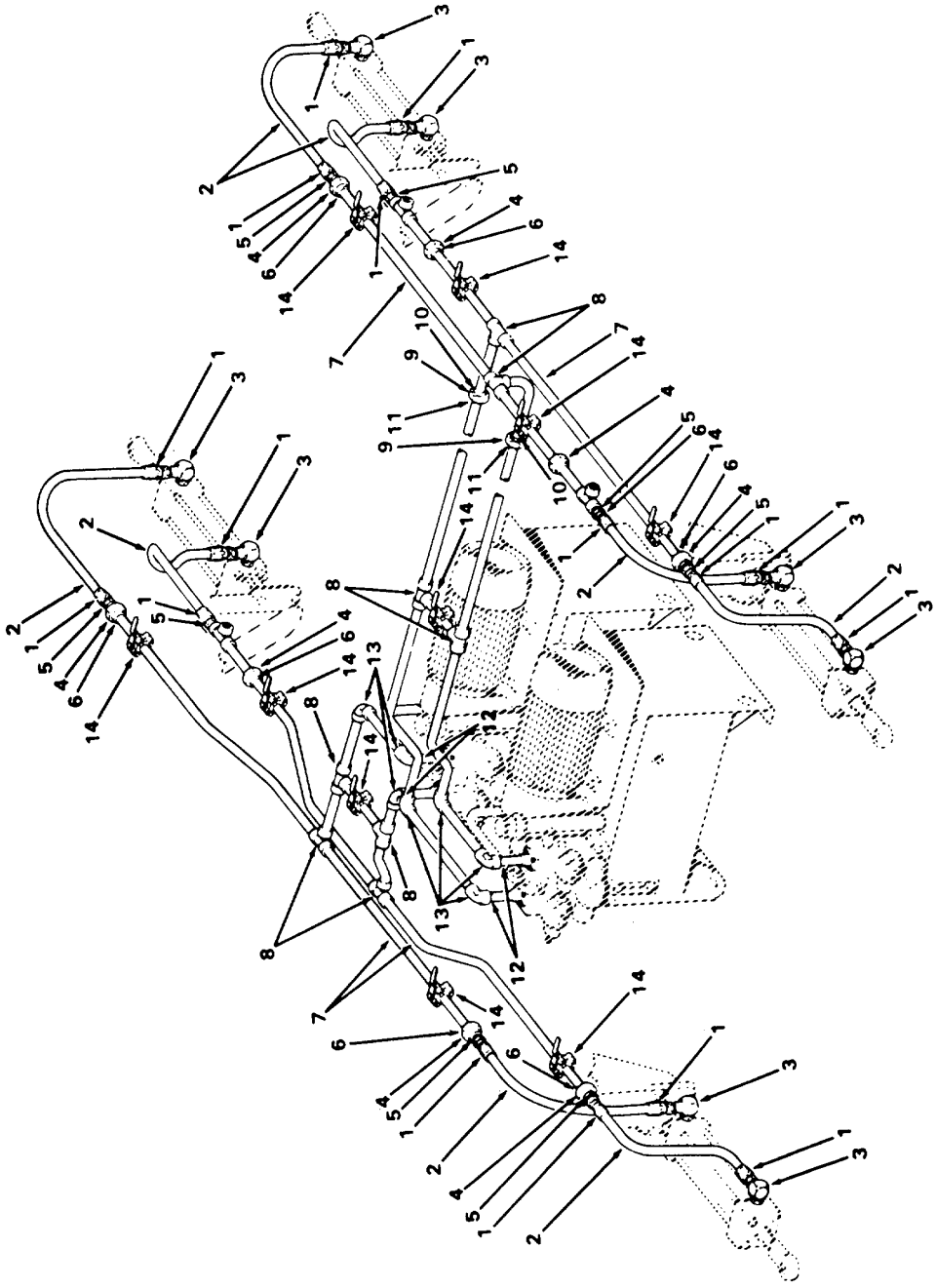
LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

ITEM NUMBER	DESCRIPTION
1.	Hose fitting
2.	Hydraulic rubber hose
3.	90° steel pipe-to-tube elbow
4.	Union nut
5.	Pipe fitting, 1/2 inch female, steel
6.	O-ring tailpiece, 1/2 inch, steel
7.	Pipe, 1/2 inch, steel
8.	Pipe, tee, 1/2 inch
9.	Union nut
10.	Pipe fitting
11.	O-ring tailpiece, 1/2, steel
12.	Reducing insert
13.	90° elbow, 1/2 inch
14.	Steering gear system ball valve

5-109. HYDRAULIC CUB PUMP UNIT - HOSES, PIPING, AND VALVES - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS



5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition** / **Condition Description**
NONE	Drydocked
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
4	NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

1. Flanking Rudder

ITEM NUMBER	DESCRIPTION
1.	Cuppoint setscrew
2.	Hex head drilled monel capscrew
3.	Flanking rudder
4.	Rudder key, square, steel stock
5.	Hex head capscrew
6.	Lockwasher
7.	Flanking rudder retaining plate
8.	Flanking rudder lower rudder seal
9.	Hex nut, plain

5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS (Continued).

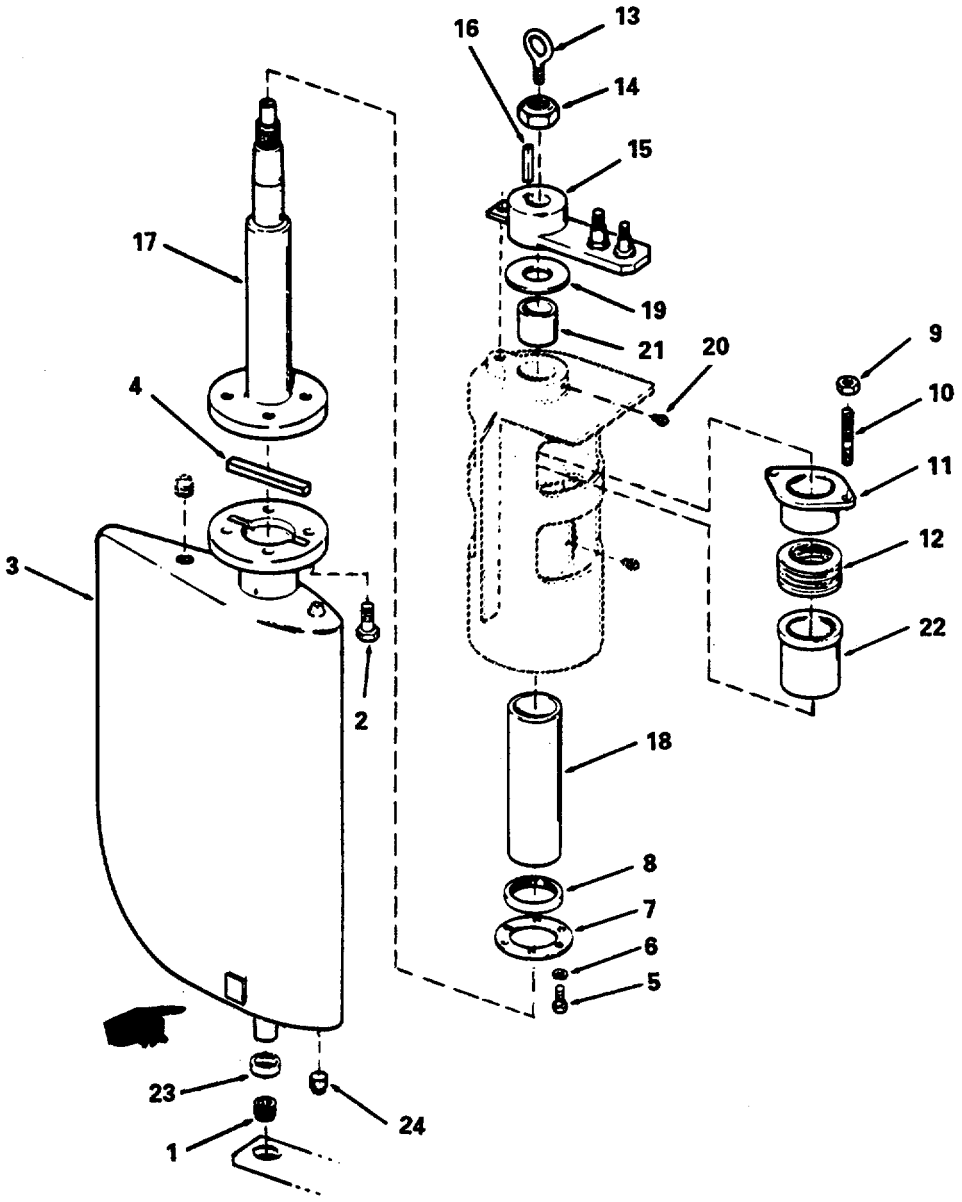
LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

ITEM NUMBER	DESCRIPTION
10.	Packing gland stud, bronze
11.	Flanking rudder packing gland
12.	Packing
13.	Eyebolt, shoulder
14.	Self-locking hex nut
15.	Flanking rudder tiller arm, inboard, starboard Flanking rudder tiller arm, inboard, port Flanking rudder tiller arm, outboard, starboard Flanking rudder tiller arm, outboard, port
16.	Flanking rudder tiller square key
17.	Flanking rudder stock
18.	Flanking stock rudder sleeve
19.	Flanking rudder floating ring
20.	Lubrication fitting
21.	Flanking rudder bushing, upper stock
22.	Flanking rudder bushing, lower stock
23.	Pintle bushing
24.	Pipe plug

5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



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5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			
2. Main Rudder			

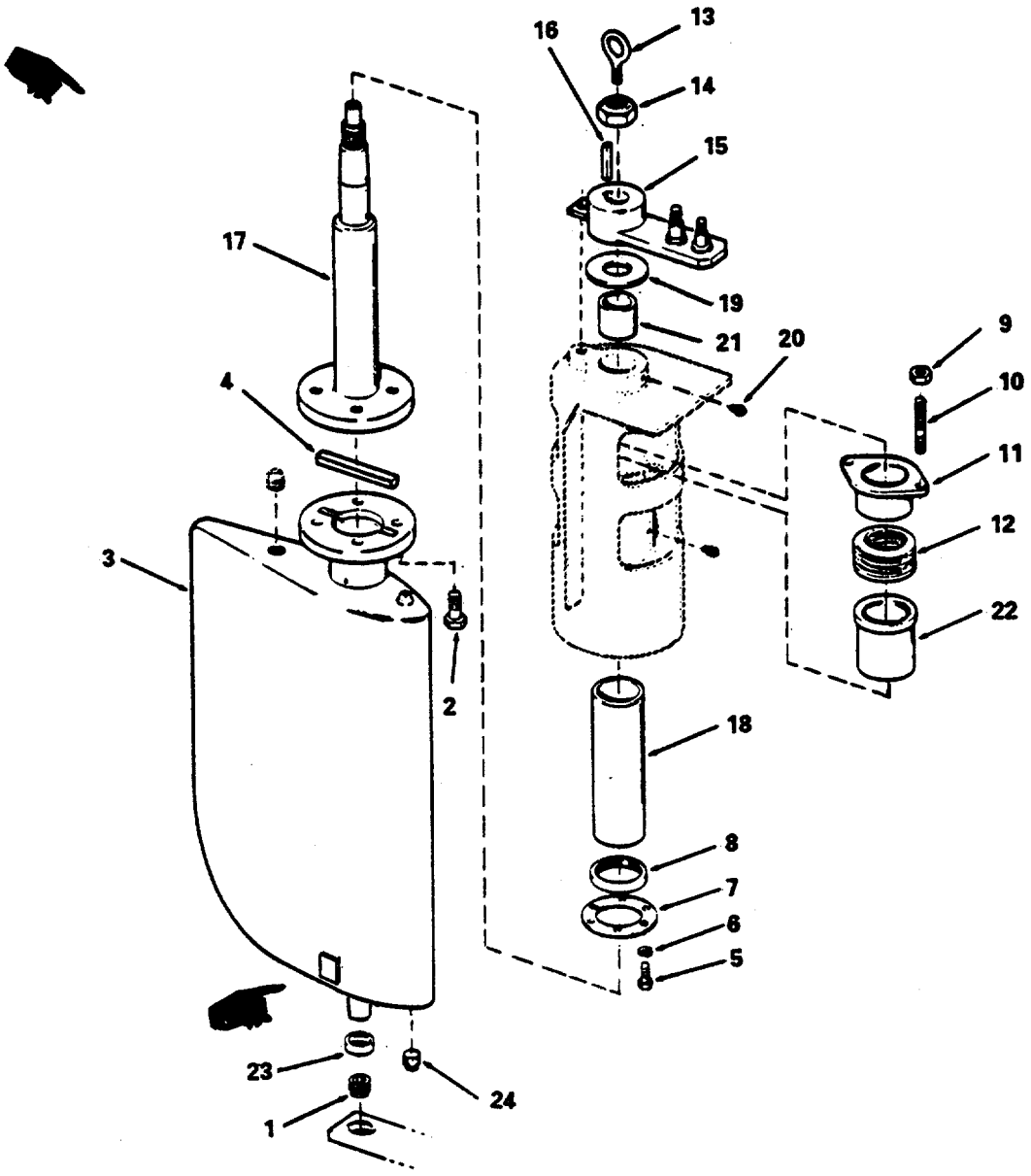
NOTE

Repair or replace the following parts of the Main Rudder, as needed.

ITEM NUMBER	DESCRIPTION
1.	Cuppoint setscrew
2.	Hex head drilled monel capscrew
3.	Main rudder
4.	Rudder key, square stock
5.	Hex head capscrew
6.	Lockwasher
7.	Rudder retaining plate
8.	Lower rudder rubber seal
9.	Hex nut, plain
10.	Packing gland stud, bronze
11.	Rudder packing gland, main stock
12.	Packing
13.	Eyebolt, shoulder
14.	Self-locking hex nut
15.	Steering rudder tiller arm
16.	Tiller square key
17.	Main rudder stock
18.	Main rudder stock sleeve
19.	Main rudder stock floating ring
20.	Lubrication fitting
21.	Rudder bushing, upper main stock
22.	Rudder bushing, lower main
23.	Pintle bushing
24.	Pipe plug

5-110. MAIN AND FLANKING RUDDERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



4955-206

5-111. RUDDER ANGLE INDICATOR - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Overhaul b. Adjustment

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

3-212 Rudder Angle Indicator

Special Tools

NONE

Equipment Condition: NONE

Condition Description: NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

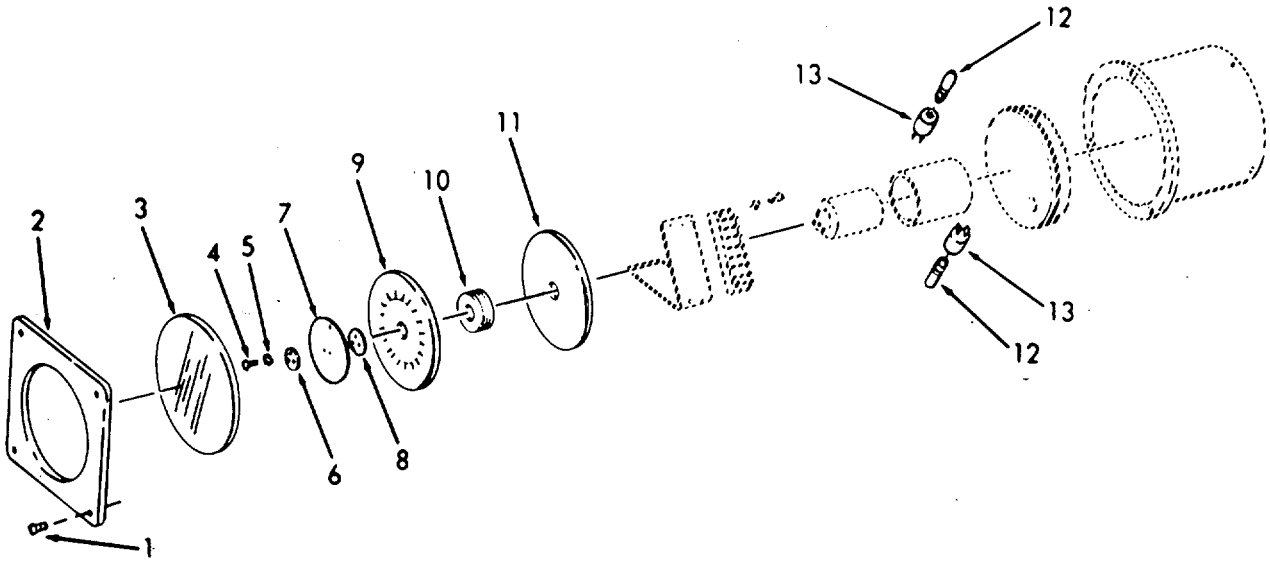
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
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 (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.



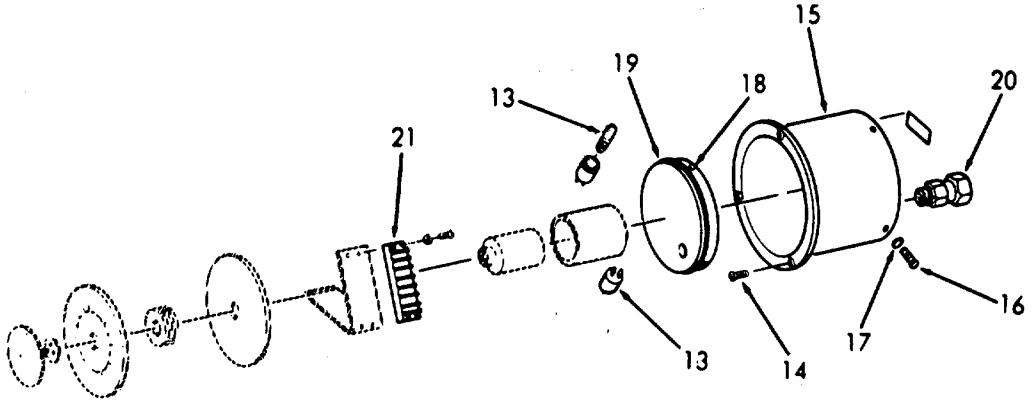
5-1253

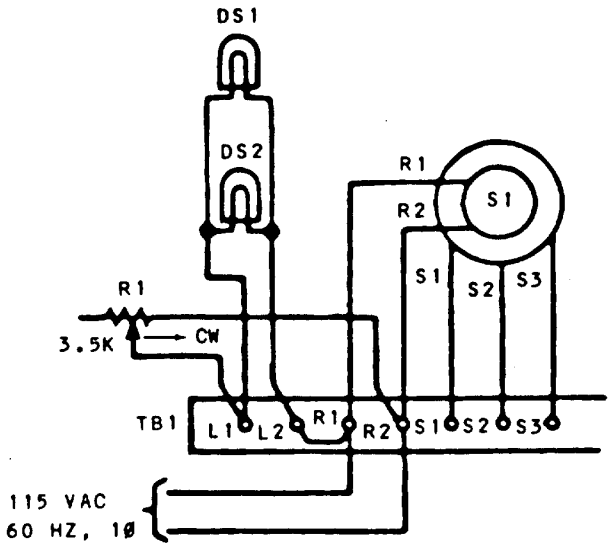
5-111. RUDDER ANGLE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

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), flat-washers (17), screws (16), and cover (15)	Reassemble.	

5-111. RUDDER ANGLE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued

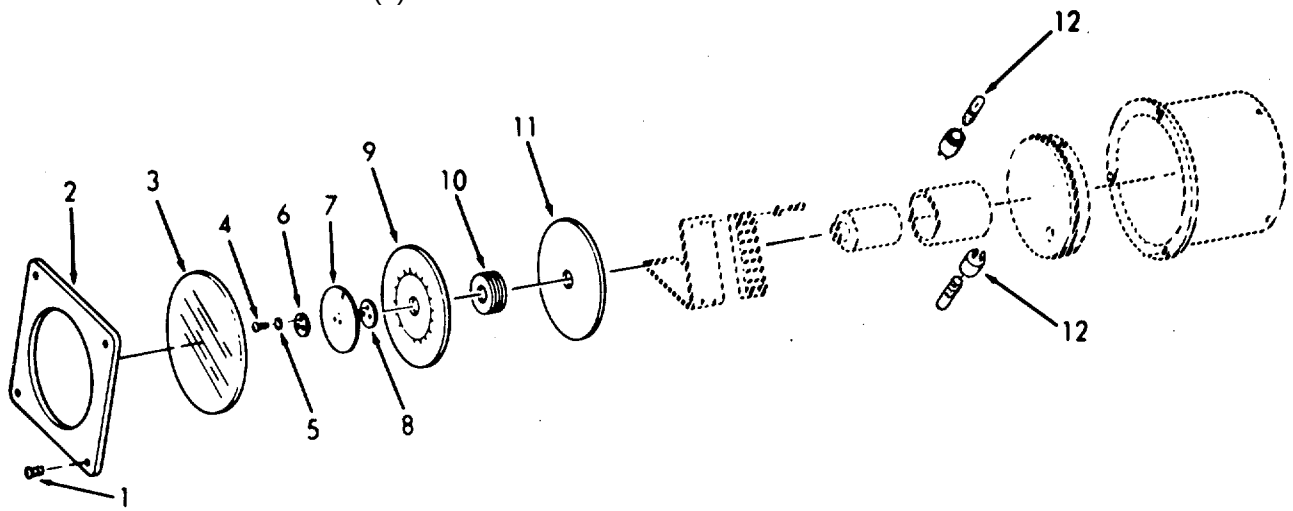
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	n. Cover (15), and screws (14)	Install in panel.	
	o. Lamp sockets (13)	Install and resolder.	





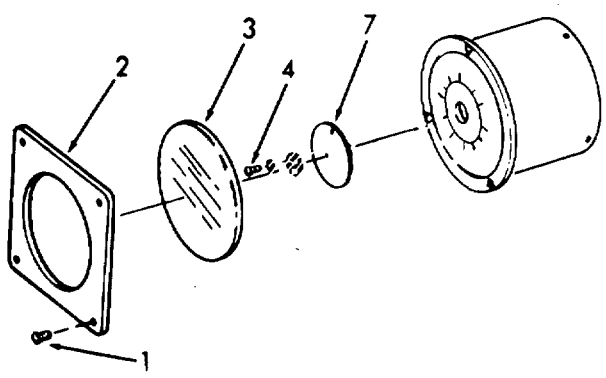
5-111. RUDDER ANGLE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	p. Lamps (12)	Install.	
	q. Light defuser (11), dial spacer (10), dial indicator (9), and pointer hub (8)	Assemble.	
	r. Pointer disc amp (7), clamps (6), and lock-washers (5)	Install.	
	s Screws (4), window (3), cover (2), and screws (1)	Install.	



5-111. RUDDER ANGLE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

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.	



5-1257

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS

This task covers:

a. Overhaul

b. Adjustment

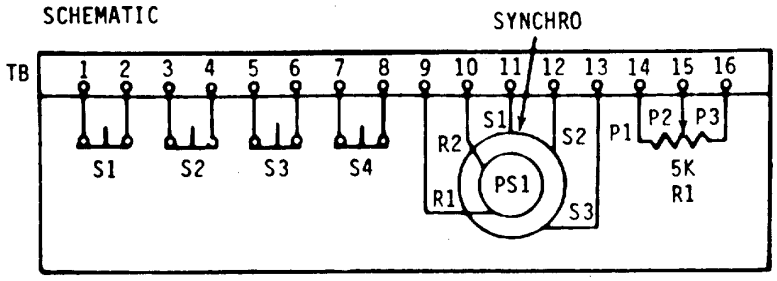
INITIAL SETUP

Test Equipment	References
Ohmmeter	NONE
Special Tools	**Equipment Condition** / **Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
Grease MIL-G-10924-Type GAA	NONE
Personnel Required	**General Safety Instructions**
1	NONE

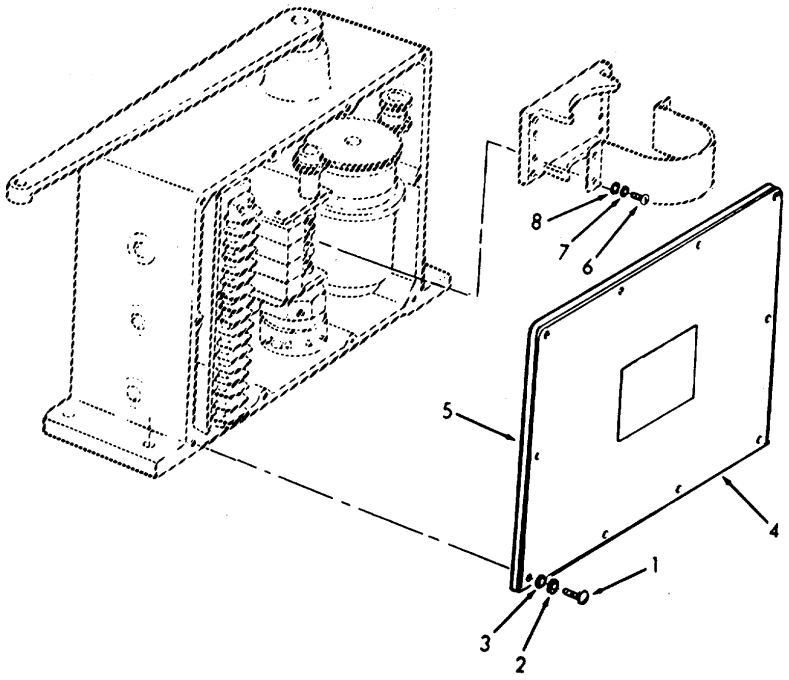
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL			
1. Synchro	a. Screws (1), lock-washers (2), and flat-washers (3)	Remove.	
	b. Cover (4), and gasket (5)	Remove.	

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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), lockwashers (7), and flatwashers (8)	Remove.	



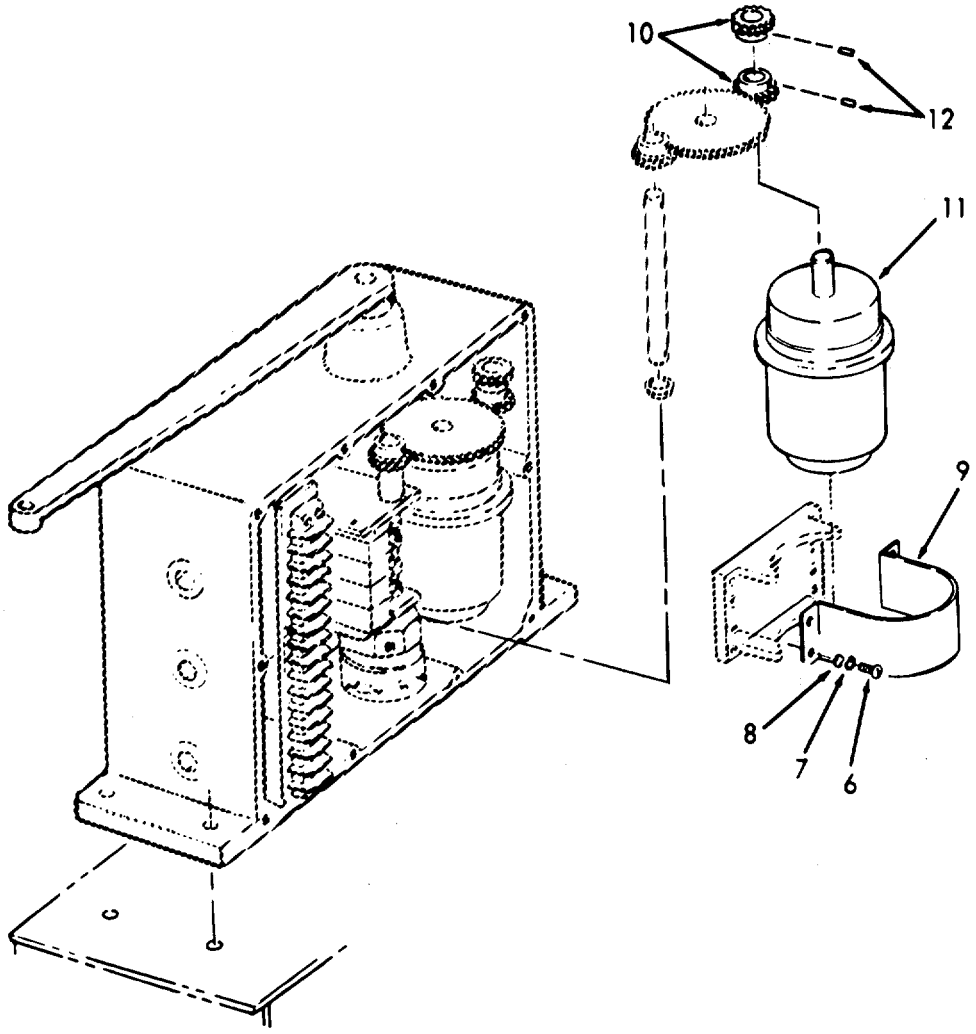
5-1259

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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)	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.

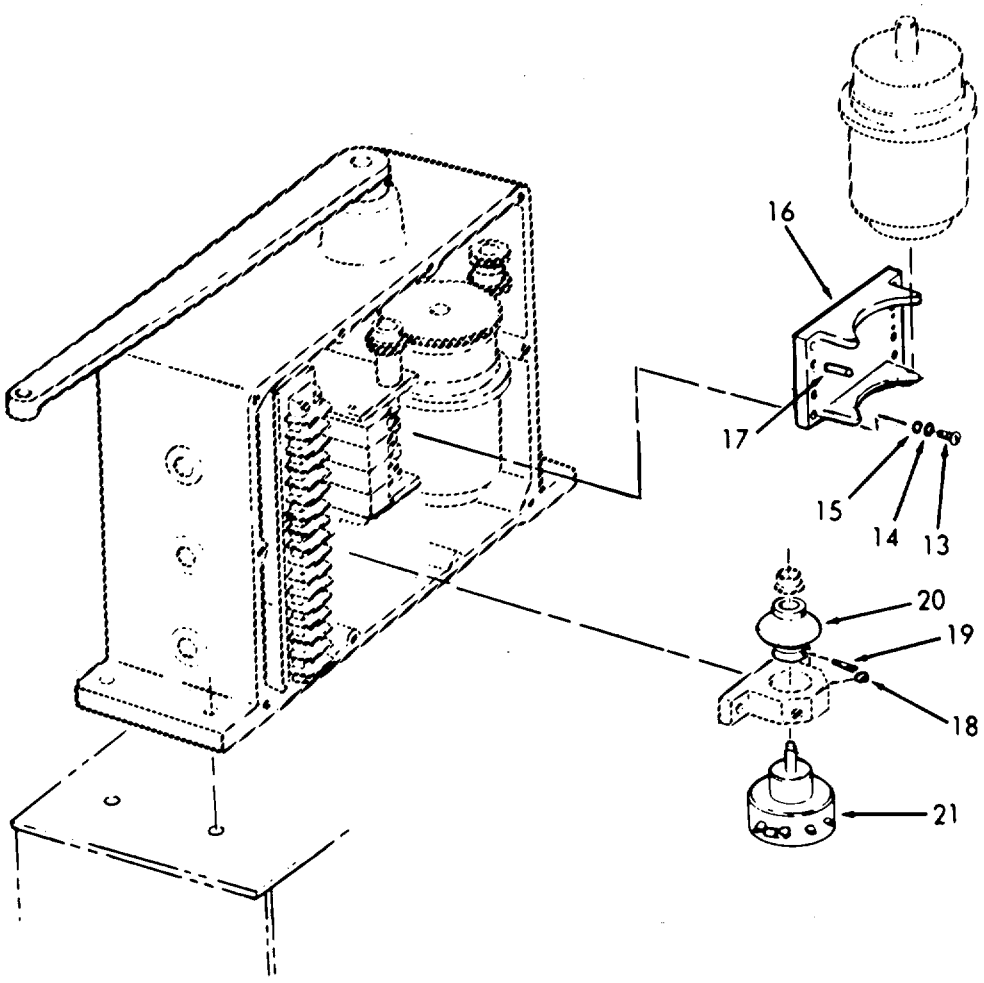


5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 Potenti-ometer	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. Potenti-ometer (21)	1. Remove.	

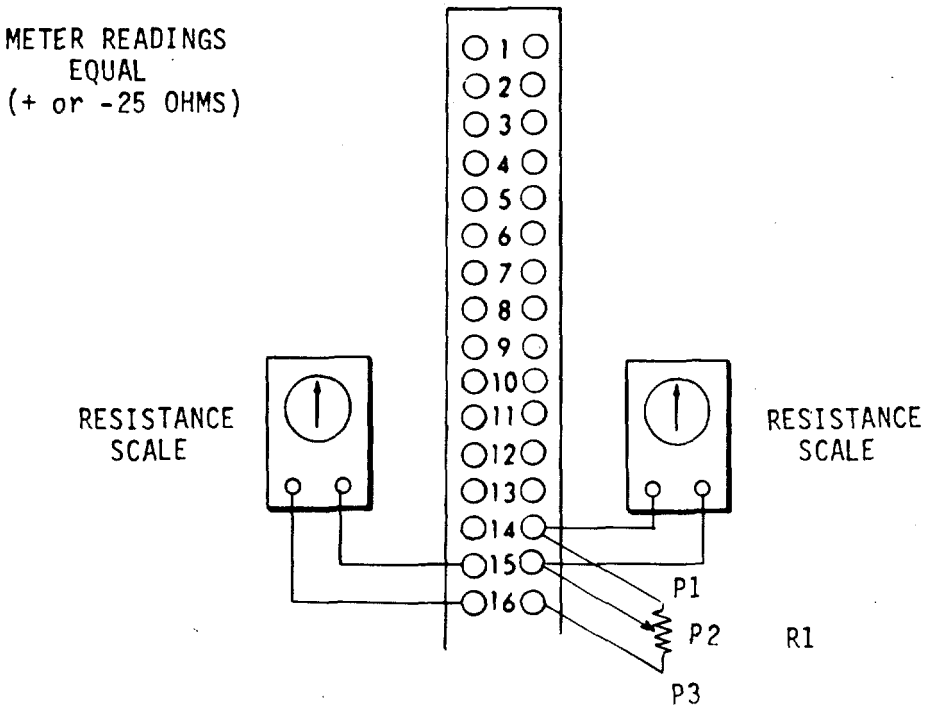
5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)		2. Set replacement potentiometer to approximately zero.	



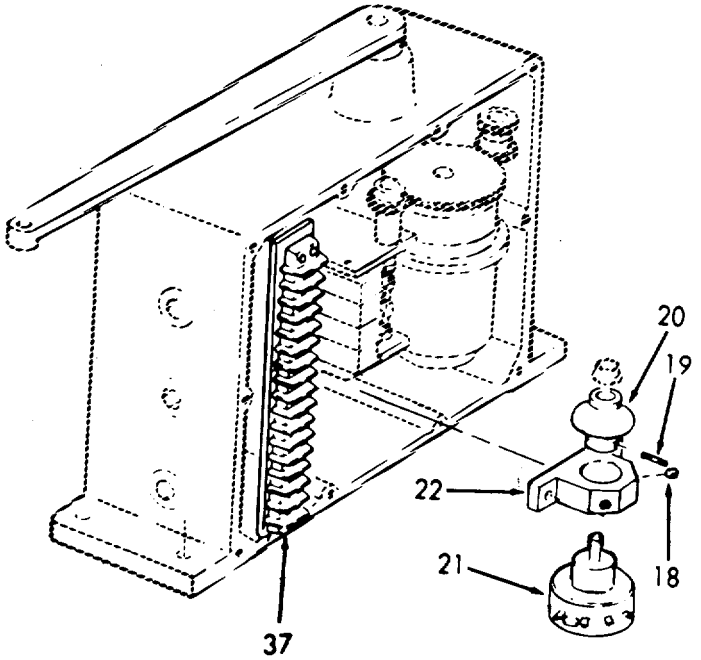
5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	e. Spring pin (19)	Install.	
	f. Setscrew (20)	Tighten.	
	g. Rudder	Position to amidships.	
	h. Ohmmeter	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.	



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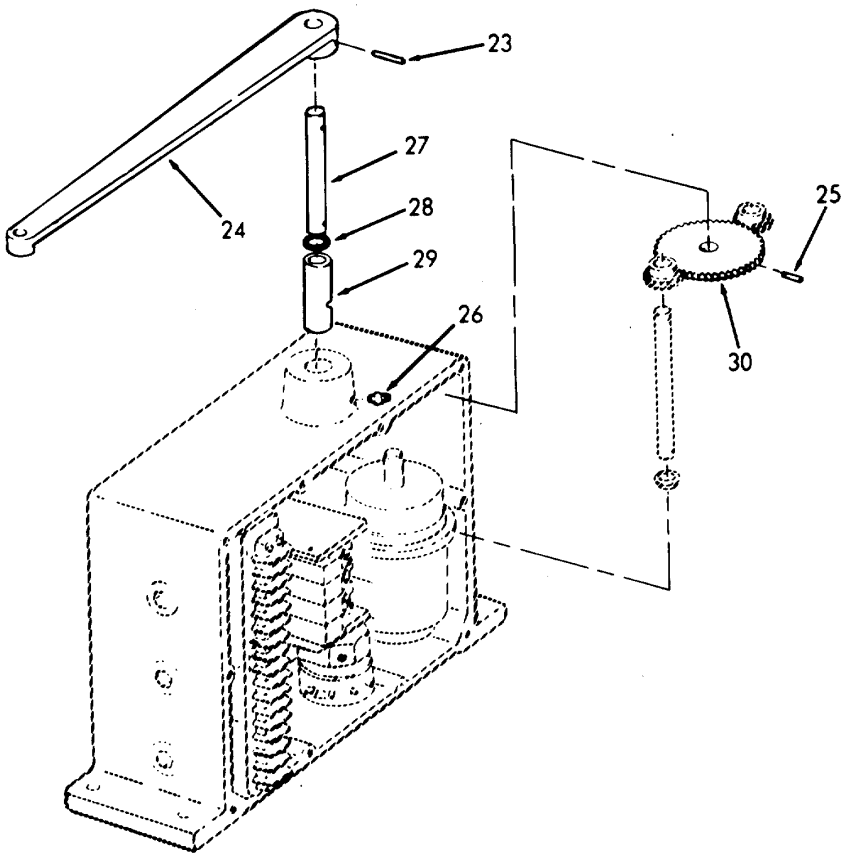
5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
4. Transmitter Arm and Associated Parts	a. Spring pin (23), transmitter arm (24), and spring pin (25)	Remove.	
	b. Lubrication 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. Lubrication fitting (26)	Install.	

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.

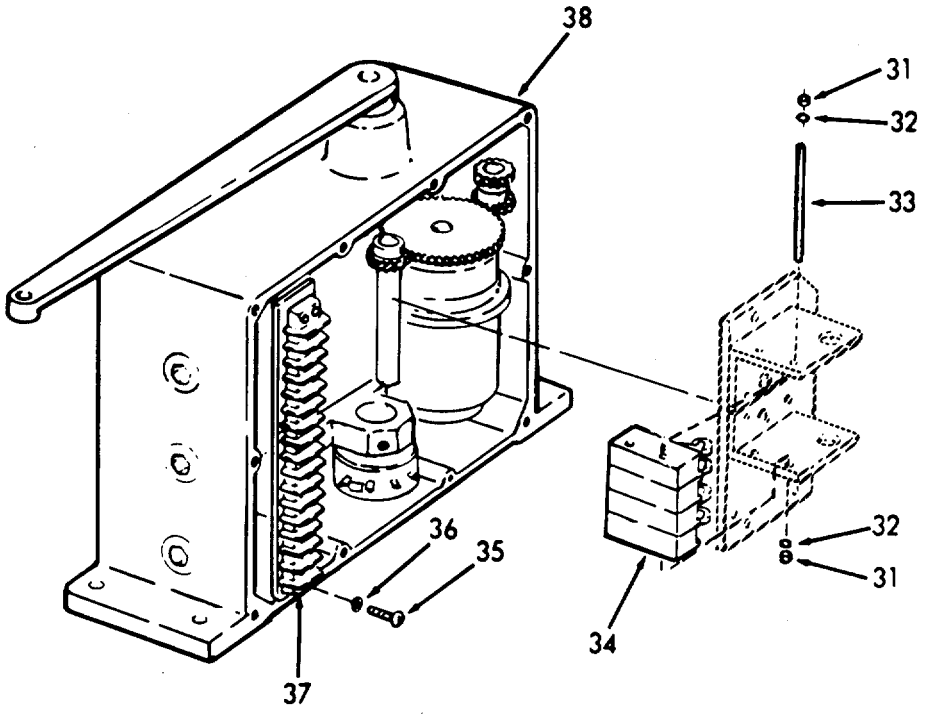


5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 identi-fication strip (38)	Replace.	

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	d. Screws (35), and lockwashers (36)	Install.	
	e. Wiring	Reconnect and remove tags.	

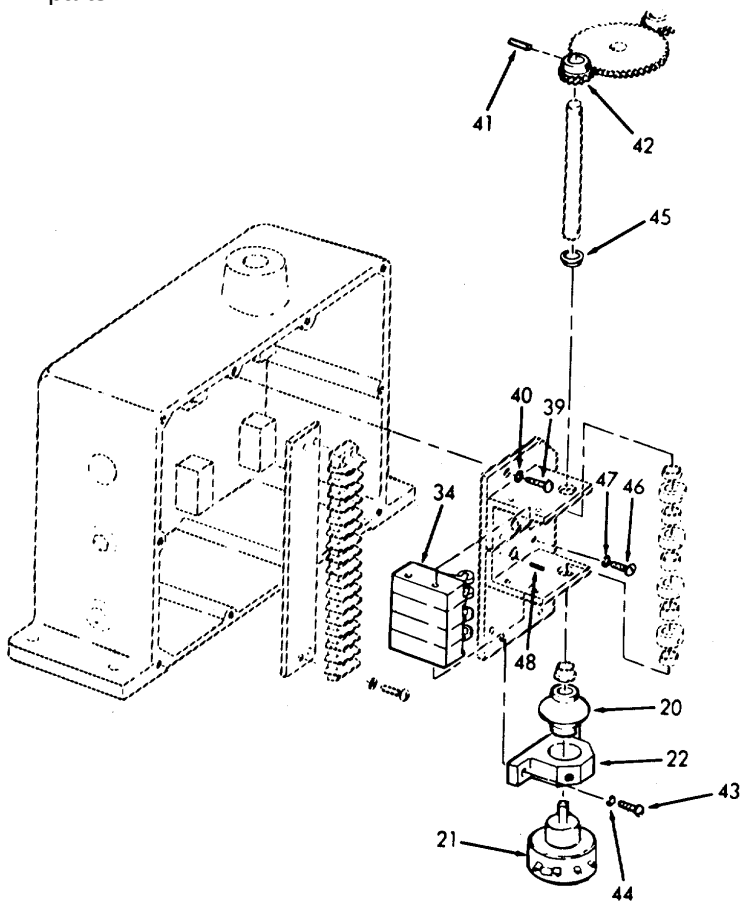


5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

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
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).	

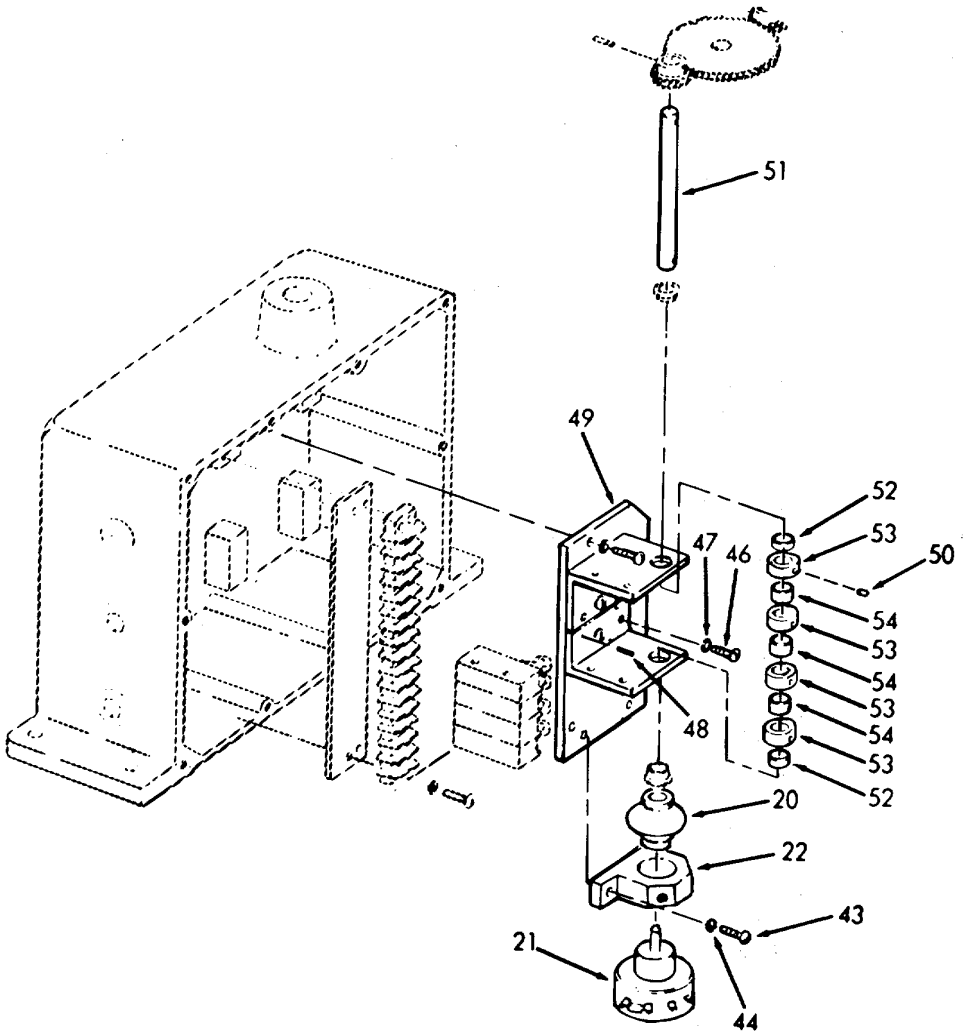


5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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)	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.	

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.

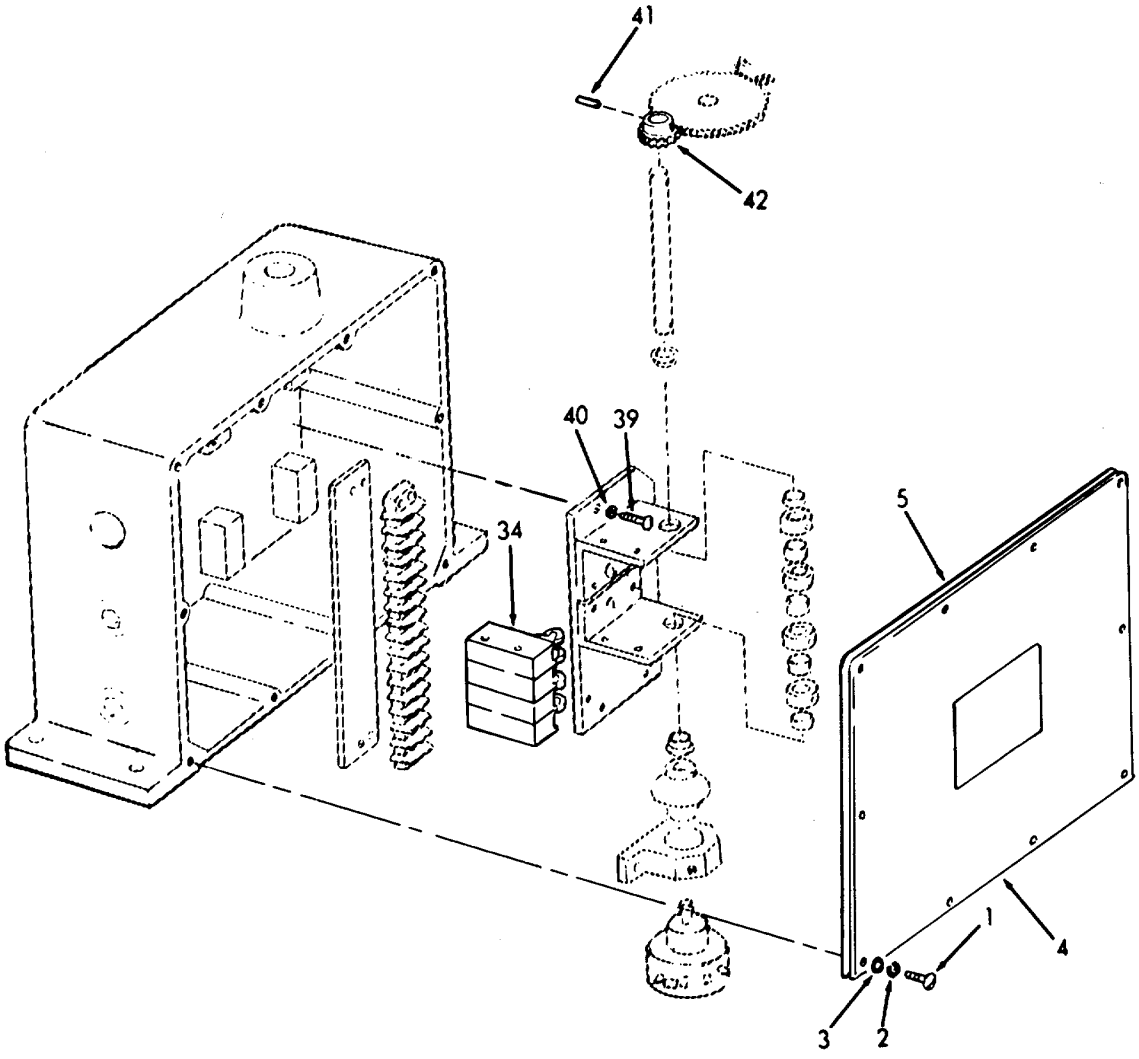


5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

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. Potenti-ometer wiring	Install.	Refer to step 3.
	aa. Limit switch adjustment	Install.	Refer to steps 9 and 10.
	ab. Synchro adjustment		Refer to step 8.
	ac. Cover (4), and gasket (5)	Install.	

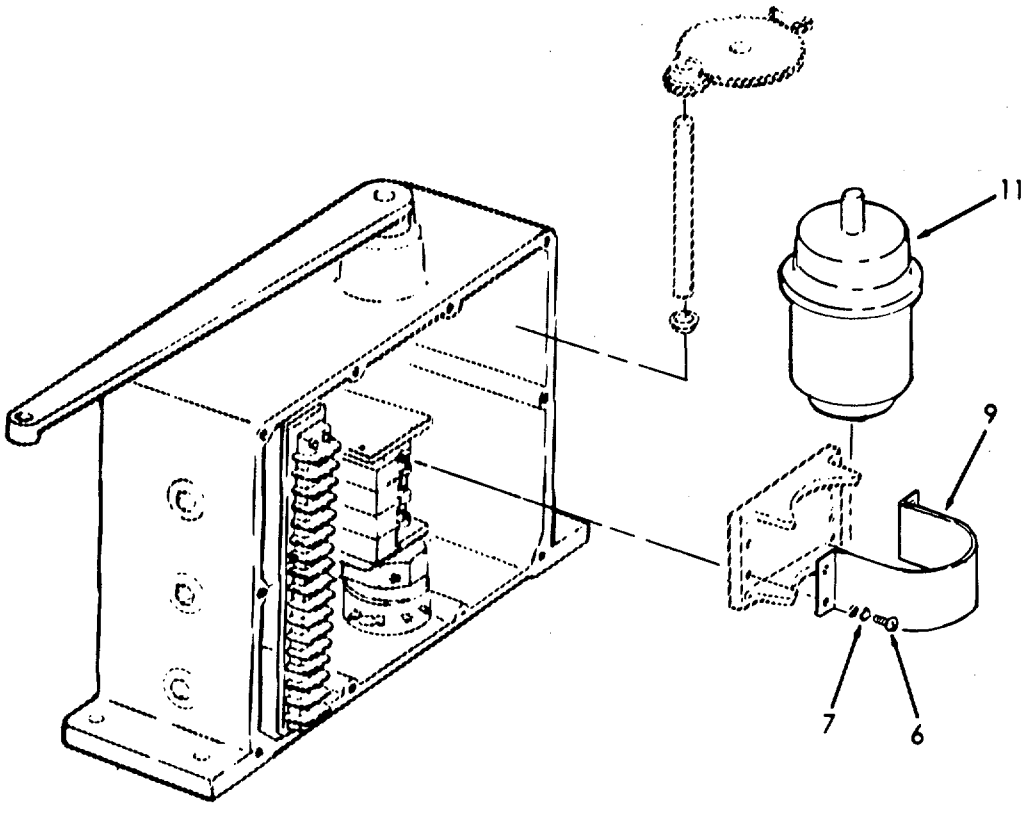
5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	ad. Screws (1), lock-washers (2), and flat-washers (3)	Install.	



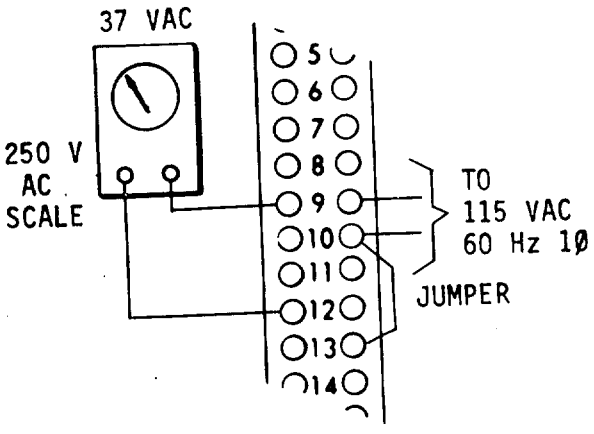
5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

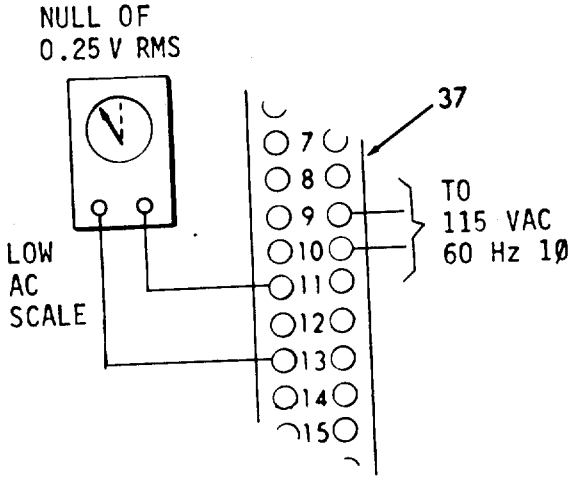
LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENT			
8.	Zeroing Synchro		
		CAUTION While performing the following procedure, make certain that the rudder is positioned amidships at all times.	
A	Screws (6), and lock-washers (7)	Loosen clamp (9) to allow synchro (11) to be rotated.	Do not remove.



5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

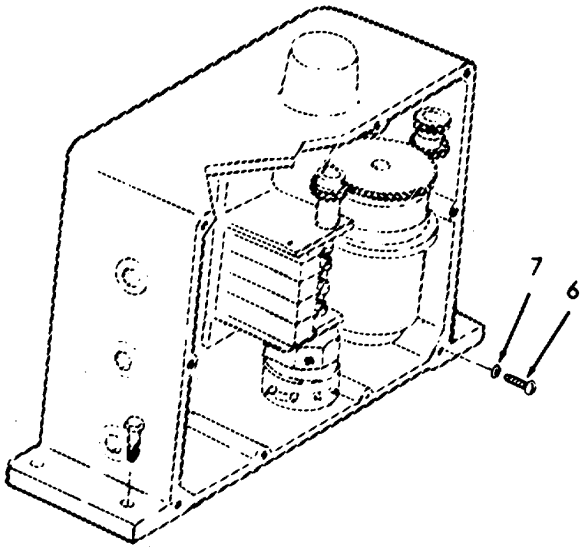
LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENT (Cont)			
	b. Wiring	Tag and disconnect all wires to terminal strip (37) - Terminals 9 (R1), 10 (R2), 11 (S1), 12 (S2) and 13 (S3).	Refer to schematic.
	c. Power source 115 VAC	Connect to terminals 9 and 10.	
	d. Jumper wire	Place between terminals 10 and 13.	
	e. Voltmeter scale.	1. Place on 250 VAC	
		2. 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	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.	



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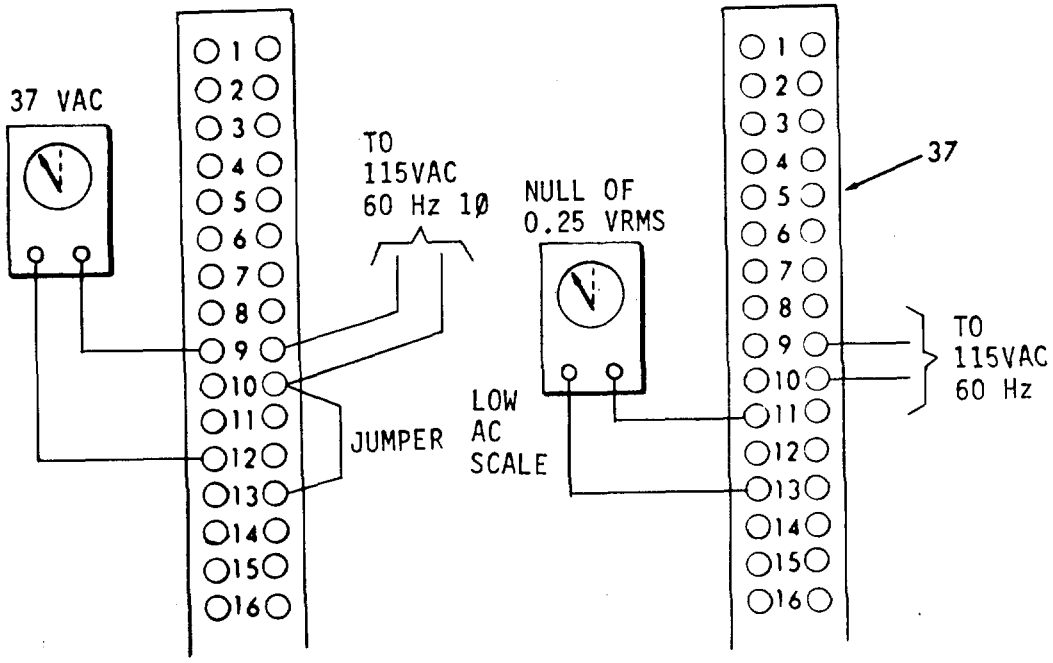
5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

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).	



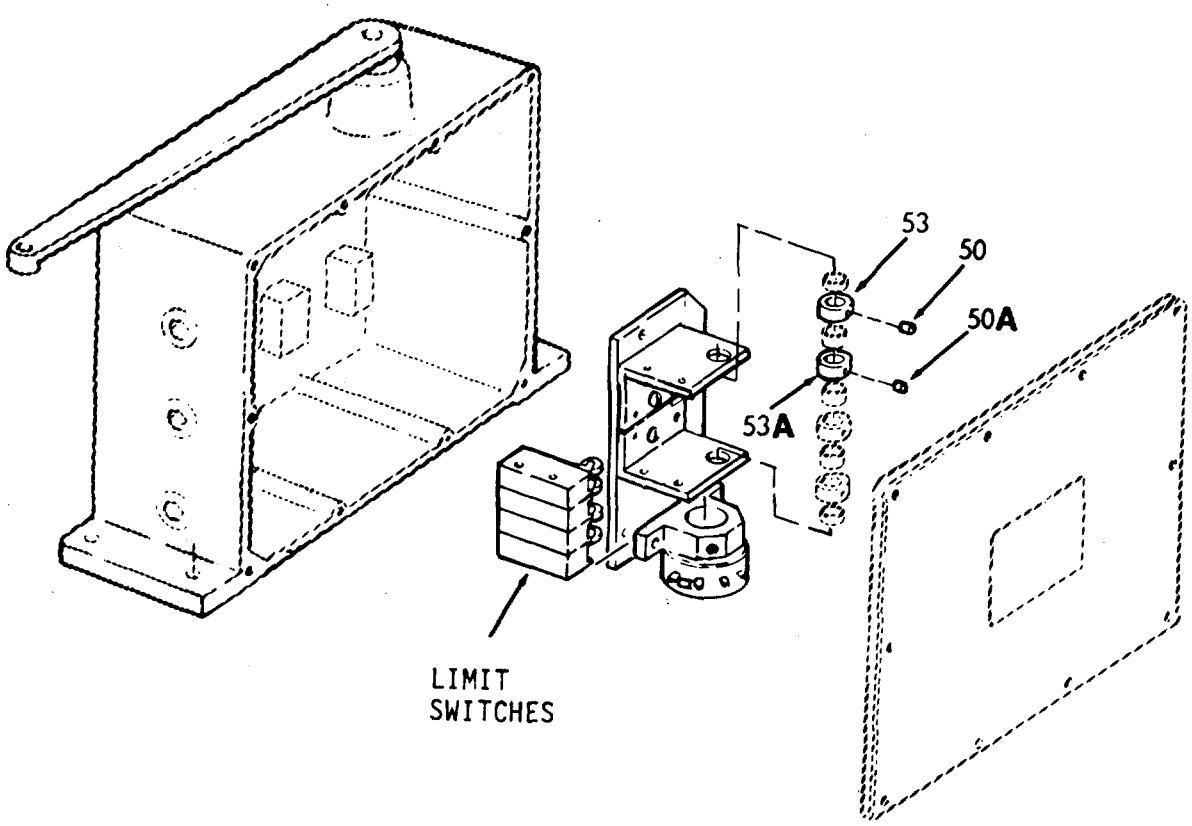
5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENT (Cont)			
9. Outside Limit Switch Adjust-Ment	a. Rudder side limit.	Place in desired out-	
	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 auto-matic steering, usually 10 to 15 degrees in either direction.	
	b. Setscrews (50A)	Loosen on cam (53A).	
	c. Cam (53A)	Rotate until limit switch opens exactly at this rudder setting.	
	d. Setscrews (50A)	Tighten.	

5-112. RUDDER ANGLE TRANSMITTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

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

Special Tools

Switch MS24523-27

Material/Parts

NONE

Personnel Required

1

References
NONE

Equipment
Condition Condition Description

NONE

Special Environmental Conditions

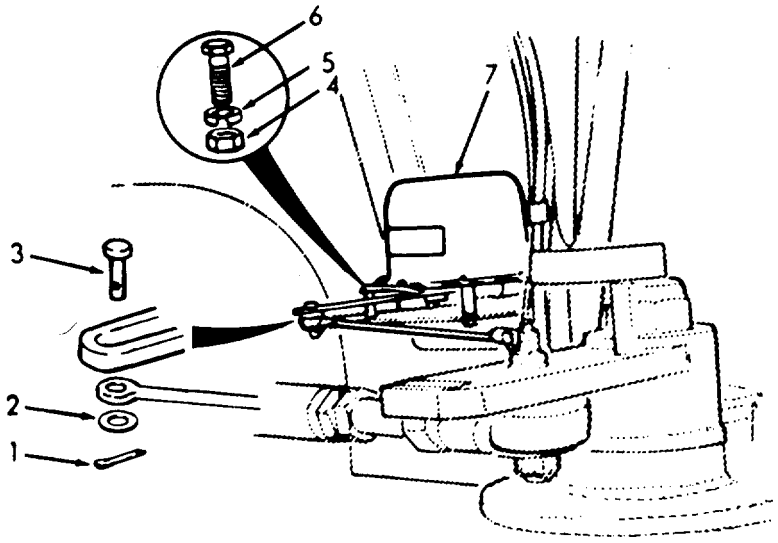
NONE

General Safety Instructions

Observe safety precautions when working with electricity.

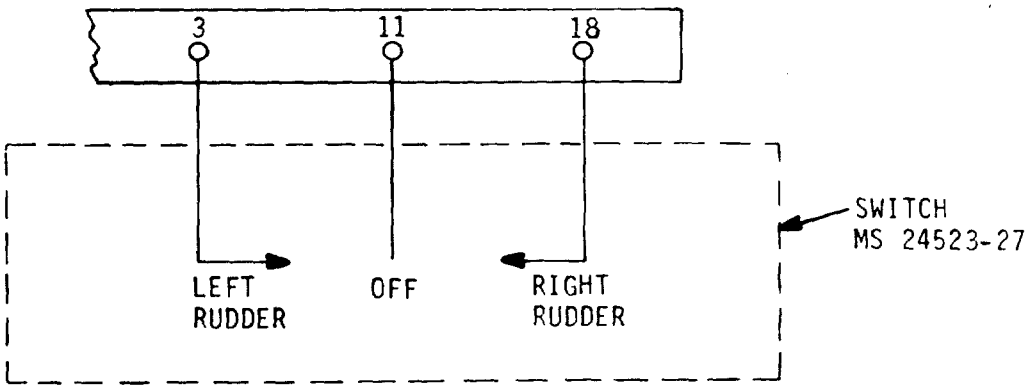
5-113. FLANKING RUDDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

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 RUDDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 MIDSHIP. Start flanking pump using local start on motor starter. Move rudder positioning spring-centered switch in either direction.

5-113. FLANKING RUDDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

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.

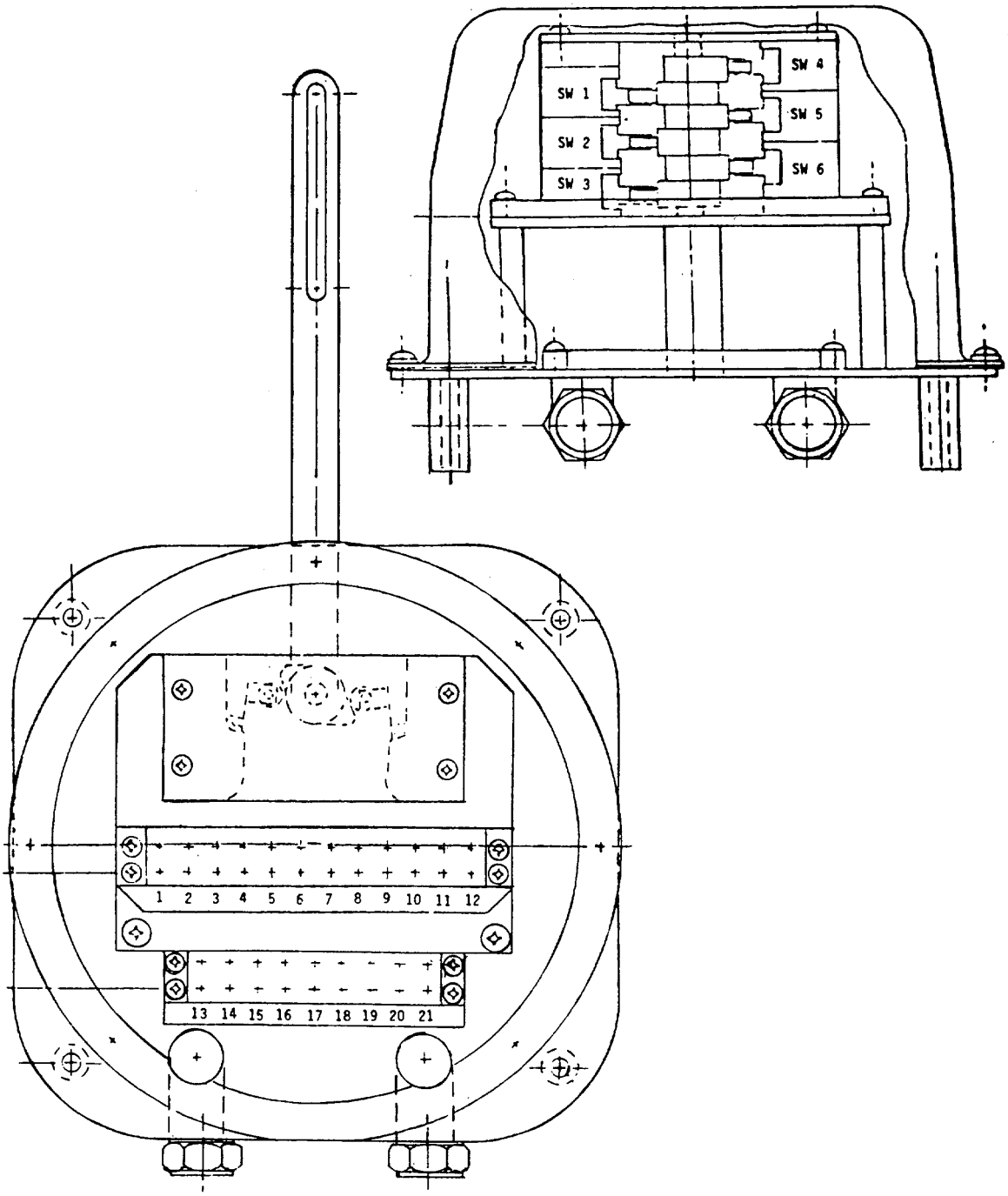
5. SW5 - Position rudder to 2° right. Set cam to close (between terminals 14 and 15) as cam is rotated from hard right back towards 2° right rudder.

6. SW2 - Position rudder to 2° 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 RUDDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

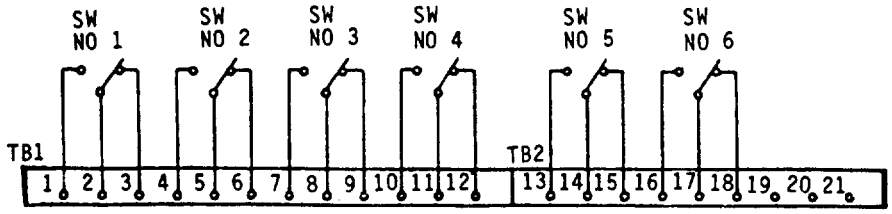
ALIGNMENT (Cont)



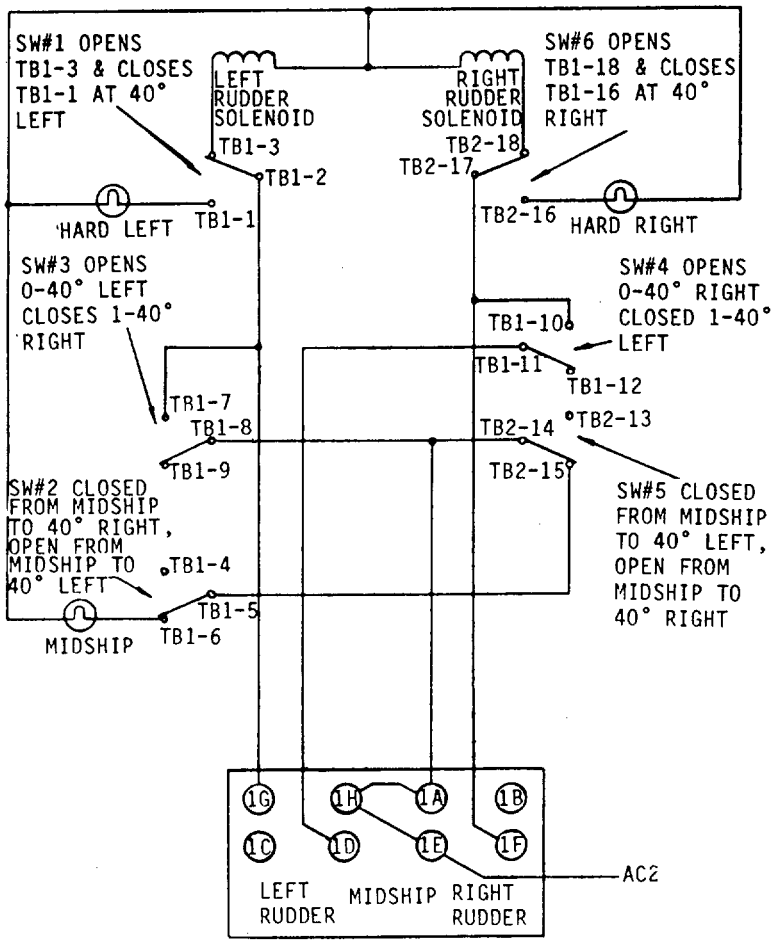
5-113. FLANKING RUDDDER LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

ALIGNMENT (Cont)



SCHEMATIC DIAGRAM



FLANKING RUDDER

5-114. STEERING CONTROL PANEL AND GYRO 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: NONE

Condition Description

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

NONE

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL

NOTE

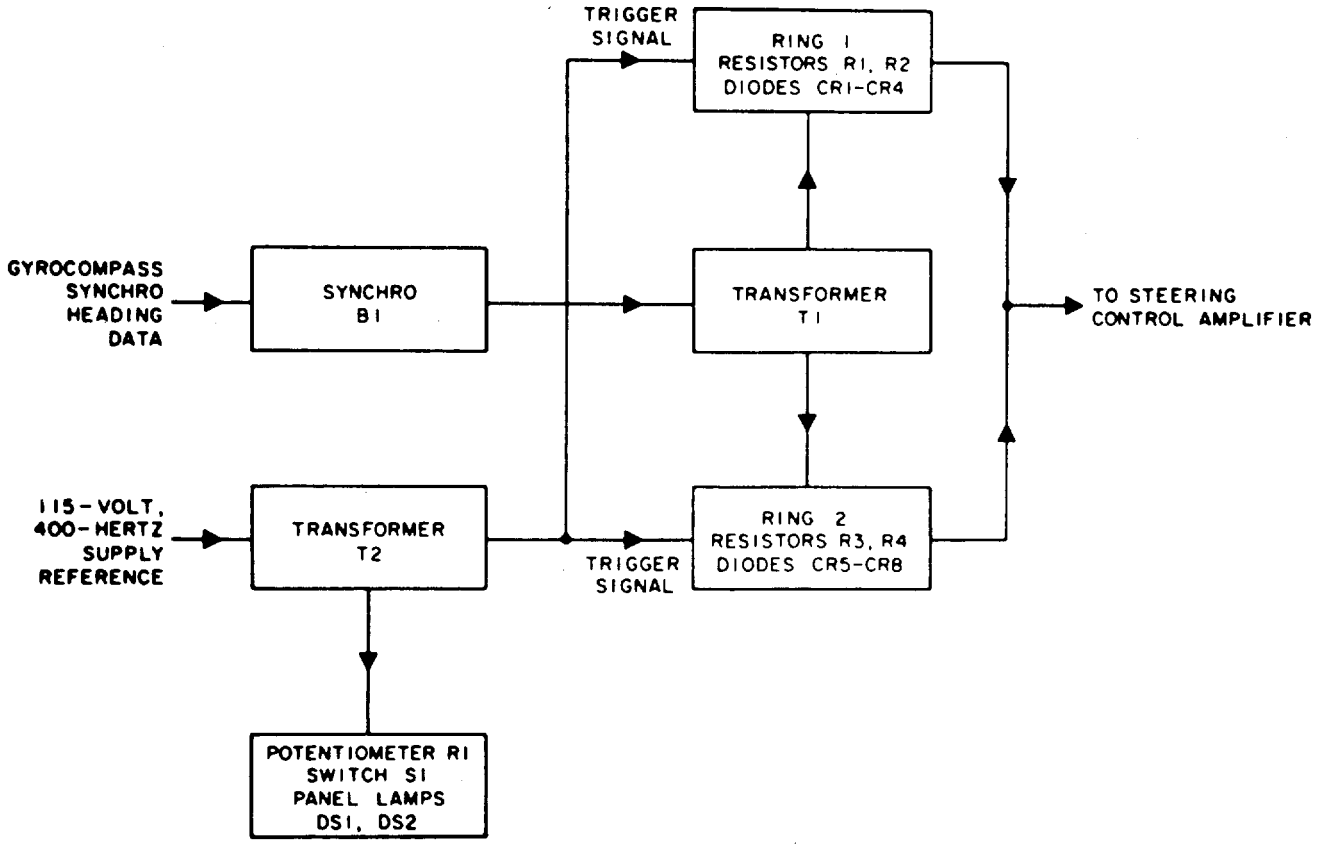
The overhaul procedure must be performed at the manufacturers' repair facility.

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.



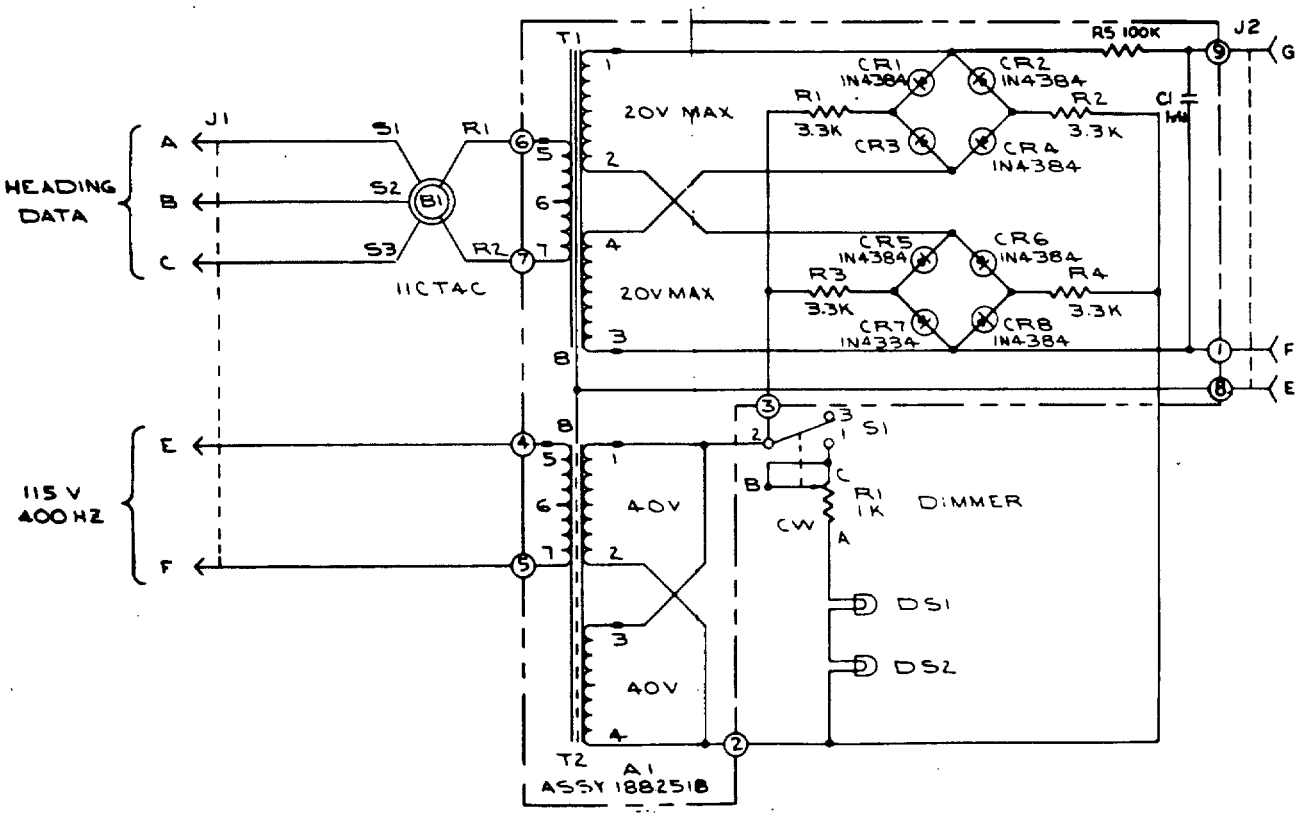
5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS.

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.

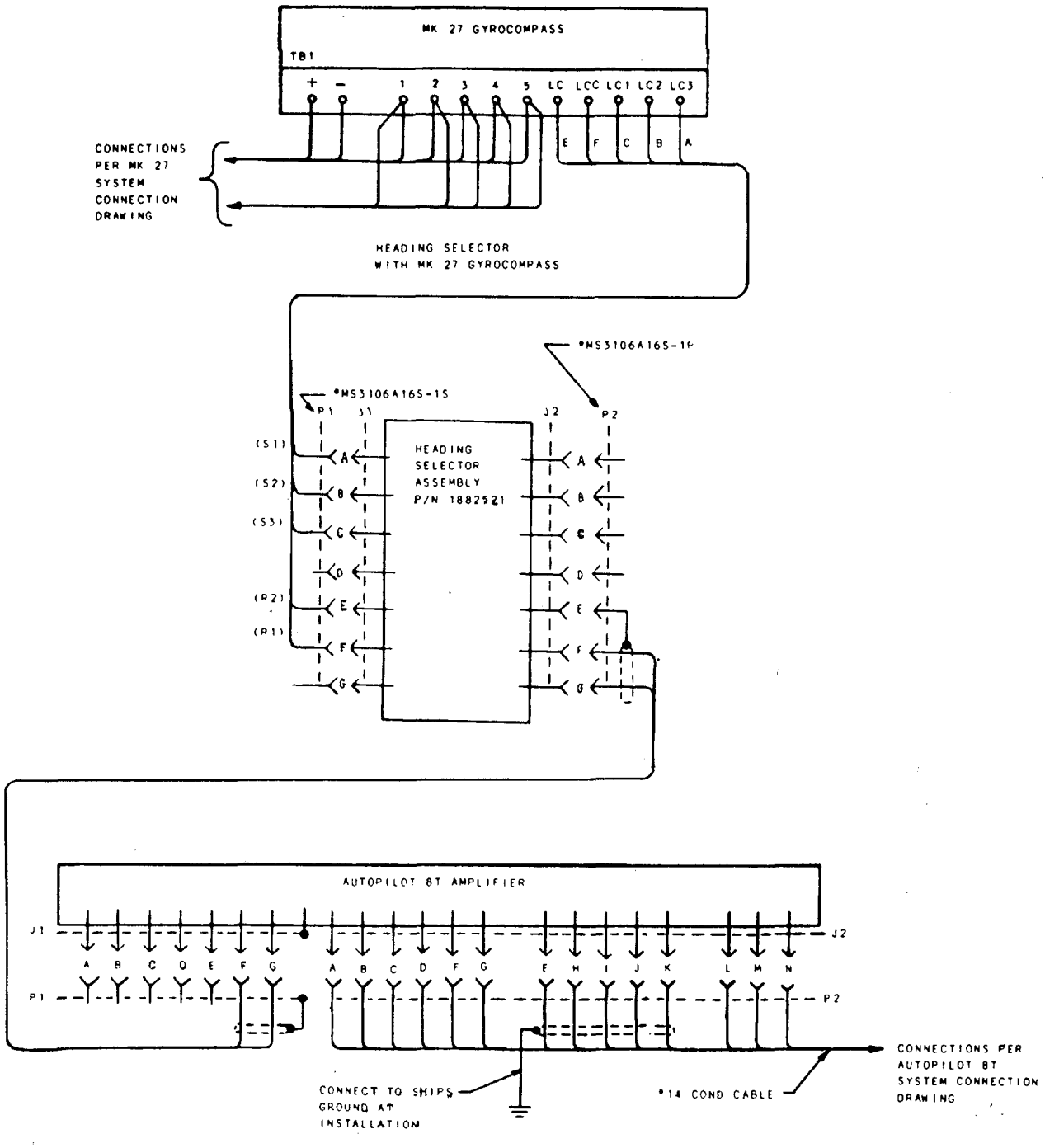
The same 115-volt, 400-hertz supply that excites the gyrocompass synchro must also be used for reference purposes in the Heading Selector. This reference voltage is applied to the primary of transformer T2. The output from transformer T2 secondaries is applied across the demodulator rings. This voltage 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 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 P5 and capacitor C1 Drovide filtering for the output.



5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS.



5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

3-126 Heading Selector Orgain-izational Maintenance

Special Tools

Soldering iron
(25 watt max)

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

NONE

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL

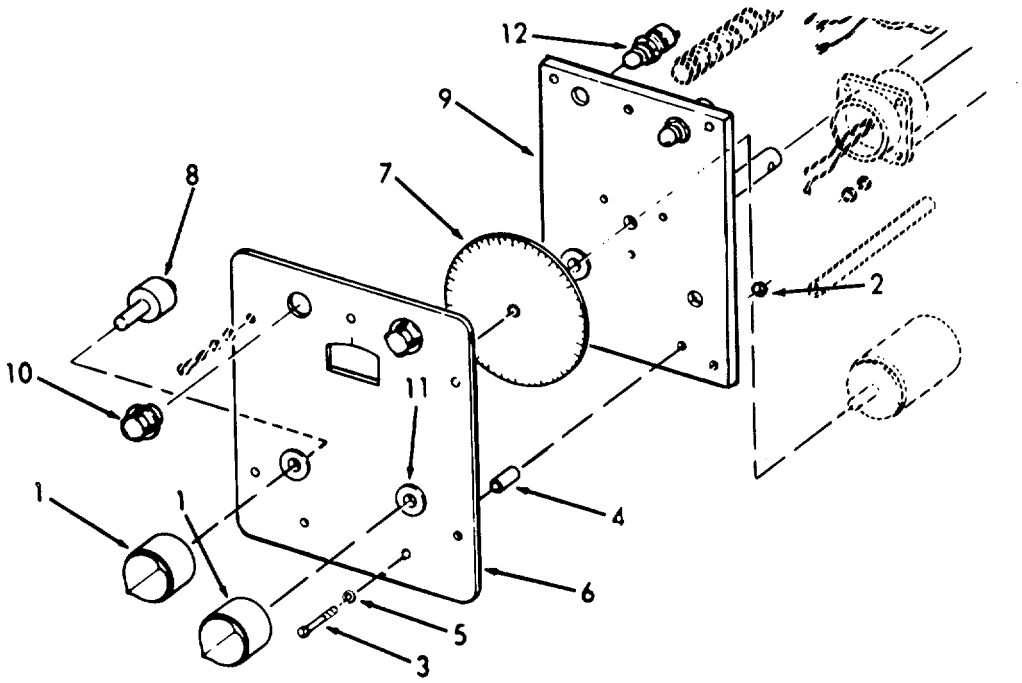
CAUTION

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.

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.	



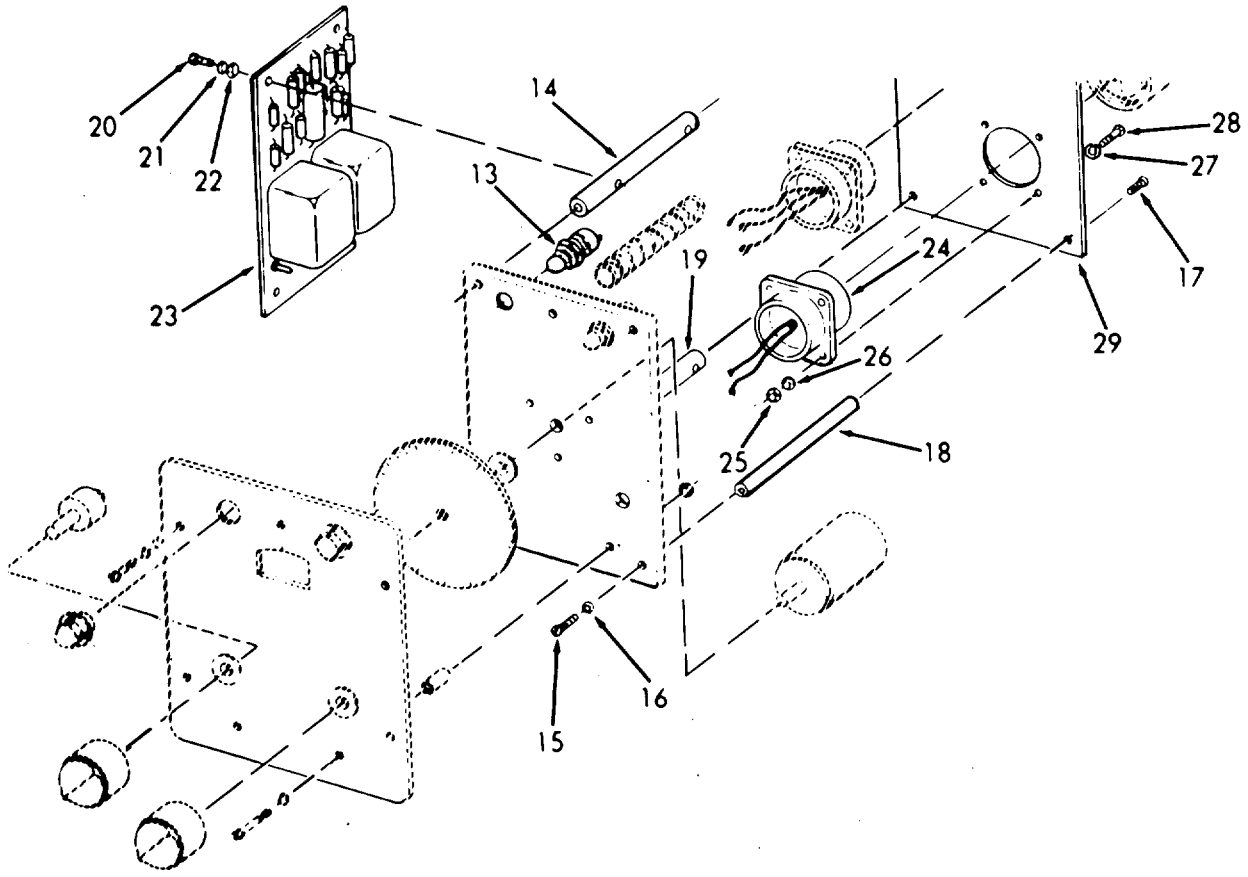
5-1293

5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS.

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.

LOCATION	ITEM	ACTION	REMARKS
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).	

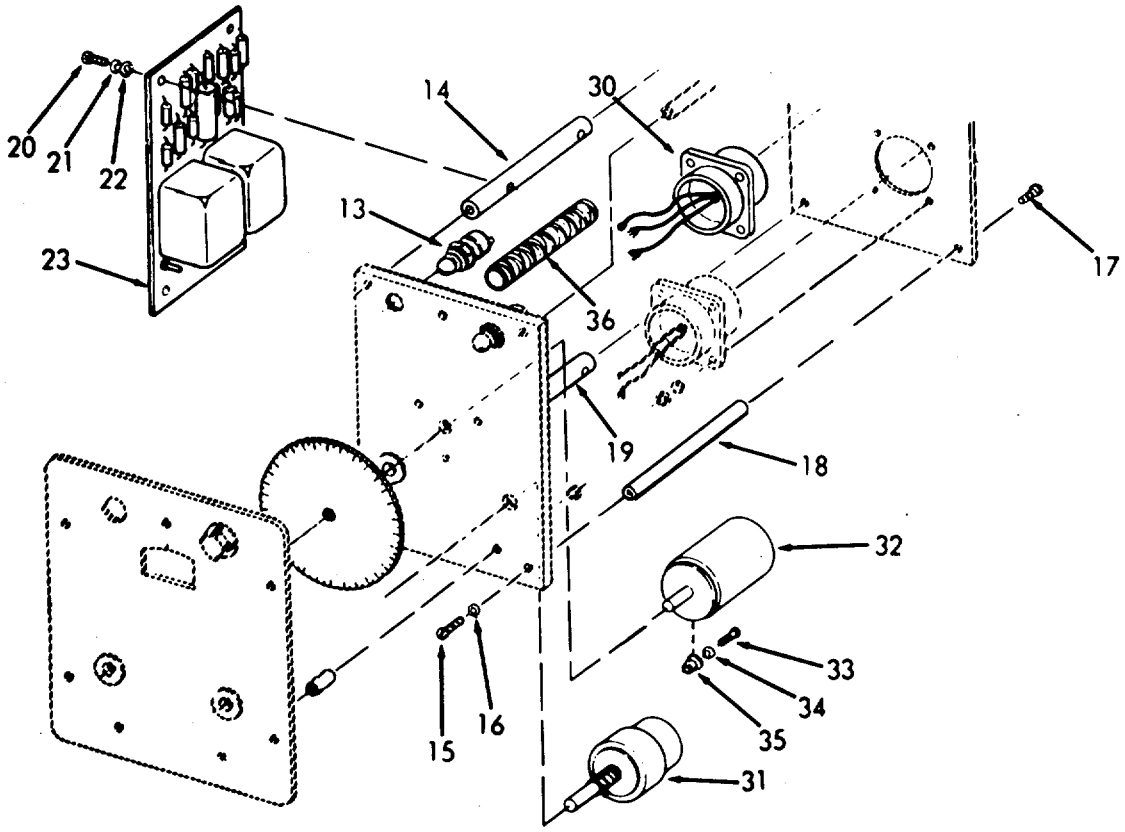


5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS.

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	1. Align with holes in front plate and back plate. 2. Install screws (15 and 17), and lock-washers (16).	

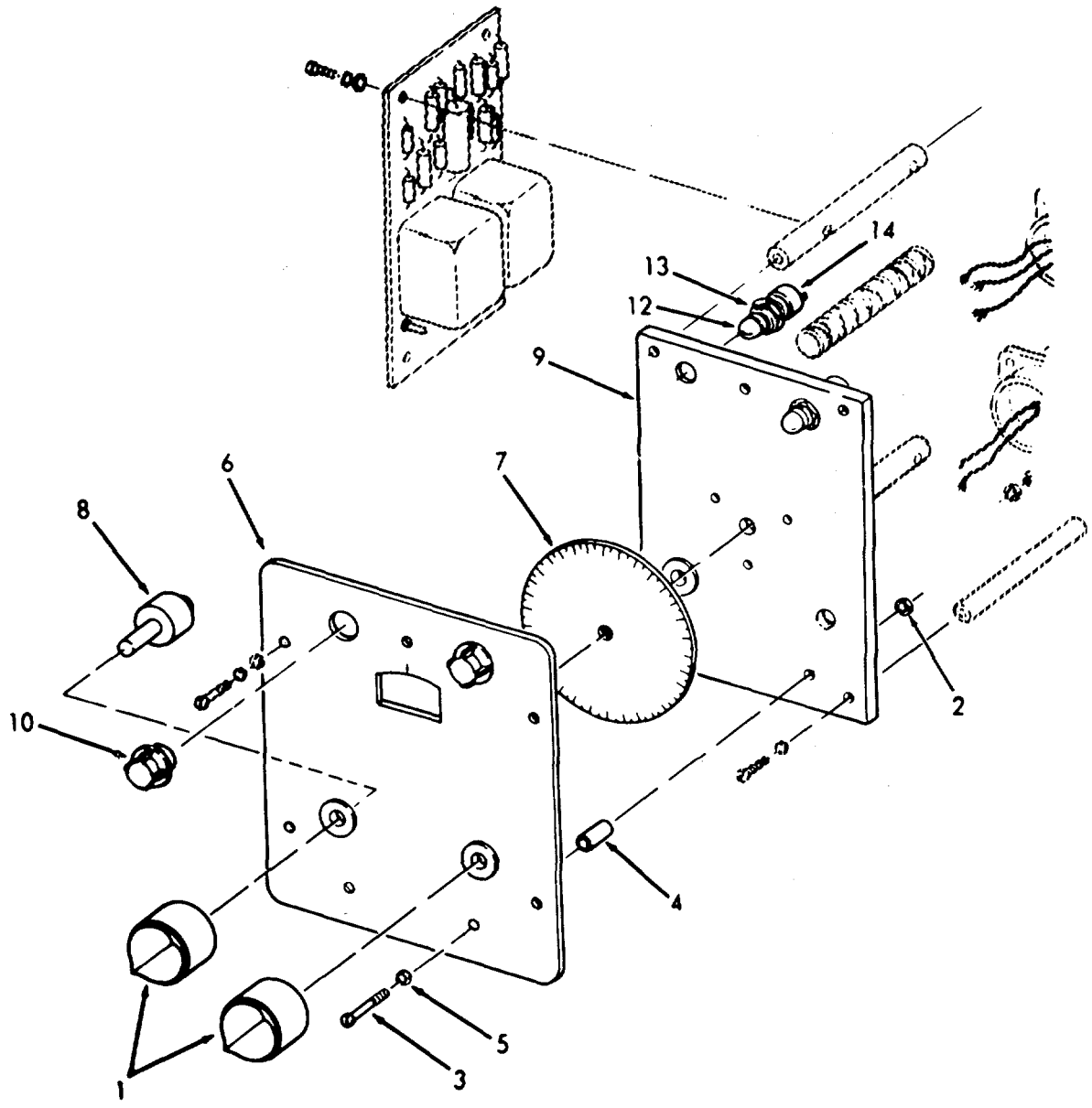


5-115. HEADING SELECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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
OVERHAUL (Cont)			



5-1299

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
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).

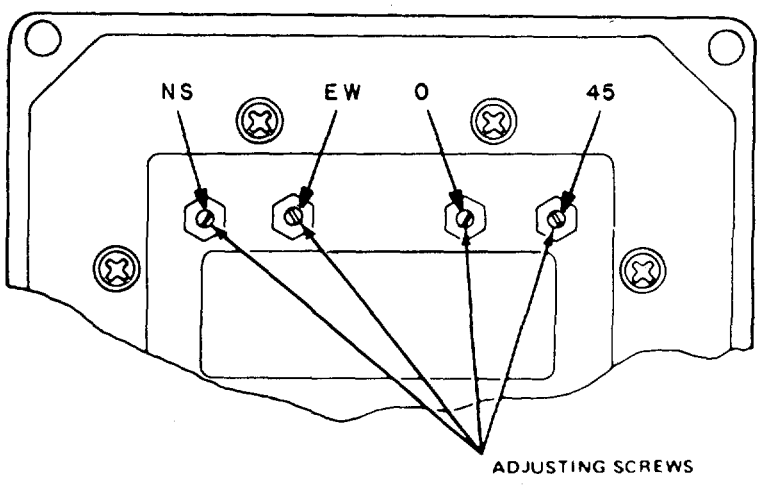
2. Cyclic Error.

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.



PARTIAL REAR VIEW OF HEADING INDICATOR

5-116. REMOTE MAGNETIC HEADING COMPASS (RMHS)- MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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 EW 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 O adjustment screw to obtain 000-degree reading on the Heading Indicator.

(h) Align the vehicle to magnetic 180-degree heading and adjust O 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.

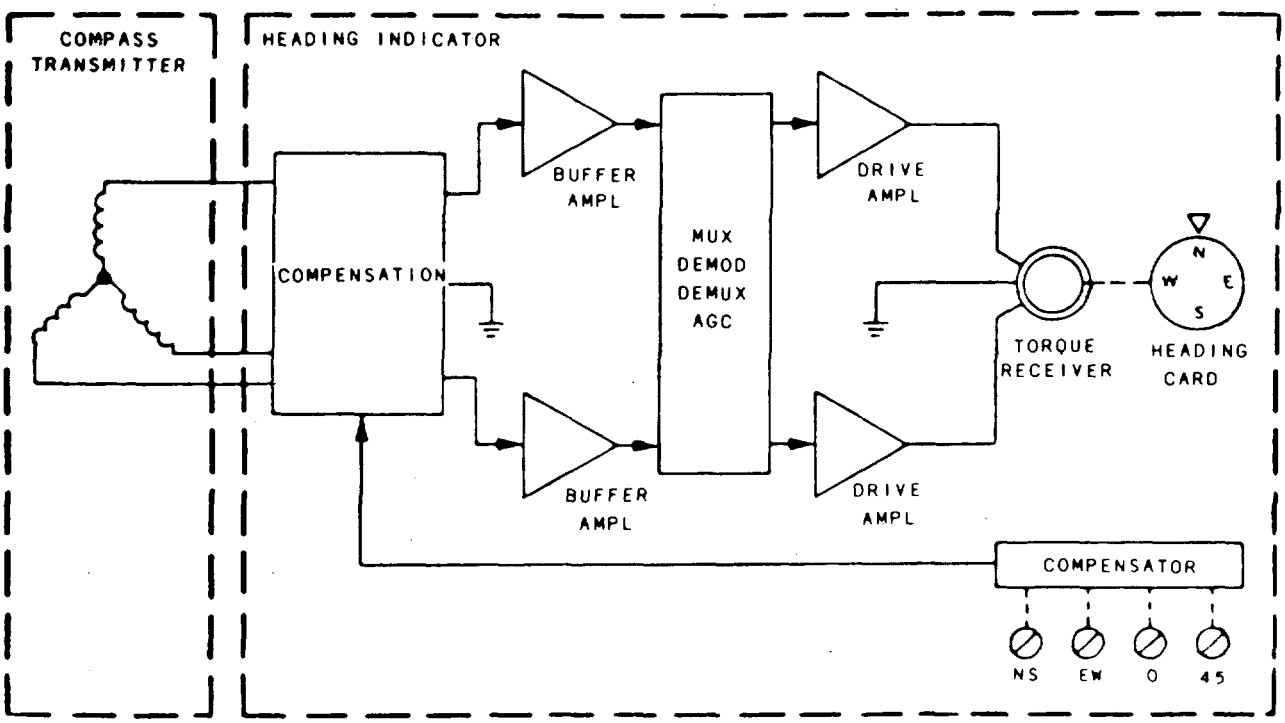
(j) Align the vehicle to magnetic 225-degree heading and adjust the 45-degree adjustment screw to remove one-half of the error indicated by Heading Indicator.

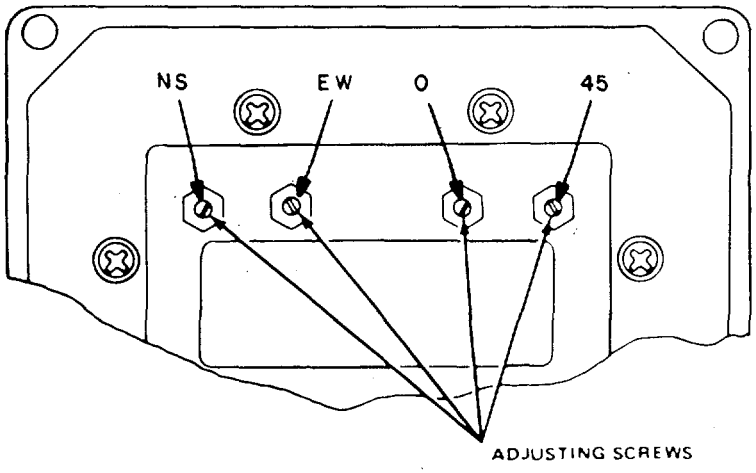
(k) Repeat steps (c) thru (j) as necessary to optimize the adjustment.

(l) Install the Heading Indicator and secure with 4 screws.

5-116. REMOTE MAGNETIC HEADING COMPASS (RMHS)- MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
ADJUST-CALIBRATION (Cont)			





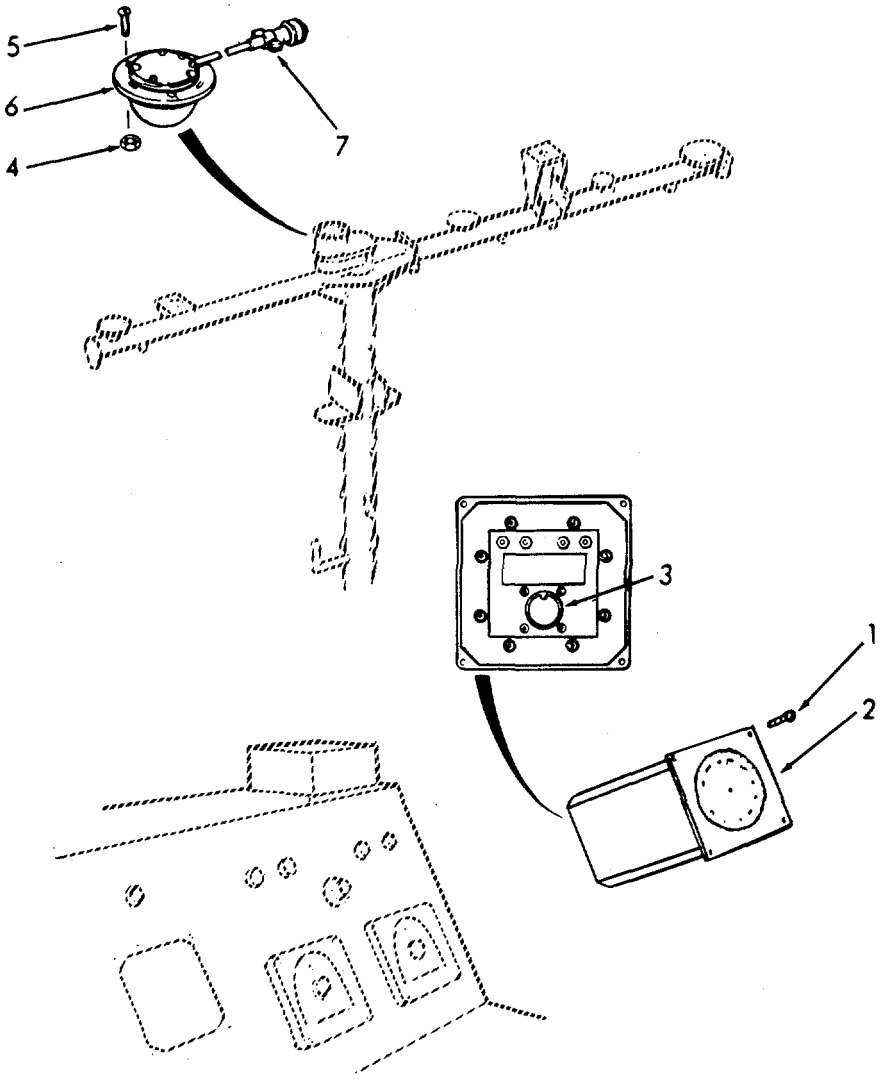
PARTIAL REAR VIEW OF HEADING INDICATOR

5-116. REMOTE MAGNETIC HEADING COMPASS (RMHS)- MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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			
	In order to avoid electrical shock, make sure all electrical devices on the mast are secured.		
	a. Nuts (4), screws (5), and trans-mitter (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)			
	c. Transmitter (6), screws (5), and nuts (4)	Install.	



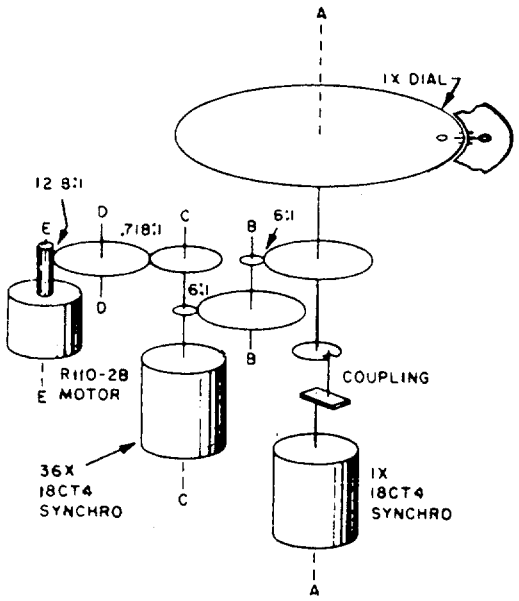
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS.

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 is 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.

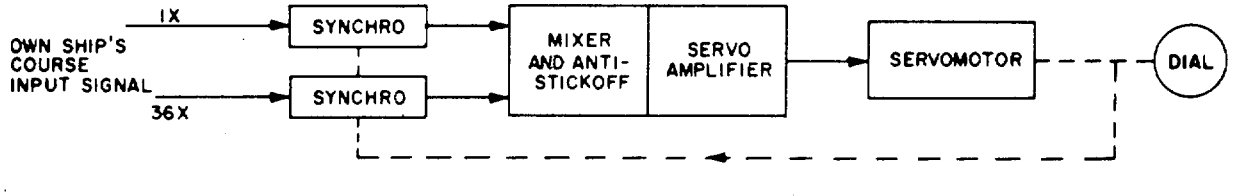
1 A SCI receives a two-speed synchro signal of the ship's heading from a master gyrocompass. This signal is impressed on the stators of a control transformer.

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 in induced in the control transformer rotor.

5-117. SHIP'S COURSE INDICATOR-MAINTENANCE INSTRUCTIONS (Continued).

If the control transformer rotor differs from this 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 pens 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 anti-stickoff voltage eliminates every false null as an input signal to the servo amplifier including the one at the 1800 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° to bring the indicator null back to a true reading. The above procedure converts the 180° 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 degree out of correspondence with the compass transmitter at which the rotor voltages of both the coarse and fine control transformers

5-117. SHIP'S COURSE INDICATOR-MAINTENANCE INSTRUCTIONS (Continued).

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 1800 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° 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° 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° point, the servo would drive away from this false null. But, because the 36X voltage has control, it drives the servo toward this 180° null point. The 36X error voltage negative between 175° and 180° tends to drive the servo to an increased angle (180°); where positive between 180° and 185° it tends to drive the servo to a decrease angle (180°) - the same point. In other words, if this condition were tolerated, the servo would lock in at a false null.

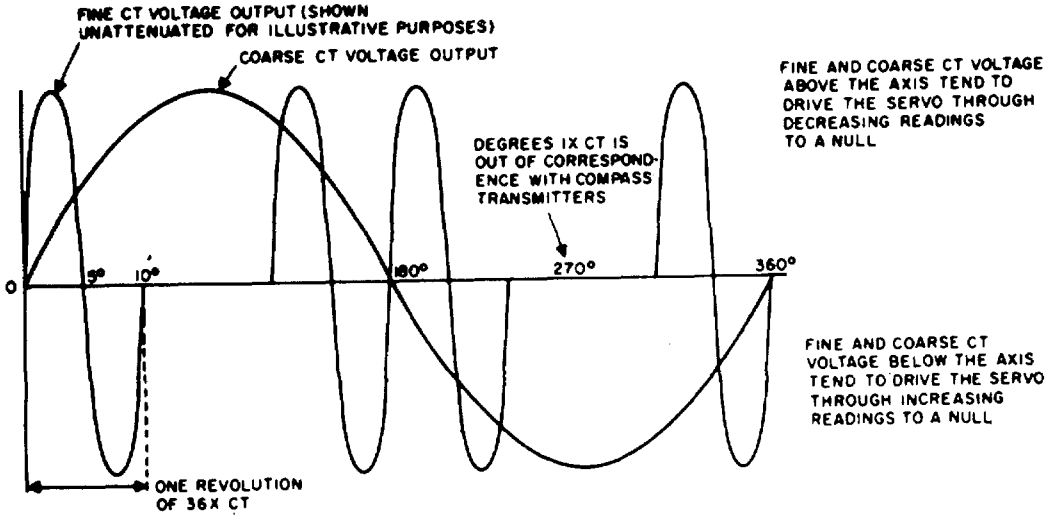


FIGURE A

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 voltage to the zero reference position, the 1XCT stator is shifted a total of 5 degrees which corresponds to 180° rotation (36 times the IX) of the 36X synchro (figure C).

FIGURE B

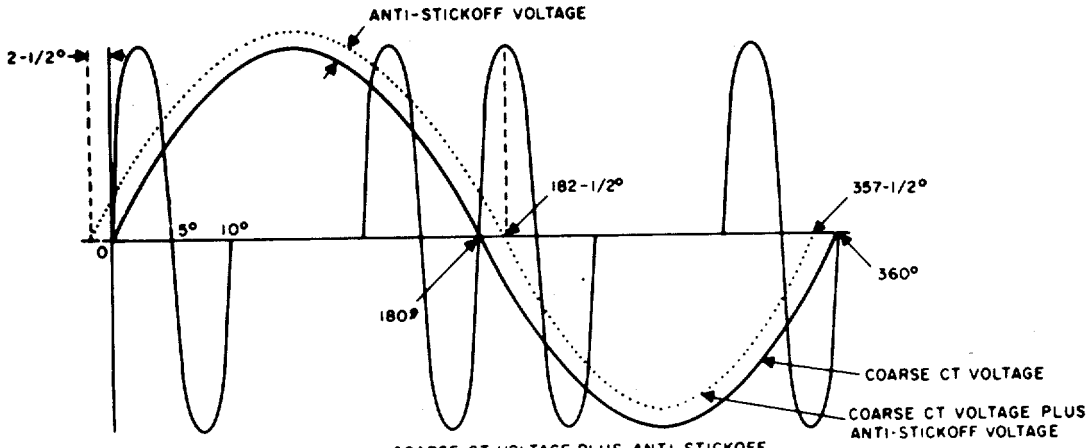
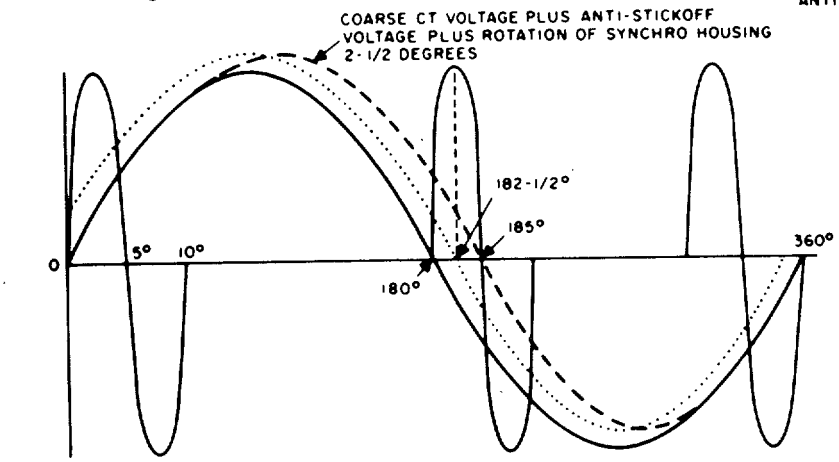


FIGURE C



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 2.5 degrees toward the correct null, and the mixing net- work switches to the 1X error signal, which drives to 2.5 degrees from the zero degree null position.

5-117. SHIP'S COURSE INDICATOR-MAINTENANCE INSTRUCTIONS (Continued).

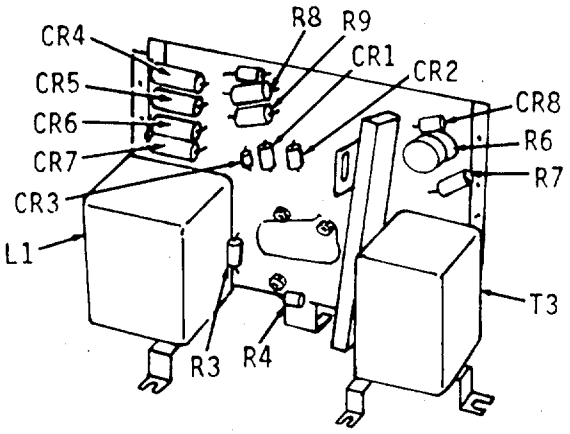
6 As the 2.5 degree point is reached, the mixing circuit automatically shifts the amplifier input signal from 1X synchro to 36X synchro. This signal, with amplifier out- put and motor torque reacting accordingly, is reduced as the servo approaches null. The final null position is reached at the point of minimum 36X synchro rotor voltage. Because the synchro voltage is very low, the amplifier output and motor torque are reduced substantially to zero.

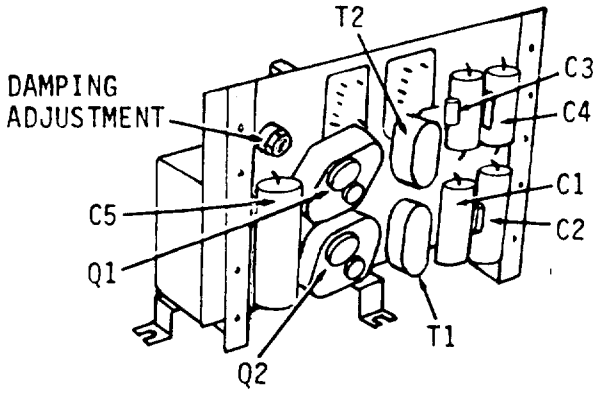
7 Mixing networks and anti-stickoff voltages are unnecessary in one-speed systems. Although synchro voltage (and thus motor torque) go to zero at the 180-degree point, this point is an unstable (decentering) null. If the servo approaches this false null with slight overshoot, the servo will not come 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.

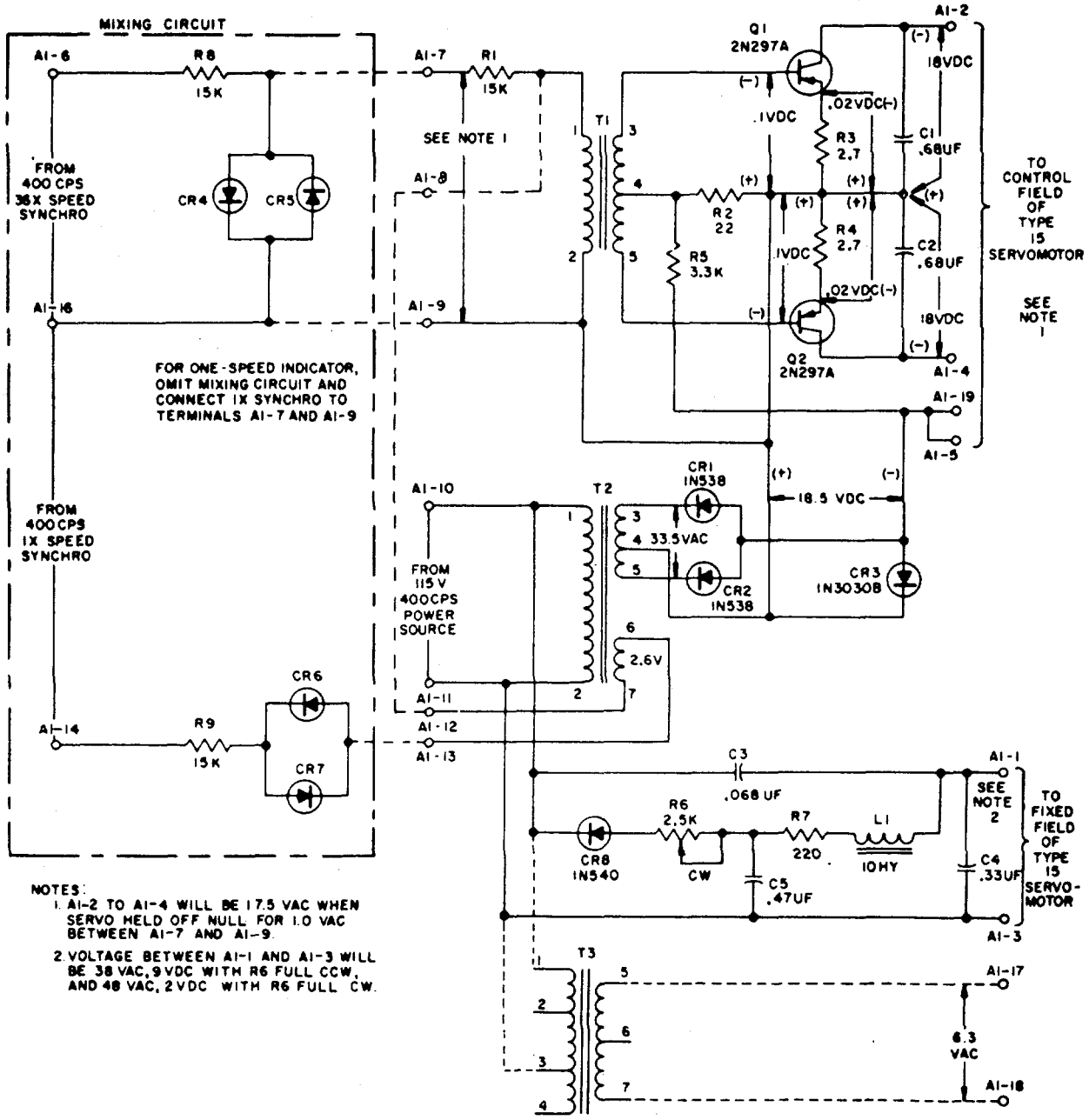
1 The 400-cps servo amplifier receives electrical position data from one or two synchro control transformers and delivers electrical power to the servomotor.

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.

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 consequence, the gears need transmit little power. Keep then 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 signficantly 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

(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 (Continued)

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 sychro.
	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).

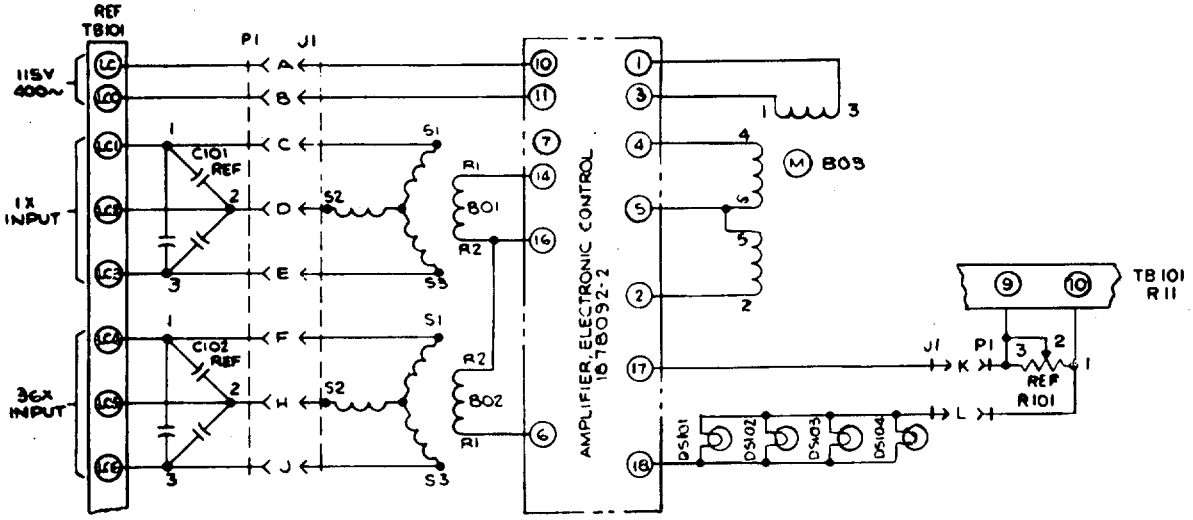
(c) De-energize the indicator servo and dial assembly by disconnecting the plug with its cable from the case. Inspect assembly for excessive gear train or bearing friction, loose clamps, loose terminal connections, loose screws, and for any signs of defective electronic components or wiring. If the gear 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).



5-117. 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

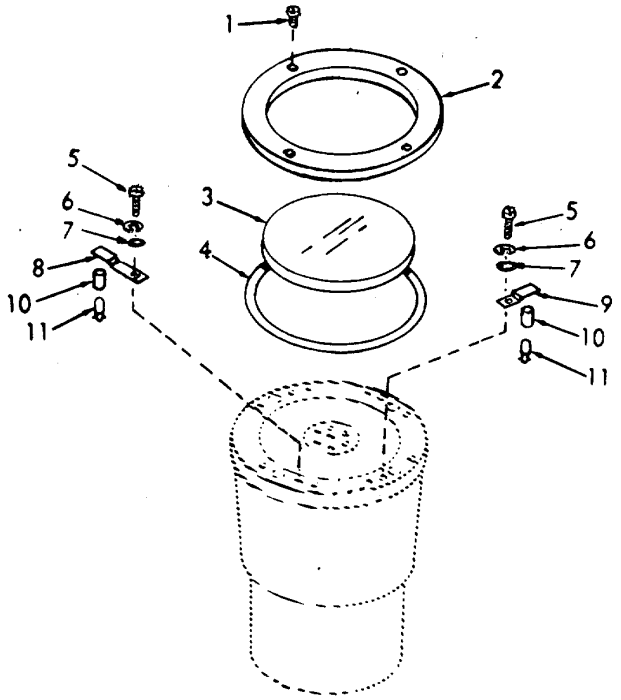
Personnel Required
1

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL DISASSEMBLY			
1. Dial Light	a. Eight screws (1), cover (2), and lens (3) b. Preformed packing (4)	Remove.	

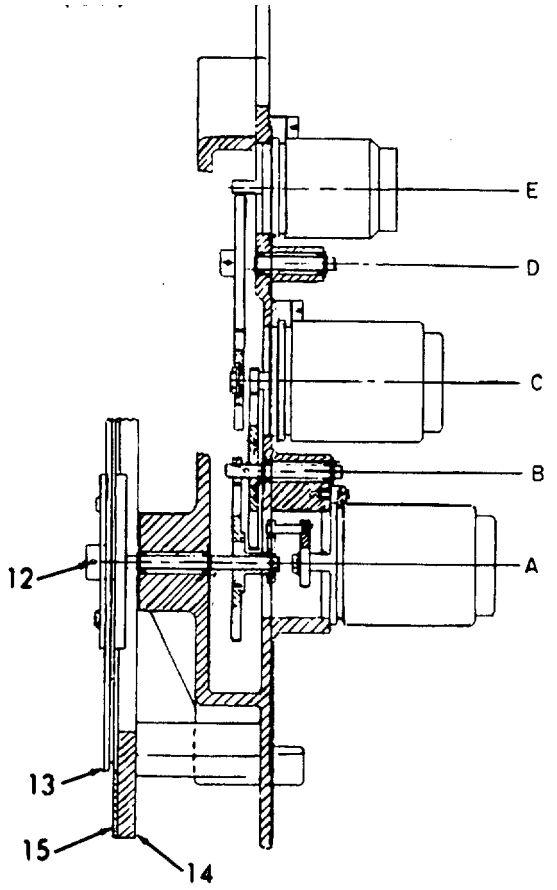
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
2 Gear Train	a. Spring pin (12), and dial assembly and hub (13)	Remove.	
	b. Light conducting panel (14), and dial (15)	Remove.	



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5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-DISASSEMBLY (Cont)

NOTE

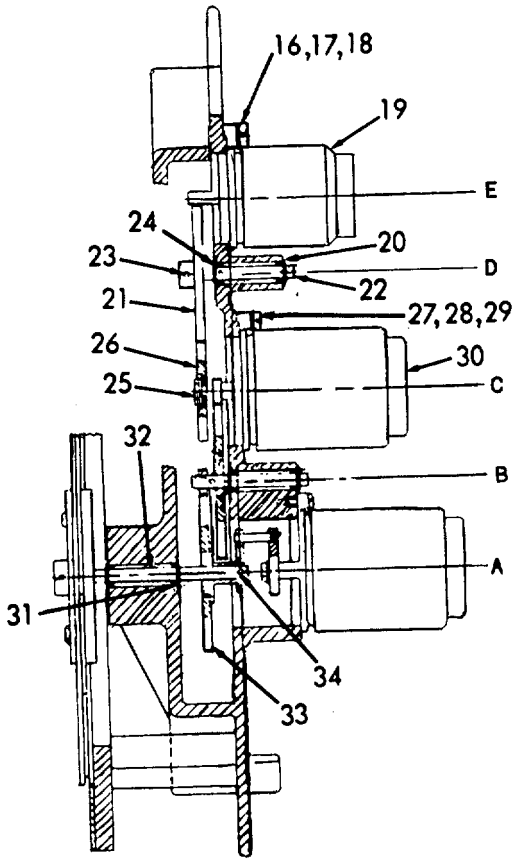
- The gears of the synchro gear train are fastened to gear shafts with spring pins. The gear shafts are shimmed for end play and held in place with retaining rings.
- When disassembling the gear train, to avoid dam-aging the bearings, remove the gear along with its gear shaft and then drive the spring 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 bear-ing preloading.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 assembled and shaft (22).	1. Remove. 2. Disassemble spring pin (23), gear (21), retaining ring (24), 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 INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
	k. Lower retaining ring (31)	Remove from shaft (32) (axis A).	
	l. Shaft (32), and gear (33) assembled	1. Lift up far enough to remove spring pin (34). 2 Pull shaft and gear assembly out the top.	

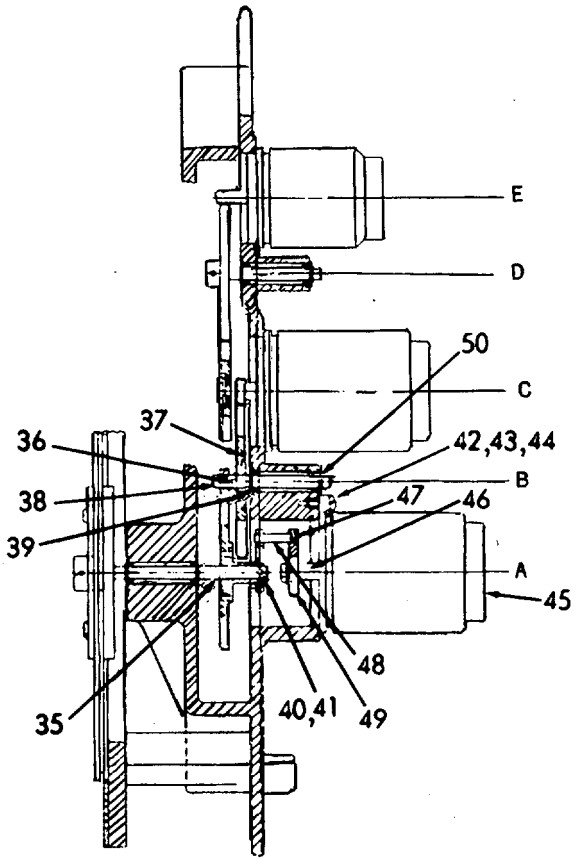


5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 BO1 (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).	

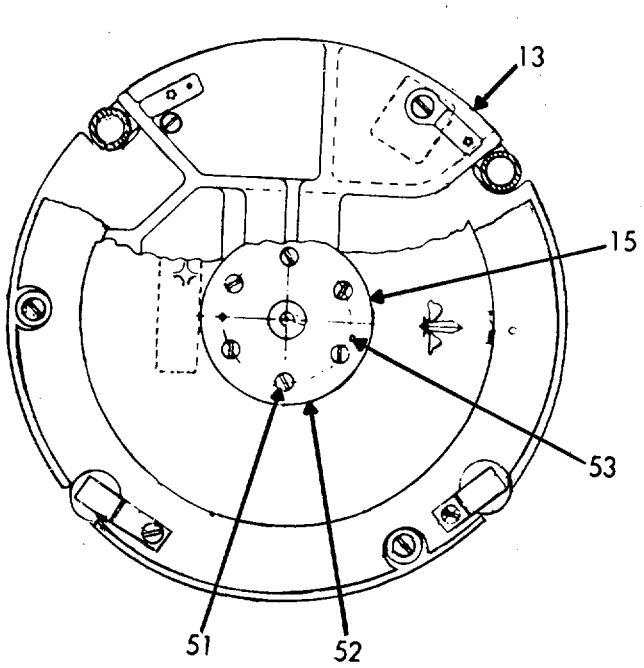
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
	w. Bearings (50)	Remove six places.	As required.



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-DISASSEMBLY (Cont)			
	x. Dial (15), and hub Assembly	1. Remove screws (51), and disc clamp (52). 2. Remove straight pins If necessary. (53).	



OVERHAUL-REASSEMBLY				
3.	Gear Train	a. Dial (15), and hub assembly (13)	1. Install straight pins (53), and disc clamp (52). 2. Install screws (51).	Use staking compound.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-DISASSEMBLY (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.

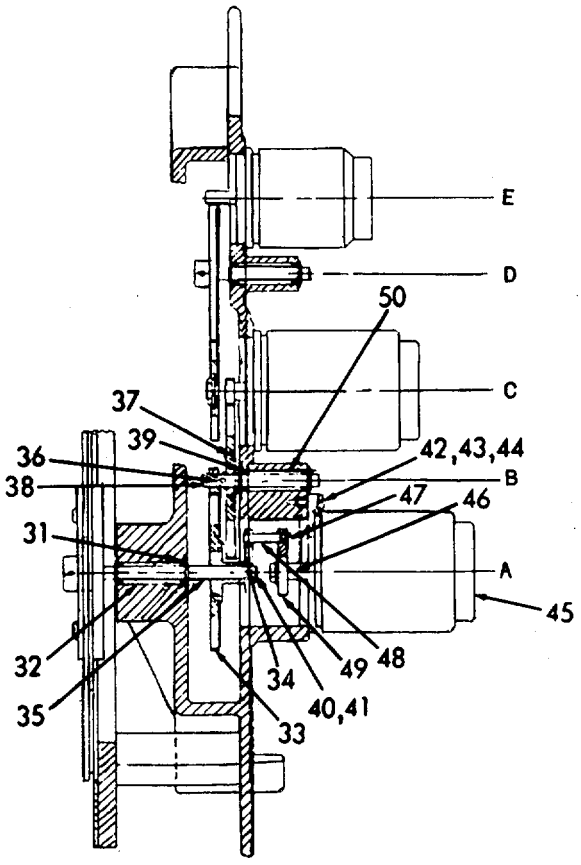
6. Press in the aligning pins and replace the dial and hub assembly on the indicator in the reverse order of disassembly.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-REASSEMBLY (Cont)			
	b. Bearing (50)	Install.	
	c. Coupling arm (49), and pins (48 and 47)	Install.	
	d. Spacer (46)	Install.	
	e. Synchro BO1 (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 INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.

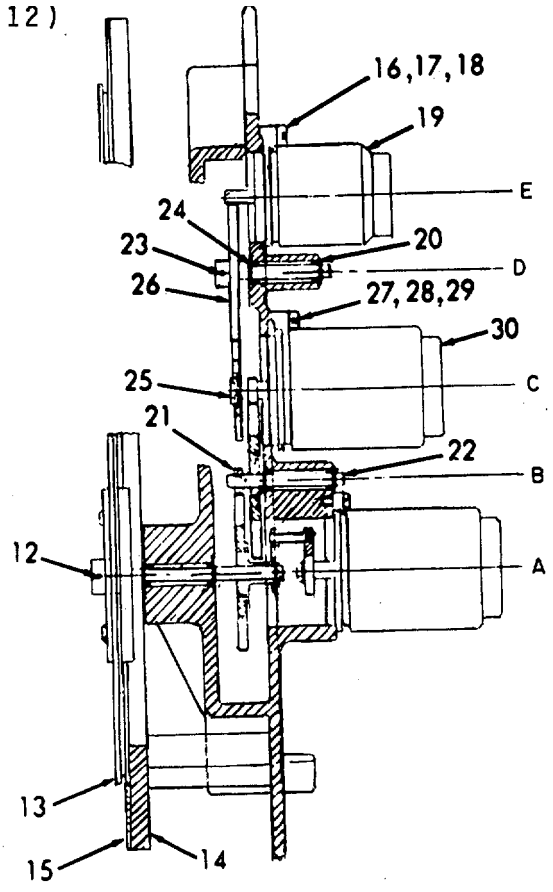


5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 lockwasher (17)	Install.	

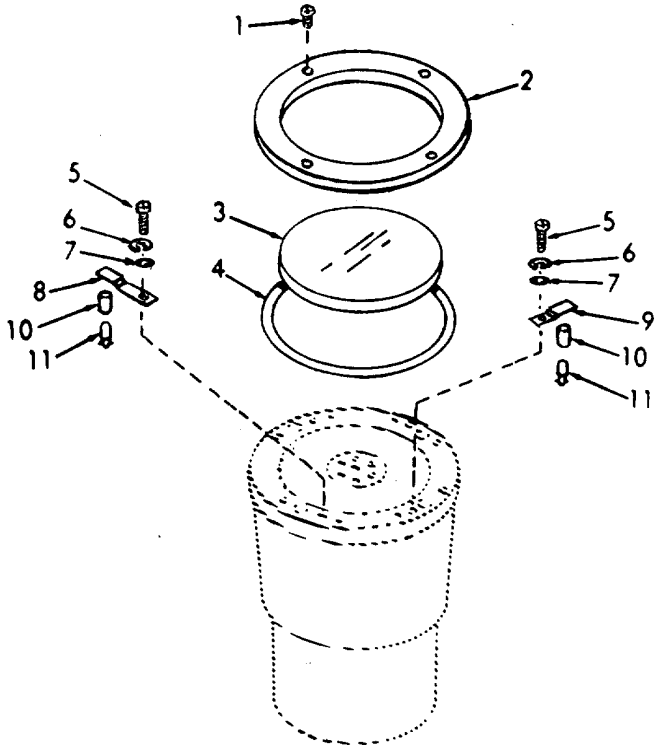
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-REASSEMBLY (Cont)			
	w. Light conducting panel (14), and dial (15)	Install.	
	x. Dial and hub assembly (13)	Install.	
	y. Spring pin	Install.	



5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL-REASSEMBLY (Cont)			
4. Dial Light	a. Dial light (11)	Push in and turn slightly clockwise.	
	b. Filter (10), retainers (9 and 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 INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	EMARKS
OVERHAUL-TEST (Cont)			

between the measured and tabulated voltages greater than ten percent indicates possible trouble as outlined in the table. In general, no voltage indicates an 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 INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-TEST (Cont)

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.

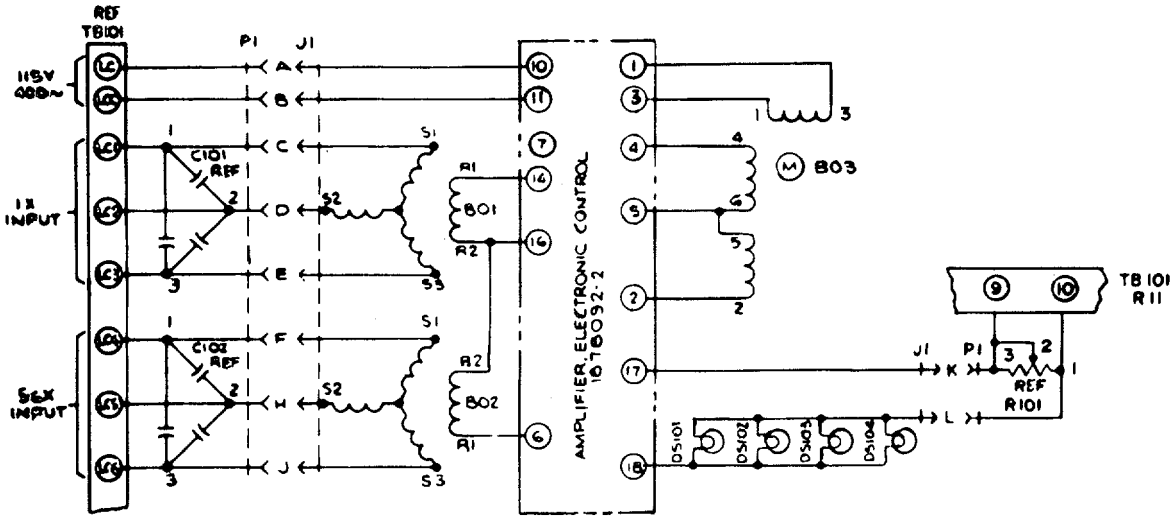
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-TEST (Cont)

D.C. 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 Al, 9-4, check transistor 01, 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.



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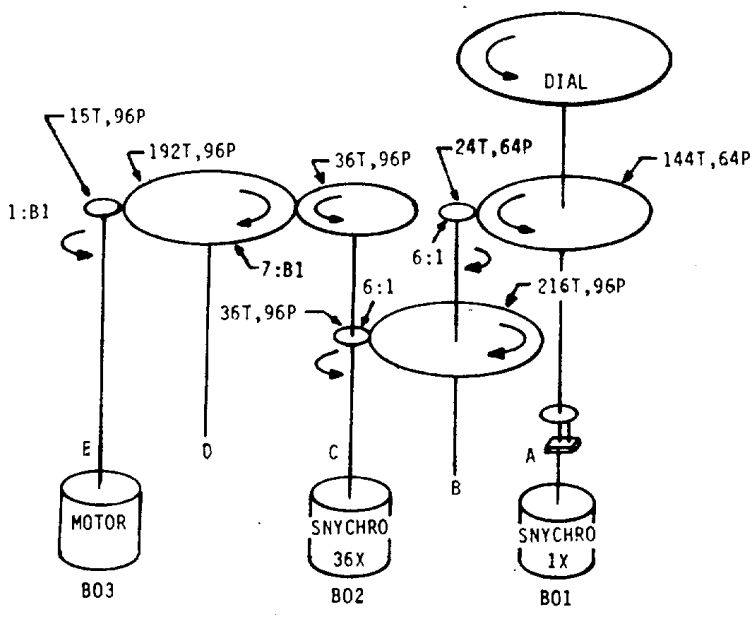
5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL-TEST (Cont)



GEARING SCHEMATIC
ARROWS SHOW ROTATIONS FOR INCREASING HEADING

OVERHAUL-ADJUSTMENT

6. Zeroing of Synchro Control Transformers and Torque Receivers.

a. Energize indicator equipment. Check to see if the reading on the indicator dials correspond to those on the synchro amplifier.

b. If it does not, deenergize the indicator, remove the cover and servo and dial assembly, re-energize, and let the servo drive to null.

c. 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 measure- ments 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 INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

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 $\pm$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 THE PROPER POWER FREQUENCY.

5-117. SHIP'S COURSE INDICATOR - MAINTENANCE INSTRUCTIONS (Continued),

LOCATION	ITEM	ACTION	REMARKS

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-stick 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) (S2 - S3) (S3 - S1)	838 838 838
Rotor	(R1-R2)	413
Winding Resistance	(Ohms)	400-cps Servomotor
Fixed Phase	1-3	120
Control Phase	2-5 4-6	60 60

c. Observe that the indicator smoothly follows rotation of the 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.

5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Disassembly b. Reassembly

INITIAL SETUP

Test Equipment	References Paragraph	
Feeler gages	4-8	Fire Pump Removal

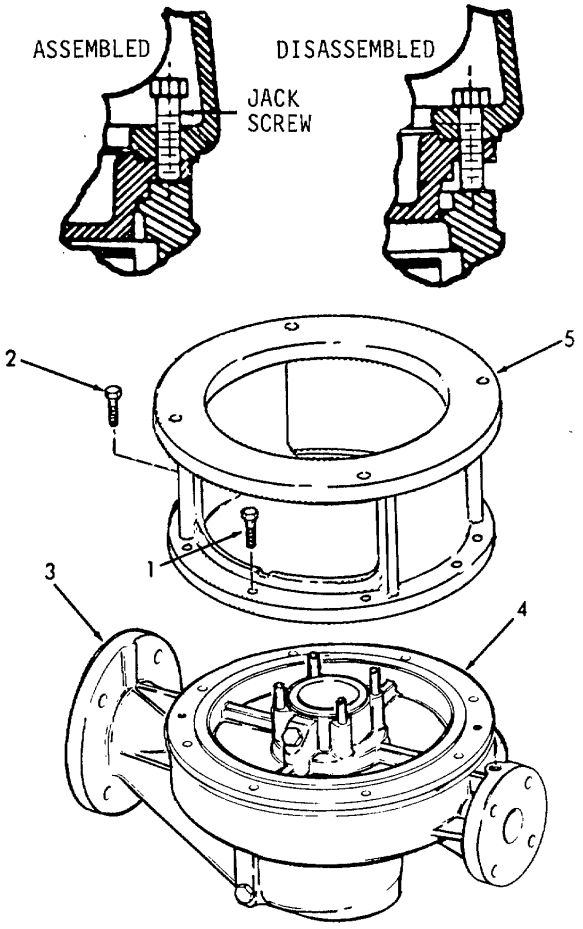
Special Tools	Equipment Condition	Condition Description
Babbit or rawhide hammer	NONE	

Material/Parts	Special Environmental Conditions
NONE	NONE

Personnel Required	General Safety Instructions
2	NONE

5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
Fire Pump	a. Screws (1)	Remove.	
	b. Jack screws (2)	1. Tighten uniformly. the unit out of 2. Draw the screws up snugly.	This will raise the casing (3) and simultaneously lock the packing box cover (4) to the adapter (5).



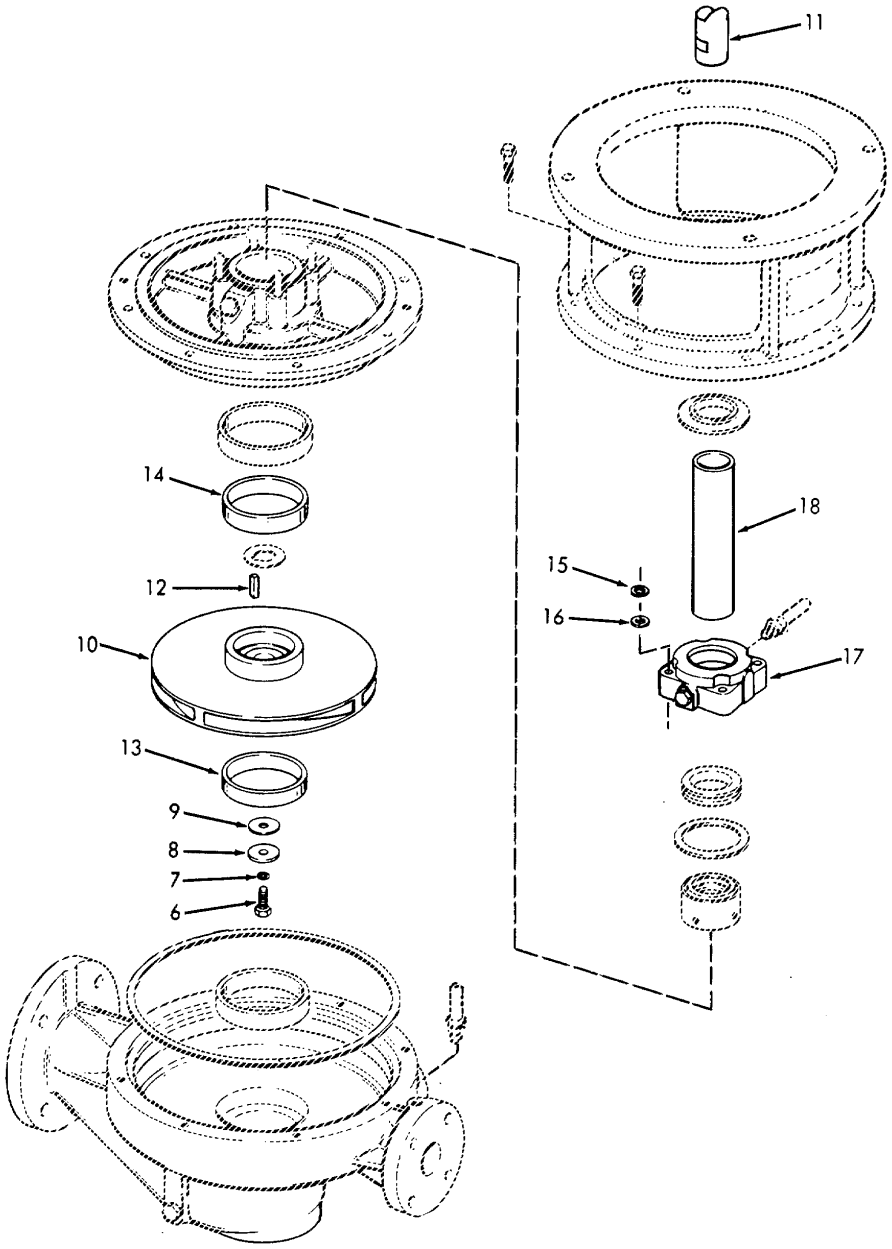
5-1343

5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont).			
	c. Motor and rotating assembly	Remove.	
	d. Impeller screw (6), O-ring (7), washer (8), and gasket (9)	Remove.	Discard O-ring and gasket.
	e. Impeller (10)	Pull from motor shaft (11).	
	f. Key (12), and wear rings (13 and 14)	1. Remove. 2. Inspect rings for signs of wear or damage.	Replace if necessary.
	g. Gland nuts (15), clips (16), and stuffing box gland (17)	Remove.	
	h. Shaft sleeve (18)	Remove.	If the shaft sleeve comes off, remove it from the packing box. If it clings to the shaft, and is not scored, it may remain there.

5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont).			

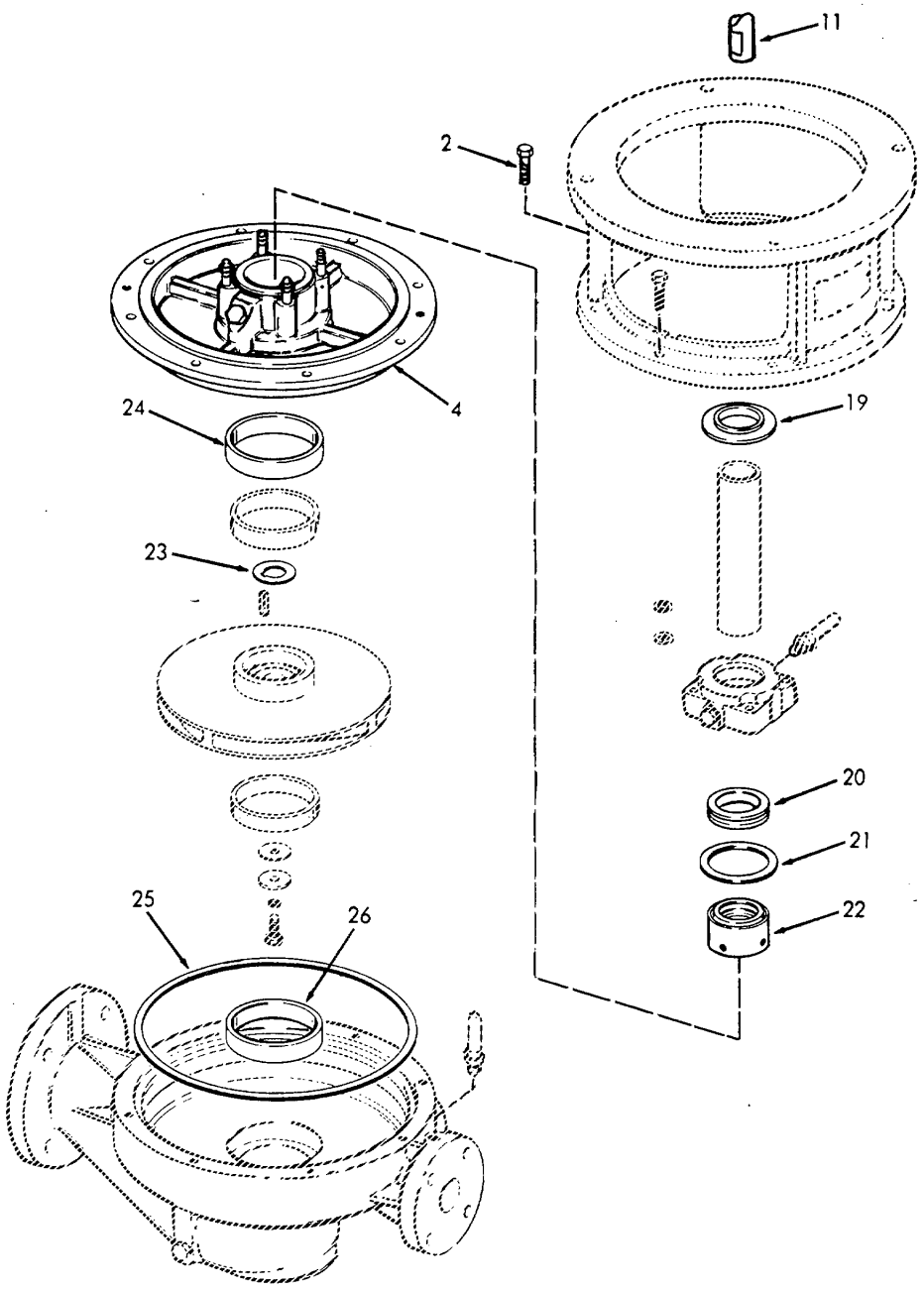


5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont).			
	i. Shaft deflector (19)	Remove.	
	j. Lantern ring (20), and gland gasket (21)	Remove.	Discard.
	k. Mechanical single seal (22), and jack screws (2)	Remove.	
	l. Packing box cover (4)	Slide off shaft (11).	
	m. Gasket (23)	Remove.	Discard.
	n. Packing box wear ring (24)	Inspect for signs of wear or damage.	Replace if necessary.
	o. Casing gasket (25)	Remove.	Discard.
	p. Casing wear ring (26)	Inspect for signs of wear or damage.	Replace, if necessary.

5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont).			

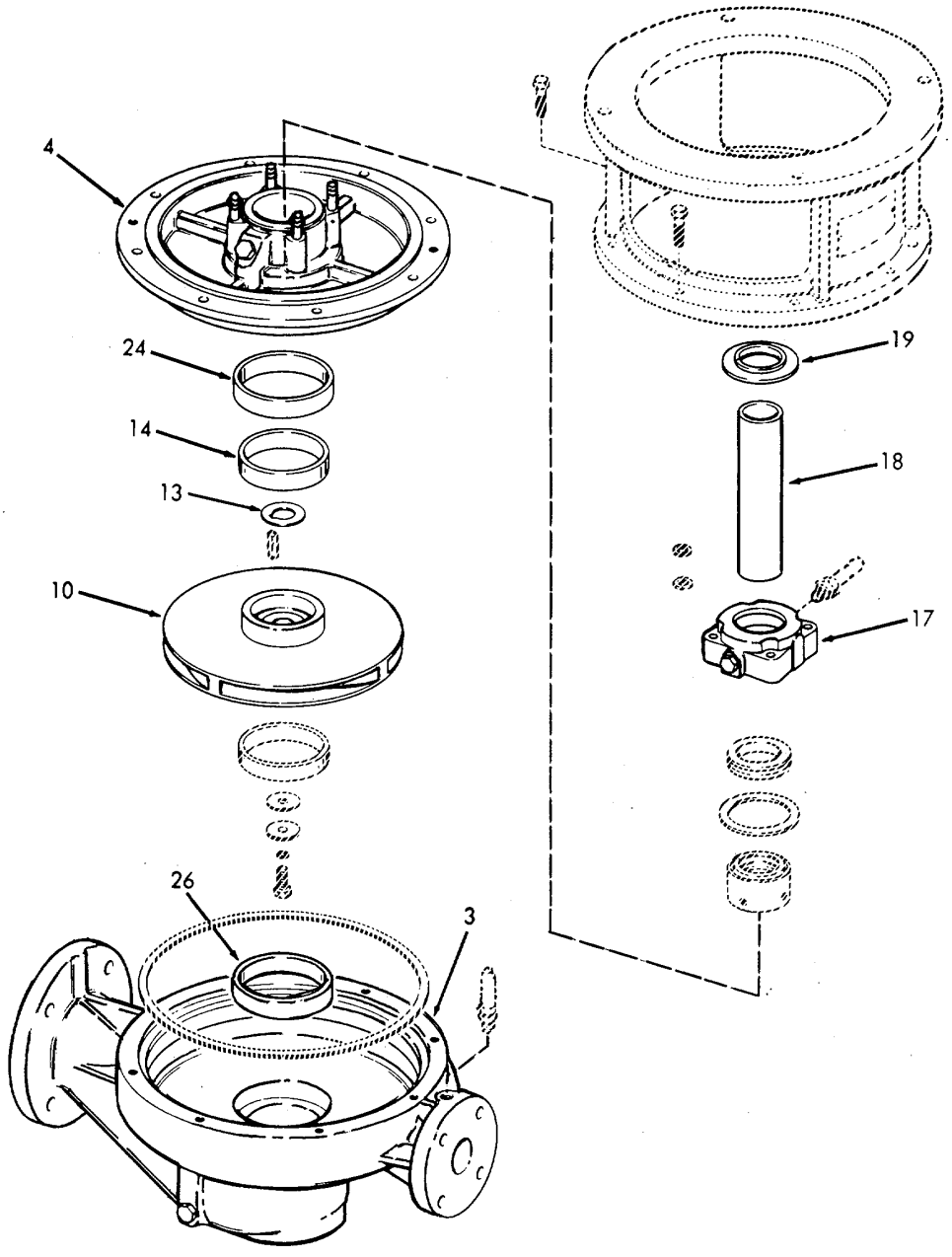


5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY			
2.	a. Packing box cover (4)	Press wear ring (24) into recess in cover.	Make certain it is properly seated.
	b. Casing (3)	Press wear ring (26) into casing until it is flush with the inside edge of the casing.	
	c. Impeller (10)	1. Press rear wear ring (14) onto shoulder at rear of impeller until it is flush with the rear face. 2. Press front wear ring (13) onto shoulder at front of impeller until it is flush with the front face. 3. Check wear ring tolerances. Clearance should be .013-.018 inch.	If not correct, it is suggested the impeller be machined to give correct clearance.
	d. Shaft deflector (19)	Place on motor shaft.	
	e. Shaft sleeve (18)	Insert into bore of packing gland (17).	
	f. Packing box (part of packing box cover (4)	1. Clean packing box. 2. Inspect parts for wear.	

5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont).			

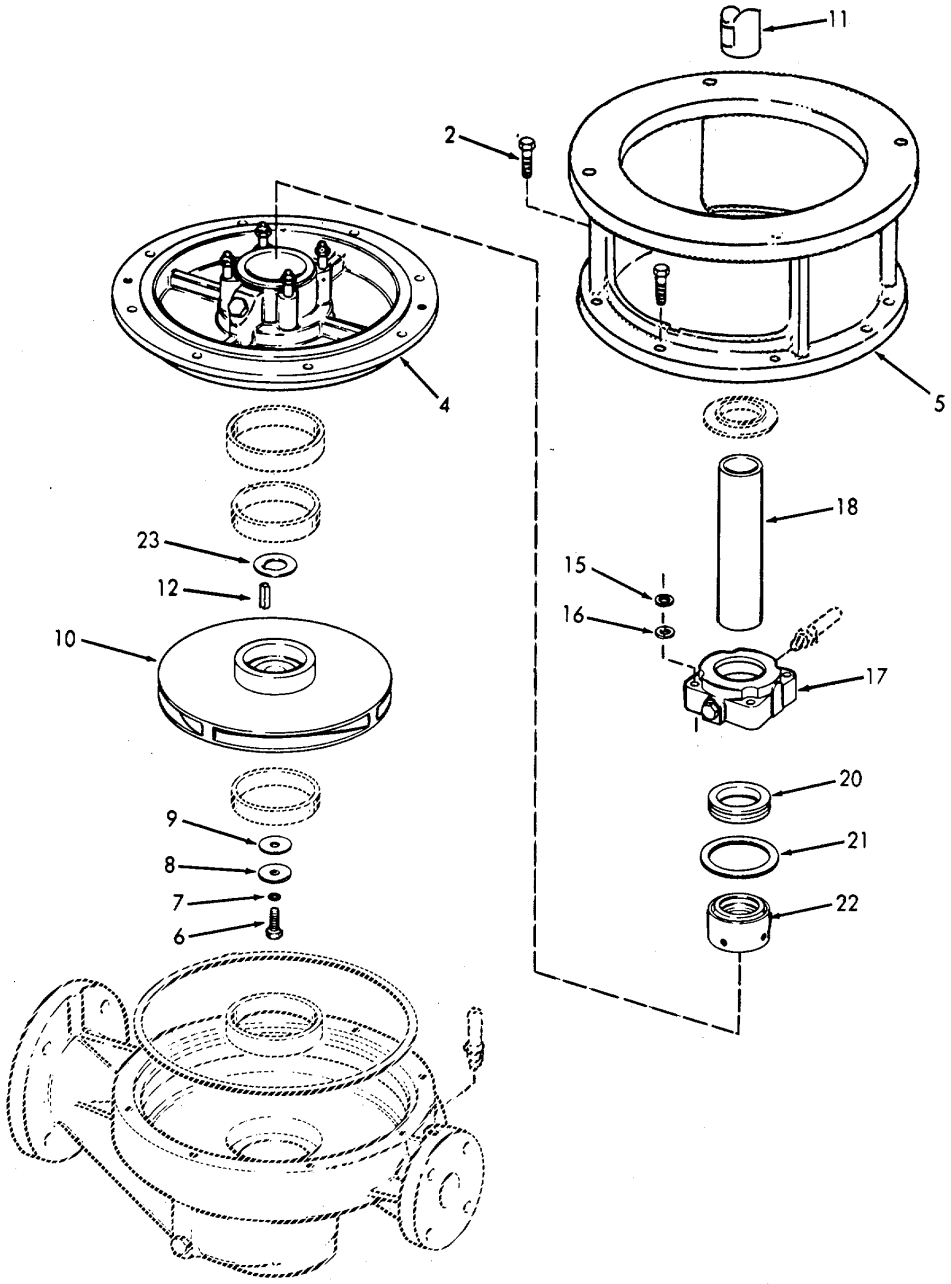


5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont).			
		3. Replace shaft sleeve If worn. (18).	
		4. Install seal (22), gasket (21), and lantern ring (20).	
		5. Install stuffing box gland (17).	
		6. Install gland nuts (15), and clips (16).	
	g. Packing box cover (4)	1. Position on adapter (5).	
		2. Line up the keyway on the sleeve (18) with the keyslot in the shaft (11).	
		3. Replace the impeller key (12).	
		4. Install jack screws (2).	Draw down snug.
	h. Shaft gasket (23)	Place over the end of the shaft (11).	
	i. Impeller (10)	Install with keyway over key.	Tap into position with a babbit or rawhide hammer.
	j. Washer gasket (9), washer (8), O-ring (7), and screw (6)	Install and tighten.	

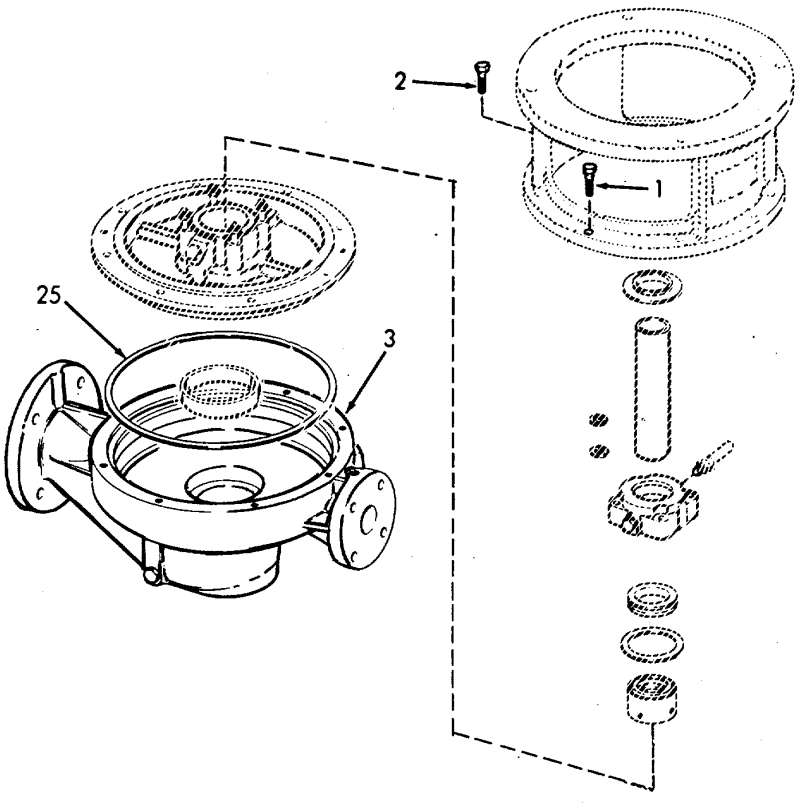
5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont).			



5-119. FIRE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont).			
	k. Casing gasket (25)	Install on casing (3).	
	l. Packing box cover assembly and casing (3)	1. Locate cover assembly on casing.	
		2. Loosen jack screws (2).	Permits the assembly to slip into the casing.
		3. Install screws (1).	
		4. Snug up jack screws (2).	Prevents them from working out.



5-120. FIRE PUMP MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

Special Tools
NONE

Material/Parts
NONE

Personnel Required
2

References
Paragraph
4-8 Fire Pump Motor

Equipment
Condition Condition Description
NONE

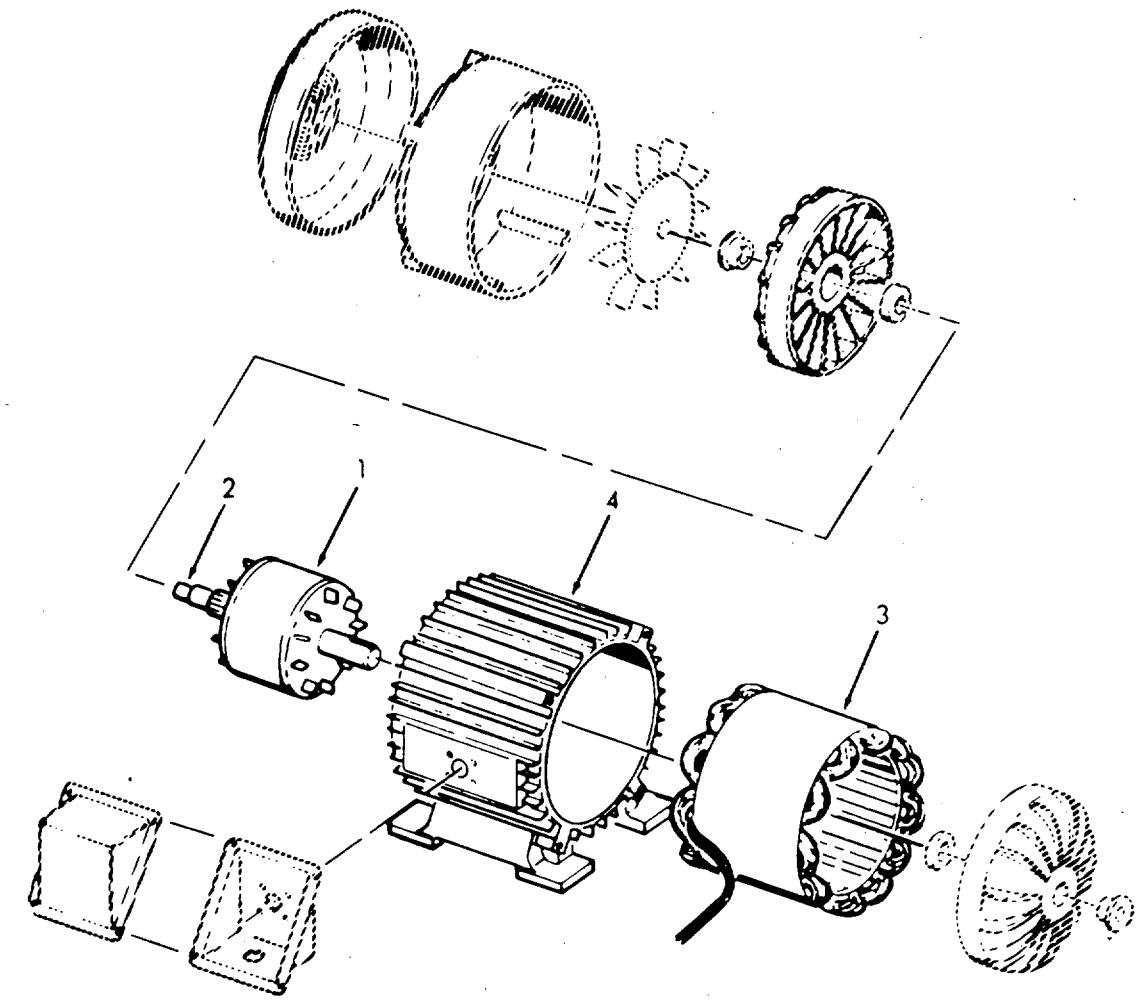
Special Environmental Conditions
NONE

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
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.	

5-119. FIRE PUMP MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont).			



5-121. FIRE PUMP CONTROLLER - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance procedures of the major internal components.

5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

Renewal set contacts
6-25-2

Personnel Required

1

References
Paragraph

4-8.4 Fire Pump Controller Maintenance Instructions

Equipment
Condition Condition Description

NONE

Special Environmental Conditions

NONE

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

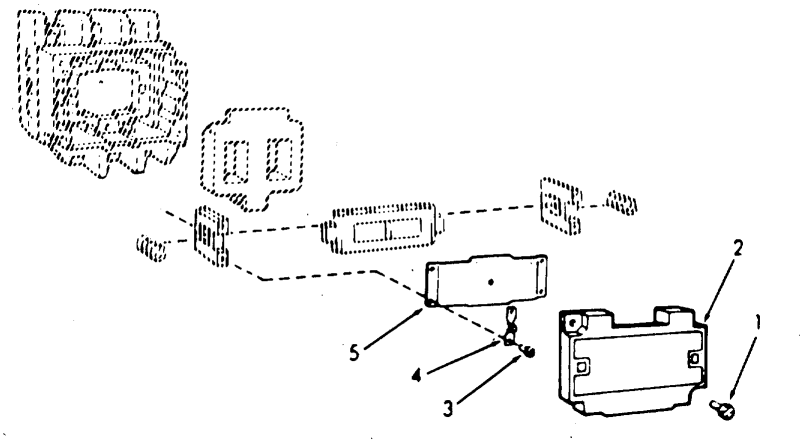
REASSEMBLY (Cont).

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.

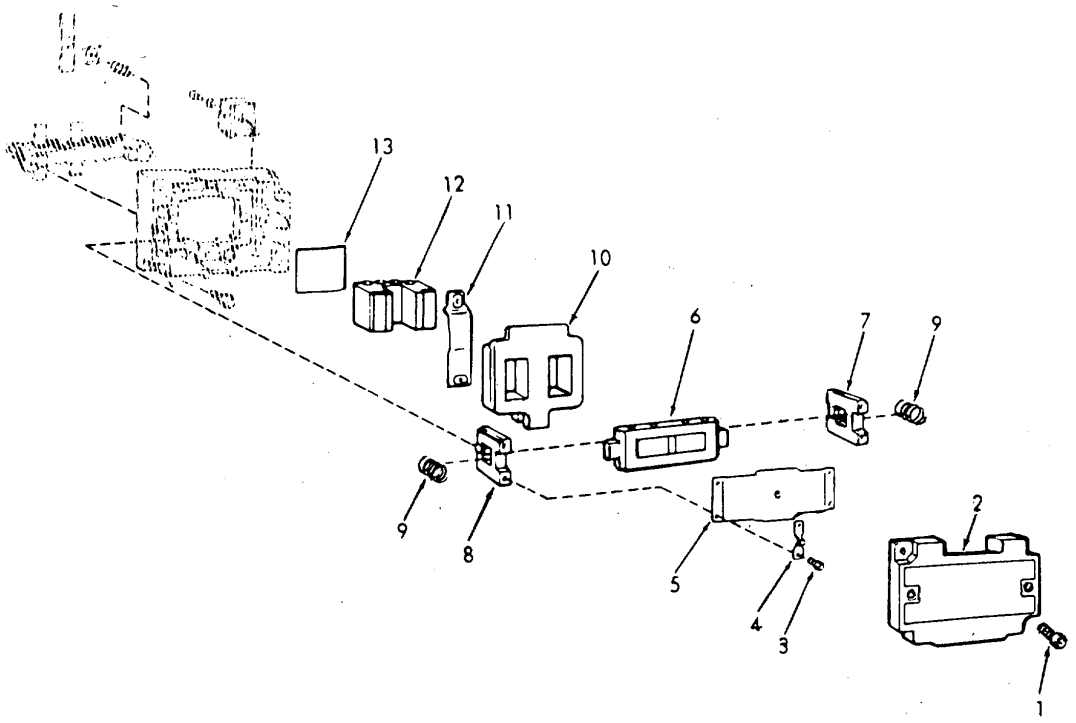


5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont).			
	c. Armature (6), right pushbar (7), left pushbar (8), and springs (9)	Remove.	There is no need to disassemble.
	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), and left pushbar (8)	Install narrow end to the left into its seated operating position.	

5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont).			
	h. Springs (9), clamp plate (5), and indicating plates (4)	Install.	
	i. Screws (3), cover (2) and screws (1)	Install.	

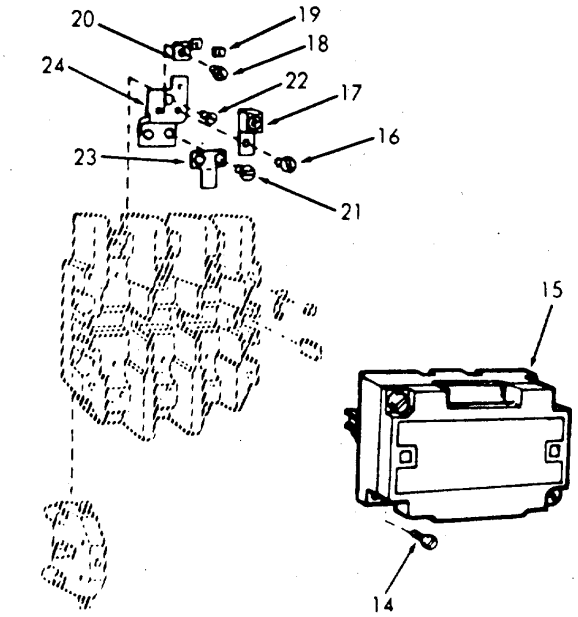


5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.	
	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 terminal s (20)	Remove.	
	c. Two screws (21), one screw (22)	Remove three per contact total 18 screws.	Discard screws.

5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont).			
	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.

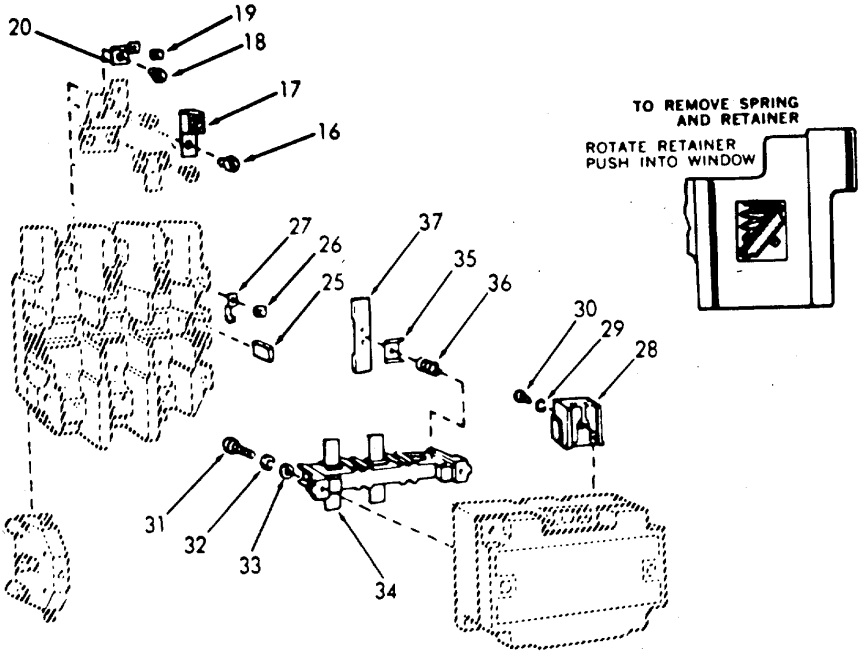


5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

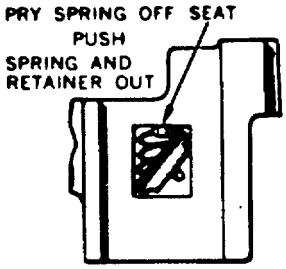
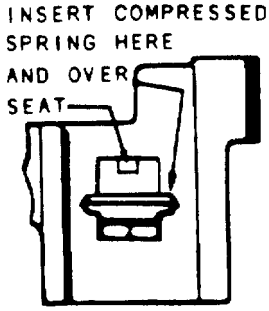
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont).			
	f. Two control terminals (20), terminal clamps (19), and screws (18)	Replace.	
	g. Six lugs (17), and screws (16)	Replace.	
4. Miscellaneous	a. Insulator (25)	Replace.	If necessary.
	b. Two terminal clamps (26), and coil terminal clips (27)	Replace.	If necessary.
	c. Six screws (28), lock-washers (29), and blowouts (30)	Replace.	If necessary.

5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont).			
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)	1. Raise retainer against spring (36) to free the movable contact (37). 2. Rotate retainer into position shown.	Movable contact will drop out.

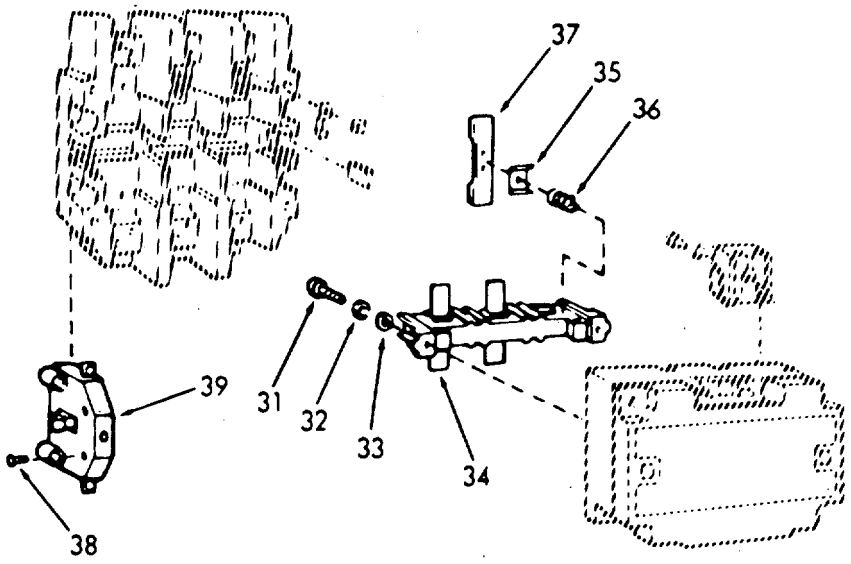


5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont).		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.
			
		6. Place and hold retainer (35), in the position shown.	Use new spring, retainer, and movable contact.
			
		7. Compress spring (36) with thumb and index finger, and insert seat into cavity above retainer (35).	

5-121.1. CONTACTOR (NEMA SIZE 3, 2, AND 3 POLE AC) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
		NOTE The contact bar is not reversable. Match ends of contact bar to fit raised projections on push bars.	
		8. Raise retainer (35) against the spring (36), and insert and position the movable contact (37).	Contact tips must face away from the retainer.
	d. Contact bar Install. (34), screw (31), lock-washers. (32), and flatwashers (33)		
6. Interlock	a. Screws (38)	Remove.	
	b. Interlock (39)	Remove and replace.	
	c. Screws (38) Replace.		



5-121.1. STARTER (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 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.

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

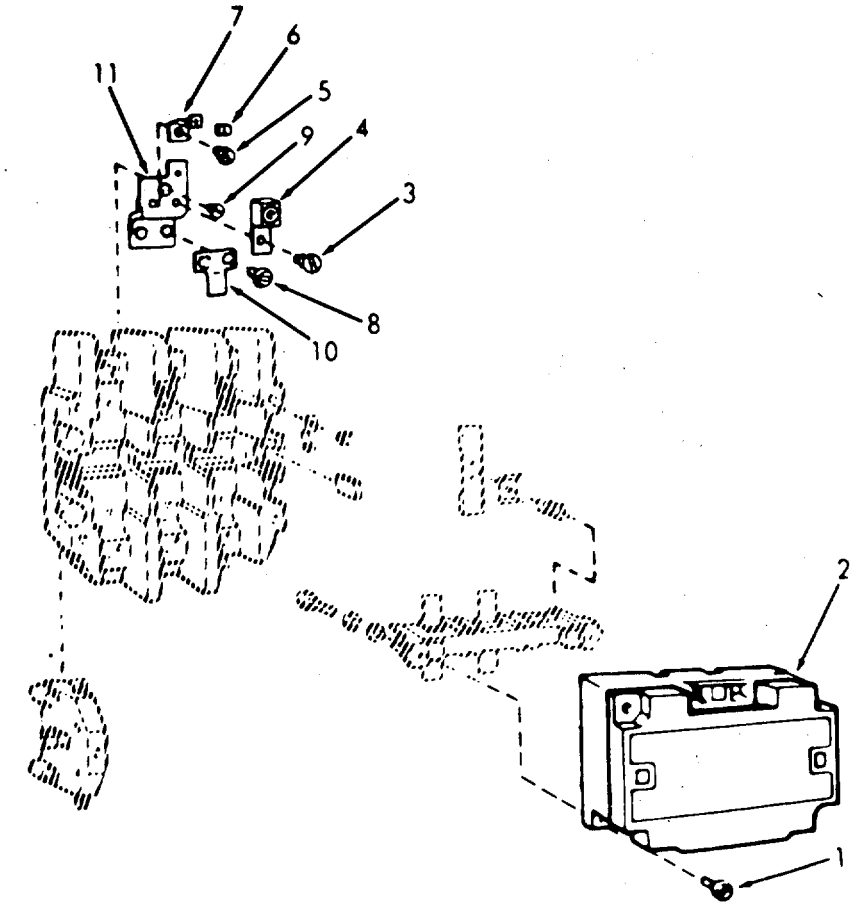
This starter is similar to the contactor in paragraph 4-8.1. The power unit in this starter is identical to the power unit in contactor in paragraph 4-8.1.

5-121.2. STARTER (NEMA SIZE 3, 3, POLE REVERSING) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
1. Power Unit	a. Two screws (1)	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), lugs (4), and two screws (5)	Remove.	
	b. 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 (11)	Remove.	Discard stationary contacts.

5-121.2. STARTER (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.

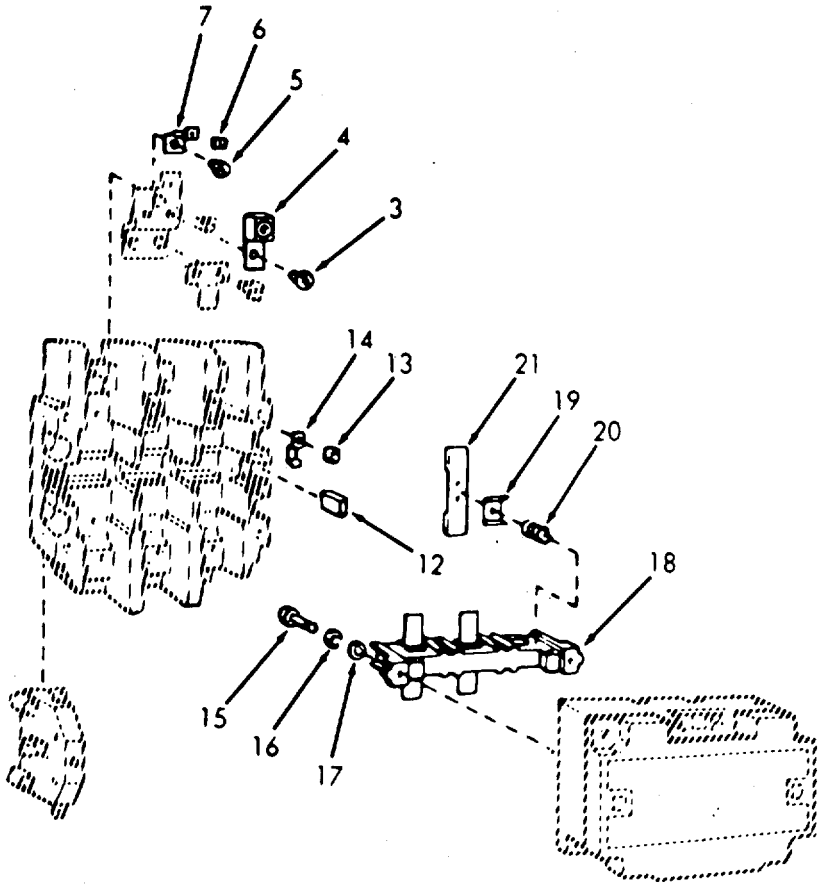


5-121.2. STARTER (NEMA SIZE 3, 3, POLE REVERSING) - MAINTENANCE INSTRUCTIONS (Continued).

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. Miscel-Laneous	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.	

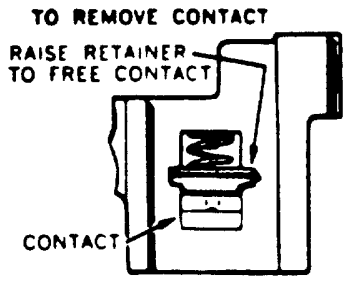
5-121.2. STARTER (NEMA SIZE 3, 3, POLE REVERSING) - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	c. Retainer (19), spring (20) and movable contact (21)	1. Raise retainer against spring (20) to free the movable contact (21).	Movable contact will drop out.

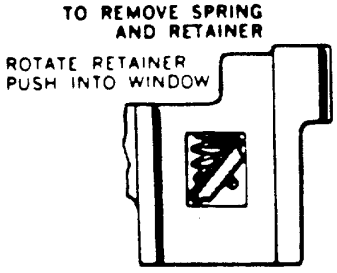


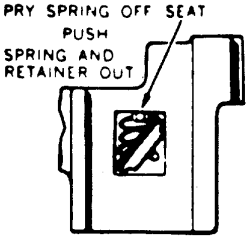
5-121.2. STARTER (NEMA SIZE 3, 3, POLE REVERSING) - MAINTENANCE INSTRUCTIONS (Continued).

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.

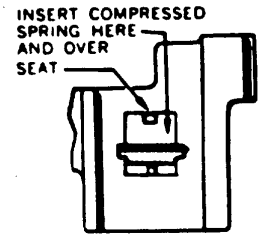




		6. Place and hold the retainer (19) in the position shown.	Use new spring, retainer, and movable contact.

5-121.2. STARTER (NEMA SIZE 3, 3, POLE REVERSING) - MAINTENANCE INSTRUCTIONS (Continued).

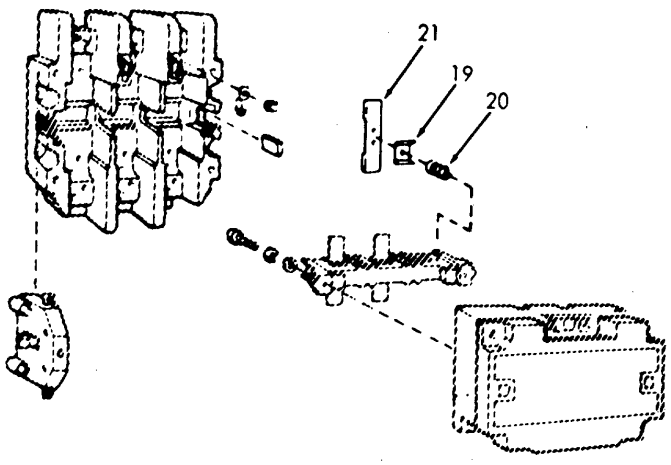
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



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.

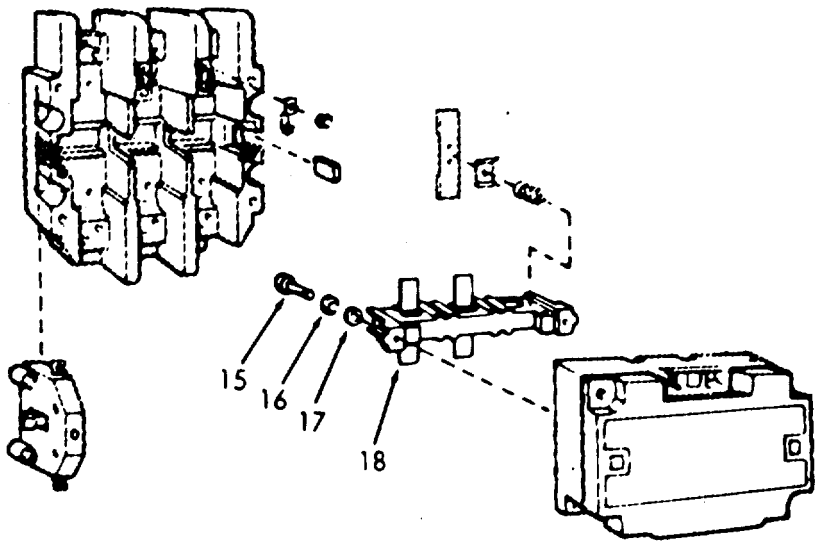


5-121.2. STARTER (NEMA SIZE 3, 3, POLE REVERSING) - MAINTENANCE INSTRUCTIONS (Continued).

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 reversable. Match the ends of the contact bar to fit the raised projections on the push bars.



5-121.3. “M” TYPE RELAY - MAINTENENCE 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
Observe WARNING in this procedure.

LOCATION	ITEM	ACTION	REMARKS

WARNING

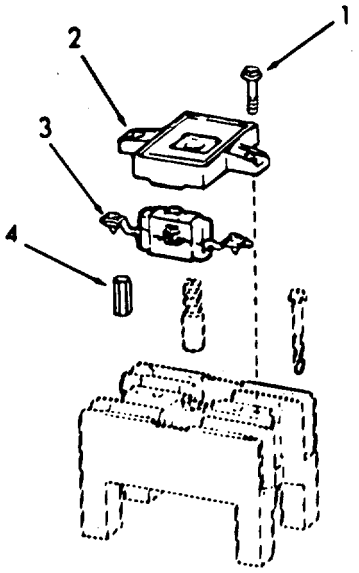
To prevent accidental shock and possible injury, tag and-place disconnect switch in the OFF position, and pull fuses as an added precaution.

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.	

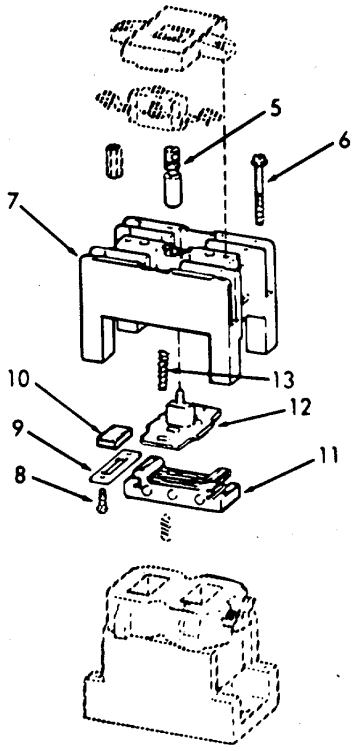


5-121.3. “M” TYPE RELAY - MAINTENANCE INSTRUCTIONS (Continued).

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.	



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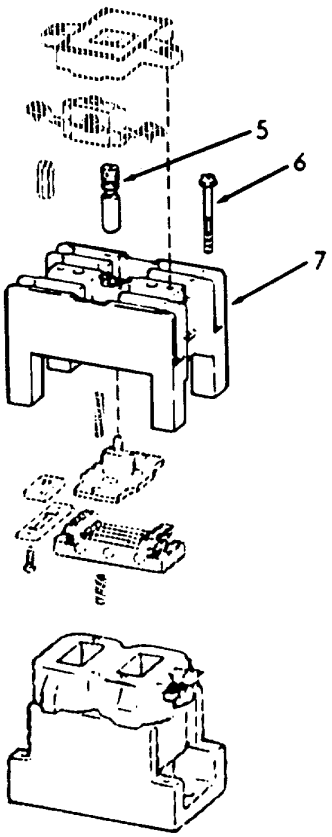
5-121.3. “M” TYPE RELAY - MAINTENANCE INSTRUCTIONS (Continued).

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. LUBE OUL PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment
NONE

Special Tools
NONE

Material/Parts
NONE

Personnel Required
2

References
NONE

Equipment
Condition Condition Description
NONE

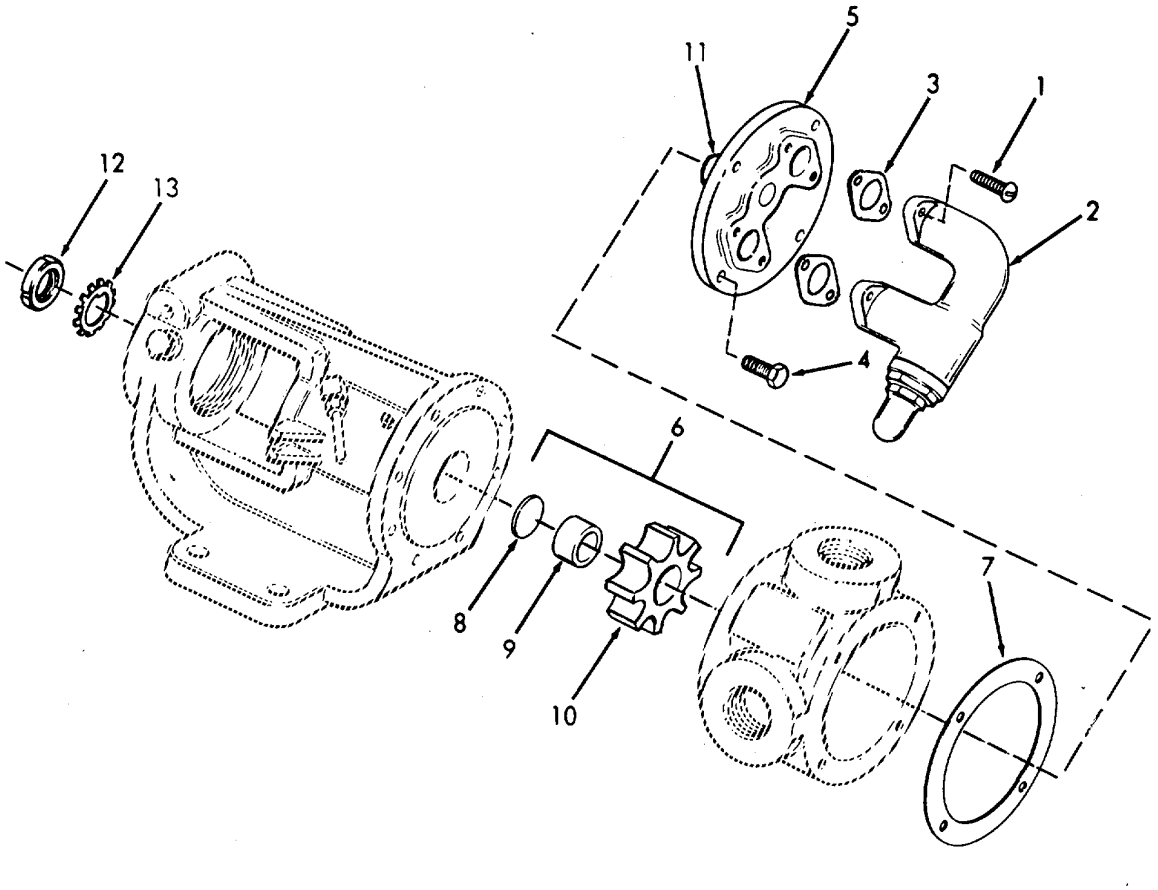
Special Environmental Conditions
NONE

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL			
1. Lube Oil Pump (1)	a. Screws	Remove.	
	b. Relief valve (2)	Remove.	
	c. Gaskets (3)	Remove.	
	d. Screws (4)	Remove.	
	e. Head (5), and attached idler (6)	Remove.	
	f. Gasket (7)	Remove.	Discard.

5-122. LUBE OIL PUMP - MAINTENENCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	g. Head (5)	Remove grease retainer (8), bushing (9), idler (10), from idler pin (11).	
	h. Locknut (12), and lock-washer (13)	Remove.	

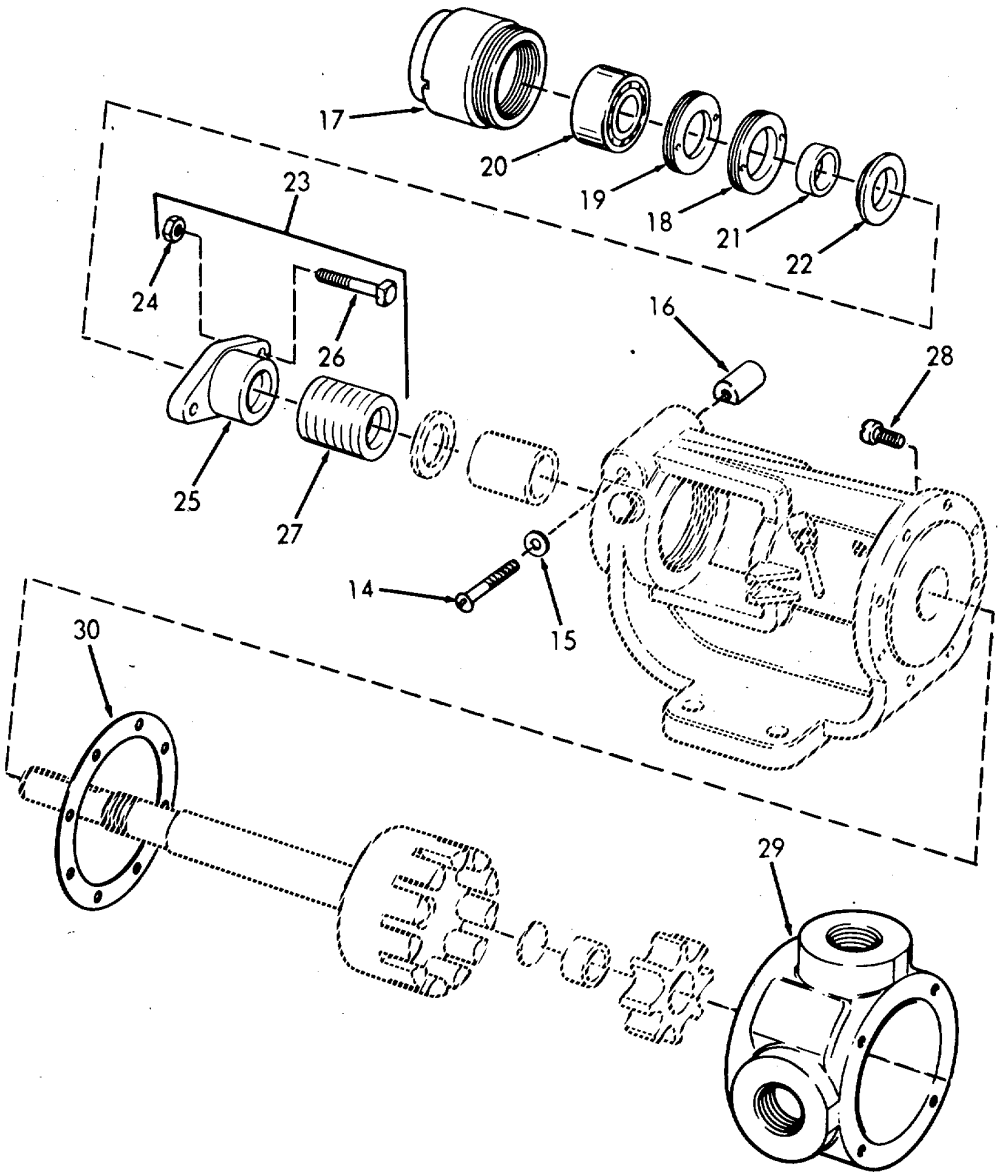


5-122. LUBE OIL PUMP - MAINTENENCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	i. Screw (14), gasket (15), and clamp nut (16)	Remove.	Head of screw may have to be tapped to free clamp nut.
	j. Rotor adjusting sleeve (17)	1. Unscrew and remove. 2. Unscrew retaining nut (18). 3. Unscrew seal nut (19). 4. Remove bearing (20), and spacer (21).	
	k. Packing seat (22)	Remove.	
	l. Gland (23)	1. Unscrew nuts (24). 2. Remove packing gland (25). 3. Remove gland screws (26). 4. Remove packing (27).	
	m. Screws (28)	Remove.	
	n. Housing (29), and gasket (30)	Remove.	

5-122. LUBE OIL PUMP - MAINTENENCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	o. Tubing Connector hole	1. Remove tubing and elbow.	If necessary.

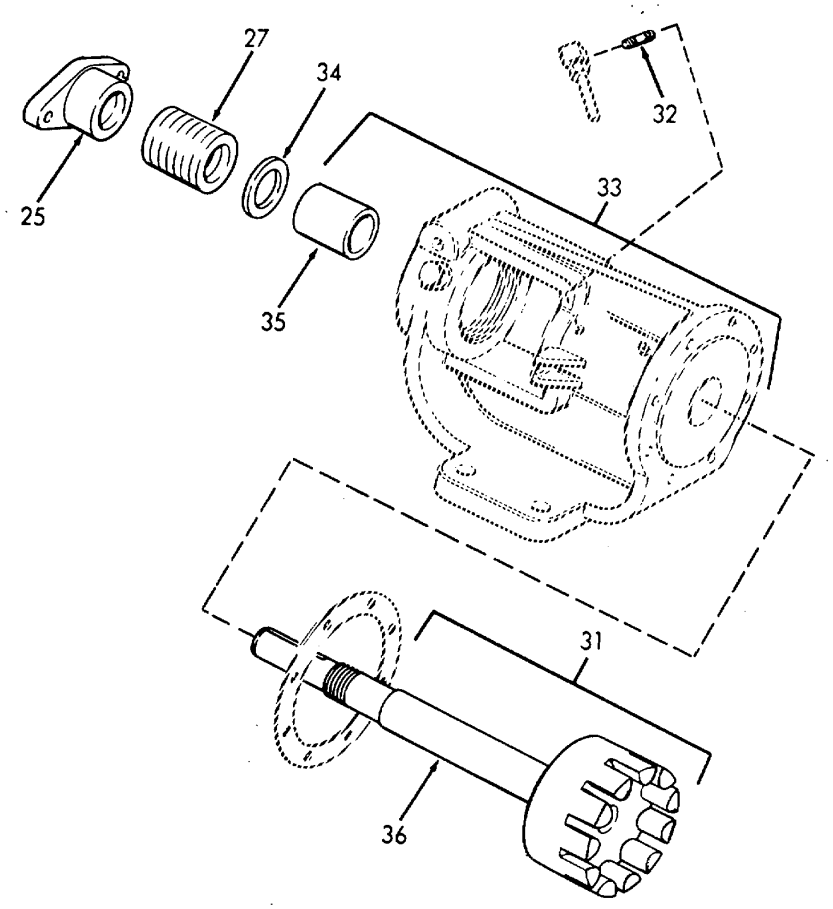


5-122. LUBE OIL PUMP - MAINTENENCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
		2. Rotate rotor and shaft assembly (31) until setscrews (32) are visible.	
		3. Remove setscrews (32).	
	p. Rotor and shaft assembly (31)	1. Pull out of pump back head (33).	
		2. Hold onto seal (34), and bushing (35).	
	q. Back head (33)	Check the inside of the seal chamber to make sure it is clean.	
	r. Rotor and shaft assembly (31)	1. Separate rotor and shaft (36).	
		2. Reassemble.	
		NOTE Special care must be exercised when handling a mech anical seal. The stationary seat and floating seat are easily damaged by rough treatment or dirt on the lapped faces. It is important to coat the in-side of the rotating member of the seal and shaft surface with clean grease before attempting to mount the seal. Slide the rotating member on and off the shaft once before assembling the pump. The stationary seal member can be pressed into the gland after coat-ing the seat gasket with clean grease.	
	s. Rotor and shaft assembly (31)	Insert into back head (33) so the end of the shaft just comes through the seal chamber.	

5-122. LUBE OIL PUMP - MAINTENENCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	t. Bushing (35), seal (34), packing (27), and packing gland (25)	1. Pass over shaft. 2. Push the rotor shaft assembly (31) all the way into the back head (33).	

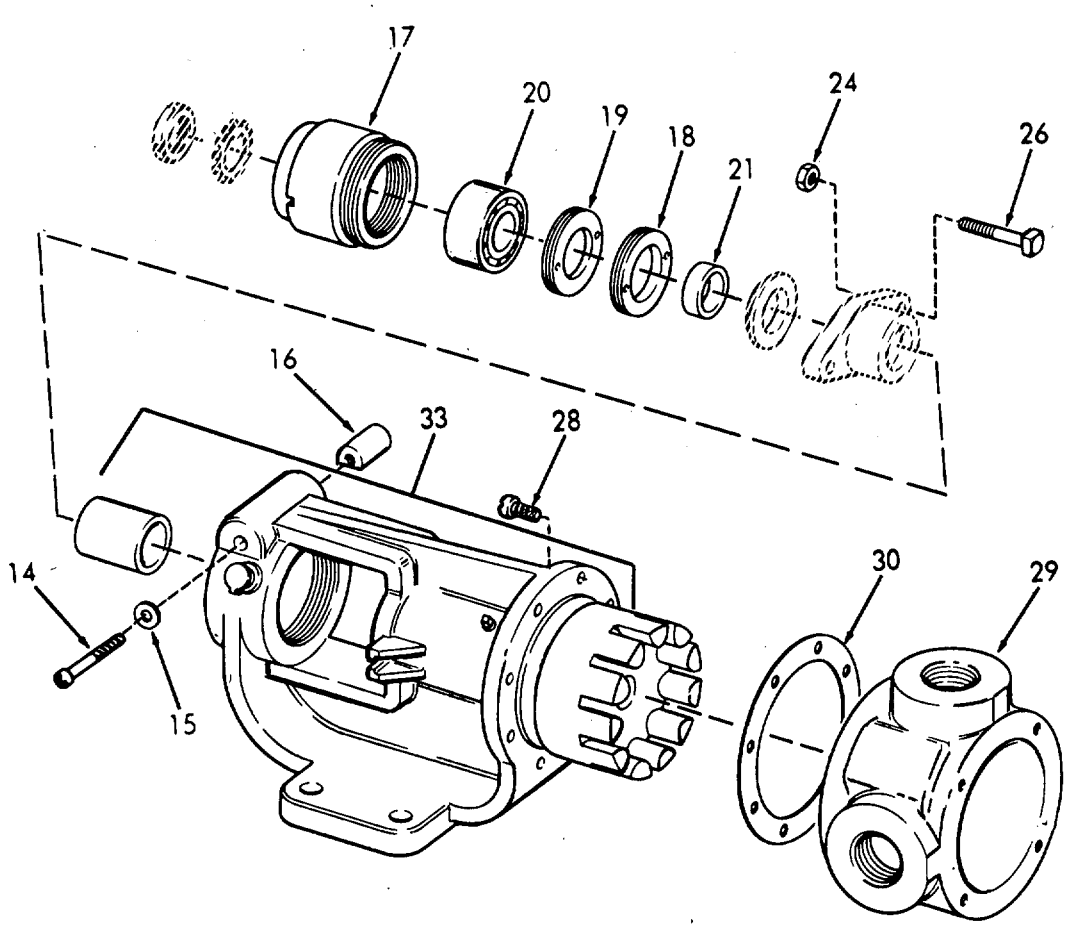


5-122. LUBE OIL PUMP - MAINTENENCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	u. Gasket (30), and housing (29)	Install.	
	v. Screws (28)	1. Install. 2. Tighten gradually and evenly.	
	w. Screws (26)	Install in back head (33).	
	x. Nuts (24)	Install.	
	y. Bearing (20), and spacer (21)	Install in rotor adjusting sleeve (17).	
	z. Seal nut (19), and retaining nut (18)	Install in rotor adjusting sleeve (17).	
	aa. Rotor adjusting sleeve (17)	1. Screw into back head (33) as far as it will go. 2. Install clamp nut (16), screw (14), and gasket (15). 3. Back off sleeve (17) until only a slight drag is felt when the shaft is rotated.	

5-122. LUBE OIL PUMP - MAINTENENCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	ab. Clamp nut (16)	Tighten to 60 inch pounds (6.78 Nm) torque.	

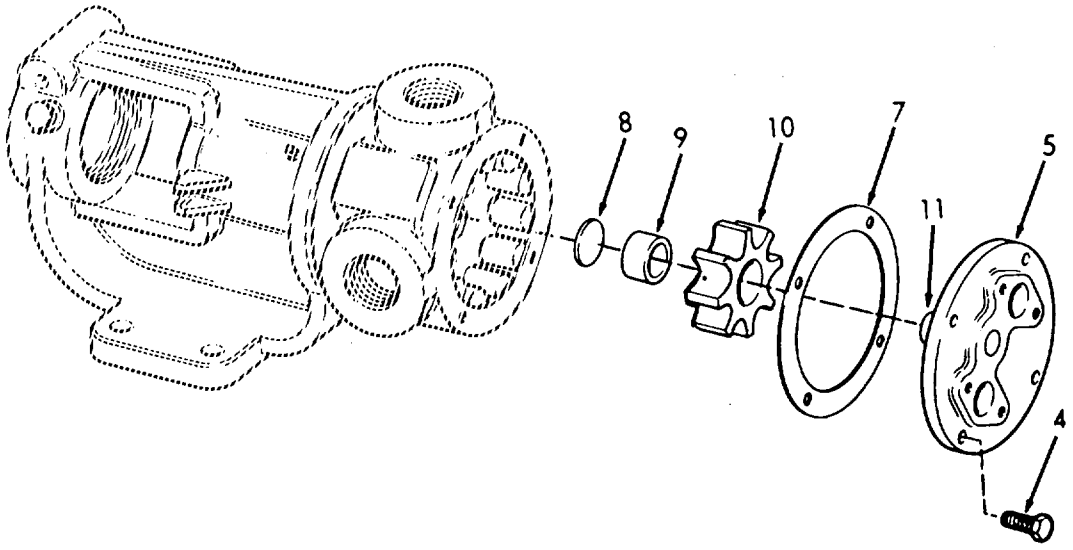


5-122. LUBE OIL PUMP - MAINTENENCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	ac. Head (5)	Reassemble idler (10), bushing (9), and grease retainer (8) to the idler pin (11).	
	ad. Head assembly and gasket (7)	Install on housing.	
	ae. Screws (4)	1. Install. 2. Tighten gradually and evenly.	
	af. Assembled pump	1. The liquid end of the pump should be blocked up to incline the shaft and cause the seal collar (34) to be visible through the 1/4 inch NPT tap in the seal housing. 2. Rotate the shaft (31), until a set-screw (32) is accessible. 3. The seal spring may have to be compressed with one hand until the set screw is exactly centered in the 1/4" NPT tap.	

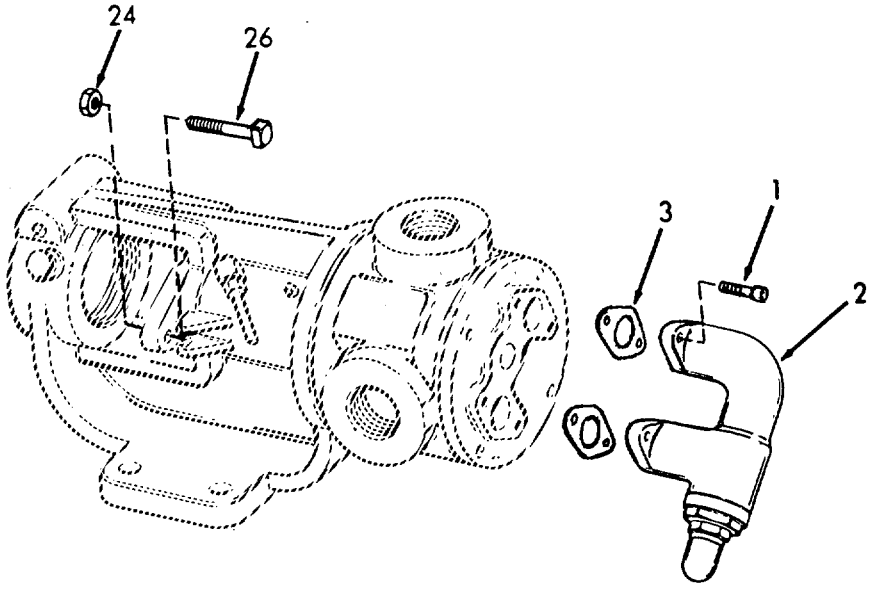
5-122. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)		4. Meanwhile, insert an Allen wrench through the tapped hole and tighten the setscrew. 5. Rotate the shaft and tighten the second set screw.	



5-122. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
		6. With the screws (26) and nuts (24) carefully draw the seal gland into dowel with the back head.	
		7. Make sure the gasket is in place and tighten.	
	ag. Relief valve (2), and gaskets (3)	Install.	
	ah. Screws (1)	Install.	



5-123. LUBE OIL PUMP MOTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment	Paragraph	References
NONE		4-10.3 Lube Oil Pump Motor

Special Tools	Equipment Condition	Condition Description
NONE		NONE

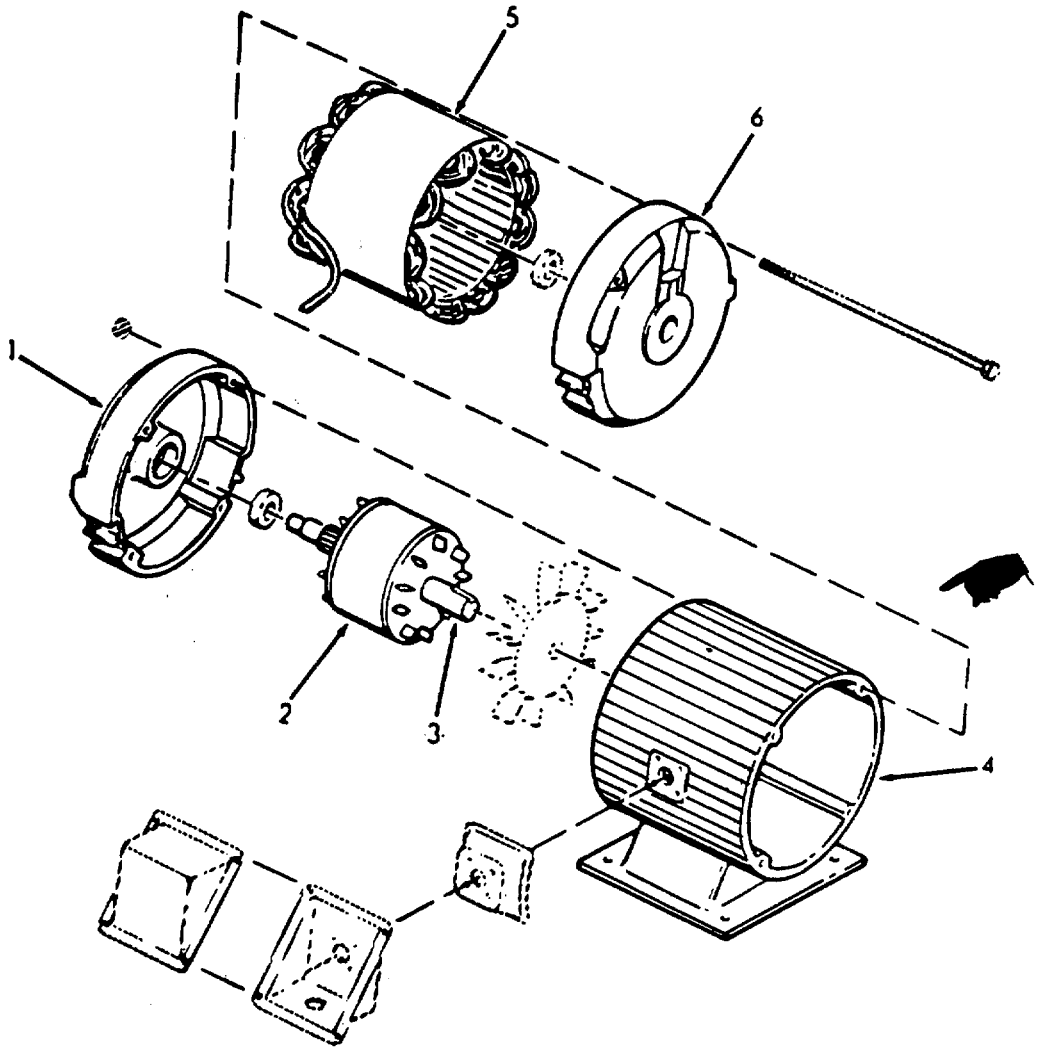
Material/Parts	Special Environmental Conditions
NONE	NONE

Personnel Required	General Safety Instructions
2	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.

5-122. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR(Cont)			



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5-124. LUBE OIL PUMP CONTROLLER - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for Controller maintenance instructions.

5-125. FR'ESH WATER PUMP MOTOR - MAINTENANCE INSTRUCTIONS.

This task covers:
Repair

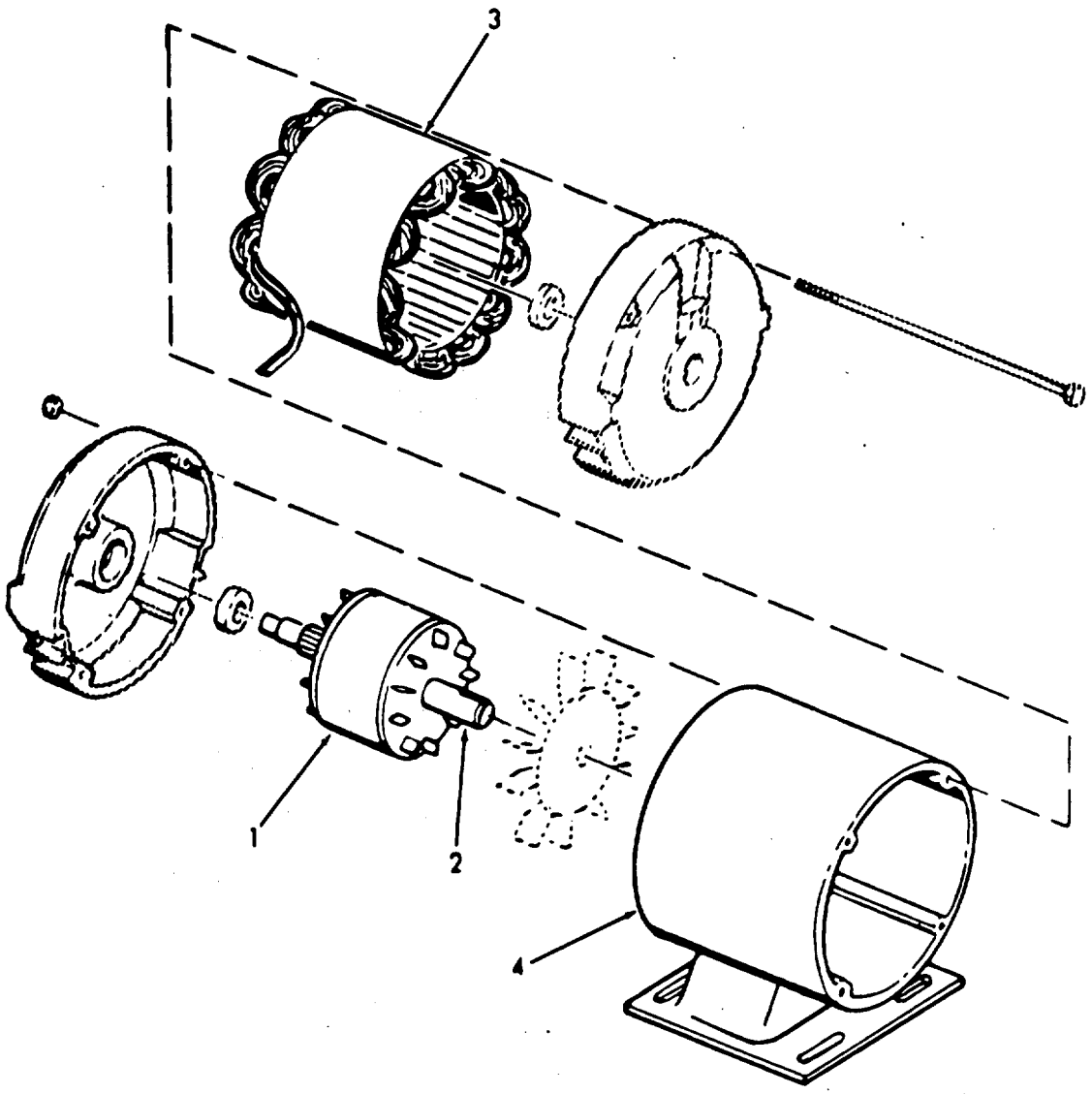
INITIAL SETUP

Test Equipment	Paragraph	References
NONE		4-11.3 Fresh Water Pump Motor
	Equipment	
Special Tools		Condition Condition Description
NONE	NONE	
Material/Parts		Special Environmental Conditions
NONE		NONE
Personnel Required		General Safety Instructions
2		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	Paragraph	References
NONE	4-12.3	Air Conditioning Water Circulation Pump

Special Tools	Equipment Condition	Condition Description
NONE		NONE

Material/Parts	Special Environmental Conditions
NONE	NONE

Personnel Required	General Safety Instructions
2	NONE

5-127. AIR CONDITIONING WATER CIRCULATION PUMP MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
1. Motor (1)	a. Rotor	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 WATER CIRCULATION PUMP CONTROLLER - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for Controller maintenance instructions.

5-129. DIESEL OIL COOLING PUMP MOTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

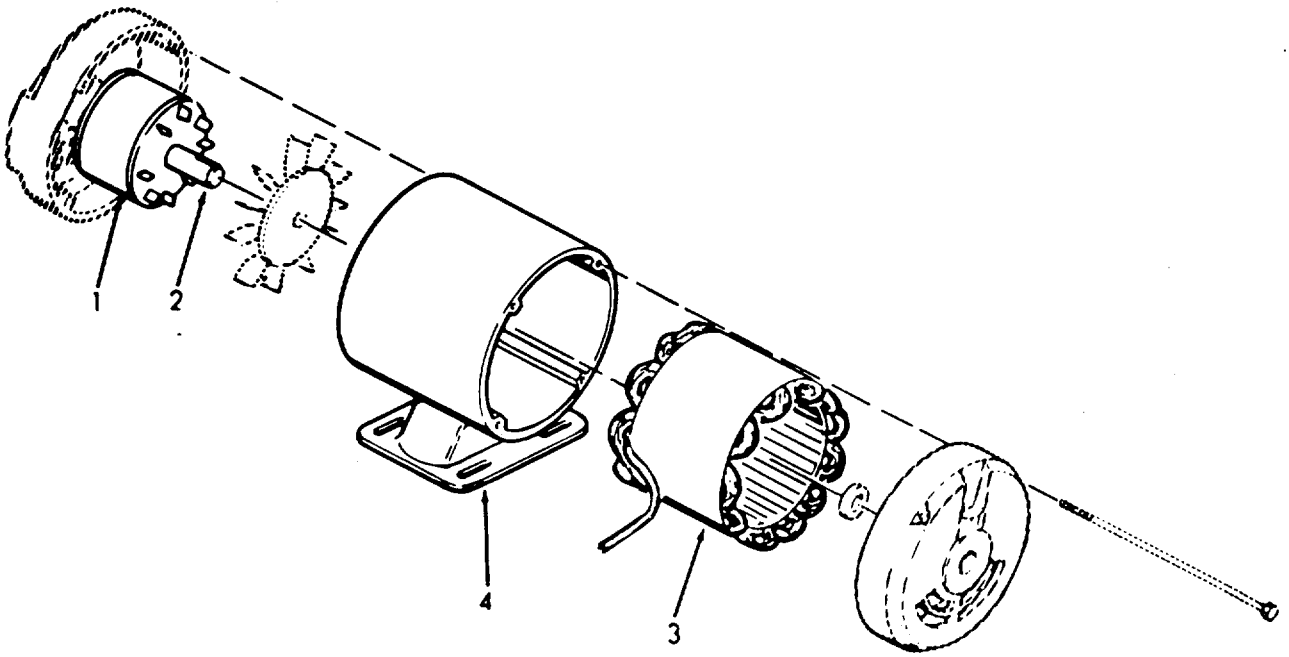
Repair

INITIAL SETUP

Test Equipment	Paragraph	References
NONE		4-13.3 Diesel Oil Cooling Pump Motor
	Equipment	
Special Tools		Condition Condition Description
NONE		NONE
Material/Parts		Special Environmental Conditions
NONE		NONE
Personnel Required		General Safety Instructions
2		NONE

5-129. DIESEL OIL COOLING PUMP MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
1. Motor (1)	a. Rotor	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.

5-131. SEWAGE VACUUM PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

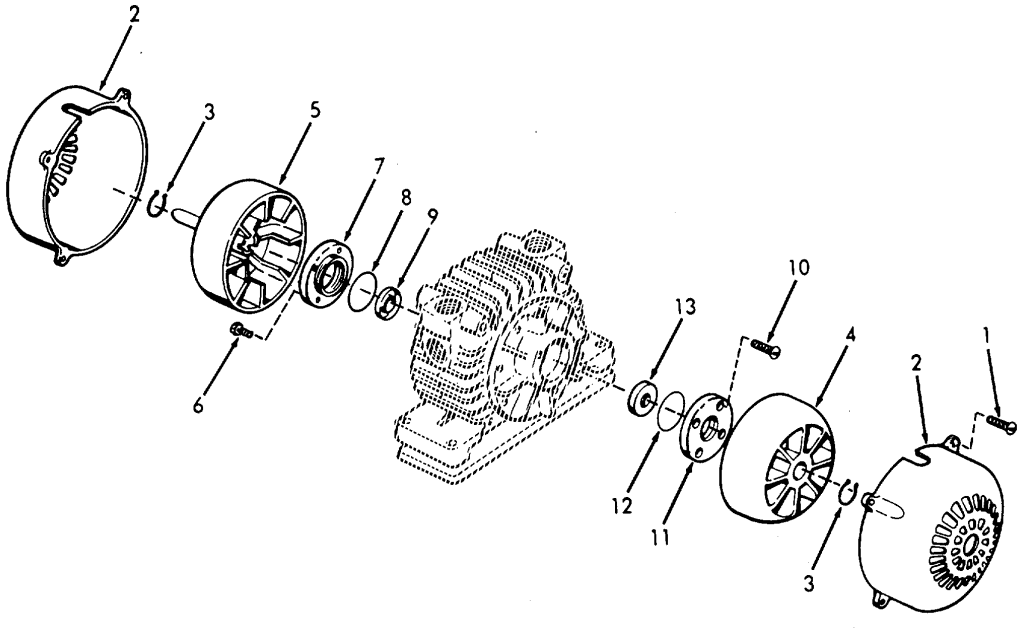
Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition / Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
Service kit P/N K295	NONE
Personnel Required	**General Safety Instructions**
1	Observe WARNING in this procedure.

5-131. SEWAGE VACUUM PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
1. Vacuum Pump	a. Screws (1)	Remove.	
	b. Fan guards (2)	Remove.	
	c. Retaining rings (3)	Remove.	
	d. Cooling fan drive end (4), and cooling fan dead end (5)	Remove.	
	e. Screws (6)	Remove.	
	f. Dead end and cap (7)	Remove.	
	g. O-ring (8), and dead end seal (9)	Remove.	Discard.
	h. Screws (10)	Remove.	

5-131. SEWAGE VACUUM PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
	i. Drive end end cap (11)	Remove.	
	j. O-ring (12), and drive end seal (13)	Remove.	Discard.

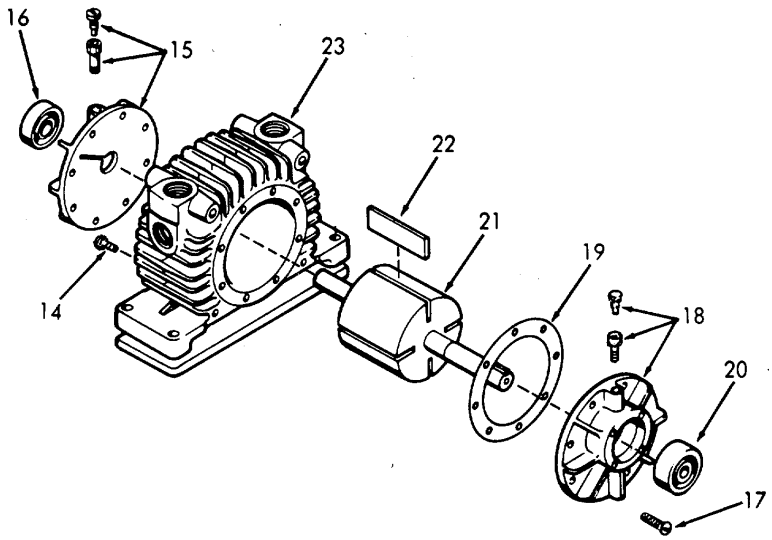


5-131. SEWAGE VACUUM PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Con't)			
	k. Screws (14)	Remove.	
	1. Dead end end plate (15)	Remove.	
	m. Dead end bearing (16)	Press from end plate (15).	
	n. Screws (17)	Remove.	
	o. Drive end end plate (18), and gasket 19)	Remove.	Discard gasket.
	p. Drive end (18). bearing (20)	Press from end plate	Discard bearing.
	q. Rotor assembly (21), and vanes (22)	Remove from body (23).	Discard vanes.
	r. All parts	1. Clean thoroughly with an approved solvent.	

5-131. SEWAGE VACUUM PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Con't)			
		WARNING Wear eye protection when using compressed air.	
		2. Blow dry with compressed air.	
s.	Dead end bearing (16)	Install a new bearing in dead end end plate (15).	
t.	Dead end plate (15)	Install on body (23) using screws (14).	

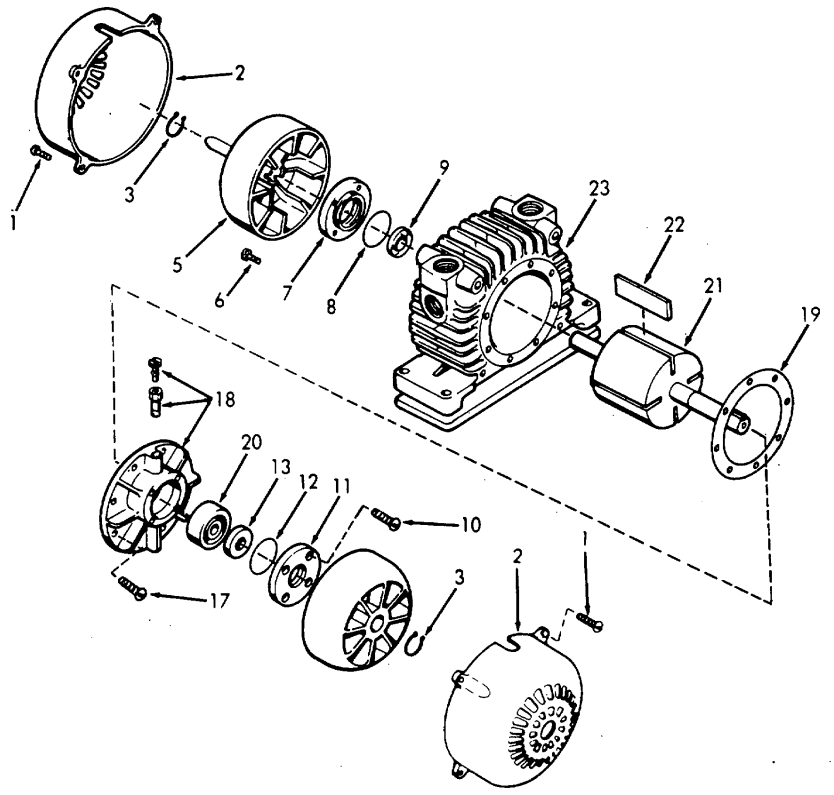


5-131. SEWAGE VACUUM PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Con't)			
	u. Rotor assembly (21)	Insert in body (23).	
	v. Vanes (22)	Insert in rotor assembly (21).	
	w. Drive end bearing (20)	Install a new bearing in drive end end plate (18).	
	x. Drive end plate (18), and gasket (19)	Install on body using screws (17).	Use new gasket.
	y. Drive end seal (13), and O-ring (12)	Install new parts.	
	z. Drive end end cap (11)	Install using screws (10).	
	aa. Dead end seal (9), and O-ring (8)	Install new parts.	
	ab. Dead end end cap (7)	Install using screws (6).	

5-131. SEWAGE VACUUM PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Con't)			
	ac. Cooling fan drive end (4), and cooling fan dead end (5)	Install using retaining rings (3).	
	ad. Fan guards (2)	Install using screws (1).	



5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Repair-Disassembly b. Repair-Reassembly c. Adjustment

INITIAL SETUP

Test Equipment
NONE

References
Paragraph'
4-19.1 Sewage Discharge Pump Equipment

Special Tools
Arbor Press

Condition Condition Description
NONE

Material/Parts
Grease
Never stick
Permatex
Oil, Type OE/HDO10

Special Environmental Conditions
NONE

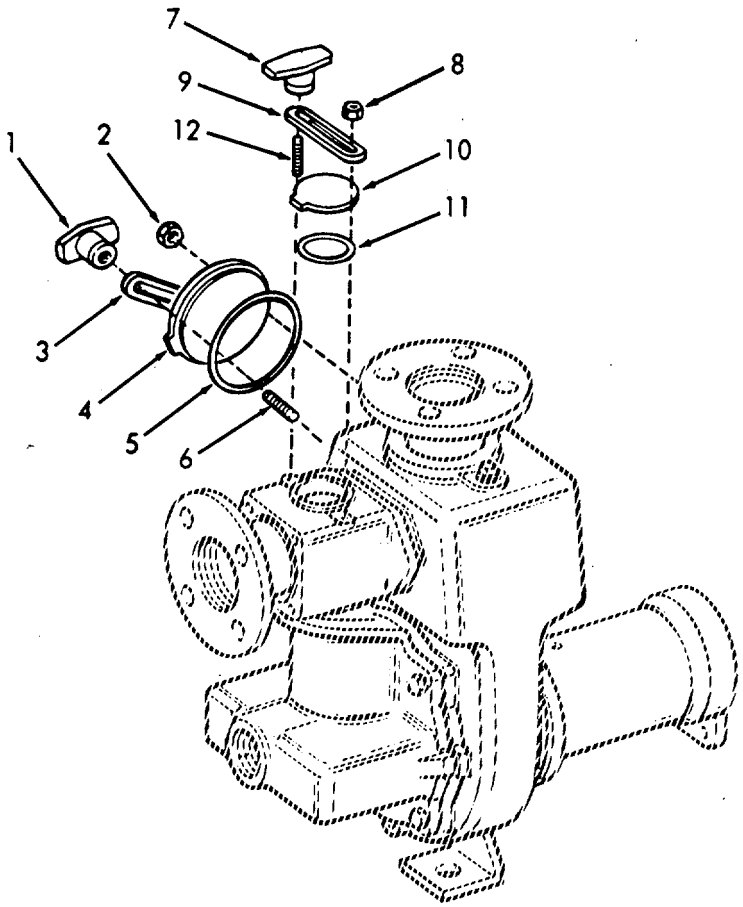
Personnel Required
1

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
REPAIR DISASSEMBLY			
1. Pump	a. Handle (1)	Unscrew and remove.	
	b. Nut (2)	Remove.	
	c. Arm (3)	Remove.	
	d. Inspection cover (4), and O-ring (5)	Remove.	
	e. Studs (6)	Remove.	If necessary.

5-131. SEWAGE VACUUM PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR DISASSEMBLY (Cont)			
	f. Handle (7)	Unscrew and remove.	
	g. Nut (8)	Remove.	
	h. Arm (9)	Remove.	
	i. Priming cover (10), and O-ring (11)	Remove.	
	j. Studs (12)	Remove.	If necessary.

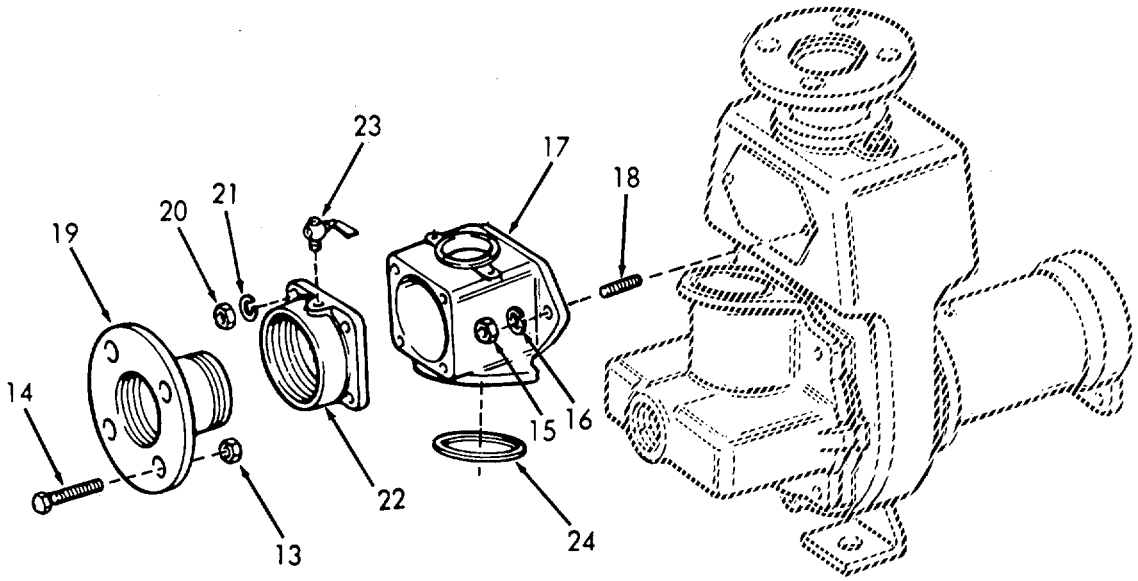


5-131. SEWAGE VACUUM PUMP - MAINTENANCE INSTRUCTIONS (Continued).

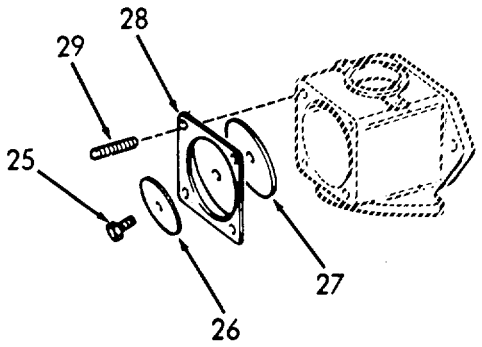
LOCATION	ITEM	ACTION	REMARKS
REPAIR DISASSEMBLY (Cont)			
	k. Nuts (13), and screws (14)	Remove.	
	l. Nuts (15), and lock-washers (16)	Remove.	
	m. Flap valve housing (17)	Lift up and remove.	
	n. Studs (18)	Remove.	If necessary.
	o. Flange (19)	Unscrew.	If necessary.
	p. Nuts (20), and lock-washers (21)	Remove.	
	q. Suction flange (22)	Remove.	
	r. Petcock (23)	Remove.	If necessary.
	s. O-ring (24)	Remove.	If necessary.

5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - DISASSEMBLY (Cont)			



t.	Screw (25), washer (26), weight (27), and flap valve (28)	Disassemble.	
u.	Studs (29)	Remove.	If necessary.

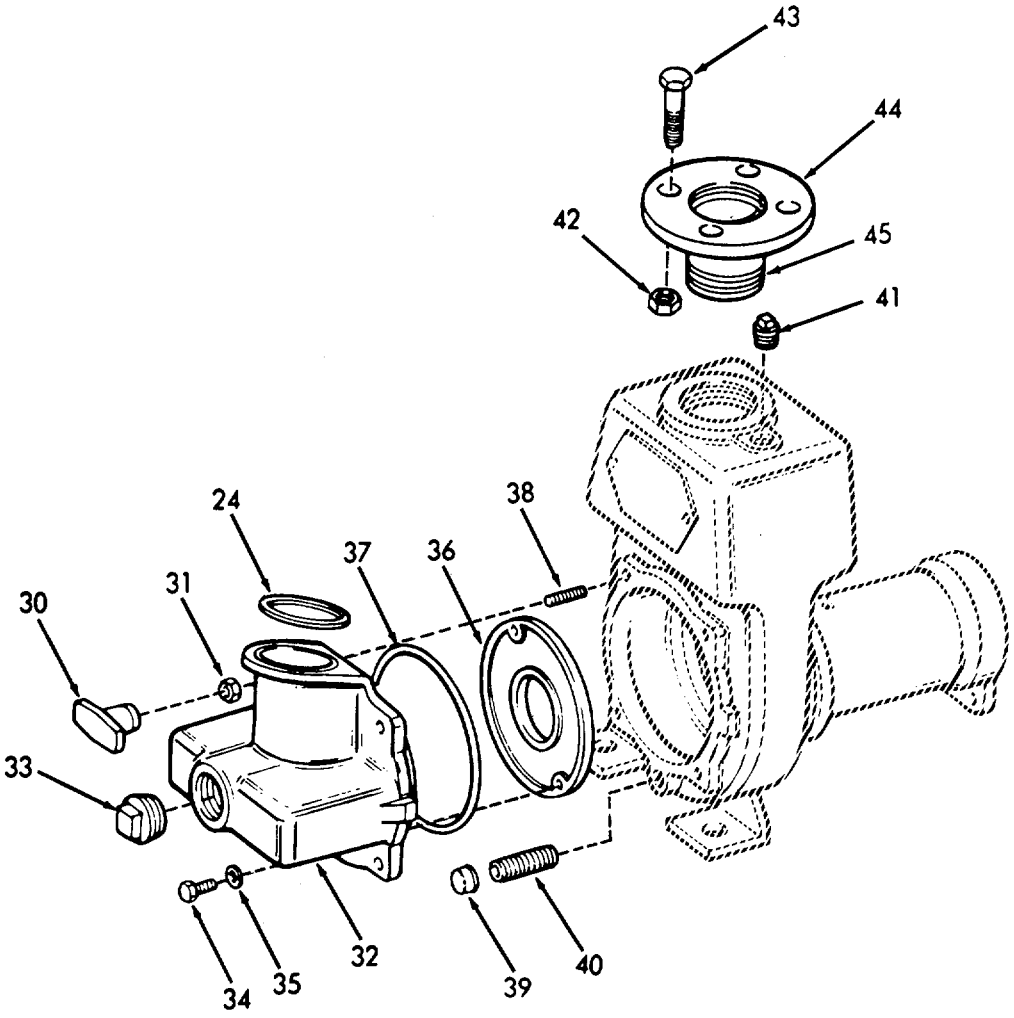


5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - DISASSEMBLY (Cont)			
	v. Handle (30), and locknut (31)	Unscrew and remove.	
	w. Inlet elbow (32), and O-ring (24)	Remove.	
	x. Pipe plug (33)	Remove.	If necessary.
	y. Screws (34), and stat-0-seals (35)	Remove.	
	z. Wear plate (36)	Remove.	
	aa. O-ring (37)	Remove.	
	ab. Studs (38)	Remove.	If necessary.
	ac. Pipe cap (39), and pipe nipple (40)	Remove.	If necessary.
	ad. Pipe plug (41)	Remove.	If necessary.

5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - DISASSEMBLY (Cont)			
	ae. Nuts (42), and screws (43)	Remove.	If necessary.
	af. Flange (44), and pipe nipple (45)	Remove.	If necessary.

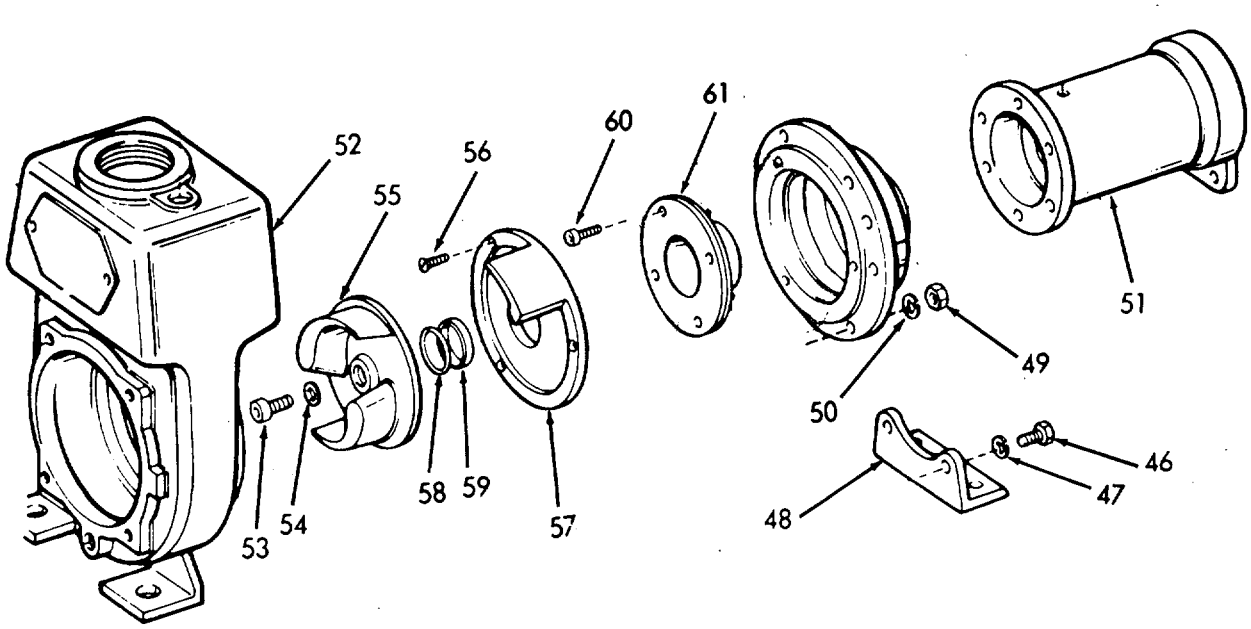


5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - DISASSEMBLY (Cont)			
	ag. Screws (46), lock-washers (47), and foot mounted support (48)	Remove.	
	ah. Nuts (49), and lock-washers (50)	Remove six places.	
	ai. Housing (51) assembled	1. Tap housing with hammer to loosen. 2. Pull complete assembly from case (52).	
	aj. Screw (53), shaft washer with pin (54)	Remove.	Screw has a right hand thread.
	ak. Impeller (55)	1. Hold impeller with bar between vanes.	
		2. Place a large Crescent wrench on shaft, pulling against key.	A pipe wrench can be used if care is used not to cut shaft.
		3. Unscrew impeller.	Impeller shaft has a right hand thread.

5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - DISASSEMBLY (Cont)			
	al. Flathead screws (56)	Remove.	
	am. Volute lipplate (57)	Remove.	
	an. O-ring (58), and shaft sleeve (59)	Slide off shaft.	
	ao. Screws (60)	1. Remove. 2. Insert two screws in tapped holes of seal plate (61).	

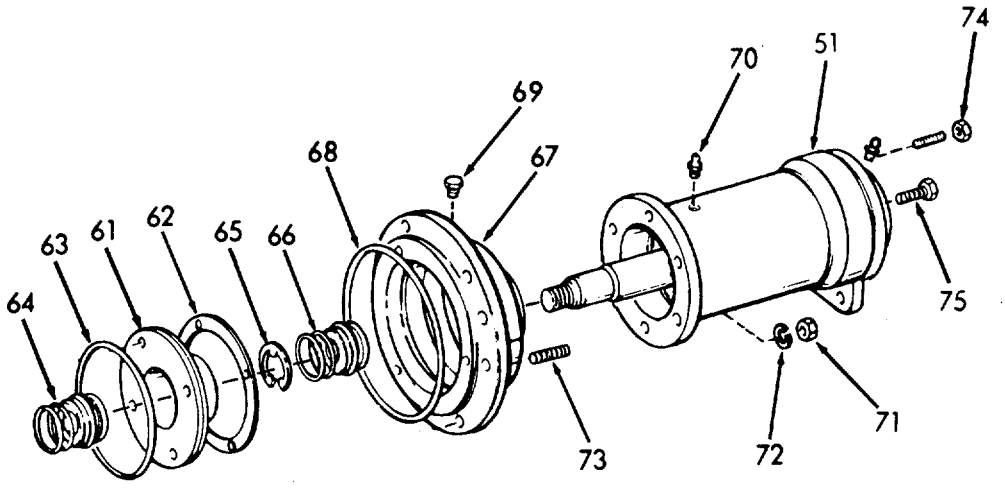


5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - DISASSEMBLY (Cont)			
	ap. Seal plate (61)	1. Use pry bar under head of screws. 2. Remove.	
	aq. Gasket (62)	Remove.	
	ar. O-ring (63)	Remove.	
	as. Carbon and ceramic face (64)	Pull out of seal plate.	Use wire hooks if necessary.
	NOTE Ceramic face can be readily removed by tapping with screwdriver to break ceramic ring. Ring should be broken only if worn or needs to be replaced.		
	at. Snap ring (65)	Remove.	
	au. Carbon and ceramic face (66)	Pull out of seal housing (67).	Use wire hooks if necessary.
	av. O-ring (68)	Remove.	
	aw. Relief-fitting (69), and grease-fitting (70)	Remove.	If necessary.

5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - DISASSEMBLY (Cont)			
	ax. Nuts (71), and lock-washers (72)	Remove.	
	ay. Seal housing (67)	Separate from bearing housing (51).	
	az. Studs (73)	Remove.	If necessary.
	ba. Nuts (74), and screws and jam nuts (75)	Remove.	
	bb. Shaft, end cap, and bearing assembly	Remove from housing (51).	It may be necessary to bump on end of shaft with plastic or rubber hammer to loosen bearings from housing.

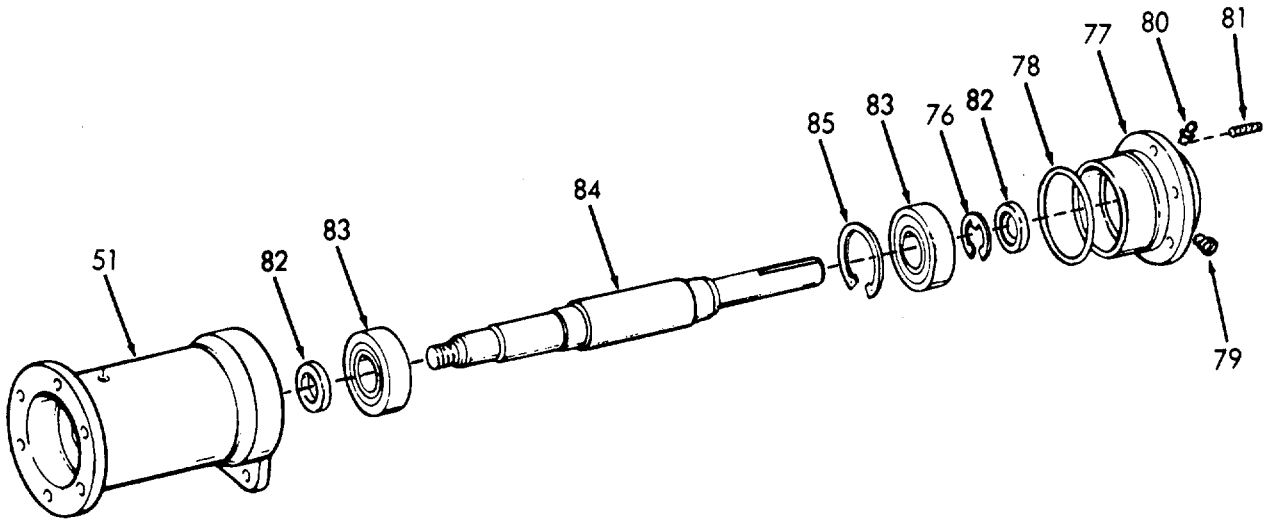


5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - DISASSEMBLY (Cont)			
	bc. Snap ring (76)	Remove.	
	bd. Shaft, and bearing assembly	Push out of end cap (77).	
	be. O-ring (78)	Remove.	
	bf. Relief-fitting (79), and grease-fitting (80)	Remove.	If necessary.
	bg. Studs (81)	Remove.	If necessary.
	bh. Seals (82)	Remove.	
		CAUTION	
	Always support or press on inner race of bearing. Never press on outer race as this can damage bearing.		
	bi. Bearings (83)	Press from shaft (84).	Use arbor press.
	bj. Snap ring (85)	Remove.	
REPAIR - REASSEMBLY			
2.	a. Housing (51), and bearing retaining cap (77)	Clean all old grease from parts.	

5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - REASSEMBLY (Cont)			
	b. Snap ring (85)	Install.	
	c. Bearings (83)	1. Pack level with grease. 2. Press onto shaft (84).	
	d. Snap ring (76)	Install.	
	e. Seals (82)	Install on shaft (84).	
	f. O-ring (76)	Install.	
	g. Bearing retainer cap (77)	Install on shaft (84).	

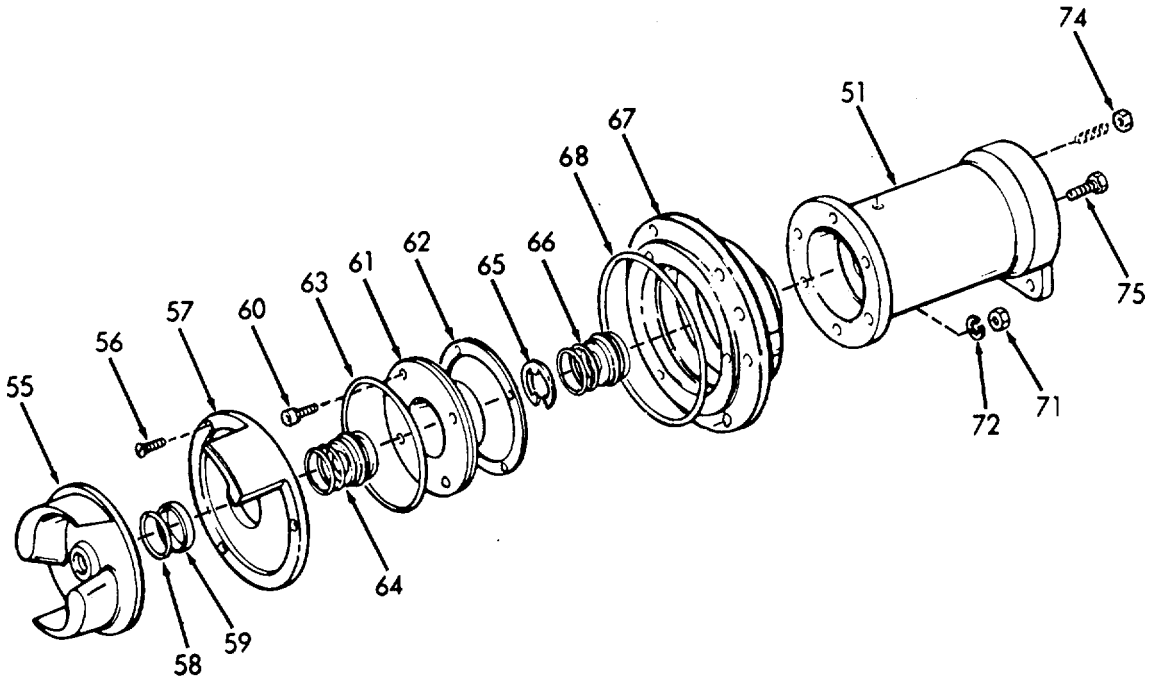


5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - REASSEMBLY (Cont)			
	h. Shaft, end cap, and bearing assembly	1. Install in housing (51).	
		2. Install nuts (74).	
		3. Install screws and jam nuts (75).	Do not tighten.
	i. Seal housing (67)	1. Wipe clean.	
		2. Install on housing (51).	
		3. Install nuts (71), and lockwashers (72).	
	j. Carbon and ceramic face (66)	1. Grease rubber cap.	
		2. Push on shaft using fingers only.	
	k. Snap ring (65)	Install on shaft.	
	l. Seal plate (61)	1. Insert carbon and ceramic face (64).	a. Grease rubber cap.
			b. Push in plate using fingers only.
		2. Install O-ring (63).	Use grease.
		3. Push on seal housing (67).	Use a new gasket (68).
		4. Cover screws (60) threads with Permatex.	
		5. Install screws (60).	

5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - REASSEMBLY (Cont)			
	m. Shaft sleeve (59), and O-ring (58)	Install.	
	n. Volute lip plate (57)	1. Install. 2. Cover screws (56) threads with Permatex. 3. Install screws (56).	
	o. Impeller (55)	Install.	Impeller has right hand threads.

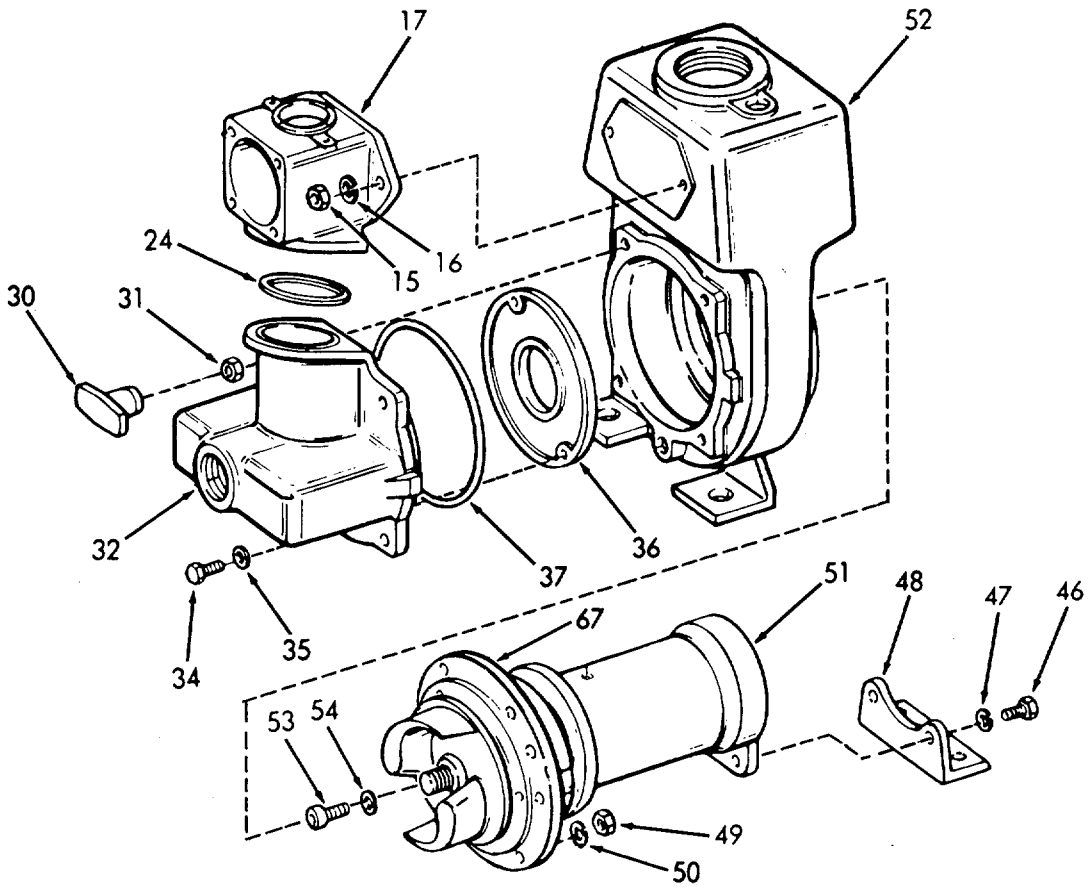


5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - REASSEMBLY (Cont)			
	p. Shaft washer with pin (54), and screw (53)	Install.	Screw has right hand threads.
	q. Impeller and shaft assembly, and seal housing (67)	1. Cover seal housing (67) face with Never Sieze. 2. Attach to case (52) using lockwashers (50) and nuts (49).	
	r. Foot mounted support (48)	Attach to bearing housing (51) using screws (46), and lockwashers (47).	
	s. Seal housing	1. Remove relief fitting. (67) 2. Refill with oil. 3. Replace relief fitting.	Use oil OE/HDO-10.
	t. Wear plate (36), stat-O-seals (35), and screws (34)	Install.	
	u. Inlet elbow (32), and O-ring (37)	Install.	

5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - REASSEMBLY (Cont)			
	v. Handle (30), and locknut (31)	Install and tighten.	
	w. O-ring (24), flap valve housing (17), lock-washers (16), and nuts (15)	Install.	

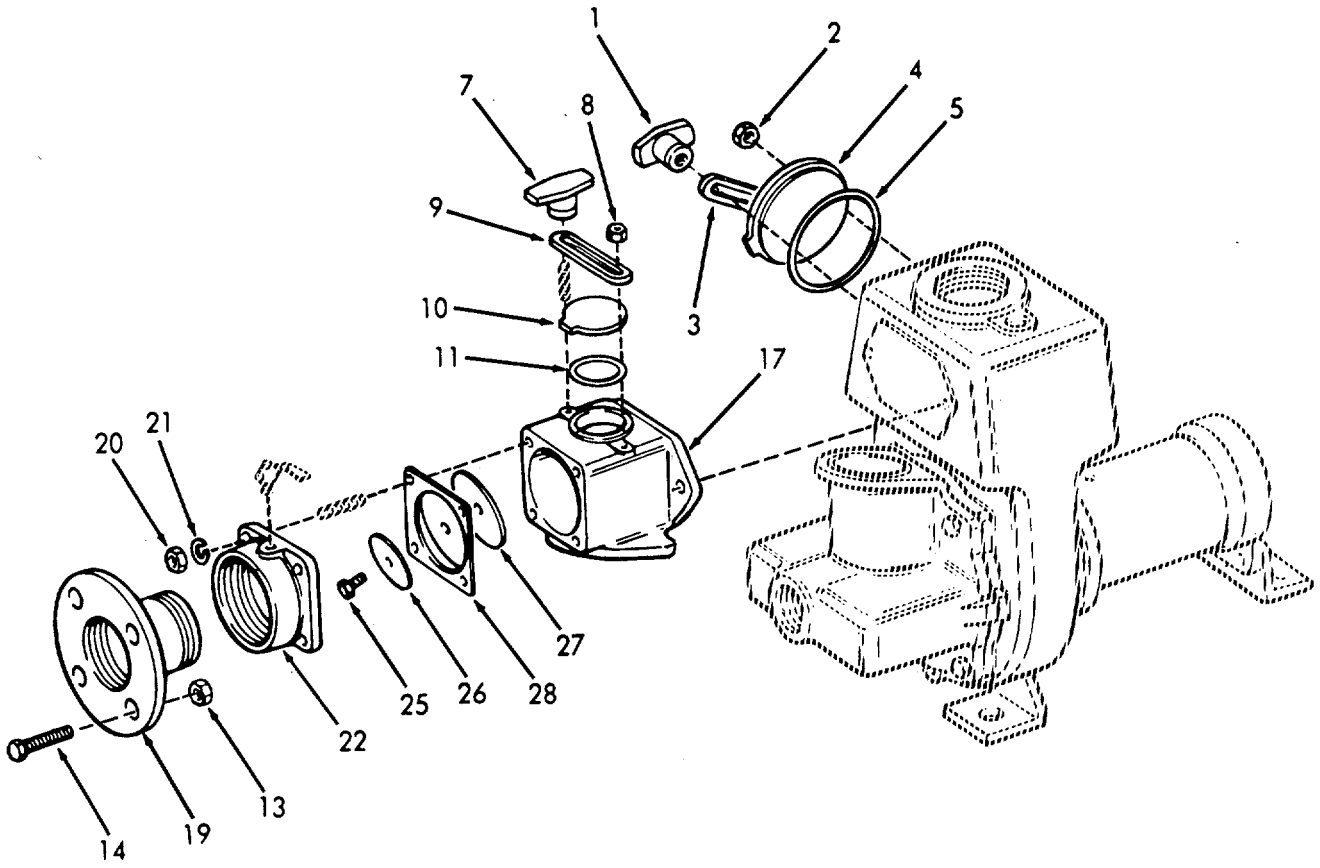


5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - REASSEMBLY (Cont)			
	x. Flap valve (28), weight (27), washer (26), and screw (25)	Reassemble.	
	y. Suction flange (22), flap valve assembly, lock-washers (21), and nuts (20)	Assemble.	
	z. Flange (19)	Install.	
	aa. Screws (14), and nuts (13)	Install.	
	ab. Priming cover (10), and O-ring (11)	Replace.	
	ac. Arm (9), and nut (8)	Install.	
	ad. Handle (7)	Install and tighten.	

5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - REASSEMBLY (Cont)			
	ae. Inspection cover (4), and O-ring (5)	Replace.	
	af. Arm (3), and nut (2)	Install.	
	ag. Handle (1)	Install and tighten.	



5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENT			
3.	Impeller Clearance		

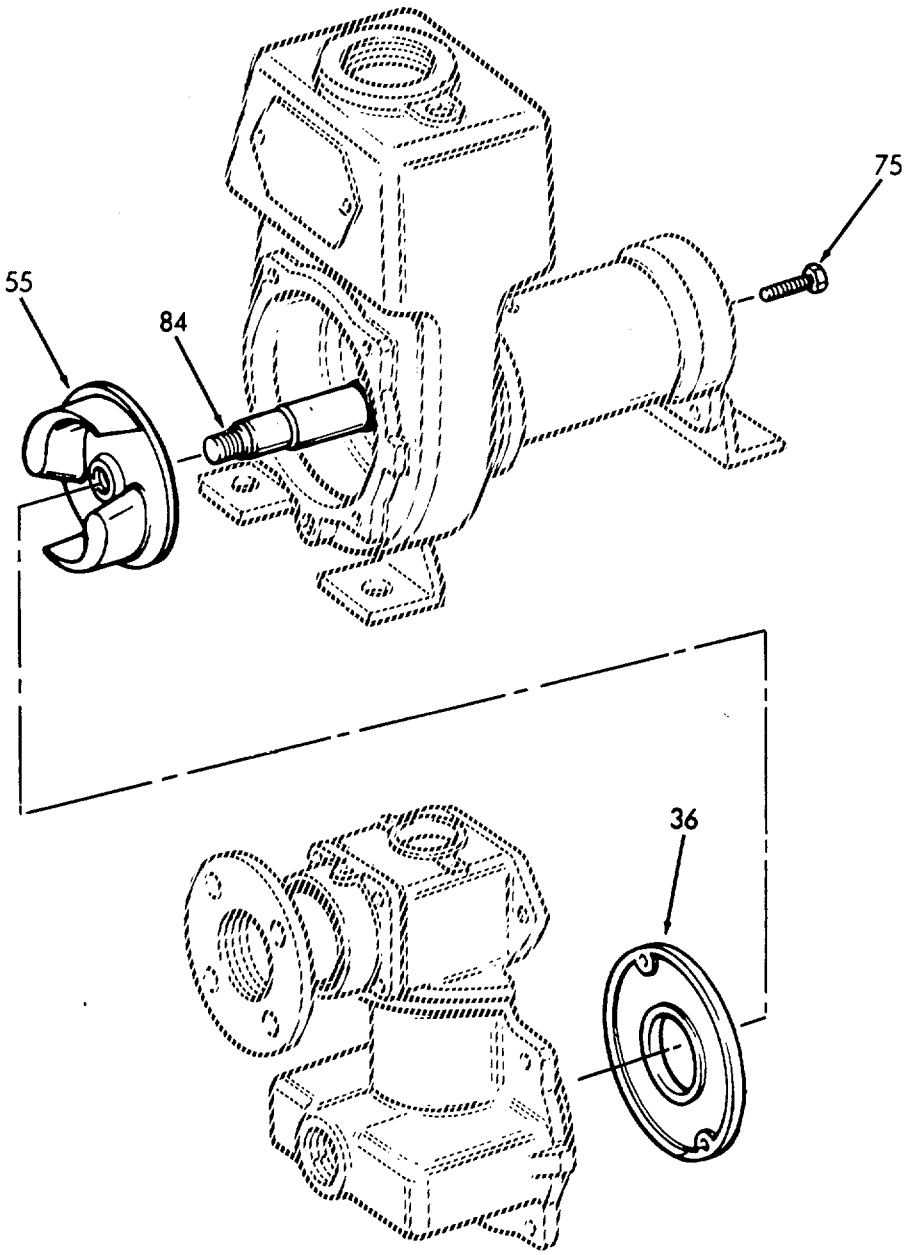
NOTE

The impeller face must be within .015 inch (.038 cm) of suction wear plate for most efficient operation.

	a. Screws and screws with jam nuts (75)	1. Loosen jam nuts. 2. Tighten screws evenly until the impeller (55) just drags on the suction wear plate (36) when the shaft (84) is turned by hand. 3. Back off the screws and place a .015 inch (.038 cm) shim under the head of the screws. 4. Turn screws up against shims. 5. Tighten screws with jam nuts pushing the housing up against the adjustment screws. 6. Retighten jam nuts.	

5-132. SEWAGE DISCHARGE PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENT (Cont)			



5-133. FLUSH WATER PUMP MOTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

NONE

Personnel Required

1

References
Paragraph

4-20.3 Flush Water Pump Motor

Equipment
Condition Condition Description

NONE

Special Environmental Conditions

NONE

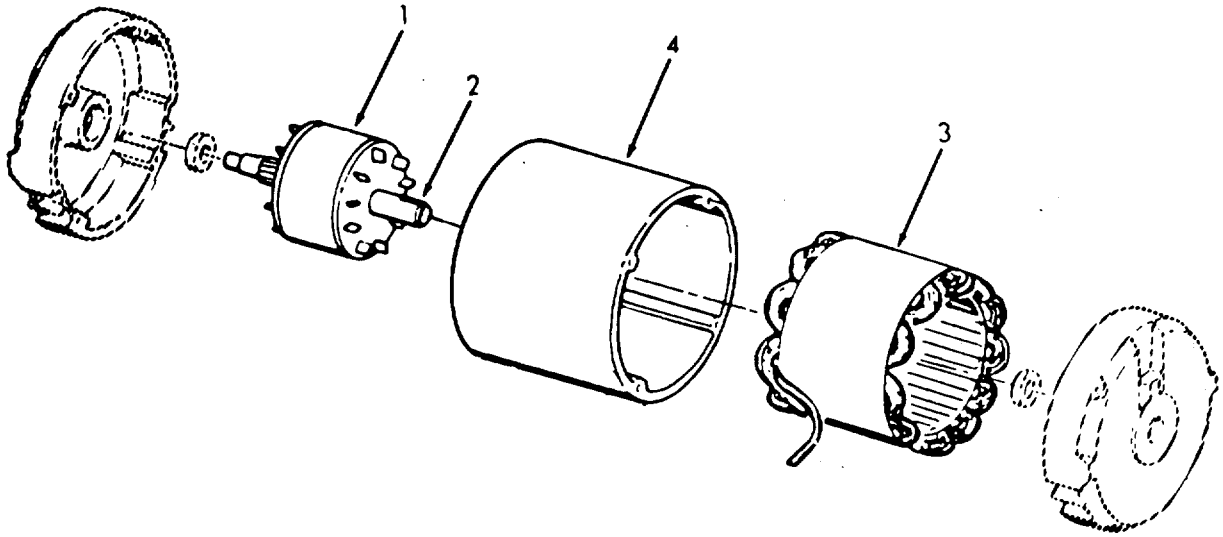
General Safety Instructions

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.	

5-133. FLUSH WATER PUMP MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



5-134. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS.

This task covers:

Replace

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

NONE

Personnel Required

2

References
Paragraph

NONE

Equipment
Condition Condition Description

NONE

Special Environmental Conditions

NONE

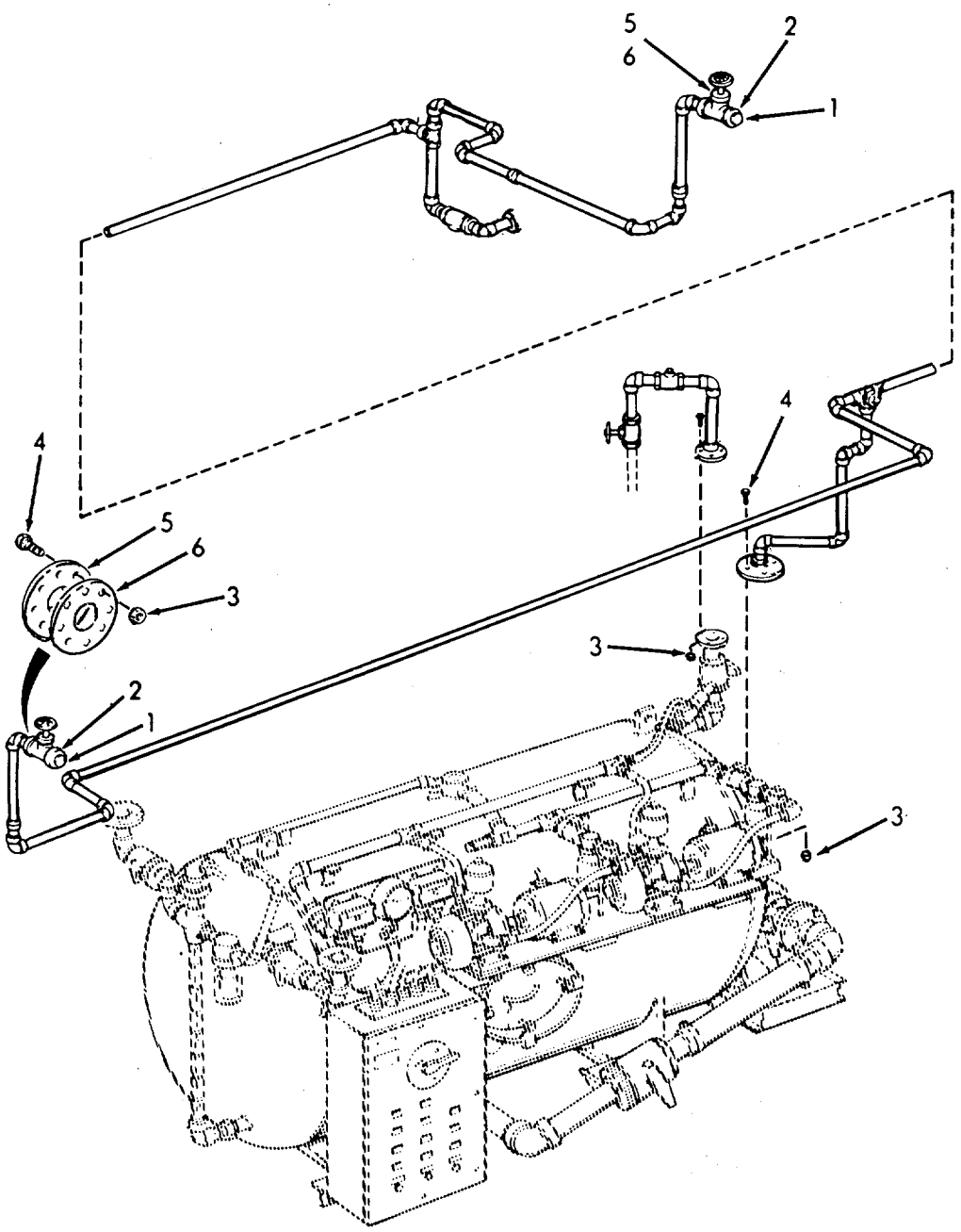
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
REPLACE			
1. Discharge Piping	a. Connector cap (1)	Repair or replace.	
	b. Cam connector (2)	Repair or replace.	
	c. Plain hex nut (3)	Repair or replace.	
	d. Hex head capscrew (4)	Repair or replace.	
	e. Flange (5)	Repair or replace.	
	f. Ring gasket (6)	Repair or replace.	

5-134. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			

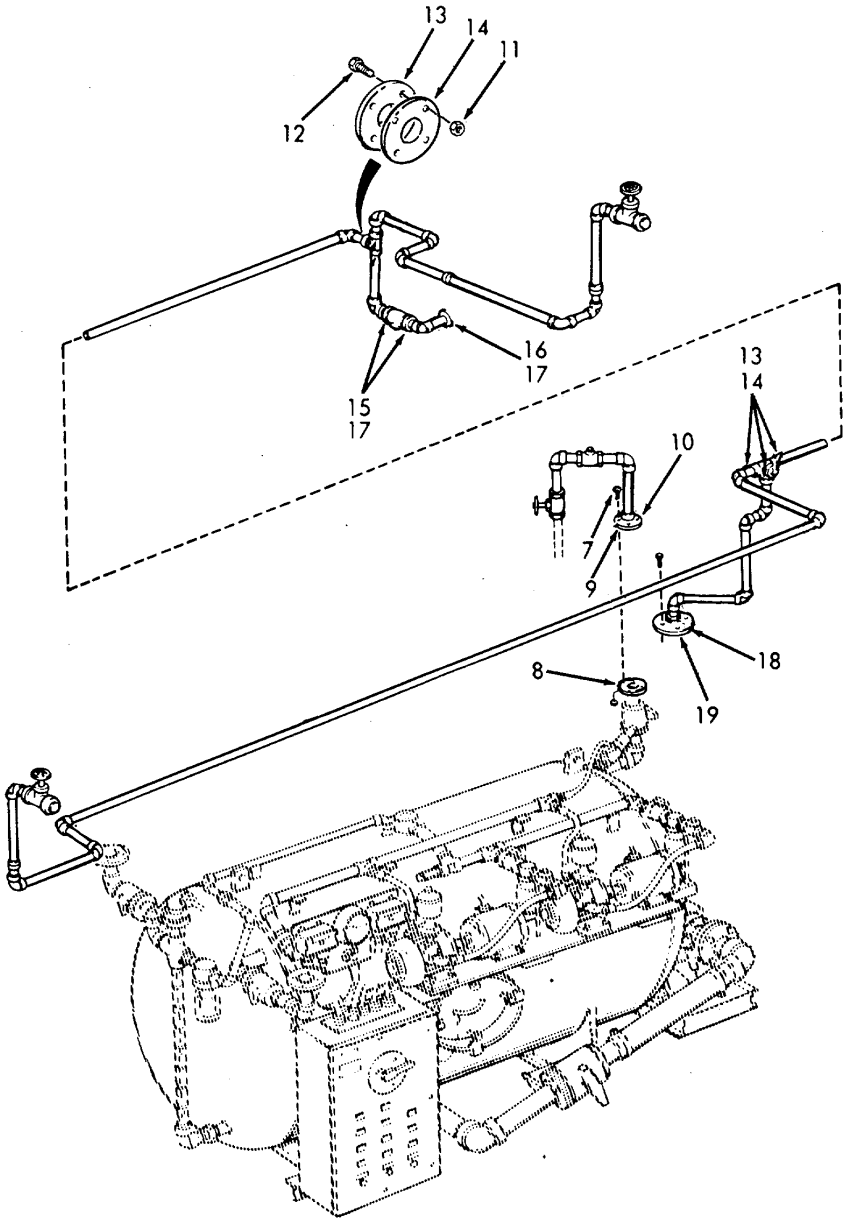


5-134. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	g. Hex head capscrew (7)	Repair or replace.	
	h. Orifice plate (8)	Repair or replace.	
	i. Flange (9)	Repair or replace.	
	j. Gasket (10)	Repair or replace.	
	k. Plain hex nut (11)	Repair or replace.	
	l. Hex head capscrew (12)	Repair or replace.	
	m. Flange (13)	Repair or replace.	
	n. Gasket (14)	Repair or replace.	
	o. Flange (15)	Repair or replace.	
	p. Flange (16)	Repair or replace.	
	q. Gasket (17)	Repair or replace.	
	r. Flange (18)	Repair or replace.	
	s. Ring gasket (19)	Repair or replace.	

5-134. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			

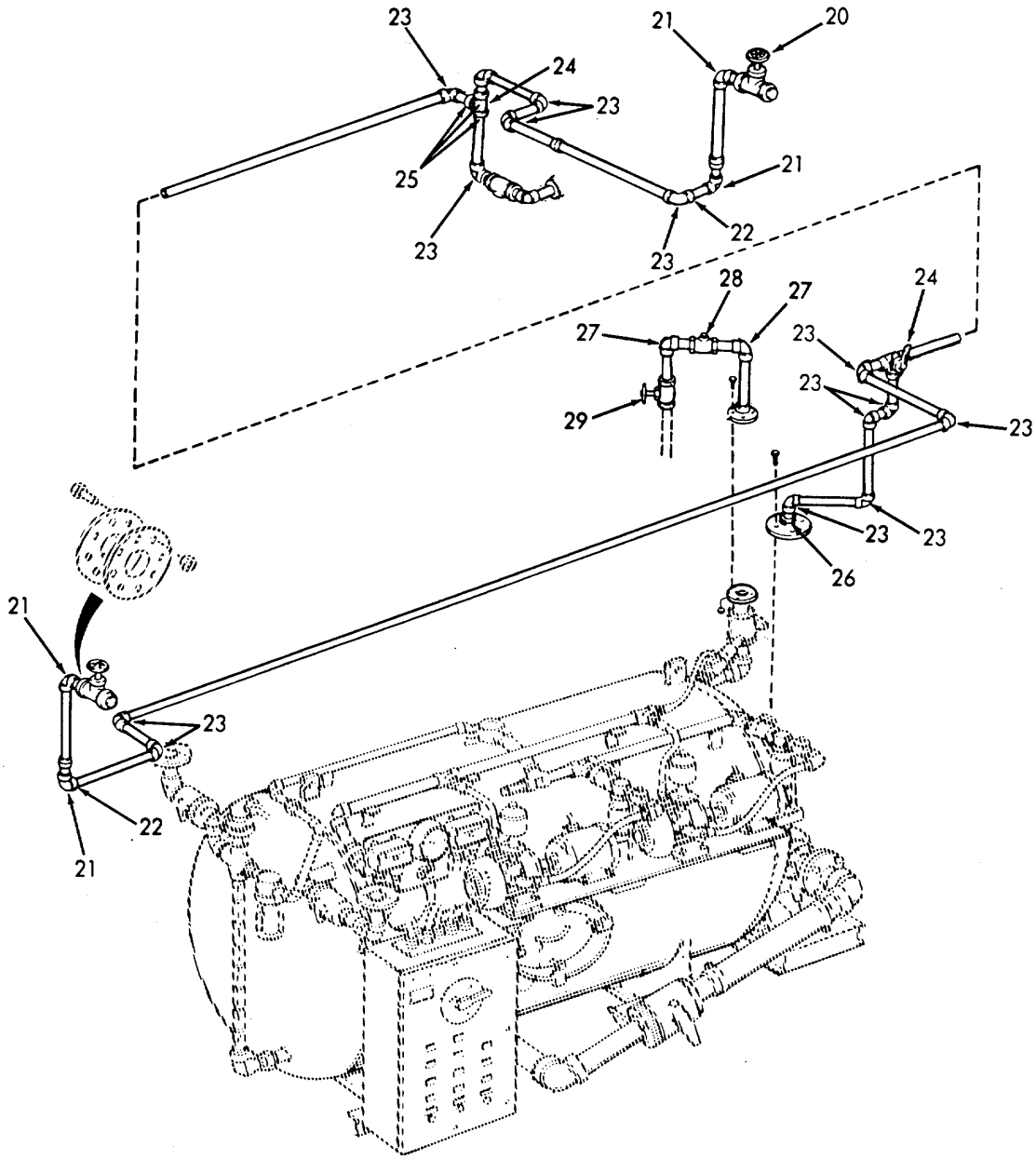


5-134. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	t. Ball valve (20)	Repair or replace.	
	u. Elbow (21)	Repair or replace.	
	v. Reducer bushing (22)	Repair or replace.	
	w. Elbow (23)	Repair or replace.	
	x. 3-way 2-port plug w/handle valve (24)	Repair or replace.	
	y. Bushing (25)	Repair or replace.	
	z. Reducer bushing (26)	Repair or replace.	
	aa. Elbow (27)	Repair or replace.	
	ab. Spring loaded check valve (28)	Repair or replace.	
	ac. Globe valve (29)	Repair or replace.	

5-134. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			

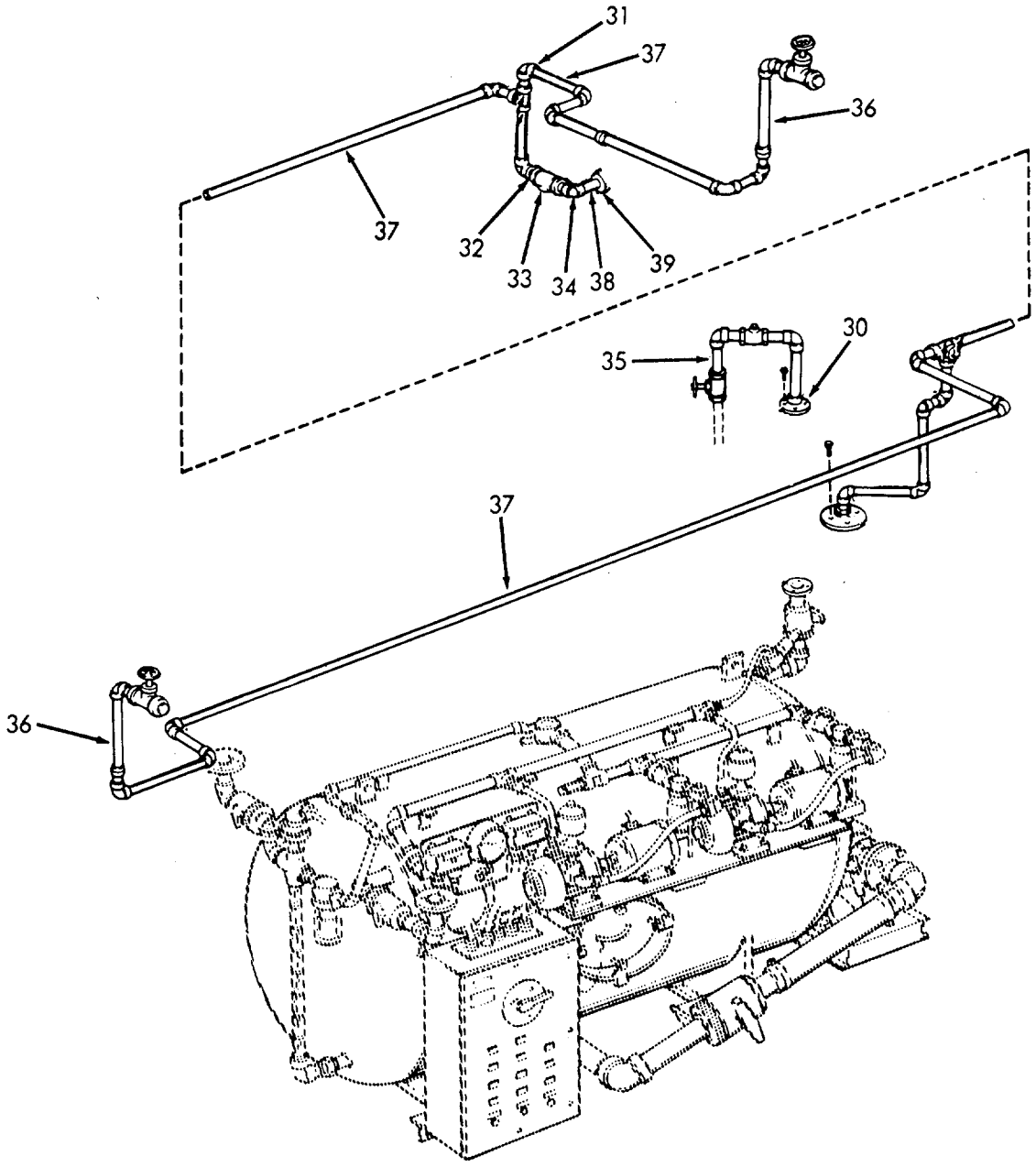


5-134. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	ad. Reducer bushing (30)	Repair or replace.	
	ae. Elbow (31)	Repair or replace.	
	af. Reducer bushing (32)	Repair or replace.	
	ag. Valve (33)	Repair or replace.	
	ah. Elbow (34)	Repair or replace.	
	ai. Pipe (35)	Repair or replace.	
	aj. Pipe (36)	Repair or replace.	
	ak. Copper tubing (37)	Repair or replace.	
	al. Pipe (38)	Repair or replace.	
	am. Pipe (39)	Repair or replace.	

5-134. SEWAGE SYSTEM DISCHARGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			



5-135. SEWAGE SANITARY DRAIN PIPING - MAINTENANCE INSTRUCTIONS

This task covers:

Replace

INITIAL SETUP

Test Equipment
NONE

Special Tools
NONE

Material/Parts
NONE

Personnel Required
2

References
NONE

Equipment
Condition — Condition Description
NONE

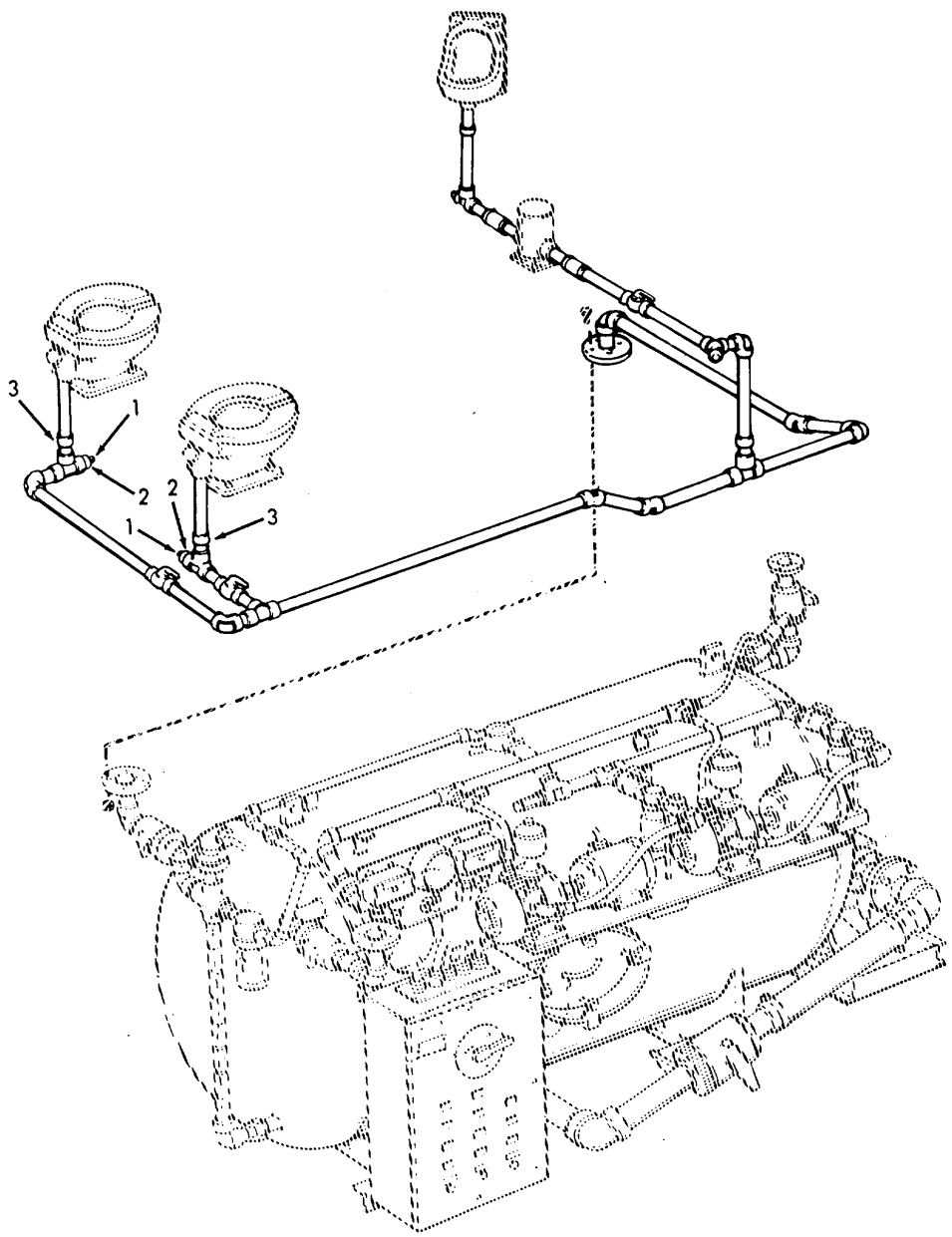
Special Environmental Conditions
NONE

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
REPLACE			
1. Sanitary Drain Piping	a. Hex head pipe plug (1)	Replace.	
	b. 2" male slip x 2" female bushing (2)	Replace.	
	c. 2" male slip x 1-1/2" female bushing (3)	Replace.	

5-135. SEWAGE SANITARY DRAIN PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			

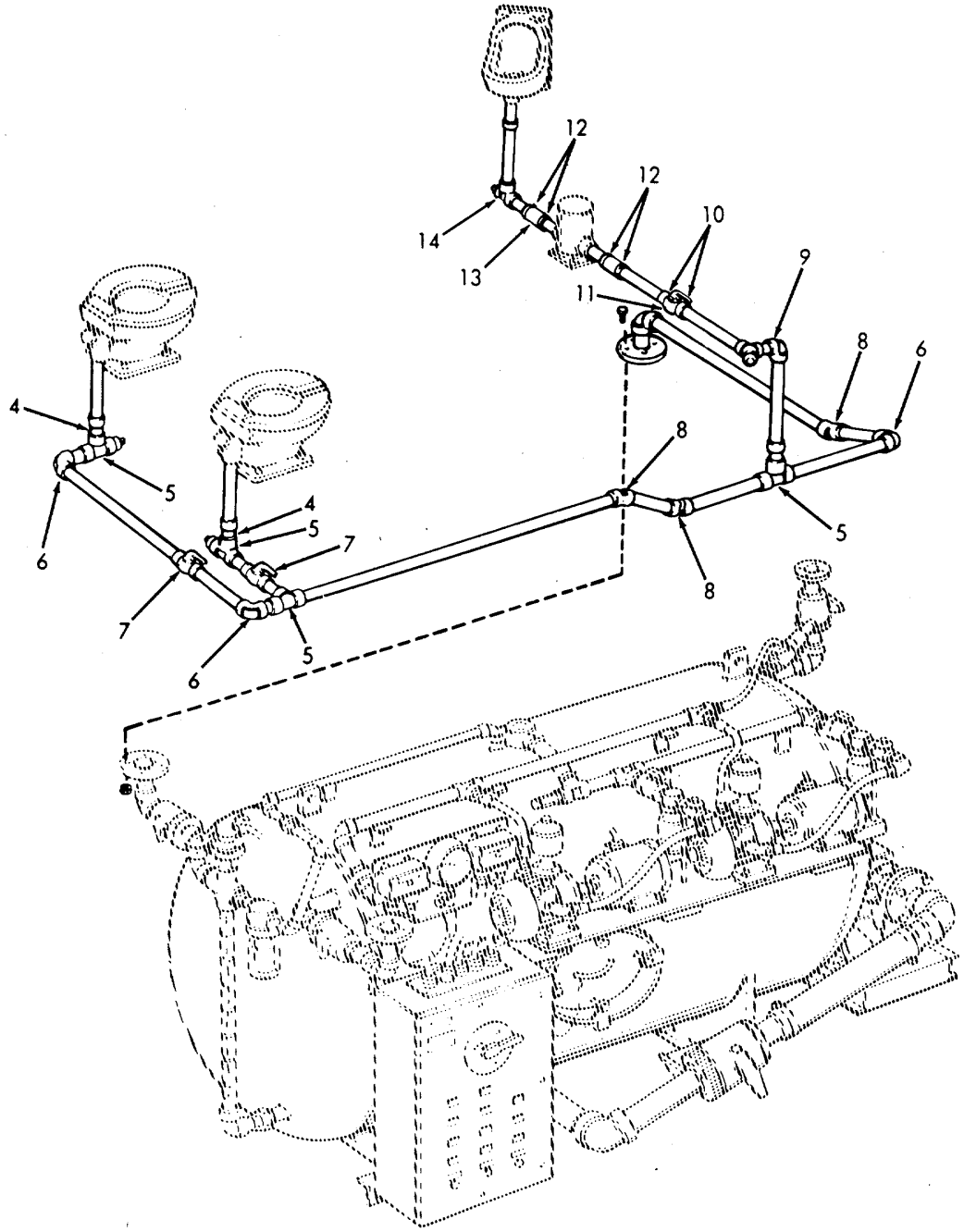


5-135. SEWAGE SANITARY DRAIN PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	d. 1-1/2 MPT x 1-1/2 bronze adaptor (4)	Replace.	
	e. 2 inch tee (5)	Replace.	
	f. 90° elbow (6)	Replace.	
	g. Port full ball valve (7)	Replace.	
	h. 45° elbow (8)	Replace.	
	i. 90° elbow (9)	Replace.	
	j. Adapter (10)	Replace.	
	k. Port full ball valve (11)	Replace.	
	l. Hose clamp (12)	Replace.	
	m. 1-7/8 inch hose (13)	Replace.	
	n. 1-1/2 inch tee (14)	Replace.	

5-135. SEWAGE SANITARY DRAIN PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			



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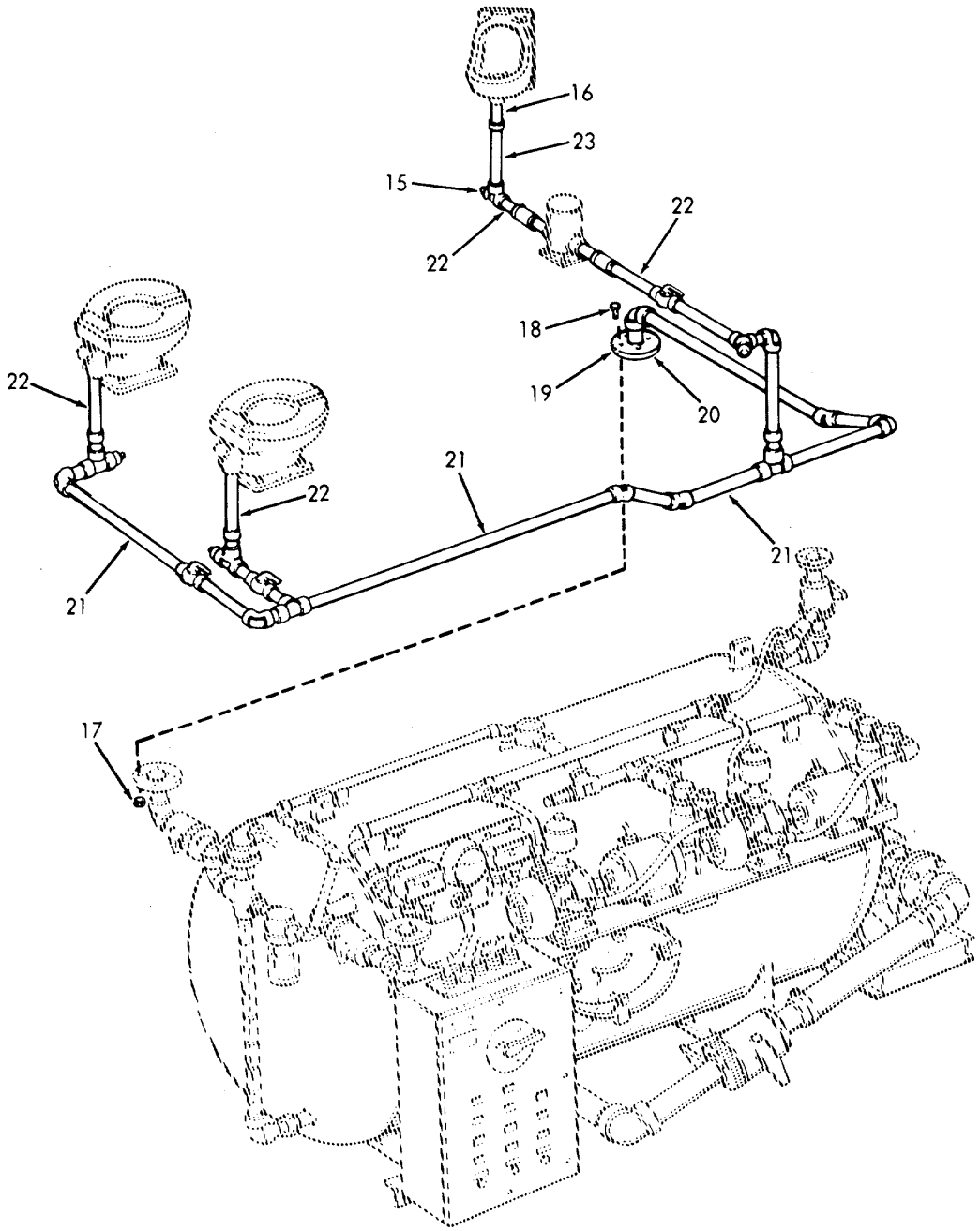
5-135. SEWAGE SANITARY DRAIN PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	o. 1-1/2 inch hex head pipe plug (15)	Replace.	
	p. 1-1/2 inch stuffing box nut (16)	Replace.	
	q. Plain hex nut (17)	Replace.	
	r. Hex head cap screw (18)	Replace.	
	s. Flat face flange (19)	Replace.	
	t. 2 inch type rubber ring gasket (20)	Replace.	
	u. PVC pipe (21)	Replace.	
	v. Copper nickel pipe (22)	Replace.	
	w. Copper pipe (23)	Replace.	

5-135. SEWAGE SANITARY DRAIN PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			



5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS

This task covers:

Replace

INITIAL SETUP

Test Equipment
NONE

Special Tools
NONE

Material/Parts
NONE

Personnel Required
2

References
NONE

Equipment Condition: Condition Description
NONE

Special Environmental Conditions
NONE

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
REPLACE			
1. Sewage Tank Piping (1)	a. Weld-steel flange	Replace.	
	b. Steel pipe (2)	Replace.	
	c. Ball valve (3)	Replace.	
	d. Hose assembly (4)	Replace.	
	e. Steel reducer bushing (5)	Replace.	

5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	f. Pipe thread reducer (6)	Replace.	
	g. 50 PSI full nozzle relief valve (7)	Replace.	
	h. 37° steel male connector (8)	Replace.	
	i. 90° steel elbow (9)	Replace.	
	j. Steel tee (10)	Replace.	
	k. Steel pipe (11)	Replace.	
	l. Steel pipe (12)	Replace.	
	m. 90° pipe elbow (13)	Replace.	
	n. Steel pipe (14)	Replace.	
	o. Steel union (15)	Replace.	

5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	p. Steel pipe (16)	Replace.	
	q. Reducer insert (17)	Replace.	
	r. Steel flange (18)	Replace.	
	s. Steel pipe (19)	Replace.	
	t. 90° elbow (20)	Replace.	
	u. Steel pipe (21)	Replace.	
	v. Steel tee (22)	Replace.	
	w. Steel pipe (23)	Replace.	
	x. Ball valve (24)	Replace.	
	y. Steel pipe (25)	Replace.	
	z. Right angle valve (26)	Replace.	

5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	aa. Unit seal-trode probe w/pipe adapter bladder (27)	Replace.	
	ab. Steel union (28)	Replace.	
	ac. Steel pipe (29)	Replace.	
	ad. 90° elbow (30)	Replace.	
	ae. Clear pipe (31)	Replace.	
	af. Electrodes probe assembly (32)	Replace.	
	ag. Ground wire assembly (33)	Replace.	
	ah. Pipe plug (34)	Replace.	
	aj. PVC pipe (35)	Replace.	
	ak. Hex head nut (36)	Replace.	
	al. Hex head cap screw (37)	Replace.	

5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	am. Steel weldment adapter (38)	Replace.	
	an. Steel weldment adapter (39)	Replace.	
	ao. Rubber plug (40)	Replace.	
	ap. Threaded fitting adapter (41)	Replace.	
	aq. Cross (42)	Replace.	
	ar. Reducer bushing (43)	Replace.	
	as. Straight run reducing tee (44)	Replace.	
	at. Short nipple (45)	Replace.	
	au. Steel pipe (46)	Replace.	
	av. 90° elbow (47)	Replace.	
	aw. Steel pipe (48)	Replace.	

5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	ax. Steel union (49)	Replace.	
	ay. Pipe plug (50)	Replace.	
	az. Brass hose clamp (51)	Replace.	
	ba. Vacuum hose (52)	Replace.	
	bb. Steel pipe (53)	Replace.	
	bc. Vacuum relief valve (54)	Replace.	
	bd. Steel pipe nipple (55)	Replace.	
	be. Steel pipe (56)	Replace.	
	bf. Pipe nipple (57)	Replace.	
	bg. Ball valve (58)	Replace.	
	bh. Steel pipe nipple (59)	Replace.	

5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

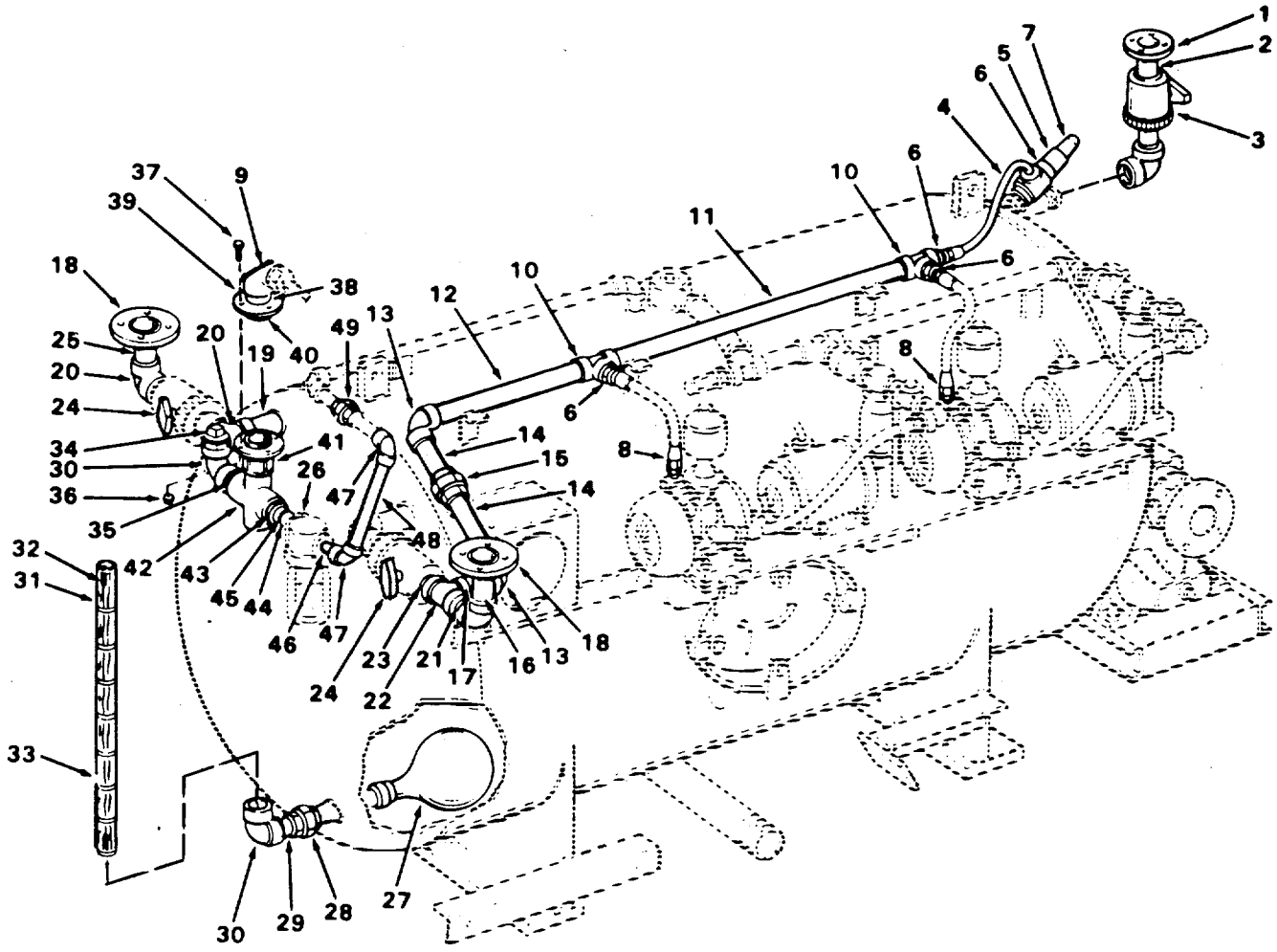
LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	bi. Pipe hanger (60)	Replace.	
	bj. Rubber liner (61)	Replace.	
	bk. Steel pipe (62)	Replace.	
	bl. 900 elbow (63)	Replace.	
	bm. 900 male elbow (64)	Replace.	
	bn. Cable ferrule (65)	Replace.	
	bo. Nylon covered cable (66)	Replace.	
	bp. 4 bolt clamp w/neoprene seal manway assembly (67)	Replace.	
	bq. Hex head nut (68)	Replace.	
	br. Hex head capscrew (69)	Replace.	
	bs. Flange gasket (70)	Replace.	

5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
	bt. Steel flange (71)	Replace.	
	bu. Steel. pipe (72)	Replace.	
	bv. 90° elbow (73)	Replace.	
	bw. Brass clamp hose (74)	Replace.	
	bx. Vacuum hose (75)	Replace.	
	by. Aluminum tube (76)	Replace.	
	bz. Steel pipe (77)	Replace.	
	ca. Ball valve (78)	Replace.	
	cb. Check valve (79)	Replace.	
	cc. Hose assembly (80)	Replace.	

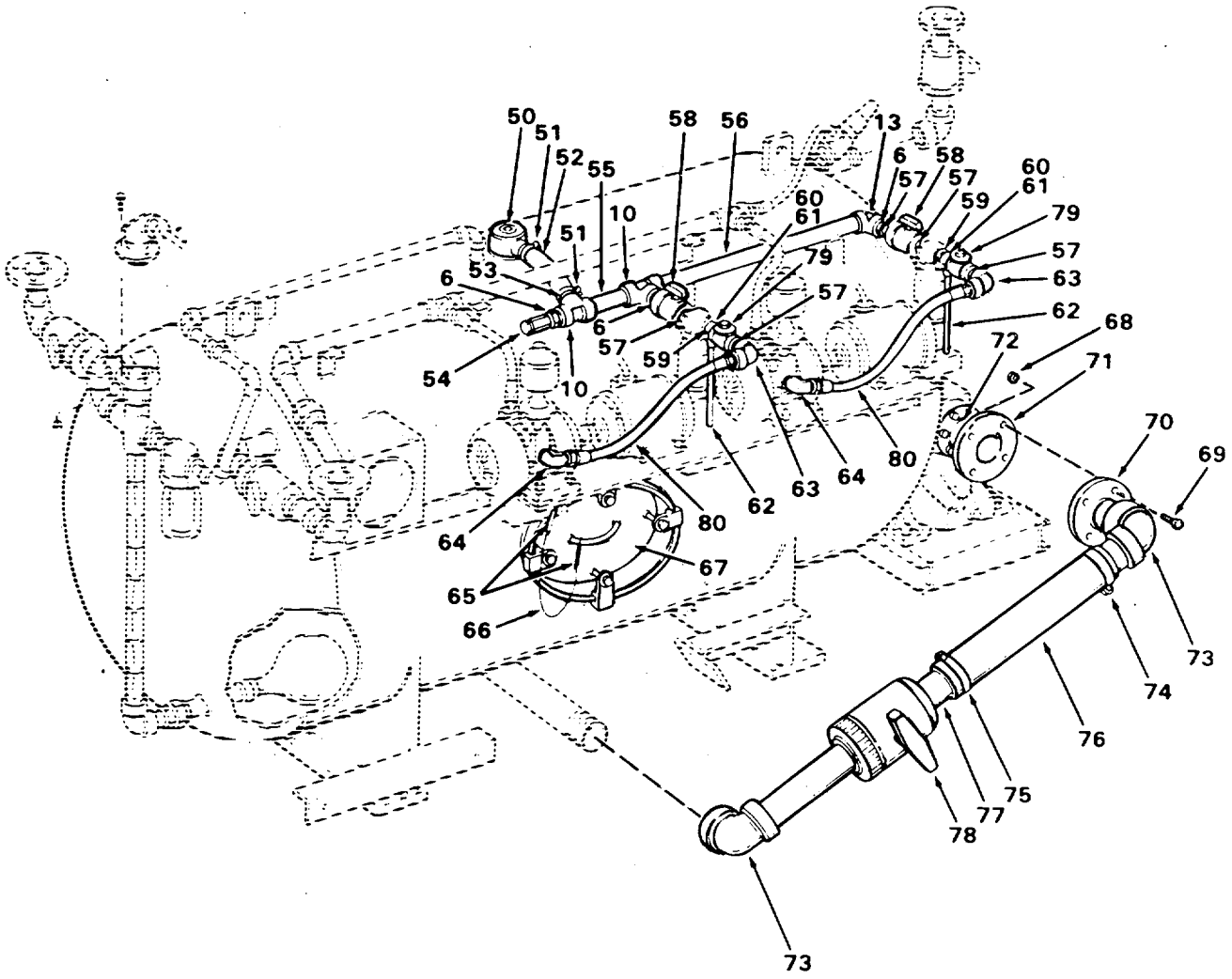
5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			



5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			

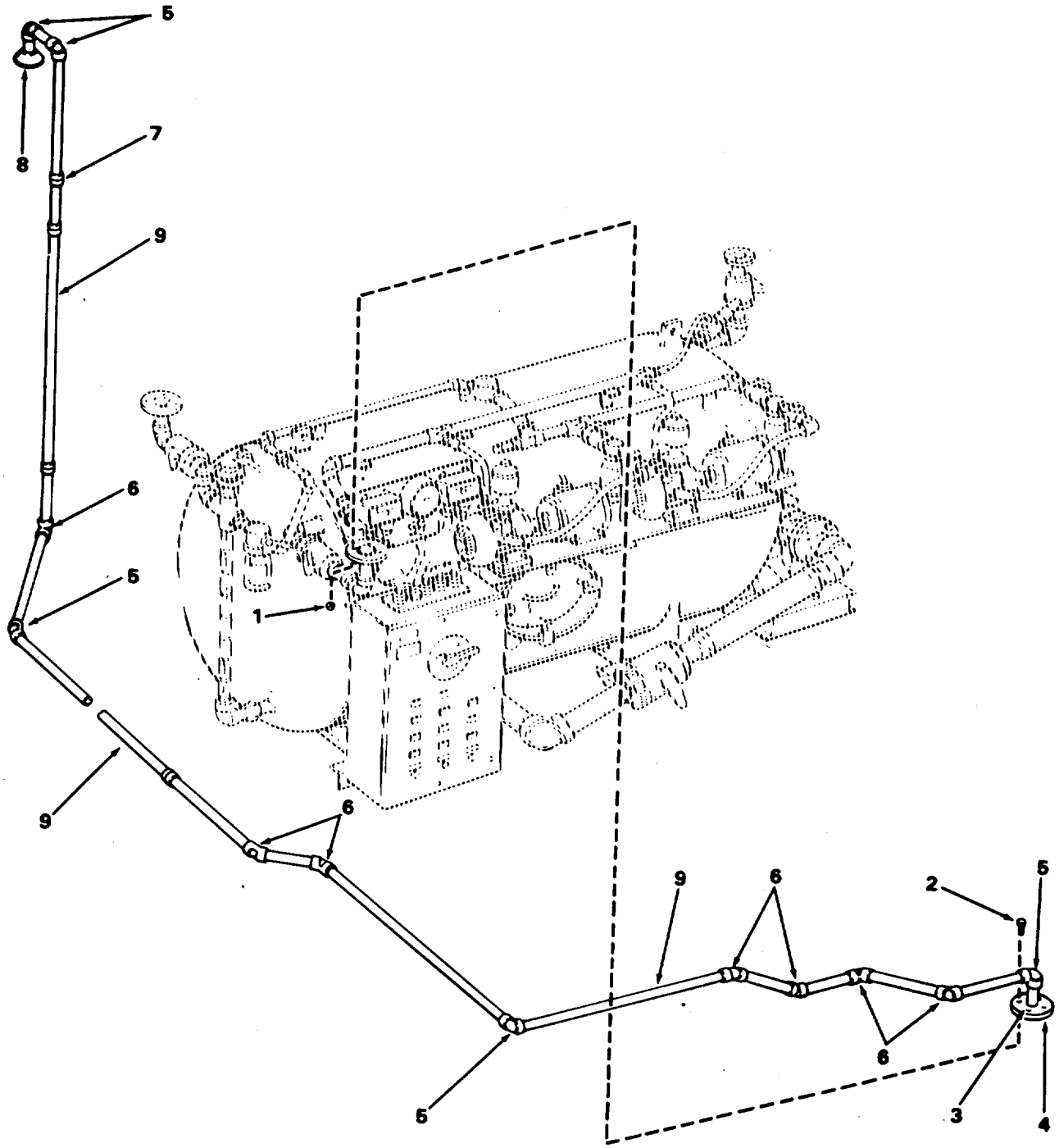


5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
2. Sewage Tank Vent Piping	a. Plain hex nut (1)	Replace.	
	b. Hex head capscrew (2)	Replace.	
	c. Flat face flange (3)	Replace.	
	d. Full face gasket (4)	Replace.	
	e. 90° elbow (5)	Replace.	
	f. 450 elbow (6)	Replace.	
	g. Bronze union (7)	Replace.	
	h. Ball check vent valve (8)	Replace.	
	i. Copper pipe (9)	Replace.	

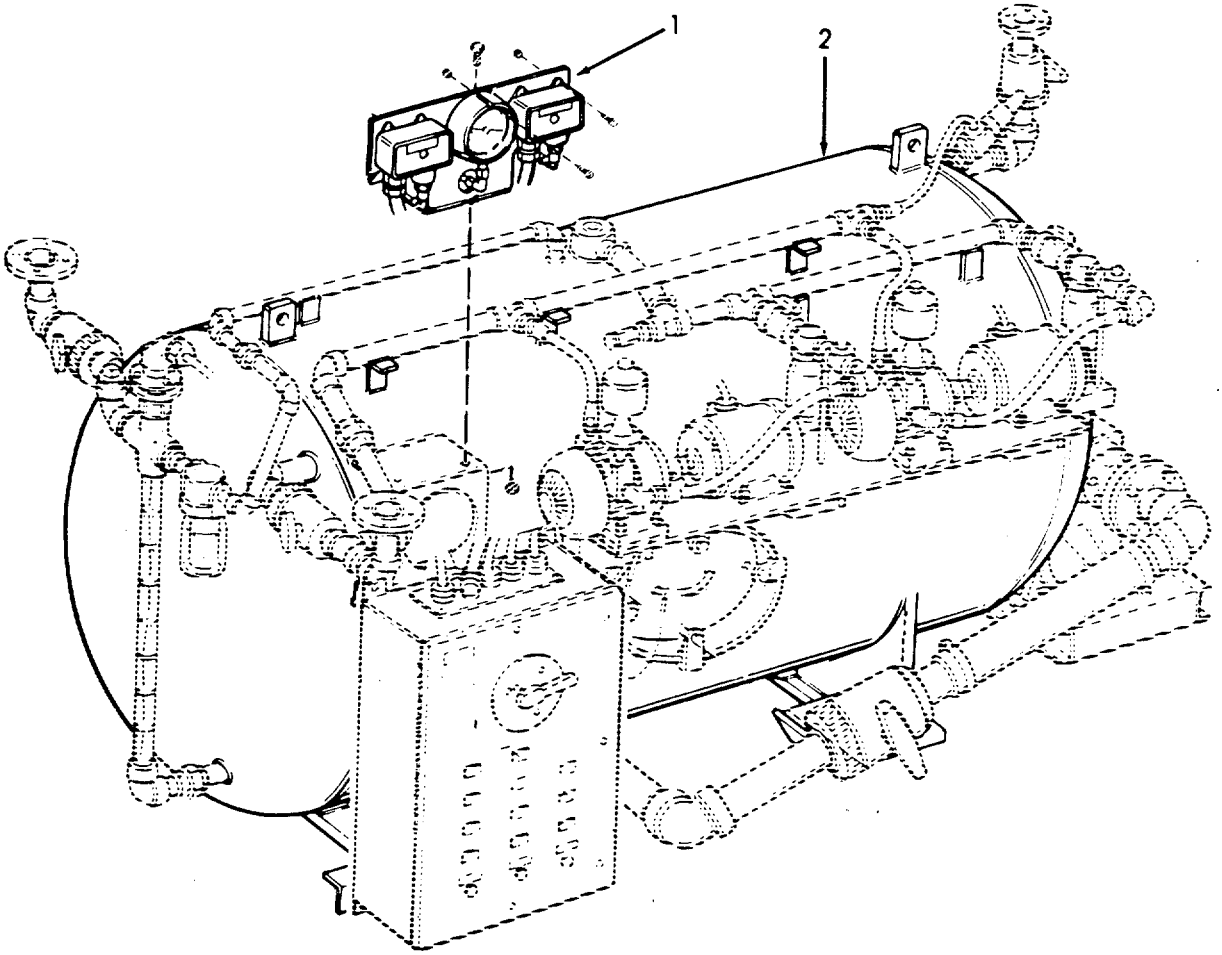
5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			



5-136. SEWAGE TANK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
3.	Tank and gages	a. Mounting plate (1)	Replace.
		b. Sewage holding tank (2)	Replace.



5-137. HEATING, VENTILATION AND AIR CONDITIONING SYSTEM.

The following is an index to the HVAC system maintenance procedures.

5-138. RECIRCULATING FAN CONTROLLER - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for Controller maintenance instructions.

5-139. 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

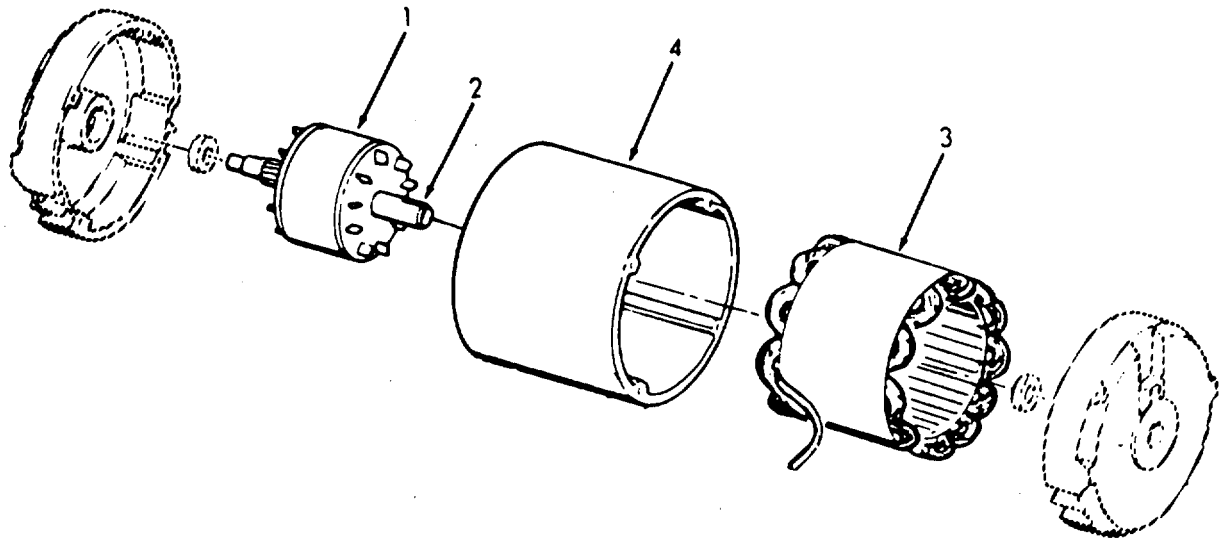
Special Environmental Conditions
NONE

Personnel Required
1

General Safety Instructions
NONE

5-139. RECIRCULATING FAN MOTOR - MAINTENANCE INSTRUCTIONS(Continued).

LOCATION	ITEM	ACTION	REMARKS
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.	



5-140. 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
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE]			
1. Ducting	a. Non-water tight access cover (1)	Repair or replace.	
	b. Pipe plug (2)	Repair or replace.	
	c. Neoprene gasket (3)	Repair or replace.	
	d. Fan flange plate (4)	Repair or replace.	
	e. 90° steel vaned turn (5)	Repair or replace.	

5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			
	f. Duct plate plate (6)	Repair or replace.	
	g. Neoprene gasket (7)	Repair or replace.	
	h. 4 inch elbow (8)	Repair or replace.	
	i 8 inch spiral duct (9)	Repair or replace.	
	j. Duct plate (10)	Repair or replace.	
	k. Duct plate (11)	Repair or replace.	
	l. Eccentric reducer (12)	Repair or replace.	
	m. Watertight ventilator valve (13)	Repair or replace.	
	n. Plate (14)	Repair or replace.	
	o. 3 inch elbow (15)	Repair or replace.	
	p. Heater flange plate (16)	Repair or replace.	
	q. Manual shutoff damper regulator set (17)	Repair or replace.	

5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			
	r. Balancing damper regulator set (18)	Repair or replace.	
	s. Diffusing terminal (19)	Repair or replace.	
	t. 4 inch elbow (20)	Repair or replace.	
	u. 4 inch spiral duct (21)	Repair or replace.	
	v. 90° galv steel 4 inch dial elbow (22)	Repair or replace.	
	w. Inside Plate (23)	Repair or replace.	
	x. Diffusing terminal (24)	Repair or replace.	
	y. Warmish watertight vent cover (25)	Repair or replace.	
	z. 8 inch return (26)	Repair or replace.	
	aa. 8 inch elbow (27)	Repair or replace.	

5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			
	ab. 11 x 8 inch reducer (28)	Repair or replace.	
	ac. Flange plate (29)	Repair or replace.	
	ad. Warmish bellmouth (30)	Repair or replace.	
	ae. Flange plate (31)	Repair or replace.	
	af. Access cover collar (32)	Repair or replace.	
	ag. Warmish exhaust terminal (33)	Repair or replace.	
	ah. 4 inch wire mesh exhaust terminal (34)	Repair or replace.	
	ai. Plain hex nut (35)	Repair or replace.	
	aj. Hex head cap screw (36)	Repair or replace.	
	ak. Plain hexagon nut (37)	Repair or replace.	
	al. Hex head cap screw (38)	Repair or replace.	

5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			
	am. Warmish louver (39)	Repair or replace.	
	an. Warmish screen (40)	Repair or replace.	
	ao. Frame (40A)	Repair or replace.	
	ap. Flathead screw (40B)	Repair or replace.	
	aq. Flathead screw (40C)	Repair or replace.	
	ar. Flat washer (40D)	Repair or replace.	
	as. Plain hex nut (40E)	Repair or replace.	
	at. Warmish 6 in. dial terminal (41)	Repair or replace.	
	au. 6 inch elbow (42)	Repair or replace.	
	av. 6 inch pipe (43)	Repair or replace.	
	aw. 4x12 inch register (44)	Repair or replace.	
	ax. Size 6 diffuser terminal (45)	Repair or replace.	
	ay. 9x9 inch return grill (46)	Repair or replace.	

5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			
	az. Warmish (47)	Repair or replace.	
	ba. Watertight vent hatch cover (47A)	Repair or replace.	
	bb. Size 5 diffuser terminal (48)	Repair or replace.	
	bc. Plain wing nut (49)	Repair or replace.	

5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

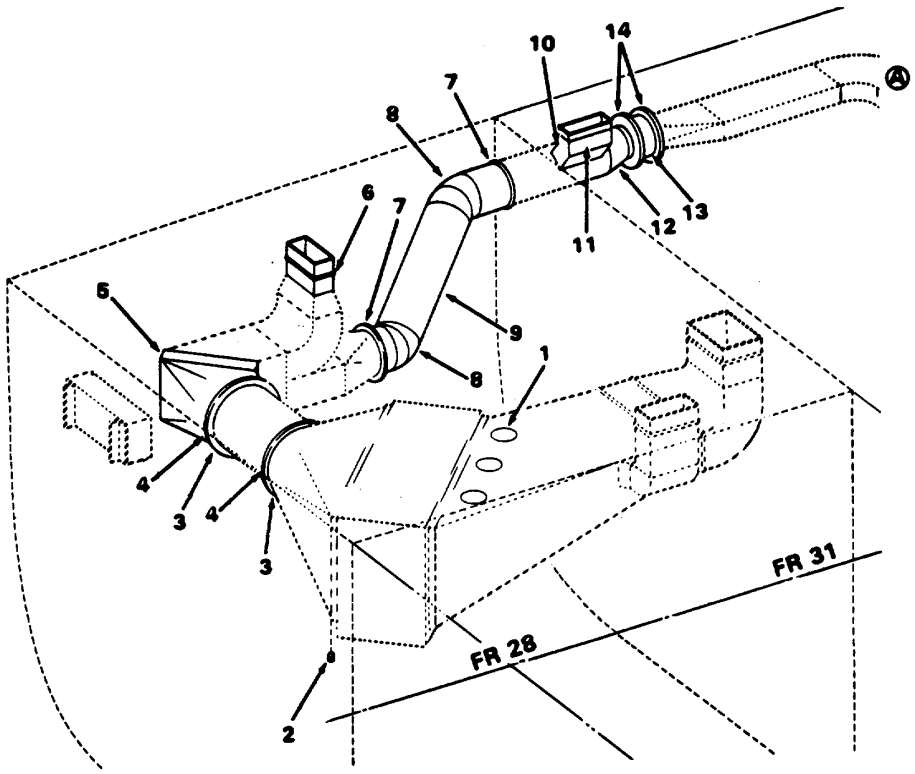
LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			
	bd. Filter to galley hood retainer (50)	Repair or replace.	
	be. Grease filter (51)	Repair or replace.	
	bf. Exhaust galley hood (52)	Repair or replace.	
	bg. Washer dryer vent (53)	Repair or replace.	
	bh. 4 inch elbow (54)	Repair or replace.	
	bi. Neoprene gasket (55)	Repair or replace.	
	bj. 6 inch elbow (56)	Repair or replace.	
	bk. Steel access cover (57)	Repair or replace.	
	bl. Flange plate (58)	Repair or replace.	
	bm. 3 inch elbow (59)	Repair or replace.	

5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			
	bn. 3 inch spiral duct (60)	Repair or replace.	
	bo. Hex head cap screw **(61)**	Repair or replace.	
	bp. 180" NPT return (62)	Repair or replace.	
	bq. 2 inch pipe (63)	Repair or replace.	
	br. 2 inch elbow (64)	Repair or replace.	
	bs. 2 inch flame arrestor water-tight closure (65)	Repair or replace.	
	bt. Flange plate (66)	Repair or replace.	
	bu. Reducer (67)	Repair or replace.	
	bv. 6 inch return (68)	Repair or replace.	
	bw. 6 inch wire mesh watertight cover (69)	Repair or replace.	

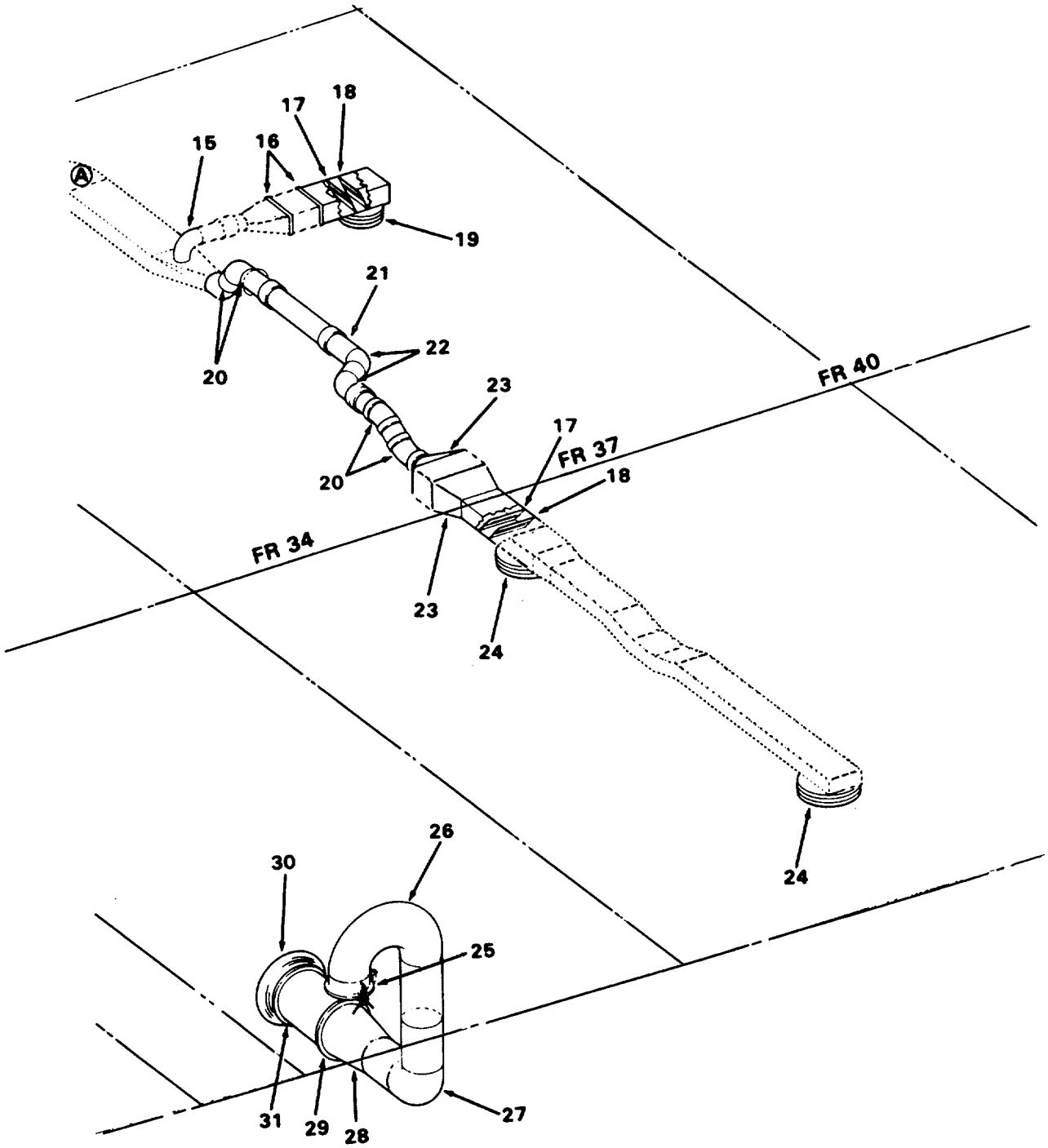
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			
	bx. 5 inch wire mesh watertight cover (70)	Repair or replace.	
	by. 5 inch return (71)	Repair or replace.	
	bz 5 inch spiral duct (72)	Repair or replace.	
	ca. 5 inch elbow (73)	Repair or replace.	
	cb. 10 x 5 inch reducer (74)	Repair or replace.	



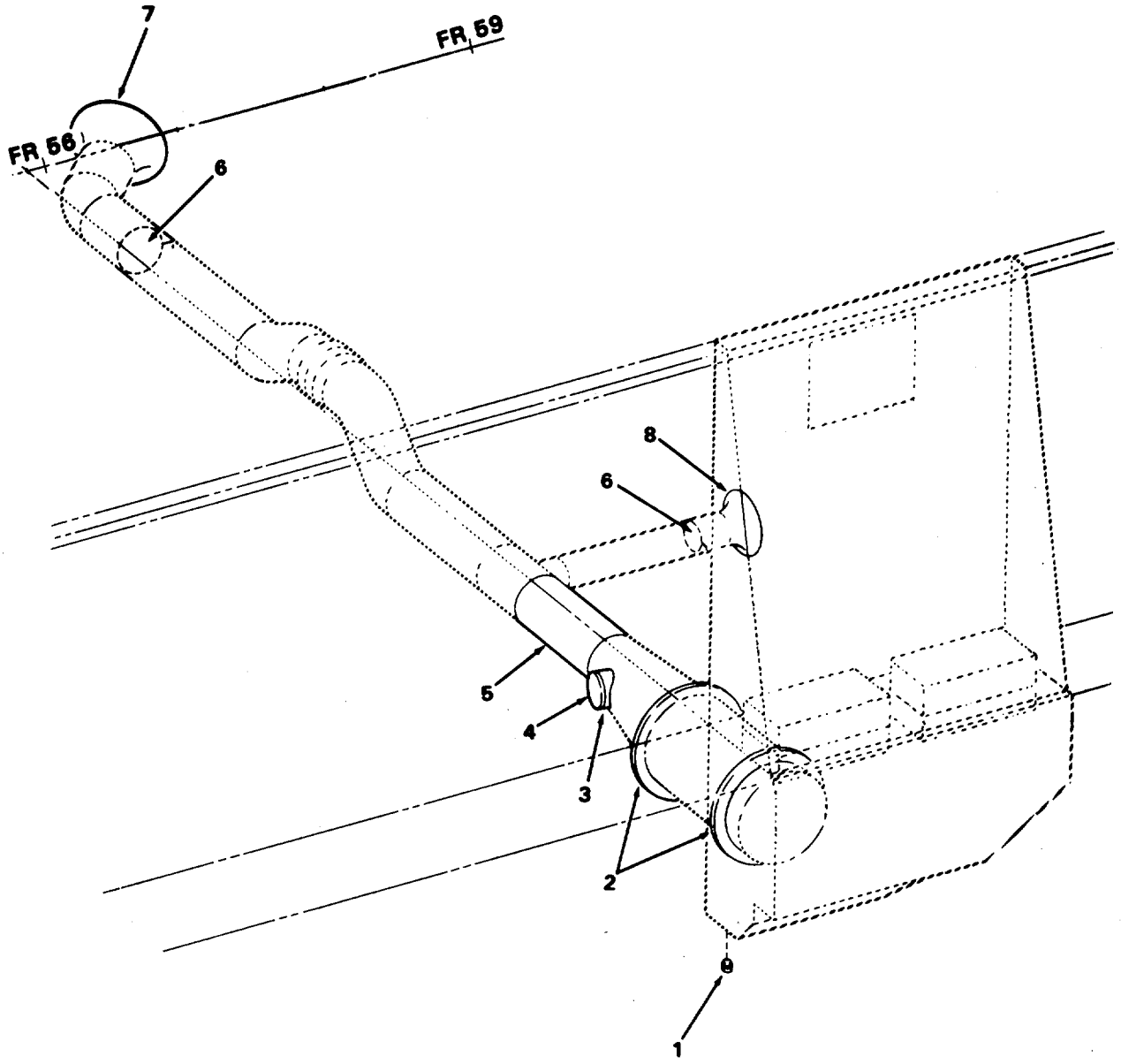
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



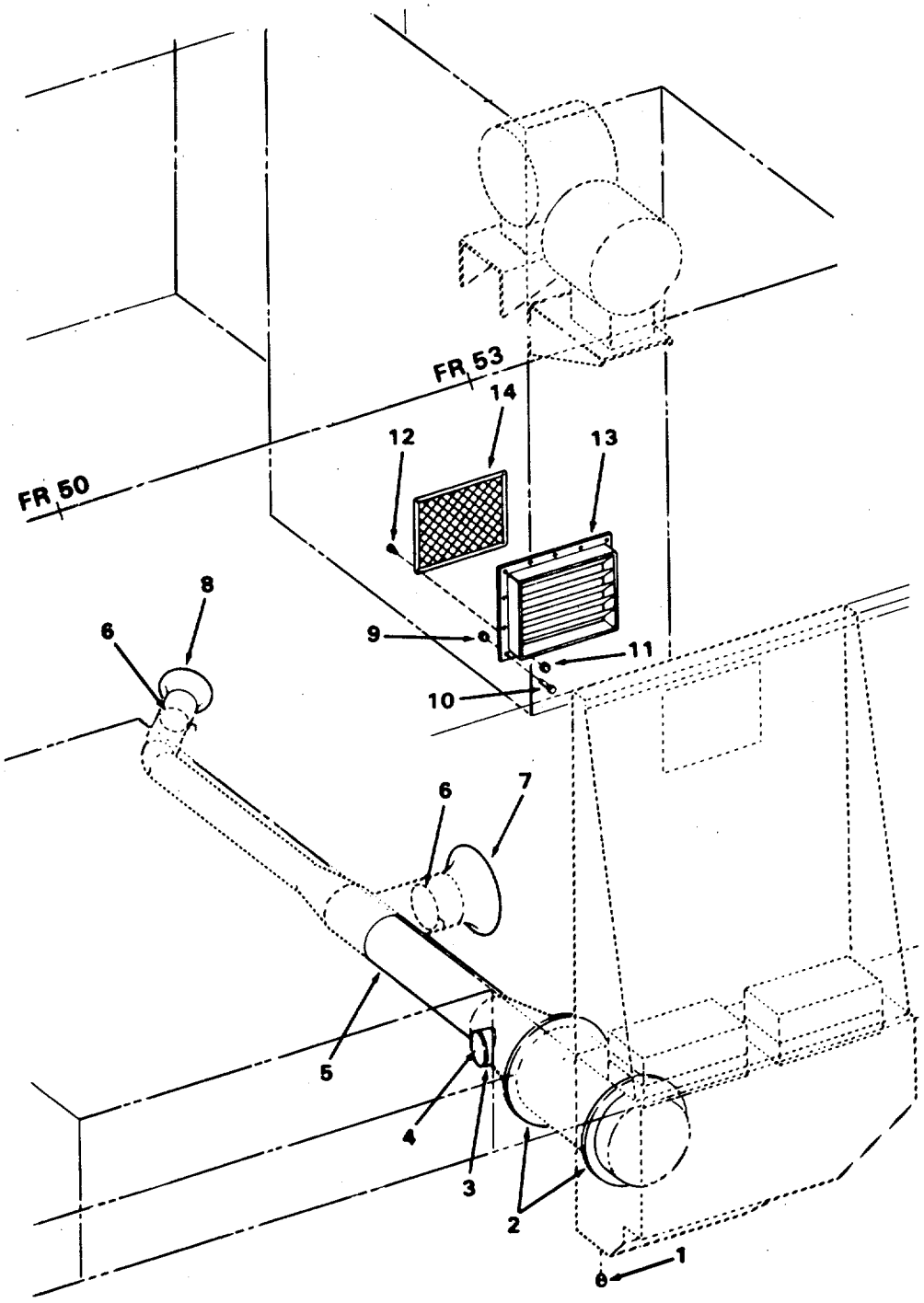
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



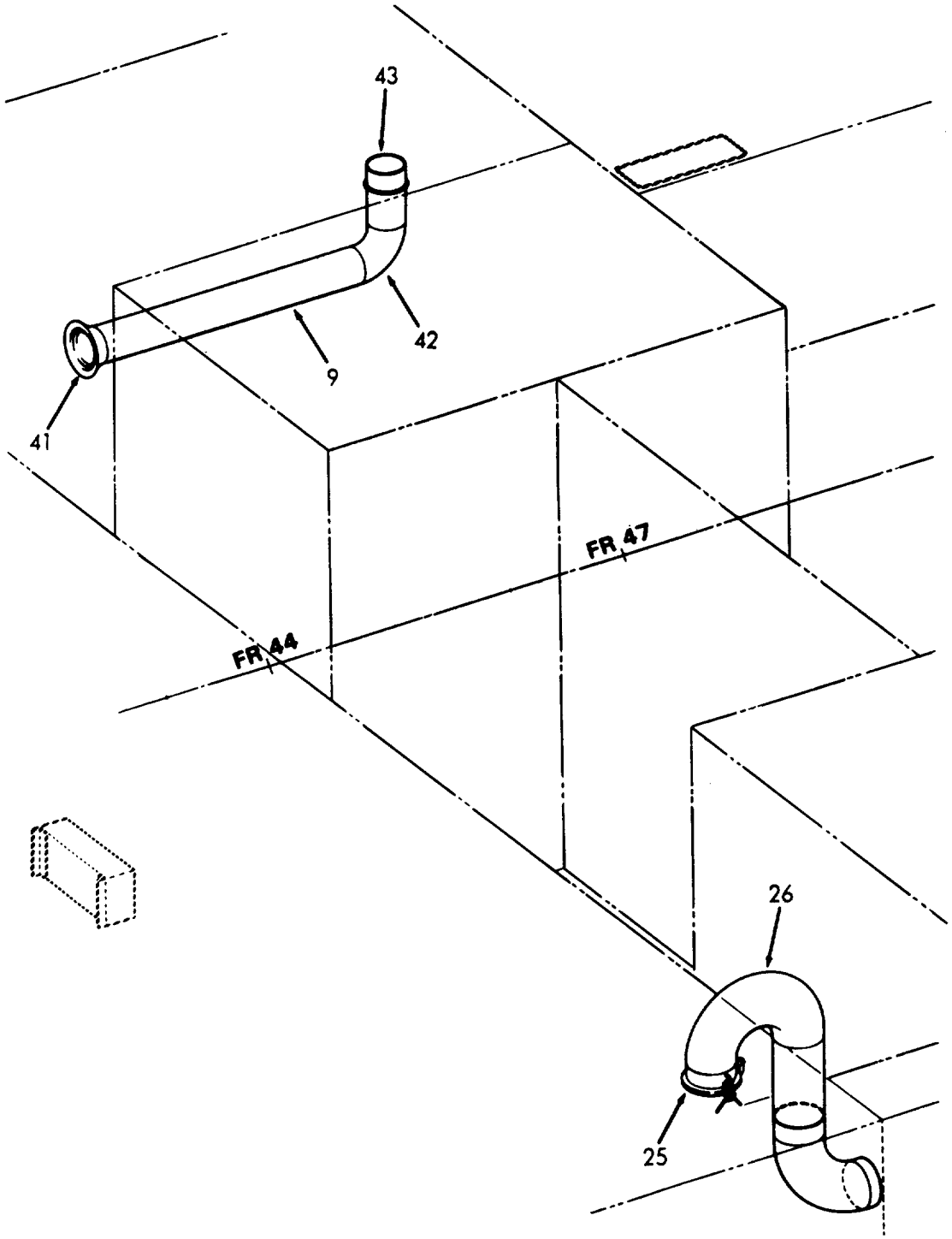
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



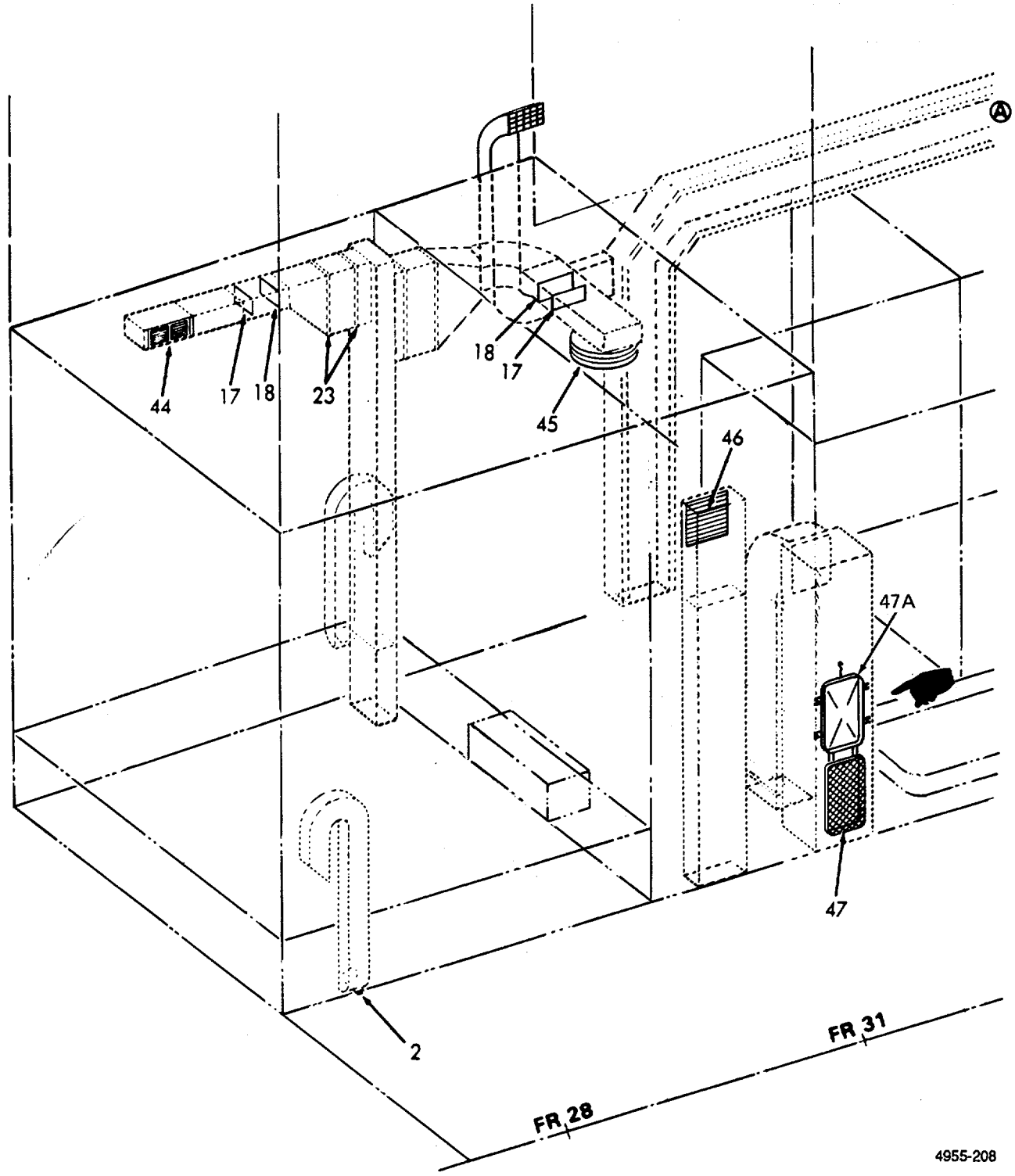
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



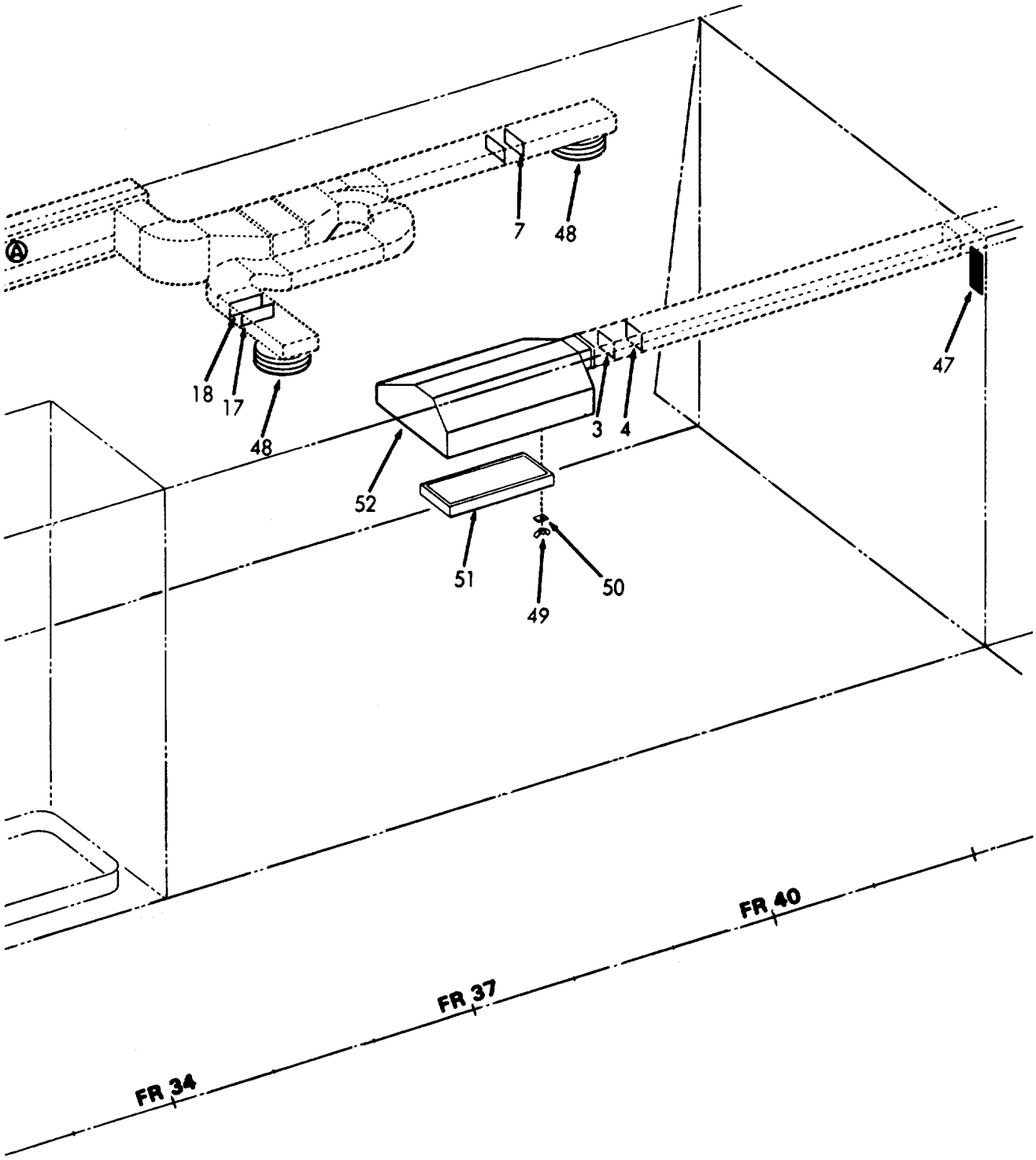
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



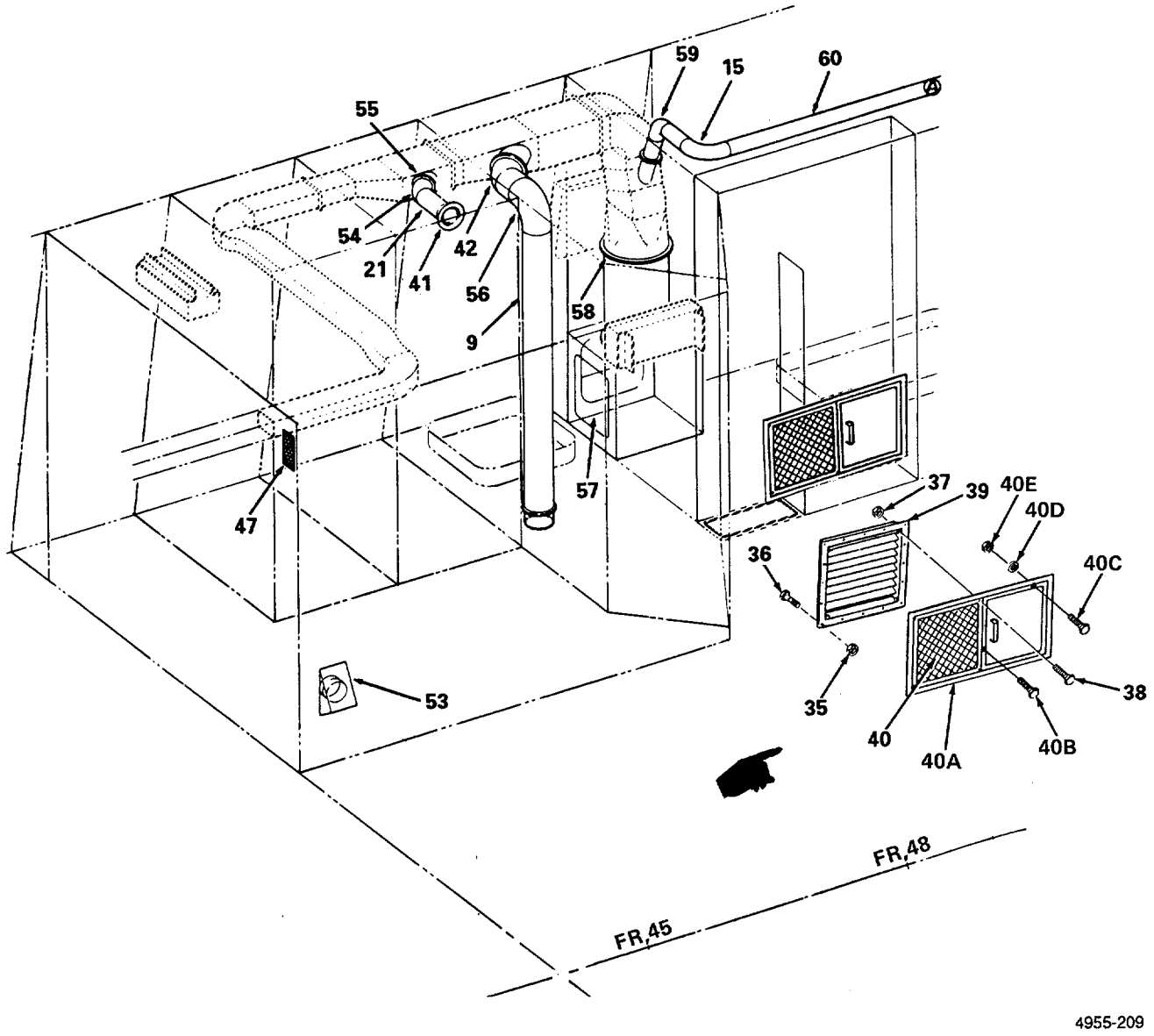
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



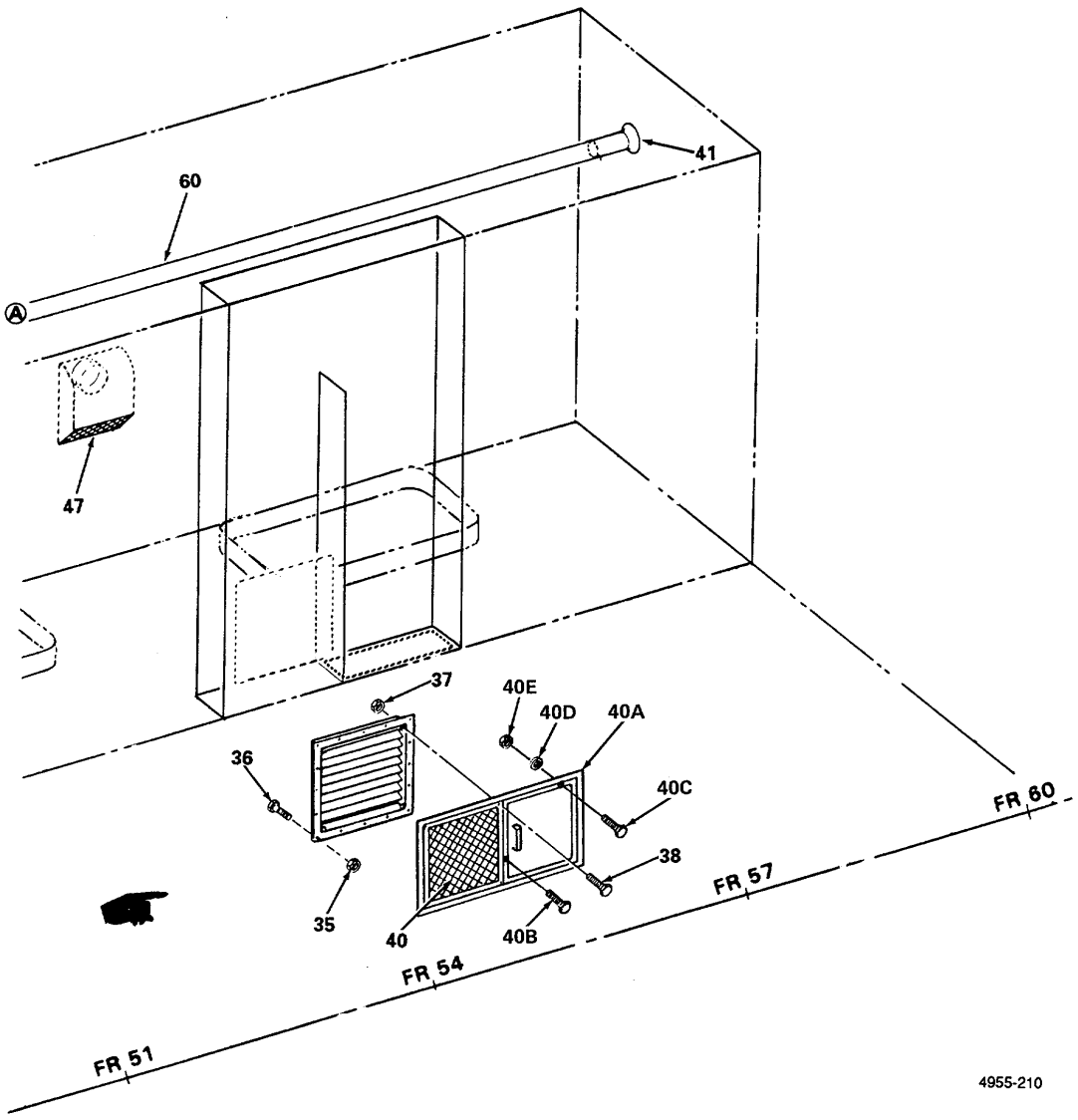
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



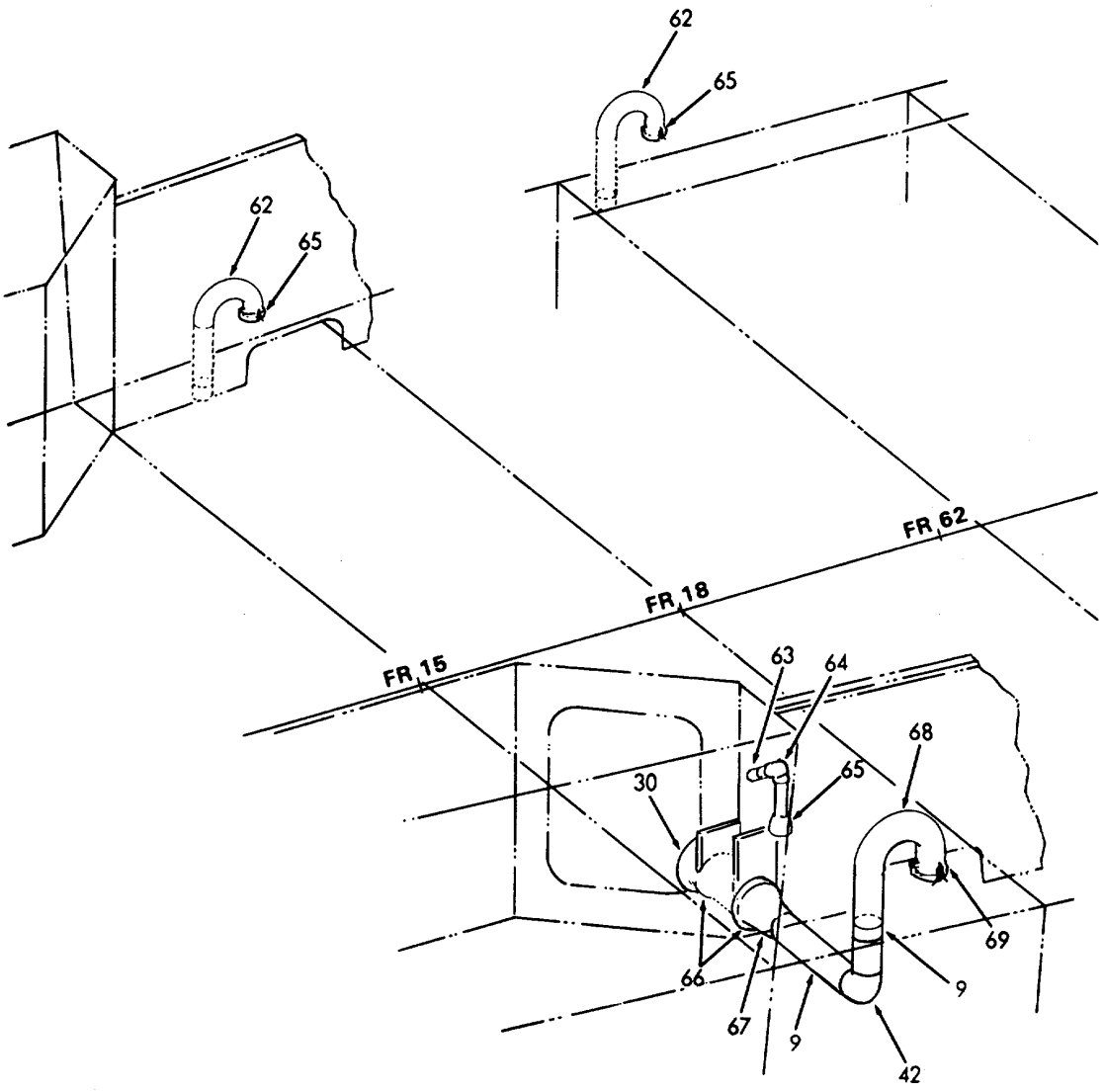
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



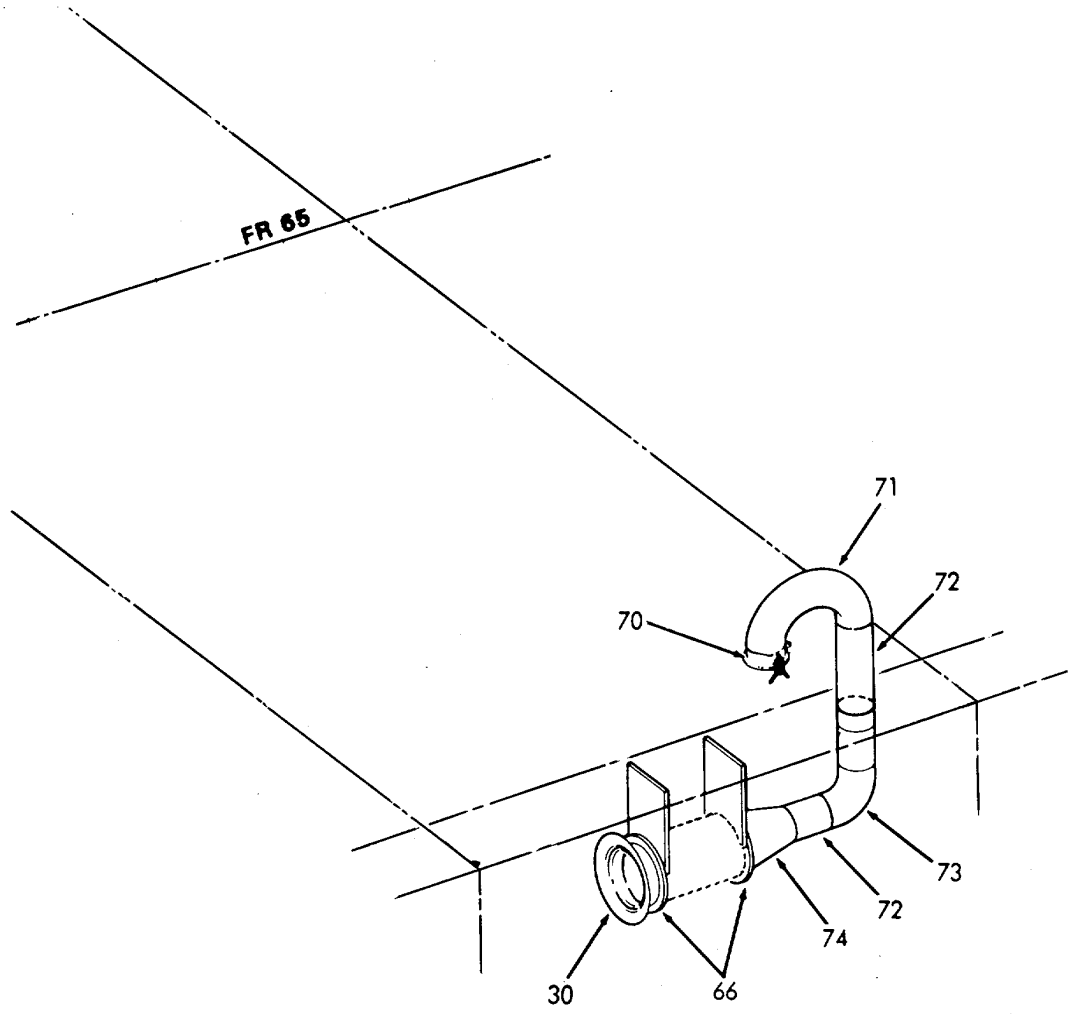
5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



5-140. HVAC DUCTING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



5-141. EXHAUST FAN CONTROLLER - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for controller maintenance instructions.

5-142. EXHAUST FAN MOTOR - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-139 for Motor maintenance instructions.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS.

This task covers:

Overhaul

INITIAL SETUP

Test Equipment	References Paragraph	
NONE	4-30	Compressor
Special Tools	Equipment Condition	Condition Description
NONE	NONE	
Material/Parts	Special Environmental Conditions	
Gasket set 5330-01-040-7867	NONE	
Personnel Required	General Safety Instructions	
1	Observe WARNING and safety precautions.	

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

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.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

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.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

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.

WARNING

• To prevent accidental shock and possible injury, tag and place disconnect switch in the OFF position.

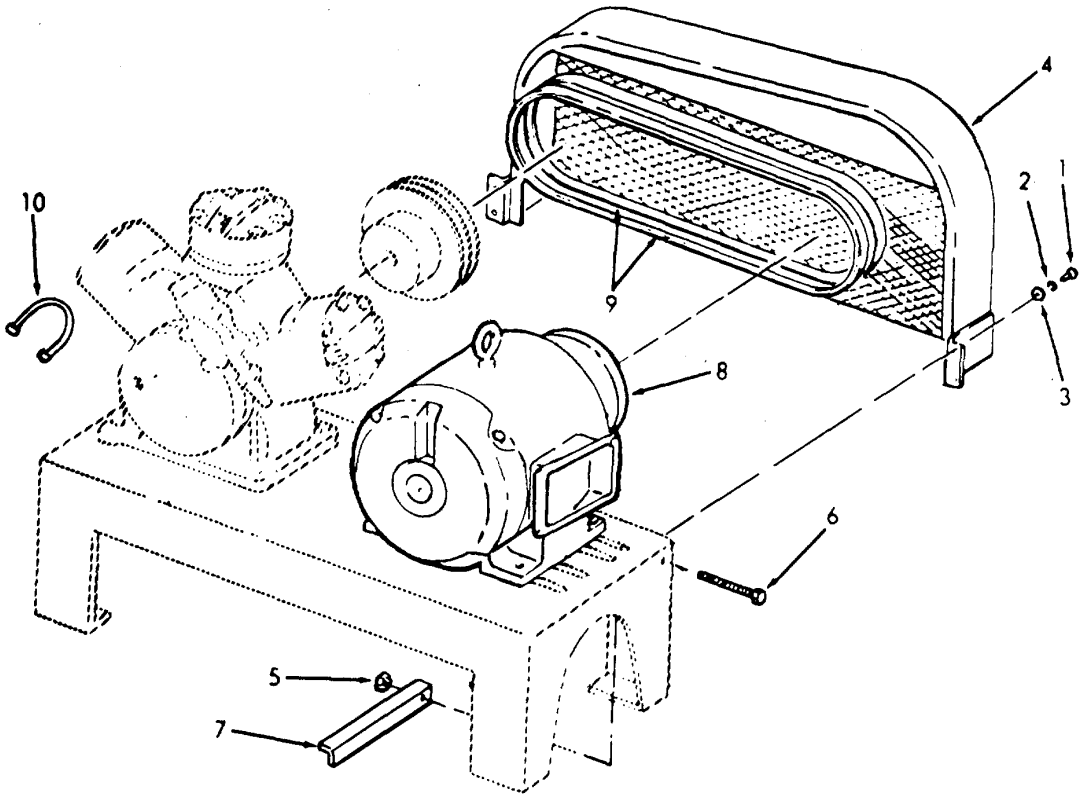
• Tag starting switch to warn against starting compressor with discharge stop valve closed. Pull fuses so that compressor cannot be started. Serious compressor damage (and possible injury to personnel) will result if discharge stop valve is not opened before compressor is started.

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.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.

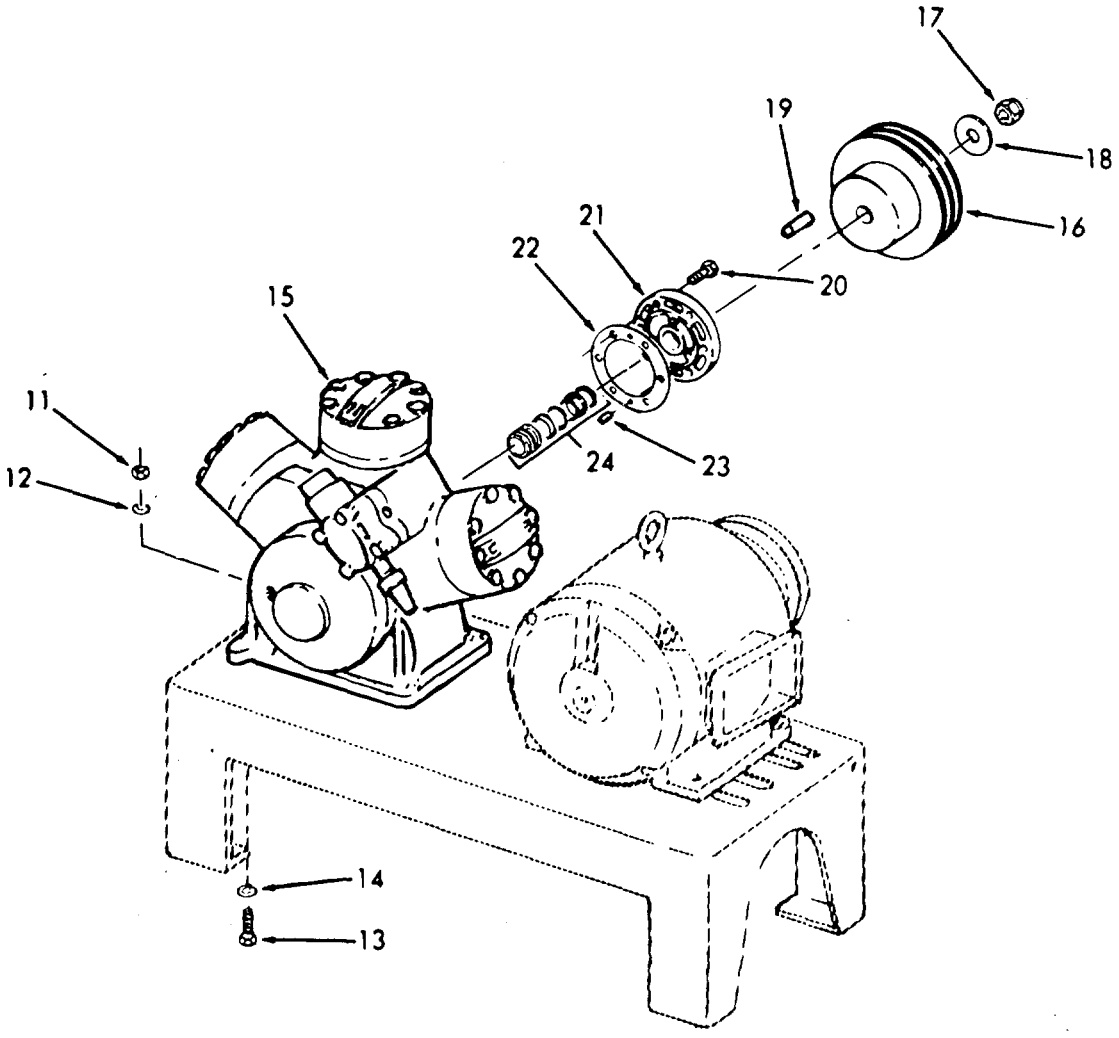


5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

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.	
		1. 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 4-30 for the maintenance instructions.	
5	Seal End Main Bearing	a. Screws (20)	Remove.	
		b Cover plate (21), and gasket (22)	Remove.	Discard gasket.

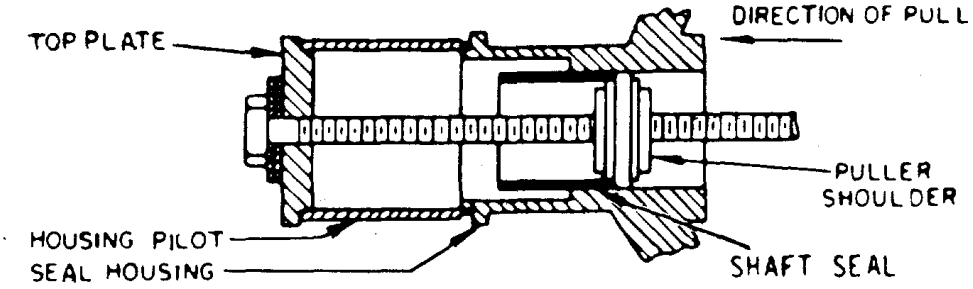
5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	c. Dowel pins (23)	Remove.	If necessary.
	d. Shaft seal assembly (24)	Remove.	a. Use seal puller.



5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

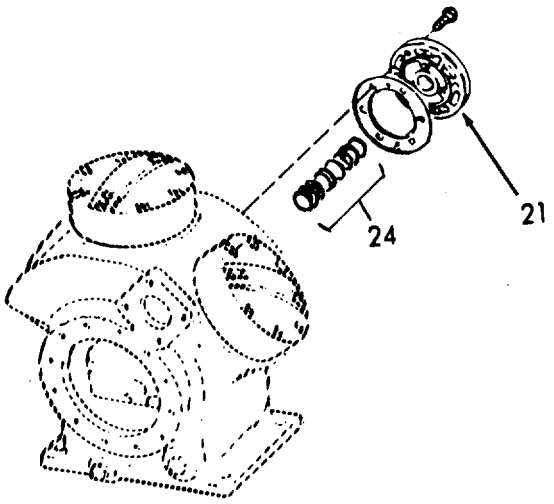
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
			b. The puller shoulder is threaded and acts as a traveling nut. The friction will keep the puller shoulder from turning with the bolt unless threads are damaged. If damaged, use a 3/4"-16 nut between the thrust washer and bolt head. Hold bolt head stationary and turn nut.

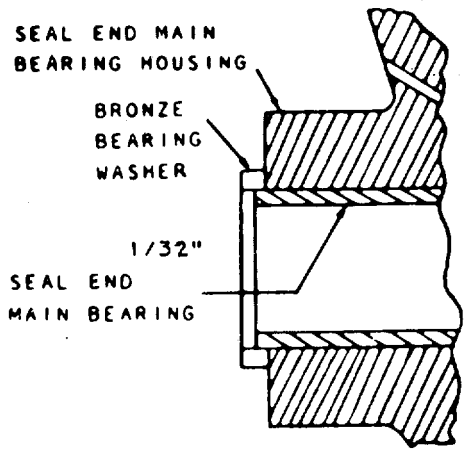


	e. Cover plate (21)	Inspect.	If a burr or a sharp edge is in the cover, remove clean.
	f. Shaft seal assembly (24)	1. Lubricate.	Use heavy grease.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.



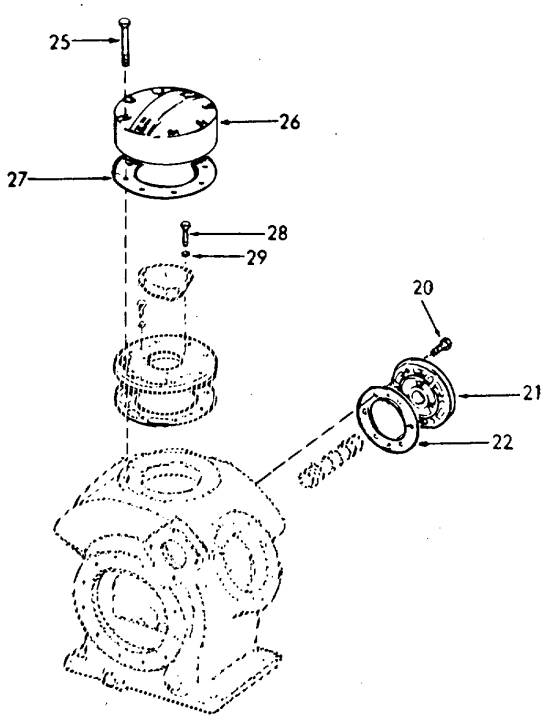


5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
		WARNING	
		Wear protective eye goggles when using compressed air.	
			e. Blow out oil groove in bearing housing.
	g. Cover plate (21), and gasket (22)	Install	Use new gasket.
	h Screws (20)	Install.	Torque to 30 to 35 lbft (40.67 to 47.45 Nm).
6. Cylinder Heads	a. Screws (25)	Remove.	
	b. Cylinder head (26) sealing surfaces.	Remove. damage gasket	Do not drop or
	c. Gasket (27)	Remove.	Discard.
	d. Cylinder head (26)	1. Clean.	Remove gasket material.
		2. Inspect. cracks, and satisfactory gasket sealing surfaces.	Inspect for

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	e. Cylinder head (26), gasket (27), and screws (25)	Reinstall.	Torque screws to 30-35 lb. ft. (40.67 to 47.45 Nm).
	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.	

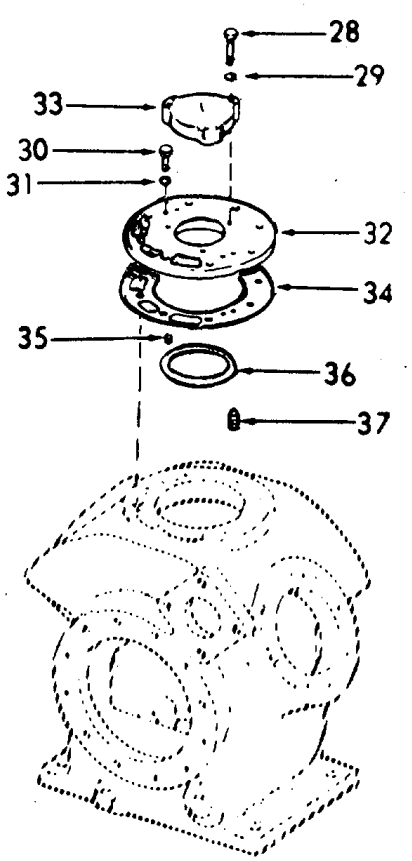


5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

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.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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).	Large coil in contact with bottom.



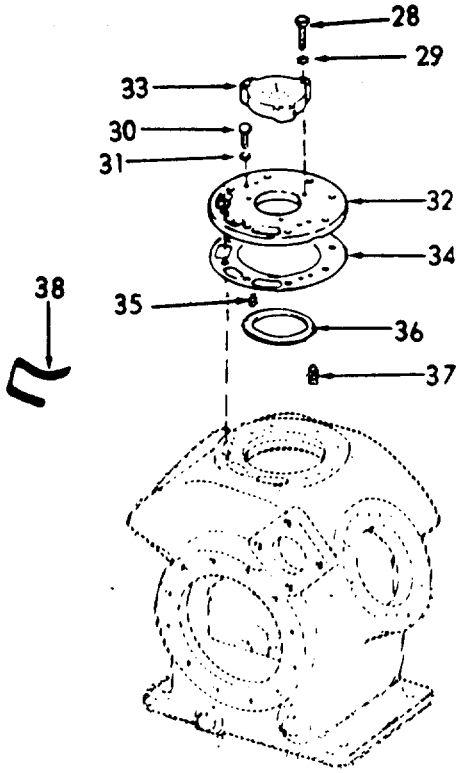
5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

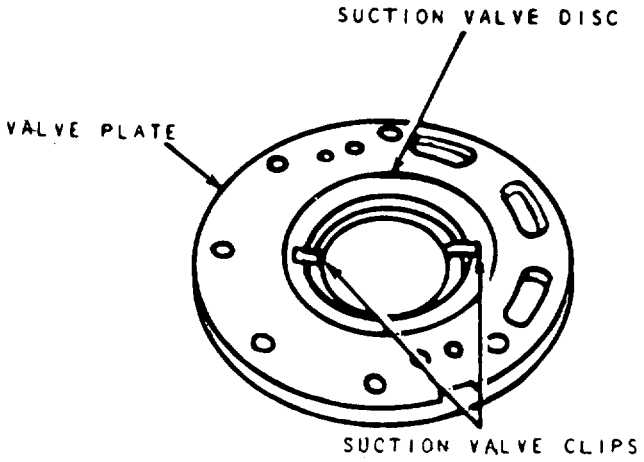
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	1. Suction valve (36)	1. Place on valve spring (35). 2. Press down in valve plate recess. 3. Install slide retainer clips (38) as shown.	Locate clips so they do not cover any valve lift pins and springs (37).
	m. Valve plate (32), and gasket (34)	Align holes with cylinder block.	Use new gasket.
	n Screws (30), and screw gaskets (31)	Install	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.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

OVERHAUL (Cont)

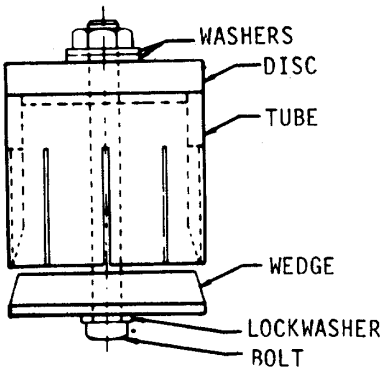


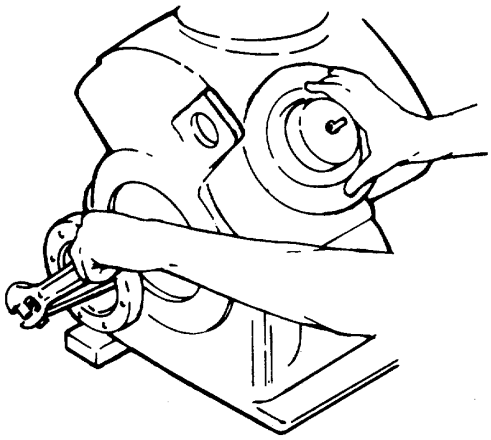


8.	Cylinder and Unloader Sleeves	a. Cylinder head	Remove.	Refer to step 6.
		b. Discharge valve	Remove.	Refer to step 7.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

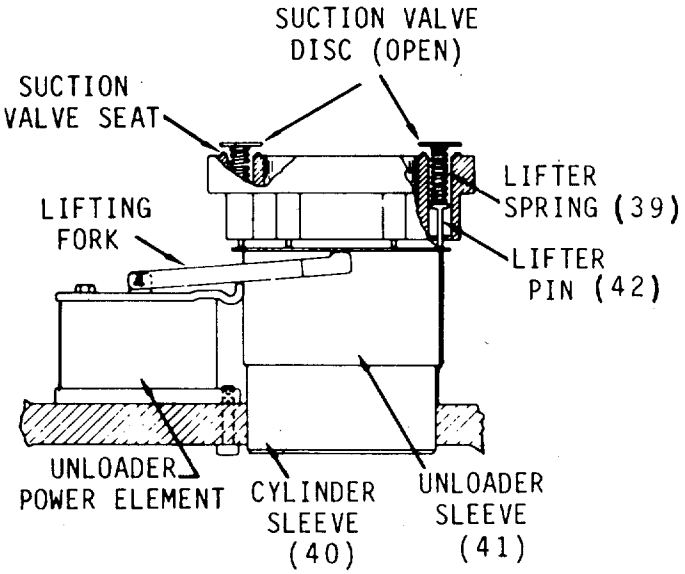
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	c. Valve lift springs (39)	1. Remove.	
		2. Inspect for wear.	Discard if damaged.
		3. Install.	
	d. Crankshaft and sleeve puller	1. Rotate crankshaft until piston is in mid-position.	
		2. Insert sleeve puller into cylinder.	
		3. Push sleeve puller down 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.

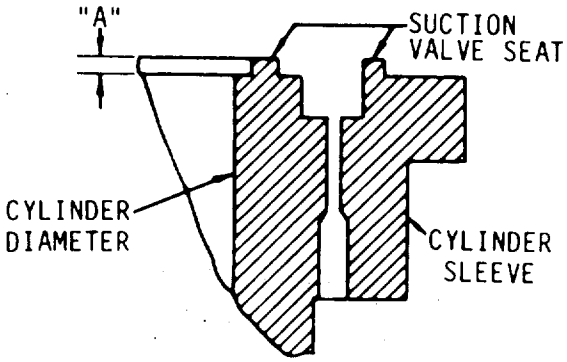




5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	e. Lifter valve pin (42)	1. Remove. 2. Inspect for wear and freedom of movement.	
	f. Unloader sleeve (41), cylinder sleeve (40)	1. Inspect bore of sleeve for wear. and 2. Inspect suction valve seats for scratches or wear. 3. Inspect for wear limits.	





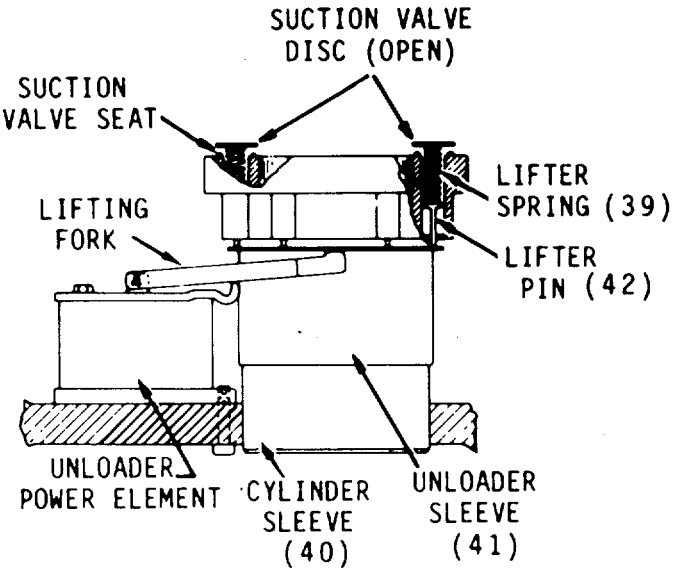
	Factory Minimum	Maximum Wear Before Repair
SUCTION VALVE		
Suction Valve Disc (Depth of Wear Below Face)		.005
Suction Valve Seat (for Dim. "A")	.012	
Minimum Height of "A" Before Replacing Cylinder Sleeve (.010)		

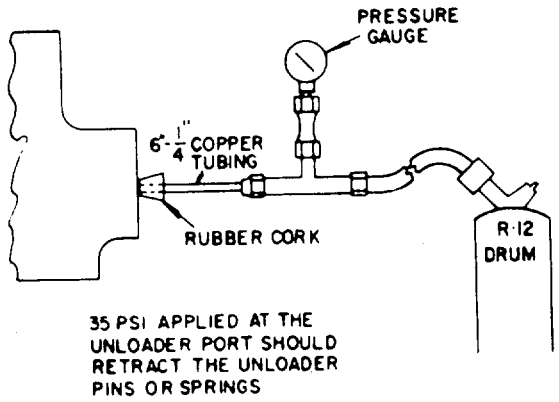
5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	g. Crank-shaft and piston	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)	Rotate so that any two valve lifter pins (42) should be equal distance from longitudinal axis of compressor. prevent undue stress on valve disc.	Valve lifter pins (42) should line up with suction valve springs and
	k. Valve lifter pins (42)	1. Make sure they operate freely. 2. Check unloader operation using the externally mounted capacity control valve.	

5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			



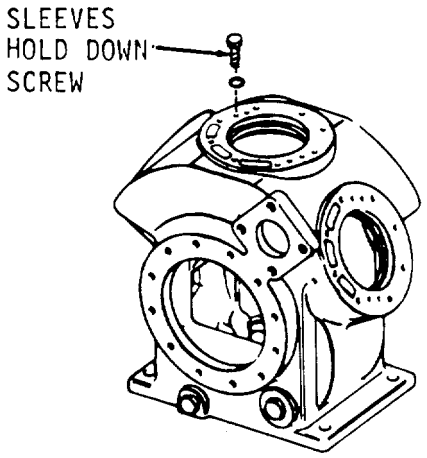


5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.



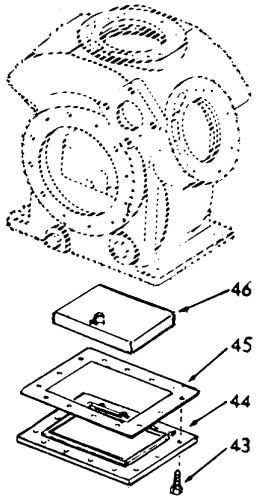
NOTE

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.

5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
9. Bottom	a. Screws Plate	Remove. (43)	
	b. Bottom plate (44), and gasket (45)	Remove.	Discard gasket.
	c. Oil screen filter (46)	1. Remove. 2. Clean. 3. Reinstall.	
	d. Gasket (45), and bottom plate (44)	Install using screws (43).	Use new gasket.

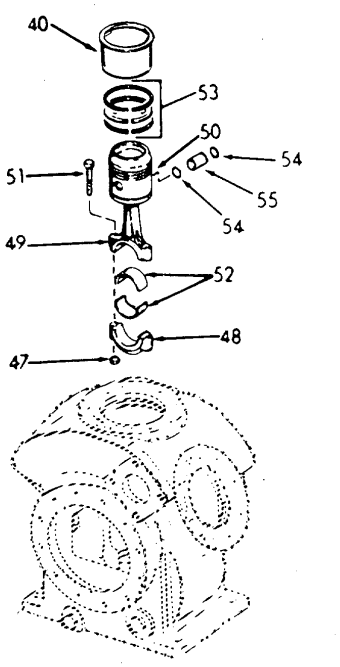


5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

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	Remove.	Refer to step 9.
	d. Nuts (47), and connecting rod caps (48)	Remove.	
	NOTE Label caps and rods so that each can be reinstalled in their respective place on the crankshaft.		
	e. Cylinder sleeve (40), connecting rod (49), and piston (50)	Remove as an assembly.	
	CAUTION 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.	

5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM		ACTION	REMARKS
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.	



5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

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

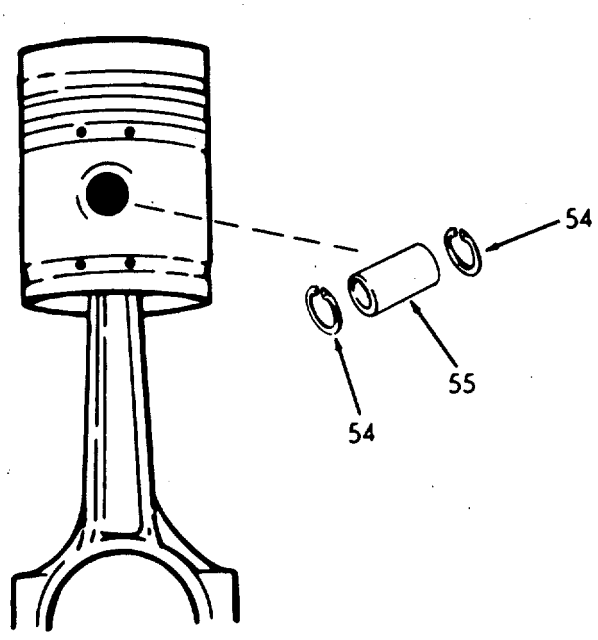
NOTE

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.

1.	Piston pins (55)	Pushfit into place.	Pressure for a dry pin is 10 to 25 lb (44.5 to 111.2 N).

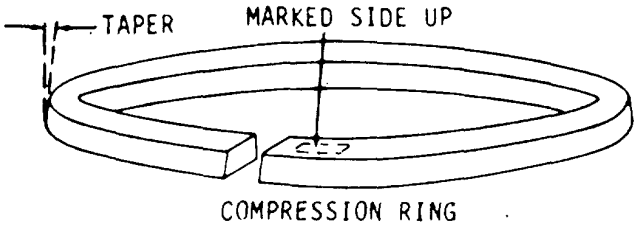
5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.

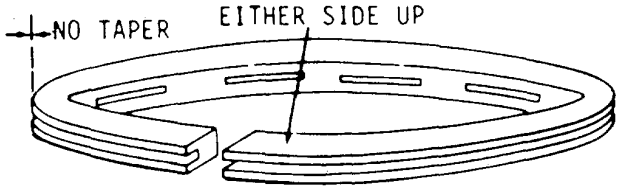


5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	n. Rings (53)	Install two compression rings (plain), an oil ring (vented), and a second oil ring on the piston skirt, as follows:	
		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).	



COMPRESSION RING



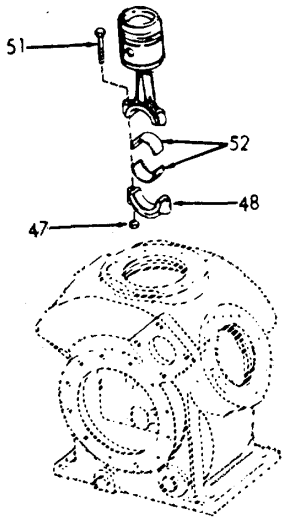
OIL RING

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.

5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
		4. Check rings for free action and measure side clearance between ring and piston with a feeler gauge. It should be .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 rod and cap end must be on same side of the journal. 3. Install bolts and nuts.	

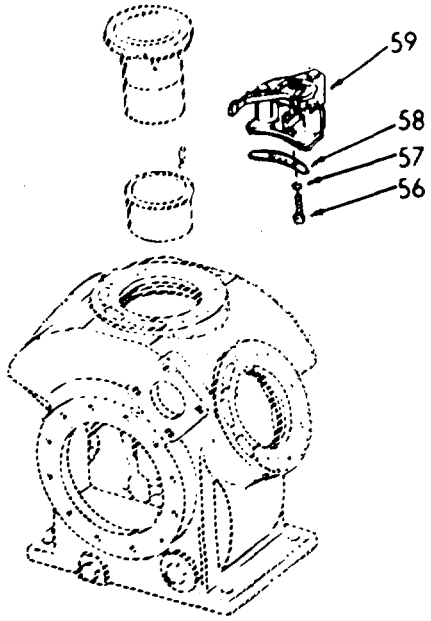


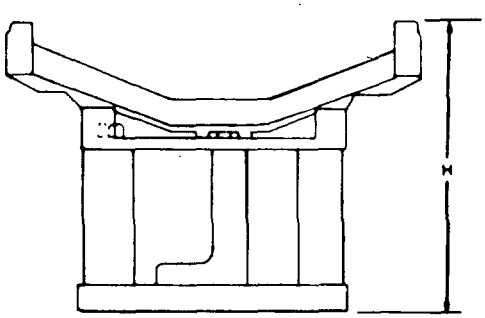
5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

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	move.	Refer to step 10
	e. Allen head screws (56), and lock-washers (57)	1. Reach into crankcase through bottom plate. 2. Remove.	
	f. Gasket (58), and unloader power assembly (59)	Remove.	Discard.
	g. Unloader power/ assembly (59)	1. Check unloader fork height of a new unloader power element.	Take measurement from base to highest point on fork arms. This will ensure even contact with unloader sleeve.
		2. Install new power element, gasket (58) using screws (56) and lockwashers (57).	Use new gasket.

5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			





$H = 2\frac{15}{32}\ ^{+\frac{1}{64}}_{-0}$

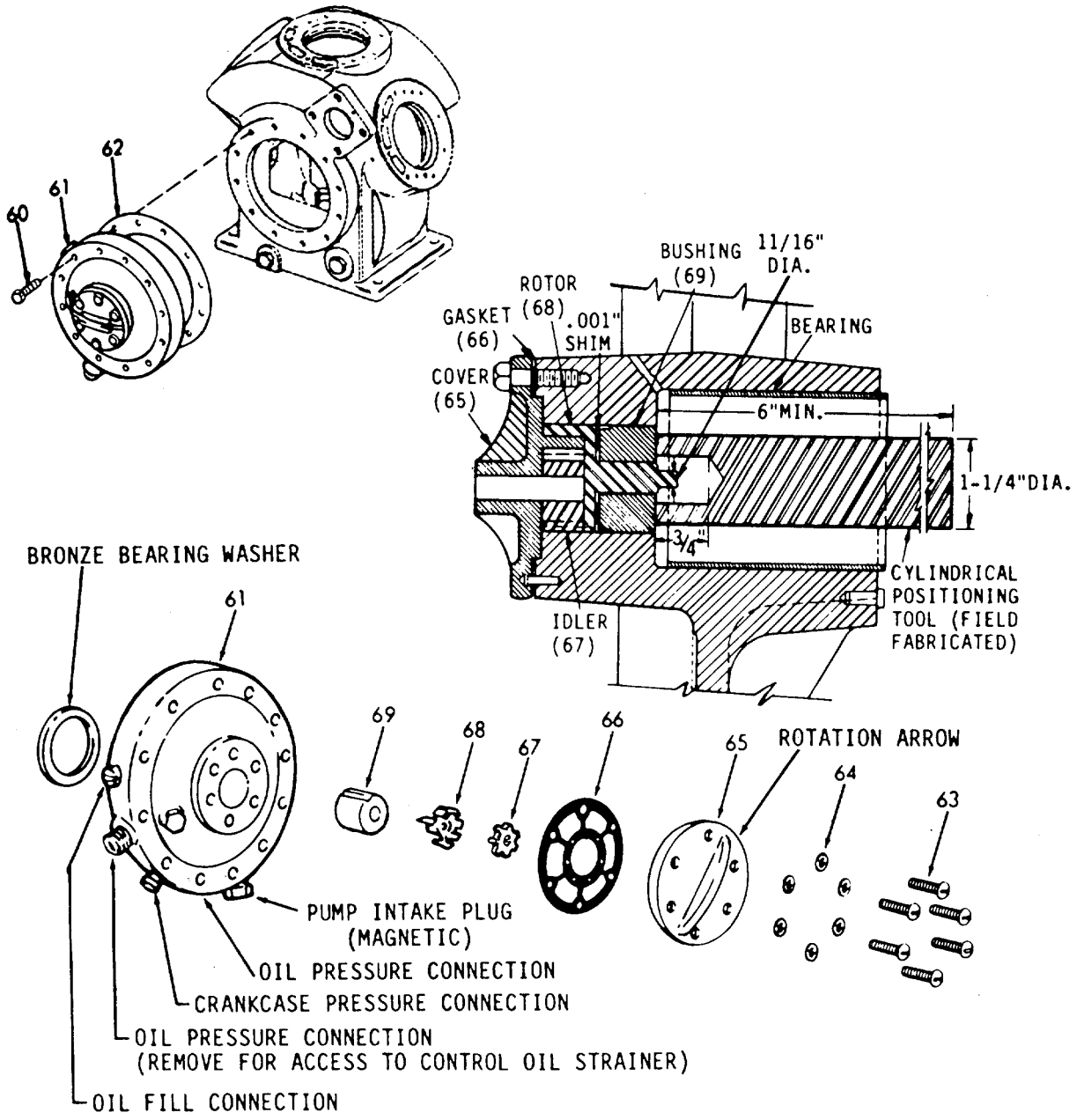
	h.	Connecting rod, piston, and cylinder sleeve	Install.	Refer to step 10.
	i.	Bottom plate	Install	Refer to step 9.
	j.	Discharge valve	Install.	Refer to step 7.
	k.	Cylinder head	Install.	Refer to step 6.

5-143. 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. 2. Replace.	Discard gasket. Use new gasket.
	c. Screws (60)	Install.	
13. Oil Pump	a. Bearing head	Remove.	Refer to step 12.
	b. Screws (63), and lock-washers (64)	Remove.	
	c. Oil pump (65), and gas-ket (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)	Iinspect for scoring.	a. If bushing is scored, replace. b. Replace com-plate bearing head and oil pump assembly if head is scored.

5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			

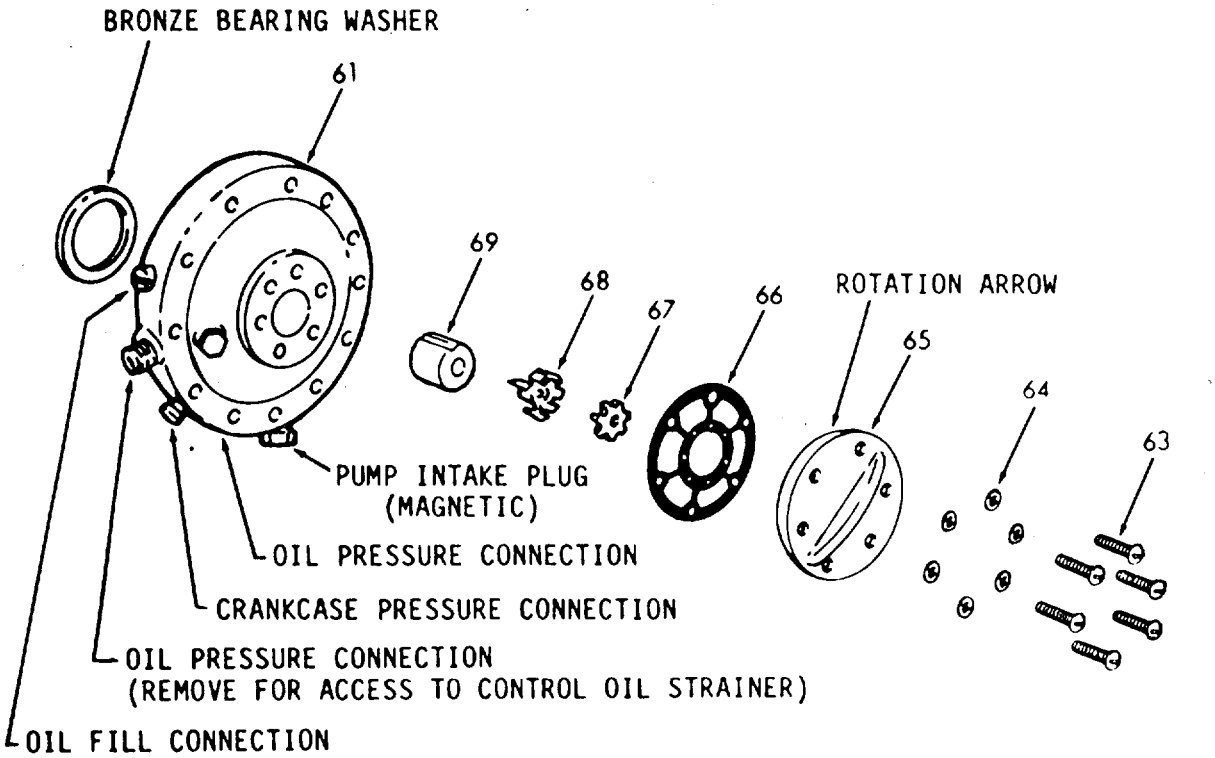


5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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)	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)	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.

5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	i. Bushing (69)	Tap towards pump until it seats against shim.	Use a cylindrical positioning tool.
	j. Screws (63), lockwashers (64), cover (65), gasket (66), rotor (68), idler (67), and shim	1. Disassemble. 2. Remove shim.	



5-143. COMPRESSOR-HVAC-MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	k. Bushing (69)	Make sure it is square in bore.	Use a depth gage,
	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.	

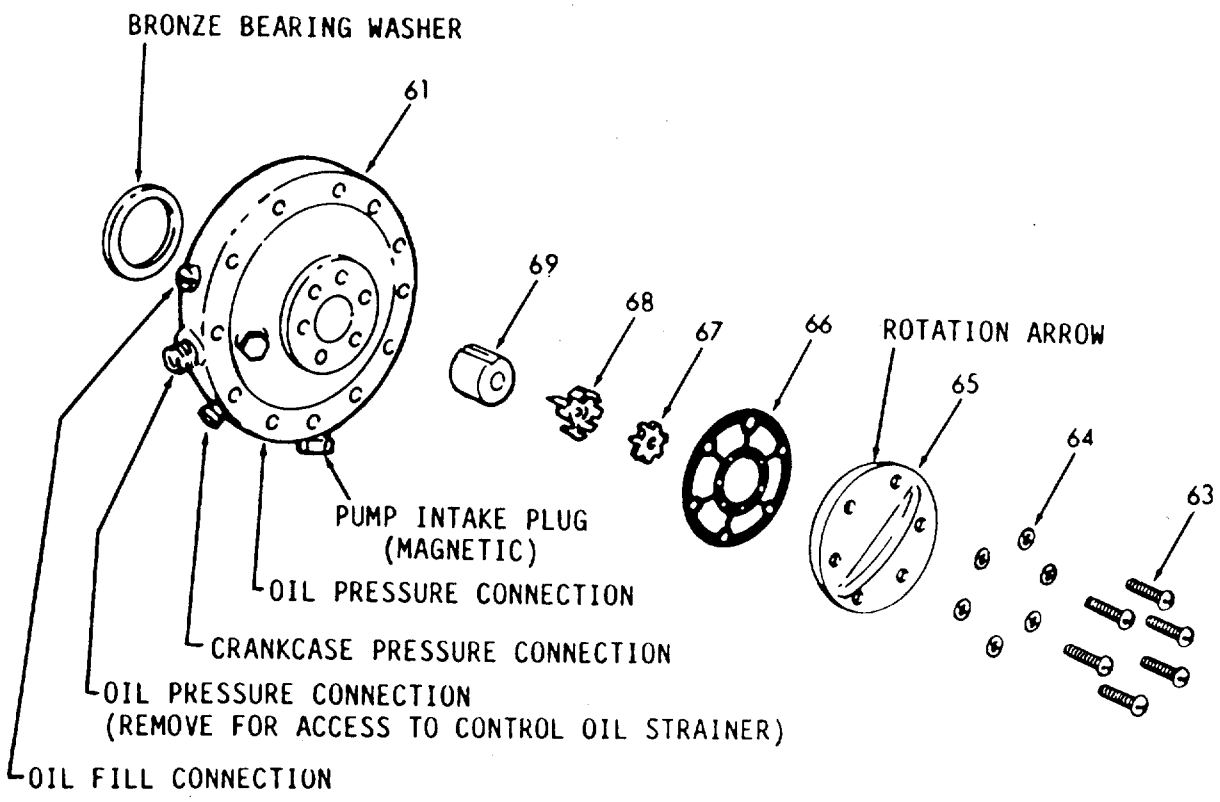
NOTE

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.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			



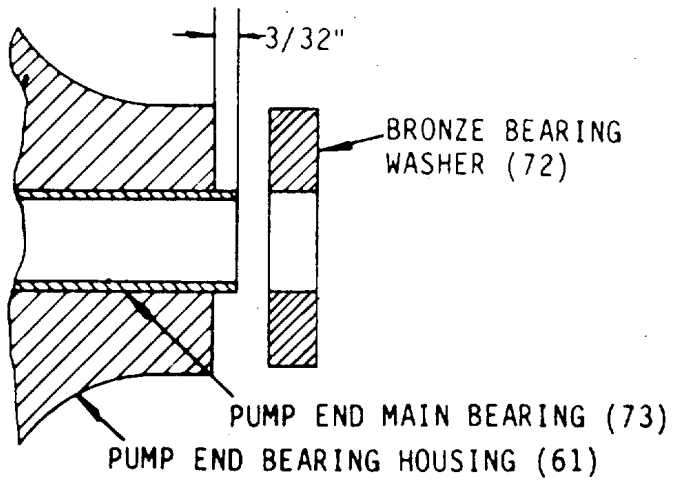
b.	Cylinder heads	Remove.	Refer to step 6.
c.	Discharge valve	Remove..	Refer to step 7
d.	Cylinder and un-loader sleeves	Remove.	Refer to step 8.
e.	Bottom plate	Remove.	Refer to step 9.

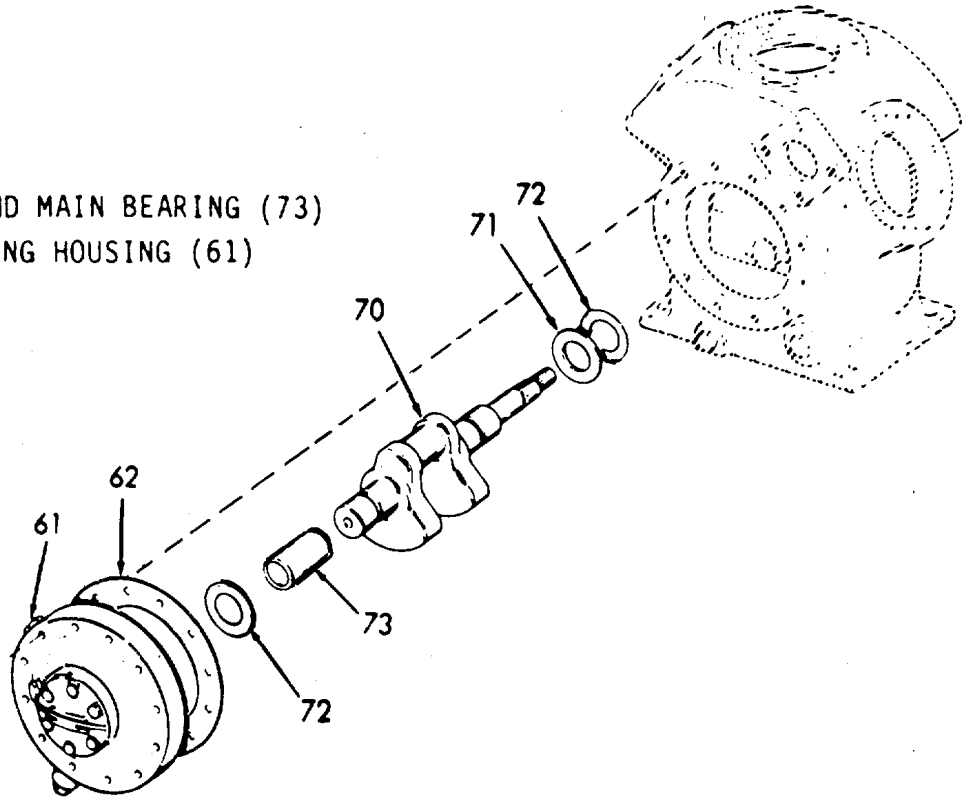
5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

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)	1. Chisel out.	Be careful not to damage pump drive or bearing housing.
		2. Inspect bearing housing for burrs,	Wipe away the filings.
		3. Clean surfaces.	
		4. Lubricate outside with heavy grease.	
		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" ±1/64" so that it will support bronze bearing washer (72).	

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

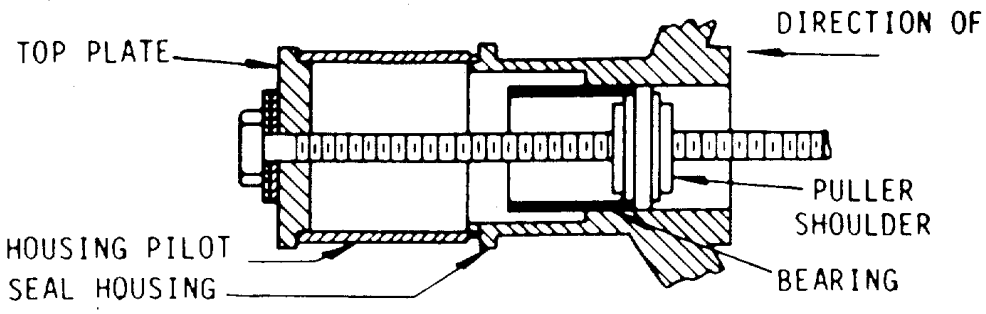
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)		6. Install new gaskets (62) along with pump end bearing head (61). Be sure that notch in the bronze bearing washer is properly positioned around dowel pin.	





5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

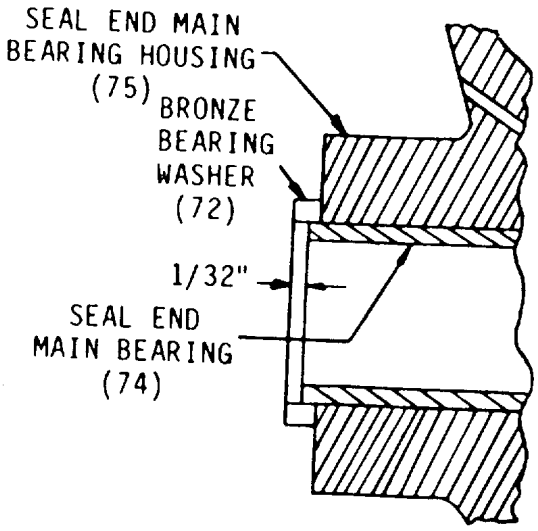
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	j. Seal end bearing (74)	1. Install bearing puller.	The puller shoulder is threaded and acts as a traveling nut. Friction will keep the puller shoulder from turning with the bolt unless the threads are damaged. If they are damaged, use a 3/4"-16 nut between 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 in line.	

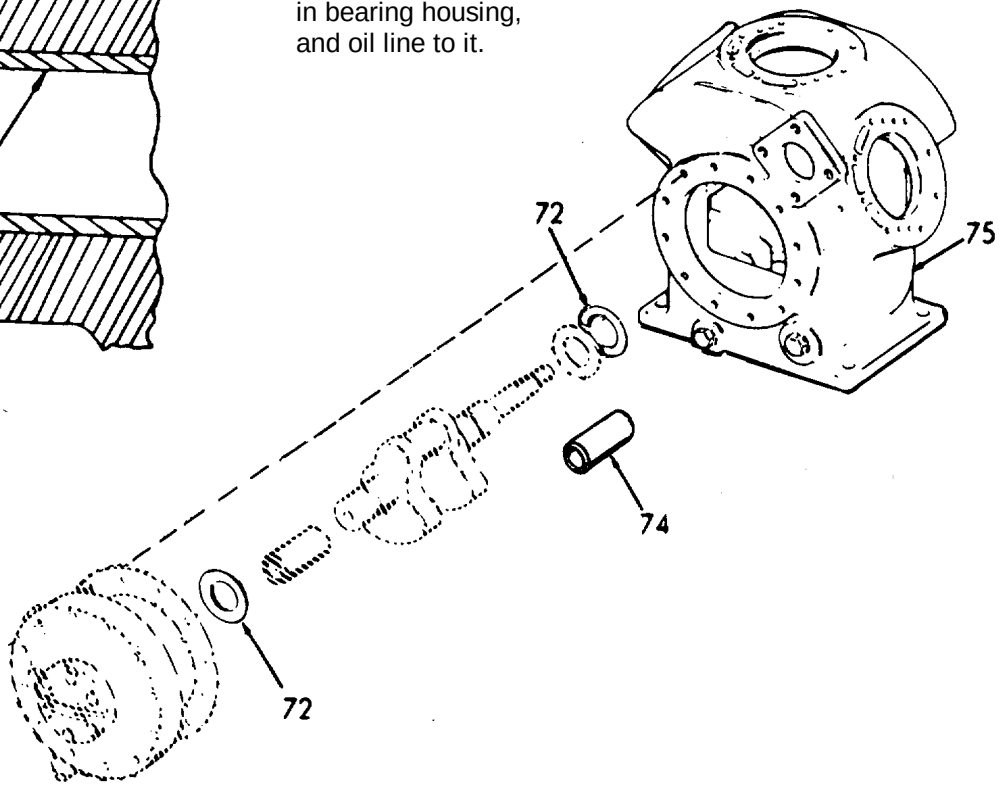


5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.



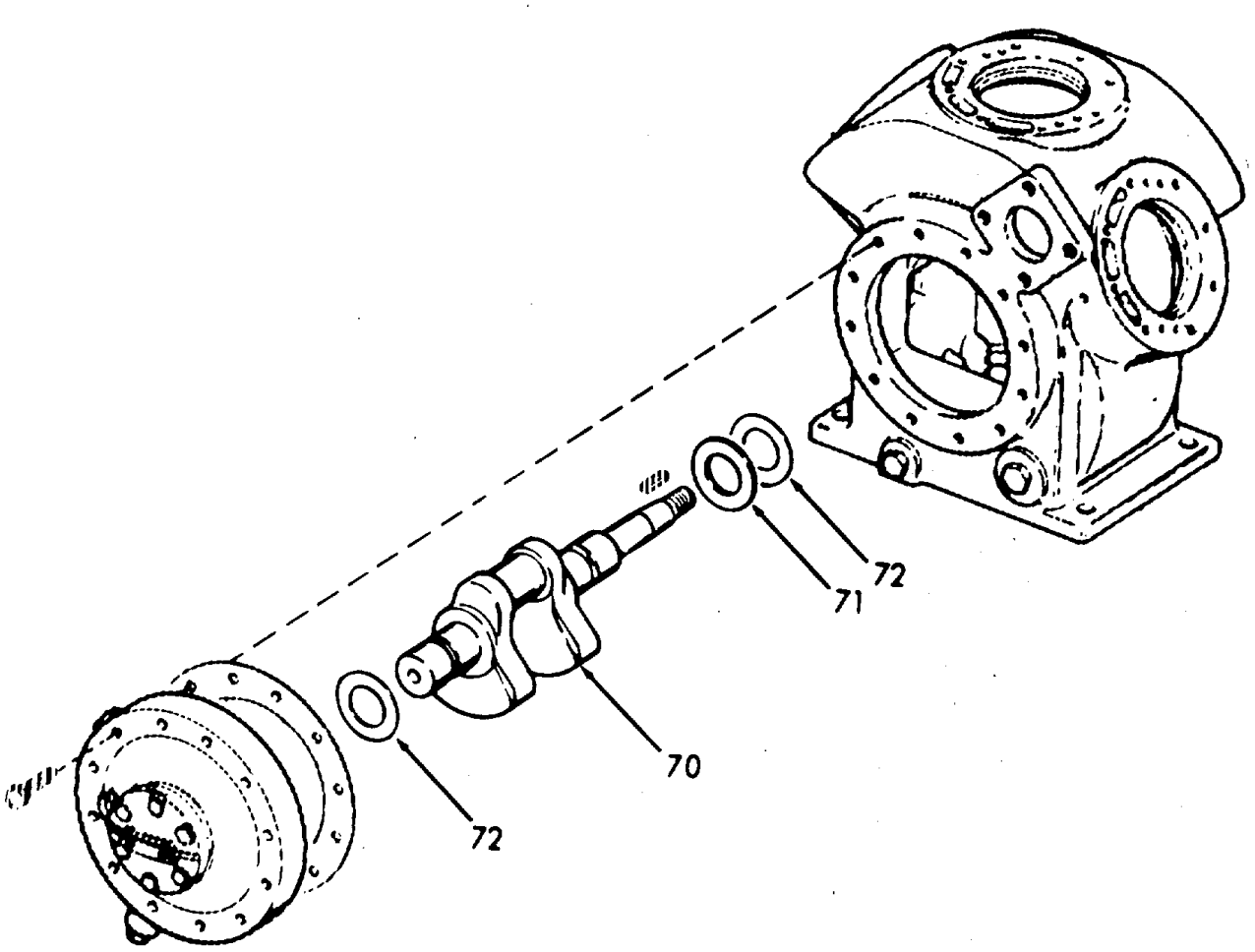


5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			
	k. Crank shaft (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.

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			



5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

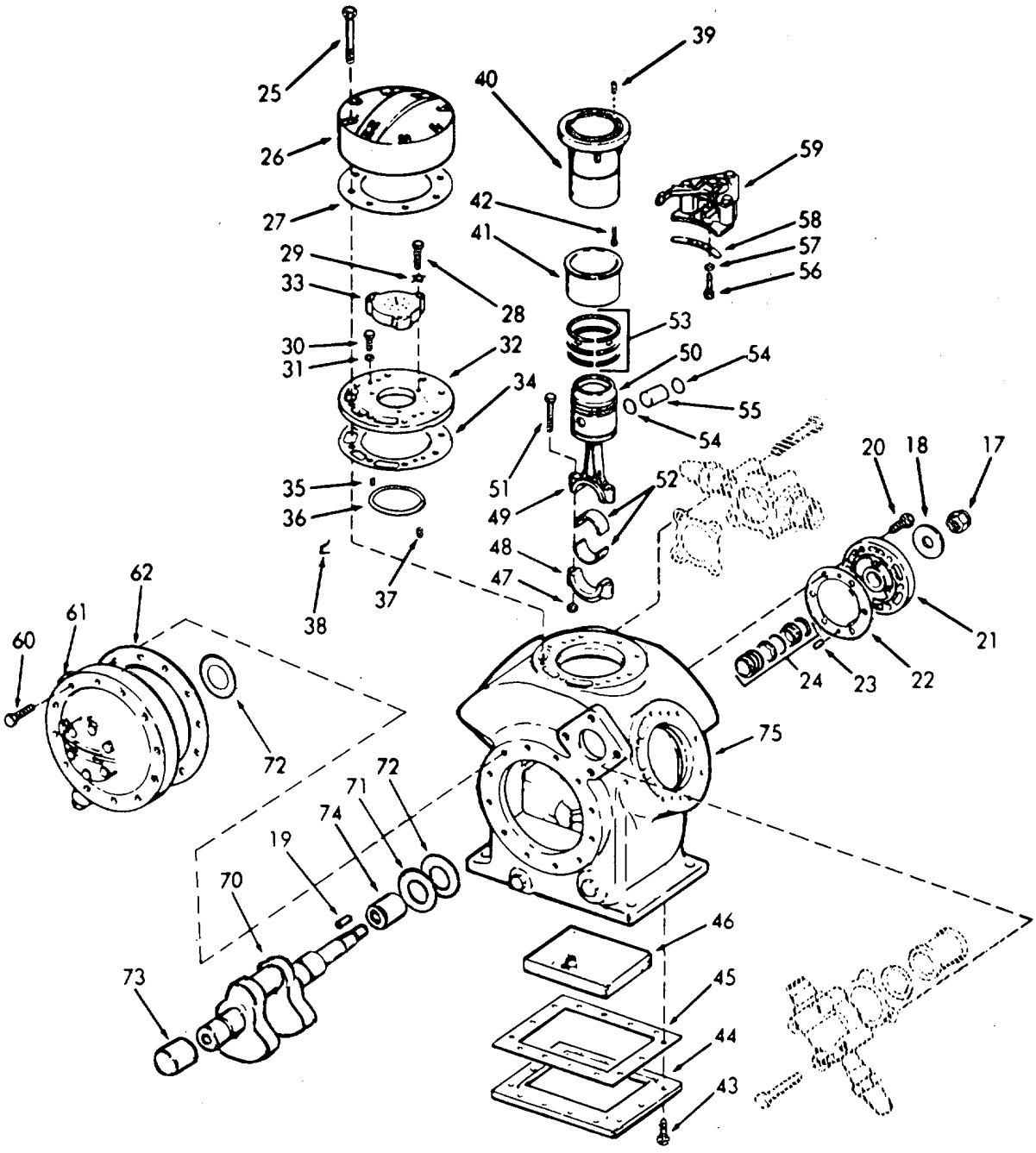
LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			

FREON COMPRESSOR LEGEND

17. Nut
18. Flatwasher
19. Key
20. Screws
21. Coverplate
22. Gasket
23. Dowel pins
24. Shaft seal assembly
25. Screws
26. Cylinder head
27. Gasket
28. Screws
29. Lockwashers
30. Screws
31. Screw Gaskets
32. Valve plate
33. Valve guide
34. Gasket
35. Suction valve springs
36. Suction valve
37. Valve lift springs
38. Retainer clips
39. Valve lift clips
40. Cylinder sleeve
41. Unloader sleeve
42. Lift valve pins
43. Screws
44. Bottom plate
45. Gasket
46. Oil screen filter
47. Nuts
48. Connecting rod caps
49. Connecting rod
50. Piston
51. Connecting rod bolts
52. Connecting rod bearings
53. Rings
54. Piston pin retaining clips
55. Piston wrist pin
56. Allen head screws
57. Lockwashers
58. Gasket
59. Unloader power assembly
60. Screws
61. Bearing head assembly
62. Gasket
70. Crankshaft
71. Thrust seal washer
72. Bearing washers
73. Pump end bearing
74. Seal end bearing
75. Housing

5-143. COMPRESSOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
OVERHAUL (Cont)			



5-144. COMPRESSOR MOTOR - HVAC - 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

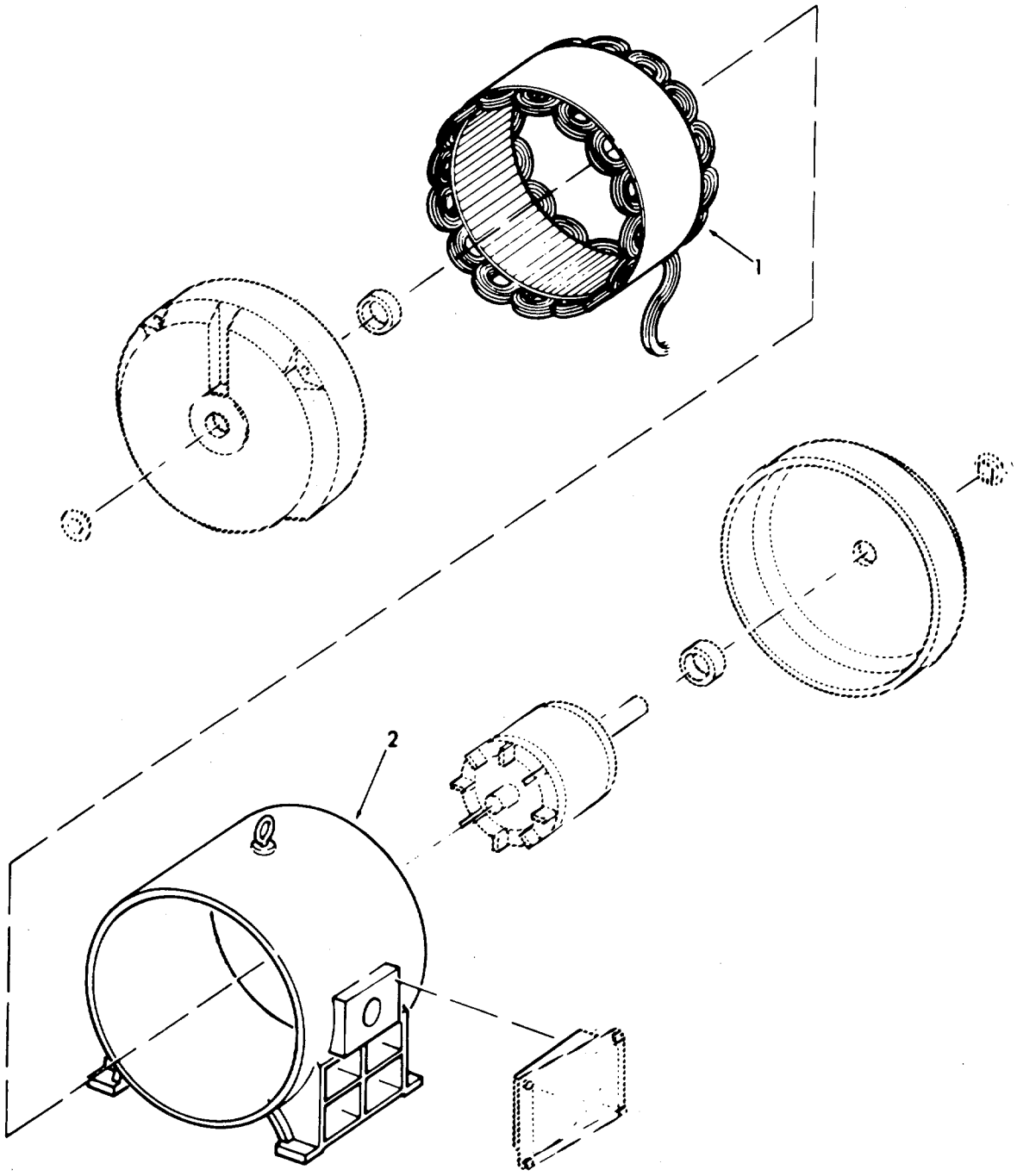
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
1. Motor	a. Stator core (1)	Repair or replace.	
	b. Stator frame (2)	Repair or replace.	

5-144. COMPRESSOR MOTOR - HVAC - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



5-145. COMPRESSOR CONTROLLER - HVAC - MAINTENANCE INSTRUCTIONS.

Refer to paragraph 5-121 for Controller maintenance instructions.

5-146. COMMISSARY SPACE EQUIPMENT - MAINTENANCE INSTRUCTIONS.

The following is an index to the Commissary Space Equipment maintenance instructions.

DESCRIPTION	PARAGRAPH
Refrigerator/Freezer	5-147
Milk Dispenser	5-148

5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Service b. Repair c. Replace

INITIAL SETUP

Test Equipment

Halide leak detector

References
Paragraph

4-38 Refrigerator/Freezer

Special Tools

NONE

Equipment
Condition Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

General Safety Instructions

Observe WARNING in this procedure.

5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS. (Continued).

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.

SERVICE

1. High head pressure.

(a) Air in system:

Air in system takes the space which is normally occupied by the refrigerant. This makes the head pressure run high. With the compressor running under normal conditions, the condenser tubes will be hot at the top, and warm at the bottom. With air in the system, it's the reverse, with the top condenser tubes cool, or slightly warm, while the bottom tubes will be very hot. Purge and recharge.

(b) Overcharge of refrigerant:

The proper charge of refrigerant in a refrigerator is that quantity of refrigerant that will refrigerate all the evaporator coils, without causing frosting of the suction line. If suction line has thick frost on it, purge refrigerant to relieve overcharge.

2. Low head pressure.

(a) Undercharge of refrigerant:

An undercharged system does not have enough refrigerant to fully refrigerate all the evaporator coils. Lack of refrigerant makes the compressor unable to pump enough volume to increase the head pressure. An undercharge would be indicated by a warm suction lines, and top and bottom tubes of condensor. Add refrigerant.

5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

SERVICE (Cont)

(b) Broken suction valve leaf:

A broken suction valve leaf, on the compressor, which is enclosed within the sealed compressor body shell, prevents the piston from compressing the refrigerant vapor to increase head pressure.

3. Short cycling.

Control out of adjustment: By visually inspecting the control settings, the range indicator should be on (43°F) for refrigerator, and (+5°F) on freezers. The differential indicator should be on (7°) for refrigerators, and (5°) for freezers. If the differential indicator is set lower than (7°), (5°) in freezers, the unit will short cycle. Adjust differential for proper cut-out.

4. Unit does not shut off.

(a) Control out of adjustment:

Using a remote reading thermometer, place the sensing bulb on a shelf in the refrigerator. If the unit does not cut-in at (43°F) a cut-out at (37°F), then visually inspect the control. If the range indicator is below (43°F) unit will not shut off. Raise range indicator to cut-in at (43°F). If differential indicator is set higher than (7°) unit will not shut off at proper temperature. Reset to (7°).

(b) Control defective: If range indicator is on (+43°F) and differential indicator is on (+6°F) turn range-knob counterclockwise to top of range scale. If unit fails to start, replace defective control.

5. Compressor inefficient.

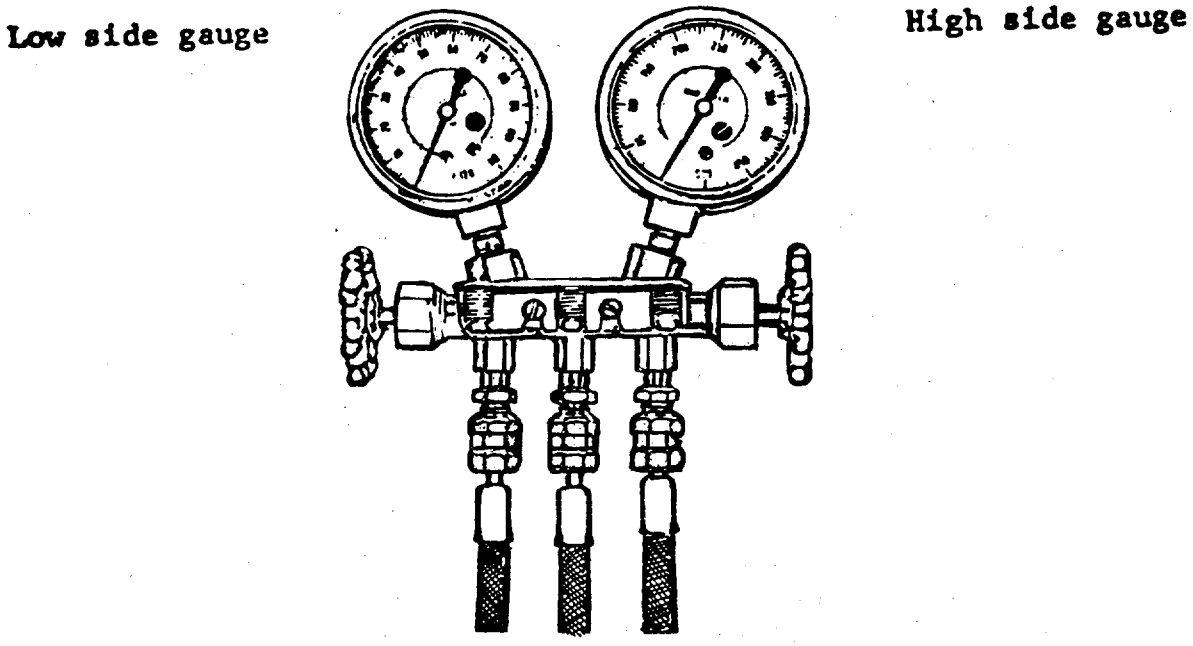
Turn unit off. Connect low side pressure gauge to suction service valve. Close high side (liquid line) service valve. Start the unit and allow to run for 5 minutes. The pressure gauge should read approximately 27" vacuum. Turn unit off. Pressure gauge should stay at 27" vacuum, then unit is efficient. If unit does not pull to deep vacuum, and/or fails to keep vacuum during test, unit is inefficient.

6. Expansion valve stuck open.

A hot liquid line and frosting suction line are indications of expansion valve open too wide. Replace expansion valve.

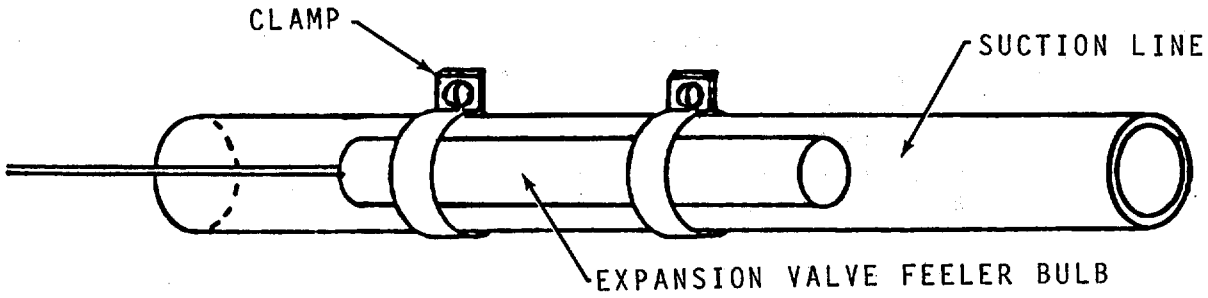
5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

SERVICE (Cont)



7. Poor contact - valve feeler bulb to suction line.

Good thermal contact between the bulb and the suction line is essential for proper operation of the expansion valve. The bulb should be securely fastened to a clean, straight horizontal run of the suction line, fastened tightly with two clamps. The bulb should be located on the side of the suction line, not on the bottom.



5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR

8. Motor compressor.

   (a) Disconnect refrigerator from power circuit.

   (b) Remove lead wires from motor compressor, and control.

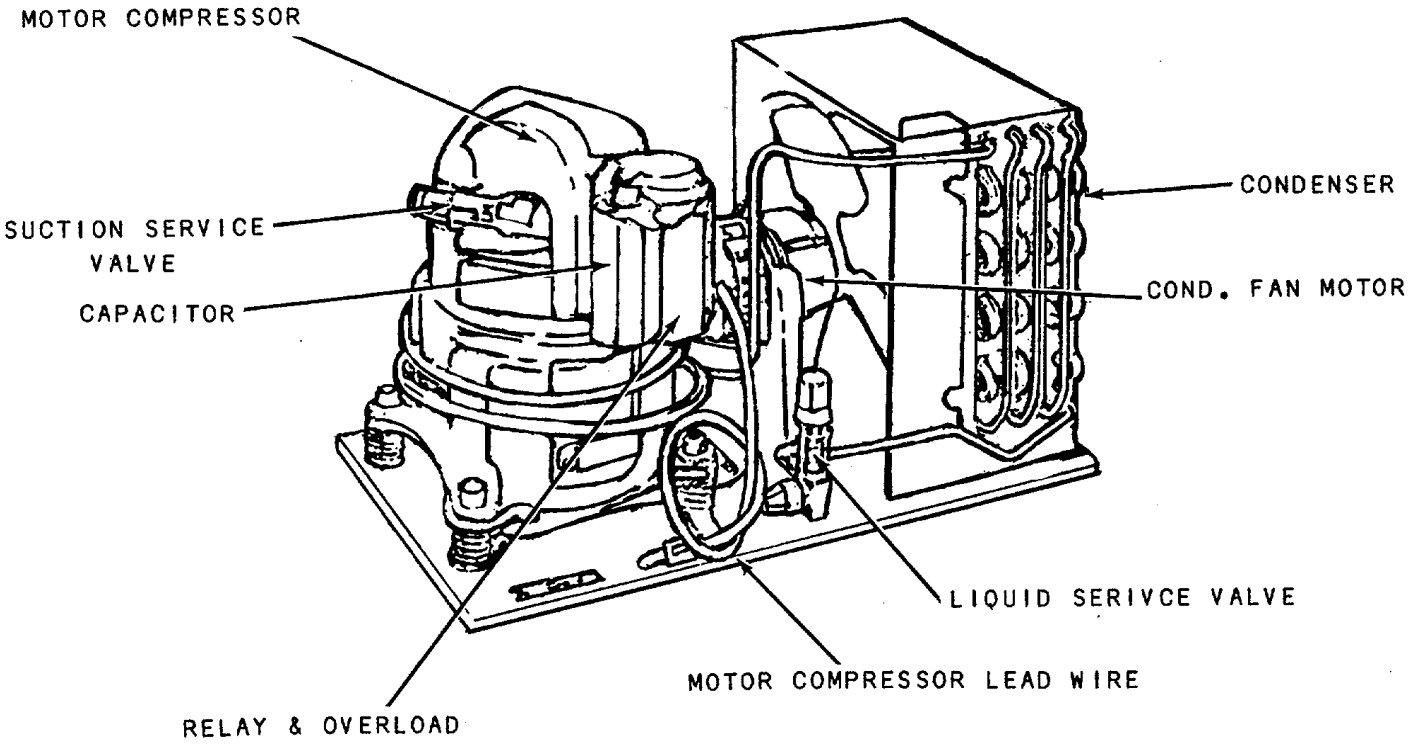
   (c) Purge, entire refrigerant charge.

   (d) Remove defective motor compressor, and mount replacement. Do Not connect suction and discharge lines yet.

   (e) Connect refrigerant drum to suction line, and purge refrigerant thru the low side of system.

   (f) Install new filter-drier, reconnect liquid and suction lines, and with vacuum pump, pull deep vacuum on system.

   (g) Reconnect motor compressor to power circuit, and control. Recharge system and check for leaks.



5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

REPLACE

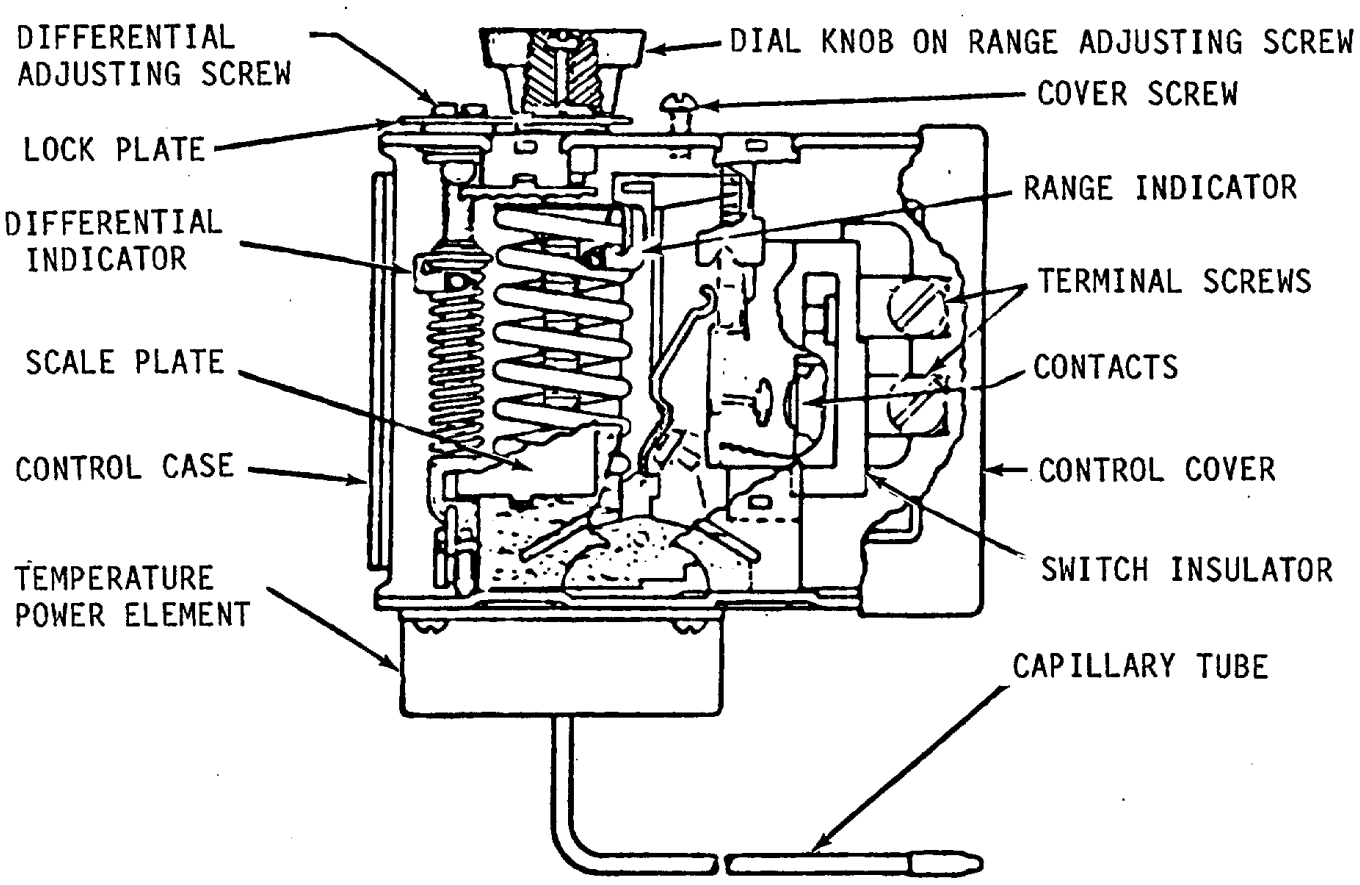
9. Control

(a) Disconnect power supply to refrigerator. Unplug power cord from wall receptacle and/or turn power off at fuse disconnect switch.

(b) Remove leads from control terminal screws.

(c) Disconnect control feeler bulb and capillary tube from clamp, inside refrigerator, and pull same out from inside refrigerator.

(d) Remove control from bracket and install new control following the above procedure in reverse.



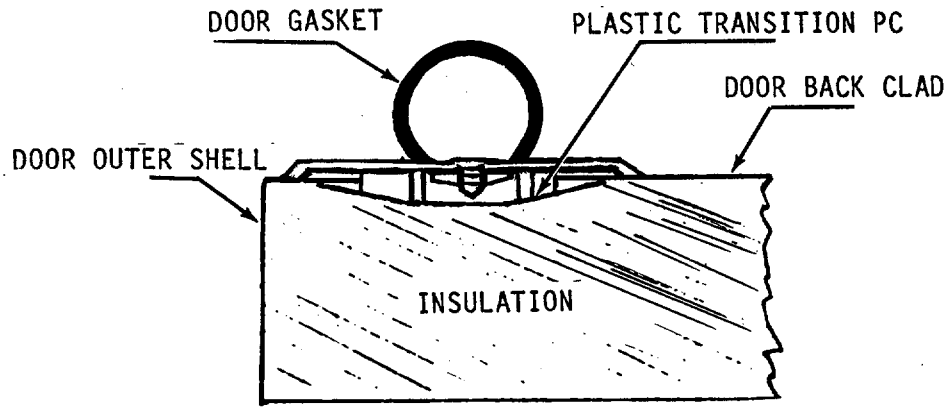
5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

REPLACE (Cont)

10. Door gasket.

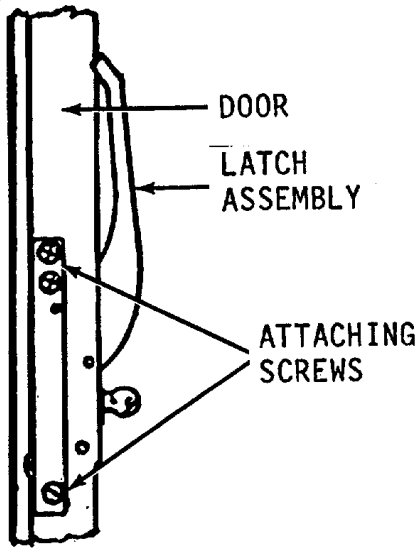
(a) Hold the door with one hand, grasp the door gasket with the other hand, and pull gasket from plastic transition place in door.

(b) To install new gasket, align back (snap-in section) of door gasket, with hole in plastic transition piece in door, and push gasket in to "snap-in" place.



11. Door latch handle.

Remove (3) screws holding handle to side of door and install new handle using same (3) screws.



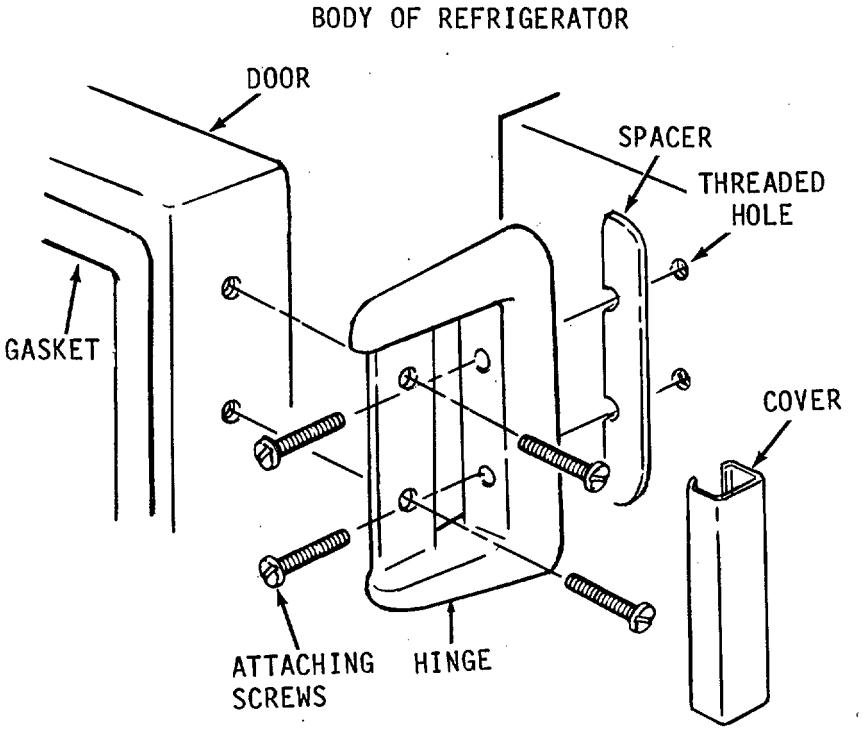
5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

REPLACE (Cont)

12. Hinge.

(a) Open door and snap hinge cover loose from inside edge of hinge with screwdriver.

(b) Close door and remove screws holding hinge to door and cabinet. Position new hinge and replace screws.



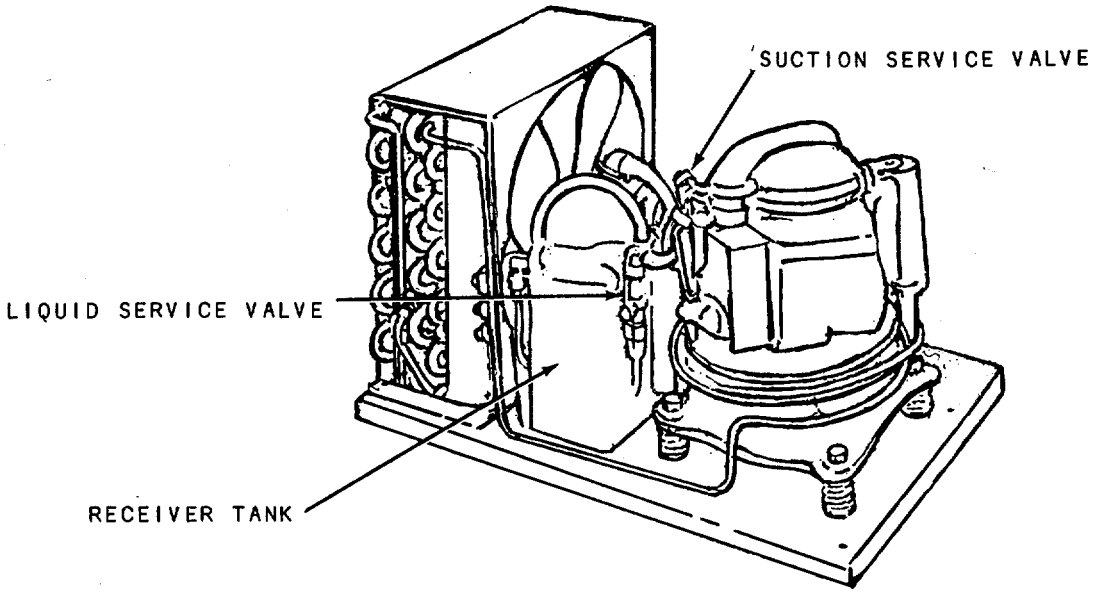
5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

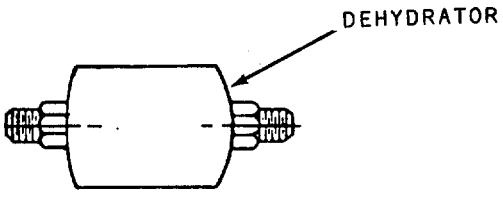
REPLACE (Cont)

13. Dehydrator.

(a) Close liquid service valve, run compressor and pump refrigerant into receiver tank until zero (0) lbs pressure reading is obtained on low side pressure gauge, then close suction service valve. On capillary tube system, purge, (let out) entire refrigerant charge from the system.

(b) Remove dehydrator from liquid line, install new dehydrator, charge system, and check for leaks.



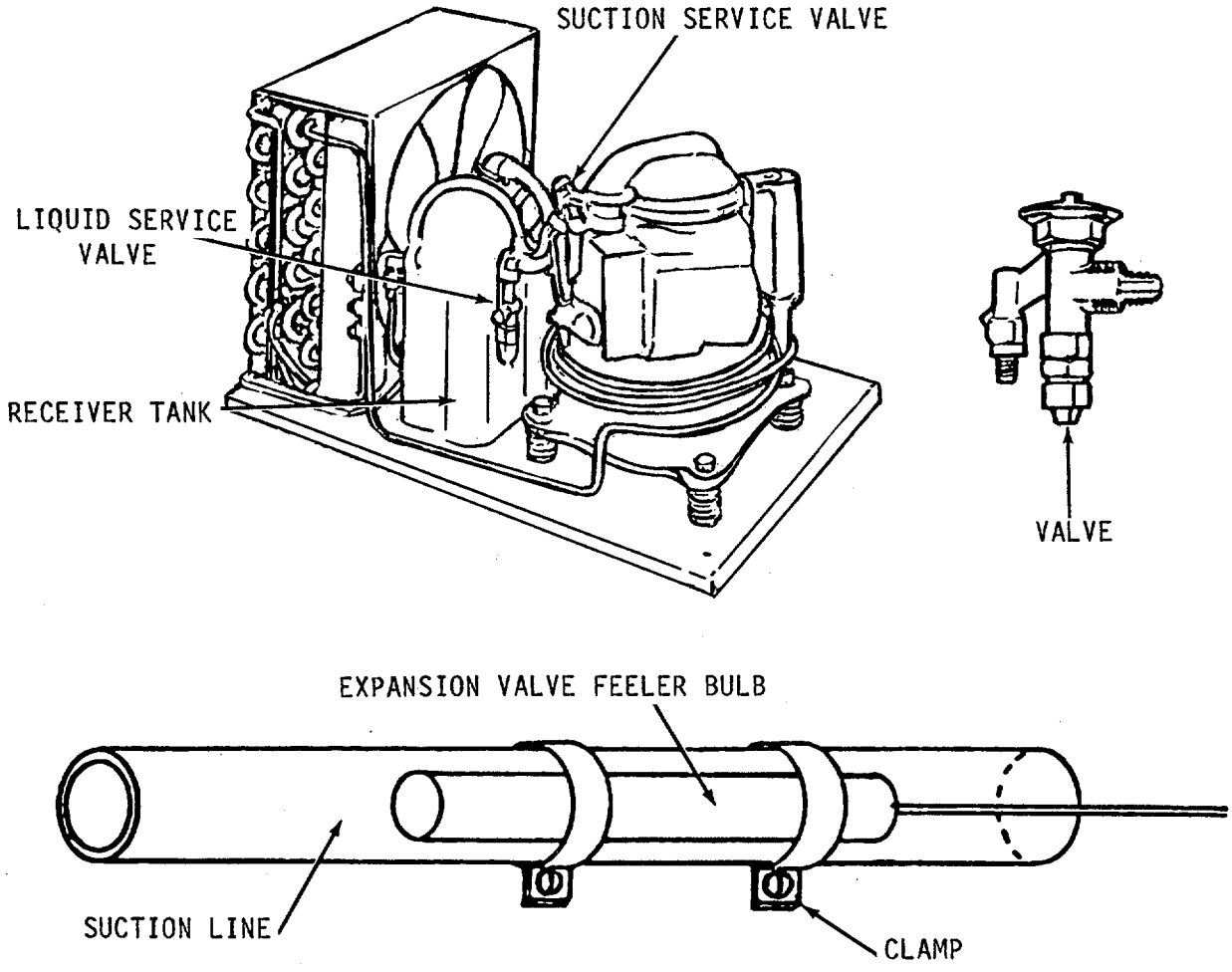


5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

REPLACE (Cont)

14. Valves.

(a) Close liquid service valve, run compressor and pump refrigerant into receiver tank until zero (0) lbs pressure reading is obtained on low side pressure gauge, then close suction service valve.
(b) Disconnect valve feeler bulb from clamp on suction line.
(c) Disconnect valve from inlet and outlet fittings. Remove valve.
(d) Install new valve, reconnect flare fittings and feeler bulb to suction line. Recharge system and check for leaks.



5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

REPLACE (Cont)

15. Testing for leaks.

(a) Refrigerant released in purging and/or charging should be blown away from the refrigerator, before checking for leaks.
(b) Pressure inside the system should be at least 75 lbs on the low side or 150 lbs on the high side.
(c) Using the Halide Torch leak detector, pass the end of the pick up tube very slowly around all sides of the joint, or connection being tested. If the blue flame turns green, this indicates a refrigerant leak.

16. Charging refrigeration system.

CAUTION

Make sure that all lines and fittings, as well as the refrigerant, are dry and clean.

(a) Back seat liquid and suction line service valves.
(b) Attach low and high side pressure gauges.
(c) Pull a vacuum on the system, with a vacuum pump, to at least 25" of vacuum, on the low side gauge.
(d) Disconnect the vacuum pump and attach refrigerant drum. Open low side gauge to allow refrigerant to enter system.
(e) Correct charge of refrigerant is noted on serial tag attached to refrigerator.
(f) Pack seat service valves, remove gauges, replace service valve and port caps.
(g) Check all connections for leaks with Haliade torch leak detector.

17. Pressure gauge readings.

Normal operating pressure range at (75°F) ambient (room) temperature (Refrigerant - (R-12)).

5-147. REFRIGERATOR/FREEZER - MAINTENANCE INSTRUCTIONS (Continued).

REPLACE (Cont)

18. Refrigerator

Head Pressure - 120-130 lbs.

Back Pressure - 24-44 lbs.

19. Freezer

Head Pressure - 120-130 lbs.

Back Pressure - 0-12 lbs.

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Repair b. Servicing

INITIAL SETUP

Test Equipment	References Paragraph	
Halide leak detector	4-40	Milk Dispenser
Special Tools	**Equipment Condition**	**Condition Description**
Brazing equipment	NONE	
Material/Parts	**Special Environmental Conditions**	
Adhesive, BF Goodrich No A815B or equivalent Brazing rod (United Wire Supply) Phason No.6 or equivalent Bulk Permagum Contact cement WA-DO No.97 or equivalent	NONE	
Personnel Required	**General Safety Instructions**	
1	Observe WARNINGS in this procedure.	

LOCATION	ITEM	ACTION	REMARKS

WARNING

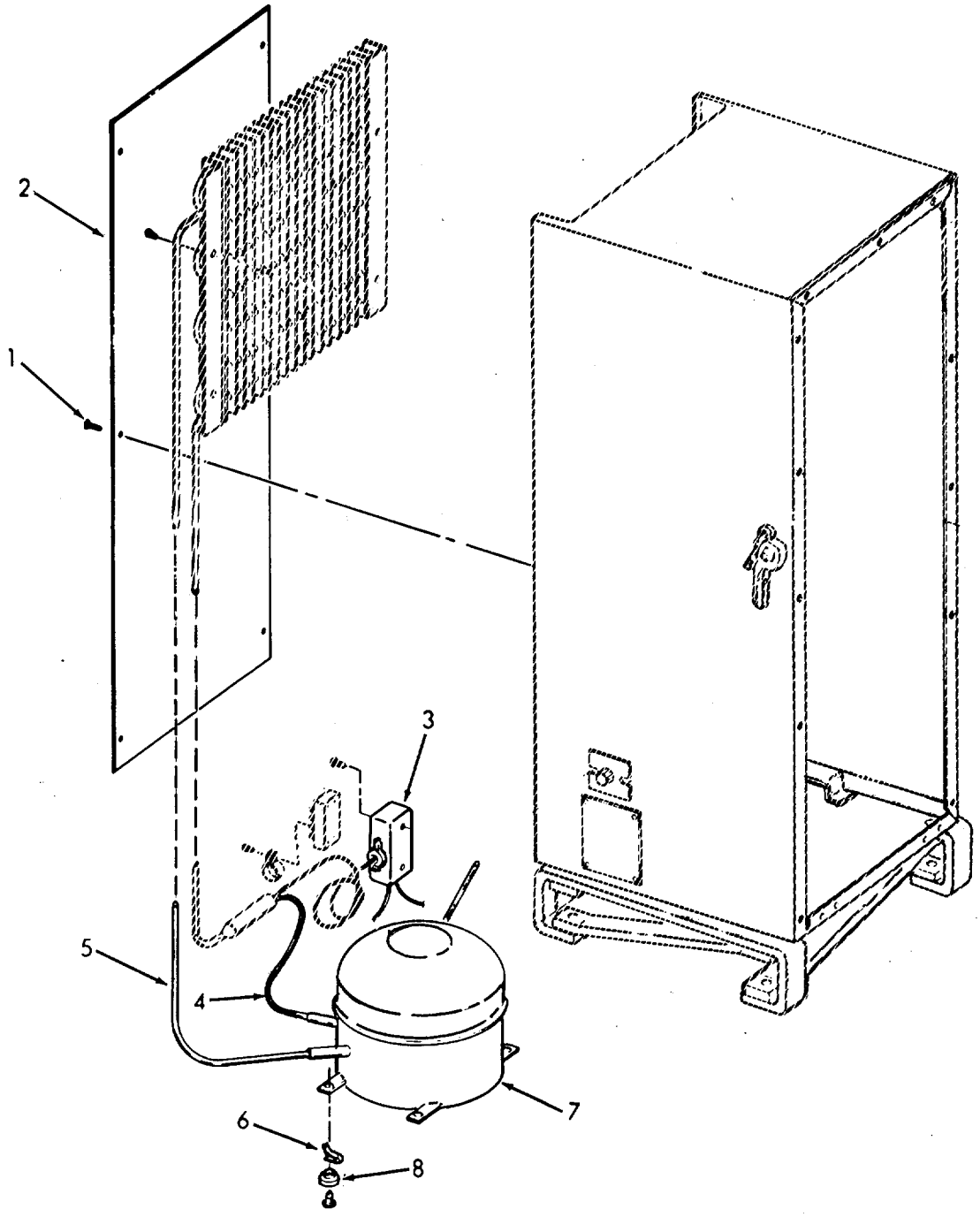
- REFRIGERANT UNDER PRESSURE is used in operation of this equipment.
- DEATH or severe injury may result if you fail to observe safety precautions.
- Avoid prolonged breathing of Freon gas.
- If gas leaks develop, avoid direct skin contact. Wear thermal protective gloves and goggles in any situation where skin-eye contact is possible.

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
	WARNING (Continued) • Prevent contact of refrigerant gas with flame or hot surfaces. Heat causes refrigerant to break down and form a highly toxic and corrosive gas. • 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.		
REPAIR			
1. Compressor	a. Screws (1)	Loosen.	Do not remove.
	b. Air duct panel (2)	Lift panel up and away from unit.	
	c. Wiring	Tag and disconnect wiring in conduit box (3).	
	d. Compressor suction tube (4), and outlet tube (5)	Cut tubes near compressor, and immediately plug open tubes.	
	e. Spring clips (6)	Remove.	
	f. Compressor (7)	Lift and remove.	
	g. Grommets (8)	1. Remove from old compressor. 2. Install in new compressor mounting holes.	

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



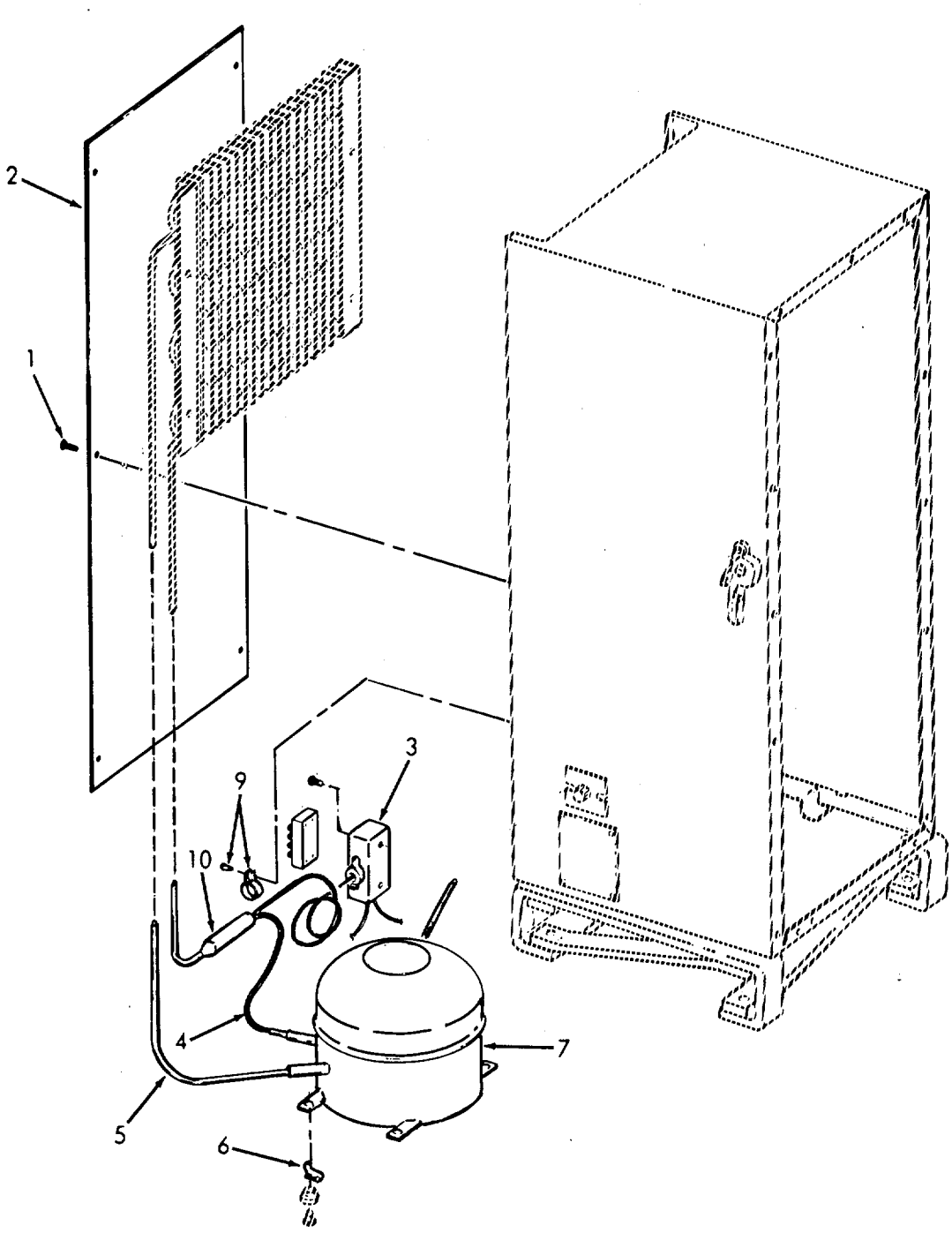
5-1541

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	h. Compressor (7) at left.	1. Position in rear of unit with control box 2. Install spring clips (6).	
	i. Compressor suction tube (4), and outlet tube (5)	Remove plug and reconnect each tube.	
	j. System	Evacuate and recharge.	Refer to step 4b.
	k. Wiring	Reconnect in conduit box (3).	
	l. Air duct panel (2)	Slide into place.	
	m. Screws (1)	Tighten.	
2. Dryer	a. Screw and clamp (9)	Loosen and remove.	
	b. Tubing	1. Cut at dryer (10). 2. Immediately install new dryer. 3. Seal connections.	Use brasing rod.
	c. Screw and clamp (9)	Reinstall and tighten.	

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			

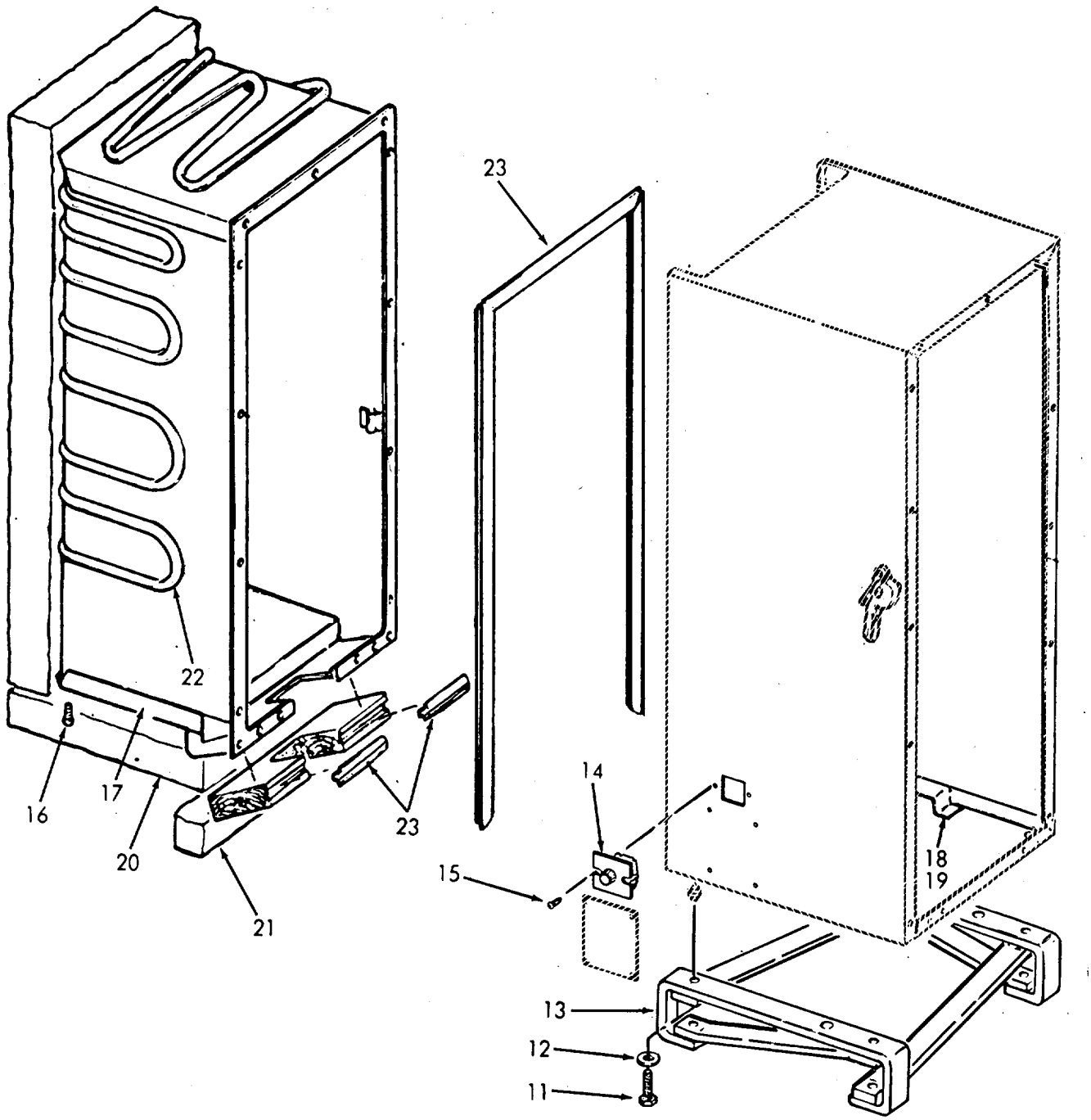


5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
3. Lowside Assembly (evaporator)	a. Compressor	Remove.	Refer to step 1.
	b. Screws (11), and lockwashers (12)	Remove.	
	c. Leg assembly (13)	Remove.	
	d. Temperature control (14)	Pull sensing element free of control well tube, and remove screws (15).	
	e. Screws (16)	1. Remove. 2. Release shell bottom (17).	
	f. Compressor compartment support right (18), and left (19)	Remove.	
	g. Bottom insulation (20), and bottom step insulation (21)	Remove from beneath lowside assembly (22).	
	h. Breaker strip assembly (23)	Remove from perimeter of low side assembly (22).	

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



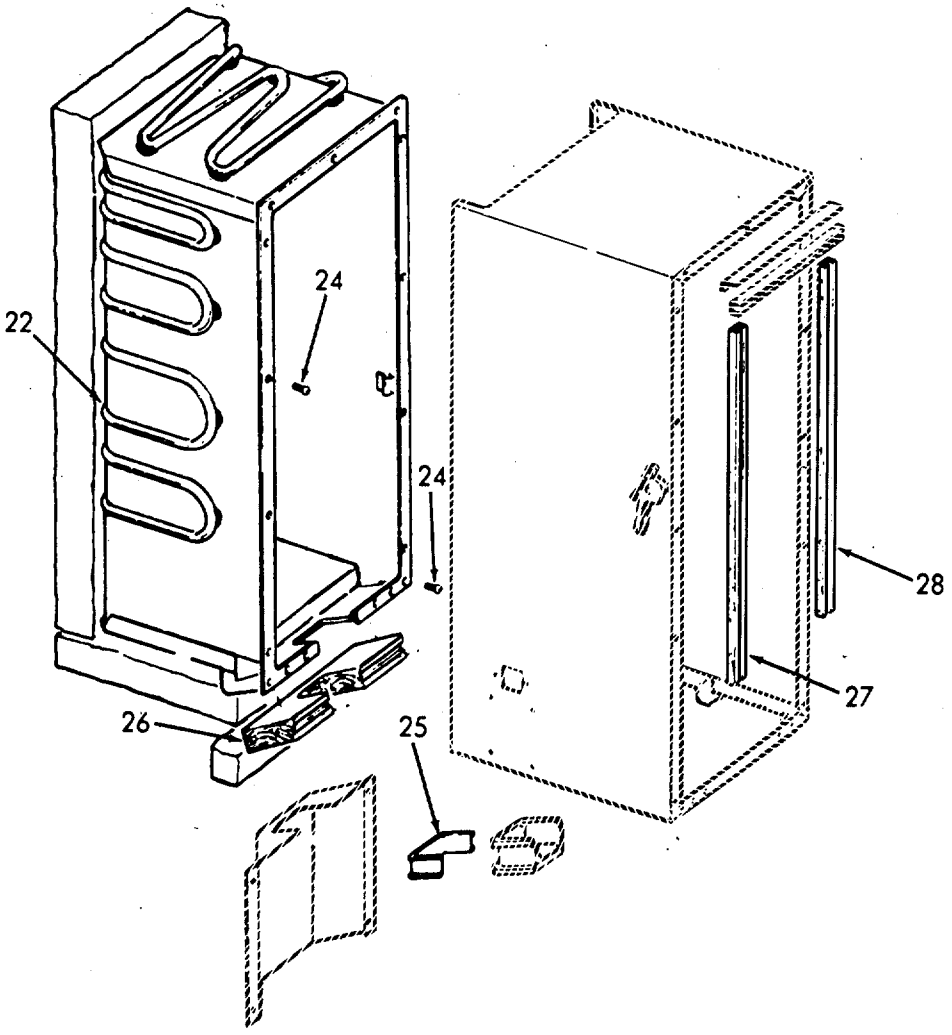
5-1545

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	i. Screws (24)	Remove.	
	j. Molding closure (25), and filler block (26)	Remove.	
	k. Lowside assembly (22)	Pull straight down to clear spacers (27 and 28).	
	l. Evaporator tube repair between tube and liner, and, if necessary, break solder joint loose.	1. When evaporator tube leak is detected, cut plastic loose from 2. Pull tubing free of liner. Use tube cutter to cut tube on each side of leaking area. Cut new tube sightly longer than removed tube to allow for swedging. Swedge both ends of tube. 3. Install new section of tube in evaporator line. Braze tubing connections with brazing rod (United Wire and Supply Company, Phoson No. 6 or equivalent).	

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)		4. Press tube back into position against liner. Solder tube as necessary with 50/50 solder. 5. Lay 1/4 inch fillet of thermo-mastic (Presstite Corporation, No. 446, or equivalent) between tube and liner to insure good contact.	



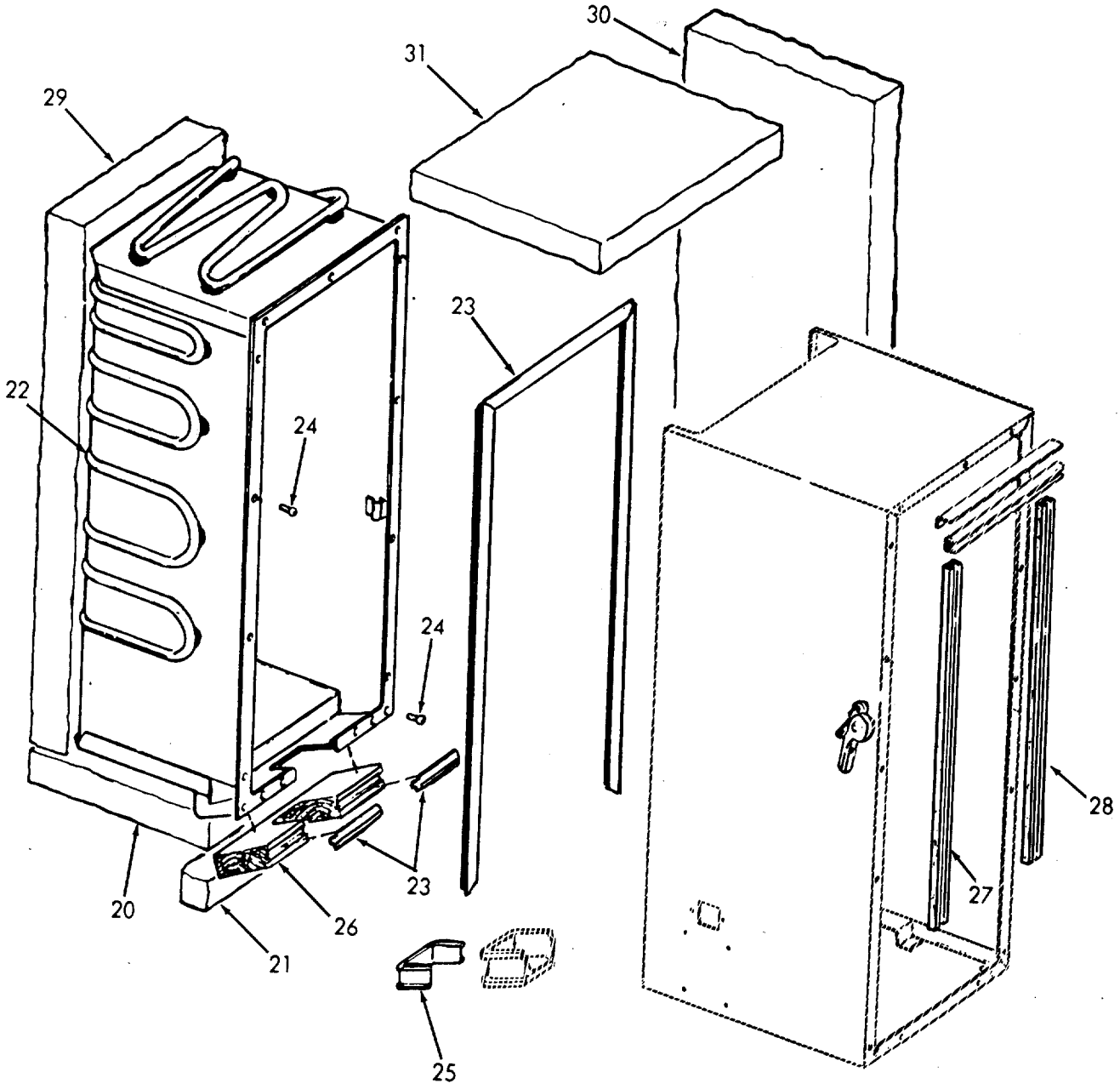
5-1547

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	m. Insulation back (29), side (30), and top (31)	Replace if damaged.	
	n. Lowside assembly (22)	1. Carefully install in cabinet from bottom. 2. Attach to side spacers (27 and 28) with screws (24).	
	o. Molding closure (25)	If molding has broken loose from filler block (26), reattach with contact cement.	
	p. Filler block (26), and attached molding closure (25)	1. Position in cabinet at bottom of lowside assembly. 2. Install screws (24).	
	q. Screws (24)	Apply adhesive over entire area where screws were installed.	
	r. Breaker strips (23)	Assemble to cabinet so adhesive moisture-seals cabinet.	
	s. Bottom insulation (20), and bottom step insulation (21)	Position under lowside assembly (22).	

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			

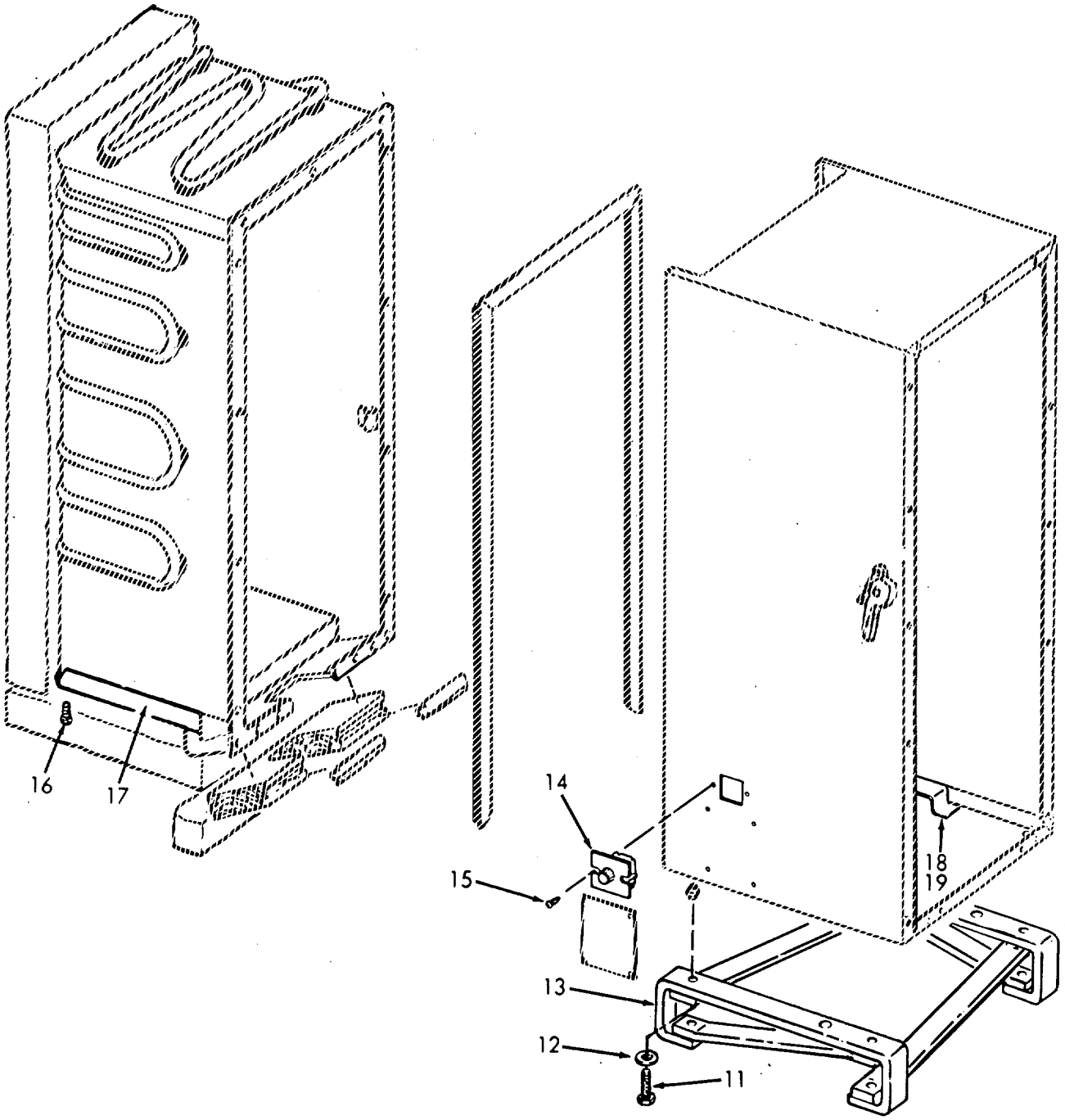


5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	t. Shell bottom (17)	1. Position tubing in hole in bottom. 2. Install using screws (16).	
	u. Compressor Install. compartment support right (18), and left (19)		
	v. Tempera-ture control (14)	1. Insert sensing element in control well tube. 2. Install screws (15).	Secure openings with bulk Permagum.
	w. Leg assembly (13)	Install using screws (11), and lockwashers (12).	
	x. Compressor	Install.	Refer to step 1.

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE			
4.	Milk Dispenser		

NOTE

In certain service operations, the refrigeration system must be opened to atmosphere allowing air and moisture to enter the system. When any refrigerant lines have been disconnected, the system must be purged, or evacuated, and recharged before the dispenser can be operated.

a. Leak detection.

(1) Visibly check refrigeration system components for leaks. Place finger beneath each soldered connection to check for small deposits of oil indicating leakage. If these procedures fail to uncover leak, proceed as follows: (2) Connect dispenser to source of refrigerant and dry nitrogen as illustrated.

NOTE

To make connection at quick coupler (Superior No. T555-4A, or equivalent) cut process tube on compressor. To utilize hermetic port valve (Madden Brass Products No. HP-41, or equivalent), hook valve over process tube between compressor and pinch off point and tighten valve so needle pierces tube wall.

(3) Open regulating valve to refrigerant source. When system pressure reaches 30 psig, close regulating valve in refrigerant line and open regulating valve in dry nitrogen line. Allow system pressure to reach 150 psig, then close regulating valve.

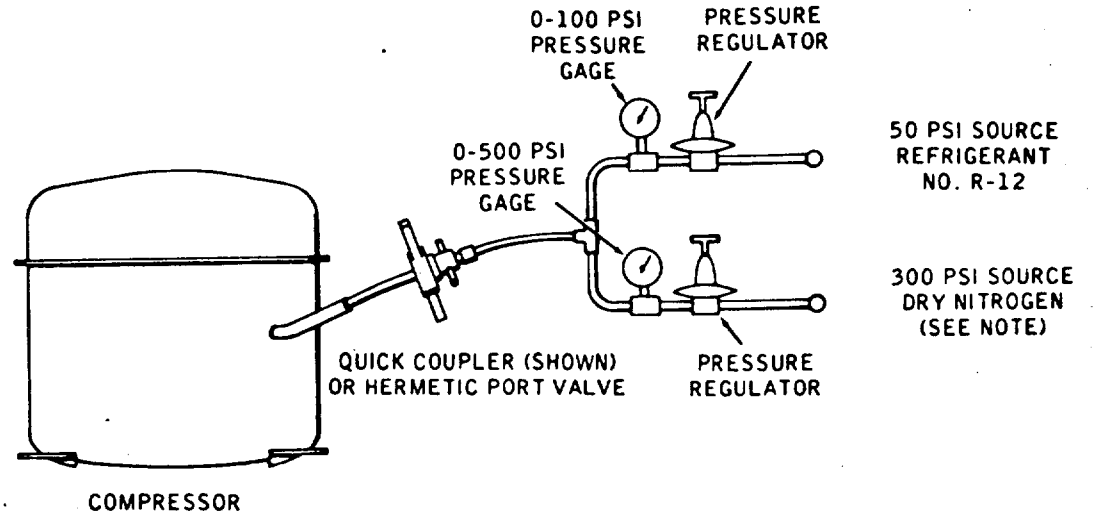
(4) Use electronic leak detector or Halide torch to check for leaks. When using Halide torch use as small a flame as possible. Place end of torch exploring tube at point of suspected leakage. Flame will change color if leak is detected.

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

SERVICE (Cont)

(5) Allow refrigeration system to bleed off before replacing defective tubing or component. Use tube cutter to cut tube on each side of leaking area. When possible, utilize coupling in replacing defective tubing or component. If this is not possible, cut new tube slightly longer than removed tube to allow for swedging ends. Swedge both ends of tube. Install tube in refrigeration system. Braze tubing connections with brazing rod (United Wire and Supply Company, Phoson No. 6, or equivalent).



NOTE: BOOST LEAKAGE PRESSURE TO
150 PSIG ON LOW SIDE
250 PSIG ON HIGH SIDE

(6) Perform leakage test on new connections per steps (3 and (4).
(7) Replace dryer. (Refer to step 2).
(8) Evacuate and recharge refrigeration system.
(9) Pinch tube between quick coupler or hermetic port valve and compressor. Remove coupler or valve. Cut process tube when valve is used. In either case solder end of tube closed.

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

SERVICE (Cont)

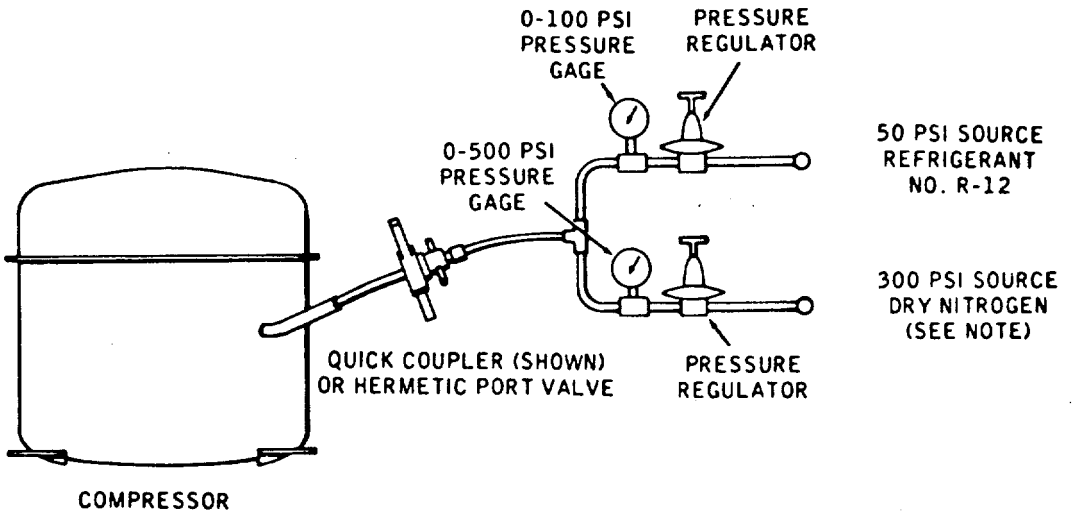
b. Evacuate and recharge. Any time the refrigeration system is opened, evacuation or purging and recharging of the system is required to remove air and noncondensable gases. Purge and recharge system as follows:

(1) Connect dispenser to source of refrigerant as shown below except dry nitrogen supply is not used. Heat discharge line connection and pull discharge line from compressor. Plug compressor discharge port.

CAUTION

Do not reuse refrigerant used in purging operation.

(2) Open regulating valve to permit flow of refrigerant through system.



NOTE: BOOST LEAKAGE PRESSURE TO
150 PSIG ON LOW SIDE
250 PSIG ON HIGH SIDE

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE (Cont)			

(3) Allow one or two pounds of refrigerant to pass through refrigeration system and drain through discharge line. Turn off regulating valve and permit refrigerant to drain until no audible escape of refrigerant can be detected.

(4) Swedge discharge tube end. Remove plug from compressor discharge port. Connect tube to port by brazing.

(5) Measure out quantity of refrigerant for use in each dispenser as applicable.

(6) Slowly inject required amount of refrigerant in process tube before compressor is operated. After refrigerant is added, start compressor and allow unit to operate for approximately two hours. Frost shall have formed on milk can compartment surface and suction tube shall feel warm and have no condensate accumulation at point where tube leaves insulated cabinet.

(7) Replace dryer again (refer to step 2).
(8) Pinch off process tube as detailed in step 4a(9).

c. Adding refrigerant.

(1) Install quick coupler or hermetic port valve on process tube as detailed in Note following step 4a(2).

(2) Start compressor. Slowly inject small amount of refrigerant in process tube and allow unit to operate for one to two hours with door open.

(3) Frost shall appear on compartment surface and no condensate shall be evidenced on compressor suction line at point where tube leaves insulated cabinet.

(4) Pinch off tube (refer to step 4a(9).

d. Bleeding refrigerant. Follow procedures of steps (1) and (4), step c. Use regulator to slowly bleed off small amount of refrigerant.

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

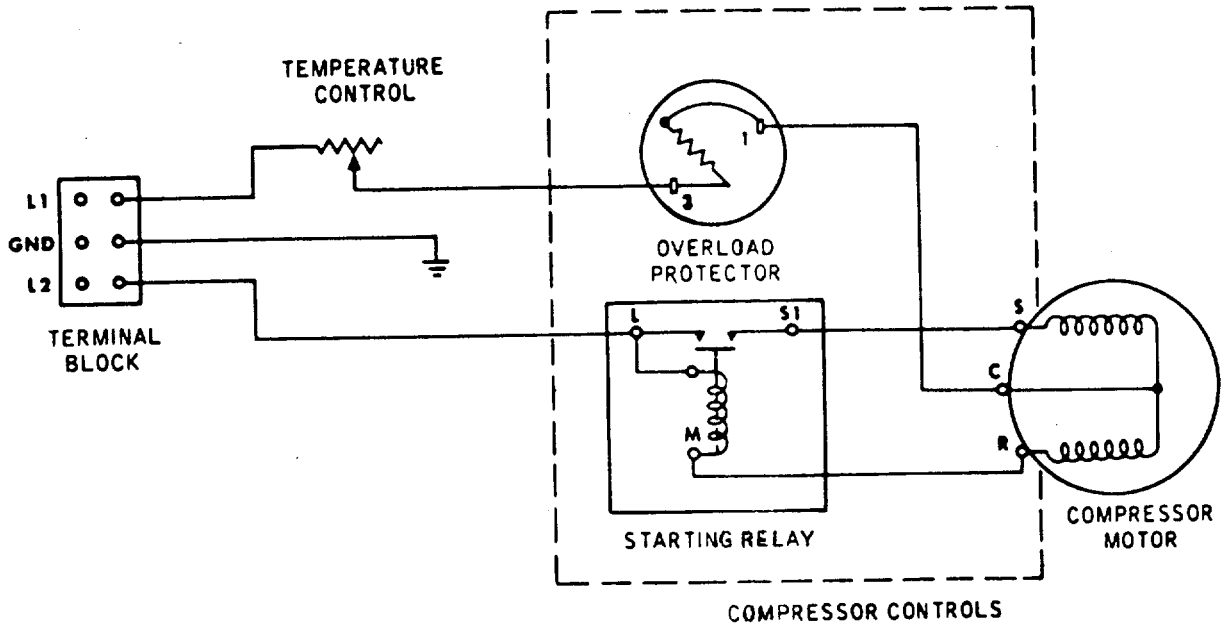
LOCATION	ITEM	ACTION	REMARKS

SERVICE (Cont)

5. Electrical system checkout.

NOTE

Before final reassembly and installation of the dispenser, check the electrical system for proper operation as follows: (see figure below).



a. The electrical system on the hermetic compressor can be checked thoroughly with an ordinary test lamp as follows:

b. With compressor plugged in, test lamp across following must light.

(1) L1 and L_2. If no light, check power source.

(2) L and 3. If no light, make sure control contacts are closed.

(3) M and 3. If no light, relay circuit is open. Replace relay.

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE (Cont)			

(4) M and 1. If no light, overload protector may be tripped off. Wait 10 minutes. If no light, replace defective overload protector.

c. Remove wires from L and 3 and insert test lamp in series with L1 and 3. Momentarily touch L2 to following points in sequence:

(1) S - If no light, start winding is open. Replace compressor.
(2) R - If no light, run winding is open. Replace compressor.
(3) S1 - If no light, Lead S1-S should be replaced.
(4) M - If no light, lead M-R should be replaced.
(5) L - If no light, replace relay.

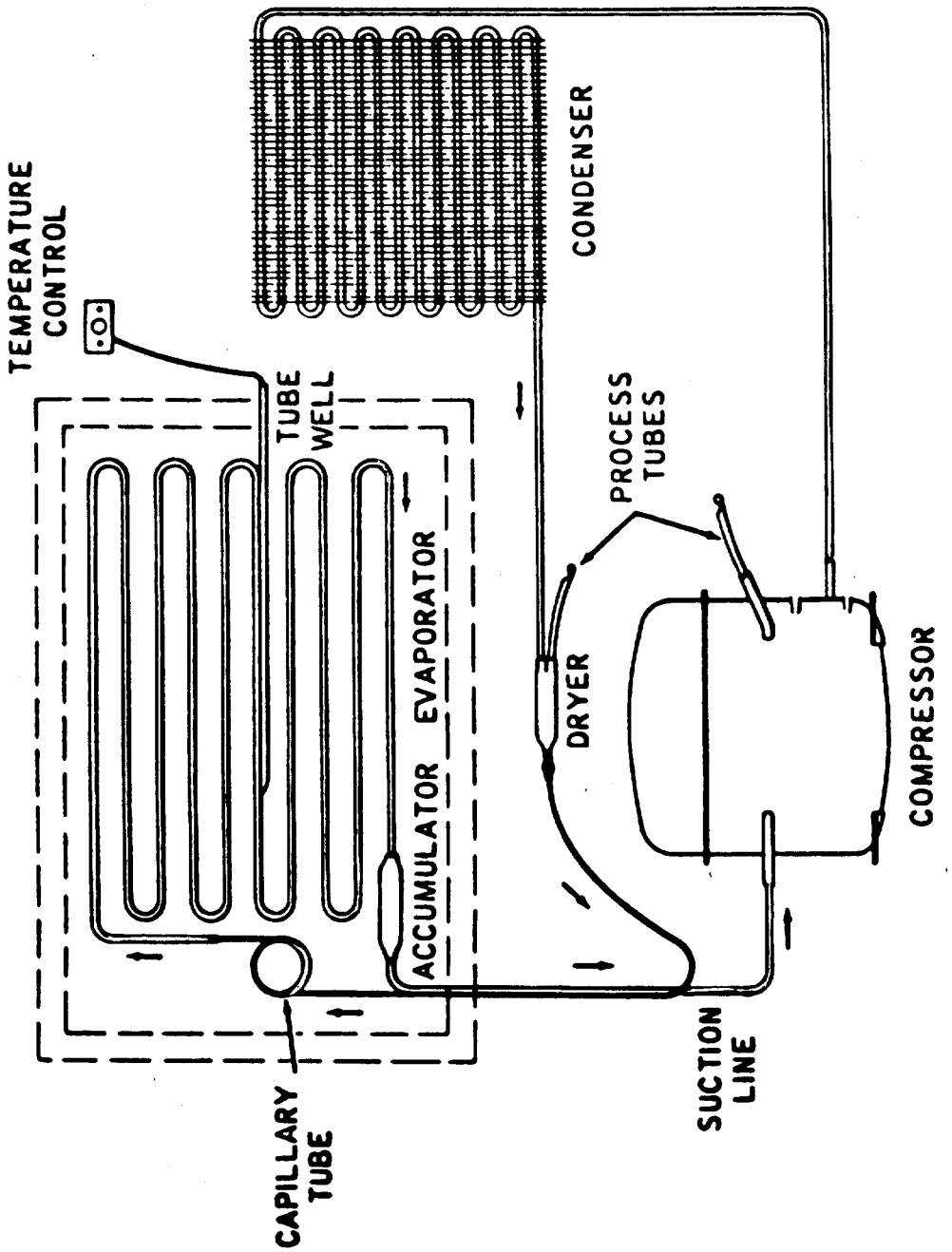
d. Remove lead M-R and insert test lamp in series with L1 and 3. If light shows when L2 is touched to L, relay should be replaced. A new relay will eliminate any faulty electrical characteristics, such as improper pick-up or drop out, which cannot be determined with a test lamp.

e. If all above test prove satisfactory, and there is no capillary restriction, and unit still fails to operate properly with a good relay, compressor should be replaced.

5-148. MILK DISPENSER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

SERVICE (Cont)



5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Test b. Replace c. Repair

INITIAL SETUP

Test Equipment

NONE

References

Paragraph
4-46 Fire Detection/Extinguishing System
FO-15 Fire Detection and Halon Alarm System

Special Tools
NONE

Equipment Condition: 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

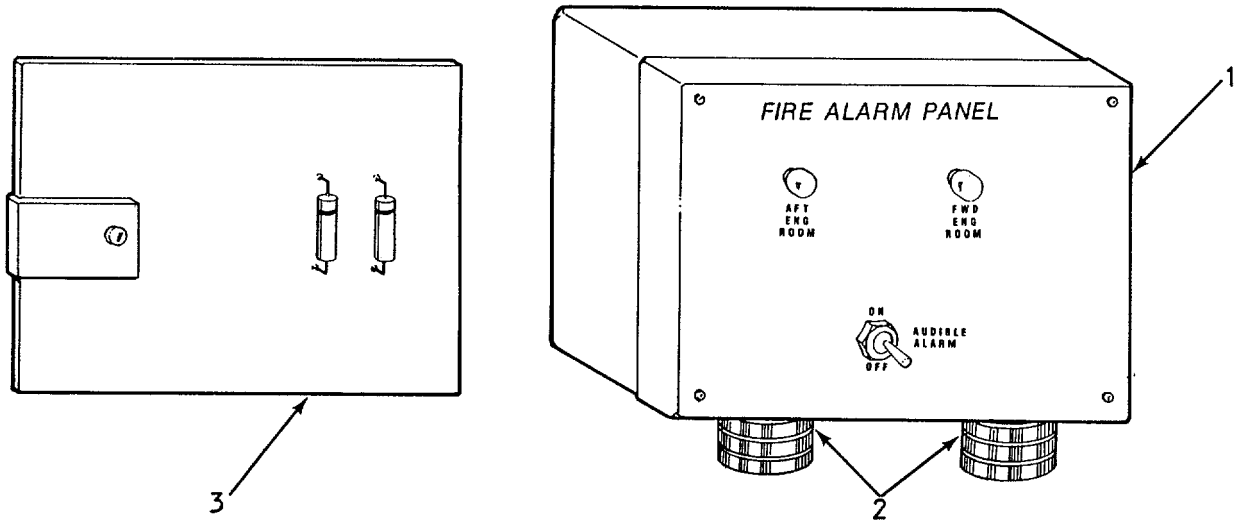
1. System — Refer to paragraph 4-46 for complete information.

REPLACE

2. System — Replace any damaged components in accordance with standard pipe procedures.

5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

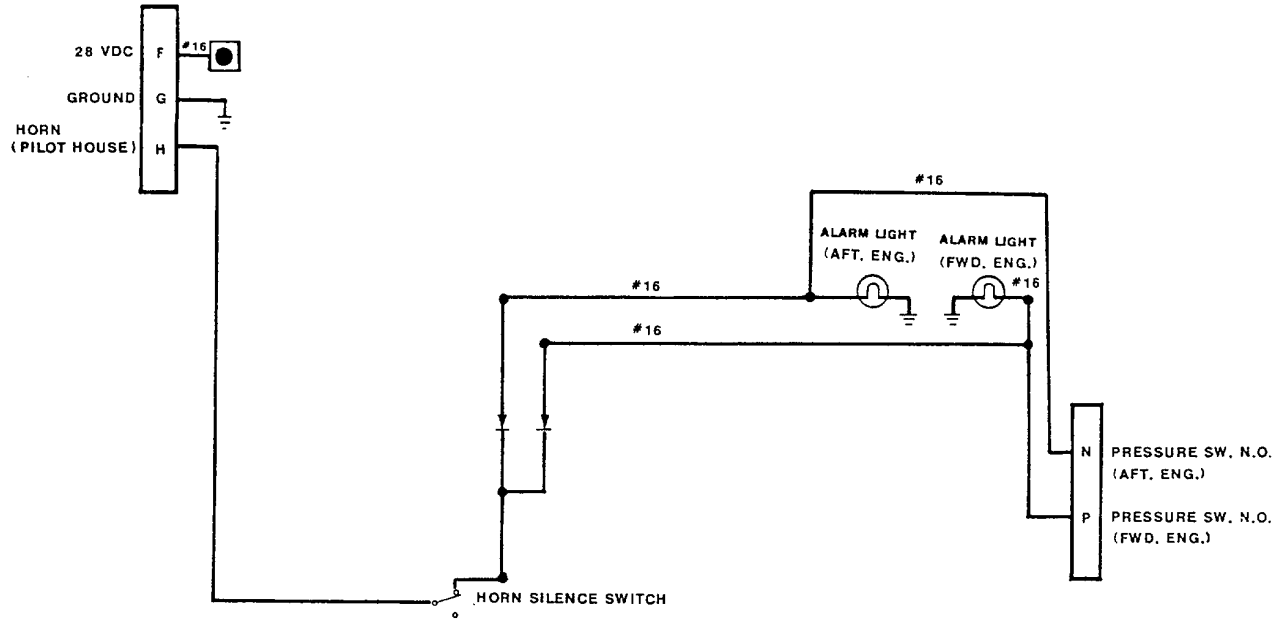
LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
3. Fire Alarm	a. Cables	Tag and disconnect.	
	b. Hardware	Remove.	
	c. Fire Alarm Panel	Replace.	
	d. Hardware	Reinstall.	
	e. Cables	Reconnect.	
4. Cylinder Assemblies	Refer to paragraph 4-46.		
5. All other Components	Refer to paragraph 4-46.1		
REPAIR			
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 5-1562.



5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

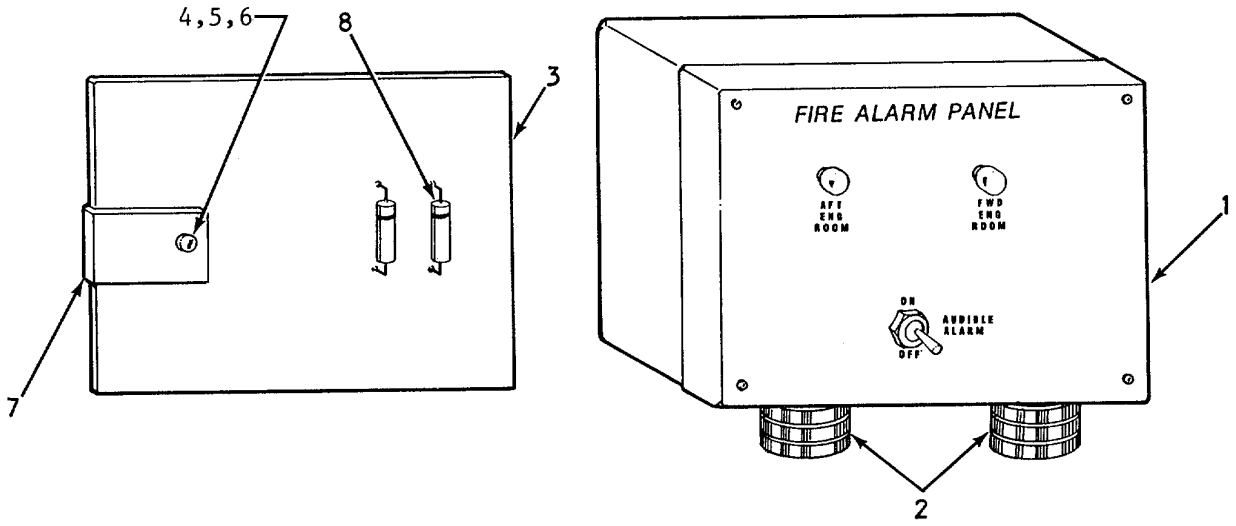
REPLACE (Cont)



NOTE: ALL WIRING IS #20 AWG, EXCEPT WHERE MARKED #16.

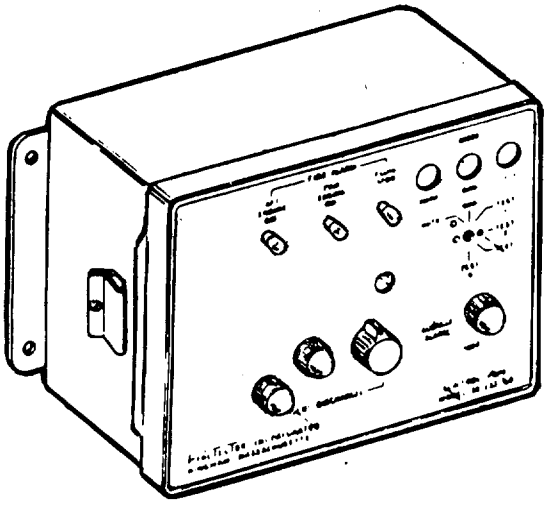
5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

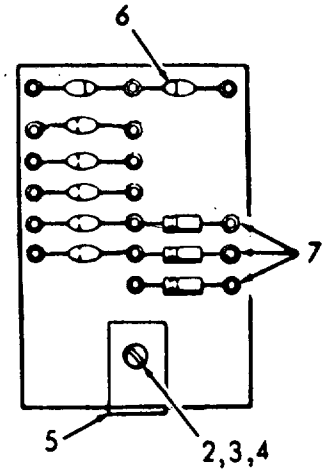
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
		2. Remove nut (4), screw (5), and lockwasher (6) from bracket (7).	
		3. Remove board assembly (3).	Use new board
		4. Reinstall screw (5), lockwasher (6), and nut (4).	
		5. Reconnect wiring.	
	c. Diodes (8)	Replace.	Observe position of solid band on diode. Install new diode with solid band in same position.
	d. Fire Alarm Panel	1. Replace cabinet (1)	
		2. Replace cables (2)	



5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

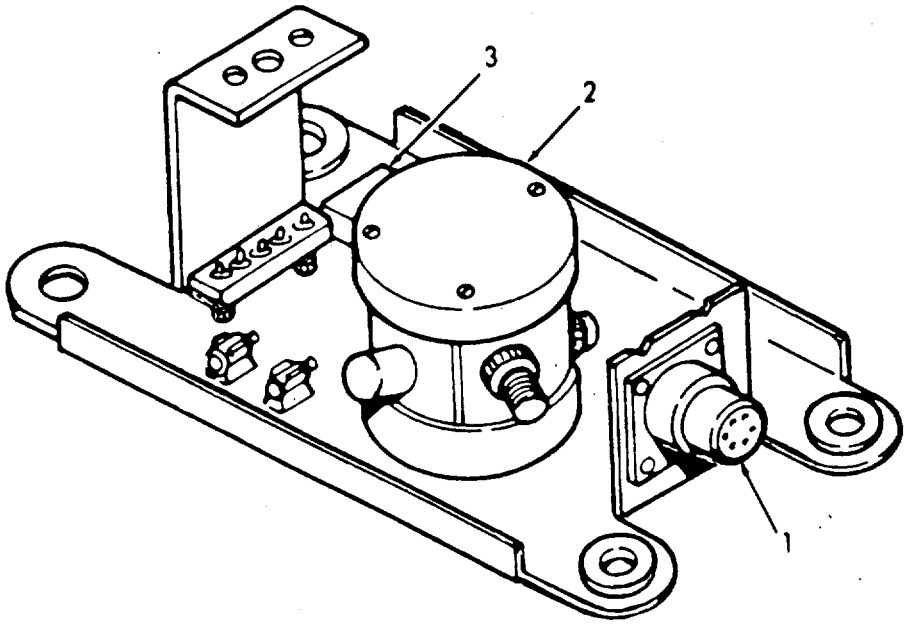
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
		2. Remove nut (2), screw (3), and lockwasher (4) from bracket (5).	
		3. Remove board assembly (1).	Use new board.
		4. Reinstall screw (3), lockwasher (4), and nut (2).	
		5. Reconnect wiring.	
	b. Diodes (6)	Replace.	Observe position of solid band on diode. Install new diode with solid band in same position.
	c. Resistors (7)	Install.	





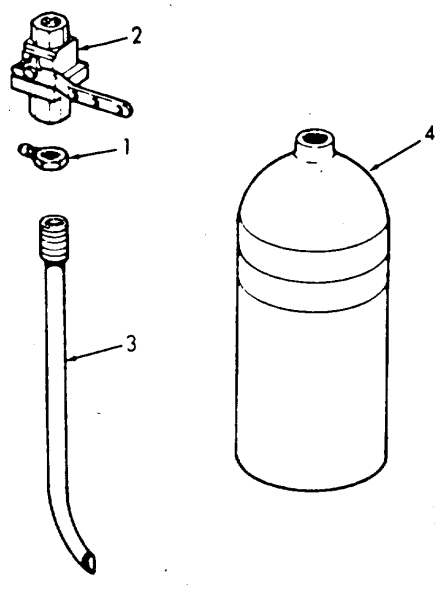
5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

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.	



5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
		WARNING Fire extinguishing agent is oxygen robbing.	
9. Cylinder Assembly (small)	a. Ball valve (1)	Replace if damaged.	
	b. Pressure relief valve (2)	Replace if damaged.	
	c. Dip tube assembly (3)	Replace if damaged.	
	d. Cylinder (4)	Replace if damaged.	

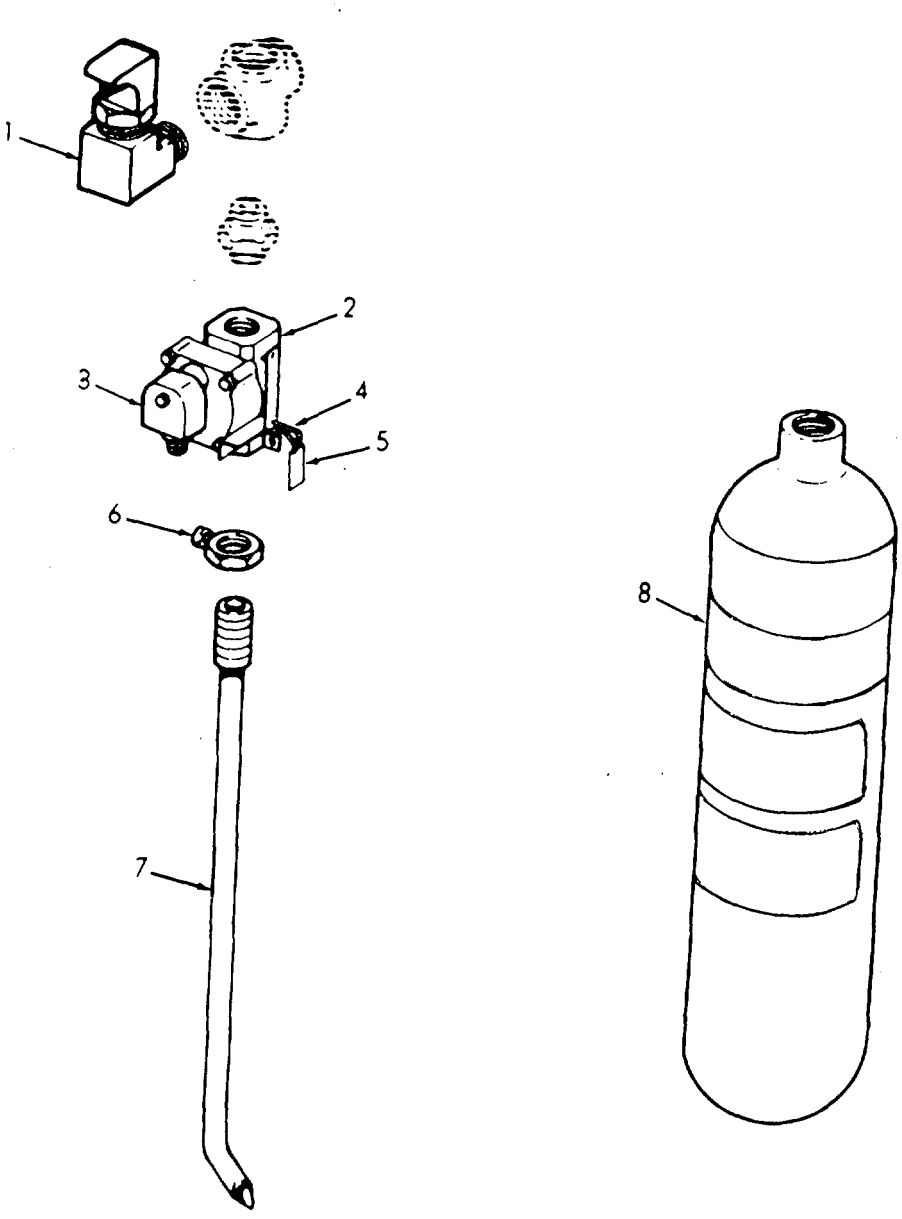


5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
		WARNING	
		Fire extinguishing agent is oxygen robbing.	
10. Cylinder Assembly (large)	a. Spray nozzle (1)	Replace if damaged.	
	b. Solenoid valve assembly (2)	Replace if damaged.	
	c. Coil housing assembly (3)	Replace if damaged.	
	d. Lockpin (4)	Replace if damaged.	
	e. Instruction tag (5)	Replace if damaged.	
	f. Pressure relief valve (6)	Replace if damaged.	
	g. Dip tube assembly (7)	Replace if damaged.	
	h. Cylinder (8)	Replace if damaged.	

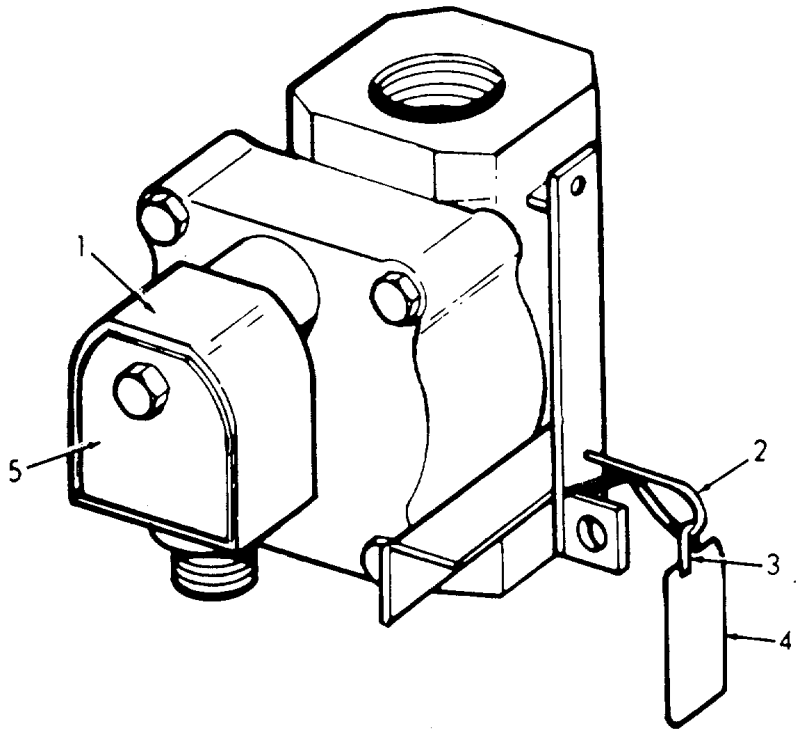
5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



5-149. FIRE DETECTION/EXTINGUISHING SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
11. Solenoid Valve Assembly	a. Coil housing assembly (1), and lockpin (2)	Replace if damaged.	
	b. Cable strap (3), and instruction tag (4)	Replace if damaged.	
	c. Nameplate (5)	Replace if damaged.	



5-150. INTERIOR COMMUNICATION SYSTEMS - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS

The following is an index to the interior communication system maintenance procedures.

5-151. 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 Condition: NONE

Condition Description

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

5-151. INTERIOR COMMUNICATION SYSTEMS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

WARNING

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

CIRCUIT	DESCRIPTION
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
SU	Cease Fire
-	Steering Control and Rudder Angle Indicating System
TL	Remote Tank Level Indicating System
FR	Fire Detection and Halon Release Alarm

5-152. ALARM SWITCHBOARD - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

4-49 Alarm Switchboard

FO-7 Alarm Switchboard Wiring Diagram

Special Tools
Soldering tools

Equipment Condition: NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

Personnel Required
2

General Safety Instructions
NONE

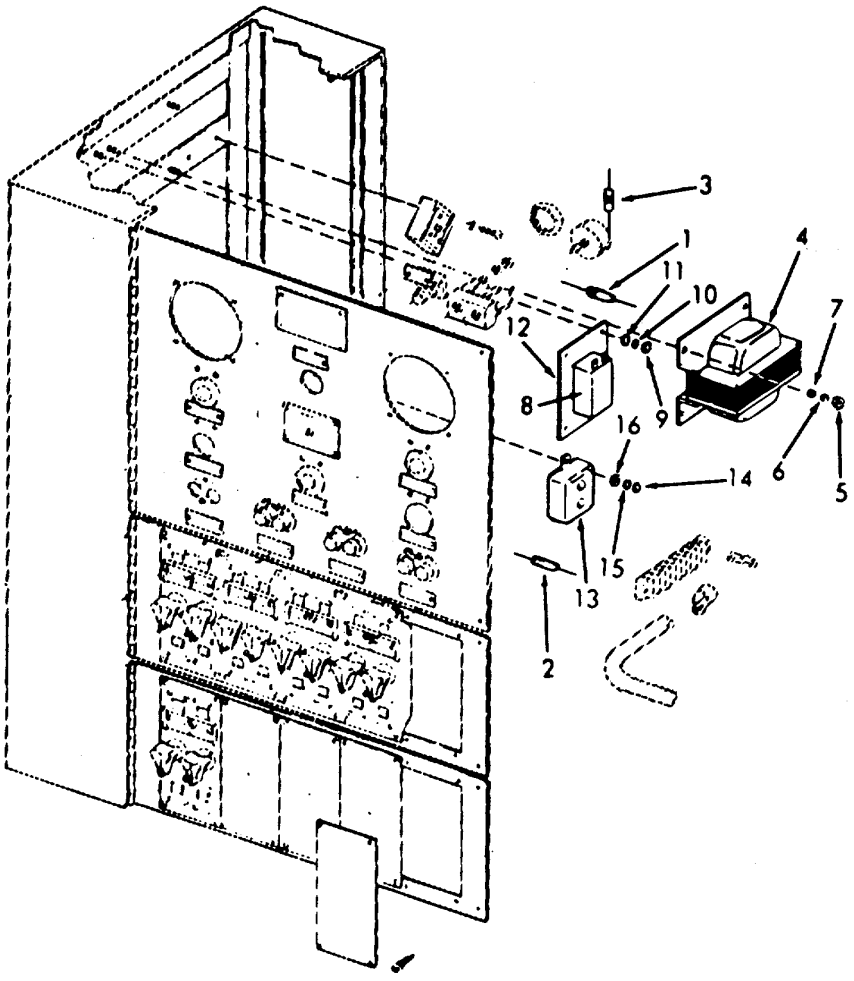
LOCATION	ITEM	ACTION	REMARKS
REPLACE			
1. Alarm Switch-board	a. Wiring	Tag and disconnect.	Refer to FO-7 for wiring diagram.
	b. Mounting hardware	Remove.	
	c. Switch-board	Replace.	
	d. Mounting Hardware	Install.	
	e. Wiring	Reconnect.	

5-152. ALARM SWITCHBOARD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
		NOTE Refer to schematic 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) (Electrolytic 2UF 600V)	1. Remove nuts (14), lockwashers (15), and flatwashers (16).	

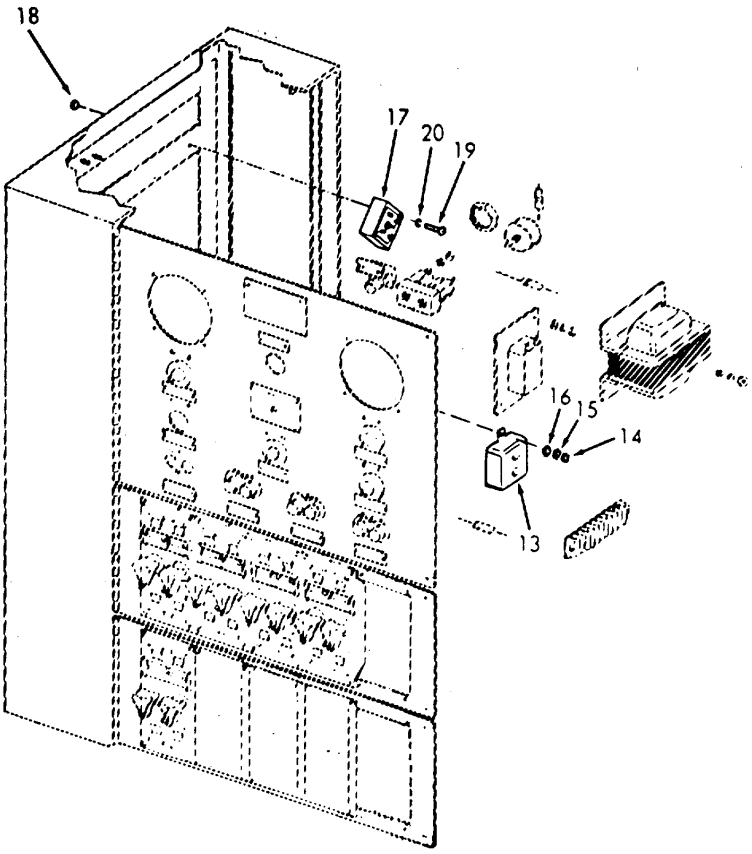
5-152. ALARM SWITCHBOARD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)		2. Tag and disconnect wiring. 3. Replace capacitor (13). 4. Install flatwashers (16), lockwashers (15), and nuts (14), and reconnect wiring.	



5-152. ALARM SWITCHBOARD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.



5-153. THERMOSTAT SWITCH AND MAGAZINE ALARM - MAINTENANCE INSTRUCTIONS.

This task covers:

Replace

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

NONE

Personnel Required

1

References

FO-1	Interior Communication System
FO-7	Alarm Switchboard Schematic

Equipment Condition	Condition Description
NONE	

Special Environmental Conditions

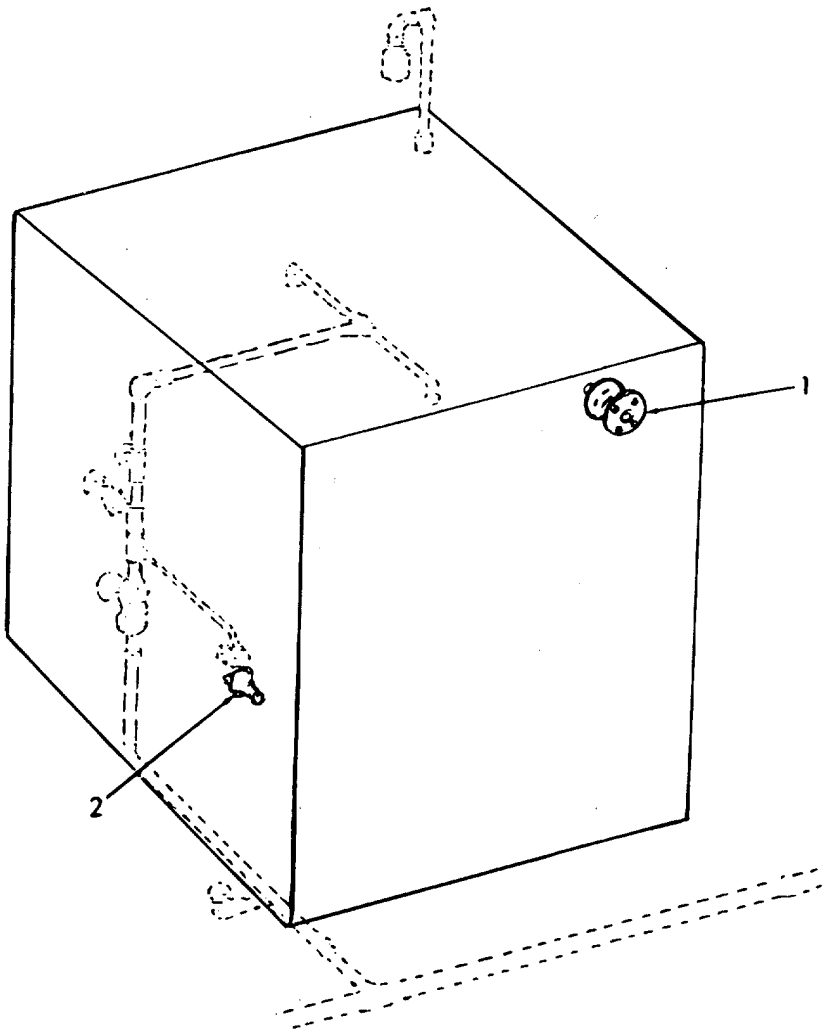
NONE

General Safety Instructions

NONE

5-153. THERMOSTAT SWITCH AND MAGAZINE ALARM - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			
1. Magazine	a. Thermo-static switch (1)	Replace	
	b. Sprinkling alarm switch (2)	Replace	



5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair

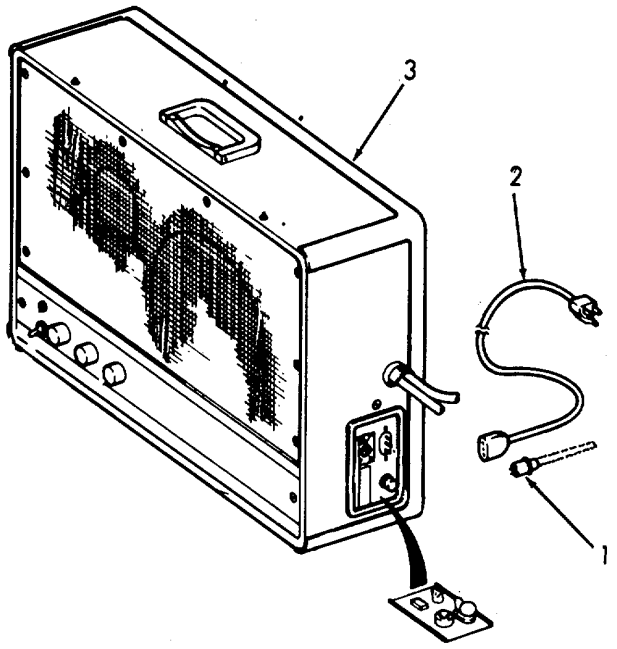
INITIAL SETUP

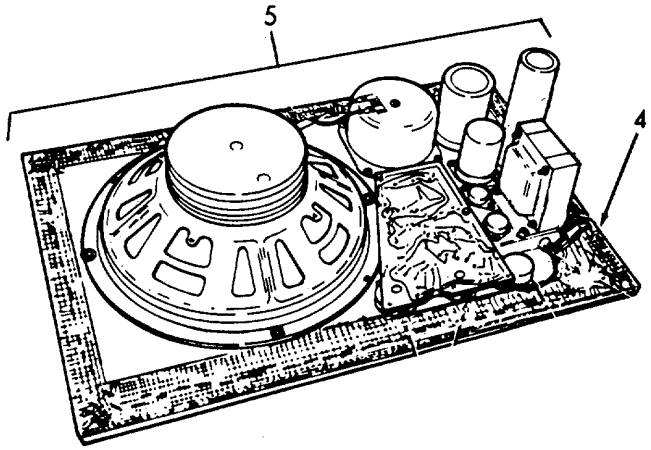
Test Equipment	References
Volt - Ohmmeter	NONE
Special Tools	**Equipment Condition** / **Condition Description**
Soldering tools	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
1	NONE

LOCATION	ITEM	ACTION	REMARKS
Repair			
1. Amplifier	a. 3 pin male audio connector (1)	Replace.	
	b. 8 foot power cord set (2)	Replace.	
	c. Loudspeaker enclosure (3)	Replace.	
	d. Amplifier loudspeaker baffle assembly (4)	Replace.	

5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	e. Amplifier assembly (5)	Replace.	



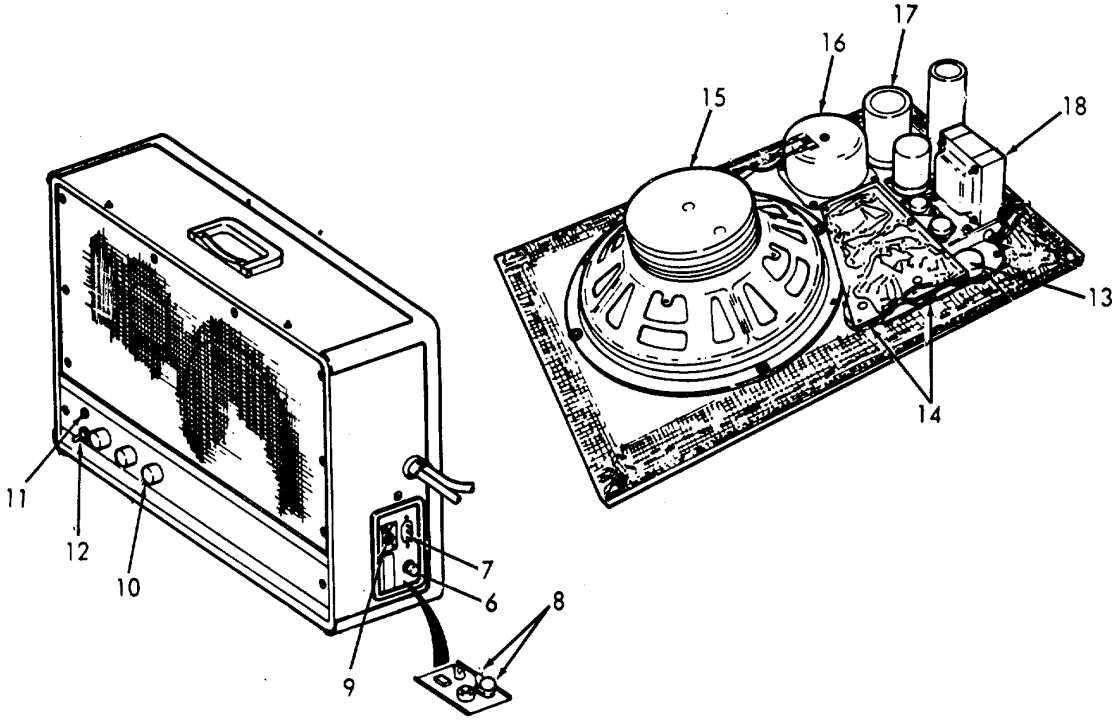


5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	f. Fuse (6)	Replace.	
	g. 3 pin male power connector (7)	Replace.	
	h. 0.005 uf -20 +80 percent 1400VDC ceramic disc capacitor (8)	Replace.	
	i. 3 socket female XL type audio input connector (9)	Replace.	
	j. Pointer knob (10)	Replace.	
	k. Pilot lamp (11)	Replace.	
	l. SPST bat-lever power switch (12)	Replace.	
	m. 100000 ohm 10 percent 2 watt variable carbon resistor (13)	Replace.	

5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	n. Single pole 5 throw rotary switch (14)	Replace.	
	o. Loudspeaker (woofer) (15)	Replace.	
	p. Loudspeaker (tweeter) (16)	Replace.	
	q. Tuned baffle duct (17)	Replace.	
	r. Power transformer (18)	Replace.	



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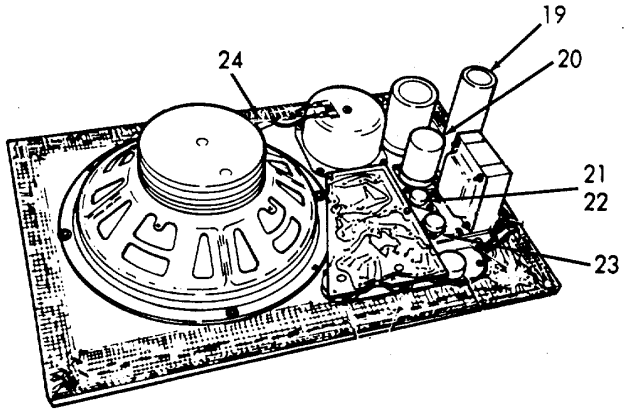
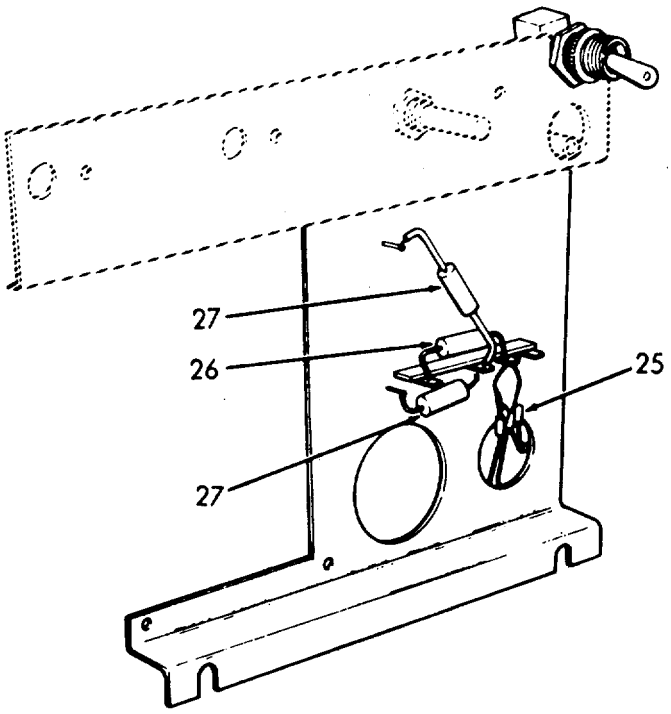
5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	s. 2000 uf 80VDC electrolytic capacitor (19)	Replace.	
	t. 1500 uf 4OVDC electrolytic capacitor (20)	Replace.	
	u. Silicon NPN power transistor (21)	Replace.	
	v. Transistor pad (for Q4) (22)	Replace.	
	w. Germanium pnp T13031 transistor (23)	Replace.	
	x. 5uf 20 per-cent 25 VDC electrolytic capacitor (24)	Replace.	



5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	y. Large signal silicon rectifier diode (25)	Replace.	
	z. 100 ohms 5 percent 1 watt fixed composition resistor (26)	Replace.	
	aa. 0.47 ohm 5 percent 2W wire-wound resistor (27)	Replace.	

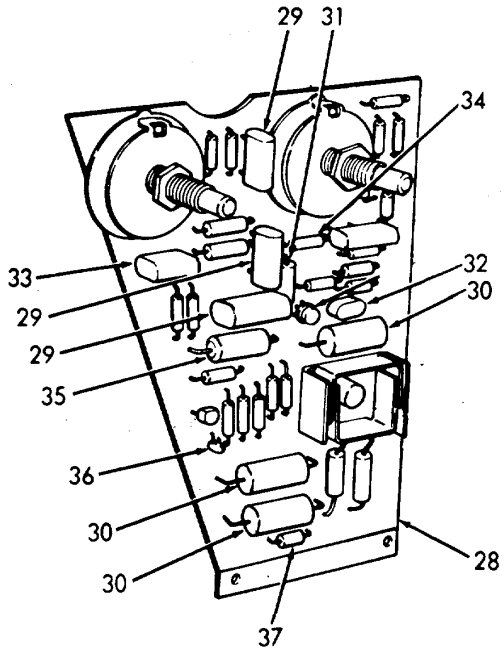


5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	ab. Printed circuit board assembly (28)	Replace.	
	ac. Mylar 0.22uf 10 percent 50 VDC capacitor (29)	Replace.	
	ad. 50uf -10 +75 percent 5OVDC electrolytic capacitor (30)	Replace.	
	ae. 2uf -10 +75 percent 25VDC electrolytic capacitor (31)	Replace.	
	af. 560uuf 5 percent 30OVDC mica capaci-tor (32)	Replace.	
	ag. Mylar 0.0068uf 5 percent 100VDC capacitor (33)	Replace.	

5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	ah. Mylar 0.022uf 10 percent 50VDC capacitor (34)	Replace.	
	ai. 15uf -10 +75 percent 50OVDC electrolytic capacitor (35)	Replace.	
	aj. 0.68uf 5 percent 25VDC tantalum capacitor (36)	Replace.	
	ak. Large signal silicon diode (37)	Replace.	

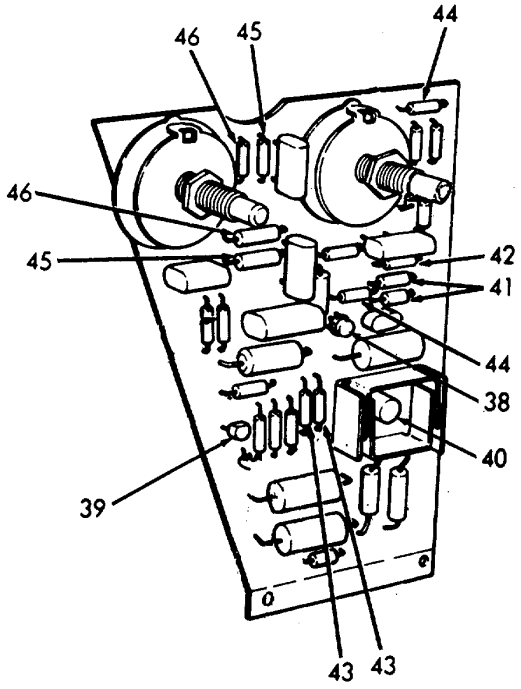


5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	al. NPN type low noise low level silicon transistor (38)	Replace.	
	am. PNP type silicon transistor (39)	Replace.	
	an. NPN type 40409 silicon transistor (40)	Replace.	
	ao. 2.2 megohms 10 percent 1/2 watt fixed com-position resistor (41)	Replace.	
	ap. 220k ohms 10 percent 1/2 watt fixed composition resistor (42)	Replace.	
	aq. 47k ohms 10 percent 1/2 watt fixed composition resistor (43)	Replace.	

5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	ar. 4.7k ohms 5 percent 1/2 watt fixed composition resistor (44)	Replace.	
	as. 7.5k ohms 5 percent 1/2 watt fixed composition resistor (45)	Replace.	
	at. 39k ohms 5 percent 1/2 watt fixed composition resistor (46)	Replace.	

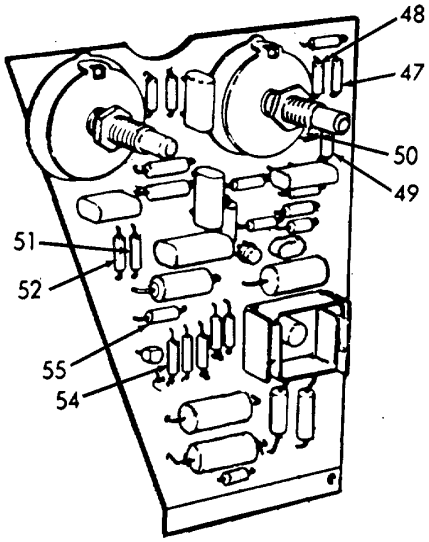


5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	au. 2.4k ohms 5 percent 1/2 watt fixed composition resistor (47)	Replace.	
	av. 6.2k ohms 5 percent 1/2 watt fixed composition resistor (48)	Replace.	
	aw. 22k ohms 5 percent 1/2 watt fixed composition resistor (49)	Replace.	
	ax. 68k ohms 5 percent 1/2 watt fixed composition resistor (50)	Replace.	
	ay 27k ohms 10 percent 1/2 watt fixed composition resistor (51)	Replace.	

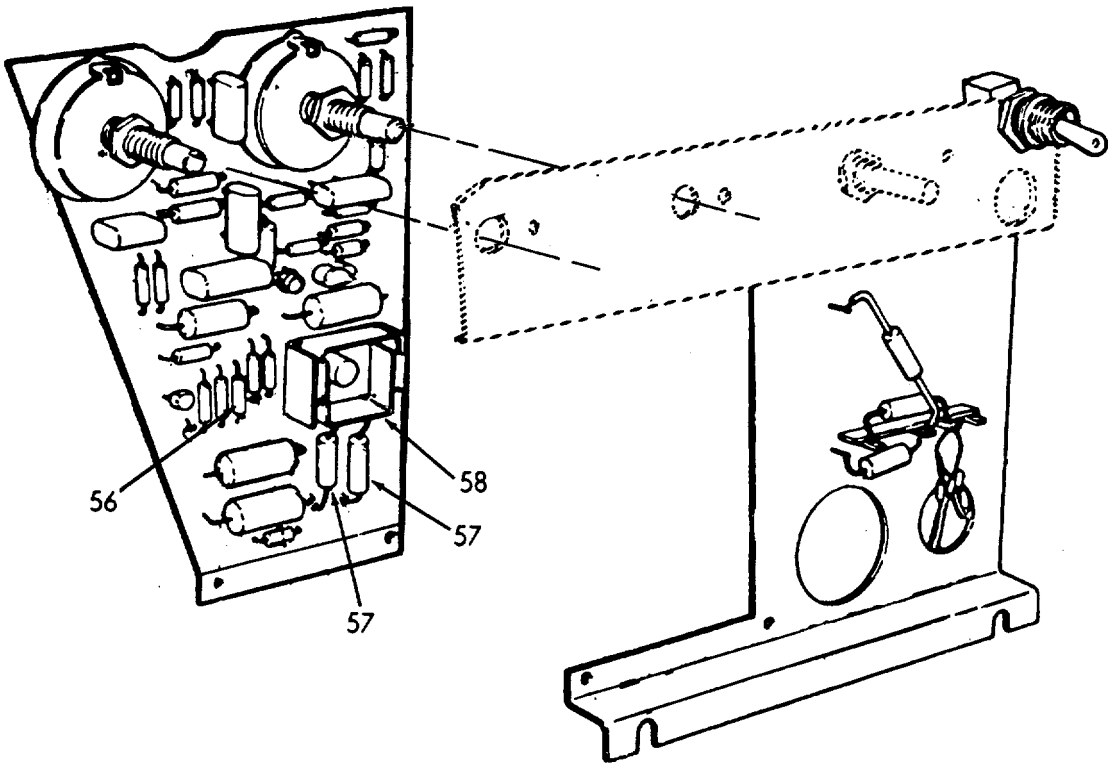
5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	az. 100k ohms 10 percent 1/2 watt fixed composition resistor (52)	Replace.	
	ba. 2.2k ohms 10 percent 1/2 watt fixed composition resistor (53)	Replace.	
	bb. 10k ohms fixed composition resistor (54)	Replace.	
	bc. 1.5k ohms 10 percent 1/2 watt fixed composition resistor (55)	Replace.	



5-154. AMPLIFIER/LOUDSPEAKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	bd. 100k ohms 10 percent 1/2 watt fixed composition resistor (56)	Replace.	
	be. 270k ohms 10 fixed composition resistor (57)	Replace.	
	bf. Transistor pad (58)	Replace.	



5-1590

5-155. 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

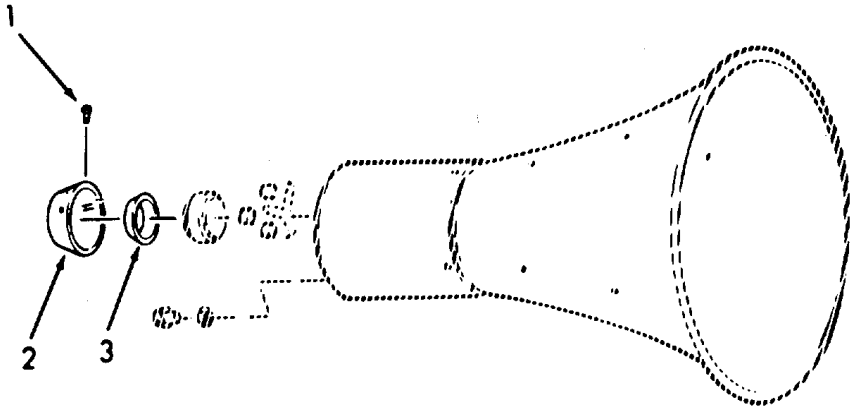
Personnel Required

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 rubber mouthpiece (3).	If damaged.

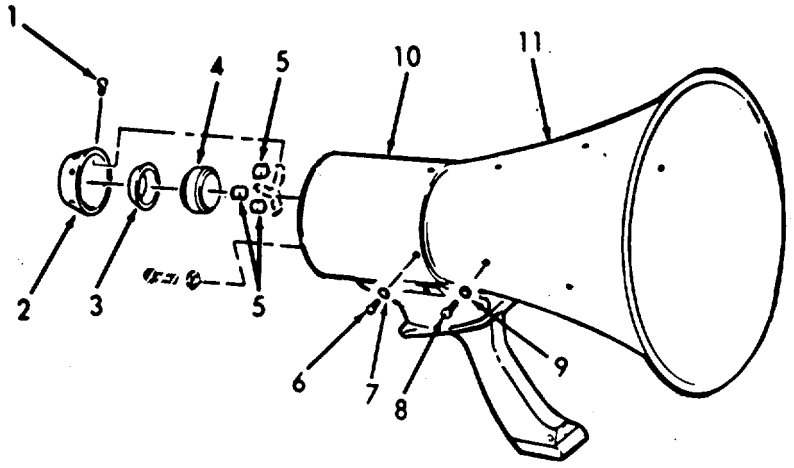


5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

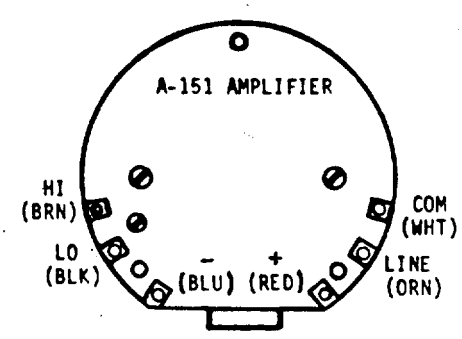
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	c. Microphone (4)	1. Remove electrical wiring by removing two screws and lugged leads.	The other end of the wires are soldered to the two press-fit terminals on the amplifier housing.
		2. Replace microphone by reinstalling two screws and lugged leads.	
	d. Neoprene bumpers (5)	Replace.	If damaged.
	e. Microphone 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).	

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			



	d. Wiring	Disconnect wires.	COM - white LINE - orange + - red - - blue HI - brown LO - black

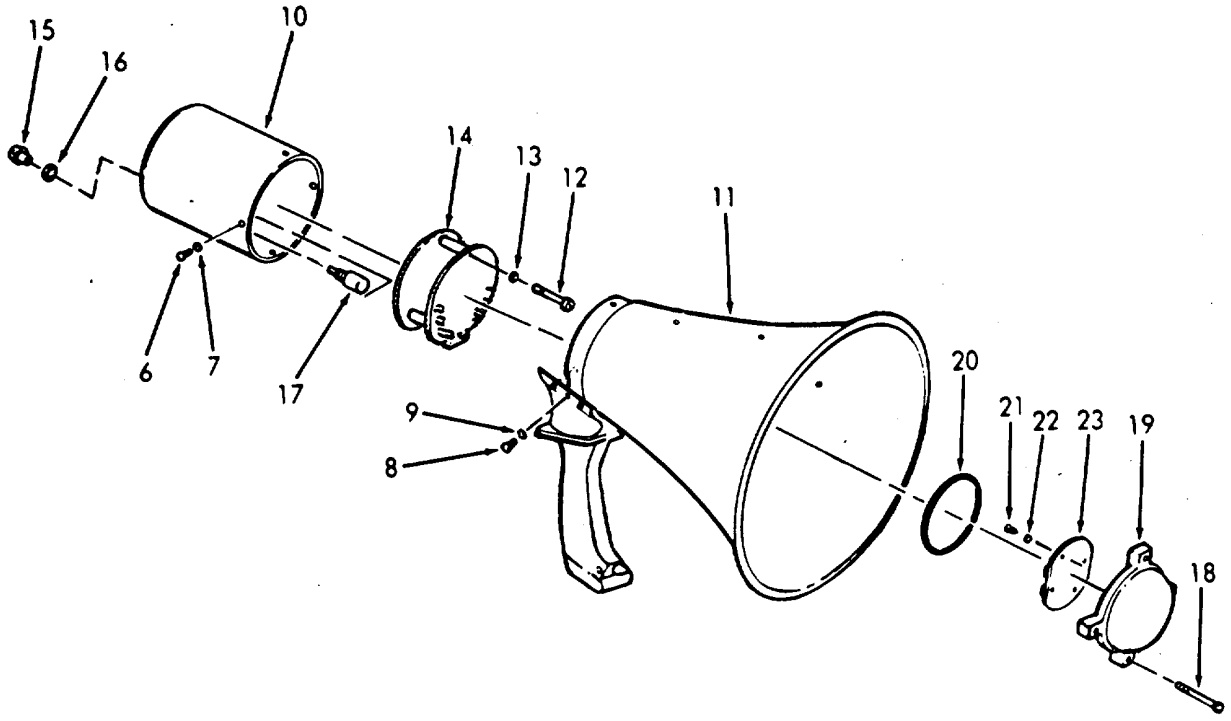


5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	e. Screws (12), and flat-washers (13)	Remove.	
	f. Amplifier (14)	Remove. for repairs.	Refer to step 6
	g. Volume control	1. Remove knob (15), seal nut (16), and variable resistor (17).	
		2. Disconnect wiring.	Refer to schematic.
		3. Replace variable resistor (17).	
		4. Reconnect wiring.	
		5. Install seal nut (16), and knob (15).	
	h. Amplifier (14)	1. Install using screws (12), and flatwashers (13).	
		2. Reconnect wiring.	Refer to step 2d.
	i. Amplifier housing assembly (10)	1. Slide onto horn (11).	
		2. Install screws (8), and lockwashers (9).	
		3. Install screws (6), and lockwashers (7).	

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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)	1. Disassemble.	If necessary.
		2. Inspect springs on the contact boards to make certain they have not become de-formed.	
		3. Inspect contacts for corrosion.	Blackening of silver plate is normal. It is not necessary to remove it. Clean with metal polish.

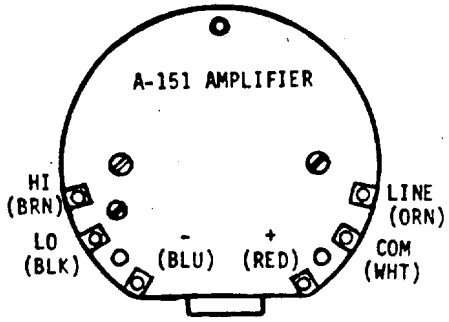


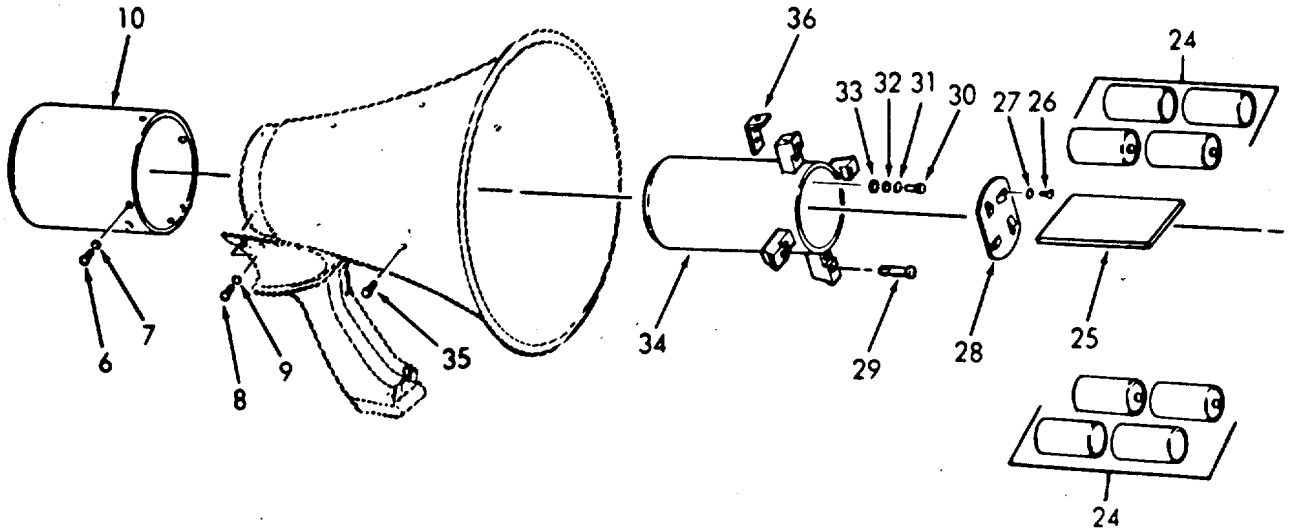
5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

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 preformed packings (33)	Remove.	
	i. Battery cartridge lung (34)	Remove.	
	j. Screws (35), and lung supports (36)	Remove.	If necessary.

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	k. Screws (6), and lock-washers (7)	Remove.	
	l. Housing assembly (10)	Remove.	
	m. Wiring	Disconnect wires to loudspeaker. COM - white LINE - orange + - red - - blue	



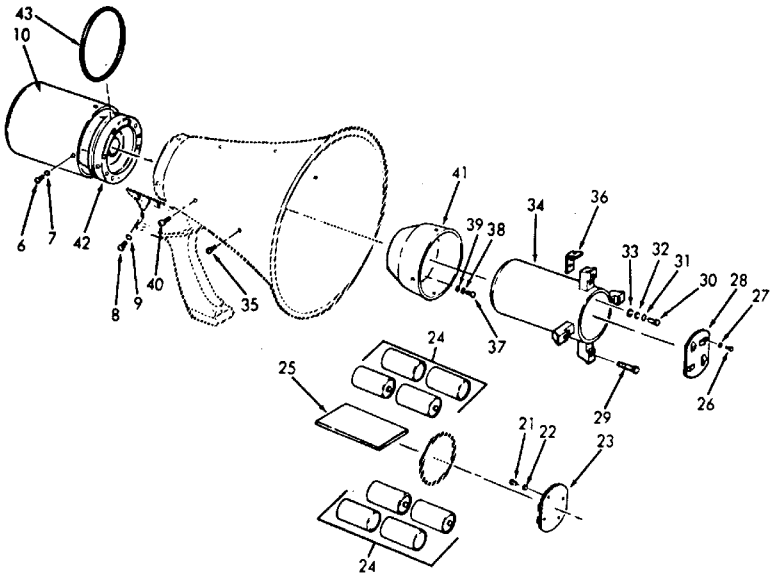


5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

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 petro-leum jelly on O-ring.
	t. Horn shell (41)	Install using screws (40 and 37), lock-washers (39), and flatwashers (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.	

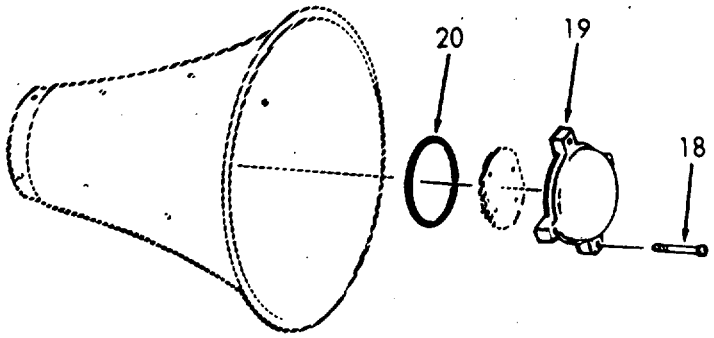
5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Con't)			
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 out-line on separator (25).	
ab.	Contact board (23)	Install with screws (21), and lockwasher (22).	



5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Con't)			
	ac. Cover (19), and pre-formed packing (20)	Install.	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.
	ad. Screws	Install.	



5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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

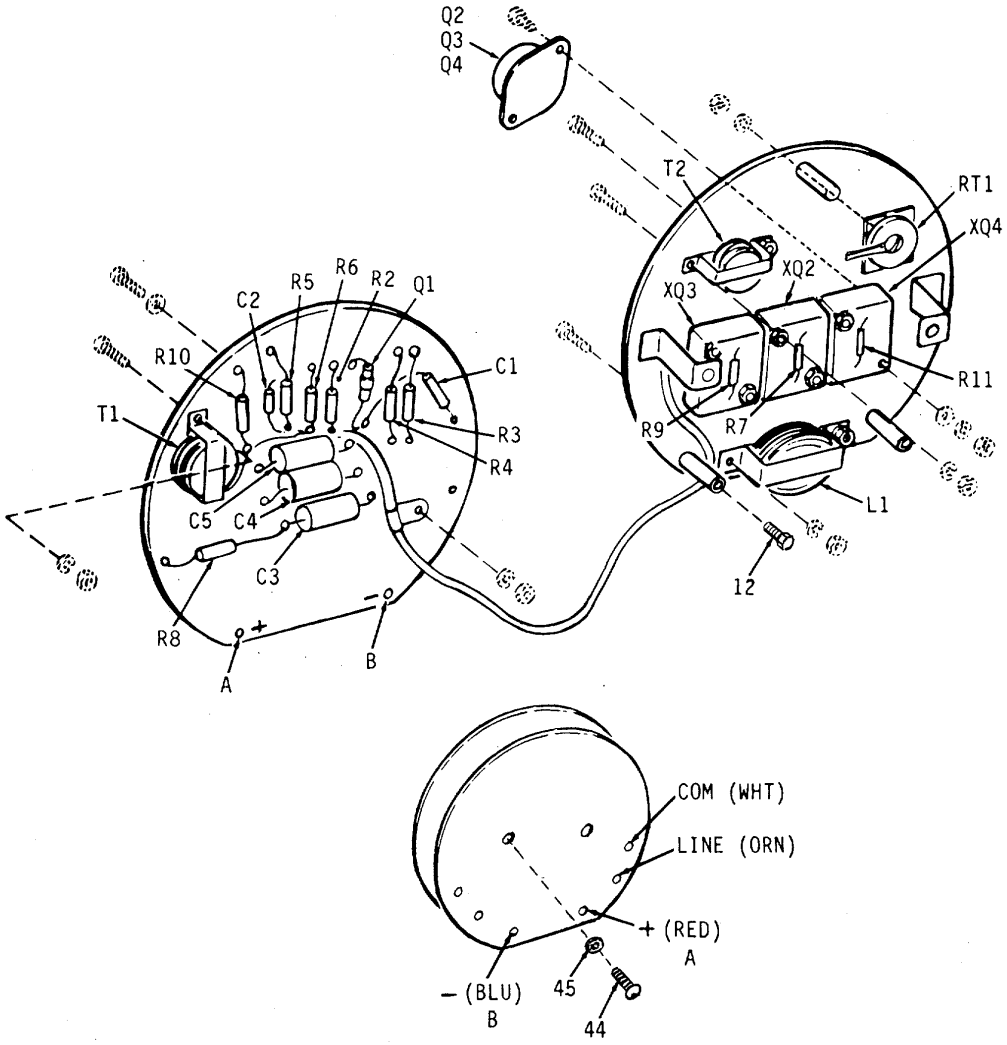
a. Refer to the electrical schematic of the Loudhailer.

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 (43), and flatwashers (44) 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.

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
TESTS Cont)			



5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
TESTS (Cont)			

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 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 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.

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 Tl-l	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

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 3-4-5	250 80	22 3.2 EA. Half	34 32	502 142 EA. Half	 Center

L1

1-2-3	150	0.4 EA. Half	23	198	Center

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 VOM
Test Point A - Positive bus
Test Point B - Negative bus
Transistors in circuit
Test set-up (see illustration)
All readings are in volts

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 convient and conductive 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.

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.

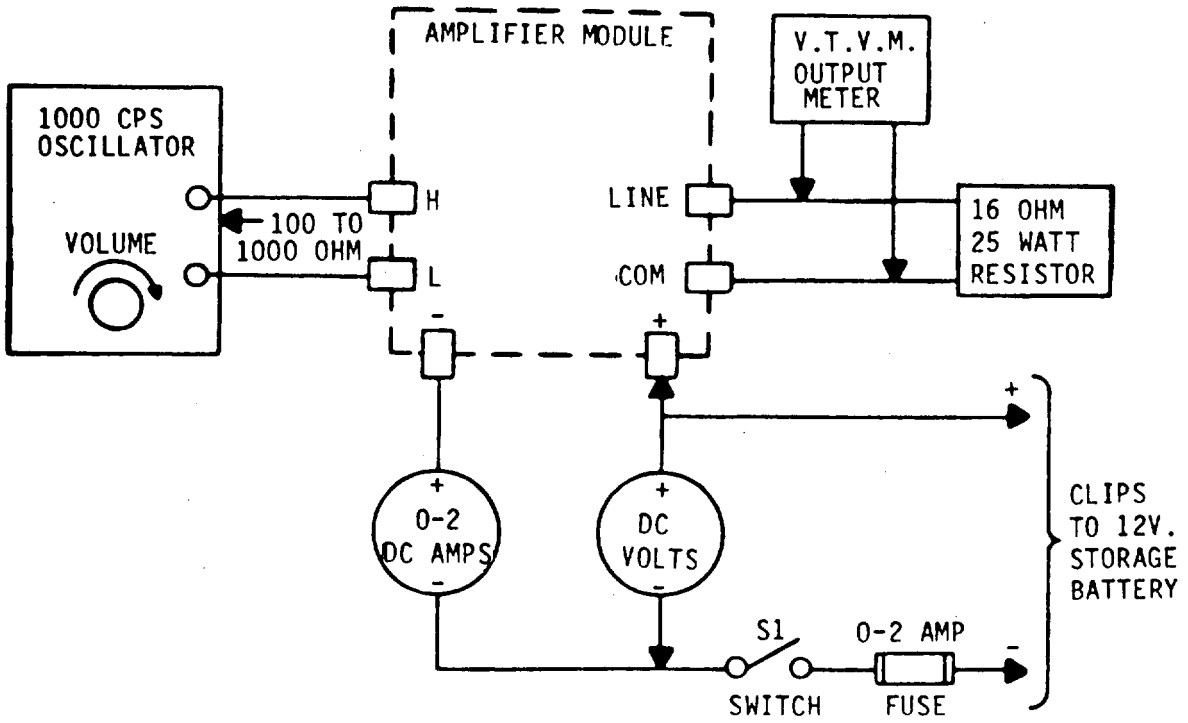
(f) Any appreciable departure in either test from the median values shown in table 3 indicates defects in the components or wiring, not evidenced in the Resistance Measurements made per table 1. Conventional methods of isolating, removing, and checking or replacing suspected defective parts are followed 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 tantalytic 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, 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.

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
TESTS (Cont)			

AMPLIFIER ASSEMBLY.

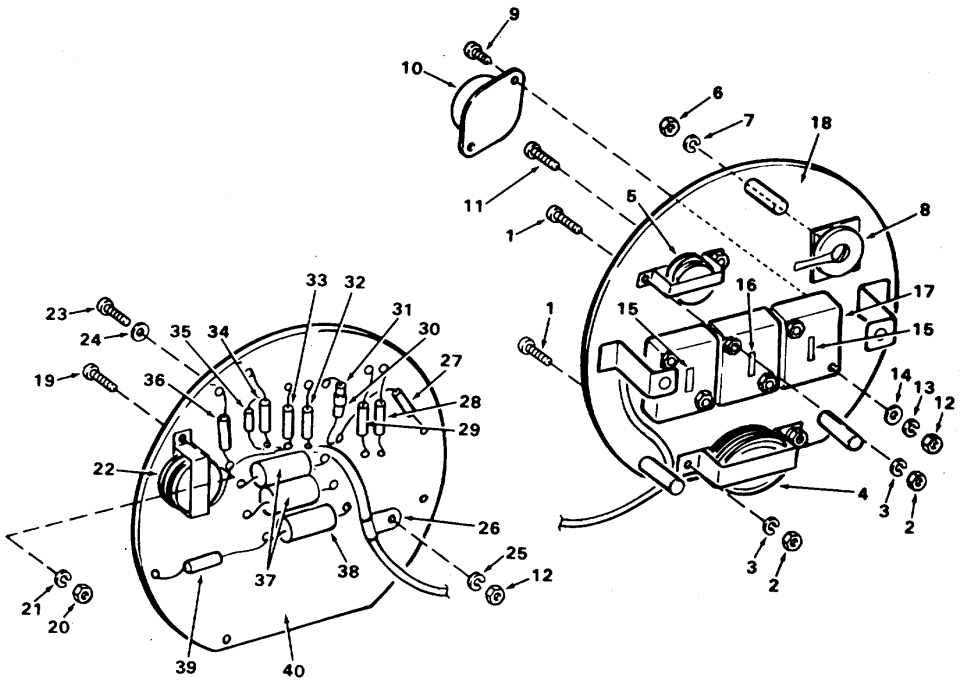
ITEM NUMBER	DESCRIPTION
1.	Machine Screw
2.	Plain Hex Nut
3.	Lockwasher
4.	Audio Frequency Inductor
5.	Audio Frequency Transformer
6.	Plain Hex Nut
7.	Lockwasher
8.	Thermistor Assembly
9.	Tapping Screw
10.	Power Transistor
11.	Machine Screw
12.	Plain Hex Nut
13.	Lockwasher
14.	Flatwasher
15.	Fixed Composition 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.	3/16 ID 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 200VDC 20 Percent Fixed Paper Capacitor
36.	0.27 Ohms 1/2 Watt Wire Wound Resistor

5-155. LOUDHAILER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
TESTS (Cont)			

AMPLIFIER ASSEMBLY.

ITEM NUMBER	DESCRIPTION
37.	Fixed Capacitor
38.	Fixed Paper Capacitor
39.	Fixed Composition Resistor
40.	Resistor Board Assembly



5-156. RADIO AND RADAR COMMUNICATION SYSTEMS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair and Replace

INITIAL SETUP

Test Equipment	References	
NONE	FO-5	Radio Communication System
	FO-6	Radar System
	5-157	Radio Antenna

Special Tools	Equipment Condition	Condition Description
NONE		NONE

Material/Parts	Special Environmental Conditions
NONE	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.

5-157. VHF ANTENNA - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair and Replace

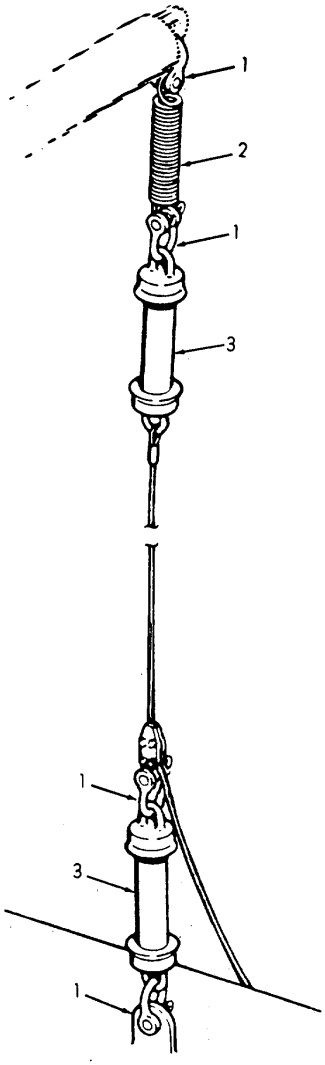
INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition / Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
1	Make sure all transmitting devices are tagged and secured.

LOCATION	ITEM	ACTION	REMARKS
REPAIR/REPLACE			
1. Antenna	a. R-390A (URR) antenna shackle (1)	Repair or replace.	
	b. R-390A antenna spring (2)	Repair or replace.	
	c. Type IL-26/U R-390A (URR) antenna insulator (3)	Repair or replace.	

5-157. VHF ANTENNA - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR/REPLACE (Cont)			

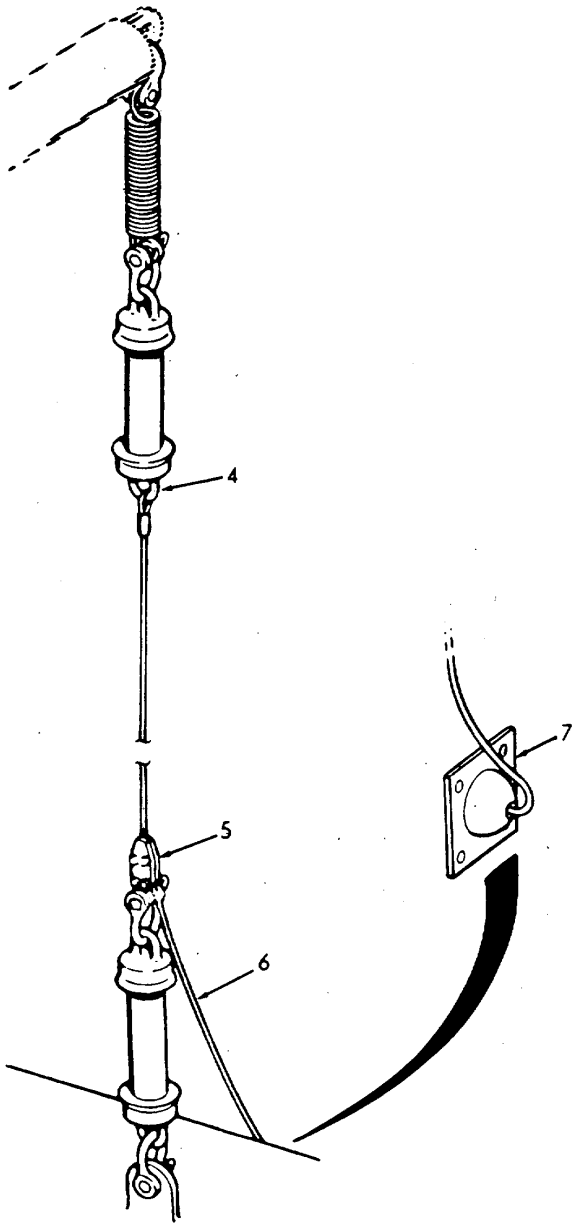


5-157. VHF ANTENNA - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.	

5-157. VHF ANTENNA - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR/REPLACE (Cont)			



5-158. OIL/WATER SEPARATION SYSTEM - MAINTENANCE INSTRUCTIONS.

Refer to TM 55-2090-201-14P for maintenance instructions.

5-159. PIPING SYSTEMS - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance instructions.

5-160. EXHAUST PIPE HANGERS - MAINTENANCE INSTRUCTIONS.

This task covers:

Replace

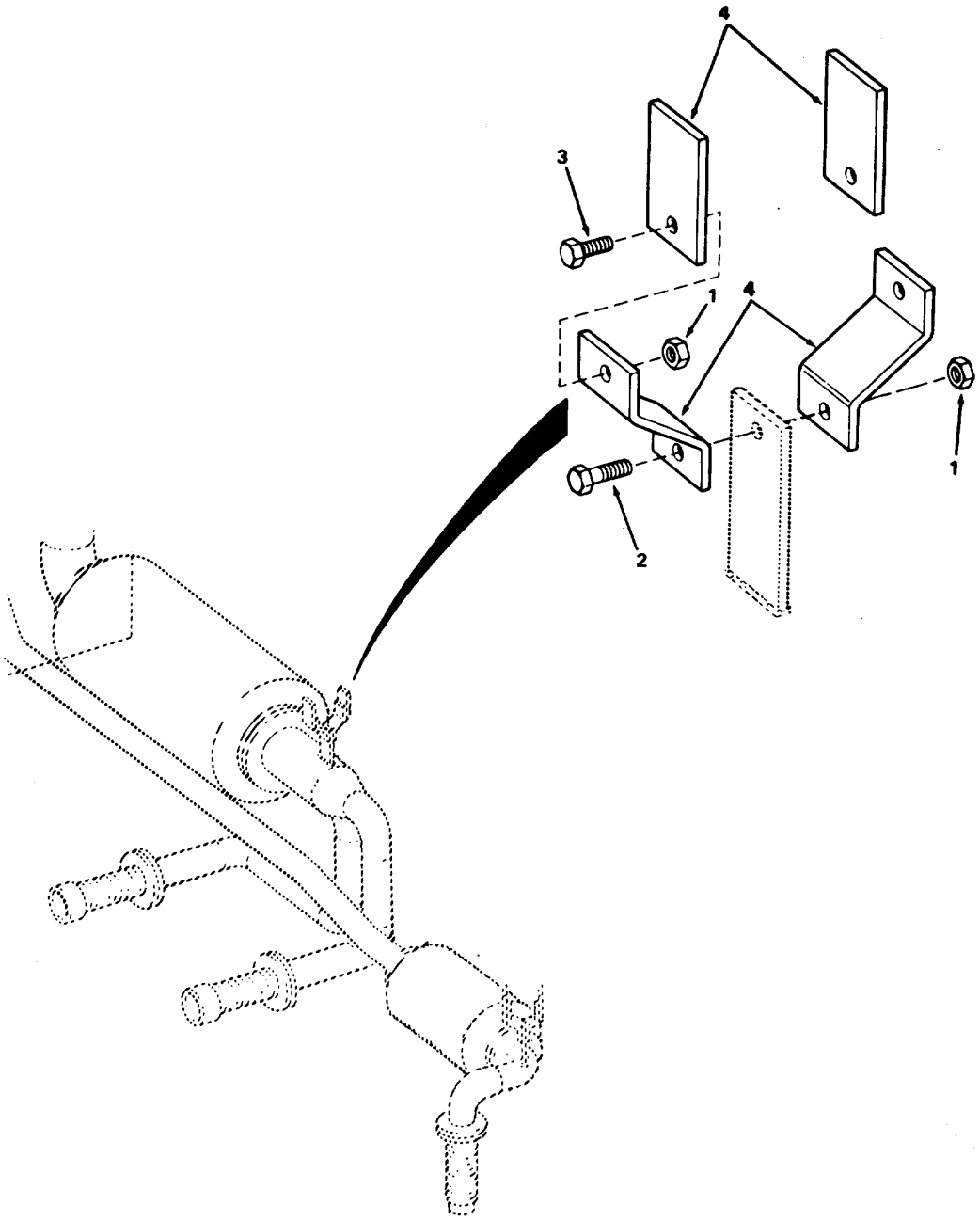
INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition / Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
1	NONE

LOCATION	ITEM	ACTION	REMARKS
REPLACE			
1. Pipe Hangers	a. Nuts (1)	Replace.	
	b. Screws (2)	Replace.	
	c. Screws (3)	Replace.	
	d. Hangers (4)	Fabricate from 2-1/4 inch wide x 1/4 inch thick flat steel bar stock.	

5-160. EXHAUST PIPE HANGERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			



5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition / Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
2	NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

1. Fire control legend

Item Number	Description
1.	Low velocity fog applicator
2.	Slotted oval head machine screw
3.	Fog applicator holder
4.	50 feet double jacketed fire hose
5.	Quick release belt
6.	Bronze adapter
7.	Bronze 90° elbow
8.	Reducing tee
9.	Tee
10.	Bronze butterfly valve
11.	45° elbow
12.	90° elbow

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

1. Fire control legend (Cont)

Item Number	Description
13.	Bronze flange lift check valve
14.	90° reducing elbow
15.	45° elbow
16.	Bronze butterfly valve
17.	Coupling
18.	Globe valve
19.	90° reducing elbow
20.	Bronze inlet angle valve
21.	Bronze gate valve
22.	In-line marine strainer
23.	Plain hex nut
24.	Hex head cap screw
25.	Bronze flange
26.	Rubber flange gasket
27.	Hex head cap screw
28.	Male flange
29.	Full face rubber insert gasket
30.	Bronze flange
31.	45° elbow
32.	Bushing
33.	Copper-nickel pipe
34.	Copper-nickel pipe
35.	Flange
36.	Hex head cap screw
37.	Plain hex nut
38.	Hex head cap screw
39.	Flange
40.	Full face Navy type gasket
41.	Hex head cap screw
42.	Navy type bronze flange
43.	Navy type gasket
44.	Reducing tee
45.	Bronze flanged globe valve
46.	Coupling
47.	Bronze gate valve
48.	Brass pipe nipple

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

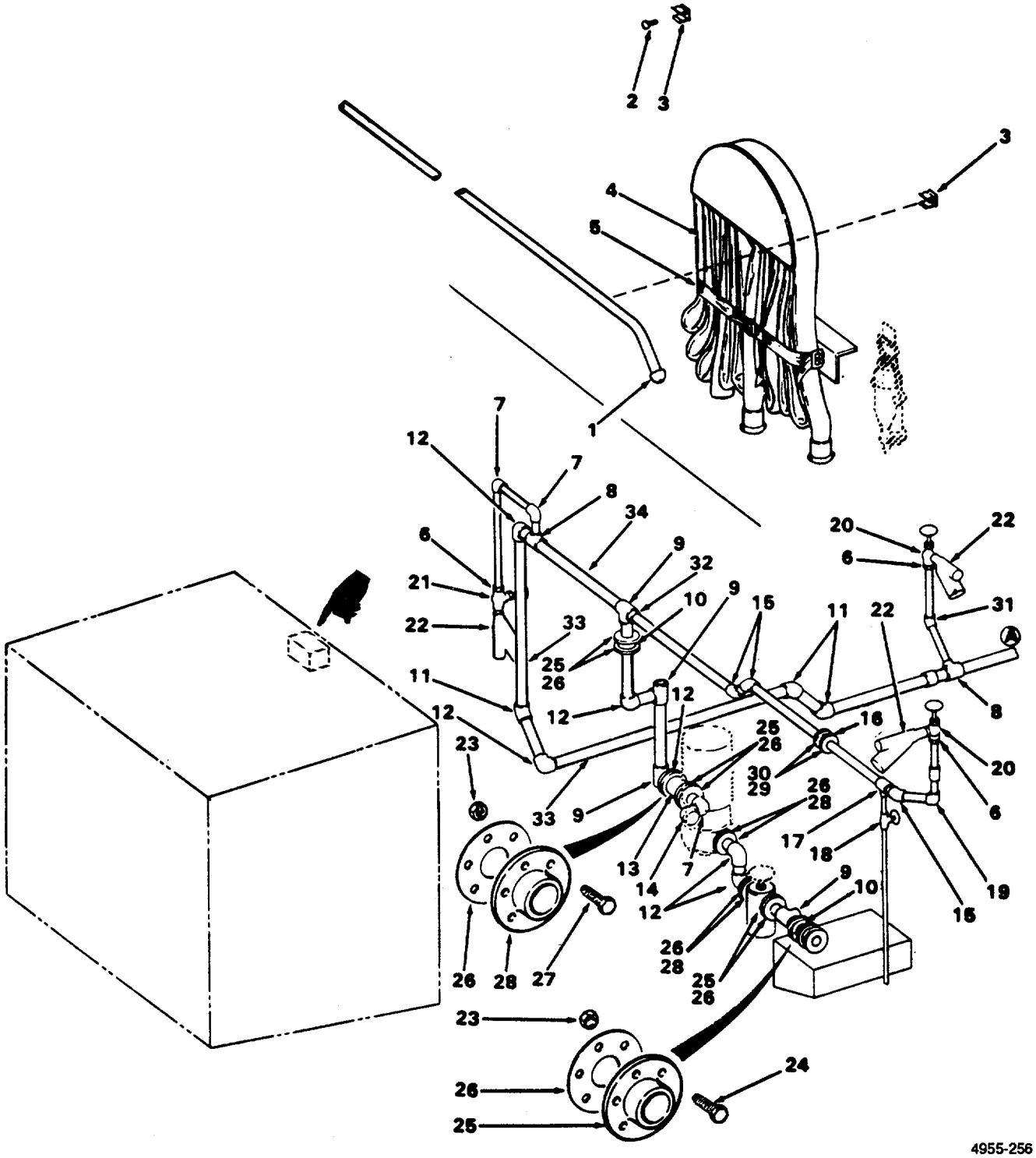
LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

1. Fire control legend (Cont)

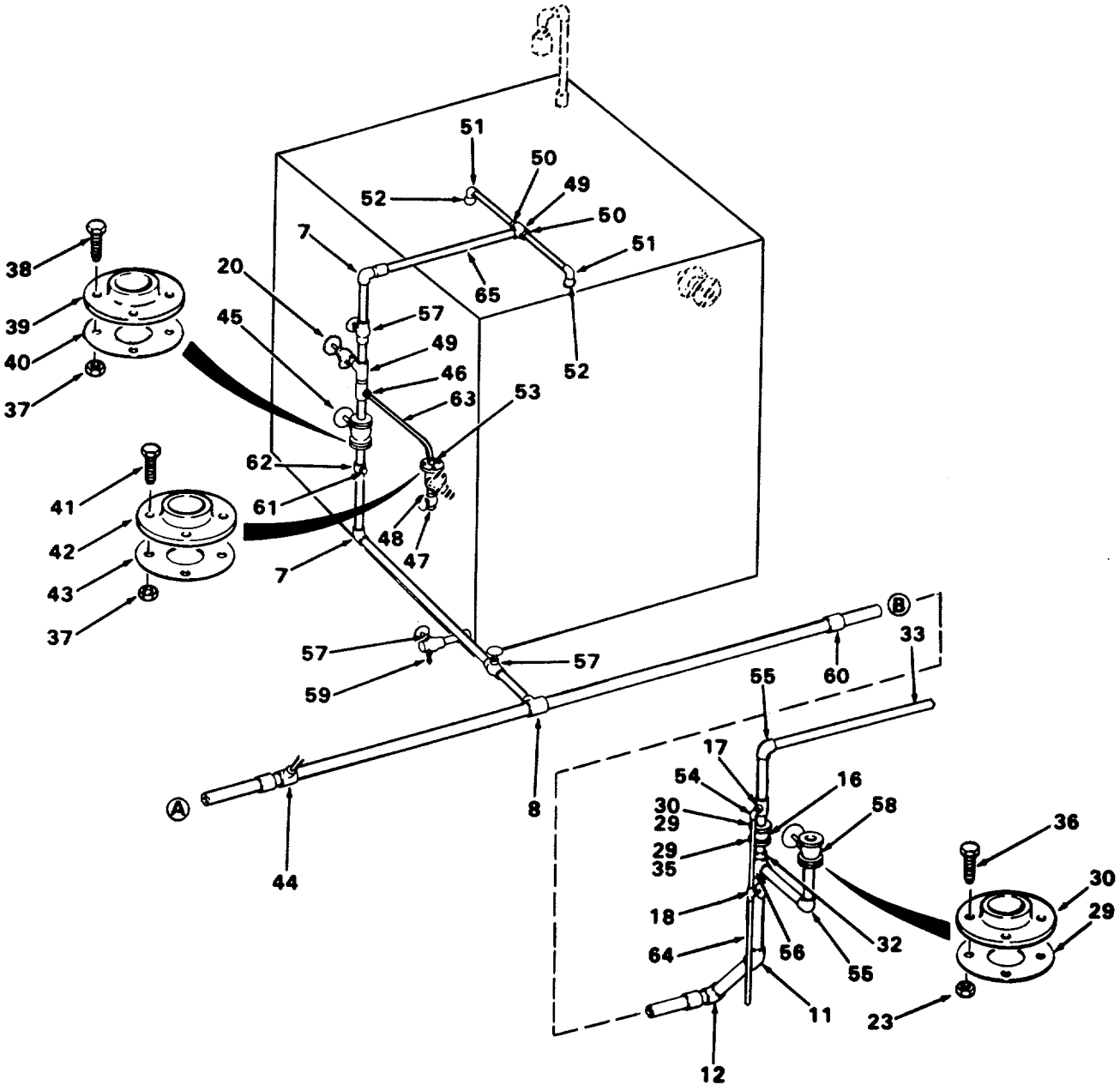
Item Number	Description
49.	Bronze tee
50.	Coupling
51.	Bronze 90° elbow
52.	Brass sprinkler head
53.	Bronze reducing bushing
54.	Bronze 90° elbow
55.	Bronze 90° elbow
56.	Bronze reducing tee
57.	Gate valve
58.	Bronze flanged gate valve
59.	Double loop pattern chain
60.	Bronze coupling
61.	Brass pipe plug
62.	Bronze outlet brazolet
63.	Copper-nickel tube
64.	Copper-nickel tube
65.	Copper-nickel tube
66.	Brazolet
67.	Bronze gate valve

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).



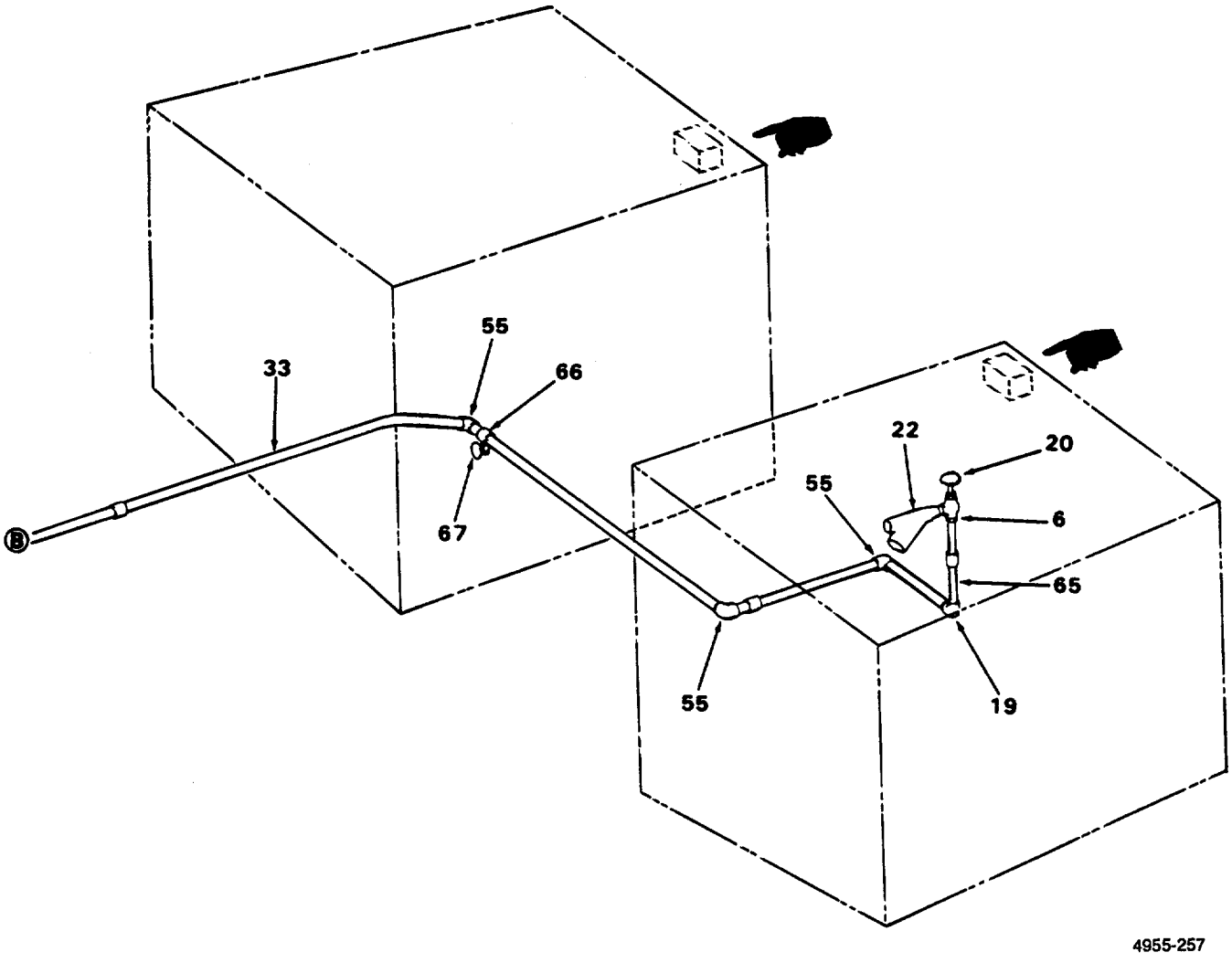
Fire Control System (Sheet 1 of 3)

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).



Fire Control System (Sheet 2 of 3)

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).



Fire Control System (Sheet 3 of 3)

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

2. Ballast legend

Item Number	Description
1.	90° elbow
2.	Reducing tee
3.	Bronze flanged gate valve
4.	Tube tee
5.	Bronze flanged butterfly valve
6.	Bronze 90° elbow
7.	Bronze reducing bushing
8.	900 elbow
9.	Bronze flanged angle valve
10.	45° elbow
11.	45° elbow
12.	180° return bend
13.	45° elbow
14.	90° elbow
15.	Bronze tee
16.	Bushing
17.	Bronze adapter
18.	Bronze globe valve
19.	Bronze relief valve
20.	Gate valve
21.	Swivel hose adapter
22.	Hose plug with chain
23.	Monel hex head capscrew
24.	Monel hex head capscrew
25.	Copper-nickel pipe
26.	Flange
27.	Gasket
28.	Plain hex head nut
29.	Hex head capscrew
30.	Hex head capscrew
31.	Flange
32.	Full face rubber gasket
33.	Male flange
34.	Hex head capscrew
35.	Male flange
36.	Full face rubber gasket

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

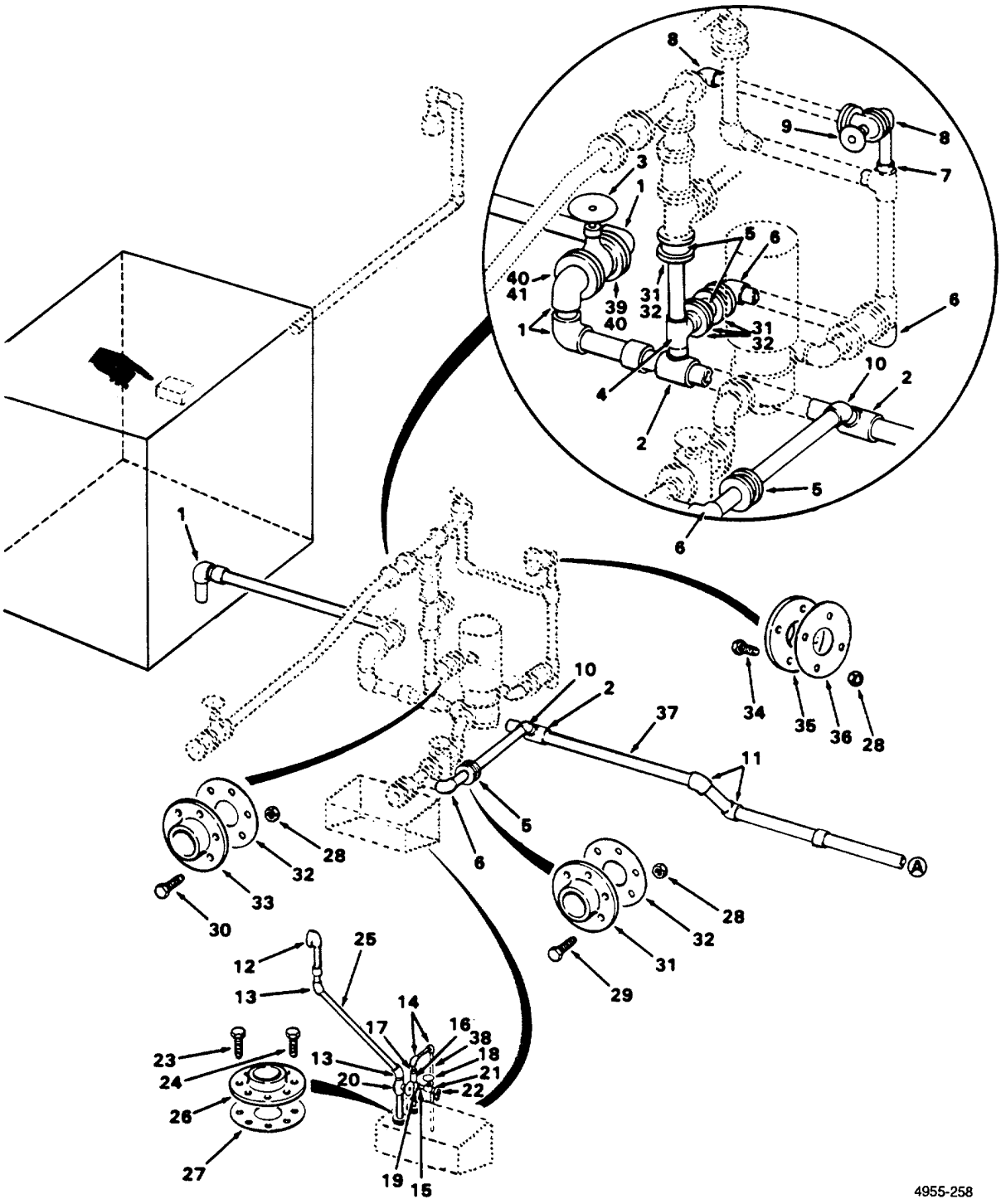
REPAIR OR REPLACE (Cont)

2. Ballast legend

Item Number	Description
37.	Copper-nickel pipe
38.	Copper-nickel pipe
39.	Male flange
40.	Flange
41.	Full face gasket
42.	Plain hex nut
43.	Hex head capscrew
44.	Bronze coupling
45.	Bronze tee

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

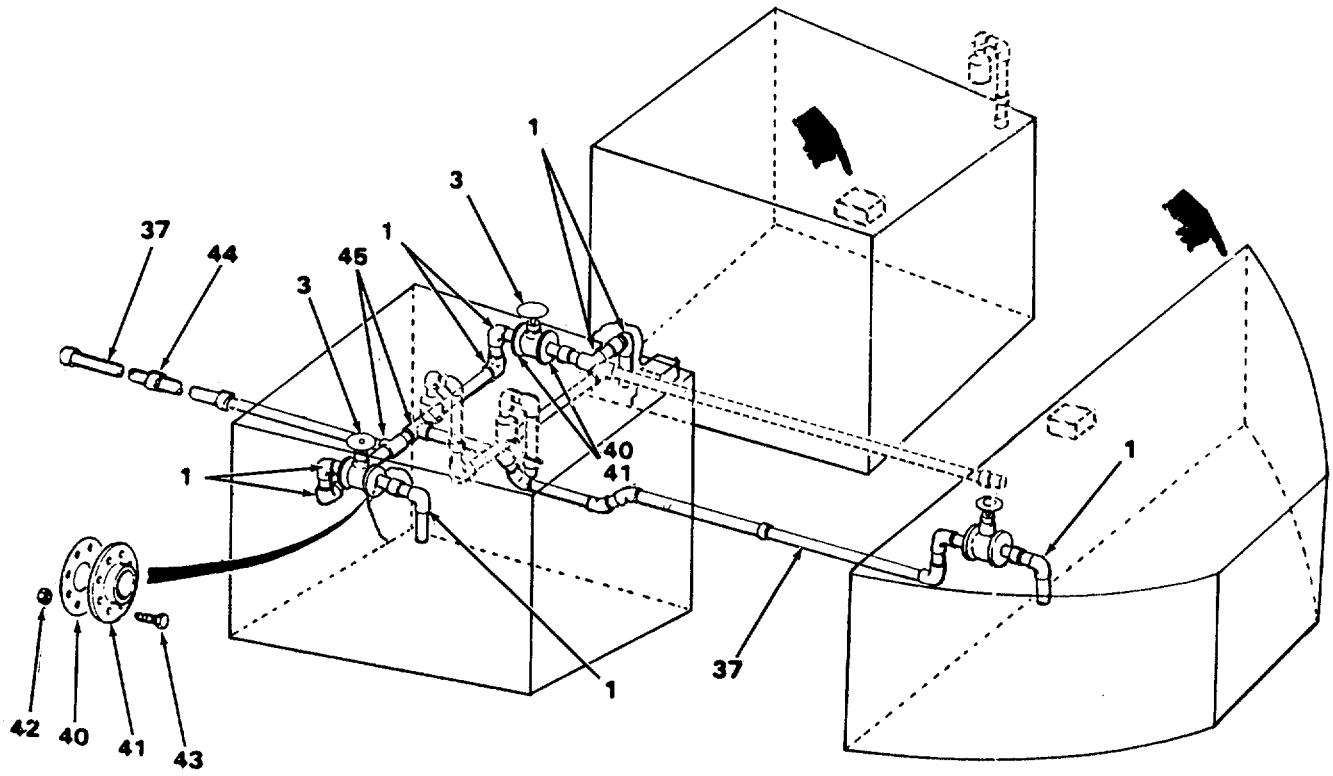
REPAIR OR REPLACE (Cont)



Ballast Piping System (Sheet 1 of 2)

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR OR REPLACE (Cont)



Ballast Piping System (Sheet 2 of 2)

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

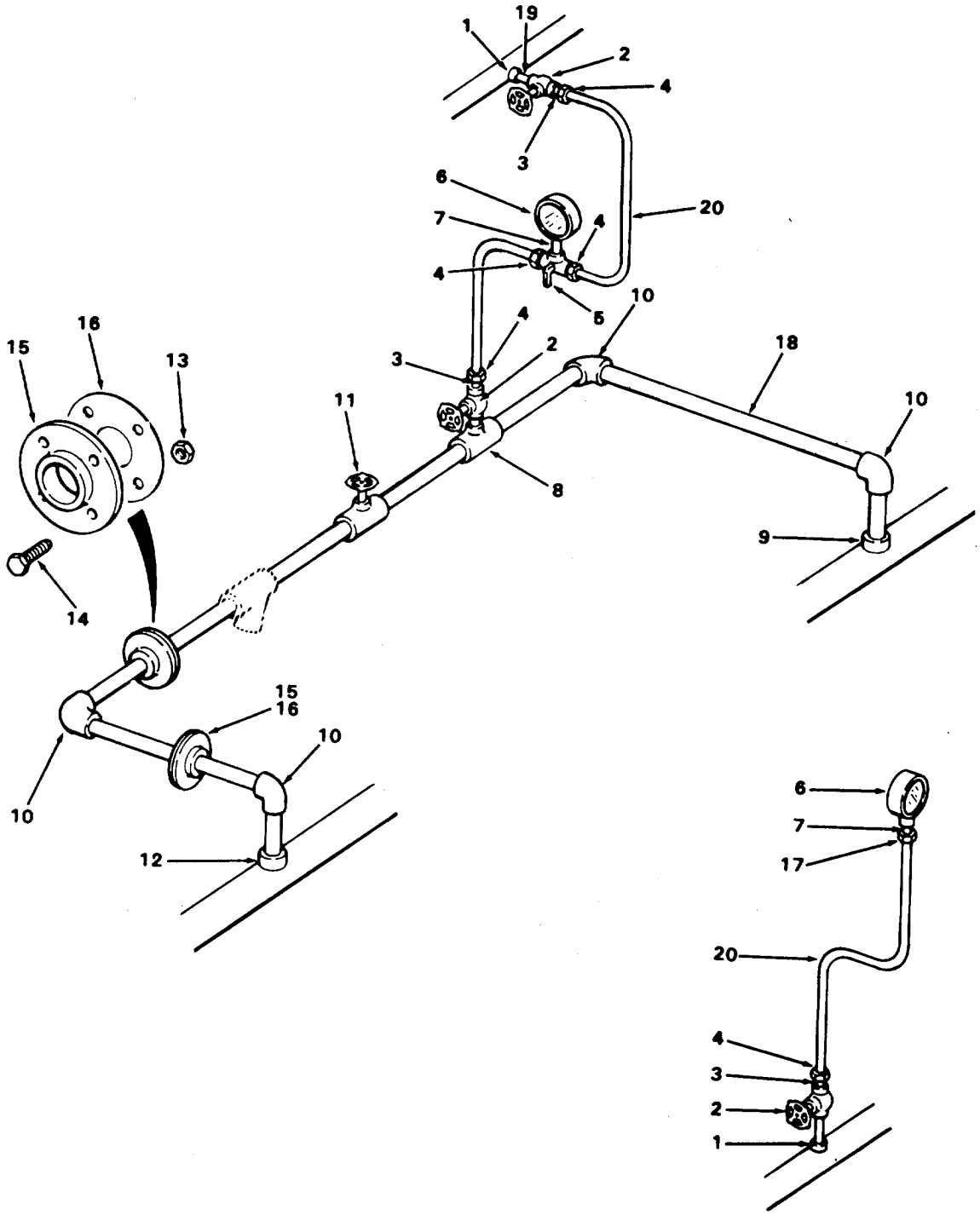
REPAIR OR REPLACE (Cont)

3. Gage piping legend

Item Number	Description
1.	Bronze coupling
2.	Gate valve
3.	Bronze adapter
4.	Flare male connector
5.	3-way bronze cock valve
6.	0-200 psi bottom connection pressure gauge
6.	0-30 psi range pressure gage
6.	15 psi range bottom connection vacuum pressure gage
7.	Brass close nipple
8.	Bronze reducing tee
9.	Bronze reducer coupling
10.	90° elbow
11.	Globe valve
12.	Bronze coupling
13.	Plain hex nut
14.	Hex head capscrew
15.	Bronze flange
16.	Navy type rubber insert gasket
17.	Brass flare female connector
18.	Copper-nickel pipe
19.	Copper-nickel tube
20	Copper tube

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR OR REPLACE (Cont)



Gage Piping.

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

4. Bilge piping

Item Number	Description
1.	Plain hex nut
2.	Hex head capscrew
3.	Suction bilge strainer
4.	90° elbow
5.	Monel plain hexagon nut
6.	Monel hex head capscrew
7.	Bronze flanged swing check valve
8.	Bronze flanged gate valve
9.	Bronze globe stop check valve
10.	Bronze flanged bilge eductor
11.	Bronze flanged swing check valve
12.	Bronze flanged tee
13.	Bronze flanged butterfly valve
14.	90° elbow
15.	Bronze flanged globe stop check valve
16.	Reducing tee
17.	Monel plain hexagon nut
18.	Monel hex head capscrew
19.	Plain hex nut
20.	Hex head capscrew
21.	Bronze flange
22.	Full face rubber insert gasket
23.	Plain hex nut
24.	Hex head capscrew
25.	Bronze flange
26.	Gasket
27.	Copper-nickel pipe
28.	Bronze 90° street elbow
29.	Male flange
30.	Plain hex nut
31.	Hex head capscrew
32.	Male flange
33.	Copper-nickel pipe
34.	Male flange
35.	Full face rubber gasket
36.	Reducing tee

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

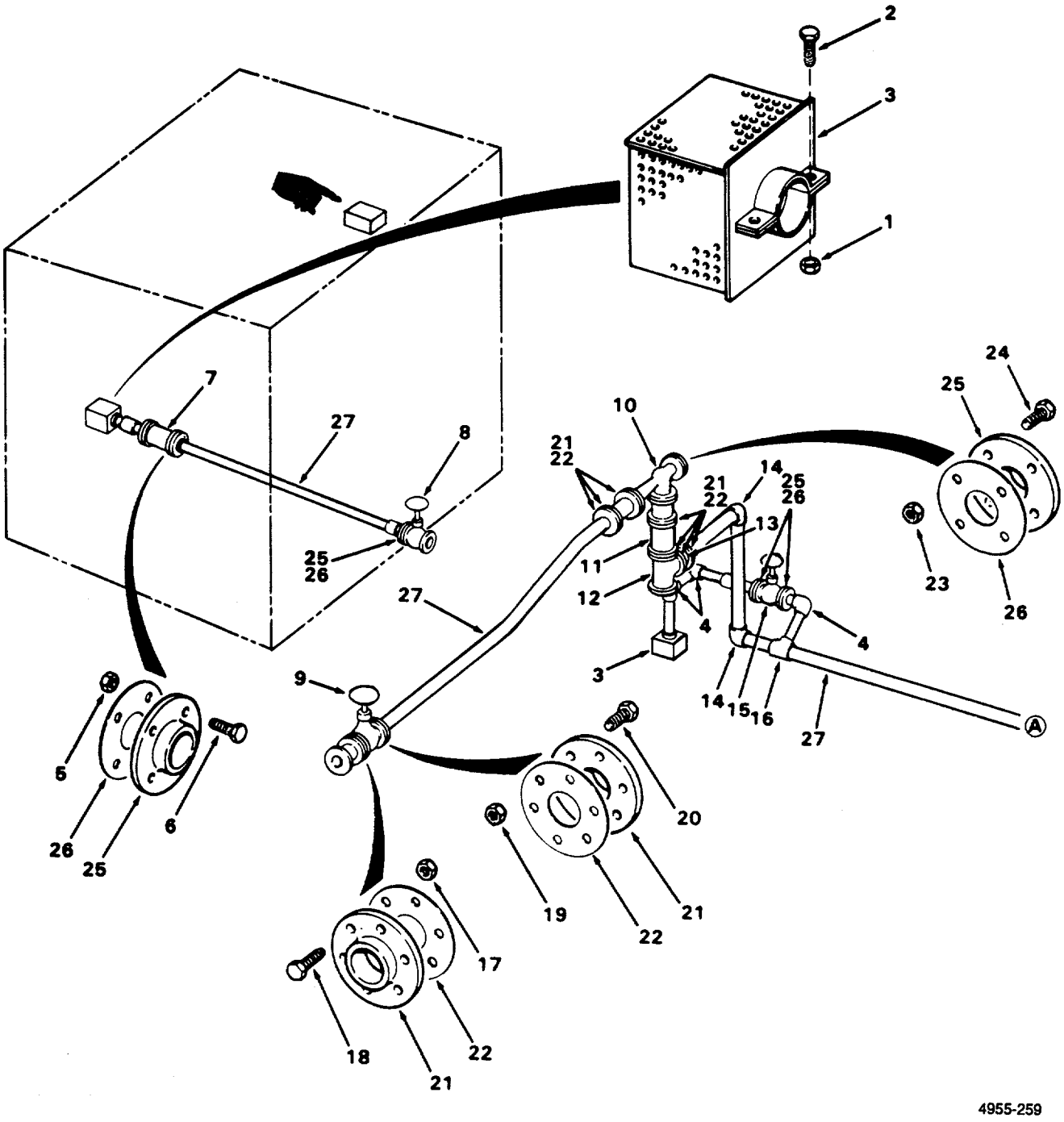
REPAIR OR REPLACE (Cont)

4. Bilge piping legend (Cont)

Item Number	Description
37.	90° elbow
38.	Bronze hose cap
39.	Bronze hose nipple
40.	Bronze globe valve
41.	Bronze flanged angle stop check valve
42.	Bronze flanged gate valve
43.	Tube tee
44.	45° elbow
45.	Stainless steel hose clamp
46.	Neoprene suction hose
47.	Bronze 90° reducing elbow
48.	Cast adapter
49.	Reducing connector
50.	Neoprene discharge hose
51.	Bronze 45°elbow
52.	Bronze 90° elbow
53.	Bronze flanged globe valve
54.	Copper-nickel pipe
55.	Reducing bushing
56.	Gate valve
57.	Brazolet
58.	Plain hex nut
59.	Hex head capscrew

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

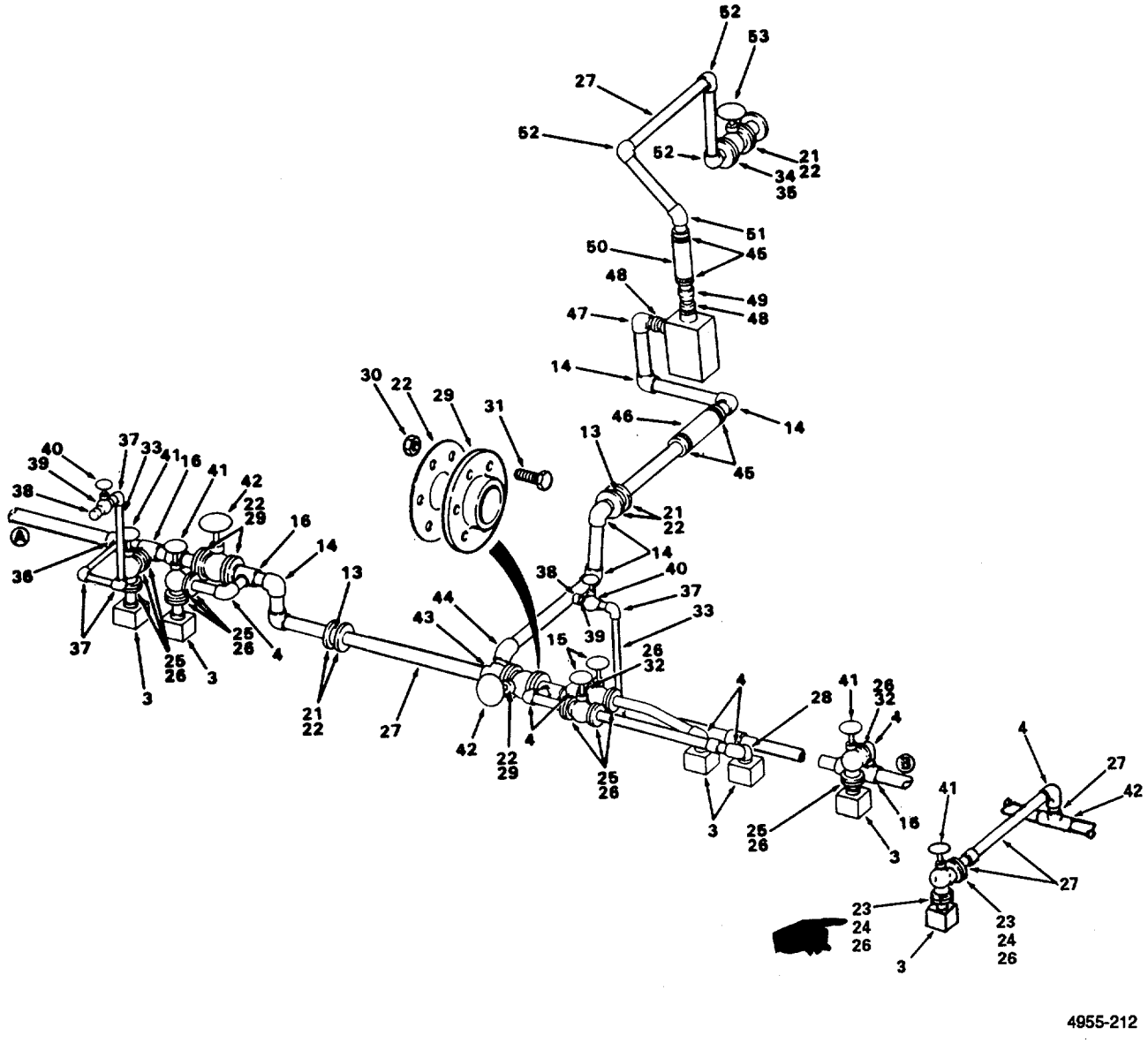
REPAIR OR REPLACE (Cont)



Bilge Piping (Sheet 1 of 3)

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

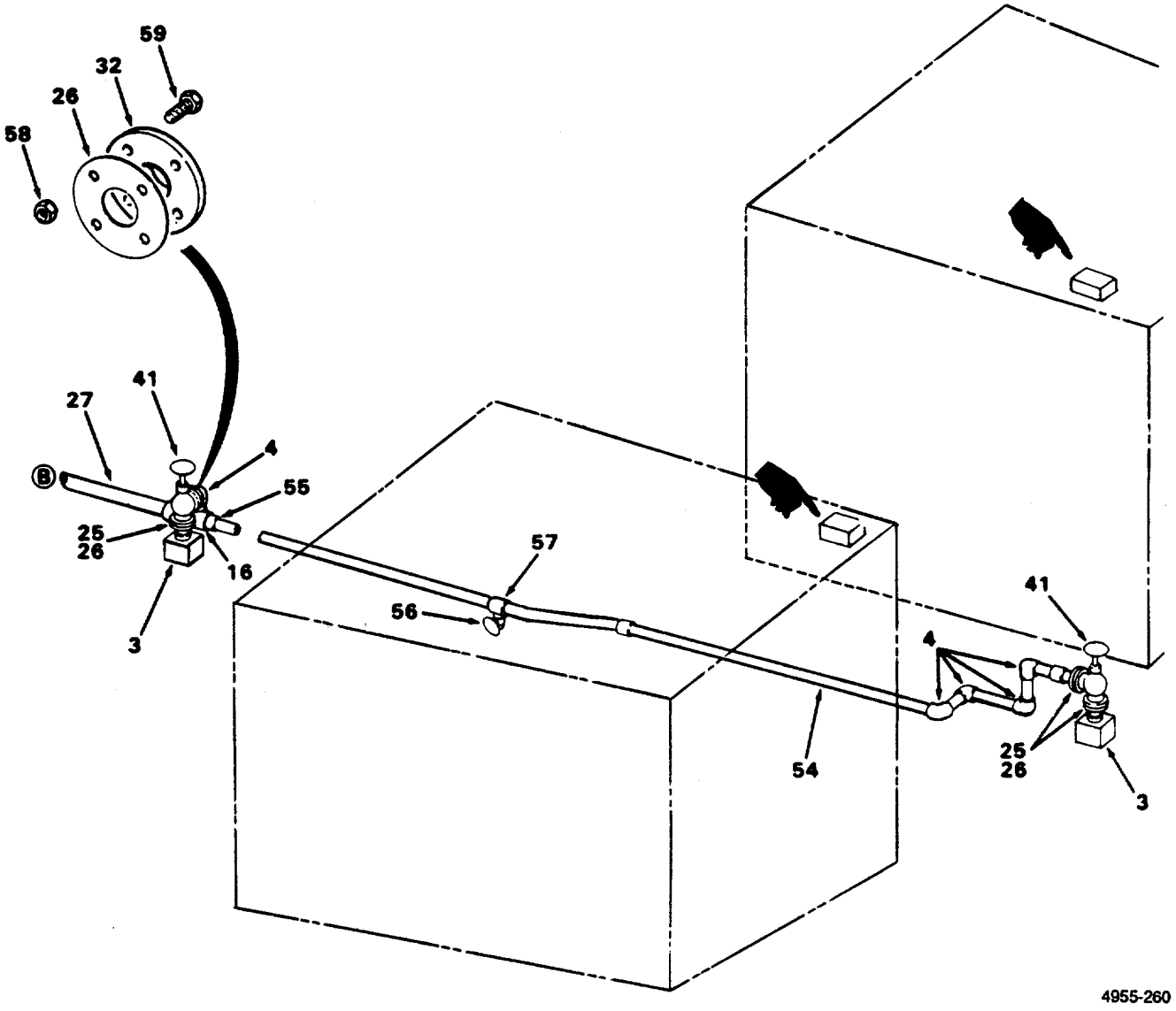
REPAIR OR REPLACE (Cont)



Bilge Piping (Sheet 2 of 3)

5-161. FIRE, BALLAST, AND BILGE PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



Bilge Piping (Sheet 3 of 3)

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment	References
NONE	NONE
Special Tools	**Equipment Condition** / **Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
2	NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

1. Generator engine cooling legend

Item Number	Description
1.	Bronze wiring pipe return bend
2.	Bronze 90° elbow
3.	Gate valve
4.	Copper-nickel tube
5.	Reducing bushing
6.	Bronze tube tee
7.	Copper-nickel pipe
8.	Bronze 45° tube elbow
9.	Copper-nickel hose adapter
10.	Neoprene discharge hose
11.	Hose clamp
12.	Pipe brazolet

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

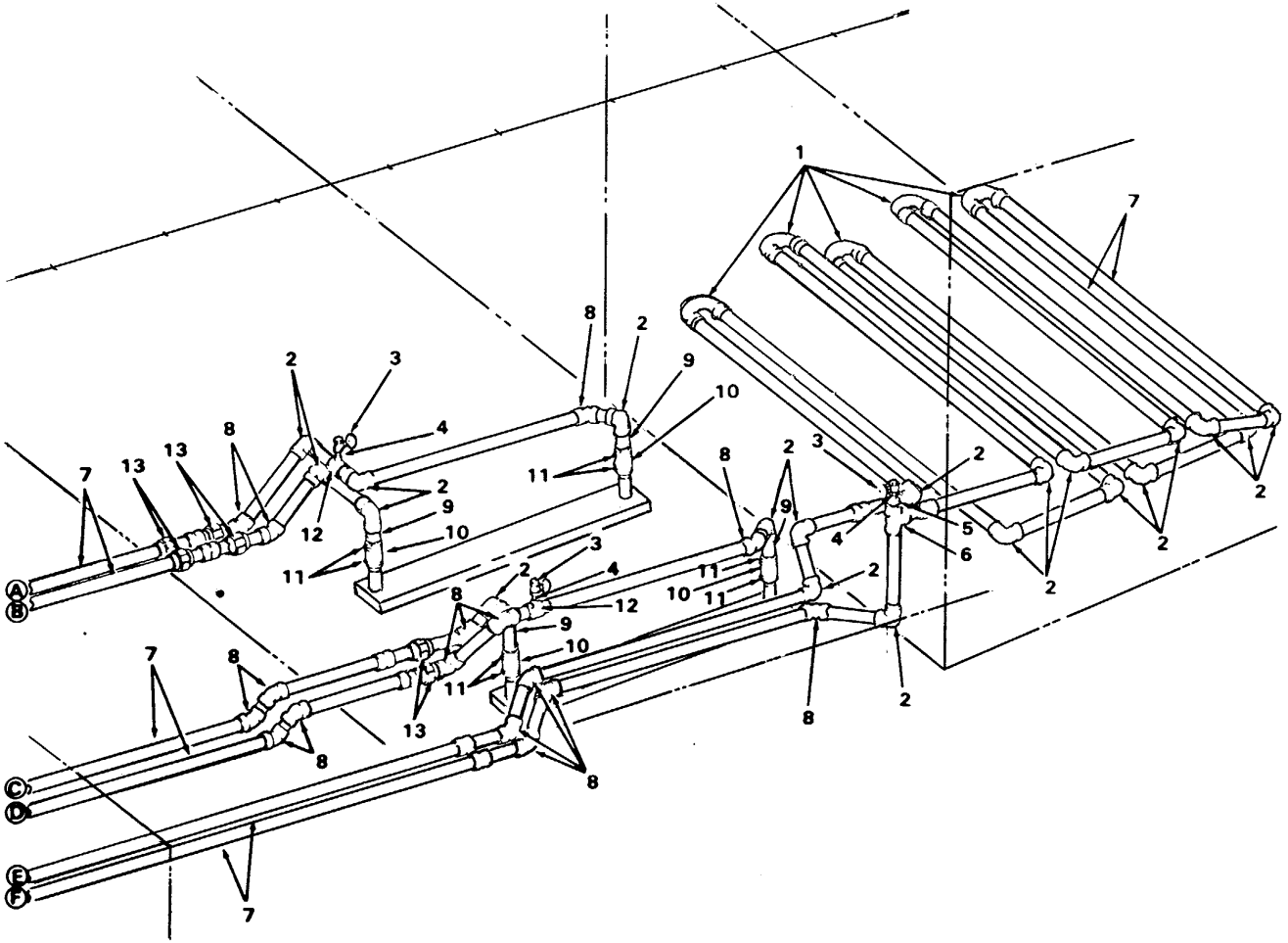
LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

Generator engine cooling legend (Cont)

Item Number	Description
13.	Bronze tube union
14.	Bronze gate
15.	Bronze reducing tube elbow
16.	Neoprene discharge hose
17.	Neoprene discharge hose
18.	Copper-nickel pipe
19.	Pipe nipple
20.	Bronze pipe return bend
21.	Bronze 90° tube elbow
22.	Bronze tube union
23.	Gate valve
24.	Copper-nickel tube
25.	Bronze brazolet tube
26.	Bronze tube elbow
27.	Copper-nickel pipe

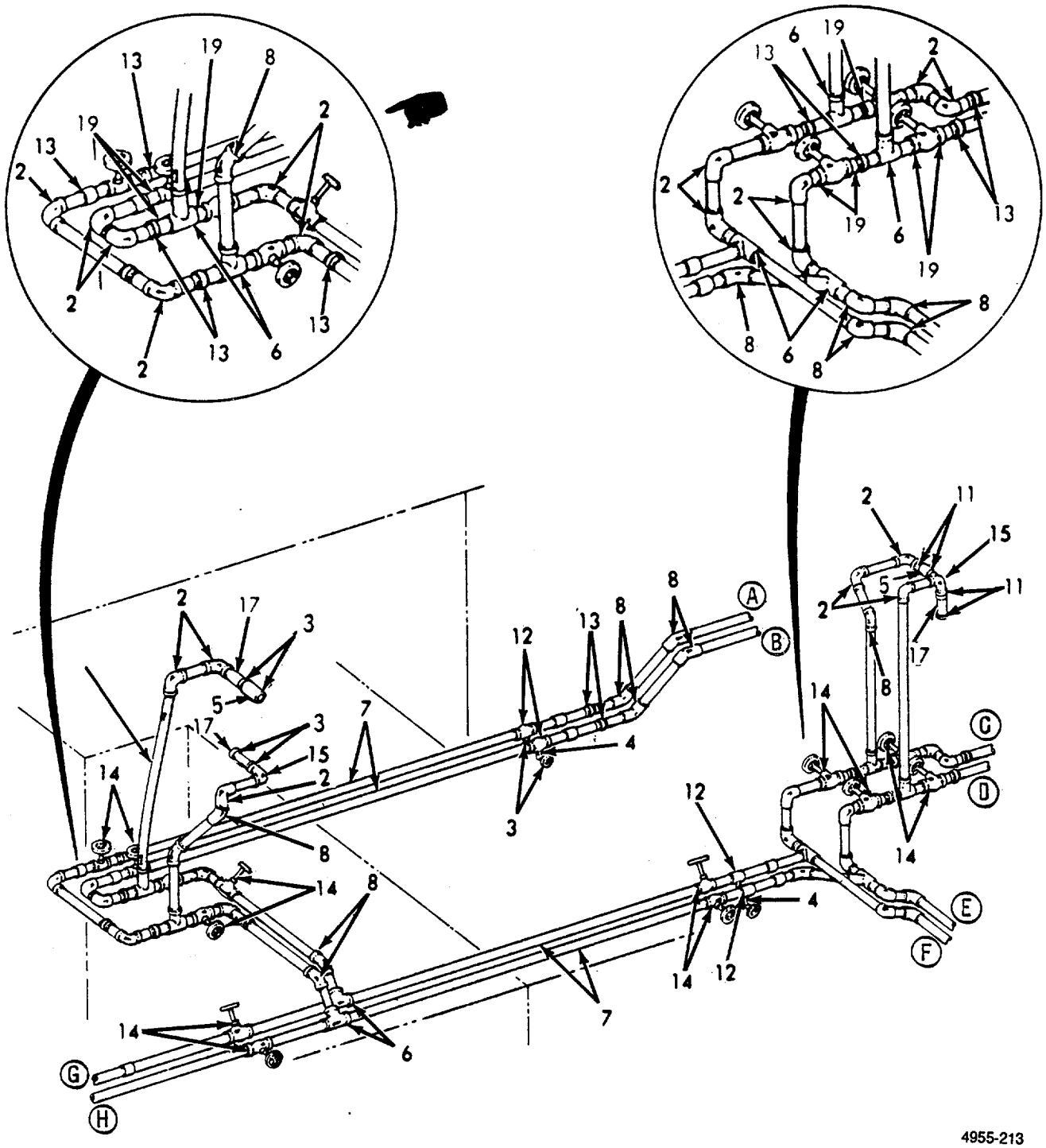
5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS
(Continued).



Generator Cooling System (Sheet 1 of 3)

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

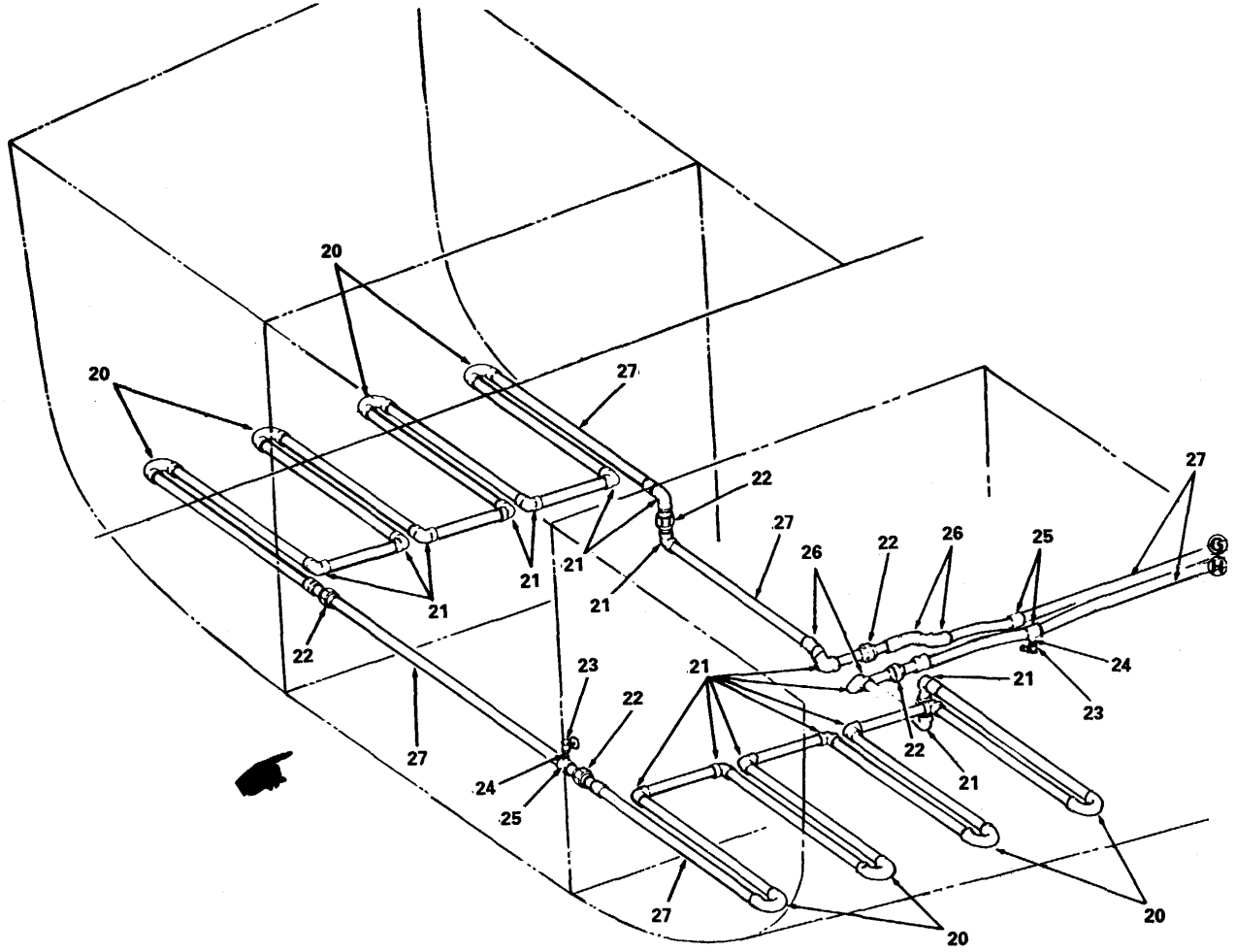
REPAIR OR REPLACE (Cont)



Generator Engine Cooling System (Sheet 2 of 3)

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR OR REPLACE (Cont)



Generator Engine Cooling System (Sheet 3 of 3).

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

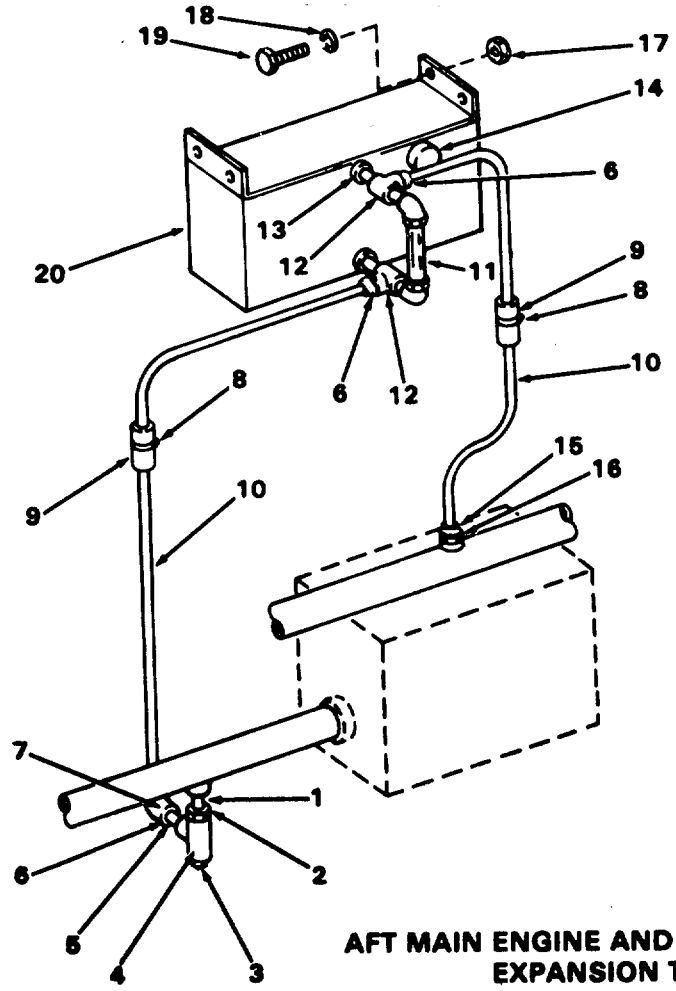
REPAIR OR REPLACE (Cont)

2. Expansion tank piping legend

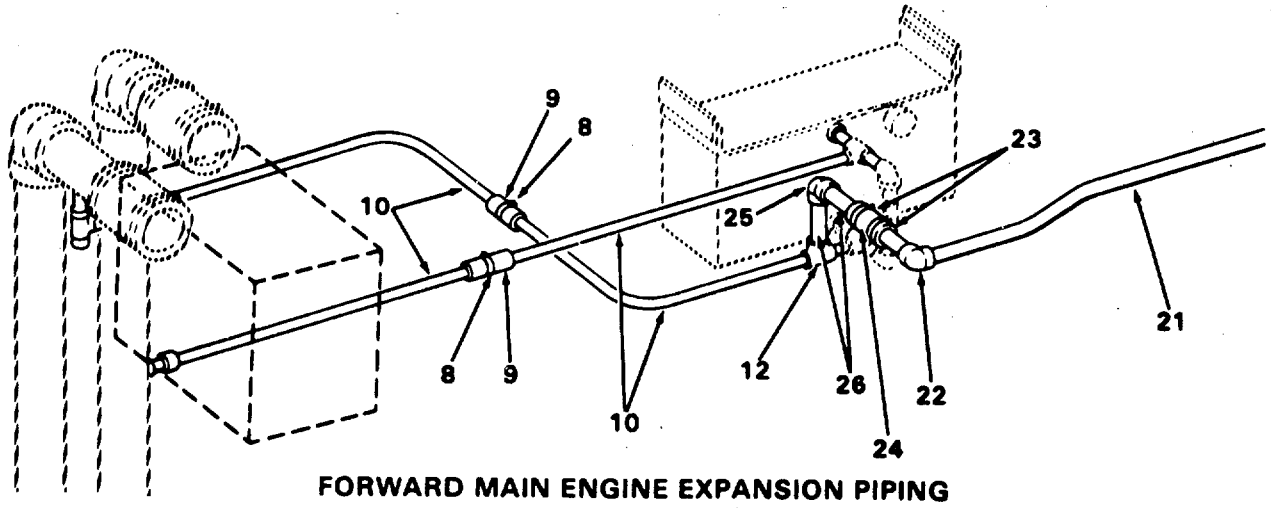
Item Number	Description
1.	Brass pipe nipple
2.	Brass reducing pipe bushing
3.	Plug
4.	Pipe tee
5.	Brass tube nipple
6.	Bronze adapter
7.	Bronze 45° tube elbow
8.	Hose clamp
9.	Neoprene suction hose
10.	Copper tube
11.	Bronze water sight indicator
12.	Bronze pipe tee
13.	Pipe nipple
14.	Bronze pipe cap
15.	Bronze adapter
16.	Brass reducing pipe bushing
17.	Plain hex nut
18.	Lockwasher
19.	Hex head capscrew
20.	Expansion tank
21.	Copper-nickel tube
22.	Bronze 90°tube elbow
23.	Hose clamp
24.	Neoprene hose
25.	Bronze reducing elbow
26.	Brass close pipe nipple

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR OR REPLACE (Cont)



AFT MAIN ENGINE AND GENERATOR ENGINES EXPANSION TANK PIPING



FORWARD MAIN ENGINE EXPANSION PIPING

Expansion Tank Piping

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

3. Propulsion engine cooling system legend

Item Number	Description
1.	Bronze 90° tube elbow
2.	Stainless steel hose clamp
3.	Neoprene discharge hose
4.	Copper-nickel pipe
5.	Bronze 90° tube elbow
6.	Plain hex nut
7.	Hex head capscrew
8.	Bronze flat face flange
9.	Flange gasket
10.	Bronze reducing tube tee
11.	Copper-nickel tube
12.	Copper-nickel tube
13.	Bronze gate valve
14.	Bronze pipe brazolet
15.	Bronze pipe brazolet
16.	Flange gasket
17.	Copper-nickel pipe
18.	Bronze 90° tube elbow
19.	Hose adapter
20.	Neoprene discharge hose
21.	Hose clamp
22.	Bronze 90° tube elbow
23.	Bronze flat face pipe flange
24.	Bronze pipe brazolet
25.	Bronze flat face pipe flange
26.	Flange gasket
27.	Bronze reducing tube tee
28.	Bronze 90° tube elbow
29.	Copper-nickel pipe
30.	Bronze tube reducing elbow
31.	Copper-nickel pipe
32.	Neoprene suction hose
33.	Hose clamp
34.	Neoprene discharge hose
35.	Bronze 45° tube elbow
36.	Pipe brazolet

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

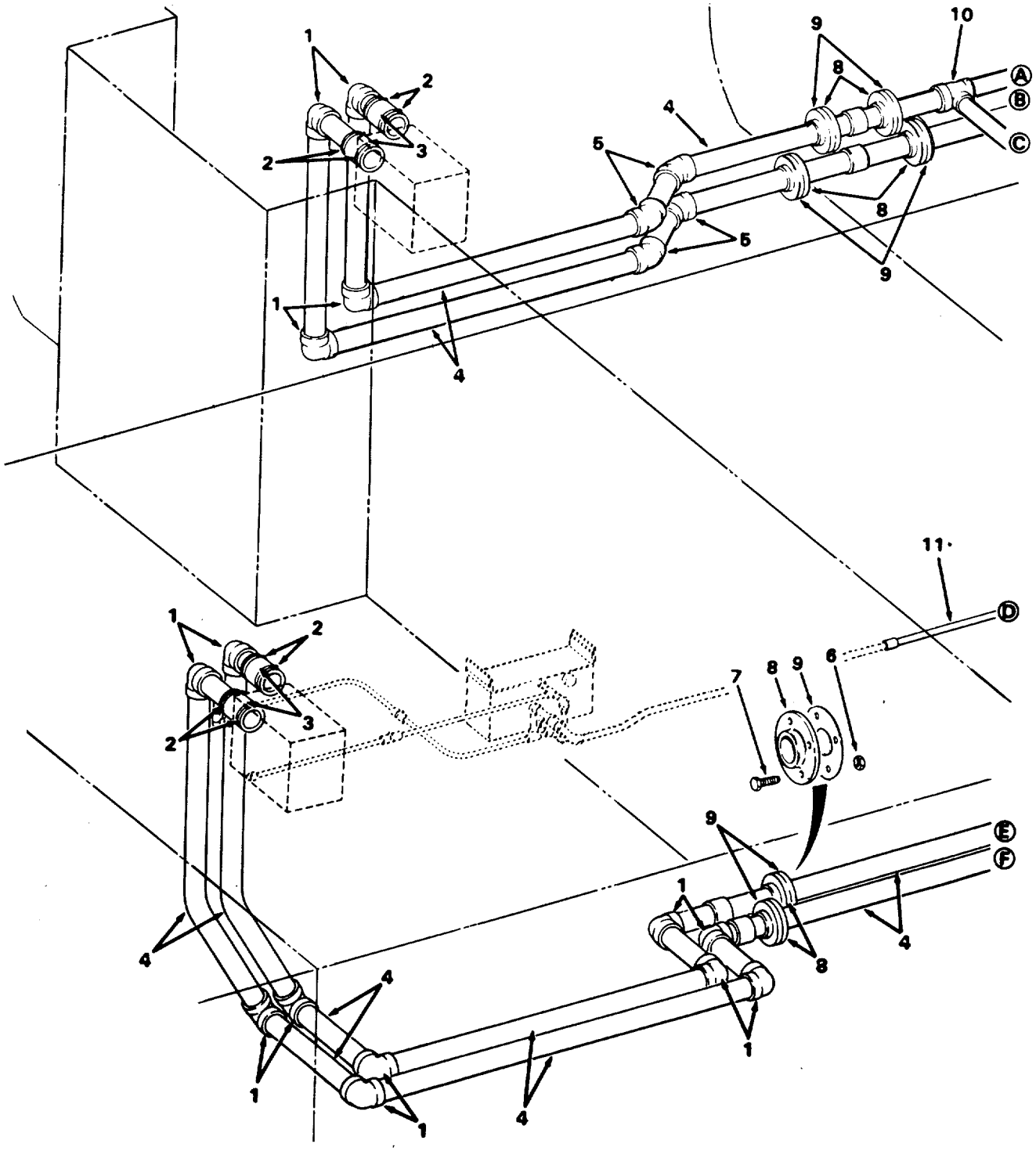
REPAIR OR REPLACE (Cont)

3. Propulsion engine cooling system legend

Item Number	Description
37.	Rubber hose
38.	Hose clamp
39.	Bronze 90° tube elbow
40.	Bronze 45° tube elbow

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

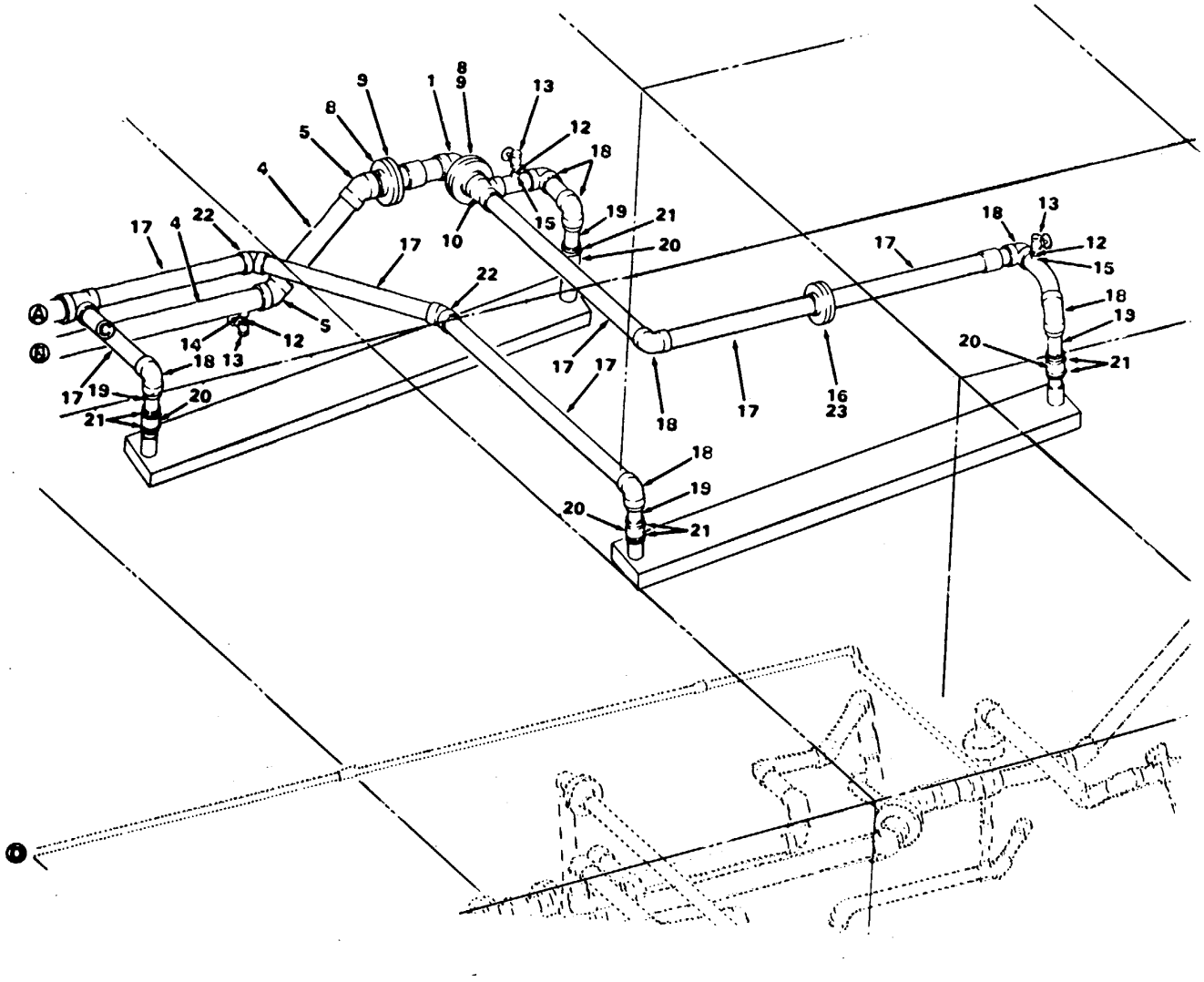
REPAIR OR REPLACE (Cont)



Propulsion Engine Cooling System (Sheet 1 of 3).

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

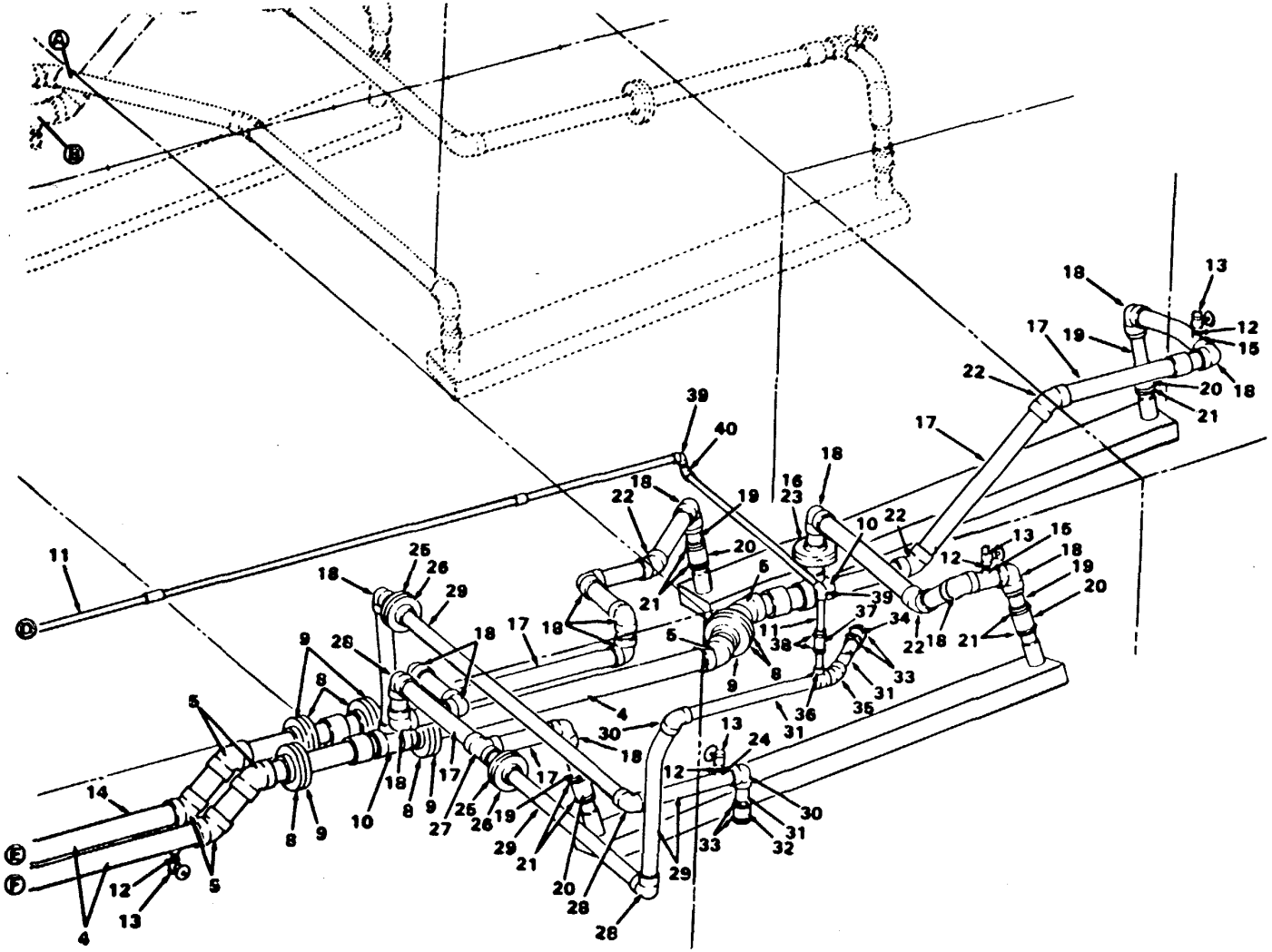
REPAIR OR REPLACE (Cont)



Propulsion Engine Cooling System (Sheet 2 of 3).

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR OR REPLACE (Cont)



Propulsion Engine Cooling System (Sheet 3 of 3).

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

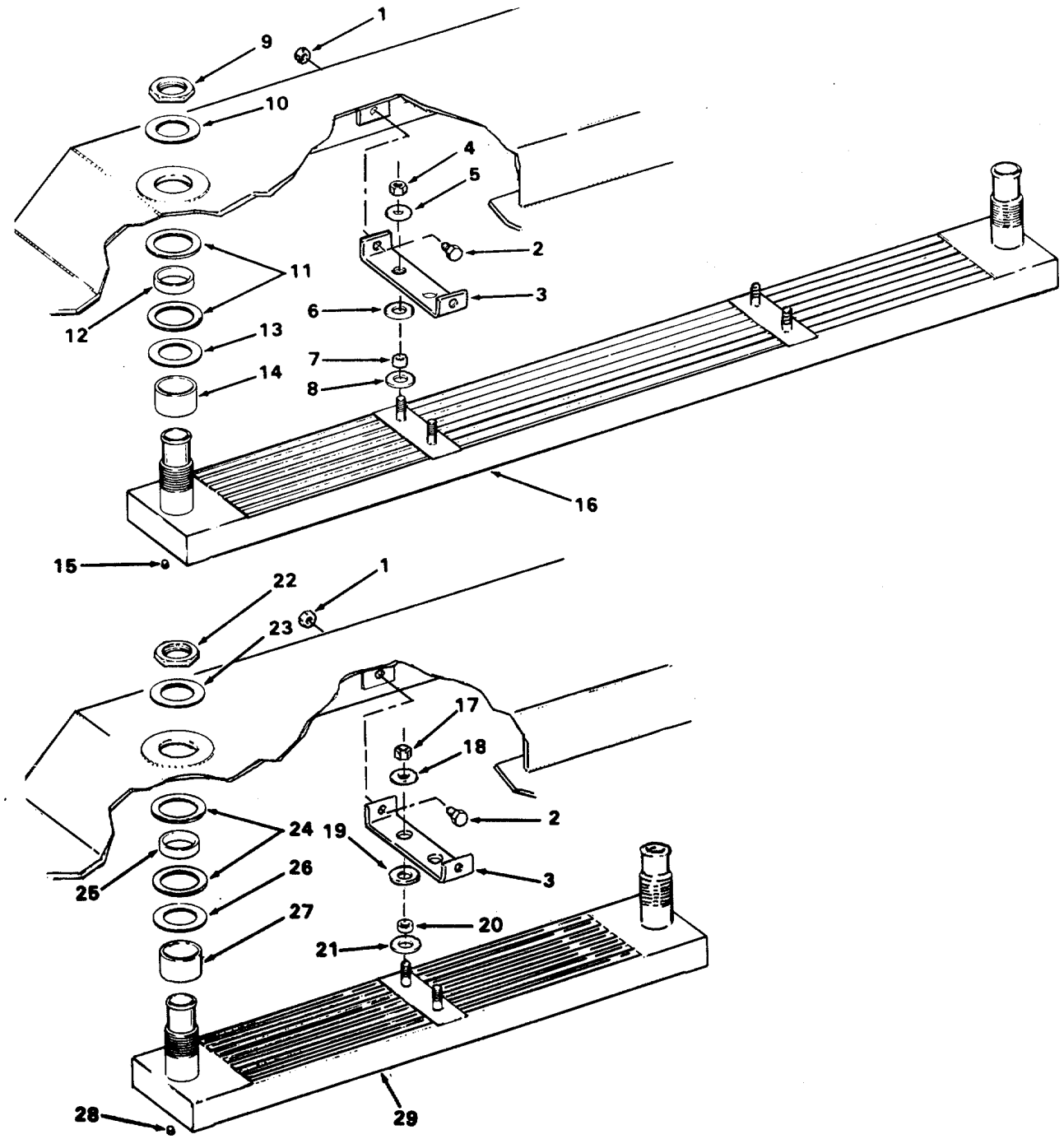
LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			

4. Hull coolers

Item Number	Description
1.	Plain hex nut
2.	Hex head capscrew
3.	Cooler hanger
4.	Support 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 (welded sub-assembly)
17.	Support bolt nut
18.	Support bolt washer
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 (welded sub-assembly)

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



Hull Coolers.

5-162. MACHINERY AND KEEL COOLERS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

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 1160°F. 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 materials 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.

(2) Before applying the epoxy compound, the surface must be clean and any internal pressure on the keelcooler 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.

5-163. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS.

This task cover:

Repair or Replace

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

NONE

Personnel Required

2

References

NONE

Equipment Condition: Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

1. Stand-by lube oil piping legend

ITEM	DESCRIPTION
1.	Steel union
2.	Steel 90° elbow
3.	Gate valve
4.	Stop check valve
5.	Wye strainer
6.	Steel union
7.	Red insert
8.	Oil pan connector
9.	Bulkhead connector
10.	Male half quick-disconnect valve coupling
11.	Dust cap
12.	Black seamless steel pipe

5-163. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (CONTINUED).

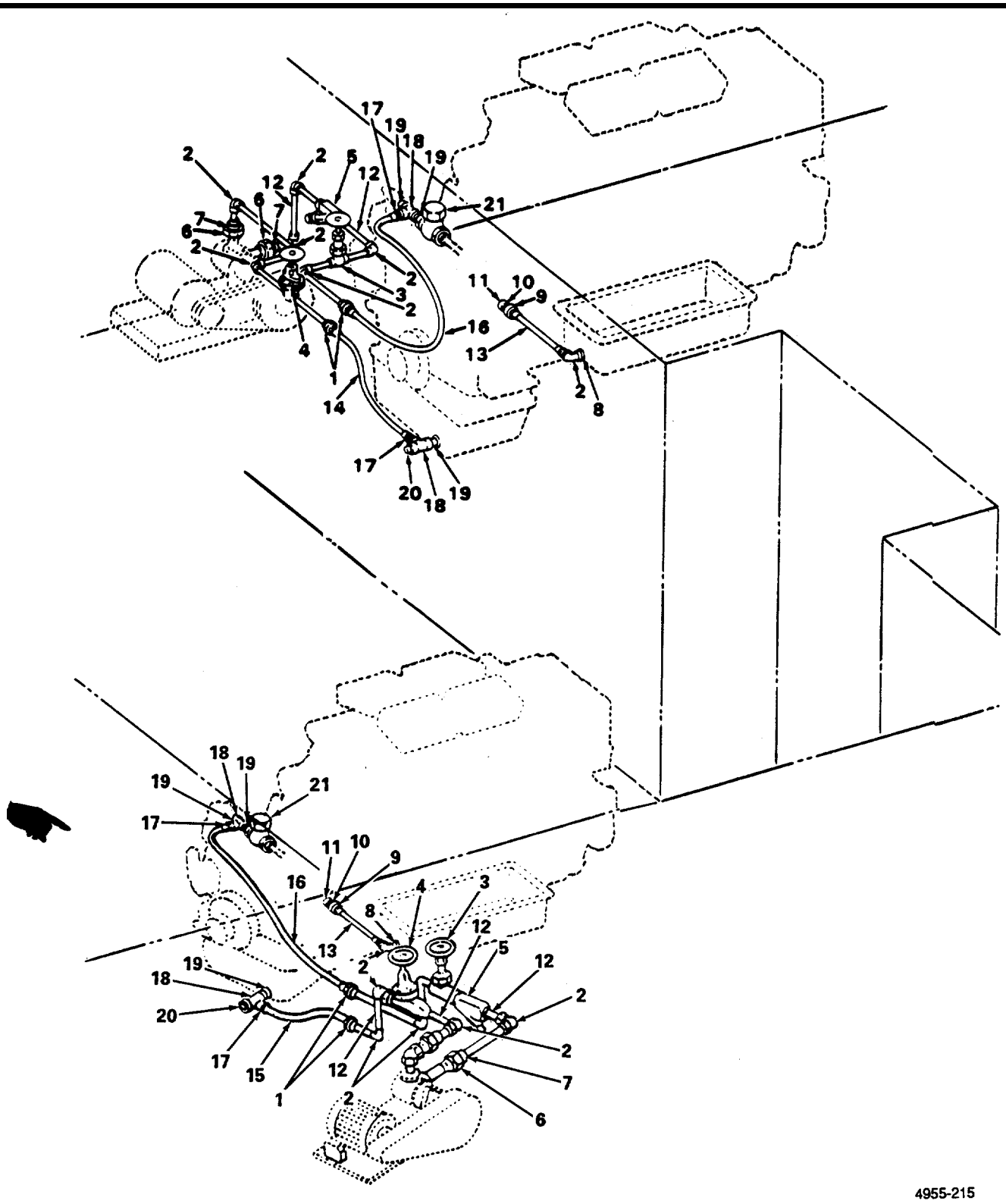
LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

Stand-by lube oil piping legend (Cont)

Item Number	Description
13.	Hose assembly Rubber hose Fitting hose Fitting hose
14.	Rubber hose assembly
15.	Rubber male hose assembly
16.	Rubber hose assembly
17.	Reducing bushing
18.	Steel tee
19.	Black steel pipe nipple
20.	Square head steel pipe plug
21.	Lift check valve

5-163. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (CONTINUED).



Stand-by Lube Oil Piping.

5-163. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (CONTINUED).

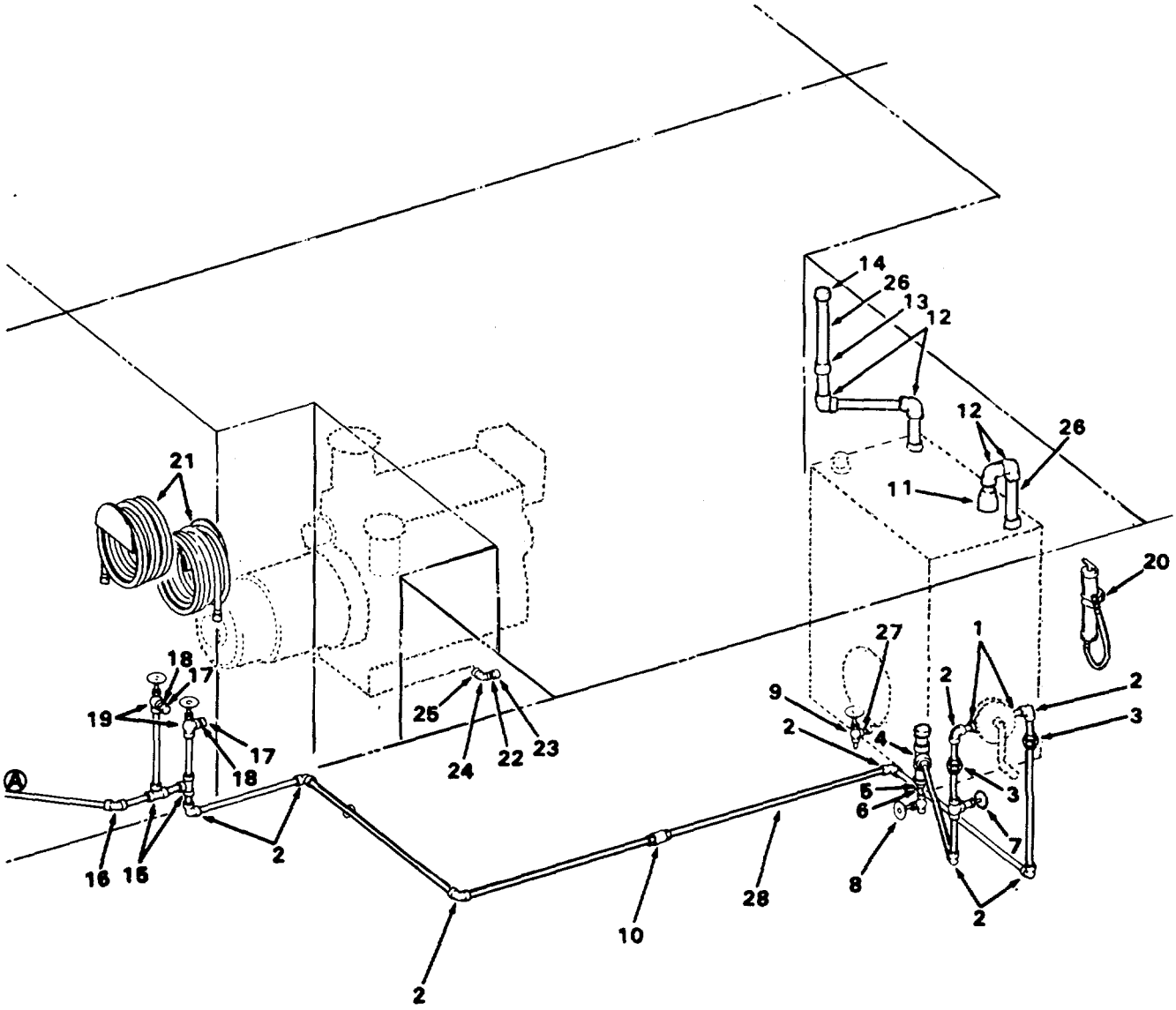
LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

2. Lube oil transfer piping legend

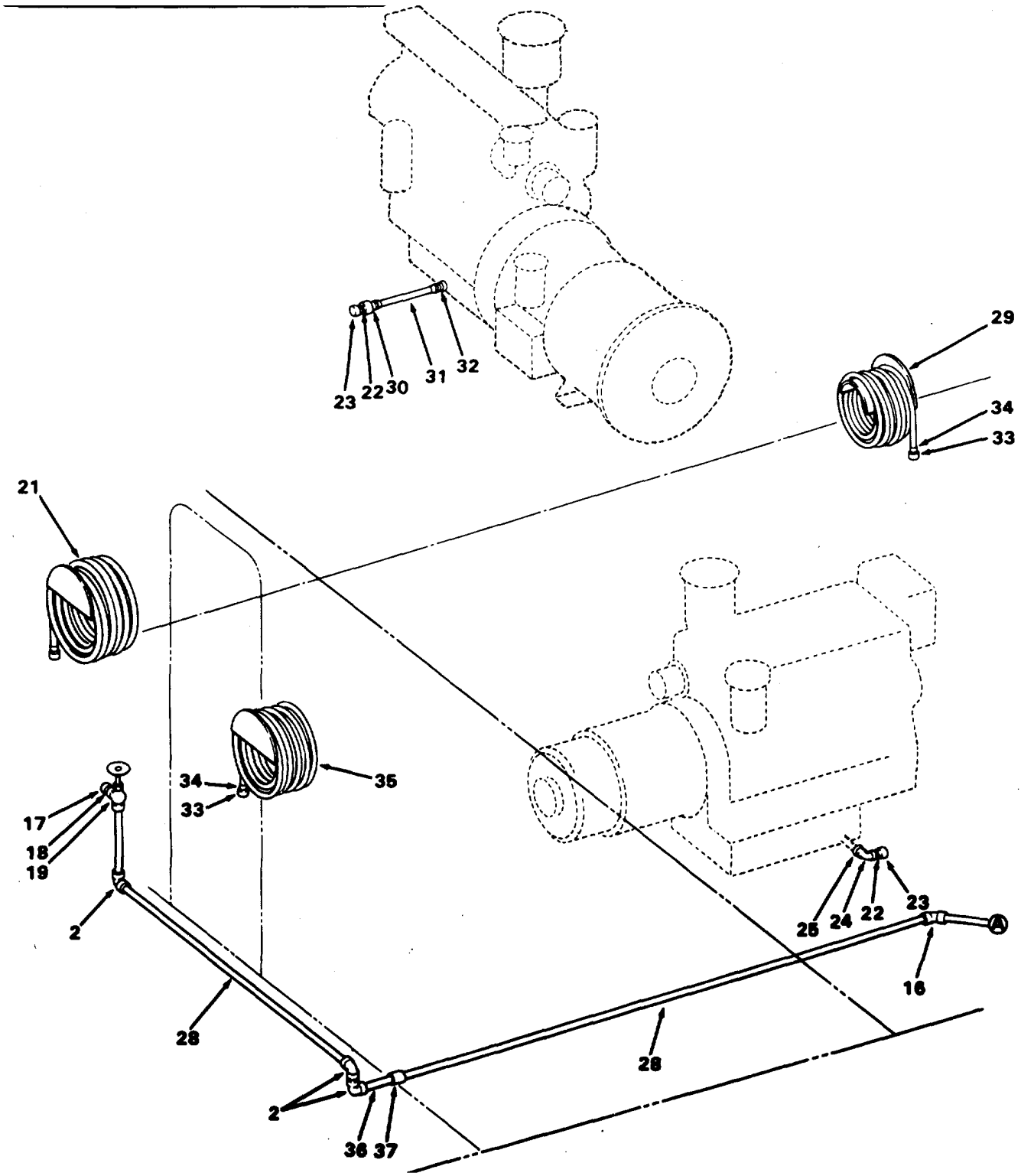
Item Number	Description
1.	2000 lb forged steel bushing
2.	90° elbow
3.	Forged steel union
4.	Forged steel tee
5.	Forged steel insert reducer
6.	Forged steel reducer coupling
7.	Gate valve
8.	Gate valve
9.	Angle valve
10.	Swing check valve
11.	Air escape terminal
12.	Forged steel 90° elbow
13.	Forged steel coupling
14.	Forged steel pipe cap
15.	Forged steel tee
16.	45° elbow
17.	Brass hose cap with chain
18.	Bronze toe nipple
19.	Angle valve
20.	Portable hand oil sump pump
21.	Rubber hose assembly includes female swivel
22.	Male half quick-disconnect valved coupling
23.	Dust cap
24.	Steel 90° elbow
25.	Malleable iron reducer bushing
26.	Black seamless steel pipe schedule 40
27.	Black seamless steel pipe schedule 40
28.	Black seamless steel pipe schedule 40
29.	Hose assembly
30.	Bulkhead connector
31.	Hose assembly
32.	Oil pan connector
33.	Female half quick-disconnect
34.	Adapter
35.	Hose assembly
36.	Black seamless steel pipe schedule 80
37.	Forged steel coupling

5-163. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (CONTINUED).



Lube Oil Transfer Piping (Sheet 1 of 2).

5-163. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (CONTINUED).



Lube Oil Transfer Piping (Sheet 2 of 2).

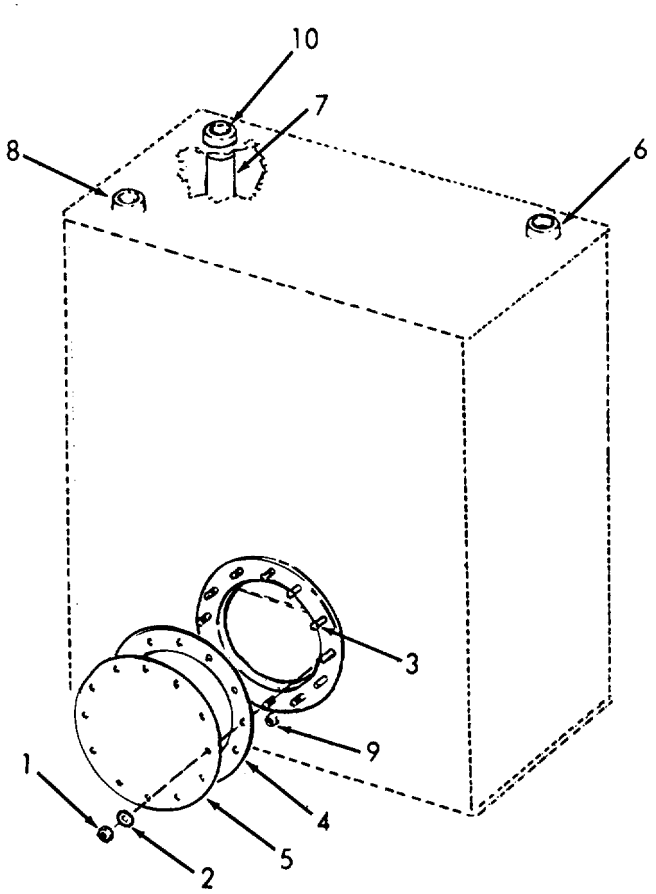
5-163. LUBE OIL PIPING - MAINTENANCE INSTRUCTIONS (CONTINUED).

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont)

2. Lube oil transfer piping legend

Item No.	Description	Item No.	Description
1.	Plain hex nut	6.	Pipe half coupling
2.	Flat washer	7.	Steel pipe
3.	Steel weld stud	8.	Half pipe coupling
4.	Fiber gasket	9.	Pipe coupling
5.	Steel hand hole plate	10.	Pipe coupling



5-164. DIESEL OIL STORAGE TANK PIPING - MAINTENANCE INSTRUCTIONS.

This task cover:

Repair or Replace

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

NONE

Personnel Required

2

References

NONE

Equipment Condition: Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

1. Diesel oil storage tank piping legend

ITEM	DESCRIPTION
1.	Plain hex nut
2.	Hex head cap screw
3.	Synthetic rubber with cloth insert ring-type gasket
4.	Steel raised face slip-on flange
5.	Gate valve
6.	90° long radius elbow
7.	Coupling
8.	Flange reducer
9.	Tee
10.	Bronze hose nipple

5-164. DIESEL OIL STORAGE TANK PIPING - MAINTENANCE INSTRUCTIONS (Continued).

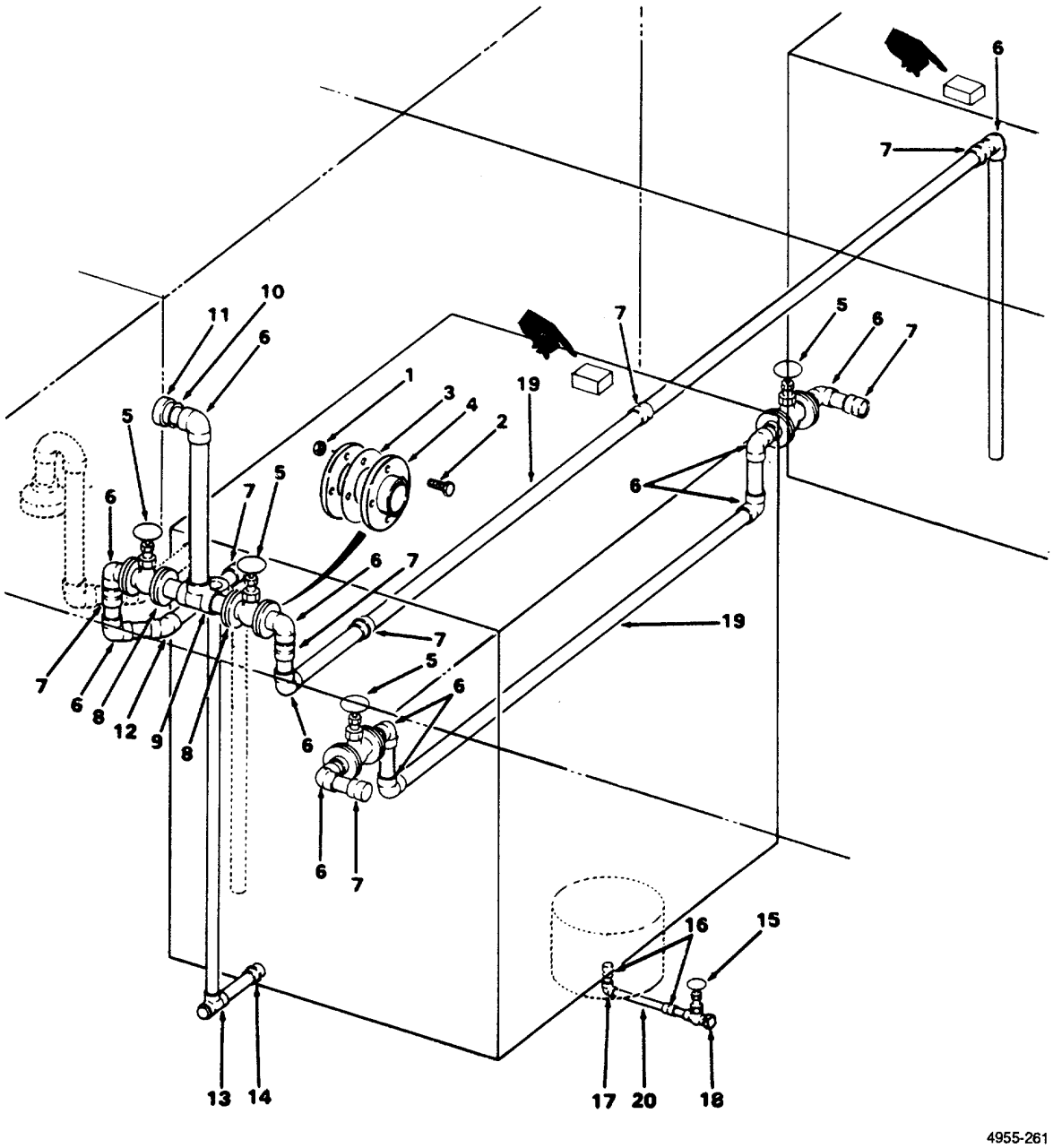
LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont).			

Diesel oil storage tank piping legend (Cont)

Item Number	Description
11.	Hose cap with chain
12.	45° elbow
13.	Tee
14.	Coupling
15.	Gate valve
16.	Coupling
17.	90° elbow
18.	150 lb malleable iron pipe cap
19.	Black seamless steel pipe schedule 40
20.	Black seamless steel pipe schedule 40

5-164. DIESEL OIL STORAGE TANK PIPING - MAINTENANCE INSTRUCTIONS (Continued).

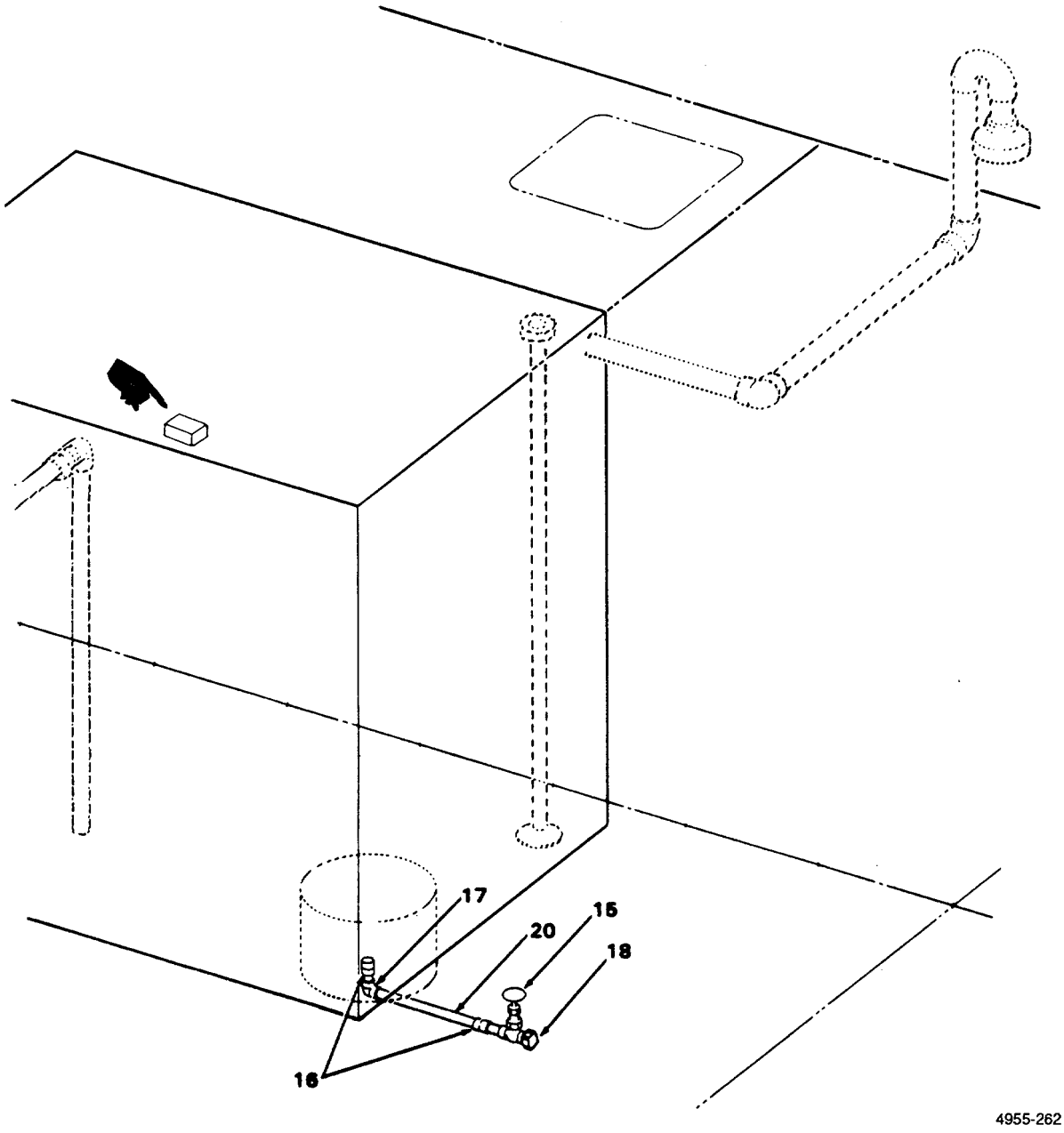
LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont).			



Diesel Oil Storage Tank Piping (Sheet 1 of 2).

5-164. DIESEL OIL STORAGE TANK PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont).			



Diesel Oil Storage Tank Piping (Sheet 2 of 2).

5-165. DIESEL OIL PIPING - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

Special Tools
NONE

Material/Parts
NONE

Personnel Required
2

References
NONE

Equipment
Condition Condition Description
NONE

Special Environmental Conditions
NONE

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

1. Diesel oil piping legend

Item Number	Description
1.	Forged steel coupling
2.	90° elbow
3.	90° elbow
4.	Forged steel coupling
5.	Angle valve
6.	Steel union
7.	45° elbow
8.	Steel union
9.	3-way steel selector valve
10.	3-way selector valve
11.	Plain hex nut
12.	Lockwasher
13.	Hex head capscrew

5-165. DIESEL OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

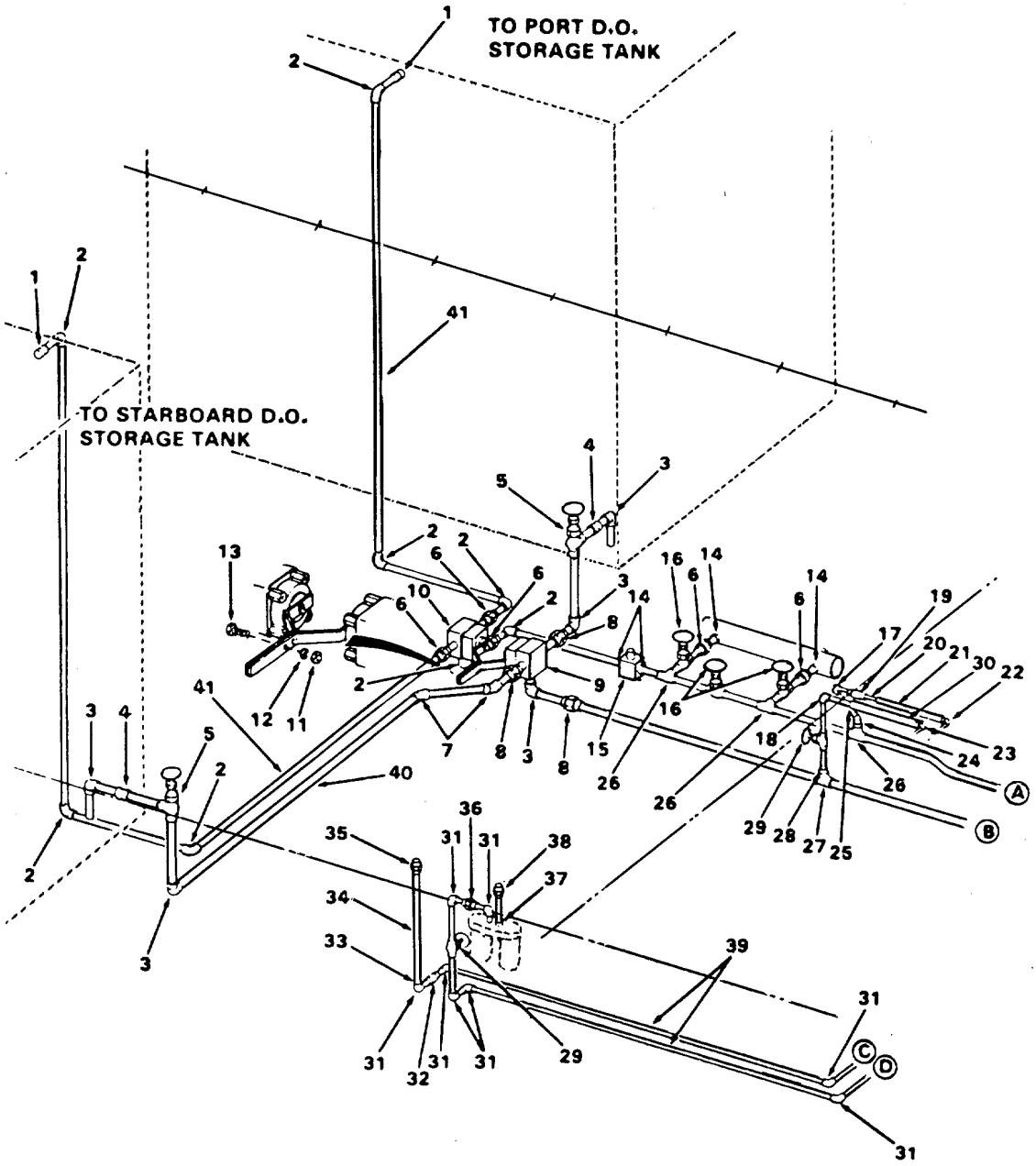
LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont).			

Diesel oil piping legend (Cont)

Item Number	Description
14.	Steel reducing bushing
15.	Flow series switch
16.	Gate valve
17.	90° elbow
18.	90° elbow
19.	Lift check valve
20.	Steel female connector
21.	Hose assembly includes swivel
22.	90° flared female elbow
23.	90° flared female elbow
24.	45° elbow
25.	Reducing insert
26.	Forged steel tee
27.	Forged steel tee
28.	Reducing insert
29.	Gate valve
30.	Hose assembly includes swivel
31.	90° elbow
32.	Lift check valve
33.	Reducing insert
34.	Seamless steel tube
35.	Forged steel union
36.	Forged steel union
37.	Black steel reducer bushing
38.	Forged steel union
39.	Seamless steel tube
40.	Seamless steel pipe
41.	Seamless steel tube
42.	Reducing insert
43.	Reducing insert
44.	Female flared connector
45.	Female flared connector
46.	45° elbow
47.	Forged steel coupling
48.	Forged steel coupling
49.	Forged steel union
50.	Seamless steel tube

5-165. DIESEL OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

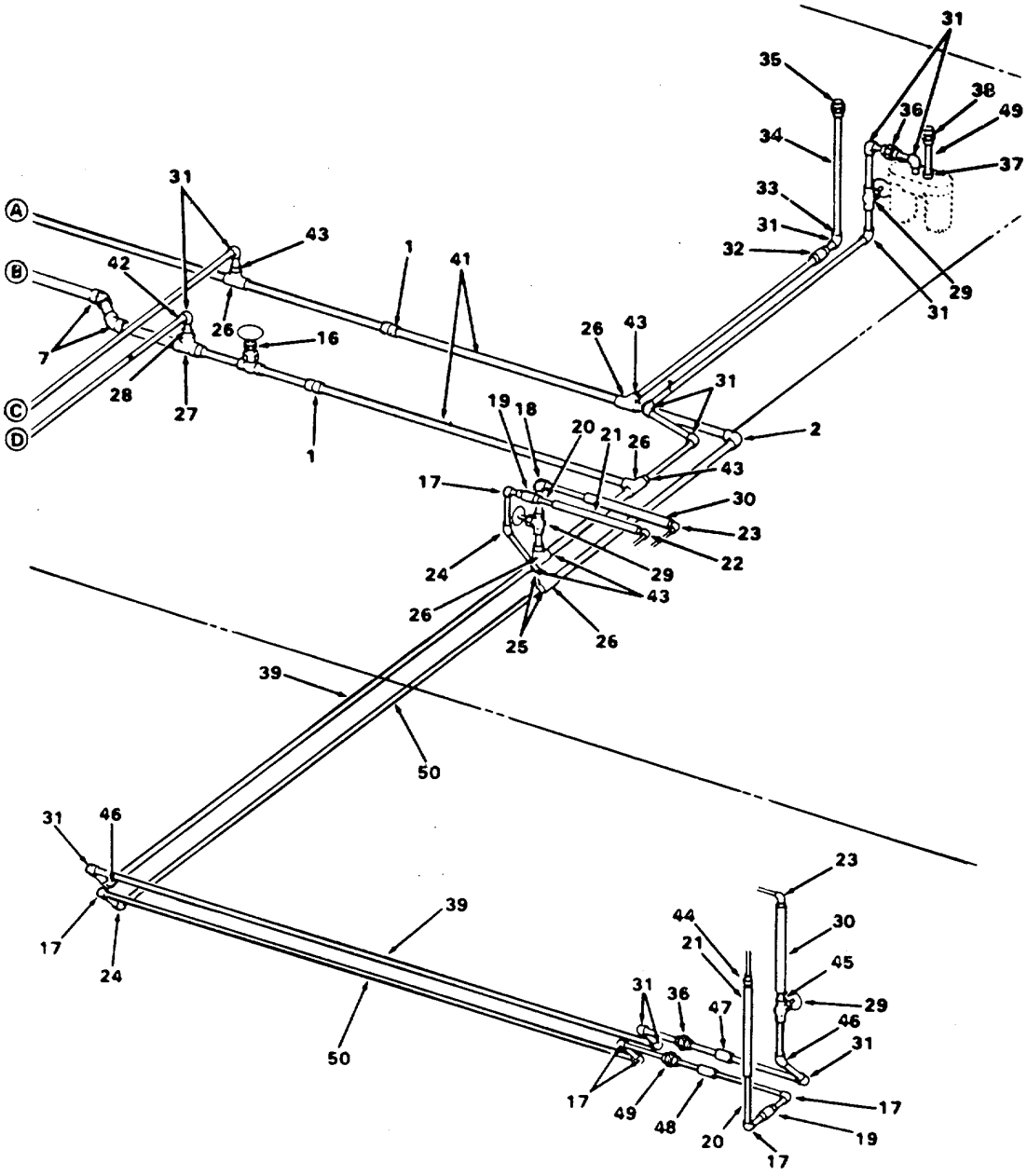
LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont).			



Diesel Oil Piping (Sheet 1 of 2).

5-165. DIESEL OIL PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont).			



Diesel Oil Piping (Sheet 2 of 2).

5-166. DIESEL OIL COOLING PIPING - MAINTENANCE INSTRUCTIONS (Cont).

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 cooling piping legend

Item Number	Description
1.	Plain hex nut
2.	Hex head capscrew
3.	Bronze standard pipe flange
4.	Flange gasket
5.	Hex head capscrew
6.	Bronze flat face pipe flange
7.	Bronze flanged gate valve
8.	Bronze pipe nipple
9.	Bronze 45° pipe elbow
10.	Copper-nickel pipe

5-166. DIESEL OIL COOLING PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

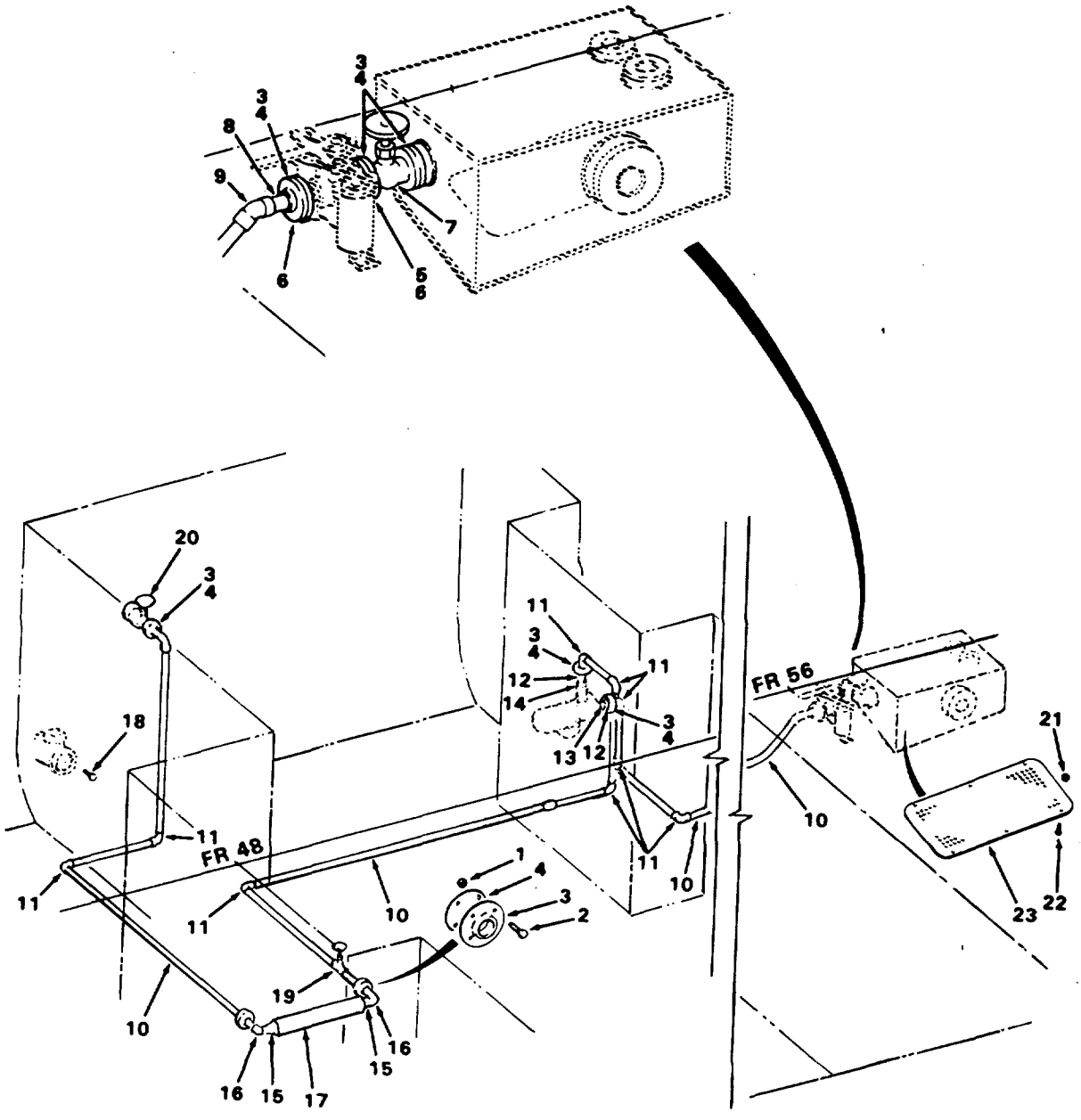
REPAIR OR REPLACE (Cont).

Diesel oil cooling piping legend (Cont)

Item Number	Description
11.	Bronze 90° tube elbow
12.	Bronze male flange
13.	Bronze pump adapter
14.	Bronze pump adapter
15.	Bronze reducing bushing
16.	Bronze 90° street elbow
17.	Diesel oil type HCF single pass heat exchanger
18.	Hex head capscrew
19.	Bronze gate valve
20.	Bronze flanged stop check valve
21.	Plain hex nut
22.	Monel flat head machine screw
23.	Fire, ballast, and keel cooler sea chest strainer plate

5-166. DIESEL OIL COOLING PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont).			



Diesel Oil Cooling Piping and Sea Chests.

5-167. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

Special Tools
NONE

Material/Parts
NONE

Personnel Required
2

References
NONE

Equipment
Condition Condition Description
NONE

Special Environmental Conditions
NONE

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

1. Forward engine room piping legend

Item Number	Description
1.	Flexible metal hose assembly
2.	Plain hex nut
3.	Hex head capscrew
4.	Slip on flat face flange
5.	Asbestos gasket
6.	90° long radius elbow
7.	45° long radius elbow
8.	Connecting reducer
9.	Flexible hose assembly
10.	Plain hex nut

5-167. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont).

Forward engine room piping legend (Cont)

Item Number	Description
11.	Hex head capscrew
12.	Slip on flat face flange
13.	Asbestos gasket
14.	Dry spark arresting type size 8 muffler
15.	45° steel elbow
16.	90° long radius elbow
17.	Steel weather cap, fabricated item
18.	Weather cap
19.	Hex head capscrew
20.	Aluminum alloy exhaust stack
21.	Insulator tape
22.	Hex head capscrew
23.	Lockwasher
24.	Exhaust piping guard, fabricated item
25.	Plain hex nut
26.	Hex head capscrew
27.	Slip flange
28.	Gasket
29.	Plain hex nut
30.	Hex head capscrew
31.	Slip on flat face flange
32.	Asbestos gasket
33.	Flexible hose assembly
34.	Plain hex nut
35.	Hex head capscrew
36.	Slip on flat face flange
37.	Asbestos gasket
38.	Slip on flat face flange
39.	Threaded flat face flange
40.	Asbestos gasket
41.	Dry spark arresting-type muffler
42.	90° reducing long radius elbow
43.	90° long radius elbow
44.	Plain hex nut
45.	Lockwasher

5-167. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

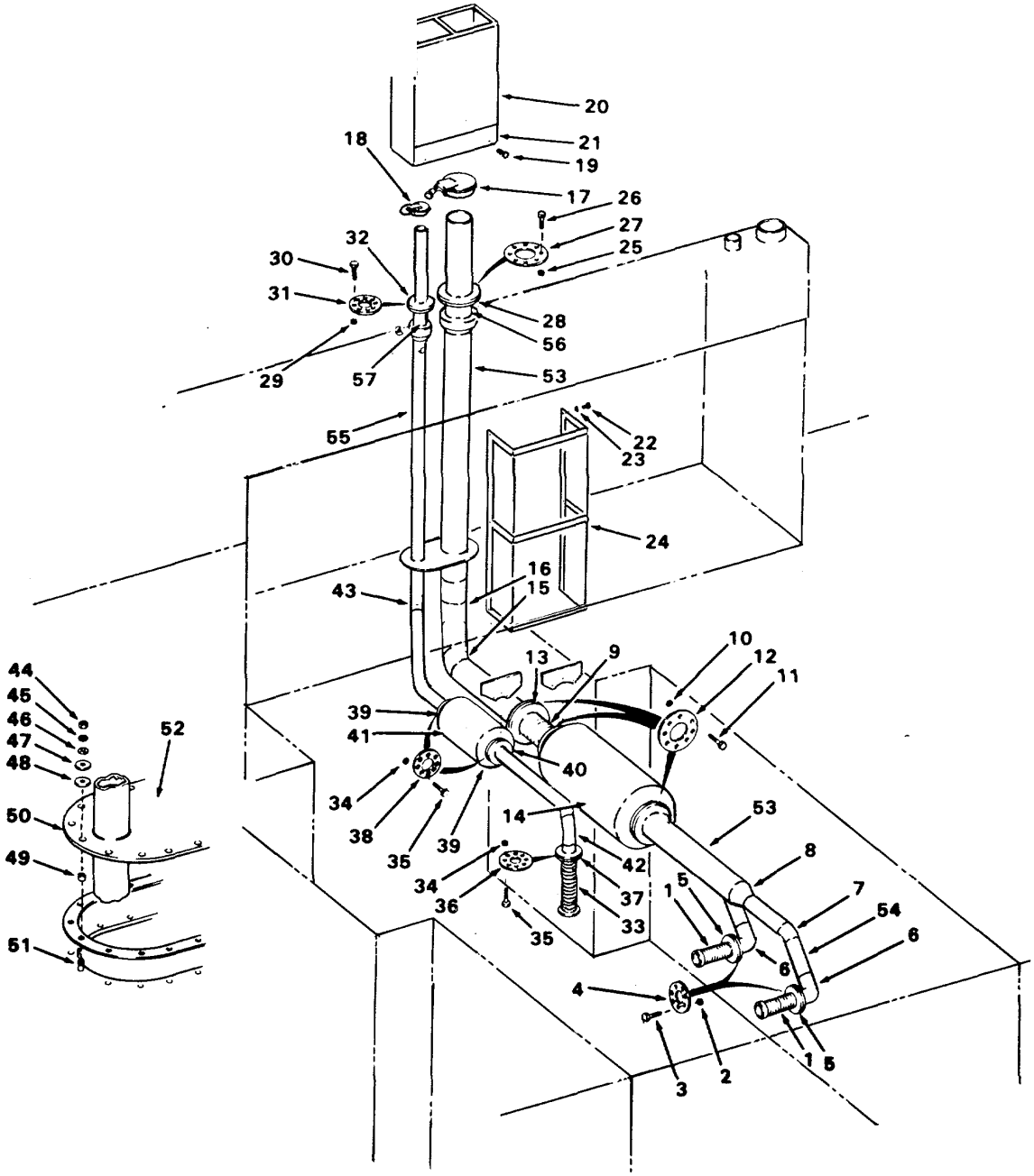
REPAIR OR REPLACE (Cont).

Forward engine room legend (Cont)

Item Number	Description
46.	Flatwasher
47.	Steel flatwasher
48.	Asbestos washer
49.	Asbestos packing
50.	Asbestos gasket
51.	Steel weld stud
52.	Pipe and plate exhaust assembly
53.	Black seamless steel pipe schedule 40
54.	Black seamless steel pipe schedule 40
55.	Black seamless steel pipe schedule 40
56.	Black seamless steel pipe schedule 40
57.	Black seamless steel pipe schedule 40

5-167. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont).			



Diesel Engine Exhaust Piping - Forward Engine Room.

5-167. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE (Cont).

2. Aft engine room and anchor winch room piping legend

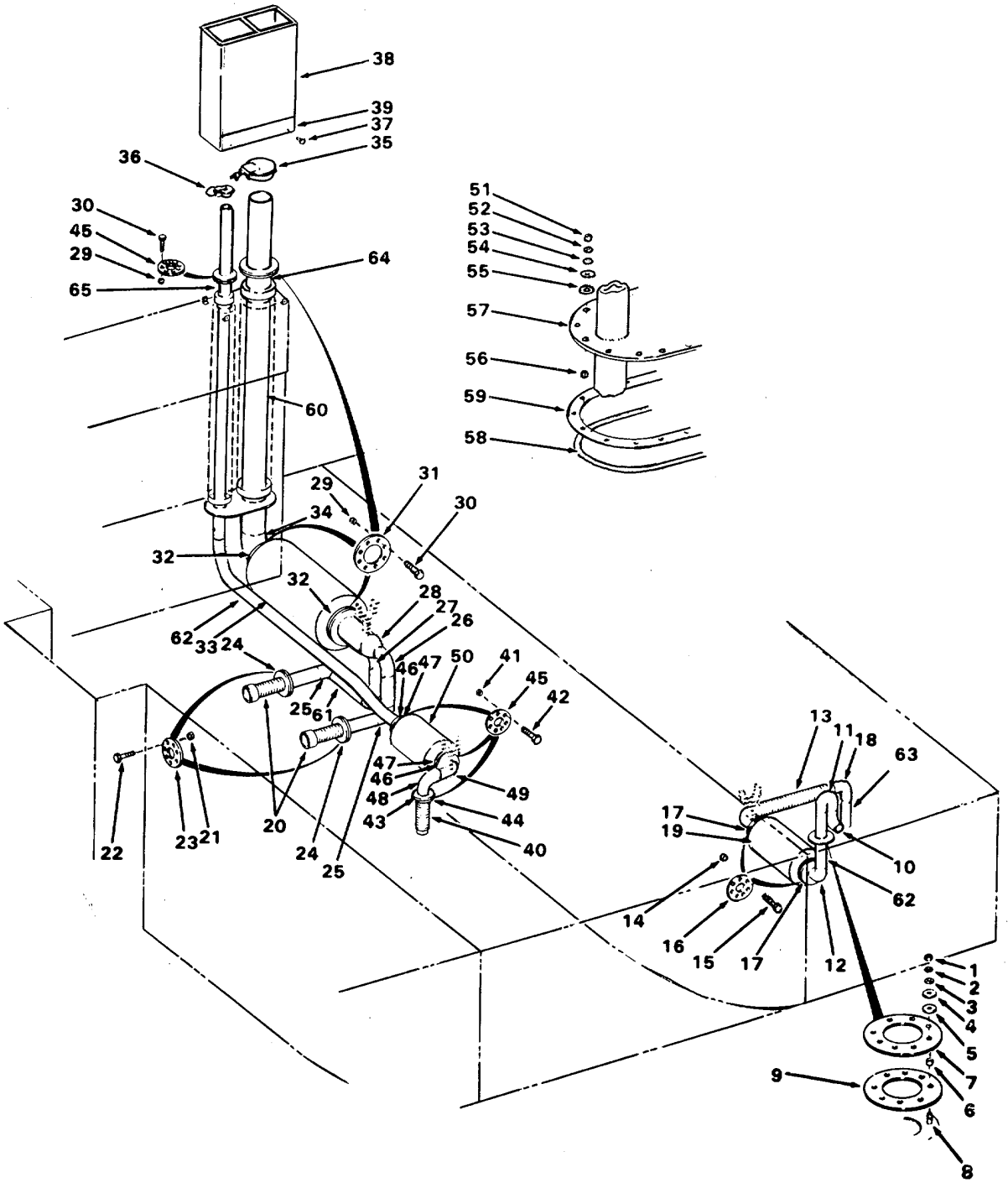
Item Number	Description
1.	Plain hex nut
2.	Lockwasher
3.	Flatwasher
4.	Steel flatwasher, fabricated item
5.	Asbestos washer
6.	Asbestos packing
7.	Asbestos gasket
8.	Steel weld stud
9.	Pipe and plate exhaust assembly
10.	90° short radius elbow
11.	180° long radius elbow
12.	90° long radius elbow
13.	Flexible metal hose assembly
14.	Plain hex nut
15.	Hex head capscrew
16.	Slip-on reducing flange
17.	Asbestos gasket
18.	90° reducing long radius elbow
19.	Dry spark arresting type size 4 muffler
20.	Flexible metal hose assembly
21.	Plain hex nut
22.	Hex head capscrew
23.	Slip on flat face flange
24.	Asbestos gasket
25.	90° short radius steel elbow
26.	90° long radius steel elbow
27.	45° long radius steel elbow
28.	Connecting reducer
29.	Plain hex nut
30.	Hex head capscrew
31.	Slip on flat face flange
32.	Asbestos gasket
33.	Dry spark arresting type size 8 muffler
34.	90° short radius steel elbow
35.	Steel weather cap, fabricated item
36.	Weather cap

5-167. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont).			
37.	Hex head capscrew		
38.	Aluminum alloy exhaust stack		
39.	Insulation tape		
40.	Flexible hose assembly		
41.	Plain hex nut		
42.	Hex head capscrew		
43.	Slip on flat face flange		
44.	Asbestos gasket		
45.	Slip on flat face flange		
46.	Threaded full face flange		
47.	Asbestos gasket		
48.	90° reducing long radius elbow		
49.	90° long radius steel elbow		
50.	Dry spark arresting type muffler		
51.	Plain hex nut		
52.	Lockwasher		
53.	Flatwasher		
54.	Steel flatwasher		
55.	Washer		
56.	Packing		
57.	Pipe and plate exhaust assembly		
58.	Steel weld stud		
59.	Gasket		
60.	Black seamless steel pipe schedule 40		
61.	Black seamless steel pipe schedule 40		
62.	Black seamless steel pipe schedule 40		
63.	Black seamless steel pipe schedule 40		
64.	Black seamless steel pipe schedule 40		
65.	Black seamless steel pipe schedule 40		

5-167. ENGINE EXHAUST PIPING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS



5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

Special Tools
NONE

Material/Parts
NONE

Personnel Required
2

References
NONE

Equipment
Condition Condition Description
NONE

Special Environmental Conditions
NONE

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

1. Fresh and flush water piping legend

Item Number	Description
1.	Brass pipe nipple
2.	Relief valve
3.	Male adapter
4.	90° tube elbow
5.	Tube union
6.	Bronze bushing
7.	Brass pipe nipple
8.	Brass reducer bushing
9.	Globe valve
10.	Snifter valve
11.	Liquid level gage
12.	Automatic air charging control

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

Fresh and flush water piping legend (Cont).

Item Number	Description
13.	Brass pipe tee
14.	Brass pipe nipple
15.	Bronze 45° pipe nut
16.	Bronze male elbow
17.	Bronze male connector
18.	Bronze female pipe cock gage
19.	Pressure gauge
20.	Brass cross pipe
21.	40 gallon fresh water pressure tank
22.	Bronze globe gage
23.	Brass petcock
24.	Tube union
25.	Bronze adapter
26.	Brass pipe bushing
27.	90° tube elbow
28.	Female outlet tee
29.	Brass hex head bushing
30.	Brass vacuum pipe breaker
31.	Male adapting elbow
32.	Pressure switch
33.	Globe valve
34.	Tube tee
35.	Gate valve
36.	Tube tee
37.	Swing check valve
38.	Square head pipe plug
39.	Bronze tee
40.	90° elbow
41.	Brass close nipple
42.	Gate valve
43.	Brass thermometer well
44.	Bronze pipe coupling
45.	Male adapter
46.	Female run tee
47.	Copper-nickel tube
48.	Copper tube

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

Fresh and flush water piping legend (Cont).

Item Number	Description
49.	Copper tube
50.	Gate valve
51.	90° tube elbow
52.	Tube union
53.	Female adapting 90° elbow
54.	Male adapter
55.	Tube tee
56.	Tube union
57.	Globe valve
58.	Adapter nipple
59.	90° elbow
60.	Globe valve
61.	Male adapting 90° elbow
62.	Tube tee
63.	Basket Y-strainer
64.	Male adapter
65.	Tube coupling
66.	Steel pipe coupling
67.	Bronze petcock
68.	Bronze female adapter
69.	Tube tee
70.	45° tube elbow
71.	45° tube elbow
72.	Copper tube
73.	Copper tube
74.	Copper tube
75.	90° elbow
76.	Tube tee
77.	Gate valve
78.	Tube tee
79.	Reducer coupling
80.	90° tube elbow
81.	Bronze hose gate valve with cap and chain
82.	Bronze 90° elbow
83.	Copper 45° tube elbow
84.	Copper adapter
85.	Multi-relief lift valve

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS

REPAIR OR REPLACE

Fresh and flush water piping legend (Cont).

Item Number	Description
86.	Copper pipe
87.	Double female hose coupling
88.	Hose increaser
89.	Double jacket hose
90.	Plain hexagon nut
91.	Lockwasher
92.	Hex head capscrew
93.	Brass cabinet hinge pins
94.	Brass pin safety hasp
95.	Hose cabinet
96.	Tube tee
97.	Copper pipe and valve supply
98.	90° tube elbow
99.	Tube tee
100.	Bronze bushing
101.	Bronze hose cap with chain
102.	Bronze pipe adapter
103.	90° tube elbow
104.	Globe valve
105.	45° tube elbow
106.	Bronze bushing
107.	Tube cross
108.	Globe valve
109.	90° reducing elbow
110.	Stainless steel hose clamp
111.	Rubber hose
112.	Copper-nickel pipe
113.	90° tube elbow
114.	Gate valve
115.	Tube tee
116.	Bronze adapter
117.	Ground joint union
118.	Swing check valve
119.	Ground joint union
120.	Bronze adapter
121.	90° tube elbow
122.	Bronze tee

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS

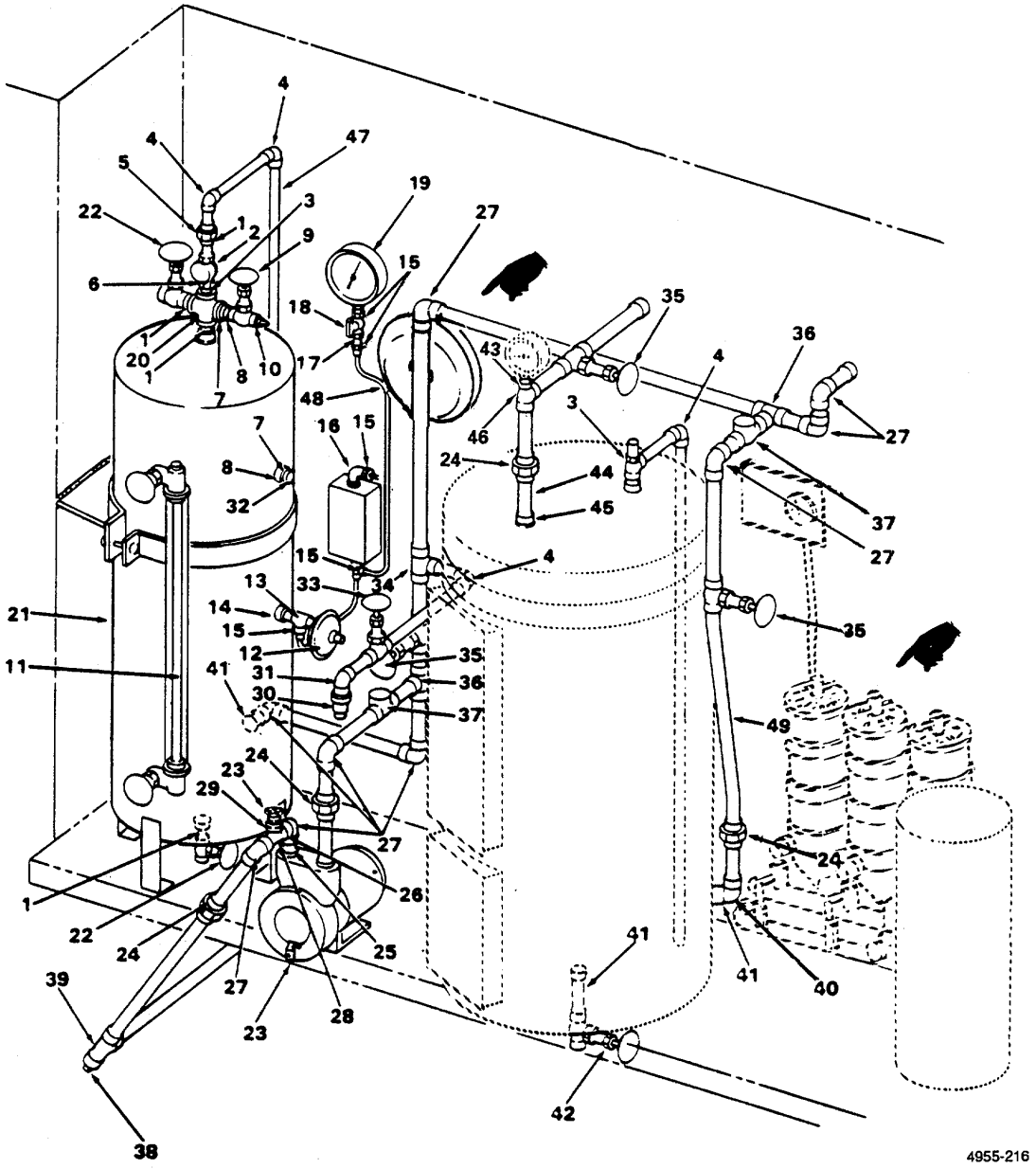
REPAIR OR REPLACE

Fresh and flush water piping legend (Cont).

Item Number	Description
123.	Y-strainer
124.	Gate valve
125.	Hex head capscrew
126.	Bronze flat face flange
127.	Full face gasket
128.	Hex head capscrew
129.	Bronze flat face flange
130.	Full face gasket
131.	Tube tee
132.	Monel flat head capscrew
133.	Strainer plate
134.	Bronze globe valve
135.	Hose adapter
136.	Bronze hose plug
137.	Gate valve
138.	Tube union
139.	90° tube elbow
140.	Pipe sleeve
141.	Pipe return bend
142.	Tube adapter
143.	Bronze bushing
144.	Relief valve
145.	Bronze adapter
146.	Reducer bushing
147.	Copper-nickel pipe
148.	Copper-nickel tube
149.	90° tube elbow
150.	Copper-nickel pipe
151.	Pressure switch
152.	Pressure steel flushing tank
153.	Brass pipe tee
154.	Bronze relief valve
155.	Reducing bushing
156.	Brass reducing bushing

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS (Continued).

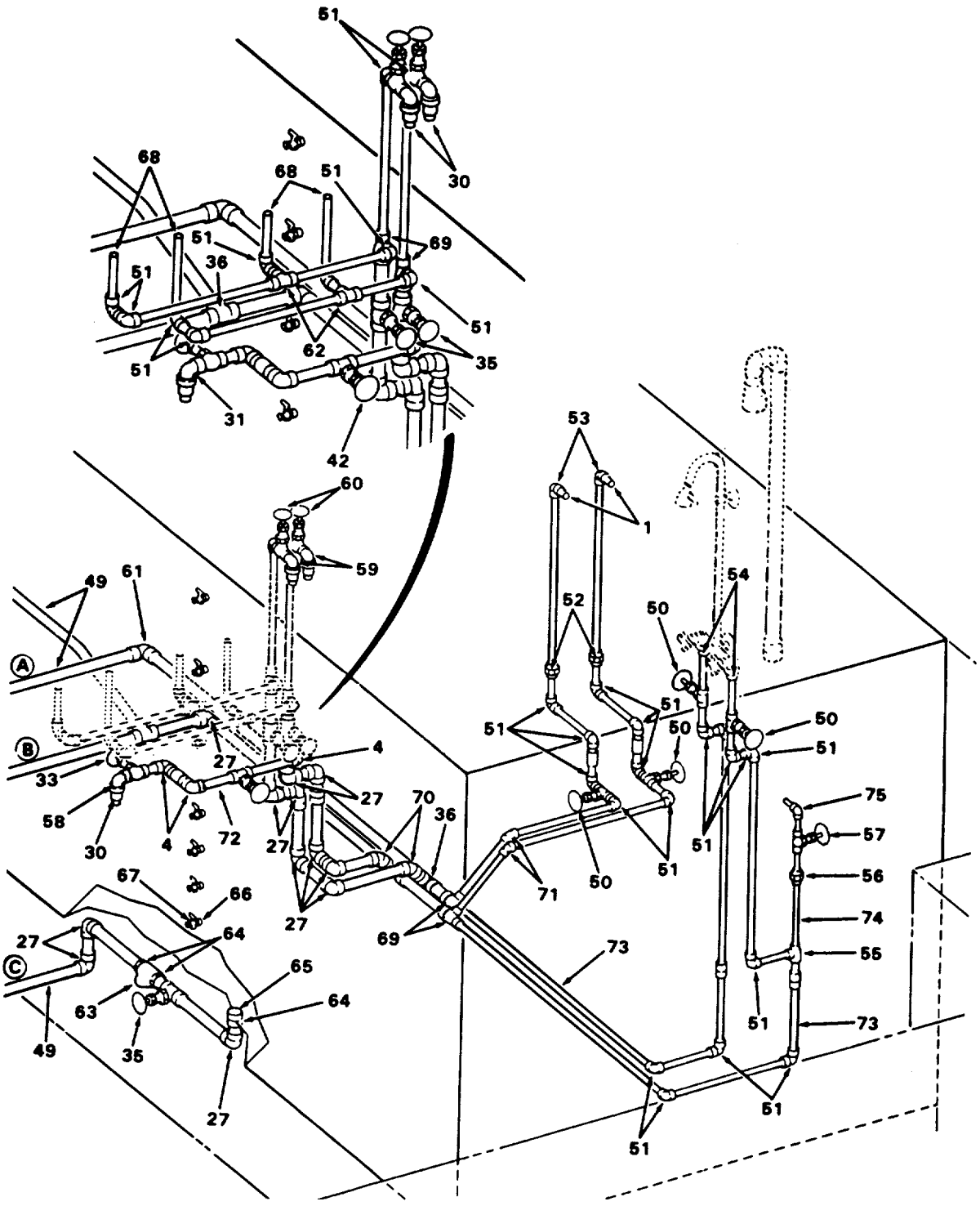
REPAIR OR REPLACE (Cont)



Fresh and Flush Water System (Sheet 1 of 7).

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR OR REPLACE (Cont)

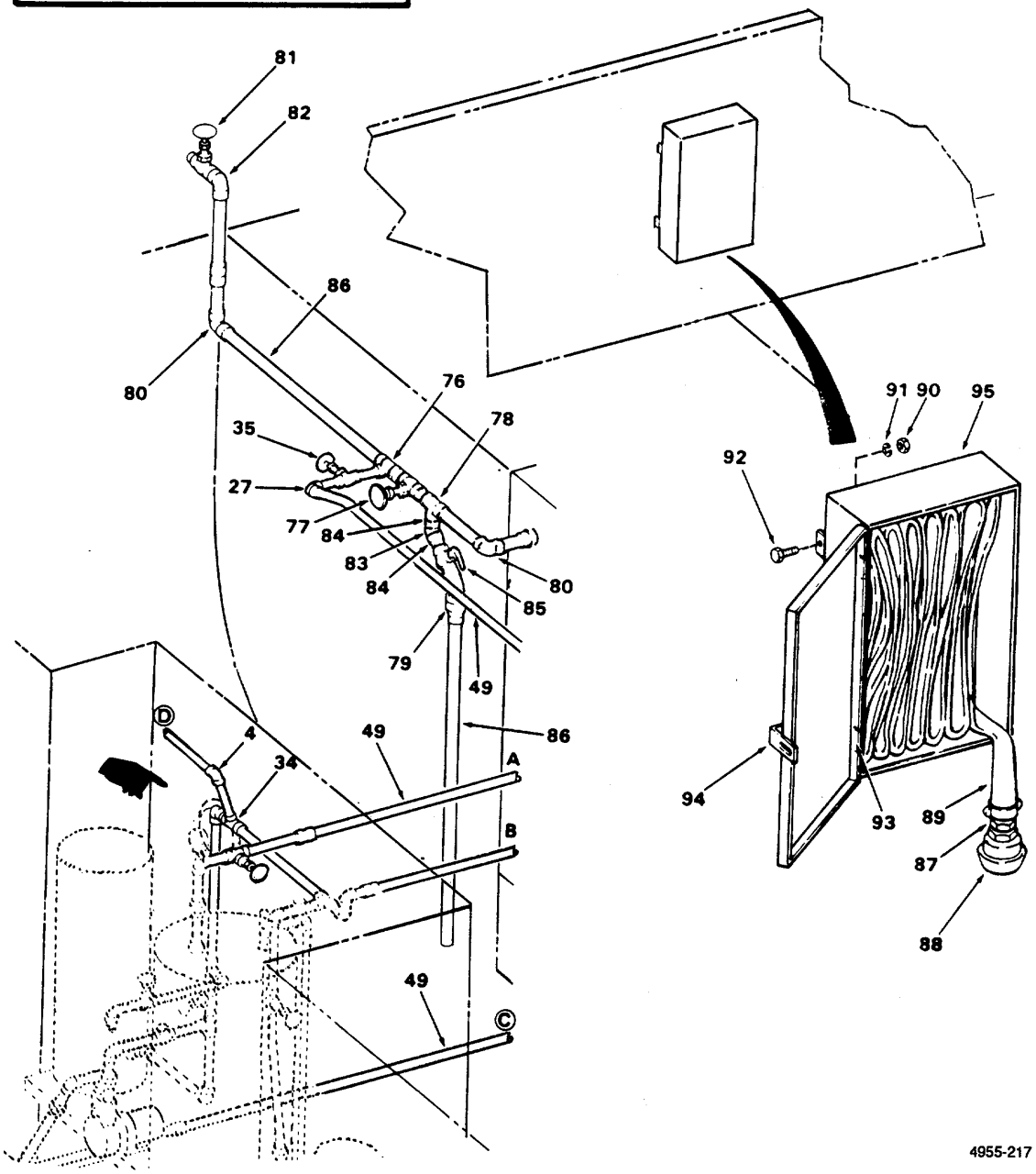


Fresh and Flush Water System (Sheet 2 of 7).

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR OR REPLACE (Cont)

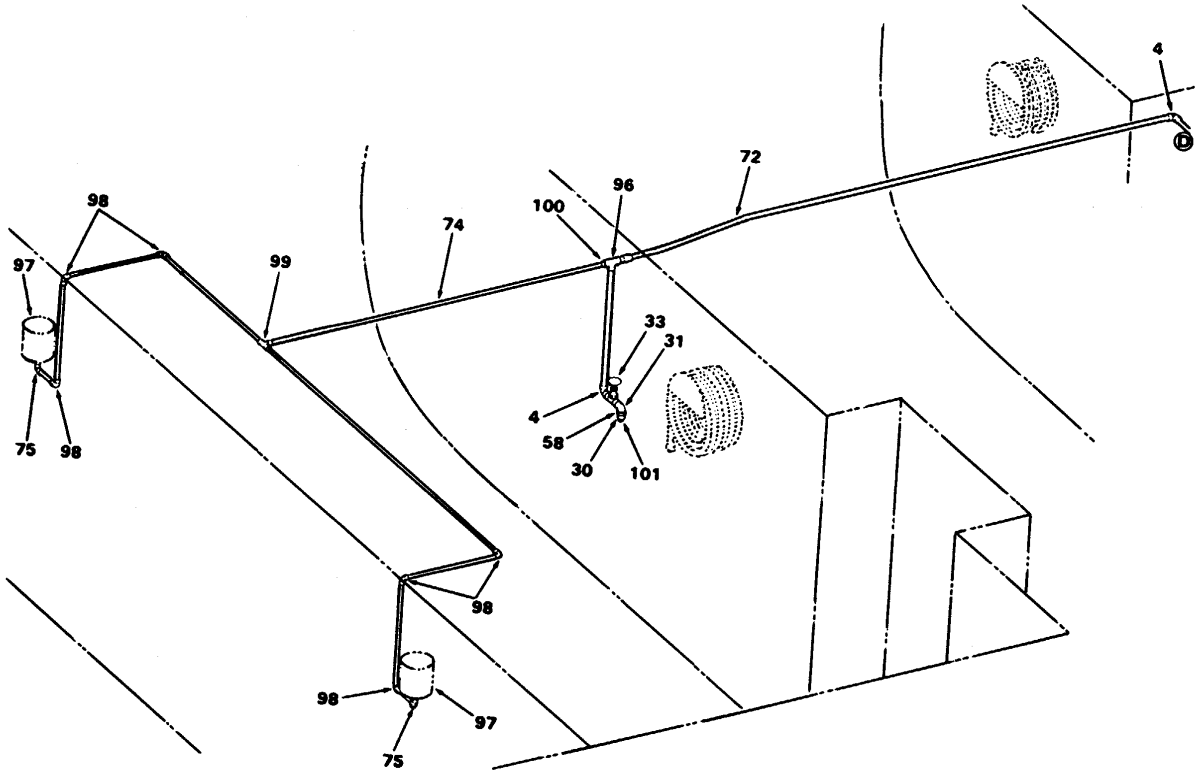
REPAIR OR REPLACE (Cont)



Fresh and Flush Water System (Sheet 3 of 7).

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS (Continued).

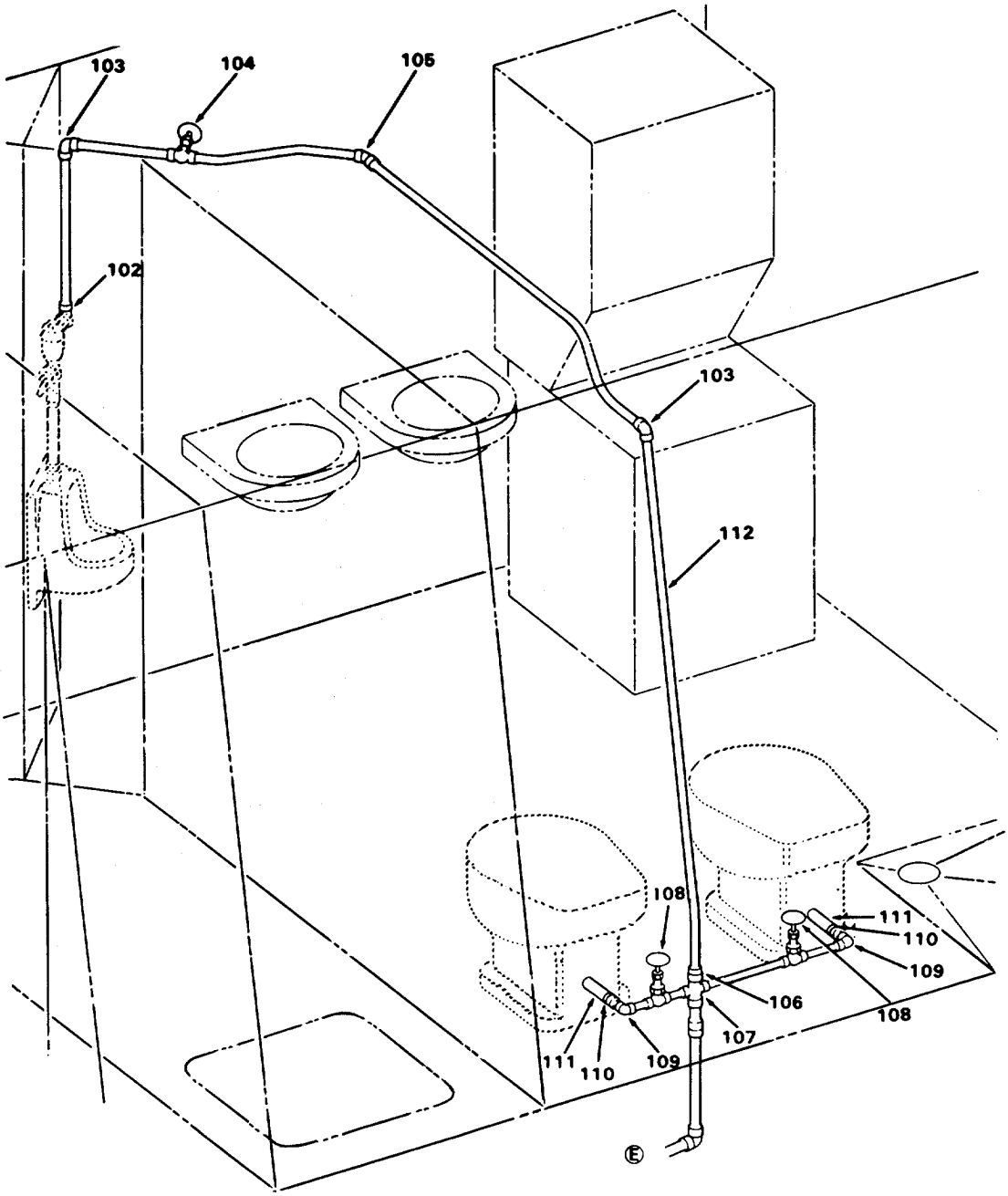
REPAIR OR REPLACE (Cont)



Fresh and Flush Water System (Sheet 4 of 7).

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS.

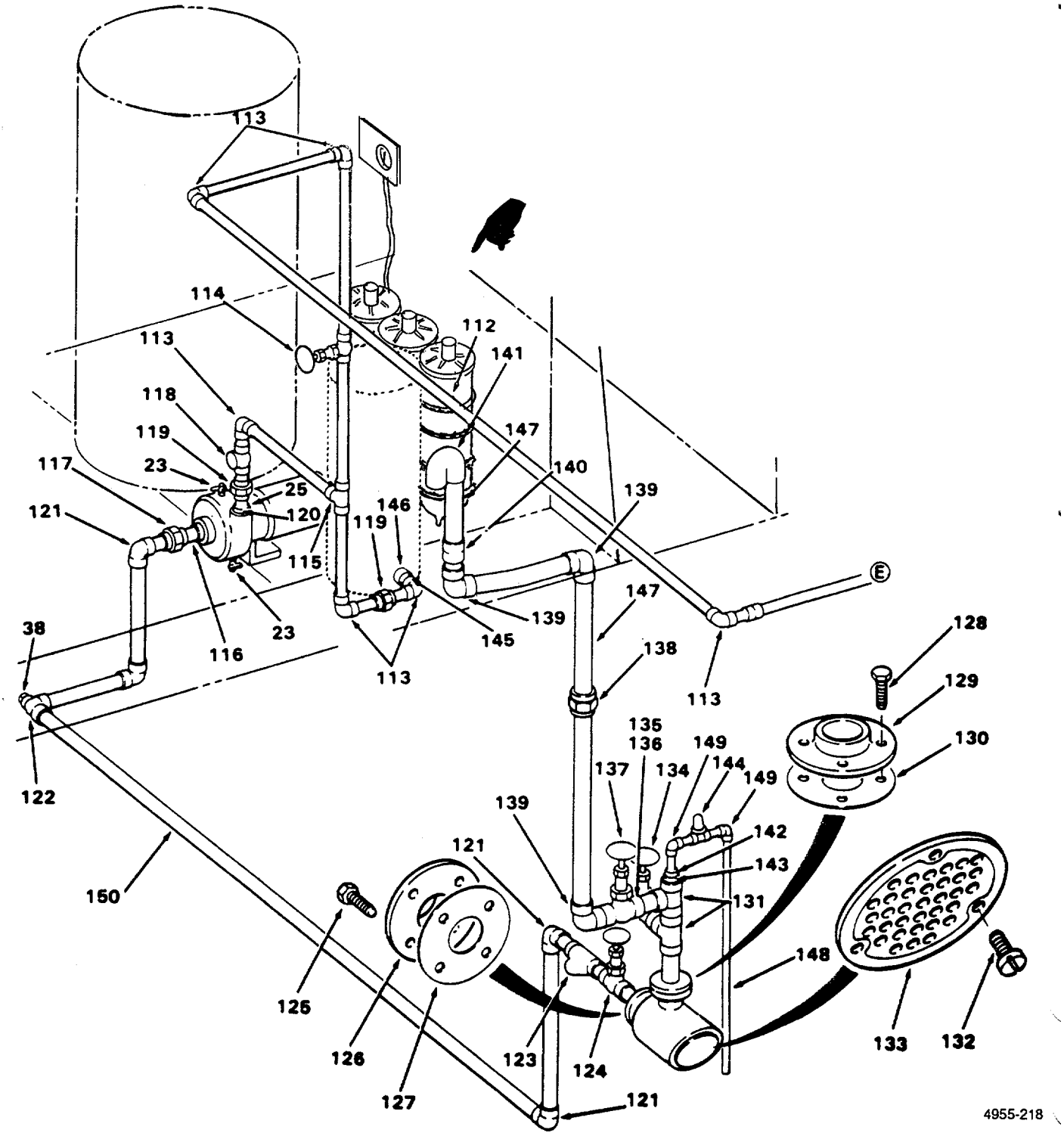
LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



Fresh and Flush Water System (Sheet 5 of 7).

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS. (Cont.)

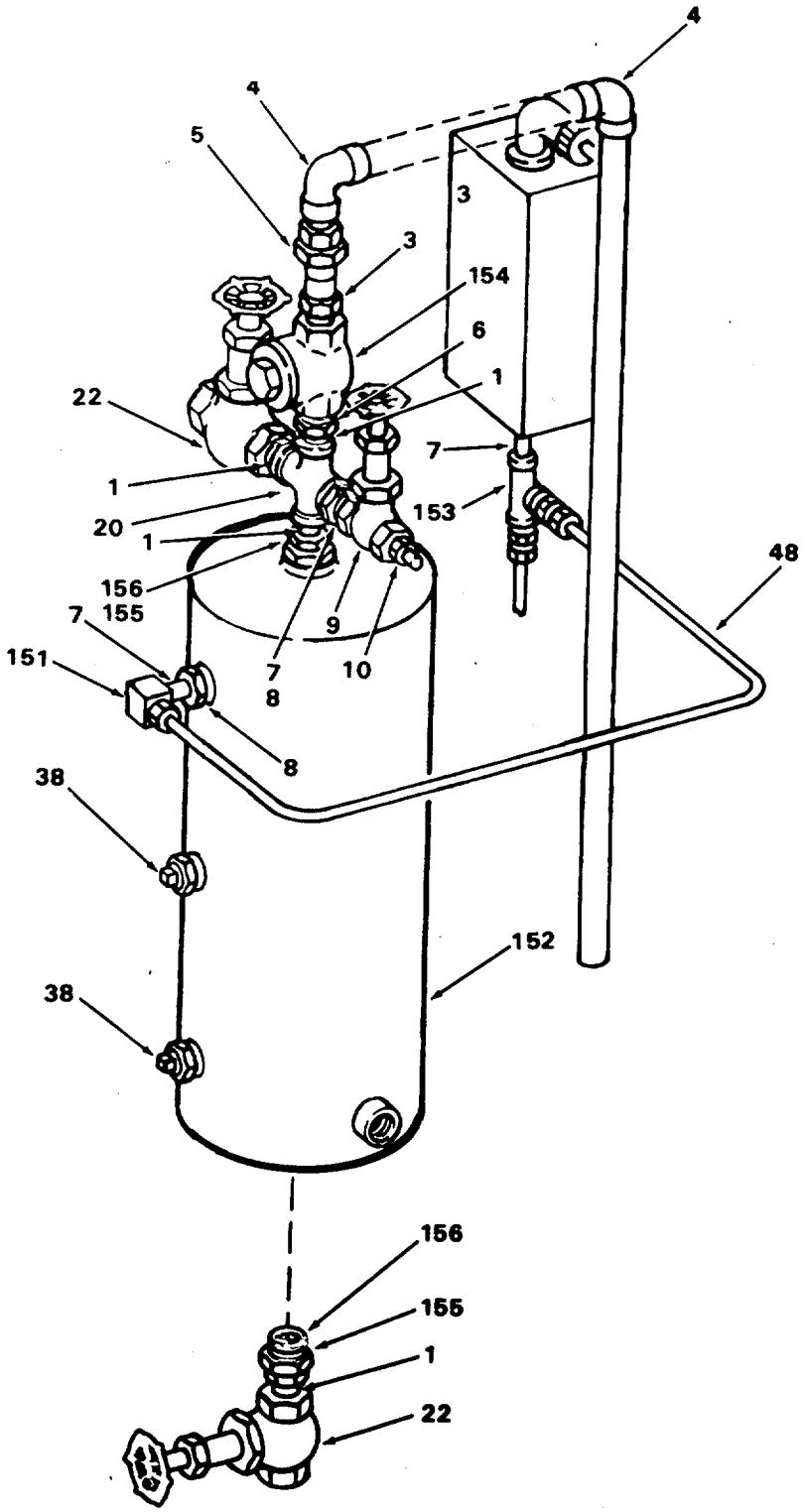
REPAIR OR REPLACE (Cont)



Fresh and Flush Water System (Sheet 6 of 7).

5-168. FRESH AND FLUSH WATER PIPING - MAINTENANCE INSTRUCTIONS. (Cont.)

REPAIR OR REPLACE (Cont)



Fresh and Flush Water System (Sheet 7 of 7).

5-169. OIL WATER SEPARATOR BILGE SYSTEM - 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. Oil/water separator bilge system legend

Item Number	Description
1.	Water gauge
2.	Steel air escape terminal
3.	Pipe nipple
4.	Black malleable iron 90° elbow
5.	Bronze ball valve
6.	Black malleable iron 90° elbow
7.	Black malleable iron pipe union
8.	Black pipe nipple
9.	Black malleable iron pipe tee
10.	Plain hexagon nut

5-169. OIL WATER SEPARATOR BILGE SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

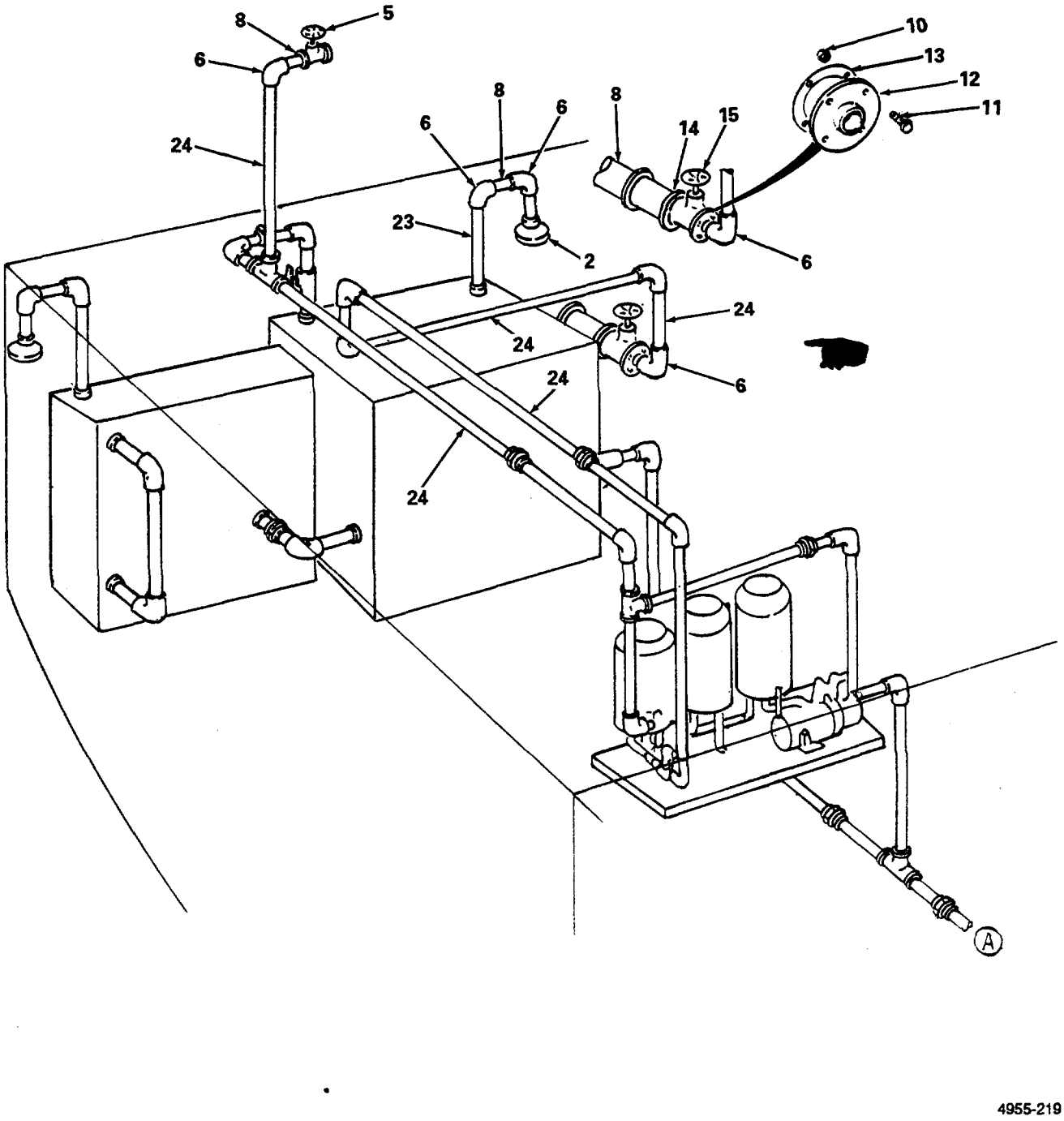
REPAIR OR REPLACE (Cont) l

Oil/water separator bilge system legend (Cont)

Item Number	Description
11.	Hex head capscrew
12.	Slip on flat face flange
13.	Full face rubber with cloth insert gasket
14.	Hex head capscrew
15.	Bronze flanged stop check valve
16.	Pipe nipple
17.	Black malleable iron reducing tee
18.	Pipe union
19.	Black malleable iron 900 elbow
20.	Pipe nipple
21.	Bronze swing check valve
22.	Bronze swing check valve
23.	Brass pipe
24.	Steel pipe
25.	Steel pipe adapter
26.	Black reducer bushing
27.	Reducer bushing
28.	Brass strainer
29.	Black malleable iron 450 elbow
30.	Bronze ball valve
31.	Steel piping
32.	Bilge suction hose assembly

5-169. OIL WATER SEPARATOR BILGE SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

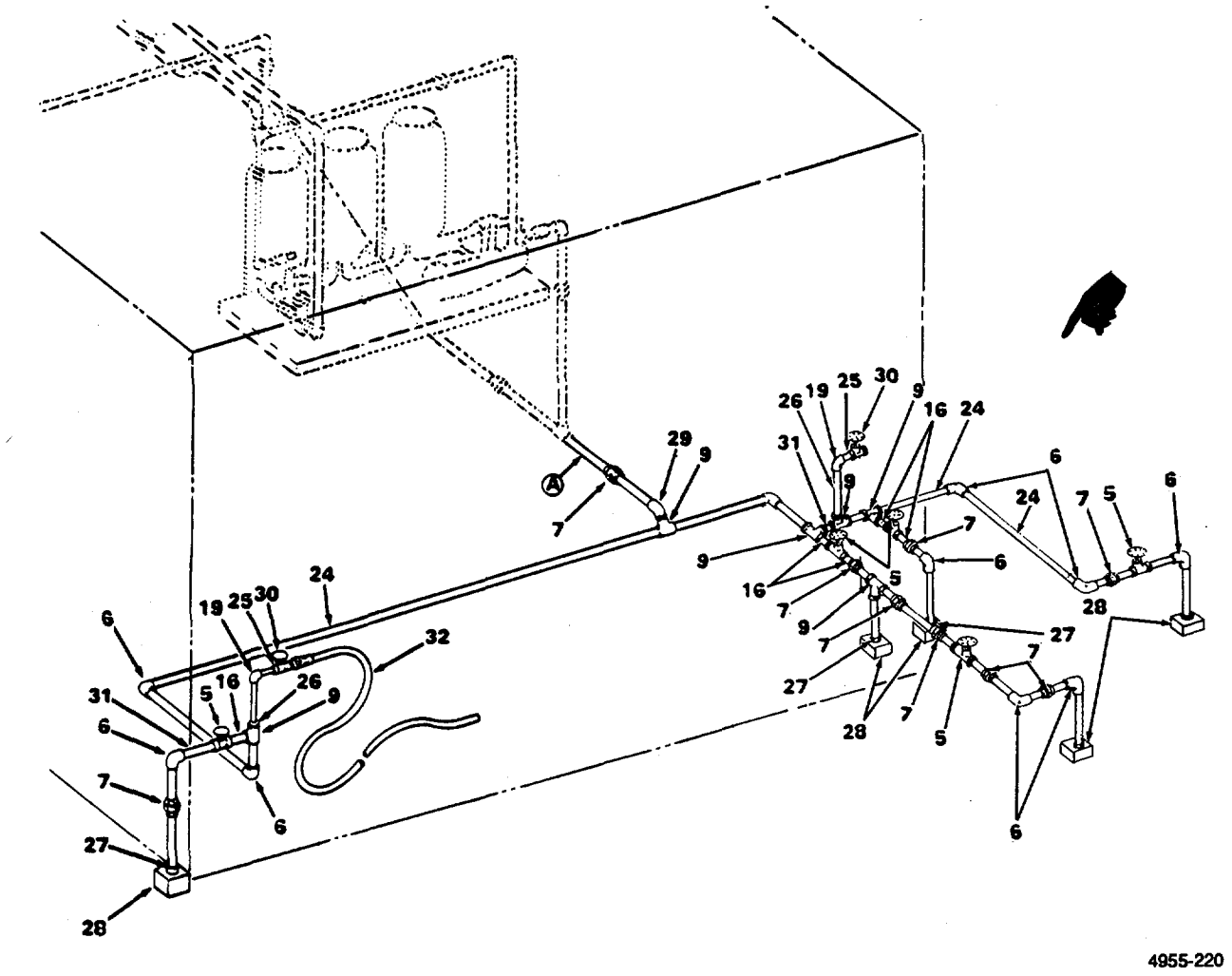
LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont) I			



Oil Water Separator Bilge System (Sheet 1 of 2).

5-169. OIL WATER SEPARATOR BILGE SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont) I			



Oil Water Separator Bilge System (Sheet 2 of 2).

5-170. 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

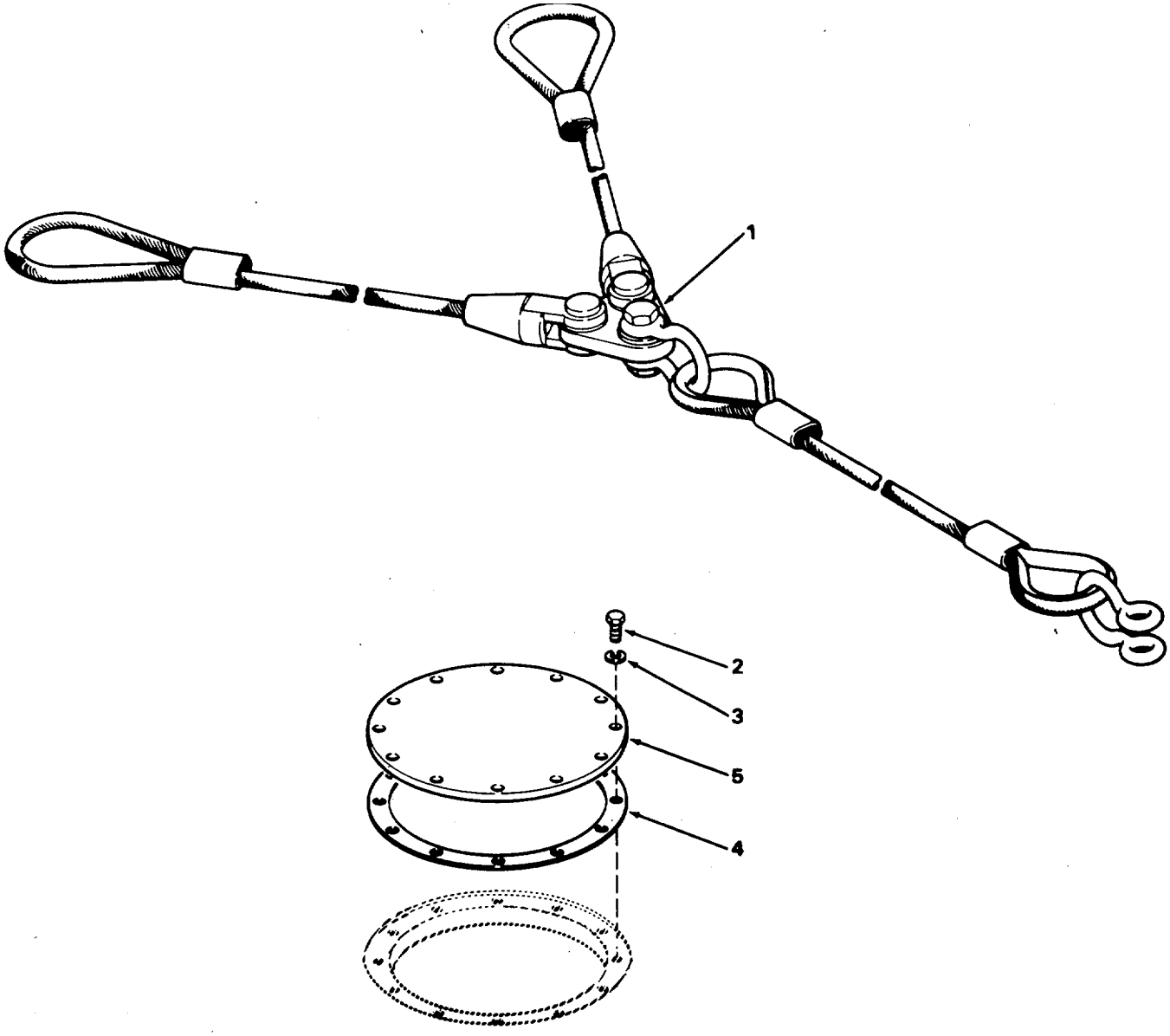
Personnel Required
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE			
1. Towing Bridle	Towing bridle (1)	Repair or replace.	
2. Deck Cover	Deck cover (2)	Repair or replace.	

5-170. DECK FITTINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



5-171. HOT WATER HEATER - MAINTENANCE INSTRUCTIONS.

This task covers:

Replace

INITIAL SETUP

Test Equipment
NONE

References
Paragraph

5-168 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 5-168 for location of piping.

5-172. TANK LEVEL INDICATION RECEIVER - MAINTENANCE INSTRUCTIONS.

This task covers:

Repair or Replace

INITIAL SETUP

Test Equipment
NONE

References
Paragraph

4-66.1 Tank Level Indication Receiver

Special Tools
NONE

Equipment Condition: Condition Description
NONE

Material/Parts
NONE

Special Environmental Conditions
NONE

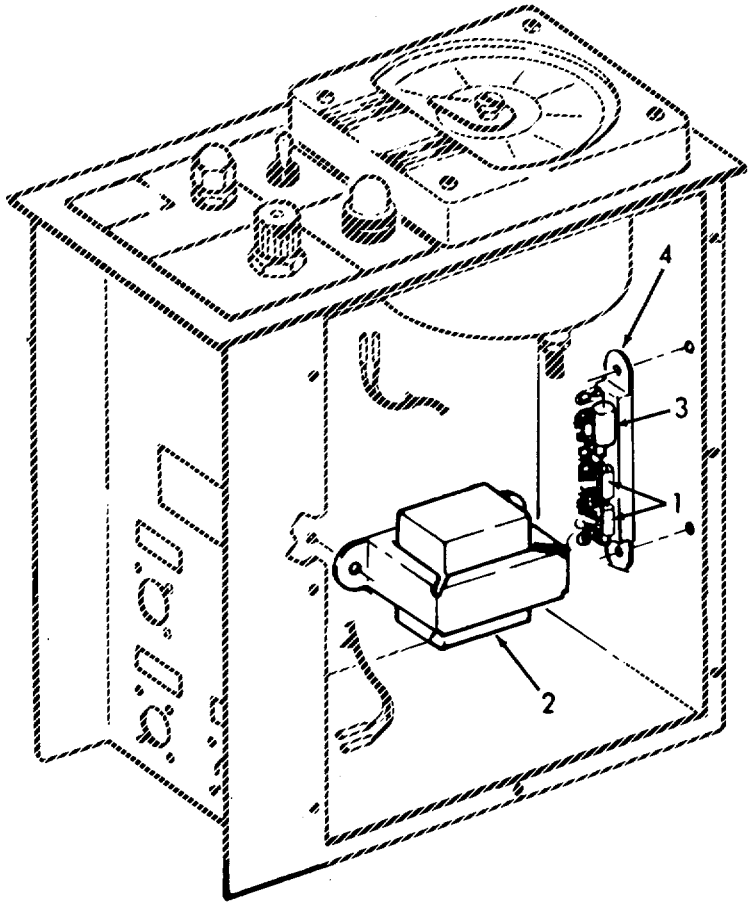
Personnel Required
2

General Safety Instructions
NONE

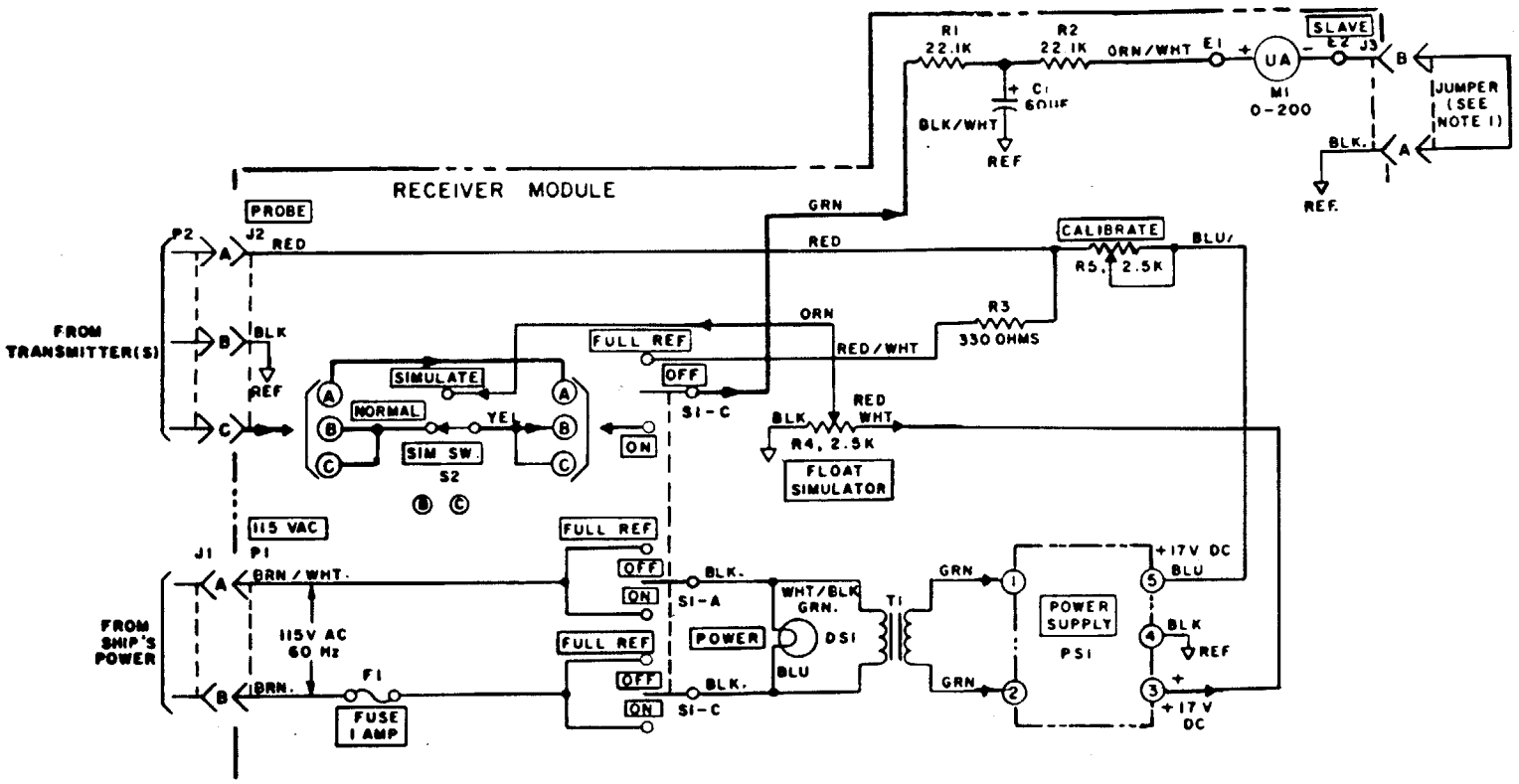
LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE			
1. Receiver	a. Resistors 22 . 1K (1)	Replace.	Refer to schematic.
	b. Resistors 330 ohm (2)	Replace.	
	c. Capacitor 60 uf, 5OVDC (3)	Replace.	
	d. Terminal strip (4)	Replace.	

5-172. TANK LEVEL INDICATION RECEIVER - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR OR REPLACE (Cont)			



5-172. TANK LEVEL INDICATION RECEIVER - MAINTENANCE INSTRUCTIONS. (Continued).



5-1702

5-173. DECK AND SANITARY DRAINS - 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
2

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS

REPLACE

1. Deck and sanitary drains legend

Item Number	Description
1.	Bronze 90° pipe elbow
2.	Copper-nickel pipe
3.	Brass solid square head plug
4.	Pipe tee
5.	Pipe tee
6.	Bronze 45° pipe elbow
7.	Bronze pipe adapter
8.	Bronze reducing tee
9.	Copper-nickel pipe
10.	Bronze 90° pipe elbow

5-173. DECK AND SANITARY DRAINS - MAINTENANCE INSTRUCTIONS. (Continued)

LOCATION	ITEM	ACTION	REMARKS

REPLACE (Cont)

Deck and sanitary drains legend (Cont)

Item Number	Description
11.	Pipe tee
12.	Brass solid square head plug
13.	Bronze 45° pipe Y-branch
14.	Bronze 45° reducing Y-branch
15.	Bronze 45° reducing Y-branch
16.	Reducing bushing
17.	Bronze 45° pipe elbow
18.	Bronze reducing tee
19.	Double sink faucet
20.	Bronze screwed coupling
21.	Copper-nickel pipe
22.	Bronze 90° pipe elbow
23.	Bronze 90° pipe elbow
24.	Bronze pipe union
25.	Bronze 90° pipe elbow
26.	Lever handle sink waste drain
27.	Bronze drain adapter
28.	Bronze pipe tee
29.	Bronze 90° pipe elbow
30.	Bronze pipe union
31.	Bronze sink strainer
32.	Brass stuffing box nut
33.	Coupling head thermoswitch
34.	Bronze reducing coupling
35.	Brass pipe nipple
36.	Bronze pipe nipple
37.	Bronze rising stem gate valve
38.	Bronze 90° reducing elbow
39.	Brass close pipe nipple
40.	Bronze 90° pipe elbow
41.	Bronze union pipe tee
42.	Copper-nickel pipe
43.	Bronze S-trap adapter
44.	Bronze unvented S-trap

5-173. DECK AND SANITARY DRAINS - MAINTENANCE INSTRUCTIONS. (Continued)

LOCATION	ITEM	ACTION	REMARKS

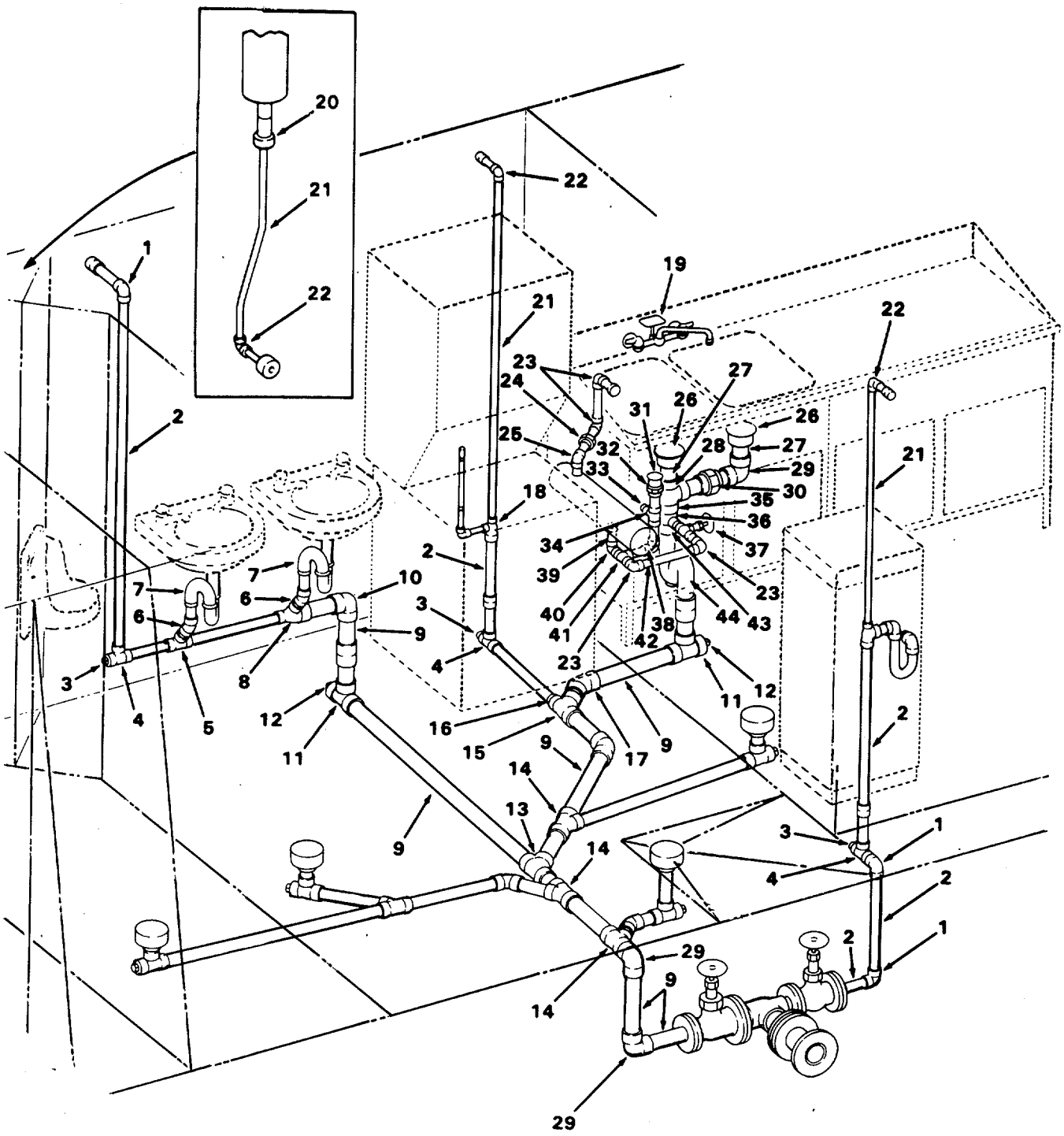
REPLACE (Cont)

Deck and sanitary drains legend (Cont)

Item Number	Description
45.	Copper-nickel pipe
46.	Bronze 90° pipe elbow
47.	Bronze reducing tee
48.	Brass close pipe nipple
49.	Bronze drinking fountain P-trap
50.	Deck drain with trap and baffle includes bronze strainer
51.	Bronze pipe adapter
52.	Bronze solid square head plug
53.	Bronze pipe tee
54.	Bronze 45° pipe Y-branch
55.	Bronze 45° pipe elbow
56.	Plain hex nut
57.	Hex head capscrew
58.	Hex head capscrew
59.	Hex head capscrew
60.	Bronze flat face flange
61.	Rubber flange gasket
62.	Bronze flat face flange
63.	Rubber flange gasket
64.	Bronze male flange
65.	Steel slip on flange
66.	Steel slip on flange
67.	Overboard discharge steel plate flange
68.	Bronze flat face flange
69.	Plain hex nut
70.	Hex head capscrew
71.	Reducing tee
72.	Bronze reducing bushing
73.	Copper-nickel pipe
74.	Copper nickel pipe
75.	Hose clamp
76.	Bronze 90° pipe elbow

5-173. DECK AND SANITARY DRAINS - MAINTENANCE INSTRUCTIONS.
(Continued)

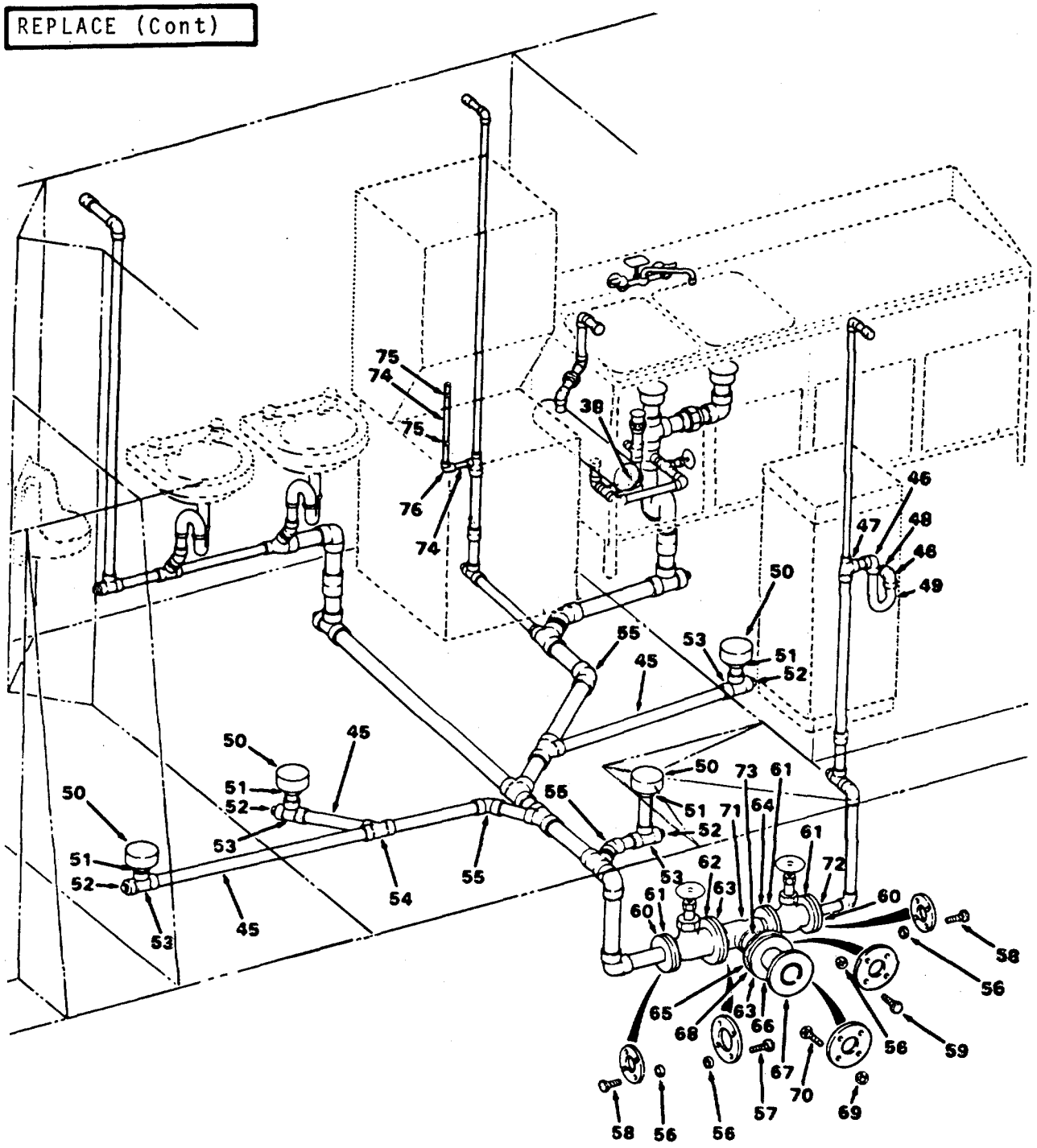
REPLACE (Cont)



Sanitary Drain System (Sheet 1 of 2).

5-173. DECK AND SANITARY DRAINS - MAINTENANCE INSTRUCTIONS
(Continued).

REPLACE (Cont)



Sanitary Drain System (Sheet 2 of 2).

5-174. VENTS AND SOUNDING TUBES - MAINTENANCE INSTRUCTIONS

This task covers:

Repair

INITIAL SETUP

Test Equipment
NONE

Special Tools
NONE

Material/Parts
NONE

Personnel Required
2

References
NONE

Equipment
Condition Condition Description
NONE

Special Environmental Conditions
NONE

General Safety Instructions
NONE

LOCATION	ITEM	ACTION	REMARKS

REPAIR

1. Vents and sounding tubes legend

Item Number	Description
1.	Cast steel diesel oil storage tank vent ball vent valve
2.	Steel 180°return
3.	Steel long radius 90° elbow
4.	45° elbow
5.	Black seamless steel pipe schedule 40
6.	Sounding tape with plumb bob
7.	Diesel oil storage tank sounding deck-plate
8.	Black seamless steel pipe schedule 40
9.	Diesel oil storage tank steel striker plate
10.	Bronze tube with insect screen fresh water tank vent coupling

5-174. VENTS AND SOUNDING TUBES - MAINTENANCE INSTRUCTIONS (Continued).

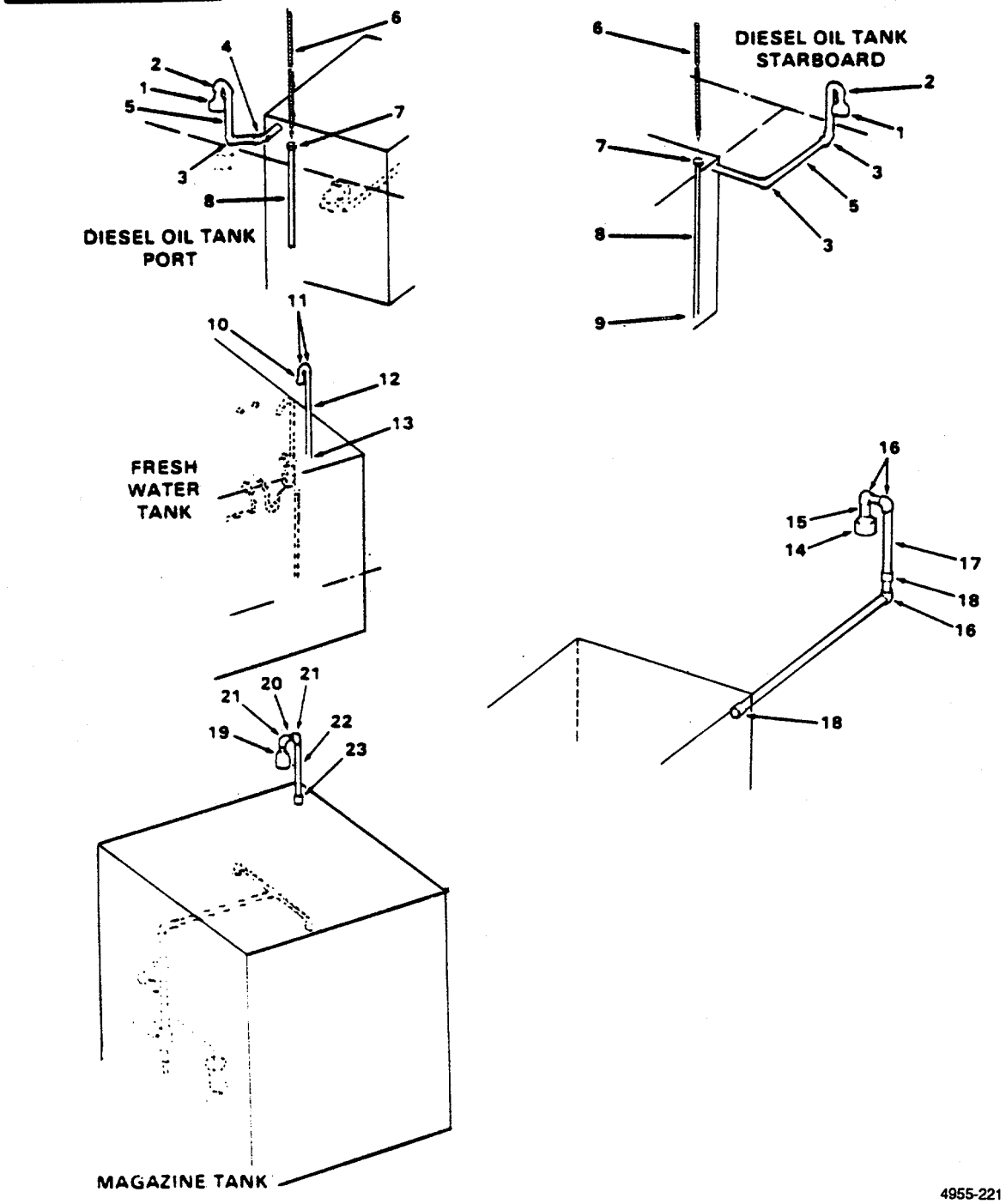
LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			

Vents and sounding tubes legend (Cont)

Item Number	Description
11.	Bronze fresh water tank vent 90° tube elbow
12.	Copper fresh water tank vent pipe
13.	Steel pipe sleeve
14.	Inverted ballast tank vent/overflow vent check valve
15.	Brass pipe
16.	Bronze 90° elbow
17.	Copper-nickel pipe
18.	Steel tube sleeve
19.	Inverted vent check valve
20.	Brass pipe
21.	90° tube elbow
22.	Copper-nickel pipe
23.	Steel tube sleeve

5-174. VENTS AND SOUNDING TUBES - MAINTENANCE INSTRUCTIONS (Continued).

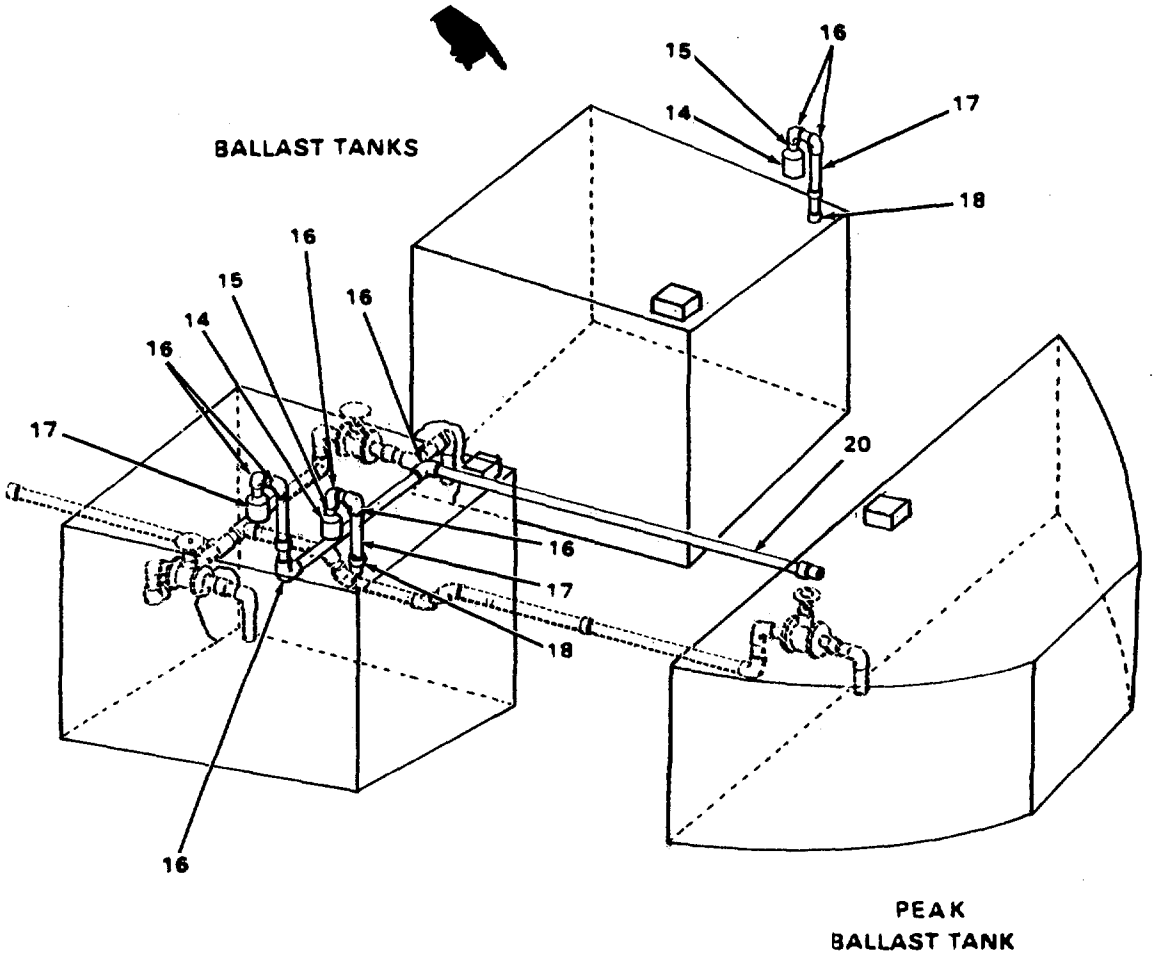
REPAIR (Cont)



Vents and Sounding Tubes.

5-174. VENTS AND SOUNDING TUBES - MAINTENANCE INSTRUCTIONS (Continued).

REPAIR (Cont)



5-175. FURNITURE AND MISCELLANEOUS FURNISHINGS - 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 2	General Safety Instructions NONE

LOCATION	ITEM	ACTION	REMARKS

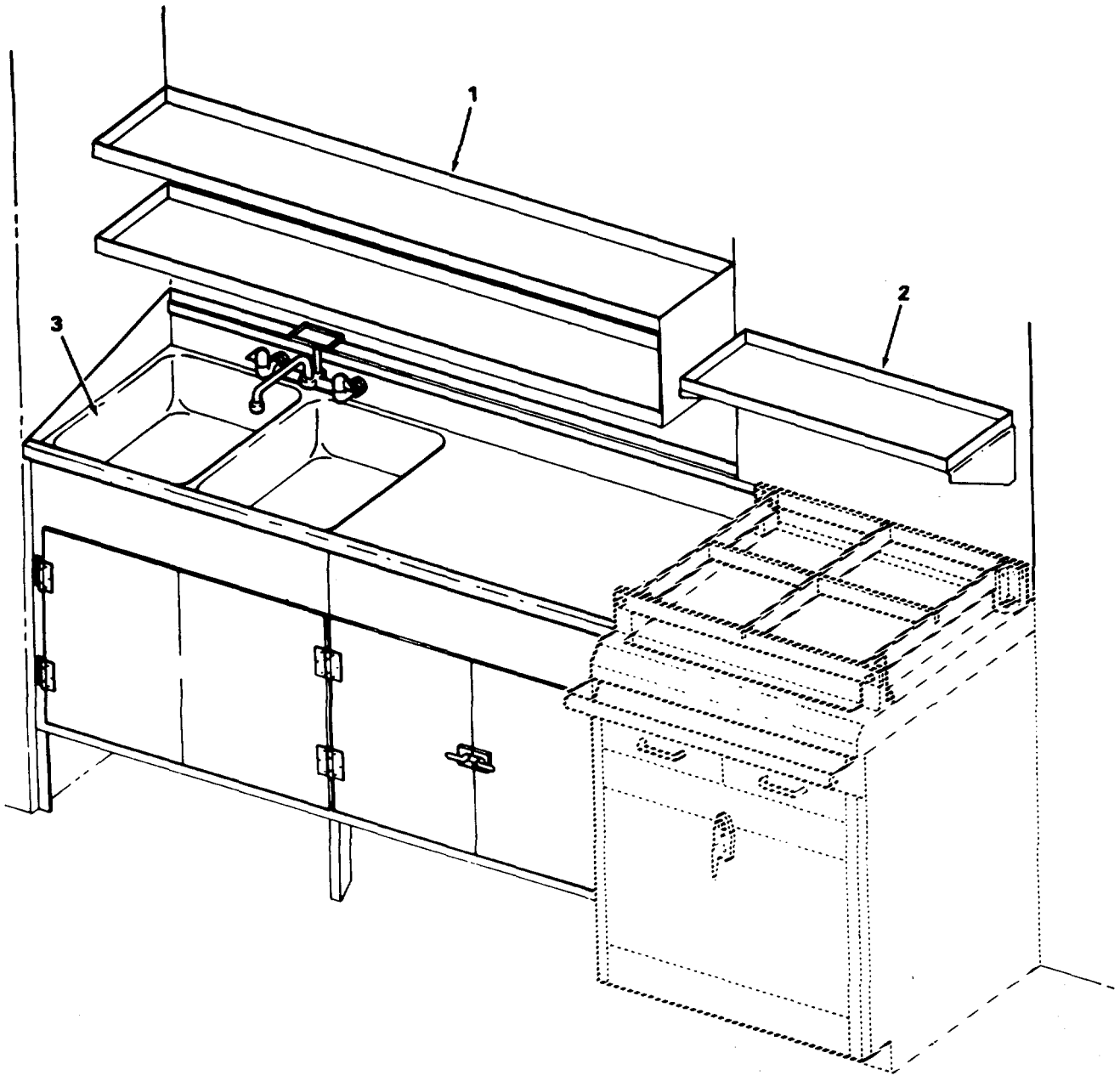
REPAIR

1. Furniture and miscellaneous furnishings legend

Item Number	Description
1.	Galley shelf set
2.	Galley shelf set
3.	Galley dresser with sinks
4.	Plain hex nut
5.	Lockwasher
6.	Hex head capscrew
7.	Galley dresser
8.	Galley wall cabinet
9.	Mess counter
10.	Hinged spring load mess seats

5-175. FURNITURE AND MISCELLANEOUS FURNISHINGS - MAINTENANCE INSTRUCTIONS (Continued).

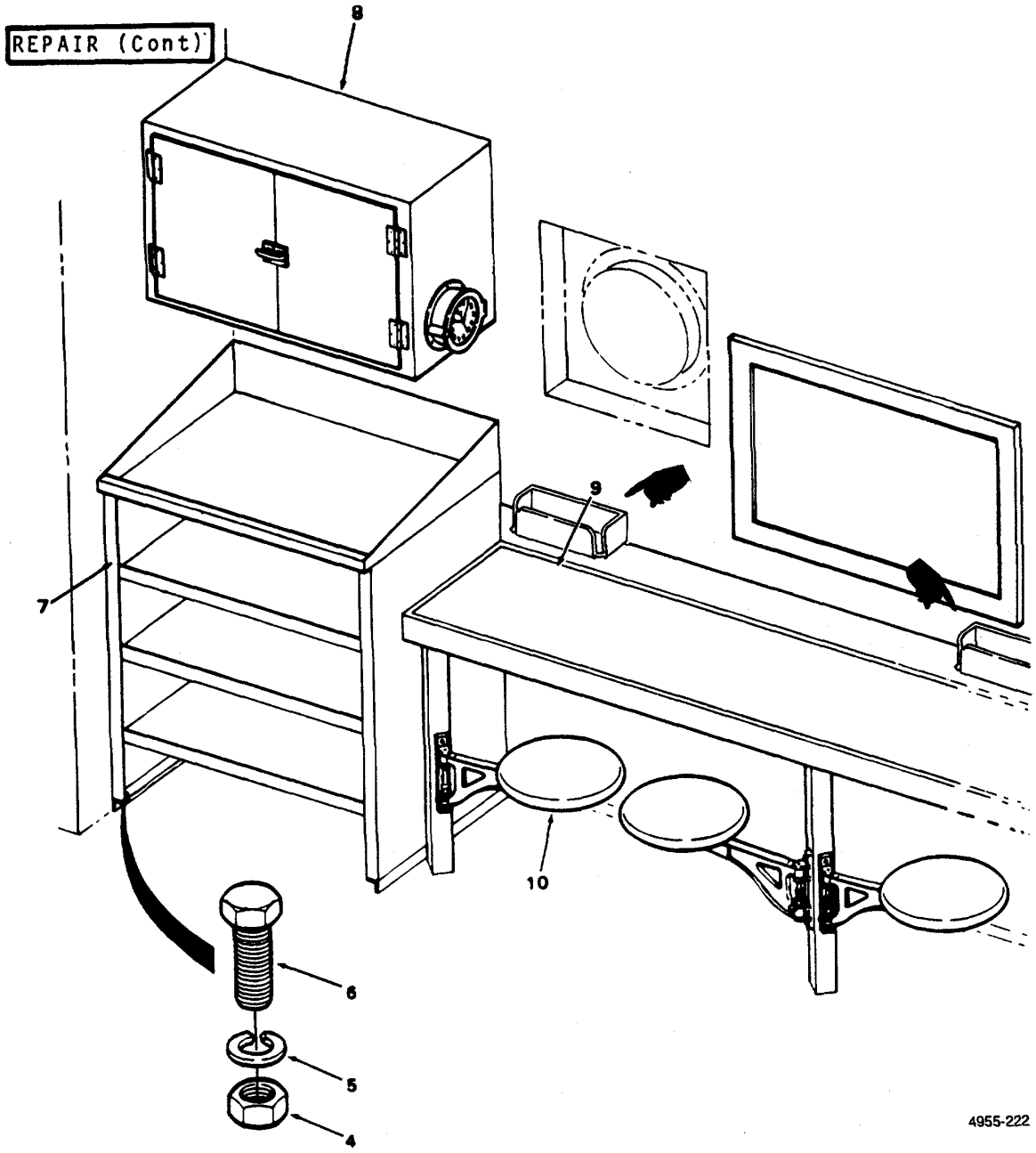
REPAIR (Cont)



Furniture - Galley and Mess Room (Sheet 1 of 2).

5-175. FURNITURE AND MISCELLANEOUS FURNISHINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS



Furniture - Galley and Mess Room (Sheet 2 of 2).

5-176. DOORS, HATCHES AND SCUTTLES - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS

This task covers:

Replace or 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

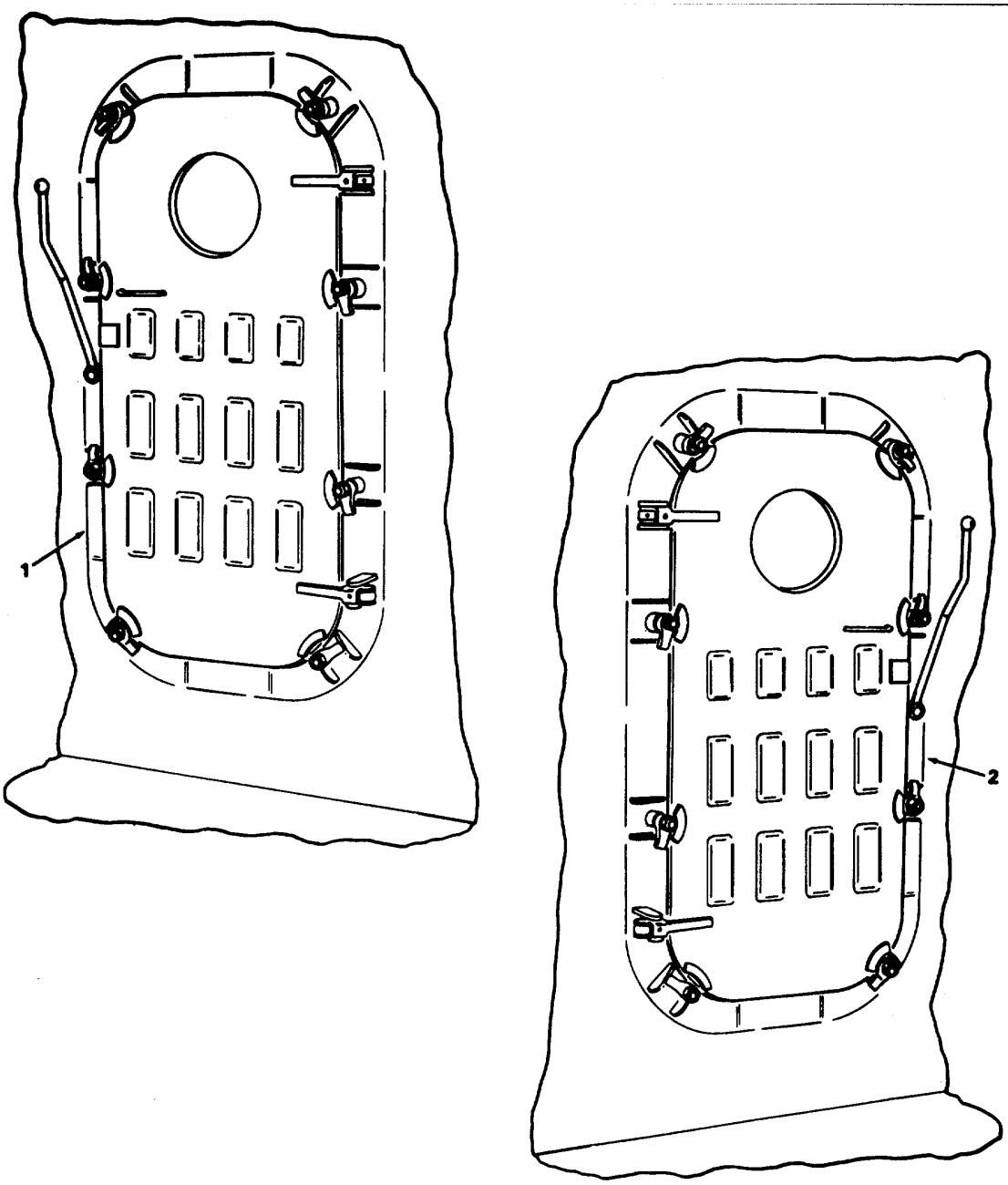
REPLACE OR REPAIR

1. Doors Legend.

Item Number	Description
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

5-176. DOORS, HATCHES, AND SCUTTLES - MAINTENANCE INSTRUCTIONS (Continued).

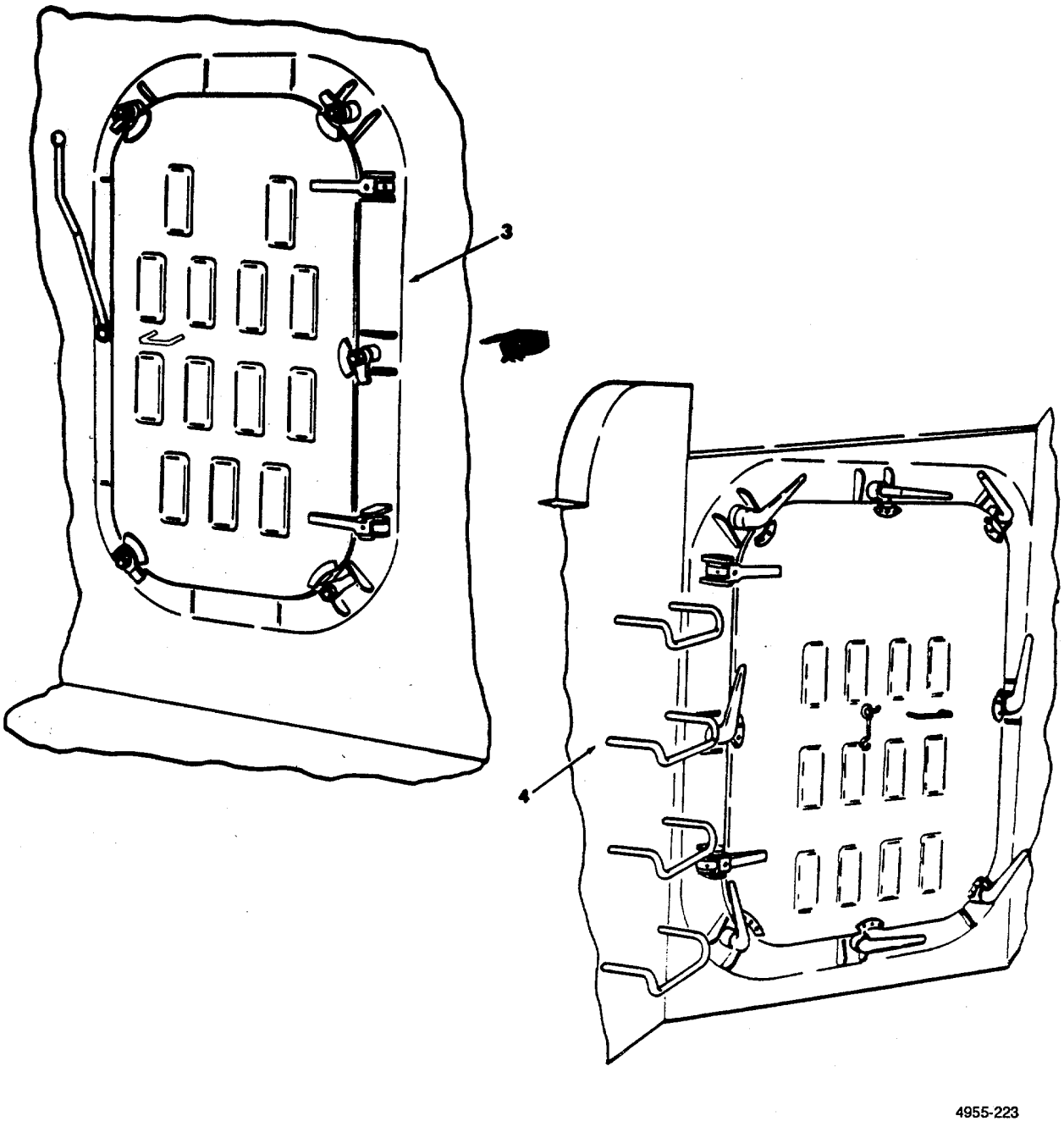
LOCATION	ITEM	ACTION	REMARKS



Doors (Sheet 1 of 5).

5-176. DOORS, HATCHES, AND SCUTTLES - MAINTENANCE INSTRUCTIONS (Continued).

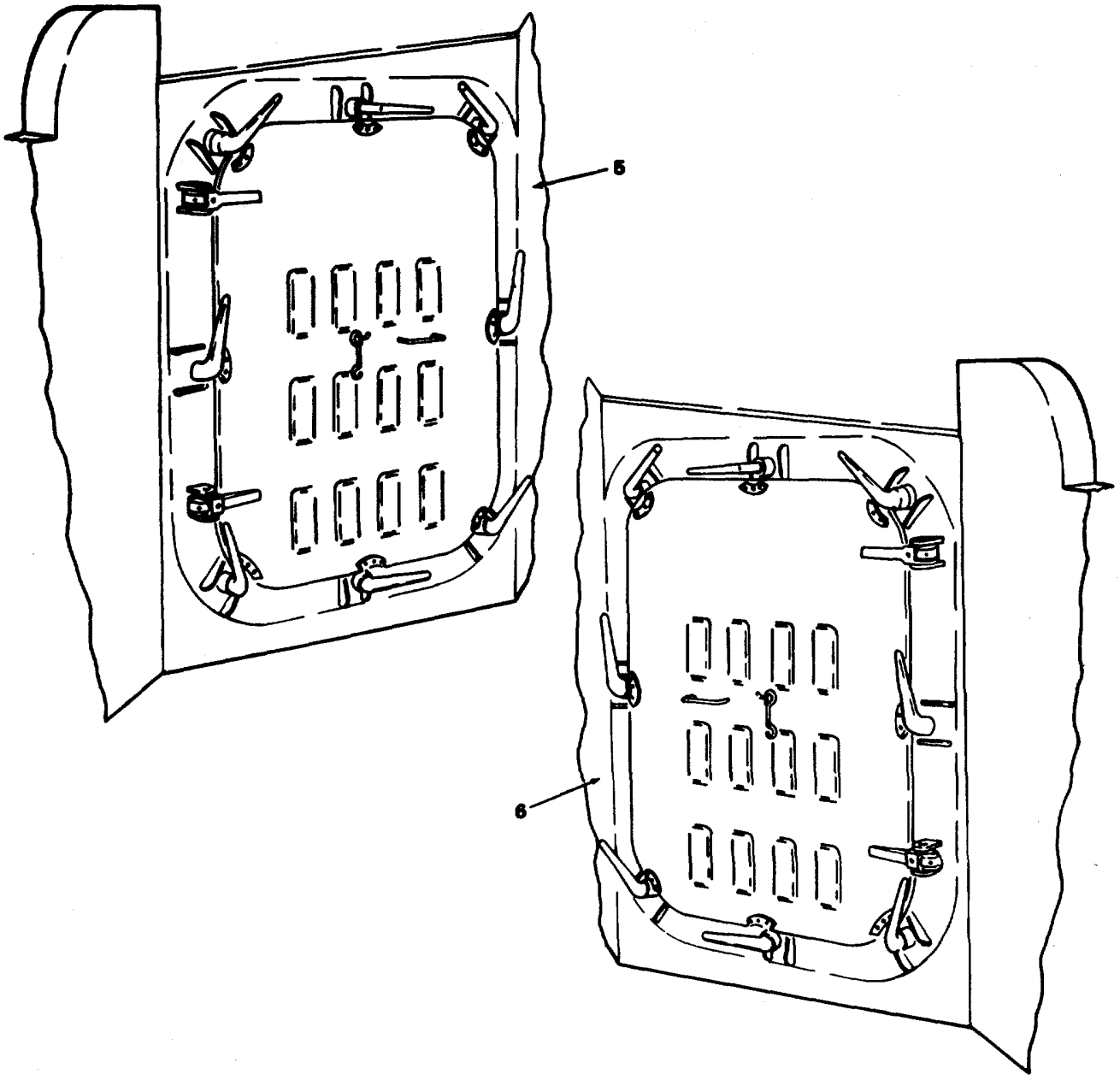
LOCATION	ITEM	ACTION	REMARKS



Doors (Sheet 2 of 5).

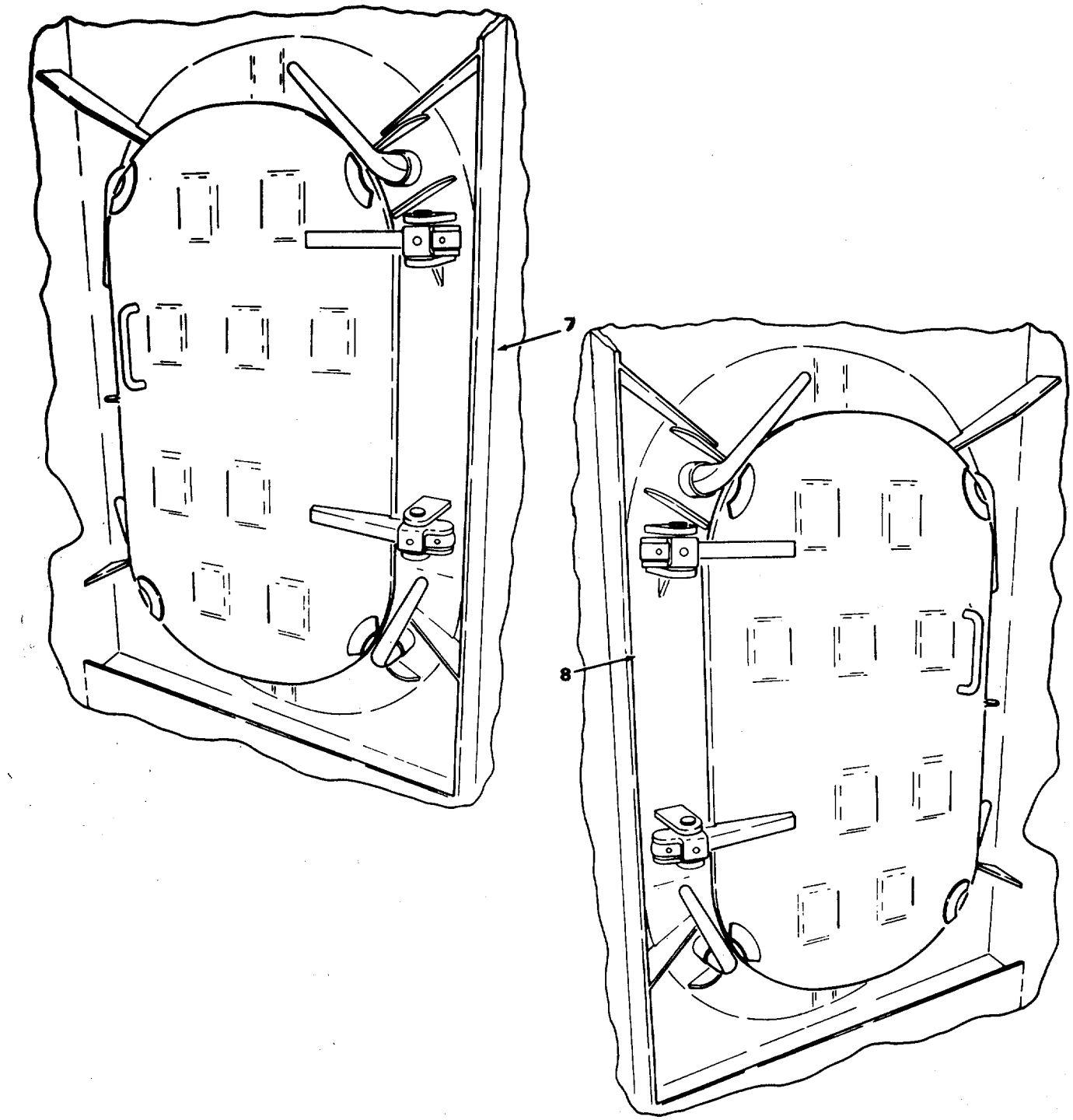
5-176. DOORS, HATCHES, AND SCUTTLES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS



Doors (Sheet 3 of 5).

5-176. DOORS, HATCHES, AND SCUTTLES - MAINTENANCE INSTRUCTIONS (Continued).

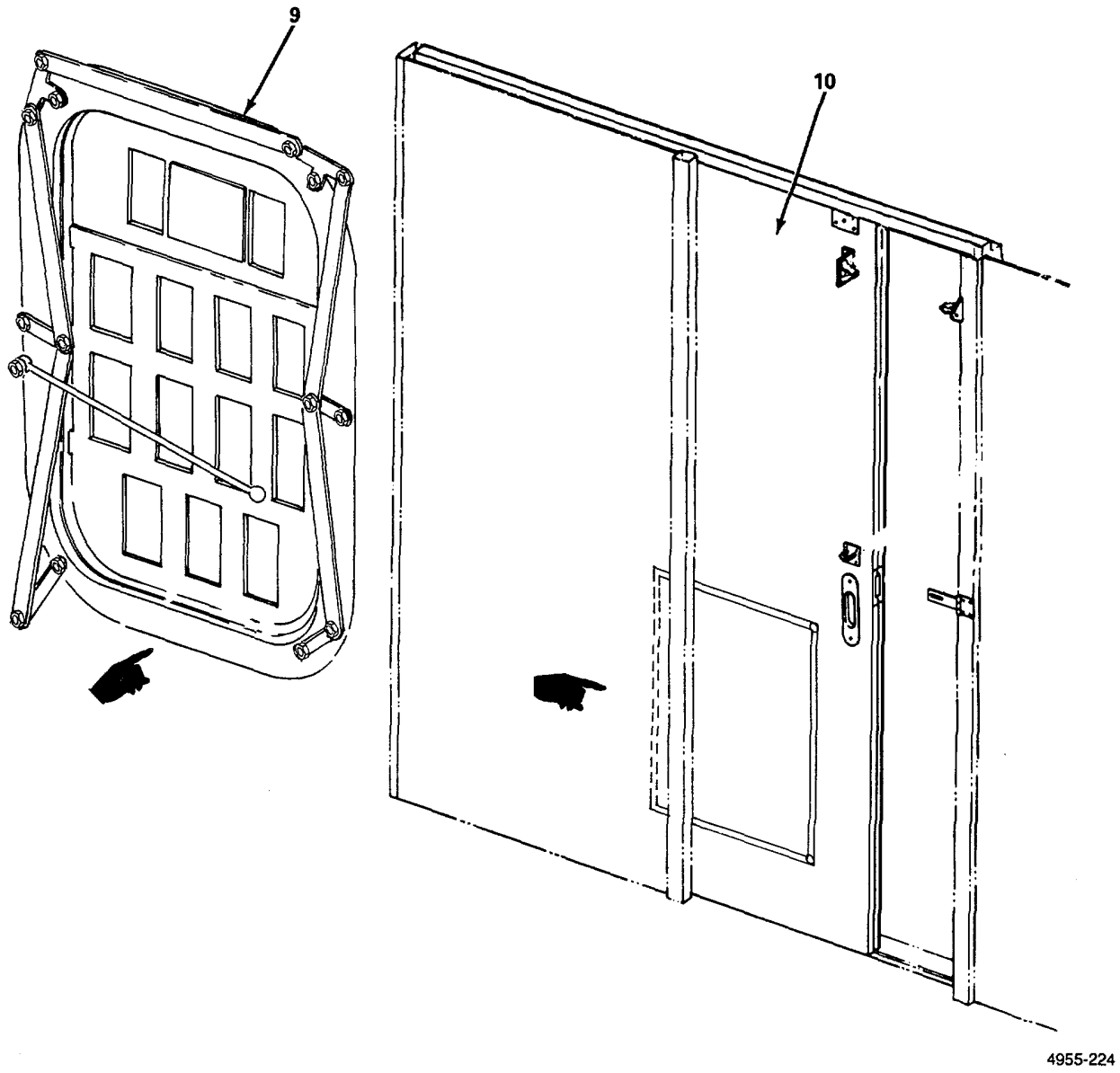


Doors (Sheet 4 of 5).

5-176. DOORS, HATCHES, AND SCUTTLES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPLACE OR REPAIR (Cont)



Doors (Sheet 5 of 5).

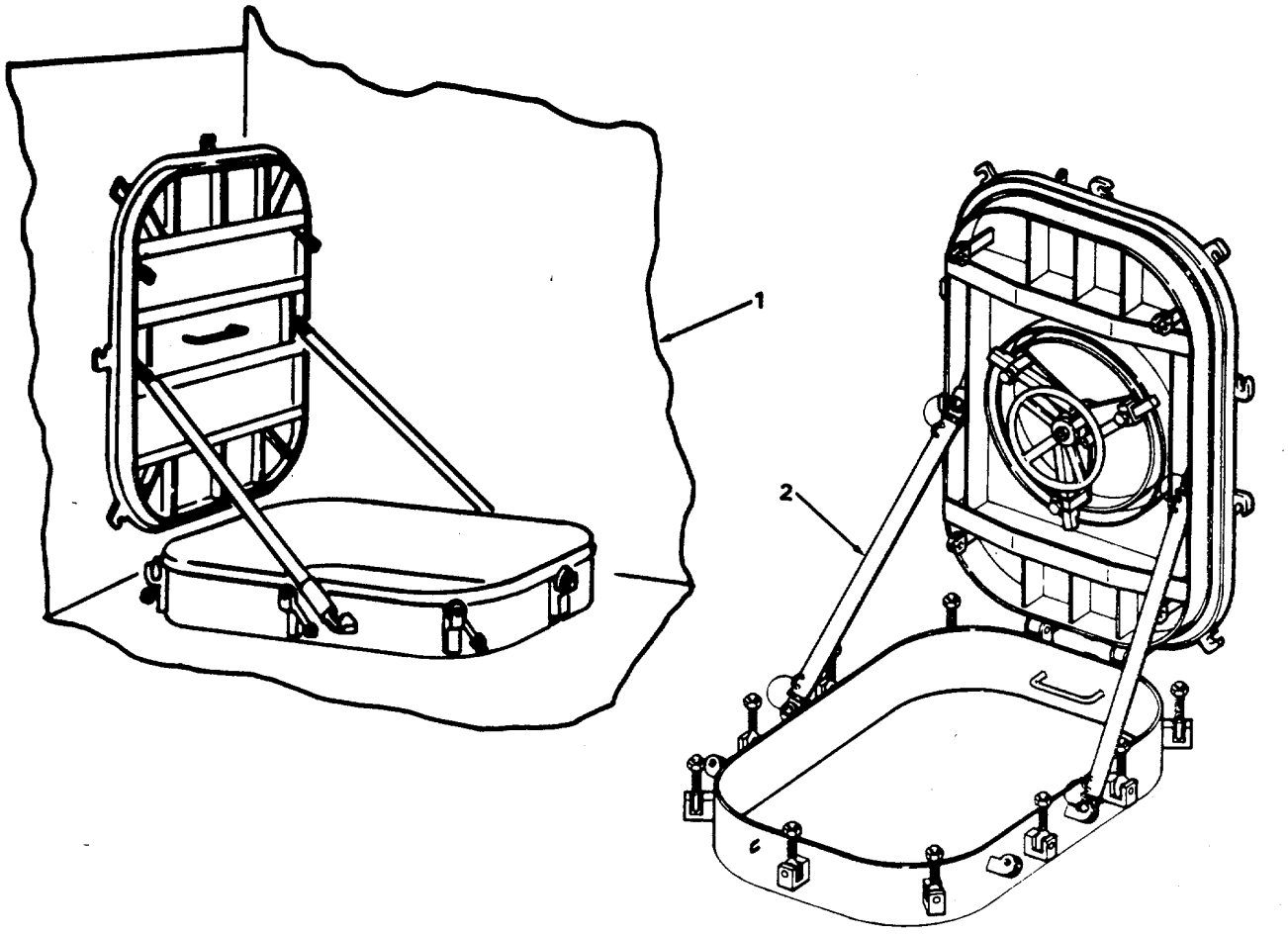
5-176. DOORS, HATCHES, AND SCUTTLES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPLACE OR REPAIR (Cont)

2. Hatches Legend.

Item-Number	Description
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

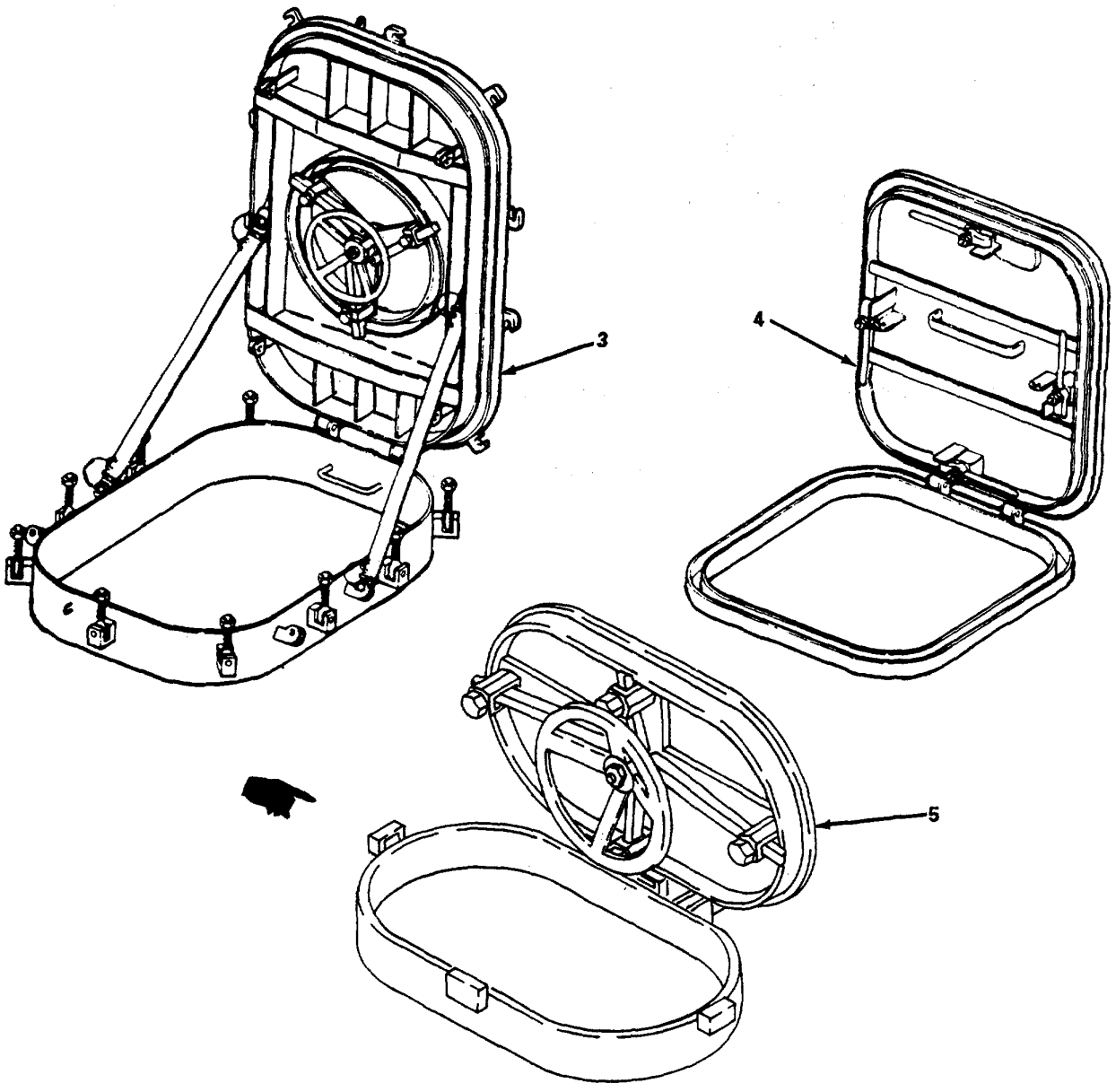


Hatches (Sheet 1 of 2).

5-176. DOORS, HATCHES, AND SCUTTLES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

REPLACE OR REPAIR (Cont)

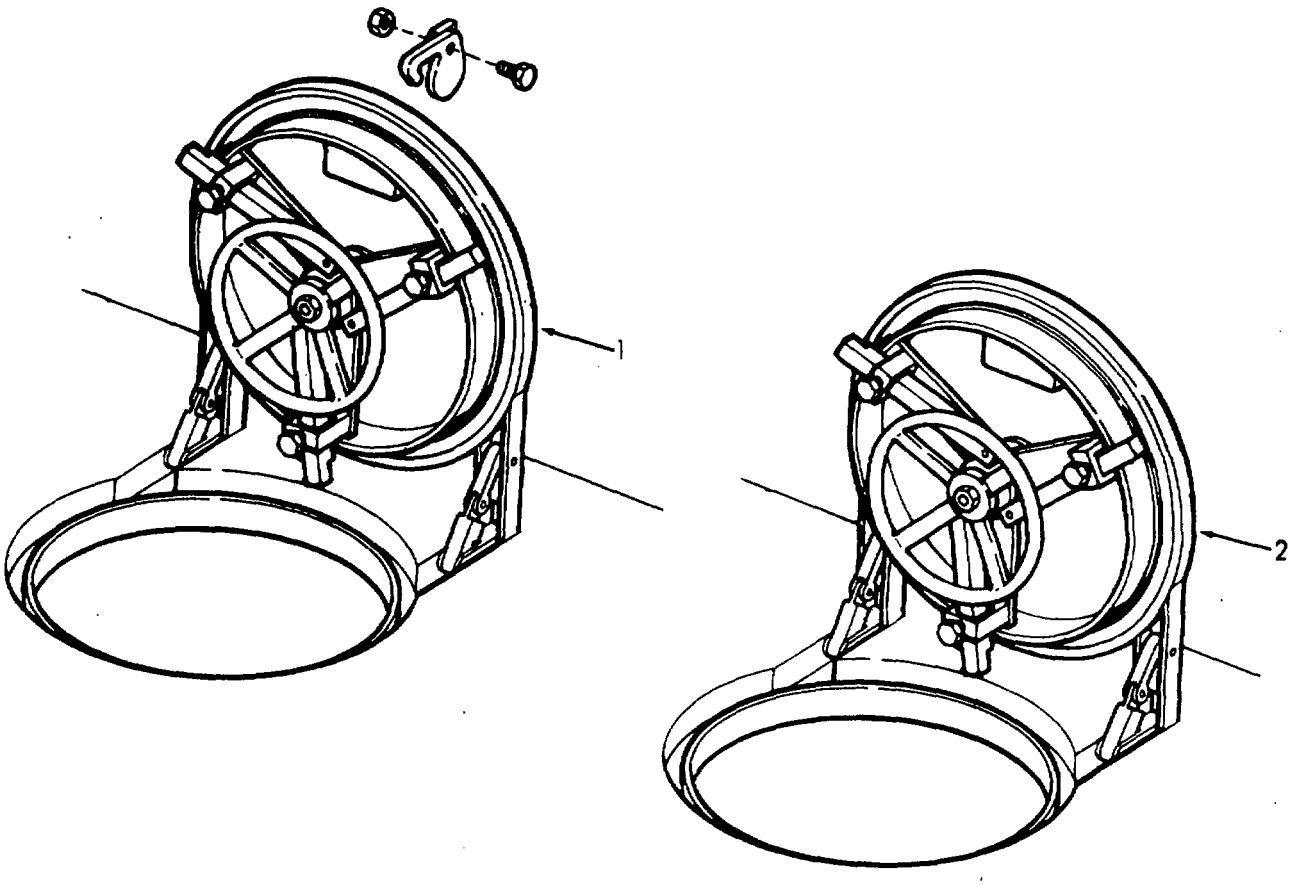


5-176. DOORS, HATCHES, AND SCUTTLES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE OR REPAIR (Cont)			

3. Scuttles Legend.

Item Number	Description
1.	Quick-acting flush watertight 18 inch scuttle
2.	Quick-acting flush watertight 20 inch scuttle



CHAPTER 6

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

OVERVIEW

The General Support maintenance instructions in this chapter apply to the following:

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

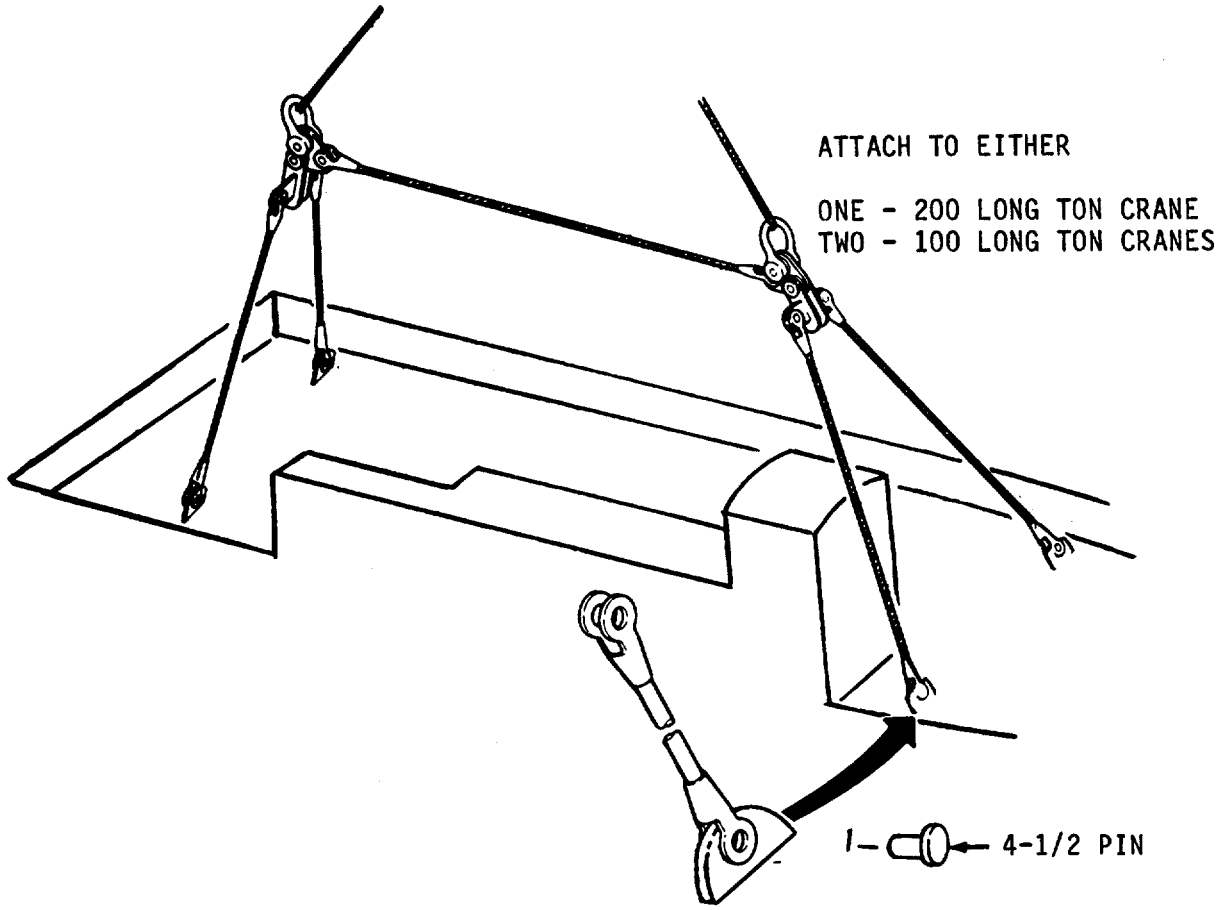
a. Prior to propeller shaft and bearing maintenance the landing craft must be either lifted from the water, or dry-docked.

(1) Lifting of the landing craft.

(a) Lifting of the landing craft can be done by either:

- o A 200 long ton (203 metric ton) crane.
- o 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) Dry-docking.

Refer to Foldout (FO-16) for the Drydock plan.

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

(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. All equipment removed or stowed for LSD docking must be replaced after removal of the LCU from the LSD, per the index below.

ITEM	DESCRIPTION	PARAGRAPH
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

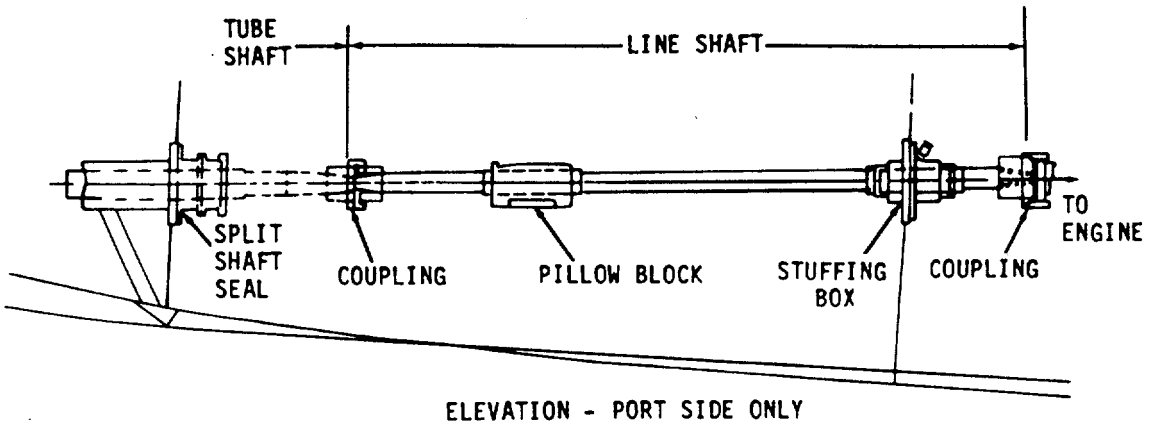
b. The propeller shafts are:

- Stub shaft (port and starboard)
- Outboard shaft (port and starboard)
- Line shaft (port only) (refer to paragraph 3-54.)
- Stern tube shaft (port and starboard)

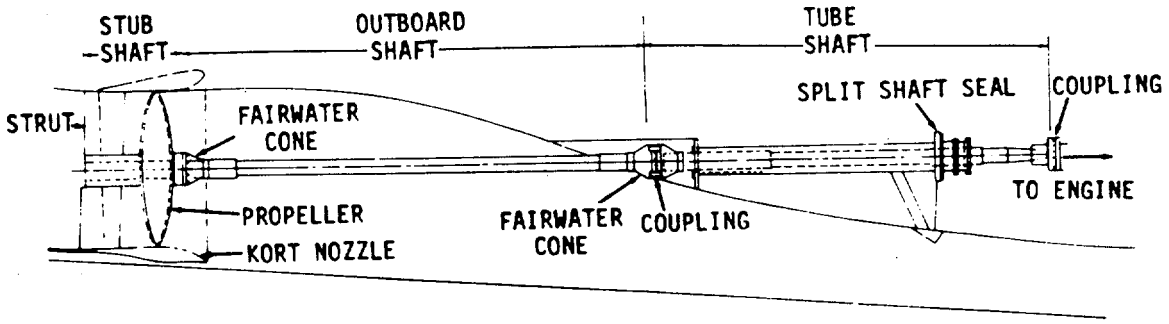
c. Each landing craft carries the following spare parts:

Item	Qty	Location
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).



ELEVATION - PORT SIDE ONLY



ELEVATION PORT & STARBOARD

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 and cutting torch

References
Paragraph

3-54 Line Shaft (Port Side) Operators Maintenance Instructions
FO-16 Drydock Plan

Special Tools

Lifting pad eyes (3 each)
Lockwire
Tallow

Equipment Condition: Condition Description

NONE

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

10

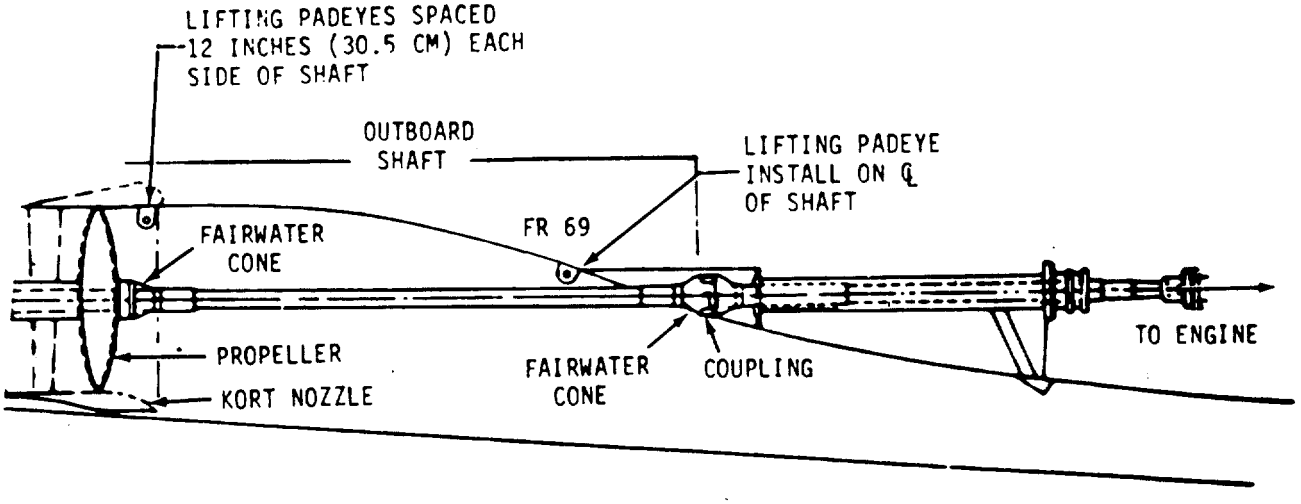
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
1. Propeller and Shaft	a. Coupling half	1. Check for cracks.	
		2. Check nuts and bolts.	Make sure they are tight.
		3. Check cotter pins for wear or breaks.	
		4. Check for wear.	

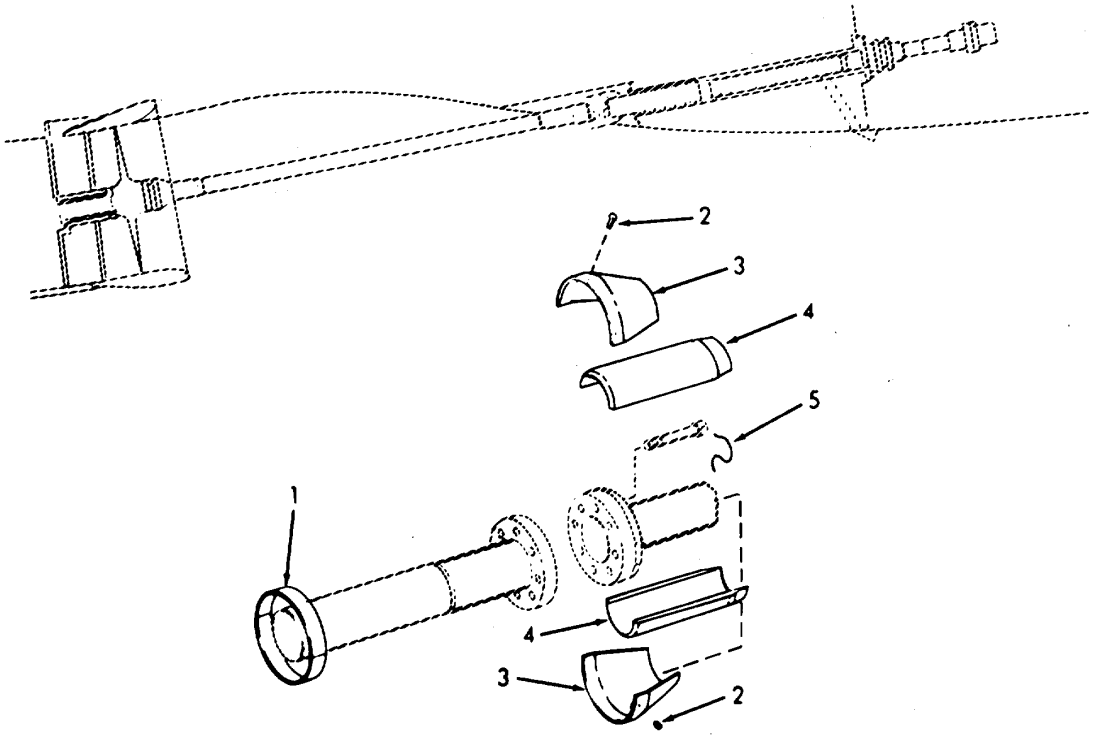
6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
		5. Check for broken lockwires.	
	b. Line	1. Check for cracks. shaft	
		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	Install chain hoists in pad eyes and to shaft.	Minimum weight 850 lbs (1874 kg).
	e. Outboard shaft sleeves (4)	Remove.	
	f. Lockwire (5)	Remove.	

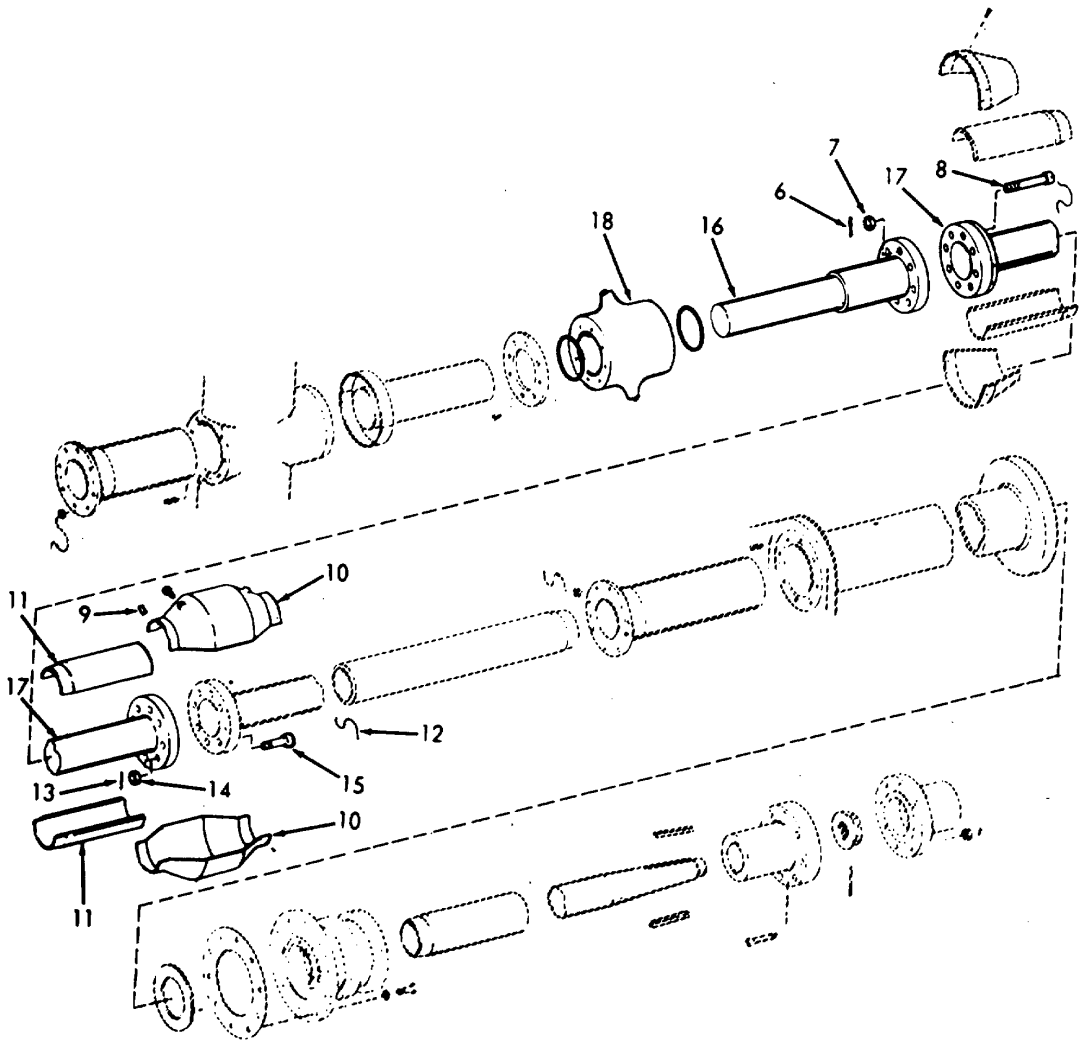


6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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.	

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	m. Propeller (18), and stub shaft (16)	Force aft.	
	n. Outboard shaft (17)	Remove.	

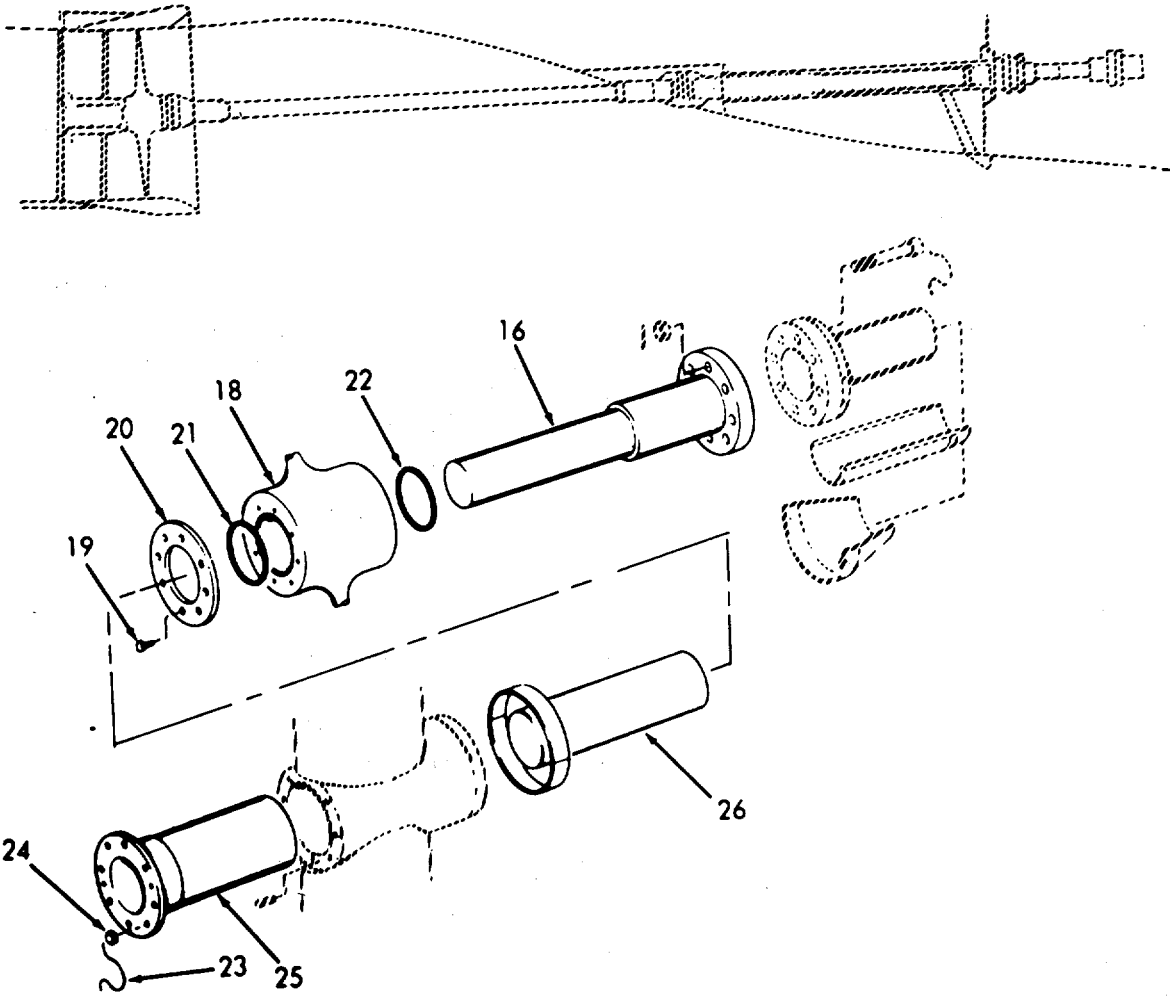


6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 lbs (97.5 kg)
	b. Screws (19), seal ring (20), and seal (21)	Remove.	
	c. Jacking screws and flange of stub shaft (16)	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)	1. Install jack screws into tapped holes of flange. 2. Remove bearing strut.	

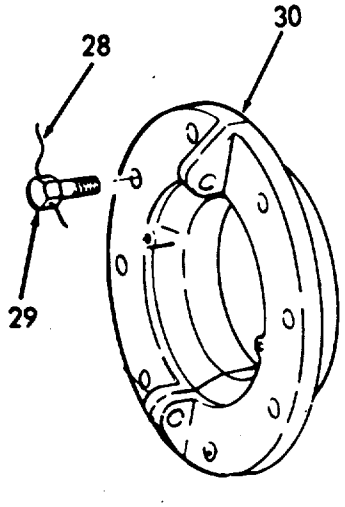
6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

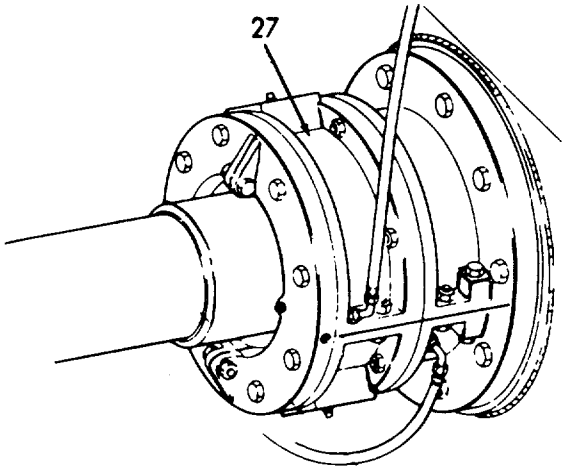
LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	d. Bearing strut (25), and stub shaft sleeve (26)	Remove.	



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).	

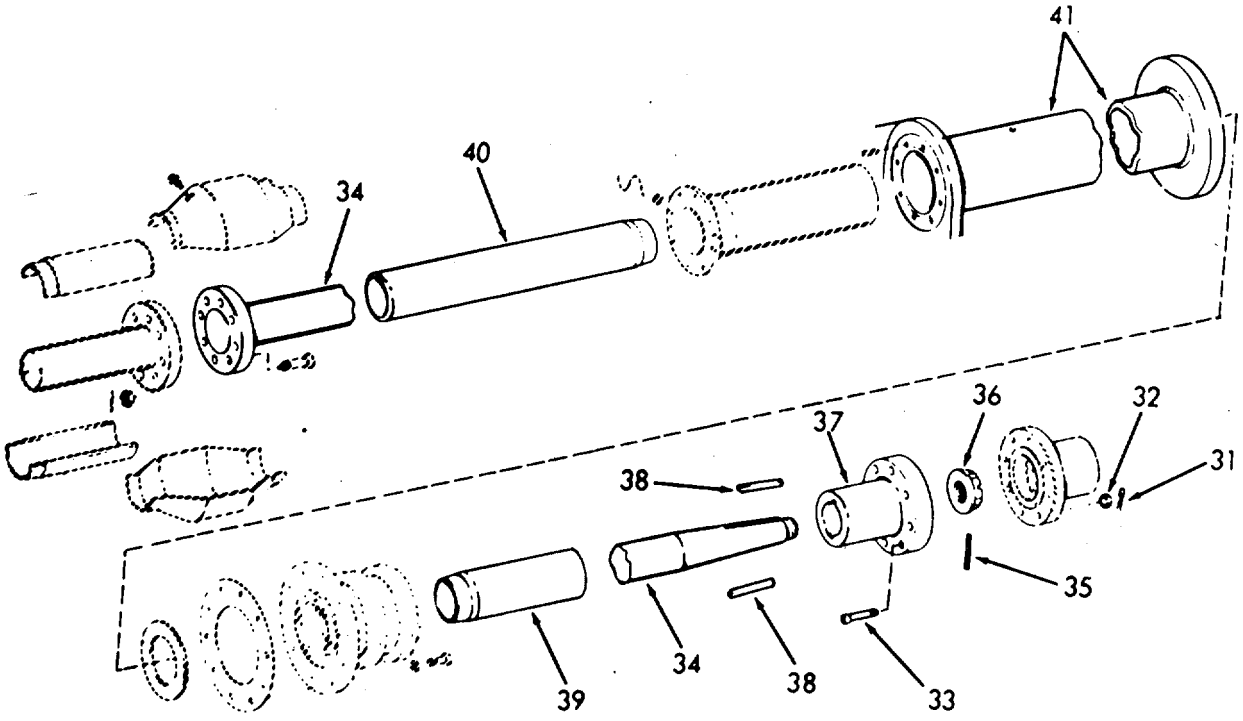




	b. Cotter pins (31), nuts (32), and bolts (33)	Remove.
	c. Tube shaft (34)	Force aft approximately 6 inches (15 cm).
	d. Cotter pin (35), and nut (36)	Remove.

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	e. Female tube shaft half coupling (37), and shaft keys (38)	Remove.	
	f. Shaft tube (34)	Pull aft and remove from stern tube.	Shaft weighs approximately 626 lbs (284 kg).

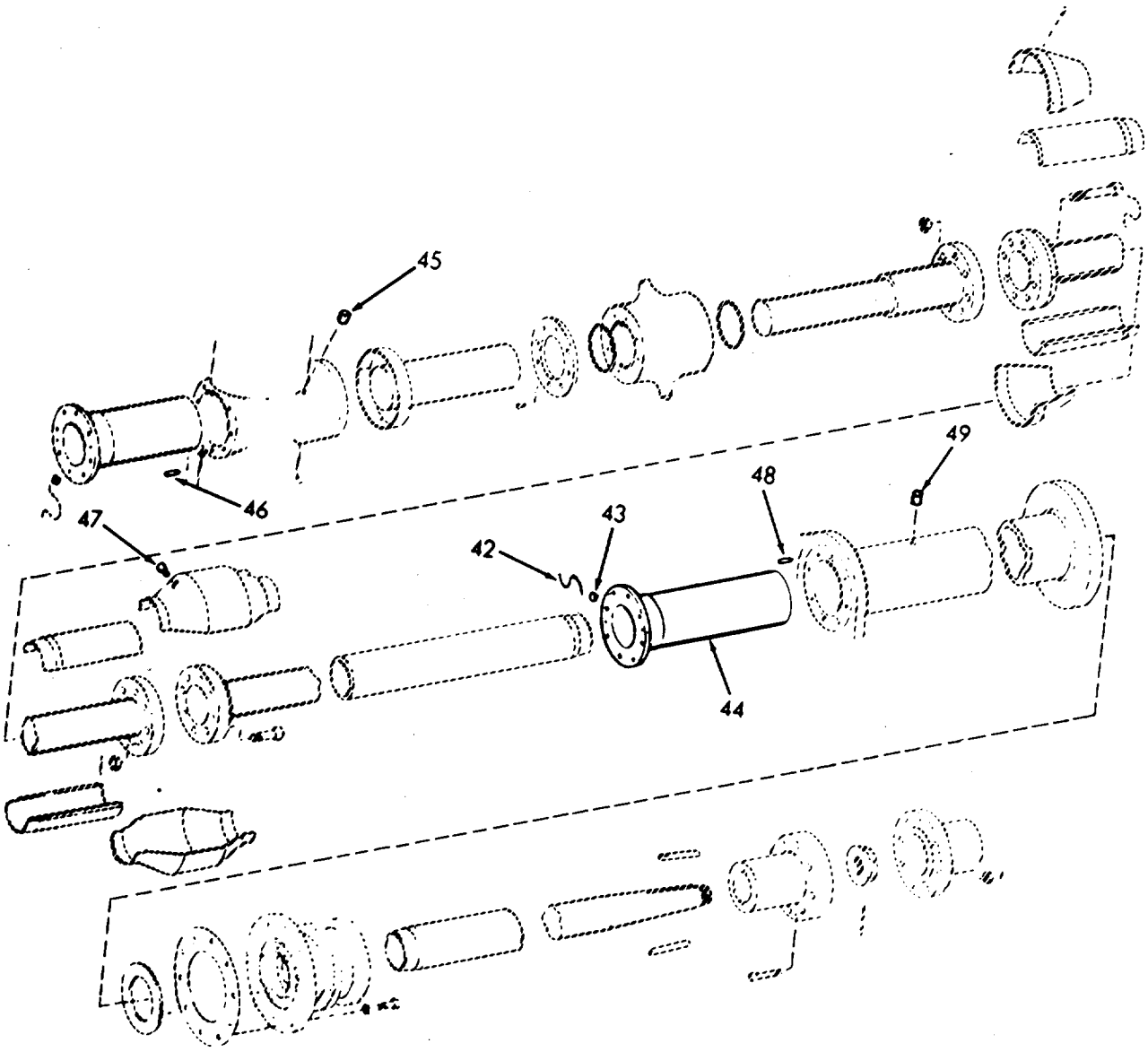


6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
6. Stern Tube	a. Shaft sleeve (aft) (39) and shaft sleeve (40) (fwd)	Remove from stern tube (41).	
	b. Lockwire (42), and slotted hex nuts (43)	Remove.	
	c. Jacking screws and flange of stern tube bearing (44)	1. Insert jack screws in tapped holes in bearing flange. 2. Tighten evenly to force the bearing out of the seat.	
7. Miscel-laneous	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
REMOVAL (Cont)			

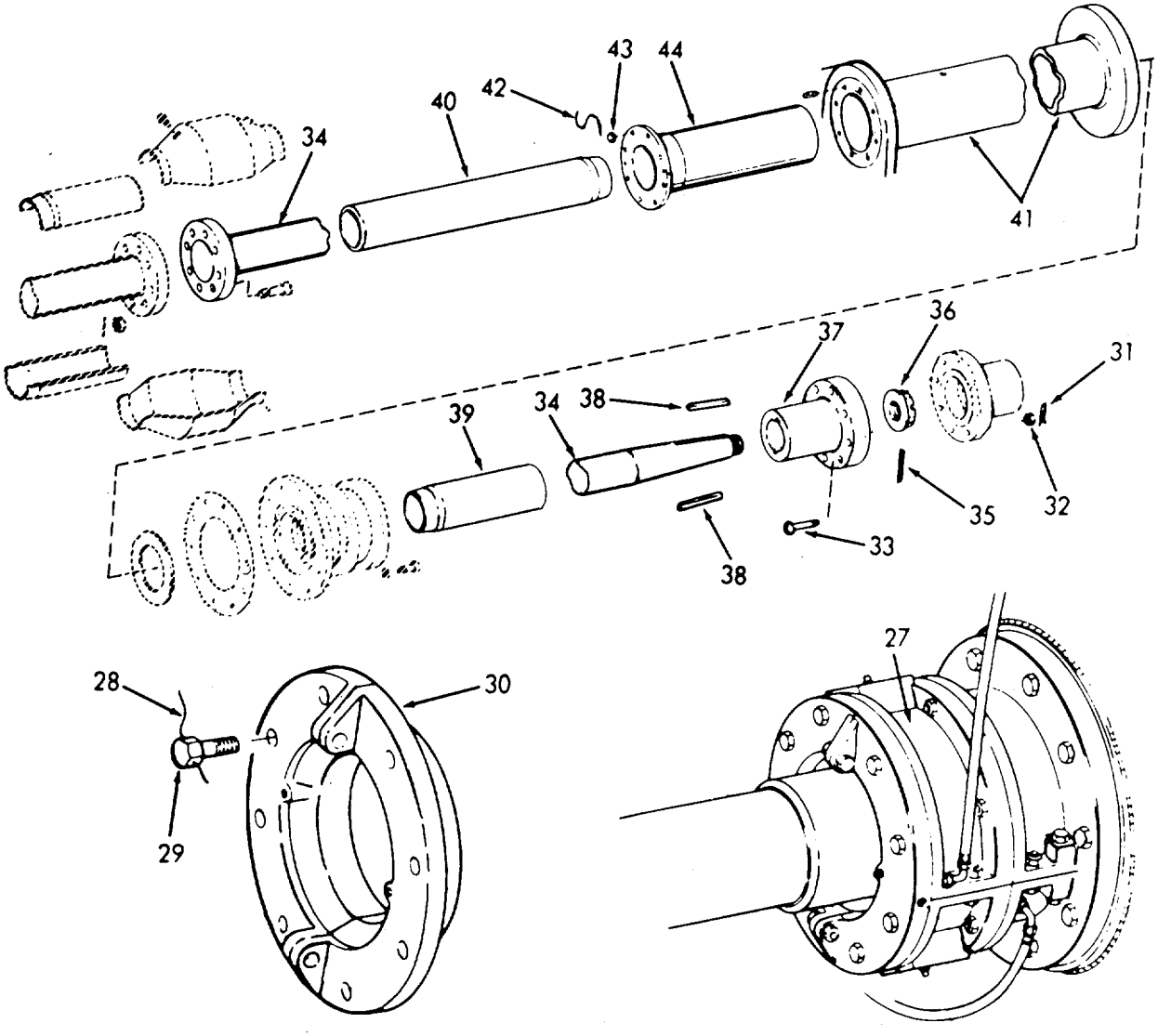


6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

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
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).	

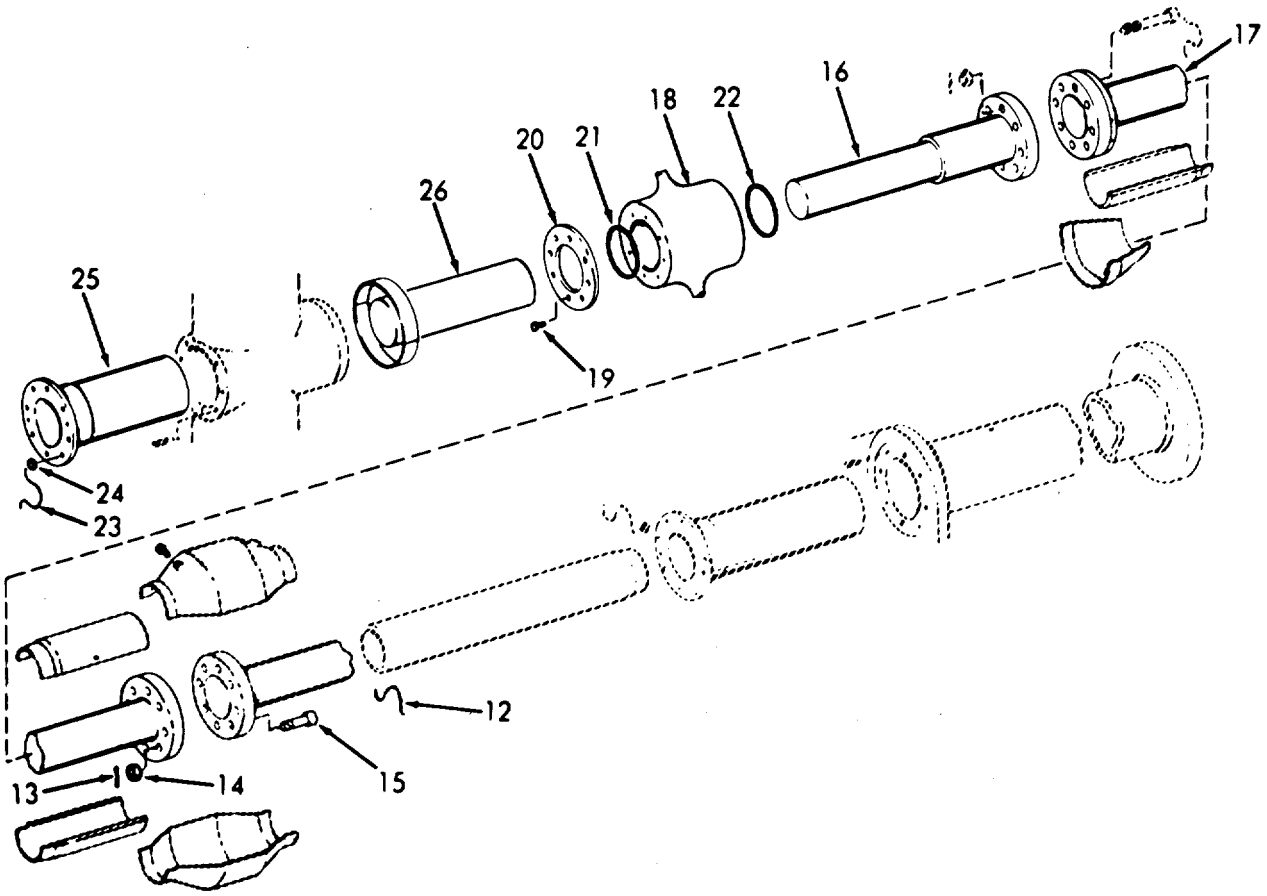


6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
10. Bearing	a. Stub Strut sleeve (26)	Install. shaft	
	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
INSTALLATION (Cont)			
	b. Bolts (15), nuts (14), and cotter pins (13)	Draw flange together and install.	
	c. Lockwire (12)	Install.	



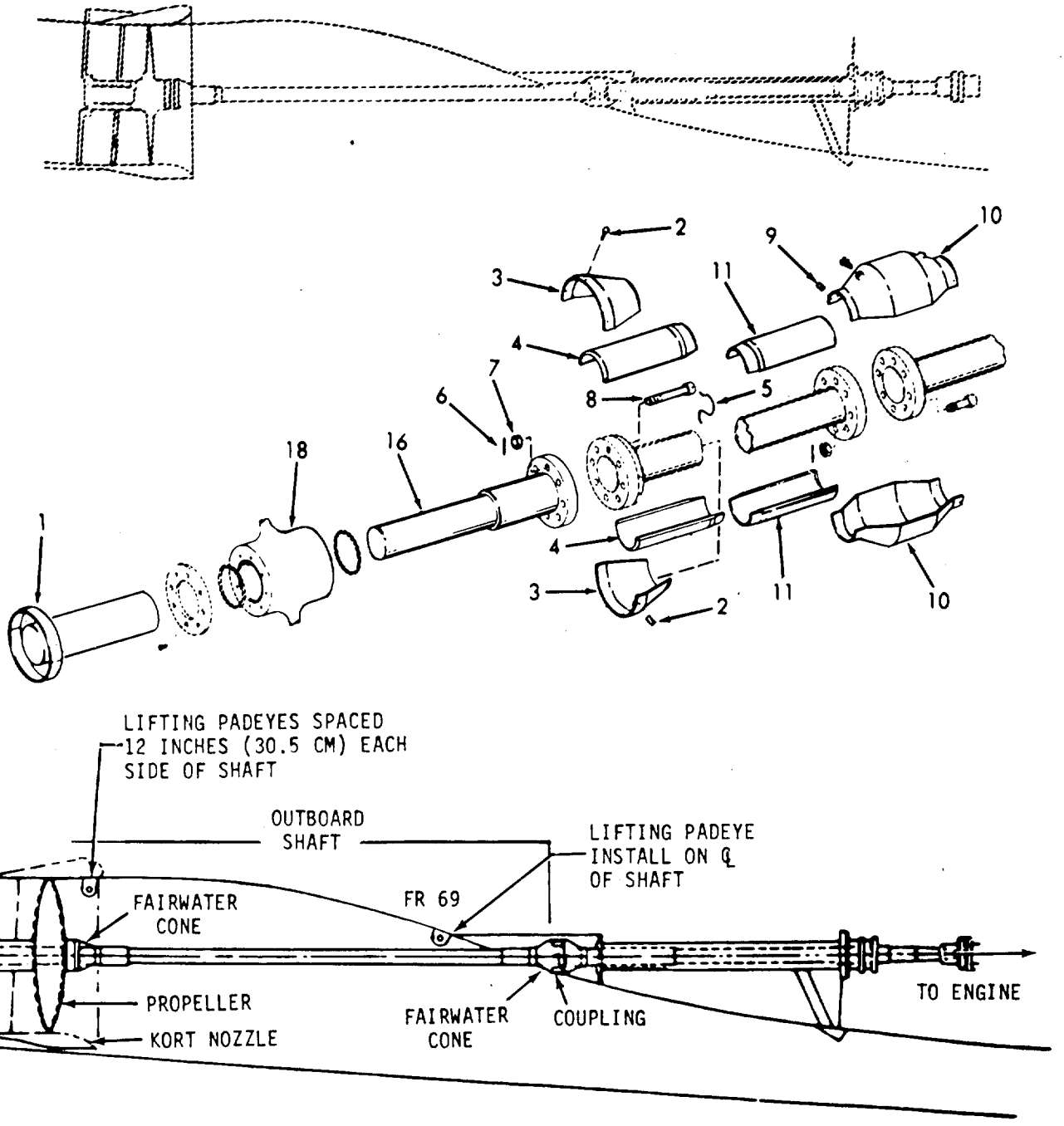
6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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 eye pads	Remove.	

6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

INSTALLATION (Cont)



6-1. PROPELLER SHAFT AND BEARINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS

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.

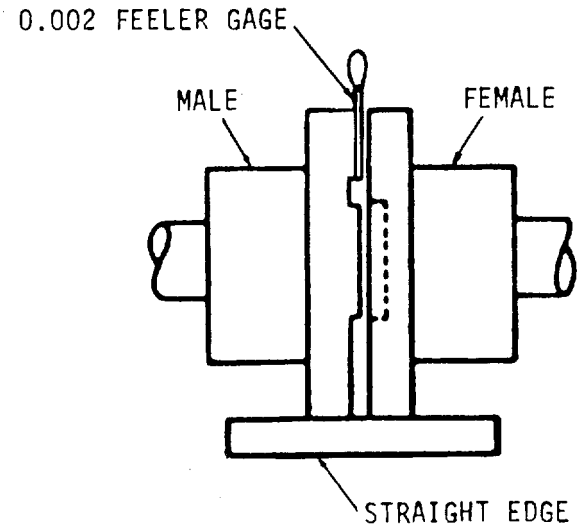
b. As the engine and marine gear comes into its aligned position, it will be possible to match the male and female halves of the output flange and propeller coupling, and prepare for bolting together. Care should be taken not to burr or mar this connection because the fit is very critical. Place a 0.002 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

ADJUSTMENT (Cont)



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 c. Installation

INITIAL SETUP

Test Equipment

NONE

References
Paragraph

3-55 Shaft Inflatable Seal
3-56 Shaft Seal

Special Tools

NONE

Equipment Condition: 6-1 — Condition Description: Propeller Shaft and Bearings - Removal

Material/Parts

NONE

Special Environmental Conditions

NONE

Personnel Required

2

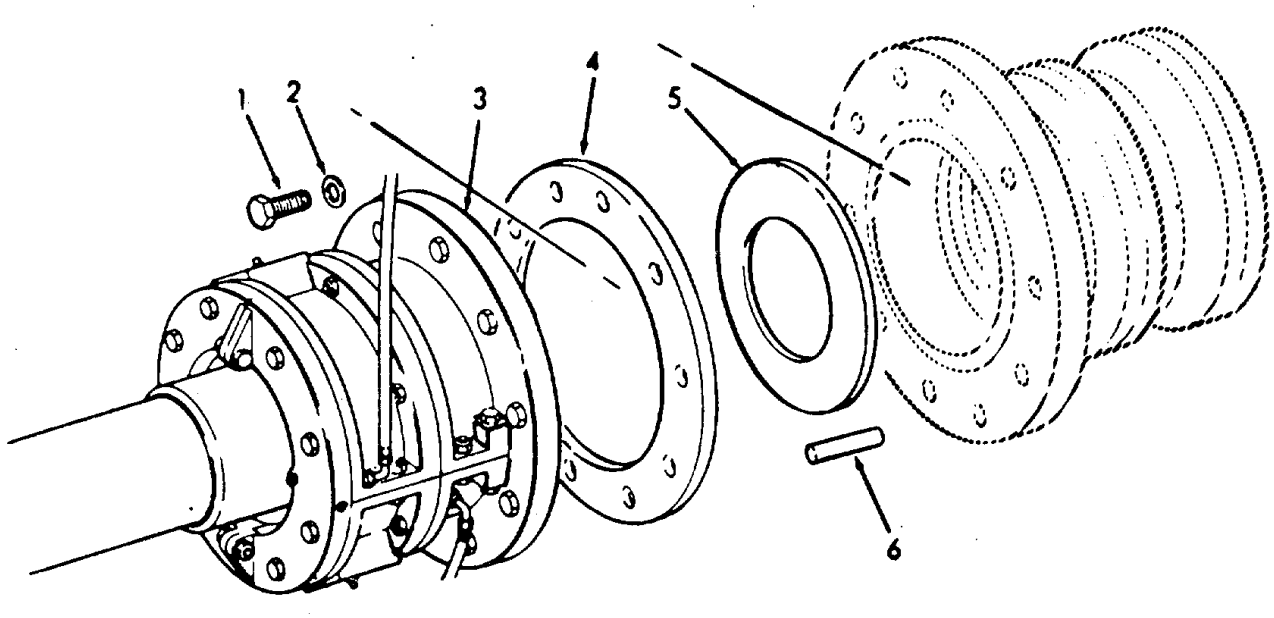
General Safety Instructions

NONE

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. Shaft Seal	a. Screws (1), and lock-washers (2)	Remove.	
	b. Shaft seal (3)	Remove.	

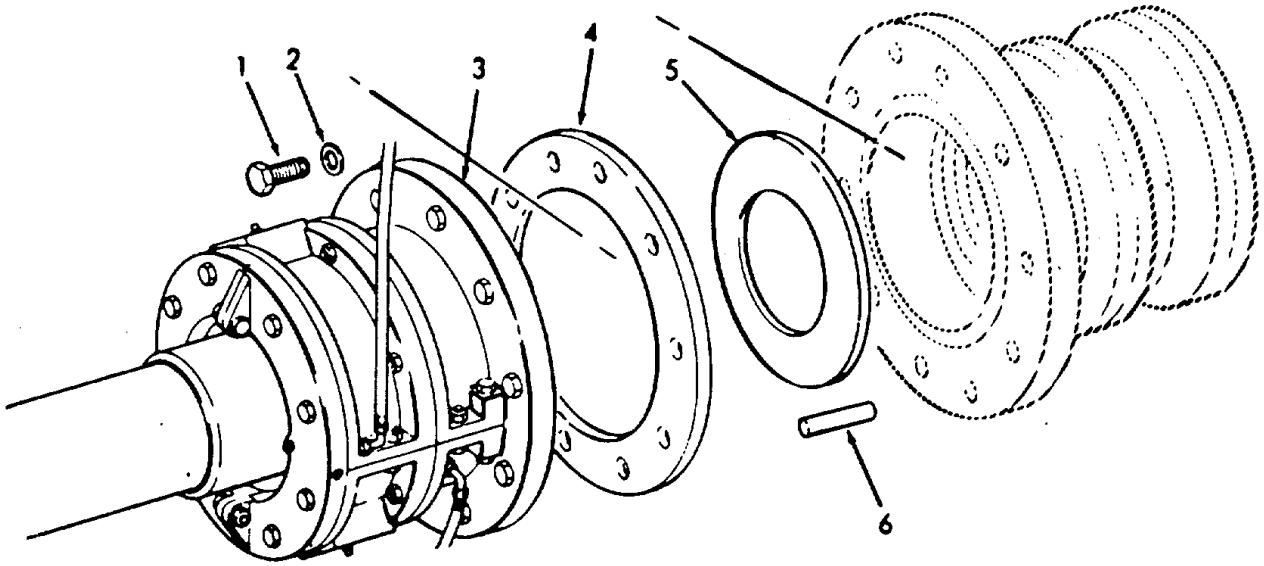
6-2. SHAFT SEAL - MAINTENANCE INSTRUCTIONS (Continued).

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	References
NONE	NONE
Special Tools	**Equipment Condition** / **Condition Description**
NONE	NONE
Material/Parts	**Special Environmental Conditions**
NONE	NONE
Personnel Required	**General Safety Instructions**
NONE	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

Special Tools

NONE

Material/Parts

NONE

Personnel Required

NONE

References

NONE

Equipment Condition — Condition Description

NONE

Special Environmental Conditions

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:

Replace

INITIAL SETUP

Test Equipment

NONE

Special Tools

NONE

Material/Parts

NONE

Personnel Required

2

References

NONE

Equipment Condition: Condition Description

NONE

Special Environmental Conditions

NONE

General Safety Instructions

NONE

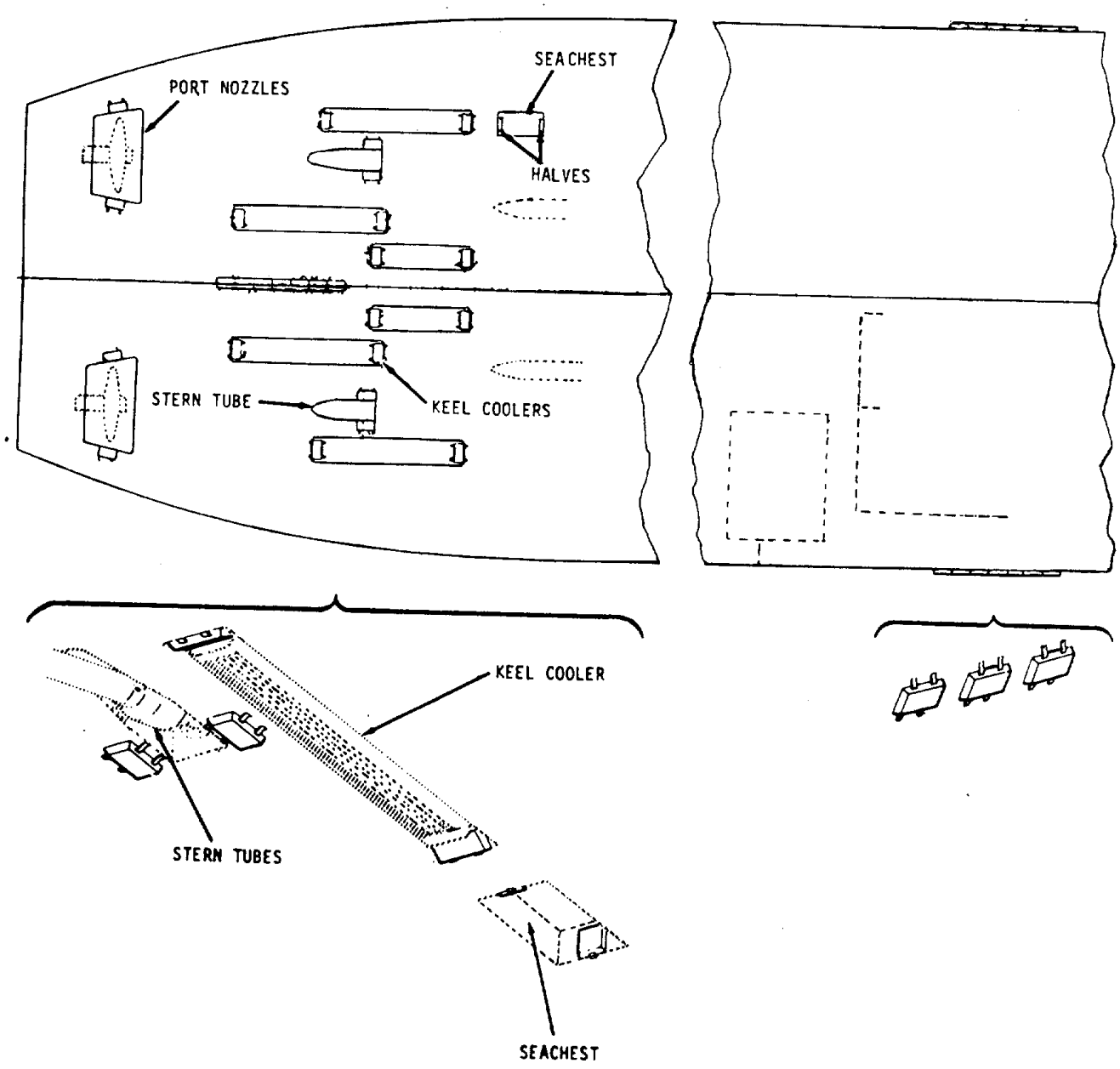
LOCATION	ITEM	ACTION	REMARKS
REPLACE			

NOTE

Replace anodes if badly pitted or deteriorated.

6-5. CORROSION PREVENTION ANODES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE (Cont)			



6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENANCE INSTRUCTIONS

This task covers:

a. Disassembly
b. Reassembly
c. Inspection

INITIAL SETUP

Test Equipment	Reference
None	5-48 5-49 5-50
Special Tools	**Equipment Condition / Condition Description**
	None
Material/Parts	**Special Environmental Conditions**
None	None
Personnel Required	**General Safety Instructions**
4	Observe WARNINGS in paragraph 5-49 and all normal precautions when handling heavy equipment.

LOCATION	ITEM	ACTION	REMARKS

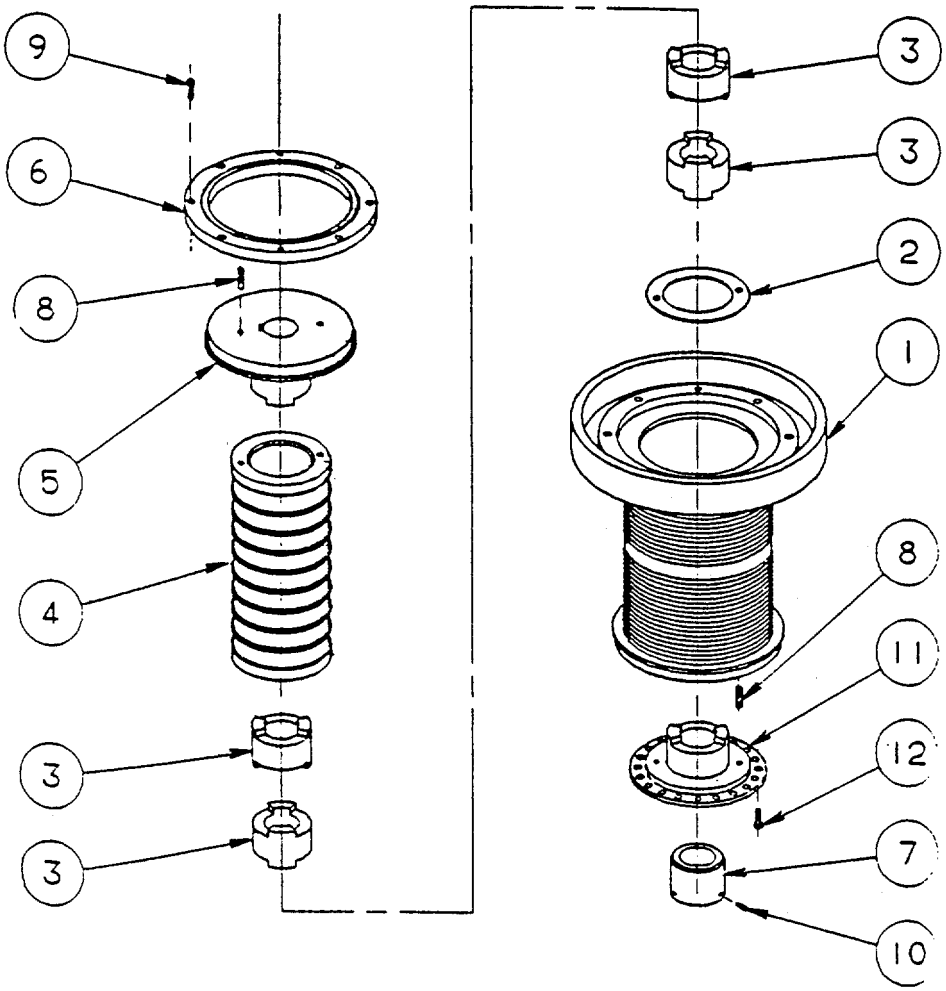
DISASSEMBLY

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 (Cont)			
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.	



6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
	e. Screws (9)	Remove.	
	f. Bearing (6)	Remove.	
	g. Inner mounting plate (5)	Remove.	
	h. Dowels (8).	Remove	Use new dowels for reassembly.
	i. Tortional 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.	

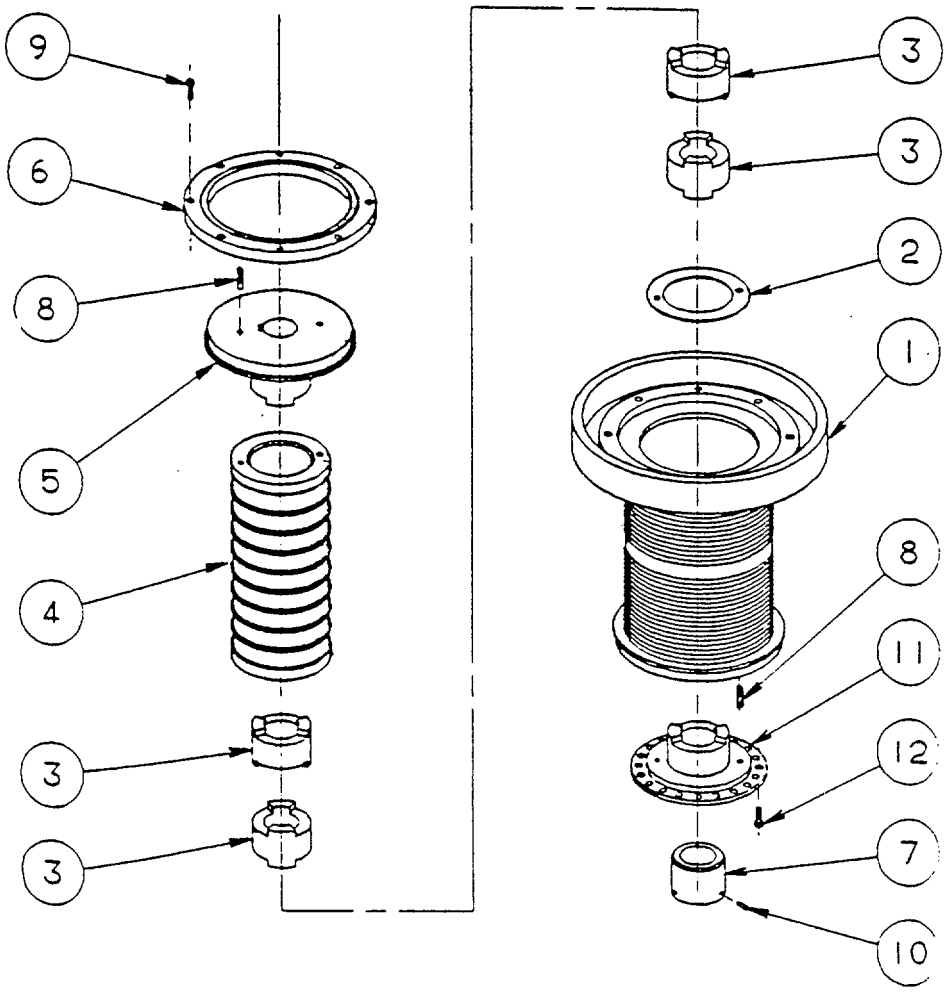
INSPECTION

2. a. Inspect the tortional 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.

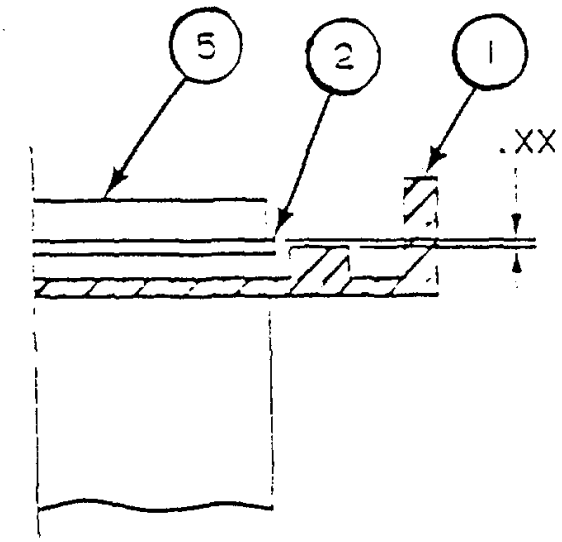
6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENANCE INSTRUCTIONS (Continued)

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)	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 (Cont)			
	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. Tortional Spring (4)	Place spring over cogs until clearance holes in the end plate of the spring fit over dowel pins. Seat the end plate of the spring against the shim (2).	
	g. Inner mounting plate (5)	Place mounting plate l11) onto tortional spring and measure the distance between the top surface of the lip and top surface of the bearing mounting surface.	



	IF .XX IS:	INSTALL ADDIATIONAL SHIMS
A)	.32 THRU .43	0
B)	.20 THRU .31	1
C)	.08 THRU .19	2
D)	.00 THRU .07	3

Figure 1.

6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	h. Shim (2)	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. Tortional Spring (4)	1. Place the tortional spring (4) over the cogs until clearance holes in the end plate of the tortional spring fit over the dowel pins. 2. Seat the end plate of the tortional spring against the shim.	
	j. Dowels (8)	Press the dowels (8) through the inner mounting plate (5) 1.62 inches deep.	
	k. Inner mounting plate (5)	Place the inner mounting plate (5) on top of the tortional soring and rotate it until the dowels seat into the clearance holes in the tortional spring(4).	
	l. Bearing (6)	Install the bearing (6) over the inner mounting plate.	

6-6. ELASTOMERIC COMPENSATING WINCH - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	m. Screws (9)	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 (10)	Install and tighten set 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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Paragraph

S

INDEX (CONTINUED)

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

DONALD J. DELANDRO
Brigadier General, United States Army
The Adjutant General

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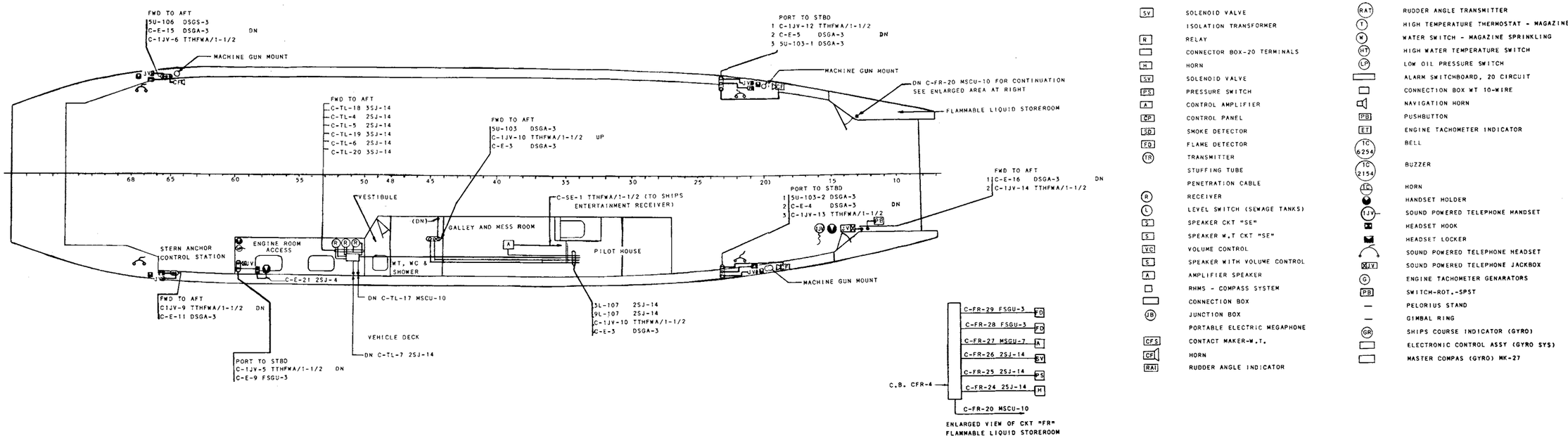

LEGEND

SV	SOLENOID VALVE
	ISOLATION TRANSFORMER
R	RELAY
	CONNECTOR BOX-20 TERMINALS
H	HORN
SV	SOLENOID VALVE
PS	PRESSURE SWITCH
A	CONTROL AMPLIFIER
CP	CONTROL PANEL
SD	SMOKE DETECTOR
FD	FLAME DETECTOR
TR	TRANSMITTER
	STUFFING TUBE
	PENETRATION CABLE
R	RECEIVER
L	LEVEL SWITCH (SEWAGE TANKS)
S	SPEAKER CKT "SE"
S	SPEAKER W.T CKT "SE"
VC	VOLUME CONTROL
S	SPEAKER WITH VOLUME CONTROL
A	AMPLIFIER SPEAKER
	RHMS - COMPASS SYSTEM
	CONNECTION BOX
JB	JUNCTION BOX
	PORTABLE ELECTRIC MEGAPHONE
CFS	CONTACT MAKER-W.T.
CF	HORN
RAI	RUDDER ANGLE INDICATOR

RAT	RUDDER ANGLE TRANSMITTER
T	HIGH TEMPERATURE THERMOSTAT - MAGAZINE
W	WATER SWITCH - MAGAZINE SPRINKLING
HT	HIGH WATER TEMPERATURE SWITCH
LP	LOW OIL PRESSURE SWITCH
	ALARM SWITCHBOARD, 20 CIRCUIT
	CONNECTION BOX WT 10-WIRE
	NAVIGATION HORN
PB	PUSHBUTTON
ET	ENGINE TACHOMETER INDICATOR
TC 6254	BELL
TC 2154	BUZZER
TC	HORN
	HANDSET HOLDER
1JV	SOUND POWERED TELEPHONE HANDSET
	HEADSET HOOK
	HEADSET LOCKER
	SOUND POWERED TELEPHONE HEADSET
MJV	SOUND POWERED TELEPHONE JACKBOX
G	ENGINE TACHOMETER GENARATORS
PB	SWITCH-ROT.-SPST
—	PELORIUS STAND
—	GIMBAL RING
GR	SHIPS COURSE INDICATOR (GYRO)
	ELECTRONIC CONTROL ASSY (GYRO SYS)
	MASTER COMPAS (GYRO) MK-27

Figure F0-1. Interior Communication System (Sheet 1 of 7)

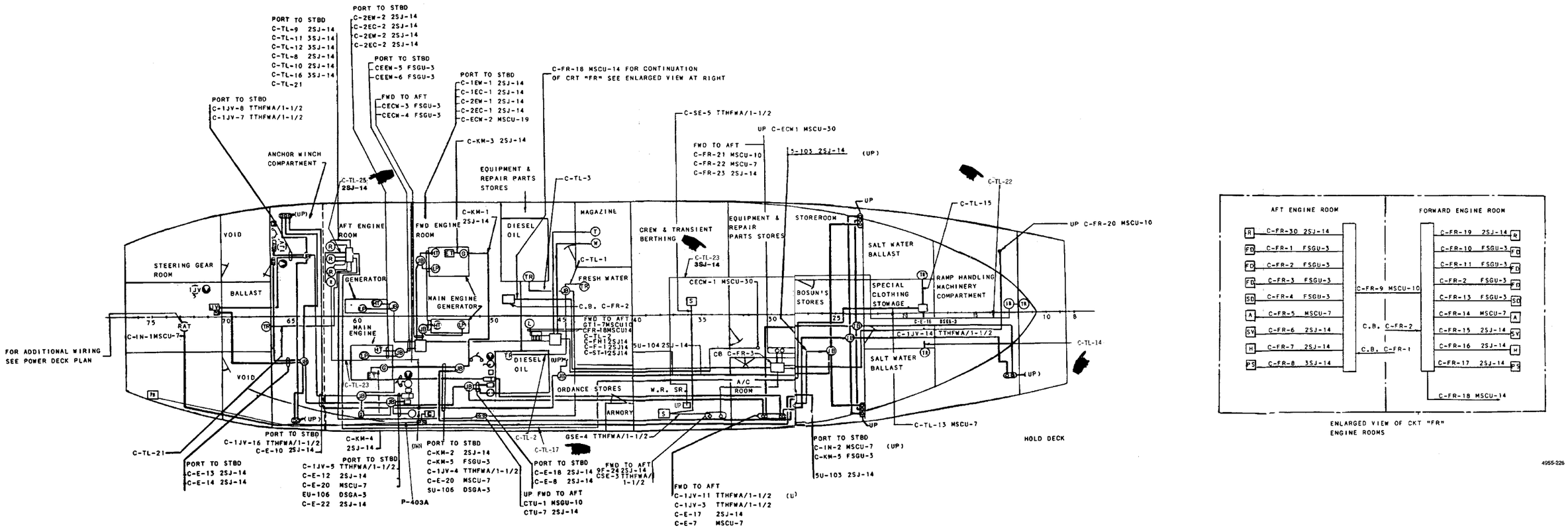

Figure FO-1. Interior Communication System (Sheet 2 of 7)

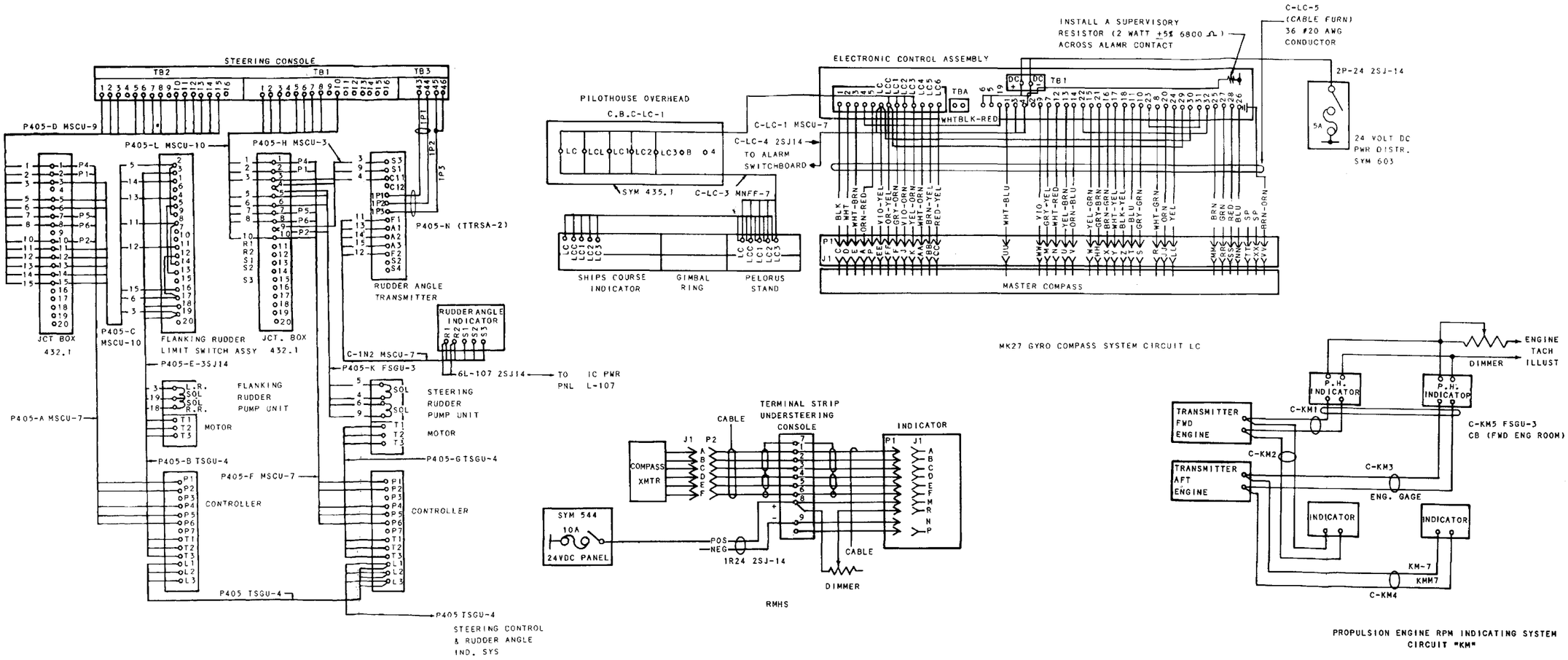

Figure FO-1. Interior Communication System (Sheet 3 of 7)

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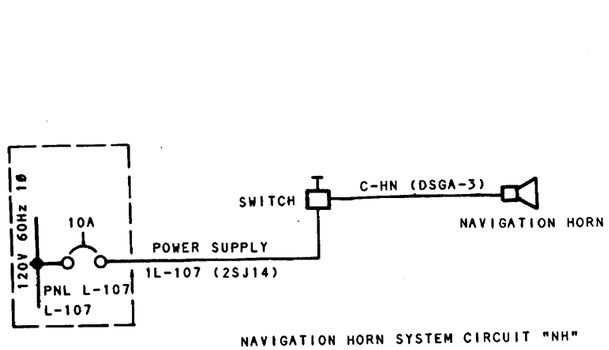
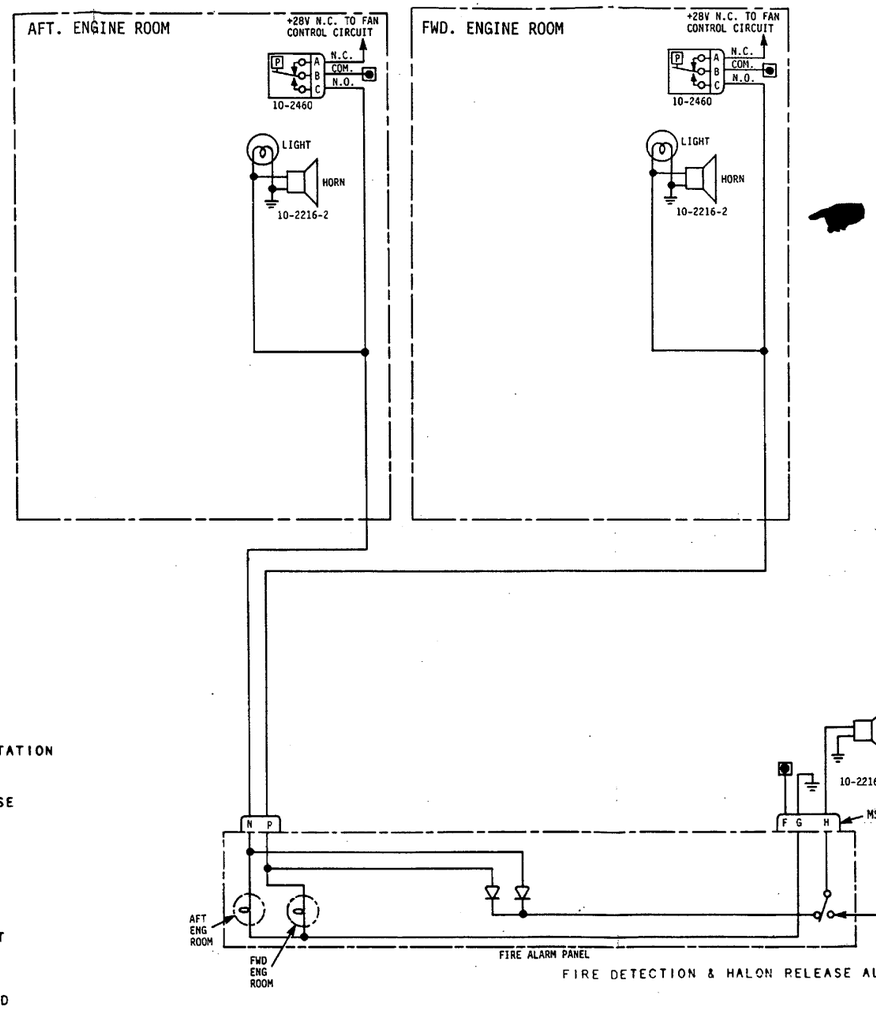
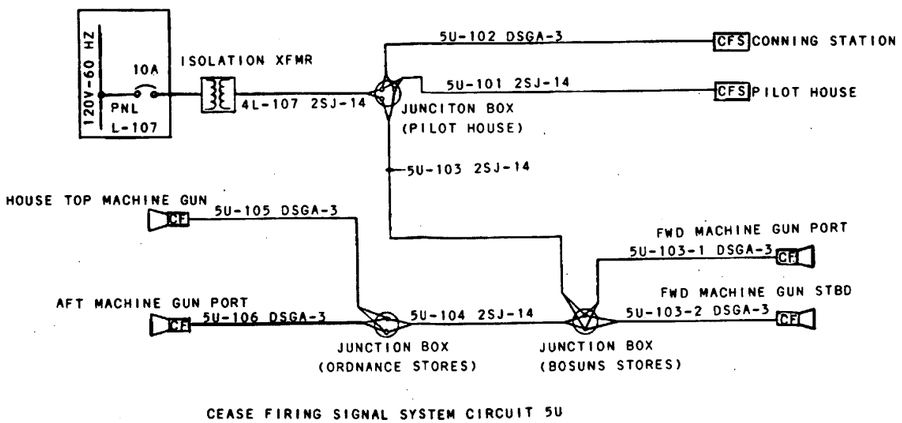


NAVIGATION HORN SYSTEM CIRCUIT "NH"





CEASE FIRING SIGNAL SYSTEM CIRCUIT 5U

Figure FO-1. Interior Communication System (Sheet 4 of 7)

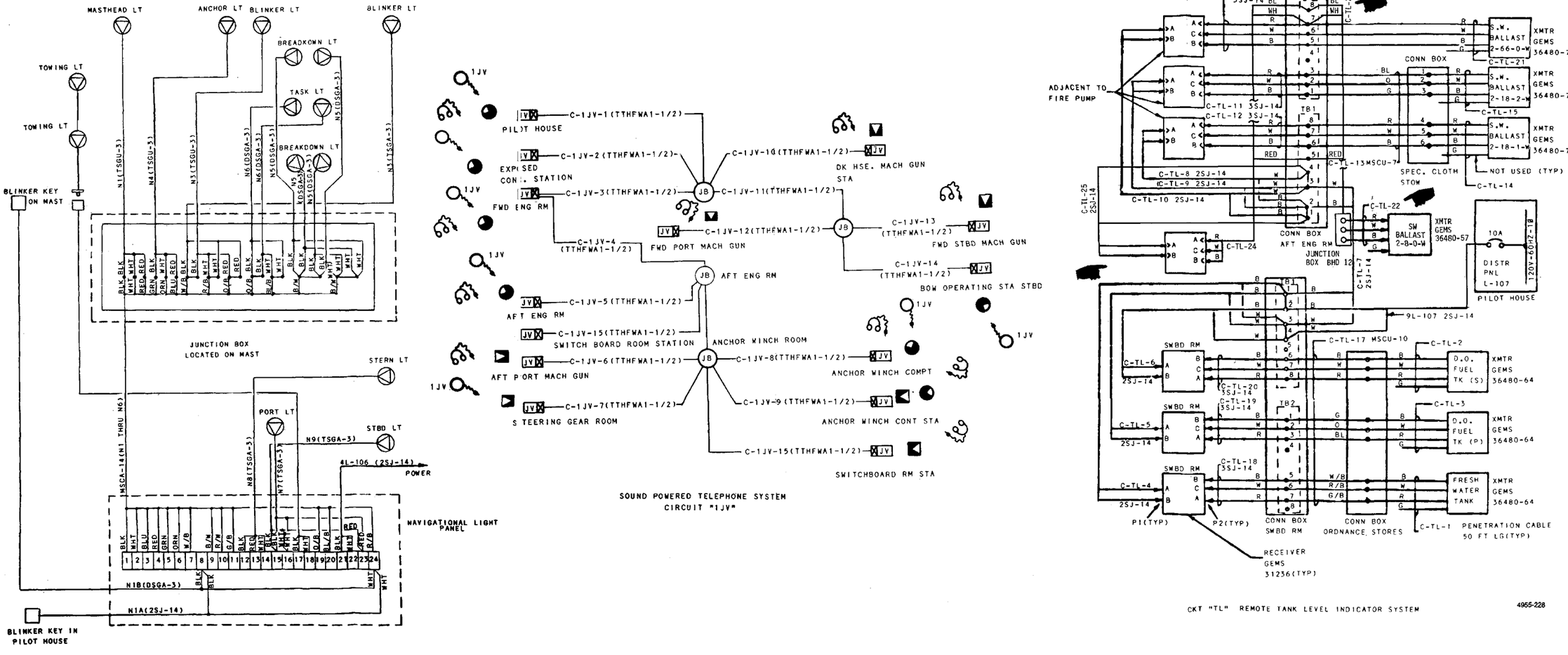


Figure FO-1. Interior Communication System (Sheet 5 of 7)

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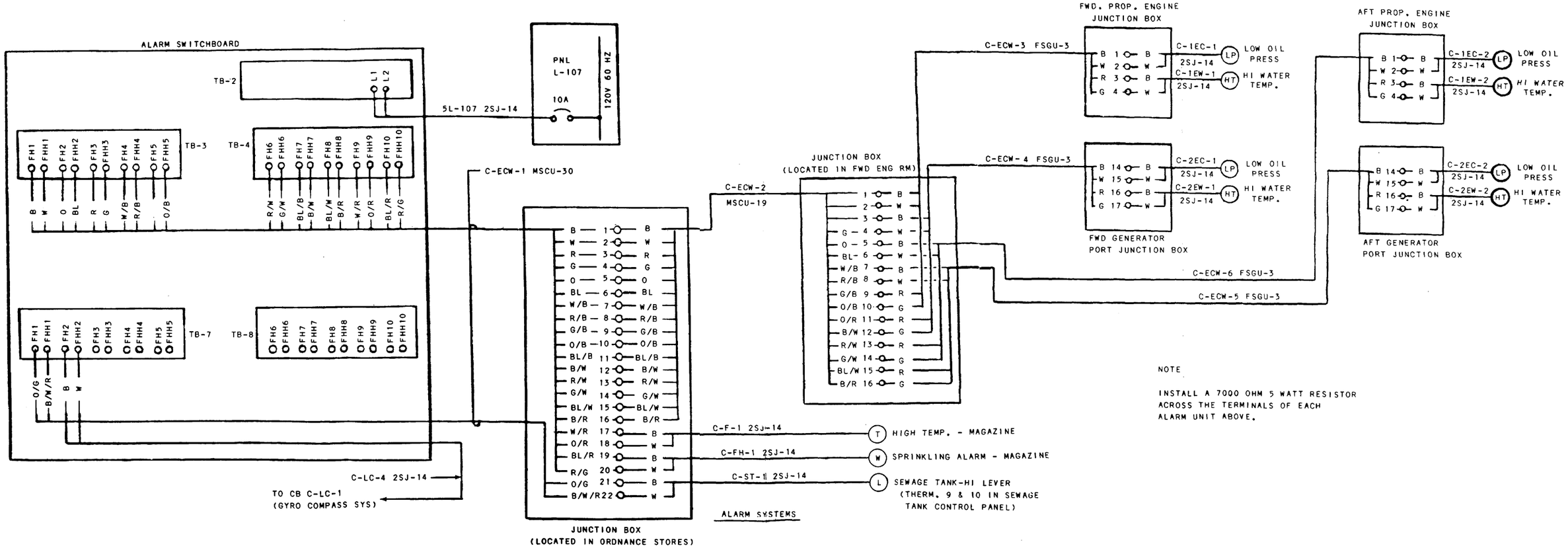

Figure FO-1. Interior Communication System (Sheet 6 of 7)

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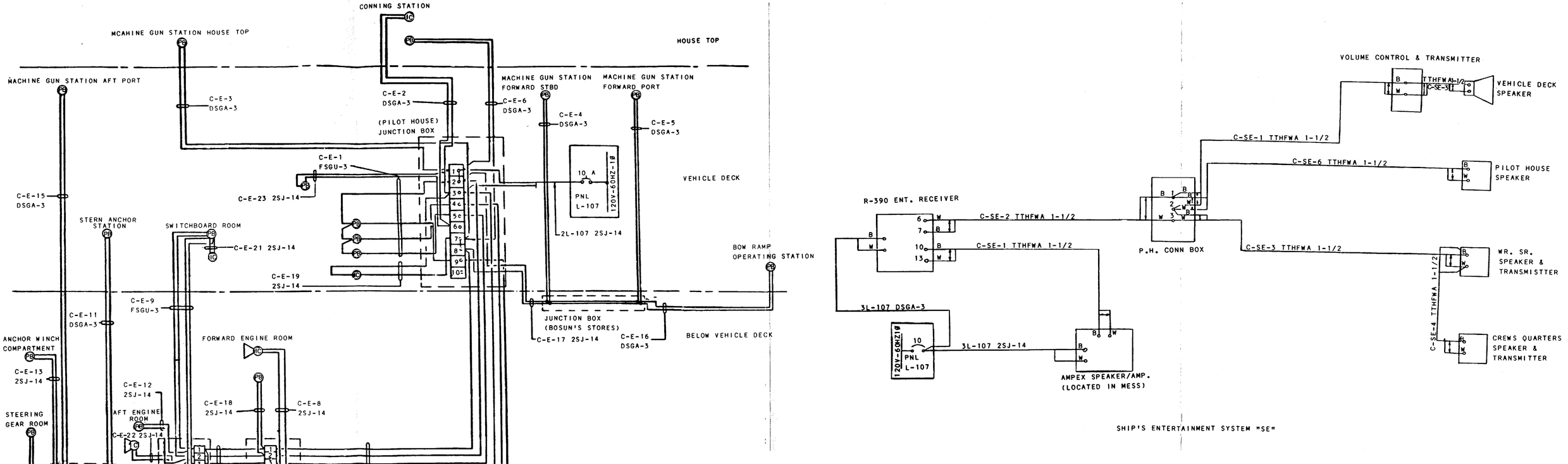


Figure FO-1. Interior Communication System (Sheet 7 of 7)

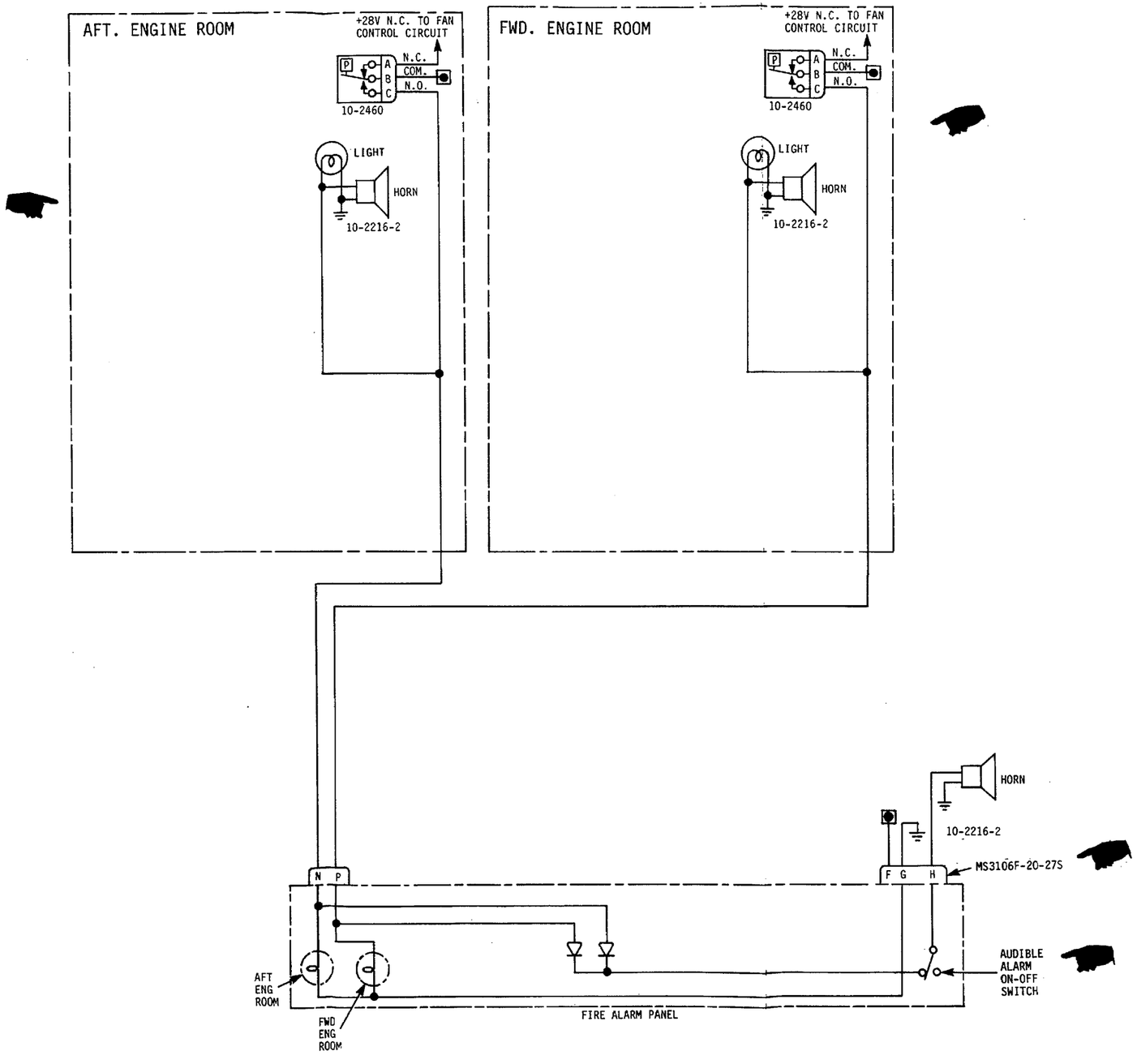


Figure FO-2. Fire Detection and Halon Alarm System

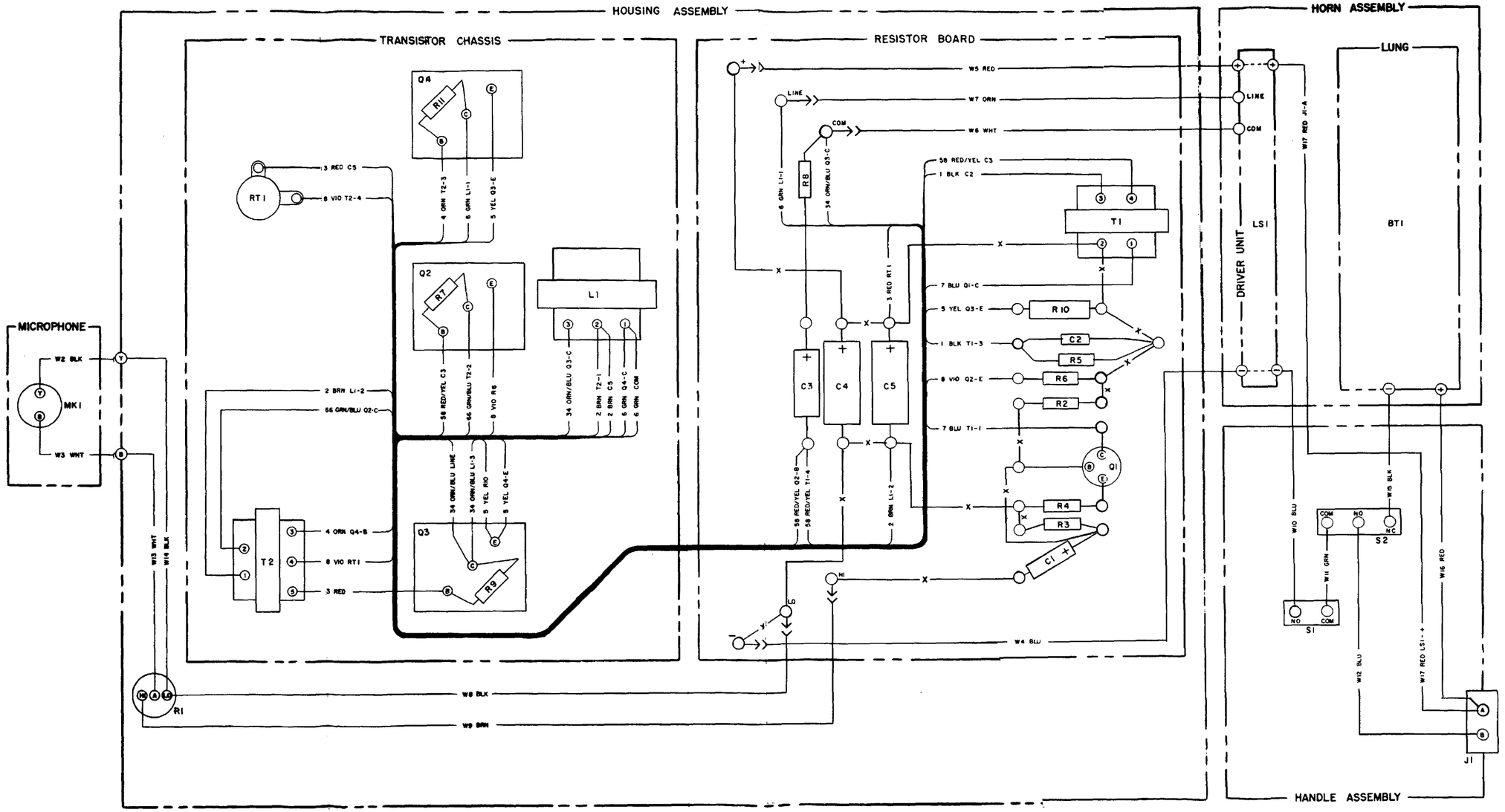
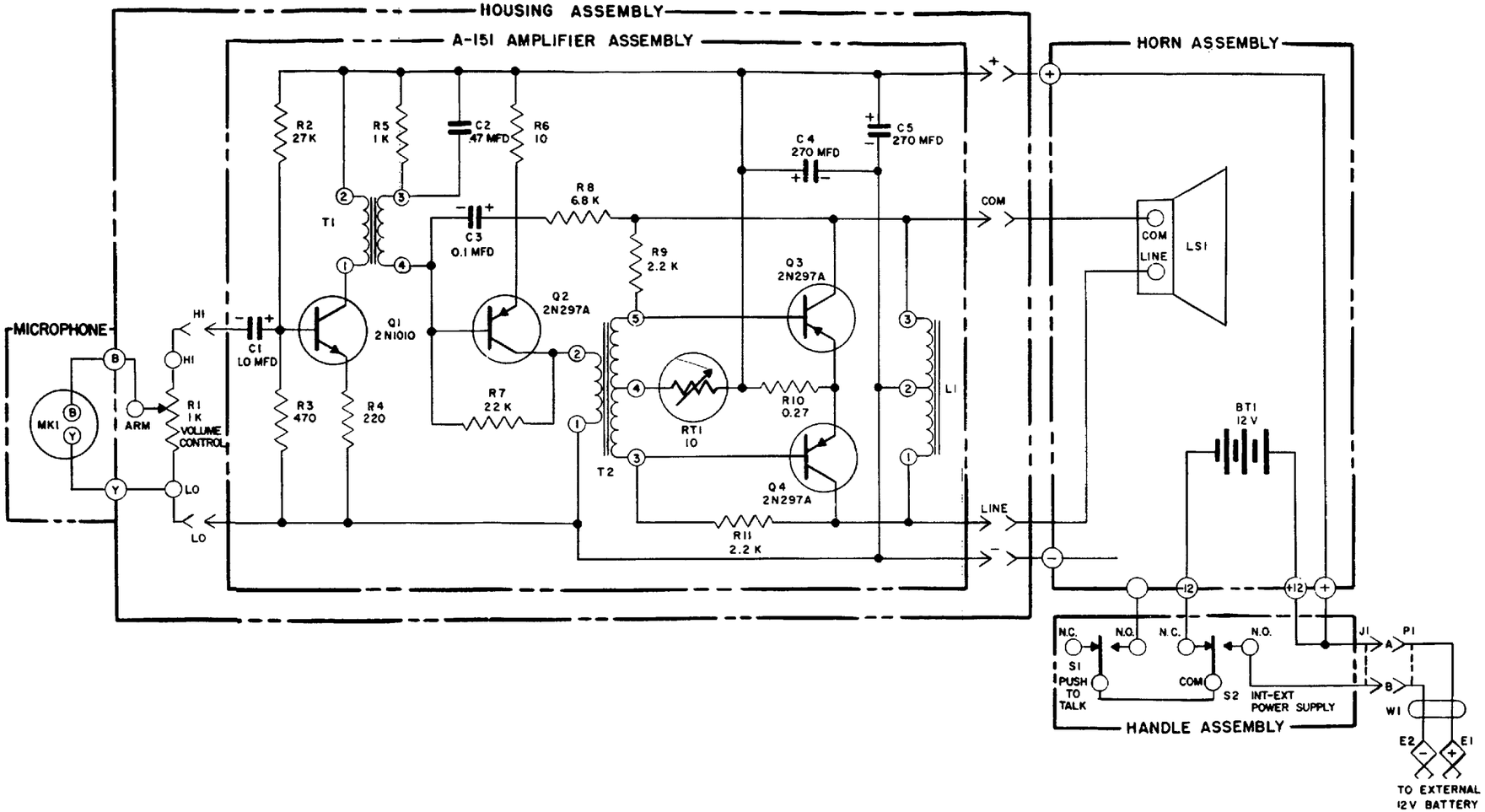


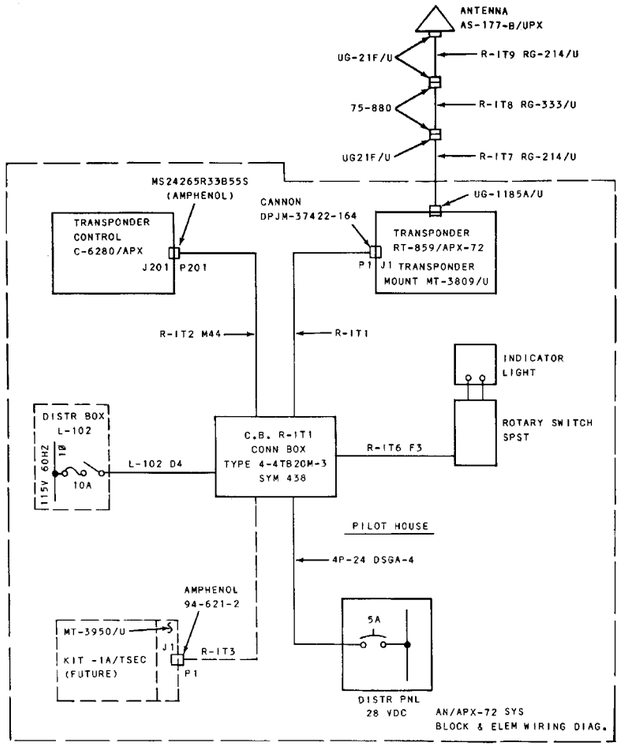
Figure FO-3. Loudhailer - Wiring Diagram

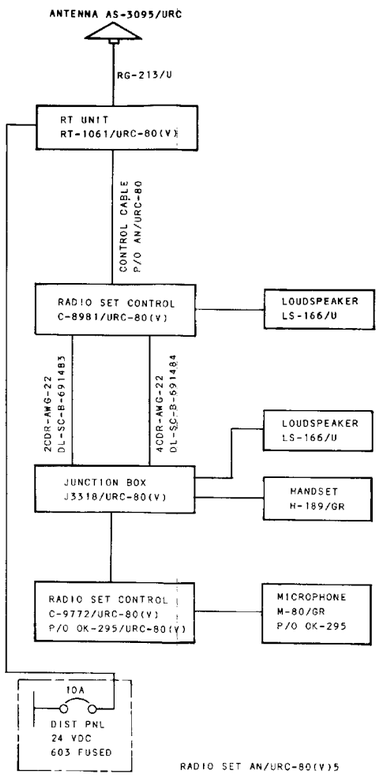


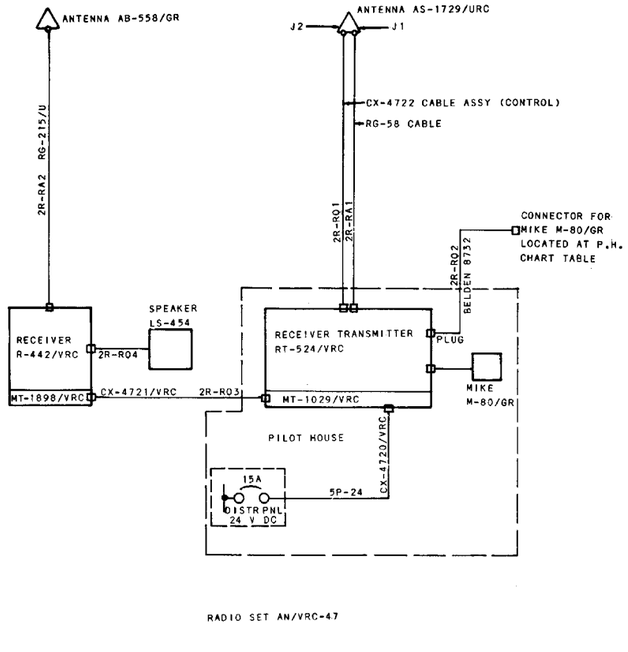
NOTES:

1. EXTERNAL SUPPLY: 12 V STORAGE BATTERY.
2. INPUT POWER:
   A. NO SIGNAL: 1.5 WATTS
   B. FULL OUTPUT: 20 WATTS
3. OUTPUT POWER: 10 WATTS
4. DO NOT APPLY BATTERY POWER WITH OUTPUT LOAD DISCONNECTED
5. ALL RESISTORS 1/2 WATT, UNLESS MARKED OTHERWISE
6. RESISTANCE VALUE IN OHMS K=1,000 M=1,000,000

Figure FO-4. Loudhailer - Schematic







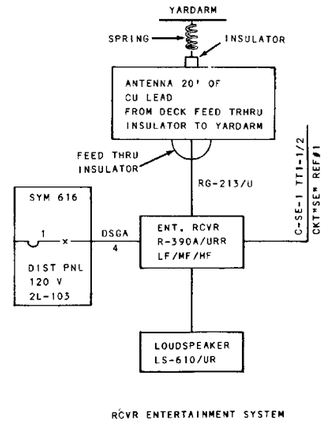


Figure FO-5. Radio Communication System (Sheet 1 of 2)

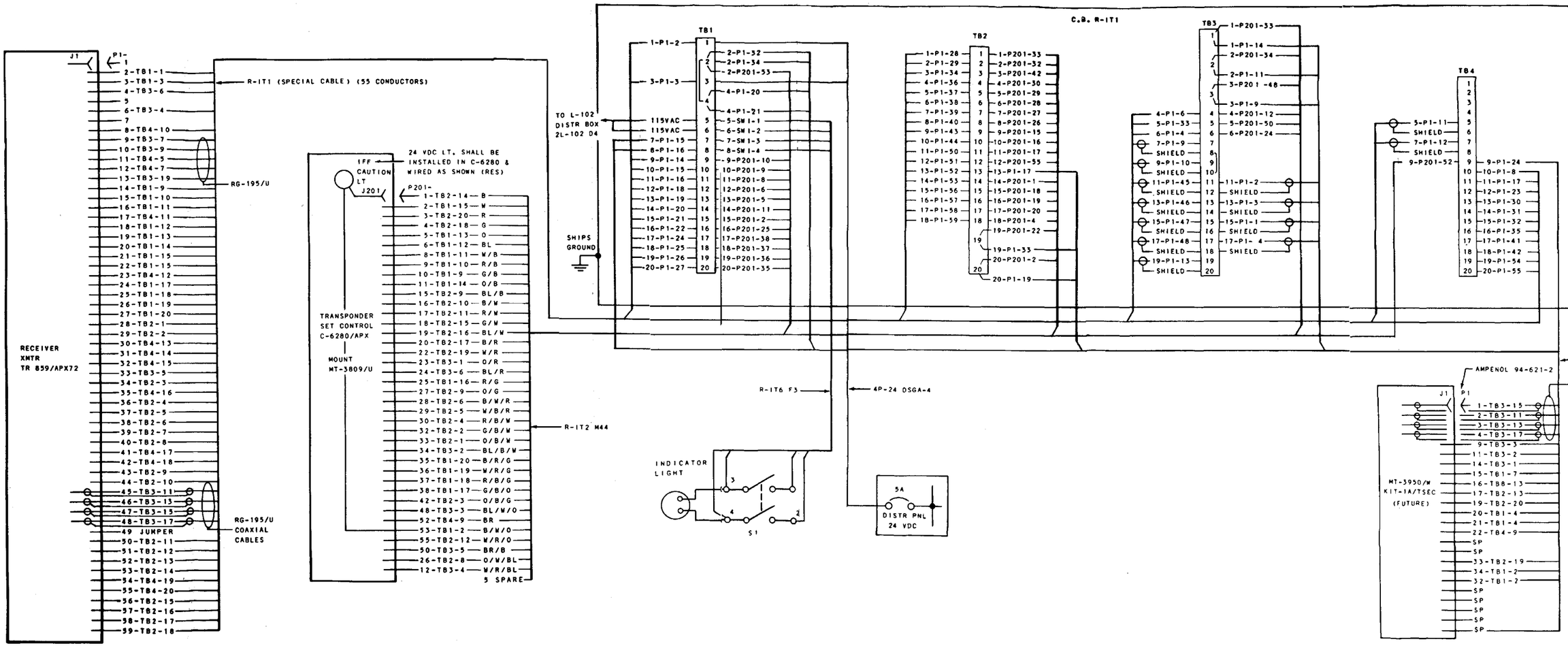
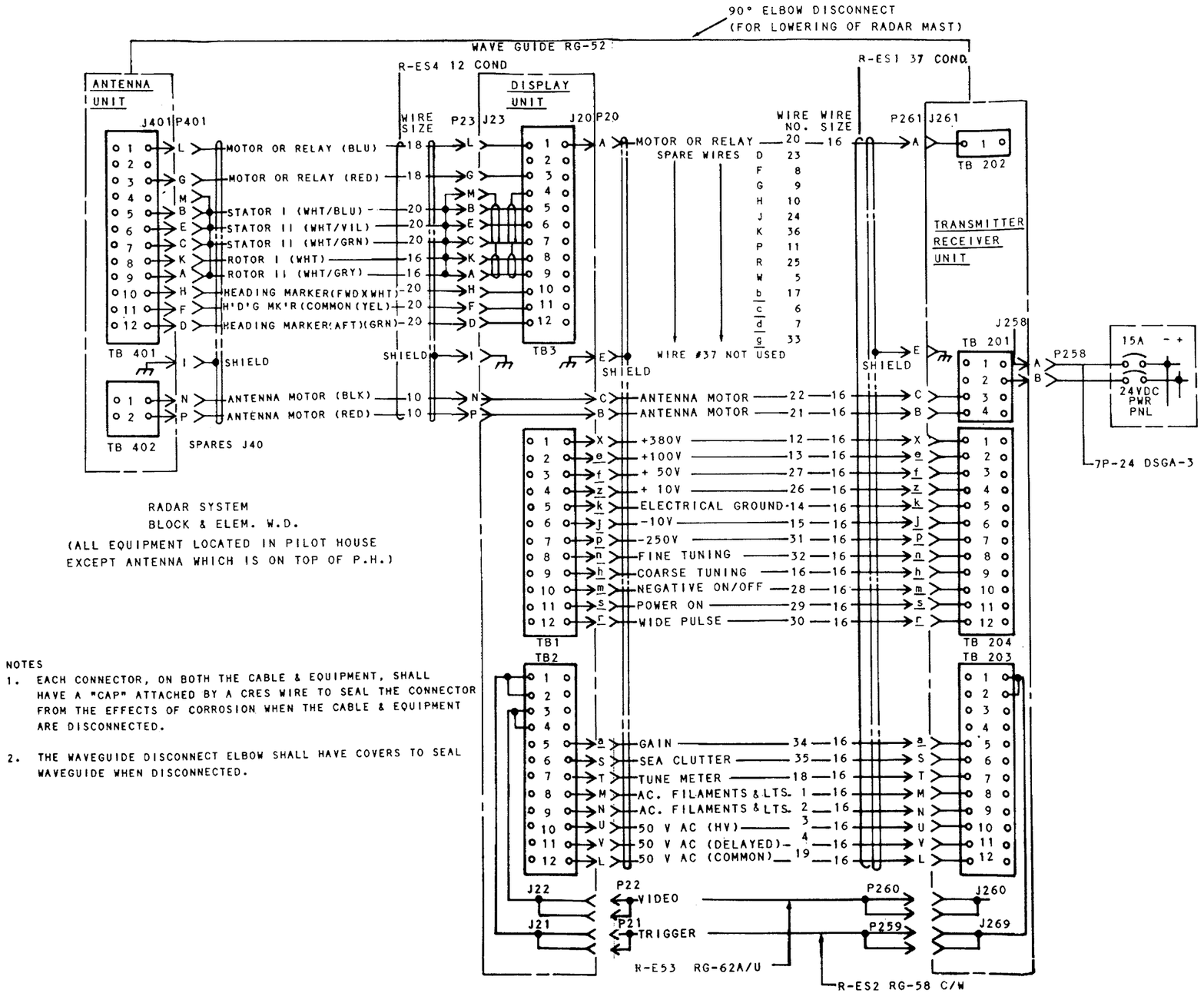


Figure FO-5. Radio Communication System (Sheet 2 of 2)

FP-23/(FP-24 blank)



RADAR SYSTEM
BLOCK & ELEM. W.D.
(ALL EQUIPMENT LOCATED IN PILOT HOUSE EXCEPT ANTENNA WHICH IS ON TOP OF P.H.)

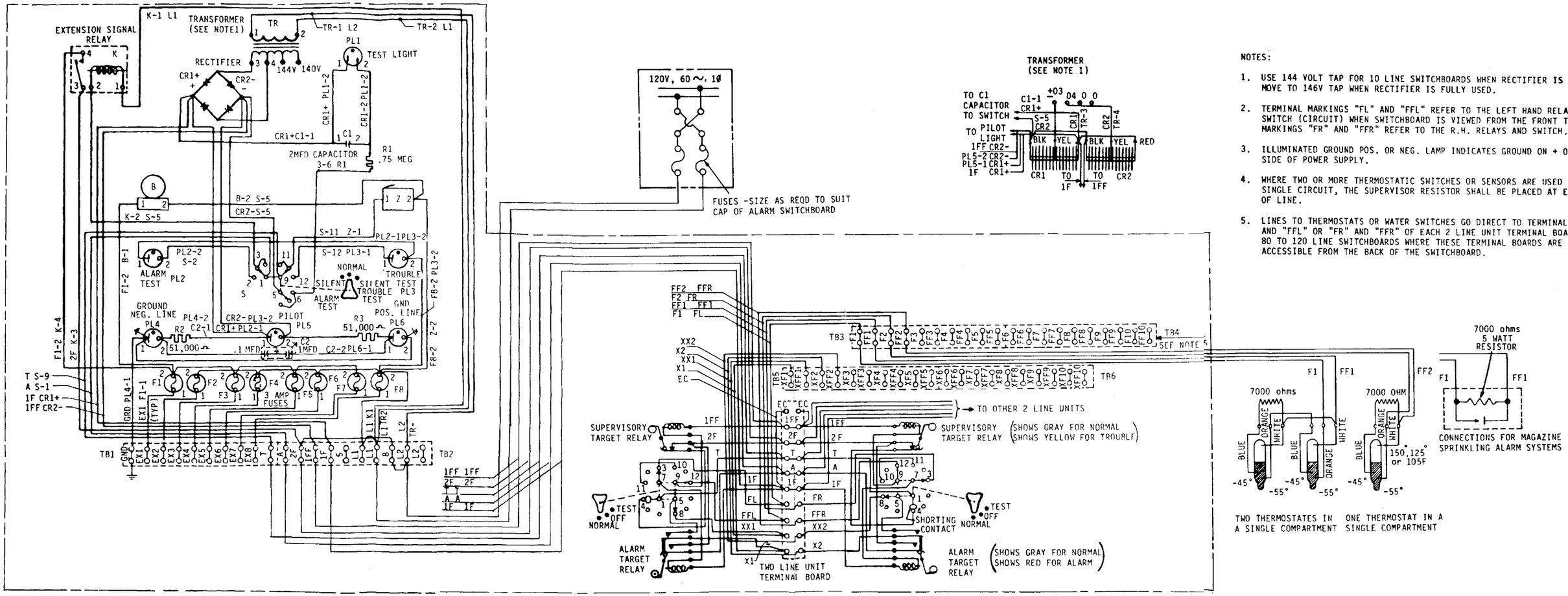
NOTES

1. EACH CONNECTOR, ON BOTH THE CABLE & EQUIPMENT, SHALL HAVE A "CAP" ATTACHED BY A CRES WIRE TO SEAL THE CONNECTOR FROM THE EFFECTS OF CORROSION WHEN THE CABLE & EQUIPMENT ARE DISCONNECTED.

2. THE WAVEGUIDE DISCONNECT ELBOW SHALL HAVE COVERS TO SEAL WAVEGUIDE WHEN DISCONNECTED.

Figure FO-6. Radar System

FP-25/(FP-26 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.

Figure FO-7. Alarm Switchboard

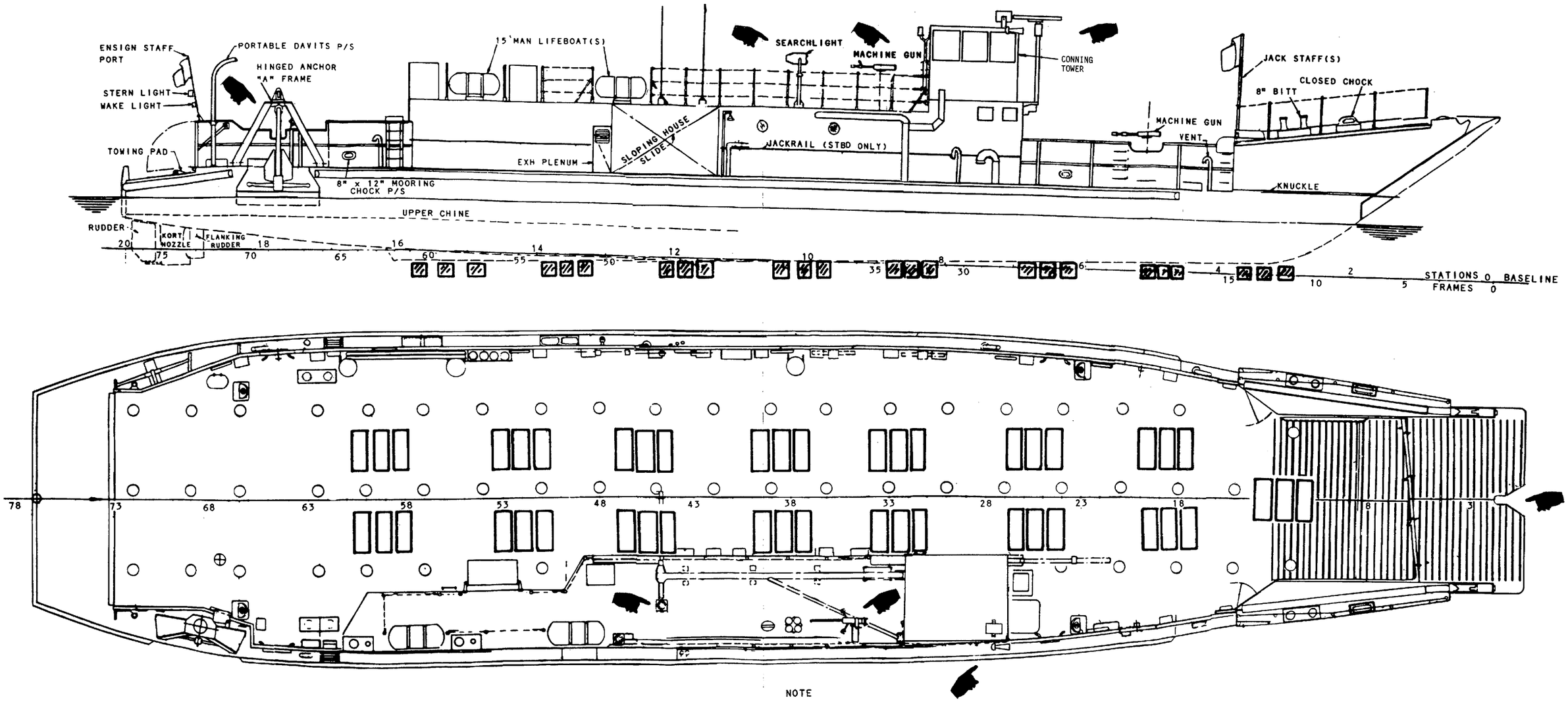
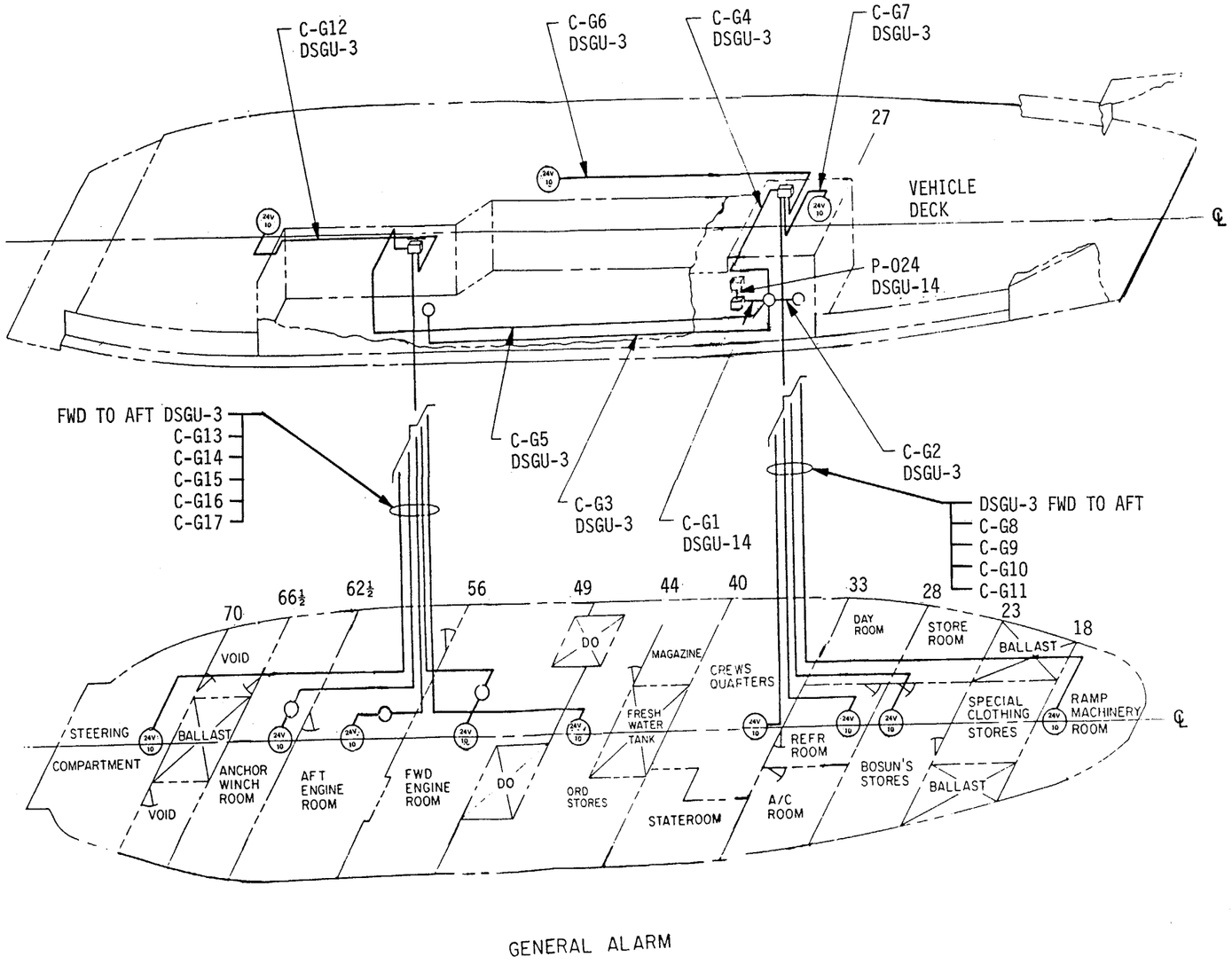
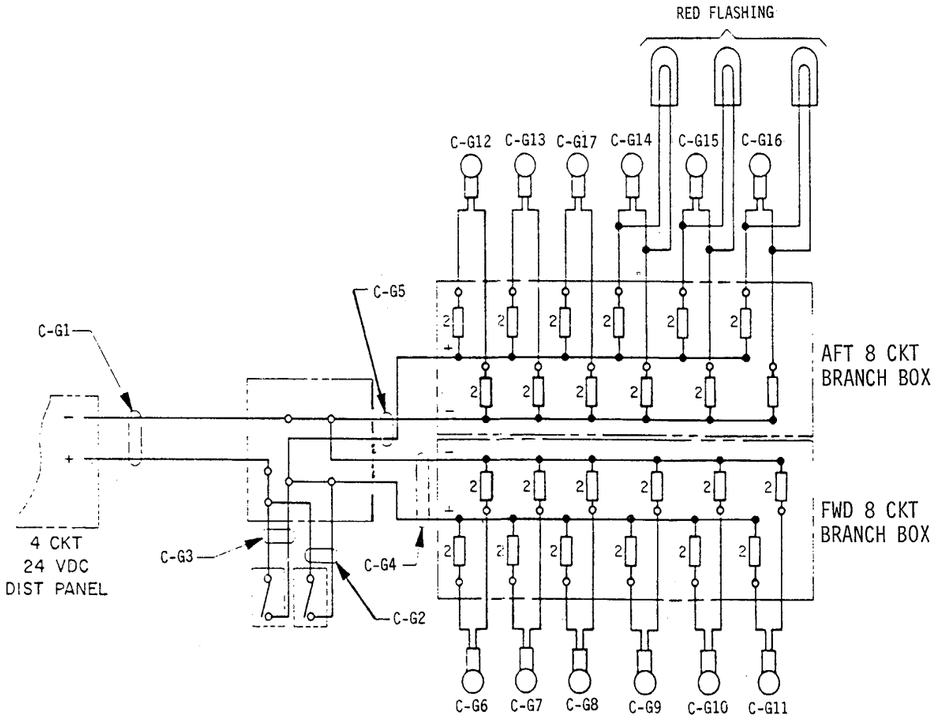


Figure FO-8. Docking Plan

Figure FO-8. Docking Plan



GENERAL ALARM



SCHEMATIC DIAGRAM
CIRCUIT G

Figure FO-9. General Alarm Wiring Diagram

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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 milliters = .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

PIN: 057584-000