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WAR DEPARTMENT TECHNICAL MANUAL

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DERRICK, FLOATING DIESEL, STEEL, 30-TON DESIGN 314, KNOCK-DOWN

WAR DEPARTMENT

APRIL 1947

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DERRICK, FLOATING
DIESEL, STEEL, 30-TON
DESIGN 314, KNOCK-DOWN



WAR DEPARTMENT

APRIL 1947

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Washington 25, D. C., 18 April 1947

TM 55-1204, Derrick, Floating, Diesel, Steel, 30-Ton, Design 314, Knock-Down, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

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PART ONE

INTRODUCTION

Section I. GENERAL

1. Scope

These instructions are published for the information and guidance of the personnel to whom this equipment is assigned. They contain information on the erection, operation, and maintenance of the equipment, as well as descriptions of the major units and their functions in relation to the other components of the equipment. These instructions apply only to the Derrick, Floating, Diesel, Steel, 30-Ton, Design 314, Knock-Down, and are arranged in four parts:

- Part One—Introduction.
- Part Two—Operating Instructions.
- Part Three—Maintenance Instructions.
- Part Four—Auxiliary Equipment.

2. Records

The following records will be used by operating and maintenance personnel to carry out the preventive maintenance schedules prescribed herein:

- Marine Craft Operator's Daily Trip Ticket and P. M. Service Record. WD AGO Form 55-124.
- Preventive Maintenance Service and Technical Inspection Work Sheet for Marine Craft... WD AGO Form 55-125.
- Work Sheet for Full Track and Tank-Like Wheeled Vehicles..... WD AGO Form 462.
- Unsatisfactory Equipment Report..... WD AGO Form 468.

Section II. DESCRIPTION AND DATA

3. Description

a. GENERAL. The equipment described in this technical manual is identified as the "Derrick, Floating Diesel, Steel, 30-Ton, Design 314, Knock-Down," manufactured by the Dolomite Products Company. The barge is prefabricated and can be assembled and disassembled in accordance with a match marking system. Each of the eight vessels or pontoons which float the barge forms the largest single unit and can be mounted on a flat car for transportation by rail. A 130-hp Diesel engine powers the derrick and hoist which, in normal service, is utilized to transfer cargo from wharf to lighter or reverse. Maximum capacity of the equipment is 30 tons on the main hook at 52 foot radius, and 5 tons for the whip hook. The lift height above water level is 58 feet at 52-foot radius. Floodlights are provided on the roof of the deck house, A-frame, and boom to furnish illumination for night operation. The main generator, belt-driven from the Diesel engine, generates electricity for the lighting system. In addition, an auxiliary generator, driven by a small Diesel engine, generates electrical power for appliances in the galley. Complete berthing, messing, and sanitary facilities for a crew of four are provided. During cold-weather operation, oil stoves heat the deck house. The barge is not self-propelled; an electrically powered capstan on the forward port side of the barge is provided for maneuvering short distances along the wharf. A name plate for the barge is located on the outside of the deck house at the entrance to the crew quarters. (See fig. 3.)

b. MAJOR EQUIPMENT. Major equipment discussed in this manual refers to that equipment used directly for hoisting or swinging. It includes main engine, air compressor, hoist, and derrick.

(1) *Main engine.* Power for operation of the hoist drums, main generator, and air compressor

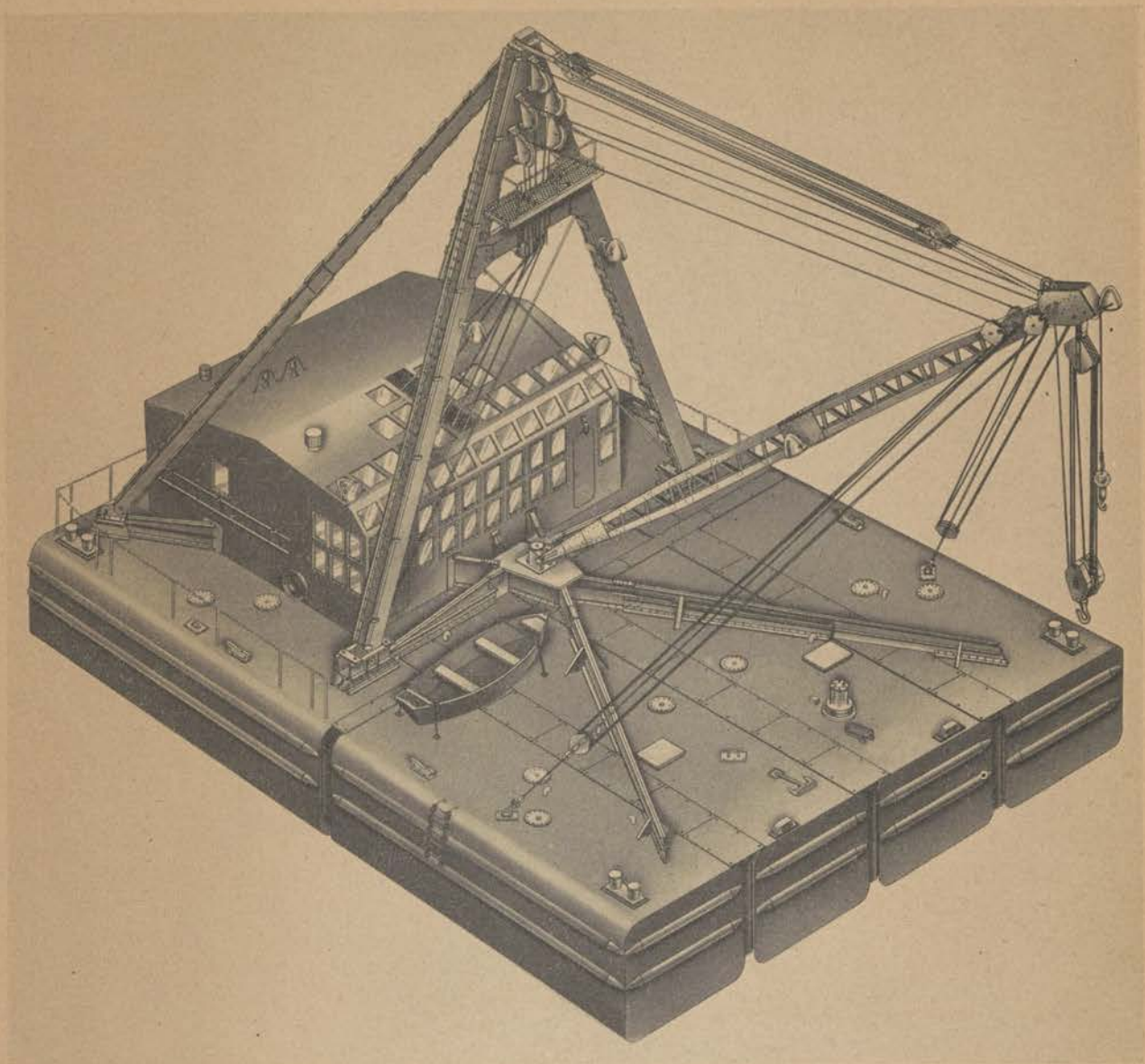
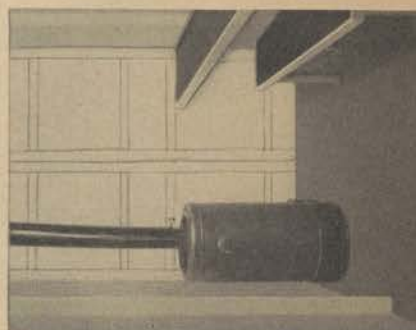


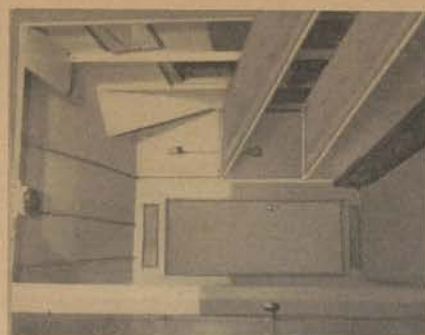
Figure 1. Derrick, floating Diesel, steel, 30-ton, design 314, knock-down. (See note, par. 7 M.)



GALLEY AFT VIEW



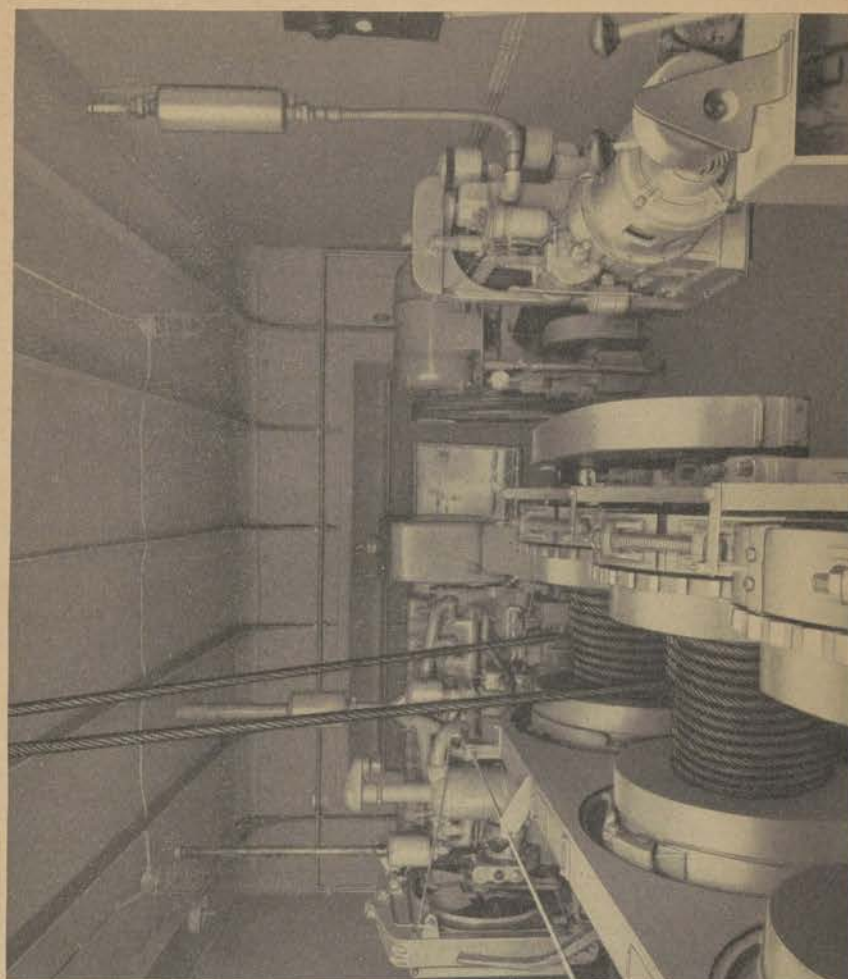
GALLEY FORWARD VIEW



CREW QUARTERS, BERTHS



CREW QUARTERS, CLOSET



MACHINERY IN DECK HOUSE

Figure 2. Arrangement of interior of deck house, barge derrick.

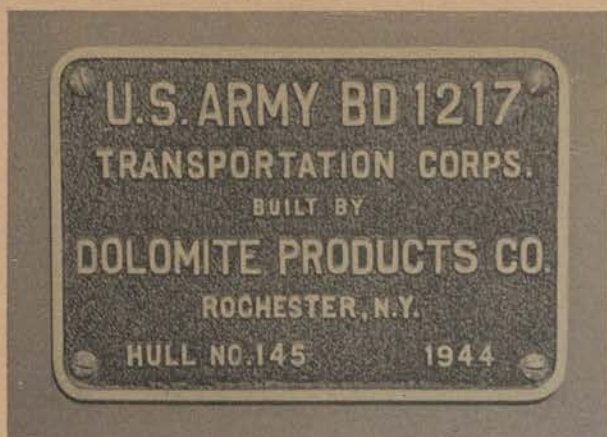


Figure 3. Name plate, barge derrick.

for the hoist drums friction clutches is provided by a Caterpillar diesel engine. The engine mounting rails are fixed to foundation girders at the entrance to the galley and directly in front of the windows at the aft end of the deck house. Suf-

ficient space is provided between the hoist and the engine to permit working on the engine and to provide clearance for cranking the starting engine which is mounted on the side of the main engine. The main engine radiator is against the side of the wall separating the galley from the engine room, and is identified by the name Caterpillar. A day fuel tank is mounted on the opposite end of the engine. The main engine and starting engine are not provided with a nameplate. The main engine is identified by the markings on the side of the radiator (fig. 4), which give the name, series and serial numbers of the engine.

(2) *Air compressor.* This unit is V-belt driven from the main engine drive shaft and is directly forward of the main generator. The compressor supplies air under pressure for pneumatic operation of the hoist drums friction clutches. The nameplate for the compressor is located on the lower part of the crankcase housing, starboard side near the chain drive of the hoist.

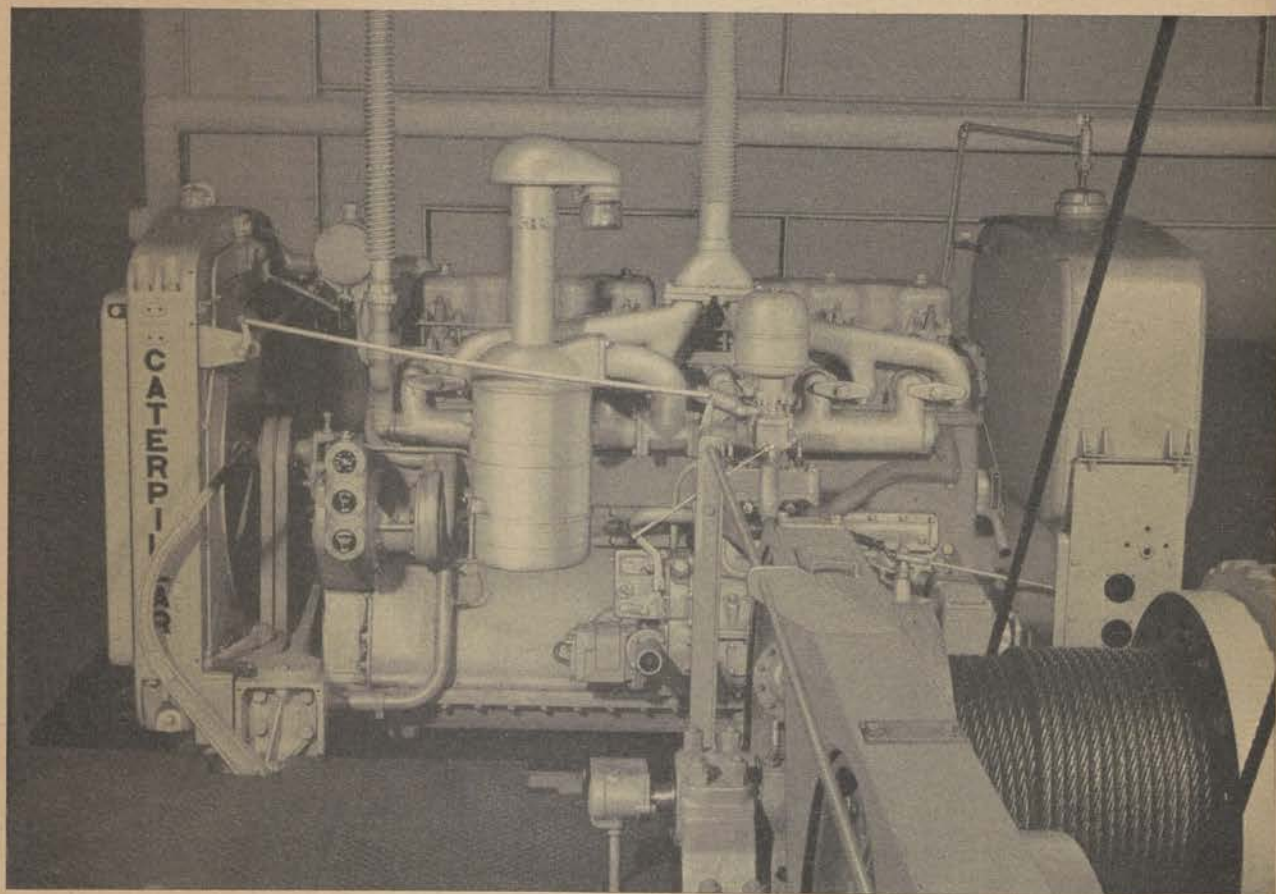


Figure 4. Main engine.

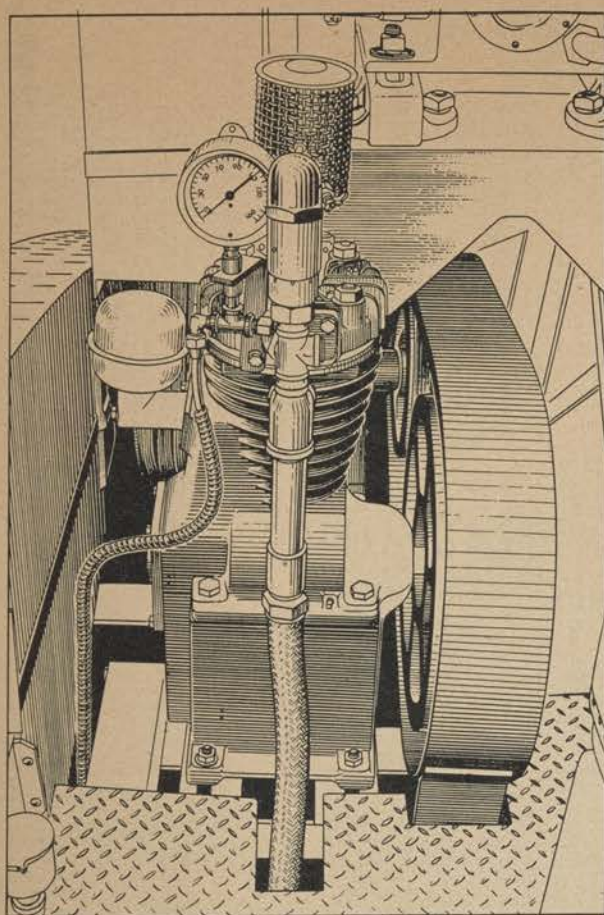


Figure 5. Air compressor.

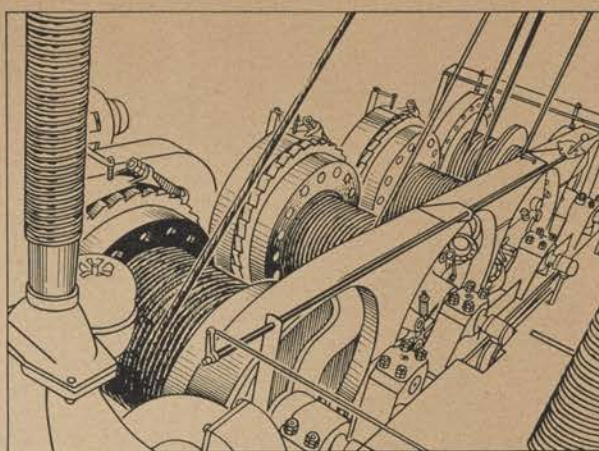


Figure 7. The hoist.

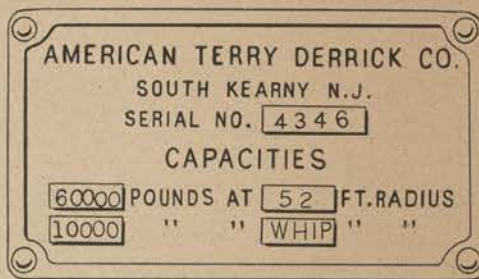


Figure 8. Nameplate, derrick.

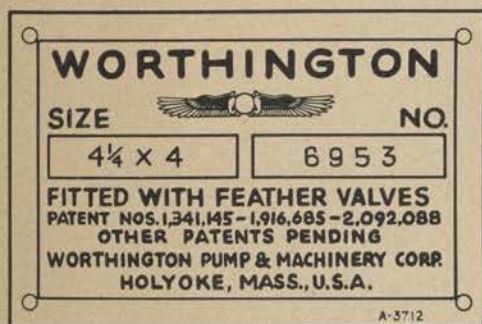


Figure 6. Nameplate, air compressor.

(3) *Hoists.* The hoist is composed of five drums, with two drums for swinging the boom mounted adjacent to each other at the forward end of the hoist. The hoist is mounted on the center line of the barge and is located inside the deck house. Two control stands for hoist operation are stationed at the forward end of the

deck house, permitting an unobstructed view of the working arc of the boom and hook. Cables from the hoist are brought out to the boom through an aperture in the deck house roof. No nameplate is provided for the equipment.

(4) *Derrick (fig. 1).* The derrick is composed of an A-frame with back legs which straddle the deck house, a 70-foot boom which pivots on the boom seat located directly in front of the deck house, and four girders on the deck supporting the boom assembly. The boom is raised by a nine-part topping line and the load block by a seven-part load line. Swinging is accomplished by two five-part vang lines. The nameplate for the derrick is located on the boom seat in front of the pivot. (See fig. 8.)

c. *AUXILIARY EQUIPMENT.* The auxiliary equipment includes the main generator, the auxiliary diesel generator set, the capstan, and the portable deck pump.

(1) *Main generator.* The main generator is mounted on a bracket located at the aft end of the deck house against the wall separating the engine room from the crew's quarters. It is belt-driven by the main engine, the belts being covered by a removable guard provided with a handle. A lifting bolt is fitted at the top of the generator cast-

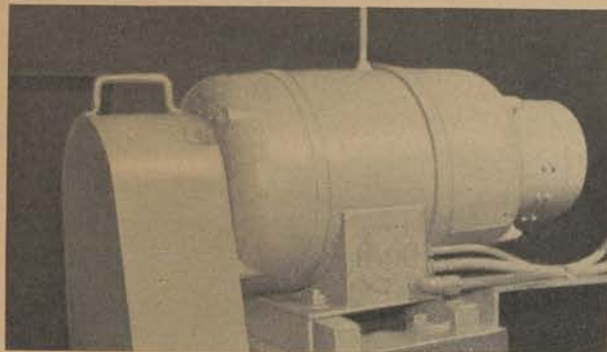


Figure 9. Main generator.

ing. The nameplate for the generator (fig. 10) is located at the center of the generator casting in front of the lifting bolt. (See fig. 9.)

AMERICAN <i>Custom Built</i> MOTORS			
CHICAGO, ILLINOIS			
K.V.A. 20	VOLTS 120-208	R.P.M. 1200	
AMPS. 55.5	MODEL 1404-6	TYPE O.G.	
PHASE 3	CYCLE 60	SERIAL # 15590	
P.F. 0.80	TEMP. 50 °C	RATING CONT.	
EXCITER VOLTAGE 125	FIELD AMPS 0.8		

Figure 10. Nameplate, main generator.

(2) *Auxiliary Diesel generator set.* An auxiliary Diesel-driven generator provided for the barge derrick supplies electrical power for lighting and operation of electrical accessories in the galley. The Diesel generator set is located in the

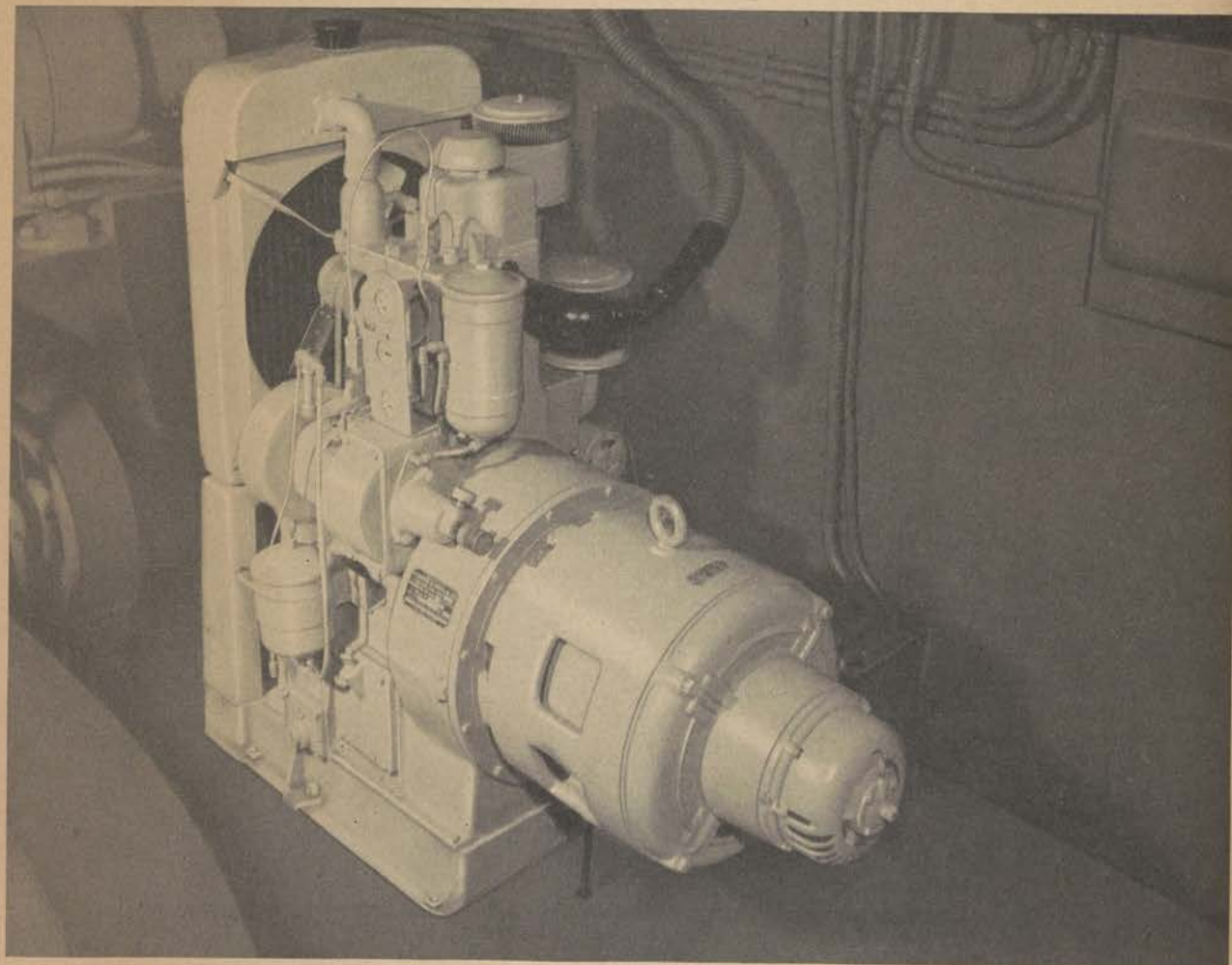


Figure 11. Auxiliary Diesel generator set.

deck house against the bulkhead separating the engine room from the crew's quarters.

A nameplate, identifying the engine, is secured to the flywheel housing on the left side of the engine. The generator nameplate is located on the motor casting in front of the lifting eyebolt.

The 12-volt starting battery for the auxiliary Diesel engine is located between the engine and the engine room bulkhead.

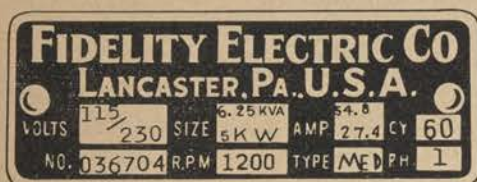
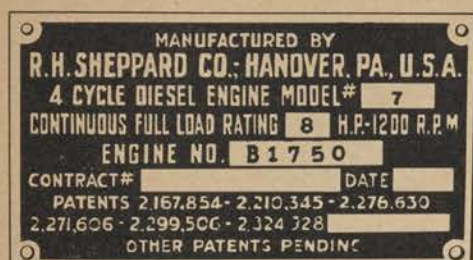


Figure 12. Nameplates, auxiliary Diesel engine (upper) and generator (lower).

(3) *Capstan.* (a) An electrically operated capstan of the single head type is located forward of the barge on the port side. A starting switch is secured to the deck adjacent to the capstan.

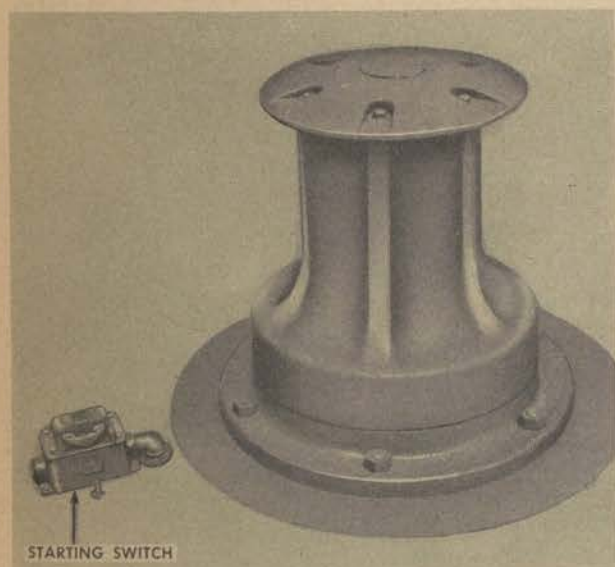


Figure 13. Capstan and starting switch, cover removed.

(b) The electric motor and reduction gearing which transmit motion to the capstan are located below deck, and are accessible through the hatch cover on the port side of the deck. The electrical switch box and brake used in conjunction with the capstan operating system are shown in figure 14.

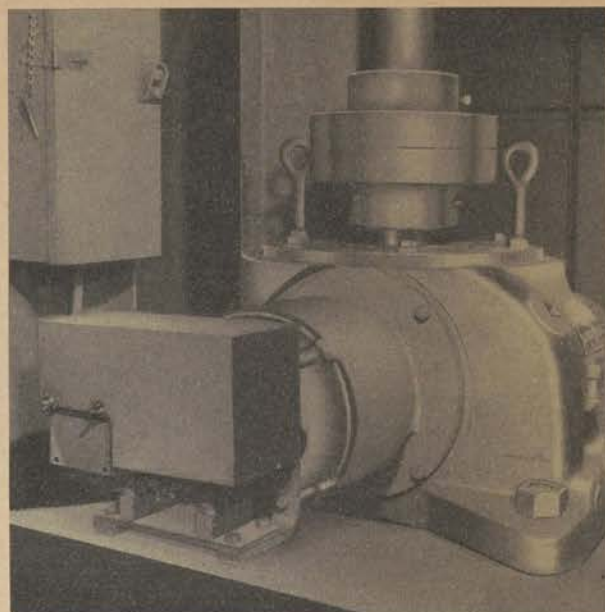


Figure 14. Capstan motor, drive and switch box.

(c) A nameplate for the capstan drive is secured to the reduction gear housing casting on the starboard side. The motor nameplate is attached to the starboard side of the motor frame.

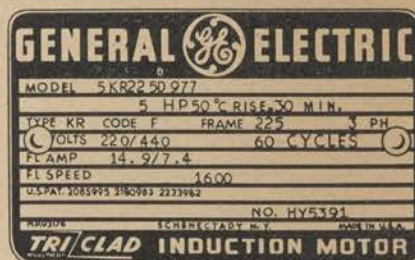


Figure 15. Nameplates, capstan drive and motor.

(4) *Portable deck pump.* An electrically operated pump for the purpose of filling ballast tanks, washing the decks, or for any other utility, is pro-

vided outside the deck house. The pump is mounted on wheels and may be moved to any convenient location on the barge deck. The pump

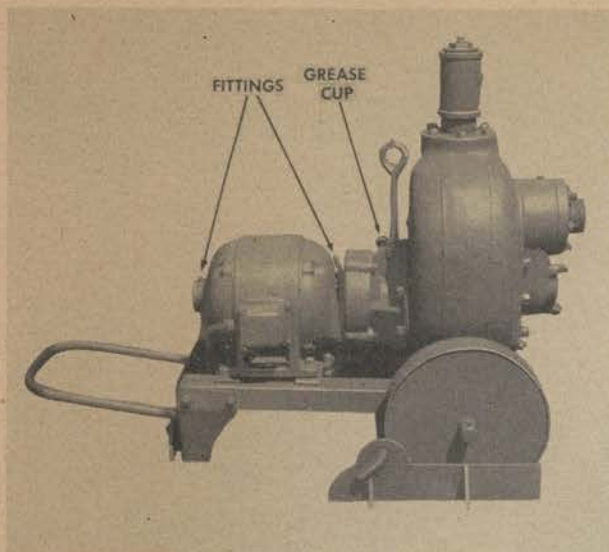


Figure 16. Portable deck pump.

is identified by a nameplate located at the bottom of the carriage frame on the side of the handles. The electric motor nameplate is secured to the frame of the motor. Pump can be operated only when the main generator is in operation.

d. DIFFERENCE IN MODELS. An additional platform has been added to the aft side of the A-frame on some models. This platform is located higher than the forward A-frame platform and is used for access to the A-frame topping block. (See fig. 132.)

4. Data

a. GENERAL DATA. (1) Barge.

Crew	4 men.
Weight, over-all, fully equipped	225 tons.
Weight, over-all, fully equipped export	227.5 tons.
Draft, on salt water, fully equipped	4.5 ft.
Barge length, over fenders	61 ft. 8 in.
Barge width, over fenders	43 ft. 8 in.
Barge depth	9.6 ft.
Number of barge sections	8.

(2) Barge and derrick.

Length, boom extended	104 ft.
Height, deck to top of A-frame	45 ft.
Height, above water line, boom topped	77.5 ft.

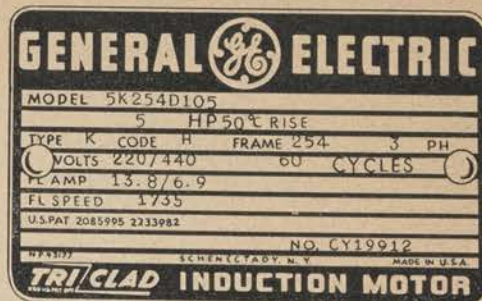


Figure 17. Nameplates, deck pump and motor.

e. SAFETY FEATURES. The following safety features are provided for the protection of the barge and its crew:

- Life rings with water lights.
- Jacket life preservers.
- Boat, which can be used as a life boat.
- Hand fire extinguishers.
- Deck pump and hose for fire fighting.
- Stanchions and guard chain around barge rail at deck house.
- Grab rail around deck house.
- A-frame platform rail.

(3) *Main engine.*

Make	Caterpillar Diesel.
Model	D-13000.
Type	6-cylinder inline.
Fuel	Diesel fuel oil.
Cooling	Fresh water, radiator cooled, V-belt driven fan. Circulation by centrifugal pump.
Starting system	Auxiliary gasoline engine mounted on right side of Diesel. (See par. 16.)
Ignition system	Compression ignition, no spark plugs.
Clutch	Plate type, flywheel, mounted.
Crankshaft rotation	Counterclockwise facing flywheel end.
Compression ratio	15.7 to 1.
Piston displacement	1246 cu. in.
Bore and stroke	5¾ by 8 in.
Cycle of operation	4-stroke cycle.
Firing order	1-5-3-6-2-4.
Lubrication	Forced feed by gear pump to all main bearings and connecting rod, piston pins and rocker arm bearings, camshaft and auxiliary drive shaft.
Weight, complete dry with radiator (starting engine excl.).	6687 lb.
Length (from radiator to face of clutch)	87½ in.
Width	42¾ in.
Height	60 in.
Number of main bearings, removable shell	7.
Diameter of main bearings	3¾ in.
Width of main bearings in inches: front to rear	2 ¹¹ / ₁₆ , 2, 2, 4 ³ / ₈ , 2, 2, 4 ¹⁵ / ₃₂ .
Diameter and width of crank-pin bearings	3 ⁵ / ₈ by 3 ³ / ₁₆ in.
Journal width	2 ³ / ₃₂ in.
Diameter and width of piston pin bearing in connecting rod.	2 ³ / ₈ by 2 ¹ / ₁₆ in.
Diameter and width of piston pin bearing in piston	2 ³ / ₈ by 2 ³⁵ / ₆₄ in.
Connecting rod length (center to center)	15 in.
Intake valve head diameter	2 ⁵ / ₁₆ in.
Intake valve head lift	0.468 in.
Intake valve head opens	12° B. T. C.
Intake valve head closes	30° A. B. C.
Exhaust valve head diameter	2 ⁵ / ₁₆ in.
Exhaust valve head opens	50° B. B. C.
Exhaust valve head closes	22° A. T. C.

(4) *Starting engine.*

Make	Caterpillar.
Model	2-cylinder, vertical type.
Fuel	Down draft carburetor, gasoline.
Cooling	Fresh water from Diesel.
Starting system	Hand crank.
Ignition	Eisemann R C-2Q magneto.
Drive	By disc clutch and helical gear to Diesel engine flywheel.
Bore and stroke	3 ⁵ / ₈ by 4 in.
Weight	350 lb.

(5) *Hoist.*

Make	American Hoist & Derrick.
Model	No. 140.
Type	Two control stations.
Number of drums	5 (3 single, 1 twin).
Drums, single:	
Diameter	16 in.
Length between flanges	19 in.
Flange diameter	30 in.
Width	36 in. diam. by 6 in.
Drums, twin:	
Diameter	16 in.
Length between flanges, each half	10 $\frac{7}{8}$ in.
Flange diameter	30 in.
Width	38 in. diam. by 4 in.
Controls	Friction clutch, outside band, air operation, 30-in. diam. by 4-in. width.
Air valve	Westinghouse Flexair, Type A-2F.
Drive	Chain drive, Diesel to back gear driving drums.
Brakes	Outside band, manual operation (foot pedal). 3 single drums—36-in. diam. by 6-in. width. 1 pair twin drums—38-in. diam. by 4-in. width.
Lines	9 part topping line, 20-in. sheaves. 7 part load line, 20-in. sheaves, 24-in. boom load line sheaves. 5 part vang lines, 16-in. sheaves.

Reduction ratios

Diesel engine drive shaft pinion to hoist intermediate

 gear drive 3.64 to 1.

Intermediate gear to drum 5.33 to 1.

Overall reduction, diesel engine to drum 19.40 to 1.

(6) *Air compressor.*

Make	Worthington Pump and Machinery Corp.
Model	S-14.
Type	VS.
Size	4 $\frac{1}{4}$ by 4 in.
Lubrication	Built-in oil pump.
Cooling	By radiation through fins cast integral with cylinder head.

(7) *Derrick.*

Make	American Hoist & Derrick.
Model	No. 140—Stiff Leg.
Type	A-frame construction. Built up of A head, 2 side members cross brace, tie rods, and two back legs, each of 2 sections.
Boom length	Foot pin to main hoist sheaves—70 ft. Foot pin to whip hoist sheaves—71 ft 3 in.
Net shipping weight	450,000 lb.
Export shipping weight	455,100 lb.

(7) *Derrick—Continued*

Sheaves:

Topping block	20 in. diam.
Boom load line	24 in. diam.
Vang line block	16 in. diam.

Swivel block sheaves:

Topping and load	20 in. diam.
Vang line	16 in. diam.

Cable sizes—6 x 19 I. P. S.:

Topping line	9 part, $\frac{7}{8}$ in. diam.
Load line	7 part, $\frac{3}{4}$ in. diam.
Vang line	5 part, $\frac{5}{8}$ in. diam.
Whip line	Single, $\frac{3}{4}$ in. diam.

Cable lengths:

Topping line	700 ft.
Load line	700 ft.
Vang line (port and starboard each)	550 ft.
Whip line	250 ft.

(8) *Main generator.*

Make	American Custom Built.
Model	140-4-6.
Type	O G.
Frequency	60-cycle.
Phase	3-phase.
Power factor	.80
Power output	20 kwa.
Voltage	120-208 a-c.
Rpm	1200.

(9) *Auxiliary Diesel engine.*

Make	Sheppard Diesel.
Model	No. 7.
Type	Single cylinder.
Fuel	Diesel fuel oil.
Cooling	Fresh water, radiator cooled, V-belt driven fan. Circulation by centrifugal pump.
Starting system	12-volt, Autolite cranking, motor model MBJ 410 S.
Battery	12-volt, Exide, type 6XHG-13 Cat. No. 27450. 100 amp-hr capacity.
Ignition system	Compression ignition, no spark plugs.
Crankshaft rotation	Counterclockwise facing flywheel end.
Bore and stroke	4 in. by 5 in.
Cycle of operation	4-stroke cycle.
Lubrication	Full pressure, force feed.
Generating system	Engine driven by V-belt Autolite model GCK 4805A provided with generator regulator with over-charge cut-out.
Weight, complete dry, with standard equipment	1,100 lb.
Length with generator over-all	49 in.
Width, over-all	29 in.
Height, over-all	49 in.

- (9) *Auxiliary Diesel engine*—Continued
- | | |
|---|---------|
| Number of main bearings (removable shell) | 2 |
| Diameter main and crank pins | 2¾ in. |
| Connecting rod bearing, diameter | 2¾ in. |
| Connecting rod bearing, length | 2 in. |
| Connecting rod length (center to center) | 10⅞ in. |
- (10) *Auxiliary Diesel generator.*
- | | |
|------------------|--|
| Make | Fidelity Electric Co. |
| Model | Frame 802 type LAED. |
| Type | Direct coupled revolving field, a-c generator with built-in exciter. |
| Frequency | 60-cycle. |
| Phase | Single phase. |
| Power factor | 0.80. |
| Power input | 6.25 kva. |
| Voltage | 115 a-c. |
| Rpm | 1200. |
| Starting battery | 12-volt. |
- (11) *Electric capstan.*
- | | |
|------------------|---|
| Make | Link Belt Co. |
| Model | No. 10. |
| Type | Single head. |
| Capacity | Capstan exerts a line pull of 5,000 lb with a line speed of 20 ft. p. m. |
| Brake | General Electric solenoid operated model CR 9516-460.
General Electric model SKR 225 D 977, type KR, 60-cycle, 5-hp. |
| Magnetic control | Allen Bradley Bulletin No. 713, marine type starter equipped with 2, Bulletin 815, overload relays, ITE circuit breaker and Bulletin 709 solenoid type across the line starter. |
- (12) *Auxiliary electric pump.*
- | | |
|-------|---|
| Make | Construction Machinery Co. |
| Model | Dual Prime 20 ME. |
| Motor | General Electric Model SK254D105-5-hp-1800 rpm 220 volts, 3-phase, 60-cycle ball bearing, splash proof. |
- (13) *Electric refrigerator.*
- | | |
|-------|---------------|
| Make | Westinghouse. |
| Model | No. L-7. |
- (14) *Galley range.*
- | | |
|------|---|
| Make | Swartzbaugh Manufacturing Co.
Everhot Electrical Rangette. |
|------|---|
- (15) *Floodlights.*
- | | |
|---------|--------------------------|
| Make | General Electric. |
| Type | L-49 Novalux Floodlight. |
| Catalog | A-44G 43. |
- (16) *Oil burner.*
- | | |
|-------|--------------------|
| Make | Evans Products Co. |
| Model | Evanoil No. 113. |

(16) *Oil burner*—Continued

Weight	110 lb.
Heat control	Detroit Lubricator Co.

b. CAPACITIES. (1) *Barge tanks.*

Diesel fuel oil	3,494 gal.
Fresh water	554 gal.
Sea water in galley	30 gal.
Sea water in closet	30 gal.
Lubricating oil	60 gal.
Gasoline	50 gal.
Kerosene	50 gal.

(2) *Main engine (Caterpillar).*

Day fuel tank	60 gal.
Lube oil in crankcase	34¼ qt.
Water in radiator	12½ gal.
Cooling water in engine	16½ gal.
Total cooling water capacity	29 gal.
Oil in air cooler	4¼ qt.
Oil in fuel injection pump housing	1 pt.

(3) *Starting engine for main engine.*

Gasoline tank on engine	1 gal.
Oil in air cleaner	½ qt.
Lube oil in crankcase	2¼ qt.
Transmission	1½ qt.

(4) *Auxiliary Diesel (Sheppard).*

Diesel fuel oil tank	6 gal.
Lube oil in crankcase	7 qt.
Lube oil absorbed by filter	1 qt.
Total cooling water capacity	20 qt.
Water in radiator	12 qt.
Cooling water in engine	8 qt.

(5) *Electric capstan drive.*

Gear case	4 gal.
-----------	--------

(6) *Air compressor.*

Lube oil in crankcase	5 qt.
-----------------------	-------

(7) *Oil burner.*

Fuel oil in tank	3½ gal.
------------------	---------

c. PERFORMANCE DATA. (1) *Derrick.*

Main hook:

Maximum load	30 tons.
At 52-ft radius	30 fpm.
Line pull	14,000 lbs.
Lift height, above water level at 52-ft radius	58 ft.
Operating radius, maximum	52 ft.
Operating radius, minimum	10 ft.

Whip hook:

Maximum load at 52 ft. radius	5 tons.
Operating radius, maximum	60 ft.
Operating radius, minimum	10 ft.

Boom:

Maximum speed hoist cable (main hook)	50 fpm.
Maximum speed hoist cable (whip hook)	180 fpm.

(2) *Main engine (Caterpillar).*

Brake horsepower	130 at 850 rpm.
Governed speed:	
Low idle	425 rpm.
High idle	1,055 rpm.
Full load	950 rpm.
Fuel consumption (full load, idle 550 rpm)	15.75 lb per hr.
Full load speed range	550 to 1,000 rpm.

(3) *Starting engine for main engine.*

Brake horsepower	24 at 2,700 rpm.
Cranking speed (high)	250 rpm.
Cranking speed (low)	85 rpm.
Governed speed:	
High idle	2,300 rpm.
Low idle	800 rpm.

(4) *Auxiliary Diesel engine (Sheppard).*

Brake horsepower, full load	8 at 1,200 rpm.
Fuel consumption (full load at 1,200 rpm)	0.52 lb per bhp-hr.
Governed speeds	Governed at all operating speeds.

d. CLEARANCES, TOLERANCES, AND ADJUSTMENT DATA. (1) *Hoist.*

Drum shaft bearings	0.005 in.
Friction clutches—clearance band and drum	0.010 in.
Brakes—clearance band and drum	0.010 in.

(2) *Main engine.*

Crankshaft diameter:	
Main bearing journals	3.749 to 3.750 in.
Connecting rod bearing journals	3.624 to 3.625 in.
Main bearing clearance	0.004 to 0.006 in.
Connecting rod bearing clearance	0.0045 to 0.006 in.
Piston pin bushing bore	2.3760 to 2.3765 in.
Piston pin bore (in piston)	2.3754 to 2.3757 in.
Piston pin diameter	2.3747 to 2.3750 in.

Piston rings:

	Gap	Side clearance
Top	0.015 to 0.030 in.	0.003 to 0.0043 in.
2d and 3d	0.020 to 0.030 in.	0.003 to 0.004 in.
Oil control	0.20 to 0.030 in.	0.0015 to 0.003 in.

Valves:

	Stem diameter	Face angle	Tappet clearance
Inlet	0.493 in.	45°	0.012 in. hot.
Exhaust	0.492 in.	45°	0.012 in. hot.

Valve stem clearance in valve stem bushing:

Inlet	0.005 to 0.007 in.
Exhaust	0.006 to 0.008 in.

Compression release clearance 0.025 to 0.030 in.

Torque wrench tension:

Connecting rod bolts	1,500 in-lb.
Cylinder head bolts:	
7/8 studs	2,000 in-lb.
5/8 studs	700 in-lb.

(2) *Main engine—Continued*

Main bearing cap stud nuts:

7/8 studs..... 4,500 in.-lb.

5/8 studs..... 700 in.-lb.

Lubricating oil pressure (engine at normal speed)..... 30 lb.

Adjust by means of oil pressure relief valve.

Cooling water temperature..... 160° F. to 190° F.

Fuel pressure..... Instrument must indicate NORMAL.

(3) *Starting engine for main engine.*

Crankshaft diameter:

Main bearing journals..... 2.1243 to 2.1250 in.

Connecting rod bearing journals..... 1.999 to 2.000 in.

Main bearing clearance..... 0.002 to 0.0037 in.

Connecting rod bearing clearance..... 0.0025 to 0.0035 in.

Piston pin bushing bore..... 1.0943 to 1.0946 in.

Piston pin bore (in piston)..... 1.0939 to 1.0943 in.

Piston pin diameter..... 1.0933 to 1.0935 in.

Piston rings:

	<i>Minimum gap</i>	<i>Side clearance</i>
Compression.....	0.010 in.	0.0015 to 0.003 in.
Oil control.....	0.010 in.	0.001 to 0.0025 in.

Valves:

	<i>Stem diameter</i>	<i>Face angle</i>	<i>Tappet clearance</i>
Inlet and exhaust.....	0.371 to .372 in.	45°	0.008 in. hot.

Valve stem bushings—ream..... 0.374 to 0.375 in.

(4) *Auxiliary Diesel engine (Sheppard).*

Crankshaft diameter:

Main bearing journals..... 2.7490 to 2.7495 in.

Connecting rod bearing journals..... 2.7490 to 2.7495 in.

Main bearing clearance..... 0.002 to 0.004 in.

Connecting rod bearing clearance..... 0.002 to 0.004 in.

Piston pin bushing bore..... 1.500 to 1.5005 in.

Piston pin bore (in piston)..... 1.500 to 1.5002 in.

Piston pin diameter..... 1.4998 to 1.500 in.

Piston rings:

	<i>Minimum gap</i>	<i>Side clearance</i>
Compression.....	0.010 in.	0.003 to 0.0045 in.
Oil control.....	0.010 in.	0.0015 to 0.003 in.

Valves:

	<i>Stem diameter</i>	<i>Face angle</i>	<i>Tappet clearance</i>
Inlet.....	0.3725 to 0.373 in.	45°	0.010 in cold or 0.007 in. hot.
Exhaust.....	0.3725 to 0.373 in.		

Valve stem bushings—ream..... 0.3755 to 0.376 in.

Lubrication oil pressure..... Must not fall below 20 lb.

Water temperature..... 160° to 190° F.

Ammeter..... 2 amp. on charge side.

Generator and starting motor, bush spring tension..... 42 to 53 oz.

(5) *Air compressor, relief valve*..... Adjust to 75 lb.

(6) *Capstan starting circuit.*

Overload relays..... Adjust to 15 amp.

PART TWO

OPERATING INSTRUCTIONS

Section III. GENERAL

5. Scope

Part Two contains information for the guidance of the personnel responsible for receiving and operating this equipment. The instructions provided are necessary for erecting the floating crane and operating the major and auxiliary equipment aboard it.

Section IV. SERVICE UPON RECEIPT OF EQUIPMENT

6. General

a. The purpose of the "knock-down" construction of the entire barge derrick is to permit disassembly of the unit in accordance with its prefabricated components, when it is required to ship the barge from one theatre of activity to another. This is necessary since the barge is not designed to be towed any great distance on sea. For this reason, the equipment is normally received by the using personnel in a condition of complete disassembly but processed for oversea shipment. Under these circumstances, personnel should refer to paragraph 7 for instructions on the handling of the equipment.

b. It is possible, however, to tow the barge short distances over calm water, and to transfer the equipment from one local activity to another. In this case, using personnel will receive the equipment assembled and should refer to paragraph 8 for information on its preparation for operation.

7. Received Disassembled

a. **ERECTION EQUIPMENT.** (1) *General.* In assembling the barge derrick, the heaviest unit to handle is the No. 7 pontoon or vessel which weighs 40,240 pounds. The second heaviest assembly is the **A-frame** of the derrick which weighs 17,500 pounds and must be raised to straddle the deck house. In order to handle these loads, a crane of at least 20-ton capacity must be available. The main subunits handled during assembly, and their weights, are listed below:

(2) *Weights of main subunits.*

<i>Subunits</i>	<i>Pound</i>
Barge vessel No. 1.....	35,300
Barge vessel No. 2.....	39,503
Barge vessel No. 3.....	37,965
Barge vessel No. 4.....	37,600
Barge vessel No. 5.....	35,940
Barge vessel No. 6.....	37,700
Barge vessel No. 7.....	40,240
Barge vessel No. 8.....	30,947
1 Kedge anchor.....	300
1 Boom seat with fittings attached.....	2,795
2 A-Frame legs, each.....	8,050
1 A-Frame top and fittings.....	7,900
1 Horizontal cross brace with fittings.....	1,300
2 Lower section back legs, each.....	2,660
2 Upper section back legs, each.....	2,660
1 Lower section boom.....	4,650
1 Upper section boom.....	5,295
1 A-Frame top block.....	625
1 Boom end block.....	790
2 Single vang line blocks, each.....	130
2 Double vang line blocks, each.....	175
2 Vang pendants, each.....	115

Subunits	Pounds
2 Vang pendant blocks, each	190
1 Upper load block	680
1 Load block hook and check weight	2,090
1 Whip ball and hook	415
2 A-hitches with pin, each	1,300
2 B-hitches with pin, each	1,300
1 Diagonal forward girder (C-P)	2,600
1 Diagonal forward girder (C-S)	2,600
1 Cross girder (D-P)	2,600
1 Cross girder (D-S)	2,600
1 Engine girder (E)	600
1 Engine girder (F)	800
1 Engine girder (G)	800
1 Engine girder (H)	100
1 Engine girder (J)	600
1 Main generator foundation	200
1 Auxiliary diesel generator foundation	225
1 Center deck house roof section	250
1 Starboard deck house section	12,000
1 Port deck house section	11,000
1 Forward deck house section	700
1 Aft deck house section	2,000
2 Forward roof sections of deck house	1,300
1 Tie girder	400
1 Aft roof section of deck house	2,000
1 Main engine with air compressor	11,500
1 Hoist with two control stands	14,500
1 Sheppard diesel generator	2,500
1 Main generator	750
1 Deck pump	750
1 Capstan drive and motor	2,000
1 Capstan and shaft	900
1 Refrigerator	225

b. ERECTION SITE. (1) In selecting a site for assembling the barge components and erection of the derrick, make sure sufficient space is available for unloading the packing cases in which the equipment is shipped. Also take into consideration space requirements for maneuvering a 20-ton crane. It is suggested that an area of 150 by 170 feet be provided for unloading and storing of packing cases, for the erection site, and for operation of the crane, making a total of about 25,000 square feet of space to be provided.

(2) The site selected must border a body of water where a minimum depth of at least 4 feet is available at a distance no greater than 5 feet from the shore.

(3) It is more desirable to assemble the barge sections in water as this avoids the construction of ways and also facilitates the maneuvering of

the individual sections into position. With the sections in water, two men can easily maneuver each section into its correct position. If the sections, which weigh approximately 15 tons each, are assembled on land, it is much more difficult to move them into correct position for matching fixed sockets.

(4) Points to remember in reference to erection site:

(a) Hard, level terrain is desirable.

(b) Nearness to a wooded area from which timber for erection of ways can be obtained.

(c) Accessibility to rail or water transportation.

(d) A source of 110 volts alternating current is obtainable by operating the auxiliary Diesel generator with which the barge is equipped.

(e) A source of compressed air for operation of a pneumatic hammer is available by operating the air compressor furnished with the barge equipment.

c. LAUNCHING WAYS. (1) Launch the barge broadside or along its longer dimension. A general view of a suggested type of launching ways is given in figure 18.

(2) Construct the fixed ways at the proper inclination and carry them far enough below the water surface to permit the barge to float. Provide sliding ways upon which the barge vessels are to be assembled. Provide suitable arrangements for holding the sliding ways in position until the assembled barge is ready for launching. Grease the ways to reduce the friction between the sliding and the fixed sections.

d. IDENTIFICATION MARKINGS. Subunits and structural members used in the erection of the barge derrick and subject to possible error in assembly, are identified by means of a match marking system. These marks are welded on the members by depositing weld metal. Corresponding numbers located on the members to which the foundation girder or structural unit is assembled, indicates how and where a member should be located. It is of extreme importance that original drawings covering the erection procedure be available to facilitate assembly of the barge derrick.

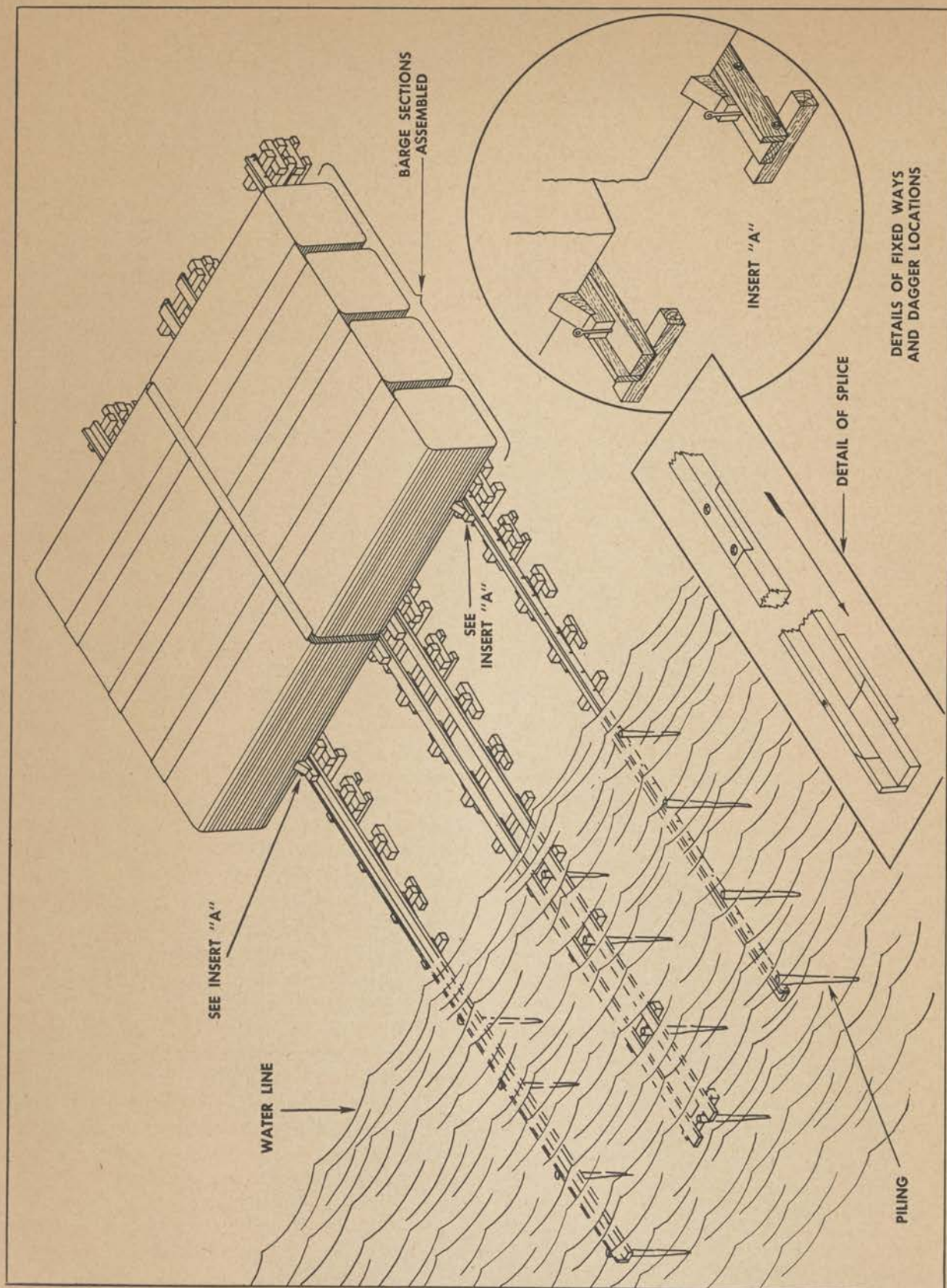


Figure 18. Typical construction of launching ways.

(1) *Barge markings.*

Marks	Description	Number of pieces
Vessel 1	Barge section	1
Vessel 2	Barge section	1
Vessel 3	Barge section	1
Vessel 4	Barge section	1
Vessel 5	Barge section	1
Vessel 6	Barge section	1
Vessel 7	Barge section	1
Vessel 8	Barge section	1
Vessel 1 to 106	Sheet piling connections	106
Vessel 107 to 130	Bridging plates	24
Vessel 142 to 143	Bridging plates	4
	Boom foundation	1
Girder A	Diagonal aft girder	1
Girder B	Diagonal aft girder	1
Girder C-P	Diagonal forward girder	1
Girder C-S	Diagonal forward girder	1
Girder D-P	Cross girder	1
Girder D-S	Cross girder	1
Girder E	Engine girder	1
Girder F	Engine girder	1
Girder G	Engine girder	1
Girder H	Engine girder	1
Girder J	Engine girder	1
Foundation K	Outbearing foundation	2
Foundation L	Air tank foundation	2
131	Towing bitts	4
132	Closed chocks	4
133	30 cleats	4
134	Vang pads	4
135	Hatch cover (24 by 30 in.)	1
136	Hatch cover (24 by 30 in.)	1
137	Hatch cover (26 by 36 in.)	1
138	Capstan and shaft	1
139	Anchor	1
140	Snatch block pad	1
141	Snatch block	1
144	2-in. gooseneck vents	16
145	3-in. check vent	1
146	14 ft. dory	1
147	Jacob's ladder	1
148	End stanchions	6
149	Single stanchions	12
150	Chain (3 lengths)	

(2) *Crane and equipment markings.*

1	Engine and winch	2
2	A-leg hitches with pins	2
3	Back leg hitches	2
4	A-frame leg	1
5	A-frame leg	1
6	A-frame top and fittings	1
7	Horizontal cross brace	1
8	Lower back legs	2
9	Upper back legs	2

Marks	Description	Number of pieces
10	Tie rods	2
11	Ladder section	2
12	Ladder section	1
13	Platform brackets	2
14	Platform	1
15	Platform guard rail	1
16	Lower section—boom	1
17	Upper section—boom and fittings	1
18	A-frame top block	1
19	Boom end block	1
20	Single vang lead blocks	2
21	Double vang lead blocks	2
22	1½ in. by 10 ft. 0 in. vang pendant	2
23	Vang pendant block	2
24	Upper load block	1
25	Load block—hook and weights	1
26	Downhaul ball and hook	1
27	Searchlights	4

e. ERECTION SEQUENCE. (1) The manner in which the barge derrick is assembled is such that no division into major assemblies is possible; that is, the erection of the barge vessels with deck house, complete, or derrick, complete, cannot be performed. Assembly of major components overlap and it is necessary to partially assemble one system, start assembly of another component, and then return to the completion of the first. The advantage of this system is that the crews can be organized to work on different assemblies simultaneously.

(2) The order of assembly procedure to be followed in erection of the barge is listed below:

(a) Assemble the eight barge vessels.

(b) Lay down the derrick, hoist, and machinery foundations. Install bridging plates.

(c) Erect the starboard, port, aft, and forward sections of the deck house, leaving off the roof sections. Install ridge girder for support.

(d) Through the roof opening, install the hoist, main engine, main generator, auxiliary Diesel generator, and air compressor.

(e) Install drives from main engine.

(f) Install the deck house roof sections.

(g) Assemble the A-frame on shore and hoist in position on the barge. Assemble the back legs.

(h) Install the boom on the boom seat.

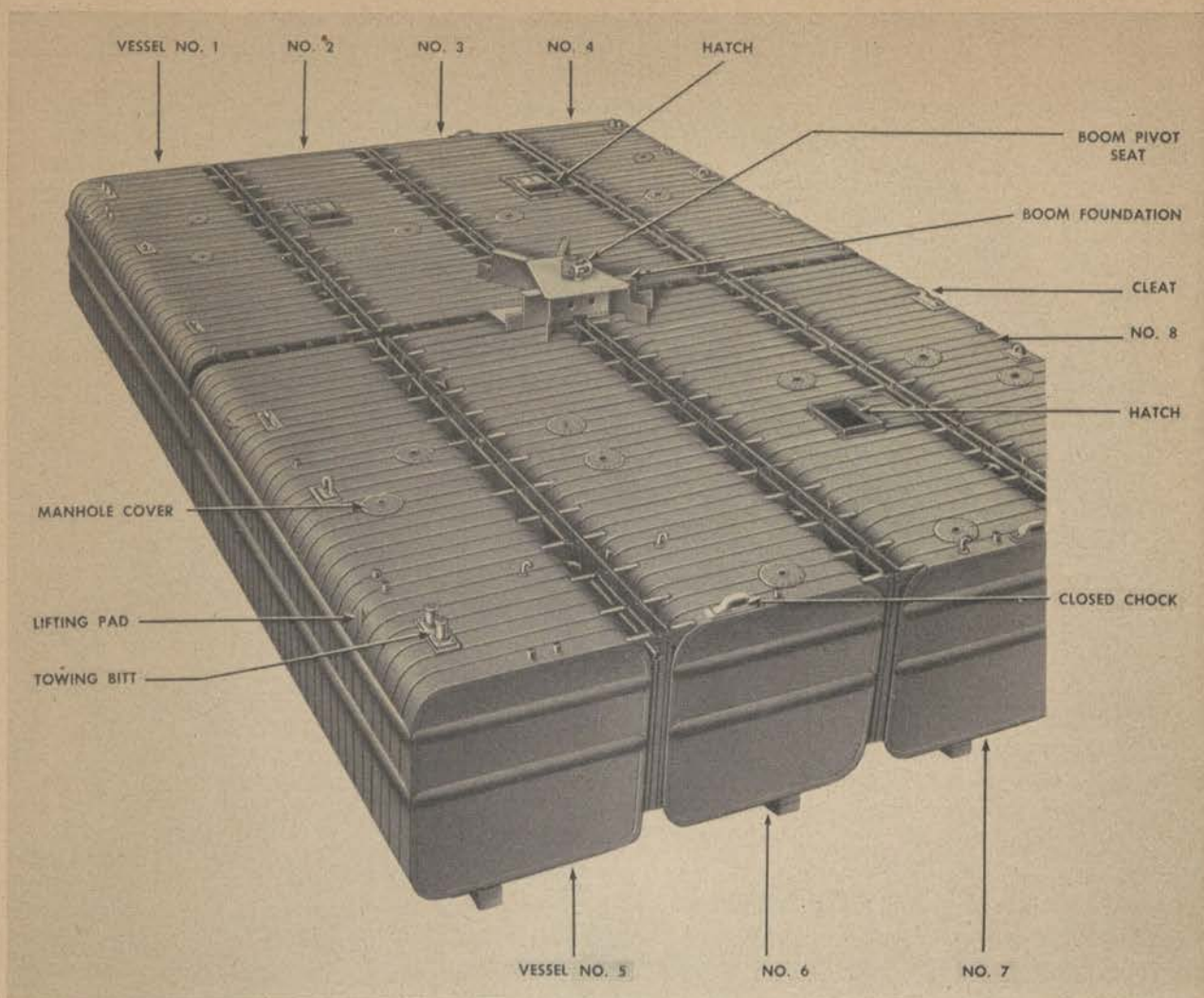


Figure 19. Barge sections assembled, boom foundation in position.

- (i) Install windows and accessories for deck house, galley and crew quarters.
- (j) Install capstan and capstan drive.
- (k) Install piping system and deck house floor plates.
- (l) Install electrical wiring system.
- (m) Install wire rope hawser reel.
- (n) Reeve hoist cables as described in paragraph 42.
- (o) Paint barge.

f. CHECK OF ALL ITEMS. The War Department Shipping Document accompanying the delivery of the barge derrick to the using activity contains a listing of all major and subassemblies comprising the complete equipment. Personnel charged with the receipt of the barge derrick should check these two references in order to insure that the

contents of all packages are in accordance with those specified.

Note. Upon receipt of barge sections, check machinery or equipment which may have been shipped stored in the sections. Remove any such items before assembling the sections.

g. DEPROCESSING. (1) *General.* Uncrate and check items for quantities and apparent damage. Remove waterproof paper, wooden plugs from structural pin holes, and adhesive tape from lubrication fittings. Remove preservative coating from unpainted metal surfaces. Refer to lubrication orders for instructions on lubrications. Refer to applicable paragraph for instructions on servicing items listed in the following paragraphs.

(2) *Diesel engine and starting gasoline engine.* Remove waterproof coverings from exhaust line,

air precleaner, and starting engine air cleaner. Remove waterproof tape from protected lubrication points. Check magneto breaker points. Tighten fan belt. Check crankcase oil level and lubrication points. Service cooling system.

Note. Do not drain anti-freeze solution from cooling system nor remove tag. Check to see that anti-freeze solution has not been lost.

(3) *Auxiliary Diesel generator set.* Remove waterproof covering from exhaust line and air inlet. Service cooling system. Check and tighten fan belt. Remove waterproof tape from protected lubrication points. Check crankcase oil level and lubrication points.

(4) *Air compressor.* Remove waterproof covering from air filter. Remove wrapping from V-belts. Check crankcase oil level.

(5) *Deck pumps.* Remove covering from suction and discharge openings. Remove preservative compound.

(6) *Capstan.* Remove tape from protected lubrication points. Fill gear box to proper level with gear lubricant. Check lubrication fittings.

(7) *Electrical system.* (a) *Motors and generators.* Remove waterproof coverings and adhesive tape from all apparatus. Remove wrappings from V-belts. Remove preservative compound from grooves of pulley sheaves. Carefully lift brushes and remove wrappings from all motor and generator commutators, and allow brushes to fall back into their normal positions. Remove preservative compound from bearings, contactor assemblies, contacts, and thoroughly clean them.

(b) *Control panels.* Remove preservative compound from all surfaces of cabinet, wiring, and exposed metal parts.

(c) *Battery.* The battery tagged "Charged and dry battery" is charged and can be placed in service one hour after adding electrolyte. Battery tagged "Uncharged and moist battery" is not charged; add electrolyte and charge fully.

(8) *Hoist.* (a) *Hoist control stands.* Remove wooden box protection covering air valves and pawl levers. Remove preservatives from foot pedal and pawl lever linkage with an authorized solvent. Clean bearing points and lubricate. Remove adhesive tape from air gage glass.

(b) *Brake and pawl linkages.* Remove pre-

servative from pin and lever bearing points. Clean and lubricate them.

(c) *Friction clutch drums and brake band drums.* Remove preservative compound. Clean drum faces until they are bright and dry.

Caution: Take care not to get any oil or grease on surfaces of either brake bands or clutch friction bands.

(d) *Hoist driving chain.* Remove preservative, clean and lubricate.

(e) *Grease fittings.* Remove preservative compound covering adhesive tape and then remove the protective tape. Clean and lubricate.

(f) *Drum gears and intermediate gears.* Remove preservative, clean and lubricate.

(9) *Derrick.* (a) *Boom pin holes and A-frame leg pin holes.* Remove protecting wood plugs, remove any remaining preservative, clean and lubricate.

(b) *Sheaves.* Remove preservative and clean and lubricate bearing surfaces of pins.

(c) *Cable.* Remove preservative as cable is unreel from shipping reels. Clean and lubricate before reeling onto hoist drums for reeving.

(10) *Galley.* Remove wrappings, adhesive tape, preservative compound, and clean all equipment. Check range burners.

(11) *Berthing.* Remove all wrappings and preservative compound on plumbing fixtures. See that stove pipe on heater is properly connected. Check position of burner rings and the operation of fan and shutter. Adjust draft regulator after chimney is hot.

(12) *Tools.* Remove preservative from unpainted metal parts. Clean and lubricate.

(13) *Spare parts.* Remove shipping containers, but do not remove preservative compound until spare parts are to be used.

h. BARGE ERECTION PROCEDURE. (1) The vessels may be assembled either on land or in water. If assembled on land, prepare ways suitable for launching the complete barge as described in *c* above. The barge is assembled from eight barge sections, or vessels, numbered 1 to 8, inclusive. While it is not important which sections are assembled first, it is necessary that the numbered sections be correctly joined in the arrangement indicated on figure 19. The following sequence is recommended:

First hook-up-----	Vessel No. 2 to vessel No. 3-----	Sides.
Second hook-up-----	Vessel No. 1 to vessel No. 2-----	Sides.

Third hook-up-----	Vessel No. 4 to vessel No. 3-----	Sides.
Fourth hook-up-----	Vessel No. 6 to vessel No. 7-----	Sides.
Fifth hook-up-----	Vessel No. 6 and No. 7 to vessel No. 2 and No. 3-----	Ends.
Sixth hook-up-----	Vessel No. 5 to vessel No. 6-----	Side and end.
Seventh hook-up-----	Vessel No. 8 to vessel No. 7-----	Side and end.

(2) Two lifting eyes are provided on each side of each section and a hoisting bridle assembly is furnished for hoisting the sections in place.

(3) The barge sections, or vessels, are joined together by a series of interlocking connections of the same type as sheet piling. In this method, vertical fixed sockets are welded to the sides of the vessels. On adjacent vessels, the spacing of the sockets is such that with the vessels in proper position, the sockets match in pairs. For each such pair of sockets, a portable interlock connection is provided. One hundred and six interlock connections are furnished for permanent connections. These are narrow vertical sheets, on each edge of which are jaws which engage and interlock with the jaws of the fixed sockets of the vessels. To make the connection, the jaws are engaged at the ends of the strips and the portable connection is slid down between the two fixed sockets. A stop plate runs longitudinally near the bottom of the vessel to hold and align the lower ends of the portable connections. (See fig. 20.) When assembling barge it may be necessary to drive wedges between interlocks and sockets to hold them in place until interlocks are permanently fastened.

CORNER DETAIL

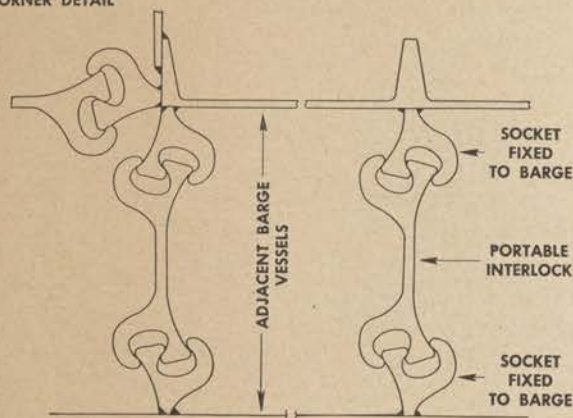


Figure 20. Interlocking system.

(4) Two assembly interlocks are furnished for temporarily holding vessels in position while inserting interlock connections. Each assembly interlock is a section of interlock connection about two feet long. On one end is welded a cap, to

prevent its being inserted too far in the fixed sockets, and a handle, for convenience in carrying, and in pulling it out of the sockets. Insert one assembly interlock at each end of the junction between the sides of vessel No. 2 and vessel No. 3. This aligns the two vessels and holds them in place while the intermediate interlock connections are partially inserted. A hole provided at the upper end of each portable interlock connection is for convenience in hoisting, and in facilitating disassembly.

Note. Before installation, protect all fixed sockets and interlock connections against salt water corrosion by coating them with rust preventive compound.

(5) Hoist each portable connection above, and in line with, its pair of fixed sockets. Engage the jaws of the connection with the jaws of the sockets where the lower end of the connection touches the upper ends of the sockets as shown in figure 20.

Caution: Take care to interlock properly each connection and its sockets exactly in the manner shown in figure 20. If interlock is inserted in the reverse position, it will not only jam but will throw the other sockets out of line.

(6) Slide the connection down between the sockets until it is firmly seated.

Note. Do not lower the portable connections full length until all connections are in place.

After partly inserting the intermediate connections, withdraw the two assembly interlocks and partly insert the last two permanent interlocks. When fully in place, each connection seats on a striking plate mounted on a longitudinal stop plate which lines up all connections. Use a sledge if necessary to drive each connection home against its stop plate.

Note. If interlocks or fixed sockets are damaged in shipment and will not fully engage, drive the interlock down as far as it will go and cut off the projecting end. A minimum of one-third of the length of the connection should be in place before cutting the end. Do not cut more than four connections on any one side of a vessel.

(7) The procedure for connecting the other barge sections to vessels No. 2 and No. 3, by means of portable interlock connections, is similar to that described above.

(8) If the barge is assembled on land, it is not necessary to use the two assembly interlocks to

foundation is provided by tilting brackets which brace the forward and aft diagonal girders.

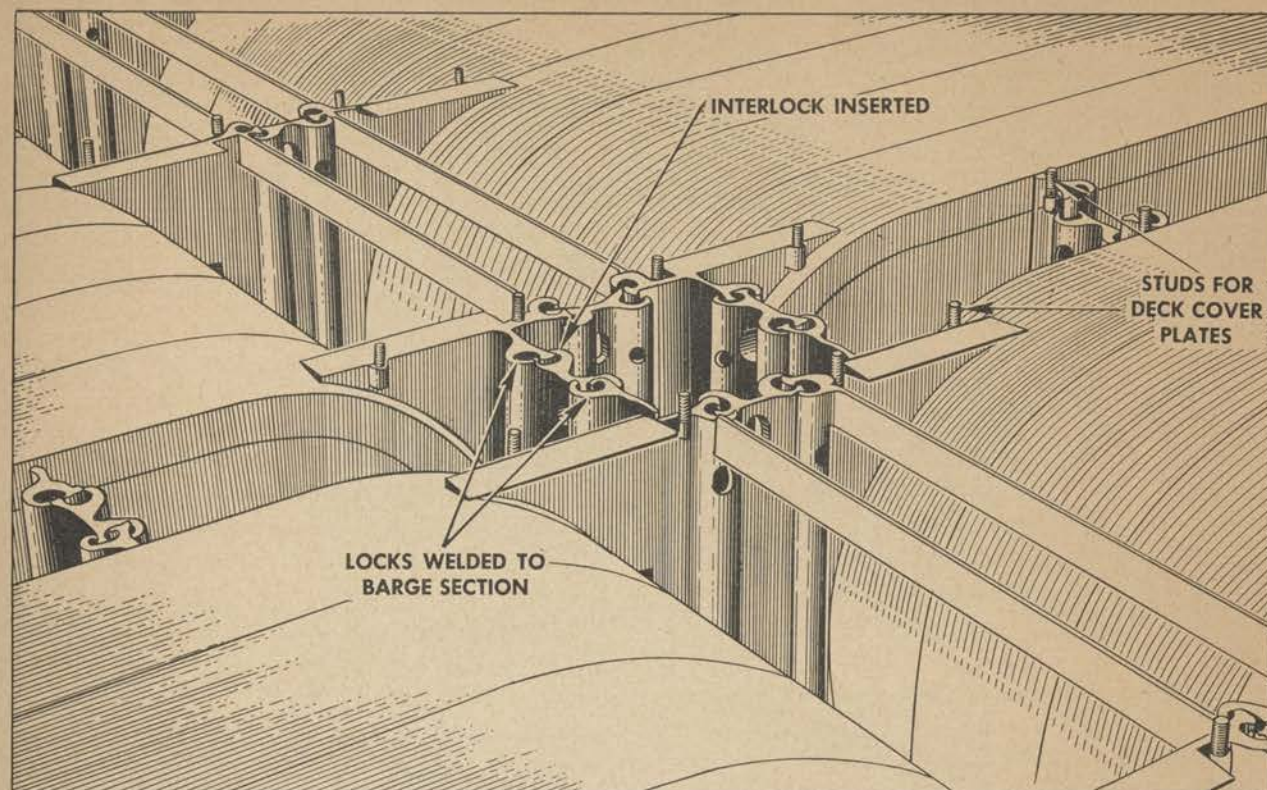


Figure 21. Typical barge section joint with interlocks in place.

hold the vessels in position while placing the intermediate connections.

i. ERECTION OF FOUNDATION AND BRIDGING PLATES. (1) *General.* The foundation girders are attached to the barge by bolting to vertical bolting plates (figs. 22 and 24) which are each 4 inches high by $\frac{1}{2}$ inch thick and are welded to the barge deck on the $\frac{1}{2}$ -inch edge. For the boom foundation, the bolting plates are double parallel plates $\frac{5}{8}$ inch apart. For the diagonal and cross girders, single bolting plates are provided.

(2) *Derrick foundation.* (a) The derrick is mounted on, and attached to, the barge vessels by foundation girders which distribute the weight of the derrick and load evenly over the barge vessels. The boom is pinned to the boom pivot which is supported by the central boom foundation. From the latter foundation, six foundation girders radiate. Four of the girders are diagonal, two forward and two aft. The remaining two cross girders support the two legs of the A-frame. Two back legs are supported on the ends of the aft diagonal girders. Additional stability for the

(b) The boom foundation, on which the boom pivot is mounted, is first lowered into position with its single plate bottom web members fitting between their respective double bolting plates. Bolt the plates and the web together, using galvanized steel bolts, $\frac{3}{4}$ -inch diameter, spaced approximately 4 inches apart. (See fig. 24.)

(c) After the boom foundation is in place, install the diagonal and cross girders (fig. 36) in the following sequence:

- Diagonal aft girders-----A and B.
- Diagonal forward girders----C port and
C starboard.
- Cross girders -----D port and
D starboard.

(d) Derrick foundation girders, port and starboard, are built up with a double web and the bolting plates for these girders are single plate. Lower the girders into position with the double web straddling the single bolting plates. Bolt the double web and the plate together, using galvanized steel bolts, $\frac{3}{4}$ -inch diameter, spaced approximately 6 inches apart. (See fig. 22.)

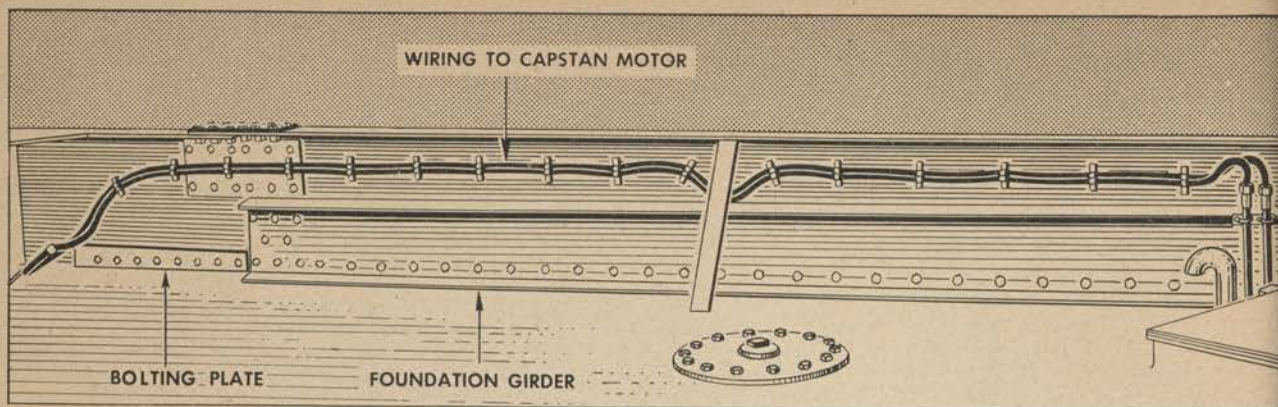


Figure 22. Detail of girder assembly to deck.

(e) One tilting bracket is mounted on the outboard side of the port and starboard aft diagonal girders and two tilting brackets are mounted on each side of the port and starboard forward girders. Secure each tilting bracket to its individual bolting plate, using two $\frac{3}{4}$ -inch-diameter galvanized steel bolts. (See fig. 23.)

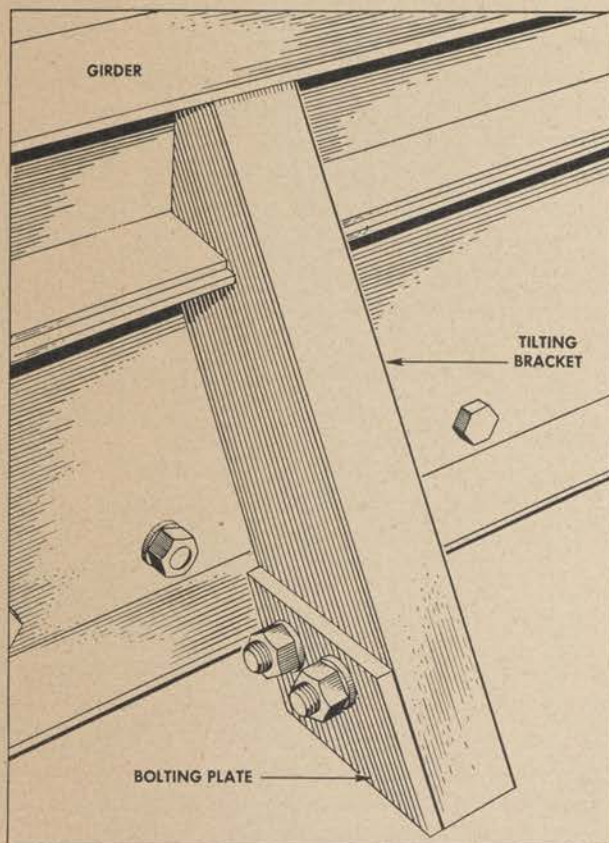


Figure 23. Detail of tilting bracket.

(f) Both the diagonal girders and the cross girders are two members high where they join the boom foundation. Bolt each of these girder web plates to the corresponding boom foundation web plates, using three rows of $\frac{3}{4}$ -inch diameter bolts. Bolt a flange cover plate to the top flanges of both the boom foundation members and the girders at the splice, with double rows of $\frac{3}{4}$ -inch-diameter bolts. (See fig. 24.)

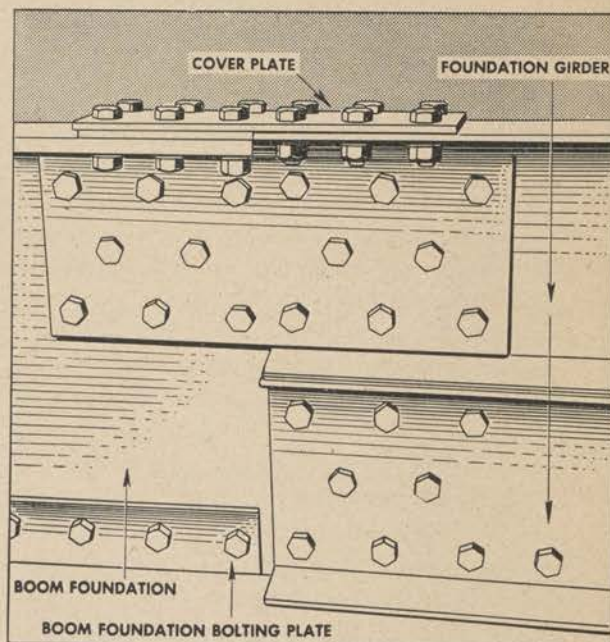


Figure 24. Detail of boom foundation and girder joint.

(g) Three bolting plates are provided at the outboard end of each cross girder and aft diagonal girder for the support of the A-frame and back leg hitches. Bolt the three web members of the

girder ends to their respective bolting plates, with galvanized bolts $\frac{3}{4}$ -inch diameter, spaced approximately 6 inches apart.

(h) Bolt each A-frame hitch to its cross girder

the hoist and engine foundations by bolting the foundation girders to single bolting plates welded to the deck in the same manner that the derrick diagonal girders are bolted in place. Bolt girders

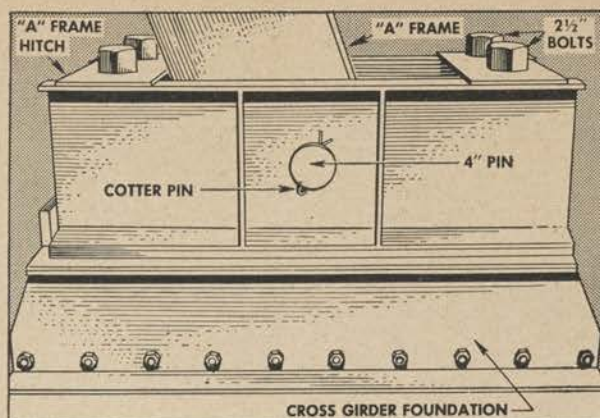


Figure 25. Details of A-frame hitch.

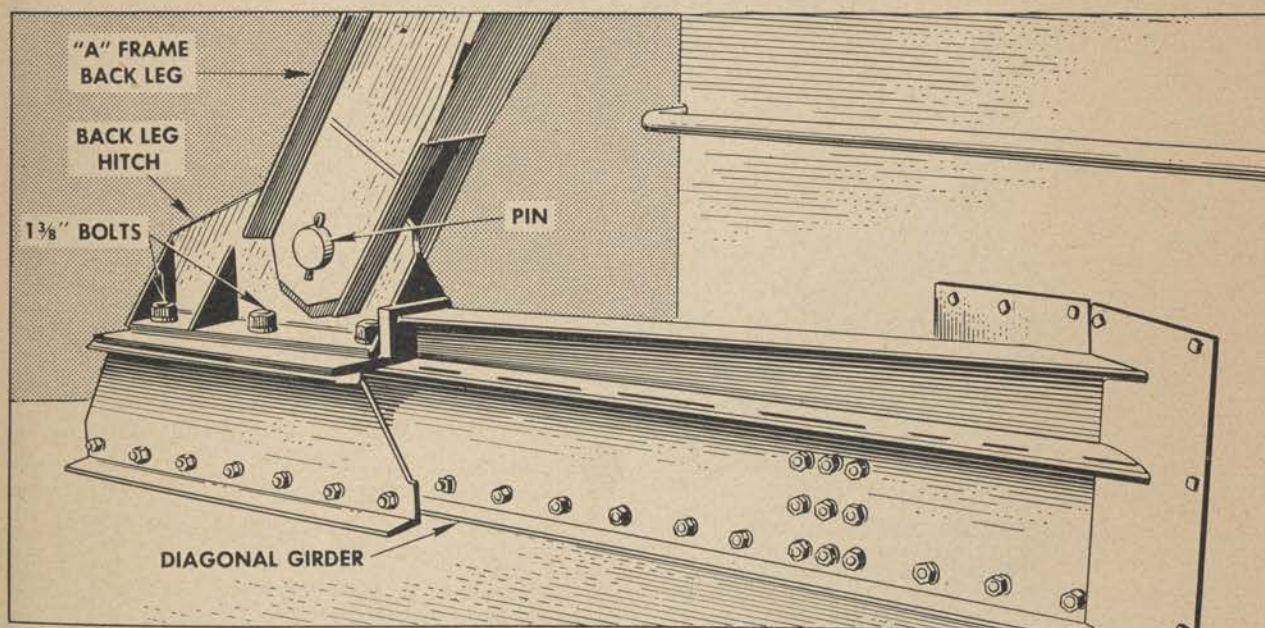


Figure 26. Detail of back leg hitch.

with four $2\frac{1}{4}$ -inch-diameter bolts. (See fig. 25.)

(i) Bolt each back leg hitch to its aft diagonal girder with six $1\frac{3}{8}$ -inch-diameter bolts. (See fig. 26.)

(j) *Vang pads.* Bolt the vang pads into place to the deck, using six 1-inch studs with hexagonal nuts for each pad. (See fig. 27.)

(3) *Hoist and engine foundations.* (a) Install

F, G, H, J and linkage bearing foundations K to their respective bolting places. (See fig. 32.)

(b) Install the air reservoir pieces L by bolting them to their respective bolting plates in the same manner as the hoist and engine foundations are bolted.

(4) *Bridging plates.* Bridging plates are provided for bridging the gap between the barge

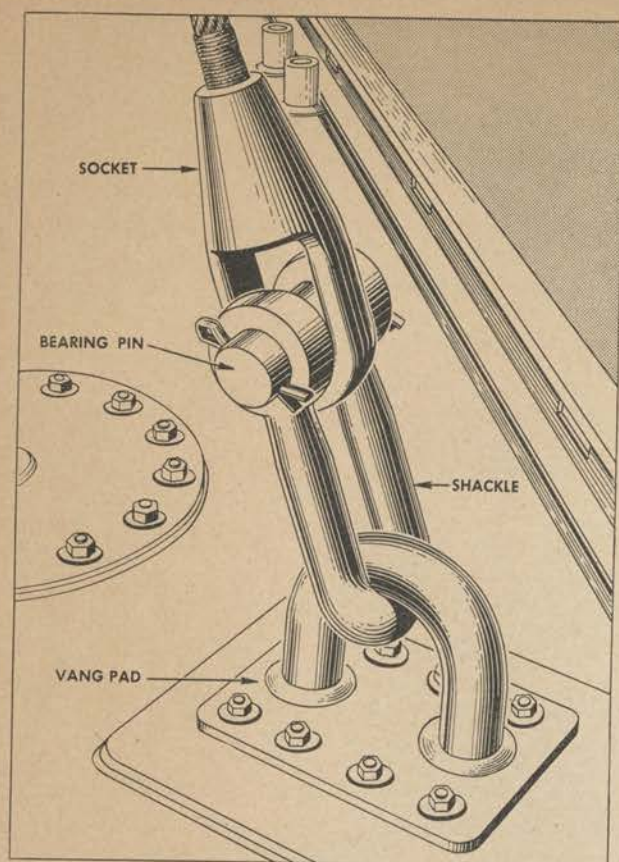


Figure 27. Detail of vang pads.

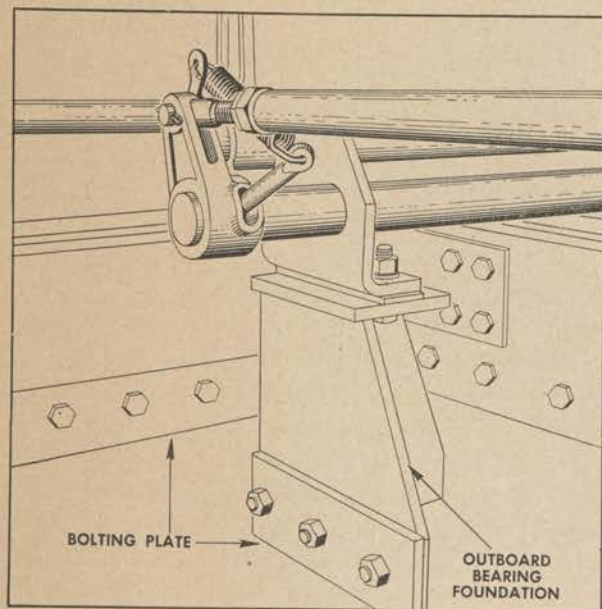


Figure 28. Detail of brake and pawl linkage foundations.

sections. Install these after completing the assembly of all the sections. Studs, $\frac{3}{8}$ -inch diameter, with hex nuts, are provided for holding down

the plates which are cut obliquely where necessary to fit the fore and aft diagonal foundation girders of the derrick. To install, place the plates in position with holes alined with the corresponding studs. Then lower the plates over the studs, seat firmly and bolt down with hex nuts. (See fig. 29.)

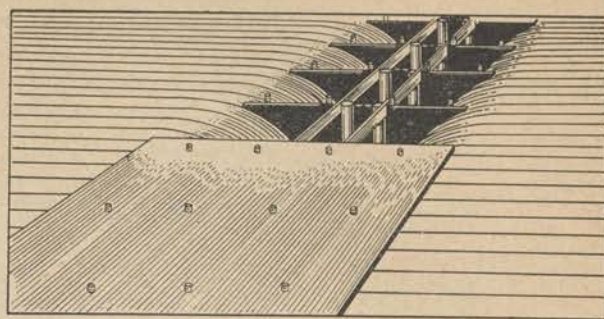


Figure 29. Installation of bridging plates.

j. ASSEMBLING DECK HOUSE. (1) Description.

(a) The following deck house subassemblies are received prefabricated ready for erection to the barge and match marked for assembling. (See fig. 30.)

1. Starboard section.
2. Port section.
3. Forward section.
4. Portable ridge beam.
5. Port and starboard forward roof section.
6. Aft roof section.
7. Cover plate section.

(b) Erect sections 1, 2, 3, and 4, install the machinery, and assemble the roof. The outside bulkheads on the port and starboard deck house sections are flush with the deck where they are bolted to vertical bolting bars, which are $2\frac{1}{2}$ inches high by $\frac{1}{4}$ inch thick (except where they are coped around pontoon radii), and are welded to the deck on the $\frac{1}{4}$ -inch edge.

(c) The port deck house, starboard bulkhead, and the starboard deck house, port bulkhead are supported by two prefabricated pipe stanchions that fit over pipe stubs. The cabin deck is 2 feet above the barge deck. A $3\frac{1}{2}$ - by $2\frac{1}{2}$ -inch inverted angle is welded to the underside of the cabin for stiffening and serving as a seat for the pipe stanchion supports. This support is composed of a 2-foot length of $2\frac{1}{2}$ -inch-diameter pipe, complete with welded seat plate, welded directly to the angle frame, leaving the open end of the

pipe stanchion to fit over a 2-inch-diameter pipe stub. The stub is complete with a base plate welded to the barge deck.

(d) The cabin decks are stiffened at the aft bulkheads by means of a 3- by $\frac{3}{8}$ -inch flat bar welded to the underdeck and angle frame.

(e) Bolt into place the portable stairs to the aft crew quarters bulkhead and to the port galley by means of two toggle bolts chained to the bulkheads. The portable stairs provide access to the barge deck located 2 feet below the cabin decks.

head placed on the starboard side of the barge.

Note. Line up the holes in sections with drift pins. Temporarily bolt them to the deck bolting bars with a minimum number of $\frac{1}{2}$ -inch-diameter hex head bolts.

(b) *Port section.* First lower the port section into position with the port bulkhead on the port side of the barge. Bolt it temporarily into place as described above.

(c) *Forward section.* Lower the forward section into place with the splice bars aft. Temporarily bolt the forward section to the bolting bars.

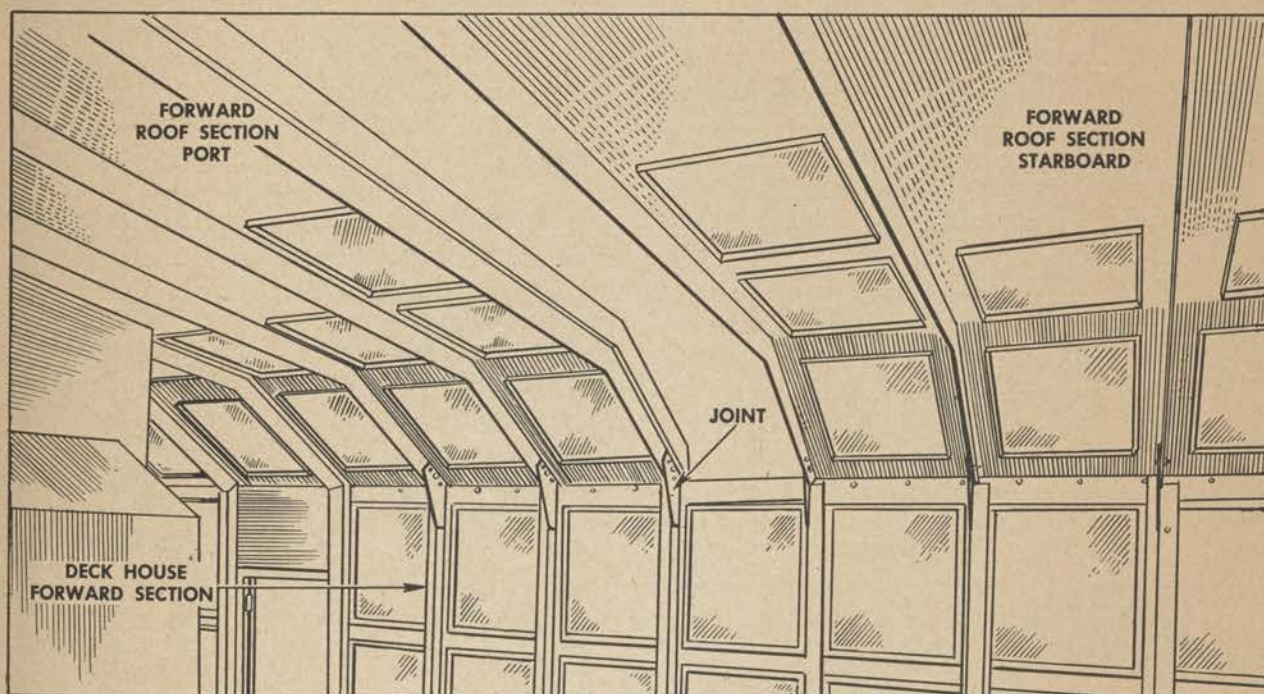


Figure 30. Assembly of forward deck house sections.

(f) The port, aft, and starboard sections of the deck house have openings to fit around the foundation girders. Use $\frac{1}{2}$ -inch-diameter bolts to bolt cover plates around these openings. (See fig. 26.)

(g) Splice bars, complete with punched holes for $\frac{1}{2}$ -inch-diameter hex head bolts, are welded to center sections for bolting splices, joining forward section to port and starboard sections, and aft section to port and starboard sections. Dip a layer of canvas in linseed oil and insert it at splices for weatherproofing.

(2) *Erection procedure for deck house.* Assemble the subassemblies and bolt them to the deck in the erection sequence that follows:

(a) The starboard section. Lower the starboard section into place with the starboard bulk-

Temporarily bolt the forward section to port and starboard sections.

(d) *Aft section.* Lower the aft section and bolt it temporarily into place.

(e) *Portable ridge beam.* Place the portable ridge beam in position and bolt it to the fixed ridge beam by means of splice plates that are welded to the fixed ridge beams. Use five $\frac{3}{4}$ -inch-diameter hex head bolts to bolt them into place at each end. The fixed ridge beam, welded to the port and starboard deck house, is supported by a 10-foot length of 3-inch extra heavy pipe stanchion.

Note. Check sections, temporarily bolted to allow some flexibility for adjusting bolt holes, to make sure the remainder of bolts can be inserted.

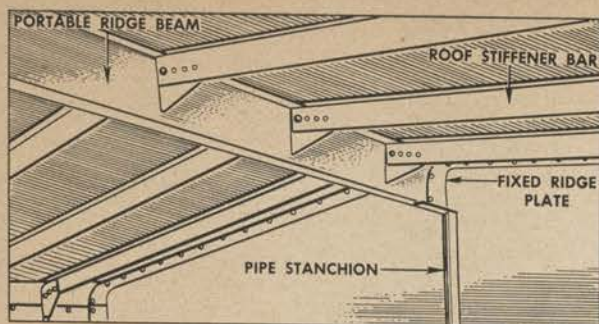


Figure 31. Assembly of port side section.

(f) With the deck house in place (with the exception of the roof), fit the remaining bolts and bolt them in place.

(g) Upon completion of the assembly of the deck house section, the next step preceding the erection of the derrick is to install the derrick and boom foundations.

k. INSTALLATION OF MACHINERY. (1) Hoist.

(a) The hoist is received as a completely assembled unit. Operators' platforms with control stands are included in the unit. The control stands are complete with air valves and air piping, together with brake pedals and pawl levers. Brake operating linkages with reach rods, levers, and springs are in position on the hoist. Air lines from individual valves are joined to one main air line (fig. 257), all in position ready for connection to the air reservoir after installation of the hoist to the reservoir.

(b) Lower the hoist unit to its position on girders F, G, H, and J.

Caution: Before bolting the hoist down, align the hoist driven gear with the Diesel driving pinion as described in paragraph below. After completing the lining up with the driving pinion, use 1-inch-diameter bolts to bolt the hoist bedplate to the foundation girders.

(c) The outboard bearings of the operating linkages for the band brakes and the drum pawls are in place on the hoist, but require separate foundations as they are outside the main hoist foundation. Two detached foundations are furnished for installation on the starboard side of the hoist. Bolt these to their respective bolting plates when installing the hoist foundation girders. After aligning the hoist gear with the Diesel pinion, and bolting the hoist bed plate to its foundation, bolt the two outboard bearings of the brake and pawl

linkages to their individual detached foundations. (See fig. 28.)

(2) *Main engine.* (a) The main engine, complete with drive shaft and two bearings, main drive pinion, generator and compressor drive pulleys, is mounted on a prefabricated foundation frame, ready for bolting to the foundation girder.

(b) Lower the main engine into place on the foundation girders J and H located aft in the engine room. The foundation girders J and H and the main engine frame are match drilled with $\frac{13}{16}$ -inch-diameter holes for $\frac{3}{4}$ -inch-diameter hex head bolts and nuts. Bolt the engine temporarily in place.

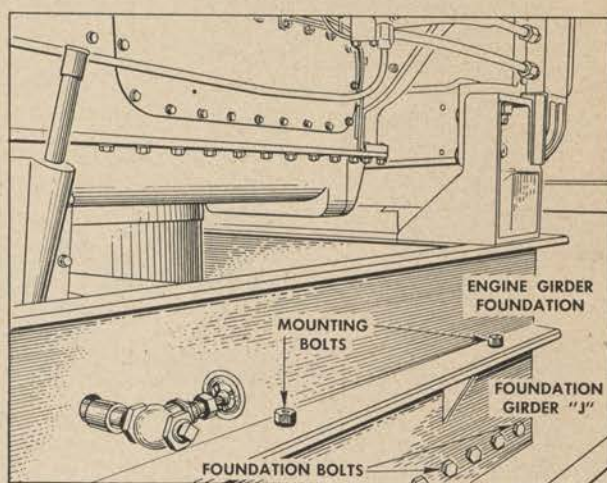


Figure 32. Engine installation.

(3) *Main generator installation.* (a) Set the main generator foundation, consisting of a frame and four legs, in place with the long leg located in the aft port section of the engine room. This leg is bolted to a $2\frac{1}{2}$ -inch high by $\frac{3}{8}$ -inch thick by $7\frac{3}{4}$ -inch long bolting bar welded to the deck on a $\frac{3}{8}$ -inch edge. The leg is provided with a welded base web drilled for four $\frac{1}{2}$ -inch-diameter hex head bolts and nuts. The leg base web plate is matched to the bolting bars and temporarily bolted in place. Bolt the two main generator starboard legs with two 1-inch-diameter hex head bolts and nuts. Bolt the port starboard leg to the foundation girder "H" with a $\frac{1}{2}$ -inch-diameter hex head bolt and nut.

(b) Lower the main generator into place with the drive end on the starboard side, and bolt it to the generator foundation with eight $\frac{7}{8}$ -inch-diameter hex head bolts and nuts with lock washers.

(4) *Installing the auxiliary diesel generator foundation.* (a) Bolt the auxiliary generator foundation frame to two 4-inch by $\frac{3}{8}$ -inch thick by 27-inch long bolting bars that are welded to the barge deck on the $\frac{3}{8}$ -inch edge, using $\frac{3}{8}$ -inch-diameter bolts.

(b) Bolt the auxiliary generator foundation to the bolting base by means of ten $\frac{3}{8}$ -inch-diameter hex bolts and nuts. Now lower the auxiliary generator in place with the radiator aft.

(c) Bolt the generator securely in place with four $\frac{1}{2}$ -inch-diameter hex head bolts and nuts with lock washers.

Caution: Do not bolt the base down to an uneven or irregular surface as it will either be broken when the screws are drawn tight, or it will be sprung, creating internal stresses in the generator, causing the bearings to wear and fail.

(d) If the foundation girder is uneven, shim up the low corners of the base with metal shims placed on each side of the foundation bolts. Do not drive the metal shims in hard enough to raise one of the other corners of the base from the floor.

(5) *Air compressor and receiver.* The air compressor, complete with skids, is received complete and ready for assembly. Set it in position with the drive end to port. Bolt the air compressor skids to the engine girders, making sure that the unit is level in all directions. Shim up the low corners of the skid base by inserting metal shims at each side of the foundation bolt. Do not drive the shim in hard enough to raise one of the corners of the base from the floor.

Note. Locate the air compressor so that fan action of pulley will blow air onto the cylinder.

Bolt the air receiver, complete with slings, securely in place below the engine to the L-foundation beams with $\frac{1}{2}$ -inch-diameter hex head bolts and nuts.

1. INSTALLING DRIVES FROM MAIN ENGINE. After installing the equipment, connect the drives to the main generator, hoist, and air compressor.

(1) *Main hoist drive.* (a) Line up the main hoist drive, consisting of the gear on the main hoist, the pinion on the engine shaft, and the silent chain drive, for assembly to the main hoist.

(b) Check the main hoist foundation bolting, making sure the main hoist is securely in place.

(c) Adjust the engine base foundation so that the engine pinion face is in line with the main hoist gear face, and that the power drive shaft

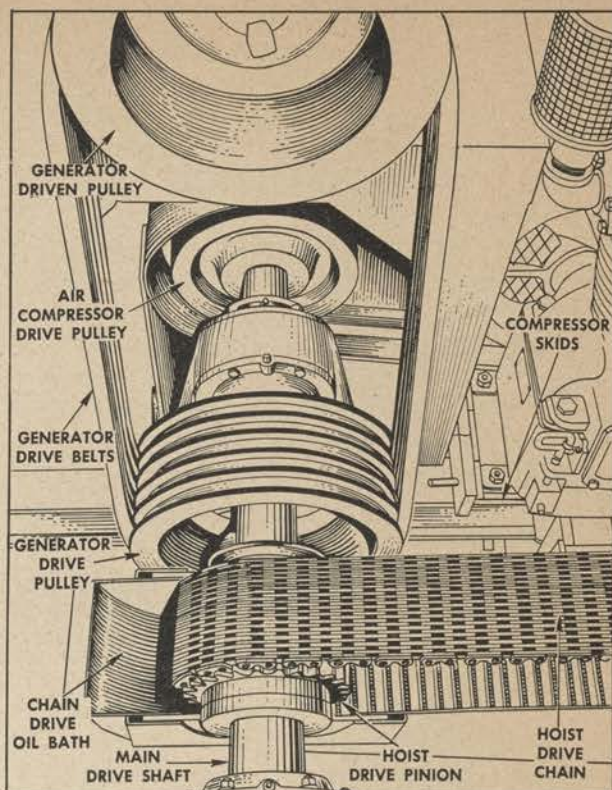


Figure 33. Hoist, main generator and air compressor drives.

is parallel with main hoist drive shaft. Do this by securing two light wires at 90° to each other, using the main hoist gear face and the main hoist drive shaft as a base. Use the wires now as a guide to line up the main engine with the main hoist.

(d) Adjust the silent chain, engaged by the main hoist gear and the main engine pinion, by the addition of any required links, and secure it by riveting in place the added links and the junction

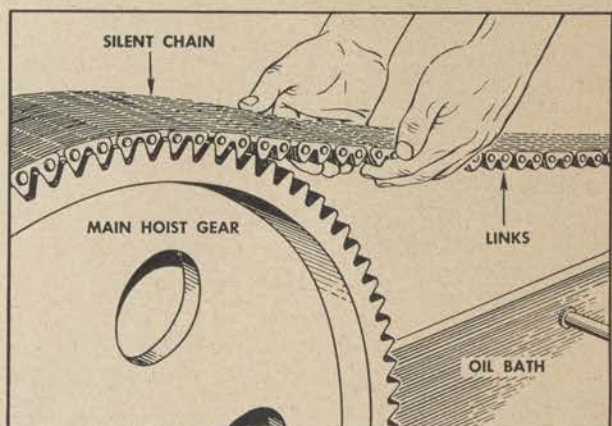


Figure 34. Installing chain drive.

of the chain ends. Set on the drive guard cover and bolt it into place. Wrench tighten the engine foundation bolts.

(2) *Generator drive.* (a) Line up the generator drive, consisting of the main generator drive pulley, the main engine drive pulley, and the V-drive belt, for assembly to the main engine. Do this by adjusting the main generator base mounting to line up the face of the main generator drive pulley with the face of the engine generator drive pulley. Line up main generator drive shaft so that it is parallel with the engine drive shaft.

(b) Adjust the generator drive, composed of five V-belts, and secure it in place around the generator driven pulley and the engine generator drive pulley. Wrench tighten all main generator foundation bolts.

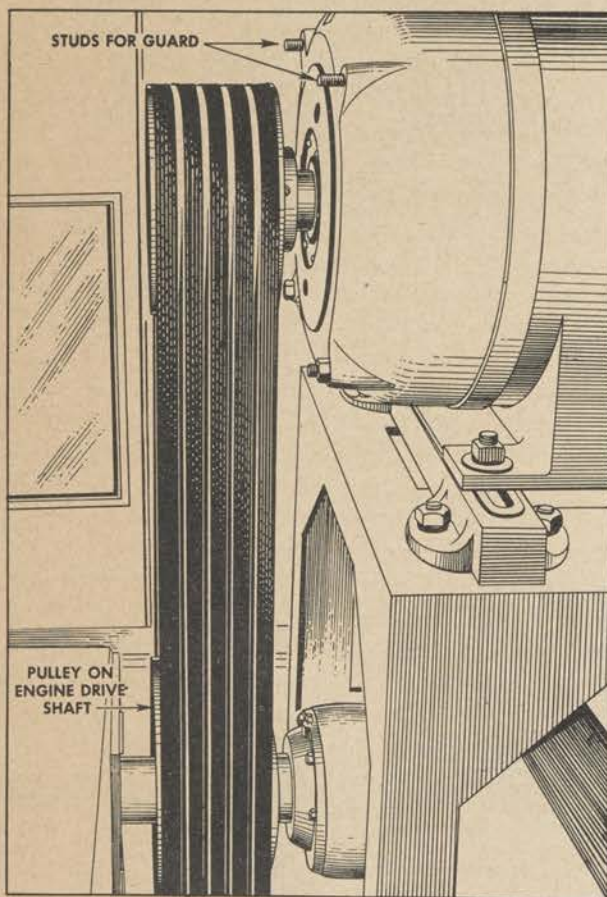


Figure 35. Main generator drive belts.

(3) *Air compressor drive.* (a) Line up the compressor driven pulley face with the engine compressor driver pulley face. Set the drive shaft

of the compressor parallel with the engine drive shaft. Make this adjustment by means of the adjustable compressor base skids.

(b) Move compressor on slide rails toward engine until belts can readily be placed in sheave grooves. *Do not roll, force, or pry belts on as permanent injury may result.*

(c) Make sure all slack is on top or bottom. Move compressor away from engine so as to seat belts snugly in grooves. Belts and engine sheave should be parallel. Misalignment causes rubbing which shortens belt life.

(d) With the V-belts secured and adjusted, and the guard cover bolted in place to the engine foundation, wrench tighten all foundation bolts for a rigid installation.

m. ASSEMBLY OF DECK HOUSE ROOF SECTIONS.

(1) *General.* (a) The roof sections are received prefabricated ready for bolting. Bracket plates are welded to the bulkhead stiffeners for bolting the roof in place. The roof is stiffened by flat bars with punched holes for $\frac{1}{2}$ -inch-diameter hex head bolts, for bolting to plate brackets. The roof plates extend 1 inch over roof junctions providing weatherproofing.

(b) Bolting bars which are 4 inches by $\frac{3}{8}$ inch complete with punched holes are welded to the outside edge of connecting roof sections for bolting to bulkheads.

(c) Bracket plates are welded to the portable ridge girders for bolting to the aft forward roof section stiffener bars. (See fig. 31.)

(d) The deck house roof is supported by pipe stanchions that fit over prefabricated pipe stubs.

(e) The ridge beams are 12- by 3-inch channels and are composed of the portable and the fixed ridge beams. The fixed ridge beams are assembled to the port and starboard section, and supported by two pipe stanchions located inside the cabins.

(f) The pipe stanchion support is composed of a 10-foot length of 3-inch-diameter pipe complete with welded seat plate. This is welded directly to the fixed ridge plate, leaving open end of the pipe stanchion to fit over a 2-inch-diameter pipe stub complete with base plate which is welded to the barge.

(g) A temporary wire brace is attached to the bottom of the pipe stanchion and secured to the stiffener for handling.

(2) *Erection procedure for deck house roof.*

(a) *Forward roof sections.* These forward roof sections are composed of port and starboard sections. Lower them into place. Place a layer of canvas dipped in linseed oil between splice bars welded to center section to be bolted. The assembly, with canvas in place at joints, is now ready to be bolted with 1/2-inch hex head bolts. (See fig. 30.)

(b) *Aft roof section.* Lower the aft roof section into place. Prepare the joints with canvas dipped in linseed oil, and bolt them in place in the same manner as the forward roof section.

(c) *Cover plate section.* Lower this section into place. Prepare the joints with canvas as described in (b) above. Bolt the section to brackets provided on deck bulkheads and to brackets welded on the portable ridge beams. Bolt 10-inch-diameter air exhaust to coaming located in aft roof section. (See fig. 88.)

n. ASSEMBLY OF DERRICK A-FRAME AND LEGS.

(1) *Erect A-frame.* (a) Subassemblies comprising the components of the A-frame and back legs are as follows:

A-frame top with fittings attached.

A-frame legs, port and starboard.

Cross brace with fittings attached.

A-frame top block.

Tie rods, port and starboard.

A-frame platform, platform brackets, guard rail and ladder sections.

Note. In some installations, an additional platform has been added to the frame for the purpose of servicing the sheaves. Figure 1 illustrates a barge with only one platform.

(b) Assemble this A-frame on the ground and hoist the completed assembly into position. Equipment of sufficient capacity to hoist the total weight of 18,065 pounds is required. The over-all assembled height is approximately 48 feet and the over-all assembled width at the base is approximately 34 feet. Select a site of proper size to contain the assembled frame. Lay out a rough outline on the ground for the proposed location of the frame.

Indicate the best position for hoisting and setting up in the A-frame hitches with a minimum of maneuvering.

(c) The A-frame top is fully inclosed and has mounted on it five swivel sheaves. It is also fitted with a mast top cap and fitting to which the four sheave boom topping blocks must be pinned.

(d) The A-frame legs, port and starboard, are each shipped in one single section on which are mounted the plates to which the cross brace must be bolted.

(e) The cross brace is shipped as a single section on which is mounted the four sheave fair lead assemblies. (See fig. 36.)

(f) The first step in the A-frame assembly is to place the A-frame top, piece No. 6, in its proper position in the selected location. Place the two side legs, pieces Nos. 4 and 5, in position and bolt them temporarily to the A-frame top for alignment. Bolt the splice between the top and the side legs on all three sides. Then place the cross brace, piece No. 7, in position and temporarily bolt it to the side leg plates for alignment. With all members in position, complete the alignment and tighten the bolts.

(g) Hoist the assembled frame, less tie rods, into position, with the pin holes in the bottoms of the legs centered with the pin holes, A-frame hitches, piece No. 2, as shown in figure 36.

(h) Insert the 4-inch frame pins and secure them by cotter pins. (See fig. 25.)

(i) Rig temporary guy lines to hold the A-frame securely in place pending placing the back legs in position.

(2) *Erection of back legs.* The back legs are shipped in two sections. (See fig. 41.) Bolt the sections, pieces Nos. 8 and 9, together at some convenient location on the ground and hoist each leg into position. Carefully align the lower pin hole of each leg with the hole of its back leg hitch, piece No. 3. Insert 3 1/2-inch pin and secure it by cotter pins. (See fig. 26.) After inserting the lower pin, align the pin hole at the top with that in the projecting plate of the A-frame top. Insert the upper 3 1/2-inch pin and secure it.

(3) *Assembling tie rods.* Complete the assembly by installing and tightening the two tie rods, piece No. 10. Make the tie rods fast at their lower end to cross members in the A-frame legs. (See fig. 37.) Upon completing the assembly, remove the temporary guy line.

(4) *Platform assembly.* A platform for lubricating and servicing the swivel blocks of the A-frame top and the fairlead sheaves is shipped disassembled as brackets piece No. 13, platform piece No. 14, and guardrail piece No. 15. Mount these on the A-frame by bolting after erecting the frame. (See fig. 132.)

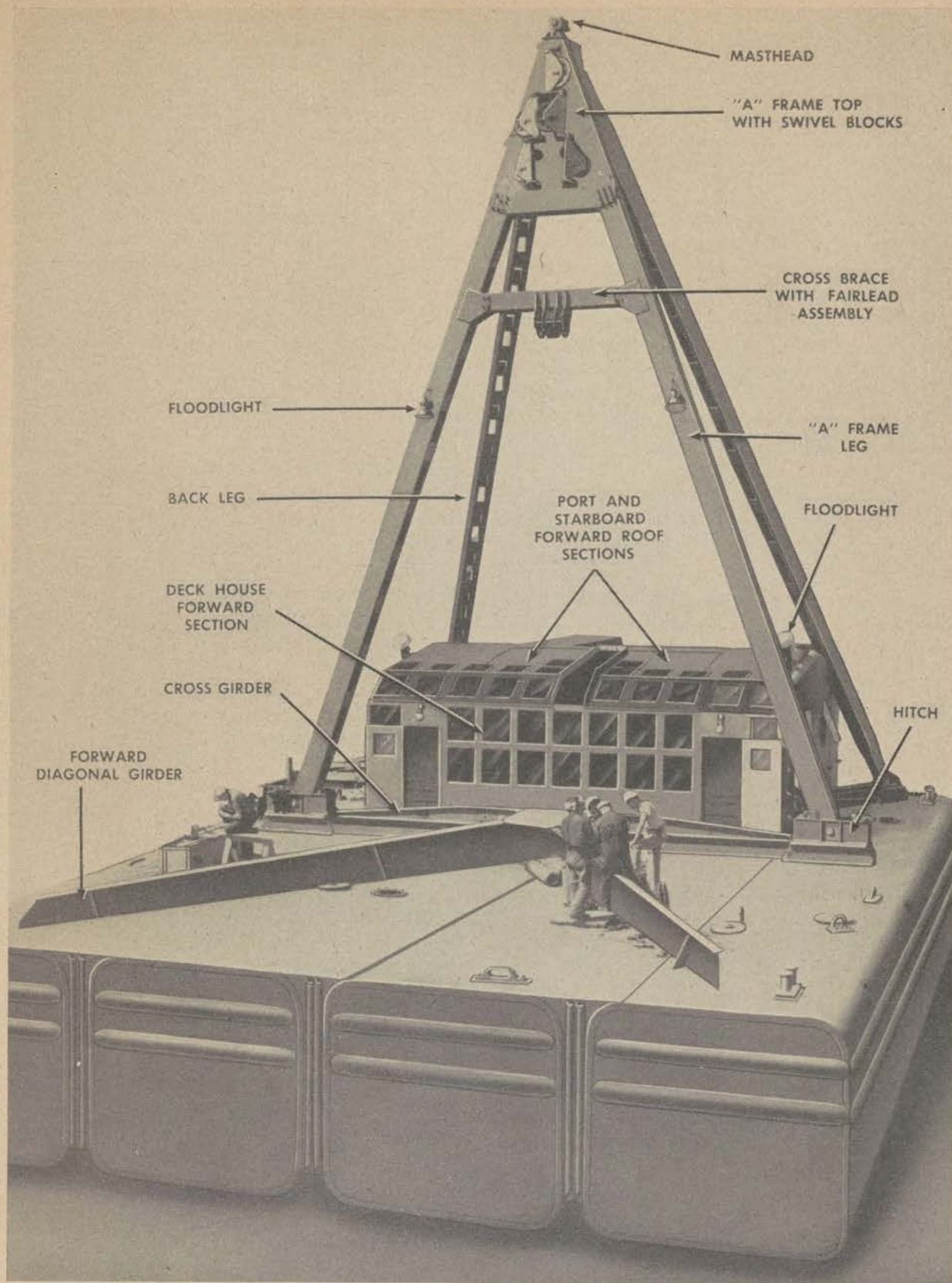


Figure 36. Stage in assembly of barge showing A-frame and forward girders.

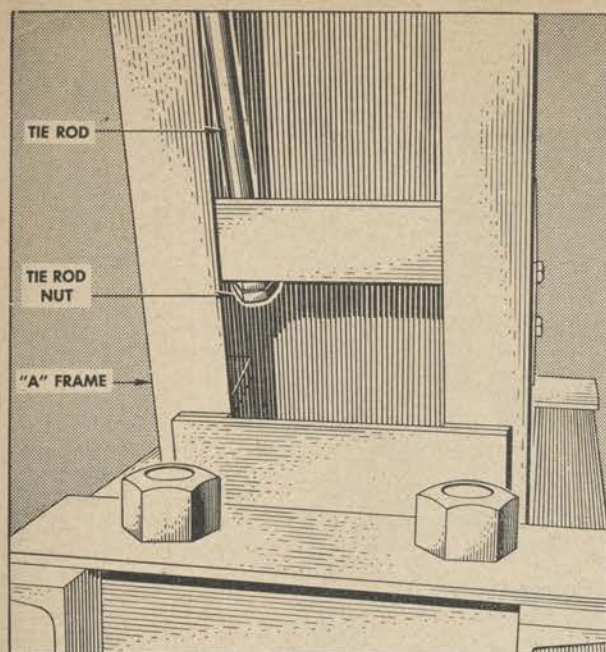


Figure 37. Detail of tie rod, piece No. 10.

(5) *Ladder assembly.* A ladder for access to the platform and A-frame floodlight is shipped in three sections, two pieces No. 11 and one piece No. 12. Bolt these sections to the frame as shown in figure 38.

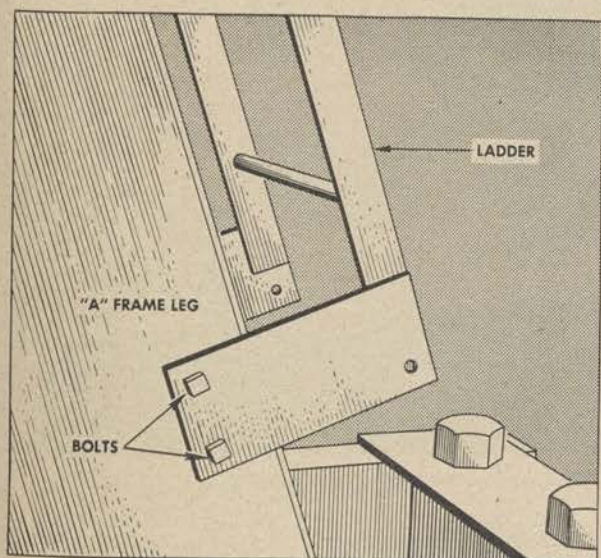


Figure 38. Detail of ladder assembly.

o. BOOM ASSEMBLY. (1) The boom is built up of an upper section, piece No. 16, and upper section, piece No. 17. Blocks are shipped separately and

must be shackled to the boom. Set the lower boom in a convenient location on level ground and fit the upper boom section to it. After alinement, bolt the two sections together. (See fig. 39.)

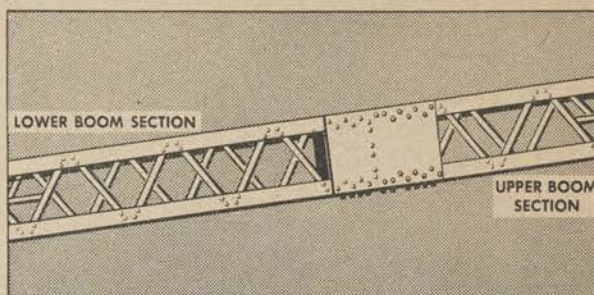


Figure 39. Boom joint detail.

(2) Hoist the assembled boom into position with the hole for the boom pin alined with the hole in the boom seat. Insert the 4-inch pin attaching the boom to the boom seat and secure it in place with a lock pin. Support the boom, to prevent excessive strain on the pin end, until the topping lines are reeved and the boom is raised clear.

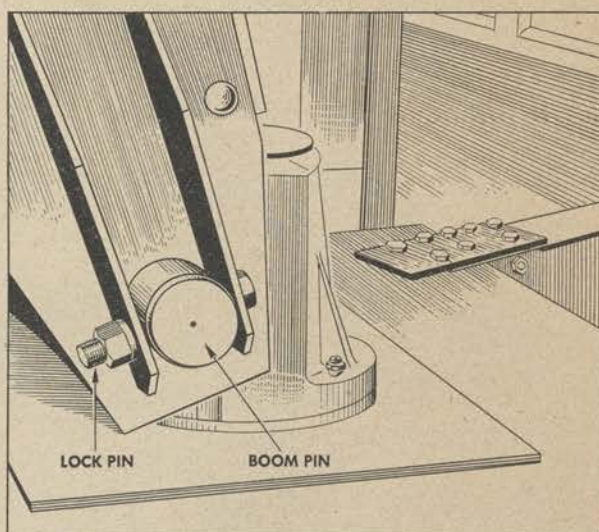


Figure 40. Boom pivot pin.

(3) After the boom is in place, attach the blocks located at the boom end preparatory to reeving. Attach one pair of single sheave vang blocks, piece No. 20, one on each side of the boom. Also attach to the boom, by shackles, one pair of double sheave, vang blocks, piece No. 21, one block on each side. Pin the boom end topping block, piece No. 19, in place on the top side of the boom end. Pin the upper load block and its hanger in place on the

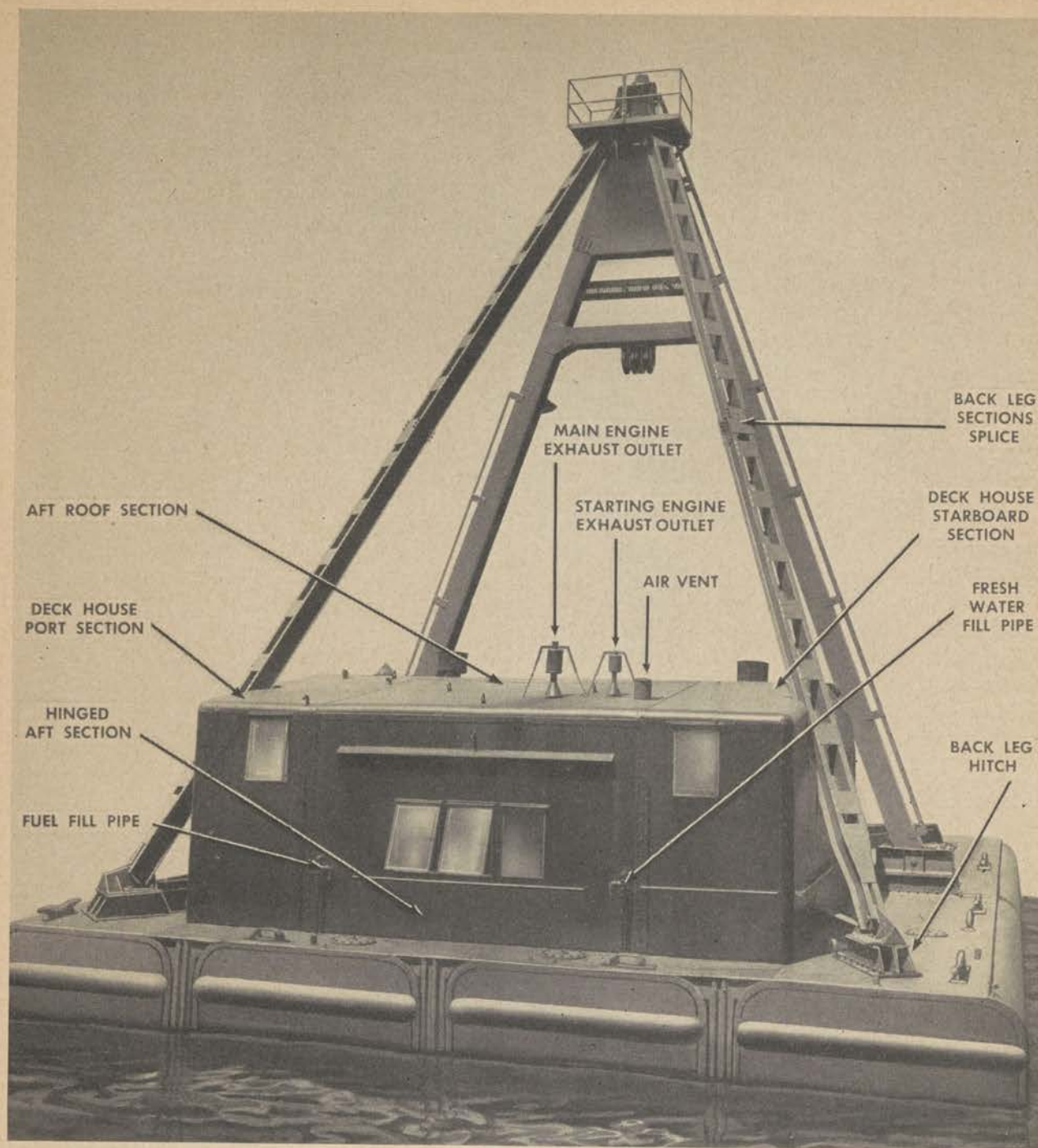


Figure 41. Barge derrick with deck house A-frame and back-legs assembled.

underside of the boom end. Figure 260 shows the boom end with all blocks assembled.

p. ASSEMBLY OF DECK HOUSE WINDOWS AND DOORS. (1) The following windows are received ready for installation in the deck house:

- 22 roof windows, 10 sloping and 12 flat.
- 18 forward section windows.

4 port windows.

6 starboard windows.

3 aft section windows.

(2) To install fixed windows in roof, imbed glass in non-hardening mastic and screw window frame in place with $\frac{1}{4}$ -inch by $\frac{3}{4}$ -inch-long roundhead machine screws. Nuts are fixed to in-

side of window by tack welding. Windows are prefabricated and must be installed where intended.

(3) Install fixed roof windows located at splice, using the angle frame composed of a $1\frac{3}{8}$ - by $\frac{7}{8}$ -inch angle and a $\frac{1}{2}$ - by $\frac{1}{2}$ -inch angle, inserted in window opening in the roof.

(4) Install the hinged movable section of the aft end bulkhead, complete with glass, frames and dogs for securing window in closed position, in aft section. Set the window in the framed opening and screw the hinges in place to the aft bulkhead with $\frac{5}{16}$ -inch roundhead machine screws. (See fig. 41.)

(5) To install the vented sash, set the window complete with angle frame, flat bar frame, and glass, in the window opening and screw the hinges into place. Secure the vented sash angle frame to the window opening with $\frac{3}{8}$ -inch-long hex head bolts, nuts, and lock washers where the windows occur in the splice of the forward bulkhead. Finish installing windows in the manner described above.

(6) Vented windows have a window brace and locking device composed of units assembled as follows: A $\frac{1}{4}$ -inch-diameter pin is welded to the window sash and a $\frac{1}{4}$ -inch-diameter pin is welded to the window frame. Offset lugs are welded to the outer edge of the inner frame. A metal brace, notched, drilled, and upset, is fitted over the $\frac{1}{4}$ -inch-diameter window sash pin. This is held in place by means of a washer and split pin inserted to the pin, allowing the brace to move freely on a horizontal plane. The ventilation is regulated by setting the notches of the brace on the $\frac{1}{4}$ -inch-diameter window frame pin.

(7) The interior and exterior doors are received prefabricated, ready for mounting to the bulkheads. Set the doors in place and secure them to the bulkhead with $\frac{1}{4}$ -inch roundhead machine screws with square nuts and lock washers.

g. INSTALLATION OF CAPSTAN. (1) The following units comprise the capstan system:

Capstan head located on deck.

Push button station located on deck.

Capstan drive (reduction gear) and motor located in the port hatch.

Combination starter located on a support in the hatch.

(2) The capstan foundation is prefabricated and welded to the inner bottom deck. A 2-foot $3\frac{1}{2}$ -

inch by 2-foot $1\frac{1}{2}$ -inch by $\frac{1}{2}$ -inch base plate is set on the foundation and allined with the $1\frac{1}{16}$ -inch-diameter holes in the foundation and base plate. Set the capstan motor drive, complete with motor and brake, in place with the brake end facing aft. Bolt the capstan drive, base plate, and foundation securely in place with $1\frac{5}{8}$ -inch-diameter hex head bolts, nuts and lock nuts. Place the reducer shaft coupling half key loosely over the capstan drive low speed shaft. (See fig. 42.)

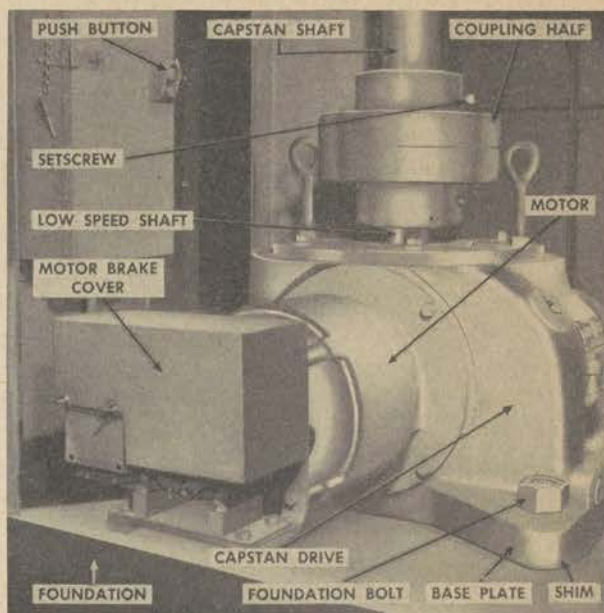


Figure 42. Capstan drive.

(3) Use the 2-foot 4-inch square by 1-inch thick prefabricated doubler plate, complete with welded-in 1-inch-diameter studs, which is welded to the deck, as the base for the capstan head. Lower the unit, complete, less the reducer shaft coupling half, in place by inserting the capstan shaft through the 8-inch-diameter opening in the deck.

(4) Prop up the capstan with wooden blocks to allow room for fitting the reducer shaft coupling half to the capstan. Carefully remove the wooden blocks and line up the whole assembly with the shaft coupling temporarily connected. Then bolt the capstan foundation into place to the doubler plate studs with 1-inch-diameter hex nuts and lock washers. (See fig. 42.)

(5) The whole unit should be true and level in all directions. If the foundation is uneven, shim up the low corners with metal shims placed on each side of the foundation bolts. Do not drive the shim in hard enough to raise one of the corners of the base from the foundation plates. Check the

final alinement of the shaft by trying to insert a feeler gage between the halves of the shaft coupling. The two halves must have a true metal to metal contact all around with zero clearance. Clearance at any point indicates that the two sections of shaft are not exactly in line. After proper alinement, wrench tighten all bolting carefully to maintain alinement. Do not completely tighten any one bolt at a time. Carefully draw down each bolt a small distance until completing the final tightening of all bolts.

(6) Fix the capstan push button station located aft of the capstan in place by means of four $\frac{5}{16}$ -inch roundhead machine screws. A plate enclosure is provided to prevent accidental operation of the push button station and to protect against the elements. Two $\frac{3}{8}$ -inch studs are welded to the deck for securing the cover with $\frac{3}{8}$ -inch hex head nuts. (See fig. 84.)

r. WIRE ROPE HAWSER REEL. The wire rope hawser reel for holding the anchor cable is located in the starboard hatch. It is mounted in a frame which is welded to the bulkhead and to the inner bottom deck. Set the complete reel, with side guard and axle, in the reel rest with the crank end forward.

8. PIPING INSTALLATION (FIG. 292). (1) *Fresh water system.* The fresh water system in the galley consists of a fresh water tank, hand pump, faucets and vents, together with a sink located in the lavatory. The fixtures are in place and are completely piped with the exception of the fresh water line running above the rear engine room aisle and secured to the aft bulkhead. Make the connections listed below to complete the fresh water piping:

(a) Connect the piping as indicated in figure 292.

(b) Connect stand pipe complete with fillcap, screened elbow, and nipples to a connection provided above the fresh water tank, located aft of the deck house. (See fig. 43.)

(2) *Sea water system.* The sea water system in the lavatory consists of sea water tank, hand pump, toilet, water closet tank and vent, connected with lengths of pipe and fittings. Install the fixtures and completely connect them.

(3) *Fuel oil storage and day tank system (fig. 292).* (a) The fuel oil system consists of a below deck fuel oil storage tank, hand pump, and day tank.

(b) Connect the stand pipe, complete with fill-

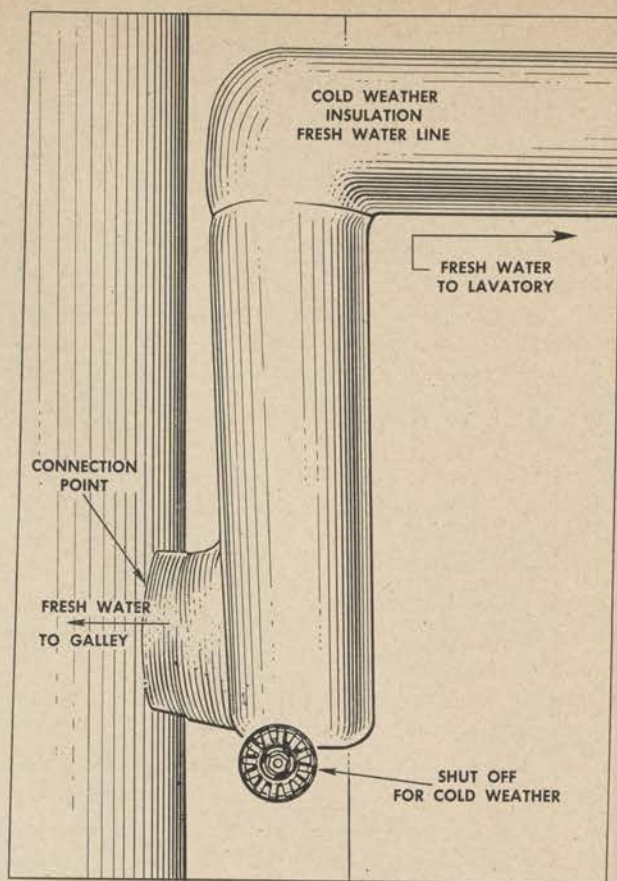


Figure 43. Connection of fresh water line.

cap, elbow with flame arrestor screen, and piping above the fuel oil storage tank located aft of the deck house. (See fig. 41.) Secure the fuel oil supply line from the storage tank to engine foundation, from which point connect it to a bypass composed of hand pump, two gate valves, check valve, and piping. Connect the bypass and drain cock to the bottom of the day tank. Connect a gate valve to the bypass which controls fuel flow to the fuel transfer pump on the engine.

(4) *Air piping installation.* After bolting the hoist and the air reservoir to their foundations, install the air line connecting the two. Install the air pipe from the reservoir to the union, as shown in figure 257. Also install the air pipe between the valve on the reservoir side of the hoist out to the other half of the union, as shown in figure 257. Complete the installation by joining the halves of the union.

(5) *Assembling deck house floor plates.* Upon completing the piping installation, install the deck house floor plates in accordance with the layout shown in figure 44. Bolts passing through

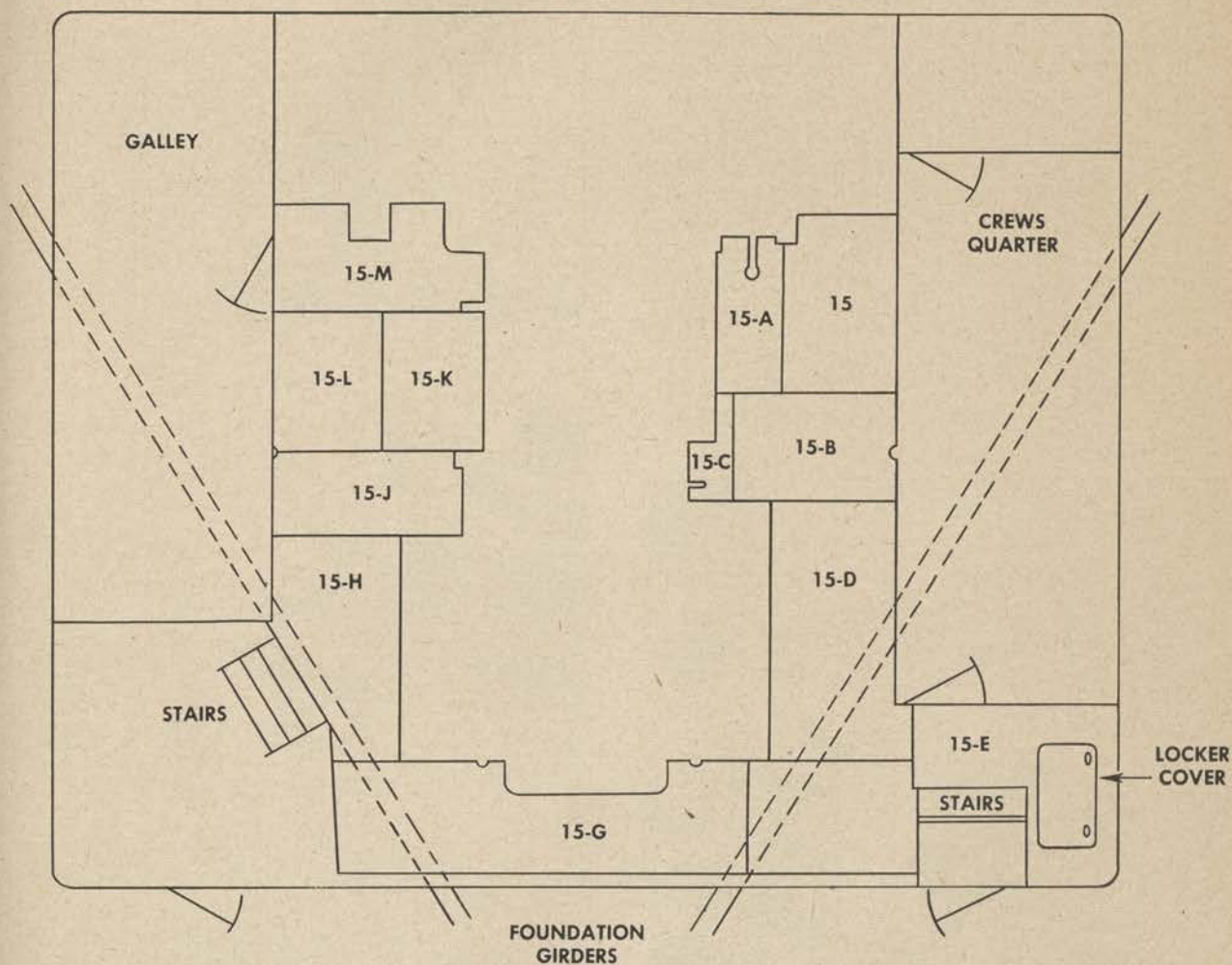


Figure 44. Lay-out of deck house floor plates.

holes drilled in the corners of the plates secure the floor sections in place.

Note. Exercise care in laying out the floor, that the plates used are in the correct position, as shown in figure 44. Follow the match marks closely since some of the plates appear alike and may be incorrectly fitted.

t. CONNECTING ELECTRICAL SYSTEM (FIG. 49).

(1) *General.* Cables carrying the electrical current to the various accessories in the barge are received prefabricated and clamped in place in the individual subassemblies of the barge. It remains only to connect the cables where sections or subassemblies are joined in order to complete the electrical wiring for the barge. Receptacles are mounted on subassemblies and on ends of cable, prepared for mounting on their proper sections. Figure 49 illustrates a complete wiring diagram of the barge, with the cables and receptacles. The information given below describes the procedure for joining cables to their respective receptacles and electrical equipment.

(2) *Main generator control panel to main generator.* Connect the three main generator cables,

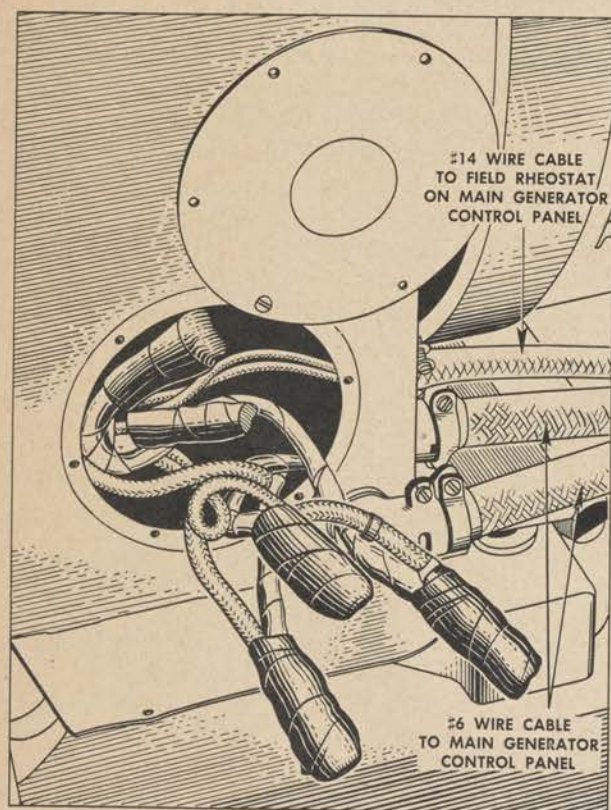


Figure 45. Main generator connection.

from the main generator control panel, to the terminals on the main generator, as shown in figure 45.

(3) *Auxiliary generator control panel to auxiliary generator.* Connect the two auxiliary generator cables from the auxiliary control panel to the terminals on the auxiliary generator. (See fig. 46.)

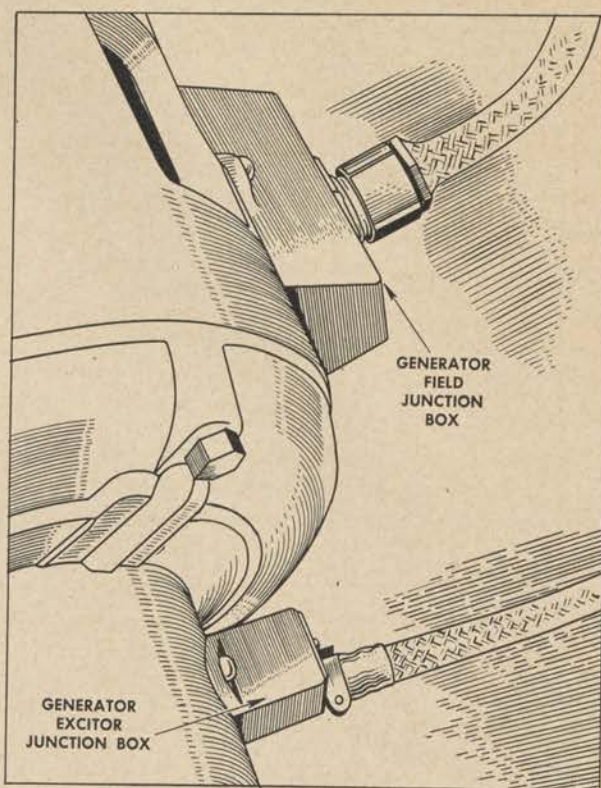


Figure 46. Auxiliary generator connection.

(4) *Deck house floodlights.* Connect the starboard floodlights on top of the deck house roof to the main control panel by means of the cable clamped to the portable ridge girders. (See fig. 47.) The port deck house floodlight is already wired correctly and needs no connecting.

(5) *Galley circuit.* The cable supplying current for the galley and accessories is connected through two junction boxes. Connect the two cables from the main generator control panel to the port junction box on the portable ridge beam. (See fig. 47.) Thread the two cables from the deck house starboard section through the portable ridge beam and connect them to the junction box on the starboard end of the ridge beam.

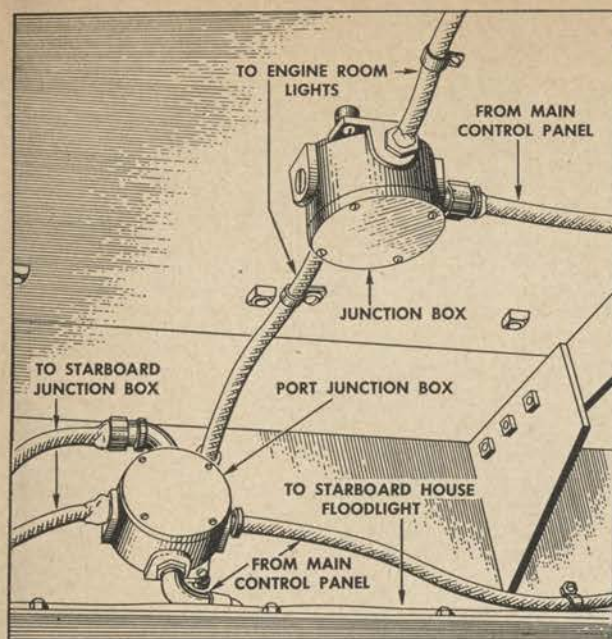


Figure 47. Junction boxes, forward roof section, starboard side.

(6) *Cabin lights.* Connect the cabin lights from the main generator control panel to the junction box on the forward roof section, port

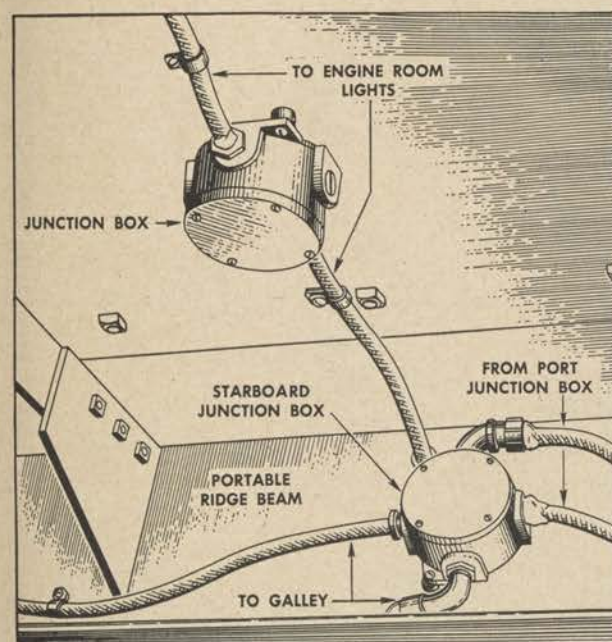


Figure 48. Junction boxes, forward roof section, port side.

side, by threading the cable through the fixed ridge plate and connecting it to the junction box.

(7) *Storeroom lights.* Connect the cable, loosely coiled, in the storeroom hatch to the junction box on deck house starboard bulkhead.

(8) *Machinery room lights.* Connect the two cables clamped to the aft roof section to the junction boxes on the forward deck house roof, by threading through the holes provided in the portable ridge girder. (See fig. 48.)

(9) *Boom floodlights.* Connect the two boom floodlight cables from the main generator control panel to the junction box on forward section, port side. The forward section of the deck house is provided with two angle type receptacles. A 2-wire 3-pole plug fits into the angle type receptacle and is provided with a length of cable which is looped on a bracket on the forward deck house section. Connect the other end of this cable to the junction box on the boom in accordance with the tag marks on the cable leads. (See fig. 50.)

(10) *A-frame floodlights.* Connect the two A-frame floodlights from the main generator control panel to the junction box on the forward section, port side. Connect the cables on the A-frame leg, port side, to the junction box on the inside of the forward deck house section.

(11) *Capstan circuit.* Connect the capstan cable from the main generator control panel to the junction box on the forward section, port side. Current for the capstan motor is carried by a cable running from the deck house junction box along the foundation girder. (See fig. 22.) Connect the capstan cable from the deck house to the junction box on the foundation girder, then to the receptacle located on a bulkhead in the port hatch. Connect the three capstan motor leads to the magnetic overload relay terminals in the combination starter housing mounted on a column in the hatch. Connect the current supply cable to the circuit breaker terminals.

u. REEVING. With the erection of the barge derrick completed, as described in the foregoing paragraphs, perform reeving of the hoist and derrick as described in paragraph 39.

v. PAINTING. Upon completing erection and reeving, clean the barge derrick and treat it for

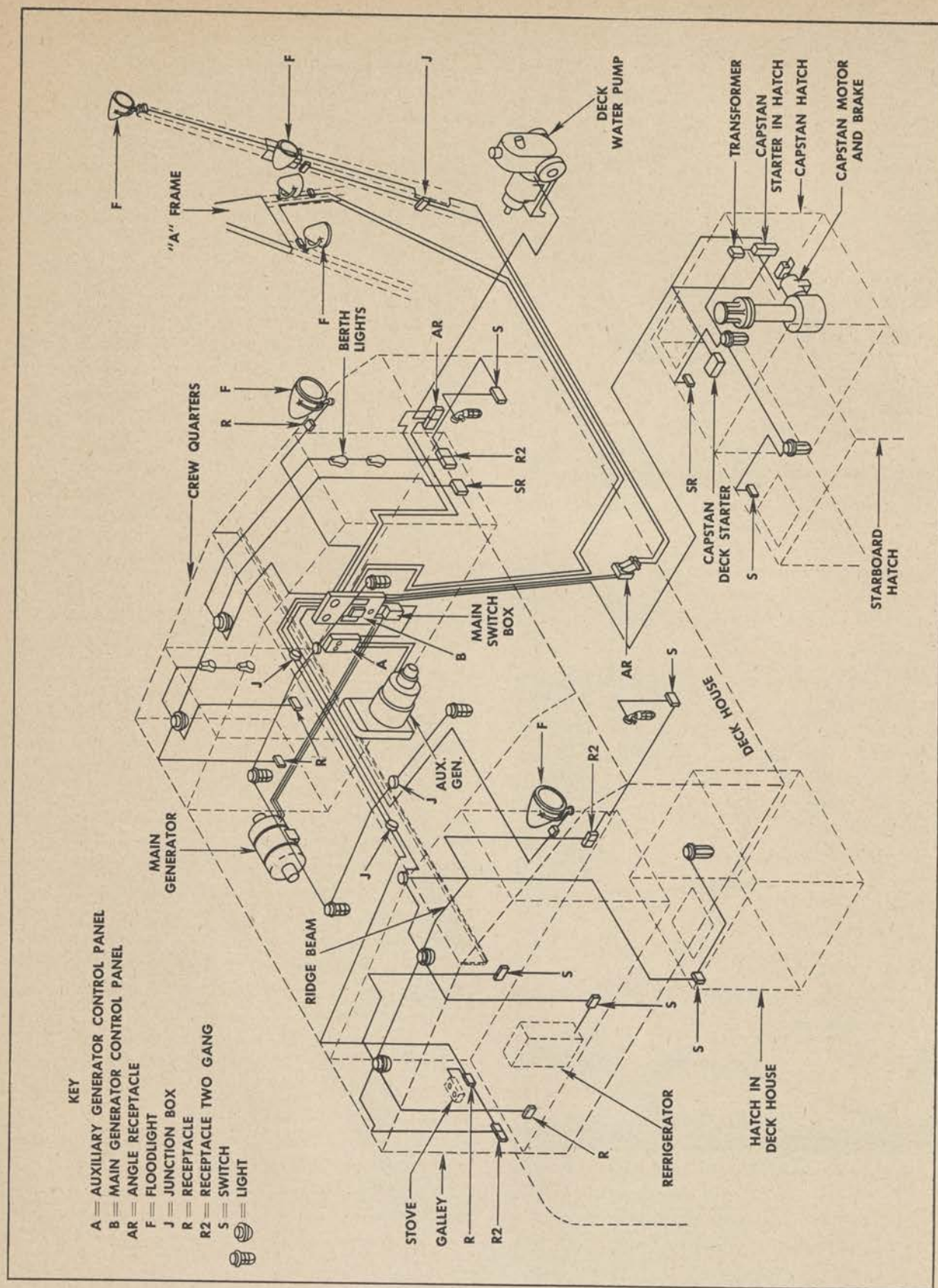


Figure 49. Electrical wiring system in barge.

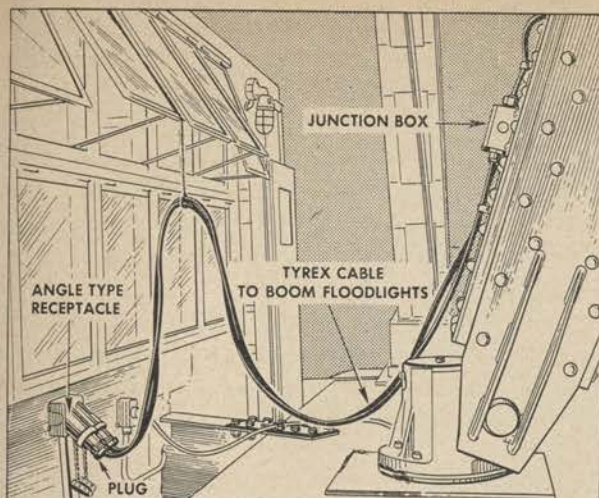


Figure 50. Cable connection to boom floodlights.

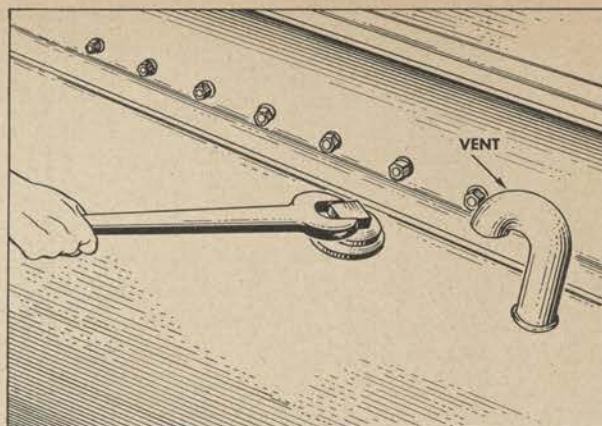


Figure 51. Checking barge section for leakage.

corrosion prevention. Then paint it in accordance with procedures prescribed in TM 9-850, ISSUED FOR ordnance matériel.

w. INSPECTION AFTER LAUNCHING. (1) After launching, remove the 4-inch deck plugs and inspect each barge section for leakage, using a flashlight. (See fig. 51.)

(2) Inspect the exterior of all barge sections for signs of damage incurred during launching. If a leak or damage to a hull is found, open the manhole for access to the compartment concerned and make a thorough interior inspection for tightness of structure and signs of damage. Manholes are opened as shown in figure 52.

(3) Report leaks and damage immediately for correction by higher authority.

(4) Instructions for launching the barge derrick are given in *c* above. Make a check on the correct assembly of the barge components by referring to the identification markings and nomenclature described in *d* above.

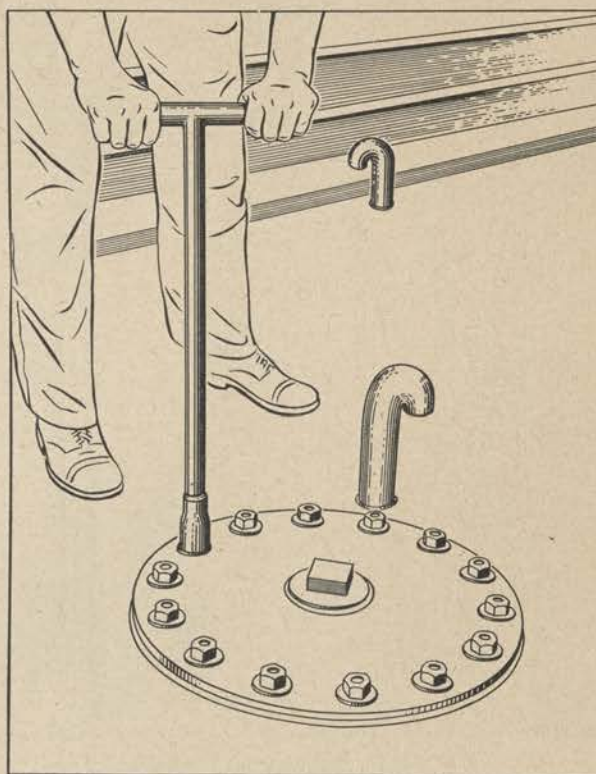


Figure 52. Opening manhole.



Figure 53. Taking tank readings.

8. Received Assembled

a. CHECK OF ALL ITEMS. Upon receipt, check tools, parts, and accessories against the lists given in paragraph 5.

b. TECHNICAL INSPECTION. Upon receipt, make the complete detailed inspection as prescribed in paragraph 31.

c. LUBRICATION. Upon receipt, lubricate all points requiring lubrication as prescribed in paragraph 30.

Caution: Do not operate equipment until the prescribed lubrication has been completed.

d. PREPARATION FOR OPERATION. (1) *General.* Before operation, make complete before-operation inspection prescribed in paragraph 35a.

(2) *Checking fresh water storage tank.* (a) The stand pipe located aft of the deck house, starboard side (fig. 41), is the fresh water inlet. Unscrew the fillcap on top and check the content of fresh water by means of a measuring rod. (See fig. 53.)

(b) The relative number of gallons, for various depth readings on the stick is listed below. If the content will not meet needs for operating period, fill fresh water tank from shore supply.

Fresh water reading chart

Measuring rod readings		Capacity in gallons
Feet	Inches	
0	3	25
0	6	50
0	9	80
1	0	110
1	3	140
1	6	170
1	9	200
2	0	230
2	3	260
2	6	290
2	9	320
3	0	350
3	3	380
3	6	410
3	9	440
4	0	470
4	3	500
4	6	530

(3) *Filling fresh water day tank.* Fill the fresh water day tank in the galley by means of the hand pump located below the tank. This pump is similar to the hand pump located in the water closet.

(4) *Filling sea water tank.* Fill the sea water tank located in water closet by operating hand pump located below the tank. (See fig. 54).

(5) *Water closet tank.* Check water level in tank.

(6) *Checking fuel oil storage tank (fig. 53).* The stand pipe located aft of the deck house, port side, is the fuel oil inlet. Unscrew the fillcap on top and check the contents of the fuel oil tank by means of a measuring rod. For relative number of gallons for various depths, see chart below. If

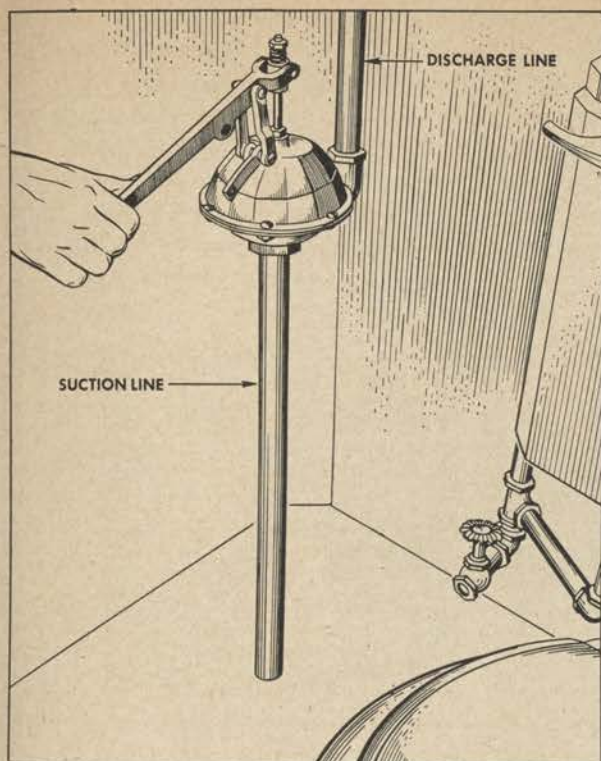


Figure 54. Operating hand pump.

the capacity does not meet needs for operating period, fill tanks.

(7) *Filling day fuel tank.* Fill day fuel tank for the main engine by means of the hand pump located below day fuel tank.

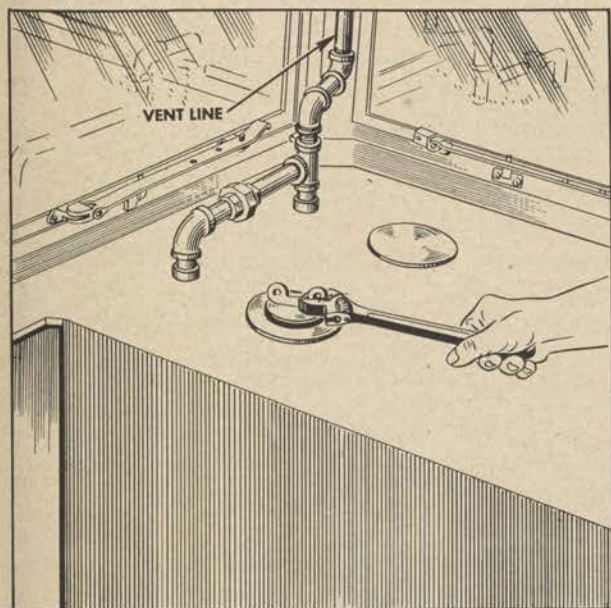


Figure 55. Removing filler cap from gasoline storage tank.

(8) *Gasoline storage tank (fig. 55).* Remove the cap from gasoline storage tank located forward of the galley on the starboard side of engine room. Fill tank to the capacity required for operational need.

Warning: Do not fill or transfer gasoline while engine is running. Smoking and all use of fire is prohibited. When handling gasoline, always provide a metallic contact between container and tank. This will prevent a spark from being generated as gasoline flows over the metallic surface. Failing to observe these rules will result in damage of equipment and injury to personnel.

Fuel tank reading chart

Measuring rod readings		Capacity in gallons
Feet	Inches	
0	6	150
1	0	350
1	6	525
2	0	700
2	6	900
3	0	1,050
3	6	1,250
4	0	1,450
4	6	1,600
5	0	1,800
5	6	2,000
6	0	2,200
6	6	2,350
7	0	2,550
7	6	2,700
8	0	2,900
8	6	3,075
9	0	3,250
9	3	3,350

(9) *Lubricating oil storage tank.* Raise inlet cover of lubricating oil storage tank located forward of galley starboard side of engine room and pour lubricating oil into the tank, filling it to the required capacity.

(10) *Floodlights.* The floodlights are provided with a horizontal adjustment of 180°, located at the floodlight swivel connection, and a vertical adjustment of 90° or 180° located at the trunnion. Either adjustment is accomplished as follows: Loosen the adjusting hex bolt, and move the floodlight to the desired position, then lock the assembly in place by screwing the hex bolt back in place.

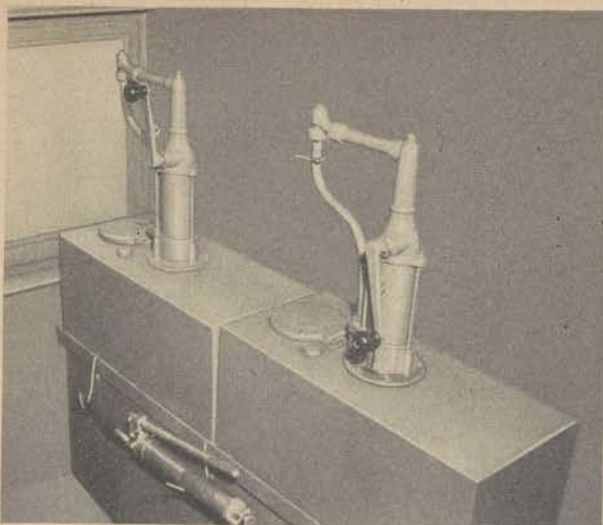


Figure 56. Lube oil storage tanks.

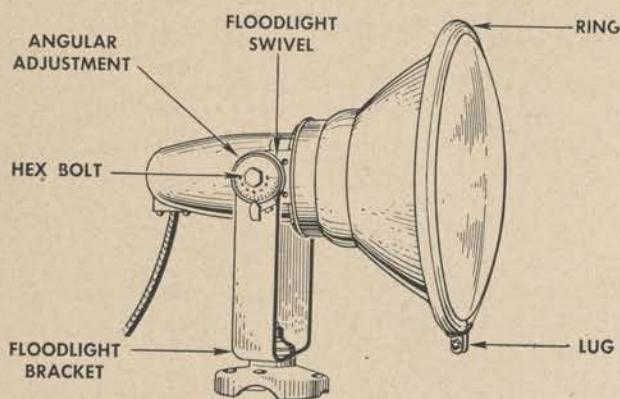


Figure 57. Floodlight assembly.

(11) *Capstan combination starter.* Prepare the capstan combination starter located in the forward capstan hatch for operation by adjusting the plunger core of the magnetic overload relay. Place the operating lever in OFF position to open the combination starter enclosure. (See fig. 254.) To adjust the magnetic overload relays for current setting, remove the lock nut and screw the plunger up into core until the calibrated line for 15 amperes is flush with the inside edge of the cap-washer. The plunger is calibrated with five lines from top to bottom. The top calibration is 30 amperes, the next is 25 amperes, and bottom is 10 amperes. Lock plunger in position with lock nut. (See fig. 58.)

Note.—Do not attempt to make any adjustments on contact block. Do not adjust the circuit breaker which is set at 15 amperes.

(12) *Filling auxiliary Diesel fuel tank.* Obtain fuel oil for the auxiliary Diesel engine from the main engine day tank. (See fig. 163.) Remove the plug from the right hand side of the auxiliary Diesel fuel tank and fill tank.

(13) *Air compressor.* Run the compressor for about 10 minutes before operating the hoist. This will permit building up the full air pressure of 70 pounds per square inch in the air system.

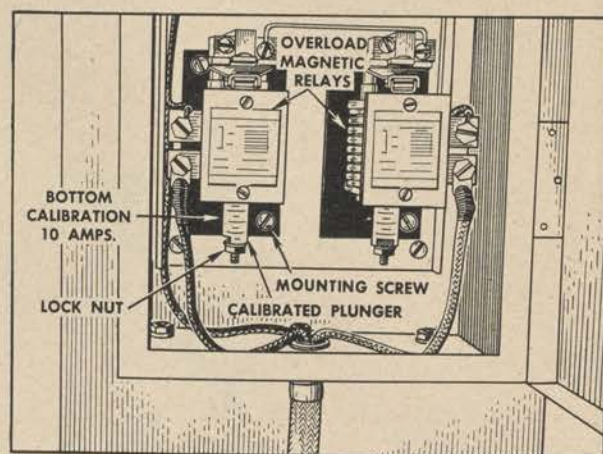


Figure 58. Capstan magnetic overload relays.

Section V. CONTROLS AND INSTRUMENTS

9. General

a. All controls, switches, and instruments necessary for the proper operation of the derrick barge are located within the deck house. For explanatory purposes all controls, switches, and instruments are divided into three groups:

(1) *Main power plant.* These controls are provided for the purpose of starting, stopping, and observing operation of the Caterpillar Diesel and its starting engine. Included as part of the main power plant is the clutch and lever which engages the drives for equipment, described in paragraph 10.

(2) *Hoist and derrick.* The two operators required for the operation of the hoist and derrick are seated before their respective control stands as shown in figure 59. They operate only such controls as are required to maneuver the boom, block, and whip. The throttle for controlling the speed

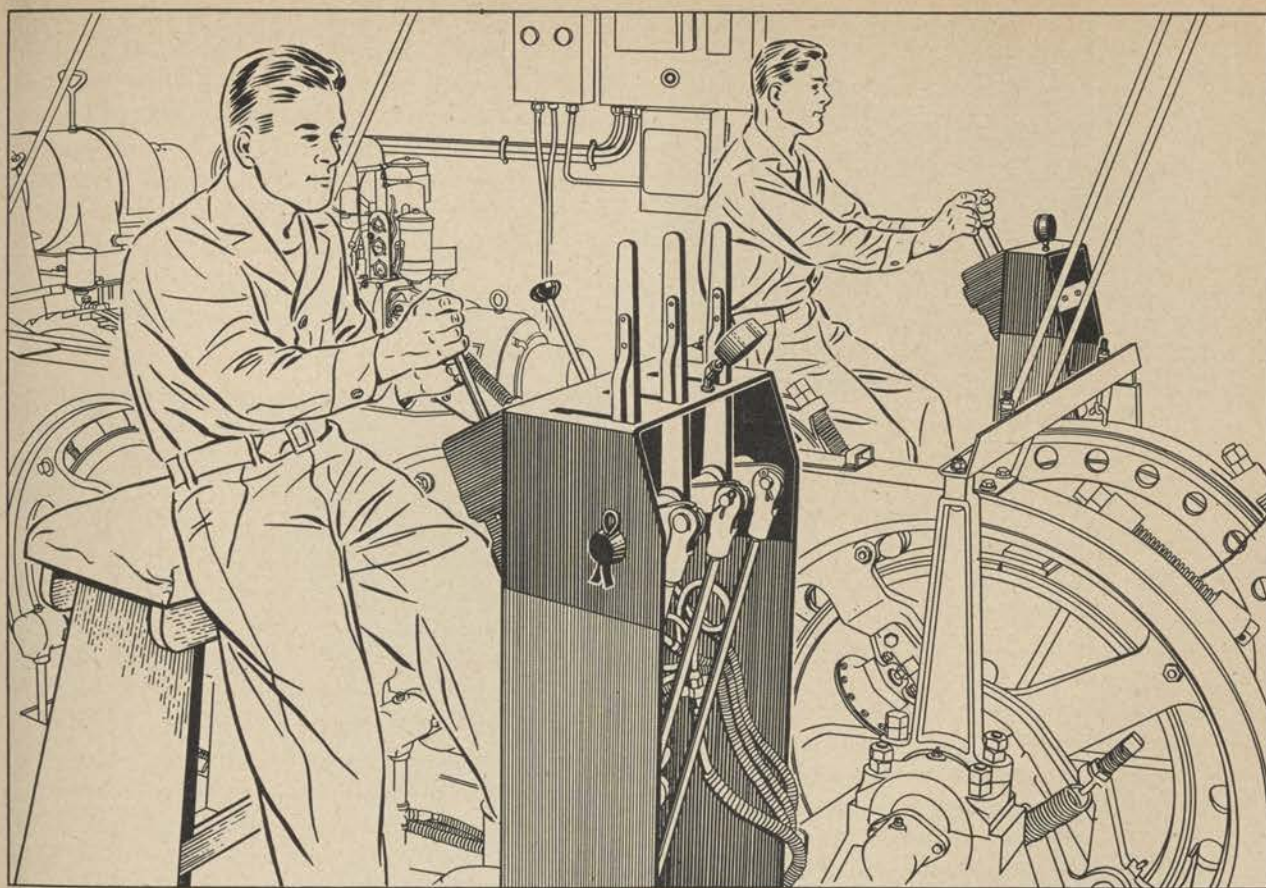


Figure 59. Hoist and derrick controls.

of the main power is located at the left hand of the boom operator and is entirely within his control.

(3) *Lighting and electric motors.* Controls and switches located in the deck house provide a means of connecting current to the various lights and accessories.

b. *USE OF CONTROLS.* Actual use of each control, included in paragraph 9, is explained in the respective operation paragraphs.

10. Operating Controls and Switches

a. *MAIN POWER PLANT (CATERPILLAR DIESEL).* Figure 60 illustrates controls and switches operated by personnel charged with starting, stopping, and adjustment of the main power plant. Paragraph numbers below are keyed to numbers in figure 60.

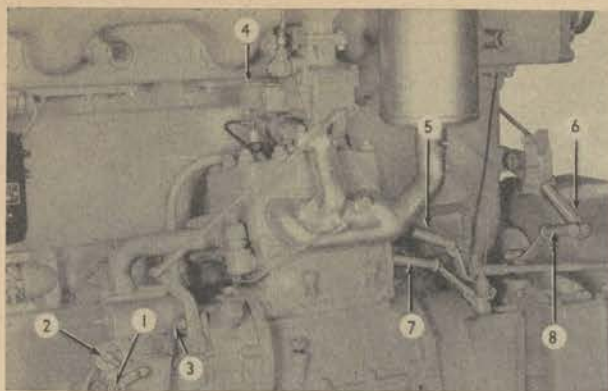
(1) *Manual spark control lever (1, fig. 60).* This lever, located on the starting engine magneto, is used in starting the engine. If the engine is

cold, move the lever to the ADVANCE position; if hot, move it to the RETARD position. As soon as the engine starts, move it to the ADVANCE position.

(2) *Starting engine magneto switch (2, fig. 60).* This switch, located on the starting engine magneto, is turned on in order to permit the magneto to deliver current to the spark plug of the starting engine.

(3) *Idling latch (3, fig. 60).* This latch controls the movement of starting engine governor control rod. For starting the engine, move it to hold the governor in the idling position.

(4) *Choke control rod (4, fig. 60).* This rod, located on the starting engine carburetor, controls the position of the carburetor butterfly valve. It is used to assist in the starting of the starting engine particularly during cold weather. The choke operates in a positive manner for three-fourths the choke rod travel, at which position the carburetor valve is fully closed. Pulling the choke the last fourth of its travel, trips the positive con-



1. Manual spark control lever.
2. Magneto switch.
3. Idling latch.
4. Choke control rod.
5. Starter pinion lever.
6. Compression release lever.
7. Clutch lever.
8. Transmitter lever.

Figure 60. Main power plant controls.

trol and the valve is then held in the closed position by spring tension. The spring tension allows the choke valve to open automatically as soon as the engine starts, thus preventing flooding of the carburetor before the choke control rod is returned to the OFF position. Pushing the choke rod all the way in returns the choke to the OFF position and re-engages the positive control.

Note. When starting, pull out the choke control rod all the way. Avoid overchoking the starting engine.

(5) *Starting pinion control lever* (5, fig. 60). This lever is located on the starting engine transmission. The starting engine cranks the Diesel engine through a sliding pinion which is engaged with the flywheel gear by pulling out on the starting pinion lever.

(6) *Compression release lever* (6, fig. 60). The compression release lever has three operating positions, START, HALF, and RUN, which control the compression of the Diesel engine for starting purposes. For starting, the normal position of the lever is at START. When the compression of the Diesel engine prevents the starting engine from cranking the Diesel, the lever is moved to the HALF position, which releases the compression of half the cylinders of the Diesel. The starting engine cranks the Diesel against compression (during cold weather) when the lever is in the RUN position.

(7) *Starting engine clutch control lever* (7, fig.

60). When the starting engine has reached operating speed, the Diesel engine is cranked by engaging the starter pinion. Perform this operation with clutch control lever disengaged. After the starter pinion is meshed with the Diesel engine flywheel, engage the starting engine clutch by pulling the lever out as far as it will go. As soon as the Diesel engine fires, disengage the lever.

Note. Take care to avoid touching the hot exhaust pipe of the starting engine when operating the starting engine clutch control lever.

(8) *Starting engine transmission control lever* (8, fig. 60). This lever governs the speed at which the starting engine cranks the Diesel. For cold weather condition, the lever is set at LOW, while for normal cranking the lever is at HIGH.

b. **HOIST AND DERRICK CONTROLS.** (1) *General.* (a) The hoist is equipped with five drums: three single drums and one pair of twin drums. Two control stands are provided, one on each side of the forward end of the unit. The control stand on the port side controls the twin vang drums, and the control stand on the starboard side controls the three hoisting drums. In order from aft forward, the single hoisting drums are identified as: boom, main load, and the whip. The twin vang drums are farthest forward. The main engine control throttle is mounted on the hoist to the left of the starboard control stand. (See fig. 63.)

(b) The hoist is chain driven from the main engine through an intermediate shaft which is geared direct to the drums. With the engine running and the main clutch engaged, all drum gears rotate continuously. Power is applied to drums through air operated friction clutches which lock the drums to the rotating drum gears. Power can be applied to the drums in only one direction, and at one speed when the engine runs at constant speed. Power is applied to any drum by moving the proper air valve from the OFF position to the ON position.

Warning: With the engine in operation and the engine clutch engaged, avoid unintentional movement of any air valve to the ON position as the corresponding drum will immediately rotate.

(c) *Brakes.* The band brakes are foot pedal operated with a catch and ratchet to hold the pedal in position. After any brake has been applied by depressing the foot pedal to the ON position, the catch must be released before the brake will release.

(d) *Pawls and ratchets.* The boom topping drum, the load drum, and the whip drum are each equipped with a hand lever operated pawl and ratchet for locking in position. Pawl and ratchet are not provided for the twin vang drums.

Warning: Unless properly instructed in the handling of hoist controls, no person is to be permitted to operate this equipment. Serious damage may result from improper operation.

(2) *Controls for raising and lowering boom.*

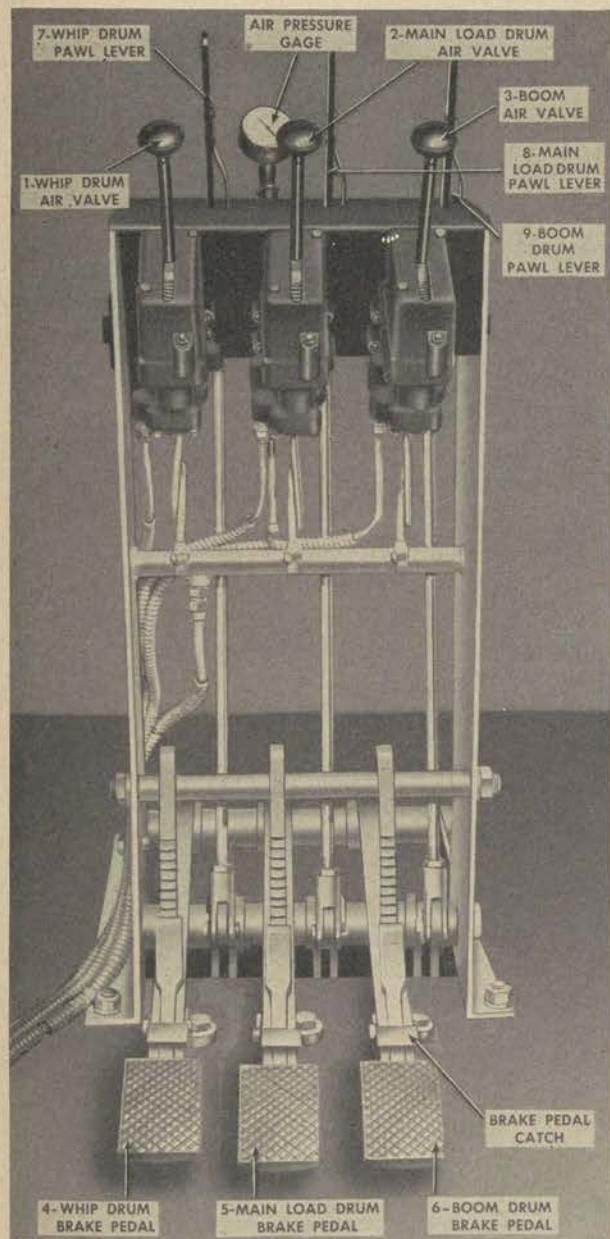


Figure 61. Control stand for raising boom.

These controls are located on the starboard, forward side of the hoist. Three air valves are abreast on one control stand, as shown in figure 61. The valve nearest the hoist controls the whip drum. The center valve controls the load drum (main load hook). The outboard valve controls the boom topping drum. Valves in forward position are OFF. Valves in aft position are ON.

(3) *Controls for drum brakes.* Three foot pedals, abreast in same control stand, are directly below the corresponding air valves. Each brake pedal is provided with a catch and ratchet to hold it in position. The brake pedal nearest the hoist operates the brake on the whip drum. The center brake pedal operates the brake on the load drum. The outboard brake pedal operates the brake on the boom topping drum. Brake pedals in the raised position are OFF. Brake pedals in the down position are ON.

(4) *Controls for drum pawls.* Three hand levers, abreast in same control stand, are directly forward of the corresponding air valves. Two notched positions are provided for each lever. The lever nearest the hoist operates the pawl of the whip drum. The center lever operates the pawl of the load drum. The outboard lever operates the pawl of the boom topping drum. All pawl levers in the forward notch are RELEASED. All pawl levers in the aft notch are LOCKED.

(5) *Controls for swinging boom.* Two air valves, abreast on one control stand (fig. 62), are on the port forward side of the hoist. The valve nearest the hoist controls the starboard vang drum. The outboard valve controls the port vang drum. Valves in forward position are OFF. Valves in aft position are ON.

(6) *Controls for vang drum brakes.* Two foot pedals, abreast in same control stand, are directly below the corresponding air valves. Each brake pedal is provided with a catch and ratchet to hold it in position. The brake pedal nearest the hoist operates the brake on the starboard vang drum. The outboard brake pedal operates the brake on the port vang drum.

(7) *Hand throttle for main power plant speed control.* This throttle is located on the hoist at the left hand of the hoist operator. A hand lever operates on a notched arc. Position down toward operator is IDLING. Position up away from operator is FULL SPEED.

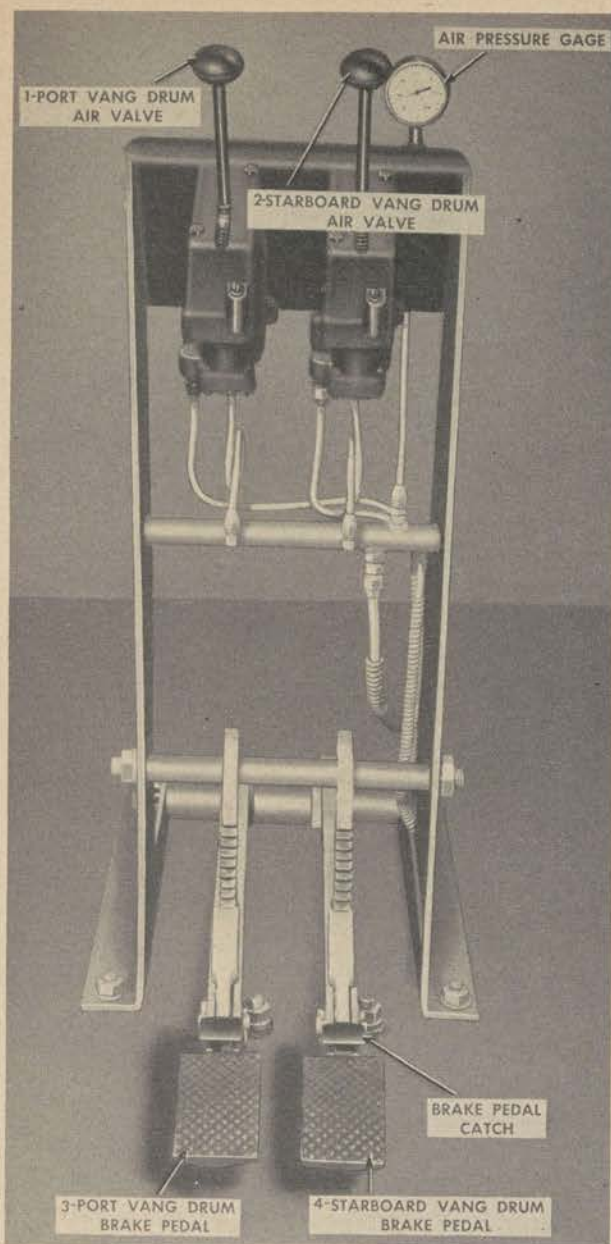


Figure 62. Controls for swinging boom.

c. **ELECTRIC MOTORS AND LIGHTING.** (1) *General.* The electric motors and lighting control system is composed of a main control panel, which is a control station for the main generator, lights and auxiliary equipment, and the auxiliary generator control panel used to control the auxiliary generator. The main control switch is used to connect either main or auxiliary generator into the circuit.

Caution: The operator must familiarize him-

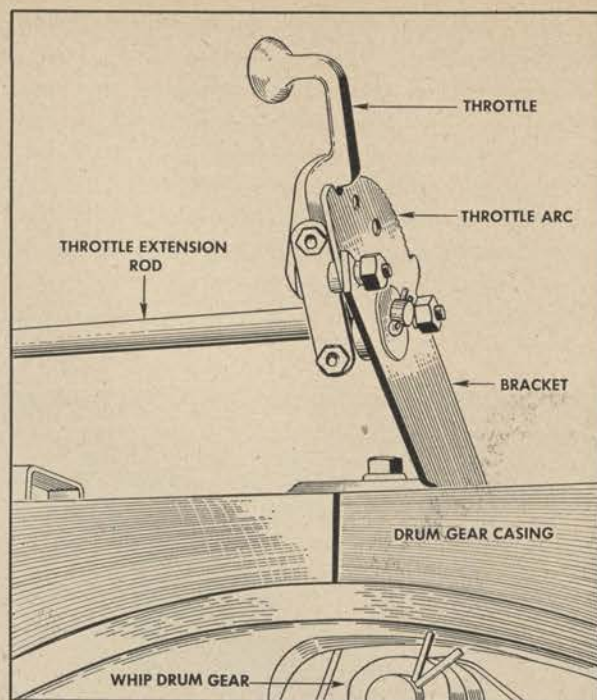


Figure 63. Main power plant speed control throttle.

self with the adjustment of the controls before attempting to operate the equipment. Maintaining voltage, etc., within safe operational limits will prevent damage to the equipment.

(2) *Main generator control panel.* The main generator control panel is located on the port deck house bulkhead. The controls are shown in figure 64. The following outlines the function of each specific control on the panel:

(a) *Voltage regulator.*

1. *General.* The voltage regulator is used to maintain a constant voltage on the output of the generator during a variation of load. When the generator is started with no external load, the voltage is adjusted with the rheostat so that the voltmeter reads between 206 and 210 volts. As a load is imposed on the generator, the voltage has a tendency to fall. This fall is compensated for by the action of the voltage regulator. During operation as the imposed load varies on the generator and the voltage tends to fluctuate, the voltage regulator maintains the voltage within the prescribed range.

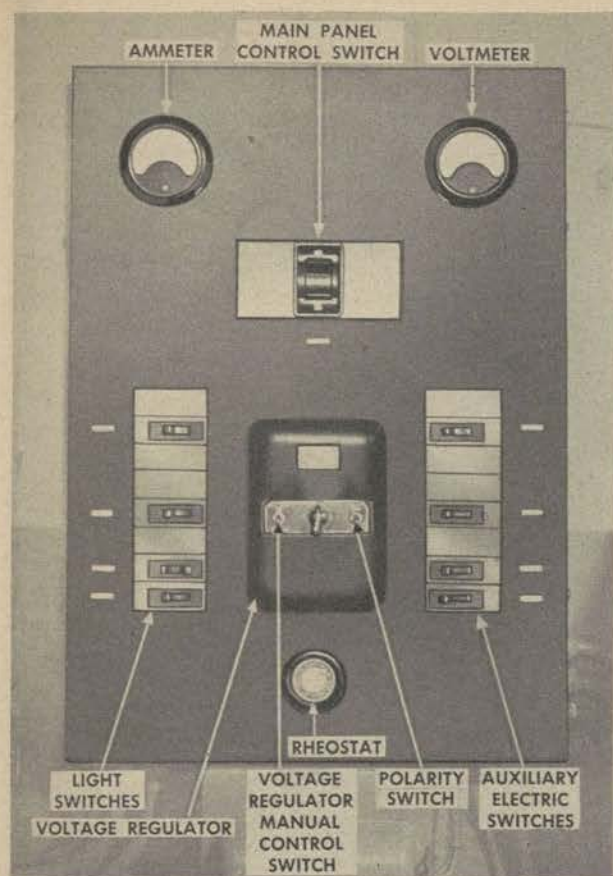


Figure 64. Main generator control panel.

2. *Voltage regulator rheostat.* The rheostat is located on the cover of the voltage regulator and is used to make final voltage adjustments after the generator is operating. The voltage setting may be raised or lowered as required.
3. *Polarity reversing switch.* The polarity reversing switch, located on the cover of the voltage regulator, is used to reverse the current flow through the contacts. If the current flows in one direction for any length of time, material is deposited from one contact to another, thus causing pitting and burning. The position of the switch should be alternated each day before placing unit in operation.
4. *Voltage regulator manual control switch.* The control switch is used to cut manually the regulator in or out of the circuit when required. The circuit is then controlled manually through the generator field rheostat.

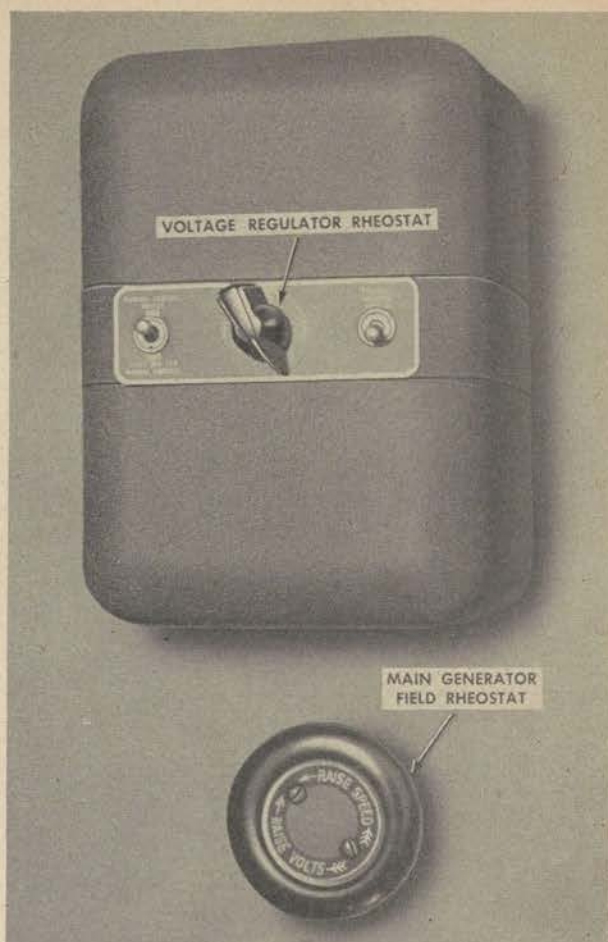


Figure 65. Voltage regulator.

(b) *Rheostat.* This unit is used for manual voltage control and for cutting the voltage regulator in and out. In addition, the rheostat may be used to control the voltage if the voltage regulator is not in operation.

(c) *Main panel control switch.* This switch is used to cut the panel board in and out.

Note. Failure to cut the panel board out when checking wiring, or other electrical equipment will result in damage to equipment or injury to personnel.

(d) *Water pump control.* This control is used to operate pump by turning current on and off.

(e) *Capstan control.* This control is used to operate capstan. In emergency, it can be used to cut off the capstan quickly instead of operating the switch on deck.

(f) *Electric stove control.* This control is used to operate the electric stove in the galley.

(g) *Electric refrigerator control.* This control is used to operate the refrigerator in the galley.

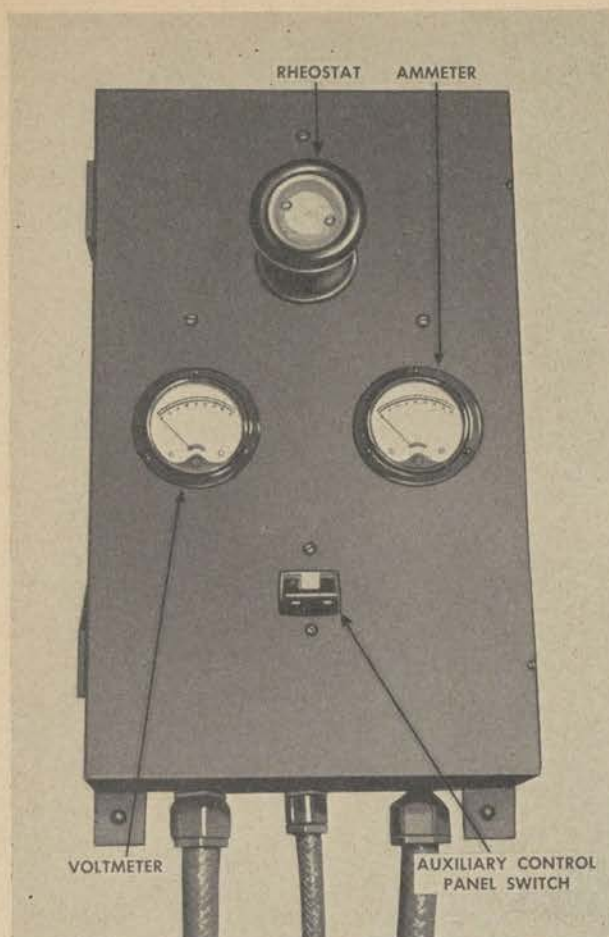


Figure 66. Auxiliary diesel generator control panel.

(3) *Auxiliary Diesel generator control panel.* This control panel is located to the left of the main panel. The controls are located and identified in figure 66. The following tabulation outlines the functions of each control on the panel:

(a) *Auxiliary control panel switch.* This switch is used to cut panel board in and out.

Note. Failure to cut panel board when checking wiring, or other electrical equipment, will result in damage to equipment and possible injury to personnel.

(b) *Rheostat.* This rheostat is used for manual voltage control. Voltage should be maintained not less than 112 or more than 118 volts as indicated on the voltmeter.

Note. Failure to adjust rheostat may result in damage to the equipment.

(c) *Control switch box.* This box, located under the main control panel, is used to cut the main and auxiliary generator in and out of service individually or both together.

Caution: Be sure the switch is off when checking wiring, etc. Failure to do this may result in damage to equipment and injury to personnel.

d. AUXILIARY DIESEL GENERATOR SET CONTROLS.

(1) Controls and switches for operation of the auxiliary Diesel generator set are illustrated in figure 66.

(2) The starting switch, located on the instrument panel, is pushed in to operate the Diesel starting motor.

(3) The governor lock screw, located on the governor housing, is loosened during the starting operation prior to adjusting the governor screw.

(4) The governor screw, located on the governor fuel pump assembly, is used for regulating the speed of the engine.

(5) The load regulator throttle nut, located on the governor screw, locks the governor screw into position after the desired operating speed is obtained.

11. Instruments

a. MAIN DIESEL ENGINE. (1) *Fuel pressure gage.* This instrument serves to indicate the condition of the fuel system while the Diesel engine is operating. The instrument dial is marked off in three colors: NORMAL (white), CAUTION (green), and OUT (red). With the fuel pump operating correctly and the system free of clogged lines or filters, the dial hand will indicate NORMAL. Should the filters become clogged with foreign material, the position of the fuel pressure gage indicator will work back from NORMAL to the CAUTION range, and eventually into the OUT range. The exact point on the OUT (red) range which the indicator will register before the resistance to fuel flow interferes with the maximum performance of the engine, is best determined by experience with the individual engine.

(2) *Lubricating oil pressure gage.* This instrument indicates the condition of the lubricating oil system of the engine. The correct pressure for the engine is approximately 30 pounds with the engine running at normal speed and operating temperature. This pressure brings the gage needle to a point about midway across the pressure scale on the gage dial. As long as the needle stays within the "operating range," it may be assumed that the lubricating oil system is operating correctly.

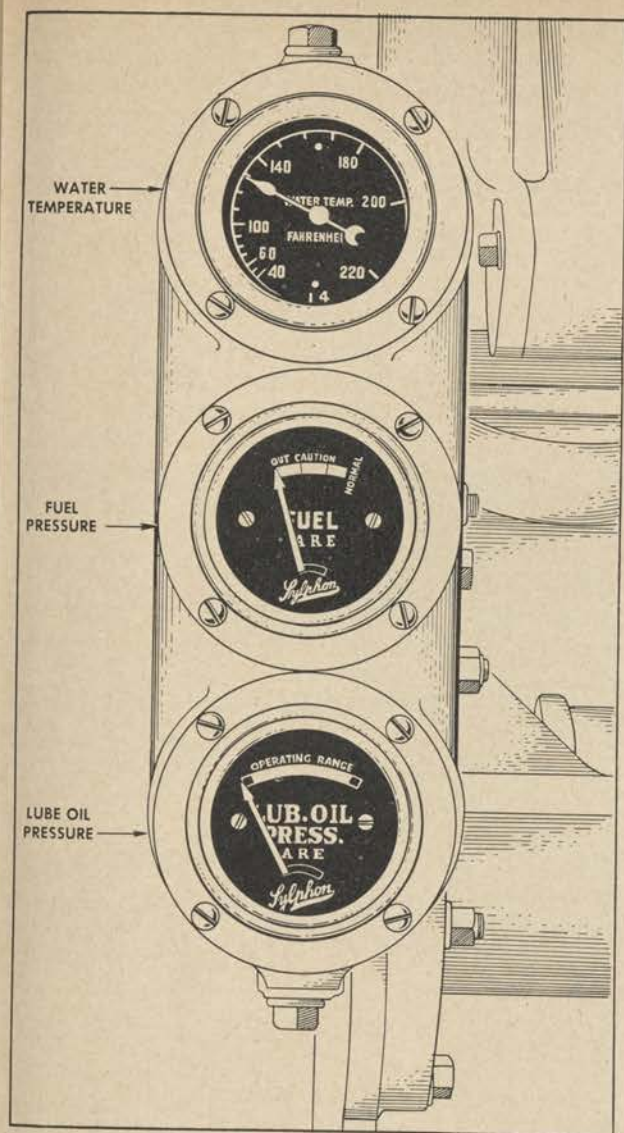


Figure 67. Diesel engine instruments.

Caution: If for any reason the oil gage does not register within the "operating range," stop the engine immediately, and determine whether the oil pump is operating correctly or whether the gage itself is at fault.

(3) *Water temperature indicator.* This instrument indicates the condition of the water cooling system. With the engine operating normally, the indicator should read between 160° and 190°.

Caution: Should the temperature as indicated by the instrument rise above 200° F., stop the engine and inspect the cooling system. (See par. 44g.)

(4) *Hour meter.* The engine is equipped with an hour meter, which is located on the right side

of the engine under the governor spring housing at the rear of the fuel injection pump housing. (See fig. 68.) The meter does not keep pace with the clock, but when the engine crankshaft turns the number of revolutions made in one hour at operating speed, the dial advances one number. Read the hour meter daily as a close check on the time to service the engine.

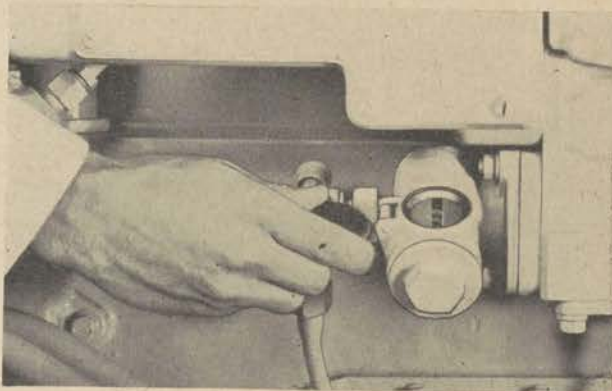


Figure 68. Cover on hour meter raised to observe dial reading.

b. *HOIST AIR PRESSURE GAGE.* One of these gages is on each hoist control stand, facing the operator. Normal working pressure is 70 pounds per square inch.

c. *ELECTRICAL INSTRUMENTS.* (1) *Main generator control panel (fig. 64).* Instruments on the main control panel are as follows:

(a) An ammeter which indicates the amperage produced by the main generator under various operating loads.

(b) A voltmeter which indicates the voltage under various operating loads. Keep voltage within 206 to 210 volts. See paragraph 18a for instructions on maintaining this voltage. Failure to keep within this voltage will result in damage to equipment.

(2) *Auxiliary generator control panel (fig. 66).* Instruments on the auxiliary control panel are as follows:

(a) An ammeter which indicates the amperage developed by the auxiliary Diesel generator set under various operating loads.

(b) A voltmeter which indicates the voltage developed by the auxiliary Diesel generator set under various operating loads. Keep voltage within 112 to 118 volts. See paragraph 22d for instructions on maintaining this voltage.

Caution: Failure to keep within this voltage will damage equipment.

d. AUXILIARY DIESEL GENERATOR INSTRUMENTS.

(1) *Lubricating oil pressure gage.* This instrument indicates the condition of the lubricating oil system of the engine. The correct oil pressure for the engine varies with the temperature conditions and viscosity of the oil, and should never be permitted to go below 20 pounds with the engine running on normal speed. As long as the needle stays between 20 and 60 pounds, it may be assumed that the lubricating oil system is operating correctly.

Caution: If, for any reason, the oil gage drops below 20 pounds, stop the engine immediately and determine whether the oil pump is operating correctly, or whether the gage itself is at fault.

(2) *Water temperature indicator.* This instrument indicates the condition of the water cooling system. With the engine operating normally, the gage should read between 160° and 190° F.

(3) *Ammeter.* This instrument indicates the rate at which the diesel generator is charging the starting batteries. With the engine operating at normal speed, the instrument must read approximately 15 amperes on the plus side. In a case where the batteries have been used severely, this rate of charge will continue for about an hour and then return to a charging rate of 2 amperes which is normal.

Section VI. OPERATION UNDER USUAL CONDITIONS

12. General

a. Proper operation of the machinery with which the barge derrick is equipped requires special knowledge. Unskilled personnel tampering with any of the equipment may cause serious damage.

Warning: It is not required that the engines be in operation for the equipment to cause destruction of life and material. Tampering with the foot pedals and air valves of the hoist control stations will release component parts of the derrick to swing uncontrollably with great destructive force.

b. Authorized personnel having experience with similar type equipment should first become thoroughly familiar with the operating instructions included in paragraphs 12 to 17, and then proceed cautiously until the "feel" and individual characteristics of the equipment involved are verified.

13. Operating Terms

<i>Operating terms</i>	<i>Description</i>
Port-----	Left side looking forward from control stand.
Starboard-----	Right side looking forward from control stand.
Aft-----	Toward the rear. Used to indicate direction.
Forward-----	Toward the front. Used to indicate direction.
Inboard-----	Toward center of barge.
Outboard-----	Toward side of barge.
Hatch-----	An opening in a deck permitting access through the deck.
Draft-----	The depth of the hull under water.
Galley-----	Kitchen compartment.
Vang-----	Line used to move boom to port or starboard or hold in position.
Five part line---	Indicates that the cable joining two pulleys passes back and forth five times between the pulleys.
Topping-----	Raising the boom.
Luffing-----	Raising or lowering the boom.
Hoisting-----	Raising the load with the boom fixed.
Slewing-----	To move the boom port or starboard.
Drag-----	Slight pressure on brake.
Sag-----	Line hanging loose.
Taut-----	Line drawn tight.
Reel in-----	Rotate drum to wind cable on it.
Pay out-----	Rotate drum to unwind cable.

14. Starting

a. GENERAL. All machinery of the barge derrick should be given a before-operation inspection described in paragraph 35*a*, prior to starting the equipment for handling of cargo. Make inspection to determine that:

(1) Sufficient space is available for the operating arc of the boom.

(2) No equipment, cargo, or other objects are on the barge deck to interfere with or be damaged by the load block and hook.

(3) Sufficient fuel is on hand to complete the work to be performed without the necessity for stopping to refuel.

(4) The main engine, air compressor, main generator, and capstan are in good operating condition.

(5) To start the auxiliary diesel generator or capstan see paragraphs 21 and 23.

b. STARTING THE STARTING ENGINE OF MAIN DIESEL.

Caution: Make sure that the flywheel clutch of the main engine is disengaged.

(1) See that the compression release lever is in the START position, as shown in figure 69, and that the throttle is locked in the extreme right position, so that the fuel injection pumps are shut off.

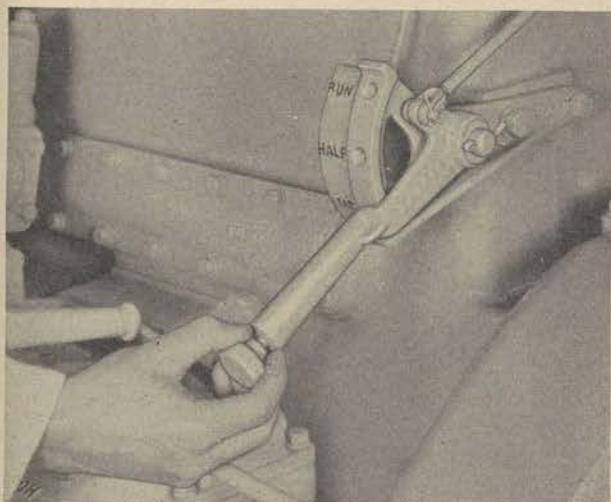


Figure 69. Compression release lever in start position.

(2) Open the starting engine fuel tank valve, and move the idling latch (3, fig. 60) to hold the starting engine governor shaft lever in the idling position.

(3) Insert the crank in the starting engine as shown in figure 70. If the engine is cold, move the manual spark control lever (1, fig. 60) to the ADVANCE position. If the engine is warm, move the lever to RETARD position. Grasp the crank with the right hand. Turn the starting engine magneto switch (2, fig. 60) to the ON position.

(4) Crank the starting engine until the compression stroke is reached; pull forward slowly from the top of the crank circle, then to start: pull the crank through the compression strokes with a rapid motion. *Do not spin the crank.*

Note. Remove the crank after the engine starts.

(5) *Choking.* Temperature and altitude will vary the length of time it is necessary to have the choke ON. (See 4, fig. 60.) Actual experience in

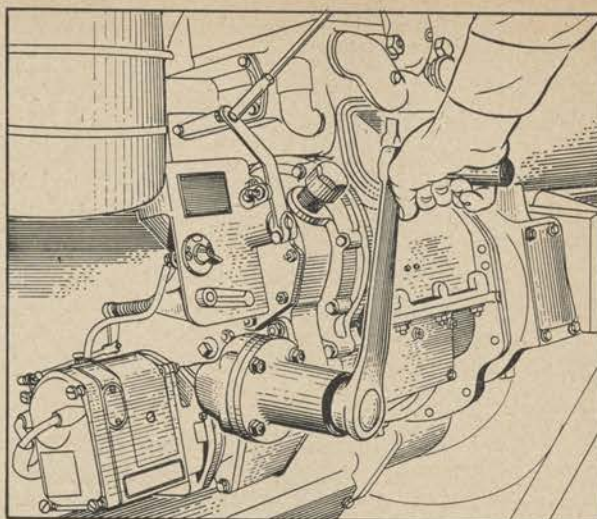


Figure 70. Correct position for cranking starting engine.

starting will determine the interval. If it is necessary to choke the engine, when starting, the *choke control rod should always be pulled out all the way.*

(6) As soon as starting engine starts, engage the manual spark control lever (1, fig. 60) in the ADVANCE position. Allow starting engine to run long enough to distribute crankcase lubricating oil thoroughly before running it at its governed speed.

c. STARTING CATERPILLAR DIESEL. (1) Disengage the starting engine clutch, figure 71, by pushing the lever in toward the Diesel engine.

(2) Engage starter pinion by pulling out on the starter pinion control lever, figure 71. If the pinion does not engage readily, partially engage the starting engine clutch for an instant, allowing the teeth to mesh with the flywheel gear.

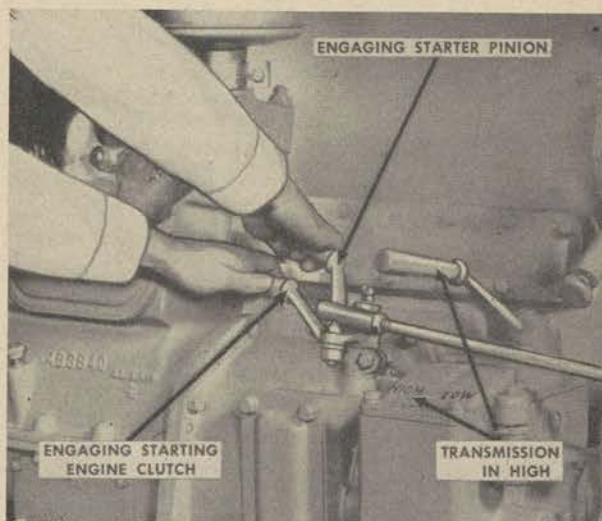


Figure 71. Engaging starting engine.

(3) After the starter pinion is engaged, allow the starting engine to run at full governed speed by releasing the idling latch. (See 3, fig. 60.)

(4) Engage the starting engine clutch by pulling out the lever, figure 71, as far as it will go.

(5) During cold weather, or at any time that oil "drag" in the Diesel engine, slows down the starting engine so that the normal cranking speed cannot be reached, disengage the starting engine clutch and shift the starting engine transmission lever, figure 71, into LOW. Engage the starting engine clutch and after the oil "drag" has been loosened, move the compression release lever to RUN position as shown in figure 72. Allow the starting engine to turn the Diesel engine for several minutes, since the heat of compression will assure easy starting. Now move the compression release lever to START position, disengage the starting engine clutch, shift the starting engine transmission to HIGH, and engage the clutch.

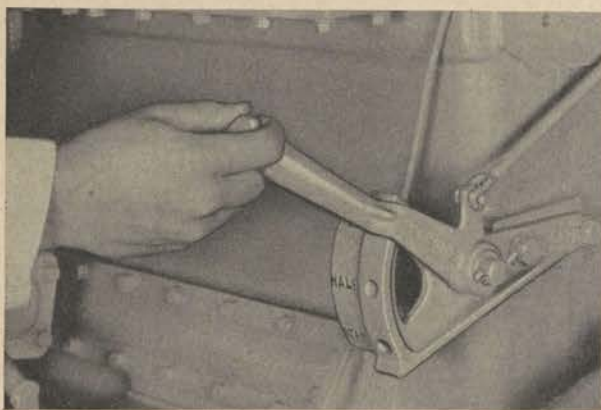


Figure 72. Compression release lever in run position.

Note. When the starting engine is cranking the Diesel engine against compression (with the compression release lever in the RUN or HALF position), the heat of compression warms the cylinders, pistons, and combustion chambers to the temperature necessary for starting. For this reason, best results are obtained by moving the compression release lever to the RUN position as soon as the starting engine will turn the Diesel engine at normal cranking speed.

(6) After the starting engine has cranked the Diesel engine against compression for a few minutes and the temperature indicator shows the proper reading as dictated by experience, push the throttle control lever over to the halfway position, figure 63. If after turning several revolutions the Diesel does not fire, move the throttle back to the OFF position and allow the starting engine to turn

the Diesel engine a little longer to raise its temperature.

(7) If the Diesel engine is thoroughly heated but fails to start, refer back to before-operation inspection, paragraph 35a. Particularly check the following:

Priming the fuel system (par. 44d (13)).

Testing the fuel injection equipment (par. 44d (7)).

(8) When the Diesel engine begins to fire, the starter pinion automatically disengages, but it is necessary to disengage the starting engine clutch by pushing in the lever (fig. 73) toward the engine.

d. STOPPING THE STARTING ENGINE. (1) Close the starting engine fuel tank valve, allowing the engine to burn all the fuel in the carburetor.

(2) Turn off starting engine magneto switch.

(3) As soon as the Diesel engine starts, immediately check the lubricating oil pressure gage which should register in the Operating Range.

(4) Allow the Diesel engine to idle for 5 minutes with the throttle at least half open, and for 5 minutes at full throttle before applying the load.



Figure 73. Engaging main engine clutch.

e. **ENGAGING MAIN ENGINE CLUTCH.** Apply load (drive to hoist, main generator, and air compressor) by pulling the clutch lever in a direction away from the clutch (toward galley). (See fig. 73.)

f. **STARTING HOIST.** Before starting the hoist, give both hoist and derrick the before-operation inspection as prescribed in paragraph 35. Upon completion of this inspection, check the positions of the boom, the main load hook, and the whip hook to verify that their movement will be unobstructed. The main hook is normally left in the safety position. Lower the hook and disengage it from the safety position before commencing operations. If only the main hook is to be used, raise the whip hook to a position 5 feet below the boom end and leave it there. If only the whip hook is to be used, raise the main hook to a position 5 feet below the boom end and leave it there.

15. Stopping

a. **STOPPING MAIN ENGINE.** Disengage the load from the engine by pushing the clutch lever in the direction opposite to that shown in figure 73 (away from galley). Set the throttle to halfway position and allow engine to idle at this speed for at least five minutes. Then move the throttle lever to STOP position. Shift the compression release lever to the START position. (See fig. 69.) Do not close the main fuel tank valve. If the temperature is below freezing, or if there is a possibility of freezing weather before engine will be started again, drain the cooling system or protect with antifreeze solution (par. 24).

b. **STOPPING HOIST.** To shut down for a period of 8 hours or longer, swing the boom to the barge center line, raise it slightly above 45°, lower the main hook and engage it in the safety position. (See fig. 74.) Hoist the whip hook to a position 5 feet below the boom end.

16. Air Compressor

a. **GENERAL.** The air compressor is driven by multi-V-belts off the engine drive shaft. It is provided with constant speed pressure regulator control.

b. **STARTING.** The compressor is kept unloaded on starting by screwing the trigger valve wing nut which keeps the trigger valve open. Allow the compressor to warm up a few minutes without building up tank pressure. Unscrew trigger valve

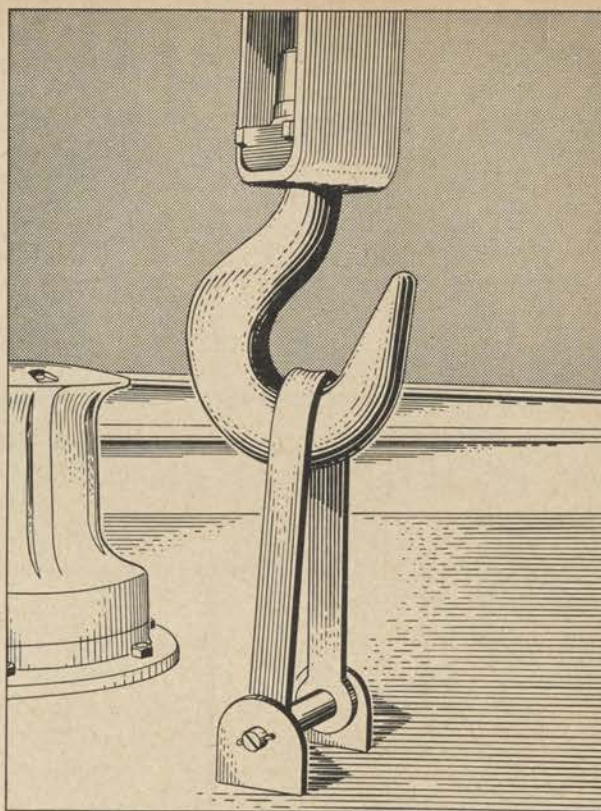


Figure 74. Main block hook in safety position.

wing nut until trigger valve is operating. Adjust trigger valve until pressure gage indicates 70 pounds' operating pressure (par. 45c (3)). Maintain 70 pounds' operating pressure by adjusting trigger valve. After compressor has run for a few hours, draw down nuts and bolts to compensate for gasket compression.

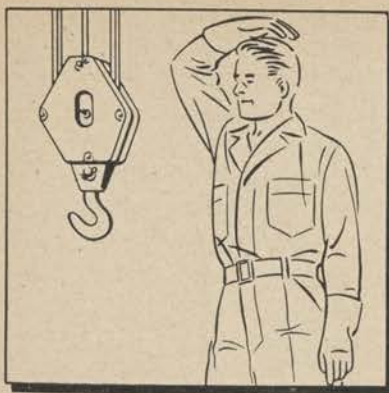
Caution: Stop engine and check trigger valve if pressure builds up to 75 pounds' operating pressure and safety valve pops.

c. **STOPPING.** The air compressor stops when the main engine is shut down; no special action is required.

17. Operations

a. **GENERAL.** The following paragraphs provide instructions necessary to perform the operations on the hoist control stations in order to accomplish the work for which the barge derrick was designed.

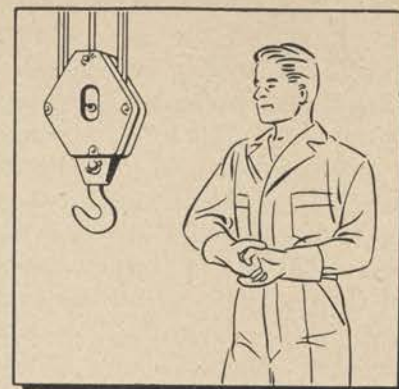
(1) The efficiency of a cargo handling operation depends largely upon the ability and flexibility of the men composing the working gang or section. The safety and timing of the operation depends



USE MAIN HOOK



USE AUXILIARY HOOK (WHIP)



ENGAGE HOIST DOG PAWLS



RAISE HOOK



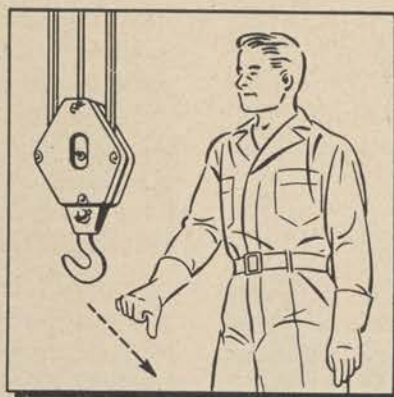
LOWER HOOK



SWING BOOM



HOIST BOOM



LOWER BOOM



STOP

Figure 75. Standard hand signals.

upon the discretion of the signal man as to when and what kind of signals are given. Personnel in the gang should be familiar with the signals used. For this purpose, figure 75, which illustrates standard hand signals for derrick operation, is included and should be followed in the absence of a bell system.

(2) Two hoist operators are required. The operator on the port side controls the vang drums for swinging, and the operator on the starboard side controls the boom topping drum, load drum, and whip drum.

(3) Drum control is through air operated friction band clutches. Air pressure applied to the clutch power chamber can be regulated by positioning the air valve lever. The clutch will take hold smoothly when the lever is moved gradually to the ON position.

(4) An air pressure gage is mounted on each control stand and operators check air pressure before and during operation. Without correct working pressure, the friction drive clutches will not function. Normal working pressure is 70 pounds per square inch.

(5) The boom topping drum, the load drum, and the whip drum are each provided with ratchet and pawl for locking in position. No ratchets and pawls are provided for the twin vang drums.

Note. Use the pawl to lock a drum in position only when the drum is to remain in that position for an appreciable time. Do not use the pawl during continuous raising and lowering of the boom or load.

(6) Inexperienced operators should attempt only one operation at a time, devoting full attention to that single operation. As operators become more experienced and skillful, double operations, such as raising both the boom and the main lead hook, may be performed at the same time. In raising and lowering the boom, careful cooperation between the hoist operator and the vang operator is required to keep the vang lines taut at all elevations of the boom.

Note. In the following description of operator's duties, the word ON applied to an air valve indicates that air pressure is applied to the clutch and the clutch is engaged. The word OFF indicates the reverse. The word ON applied to a brake foot pedal indicates that the brake pedal is depressed and the brake band is contracted on the brake drum. The word OFF indicates the reverse. The word LOCKED applied to a pawl lever indicates the pawl is engaged in the drum ratchet. The word RELEASED indicates the reverse.

b. VANG OPERATOR'S DUTIES (SWINGING BOOM).

(1) *General.* The vang operator manipulates two air valves, one for each vang drum friction clutch and two brake pedals, one for each vang drum brake.

(2) *Swinging boom to starboard (fig. 78).* (a) Release catch on left foot pedal and hold pedal (fig. 62) in position with the left foot.

(b) Release catch on right foot pedal and let the pedal (4, fig. 62) rise to the OFF position.

(c) Move the right air valve (fig. 62) aft to the ON position. The clutch will take hold smoothly as the valve lever is gradually pulled back.

(d) As the starboard vang line is reeled in, ease off on the left foot pedal (fig. 62), permitting the port vang line to pay out under control of the brake. Keep a slight drag on the brake on the port drum. Do not permit the port vang line to sag.

(e) When the boom has reached the desired position, depress the left foot pedal (fig. 62) to full ON position with catch ON.

(f) Depress right foot (fig. 62) pedal to full ON position with catch ON.

(g) Move right air valve (fig. 62) forward to OFF position.

(3) *Swinging boom to port (fig. 80).* (a) Release catch on right foot pedal and hold pedal (fig. 62) in position with right foot.

(b) Release catch on left foot pedal and allow pedal (fig. 62) to rise to OFF position.

(c) Move the left air valve (fig. 62) aft to the ON position. The clutch will take hold smoothly as the valve lever is gradually pulled back.

(d) As the port vang line is reeled in, ease off on right foot pedal (fig. 62), permitting the starboard vang line to pay out under control of the brake. Keep a slight drag on the brake of the starboard drum. Do not permit the starboard vang line to sag.

(e) When the boom has reached the desired position, depress right foot pedal (fig. 62) to the full ON position with catch ON.

(f) Depress left foot pedal (fig. 62) to full ON position with catch ON.

(g) Move left air valve (fig. 62) forward to OFF position.

(4) *Holding boom in position.* Place both air valves forward in the OFF position. Depress both foot pedals (fig. 62) to the ON position and

permit foot pedal catches to engage the ratchets and hold the pedals down.

(5) *When boom is raised.* With the boom in the desired position, port or starboard, and the hoist operator prepared to raise it, first release the catches on both foot pedals and hold in position. As boom is raised, ease off both foot pedals (fig. 62) and pay out both vang lines equally under control of the brakes. Keep a slight drag equally on both foot pedals to keep both vang lines taut while paying out. Pay vang lines out equally otherwise boom will swing in the direction of the taut line. When boom has reached the proper position and hoist operator stops raising, depress both foot pedals (fig. 62) to the ON position with catches ON.

(6) *When boom is lowered.* With the boom in its correct position, port or starboard, and the hoist operator prepared to lower it, first release the catches of both foot pedals and let pedals (fig. 63) rise to the OFF position. Move both air valve handles (fig. 62) aft to the ON position and reel in both vang lines equally as the boom is lowered and lines slacken. Both vang lines must be reeled in equally, otherwise the boom will swing in the direction of the taut line. When boom has reached the desired position, and hoist operator stops lowering, depress both foot pedals (fig. 62) to the full ON position with catches ON. Move both air valves (fig. 62) forward to the OFF position.

Note. Reel in only enough line to take up the slack caused by the lowering of the boom.

c. HOIST OPERATOR'S DUTIES. (1) *General.* The hoist operator has control of three air valves, one for each drum friction clutch and three brake pedals, one for each drum brake. He also manipulates three pawl handles for locking each drum in position. In addition he has control of the main engine throttle which varies the engine speed from IDLING to FULL SPEED. For handling light loads on the whip hook, the throttle is set at an intermediate speed.

(2) *Raising the boom (fig. 79).* (a) Release the catch on the boom foot pedal and hold the pedal (fig. 61) in place.

(b) Release the pawl handle (fig. 61) from LOCKED notch and move it to the RELEASED notch.

(c) Move the boom air valve lever (fig. 61) aft to the ON position. The clutch will take hold

smoothly as the valve lever is gradually pulled back.

(d) As the boom line begins to reel in, ease off on the foot pedal (fig. 61), permitting the pedal to rise to the OFF position.

(e) When the boom has reached the desired height, depress the foot pedal (fig. 62) to the ON position with the catch ON.

(f) As the brake takes hold, move the boom air valve (fig. 61) forward to the OFF position.

(g) Move the pawl lever (fig. 61) from the RELEASED to the LOCKED position if boom is to remain at this height.

Warning: Lock the boom in position by using the drum pawl if the boom is to stay in that position any length of time. Do not use the pawl during continuous raising and lowering of the boom.

Caution: Hold the boom in position with the foot pedal until the boom drum begins to move and take over the load.

(3) *To lower the boom (fig. 81).* (a) Release the catch on the boom foot pedal and hold the pedal (fig. 61) in place.

(b) Release the pawl handle (fig. 61) from LOCKED notch and move it to the RELEASED notch.

(c) Move the boom air valve (fig. 61) aft to the ON position. The clutch will take hold smoothly as the valve lever is gradually pulled back.

(d) As the boom line begins to reel in, ease off on the foot pedal (fig. 61), permitting the pedal to rise to the OFF position.

(e) Reel in only enough boom line to move the drum far enough to disengage the pawl from the ratchet tooth. As soon as the pawl is RELEASED, move the boom air valve (fig. 61) forward to the OFF position.

(f) Keep the drum under the control of the foot pedal and ease the boom down under brake control.

(g) When the boom has been lowered to the desired height, depress the foot pedal (fig. 61) to the full ON position with catch ON.

(h) Move the pawl lever (fig. 61) from the RELEASED to the LOCKED position if boom is to remain at this height.

Caution: Keep boom under control of foot pedal at all times.

(4) *Hoisting the load.* (a) Release the catch on the load drum foot pedal and hold the pedal (fig. 61) in place.

(b) Release the pawl handle (fig. 61) from LOCKED notch and move it to the RELEASED notch.

(c) Move the load drum air valve lever (fig. 61) aft to the ON position. The clutch will take hold smoothly as the valve lever is gradually pulled back.

(d) As the load drum line begins to reel in, ease off on foot pedal (fig. 61), permitting the pedal to rise to the OFF position.

(e) When the load has been hoisted to the desired height, depress foot pedal (fig. 61) to the ON position with the catch ON.

(f) As the brake takes hold, move the hoist air valve lever (fig. 61) forward to the OFF position.

(g) Move the pawl lever (fig. 61) from the RELEASED to the LOCKED position if load is to remain at this height.

Warning: Lock the load in position by using the drum pawl if the load is to stay at that height any length of time. Do not use the pawl during continuous raising and lowering of the load.

(5) *Lowering the load.* (a) Release the catch on the load drum foot pedal and hold the pedal (fig. 61) in place.

(b) Release the pawl handle (fig. 61) from the LOCKED notch and move it to the RELEASED notch.

(c) Move the load drum air valve (fig. 61) aft to the ON position. The clutch will take hold smoothly as the valve lever is gradually pulled back.

(d) As the load drum line begins to reel in, ease off on foot pedal (fig. 61), permitting the pedal to rise to the OFF position.

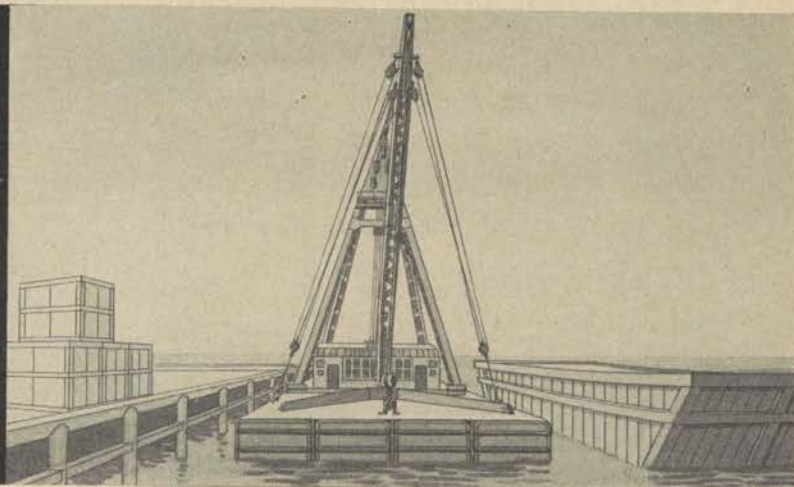
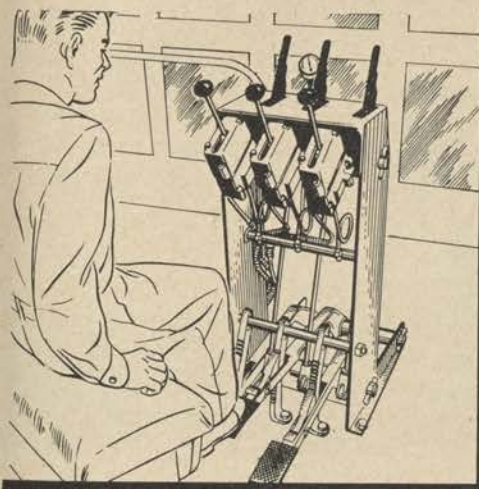


Figure 76. Lowering load block by releasing center pedal.



Figure 77. Raising load block, using center air valve and lowering boom by releasing right pedal.

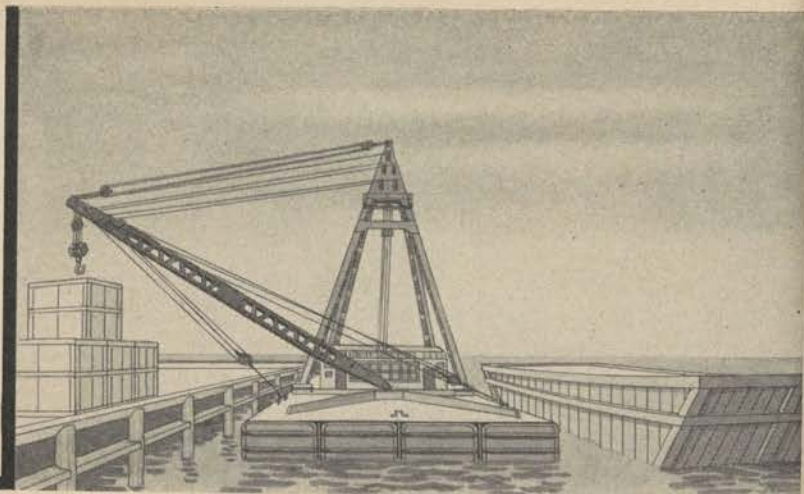


Figure 78. Swinging boom to right, using right air valve and releasing left pedal.

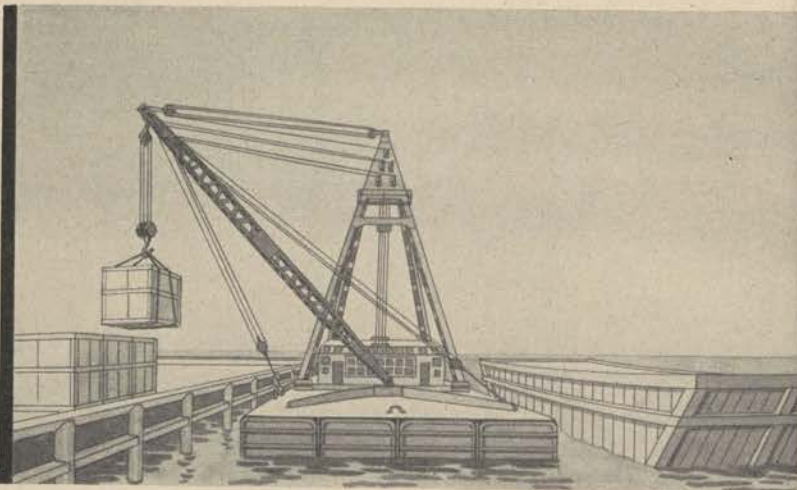


Figure 79. Raising boom, using right air valve.

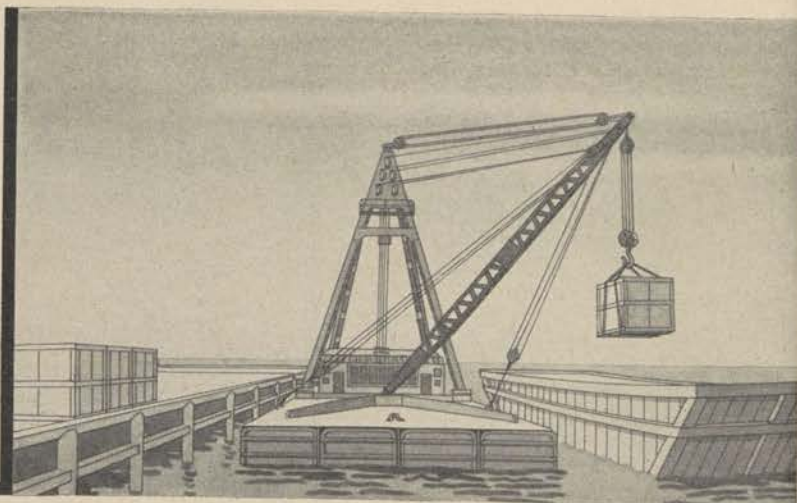


Figure 80. Swinging boom to left, using left air valve and releasing right pedal.

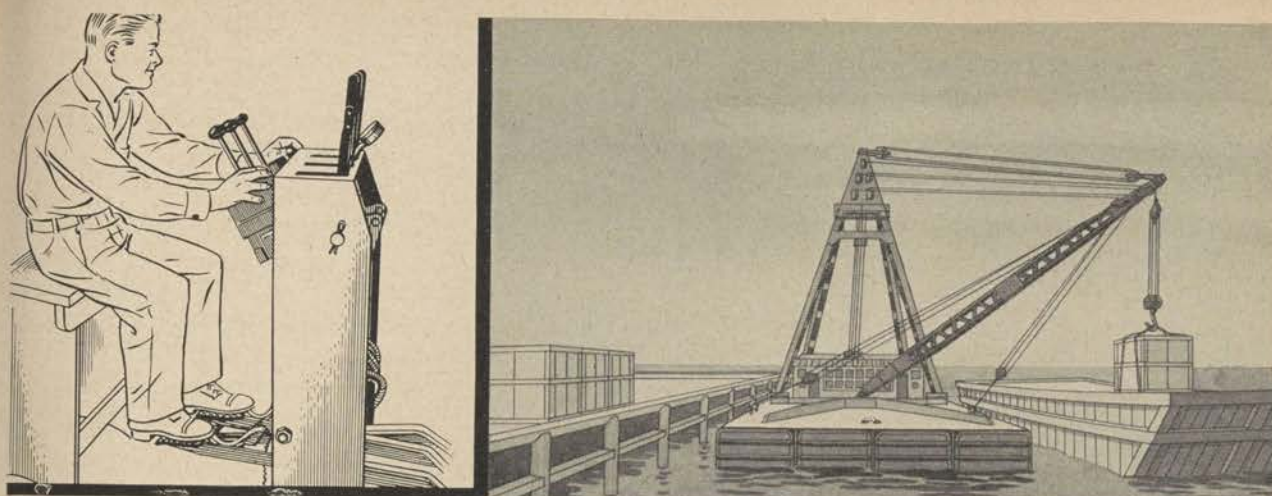


Figure 81. Lowering boom and load block by releasing center and right pedals.

(e) Reel in only enough line to move the drum far enough to disengage the pawl from the ratchet tooth. As soon as the pawl is **RELEASED**, move the boom air valve (fig. 61) forward to the **OFF** position.

(f) Keep the drum under the control of the foot pedal (fig. 61) and ease the load down under brake control.

(g) When the load has been lowered to the proper height, depress the foot pedal (fig. 61) to the full **ON** position with catch **ON**.

(h) Move the pawl lever (fig. 61) from the **RELEASED** to the **LOCKED** position if load is to remain at this height.

Caution: Keep the load under control of the foot pedal at all times.

(6) *Hoisting whip hook* (fig. 82). (a) Release the catch on the whip foot pedal and hold the pedal (fig. 61) in place.

(b) Release the pawl handle (fig. 61) from **LOCKED** notch and move it to the **RELEASED** notch.

(c) Move the whip air valve (fig. 61) aft to the **ON** position. The clutch will take hold smoothly as the valve lever is gradually pulled back.

(d) As the whip line begins to reel in, ease off on foot pedal (fig. 61), permitting the pedal to rise to the **OFF** position.

(e) When the whip hook has been hoisted to the desired height, depress foot pedal (fig. 61) to the **ON** position with the catch **ON**.

(f) As the brake takes hold, move the whip air valve lever (fig. 61) forward to the **OFF** position.

(g) Move the pawl lever (fig. 61) from the

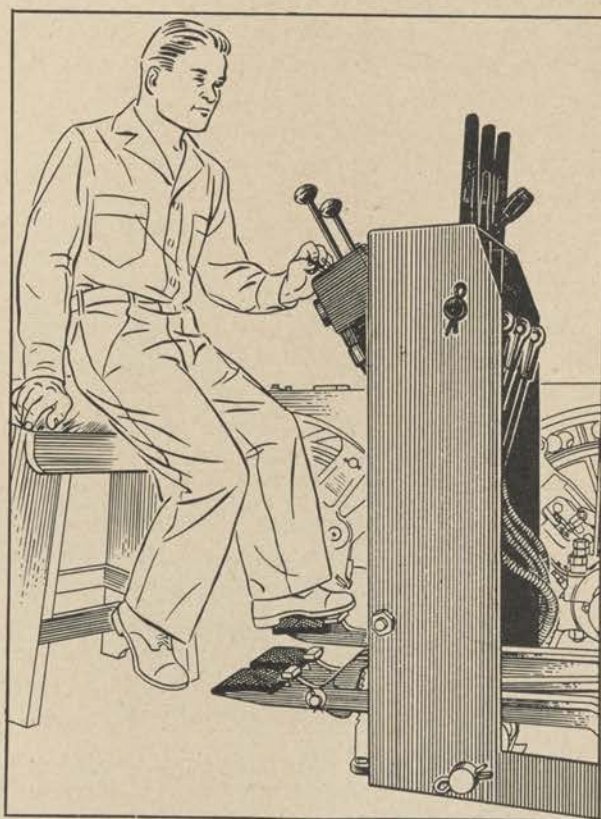


Figure 82. Raising the whip hook.

RELEASED to the **LOCKED** position if whip hook is to remain at this height.

Warning: Lock the load in position by using the drum pawl if the load is to stay at that height any length of time. Do not use the pawl during continuous raising and lowering of the load.

(7) *Lowering the whip hook.* (a) Release the catch on the whip foot pedal and hold the pedal (fig. 61) in place.

(b) Release the pawl handle (fig. 61) from the LOCKED notch and move it to the RELEASED notch.

(c) Move the whip air valve lever (fig. 61) aft to the ON position. The clutch will take hold smoothly as the valve lever is gradually pulled back.

(d) As the whip line begins to reel in, ease off on foot pedal (fig. 61), permitting the pedal to rise to the OFF position.

(e) Reel in only enough whip line to move the drum far enough to disengage the pawl from the ratchet tooth. As soon as the pawl is RELEASED move the whip air valve lever (fig. 61) forward to the OFF position.

(f) Keep the drum under the control of the foot pedal (fig. 61) and ease the whip hook down under brake control.

(g) When the whip hook has been lowered to the proper height, depress the foot pedal (fig. 61) to the full ON position with the catch ON.

(h) Move the pawl lever (fig. 61) from the RELEASED to the LOCKED position, if the whip hook is to remain at this height.

Caution: Keep the whip hook under control of foot pedal at all times. When lowering, lower the load slowly.

d. **TYPICAL OPERATION.** (1) Figures 76 to 81, inclusive, illustrate a typical operation in normal service such as the transfer of a packing case from a wharf on the starboard side of the barge to deck of a lighter alongside the port side of the barge. The steps listed below cover only the basic operations of raising and lowering the boom and the main load hook, and swinging the boom in both directions. Both the movements of the operators and resulting maneuvers of the derrick are illustrated in figures 76 to 81.

(2) Lower the main hook in order to disengage it from the safety position. (See fig. 76.)

(3) Lower the boom to secure the required reach and raise the hook to clear the lead. (See fig. 77.)

(4) Swing boom to the right over the load. (See fig. 78.)

(5) Raise the boom. (See fig. 79.)

(6) Swing the boom to the left over the lighter. (See fig. 80.)

(7) Lower the boom and the main hook to set down the load. (See fig. 81.)

Section VII. OPERATION OF AUXILIARY EQUIPMENT

18. Main Generator

a. **STARTING MAIN GENERATOR.** (1) *General.* Before starting the main generator be sure that the manual control switch on the voltage regulator is in the OFF position.

(2) *Main control switch.* The main control switch lever is manually operated. It has three positions: ON for main generator, which is at the top; OFF in center position; and ON at bottom, for auxiliary generator. Throw switch up from OFF position to ON position. (See fig. 64.)

(3) *Main control panel switch.* Two positions are provided: ON (upper) and OFF (lower). Place in ON position.

(4) *Rheostat (fig. 64).* Adjust to approximately 50 volts.

(5) *Voltage regulator.* The manual control switch on the voltage regulator (fig. 65) is now placed to ON position. The voltage should come up to somewhere near normal voltage (approximately 208 volts).

(6) *Voltage regulator rheostat (fig. 65).* The voltage regulator rheostat, located on the cover of the voltage regulator, marked RAISE and LOWER, is used to adjust the voltage to the proper operating value. The voltage should be approximately 208 volts. This completes the starting operation of main generator. The voltage is now automatically controlled by means of the voltage regulator.

(7) *Voltmeter (fig. 64).* The needle on the voltmeter will vibrate regularly when the load is applied to the generator. When the load is added or removed the needle will hesitate slightly or just long enough for this voltage to return to normal. Keep voltage at approximately 208 volts.

(8) *Polarity reverse switch (fig. 64).*

Caution: Reverse this switch once a day. Failure to reverse polarity daily will result in failure of voltage regulator to function properly, and cause damage to equipment.

(9) *Voltage regulator (fig. 65).* To remove voltage regulator from the circuit without disrupting the voltage, turn rheostat in a direction to raise voltage to approximately 230 volts. Place

the voltage regulator manual control switch at the OFF position. Now control voltage manually with the rheostat. To return the voltage regulator to the circuit without disrupting voltage under manual control, lower the voltage with the rheostat to 190 volts, turn the regulator manual control switch to the ON position, and return the rheostat to normal operating point.

b. DISCONNECTING MAIN GENERATOR. To stop the main generator, throw the main control switch lever to the OFF position and place voltage regulator manual control rheostat (fig. 65), in OFF position.

19. Auxiliary Diesel Generator Set

a. STARTING AUXILIARY DIESEL. (1) Before starting the engine, perform before-operation inspection described in paragraph 35.

(2) Prime the fuel system as described in paragraph 53c (7).

(3) Press the starting button on the left-hand side of the instrument panel. (See fig. 83.)

(4) With the right hand, loosen the governor lock screw on the fuel pump about one-half turn and turn horizontal governor screw about half-way into the fuel pump.

(5) With the governor screw turned into the fuel pump a sufficient distance, the engine will start promptly.

(6) Release the starter switch as soon as the engine begins to fire. Throttle the engine down to a point where it will idle conveniently (600 or 800 rpm) by turning the governor screw out of the fuel pump. Allow to idle for about two minutes until engine warms up before throwing on full load.

(7) With the engine operating at full load and normal speed, apply the hand to the injector tube and check the pulsation of each injector. If the pulsation in the injector tube is irregular or weak, loosen the cylinder bleeder screw (fig. 270) in the fuel pump, while the engine is running, until all the air is removed from the pump, then tighten.

Note. When first starting the engine, a pronounced combustion knock may be experienced. This knock is caused by air in the injectors and will disappear as soon as the air is let out. The knocking may be stopped immediately by turning down the rheostat on the auxiliary generator control panel. (See fig. 250.) Do this with the engine operating at full throttle, since the increased quantity of oil flowing through the lines pushes the air out ahead of it.

b. STOPPING ENGINE. (1) To stop the engine, turn the governor screw (fig. 83) out until the engine stops.

Note. Do not stop by turning off the fuel supply line.

(2) Perform "After Operation Inspection" described in paragraph 34b (1) (d).

20. Auxiliary Generator Controls and Instruments

a. GENERAL. With the auxiliary Diesel generator set started, the electrical control on the equipment is achieved as described below:

b. AUXILIARY GENERATOR CONTROL PANEL SWITCH. The auxiliary control panel switch has two positions, ON at the top and OFF at bottom. Set switch up to ON position connecting panel.

c. MAIN CONTROL SWITCH (FIG. 250). The main control switch lever has three positions: ON, OFF, and ON. The ON position at top is for the main generator, the center OFF position cuts out both generators, and the bottom ON position is for connecting the auxiliary generator. Throw switch to ON position to connect the auxiliary generator into circuit.

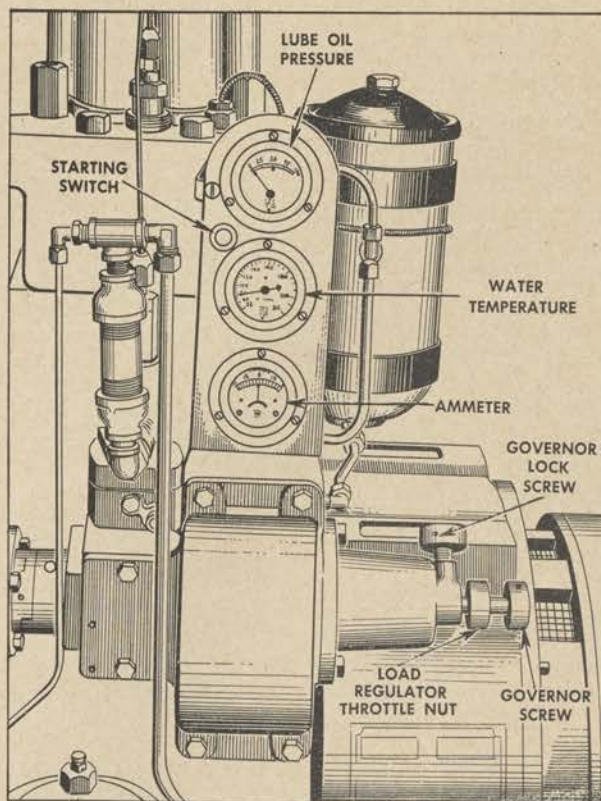


Fig. 83. Auxiliary generator engine controls.

d. **RHEOSTAT** (FIG. 250). The rheostat is used to adjust voltage. Keep the voltage within 112- to 118-volt range.

e. **VOLTMETER** (FIG. 250). The voltmeter indicates voltage developed by the auxiliary generator. When the voltage is under 112 volts and over 118 volts, adjust it by means of the control on rheostat.

f. **AMMETER** (FIG. 250). The ammeter indicates the amperage supplied by the auxiliary generator.

g. **DISCONNECTING THE AUXILIARY GENERATOR FROM THE CIRCUIT.** To open the auxiliary generator circuit, throw the main control switch lever (fig. 250) to the OFF position. See paragraph 35 for after-operation inspection.

21. Capstan

a. **CONTROLS.** The capstan can be operated from three separate locations on the barge: port side of forward deck, capstan hatch, and engine room. The capstan is controlled from the deck by means of a push button station, located on the deck; from the engine room by means of a switch on the main control panel; and from the capstan hatch by means of a push button and operating lever on the combination starter.

b. **OPERATING CAPSTAN FROM ENGINE ROOM.** (1) *Operating lever.* Throw the operating lever on the combination starter enclosure in the port hatch to the ON position. (See fig. 254.)

(2) *Capstan control switch.* Throw the capstan control switch located on the main control panel in the deck house to the ON or OFF position to start and stop the capstan. (See fig. 250.)

c. **OPERATING CAPSTAN FROM DECK.** (1) *Operating lever.* Throw the operating lever on the combination starter enclosure to the ON position.

(2) *Push button station.* Push the START button located under the enclosure, to start the capstan; push the STOP button to stop the capstan. (See fig. 84.)

d. **OPERATING CAPSTAN FROM CAPSTAN HATCH** (FIG. 254). (1) *Operating lever.* Throw the operating lever on the combination starter enclosure to the ON position.

(2) *Push button control.* Push the START button located on the combination starter enclosure, to start the capstan; push the STOP button to stop the capstan.

Note. The overload relays are of the instantaneous trip type. Hold the START button until motor is up to speed.

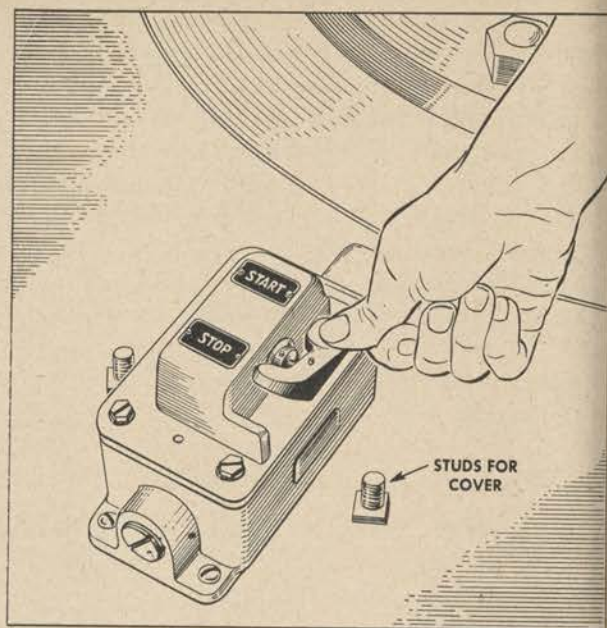


Figure 84. Operating capstan push button station.

e. **STARTING CAPSTAN AFTER CIRCUIT BREAKER IS TRIPPED.** (1) When the circuit breaker trips, due to current overload, etc., before the starter can be reset, perform the operation described below.

(2) First move the operating lever on the combination starter enclosure to the OFF position, and then return it to the ON position.

(3) Press START button on push button station, or throw circuit breaker to ON position to restart capstan.

22. Lighting System and Electrical Accessories

a. **CONTROLS.** The circuit breakers for the lighting system operating on 120 volts, are located on the main generator control panel. They are marked HOUSE LIGHTS, CABIN LIGHTS, ENGINE ROOM LIGHTS, and STORE ROOM LIGHTS. The capstan control on the main generator panel also lights the two forward hatch lights. Move a circuit-breaker switch from left to right or vice versa to open or close the circuit. With the circuit-breaker switch in the ON position, turn switch lamps on or off by means of individual switches provided for each light in the base or wall receptacle.

b. **SHORE LINE.** Current for the lighting system may be obtained from an available shore line for use when generators are not operating. Use

only 120-volt, 60-cycle, single-phase current. The receptacle for the shore line is located on the outside of cabin bulkhead, port side. The forward receptacle is for the shore line, a tyrex shore line cable being provided for making the connection. With the connection made, lighting is controlled in the normal manner by the circuit-breaker switches on the main generator control panel.

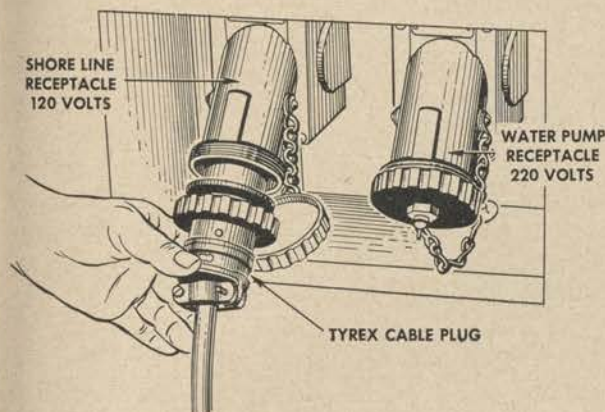


Figure 85. Connecting shore line.

c. FLOODLIGHTS AND CONTROLS. The circuit-breaker switches for the floodlights, operating on 208 volts, are located on the main generator control panel. They are marked FLOODLIGHTS BOOM and FLOODLIGHTS HOUSE. The circuit-breaker switch marked FLOODLIGHTS BOOM controls the two floodlights on the A-frame and the two floodlights on the boom. The circuit-breaker switch marked FLOODLIGHTS HOUSE controls the two floodlights located on the deck house roof. Operate circuit-breaker switches for the floodlights manually, moving the switch from left to right or vice versa to turn floodlights on or off.

d. REFRIGERATOR. (1) *Controls.* The refrigerator controls consist of a temperature control and control switch. The temperature control for the refrigerator is located under the cabinet door inside the refrigerator cabinet.

(2) *Starting refrigerator when generators are operating.* Set refrigerator control switch on main generator control panel at ON position. Connect refrigerator plug to wall receptacle. Make sure temperature control dial (fig. 86) is not on OFF position.

(3) *Starting refrigerator when generators are not operating and when a shore line is available.* Connect shore line. (See fig. 85.) Place refrigerator control switch on main generator control

panel at ON position. Connect refrigerator plug to wall receptacle.

(4) *Operation of refrigerator.* The refrigerator is equipped with a special temperature control marked TRUE TEMP CONTROL. The control is a solid vertical dial, operated manually with the finger. The markings on the dial are COLD-EST, FREEZING 32°, EXTRA COLD 34°, HEAVY DUTY 37° NORMAL 40°, ECONOMY 43°, VACATION 46°, DEFROST 50°, and OFF.

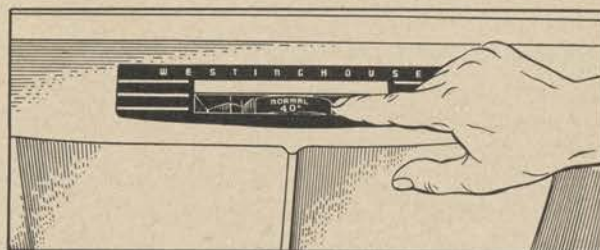


Figure 86. Refrigerator temperature control.

The dial is operated manually to bring the selected temperature to the upper center position. Normal 40° F. is recommended as the best average temperature for the food compartment.

(5) *Stopping refrigerator.* The temperature control should be placed at OFF position. If refrigerator is not to be used for some time, turn off the refrigerator switch on the main generator control panel.

e. ELECTRIC STOVE. (1) *Controls.* The stove controls consist of a temperature control and control switch. The temperature control is located on the left-hand side of stove.

(2) *Starting electric stove when generators are operating.* Set electric stove control switch on main generator control panel at ON position. Connect stove plug to the wall receptacle.

(3) *Starting electric stove when generators are not operating and shore line is available.* Connect shore line. (See fig. 85.) Place electric stove control switch on main generator control panel at ON position. Connect stove plug to wall receptacle.

(4) *Operation of electric stove control.* The stove control is marked as follows: OFF, LOW, MEDIUM, and HIGH. It is operated manually. Rotate the indicator to the desired temperature and the stove is ready for use.

(5) *Shutting down stove.* Turn dial to OFF to turn it off. Return to use by turning dial to required temperature.

Section VIII. OPERATION UNDER UNUSUAL CONDITIONS

23. Barge Operation

a. In northern waters, take care not to move the barge through heavy ice cakes which may damage the thin hulls of the barge vessels. If kept moored in one place, the barge derrick can be used in extreme weather to the same extent that any similar equipment can be used. Before operating, clear ice and snow from exposed blocks and lines.

Caution: Haul the barge out of the water, or move it to warm waters, if there is danger of water freezing solid. The hull plating may be crushed and the barge sunk by solid ice.

b. Due to its shallow draught, the barge is susceptible to both high wind and rough water. These elements make special handling of the load necessary. When the wind velocity exceeds 20 miles per hour, exercise care both in picking up and setting down loads which may tend to "bounce" with resulting damage to cargo. Rough water, which usually accompanies high wind, may cause rough landings and pick ups; use extreme care and skill under such conditions. Under extreme conditions of wind and sea, suspend operations.

24. Extreme Cold

a. CATERPILLAR DIESEL ENGINE. (1) *General.* If the Diesel engine and its starting engine have been maintained in good mechanical condition, and the precautions necessary for cold weather operation as listed below are taken, ordinary cold weather will not cause difficulty in starting or loss of efficiency.

(2) *Gasoline for starting engine.* Use the authorized grade of gasoline to avoid cold weather starting difficulties.

(3) *Storage and handling of gasoline for starting engine.* In cold weather, condensation of moisture in the air will cause water to accumulate in the storage tank and containers. This water will freeze and form ice crystals that will clog fuel lines and carburetor jets unless the following precautions are taken:

(a) Use filter paper or strainer when filling gasoline storage tank and fuel tank, or when transferring fuel from one container to another.

(b) Remove snow or ice from gasoline storage tank or dispensing equipment.

(c) Keep filler caps on all gasoline tanks properly tightened.

(d) To reduce hazard of ice formation in fuel tank, add $\frac{1}{2}$ pint of denatured alcohol, grade 3, each time 25 or more gallons of fuel are added.

(e) If possible, keep fuel tank full when operating in extreme cold weather.

(4) *Fuel oil.* Use only the authorized grade of Diesel fuel oil.

(5) *Storage and handling of fuel oil for Caterpillar.* Observe precautions in handling as listed for starting engine ((3) above).

(6) *Protection of cooling system.* When temperatures of 40° F. or below are expected, use an authorized antifreeze solution in the system to prevent freezing and damage to the cylinder heads and blocks. Before installing any antifreeze solution, check the following items:

(a) Drain cooling system (par. 44g).

(b) *Clean cooling system.* Make sure that the cooling system is completely free from rust or other foreign substances.

(c) *Attend to leaks.*

1. Tighten all water connections. Hose connections should be in good condition inside and out.

2. Inspect water pump for leaks. Tighten packing gland nut or repack if necessary.

3. Adjust fan belt to proper tension (par. 44g).

(d) *Add antifreeze solution.* When the cooling system has been cleaned and checked for leakage, partially fill the radiator with clean soft water and add antifreeze solution, using proportions in accordance with table listed below. Protect the system to at least 10° F. below the temperature expected during cold season.

(e) *Warm engine.* After adding antifreeze, fill cooling system to slightly below filler neck of radiator. Then start and operate the engine until normal operating temperature is reached.

(f) *Test strength of antifreeze solution.* Stop the engine and check the solution with a hydrometer. See specific gravity readings in chart (d) (5) below).

(g) *Weekly inspection.* After every 64-hour operation period of the engine, inspect the antifreeze solution for strength and color. If found to be rusty, drain and clean the cooling system. Add new solution to obtain required strength.

(7) *Starting the starting engine.* (a) Crank the starting engine several revolutions with the ignition switch off and the starting engine clutch disengaged.

(b) Moisture or fuel which has not vaporized sometimes collects on the starting engine spark plugs. Remove plugs and dry electrodes by applying gasoline. Ignite the gasoline and allow it to burn.

Note. Pouring a small amount of gasoline on the spark plug electrodes before they are replaced in the engine is effective in promoting combustion.

(c) Avoid overchoking and overpriming of the starting engine when attempting to start. If the starting engine is flooded, proceed as follows:

1. Open the choke valve (fig. 60) by pulling the choke control to the OFF position.
2. Turn the magneto switch off.
3. Move the idling latch to hold the governor shaft lever in idling position.
4. Crank the engine several complete revolutions, then attempt to start with the choke remaining in the OFF position. If engine fails to start, proceed in the usual manner with the choke ON.

(d) The starting engine can sometimes be

started more quickly by leaving the idling latch free of the governor shaft lever. As soon as the engine starts, move the governor shaft lever to the idling position in order to keep engine speed low.

(8) *Air vent.* An adjustable air vent is located on the roof of the deck house directly above the Caterpillar Diesel engine radiator. In extreme cold weather, regulate this vent to provide a minimum of cold circulating air for the engine radiator.

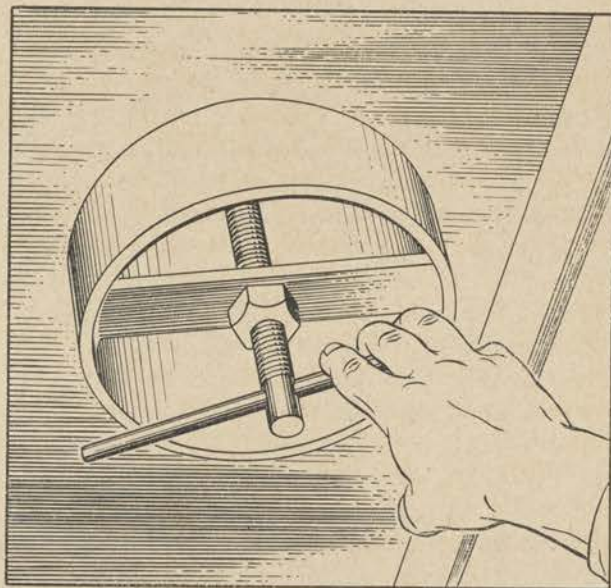


Figure 88. Adjusting deck house air vent.

(9) *Lubrication.* When the engine is operating in temperatures consistently below 32° F., the engine oil must be changed to comply with WDLO 55-U21.

b. TANKS AND PIPING. Prepare for extreme cold weather as described below:

Caution: Exercise extreme care in filling fuel oil containers to remove ice and snow from fuel oil filler caps and in dispensing equipment before filling with fuel oil. Tighten the fill caps properly to keep snow, rain, and dirt out of tanks. Failure to observe these rules will interrupt operation.

(1) *Fresh water storage tank.* Insulate well the fresh water storage tank, accessible through the hatchway in the deck house, and the exposed piping.

(2) *Fresh water tank.* Protect the fresh water tank, located in the galley above the sink, with

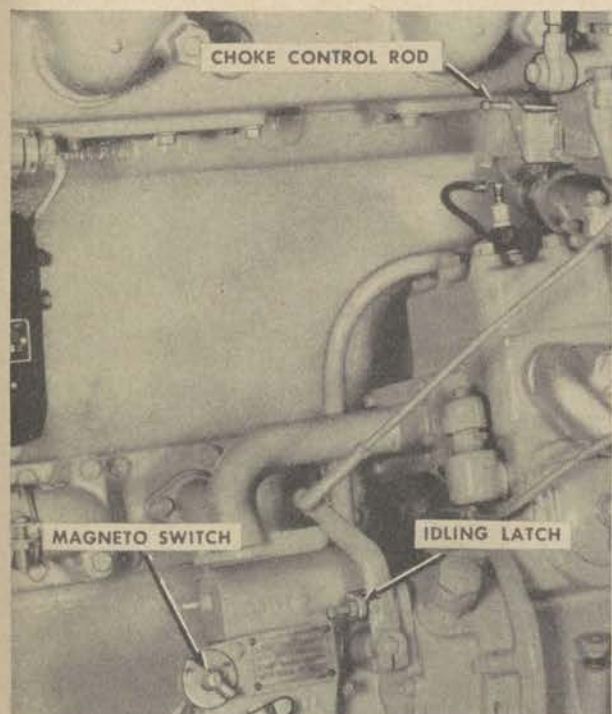


Figure 87. Starting engine controls.

fiber glass insulation and sewed canvas covering.

(3) *Sea water tank.* Protect the sea water tank, located in the water closet, with fiber glass insulation and sewed canvas covering.

(4) *Piping.* Protect all the exposed piping against extreme cold weather by using fiber glass insulation and sewed canvas covering.

(5) *Sink in lavatory.* To prevent freezing of the pipe during extremely cold weather, shut off the valve on the fresh water line running above the deck house rear aisle from the galley to the sink in the water closet. (See fig. 43.)

c. ELECTRICAL SYSTEM. (1) Keep free of ice all exposed electrical controls and receptacles, cables, etc.

Caution: Take care when removing ice not to use a sharp or pointed instrument. Failure to observe this rule will result in damage to equipment and possible injury to personnel.

(2) Inspect and clean all wiring. Tighten all connections, especially battery terminals. Make sure that there are no short circuits in wiring due to water seepage from ice concentration.

d. AUXILIARY DIESEL GENERATOR SET. (1) *General.* The auxiliary Diesel generator is started at temperatures as low as 32° F. For temperatures lower than 32° F. protect against freezing by following generally the procedure listed for cold weather starting of the Caterpillar Diesel engine (a above). Follow these precautionary measures as soon as the temperature reaches 40° F.: Keep the fuel tank full. Use only the authorized grade of Diesel fuel oil.

(2) *Protection of cooling system.* Refer to protection of cooling system for Caterpillar Diesel engine (a above).

Note. Do not flush radiator or cooling water system with any flushing compounds as this may damage the water seal of the pump.

(3) *Starting in cold weather.* To start the engine in cold weather, turn the governor screw in about halfway and continue pressing the starting switch, since it will be necessary to crank the engine for about one minute. While the engine is turning over, turn the throttle screw into full throttle position and continue to adjust this screw back and forth until the engine starts. To facilitate starting, listen to the starting motor while adjusting the throttle screw. Turning the screw too far in either direction will cause the engine to slow down slightly. Listen to the starting mo-

tor and turn the throttle screw to the point where the engine appears to turn over at highest rate of speed.

Note. In extremely cold weather, under certain conditions, the engine may misfire for as long as 10 to 15 minutes. This is caused by the plunger of the fuel pump sticking, due to deposits of wax in the fuel oil. This condition will be corrected as soon as the fuel pump reaches operating temperature. Hasten the warming up by applying heat from some outside source around the pump body. Under no circumstances use a flame.

(4) *Lubrication.* When the engine is operating in temperatures consistently below 0° F. follow the procedure described for lubrication system of the Caterpillar Diesel engine under cold weather conditions (a(9) above).

(5) *Battery freezing.* The freezing point of the battery electrolyte depends upon its specific gravity. The table below shows how this varies:

Specific gravity	Freezing point
1.225	-35° F.
1.200	-16° F.
1.175	-4° F.
1.150	-5° F.
1.125	13° F.
1.100	19° F.

From this table it can be seen that there is little danger of freezing in a temperate climate zone, except with a completely discharged battery. Moreover, at these freezing points, the solution is slushy and does not become hard until the temperature goes still lower.

Caution: If water is added to a battery in freezing temperatures, and the battery let stand in the cold and not charged to mix the water with the electrolyte, the water will remain on top and freeze.

25. Extreme Heat

a. CATERPILLAR DIESEL ENGINE. (1) *General.* When operating in extremely high temperatures, efficient cooling and adequate lubrication are vitally important. Check the cooling system frequently for leaks and to make certain that the circulation is not impaired. Pay special attention to the radiator fan belt for condition and proper adjustment. Replace fan belt if frayed or stretched to the extent that it cannot be adjusted properly. Inspect the air cleaners for both the starting engine carburetor and Diesel engine twice daily, making sure that the cleaners are well supplied with oil. The air vent (fig. 88) should be

fully opened so that air can be drawn in for the Diesel radiator.

(2) *Cooling system.* One of the common causes of engine-overheating is a rust-clogged cooling system. Refer to paragraph 44g, for detailed information on the care of the cooling system, paying particular attention to the following: clean and flush cooling system at frequent intervals. Test the temperature regulator as described in paragraph 44g (8) to insure that it opens at the proper temperature to prevent overheating of the cooling liquid.

(3) *Lubrication.* For extreme hot weather operation, change the engine oil to grade specified in WDLO 55-U21. Check and replace the oil filter element at more frequent intervals when operating in hot weather. Service crankcase breather frequently.

b. *AUXILIARY DIESEL ENGINE.* Follow the recommendations for operating in extreme heat, as described for the main Diesel engine in the preceding paragraph.

Section IX. DEMOLITION

26. Danger of Capture

a. The barge and its equipment must be destroyed or rendered unserviceable if in danger of capture by the enemy. Destruction shall be carried out only upon orders of a commanding officer. Instructions given in this section cover both deliberate, thorough destruction, and destruction under conditions of extreme emergency.

b. *DESTRUCTION PROCEDURE.* (1) *When time permits, and TNT is not available.* (a) *Boom.* Lower boom to the deck, cut cables, unshackle sheave blocks, main load block, and throw them overboard.

(b) *Hoist.* Using a sledge hammer, smash brake and pawl mechanisms at control stands at reach rod outboard bearings. Remove air valve covers and smash air valves. Smash air swivel joints and power chambers. Smash clutch levers. With a sledge hammer, damage hoist drive gear, intermediate gear, and all drum gears. Remove and throw overboard drum bearing caps.

(c) *Main Diesel engine.* Drain off all lubricating oil and water. Run engine at full speed, throttle wide open.

(d) *Diesel starting engine.* Smash carburetor and magneto.

(e) *Main drive shaft.* Using a sledge hammer,

smash two main bearings, hoist drive pinion, and two V-belt pulleys.

(f) *Auxiliary Diesel generator.* Drain off all lubricating oil and water. Run engine at full speed, throttle wide open.

(g) *Air compressor.* Smash cylinder head, trigger valve and automatic unloader.

(h) *Electrical system.* Smash control panels and instruments.

(i) *Capstan.* Smash deck switch, control panel, motor, and brake.

(j) *Deck pump.* Smash pump casing and throw overboard.

(k) *Main generator.* Remove terminal box cover plate, saturate terminal box with gasoline, and ignite.

(l) *Fuel tank.* Transfer all gasoline on hand for operation of the gasoline starting engine to the Diesel oil storage tank. Ignite the Diesel oil storage tank.

(m) *Scuttling.* Make efforts to scuttle the barge by entering each vessel through a manhole and attempting to smash a hole in the bottom, using a pickax or sharp instrument.

(2) *When TNT is available.* Fasten a 1/2-pound block of nitro-starch, TNT, or other explosive at the points indicated below, and detonate.

(a) *Main Diesel engine.* Against cylinder block and starting engine.

(b) *Main clutch.* Against clutch on yoke side.

(c) *Main generator.* At terminal box.

(d) *Compressor.* At cylinder base on flywheel side.

(e) *Auxiliary Diesel generator.* At cylinder base on generator side.

(f) *Hoist.* At each drum shaft bearing on clutch (right) side.

(g) *Capstan.* On gear box, motor side.

(h) *Deck pump.* Between motor and pump.

(i) *Derrick.* At each A-frame and back-leg hitch. At boom pivot and also at boom end assembly.

(j) *Barge vessels.* One charge at bottom of each vessel.

(3) *Under conditions of extreme urgency.* Using a sledge hammer, smash the hoist air valves and control stands. On both the main and auxiliary Diesel engines, open the lubricating oil drain and the cooling water drain. Run both engines at full throttle. Ignite both the Diesel oil storage tank and the gasoline storage tank.

PART THREE

MAINTENANCE INSTRUCTIONS

Section X. GENERAL

27. Scope

The information in part three is for the guidance of the operating crew and the maintenance personnel of the organization using the barge derrick. It contains information necessary to perform scheduled lubrication and preventive maintenance services on all major equipment and auxiliary equipment. Part three also describes the major equipment and major systems, and gives instructions for replacement of their parts and assemblies. Instruction for replacement of parts and assemblies on auxiliary equipment is contained in part four.

Section XI. SPECIAL ORGANIZATIONAL TOOLS AND EQUIPMENT

28. Tools, Parts, and Equipment

a. Tools, parts, and equipment supplied with the material are listed in War Department Supply Catalog TC 5.

b. Specially designed tools are listed below for information only. This list is not to be used for requisitioning replacements.

Ref. fig.	Mfg. stock No.	Tool	Quantity
CATERPILLAR DIESEL TOOLS			
	Caterpillar		
A	1B7412	Wrench, front idler adj. bolt	1
B	L-2303	Wrench, $\frac{9}{16}$ " hex	1
C	1B8794	Wrench, $\frac{15}{16}$ " hex	1
E	2B4317	Brush	1
F	1B5171	Wrench, ctsk. drain plug	1
G	4A62	Wrench, fuel pump vent screw	1
H	3B2301	Grease Gun	1
I	4A334	Wrench, water pump packing nut	1
J	3B1285	Wrench, $\frac{7}{8}$ " and $\frac{15}{16}$ "	1
K	3563-A	Wrench, $\frac{15}{16}$ " and $1\frac{1}{8}$ "	1

Ref. fig.	Mfg. stock No.	Tool	Quantity
DERRICK TOOLS			
	Amer. Terry Co.		
D	5585	Grease Gun	1

29. Stowage of Tools and Spare Parts

a. **TOOLS.** A metal box, provided for the stowage of the tools for the main Diesel engine, is located at the level of the machinery room floor plates near the Diesel engine clutch operating lever. (See fig. 89.) Store other tools in the recess under the hinged floor plate located at the door of the sleeping quarters, next to the deck house bulkhead.

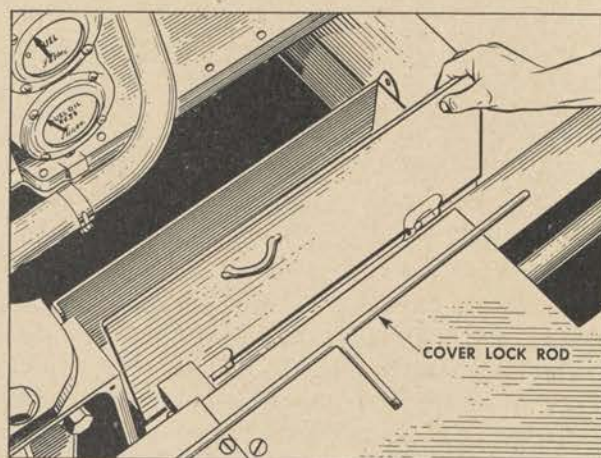


Figure 89. Stowage space, Diesel engine tools.

b. **SPARE PARTS.** Protect spare parts where needed with authorized preservatives and stow in the storage compartment. Access to this compartment is by an inclined ladder below a hatch in the barge deck. The hatch is near the entrance to the

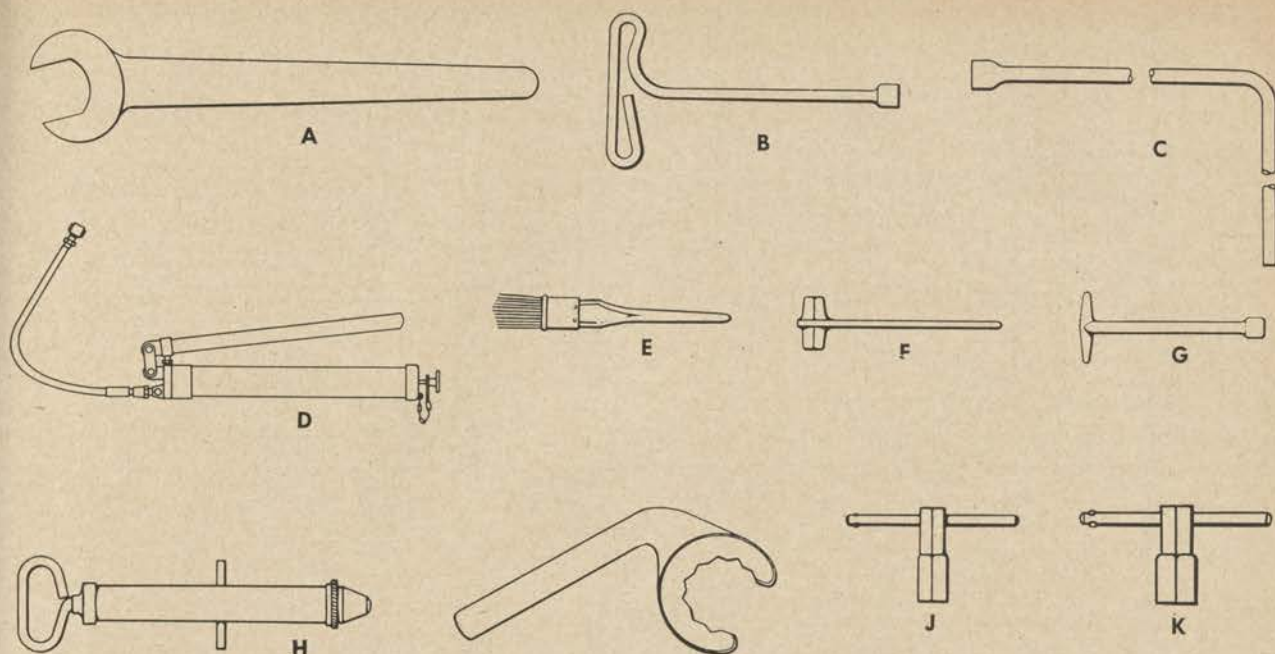


Figure 90. Caterpillar Diesel and derrick tools.

mess-galley compartment and is reached by raising a hinged section of the machinery room floor plates.

Note. Requisition new spares as replacements immediately upon withdrawing spares from stock for use.

Section XII. LUBRICATION

30. Lubrication Orders

a. The following War Department Lubrication Orders prescribe lubrication maintenance for the equipment of the barge derrick:

(1) WD LO 55-1204 Derrick, Floating, Diesel, Steel, 30-Ton, Design 314, knocked-down (American Hoist and Derrick Model 140-5 Drum).

(2) WD LO 55-U36 Hoist, Derrick, 30-Ton (American Hoist and Derrick Model 140-5 Drum).

(3) WD LO 55-U21 Power Unit Engine, Diesel (Caterpillar D-13000).

(4) WD LO 55-U39 Generating Set, Diesel Engine Driven, 5 KW. (The figure references at

sides of these illustrations refer to the localized views.) (See figs. 96 to 127, inclusive.)

b. A set of lubrication orders is issued with each barge and is to be carried with it at all times. In the event the barge is received without a complete set of lubrication orders, or if any of the orders is destroyed, lost, or stolen, the using arm will immediately requisition replacements.

c. Lubrication instructions on the lubrication orders are binding on all echelons of maintenance and there shall be no deviations from these instructions.

d. Service intervals specified on the lubrication orders are for normal operating conditions. Reduce these intervals under unusual conditions such as heavy or prolonged rain, in the case of exposed equipment.

e. Lubricants are prescribed in the keys in accordance with three temperature ranges: above $+32^{\circ}\text{F.}$, $+32^{\circ}\text{F. to }0^{\circ}\text{F.}$, and below 0°F. Change the grades of lubricants only when air temperatures are consistently in the next higher or lower bracket.

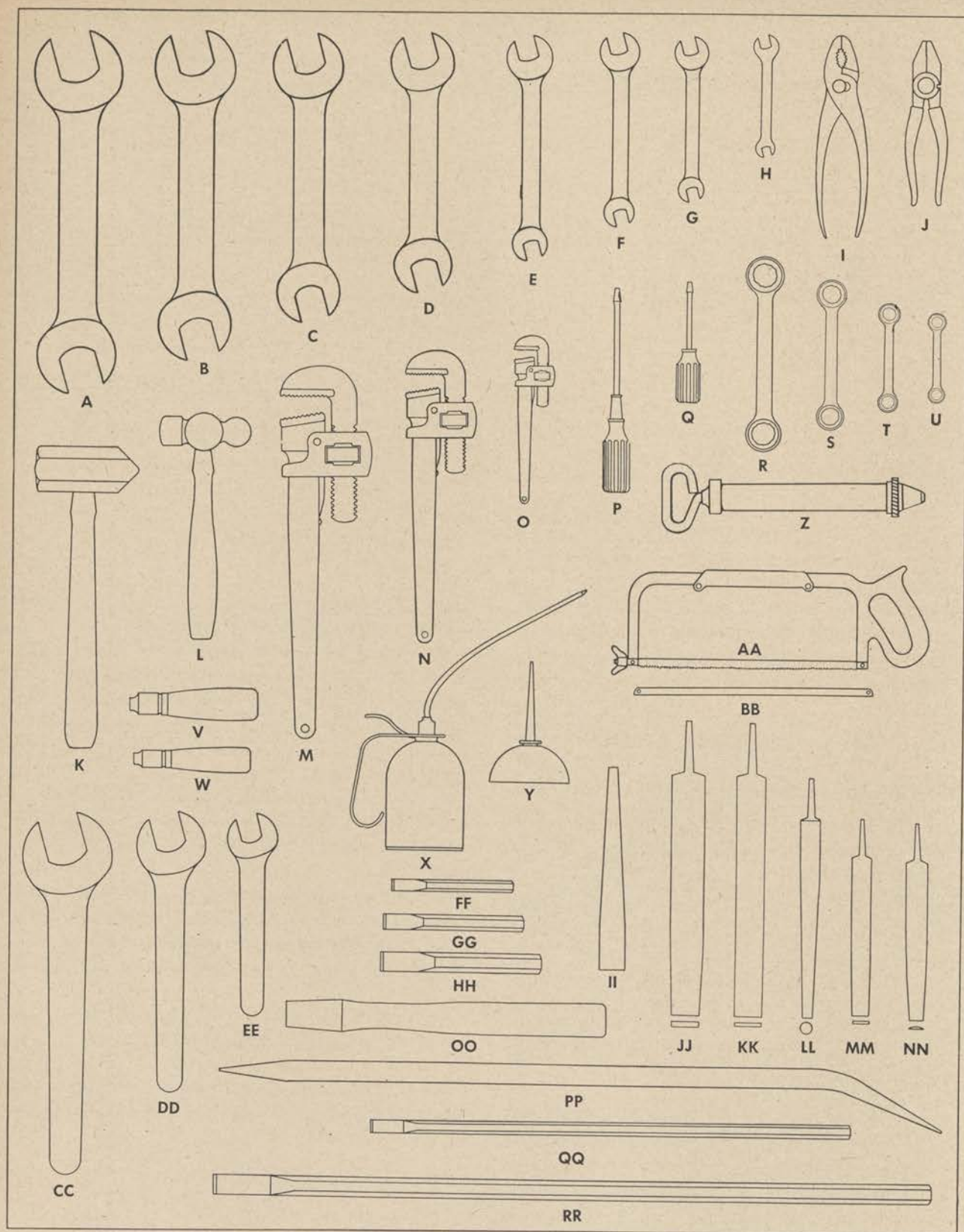


Figure 91. General purpose tools.

WAR DEPARTMENT LUBRICATION ORDER

LO 55-1204

25 AUG 1945

DERRICK, FLOATING, DIESEL, STEEL, 30 TON, DESIGN 314, KNOCK-DOWN (AMERICAN HOIST & DERRICK, HOIST MODEL 140-5 DRUM) (CATERPILLAR POWER UNIT MODEL D-13000)

References: TM 55-1204, LO 55-U36 (Hoist), LO 55-U21 (Power Unit), LO 55-U39 (Generator)

Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened to compensate.

Clean fittings before lubricating. Lubricate dotted arrow points on both sides of equipment.

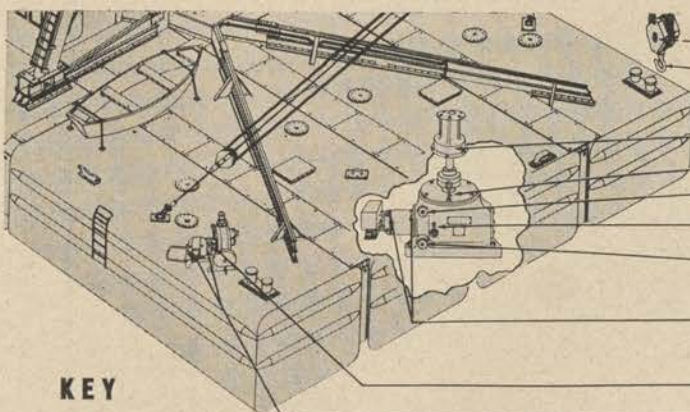
Interval • Lubricant

DERRICK

- W CG "A" Frame Topping Block — Fig 112
- W CG Swivel Blocks — Fig 114-117
- W CG Fairlead Assembly — Fig 113
- W CG Boom End Topping Block — Fig 110
- W CG Vang Blocks — Fig 111
- W CG Whip Sheaves — Fig 107
- W CG Vang Blocks — Fig 111
- 3D CG Upper Load Block — Fig 109
- 3D CG Boom Load Sheaves — Fig 107
- W CG Vang Blocks — Fig 111
- M OE Whip Hook — Fig 106
- D CG Boom Pivot — Fig 106
6 points

FOLD

FOLD



KEY

- 3D CG Lower Load Block — Fig 108
- M OE Main Hook
- CAPSTAN**
- D WP Base
- D WP Drive Shaft — Fig 126
- M GO Gear Box Fill — Fig 126
- M Gear Box — Fig 126
Check level
- 3M Gear Box Drain — Fig 126
Drain and refill
Capacity 4 gals.
- W CG Motor Bearings — Fig 126
- DECK PUMP**
- W WP Pump Seal — Fig 127
- M CG Motor Bearings — Fig 127

LUBRICANTS	EXPECTED TEMPERATURES			INTERVALS
	Above +32° F.	+32° F. to 0° F.	Below 0° F.	
OE-OIL, Engine	OE 30 or Navy Symbol 9250	OE 30 or Navy Symbol 9250	OE 10 or Navy Symbol 9110	D Daily
GO-LUBRICANT, Gear, Universal	GO 90 or Navy Spec. 14L4 CLB	GO 90 or Navy Spec. 14L4 CLB	GO 75	3D Three days
CW-OIL, Lubricat- ing Chain and Wire Rope	CW 3	CW 2	CW 2	W Weekly
CG-GREASE, General Purpose	CG 1 or Navy Spec. 14L9	CG 0	CG 0	M Monthly
WP-GREASE, Water Pump	WP or Navy Spec. 14L11	WP or Navy Spec. 14L11	WP or Navy Spec. 14L11	3M Three months

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 25 Aug 1945.

[A.G. 300.8 (25 Aug 1945)]

By Order of the Secretary of War:

G. C. MARSHALL,
Chief of Staff.

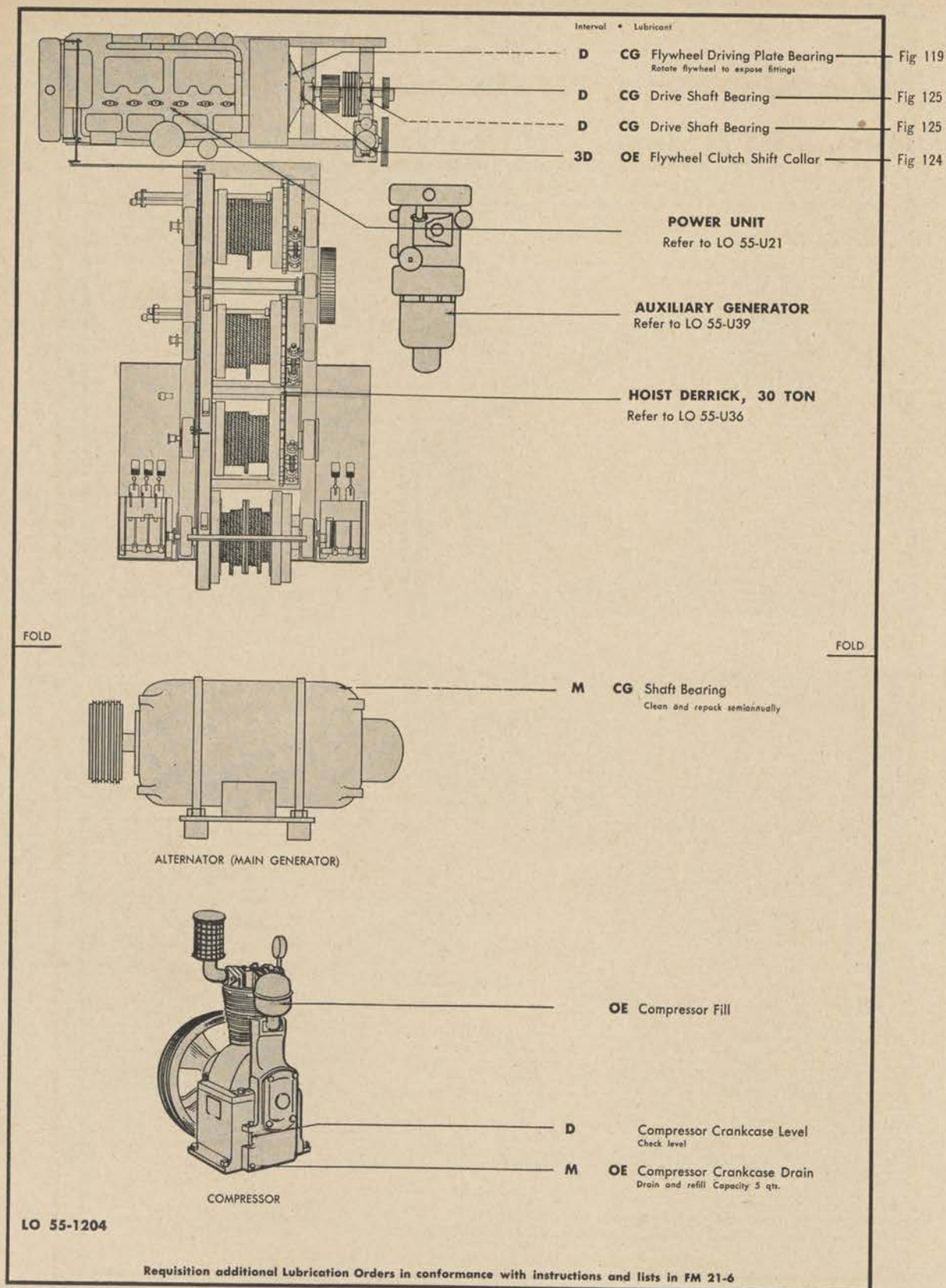
Official:

EDWARD F. WITSELL, Major General,
Acting The Adjutant General.

Note 1 — Cable and Cable Ends—Lubricate Weekly with CW

①

Figure 92. War Department Lubrication Order LO 55-1204 Derrick, Floating, Diesel, Steel, 30-Ton, Design 314, Knock-Down.



WAR DEPARTMENT LUBRICATION ORDER

LO 55-U21

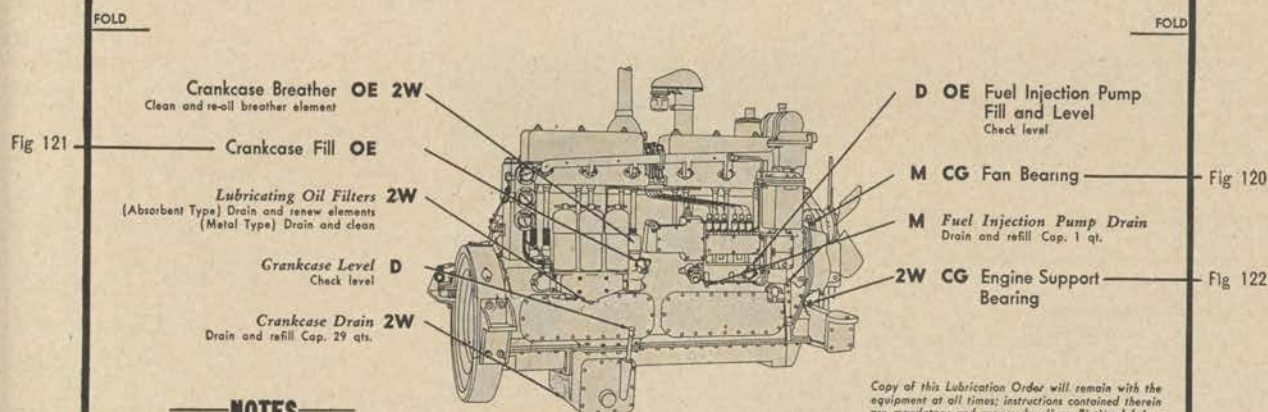
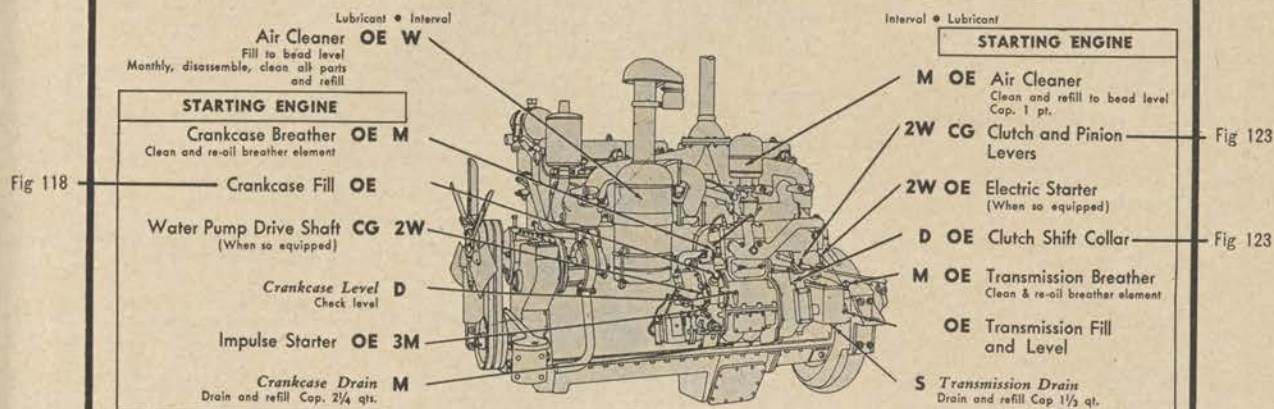
1 AUG 1945

POWER UNIT, DIESEL ENGINE

(CATERPILLAR D-13000)

Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened to compensate.

Clean fittings before lubricating.
Clean parts with SOLVENT, dry cleaning, or with OIL, fuel, Diesel.
Dry before lubricating.



NOTES

1. GENERATOR (When so equipped)—lubricate with OE every 2 weeks.
2. OIL CAN POINTS—Daily, lubricate Throttle Control Pins, Fulcrums, and Levers, Compression Release Shaft, Linkage and similar friction points with OE.

KEY

LUBRICANTS	EXPECTED TEMPERATURES			INTERVALS
	above +32°F.	+32°F. to 0°F.	below 0°F.	
OE—OIL, engine	OE-30 or Navy Symbol 9250	OE-10 or Navy Symbol 9250	OE-10 or Navy Symbol 9110	D —Daily W —Weekly 2W —2 Weeks M —Monthly 3M —3 Months S —6 Months
CG—GREASE, general purpose	CG-1 or Navy Spec. 14L9	CG-0	CG-0	

Requisition additional Lubrication Orders in conformance with instructions and lists in FM 21-6

Figure 93. War Department Lubrication Order LO 55-U21 Power Unit, Diesel Engine.

WAR DEPARTMENT LUBRICATION ORDER

LO 55-U36

15 AUG 1945

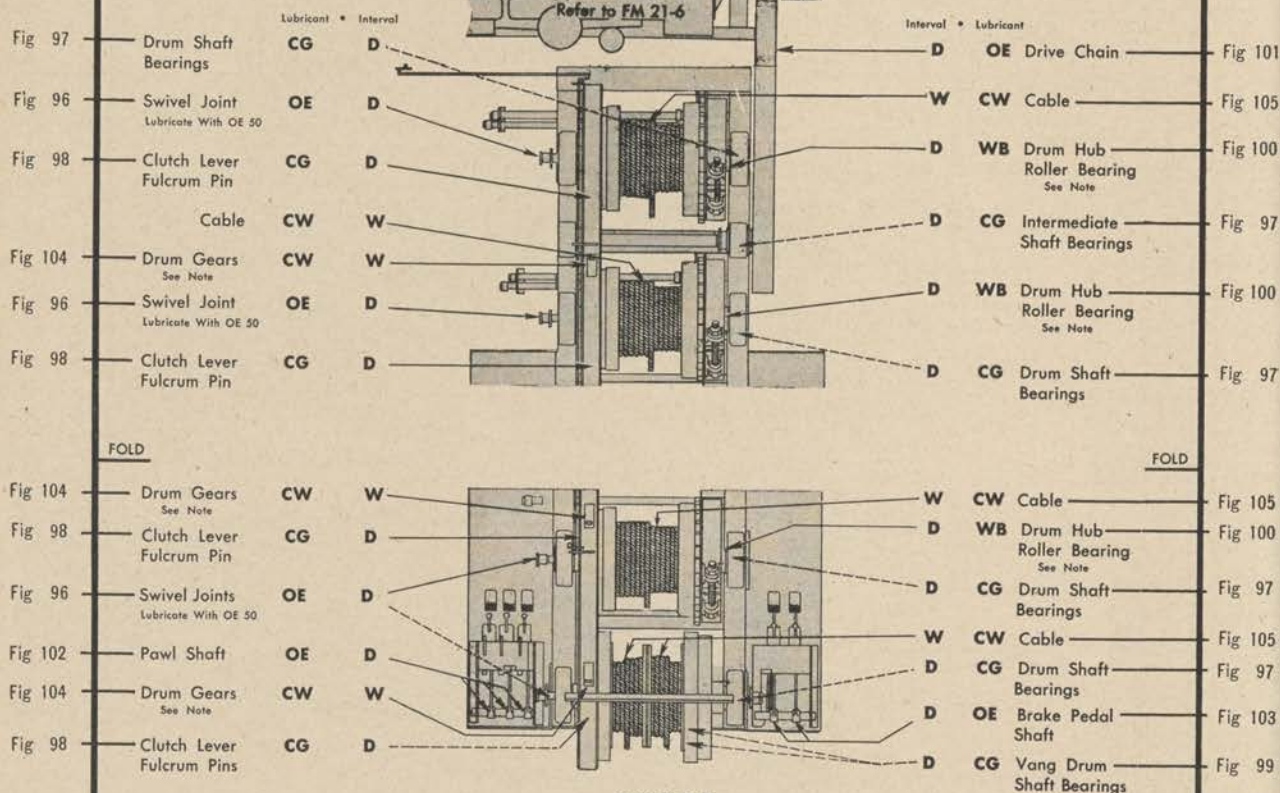
HOIST, DERRICK, 30 TON

(AMERICAN HOIST & DERRICK MODEL 140-5 DRUM)

References: LO 55-U21 (Power Unit, CATERPILLAR D13000)

Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened to compensate.

Clean fittings before lubricating. Lubricate dotted arrow points on both sides of equipment.



NOTES

OIL CAN POINTS: Lubricate daily with OE—Pins, lever bearings of brake and pawl operating linkages, brake band and clutch band dead ends, engine throttle extension friction points.

DRUM HUB ROLLER BEARINGS: Maintain shaft housing 1/2 full of

lubricant. Lubricate by removing pipe plug in drum hub. Insert lubricant through opening. **CAUTION:** Replace pipe plug in drum hub before drum is rotated.

DRUM GEARS: Heat lubricant to pour over gear teeth.

KEY

LUBRICANTS	EXPECTED TEMPERATURES			INTERVALS
	ABOVE +32° F	+32° F to 0° F	BELOW 0° F	
OE — Oil, engine	OE 30 or Navy Symbol 9250	OE 30 or Navy Symbol 9250	OE 10 or Navy Symbol 9110	D — Daily W — Weekly
CW — Lubricant, exposed gears, chains, and wire rope	CW 3	CW 2	CW 2	
CG — Grease, General Purpose	CG 1 or Navy Spec. 14L19	CG 0	CG 0	
WB — Grease, General Purpose	WB or Navy Spec. 14L10	WB or Navy Spec. 14L10	WB or Navy Spec. 14L10	

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 15 Aug 1945.

[A.G. 300.8 (15 Aug 1945)].

By Order of the Secretary of War:
G. C. MARSHALL, Chief of Staff.

Official:
EDWARD F. WITSELL, Major General,
Acting the Adjutant General.

Requisition additional Lubrication Orders in conformance with instructions and lists in FM 21-6

Figure 94. War Department Lubrication Order LO 55-U36 Hoist, Derrick, 30-Ton.

WAR DEPARTMENT LUBRICATION ORDER

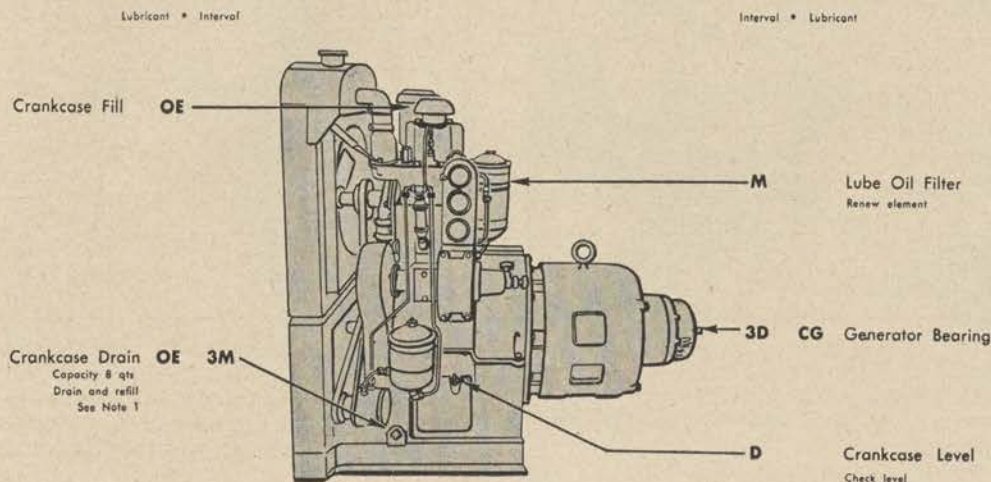
LO 55-U39

15 AUG 1945

GENERATING SET, DIESEL ENGINE DRIVEN, 5 KW (R. H. SHEPPARD MODEL NO. 7)

Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened to compensate.

Clean fittings before lubricating. Clean parts with SOLVENT, dry cleaning, or with OIL, fuel, Diesel. Dry before lubricating.

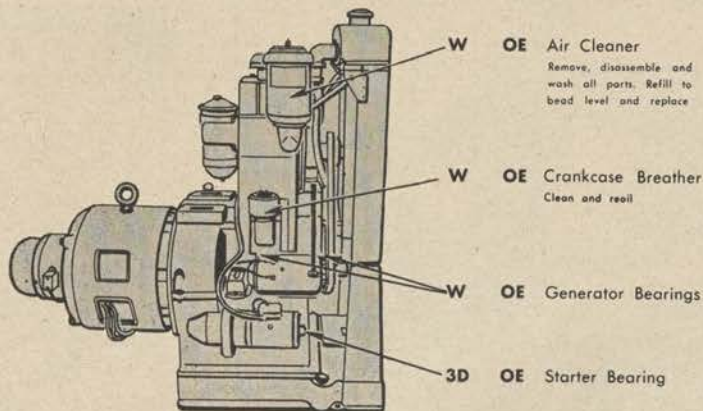


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NOTES

1. CRANKCASE—Drain while oil is hot. Refill with 7 quarts plus one quart for filter.



— KEY —

LUBRICANTS	EXPECTED TEMPERATURES			INTERVALS
	ABOVE +32° F	32° F TO 0° F	BELOW 0° F	
OE—Oil, Engine	OE 30 or Navy Symbol 9250	OE 10 or Navy Symbol 9110	OE 10 or Navy Symbol 9110	3D—3 Days W—Weekly M—Monthly 3M—3 Months
CG—Grease, General Purpose	CG 1 or Navy Spec. 14L9	CG 1 or Navy Spec. 14L9	CG 0	

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 15 Aug 1945.

[A.G. 300.8 (15 Aug 1945)].

By Order of the Secretary of War:
G. C. MARSHALL, Chief of Staff.

Official:
EDWARD F. WITSELL, Major General,
Acting the Adjutant General.

Requisition additional Lubrication Orders in conformance with instructions and lists in FM 21-6

Figure 95. War Department Lubrication Order LO 55-U39, Generating Set, Diesel Engine Driven, 5 KW.

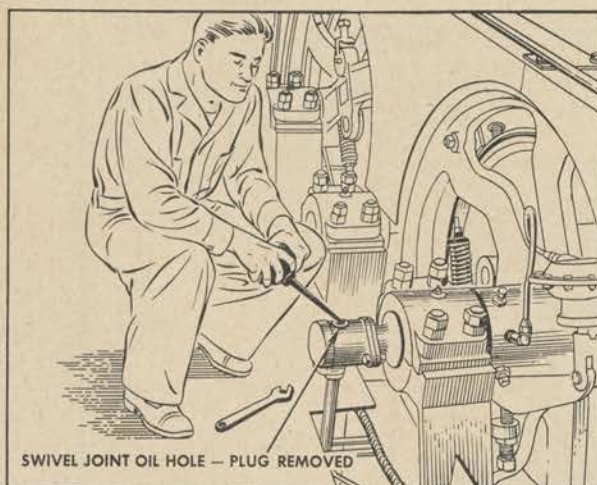


Figure 96. Lubrication of swivel joints.

Five identical points: one point on each end of twin drum shaft, one point on right end of each single drum shaft. Fill with engine oil.

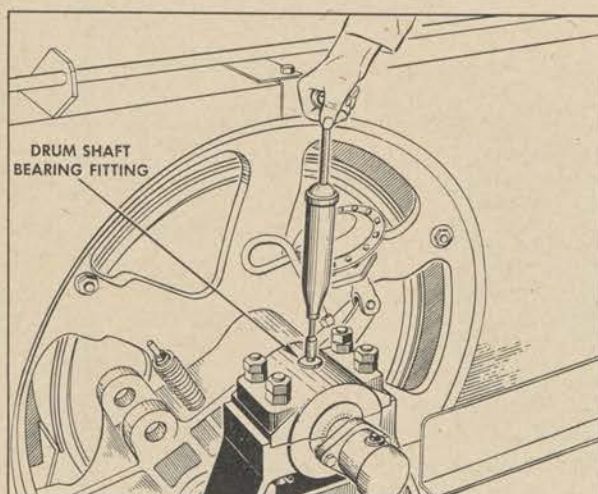


Figure 97. Lubrication of drum shaft bearings and intermediate shaft bearings.

Ten identical fittings: one fitting on each end of four drum shafts and on each end of intermediate shaft. Fill bearing until old lubricant is forced out and new lubricant appears.



Figure 98. Lubrication of clutch lever fulcrum pins.

Five identical fittings: one on each clutch of twin drums and single drums. Fill bearings through fittings until old lubricant is forced out and new lubricant appears.

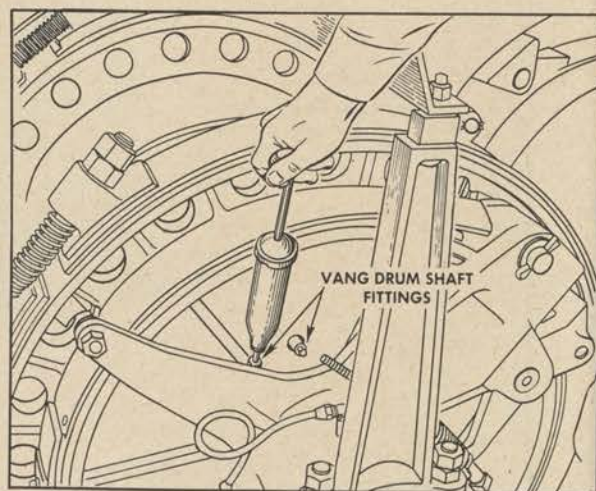


Figure 99.—Lubrication of vang drum shaft bearings.

Four identical fittings: two on each end of twin drum shaft. Use pressure gun until bearings are filled.

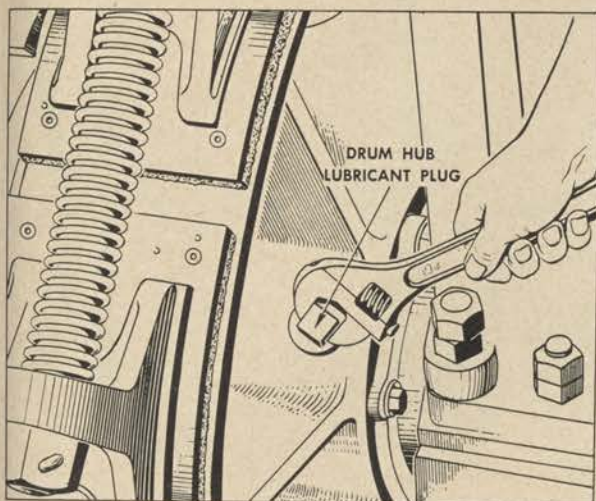


Figure 100. Lubrication of drum hub roller bearing.

Three identical points: one on left end of each single drum shaft. Insert lubricant through opening until housing is half full.

Caution: Replace plug before rotating drum.



Figure 101. Lubrication of drive chain.

Fill cup with engine oil until cotton waste is well saturated.

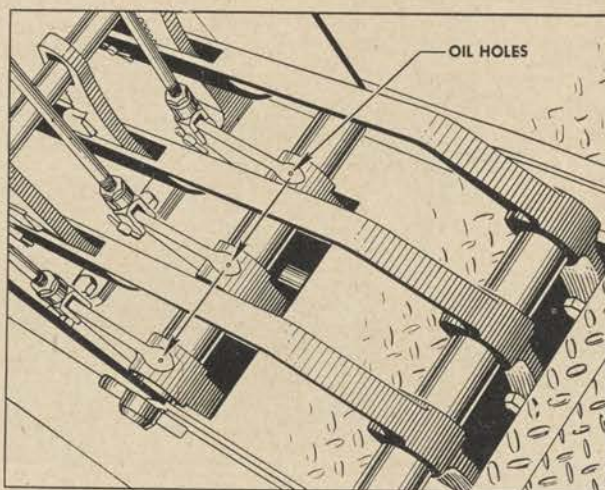


Figure 102. Lubrication of pawl shaft.

Lubricate with engine oil.

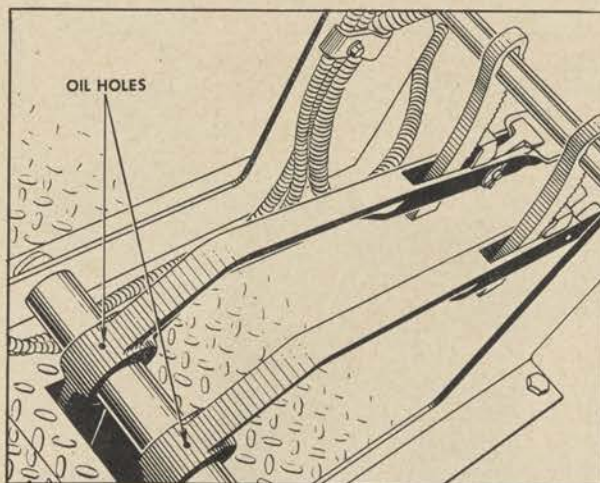


Figure 103. Lubrication of brake pedal shaft.

Lubricate with engine oil.



Figure 104. Lubrication of drum gears.

Three identical openings. Heat lubricant and pour through openings as gears revolve slowly until gear teeth are well covered.

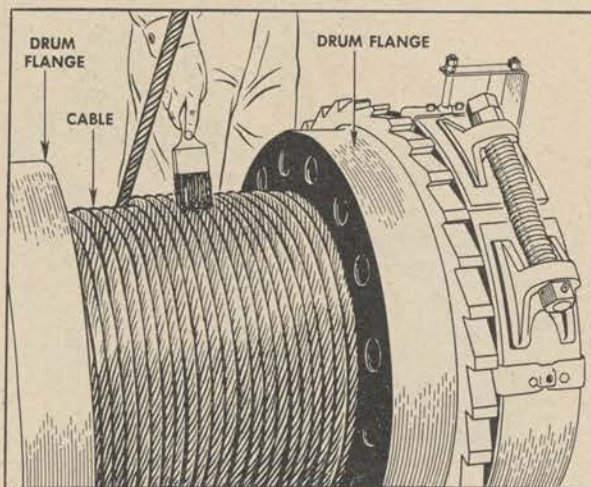


Figure 105. Lubrication of cables.

Five drums. Apply lubricant freely with brush to cover cables as drum revolves slowly.

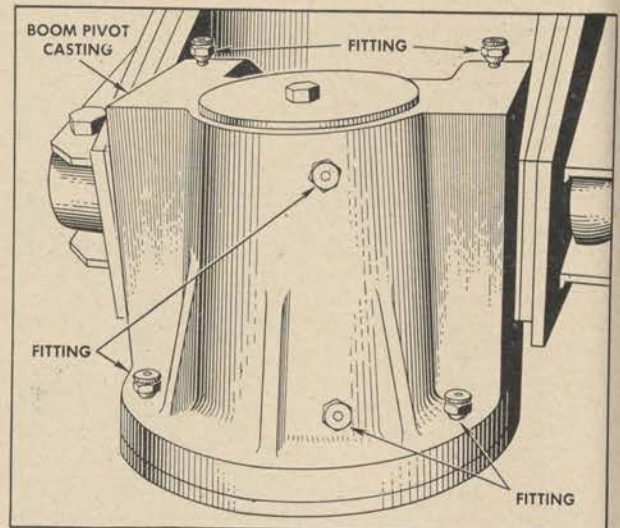


Figure 106. Lubrication of boom pivot.

Apply lubricant with pressure gun until bearings are filled.

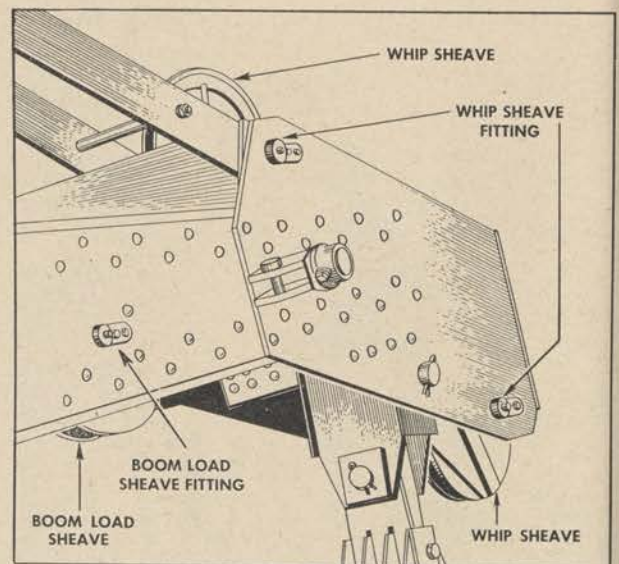


Figure 107. Lubrication of whip sheaves and boom load sheaves.

Apply lubricant to bearing with pressure gun through fitting on each end of each sheave pin until forced out of bearings.

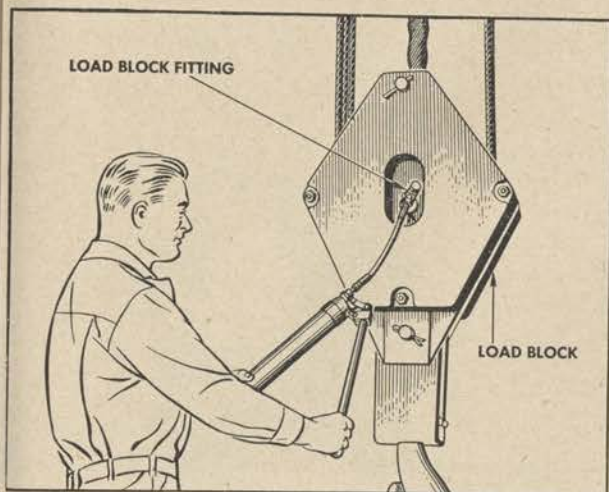


Figure 108. Lubrication of lower load block.

Fill bearing through fitting on each end of sheave pin with pressure gun.

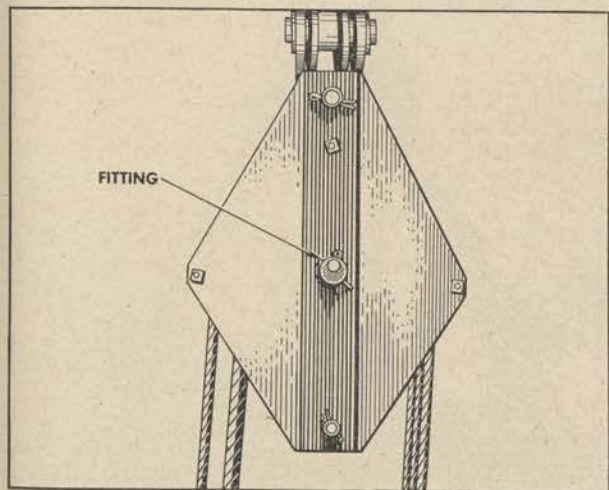


Figure 109. Lubrication of upper load block.

Fill bearing through fitting on each end of sheave pin with pressure gun.

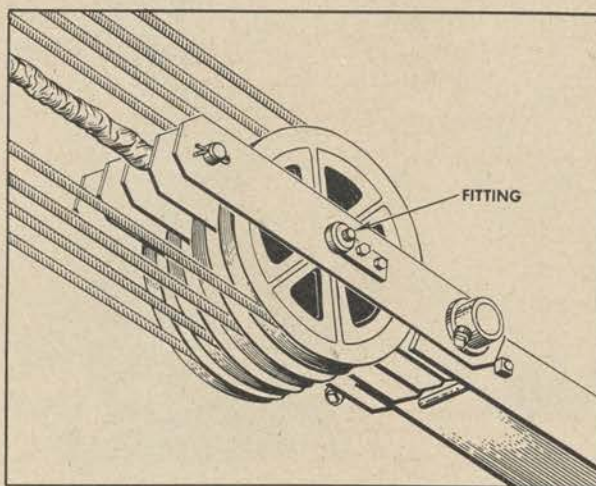


Figure 110. Lubrication of boom end topping block.

Apply lubricant with pressure gun in fitting on each end of sheave pin until old lubricant is forced out and new lubricant appears.

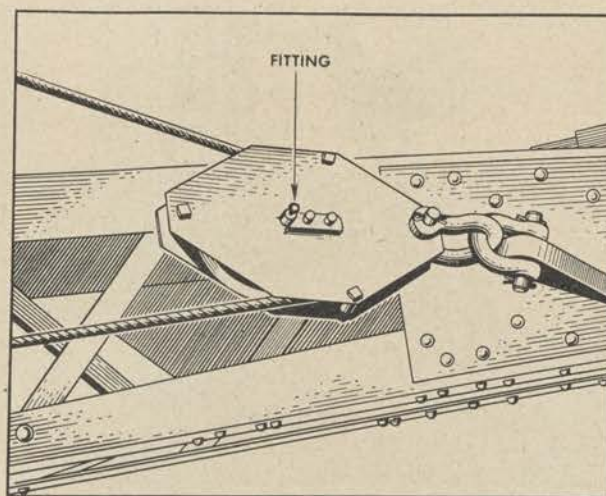


Figure 111. Lubrication of vang block.

Apply lubricant with pressure gun in sheave pin fitting until old lubricant is forced out and new lubricant appears.

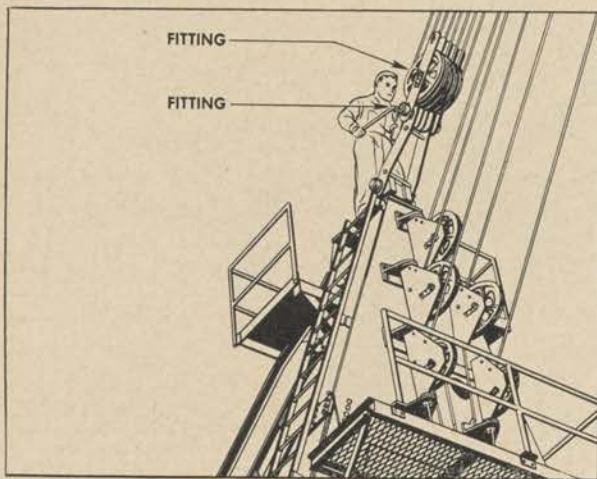


Figure 112. Lubrication of A-Frame topping block.

Apply lubricant to bearing with pressure gun in each sheave pin fitting until old lubricant is forced out and new lubricant appears.

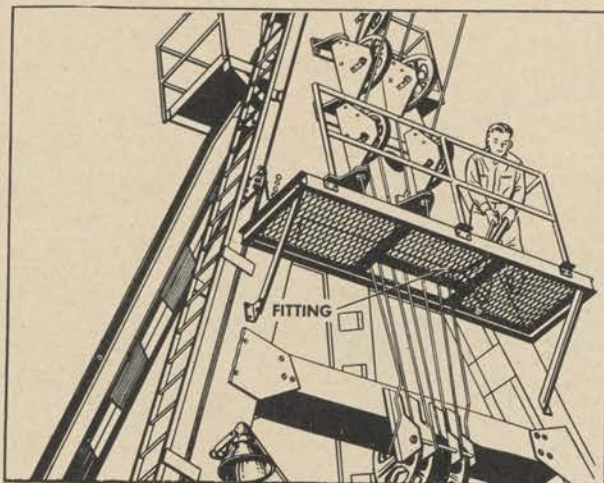


Figure 113. Lubrication of fairlead assembly.

Apply lubricant to bearing with pressure gun in each sheave pin fitting until old lubricant is forced out and new lubricant appears.

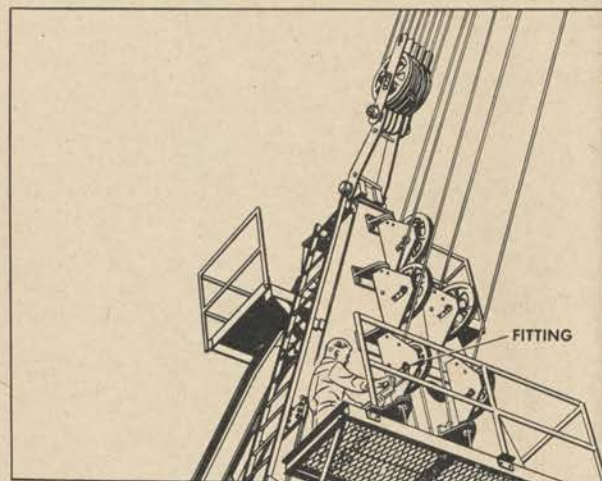


Figure 114. Lubrication of starboard vang swivel block.

Apply lubricant to bearing with pressure gun in each sheave pin fitting until old lubricant is forced out and new lubricant appears.

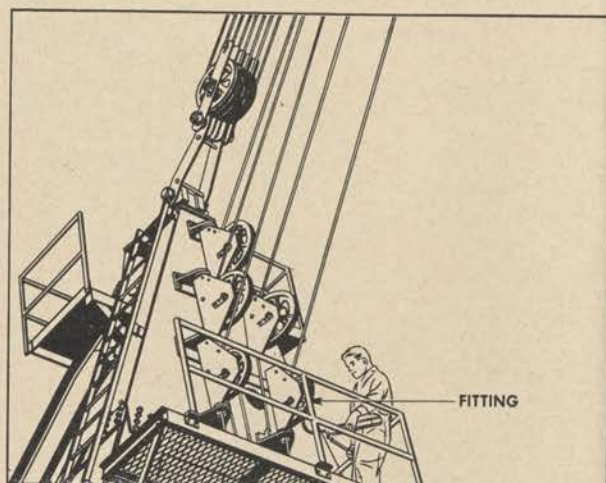


Figure 115. Lubrication of port vang swivel block.

Apply lubricant to bearing with pressure gun in each sheave pin fitting until old lubricant is forced out and new lubricant appears.

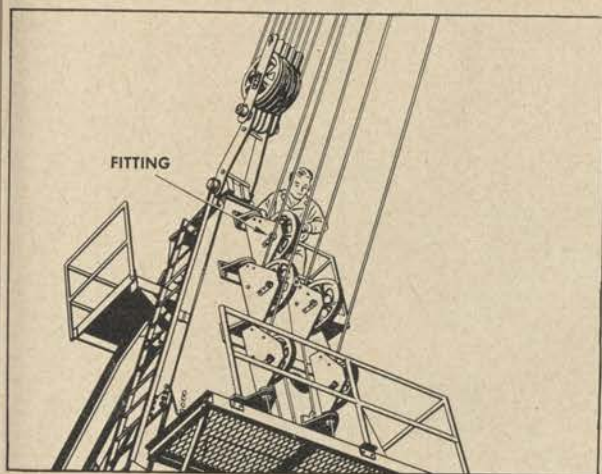


Figure 116. Lubrication of topping swivel block.

Apply lubricant to bearing with pressure gun in each sheave pin fitting until old lubricant is forced out and new lubricant appears.

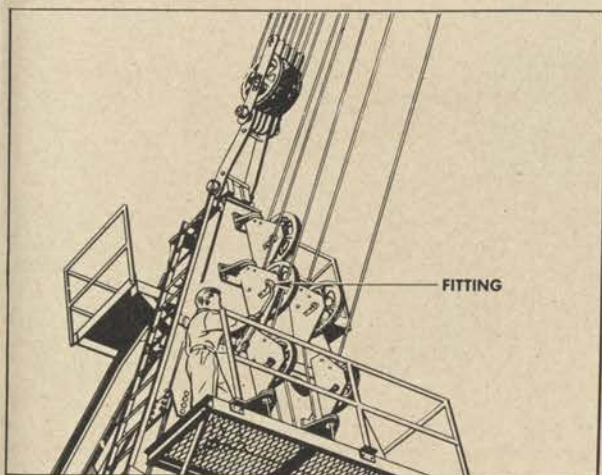


Figure 117. Lubrication of load swivel block.

Apply lubricant to bearing with pressure gun in each sheave pin fitting until old lubricant is forced out and new lubricant appears.

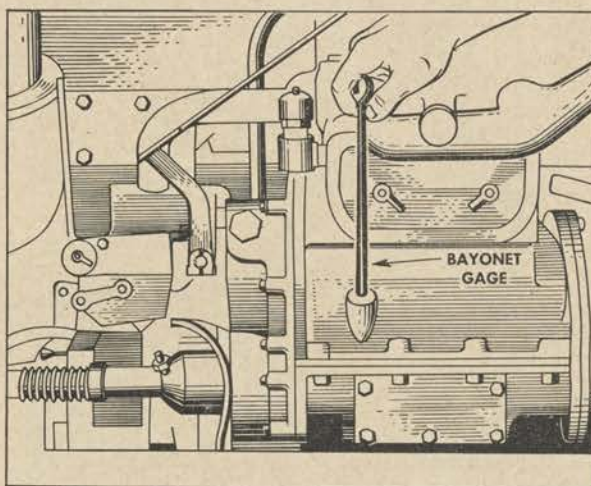


Figure 118. Checking starting engine crankcase.

Starting engine. Check level: Check the oil level with the bayonet gage. If below the full mark, add sufficient engine oil to bring the oil level up to the proper operating level. **Drain:** Drain crankcase while engine is hot, preferably immediately after operation to obtain a better drainage of lubricating oil contaminants which would otherwise settle and accumulate in crankcase if permitted to cool. **Refill:** When crankcase has been completely drained, replace the plug securely and refill the crankcase with $2\frac{1}{4}$ quarts of engine oil.

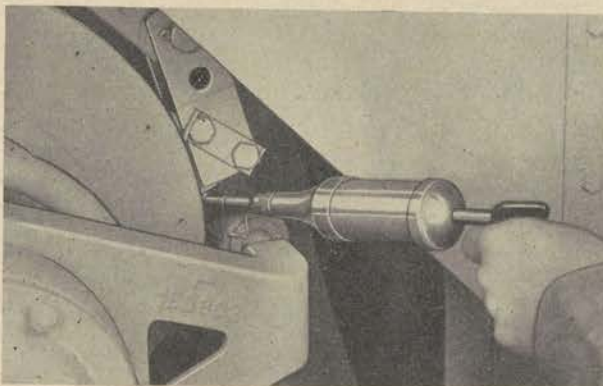


Figure 119. Lubricating flywheel driving plate bearing.

Rotate flywheel to expose fittings. Fill bearing through fitting with pressure gun.

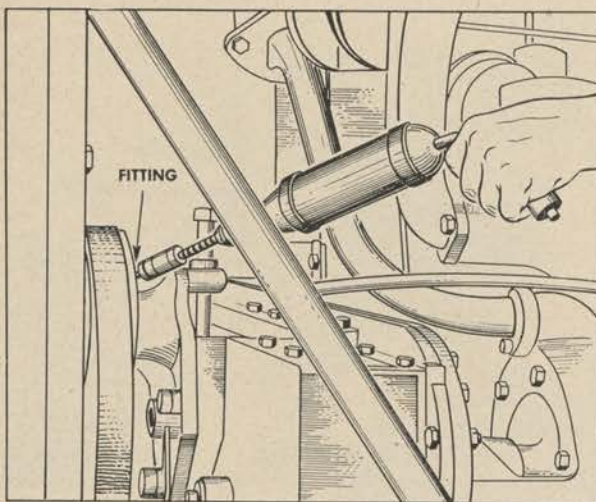


Figure 120. Lubricating main engine fan bearing.

Apply lubricant with pressure gun until old lubricant is forced out and new lubricant appears.

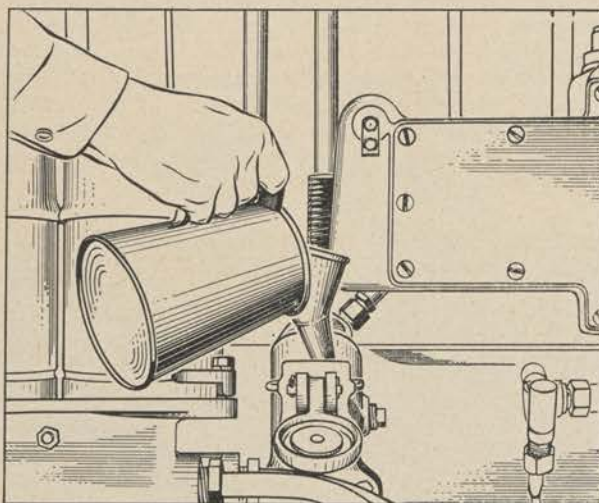


Figure 121. Filling main engine crankcase.

Main engine crankcase. Drain: Drain crankcase while engine is hot, preferably immediately after operation to obtain better drainage of lubricating oil contaminants which would otherwise settle and accumulate in crankcase if permitted to cool. **Refill:** When the crankcase has been completely drained, replace the plug securely and refill the crankcase with 29 quarts of engine oil.

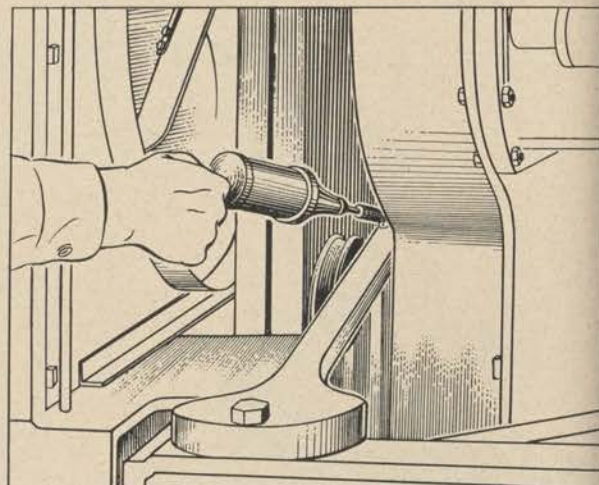


Figure 122. Lubricating main engine support bearing.

Apply lubricant to bearing with pressure gun in fitting until old lubricant is forced out and new lubricant appears.

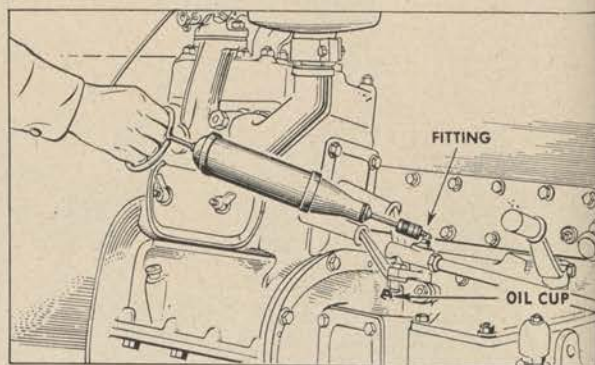


Figure 123. Lubrication of starting engine clutch and pinion levers and clutch shift collar.

Clutch shift collar: Fill oil cap with engine oil. **Clutch and pinion:** Apply lubricant to bearing through fitting with pressure gun until old lubricant is forced out and new lubricant appears.

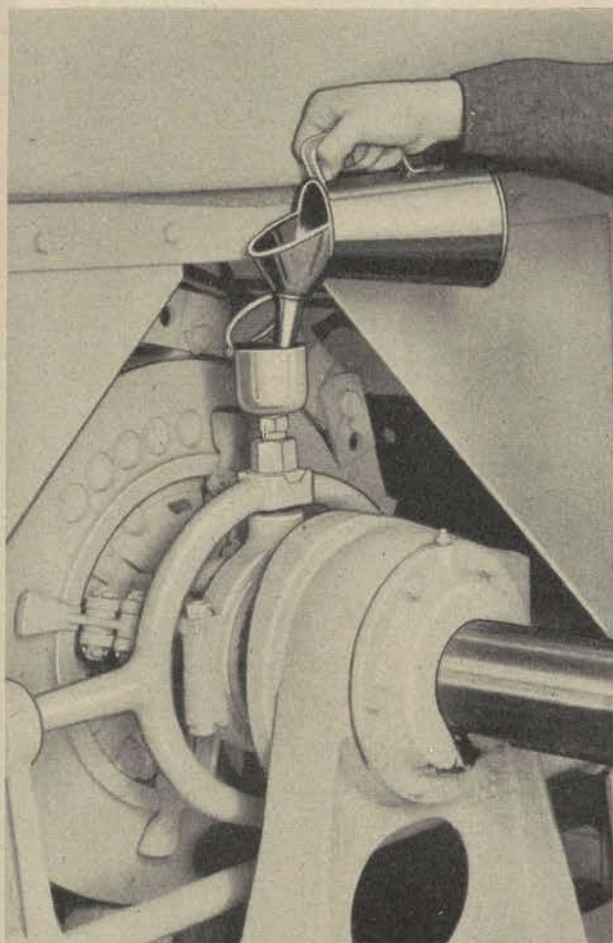


Figure 124. Lubricating main engine flywheel clutch shift collar.

Fill cup with engine oil.

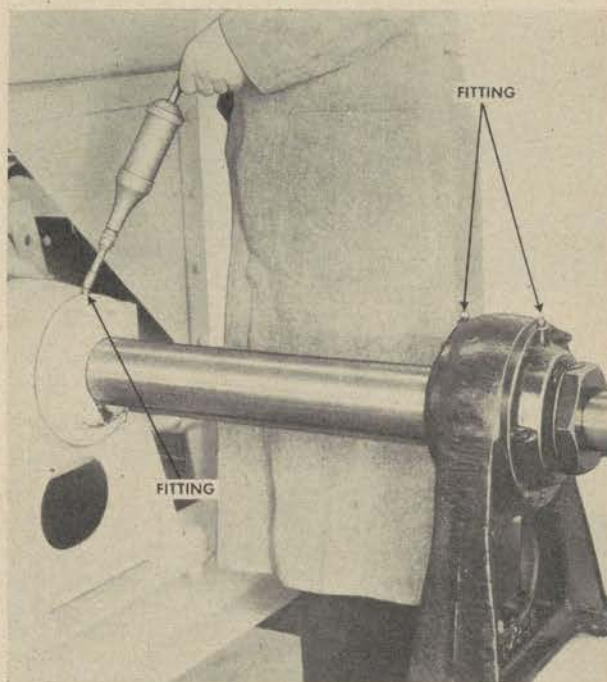
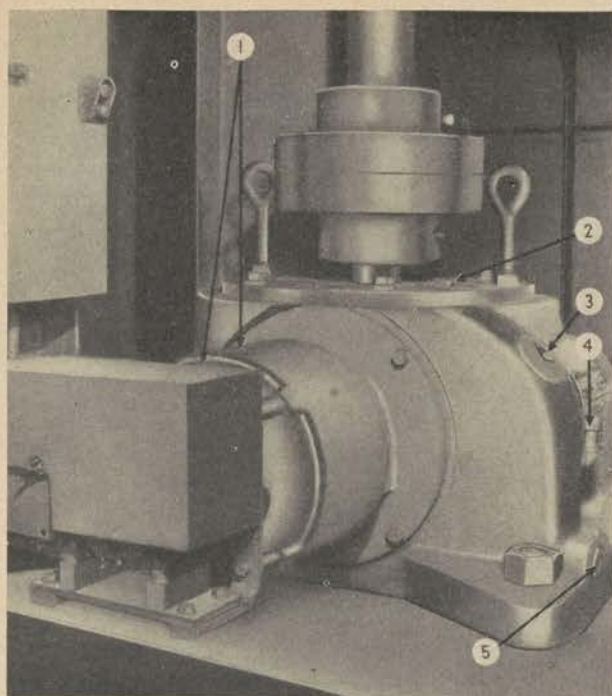


Figure 125. Lubricating drive shaft bearings.

Fill bearing through each fitting with pressure gun until old lubricant is forced out and new lubricant appears.



1. Motor bearings.
2. Drive shaft fitting.
3. Gear box fill.
4. Gear box level gage.
5. Gear box drain plug.

Figure 126. Lubrication of capstan motor, drive shaft, and gear box.

Motor: One shot of lubricant in each fitting.

Drive shaft: Two shots of lubricant in fitting.

Gear box: Check level: Check level with bayonet gage. If below the full mark, add sufficient lubricant to bring the level up to the proper operating mark. Drain: Drain gear box immediately after operation to obtain a better drainage of lubricant contaminants which would otherwise settle and accumulate in crankcase. Refill: When gear box has been completely drained, replace plug securely and refill with 4 gallons of lubricant.

Section XIII. PREVENTIVE MAINTENANCE SERVICES

31. General

a. Regular execution of the preventive maintenance services prescribed in this manual is the responsibility of the operating crew and the using organization maintenance personnel.

b. The inspection prescribed for the operating crew will be made on the equipment before operation, during operation, and after operation. The organizational maintenance inspections will be made on the equipment by using organization maintenance personnel weekly and monthly.

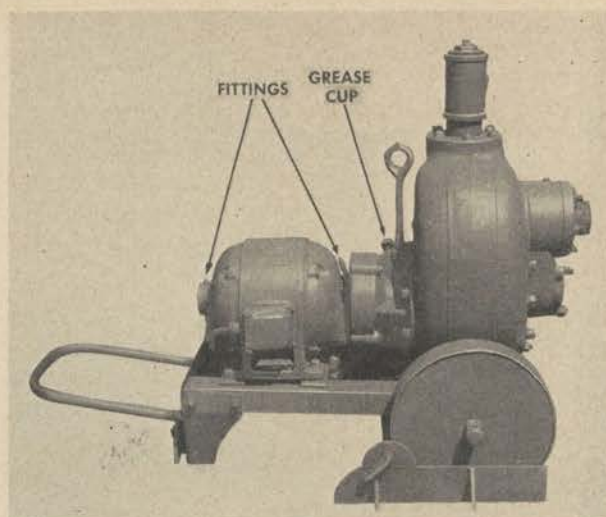


Figure 127. Lubricating deck pump motor and pump seal.

Pump seal: Fill grease cup with lubricant.

Motor: Apply several shots of grease, remove fittings, run motor, remove excess grease from opening, replace fittings.

c. The operator will report inspection findings regarding unsatisfactory operation, chronic troubles, or technical failures on WD AGO Form 468, (Unsatisfactory Equipment Report).

32. Preventive Maintenance Services

a. **GENERAL.** The purpose of preventive maintenance services is to insure satisfactory operation of equipment and to eliminate preventable mechanical failures. This is accomplished through systematic schedules of services designed to prevent or detect defects and deficiencies. By regular inspections of equipment, early detection and correction of defects can be made, and a major failure or breakdown prevented. Preventive maintenance services, together with emergency repairs, are also designated as "organizational maintenance," that is, maintenance services performed by the using organization. Organizational maintenance is limited by the first and second echelon tools and repair facilities, which are generally adequate only for minor repairs and corrections. Repairs beyond the scope of the using organization are designated as "maintenance," and are performed by the third, fourth, and fifth echelons of the Transportation Corps at base depots and shops. The effectiveness of preventive maintenance services, however, rests primarily with the operating personnel of the barge.

b. **FIRST ECHELON.** (1) The first echelon work of the crew includes the following duties: to replenish fuel, oil, grease, water, and battery liquid; to keep the barge clean and free of fire and other hazards; to tighten loose nuts; to care for tools, gear, and accessory equipment; to make corrections and emergency repairs; to check lubricant levels periodically as required by the authorized lubrication order.

(2) The first echelon performs all services in accordance with the schedule outlined on the reverse side of WD AGO Form 55-124 (Marine Craft Operators Daily Trip Ticket and Preventive Maintenance Service Record). Detailed instructions for accomplishing these services are given in paragraph 35.

c. **SECOND ECHELON.** The second echelon work of the crew includes monthly and semi-monthly preventive maintenance service, performed in accordance with the schedule outlined on the WD AGO Form 55-125. (Preventive Maintenance Service and Technical Inspection Work Sheet for Marine Craft.) Instructions for accomplishing these services are given in paragraph 36.

d. **CREW TRAINING.** (1) The schedules on WD AGO Forms 55-124 and 55-125 outline the scope of the preventive maintenance services required of the crew; these schedules will serve them as reference charts and check lists. A properly trained crew will in a short time have memorized all the items on both schedules, and should be thoroughly familiar with all the service procedures set forth in paragraph 35.

(2) The general inspection and servicing of an item should always determine whether the item is in good condition, correctly assembled, secure, or excessively worn, and shall also include an examination of all supporting members or connections. To achieve uniformity of procedure, the following basic definitions will be considered standard:

(a) *Good condition.* The examination for good condition is usually an external visual inspection to determine whether the unit is damaged beyond safe or serviceable limits, or in such condition that damage or failure will result upon operation. In particular, good condition means not rusted, corroded, bent, twisted, chafed, burned, broken, cracked, bare, frayed, dented, collapsed, torn, cut, or inadequately lubricated.

(b) *Correctly assembled.* Examination of a unit to see whether it is correctly assembled is

usually an external visual inspection to determine whether it is in its normal position.

(c) *Secure.* Examination of a unit to determine whether it is secure is usually an external inspection, a hand-feel, or a wrench-check for looseness. The examination should include any brackets, lock washers, lock nuts, lock wires, or cotter pins used in the unit assembly.

(d) *Excessively worn.* "Excessively worn" will be understood to mean worn close to or beyond serviceable limits, and liable to result in a failure if not replaced before the next scheduled operation.

33. Coordination of Preventive Maintenance and Technical Inspections

a. **PREVENTIVE MAINTENANCE SERVICES.** Monthly and semiannual inspections and services, a second echelon preventive maintenance function, are the responsibility of the commanders of operating organizations. These intervals (monthly and semiannual) are considered to be the minimum servicing frequencies adequate for normal operation of barge. Under unusual operating conditions, it may be necessary to perform maintenance inspections more frequently.

b. **TECHNICAL INSPECTIONS.** These inspections are performed by technically qualified personnel of the third, fourth, and fifth echelon maintenance organizations, and will be in accordance with the schedule listed on WD AGO Form 55-125. Technical inspections are made for the following purposes:

(1) Whenever a barge goes to a third or higher echelon maintenance shop for repair, it will receive a technical inspection to insure that all defects have been corrected before it is returned to the using organization.

(2) Whenever accountability is transferred, except in theaters of operation, technical inspections will be made to determine barge condition.

(3) To determine whether a barge should be continued in service or withdrawn for overhaul or reclamation of component parts.

(4) To determine extent of damage and estimated cost of repair in Report of Survey or similar proceedings.

(5) To discover causes of difficulties encountered in operation of barge so that efficiency may be improved.

c. **FORMAL COMMAND INSPECTIONS.** These in-

spections, conducted by all commanders, at intervals set by their own judgment, are for determining the condition and economical use of their equipment and supplies, and for insuring that subordinate commanders are complying with mandatory procedures and regulations.

d. SPOT-CHECK INSPECTIONS. These inspections, made by a staff officer or his representative, are carried out as informally as possible without prior notice to the unit concerned. Since spot-check inspections are made at irregular intervals, they should not interfere with the normal routine of the scheduled preventive maintenance services or with technical inspections. Spot-check inspections will be as detailed or as brief as the supervising officer decides.

e. DETERMINING ECHELON. The following considerations will govern in determining whether a maintenance operation should be referred to a higher echelon or be performed by the operating organization. Repair to barge will be performed in the lowest echelon of maintenance depending upon—

- (1) Availability of suitable tools.
- (2) Availability of necessary parts.
- (3) Capabilities of personnel.
- (4) Time available.
- (5) Tactical situation.

f. RETURN TO OPERATION. After a technical inspection, first and second echelon should immediately correct all defects found on the barge, unless the supervising officer orders the barge deadlined for repairs.

g. MINIMUM DISASSEMBLY. Perform preventive maintenance services without disassembling units, unless prescribed in the procedures, or unless disassembly must be made to comply with instructions included in this manual. Generally use new gaskets when reassembling units.

h. NEW INSTALLATIONS. When installing new or overhauled sub-assemblies, take care to see that they are clean, properly lubricated, and adjusted to specifications.

i. INSPECTION COVERAGE. The general inspection of each item applies also to any supporting member or connection, and invariably includes a check to see whether the item is in good condition, correctly assembled, secure, or excessively worn. These terms are defined in paragraph 32*d* (2).

j. MANDATORY SERVICE SYMBOLS. The symbols in the boxes opposite the items on the second

echelon preventive maintenance work sheet, (WD AGO Form 55-125) indicate services that are mandatory. Perform these services as a minimum, and in addition to any other services that may be required. The services represented by the symbols are defined as follows:

(1) *A, Adjust.* Make all necessary adjustments in accordance with instructions included in this manual, special bulletins, or other directives.

(2) *C, Clean.* Remove lubricant or dirt with dry-cleaning solvent. Rinse parts in clean solvent and dry them well. After cleaning and drying, immerse parts in oil, then drain. Be especially careful to keep parts clean during the interim between cleaning and reassembly. Do not allow cleaning fluid to come in contact with rubber or other material which it will damage. Clean protective grease coating from new parts, since this material is not a good lubricant.

(3) *L, Special lubrication.* Perform special lubrication as directed; do this usually in connection with maintenance work when disassembling for inspection.

(4) *S, Serve.* Servicing usually consists of performing routine operations such as replenishing battery water, draining and refilling units with oil, and changing or cleaning filters, strainers, and tanks.

(5) *T, Tighten.* Perform all tightening operations with sufficient force on the wrench handle to tighten the units according to good mechanical practice, using the proper tool without extension handle. Use a torque-indicating wrench where specified. Do not overtighten, since this may strip threads, shear bolts or screws, or cause distortion. While tightening, replace lock washers, lock nuts, cotter pins, or lock wire where needed.

k. PARTIAL MAINTENANCE SERVICE. When conditions make it impractical to perform the complete preventive maintenance service at one time, do it in installments. Give first consideration to items marked with mandatory service symbols in the work sheet boxes.

l. SERVICE WHEN UNIT IS DISASSEMBLED.—If it is necessary to disassemble a unit, perform the mandatory services indicated in the semiannual column on the work sheet.

34. Forms

a. DESIGNATION. The following forms are basic in carrying out inspection procedures and pre-

preventive maintenance services for harbor barges:

(1) WD AGO Form 55-124 (Marine Craft Operators Daily Trip Ticket and Preventive Maintenance Service Record).

(2) WD AGO Form 55-125 (Preventive Maintenance Service and Technical Inspection Work Sheet for Marine Craft).

(3) WD AGO Form 460 (Preventive Maintenance Roster).

(4) WD AGO Form 811 (Work Request and Job Order).

(5) WD AGO Form 468 (Unsatisfactory Equipment Report).

(6) WD AGO Form 478 (MWO and Major Unit Assembly Replacement Records and Organizational Equipment File).

b. INSTRUCTIONS IN USE OF FORMS. (1) WD AGO Form 55-124 serves as a daily trip ticket for the barge derrick. On the reverse side of the form there is a comprehensive schedule of preventive maintenance services applicable to the equipment. Use this itemized schedule of services as a check list. Detailed instructions for performing the listed services are given in paragraph 35. Item numbers in the list of instructions correspond to item numbers on the form. Disregard items that are not applicable to the equipment being used. The function of this schedule of services is based on the following considerations:

(a) *Before-operation services.* Perform these services to determine whether the condition of the equipment has changed since the last after-operation services. Any of the following could have affected the apparatus: sabotage, collision, falling objects, installation of booby traps, fire, moisture damage to the electrical system, and/or the reduction of the oil, fuel, or water supply through leaks. Even in extreme tactical situations, do not omit a before-operation check-up.

(b) *During-operation services.* The during-operation services are intended for quick detection of improper performance. Be constantly on the alert for unusual noises, smoke, steam, or odors; detect unsatisfactory performance of engine or other equipment; and take corrective steps before any defect develops to the point of breakdown, fire, or accident.

(c) *At-halt services.* During short at-halt or shut-down periods, correct any unsatisfactory condition which was noticed during operation, which was not serious enough to require action at the

time; or, which because of the tactical situation, could not be given corrective attention. Report promptly results of the at-halt services to the crew chief or other designated authority.

(d) *After-operation services.* The purpose of the after-operation services is to prepare the barge to operate again at a moment's notice. Inspect the barge thoroughly to detect any defects that may have developed, and make all possible corrections. Use WD AGO Form 55-124 to submit a prompt report of the result of the service to the crew chief or other designated authority. Do not omit after-operation services even in extreme tactical situations. Where adverse circumstances dictate, a minimum of bare fundamentals should nevertheless be performed.

(e) *Weekly services.* The weekly services are designed to reinforce daily maintenance. They consist of additional attention to certain designated items (marked with an asterisk) on the after-operation list of services. This weekly service should include a detailed check by the crew chief and the company officer, on the quality of maintenance performed by the crew.

(2) Form 55-125 serves as a work sheet and record of monthly and semiannual maintenance services and tests. It is also designed to be used as a work sheet and record of technical, command, and spot-check inspections. Paragraph 36 gives detailed instructions for performing the monthly and semiannual maintenance services that fall within the scope of second echelon personnel. These instructions also cover all inspection-originating services within the scope of second echelon personnel. See paragraph 33 for explanation of mandatory service symbols. Inspectors will use the symbols designated on the form. Correct all defects upon discovery, or report them to higher echelons for repair.

Note. It will often be found that a particular service procedure applies only to semiannual maintenance. In the list of instructions in paragraph 35, the item numbers correspond to the item numbers on WD AGO Form 55-125. The column in which the number stands indicates the interval of service (M—Monthly; S—Semiannual). In technical inspections ALL items must be inspected. In command and spot-check inspections, it is the supervising officer who determines the extent of the inspection.

(3) WD AGO Form 460 is the Preventive Maintenance Roster. Preventive maintenance services will be scheduled continuously throughout the month in the following manner:

(a) The inside right-hand page contains 31 columns for the 31 days of the month. Use the adjacent columns on the left-hand inside page to list all barge derricks under command of the using organization. Give under the heading Rank & Name the rank and name of the master of the barge. Use the remaining columns for appropriate entries as indicated by the headings. For each barge use only one line (across both pages) to record the periodic maintenance services performed on it during the month. In the Remarks column, note transfers of equipment. Disregard the Accessory column.

(b) Use the following symbols on the right-hand page:

W. To indicate a weekly maintenance service, W1, W2, W3, etc.,—to indicate first, second, and third weekly maintenance services since the last monthly maintenance service.

M. To indicate a monthly maintenance service, M1, M2, M3, M4, and M5—to indicate the first, second, third, fourth, and fifth monthly maintenance services since the last semiannual maintenance service.

S. To indicate a semiannual maintenance service. Do not place any numeral after the symbol S.

P. To indicate equipment deadlined for lack of parts.

A. To indicate equipment deadlined because of accident.

R. To indicate equipment deadlined in shop, undergoing repairs.

(4) Use WD AGO Form 811 when the master of an operating unit requests higher echelon work.

(5) Use WD AGO Form 468 to report unsatisfactory performance of new equipment.

(6) Keep WD AGO Form AGO 478 in possession of second echelon maintenance personnel and send it with equipment upon transfer or evacuation to a higher echelon. After completing a Modification Work Order or a major unit assembly replacement, make the appropriate entries.

35. First Echelon Preventive Maintenance Services Itemized Instructions

a. BEFORE-OPERATION SERVICES. (1) *Item 1, Tampering and damage.* Inspect for any injury to barge or special equipment. Look for damage

that may have occurred from falling objects, shell fire, sabotage, fire, or collisions. Watch out for booby traps. Open all engine compartment doors, and look for signs of tampering or sabotage such as loosened or damaged accessories or drive belts. Dry the spark plugs, and/or magneto and wiring.

(2) *Item 2, Fire extinguishers and fire fighting equipment.* Inspect extinguishers for tight mountings, full charge, corroded nozzles, closed valves, and broken seals. Inspect the deck pump and its motor to see that they are in operating condition. Check the condition of the pump overboard suction hose and its discharge hose and nozzle to see that they are serviceable. As a precaution against fire or explosion, open the ventilators or hatches to be sure that the hull compartments, particularly the engine compartment, are clear of gas fumes.

(3) *Item 3, Fuel, oil, water.* Check the amount of fuel in the tanks, noting any indications of leaks or tampering. Add fuel, if needed, and check the spare fuel cans. Check lubricating oil level, and add oil if needed. Lubricate all points specified on the lubrication orders. Check coolant for correct level, and inspect for deterioration. When antifreeze is in use, make a hydrometer test of the coolant if a considerable amount of water is required for replenishment; if test shows need, add sufficient antifreeze to meet lowest anticipated temperatures.

Caution: Investigate any appreciable change in levels of oil, fuel, or water and report them to proper authority.

(4) *Item 4, Accessories and drives.* Inspect all accessories such as fans, shrouds, and water pumps for loose connections and mountings.

(5) *Item 5, Start controls.* Start the main Diesel engine and note the operation of the starting engine. Start the auxiliary Diesel engine and note action of the starting motor, particularly whether the starter has adequate cranking speed and engages and disengages without unusual noise. Set the throttle of each engine for normal warm-up speed and check oil circulation immediately. If oil pressure gage does not indicate properly within 30 seconds, stop the engine and investigate or report defect to proper authority.

(6) *Item 6, Instruments.* (a) *Oil pressure gages.* Check the gage of each engine to see whether it indicates approximately normal pressure.

(b) *Ammeter, auxiliary Diesel generator set.* The ammeter should show a high charging rate for the first few minutes after starting. After this period (when the generator has restored to the battery the current used in starting) the ammeter should register a zero or slight charge. Investigate any unusual drop or rise in reading. A high charge reading for an extended period may indicate a critically low battery or faulty generator regulator.

(c) *Hour meter, main engine.* Observe whether instrument is registering.

(d) *Temperature gages.* The temperature of each engine should increase gradually during the warm-up period. Extremely low temperature after a reasonable warm-up period may indicate existing troubles that should be investigated and corrected. Extremely high temperature may indicate a defect in the cooling system.

(7) *Item 8, Leaks—general.* Inspect the engine compartment and interior of the hull for leaks. Inspect all water connections and valves; observe whether oil is leaking from crankcase, oil tanks, oil coolers, filters, or lines. Inspect the fuel system for leaks, paying particular attention to connecting hose. Trace all leaks to their sources, and correct or report them to the proper authority. Wipe up fuel or oil drippings.

(8) *Item 10, Glass and tarps.* Inspect glass, frames, and brackets for damage; clean the door glass. Inspect tarpaulins for rips and holes; if not in use, see that they are properly and securely stowed.

(9) *Item 11, Lamps.* Within the limits permitted by the tactical situation, check operation of all light switches. See that lamps are secure, and that lenses and reflectors are clean and not broken or cracked.

(10) *Item 13, Tools, spare parts and equipment.* See that tools, spare parts and equipment belonging to the barge are present, clean, serviceable, and properly mounted or stowed.

(11) *Item 14, Auxiliary equipment.* Inspect all auxiliary equipment such as deck pump, auxiliary Diesel generating set, and capstan for secure mountings, unobstructed.

(12) *Item 14a, Air reservoir.* Inspect the air reservoir tank to see that it is secure and undamaged, and that all air-line connections are tight. Drain water (condensation) from the tank. Be sure all pet cocks are closed.

(13) *Item 14b, Hoists.* Inspect drums to see that they are free of obstructions or debris, and to be sure the cables are wound in smooth, tight layers and adequately lubricated.

(14) *Item 14c, Boom, sheaves, cables.* Inspect for correctness of assembly, security of boom and boom splicing, broken or loose sheaves, frayed or kinked cables. Give special attention to correct reeving of cables.

(15) *Item 14d, Safety appliances.* Check condition of rowboat and oars. Check number and condition of ring life buoys and jacket life preservers. Inspect grab rails, safety stanchions, and chain guards for serviceability.

(16) *Item 14e, Operation publications.* Crew chief must make sure that all publications pertaining to the equipment for which he is responsible are either in his possession or are with the equipment. These will include such publications as the War Department Lubrication Orders, specific technical manuals pertaining to the equipment, and WD AGO Forms 55-124 and 55-125.

b. DURING-OPERATION SERVICES. (1) *Item 15, engine operation.* Be on the alert for irregularities in engine performance of both the main engine and the auxiliary Diesel, such as lack of usual power, misfiring, unusual noise or stalling, indications of engine overheating, unusual exhaust smoke, and improper lubricating oil pressure or temperature.

(2) *Item 16, Controls and drives.* Check both Diesel engine and the gasoline starting engine to see that they respond to their controls satisfactorily, and that the controls are in proper adjustment and correct position. Note whether the starting engine clutch or the main drive clutch grabs, chatters, or squeals during engagement, or slips when fully engaged. The main drive clutch lever must have adequate free travel before it begins to disengage the clutch; otherwise, the clutch may slip when under load. The starting engine gears and clutch must engage smoothly, operate quietly, and not disengage during operation. Jumping out of gear may indicate faulty adjustment or excessively worn parts. Inspect all drives for overheating and oil leaks.

(3) *Item 18, Fuel oil, water.* Check circulation of water through engine and radiator. Inspect for leakage throughout entire lubrication, fuel, and water systems.

(4) *Item 19, Instruments.* During operation,

frequently observe the readings of all instruments.

(a) *Temperature gage.* Excessive engine heat may indicate trouble. Investigate it immediately.

(b) *Oil pressure gage.* In case of an unusual drop in oil pressure, stop the engine immediately. Lack of proper oil pressure may indicate insufficient oil, leaks, loose bearings, or a defective oil pump, and may result in serious damage to the engine.

(c) *Ammeter, auxiliary Diesel generator set.* During operation, the ammeter should indicate a zero or a positive reading. A discharge reading may indicate a faulty generator or regulator.

(5) *Item 20, Temperatures and pressures.* Frequently observe engine pressures and temperatures as indicated on the various engines and check to insure that values are within the limits prescribed. Abnormal temperatures and pressures serve to indicate existing or impending engine difficulties.

(6) *Item 22, Accessories and drives.* See that water pumps, generators, fuel-injector pumps, carburetors, regulators, starter, fans, and shrouds are secure, and that all their drives and drive belts are in correct adjustment and are functioning properly.

(7) *Item 23, Leaks—general.* Observe whether oil is leaking from crankcase, oil tank, oil cooler, filters, or lines. Inspect fuel system for leaks, particularly valves, couplings, fittings, and connections. Inspect radiator core and connecting hose of the engine cooling system.

(8) *Item 27, Appearance and glass.* Keep the barge machinery clean and free of tools while the equipment is in operation. Keep the windows in the deck house free of dirt and dust in order to present maximum visibility for the hoist operators. Promptly remove from decks any wood or packaging material that may have broken loose while handling cargo.

(9) *Item 28, Auxiliary equipment.* As each piece of auxiliary equipment is put into use, consider its performance a test of its condition. Observe how it responds to its controls and whether it functions satisfactorily. Report any malfunction to the crew chief.

(10) *Item 28a, Hoists.* Listen for squeals or hums as cables wind and unwind on the drums. Watch for uneven winding, or kinked or frayed cables. Report immediately to operator or crew chief any of these or other unusual conditions.

(11) *Item 28b, Boom, sheaves, cables.* During operation, look for looseness of sections in the boom, usually indicated by a whipping action in the boom when a load is hoisted off the ground. Listen for squeals or hums indicating binding or fraying of the cables or lack of lubricant in the sheave bearings. If any malfunction is noticed under load, report the condition to proper authority.

c. AT-HALT SERVICES. (1) *Item 28c, Fuel, oil, water.* Check circulation of fresh water. Check the fuel supply. When refueling, use safety precautions for grounding static electricity, and allow space for expansion. Leave filler cap vents open. Check the crankcase oil level and, if needed, add oil to proper level. Remove radiator filler cap; be careful of steam. Check coolant to see that it is at proper level; replenish as needed. Do not fill to overflowing; leave space for expansion. If engine is hot, fill slowly while it is running at fast idle.

(2) *Item 28d, Leaks—general.* Inspect tanks and piping for leaks and make needed corrections. Inspect each individual vessel for leaks in its hull.

(3) *Item 28e, Accessories and drives.* Inspect fan, water pump, and generator to see that they are secure, and that all drive belts are in correct adjustment and undamaged. Report any unsatisfactory condition to crew chief.

(4) *Item 28f, Air cleaners.* If operating under dusty conditions, inspect the air cleaners and breather caps to see that they are in proper condition to clean the air going to the engine. Service the air cleaners, if needed, according to instructions on WDLO 55-U21.

(5) *Item 28g, Auxiliary equipment.* Inspect all auxiliary equipment used during operation. Look for loose mountings and electrical connections, oil leaks, and obstructions such as mislaid tools or debris. If housings are wet, wipe them dry.

(6) *Item 28h, Boom, sheaves, cables.* Inspect for possible damage that may have occurred during operation. Apply lubrication to blocks, if needed.

(7) *Item 28i, Hoists.* Inspect for loose mountings, bolts, and general condition of cables.

d. AFTER-OPERATION AND WEEKLY SERVICES. (1) *Item 29, Engine—main Diesel, starting engine, and auxiliary Diesel.* Idle the engines to determine the correctness of adjustments. Accelerate and decelerate the engines, and note any

tendency to miss or backfire, or any unusual engine noise or vibration that might indicate worn parts, loose mountings, incorrect fuel mixture, or faulty ignition. Clean the exterior of the engines and dry thoroughly. Clean the engine room.

(2) *Item 30, Fuel, oil, water.* Check coolant level and replenish as required, taking care to leave space for expansion. If a large amount of coolant is required, inspect for leaks. When anti-freeze is used, take an hydrometer test of the coolant, and add sufficient anti-freeze to meet lowest anticipated temperature during next operation period. Fill fuel tank, observing safety precautions for grounding static electricity. Bring engine oil to proper level. If an unusual amount of oil is required for the engine, check for leaks and report condition. Fill portable water tank. Refill spare fuel, oil, and water cans.

(3) *Item 31, Instruments.* Inspect instruments for security of mountings and connections. If any instruments are suspected of being out of calibration, remove and send them to a repair depot for testing.

(4) *Item 32, Batteries.* Inspect batteries to see that they are clean, secure, and not leaking.

Weekly: Clean tops of batteries, cables, and vent caps with a soda solution. If terminal connections or posts are corroded, clean them thoroughly and apply a thin coating of grease. Tighten loose terminal bolts. Remove vent caps and check level of electrolyte. Add distilled or clean fresh water if required, taking precautions against damage to the battery during freezing temperatures. Inspect batteries for bulges, cracks, and leaks. The battery carrier should be secure, clean, free of rust, and well painted. Tighten loose mountings cautiously, so as not to damage the battery case. Report any damage to crew chief.

(5) *Item 33, Accessories and drives.* Inspect all accessories such as carburetors, generators, regulators, starters, fans, shrouds, and water pumps for loose mountings and connections, and for lubrication.

Weekly: Inspect adjustment of drive belts. Belts should deflect the amount specified in TM 55-1204. Also examine belts for fraying, cracking, or presence of oil. Inspect drive shafts and couplings to see that they are secure and not leaking or damaged.

(6) *Item 34, Electrical wiring.* Inspect all elec-

trical wiring to see that it is securely connected, clean, and undamaged.

(7) *Item 35, Air cleaners, breather caps.* Inspect air cleaner to see whether the oil is at the correct level and not excessively dirty. It is usually unnecessary to remove the air cleaner to make this inspection. If the oil in the cleaner is excessively dirty, clean and refill the cleaner with fresh oil in accordance with instructions in WDLO 55-U21.

Weekly: Remove and disassemble the air cleaners. Clean the bodies and elements in solvent. Fill the reservoirs to the correct level with clean engine oil. Apply engine oil to the elements and allow the excess to drain off. When reassembling the cleaners, make sure that all gaskets are in good condition and in place. Reinstall the air cleaners, giving special attention to the mountings. See that the cleaners are pressed firmly in place against the air-horn seals, are correctly aligned, and are secure. Remove all breather caps and crankcase filter cleaning elements. Wash them thoroughly in dry cleaning solvent, dip in engine oil, drain, and reinstall.

(8) *Item 36, Filters, strainers.* Inspect all fuel and oil filters for leaks.

Weekly: Close the shut-off valve in the fuel line and remove the drain plug to allow water and sediment to drain out of the filter bowl. Then replace drain plug, tighten it securely, reopen shut-off valve in fuel line, and note whether fuel is leaking from drain plug. Do not wash oil filter bags for reuse. Clean metal type filters with dry-cleaning solvent or Diesel fuel. Inspect and clean circulating water strainers, screens, and bypasses, noting conditions of the mesh.* Replace defective mesh.

(9) *Item 37, Main engine controls.* Inspect for worn or bent linkages. Check adjustments to see whether controls coincide with markings, or if free travel is too little or too much.

(10) *Item 39, Gear oil levels.* Inspect drives, transfer units, and gear cases for lubricant level and leaks. Refer to WDLO 55-1204 for correct lubricant level type.

Weekly: Observe condition of lubricant; replace if needed. Refer to lubrication order for normal replacement interval.

(11) *Item 40, Air compressor.* Inspect air compressor to see that it is secure and properly aligned with its drive pulleys. Open air tank pet

cocks and drain water (condensation). Correct any maladjustments noted during operation.

Weekly: Lubricate in accordance with WDLO 55-1204. Clean air strainer, adjust unloader valve clearance, tighten or adjust all drives, drive belts, pulleys, hubs, and engine mounts. Tighten loose tank mountings and air line connections. Clean air line of any grease or oil.

(12) *Item 41, Leaks—general.* Inspect engine compartment and engine for evidences of fuel, oil, air, or water leaks. Trace all leaks to their sources, and correct or report them.

(13) *Item 43, Fire extinguishers.* See that the unit is in good condition and securely mounted. If the extinguisher has been used, report it for refill or replacement. Clean all nozzles of obstructions or corrosion.

(14) *Item 45, Glass and lamps.* Check all light switches and bulbs. Inspect all lenses and reflectors for cleanliness and damage. Clean all windshields and windows.

(15) *Item 47, Tools, spare parts and equipment.* Check with stowage lists to see that all tools, spare parts, and equipment assigned to the barge are present and properly stowed or mounted.

Weekly: Clean all tools and equipment of rust, mud, or dirt. Report missing or unserviceable items to crew chief.

(16) *Item 48, Auxiliary equipment.* Inspect all auxiliaries such as capstans, lighting plant, and pumps for loose connections and mountings. Check adjustment of drive shafts, belts, and bearings. Belts should deflect the amounts specified in this manual. Report loose or unserviceable belts to crew chief.

Weekly: Tighten or adjust linkage, connections, and mountings on auxiliary equipment and their driving units.

(17) *Item 49, Hull, tarps.* Inspect hull for possible damage. Inspect tarpaulins for rips and holes. Report any damage to proper authority.

(18) *Item 50, Lubricate as needed.* Check and service items such as hinges, latches, springs, rails, rollers, and other points that are lubricated manually.

Weekly: Lubricate all points shown on the lubrication order requiring weekly attention, also all other points where experience and inspection indicate a need for lubrication.

(19) *Item 51, First aid kit, life preservers, safety rails.* Check contents of first aid kit against list. Report deficiencies to proper authority. Inspect ring buoys and jacket life preservers for condition and check quantity against list. Check boat and oars. Check grab and guard rails.

(20) *Item 51a, Boom, sheaves, cables.* Inspect boom and accessories for looseness, cracked or broken sheaves, frayed or kinked cables.

Weekly: Tighten loose boom section bolts. Inspect cables thoroughly for wear. Lubricate cables.

(21) *Item 51b, Hoist.* Inspect for looseness of mountings.

Weekly: Tighten or adjust any loose connections, linkages, or mountings on accessories. Examine all belts for fraying, wear, cracking or presence of oil. Check all belts halfway between their respective pulleys to determine whether the belts are properly adjusted. Report improperly adjusted or unserviceable belts to the crew chief.

36. Second Echelon Preventive Maintenance Services—Itemized Instructions

Item 5*	Nos. M*
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Air System (Build-up, Unloader, Low Pressure Indicator, Controls, Leaks)

- | | | |
|---|---|--|
| 1 | 1 | Operate the main Diesel engine at idling speed and observe whether the air pressure builds up at a normal rate to the specified maximum limit. The unloader should cut off the compressive action when the air pressure reaches the maximum limit. Bleed the air tank and observe whether the low pressure indicator goes on at the specified minimum mark. Test all controls that employ compressed air. Inspect the entire air system for leaks. Inspect all mountings, lines, and connections to see that they are in good condition and secure. If unloader fails to function properly, send the unit to repair depot for overhaul and adjustment. |
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*S—Semiannual; M—Monthly.

Item S*	Nos. M*	
		Instruments and Gages (Fuel, Water, Temperature, Air Pressure)

- | | | |
|---|---|--|
| 2 | 2 | Inspect all gages to determine whether they are in functional condition, securely mounted, and tightly connected. |
| 2 | | Disconnect all pressure, temperature, air and fuel gages, and send them to maintenance depot for calibration check-up. |

Meters (Voltmeter, Ammeter, Hour Meter)

- | | | |
|---|---|---|
| | 2 | Inspect all meters to determine whether they are in functional condition, securely mounted, and properly connected. |
| 2 | | Disconnect all meters and send them to maintenance depot for calibration check-up. |

Clutch Drive (Free Travel, Drag, Chatter, Grab, Slip, Housing, Bearings)

- | | | |
|---|---|---|
| 4 | 4 | With engine running observe whether the clutch lever has satisfactory free travel before beginning to engage or disengage the clutch. The clutch lever should release the clutch completely before it has traveled its full stroke. Note whether there are any unusual noises in the clutch release mechanism that might indicate dry or defective release bearings, defective clutch plate, or pilot bearings. When engaging the clutch, and when it is fully engaged, observe whether there are any indications of slipping, grab, chatter, or drag. If inspection indicates that adjustment of clutch lever is required, follow instructions in engine manual. If the clutch itself requires adjustment or repair, refer to third or higher echelon. |
|---|---|---|

Item S*	Nos. M*	
		Engine (Idling, Acceleration, Power, Governed Speed, Noise, Exhaust)

- | | | |
|----|----|--|
| 10 | 10 | IDLING. Observe whether each engine runs smoothly at idling speed, listen for knocks and rattles as it is accelerated and decelerated, and while it is under light and heavy loads. |
|----|----|--|

ACCELERATION, POWER, NOISE. Observe whether each engine has normal acceleration, pulling power, and operating characteristics in each speed. Listen for noises that might indicate damaged, excessively worn, or inadequately lubricated engine parts or accessories, or loose drive belts.

SMOKE. Observe exhaust. If excessive smoke is evident find the source and cause.

GOVERNED SPEED. Check speed while slowly accelerating each engine. Note whether the engine exceeds the specified governed speed.

Caution: Do not accelerate beyond fast idle without load.

Leaks

Inspect the engine compartment thoroughly, including each engine while running, for evidences of oil, air, water, or fuel leaks. Determine source of any leaks and correct the condition immediately.

Cylinder Heads

If inspection for leaks shows necessity for tightening cylinder heads, use a torque-indicating wrench to tighten in the sequence and to the tension specified in the engine manual. When installing a new gasket, tighten three times as follows: first, upon installation; second, after en-

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gine warms up; third, after completing final test. Adjust the tappet clearances to specifications after the final tightening of the head nuts.

Valve Mechanism (Clearance, Lubrication, Cover Gaskets)

- 14 14 Examine valve tappet clearances while hot. Valve tappets, rocker arms, shafts, and springs should be in good condition, correctly assembled, and secure. Oil should be delivered properly. Make sure that the valve cover gaskets are also in good condition. Make the above inspection only as the need for such service is indicated by valve noises or engine performance. Remove valve mechanism covers, check valve clearances, and note condition of valve mechanism. Adjust the clearances to specifications, taking care that the lock nuts are secure.

Diesel Fuel Nozzles and Lines

- 15 15 If a fuel nozzle test stand is available, test nozzles for spray pattern and after-dribble. Replace nozzles with improper spray pattern or after-dribble with new, or reconditioned and tested nozzles. Tighten all fuel nozzles, cap screws, and line connections securely. If no test stand is available, replace all fuel nozzles with new or reconditioned ones and send the old ones to maintenance for testing. Clean fuel nozzles thoroughly in dry cleaning solvent before reinstalling.

Spark Plugs (Gaps, Deposits)

- 16 16 Inspect the spark plugs before removal to see whether there is any leakage around the gaskets. Then remove the spark plugs and inspect them for broken insulation, excessive carbon deposits, and electrodes which are burned thin. Discard unserviceable spark plugs. Report ex-

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cessive deposits or damaged insulators to proper authority, since these conditions may indicate incorrect heat-range. (The porcelain insulators inside spark plugs of proper heat-range will be coffee-brown in color.) If a plug cleaner is available, clean deposits from electrodes and insulators. Adjust gaps to specifications. After completing the compression test (item 18), reinstall the plugs, using new gaskets. Take care not to overtighten the plugs.

Compression Test

- 17 GASOLINE ENGINE. With all spark plugs out and engine warm, insert the compression gage in a spark plug hole and, with the throttle wide open, revolve the engine at cranking speed until the maximum compression is indicated. Record the reading in the space provided on the back of WD AGO Form 55-125. Repeat this procedure for each cylinder. Refer to the engine manual for specified compression pressures and for variations due to condition and wear. If pressure in a cylinder is below normal, squirt sufficient engine oil on the piston head to prevent temporary loss of compression, and recheck the compression of the cylinder. Low compression, brought up to normal by oil sealing, indicates piston, ring, or cylinder wear or damage. Low compression not brought up to normal by this method indicates compression leakage by valve or gasket.
- 17 MAIN AND AUXILIARY DIESEL ENGINES. Attach pressure indicator to cylinder, turn scale sleeve to bring red disc in register with letter C for compression readings.

Note. Set index sleeve to read about 50-100 p. s. i. in excess of the expected maximum cylinder pressure.

Connect neon flasher to indicator valve and obtain reading of the cylin-

Item S*	Nos. M*	
		der pressure. Repeat this process for each cylinder. Record the readings in the space provided on the back of WD AGO Form 55-125.

Engine Mounting

18	18	Inspect engine mountings, ground straps, and braces to see that they are securely tightened. Be sure engine side pans are in good condition, correctly assembled, and not leaking.
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Manifolds and Heat Control (Intake/Exhaust)

19	19	Note whether the manifolds and their gaskets are in good condition, correctly assembled, secure, and not leaking. Inspect for leaks by looking for carbon streaks. Check exhaust temperatures. Equalize exhaust temperatures to a minimum of variations. Check the water regulator of the main engine and the thermostat of the auxiliary Diesel to see that they are in good condition, secure, and set at the correct positions. Tighten all nuts evenly on the manifold assembly, mounting, exhaust pipe, and carburetor connecting flange.
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Exhaust Pipes and Mufflers

20	20	Note whether exhaust pipes and mufflers are in good condition, securely assembled and mounted, and whether there are evidences of exhaust leaks, usually indicated by carbon streaks. Be sure the drain holes in the muffler are not clogged. Tighten all mounting bolts and connections securely.
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Fuel (Tanks, Vents, Lines, Filters, Screens)

21	21	Inspect fuel tanks to see that they are in good condition and securely mounted. Examine caps for defective gaskets. Note whether the vents are open, and whether there are indications of fuel leaks from the
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Item S*	Nos. M*	
		tanks, lines, or pumps. See that the filler necks are in good condition and that the caps fit securely.

Fuel Filters, Screens, and Liners

22	22	Inspect fuel lines and fittings to see that they are in good condition, securely supported, and not leaking. Remove the fuel tank drain plugs and drain off the accumulated water and sediment. Drain only until the fuel starts to run clean. Note whether the fuel filters and cleaner bowls are in good condition, secure, and not leaking at gaskets or connections. Remove fuel screens and cartridge type elements, clean all screens thoroughly in dry cleaning solvent, dry with compressed air, and reinstall. Determine whether the cartridge type element is in satisfactory condition for further service. If so, clean and reinstall it, being sure that all element and cover gaskets are in good condition and in place. On a disc type filter, remove the element from the cleaner bowl, and wash it in dry cleaning solvent until the discs are clean and free. Clean the bowl thoroughly and reinstall the element, making sure all gaskets are in good condition and in place. Do not scrape or damage the discs.
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Fuel Pumps

23	23	See that the fuel pump lines of all engines are in good condition, secure, and not leaking. With the engines idling, note whether the pump pressures are within specified limits. Replace any pump that does not produce proper pressure, being sure to test the new pump as well.
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Fuel Injector Pumps

24	24	Note whether the pumps are in good condition, correctly assembled, securely mounted, and not leaking at their connections. Drain the oil and
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*S—Semiannual; M—Monthly.

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		refill to correct level with specified oil. Tighten all assembly and mounting bolts and cap screws. Adjust the fuel injector pump timing according to the instructions and specifications in this manual.

Throttles

25	25	Inspect the throttles and all connecting linkages to see that they are in good condition and securely connected. Lubricate all linkage pins, fulcrums, joints, and other connections requiring lubrication. Refer to applicable lubrication order.
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Engine Oil (Tanks, Coolers, Lines and Fittings, Filters)

26	26	Inspect tanks, coolers, lines, and fittings to determine whether they are in good condition, correctly assembled, securely mounted, and not leaking. Tighten all mountings, support clips or brackets securely.
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26		CONDITION OF OIL. Examine a sample of the oil for grit, water, or fuel dilution, and check the viscosity with a "visgage."
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26		DRAIN AND SERVE TANK. Drain all oil from the supply tank, close the drain cock, and fill tank approximately one-fourth full with light engine oil. Agitate with a clean stick or rod to loosen the sediment. Continuing to stir the oil, open the drain cock and drain the oil and sediment from the tank. After the flushing oil is thoroughly drained, close the drain cock and fill the tank to the proper level with specified engine oil.
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CRANKCASE. See War Department Lubrication Order applicable to each engine for crankcase maintenance.

27	27	ENGINE OIL FILTERS. Inspect oil filters, coolers, and all external engine oil lines to see whether they are in good condition, secure, and not
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Item S*	Nos. M*	
		leaking. Examine each oil filter cartridge. If replacement is necessary, remove the cartridge, clean the case with dry cleaning solvent, and install a new cartridge of the correct type. Install new gaskets and tighten the cover securely. On disc type filters, remove drain plug and drain off contents. Then remove cover and element and, without disassembling, clean them in dry cleaning solvent. Blow dry with compressed air, if available. If solvent is serviceable, reinstall it; if not, replace it.

Air Cleaners (Diesel, Carburetor, Compressor)

28	28	Remove all Diesel, carburetor, or compressor air cleaners. Disassemble cleaners and wash elements in dry cleaning solvent; dry elements and apply engine oil; drain excess oil. Reassemble and reinstall air cleaners, making certain all elements are in good condition and in place. Be careful to press cleaners firmly into place, and see that the mounting is secure.
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Water Pumps

29	29	Inspect the auxiliary Diesel pump to see that drive is in good condition and properly adjusted, and that the pulleys and belt are in good condition, secure, properly aligned, and not excessively worn. Examine shaft for end play and loose bearings. Tighten all pump mountings and assembly bolts of both engines securely. Tighten all pump packing nuts carefully; overtightening will score shafts and cause leaks.
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Accessory Drives (Chain Belts, Pulleys, Clutches, Shafts and Couplings)

30	30	See that these items are in good condition, correctly assembled, and secure. See that main drive chain is
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in good condition and gear and pinion properly alined. Note whether all V-belts and pulleys are well alined and not excessively worn, also whether they are frayed. Adjust all V-belts according to instructions in this manual, taking care to lock all adjustment devices securely. Check capstan shaft and coupling for alinement. Inspect all operating clutches for alinement and wear, paying particular attention to fulcrum arms, pins, links, and anchors. Make adjustments. If parts are excessively worn or damaged, replace with new parts. Inspect band linings for wear, and replace lining if wear is excessive. Remove oil or grease from linings by washing them with dry cleaning solvent. In some instances, it may be necessary to remove band assembly to clean lining properly. Clean oil-saturated and glazed band linings with a rough file.

Heat Exchanger or Radiator (Core, Shutters, Hose, Cap, Scale)

- 31 31 Inspect these items to see that they are in good condition, correctly assembled, securely mounted, and not leaking. Examine coolant to see whether it is contaminated with rust, oil, or other foreign matter that would require cleaning the cooling system. If cleaning is needed, do it according to current directives, using only specified cleaner. Clean all dirt from the exterior core. Tighten all loose mountings, plates, and clamps.

Generators (Mounting, Commutator, Brushes, Wiring)

- 33 33 Remove the exciter brush cover plate and inspect the commutator to see whether it is in good condition and not excessively worn. Observe whether the brushes are clean, free in their holder, properly spring-loaded, and not excessively worn.

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Inspect connections for tightness, and check generator drive for correct alinement. Clean the commutator by placing a strip of very fine sandpaper (No. 00 to No. 8/0) over a wooden block of the correct size and, with the engine running slowly, press the sandpaper against the commutator until it is clean. Do this only when absolutely necessary. Blow out with compressed air. Tighten mounting bolts and electrical connections securely.

Regulator Unit

- 34 34 Inspect the unit to see that it is in good condition, and that all connections and mountings are secure.
- 34 TEST. Connect the low voltage circuit tester and observe whether the generator output is properly controlled by the voltage regulator, current regulator, and cut-out. In making the test, follow the instructions in the engine manual, or those which accompany the test instrument. If the test shows faulty operation, replace the unit.

Carburetor (Throttle; Choke, Governor, Linkage)

- 35 35 Inspect the carburetor to see that it is in good condition, correctly assembled, securely installed, and not leaking. Inspect the control linkage, including the choke valve, to see that it opens fully when the control is in its released position. See whether the throttle valve opens fully when the accelerating lever is fully depressed, and whether the governor is secure and properly sealed. Drain the carburetor bowl and clean the screen.

Magneto

- 37 37 Inspect the magneto to see that it is in good condition and securely mounted. Note whether there is evi-

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dence of oil leaks at the mounting pad gaskets. Remove the breaker point inspection covers and inspect the points to see that they are in good condition and clean. Inspect the breaker points to see that they are well alined. Examine the mating surfaces to see that they engage squarely. Adjust the breaker point gaps in accordance with specifications in engine manual. Replace unserviceable points.

Battery (Cables, Hold-Down, Gravity and Voltage, Discharge Test)

- 39 39 Inspect the batteries externally to see whether their cases, posts, and cell straps are in good condition and secure. Note whether the cases are leaking. Wipe dirt from filler caps and covers, remove caps, and note whether cap vents are open. Check the level of electrolyte in the cells. This level should be above the top of the plates and may extend up to one inch above the plates. Before adding any water to the cells, test the specific gravity of each cell with a battery hydrometer, and record the battery readings in the spaces provided on the back of WD AGO Form 55-125. While the samples of the electrolyte are in the hydrometer for the gravity test, observe whether the electrolyte is discolored to a reddish-brown color, which may indicate that the battery is being overcharged due to improper regulator action. Report any gravity readings below 1.225 and variations of more than 0.025, and any reddish-brown discoloration of the electrolyte. Take the voltage reading of each cell, and record it in the space provided on the back of Form 55-125. Examine the battery cables, terminals, and terminal bolts to see whether they are

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in good condition, secure, and not corroded. Inspect the battery hold-downs to see that they are securing the battery properly; inspect the battery carrier to see that it is in good condition and secure.

CLEAN. Clean the top of the battery with a water and soda wash, finish the cleaning with clean water, and wipe or blow dry. Clean the battery carrier in the same manner, and paint the carrier if it is corroded. Clean the cable terminals, terminal bolts and nuts, and battery posts. Apply a light film of grease to all these points.

SERVE. Bring the electrolyte to the correct level with distilled water. Tighten terminals and hold-downs carefully. Overtightening will damage the battery.

- 39 DISCHARGE TEST. Make a high-rate discharge test of the battery to see whether the cells are in satisfactory condition. Take care to make the test according to the instructions for a condition test which accompany test instrument. A true test cannot be made if the gravity of the battery is below 1.225. If the difference in the specific gravity readings obtained from the cells exceed 0.031, replace the battery.

Air Compressor (Build-Up, Unloader, Low Pressure Indicator, Controls, Leaks)

- 40 40 Operate the engine at idling speed and observe whether the air pressure builds up at a normal rate to the specified maximum limit. The unloader should cut off the compressive action when the air pressure reaches the maximum limit. Bleed the air tank and observe whether the low pressure indicator goes on at the specified minimum mark. Test all controls that employ compressed air.

Item S*	Nos. M*	
		Inspect the entire air system for leaks. Inspect all mountings, lines, and connections to see that they are in good condition and secure. If un-loader fails to function properly, send the unit to repair depot for overhaul and adjustment.

Gear Oil Levels

41	41	See WD LO 55-U36 for hoist lubrication instructions. Raise covers on hoist drum guards and check gear teeth lubrication. Open slide door of hoist chain drive housing and check chain lubrication. Check level of capstan drive housing as indicated in WD LO 55-1204.
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Starting Motor (Main Engine, Electric, Hand Crank)

42	42	MAIN ENGINE. Try the starting engine hand crank to see if the starting engine turns over satisfactorily. Start the starting engine and check the operation of the starting engine clutch and gear for satisfactory starting of the main engine.
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AUXILIARY DIESEL GENERATOR SET. Inspect starter to see that it is in good condition, securely mounted, and tightly connected. Start the engine and observe whether the general action of the starter is satisfactory, particularly whether it engages or operates properly without excessive noise, and that it has adequate cranking speed. TIMING (Diesel; gasoline).

43	43	GASOLINE ENGINE. Check the ignition timing according to the instructions in this manual. Accelerate the engine gradually and observe whether the automatic controls advance the spark. If the ignition is out of time, adjust it according to the specifications in this manual, taking care to secure the magneto and/or distributor well when the adjustment is completed.
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Item S*	Nos. M*	
		MAIN DIESEL ENGINE AND AUXILIARY DIESEL ENGINE. Check or adjust timing of fuel injection pumps and nozzles according to instructions and specifications in this manual.

Winches, Hoist, Capstan (Bearings, Brakes, Cables)

48	48	Inspect the hoists (drum assemblies) to see that they are in good condition and that all mounting bolts are secure. Inspect cables for broken strands. Observe the hoisting assembly while it is operating under load, and note any noises such as hums or squeals which might indicate excessively worn bearings or brake linings. Observe the engagement and disengagement of the operating clutches to determine whether they are in good condition and properly aligned.
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48	48	CAPSTAN. Inspect capstan and drive for condition, if securely mounted, and satisfactory operation.
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Electric Motors, Deck Pump and Capstan (Commutator, Brushes, Control Box, Wiring)

49	49	Follow procedure outlined for Generator, Item 33.
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Generators (Commutators, Brushes, Control Box Wiring)

50	50	Follow procedure outlined for Generator, Item 33.
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Refrigerator Unit

51	51	Defrost refrigerator and clean thoroughly. Test temperature control by restarting unit and observing whether temperature is maintained in compartment in accordance with dial marking. Report improper operation to higher authority. Defrost more frequently if ice coating on freezing unit becomes too thick for satisfactory operation.
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Item S*	Nos. M*	
Ventilators		
52	52	Inspect roof ventilator and exhaust heads for cleanliness, condition of paint, and security of mounting. Check operation of ventilator damper.
Superstructure (Doors, Hardware, Seats, Safety Railing and Grab Rails, Davits, Bitts, Hatches)		
54	54	Inspect all superstructure items for position, cleanliness, condition of paint or varnish, and security. Oil all door hinges. Inspect black-out screens and accessories to see that they are properly mounted and that they operate freely and effectively.
Hull (Plugs, Decks, Plates, Bulkheads)		
55	55	Inspect the hull to see that the frame, reinforcement plates, and bulkheads are in good condition and secure. Look for bulges and indications of leaks between the bulkheads or in the hull. Inspect the decks for good condition and cleanliness. <i>Note.</i> All hulls should be hauled and the bottoms inspected and serviced, in April and September.
Derrick (A-Frame, Boom, Blocks, Cable)		
56	56	Inspect A-frame and boom for alignment, breaks or cracks, and excessive wear of pin holes and brackets. Tighten all mounting bolts securely. Check to see that rivets are in place and tight. Inspect pins and bushings for excessive wear. Inspect all sheaves for excessive wear and broken flanges.
Wiring (Junction Boxes and Terminal Blocks)		
57	57	Inspect all exposed electrical wiring and conduits to see that they are in good condition, well supported, and securely connected to terminals. Note whether junction and terminal

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		blocks and boxes are in good condition and secure, and whether all required fuses are in place. Inspect mounting and connections of cut-out switch for main panel.
Heaters		
58	58	Inspect oil heaters for leaks, cleanliness, operation of floats and controls.
Plumbing Fixtures		
59	59	Inspect all plumbing for good condition and security. Look for evidences of leaks in the control valves and water and waste lines. Inspect all control valves, gages, and floats to determine whether they are operating freely, not clogged or corroded, and are in generally serviceable condition.
Fire Extinguisher System (Mountings, Valves, Hose, and Nozzles)		
60	60	Inspect fire extinguishers to see that they are in good condition, securely mounted, and fully charged. The charge may be determined by shaking. Recharge or replace units that are not full. Inspect extinguisher handles to see that they are in good condition and free to operate at a moment's notice. Note whether nozzles are in good condition and securely connected. Inspect condition and serviceability of suction connection and discharge hose and nozzle of deck pump.
Paint and Markings		
61		Inspect the paint on the entire craft or crane to see whether fresh paint is needed for appearance or to retard deterioration. Inspect all the markings on the craft or crane; repaint those which have become faint. Clean all metal identification plates.
Anchor		
64	64	Inspect anchor for condition and to see if securely mounted on deck.

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Tools and Equipment

- 65 65 Take an inventory of tools, spare parts, and barge gear such as lines, cables, slings, boat hooks, and hand bilge pumps, paint and hardware. Check the inventory against the stowage lists. Inspect tools with cutting edges to see whether they need sharpening. Inspect all tool-mounting brackets to see that they are secure. Inspect spare parts and other stowed equipment to see whether they are adequately protected with rust-preventive compound.

First Aid Kit and Life Preservers

- 66 66 Check contents of first aid kit against list of official requirement. Report any deficiencies immediately. Inspect jacket life preservers, and ring life buoys with water lights to see whether they are in serviceable condition, complete with accessories,

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and securely stowed or mounted. Report any deficiency immediately.

Glass

Clean all windows, windshields, and door panels. Replace all broken or cracked glass.

Technical Manuals, Forms, and War Department Lubrication Orders

Take an inventory of technical manuals, lubrication orders and blank forms, and check against official list of requirements.

Section XIV. TROUBLE SHOOTING

37. General

This section contains information which will help to diagnose unsatisfactory operation. Each trouble, cause, and remedy is listed under the nomenclature of the assembly to which it applies.

38. Trouble Shooting Chart

a. MAIN DIESEL ENGINE.

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
(1) Engine fails to start.	No fuel in tank, or valve closed.	Open valves and check tank (par. 44d (2)).
	Air in fuel line.	Vent fuel line (par. 44d (13)).
	Fuel filter or fuel lines clogged.	Replace filter elements and clean lines (par. 44d (12)).
	Water in fuel system.	Drain all fuel oil and replace with fresh supply (par. 44d (2)).
	Air inlet clogged.	Check air supply for dirt or obstruction (par. 44e (3)).
	Throttle shaft or linkage jammed.	Inspect shaft, linkage, and adjust.
	Fuel transfer pump defective.	Check and replace if necessary (par. 44d (6)).
	Fuel injection pump plunger stuck in barrels, or springs broken.	Clean thoroughly. Replace broken springs or defective plunger barrel assemblies (par. 44d (8)).
	Fuel pumps leak.	Replace pump assemblies (par. 44d (8)).
	Fuel injection valves not seating properly or springs broken.	Clean or replace parts (par. 44d (7)).
	Fuel pump timing incorrect.	Adjust timing (par 44d (10)).

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<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
	Piston rings stuck, or worn cylinder liner.	Clean piston rings, grooves. If liner is worn excessively, replace (par. 44c (10)).
	Fuel governor out of adjustment.	Adjust (par. 44d (11)).
	Valves riding open or not properly seated.	Check valve mechanisms, valve springs. Reseat valves (par. 44c (2), (3)).
(2) Engine slows down or stops when running.	Air in fuel line.	Vent fuel system (par. 44d (13)).
	Defective fuel transfer pump.	Check and replace if necessary (par. 44d (6)).
	Fuel injection pump plungers stuck or springs broken.	Clean or replace defective pump assemblies and springs (par. 44d (8)).
	Obstructed fuel lines, filter or water in fuel.	Drain and clean system. Replace filter elements if necessary (par. 44d (12)).
	Piston seizing.	Stop engine immediately. Examine piston and replace if necessary. Check cooling and lubricating oil and remove all metallic particles, cleaning oil lines and filters (par. 44c (10), f (7)).
	Bearing seizure due to lack of lubrication.	Replace with new bearing shells. Examine crank journals for damage. Check lubricating oil system (par. 44c (10), f (2)).
(3) Engine fires irregularly.	Obstructed fuel lines; filter or water in fuel.	Drain and clean system. Replace filter elements if necessary (par. 44d (12)).
	Worn piston rings.	Replace rings (par. 44c (10)).
	New piston rings not broken in.	Break in rings (par. 44c (10)).
	Fuel nozzle spray tips clogged, damaged or worn.	Inspect, clean and replace if necessary (par. 44d (7)).
	Incorrect timing of fuel pumps.	Check and adjust timing (par. 44d (10)).
	Uneven compression in various cylinders.	Check for, and correct, the following causes for loss of compression: Worn or stuck piston rings, worn piston or cylinder liner, too high temperature of cooling water, blown cylinder head gaskets or leaky valves (par. 44c (2), (10), g (3)).
	Governor sticks.	Inspect and adjust (par. 44d (11)).
(4) Smoky exhaust, black smoke.	Fuel nozzle spray tips clogged, damaged or worn.	Inspect, replace and clean if necessary (par. 44d (7)).
	Fuel injection valves not seating properly, or springs broken.	Clean or replace parts (par. 44d (7)).
	One or more fuel injection pumps delivering too much fuel per stroke.	Check fuel pumps (par. 44d (8)).
	Air inlet clogged.	Check air supply for dirt or obstruction (par. 44e (3)).

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
(5) Smoky exhaust, blue smoke.	Lubricating oil in exhaust.	Clean piston rings, grooves. If liner is worn excessively replace (par. 44c (10)). Check fuel system (par. 44d (12)).
(6) Smoky exhaust, white smoke.	One or more cylinders not receiving fuel. Usually noticeable at light load or when idling engine.	Adjust timing (par. 44d (10)). Clean thoroughly. Replace broken springs or defective pump assemblies (par. 44d (8)).
(7) Engine knocks.	Fuel pump timed too early.	Inspect, clean, and replace if necessary (par. 44d (7)).
	Fuel pump plungers stuck in barrels, or springs broken.	Check valves (par. 44d (7)).
	Fuel nozzle spray tips clogged, damaged or worn.	Check by cutting off fuel from cylinder. If knocking stops, measure piston skirt clearance. Install new liner or piston (par. 44c(10)).
	Fuel injection valve spring pressure incorrect.	Check by setting piston B. D. C. and testing with pry bar. Replace pin or bushing if required (par. 44c (10)).
	Piston too loose in liner.	Replace bearing shells (par. 44c (12)).
(8) Noisy valve mechanisms.	Loose piston pin or piston pin bushing.	Check valve mechanisms and valve springs (par. 44c (2), (3)).
	Main bearings worn.	Adjust (par. 44c (2)).
	Valves riding open or not properly seated.	Replace (par. 44c (2)).
	Improper setting of valve tappet adjusting screw.	Clean and adjust (par. 44f (5)).
	Defective valve springs.	Check pump, replace (par. 44f (3)).
(9) Low oil pressure.	Incorrect setting of oil pressure relief valve, or improper seating.	Replace (par. 44f (3)).
	Lube oil pressure pump defective.	Install new shells (par. 44c (12)).
	Worn oil pump gears.	Clean filter, check and clean suction (par. 44f (7)).
	Loose or worn main bearing.	Clean and adjust (par. 44f(5)).
	Oil filter clogged or suction screen clogged.	Clean cooler (par. 44f (6)).
(10) Oil pressure too high.	Incorrect setting of oil pressure relief valve or improper seating.	Vent water lines (par. 44g (2)).
(11) Oil temperature too high.	Oil cooler passages clogged.	Add water (par. 44g (2)).
(12) Water pressure too low.	Air in fresh water pump.	Vent water lines (par. 44g (2)).
(13) High water temperature.	Low water level.	Clean lines (par. 44g (3)).
	Air in fresh water pump.	Clean radiator (par. 44g (3)).
	Discharge water lines clogged.	Adjust (par. 44g (6)).
	Radiator passages clogged.	Inspect and replace if needed (par. 44g (8)).
	Loose fan belt.	
	Water temperature regulator stuck.	

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
	Water pump impeller badly corroded or loose on shaft.	Repair or inspect and replace pump if necessary (par. 44g (7)).
	Excessive deposits in cylinder head and block.	Clean cooling system (par. 44g (3)).
<i>b. MAIN DIESEL ENGINE</i>	<i>STARTING ENGINE.</i>	
(1) Engine fails to start.	No gasoline in tank.	Fill tank (par. 44h (5)).
	Carburetor and engine flooded by excessive use of choke.	Crank without choke to clear engine (par. 10 a (4), and 14b (5)).
	Choke control not operating properly.	Adjust controls (par. 10 a (4) and 14b (5)).
	Dirt in fuel line or tank.	Clean line and tank.
	Dirt or water in carburetor or float studs.	Check and clean carburetor (par. 44h (5)).
	Fuel filter clogged.	Clean filter (par. 44h (5)).
	Defective, dirty or unadjusted spark plugs.	Clean, adjust, or replace plugs (par. 44h (10)).
	Improper timing.	Check and adjust timing (par. 44h (10)).
	Magneto breaker points worn or out of adjustment.	Adjust (par. 44h (10)).
	Magneto armature or condenser defective.	Report to higher authority (par. 44h (10)).
	Lack of compression.	Scored cylinders, leaky valves, worn or defective piston rings, leaky spark plug gaskets, defective cylinder head, leaky cylinder head gaskets (par. 44h (4), (10)).
(2) Engine starts but misfires.	Defective, dirty, or unadjusted spark plugs.	Clean, adjust, or replace plugs (par. 44h (10)).
	Defective magneto cables.	Replace.
	Defective magneto.	Replace (par. 44h (10)).
	Improper timing.	Check and adjust timing (par. 44h (10)).
	Poor compression.	Scored cylinders, leaky valves, worn or defective piston rings, leaky spark plug gaskets, defective cylinder head (par. 44h (4), (10)).
	Leaky cylinder head gasket.	Replace gasket (par. 44h (4)).
	Weak or broken valve springs.	Replace (par. 44h (4)).
	Bent, worn, or sticking valve stems.	Clean and lubricate stems or replace valves (par. 44h (4)).
	Mixture too lean.	Check and adjust carburetor (par. 44h (5)).
(3) Engine backfires.	Choke stuck.	Loosen (par. 10a (4)).
	Mixture too lean.	Check and adjust carburetor (par. 44h (5)).
	Excessive carbon in cylinders.	Remove carbon.
	Leaky or improperly adjusted intake valves.	Check for and correct bent or defective valve stems, excessive carbon deposit on valve seat or stem (par. 44h (4)).

Trouble

Cause

Remedy

Valve holding open due to lack of compression.

Valve springs weak.

Improper timing.

Fuel filter clogged.

Choke not functioning properly.

Obstruction in exhaust line.

Carburetor improperly adjusted.

(4) Engine knocks.

Excessive carbon in cylinders.

Magneto incorrectly timed.

Connecting rod or main bearing burned out.

Loose piston pin or bushing.

Loose piston.

Loose gears on crankshaft or magneto drive shaft.

Weak valve springs.

Overheated engine.

(5) Engine lacks power.

Mixture too rich.

Mixture too lean.

Air cleaner dirty.

Poor compression.

Excessive carbon.

Improper valve adjustment.

Choke partially closed or throttle not open fully.

Choked exhaust pipe or muffler.

Ignition timing late.

Defective, dirty, or unadjusted spark plugs.

Defective magneto.

Weak or broken valve springs.

Bent or sticking valve stem.

Lack of lubrication.

Leaky gaskets.

Engine overheated.

(6) Engine operates but speeds up and slows down alternately.

Partial obstruction in gas supply.

Check for, and correct, causes for poor compression ((9) below).

Replace (par. 44h (4)).

Adjust (par. 44h (10)).

Clean (par. 44h (5)).

Check and adjust (par. 10a (4)).

Examine exhaust for collected carbon or foreign matter.

Check and adjust carburetor (par. 44h (5)).

Check for, and correct, following causes: obstruction in exhaust line, leaky piston rings, defective spark plugs. Remove carbon (par. 44h (4), (10)).

Adjust (par. 44h (10)).

Replace bearing (par. 44h (4)).

Replace (par. 44h (4)).

Replace (par. 44h (4)).

Repair or replace (par. 44h (10)).

Replace (par. 44 h (4)).

Check for, and correct, causes for overheated engine ((7) below).

Check and adjust carburetor (par. 44h (5)).

Check for obstruction in gas supply (par. 44h (5)).

Clean (par. 44h (6)).

Check for, and correct, causes for poor compression ((9) below).

Remove carbon.

Adjust (par. 44h (4)).

Check choke and throttle (par. 10a (4)).

Examine and clear.

Adjust timing (par. 44h (10)).

Clean, adjust, or replace plugs (par. 44h (10)).

Adjust or replace (par. 44h (10)).

Replace (par. 44h (4)).

Clean, lubricate, or replace (par. 44h (4)).

Check lubrication (par. 44h (9)).

Replace (par. 44 h(4)).

Check for, and correct, causes for overheated engine ((7) below).

Clean fuel system (par. 44h (5)).

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>	
(7) Engine overheats.	Excessive carbon in cylinders; preignition. Improper timing. Air cleaner clogged. Lack of lubrication. Damaged muffler, clogged exhaust pipe. Valve timing wrong.	Remove carbon. Adjust (par. 44h (10)). Clean (par. 44h (6)). Check lubrication (par. 44h (9)). Replace muffler, clean pipe. Adjust (par. 44h (10)).	(2)
(8) Piston pumps oil.	Leaky valves. Oil level too high. Piston rings sticky, broken, or ineffective due to loss of tension. Cylinder walls scored or worn. Rings too loose on piston. Defective ignition. Defective magneto cables. Oil leak around intake valve guides.	Adjust, regrind, or replace (par. 44h (4)). Drain to correct level. Replace rings (par. 44h (4)). Report to higher authority. Replace rings (par. 44h (4)). Check spark plugs and magneto (par. 44h (10)). Replace. Replace valves or guides (par. 44h (4)).	(4) starbo (5) port.
(9) Poor compression.	Scored cylinder. Leaky valves. Worn or defective piston ring. Leaky spark plug gasket. Defective cylinder head. Leaky cylinder head gasket. Incorrect valve adjustment.	Report to higher authority. Adjust, regrind, or replace (par. 44h (4)). Replace (par. 44h (4)). Replace (par. 44h (10)). Report to higher authority. Replace (par. 44h (4)). Adjust (par. 44h (4)).	Ma (6) raise.
(10) Abnormal engine noises.	Leaky manifolds, leaky cylinder head gaskets, or leaky spark plug gaskets. Overheated engine; clogged exhaust line.	Replace (par. 44h (4) (10)). Clear exhaust line.	(7) lower.
(11) Fuel reaches carburetor but does not enter cylinder.	Choke does not close. Fuel passages in carburetor clogged. Carburetor float stuck closed.	Free and lubricate. Clean (par. 44h (5)). Loosen (par. 44h (5)).	
c. DERRICK AND HOIST.			
(1) Boom will not raise.	Boom hoist clutch slipping. Boom hoist brake does not release. Cable off sheaves. No air pressure.	Adjust clutch (par. 46b (2)). Adjust brake (par. 46c (2)). Pick up weight of boom by another derrick or by blocks and jacks until topping cable slacks off. Place slack cable in proper position on sheaves. Check air system ((18), (19) below).	(8)

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
(2) Boom will not lower.	Pawl not disengaged. Boom hoist brake does not release. Cable off sheaves.	Check pawl linkage (par. 46d). Adjust brake (par. 46c (2)). (c (1) above.)
(3) Boom operation jerky.	Cable crossed on drum. Boom hoist brake drags. Boom hoist clutch grabs or slips. Drive gear teeth broken. Drive chain teeth broken Drive chain loose. Engine throttle. Governor not functioning.	Remove and aline cable (par. 40). Adjust brake (par. 46c (2)). Adjust clutch (par. 46b (2)). Report for repair. Replace chain (par. 7l (1)). Adjust chain (par. 7l (1)). Adjust throttle (par. 10b (7)). Adjust governor (par. 44d (11)).
(4) Boom will not swing to starboard.	Starboard vang line will not reel in. Port vang line will not reel out.	Check starboard vang operation ((12), (13) below). Check port vang operation ((15), (16) below).
(5) Boom will not swing to port.	Port vang line will not reel in. Starboard vang line will not reel out.	Check port vang operation ((15), (16) below). Check starboard vang operation ((12), (13) below).
<i>Main load hook.</i>		
(6) Load hook will not raise.	Load hoist drum clutch slipping. Load hoist drum brake does not release. Cable off sheaves. No air pressure.	Adjust clutch (par. 46b (2)). Adjust brake (par. 46c (2)). Lower boom until load hook is set down. Ease off until load cable is slack. Place slack cable in proper position on sheaves. Check air system ((18), (19) below).
(7) Load hook will not lower.	Pawl not disengaged. Load hoist brake does not release. Cable off sheaves.	Check pawl linkage (par. 46d). Adjust brake (par. 46c(2)). Lower boom until load hook is set down. Ease off until load cable is slack. Place slack cable in proper position on sheaves.
(8) Load hoist operation.	Cable crossed on drum. Load hook clutch grabs or slips. Load hook brake drags. Drive gear teeth broken. Drive chain teeth broken. Drive chain loose. Engine throttle mechanism loose. Governor not functioning.	Remove and aline cable (par. 40) Adjust clutch (par. 46b (2)). Adjust brake (par. 46c (2)). Report for repair. Replace chain (par. 7l (1)). Adjust chain (par. 7l (1)). Adjust throttle (par. 10b (7)). Adjust governor (par. 44d (11)).

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>	
(9) Whip hook will not raise.	Whip hoist clutch slipping. Whip hoist brake does not release. Cable off sheaves. No air pressure.	Adjust clutch (par. 46b (2)). Adjust brake (par. 46c (2)). Lower boom until whip hook is set down. Ease off until whip cable is slack. Place slack cable in proper position on sheaves. Check air system ((18), (19) below).	(15) I t reel
(10) Whip hook will not lower.	Pawl not disengaged. Whip hoist brake does not release. Cable off sheaves.	Check pawl linkage (par. 46d). Adjust brake (par. 46c (2)). Lower boom until whip hook is set down. Ease off until whip cable is slack. Place slack cable in proper position on sheaves.	(16) I t reel
(11) Whip hook operation jerky.	Cable crossed on drum. Whip hoist clutch grabs or slips. Whip hoist brake drags. Drive gear teeth broken. Drive chain teeth broken. Drive chain loose. Engine throttle mechanism loose. Governor not functioning.	Remove and aline cable (par. 46d). Adjust cable (par. 46b (2)). Adjust brake (par. 46c (2)). Report for repair. Replace chain (par. 7l (1)). Adjust chain (par. 7l (1)). Adjust throttle (par. 10b (7)). Adjust governor (par. 44d (11)).	(17) E n jerk Air sy (18) I o high Fricti (19) C e.
(12) Starboard vang line will not reel in.	Vang drum clutch slipping. Vang drum clutch slipping. Vang drum brake does not release. Cable off sheaves. No air pressure.	Adjust clutch (par. 46b (2)). Adjust clutch (par. 46b (2)). Adjust brake (par. 46c (2)). Ease off on port vang line until starboard vang line is slack. Place slack cable in proper position on sheaves. Check air system (18), (19) below).	(20) C t quic (21) C Clutch
(13) Starboard vang line will not reel out.	Vang drum brake does not release. Cable off sheaves.	Adjust brake (par. 46c (2)). Ease off on port vang line until starboard vang line is slack. Place slack cable in proper position on sheaves.	Brake (22) I t quic (23) I
(14) Starboard vang line jerky.	Drive gear teeth broken. Drive chain teeth broken. Drive chain loose. Engine throttle mechanism loose. Governor not functioning.	Report for repair. Replace chain (par. 7l (1)). Adjust chain (par. 7l (1)). Adjust throttle (par. 10b (7)). Adjust governor (par. 44d (11)).	(24) C ables. (24) C

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
(15) Port vang line will not reel in.	Vang drum clutch slipping. Vang drum brake does not release. Cable off sheaves.	Adjust clutch (par. 46b (2)). Adjust brake (par. 46c (2)). Ease off on starboard vang line until port vang line is slack. Place slack cable in proper position on sheaves.
	No air pressure.	Check air system ((18), (19) below).
(16) Port vang line will not reel out.	Vang drum brake does not release. Cable off sheaves.	Adjust brake (par. 46c (2)). Ease off on starboard vang line until port vang line is slack. Place slack cable in proper position on sheaves.
(17) Port vang line operation jerky.	Drive gear teeth broken. Drive chain teeth broken. Drive chain loose. Engine throttle mechanism loose. Governor not functioning	Report for repair. Replace chain (par. 7l (1)). Adjust chain (par. 7l (1)). Adjust throttle (par. 10b (7)). Adjust governor (par. 44d (11)).
<i>Air system.</i>		
(18) Pressure too low or too high.	Compressor not functioning. Air pipe leaking or clogged.	Check compressor (par. 45c (1)). Check piping (par. 48a).
<i>Friction clutches.</i>		
(19) Clutch does not operate.	Air valve not functioning. Power chamber not functioning. Low air pressure.	Check valve adjustments (par. 48b (3)). Check power chamber (par. 48c (1)). Check air system ((18) above.)
<i>Clutch bands.</i>		
(20) Clutch linings wear out quickly.	Bands dragging. Dirt on lining.	Adjust bands (par. 46c (2)). Remove band and clean (par. 46b (3)).
(21) Clutches slip.	Dirt on lining. Improper adjustment. Low air pressure.	Remove and clean (par. 46b (3)). Adjust (par. 46b (2)). Check air system ((18), (19) above).
<i>Brakes.</i>		
(22) Brake linings wear out quickly.	Bands dragging. Dirt on lining.	Adjust bands (par. 46c (2)). Remove band and clean (par. 46c (3)).
(23) Brakes slip.	Dirt on lining. Improper adjustment. Linings glazed.	Remove and clean (par. 46c (3)). Adjust band (par. 46c (2)). Remove and roughen with file (par. 46c (3)).
<i>Cables.</i>		
(24) Cable operation jerky.	Cable kinked or wound unevenly on drum. Drum brakes grabbing or jerky.	Remove cable, straighten (par. 40). Adjust bands (par. 46c (2)).

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
(25) Cables wear out quickly.	Sheave bushings dry.	Lubricate (par. 30).
	Cables not sufficiently lubricated.	Lubricate (par. 30).
	Cables twisted, kinked, or crossed on drums.	Remove and straighten (par. 40d).
(26) Cables tend to flatten out.	Sheave channel clearance too great.	Replace sheaves (par. 50b (2)).
	Cables crossed on drums.	Align cables (par. 40).
(27) Cables twist during operation.	Cables twisted or kinked.	Repair and install correctly (par. 40).

d. AUXILIARY DIESEL GENERATOR.

(1) Cranking motor will not crank engine.	Battery discharged.	Replace or charge battery (par. 53c (13)).
	Battery terminals or ground cable loose or corroded.	Remove, clean, and reinstall firmly (par. 53c (13)).
	Cranking motor drive gear jammed.	Loosen cranking motor (par. 53c (11)).
	Excessive engine friction due to seizure or improper oil.	Change oil to proper grade; if seizure has occurred, take down engine, correct the cause, and replace damaged parts (par. 53c (5)).
	Cranking motor runs but fails to crank engine; gear does not engage.	Clean bendix drive (par. 53c (11)).
(2) Engine turns over but fails to start.	No fuel in tank.	Check tank (par. 53c (7)).
	Air in fuel line.	Vent fuel line (par. 53c (7)).
	Fuel filter or fuel inlet line clogged.	Replace filter cartridge (par. 53c (7)).
	Fuel transfer pump not delivering fuel.	Check pump belt, bleed air. Bypass valve not adjusted (par. 53c (7)).
	Fuel pump defective.	Check and replace if needed (par. 53c (7)).
	Water in fuel system.	Drain all fuel oil and replace with fresh supply (par. 53c (7)).
	Air inlet clogged.	Check air supply for dirt or obstruction (par. 53c (9)).
	Throttle stuck.	Check and adjust (par. 53c (7)).
	Fuel injection valve not seating properly or spring broken.	Clean or replace parts (par. 53c (7)).
	Fuel pump timing incorrect.	Adjust timing (par. 53c (7)).
	Piston rings stuck or worn cylinder liner.	Clean piston rings and grooves. If liner is worn excessively, replace (par. 53c (5)).
	Fuel governor out of adjustment.	Adjust (par. 53c (7)).
	Valves riding open or not properly seated.	Check valve mechanism and valve springs. Reseat valves (par. 53c (2), (3)).

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
(3) Engine slows down or stops when running.	Air in fuel line.	Vent fuel system (par. 53c (7)).
	Fuel transfer pump not delivering fuel.	Check pump belt, bleed air. Bypass valve not adjusted (par. 53c (7)).
	Fuel pump defective.	Check and replace if needed (par. 53c (7)).
	Obstructed fuel line, filter or water in fuel.	Drain and clean system. Replace filter cartridge if needed (par. 53c (7)).
	Piston seizing.	Stop engine immediately. Examine piston and replace if needed. Check cooling and lubricating systems. Change lubricating oil and remove all metallic particles, cleaning oil lines and filters (par. 53c (5), (8)).
	Bearing seizure due to lack of lubrication.	Replace with new bearing shells. Examine crank journals for damage. Check lubricating oil system (par. 53c (5) (8)).
(4) Engine runs irregularly.	Obstructed fuel lines, filter or water in fuel.	Drain and clean system. Replace filter cartridge if needed (par. 53c (7)).
	Worn piston rings.	Replace rings (par. 53c (5)).
	New piston rings not broken in.	Break in rings (par. 53c (6)).
	Injector nozzle valve clogged or worn.	Inspect, clean, and replace if needed (par. 53c (7)).
	Incorrect timing of fuel pump.	Check and adjust timing (par. 53c (7)).
	Governor sticks.	Inspect and adjust (par. 53c (7)).
(5) Smoky exhaust, black smoke.	Injector nozzle valve clogged or worn.	Inspect, clean, and replace if needed (par. 53c (7)).
	Valves out of adjustment.	Adjust valves (par. 53c (2)(3)).
	Air inlet clogged.	Check air supply for dirt or obstruction (par. 53c (9)).
(6) Smoky exhaust, blue smoke.	Lubricating oil in exhaust.	Clean piston rings, grooves. If liner is worn excessively, replace (par. 53c (5)).
	Incorrect timing.	Check and adjust timing (par. 53c (7)).
	Valves out of adjustment.	Adjust valves (par. 53c (2)(3)).
	Engine cold.	Warm up engine.
(7) Smoky exhaust, white smoke.	Incorrect timing.	Check and adjust timing (par. 53c (7)).
	Valves out of adjustment.	Adjust valves (par. 53c (2)(3)).
(8) Engine knocks.	Fuel pump timed too early.	Adjust timing (par. 53c (7)).
	Injection nozzle valve clogged or worn.	Inspect, clean, and replace if needed (par. 53c (7)).

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
	Fuel pump piston stuck in cylinder.	Inspect, clean, and replace if needed (par. 53c (7)).
	Piston too loose in liner.	Check piston skirt clearance. Install new liner or piston as required (par. 53c (5)).
	Loose piston pin or piston pin bushing.	Check by setting piston at B. D. C. and testing with pry bar. Replace pin or bushing if required (par. 53c (5)).
	Main bearings worn.	Replace bearing shells (par. 53c (5)).
	Valves riding open or not properly seated.	Check valve mechanisms and valve springs (par. 53c (2)(3)).
(9) Engine lacks power.	Engine overloaded.	Check load.
	Not operating at rated speed.	Check and increase speed.
	Back pressure in exhaust line.	Check and clear exhaust line.
(10) Noisy valve mechanism.	Loose rocker arm journal.	Tighten (par. 53c (1)).
	Loose valve push rod nut.	Tighten (par. 53c (1)).
	Defective valve springs.	Replace (par. 53c (1)).
(11) Low oil pressure.	Defective lube oil pump.	Check, replace (par. 53c (8)).
	Defective oil pump gears.	Replace (par. 53c (8)).
	Loose or worn main bearing.	Install new shells (par. 53c (5)).
	Oil filter clogged or pump screen clogged.	Check filter and replace cartridge if needed. Clean screen (par. 53c (8)).
(12) High water temperature.	Water line clogged.	Clean water line connections (par. 53c (10)).
	Radiator clogged.	Clean radiator (par. 53c (10)).
	Loose fan belt.	Adjust (par. 53c (10)).
	Thermostat stuck.	Check and replace if necessary (par. 53c (10)).
	Water pump impeller badly corroded or loose on shaft.	Repair or replace impeller (par. 53c (10)).
	Deposits in engine block passages.	Clean entire cooling system (par. 53c (10)).
	Insufficient air for radiator.	Keep radiator clear.
	Water level low.	Refill, check for leaking hose connection or leak in radiator (par. 53c (10)).
	Lubricating oil low.	Check level (par. 53c (8)).
	Lubricating system faulty.	Check system (par. 53c (8)).
	Back pressure in exhaust line.	Check exhaust for obstructions.
(13) Engine runs cold (below 150° F.).	Too much cold air through radiator.	Cover part of radiator.
	Thermostat stuck.	Check and replace if needed (par. 53c (10)).
(14) Engine pumps oil.	Sticking piston rings caused by running with smoky exhaust.	((5), (6), (7) above.)

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
	Dirty filter cartridge.	Install new cartridge (par. 53c (8)).
(15) Excessive vibration.	Worn out rings. Engine base not level. Foundations bolts loose.	Replace (par. 53c (5)). Level with shims. Tighten.
<i>e. COMPRESSOR.</i>		
(1) Insufficient pressure.	Belts loose. Automatic unloader stuck.	Tighten belts (par. 45c (14)). Check and adjust unloader (par. 45c (3)).
	Trigger valve leakage. Feather valves leak or broken.	Clean and adjust (par. 45c (3)). Adjust or replace valves (par. 45c (6)).
(2) Compressor knocks.	Leaky gaskets. Main or connecting rod bearings worn.	Replace gaskets (par. 45c (1)). Replace bearings (par. 45c (8)).
(3) Compressor runs hot.	Insufficient lubrication.	Check oil level and lubrication (par. 30).
(4) Pumps oil.	Oil level too high. Piston rings stuck.	Drain off to proper level (par. 30). Clean rings, grooves. Replace rings if needed (par. 45c (8)).
(5) Noisy valves.	Dirty trigger valve.	Clean valve (par. 45c (3)).
(6) Vibration.	Insecure foundation. Improper tension on drive belts.	Check foundation and bolts (par. 45c (2)). Adjust belt tension (par. 45c (14)).
<i>f. CAPSTAN.</i>		
(1) Does not turn.	Motor starter defective. Overload relay defective. Circuit breaker defective. Start switch defective. Electric brake defective.	Check starter, replace defective parts (par. 47g (2)). Replace (par. 47g (2)). Replace (par. 47g (2)). Replace switch (par. 47g (2)). Check brake, replace defective parts (par. 47g (2)).
	Defective coupling. Defective transmission gears.	Report to higher authority. Report to higher authority.
(2) Noisy operation.	Shaft out of line. Defective transmission gears. Holding down bolts loose.	Aline shaft (par. 7q (5)). Report to higher authority. Tighten.
<i>g. DECK PUMP.</i>		
(1) Fails to pump because of loss of prime.	Leaky suction check valve. Leak in grease seal.	Inspect valve and replace if needed (par. 59c). Check seal and repack (par. 59c).
(2) Fails to pump because suction plugged.	Dirt in pump case or impeller. Defective suction line, lining loose.	Clean case and impeller (par. 59c). Replace suction line (par. 59c).
(3) Does not run.	Defective motor connection. Defective cable connection.	Check connection. Check cable connection.

<i>Trouble</i>	<i>Cause</i>	<i>Remedy</i>
<i>h. REFRIGERATOR.</i>		
Fails to maintain proper temperature.	Control not properly set.	Set control (par. 22 <i>d</i>).
	Thick ice on freezing unit.	Report (par. 22 <i>d</i>).
	Defective wiring connection.	Check and repair wiring connection.
	Defective mechanism.	Report to higher authority.
<i>i. GENERATORS, MAIN AND AUXILIARY.</i>		
(1) No voltage to generator field.	Loose terminal—field connection.	Tighten terminals.
	Loose exciter brushes.	Check brush contact (par. 54 <i>c</i>).
	Exciter commutator dirty.	Clean commutator (par. 54 <i>c</i>).
	Defective field rheostat.	Check and replace (par. 47 <i>b</i> and <i>c</i>).
(2) Does not build up line voltage.	Belts slipping—main generator.	Adjust belts (par. 52 <i>b</i>).
	Clutch broken—auxiliary generator.	Report to higher authority.
	Main circuit breaker switch tripped.	Reset switch. If trips again look for short circuit or report to higher authority.
(3) No reading at voltmeter.	Defective voltmeter.	Replace voltmeter (par. 47 <i>b</i> and <i>c</i>).
	Defective voltmeter connection.	Tighten or replace.
	Fuse blown—main voltmeter.	Replace fuse (par. 47 <i>b</i>). If blows again, look for short circuit or report to higher authority.
<i>j. MOTORS, CAPSTAN, AND DECK PUMP.</i>		
Motor does not turn over.	Driven unit jammed.	Check capstan and drive (par. 7 <i>q</i> (5)).
	Defective switch.	Check deck pump and drive (par. 59 <i>c</i> (2)).
	Defective cable or cable connection.	Replace switch (par. 47 <i>b</i>).
	Defective motor bearings.	Check cable and tighten connections.
(2) Noisy operation.	Holding down bolts loose.	Check bearings. Check lubrication (par. 30).
		Tighten bolts.
<i>k. PANELS, MAIN, AUXILIARY, CAPSTAN STARTING.</i>		
(1) Circuit breaker switch trips without cause.	Defective switch.	Replace (par. 47 <i>b</i> (12)).
(2) Loose connections.		Tighten.
(3) Broken connections.		Replace.
(4) Broken instrument glass or dial.		Replace instrument (par. 47 <i>b</i> and <i>c</i>).
(5) Short circuit.	Moisture, condensation.	Dry out connection.
<i>l. FLOODLIGHTS.</i>		
(1) Will not light.	Defective lamp.	Replace (par. 47 <i>h</i>).
	Defective lamp socket.	Replace (par. 47 <i>h</i>).
	Defective switch.	Replace (par. 47 <i>b</i>).
	Defective connecting plug.	Replace (par. 47 <i>h</i>).
	Defective wiring.	Repair or replace.
(2) Broken glass.		Replace (par. 47 <i>h</i>).

Section XV. CABLE REEVING

39. General

a. The following lengths and sizes of cable are provided for installation on the derrick:

Description	Construction (strands and wires)	Size (diameter) (inch)	Length (feet)
Boom topping (9-part line) --	6 x 19	$\frac{7}{8}$	700
Load line (7-part line) -----	6 x 19	$\frac{3}{4}$	700
Vang line (5-part line) -----	6 x 19	$\frac{5}{8}$	550
Whip line (single line) -----	6 x 19	$\frac{3}{4}$	250

b. The installation of various wire ropes or cables is known as reeving. Efficient and safe operation requires proper handling, installation, and lubrication of all cables. Avoid damage to cable through overloads, sudden stops, unnecessary exposure to weather, and infrequent inspection.

40. Cable Maintenance

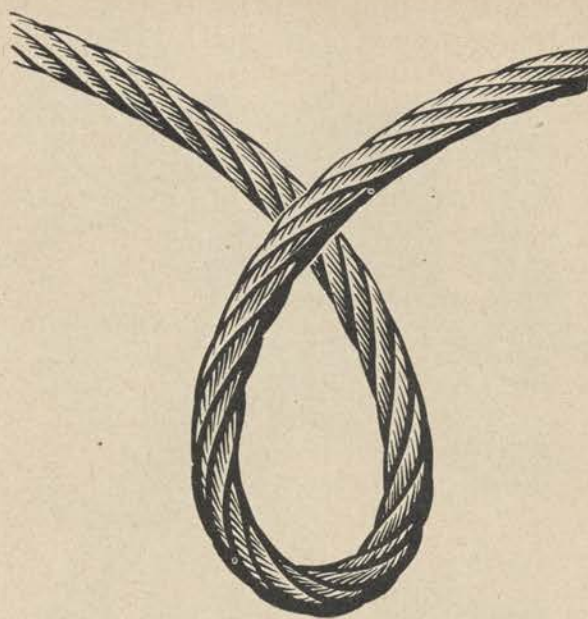
a. **INSPECT CABLES FREQUENTLY.** Examine cables daily for frayed or broken wires. Make sure that cable clamps are properly installed and are tight. Examine cables most carefully where they are attached by clamps, sockets, or splicing.

b. **DO NOT KINK CABLE.** Kinks are sharp bends in cable strands. Use of cable in this connection will cause strands to break quickly and the cable to fail. Follow carefully the recommended procedure for installing and removing cable to prevent it from kinking. Remove cable from a reel by rotating the reel. Remove cable from a coil by rolling the coil. Do not lay a reel or a coil down on its side and peel or lift the cable off. To do this will cause kinks. (See fig. 128.)

c. **KEEP CABLES PROPERLY COILED.** Use reels when available to coil and uncoil cables. When reels are not available, make a 3-foot loop at the end of the cable and secure it. Stand loop on end and roll along the ground toward the opposite end of the cable. When the cable is completely coiled, tie it together in three or four places.

Note. Always remove and properly coil a cable that is not being used.

d. **OPERATE NEWLY INSTALLED CABLE WITHOUT LOAD.** After installing a cable, operate it for a few minutes without load. This will permit it to



THE START



SECOND STEP



THE RESULT

Figure 128. Cable kinking.

become properly seated in sheaves and adjusted to working conditions.

e. **KEEP CABLES CLEAN AND LUBRICATED.** Remove grit in all forms from cables in and out of use. Keep cables well lubricated at all times to prevent internal deterioration and reduce internal friction while in use. Lack of lubrication will



Figure 129. Unreeling and uncoiling cable.

weaken internally a cable which is apparently in good condition at visual inspection. Lubricate new cables well when originally reeving them. For cable lubrication, see WD LO 55-U36.

f. **REVERSE WORN CABLES AND INSPECT SHEAVES.** Twists, kinks, improper lubrication, grit, or misaligned sheaves cause excessive cable wear. Replace sheaves that are scored or otherwise damaged. Replace sheaves that are improperly aligned. Remove cable and install in reverse position, end for end, to prolong life.

g. **KEEP CABLES PROPERLY WOUND ON DRUM.** To avoid sudden jerks and unnecessary cable wear during operation, see that cables wind properly on drums. To get proper performance, remove and reinstall cable.

h. **USE CABLES OF SPECIFIED LENGTH.** The designed correct lengths of the various cables are as given in paragraph 39a. When a cable is unwound for maximum working requirements, a minimum

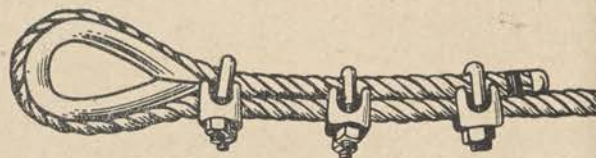
of at least $1\frac{1}{2}$ turns should remain on the drum. A smaller number of turns will exert excessive strain on cable drum socket and endanger operation of the hoist.

Warning: Replace damaged or worn cables before it is too late. Do not invite accidents by operating with dangerous cables. Prevent serious injuries to the operator, to others, and to the equipment by removing faulty cables.

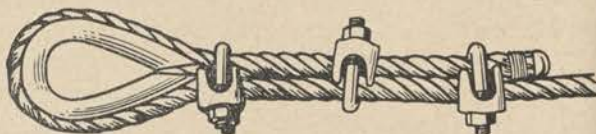
41. Installing Cable Clamps (Crosby Clips)

a. **LOCATE CLAMPS.** Position clamps on cable so that the distance apart, center to center, is six times the diameter of the cable. Example: Distance between clamps on a $\frac{3}{4}$ -inch cable is six times $\frac{3}{4}$ inch, or $4\frac{1}{2}$ inches.

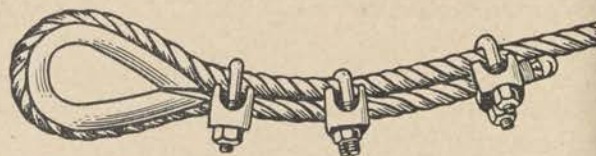
b. **ATTACH U-BOLTS.** Fit U-bolts around dead end of cable, and clamp dead end securely to cable. (See fig. 130.)



CORRECT—DEVELOPS 80% OF CABLE STRENGTH



INCORRECT—DEVELOPS 75% OF CABLE STRENGTH



INCORRECT—DEVELOPS 70% OF CABLE STRENGTH

Figure 130. Proper method of installing cable clamps.

c. **INSPECT CLAMPS AFTER OPERATION.** Under load, cables stretch slightly and clamps that were tight when installed under no-load condition become loose. For this reason check newly installed clamps after two hours of operation, to see that nuts and U-bolts have not worked loose. Inspect all cable fastenings for proper tightness at each after-operation inspection, as described in paragraph 35.

42. Reeving

a. GENERAL. With barge derrick components completely installed and the main engine and hoist aligned, begin the reeving operation. Normal procedure for handling the coils of cable is to wind the cable (replacement or original) directly from the reel to the pertinent hoist, with the engine rotating the drum at idling speed. Perform this operation carefully, making certain that the cable is so wound that it will lay on the drum in the same manner that it is wound on the reel, and that the end of the cable will come off the side of the drum in the manner illustrated in figure 131. See paragraph 40 for instructions on the correct method of unreeling and uncoiling cables.

Note. The terms "right" and "left" used in the description of reeving refer to the right and left side of pulley block assemblies as viewed by an observer looking at the pulley from the aft end of the barge, facing forward. "In front" and "behind" refer to the forward and aft ends of the barge.

b. ORDER OF REEVING. In order to facilitate reeving of the derrick, follow the order given below:

- (1) Install cable that raises and lowers the boom (topping).
- (2) Install starboard vang line cable.
- (3) Install port vang line cable.
- (4) Install main load line cable for raising or lowering the block.
- (5) Install the whip line.

c. IDENTIFICATION OF DERRICK REEVING SHEAVES AND HOIST DRUMS. The five drums used on the derrick are identified in figure 131. The forward drum is of twin construction and contains the right and left vang line drums; the next drum winds the whip cable; the third drum is for the main load cable; and the last drum (nearest the engine) is for the boom topping cable.

- (1) All cables coming from the drums through the aperture of the deck house roof pass over the

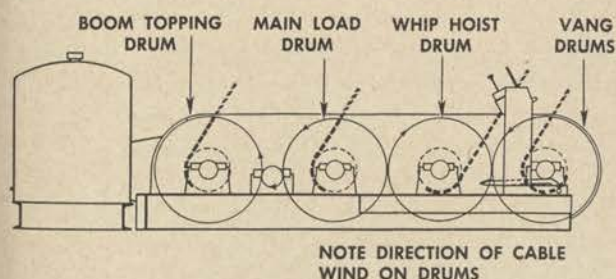


Figure 131. Identification of hoist drums.

fairlead block pulley assembly located on the A-frame cross brace. (See fig. 132.)

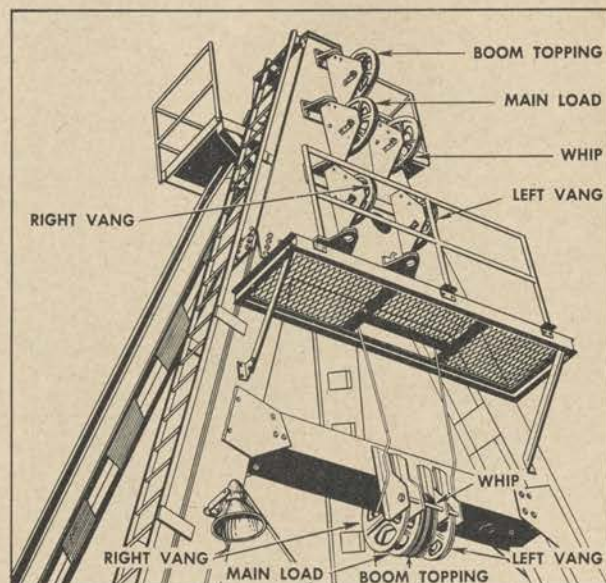


Figure 132. Fair leads on A-frame.

(2) The fairlead block assembly on the cross-brace consists of five sheaves: a center assembly of sheaves carrying the main load cable, the topping cable and the whip cable, the right sheave for the right vang cable, and the left sheave for the left vang cable. Figure 132 also illustrates the remaining five sheaves mounted on the A-frame. These are identified as follows, viewing from bottom to the top:

- (a) Two swivel blocks, 16 inches in diameter, for the right and left vang cables.
- (b) Two center swivel blocks, 20 inches in diameter. These carry on the right, the main load cable, and on the left, the whip cable.
- (c) Top swivel block which carries the topping cable, for raising and lowering the boom.
- (3) Remaining blocks and sheaves for the reeving of the cables are described under individual reeving instructions.

d. REEVING TOPPING CABLE. (1) Unreel the cable from the reel to the boom topping drum, making sure that the cable is reeled on the drum in the direction shown in figure 133, in order to have the cable from the drum lead off the rear of the drum. The end of the cable should first be clamped to the drum flange as shown in figure 134. Clamping is performed by passing the end of the cable through the slot provided in the drum flange,

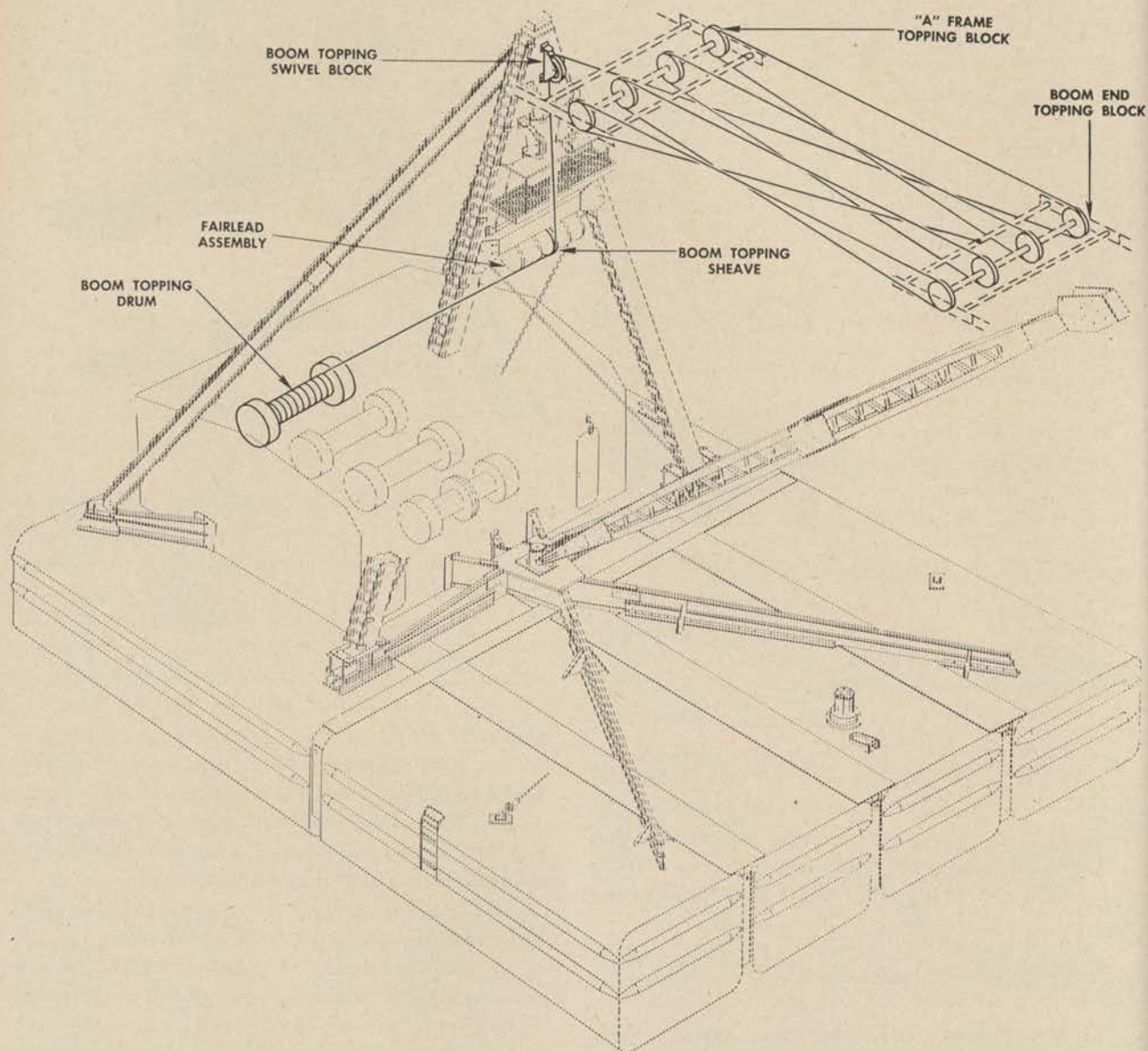
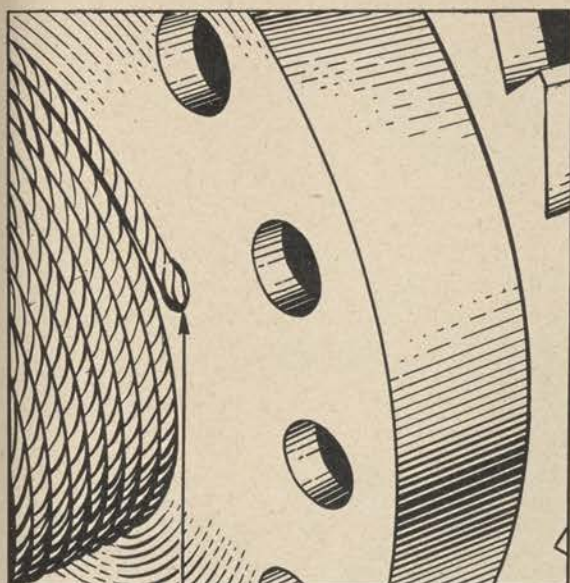
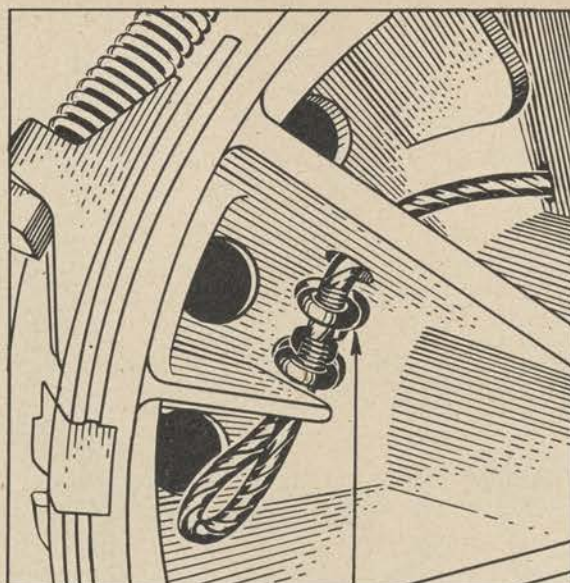


Figure 133. Reeving of boom topping cable.



**CABLE ENTRY
IN FLANGE**



**CABLE CLAMPED AT
OUTSIDE OF FLANGE**

Figure 134. Method of securing cable end to drum flange.

and securing it by applying a cable clip to the end of the cable, projecting outside the flange.

(2) With the cable completely reeled on the drum, pass the free end through the aperture in the deck house roof, over the front center sheave on the fairlead, as shown in figure 133, thence through the uppermost single swivel block at the top of the A-frame.

(3) From the top swivel block pass the cable around the left sheave of the topping block secured to the boom end, and around the left sheave of the topping block secured to the mast of the A-frame. Continue reeving back and forth through the remaining four sheaves until the last (right side) sheave of the block on the A-frame end is reached. Secure the end of the cable to the anchor pin, located in the center of the block yoke. (See fig. 133.) The method of anchorage is by splicing, using a thimble.

Caution: The topping system is now completed and the boom will rise if the engine is operated with the clutch in and the boom topping air valve in the ON position. Make sure that everything is clear in the event it is desired to raise the boom.

c. REEVEING STARBOARD VANG CABLES. (1) Before proceeding with the reeving of the starboard and port vang cables, it will be necessary to install the pendants and vang line blocks at the port and

starboard side of the deck. (See figs. 135 and 137.) The 10-foot pendant lines are equipped with sockets already installed on each end of the pendant lines. Secure the sockets to the vang line blocks by means of the bearing pin and the cotter pins, and to the deck pads by means of a shackle, bearing pin, and cotter pins.

(2) Reel the vang cable on the right drum of the twin vang drum installation of the hoist. Make sure that the cable is securely clamped, and that the direction of unreeling will be such as to have the end of the cable lead off the rear of the drum.

(3) Pass the free end of the cable around the right sheave of the fairlead, located on the cross-brace, thence up to the lowest right swivel block, as shown in figure 135. From the right swivel block, pass the cable around the single sheave block, on the right side of the boom, and pass down to the vang line block at the end of the pendant, to the left sheave. From this point, the cable is passed around the two-sheave vang block which is secured to the boom end directly above the single sheave. (See fig. 135.)

(4) Pass the cables around both sheaves of the upper and lower vang blocks (back and forth), bringing the free end of the cable from the right sheave of the upper vang block down to the lower

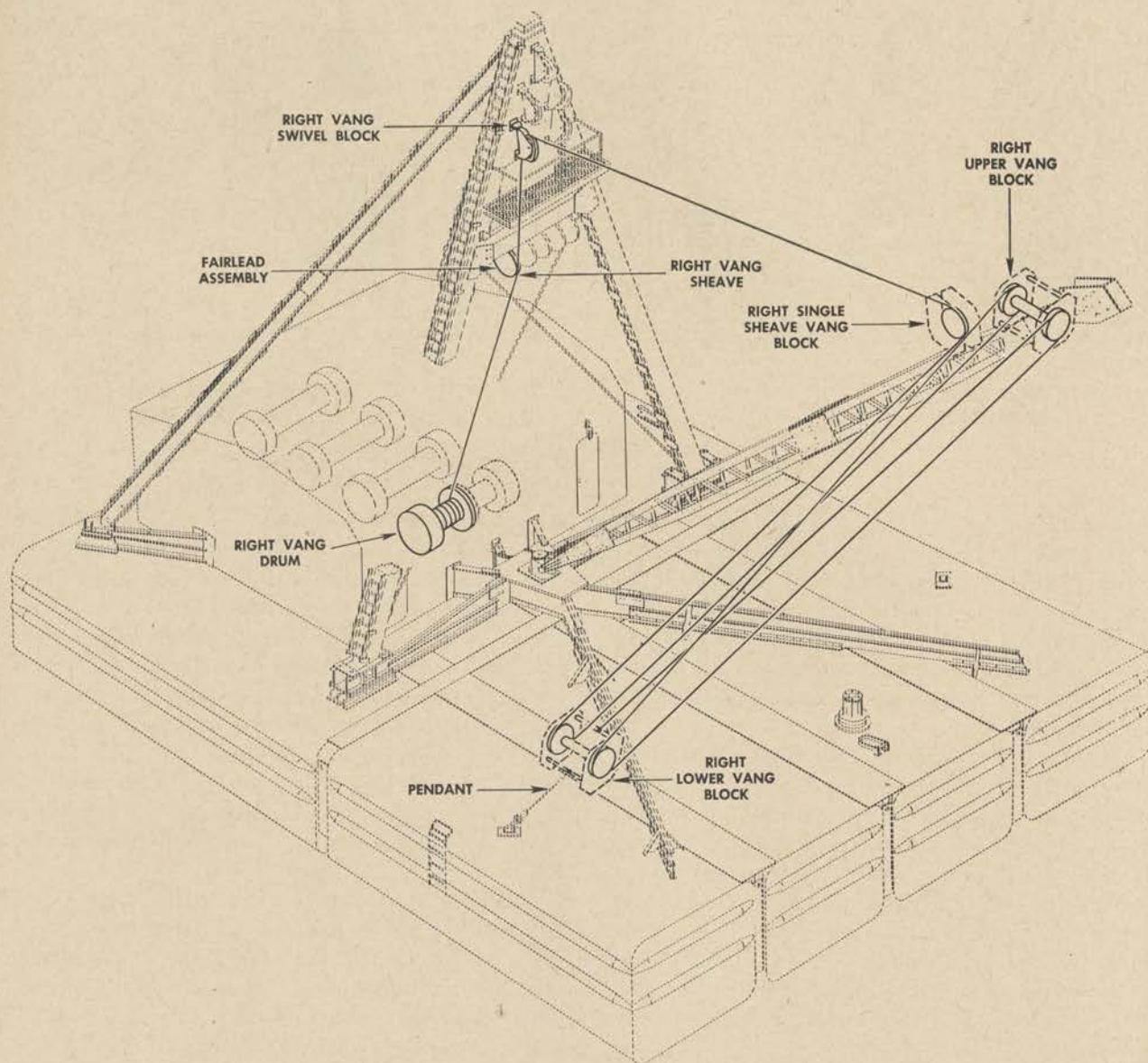


Figure 135. Reeving of starboard vang cable.

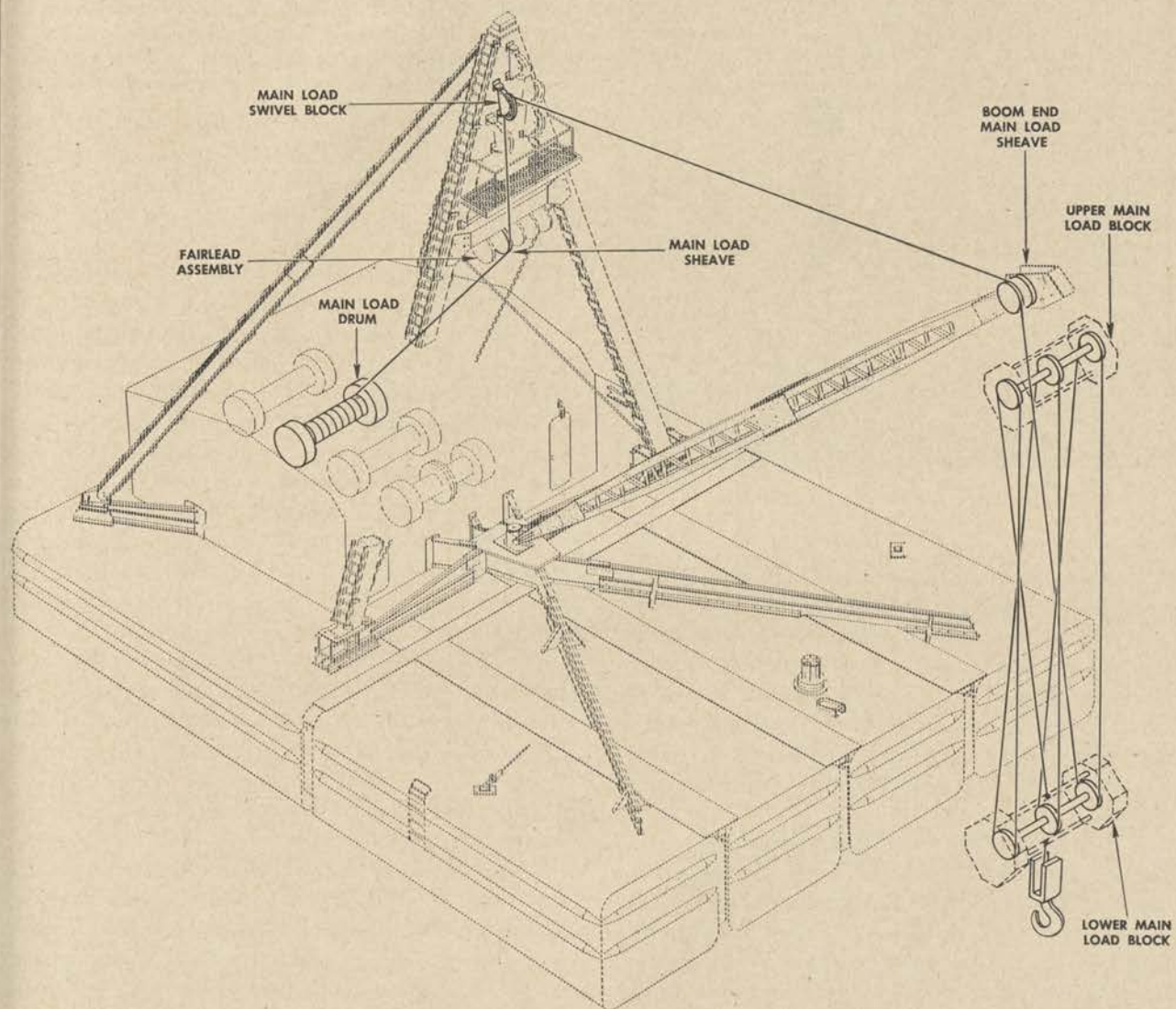


Figure 136. Reeving of load cable.

vang block and secure it by clamping to the hitch pin, using clamps. (See fig. 135.)

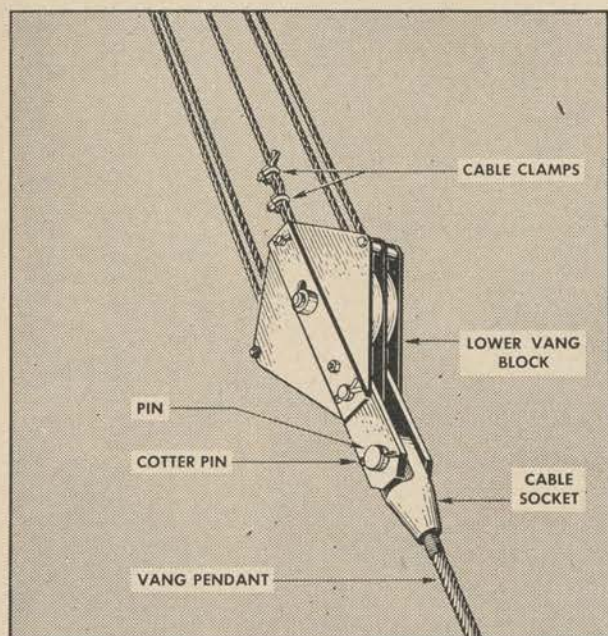


Figure 137. Lower vang line reeved.

f. REEVING PORT VANG LINES. Reeve the port vang line in exactly the same manner as the star-board vang line, using the left side fairlead swivel blocks and the sheaves, and reeve the cable around the single sheave vang block on the left side of the boom. Be sure that the reeving between the upper and lower two sheave vang blocks starts by first passing the cable over the sheave nearest the boom side.

g. REEVING MAIN LOAD LINE (FIG. 136). (1) Unreel the main load cable on to the main load drum of the hoist. Make sure that the direction of reeling is such as to have the end of the cable lead off from the rear of the drum. Also make certain that the cable is securely clamped to the drum flange, as shown in figure 134.

(2) Since reeving the main load line requires a suspension of the load block and the load block hanger, it will be found convenient to raise the boom to a comfortable working height by operating the Diesel engine.

(3) Bring the free end of the cable from the main load line drum out through the opening of the deck-house roof, and pass the cable around the sheave and swivel block. (See fig. 136.)

(4) Pass the end of the cable from the right hand swivel block around the main load line sheave, which is centered in the boom end.

Note. Use either of the 24-inch sheaves provided at this point. However, the sheave carrying the load should be interchanged periodically in order to avoid excessive wearing on the pulley bushing, and to equalize wear.

(5) Pass the end of the cable around the load block, starting with the left sheave, around the left sheave of the load block hanger, thence back and forth until the three sheaves have been reeved.

(6) Anchor the loose end of the cable to the anchor pin of the lower load block, by splicing.

h. REEVING WHIP LINE. (1) Unreel the cable for the whip line onto the whip drum of the hoist. Note that the whip cable is reeled onto the drum in a direction opposite the foregoing three cables; that is, the end of the cable must lead off from the front of the drum, as shown in figure 138. Be sure to clamp the cable securely to the drum flange.

(2) Pass the cable end out through the opening in the deck-house roof and around the left sheave and left swivel block of the A-frame. (See fig. 138.)

(3) From the left swivel block on the A-frame, bring the end of the whip cable under and around the sheave at the aft of the boom tip, and thence around the forward 20-inch sheave, as shown in figure 138.

(4) Secure the downhaul ball and hook by means of clamps.

i. RUNNING IN NEW CABLE. When all cables have been reeved, check both hoist and derrick, following thoroughly the before-operation inspection procedures. Check particularly the position of the boom, the main load hook, and the whip hook to make sure that their movements will not be restricted. Start the engine and hoist, rotating each drum to the fullest extent of its line without load. Repeat running each line, full out and in, several minutes to insure that it is free running, and to seat it in the sheaves.

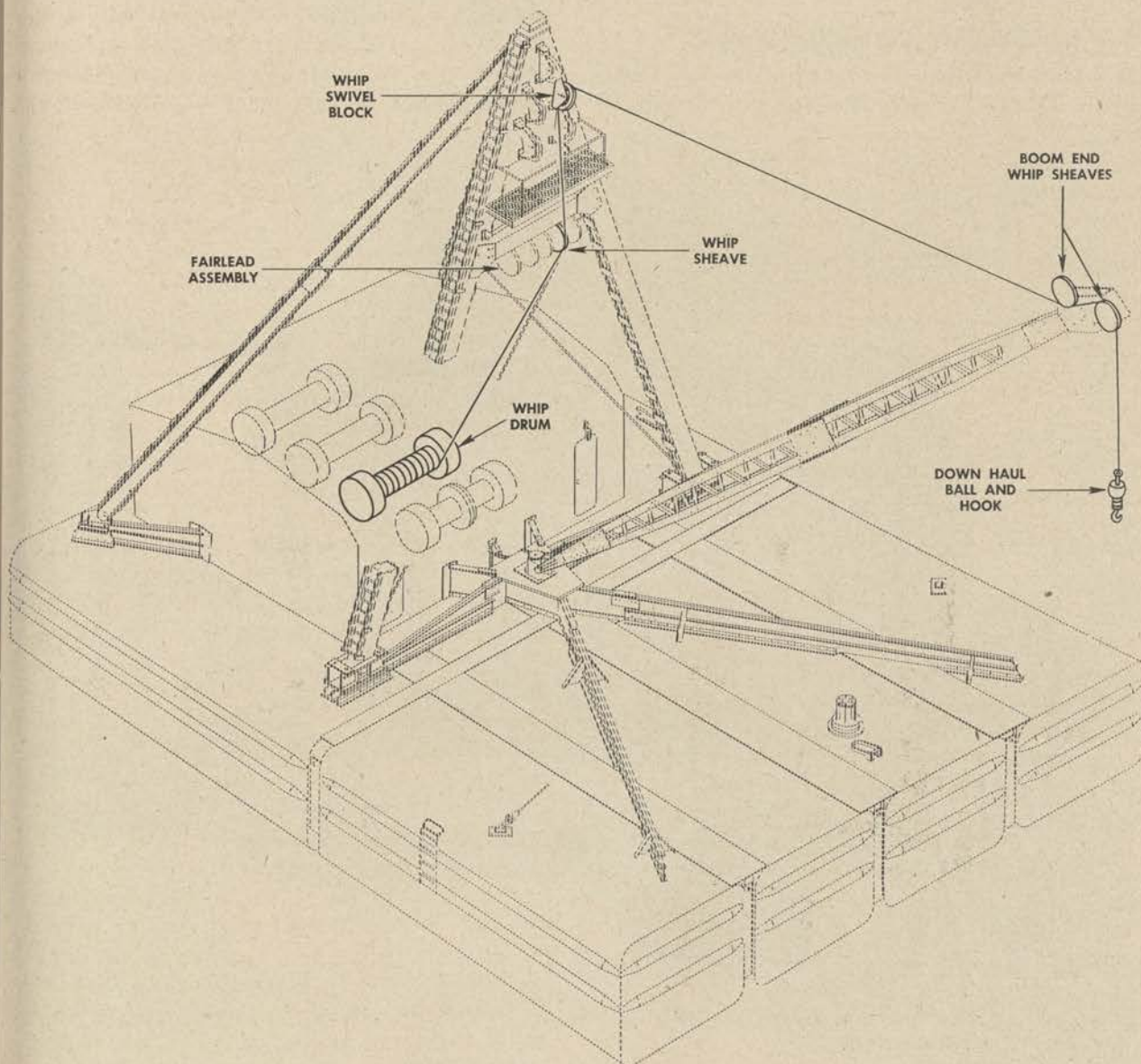


Figure 138. Reeving of whip cable.

Section XVI. MACHINERY HOUSE ASSEMBLY

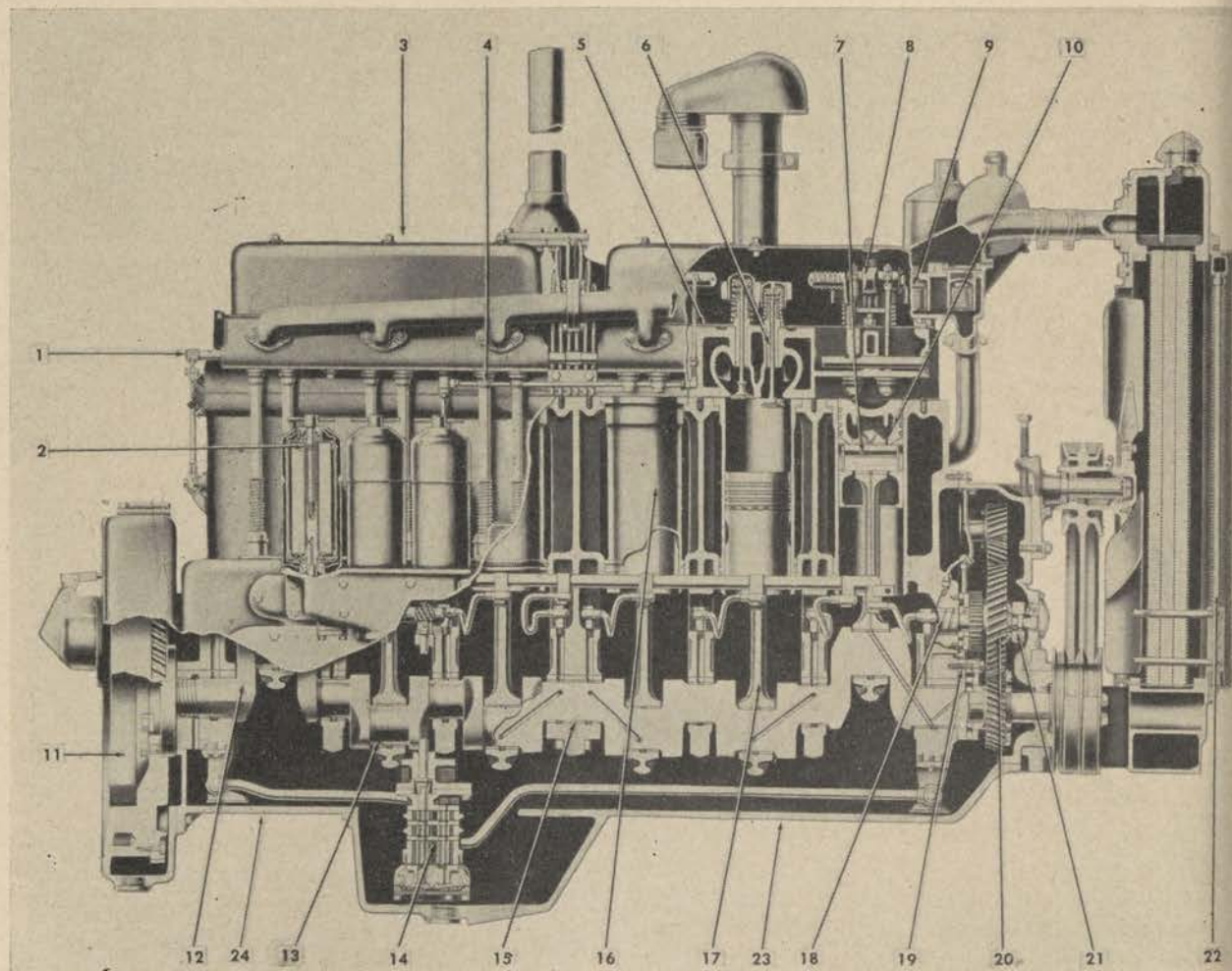
43. General

The instructions given in this section apply only to major equipment located inside the machinery house.

44. Main Engine (Caterpillar Diesel)

a. GENERAL. (1) The main engine is a Caterpillar Diesel, manufactured by the Caterpillar

Tractor Company, D-13000 series. It is a six-cylinder engine operating on the four-stroke cycle, compression ignition principle. It burns fuel commercially known as Diesel fuel, without the use of spark plugs or externally heated surfaces. The function of the engine is to supply power for rotation of the hoist drums. A shaft, coupled to the aft end of the engine, drives the main generator and air compressor through individual driving belts. A clutch, coupled to the engine fly-



1. Compression release lever.
2. Lubricating oil filters.
3. Valve cover.
4. Valve push rod tube.
5. Cylinder head.
6. Valve.
7. Piston pin.
8. Valve rocker arm assembly.
9. Water temperature regulators.
10. Piston.
11. Flywheel.
12. Crankshaft.

13. Connecting rod bearing.
14. Lubricating oil pump.
15. Main bearing.
16. Cylinder liner.
17. Connecting rod.
18. Camshaft.
19. Crankshaft and thrust plate.
20. Timing gears.
21. Governor weights.
22. Oil cooler.
23. Oil pan, front section.
24. Oil pan, rear section.

Figure 139. Cross section of main engine.

wheel, is engaged by means of a hand lever to transmit drive to the hoist drums, main generator, and air compressor.

(2) Right and left sides of engine. The right side of the engine as used in this manual is identified as the side at the right of the operator standing at the flywheel end of the engine looking toward the radiator.

b. ENGINE REMOVAL. (1) The main engine, complete with drive shaft and bearings, main drive pinion, generator, and compressor drive pulleys, together with mounting rails, is removed as a unit from the foundation girder.

(2) Remove aft and forward roof sections of the deck house as described below, before attempting to remove the engine.

(a) Separate cover plate section from the roof by removing bolts and nuts from cover plate and ridge beam brackets.

(b) Remove port and starboard forward roof section by removing bolts and nuts.

Note. Replace weatherproofing on reassembly of roof by applying strips of canvas, dipped in linseed oil, in the joints.

(c) Remove aft roof section by removing bolts and nuts from aft roof section and bracket plates.

(3) Remove main generator and main generator foundation.

(4) Disassemble compressor drive by loosening skids on compressor and moving the compressor on slide rails until belts can be disengaged readily from sheave grooves. Then remove compressor belt guard and belt from the compressor pulley.

(5) Disassemble the main hoist drive. Remove guard case from chain drive. Remove any link by filing the head from the link pin, and driving it clear with a center punch and hammer. Disengage silent chain drive from the main hoist gear and the engine pinion.

(6) Separate the main engine foundation from the foundation girder by removing the $\frac{3}{4}$ -inch hex head bolts and nuts.

(7) Lift engine and drive through deck house roof by means of a crane.

(8) To reassemble the engine and drivers, set engine on foundation girder and bolt temporarily in place (par. 7e(2)). Then install main hoist drive (par. 7e(1)), main generator and drive (par. 7e(2)), and air compressor drive (par. 7e(3)).

Note. Aline drives to insure proper operation of V-belt.

Wrench tighten all foundation bolts after checking and adjusting alinement, and replace all drive guards.

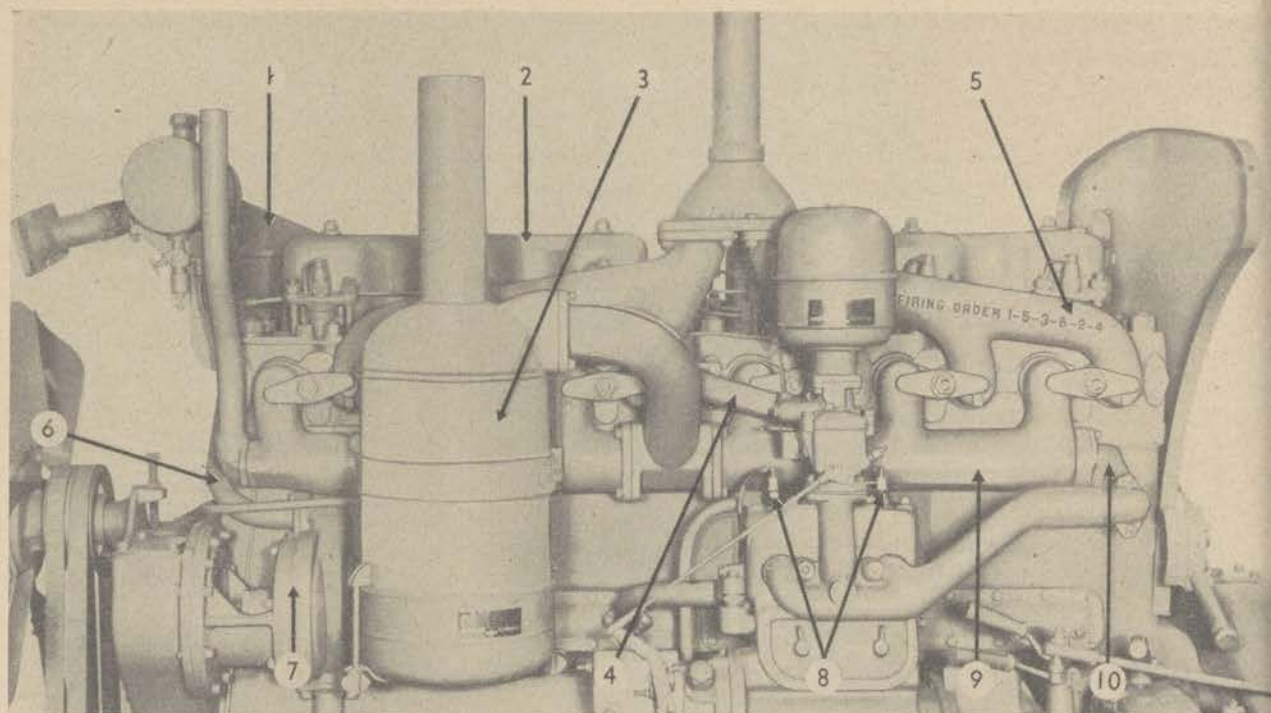
c. ENGINE REPAIRS. (1) *Cylinder head.* Two cylinder heads are used on the engine, each covering three cylinders. Copper water directors direct the flow of the cooling water around the valve ports and precombustion chambers. Rubber seals and ferrules seal the water passages between the cylinder heads and cylinder block.

(a) *Cylinder head removal.* Figure 140 identifies the left side of the engine. Numbers in the illustration refer to parts to be removed in order to take off a cylinder head as described below:

1. Remove the starting engine spark plugs (8, fig. 140).
2. Withdraw the water pipe connection (4) between the Diesel engine cylinder heads and starting engine cylinder head.
3. Remove the Diesel engine inlet and exhaust manifold assemblies and the air cleaner. First disconnect the starting engine fuel line at the carburetor. Remove the elbow (10) between the starting engine exhaust manifold and Diesel engine inlet manifold assembly. After removing the nuts and clamps from the studs, take off the Diesel engine exhaust manifold (5) and lift out the Diesel engine inlet manifold assembly (9) and air cleaner (3) as a unit.
4. Lift off the valve rocker covers (2) by removing the nuts and washers from the studs.
5. Remove the water bypass tubes (6) between the water pump (7) and water regulator housing (1).
6. Take off the starting engine fuel tank and bracket.
7. Disconnect the fuel injection lines from the injection valves.

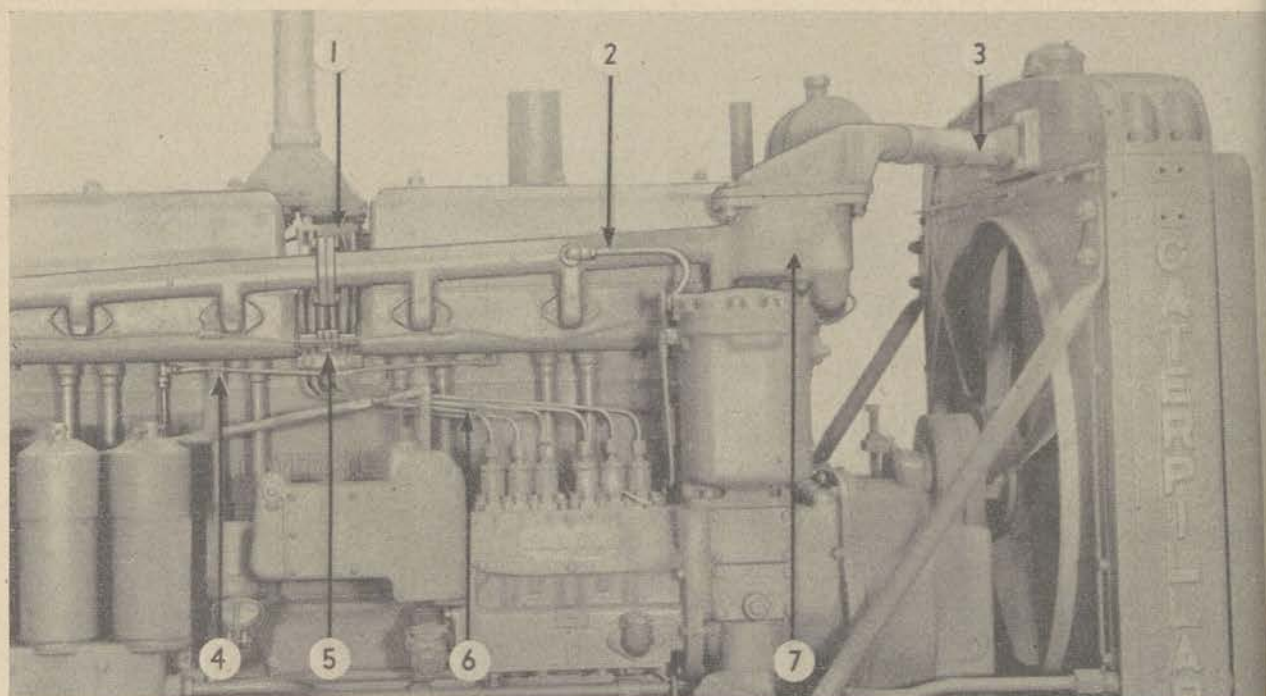
Note. Remove or disconnect the following items from the right side of the engine.

8. Remove the fuel injection lines (6, fig. 141).
9. Remove the oil tubes (4) to valve rocker arm assemblies.
10. Take off the copper tube (2) from the water manifold to the fuel filter housing at the water manifold end.



- | | | | |
|-----------------------------|----------------------|-----------------|--------------------|
| 1. Water regulator housing. | 4. Water pipe. | 7. Water pump. | 9. Inlet manifold. |
| 2. Rocker covers. | 5. Exhaust manifold. | 8. Spark plugs. | 10. Elbow. |
| 3. Air cleaner. | 6. By-pass tube. | | |

Figure 140. Left side of engine.



- | | |
|--|--------------------------|
| 1. Section joint bolts. | 5. Coupling. |
| 2. Copper tube from water manifold to fuel filter housing. | 6. Fuel injection lines. |
| 3. Inlet elbow. | 7. Regulator housing. |
| 4. Oil tubes to valve rocker. | |

Figure 141. Right side of engine.

11. Remove the temperature indicator tube at the water regulator housing (7), and from the clamps on the cylinder heads.
12. Withdraw the bolts holding the two sections of the water manifold together at (1).
13. Disconnect the oil tube from the oil pressure gage.
14. Remove the bolt which passes through the coupling (5) between the two compression release shafts. Slide the coupling onto either shaft far enough to clear the other.
15. Withdraw the capscrews which hold the water inlet elbow (3) to the top tank of the radiator.
16. Remove the valve rocker assemblies, as described in *c*(2) below, and the pushrods and cylinder head nuts. Lift off either one or both heads, as shown in figure 142.

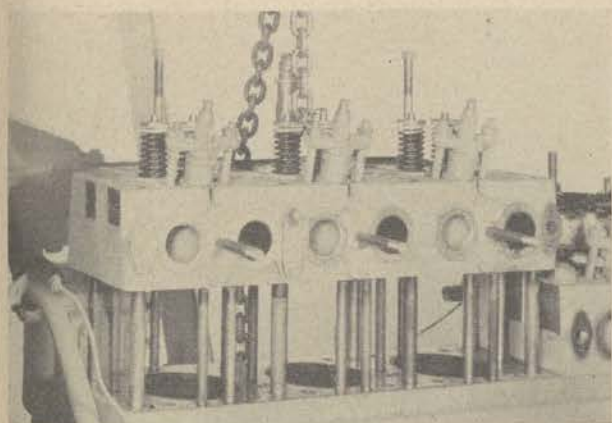


Figure 142. Removing cylinder head.

(b) *Precombustion chambers, removal and replacement.* The precombustion chambers are pressed into the cylinder head and held in place by the fuel injection valve which fits into the chamber. A copper gasket is used as a seal at the bottom of the chamber, and a rubber ring is used at the top. To remove a precombustion chamber, first remove the fuel injection valve which is held by a flange and nuts, and then remove the valve rocker cover. Then pull the chamber out of the head as shown in figure 143, using the precombustion chamber extractor tool. Screw the large threaded end of the tool shaft into the

precombustion chamber, fit the saddle over the two studs, install the nut assembly, and turn it down on the shaft.

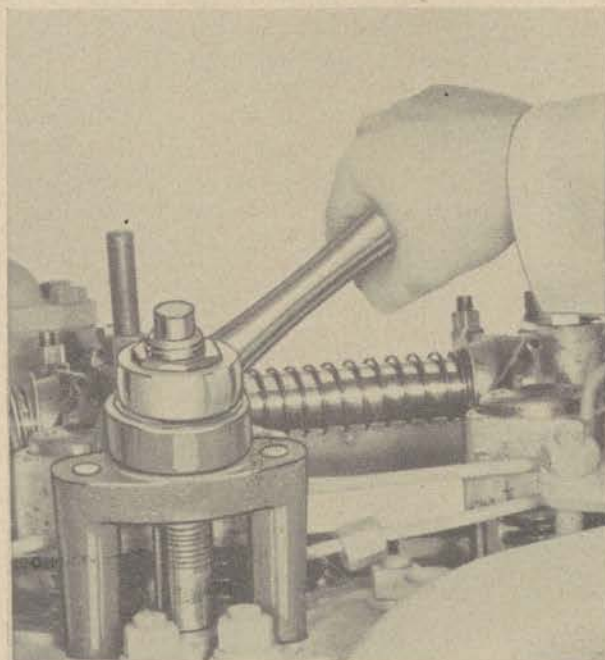


Figure 143. Removing precombustion chamber.

When replacing a precombustion chamber, use a new copper gasket (fig. 144) at the bottom, and a new rubber seal in the groove at the top. Coat the chamfered portion of the cylinder head and the rubber seal with soap, insert the chamber in the head and use a fuel valve gage driver, which is a special tool furnished for this purpose, to drive it into place.

(c) *Cylinder head cleaning.* After removing a cylinder head from the engine and the valve assemblies from the head, carefully scrape all carbon accumulations from the parts. Be sure to clean thoroughly the valves as well as the valve stem bushings and valve parts.

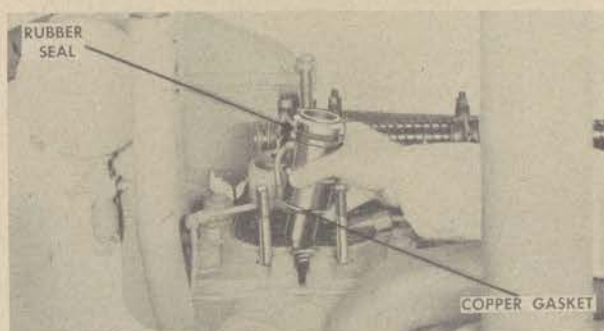


Figure 144. Precombustion chamber seals.

(d) *Cylinder head installation.*

1. *Cylinder head gaskets.* Use the gaskets more than once, unless they are damaged. If the gaskets show cracks or blow-by marks, install new ones. Place the gaskets on the cylinder block and install the ferrules and rubber seals. Carefully lower the heads onto the block. Install the hold down nuts and tighten them evenly, starting with those nearest the center of each head. Use a torque wrench to tighten the nuts on $\frac{7}{8}$ -inch studs to 2,000 inch-pounds and the nuts on the $\frac{5}{8}$ -inch studs to 700 inch-pounds.

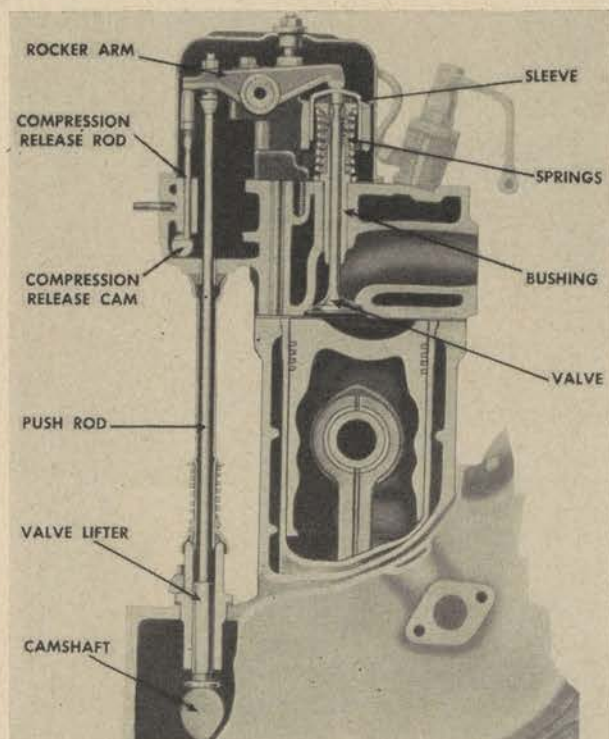


Figure 145. Valve mechanism.

2. Install the push rods and valve rocker mechanism. Securely tighten the nuts which hold the valve rocker mechanism in place.
3. Set the valve clearances as described in (3) (b) below.
4. When installing the inlet manifold, be sure all gaskets, including those at the front and rear, are in good condition. The inlet manifold is heated by the starting engine exhaust gases passing

through a tube assembly extending through the length of the Diesel engine inlet manifold. If the gaskets of the manifold should leak, unfiltered air would be drawn into the Diesel engine.

(2) *Valves and valve mechanism.* (a) *General.* The inlet and exhaust valves located in the cylinder heads are operated by a gear driven camshaft through a lifter push rod and rocker arm arrangement. The valve stems operate in replaceable bushings. Sleeves are provided to eliminate side thrusts from the valve stems. Compression release for starting is accomplished by a cam and push rod which act as the inlet valve rocker arms to hold the inlet valves open.

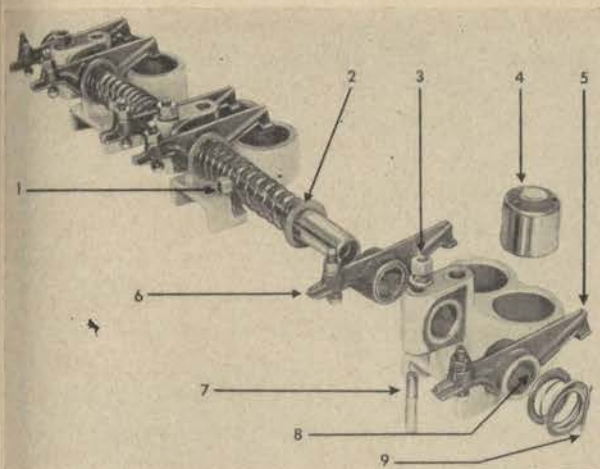
(b) *Checking valves.* Check the valves for proper seating by "rocking" the engine against compression with the Diesel engine hand crank. If the engine does not "rock back" against compression, it may indicate that the valves and valve seats should be refaced and reground. Valve leakage can often be heard distinctly in the manifolds.

Note. Worn piston rings, improperly adjusted valves, or a damaged cylinder head gasket will keep the engine from "rocking" against compression; therefore, check these items before concluding that the valves are at fault. Worn piston rings usually can be detected without dismantling the engine, since considerable oil vapor will come out of the breather while the engine is running and will be accompanied by high oil consumption.

(c) *Rocker arms, removal and assembly.*

1. *General.* The rocker arm is removable from the cylinder head. Figure 146 illustrates the disassembly of the unit; numbers in the illustration are keyed to disassembly procedure following.
2. *Removal.* Pull the cotter pin (9) and slide off washers, spring, and outer rocker arm (5). Remove nut (3) and tap the lock bolt (7) down sufficiently to release the shaft. Do not remove the lock bolt. Slide the bracket off the shaft and withdraw the other rocker arm (6).
3. *Reassembly.* After making any necessary replacements, install a rocker, the bracket, and the outer rocker arm onto the shaft. Sever the nut on the lock bolt (7) but do not tighten it until after placing the assembly on the cylinder head.

130



- | | |
|------------------------------|----------------|
| 1. Rocker arm shaft fitting. | 6. Rocker arm. |
| 2. Spring. | 7. Lock bolt. |
| 3. Nut. | 8. Bushings. |
| 4. Valve spring sleeve. | 9. Cotter pin. |
| 5. Outer rocker arm. | |

Figure 146. Disassembly of rocker arm unit.

(d) *Valve removal.* With the cylinder head removed, use a valve spring compressor to take the valves out of the head. (See fig. 147.) Com-

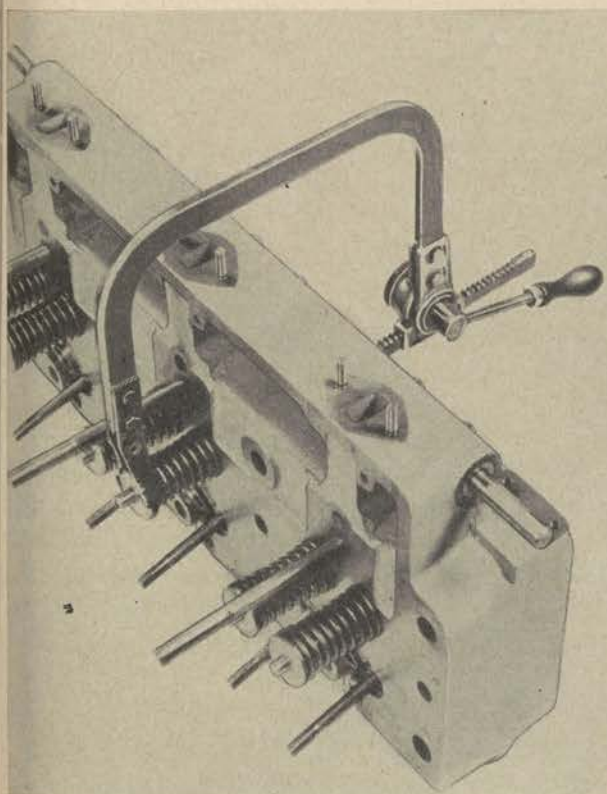


Figure 147. Compressing valve springs.

press the valve springs and remove the locks, then release the compressor tool and withdraw the retainers and valve springs. Remove the valves.

Note: When removing the valves, tag them to replace in the same parts when reassembling.

(e) *Valve inspection and reconditioning.* With the valves removed, carefully inspect them for burning or pitting. Note that the exhaust valves in particular have the appearance of being pitted due to the accumulation of carbon particles. This condition does not affect the operation of the engine, and valves do not necessarily require refacing unless there has been a definite indication of blow-by. Refacing of valve is accomplished on a standard valve refacing machine or on a lathe, and the valve seat worked to exactly 45° . Take care to remove only sufficient metal to eliminate the pits and make the seat concentric with the stem. After grinding the valve seats, clean all parts thoroughly. Replace badly warped or deeply pitted valves.

(f) *Checking valve seats.* Coat the valve face with a thin film of prussian blue, and rotate the valve in the valve seat. The entire circumference of the valve seat should indicate contact with the valve on most of its area. Minor imperfections in the valve seat can be corrected by lapping in the valve.

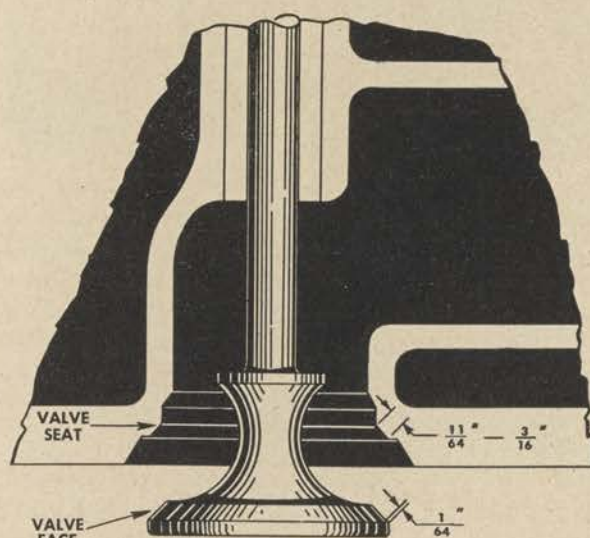


Figure 148. Valve face and seat width.

Caution: Never turn valves one complete revolution while lapping as the compound is likely to create grooves in the seats.

If the valve seat (fig. 148) contacts the valve face within $\frac{1}{65}$ inch of the top of the valve face, reduce the width of the seat to $\frac{11}{64}$ inch— $\frac{3}{16}$ inch. Narrow the seat with a 15° stone or fly cutter.

(g) *Checking valve stem bushings.* The valve stem operates in replaceable bushings. Check the valve stem bushing for wear by first cleaning it thoroughly, inserting a new valve in the bushing, and checking the clearance with a narrow feeler gage. Normal valve stem clearance in a valve stem bushing is from 0.005 to 0.007 inch for an inlet valve and from 0.006 to 0.008 inch for an exhaust valve. If the inlet or exhaust valve stem clearance exceeds 0.012 inch, replace the valves or valve bushings. Valve stem bushings can be driven out from the inside of the head with a suitable drift. To prevent damage to the ends of the bush-

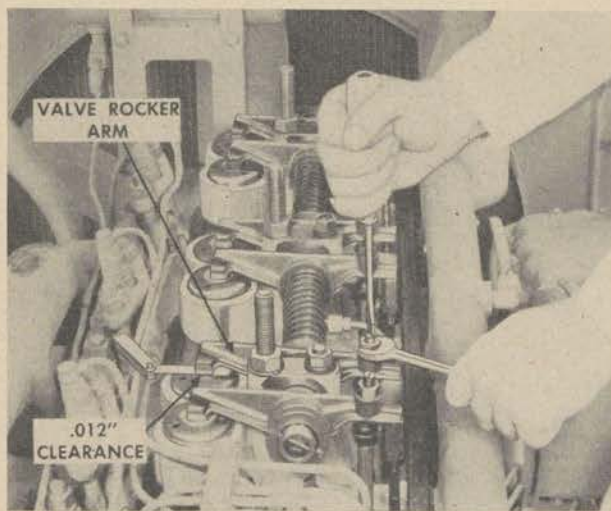


Figure 149. Valve clearance adjustment.

ings, press them into place carefully with an inserting tool. A 0.449- to 0.500-inch reamer run through the bushings after installation will insure correct valve stem clearances.

(h) *Replacing valve springs.* Using the valve compressor tool, compress the springs. Remove the defective spring and replace with the new part. Install the retainer on top of the spring and compress until the spring retainer lock can be inserted in the retainer. Then release the valve compressor tool, making sure that the locks are held in place correctly. A small quantity of cup grease on the locks will help to hold them in position.

(i) *Valve installation.* Install exhaust valves marked EX on the valve head, in the exhaust ports. Install inlet valves marked IN on the valve head, in the inlet ports.

(3) *Valve clearance adjustment.* (a) *General.* Make initial valve clearance adjustment at the time of tightening the cylinder head stud nuts after the first few hours of engine operation. Check the clearance again after the engine has run for 120 hours. Thereafter, check the clearance and adjust it if needed after every 240 hours of engine operation as read on the hour meter. Make the valve clearance adjustment while the engine is hot; that is, after the engine has been stopped 10 minutes, and before it has cooled 20 minutes. If the adjustment is incomplete during this 10-minute interval, start the engine and allow it to warm up.

Note. Before adjusting the valves, check the cylinder head nuts and rocker arm assembly holddown nuts to see that they are tight.

(b) *To adjust.*

1. Set the compression release lever in the RUN position.
2. Adjust the valves in the firing order of the engine (1:5:3:6:2:4). (Valve clearance can be adjusted with the engine running or stopped.)
3. Crank the engine in the direction of normal rotation until the inlet valve on No. 1 cylinder closes. This is the point at which the valve and valve guide sleeve (fig. 145) reach the highest point of travel. Now give the engine an additional one-half turn and adjust both valves on No. 1 cylinder at the same time.
4. Loosen the valve adjusting screw lock nut on the valve rocker arm (See fig. 149.) Insert the feeler gage between the sleeve over the valve stem and valve rocker arm. Turn the screw to obtain 0.012-inch clearance. Clearance should be the same for both inlet and exhaust valves.
5. Recheck the adjustment, after tightening the adjusting screw lock nut.
6. Rotate the engine crankshaft $\frac{1}{3}$ revolution and adjust the valves on the next cylinder in the firing order.

(4) *Compression release.* (a) *General.* The compression release mechanism (fig. 145) consists of a cam shaft in the right side of each cylinder. This creates a cam action to raise the auxiliary

push rods which hold the exhaust valve of each cylinder open when the compression release lever is moved to the START position.

(b) *Checking clearances.* After adjustment of the exhaust valve clearance, and while the compression release lever is in the RUN position, check the clearance between the upper end of the compression release push rod and the end of the valve rocker (See fig. 150.) This clearance should be 0.025 to 0.030 inch.

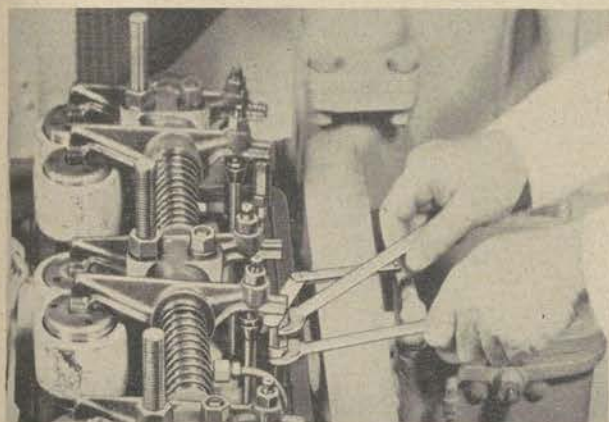


Figure 150. Adjusting compression release.

(c) *To adjust.* To adjust the compression release, loosen the lock nut on the compression release push rod, and turn the adjusting nut (fig. 150) until the correct clearance is obtained. Re-check adjustment after tightening the lock nut.

Note. Check this clearance each time the exhaust valve clearance is changed or checked.

(5) *Valve lifter and guide assembly.* The valve lifters and guides are located on the right side of the engine block. To remove them or make replacements, take off the valve rocker covers and valve rockers and lift out the push rods. Compress the springs (fig. 147) to permit the tube assemblies that enclose the push rods to be lowered and removed. If the packing at the upper or lower ends of these tubes is damaged, replace it. Remove the yokes which hold the valve lifter guides in the cylinder block and withdraw the guides and lifters. Be careful that the lifters do not fall into the crankcase as the guides are removed. Retighten the nuts on each of the yokes, after the engine has been under operation for a few days, so as to seat the lifter guides against the cylinder block.

Note. Replace the valve lifters or guide if the clearance exceeds 0.008 inch.

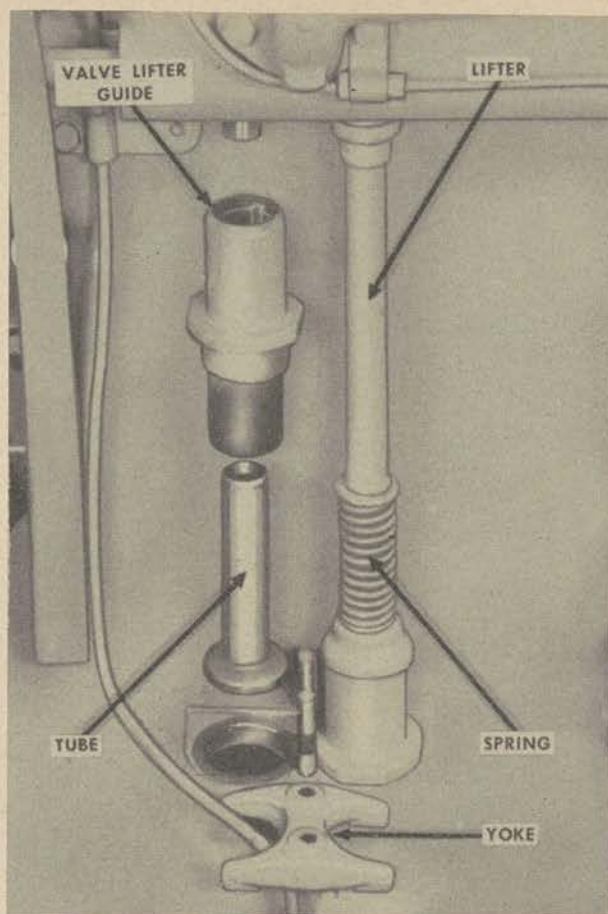


Figure 151. Valve lifter and guide assembly.

(6) *Valve timing, timing gears.* (a) The valve timing is controlled by the setting of the timing gears. Corresponding marks on the crank shaft, cam shaft, idler and accessory shaft gears must be in line before installing timing gear cover.

(b) The timing gear assembly consists of a train of gears driven by the crank shaft. The crank shaft gear (fig. 152) meshes with the cam shaft gear, which consists of a large helical gear and a smaller spur gear. The helical teeth on the cam shaft gear mesh with the idler gear which drives the water pump drive gear. The spur teeth of the cam shaft gear mesh with the accessory shaft gear to rotate the accessory shaft and drive the fuel injection pump cam shaft.

(c) The cam shaft gear is timed to the crank shaft gear by mating the marked teeth. (See fig. 152.) Also, the accessory shaft gear is timed to the cam shaft gear by mating the marked teeth. (See fig. 152.)

(7) *Accessory drive shaft housing.* (a) *General.* Figure 153 is used in conjunction with the

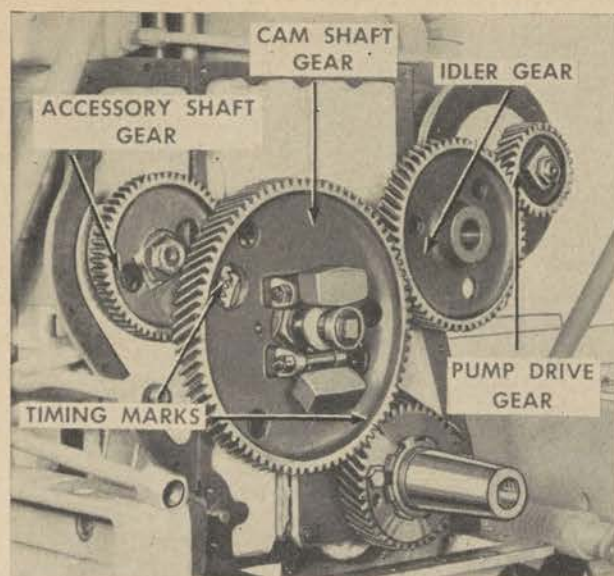


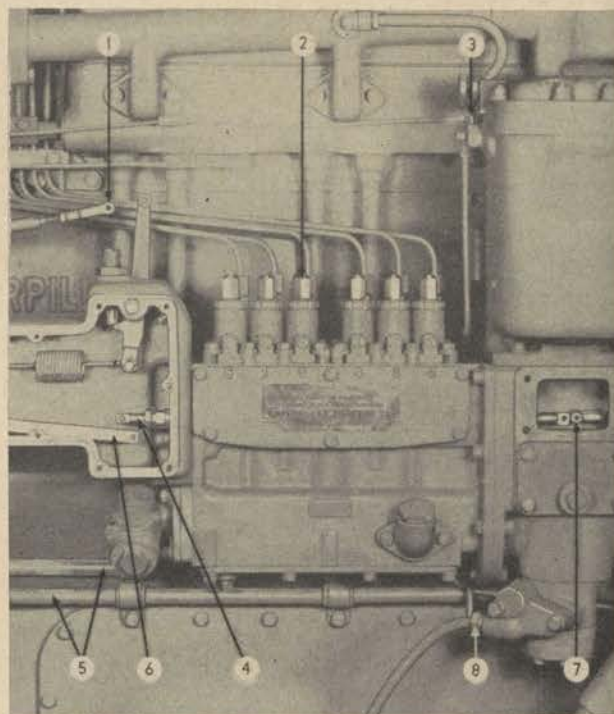
Figure 152. Timing gear assembly.

description given below for the removal of the accessory drive shaft housing when making replacements.

(b) Removal.

1. Disconnect the fuel line of the transfer pump at (8), figure 153, fuel injection lines at the fuel injection pumps (2), and the throttle rod yoke (1) from the governor spring lever.
2. Remove the oil tubes (5) between the oil filter base and the oil cooler.
3. Remove the water line (3, fig. 153) between the water manifold and the fuel filter housing, and the water line between the fuel filter housing and the elbow on the water pump. (See fig. 154.)
4. Take off the rectangular cover beneath the fuel filter housing and disconnect the fuel injection pump slide bar from the governor yoke by removing the pin and cotter pin. If the head of the pin is facing in toward the side of the engine, its removal will be restricted. If this condition is present, loosen the locknut (7), and disconnect the other end of the slide bar (4) from the link (6). Rotate the slide bar so that the yoke (7) is turned one-fourth revolution to face the head of the pin "up" for removal. Lock the nut on the yoke (7).

5. Support the housing with ropes, and the hoist, and remove the bolts and cap screws that fasten the accessory shaft housing to the timing gear housing and cylinder block.



1. Throttle rod yoke.
2. Fuel injection pump.
3. Water line.
4. Slide bar.
5. Oil tubes.
6. Slide bar link.
7. Governor rod yoke.
8. Fuel transfer pump.

Figure 153. Removal of accessory shaft housing.

6. Due to the dowels (fig. 154), the unit must be moved away from the engine about $\frac{1}{2}$ inch distance before it can be brought around and removed.
7. A drilled passage in the cylinder block (fig. 154) conducts oil from the front camshaft bearing to the tube and drilled passage in the accessory shaft housing. This oil passage provides pressure lubrication for the accessory shaft bearing in which a hole is drilled to line up with the oil passage.
8. Before replacing the housing, replace the seal in the counterbore around tube with a new part.

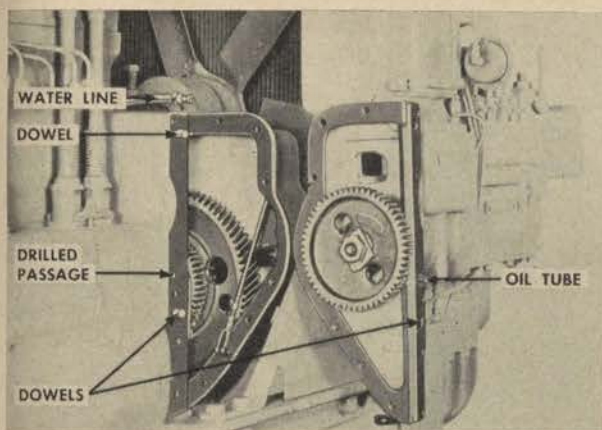


Figure 154. Accessory drive shaft housing removed.

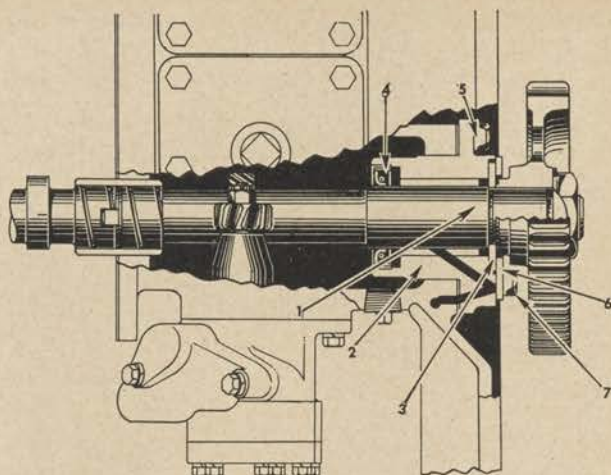
(c) *Reinstallation.* On replacing the housing, take care to assure that the accessory shaft gear is timed with the cam shaft gear. Check this through the inspection cover on the front of the timing gear housing. Use of the mirror and flash light will make it easier to observe the mark on the gears.

(8) *Accessory drive shaft. (a) Removal.*

1. The accessory drive shaft (1, fig. 155) and bearing assembly (2) may be removed as a unit from the housing, after removing the cap screws (5) which hold the bearing assembly to the housing.
2. Remove the shaft with the gear installed by withdrawing the cap screws (5) which may be reached through the the holes of the gear.

Note. There are two sets of cap screws at this point. The other set of cap screws (7) hold the thrust plate (6) to the bearing assembly and are not to be removed to pull the shaft.

3. If the seal (4) is worn or damaged, replace it, since a faulty seal at this point will allow oil to flow from the bearing and cause the oil level in the fuel injection pump housing to rise rapidly. Install the seal with the wiping edge facing forward toward the bearing.
4. When assembling the shaft, gear and bearing assembly in the housing, rotate the shaft as it is installed, to insure proper meshing to the fuel transfer pump driving gear, and to obtain proper coupling of the "off center" tangs of the accessory shaft with the



1. Accessory drive shaft.
2. Bearing assembly.
3. Thrust washer.
4. Seal.
5. Bearing cap screws.
6. Thrust plate.
7. Thrust plate cap screw.

Figure 155. Accessory drive shaft in housing.

grooves of the fuel injection pump cam shaft.

(9) *Cam shaft.* The cam shaft is driven by the cam shaft gear which meshes with the engine crank shaft gear. The cams are forged integrally with the shaft and actuate the engine inlet and exhaust valve. Also, the integral part of the shaft is the gear which drives the lubricating oil pump. The governor flyballs are attached to the cam shaft gear.

(10) *Piston, connecting rods, and cylinder liners. (a) General.* The first noticeable symptoms of worn piston rings and cylinder liners are increased oil consumption and excessive vapor from the crankcase breather. Extreme wear may result in poor compression, loss of power, and hard starting.

(b) *Removing connecting rod and piston.* Before removing the piston and connecting rod, drain the engine of water and oil. Remove the cylinder head, and take off the cylinder block inspection covers, to gain access to the connecting rod bearing desired. With the cylinder head removed, scrape off the accumulation of carbon upon the upper walls of the cylinder liner. Do this with a soft instrument. Remove the connecting rod bearing cap through the cylinder block inspection opening. Rotate the engine crank shaft until the piston to be removed is at top dead center. Now, through

the inspection opening, push the connecting rod up until the top of the piston is about 1 inch above the top of the cylinder block. Using the piston extracting tool provided for the purpose, tightly clamp tool to the top of the piston and withdraw the piston and connecting rod assembly.

(c) *Cleaning pistons.* Clean the pistons with an authorized solvent. Apply solvent over the piston and loosen the carbon deposits in the bottom of each groove, in order to avoid the necessity of scraping. Thoroughly clean the bottom of ring grooves. Never scrape the sides of the ring grooves or the contact surfaces of the piston. The area above the top ring may be filed smooth, but replace pistons badly scored below the top ring groove.

(d) *Replacing piston rings.*

1. Piston rings seal compression and control the amount of oil on the cylinder walls. If oil consumption is not excessive, and compression is satisfactory, do not remove pistons nor install new rings, when the engine is dismantled for some other reason.
2. The correct ring gap clearance in the cylinder liner should be 0.000 inch. Check the gap clearance by inserting the ring squarely in the liner and measuring at a distance of 3 inches from the top.
3. After thoroughly cleaning and checking the piston, remove the rings. Use a proper ring expander, necessary in order to avoid damage to the piston.



Figure 156. Ring expanding tool.

4. When installing, place the ring on the piston in its proper groove. The upper compression ring has a special overlap type joint. The side clearance between the new ring and the top ring groove should not exceed 0.012 inch.

Note. Be sure to use a piston ring expanding tool when placing the rings in the groove. The ring expander is not only a time saver, but will also prevent breaking or distorting rings, and damaging the ring grooves.

5. After installing new rings, operate the engine in accordance the the recommended "run in" schedule, (j) below, before assuming a full load.

(e) *Piston pins.* Remove the piston pin for replacement purposes by taking out the wrist pin retainers on each side of the piston boss.

(f) *Connecting rod bearings.*

1. *General.* Connecting rod bearings are located in the crank shaft end of the connecting rod. The bearing caps and rods are numbered consecutively 1 to 6 from the front of the engine on the right side, so that the numbers can be seen through the inspection openings on the right of the cylinder block. Reassemble the rods with the numbers in this position.
2. *Removal.* Connecting rod bearings are the precision type and are to be installed without fitting or scraping the shells. Remove the bearing shells, inspect, and replace them through the inspection openings without removing the rod from the engine. To remove a connecting rod bearing through the inspection opening, remove the cover and rotate the crank shaft until the bearing to be removed is accessible. Remove the cotter pins and nuts from the connecting rod bolts and withdraw the cap and lower shell. To remove the upper shell, turn the crank shaft or push the rod up slightly.

Note. Inspect the connecting rods, bearing caps, and backs of bearing shells to insure that they are smooth and free from oil, dirt, or grease, before replacing any bearings. This is important since the bearing shells will not seat if any of these is present.

3. *Inspection and replacement.* The babbitt line shells rarely need to be replaced because of wear. If dirt is allowed to enter the engine, it will imbed itself in the babbitt and act as an abrasive against the crank shaft bearing journals. Replace bearings having a sandy surface. New standard connecting rod bearing shells are 3.630 inches in diameter, giving a clearance of 0.0045 to 0.006 inch between the bearing and crank shaft. The dowel pin hold in one of the shells in each rod is elongated to assure proper alinement of the bearing in the connecting rod.

Note. Replace connecting rods that are bent and not suitable for service. Do not attempt to aline connecting rods by bending.

(g) *Piston pin bushings.* Install a new bushing when the clearance between the bushing and the new piston pin exceeds 0.005 inch. After pressing the new bushing into place, machine it accurately from 0.005 to 0.001 inch larger than the new piston pin diameter.

(h) *Cylinder liners.*

1. *General.* A cylinder liner may be removed from the engine lock with the crank shaft installed with the cylinder head piston and connecting rod removed. Replacement of the liners is necessary only when they are worn at the top of the ring travel in excess of 0.020 inch, or when they are scratched or scored.

2. *Removing cylinder liners.* Before attempting to remove the cylinder liner, protect the crankshaft bearings with clean cloths to prevent water jacket sediment from entering the oil passages and bearings. Figure 157 illustrates the necessary tools and the method of removing the liner.

3. *Replacing cylinder liners.* Each liner installed should have a new copper gasket at the top, between the flange underliner and the cylinder block, and new rubber seals in the grooves at the bottom of the liner to prevent water leaks.

Note. Be sure to remove the old copper gasket before installing the new one.

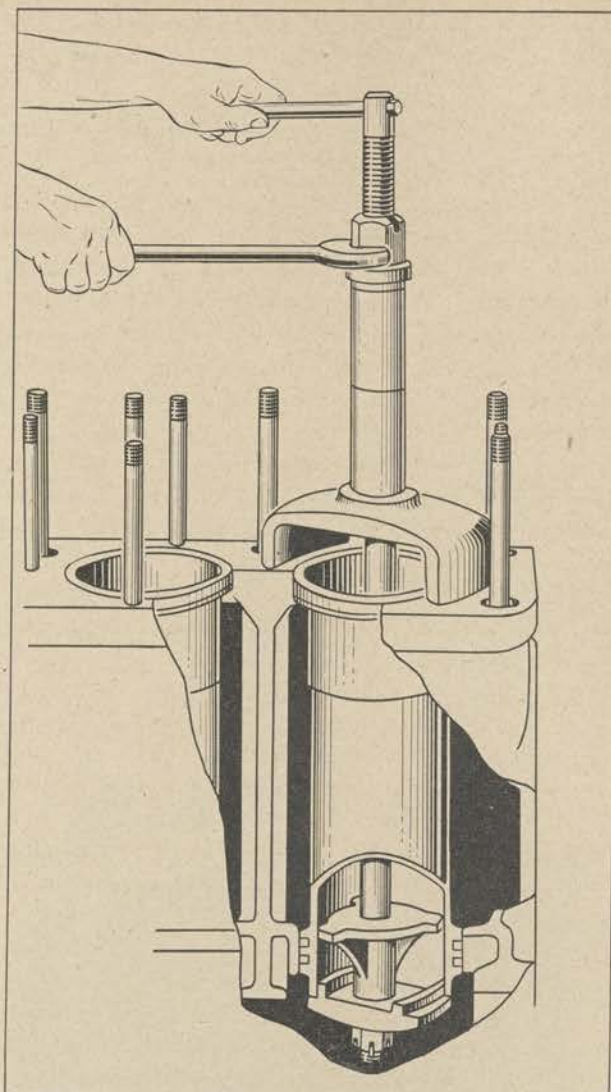


Figure 157. Cylinder liner removal.

Thoroughly clean the upper and lower sealing surface of the block to be sure the chamfer around the top of the lower bore is smooth, to prevent cutting the rubber seals when the liner is installed. Before installing it, place the rubber seals in the grooves on the liner, and coat with a mixture of soap and water. Lower the liner carefully into the cylinder block, using the cylinder liner removal tool, shown in figure 157. With the liner properly installed, it should extend slightly above the top face of the cylinder block. This insures proper holding and sealing of

the liner against the cylinder head gasket when the head is drawn down.

Note. Liners may be slightly loose in the bore at the bottom, yet serve satisfactorily without water or antifreeze leaking past the rubber seals.

(i) *Replacing piston and connecting rod.* Assemble the piston and connecting rod. The connecting rod and its bearing cap are not interchangeable. Before installing the piston, cover the walls of the cylinder liner with a light coat of lubricating oil. Place a piston ring compressor over the cylinder into which the piston is to be inserted. Place a piston extracting tool on the top of the piston and lower the piston and connecting rod assembly into the cylinder until the bottom ring rests on the compressor below. Remove the piston extracting tool assembly and press the piston into the cylinder. The piston rings will be compressed as the piston is pushed through the compressor tool.

Note. As the piston is lowered into place, rotate it so that at the V mark at the top of the piston lines up with the V at the top of the cylinder block. This will place the crater of the piston directly under the opening in the precombustion chamber.

Use a torque wrench to tighten the connecting rod bearing bolts. Exert a torque of 1,500 inch-pounds. It is permissible to exceed this value by the amount required to turn the nut of the next lot for alinement with the cotton-pin hole.

(j) *Running in schedule.* Whenever new rings, piston assemblies, or liners are installed, be sure to run in the engine at least six hours before operating on normal load. Avoid loading the engine excessively at any time during the running in period. Adhere to the following schedules:

Period 1: 1 hour.

Operate the engine idle with the throttle half-way between the slow speed idle and full speed idle position.

Period 2: 1½ hours.

Operate the engine in work approximating one-quarter maximum load.

Period 3: 1½ hours.

Operate the engine in work approximating one-half maximum load.

Period 4: 2 hours.

Operate the engine in work approximating three-quarters maximum load.

(11) *Oil pan.* (a) It is necessary to remove the oil pan (23 and 24, fig. 139) before doing any

work on the main bearings. Work on the oil pan can be facilitated by removing the deck plates at the side of the engine.

(b) *Removal.*

1. Fasten ropes to the main frame so that they pass under the front section of oil pan.
2. Remove the capscrews that connect the front section of the oil pan to the rear section, and the bolts and capscrews holding the front section to the cylinder block. Lower the front section of the pan between the engine mounting rails.
3. Remove the capscrews holding the rear section of the oil pan to the cylinder block and to the flywheel bell housing.
4. Lower the rear section, at the same time swinging the left side up toward the main frame, until the rear suction bell has been cleared. Then swing the high side forward so that the entire rear pan section will pass around the main pump suction bell for removal.

(c) *Installing.* When installing the pan, two ⅜-inch n. c. studs 2 inches long, installed at the front end of the cylinder block, will assist in holding the pan gasket in place and will act as guides for alining the holes properly.

(12) *Main bearings.* (a) *General.* The main bearings are of the precision type babbitt line shells. Upper and lower shells are held in alinement by dowel pins in the lower shell, that protrude into the upper shell. Bearing caps and the upper bearing supports that hold the upper shells are numbered consecutively from the front of the engine on the left side.

(b) *Inspection and replacement.* Bearings may be removed, inspected, and replaced without removing the engine or removing the crankshaft from the engine. Precision main bearings are obtainable in complete sets, and should be installed without fitting. Single replacement bearings of this type are also available and are installed without fitting. If a single bearing is installed, take care that the other bearings are not worn to the extent that a large part of the normal load will be carried on the new bearing. Main bearing clearance in the new engine is 0.004 to 0.006 inch. If a clearance approaches 0.014 inch, bearings or

crankshaft (depending upon which part is worn), must be replaced.

(c) *Removing main bearings.*

1. To make the mainbearings accessible, remove the oil pan, the auxiliary pump suction bell (fig. 190), and the lubricating oil pump (fig. 189).
2. The rear main bearing cap (fig. 158) comes drilled and tapped for pulling with bearing puller tool, as shown in figure 159.

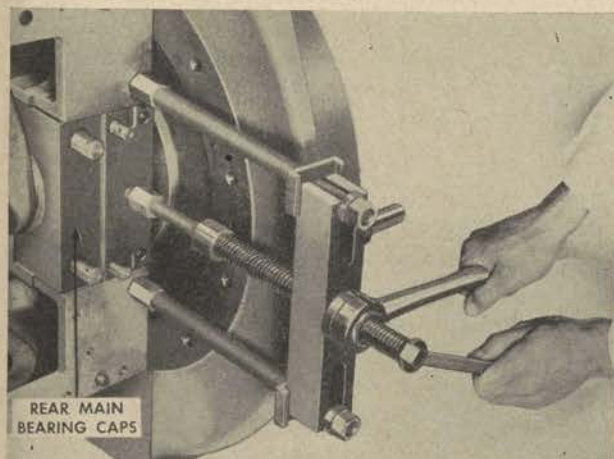


Figure 158. Removing rear main bearing cap. (engine on side).

3. Remove the hollow head screws in the rear main bearing with a wrench.
4. The remaining caps have recesses (fig. 159), which permit their removal by means of either a pry-bar or a bearing cap pulling tool fitted with an adapter.

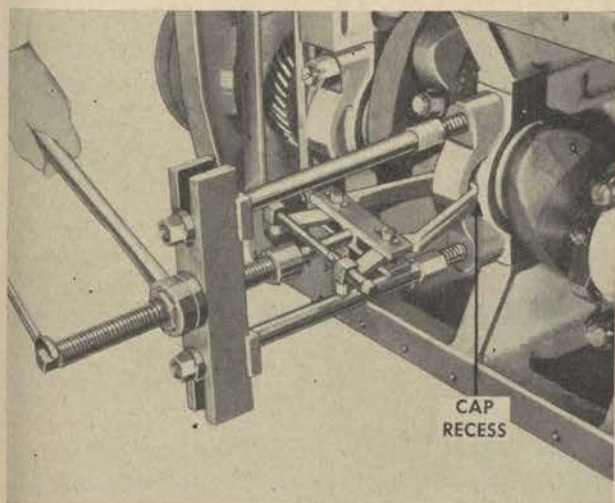


Figure 159. Pulling bearing caps with tool and adapter (engine on side).

5. The upper main bearing shells, where the crankshaft journals are drilled, can be rotated out of position by using a small capscrew (fig. 160) in the oil hole, and turning the crankshaft. If a bearing shell is tight, place a short piece of key stock between the edge of the shell and the capscrew to prevent damaging the shell.
6. On bearings where the crankshaft journal is not drilled, rotate the shell out of place by driving against the edge of the shell with a small curved rod.

(d) *Replacing bearing shells.*

1. Before installing new bearing shells, clean out the drilled oil passages in the crankshaft and block with a rifle barrel brush. Blocked oil passages prevent adequate lubrication to the new bearings installed. Make sure crank pin and bearing shell replaced are well lubricated with engine oil before starting the engine for the first time.

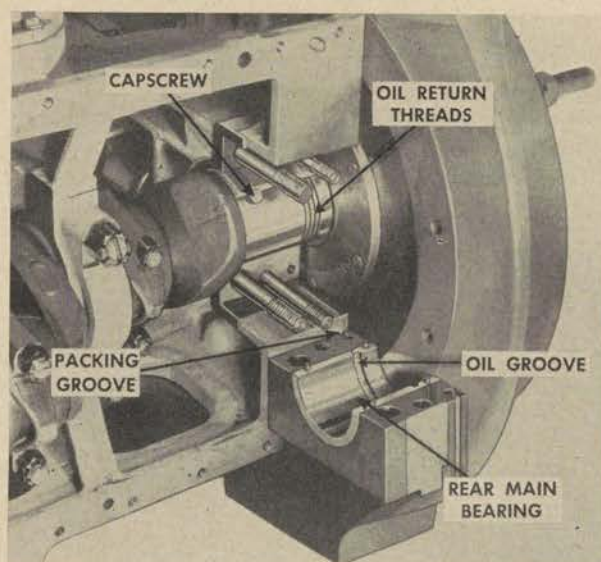


Figure 160. Installing upper bearing shell (engine on side).

2. The flywheel end of the rear main bearing is bored .005-inch larger in diameter (fig. 160) and consequently the crank shaft should not touch this part of the bearing. This counterbore provides for oil control by permitting the oil return threads on the crank shaft to pump oil back to the oil groove,

from which a passage in the bearing and cap returns oil to the crankcase.

(e) Tighten main bearing cap stud nuts. Tighten the nuts on the bearing caps with a torque wrench. Tighten nuts on the $\frac{7}{8}$ -inch studs to 1,500 inch-pounds and the nuts on the $\frac{5}{8}$ -inch studs to 700 inch-pounds.

(f) Sealing rear main bearing.

1. After installing the rear main bearing, and tightening the hollow head screws and nuts, seal the rear end of the bearing with packing, as shown in figure 161.
2. First, soak the packing in pitch or paint, and then fit it into the grooves (fig. 161) on each side of the cap, tamping it tightly with a hammer and a long thin punch in progressive folds until the groove is filled.

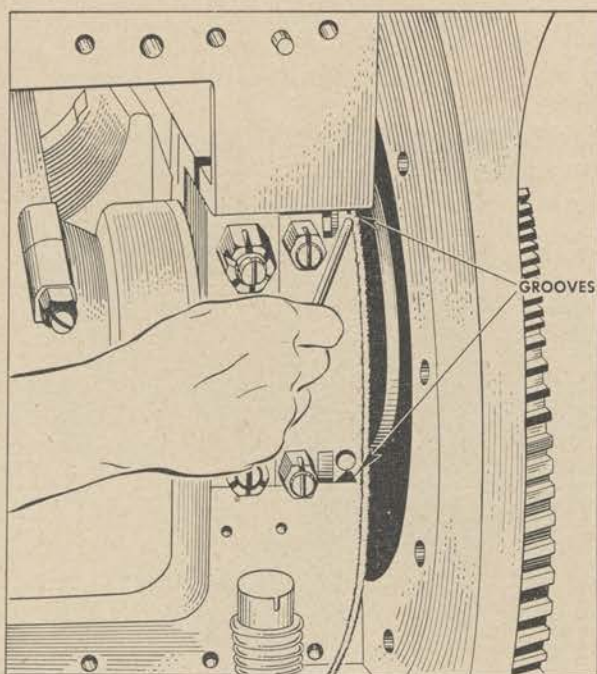


Figure 161. Rear bearing packing seal.

d. FUEL SYSTEM. (1) General. Expect maximum efficiency of the fuel system only when using clean fuel. Dirty fuel caused by careless handling or improper storage facilities will cause wear to the fuel transfer pump and fuel injection equipment, and eventually result in improper operation of the Diesel engines. It is important to clean out the fuel tank, storage and day, and fuel lines,

whenever installing new fuel injection equipment. This prevents dirt and sediment accumulations from finding their way into the newly installed equipment.

(2) Care of fuel supply. Fill the engine day fuel tank at the end of each day; the incoming fuel will drive out the moisture laden air in the tank and prevent condensation. Every two weeks, prior to starting the engine, open the drain-cock and drain off any sediment or water which may have accumulated. Clean the fuel filter regularly, as described in d(12) below.

(3) Fuel oil storage and day tank system (fig. 292). The fuel oil storage and day tank system consists of the assemblies listed below.

(a) Fuel oil storage. The fuel oil storage is composed of fuel oil tanks, fill and vent pipe complete with fill cap, flame arrestor elbow, and vent. Fuel is supplied to the inlet of the fill and vent pipe located aft of the deck house on the port side, where it flows into the fuel oil storage tank located below deck.

(b) Fuel oil suction line. The fuel oil suction line is made up of hand pump, bell mouth screen, and foot valve and gate valve. Fuel oil is pumped from the storage tank through the bell-mounted screen and foot valve by means of a manually operated hand pump. Fuel oil is pumped through the open gate valve to the hand pump.

(c) Fuel oil discharge line. The fuel oil passes through the hand pump where it is lifted to the day tank (See 8, fig. 292.)

(d) Feed and return line. Two gate valves, one used for fuel oil feed and the other for fuel oil return, and a check valve comprise this system. Fuel oil flows from the day tank through check valve and open gate valve through the action of fuel oil transfer pump located on the engine. When the fuel day tank is drained the flow is by gravity through the open gate valve back to the storage tank.

(e) Fuel oil overflow and vent line. The day tank is provided with an overflow connection at the top which also acts as a vent by means of the pipe line from the top of the day tank extending to the storage tank. The vent is located in an elbow provided with a flame arrestor. This elbow is part of the fill pipe.

(f) Pumping fuel oil. To pump fuel oil from the storage tank in vessel No. 6 to the day tank (11, fig. 292), close valves in hand pump bypass

line, open valves in hand pump suction and discharge line, and operate hand pump. (See 8, fig. 292.)

(g) *Draining day tank.* To drain fuel oil from the day tank (11, fig. 292) back into the storage tank, open the valves in hand pump bypass line, and open tank drain valve.

(h) *Check valve.* The check valve incorporated in the supply line from the storage tank to the day tank prevents feed back. In addition a gate valve can be shut off to close the fuel supply to the Diesel engine.

(i) *Fuel oil tap.* In order to obtain fuel for the operation of the auxiliary Diesel generator set, and to fill the tanks for the oil stove in the gallery and crew quarters, a stop cock is provided and located at the bottom of the day tank, as shown in figure 163.

(4) *Day tank to injection valve fuel system.* (a) After the fuel leaves the day tank, mounted on the flywheel end of the engine, it flows by gravity to the transfer pump, which delivers it to the lower chamber of the fuel filter housing, as shown in figure 164.

(b) The pressure regulating valve on the transfer pump maintains a pressure of approximately 15 pounds on the fuel in the lower chamber of the pump. This pressure forces the fuel through the fuel filter elements and then into the upper chamber.

(c) A vertical passage on the side of the housing carries the fuel from the upper chamber down to the horizontal manifold in the fuel injection pump housing. From this manifold, the fuel is delivered by separate passages to the individual fuel injection pumps.

(d) A fuel pressure gage is connected and registers pressure on the fuel delivered to the injection pumps. The gage also serves to indicate the condition of the fuel filter elements and the transfer pump.

(e) On the injection side of the system, the fuel injection pumps deliver the fuel to the injection valves. The injection valve controls the injection pressure and atomizes the fuel delivered to the cylinders. The overflow from the injection valves is carried by the overflow lines to the suction side of the transfer pump.

(5) *Checking fuel system.* (a) Many times the fuel system is blamed when the fault lies elsewhere. For example, a smoky exhaust may be caused by

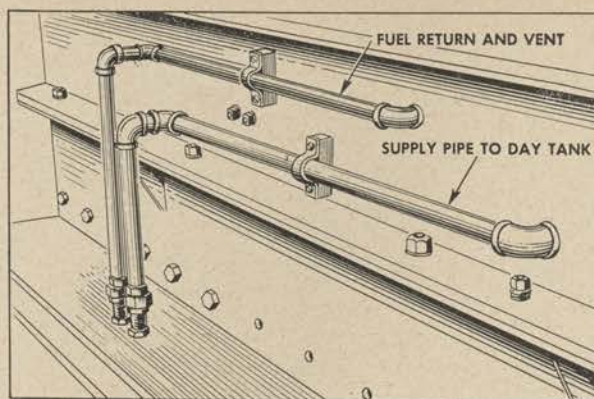


Figure 162. Fuel discharge and return lines.

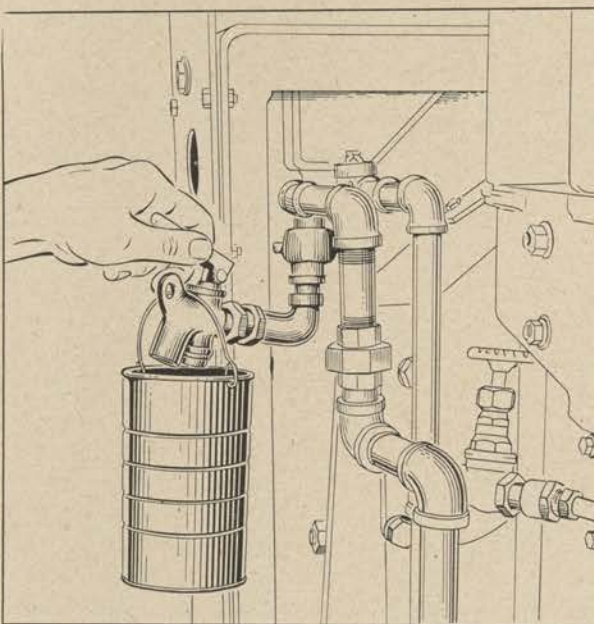


Figure 163. Draining fuel oil for auxiliary Diesel Engine.

faulty fuel injection valves, but it can also be caused by a dirty air cleaner or badly worn piston rings. Irregular firing can be caused by faulty fuel injection valves; it can also be caused by the burning of excessive lubricating oil which gets past worn piston rings or rings not yet broken in.

(b) Lack of pressure on the fuel oil gage is an indication of trouble in the supply side of the fuel system. This could be caused by: empty fuel tank, closed shut-off valve at the tank, clogged filters, open bleed valves, or faulty transfer pump. If clogged filters are responsible for the lack of pressure, there should still be pressure in the lower chamber of the fuel filter housing. Check this by opening the lower chamber bleed valve. Air or water in the fuel system is largely responsible for

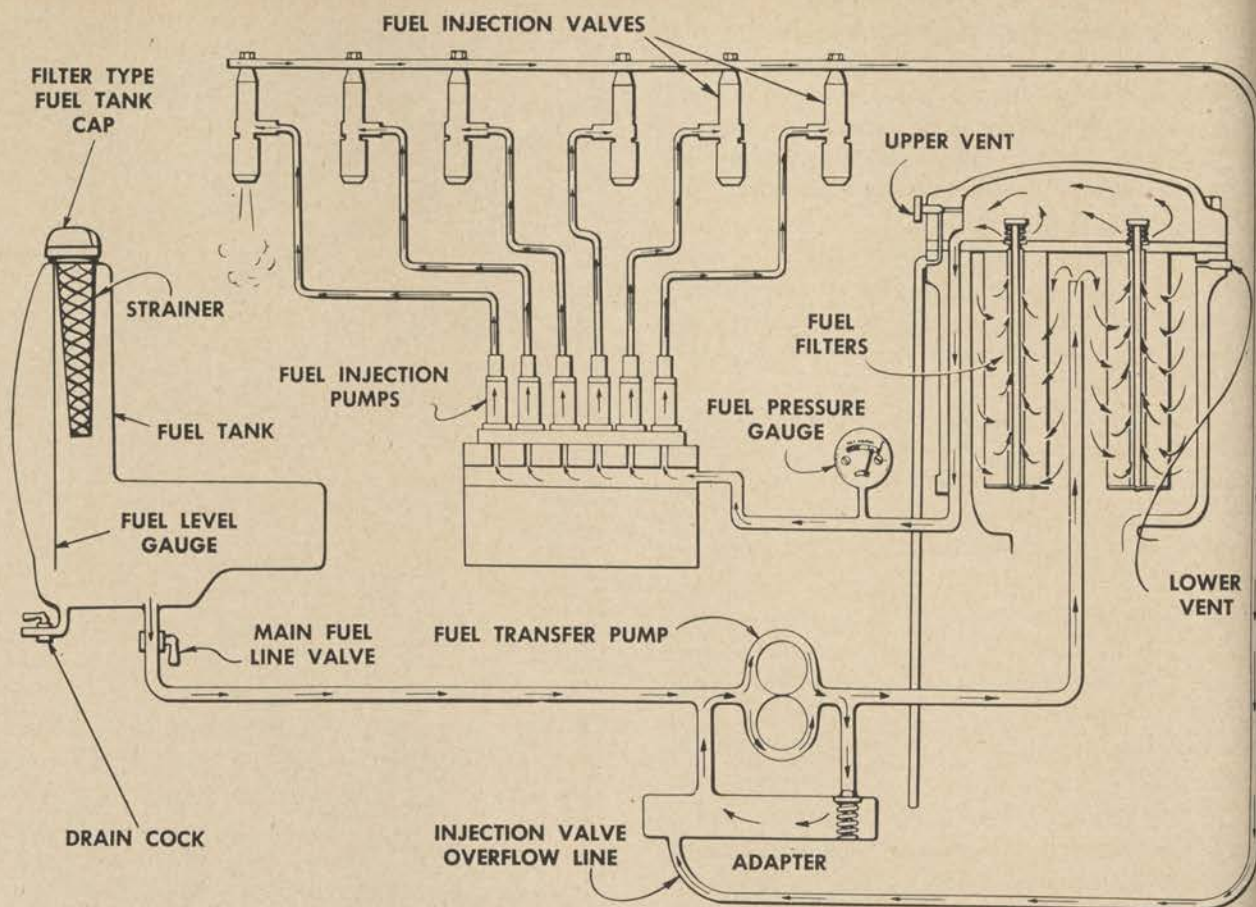


Figure 164. Day tank to injection valve fuel system.

the engine firing irregularly or failing to start. After checking the items in (5) above, and trouble in the fuel is still evident, check the injection side of the system; that is, the fuel injection pump ((8) below) and fuel injection valves ((7)(c) below).

(6) *Fuel transfer pump. (a) Description.* The fuel transfer pump, of a self-priming type, is located under the rear of the accessory shaft. The adapter (fig. 166), mounted on the side of the transfer pump, contains a plunger and spring which regulate the fuel pressure to the fuel filters and fuel injection pumps. The plunger opens when the fuel injection pumps do not use all the fuel delivered, or when the fuel filters become clogged. The spring loaded plunger allows excess fuel to be bypassed within the pump and adapter, thus preventing excessive pressure that might cause damage to the fuel filter housing or fuel filter pressure gage mechanism.

(b) *Disassembly and replacement.* The transfer pump and adapter may be removed as a unit,

or either the adapter or the cover, body and one gear, may be removed without taking out the entire unit. Figure 167 illustrates the fuel transfer pump completely disassembled in its proper order. The plunger may fail to function properly if dirt gets in between seat and plunger. This may cause the fuel filter pressure gage needle to show low fuel pressure, or a wide variation between low idle and high idle speed. After cleaning the contact surfaces, check to see that the seat is smooth and flat, and that the sealing surface of the plunger is in good condition. If the plunger is functioning properly, the gage needle should vary only slightly. Wear in the pump gear may be caused by dirty fuel. A worn pump may be made serviceable by installing new gears, providing the cover and bracket are not worn.

Note. Before reinstalling a pump in the engine rotate the pump shaft to see that it turns freely.

(c) *Shaft seals and seat.* Fuel transfer pump shaft seals keep the fuel and lubrication from leaking along the shaft. Should fuel leak past the

seals, dismantle the pump and replace the seals. Remove the seat assembly and replace the seals, after pulling the gear from the end of the shaft. The spring between the two seal assemblies make them self-adjusting.

(7) *Checking fuel injection equipment.* (a) *General.* Black smoke from the exhaust means insufficient engine output, indicating that fuel is passing through the engine without being burned. This may be due either to overloading the engine or faulty fuel injection equipment. Continued operations under these conditions may cause abnormal wear to working parts of the engine. Never permit the engine to continue with improperly functioning fuel injection equipment. As the clearance between the plunger and the barrel of the fuel injection pump increases due to wear, fuel leakage occurs. If the leakage increases to the point where insufficient fuel is injected into the cylinder, a loss of power will be noticeable. In addition, difficult starting may be encountered, when improper fuel injection is affecting Diesel engine operation, make a systematic check to determine the cause. The most likely cause is dirt

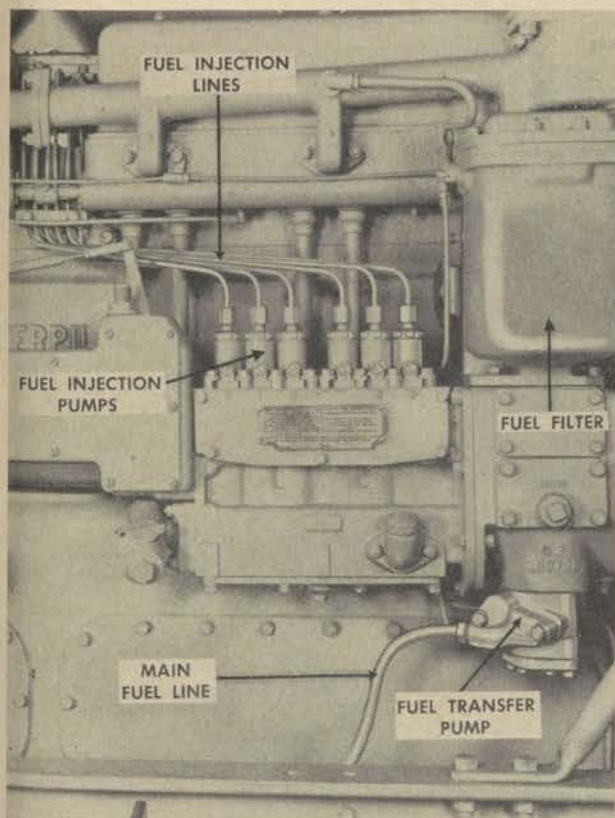


Figure 165. Fuel system.

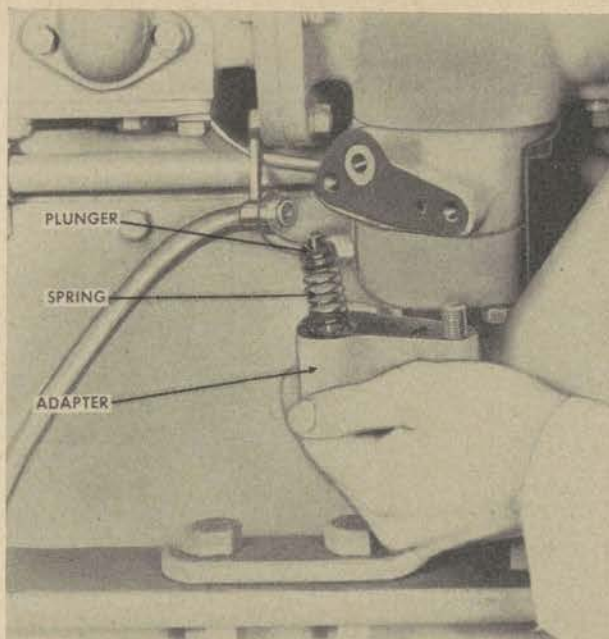


Figure 166. Fuel transfer pump adapter.

or water in the fuel. Strain the sediment from the fuel tank and service the fuel filters as described in *d* (12) below. Prime the fuel system until clean fuel passes through the vent valves on the fuel injection pump. If the fuel system is air-bound, priming the system will overcome the difficulty.

(b) *Primary check on fuel injection pump and valve.* When the engine runs irregularly, and smokes, it may be that the fuel injection valve is not spraying the fuel properly, allowing some of it to pass into the exhaust manifold without being completely burned. Before removing the fuel injection valve or pump from the engine that is operating irregularly, make a simple check to determine which cylinder is not firing properly. With the engine running at a speed that makes the firing irregularity most pronounced, and momentarily loosening the fuel line nut just above the fuel injection pump a sufficient amount to cut out the cylinder, check each cylinder in the same manner. If one is found where loosening makes no difference in operation of the engine, it is probable that the valve and pump for that cylinder need only to be tested.

(c) *Removing and checking fuel injection valve.*

1. Before removing a fuel injection valve, clean all the dust and dirt from the valve and adjacent areas, then disconnect the fuel injection line, and fuel drain line, and remove the hold-down

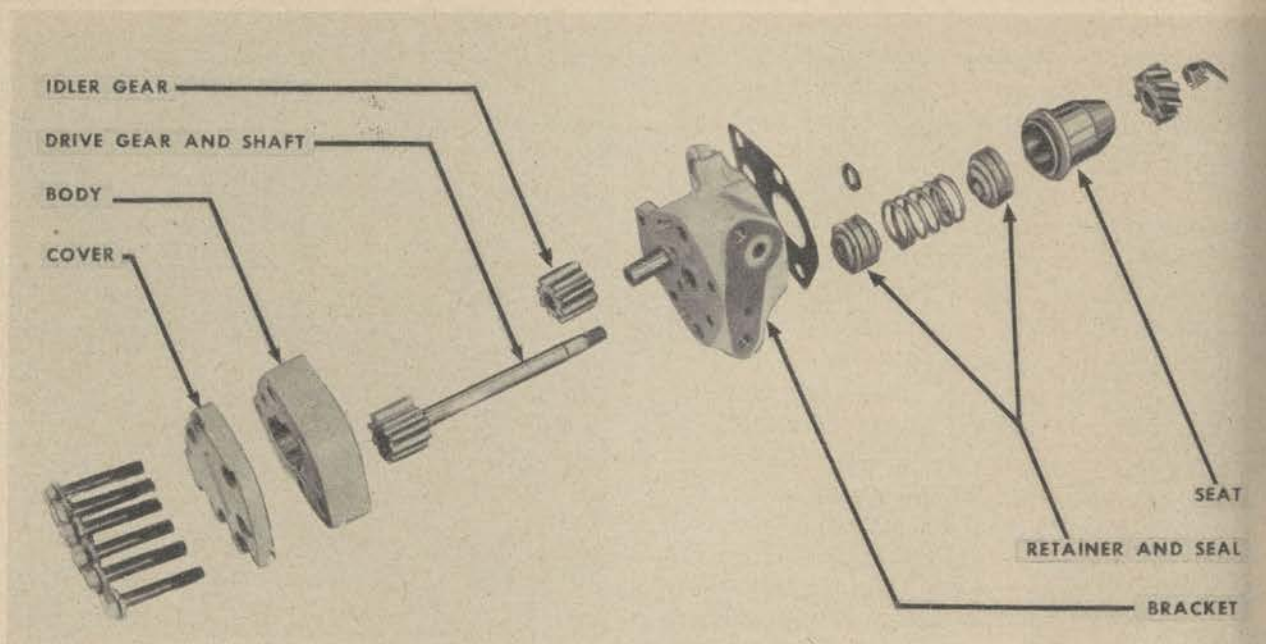


Figure 167. Fuel transfer pump disassembly.

nuts and flange that keep the valve in place. Withdraw the valve inserted in the precombustion chamber from which it was removed, and reconnect the fuel line. (See fig. 169.)

Note. Before checking the fuel injection valve, plug the overflow line to prevent air instead of fuel from being drawn into the pump.

2. Before testing the valve, loosen the fuel line nut above each pump and inspect the line that supplies the valve being tested. This will prevent fuel being injected into the cylinders.

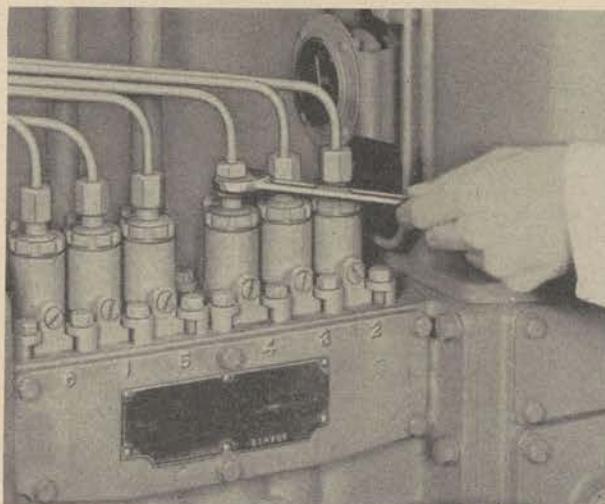


Figure 168. Loosening fuel line nut.

3. Start the starting engine, and with the Diesel engine compression release lever in the START position, engage the starter pinion and clutch. If the starting engine is operated slightly above

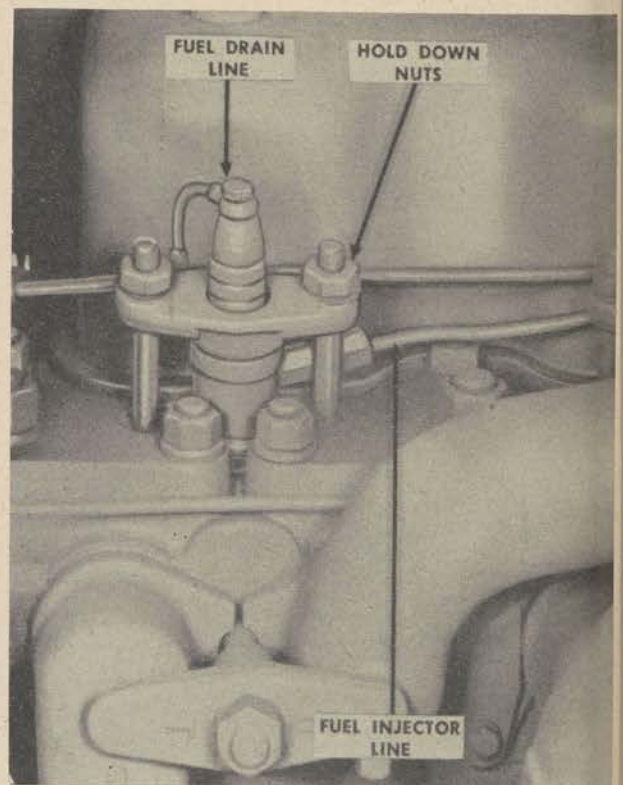


Figure 169. Removing fuel injection valve.

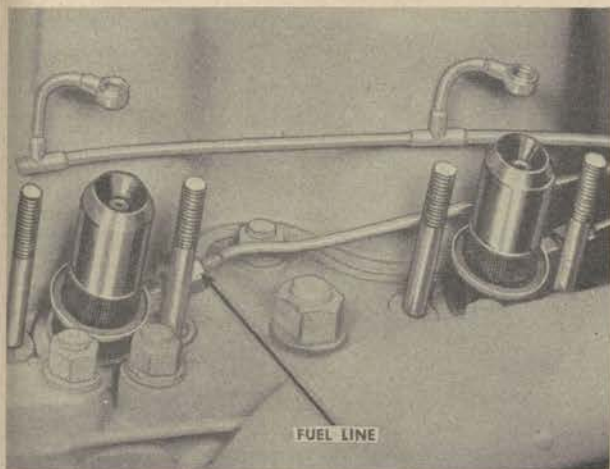


Figure 170. Injection valve inverted for testing.

its low idle speed, the Diesel engine will be turned sufficiently fast to insure an accurate check on the spray characteristics of the injection valve.

4. With the starting engine cranking the Diesel engine, open the Diesel engine throttle wide and observe the fuel spray emitted from the fuel injection valve. If the fuel injection valve emits a fine, even spray in the form of a mist, the injection valve is in good condition.
5. If the spray characteristics of the fuel injection valve are not satisfactory, remove any accumulated carbon from the nozzle end with a blunt piece of wood, and clean the fuel discharge hole with a cleaning tool.
6. The fuel discharge hole in the nozzle end will not clog completely with carbon accumulations but may, under some conditions, collect a small amount of carbon on the inner diameter of the fuel discharge opening. If slightly more carbon forms on one side of the opening than on the other, the resultant spray will be unsymmetrical. Cleaning of the fuel discharge opening in the nozzle end of the fuel injection valve should make the valve operate normally. However, replace the valve if, after cleaning, the spray characteristics are a fuel discharge in a solid stream or jet, or a fuel spray emitted on one side of the nozzle.

Note. Do not reject the injection valve unless it fails to spray properly when the starting engine is operated at full governed speed.

Remember that the quality of the spray is determined by the condition of the fuel injection valve, while the quantity of the spray is determined by the condition of the fuel injection pump.

7. When installing fuel injection valves, draw down the hold-down nuts evenly, and only tight enough to prevent leaks between the valve and valve seat. Excessive tightening will cause distortion of the injection valve. Make sure to obtain a good seal between the fuel return line and the top of each valve.

(8) Fuel injection pumps. (a) Description.

1. Each pump matches the amount of fuel to be injected into the cylinder it serves, and produces the pressure for injection. The injection pump plunger is lifted by a cam, and always makes a full stroke. The amount of fuel pumped during any one stroke is varied by turning the plunger in the barrel. The plunger is turned by the governor action, through a rack which

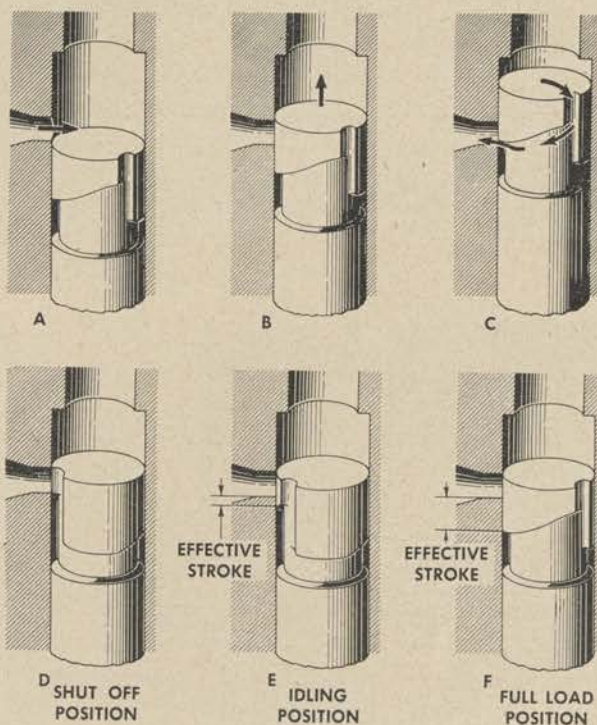


Figure 171. Operation of fuel injection pump.

meshes with a gear segment at the bottom of the pump plunger.

2. Inserts A, B, and C of figure 171 illustrate the functioning of an injection pump as the plunger makes a stroke. Inserts D, E, and F of figure 171 illustrate how rotating the pump plunger affects the quantity of fuel injected.
3. In A, the plunger is down and the inlet port is uncovered. Fuel flows into the space above the plunger through the slot and into the recesses around the plunger.
4. In B, the plunger has started up and the port is covered. The fuel is trapped and will be forced through the check valve, fuel line, and injection valve as the plunger moves upward.
5. In C, the plunger is moved "up" until the port is uncovered by the recesses in the plunger.
6. As fuel can now escape back through the port into the fuel manifold, and injection ceases, note that the recesses in the pump plunger form a helix around the upper end of the plunger.
7. In D, the plunger has been rotated into the SHUT-OFF position. The slot connecting the top of the plunger with the recesses is in line with the port; no fuel can be trapped and injected.
8. In E, the plunger has been rotated into idling position. The narrow part of the plunger formed by the helix covers the port for only a short part of the stroke. This permits only a small amount of fuel to be injected in each stroke.
9. In F, the plunger has been rotated into the full load speed position. The wide part of the plunger formed by the helix covers the port for a longer part of the stroke. This permits a larger amount of fuel to be injected for each stroke.

(b) Effect of worn fuel injection pumps.

Worn fuel injection pumps will result in loss of power and hard starting. These same conditions may be present if the piston rings and cylinder liners are badly worn. However, in the case of worn piston rings and liners, hard starting and

loss of power will be accompanied by poor compression, smoky exhaust, and excessive blow-by gases from the crankcase breathers. Normally, if one fuel injection pump on engine is found defective, all of the injection pumps are worn and should be replaced.

(c) Fuel injection pump removal.

1. The end pumps, numbers 1, 3, 4, or 6 of each set of three pumps, may be removed without disturbing the other pumps, but neither of the center pumps, 2 or 5, should be removed until an end pump adjacent to it has been taken out. This procedure eliminates the necessity of removing the plungers from the two center pumps.

Note. Owing to the small clearance between the plunger and the barrel of each individual pump, do not change the plunger from one pump to another. To do so would affect the efficiency of the pump and cause unsatisfactory engine operation.

2. Take every precaution to prevent dirt from entering the fuel injection pumps or housing. Brush clean the top of the housing and around the inspection plate, before removing them. Disconnect the fuel injection lines from the pump and immediately cap the openings.
3. Remove the inspection plate. Two racks are provided, each of which meshes with three pump gears. Remove the coupling that fastens the slide bar through the rack of the pump to be removed. Remove the capscrews and retaining plates that hold the rack in place, and pull the rack out of the housing.
4. Remove the capscrews and clamps that hold the fuel injection pump to the housing, and lift the pump straight up sufficiently to clear the dowel pins. Reach through the inspection opening to prevent the plunger from dropping out of the pump barrel. Shift the pump to free the end of the pump plunger from the slot in the lifter, and remove the pump and plunger assembly from the housing.
5. Cap the fuel outlet (fig. 172) on top of the fuel pump housing to keep out dirt.

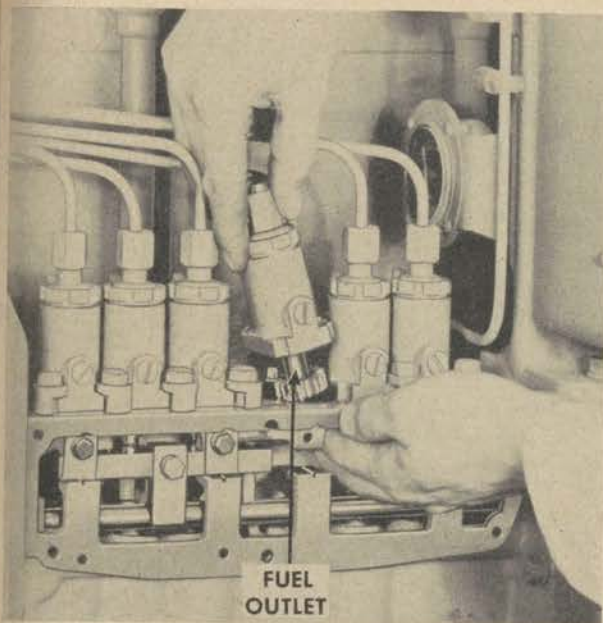


Figure 172. Removing fuel injection pump.

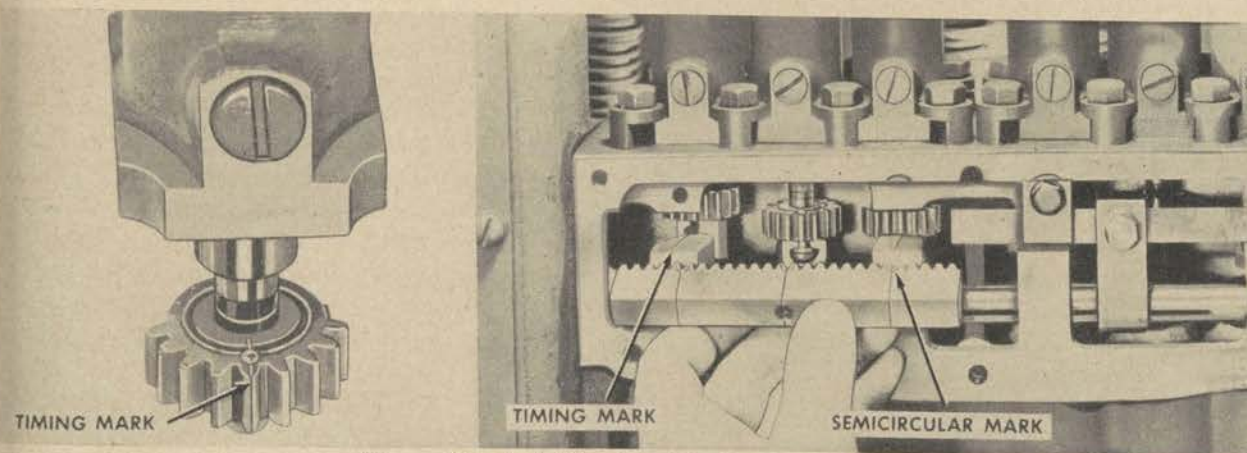


Figure 173. Installing fuel injection pump rack.

(d) *Fuel injection pump installation.*

1. Remove the plug from the fuel outlet on top of the housing, and lower the pump assembly into the housing, taking care that the pump plunger does not drop out of the pump barrel. If the pump plunger does accidentally fall out, wash it thoroughly with clean fuel oil and replace it in the pump barrel.
2. Slide the end of the plunger into the slot in the lifter and lower the pump body onto the dowel pins, then secure the pump in place. Check to see that

the pump plunger is free by rotating the gear segment at the end of the fuel injection pump plunger.

3. Rotate the gears on the pump plungers until the marked teeth (fig. 173) on each gear face outward. Aline the end pumps with the marks on the rack supports of the fuel pump housing.
4. The top of the rack is indicated by the semicircular marks. As the rack is slipped into place, the marked teeth must be made to engage the marked teeth on the pump plunger gears.
5. Install the rack retaining plates (fig. 174) and capscrews. After installing the plates, be sure the rack is absolutely free in the pump housing.
6. Pull back the throttle lever and install the coupling between the rack and the fuel pump slide bar. (See fig. 174.)

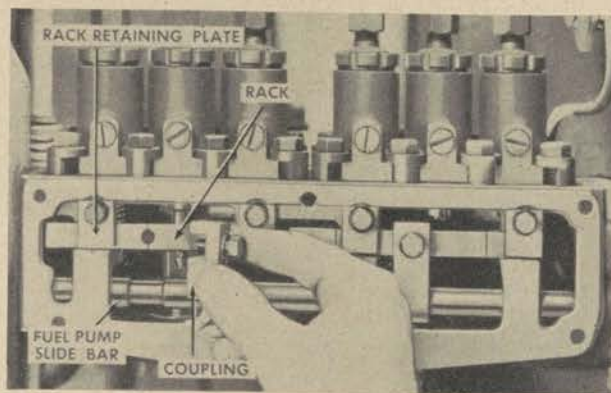


Figure 174. Installing rack and slide bar coupling.

7. Install the cover on the side of the fuel injection pump housing and connect the fuel injection lines.
8. Prime the fuel system to expel the air before attempting to start the Diesel engine (d (13) below).

(9) *Fuel injection pump lifter springs.* (a) *General.* In the event the lifter spring is broken, replace it after removing the fuel injection pump housing from the engine.

(b) *Removal of injection pump housing* (fig. 175).

1. Drain the oil from the fuel injection pump housing. Disconnect the fuel injection lines from the injection pumps and immediately cap the openings.
2. Remove the covers from the governor spring housing and from the rectangular inspection opening just below the fuel filter housing. Disconnect the fuel injection pump slide bar from the governor yoke (fig. 175) by removing the pin and cotter pin. If the head of the pin is facing "in" toward side of the engine, its removal will be restricted. If this condition is present, loosen the lock nut on the yoke and disconnect the other end of the slide bar from the link. This permits the slide bar to be rotated so that the yoke is turned one-fourth revolution to face the head of the pin up for removal.

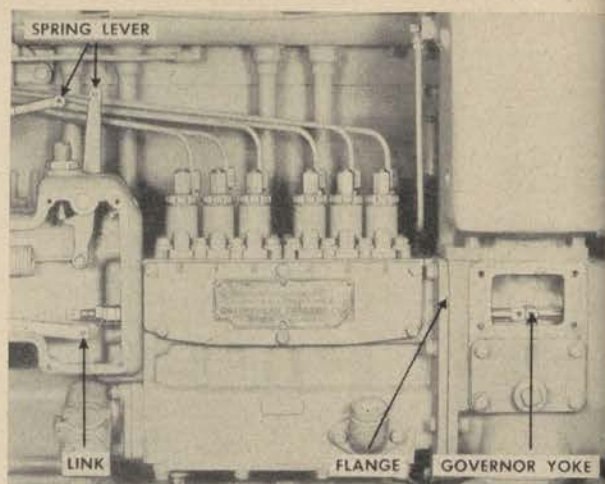


Figure 175. Fuel injection pump housing.

3. Turn the yoke back to its original position and tighten the lock nut. Uncouple the throttle yoke and governor spring lever. After removing the nuts and capscrews around the flange that hold it to the accessory shaft housing, take off the fuel injection pump housing.

(c) *Disassembly and spring replacement.*

1. Remove the fuel injection pumps as described in (8) (c) above and take the hour meter from the injection pump housing.
2. To remove the slide bar (fig. 176), take off the governor spring housing and remove the pin in the slide bar collar

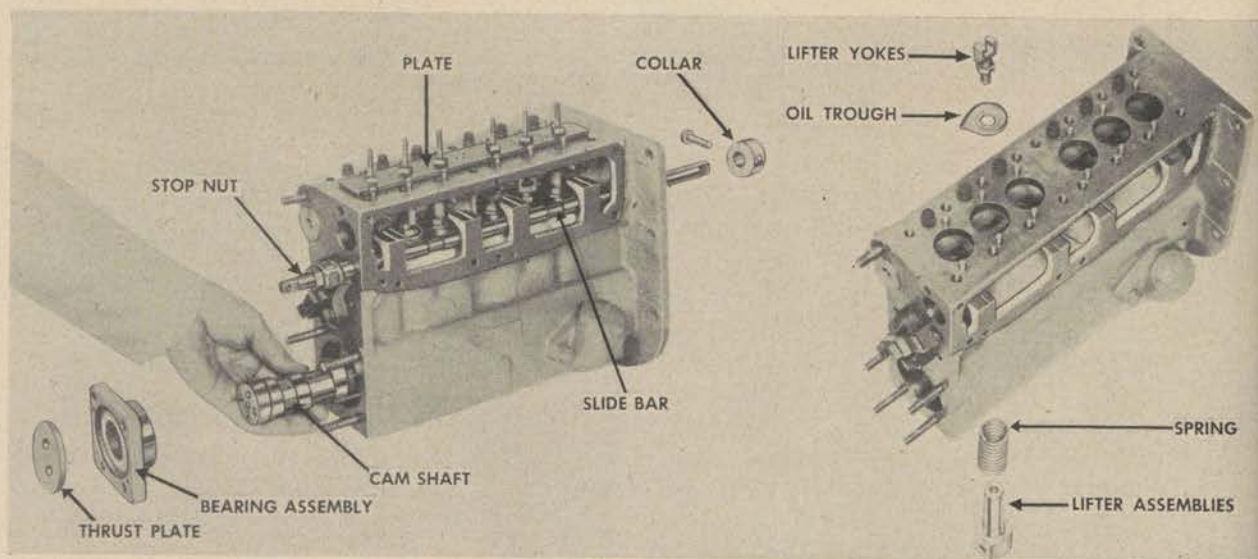


Figure 176. Removing fuel injection pump camshaft and lifter assembly.

at the front end of the fuel injection pump housing, so as not to disturb stop nut at the rear end.

3. With the plate constructed as shown in figure 176, hold up the lifter assemblies, with carriage bolts; insert the bolt heads in the filter yokes and tighten the nuts on the bolts against the plates.

Note. If the plate is not used, the lifter assemblies can be wired in position.

4. Remove the thrust plate and bearing assembly from the rear of the fuel injection pump housing, then remove the fuel injection pump cam shaft.
5. Release the lifter with the broken spring. Remove the lock nut, yoke, and oil trough from the top of the housing.
6. Lower the spring and lifter assembly out of the bottom of the housing. Then install the lifter spring and reassemble the unit.

Note. Inspect gaskets in the housing assembly before replacing, to insure that they are not damaged. Replace if needed.

(10) Fuel injection pump lifter adjustment.

(a) *General.* Adjustment of the fuel lifter is required only if the pump lifter assembly is taken apart as in the replacement of a lifter spring. On machines that have seen considerable service, it may be advisable to check the adjustment to correct for wear that may have occurred in the pump lifter assembly.

(b) *Adjustment.*

1. Place the compression release lever in the START position and turn the diesel engine crankshaft with the hand crankshaft until the lifter to be checked begins to rise.
2. Continue to rotate the crankshaft until the top center timing mark on the flywheel, corresponding to the cylinder number of the lifter to be checked, coincides with the pointer at the top of the flywheel bell housing. (See fig. 177.)
3. Remove the hour meter and install the pointer spindle (fig. 176) at the end of the fuel cam-shaft over the thrust washer, by removing the thrust washer capscrews and lock, and using the longer capscrews supplied with the in-

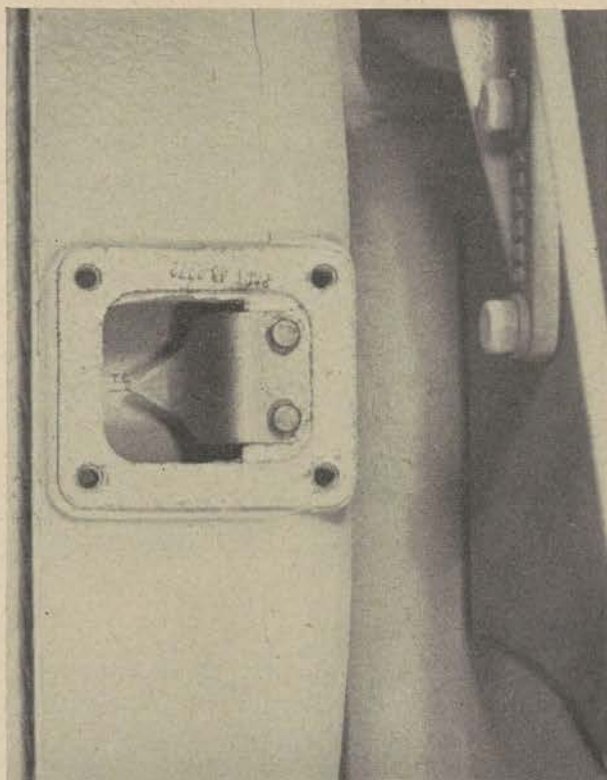


Figure 177. Timing mark.

dicator. Then install the indicator plate over the four studs, at the rear end of the fuel injection pump housing, with the spacers between the plate and the housing.

4. Place lifter screw wrench over the lifter screw and replace the fuel pump with the lifter gage.
5. Set the pointer of the indicator to 0° on the indicator plate.
6. Turn the crankshaft back approximately 60° and then forward until the pointer returns to the 17½° marked on the indicator.
7. Place a straightedge across the top of the gage. If the fuel pump is correctly adjusted, the top of the stem should be flush with the top of the gage.
8. If the variation is greater than 0.002 inch, loosen the lock nut wrench and reset the fuel pump lifter adjustment. Recheck the lifter setting, after making adjustment and tightening the lock nut, to insure that the setting has not been changed.

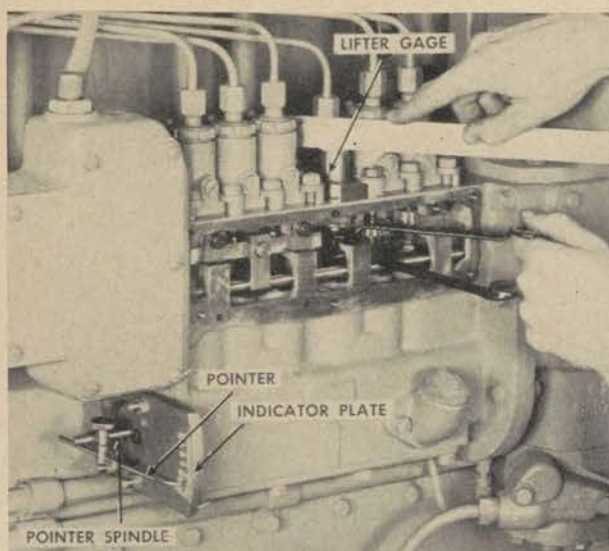


Figure 178. Setting lifter adjustment.

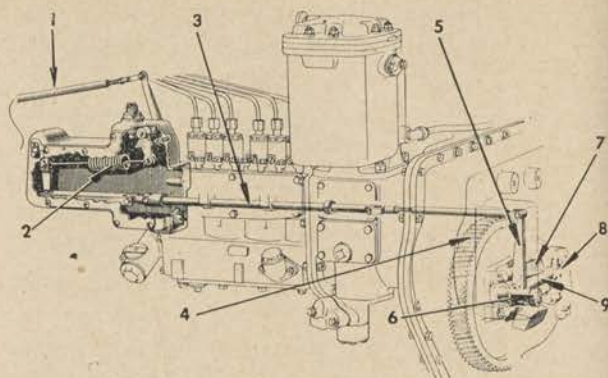
9. Before turning the crankshaft to the proper position for checking the next lifter, remove the gage and loosen the pointer clamp.

10. Checking each lifter will insure proper fuel injection timing.

(11) *Governor.* (a) *Description.* The horizontal flyball type governor controls the speed of the engine. The governor spring (2, fig. 179) is located in the housing at the rear of the fuel injection pump housing. The governor weights (7) are attached to the cam shaft gear (4). The forces of the governor weights (7) and governor spring (2) act upon the slide bar (3) to govern the speed of the engine in accordance with the tension placed on the governor spring by the setting of the hand throttle control (1). As the governor weights vary in position with the load and speed of the engine, their horizontal travel is transmitted through thrust bearing (6) and levers (8) and (5) to the fuel injection pump slide bar (3). Lubrication for the thrust bearing and governor weight is supplied by the oil delivered under pressure in the timing gears.

(b) *Adjustment.*

1. *General.* Engine speed can be checked at the rear of the fuel injection pump cam shaft which operates at one-half engine speed. Remove the hour meter and install the pointer spindle (fig. 180) on the end of the cam shaft over the thrust



1. Throttle rod.
2. Governor spring.
3. Fuel injection pump slide bar.
4. Cam shaft gear.
5. Control shaft lever.
6. Thrust bearing.
7. Governor weights.
8. Control shaft lever.
9. Governor control shaft.

Figure 179. Governor and governor control mechanism.

washer. Do this by removing the thrust washer cap screws and lock, and using the longer cap screws supplied by the indicator. The pointer spindle is part of the fuel injection cam shaft group.

2. *Low idle speed adjustment.* Operate the engine at low idle speed and check the engine rpm from the pointer spindle, using a revolution counter (fig. 180) equipped with a cup-shaped rubber tip. Adjust the low idle speed from the outside of the governor spring housing by turning the screw (fig. 180) at the top of the housing. Loosen the lock nut and turn the screw in to increase the low idle speed, or out to decrease the speed. Alter the position of the hand throttle when making the low idle adjustment, to insure that the governor lever is properly contacting the spring loaded adjusting screw stop. Lock the nut after making the final adjustment, to obtain an engine speed of approximately 425 rpm.

3. *Full load speed adjustment.*

(a) Remove the cover from the governor spring housing and loosen the lock nut (fig. 180)

on the adjusting screw, which acts as a stop for the hand throttle control lever.

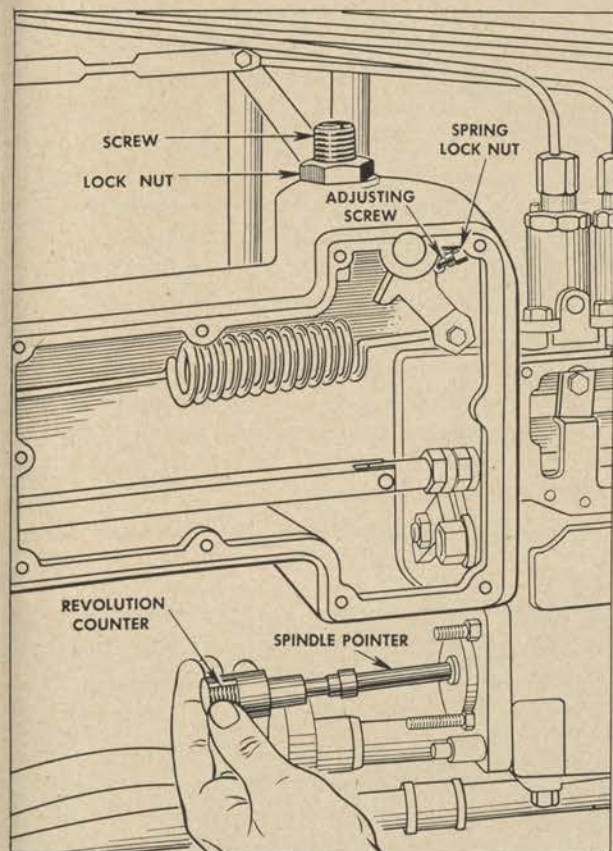


Figure 180. Checking engine speed.

- (b) Set the hand throttle to obtain an engine speed of 1,055 rpm and turn the adjusting screw until it contacts the lever to which the governor spring is attached. This throttle position will result in a full load speed of approximately 950 rpm.
- (c) Use the governor setting fixture to obtain a more nearly accurate full load speed setting. With the use of this fixture, the engine speed, while still controlled by the governor, is made independent of the normal position of the fuel pump slide bar. In this way, the fuel load speed can be adjust-

ed accurately without loading the engine.

- (d) Remove the couplings between the fuel injection pump slide bar and the fuel injection pump racks. Place the rack adjusting bracket between the rear pump rack and the slide bar, making sure that the rack adjusting bracket fits down into the relief for the coupling on the slide bar.
- (e) Install the connection bar (fig. 181) between the two pump racks, using a capscrew in the rear rack and the special stud and cotter pin in the front rack.
- (f) The connecting bar holds the two racks in the same position to one another that they assume in normal operation.
- (g) The rack adjusting bracket makes it possible to vary the speed of the engine independently of the hand throttle by rotating the knurled nut to change the position of the racks relative to the slide bar.
- (h) Rotating the screw to close the gap will increase the speed of the engine, while widening the gap decreases the speed.

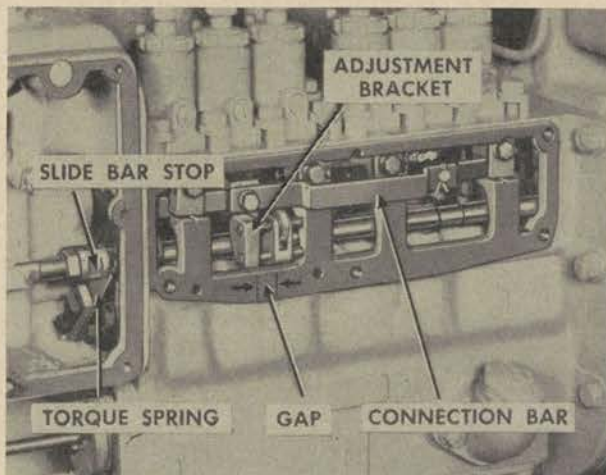


Figure 181. Full load speed adjustment.

- (i) With the gap of the rack adjusting bracket in its widest position, start the Diesel engine and move the hand throttle control to the full advance position.
- (j) Increase the engine speed by turning the knurled nut until slide bar stop nut just contacts the torque spring, but do not compress it. Check the speed of the engine from the pointer spindle previously installed at the end of the fuel injection pump cam shaft. Engine speed should be 950 rpm with the stop nut balancing against the torque spring.
- (k) If the speed is more or less than 950 rpm, vary the position of the throttle control lever adjusting screw and the knurled nut to obtain a balance at 950 rpm. This insures the maximum hp output of the engine at 950 rpm, although the high idle speed may now be below 1,055 rpm. After obtaining the correct throttle position, turn the adjusting screw (fig. 180) until it contacts the governor spring lever and locks it in position.

(12) *Care of fuel filter. (a) General.*

1. Every week, drain the filter housing of sediment which settles at the bottom of the compartment. Close the main fuel tank valve, remove the filter housing drain plug, and open the lower and then the upper vents in the housing. Replace the drain plug and prime system (d(13) below).
2. When the absorbent filter elements have collected enough contamination to interfere with engine performance, replace them. These elements will continue to absorb particles until fuel no longer flows through them. The fine grade filter paper at the core prevents the elements from discharging their burden into the clean fuel. Because

these filter elements absorb and hold contaminants, do not wash or otherwise restore them.

3. As the filters gradually become clogged with foreign material, the position of the fuel pressure gage indicator will work back from the original position to the NORMAL (white) range, to the CAUTION (green) range, and later into the OUT (red) range. When considerable stoppage has occurred, the indicator will show a marked reduction in pressure from no load to full load. The exact point on the OUT range which the indicator will register before the resistance to fuel flow interferes with the maximum performance of the engine can best be determined by experience by the individual, taking into consideration the load, operating speed, temperature of the engine, and

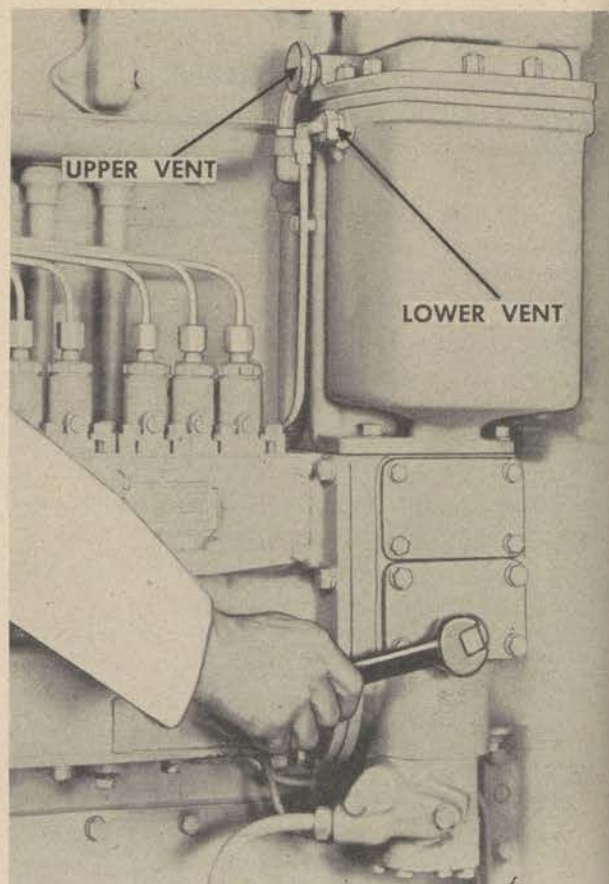


Figure 182. Draining filter housing.

viscosity of the fuel. When the old filter elements become clogged, discard them, and install all new filter elements, never only one.

(b) *Removing used filter elements.* Thoroughly clean the top of the filter cover and around the edges of the gasket joint between the filter body and cover, to guard against loose dirt dropping into the filter housing when the cover is removed. Close the fuel tank valve, remove the filter housing drain plug, open the lower and then the upper filter housing vents. Remove the cover and lift the assembly of filter element plate and all filter elements out of the housing. To remove the used filter elements, set the assembly on a flat surface and compress each spring until the retainer will permit removal of the pin. Lift off the filter element plate and remove the used element from the retainer rods.

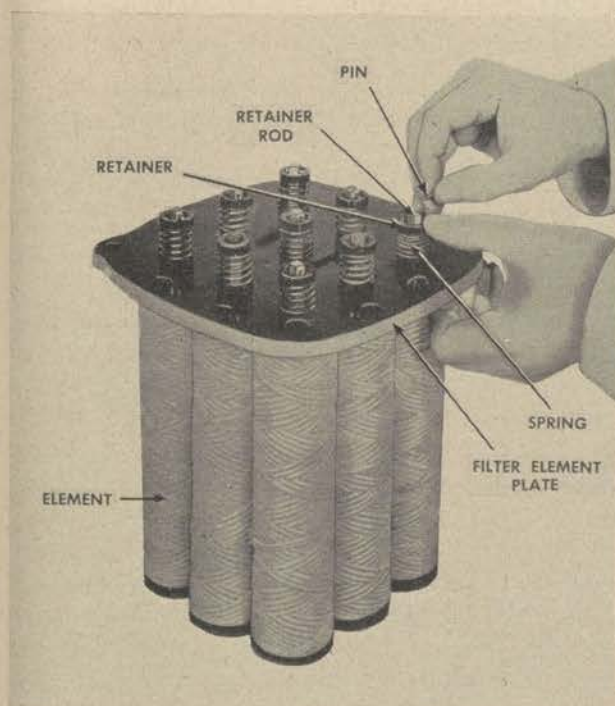


Figure 183. Removing filter element.

(c) *Attaching new filter elements to filter element plate.* Thoroughly wash the plate, retainer rods, retainers, pins, and springs in clean washing fluid—kerosene, Diesel fuel, or a noninflammable cleaning solvent. Make sure that the hands are clean before attempting to install the new parts.

Place the retainer rods into each new filter element; attach them to the plate individually by compressing the spring and inserting the pin so that it is held securely in the counterbore of the retainer. Grasp each element at the bottom end and give it approximately one-half turn under light pressure, to seat the end of the element against the disc on the bottom of the retainer rod. While performing this operation, keep the elements parallel to each other and the ends square with the plate.

(d) *Installing filter elements in housing.* Before installing the elements in the housing, flush out the housing with clean fuel and replace the drain plug. Install the new plate gaskets supplied with each set of elements. Exercise extreme care to see that the top side of the retainer plate, retainer assembly, and the inside of the housing cover are clean. These parts are on the clean side of the elements and if dirt is not completely removed, it will find its way into the fuel injection equipment. Replace the cover. Open the main fuel tank valve and follow the instructions for priming ((13) below). Always keep the elements wrapped in their original cartons, to insure against dust and dirt accumulations; these will shorten the life of the elements if they get on the outside, or may cause damage to the fuel injection equipment if they get on the inside.

(13) *Priming fuel system.* (a) *General.* Any time the fuel flow is broken and air is allowed to get in, prime the fuel system. If air is left in the lines, the system may become air-bound, resulting in inability to start the Diesel engine, or the misfiring of one or more cylinders.

(b) *Priming.* Check to see that the main fuel line valve is open. Open the fuel filter vent valves and the vents on the fuel injection pumps. Then start the starting engine, engage the starter pinion, and the starting engine clutch. Allow the starting engine to crank the Diesel engine at idle speed, with the compression release lever in the START position, so that the transfer pump will force the air and fuel through the fuel filters and into the fuel pumps. The throttle control lever should be in OFF position. When the flow of fuel through the vents becomes continuous and contains no air bubbles, close the vents. Open and close the vents several times in succession to be sure that all the air is bled from the system.

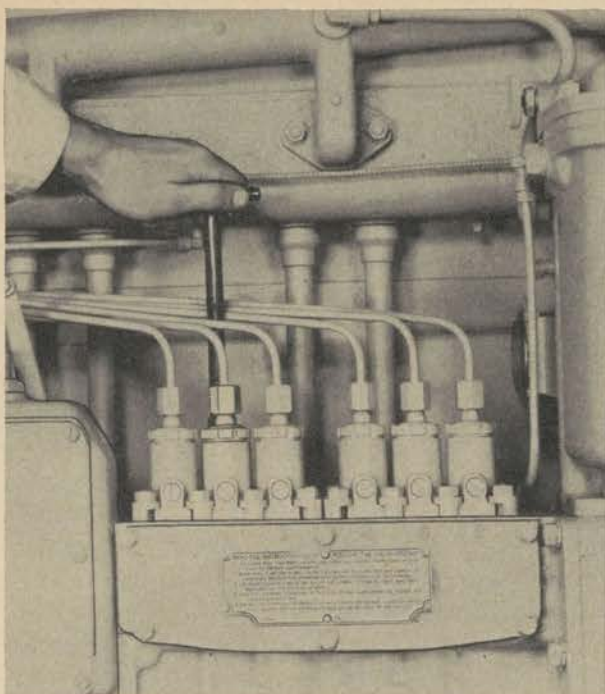


Figure 184. Opening fuel injection pump vent valve.

e. AIR INTAKE SYSTEM. (1) *Manifolds.* For starting purposes, the inlet manifold for the engine is heated by the starting engine exhaust gases. These hot gases are conducted through a tube assembly extending through the length of the engine inlet manifold. A copper bellow is incorporated in the center of the tube assembly to compensate for heat expansion. Each end of the tube assembly is sealed with a bushing and retainer rings to minimize the possibility of starting engine exhaust gases, dust, or dirt entering the Diesel engine through the inlet manifold. Copper asbestos gaskets form a seal for the elbow which connects the starting engine exhaust pipe to the manifold, for the Diesel engine air cleaner pipe for the center elbow which separates the two end sections of the manifold, and for the starting engine exhaust pipe at the front of the manifold.

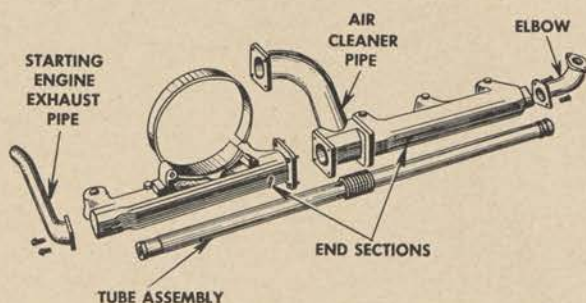


Figure 185. Diesel engine inlet manifold assembly.

(2) *Checking manifold.* Test the inlet manifold for leaks or cracks that would permit the entrance of unfiltered air into the engine, by holding a lighted match above the opening of the starting engine exhaust pipe or the front of the inlet manifold. With the engine operating at high idle speed, leaks or cracks will be indicated by a downward suction of the match flame.

(3) *Disassembling manifold.* Remove the elbow assembly and pipe assembly from the ends of the inlet manifold. Pull either end of the tube assembly out of the inlet manifold far enough to remove the retainer rings. Use a special puller attachment, or a pair of pliers, to pull the tube assembly out of the manifold. Remove the retainer rings from one end of the tube assembly, then push the assembly toward the opposite end, and remove the other two rings. Next remove either section of the inlet manifold from the air cleaner pipe elbow, and slide the section off the tube. Then withdraw the tube from the remaining section and the air cleaner pipe elbow.

Note. Remove one section of the manifold from the air cleaner elbow, before withdrawing the tube assembly. This will provide clearance for the bellows, which will not pass through the ends of the inlet manifold sections.

(4) *Air cleaner.* (a) *Description.* The air cleaner on a Diesel engine will clean and pass a greater volume of air in a day's run than the air cleaner on a gasoline engine doing the same work under like conditions. Each Diesel engine cylinder draws in a full charge of air on every inlet stroke, regardless of the engine speed or the amount of work the engine is doing; whereas the volume of air taken in by a spark ignition engine is regulated by the position of the butterfly valve in the carburetor and changes with varying conditions. The air cleaners do their work efficiently only so long as the oil in the cup is thin enough to flow freely, so it will spray into the filter section and wash back the dirt collecting there. For this reason, inspect air cleaners frequently and service them promptly.

(b) *Maintenance.* The interval between oil changes and cleaning will vary with the weather and the working conditions. In damp weather, and on jobs where there is little or no dust, this operation may be necessary only every week. However, do not depend on visible detection of dust, or lack of dust, in the air as a basis for servicing the air cleaner. The high efficiency of the

precleaner prevents the large dust particles from entering the air cleaner, but it does not exclude the finer ones. For this reason, the oil in the air cleaner may become saturated with dust, due to its fineness, much more rapidly than in instances where dust is more apparent. The fine particles of dust become suspended in the oil, lowering its cleaning efficiency, without leaving any noticeable sediment in the cup. Consequently, change the oil in the air cleaner when it becomes thicker than normal.

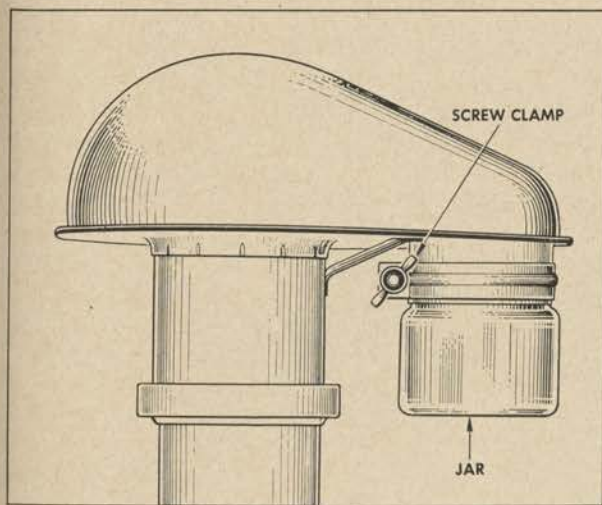


Figure 186. Precleaner.

(c) *Inspecting oil in air cleaner cup.* Unscrew the wing nuts and take off the oil cup. Wash the air cleaner cup and refill it when the oil shows evidence of cloudiness. Inspect the inside of the air inlet pipe and air cleaner screen each time the oil cup is removed. Clean or wash them if needed. When refilling the oil cup take care to fill both the inner and outer sections of the cup to the oil level bead. Fill to the level bead only, as a higher oil level does not increase efficiency; in fact it prevents proper oil spray in the air cleaner. Never attempt to change the oil in the air cleaner cup when the engine is running. Doing so will permit dirty oil being held in the screens by intake action; this will contaminate the fresh oil and also cause an abnormally high oil level.

(d) *Care of precleaner.* Loosen the screw clamp holding the glass jar in place and empty it before it becomes three-fourths full. Inspect the fins in the precleaner regularly; if they are dirty, remove entire precleaner and wash it in a non-inflammable cleaning fluid.

(e) *Washing air cleaner screens.* Remove the lower screen by unscrewing the two wing nuts that hold it in place. Slip the other screens off the air inlet pipe, one at a time, and shake them in a pan of kerosene or some noninflammable cleaning fluid. When a perfectly clean screen is found, there is no need to remove the screens above it. Only six screens are removable. Replace the screens so the frame cross arms of each pair are facing each other. The wing nuts holding the screens in place should be drawn up snugly to prevent vibration of the screens. Refill the oil cup to the oil level mark and replace it. Make sure all connections are air tight. At least once a year—more often in dusty areas—remove the entire air cleaner from its support and thoroughly flush out the fixed screens in the upper part of the cleaner body. To facilitate cleaning, first remove the oil cup and removable screens. Wash all parts thoroughly and when reassembling, make certain that all connections are air tight.

f. *LUBRICATING SYSTEM.* (1) *General.* The main engine is provided with a full pressure lubricating system. The oil pump assembly contains two auxiliary pump sections (4, fig. 187), each connected to a screened suction bell located at the front and rear end of the oil pan. These pump sections return accumulated oil from the low end of the oil pan to the center sump in which is located the pressure pump suction bell. The pressure pump suction bell section (8) circulates the lubricant under a pressure of approximately 30 pounds to all working parts of the engine. Oil is forced from the pump to the base of the filters (2), where a bypass valve allows oil to go to the oil cooler (9), unless the engine is cold. From the cooler it is forced through the filters (2) to the manifold tube assembly (6) and then to the following:

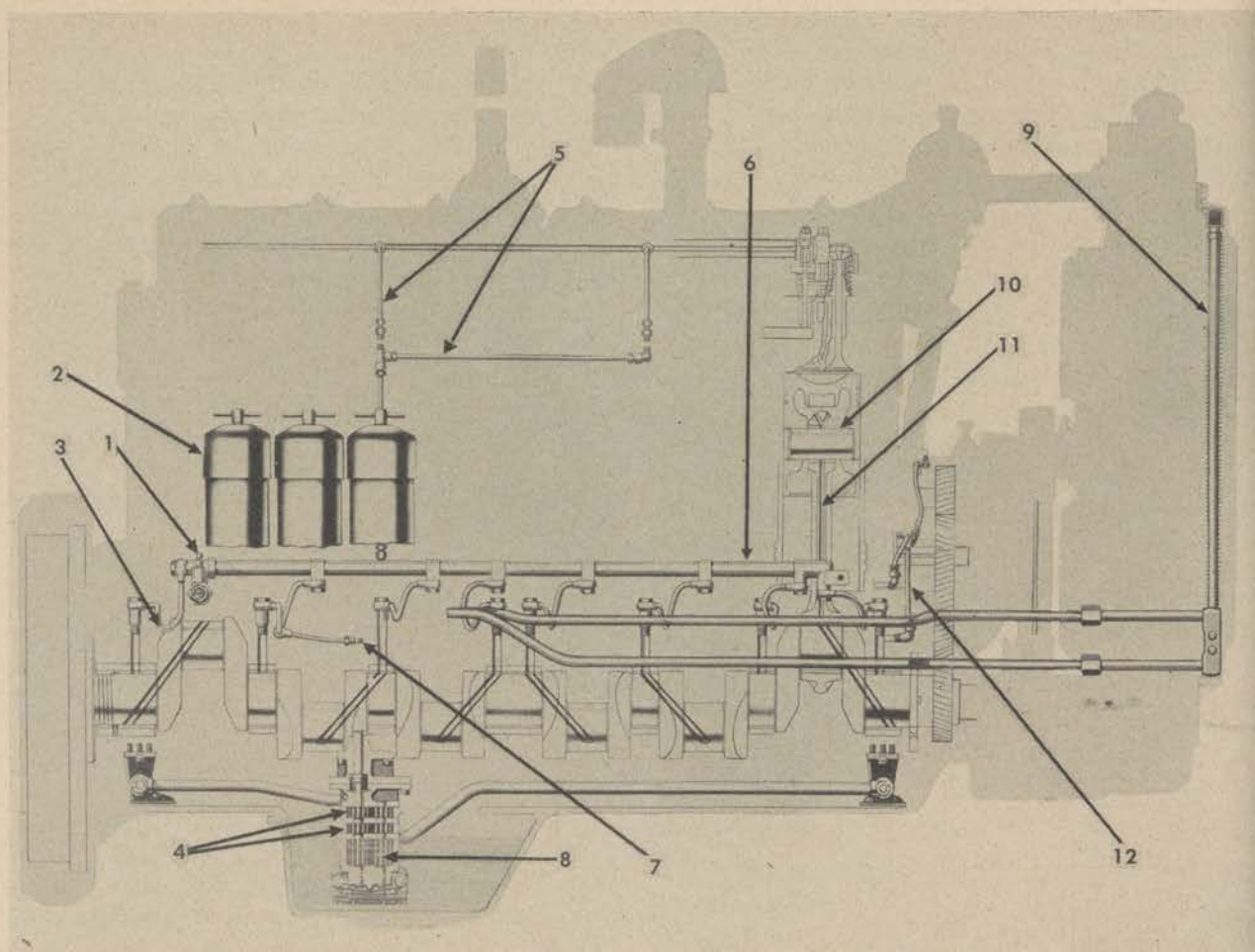
(a) From the manifold tube assembly (6) through tubes (3) to the main bearings.

(b) From the main bearings through drilled passages in the crankshaft to the connecting rod bearings.

(c) From the connecting rod bearings through the drilled rods (11) to the piston pin bushings and through oil spray holes (10) for piston cooling.

(d) From the manifold tube assembly (6) through tubes (5) to the hollow rocker arm shafts and valve rockers.

(e) From the manifold tube assembly (6)



1. Connection to oil pressure gage.
2. Filter.
3. Tubes to main bearing.
4. Auxiliary pump sections.
5. Oil tubes to rocker arm shafts.
6. Manifold tube.

7. Oil tube to oil sump upper shaft bearing.
8. Pressure pump section.
9. Oil cooler.
10. Oil spray holes.
11. Drill rods to piston pin bushing.
12. Oil tube to idler gear bearing.

Figure 187. Main engine lubricating system.

through the tube (7) to the bearing for the upper shaft of the oil pump.

(f) From the front main bearing through the tube (12) to the idler gear bearing, front cam shaft bearing, and accessory shaft bearing.

(2) *Oil gage.* (a) The oil gage (fig. 187) indicates the oil pressure which is set at approximately 30 pounds by the oil pressure relief valve in the pump. If low oil pressure or none at all is indicated, check these items in the order given:

1. Oil level.
2. Clogged oil filters.
3. Defective oil gage or clogged or broken line to the gage.

4. Clogged oil pump screen.
5. Sticking oil pump plunger.
6. Leaking connections.
7. Loose bearings.
8. Worn oil pump gears.
9. Improper adjustment of oil pressure adjusting screw.

(3) *Oil pumps.* (a) *General.* The oil pump is driven from a gear on the cam shaft through a vertically mounted two-piece tongue and groove shaft. It circulates oil under pressure to the oil cooler, oil filters, engine bearings, and other operating parts.

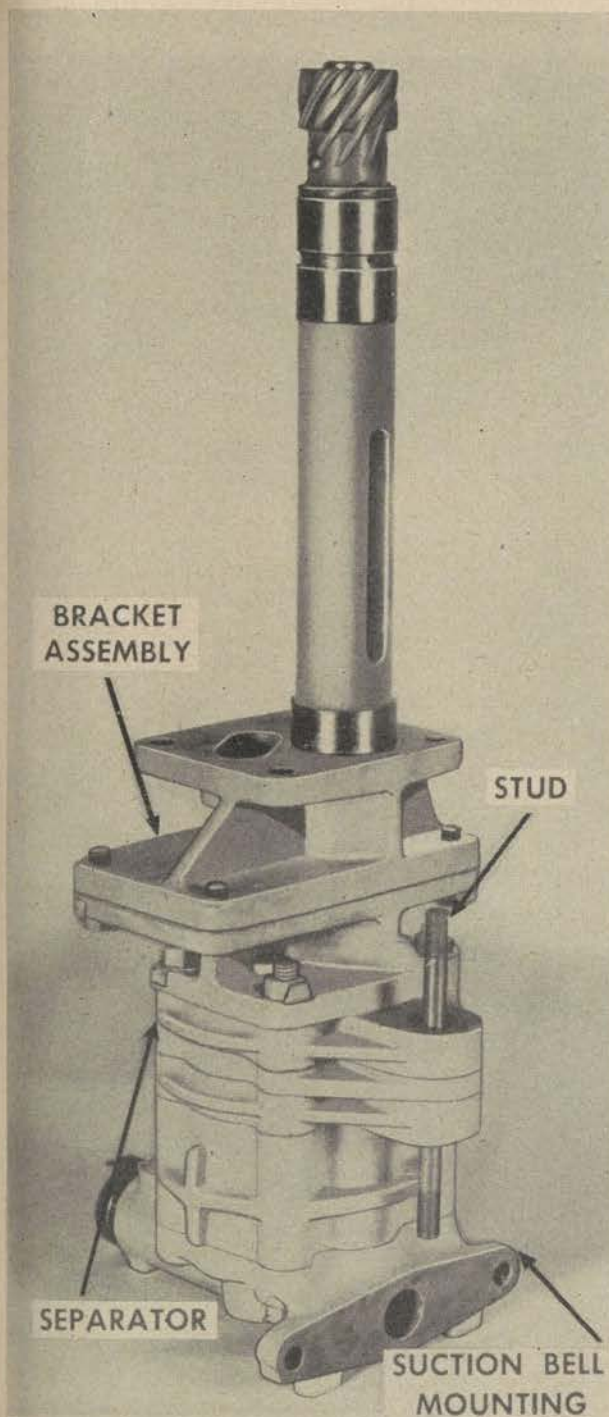


Figure 188. Step 1 in removal of oil pump.

(b) Oil pump removal and replacement.

1. The oil pump assembly can be removed through the side opening of the oil pan. Take off both oil pan side covers.
2. Remove the suction bell assembly from

the oil pump suction bell mounting. (See fig. 188.)

3. Remove the nuts, locks and lockwashers from each end of the stud on which the two auxiliary pump suction bell tubes are held to the pump.
4. Install two nuts (one nut to drive against a lock nut) on one end of the stud, and force up out of the separator assembly.
5. When the center threads of the stud have cleared the separator, remove the nuts and raise the stud high enough for its lower end to clear the fitting on the end of the auxiliary suction tube which leads to the front suction bell.
6. Remove the capscrews holding the pump to the bracket assembly (fig. 188), lower the pump to the bottom of the oil pan to clear the upper end of the stud from the fitting on the rear auxiliary suction tube, and then remove the pump from the door on the right side of the oil pan. (See fig. 189.)

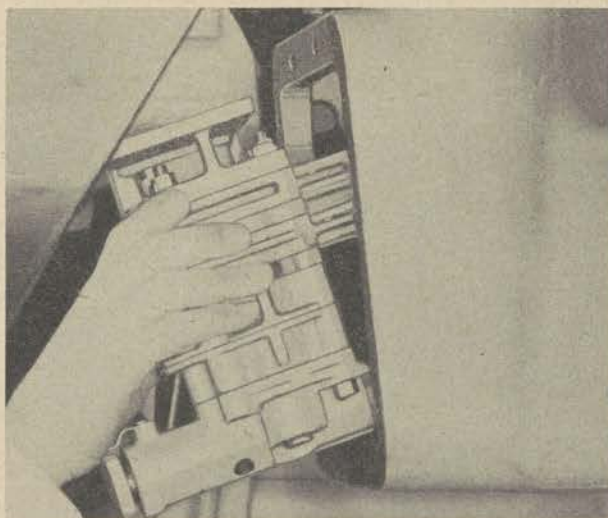


Figure 189. Removing oil pump.

7. Before replacing the pump in the engine examine the oil pump bracket gaskets, and replace any damaged ones.

(4) Suction bell and screen. (a) Removal. Remove the oil pump suction bell through the side opening of the oil pan by backing off the nuts from the studs (fig. 190) that hold it to the oil pump. Remove the capscrews that hold the cover to the bell assembly and slide out the screen as-

ssembly. Wash the screen assembly and suction bell in kerosene before replacing them. Clean screen assembly at least twice a year, or more frequently if needed.

(b) *Replacement of gaskets.* When reassembling, install new gaskets between the cover and screen assembly, between the screen assembly and suction bell, and between the oil pump and suction bell.

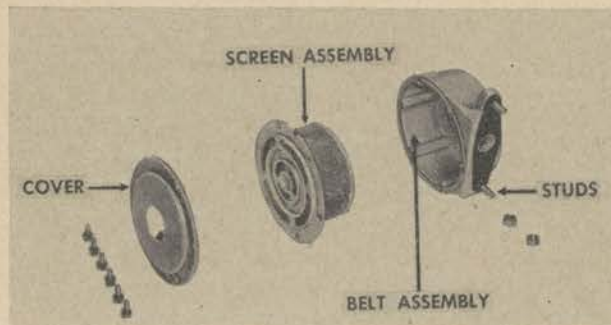


Figure 190. Suction bell and screen.

(5) *Oil pressure relief valve.* (a) *Adjustment.* The relief valve arrangement provides a means by which the oil pressure may be kept reasonably constant under normal operating conditions, unless excessive wear takes place in the pump or engine parts. This valve consists of the plunger (fig. 191), spring, and adjusting screw. It may be reached for adjustment without draining the crankcase oil, by removing the inspection cover on the right side of the cylinder block. Increase or decrease the oil pressure by turning IN or OUT on the adjusting screw.

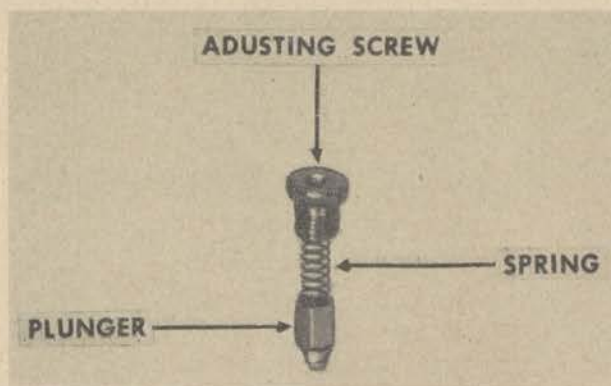


Figure 191. Pressure relief valve.

(b) *Plunger.* The plunger may fail to function properly if foreign material gets between it and the seat. If the plunger is removed for cleaning or inspection, mark the adjusting screw and

pump body. Count the number of turns required to remove the screw. By this means the screw can be returned to its original position and thus retain the same oil pressure. After cleaning the contact surfaces, check to see that the seat is smooth and flat, and that the sealing surface of the plunger is in good condition. If this plunger is functioning properly, the gage needle should vary only slightly. When replacing a worn plunger, adjust until the desired pressure is obtained.

(6) *Oil cooler.* (a) *Description.* Lubricating oil flows from the oil pump to the oil cooler before it passes through the oil filters. The oil cooler is located just ahead of the water radiator and can be removed separately or as a unit with the radiator assembly.

(b) *Cleaning.* Remove the screen guard assembly. Drain the oil from the oil cooler by loosening the vent plug (fig. 192) at the top left of the cooler and removing the drain plug at the bottom. Drain the oil filter base and disconnect the oil cooler tubes. Remove the capscrews that hold the oil cooler to the radiator, and lift off the oil cooler. Flush out with water or compressed air, any accumulation of debris between the fins and tubes. Wash the inside of the cooler with kerosene.

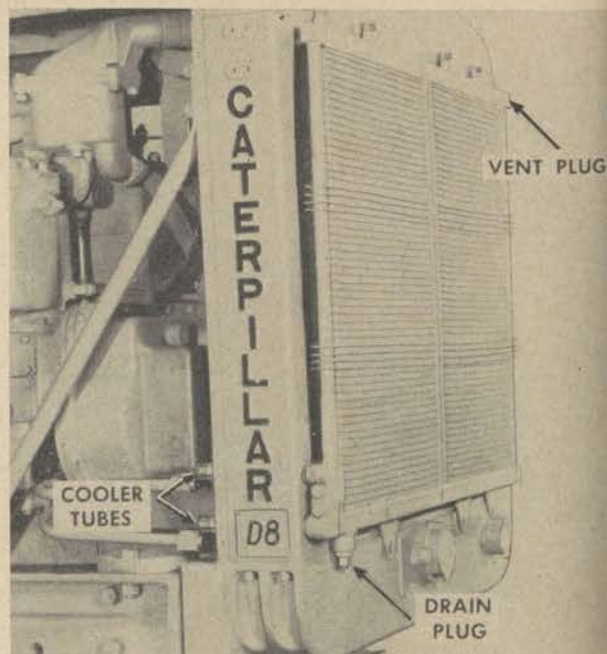


Figure 192. Oil cooler.

(7) *Oil filters.* (a) *General.* Each oil filter has an edge type metal element surrounding an absorbent type element. (See fig. 193.) The oil filtered by the outer element goes to the bearings.

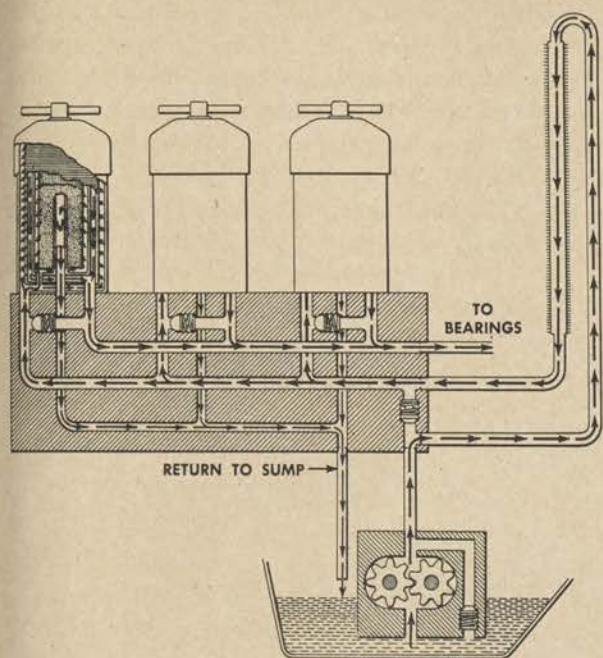
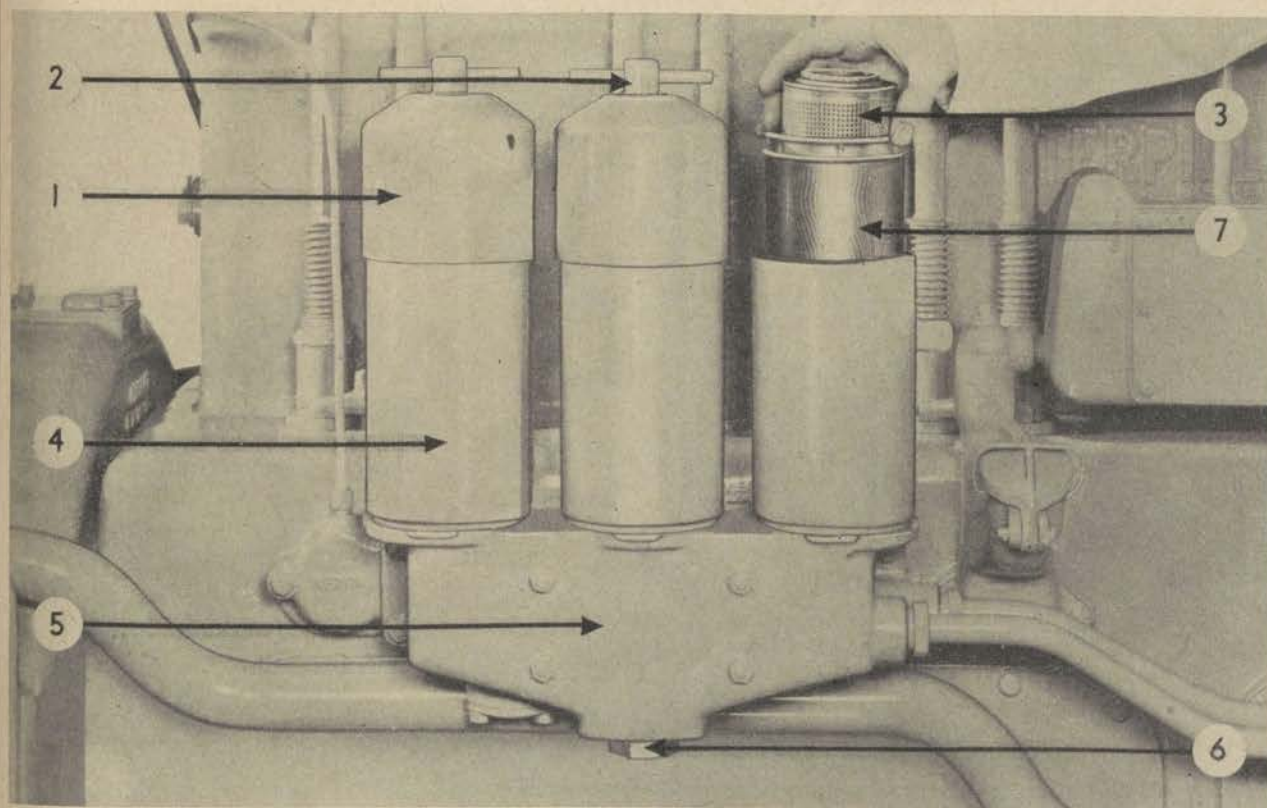


Figure 193. Oil filter system.

while the oil filtered by the inner element is returned through the metering hole in the stud to the oil pan. If the oil is cold and viscous, a bypass valve in the filter base opens to permit oil to flow directly to the filters from the pump without passing through the oil cooler. If the outer element becomes clogged, another bypass opens to permit oil to flow directly to the bearings without passing through the filter elements. Check these bypass valves to insure that they are functioning properly.

(b) *Washing oil filters.* Service the filters each time the crankcase is pumped out. Remove the drain plug (fig. 194) from the bottom of the oil filter sludge compartment and remove the clamp nuts from the top of the oil filters. Then remove the cover and lift out the filter elements. Separate the outer and inner elements by pulling them apart. Wash all the parts removed with kerosene and allow them to drain thoroughly. Wash the case and sludge compartment. Replace the filters and reassemble.



1. Cover.
2. Clamp bolt.
3. Inner filter element.

4. Case.
5. Sludge compartment.

6. Drain plug.
7. Outer element.

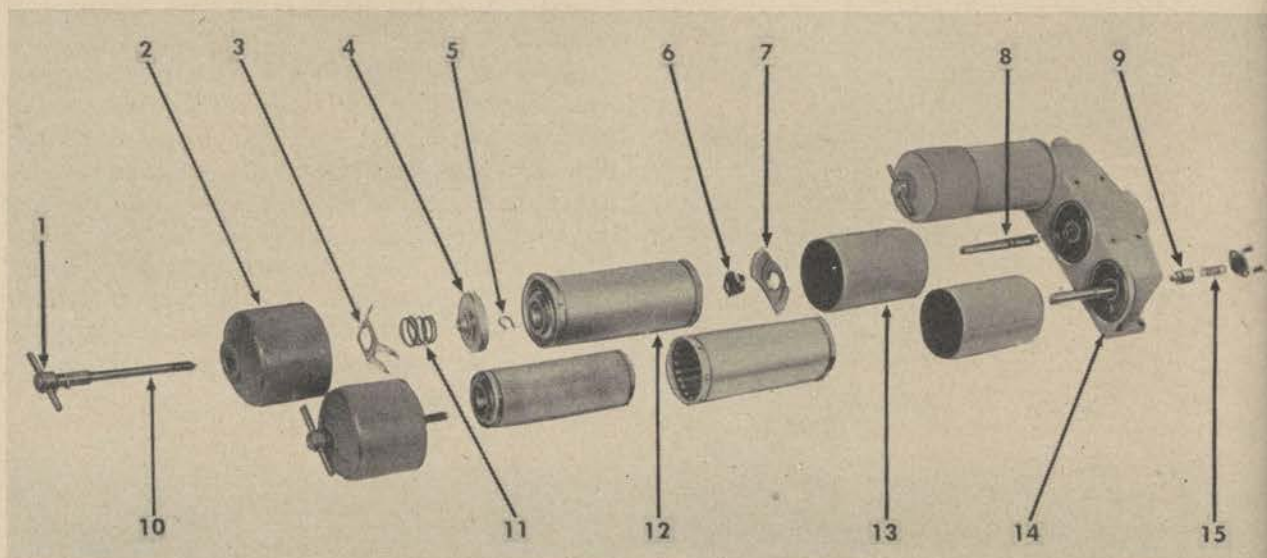
Figure 194. Removing crankcase oil filter

(c) *Disassembly of filter for replacement.*

1. Figure 195 shows the filter housings and base completely disassembled.
2. The screw assembly (10), gasket (1), spring (3), and plate assembly (4), are held in place in the top cover (2), by a snap ring (5), that fits in a groove on the screw assembly (10). They, in

(8) *Draining and washing crankcase.* A pipe fitted with a valve is connected to the crankcase sump. To drain, run the engine until the oil is heated, then open the valve on the engine mounting rail. (See fig. 196.)

Wash or flush the crankcase periodically to remove foreign particles. Once every month when the lubricating oil is changed, drain the crankcase



- | | | | | |
|---------------|--------------------|-----------------|---------------------|-------------------|
| 1. Gasket. | 4. Plate assembly. | 7. Clamp. | 10. Screw assembly. | 13. Element case. |
| 2. Top cover. | 5. Snap ring. | 8. Filter stud. | 11. Spring. | 14. Base. |
| 3. Spring. | 6. Nut. | 9. Plunger. | 12. Filter element | 15. Spring. |

Figure 195. Oil filter disassembled.

turn, hold the filter elements in position.

3. With the top cover assembly and filter elements removed, remove the nut (6) at the bottom of the filter stud (8). This nut holds the retainer clamp (7) that secures the filter element case (13) to the base (14). Remove the filter stud (8) with a pipe wrench, taking care not to damage the metering hole in the stud.
4. Remove the plunger (9) and spring (11), and clean or replace them if needed, whenever the filter assembly is taken apart. The plunger permits oil to flow directly to the oil filters when the oil in the system is too cold or viscous to flow through the oil cooler. Thoroughly clean the oil passages in the filter base (14) and stud (8).

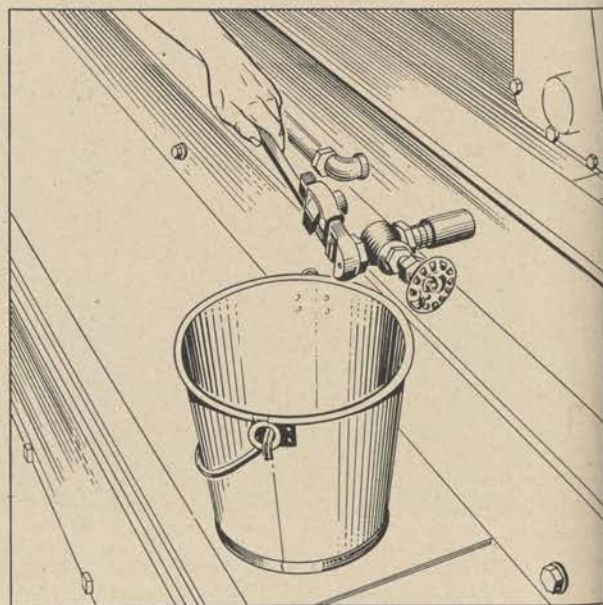


Figure 196. Draining engine sump.

while the engine is hot. Pour two gallons of engine flushing oil into the crankcase. Run the engine for three minutes, checking to insure that the oil gage indicates pressure. Then drain out the flushing oil. If sludge is noticeable when removing the oil from the crankcase, inspect the pressure system oil pump screen and clean it if needed. (See *f*(4) above and fig. 190, suction bell.)

g. COOLING SYSTEM. (1) *Description.* (a) A gear-driven centrifugal pump circulates a coolant through the cooling system. The water jackets extend the whole length of the cylinders. Water directors provided in the cylinder heads direct the water against the valve ports and precombustion chambers.

(b) The starting engine and diesel engine cooling systems are so interconnected as to have the heat from the starting engine assist in warming up the Diesel engine for starting in cold weather.

(c) A sealed pressure overflow valve on the radiator prevents the loss of water by maintaining a pressure of about 6 pounds per square inch in the cooling system. The sealed pressure overflow reduces the natural loss of coolant by evaporation. This is especially beneficial when antifreeze solutions are used in the cooling system.

(d) Make every effort to use soft water or clean rain water in the cooling system. Soft water will make a good lather with ordinary soap; hard water will not. If it is necessary to use hard water, treat it with an authorized water softener.

(2) *Overheating.* If difficulty is experienced with the engine over-heating, check the probable causes in this order:

(a) Insufficient water in the cooling system. If the water level has been allowed to fall so low that there is no longer circulation, stop the engine immediately and allow it to cool before adding water. Add water slowly while the engine is running. These precautions will minimize the possibility of cracking cylinder heads.

(b) Loose fan belts. Adjust the fan belt as described in (6) below.

(c) Failure of water temperature regulator to open. Check the regulator for opening temperature as described in (8) below. Observe the amount of scale deposited on the bellows. Too much scale will obstruct the operation of the regulators.

(d) Badly corroded water impeller or impeller loose on shaft.

(e) Excessive scale or sediment deposits in radiator, cylinder head, and block. Such deposits can cause serious damage to the engine and cause lubricating oil to deteriorate rapidly by retarding the transfer of heat from the head and cylinders to the cooling water. In such cases, the water temperature may not be above normal. However loose scales and sediment may deposit in water passages to such an extent that circulation will be retarded, in which case the water temperature will rise above normal.

(3) *Cleaning cooling system.* Check for lime and scale in the cooling system, when hard water has been used, by removing one of the precombustion chambers and inspecting the surface which comes in contact with the cooling water. Drain the cooling system by opening the valve at the lower left hand corner of the radiator, removing the pipe plug at the rear of the water manifold on the left side of the engine, and opening the drain cock on the underside of the starting engine water pump impeller housing. To remove the scale, fill the cooling system with an authorized scale remover or cleaning solution. Operate the engine for three hours and then drain the cleaning solution. Flush the system thoroughly to remove all traces of the scale remover, and refill with clean, soft water.

(4) *Radiator removal.* Drain the cooling system, oil cooler, and oil filter base. Remove the hood. Take off the guard assemblies between the radiator and radiator braces. Disconnect the oil cooler tubes (fig. 197), the water connections, brace rods, and nuts holding the radiator to the front supports. Then lift off the radiator and oil cooler as a unit, with a chain hoist. After cleaning all the inlet and outlet pipes thoroughly, carefully check all gaskets, and replace damaged ones. Inspect the inlet and outlet hose, particularly about the clamping points, to insure that they are not deteriorated, and are free from leaks. Thoroughly flush out and clean the radiator body.

(5) *Sealed pressure overflow.* (a) A sealed pressure overflow assembly is provided on the engine to prevent the loss of cooling water through the radiator overflow tube. Due to the expansion of the coolant by rising temperature, a pressure will be built up in the cooling system each time the engine is started. If there is no pressure in the cooling system, the coolant will not escape through the radiator overflow tube.

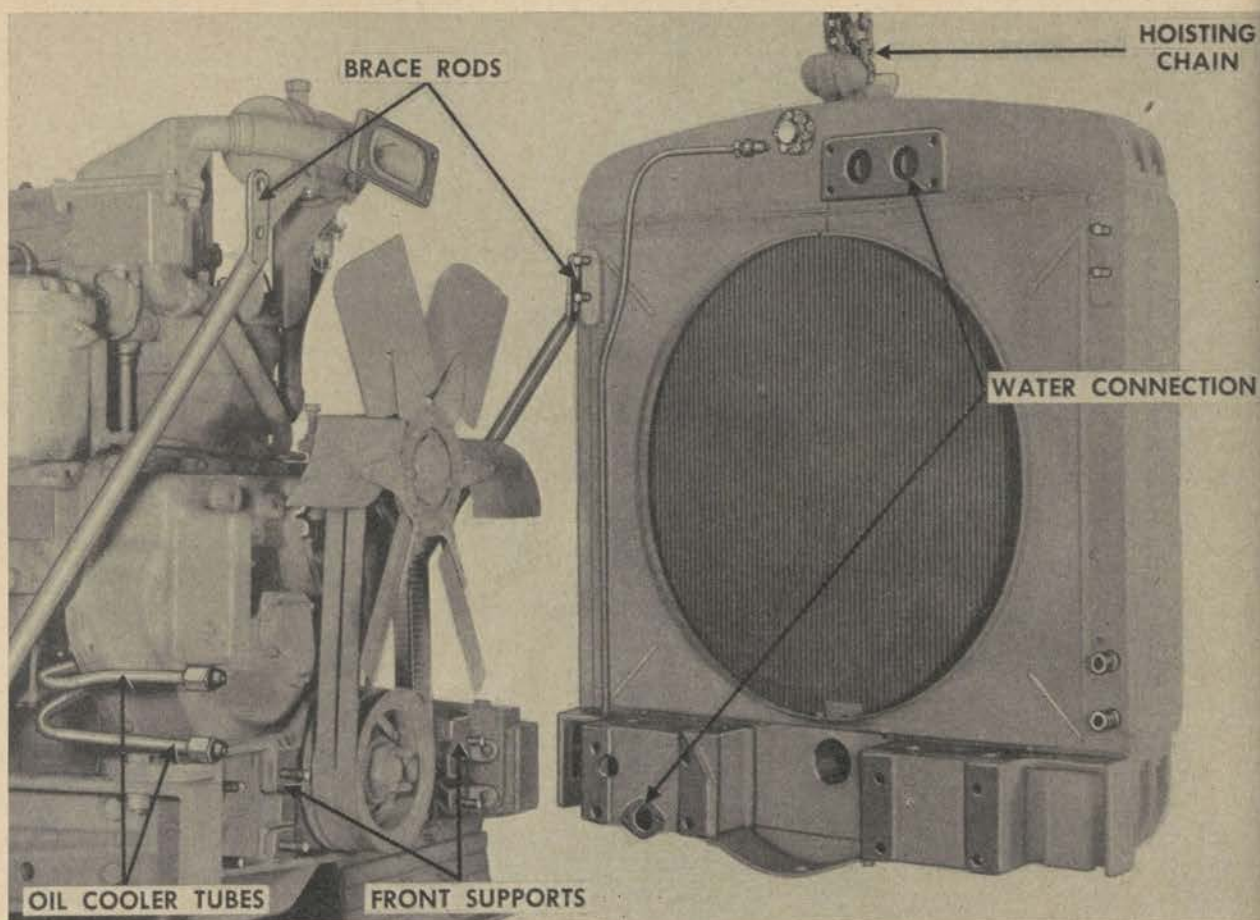


Figure 197. Radiator removal and reassembly.

(b) When a pressure in excess of 6 pounds per square inch exists, the pressure relief valve will be forced away from its seat and the coolant will flow out of the radiator overflow tube. As the pressure decreases, the valve will begin to close, and close fully when the pressure reaches 6 pounds per square inch.

(c) When a vacuum of 1 pound per square inch exists in the cooling system, the vacuum release valve will open. This permits air to enter the cooling system until the vacuum becomes less than 1 pound per square inch.

(d) Remove the seal assembly (fig. 198) by taking out the machine screws that hold the housing in place, and remove the housing and the seal plate.

(e) Replace any leaky gaskets between the radiator tank and the seal plate, and between the seal plate and the housing.

(f) To remove the seal assembly, pry under the opposite edges of the pressure relief valve.

(g) To install a new seal assembly, place the seal assembly in position in the housing and press down evenly with the thumb on the seal of the pressure relief valve. The edge of the cup on the end opposite the pressure relief valve should be firmly seated and recessed in the housing.

Note. While replacing the gaskets, be sure that when the housing is installed, the cutout portion of the gasket and the relieved portion in the housing register with the lower hole in the radiator top tank.

(6) *Fan.* (a) *Description.* The fan is driven by two V-belts from the crankshaft to the engine. Keep the fan belt clean of any accumulations of dirt and grease, since such foreign material acts as a grinding compound and will cause excessive wear of the fan belt pulleys.

(b) *Fan belt adjustment.* Keep the fan belts adjusted so that with light pressure they can be pushed inward at the center approximately $1\frac{1}{2}$ inches. If the fan belts are too loose, they will

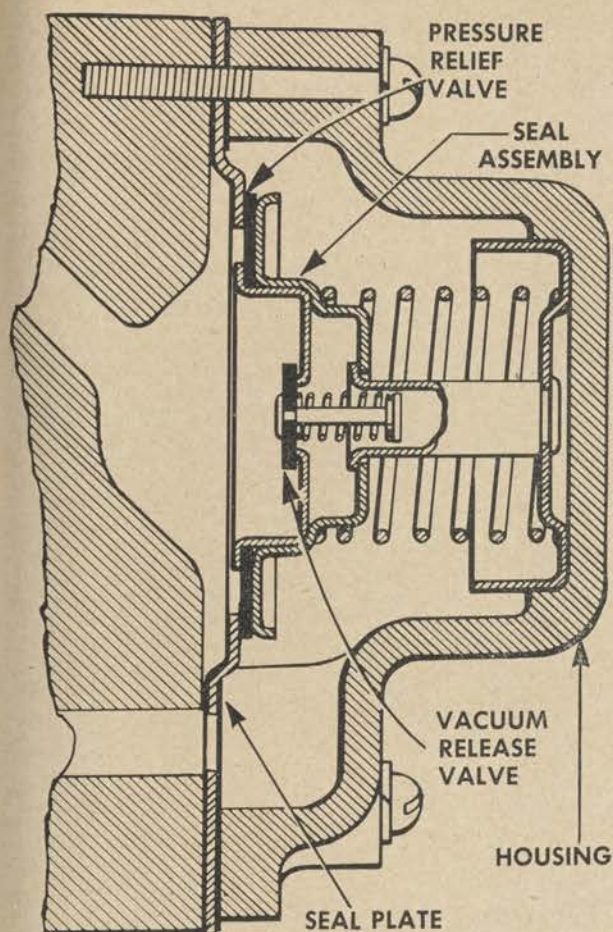


Figure 198. Pressure relief valve.

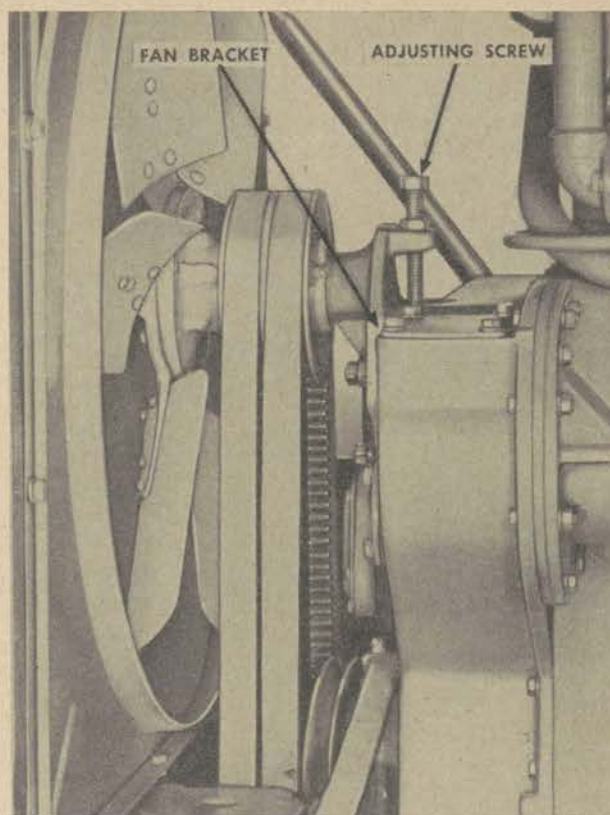


Figure 199. Adjustment for fan belt.

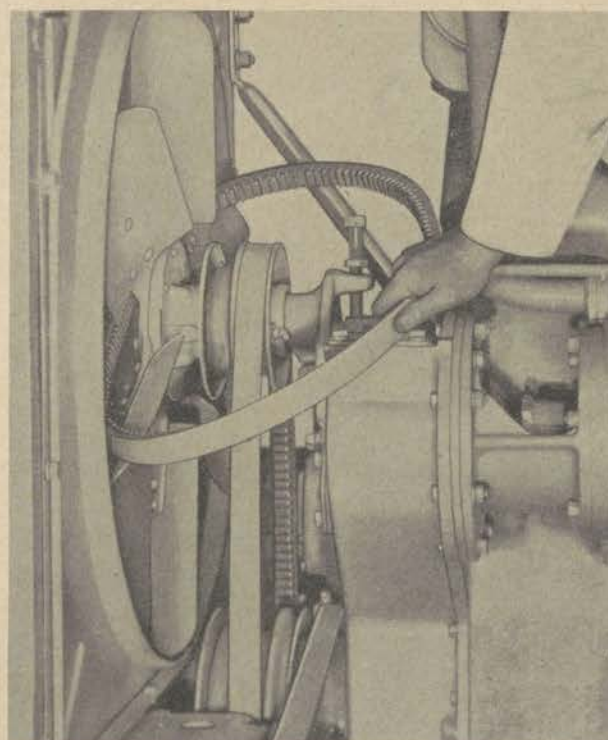


Figure 200. Installing fan belts.

slap against the pulleys, causing unnecessary wear to the belt, and possible slipping to the extent that the engine will overheat. If the pulleys are too tight, unnecessary stresses placed upon the fan bearings and belts shorten the life of both. To adjust the belt, loosen the lock nuts holding the bracket (fig. 199) to the timing gear cover; turn the adjusting screw clockwise to tighten belts, or counterclockwise to loosen them. When the adjustment is complete, tighten the lock nut on the adjusting screw and fan bracket retaining nuts.

(c) *Fan belt replacement.* Replace worn belts, or belts stretched to a point where adjustment is impractical. Do this by loosening the nuts holding the fan bracket (fig. 199) to the timing gear housing, and backing off the adjusting screw (this will shift the position of the bracket on the timing gear housing) until there is sufficient room to install the belt. (See fig. 200.)

(7) *Water pump.* (a) *Description.* The Diesel engine water pump, mounted to the rear of the timing gear case on the left-hand side of the engine, circulates the coolant through the engine.

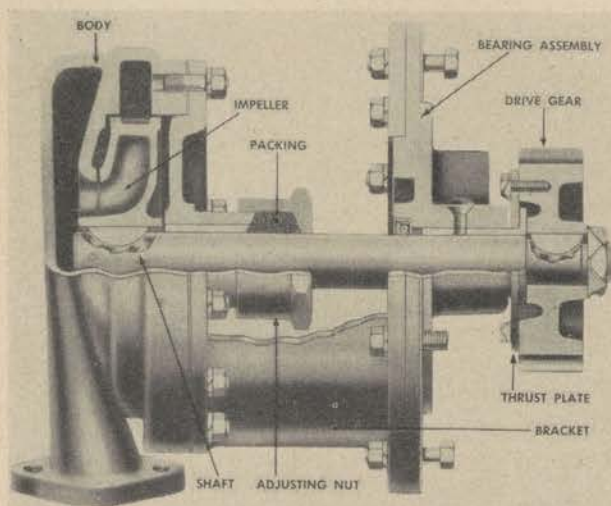


Figure 201. Cut-away of water pump.

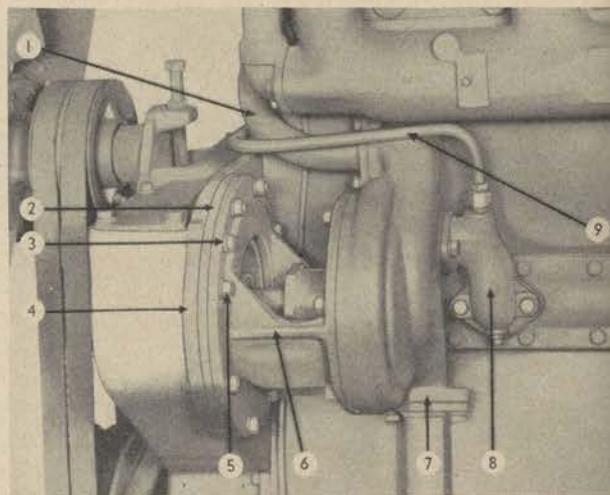
(b) *Water pump packing nut adjustment.* Take care when tightening the water pump pack nut not to bind the shaft by overtightening. Too tight an adjustment prevents coolant from wetting and lubricating the pump packing and shaft, resulting in scoring the shaft. If the pump leaks when adjusted properly, install new packing. Tighten the water pump packing nut by turning in the direction the shaft rotates, until the water leak is stopped, then back off one-sixth of a turn. The packing should be only tight enough to stop any leak, but not tight enough to bind the shaft.

(c) *Water pump removal and replacement.*

1. To remove the water pump, it is first necessary to remove the air cleaner, in order to obtain sufficient clearance for withdrawing the water pump drive gear from the timing gear housing. (See 4, fig. 202.)
2. Remove the capscrews between the regulator bypass tube (1, fig. 202) and the water pump, and the capscrews from the pump inlet line (7).
3. Remove the elbow (8) between the water pump and the cylinder block.
4. Disconnect the tube (9) between this

elbow and the fuel filter at the fuel filter end.

5. Remove the nuts (5) and all the capscrews around the pump except (3) and the one directly opposite. Remove the pump.



- | | |
|-------------------------|----------------------|
| 1. Bypass tube. | 6. Bracket assembly. |
| 2. Bearing assembly. | 7. Pump inlet line. |
| 3. Hold-down screws. | 8. Water elbow. |
| 4. Timing gear housing. | 9. Water tube. |
| 5. Nuts. | |

Figure 202. Water pump removal.

6. The two capscrews not removed hold the bearing assembly (2) to the bracket assembly (6), and do not extend into the timing gear case.
7. When replacing the pump, examine the water pump body and attaching gaskets. Replace if damaged.

(8) *Water temperature regulator.* (a) *Description.* Water temperature regulators are used to restrict the flow of coolant through the radiator, until the engine warms up. The regulators are so constructed that if the element should be punctured accidentally, they will immediately open to a position of safety.

(b) *Checking.* A regulator should be fully open at 180° F. (plus or minus 5° F.). To check the water temperature regulator, suspend the unit in an open pan of water so that the regulator is completely covered. Gradually heat the water until the regulator reaches its fully open position.

Use an accurate thermometer to note temperature; stir the water to obtain a more nearly accurate check.

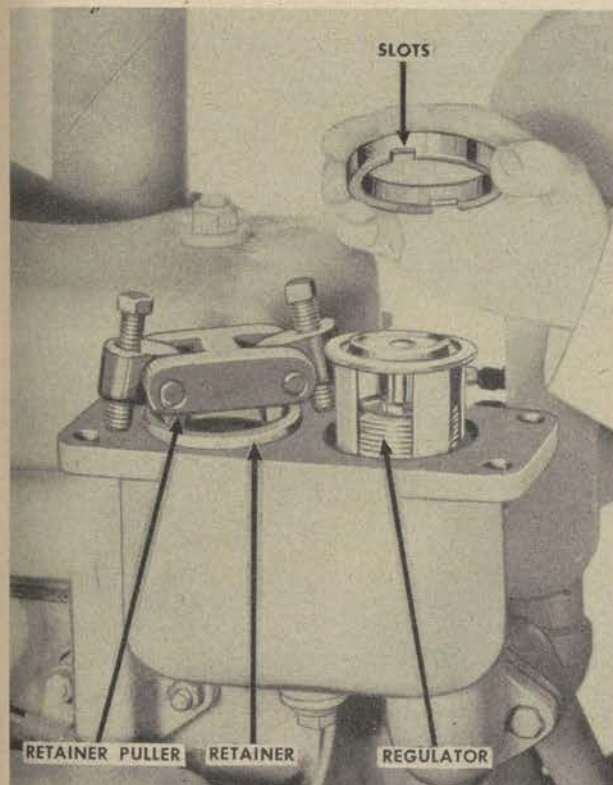


Figure 203. Removing regulator retainers.

(c) *Removing and installing.* Drain the cooling system until coolant level is below the regulators. Remove the regulator housing cover, hose connection, and pipe assembly as a unit. Use a retainer puller, provided for the purpose, to remove the retainer from the housing bore. (See fig. 203.) The hooks of the puller fit in the slots of the retainer. Lift out the regulator. When installing a retainer, locate the slots to permit future use of a puller. Also, firmly seat the retainer in its bore.

h. STARTING SYSTEM. (1) *General.* The Caterpillar diesel engine employs an auxiliary starting engine mounted on the left side of the diesel, for starting purpose. The engine is of the gasoline-operated, two-cylinder, four-cycle type, developing 24 hp.

(2) *Removing the starting engine.* (a) Drain the oil from the starting engine transmission and

crankcase and drain the Diesel engine cooling system. Disconnect the carburetor control rod (6, fig. 204) and the fuel line at the carburetor. Remove the nuts holding the inlet and exhaust manifold assembly (4) to the starting engine and to the Diesel engine inlet manifold elbow (5). The starting engine manifold, carburetor, and air cleaner may then be lifted off as an assembly. Remove the capscrews that hold the Diesel engine air cleaner to the inlet manifold elbow. Remove the Diesel engine cleaner clamp nut (1), swing the clamp forward and lift off the Diesel engine air cleaner.

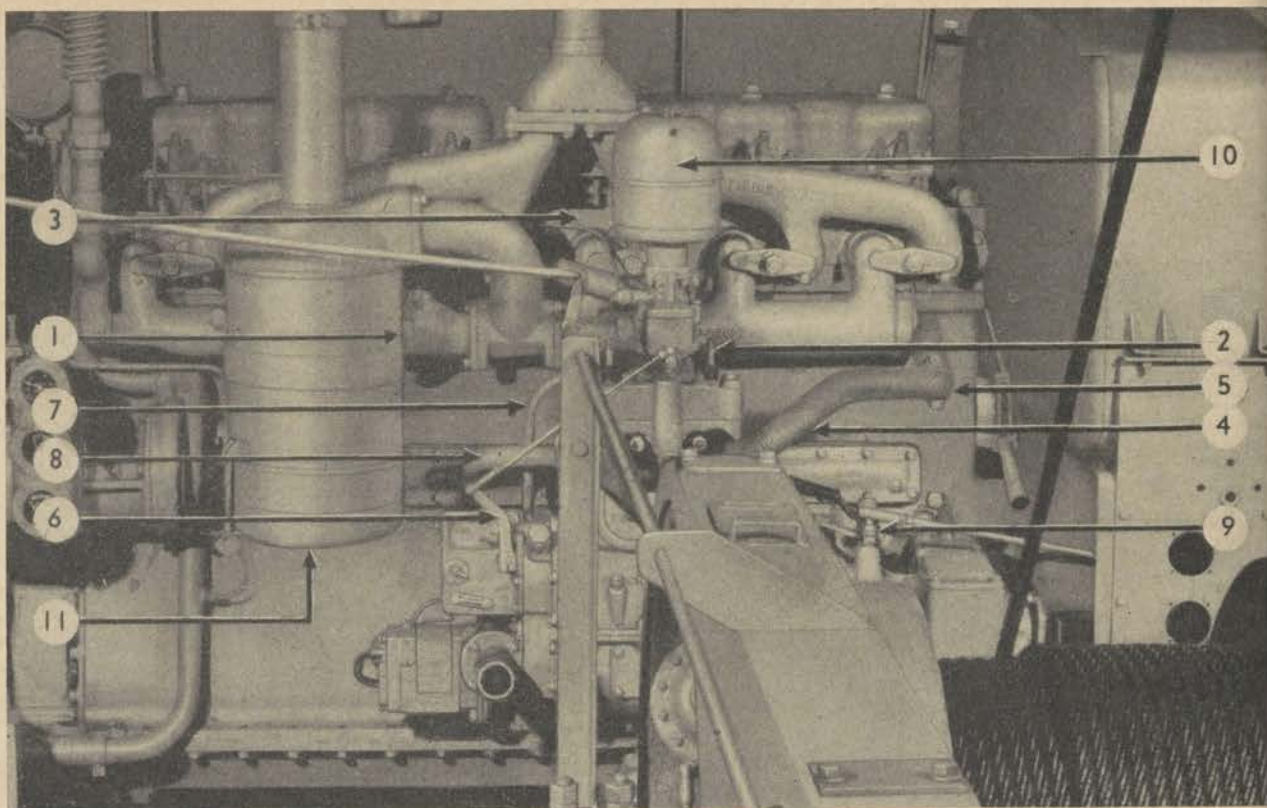
(b) Remove the inlet and outlet water connection pipes (8) and (3) to the diesel engine. Take off the wiring conduit (7) and spark plugs (2). Also disconnect the control rod from the pinion engaging lever (9).

(c) Take off the starter pinion control housing which is attached to the rear flange of the diesel engine flywheel housing. After removing the cotter pin and nut, take off the cylindrical guard that covers the starter pinion latch. If the starter pinion is meshed with the flywheel ring gear, press on the two latches to disengage the pinion from the flywheel.

(d) Remove the capscrew holding the starting engine transmission housing to the flywheel housing of the Diesel engine. Remove the three capscrews and cover over the starting engine flywheel. Support the weight of the starting engine with a hoist, and remove the remaining capscrews holding the starting engine to the Diesel engine cylinder block.

(e) Pull the front end of the starting engine away from the Diesel engine far enough for the flywheel to clear the rib. Move it forward until the starter pinion and latch assembly clean the opening in the flywheel housing. Hold the two flanges at the rear of the transmission together so the starter pinion shaft will not be pulled out of the transmission. Lift out the starting engine.

(3) *Reinstalling the starting engine.* When installing the starting engine, it is recommended that a new gasket be used between it and the Diesel engine. Clean the gasket surfaces and cement the gasket in place on the starting engine. Allow the cement to set and then coat the surface of the gasket with grease. Maneuver the starting engine into place, taking care to avoid damaging the gasket.



1. Diesel engine air cleaner clamp nut.
2. Spark plugs.
3. Water connection between diesel engine cylinder head and starting engine cylinder head.
4. Inlet and exhaust manifold assembly.
5. Diesel engine inlet manifold elbow.
6. Carburetor control rod.
7. Wiring conduit.
8. Inlet water pipe.
9. Pinion engaging lever.
10. Starting engine air cleaner.
11. Diesel engine air cleaner.

Figure 204. Starting engine.

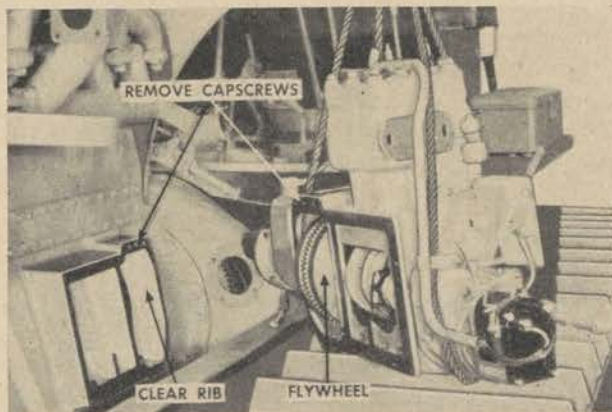


Figure 205. Removing starting engine.

(4) *Starting engine repairs.* (a) *Valves and valve mechanism.*

1. *General.* Compression pressure losses occur when the valve faces and seats become pitted. Check valves occas-

ionally to see that they are seating properly. Do this by rocking the starting engine against compression. If the cylinder head gaskets and piston rings are in good condition and the engine does not "rock back" against compression, it is likely that the valves and seats should be refaced and re-ground.

2. *Valve inspection and reconditioning.*

- (a) With the starting engine removed from the engine, take off the nuts holding the cylinder head to the cylinder block, and remove the cylinder head.
- (b) With a valve spring compressing tool, compress the spring (fig. 206) until the locks can be removed from the retainer. Lift

out the valve and remove the retainer and spring.

- (c) Inspect the valve seats in the cylinder block and the faces of the valves as outlined in the Diesel engine section. Recondition them, if needed. If the faces of the valves are pitted or warped, replace them with new valves.

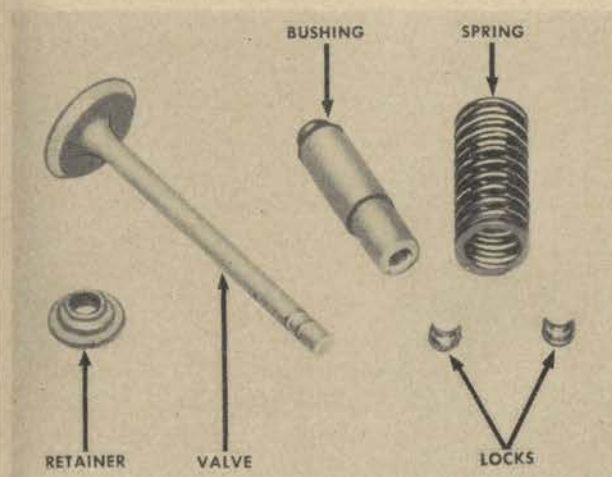


Figure 206. Valve assembly.

- (d) Clearance between a new valve stem and a new bushing is 0.002 to 0.004 inch, with a worn limit of 0.005 inch for inlet and 0.007 inch for exhaust valves. If the valve stem bushings are worn, replace them with new bushings. After taking out the capscrews and locks that hold the valve lifter and guide assembly in place, remove it. (See fig. 207.) Using a drift shaped to fit the bore of the bushing drive each bushing down out of the cylinder block.

3. *Bushings.* New replacement bushings are finished to the proper bore dimension and require no reaming after installation. When installing new bushings, press them down into the cylinder block with the inserting tool until the top of each bushing is $1\frac{3}{16}$ inches

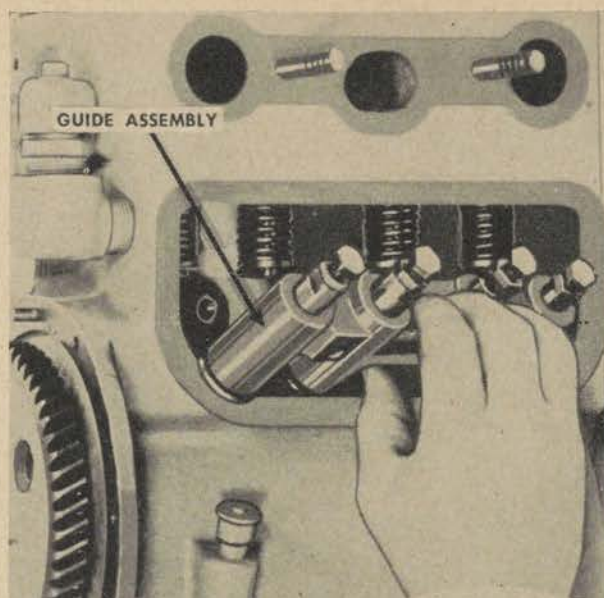


Figure 207. Removing valve guide and lifters.

below the top of the cylinder block or the distance (A). (See fig. 208.) If a longer exhaust valve bushing is used, press it in until the bottom of the bushing is even with the bottom of the inlet valve bushing.

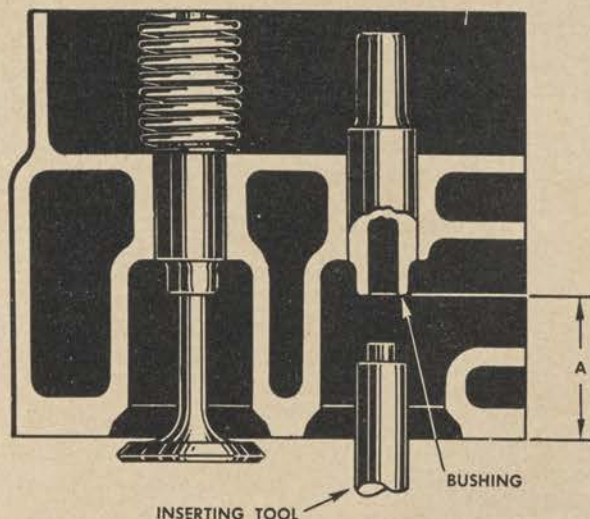


Figure 208. Installing valve stem bushing.

4. *Reassembly.* Carefully clean the parts of the valve mechanism before reassembling them. When reassembling, check to see that the locks are correctly installed in the lock retainer. Coating the inside of the locks with heavy

grease facilitates installation. When reinstalling the cylinder head on the block, replace the cylinder head gasket with a new part.

5. *Valve clearance adjustment.* Make the valve clearance adjustment while the engine is hot. Crank the engine until the valve closes and the valve lifter is at its lowest point. Loosen the lock nut on the valve adjusting screw and turn the screw until there is 0.008-inch clearance between the end of the valve stem and the head of the adjusting screw. Tighten the lock nut and check the adjustment.

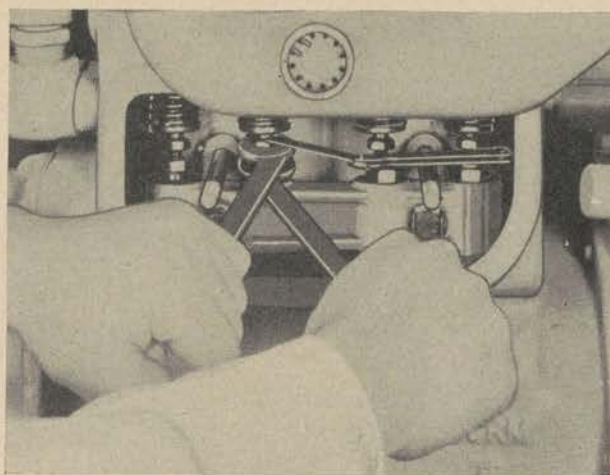


Figure 209. Valve clearance adjustment.

(b) *Piston, rings, and connecting rods.*

1. *Removal.* The piston and connecting rod assembly can be removed from the top of the cylinder block after removing the cylinder head and connecting rod bearing caps. An engine that shows a loss of power, excessive oil consumption, and loss of compression may need to have the cylinder bores reconditioned. While the piston is removed, it is a good practice to gage the cylinder bore for possible out-of-round (eccentricity) and wall taper. If the cylinder bore shows an out-of-round of more than 0.005 inch or a taper of more than 0.010 inch, the cylinder bore should be reconditioned and new pistons and rings installed.

2. *Pistons.* Measure the piston clearance on the thrust side of the piston with a thickness gage. The piston skirt clearance of a new piston should be 0.006 to 0.008 inch. Thoroughly clean the piston surfaces and ring grooves before installing rings or replacing pistons in the cylinder. The most satisfactory method of cleaning these pistons is to follow the recommendations outlined for cleaning the diesel engine pistons.

3. *Rings.* New compression rings should have 0.0015 inch to 0.003 inch side clearance, and oil rings should have 0.001 to 0.0025 inch clearance, in the ring groove. After installation on the pistons, the rings should be free in the grooves so they can be rotated without binding. The ring cap for the compression rings and oil control rings should be 0.012 to 0.020 inch. Take this measurement at the smallest diameter of the cylinder bore.

4. *Piston pin bushing.* It is not always necessary to replace piston pin bushings whenever new precision bearing shells are installed in a connecting rod. In many cases, bushings may be serviceable even though the second replacement of bearing shells has been made. After removing the oil from the pin and bushing, it is possible to feel the clearance between them. Install a new bushing only when the clearance exceeds 0.003 inch.

A new piston bushing must be finished to the correct size after it is pressed into the connecting rod and the oil hole drilled. New connecting rods have the piston pin bushing bored in a special machine which maintains the proper center-to-center distance and parallelism of the connecting rod bearing and piston pin bore. Recondition rods in the same manner. A new connecting rod makes the best templet for center-to-center distance. The piston pin should be a thumb push fit in the connecting rod bushing and piston, at normal room temperature (70° F).



Figure 210. Checking piston pin bushing.

Never force the piston pin into the piston. Replace the piston assemblies in the same cylinders from which they were removed. The connecting rods are marked on the camshaft side to assure correct assembly. Cylinder No. 7 is located at the timing gear end of the engine.

5. *Connecting rod bearings.* Precision babbitt-lined bearing shells are used. These bearings do not require fitting, and they may be removed and replaced through the inspection opening of the crankcase pan. New bearing clearance is 0.0025 to 0.0035 inch. Before inserting a new bearing, always check the crankshaft bearing surface to see that it is not scored or damaged. Bearings 0.020 inch undersize are serviced for reground crankshafts. When replacing the bearings, check to see that the protruding portion on the back of each bearing half lines up with its corresponding groove in the connecting rod and bearing in cap. This

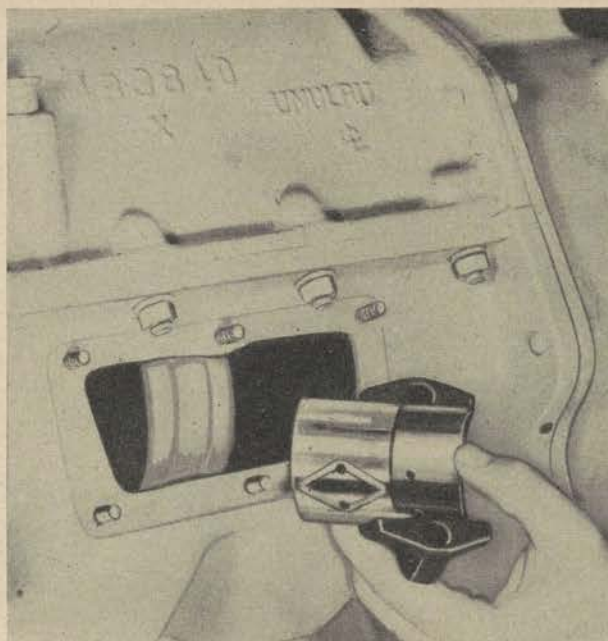
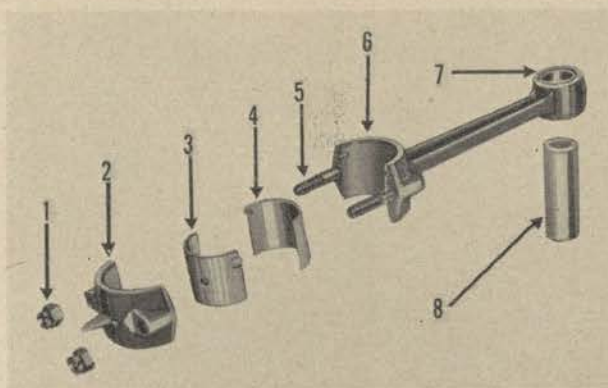


Figure 211. Connecting rod bearing and cap.



1. Connecting rod bolt nut.
2. Connecting rod bearing cap.
3. Lower bearing shell.
4. Upper bearing shell.
5. Connecting rod bolt.
6. Connecting rod bearing.
7. Piston pin bushing.
8. Piston pin.

Figure 212. Connecting rod assembly.

locks the bearing in place and keeps it from rotation.

- (5) *Fuel system.* (a) *General.* The starting engine gasoline tank, mounted on the radiator end of the Diesel engine, supplies fuel to the carburetor on the starting engine by gravity feed. Air, entering the carburetor through an air filter, mixes with the fuel in the carburetor and is supplied to the cylinder through the intake manifold.

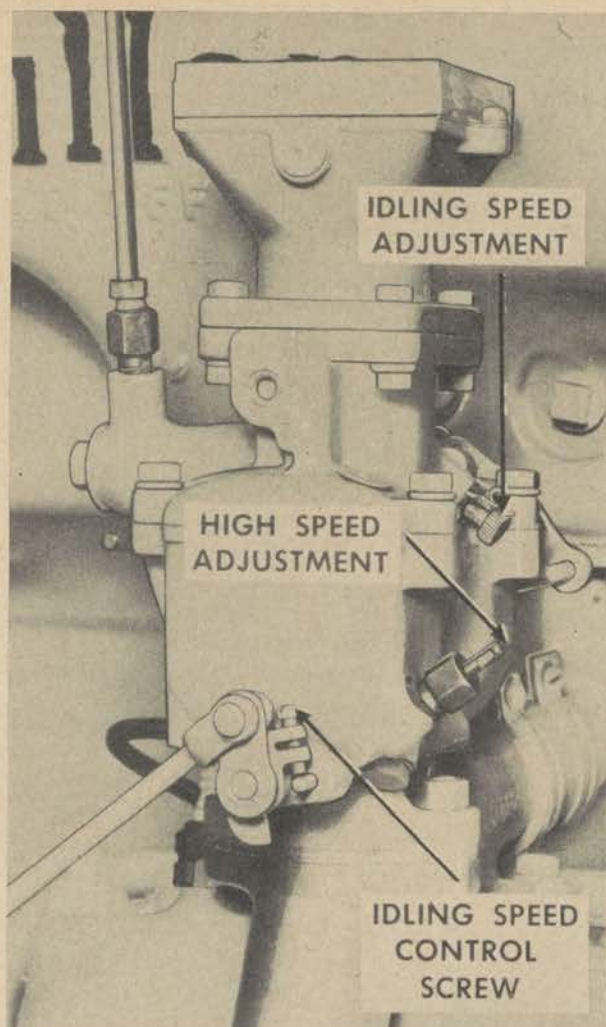


Figure 213. Carburetor adjustment.

(b) *Carburetor adjustment.* To obtain an approximate adjustment, turn the high speed adjusting screw one turn from the closed position. Turn the idling speed adjusting screw two turns from the closed position. Start the engine and allow it to warm up. A more accurate adjustment can be obtained by turning the high speed screw out to make the adjustment richer, or in to make it leaner. Adjust this screw to a point that will give the greatest amount of power with a clear exhaust. Turn the idling speed adjusting screw to a point where the engine will idle regularly at slow speed without emitting black smoke from the exhaust. Turn this screw in to make the mixture richer, or out to make it leaner. Turn the idling speed control screw to the left (out) to decrease the idling speed, or to the right (in) to increase it.

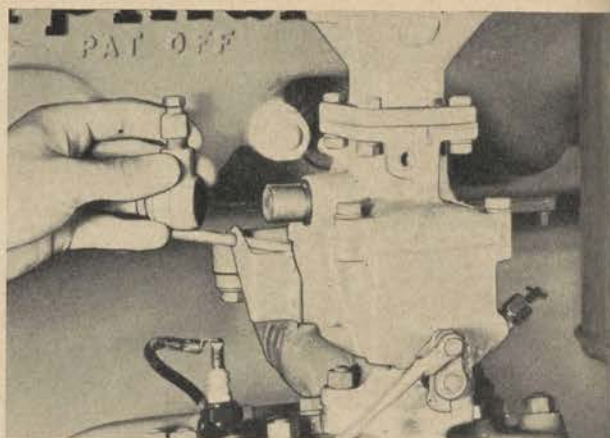


Figure 214. Removing fuel line screen.

(c) *Sediment bowl and filter.* The sediment bowl collects water and sediment that may be in the fuel. To remove the collected water and sediment, close the valve under the fuel tank and remove the bowl by unscrewing the nut that clamps it to the body of the valve. Unscrew the edge type filter and shake it in kerosene or some noninflammable washing fluid. When replacing the bowl, see that the gasket is clean, is in the correct position, and is not broken. Remove the fuel line screen in the carburetor and clean it whenever servicing the sediment bowl. Do this by removing the screw that holds the body assembly in place over the screen and stud; then remove the body assembly and slide the fuel line screen off the stud. Occasionally remove the drain filter on the starting engine inlet manifold and inspect the filter element. If it is deteriorated, replace it.

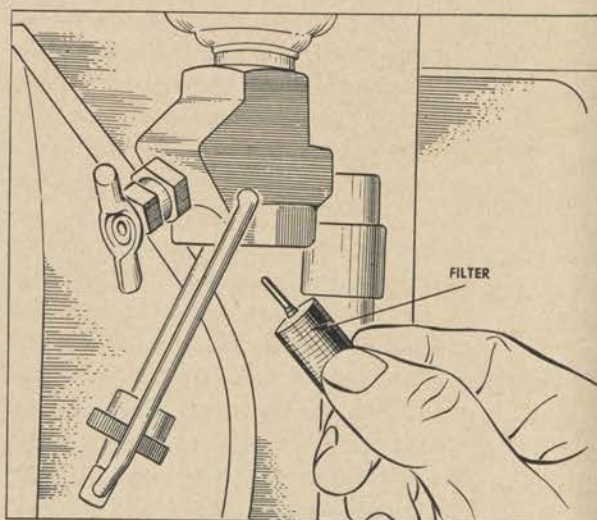


Figure 215. Starting engine sediment bowl filter.

(d) *Carburetor.*

1. *Type.* The starting engine is equipped with a downdraft carburetor of the double venturi type.
2. *Removal.* Disconnect the fuel line from the inlet body. Drain the bowl by removing the plug in the base. Remove the air cleaner and adapter assembly and the throttle control rod. Remove the nuts which attach the carburetor to the inlet manifold and lift off the carburetor.

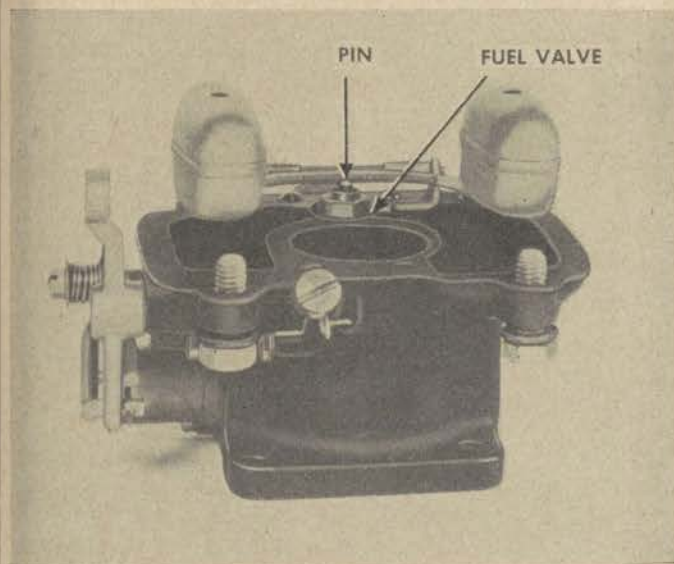


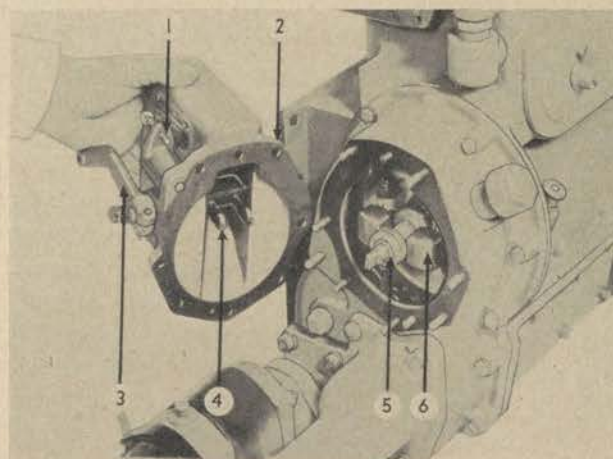
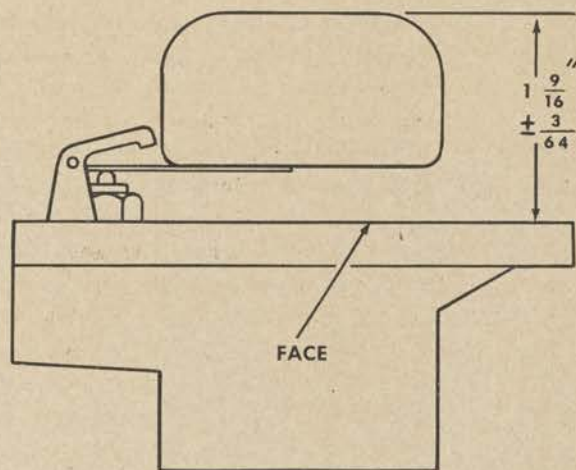
Figure 216. Float replacement.

3. *Float assembly.* If the fuel valve leaks as evidenced by the fuel leaking out of the intake manifold breather on the starting engine, inspect the seat of the valve assembly after removing the pin and float assembly. Clean any foreign material from the seat or if worn, replace the valve assembly. If a measurement of $1\frac{9}{16}$ inches does not exist between the face of the air intake assembly (without gasket) and the float as shown, replace the float assembly.
4. *Replacing carburetor gaskets.* When replacing the carburetor on the starting engine, fit a new gasket between the two bodies of the carburetor flange. Install a new gasket between the two bodies of the carburetor whenever the

bodies are separated, or if fuel leakage is evident.

(e) *Governor.*

1. *Description.* The governor weights (6, fig. 217) are attached to the camshaft gear in the timing gear housing. The governor spring is located in the governor control housing (2). The rotation of the governor weights sets up a force through the sliding sleeve (5) and governor control lever (4) to act against the tension of the governor



- | | |
|-----------------------------|----------------------|
| 1. Low idle latch. | 4. Governor. |
| 2. Housing. | 5. Sliding sleeve. |
| 3. Carburetor control lever | 6. Governor weights. |

Figure 217. Removing governor control housing.

spring. Since action of the lever is transmitted through the carburetor control lever (3) and rod to the carburetor, the position of the sliding sleeve and lever arrangement determines the opening of the carburetor throttle shutter. Thus the engine speed is governor-controlled at all times except at low idle. At low idle the control rod is held in a fixed position by swinging the low idle latch (1) down to limit the forward travel of the carburetor lever (3).

2. *Replacing control lever packing.* Fuel leakage through the carburetor control lever can be corrected by installing new packing. Remove the carburetor control lever after loosening the capscrew that holds it to the shaft. Withdraw the washer and packing from the counterboard hole in the housing. Insert new packing and replace washer. Place the key on the shaft and clamp the control lever.

3. *Low idle speed adjustment.* The low idle speed is controlled by the adjusting screw in the lever (fig. 218) on the carburetor. Set the adjusting screw for a low idle speed of approximately 800 rpm. Then adjust the set screw in the latch so that the low idle speed adjusting screw will be held against the stop. The governor controls the speed of the engine when the latch is thrown back away from the governor lever.

4. *High idle speed adjustment.* The high idle speed is controlled by the governor spring. (See fig. 219.) Increasing the tension on the spring increases the high idle speed, while decreasing the tension decreases the speed. Loosen the lock nut and turn the adjusting nut on the front of the governor spring housing until the correct idle speed of 2,850 rpm is obtained. If the starter pinion latches disengage before the Diesel engine starts, adjust the starter pinion latches ((7) below). If the governor has a tendency to "surge" or "hunt," the condition can

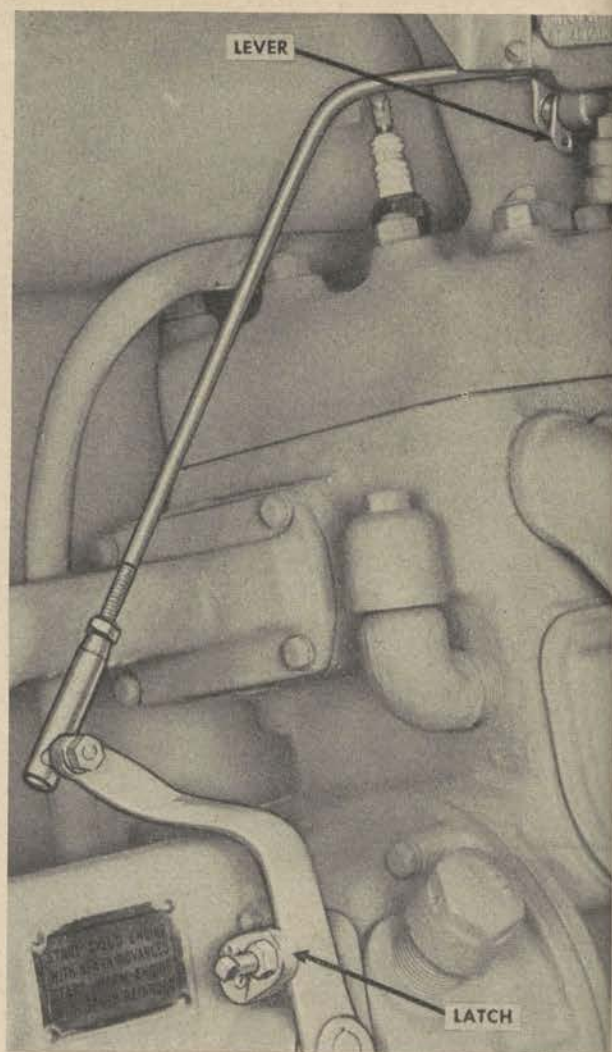


Figure 218. Low idle speed adjustment.

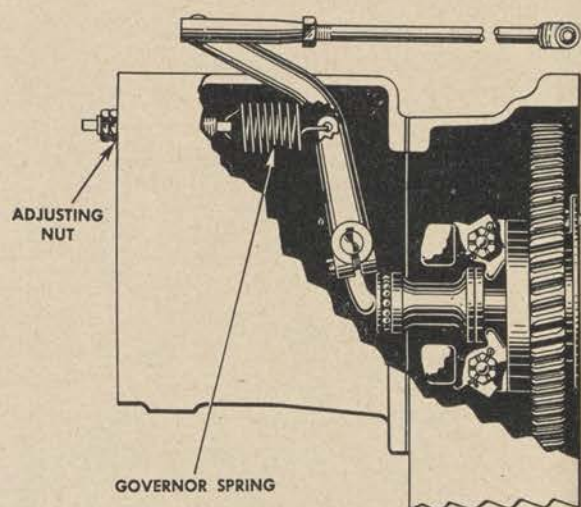


Figure 219. Governor control mechanism.

usually be corrected by freeing the linkage or by changing the length of the control rod from the governor to the carburetor throttle shutter.

(6) *Intake air system.* (a) *Manifolds.* The inlet manifold (4, fig. 204) distributes the air-fuel charge to the engine cylinders. It is important that the air intake system from the manifold flanges to the air cleaner on the carburetor be kept free of any air leakage.

1. *Removing manifolds.* The manifold is removed from the engine by taking out the nuts holding the unit to the cylinder heads and to the heater pipe elbow assembly.

2. *Replacing gaskets.* Whenever the manifold is removed from the starting engine, install new gaskets between manifold flange and cylinder head inlet part, and manifold flange elbow assembly.

(b) *Air cleaner.* Air entering the carburetor first passes through a filter, which is removed by lifting out of the carburetor intake.

1. *Washing air cleaner.* Unscrew the nut at the top of the dome and remove the filter section from the oil cup. Wash by shaking the filter section in a pan of kerosene or authorized washing fluid. Wash and refill the oil cup and reassemble the air cleaner.

2. *Replacing gasket.* The connection between the air cleaner and carburetor must be kept air tight. Before replacing the air cleaner on the carburetor, examine gasket carefully, replacing if worn or cracked.

(7) *Starting mechanism.* (a) *Description.* The starting engine transmits its power through a single plate clutch and a two-speed transmission to a sliding pinion which is engaged with the Diesel engine flywheel gear by means of a hand lever. The pinion is automatically disengaged by centrifugal force acting on the pinion latches when the Diesel begins to operate under its own power.

(b) *Clutch.* It is important to maintain the starting engine in proper adjustment, as described below. This will assure longer clutch facing wear, and more satisfactory starting of the Diesel engine.

Note. Neglecting to drain the starting engine clutch compartment periodically may cause the clutch facings to be damaged by oil.

(c) *Clutch adjustment.* To test the adjustment, pull the clutch lever to the engaged position. The lever should go into this position with a distinct snap, and should require a reasonably hard pull. To adjust, remove the plate from the side of the clutch compartment. Turn the clutch adjusting collar until the lock pin is accessible. Pull the lock pin out and turn the collar to the right until the lock pin drops into the next hole. Test adjustment by engaging the clutch. If one hole gives a slightly loose adjustment and the next gives too tight an adjustment, use the looser adjustment. Test the clutch frequently and adjust when needed. If oil is noticed in the housing, remove the plug to drain the compartment.

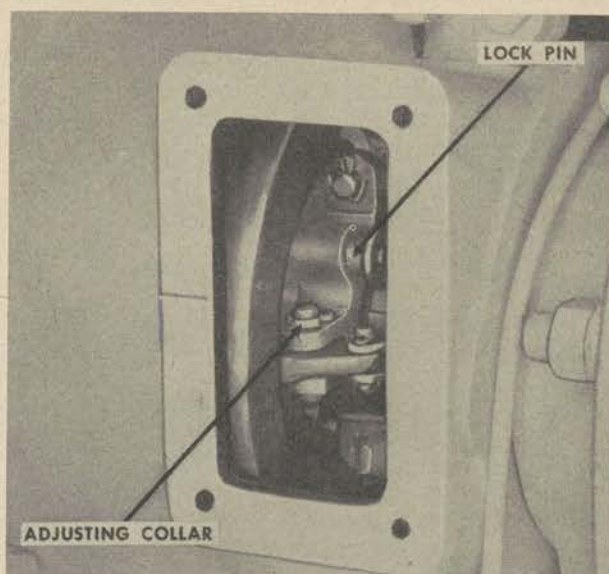


Figure 220. Starting engine clutch adjustment.

(d) *Clutch removal.*

1. With the starting engine off the Diesel, remove the transmission and starter pinion assemblies as a unit from the clutch housing.

Caution: If the transmission is not to be disassembled, take care not to allow the starter pinion shaft to slip out of the transmission.

2. Remove the capscrews holding the clutch housing to the cylinder block. Lift up on the clutch housing so the clutch driving plate will slide out of the fly-

wheel, and withdraw the clutch housing and clutch assembly as a unit from the starting engine. The clutch shaft is piloted in the flywheel on a roller bearing.

(e) *Clutch disc replacement.* The adjusting collar (fig. 220) is threaded onto the hub of the front pressure plate. Pull out on the adjusting collar lock pin and back the collar away from the front pressure plate until the key can be lifted out of the front pressure plate hub and shaft. Slide the entire clutch assembly from the shaft. With the clutch assembly off the shaft, the adjusting collar may be backed the rest of the way off. If the front or rear pressure plates are scored, replace them with new plates. New clutch facings (discs) may be riveted to the clutch plate or, if the plate is worn or damaged, replace it with a new lined plate assembly.

(8) *Cooling system.* (a) *Description.* Cooling water for the starting engine is provided by an inlet pipe (fig. 204) from the Diesel engine block which carries coolant to the cylinder head of the starting engine. Heated water from the cylinder heads is conducted by an outlet pipe to the Diesel water inlet, thus assisting in starting the Diesel engine.

(b) *Gaskets.* Whenever the starting engine is removed from the Diesel, or whenever water leakage is evident, replace gaskets at inlet and outlet water pipe flanges.

(9) *Lubrication.* (a) *Description.* The starting engine is lubricated by the splash system, lubricating oil being stored in the crankcase of the starting engine. Lubrication of the transmission is independent of the engine system; for supplying the lubricating oil, remove a separate oil filler plug in the transmission case.

(b) *Washing crankcase.* Remove the drain plugs while the engine is warm. Replace the plugs and refill the crankcase with $1\frac{1}{2}$ quarts of flushing oil. Run the engine 3 minutes and drain. Refill with fresh crankcase lubricating oil.

(c) *Washing transmission.* Whenever changing the grade of oil for the transmission, in accordance with cold and hot weather operations, wash the starting engine transmission case. Remove the drain plug after the engine has been turning the transmission gears and the oil has warmed up. After the oil has drained, replaced the plug and fill to the normal level with kerosene. Allow the

engine to turn the transmission gears for several minutes, then remove drain plug. After all washing fluid has been drained, replace plug and refill case with proper grade of oil.

(10) *Ignition.* (a) *Description.* The starting engine ignition system is composed of a magneto which supplies current to each of the spark plugs in the two cylinders of the engine.

(b) *Spark plugs and wires.* Once monthly, remove spark plugs and clean them of carbon accumulation between electrodes. Measure the gap with a thickness gage and keep it at approximately 0.022 inch. To adjust the gap, bend the outer electrodes. Check wires from the spark plugs to the magneto to see that they are in good condition, that insulation is unbroken, and that terminals and clips are making good contact. Replace wires if any deterioration is indicated.

(c) *Adjusting contact points.* First remove the cables from the spark plugs. Then remove the distributor plate and lift out the distributor rotor. To check the adjustment it is necessary to release the impulse starter pawl. Do this by removing the plug screw in the side of the magneto housing and inserting a nail or stiff wire in the hole as the engine is cranked slowly. The nail depresses the short end of the pawl and releases it from the catch plate.

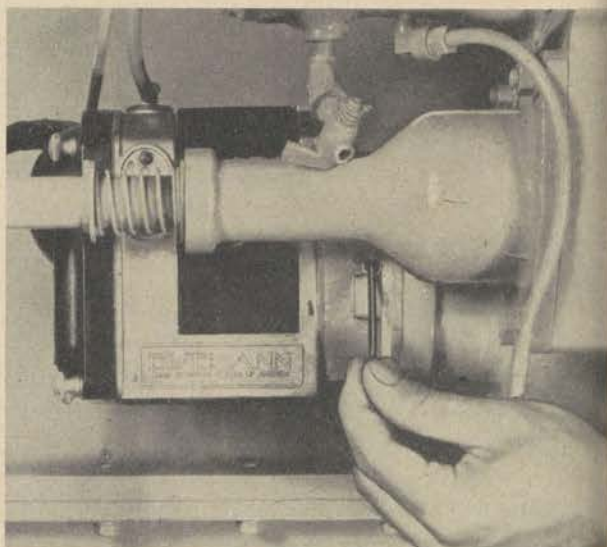


Figure 221. Tripping impulse starter.

Turn the crank until the bumper block is on the highest elevation of the cam. Check the clearance with a thickness gage. This should be 0.020 inch. To adjust, loosen the screw (fig. 222)

which secures the adjustable contact point bracket and move the bracket by inserting a screwdriver in the space between the head of the screw and the lip of the bracket. Then tighten the screw and recheck the adjustment.

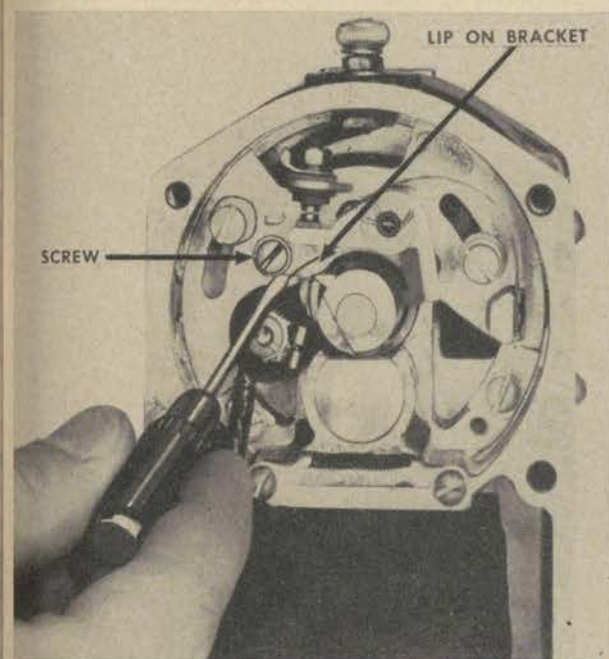


Figure 222. Adjusting magneto gap.

(d) *Testing.* A magneto may be tested when coupled to the engine by turning the switch ON, removing the cable from the spark plug, and holding the terminal $\frac{1}{8}$ inch (3.17 mm) away from the metal part of the plug while the engine is being cranked. If no spark passes from the cable to the plug body, disconnect the magneto switch wire from magneto and test again. If the magneto fails to fire, remove the magneto, cables, spark plugs, and switch and take them to the nearest shop for testing.

(e) *Removing magneto.* Disconnect the cables from the spark plugs and the wire from the switch. Remove the ignition wire conduit by removing the clips that hold it to the engine. Remove the magneto by removing the nuts or capscrews that hold it in place. Earlier machines have a metal strip around the magneto that must also be removed.

(f) *Cleaning.* Remove the distributor plate by loosening the screws. (See fig. 223.) Using a clean soft cloth dampened with gasoline, carefully clean the inside of the plate of carbon dust. Replace the gasket if damaged. Pull the rotor from the shaft and clean both sides.

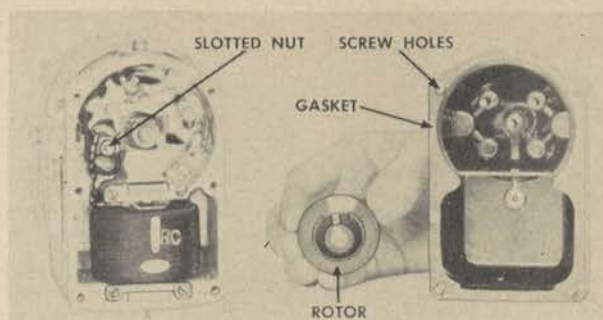


Figure 223. Cleaning distributor and rotor.

(g) *Replacing breaker assembly (fig. 224).* In order not to disturb the spark advance fork stops (2) when removing the breaker assembly, take off the spark advance lever (9), and plate (8), and then the lever assembly (7). Remove the slotted head screws (1) and pull out the breaker assembly (4) after removing the lead (3) from the condenser post. The breaker assembly is replaceable as a unit. The lever assembly (7) is provided with tungsten contact which can be pressed out and replaced with a new rivet. If the lever assembly cam service is worn, replace the lever itself. Before replacing the breaker assembly, adjust the unit as described below.

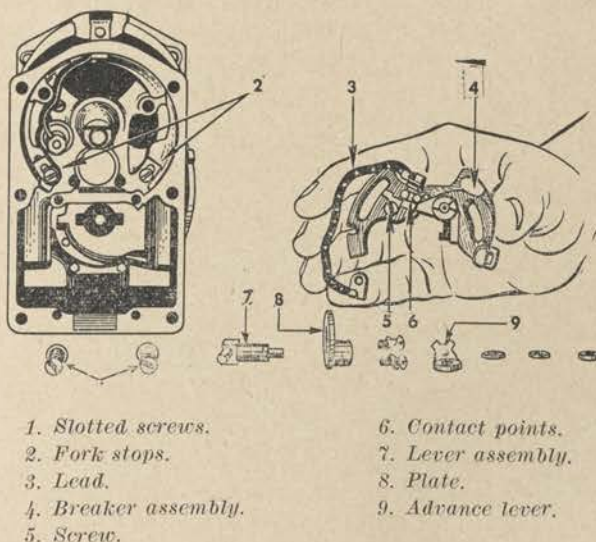


Figure 224. Breaker assembly.

(h) *Adjustment.* Insert a 0.020-inch feeler gage between the contact points (6) after positioning the breaker lever bumper block on a high point of the cam. To adjust the gap, loosen the screw (5) which secures the adjustable contact point

bracket and move the bracket by inserting a screw driver in the space between the head of the screw and the lip on the bracket. Move the bracket to obtain a 0.020-inch gap. Tighten the screw (5).

(i) *Timing.* To obtain maximum spark intensity when the breaker points separate, and to insure proper timing, position the induction rotor with respect to the breaker plate. Remove the plate and gasket covering the inspection holes in the base of the housing. With the magneto lying on its side so the top is toward the operator and the impulse starter is to the right, insert the shank of a No. 31 drill (0.1200-inch diam.) or a 1/8-inch drill through the upper hole. Turn the impulse starter the reverse of the operating direction until the drill is locked lightly between the inductor rotor and lower pole-shoe. Loosen the fork stop screws (2, fig. 224) and shift the breaker plate until the contact points just start to separate. To check this, use a 6-volt "split lamp circuit," or draw a piece of cigarette paper between the contact points. This is the maximum spark advance position. Lock the fork stop against the breaker plate on the opposite side of the magneto from the advance lever. This limits the travel of the breaker plate. To obtain the retard position, rotate the breaker plate counterclockwise 3/8 inch or 15° and lock the fork stop adjacent to the advance lever.

(j) *Replacing seal.* With the distributor cover removed, inspect the seal carefully to insure that no leakage is possible. Use a new seal to prevent the starting engine oil from entering the magneto.

(k) *Timing magneto to engine.* Carefully check the contact points for the proper opening. Locate the firing of No. 1 cylinder by removing the cover from the side of the starting engine clutch housing and the spark plug from No. 1 cylinder. Hold a finger over the spark plug hole and turn the crank slowly until noting a rush of air coming from the cylinder. This indicates that the piston is coming up on the compression stroke. Observe the side of the flywheel, and turn the crank slowly until the mark M or MAG is even with the mark on the housing. The crank on No. 1 cylinder is now 25° ahead of top center on the compression stroke, which is the correct firing point. Remove the small cover at the end of the magneto by taking out the two small fastening screws. Release the impulse starter pawls and turn the magneto shaft until the white line on the distributor gear lines up with the pointer in the end plate

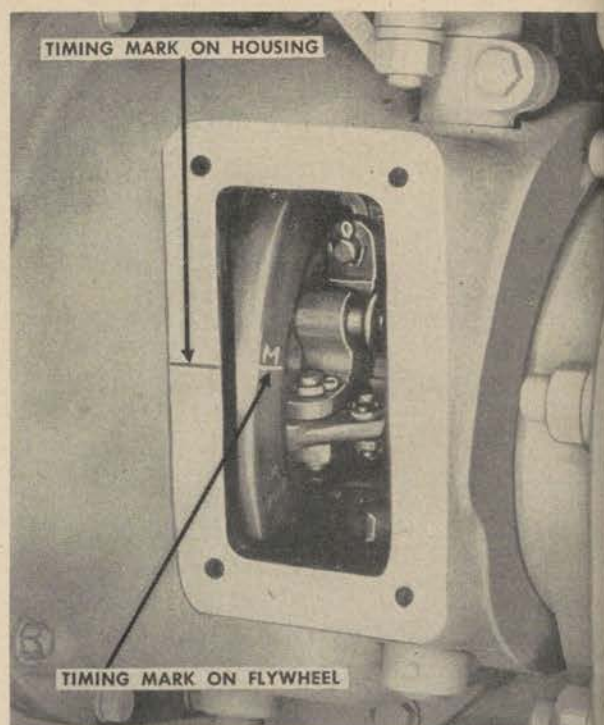


Figure 225: Starting engine magneto timing marks.

casting. At this point the distributor rotor should be in contact with the conductor which is connected by wire to the spark plug of No. 1 cylinder, and the contact points should be barely separated. Slide the magneto into position and bolt in place. Check the location of the rotor before replacing the rear cover to be sure it has not changed its position.

i. **MAIN ENGINE FLYWHEEL CLUTCH.** (1) *Description.* The clutch, mounted on the flywheel end of the main engine, is operated through linkages by means of a hand lever located near the radiator. (See fig. 76.) With the engine running and the clutch engaged, drive is imparted to the hoist drums, main generator, and compressor.

(2) *Testing operation of clutch.* Pull the clutch lever to the engaged position. The lever should go into position with a distinct snap and should require a reasonably hard pull.

(3) *Adjusting the clutch.* Set the lever to the disengaged position (lever towards fuel tank). Loosen the nut on the adjusting collar clamp bolt and turn the adjusting collar a few degrees in a clockwise direction, then tighten the clamp bolt (fig. 226) before testing for correct adjustment.

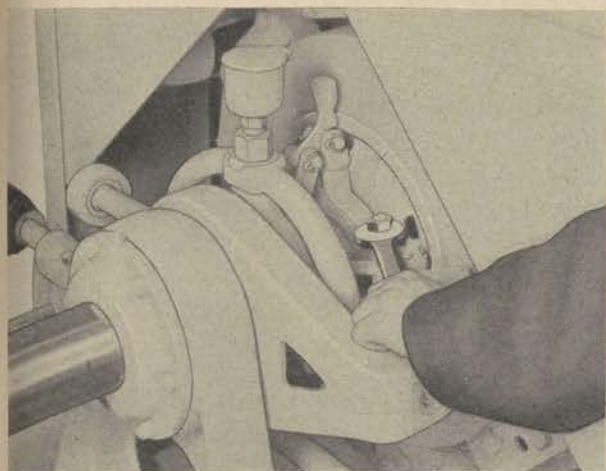


Figure 226. Adjusting flywheel clutch.

Repeat this adjustment until the satisfactory clutch snap is obtained.

45. Air Compressor

a. GENERAL. The air compressor is of the vertical single cylinder, air-cooled type, having a $4\frac{1}{4}$ -inch bore and 4-inch stroke. It supplies air under pressure for the pneumatically operated main hoist friction clutches. The main Diesel engine drives the compressor by means of three V-belts from a pulley on the engine drive shaft to a pulley on the compressor. Air is drawn in through an air filter attached to the suction side of the compressor, then through the compressor where it is piped from the exhaust side to the air receiver tank, and thence to the pneumatically operated main hoist friction clutches. Air pressure is regulated by means of a pipe that feeds air back from the air receiver through the pressure regulator (constant speed control) to the top of the cylinder head.

(1) *Constant speed control.* The constant speed control (pressure regulator) allows the compressor to run continuously after it is started, unloading and reloading the compressor according to demand. Unloading is accomplished by the automatic unloader and trigger valve.

(a) *Automatic unloader.* The automatic unloader is a spring loaded, air-operated plunger operating within a cylinder which is secured to the compressor cylinder head. When depressed by air pressure, it holds the suction valve off its seat, thus unloading the compressor.

(b) *Trigger valve.* Admission of air to, and release of air from, the automatic unloader is con-

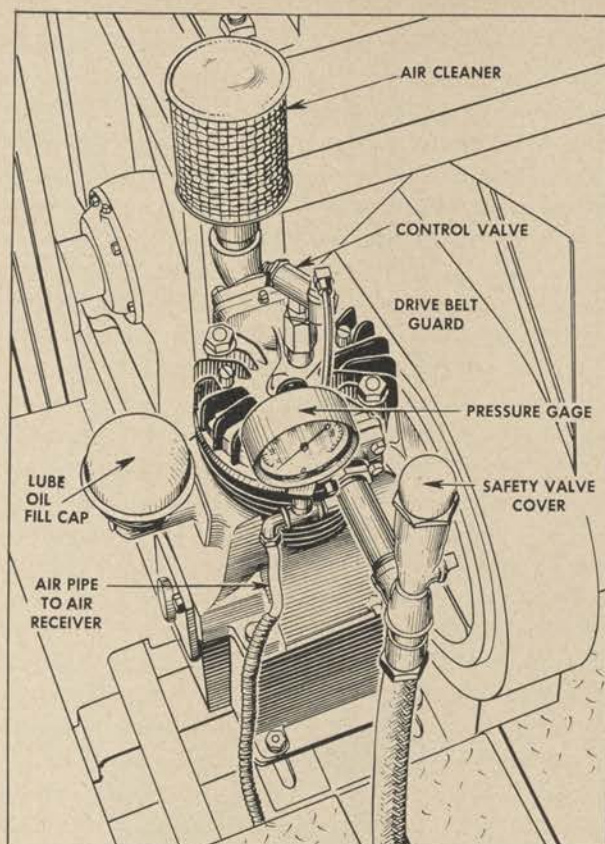


Figure 227. Air compressor.

trolled by the trigger valve located above the automatic unloader.

(2) *Pressure gage.* The pressure gage, located between the trigger valve and the air receiver, indicates the operating air pressure in the system. Be sure that the pressure is not below 65 pounds when the hoist is in operation.

(3) *Safety valve.* The safety valve, located on the exhaust side of the compressor, is set for 75 pounds pressure. When the air pressure reaches or exceeds 75 pounds pressure, the compressor is automatically unloaded to atmosphere.

(4) *Air receiver.* The air receiver, located below the engine deck, is used to store air from the compressor.

(5) *Air filter.* The air filter, located on the suction side of the compressor, is used to provide clean air to the air compressor.

(6) *Oil filter and fill cap.* The oil filter, located on the breather side above the oil pump, is used to replenish lubricating oil in crankcase.

b. AIR COMPRESSOR REMOVAL. Disconnect the air return line from the suction valve on the com-

pressor cylinder head to the air receiver by unscrewing the union at the compressor. Disconnect the air supply line from the compressor by unscrewing the female union at the end of the flexible hose where it is connected to the compressor just below the safety valve. Remove foundation bolts from compressor skids. Lift the air compressor out and remove the discharge line complete with safety pop valve and flexible hose, by unscrewing the 1¼-inch hex bushing at suction side of air compressor. To install a new air compressor, reverse procedure for removal.

c. AIR COMPRESSOR MAINTENANCE. (1) *Failure to build up pressure.* This condition may arise from several causes such as leaky head gaskets, leaky discharge pipe or relief valve, and leaky or broken feather valve strips in the compressor. Leaky gaskets at the cylinder head may be caused by a defective gasket or loose cylinder head bolts. Replace the defective gasket or tighten the cylinder head bolts after the compressor has reached running temperature. Leaking at the discharge flange gasket is caused by misalignment or defective gasket. It may also be due to discharge flange supporting the weight of the discharge line, which can be relieved by external support. Broken or improperly seated feather valve strip will prevent building up a pressure. Replace the feather valve strip by following the procedure outlined in (6) below.

(2) *Compressor vibrations.* Vibration in the whole unit is usually caused by improper foundation bolting. Check and wrench tighten all foundation bolting, being careful not to cause misalignment of the compressor unit.

Note. Do not use any method of wrench extension to gain leverage bolt pull. Wrench tighten bolts carefully to avoid any stripping of threads, or shearing of bolts or studs. Make sure nuts are threaded on properly, and that all surfaces are clean and clear of foreign matter to prevent seating. Hand-tighten bolts first to insure surfaces will be brought together evenly.

Vibration may be caused by running the multi-V-belts at improper tension. Check belting carefully (14) below.

(3) *Constant speed control.* This assembly consists of the trigger valve and automatic unloader.

(a) *Removal.* Remove the trigger valve by disconnecting the outlet unions and unscrewing from the automatic unloader. Unscrew the automatic unloader from cylinder head. Replace un-

loader gasket and the constant speed control by following the reverse procedure for removal.

(b) *Adjusting trigger valve.* The pressure at which the trigger valve operates is regulated by the adjustment screw which is held in place by the spring retainer lock nut. Drop in pressure between points of unloading and loading is determined by the travel of the trigger valve plunger and by the adjustment of the set screw. The set screw is adjusted at manufacture; do not tamper with it unless it becomes stopped up with dirt. If the drop in pressure becomes too small, reduce the travel of the trigger valve plunger by adjusting the spring retainer and relocking with the trigger valve lock nut. The greater the travel of the trigger valve plunger, the smaller is the drop in pressure between points of loading and unloading, and vice versa. If it is necessary or desirable to keep the compressor unloaded, hold open the trigger valve by turning the wing nut.

(c) *Cleaning trigger valve seat.* Clean the trigger valve seats to eliminate trigger valve chat-

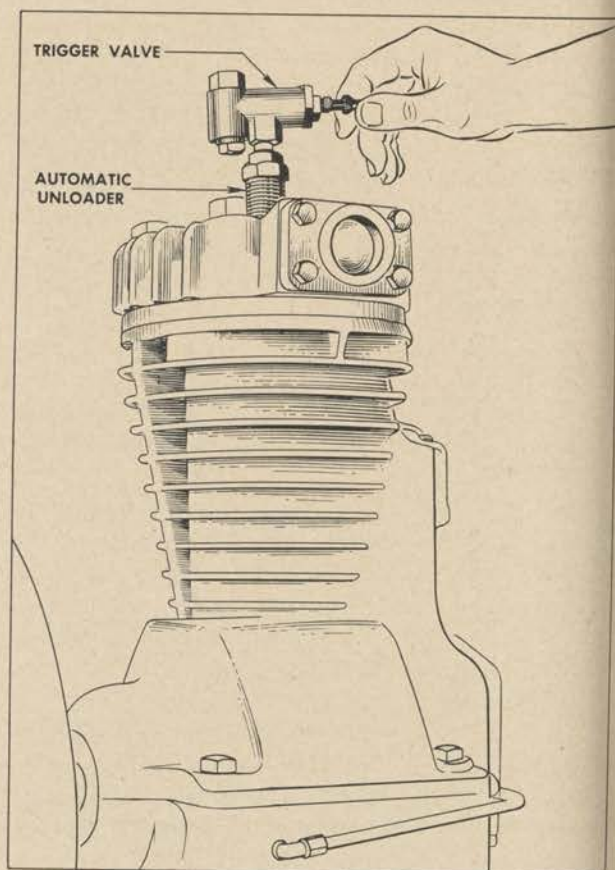


Figure 228. Adjusting trigger valve.

ter or excessive leakage. If cleaning does not correct either of these troubles, grind the valve seats and disconnect the trigger valve from the compressor unit ((a) above). Unscrew the adjusting spring retainer. Remove the valve adjustment assembly. Remove the trigger valve plunger by probing through the trigger valve outlet. Clean and lubricate trigger valve upper and lower seats with light oil. Grind the trigger valve upper and lower seats with a very fine grinding compound. Clean thoroughly afterward to prevent the grinding compound cutting the sides of the trigger valve or the unloader operating plunger. Reassemble the trigger valve by inserting the plunger into trigger valve body, being careful to obtain proper valve seating. Replace valve adjustment assembly by carefully screwing valve spring retainer into trigger valve body. Adjust trigger valve ((b) above).

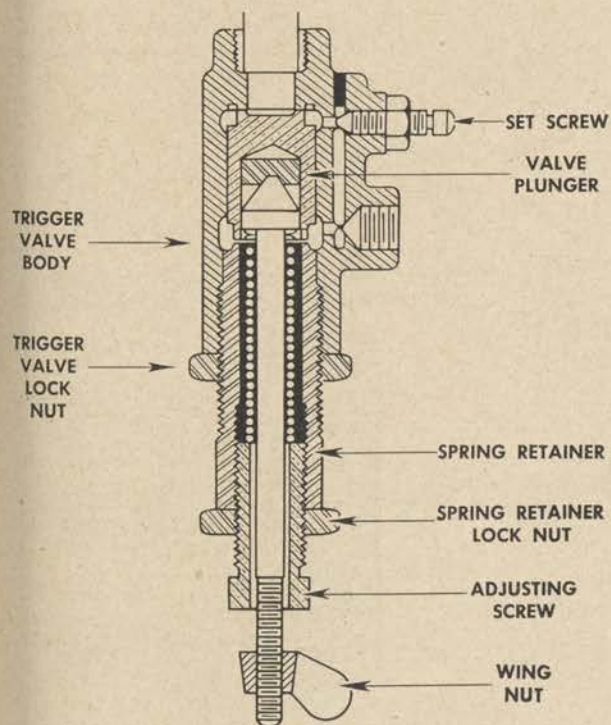


Figure 229. Trigger valve assembly.

(d) *Cleaning automatic unloader.* Although trigger valve functions normally, the compressor may fail to load or reload, due to the automatic unloader above the suction valve being stuck in one position. Remove and clean automatic unloader piston. Remove the automatic unloader from air compressor unit ((a) above). Remove

retaining screw and unloader piston. Clean and lubricate with light oil. Replace piston, making sure it moves easily within unloader cylinder. Insert the retainer screw in outlet and reassemble to compressor unit.

(4) *Removing cylinder head and valve plate.* Remove four $\frac{5}{8}$ -inch hex head nuts and washers from fixed cylinder studs. Tap edge of cylinder head lightly with hammer, and pry up carefully with screwdriver, without damaging gasket. Lift up cylinder head and valve plate, being careful not to strip studs fixed to cylinder.

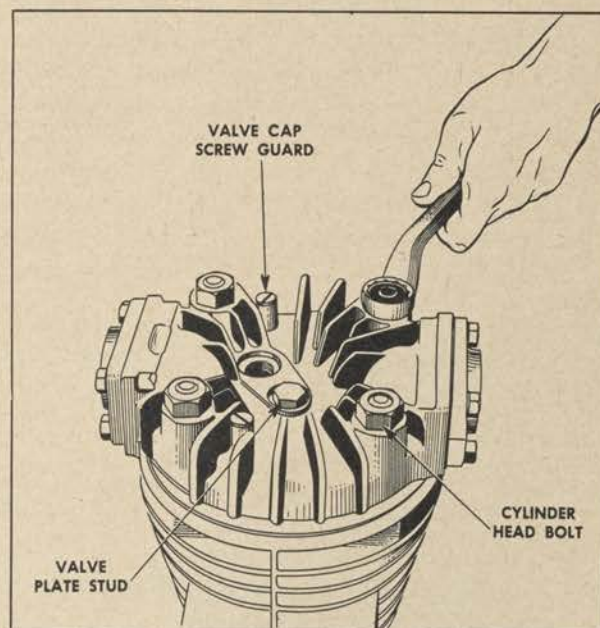


Figure 230. Removing cylinder head.

(5) *Removing valve plate from cylinder head.* Remove valve plate stud and gasket from the cylinder head. Separate them carefully, removing the cylinder and cylinder head gaskets. This exposes the feather valve guards and strips which are secured to the cylinder head and to the valve plate.

(6) *Installing new suction valve.* (a) *Removal.* While holding the cap screw head in place, remove the two cap screws and lock washers by unscrewing the guards located on the cylinder head. Lift the feather valve guard off the cylinder head and remove the feather valve strip.

(b) *Replacement.* Place feather valve strip in recess provided in the feather valve guard. Secure the feather valve guard to cylinder head with two

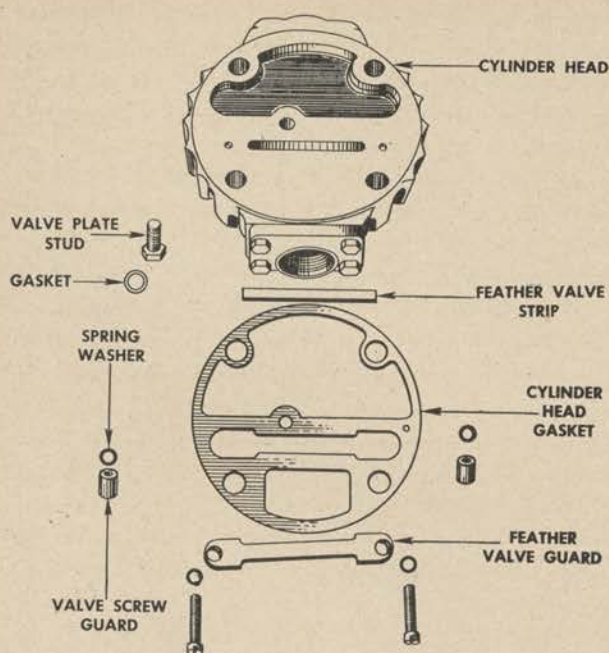


Figure 231. Suction valve assembly.

roundhead caps, screws, screw guards, and lock washers, placing the screw guards on the outside of the cylinder head.

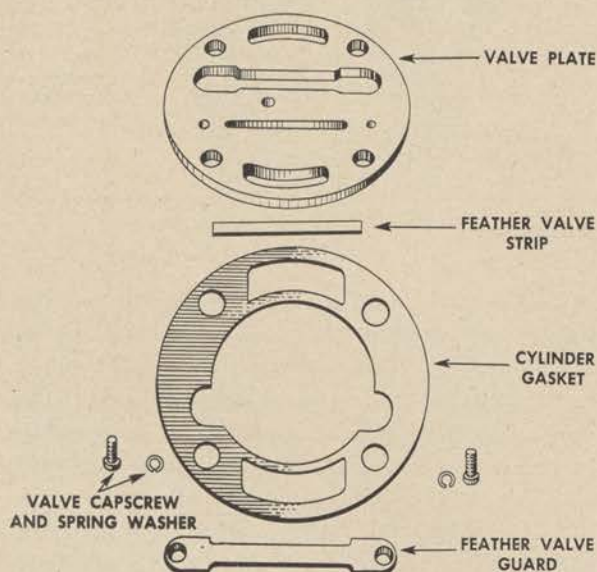


Figure 232. Discharge valve assembly.

(7) *Replacing feather valve strip.* Unscrew the two roundhead cap screws and lock washer from the valve plate and remove them. Lift the feather valve guard off the valve plate and remove the feather valve strip. Do not turn valve strip

over to use other side. Replace scored feather valve strips. Place new feather valve strip in recess provided in the feather valve guard. Screw the feather valve guard to the valve plate with two roundhead cap screws and lock washers.

Note. In making this replacement, be sure that the valve strip has an end clearance of at least $\frac{1}{32}$ inch and is free to move in its seat. If there is not sufficient side and end clearance, dress the strip with a fine file. Take care to see that the strip is not pinched between the guard and the valve plate. Use a small amount of cup grease or vaseline on the end of the valve strip to hold it in place when assembling on the valve plate. When the cylinder head and the valve plate assembly have been removed, use new gaskets on reassembling.

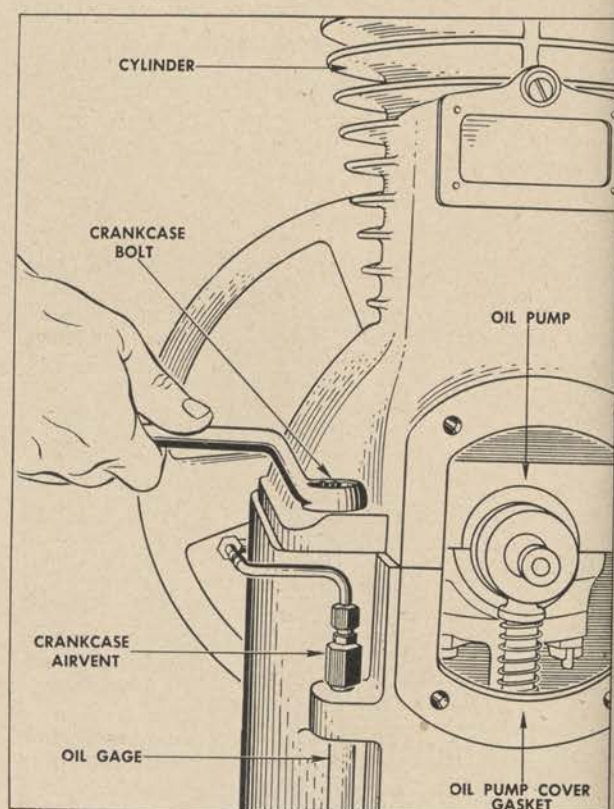


Figure 233. Removing cylinder.

(8) *Removing cylinder from crankcase.* Remove the four $\frac{1}{2}$ -inch hex bolts from crankcase. Tap edge of cylinder bolting flange lightly with hammer, and carefully pry loose with screw driver, without damaging gasket. Lift up cylinder complete with crankshaft and oil pump. Set cylinder carefully on wooden blocks with crankcase upward.

(9) *Replacing crankcase to cylinder gasket and felt washers.* Remove cylinder as described above.

Set gasket halves in place on crankcase, matching bolt holes, and set felt washer in place on crankcase shaft bearing.

(10) *Reinstalling cylinder.* Lower cylinder into place on crankcase, matching bolts and aligning gaskets. Place four 1/2-inch hex head bolts in position, carefully lining up cylinder by lightly tapping edge of flange with hammer. Hand-tighten bolts to crankcase by turning each bolt a few turns each time. Do not wrench-tighten any one bolt fully. Pull gasketed flanges together evenly. Wrench-tighten the four hold-down bolts, securing cylinder to crankcase.

(11) *Replacing cylinder head, valve plate, and cylinder head gaskets.* Set gasket in place over the feather valve guards, being careful to match drilling, and making sure that the gasket material fits around and follows the outline of the feather valve guards.

Note. The gasket for use between valve plate and cylinder head has a strip across the diameter which is intended to seal the joint between the suction and discharge ports when the valve plate stud is wrench-tightened. Do not confuse this gasket with the ring gasket which is used between the valve assembly and the top of cylinder. Transposition of these gaskets will result in failure of compressor to operate.

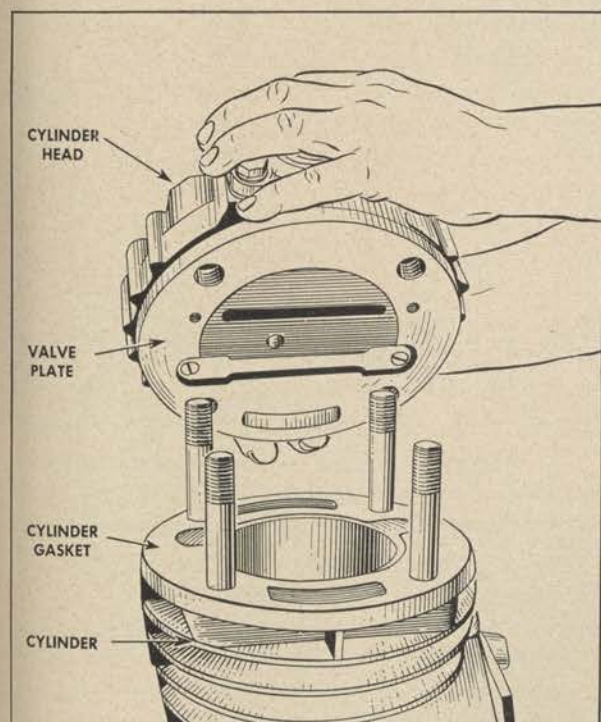


Figure 234. Replacing cylinder head and valve plate.

Thrust valve plate stud with washer through the cylinder head and engage valve plate threads. Hand-tighten valve plate to cylinder by means of the valve plate stud. Lower cylinder head and valve plate in place, tapping the edge of the head lightly to obtain proper alignment. Pull down head evenly by wrench-tightening the four hex nuts, holding the cylinder in place. Wrench-tighten valve plate stud.

(12) *Cleaning oil pump filter screen.* Remove cylinder ((8) above), and remove oil pump screen retainer by spreading ends and lifting out. Remove screen from oil pump inlet and clean carefully.

Warning: Do not use gasoline or kerosene for cleaning any part of compressor. Their use may cause an explosion in compressor or tank, resulting in destruction to equipment and injury to personnel.

Replace screen on oil pump inlet and secure screen with screen retainer by spreading over inlet.

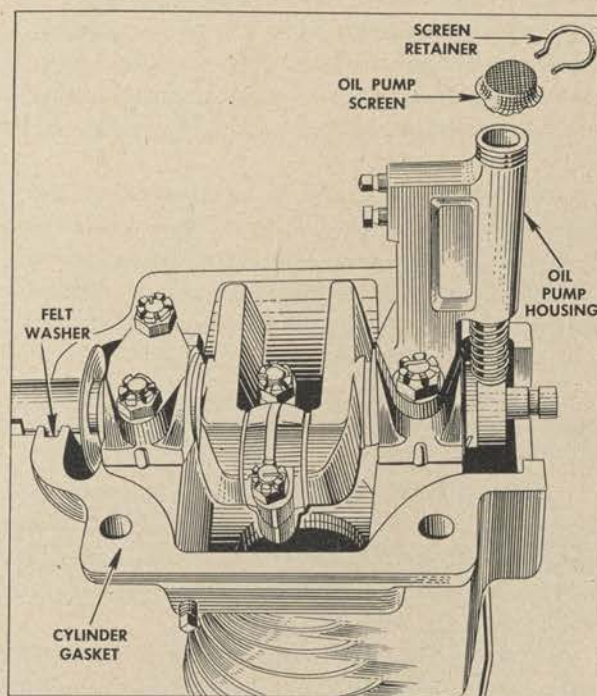


Figure 235. Location of oil pump screen.

(13) *Setting safety valve.* Remove hex ball cap with wrench and adjust trigger valve on air compressor until pressure gage indicates 75 lbs. operating pressure. Adjust hex lock nut until safety valve pops. Replace safety valve cap. Adjust trigger valve until the pressure gage indicates an air operating pressure of 70 lbs. pressure.

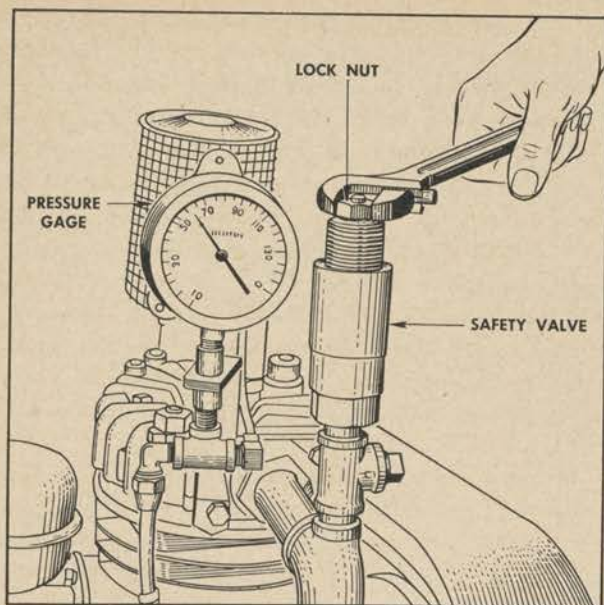


Figure 236. Adjusting safety valve.

(14) *Drive belt adjustment.* (a) The air compressor is driven by the engine by means of a multi-V-belt drive. This drive consists of three V-belts engaged from compressor drive pulley to the compressor drive pulley on the engine drive shaft.

(b) Remove the multi-V-drive belts by loosening the compressor skid bolts and slide compressor toward engine until the belts can be removed from the pulley sheaves. Remove and replace belts and adjust tension so that a light pressure at the center will push them in about 1 inch.

Note. Be sure belts are properly aligned after tightening pulley or noise will develop in compressor and the life of the belt will be shortened. (See par. 71.)

(c) With belts snugly in grooves, secure compressor to base and start unit. If belts squeal, tighten them further, being sure to maintain alignment. Excessive tension reduces belt life and causes bearings to overheat.

(d) After the first 8 and 10 hours of running time, new belts require further tightening. Thenceforth check tension and alignment about every 2 months.

Note. Never use belt dressing on V-belts.

46. Hoisting drums.

a. *DESCRIPTION.* (1) The hoist is of the five drum types employing three single drums and one pair of twin drums mounted on one bedplate. The

drums are gear-driven from the main drive shaft through a silent chain. Controls for the hoist are arranged for two-man operation, the operators being stationed at each side of the twin drums. Power is applied to the drums by air-operated, external contracting friction band clutches. Brakes are foot-pedal operated external contracting band type. The three single drums are provided with ratchets and pawls for locking in position.

(2) *Control stands.* Two control stands are provided. The one on the left of the hoist is a double stand (fig. 62) for the control of the twin vang drums. That on the right of the hoist (fig. 61) is a triple unit for the control of the three single drums. The double stand is provided with two air valves for control of the vang lines twin drum friction clutches. Also mounted at the top of the stand is the air pressure gage. Two foot pedals are mounted at the base of the stand for operation of the brakes of the twin vang drums. Each pedal is provided with a footoperated catch and ratchet for holding it in position. The triple stand is provided with an air gage, three air valves, and three foot pedals similar to those of the double stand. Also provided are three hand levers, located at the top of the stand in line with and ahead of their respective air valves, for operating the pawls of the three single drums.

b. *SINGLE DRUMS.* (1) The three single drums are each provided with friction clutch drive, foot-pedal operated hand brake, and hand lever operated pawl. The friction clutch is mounted at the right end of the drum. The band brake together with the pawl and ratchet are mounted at the left end of the drum. The rotation of the whip drum, when hoisting, is opposite to that of the other two drums and its pawl is, therefore, set to swing up on the rear side of the drum instead of swinging up on the front side as it does on the other two drums. The mechanisms are otherwise identical.

(2) *Friction clutches.* (a) All drum gears on the hoist, with their clutch mechanisms and clutch bands, rotate constantly when engine power is applied. Individual drums rotate only when each is engaged with its drum gear by means of its clutch. The friction clutch drive system is pneumatically operated. Air from the belt-driven compressor is piped to an air reservoir from which branch pipes are led to each control stand. (See fig. 257.) At the control stand, lines are led to

each air valve, and from the air valves to the individual clutch power chambers, which are of the single action spring return type. Air to the power chambers is piped through swivel joints located at the right end of each of the single drum shafts, and at both ends of the twin drum shafts.

(b) The friction clutch is the external contracting band type. The pull necessary to apply the clutch is furnished by the clutch power chamber (fig. 237), and is transmitted through the clutch lever. The entire mechanism is mounted on, and revolves with, the drum gear.

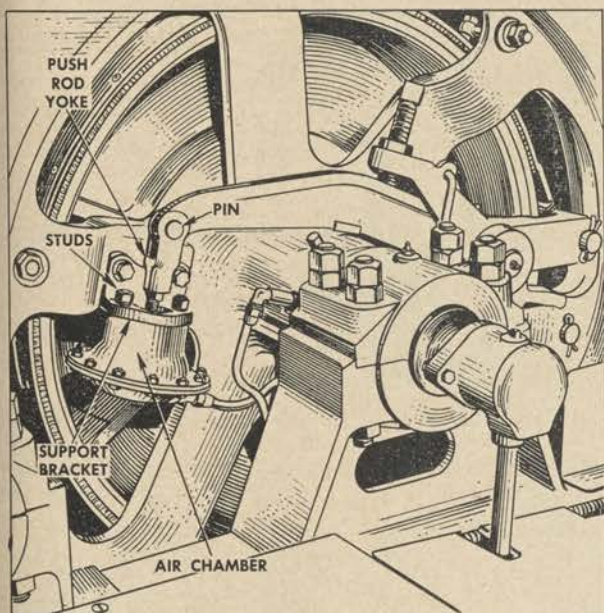


Figure 237. Arrangement of friction clutch.

(c) When air under pressure is admitted to the clutch power chamber, it acts upon and moves a flexible diaphragm. The air pressure applied to the diaphragm can be regulated by holding the air valve lever in any intermediate position. The pressure will then be determined by the location of the lever, between zero pressure in the OFF position to full pressure in the ON position. The movement of the diaphragm displaces a push rod which moves one end of the clutch lever. The clutch lever is pivoted at the clutch lever fulcrum. Also pivoted at the clutch fulcrum is a bell crank, on one end of which is an adjusting bolt which bears upon the clutch lever. (See fig. 237.) The relative positions of the lever and the bell crank are changed by changing the setting of the adjusting bolt.

(d) Movement of the clutch lever swings one end of the bell crank upward and the opposite end, to which the clutch band is pinned, downward. This downward movement pulls the clutch band in and tightens it on the clutch drum, which is a part of the hoist drum, thus engaging the revolving drum gear and the drum, and causing the drum to revolve with the gear.

(e) Contact between the bell crank adjusting bolt and the clutch lever is maintained by a spring compressed rod which holds the bell crank bolt tightly against the clutch lever, but permits it to move with the thrust of the air chamber push rod.

(f) The clutch band is centered by adjustable centering bolts which hold it in the proper position, where it neither springs out when the clutch is released nor drags on the drum. A clearance of 0.010 inch between the band and the drum should be maintained with the clutch released.

(3) Adjusting friction clutch (single drum).

(a) In service, the clutch band lining becomes worn and the mechanism must be tightened so that the clutch will be fully engaged when the air valve is ON. Tighten the band by means of the adjusting bolt on the bell crank, as follows:

1. Loosen lock nut on clutch lever adjusting bolt.
2. Turn adjusting bolt to tighten or loosen clutch friction band.
3. Tighten lock nut to maintain adjustment. Hold adjustment bolt firmly in position while tightening lock nut. (See fig. 238.)

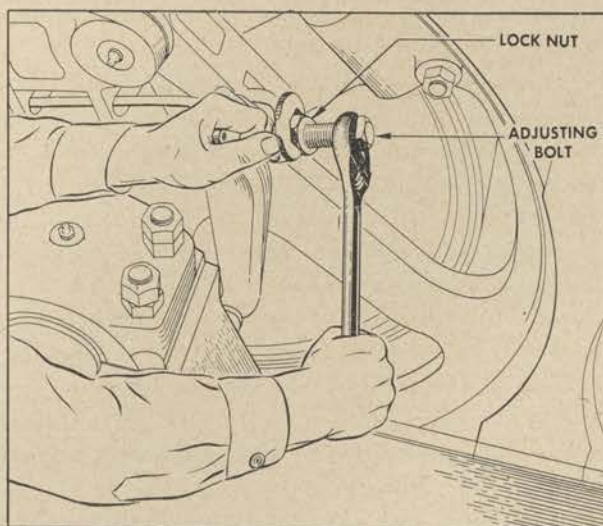


Figure 238. Adjusting friction clutch adjusting bolt.

(b) Replace the clutch lining before it is worn down to expose the rivets. In this case, remove the band and replace it by a band with a new lining.

(4) *Installing new clutch band (single drum).*

(a) *Removal.*

1. Loosen three adjustable positioning bolts.
2. Remove pins from both the anchored end and the working end of the clutch band.
3. Slide band toward center of rope drum until clear of clutch drum face.
4. Lift band clear of drum.

(b) *Replacement.*

1. Lower band down over rope drum.
2. Slide band over clutch drum.
3. Replace pins on both anchored end and working end of band.
4. Adjust positioning bolts for correct position to prevent band from springing or dragging.

c. **HOIST DRIVE BRAKING SYSTEM.** (1) *Description.* (a). A system of levers, reach rods, and cross shafts is used to transmit the motion of the brake foot pedals to the brake bands. The downward movement of each foot pedal results in pulling the movable end of the brake band tight around the brake drum. A spring returns the brake to the released position when pressure is removed from the brake pedal. The general arrangement of the reach rods and cross shafts of the brake and pawl linkages is shown in figure 239. The arrangement of the brake pedals on the control stands is shown in figure 61 and figure 62.

(b) A foot pedal catch engages in the teeth of a vertical ratchet arc to hold the foot pedal in any desired position against the pull of the spring.

(c) Do not permit the brake band to drag on the brake drum. A clearance of 0.010 inch at all points between the band and the drum, with the brake in the OFF position, should be maintained. Check clearances by inserting a feeler gage between the band and drum and measuring throughout the entire circumference (See fig. 240.)

(2) *Brake adjustment.* (a) Tighten or loosen the brake band by turning the brake band adjusting nut. (See fig. 241.)

(b) With continued use, the brake band lining will wear to such an extent that it will be necessary

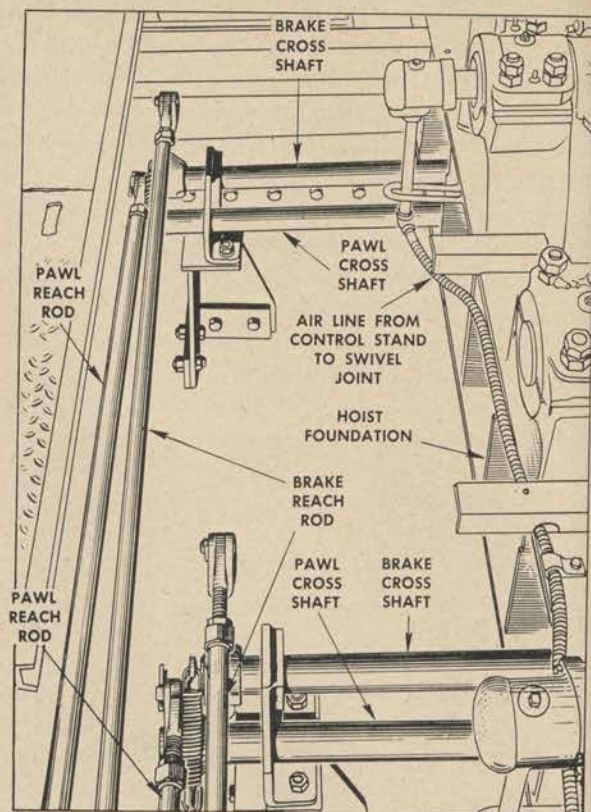


Figure 239. Brake and pawl linkage arrangement

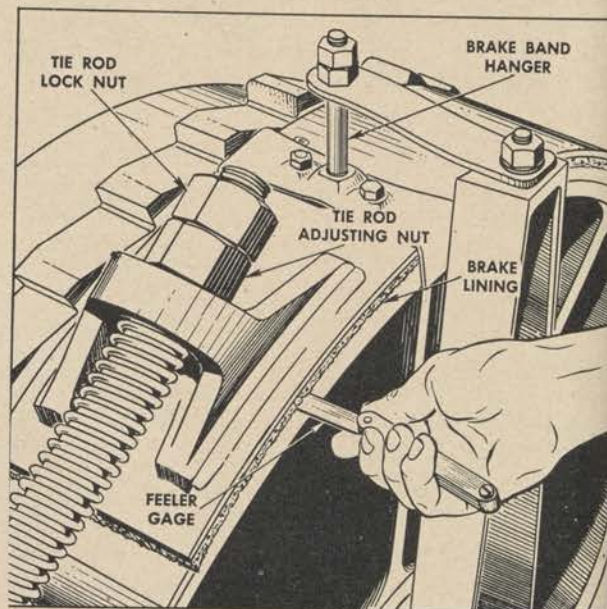


Figure 240. Measuring brake band clearance.

to renew it. Always renew the lining before it is worn to expose the rivets.

(3) *Installing new brake band (fig. 241).* (a) *Removal.* Remove tie rod lock nut and tie rod

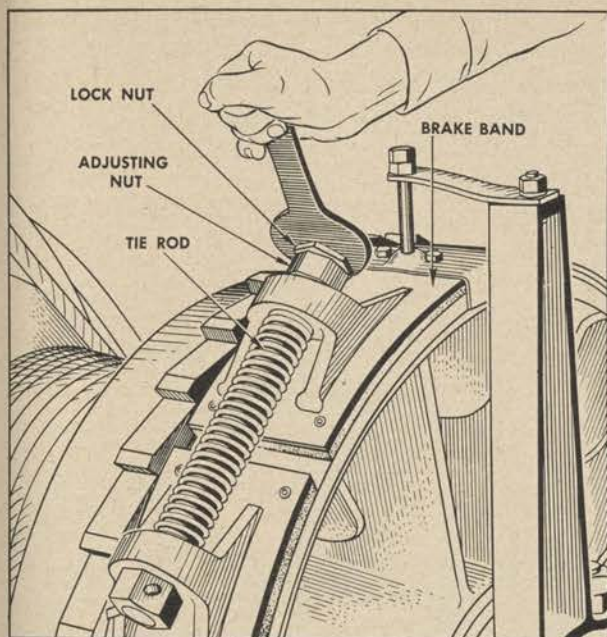


Figure 241. Tightening brake band.

adjusting nut; the tie rod and spring; the brake band hanger support; the pins at both the anchored end and at the working end of the brake band; and the brake band in two sections.

(b) *Replacement.* Replace brake band section; the pins at both the anchored end and at the working end of the brake band; the brake band hanger support; the tie rod adjusting nut and lock nut; adjust for band clearance, and tighten lock nut.

d. *DRUM PAWL LINKAGE.* The pawl is operated by a hand lever through a linkage system of levers and reach rods. (See fig. 242.) Movement of the

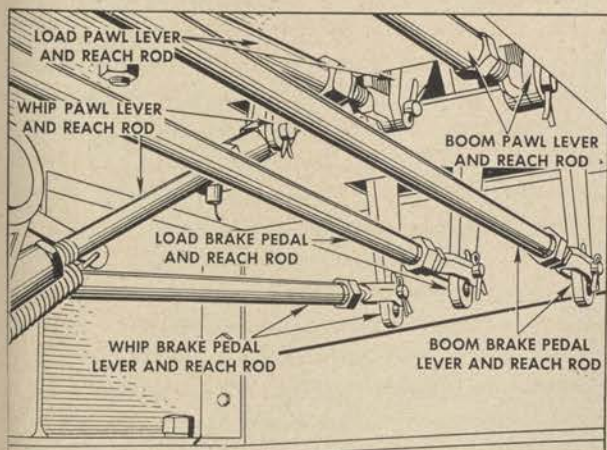


Figure 242. Linkage from control stand for raising boom.

hand lever moves the pawl into position either to engage the ratchet or to completely clear all ratchet teeth. The pawl linkage hand lever (fig. 61) is located on the control stand in front of the corresponding air valve. Two notches are provided for positioning the lever. The notch nearest the operator is for pawl **LOCKED** and the notch away from the operator is for pawl **RELEASED**.

e. *DRUM SHAFT BEARING CLEARANCE.* (1) The entire load of any drum is carried by the drum shaft bearings which are therefore subject to wear. Normal clearance between the shaft and the bearing should be 0.005 inch, and is checked by inserting a feeler gage between the shaft end and the bearing halves. (See fig. 243.)

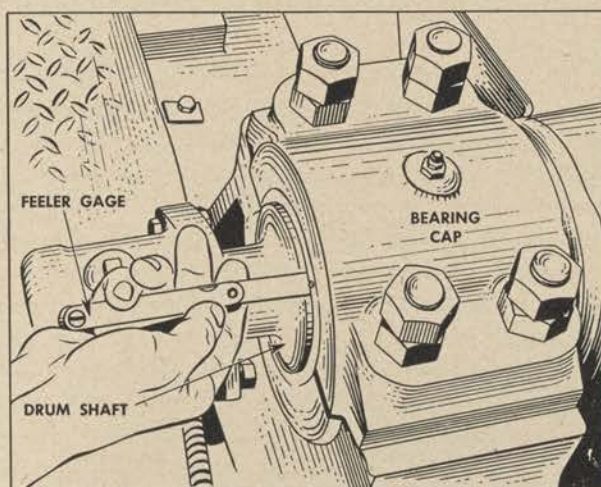


Figure 243. Measuring clearance on drum shaft bearing.

(2) The maximum clearance between the shaft and its bearing is at a point opposite the point of contact of the shaft and bearing. Measure the clearance at this point of maximum clearance, using a feeler gage. When the clearance exceeds 0.010 inch, the bearing should be taken up by removing shims and scraping the babbitt bearing to secure even contact with the cap in its new position. The procedure for removing bearing shims and scraping bearing follows:

(a) *Removing bearing shims.* Remove all four lock nuts from bearing cap, all four bearing cap nuts, and the bearing cap. Mark cap for identification to insure replacement in same position. Remove shims as necessary to secure clearance of 0.005 inch between shaft and bearing.

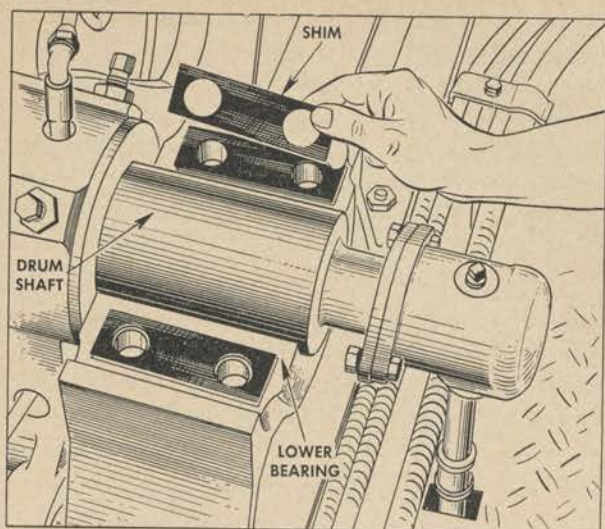


Figure 244. Removing shims on outboard bearing.

(b) *Fitting bearing cap.* Proceed with fitting bearing cap by scraping as follows: Apply an even coat of blue to shaft. Wipe bearing cap clean and place clean bearing in its normal position on shaft as indicated by identification marks. Remove bearing cap. High spots in bearing will show up blue where contact was made with blued shaft, as shown in figure 245. Use bearing scraper to remove high spots.

Caution: Use scraper with great care and gradually work down only the high spots. Do not gouge the bearing.

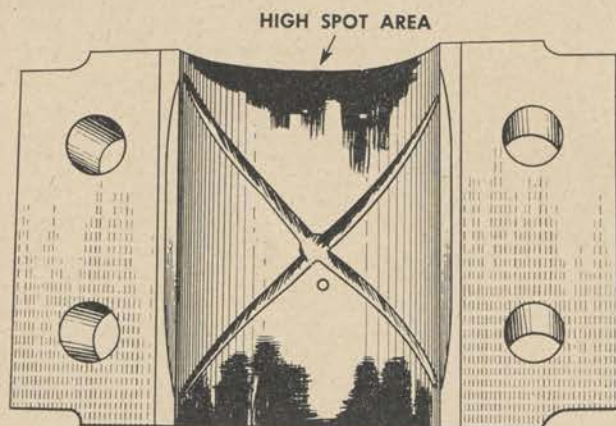


Figure 245. Improper bearing contact.

Then reblue the shaft to secure an even coat, wipe bearing clean, and replace it on shaft. If all high spots have been properly removed, bearing will show an even coat of blue to indicate true contact

with blued shaft. It will usually be necessary to repeat this process several times before an even coat of blue will show on the bearing, indicating correct fit of the cap on the shaft.

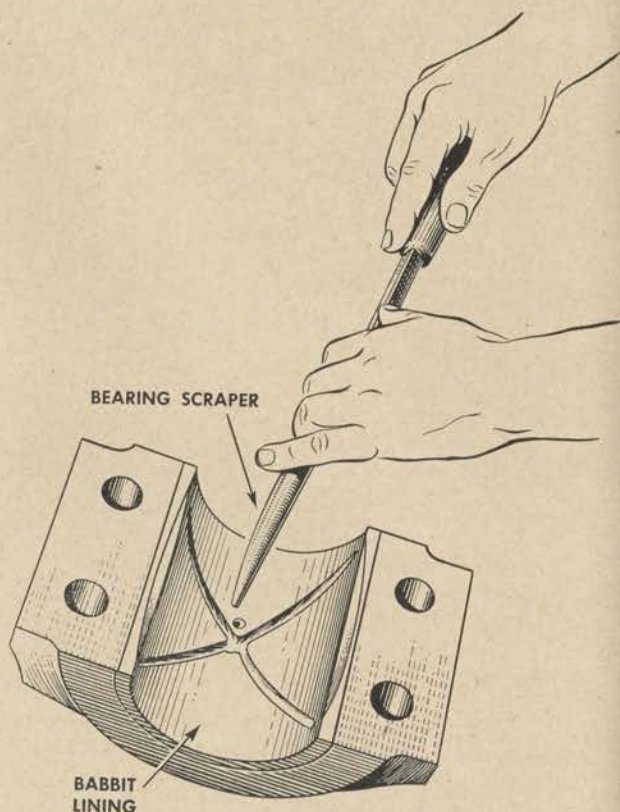


Figure 246. Scraping bearing.

f. *TWIN DRUMS.* (1) *Description.* On the twin drums, the friction clutch and the band brake are both mounted on the outer end of each drum: at the right end of the right drum, and at the left end of the left drum. (See fig. 247.) The right twin drum is driven from the drum gear through the right drum clutch. The clutch band mechanism of the left drum and drum gear that drives the right drum are keyed to the same shaft and revolve together. The left drum is driven by this gear when the left drum is engaged.

(2) *Friction clutch and brake band.* The friction clutch mechanism and the bandbrake mechanism of the twin drums are similar to those on the single drums. Adjustments and replacements of these mechanisms for the twin drums are similar to those of the single drums except in the case of the clutch band. When removing clutch bands on the twin drums, remove them away from the

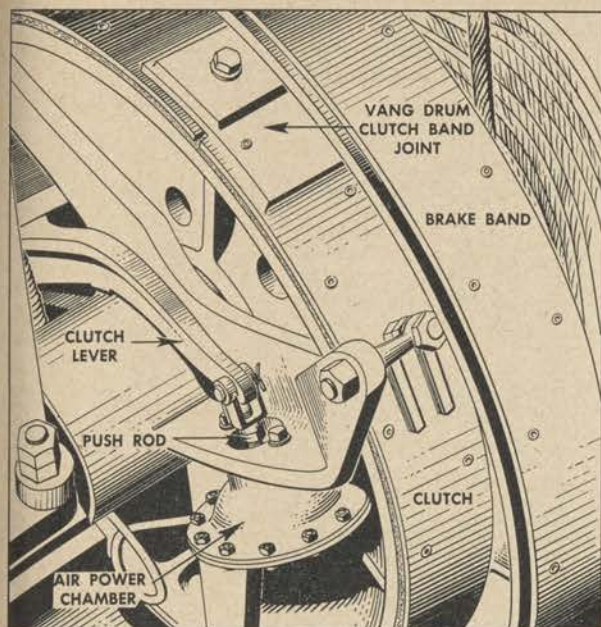


Figure 247. Vang drum assembly.

rope drum and not toward the center of the rope drum as on the single drum.

(3) *Installing new clutch band (twin drum).*

(a) *Remove.* The twin drum clutch band is assembled in three sections. Mark sections for identification for assembly in same position. First remove bolts connecting the sections, and the pins from both the anchored end and the working end of the clutch band. Then remove adjustable positioning bolts with their supporting brackets. Remove each band segment independently away from rope drum. (See fig. 247.)

(b) *Replace.* Replace each section independently in same position from which it was removed, as identified by markings. Replace bolts connecting section to each other, the pins at both the anchored end and the working end of the band, and the positioning bolts for correct location, to prevent band from springing or dragging.

(4) *Centering friction clutch band (twin drum).* Loosen upper and lower lock nuts on clutch band centering bolt, turn adjusting nut to adjust position, or centering, of clutch friction band; tighten upper and lower lock nuts to hold adjusting nut in position. Hold adjusting nut firmly in position while tightening lock nuts. (See fig. 248.) Then adjust the position bolts on the clutch band so that the band does not spring away from the clutch face when clutch is released, or does not drag at any point.

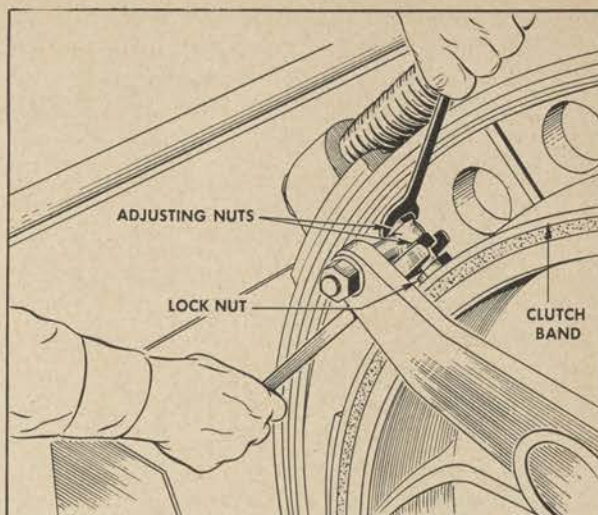


Figure 248. Centering friction clutch band on twin drums.

47. Electrical Control System (figs. 53 and 250)

a. GENERAL. (1) Electrical energy for the barge derrick is developed by the main generator when the main engine is in operation, and by the auxiliary Diesel generator set when the main engine is shut down. Current for the equipment is distributed by four units: main generator control panel, auxiliary generator control panel, main switch, and shore line.

(2) The major electrical systems in the barge derrick consist of barge lighting and electrical accessory system operating from 120 volts, capstan electrical system operating from 208 volts, and floodlight and deck pump system operating from 208 volts.

(3) With the main generator in operation, all three systems are supplied. Control is through the main generator control panel. With the auxiliary Diesel generator in operation, only the 120-volt barge lighting and electrical accessory system (refrigerator and galley) is supplied. Control remains through the main generator control panel switches.

(4) A three-pole double-throw main switch is mounted below the main generator control panel. It is the fully enclosed, safety type and the enclosure cannot be opened until the handle is in the OFF position. One side of this switch is connected to the main generator and the other side is connected to the auxiliary generator. (See fig. 250.)

(5) An angular type receptacle located on the outside of the port deck house wall (fig. 88) is

provided for connection to a 120-volt, 60-cycle, single-phase a-c supply from a shore line when the generators in the barge are not in operation.

b. MAIN GENERATOR CONTROL PANEL (FIGS. 249 AND 250). (1) *Description.* (a) The panel contains the following units:

- Panel board enclosure and cover.
- Voltage regulator.
- Rheostat.
- Circuit breaker switches.
- Ammeter.
- Current transformer.
- Voltmeter.
- Voltmeter fuses.
- Voltmeter resistors.
- Neutral bar.

(b) When current is delivered to this panel by the main generator, all electrical units in the barge are under control by means of three-pole, 25- and 35-ampere circuit-breaker switches that open when the load exceeds the rated amperages of the circuit breakers. Voltage control is maintained automatically by the voltage regulator or manually by the rheostat. The ammeter indicates the main generator operating amperage. It operates through an instrument transformer. The voltmeter indicates the operating voltage of the 208-volt circuit. It is protected by two 100-ohm resistors and two 15-ampere fuses. A three-pole circuit breaker switch is provided for panel board control and protection. The center vertical bus bar is the neutral bar.

(2) *Removing main generator control panel inclosure cover.* Remove six roundhead machine screws from outside frame with a screwdriver. Unscrew two knurled thumbscrews from top of the voltage regulator, grasp the top half of regulator cover, and remove by lifting up. Remove bottom half of cover by pulling down. This exposes the four terminals and connectors marked O, M, A, and C. Disconnect the four wires from voltage regulator terminals and withdraw wires through hole in panel. Remove the two roundhead machine screws from the rheostat handwheel with a small screwdriver, and remove handwheel by pulling forward. Lift inclosure cover away from panel board, being careful not to strip insulation from the regulator leads that are pulled through the inclosure hole.

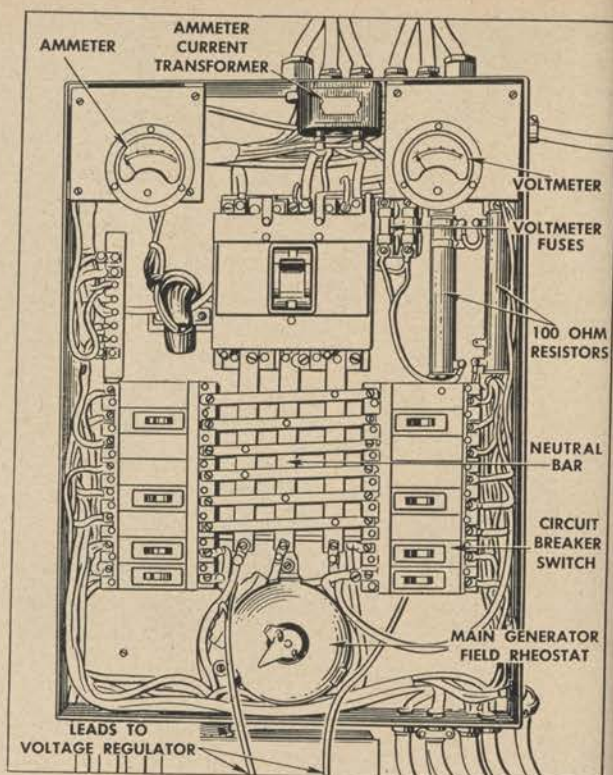


Figure 249. Main generator control panel with cover removed.

(3) *Replacing main generator control panel inclosure cover.* Thread the regulator leads through hole in cover. To replace inclosure cover reverse preceding step, making sure to connect regulator leads marked O, M, A, and C to their respective marked terminals on the regulator.

(4) *Removing voltage regulator.* Remove the voltage regulator cover as described in (2) above. Disconnect the four leads and thread through the inclosure cover. Remove the general voltage regulator from control panel by taking out the four roundhead machine screws and lock washers with a screwdriver and pliers.

(5) *Replacing voltage regulator.* Mount the regulator in place on the panel and secure it with four roundhead machine screws and lock washers. Thread the four leads and connectors through hole in panel. Connect leads marked O, M, A, and C to the respective terminals on the regulator and tighten leads to terminals with a screwdriver. Replace top and bottom regulator covers and replace control panel cover.

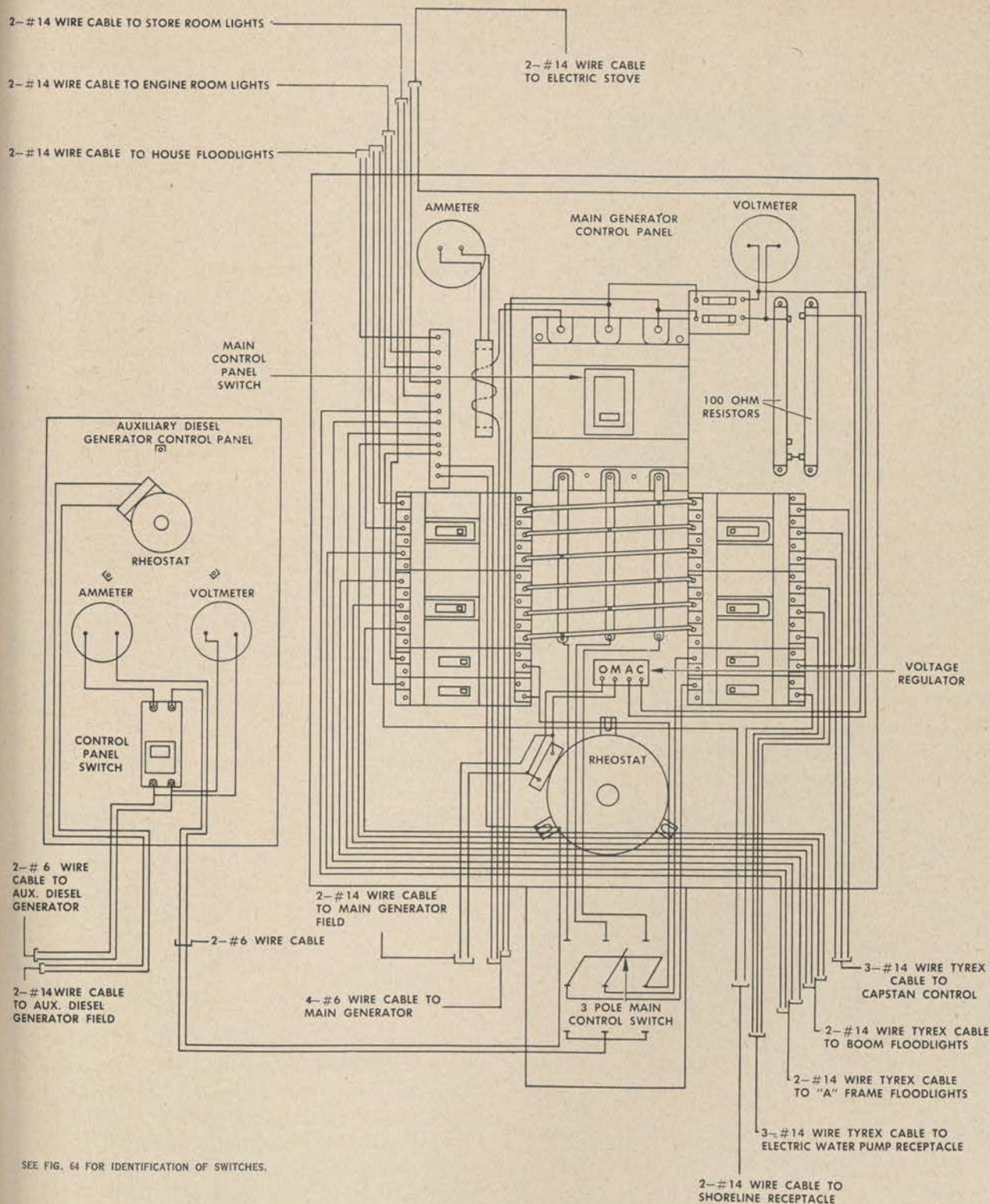


Figure 250. Wiring diagram—control panels.

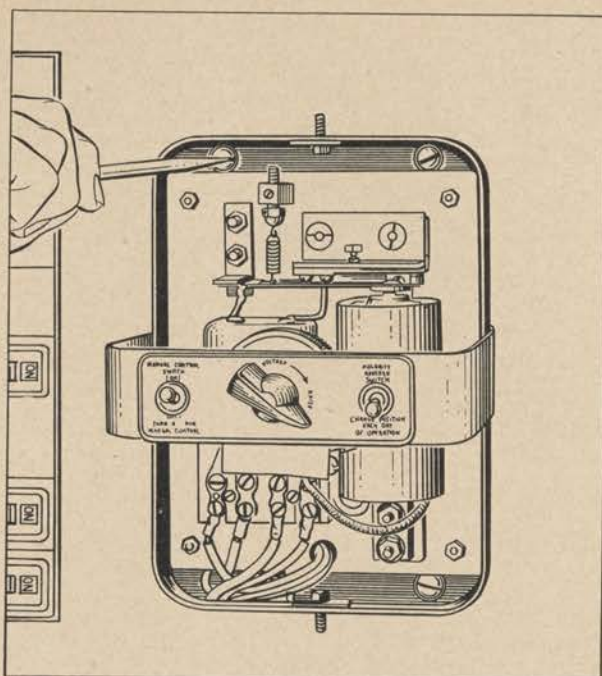


Figure 251. Replacing voltage regulator.

(6) *Replacing voltage regulator resistor.* Remove control panel cover as described in (2) above. Disconnect wires, tagging them for reassembly, and loosen mounting screws with screwdriver. Remove resistor by grasping firmly, swinging down and out from mounting screws. Replace with new element by reversing procedure described for removal.

Note. When replacing parts or units that require wiring or servicing, replace wires that are frayed, broken, have cracked insulation, or are generally deteriorated. Be sure to replace all wires in accordance with tagging. Check with wiring diagram if uncertain as to correct wiring.

(7) *Replacing voltmeter.* Remove main generator control panel cover as described in (2) above. Remove voltmeter by taking out three screws, and disconnect wires, tagging them for reassembly. Install new voltmeter by reversing the order of removal.

(8) *Replacing voltmeter fuses.* Remove main generator control panel cover. Remove fuse by pulling free from clips. Install fuse by reversing order of removal.

(9) *Replacing voltmeter resistor.* Remove main generator control panel cover. Remove mounting screws and disconnect the wires, tagging them for reassembly. Install new voltmeter resistor by reversing order of removal.

(10) *Installing new ammeter.* Remove main generator control panel cover, and remove ammeter by withdrawing three screws. Install new ammeter by reversing order of removal.

(11) *Replacing ammeter current transformer.* Remove main generator control panel cover, and disconnect wires, tagging them for reassembly. Remove the transformer by taking out the two mounting screws. Install new ammeter current transformer by reversing the order of removal. Wrap wires to transformer with friction tape.

(12) *Replacing circuit breaker switches.* Remove the main generator control panel cover, and disconnect wires, tagging them for reassembly. Remove the switch by withdrawing the $\frac{1}{2}$ - by 3-inch roundhead machine screws with hex nuts. Install new circuit-breaker switch by reversing order of removal.

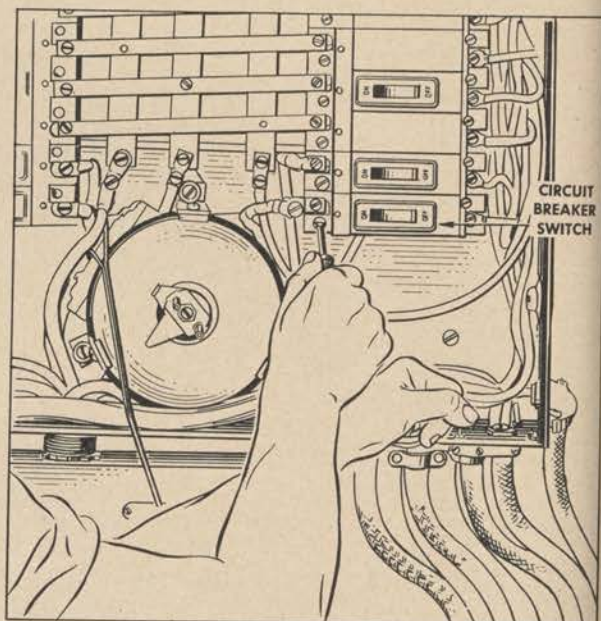


Figure 252. Removing the circuit breaker switch.

(13) *Replacing rheostat.* Remove the main generator control panel cover. Separate the rheostat body from the rheostat bracket by removing the three button-head screws from the rheostat body. Identify the wiring for reassembly by tagging and disconnect the wiring. Install new rheostat by reversing order of removal.

c. AUXILIARY DIESEL GENERATOR CONTROL PANEL. (1) *Description.* (a) The auxiliary Diesel control panel consists of—

Panel board and door.

Rheostat.
Ammeter.
Voltmeter.
Control panel switch.

(b) With the auxiliary Diesel generator in operation, all electrical units requiring 110 volts alternating current are supplied. This includes the lighting system for the barge, refrigerator, and galley range. Control of these units remains through the switches on the main generator control panel.

(c) The auxiliary Diesel control panel is equipped with an ammeter and voltmeter for indicating the operation amperage and voltage. A rheostat on the board is used for manual control of the operating voltage. The control panel is protected and controlled by a three pole circuit breaker switch.

(2) *Replacing elements in control panel.* Replace defective units on the panel by opening the panel door and removing the unit from its mounting on the back of the door. (See fig. 253.) To open, remove two flathead screws at the front of the panel and swing the door panel out on its hinges, being careful not to impair the wiring connection.

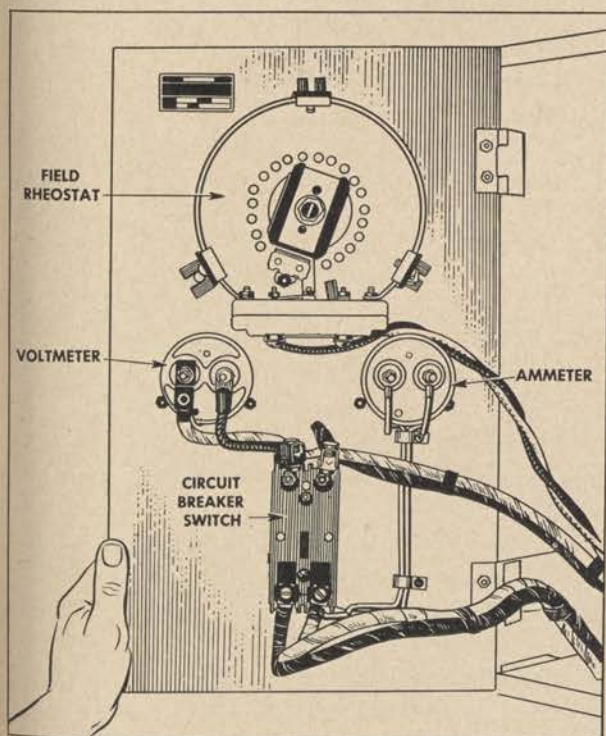


Figure 253. View in back of auxiliary generator control panel.

(3) *Replacing control panel.* Open control panel door. Identify wiring for reassembly by tagging. Disconnect wiring. Separate the switch from the control panel by removing the 1/4-inch by 3-inch-long flathead screws. Install new switch by reversing the order of removal.

(4) *Replacing rheostat.* Open control panel cover. Remove handwheel from rheostat by removing the two retaining screws. Identify wiring for reassembly by tagging. Disconnect wiring. Separate rheostat body from rheostat brackets by removing the three screws which secure the unit. Install new rheostat by reversing the order of removal.

(5) *Installing new ammeter.* Open control panel door. Identify wiring for reassembly by tagging. Use a wrench to disconnect wiring. Separate ammeter from the control panel by removing the three mounting screws holding the instrument in place. Install new ammeter by reversing the order of removal.

(6) *Installing new voltmeter.* Open control panel door. Identify wiring for reassembly by tagging. Disconnect wires. Separate the voltmeter from the control panel by removing the three flat head machine screws and hex nuts holding the instrument in place. Install new voltmeter by reversing the order of removal.

d. MAIN CONTROL SWITCH. (1) *Description.* This unit is a three pole double throw a-c switch encased in a dust proof safety enclosure. The switch is used to connect the main generator or the auxiliary generator to the main generator control panel circuit. Operation of the switch also breaks the circuit to whichever generator is in operation. The cover can not be opened unless the handle is in the OFF position.

(2) *Maintenance.* The main switch requires no maintenance other than periodic cleaning of the terminal connection and inspection for frayed or deteriorated wiring. The enclosure cover can be opened by setting the operating lever in the OFF position.

e. SHORE LINE RECEPTACLE. 120-volt, 60-cycle, single-phase, a-c connection from the shore is made to the barge through an angle type 2-wire, 3-pole, waterproof and weatherproof receptacle located on the forward port deck bulkhead. (See fig. 88.) Current from this receptacle is distributed through and controlled by the main generator control panel switches, to supply power for operation of the

barge lights (excluding floodlights), refrigerator, and galley stove.

Caution: Connect only 120-volt, 60-cycle, single-phase, alternating current to the shore line receptacle. Any other current will result in damage to the equipment.

A cable complete with a 2-wire, 3-pole weather and watertight plug, is provided for attaching this circuit to a receptacle ashore.

f. BARGE LIGHTING AND ELECTRICAL ACCESSORY SYSTEM. (1) *General.* (a) The a-c lighting system is supplied with current by the main or auxiliary Diesel generator, providing electrical energy for the following sections of the barge:

- Engine room lights.
- Crew quarters lights.
- Galley lights, refrigerator and stove.
- Storeroom lights.
- Forward hatches lights.
- Cabin deck lights.

(b) The circuits are controlled and protected by means of circuit-breaker switches, properly identified, on the main control panel. The circuit-breaker switches are of the instantaneous trip type that shut off when the load exceeds the rated amperage of the switches. For this reason no fuses are provided in these circuits.

(c) *Engine room lights.* The engine room lighting circuit consists of four lights complete with screwed type marine globes and guards and two junction boxes. Current is supplied to the engine room circuit by means of a cable connected to the main generator control panel.

(d) *Crew quarter lights.* The crew quarters consist of lavatory and sleeping quarters. The sleeping quarters lighting circuit consists of four marine type lights, one combination light and junction box complete with flat screwed type marine globe, and a marine type combination switch and receptacle. Current is supplied to the sleeping quarters by means of a cable connected to the main generator control panel. Current is also supplied to the two sleeping quarters berth lights on the aft sleeping quarters bulkhead by means of a cable connected from the lavatory ceiling light to the top berth light base. The lavatory lighting circuit consists of combination light and junction box complete with flat, screwed type marine globe, and marine type receptacles. The lighting circuit is supplied with current by means of a

cable connected from the sleeping quarters ceiling light to the lavatory ceiling light.

(e) *Galley lights.* The galley lighting circuit consists of two combination light and junction boxes complete with flat, screwed type marine globes and three marine type receptacles to which the refrigerator and galley stove are plugged. Current is supplied by means of a cable connected to a junction box on the portable ridge girder. This junction box is connected to the main control panel.

(f) *Storeroom lights.* The storeroom lighting circuit consists of one light complete with marine screwed type globe and guard; and a marine type combination switch and receptacle. Current is supplied to the storeroom circuit by means of a cable connected to a junction box located on the machinery room starboard bulkhead. This junction box is connected to the main generator control panel.

(g) *Forward hatch lights.* The capstan hatch lighting system consists of one light complete with marine type globe and guard and a marine type combination switch and receptacle. A lighting transformer reduces the 200-volt capstan circuit to 110 volts for lighting purposes. The wire rope hawser reel hatch lighting circuit consists of a light complete with a marine screwed type globe and guard, and a marine type switch. Current is supplied by means of a cable connected to the capstan hatch lighting circuit.

(h) *Cabin deck lights.* The port and starboard cabin deck light circuit consists of a marine bulkhead type light complete with box, gooseneck, screwed type globe, and marine switch. Current is supplied to the port cabin deck house circuit by means of cables connected to a 2-gang receptacle which is connected to the main generator control panel.

(2) *Maintenance.* (a) *Wiring.* Check wiring for cracked insulation and general deterioration. Replace frayed, cracked, or otherwise damaged wiring.

Caution: Before removing any part of the lighting system, see that the generating unit is inoperative or disconnected. Always replace wiring of the same size as that removed, to insure proper flow of current and general efficiency of system.

Check all terminals to make sure they are clean, securely attached, and properly insulated.

(b) *Replacements.*

1. To replace ceiling and berth light lamps in galley and crew quarters, remove globe by unscrewing and remove lamp. Replace with new lamp of same wattage. Replace globe by screwing back in receptacle.
2. To replace lamps in machinery room, storeroom, hatches, and cabin deck fixtures, remove guard by unscrewing and take out. Remove lamp and replace with new lamp of same wattage. Replace globe and guard.
3. To replace single pole switch interior of receptacles, remove cover and gasket from receptacle by taking out the four roundhead machine screws. Disconnect the wires and separate interior from the receptacle by removing the two roundhead screws. Replace with a new interior. Reassemble by reversing the procedure for removal.
4. To replace two wire plug box interiors or receptacles, remove receptacle cover and gaskets by unscrewing the four machine screws. Disconnect wires. Separate interior from receptacle by removing two machine mounting screws. Replace with a new interior. Reassemble by reversing order of removal.
5. To replace two and three wire plug receptacles, unscrew guard on plug by hand and disconnect wires. Remove interior from plug and replace with a new interior. Reassemble by reversing order of removal.
6. To replace lamp socket interiors, remove guard, globe, and lamp. Remove interior cover by removing two machine screws. Disconnect wiring. Replace with a new interior. Reassemble by reversing order of removal.

g. CAPSTAN CONTROL SYSTEM. (1) Description. Arrangement of the capstan control circuit is such that it permits control over the capstan motor from three locations. Combination starter unit in the capstan hatch is composed of: inclosure and door, circuit breaker, solenoid switch, magnetic overload relays, start and stop switch. A push button station is on deck near the capstan head.

A capstan switch is on the main generator control panel. The combination starter inclosure door is opened by placing the operating lever in the center OFF position. Remove the pin from the hasp and swing the door open on its hinges.

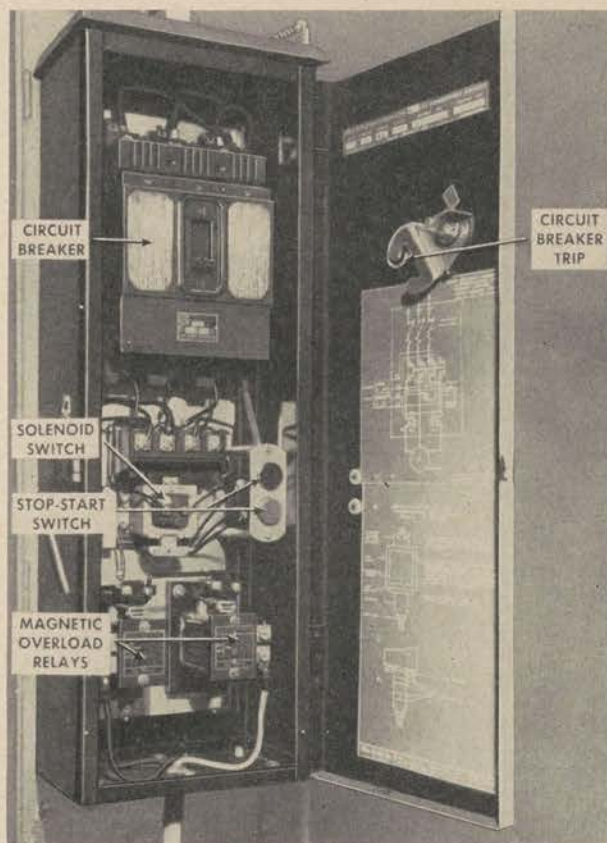


Figure 254. Capstan combination starter.

(2) *Maintenance. (a) General.* Maintenance on the capstan circuit consists of inspecting the electrical cable for deterioration, keeping all wiring connections clean and tight, and replacing defective electrical elements.

Note. Replace all frayed or damaged wiring with new cable of the same type and size. Be sure to tag all connections before disconnecting any of the elements, in order to insure correct assembly during installation of a new unit.

(b) *Installing new capstan circuit breaker.* Open the combination starter door, identify the wiring for reassembly by tagging, and disconnect it. Separate the circuit breaker from the enclosure by removing the four 1/4-inch by 1 1/2-inch round-head machine screws, washers, and spring washers. Install new circuit breaker by reversing the procedure used for removal.

(c) *Installing new capstan solenoid switch.* Open inclosure door. Identify the wiring for reassembly by tagging, and disconnect it. Separate the switch from the inclosure by removing the four roundhead machine screws and spring washers. Install new switch by reversing the procedure used in removal.

(d) *Installing new magnetic overload relays.* Open the inclosure door, identify the wiring for reassembly by tagging, and disconnect it. Separate the overload relay from the inclosure by removing the two $\frac{1}{4}$ -inch by $\frac{7}{8}$ -inch round head machine screws, washers, and spring washers.

(e) *Installing new capstan start and stop button.* Open the inclosure door and using a screw driver remove the two buttonhead screws, spring washer, spacers, and guide plate from the supports. Lift push button switch up, identify wiring for reassembly by tagging, and disconnect it. Install the new start and stop button by reversing the procedure for removal.

(f) *Installing new push button station on deck.* Lift off the inclosure cover over the switch housing by removing the two $\frac{3}{8}$ -inch hex nuts. Separate the push button station from the deck by removing the four roundhead receptacle machine screws, and the two roundhead elbow flange screws. Identify wiring for reassembly by tagging, and disconnect it. Install new push button station by reversing the procedure used in removal.

Warning: Keep inclosure in place on push button station while not in use. Accidental starting of capstan may result in injury to personnel.

(g) *Installing new capstan motor brake.* Remove motor brake inclosure by loosening four wing nuts. Loosen stop nut and end nut from the connecting rod. (See fig. 255.) Separate motor brake from foundation by removing four hex head bolts and nuts, and slide brake horizontally off motor wheel. Install capstan motor brake by assembling in the reverse order of removal.

Note. When fitting brake shoe and lining to motor wheel, allow a clearance of 0.010 inch between the lining and wheel. Measure clearance with feeler gage.

(h) *Installing new capstan motor brake shoe and lining.* Remove inclosure by loosening four wing nuts. Loosen stop nut and end nut on ends of connecting rod, and remove the four machine bolts and nuts from base. Slide brake horizontally off wheel. Remove two $\frac{5}{16}$ -inch hexhead bolts and nuts from yoke releasing brake shoe and

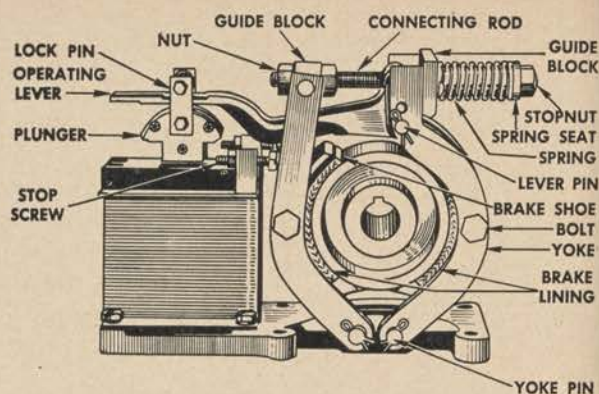


Figure 255. Capstan motor brake.

lining, and remove brake shoe and lining; replace them by placing in yoke, matching brake shoe contour with yoke contour. Bolt brake shoe and lining to yoke with two $\frac{5}{16}$ -inch hexhead bolts, nuts, and washers. Move brake horizontally to engage motor wheel. Line up brake carefully, making sure to match base drilling for reassembly. Secure brake to motor wheel leaving clearance of 0.010-inch.

NOTE. Use feeler gage to measure clearance, making sure feeler enters easily.

Bolt base to foundation with four hexhead bolts and nuts. Replace motor brake inclosure by hand-tightening the four wing nuts.

h. FLOODLIGHT SYSTEM. (1) *Description.* Floodlights operate on 208-volts alternating current supplied by the main generator. Controls for the floodlights are through circuit-breaker switches located on the main generator control panel. Angular adjustment at the floodlight mount permits maximum concentration of the lighting within the area of operation. The system is composed of these circuits: boom floodlights, A-frame floodlights, and deck house floodlights.

(a) *Boom floodlights.* The two boom floodlights are supplied with current by means of two cables from the main control panel which are connected to two angle receptacles mounted on the forward deck house, port side. Two cables, complete with plugs, are connected to the angle receptacles and are loosely looped and hung on a bracket attached to the forward deck house bulkhead, allowing free play around the boom seat. (See fig. 53.) A junction box, mounted directly above the boom seat, provides connections for cables which continue to the floodlights. Each

floodlight has a receptacle mounted on the boom for connecting the floodlight to the circuit.

(b) *A-frame floodlights.* The two A-frame floodlights are supplied with current by means of two cables that are connected to the main control panel, and are connected at the other end to two receptacles mounted on the forward deck house section. From this point two cables continue to the A-frame port leg where one of the cables is connected to supply current for the floodlight. The other cable continues across the A-frame cross piece to the starboard leg A-frame floodlight. Each floodlight is provided with a receptacle near its mounting.

(c) *Deck house floodlights.* The two house floodlights are supplied with current by means of two cables that are connected to the main control panel. One of these cables is clamped in place to the cabin bulkhead, running up to the portable ridge girder, where it continues across the ridge girder and thence to a receptacle mounted on the aft starboard roof section. The starboard house floodlight is connected to this receptacle. The port house floodlight cable is clamped in place to the port section deck house, where it extends through the roof to a receptacle mounted on the forward port roof section. The port house floodlight is connected to this receptacle.

(2) *Maintenance.* (a) *Replacing lamps.* Remove reflector clamping ring by removing roundhead machine screw and square nut from ring. Carefully remove door glass, and unscrew lamp from socket. Replace lamp with a new one of same wattage. Reassemble by reversing the procedure for removal.

(b) *Replacing door glass.* Remove reflector clamping ring and take out broken glass. Reassemble by replacing reflector clamping ring. Secure assembly by tightening lug with roundhead machine screw and square nut.

(c) *Replacing floodlight socket.* Remove clamping ring and take out door glass. Remove lamp. Withdraw the socket housing from the reflector by removing the four machine screws from the housing. Remove gasket and reflector from the socket housing. Separate the cable gland from the socket housing by removing the two machine screws, and remove socket from socket housing by unscrewing two mounting screws. Pull socket out carefully, feeding cable through socket housing gland. Disconnect wires, install new socket,

and connect wiring. Secure socket in socket housing with two mounting screws and pull the cable back in place, securing cable snubbing gland with two machine screws. Examine socket housing gasket and replace if damaged. Install reflector to socket housing with four machine screws. Then replace lamp, install door glass, and secure to reflector with the reflector clamping ring. Secure clamping ring with a machine screw and square nut at lug.

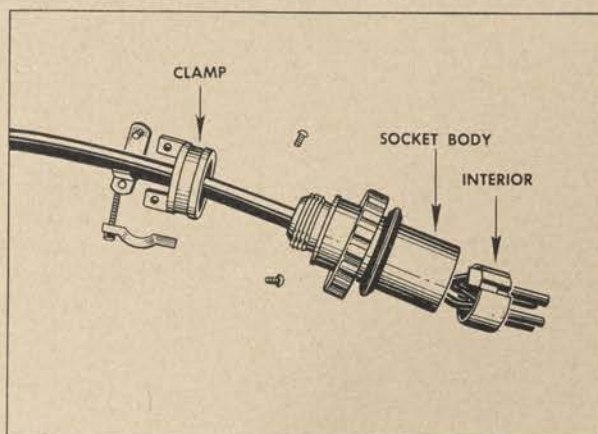


Figure 256. Replacing angle type plug interior.

(d) *Replacing angle type receptacle plug interior.* Remove plug from angle type receptacle. Remove the cable clamp from the interior body cap by unscrewing the two cap screws. Separate the interior body cap from the socket body, and pull back interior body, cap, and clamp. Loosen the interior by removing two small screws from the interior body shell, and carefully pull from the interior body. Disconnect the wires. Install new interior and connect wires. Pull the cable to return interior to the interior body. Screw the interior body cap back in place, secure plug to cable with a clamp and rubber washer which is held to the interior body cap by two cap screws. Secure interior to the interior body with two machine screws.

(e) *Replacing angle type receptacle interiors.* Separate the angle cover from the receptacle by unscrewing the four round head machine screws. Carefully pry the cover loose with a screwdriver. Remove the two round head machine screws from the angle cover shell. Remove angle cover, disconnect wires from the interior, and install new interior and connect wiring. Replace the interior into the angle cover. Secure the interior in the

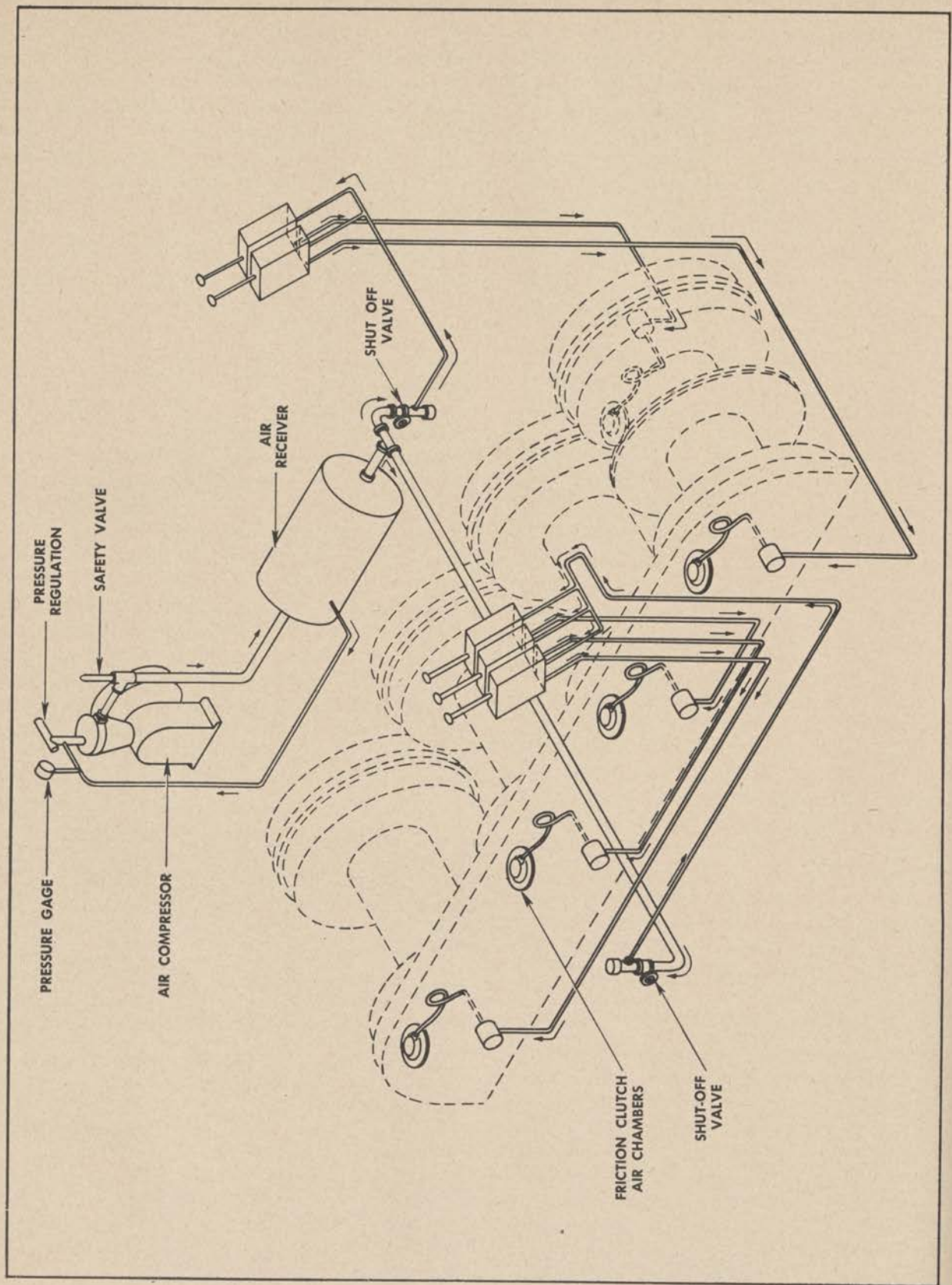


Figure 257. Air control system for hoist friction clutches.

angle cover by screwing the two roundhead machine screws into the angle cover shell. Replace the angle cover gasket if damaged. Secure the angle cover to the receptacle with four roundhead machine screws.

48. Air Control System (fig. 257)

a. GENERAL. The air control system is provided to furnish complete pneumatic control of the hoist drum friction clutches. The compressor, V-belt driven from the main Diesel engine, supplies air through a flexible connection to the air reservoir which is located under the deck house floor plates. Air is led from the reservoir in a single cross line under the floor plates from which two valve controlled branch lines are led forward, one to each of the control stands. At the control stands, lines are led to each air valve, and thence to their respective clutch power chambers. The power chambers are attached to, and revolve with, the drum gears, and the air connection is made through a swivel joint at the end of the drum shaft. Air pressure admitted to the power chamber acts on a flexible diaphragm which, through a push rod, moves the clutch lever, operating the clutch. The air pressure applied to the diaphragm can be regulated by the lever position, from zero pressure in the OFF position to full pressure in the ON position. By moving the valve lever slowly to the ON position, the pressure is gradually built up and the clutch takes hold smoothly. Gages are installed on both control stands to indicate to the operators the amount of air pressure furnished to the air control.

b. AIR CONTROL VALVES. (1) *Cleaning.* Should the small internal air valve ports and valve seats become clogged with grease or dirt, the valve will not function properly and must be cleaned. Remove defective valve and replace it.

Note. Cleaning of an air control valve requires special knowledge and tools. Such units, when found to be dirty, should be submitted to a higher echelon for cleaning or repair, and a complete valve assembly substituted.

(2) *Removing air valve.* Close the branch shut-off valve between the control stand and the air receiver. Disconnect the air supply line to the valve and the air delivery line from the valve to the power chamber. Remove the four mounting bolts securing the back of valve to the control stand. Lift the valve from the control stand.

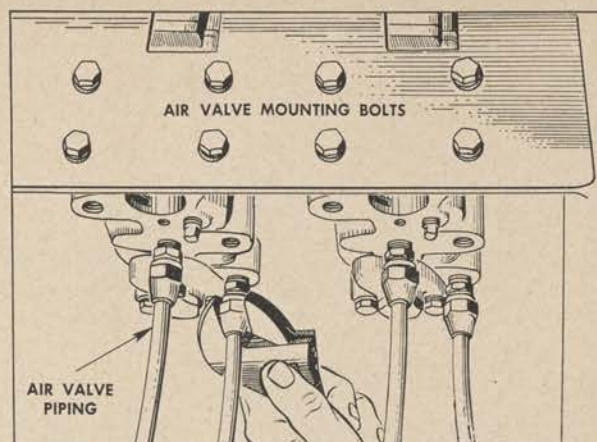


Figure 258. Removing air valve.

(3) *Air valve adjustment.* (a) *General.* Check the two adjustments provided for the air valve, when installing a new valve or when trouble is experienced in the valve operation. The first adjustment insures that no air passes through the valve to the power chamber when the valve lever is in the OFF position. The second adjustment insures that full pressure is delivered through the valve to the power chamber when the valve lever is in the full ON position.

(b) *OFF position adjustment.* Loosen lock nut of the adjusting screw projecting through the valve cover. Set this adjusting screw so that, with the valve lever in the OFF position, no air is admitted to the power chamber, and the power chamber push rod is in its OFF position (fully retracted). Tighten lock nut to maintain adjustment. Hold adjusting screw firmly in place while tightening lock nut. (See fig. 259.)

(c) *ON position adjustment.* Loosen lock nut of the adjusting screw located under the valve cover. Set this screw so that, with valve lever in the full ON position, full air pressure is admitted to the power chamber and the power chamber push rod is in the full ON position (fully extended).

c. AIR POWER CHAMBER. (1) *General.* When air is admitted to the power chamber, it acts upon a flexible diaphragm which in turn moves the push rod. In service, continued flexing of the diaphragm causes it to deteriorate and eventually it must be replaced. When this occurs, remove the complete power chamber, and turn in the defective unit to a higher echelon for diaphragm renewal.

(2) *Removing complete power chamber.* Shut off branch air line valve, disconnect power chamber

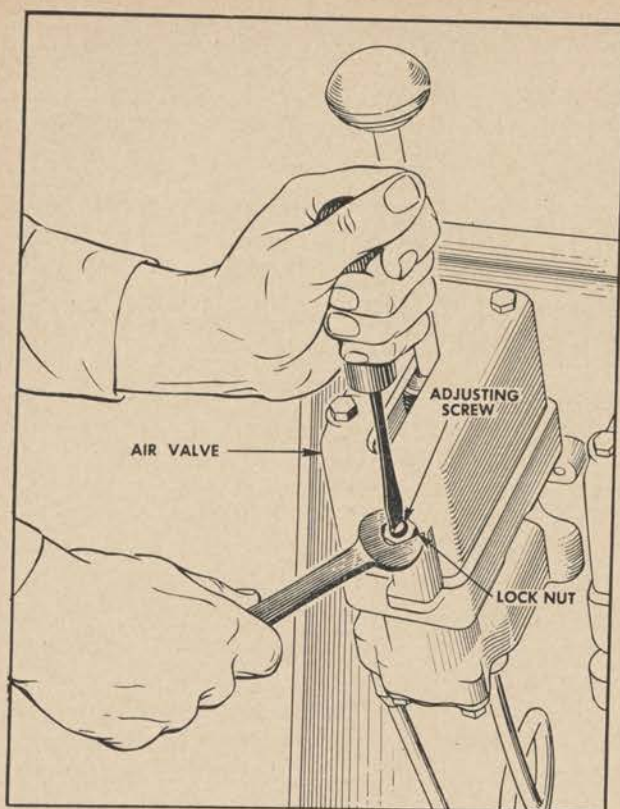


Figure 259. Adjusting air valve on vang and boom controls.

air supply line, remove cotter pin from pin connecting power chamber, push rod yoke to clutch lever (fig. 237), and remove nuts from studs attaching power chamber to support bracket. Lift chamber from its support bracket, withdrawing push rod and yoke through opening in the bracket.

(3) *Replacing complete power chamber.* Substitute new power chamber and mount on its support bracket by inserting push rod and yoke through opening in bracket. Insert power chamber studs through holes in support bracket, place nuts on studs securing chamber to bracket, and tighten. Insert pin connecting yoke to clutch lever, and cotter pin in yoke pin. Connect power chamber air supply line.

Section XVII. BOOM ASSEMBLY

49. General

a. The length of the boom from the boom seat pin to the hitch pin of the load block hanger is 70 feet. It is all steel, of lattice construction, and

built up of two sections bolted together at a center splice with $\frac{7}{8}$ -inch bolts. The boom is pinned to the boom pivot by a 4-inch pin which is secured in place by a bolt passing through the two stiffening plates projecting from the base of the boom. Inspect the boom periodically, giving particular attention to the tightness of the splice bolts. In addition, check carefully the entire boom structure for loose rivets, cracks, corrosion, and other signs of structural weakness.

b. Three sets of sheaves are built in at the outer end of the boom structure. Two of these are the 20-inch whip sheaves, one of which is located forward of the load block hanger, and the other aft of this hanger at the point where the boom end topping block hanger is pinned to the structure. The remaining set consists of twin 24-inch load sheaves.

c. Two pairs of vang blocks are attached to the sides of the boom end by means of shackles, one block of each pair being mounted on each side of the boom. The pair nearest the boom end consists of double 16-inch sheave blocks, which serve as the upper blocks of the port and starboard vang lines. The other pair consists of single 16-inch sheave blocks, to which the port and starboard vang lines from the A-frame fairleads are reeved. To avoid interference, the double vang blocks are shackled to collars mounted on the 2-inch hitch pin projecting from the sides of the boom. The single vang blocks are shackled to lugs set close to the boom.

50. Blocks and Sheaves

a. *GENERAL.* In service, sheave pins become worn and sheaves themselves may be damaged and require replacement. Sheave pins are secured in place by cotter pins and are readily removed for replacement. Inspect blocks and sheaves periodically for signs of wear, weakness, or corrosion. Examine sheaves for alinement, and remove burrs or roughness by filing.

b. *LOAD LINE SYSTEM.* (1) *General.* The twin 24-inch load sheaves, mounted in the boom structure, are carried on a $2\frac{1}{2}$ -inch pin. To remove them, drive out the pin, after removing the cotter pin. The upper load block hanger is pinned to the boom end by a hitch pin. The load block,

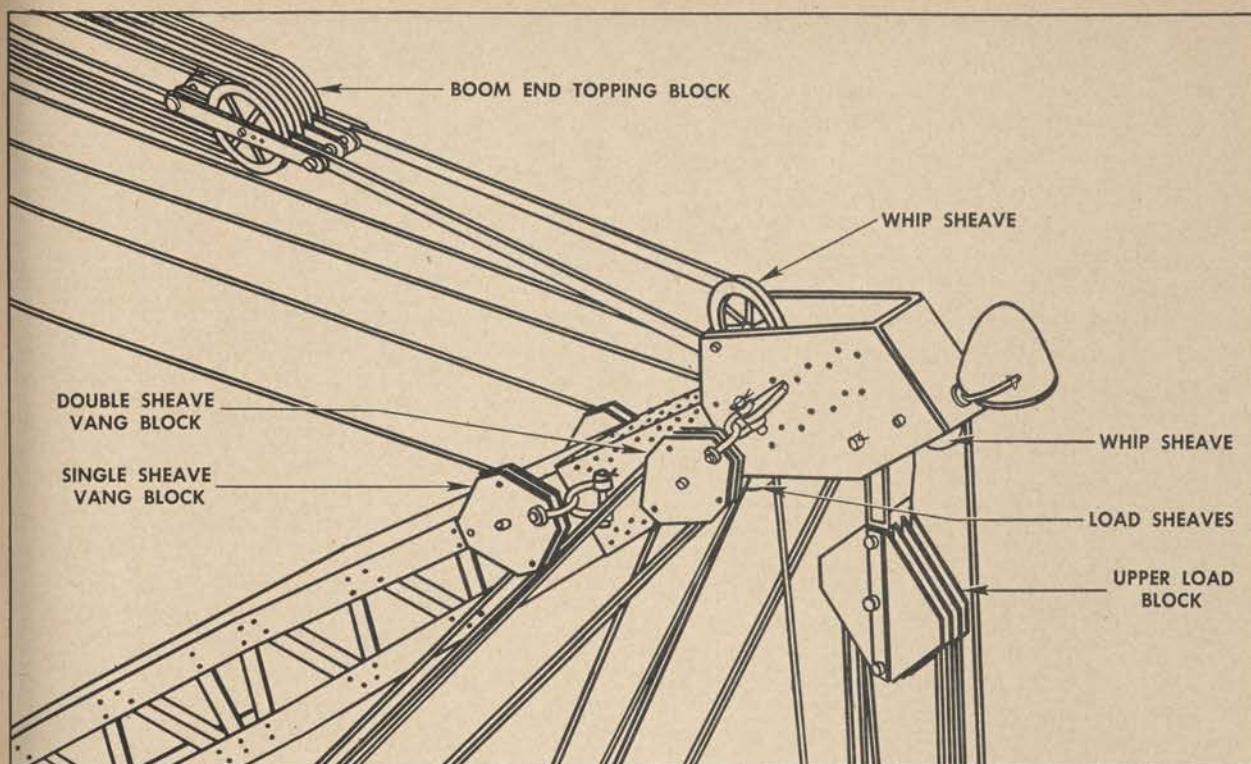


Figure 260. Boom end blocks and sheaves.

in turn, is pinned to the load block hanger. Remove the block from the hanger by taking out the cotter pin and driving out the load block hitch pin.

(2) *Removing sheave from main load block (fig. 261).* (a) Lower block until hook is near deck.

(b) Place timbers under checkweights on both sides of the block, to distribute the load over the deck and to support the block clear of the deck.

(c) Swing hook out of the way so that checkweights will rest on blocks. Lower block with the hook in a horizontal position resting on deck.

(d) Place blocks on both sides of sheaves to hold sheaves when sheave pin is driven out.

(e) Remove grease fittings from ends of the sheave pin.

(f) Withdraw the cotter pin from sheave pin.

(g) Drive sheave pin out far enough to release sheave, using brass drift.

(h) Remove the nut, tie bolt, and spacing collar between the sheave plates.

(i) Use a crowbar to ease sheave out of block. (See fig. 261.)

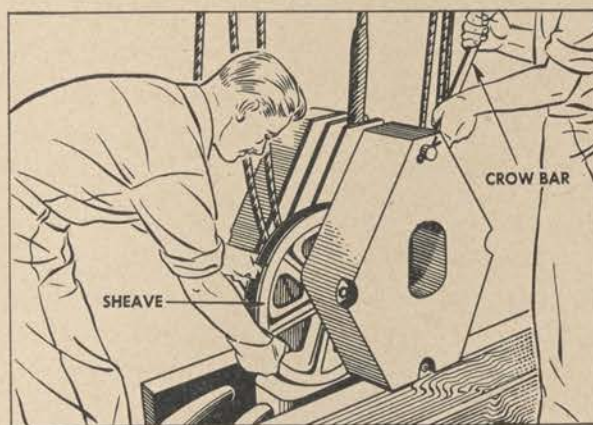


Figure 261. Load block—removing sheave.

(3) *Replacing sheave in main load block.* Roll the sheave into position in block, using a crowbar to locate in correct position. Use a brass drift to drive sheave pin into place, then insert the cotter pin. Replace the spacing collar between the sheave plates and replace tie bolt and nut. Replace grease fittings on sheave pin. Hoist block clear of timbers, and lubricate the sheaves before operating the block.

c. WHIP LINE SYSTEM. The whip sheaves, located one above and the other on the boom end, are mounted on $2\frac{1}{2}$ -inch pins. Remove them by withdrawing the cotter pin from the sheave pin and driving the sheave pin out to release the sheave, which can then be slipped from the boom end.

d. VANG LINE SYSTEM. Both the single and double vang blocks are attached to the boom by shackles. To unshackle the vang block, remove the cotter pin from shackle pin and withdraw the shackle pin. (See fig. 262.) Remove the sheaves from the blocks by removing the sheave pin cotter pins, and driving out the sheave pins, in the same manner as described for the main load block, (2) above.

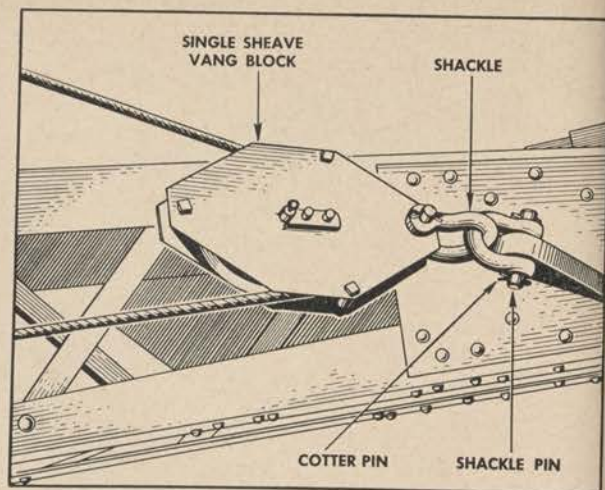


Figure 262. Vang block and shackle.

PART FOUR

AUXILIARY EQUIPMENT

Section XVIII. GENERAL

51. Scope

Part four contains information for the guidance of organizational maintenance personnel. It contains information necessary to make adjustments and replace parts of auxiliary equipment within the scope of organizational maintenance.

Section XIX. MACHINERY HOUSE ASSEMBLY

52. Main Generator (fig. 9)

a. GENERAL. With the main engine operating, current for the barge derrick is supplied by a 20-kva, 3-phase, 60-cycle, 120/208-volt, American Custom Built Generator, Model 140-4-6 Type OG. The generator is belt-driven from the main drive shaft. The lighting system, refrigerator, and galley stove operate on a 120-volt circuit while the capstan motor, deck pump, and floodlights utilize 208 volts.

b. GENERATOR REMOVAL. (1) Provide a hoist capable of handling the generator weight of 750 pounds.

(2) Separate generator from generator foundation by removing the eight $\frac{7}{8}$ -inch-diameter hex head bolts and nuts.

(3) Remove the belt guard from the generator by removing the four $\frac{1}{2}$ -inch hex nuts.

(4) Remove generator conduit box from the generator to expose wiring by removing the six roundhead machine screws. (See fig. 48.)

(5) Identify wiring for generator assembly by tagging leads.

(6) Disconnect wiring.

(7) Carefully hoist and tilt generator to disengage the V-belt drive.

(8) Hoist generator from generator foundation.

(9) Separate the generator foundation from the foundation and engine girders by removing bolts.

(10) Remove generator foundation.

(11) Reassemble generator in place to barge by reversing preceding steps (par. 7m (3)). Repeat steps for reassembly.

Note. Aline generator in accordance with paragraph 7m (2). Adjust belt tension by loosening hex nuts on rail and sliding generator forward or aft. Secure generator to rails by tightening four hex nuts. Noise and rapid belt wear will result if drive is misaligned or run at improper tension.

c. REPAIR. Report malfunction of generator to higher authority. Replacement or repairs for the main generator are beyond the scope of second echelon maintenance.

53. Auxiliary Diesel Generator Set

a. GENERAL. The auxiliary Diesel generator set (fig. 11) operates independently of the main generator and main engine. It is used in the barge to provide electrical energy for operating the refrigerator, galley stove, and lighting system when the main engine is shut down. The engine is a single cylinder Diesel engine. It operates on the four-stroke-cycle compression principle, and burns fuel commercially known as Diesel fuel, without use of spark plugs or externally heated surfaces. The generator is coupled to the engine and delivers 110-volt, 60-cycle, single-phase alternating current.

b. AUXILIARY DIESEL GENERATOR REMOVAL. (1) Remove aft and forward roof section (par. 7o).

(2) Remove the conduit boxes from the generator to expose wiring, by removing the round head machine screws. (See fig. 46.)

(3) Disconnect the starting battery.

(4) Identify wiring for reassembly by tagging when disconnecting it.

(5) Separate auxiliary generator foundation

frame from the deck bolting bars by removing the 10 $\frac{3}{8}$ -inch-diameter hex head bolts and nuts.

(6) Insert eyebolts into the two lifting nuts on the cylinder head of the engine. With a sling secured to the two eyebolts of the engine and the single eyebolt on the generator frame, lift the Diesel generator set out through the deck house roof by means of a hoist having a capacity of 3,000 pounds.

(7) Install the replacement Diesel generator set through the roof and bolt in position as described in paragraph 7m (4).

(8) Replace roof section (par. 7o).

c. AUXILIARY DIESEL GENERATOR MAINTENANCE.

(1) *Cylinder head.* (a) *Description.* The single cylinder head contains the valves and valve springs, combustion chamber, and rocker arm assemblies. Two head lifting nuts are secured to the head and are threaded to receive lifting bolts for raising the engine during installation. (See fig. 263.) The cylinder head is cored for cooling water passages. A thermostat fitting mounted on the cylinder head regulates water cooling temperature.

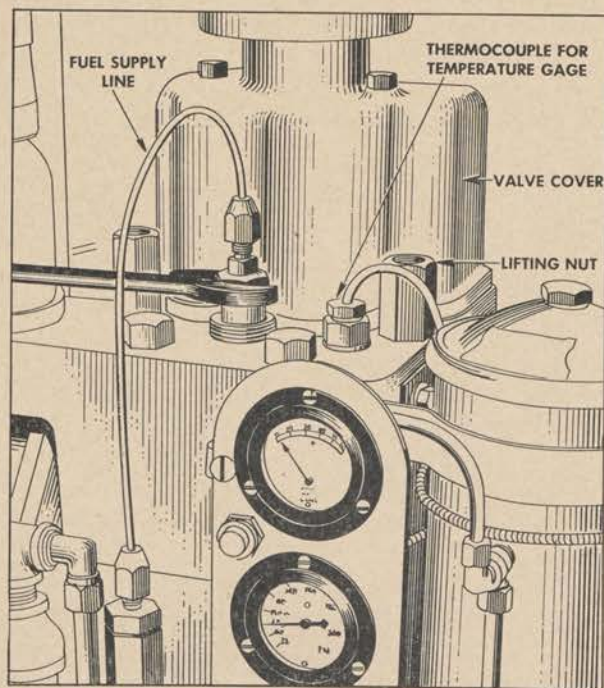


Figure 263. Removing fuel injection valve.

(b) Removing cylinder head.

1. Remove the valve cover by taking out the two capscrews.
2. Remove the rocker arm shaft by taking

off the nuts on top of the journals and lifting out the shaft. Lift off the rocker arm shaft journals and withdraw the push rods. Be sure to keep all of these parts in their original order so that they may be replaced in their correct position upon reassembly.

3. Remove the fuel injector from the cylinder head, using a 1-inch wrench on the body of the assembly. (See fig. 263.)
4. Turn the hold-down nut until the assembly is screwed out. It will probably be necessary to use a pair of pliers on the two-sided milled flats and twist slightly back and forth in order to break loose the carbon formation and permit withdrawal of the fuel injector assembly. Do this carefully, in order to avoid kinking the injector tube.
5. Drain the water from the engine as described in paragraph 44g (3).
6. Remove the water temperature gage thermocouple.

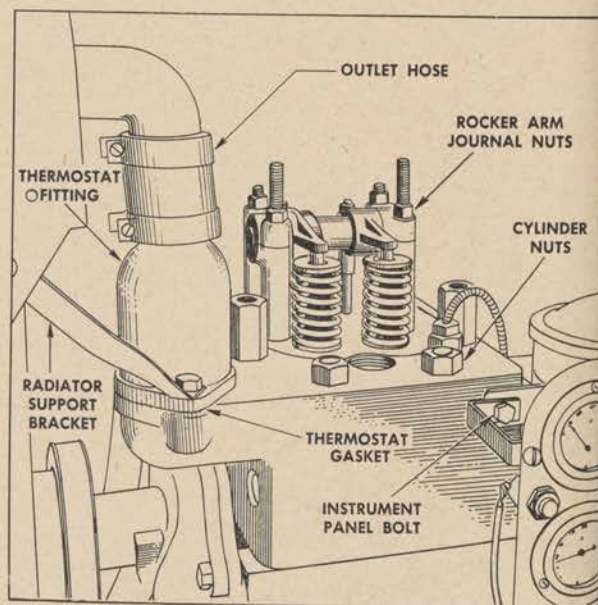


Figure 264. Removal of cylinder head

7. Remove the exhaust manifold pipe connection to the cylinder head. Disconnect the instrument panel support bracket, the filter support bracket, and the radiator braces to the cylinder head. Loosen the water outlet rubber hose clamps and raise up the hose.

8. Disconnect the thermostat bypass water hose to the thermostat fitting and remove the thermostat fitting, being careful not to drop the thermostat.
9. With a long-handle socket wrench, remove the four cylinder hold-down nuts. Lift off the head by grasping it on each side by the manifolds. If the head is hard to break loose, start it by wedging in a screwdriver a short distance between the head of the block.

Warning: With the cylinder head removed, do not crank the engine by hand or with the starter, as this will lift the liner out of its seat.

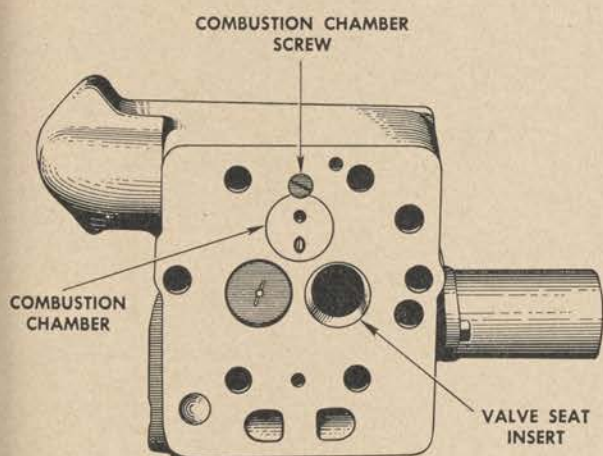


Figure 265. Bottom view of cylinder head.

(c) *Removing and replacing combustion chamber.* Position the head as shown in figure 265, being careful not to bend the studs on top of the head. With screwdriver, loosen the flathead screw securing the combustion chamber. (See fig. 265.) With a small piece of wood, or a piece of brass rod inserted in the injector hole, push the combustion chamber out. Insert new combustion chamber and replace screw.

(2) *Valves and valve mechanism.* (a) *General.* The inlet and exhaust valves located in the cylinder head are operated by gear-driven cam shaft to a lifter push rod and rocker arm arrangement. Valve stems operate in replaceable bushings.

(b) *Checking valves.* See procedure for checking valves for Caterpillar Diesel (par. 44c).

(c) *Valve removal and replacement.* Place the cylinder head right side up on a flat clean surface and depress the spring keepers far enough to

expose the horseshoe-shaped valve keeper. Use a forked piece of steel to depress the spring keepers. Displace the valve keeper sideways; take it out and remove the spring keeper and spring. Now remove the valve from the opposite side of the head.

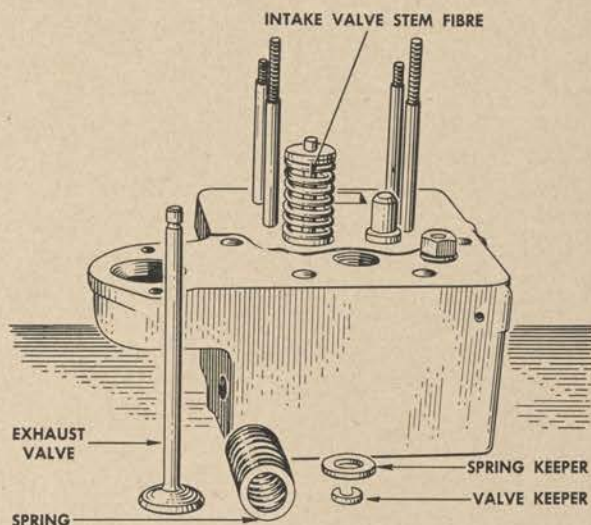


Figure 266. Exhaust valve assembly removed from head.

(d) *Valve inspection and reseating.* Refer to valve inspection and reseating as described for the Caterpillar Diesel engine, paragraph 44c (2), for instructions on valve inspection and reseating.

(e) *Valve seats and valve stem bushings.* Note that the valve seats must be exactly the same width as the ground faces of a new valve. Before grinding, run a $\frac{3}{8}$ -inch standard reamer through each of the valve guides to remove any carbon. After grinding, wash in kerosene and dry the head valves, springs, rocker arm, etc.

(3) *Assembling cylinder head.* (a) Assemble the head by placing it right side up on the flat surface, with the valves in place.

(b) Examine the valve stem fibre oil seal on the intake valve stem, and replace it if worn.

(c) Drop the springs on the valve guides and the spring keepers over the springs.

(d) Using the forked steel tool, previously described, depress the spring and spring keeper, and slip the valve keepers into place.

(e) Before replacing the cylinder head on the block, be sure to install a new cylinder head gasket. Tighten the cylinder head studs down gradually and evenly, tightening the nuts across the cylinder.

Note. When using a new cylinder head gasket, be sure that there are holes for all the drilled passages in the head and block.

(f) Put into position and adjust the rocker arm shaft journals, the push rods, and the rocker arm shaft and rockers.

(g) Adjust valve clearances as described in (4) below.

(h) Replace the valve cover, examining the gasket for condition. If the gasket is replaced on the valve cover, shellac it to the cover, being careful to squeeze out and wipe off all excess shellac.

(i) Install a new thermostat gasket before bolting the thermostat to the cylinder head.

(4) *Adjusting valve clearance.* (a) Make initial valve clearance adjustment when tightening at the cylinder head stud nuts, after the first few hours of engine operation; check clearance again about 100 hours after valves have been reground.

(b) Loosen the valve adjusting screw lock nut on the valve rocker arm. Insert a feeler gage between the push rod and valve rocker arm. Adjust clearances for both intake and exhaust to 0.007 inch when hot, or to 0.010 inch when cold. Recheck the adjustment after tightening the adjusting screw lock nut.

(5) *Piston, connecting rods, and cylinder liners.* (a) *General.* The first noticeable symptoms of worn piston rings and cylinder liners are increased oil consumption with excessive vapor from the crankcase breather. Extreme wear may result in poor compression, loss of power, and hard starting.

(b) *Removing connecting rod and piston.* Before removing the piston and connecting rod, drain the engine of water and oil. Remove the cylinder head and remove the panside cover. With the cylinder head removed, use a soft instrument to scrape off the carbon accumulation from the upper walls of the cylinder liner. Rotate the engine crankshaft until the connecting rod bearing bolts are accessible through the panside cover opening. Remove the four connecting rod bearing bolts, being careful not to drop the bearing shells.

Note. When replacing connecting rod bearings only, do not remove the cylinder head or drain the water from the engine. Drain only the lubricating oil.

(c) *Removing cylinder liner.* Remove the cylinder liner before withdrawing piston and connecting rod, since the large end of the rod will not pass through the liner. To pull the liner, use the special cylinder liner puller which is provided with two sets of screws (short and long). Insert the tool (circular portion with washer) inside the

cylinder liner just below the top. Screw the nut of the tool down and place the cross piece over the nut; then slip the top nut over the cross piece. Using the short pair of screws, screw down until the liner is loose. If necessary, remove the short screws and insert the long pair to obtain leverage for raising the cylinder liner higher. Remove the liner, connecting rod, and piston as an assembly and withdraw the connecting rod and piston through the bottom of the liner.

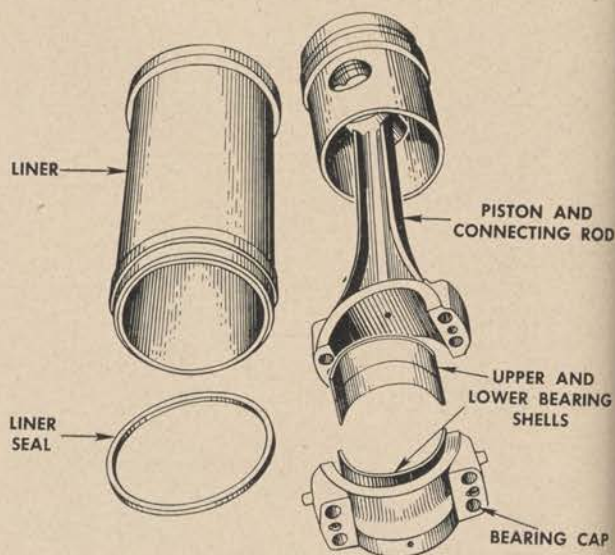


Figure 267. Connecting rod, piston, and liner.

(d) *Removing piston pin and cleaning piston.* Remove the piston pin by taking out the snap ring from the piston bosses and driving out the pin with a soft piece of wood. To clean the piston, refer to the procedure for cleaning pistons on the Caterpillar Diesel engine, as described in paragraph 44e(10).

(e) *Piston pin bushings.* Install a new bushing when the clearance between the bushing and the new piston pin exceeds 0.005 inch. After pressing new bushing into place, it should be machined accurately from 0.005 to 0.001 inch larger than the new piston pin diameter.

(f) *Replacing piston rings.* The piston is provided with four rings: the lower ring, an oil ring of the four-piece construction type, the second from the bottom ring also an oil ring, and the two upper rings for compression. After thoroughly cleaning and examining the piston, remove the rings with a ring expander. Check the ring gap clearance in the cylinder liner and see that it does

not exceed 0.010 inch. Check clearance by inserting the ring squarely in the liner. Measure at a distance of about 3 inches from the top. When installing new rings, use a ring expander to place them in their proper grooves right side up. A ring expanding tool should be used in placing the rings in the grooves. After installing new rings, operate the engine in accordance with the recommended "run in" schedule given in (6) (b) below.

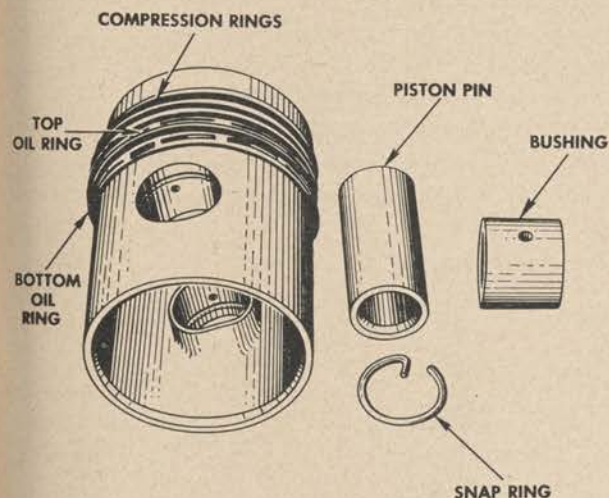


Figure 268. Piston assembly.

(g) *Replacing connecting rod bearings.* Connecting rod bearings are of the precision type. Install them without fitting or scraping the shells. Remove, inspect, and replace bearing shells through the sidepan cover without removing the connecting rod on the engine. Remove the bearings by withdrawing the four connecting rod bearing bolts.

Note. Inspect the connecting rod, bearing cap, and backs of bearing shells to insure that they are smooth and free of oil, dirt, and grease before replacing any bearings. This is important since the bearing shells will not seat properly if any of these are present.

(h) *Inspection and replacement of connecting rod and liner.* Replace bent connecting rods; they are not suitable for service. Do not attempt to align connecting rods by bending. Replace liners only when they are worn at the top of the ring travel in excess of 0.020 inch or when they are badly scratched or scored.

(i) *Replacing cylinder liner.* See that each liner installed has a new rubber seal in the groove at the bottom of the liner to prevent water leaks. Be sure to remove the old seal before installing the new one.

(j) *Replacing piston and connecting rod.* Refer to procedure for replacing piston and connecting rod in the Caterpillar Diesel engine (par. 44c).

Caution: Before placing the rod in the piston, determine in which direction the two small drilled holes in the very top of the rod are pointing. (See fig. 269.) These holes, with the connecting rod installed, must point to the injector side of the engine. Insert the connecting rod bearing bolts so that the flat sides of the head are adjacent to the rod side. If this is not observed, it will not be possible to install the rod and bearing cap correctly.

Whenever installing new rings, piston assembly, or liner, run the engine in accordance with the "run in" procedure described in (6) below.

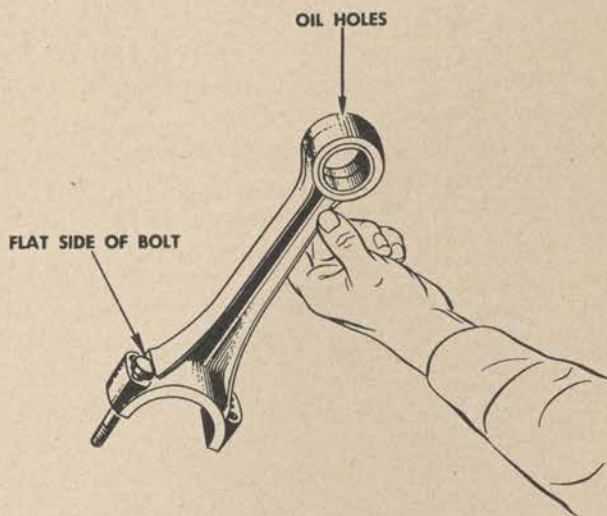


Figure 269. Connecting rod.

(6) *Run-in schedule.* (a) Whenever installing new rings, liners or bearings, observe an operating schedule similar to that performed on new engines.

(b) Start the engine and run for ten minutes, at about one-third load, with a speed of approximately 1,100 rpm. Repeat this 10-minute operating schedule three or four times, checking the engine for excessive tightness after each stop. Increase the running periods gradually to intervals of 30-minute runs. After an operating time of 10 hours, increase the engine speed to 1,200 rpm and continue to stop the engine every 30 minutes. After an operating time of 20 hours, increase the load to half and continue to stop the engine every 30 minutes. After an operating time of 30 hours, increase the load to 75 or 80 percent of full, and

stop the engine every 30 minutes. The engine is prepared to operate at full normal load continuously at the end of 40-hour break-in period described above.

(c) After the engine has been run for several hours, remove the valve cover and tighten the cylinder head nuts while the engine is hot.

(7) *Fuel system (fig. 270).* (a) *Description.* The auxiliary Diesel fuel tank is located at the base of the engine. A filler cap is located in the base at the right side of the engine near the radiator, and is removable for filling the tank. Fuel is obtained by tapping the day fuel tank of the Caterpillar Diesel, as shown in figure 163. Use a funnel and pipe arrangement to fill the tank, since the clearance between the deck house wall and

filler plug is insufficient to permit direct filling. The engine fuel system employs a fuel transfer pump which draws fuel from the tank in the base of the engine and forces it through a filter. (See fig. 270.) The fuel suction lines from the filter send oil into the filter in the fuel pump cylinder. After quantity regulation by the governor, the fuel pump forces the fuel to the injector assembly where it is injected by the spray valve into the combustion chamber.

(b) *Checking fuel injection equipment.* Refer to "Checking fuel system" as described for the Caterpillar Diesel engine (par. 44 d.)

(c) *Checking fuel injector assembly.*

1. Before removing a fuel injector assembly from the cylinder head, clean all dirt

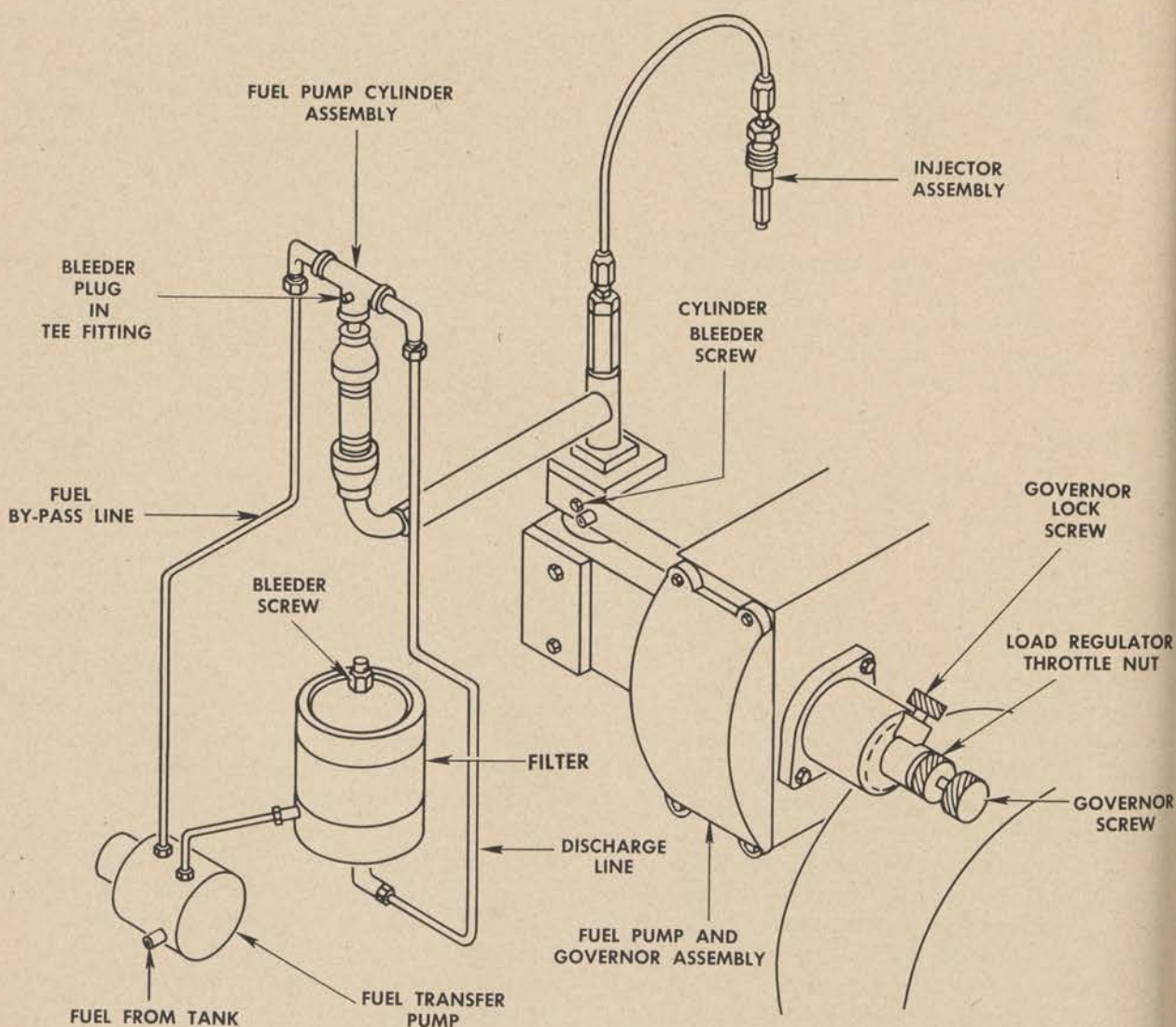


Figure 270. Auxiliary Diesel fuel system.

or oil accumulations from the assembly and adjacent areas.

2. Remove the fuel injector assembly (par. 44d).
3. Using a standard nozzle tester, check the injector to insure that the injector valve emits a fine, even spray in the form of a mist. If fuel forms in droplets at the nozzle tip, or if spray is unsymmetrical, disassemble the injector as shown in figure 271. Clean the parts in kerosene and remove any carbon formation from the nozzle end with a blunt piece of wood.

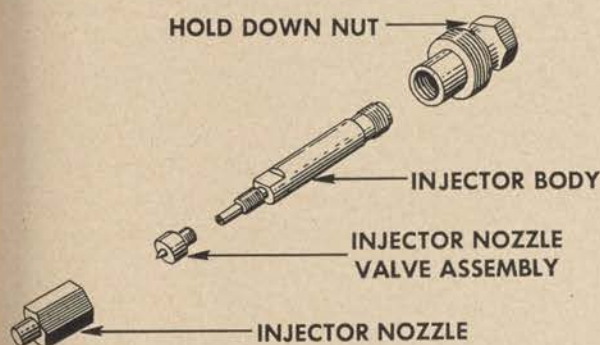


Figure 271. Fuel injector assembly.

4. Carefully clean the fuel discharge opening in the nozzle valve assembly. Replace the assembly, consisting of spring, seat and valve, as a single unit if, after cleaning and drying, the spray characteristics show a fuel discharge in a solid stream or jet, or a spray emitted on one side of the nozzle.
5. After cleaning, reassemble the injector, using a new injector valve seat gasket. Obtain a tight seal for the fuel injection tube at the injector and fuel pump cylinder connections.

(d) *Replacement of fuel pump head plate gasket.* Disconnect the suction and bleeder fuel lines from the tee fitting on the fuel pump cylinder. Remove the two screws holding the fuel pump cylinder assembly to the equalizing head. (See fig. 272.) Remove the old gasket and install new part, making sure that the gasket is neatly trimmed and does not project from under the base.

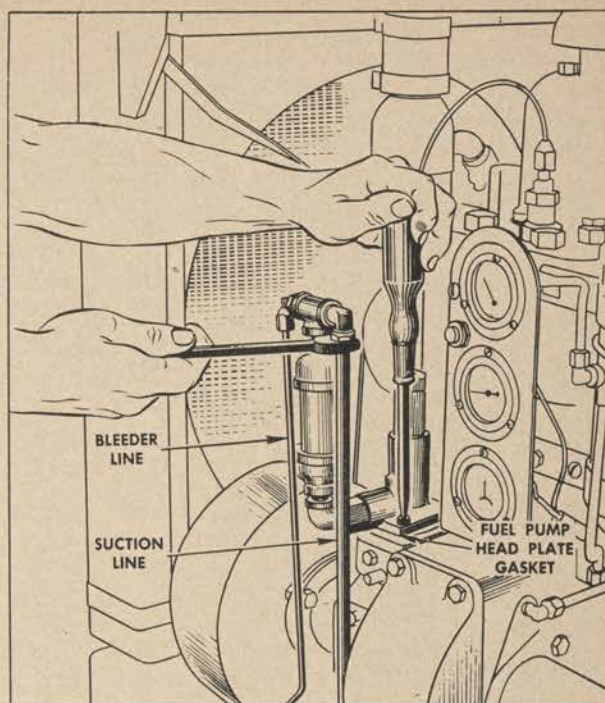


Figure 272. Removing fuel pump cylinder assembly.

(e) *Removal of fuel pump and governor assembly.* To remove the fuel pump and governor assembly from the engine, first disconnect the suction and bleeder fuel lines from the tee fitting. (See fig. 273.) Then disconnect the suction line from the filter and the lubricating line from the governor to the lubricating oil filter. At the upper end of the governor housing, behind the instrument panel, take out the three capscrews holding the assembly to the cylinder block. Remove the three socket-head screws at the lower end of the governor housing. (See fig. 273.)

Note. When removing the assembly, do not drop the fuel pump drive coupling and the three felt washers.

(f) *Replacing fuel pump oil seal.* With the fuel pump and governor assembly removed from the engine, replace the oil seal as follows: loosen the socket-head setscrew from the fuel pump driven coupling and remove the coupling. (See fig. 274.) Drive out the Woodruff key from the pump and drive shaft. Take out the four screws from the oil seal cover and remove the cover. Examine the oil seal cover gasket and replace if damaged. Wedge out the oil seal and replace with a new part. (See fig. 274.)

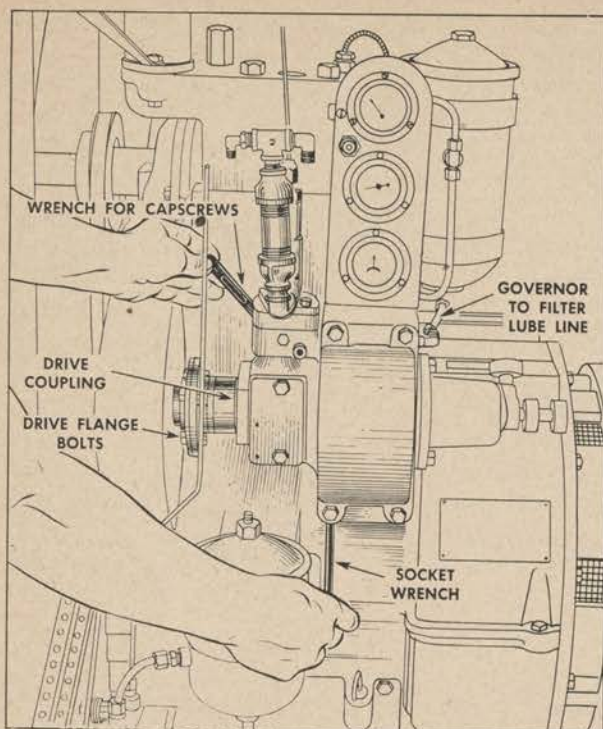


Figure 273. Removing fuel pump and governor assembly.

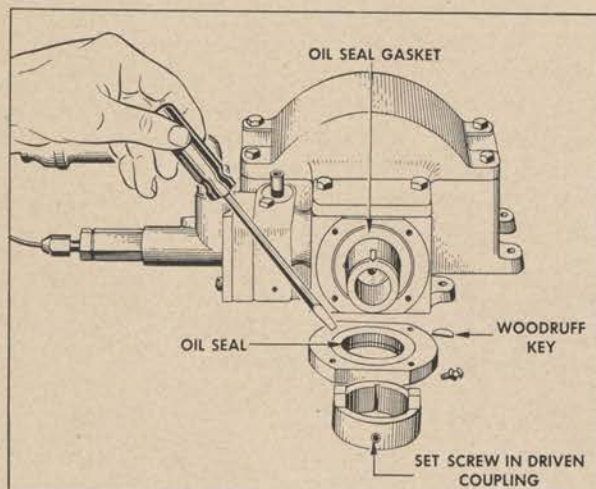


Figure 274. Replacing fuel pump oil seal.

(g) *Replacing fuel pump governor assembly.* Before installing the assembly, replace the gasket between the fuel pump and crankcase. When removing or disassembling the unit, replace gaskets in the fuel pump governor assembly. Replace the coupling half on the pump, observing that the marks on the end of the pump line up with those on the coupling half. Bolt the pump to the crankcase, making sure that the drive coupling timing

mark coincides with the scribed timing mark on the driving flange. Before tightening the pump in position, line it up horizontally with the driving shaft. Determine this by holding a straight edge on top of the coupling and sighting under it. With the pump alined, tighten the six screws holding it to the crankcase.

Note. Although there is no necessity for disturbing the fuel pump timing when installing or removing a new pump for service, check the timing after assembly as described in (7) (k) below.

(h) *Priming fuel system (fig. 270).* Priming is necessary if the engine is permitted to run out of fuel and air enters the fuel system. In this case, fill the fuel tank and proceed as follows: Remove the drive belt from the fuel transfer pump and loosen the filter bleeder screw. (See fig. 270.) Rotate the pump in a clockwise direction by hand, until a steady stream of oil flows from the top of the filter. Replace the screw, rotate the transfer pump several additional revolutions, and replace the belt. Turn the throttle screw in almost fully, and loosen, with out removing, the fuel pump cylinder bleeder screw. (See fig. 270.)

Note. If the bleeder screw is removed, the ball check will drop out. Loosen the screw only when priming.

Press the starter button until fuel oil squirts out strongly around the threads of the cylinder bleeder screw at regular intervals. Tighten the screw with a hollow head setscrew wrench.

(i) *Bleeding fuel injection pump.* Remove the $\frac{1}{8}$ -inch hollow pipe plug in the fuel pump suction tee fitting (fig. 270), allowing fuel to escape, until a solid stream of fuel, free of air bubbles, flows from the opening. Tighten plug.

(j) *Care of fuel filter.* The fuel oil cartridge in the filter, under ordinary conditions, will function satisfactorily for a period of 500 to 600 hours of engine operation. Excessive rust and dirt are visible on the top of the cartridge when the cover is removed. Under this condition, service the filter by removing the plug at the bottom of the filter (fig. 275), and allow the oil in the filter case to drain. Remove the filter cover and withdraw the cartridge. Flush the filter case with fuel oil until all dirt is removed. Drain the flushing oil and install a new cartridge. After installing a new cartridge in the filter, it is necessary to fill the case completely with fuel oil in order to prevent air locks. Tighten the cover and prime the fuel system as described in (h) above. Check the con-

dition of a cartridge during the priming operation, when fuel oil should flow strongly from the air vent in the filter cover. A slow trickle from this opening indicates a worn out filter cartridge.

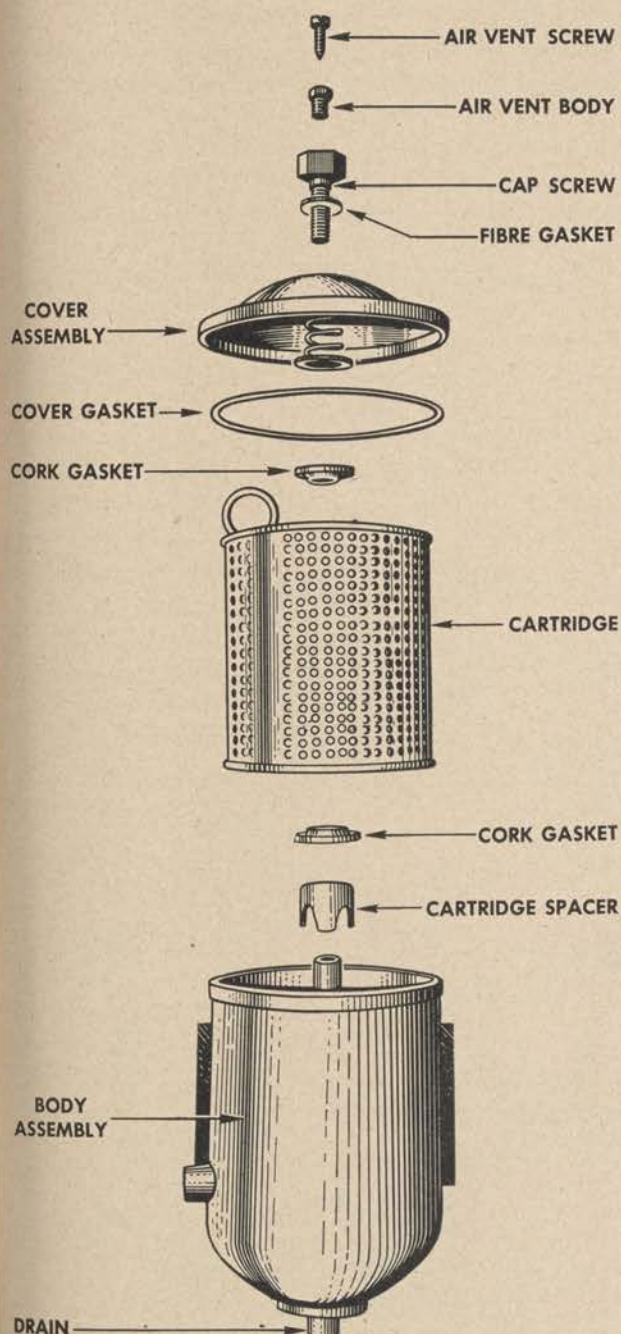


Figure 275. Disassembly of fuel oil filter.

supplying current. After the engine has been operating at normal speed for about 15 minutes, observe the exhaust coming from the exhaust pipe. The exhaust should be practically invisible at full-load and also at no-load full speeds. If smoke is visible at either full- or no-load, it is evidence of improper timing.

2. To adjust the timing, loosen slightly the three bolts in the driving flange between the flexible coupling and the gear housing (fig. 273), observing the setting present. Move the fuel pump either "advance" or "retard," a distance of one mark on the periphery of the flange. Tighten the three bolts and start the engine. Apply, first, full load full speed, and then no-load full speed, noting carefully any difference in the density of the exhaust. If no improvement is evident, or if the exhaust is heavier, move the fuel pump in a direction opposite that previously moved, a distance of two marks. Repeat engine operation. Moving the fuel pump one mark at a time, first in one direction and then in the opposite, will indicate the position of correct setting.

Note. When viewing the exhaust for timing purposes, the same background, weather, and light conditions should be present, as these factors have a bearing on the apparent density of the exhaust.

(8) *Lubricating system.* (a) *General.* The auxiliary diesel engine is provided with a pressure lubricating system. The oil pump located in the engine crankcase sends oil to the main bearings, crank pin, piston, and governor. Oil is circulated through a filter which is connected by lubricating oil lines to the governor and engine.

(b) *Draining and cleaning crankcase.* See WDLO 55-U39 for draining interval and lubricant to be used for refilling. Drain the oil and remove the oil pan side cover (See fig. 276.) Then clean the screen at the bottom of the lubricating oil pump with a small brush dipped in kerosene. With the cover removed, clean the bottom of the oil pan of dirt and sludge with a cloth dipped in Kerosene. Replace worn gaskets for the drain plug and pan side cover.

(k) *Timing fuel pump.*

1. Perform the timing of the engine while it is warm, and when the generator is

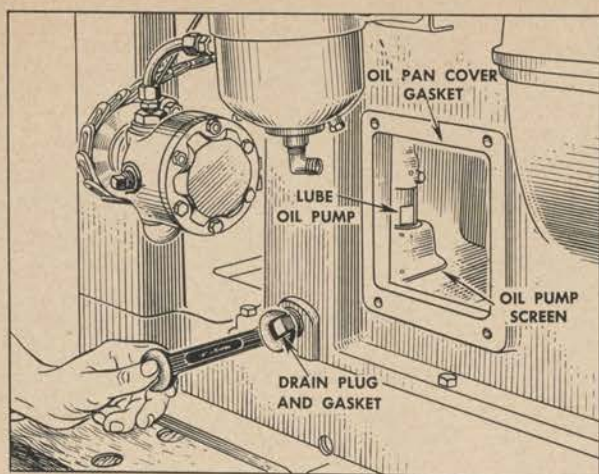


Figure 276. Draining the crankcase.

(c) *Cleaning lubricating oil filter.* Check weekly the color of the lubricating oil, using the dipstick at the side of the oil pan. If the oil begins to darken, change the lubricating oil cartridge on the filter. If the cartridge is not changed promptly when the oil becomes dark, sticking rings and valves may result. To change the cartridge, remove the nut from the cover, remove the cover and withdraw the cartridge. Install new cartridge and add one quart of lubricating oil to replace that removed with the old cartridge.

(9) *Servicing air cleaner and breather.* (a) *Description.* The oil bath type air intake cleaner and crankcase breather are of the oil bath type. Uncleaned air is drawn into the cleaner inlet openings and the direction of air travel reversed above the oil level in the oil cup. This reversal of air flow causes the larger particles of dirt in the air to fall into the oil. The partially cleaned air then travels upward, through the oil-moistened filtering element, where any remaining dirt and dust particles are removed.

(b) *Servicing.* Remove air cleaner or breather by loosening the clamp screw nut. Remove wing nut at top of cleaner and lift filter element from oil cup. Empty oil from cup, clean it inside and out with cleaning solvent; wash filter element in cleaning solvent, allow to dry, drain; fill oil cup to level of mark with engine oil. Place air filter element in oil cup and install wing nut. Then install air cleaner or breather on the engine.

(10) *Cooling system.* (a) *General.* The auxiliary diesel engine is cooled by water circulated by a centrifugal pump through a fan-cooled radiator. Water jackets extend the entire length of the

cylinder. The cooling system is equipped with a thermostat which helps control the water temperature under extreme hot or cold operating conditions. Use a soft water in the cooling system. If it is necessary to use hard water, first treat it with an authorized water softener. Soft water will make a good lather with ordinary soap. Hard water will not make a good lather with ordinary soap.

(b) *Overheating and cleaning system.* See "cooling system" description for Caterpillar Diesel engine, paragraph 44g. For fan belt adjustment, see (c) below.

(c) *Adjusting fan belt.*

1. *General.* The radiator fan, water pump, and generator are operated from the same V-belt. Adjust this belt so that it is firm to the touch but not taut or loose. A loose fan belt causes wear to the belt and possible slipping to the extent that the engine will overheat. A tight belt places unnecessary stresses on the belt and bearings, thereby shortening their operating life.

2. *Adjusting belt.* Adjust the belt by varying the position of the generator. (See fig. 277.) Loosen the generator support bracket nut on the cylinder block, and loosen the generator pivot bracket bolts. (See fig. 277.) Swing the generator from the engine to tighten the belt, or toward the engine to loosen it. Tighten the bolts after obtaining the correct belt tension.

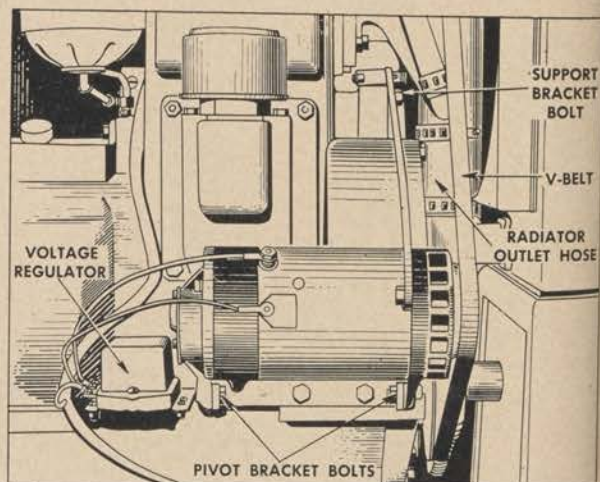


Figure 277. V-belt adjustment.

3. *Removing belt.* To remove the belt for servicing the engine, or for replacement purposes, remove the water outlet hose (fig. 277) from the radiator by loosening bolt hose clamps and sliding the hose out of position. Then slip out the belt after loosening the generator, as described in the preceding paragraph.

4. *Draining cooling system.* Drain water from the engine by opening the drain cock located in the cylinder block behind the fuel pump drive coupling. Figure 278, showing the fuel pump and governor assembly removed, gives the location of the drain cock. Remove the radiator fill cap to permit all water to drain from both the radiator and the cylinder block. Be sure to close the drain cock before refilling the cooling system.

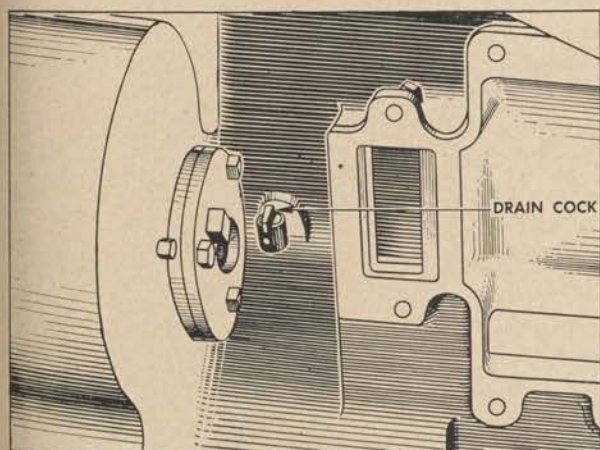


Figure 278. Water drain cock.

(11) *Starting system.* (a) *General.* Cranking of the auxiliary Diesel engine is accomplished by a 12-volt Auto-lite cranking motor located on the lower right side of the engine. Specifications for the motor follow:

Rotation: Clockwise at drive end.

Drive: Bendix right-hand outboard.

Starting switch: Mounted on instrument panel with solenoid switch mounted on motor.

Poles: Four.

Brushes: Four.

The bendix drive consists of a threaded sleeve fastened to the armature shaft through the drive spring and pinion mounted on the threads of the sleeve. When the starting circuit is closed, the armature revolves, turning the sleeve within the pinion and forcing the gear forward, meshing it with the engine flywheel. The shock of meshing is absorbed by the spring. When the engine starts, the pinion is driven faster than the sleeve and is forced back along the threads, automatically demeshing it from the flywheel.

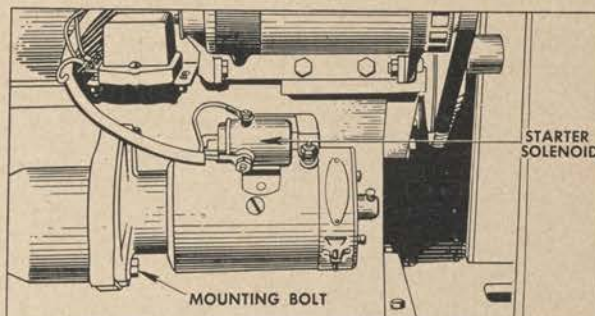


Figure 279. Starting motor for auxiliary diesel.

(b) *Replacing cranking motor.* Remove the wiring connections from the starting motor solenoid to the ammeter, battery, and starting switch. Withdraw the bolts holding the starting motor flange to the engine flywheel housing. Install the new starting motor and make the connections to the battery, starting switch, and ammeter. Refer to figure 280 for wiring diagram showing the cable connections in the electrical system.

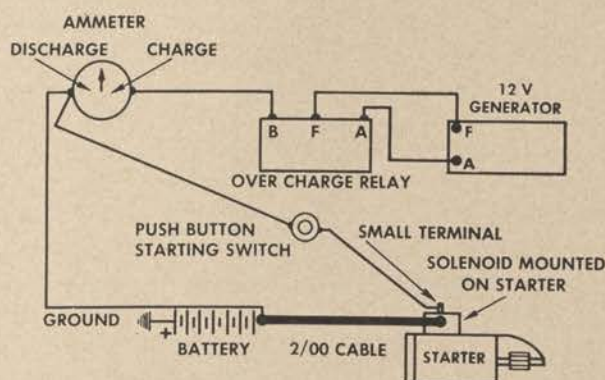


Figure 280. Wiring diagram of starting system and charging generator.

(c) *Replacing bendix drive.* Should the bendix pinion fail to disengage with the flywheel of the engine, after the engine has been started, remove

the starting motor and check by holding the armature and turning the bendix pinion. It must move out along the shaft without restrictions other than the anti-drift pin. When the pinion reaches the "stop," it must lock to the armature shaft. If bendix does not act in this manner, or if any other doubt exists as to the condition of the bendix drive, replace the unit. To remove the bendix, unclinch the head spring screw lock washer and back off the head spring screw (See fig. 281). Slide bendix from the shaft. Remove the Woodruff key and the intermediate bearing plate.

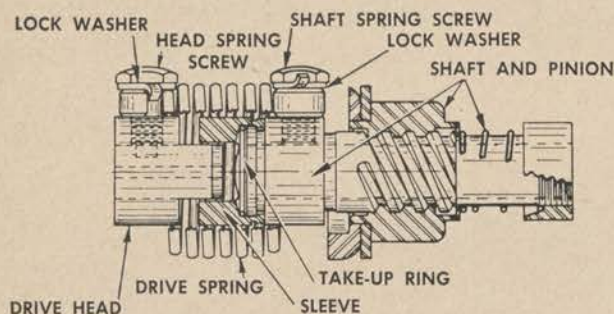


Figure 281. Removing bendix head spring screw.

(d) *Replacing bendix drive spring.* A twisted or broken bendix drive spring can be replaced by removing the spring screws and lock washers, and withdrawing the drive spring. Replace with a new unit, making sure to install the lock washers.

(e) *Replacing motor brushes.* Remove the head band and inspect the condition of the brushes. These should slide freely in their holders and should not be oil-soaked; if oil-soaked, or worn to less than one-half their original length, replace them. Two of the brushes are ground to the commutator head by the jumper lead, while the other two are soldered to the field coil windings. Before replacing brushes, clean the commutator of carbon accumulation by holding a piece of No. 00 sandpaper against the commutator while turning the armature slowly. After cleaning, blow the sand out of the motor. While sanding down, be sure not to cut the mica between the commutator bars. To replace the brushes, unsolder the brush pigtail from the loop in the connector and open up the loop slightly. Insert the new brush lead and clinch the loop tightly, then solder to make a good connection.

(f) *Replacing brush springs.* Spring tension should be between 42 and 53 ounces on new brushes, and slightly less with springs that have been in

service. Adjust tension by twisting the spring holder.

Note. When twisting the spring holder, do not disturb the spring or holder. Be sure spring is clamped firmly.

Measure the spring tension with a spring scale hooked under the brush spring at the bend, taking the reading just as the spring leaves the brush. Pull the scale on a line parallel to the face of the brush. (See fig. 282.)

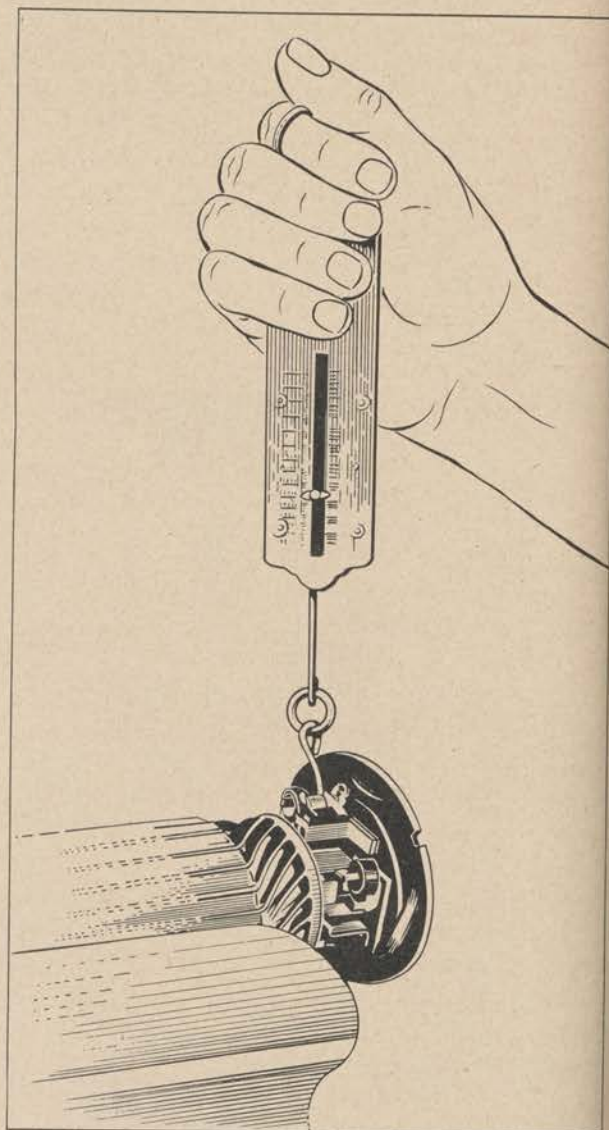


Figure 282. Measuring brush spring tension.

(12) *The charging generator system.* (a) *Description.* The charging generator for the auxiliary Diesel engine starting motor, located on the lower right side of the engine, is driven by a V-

belt which also drives the fan and water pump. Specifications of the generator follow:

Volts: 12.

Rotation: Clockwise at the drive end.

Poles: 2.

Brushes: 2.

Control: Vibration type current voltage regulator.

The generator is of a 2-pole, 2-brush construction with output controlled by a separately mounted current and voltage regulator shown in figure 277.

Note. The generator has no internal regulation and must be used with the regulator designed to operate with the generator. Do not substitute the regulator on the engine with one of a different type.

(b) *Replacement of generator.* Disconnect the leads from the generator to the voltage regulator and battery in accordance with wiring diagram. (See fig. 280.) Procedure for removal of the generator is described under "Adjusting fan belt" ((10)(c) above). Additional bolts holding the generator to the engine block are indicated in figure 277.

Caution: When a new generator or battery is installed in the engine, close the contact points of the cut-out relay in the voltage regulator for a few seconds before starting the engine. This will permit the battery to discharge through the generator and polarize it. The cut-out relay of the regulator is identified as that terminal to which the battery is connected.

(c) *Replacing charging generator brushes.* Remove the head band. The brushes should slide freely in their holders. If brushes are oil-soaked, or if worn to less than one-half of their original length, install new ones. To install new brushes, first clean the commutator of carbon accumulation by holding a piece of No. 00 sandpaper against it while turning the armature slowly. Then remove the brush lead screw and lift the brush arm. Securely fasten the brush lead, making sure the brush is turned so that the bevelled face fits the commutator. Check the brush alignment to see that the brush edge is parallel with the commutator segments. If the alignment is off or if the brushes do not slide freely, check the commutator end plate as described in (12)(e) below. Sand the brushes for proper fit on the commutator. To do this, cut a strip of No. 00 sandpaper to exact width of the commutator. Slip this strip under a brush and pull so that the brush is forced against the

holder. (See fig. 283.) Be careful not to break the edge of the brush. Repeat the sanding on the other brush.

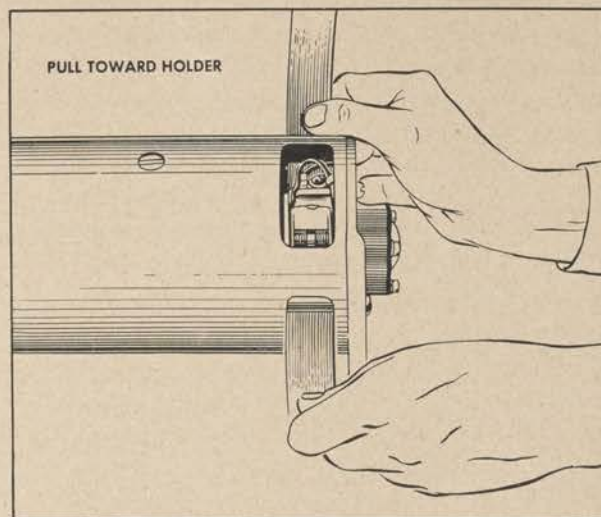


Figure 283. Seating new generator brushes with No. 00 sandpaper.

(d) *Checking generator brush spring tension.* Measure the spring tension with a spring scale hooked in the hole in the end of the brush arm. Pull the scale on a line parallel with the face of the brush and take the reading just as the arm leaves the brush. Brush spring tension should not be more than 53 ounces maximum.

(e) *Commutator end plate.* If brush alignment on the commutator is off, and brushes do not slide freely, remove the commutator end plate and check the brush holders to see that they are not bent. To remove the plate, take out the cover attaching screws and lift off cover and gasket. (See fig. 284.) Clean the commutator head and brush holders with an authorized cleaning solution and wipe dry. Replace felt washer (fig. 284), cover gasket, and cover.

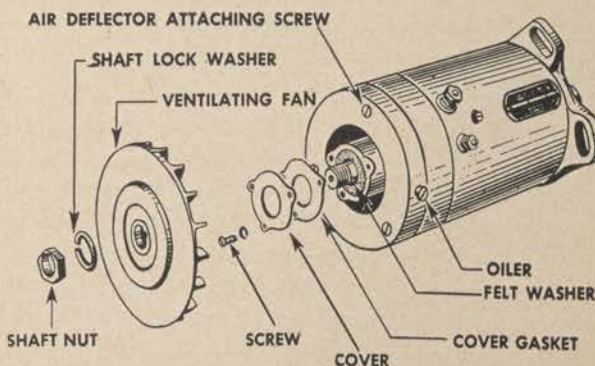


Figure 284. Generator commutator end.

(13) *Battery.* (a) *Keeping battery clean.* Brush dirt off with a stiff bristle, not metal, brush. Wipe with a cloth wet from an approved cleaning solution to neutralize any electrolyte sprayed or spilled out; then wash battery with water, making sure vent plugs are tight in place. Examine vent plugs to make sure the gas escape holes are clear. If any corrosion is evident, scrape or brush off. Then wash with an approved cleaning solution which will neutralize any electrolyte remaining on the metal surfaces. After rinsing in water and drying, apply a thin coating of grease or vaseline.

(b) *Hydrometer readings, specific gravity.*

1. The specific gravity of the electrolyte in batteries lowers on discharge and rises again on charge. Consequently, if the specific gravity or hydrometer reading is known, it can be determined if the battery is fully charged, or the extent of discharge. With all the cells connected in series, the gravity reading of one cell, known as "pilot cell," will indicate the state of discharge or charge of the whole battery.
2. Determine the specific gravity by allowing an hydrometer to float in the electrolyte. When the specific gravity is high or strong, the hydrometer will not sink as far into the liquid or electrolyte as when the specific gravity is low or weak. (See fig. 285.)
3. To take an hydrometer reading, insert the nozzle of the hydrometer syringe (fig. 285) in the electrolyte, squeeze the bulb and slowly release it, drawing up enough electrolyte to float the hydrometer freely. Holding the syringe vertically, the reading on the stem of the hydrometer at the surface of the electrolyte is the specific gravity of the electrolyte. After reading, return the electrolyte to the same cell.
4. Both temperature and level of electrolyte affect the specific gravity reading somewhat, and it is therefore desirable to record the temperature and level of the electrolyte at the same time as its gravity reading. In the pilot cell, keep the level within $\frac{1}{4}$ inch of the bottom of the filling tube, so that variations due to level will be minimized.

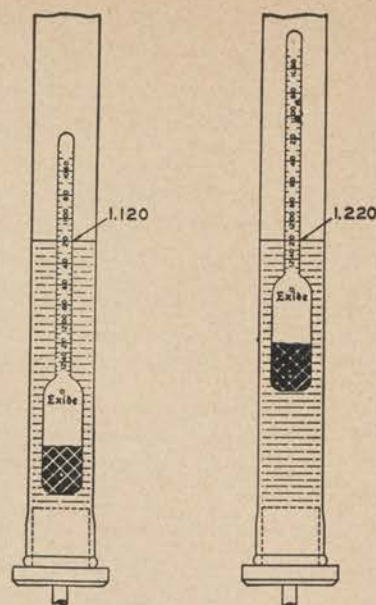


Figure 285. Hydrometer readings and syringe.

5. Do not take a gravity reading immediately after adding water; such a reading is false. Allow a day or two for the water to mix with the electrolyte by gassing (bubbling) of the electrolyte resulting from charging the battery.

(c) *Adding water.*

1. Add approved water regularly to each cell. The low level point is the top of the separators and the high point $\frac{1}{4}$ inch below bottom of filling tube. Maintain the level between these points by adding approved water.
2. The time of adding water is important in the winter, if the battery is not in a heated room. Add water just before charging the battery in order to mix the water with the electrolyte by the charging current. If water is added and the battery left standing in freezing temperatures, the water will freeze just the same as though it were outside the battery.

3. Electrolyte loses some of its water by charging of the battery and a little by evaporation, but acid is never lost in this manner. Therefore do not add any acid or electrolyte, unless some electrolyte is spilled or lost from the cell. This loss is usually the result of carelessness in not keeping the vent plugs tight, or in adding water too high. Add only distilled or other approved water.
4. If the cells flood or sputter electrolyte, the level is too high; lower it by withdrawing electrolyte. Keep vent plugs tight in the cells.
5. All the cells in the battery should take the same amount of water. If one cell takes more than the other, examine it for leakage.

54. Auxiliary Generator

a. REMOVING AUXILIARY GENERATOR FROM DIESEL. (1) Disconnect the leads from the generator to the auxiliary generator control panel. (See fig. 286.)

(2) Remove the rear bearing cover plate from the exciter housing.

(3) Lift the brush holders so that the brushes clear the commutator.

(4) Provide means for sliding the generator

away from the engine by blocking underneath. If available, a block and tackle, or chain hoist, hooked to the generator lifting screw as shown in figure 286, will be extremely convenient.

(5) Remove the $\frac{3}{8}$ -inch cap screws holding the adapter ring to the flywheel housing. Move the generator frame away from the engine a sufficient distance to permit inserting a wrench between the generator and engine. Use an angle socket wrench to remove the six $\frac{3}{8}$ -inch cap screws holding the coupling to the flywheel.

(6) The armature is now free from the engine; remove the armature and generator frame.

b. REPLACING GENERATOR. In replacing the generator to the engine, follow the procedure for removal in reverse. With the generator sufficiently close so that the coupling can be secured to the flywheel, take care in bringing the flywheel up to the adapter ring to insure that the armature shaft slides back into the rear bearing of the exciter. Avoid forcing. If any difficulty is experienced, examine the clearances of the armature which may be resting on the field, by slightly lowering the generator frame. This frame should slide back easily without being forced. With the generator frame close to the engine, replace the holding screws and tighten equally and firmly. Then replace the brush holders on the commutator and secure the rear plate to the exciter housing.

Caution: Before starting the engine, after replacing a generator, turn the engine over slowly with the hand crank to insure that there is free movement.

c. REPLACING GENERATOR COMMUTATOR BRUSHES. Remove the two screws holding the commutator end bell cover to the generator exciter housing. There are two main brushes, one on each side of the commutator. Disconnect the brush pigtail by loosening the nut on the brush holder. (See fig. 287.) Raise the brush spring off the brush and move to one side. Withdraw the used brush. Rotate the generator commutator and with a soft cloth or very fine sandpaper, clean commutator bars of any accumulation of carbon. Do not undercut the mica insulation between the commutator bars. Install new brush, replace spring and connect pigtail. To make sure of perfect brush fit before full power is delivered, run the Diesel engine with the auxiliary control box main switch in the ON position until 108 to 112 volts are indicated on the voltmeter.

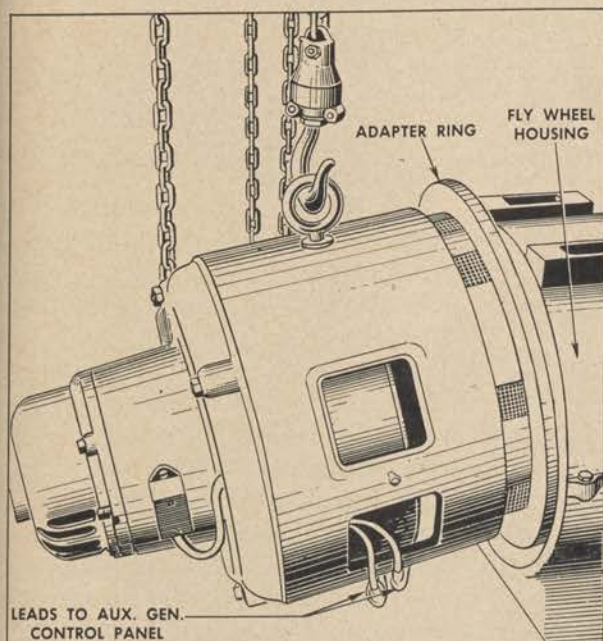


Figure 286. Removing auxiliary generator from Diesel.

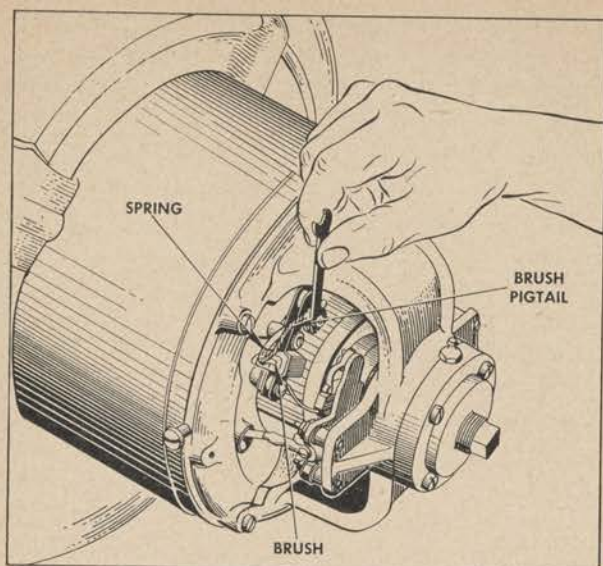


Figure 287. Replacing generator commutator brushes.

d. REPLACING GENERATOR COLLECTOR RING BRUSHES. Remove the commutator end bell cover. There are four collector ring brushes, two on each side of the ring. With a screw driver, disconnect the brush pigtail from the brush holder. (See fig. 288.) Raise the spring off the brush and withdraw old brush. Clean the collector ring assembly of carbon and install new brushes. Then replace

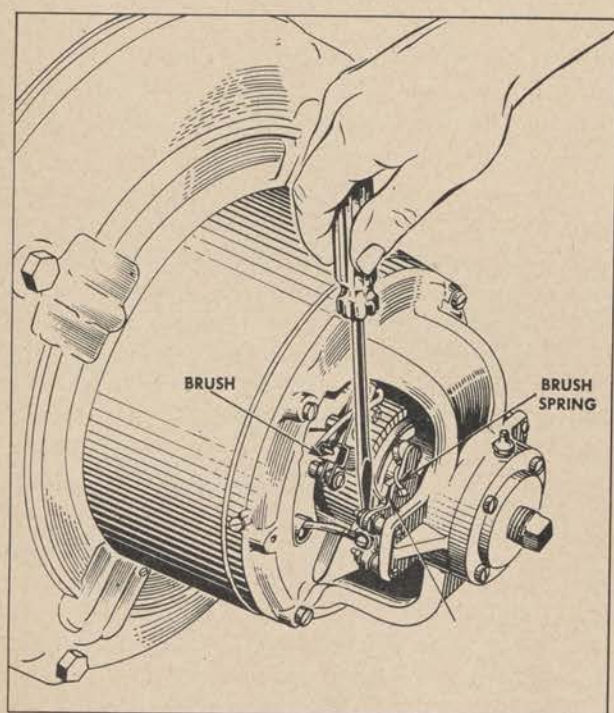


Figure 288. Replacing generator collector ring brushes.

spring and pigtail connection and run in brushes as described in the preceding paragraph.

55. Instructions for Replacement of Rear Oil Seal in Auxiliary Diesel Generator

a. GENERAL. During shipment of the auxiliary Diesel generator set, or if the barge is subjected to extreme vibration, sufficient displacement may occur between the engine flywheel housing and generator frame to cause distortion or damage to the rear oil seal and result in oil leaking through to the generator unit. Check for oil leakage every week by removing the plug at the rear of the engine below the flywheel housing. Figure 289 illustrates removal of the plug for checking with the generator unit off. Do not remove the generator for the sole purpose of making this check. The oil seal must be replaced on evidence of oil leakage.

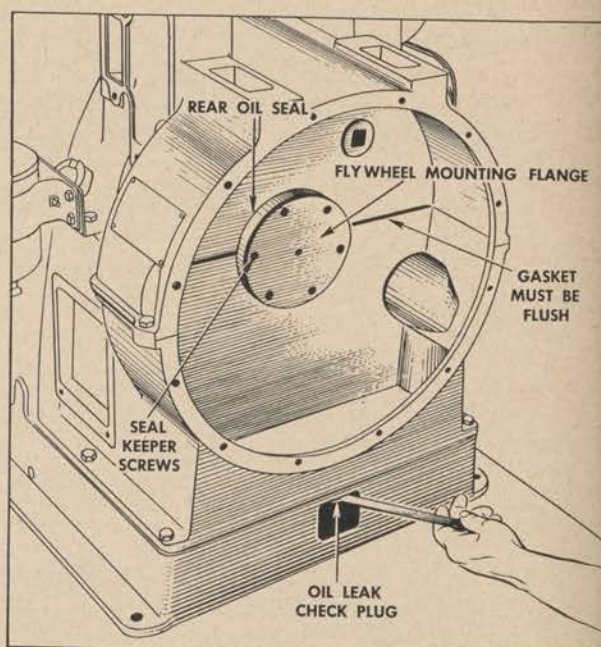


Figure 289. Flywheel housing with generator removed.

b. REMOVING FLYWHEEL. (1) Remove the flywheel before replacing the rear oil seal. Remove the $\frac{1}{2}$ -inch-20 screws holding the flywheel to the crankshaft. To facilitate removal of the flywheel, use two $\frac{1}{2}$ -inch-20 headless studs approximately $3\frac{1}{2}$ inches long, slotted at one end to receive a screwdriver. Insert these screws in two holes and screw them into the crankshaft flange to provide leverage for removal of the flywheel.

(2) With the flywheel removed, turn the en-

engine crankshaft until the six tapped holes in the flywheel mounting flange (fig. 289) coincide with the screws in back of the holes. This position will be with two opposite holes in perpendicular position to the center of the shaft. The screw heads visible through the holes in the flange are those holding the oil seal cover in place.

(3) Unscrew the upper three screws and remove from the flange. Then lift the upper half of the oil seal cover and oil seal from in back of the flange.

(4) Unscrew the lower three screws and remove the lower half of the oil seal cover and oil seal.

(5) Examine the gasket between the pan and the upper part of the engine to see that it is flush with the finished surface against which the oil seal rests. If not flush, cut the gasket flush with the finished surface on the engine block. The gasket must not be below the finished surface against which the oil seal rests. If below the surface, fill the space flush with gasket compound.

(6) Remove the oil seals from the covers, making sure that all surfaces are cleaned carefully.

(7) Replace with new oil seals. (See fig. 290.) Be sure to install the seals correctly and to have the seal extend equally beyond the cover.

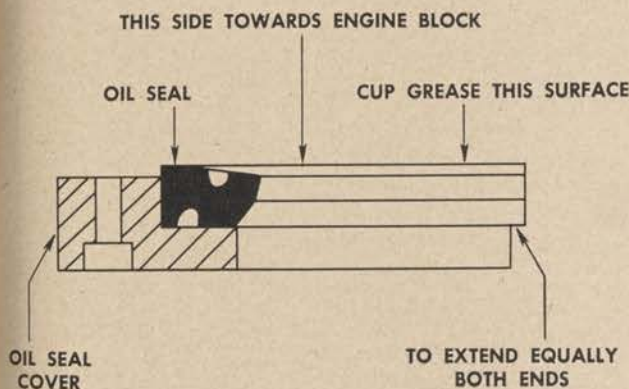


Figure 290. Replacing rear oil seal.

(8) Before replacing the oil seal and its cover, wipe the inside surface of the oil seal with cup grease. Insert the lower half of the cover and oil seal first, with the oil seal toward the engine block. Replace the bottom screw while holding the seal in position, but do not tighten. Follow this procedure with the other two screws. Turn the screws up snugly but not tight.

(9) Repeat the procedure with the upper half of the cover and oil seal.

(10) Insert the oil seal tool (fig. 291) in back of the flywheel flange at the top and bottom of the oil seal cover and lock the tool bearing down hard enough only to bring the two halves of the oil seal together tightly.

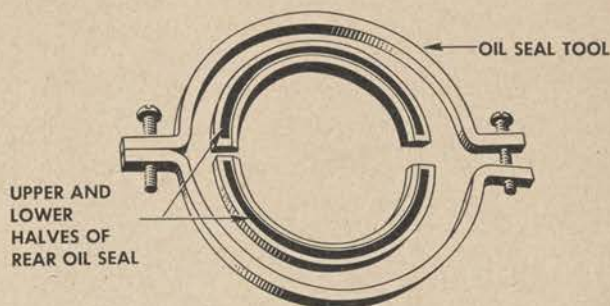


Figure 291. Rear oil seal and tool.

(11) With the oil seal tool in place, start tightening up on the oil seal screws, using a progressive tightening procedure from one screw to the other around the flange.

(12) With the seal in place, use a 0.002-inch feeler gage to see that the oil seal is snugly up against the block and pan. If either half of the oil seal indicates more clearance, tighten accordingly.

Caution: Use a smooth feeler gage and take care that the oil seal is not cut or injured in any way as this will cause leakage.

c. REPLACING FLYWHEEL. Be sure that the flywheel is fitted firmly over the crankshaft flange and that the $\frac{1}{2}$ -inch-20 screws are tightened carefully in a progressive manner.

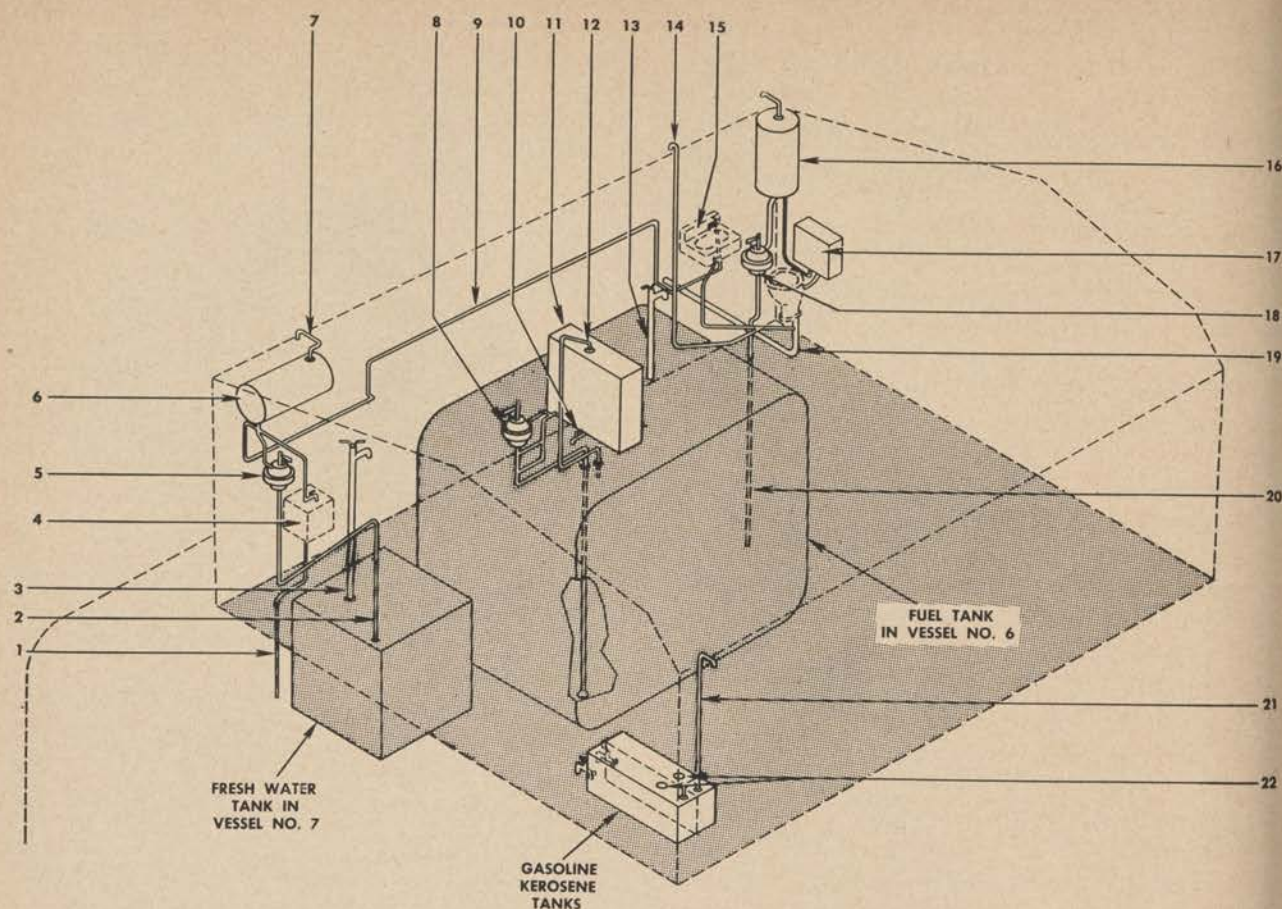
Section XX. BARGE ASSEMBLY

56. Barge Piping (fig. 292)

a. DESCRIPTION. (1) *Fresh water system.* Fresh water is used on the barge for drinking, preparation of food, and washing. The system consists of the following components:

(a) *Storage tank.* Fresh water is admitted to the tank through the inlet pipe located aft of the deck house on the starboard side. The tank is located in vessel 7 of the barge.

(b) *Suction line.* This line is composed of hand pump (5, fig. 292) and suction line (2, fig. 292) complete with bellmouthed screen. Fresh water is pumped from the fresh water storage tank through the bellmouthed screen by means of the manually operated hand pump.



1. Fresh water disposal.
2. Fresh water suction.
3. Fresh water fill pipe and vent.
4. Sink in galley.
5. Water hand pump.
6. Fresh water day tank.
7. Vent.
8. Fuel oil hand pump.
9. Fresh water line.
10. Fuel take off tap.
11. Fuel oil day tank.

12. Fuel oil overflow and vent.
13. Fuel oil fill pipe and vent.
14. Vent.
15. Closet sink.
16. Sea water tank.
17. Water closet tank.
18. Sea water hand pump.
19. Waste disposal line.
20. Sea water suction.
21. Gasoline tank vent.
22. Fill caps.

Figure 292. Barge piping system.

(c) *Hand pump discharge.* This is composed of hand pump and check valve. Fresh water is discharged from the hand pump and lifted through the check valve which prevents the return of water to the fresh water tank.

(d) *Fresh water day tank (6, fig. 292).* Fresh water is stored in the tank located in the galley. It is vented to the atmosphere by means of pipe and fittings that extend through the galley roof.

(e) *Sinks.* Fresh water is dispensed by means of two faucets located above two sinks, located in the galley (4, fig. 292) and water closet (15, fig.

292). The faucets tap the fresh water line below the tank. The faucet in the water closet is tapped at a point below the fresh water tank in the galley by means of a pipe extending across the machinery room rear aisle. The galley sink drain is piped to a common waste disposal pipe that drains the plumbing in the water closet.

(2) *Sea water system.* Sea water is used on the barge for the sanitation facilities. The system consists of the following components:

(a) *Suction line (20, fig. 292).* Sea water is drawn from overboard into the suction line inlet

through a strainer to the hand pump suction by operation of the hand pump handle.

(b) *Hand pump discharge.* Sea water is discharged from the hand pump (18, fig. 292) during its operation through a strainer in the sea water tank located in the water closet.

(c) *Storage tank.* The sea water tank (16, fig. 292) is vented to the atmosphere by means of piping that extends through the water closet roof. A tank outlet supplies sea water to the water closet tank.

(d) *Water closet tank.* The water closet tank (17, fig. 292) consists of tank, ball float, valve, overflow pipe, trip handle, trap, and piping. Sea water is supplied to the water closet tank by the sea water tank until it reaches operational level. When trip handle, located on the outside of the water closet, is tripped, the ball trap is lifted from the water closet tank outlet and held at ball trap high point by flotation. Water rushes out of the tank and the ball float drops, opening the supply valve. When the water level reaches the ball trap high point, the ball trap drops and is pulled into the water closet tank outlet seat by suction, thus stopping the flush. The valve supplies water to refill the tank through a refill tube bent down to discharge water in the tank. Water is also supplied from the valve through an overflow tube to the closet bowl in order to renew the seal in the trap. When the ball float reaches normal position, the valve closes and the tank is ready for reuse.

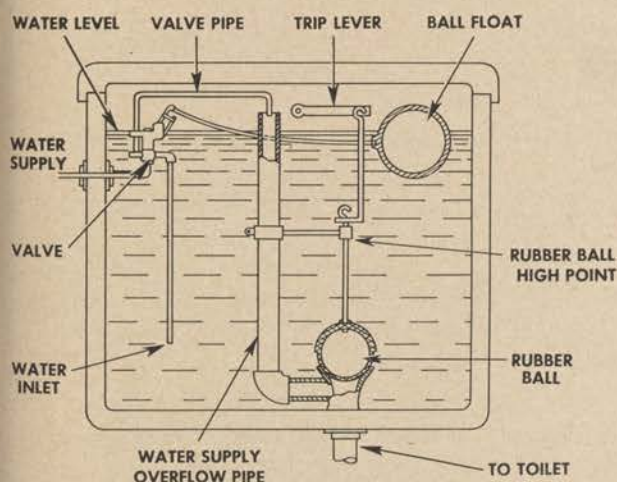


Figure 293. Water closet tank.

(e) *Waste line.* Waste from the toilet and two sinks is discharged overboard by a common outlet. The waste line (19 fig. 292) is vented to

atmosphere by means of piping that extends through the top of the water closet bulkhead.

b. MAINTENANCE. (1) *Leaks in piping system.* Stop leaks at piping joints by removing the length of pipe adjacent to the joint, and coating the threads with red lead and oil. Replace the pipe and tighten.

(2) *Installing check valve.* Remove the nearest pipe union to the faulty check valve. Spring the pipe back and remove the check valve from the line. Install new check valve and reassemble pipe and union.

Note. Paint all threaded connections with red lead and oil before assembling.

(3) *Replacing faucet washer.* Separate the handle from the faucet by removing the round-head screw. Unscrew the cap from the faucet, remove the worn faucet with a screwdriver, and install new washer. Reassemble the faucet.

57. Hand Operated Pumps

a. GENERAL. The three hand-operated pumps are used in the fuel oil system, fresh water system, and sea water system to pump oil and water to the day tanks.

b. HAND-OPERATED PUMP REMOVAL. Disconnect the union on the suction and discharge sides of the pump. Remove pump.

c. HAND-OPERATED PUMP MAINTENANCE. (1) *Disconnecting connecting rod and diaphragm assemblies.* Remove pump from line, loosen pack nut, and remove connecting rod cotter pin with a pair of pliers. Loosen collar with screw driver and remove six main housing bolts. Separate housings, using screw driver between flanges, and remove connecting rod from top casting, being careful to salvage washers and springs for replacement.

(2) *Replacing diaphragm.* (a) Remove connector rod and diaphragm assembly from top housing and separate connecting rod and valve retainer plate from diaphragm assembly by removing four hex nuts on top of valve retainer plate.

(b) Remove valve disc and spring, and remove top and bottom retainer plates from diaphragm screws, and hex spacers with screw driver and pliers.

(c) Install new diaphragm by assembling top and bottom retainer plates to diaphragm, using four roundhead screws and hex spacers. Make

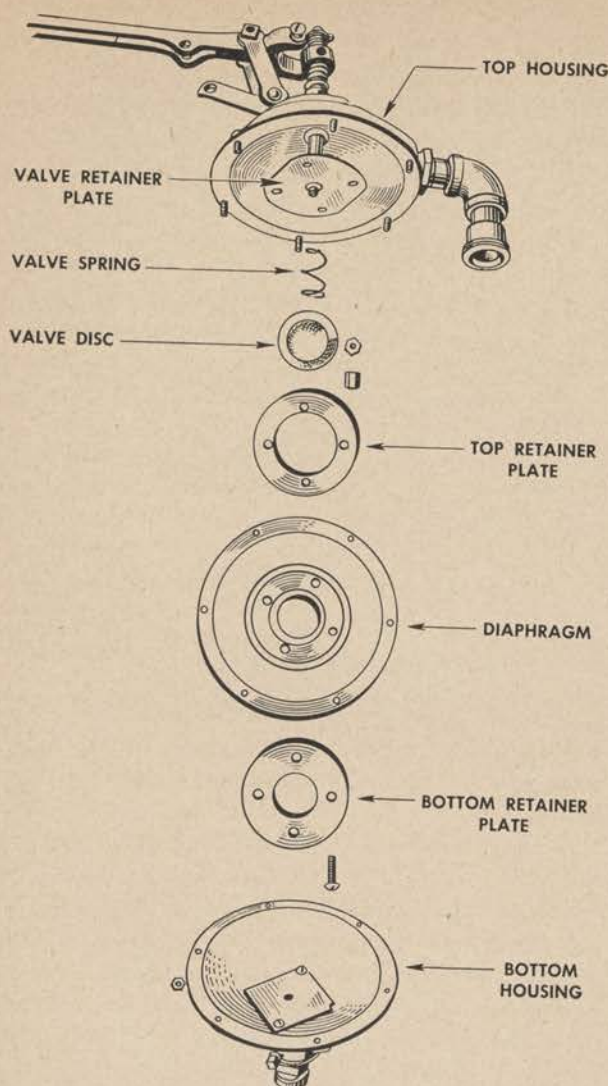


Figure 294. Hand-operated pump.

sure that the top retainer plate (with largest opening) is on top to receive the valve disc in its opening. When the top and bottom retainer plates are assembled the sequence is as follows:

1. Bottom retainer plate (small opening).
2. Diaphragm.
3. Top retainer plate (large opening).
4. The head of diaphragm screw on the bottom retainer plate side.
5. The hex spacer on the top retainer plate side.
6. The valve disc fits flush in large opening of top retainer plate.

(d) Assemble valve disc by placing smooth side into large opening of top retainer plate, and plac-

ing spring with large diameter in center of valve disc.

(e) Assemble diaphragm assembly, valve disc, and spring to connecting rod and valve retainer plate by locating small diameter of spring on center valve retainer plate over end of connecting rod.

(f) Connect diaphragm assembly to connecting rod and valve retainer plate, by threading four hex nuts on diaphragm screws.

(3) *Assembly of connecting rod and diaphragm assembly to pump body.* Loosen pack nut on top housing. Insert connecting rod through top housing. Insert the six housing bolts through top housing flanges and through the six holes in the diaphragm. Place this assembly over bottom housing and push bolts through holes. Secure in place with the six hex nuts.

Note. Make sure there are no wrinkles in diaphragm material between flanges; tighten the nuts evenly by hand to allow diaphragm to slide snugly between flanges for adjustment.

(4) *Installing collar, springs, and washers on connecting rod.* (a) For proper assembly, follow this sequence:

1. Pack nut.
2. Washer and spring.
3. Collar.
4. Spring and washer.
5. Cotter pin.

(b) Connect collar and handle.

(c) Press handle to extreme down stroke, and tighten pack nut with wrench to lock connecting rod in place temporarily.

(d) Securely tighten six housing bolts and hex nuts.

(e) Loosen pack nuts to permit free pumping.

(5) *Replacing valve disc and spring.* Remove connecting rod and diaphragm assembly from pump housing. Separate diaphragm assembly from connecting rod and valve retainer plate. Replace valve disc and spring.

Note. Do not polish, clean, or turn valve disc over. Replace scored valve disc with new disc. Valve disc should have highly polished surface turned down, opposite side of valve spring.

Reassemble connecting rod and valve retaining plate to diaphragm assembly ((3) above). Reassemble connecting rod and diaphragm assembly to pump housing ((2) above).

58. Oil Stove

a. DESCRIPTION. The barge is equipped with two oil stoves to heat the galley, and keep crew quarters warm during cold weather. Obtain fuel for the stove by tapping the day tank of the main Diesel engine (fig. 163); store it in a tank having a capacity of $3\frac{1}{2}$ gallons. Fill the tank by removing the cover as shown in figure 295.

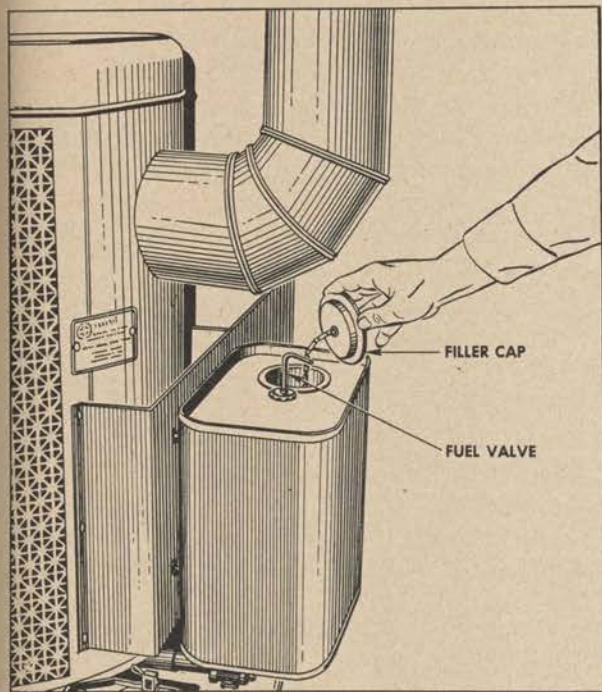


Figure 295. Oil stove fuel tank.

b. CONTROLS. Two controls are provided: The fuel valve (fig. 296) which limits the amount of fuel delivered to the float valve, and the control valve which can be adjusted to vary the heat in accordance with a "low" and "high" setting. Two levers, one short and one long, are provided at the forward end of the safety float. The long lever acts as a safety trip in the event the float clogs and permits excessive fuel delivery. The short lever is used to reset the float after the cause of clogging has been removed.

c. OPERATION. (1) *Lighting stove.* Open fuel valve on top of fuel tank five or six turns. (See fig. 296.) Lift up the long lever at end of the safety float valve. Turn the fuel control knob on the valve to "high" fire (fig. 296) until oil appears in the burner; then turn to "low" fire and toss a small piece of burning paper in the bottom of burner. Allow burner to operate on "low" fire

for at least five minutes before changing position.

Caution: Do not attempt to light a hot burner. Allow it to cool at least 10 minutes. Do not turn on oil without lighting burner. Keep fire door closed.

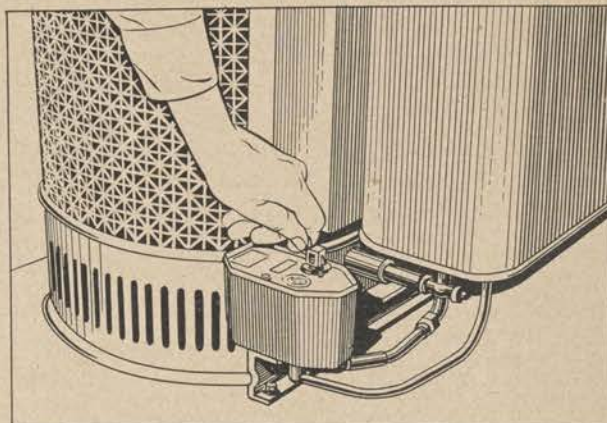


Figure 296. Adjusting heat control knob on control valve.

(2) *Flame adjustment.* Set the pilot fire adjusting screw on the float valve so that the flame obtained occupies the entire pilot ring in the burner. If the flame is yellow, increase the flow of fuel oil until a blue flame is obtained. Do not open the fire door.

(3) *Draft adjustment.* The draft regulator, located in the chimney, is provided with a knob and pointer which may be set to LOW, MEDIUM, or HIGH position. Always set the pointer on draft regulator to a corresponding setting of the fuel control knob. Failure to do so will cause poor combustion and inefficient operation.

(4) *Turning off stove.* Turn fuel control knob to OFF position and fire will go out in a few minutes. If stove is to be shut off for an extended period of time, trip the long lever located at the end of the float valve to the DOWN position by pressing on the adjacent short trip lever.

(5) *Excess oil removal.* If the oil stove has been turned on and not lighted, resulting in an accumulation of more than $\frac{1}{4}$ inch of oil in the bottom of the burner, drain off excess oil by removing the plug from the oil line, or by sponging. Lighting with a deep pool of oil in the burner will overheat the stove and cause damage.

d. MAINTENANCE. (1) *General.* Trip and reset the short trip lever at the end of the control valve every three weeks, to prevent accumulation of wax on the internal metering groove.

(2) *Safety cut-off.* Wax and foreign matter may collect on inlet needle and seat and prevent normal float level control. When this occurs, fuel will rise approximately $\frac{1}{4}$ inch above normal level and operate the safety cut-off mechanism. Frequent operation of the safety cut-off indicates the float needle and seat need cleaning or replacing.

(3) *Cleaning float inlet needle and seat.* Remove nameplate, spring, and trip the short lever. Turn float needle 90°, lift out, and wipe the point with a cloth. Clean the seat with a soft wood stick, replacing needle in the same position it was before removal. Replace trip lever, spring, and nameplate.

(4) *Cleaning metering stem and seat.* Remove nameplate, handle, and stem guide. Turn stop clockwise to clear the stem. Remove metering stem and clean with cloth. Remove spring and clean metering seat with a soft wood stick. Replace parts in reverse order to their removal.

(5) *Cleaning strainer.* Loosen the clamp screws on outside of case and remove the clamp and strainer cap. Remove strainer, clean with kerosene, and replace.

59. Deck Pump

a. DESCRIPTION. The barge is equipped with a portable deck pump mounted on wheels and capable of being moved to any point on the deck. The pump is used for washing down the decks, pumping water into or out of the barge vessels, and for general utility. A direct coupled electric motor operating on 220-volt, 3-phase, 60-cycle, a-c drives the pump.

b. STARTING PUMP. Prime the pump by removing the pipe plug at the top of the discharge tee, and fill the pump case with water. Connect the plug at the end of the cable provided with the pump, to the 208-volt receptacle located on the port side of the deck house. (See fig. 85.)

c. MAINTENANCE. (1) *Air leaks and loss of prime.* If the pump is slow in priming, shows a tendency to lose prime, or fails to pump, the condition may be due to an air leak in the suction line or grease seal. Check the following:

(a) Prime the pump (*b* above).

(b) Inspect the suction line connection for tightness and condition of hose.

(c) Examine check valve on the suction head of the pump for dirt, and clean if needed.

(2) *Cleaning pump.* Failure of the unit to

pump water may be caused by stones, leaves, or other foreign material lodging in the pump case or impeller. Clean the unit as follows:

(a) Remove the suction casting for access to the front of the pump case, and clean unit with a stiff wire brush.

(b) Remove the clean-out plate on the pump housing and clean the priming nozzles with a small piece of wood.

(c) Check the suction hose to make sure that it is not clogged and that the lining is not pulled away from the wall of the hose.

Section XXI. PROCESSING, PACKAGING, AND PACKING

60. Processing

a. CLEANING. Prepare all parts of the barge which are to receive rust preventive treatment by cleaning and drying.

b. PRESERVATIVE COMPOUND. After cleaning, protect all the following items with rust preventive:

(1) *Barge sections.* Clean and inspect all barge sections below decks. Coat all damaged painted surfaces with compound, rust preventive, thin film, AXS-673. Stow and secure in the hold all exterior portable equipment: Anchor, deck pump, surplus heaving lines, life preservers, etc. Secure all hatch and manhole covers.

(2) *Boom.* Dismantle and matchmark the boom and coat all unpainted surfaces with compound, rust preventive, thin film, AXS-673. Plug pin holes with wooden plugs treated with compound, rust preventive, thin film, AXS-673. Paint bolt holes. Brace or support by wooden blocking and bracing, castings and plates liable to bend or break.

(3) *Rigging.* (a) *Blocks.* Remove pins and dismantle boom vang blocks, vang blocks, A-frame topping block, boom end topping block, upper and lower load blocks, and whip downhaul ball and hook.

(b) *Sheaves.* Coat non-bearing surfaces of all sheaves with compound, rust preventive, thin film, AXS-673. Coat bearing surfaces of pins with a heavy application, compound, rust preventive, USA 2-121.

(c) *Wire rope.* Unreel, clean, and process wire rope with compound, rust preventive, thin film, AXS-673, in accordance with Transportation

Corps Packing Instruction MD-P1-102, and re-wind on the drums.

(4) *Boom, pivot pins.* Coat the boom pivot pin with oil, lubricating preservative, USA 2-122.

(5) *Boom pivot seat.* Coat all unpainted surfaces of the boom pivot seat with compound, rust preventive, thin film, AXS-673. Plug pivot holes with wooden plugs and treat with the same compound.

(6) *A-frame.* Plug the A-frame topping block pin hole with wood treated with compound, rust preventive, thin film, AXS-673.

(7) *Engines (Diesel).* (a) *Sequence.* Process all Diesel engine driven equipment, such as power take-off, generator, and air compressor before processing the engine.

(b) *Cooling system.* Drain and refill the cooling system with a mixture of 60 percent compound, antifreeze (ethylene glycol), conforming to USA 4-1116, and of 40 percent water. Circulate the solution through the cooling system during subsequent processing procedure but do not drain. Attach waterproof tags reading "Engine cooling system is protected down to minus 60° F. with compound antifreeze (ethylene glycol) conforming to USA 4-1116. DO NOT DRAIN," to the cooling system fill pipe and to the instrument panel.

(c) *Crankcase.* Disconnect all oil lines from the engine to the cooler and filter and flush the crankcase and lubricating system with grade 2, Polar type compound, rust preventive, thin film, U. S. Navy 52-C-18. Drain compound from the crankcase and reconnect oil lines.

(d) *Valve compartment.* Remove the valve inspection cover and clean the inside of the cover and compartment thoroughly with a petroleum solvent. Spray valve stems, tappets, and springs with oil, engine, preservative, AXS-934 grade 1. Replace the cover and seal all vents, breathers, and other openings to the valve compartment with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1.

(e) *Cylinders and fuel system.* Connect fuel system to a source of Polar type compound, rust preventive, thin film, U. S. Navy 52-C-18 grade 2, and operate the engine at the slowest possible speed until the through flow emits clear rust preventive compound. Then shut off the engines. Compress each injector several times by means of a lever, with each piston in the bottom dead

center position. Drain the entire fuel system and reconnect the fuel lines.

(f) *Day fuel tank.* Drain the fuel tank. Fog the interior of the fuel tank with oil, engine, preservative, AXS-934 grade 1. Drain excess preservative oil from the bottom of the tank at the drain plug. Spray or brush the filler cap threads with oil, engine, preservative, AXS-934 grade 1. Use grade 2, Polar type compound, rust preventive, thin film, U. S. Navy 52-C-18 in place of oil, engine, preservative AXS-934, if desired.

(g) *Generators and starters.* Keep brushes in place and insert grade A greaseproof wrapper, JAN-P-121, between the brushes and commutator. Seal vents and openings with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1, and spray compound, insulation, ignition, USA 3-182 over the exterior of the entire electrical system.

(h) *Belts.* Adjust belts to their proper tension and prevent them from adhering to pulleys by inserting a thin strip of paper free from wax or oil between the pulleys and belts. Do not rotate unit after this operation.

Alternate. Remove and wrap belts in grade C, type 1, greaseproof, wrapper JAN-P-121 and seal with compound, sealing, dip coating, AXS-1015; secure them in the engine compartment. Apply compound, insulation, ignition, USA 3-182, to the pulley sheaves. Seal outlets, breathers, air intakes, crankcase breathers, valve cover vents, and all other openings to the interior of the engine with grade C type 1, greaseproof wrapper, JAN-P-121 and secure them with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1.

(i) *Exterior surface of engine.* After cooling the exterior surfaces of the engine, clean them of all oil, dirt, and grit. Spray compound, insulation, ignition, USA 3-182 over its entire surface, including the exposed pulley grooves and wiring.

Caution: Do not allow lubricants, solvents, or corrosion preventive compounds to come in contact with rubber, leather, cork, paper, and fabric; rapid deterioration of these materials may result.

(j) *Radiators and engine coverings.* Cover exposed radiators of unboxed equipment with a sheet of waterproof barrier material, conforming to AXS-1246, and secure them with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1. Secure waterproof barrier material in place with flat or round steel wrappings. Obtain additional waterproofing by placing a shroud over the en-

gine; the material shall be type E-2, waterproof, barrier material, conforming to AXS-1246.

(8) *Engines (gasoline)*. (a) *Sequence*. Process the following parts of the gasoline engine as described for engines (Diesel) in (7) above, and follow the same sequence of operation: cooling system, valve compartment, openings, and exterior surfaces of engine.

(b) *Crankcase*. Drain crankcase while the engine is still warm and refill with a full charge of oil, engine, preservative, AXS-934 grade 1. Operate the engine 10 to 15 minutes at one-half throttle, using lead free white gasoline, conforming to USA 2-116 only. At the end of this period, fog oil, engine, preservative, AXS-934 grade 1, into the air intake, until the engine emits a light blue smoke. Shut off the engine. *Do not operate engine under power after this procedure*. Tag crankcase filler cap "Crankcase filled with oil, engine, preservative, AXS-934 grade 1, good for 5 hours."

(c) *Cylinders*. Remove spark plugs and process the cylinder walls, piston heads, and valves by fogging oil, engine, preservative, AXS-934 grade 2 into each cylinder through the spark plug hole, while rotating the engine by hand (at least five complete revolutions for each cylinder).

(d) *Spark plugs*. Clean, test, and adjust spark plugs. If serviceable, coat the points and threads on both body and terminal with oil, engine, preservative, AXS-934 grade 2 and replace them. If not serviceable, install new spark plugs processed in the same manner. Connect all wiring to the spark plugs.

(e) *Fuel system*. Drain the carburetor, pump, fuel lines, sediment bowl, and fuel tank. Fog the interior of the fuel tank with oil, engine, preservative, AXS-934 grade 1. Drain excess preservative oil from the bottom of the tank at the drain plug, and replace the plug. Spray or brush the filler cap threads with oil, engine, preservative, AXS-934 grade 1. Spray or brush all carburetor and governor linkage with compound, rust preventive, USA 2-121.

(f) *Exhaust and intake pipes*. Cover exhaust and intake pipe openings with a double layer of waterproof barrier material conforming to AXS-1246 and seal them with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1.

(9) *Gears*. (a) Coat precision and semi-precision gears with compound, rust preventive,

USA 2-121. Gears inclosed in oil tight housings require no processing. However, check housings for a full supply of lubricant.

(b) Coat nonprecision gears, full gear, pinion gears or cable wheel with compound, rust preventive, thin film, AXS-673.

(10) *Gear housings*. Check gear housings for the presence of water; where present, drain and refill the entire can with the approved lubricant. Seal all openings in the gear housing with grade C type 1, greaseproof wrapper, JAN-P-121, and secure them with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1. Seal unprotected shift levers and other controls at points where they enter the gear case. Immobilize shift levers.

(11) *Drums and drum assemblies*. (a) Coat exterior unpainted surfaces of drums, drum gear cases, levers, nonprecision shafting, and base with compound, rust preventive, thin film, AXS-673. Coat interior surfaces of the drum gear cases and exposed surfaces of the gears with the same preventive compound.

(b) Seal openings in the drums and gear cases with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1. Spray all sealed openings with compound, insulation, USA 3-182.

(c) Release foot brake drums to completely clear the brake drum. Coat bright metal surfaces of the brake drum with compound, rust preventive, thin film, AXS-673. Be careful to prevent application of this compound to surfaces of the brake band. Do this by applying the compound at the opening in the brake band and by rotating the brake drum during the operation. Dry the compound thoroughly before allowing the brake band to contact the brake drum.

(12) *Driving chain*. Coat precision type driving chain with oil, lubricating, preservative, USA 2-122.

(13) *Bearings*. Preserve antifriction bearing with compound, rust preventive, special, AXS-1347, in accordance with Ordnance Department Specification AXS-1470.

(14) *Clutch*. Apply a thin film of oil, engine, preservative, AXS-934 grade 1, to the band type clutch drum facings. Coat clutch pins, linkage, and collars with compound, rust preventive, USA 2-121. Do not let preservative compound come in contact with the clutch facings.

(15) *Air compressor*. Drain air compressor completely and operate it with dry compressed

air. Remove the reversing valve chamber cap and fill the chamber with oil, engine, preservative, AXS-934 grade 2. Replace cap and operate the compressor by dry air until preservative has worked into the steam cylinder. Refill valve chamber with oil, engine, preservative, AXS-934 grade 2.

(16) *Mufflers*. After processing engines, scrape the exterior of mufflers and clean them of all burnt paint. Repaint the exterior of mufflers with similar paint used on the exterior of equipment.

(17) *Electrical equipment (motors—generators)*. (a) Lift brushes and wrap the commutator with grade A greaseproof wrapper, conforming to JAN-P-121. Do not disconnect connecting wires (pigtales) from the brush holders; let the brushes rest on the grade A wrapper around the commutator. Lubricate bearings with compound, rust preventive, special, AXS-1347, and seal all openings to the interior of the motor or generator with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1.

(b) Spray wiring and other noncritical and noncontacting surfaces, terminals, connecting lugs, and similar parts where conductivity will not be affected with compound, insulation, ignition, USA 3-182. Reinforce instrument glasses by placing a strip of tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1, crisscross on face of instrument glasses.

(c) Seal all openings in the switch or terminal boxes with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1. Treat electrical panel boards, generators, and motors as specified in (a) and (b) above, and shroud them with waterproof barrier material conforming to AXS-1246. Secure the shroud with tape, adhesive, pressure-sensitive, JAN-P-127, grade B type 1.

(d) Cover contacting assemblies with a thin film of compound, rust preventive, light, USA 2-84B.

(18) *Battery*. Give the battery a slow discharge. When discharged, empty the electrolyte and fill with water. Empty this water, refill with distilled water, and set caps in place. Secure the battery in the unit to avoid shifting. Coat cable terminals with compound, rust preventive, USA 2-84; wrap them with grade A type 1, greaseproof wrapper, JAN-P-121 and seal with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1. Seal all vents in the caps with tape, adhesive,

pressure-sensitive, JAN-P-127 grade B type 1. Coat battery posts with compound, rust preventive, USA 2-84. Tag the battery with a metal or waterproof label reading: "Uncharged and moist battery. This battery is not charged; add electrolyte and fully charge."

(19) *Electrolyte*. Pack bottles or jugs containing electrolyte in accordance with U. S. Ordnance Department Specifications FPL-967-2 or FPL-1113. Label the wooden box containing electrolyte in accordance with Interstate Commerce Commission Regulation #4, and secure it in the cab.

(20) *Fuel oil tank*. Coat the exterior unpainted surfaces of the fuel tank, pipe, etc., with compound, rust preventive, thin film, AXS-673. Fog interior surfaces of the fuel oil tank with oil, engine, preservative, AXS-934 grade 1.

(21) *Control box*. Treat independent control boxes as follows: mask all electrical contact surfaces of switches, variable resistor relays, arc shields, etc., with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1. Spray all interior surfaces of the cabinet, exposed wiring, switchboard surfaces, and exposed metal parts with two coats of compound, insulation, ignition, USA 3-182. Allow sufficient time between coats for the compound to dry.

(22) *Gages*. Deadweight test all gages with oil, lubricating, preservative, USA 2-120. Drain and cap gages. Cover gage glasses with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1.

(23) *Shafting*. Coat exterior surfaces of precision shafting with compound, rust preventive, USA 2-121.

(24) *Deck pump*. Remove all plugs and thoroughly drain the pump. Replace plugs.

(25) *Floodlights*. Detach floodlights from the machinery deck and package them.

(26) *Spare parts*. Process spare parts in accordance with the applicable provisions of SB 55-14.

(27) *Tools and tool box*. Remove tools from the tool box and process them in accordance with the applicable provisions of SB 55-14. Pack tools in the container with the spare parts. Secure empty tool box in place and seal with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1.

(28) *Galley*. Remove all foodstuffs and thor-

oroughly clean all equipment. Drain all water piping, the pump, and sink trap. Disconnect electrical connections on range and refrigerator. Empty oil reservoir on oil stove and clean the burner. Process any steel cooking utensils and mess equipment in accordance with the applicable provisions of SB 55-14.

(29) *Berthing compartment.* Drain water closet tank, the pump, and all water piping. Fill water closet bowl with kerosene after draining the trap. Drain all other traps. Empty oil reservoir on oil stove and clean the burner. Thoroughly clean all bedding, then pack in a waterproof barrier.

(30) *Doors and windows.* Close doors and windows. Secure doors with bolts and nuts; upset threads of the bolts. Reinforce window glass by stripping with tape, adhesive, pressure-sensitive, JAN-P-127 grade B type 1. Cover the exterior of the windows with wood sheathing, which shall not bear on the glass. Secure by strapping or bolts. Seal cracks around doors and windows with same tape as used for the windows, but coat the tape with USA 3-182.

61. Packaging

Package spare parts and tools processed as prescribed in accordance with the applicable provisions of the Transportation Corps Specification SB 55-14.

62. Packing

a. EXPORT SHIPPING CONTAINER. The interior shipping container shall be style 2 or style 4 nailed wooden boxes constructed in accordance with JAN-P-106. The export shipping container shall be nailed, wooden, sheathed crate, constructed in accordance with Transportation Corps Specification TC-P1-50.

b. WATERPROOF BARRIER. Place into style 2 or 4 containers a liner of waterproof barrier material, conforming to Ordnance Department Tentative Specification AXS-1246. Seal the liner securely with a water-resistant adhesive at all points, seams, folds and closures, so as to provide protection throughout equal to that afforded by the body material. It shall be of proper size to fit snugly into the interior of the shipping container. Leave the lining free within the box to prevent it from being subjected to strain produced by shock, wracking, or shrinkage of the container. Where needed,

fasten the lining to the container with an adhesive. Do not use tacks, nails, or staples for securing the lining.

c. INTERIOR PACKING, LOADING, AND BLOCKING.

(1) Boom section assemblies are shipped open. Whenever any assembly plates, sheave plates, and tie plates extend beyond the sides of the boom proper, block or brace them with lumber, cut to fit; use tie bars wherever there is a possibility of bending in shipment. Block or brace boom section assemblies in accordance with Association of American Railroad Standards. Secure permission through the contracting officer for shipments of items over 39 feet in length.

(2) Pack miscellaneous component parts, assemblies and subassemblies less than 1,000 pounds net weight, within the export shipping container. The gross weight of the export shipping container shall not exceed 11,200 pounds, unless the unit weight of the item exceeds this figure.

(3) Fit snugly spare parts, tools, component parts, assemblies, and subassemblies less than 1,000 pounds net weight, within the interior shipping container. Where needed, use nailed wood blocking to prevent all interior movement within the container. The gross weight of any interior wooden container described herein shall not exceed 200 pounds, unless the unit weight of the item exceeds this figure. Pack interior wooden containers within an export shipping container. Fit the boxes snugly within the export shipping container, so as to prevent all interior movement. The gross weight of the export shipping container shall not exceed 11,200 pounds.

d. STRAPPING. Each style 2 or 4 nailed wooden shipping container shall be strapped and stapled, in accordance with the applicable provisions of JAN-P-106.

63. Marking

a. MARKING OF INTERIOR CONTAINERS. Unless otherwise specified, mark all interior items and containers in accordance with the provisions of Transportation Corps Specification MDPS-4, Marking and Identification of Processed Parts and Assemblies.

b. MARKING OF SHIPPING CONTAINERS. Mark style 2 or 4 nailed wooden shipping containers, nailed wood crates, and unboxed dismantled parts, in accordance with provisions of U. S. Army Specification 100-2, Standard Specification for Marking Shipments by Contractors.

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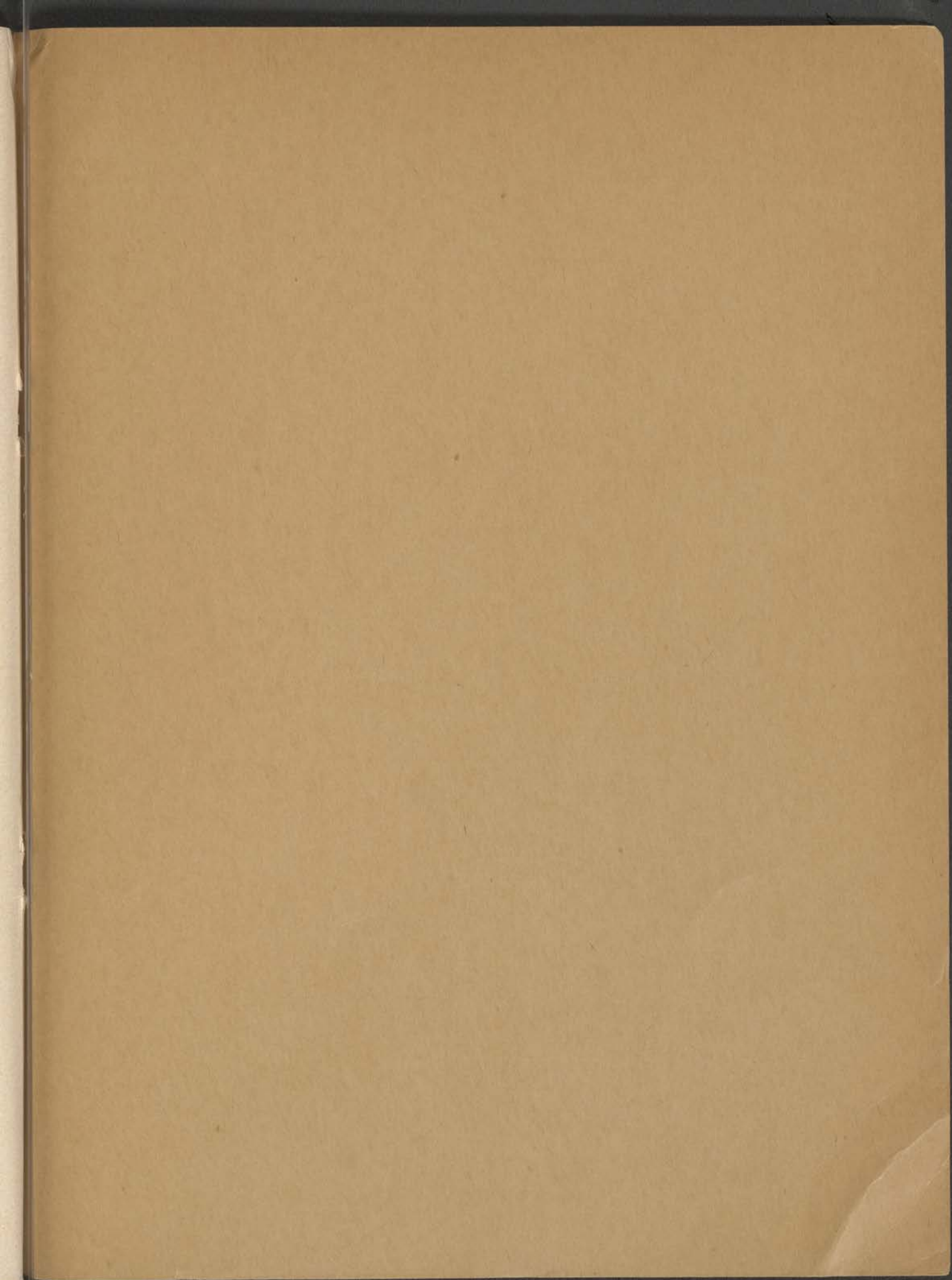
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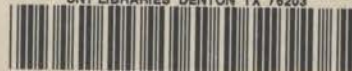


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