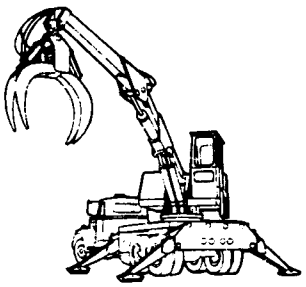
BARKO LOADERS



SERVICE MANUAL

MODEL 160A

Your new Barko loader has been built to work hard for you for a long time - but just how hard and just how long will be determined by your technique of operation and your efforts at proper care and maintenance.

However, before you can properly operate the loader or give it proper maintenance, you need to know something about its construction and the theory of its operation. In other words, as with any other piece of operating equipment, you should get to know your Barko loader well. We hope this manual will help you with this process of familiarization.

PLEASE NOTE: The information and illustrations in this manual have been approved as accurate at the time of printing. However, the manual may contain information on options not present on your loader. The right is reserved by Barko Hydraulics to make changes and improvements in its product at anytime without notice or obligation. This book is for instructional purposes only.

BARKO HYDRAULICS
PO BOX 6227 / DULUTH, MINNESOTA 55806

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I. INTRODUCTION

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WHAT IS HYDRAULIC POWER?

Simply said -- it is energy transmitted by a liquid in a confined system.

In today's hydraulic systems, the fluid is usually some form of oil; the pressure is provided by a pump; there are hoses or tubes for containing and transmitting the fluid under pressure, and hydraulic cylinders and fluid motors to convert the energy in the fluid into mechanical work. In addition, the system includes valves to control and direct the flow of fluid and limit the pressure, a reservoir to contain the supply of the fluid, and return lines to carry the fluid back to the reservoir after it has done its job. Below, is shown the basic components of a simple hydraulic system.

Translated to the actual operation of the Barko loader, all of this simply means that as you move the foot and hand controls in the operator's cab, you are regulating and directing the flow of liquid from the oil reservoir and the pump to either hydraulic cylinders, motors or other hydraulic components. Your foot and hand control levers are attached to valves which control, direct and limit the oil flow to the various working parts of the loader.

Because the direction and control of oil pressure and flow within the loader system is what makes the loader work for you, we will bear down rather heavily in this manual on the necessity of a smooth operating technique, of keeping the oil in the system clean and free of any dirt and debris, and of maintaining a leak-free system. These precautions observed at all times will ensure not only a trouble-free, productive operation -- but also safety on the job.

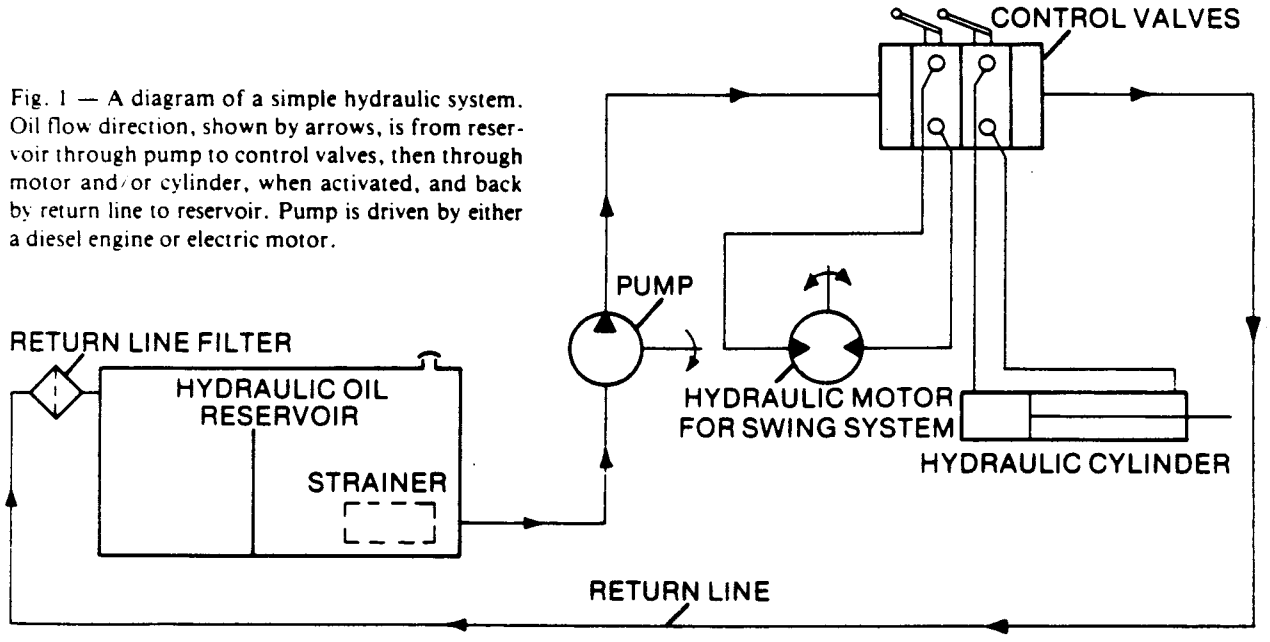
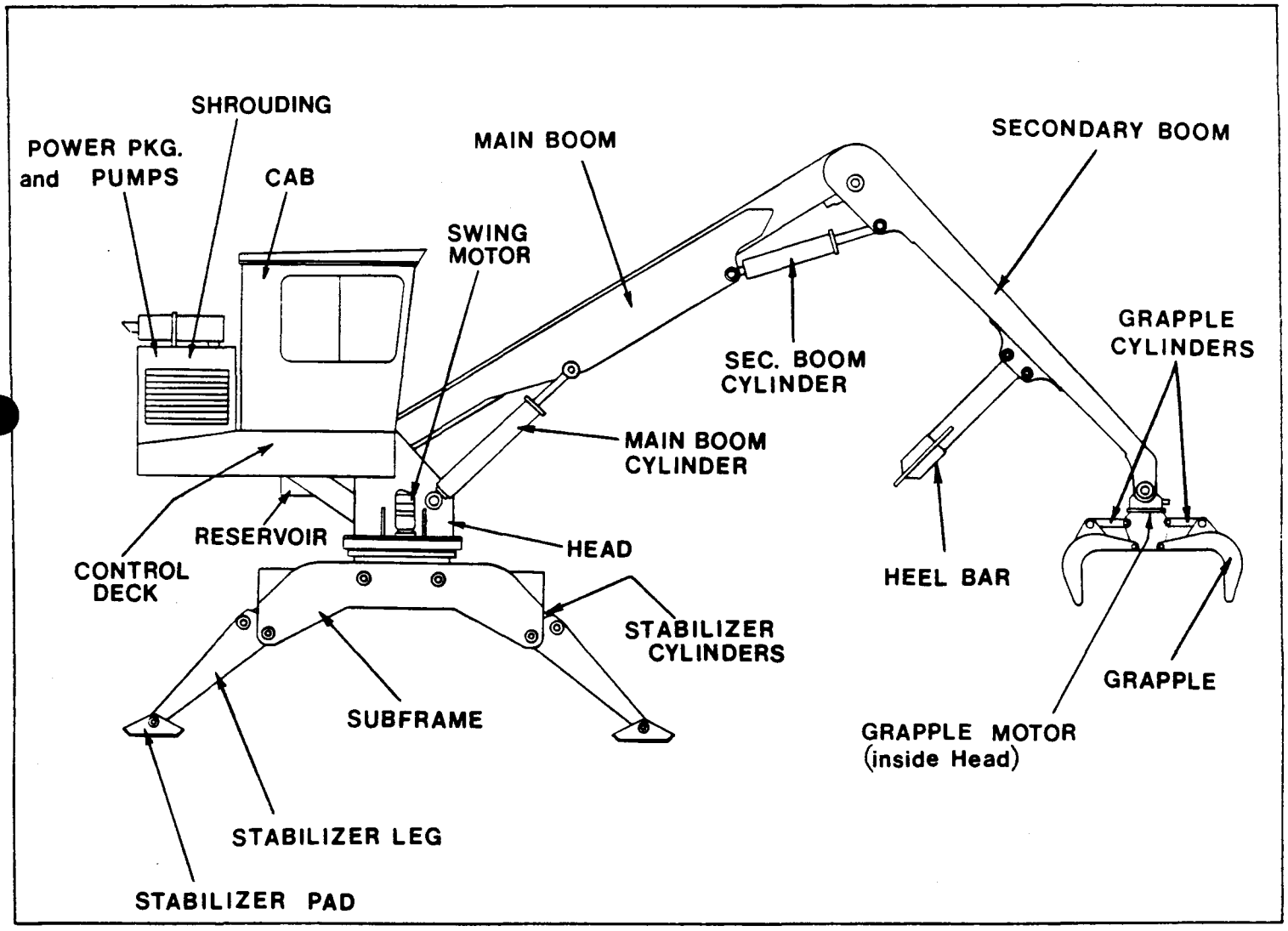


Fig. 1 — A diagram of a simple hydraulic system. Oil flow direction, shown by arrows, is from reservoir through pump to control valves, then through motor and/or cylinder, when activated, and back by return line to reservoir. Pump is driven by either a diesel engine or electric motor.

LOADER COMPONENT IDENTIFICATION

Use this diagram to identify your loader's components for future service reference:



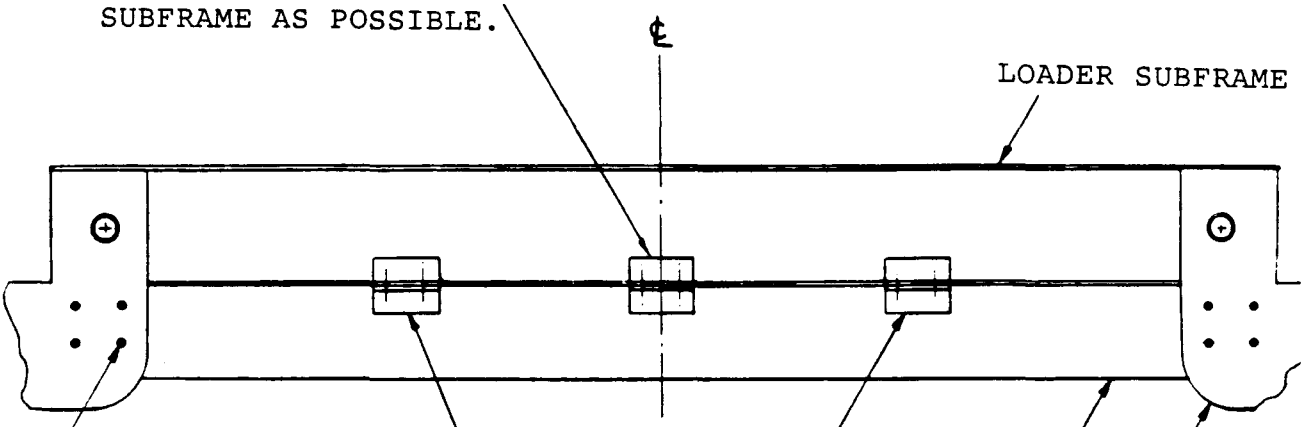
MOUNTING INSTRUCTIONS

(Subframe to Truck Frame)

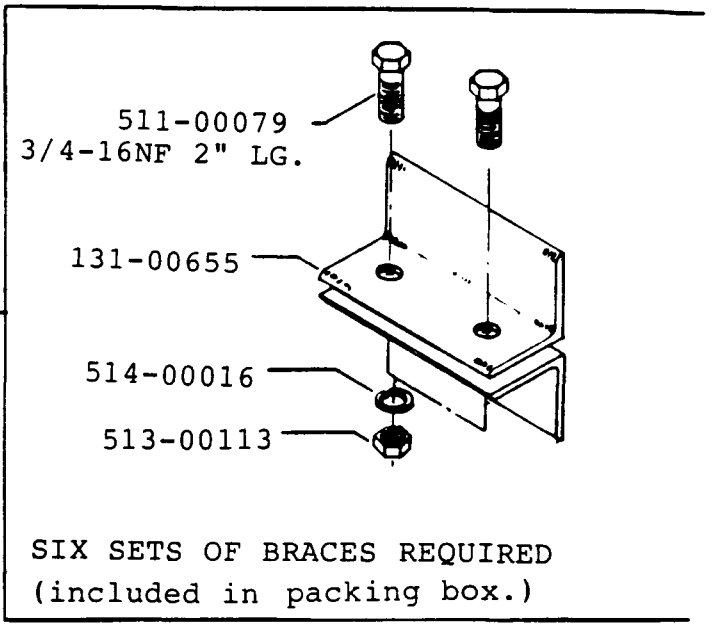
MODEL 160A

NOTE: BOLT OR WELD TO TRUCK FRAME, AS REQUIRED.

NOTE: THIS MOUNTING BRACE SHOULD BE MOUNTED AS CLOSE TO CENTER OF SUBFRAME AS POSSIBLE.



MOUNTING KIT 141-00100



SIX SETS OF BRACES REQUIRED (included in packing box.)

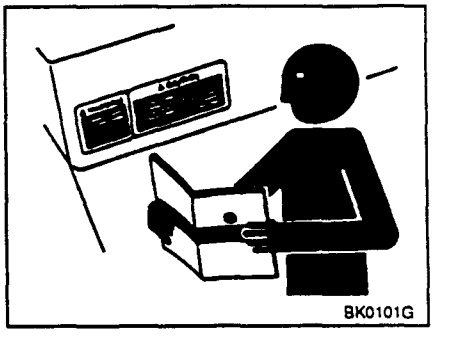
SAFETY SUMMARY

Failure to follow the safety precautions in this manual can result in personal injury or property damage. Observe the same precautions as with any other similar machinery where carelessness in operation or maintenance is hazardous to personnel. Carefully read the safety precautions below and within this manual.

⚠ DANGERS - Indicate immediate hazards which WILL result in severe personal injury or death.

⚠ WARNINGS - Indicate hazards or unsafe practices which could result in severe personal injury or death.

⚠ CAUTIONS - Indicate hazards or unsafe practices which could result in damage to the machine or minor personal injury.



OBSERVE SAFETY

⚠ DANGER

Never approach power lines with any part of the machine. Current in a high voltage line may arc some distance to jump from the wire to a nearby "ground." KEEP WELL CLEAR!

⚠ WARNING

Lifting heavy components incorrectly can cause severe injury or machine damage.

⚠ WARNING

Always lower the boom to the ground before leaving the cab. If necessary to work on a machine with lifted boom, securely support the machine or attachment.

⚠ WARNING

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

⚠ WARNING

Do not operate machine without lowering stabilizers.

⚠ WARNING

Allow only the operator on the machine. Keep riders off. Riders on machine are subject to injury such as being struck by foreign objects and being thrown off the machine. Riders also obstruct the operator's view, resulting in the machine being operated in an unsafe manner.

⚠ WARNING

Clear all persons from area of operation and machine movement.

⚠ WARNING

Never use a boom attachment for a work platform or personnel carrier.

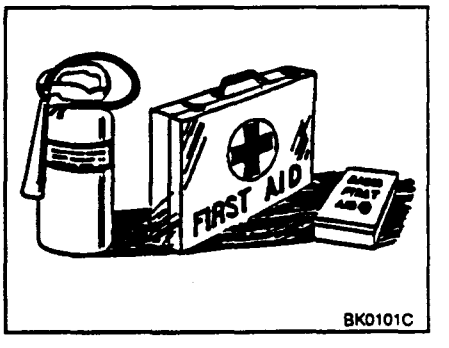
⚠ WARNING

Never move loads over the heads of other persons.

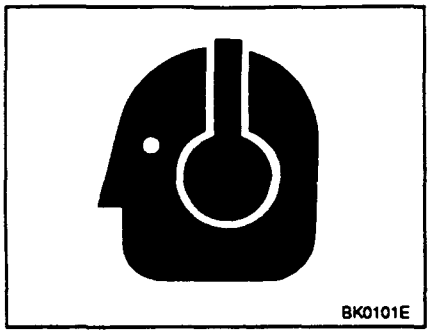
⚠ WARNING

Do not jump off from the machine.

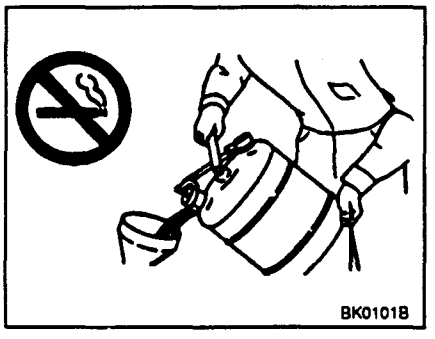
NO RIDERS



HAVE SAFETY EQUIPMENT



USE HEARING PROTECTION



NO SMOKING

AVOID ESCAPING FLUID

⚠ WARNING

Under no circumstances should any modifications be made to Barko machinery without factory authorization. Any modifications may void the warranty. This machine was designed to do a specific job and alterations could result in injury to operator or machine.

⚠ WARNING

Handle fuel carefully. If the engine is hot or running, do not fill the fuel tank. Do not smoke while filling fuel tank or working on fuel system.

⚠ CAUTION

Stop the machine if voltmeter exceeds normal operating limit to prevent damage to the electrical components.

⚠ CAUTION

Stop the machine immediately if the engine oil pressure is too low. Low engine oil pressure could result in damage to the machine.

⚠ CAUTION

Stop the engine immediately if water temperature exceeds normal operating limit to prevent damage to the engine from overheating.

⚠ CAUTION

Wear close-fitting clothing and safety equipment appropriate to the job.

⚠ CAUTION

Prolonged exposure to loud noise can cause impairment or loss of hearing. Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

⚠ WARNING

Before servicing or shutting down the machine:

- Lower the boom to the ground.
- Stop the engine.

⚠ WARNING

Escaping fluid under pressure can penetrate the skin, causing serious injury. Relieve pressure before unhooking hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard to search for leaks.

⚠ WARNING

If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result.

⚠ CAUTION

If loader is not functioning properly, shut machine down and follow proper repair procedures.

⚠ CAUTION

Make sure that all walking and climbing surfaces of the machine are free of dirt, debris, water, grease, oil, ice and snow. Don't leave loose tools and rags on the machine.

⚠ CAUTION

Wear shoes with some kind of nonslip soles and hard toe protection.

⚠ CAUTION

Always use both hands when climbing on or off the machine.

⚠ WARNING

Do not tamper with any hydraulic line or component while it is pressurized.

⚠ WARNING

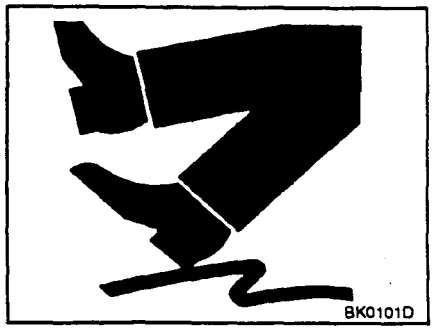
Mechanically connected controls will cause movement of components at all times - even if the pump or engine is not operating. Always be certain that the boom and grapple are properly supported or resting on firm ground before stopping the engine, to minimize the chance of accidental movements of components and injury.

⚠ WARNING

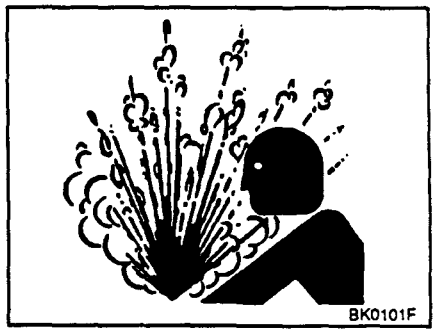
Do not weld on any structural member unless specifically authorized by Barko Hydraulics. Any unauthorized welding or welding procedures will void the warranty, and may cause structural failure.

⚠ CAUTION

Remove or secure all personal or maintenance items such as lunch buckets, chains, shovels, etc. before moving or operating the machine.



WEAR NON-SLIP SOLES



UNDER PRESSURE

MODEL 160A

⚠ WARNING

MAXIMUM HYDRAULIC PRESSURE FOR THIS MACHINE IS 2,000 psi. SETTINGS HIGHER THAN THIS MAY RESULT IN HARM TO PERSONS AND PROPERTY.

BARKO HYDRAULICS

In many instances, we have learned that the hydraulic relief valves of this equipment have been reset, increasing the maximum system pressure, and with it, the load the unit will lift before the relief valve opens. In some instances, the consequences of increasing this setting have been serious. The function of the relief valve is to provide a fuse action to protect the machine and the operator from overloading. When overloaded, different portions of the machine can become stressed to a level where parts fracture and serious physical damage to the equipment and personnel can result. **This is an extremely dangerous practice.**

Accordingly, you are advised that the setting of this valve is limited to a maximum of **2,000 psi.** Pressure settings in excess of this level render each and all Barko warranties null and void and constitute an obvious misuse and abuse of our product.

NOTE: 2000 psi IS THE SYSTEM PRESSURE. GRAPPLE PRESSURE SETTINGS MAY BE LOWER, AND MUST BE NOTED.

II. MAINTENANCE

PREVENTIVE MAINTENANCE

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Special New Machine Instructions 2-1

Service Schedule 2-2

Lubrication Diagram 2-3

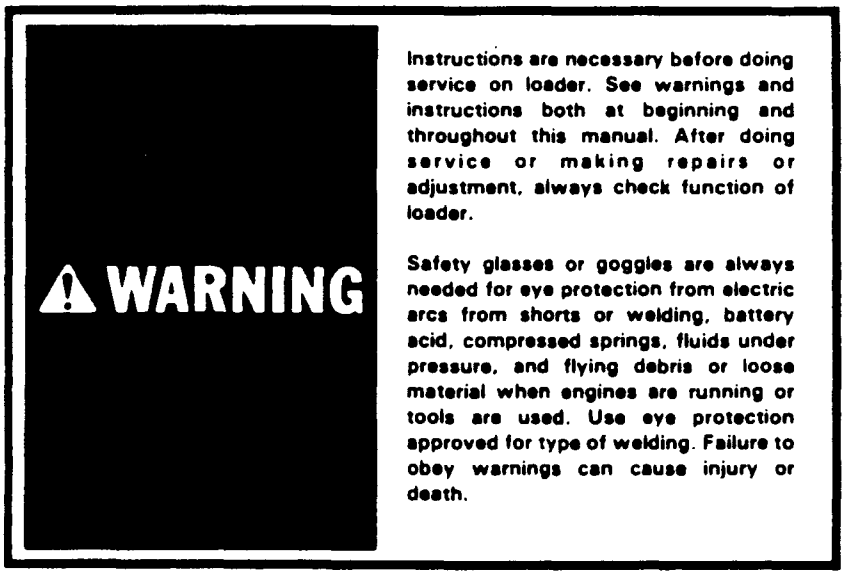
Cold Weather Start-up 2-5

PREVENTIVE MAINTENANCE

Preventive maintenance is really just a simple matter of common sense. If you keep any piece of mechanical equipment clean and properly lubricated, and promptly replace any worn or damaged parts, you are going to "prevent" deterioration and promote long life and safe, productive service. The only other requisite to such a program is the regular scheduling of such maintenance.

Obviously, when you are operating under severe job conditions, such as a dusty job site, in extreme heat or cold, a long operating day, or extremely heavy loads, the recommended intervals in the schedule should be shortened.

The suggested schedule on the following page is designed to be just a reminder of what should be done. For detailed instructions on each item, consult the Table of Contents for where each is located in this manual.



SPECIAL NEW MACHINE INSTRUCTIONS

A new machine needs a special maintenance procedure after the first 50 hours of operation. In addition to an overall inspection of the loader, the torque of the turntable mounting bolts and pin nuts of the boom and grapple should be checked and retorqued, if necessary. Also, hydraulic filter elements should be changed and inspected. If excessive dirt is found, the hydraulic reservoir should be drained, cleaned and refilled.

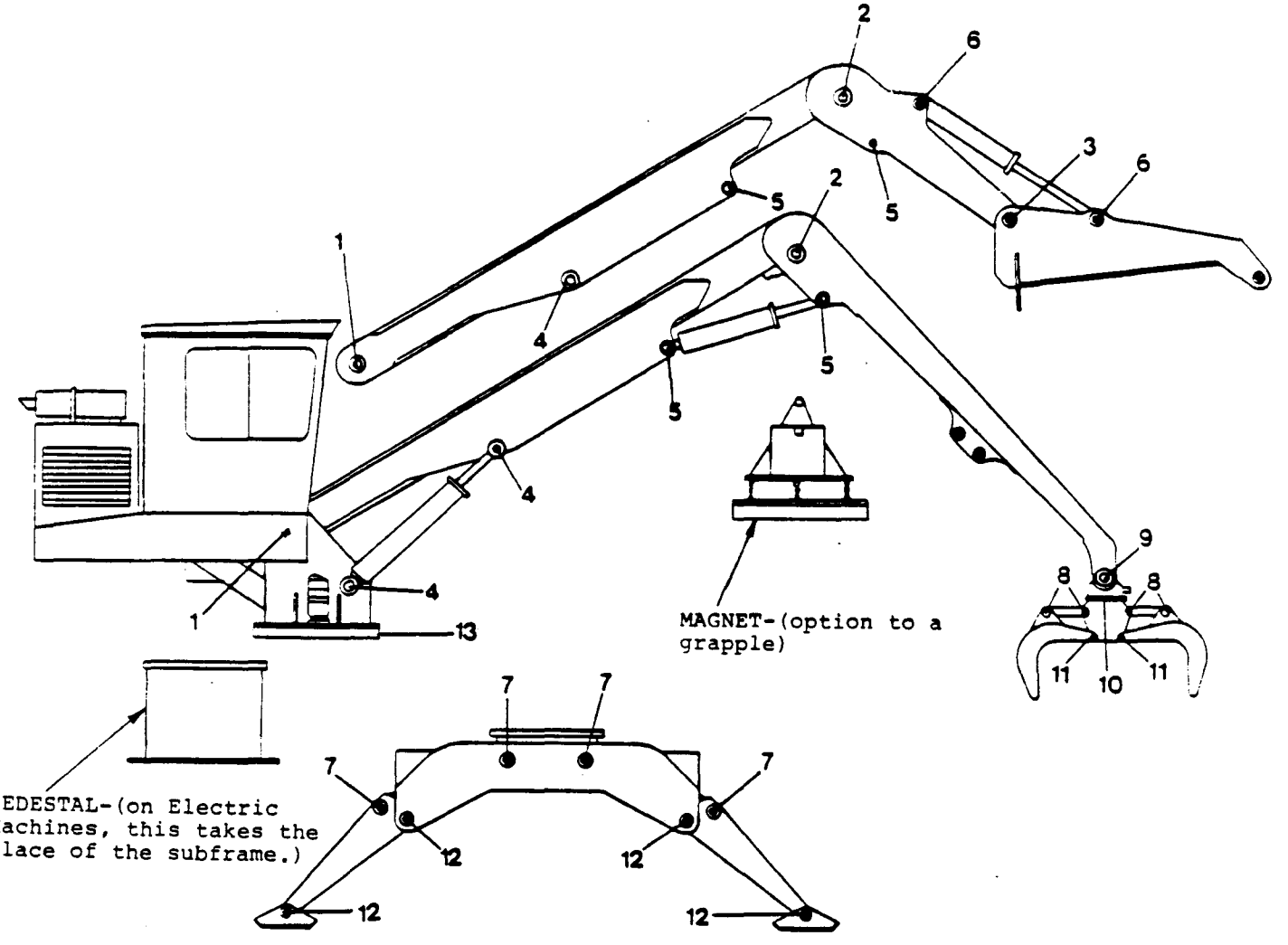
SERVICE SCHEDULE:

This Service Schedule is a guide for correct maintenance of the loader, that must be done regularly. Always use these service intervals unless very hot, cold, dusty, or corrosive operating conditions make it necessary to increase the frequency of service. Failure to do so will cause damage to the machine or the engine.

ITEM	SERVICE REQUIRED	HOURS				
		8	50	100	400	1000
Hydraulic Oil Reservoir	Check level & quality of oil.	■				
Diesel Fuel Tank	Check level and fill, if necessary.	■				
Engine Crankcase Oil	Check level.	■				
Engine Radiator	Check coolant level, and inspect exterior for dirt, leaves, bugs, etc.	■				
Hoses, Connections, Cylinders	Inspect for oil and water leaks and damage.	■				
Fan & Drive Belts	Check for looseness and wear.	■				
Vehicle Tires	Check for proper pressure.	■				
Operator's Deck	Clean off debris, tools, rags, water, ice and snow.	■				
Boom, Grapple, Stabilizer Fittings	Lubricate all fittings with multi-purpose grease. See Lubrication Diagram.	■				
Turntable Bearings	Lubricate per instructions on Lubrication Diagram.	■				
Hydraulic Oil Tank Breather	Clean with fuel oil or nonflammable solvent.		■			
Nuts and Bolts	Inspect for tightness and/or damage on boom, grapple, turntable, and mounting nuts and bolts.		■			
Engine Air Filter	Service as per instructions in Power Package Maint.		■			
Control Linkage	Lubricate per instructions on Lubrication Diagram.		■			
Turntable Bolts	Check torque, and retorque if necessary. See Torque Specifications.			■		
Hydraulic Oil Cooler	Inspect and clean cooler fins.			■		
Hydraulic Oil Collector	Check tightness of attaching bolts.			■		
* Hydraulic Oil Filters	Check condition and change. See note below.		*		■	
Hydraulic Reservoir	Drain old oil, clean tank and suction screens, and refill with new oil.					■
Entire Loader	Steam clean, and check for stress and wear signs, cracks,damage and looseness.					■
Pump Drive	Check fluid level. Change fluid using 80-90 gear lube every 400 hours.				■	

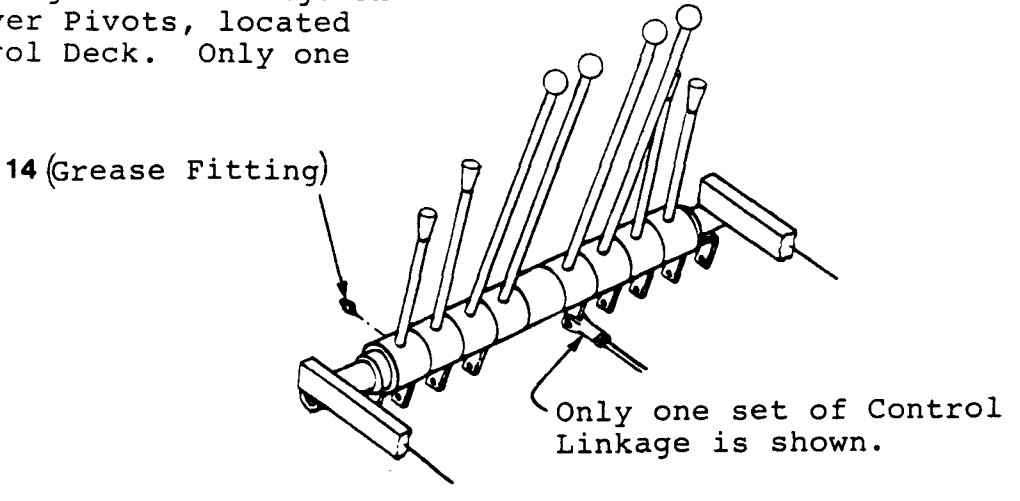
* on new machines the initial change must be done at 50 hours; and at 400 hours thereafter.

LUBRICATION DIAGRAM:



CONTROL LEVER LUBRICATION

There are 9 grease fittings on the Control Lever Pivots, located below the Control Deck. Only one is shown.



Ref. No.	Lubrication Point	Type of Lubricant	Interval
1	Main Boom Pivot	Items 1 to 12 use a multi-purpose grease. Apply with pressure gun until grease is visible at ends of bushings.	8 Hours Daily
2	Secondary Boom Pivot	"	"
3	Live Heel Boom Pivot (If Applicable)	"	"
4	Main Boom Cylinder	"	"
5	Secondary Boom Cylinder	"	"
6	Live Heel Boom Cylinder (If Applicable)	"	"
7	Stabilizer Cylinder (If Applicable)	"	"
8	Grapple Cylinder	"	"
9	Grapple Hanger	"	"
10	Grapple Head	"	"
11	Grapple Arms	"	"
12	Stabilizer Legs	"	"
13	Bearings and Pinion Gear	For a general lubrication use a lithium base grease with E.P. additives and rust inhibitors. Above 32°F-#2 grease: below 32°F-#1 grease. See Turntable Bearing Maintenance in Structural Section.	8 Hours Daily
	Hydraulic Pump Drive (not shown)	See Service Schedule	
14	Control Handle Pivot (grease fittings) - located below control deck.	Multi-purpose grease	24 Hours or Twice Weekly

COLD WEATHER START-UP:

In cold weather, special precautions must be taken to ensure that the hydraulic oil supply is warmed up enough for proper circulation before the loader is put to work. A disconnect clutch is recommended.

The following method may be used to warm the oil:

1. Jog Pump with Disconnect Clutch: on 5 seconds off 20 seconds (ten times) then on 20 seconds off 20 (about 5 times). Idle system a few minutes.

2. Run pump at 1/2 speed (about 800 to 1000 engine RPM) and fully extend cylinder, thus blowing oil through the pressure relief valve. Relieve pressure 10 seconds of each minute.

3. Oil passing thru the relief valve does no useful work and picks up 8-1/2 degrees of warmth per 1000 pounds of pressure drop.

For prolonged service in sub zero temperatures, consult factory.

HYDRAULIC SYSTEM

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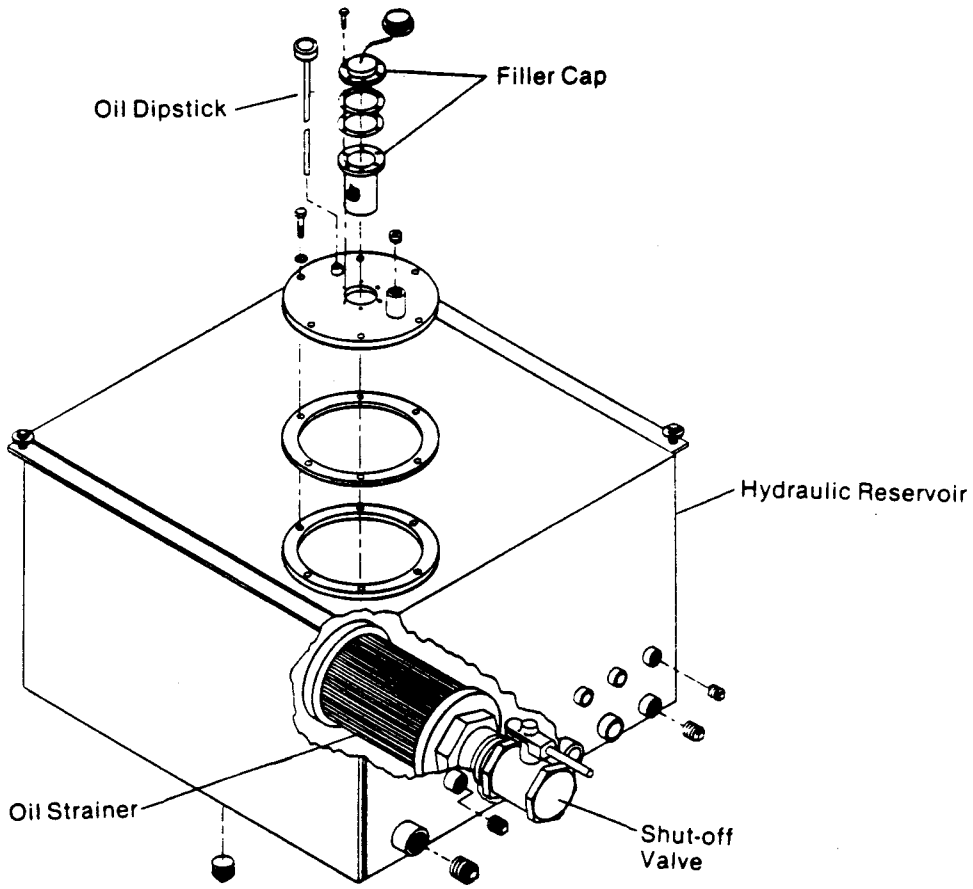
Hydraulic Pump Maintenance 3-25
Swing Motor Maintenance 3-71

The power source for your loader is the hydraulic system. It consists of: a hydraulic oil reservoir, a diesel engine, oil pumps, control valves, hose network, oil collector, hydraulic cylinders for booms, attachment, and stabilizers, and swing motor(s) for rotation.

HYDRAULIC OIL RESERVOIR MAINTENANCE:

The supply source for the hydraulic system, the oil reservoir, is located on the control deck to the left of the operator's cab. The reservoir features return line filters and suction screens to keep the oil clean. Filters are cleanable, and/or replaceable. A dipstick for checking oil quantity is located near the filling spout.



⚠ WARNING

Diesel fuel or hydraulic fluid under pressure can penetrate the skin or eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks but do not use bare hand. Wear safety goggles. If fluid enters skin or eyes, get immediate medical attention.

Check oil level in reservoir before each period of operation, or daily. If, at any time, you find the level is low, check the loader for leaks around tubes, hoses, fittings, and couplings.

HYDRAULIC OIL CHANGING PROCEDURE

This procedure should be used once during the breaking in period of a new loader (after one week, or 50 hours of operation) and then every six months, or 1000 hours.

Throughout the oil changing procedure remember that cleanliness is absolutely necessary. Hands, tools, funnels, oil filling equipment, the oil filler opening and, above all, the hydraulic oil itself must be kept absolutely clean. Dirt in the hydraulic system can cause serious damage to pumps, valves, and cylinders.

DRAINING THE RESERVOIR

1. First, raise main boom and extend secondary boom to their limits, and then turn off the engine.

2. Remove the reservoir drain plug to drain oil.

3. After the tank has drained, lower main and secondary booms gradually to force oil out of cylinders. DO NOT START ENGINE.

CLEANING THE RESERVOIR

1. Clean the area around the inspection cover on tank, and then remove the cover.

2. Remove suction strainer from inside reservoir. Clean it with a solvent.

3. Remove all dirt and sediment from inside the reservoir.

4. Clean the oil filler screen and check for damage. If damaged, replace screen.

5. After everything in and around reservoir is completely clean, replace suction strainer, drain plug and inspection cover.

FILLING THE RESERVOIR

1. With drain plug in place and tightened, refill the tank with recommended oil. Be sure filler opening screen is in place and clean.

2. Start engine, running it slowly until the new oil circulates throughout system.

3. With all control valves in neutral, run engine until the pump quiets down, then add more oil, if needed.

4. As an operator works the main and secondary booms, grapple and stabilizers, add more oil as needed to maintain proper level in reservoir. This will work the air out of the system and prevent cavitation, which is caused by air bubbles in the oil as it passes through a pump.

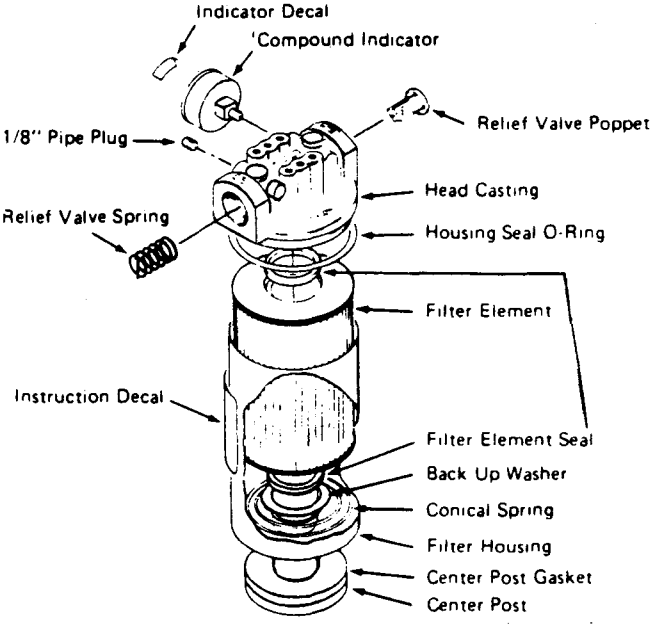
5. Check oil level again after the loader has been operating for anhour or two.

HYDRAULIC OIL FILTER MAINTENANCE:

HYDRAULIC OIL FILTERS

The hydraulic oil filters are mounted in the vicinity of the reservoir. They are similar in construction except for the Relief Valve Spring. (See NOTE on following page). Each contains a replaceable filter element and a filter condition indicator, or gauge.

On the Barko 160A, there are two return line filters (33 micron), and one suction line filter (10 micron). See parts manual for part numbers and parts breakdown.



HOW TO CHANGE ELEMENTS ON RETURN LINE FILTERS

Order for Disassembly

1. Unscrew and drop the Center Post.

2. Now remove the Filter Housing, Back-up Washer, Gasket, and Element

3. Clean all parts and filter housing. CAUTION: Do NOT use solutions like perchlorethylene or trichlorethylene as they tend to cause swelling of the cork gaskets, which could result in malfunction of the filter when reassembled.

Reassembly order

1. Put the Center Post in Filter Housing, making sure that the Gasket Seal is in place. Also, be sure that the Gasket, bottom of the Filter Housing, and the flange of the Center Post are completely free of oil and grease. This will prevent unwanted extrusion of the Gasket.

2. Now insert Conical Spring, small coil end down.

3. Now insert the 4-1/4" Back-up Washer (bottom).

4. Next insert the Bottom Gasket.

5. Now, install the new Filter Element, followed by the Top Gasket and the top Back-up Washer.

6. Position the Filter Housing and tighten the Center Post to a maximum of 20 Ft. Lbs. of torque.
CAUTION: When tightening Center Post, hold the can to keep from turning otherwise the O-Ring may stretch out of shape and a leak may occur.

7. Check to be sure that the indicator gauge reads "0" when system is not in operation.

IMPORTANT

When making repairs on hydraulic system, keep all parts clean and remove all dirt from the area before you begin disassembly. Use caps and plugs to keep dirt out of tubelines and openings.

The filter elements should be changed each time the hydraulic reservoir is drained and refilled (every 1000 hours) and the elements should be removed and changed as shown by the Service Schedule.

DO NOT REUSE FILTER ELEMENTS!

INSTRUCTIONS TO REPLACE RELIEF VALVE SPRING:

Tools Required:

One (1) 1/2" Allen Wrench

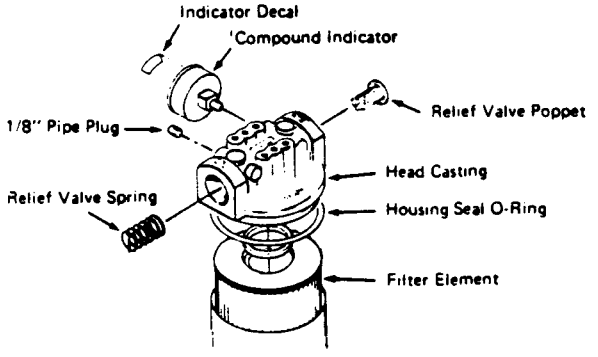
One (1) Spring Replacement Tool, made as follows:

A. Cut a section of 1-1/8" O.D., 1" I.D. by 4" long electric conduit or equal.

B. Cut 2 notches 1/8" wide by 1/8" deep.

Replacement:

1. Insert Allen Wrench through outlet port and into Relief Poppet to hold Poppet in place.



2. Place notches of Spring Replacement Tool over Spring. Depress Spring and turn clockwise.

3. Remove Spring and Poppet.

4. Install new Spring.

NOTE: The 5 PSI Spring is standard for suction line applications. The 15 PSI Spring is standard for return line applications.

CAUTION: When replacing Poppet and Spring, make sure that Poppet is always installed from the outlet side of the Filter Head and the Spring from the inlet side.

When Filter is installed in "Suction Line", ahead of pump, some allowable restriction is created. As dirt or foreign matter is collected in Filter, increased suction is required. This may cause starvation of cavitation of pump prior to the opening of Filter Relief Valve, which is normally set at 10" Hg (5 PSI Spring).

HYDRAULIC FLUID MAINTENANCE:

Hardworking equipment such as your Barko loader requires careful operation and regular maintenance if you want it to continue to work hard for a long time.

Just as important is the selection of lubricants to be used in the maintenance procedure. This includes the hydraulic oil that goes into the reservoir and the grease that lubricates all moving parts.

The hydraulic fluid used in your loader will have to be tough enough to provide peak pressure and instant power through many hours of constant operation. It has to be ready to go on cold winter mornings and not let you down on hot summer afternoons.

Because of the wide variety of oils available we will not recommend oil by brand name. However, the following list of features to look for in an oil should help you in ordering the right oil from your supplier, or, contact your Barko dealer for his advice. The hydraulic oil for your loader should feature:

1. Rust resistant additives to prevent rust formation from moisture condensation.
2. Anti-foam agents to break up air bubbles and prevent "foaming" that causes sluggish and erratic operation.
3. High stability to resist oxidation and prevent varnish formation and deposits that foul systems.
4. Anti-wear properties to prevent scuffing and excessive wear at high speeds and high pressure operation.
5. Good viscosity index for easy flow at low temperatures without thinning out at high temperatures after hours of use.

For operation in different outside temperatures, please use the following chart for selection of your hydraulic oil.

ISO VISCOSITY GRADE	AVERAGE AMBIENT TEMP.	SYSTEM OPERATING TEMP.
46	32°F TO 45°F	150°F MAX.
68	ABOVE 45°F	190°F MAX.

BELOW 32°F AMBIENT, CONSULT FACTORY.

⚠ WARNING

Diesel fuel or hydraulic fluid under pressure can penetrate the skin or eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks but do not use bare hand. Wear safety goggles. If fluid enters skin or eyes, get immediate medical attention.

ELIMINATING AIR FROM THE SYSTEM

All hydraulic fluid contains some dissolved air, usually about 10% by volume. Under increased pressure, the fluid will absorb much more air. Aeration in a hydraulic circuit is the presence of free air in places where there ought to be only fluid. Usually the air will be in the form of bubbles dispersed through the fluid.

Difficulties with aeration will occur more frequently as flow velocities increase in hydraulic components. This bulletin covers some of the causes of air being introduced into a system and the suggested practices to effectively reduce and eliminate this problem.

CAUSES

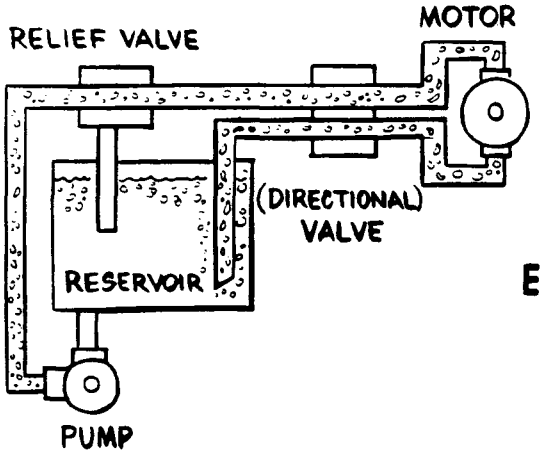
The most common places for air to be introduced into a hydraulic system or for aeration to occur are listed below:

1. Damaged inlet line; loose or defective fittings or seals at any component.

2. Damaged return line; loose or defective fittings or seals at any component.

3. Damaged or worn cylinder rod, packing or seals.

4. Cracked junction blocks, tees or piping.



ELIMINATING AIR FROM THE SYSTEM

NOTE: Because fluid acts as a sealant at atmospheric pressure, when system drops below atmospheric pressure air may be drawn in where fluid will not necessarily leak out.

5. Fluid level too low. This can cause vortexing at pump inlet in reservoir, thus drawing in air.

6. Air trapped in filter with no means of bleed off.

7. Return fluid discharged above fluid level in reservoir. Poor baffling in the reservoir can also cause turbulence and resultant introduction of air.

8. Air trapped in system during original filling, or when adding fluid for makeup.

DAMAGE TO SYSTEM

The conditions listed in the previous paragraph all contribute to inducing air into a hydraulic system or what is commonly known as aeration. Excessive aeration can cause pump damage, resulting in immediate failure to contribution to later failures. The two causes of damage to components by aeration is lack of lubricity and overheating. In addition, aeration can cause jerky and uneven movement in pumps or motors which, in combination with the causes previously mentioned, will cause failure.

Loss of lubricity in a hydraulic component will eventually result in seizure and subsequent pump failure. Overheating is caused by a breakdown of hydraulic fluid as a result of oxidation. Oxidation of fluid leads to sludging and varnish formation. Operating a system with aeration can oxidize the whole charge of fluid and eventually sludge and varnish will cause the motor or pump to overheat excessively and cause failure.

HOW TO AVOID AERATION

Regular inspection and regular maintenance are the best ways to prevent air from being introduced into a hydraulic system. Keeping all connections and fittings tight is the easiest way to avoid the introduction of air.

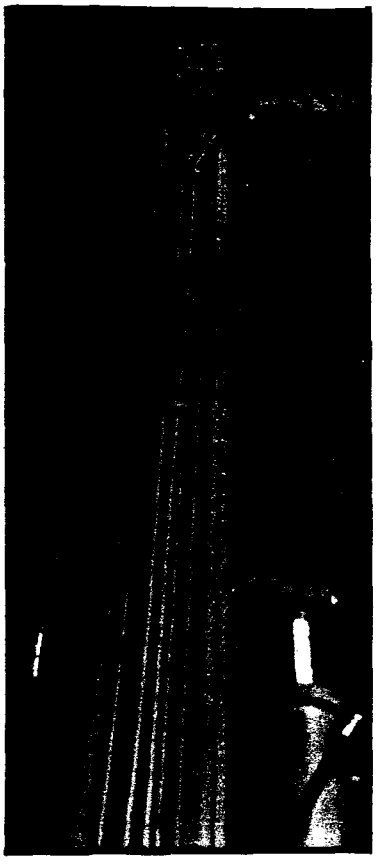
Return fluid entering the reservoir will create aeration if it is discharged above the main body of the fluid in the tank. To prevent this condition, maintain sufficient fluid in the tank to keep the return line submerged. The pump intake line should always be below the fluid surface for the same reason.

In starting a new system, or after a system has been completely drained and flushed, a tendency for the fluid to aerate may exist until all air is purged from all line and components. To correct this condition, a thorough purging of the entire system should be performed.

If air is being trapped in the reservoir filter, a bleed device should be installed in the top of the filter or inlet air breather.

In general, there is a great deal more service life built into hydraulic equipment than is now realized in many cases. Improved service life depends on maintaining proper conditions within the system.

HYDRAULIC HOSE & FITTINGS AND TUBING NETWORK:



A heavy-wall tubing and multi-wire hose network carries the hydraulic oil from the reservoir to the pumps and valves and then to cylinders and motors and finally back to the reservoir. Operating pressure of the hydraulic system varies from model to model. For your loader, consult the specifications page in this manual.

Replace any tubelines which are bent or have become flat. There will be a restriction of fluid flow which will make hydraulic action slow and cause heat. Replace hoses which show signs of wear, damage or weather-cracked rubber.

IMPORTANT

When making repairs on hydraulic system, keep all parts clean and remove all dirt from the area before you begin disassembly. Use caps and plugs to keep dirt out of tubelines and openings.

PIPE THREAD SEALER

The main causes of air being introduced into a hydraulic system are loose connections and fittings. This not only creates aeration in the fluid but also provides the risk of contamination entering the fluid and components with the air. The easiest way to effectively reduce and possibly eliminate this problem is to use an adequate pipe thread sealer at all connections and fittings.

While other pipe thread sealers may meet specifications, the methods which Barko uses are Teflon tape, and Locktite Teflon Thread Sealer.

The sealer will form a flexible, non-hardening seal that can be easily broken at any time without stripping the threads or damaging the pipes or fittings. It will also provide a non-shrinking bond that will inhibit rust or corrosion in the threads and will not gall, seize, or block the threads.

APPLICATION

The pipe thread sealer is intended for use on threaded steel pipe in fixed installations. It can be easily applied by the tube it comes in. This sealer is intended for use with petroleum fluids only. Apply sealer sparingly and leave the first two threads near the end of the pipe or fitting bare.

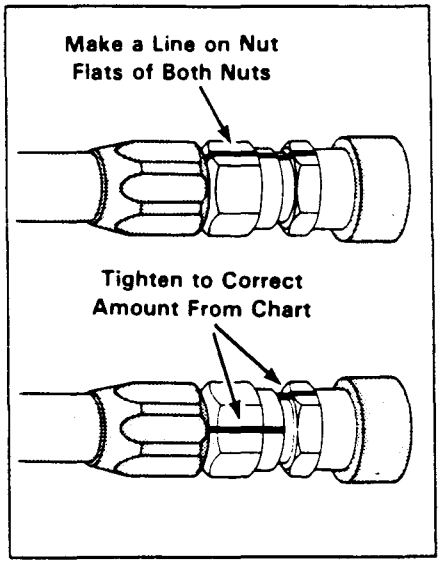
Barko recommends the use of pipe thread sealer on all exterior pipe plug threads and pipe fittings.

TIGHTENING HYDRAULIC FITTINGS

Use the following procedure to tighten the flare fittings:

1. Tighten the nut until it makes contact with the seat.

2. Make a mark across the "flats" of both the male and female parts of the connection. See illustration.



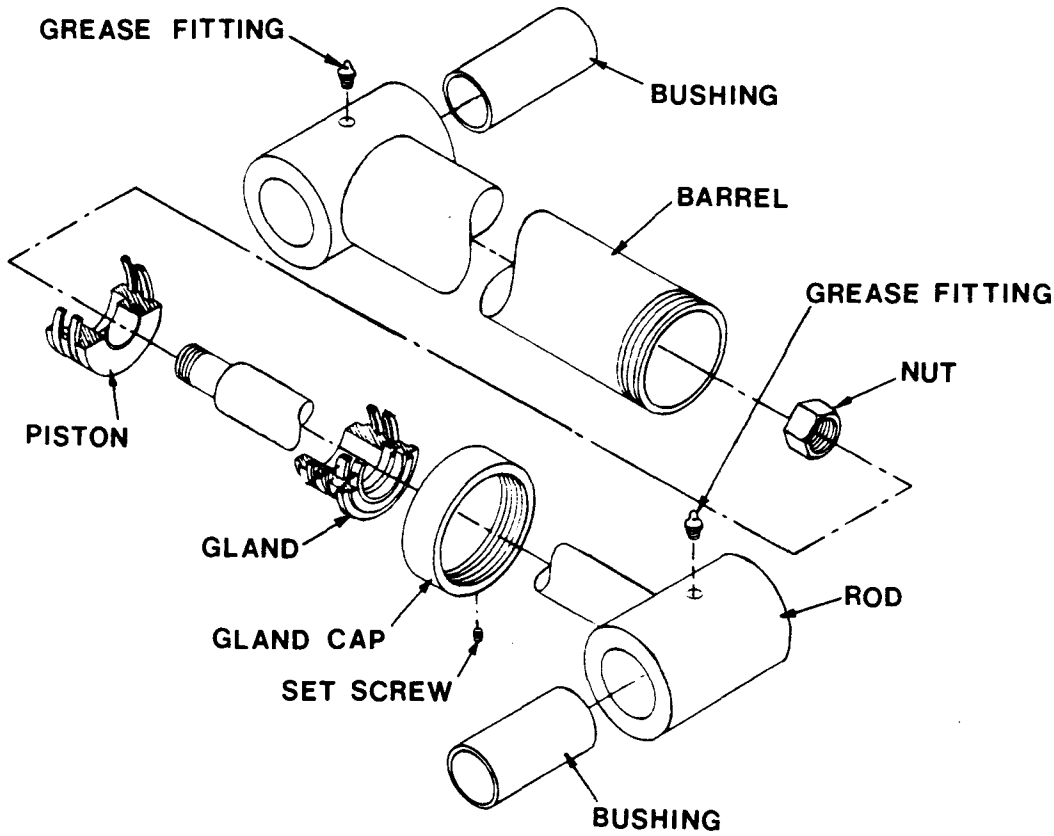
3. Use the chart below to find the correct tightness.

Wrench Size	Tube Size (OD)	Fitting Thread Size	Rotate No. Of Hex Flats
5/8"	5/16"	1/2 – 20	2-1/2
11/16"	3/8"	9/16 – 18	2
7/8"	1/2"	3/4 – 16	2
1"	5/8"	7/8 – 14	1-1/2 – 2
1-1/4"	3/4"	1-1/16 – 12	1
1-3/8"	1"	1-5/16 – 12	3/4 – 1
2"	1-1/4"	1-5/8 – 12	3/4 – 1
2-1/4"	1-1/2"	1-7/8 – 12	1/2 – 3/4

If the fitting leaks after tightening, disconnect it and inspect the seat area for damage. Replace as needed.

HYDRAULIC CYLINDERS:

The "business-end" of the loader's hydraulic system -- the part that does all the work -- is the hydraulic cylinder. Cylinders move the main boom, the secondary boom, and in loaders so equipped, the live heel boom. They also provide the force for the attachments and stabilizers.

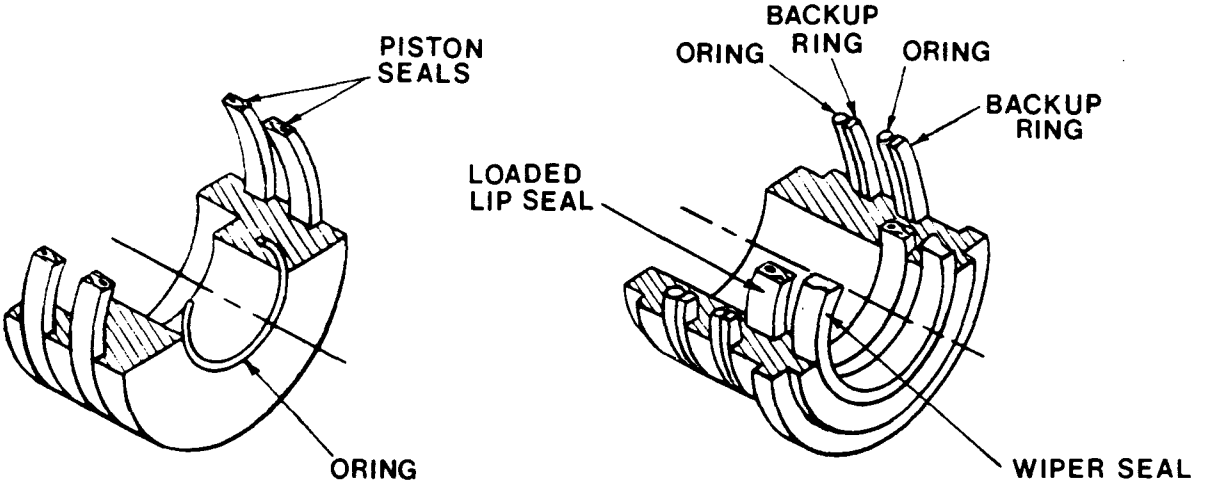


* Lubricate cylinder grease fittings as per Lubrication Diagram.

SEAL SERVICING

1. Remove cylinder from machine.
2. Remove gland cap using an adjustable chain wrench. Gland cap is held in place with an allen-head set screw.
3. Remove rod assembly from the cylinder barrel.
4. Unscrew nut from piston end of rod and remove piston.

5. Before removing the old seals, note the position they are in, for proper reassembly.



PISTON GLAND

6. Clean and inspect all parts. If worn or damaged, replace them.

7. Install new seals.

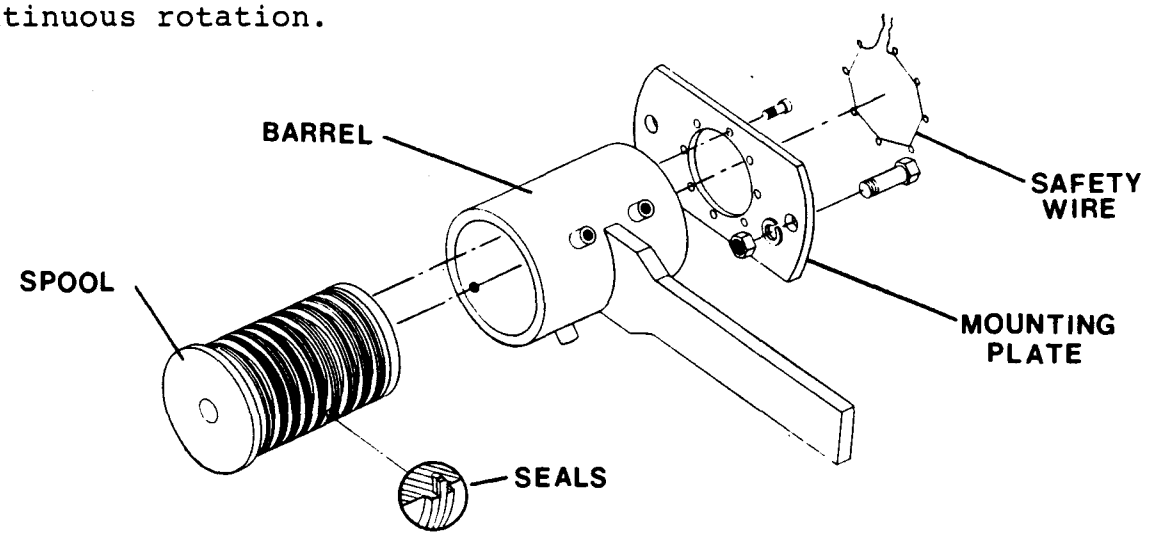
8. Oil new seals lightly before installing the rod assembly in the cylinder barrel.

9. Reinstall gland cap, and then reinstall cylinder on machine.

Separate seal kits for both Piston, and Gland, can be ordered through your Barko dealer. A complete cylinder seal kit is also available. See parts manual for proper part numbers and complete parts breakdown.

HYDRAULIC COLLECTOR:

All hydraulic components below the turntable bearing continue to be operable during rotation of the upper because of the hydraulic collector. Located on the rotating turntable assembly, the collector is so designed as to allow the flow of hydraulic oil to the cylinders at all points in the turntable rotation. On most stationary electric models the hydraulic collector is replaced by an electric collector that feeds the power to the upper to run the electric motors and still allow for continuous rotation.



SERVICING

When the seals inside the collector wear out, a new seal kit must be purchased from your Barko dealer. (Seal Kit numbers are in the Parts Manual on the Collector illustration/parts list.) The port numbers are stamped into the collector for easy reference.

HYDRAULIC COLLECTOR SEAL KIT INSTRUCTIONS

DISASSEMBLY:

- Remove safety wire and bolts from spool retaining plate and other parts as required.
- Remove spool from barrel using proper driving equipment, being careful not to damage seal lands or polished I.D. of barrel.
- Remove seals from spool by cutting with sharp knife, being careful not to damage spool lands.

CLEAN AND INSPECT:

- Barrel with grooves worn deeper than .007 is no longer safely usable.
- Spool with lands worn on O.D. more than .004 below standard is no longer safely usable.

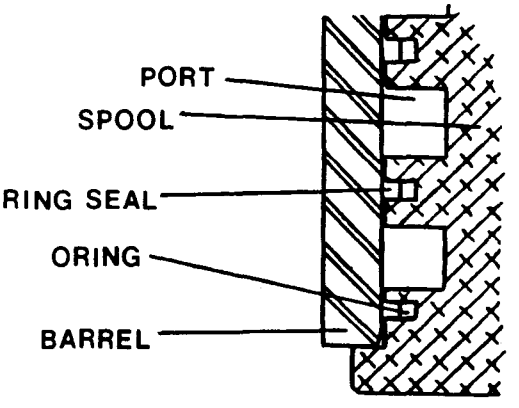
(7" standard O.D. - 6.985) (5" standard O.D. - 4.985)
(6" standard O.D. - 5.985) (3-1/2" standard O.D. - 3.485)

- Seal grooves of .160 standard width worn beyond .185 at O.D. are no longer safely usable.

- Grooves of .130 standard width beyond .150 at O.D. are no longer safely usable.
- Loaded lip seal grooves of .275 standard width worn beyond .325 at O.D. are no longer safely usable.
- Inspect other factors such as port threads, bolt holes and threads, hole elongation, broken spool lands, etc., to make determination of parts.

ASSEMBLY:

- All parts must be clean and free of oil and dust.
- Install o-rings in seal grooves.



- Seal kits with two polyurethane rings: install these in seal grooves on each end only. (These are identified by appearance or by their resilience being superior to that of Teflon).
- Install Teflon rings on top of o-rings (do not stretch beyond reasonable limits).
- Inspect for proper seal alignment and install spool in barrel using suitable assembly equipment.
- Assemble remaining parts, tighten bolts to proper torque value and install safety wire where required. (Torque values in ft. lb.: 1/4 UNC - 10; 5/16 UNC - 20; 3/8 UNC - 35; 1/2 UNC - 60).

RELIEF VALVE MAINTENANCE:

Earlier in this manual we said that the control valves in our hydraulic system have three functions: to control, direct and limit the oil flow. It is the third function -- to limit flow (or pressure) -- to which the relief valve portion of the control valves in your Barko loader is dedicated. It can be said a different way -- that the relief valve is designed to relieve excess pressure in the hydraulic system if for any reason pressure is built up above a predetermined, safe maximum.

The main relief valves can be and should be checked for correct system pressure on a regular basis. The correct relief pressure for the Barko 160A is 2000 P.S.I.

⚠CAUTION - The relief valve pressure setting has been arrived at by our engineers after considerable experience with and testing of this loader. The setting listed will provide maximum safety and efficiency of operation. DO NOT ALTER THIS RELIEF SETTING! Relief settings increased beyond this setting could be dangerous to life, limb and property -- and altering the settings on a new machine will void the warranty.

RELIEF VALVE SETTINGS

Main System - main relief 2000 P.S.I.

Main Boom Cylinder Port Relief
600 P.S.I. down - rod end of cylinder
3000 P.S.I. up - butt end of cylinder

Secondary System - main relief 2000 P.S.I.
Secondary Boom Cylinder Port Relief
3000 P.S.I. down - rod end of cylinder
3000 P.S.I. up - butt end of cylinder

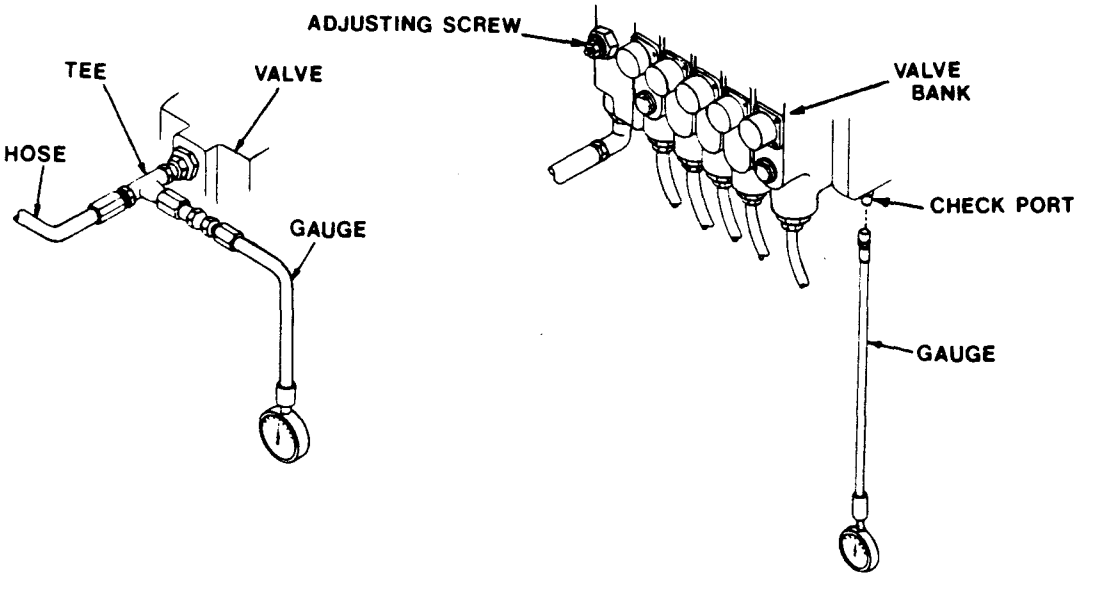
Swing System Port Relief - 2000 P.S.I. right
2000 P.S.I. left

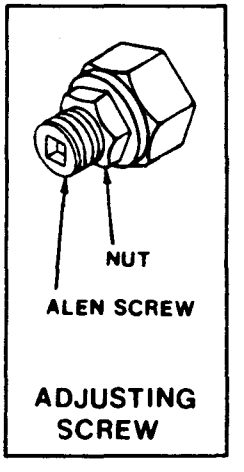
Servo Pressure (when applicable) - 350 P.S.I.

NOTE: The Swing Pressure is not adjustable and is controlled by the Port Reliefs in the Secondary Valve Bank.

RELIEF VALVE GAUGES

Relief valve pressures can be checked by attaching gauges to the check ports on the valve banks, and, by attaching the gauge in the line with a tee.



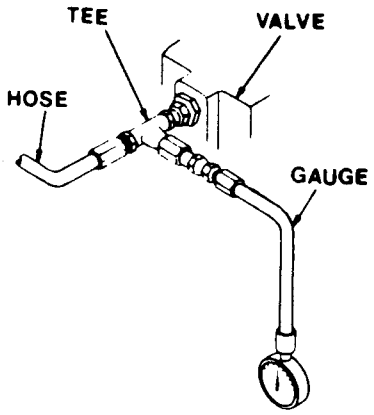


Run the machine to check the pressure. Each function must be operated to it's maximum position to get a proper reading.

Adjust the pressure to the proper setting by loosening the nut on the adjusting screw and turning the alen screw in to raise the pressure, and out to lower it.(See illustration above).

PRESSURE CHECKING THE SWING SYSTEM

When pressure checking the Swing System install gauge between the pump and the Swing Lock Valve as shown by the diagram. Close the Swing Lock Valve and gently stroke Swing Pedal, if pump is good the gauge should read 4000 - 4500 P.S.I. Then open the Swing Lock Valve and jam grapple into the ground or a log pile so that the loader cannot rotate and gently stroke the Swing Pedal. If swing port reliefs and motors are good, the gauge should read 2000 P.S.I. If pump is good and loader still fails to swing it may be necessary to disconnect one motor at a time to isolate the problem.



CONTROL VALVE MAINTENANCE:

The valve system in the Barko loader performs a three-way job -- to direct the oil flow to the cylinders and motors, to control the volume of oil, and to limit the pressure at difference points. The Barko loader uses stack-type valves to perform this task. The valve banks are mechanically activated by the control levers on the operator's platform. On large models these valves may be activated hydraulically by hand.

The following small "manual" contains your service and maintenance information on the Control Valves used on the Barko 160A.

DIRECTIONAL CONTROL VALVE

SERVICE MANUAL

Contents

Section 1 Description
Section 11 Maintenance

List of Illustrations

Figure 1 Schematic View of Typical Control Valve Assembly
Figure 2 Spool Seal Assembly
Figure 3 Directional Control Valve, Typical Main Assembly
Figure 4 4-Way, 3-Position Work Section
Figure 5 Spring Return to Neutral Positioner
Figure 6 3-Position Detent Positioner

SECTION I
DESCRIPTION

Directional Control Valves are available with five different types of work sections, plus various options to meet specific job specifications.

The following paragraphs describe the five work sections and options with reference to the parts illustrations.

4-WAY, 3-POSITION WORK SECTION (Refer to Figure 4)
Provides control of double acting cylinders without the floating action plus hydraulic motor start, stop, and reverse control where free-wheeling is NOT required. Cylinder ports are blocked in neutral position.

SPOOL ACTION OPTIONS

SPRING RETURN TO NEUTRAL (Standard) (Refer to Figure 5).
Spool will return to neutral position from A or B power position when handle is released.

3-POSITION DETENT, "D" Option (Refer to Figure 6).
Valve spool remains in any of three detented positions. No spring return to neutral.

INLET and OUTLET COVERS (Refer to Parts manual).

RELIEF VALVES and WORK PORT CHECKS (Refer to Parts Manual).

SECTION II

MAINTENANCE

REPLACING, ADDING OR REMOVING WORK SECTION ASSEMBLIES

NOTE

For clarification, the side containing the inlet cover (the cover containing the main relief valve) will be called the left end of the valve assembly. Refer to Figure 1.

1. Before disassembly, it is suggested that each work section be marked numerically to avoid incorrect reassembly.

2. Remove four hex nuts (Item 10, Figure 3) from the right end of the valve assembly using a 9/16" socket wrench. If the valve assembly consists of only one or two work sections, bolts and lock washers must be removed instead.

3. Remove the outlet cover and each section by sliding from assembly studs (Item 9, Figure 3).

4. If work sections are to be added or subtracted from the valve assembly, the four studs must be removed from the inlet cover and replaced with studs of proper length.

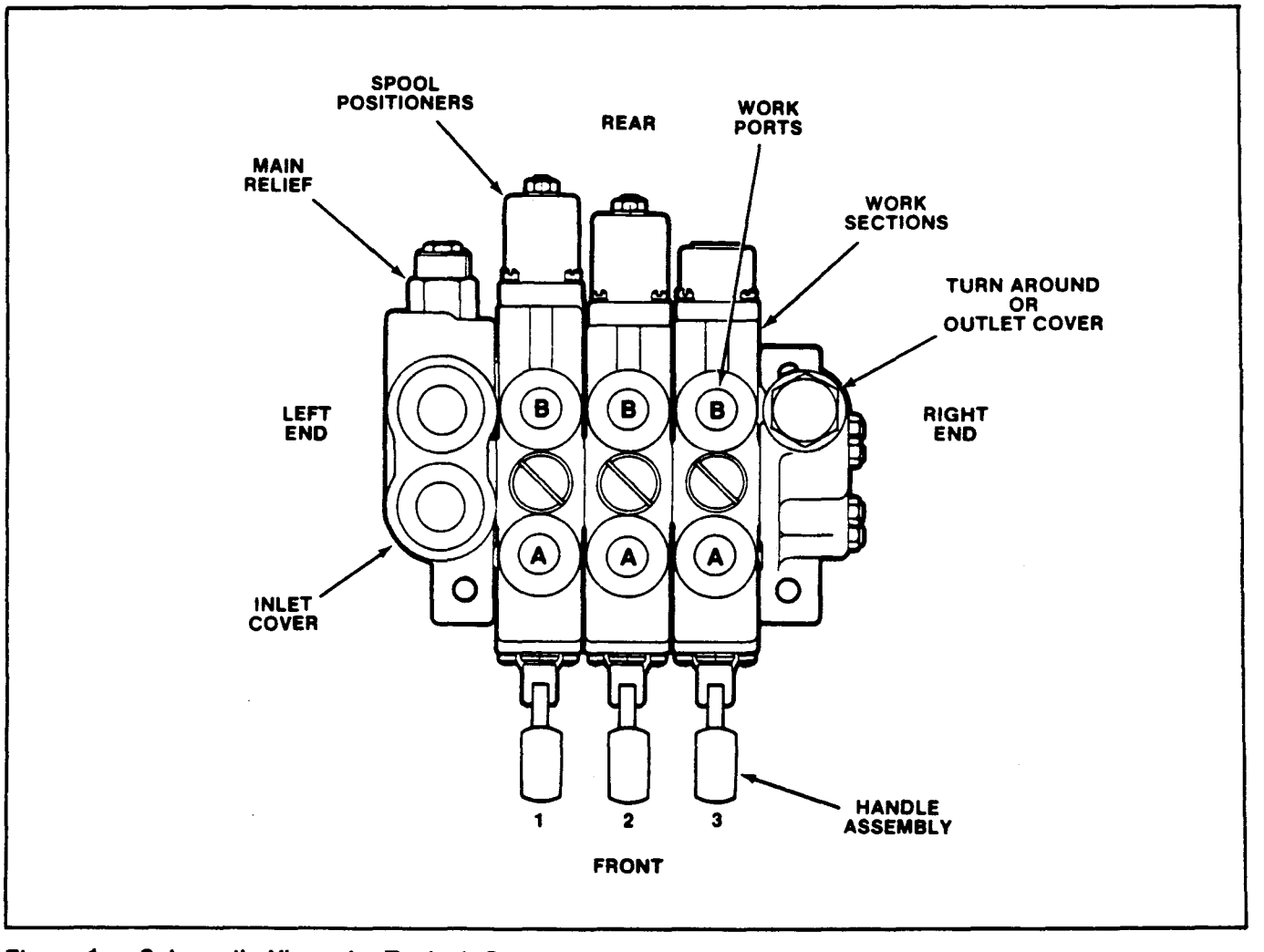


Figure 1 Schematic View of a Typical Control Valve Assembly.

NOTE

Use lock nuts, four required, with all assembly studs. Except for valve assemblies containing only one or two work sections, NO LOCK WASHERS required. Studs are of stress-proof material and should be replaced only with original equipment replacement parts. If the valve assembly contains only one or two work sections, assembly bolts with lock washers, are used.

5. Thoroughly clean O-ring counterbores and ground surfaces of each section.

6. Replace the three O-ring seals

7. Replace work sections on assembly studs in the same order in which they were removed. O-ring counterbores (with O-rings in place) should be to your left when facing the "A" port or front side of the valve assembly.

NOTE

Use care in replacing work section to avoid dislodging O-rings from counterbores.

8. When all work sections and the outlet cover are positioned on the assembly studs, replace stud nuts and tighten evenly to 24-26 foot pounds [33-35 Nm].

CAUTION

If stud nuts are not tightened to the proper torque, valve spools may bind or stick, or cause section seals to extrude.

REPLACING SPOOL SEALS

Figure 2 shows spool assembly — less the complete handle assembly. When the handle bracket is furnished, retainer plate and retainer screws are not used. Seal assembly is retained by handle bracket and its attaching parts.

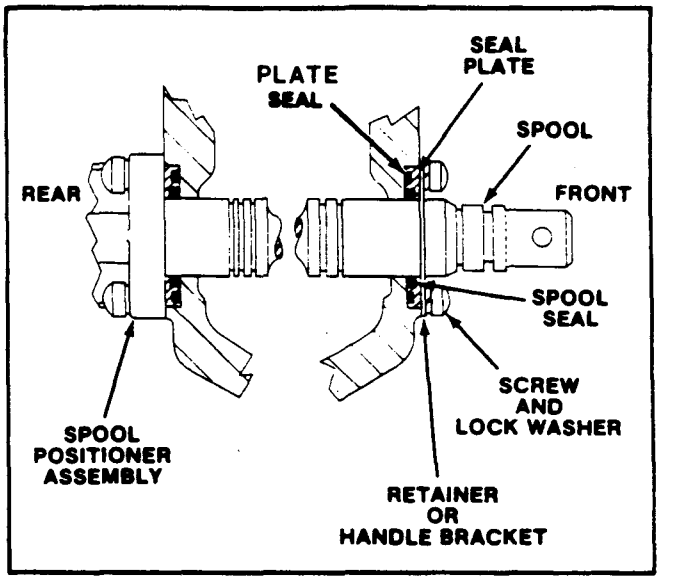


Figure 2 Spool Seal Assembly.

1. Remove spool positioner assembly from rear of work section. Keep in order of disassembly.

2. Remove complete handle bracket assembly or retainer and retainer screws from front of work section.

3. Remove seal plate from each end of work section.

4. Remove quad seals and spool seals from seal plates and thoroughly clean plates.

5. Lightly oil new seals. Insert them into grooves in seal plate.

6. Slide the seal plates over each end of the spool into the counterbore in the work section.

7. Reassemble parts in reverse order of disassembly.

8. Torque bonnet screws and handle bracket or seal retainer screws to 8-10 foot pounds [11-14 Nm].

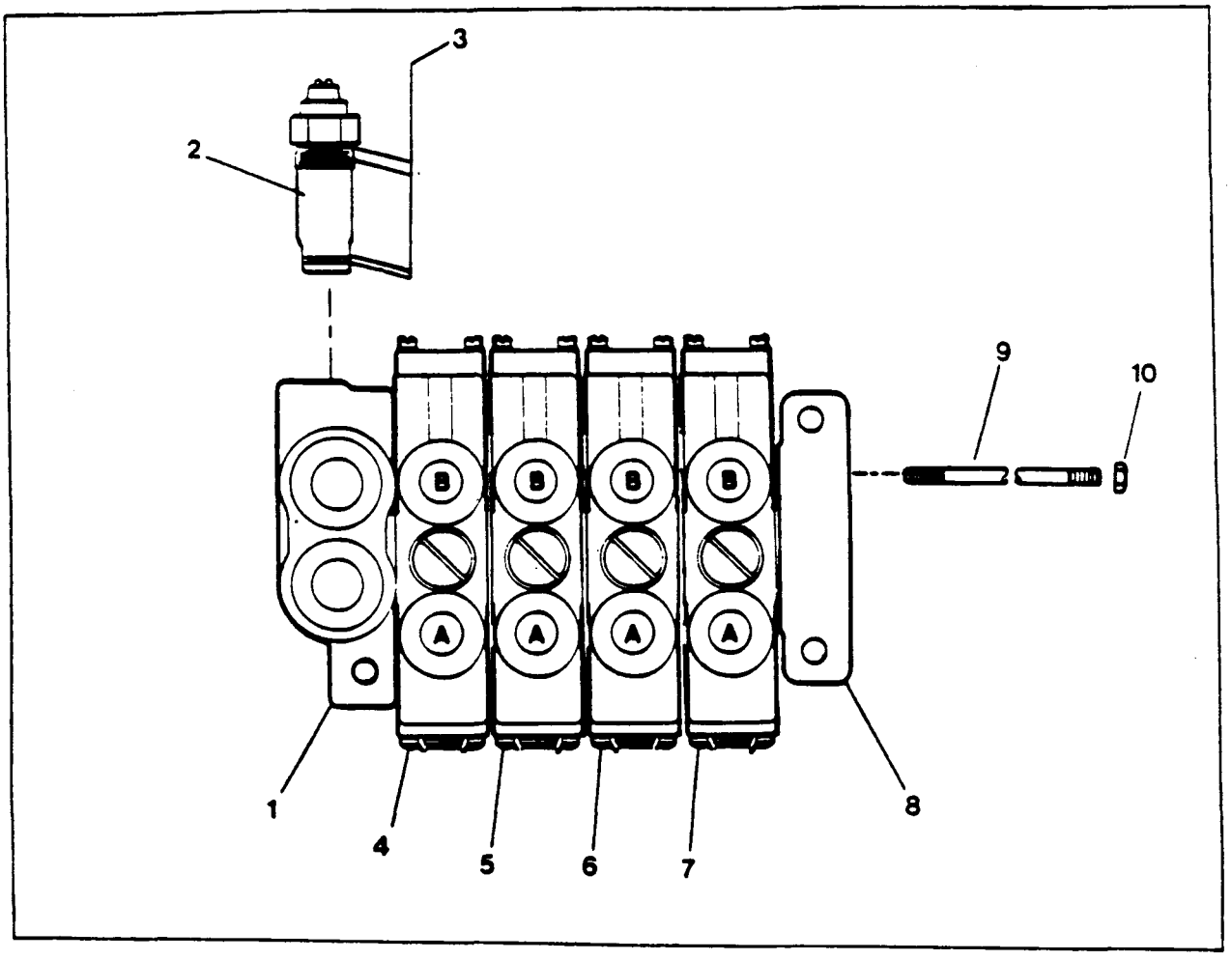


Figure 3 Directional Control Valve, Typical Main Assembly.

ITEM	QTY	DESCRIPTION
	1	ASSEMBLY, complete
1	1	COVER, left
2	1	RELIEF, main
3	1	KIT, seal
4	1	ASSEMBLY, valve section LEFT REAR STABILIZER
5	1	ASSEMBLY, valve section LEFT FRONT STABILIZER
6	1	ASSEMBLY, valve section GRAPPLE OPEN AND CLOSE
7	1	ASSEMBLY, valve section MAIN BOOM
8	1	COVER, right
9	4	STUD
10	4	NUT

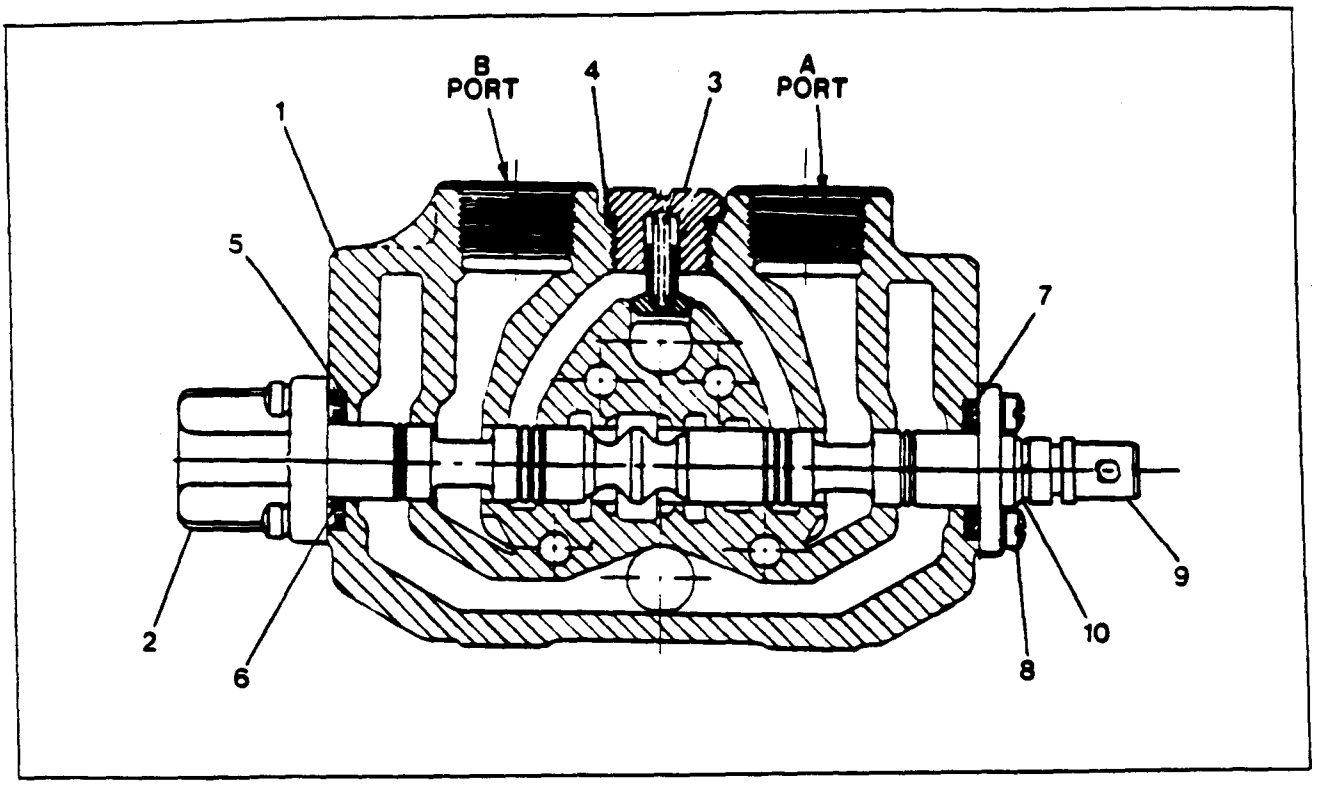


Figure 4 4-Way, 3-Position Work Section

	ITEM	QTY	DESCRIPTION
		1	ASSEMBLY, complete (includes all items listed below)
	1	1	HOUSING (includes item no. 2)
	2	1	ASSEMBLY, bonnet
	3	1	ASSEMBLY, check plug (includes item no. 4)
(1)	4	1	O-RING
(1)	5	2	SEAL, square ring
(1)	6	2	SEAL, spool
(1)	7	2	SEAL, plate
	8	1	ASSEMBLY, retainer
	9	1	ADAPTOR, male clevis
	10	1	WASHER, lock
(1) (2)	11	1	SEAL, large section (not shown) (see kits listed below)
(1) (2)	12	2	SEAL, small section (not shown) (see kits listed below)

SEAL KIT NO.	QTY	DESCRIPTION
(1)	1	Included in Seal Kit
(2)	1	Included in Section Seal Kit

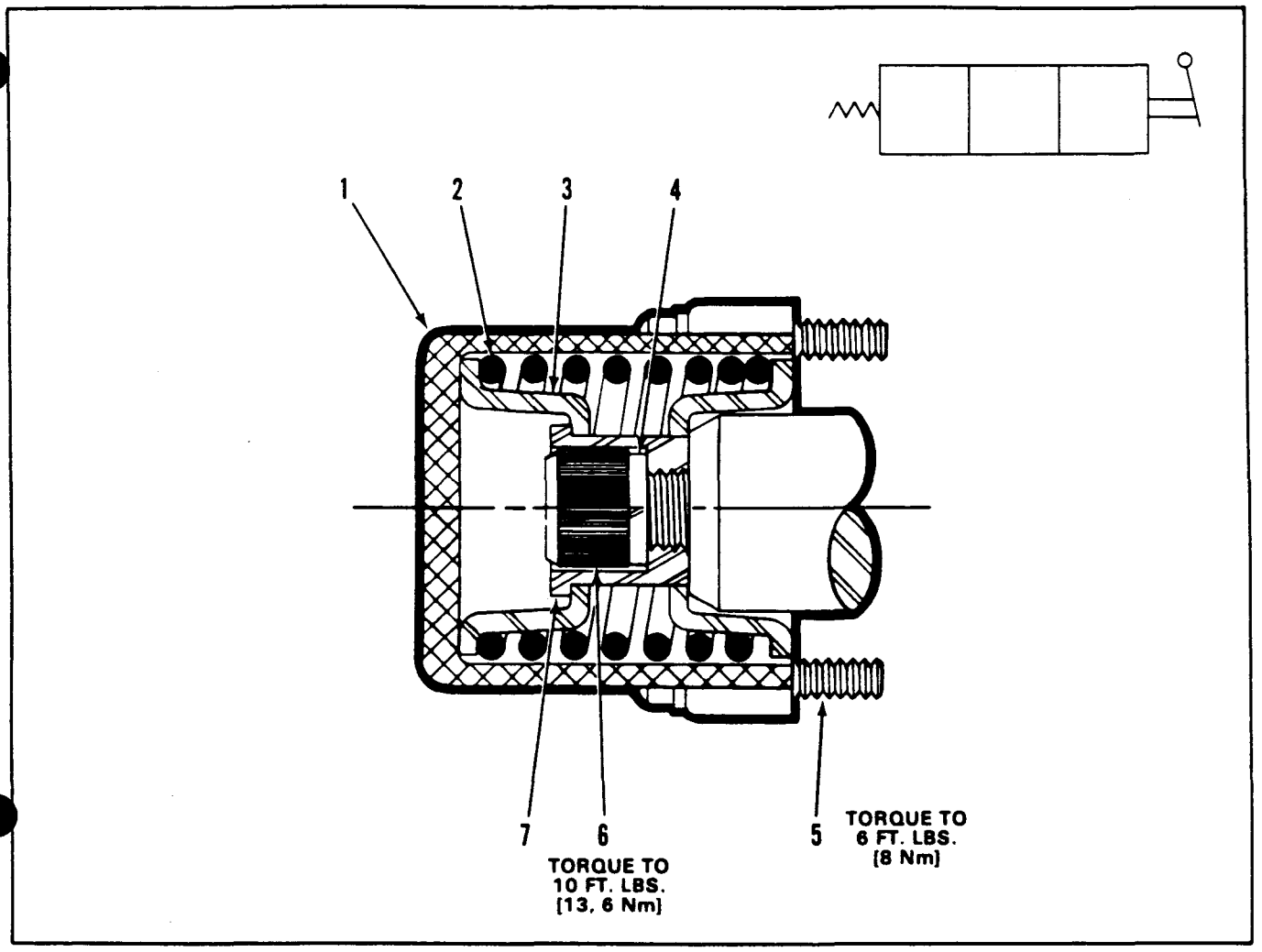


Figure 5 . Spring Return to Neutral Positioner

SPRING RETURN TO NEUTRAL POSITIONER

Item No.	Description	Quantity
	REPLACEMENT KIT (Contains all items listed below)	
1	BONNET	1
2	SPRING	1
3	COLLAR, Stop	2
4	WASHER, Lock	1
5	SCREW, Fil. Hd., 1/4—20 by 1 inch long	4
6	SCREW, Hex. Soc. Hd., 3/8—16 by 3/4 inch long	1
7	COLLAR, Spool	1

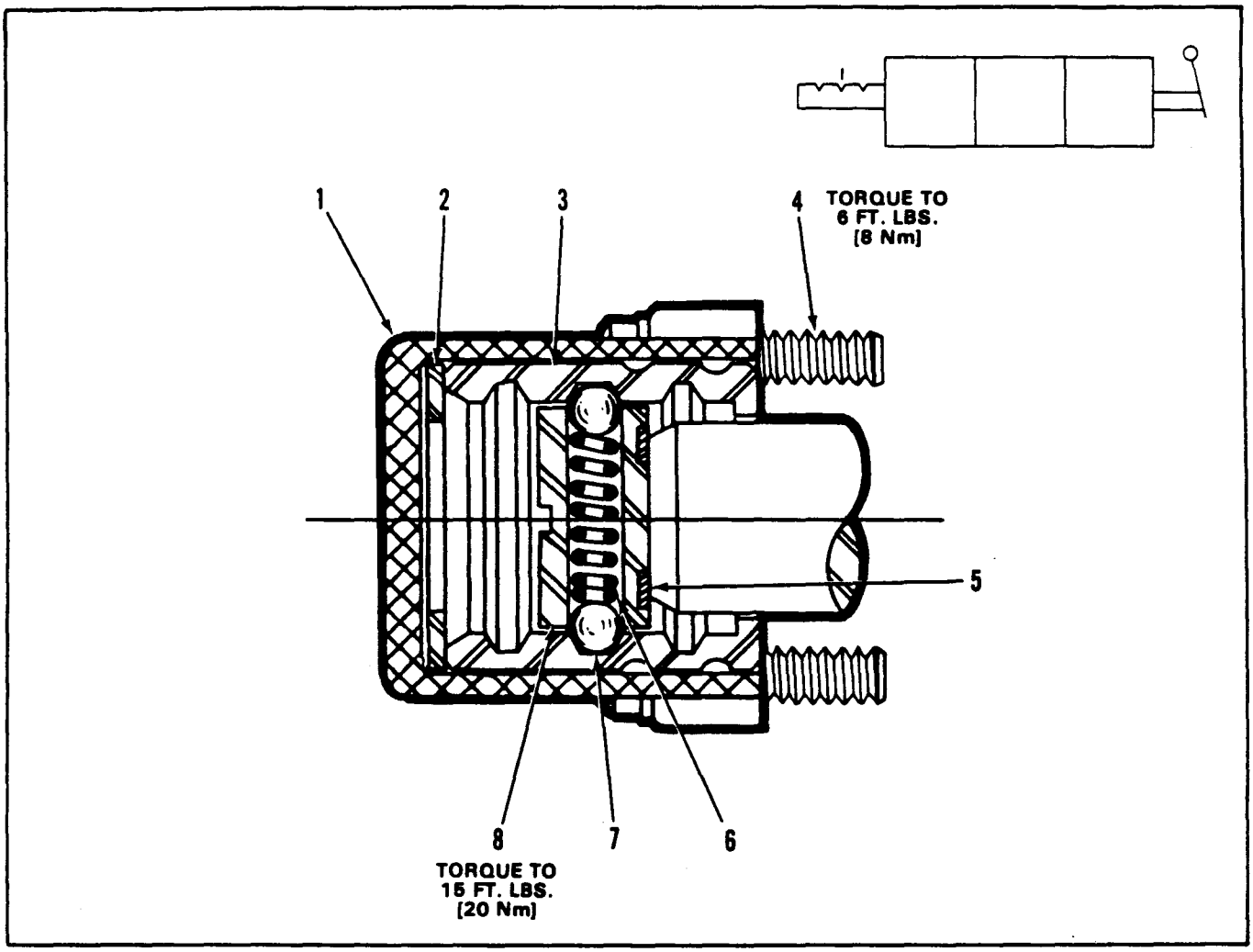


Figure 6 3-Position Detent Positioner

3-POSITION DETENT POSITIONER

Item No.	Description	Quantity
	REPLACEMENT KIT (Contains all items listed below)	
1	BONNET	1
2	WASHER, Detent Stop	1
3	SLEEVE, Detent	1
4	SCREW, Fil. Hd., 1/4—20 by 1 inch long	4
5	WASHER, Lock	1
6	SPRING, Detent	1
7	BALL	2
8	HOLDER, Detent	1

HYDRAULIC PUMP MAINTENANCE:

The Barko loader has hydraulic pumps to provide pressure and flow for the system -- to power the boom, grapple, and stabilizer cylinders (this is the Tandem Pump) -- and to power the swing system (this is the Swing Pump). Driven by the power output of the diesel engine, the pumps are located in the engine enclosure (shrouding). See Photo.

The following are two small service "manuals". One for the Swing Pump, and one for the Tandem Pump, giving service and maintenance information on each type.

SWING PUMP

SERVICE INFORMATION

EFFECTIVE 11-2-89

SECTION I - INTRODUCTION

A. Purpose of Manual

This manual describes the basic operational characteristics and provides service and overhaul information for the hydrostatic variable displacement inline piston pump.

B. Description

The assembly and A. S. A. schematic diagram of the hydrostatic pump is shown in Figure 1. The major components of the units are: the housing, drive shaft, rotating group, swash plate, valve plate, and a yoke.

The valve plate subassembly also serves as the back cover of the entire unit and includes the gerotor pump components, the replenishing relief valves, and the inlet and outlet ports. A bearing in the cover and one in the housing support the drive shaft.

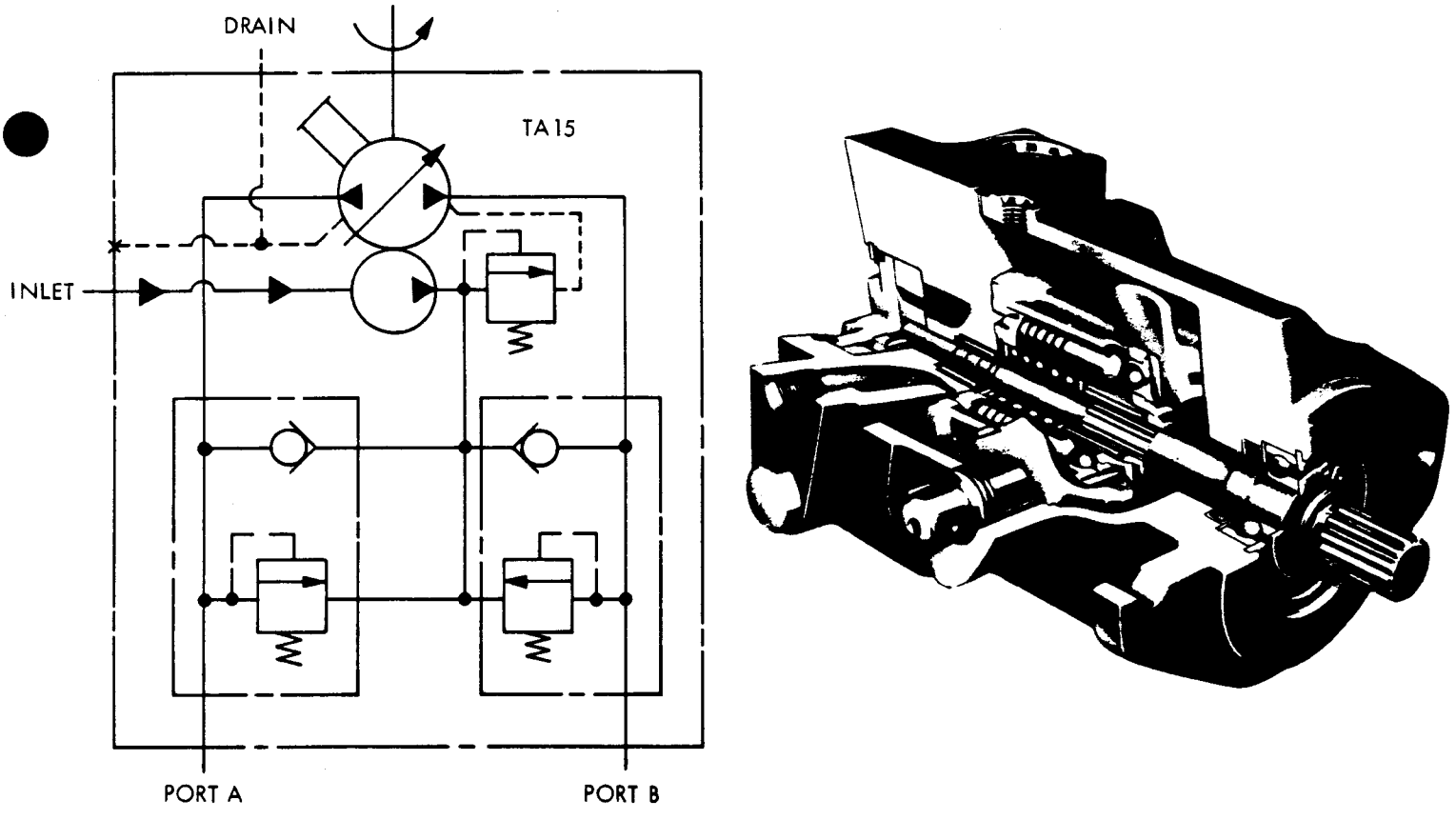


Figure 1

SECTION II - PRINCIPLES OF OPERATION

A. Gerotor Pump Unit Operation (Replenishing Pump)

The gerotor pump mechanism consists of a pair of gear-shaped elements, one within the other, mounted in a pump chamber. The inner gear is directly connected to the shaft, and itself drives the outer gear.

The inner gear has one fewer teeth than the outer gear. The tooth form of each gear is related to that of the other in such a way that each tooth of the inner gear is always in sliding contact with the surface of the outer gear. Each meshing pair of teeth of the two gears definitely engages at just one place in the pump.

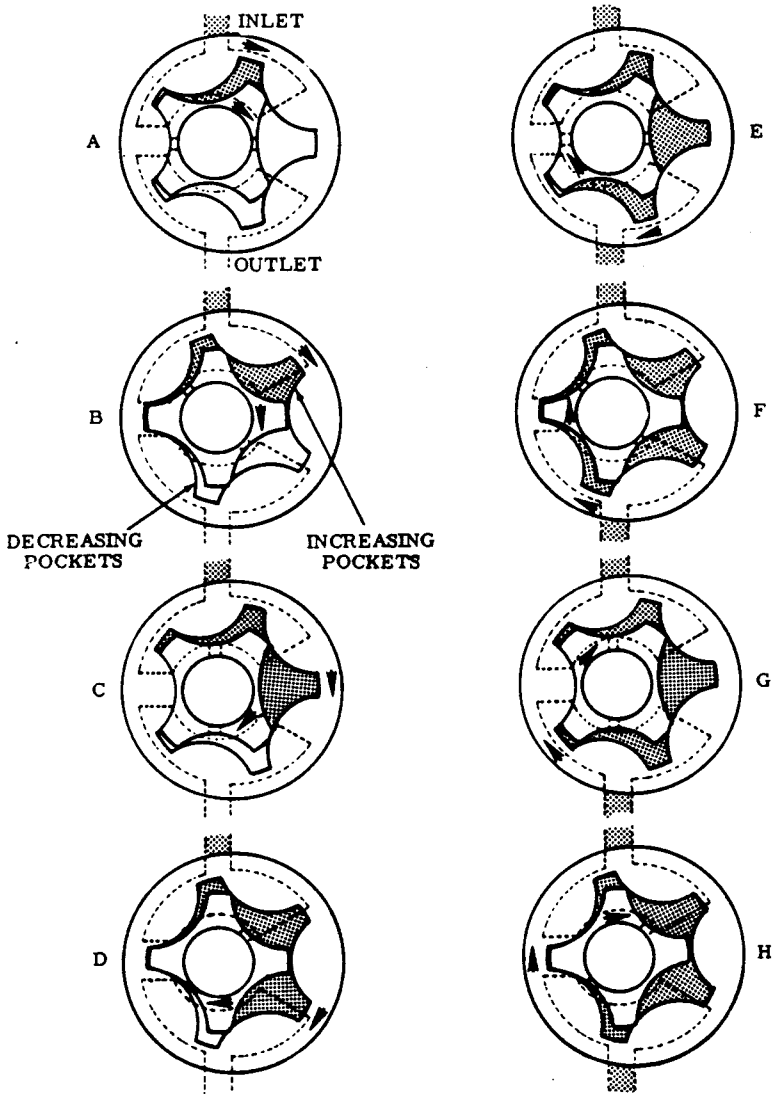


Figure 2

At one side of the point of mesh, pockets of increasing size are formed as the gears rotate, while on the other side the pockets decrease in size. The pockets of increasing size are suction pockets while those of decreasing size are discharge pockets. In Figure 2, it will be noted that the pockets on the right hand side of the drawings are increasing in size as one moves down the figure, while those on the left hand side are decreasing in size. The intake side of the replenishing pump is at the top, and the discharge is at the bottom of this illustration.

The two gears travel slowly with respect to each other, even though the shaft is rotating rapidly.

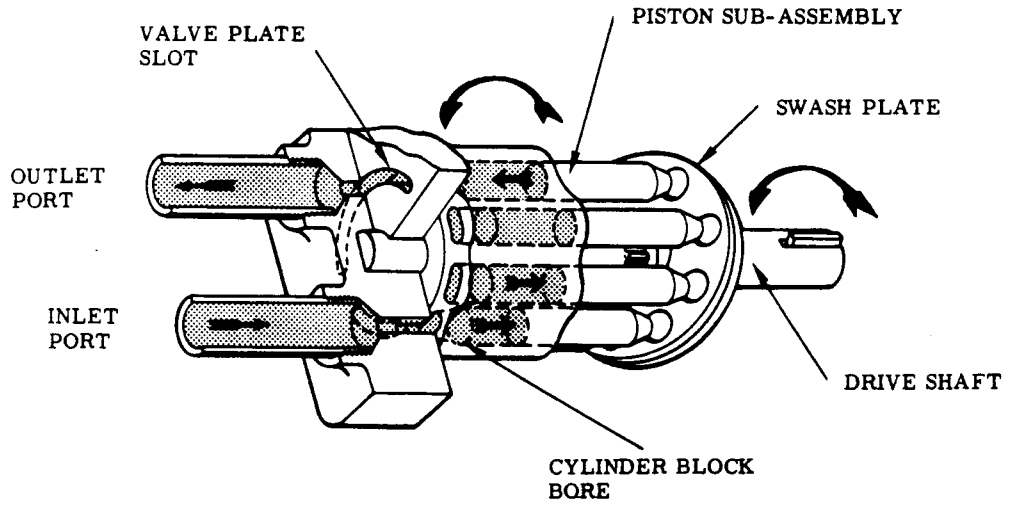
B. In-Line Piston Pump Unit Operation

Rotation of the drive shaft imparts a reciprocating motion to the pistons with respect to their cylinder block bores, as a result of the angularity between the axis of rotation of the drive shaft and the plane of the piston shoe bearing surface on the swash plate (see Figure 3). Each piston reaches two dead-center positions in one revolution or cycle.

As the piston revolves past the bottom dead-center position (when the piston is nearest the valve plate), it begins to withdraw from the cylinder block bores and thus begins its intake or suction stroke. During the intake stroke of the piston, fluid is drawn into the corresponding cylinder block bore through a porting arrangement located on the face of the valve plate and cylinder block.

As the piston reaches top dead-center (when the piston is furthest from the valve plate) its withdrawing motion ceases, ending the intake stroke. This point is 180° from bottom dead-center. Further rotation of the cylinder block, and piston, creates a return motion of the piston towards the valve plate and thereby establishes the discharge stroke of the piston. During the discharge stroke, fluid is expelled from the cylinder block bore through the outlet port of the valve plate in a reverse manner to the intake stroke.

Figure 3



When the piston reaches bottom dead-center, axial piston motion ceases, and the discharge stroke is ended. The pumping cycle described above is made by each piston as it and the cylinder block are revolved through 360°.

The pumps turn in one direction by the engine and can deliver oil to the propelling motor through either of its ports (A or B).

Variable displacement is effected by altering the angularity between the swash plate and the drive shaft axis as shown by views A, B, and C in Figure 4. The amount of angular movement of the swash plate (i.e. displacement change) is determined by control lever position.

When the yoke is straight across at right angles to the center line of the pump, there is no flow (refer to Figure 4, View B). When the yoke is moved to an extreme angular position, maximum pump delivery will result through one of the ports. (View A) Moving the yoke over center to an extreme angular position (View C) on the opposite side of the pump will result in maximum oil delivery through the opposite port. By changing the position of the yoke from one side to the other, the oil flow path changes to the motor.

Since either port of a cross center pump can be inlet or outlet, replenishing relief valves are required to provide access to relief valve protection. (See Figure 5)

Some fluid is constantly being lost from the system; this fluid is replenished by use of the replenishing pump. Fluid is drawn into the replenishing pump inlet from the reservoir by atmospheric pressure. It discharges from this pump to a common passage. When the piston pump delivery is directed to ports A or B, the replenishing fluid overcomes the 10 PSI spring setting and discharges into the inlet passage of the piston pump at a pressure in excess of 10 PSI (see Figure 5).

Any excess pressure in the common passage empties over the 25 PSI relief valve into the pump housing and back to the reservoir. The 25 PSI relief valve consists of a poppet and spring. Pressure acts directly on the poppet against the spring.

To take care of pressure surges in the outlet passage, relief valve action is provided. The replenishing and relief valve cartridges are pre-set and pre-tested at the factory. The cartridges pressure adjustment cannot be changed in the field. The outer shell of these cartridges is made of hexagon stock to provide a fluid passage.

The cartridge relief valve operates when the outlet pressure on the end of the pin creates a force greater than the pilot spring force (4500 PSI) and unseats the inner poppet. The unseating of the poppet reduces pressure in the 20 PSI spring chamber to a point where the outer poppet moves, thus discharging excess pressure to the relief cavity and to the reservoir.

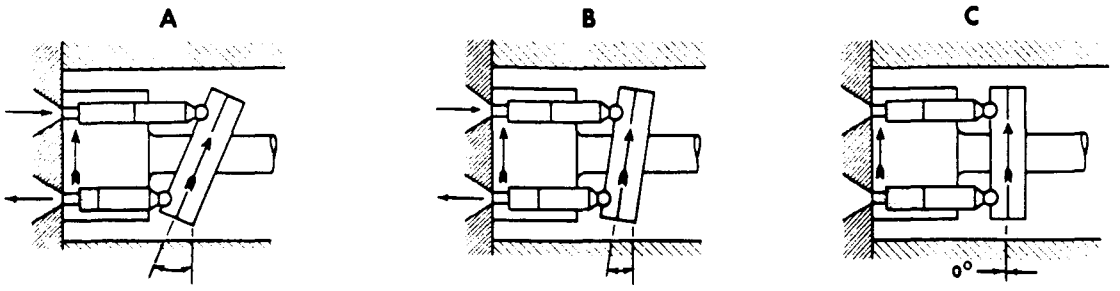


Figure 4

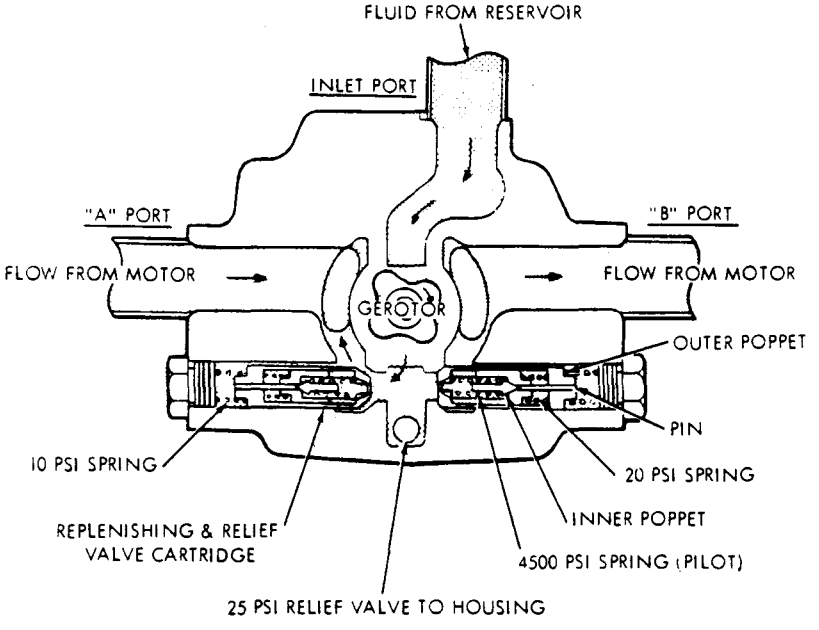


Figure 5

SECTION III - GENERAL OVERHAUL PROCEDURES

CAUTION

Block vehicle if it is on a slope. The hydraulic transmission cannot act as a parking brake.

Before breaking a circuit connection, make certain that the power is off and the system pressure has been released.

Lower all vertical cylinders, discharge all accumulators, and block any load whose movement could generate pressure.

Completely drain the oil from the vehicle's hydraulic system. Discard this oil and use new clean oil when restoring the unit to service.

After removing the hydrostatic pump from the vehicle and before disassembly, cap or plug all ports and disconnected hydraulic lines and clean the outside of the unit thoroughly to prevent entry of dirt into the system.

CAUTION

Absolute cleanliness is essential when working on a hydraulic system. Always work in a clean area. The presence of dirt and foreign materials in the system can result in serious damage or inadequate operation.

SECTION IV - DISASSEMBLY

All models are disassembled in the same general sequence as shown in the exploded view Figure 7.

1. The lever arm has been removed from the control pintle. This pintle governs the movement of the yoke inside the pump which, in turn, allows variable displacement to occur, depending on the position or angle of the yoke in respect to the shaft axis.

A. End Plate and Gerotor - Clamp pump mounting flange in a machinist's vise, being certain to use protective jaws. Remove end plate, snap ring, and washer.

Remove the relief valve snap ring and lift out the plug, poppet, o-ring, and spring from the valve plate.

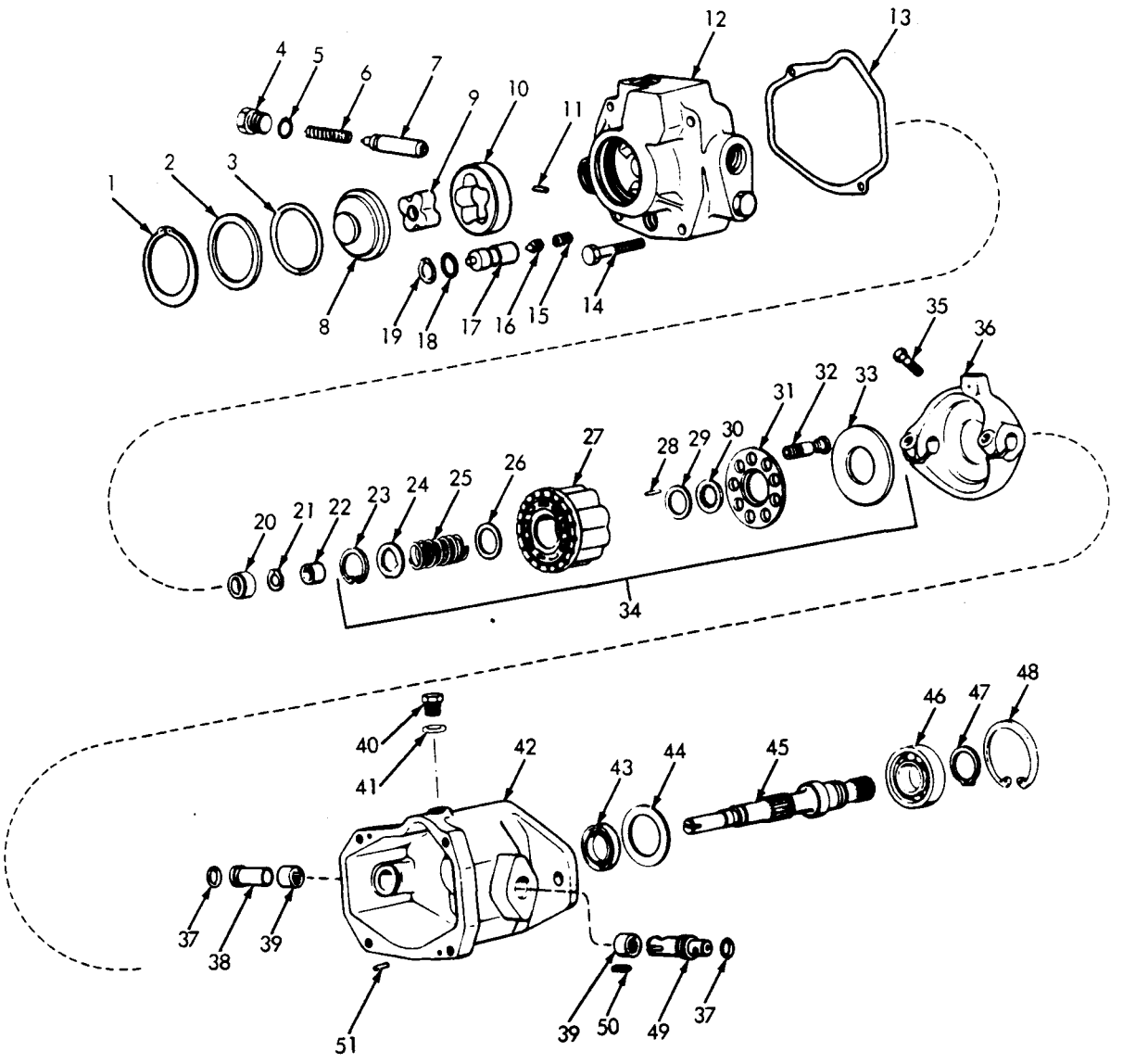
B. Separate the end plate from the valve plate. Remove the gerotor assembly and pin.

Remove the relief and replenishing valve plugs. Carefully slide out the spring and plunger valve cartridge.

2. Valve Plate - Remove the four valve-plate mounting screws. Carefully remove the valve plate from the unit.

3. To begin removal of the rotating group, first remove the snap ring that holds the bearing sleeve on the shaft. Use snap ring pliers to accomplish this.

4. Next, slide the bearing sleeve off the shaft.



1. SNAP RING
2. WASHER
3. "O" RING
4. PLUG
5. "O" RING
6. SPRING
7. PLUNGER VALVE
8. END PLATE
9. INNER ROTOR
10. OUTER ROTOR
11. PIN
12. VALVE PLATE
13. GASKET
14. SCREW
15. SPRING
16. POPPET
17. PLUG
18. "O" RING
19. SNAP RING
20. BEARING
21. RETAINING RING
22. SLEEVE
23. SNAP RING
24. WASHER
25. SPRING
26. THRUST WASHER
27. CYLINDER BLOCK
28. PIN
29. WASHER
30. SPHERICAL WASHER
31. SHOE PLATE
32. PISTON KIT
33. SWASH PLATE
34. ROTATING GROUP KIT
35. SCREW
36. YOKE
37. "O" RING
38. PINTLE
39. BEARING
40. PLUG
41. "O" RING
42. HOUSING
43. SHAFT SEAL
44. SPACER
45. SHAFT
46. BEARING
47. SNAP RING
48. SNAP RING
49. CONTROL PINTLE
50. KEY
51. PIN

Figure 7

5. Now carefully remove the rotating group assembly, which consists of the cylinder block and piston shoe subassembly.

   Hold the complete cylinder block and piston shoe subassembly together to avoid separation while removing from the pump.

6. Place rotating group on a clean surface, being careful not to drop or scratch the running surface of the assembly. Then hold washer and spherical washer in place with your index finger.

7. Remove piston subassembly from the cylinder block by lifting straight up, still holding washer in place with your index finger.

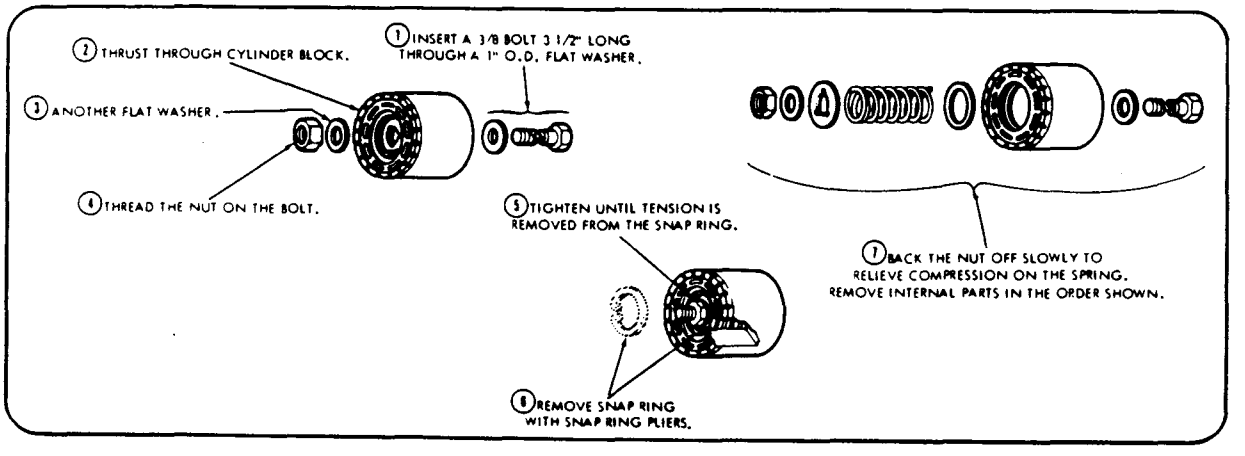
8. Then continue disassembly of the rotating group in the sequence.

9. Now you are ready to disassemble the cylinder block subassembly, which consists of a snap ring, two washers, and a heavy spring.

   WARNING

   The cylinder block subassembly includes a heavy spring. To avoid injury, use the following special method of relieving spring tension before slipping the spring out of the block.

10. To relieve the spring tension, use a bolt, nut, and two washers as shown in this figure.



11. The spring is now compressed and held firmly and safely in place.

    Remove the snap ring from the cylinder block with snap ring pliers; then relieve the tension of the spring by gradually unscrewing the nut from the special bolt, washer, and nut in the cylinder block.

12. To accomplish the next step in the disassembly procedure, removing the swash plate, rotate the plate and pull out evenly from the yoke.

    When assembled, the swash plate rests in a recess of the yoke and can be freely rotated with the finger tips; however, removal may be difficult due to oil suction under the plate.

13. Now to remove the shaft, remove the large snap ring retainer next to the bearing.

14. After the snap ring is out, tap the shaft on the small end with a plastic tip hammer for proper removal.

15. Remove spacer that fits between the bearing and shaft seal.

16. Using snap ring pliers, take off the large snap ring next to the bearing on the shaft.

17. Then remove the bearing with a bearing puller (or arbor press if available). ANY OTHER METHOD OF BEARING REMOVAL MAY DAMAGE THE BEARING.

18. After the shaft has been removed, the pintles and yoke are next. To remove the pintles, begin by removing the retaining screws from the yoke.

    The housing containing the yoke should be held firmly in a vise when removing the yoke screws because of the torque.

19. Now you will be able to take out the pintles. To do this, use a hammer and a 3/8" brass rod about 10 inches long; tap out pintle #1.

20. Pintle #2 is then easily removed by inserting the brass rod through the hole vacated by pintle #1 and tapping it out.

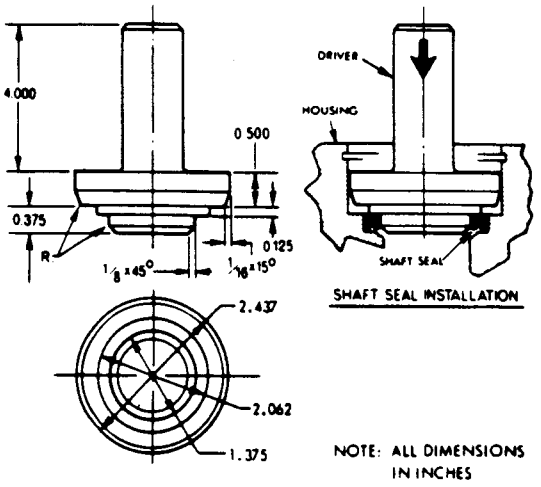
21. The key way, key, and pintle, must be assembled with the key to lock the pintle to the yoke so that the yoke can be positioned from outside the transmission.

22. Once you have removed the yoke and pintles, you can pull the pintle bearings if necessary. Use the proper bearing puller.

23. Again, use a bearing puller to pull the bearing in the valve plate. Be sure to protect the valve plate surface against scratches or nicks during the operation. Note that two pieces of copper or brass shim stock should be used for this purpose.

A. If the shaft seal is to be replaced, use a shaft seal driver of the proper dimensions or an arbor press, if available.

B. Position the shaft seal on the driver; then place the seal in position and drive it into the motor housing. Shaft seal driver dimensions are given below.



24. After the seal is in place, remove the driver.

25. The shaft seal should be properly seated and bottomed out against the shoulder of the recess.

    The following sequence highlights the importance of applying proper torque to the screws in reassembly.

26. Torque the yoke screws at 55 to 60 ft-lb.

27. Torque the cover screws at 42 to 45 ft-lb.

SECTION V - INSPECTION AND REPAIR

Clean all parts thoroughly with mineral spirits prior to inspection and after any stoning or machining operation. Inspection and repair procedures are as follows:

1. Valve Plate - Inspect the flat surface that mates with the cylinder block for wear or scoring. Remove minor defects by lightly stoning the surface with a hard Arkansas stone. Be sure to stone lightly; the surface is hardened and excessive stoning will remove hardened surface. If wear or damage is extensive, replace the valve plate.

2. Rotating Group - Inspect the bores and the valve plate mating surface of the cylinder block for wear and scoring. Remove minor defects on the running face by lightly stoning or lapping the surface. If the defects cannot be removed by these methods, replace cylinder block.

If one or more piston and shoe subassemblies need to be replaced, check all piston and shoe subassemblies in the unit to insure that all piston shoes ride properly on the swash plate (Figure 8). For a complete set of nine pistons, variations in thickness greater than 0.001 of an inch from one shoe to another will result in excessive internal leakage and shoe wear. The replacement of all nine piston and shoe subassemblies in the pump and motor, as well as the cylinder block, is recommended for maximum service between overhauls.

If necessary, hand-lap the shoes with 500-A emery paper (Tuff-Bak Durite Silicon Carbide) backed up by a lapping plate. Good results may be obtained by dipping the paper in kerosene and keeping it wet during polishing.

3. Swash Plate - Inspect the swash plate for wear and scoring. If the defects are minor, lightly stone the swash plate. If wear or damage is extensive, replace the swash plate.

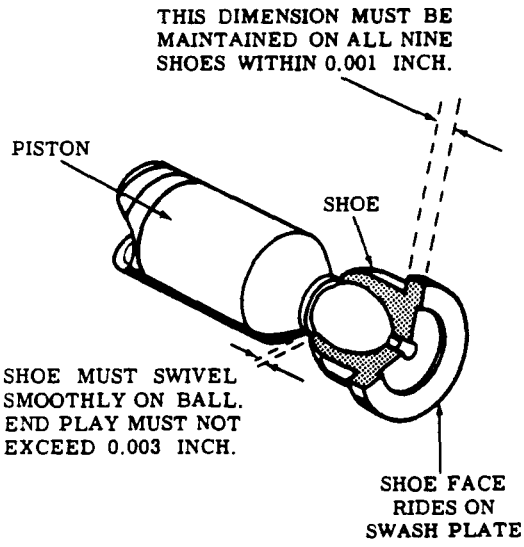


Figure 8

4. Bearings and Drive Shaft - Inspect all bearings for roughness or excessive play and replace if necessary. Examine the shaft seal area of the shaft for scoring or wear. If the drive shaft is bent or worn excessively, replace it.

5. Gerotor Assembly and End Plate - Inspect the surfaces of all parts which are subject to wear. Light scoring may be removed from the faces of the end plate with crocus cloth (by placing the cloth on a flat surface), medium India stone or by lapping.

SECTION VI - ASSEMBLY

The procedures for assembling the pump are basically the reverse of the disassembly procedures shown in detail in Section IV.

Install new gaskets, seals, and o-rings when assembling the unit. Apply a light film of clean hydraulic fluid to ease assembly. Squirt oil on the cartridge for initial lubrication. Use Vaseline on the o-rings when installing.

Piston Pump

1. Yoke - Install the yoke in the housing. With o-rings and keys in place, insert the pintles through the housing into the yoke. Align the holes and install the screws.

2. Drive Shaft and Bearing - Install new shaft seal in the housing. Then install the drive shaft in the housing. Secure the drive shaft bearing with the retaining snap ring, making certain that the sharp edge on the snap ring faces out.

3. Swash Plate - Install the chamfered edge of the swash plate toward the shaft seal. Be sure that the swash plate is properly seated in the yoke and that it can be freely rotated with the fingers.

4. Rotating Group Assembly - If the spring and washers were removed from the cylinder block, reassemble them. When properly assembled, the spring can be compressed about 1/8 inch with the three pins in place.

SECTION VII - START-UP AFTER REPAIR

Take the following precautions when starting a vehicle after repair:

1. Fill transmission case with new, clean oil through case drain openings before connecting drain lines and before installing transmission in vehicle.

2. Connect all hydraulic lines to the proper transmission port lines and set hydraulic controls in neutral position.

3. Remove reservoir cap and add new, clean oil to reservoir.

4. Jog the starter several times with engine coil wire disconnected (for about one minute). Recheck reservoir oil level and if necessary add oil to maintain operating oil level.

5. Replace engine coil wire. Start the engine and run it to a speed of about 800 rpm (avoid high speed start-up). Recheck reservoir oil level again.

6. Move the controls to the forward position and run vehicle slowly on level ground for a few yards.

7. Then, after a short interval, place controls in reverse and move vehicle slowly backwards an equal span.

8. After several short trips back and forth, the air should be dispelled from your Hydraulic System. Check oil level; add oil if necessary.

After all the above steps are complete, you may operate the vehicle at regular speeds and loads. In cold weather, make sure the hydraulic components are warm to the touch before operating the vehicle.

SECTION VIII - GENERAL MAINTENANCE

Lubrication

Internal lubrication is provided by the system oil flow.

Adjustments

No periodic adjustments are required other than maintaining proper shaft alignment with the driving medium.

Adding Fluid to the System

When adding hydraulic fluid to the system, pour it through a 10-micron filter. If such a filter is not available, use a funnel with a fine wire screen (200 mesh or better).

Oil Filter

The oil filter controls the cleanliness of the oil. A simple way of determining whether or not the oil is dirty is to rub some of the oil from the filter between your fingers. If it feels gritty, change the filter cartridge.

Experience with various kinds of duty and operating conditions will help you to determine how often to schedule a cartridge change. Check the condition of the oil periodically until you can establish a replacement pattern. In the meantime, change the cartridge after the first 50 hours of vehicle operation and every 500 hours thereafter.

> CAUTION
>
> It is important that oil be clean and free of all substances that could cause improper operation and excessive wear of any unit in the system.

Troubleshooting

The cause of improper functioning in a hydraulic system is best diagnosed with the use of proper and adequate testing equipment and a thorough understanding of the complete hydraulic system.

> CAUTION
>
> A hydraulic transmission unit that exhibits an excessive increase in heat or noise is a potential failure. When either of these conditions are noticed, immediately shut down the machine, locate the trouble, and correct it.

Detailed troubleshooting information is given in the following section of this manual.

SECTION IX - TROUBLE, CAUSE, AND REMEDY INFORMATION

General

Transmissions are closed or open loop circuits; the same oil continuously circulates between the pump and the motor except for normal lubrication and cooling leakage which is made up by the supercharge (auxiliary) pump. The supercharge pump maintains a positive pressure at the system pump inlet.

If it is properly maintained, such a hydraulic system will give productive, trouble-free operation. However, heat, dirt, free air, and cavitation can cause a malfunction in the system. The information below describes some of the symptoms of an improperly functioning system; the causes of such problems; methods of correcting them; and, consequently, ways of preventing expensive breakdowns.

Transmission Making Excessive Noise

Air in the system sometimes presents a "milky" appearance in your reservoir oil. A leak at the intake (suction) side of the pump will cause aeration in the fluid. When this condition exists, there is a mixture of free air with the oil. Since air is compressible, as it is pressurized and released within the high-pressure pump, an explosion of the tiny air bubbles occurs. This phenomenon may be translated into an audible sound above the normal hydraulic sound level. Air which is audible in the fluid system sounds as if marbles were going through the pump. Consequently, reduced lubrication and an erratic action in your hydraulic system results.

In the event of aeration in your hydrostatic transmission, check the operation of the supercharge pump.

Cavitation is caused by a low-pressure condition at the inlet port of the piston pump. Vapor pockets are formed separating the oil molecules, resulting in a noisy and erratic operation of the hydraulic transmission. Serious erosion of the pumping unit parts occurs in a relatively short operational period.

A worn or failed replenishing pump is the primary cause of cavitation in a closed-loop hydrostatic transmission circuit.

Cavitation can also be caused by using too heavy an oil in the hydraulic system. After overhaul or when refilling with fluid, be certain to use recommended oil types.

During cold weather, the oil will thicken after standing idle overnight or for a considerable length of time. You may experience cavitation at initial start-up. This will disappear as the oil begins to warm up and thin out a little. (Be sure to follow the cold weather start-up procedures given in the oil recommendation data sheet.)

Hydraulic Transmission Overheating

Overheating of the hydraulic system can cause system failure. When hydraulic oil becomes excessively hot, the fluid will oxidize. If oxidation occurs, the oil will not lubricate as well and the transmission will wear out faster.

As an example, the rate of oxidation will double for every 10 degrees of temperature rise over 160°F. At high temperatures, o-rings, seals, and gaskets will deteriorate.

Internal leakage is one of the reasons for excessive heat. If a pumping unit becomes worn, slippage occurs; that is, fluid will move through the leakage passages and create a rapid heat build up. This condition can be recognized by a slowing-down of the vehicle. Field repair under these circumstances is not feasible. Return the vehicle to the maintenance shop for exchange of transmission.

Another reason for excessive heat may be a plugged or failed heat exchanger system. This can be readily determined and a "field fix" is possible.

In summary, if the vehicle loses speed, especially after it has been operating for a while, check the temperature of the hydraulic system fluid. This can be done by immersing a standard thermometer (of sufficient range) in the reservoir. Compare the resultant temperature reading with your maximum operating temperature recommendations.

SYSTEM NOT DEVELOPING PRESSURE

There are two reasons for loss of pressure in a hydraulic system: (1) either one of the two relief replenishing valves has "failed open", or (2) you are losing the complete volume of fluid by internal leakage (slippage) or external loss.

If the relief replenishing valve fails, the vehicle will generally move in one direction but not in the other (forward or backward). It is unlikely that both relief replenishing valves will fail simultaneously. Such failure may be checked by swapping relief replenishing valves from one side to the other.

If your vehicle slows down or will not move in either direction, the fluid supply may be going back to the reservoir by internal slippage, or a ruptured line or joint may be causing external loss of fluid.

Of course, you should check for linkage or shaft disengagement.

External Leakage

Ruptured lines, loose joints, or worn gaskets and seals can cause leakage problems.

The line and joint leakage is obvious and simple to correct. However, seal or gasket leakage requires disassembly of part or all of the hydrostatic transmission. The possibilities are shaft seal leakage or leakage between the valve block and pump or motor externally. If an o-ring within the unit is cut, worn, or hardened, internal leakage may occur as evidenced by a slowing-down action of the vehicle when in motion.

When replacing seals or gaskets, follow suggested disassembly procedures and use o-ring seals of proper durometer, and recommended gaskets.

Miscellaneous

In troubleshooting a hydraulic system, do not overlook the possibility of mechanical failure of parts related to the hydrostatic transmission.

Check for sheared shaft keys, disconnected or misadjusted control linkage and disconnected or broken drive mechanisms.

If an overspeeding condition occurs, check your engine governor for malfunction.

The hydrostatic transmission is designed for long, trouble-free life if recommended maintenance procedures are followed. When trouble occurs, first check the most obvious possibilities. For successful operation and maintenance, make it a point to KNOW YOUR HYDROSTATIC TRANSMISSION WELL.

TROUBLE, CAUSE, AND REMEDY CHART

Trouble	Cause	Remedy
I. Excessive noise in hydrostatic transmission	Air in the system	1. Open reservoir cap and operate hydraulic system until purged. 2. "Bleed" hydraulic lines at highest point downstream of auxiliary pump and while system is under pressure.
	Vacuum condition	1. Check inlet (suction) lines and fittings for air leaks. 2. Check auxiliary pump function.
	Oil too thick	Be certain correct type of oil is used for refilling or adding to the system.
	Cold weather	Run hydraulic system until unit is warm to the touch and noise disappears.
II. Hydraulic transmission overheating	Internal leakage	If established that excessive internal leakage is evident, return vehicle to maintenance shop for evaluation and repair.
	Heat exchanger not functioning	Locate trouble and repair and replace.
	Fluid level low	Add oil to operating level.
III. System not developing pressure	Relief replenishing valve open	Replace one or both. Do not attempt to repair cartridges; they are factory assembled and preset.
	Loss of fluid internally (slippage)	Return vehicle to maintenance shop for repair of hydraulic system.
IV. Loss of fluid	1. Ruptured hydraulic lines 2. Loose fittings 3. Leaking gaskets or seals in hydrostatic transmission	1. Check all external connections, tubing, and hoses. Tighten connections, replace ruptured tube or hose. 2. Observe mating sections of hydrostatic transmission for leaks. Replace seals or gaskets if possible.
V. Miscellaneous	1. Sheared shaft key 2. Misadjusted or broken control linkage. 3. Disconnected or broken drive mechanisms.	Locate and repair.

TANDEM PUMP

SERVICE INFORMATION

EFFECTIVE 11-2-89

SECTION I - INTRODUCTION

A. Purpose of Manual

This manual has been prepared to assist the users high performance double pumps in properly installing, maintaining and repairing their unit. The double pumps are described in detail and their theory of operation is discussed in addition to instructions for installation, maintenance and overhaul.

SECTION II - DESCRIPTION

A. General

Pumps in this series are used to develop hydraulic fluid flow for the operation of Mobile equipment. The positive displacement pumping cartridges are of the rotary vane type with shaft side loads hydraulically balanced. The flow rate depends on the pump size and the speed at which it is driven.

All units are designed so that the direction of rotation, pumping capacity and port positions can be readily changed to suit particular applications.

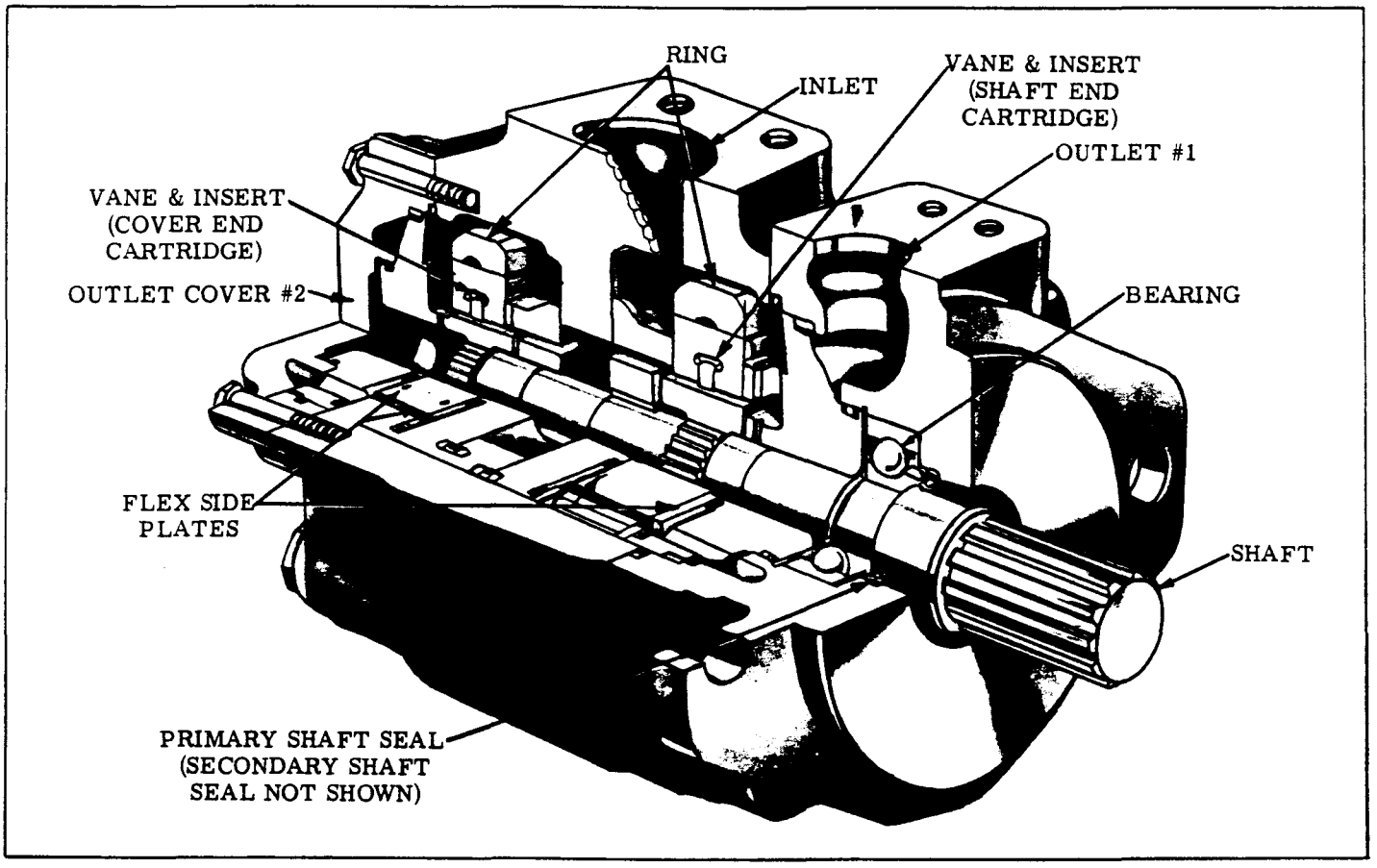


Figure 1. Cutaway View of Typical Double Pump.

B. Assembly and Construction

1. Basic Pumps: The pump illustrated in Figure 1 is representative of all double pumps in this series. The pump consists principally of an inlet housing, two outlet bodies, a drive shaft and two pumping cartridges. The principal components of a cartridge are an elliptical cam ring, a slotted rotor splined to the drive shaft, an inlet and outlet support plate fitted with four special seal pack subassemblies, two flex side plates, and ten vanes and inserts fitted to the rotor slots. Fluid enters the cartridge through the inlet port and is discharged through the outlet of flex side plate and support plate to the outlet ports.

C. APPLICATION

Pump rating in USGPM, are at 1200 RPM and 100 PSI.

SECTION III - PRINCIPLES OF OPERATION

A. Pumping Cartridge

As mentioned in Section II, fluid flow is developed in the pumping cartridge. The action of the cartridge is illustrated in Figure 2. The rotor is driven within the ring by the drive shaft, which is coupled to a power source. As the rotor turns, centrifugal force on the vanes, aided by under-vane pressure fed from the outlet port, causes the vanes to follow the elliptical inner surface of the ring.

Radial movement of the vanes and turning of the rotor causes the chamber volume between the vanes to increase as the vanes pass the inlet sections of the ring. This results in a low pressure condition which allows atmospheric pressure to force fluid into the chambers.

An additional inlet fluid path exists through a drilled hole in the cam ring. This hole connects the inlet port directly to the inlet areas of the cam ring and provides an additional flow path for fluid to get into the cartridge. See Figure 1 and 15.

Fluid is trapped between the vanes and carried past a sealing land to the outlet section of the ring. As the outlet section is approached, the chamber volume decreases and fluid is forced out into the system. System pressure is fed under the vanes, assuring their sealing contact against the ring during normal operation.

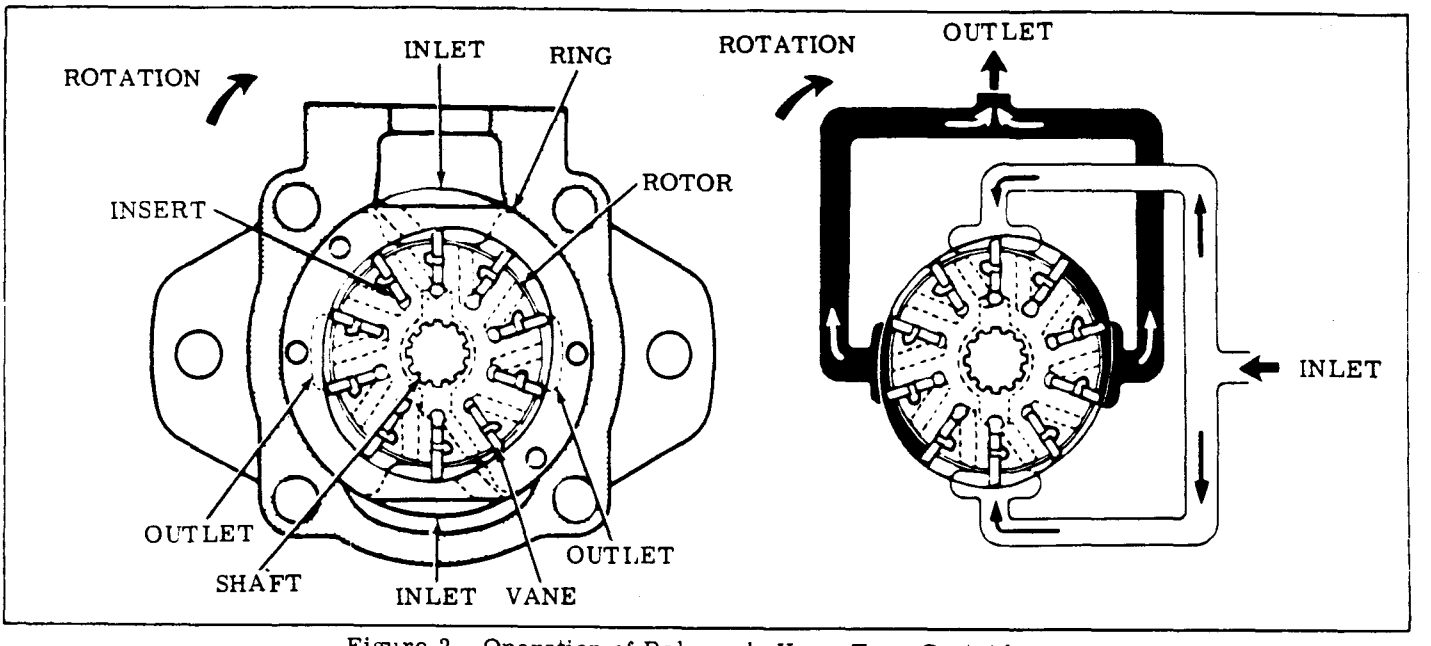


Figure 2. Operation of Balanced, Vane-Type Cartridge.

B. Vane Pressure Feed

The intra-vane design provides a means of controlling the outward thrust of the vane against the ring and maintains tip loads within reasonable limits. In the intra-vane cartridge, full system pressure is continuously applied only to the area between the vane and insert. This area is small and thrust is correspondingly light. During vane travel through pressure areas, full system pressure is applied against the bottom area of the outer vane. The valving of pressure to and from the bottom area of the vane is through holes drilled in the rotor, as shown in Figure 3. This selective application of pressure maintains the vane in substantially constant radial hydraulic balance in all positions.

Vane tip wear is compensated for automatically. As the vane wears, pressure moves the vane farther out in the rotor slot holding the vane tip against the cam ring.

C. Hydraulic Balance

The pump ring is shaped so the two pumping chambers are formed 180 degrees apart (Figure 2). Thus, opposing hydraulic forces which develop side loads on the shaft cancel out.

D. Flex Side Plate Operation

The flex side plates for both inlet and outlet are symmetrical. Pressure is fed behind each side plate into two kidney shaped cavities, which are sealed by special seal pack subassemblies. The two flex side plates and their associated kidney shaped cavities function in the following manner. As pressure builds up in the outlet, pressure also builds up in the cavities. The pressure in the cavities hold the flex side plates in hydrostatic balance against the rotor and provide optimum running clearances for minimum internal leakage and minimum friction. (See Figure 4)