SERVICE MANUAL

TRAVELIFT® CRANE

500/650AI

PART NO. S-406218M1

MI-JACK PRODUCTS
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WARNING!

Improper operation of this machine may result in injury or death. Before operating this machine study the following SAFETY RULES and read this manual thoroughly.

Look for this symbol which points out important safety precautions. It means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

SAFETY PRECAUTIONS

- Never smoke while refueling, servicing the fuel system, or working with batteries.
- Always use a non-flammable solvent for cleaning component parts. Do not use gasoline or other flammable substances.
- Storage batteries give off highly explosive hydrogen gas when being charged. Keep sparks and open flames away from them.
- If battery electrolyte contacts skin or clothing, flush immediately and thoroughly with water.
- Whenever servicing the machine, always tag mark the ignition switch to alert other operators and prevent accidental start-ups.
- Keep hands, feet, and loose clothing away from belts, pulleys and drive shafts when engine is running.
- Keep working area as clean as possible at all times. To prevent slips and falls, wipe up oil spills immediately.
- When working on the hydraulic system, be sure to relieve all pressure in the lines by working the controls back and forth several times before removing component.
- Always deflate tires before removing them from the machine for servicing. Tires can come apart with an explosive force if not handled properly.
- When servicing the cooling system, be sure to relieve pressure in the system by carefully turning the radiator cap to its first position before removing it completely.
- Wear proper safety equipment. Do not wear loose fitting clothing that may become entangled in machinery or will encumber your movement.
- Store tools, oil cans, replacement items, etc. in tool box or designated storage area. Do not allow these items to lie loose in the cab or on platforms.
- Have both hands free when climbing ladders. Carry tools or equipment in pockets or on belt or carry articles up on hand line.
- Always shut down the engine while refueling the machine.
- Face ladder when ascending or descending. Keep platforms and ladders free from grease or oil. Keep soles of your shoes clean.
- Keep fire extinguishers and first aid kit handy and know how to use them.
- De-energize all controls and circuits before working on the electrical system. Place tags marked, "Controls de-energized because maintenance is being performed – Do not re-energize", on all controls and switch boxes.
- Never grease, oil or perform maintenance with the engine running unless so instructed in this service manual.
- Report defective ladders or walkway to the appropriate authority.
- To prevent eye injuries wear safety glasses when servicing this machine.

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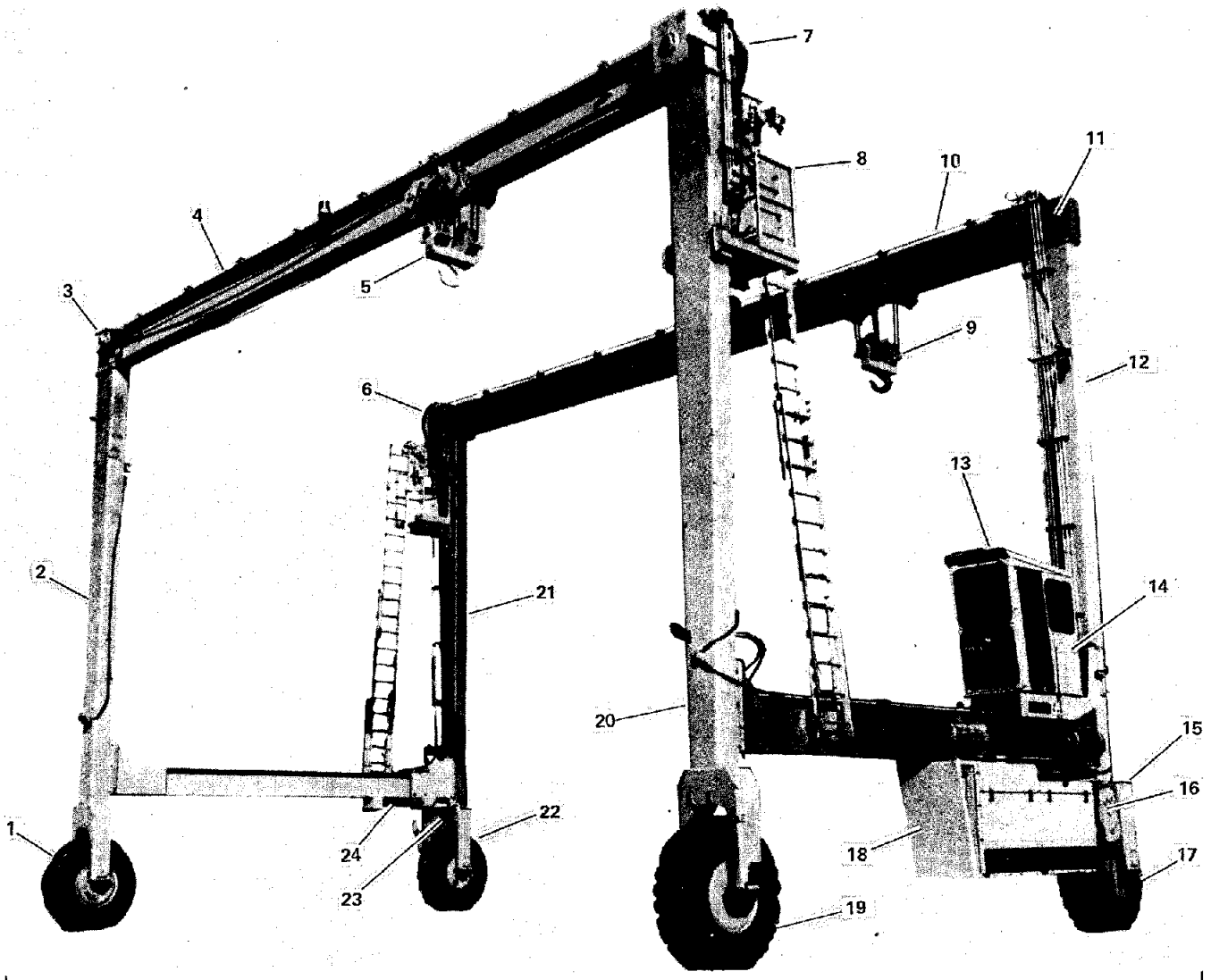

1. Right front wheel
2. Right front column and wheel yoke assembly
3. Front traverse reducer and motor
4. Front top beam
5. Front trolley and hoist block
6. Rear hoist transmission, motor and brake
7. Front hoist transmission, motor and brake
8. Column platform
9. Rear trolley and hoist block
10. Rear top beam
11. Rear traverse reducer and motor
12. Left rear column
13. Operator's cab
14. Main hydraulic valve location (behind cab)
15. Left rear wheel yoke
16. Left drive transmission, motor and brake
17. Left steer and drive wheel
18. Engine compartment — including:
    - A. Engine
    - B. Power steering pump
    - C. Pump drive transmission
    - D. Main hydraulic pumps
    - E. Hydraulic oil reservoir
    - F. Fuel tank
19. Right front wheel
20. Left front column and wheel yoke assembly
21. Right rear column
22. Right steer and drive wheel
23. Right drive transmission, motor and brake
24. Power steering cylinder

Figure 1. TRAVELIFT Nomenclature

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INTRODUCTION

GENERAL

This manual is a guide for maintaining and servicing the DROTT 500AI and 650AI TRAVELIFTS. All components and functions are thoroughly covered. For engine service, refer to the Manufacturer's manual.

This manual is divided into five sections: Introduction, Scheduled Preventive Maintenance, Service, Troubleshooting, and Component Disassembly and Repair. Torque values and hydraulic and electrical schematics are presented in the rear of the manual.

Directional Reference

All directional references are given in relation to the operator's seat. LEFT is to the operator's left, RIGHT is to the operator's right.

Parts and Service

When writing or calling the Dealer or Manufacturer for parts or service, always refer to the model and serial number of the machine as well as the part name and location.

DESCRIPTION

The basic nomenclature for the TRAVELIFT is shown in Figure 1. The functional flow diagrams for the 500AI TRAVELIFT and the 650AI TRAVELIFT are shown in Figures 2 and 3, respectively. Although operation of the two systems is virtually identical, for purposes of clarity, each is discussed separately below.

500AI Travelift

As is shown in Figure 2, the hydraulic system encompasses four basic operations: drive, steer, hoist and traverse. All power to perform these operations is supplied by the engine. Engine power is converted to hydraulic energy by the two main pumps located at the rear of the engine and by a single pump located ahead of the engine. The two main pumps feed both main control valve banks, which direct fluid to the proper drive motor, hoist motor, or traverse motor.

The traverse motor is coupled directly to the traverse gearbox which is connected by a drum and cable to the trolley. Operation of the individual traverse motors is accomplished by the operator through selection of the appropriate control valve and actuation of the pumps. It is important to note that the speed of any operation is controlled by the pumps — not the valves.

Hoist operation is accomplished in a similar manner, except that the hydraulic fluid is directed to the hoist counterbalance circuits enroute to the hoist motors. The function of the counterbalance circuit is to provide controlled lowering of the load.

The hoist system is also equipped with a spring-applied, hydraulically-released brake on the input shaft of the hoist gearbox. This means that the brake is applied to the input shaft at all times when the hoist system is not operating. When the hoist system is pressurized, hydraulic fluid from the hoist counterbalance circuit releases the brake.

Drive operation is again similar to the hoist and traverse systems. Selection of the appropriate control valve and actuation of the pumps directs hydraulic fluid to the drive motors, which converts the energy to mechanical energy via the gearboxes. As in the case of the hoist system, the drive gearbox is equipped with a spring-applied, hydraulic-released brake system. Brake release hydraulic fluid, in this case, is supplied from the single section gear pump located in front of the engine, via the operator-controlled parking brake control valve. Note that the drive gearboxes are also equipped with a standard automotive type service brake.

Steering is accomplished by means of double-acting cylinders mechanically linked to the rear wheel yokes. The cylinders are controlled by means of the steering orbitrol, which receives hydraulic fluid from the front gear pump. Supercharge pressure for the two variable displacement pumps is taken from the front gear pump.

650AI Travelift

As is shown in Figure 3, functional operation of the 650AI TRAVELIFT is essentially identical to the 500AI TRAVELIFT, with the exception of the supercharge circuit. The 650AI TRAVELIFT uses a two-section gear pump located ahead of the engine to supply steering hydraulic fluid and supercharge pressure to the variable displacement pumps.

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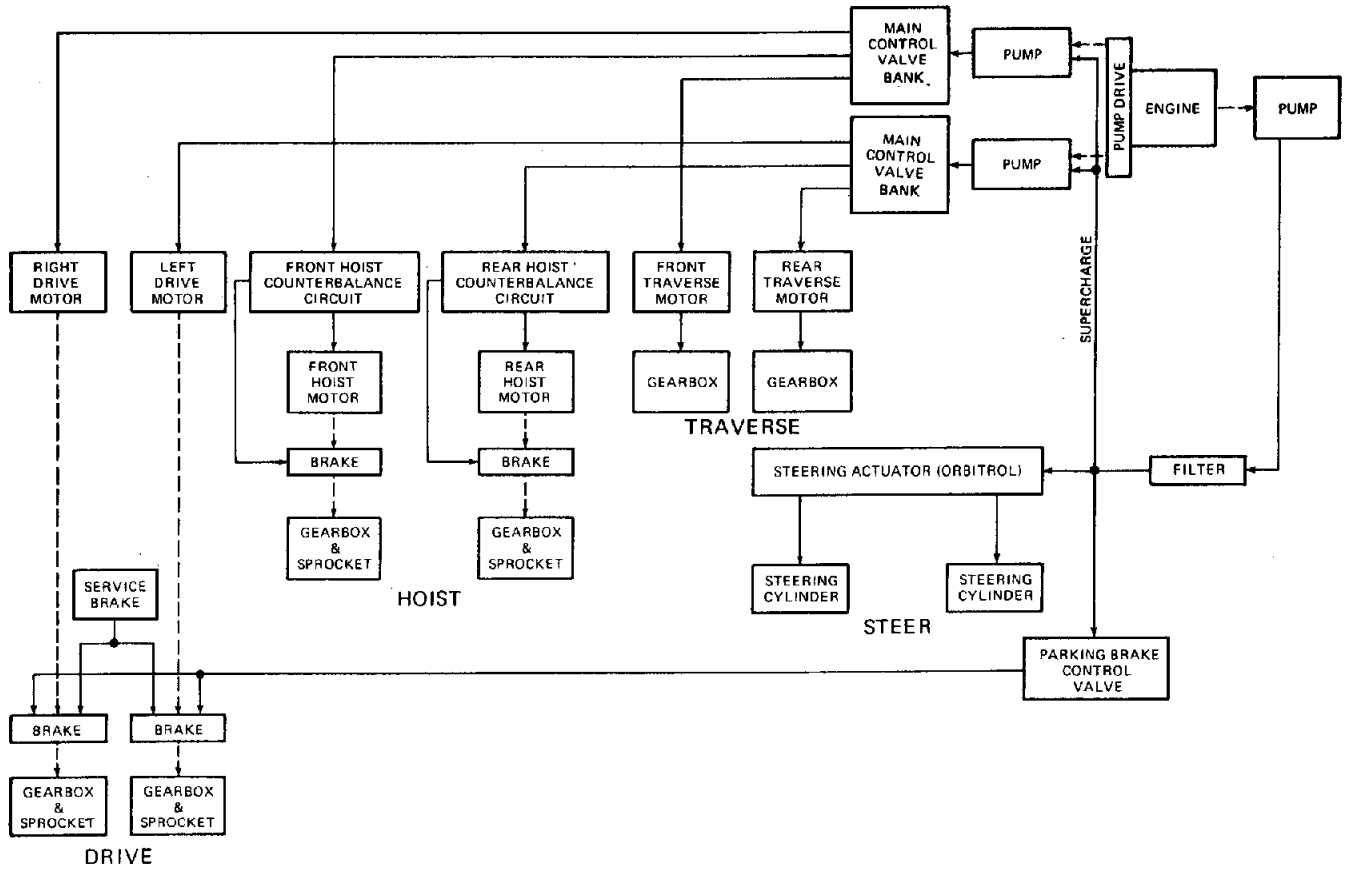

Figure 2. 500AI TRAVELIFT Flow Diagram

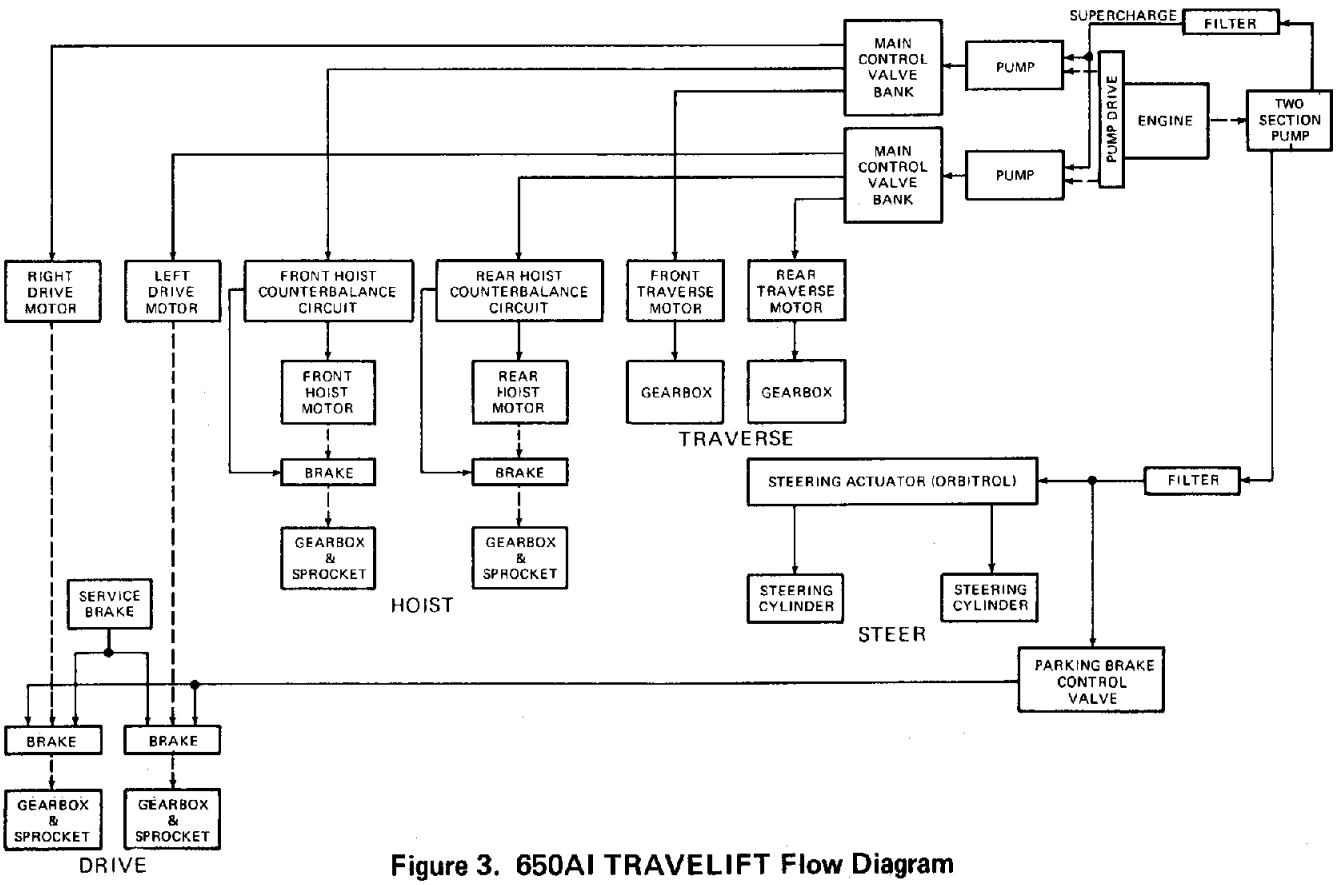

Figure 3. 650AI TRAVELIFT Flow Diagram

Courtesy of CraneMarket.com

SCHEDULED PREVENTIVE MAINTENANCE

INTRODUCTION

GENERAL

Scheduled preventive maintenance is essential to keeping the TRAVELIFT in top operating condition. Decide from the start upon a maintenance schedule that will best suit your particular needs. The type of work being done, the size of loads, and ground and weather conditions should all be taken into consideration when establishing a schedule.

Use the engine hourmeter along with a calendar and checklist to ensure that all recommended maintenance is performed at the prescribed intervals. Recommendations contained in this manual are based upon average operating conditions, and should be considered as MINIMUM maintenance requirements for the TRAVELIFT.

Depart from recommended intervals only when conditions warrant shortening them, or when changes in ambient temperature require it. Recommended intervals should be shortened whenever the machine is operated under extreme conditions, such as on a dusty job site, in extreme heat or cold, under intermittent operation or with extremely heavy loads.

SOUNDPROOFING INSULATION

Care must be taken when cleaning the cab interiors that have soundproofing insulation. To clean the insulating material, use only a vacuum cleaner or damp cloth with plain water or mild detergent solution.

DO NOT steam clean, wash or rinse with a water hose, etc., since only slight wetting of the insulation will substantially reduce its soundproofing capabilities.

SPARK ARRESTING MUFFLER

Laws of some states or provinces may require that this unit be equipped with a spark arrestor or spark muffler. The state of California, as an example, is one state which has such regulations for agricultural and forestry applications, plus a regulation for construction applications in forest-covered, brush-covered, or grass-covered lands.

Typically, such laws and regulations require spark arresting devices to be maintained in good working order and typically to be attached to the exhaust system on naturally aspirated engines (engines without a turbo-charger).

LUBRICANT AND FLUID RECOMMENDATIONS

LUBRICANTS

It is not the policy of DROTT Manufacturing to publish lists of approved lubricants or to guarantee lubricant performance. The responsibility for the quality of any lubricant rests solely with the lubricant Distributor or Manufacturer.

Throughout this manual, the statement "Use (lubricant brand name) or functional equivalent" is used. This statement does not constitute an unconditional guarantee of the performance of the brand of oil mentioned; it is intended only as a guide as to the type of lubricant recommended for a given application.

HYDRAULIC OIL

500AI Travelift

DROTT DHF Fluid is recommended for year-round use in the hydraulic system; or as an alternate, use SAE 10W (system temperatures 0° to 180°F −18° to 82°C), SAE 20-20W (system temperatures 50° to 210°F or 10° to 99°C), and SAE 5W or SAE 5W-20 (arctic conditions).

The viscosity of the oil at start-up should not exceed 4000 SSU or drop below 60 SSU for sustained high temperature operation. The optimum operating conditions are between 80 SSU and 180 SSU. The viscosity index should not be less than 90 (for this service).

Under arctic conditions the use of an auxiliary heater, a warm-up period avoiding high speed operation of hydraulic components until the system is warm, and the use of SAE 5W or SAE 5W-20 oils may be necessary, provided the viscosity requirements sustained high temperature operation are not exceeded at maximum temperatures. See paragraph on viscosity.

650AI Travelift

For later models of the 650AI TRAVELIFT, Drott recommends type "F" automatic transmission fluid for all year service in the hydraulic system. It has a viscosity of 3200 SUS at 0°F, (−18°C) and 57.2 SUS at 210°, (99°C) with an operating range between −15° to 200°F, (−26°C to 93°C). Type "F" fluid is used for initial Drott factory testing of these units. It is imperative that any fluid added is compatible with type "F". If entire hydraulic system is drained, refill with an equivalent fluid which meets Drott's requirements.

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COMPONENT CAPACITIES

Component/System	Capacity	Lubricant/Fluid
Fuel Tank	35 Gallons (132 liters)	Refer to engine Manufacturer's
Engine Cooling System	International UC-263 Gasoline 9 Gallons (34 liters) Ford 361 Gasoline 8-1/4 Gallons (31.2 liters) GMC 3-53 Diesel 7 Gallons (26.5 liters) GMC 4-53 Diesel 7-1/4 Gallons (26.7 liters)	Above 32°F (0°C) Distilled water with rust inhibitor. Below 32°F (0°C) Anti-freeze solution.
Engine Crankcase	International UC-263 Gasoline 8 Quarts (7.6 liters)* Ford 361 Gasoline 8 Quarts (7.6 liters)* GMC 3-53 Diesel 10-1/2 Quarts (9.9 liters)** GMC 4-53 Diesel 10-1/2 Quarts (9.9 liters)**	Refer to engine Manufacturer's Manual.
Hydraulic Reservoir	18 Gallons (68 liters)	Refer to "HYDRAULIC SYSTEM" section for hydraulic oil recommendations.
Complete Hydraulic System	35-50 Gallons depending on unit length and height (132-189 liters)	Refer to "HYDRAULIC SYSTEM" section for hydraulic oil recommendations.
Pump Drive Transmission	4.5 Quarts (4.25 liters)	E.P. 80-90 Gear Lube
Drive Gearbox	4 Quarts (3.8 liters)	SAE No. 30 Oil
Hoist Gearbox	4 Quarts (3.8 liters)	SAE No. 30 Oil
Traverse Gearbox	1 Quart (.9 liters)	SAE No. 140-5 Gear Lube
Master Brake Cylinder		Type "A" Brake Fluid must meet or exceed SAE Spec. J1703C
Lube Fittings		Lithium Base E.P. No. 2 Grease

*Add 1 quart (.9463 L) for filter. **Add 2 quarts (1.89 L) for filter.

HYDRAULIC SYSTEM OPERATING PRESSURES

Valve/Circuit	500AI	650AI
Supercharge	85 PSI ±25 (590 kPa ±170)	125 PSI ± (8625 kPa ±170)
Servo Control	300 PSI ±25 (2070 kPa ±170)	250 PSI ±25 (1725 kPa ±170)
Steering Valve	2000 PSI ±50 (13800 kPa ±345)	2000 PSI ±50 (13800 kPa ±345)
Main Relief Valve	2750 PSI ±50 (18975 kPa ±345)	2750 PSI ±50 (18975 kPa ±345)

ENGINE STALL CHART

		Low Idle	Max. No. Load	Max. Loaded
500AI				
I.H.C. UC-263	Gasoline	800 rpm	2600 rpm	2400 rpm
Detroit Diesel 3-53	Diesel	800 rpm	2700 rpm	2525 rpm
650AI				
Ford 361 V8	Gasoline	800 rpm	2600 rpm	2450 rpm
Detroit Diesel 4-53	Diesel	800 rpm	2600 rpm	2450 rpm

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MAINTENANCE SCHEDULE CHART

RUN-IN 10 HOURS

Engine oil and filters ..... See engine Manufacturer's handbook
Hydraulic oil filters ..... Change after 10 hours

DAILY OR EVERY 10 HOURS
(Pre-operational and Post-operational Checks)

Radiator ..... Check coolant level
Cab area ..... Check for cleanliness
Hydraulic filters ..... Check element condition on Visual Indicators
Hydraulic reservoir ..... Check for proper fluid level

WEEKLY OR EVERY 50 HOURS

Grease all fittings ..... Refer to Maintenance Schedule
Hoist and drive chains ..... Check tension
Clean with non-flammable solvent and oil with SAE No. 10 motor oil
When operating in dusty environment, clean daily with non-flammable solvent but do not lubricate
Battery electrolyte ..... Check specific gravity
Radiator coolant ..... Check specific gravity
Hoist and traverse cables ..... Inspect for wear, broken strands, etc.
Hoist cable ..... Clean and lubricate with SAE No. 10 motor oil
Traverse cable ..... Check tension. Do not lubricate
Tires ..... Check for proper inflation, general condition

MONTHLY OR EVERY 250 HOURS

Engine air filter element ..... Remove and clean. Change every 5th time
Pump drive transmission ..... Check oil level
Drive gearbox ..... Check oil level
Hoist gearbox ..... Check oil level
Traverse gearbox ..... Check oil level
Service brake master cylinder ..... Check fluid level
Structural members ..... Inspect for damage, corrosion, distortion, and loose nuts and bolts

EVERY 2 MONTHS OR 500 HOURS

Drive brake ..... Check for condition, adjust
Hydraulic oil filters ..... Replace elements
Wire rope sheaves ..... Inspect for corrugations, pinching grooves
Hoist mechanism ..... Remove hoist motor and check motor shaft for wear
Remove hoist brake and internal/external splined coupling
Inspect brake discs for wear. Check both spline and linings
Inspect splined coupling for wear
Check both internal and external splines
With brake removed, check transmission input shaft for wear

SEMI-ANNUALLY OR EVERY 1500 HOURS

Pump drive transmission ..... Change oil
Drive gearbox ..... Change oil
Hoist gearbox ..... Change oil
Traverse gearbox ..... Change oil
Hydraulic system ..... Drain and refill
Hydraulic tank outlet screen ..... Remove and clean

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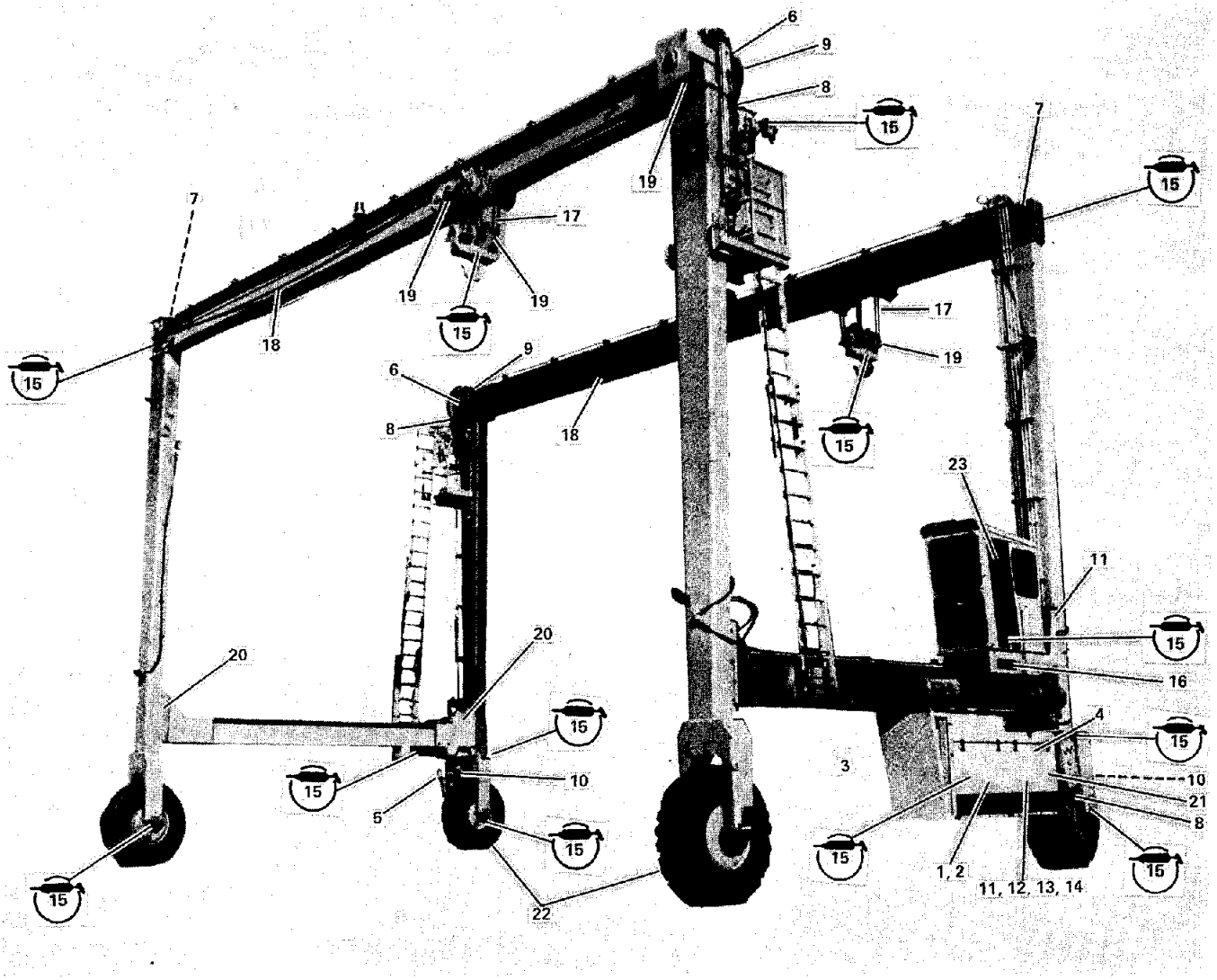

Figure 4. Service Points

Courtesy of CraneMarket.com

SERVICE CHART

1. ENGINE OIL AND FILTERS – (Run-in 10 hours) – See Engine Manual.
2. ENGINE AIR FILTER ELEMENT – (Monthly or 250 hours) – Remove and clean. Change every 5th time.
3. RADIATOR – (Daily or 10 hours) – Check coolant level. Check specific gravity weekly or 50 hours. Drain and flush system every six months or 1500 hours.
4. PUMP DRIVE TRANSMISSION – (Monthly or 250 hours) – Check oil level. Change oil every six months or 1500 hours.
5. DRIVE GEARBOX – (Monthly or 250 hours) – Check oil level. Change oil every six months or 1500 hours.
6. HOIST GEARBOX – (Monthly or 250 hours) – Check oil level. Change oil every six months or 1500 hours.
7. TRAVERSE GEARBOX – (Monthly or 250 hours) – Check oil level. Change oil every six months or 1500 hours.
8. HOIST AND DRIVE CHAINS – (Weekly or 50 hours) – Check tension. Clean with non-flammable solvent and oil with SAE No. 10 motor oil. In dusty environment, clean daily but do not lubricate.
9. HOIST MECHANISM – (Every 2 months or 500 hours) – Remove hoist motor and check motor shaft for wear. Remove hoist brake and internal/external splined coupling. Inspect brake discs and both internal and external splines for wear. With brake removed, check transmission input shaft for wear.
10. DRIVE BRAKE – (Every 2 months or 500 hours) – Check for condition, adjust.
11. HYDRAULIC OIL FILTERS – (Run-in 10 hours) – Change after 10 hours. Check element condition on Visual Indicators daily or 10 hours. Replace elements every two months or 500 hours.
12. HYDRAULIC RESERVOIR – (Daily or 10 hours) – Check for proper fluid level.
13. HYDRAULIC SYSTEM – (Every six months or 1500 hours) – Drain and refill.
14. HYDRAULIC TANK OUTLET SCREEN – (Every six months or 1500 hours) – Remove and clean.
15. PRESSURE GUN FITTINGS – (Weekly or 50 hours) – Use Lithium Base EP No. 2 grease.
16. SERVICE BRAKE MASTER CYLINDER – (Every month or 250 hour) – Check fluid level.
17. HOIST CABLE – (Weekly or 50 hours) – Inspect for wear, broken strands, etc. Clean and lubricate with SAE No. 10 motor oil.
18. TRAVERSE CABLE – (Weekly or 50 hours) – Inspect for wear, broken strands, etc. Check tension. Do not lubricate.
19. WIRE ROPE SHEAVES – (Every two months or 500 hours) – Inspect for corrugations, pinching grooves.
20. STRUCTURAL MEMBERS – (Monthly or 250 hours) – Inspect for damage, corrosion, distortion, and loose nuts and bolts.
21. BATTERY – (Weekly or 50 hours) Check electrolyte specific gravity and level, fill. Clean post periodically.
22. TIRES – (Weekly or 50 hours) – Check pressures. Keep inflated to 95 psi.
23. CAB AREA (Daily or 10 hours) – Check for cleanliness.

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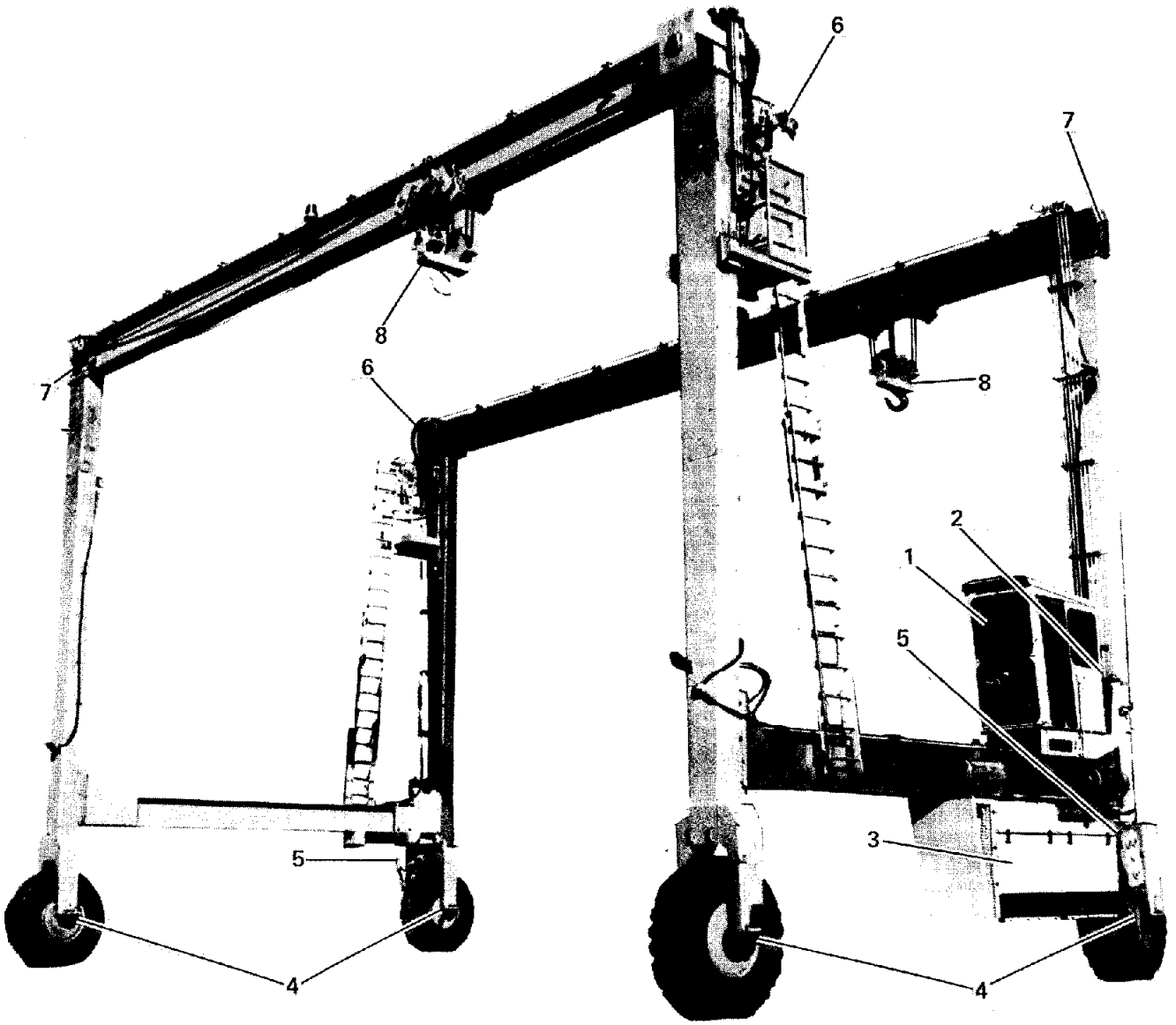

The following list of lubrication points is provided to serve as a guide to the location of the various grease fittings, and other areas which require lubrication. Use the list in conjunction with above illustration to locate the points on your particular TRAVELIFT which require lubrication. Lubricate all grease fittings on the machine weekly or every 500 hours, whichever occurs first. Use LITHIUM BASE EP NO. 2 grease for lubricating purposes.

No.	Location/Component	Qty.
1	Operator's Cab — Levers and Pedals	6
2	Rear of Operator's Cab — Bellcranks	6
3	Engine Compartment	
	Throttle Compartment	1
	Main Pump Linkage	2
	Power Steering Pump Drive Shaft	2
4	Wheels — Pillow Block Bearings (500AI)	8
5	Steering Linkage	12
6	Hoist Drum, Hoist Drive and Idler Sprocket Shafts (Front and Rear)	10
7	Traverse Drum Shafts (Front and Rear)	8
8	Hoist Block and Trolley Sheaves	37

Figure 4A. Lubrication Fitting Location Guide

Courtesy of CraneMarket.com

SERVICE

MECHANICAL SYSTEM

GENERAL

The mechanical system consists of all components and elements not hydraulically or electrically operated, and includes the engine and pump drive transmission, gear boxes, drive chains and sprockets, service brakes, tires, wire ropes and sheaves.

ENGINE

With the exceptions of the engine cooling system and the engine air breather system, all engine maintenance is covered in a separate engine manual which accompanies each machine. Refer to the engine manual specifications, maintenance tune-ups and governor adjustments.

For major servicing and overhaul, contact your nearest engine distributor.

Engine Cooling System

The entire cooling system should be inspected regularly and serviced at prescribed intervals. The TRAVELIFT cooling system is filled with a permanent type antifreeze solution of 1/2 water and 1/2 ethylene glycol base when shipped from the factory. Any high boiling point type antifreeze is suitable. However, sealant type antifreeze should be avoided.

NOTE: Antifreeze with sealer additives is not recommended for use with the Detroit Diesel engine due to plugging problems which can develop throughout the cooling system.

A non-chromate type inhibitor is recommended for use with either water or the ethylene glycol base solution to retard rust and scale buildup within the cooling system. Borates, nitrates and nitrites are acceptable corrosion inhibitors. Do not use chromates or soluble oil as corrosion inhibitors.

All corrosion inhibitors dissipate under normal operating conditions and should therefore be replenished at approximately 500 hour intervals. Check radiator coolant level daily. Coolant level should be within 2" of the top of the filler neck.

WARNING: When checking coolant level, remove cap slowly to relieve pressure within the system.

If coolant is consistently low, check for leaks in the radiator or connecting hoses. Clean radiator fins at least once a week, using compressed air. Check fan belts for fray, proper tension and alignment. Be sure radiator cap and thermostats are functioning properly.

Drain and flush cooling system twice a year, preferably in the spring and fall. Use the following procedure:

1. Open radiator petcock or remove lower hose and allow the system to drain completely.
2. Close petcock and refill system with water.

IMPORTANT: If engine is hot, refill slowly to prevent rapid cooling and distortion of engine castings.

3. Run engine for approximately 15 minutes to circulate water throughout the system and again drain system completely.
4. Refill with recommended coolant, and operate engine for several minutes to circulate the coolant. Recheck coolant level.

For further information on thermostat replacement and cooling system maintenance, refer to the engine manual.

Engine Air Breather System

The air cleaner is designed to supply an adequate amount of clean air for engine operation. Loose connections, damaged hoses or a clogged filter element defeat the purpose of the air cleaner and can result in extensive wear on the engine.

Remove filter element every two weeks or every 100 hours, and clean as instructed below. Check dust accumulation in air cleaner dust tube weekly, or under extremely dusty conditions, at shorter intervals. An over-abundance of dust in the collector tube indicates a need for additional service.

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SERVICE

The air cleaner element should be replaced after five cleanings or every 500 hours, whichever occurs first.

> NOTE: The engine should never be operated without an element in the air cleaner, or with the dust collector tube removed.

To service the element or air cleaner, refer to Figure 5 and proceed as follows:

1. Remove and wash intake cap, and dry with compressed air.
2. Unscrew element lock nut and remove filter element. Clean inside of element housing with damp cloth.
3. Clean the element either by tapping it against the palm of the hand and blowing from inside out with compressed air, or by rinsing it in a solution of non-sudsing detergent (do not use hot water) and then shaking out excess solution and letting it dry.

> NOTE: To speed drying process, insert damp element into housing and run engine (away from dust) for about ten minutes.

4. Inspect the element by holding a lighted bulb inside the element. Weak spots may be detected by noting where light shows through with more intensity. If weak spots are apparent, replace the element.

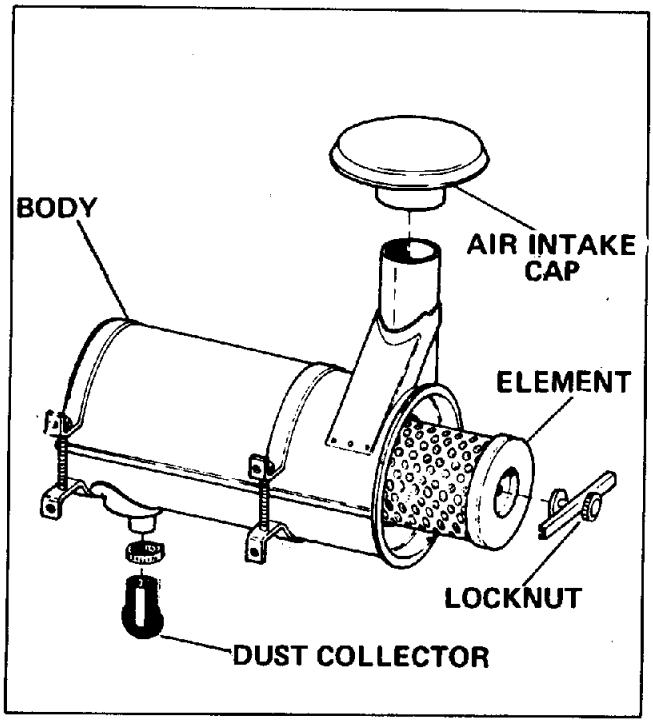

Figure 5. Engine Air Cleaner

Engine Performance Check

Engine performance affects the performance of the entire machine. Proper throttle linkage adjustment is essential to obtain the recommended range of engine rpm as shown in the engine stall chart. Maximum governed rpm is determined by running engine at full throttle under minimum load conditions (all controls in neutral).

> NOTE: The engine and hydraulic oil should be warmed to operating temperature before any performance checks are made.

To check engine rpm, use a strob-tachometer aimed at a chalk mark on the engine crankshaft pulley. Make sure that the RED wire of the strob-tachometer is connected to the POSITIVE (+) or "hot" terminal from the battery, and the BLACK wire to the NEGATIVE (–) or "ground" terminal of the battery. Aim the timing light at chalk mark on engine crankshaft pulley, then adjust strob-tachometer until timing light "stops" chalk mark. Read tachometer.

> NOTE: If throttle linkage is suspected malfunction, disconnect the linkage and work engine governor lever by hand. Check engine speeds obtained in this manner against speeds obtained with throttle linkage connected.

PUMP DRIVE TRANSMISSION

The pump drive transmission is located directly behind the engine (see Figure 6 and 7). The function of this unit is to convert engine power into hydraulic energy by driving the two main pumps.

Check the transmission oil level every 250 hours or every month, whichever occurs first. Replenish with EP-90 oil as required.

Drain and refill the transmission every 1500 hours or six months, whichever occurs first. Check for metal particles or discolered oil, which indicates excessive parts wear and overheating.

GEARBOXES

The gearboxes convert hydraulic energy into mechanical energy to operate the drive, hoist and traverse mechanisms. Except for their output shafts, the drive and hoist gear boxes are identical.

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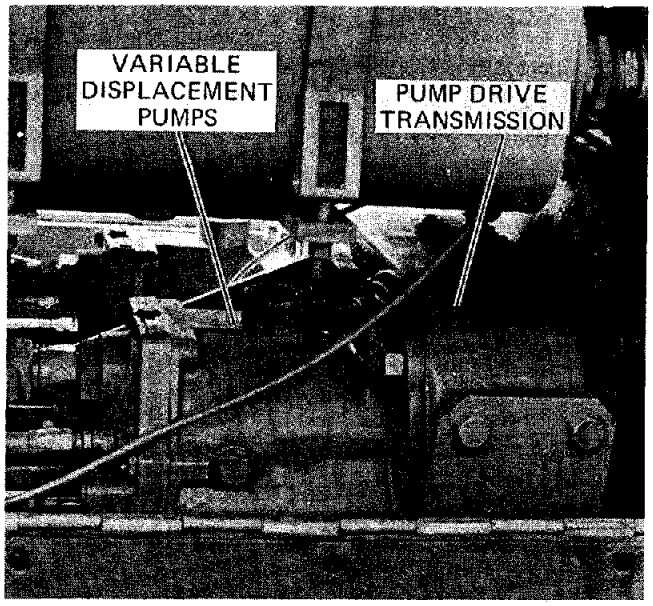


Figure 6. Pump Drive Transmission (500AI)

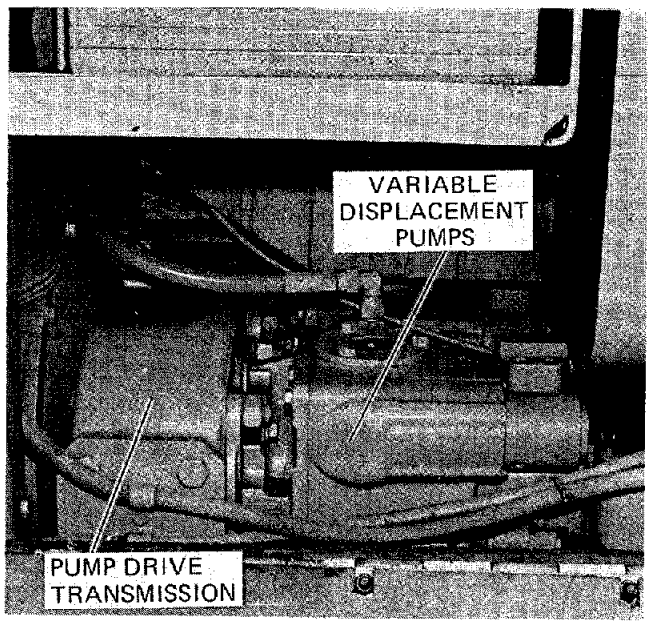


Figure 7. Pump Drive Transmission (650AI)

Drive Gearbox

The drive gearboxes are mounted on the left and right steering yokes (Figure 8). Service the gearbox as follows:

1. Check oil level of gearbox every 250 hours or every month, whichever occurs first. Fill, check and drain plugs are indicated in Figure 8. Replenish with No. 30 motor oil as required.
2. Drain and refill gearbox every 1500 hours or six months, whichever occurs first. Check for metal particles or discolored oil, which would indicate the need for service.

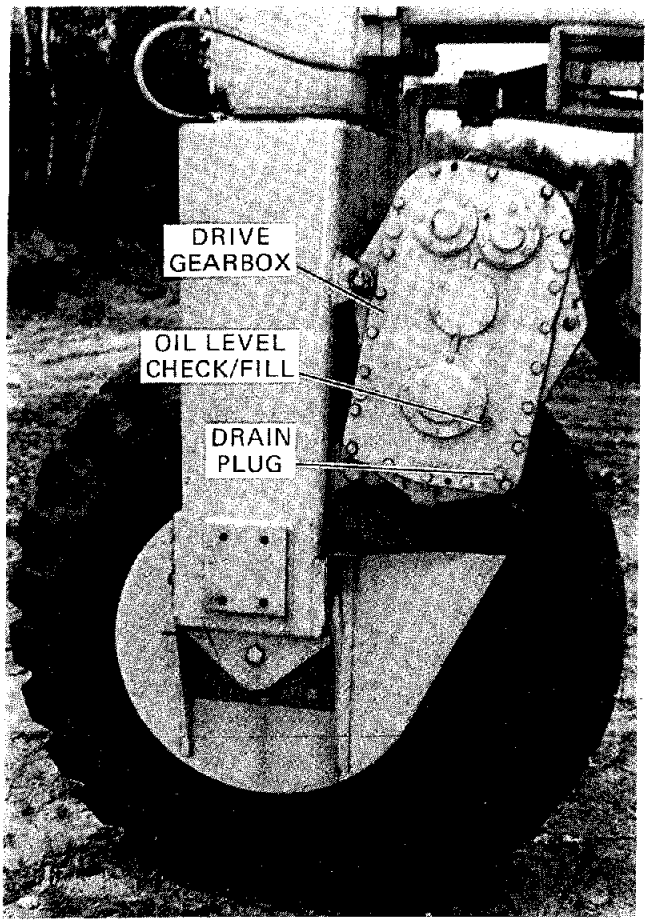


Figure 8. Drive Gearbox

Hoist Gearbox

The hoist gearboxes are located on the top beams (Figure 9). Service the gearbox as follows:

CAUTION: Before working on the hoist mechanism, unload the hoisting system by lowering the hoist block until it rests on a suitable support.

1. Check the level of lubricating oil every 250 hours or one month, whichever occurs first. Replenish with No. 30 motor oil, as required.
2. Drain and refill the gearbox every 1500 hours or six months, whichever occurs first. Check for metal particles or discolored oil which indicate the need for further service.
3. Remove the hoist motor every 500 hours and check shaft for wear. Because of constant use and stress of loads, motor shaft failure will be alleviated by a periodic check of the shaft for wear, proper fit, etc.

Courtesy of CraneMarket.com

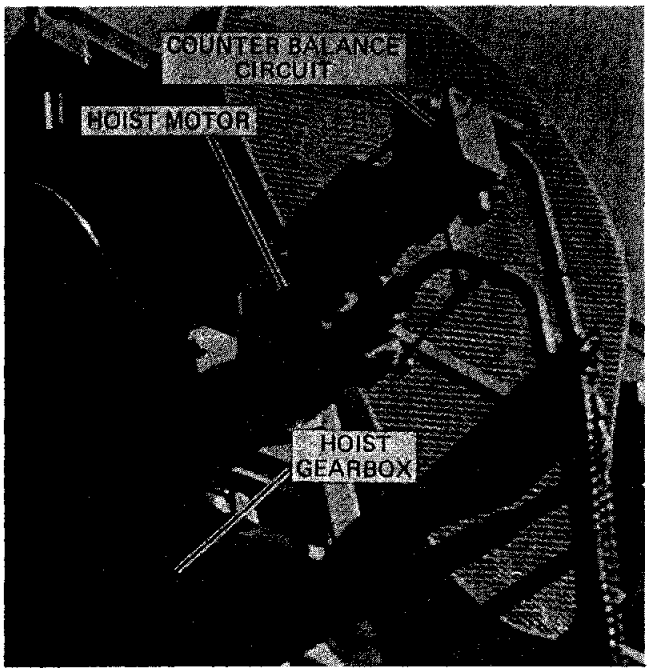


Figure 9. Hoist Gearbox "Earlier Models Only"

Traverse Gearbox

The traverse gearboxes are located on the top beams (Figure 10). Service the gearhoxes as follows:

1. Check the level of oil every 250 hours or one month, whichever occurs first. Add No. 140-5 worm gear lube if needed.
2. Drain and refill the gearbox every 1500 hours or six months, whichever occurs first. Check for metal particles or discolored oil which would indicate a need for service.

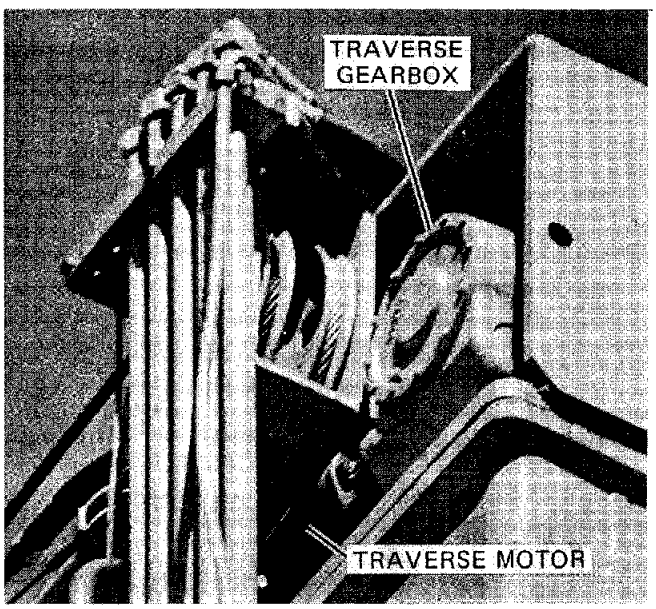


Figure 10. Traverse Gearbox

DRIVE CHAINS AND SPROCKETS

The drive chains and sprockets are the mechanical linkage between the drive gearbox and wheels, and should be serviced regularly as described below.,

Drive Chain

To ensure proper operation and maximum wear life, the drive chain must be correctly aligned, should have proper tension (Figure 11), and should be lubricated at regular intervals.

Caked lubricants, trapped dirt and grit must be removed periodically to assure maximum sprocket and chain life. When necessary, remove chain and wash it and sprockets in non-flammable solvent. When removal is impractical, use a swab or brush, brush dry. Allow cleaning fluid to drain off and evaporate. If available, steam clean chains and sprockets. After cleaning, check chains and sprockets for signs of wear, and corrosion.

After chains and sprockets have been cleaned thoroughly, soak chain in SAE 40 oil to restore lubricating film to chain moving parts. If removal is impractical, apply oil with swab, brush or oil can. Allow excess oil to drain off before using TRAVELIFT. When operating in dusty conditions clean drive chains daily, then lubricate sparingly with light machine oil.

> NOTE: Heavy oil applied to the outside of the chain may not reach working parts and will only catch grit when operating under dusty or dirty conditions.

Tighten drive chain for zero slack, without excessive tightness. This provides positive drive action when reversing TRAVELIFT direction. Adjust clevis bolt (Figure 9) at lower end of drive gearbox to achieve proper chain tension.

Drive Sprockets

Drive sprockets (Figure 12) should be inspected regularly for wear and proper alignment. Never run new chain over sprockets with worn or hooked teeth. Worn chains should never be used on new sprockets. Sprocket pitch and chain pitch are affected by wear. Inspect sprockets as follows:

1. Check chain and sprocket to determine each has the same pitch.
2. Check that sprocket shafts are level and parallel.
3. Check that sprockets are mounted squarely and securely on their shafts.

Courtesy of CraneMarket.com

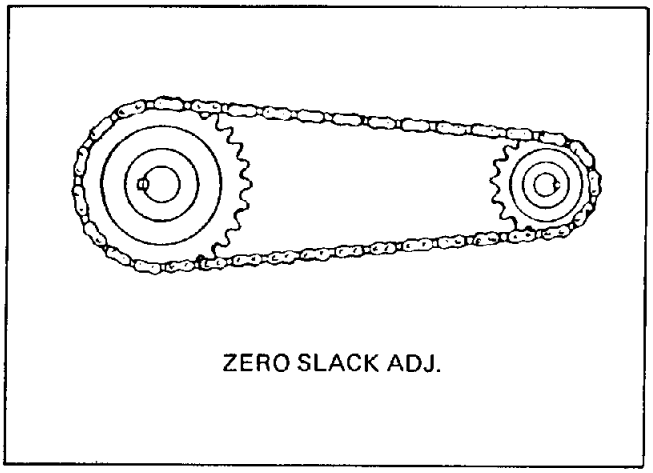
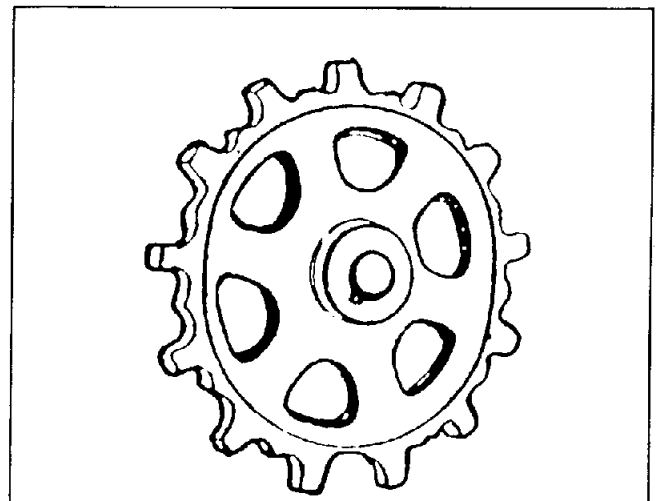


Figure 11. Drive Chain Adjustment



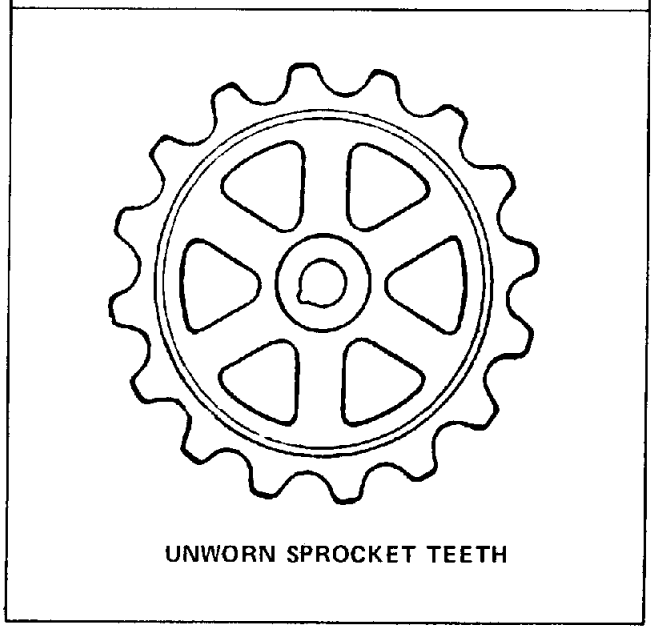


Figure 12. Drive Sprockets

SERVICE BRAKES

The TRAVELIFT is equipped with a standard automotive-type service brake to permit braking during drive operation. The service brake is operated by the foot pedal located on the cab floor to the left of the steering column. The master cylinder (Figure 13), located under the operator's cab floor, when actuated by the foot pedal supplies hydraulic fluid under pressure to the brake cylinders on the brake housings. Note that the hydraulic system used for the service brakes is independent of the main hydraulic system.

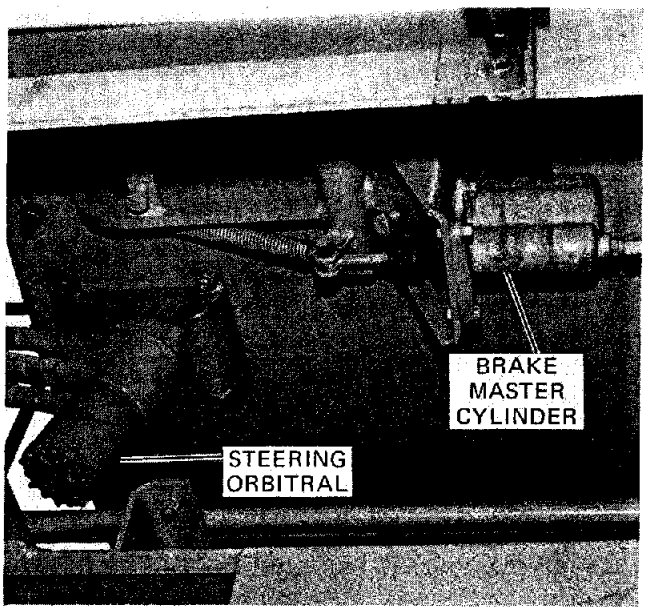


Figure 13. Service Brake Master Cylinder

Service Brake Pedal Adjustment

The service brake pedal should be adjusted to approximately 2 inches (5.08 cm) of free movement at the tread portion of the pedal before the pressure stroke begins. This free-movement allows the master cylinder piston and cup to return and uncover the compensating port thereby allowing the brakes to fully release. Second, it allows for fluid expansion caused by heat, which may otherwise cause self-application of the brake.

Bleeding the Brake System

It is necessary to bleed the brake system whenever the brake line is removed and reconnected to the master cylinder or brake slave cylinder. The system is bled at the bleed fitting on the brake slave cylinder. Bleed brake system as follows:

1. Thoroughly clean around the bleed fitting in the brake slave cylinder, and around the brake master cylinder filler cap.

Courtesy of CraneMarket.com

2. Be sure master cylinder reservoir is full of clean fluid that is free of air bubbles.
3. Slip a hose over the end of the bleed fitting on the slave cylinder. Submerge the other end in a glass jar partly filled with brake fluid, so that air bubbles escaping from hydraulic system can be seen.
4. Open bleed fitting on slave cylinder and slowly depress brake pedal.
5. When pedal is all the way down, close bleed fitting.
6. Check master cylinder for fluid level and fill if necessary.
7. Repeat Steps 4, 5 and 6 until air is removed from brake system. Remove bleed hose.
8. Fill master cylinder reservoir with clean fluid to within 3/4" of top. Replace cap.

NOTE: Keep reservoir at least half full when bleeding system. If reservoir is drained during bleeding, air will again enter the system, requiring re-bleeding.

Master Cylinder

If the brake pedal descends slowly to the end of its stroke when pushed hard, without visible external leakage, check for a worn cup in the master cylinder. Refer to the Troubleshooting Section of this manual for other malfunctions concerning the master cylinder.

TIRES

Tires should be checked for wear, cuts or other damage that may lead to tire failure at regular intervals. The recommended tire pressure is 95 psi (653 kPa).

WIRE ROPES AND SHEAVES

Wire Rope Inspection

All wire ropes should be inspected over their entire length at least once each week. The object of this inspection is to determine the degree of deterioration at the worst rope lay. A rope lay is that length of rope in which one strand makes a complete revolution about the core. In general, the time for rope removal is indicated by a marked reduction in rope diameter, evidence of excessive abrasion on the outside of the wires, broken outside wires, or indications of severe corrosion.

Wire rope should be taken out of service when one of the following conditions exist:

1. In rigging ropes, six randomly distributed broken wires in one lay, or three broken wires in one strand in one lay.
2. Wear of 1/3 the original diameter of outside individual wires, bird caging or other damage resulting in distortion of the rope structure.
3. Evidence of heat damage.
4. Reductions from nominal diameter of more than 3/64 in. (4.76 mm) for diameters 9/16 in. (14.29 mm) up to and including 3/4 in. (19.05 mm). Wire rope size on the 500AI and 650AI TRAVELIFT is 5/8 in. (15.875 mm).
5. In standing ropes, more than two broken wires in one lay in section beyond end connections or more than one broken wire at one end connection (dead end plug).

Hoist Wire Rope

Wire rope, even if properly lubricated and maintained will eventually wear and deteriorate to a point where it is no longer serviceable. The three basic causes of rope deterioration are abrasion and wear, corrosion, and fatigue, resulting from pulling, bending, crushing or kinking forces acting upon the rope during normal service.

While these causes cannot be eliminated, they can be minimized to ensure longest possible safe service life of the rope. Proper maintenance entails:

1. Thorough inspection at regular intervals.
2. Proper lubrication at regular intervals.
3. Proper maintenance of sheaves over which the rope must pass.

Hoist Wire Rope Lubrication

Wire ropes, unless otherwise ordered, usually are internally and externally lubricated during fabrication with a material that retains its effectiveness for long periods of time under normal service conditions. The original lubrication should be replenished with periodic applications of a good lubricant for maximum protection to the rope and sheaves and to get the most efficient performance. The lubricant should be thin enough to penetrate the strands to the core, but not so thin that it will run off the rope. Suggested methods of lubricating the rope are as follows:

1. The rope should be clean and dry before lubrication. Clean with jet of air, steam, or wire brush. Allow rope to dry.

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2. The following are some of the simple and effective methods of applying lubrication. Use the most convenient method.
   a. Apply with narrow paint roller, paint brush or swab or with rags or a piece of sheepskin.
   b. Use leather gloves to dip dressing from bucket and apply to rope.
   c. Make a simple lubricating device such as a wooden trough with a sheave mounted in the center and at both ends. Run wire rope over one end of sheave, through trough under center sheave, and out over end sheave. Hold cloth at outgoing end to wipe off excess lubricant.

Hoist Wire Rope Sheaves

To assure maximum wire rope life, sheave grooves must be smooth and slightly larger than the diameter of the rope to prevent pinching and excessive wear. Inspect sheaves every 500 hours of operation as follows:

1. Check that the sheave runs true and does not wobble on its bearing.
2. Keep the groove free from roughness or burrs of any kind.
3. Make sure the groove is larger than the wire rope.
4. Make sure replacement sheaves have grooves that are proper size for rope. Sheaves should be made of material that will stand up under rope pressure encountered.

Removing Hoist Wire Rope

Detach rope at hoist drum by removing wedge. Detach other end of cable by disconnecting dead end at hoist drum. Pull wire rope over sheaves.

If the wire rope is to be unwound from a coil, the free end of the coil should be held and the coil rolled on the ground like a hoop. If the coil does not rotate, the rope will be twisted as it is uncoiled, and kinking will result.

Reaving Hoist Wire Rope

There is no established procedure for stringing the hoist wire rope. However, the method most commonly used is to string the wire rope over the first sheave from the drum, then running it to the drum and securing it there (refer to Figures 14 through 17). Bring the end of the rope through the drum, form a loop and insert drum wedge. Then snug up to slot in drum. Continue stringing wire rope over sheaves and secure dead end to top beam.

A brief break-in period under light loads and slow speeds will result in better spooling, more efficient performance and longer wire rope life. Break in rope as follows:

1. Check sheaves, drums, etc. to determine that they are in good repair and operate properly.
2. Check that rope is firmly anchored to the equipment.
3. After rope is attached and reaved around the sheaves and drums, operate it with a light load several times. Check that rope is flexing easily over sheaves and winds correctly on the drums.
4. Gradually increase the line speed and load until unit is operating at capacity.
5. Check for corrugations in sheave which indicates that the sheave is too small or the material in sheave is too soft.

> **NOTE:** A sheave groove usually wears smaller, not larger. The deeper a sheave is worn, the more it pinches the rope and increases friction.

Traverse Wire Rope

The traverse wire rope should be kept tight enough to prevent slippage at the traverse drum when the trolley reaches the limit stop. If the rope becomes slack, slippage will occur at the traverse drum and cause excessive drum and cable wear. If the traverse wire rope is too tight, excessive drum and sheave bearing wear will occur.

Maintenance of the traverse wire rope is essentially identical to that described under the hoist system, except that the traverse wire rope should NEVER be lubricated.

Replacing Traverse Wire Rope

To replace the traverse wire rope remove traverse cable by disconnecting the dead ends at the trolley and pulling rope over the drums and idler sheave. Pass one end of wire rope over idler sheave and attach end of rope over and around traverse drums and attach dead end to trolley (refer to Figures 14 through 17). Tighten dead ends so rope is tight and without deflection.

> **NOTE:** Check traverse wire rope tension daily for first week of operation after replacement.

Courtesy of CraneMarket.com

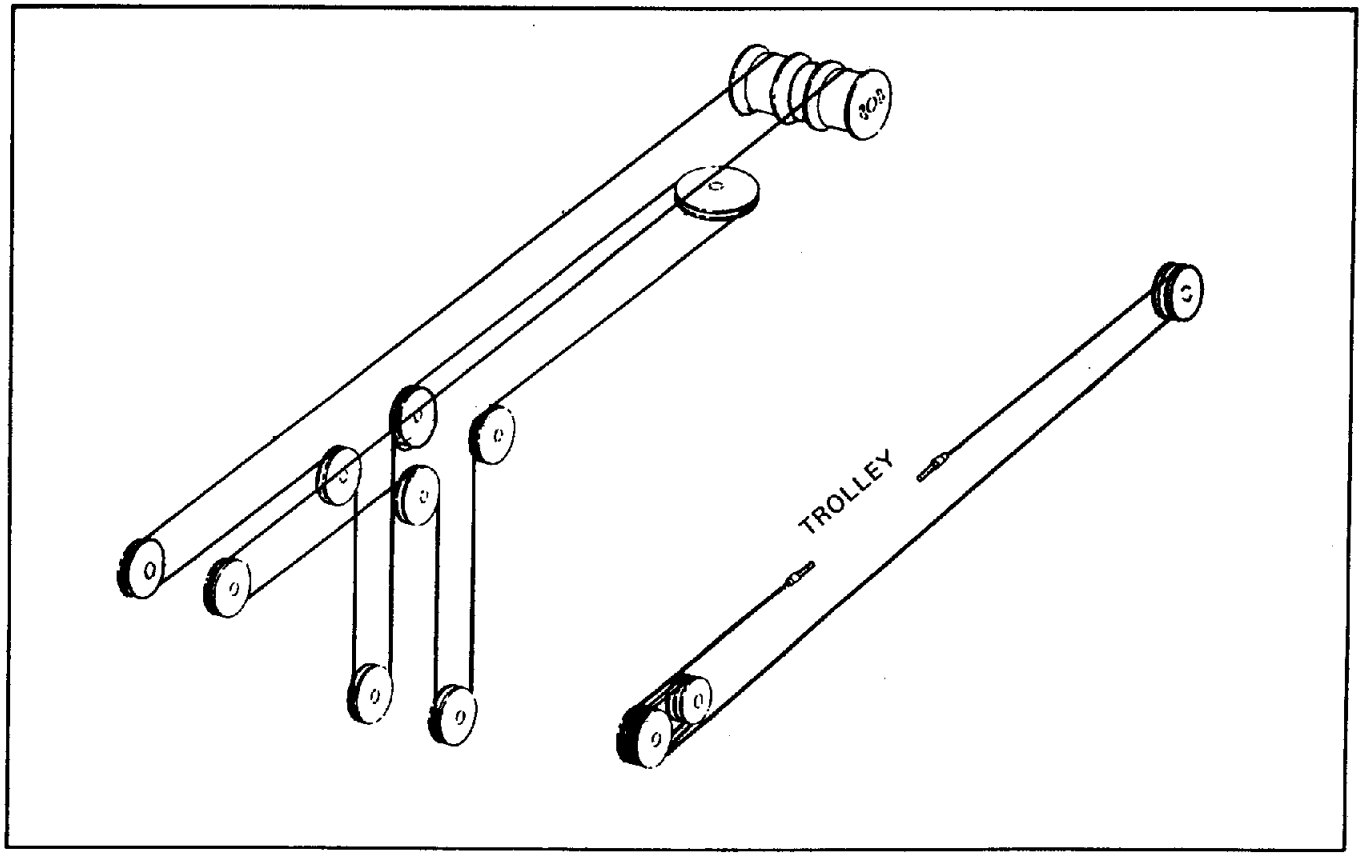

Figure 14. Hoist and Traverse Rigging, Single Trolley (500AI)

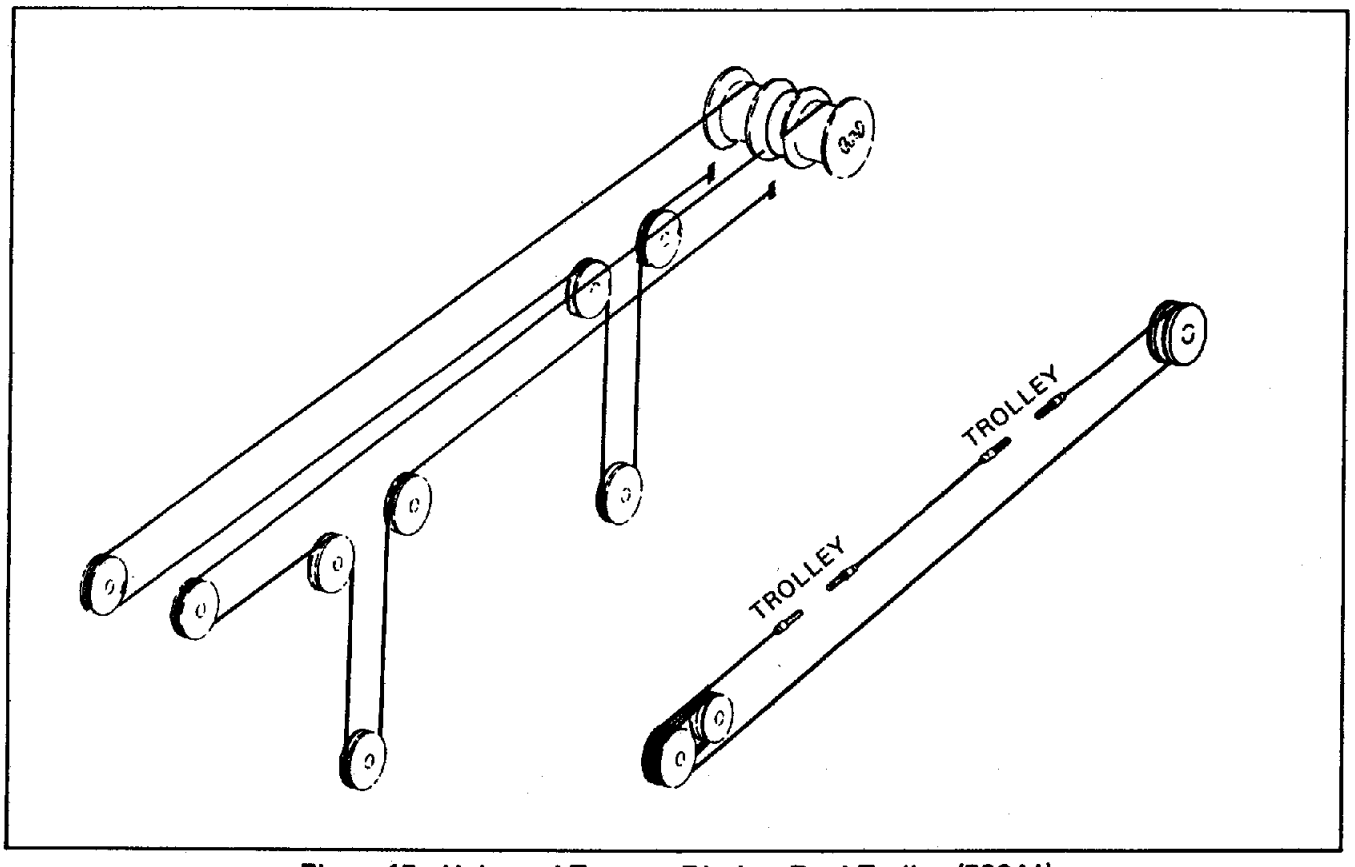

Figure 15. Hoist and Traverse Rigging, Dual Trolley (500AI)

Courtesy of CraneMarket.com

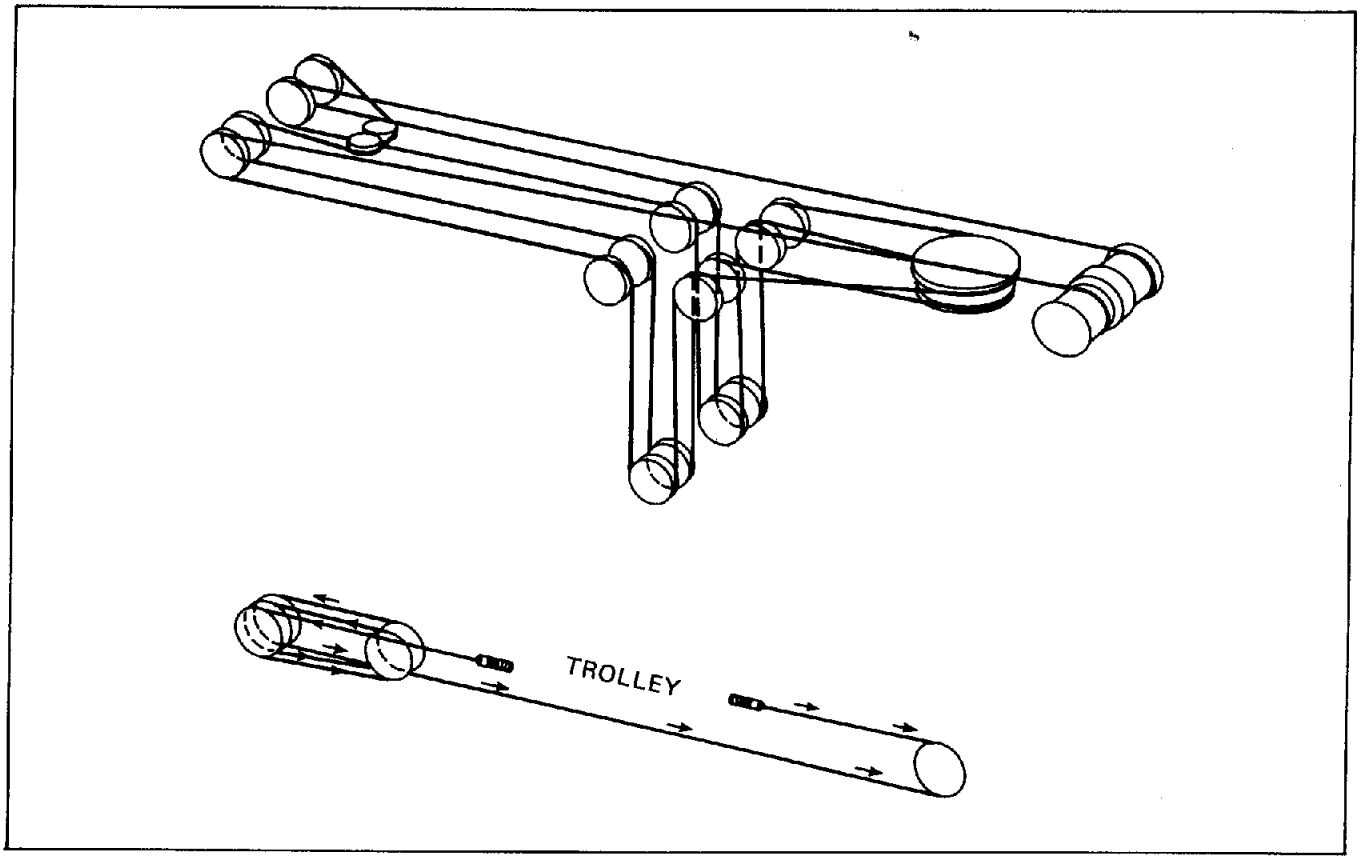

Figure 16. Hoist and Traverse Rigging, Single Trolley (650AI)

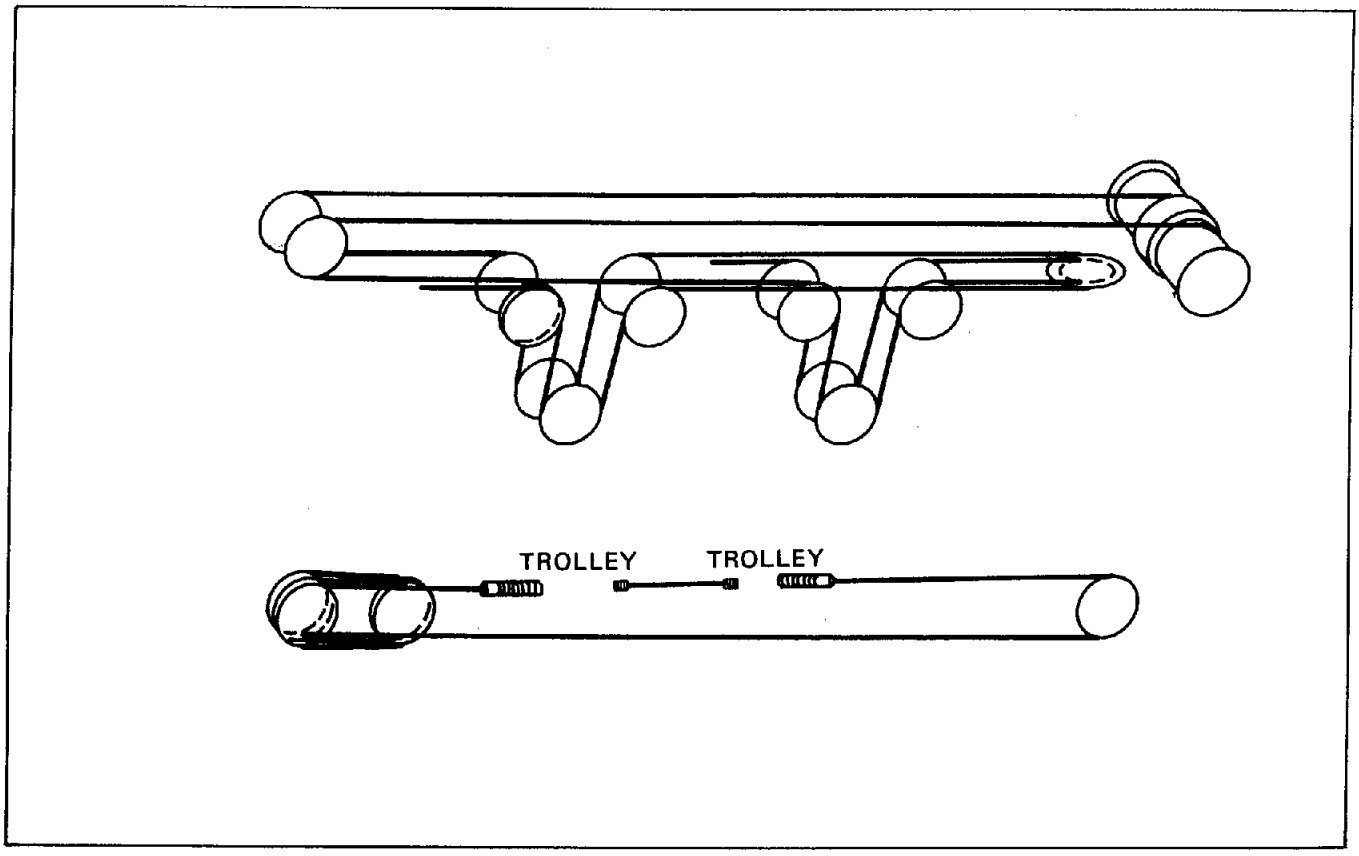

Figure 17. Hoist and Traverse Rigging, Dual Trolley (650AI)

Courtesy of CraneMarket.com

ELECTRICAL SYSTEM

INTRODUCTION

A few basic terms and facts are offered here to aid in understanding the electrical system.

Electrical Energy – energy caused by electron flow. Electrons are negatively-charged particles which are attracted to positively charged particles called protons.

Amperage – rate of flow of electrons, measured in Amps.

Voltage – the electromotive force which propels electrons through an electrical circuit, measured in Volts.

Electrical Resistance – any opposition to the flow of electrons, measured in Ohms.

Important Facts: The following points should be kept in mind when testing or analyzing an electrical problem.

1. Current always flows from positive (+) to negative (–) or from the point of highest potential. (Conventional Theory).
2. All current that leaves the source or battery returns to the source or battery.
3. In a series circuit arrangement, the electromotive force (Volts) is completely used up or dropped around the circuit, when current is flowing. In parallel circuit arrangements, the voltage remains constant.
4. When voltage remains constant, resistance (Ohms) determines the current flow (amps) in an electrical circuit. In other words, current (DC) is directly proportional to the voltage and inversely proportional to the resistance in a circuit.

The electrical system is in many ways similar to the hydraulic system. Both require a "pump" to cause the flow which creates energy. Each requires a complete circuit to bring the flow back to storage or supply. Both require "valves" to direct and control the flow through the system. Some of these similarities are shown below.

Electrical System	Hydraulic System
Alternator	Pump
Battery	Reservoir
Switches	Valves
Wires or Cables	Tubes or Hoses
Diodes	Check Valves
Volts	PSI or kPa
Amps	GPM or l/m
Ohms	Resistance

TRAVELIFT ELECTRICAL SYSTEM

The TRAVELIFT electrical system is a 12 volt direct current, grounded system. One or more 12 volt, 90 amp, 78 plate Batteries, connected in parallel, provide power to the system. An alternator provides current to operate system components and recharge the batteries when the engine is running. An ammeter, wired into the system, gives a constant reading of alternator output. Two main wiring harnesses, engine and main frame, are used to deliver power to all the circuits of the system.

Circuit overload protection is provided by a circuit breaker. The circuit breaker is of the thermal type and will reset automatically. If it fails to reset, it must be replaced.

A charging circuit provides power for the operation of lights, instruments and electrical accessories, as well as to maintain a charge in the batteries. The charging circuit consists of the alternator, voltage regulator, batteries, ammeter and connecting wires.

The Lead-acid type batteries have three major functions:

1. To provide a source of electrical power for starting the engine.
2. To act as a stabilizer to the voltage in the system.
3. To furnish current when the electrical demands of the unit exceed the alternator output.

Precautions must be taken when working on or around charging system components. The diodes in the circuit are extremely sensitive and easily damaged. The following precautions must be observed:

1. Avoid grounding output or field wires between the alternator and voltage regulator. These wires are always "hot", regardless of whether the engine is running, and grounding them can damage alternator diodes.
2. Never reverse battery connections, and never attempt to polarize an alternator. The diodes maintain correct polarization.
3. Never operate an alternator on an "open" circuit.
4. Never disconnect batteries while the alternator is in operation. This results in a momentary high voltage condition and damages the diodes.

Courtesy of CraneMarket.com

5. If a booster battery must be used, be sure batteries are properly connected (positive to positive and negative to negative). Make sure the alternator field connection is disconnected before connecting a booster battery.
6. Never use a charger with the batteries connected, or as a booster for battery output.
7. Alternator diodes are extremely sensitive to heat. Keep all heat sources away from the alternator.

WARNING: Keep flame and sparks from Batteries. Never smoke near them. The hydrogen gas generated by batteries is extremely flammable. Charge batteries in a well ventilated area.

A schematic of the electrical system is presented at the rear of this manual.

BATTERIES

Check electrolyte level regularly. Check the level more frequently in hot weather, especially during long runs or shifts. Fill with distilled water to the split ring in the bottom of the vent well. Never overfill, since this will cause poor performance and early failure. Clean battery tops, posts and clamps with baking soda and flush with clear water.

IMPORTANT: Do not allow soda solution to enter the battery.

Addition to acid is necessary if electrolyte has been lost through leakage. Before adding acid, be sure batteries are fully charged. Put the batteries on charger and take hourly specific gravity readings on each cell. When all cells are gassing freely and three successive hourly readings show no rise in specific gravity, the batteries are considered charged, and additional acid may now be added. Continue charging for another hour and again check specific gravity. Repeat this procedure until all cells indicate a specific gravity of 1.260 to 1.265 corrected to 80° F (26.6°C).

NOTE: Use 1.400 strength when making specific gravity adjustments. Acid of higher strength will attack the plates and separators before it has a chance to diffuse into solution.

CAUTION: Battery electrolyte is sulphuric acid solution. Be careful not to spill on skin, clothing, paint, or other objects.

ALTERNATOR

Inspect slip rings and brushes periodically, or when a malfunction is suspected. Slip rings can be inspected through the end frame. If dirty, clean with 400 grain or finer polishing cloth. NEVER USE EMERY CLOTH TO CLEAN SLIP RINGS. Hold the polishing cloth against the slip rings and turn alternator by hand. Blow away all dust after cleaning. If slip rings are rough or out of round have them replaced.

Inspect for proper V-belt tension. Make sure the alternator rotates freely. It is recommended that major alternator repairs be accomplished at an automotive repair facility.

VOLTAGE REGULATOR

Inspect voltage regulator when the alternator is checked. Make sure all connections are clean and tight. If a malfunction is suspected, refer to "Testing the Charging System", below.

AMMETER

Check ammeter terminals periodically for cleanliness and tightness. If the ammeter is suspected of being inaccurate, install a test ammeter in series with it. Both ammeters should read the same.

TESTING

Diagnosing electrical problems is difficult without the aid of proper testing instruments. The instruments most commonly used are a voltmeter, ammeter and ohmmeter. The multimeter combines the functions of all three. Check instruments for performance and accuracy.

The voltmeter must always be connected in parallel to the circuit. The ammeter should be connected in series with the circuit. When using the ohmmeter remember to disconnect the component from the electrical source or remove it from the circuit.

Troubles in the charging system are generally either an overcharged or undercharged battery. Overcharging is detected by excessive water usage. If overcharging is caused by high system voltage, light bulbs and other accessories may begin to fail.

An undercharged battery is one that runs down, or becomes discharged. There will be little or no water usage in this case.

Light Load Test

To determine the electrical condition of the batteries, a voltmeter capable of reading .01 volt per scale division is required. Perform the test as follows:

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1. Be sure battery water level is correct.

2. Place a load on the batteries by holding the start switch down for several seconds, or until the engine starts. If the engine starts, shut down immediately.

3. If any cell reads lower than 1.95 volts, recharge the battery and check the charging system for defects. If all cells read 1.95 volts or more and the difference between the highest and lowest cell is less than .05 volt, the battery is good.

4. If all cells read 1.95 volts or more, and there is a difference of .05 volt or more between the cells, replace the battery.

5. If all cells read less than 1.95 volts, the battery is too low to test properly. Charge the battery and repeat the light load test. If none of the cells come up to 1.95 volts after charging, repeat the charge. Batteries that do not come up to full charge a second time should be replaced.

Voltage Regulator Checks

To test the voltage regulator, proceed as follows:

1. Place a voltmeter across the batteries.

> **NOTE:** Batteries must be fully charged for this test.

2. Start the engine and run at 1500 rpm or slightly higher. Note the voltmeter reading. Voltage should be 13.2 to 15.2 volts. If not, replace the regulator, and check for improved battery performance over a period of time.

Alternator Output Check

Make sure the batteries are sufficiently charged to crank the engine. Then check alternator output as follows:

1. Connect a voltmeter across the batteries.
2. Start engine and run at 1500 rpm or slightly higher. Turn on lights and heater blower. If voltage reading is 12.5 volts or more, alternator is operating properly. If reading is less than 12.5 volts, it is recommended that the alternator be repaired or replaced.

Starting System

The electric starting motor has an over-running clutch drive. The over-running clutch drive starters have the solenoid mounted on the starter and have a totally enclosed shifting mechanism.

To start the engine, a switch is used to energize the starting motor. The switch should be released immediately after the engine starts.

When the starter relay is energized, voltage from the batteries is available to the starter to crank the engine.

Lights and Instrumentation

Instrumentation on the TRAVELIFT consists of the following components, located on the instrument panel:

1. Ammeter – Indicates alternator output.
2. Tachometer – Indicates engine RPM.
3. Hourmeter – Indicates total engine operating time used, along with a calendar, to plan scheduled preventive maintenance on the machine.
4. Engine Temperature Gauge – Indicates temperature of the engine coolant. Needle should stabilize between 180-190 when engine is fully warmed and operating.
5. Oil Pressure Gauge – Indicates engine oil pressure.
6. Supercharge Pressure Gauge – Indicates supercharge pressure in the hydraulic system.

The ammeter is connected directly across the alternator and battery to measure full electrical system current. The tachometer on the gasoline engine is connected to the engine distributor, and to a pulse generator on the diesel engine. The hourmeter is connected directly across the ignition to monitor total operating time. Engine oil pressure and temperature are monitored by sending units at the engine. The supercharge pressure gauge is connected to a warning light and buzzer, which actuate when supercharge pressure drops below specified limits.

The machine is equipped with eight operating lights, two on each column, for night operation. In addition there are two emergency lights and two dash lights. The operating lights and dash lights are operated at the light switch on the instrument panel. The emergency lights are connected to a separate rotating light switch, directly off the alternator.

The TRAVELIFT is equipped with a warning bell which rings whenever the machine is operating. The bell may be disengaged by a switch in the operator's cab.

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HYDRAULIC SYSTEM

HYDRAULIC PRINCIPLES

Hydraulics is the science of transmitting force and/or motion through the medium of a confined fluid. Because of its near-incompressibility, liquid is used in the hydraulic system to make the action instantaneous as long as the system is primed and full of fluid. The basic hydraulic system consists of:

- a pump to make the liquid flow, and cause motion.
- a control valve to direct the flow of fluid.
- a motor for converting fluid energy to mechanical energy (rotary).
- or a cylinder for converting fluid energy to linear mechanical motion.
- a reservoir for storing hydraulic fluid.
- a filter for removing contaminants from the fluid.
- the necessary lines, hoses and fittings which connect the components together.

HYDRAULIC TERMS

Two fundamental conditions encountered in a hydraulic system are flow and pressure.

Fluid flow is responsible for making something move or causing motion. Flow is the movement of hydraulic oil through a system. The flow is caused by the pump.

Pressure is responsible for pushing or exerting a force or torque. Fluid pressure is caused by any resistance to the flow of hydraulic fluid. The two types of pressure are:

1. High pressure: Pressure applied to the hydraulic fluid whenever the pump is overcoming an external (load) resistance.
2. Low pressure: Pressure applied to the hydraulic system to overcome the internal (component) resistance of that system.

Hydraulic resistance is any opposition to the flow of hydraulic fluid through a system. The two classes of resistance are:

1. Internal (component) resistance: The resistance of a hydraulic system while oil is flowing through it, but no work is being done.
2. External (load) resistance: The force against which the hydraulic system must work. (Moving the TRAVELIFT, raising a load, etc.)

HYDRAULIC COMPONENT FUNCTIONS

Pump

The pump is the heart of the hydraulic system. It is used to create the flow of oil through the system; it does not pump pressure. As fluid flow meets resistance, both internal and external, the resistance causes system pressure to increase. The pump will then continue to force fluid into the system until the resistance has been overcome or the main relief valve opens.

Valves

In a hydraulic system, valves provide two functions. First, valves can provide directional fluid flow control throughout the system. An example of this type control would be the main valve bank. Second, valves can provide system or circuit pressure control. Main relief valves are an example of system pressure control valves.

Motors and Cylinders

Because they convert fluid pressure into mechanical energy, hydraulic motors and cylinders are the actual working tools of the hydraulic system. The cylinder converts fluid pressure into linear (push-pull) motion. The hydraulic motor produces torque or rotating motion.

Reservoir

The reservoir is designed to ensure a steady supply of fluid to the pump under all conditions. Because cylinder rods take up space in the cylinders, the oil level in the reservoir will be higher with all cylinders retracted than with all cylinders extended.

All components in this hydraulic system are closed to air except the reservoir, which is under atmospheric pressure only. The oil reservoir, is equipped with a fill cap and an air filter breather. Normally, dirt can only enter the system through a damaged air breather filter, or while the reservoir fill cap is off. It is, therefore, very important that these two items be in place and in good condition at all times.

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TRAVELIFT HYDRAULIC SYSTEM

The TRAVELIFT hydraulic system is a closed circuit, supercharged system. (Supercharging guards the system against cavitation by compensating for oil loss due to normal drainage that occurs during the course of operation.) Closed system means that oil coming from the reservoir and fed through the pumps and components eventually returns to the reservoir.

Dual variable displacement pumps mounted behind the engine supply oil to the main control valve banks. From there, the oil is routed to the drive, hoist, and traverse motors. A gear type pump mounted ahead of the engine supplies oil to the steering cylinders, parking brake and supercharge lines.

The variable displacement pumps are controlled by a volume control pedal on the floor of the operator's compartment. On the 500AI TRAVELIFT, when the pedal is depressed, a master cylinder forces hydraulic fluid into a slave cylinder. The slave cylinder, in turn, controls the stroke of the variable displacement pumps, causing oil to flow through the system at the desired volume. The 650AI TRAVELIFT uses cable from pedal to pump.

The main valves control the direction of oil flow through the system. Valve spools, connected to levers in the operator's compartment, divert oil flow to the work components selected by the operator. The inlets to the valve banks are equipped with relief valves to safeguard the motors against excessive pressures.

Drive System

TRAVELIFT drive motion is provided by hydraulic motors, which are direct coupled to the rear drive wheels through a brake, gearbox and drive chain. The flow of hydraulic fluid to the drive motors is supplied from the main variable displacement pumps, which are controlled by the volume control pedal in the operator's cab. Hydraulic oil from the main pumps is routed to the correct drive motor by the main control valves, which are controlled by the drive pedal in the operator's cab. When the drive pedal is depressed, valve spools linked to the drive pedal are shifted into the work position and fluid from the pumps is directed to the drive motors. Drive motor output fluid is routed through filters and back to the pump inlet and reservoir.

The Drive System is also equipped with a spring applied, hydraulically released brake. The brake is automatically applied unless the operator releases it by operating the parking brake lever in the operator's cab. When the parking brake lever is moved, hydraulic fluid is directed to the parking brake on the drive gearbox to override the spring applied brake.

Hoist System

The hoist system also has a counterbalance valve to provide controlled lowering of the load. An hoist drum.

The front hoist motor receives hydraulic fluid from the left main pump and is controlled by the inlet section of the left main control valve. Hydraulic fluid for operation of the rear hoist is supplied by the right main pump and controlled by the inlet section of the right main control valve. The valve spools are connected by mechanical linkage to levers in the operator's compartment. When the hoist levers are moved, the output from the main pumps is diverted by the valve spools to operate the hoist motors. Hoist motor output is routed back through the main control valve to the supercharge line through a filter to the main pump inlet. Excess fluid is routed from the supercharge line through the supercharge check valve into the reservoir.

The hoist system has a counterbalance valve to provide controlled lowering of the load. An internal check valve allows hydraulic oil to flow freely through the counterbalance valve when a load is being raised, but stops return oil flow from the motor when the load is stopped. When the hoist control is moved to the hoist down position and the volume control pedal is depressed, pressure is applied to the counterbalance valve, forcing the valve open, and allowing oil to flow from the motor at a controlled rate.

The hoist brake is mounted on the hoist gearbox and is directly coupled to and located between the hoist motor and the gearbox. The brake is spring-applied and hydraulically released. The brake is applied whenever the hoist system is not functioning. The tension of the spring expands the friction surfaces of the actuating disc and forces the middle discs against the friction surfaces of the adapter and brake housing setting the brake. When the operator moves the hoist control valve to the "Hoist Up" or "Hoist Down" position, hydraulic pressure extends the brake cylinder, over-riding the pressure of the spring and releases the brake. The

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brake is reapplied when the operator moves the hoist control to the neutral position or if hoist system pressure is lost.

Traverse System

The traverse system components are mounted on the front and rear top beams and provide a means of moving the trolleys laterally on the beam. The system consists basically of a hydraulic motor, gearbox, wire rope drum, wire rope reaved over sheaves, and the trolley. The front traverse motor receives hydraulic fluid from the right main pump and is controlled by the outlet section of the left main control valve. Hydraulic fluid for operation of the rear traverse motor is supplied by the left main pump and controlled by the outlet section spool of the right control valve. The valve spools are connected by mechanical linkage to levers in the operator's compartment. Traverse motor output is routed back through the main control valve to the supercharge line, through a filter, to the main pump inlet. Excess fluid is routed from the supercharge line through the supercharge check valve into the reservoir.

Steering System

The TRAVELIFT is steered by means of double-acting cylinders which are mechanically connected to the rear wheel yoke frames. Hydraulic fluid is directed to the head end ports of either cylinder by the orbitrol mounted on the lower end of the steering column. The rod end ports of the two steering cylinders are interconnected hydraulically. As the operator turns the steering wheel, hydraulic fluid is directed and metered to steering cylinders which turn the steering yokes. When the operator stops turning the steering wheel, the flow of hydraulic oil to the steering cylinders is interrupted and the orbitrol remains in the "hold" position.

TESTING THE HYDRAULIC SYSTEM

Procedures for testing the hydraulic system include checking the following:

1. Engine low and high rpm settings.
2. Main pump output.
3. Main relief valve pressure setting.
4. Steering relief valve pressure setting.
5. Pilot (Servo) relief valve pressure setting.
6. Super-charge relief check valve pressure setting.

Variable Displacement Pump Output (500AI TRAVELIFT)

1. Connect a flowmeter into the main variable displacement pump output lines. It is recommended that the flowmeter have a 60 gpm (230 liters per minute) capacity, 0-250°F (−18 to −121°C) temperature gauge and 0 to 3000 psi (0 to 20 685 kPa) pressure gauge.
2. Perform a routine pre-operational check on the TRAVELIFT.
3. Start engine and warm the hydraulic oil to approximately 100°F (38°C).
4. Check the engine low and high rpm settings. The low setting should be 800 rpm. The high setting should be 2700 rpm for the GMC 3-53 diesel engine and 2600 for the IHC VC-263 gasoline engine.
5. Check each pump to determine that there is zero output with the engine running at low rpm setting and the volume control in the neutral position.
6. Check maximum output at each pump as follows:
   a. Place the volume control pedal all the way forward to full-on position.
   b. With engine operating at full rpm, gradually close the flowmeter valve until pressure gauge indicates 2750 psi (18 975 kPa).
   c. Check and record the output of each pump. The output of each pump at engine RPM 2525, should be approximately 41 gpm (155 liters per min) at main relief pressure.

Testing Variable Displacement Pump Output with Flowmeter (650AI TRAVELIFT)

The procedure for testing the 650AI TRAVELIFT variable displacement pump output is identical to that of the 500AI TRAVELIFT, with the following exceptions:

1. Engine high setting is 2600 rpm for both the gasoline and diesel engines.
2. Output of the pump at engine RPM 2450, should be 45 gpm (170 liters per min) at main relief pressure.

Main Relief Valve Pressure Check/Setting (500AI and 650AI TRAVELIFT)

A pressure gauge capable of reading at least 5000 psi (34 475 kPa) is required to check the pressure settings of the main relief valves. The main relief valves are located at the inlet and mid-inlet of the main control valves (refer to Figure 18). Check and adjust the main relief valve as follows:

1. Start engine and warm hydraulic oil to 160-180°F (71-82°C).

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2. Connect pressure gauge to the pump output disconnects at the test station (Figure 19).
3. Operate hoist (front or rear depending on the valve being tested) until it reaches the upper limit stops.
4. Operate system with engine at full rpm and with volume control pedal full on long enough to obtain a pressure reading. Pressure should be 2750 psi ± 50 (18 975 kPa ± 345).
5. If pressure is not within the above range, set main relief pressures as follows:
   a. Remove castle nut from the end of the relief valve adjusting screw, then loosen the lock nut.
   b. Insert screwdriver in adjusting screw slot and turn clockwise to increase pressure or counterclockwise to decrease pressure until pressure reading is correct.

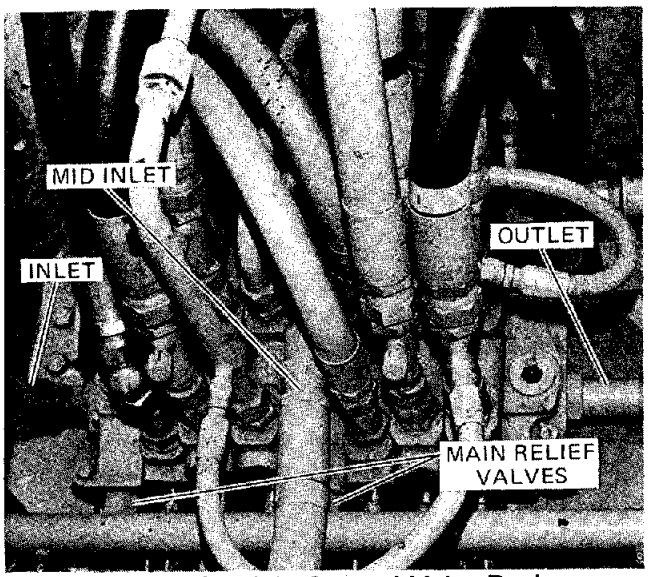

Figure 18. Main Control Valve Banks

Steering Pressure Relief Valve (500AI and 650AI TRAVELIFT)

A pressure gauge capable of reading at least 5000 psi (34 475 kPa) is required to check the steering pressure relief valve (Figure 20). The purpose of the relief valve is to maintain the appropriate hydraulic pressure in the power steering system. Check and adjust the relief valve as follows:

1. Attach the pressure gauge to the relief valve test station (quick disconnect, Figure 19).
2. Start and run engine, proceed with test after hydraulic oil has reached a temperature of 160-180° F (71-82° C).
3. Turn the steering wheel until the steering yokes contact the stops.

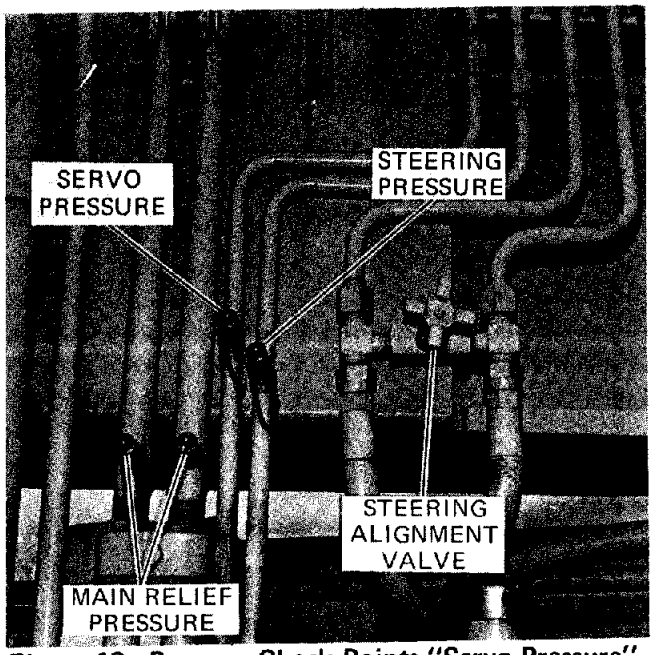

Figure 19. Pressure Check Points "Servo Pressure"

4. Operate the engine at full rpm. The pressure gauge should read 2000 psi (11 730 kPa).
5. If pressure is not correct, shut down engine and proceed to adjust valve as follows:
   a. Relieve system pressure and disconnect the pressure line at the bottom of the valve.
   b. Insert the correct size allen wrench into the valve and turn clockwise to increase pressure or counterclockwise to decrease pressure.
   c. Connect the line and repeat Steps 1 through 4 until correct pressure is obtained.

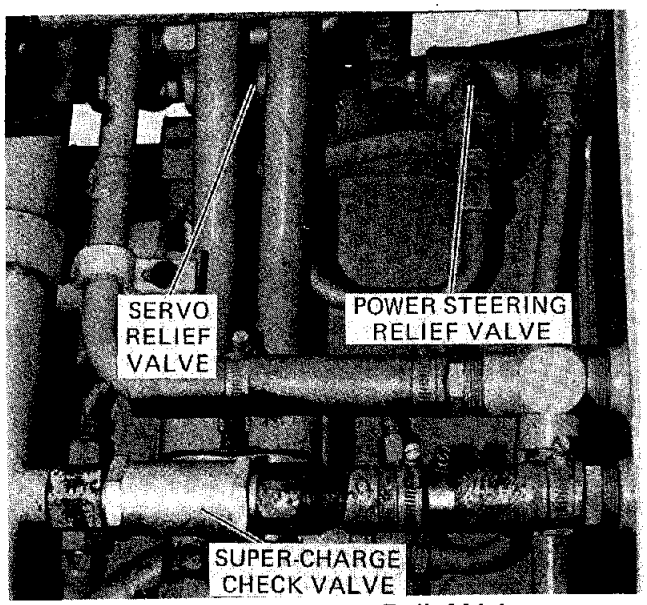

Figure 20. Pressure Relief Valves

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Pilot (Servo) Pressure Relief Valve (500AI and 650AI TRAVELIFT)

The pilot (servo) pressure relief valve maintains pressure in the variable displacement pump servo system. The relief valve, located in the engine compartment (Figure 20), should be checked and adjusted as follows:

1. Attach a pressure gauge, capable of a 1000 psi (6 894 kPa) to the relief valve test station (Figure 19).
2. Start and operate engine until hydraulic oil reaches a temperature of 160-180° F (71-82° C).
3. Operate engine at full rpm. Pressure gauge should read 300 ± 25 psi (2 070 kPa ± 170) for the 500AI, or 350 ± 25 psi (2 413 ± 170 kPa) for the 650AI TRAVELIFT.
4. If pressure is not within this range proceed as follows:
   a. Remove hydraulic line from bottom of valve. Insert the appropriate allen wrench and turn clockwise to increase pressure and counterclockwise to decrease pressure.
   b. Reconnect line and repeat Steps 1 through 4 until proper pressure is obtained.

Supercharge Pressure Relief Check Valve (500AI and 650AI TRAVELIFT)

The supercharge pressure relief check valve is located in the engine compartment (Figure 20). Check the valve as follows:

1. Start and operate engine at 800 rpm.
2. Check supercharge pressure on pressure gauge located in operator's cab. The gauge should read 125 psi (863 kPa) on the 500AI and 135 psi (931 kPa) on 650AI TRAVELIFT.
3. The relief check valve is not adjustable and must be replaced if not reading correctly on gauge.

DRAINING AND REFILLING THE HYDRAULIC SYSTEM

It is impossible to overstress the importance of a clean and sufficient oil supply. The components of the hydraulic system are precision mechanisms and their continued smooth operation depends on proper care. If the reservoir level is allowed to drop too low, cavitation will result and cause almost immediate damage to the pumps. A clogged filter will cause loss of power at first, and may eventually lead to more serious problems. If the system is run too long without an oil change, the oil will lose its ability to lubricate.

The entire system is a closed loop and dirt can normally enter only through the oil reservoir breather. It is essential that this breather be kept clean for proper air filtration and to keep the reservoir at atmospheric pressure.

Check oil level daily. Clean around the filler cap before removing it. When adding oil, make sure oil, funnel, and container are clean. Pour oil into the tank through a 200 mesh or finer screen. Never use a cloth to strain hydraulic fluid.

> **NOTE:** Do NOT use cloth as a filter because oil will pick up lint as it passes through.

When adding oil, make sure that oil is of the proper viscosity and API service classification. See Hydraulic Oil Recommendations.

If oil level is consistently low, check the entire hydraulic system for leaks. Look for dark colored accumulations of dirt around fittings. These may indicate leakage points.

Draining Hydraulic Fluid

Drain and refill the system every 1500 hours or semi-annually, whichever comes first. Complete the drain and refill procedure as outlined below along with every third filter change. The entire system holds between 35 and 50 gallons (132-190 liters).

1. Operate the TRAVELIFT until normal operating temperatures have been reached. Set the hoist hooks, or other lifting devices, on the ground. Shut down the engine.
2. Using a suitable container, remove the plug from the bottom of the hydraulic reservoir, and allow it to drain. DO NOT START THE ENGINE AFTER THE RESERVOIR HAS BEEN DRAINED.

> **NOTE:** The reservoir contains a de-aeration baffle which prevents all fluid from being drained until the screen has been removed from the outlet port.

3. Disconnect the inlet lines at both main pumps and allow them to drain. Remove the gravity feed line from the power steering pump and allow it to drain. Disconnect the hydraulic lines on the right columns, at their lowest point and allow them to drain. Set the hoist and traverse levers forward and leave them there until all drainage has stopped. Then move them to the rear and leave until all drainage has stopped.

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4. When all previously disconnected lines have drained, reconnect them.
5. Disconnect the outlet line from the reservoir. Then remove the four capscrews that retain the screen filter in the reservoir. Remove the screen filter and clean it in a non-flammable solvent. Replace the O-ring seal on the filter flange.
6. Remove the reservoir breather, wash in non-flammable solvent, blow dry with compressed air and reinstall.
7. Clean the inside of the reservoir. Then install the screen filter. Install the drain plug.
8. Replace hydraulic filter elements.

Refilling Hydraulic System

System draining is now completed. The system must be refilled with CLEAN fluid. Since the total system holds more fluid than the reservoir, several fillings of the reservoir will be necessary. Refill the system as follows:

1. Reconnect all lines previously removed or loosened.
2. Fill the reservoir with hydraulic oil. Filter the oil through at least a 200 mesh screen.

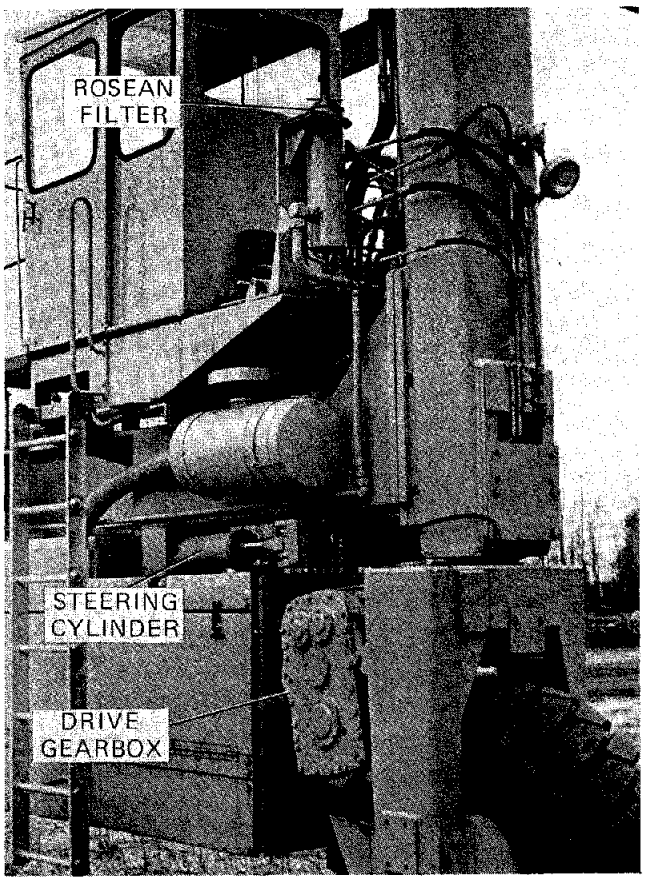

Figure 21. Left Rear Column

3. Loosen the power steering pump inlet line and bleed air from line. Bleed the main pump inlet lines. Then retighten all lines loosened, and refill the reservoir.

IMPORTANT: If the Rosean filter is not filled, or if the main pump return line is not primed the hydraulic pump could cavitate.

4. Fill the Rosean hydraulic filter (Figure 21) with clean fluid prior to starting engine.
5. Operate the engine at 1000 rpm. Continue filling the reservoir as the system fills with fluid. Operate the volume control pedal to fill the main system.
6. Bleed the steering system.
7. Continue to fill the reservoir until the fluid level in the reservoir no longer drops. After the machine has operated for a short period, recheck the reservoir.

FLUSHING THE HYDRAULIC SYSTEM

Prior to replacing a damaged component with a new or repaired part the hydraulic system must be flushed. Use the following procedures to flush the system.

1. Using high pressure cleaner or steam, clean excess dirt from areas surrounding component, to be removed, hydraulic reservoir and manifold.
2. Completely drain all the oil from the hydraulic system as follows:
   a. Remove drain plug from bottom of hydraulic tank and let oil drain into a suitable container.
   b. Bleed hydraulic lines at the lower corner of all four vertical columns (see Figure 21).
3. Remove the hydraulic reservoir. Remove the 100 mesh screen strainer and clean with solvent. Use steam or solvent to clean the inside of the hydraulic reservoir. Be sure to clean both sides of the baffle.
4. Disconnect and reconnect to bypass tubes or hoses all lines leading to the hoist, drive and traverse motors. Disconnect and plug all other lines connected to pumps and motors.
5. Remove and thoroughly clean all pumps, motors and valves not being replaced. Check for signs of contamination and/or damage.

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6. Replace all filter elements and clean element canisters thoroughly.
7. Install cleaned hydraulic reservoir and reconnect all lines.
8. Install cleaned or new pumps and motors. Reconnect all lines (except for lines to the hoist, drive and traverse motors). Leave inlet lines a little loose to allow air to escape when filling manifold.
9. Fill the reservoir with appropriate hydraulic fluid, straining fluid through a 200 mesh screen.

IMPORTANT: This initial fill will not be sufficient after start up when fluid fills the system. Carefully recheck reservoir level after start-up.

10. Fill the manifold and main pumps by pouring hydraulic fluid through a 200 mesh screen into the Rosean filter (Figure 22). Continue filling the filter until straight fluid (no air bubbles) come out at the tube connectors that were left loose at the pumps. Tighten tube connectors. Check fluid level in filter canister and replace filter cover.

IMPORTANT: If the Rosean filter is not filled or if the main pump return line is not primed the hydraulic pump could cavitate.

11. Prime the hydraulic system to the pumps only, by cranking the engine as follows:
    a. On units equipped with gasoline engines pull the distributor wire.
    b. On units equipped with diesel engines pull the emergency stop button.
    c. Crank the engine over until the pumps, manifold and connecting lines are primed. Check reservoir level and refill as necessary.
    d. Check all lines and connections for leaks.
    e. Reset engine for normal start-up.
12. Start the engine and set throttle at minimum rpms (approximately 800 rpms). Run the pumps for 15 to 20 minutes at this speed.

IMPORTANT: If pump has been rebuilt or replaced do not operate either the control levers, pedals or volume control pedal during this time. Make sure an adequate fluid level in the hydraulic reservoir is maintained during this period.

13. After the initial run-in period increase engine speed to 1000 rpms. Slowly stroke the volume control pedal to full stroke and hold it in this position for several minutes. Release the pedal and repeat this procedure 20 times. Check hydraulic fluid level and replenish if necessary.
14. To complete priming the system continue by making sure the valve controls are in a neutral position and increasing engine speed to 1800 rpm.

IMPORTANT: During the following steps constantly watch hydraulic reservoir fluid level and replenish as necessary.

15. Turn the steering wheel slowly in both directions to fill the steering cylinders. Bleed both cylinders before proceeding.
16. Turn the steering wheel until the wheels reach the stops allowing hydraulic fluid to by-pass over the steering relief valves. Check pilot and supercharge pressure. Hold steering wheel at full stop until hydraulic fluid heats to 180°F (82°C). Do not allow temperature to exceed 200°F (93°C).
17. Maintain engine speed of 1800 rpm. Pull one traverse lever and stroke volume control pedal. Hold this position for 3 minutes. Reverse the direction of the lever and again hold for 3 minutes.
18. Repeat the procedure outlined in Step 17, for the hoist and drive circuits.
19. Increase the engine speed to maximum rpm and repeat Steps 17 and 18 for the traverse, hoist and drive circuits.
20. Flushing the system has been completed. Proceed to set up unit for an operating condition. Shut down the engine, remove motor by-pass lines.
21. Drain fluid and clean reservoir as described in Steps 2 and 3. Change all system filters.
22. Refill the reservoir and Rosean filter with clean hydraulic fluid as described in 9 and 10.
23. Start the engine and set at idle speed. Stroke the pump control pedal slowly, while watching the reservoir level carefully. Replenish hydraulic fluid as necessary. Return the control pedal to neutral and repeat procedure several times.
24. Engage the traverse lever and stroke the volume control pedal until the trolley begins to move. Release pedal and change the traverse lever to the opposite direction. Again stroke

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the volume control pedal until the trolley begins to move. Repeat this process until there is no time lag between engaging lever and trolley movement.

25. Repeat Step 24 for the other traverse circuit, hoist circuit and drive circuit.
26. After all circuits are operating normally increase engine rpm to maximum speed. Continue to work all circuits without any load, for several hours.
27. Shut down engine and change all hydraulic filter elements.
28. The unit is now ready for normal operation except that it is important to operate well below maximum load for the first few hours.

MAIN SYSTEM

Main Hydraulic Pump (500AI)

The main variable displacement pump is an axial piston, variable displacement pump. The output volume of the pump is infinitely variable and is controlled by an adjustable pedal located in the operator's compartment.

As the pump (see Figure 22) operates, the piston is drawn out of the cylinder and fluid is drawn into the inlet port. As the cylinder rotates, the piston forces fluid out as it passes over the outlet port. The output volume is determined by the angle of the swash plate relative to the drive shaft axis. The pump stroke mechanism governs the angle of the yoke and swash plate and consequently controls the stroke-length of each piston as it rotates within the pump cylinder block.

The volume output of the main pump is controlled by the operator. A foot pedal, located in the cab, is connected to the piston of the volume control master cylinder by a mechanical linkage. The master cylinder is connected to the slave cylinder by a hydraulic line. The slave cylinder, in turn, is connected to the pump stroking mechanism by mechanical linkage.

Adjusting Volume Control (500AI). Both main variable displacement pumps must deliver the same volume of oil if the TRAVELIFT is to function efficiently. If one pump is not putting out full volume of oil when the volume control is in full stroke, and both pumps are in good working condition, it will be necessary to adjust the stroking linkage. Adjust linkage as follows:

1. Install a flow meter in the outlet ports of both main pumps.

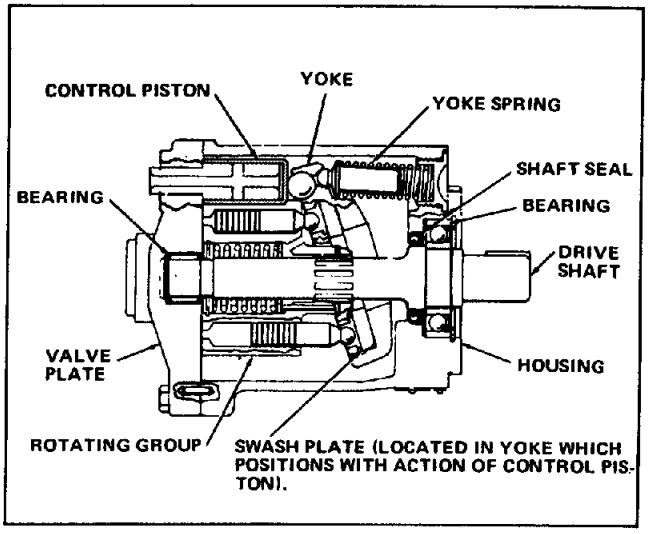

Figure 22. Cross Section of Variable Displacement Pump

2. Start the engine and allow the oil to warm up. With the volume control pedal at FULL OFF, both flowmeters should indicate ZERO FLOW. Double-check the pumps for ZERO flow by positioning one traverse lever at a time to either of its positions. The right pump provides flow for the rear trolley, the left pump for the front trolley. Neither trolley should have moved.
3. If either pump indicates flow, adjust the volume control linkage as follows:
   a. Loosen jam nut on push rod.

> **IMPORTANT:** Do not turn the push rod too far in the clockwise direction as the pump can be set to a reverse-flow stroke, which will pressurize the low pressure side of the hydraulic system.

   b. Turn the push rod clockwise and watch flowmeter for indication as to whether the flow increases or decreases. If the flow increases, turn rod counterclockwise until a zero reading is obtained on flowmeter. If the flow decreases, turn clockwise until flowmeter reads zero (no-flow).
   c. Using care not to change rod position, tighten jam nut.
   d. Again, check the flowmeters to insure a zero reaching has been maintained. Shut down engine. Remove flowmeters and reconnect hydraulic tubes to pump.

Main Variable Displacement Pumps (650AI)

The two main hydraulic pumps are of the variable

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displacement rotary piston type. The pumps are mounted to the pump drive transmission and supply hydraulic oil under pressure for the hoist, traverse and drive systems. One pump supplies the front hoist, front traversing and right drive wheel. The other pump supplies the rear hoist, rear traversing and left drive wheel.

The pumps are variable displacement, piston type and provide infinite control of speed. When the operator moves the volume control pedal on the cab floor, the swash plates in the pumps are tilted from neutral. When the swash plate is tilted, a positive stroke to the pistons is created, producing a corresponding flow from the pump. This flow from the pumps is transferred through the main control valve and high pressure lines to the drive, hoist and traverse motors.

The pump stroking pedal (volume control) is linked by cable to the servo mechanism on both hydraulic pumps.

Volume Control Adjustment (650AI). The SUNDSTRAND Pumps incorporate a Servo Valve to control the pump swash plate angle and pump volume output. A cable connects the volume control pedal to the pump servo control unit, through a pump arm. When the pedal is released by the operator, the pump returns to its neutral, "no-flow" condition.

Adjust the volume control pedal linkage so that 26° of pump actuating bar travel is available from the NEUTRAL (Full OFF) position to the maximum flow (Pedal fully depressed) position. To adjust the pump linkage, proceed as follows:

1. Install a flowmeter into the outlet ports of both main pumps.
2. Start the engine and allow the oil to warm up. With the volume control pedal at FULL OFF, both flowmeters should indicate ZERO FLOW. Double-check the pumps for ZERO flow by positioning one traverse lever at a time to either of its positions. The right pump provides pressure for the front traverse trolley, the left pump for the rear trolley. Neither trolley should have moved. If ZERO flow is indicated and neither trolley moved, go to Step 4.
3. If the flow meters do NOT indicate ZERO flow, or if either of the trolleys moved, adjust the volume control pedal linkage as follows:
   a. Remove the cotter pin and clevis pin from the cable yoke and actuating bar of the pump that indicated flow. The pump arm will return to NEUTRAL (no-flow) and the flowmeter should now indicate ZERO flow. Move the front traverse lever; no trolley movement should result.
   b. Loosen the cable yoke jam nut. Adjust the cable yoke until the clevis pin can be easily installed through the yoke and the actuating bar. With clevis pin installed, the flowmeters should indicate ZERO flow.
4. Pin is not against its Stop, adjust the Stop. Then proceed as follows:
   a. Use a suitable measuring device, such as a bevel protractor, to measure the angular travel of the actuating bar. Travel from NEUTRAL to MAXIMUM (pedal fully depressed) should be 26 degrees. If travel is not 26 degrees, adjust the stop until 26 degrees of travel is obtained. Then adjust the left hand (inside) pump yoke until its actuating bar travel is 26 degrees. Flow from both pumps should be nearly equal.
   b. Operate the volume control pedal several times. Then recheck the actuator bar for 26 degrees of travel.

Power Steering Pump (500AI)

The power steering pump is a gear-type pump mounted ahead of the engine. The pump supplies hydraulic oil for operation of power steering, parking brakes, and supercharge pressure for the variable displacement pump supercharge system.

The gear pump consists essentially of two meshed gears in a closely fitted housing with inlet and outlet ports opposite each other. One gear is driven by the engine and, in turning, drives the other. As the gear teeth separate and travel past the inlet, a partial vacuum is formed. Oil drawn into the inlet is carried to the outlet in pumping chambers formed between the gear teeth and housing. As the gear teeth mesh at the outlet, there is no place for the oil to go but out.

Supercharge and Power Steering Pump (650AI)

The supercharge and power steering pump is mounted ahead of and is driven by the engine. Operation of this pump is essentially the same as that described above for the 500AI TRAVELIFT, except that the 650AI TRAVELIFT uses a two-section gear-type pump. One section supplies supercharge pilot (servo) pressure and steering for the variable displacement pumps, and the other section supplies oil to the supercharge system.

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Main Control Valve Banks

The main control valve banks (Figure 18) contain valves which are used to control the flow of hydraulic oil through the main hydraulic system. The valve spools are connected by mechanical linkage to levers in the operator's compartment. When the levers are shifted, the discharge from the variable displacement pumps is diverted by the valve sections to operate the wheel drive motors, the hoist motors, and the traverse motors. The valve bank has two inlet and two outlet ports. The inlets are equipped with relief valves 2750 psi ± 50, 18 975 kPa ± 345) to maintain proper system pressure and to protect the system. Oil that is discharged through the outlet ports is piped through the supercharge line or the main hydraulic system return line to the main variable displacement pumps and the reservoir.

Relief and Check Valves

Check Valves. Check valves are utilized in the hydraulic systems to ensure the free flow of hydraulic oil in one direction only. The valve consists basically of a housing, poppet and spring. When the hydraulic oil pressure exceeds the pre-set spring pressure, the poppet will unseat.

Relief Valves. Relief valves are installed in the hydraulic system to maintain the proper system pressures. The valves are simple cartridge types, and may be adjusted to obtain specific pressures. Most relief valve problems stem from faulty cartridges, which are replaceable.

Hydraulic Reservoir

The reservoir provides an 18 gallon (68 liters) reserve oil supply for the hydraulic system and is located above the main pump drive transmission in the engine compartment (see Figure 23). The reservoir has a sight glass for checking oil level. A hydraulic tube from the reservoir supplies oil to the gear pumps located on the front of the engine. From here the oil is pumped into the system.

Hydraulic Filters

The TRAVELIFT hydraulic system uses two hydraulic filters: the Case hydraulic filter and the Rosean hydraulic filter. The Rosean filter is located in the main hydraulic circuit, and the Case filter is located in the power steering and supercharge circuit. The filters are serviced as follows.

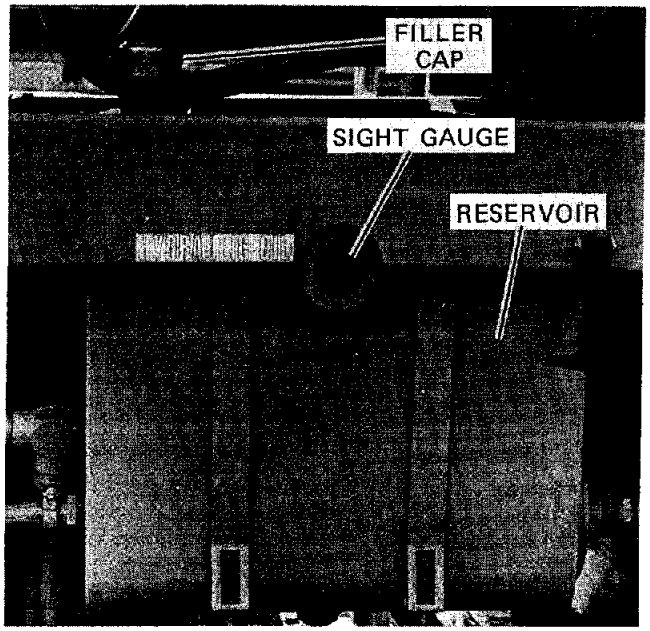

Figure 23. Hydraulic Reservoir

Servicing J.I. Case Hydraulic Filter

Refer to Figure 24 and service the Case hydraulic filters as follows:

1. Provide a 12 gallon (45.2 liters) container.
2. Check the supercharge system pressure gauge.

WARNING: If supercharge pressure was not relieved on shutdown, drain plugs can be blown out under force during removal.

3. Loosen the drain plug in the filter and allow the filter to drain. Then turn the filter hex head until the filter can be disassembled.
4. Discard old element and seals. Clean all parts in non-flammable solvent and blow dry with compressed air.
5. Using new element and seals, reassemble the filter as shown in Figure 24.
6. If the filter was in the power steering pressure line, bleed the power steering system in accordance with procedures outlined in the Steering Section of this manual.

Servicing Rosean Hydraulic Filter

Rosean filters are equipped with a dial indicator which can be visually checked for filter condition. Service these filters as follows:

1. Provide a suitable container for draining fluid. Turn the tee handle until the tie rod is disconnected. Then remove the cover.

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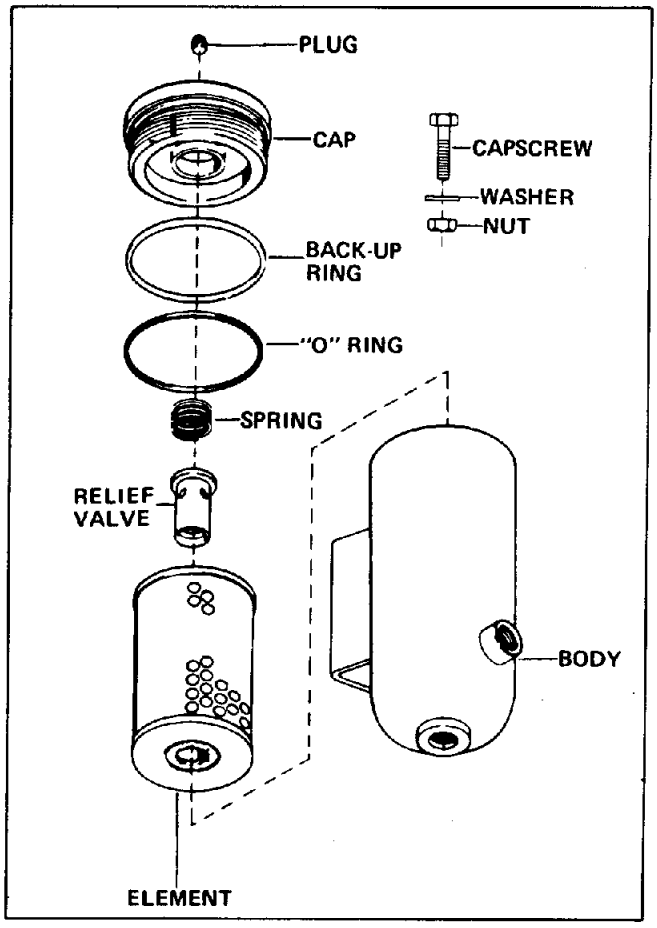

Figure 24. Case Hydraulic Filter

2. Remove components as shown in Figure 25. Inspect the magnet for metal. Metal larger than "fuzz" size should be investigated to determine its origin.
3. Discard the old filter element and seals. Clean all parts in non-flammable solvent. Blow dry with compressed air.
4. Reassemble the filter as shown in Figure 25. Before installing the cover, loosen the inlet line to the main pumps at the pump fittings. Fill the filter with clean fluid filtered through a 200 mesh screen. Continue filling until air-free fluid comes from the loosened lines. Make sure the filter is completely full of fluid, then install the cover and tighten hand tight using the tee handle.

IMPORTANT: If the Rosean filter is not filled, or if the main pump return line is not primed, the hydraulic pumps could cavitate, resulting in damage to the system. When any maintenance action has been performed that might deplete the fluid level in the filter, make sure it is refilled.

Hydraulic Fittings

Consult the "Torque Chart for Hydraulic Swivel Fittings" in the back of this manual whenever connecting a hydraulic fitting. Use pipe sealing compound or Loctite to seal fittings against leakage (do not let any compound get into the system).

Loose connections waste oil, lower working pressures, let dirt into the system, and may admit air to cause noisy and erratic operation. Air bubbles in the hydraulic oil will destroy the finish of pump, motor and valve parts.

DRIVE SYSTEM

The drive systems are attached to the rear wheel yoke frames and consist basically of a hydraulic motor, drive brake, and drive gearbox.

Drive Motor

The drive motors are positive displacement piston motors. Motor speed is determined by input fluid volume. When the control valve is moved to the "work" position, inlet fluid is forced into the cylinder bores which are open to the inlet port. The remaining bores are either open to the outlet port or blocked by the valve plate. The force on the pistons pushes them against the swash plate.

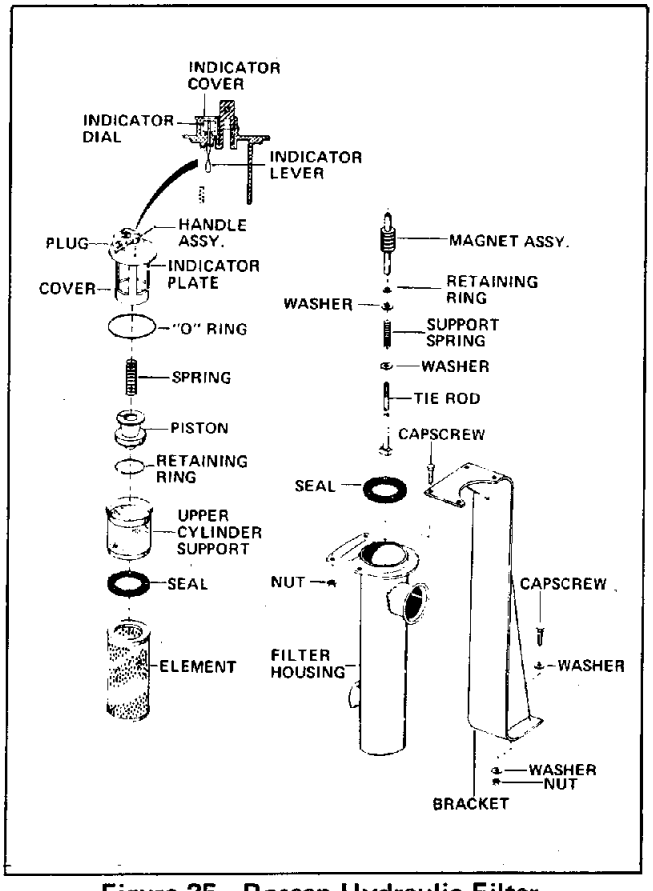

Figure 25. Rosean Hydraulic Filter

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They can move only by sliding along the swash plate to a point further away from the piston barrel. In so doing, they cause the cylinder barrel to rotate. As the pistons move over the outlet port, the fluid is discharged and returned to the valve bank.

Parking Brake

The drive brake is a spring-released, hydraulically applied brake. The brake may be operated manually through a lever in the operator's cab. The parking brake prevents the machine from moving while parked and also serves as an emergency braking system.

The brake should be adjusted every 500 hours or every two months, whichever occurs first. Adjust the brake as follows:

1. Loosen jam nut on the upper adjustment bolt (Figure 26). Tighten adjusting nut on upper adjustment bolt, then back off nut 1-1/2 turns. Tighten jam nut.
2. Loosen lower nut and capscrew in auxiliary brake lever. Turn lower screw until there is approximately 1/16 in. (1.59 mm) between the bolt and the service brake lever. Tighten jam nut.
3. Test brake adjustment by operating the TRAVELIFT. If brake becomes hot after 20 or 30 feet of travel, the brake is set too tightly.

HOIST SYSTEM

The hoist system is powered by a piston-type hydraulic motor, coupled to a hoist gearbox, which drives the hoist drum. The hoist gearbox is equipped with a spring-applied, hydraulically-released brake on its input shaft. The hoist also contains a counterbalance circuit which hydraulically locks the piston motor if there is a pressure loss in the hoist down circuit.

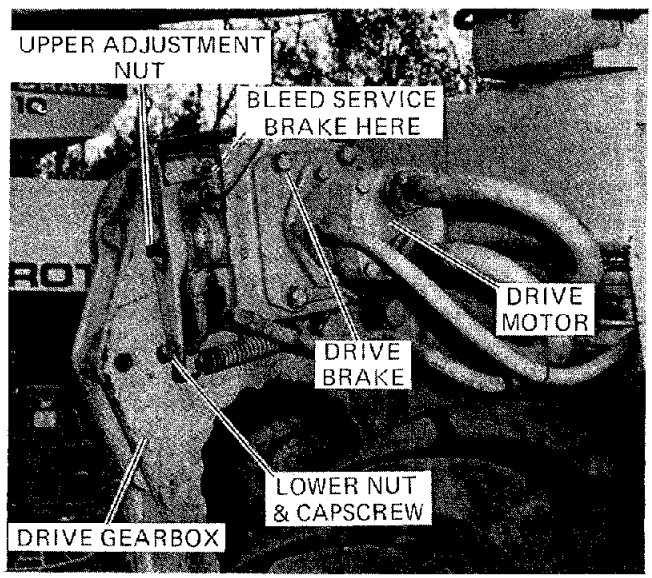

Figure 26. Drive Brake Adjustment "Bleed Service Brake Here"

Hoist Motor

The hoist motor is a positive displacement, piston motor. Motor speed is determined by input fluid volume. When the control valve is moved to the "work" position, inlet fluid is forced into the cylinder bores which are open to the inlet port. The remaining bores are either open to the outlet port or blocked by the valve plate. The force on the pistons pushes them against the swash plate. They can move only by sliding along the swash plate to a point further away from the piston barrel. In so doing, they cause the cylinder barrel to rotate. As the pistons move over the outlet port, the fluid is discharged and returned to the valve bank.

Every 500 hours, service the hoist motor as follows:

CAUTION: Before working on the hoist mechanism, unload the hoisting system by lowering the hoist block until it rests on a suitable support.

1. Remove the hoist motor and check the motor shaft for wear.
2. Remove the hoist brake and the internal/external splined coupling. Inspect the brake discs for wear. Check both the spline and linings.
3. Inspect the splined coupling for wear. Check both the internal and external splines.
4. With the brake removed, check the transmission input shaft for wear.

Hoist Brake

The hoists are equipped with Rockwell spring-applied, hydraulically-released brakes which function as automatic safety devices. The brake receives hydraulic pressure from the hoist circuit, and remains off as long as there is sufficient operating pressure for the hoist. Should the hoist fail for lack of pressure, the brake will apply automatically to hold the load.

The Rockwell brakes are self-adjusting. However, earlier TRAVELIFT models are equipped with hoist brakes similar to those used in the drive system. These hoist brakes should be adjusted every 500

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hours or every two months, whichever occurs first. This is done to compensate for normal brake lining wear. Two adjustment points are provided, an upper adjustment ball seat nut and a lower capscrew and nut. The upper adjustment ball seal nut establishes the clearance between the brake lining and brake discs. The lower capscrew establishes the tension on the brake. Use the following procedure to adjust the brake (Figure 27).

1. Loosen the jam nut on the upper adjustment rod. Tighten the ball seat nut until it is just snug, then back off 1-1/2 turns. Tighten the jam nut.

2. Loosen the capscrew and nut in the auxiliary brake lever. Turn the capscrew until approximately 1/16" (1.58 mm) clearance is observed between the end of the capscrew and the service brake lever, then tighten the jam nut.

3. Test the adjustment by operating hoist. If operation is jerky, or if the brake housing becomes hot, the brake is set too tight. If this happens, back off on the upper adjustment ball seat nut 1/2 turn and repeat Step 2 above. Then repeat the test and the adjustment until the housing no longer becomes hot.

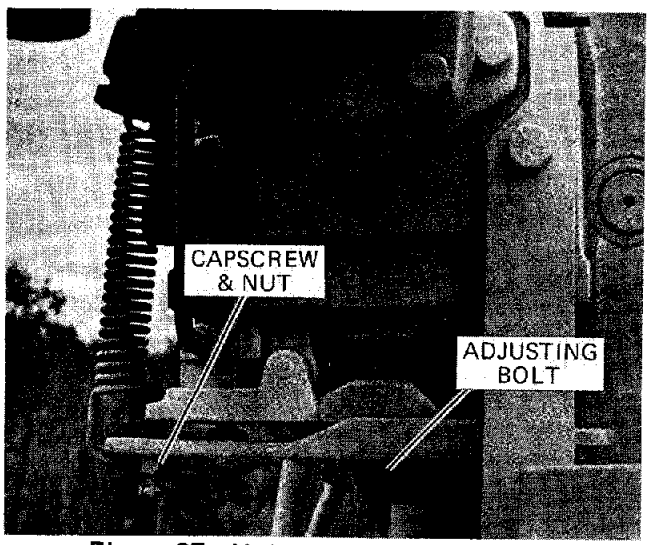

Figure 27. Hoist Brake Adjustment (Earlier Model TRAVELIFTS) "Earlier Model Only"

TRAVERSE SYSTEM

The traverse system consists basically of a hydraulic motor, gearbox, wire rope drum, reaving over sheaves and a traverse trolley. The traverse system components, mounted on the front and rear top beams, provide a means of moving the trolley laterally on the beam. Trolley movement is controlled by levers located in the operator's cab.

Traverse Motor

The traverse motor is a gear type and is essentially the same design and construction as the supercharge and power steering pump. The internal arrangement of the gear housing is the same, however, the drive shaft arrangement differs. The pump receives hydraulic fluid under pressure from the main control valve. The traverse trolley system also contains a relief valve set at approximately 2000 psi. This is to prevent the operator from running the trolley to the end and then continuing to traverse until the sheave is worn out or the cable frays. The valve spools for motor operation are linked mechanically to levers in the operator's cab.

STEERING SYSTEM

The steering circuit is controlled by the orbitrol on the steering wheel shaft which diverts the proper amount of hydraulic fluid to the steering cylinders when the steering wheel is turned. The steering control valve directs and meters oil flow to the double-acting steering cylinders mounted over the rear wheels. When the operator stops turning the steering wheel, the flow of oil to the steering cylinders is interrupted and the orbitrol remains in "hold" position.

Checking the Steering System

A functional check of the steering system should be made periodically to ensure satisfactory operation.

1. Check the steering system for foreign material as follows:

   a. Place the TRAVELIFT on a smooth paved surface, preferably dry concrete.

   b. Turn the steering wheel through full travel. Do this at engine idle and at full throttle, with the machine standing still and with it rolling slowly. If there are irregularities in steering motion, or if a "sticking" sensation is felt through the wheel, this may indicate dirt in the system.

   c. If under any of these conditions, the steering wheel continues to rotate after being released, a condition known as "motoring" exists. This also may indicate dirty hydraulic fluid.

   d. If dirty fluid is suspected, drain and flush hydraulic system thoroughly. Change filters.

NOTE: It is often less costly to flush out and refill a hydraulic system than to overhaul a component.

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2. Check for air in the steering system as follows:
   a. Perform functional check (para. 1b) above, and watch steering cylinder to make certain it achieves full travel without hesitation.
   b. If the cylinder pauses noticeably in its travel, this may indicate it contains trapped air.
   c. Crack fittings at cylinder and operate steering until steady flow of hydraulic oil (without air bubbles) is observed. Tighten fittings.
3. Inspect the steering limit stops for general condition. If they are worn, distorted or broken, replace them.

Steering Orbitrol

The orbitrol steering unit (Figure 13) directs the flow of hydraulic oil to the steering cylinders. The unit is equipped with four ports labeled "inlet", "outlet", "right", and "left". When removing lines from the orbitrol, mark each one so they may be reconnected to the proper ports. If malfunction of the orbitrol is suspected, perform the checks outlined above.

Steering Alignment

If the TRAVELIFT steering is not properly aligned, make the following steering alignment adjustment:

> **NOTE:** Steering misalignment may be caused by leaks in the hydraulic circuit such as oil leaking past the steering cylinder piston, or by air in the lines. If misalignment persists, check for leaks.

1. Use the steering wheel to line up the left rear wheel with the left front wheel.
2. Open steering alignment valve (Figure 19) which is located just back of the operator's cab. This valve must be opened fully to isolate steering action to one wheel.
3. Turn steering wheel to align the right rear wheel with the right front wheel.
4. Recheck both steering wheels for alignment with the non-drive wheels and close alignment valve which was opened in Step 2. Steering alignment should now be correct.

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TROUBLESHOOTING

ENGINE

Problem	Probable Cause	Remedy
Engine lacks power, stalls at low speeds.	1. Clogged air cleaner.	1. Remove and clean or replace element, check dust collector.
	2. Engine needs tune-up.	2. See engine manual.
Engine overheats.	1. Insufficient coolant.	1. Check coolant level and fan belt.
	2. Dirty radiator.	2. Flush radiator and replace coolant.
	3. Defective thermostat.	3. Replace, see engine manual.
	4. Insufficient lubricating oil.	4. Add oil, see engine manual.
Engine does not develop full rpm.	1. Accelerator linkage out of adjustment.	1. Adjust linkage to governor.
	2. Engine needs tune-up.	2. See engine manual.
Engine responds sluggishly when accelerator pedal is depressed.	1. Defective fuel system.	1. See engine manual.
Engine won't start.	1. Faulty cranking system.	1. See engine manual and Electrical System section of this manual.
	2. Faulty fuel system.	2. See engine manual.

ELECTRICAL SYSTEM

Problem	Probable Cause	Remedy
Panel, cab identification lights, do not operate.	1. Bulb burned out.	1. Replace.
	2. Switch defective.	2. If all else fails, check the circuit for continuity using ohmmeter. Also check ground wires for firm contact.
	3. Shorted or loose wire.	3. Test with ohmmeter; replace.
Defroster fan inoperative.	1. Defective switch.	1. Check with ohmmeter; replace.
	2. Loose wire.	2. If still no remedy, remove unit and check for internal mechanical or electrical problem.
	3. Broken wire.	
	4. Fan blade stuck.	
	5. Motor burned out.	

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ELECTRICAL SYSTEM (Continued)

Problem	Probable Cause	Remedy
Wiper motor inoperative.	1. Defective switch.	1. Check with ohmmeter; replace.
	2. Wire shorted.	2. Remove motor to test for internal electrical or mechanical problem.
	3. Motor corroded.	3. Check ground wire for firm contact.
Fuel gauge registers empty continually.	1. Tank sending unit defective.	1. Check across unit with ohmmeter if defective, replace.
	2. Gauge defective.	2. Replace.
External lights inoperative.	1. Light switch on instrument panel defective.	1. Check switch with ohmmeter across switch terminals.
Entire electrical system weak or inoperative.	1. Loose pulley belts on alternator.	1. Tighten.
	2. Corroded terminals, loose wires.	2. Clean and tighten.
	3. Dead battery – diode connection not firm.	3. Adjust to give firm contact.
	4. Internal mechanical problem.	4. Remove and check.
	5. Voltage regulator out of adjustment.	5. Check voltage regulator with voltmeter to see whether voltage equals 12 volts for this model; if defective; replace.
	6. Battery electrolyte low.	6. Check level; refill and charge.
Engine gauges or hourmeter inoperative.	1. Loose ground terminal contact on gauge.	1. Tighten ground wire on hourmeter.
	2. Defective pressure switch.	2. Check with ohmmeter when switch is closed.
Ammeter gauge shows discharge.	1. Battery cable connections loose.	1. Tighten, clean post, if necessary, with fine sandpaper.
	2. Voltage regulator defective.	2. Replace or adjust.
	3. Short or overload in circuit.	3. Check fuses and circuit breakers; test for direct short on jumper wire units.
	4. Starter solenoid is defective.	4. Replace solenoid if defective.

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ELECTRICAL SYSTEM (Continued)

Problem	Probable Cause	Remedy
Heater inoperative.	1. Loose ground wire. 2. Blown fuse. 3. **Internal electrical problem.**	1. Tighten ground wire contact. 2. Check with ohmmeter; replace if necessary. 3. **Check with ohmmeter across heater terminals.**
Full charged batteries and high charging rate (overcharged battery).	1. Water level in batteries low. 2. Defective system wiring. 3. Loose or dirty system connections. 4. Defective voltage regulator needs to be adjusted.	1. Refill to proper level — perform light load test. 2. Locate, repair and replace bad wiring. 3. Tighten or clean connections. 4. Repair or replace regulator.
Low batteries and little or no charging rate (undercharged battery).	1. Defective or loose fan belt. 2. Defective battery. 3. Grounded circuits. 4. Loose or dirty system connections. 5. Defective system wiring. 6. Defective alternator. 7. Defective voltage regulator.	1. Replace or adjust fan belt. 2. Perform light load test. 3. Locate and correct grounded circuit. 4. Tighten or clean connections. 5. Locate, repair or replace defective wiring. 6. Check alternator output. (See alternator output check.) 7. Repair or replace voltage regulator. (See voltage regulator check.)

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HYDRAULIC SYSTEM

Problem	Probable Cause	Remedy
Noisy operation.	1. Air in system.	1. Bleed hydraulic system.
	2. Insufficient oil supply.	2. Check level of oil in oil reservoir. Add if necessary.
	3. Partially blocked pump inlet.	3. Drain hydraulic system and clean strainer.
	4. Dirty oil filter.	4. Replace filter.
	5. Pump bearings worn.	5. Replace pump or bearings.
	6. Pump coupling worn.	6. Replace.
	7. Pump squealing caused by 1, 2 or 5.	7. Either 1, 2, or 5.
	8. Chattering relief valve spring.	8. Replace relief valve.
TRAVELIFT does not operate at normal speed.	1. Engine not operating properly.	1. Check engine.
	2. Partially clogged pump inlet (Pump squealing).	2. Clean hydraulic system.
	3. Air leak in pump inlet.	3. Replace O-ring seal.
	4. Pressure relief valve plunger leaking.	4. Check for foreign matter on valve seat. Clean and replace if necessary. Check for leaking O-rings.
	5. Aerated oil supply.	5. Check hydraulic system for leaks.
	6. Badly scored relief valve spool plunger seat.	6. Replace.
	7. Pump wearing out.	7. Repair.
	8. Volume control pedal.	8. Adjust.
Hoist, traverse and drive not working properly.	1. Main pump cavitating.	1. Low on oil. Fill reservoir.
		Supercharge check valve leaking. Remove and repair.
		Main pump worn. Replace.
	2. Loss of supercharge pressure.	2. Supercharge check valve leaking. Remove and repair.
		Spring collapsed in check valve. Replace.
		Poppet scored or cracked in check valve. Replace.
		Dirt in supercharge check valve. Clean. Change fluid, filter, clean filter screen.

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HYDRAULIC SYSTEM (Continued)

Problem	Probable Cause	Remedy
Pump takes too long to respond or fails to respond.	1. Low oil supply. 2. Pump worn or damaged.	1. Fill to proper level. 2. Inspect, repair or replace.
Oil foaming.	1. Air leaking into inlet line from tank to pump. 2. Wrong kind of oil. 3. Oil level too low.	1. Tighten all connections. 2. Drain and refill with non-foaming type of hydraulic oil. 3. Fill to proper level.
Oil leakage at front of pump.	1. Seal in pump cap defective.	1. Replace seal.
No motion of hydraulic system when first started.	1. Low oil level due to leakage. 2. Oil viscosity too heavy. 3. Air leak in pump inlet passage. 4. Restricted pump inlet passage. 5. Broken pump drive shaft. 6. Pressure relief valve plunger leaking and/or defective. 7. Broken pump servo. 8. Pump worn out. 9. Broken relief valve spring.	1. Examine hydraulic lines, strainer, etc., and correct. 2. Refer to "HYDRAULIC SYSTEM" section for hydraulic oil recommendations. 3. Inspect pump line mountings for leakage, and correct. 4. Examine oil strainer and clean. 5. Replace or repair. 6. Check for foreign matter on valve seat or broken plunger. Replace if necessary. 7. Repair. 8. Replace. 9. Replace spring.
Loss of motion during operation.	1. Insufficient oil. 2. Pump defective. 3. Broken connecting line, or hose. 4. Either of the following listed under "No motion of hydraulic system when first started" 1, 3, 4, 5, 6, 7, 8, 9.	1. Check level of oil in oil tank and add oil if necessary. 2. Replace or tighten. 3. Replace.

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HYDRAULIC SYSTEM (Continued)

Problem	Probable Cause	Remedy
Short life of pump bearings, shafts, wear plates, etc.	1. Dirty oil.	1. System should be drained, flushed and refilled. Breathers, seals and gaskets must be kept in good condition.
	2. Wrong oil.	2. Use of proper viscosity oil.
	3. Incorrect pump assembly.	3. Disassemble and correct.
Oil heating up.	1. Foreign matter lodged between the relief valve plunger and relief valve seat.	1. Inspect and remove foreign matter.
	2. Using very light oil in a hot climate.	2. Drain and refill with proper oil.
	3. Dirty oil.	3. Drain, flush and refill with oil.
	4. Oil level too low.	4. Fill to proper level.
	5. Insufficient relief valve pressure.	5. Set to correct pressure.
	6. Relief valve pressure too high.	6. Set to correct pressure.
	7. Pump worn. (Slippage)	7. Replace or repair.
	8. Engine rpm's too high.	8. Lower to recommended rpm.
Hydraulic oil tank overflows when unit stands for several days.	1. Supercharge check valve.	1. Replace seat and O-ring in supercharge check valve.
	2. Pump case drain check valves.	2. Replace case drain check valves.
	3. Power steering/supercharge pump.	3. Replace wear plates, gears and gear sections if worn.
	4. Hoist motor Case drain check valve.	4. Replace check valve.

DRIVE SYSTEM

Problem	Probable Cause	Remedy
Insufficient drive power.	1. Parking brake not released.	1. To release brake, put brake lever in OFF position.
	2. Brake out of adjustment.	2. Readjust brake.
	3. Drive hose could be twisted or collapsed.	3. On twisted hose, remove hose and check inside. Inner lining could be collapsed. Replace hoses.
	4. Drive motor is damaged.	4. Remove, inspect and replace if necessary.

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HOIST SYSTEM

Problem	Probable Cause	Remedy
Hoist won't raise or lower.	1. Hoses and connections.	1. Replace twisted or collapsed hose. Tighten all fittings.
	2. Counterbalance not opening.	2. Check O-rings, replace if necessary.
	3. Spool in main valve hoist section not moving.	3. Dirty system. Clean and flush.
		Check operation of spool for free play.
	4. Hoist brake not releasing.	4. Remove brake, repair or replace.
	5. Motor damaged.	5. Remove pump or motor check over and replace if necessary.
	6. Counterbalance valve.	6. Internal drain plugged up. Remove and clean.
Hoist won't pick up maximum load.	1. Hoist motor-to-gearbox coupling.	1. Misalignment of coupling between hoist motor and gearbox will result in loss of power. Check coupling. Re-align if necessary.
		Loose set-screws or sheared keys in hoist mechanism will cause stoppage. Repair/replace if necessary.
	2. Cable.	2. If cable is binding in sheaves, free it.
		Cable may not be reaving properly on hoist drum. Run out cable and reave it on drum correctly.
	3. Hoist gear reducer.	3. Check fluid level in gearbox. Be sure it is not low.
		Be sure the right oil has been put in hoist gearbox.
		Check gears for wear. Replace badly worn gears.
		Replace worn bearings.
	4. Hoist motor worn.	5. Check case drain while motor is in operation.
	5. Main valve bank.	6. Dirt in system. Clean.
		Spring collapsed in bottom of valve section. Replace.
		Seal leaking. Replace.
		O-ring leaking. Replace.

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HOIST SYSTEM (Continued

Problem	Probable Cause	Remedy
Hoist not working evenly.	1. Main pump not adjusted properly.	1. When pumps are out of synchronization or when installing new pumps it is necessary to synchronize the pump stroking system. Refer to section on Pump Adjustment.
	2. Main valve spool or hoist section in main control valve not working properly.	2. Dirt in system. Clean and flush. O-ring out of groove or broken O-ring. Check and replace. Check to see spool is free. Check for full stroke. Check O-rings for cracks. Replace.
	3. Worn hoist motor.	3. Replace motor.
Hoist jerking going down.	1. Counterbalance valve not functioning properly.	1. Remove counterbalance valve repair or replace valve.
	2. Brakes not releasing properly.	2. Replace seals.

TRAVERSE SYSTEM

Problem	Probable Cause	Remedy
Traverse not working.	1. Cable not tight.	1. Take up cable adjustment.
	2. Oil on cable.	2. Wipe off. Remove excessive oil.
	3. Spool in traverse main section.	3. Check for collapsed spring in bottom of valve section. Replace if collapsed. Replace damaged O-rings. Check for leakage in valve. Remove spool and inspect for wear. If valve section is worn or cracked, replace valve section.
	4. Traverse motor by-passing.	4. Gear worn. Replace. Worn bearing. Replace. O-ring leaking. Replace. Gaskets leaking. Replace. Worn thrust plates. Replace. Housing worn. Replace. Key sheared. Replace. Seal leaking. Replace.
	5. Cross-over relief.	5. Set too low or dirt holding open.

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STEERING SYSTEM

Problem	Probable Cause	Remedy
Steering wheels not staying in line.	1. Air in circuit.	1. Loose-fitting. Tighten. Bleed circuit.
		Packing flange leaking in cylinder. Tighten.
		Wiper ring seat leaking in cylinder. Replace.
		Low in oil. Add.
	2. Steering alignment needle valve.	2. Steering alignment needle not tight. Tighten.
		Steering needle valve leaking. Repair/replace as required.
		Replace with new valve.
	3. Steering cylinder.	3. Worn packing. Replace.
		Check packing flange. Tighten if necessary.
		Check wiper seal seat. Replace.
		O-rings leaking. Replace.
		Check cylinder wall for pits, scratches, cracks, or other defects which cause hydraulic fluid leaks. Replace cylinder if necessary.
Steering not operating properly.	1. Steering pump.	1. Check shaft coupling.
		O-rings leaking. Replace.
		Worn bearing. Replace.
		Shaft seal. Replace if worn.
		Check oil level and filters in tank. Change oil if dirty.
	2. Relief valve.	2. Dirt in relief valve. Clean.
		Valve spring collapsed. Replace.
		Valve worn. Replace.
		O-ring leaking. Replace.
		Poppet scored or cracked. Replace.
	3. Steering filter.	3. Replace.

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BRAKE SYSTEM

Problem	Probable Cause	Remedy
Service brake not working.	1. Air in brake circuit.	1. Bleed brake circuit. This is done best with a brake bleeder ball.
	2. Leak in brake system.	2. Tighten fitting or tubing. Bleed brake system.

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COMPONENT DISASSEMBLY AND REPAIR

Pump Drive Transmission

Main Hydraulic Pump (500AI TRAVELIFT)

Main Hydraulic Pump (650AI TRAVELIFT)

Power Steering Pump (500AI)

Supercharge and Power Steering Pump (650AI TRAVELIFT)

Main Control Valves

Miscellaneous Control Valves

Steering Orbitrol Seal Replacement

Steering Cylinder

Master Brake Cylinder

Parking Brake Control Valve

Drive Brake

Hoist Brake

Motor (Drive and Hoist)

Traverse Motor

Gearbox (Drive and Hoist)

Traverse Gearbox

Wheels and Tires

Steering Yoke

GENERAL

The following cleaning instructions are general in nature and are applicable to all components of the TRAVELIFT that are going to be removed and disassembled.

1. Prior to removing a component from the TRAVELIFT it should be steam cleaned on the outside to facilitate removal and prevent dirt from entering the component. Make sure all ports or openings on the component are plugged to prevent contamination from entering the component.
2. Parts such as castings and housings may be cleaned in a hot solution tank with a mild alkali solution as long as none of these parts have ground or polished surfaces. Keep the parts in this solution until the parts are thoroughly cleaned and heated. Parts should be thoroughly rinsed after cleaning to remove all traces of alkali. Because the parts are heated the rinse water will evaporate faster.
3. Clean parts having ground or polished surfaces such as gears, bearing, shafts and collars in a non-flammable cleaning solvent.

CAUTION: Do not use flammable solvents (gasoline, etc.) for cleaning parts.

IMPORTANT: Do not clean these parts with gasoline or in a hot solution tank with water and alkaline solutions such as sodium hydroxide, orthosilicates or phosphates.

4. Dry parts with moisture free compressed air or a soft, clean, lintless cloth. Bearing may be rotated slowly by hand to aid drying or they may be dried with compressed air but DO NOT allow bearings to spin while drying.
5. Lubricate parts that are to be reassembled immediately with a light oil to prevent corrosion. Parts that are to be stored for any length of time should be treated with a rust preventative and wrapped in a corrosion resisting paper.

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PUMP DRIVE TRANSMISSION

REMOVAL

Refer to Figure 28. When removing the main pumps and the transmission, relieve the weight of the components to prevent attaching hardware from binding.

1. If possible, steam clean the pumps and transmission. If steam cleaning is not practical, wash thoroughly with solvent and blow dry with compressed air. Drain transmission oil and discard.
2. When the pumps are disconnected and removed, cap all lines and ports to prevent entrance of foreign material. Work pumps toward rear of machine, keeping weight off pump input shaft. Adapter sleeves (11) may stay with the pump or remain in the transmission.
3. To remove transmission from flywheel housing, remove capscrew (21) from flywheel housing cover (20). The transmission is now free and must be pulled out until splines of gear drive shaft are cleared.

DISASSEMBLY

A clean working space should be provided with sufficient area to arrange disassembled parts.

NOTE: All bearings are press fit. If bearings must be removed from the gear, reuse of bearing is not recommended.

1. Pull shaft (19) from pinion gear (23). Remove adapter sleeves (11) and pump O-rings (10).
2. Drive plate (18) can be removed from engine flywheel by removing place bolts (17).
3. Remove special stud (16). Tap or pry flywheel housing cover (20) from housing. Remove O-rings (4), then drive out oil seal (22) from housing.
4. Remove gear (23) by prying out on bearing (3) using two pry tools.
5. Remove nuts (8) and washer (6). Pry adapters (5) from housing using two pry tools.
6. To remove gears (12), pry out on bearings (3) with two pry tools. Gear and bearings come out together.

REASSEMBLY

Reassemble the pump drive transmission as follows:

1. If bearings (3) have been removed from gears (12 or 23), press into place on each side of the gears. Both sides of gears (12 and 23) are identical and cannot be installed backwards.

NOTE: All bearings are a "press fit" on gears. The inner race of these bearings must be supported when installing on gears.

2. Insert gears (12) into housing and press into place.
3. Install O-rings (4) on adapters (5). Position adapter over bearing and tap into place. Install lockwashers (6) and nuts (8).
4. Insert gear (23), with bearings installed, into housing and press into place.
5. Press oil seal (22) into cover (20). Install O-ring in cover, then position cover over bearing and tap into place. Install special stud (16) and washer (6).
6. Install plugs (2, 13, 14 and 15), reducer bushing (25) and breather (24).

INSTALLATION

Install the assembled unit as follows:

1. Position drive plate (18) on engine flywheel and secure with place bolt (17).
2. Insert pinion drive shaft (19) in transmission. Position transmission on flywheel housing and secure with capscrews (21).
3. Install pumps and connect hydraulic hoses. If the pumps were disconnected and the system drained, refer to Hydraulic System Maintenance for instructions on replenishing the system hydraulic oil supply.

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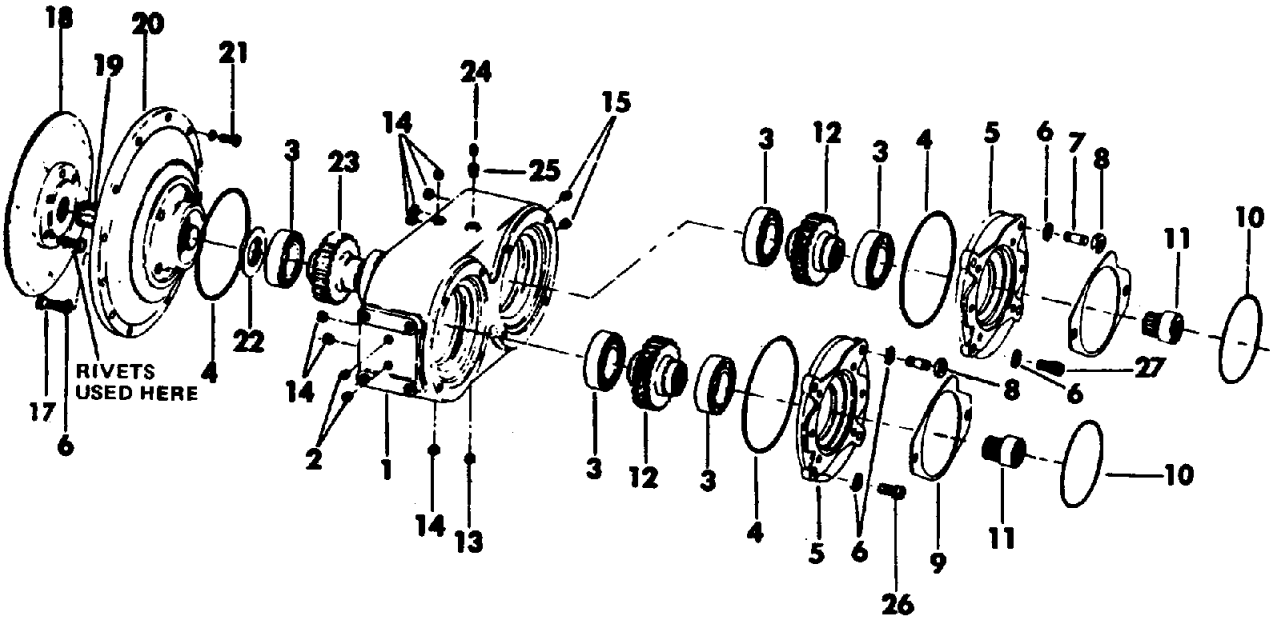


1. Transmission housing
2. Pipe plug
3. Bearing
4. O-ring
5. Pump to housing adapter
6. Lockwasher
7. Stud
8. Nut
9. Adapter to Pump Gasket
10. O-ring
11. Sleeve adapter
12. Driven gear
13. Drain plug
14. Plug
15. Plug, oil level check
16. Special stud
17. Place bolt
18. Drive plate
19. Pinion drive shaft
20. Flywheel housing cover
21. Capscrew
22. Oil seal
23. Pinion gear
24. Breather
25. Reducer bushing
26. Socket head capscrew
27. Socket head capscrew
28. Elbow 90°

Figure 28. Pump Drive Transmission

MAIN HYDRAULIC PUMP (500 AI TRAVELIFT)

REMOVAL

Before breaking a hydraulic circuit connection, be sure engine is shut-off and system pressure has been released. This can be done by moving control levers after engine has been shut-off.

1. Mark hoses for ease of hook-up when reinstalling pump. After disconnecting hydraulic fittings at the pumps, plug all ports and cap lines to prevent contamination of hydraulic fluid in system.
2. Disconnect the pump stroking servo rod from the stroking bell crank.
3. Index mark the pump and transmission. Remove pump from machine by taking out the mounting capscrews.

Courtesy of CraneMarket.com

DISASSEMBLY AND REPAIR

DISASSEMBLY

Be sure that disassembly area is free of dirt. Keep hands and tools as clean as possible. As parts are removed during disassembly, they should be dried with filtered compressed air and arranged in an orderly manner on a surface free of dirt and lint.

1. Valve plate removal. (Number callouts refer to Figure 29).
   a. Index mark valve plate (15) and pump housing (31).
   b. Remove valve plate by taking out capscrews (49). Stroking servo assembly (1 through 14) will come out with valve plate.
2. Rotating group removal and disassembly.
   a. Turn the rotating group (Figure 22) slightly to free it from the swash plate.
   b. Tilt the housing and remove the rotating group. Exercise care that the cylinder block does not become separated from the rotating group during removal from the housing.
   c. Lift the shoe assembly (44, Figure 29), along with the piston and shoe assemblies (43) from the cylinder block (21). Exercise extreme care that machined surfaces of pistons are not nicked or damaged. Even a minor burr on a piston can severely score the cylinder block.

WARNING: If it is necessary to remove spring (19), and washers (20 and 46) from the cylinder block (21), refer to Figure 30 for proper procedures. Bodily injury can be caused by the sudden release of cylinder block spring (19, Figure 29).

3. Swash plate removal. Rotate the swash plate (42, Figure 29) and pull out evenly from yoke (29). Removal may be slightly difficult due to suction of oil under the plate.
4. Drive shaft removal.
   a. Remove retainer snap ring (39, Figure 29) with Truarc pliers.
   b. Tap the end of drive shaft (40) with soft tip hammer to free the shaft and bearing (37) from the housing (31).
5. Yoke removal.
   a. Remove the yoke return spring assembly.
   b. Remove plug (36), from housing along with O-ring (35), spring (34), and seat (33). Exercise care when removing plug since spring (34) is compressed slightly.
6. Pintle and yoke removal (Figure 31).

NOTE: Swash plate must be removed from yoke to remove pintle.

   a. Back-off lock screw (28, Figure 29) at yoke until pintle groove clears.
   b. Lightly tap pintle toward inside of unit to remove.

CLEANING, INSPECTION AND REPAIR

Clean all parts in mineral oil solvent and blow dry with filtered compressed air before inspection and after any lapping or machining operation.

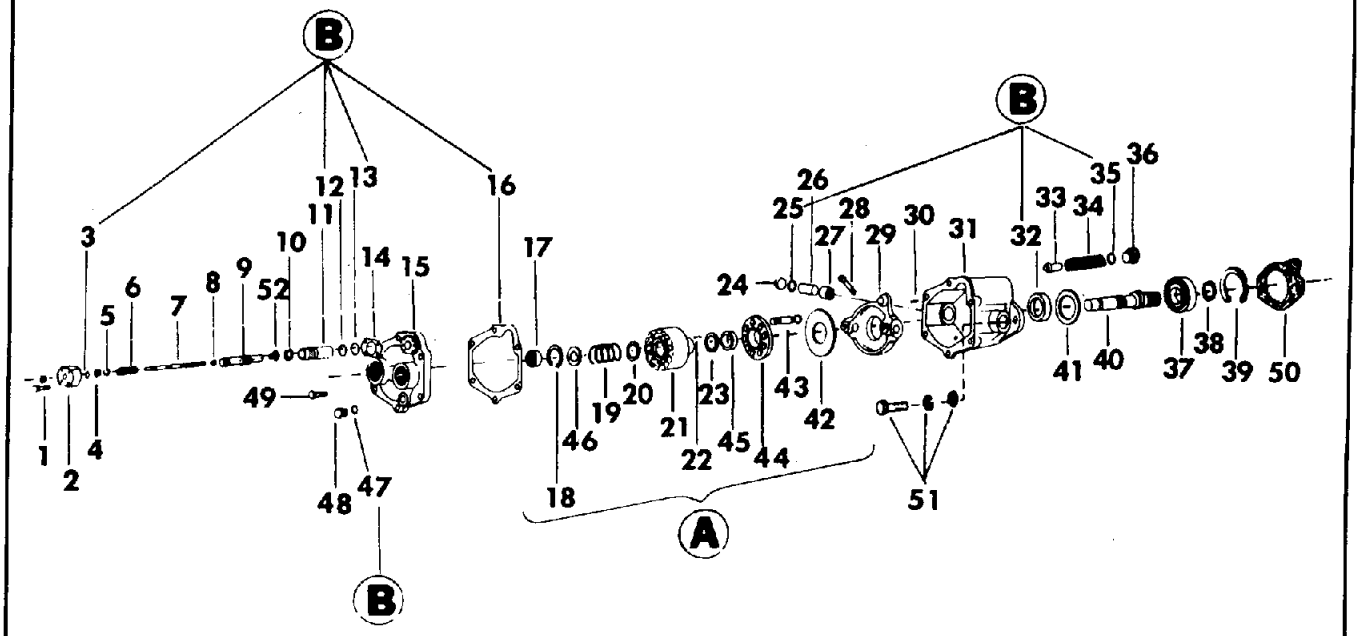
Inspect yoke pintle assemblies, and pintle needle bearings for wear or damage. Inspect stroking servo assembly for signs of wear or damage. Check piston and shoe assembly tolerances as shown in Figure 32. Discard all gaskets, seals and O-rings regardless of condition.

REASSEMBLY

Reassemble the hydraulic pump as follows:

1. Install pintle and yoke.
   a. Insert the pintle through the housing into the yoke.
   b. Align the grooves and thread in lock screw.
   c. Remove pull-screw and insert O-ring and core plug. Press plug in place. Approximately 350 ft-lbs. (475 Nm) force is required to properly seat plug against O-ring for leak-proof seal.
   d. Assemble seat (33, Figure 29), spring (34), and plug (36), and insert the assembly through hole in drive-end of pump housing.
2. Install drive shaft and bearing.
   a. If bearing (37) requires replacement, press new bearing on shaft over drive-coupling end. Support bearing inner race while pressing into position. Install retaining ring (38).
   b. Install new shaft seal (32, Figure 29) in housing. Place washer (41) over shaft seal and then install drive shaft (40) in the housing.

Courtesy of CraneMarket.com



LETTER A – INDICATES ROTATION GROUP
LETTER B – INDICATES SEAL KIT

1. Snap ring
2. Cover
3. O-ring
4. Snap ring
5. Washer
6. Spring
7. Spool
8. Plug
9. Piston
10. Snap ring
11. Cylinder
12. O-ring
13. O-ring
14. Gasket
15. Valve plate
16. Gasket
17. Bearing
18. Snap ring
19. Spring
20. Washer
21. Cylinder block
22. Pin
23. Washer
24. Plug
25. O-ring
26. Pintle
27. Bearing
28. Capscrew
29. Yoke
30. Pin
31. Housing
32. Seal
33. Seat
34. Spring
35. O-ring
36. Plug
37. Bearing
38. Snap ring
39. Snap ring
40. Shaft
41. Washer
42. Swash plate
43. Piston
44. Shoe plate
45. Spherical washer
46. Washer
47. O-ring
48. Plug
49. Capscrew
50. Capscrew

Figure 29. Main Hydraulic Pump (500AI TRAVELIFT)

Courtesy of CraneMarket.com

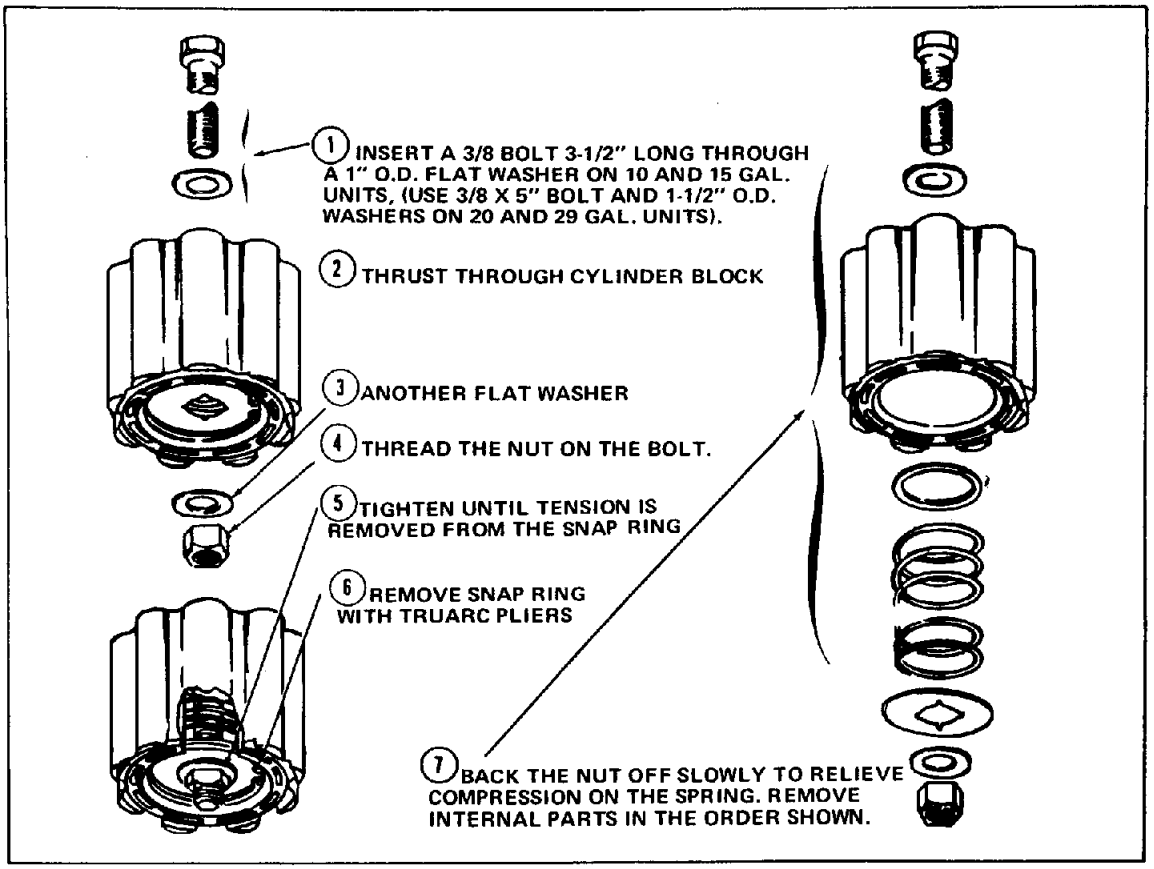


Figure 30. Disassembly and Assembly of Cylinder Block

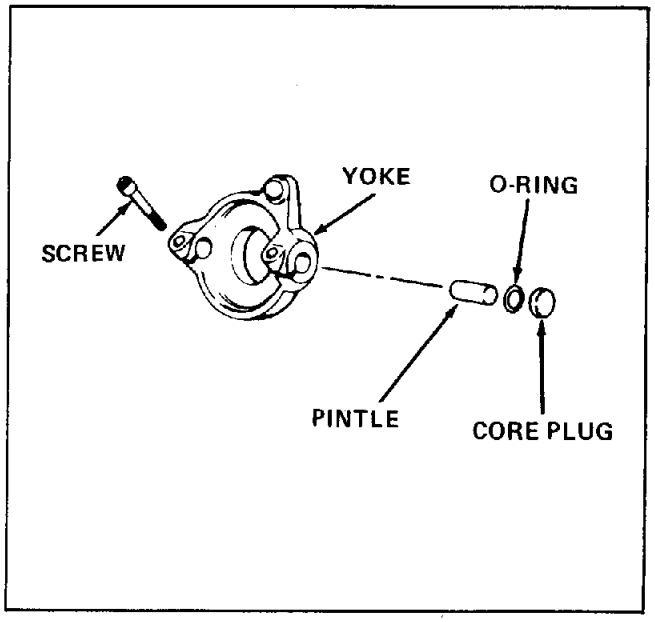


Figure 31. Pintle and Yoke

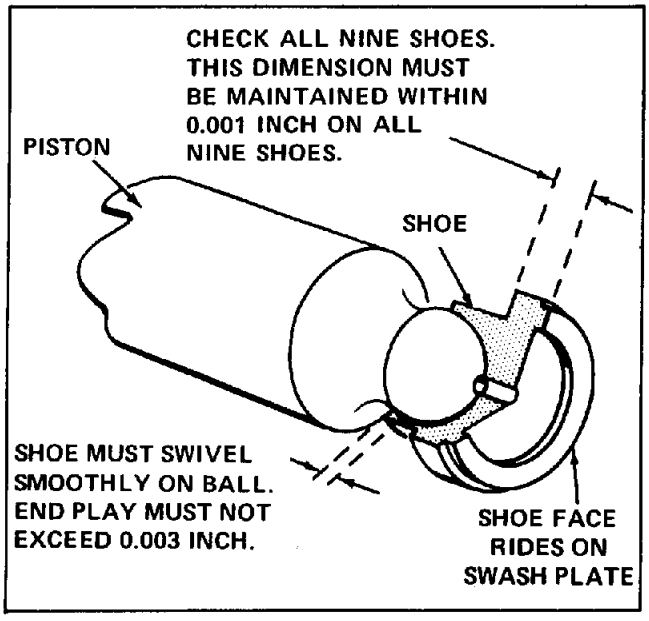


Figure 32. Piston and Shoe Assembly Tolerances

Courtesy of CraneMarket.com

c. Secure assembly in housing with snap ring (39).

3. Install Swash Plate. Lubricate and install swash plate (42) with round outside edge down. Plate should rotate freely with fingers.

4. Reassembly and Installation of Rotating Group. If the spring and washers were removed from the cylinder block, re-install them as shown in Figure 30. Assemble the piston and shoe assemblies in the cylinder block as follows:

   a. Place cylinder block face down on a smooth, clean surface.

   b. Insert three pins (22, Figure 29) in their holes in the cylinder block.

   c. Grease back-up washer (23) and spherical washers (45) and place them on the pins.

   d. Clamp pump in a vise with the shaft pointing down. Pour clean hydraulic fluid in piston holes of the rotating group until they are full.

5. Insert rotating group in housing as follows:

   a. Hold motor shaft with one hand and tilt motor on edge at about a 45 degree angle. Install rotating group with other hand.

   b. Carefully rotate block until the spherical washer and cylinder block splines fall into alignment with the splines on the drive shaft.

6. Valve plate assembly and installation.

   a. If needle bearing (17, Figure 29) requires replacement, install new bearing in bore of valve plate (15).

   b. Install stroking servo assembly (1 through 14) on the valve plate.

   c. Install valve plate on pump housing; make sure that stroking piston lines up with ball on yoke. Refer to the Torque Chart in the back of this manual when tightening the six valve plate mounting capscrews.

   d. Push the nine piston-and-shoe assemblies (43) through holes in shoe plate (44) until shoes seat in shoe plate.

   e. Hold shoe plate so that pistons do not strike each other, align the pistons with the bores in cylinder block and maneuver them into place. The pistons must move freely in the lubricated block bores.

INSTALLATION

Install the main hydraulic pump as follows:

1. Position pump on transmission. It may be necessary to rotate shaft slightly in order to line up splines on drive shaft with splined drive coupling in transmission.

2. Install and tighten attaching capscrews. Refer to Torque Chart.

3. Connect hoses as marked during removal.

4. Remove O-ring type allen plug from top of valve plate. When oil runs out of plug hole, reinstall plug. This will fill pump outer case with oil.

5. After pump has been installed, insert link between stroking servo rod and stroking linkage bell crank.

PUMP BREAK-IN PROCEDURE

To properly break-in a new or rebuilt pump, the pump should be operated under a no-load or a minimum load condition for a specified period. The following procedure is the specified break-in period and should be followed to get maximum service life from your new or rebuilt pump.

Start the engine and set the throttle at minimum (engine speed approximately 800 rpm). Run the pumps for 15 to 20 minutes at this time. DO NOT OPERATE EITHER THE CONTROL LEVERS AND PEDALS OR PUMP STROKING PEDAL DURING THIS TIME. Continuously check the hydraulic oil level. It should remain stable during this period. Add oil if necessary.

After the initial run-in period, increase engine speed to 1000 rpm. Slowly stroke the volume control pedal to full stroke and hold it for several minutes. Release the pedal. Repeat this sequence twenty times. Check the hydraulic fluid level.

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MAIN HYDRAULIC PUMP (650AI)

NOTE: If Sundstrand pump or motor repairs are necessary during Drott warranty period, other than shaft seal or servo control, complete pump or motor assembly must be replaced. Beyond warranty period, field repair is not recommended. Inquire about the Drott exchange program for Sundstrand pumps and motors.

In an emergency — where field repairs are absolutely necessary — proceed according to the following procedures.

REMOVAL

Remove the pump from the TRAVELIFT as described in the following steps:

1. If possible, the pump should be steam cleaned while still on the TRAVELIFT and before any hose is disconnected. If a steam cleaner is not available, wash the pump, especially the fittings, with suitable cleaning solvent. Remove any dirt from the machine which could be accidentally dislodged and enter the pump during the reinstallation procedures.

2. Disconnect hoses connected to pump and drain oil into a suitable container. It is recommended that the oil be discarded and replaced with new oil when the pump is replaced.

3. Remove the mounting bolts and set the pump on a clean work bench. Working on the pump in a drip pan will aid in keeping the work bench clean.

DISASSEMBLY

Refer to Figure 33 and disassemble the pump as follows:

1. Remove snap ring (45) (in some cases four capscrews may be used instead of a snap ring). Remove the O-ring (1A), the seal retainer (47), and the steel half of the seal (1C). Items 1A, 1B and 1C will come out with the seal retainer. Set these parts aside to avoid damaging them during further disassembly. Unless the seal will be replaced it is important to protect the lapped edge of the steel half of the seal (1C) from damage.

2. Remove the bronze half of the seal (1D). This part is held in place by the squeeze on the O-ring (1F). It can usually be wiggled off the shaft. A few seals incorporate a small spread pin in the drive shaft to "drive" the bronze half of the seal. Check to see if this pin may have worn a groove into the I.D. of the seal half. If so, hold the shaft stationary and rotate the seal half as far as it will go in the direction of shaft rotation. This will again line up the slot in the seal half with the drive pin and the seal half can be removed. However, once in awhile even after the drive pin is lined up with the slot, it may be necessary to pry the part loose by using two screwdrivers. If this is necessary, make sure all pressure is applied against the sides of the seal half and that the lapped sealing surface is not damaged in any way.

3. Remove the cover plate (22) by removing the six capscrews (21). Inspect the gasket for damage and replace if necessary.

4. Remove the end cap as follows:

   a. Remove the eight bolts (19) holding the end cap in place. If the end cap does not separate from the housing, carefully tap it with a rubber hammer to loosen it.

IMPORTANT: Never use a screwdriver to pry between any two surfaces of the pump. Use extreme care to avoid damage to lapped surfaces on components of the pump.

   b. The valve plate (52) is loosely doweled (51) to the end cap for position only. However, due to the extreme flatness of the face of the end cap and the mating surface of the valve plate, an oil seal will exist between these two parts causing the valve plate to cling to the end cap. On occasion, the brass bearing plate (53) will, for the same reason, cling to the valve plate. Therefore, as the end cap is lifted, care should be exercised to prevent the valve plate from being damaged should it become loose and fall.

   c. Set the end cap aside with the lapped surface up. The lapped surface should be protected from damage at all times.

   d. Remove the gasket (15) and O-ring (17) and replace if damaged.

5. Remove the brass bearing plate (53). The ma-

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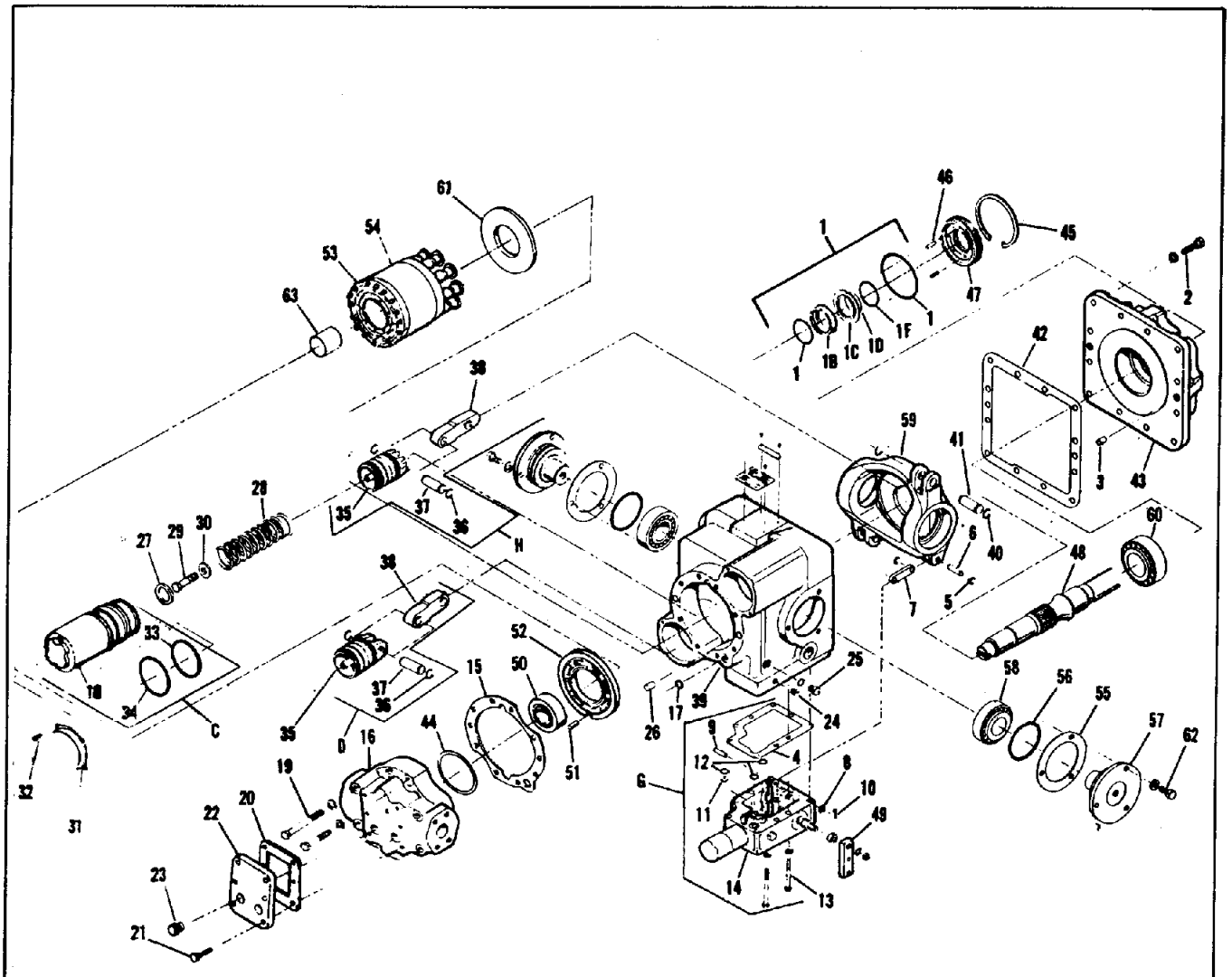

1. Seal assembly
2. Bolts
3. Dowel pins
4. Control valve gasket
5. Retainer ring
6. Clevis pin
7. Control link
8. Washer
9. Clevis pin
10. Cotter pin
11. Orifice plug
12. O-ring
13. Capscrews
14. Control valve assembly
15. End cap gasket
16. End cap
17. O-ring
18. Servo sleeves
19. Hex head bolts
20. Gasket
21. Capscrew
22. Plate
23. Plug
24. Plug
25. Plug
26. Dowel pin
27. Spring guide
28. Servo control spring
29. Screw
30. Washer
31. Sleeve retainer
32. Socket head set screws
33. O-ring
34. O-ring
35. Servo piston
36. Retainer ring
37. Servo piston pin
38. Servo piston link
39. Housing
40. Retainer ring
41. Swash plate pin
42. Cover gasket
43. Front cover
44. Shim
45. Snap ring
46. Stop pin
47. Seal retainer
48. Drive shaft
49. Control lever
50. Rear bearing
51. Dowel
52. Valve plate
53. Brass bearing plate
54. Rotating group (cylinder block and pistons)
55. Trunnion gaskets
56. Trunnion O-ring
57. Trunnion
58. Trunnion bearing
59. Swash plate
60. Bearing
61. Thrust plate
62. Trunnion bolts
63. Spring guide

Figure 33. Main Variable Displacement Pump (650AI TRAVELIFT)

Courtesy of CraneMarket.com

terial in this plate is relatively soft and can be easily scratched and damaged. Wash the plate with clean solvent to break the oil seal and lift the plate from the rotating group (54). There are drain slots milled into the back of the brass bearing plate running radially to the outside diameter. As an aid in removing the brass bearing plate, a brass pry can be carefully inserted into one of these drain grooves and the bearing plate lifted. *Do not force* these two pieces apart at any other point other than at the drain slots.

6. Remove the rear bearing (50). Use a standard bearing puller to pull the rear bearing. Be sure you can rotate bearing cage while pulling. Pull only on the inner race not the cage or rollers. The pump shaft should be protected from damage by placing a suitable piece of metal between the ram of the puller while assembling the jaws under the bearing.

7. Remove the spring guide (63). Remove the rotating group (54) by placing the pump housing (39) in a horizontal position. Grasp the cylinder block with the fingers and pull. Remove the block with the pistons in place.

NOTE: Do not disassemble the rotating group.

8. Remove the thrust plate (61). This part is cradled in the swash plate (59) with very little side clearance. If the pump is to be completely disassembled, it is easier to remove the thrust plate after the swash plate has been removed from the housing. If the swash plate is not going to be removed, a metal rod approximately 10 in. (25.40 cm) long and with a small hook approximately 1/16 in. (1.588 mm) high on the end makes a good tool for removing the thrust plate. Two notches are provided in the I.D. of the swash plate on a plane parallel to the center line of the trunnions. These notches provide clearance behind the thrust plate permitting the engagement of the hook. By pulling first on one side and then the other, the thrust plate can be "worked" out of the swash plate and removed.

9. Remove the front cover (43) by removing the eight bolts (2). The front cover is positioned by two dowel pins (3). If it does not fall loose tap with a rubber or plastic hammer to free it.

10. Remove the front cover gasket (42). If necessary, scrape both the front cover and pump housing free of any particles of gasket material that might have remained on either.

11. Remove the drive shaft (48). With the front cover removed, the shaft will easily slide out the front of the housing.

12. Remove the control valve assembly (14).

    a. Remove the eight capscrews (13) which hold the control valve assembly (14) in place and lift the control assembly up and out.

    b. Remove the small clevis pin (9) which connects the two follow-up links on the control with the connecting link attached to the swash plate. *If the control valve assembly (4) is being removed without the rest of the pump being disassembled,* it is strongly recommended that before removing the small cotter key (10) used to hold the clevis pin, a long piece of tag wire or equivalent be run through the eye of the cotter key. This will prevent the cotter key from accidentally falling into the pump if dropped.

    c. The clevis pin (9) can now be removed. The clearance between the O.D. of the body of this pin and the I.D. of the three holes it passes through is very small; therefore, the pin does not slide out easily. Wiggling the control housing (14) as you pull on the clevis pin will make its removal easier. Here again, *if the control valve assembly (14) is being removed without the pump being disassembled, take care not to drop the clevis pin inside the pump housing.* If you do and it cannot be fished out with a magnet, it will be necessary to disassemble the pump piece by piece until the clevis pin is found.

    d. Lay the control valve assembly aside. Further disassembly of this valve is usually not necessary. It should be thoroughly washed and blown out with compressed air.

13. Remove the trunnions (57). Remove the three bolts (62) that hold each trunnion in place. Use a spanner wrench and rotate the trunnion back and forth with one hand as you push on the inside face of the trunnion with the other hand. It is necessary to overcome the drag of the O-ring (56) to remove the trunnion. The inner race of the trunnion bearings (58) usually comes out with the trunnion.

Courtesy of CraneMarket.com

14. With the trunnions removed, it is now possible to lift the swash plate (59) out of the housing.

The pump is now completely disassembled. All parts should be inspected. Those needing to be replaced should be replaced and those needing rework, reworked. Thoroughly wash all parts in clean solvent or fuel oil and then keep them clean. Wrap them in either clean rags or plastic. If the parts are to remain disassembled for any period of time, they should be protected from rust and accidental damage. Do not allow any lapped surface to become scratched or nicked. Due to the high pressures the pumps and motors are required to handle today, any abuse to the parts during the repair procedure will result in an inefficient or inoperative unit after it is assembled.

REASSEMBLY

During reassembly it is important to make sure all parts are thoroughly clean. As the parts are being reassembled lubricate with the same type fluid being used in the system.

IMPORTANT: Never allow two unlubricated surfaces to rub against each other.

Refer to Figure 33 and reassemble the pump as follows:

1. Replace bearings (50, 58 and 60) if necessary. These bearings should be pressed rather than driven into place.

BEARING FITS

Bearing		Mating Part	Fit
Front	Cup*	Front Cover (Item 43)	Slip
Item 60	Cone	Drive Shaft (Item 48)	Press
Rear	Cup	End Cap (Item 16)	Slip
Item 50	Cone**	Drive Shaft (Item 48)	Press
Trunnion	Cup	Swash Plate (Item 59)	Press
Item 58	Cone	Trunnion (Item 57)	Slip

*See procedure for establishing shaft end play Step 3.

**Do not press the cone of the rear bearing onto the shaft until the cylinder block is in place, see Step 16, or unless the drive shaft end play is to be checked, see Step 3.

2. Set preload on trunnion bearings. If either a new swash plate (59), trunnion (57), or trunnion bearings (58) were replaced or if the plastic trunnion gaskets (55) were lost, it will be necessary to establish the desired preload on the trunnion bearings as follows:

   a. Remove the O-rings (56) from the trunnions.

   b. Return the same thickness of gasket (55) to each trunnion that was present when the pump was disassembled.

   c. Slip the trunnion bearing cones onto the trunnions.

   d. Place the swash plate (59) in the housing, lining up the bearing races with trunnion bores in the housing (39).

   e. Insert the trunnions, minus the O-rings, into the housing and swash plate. The clearance between the trunnions and their bores in the housing is small, therefore, it is easy to bind the trunnions as they are being put into place. A plastic hammer may be used to lightly tap the trunnions as an aid in assembly.

   f. Tighten one trunnion bolt (62) on each trunnion.

   g. Attach a spring scale to either of the two bores for the swash plate pin (41). With the proper thickness of trunnion gaskets, it will require between 3 and 4 pounds (1.35-1.8 Kg) pull to move the swash plate. Add or remove gaskets (55) until this reading is obtained. Gaskets should be added or removed evenly to each side. The total thickness of gaskets on one trunnion should not exceed the total thickness of gaskets on the other by more than .005" (.1270 mm).

   h. When the proper preload is established, remove the trunnions from the housing.

3. The shaft end play. If a new drive shaft (48), end cap (16), front cover (43), and front bearing (60) are used, the shaft end play should be checked as follows:

   a. Press the cone of both the front and rear bearings onto the drive shaft.

   b. Install the end cap gasket (15) and end cap (16).

   c. Tighten two of the end cap bolts to 27-30 ft-lbs. (36-40 Nm).

   d. Put the front cover gasket (42) onto the housing.

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e. Place the drive shaft in the housing with the cone of the rear bearing in its cup.

f. Place the front cover (43) into place.

g. Tighten at least one bolt (centrally located) on each side to 27-30 ft-lbs. (36-40 Nm).

h. The end play of the shaft can now be checked and should be between .003" and .013" (.0762 to .3302 mm).

4. Assemble the servo pistons (35) as follows:

NOTE: If the old swash plate (59), the two servo piston assemblies (27 through 41), and the two servo sleeves (18) are to be reused, they shall all be returned to the same position they were removed from. See Step 10 for the correct procedure to follow to set the neutral position of the swash plate if any of these parts are replaced with new or if the parts have become mixed up.

a. Check the grooves on the O.D. of the servo piston (35) making sure there are no burrs or foreign material present.

b. Place the servo control spring (28) in the I.D. of the servo piston (35).

c. Insert the spring guide (27) into the servo control spring.

d. Insert the 1/4-20 screw (29) into the washer (30) and drop both into the I.D. of the spring guide to the screw threads extend through the hole in the end of the guide.

e. Compress the servo control spring until the 1/4-20 screw can be engaged and tightened into the servo piston.

f. Place the servo piston link (38) into the clevis of the servo piston.

g. Insert the servo piston pin (37) into place, pinning the link to the swash plate.

h. Fasten the servo piston pin into place with two snap rings (36).

i. Assemble the other piston assembly in the same manner.

5. Attach the servo piston assemblies to the swash plate as follows:

a. Lay the swash plate flat on the workbench and place the free end of the servo piston links (38) into the two clevises provided on the swash plate. The joggle in the servo piston link should be arranged so that the pistons are "stepped" outward from the center line of the pump.

b. Insert the two swash plate piston pins (41) through the clevis of the swash plate, pinning both links to the swash plate.

c. Fasten the pin in place with two snap rings (40).

6. Attach the control link (7) to the swash plate as follows:

a. Position the control link (7) in the clevis provided in the swash plate.

b. Insert the clevis pin (6) into place pinning the link to the swash plate.

c. Fasten the pin in place with two small snap rings (5).

7. Install the swash plate (59) as follows:

a. Set the pump housing on the bench with the front cover opening facing you and the opening for the control upward.

b. Insert the swash plate with the servo piston assemblies and control link attached into the housing. As this is done, the two servo pistons should be placed into the openings provided for the servo sleeves. This should be done with care to prevent damage to the pistons.

NOTE: Make sure the swash plate is positioned so that the control link (7) is next to the opening provided in the housing for the control assembly (14), and pointing toward the end cap (rear) end of the housing.

8. Install the trunnions as follows:

a. Cover the trunnion O-rings (56) with grease and put them in place on the trunnions. The grease is used to prevent the O-ring from being damaged as the trunnion enters the housing.

b. Place the trunnions through the bores in the housing and into the swash plate. The clearance between the trunnion and its bore is small and it is, therefore, easy to bind the two parts together. A plastic or babbit hammer may be used to lightly tap the trunnion "home", if necessary.

c. Tighten the trunnion bolts (62) to 27-30 ft-lbs. (36-40 Nm).

Courtesy of CraneMarket.com

9. Install the servo sleeves (18, Figure 33) as follows:

   a. Cover the O-rings (33 through 34) with grease and put them in place on the sleeves.

> **NOTE:** O-ring (34) is slightly smaller in O.D. than (33) and goes in the groove toward the open end of the sleeve.

   b. Turn both sleeves into the housing until the scribed lines on the sleeves and those on the housing line up. These lines should have been scribed at the factory during the original assembly or at the time of disassembly. If the swash plate, all parts of the servo piston assemblies and both of the servo sleeves are to be returned to the pump and not replaced with new parts, lining up the scribed marks will return the swash plate to its neutral position.

10. Setting neutral position of swash plate as follows:

   a. If any of the parts mentioned in Step 9 were replaced with new parts or as a check to make sure the swash plate is in absolute neutral, the following procedure should be used.

   b. Turn both servo sleeves into the housing as evenly as possible, until all angular play is taken out of the swash plate. This will happen when the servo sleeves are both just touching the spring guides (27). Do not turn the sleeves in beyond this point causing any compression of the servo control spring (28).

   c. Using a depth mike measure from the machined surface of the housing, which makes contact with the end cap gasket, to the machined surface of the swash plate. This is the surface against which the thrust plate bearings. The measurement should be made at two points equally spaced from the center line of the pump and as near to the outside diameter of the machined recess as possible. Measure one side then the other. Note which side is low and back off (turn counterclockwise) the servo sleeve nearest this side 1/8—1/4 turn. Turn the other sleeve in (clockwise) a like amount or until the angular free play is again removed from the swash plate. Repeat this process until the machined recess of the swash plate is *absolutely* parallel to the machined surface of the housing which touches the end cap gasket and there is *absolutely* no angular free play in the swash plate.

   d. Install the sleeve retainer (31).

   e. Use the socket head set screws (32) previously removed. Use a screwdriver to set retainer in slot in the sleeve to prevent the sleeve rotation.

11. Install the control assembly.

   a. Put the control gasket (4) in place.

   b. Cover the three O-rings (12) with grease to hold them in place and put them in the recesses provided in the control valve housing.

   c. If used, press the orifice plug (11) into O-rings in the middle port in the control valve housing.

   d. Place the swash plate link (7) between the "follow-up" linkage of the control.

   e. Put the small snap ring in the groove in the clevis pin (9) and insert it through the "follow-up" links and the swash plate control link.

   f. Place the small washer (8) on the clevis pin.

   g. Insert the small cotter pin (10) through the clevis pin. Do not use the old cotter pin.

   h. Fasten in place using the proper bolts (13). Tighten to 85-90 in-lbs. (11.77-12.47 meters Kg).

> **NOTE:** Be sure to put the proper length bolt in the correct hole.

12. Install the thrust plate (61). Place the thrust plate into the machined recess in the swash plate. The chamfered side goes against the swash plate. The clearance between this plate and its recess is small, therefore, care should be taken to insure it lies flat.

13. Install the drive shaft (48). If the cone of the rear bearing was pressed onto the drive shaft to establish the shaft end play, it should be removed at this time. The cone of the front bearing should be in place. Slide the shaft through the I.D. of the swash plate from the front cover end taking care not to move the thrust plate out of position.

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14. Install the front cover gasket (42).
15. Install the front cover (43). Tighten the bolts that hold it in place to 27-30 ft-lbs. (3.74-4.16 meters Kg).
16. Assemble the cylinder block assembly into the housing as follows:
    a. Lay the housing on its side with the control up (14).
    b. Turn the drive shaft until the missing tooth in the spline is on top.
    c. Pull the drive shaft as far as possible toward the front of the pump and clamp a collar or "C" clamp onto it to prevent it from being bumped or pushed toward the rear of the pump as the assembly continues.
    d. Cover the cylinder block and piston assemblies liberally with clean oil. Pick up the cylinder block assembly and slide it into the housing and onto the drive shaft. It is necessary to line up the missing tooth on the shaft with the missing tooth in the retainer guide and the cylinder block. Push the block all the way "home".
17. Install the spring guide (63). This sleeve-like part is used as a spacer. It should slide freely onto the shaft and into the block. If it does not drop into place freely, the block spring is not concentrically positioned and should be moved into proper position with a screwdriver.
18. Press the cone of the rear bearing (50) onto the shaft. This can either be done with an arbor press or a bearing puller. In either case, make sure the tool is clean. If not dirt will fall into the pump. As the cone is pressed into position, the slipper retainer springs in the rotating group will be compressed and the whole cylinder block assembly will drop into the housing a quarter to three quarters of an inch (6.35 to 19.05 mm) depending on the size pump.
19. Install the bearing plate (53) as follows:
    a. Set the pump shaft downward on the block of wood used during assembly.

NOTE: Do not bump or push the shaft toward the rear of the pump. If this happens, the shaft spline can become disengaged with the spline in the retainer guide and the two parts can then become out of phase. The retainer guide will, in this case, be extensively damaged as the end cap is bolted in place.

    b. Put the dowel pins (71) into the block. Make sure the face of the cylinder block and the bearing plate are *absolutely* free of any foreign material such as dirt, lint, etc. These two parts should lie absolutely flat against the other.
    c. Cover the bearing plate liberally with oil.
20. Place the valve plate (52) on the end cap (16) as follows:
    a. Put the cup of the rear bearing (50) and dowel pin (51) in place in the end cap. Make sure the end cap and valve plate are free of any dirt or lint that would prevent the parts from laying absolutely flat against the other.
    b. Cover the face of the end cap with a *thin, even* coat of oil soluble grease such as vasoline. Put the valve plate (52) into place and press it down into the grease.
21. Put the end gasket (15), O-ring (17), and dowel pins (26) into place on the housing. Coating the gasket with a thin, even coat of light grease will make it easier to remove the gasket should it be necessary to again service the pump in the future.
22. Install the end cap (16). Carefully pick up the end cap, with the valve plate in place, turn it over, and lower it in place until the valve plate touches the bearing plate. This should be done carefully so as not to dislodge the valve plate.
23. Install the cover plate (22) as follows:
    a. Lay the pump on its side.
    b. Place the plate gasket in place.
    c. Position plate on pump and install six bolts.
    d. Tighten the six bolts that hold the cover plate in place to 85-90 ft-lbs. (15-122 Nm).
24. Install the shaft seal (1) as follows:
    a. Cover the shaft seal O-ring (1F) with grease and put it in place in the I.D. of the shaft seal (1D).
    b. Check the end of the pump drive shaft for any burrs that would cut the shaft seal O-ring. Slide shaft seal (1D) onto the shaft and press it into place with the skirt flat against the inner race of the front bearing.
    c. Place the seal springs (1B) in place in the seal retainer (47). The stop pin (46)

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should be driven securely into the seal retainer.

d. Cover the housing seal O-ring (1A) with grease and put it in place on the skirt of the housing seal (1C).

e. Press the housing seal (1C) into the retainer with the fingers, engaging the stop pin in the slot in the housing seal. Press down on the housing seal, compressing seal back to its original position. This will insure an even pressure being maintained between the seal halves.

f. Cover the retainer O-ring (1E) with grease and put it in place on the O.D. of the retainer.

g. Push the retainer, as assembled in Steps D through F, into the housing far enough to allow the snap ring (45) to be put in place.

h. Using a large set of Tru-Arc pliers, place the seal snap ring in place.

25. Using a lever, such as a pair of channel locks, rotate the pump shaft several revolutions by hand, making sure it turns fairly free.

If the pump is to be in storage for any length of time, it should be completely filled with oil and all ports plugged. Just prior to being installed on a vehicle, the shaft should again be rotated several revolutions by hand.

PUMP BREAK-IN PROCEDURE

To properly break-in a new or rebuilt pump, that pump should be operated under a no-load or a minimum load condition for a specified period. The following procedure is the specified break-in period and should be followed to get maximum service life from your new or rebuilt pump.

Start the engine and set the throttle at minimum (engine speed approximately 800 rpm). Run the pumps for 15 to 20 minutes at this setting. DO NOT OPERATE EITHER THE CONTROL LEVERS AND PEDALS OR PUMP STROKING PEDAL DURING THIS TIME. Continuously check the hydraulic oil level. It should remain stable during this period. Add oil if necessary.

After the initial run-in period, increase engine speed to 1000 rpm. Slowly stroke the volume control pedal to full stroke and hold it for several minutes. Release the pedal. Repeat this sequence twenty times. Check the hydraulic fluid level.

POWER STEERING PUMP (500AI)

REMOVAL

1. Drain the hydraulic system. Refer to instruction under "Hydraulic Systems". Discard the drained oil.

IMPORTANT: Place appropriate tags in the operator's compartment that the TRAVELIFT is not to be operated with hydraulic system drained.

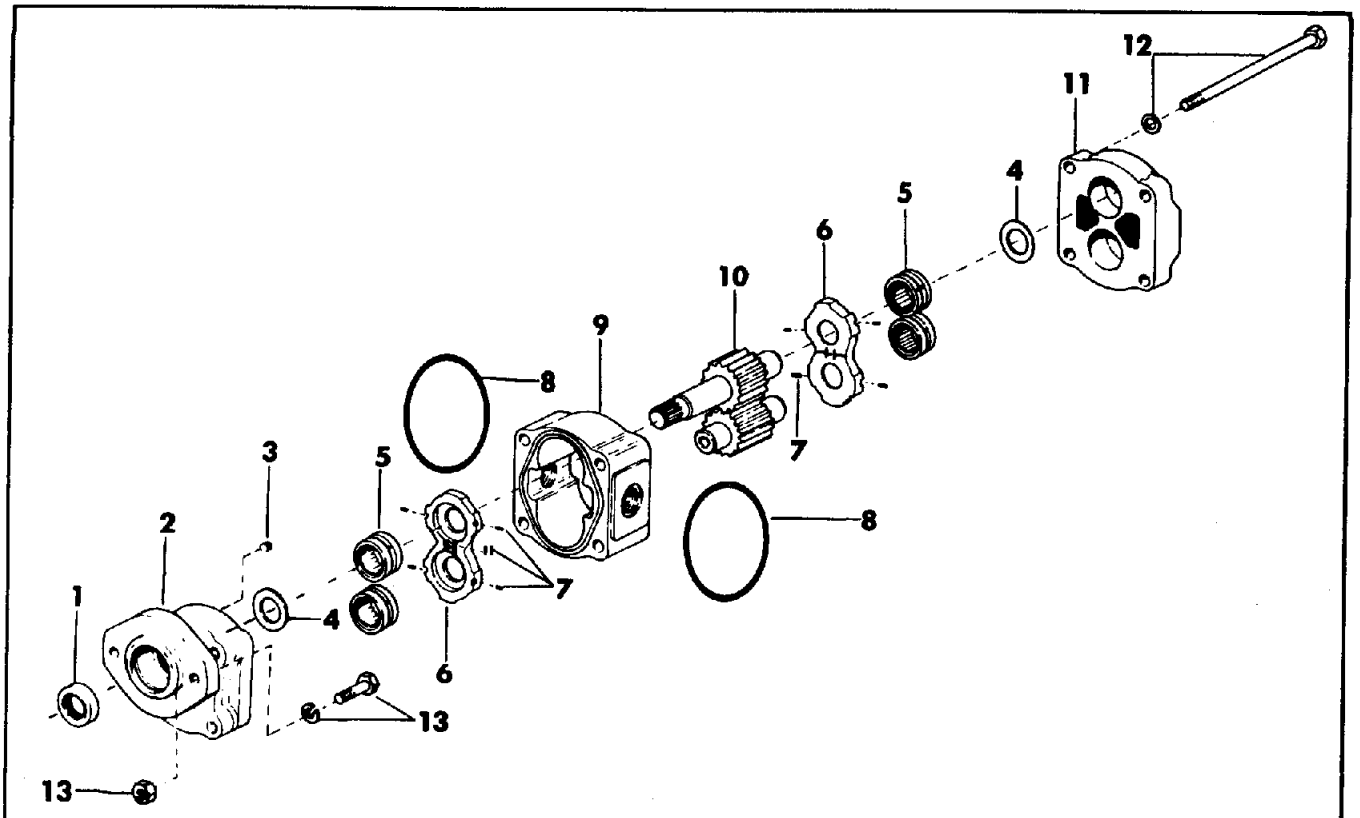
2. Disconnect the pump inlet and outlet lines at the pump ports. Cap and plug all open fittings immediately.

3. Remove the mounting capscrews that hold the pump to the mounting bracket and remove the pump.

Courtesy of CraneMarket.com

DISASSEMBLY

1. Index mark the port end cover (11, Figure 34), gear housing (9), and shaft end cover (2) to facilitate reassembly.
2. Remove the four capscrews and washers (12).
3. Lift off port end cover (11). The thrust plate (6) with rings seal (4), pocket seal (7) and roller bearings (5) will be removed with cover.
4. Remove the driven gear and drive gear set (10) and gear housing (9) from shaft end cover (2). Gears are a matched set and must be kept together.
5. Turn shaft end cover (2) so that thrust plate is up. Pry off thrust plate (6) carefully with thin screwdriver. Remove and discard pocket seals (7).
6. If bearings (5) are to be replaced, remove them from the shaft end cover with a bearing puller.
7. Remove and discard O-rings (8).
8. Remove and discard lip seal (1) from shaft end cover (2).



1. Double lip seal
2. Shaft end cover
3. Set screw
4. Ring seal
5. Roller bearing
6. Thrust plate
7. Pocket seal
8. O-ring
9. Gear housing
10. Gear set
11. Port end cover
12. Capscrew
13. Capscrew

Figure 34. Power Steering Pump (500AI TRAVELIFT)

Courtesy of CraneMarket.com

INSPECTION AND REPAIR

The reason why the pump was disassembled will usually determine the pump parts that require replacement.

1. Cavitation. A pump that has been making a great deal of noise due to cavitation or improper oil supply will need bearings and new gear housing. Replace all parts that are pitted.
2. Leakage. A pump that has been leaking between sections will need new O-rings. Check thrust plates and gear housing faces for defects or damage.
3. Low Output. A pump that has been delivering low volume may need new pocket seals, or it may have some badly worn or scored parts.
4. Broken Parts. If a part of your pump is visibly chipped or broken, foreign matter may be circulating in the hydraulic system. Flush the system; remove filters, check them for ruptures, and replace them. Check filter screen in reservoir; if damaged, replace it. Replace broken or scored parts of pump.
5. Bearing Test. Test all bearings by rotating a gear or shaft in them under slight side pressure to check (by feel) for pitted or cracked races. Replace bearings as necessary.
6. Gears and Bearings. If bearing-mating surfaces of gears are scored, obtain a new set of matched gears. In this case, bearings must also be replaced.
7. Housing Components. Check housing and thrust plates for scoring and wear.

Replace all damaged, worn, or scored parts that cannot be repaired. Clean and dry (with compressed air). If pump is not to be reassembled immediately, store parts in clean hydraulic fluid, making sure to keep matched gear sets and roller bearings together.

REASSEMBLY

Shaft End Cover

1. Press bearing in bores of shaft end cover if they have been removed. Install seal rings in bores before installing bearings.
2. Install double lip seal (Figure 34A).

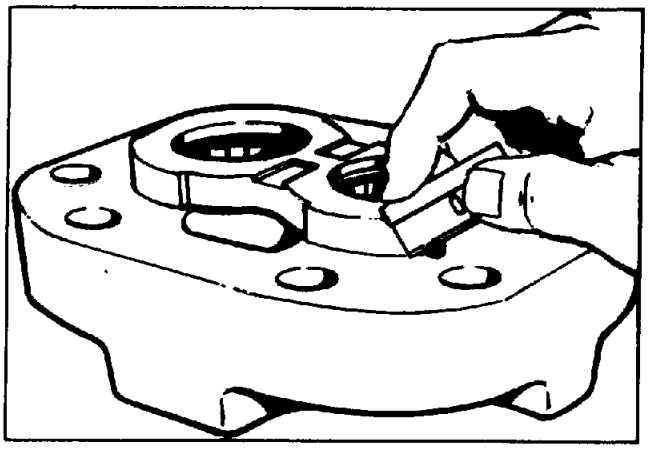


Figure 34A. Trimming Pocket Seals.

3. Place small amount of heavy grease into the two middle slots in the open face of the thrust plate (6) and insert pocket seals (7).
4. Place the thrust plate (6) with pocket seal slots toward the face of the shaft end cover over the bearings (5). Check to see that the pocket seals (7) in the center slots are still in place before tapping thrust plate into position. Leave a clearance of approximately 1/32" (.794 mm) between the thrust plate (6) and the shaft end cover (2).
5. Into each of the four open slots in the thrust plate (6) insert a pocket seal (7). Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the shaft end cover. Using a razor blade or sharp knife, trim away the excess from the exposed ends of the pocket seals (7) square and flush with side of the thrust plate.

Port End Cover

1. Install the two roller bearings (5) into their respective bores in the port end cover (11) — IF — they were removed. Install rings seal (4) first.
2. Place small amount of heavy grease into the two middle slots in the open face of the thrust plate (6) and insert pocket seals.
3. Place the thrust plate (6) with pocket seal slots toward the face of the port end cover (11) over the bearings (5). Check to see that the pocket seals in the center slots are still in place before tapping the thrust plate into position. Leave a clearance of approximately 1/32" (.794 mm) between the thrust plate (6) and the port end cover (11).

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4. Into each of the four open slots in the thrust plate (6) insert a pocket seal. Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the port end cover. Using a razor blade or sharp knife, trim away the excess from the exposed ends of the pocket seals square and flush with sides of the thrust plate.

Final Assembly

1. Place the assembled shaft end cover (2) in a vise, gear side up.
2. Pour a small amount of oil on face of thrust plate to provide lubrication of gears. Install the drive gears (10) on the shaft. Stone the gear ends before installation to remove any minute burrs.
3. Stone the faces of the gear housing (9) to remove any burrs that might have occured in handling. Blow or carefully wipe the housing clean before installing pregreased O-rings (8) in the grooves in the faces.
4. Place the gear housing (9) on the shaft end cover and tap into position with a soft hammer (plastic or leatherhead). Be careful not to pinch the O-ring (8) when positioning the housing. Pour a small amount of oil over the gears to provide initial lubrication when putting the pump back into service.
5. Install the bearing carrier subassembly on the gear housing (9). Hubs of gears fit into the I.D. of the roller bearings (5) and thrust plate (6) fits into the gear housing. Use a soft hammer to seat the port end cover assembly against the housing. Make sure the O-ring on the face of the housing is not pinched.
6. Thread the four capscrews (12) with washers, into the shaft end cover. Torque the four capscrews alternately to 200 ft-lbs. (270 Nm). Rotate the shaft with a six inch wrench. Protect the shaft splines when using a wrench. The shaft should rotate easily.

INSTALLATION

1. Position pump on mounting bracket, align drive shaft.
2. Install pump attaching parts.
3. Connect hydraulic lines.
4. Replenish hydraulic system fluid.

NOTE: To avoid possible damage to a new or rebuilt hydraulic pump, RUN IT IN WITHOUT A WORKING LOAD for no less than *half an hour.* After this, the pump may be operated under actual working conditions. Failure to observe this precaution can result in early pump failure, especially if working conditions are severe.

SUPERCHARGE AND POWER STEERING PUMP (650AI TRAVELIFT)

REMOVAL

Refer to Figure 35 and proceed as follows:

1. Drain the hydraulic system and discard the drained oil.

IMPORTANT: Place appropriate tags in the operator's compartment to guard against operation with the hydraulic system drained.

2. Disconnect lines at the pump ports. Cap and plug all open fittings immediately.
3. Remove pump from drive shaft and mounting bracket.

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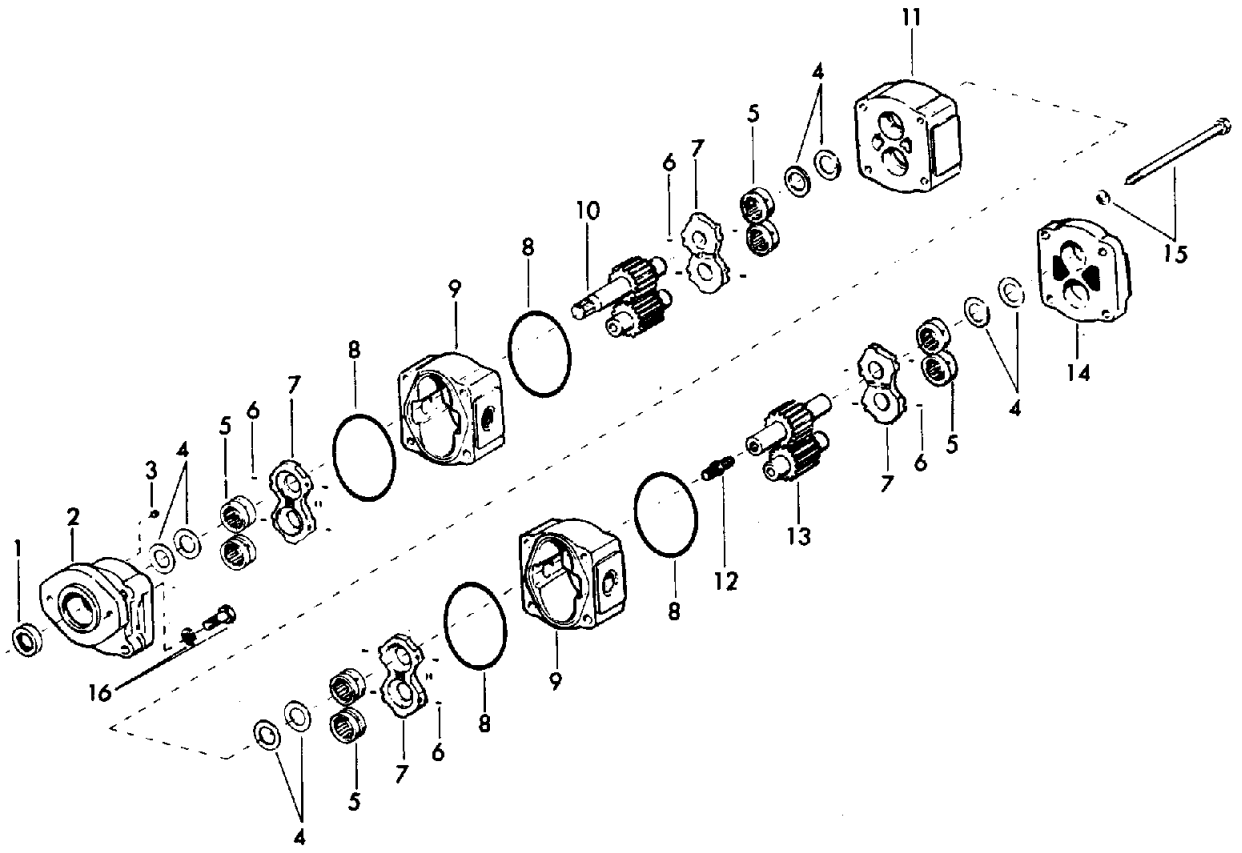

1. Double lip seal
2. Shaft end cover
3. Set screw
4. Ring seal
5. Roller bearing
6. Pocket seal
7. Thrust plate
8. O-ring gasket
9. Gear housing
10. Gear set
11. Bearing carrier
12. Shaft
13. Gear set
14. Port end cover
15. Stud with washer and nut
16. Capscrew with lockwasher

Figure 35. Supercharge and Power Steering Pump (650AI TRAVELIFT)

Courtesy of CraneMarket.com

DISASSEMBLY

Do not attempt to overhaul the pump unless proper tools and clean surroundings are available. Every precaution should be exercised to prevent entry of dirt into the system.

1. Lift off port end cover (14). Thrust plate (7), seal rings (4), pocket seal (6) and roller bearings (5) will be removed with cover.

2. Remove the driven gear and drive gear set (13) and gear housing (9) from bearing carrier (11). Gears are a matched set and must be kept together.

3. Turn shaft end cover (2) so that thrust plate (7) is up. Pry off thrust plate (7) carefully with a thin screwdriver. Remove and discard pocket seals (6).

4. If bearings (5) are to be replaced, remove them from the shaft end cover with a bearing puller.

5. Remove thrust plates (7) and bearings (5) from bearing carrier (11) and port end cover (14) by following Steps 5 and 6 above.

6. Remove and discard O-rings (8). Remove and discard lip seal (1) from shaft end cover (2).

REASSEMBLY

1. Reassemble shaft end cover as follows:
   a. Press bearing in bores of shaft end cover if they have been removed. Install seal rings in bores before installing bearings.
   b. Install double lip seal (1).
   c. Place small amount of heavy grease into the two middle slots in the open face of thrust plate (7) and insert pocket seals (6).
   d. Place thrust plate (7) with pocket seal slots toward the face of the shaft end cover, over the bearings (5). Be sure that pocket seals (6) in the center slots are still in place before tapping thrust plate into position. Allow clearance of approximately 1/32 inch (.794 mm) between thrust plate (7) and shaft end cover (3).
   e. Insert a pocket seal (6) into each of the four open slots in thrust plate (7). Push each seal all the way into the slot so that the hidden end is in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the shaft end cover. Using a razor blade or sharp knife, trim away the excess from the exposed ends of the pocket seals (6) so that the seals are flush with the side of the thrust plate.
2. Reassemble port end cover as follows (refer to Figure 35):
   a. Install seal rings (4). Install two roller bearings (5) into their respective bores in the port end cover (14).
   b. Place small amount of heavy grease into the two middle slots in the open face of the thrust plate (7) and insert pocket seals.
   c. Place thrust plate (7) with pocket seal slots toward the face of the port end cover (14) over the bearings (5). Be sure that the pocket seals in the center slots are still in place before tapping the thrust plate into position. Allow clearance of approximately 1/32 inch (.794 mm) between through thrust plate (7) and port end cover (14).
   d. Insert a pocket seal into each of the four open slots in thrust plate (7). Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the port end cover. Using a razor blade or sharp knife, trim away the excess from the exposed ends of the pocket seals square and flush with sides of the thrust plate.
3. Reassemble bearing carrier. The reassembly procedure for the bearing carrier (11) is essentially the same as for the shaft end cover and port end cover.

FINAL ASSEMBLY

Refer to Figure 35 and proceed as follows:

1. Place the assembled shaft end cover in a vise, gear side up.
2. Pour a small amount of oil on face of thrust plate to provide lubrication for the gears. Install drive gears (10) on the shaft. Stone the gear ends before installation to remove any minute burrs.
3. Stone the faces of gear housing (9) to remove any burrs that might have been incurred in handling. Blow or carefully wipe clean before

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installing pregreased O-rings (8) in the grooves in the faces of the housing (9).

4. Place gear housing (9) on the shaft end cover and tap into position with a soft hammer (plastic or leatherhead). Be careful not to pinch O-ring (8) when positioning the housing. Pour a small amount of oil over the gears to provide initial lubrication when putting back into service.
5. Install the bearing carrier subassembly on gear housing (9). Hubs of gears fit into roller bearings (5), and thrust plate (7) fits into the gear housing. Use a soft hammer to seat or position the port end cover assembly against the housing. Make sure the O-rings on the face of the housing are not pinched.
6. Install second set of gears, gear housing and port end cover (14) by repeating Steps 2 through 5 above.
7. Thread four studs (15), with washers under the heads of the nuts, into the shaft end cover. Tighten the four nuts alternately to 200 ft-lbs (266 Nm). Rotate the shaft with a six inch wrench. Protect the shaft splines when using a wrench. The shaft should rotate easily.

INSTALLATION

Position the pump on the pump bracket and secure with attaching parts. Connect hydraulic lines.

> **NOTE:** To avoid possible damage to a new or rebuilt hydraulic pump, RUN IT IN WITHOUT A WORKING LOAD for no less than *half an hour.* After this, the pump may be operated under actual working conditions. Failure to observe this precaution can result in early pump failure, especially if working conditions are severe.

MAIN CONTROL VALVES

REMOVAL

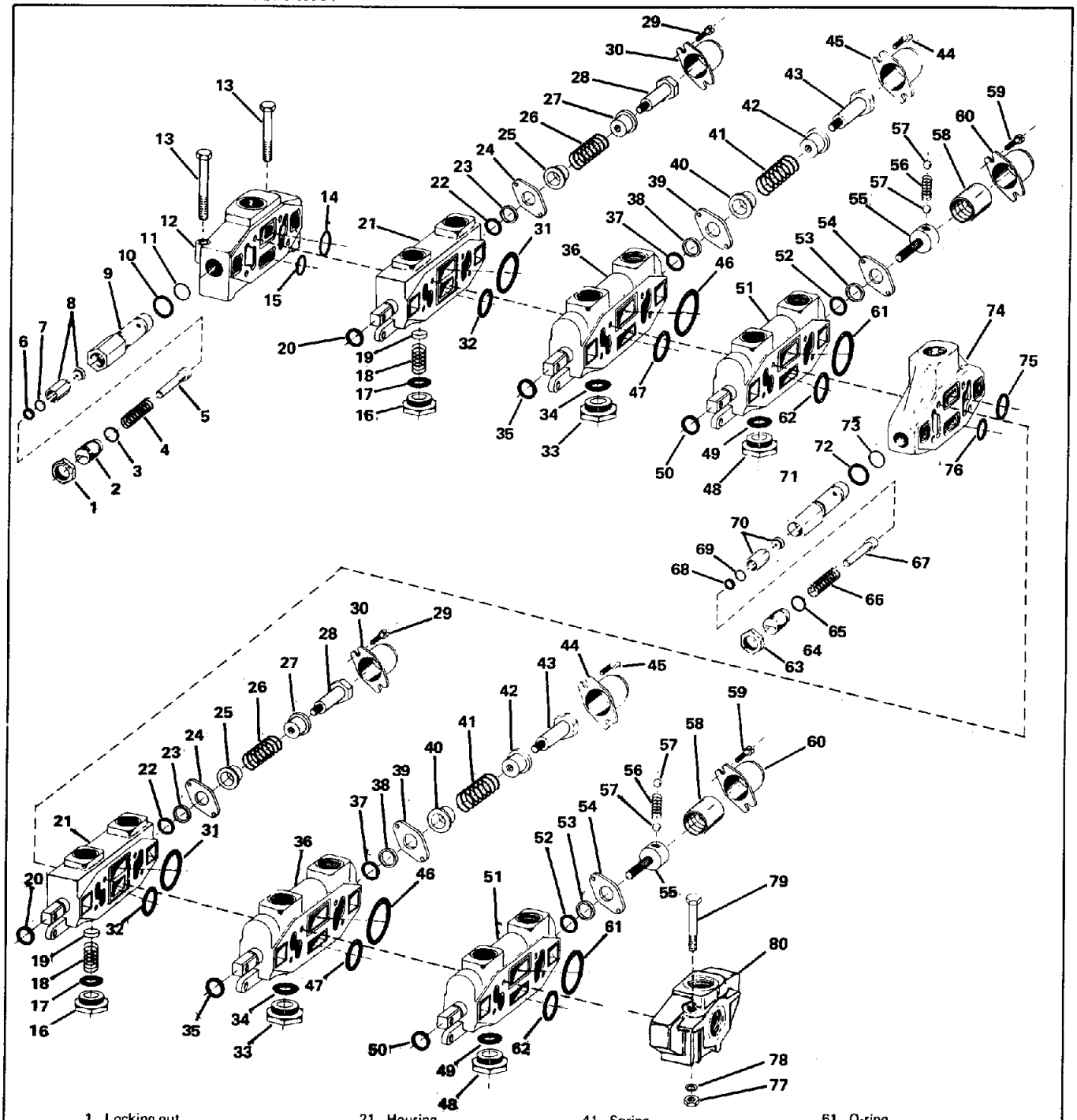
1. Relieve all pressure in the hydraulic system by working the appropriate control levers back and forth several times with the engine off.
2. Thoroughly clean the main valves and the surrounding area.
3. Label all tube lines and hoses to insure correct reassembly. Disconnect all lines, then plug or cap open fittings and ports.
4. Disconnect the control rods.
5. Remove four mounting bolts and rubber pucks which hold the valve bank in place. (Early models are equipped with three mounting bolts.)

DISASSEMBLY

Never attempt to disassemble the valve or any other hydraulic component unless a clean, dust free area is available. The work area should have enough space to arrange all parts in an orderly manner for reassembly. Keep all parts from each valve section together to make certain they will be returned to the same section. Spools are selectively fitted to valve bores and must be returned to the same sections from which they are removed.

1. Remove the four through bolts (Figure 36), nuts and spacers. Separate the valve sections.
2. Disassemble the valves as shown in Figure 36.

Courtesy of CraneMarket.com



1. Locking nut
2. Adjustable screw
3. O-ring
4. Spring
5. Plunger
6. Back-up ring
7. O-ring
8. Floating & snubber assy seat
9. Shell cartridge
10. Gasket
11. O-ring
12. Housing
13. Capscrew
14. O-ring
15. O-ring
16. Check valve cap
17. O-ring
18. Spring
19. Poppet
20. Quad seal ring
21. Housing
22. Quad seal ring
23. Back-up ring
24. Retaining plate
25. Spring guide
26. Spring
27. Spring guide
28. Bolt
29. Capscrew
30. Valve cap
31. O-ring
32. O-ring
33. Check valve cap
34. O-ring
35. Quad seal ring
36. Housing
37. Quad seal ring
38. Back-up ring
39. Retainer plate
40. Spring guide
41. Spring
42. Spring guide
43. Bolt
44. Screw
45. Valve cap
46. O-ring
47. O-ring
48. Check valve cap
49. O-ring
50. O-ring
51. Housing
52. Quad seal ring
53. Sock up ring
54. Retainer plate
55. Retainer poppet
56. Spring
57. Steel ball
58. Poppet sleeve
59. Screw
60. Valve Cap
61. O-ring
62. O-ring
63. Locking nut
64. Adjustable screw
65. O-ring
66. Spring
67. Plunger
68. Back-up ring
69. O-ring
70. Snubber assy and seat
71. Shell cartridge
72. Gasket
73. O-ring
74. Housing
75. O-ring
76. O-ring
77. Nut
78. Lockwasher
79. Capscrew
80. Housing

Figure 36. Main Control Valve Bank

Courtesy of CraneMarket.com

CLEANING, INSPECTION AND REPAIR

1. Wash all parts in clean mineral oil solvent and place them on a clean surface for inspection. Remove and discard old seals. See Parts Catalog for available seal kits.
2. Carefully remove burrs by stoning or lapping the valve sections. Use No. 4A grinding compound when lapping. Make certain there isn't any paint or burrs on mating surfaces of valve sections.
3. Inspect valve spools and bores for burrs and scoring. Minor scoring that will not cause objectionable leakage can be stoned or polished with crocus cloth. If scoring is excessive, the valve section and spool must be replaced. Check the valve spool for free movement in the bore.

NOTE: NEVER use emery cloth to clean a valve spool. Remove sludge or lacquer deposits with solvent.

REASSEMBLY

1. Coat all parts with clean hydraulic fluid to facilitate reassembly and provide initial lubrication. Petroleum jelly may be used to hold new O-rings in place during reassembly.
2. Install new O-rings, seals, and seal retainers in each valve section.
3. Assemble working sections, inlets, and outlets as shown in the figure.
4. Put the valve sections together in their proper order. Coat through bolt threads with "Loctite" (blue) or equivalent sealing compound, and install the nuts. Tighten nuts to 35 ft-lbs. (46 Nm).

INSTALLATION

1. Install the valve bank on the machine and secure with four mounting bolts and rubber pucks. Draw mounting bolts down until the pucks bulge. (On early models, refer to the torque chart for proper torque.)
2. Connect and tighten the tube and hose lines. Refer to "Torque Valve Chart for Hydraulic Swivel Fittings" when tightening.

MISCELLANEOUS CONTROL VALVES

Leakage and binding caused by defective seals or contamination will be the major cause of valve malfunctions. Usually, a disassembly and thorough cleaning are sufficient remedy.

Careful inspection of seals and valve parts will determine the cause of malfunction. If sleeves, poppets or pistons are worn or scored, they must be replaced.

STEERING ORBITROL SEAL REPLACEMENT

REMOVAL

Refer to Figure 37 and remove steering orbitrol as follows:

1. Remove left side panel from steering column bracket.
2. Thoroughly clean area around orbitrol ports to prevent entry of dirt into system.
3. Relieve pressure, then remove and plug hydraulic lines at orbitrol.
4. Remove the two capscrews which fasten the orbitrol and column to the mounting bracket.
5. Lower the entire assembly enough to provide access to the two capscrews which fasten the column to the lower unit. Remove the capscrews, then carefully separate column assembly from orbitrol. Transfer orbitrol to clean work area for disassembly.

NOTE: Major field repair of orbitrol unit is not recommended. If orbitrol requires servicing beyond seal replacement contact Char-Lynn Distributor.

Courtesy of CraneMarket.com

SEAL REPLACEMENT

1. Clamp orbitrol with control end up in soft jawed vise. Do not exert excessive pressure on orbitrol housing.
2. Remove the four capscrews which fasten mounting plate to housing.
3. Carefully remove mounting plate. Hold center spool down with thumbs while exerting upward pressure on mounting plate with fingers.
4. Inspect mating surfaces for obvious leakage paths, wear and seal condition.
5. Remove seals. Seals are available in kit form. See Parts Book.
6. Check the mounting plate and shaft seal carefully to insure that they are clean and in good condition. Ensure that the mounting plate seal grooves are clean and smooth. Each seal is slightly larger than its seal groove so that they will be adequately retained in service. Push each gently into place and smooth down into seal groove with finger tip.

   NOTE: Quad ring shaft seal may be used to replace O-ring shaft seal in early units and will function properly in original groove.

7. The oil seal at exterior of mounting plate is a dirt exclusion seal and does not generally need replacement. If this is replaced it should be pressed into counterbore so that the lip is directed away from the unit.
8. Place the mounting plate sub-assembly over the shaft and slide down into place over cap locator bushing smoothly so that seals will not be disrupted in assembly. Align bolt holes with tapped holes. Be certain that the mounting plate rests fairly flush against end of housing assembly so that the cap locator bushing is not cocked. Install four mounting plate capscrews. Tighten these evenly and gradually to 21 lb-ft. (28 Nm).

INSTALLATION

Refer to removal and install in reverse order.

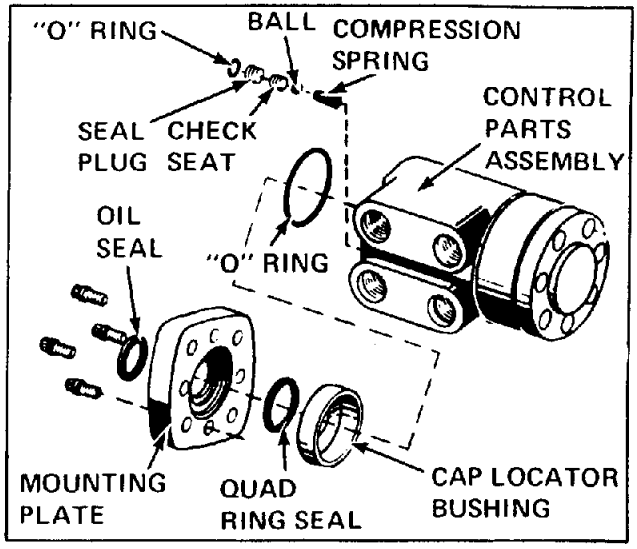


Figure 37. Steering Orbitrol

STEERING CYLINDER

REMOVAL

Refer to Figure 38 and remove steering cylinder as follows:

1. Disconnect hydraulic lines and cap all fittings and ports.
2. Remove pins to free piston rod.
3. Support the cylinder and remove pins.

DISASSEMBLY

Overhaul of the steering cylinder should be attempted only if adequate tools and a clean work area is available. (Number callouts refer to Figure 39.)

1. Clamp the base of the cylinder tube (13) in a vise firmly enough to hold the cylinder disassembly.

   NOTE: Do not attempt to hold cylinder in vise in a horizontal position. Provide a support under the cylinder if it is necessary to hold it in a horizontal position.

2. Loosen the packing flange lock screws (10). Using adjustable spanner wrench, turn the cylinder head (7) out of the cylinder tube (13).

   NOTE: Exercise care that piston rod does not damage threaded portion of cylinder tube.

Courtesy of CraneMarket.com

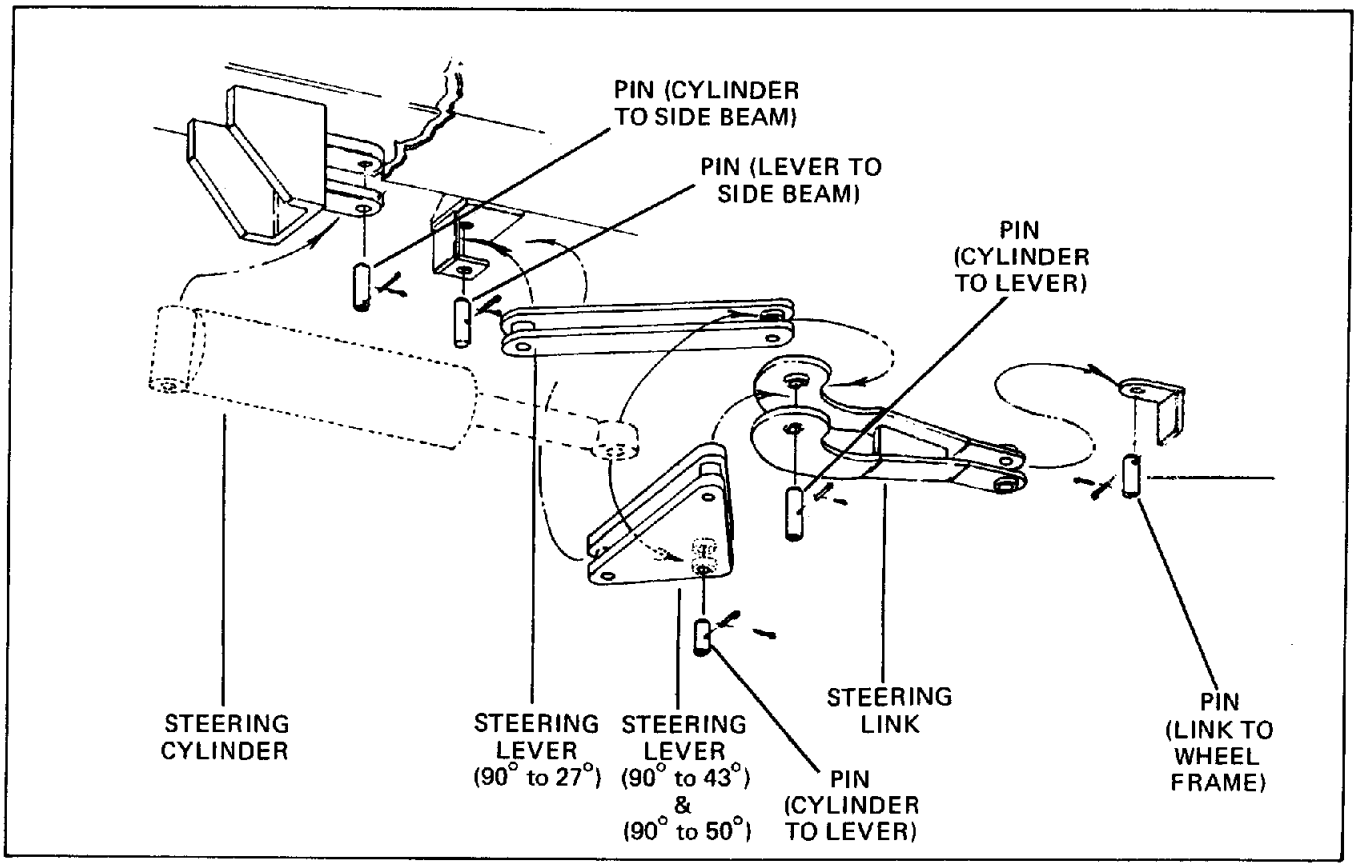
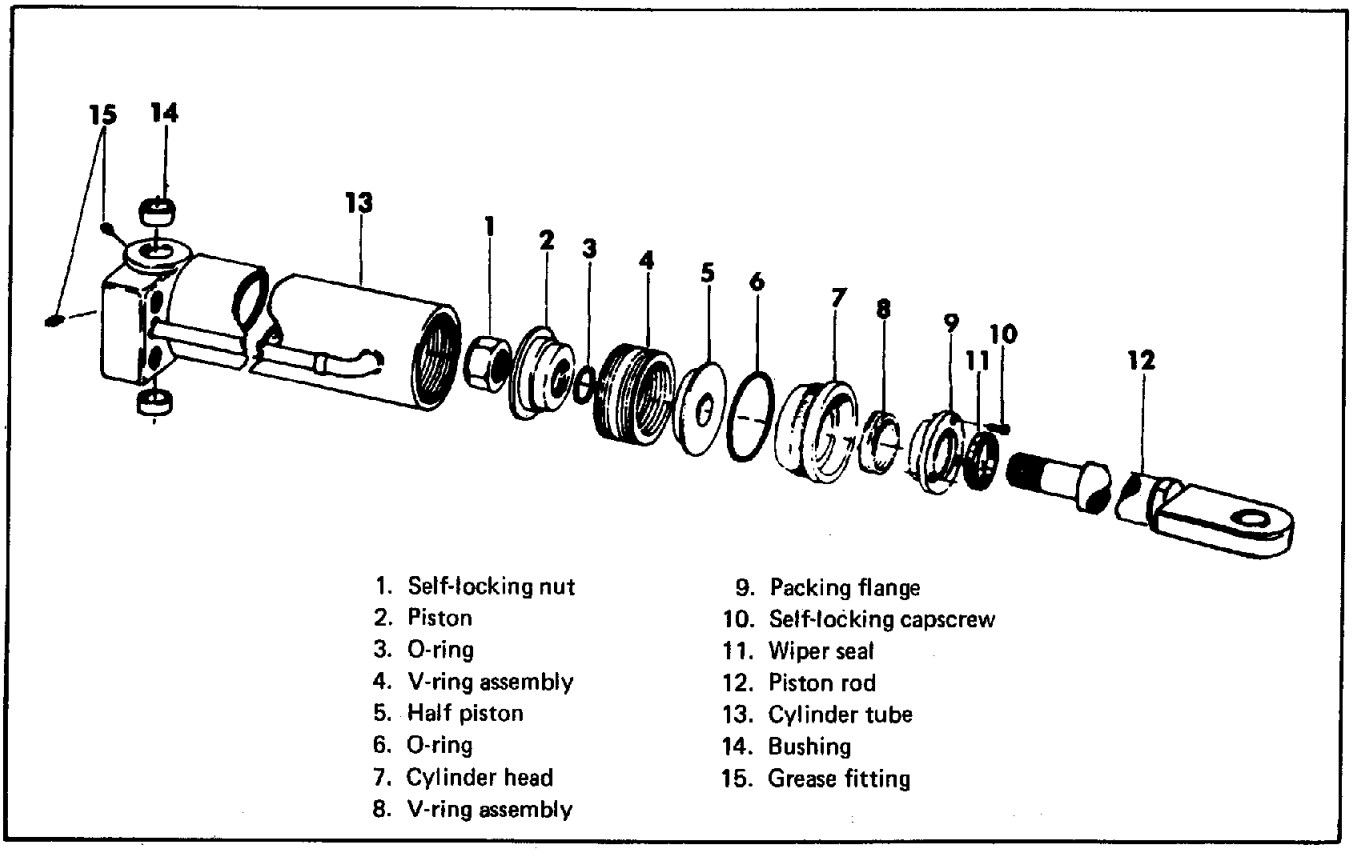


Figure 38. Steering Linkage



1. Self-locking nut
2. Piston
3. O-ring
4. V-ring assembly
5. Half piston
6. O-ring
7. Cylinder head
8. V-ring assembly
9. Packing flange
10. Self-locking capscrew
11. Wiper seal
12. Piston rod
13. Cylinder tube
14. Bushing
15. Grease fitting

Figure 39. Steering Cylinder

Courtesy of CraneMarket.com

3. Carefully pull the piston rod assembly from the cylinder tube. Pull firmly and keep the piston rod centered in tube to avoid binding on the inside. Remove cylinder tube from vise.
4. Using copper jaw protectors on vise, clamp the rod eye in the vise and rest the rod end on a support. Remove the self-locking nut (1) from the piston rod (12).
5. Remove bottom piston (2), O-ring (3), V-ring assembly (4) and piston half (5) from piston rod.
6. Remove the cylinder head assembly (6, 7, 8, 9, 10 and 11) from the piston rod (12) using a rubber mallet.

CLEANING, INSPECTION AND REPAIR

Clean and inspect all parts and replace O-rings. Inspect walls of cylinder tube (13) for scoring that could result in leakage past the piston V-rings (4). Scoring can be removed by honing, which cannot exceed .007 inch (.178 mm). Never hone a cylinder more than once. Replace cylinder if scoring cannot be corrected. Check V-rings (4 and 8) for fraying, excessive wear, extrusions, flat spots or cracks.

REASSEMBLY

Assembly of the steering cylinder is essentially the reverse of the disassembly with the following special instructions.

1. Grease O-ring (3 and 6, Figure 39) with lubriplate, or equivalent.
2. Coat piston rod (12) with a light coating of oil.
3. Apply a light film of oil between each ring of V-rings (4 and 8).
4. Assemble items (2 through 11) on piston rod (12) and torque self-locking nut (1) to 600 ft-lbs. (813 Nm).
5. Carefully insert rod in cylinder and tighten cylinder head (7) with spanner wrench. Do not tighten the packing flange screws (10) until the cylinder has been installed on the machine.
6. With steering cylinder and linkage reconnected, operate the steering system. Adjust the packing flange so a light film of oil remains on the cylinder rod as it is extended.

> **NOTE:** The cylinder rod should never be operated completely dry. A light film of oil will aid in longer seal life.

7. When packing flange adjustment has been made, tighten the packing flange screws.

INSTALLATION

Refer to removal and install in reverse order.

MASTER BRAKE CYLINDER

REMOVAL

Refer to Figure 40 and remove master brake cylinder as follows:

1. Disconnect the master cylinder push rod from the brake pedal by removing clevis pin and cotter pin.
2. Disconnect the hydraulic line from cylinder.
3. Remove mounting holes to free cylinder.

DISASSEMBLY

Disassemble master brake cylinder as follows:

1. Clamp brake cylinder in a vise equipped with soft metal protective jaws, being careful that vise jaws do not distort cylinder bore.
2. Pry lockwire from groove in cylinder bore with screwdriver.
3. Remove from vise and slide internal parts from cylinders.

CLEANING, INSPECTION AND REPAIR

Degrease cylinder casting. If cleaned with commercial parts cleaner, rinse in denatured alcohol or brake fluid to remove traces of solvent. Dry with compressed air, or lint-free cloth. Protect parts from dust and foreign material until master cylinder is reassembled. Clean rubber parts by washing in clean denatured alcohol or hydraulic brake fluid.

Courtesy of CraneMarket.com

CAUTION: Never wash rubber parts in mineral-base cleaning solvent. These solvents deteriorate rubber parts.

Any remaining accumulations of dirt or gummy substances may be removed with crocus cloth or jeweler's rouge. Inspect cylinder bore for blemishes, pitting, scratches, visible wear patterns (refer to Figure 41).

A hone may be used to clean the cylinder, provided it does not materially increase the diameter of the cylinder bore. The cylinder bore must not exceed the standard (nominal) diameter by more than 0.007 inch (.178 mm). Check by inserting the piston and using a wire gauge to check for clearance of 0.007 inch (.178 mm).

Check compensating port of honed cylinder for burrs, which may damage the piston cup lip. Remove with deburring tool. Check to make sure intake and compensating ports are open. It is difficult to see the compensating port, however, the port may be probed with a soft copper wire not larger than 0.020 inch (.508 mm) diameter. Never use steel wire to check port.

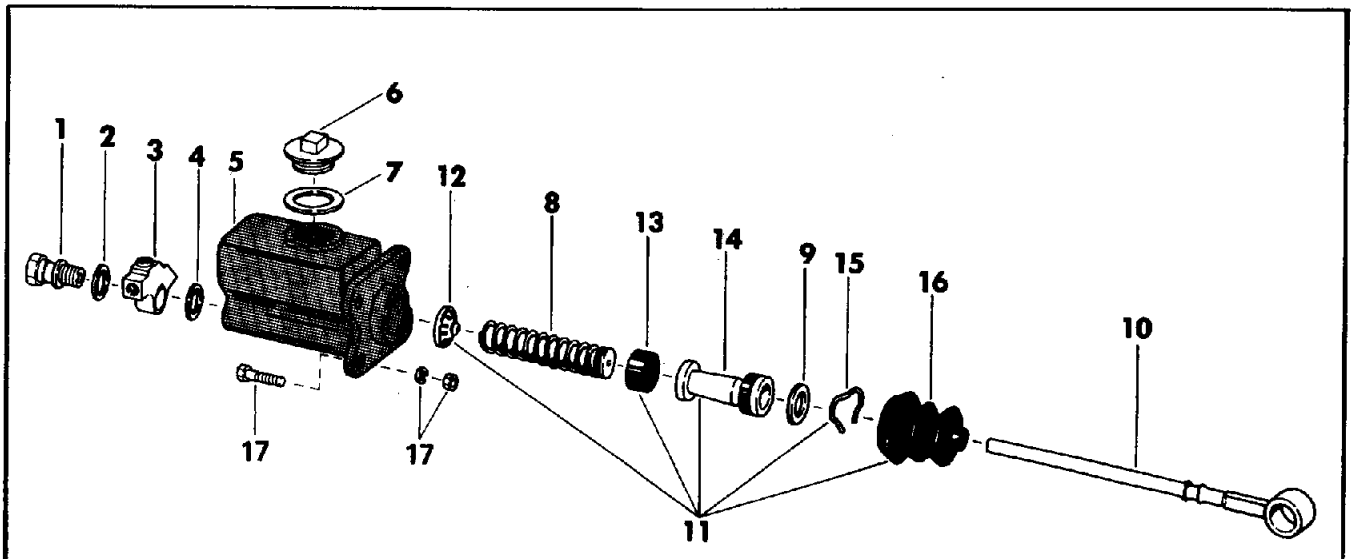
REASSEMBLY

Reassembly of the master cylinder is essentially the reverse of disassembly.

1. Coat ports with clean brake fluid to prevent damage during assembly and to provide initial lubrication. Make sure parts are properly oriented (Figure 40). Be sure that lockwire (lock ring) is properly expanded in the groove.
2. Bench bleed the cylinder. Fill reservoir with oil and force piston through one full stroke. Repeat piston stroking until fluid is forced past check valve and out of inlet port. This leaves the master cylinder filled with fluid prior to installation.

INSTALLATION

Installation is essentially the reverse of removal. Refer to "Service Brake" for adjustment and bleeding procedures.



1. Relief valve
2. O-ring
3. Adapter
4. O-ring
5. Reservoir
6. Filler cap
7. Filler cap gasket
8. Return spring
9. Stop plate
10. Push rod
11. Repair kit
12. Valve
13. Cylinder cup
14. Piston
15. Lockwire
16. Boot
17. Nut and washer capscrew

Figure 40. Master Brake Cylinder

Courtesy of CraneMarket.com

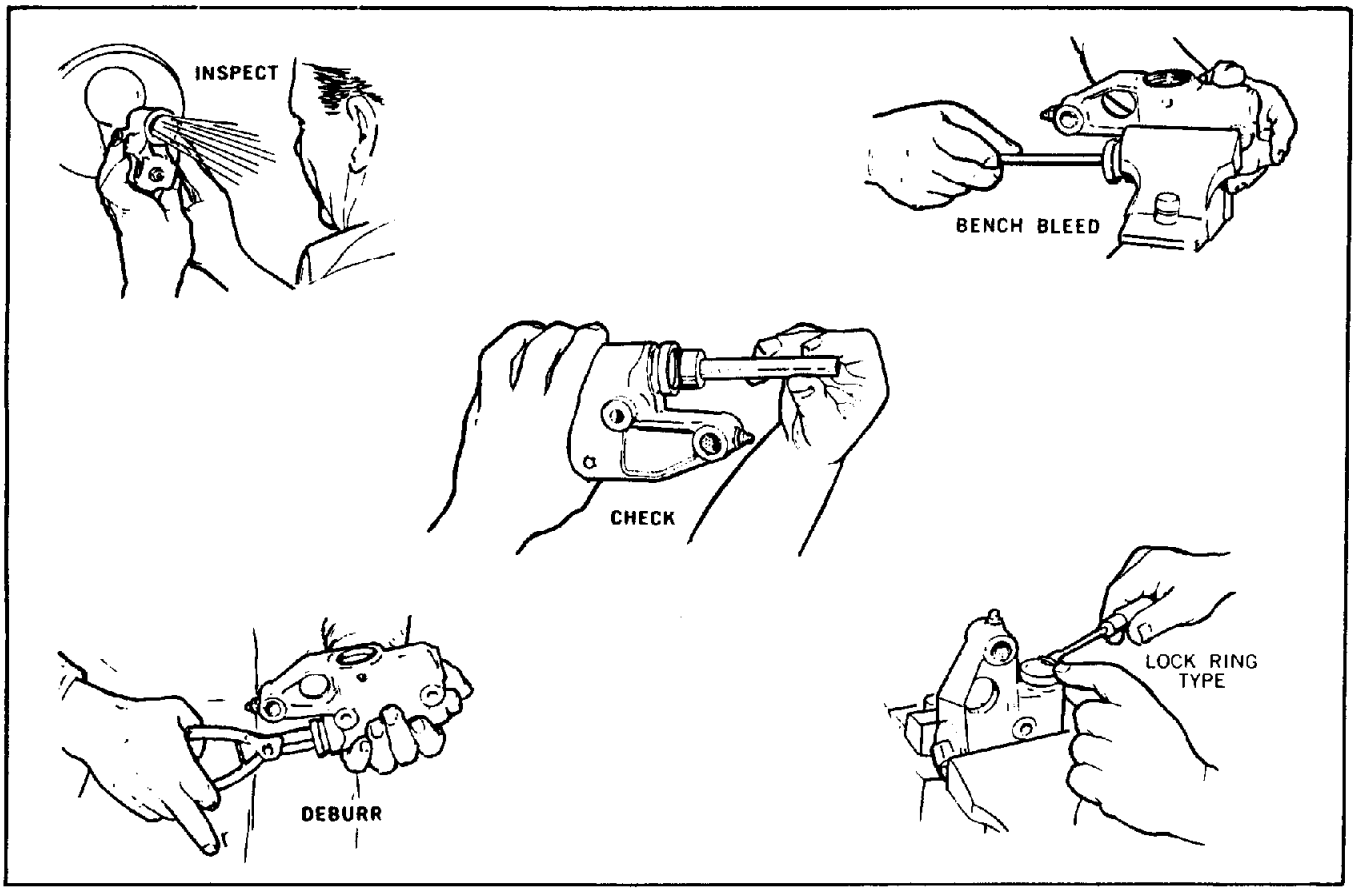


Figure 41. Master Cylinder Repair and Inspection

PARKING BRAKE CONTROL VALVE

REMOVAL

Disconnect hydraulic lines from valve ports. Cap the lines. Remove valve from machine by removing the attaching parts.

DISASSEMBLY

Refer to Figure 42 and disassemble the control valve:

1. Loosen jam nut (21) and back off metering screw (20). Drive out roll pin (17) in rocker arm pivot, then tap out shaft (23) with drift to release rocker arm from body.
2. Remove bushing (4) from housing, then dislodge valve spool assembly from the valve body by tapping top down against the hand or protected surface. The valve spool assembly includes built-in relief valve, valve spool and return spring.

INSPECTION AND REPAIR

Inspect all parts for wear or damage. Replace parts as necessary. Remove spring (2) from bushing (4) and replace if it is worn or weakened.

If the valve has not been passing sufficient pressure, yet has not been leaking oil, the built-in relief valve may be at fault. Disassemble relief valve and install a new spring. The spacer at upper end of relief valve between spring and seat raises relief pressure from 200 psi to 250 psi (1380 to 1725 kPa). Be sure the spacer is in position before reassembling the relief valve. Replace all gaskets and O-rings before reassembling valve.

REASSEMBLY

Refer to Figure 42 and proceed as follows:

1. Clean all valve spool parts with light mineral oil and blow completely dry with compressed air.

Courtesy of CraneMarket.com

Coat each part lightly with hydraulic oil to facilitate assembly.

2. Insert spring (16) and spool (15), in body. Assemble relief valve (9 through 14) and insert in body.
3. Position rocker (22) on body (18) and insert shaft (23) and roll pin (17).
4. Insert rod (7) in bushing (4) and install bushing in body. Install detent spring on bushing.
5. Install screws (20) so they just touch rod (7) when control is in neutral. Tighten jam nut (21).

INSTALLATION

Reinstall valve on machine. Connect hoses to proper ports. Refer to maintenance section for bleeding procedures.

1. Ring, retaining
2. Spring, flat
3. Capscrew, socket head
4. Bushing
5. O-ring
6. O-ring
7. Rod
8. Spring, sub-assembly
9. Retainer
10. Washer
11. Spring
12. Washer
13. Retainer
14. Rod
15. Spool
16. Spring
17. Pin, roll
18. Body, secondary
19. Ball, steel
20. Screw (special)
21. Nut, jam
22. Rocker
23. Shaft

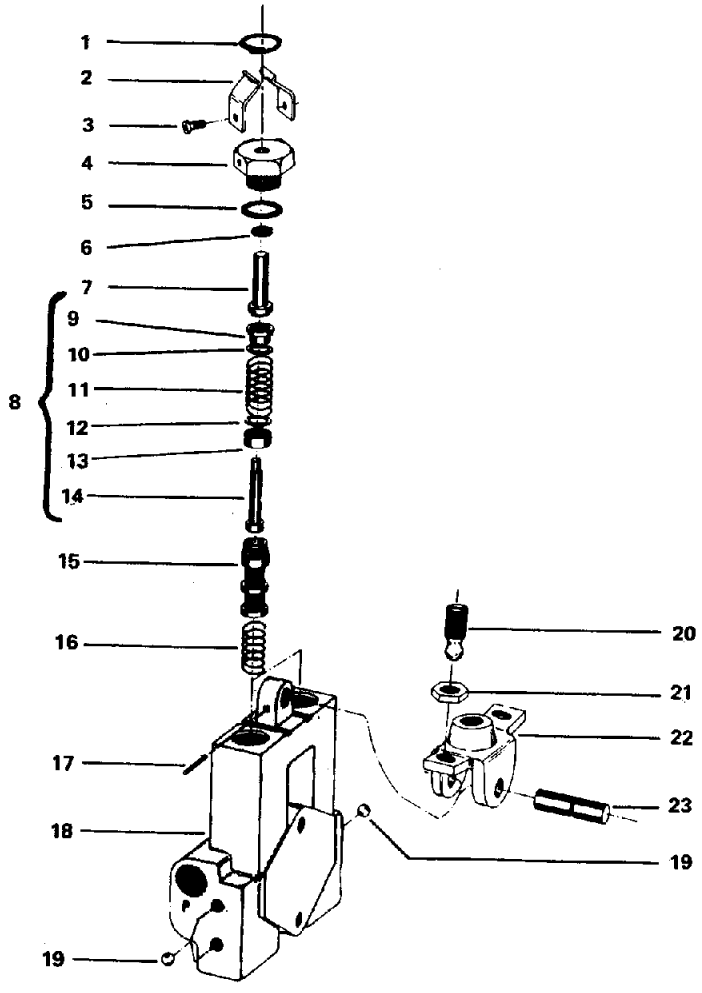


Figure 42. Parking Brake Control Valve

Courtesy of CraneMarket.com

DRIVE BRAKE

REMOVAL AND DISASSEMBLY

Refer to Figure 43 and proceed as follows:

1. Remove brake cylinder tube lines. Remove brake lever spring (20). Remove roll pins and pivot pins for the auxiliary brake lever (9) and remove lever.
2. Remove roll pins and pivot pin for service brake lever (19). Remove lock nut and ball seat nut and service brake lever. Remove the brake cylinder (10).
3. Remove brake cylinder base (15) and brake hydraulic lines. Remove the four bolts attaching the hoist motor to the brake housing and remove motor.
4. Remove four bolts attaching brake housing and using a brass drift, drive housing from studs.
5. Check actuating discs and brake discs for wear.
6. Pull rubber boots off the cylinder, as shown in Figure 44. Push internal parts from cylinder bore. If any parts are frozen in the cylinder, they may be loosened by driving them with a wooden dowel.

CLEANING, INSPECTION AND REPAIR

Cleaning procedures are similar to those for the brake master cylinder. Degrease cylinder casting and metal parts. Clean rubber parts and thoroughly rinse castings and metal parts in denatured alcohol or hydraulic fluid.

Remove accumulations of dirt or gummy substances with crocus cloth or jewelers rouge. Inspect cylinder bore for blemishes, pitting, scratches, and visible wear patterns.

A hone may be used to clean the cylinder, provided it does not materially increase the diameter of the bore. The cylinder bore under 1 inch (25.400 mm) in diameter must not exceed the standard (nominal) diameter more than 0.005 inch (.127 mm). Cylinders over 1 inch (25.400 mm) in diameter or over must not exceed the standard diameter by more than 0.007 inch (.178 mm). Use a "no-go" gauge or micrometer to check oversize.

REASSEMBLY

Cylinder assembly is essentially the reverse of disassembly. Refer to Figure 44 and proceed as follows:

1. Dip parts in clean brake fluid prior to installation on the cylinders.
2. Exercise care when installing cups to avoid damaging the lips. Assemble cups from each end, do not slide them through the cylinder.
3. Refer to Figure 43 and position housing and attach with four bolts.
4. Install brake assembly (1) into housing along with attaching parts as shown in Figure 43.
5. Install drive motor and attach with four bolts. Connect brake hose and hydraulic lines. Bleed brake systems.

HOIST BRAKE

Current TRAVELIFT hoists are equipped with Rockwell spring-applied, hydraulically-released brakes. Disassembly of this brake is described below. Earlier TRAVELIFT hoists are equipped with brakes similar to the current drive brake. This case is discussed separately here.

REMOVAL

Refer to Figure 45 and remove the hoist brake as follows:

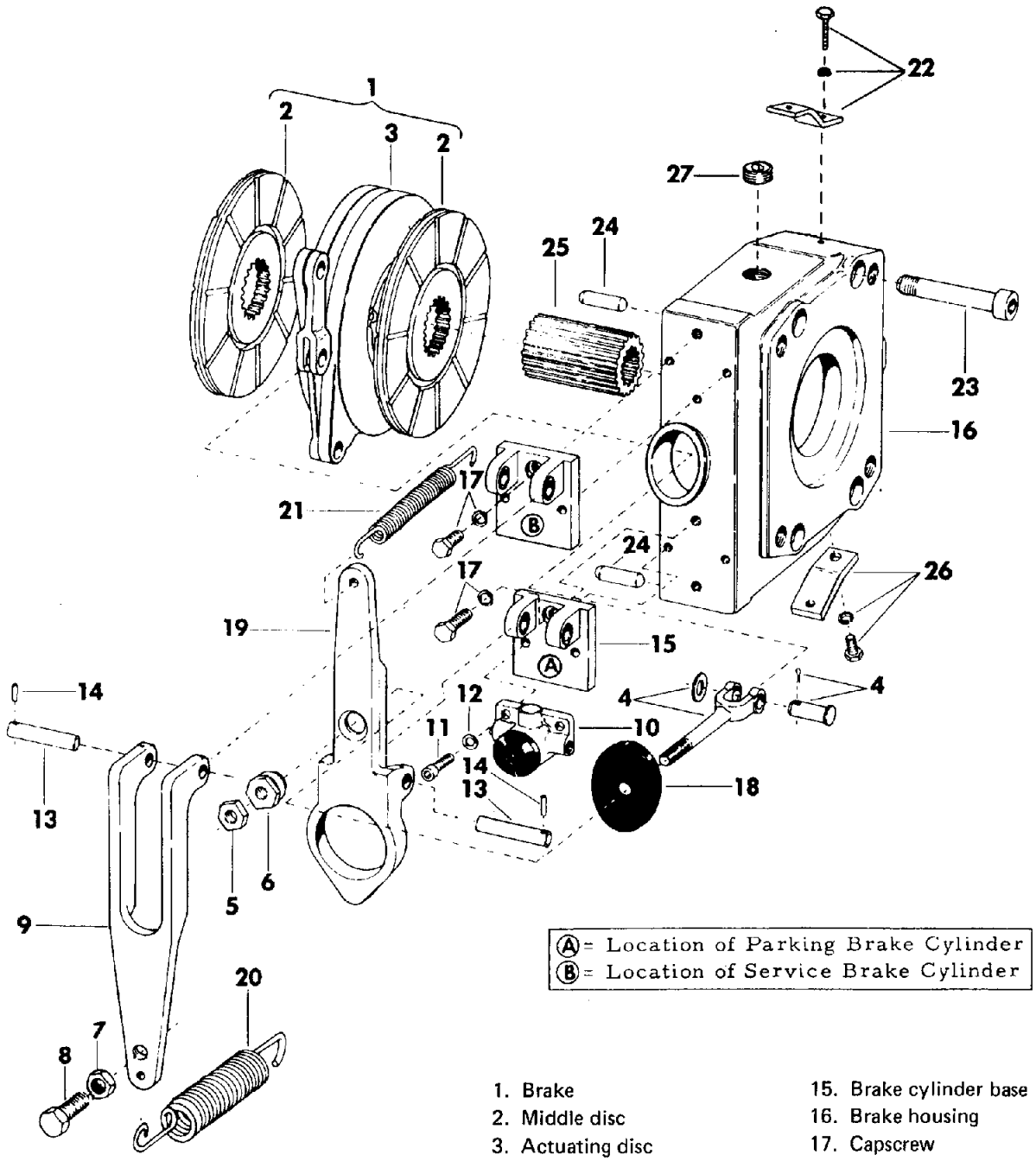
1. Loosen hoist motor and swing aside.
2. Remove brake by removing attaching parts (3 and 4) and sliding off hoist gearbox splined shaft.
3. Adapter plate will remain attached to gearbox.

DISASSEMBLY

Repair of the hoist brake should be attempted only if adequate work space and tools are available. Work area should be clean to prevent entrance of foreign material into brake. Refer to Figure 45.

1. Index-mark cover (5) and housing (9). Separate cover (5) from housing (9) by removing capscrews (2 and 3). Brake is spring-set and hydraulically released so capscrews should be loosened alternately until spring tension is relieved, carefully work cover loose from housing.
2. Lift out disc brake plates (10) and brake discs (13).

Courtesy of CraneMarket.com



1. Brake
2. Middle disc
3. Actuating disc
4. Rod end clevis
5. Lock nut
6. Ball seat nut
7. Lock nut
8. Capscrew
9. Auxiliary brake lever
10. Brake cylinder
11. Socket head capscrew
12. Lockwasher
13. Brake lever pin
14. Roll pin
15. Brake cylinder base
16. Brake housing
17. Capscrew
18. Rubber, dust boot
19. Service brake lever
20. Brake lever spring
21. Service brake spring
22. Spring bracket
23. Capscrew
24. Dowel pin
25. Input shaft
26. Spring bracket
27. Plug

Figure 43. Drive Brake

Courtesy of CraneMarket.com

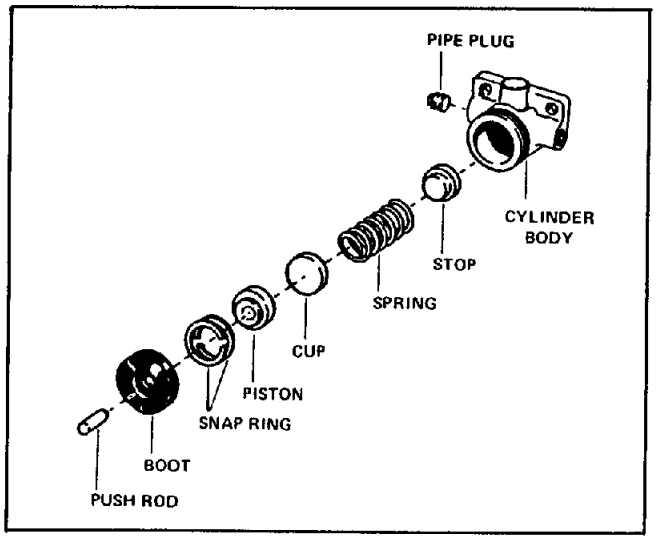


Figure 44. Brake Cylinder

3. Lift out packing (7) and brake piston (8).

4. Remove O-ring (6) from cover (5).

CLEANING AND INSPECTION

Clean all metal parts in commercial parts cleaner, then rinse thoroughly in denatured alcohol or hydraulic fluid to remove trace of solvent. Dry with compressed air or lint-free cloth.

Clean rubber parts by washing in clean denatured alcohol or hydraulic fluid. Check disc brake plates (10) and brake discs (13) for wear. Inspect O-ring (6) and packing (7) for wear, distortion or deterioration. Replace if not in good condition. Check springs (11) for proper tension or distortion.

REASSEMBLY

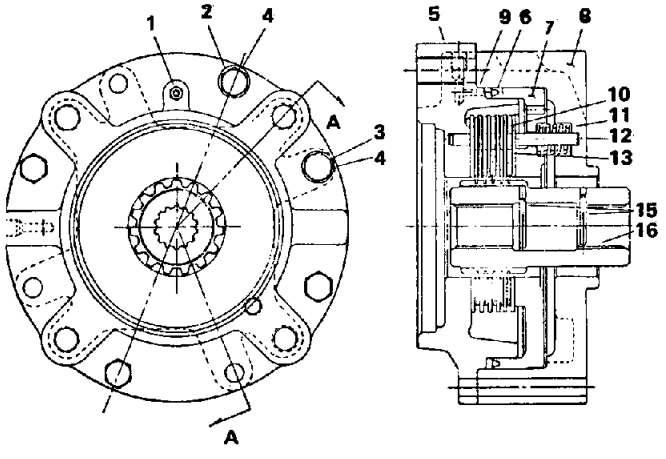
Refer to Figure 45 and proceed as follows:

1. Position springs (11), brake piston (8), disc brake plates (10) and brake discs (13) over brake plate lock pins (12). Align discs (13) with splines on shaft (16).

2. Lubricate packing (7) and O-ring (6) with hydraulic fluid. Place packing in position on piston. Position O-ring (6) on cover.

3. Using index marks as guide, carefully insert cover on housing. Exercise extreme care that packing (7) and O-ring (6) are not deformed during this operation.

4. Insert capscrews (2 and 3) in cover and tighten alternately until cover seats.



1. Bleeder screw
2. Capscrew
3. Capscrew
4. Lockwasher
5. Cover
6. O-ring
7. Brake piston
8. Housing
9. Disc brake plate
10. Brake piston spring
11. Brake piston spring
12. Brake plate lock spring
13. Brake disc
14. Shaft and pin assembly
15. Pin
16. Shaft
17. Dowel (not illustrated)
18. Adapter plate w/capscrew (not illustrated)
19. Capscrew (mounts brake to adapter plate – not illustrated)
20. Pin (not illustrated)

Figure 45. Hoist Brake

Courtesy of CraneMarket.com

INSTALLATION

Hold brake shaft in position in brake and slide shaft over splined shaft of hoist gearbox. Be sure bleeder screw (1) is up. Secure brake housing to adapter plate with attaching parts (3 and 4). Refer to "Hoist Motor" section for motor installation procedures. Bleed hoist brake.

HOIST BRAKE–EARLY MODEL

REMOVAL AND DISASSEMBLY

Refer to Figure 46 and proceed as follows:

1. Remove brake cylinder tube lines. Remove brake lever spring (20). Remove roll pins and pivot pins for the auxiliary brake lever (9) and remove lever.

2. Remove roll pins and pivot pin for service brake lever (19). Remove lock nut and ball seat nut and service brake lever. Remove the brake cylinder (10).

3. Remove brake cylinder base (15) and brake hydraulic lines. Remove the four bolts attaching the hoist motor to the brake housing and remove motor.

4. Remove four bolts attaching brake housing and using a brass drift, drive housing from studs.

5. Check actuating discs and brake discs for wear.

6. Pull rubber boots off the cylinder, as shown in Figure 44. Push internal parts from cylinder bore. If any parts are frozen in the cylinder, they may be loosened by driving them with a wooden dowel.

CLEANING, INSPECTION AND REPAIR

Cleaning procedures are similar to those for the brake master cylinder. Degrease cylinder casting and metal parts. Clean rubber parts and thoroughly rinse castings and metal parts in denatured alcohol or hydraulic fluid.

Remove accumulations of dirt or gummy substances with crocus cloth or jewelers rouge. Inspect cylinder bore for blemishes, pitting, scratches, and visible wear patterns.

A hone may be used to clean the cylinder, provided it does not materially increase the diameter of the bore. The cylinder bore under 1 inch (25.400 mm) in diameter must not exceed the standard (nominal) diameter more than 0.005 inch (.127 mm). Cylinders over 1 inch (25.400 mm) in diameter or over must not exceed the standard diameter by more than 0.007 inch (.178 mm). Use a "no-go" gauge or micrometer to check oversize.

REASSEMBLY

Cylinder assembly is essentially the reverse of disassembly. Refer to Figure 44 and proceed as follows:

1. Dip parts in clean brake fluid prior to installation on the cylinders.

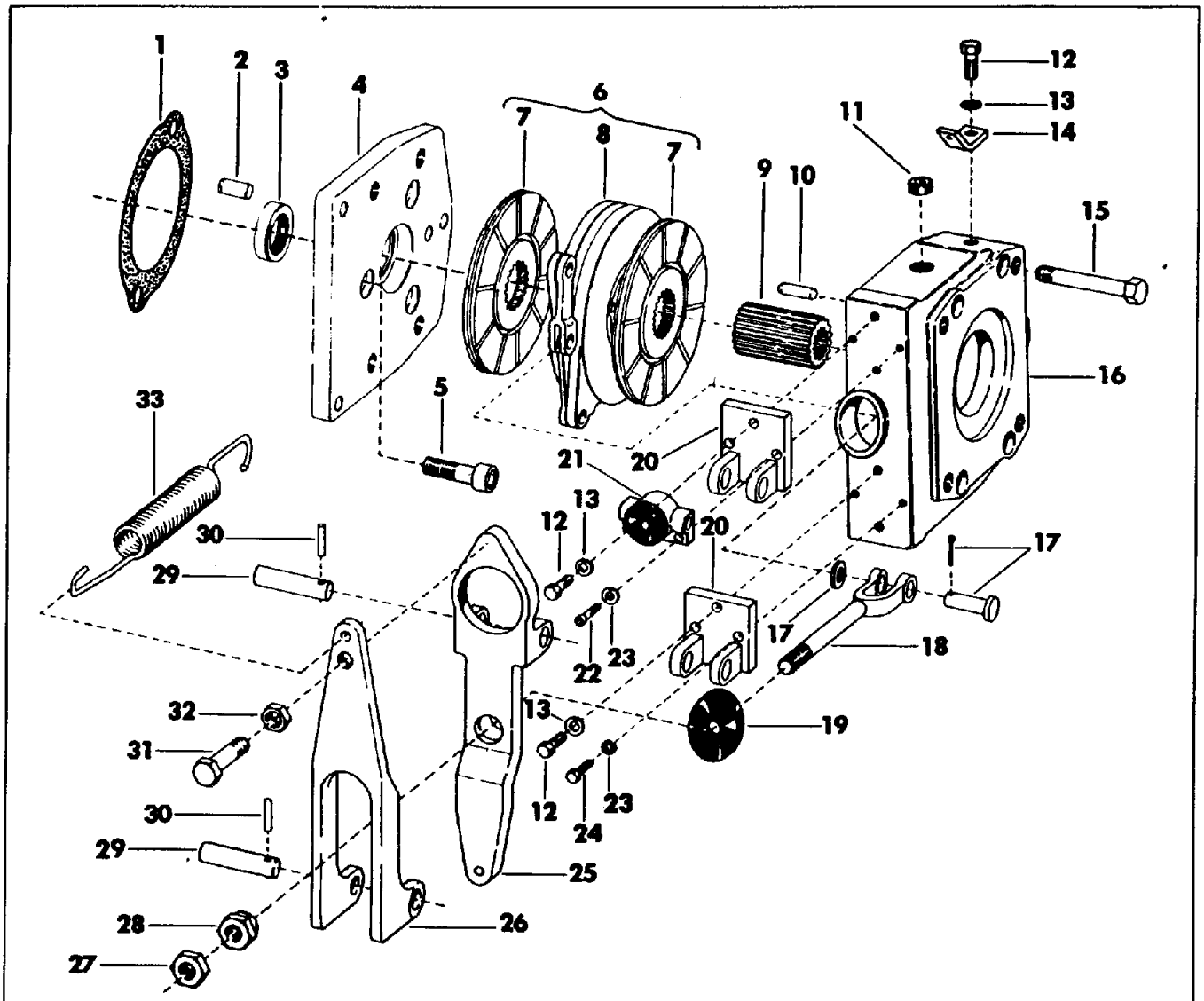
2. Exercise care when installing cups to avoid damaging the lips. Assemble cups from each end, do not slide them through the cylinder.

3. Refer to Figure 46 and position housing and attach with four bolts.

4. Install brake assembly (6) into housing along with attaching parts as shown in Figure 46. Install adapter (4), oil seal (3), and dowel (2).

5. Install drive motor and attach with four bolts. Connect brake hose and hydraulic lines. Bleed brake systems.

Courtesy of CraneMarket.com



1. Brake housing gasket
2. Dowel
3. Oil seal
4. Adapter
5. Capscrew
6. Brake
7. Brake disc
8. Actuating disc
9. Input shaft
10. Dowel pin
11. Pipe plug
12. Capscrew
13. Lockwasher
14. Spring bracket
15. Capscrew
16. Brake housing
17. Clevis pin
18. Rod end clevis
19. Rubber dust boot
20. Lower base
21. Brake cylinder
22. Capscrew
23. Lockwasher
24. Socket head capscrew
25. Service brake lever
26. Auxiliary brake lever
27. Lock nut
28. Ball seat nut
29. Brake lever pin
30. Roll pin
31. Capscrew
32. Lock nut
33. Spring

Figure 46. Hoist Brake – Early Model

Courtesy of CraneMarket.com

MOTOR (DRIVE AND HOIST)

REMOVAL

Before breaking a circuit connection in the hydraulic system, be sure engine is shut-down and the system pressure released. This can be done by moving the control levers back and forth after shutting the engine down. After disconnecting the hydraulic fittings at the motor, plug ports and cap lines, to prevent contamination of the hydraulic system. Remove motor from machine by taking out the two mounting capscrews.

DISASSEMBLY

Refer to Figure 47 and proceed as follows:

1. Index-mark valve plate (2) and housing (17). Remove valve plate (2) by taking out four mounting capscrews (1).
2. To remove rotating group turn the group slightly to free it from the swash plate (15). Tilt the housing and remove the rotating group. Do not separate cylinder block (9) from the rotating group during removal from housing.
3. To disassemble the rotating group, lift the piston and shoe sub-assemblies (14) from the cylinder block (9). Exercise care that the pistons are not marred or scored. Even a minor burr on a piston can severely score the cylinder block.

WARNING: If spring (7) and washers are to be removed from the cylinder block, follow the procedures outlined in Figure 30 to prevent bodily injury from the sudden release of the cylinder block spring.

4. Remove the swash plate (15) by pulling it out evenly from housing. Removal may be slightly difficult due to suction caused by oil under swash plate.
5. To remove drive shaft (20), remove the shaft retainer snap-ring (23) with Truarc pliers, then tap end of drive shaft with a soft-tip hammer to free the shaft and bearing from the housing.

CLEANING, INSPECTION AND REPAIR

Clean all parts thoroughly with a non-flammable solvent prior to inspection and after any lapping or machining operation. Inspect flat surface of valve plate (2) that mates with the cylinder block (9) for wear or scoring. Replace plate if wear or damage is extensive.

Inspect the bores and valve plate mating surface of cylinder block (9) for wear and scoring. Inspect the piston and shoe assemblies (14) for wear or damage. Check the shoe face-to-back shoulder dimension as shown in Figure 32. Excessive wear will result if this dimension is excessive. Replace all nine piston and shoe assemblies if any one requires replacement.

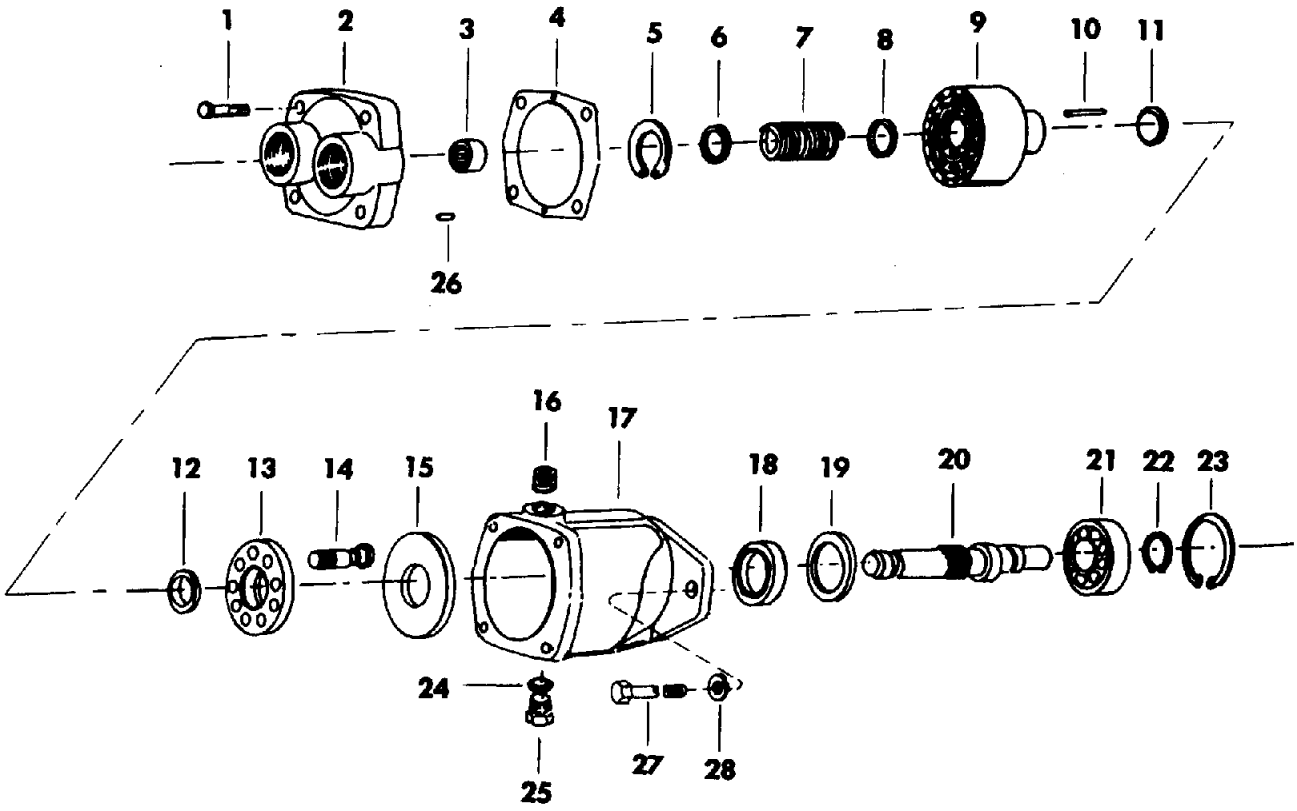
Examine swash plate (15) for wear or scoring. If wear or damage is extensive, replace swash plate. Inspect bearings (3 and 21) for roughness or excessive play and replace if necessary. Inspect drive shaft (20) at the seal journal for scoring or wear. Replace drive shaft if wear is excessive.

REASSEMBLY

Reassembly of the motor is basically the reverse order of disassembly. Install new gaskets, seals, and O-rings when assembling the unit. Apply a light film of hydraulic fluid to each part to aid in assembly and provide initial lubrication. Refer to Figure 47.

1. Install a new shaft seal (18) in housing (17). Place washer (19) over seal and install drive shaft (20) with bearings (21) in housing. Secure shaft and bearing assembly in housing with retaining snap ring (23).
2. Install swash plate (15) in housing with rounded edge of plate down. It should be possible to rotate the plate freely with the fingers.
3. If spring (7) and washers (6, 8, 11 and 12) were removed from the cylinder block (9) assemble them as illustrated in Figure 30.
4. Assemble piston and shoe assemblies in cylinder block as follows:
   a. Place cylinder block face down on a smooth, clean surface.
   b. Insert three pins (10) in their holes in the cylinder block.
   c. Grease back-up washer (11) and spherical washers (12) and place them on the pins.
   d. Push the nine piston-and-shoe assemblies (14) through holes in shoe plate (13) until shoes seat in shoe plate.

Courtesy of CraneMarket.com



1. Screw
2. Valve plate
3. Bearing
4. Gasket
5. Snap ring
6. Washer
7. Spring
8. Washer
9. Cylinder block
10. Pin
11. Washer
12. Spherical washer
13. Shoe plate
14. Piston
15. Swash plate
16. Plug
17. Housing
18. Seal
19. Washer
20. Shaft
21. Bearing
22. Snap ring
23. Snap ring
24. O-ring
25. Plug
26. Pin
27. Capscrew
28. Lockwasher

Figure 47. Hoist and Drive Motors

Courtesy of CraneMarket.com

e. Hold shoe plate so that pistons do not strike each other, align the pistons with the bores in cylinder block and maneuver them into place. The pistons must move freely in the lubricated block bores.

5. Insert rotating group in housing as follows:

   a. Hold motor shaft with one hand and tilt motor on edge at about a 45 degree angle. Install rotating group with other hand. Carefully rotate block until the spherical washer and cylinder block splines fall in alignment with the splines on the drive shaft.

   b. Clamp motor in a vise with the shaft pointing down. Pour clean hydraulic fluid in piston holes of the rotating group until they are full.

WARNING: The hoist motor must be installed in the exact position that it was removed. Failure to properly install hoist motor could cause load to drift down.

NOTE: If the hoist will not hold the load (load drifts down) after repair, remove the hoist motor from the hoist brake, rotate the motor 180°, and reinstall it on the brake.

6. Align index marks on valve plate (2) and housing. Secure plate with retaining screws (1).

INSTALLATION

Install motor on drive or hoist brake and attach with two capscrews. Remove port plugs and line caps and connect hydraulic lines to motor. Before installing drain line to the top of the motor, pour hydraulic oil into the drain port until the motor case is full. Break-in motor by operating TRAVELIFT for 1/2 hour without load.

TRAVERSE MOTOR

The traverse motor is a gear type and is essentially the same design and construction as the supercharge and power steering pump. The internal arrangement of the gear housing is the same. The arrangement of the drive shaft in the gear housing differs from the pump drive.

REMOVAL

Remove traverse motor as follows:

1. Disconnect the two hydraulic lines at the end of the motor.
2. Drain the traverse gear box oil.
3. Slide motor from gearbox.

DISASSEMBLY

Overhaul of the traverse motor or any other hydraulic component should be performed only in a clean room completely free from dirt and dust. Clean surroundings are imperative since any foreign material that is allowed to enter the hydraulic system will invariably cause damage to components with close working tolerances. (Number callouts refer to Figure 48.)

1. Disassembly into sub-assemblies.

   a. Back off threaded retainer ring (9) at least three full turns to release bearing preload.

NOTE: Bearing preload must be released before any service work is performed on the motor.

   b. Index-mark port end cover (17), gear housing (16), and shaft end cover (3) to assure correct reassembly.

   c. Remove capscrews (18) and washers (19) from port end cover (17) and remove cover. Thrust plate (13) with pocket seals and roller bearings (12) will also be removed.

   d. Remove gears (15) and gear housing (16) from shaft end cover (3). Keep gears together as they are a matched set.

2. Disassembly of shaft end cover.

   a. Remove retainer ring (9) from cover (3) and slide assembled drive shaft out of cover.

   b. Carefully pry thrust plate (13) from cover (3) with a thin screwdriver. Remove and discard pocket seals (14).

   c. Remove roller bearings (12) from shaft end cover only if they are to be replaced. If bearings are to be replaced, remove them with a bearing puller. If shaft bushing (10) and spring (11) require removal, pull the shaft end drive bearing only.

Courtesy of CraneMarket.com

d. Press tapered bearing (6) and cup, and seal retainer (9) with lip seal off drive end of shaft (4).

e. Remove and discard O-ring (8) from shaft bore.

f. Remove lip seal (7) from retainer and discard.

3. Housing. Remove O-rings (1) from grooves in housing faces and discard.

4. Port end cover assembly.

a. Carefully pry thrust plate (13) from cover with a thin screwdriver. Remove pocket seals and discard.

b. If bearings (12) in port end cover (17) are to be replaced remove them with bearing puller.

CLEANING AND INSPECTION

Clean all parts with non-flammable solvent and blow dry with compressed air. Check bearings (6 and 12) for excessive wear and roughness. Check gears (15) for wear and proper running clearance in housing (16). Check spring (11) for proper tension and distortion.

REASSEMBLY

Refer to Figure 48 and assemble the motor as follows:

1. Shaft end cover.

a. Place shaft end cover (3), gear side up, in a vise with soft jaws. Install bronze shaft bushing (10) with flange side toward bottom of bore.

b. Next, install conical spring (11) with smaller end of spring over pilot shoulder of shaft bushing.

c. Install two roller bearings (12) in the bores of the cover if they were removed. Be sure top of spring (11) does not wedge between bearing and bottom of bearing counterbore.

d. Turn shaft end cover (3) over in vise with flange side up.

e. Repack tapered roller bearing (6) with a good #2 lithium base, high temperature bearing grease. Press the bearing onto the drive shaft (4), be sure that larger diameter of bearing is seated against the shaft shoulder. Insert the assembled shaft in the shaft end cover (3), and be sure shaft bushing (10) is centered around shaft bore.

f. With lip of the seal (7) facing outward, install O-ring (8) into the bearing bore on top of the bearing cup (6). Next, install seal retainer subassembly over shaft (4) making sure it is seated against top side of bearing cup (3).

g. Thread retainer ring (9) loosely into the shaft end cover (3). DO NOT preload the bearing when installing the retainer ring.

h. Turn shaft end cover over in vise with gear side up. See that plug or check assemblies are in proper place, if they were removed.

i. Place small amount of heavy grease into the two middle slots in the open face of thrust plate (13) and insert pocket seals (14).

j. Place thrust plate (13) with pocket seal slots toward the bearings (12). Check to see that pocket seals (14) in the center slots are still in place before tapping the thrust plate into position. Leave a clearance of approximately 1/32 in. (.794 mm) between the thrust plate (13) and the shaft end cover (3).

k. Into each of the four open slots in the thrust plate (13) insert a pocket seal (14). Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the shaft end cover. Trim away the excess from the exposed ends of the pocket seals (14) with razor blade or sharp knife. Cut seals square and flush with side of the thrust plate.

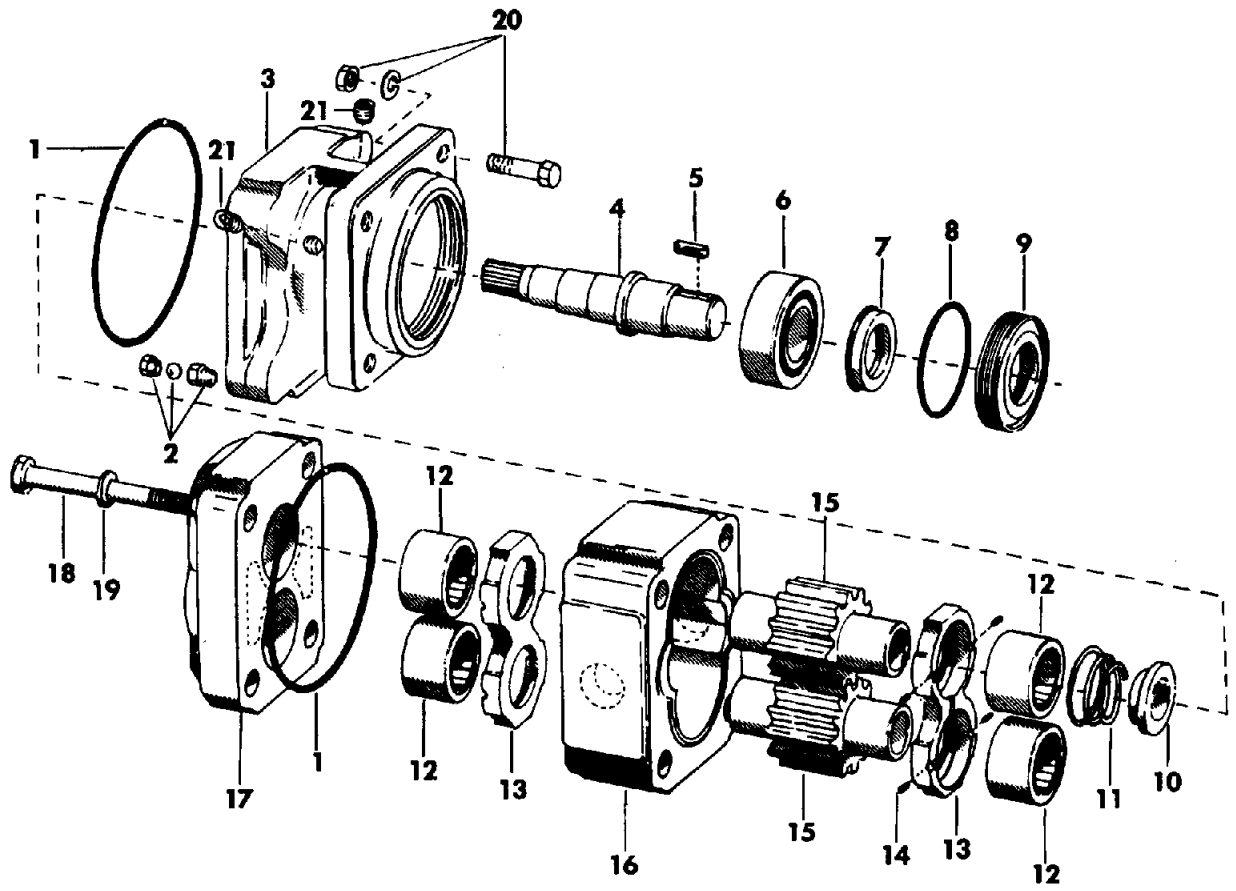
2. Port end cover sub-assembly.

a. Install two roller bearings (12) into their respective bores in port end cover (15), if they were removed.

b. Place small amount of heavy grease into the two middle slots in the open face of the thrust plate (13) and insert pocket seals.

c. Place thrust plate (13) with pocket seal slots toward the face of the port end cover (17) over bearings (12). Check to see that the pocket seals in the center slots are still in place before tapping the thrust plate into position. Leave a clearance of approximately 1/32 in. (.794 mm) between the thrust plate (13) and the port end cover (17).

Courtesy of CraneMarket.com



1. O-ring
2. Check valve
3. Cover, shaft end
4. Drive shaft
5. Key
6. Bearing, tapered roller
7. High pressure seal
8. O-ring
9. Retainer ring
10. Shaft bushing
11. Spring
12. Roller bearing
13. Thrust plate
14. Pocket seal
15. Gear set
16. Gear housing
17. Port end cover
18. Capscrew
19. Flat washer
20. Capscrew
21. Pipe plug

Figure 48. Traverse Motor

Courtesy of CraneMarket.com

d. Into each of the four open slots in the thrust plate (13) insert a pocket seal. Push each seal all the way into the slot so that the hidden end is always in contact with the roller bearing race. Tap the assembled thrust plate into position against the face of the port end cover. Using a razor blade or sharp knife, trim away the excess from the exposed ends of the pocket seals. Cut seals square and flush with sides of the thrust plate.

3. Final assembly.

a. Place the assembled shaft end cover in a vise, gear side up.

b. Pour a small amount of oil in face of thrust plate to provide lubrication of gears. Install the drive gears (15) on the shaft. Stone the gear ends before installation to remove any minute burrs.

c. Stone the faces of gear housing (16) to remove any burrs that might have occured in handling. Blow or carefully wipe clean before installing pregreased O-rings (1) in the grooves in the faces of the housing (16).

d. Place gear housing (16) on the shaft end cover and tap into position with a soft hammer (plastic or leatherhead). Be careful not to pinch O-ring (1) when positioning the housing. Pour a small amount of oil over the gears to provide initial lubrication when putting the motor back into service.

e. Install the port end cover sub-assembly on gear housing (16). Hubs of gears fit into the I.D. of the roller bearings (12) and thrust plate (13) fits into the gear housing. Use a soft hammer to seat or position the port end cover assembly against the housing, making sure the O-ring on the face of the housing is not pinched.

f. Thread four capscrews (18) with washers (19) under the heads of the capscrews, into the shaft end cover. Tighten the four capscrews alternately to 200 ft-lbs. (270 Nm). Rotate the shaft with a six inch wrench. Protect the shaft splines when using the wrench. The shaft should rotate easily.

g. Remove the assembled motor from the vise and turn it over so the end of the shaft is up. Tighten retainer ring (9) with a spanner wrench until it is tight. Proper bearing preload and running clearance is obtained by backing off the threaded retainer ring.

ADJUSTING MOTOR PRELOADING OF BEARING

Final adjustment of running clearance is obtained in the following manner. With the threaded retainer ring tightened until it stops or is snug, scribe a line, so that it is visible across the face of the retainer ring and over onto the face of the flange or pilot of shaft end cover. Now back the retainer ring off 1/2 in. (12.7 mm), measuring from the scribed line at the outside diameter or edge of the retainer ring.

This amount of movement or back-off will provide approximately .005 in. (.1270 mm) clearance, which has been carefully calculated as the prescribed bearing adjustment.

With the retainer ring backed off to the proper setting, stake the outer edge of the retainer ring into the groove or slot provided at the inside diameter of the pilot of the shaft end cover. Use a blunt tool to force the metal from the outer edge of the retainer ring into the groove or slot. Make sure the retainer ring is securely locked in this manner.

NOTE: To avoid possible damage to a new or rebuilt hydraulic motor, RUN IT IN WITHOUT A WORKING LOAD for no less than half an hour. After this, the motor may be operated under actual working conditions. Failure to observe this precaution can result in premature motor failure.

INSTALLATION

Position motor on traverse gearbox and secure with two bolts. Connect the two hydraulic lines to fittings on motor. Refill traverse gearbox with 1 quart of No. SAE 140-5 gear lube.

Courtesy of CraneMarket.com

GEARBOX (DRIVE AND HOIST)

Gearboxes used for hoist and drive are very similar in construction. The gearboxes have different filler ports and output shafts. Service problems are usually limited to bearing replacement.

> **NOTE:** The housing and cover are line bored as a matched set and must be replaced as a unit.

REMOVAL

Remove the gearbox as follows:

1. Remove the chain guard and loosen nuts on clevis rod.
2. Remove connecting link in drive chain and remove chain. Disconnect hydraulic lines, cap, fittings and ports, and remove brake.
3. Swing motor out of the way.
4. Drain gearbox in suitable container and discard the oil.
5. Remove attaching bolt.

Replacing Bearings on Cover Side

The shaft bearings located in the cover can be removed and replaced without disassembling the entire gearbox. If these bearings require replacement, proceed as follows:

1. Remove bearing caps (17, 21 and 28, Figure 49) from cover by removing attaching parts.
2. Remove snap ring (15 and 31) securing shafts (11, 19 and 30) to cover. The intermediate shaft (23) is not secured with a snap ring as it is shimmed securely into the cover.
3. Remove bearings (10, 24 and 32) from shafts with a bearing puller. It is not necessary to remove cover from gearbox.
4. Install new bearings as follows. Use of bearing and seal drives is recommended.
   a. Press bearing (10) onto input shaft (11).
   b. Use Tool S216363 and press bearing (10) on drive shaft (19).
   c. Press bearing cup (24) into intermediate cluster gear assembly bore using Tool S216370.
   d. Use Tool S216369 and drive bearing core (24) onto intermediate cluster gear shaft (23).
   e. Press bearing (32) onto output shaft (30).
5. Check that all bearings are pressed down on the shafts until they clear the snap ring depression, except on the intermediate cluster gear shaft. There is no snap ring holding this bearing on the shaft; instead it is shimmed tight into the cover. See shimming instructions below.
6. Press bearing (24) on shaft (23) until it is completely depressed in the bore.

> **NOTE:** Do not exert excess pressure, since this may crack the cover.

7. Using a depth micrometer, measure the distance between the top of the bearing and the machined surface of the cover. Measure this distance in at least three locations and average the readings.
8. Place shims equaling this averaged reading on top of the machined surface of the cover and place the bearing cap on top of the shims.
9. Insert capscrews and tighten to 17 ft-lbs. (23 Nm).

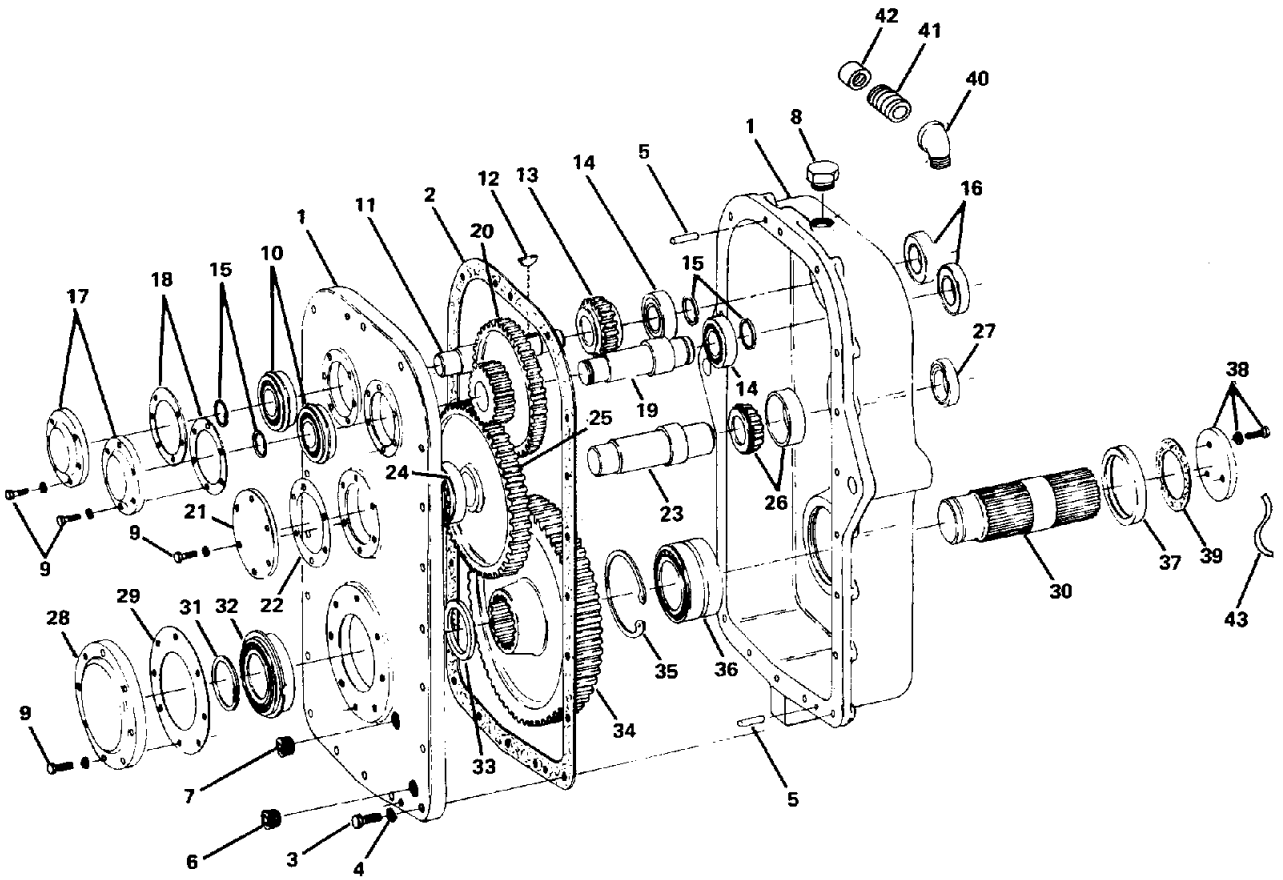
> **NOTE:** Capscrews are equipped with a nylon insert for locking purposes. If original capscrew is to be re-used, coat with Loc-tite Nut Lock (Blue) to insure that the capscrew is locked in place.

Replacing Bearings on Housing Side

Refer to Figure 49 and proceed as follows:

1. Remove cover mounting capscrews (3) around outside edge of cover. Insert capscrews in jackscrew holes and break seal of cover to housing.
2. Position gearbox, cover down, on blocking at the mounting flanges on the side and end. The cover must be far enough away from any surfaces to allow the shafts to be driven out of the housing.
3. Remove snap rings (15 and 35) on the ends of the shafts. (The intermediate cluster gear assembly shaft does not have a snap ring.)
4. Drive the shafts out of the housing with a brass drift and a hammer.
5. Since the intermediate cluster gear shaft assembly bearing cap and the output shaft bearing remain in the housing, these must be removed with a puller if they are to be replaced.

Courtesy of CraneMarket.com



1. Case and cover
2. Cover gasket
3. Capscrew
4. Lockwasher
5. Dowel
6. Magnetic drain plug
7. Oil level check plug
8. Breather vent
9. Capscrew, lockwasher and seal washer
10. Bearing
11. Input shaft
12. Woodruff key
13. Input shaft pinion
14. Bearing
15. Snap ring
16. Seal
17. Bearing cap
18. Gasket
19. Drive shaft
20. Drive shaft gear cluster
21. Intermediate shaft gear cover
22. Shim
23. Intermediate shaft
24. Bearing
25. Intermediate shaft cluster gear
26. Bearing
27. Intermediate shaft seal
28. Output shaft cap
29. Gasket
30. Output shaft
31. Snap ring
32. Bearing
33. Spacer
34. Final drive gear
35. Snap ring
36. Bearing
37. Seal
38. End cap w/capscrew and washer
39. Gasket
40. Elbow 90° (hoist only)
41. Pipe nipple (hoist only)
42. Pipe coupling (hoist only)
43. Wire
44. Mounting spacer (drive only)

Figure 49. Drive and Hoist Gearbox

Courtesy of CraneMarket.com

NOTE: Remove bearings (10 and 14) from case and cover (1).

6. Install new bearings on shafts (housing side) as follows:
   a. Insert bearing (36) into the output shaft bore and drive it tight.
   b. Place bearing cup (26) into the intermediate cluster gear shaft assembly bore using Tool S216368.
   c. Press bearing cone (26) onto intermediate cluster gear shaft using Tool S216367.
   d. Press bearing (14) onto input shaft (11) with Tool S215712.
   e. Press bearing (14) onto drive shaft (19).
7. Align all shaft assemblies with the appropriate bore in the housing. Press the shafts and bearings down until the cover fits tight against the housing.
8. Turn the housing over and install snap rings on the input and drive shafts.
9. Use Tool S216364 with sleeve S216363 to press oil seals (16) into input and drive shaft bores (housing side).
10. Use Tool S216366 with sleeve S216365 to press oil seal (27) into the intermediate cluster gear shaft bore (housing side).
11. Use Tool S216361 to press oil seal (37) into output shaft bore (housing side).
12. Install mounting capscrews (3) in the cover. If original capscrews are being re-used, coat each with a few drops of Loc-tite Nut Lock (blue) and torque to 17 ft-lbs. (2.35 meters Kg).

INSTALLATION

Install the gearbox as follows:

1. Position gearbox and insert and tighten through bolt. Install drive chain and adjust clevis bolt to achieve proper chain tension.
2. Install motor and brake on gearbox. Install chain guards.
3. Service gearbox according to maintenance schedule. Bleed drive brake line.

TRAVERSE GEARBOX

REMOVAL

Proceed as follows:

1. Relieve pressure in hydraulic lines by working the traverse control lever back and forth with engine shut down.
2. Drain gearbox housing.
3. Disconnect the hydraulic lines to the motor and plug the fittings.
4. Remove the gearbox and motor from top beam by removing the attaching capscrews.

CAUTION: The traverse area is not equipped with ladders and platforms. Use suitable staging.

DISASSEMBLY

Refer to Figure 50 and proceed as follows:

1. With gearbox and motor on a clean, level workbench, remove bottom housing cover (22) for access to drive gear, bearings, shaft and seals. Save shims (19, 20 and 21) for reassembly.
2. Remove motor and motor adapter (11) to gain access to the worm shaft. Save shims (9 and 10) for reassembly.

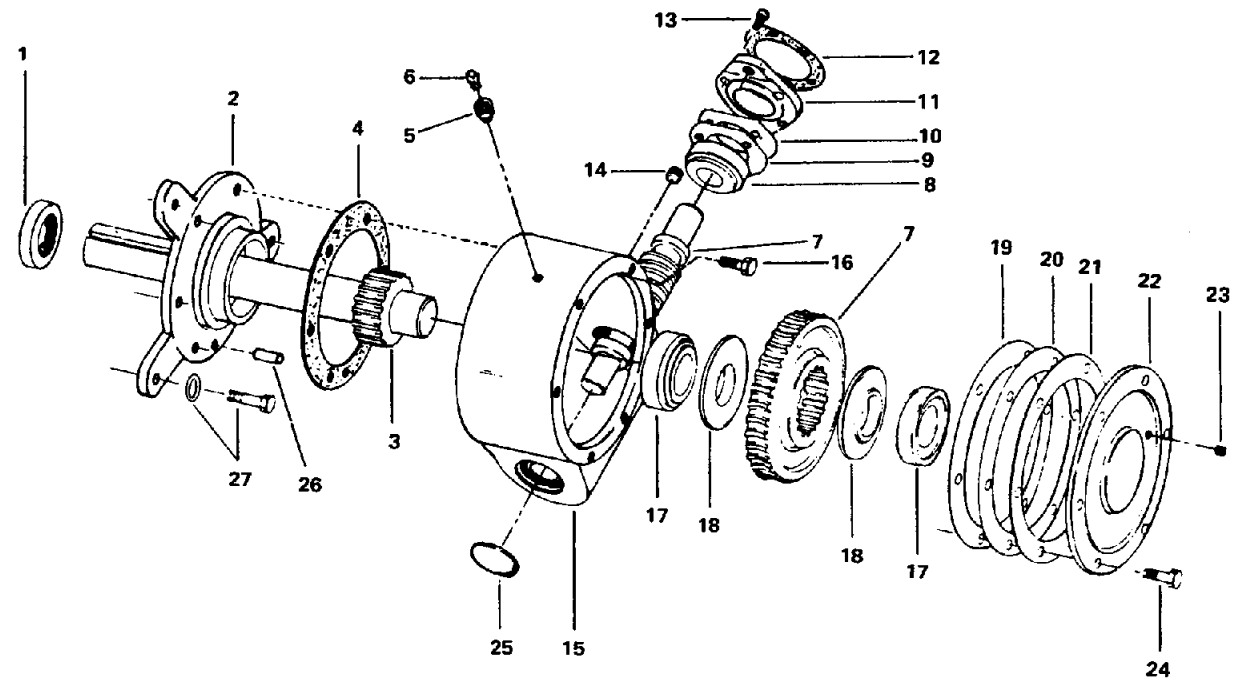
CLEANING, INSPECTION AND REPAIR

Clean all parts in solvent and dry. Inspect bearing for excessive play. Rotate the bearing while applying sideways pressure to check for pitted or cracked races. Replace bearings if unserviceable. Check the gear teeth of gear and shaft matched set (7) for excessive wear, chipped areas, etc. Check splines of shaft (3) and gear for excessive wear and proper fit.

REASSEMBLY

Replace any gasket that has been removed. Each part should be lightly coated with gear lubricant before reassembly. It is necessary to install shims

Courtesy of CraneMarket.com



1. Seal
2. Housing cover
3. Output shaft
4. Gasket
5. Reducer bushing
6. Vent
7. Gear and shaft (matched set)
8. Worm bearing
9. Shim
10. Shim
11. Adapter
12. Gasket
13. Capscrew
14. Pipe plug
15. Housing
16. Capscrew
17. Bearing
18. Spacer
19. Shim
20. Shim
21. Shim
22. Housing bottom cover
23. Pipe plug
24. Capscrew
25. Expansion plug
26. Dowel
27. Capscrew and lockwasher

Figure 50. Traverse Gearbox and Coupling

between the housing and motor adapter and between housing and lower cover to ensure proper internal clearances. Clearances affected by wear and parts replacement must be checked each time the gearbox is disassembled. Reassemble the gearbox as follows:

1. Install the complete worm shaft, including shaft (7), bearings (8), shims (9 and 10), then position hydraulic motor adapter (11) and hold firmly in place.
2. Check clearance between adapter and housing with feeler gauge. Remove adapter and install the proper combination of shims to match the feeler gauge reading. Position adapter and attach with capscrews.
3. Check worm shaft torque with 12 in. torque wrench. Two ft-lbs. of torque should be required to turn shaft. If torque valve is higher, add shims; if less, remove shims. Install the required number of shims to achieve the required 2 ft-lbs. torque. Install adapter and secure with capscrews.
4. Install output shaft and gear assembly. Position housing bottom cover and check clearance between housing and cover with feeler gauge. Remove cover and install shims to match feeler gauge reading. Position cover and secure with cover capscrews. Tighten all capscrews per Torque Chart.
5. Install hydraulic motor on gearbox.
6. Position gearbox on top beam and secure with capscrews. Use Loc-tite or equivalent on capscrew threads. Attach hydraulic lines.
7. Fill gearbox with SAE 140-5 gear oil or equivalent.

Courtesy of CraneMarket.com

STEERING YOKE

Repair procedures for the steering yoke are usually limited to the replacement of the bearings. Bearing replacement will be in order when uneven tracking of the drive wheel is noted and there is a noticeable movement in the yoke when changing from forward to reverse.

REMOVAL

Refer to Figure 51 and proceed as follows:

1. Refer to "Wheels and Tires" for jacking machine and removing tires.
2. Block up the side beam. Use proper cribbing so that side beam will not fall down.
3. Disconnect steering cylinder at yoke.
4. Rig a hoist from the side beam to support the yoke.
5. Remove lock nut, then remove lockwasher, bearing ring and bearing cup and cone.
6. Lower yoke to free bearing cup and cone and bearing ring.

CLEANING AND INSPECTION

Clean all parts in non-flammable cleaning solvent and blow dry with compressed air. Check bearings for roughness, pitting, galling, etc.

INSTALLATION

1. Position bearing cup and cone and bearing ring in yoke.
2. Raise yoke into position on column and lower bearing, seal, lockwasher and lock nut. Tighten nut until yoke rotates freely without side play.
3. Attach steering cylinder.
4. Install wheel and tires.

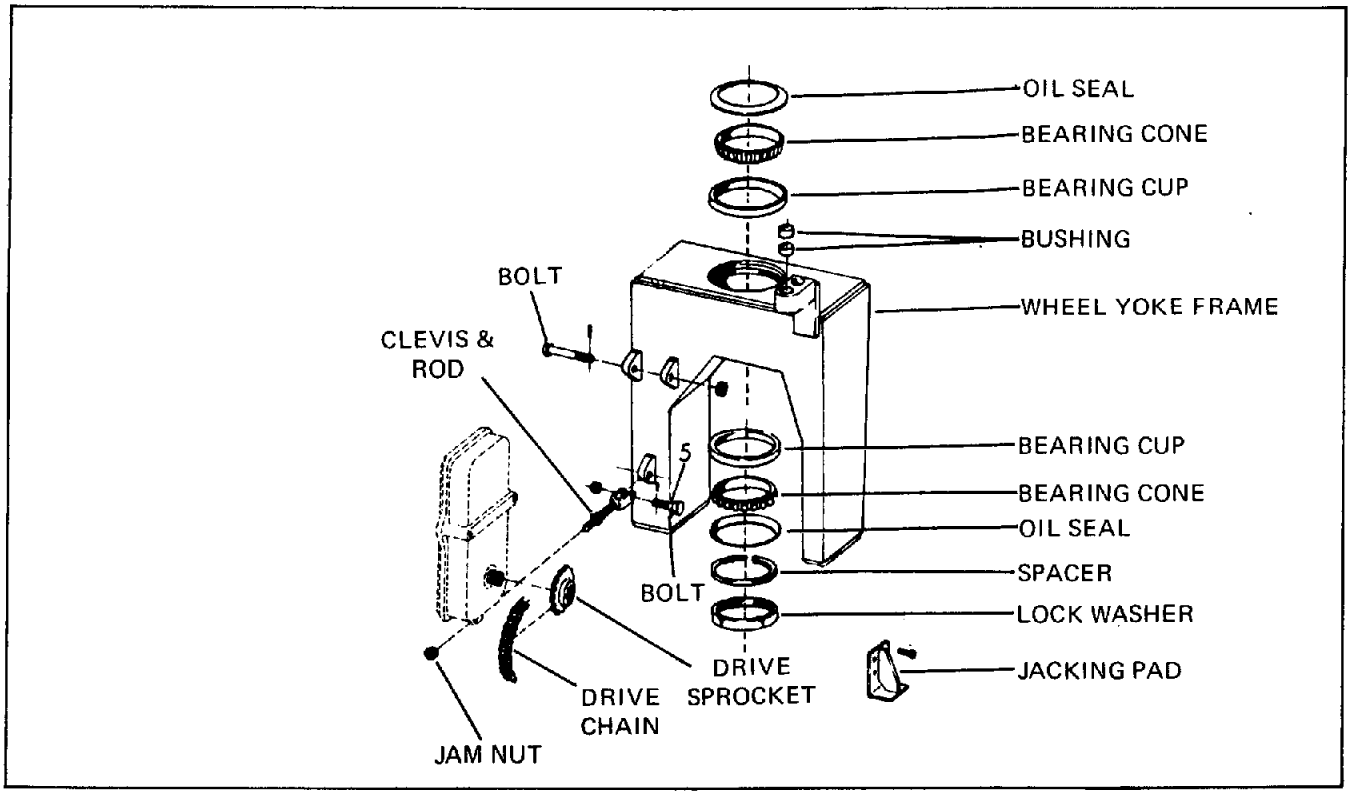


Figure 51. Steering Yoke

Courtesy of CraneMarket.com

WHEELS AND TIRES

REMOVAL OF FRONT WHEELS

WARNING: Improper handling of wheels and tires can result in the wheels coming apart with explosive force. Exercise extreme caution when inflating or handling tires. Use a chain guard or safety cage when inflating tires.

The TRAVELIFT must be on firm and level terrain when wheels are removed. Operate traverse and position the trolley on opposite side of machine from wheel being changed to relieve weight. Refer to Figure 52 and proceed as follows:

1. Use a jack of sufficient capacity and the jacking pad and jack-up machine.
2. Remove four castellated nuts attaching bearing blocks to studs on vertical leg.
3. Remove wheel from under yoke. Disassemble wheel and tire as necessary using standard tire tools.

REMOVAL OF REAR WHEELS

Remove wheels as follows:

1. Remove chain guard.
2. Loosen drive transmission by loosening nuts on clevis and rod.
3. Remove master link in drive chain, and remove chain. Jack up the machine.
4. Remove nuts attaching pillow blocks to stud on vertical member.

CHANGING TIRES

Change tires as follows:

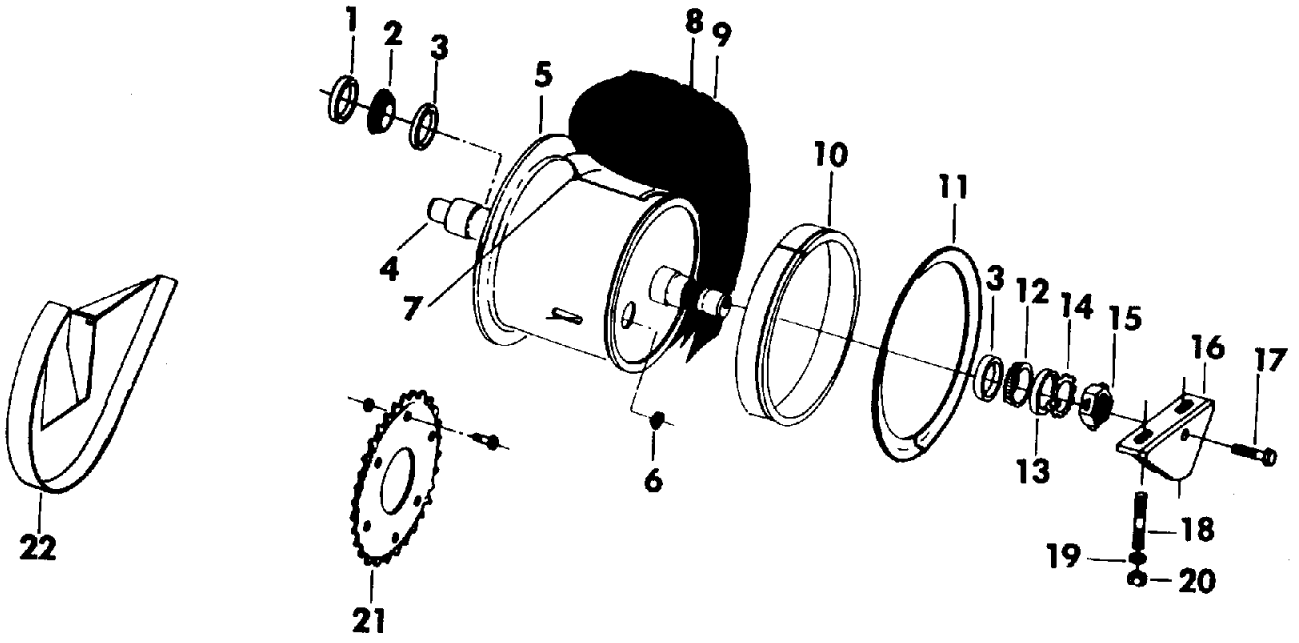
1. Deflate tire completely by removing valve stem.

WARNING: The tire must be completely deflated or injury may result.

2. Remove split retainer ring. Remove inner ring.
3. Use standard tire tools to remove tire from wheel.

NOTE: Maximum tire pressure is 95 psi (655 kPa).

Courtesy of CraneMarket.com



1. Oil seal
2. Bearing cone
3. Bearing cup
4. Axle
5. Wheel
6. Valve support washer
7. Tire flap
8. Tube
9. Tire
10. Locking ring
11. Side ring
12. Bearing cone
13. Oil seal
14. Lockwasher
15. Lock nut
16. Trunnion
17. Capscrew
18. Stud
19. Spacer
20. Self-locking nut
21. Drive sprocket
22. Chain cover

Figure 52. Wheels and Tires (Typical)

Courtesy of CraneMarket.com

LUBRICATED TORQUE VALUES IN FOOT-POUNDS FOR GRADE 5, 8 and SPECIAL DMC BOLTS (NC OR NF THREADED)

Size Diameter	Grade 5 Bolts	Grade 8 and Special DMC Bolts
1/4	8	12
5/16	17	26
3/8	26	42
7/16	43	66
1/2	65	100
9/16	95	150
5/8	130	200
3/4	220	360
7/8	350	560
1	530	860
1-1/8	750	1200
1-1/4	1050	1700
1-1/2	1800	2950
1-3/4	2850	4700
2	4400	7250

Hardened washers shall be used with grade 8 or better bolts.

Torque values for bolts listed above are with engine oil or Loctite applied to threads and under head. Applies to plated and non-plated bolts

Courtesy of CraneMarket.com

MAXIMUM RECOMMENDED TORQUE VALUES FOR JIC SWIVEL NUTS (37°SEAT)

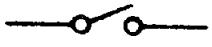
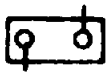
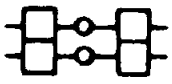
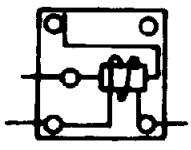
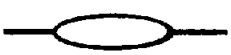
THD Size	Size	OD Tube	FT/LBS Pressure
7/16-20	-4	1/4	9
1/2-20	-5	5/16	17
9/16-18	-6	3/8	20
3/4-16	-8	1/2	30
7/8-14	-10	5/8	40
1-1/16-12	-12	3/4	85
1-3/16-12	-14	7/8	100
1-5/16-12	-16	1	110
1-5/8-12	-20	1-1/4	150
1-7/8-12	-24	1-1/2	170
2-1/2-12	-32	2	300
2-1/2-12	-40	2-1/2	400
2-1/2-12	-48	3	500

These values are recommended torque values for JIC (37° Seat) swivel nuts whether swaged or brazed type. The swivel nuts will normally withstand this torque for a minimum of 15 repeated assemblies.

The Torque required to seal swivel female fittings or hose couplings to a male connector depends on many variables such as, fluid medium surface, finish, etc. The above values are intended only as a guide for the maximum values the fittings may be subjected to.

Courtesy of CraneMarket.com

GRAPHIC SYMBOLS FOR ELECTRICAL DIAGRAMS

	GROUND
	FUSE
	SWITCH SINGLE POLE
	SWITCH PUSH BUTTON
	LAMP
	BATTERY
	CIRCUIT BREAKER
	MOTOR
	COLLECTOR RING
	SEPARABLE CONNECTOR
	HORN
	MICRO SWITCH
	SOLENOID
	JUMPER WIRE

Courtesy of CraneMarket.com

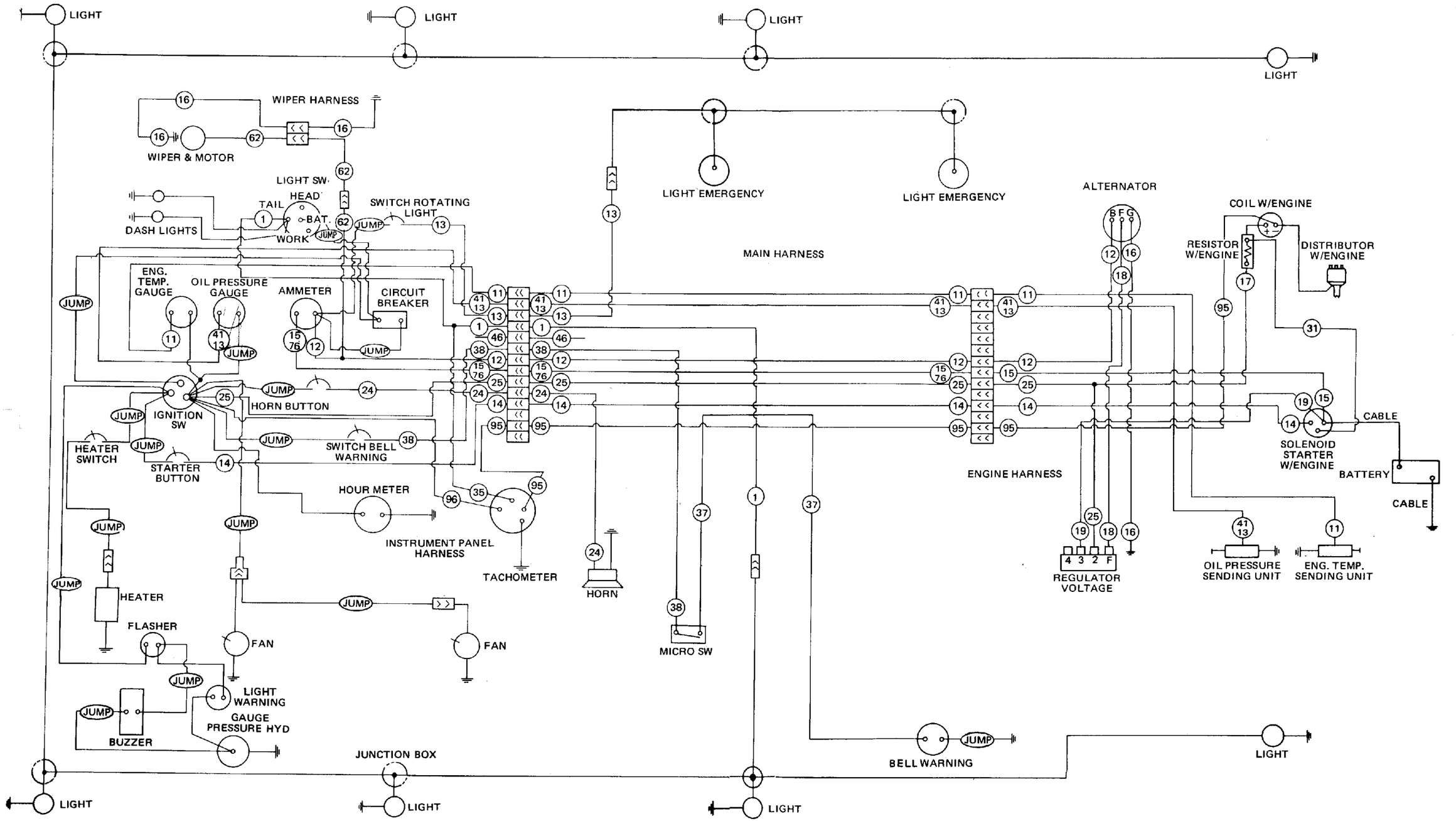
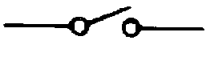
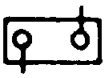
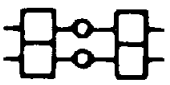
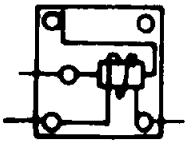


Figure 53. 500AI Electrical Schematic (IHC Gas Engine)

Courtesy of CraneMarket.com

GRAPHIC SYMBOLS FOR ELECTRICAL DIAGRAMS

	GROUND
	FUSE
	SWITCH SINGLE POLE
	SWITCH PUSH BUTTON
	LAMP
	BATTERY
	CIRCUIT BREAKER
	MOTOR
	COLLECTOR RING
	SEPARABLE CONNECTOR
	HORN
	MICRO SWITCH
	SOLENOID
	JUMPER WIRE

Courtesy of CraneMarket.com

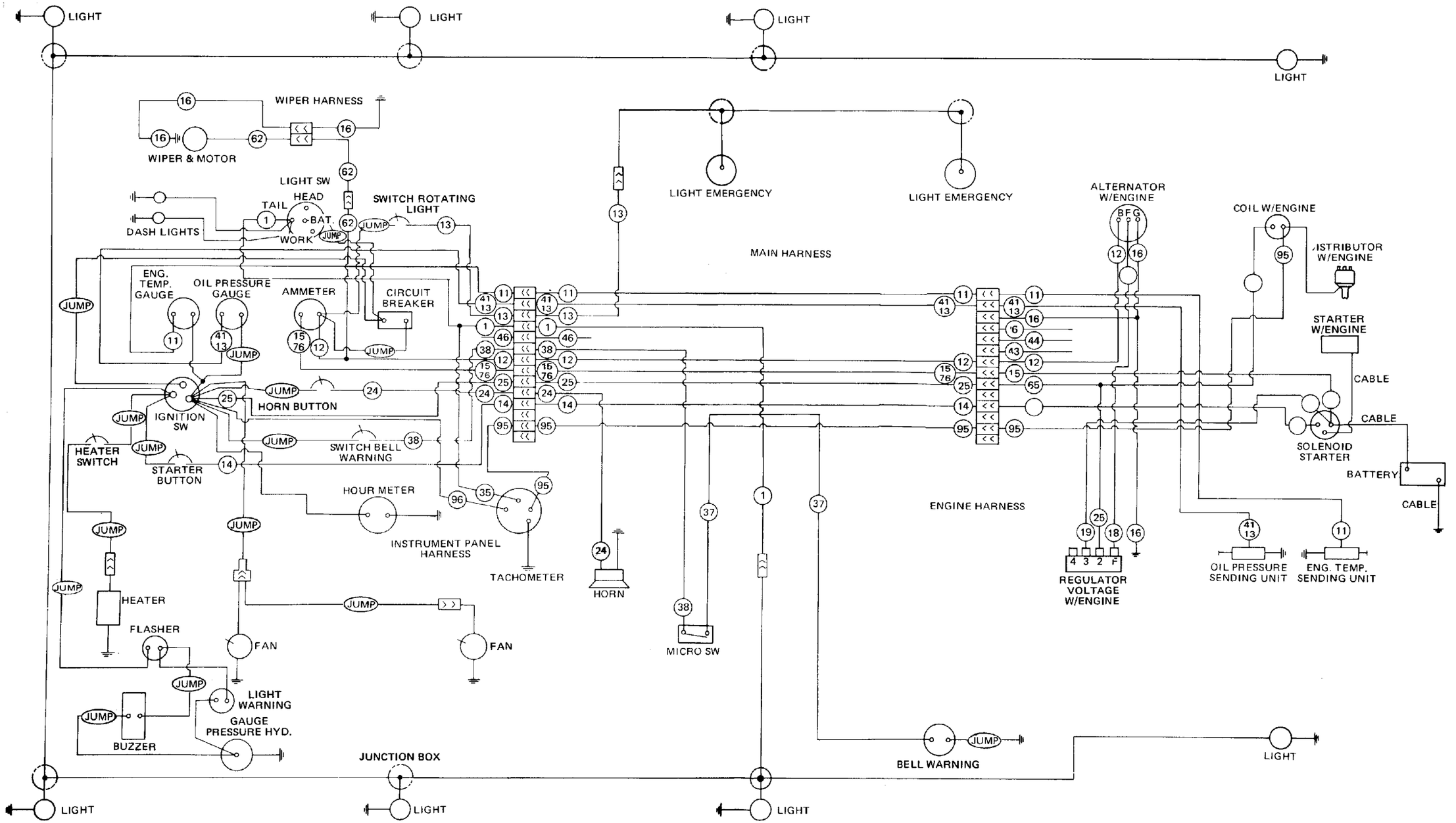
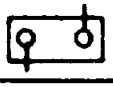
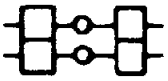
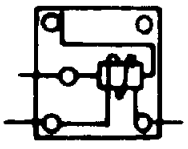


Figure 54. 650AI Electrical Schematic (Ford Gas Engine)

Courtesy of CraneMarket.com

GRAPHIC SYMBOLS FOR ELECTRICAL DIAGRAMS

	GROUND
	FUSE
	SWITCH SINGLE POLE
	SWITCH PUSH BUTTON
	LAMP
	BATTERY
	CIRCUIT BREAKER
	MOTOR
	COLLECTOR RING
	SEPARABLE CONNECTOR
	HORN
	MICRO SWITCH
	SOLENOID
	JUMPER WIRE

Courtesy of CraneMarket.com

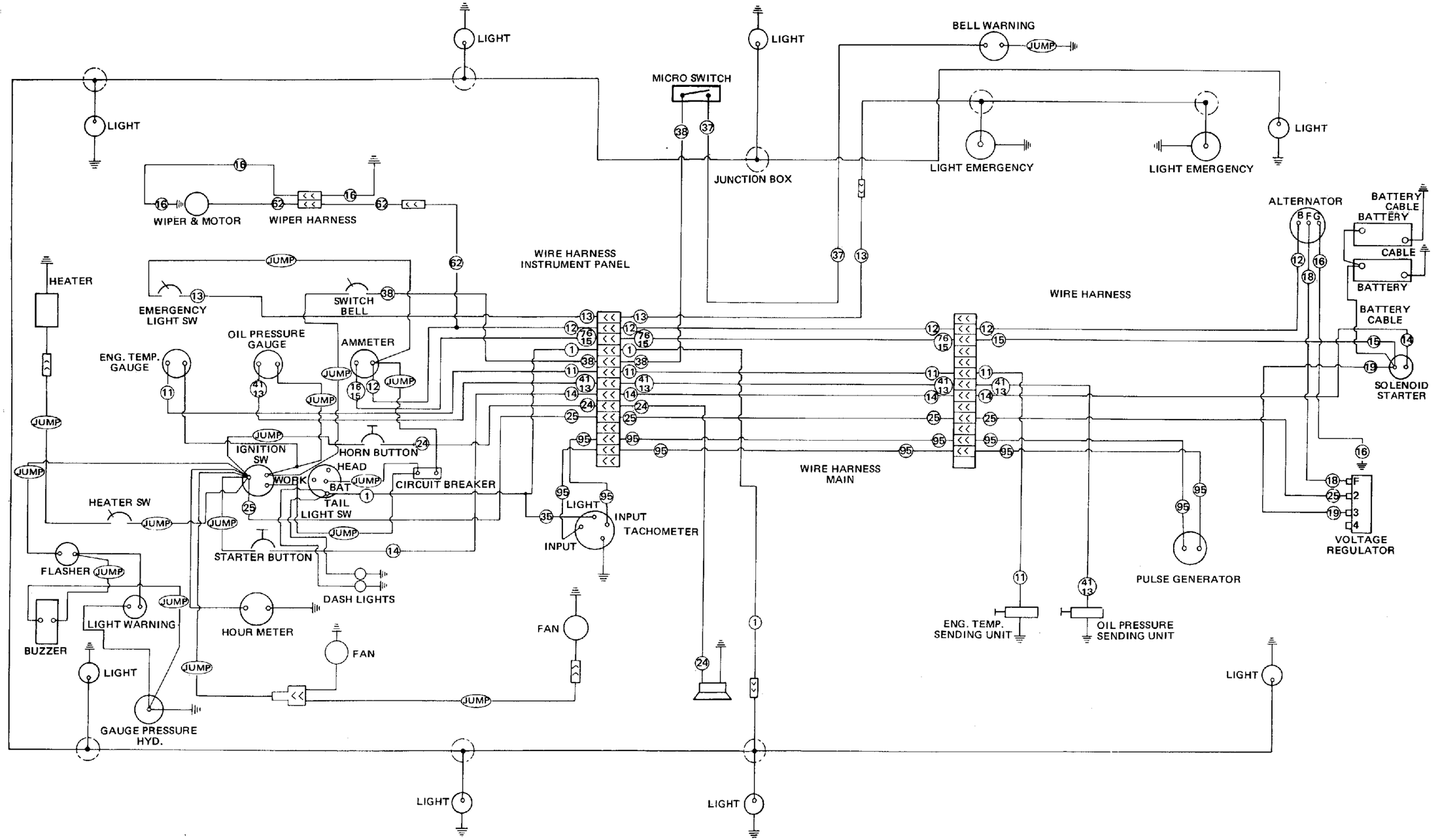
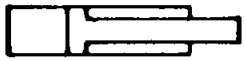
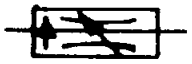
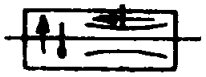
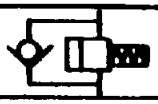


Figure 55. 500AI/650AI Electrical Schematic (G.M. Diesel Engine)

Courtesy of CraneMarket.com

GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

	CYLINDER
	RELIEF VALVE
	CHECK VALVE
	MOTOR
	PUMP
	DIRECTIONAL VALVE
	FLOW REGULATOR
	FILTER
	SHUT-OFF VALVE
	FLOW DIVIDER
	MANUAL OPERATED SELF CENTERING
	OVERCENTER VALVE
	SPRING

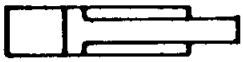
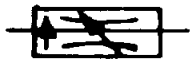
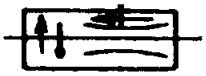
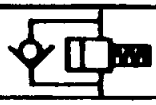
Courtesy of CraneMarket.com

REAR TRAVERSE HYDRAULIC MOTOR
NEEDLE VALVE
RELIEF VALVE
MASTER CYLINDER (BRAKE)
MAN
FRONT TRAVERSE HYDRAULIC MOTOR
LEFT DRIVE HYDRAULIC MOTOR
TRANS
BRAKE
MAN DET.
CONTROL VALVE (PARKING BRAKE)
PF
STEERING ACTUATOR
DRIVE-LEFT
HOIST-FRONT
TRAV.-FRONT
FILTER
MASTER CYLINDER (SERVO)
MID-INLET
DRIVE-RIGHT
HOIST REAR
TRAV. REAR
INLET SEC.
300 PSI
2000 PSI
2750 PSI
MAIN CONTROL VALVE
CAB SUPERCHARGE PRESSURE GAUGE (85 ±25 PSI)
CHECK VALVE (1-PSI)
STEERING PUMP
PUMP
PUMP DRIVE
ENGINE
CHECK VALVE (1 PSI)
CHECK VALVES (15 PSI)
REAR HOIST HYDRAULIC MOTOR
CHECK VALVE (5 PSI)
CHECK VALVE (1 PSI)
SERVO RELIEF VALVE
STEERING RELIEF VALVE
SUPERCHARGE CHECK VALVE (85 PSI)
STR
COUNTERBALANCE VALVE
RIGHT DRIVE HYDRAULIC MOTOR
FILTER ASSEMBLY
FRONT HOIST HYDRAULIC MOTOR

Figure 56. 500AI Hydraulic Schematic

Courtesy of CraneMarket.com

GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

	CYLINDER
	RELIEF VALVE
	CHECK VALVE
	MOTOR
	PUMP
	DIRECTIONAL VALVE
	FLOW REGULATOR
	FILTER
	SHUT-OFF VALVE
	FLOW DIVIDER
	MANUAL OPERATED SELF CENTERING
	OVERCENTER VALVE
	SPRING

Courtesy of CraneMarket.com

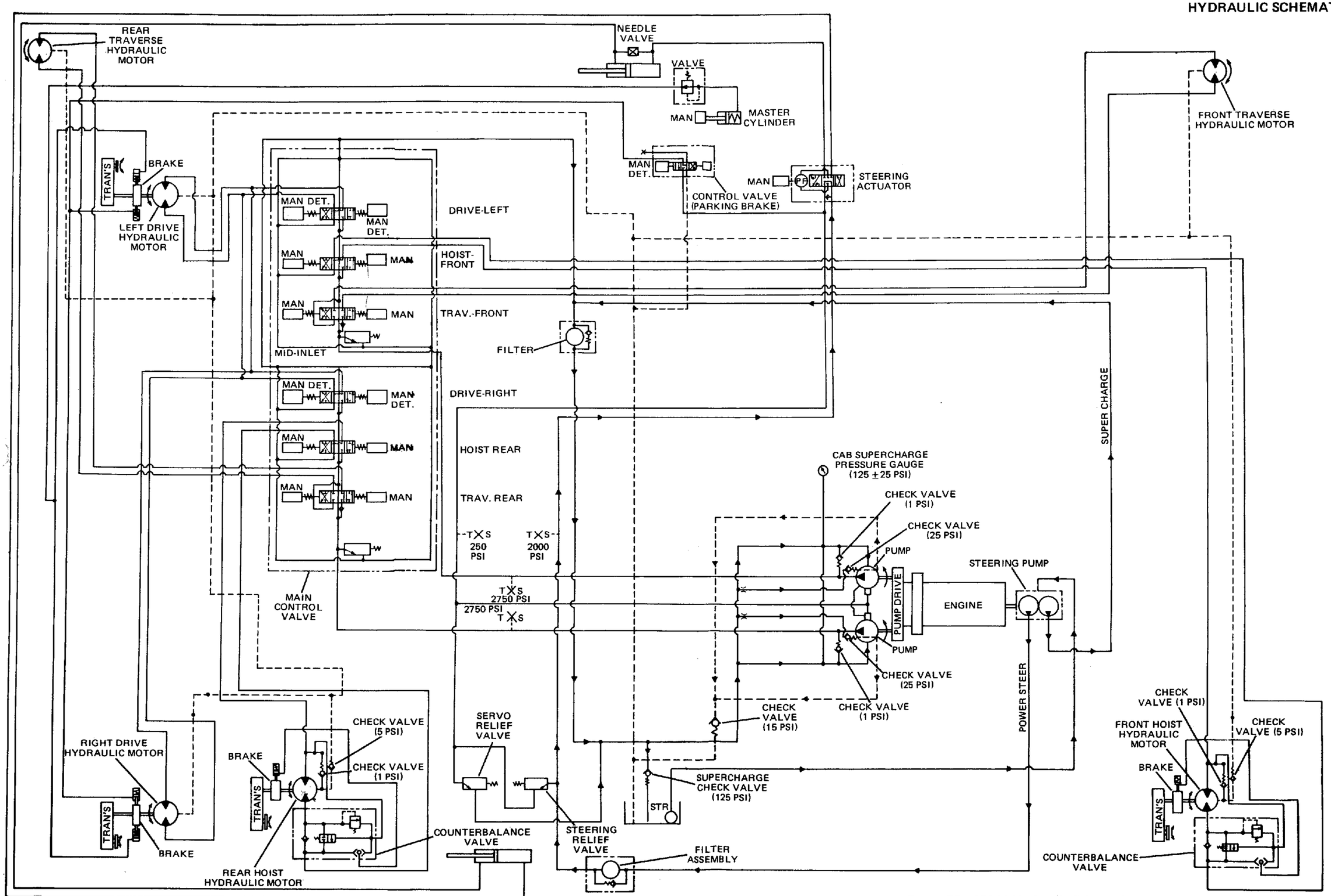


Figure 57. 650AI Hydraulic Schematic

Courtesy of CraneMarket.com