



MAINTENANCE MANUAL

TRIPLEX PUMP

WS-1300/1600



White Star Pump Co.
22718 Commercial Lane, Tomball, Texas 77375
2005

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SECTION 1. GENERAL

This section contains the instructions for the installations and startup of the pump at the drilling site. The instructions presented in this section should be followed for the initial Installation and startup of the pump, whenever the pump has been moved to a new location, or whenever major repairs have been made.

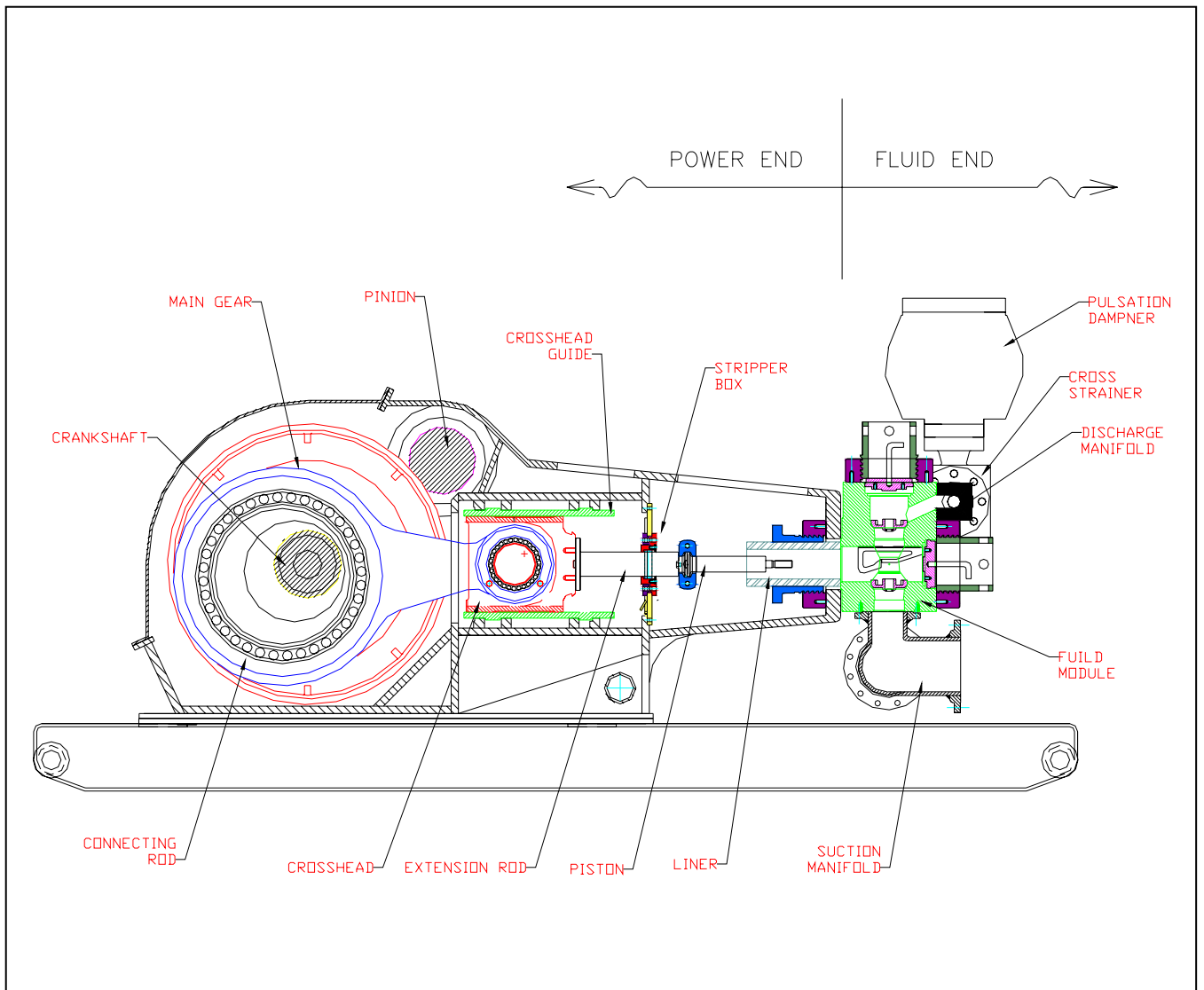


Fig 1-1. White Star Triplex Pump with One Piece Module

WARNINGS

NEVER REACH INSIDE OPERAING PUMP.

NEVER RUN PUMP AGAINST CLOSED VALVES (ALL DISCHARGE VALVES CLOSED).

STOP PUMP OPERATION BEFORE ATTEMPTING REPAIRS.

PROPERLY LOCK-OUT OR DISCONNECT MAIN POWER SOURCE TO THE PUMP BEFORE CONDUCTING INSPECTION, MAINTENANCE OR REPAIR.

COMPLETELY BLEED ALL PRESSURE FROM FLUID END BEFORE ATTEMPTING MAINTENANCE OR REPAIR.

CAUTIONS

- A CHARGING PUMP IS ESSENTIAL FOR PROPER OPERATION. FAILURE TO USE A CHARGING PUMP WILL VOID THE **PUMP WARRANTY**.
- INSTALL A SUCTION DESURGER TO MINIMIZE MUD CAVITATION.



Fig 1-2 Fluid End

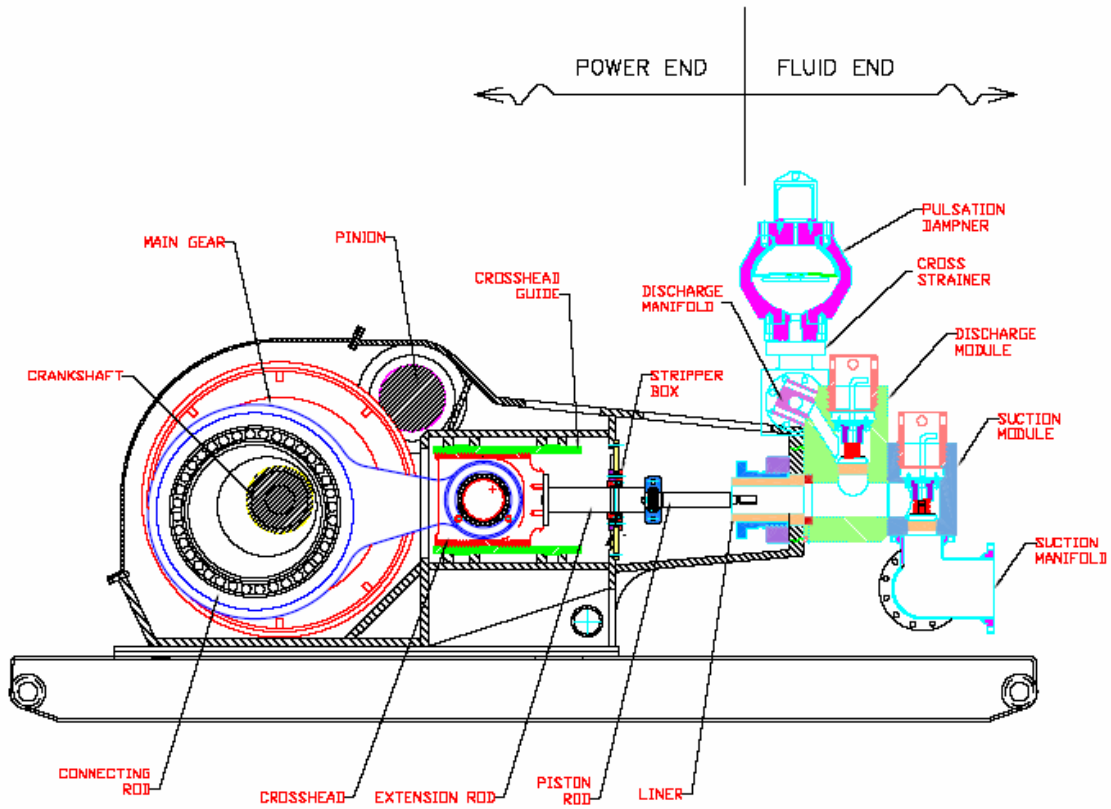


Figure 1-1-1 White Star Triplex Pump with Split Modules

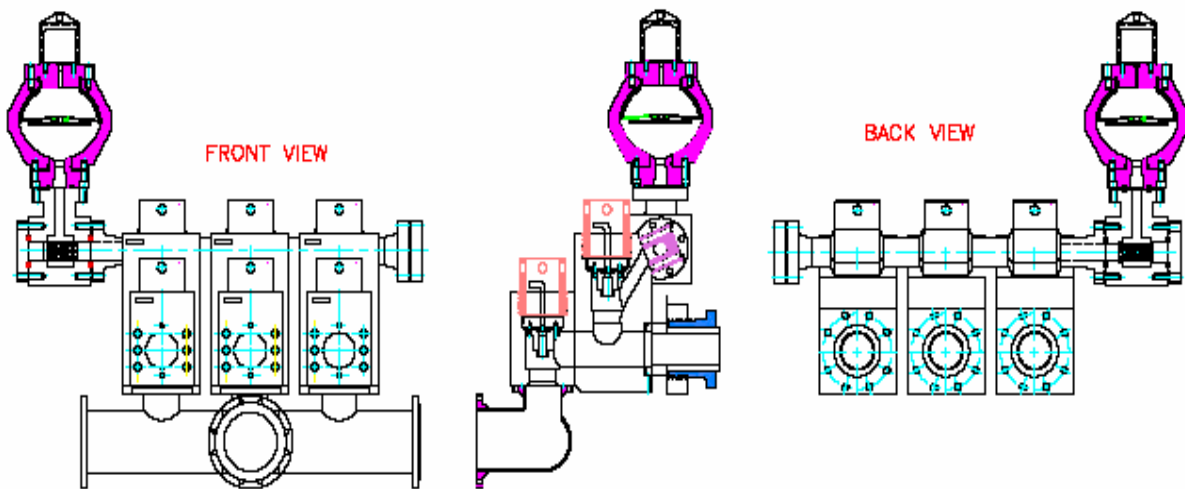


Figure 1-2-1 Fluid End with Split Modules

SECTION 2. INSTALLATION

PUMP

1. Be sure that the pump foundation is level and able to support the weight of the pump.
2. Install the pump as close as possible to the mud tank or pit to reduce drop in suction line.

SUCTION SYSTEM

1. The diameter of the suction line must be equal to or exceed the diameter of the pump suction connection.
2. Use as short a suction line as possible.
3. Install the suction line in as straight a line possible. If turns are necessary use long radius **ells**.
4. Install a section hose in the suction line to isolate vibration.
5. Be sure there are no air traps or air leaks in the suction line.
6. Install a charging pump in the suction line. (See CHARGING PUMPS.)
7. Install a suction desurger to prevent mud cavitation. (Refer to FLUID END ACCESSORIES in Section 4 of this guide.)
8. Fully open all valves in the suction line before operating the pump.

DISCHARGE SYSTEM

WARNING

THE DISCHARGE SYSTEM IS SUBJECT TO HIGH PRESSURES.

FAILURE TO FOLLOW APPROVED WELDING PROCEDURES ON ANY OF THE DISCHARGE PIPE MANIFOLDING; OR, PIPING BEYOND MANIFOLDING SUBJECTED TO INTERNAL PRESSURES FROM PUMP OPERATION COULD RESULT IN PIPING FAILURE CAUSING EQUIPMENT DAMAGE OR PERSONAL INJURY.

1. Install a pressure relief valve in the discharge system. Be sure there are no valves or restrictions, including the strainer assembly, between the pump and the relief valve.

CAUTION

- THE PRESSURE SETTING OF THE VALVE MUST NOT EXCEED THE PRESSURE RATING OF THE LINER SIZE INSTALLED IN THE PUMP.

NOTE:

The pressure ratings for the liners are listed in the specification charts at the back of this guide. They are also indicated on the pump serial number plate.

2. Install a pulsation dampener in the discharge system to reduce vibration and increase component service life. (Refer to FLUID END ACCESSORIES in section 4 of this guide.)

NOTE:

The standard WHITE STAR strainer assembly has an API 4" 5000 psi WP RTJ flange for dampener installation.

DIRECTION OF THE PUMP ROTATION

1. Be sure that the pump is set to rotate in the direction indicated by the arrow in the picture below the (Figure 1-3)
2. Do not rotate the pump in the opposite direction of the arrow unless the oil pump suction and discharge lines have been reversed.
3. If it becomes necessary to use the back side of the gear teeth (because of normal wear), turn the pinion and crankshaft assemblies end for end and move the oil pump to the opposite side of the crankcase.

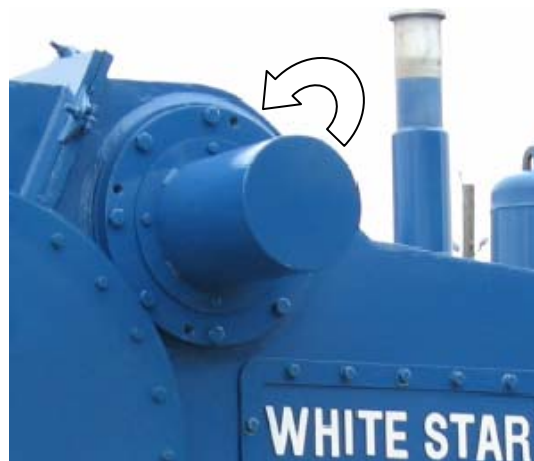


Fig. 1-3 Direction of Rotation

INITIAL OPERATION

Take special care when operating the pump for the first time or after major repairs have been made. Refer to the caution remarks under STARTUP, [Page 1-4](#)

CAUTION

- PUMPS ARE SHIPPED FROM THE FACTORY WITHOUT LUBRICANT. BE SURE THE PUMP IS PROPERLY LUBRICATED BEFORE OPERATING.

PREPARATION

1. If the pump was not completely assembled at the factory, complete the assembly as required.
2. Check to be sure the suction and discharge systems have been properly installed. (SEE INSTALLATION)
3. Remove the cover plates from the power end.
4. Inspect the power end for contamination. Clean as required.
5. Drain all condensation from the power frame (Figure 1-4).

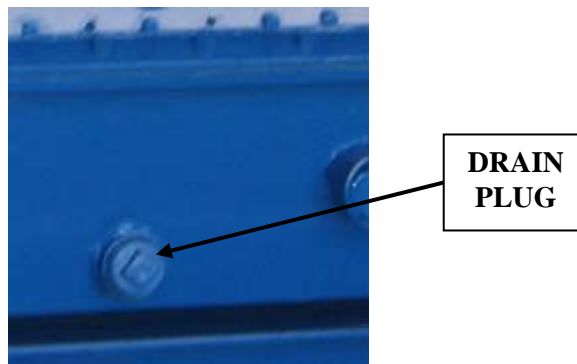


Fig. 1-4 Power end drain plug

Do not attempt to drain condensation from power frame if unit has been filled with lubricant. (why?)

6. Install cover plates.
7. Check that crankcase drain plug is installed and tight.
8. Fill the power end with correct lubricant.

NOTE:

Lubricant specifications and quantities for the pump are listed in LUBRICATION section of this guide and on the pump name plate.

9. Check and lubricate grease fittings on piston wash system.
10. Make sure all covers are installed and all nuts and bolts are tightened to the torque specifications listed at the back of the guide.
11. Fill piston wash system with water and / or coolant.
 - a. Slide reservoir cover open to fill reservoir.
 - b. Replace cover.

NOTE:

Add anti-freeze to piston wash system if there is a possibility of freezing.

CAUTION

- IF THERE ARE UNUSUAL NOISES OR OTHER INDICATIONS THAT THE PUMP IS NOT OPERATING CORRECTLY, STOP THE PUMP IMMEDIATELY AND CORRECT THE PROBLEM BEFORE CONTINUING OPERATION.
 - IF OIL PRESSURE EXCEEDS 40 PSI OR FALLS BELOW 5 PSI STOP THE PUMP IMMEDIATELY AND CORRECT THE PROBLEM BEFORE CONTINUING.
1. Operate pump slowly, 50 strokes per minute maximum, for 5 minutes with no fluid end pressure.
 2. Be sure that the oil pressure gauge indicates between 5 and 40 psi (Figure 1-5)

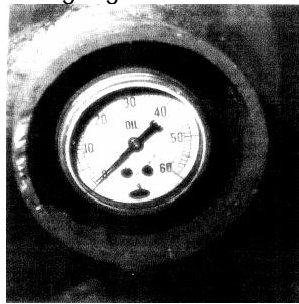


Fig. 1-5 Oil pressure gauge

3. Check each liner to ensure that the position wash system is operating properly.
4. After 5 minutes of slow speed operation, stop the pump. Allow 10 minutes for oil to return to the crankcase and check the lubricant level. If required, add oil until the level reaches the FULL mark on the dipstick. (Refer to the LUBRICATION section of the guide.)
5. Restart the pump. With no pressure on the fluid end, gradually increase the speed until the normal operating speed is reached.

CAUTION

- IF THERE ARE UNUSUAL NOISES OR OTHER INDICATIONS THAT THE PUMP IS NOT OPERATING CORRECTLY, STOP THE PUMP IMMEDIATELY AND CORRECT THE PROBLEM BEFORE CONTINUING.
 - IF OIL PRESSURE EXCEEDS 40 PSI OR FALLS BELOW 5 PSI STOP THE PUMP IMMEDIATELY AND CORRECT THE PROBLEM BEFORE CONTINUING.
6. Be sure the oil pressure gauge indicates between 5 and 40 psi.
 7. Check each liner to ensure that the piston wash system is operating properly.
 8. Gradually increase fluid end pressure until the **desired pressure** is reached.

WARNING

DO NOT EXCEED THE MAXIMUM OPERATING PRESSURE INDICATED ON THE PUMP NAME PLATE AND LISTED IN THE SPECIFICATION CHARTS IN THIS GUIDE.

DO NOT ATTEMPT TO PUMP AGAINST CLOSED DISCHARGE VALVES.

9. Operate pump for 30 minutes at required operating pressure. As pump operates inspect around the nuts of the liners, the cylinders and the valves for leaks. If leaks are found, stop the pump immediately, make the necessary repairs and restart the pump.
10. Stop the pump after 30 minutes of operation.
11. Inspect all studs, nuts and cap screws. Tighten if necessary. Torque specifications are listed at the back of this guide.
12. The pump is now ready for normal operation.

CHARGING PUMPS

CAUTION

- FAILURE TO USE A CHARGING PUMP WILL **VOID PUMP WARRANTY.**

The charging pump provides back pressure to the suction and prevents mud cavitations. This is essential to the flow and life of the fluid end.

Existing mud circulation pumps can be piped into the suction line if they are capable of delivering the maximum rated flow rate of the triplex pump while maintaining a pressure of 40 psi. Refer to the performance charts.

NOTE:

Maintain proper belt tension on charging system pump.

SECTION 3 LUBRICATION SYSTEM

WARNINGS

NEVER REACH INSIDE OPERATING PUMP.

NEVER RUN PUMP AGAINST CLOSED VALVES (ALL DISCHARGE VALVES CLOSED).

STOP PUMP OPERATION BEFORE ATTEMPTING REPAIRS.

PROPERLY LOCK-OUT OR DISCONNECT MAIN POWER SOURCE TO THE PUMP BEFORE CONDUCTING INSPECTION, MAINTENANCE OR REPAIR.

COMPLETELY BLEED ALL PRESSURE FROM FLUID END BEFORE ATTEMPTING MAINTENANCE OR REPAIR.

CAUTIONS

- PUMPS ARE SHIPPED FROM THE FACTORY WITHOUT LUBRICANT. BE SURE PUMP IS PROPERLY LUBRICATED BEFORE OPERATING.
- IF OIL PRESSURE EXCEEDS 40 PSI OR FALLS BELOW 5 PSI STOP THE PUMP IMMEDIATELY AND CORRECT THE PROBLEM BEFORE CONTINUING OPERATION.

SYSTEM DESCRIPTION

White Star Triplex pumps have two independent lubrication systems which provide lubricating oil to all moving parts of the pump. In addition to a pressure-fed primary system, each pump has a gravity -fed secondary system that is supplied by splash from the main gear.

Model WS1600 may have an external lubrication pump driven by motor on request.

Normal oil pressure for the primary lubrication system, as indicated by the pressure gauge, is 5 to 40 psi depending upon the temperature of the oil and the operating speed of the pump.

PRIMARY SYSTEM

Oil in the crank case sump enters the strainer and supplies the pump through the suction line. The oil is then pumped to the gearcase manifold which contains the pressure gauge connection, a relief valve (set to open at 40 psi), and outlets to main bearings, pinion bearings and crosshead manifold.

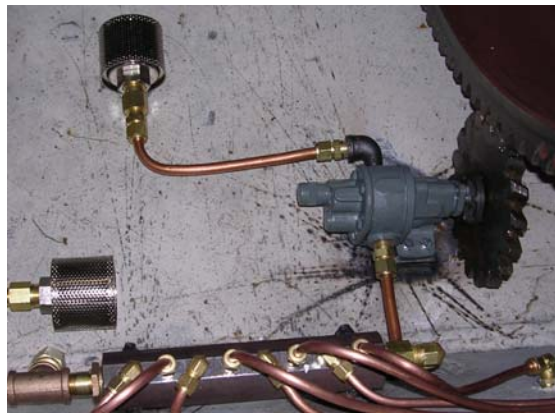


Fig. 2-1 Oil pump location

Oil pumped to the crosshead manifold is directed to each crosshead guide and onto each crosshead via grooves. The oil lubricates the upper crosshead guides and crosshead and then flows into the connecting rods, through holes in the rods and into the wrist pin bearings. The oil flows out of the wrist pin bearings through hole in the bottom of the crossheads and onto the lower crosshead guides.

Oil from the crosshead manifold also feeds an oil cup on each wrist pin retainer plate. This oil passes through a hole in each wrist pin to the inner race of the wrist pin bearings and then onto the lower crosshead guides ensuring adequate lubrication of the bearings.

The crosshead manifold also supplies a stream of oil to each extension rod as the rods pass through the stripper boxes.

SECONDARY SYSTEM

Each part lubricated by the primary system also receives oil from the gravity-fed secondary lubricating system. Two reservoirs, one above the crosshead compartment and one behind the pinion (Figure 2-2) are supplied with oil by splash from the main gear.



Fig. 2-2 Secondary lubricating system.

LUBRICANT LEVEL

1. Check the lubricant level of the pump at regular intervals. The dipstick is located at the rear of the power frame (Fig 2-3).



Fig. 2-3. Dipstick

NOTE:

Every pump is equipped with two dipsticks (one on each side of the power frame) for convenience.

2. If the Pump is operating, the lubricant level should be at the run mark on the dipstick.

NOTE:

If the lubricant level does not reach the RUN mark on the dipstick when checked, stop the pump.

3. If the pump has been stopped for at least 10 minutes, the lubricant level should be between the ADD and FULL marks on the dipstick.
4. Add lubricant if necessary.

RECOMMENDED LUBRICANTS**NOTE:**

The recommended lubricants for the White Star mud pumps are shown in Fig. 2-6. Consult your White Star service representative before using lubricants other than those listed

LUBRICANT CHANGES

1. Drain the old lubricant every 4 months or 1000 operating hours, whichever occurs first. The drain plug is located at the rear of the power frame (Figure 1-4).
2. Fill the pump with fresh lubricant. (Fig. 2-6)

CAUTION

CHANGE LUBRICANT IF CONTAMINATED BY DIRT, DRILLING FLUID, EXCESSIVE CONDENSATION OR OTHER FOREIGN SUBSTANCES.

BRAND OF LUBRICANT	AMBIENT TEMPERATURE	
	- 20 Deg F to +15 Deg F	+15 Deg. F to 125 Deg F
AGMA NO.	No. 1 EP	No. 4 EP
GULF	-	EP Lubricant 75
EXXON	Pen-O-Led EP 1	Pen-O-Led
SHELL	-	Spirax HD 90
MOBIL	Comp AA Mobilgear 626	Comp. BB Mobilgear 629
TEXXACO	Meropa Lubricant 1 Multigear Lubricant EP 80	Meropa Lubricant 2

NOTE: The Capacity of Oil for White Star WS-1300/1600 is 120 gal.

Fig. 2-6. Recommended lubricants

SECTION 4 INSPECTION AND MAINTENANCE

WARNINGS

NEVER REACH INSIDE OPERATING PUMP.

NEVER RUN THE PUMP AGAINST CLOSED VALVES (ALL DISCHARGE VALVES CLOSED).

STOP PUMP OPERATION BEFORE ATTEMPTING REPAIRS.

PROPERLY LOCK-OUT OR DISCONNECT MAIN POWER SOURCE TO THE PUMP BEFORE CONDUCTING INSPECTION, MAINTENANCE OR REPAIR.

COMPLETELY BLEED ALL PRESSURE FROM FLUID END BEFORE ATTEMPTING MAINTENANCE OR REPAIR.

PREVENTIVE MAINTENANCE

The primary goal of a preventive maintenance program is to help the pump owner realize and control fluid circulating equipment operating costs. It is possible to control mud pump cost if life of fluid end parts can be reasonably predicted so that they can be replaced before they fail. Parts that are run to the point of failure result in unscheduled downtime, damage to other parts and excessive man hours being spent for pump repair.

Besides following a program of scheduled inspection and maintenance, the owner should develop a plan for the timely replacement of expendable components based upon the average life expectancy of these components.

By changing expendable parts in a group on a timely basis you can eliminate the need to continually go into the pump for routine maintenance. Changing parts or performing other schedule inspections while you are shut down for some other event that does not require pump operation (making cement, logging, etc.) further reduces pump down time.

SCHEDULE MAINTENANCE

DAILY (8 HOURS)

1. CHECK CRANKCASE OIL LEVEL.
2. CHECK OIL PRESSURE.
3. CHECK OIL FOR CONTAMINATION.
4. CHECK STRIPPER BOX PACKING.

5. LUBRICATE CHARGING PUMP.
6. CHECK DISCHARGE PRESSURE.
7. CHECK FOR OIL LEAKS.
8. CHECK FOR FLUID LEAKS.
9. CHECK SUCTION DESURGER FOR PROPER PRESSURE.
10. CHECK DISCHARRGE PULSATION DAMPENER FOR PROPER PRESSURE.
11. CHECK PISTON LUBRICATION SYSTEM.
12. CHECK PUMP FOR CLEANLINESS.
13. CHECK WORK AREA FOR CLEANLINESS.

WEEKLY (40 HOURS).

1. CHECK ALL SAFETY CONTROLS.
2. CHECK PISTON ROD CLAMPS.
3. PERFORM ALL DAILY CHECKS.

MONTHLY (200 HOURS).

1. CHECK ALLL FLUID END AND POWER END BOLTS FOR PROPER TIGHTNESS.
2. CHECK LINER AND PISTON WEAR.
3. CHECK EXTENSION ROD FOR WEAR.
4. CHANGE PISTON WASH SYSTEM WATER.
5. CLEAN CRANKCASE BREATHERS.
6. CLEAN OIL FILTER (S).
7. CHECK VALVE SEATS AND VALVE SPRINGS.
8. CHECK AVAILABILITY AND CONDITION OF SPECIIAL TOOLS.
9. PERFORM ALL DAILY AND WEEKLY CHECKS.

SIX MONTHS (1000 HOURS)

1. CHECK CROSSHEAD CLEARANCE (SEE SPECIFICATIONS).
2. CHECK FOUNDATIONS AND/ OR HOLD ON BOLTS.
3. CHECK GEARS AND / OR CHAIN AND SPROCKETS FOR WEAR.
4. CHECK SUCTION FLANGE BOLTING.
5. CHECK DISCHARGE FLANGE BOLTING.
6. CHECK PUMP SHEAVE, SPROCKET OR COUPLING.
7. CHANGE OIL.
8. PERFORM DAILY, WEEKLY AND MONTHLY CHECKS.

SECTION 5. FLUID END REPAIR

EXPENDABLES

Gaskets, valves, valve seats, valve springs, liners and pistons are considered expendable components. A liner davit (Figure. 4-1) is available to aid in handling heavy components.



Figure 4-1 Liner davit

WARNINGS

NEVER REACH INSIDE OPERATING PUMP.

NEVER RUN PUMP AGAINST CLOSED VALVES (ALL DISCHARGE VALVES CLOSED).

STOP PUMP OPERATION BEFORE ATTEMPTING REPAIRS.

PROPERLY LOCK-OUT OR DISCONNECT MAIN POWER SOURCE TO THE PUMP BEFORE CONDUCTING INSPECTION, MAINTENANCE OR REPAIR.

COMPLETELY BLEED ALL PRESSURE FROM FLUID END BEFORE ATTEMPTING MAINTENANCE OR REPAIR.

Be sure to tighten fasteners to the proper torque value. Torque specifications for important fluid end fasteners are given at the back of this guide. Refer to standard SAE torque chart for any fasteners not listed in this guide.

GASKET REPLACEMENT

1. Use a hammer and steel bar to remove threaded cylinder head or discharge valve cover plug retainer. (Fig. 4-2)

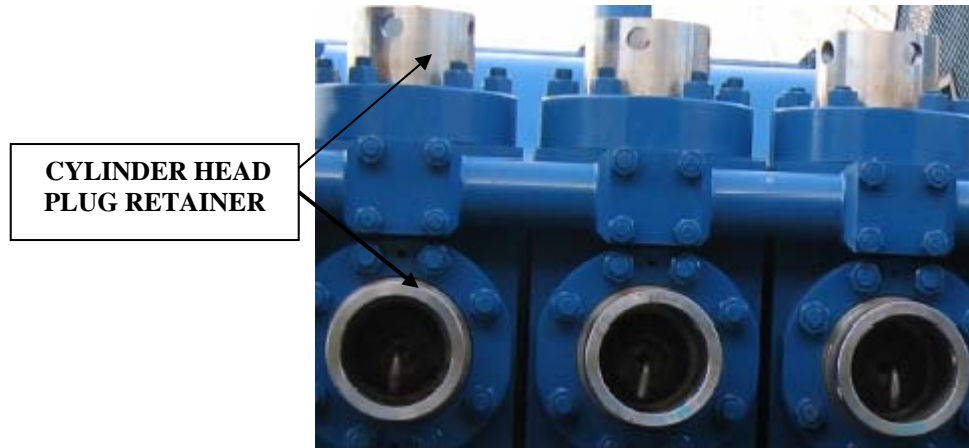


Figure 4-2 Removing cylinder head plug retainer

2. Remove cylinder head or discharge valve cover plug and gasket. (Fig 4-3)

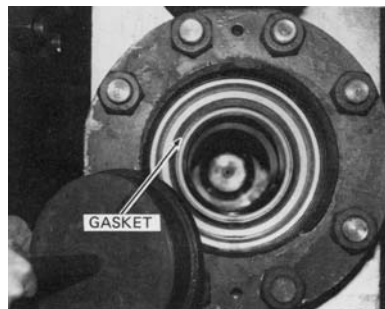


Figure 4-3 Cylinder head plug and gasket

3. Inspect gasket. Discard if damage or worn.
4. Clean gasket groove and lubricate with multipurpose grease. (Fig. 4-4)

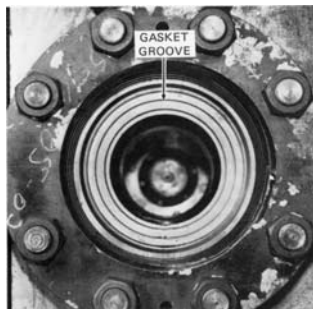


Figure 4-4 Gasket groove

5. Install gasket. Use new gasket if necessary.
6. Install cover plug and retainer. Tighten retainer with hammer and steel bar.

NOTE:

Threaded retainers are buttress fit and must be tighten completely.

SUCTION VALVES

REMOVAL

1. Remove cylinder head plug retainer (Figures 4-2)
2. Remove cylinder head plug and inspect gasket (Figure 4-3). Remove and discard gasket if damaged or worn.
3. Pull wedge shaped valve retainer from slot in suction valve guide (Figures 4-5)

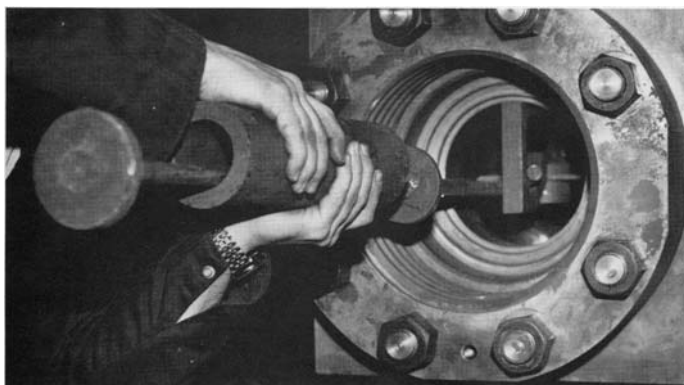


Fig. 4-5 Removing suction valve retainer

4. Rock valve guide slightly to loosen. Lift guide upward in vertical bore and rotate 90 degrees to remove (Figures 4-5, 4-6).

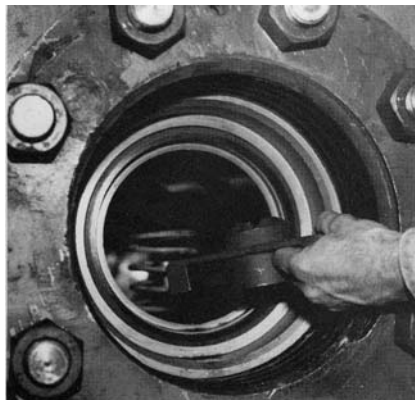


Figure 4-6 Removing suction valve guide

5. Remove suction valve and valve spring (Figures 4-7)

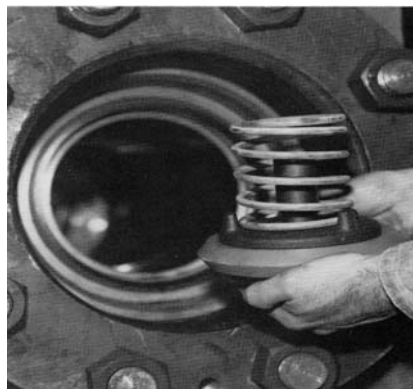


Fig. 4-7 Removing suction valve and valve spring

INSTALLATION

1. Position valve on valve seat.
2. Place valve spring over valve.
3. Insert valve guide lengthwise (with one of the curved surfaces facing the piston) until the center of the guide is over the valve stem and spring (Figure 4-8)

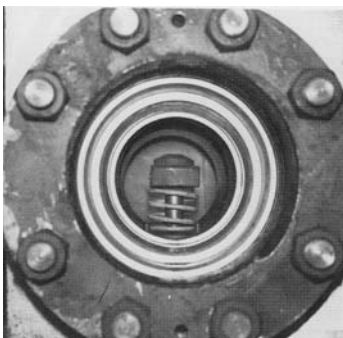


Figure 4-8 Installing suction valve guide

4. Rotate the guide 90 degrees, mating the curved surfaces to the guide with the curved surfaces of the vertical bore.
5. Push the guide down over the valve stem and spring.
6. Push valve guide down and install wedge-shaped retainer in slot valve guide. (Figure 4-9)

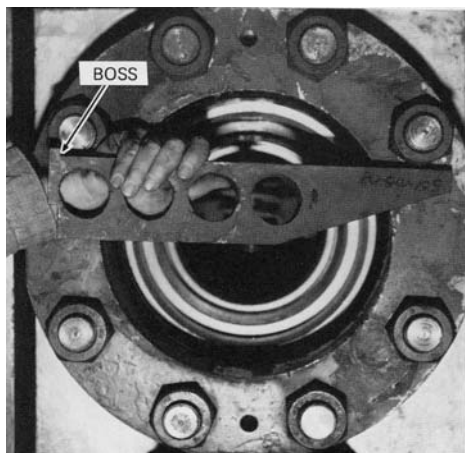


Figure 4-9 Installing suction valve retainer

NOTE:

Make sure valve guide retainer is all the way in.

CAUTION

- VALVE GUIDE WILL BE DAMAGED DURING PUMP OPERATION IF COCKED OR MISALIGNED DURING INSTALLATION.

7. Inspect the valve guide and retainer to be sure they are installed correctly. (Fig. 4-5)
8. Install cylinder head gasket.
9. Use pipe dope or grease for threads and install cylinder head plug and retainer.

10. Tighten cylinder head plug retainer with hammer and steel bar.

NOTE:

Cylinder head plug retainer is buttress fit and must be tighten completely.

DISCHARGE VALVES

REMOVAL

1. Remove the threaded cover plug retainer with hammer and steel bar.
2. Remove the cover plug with valve guide (Figure 4-10).

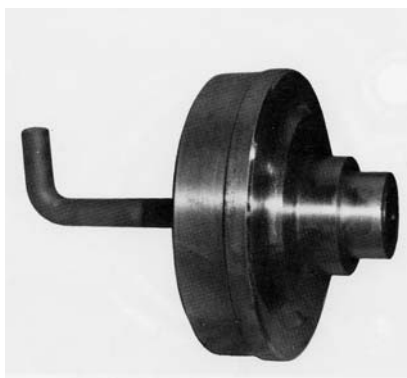


Figure 4-10 Cover plug with valve guide

NOTE:

The discharge valve guide for White Star-1600 is bolted to the cover plug. (Figure 4-10).

3. Remove discharge valve and valve spring.

INSTALLATION

1. Position discharge valve on the valve seat.
2. Place valve spring over valve.
3. Inspect cover plug gasket. Replace if damaged or worn.

4. Install cover plug making sure that the valve guide is correctly positioned over valve.
5. Install threaded cover plug retainer. Tighten with hammer and steel bar. (Figure 4-11).



Figure 4-11 Tightening thread retainer

NOTE:

Threaded cover plug retainer is buttress fit and must be tightened completely.

VALVE SEATS

REMOVAL

CAUTION

- NEVER USE A TORCH TO REMOVE VALVE SEATS. EXCESSIVE HEAT WILL DISTORT FORGINGS AROUND VALVES SEATS.
1. Remove valve guide and valve (see section on appropriate valve).
 2. Use a suitable puller to remove valve seat. (See CAUTION and NOTE).

INSTALLATION

NOTE:

Do not re-use valve seats. Always replace removed valve seats with a new one.

1. Remove all mud and scale from area that valve seat contacts with wire brush.
2. Thoroughly clean the area that the valve seat contacts with rags and a suitable cleaning solution.

WARNING

NEVER USE GASOLINE AS A CLEANING SOLUTION.

3. Wipe the contact area dry with a soft clean rag. Area must be completely dry before installing valve seat.
4. Install valve seat into the tapered area.

NOTE:

Use API # 7 seats in White Star-1600 pumps.

5. Drive the valve seat into place with a hammer and wooden block (Figure 4-12).

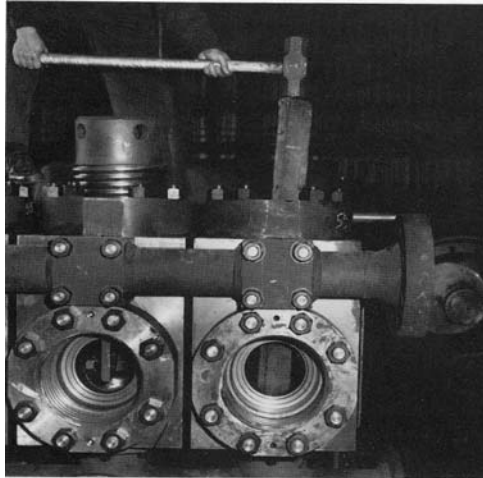


Figure 4-12 Installing valve seat

NOTE:

Pump pressure will drive the seat into its final position.

6. Install the valve, valve spring and valve guide.

PISTONS AND PISTON RODS

White Star Triplex pumps have API SA-4 piston rod connections designed for single acting pistons and 1-1/2 inch diameter bores in the piston body. The threads on the piston rods are 1-1/2"-8UN.

REMOVAL

1. Remove cylinder head plug retainer and cylinder head plug.
2. Remove and inspect gasket. Discard if damaged or worn.

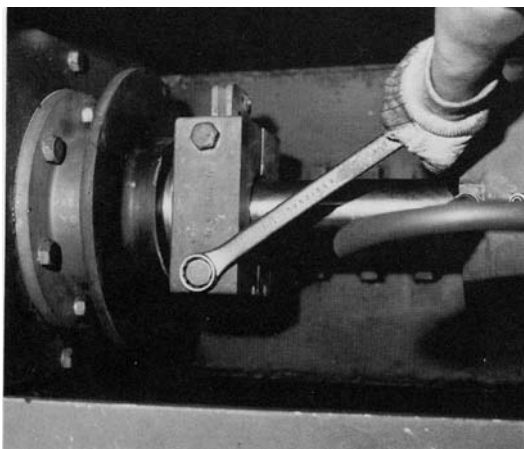


Figure 4-13 Removing piston rod clamp

3. Remove suction valve retainer and guide.
4. Completely retract the extension rod and remove the piston rod clamp (Figure 4-13).
5. Push piston rod and piston out through cylinder head.
6. Remove stop nut and piston from piston rod (Figure 4-14).

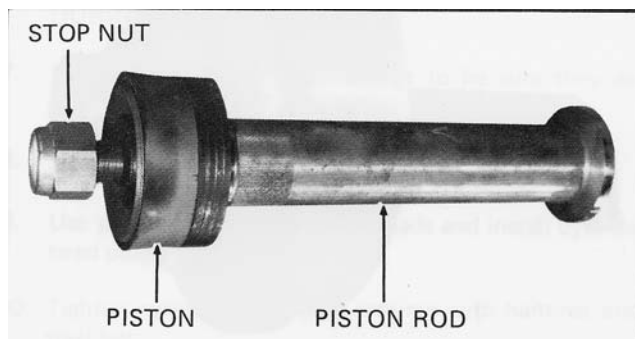


Figure 4-14 Piston, Piston Rod, and Stop Nut

INSTALLATION

NOTE :

Burrs and rough spots on the extension and piston rod flanges will cause piston and liner misalignment. Before re-assembly and installation, inspect the extension and piston rod flanges. Remove any burrs or rough spots by filing or grinding.

1. Install new piston with O-ring onto piston rod.
2. Install stop nut on piston rod. Torque stop nut to 870 ft-lbs.
3. Lubricate liner bore and piston with multipurpose grease.
4. Insert the assembled piston and piston rod, flange end first, into the fluid end and through the liner.
5. Position the piston rod flange against the extension rod flange with the pilot boss on the piston rod fitting into the hole in the extension rod. (Figure 4-15).

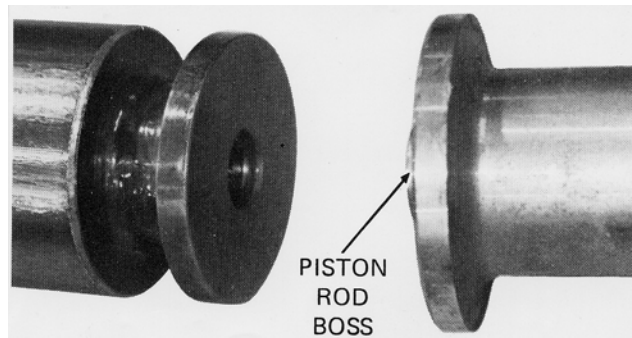


Figure 4-15 Piston and extension rod flanges

NOTES:

There should be no space between the piston rod and extension rod flanges.

If the piston rod clamp will not tighten completely, inspect the clamping faces of the extension rod, piston rod and clamp for grooves or burrs. Carefully remove any grooves or burrs on the clamping faces by filing or grinding.

6. Install the piston rod clamp (Figure 4-16).

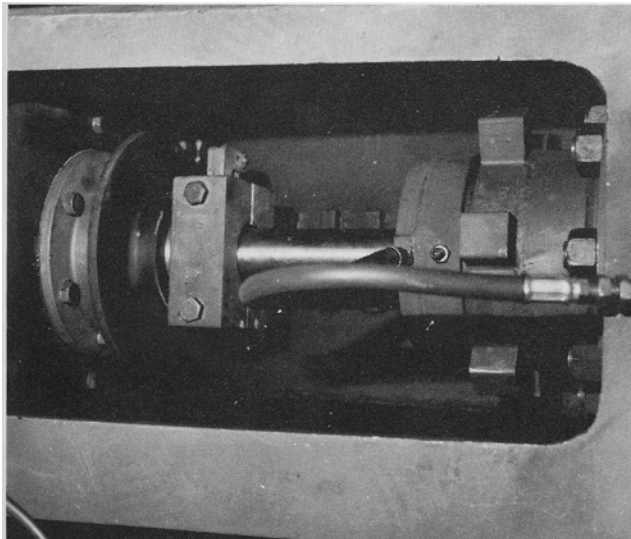


Figure 4-16 Piston rod clamp installed

7. Torque the $\frac{3}{4}$ " clamp bolts evenly to 200 ft-lb. The clamp should fit tightly around the rod flanges and should not rotate.
8. Install the suction valve, valve spring, valve guide and retainer.
9. Install gasket, cylinder head plug and retainer. Tighten retainer with hammer and steel bar.

LINERS

WARNING

USE THE LINER DAVIT WHEN HANDLING LINERS. LINERS ARE HEAVY AND WORK SPACE IS CONFINED.

REMOVAL

1. Remove the cylinder head cover and suction valve.
2. Completely retract the extension rod and remove the piston rod clamp.
3. Remove the piston rod and piston.
4. Remove the liner retainer from the threaded ring (Figure 4-17)
- 5.



Figure 4-17 Removing liner retainer

6. Pull the liner out of the frame bore.

NOTE:

If liner cannot be easily removed from the frame bore, contact your White Star service representative for alternate method of removing liner.

INSTALLATION

1. Grease the liner boss and face with heavy grease (Figure 4-18). This lubrication prevents corrosion and aids in removal of the liner for later maintenance or replacement.



Figure 4-18 Liner

2. Clean the liner bore and face of the fluid end. (Figure 4-19).

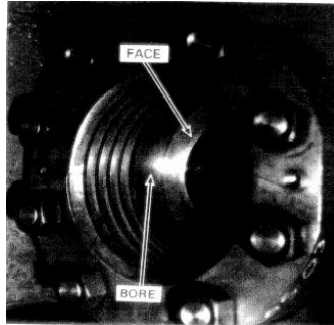


Figure 4-19 Liner bore

3. Lubricate the gasket groove or recess and install a gasket on the front of the liner.
4. Install the liner in the liner bore. Push liner into the bore until it stops against fluid end block.
5. Place the threaded liner retainer over the liner and install into threaded ring.
6. Tighten threaded liner retainer against the liner and tighten with hammer and steel bar.

NOTE:

Threaded liner retainer is buttress fit and must be completely tight.

FLUID END ACCESSORIES**LINER RINSING SYSTEM**

The service life of the piston and liner depends upon the quality of water used in the liner rinsing system. The liner rinsing system is designed to use either an outside source of clean, cool water or a self-contained system available from White Star. The self contained system features a portable 90 gallon tank, assuring ample time for water to cool during circulation. White Star offers either a pinion-powered or electrically-powered self contained system.

Periodically clean the tank of the self contained system by flushing out sediment through the two flanges (Figure 4-20). Inspect and clean the tank strainer at regular intervals.

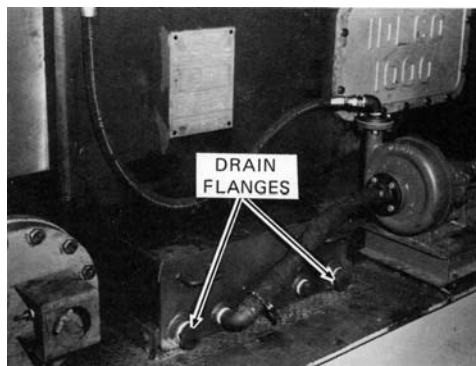


Figure 4-20 Piston wash system drain flanges

SUCTION DESURGER

The suction desurger is located on the end of the suction manifold. The suction desurger extends the service life of the charging pump by smoothing the suction flow.

Before starting the pump for the first time, as well as periodically during pump operation, check the air pressure in the desurger. (Figure 4-21)

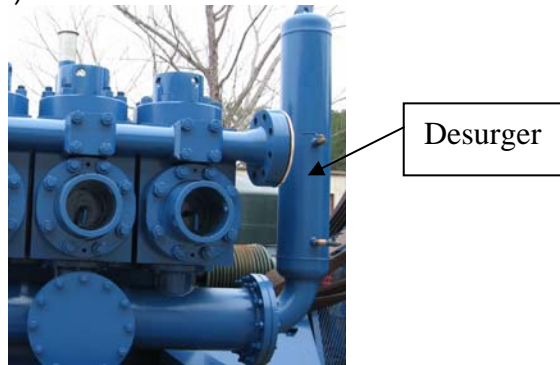


Figure 4-21 Desurger

1. Open the angle valve.
2. Use a standard tire pressure gauge to check air pressure. Pressure should be 20 psi. If lower, use standard air compressor to fill to 20 psi.
3. Close angle valve.
4. In the case the rubber diaphragm is installed, If pressure integrity is lost at any time, inspect the rubber diaphragm inside the suction manifold for damage. Tighten the hose clamps or replace the diaphragm if necessary.

STRAINER ASSEMBLY

This standard accessory consists of a studded strainer body, flange and strainer screen (Figure 4-25). The strainer assembly supports the pulsation dampener and strains the mud to prevent trash from entering the high pressure mud system. Inspect the strainer screen at regular intervals or if relief valve discharges excessively.

WARNING

COMPLETELY BLEED ALL PRESSURE FROM FLUID END BEFORE ATTEMPTING MAINTENANCE OR REPAIR.

1. Remove the flange with the bull plug.
2. Clean or replace screen.

3. Install the flange with the bull plug. Refer to torque charts in the back of this guide.



Figure 4-22 strainer assembly

NOTE:

Two studded outlets for 5" 5000 psi WP API companion flanges are provided for discharge and bleed off purposes. The flanges are not included

SECTION 6 POWER END REPAIR

POWER END REPAIR

WARNINGS

NEVER REACH INSIDE OPERATING PUMP.

NEVER RUN PUMP AGAINST CLOSED VALVES (ALL DISCHARGE VALVES CLOSED).

STOP PUMP OPERATION BEFORE ATTEMPTING REPAIRS.

PROPERLY LOCK-OUT OR DISCONNECT MAIN POWER SOURCE TO THE PUMP BEFORE CONDUCTING INSPECTION, MAINTENANCE OR REPAIR.

COMPLETELY BLEED ALL PRESSURE FROM FLUID END BEFORE ATTEMPTING MAINTENANCE OR REPAIR.



Figure 5-1 Power End Cover Plates

CAUTIONS

- BE SURE TO TIGHTEN FASTENERS TO THE PROPER TORQUE VALUE (Torque specifications for important power end fasteners are listed at the back of this guide. Refer to standard SAE torque chart for other fasteners.)
- REPLACE LOCKWIRES DURING REASSEMBLY.

CRANKSHAFT ASSEMBLY

REMOVAL

1. Remove right and left crankshaft cover plates and gaskets (Figure 5-1).
2. Remove gear case cover and gasket (Figure 5-1).

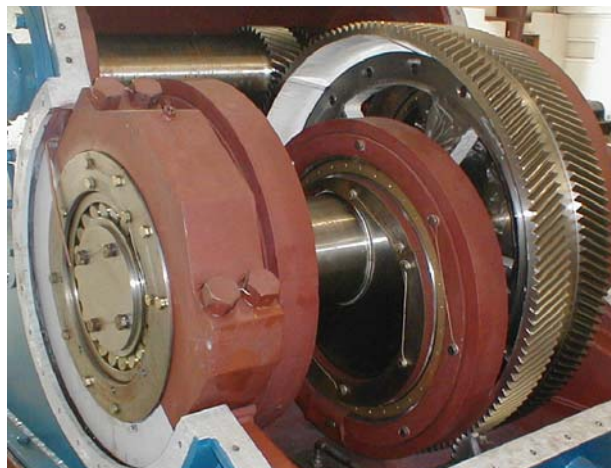


Figure 5-2 Crankshaft Assembly

3. Mark and remove right and left crankshaft bearing (main) retaining rings (each retaining ring is secured by 16 capscrews) (Figure 5-2, 5-3)

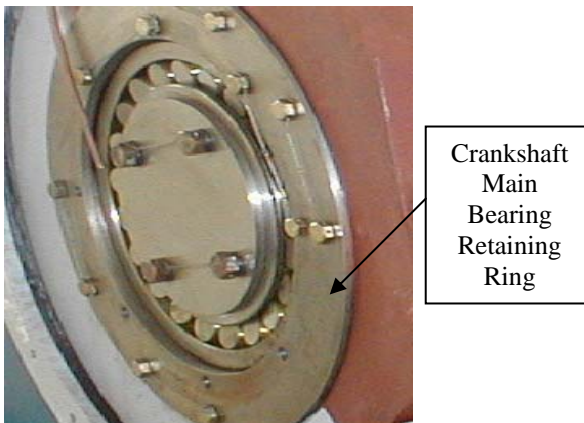


Figure 5-3 Crankshaft Main Bearing Retaining Ring

4. Mark and remove right and left crankshaft main bearing housing top (Figure 5-4).

NOTE:

DO NOT interchange bearing housings during subsequent reassembly.

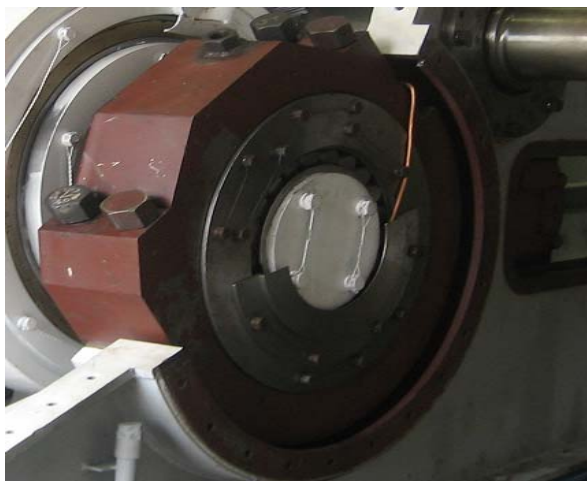


Figure 5-4 Crankshaft Main Bearing Housing

5. Remove oil pump and clear all oil piping from the crankshaft area. (See OIL PUMP).
6. Remove the crosshead are cover plates. (Figure 5-1).
7. Remove the cap screws (4 in each retaining plate) that hold the wrist pin retaining plates. (Figure 5-5)

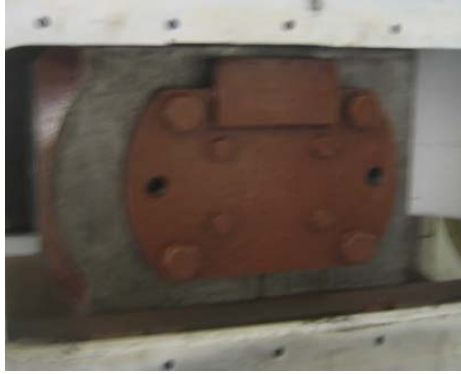


Figure 5-5 Wrist pin retainer plate

8. Mark and remove wrist pin retaining plates and attached wrist pins.

NOTE:

DO NOT interchange wrist pins during subsequent reassembly.

WARNING

CRANKSHAFT ASSEMBLY IS EXTREMELY HEAVY SEE CHART BELOW TO SELECT SUITABLE HOIST AND SLING FOR REMOVAL.

THE WEIGHT OF WHITE STAR-1600 CRANKSHAFT IS 15,000 LBS.

9. Use a suitable hoist to remove crankshaft assembly from the power frame (Figure 5-6).
10. Lower crankshaft assembly onto suitable cribbing for further disassembly.

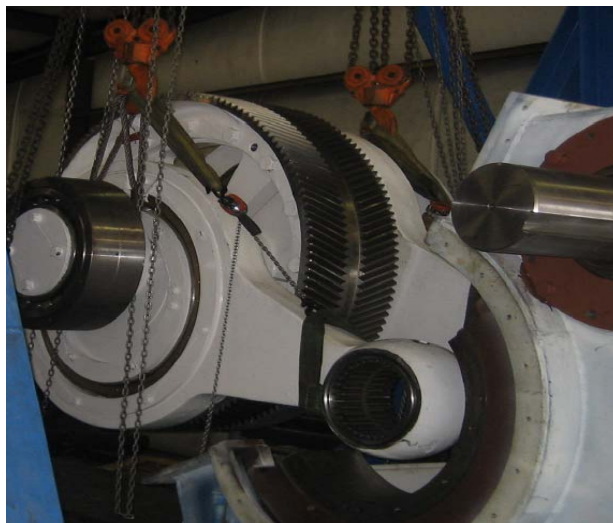


Figure 5-6 Removing crankshaft assembly

MAIN BEARINGS

1. Remove cap screws (4) from each crankshaft bearing (main) retainer plates (figures 5-2, 5-7)

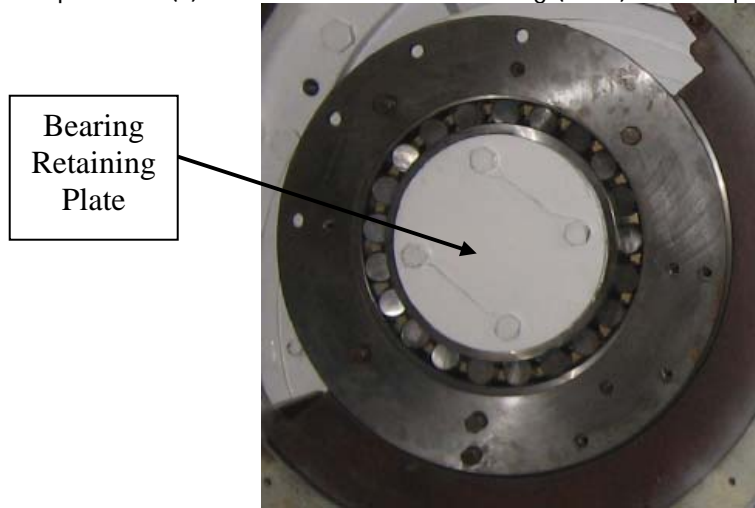


Figure 5-7 Crankshaft bearing retaining plate

2. Heat Main bearings and use a hydraulic puller pulling on spacer to remove crankshaft (Figure 5-2)

CONNECTING RODS, CONNECTING ROD BEARINGS

1. Remove the cap screws that secure the internal retaining ring to the connecting rod (Figures 5-2, 5-8)

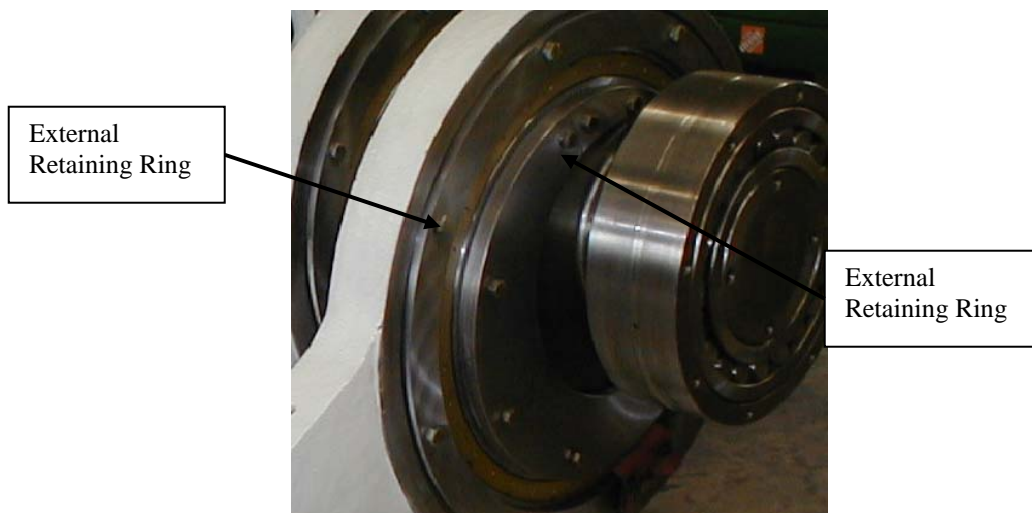


Figure 5-8 Internal and external retainer rings

NOTE:

The connecting rod farthest from the main gear has an internal retaining ring on each side of the eccentric.

2. Slide the connecting rod (with connecting rod bearing attached) off the crankshaft (Figs 5- 9).

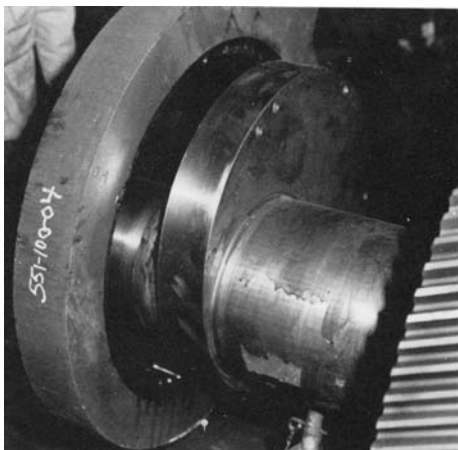


Figure 5-9 Removing/Installing Connecting rod

- 3 Remove the external retaining ring from the connecting rod (Figure 5-2, 5-8).
- 4 Use a hammer and suitable drift to remove connecting rod bearing from connecting rod (Figure 5-10)

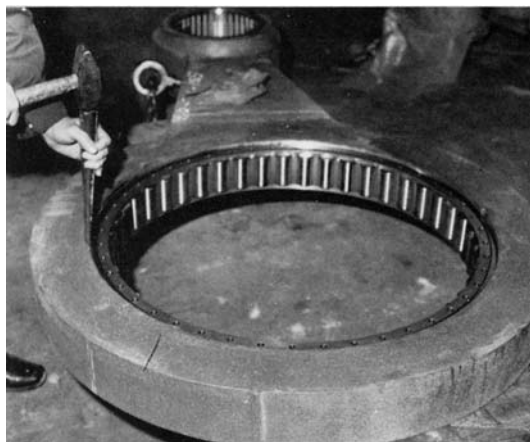


Figure 5-10 Removing connecting rod bearing

NOTE:

Notches are provided in the connecting rod to aid removal of the eccentric bearing.

2. Heat inner connecting rod bearing race slightly (do not let metal turn blue from heat) and slide bearing race off eccentric.

MAIN GEAR

1. Remove bolts and stop nuts that secure main gear to crankshaft (Figure 5-11).

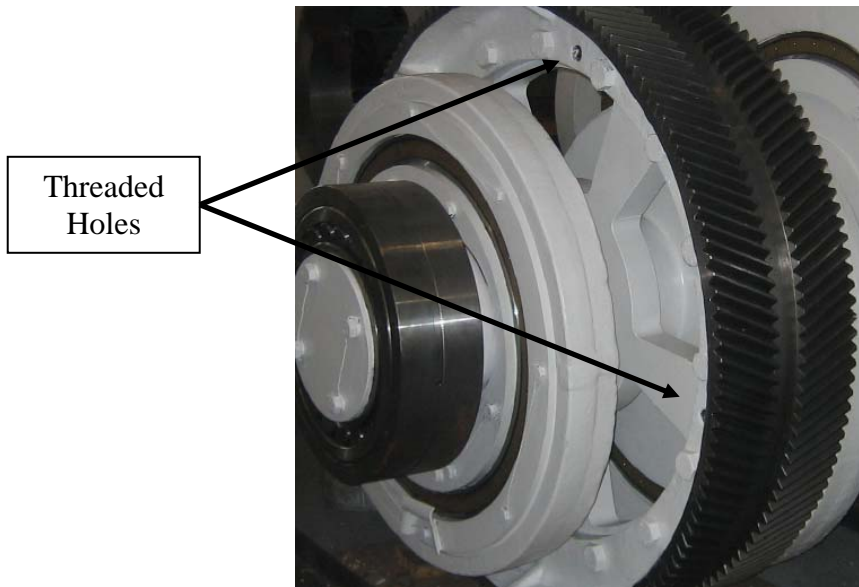


Figure 5-11 Main gear

2. Use bolts in threaded holes in main gear to remove main gear from crankshaft.

INSTALLATION**MAIN GEAR**

1. Pilot main gear to crankshaft.
2. Secure main gear to crankshaft with bolts and stop nuts (figure 5-11)
3. Torque bolts and stop nuts. WS-1300/1600 – 870 ft-lbs.

CONNECTING RODS, CONNECTING ROD BEARINGS

1. Install eccentric outer race and roller bearing in each connecting rod (Figure 5-2)
2. Secure bearing by installing external retaining ring on each connecting rod. (Figures 5-2, 5-8).
3. Install eccentric bearing inner races on crankshaft eccentric.

NOTE:

Install connecting rod bearing inner race, inner race retainer and connecting rod on eccentric farthest from bull gear after center connecting rod has been installed.

4. Slide connecting rods, with bearing assemblies installed onto the crankshaft eccentric (Figure 5-9).
5. Install internal retaining rings to secure connecting rods on crankshaft.

CRANKSHAFT MAIN BEARINGS

1. Install crankshaft bearings into bearing carriages.

NOTE:

Heat bearing assemblies in hot oil bath or with shielded flame to install on crankshaft.

2. Install bearing in fixed bearing carriage on end of crankshaft nearest bull gear (Figure 5-2)
3. Install bearing in floating bearing carriage on end of crankshaft farthest from bull gear (Figure 5-2)
4. Install retainer plates on ends of crankshaft (Figures 5-2, 5-7).

CRANKSHAFT ASSEMBLY

CAUTION

- DONOT DAMAGE EXPOSED OIL LINES DURING CRANKSHAFT INSTALLATION.

NOTES:

Support connecting rods during crankshaft installation.

Do not interchange left and right bearing caps during installation.

Do not interchange wrist pins during installation.

1. With suitable hoist, raise crankshaft assembly and install in power frame (Figure 5-12).



Figure 5-12 Installing crankshaft assembly

2. Install right and left crankshaft bearing retaining rings (Figure 5-3).
3. Install and secure bearing caps (Figure 5-4).
4. Align each crosshead with its connecting rod and install wrist pin retaining plate (with attached wrist pin) (Figure 5-5).
5. Install oil pump(s) and lines (See Oil pumps).
6. Install covers with new gaskets (Figure 5-1).

CAUTION

- WATCH OIL PRESSURE CLOSELY AS YOU OPERATE THE PUMP AFTER REPLACEMENT OF ANY OIL SYSTEM COMPONENT. AT THE FIRST SIGN OF LOW OIL PRESSURE (LESS THAN 5 PSI), STOP THE PUMP IMMEDIATELY AND CHECK THE OIL SYSTEM.

OIL PUMP

REMOVAL

1. Drain Oil (Figure 1-4)
2. Remove rear inspection plate (Figure 5-1)
3. Disconnect pump outlet line (manifold feed line).
4. Remove oil pump mounting capscrews (4) and remove oil pump with input line and strainer.
5. Remove input line and strainer from oil pump.
6. Remove drive gear from oil pump.

INSTALLATION

CAUTION

- DO NOT CHANGE DIRECTION OF OIL PUMP SHAFT ROTATION WITHOOUT EXCHANGING INPUT AND OURPUT LINE LOCATIONS.



Figure 5-13 Oil pressure gauge

1. Install drive gear and oil pump shaft.
2. Install input line and strainer on oil pump.
3. Position oil pump on pump base and secure with cap screws. (4).
4. Connect oil pump output line.
5. Install cover plate and gasket.

OIL PRESSURE GAUGE, OIL PRESSURE RELIEF VALVE

The oil pressure gauge (Figure 5-13) and the oil pressure relief valve can be easily replaced if necessary. Simply un-screw the old unit from the gearcase manifold and screw in the replacement unit.

CROSSHEAD ASSEMBLY**CAUTION**

CROSSHEAD EXTENSION RODS HVE HIGHLY POLISHED SURFACES. DO NOT NICK OR SCRATCH DURING REMOVAL OR INSTALLATION.

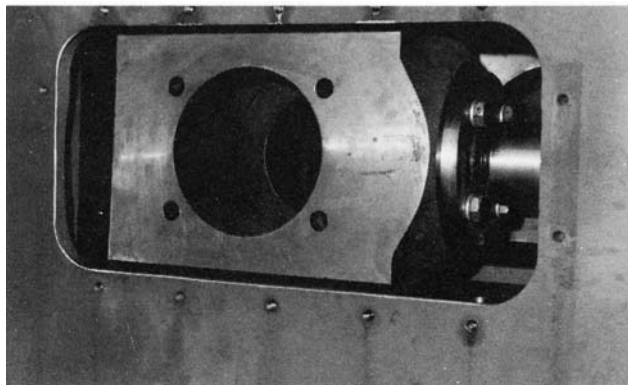


Figure 5-14 Crosshead Assembly

REMOVAL

1. Separate the connecting rods from the crossheads. (See crankshaft assembly) (Figure 5-15).
2. Remove piston, piston rod and lines. (See LINERS). Remove rod lubrication pipe (Figure 5-14).
3. Slide crosshead (with extension rod attached) forward to permit access to bolts securing extension rod to crosshead. (Figure 5-15,).
4. Remove extension rod from crosshead.
5. Slide crosshead out of crosshead guides.
6. Remove socket had cap screws (4) that secure each crosshead guide to the power frame (Figure 5-16).

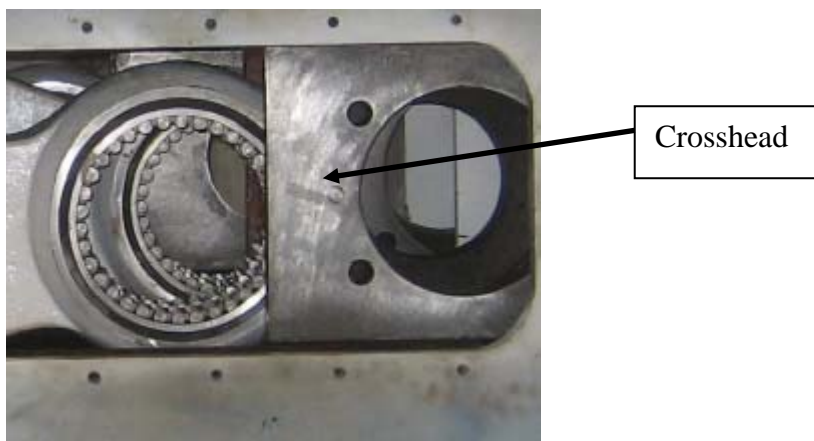


Figure 5-15 Crosshead

CAUTION

- DO NOT LET TOP CROSSHEAD GUIDES FALL.

INSTALLATION

1. Secure each crosshead guide to power frame with four socket head cap screws.

NOTE:

Make sure crosshead guides are in firm contact with power frame.

2. Lubricate the crosshead guides thoroughly with clean oil.
3. Slide crosshead into crosshead guides.
4. Attached extension rod to crosshead (5-15)
5. Align crosshead with connecting rod.

NOTE:

Do not interchange wrist pins during reassembly.

6. Install wrist pin retainers (with attached wrist pin) into crosshead and connecting rods.
7. Secure each wrist pin retainer with cap screws (Figure 5-5).
8. Install liner, piston and piston rod.
9. Install crosshead access plates with new gaskets.

STRIPPER BOX PACKING

The stripper box packing is the part of the crosshead assembly which seals around the extension rod as the pump strokes. The packing keeps the oil in the power end and prevents mud, water or other contaminants from entering the power end and contaminating the lubricating oil.

1. Replace the packing seals if the lubricating oil becomes contaminated or if excessive oil leaks from around the extension rod.
2. Refer to the Parts Manual for your pump for seal part numbers.
3. Install the seals.

PINION SHAFT ASSEMBLY

REMOVAL



Figure 5-16 Pinion Assembly

1. Remove the cap screws (4) from each pinion bearing housing (Figure 5-16, 5-17).
2. Remove oil lines to pinion bearing housing.
3. Remove bearing housings (with outer race and roller assembly) by pulling straight out. (Inner race will remain on pinion shaft).

NOTE:

Threaded holes are provided in the pinion bearing housing to aid removal.

4. Remove and discard oil seals.
5. Remove pinion shaft from pump frame.

NOTE:

If the crankshaft is in place it will be necessary to raise the pinion shaft slightly to clear it from the bull gear.

6. Remove the cap screws that secure the bearing retainer to the pinion bearing housing and remove the retainer.

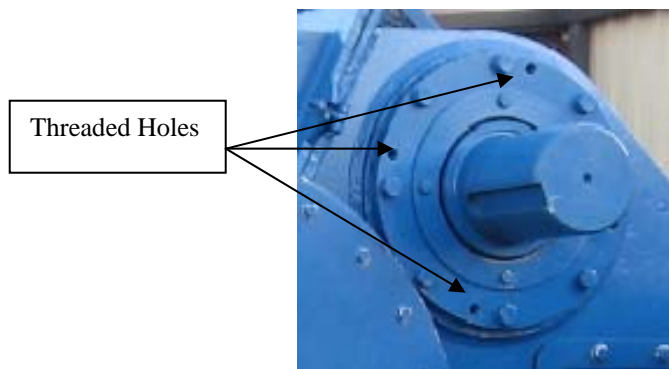


Fig. 5-17 Pinion bearing housing

7. Knock out space is provided in the pinion bearing housings. Use hammer and drift to remove the outer pinion bearing race and roller assembly from the housing.
8. To remove inner bearing race, heat and slide from pinion shaft.

INSTALLATION

NOTE:

It may be helpful to chill the outer bearing race and roller assembly before installing in housing.

1. Heat bearing housing and install inner race and roller assembly.
2. Attach bearing retainer to housing with cap screws.

NOTE:

Each bearing has an oil cup (attached to the retainer) which must be properly position during reassembly.

3. Install new oil seals in bearing housings.
4. Heat and install inner bearing races on pinion shaft.
5. Install pinion shaft in pump frame. Be sure pinion gear meshes with bull gear.
6. Install bearing housings (with assembled bearings) on each end of pinion shaft.
7. Secure bearing housings in place with cap screws.