SERVICE MANUAL

This Manual has been prepared for and is considered part of -

RT540E

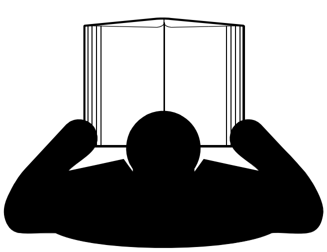
Crane Model Number

This Manual is divided into the following Sections:

NOTICE

The crane serial number is the only method your distributor or the factory has of providing you with correct parts and service information.

The crane serial number is stamped on the top of the outrigger box. ***Always furnish crane serial number*** when ordering parts or communicating service problems with your distributor or the factory.



⚠ WARNING

To prevent death or serious injury:

- Avoid unsafe operation and maintenance.
- This crane must be operated and maintained by trained and experienced personnel. Manitowoc is not responsible for qualifying these personnel.
- Do not operate or work on this crane without first reading and understanding Operator's Manual and Rating Plate supplied with crane.
- Store Operator's Manual in holder provided on crane.
- Attach laminated Capacity Charts supplied with crane to chain in operator's cab.
- If Operator's Manual or Capacity Charts are missing from cab, contact your distributor for new ones.

Published 2-20-2007, Control # 101-00

1 2 3 4 5 6 7 8 9

SECTION 1
INTRODUCTION

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Table 1-2

Zone	Classification
A	Tropical Moist: All months average above 18° C. Latitude 15° - 25° North and South
B	Dry or Arid: Deficient precipitation most of the year. Latitude: 20° - 35° North and South
C	Moist Mid-Latitude: Temperature with mild winters. Latitude: 30° - 50° North & South
D	Moist Mid-latitude: Cold winters. Latitude 50° - 70° North & South
E	Polar: Extremely cold winters and summers. Latitude: 60° - 75° North & South

1. Visually inspect hoses and fittings once a month or every 250 hours for the following:
    - a. Leaks at hose fitting or in hose
    - b. Damaged, cut, or abraded cover
    - c. Exposed reinforcement
    - d. Kinked, crushed, flattened, or twisted hose
    - e. Hard, stiff, heat cracked, or charred hose
    - f. Blistered, soft, degraded, or loose cover
    - g. Cracked, damaged, or badly corroded fittings
    - h. Fitting slippage on hose
    - i. Other signs of significant deterioration

If any of the above conditions exist, evaluate hose assemblies for correction or replacement. For replacement of hose assemblies, refer to your Manitowoc CraneCARE Parts Manual.

2. At the same service interval, visually inspect all other hydraulic components and valves for the following:
    - a. Leaking Ports
    - b. Leaking valve sections or manifolds and valves installed into cylinders or onto motors.
    - c. Damaged or missing hose clamps, guard, or shields.
    - d. Excessive dirt and debris around the hose assemblies.

If any of these conditions exist, address them appropriately.

3. All hydraulic hose assemblies are recommended to be replaced after 8000 hours of service life.
4. Hydraulic hose assemblies operating in a temperature climate zone “C” (Table 1-2) are recommended to be replaced after 8000 hours of service life.
5. Hydraulic hose assemblies operating in climate zones “A” and “B” (Table 1-2) with high ambient temperatures, could see hose service life reduced by 40 to 50%, therefore, it is recommended to replace these hoses after 4000 to 5000 hours of service life.
6. Hydraulic hose assemblies operating in climate zones “D” and “E” (Table 1-2) cold climates should expect a degrade of mechanical properties such as elasticity, therefore, it is recommended these hoses be inspected and addressed accordingly.

Electrical System

Connectors, Harnesses, Wires, and Connectors

Visually inspect all electrical harnesses, cables, and connectors every month or 250 hours for the following:

- Damaged, cut, blistered, or cracked insulation.
- Exposed bare wires.
- Kinked or crushed wires and cables.
- Cracked or corroded connectors, battery terminals, and ground connections.

If any the above conditions exist, evaluate and replace as necessary.

The climate in which the crane operates affects the service life of the electrical components. The climate zones are defined in (Table 1-2). Recommended replacement of harness and cables is as follows:

- Climate zone C after 10,000 hours of service.
- Climate zones A and C with high ambient temperatures and duty cycles after 8000 hours of service.
- Climate zones D and E after 10,000 hours of service.
- Salt water conditions after 8,000 hours of service.

Fatigue of Welded Structures

Experience has shown that highly stressed welded structures when repeatedly subjected to varying stresses caused by twisting, shock, bending, and intentional and/or unintentional overloads, often become subject to weld cracking which may be attributed to fatigue of the welded joint. This condition is not uncommon in construction equipment.

Equipment should be periodically inspected for evidence of weld fatigue. The frequency of these inspections should be

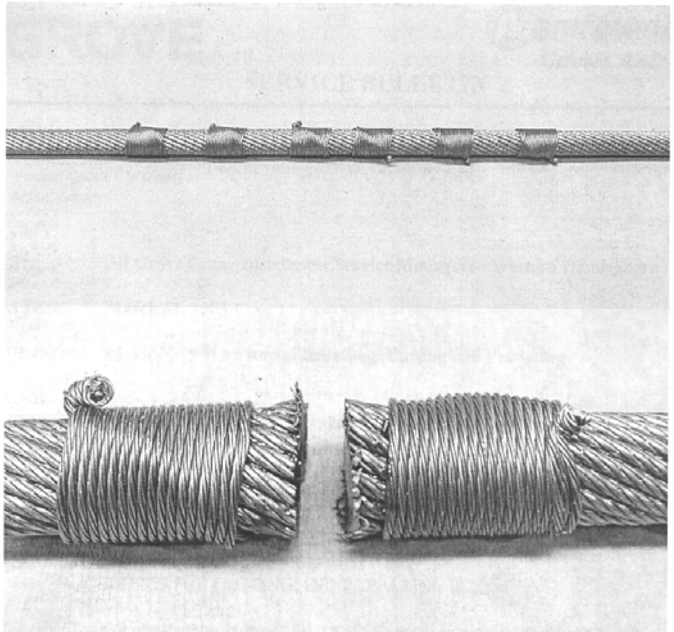

FIGURE 1-10

When hydraulic oils are changed, recheck the reservoir hydraulic oil level after brief system operation and add hydraulic oil as required. Working reservoir capacity (capacity to full mark) is 395.99 liters (104.6 U.S. gallons). Ensure the crane is level and in the travel mode of operation when the hydraulic system is being filled. The system must be filled with all cylinders retracted. Fill the reservoir to the full mark on the reservoir sight gauge. After the reservoir is filled, operate all circuits and recheck the reservoir sight gauge. Add hydraulic oil as required.

Removing Air from the Hydraulic System

Air entering the hydraulic oil will normally be removed automatically by passage of the hydraulic oil over the baffles in the hydraulic reservoir. If a component has been replaced, the reservoir level is too low, or a leak develops in the suction lines to the pumps, air can enter the system. If air becomes entrapped in the hydraulic oil, it may be detectable in pumps and motor operated components such as the swing mechanism and hoist(s), because it can cause these units to become noisy during operation. If noisy operation occurs, first check the level of the hydraulic reservoir and replenish as necessary. Then inspect for leaks in the suction lines leading to the pumps.

Minute leaks may be hard to locate. If a leak is not readily detectable, use the following way to check for it:

Seal all normal openings in the hydraulic system and the reservoir. Using a positive means to control the pressure (like a regulator), pressurize the hydraulic system to 13.8 to 27.6 kPa (0.14 to 0.28 bar) (2 to 4 psi) and inspect all joints and fittings for evidence of leaks. A soap solution applied to the fittings and joints may also prove helpful in detecting minute leaks while the system is pressurized. Remove the pressure, repair any leaks found, and reopen any openings (such as a vent) closed for inspection. Refill the reservoir after completing any repairs or service. Operate all hydraulic circuits several times in both directions.

This action should return any entrapped air to the reservoir where it can be removed from the hydraulic oil by the baffles.

DANGER

Tipping Hazard

To avoid death or serious injury, locate the machine on a firm supporting surface and position the boom over the front on outriggers when extending the boom at low angles.

To remove entrapped air from telescope cylinders, lower the boom to below horizontal and fully telescope the boom in and out several times.

If the air is not readily removed, lower the boom to below horizontal, extend the telescope cylinders as far as practicable, and allow the boom to remain in this position overnight. This should allow entrapped air to find its way to the holding valve so that telescoping the boom IN the next morning should force the air back to the reservoir. Ensure the boom is first telescoped IN (not OUT) in the morning. Telescoping OUT may cause air to be forced back into a cylinder.

DANGER

Pressurized fluid can cause serious injury or death. Extreme care must be used when removing any plugs or restrictions from a hydraulic system suspected to have entrapped air that may be pressurized.

Entrapped air may be removed from cylinders having wet rods by cycling. On certain cylinders, a plugged port is provided on the rod end to bleed off entrapped air.

DANGER

Pressurized fluid can cause serious injury or death. Do not attempt to loosen fittings in pressurized lines or while the hydraulic pumps are in operation.

In the event that air entrapment should persist, bleeding of air by loosening various clamp and screw type fittings may become necessary.

If the above procedures fail to eliminate air entrapment, contact your authorized Grove Distributor.

Parts Replacement

Parts found damaged or out of tolerance when maintenance is being performed should be replaced. Refer to the Manitowoc CraneCARE Parts Catalog for proper replacement parts.

Directional Control Valves

The control valves that control the crane functions are installed on the right side on the outside of the superstructure side plate, and between the left and right superstructure side plates under the main hoist.

Inspection

Inspect the control valves for visible damage, binding spools, and evidence of leakage. If excessive internal leakage is suspected during operation with a spool in its center position, it is possible that the area between the spool and working section bore of the valve body is worn beyond serviceable

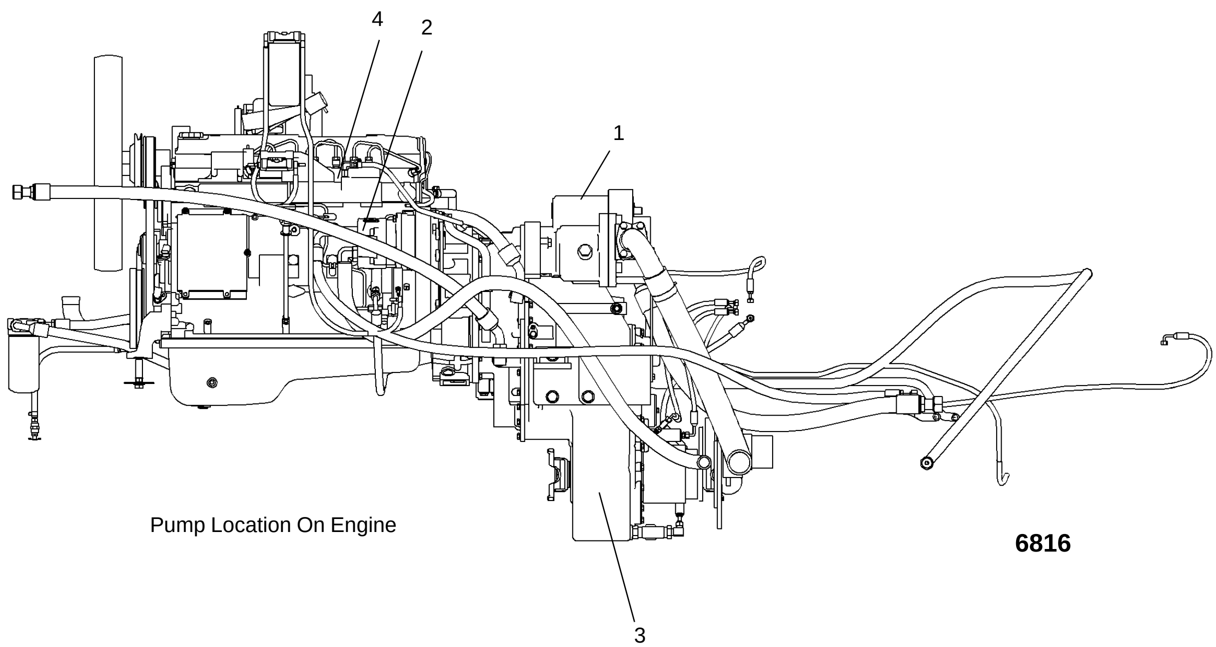

FIGURE 2-6

Item	Description
1	No. 1 - Piston Pump
2	No. 2 - Gear Pump

Item	Description
3	Transmission
4	Engine

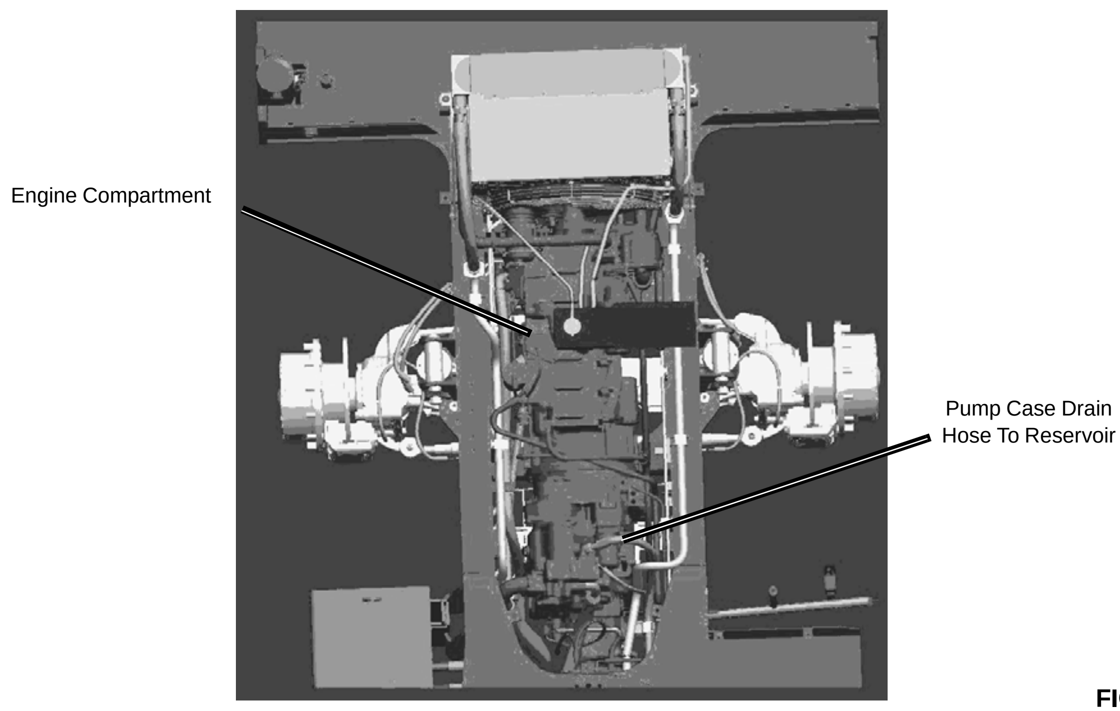

FIGURE 2-7

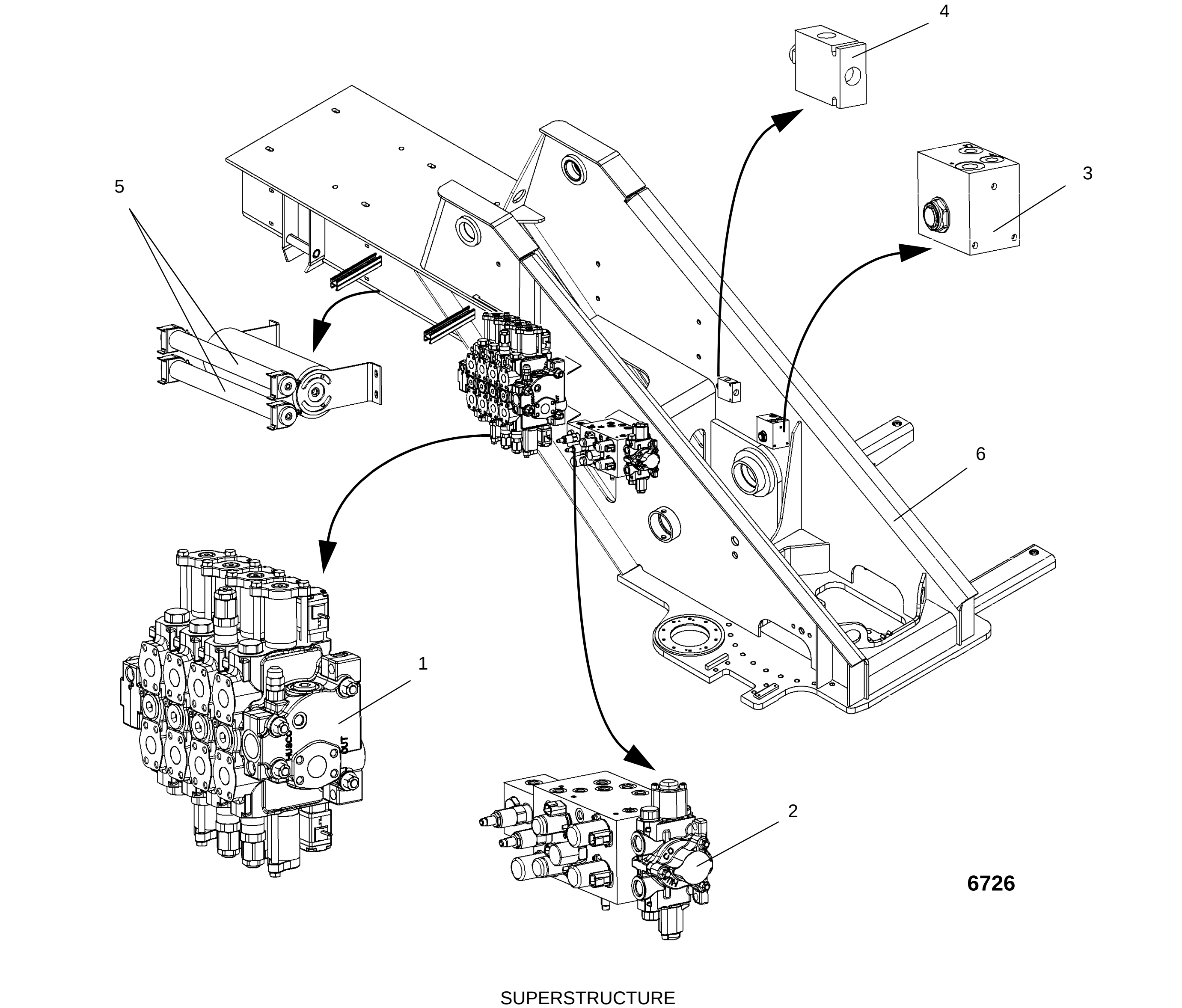

FIGURE 2-13

Item	Description
1	Hoist/Telescope/Lift Directional Valve
2	Swing/Steer Directional Valve
3	Service Brake Dual Accumulator Charge Valve

Item	Description
4	Secondary Steer Valve (CE Option)
5	Accumulator
6	Superstructure

DUAL ACCUMULATOR CHARGE VALVE

Description

The load sensing dual accumulator charging valve is located on the inside of the left superstructure side plate. The purpose of the valve is to provide pressure regulation to the service brake circuit.

The dual accumulator charge valve consists of an inlet main check valve, a load sense control section with a pilot spool that controls the pump stroke and an inverted shuttle that controls the accumulator charging (Figure 2-18).

When the valve is charging the accumulators, the load sense control section is in neutral position, connecting the load to the pump by way of the load sense line. This brings the piston pump No. 1 on stroke to supply fluid for charging. Fluid passes through the main check valve connecting to the pilot end and through the spool onward to the inverted shuttle that connects the accumulators.

When the control pilot spool bias spring senses the low limit pressure of 13,445 kPa/134 bar (1950 psi), the spool shifts to the neutral position, allowing the pump to charge the accumulators to a maximum of 16,202 kPa/162 bar (2350 psi). The inverted shuttle cartridge senses the pressure in the accumulators to pilot the cartridge closed when maximum charge pressure is reached. Maximum charge pressure also pilots the control pilot spool to open the load sense line to tank, destroking the piston pump No. 1.

Maintenance

Removal

1. Tag and disconnect the hydraulic hoses from the valve. Cap or plug the lines and ports.
2. Remove the capscrews, flatwashers and lockwashers securing the valve to the turntable. Remove the valve.

Installation

1. Position the valve on the turntable and secure with the capscrews, flatwashers, and lockwashers. Torque capscrews 10 to 11 Nm (7.4 to 8.11 pounds-foot).
2. Connect the hydraulic hoses to the valve ports as tagged during removal.
3. Start the engine and check for leaks. Make repairs as needed.
4. Depress the brake pedal several times to cause the brake valve to charge. Make several turns with the steering wheel, and swing the superstructure left and right. Verify the brakes, swing, and front steering work properly.

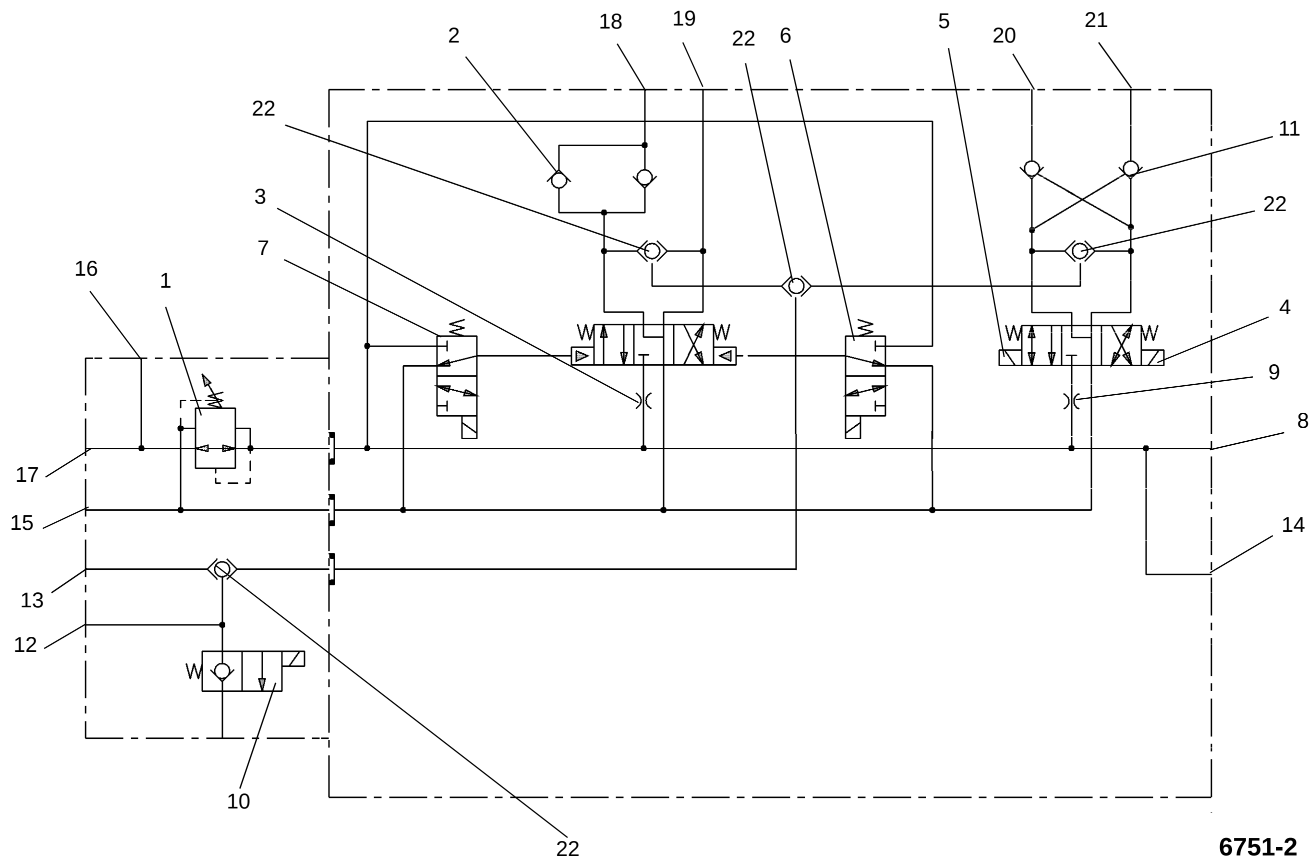

FIGURE 2-22 continued

Item	Description
1	Pressure Reducing Valve - PR1
2	Check Valve - CV1
3	Orifice - ORF1
4	Solenoid Valve - Rear Steer S1
5	Solenoid Valve - Rear Steer S2
6	Solenoid Valve - SV2
7	Solenoid Valve - SV1
8	Gauge Port - G2
9	Orifice - ORF2
10	Solenoid - SF1
11	Check Valve - CV4

Item	Description
12	Load Sense - LS0
13	Load Sense - LS1
14	Port ALO - To Axle Lockout Valve
15	Port T - Tank
16	Port G1 - Gauge Port
17	Port P - Pressure From Pump #1
18	Port A - Outrigger Retract
19	Port B - Outrigger Extend
20	Port RSA - Left Rear Steer
21	Port RSB - Right Rear Steer
22	Load Sense Shuttle valve

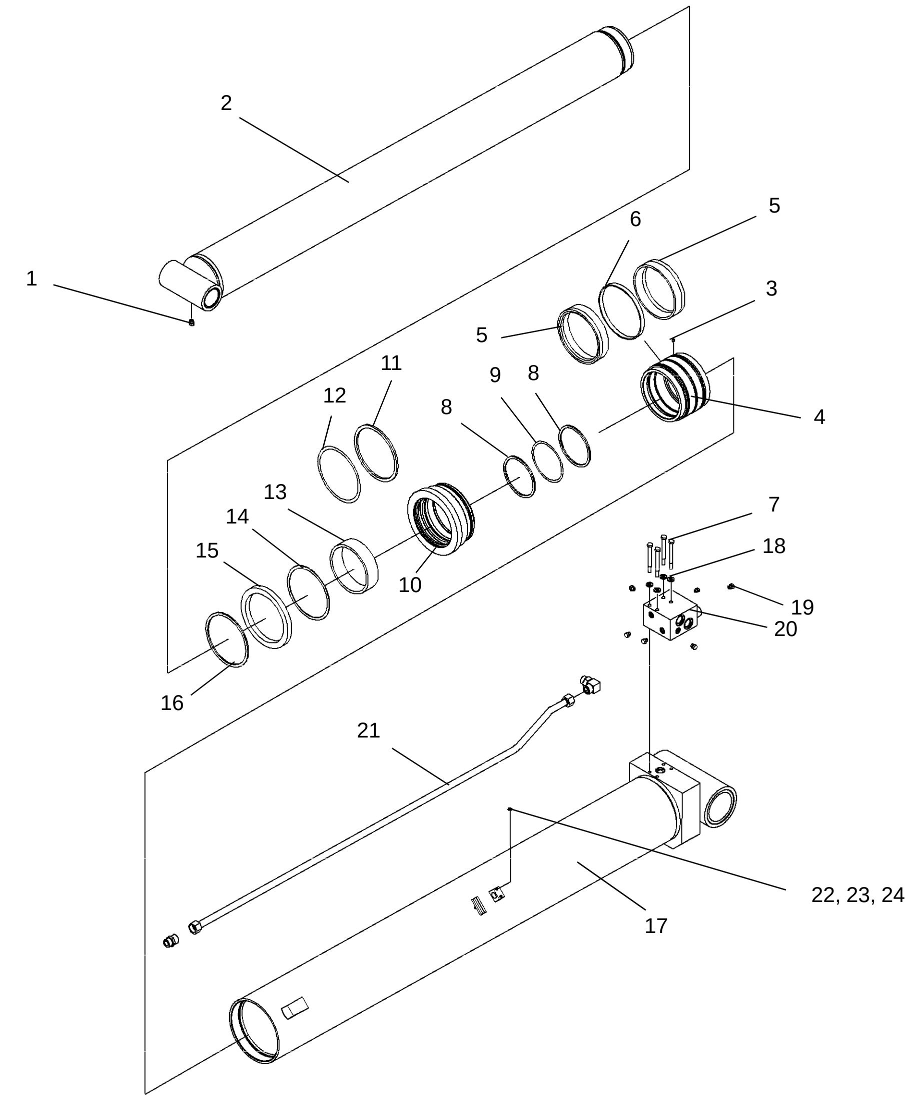

FIGURE 2-27

Item	Description
1	Grease Fitting
2	Rod
3	Setscrew
4	Piston
5	Seal Assembly
6	Guidelock Ring
7	Capscrew
8	Backup Ring
9	O-ring

Item	Description
10	Head
11	Backup Ring
12	O-ring
13	Wear Ring
14	Buffer Seal
15	Rod Seal
16	Wiper Ring
17	Barrel
18	Washer

STEER CYLINDER

Description

The steer cylinders (Figure 2-37) are mounted on the axles, two cylinders on each axle. The front and rear steer cylinders each have 6.3 cm (2.5 inch) diameter bores. The front and rear steer cylinders each have a retracted length of 53.1cm (20.94 inches) from bushing center to bushing center. The front and rear steer cylinders each have an extended length of 74.1cm (29.19 inches) from bushing center to bushing center. Each cylinder has a stroke of 20.9 cm (8.25 inches). A wiper ring prevents foreign material from entering each cylinder. O-rings and other seals prevent internal and external leakage.

The cylinder weighs approximately 9.07 kg (19.9 pounds).

Maintenance

Disassembly

NOTE: Any maintenance requiring disassembly of the cylinders should include replacement of all seals and rings. A seal kit will supply the required items.

1. Secure the cylinder in a clean work area by use of clamps or a chain vise to prevent rolling.
2. Retract the cylinder fully to avoid damaging the rod during removal.

NOTE: Mark or note the piston and head relationship to the rod and barrel.

3. Clean away all dirt from the head. Place protective padding around the rod near the head to prevent damaging the chrome during head removal.

DANGER

Do not use air pressure to remove the rod. Use only a source of controlled hydraulic oil pressure if the rod is hard to move.

CAUTION

Exercise extreme care when handling or setting down the rod. Damage to the rod surface may cause unnecessary maintenance and expense.

4. Position the rod mount with the ports facing down.
5. Using a means of collecting the oil, remove the port plugs and allow cylinder to drain.
6. Rapidly pull the rod against the head to free it. Remove rod and attached parts from the barrel. Place the rod on a surface that will not damage the chrome or allow the rod assembly to drop.

NOTE: Cover the barrel opening to avoid contamination.

CAUTION

When removing seals and rings, avoid scratching the grooved and gland surfaces.

7. Remove the seal from the outside of the piston.

NOTE: Arranging discarded seals and rings in the order of disassembly will aid in installation of new seals and rings. Pay attention to how each seal and ring is installed to avoid installing replacement seals and rings improperly.

8. Loosen and remove the nut securing the piston. Remove the piston from the rod.
9. Remove the O-ring from the inside of the piston.
10. Remove the head from the rod. Remove the O-ring and backup ring from the outside of the head. Remove the wiper ring and the rod seal from the inside of the head.

Inspection

1. Clean all parts with solvent and dry with compressed air. Inspect for damaged or worn parts and replace as required.

CAUTION

Clean all surfaces and remove all burrs and nicks before installing new seals and rings. Replace all damaged or worn parts.

2. Stone out minor blemishes and polish with fine crocus cloth.
3. Clean all with solvent and dry with compressed air any parts that have been stoned and polished.
4. Inspect the barrel for scoring.

Assembly

CAUTION

When installing new seals and rings, clean all surfaces and carefully remove burrs and nicks. Parts displaying excessive wear or damage should be replaced.

NOTE: Lubricate new seals and rings with clean hydraulic oil.

1. Install the replacement wiper ring into the head.
2. Install the rod seal in the inside of the head. Make sure the lips of the seal face the piston.

SECTION 3
ELECTRIC SYSTEM

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3. Inspect the wiper arm and parts of the linking component kits (pantograph adapter kit, pivot shaft kit, wiper motor kit link and crank, wiper motor bracket) for damage. Replace as needed.

Installation

1. Verify the pivot shaft and the wiper motor kit link and crank are in place on the motor bracket. (Washers and clip springs fasten the link to the pivot pins on the crank and the pivot shaft. The pivot shaft's pivot pin mounts in the hole nearest the end of the pivot shaft's lever.)
2. Connect the wiper motor to the motor bracket with screws and washers. Connect the wiper motor's shaft to the wiper motor kit crank with the nut and washer.
3. Secure the adapter and the gasket of the pantograph adapter kit to the cab exterior with capscrews and lockwashers.
4. Install the motor bracket and attached parts in the cab interior with attaching hardware. Ensure the pivot shaft sticks through the hole in the pantograph adapter kit.

NOTE: Take care not to damage any parts while moving the bracket and attached parts around the steering column.

5. Secure the pivot shaft to the pantograph adapter with the pivot shaft kit's nut and washers. Install the flanged sleeve on the pivot shaft.
6. Install the wiper arm on the shafts of the pantograph adapter kit and the pivot shaft kit. Secure the wiper arm to the pantograph adapter kit shaft with the kit's own washer and cap nut. Secure the wiper arm to the pivot shaft with the pivot shaft kit's own tapered sleeve, washer, and cap nut.
7. Connect the wiper arm's washer hose to the washer nozzle fitting assembly.
8. Connect the electrical leads to the wiper motor as marked before removal.
9. Connect the batteries.

Check

1. Squirt some cleaning fluid onto the windshield with the windshield washer.
2. Operate the windshield wiper. Verify it works. (Replace wiper blade as needed if it streaks or otherwise wipes poorly.)

Windshield Washer Assembly Replacement

Removal

1. Disconnect the batteries.
2. Locate the windshield washer container and pump on the left rear side of the cab.
3. Tag and disconnect the pump's electrical lead and ground wire.
4. Disconnect the hose from the windshield washer pump. Point it so it won't spill cleaning fluid. Catch cleaning fluid from the windshield washer container with a suitable container.
5. Remove four self tapping screws securing the windshield washer container to the cab. Remove the windshield washer container and pump.
6. Remove pump and pump seal from container.

Inspection

1. Visually check the pump for evidence of cracks, leaks, or other damage. Replace pump if damaged.
2. Inspect the container for leaking. Replace pump seal if it is leaking. Replace container if it is damaged and leaking.
3. Inspect spray nozzle on the wiper arm. As needed, clean the nozzle with a fine piece of wire and compressed air.

Installation

1. Install pump and pump seal on container.
2. Install windshield washer container on the cab. Secure the container with four self tapping screws.
3. Attach the hose to the windshield washer pump.
4. Connect the pump's electrical lead and ground wire as tagged during removal.
5. Connect the batteries.
6. Fill the container with cleaning fluid.

Check

1. Squirt some cleaning fluid onto the windshield with the windshield washer.
2. Make repairs if windshield washer doesn't work.

Skylight Wiper Assembly Replacement

Removal

1. Disconnect the batteries.
2. Tag and disconnect the electrical leads from the motor.

enough to gain access to the top rear adjustable wear pads on the inner mid (2). (Figure 4-11)

FIGURE 4-11

2. Remove the bolt (1), washer, and offset washer securing each top rear adjustable wear pad and remove the wear pads, keeper plates and bolts (2) from the top of the inner mid. Note location of wear pads and shims for installation. (Figure 4-12)

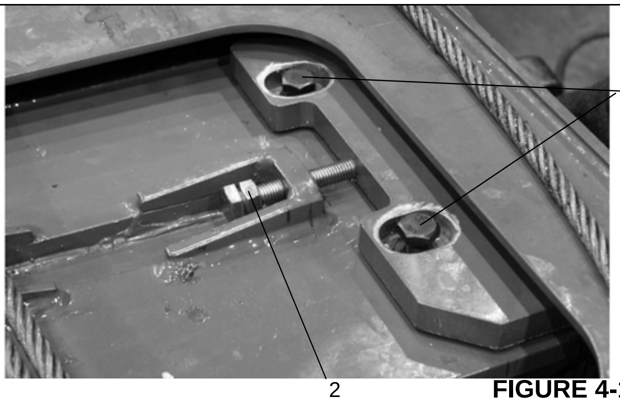

FIGURE 4-12

3. On the top front of the base section, remove the two bolts securing each kicker plate and remove the plates.
4. Remove the bolts securing the outer mid retract cable anchor plates to the lower front of the base section. Remove the cable locknuts and the anchor plates from the cables.
5. Remove the two screws securing each top and bottom side wear pads at the front of the base section. Remove wear pads, shims, and mounting anglen (top left side only).
6. Attach a suitable lifting device to the Fly/Outer/Inner Mid assembly. Raise the front of the assembly slightly and remove the wear pads from the pockets in the bottom of the base section.
7. Continue to pull the assembly until it is clear of the base section.

NOTE: Be sure to pull the cables out with the assembly to prevent them from becoming damaged.

8. Place base section in a secure location

Disconnect the Inner Mid Section

Do not attempt to work on the boom without experienced supervision.

DANGER

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

4

1. At the bottom rear of the inner mid, remove the bolt and cable retainer bushing from the rear of each retract cable sheave assembly (1). (Figure 4-13)
2. On both sides, remove the bolts securing each retract sheave assembly shaft weldment. Remove the shaft, spacer bushing, sheave assembly, and thrust washers.If necessary, remove the grease fitting from the shaft weldments.

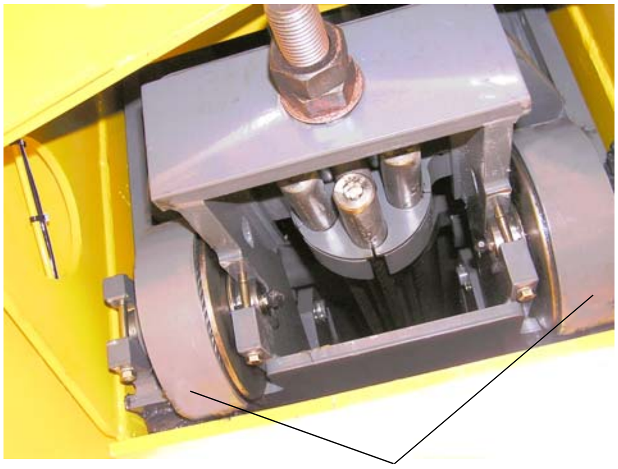

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FIGURE 4-13

3. Remove the two bolts and washers securing the cylinder inner rod (1) to the rear of the inner mid (2). (Figure 4-14)

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FIGURE 4-39

Install the Outer Mid Section

Do not attempt to work on the boom without experienced supervision.

DANGER

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

NOTE: Before the fly section is installed the center point of the fly section must be determined. Measurement from this center point will be used to properly set the adjustable wear pads

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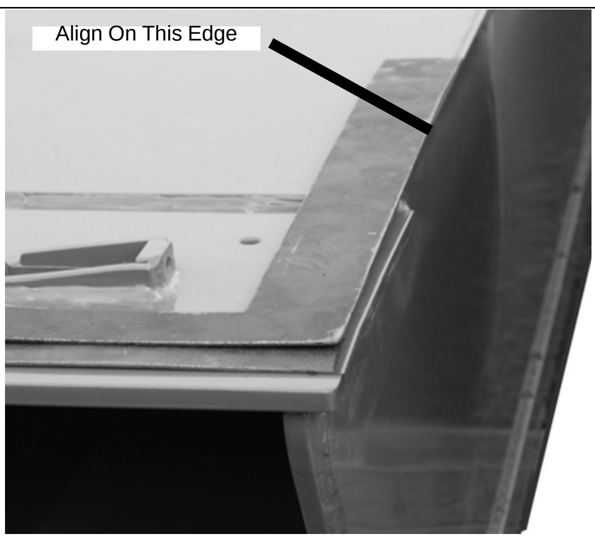

FIGURE 4-40

1. Align two straight edge tools with the **outer edge of the Fly Section** at the rear of the section (not the wear pad adjustment weldment). The tools should extend past the wear pad adjustments (Figure 4-40).
   - **a.** Measure and note the total width of the boom section.
   - **b.** Using the measurement obtained determine the center point of the boom section and clearly mark it (Figure 4-41).

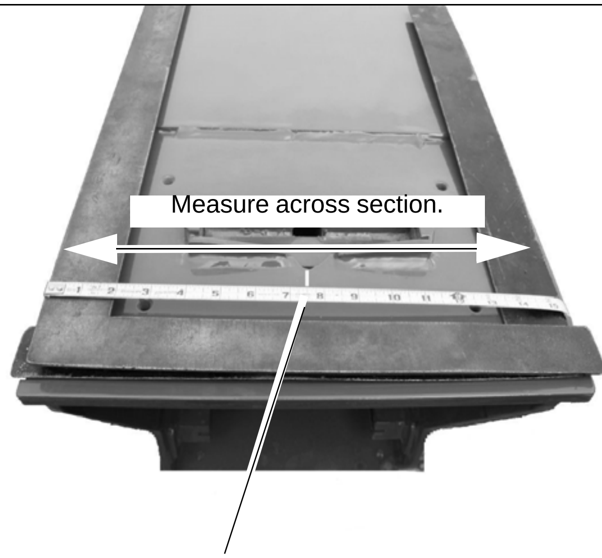

FIGURE 4-41

2. Install the lower brass wear pads. Back out the adjustment set screw so the pad seats fully into the pocket. The pad should extend no more than 1/8 of an inch into the boom section for the initial installation. (Figure 4-42)

NOTE: Use grease to aid in holding the wear pad in place.

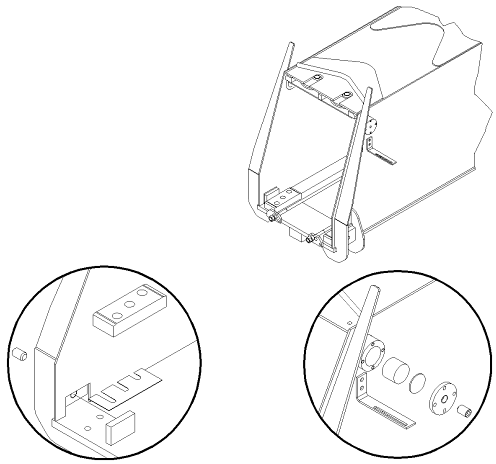

FIGURE 4-42

FIGURE 4-75

35. Turn Telescopic Cylinder port block so that the test port is down (Figure 4-76).

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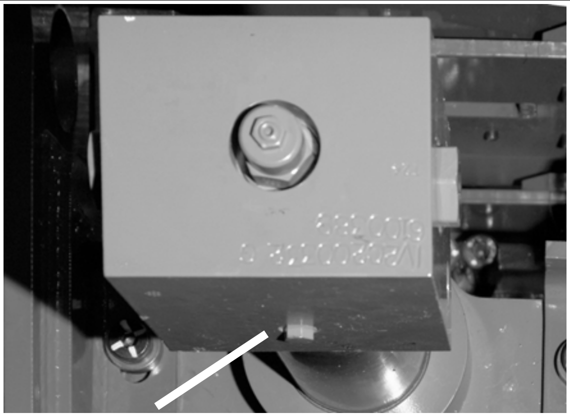
CAUTION

Failure to properly position the port block will cause problems when mounting the boom on the crane. The crane hydraulic system will not function properly if the port block in installed incorrectly.



Test Port

FIGURE 4-76

Install the Base Section

Do not attempt to work on the boom without experienced supervision.

DANGER

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

1. Insert Inner mid section into the base section until the section is past the side wear pad access and stop.

2. Install lower front wear pads between sections.

NOTE: Use grease to hold wear pads in place during assembly.

3. Install wear pad thru access hole in side of the base and slide inner mid past wear pad and install lock plate.

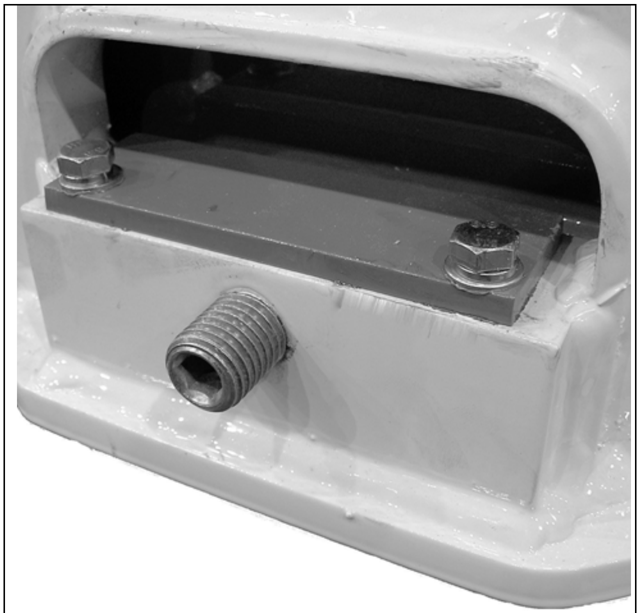


FIGURE 4-77

4. Connect the Mid Retract cables to front end of base.

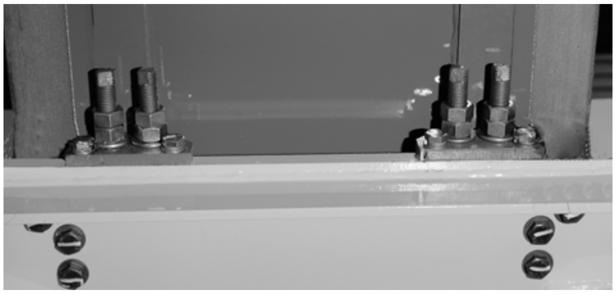


FIGURE 4-78

5. Install kickback bar between the inner mid section and the base section (top front of base).

6. Install top wear pad adjusting assembly inside base at top rear access opening.

Symptom	Probable Cause	Solution
3. Boom raises slowly.	**a.** Low hydraulic oil level.	**a.** Replenish hydraulic oil to proper level.
	b. Low engine rpm.	**b.** Increase and maintain engine rpm.
	c. Damaged relief valve.	**c.** Repair or replace relief valve.
	d. Extremely cold hydraulic oil.	**d.** Operate unit to bring oil to operating temperature.
	e. Improper hose or fittings, installed.	**e.** Replace hose or fittings. (Refer to Manitowoc CraneCARE Parts Manual).
	f. Operating two functions with in the same control valve bank assembly.	**f.** Feather controls to obtain desired speed of both functions.
	g. Restriction in return hose.	**g.** Replace return hose.
	h. Cylinder piston seals leaking.	**h.** Replace all cylinder seals.
	i. Scored cylinder barrel.	**i.** Hone or replace barrel.
	j. Worn hydraulic pump section.	**j.** Repair or replace pump section.
4. Boom lowers slowly.	**a.** Low hydraulic oil level.	**a.** Replenish hydraulic oil to proper level.
	b. Low engine rpm.	**b.** Increase rpm to recommended level.
	c. Damaged relief valve.	**c.** Repair or replace relief valve.
	d. Operating two functions within the same control valve bank assembly.	**d.** Feather controls to obtain desired speed of both functions.
	e. Extremely cold hydraulic oil.	**e.** Operate unit to bring oil to operating temperature.
	f. Improper hose or fittings installed.	**f.** Replace hose or fittings. (Refer to Manitowoc CraneCARE Parts Manual).
	g. Restriction in return hose.	**g.** Replace return hose.
	h. Cylinder piston seals worn.	**h.** Replace all cylinder seals.
	i. Scored cylinder barrel.	**i.** Hone or replace barrel.
Boom lowers slowly. (Continued)	**j.** Worn hydraulic pump section.	**j.** Repair or replace pump section.
	k. Piston rod broken (loose from piston).	**k.** Replace piston rod and all cylinder seals.
5. Boom will not raise.	**a.** Low hydraulic oil.	**a.** Replenish hydraulic oil to proper level.
	b. Main relief valve or circuit relief valve damaged.	**b.** Repair or replace relief valve.
	c. Excessive load.	**c.** Reduce load as required.
	d. Worn or damaged hydraulic pump section.	**d.** Repair or replace pump section.
	e. Broken pump shaft.	**e.** Replace pump shaft and seals.
	f. Broken pump drive coupling.	**f.** Replace drive coupling.
	g. Broken control valve spool.	**g.** Replace control valve.

PISTON MOTOR AND CONTROL VALVE

Description

The piston motor is a bent axis, bidirectional, variable displacement heavy-duty motor. The motor is bolted to the hoist and is geared directly to the hoist planetary.

The motor control valve is bolted to the motor.

Maintenance

Removal

1. Thoroughly clean the external surfaces of the drum and motor with steam or clean solvent and blow dry.
2. Tag and disconnect the hydraulic lines connected to the hoist motor and the motor control valve.
3. Remove the capscrews and lockwashers that secures the motor and motor control valve to the hoist.
4. Place the motor and motor control valve in a clean, dry suitable work area.

Installation

NOTE: Care must be taken to assure the primary thrust plate remains properly located in its counterbore when the motor is re-installed. If the winch is operated with the primary thrust plate wedged between the primary gears and the planet carrier, or with a thrust washer out of position severe damage to internal winch components could result.

1. Install a new O-ring on the motor pilot then lubricate with petroleum jelly or gear oil. Engage the motor shaft with the brake clutch inner race and lower into place.
2. Apply Loctite No. 242 to the mounting bolts, and install the bolts and lockwashers. Torque the bolts to 102 Nm (75 pounds-foot).
3. Connect the hydraulic lines as tagged during removal.
4. Fill the drum with oil. Refer to Section 9 - LUBRICATION in this manual.

SECTION 6
SWING SYSTEM

INTRODUCTION

Description

The purpose of the swing system is to allow the crane superstructure to rotate atop the carrier frame. The superstructure swing system provides full 360 degree rotation in both directions and is equipped with free swing capabilities. The term free swing means that, with the SWING BRAKE switch in the OFF position, the superstructure will swing freely after the SWING control lever is released until it coasts to a stop or the glide swing brake pedal is depressed.

Swing is activated using the control lever in the cab. When the swing lever is actuated, hydraulic pressure is routed to the swing motor to drive the gearbox in the appropriate direction. As the gearbox rotates, the pinion gear meshes with the teeth on the swing bearing and rotates the superstructure. Swing speed can be controlled by the control lever and a HIGH/LOW swing speed switch on the front console. The maximum rotation speed is 2.0 - 2.5 rpm with no load. Braking is accomplished by depressing a glide swing brake pedal which is a proportionate control valve that provides a controlled braking of the swing motion.

The swing system consists of a hydraulic remote controller, swing speed switch, a directional control valve, the swing drive, the swing brake assembly, the brake pedal and power brake valve, and a swing brake release solenoid valve.

The crane is equipped with a pin type turntable lock as standard and a 360 degree positive swing lock. The 360 degree positive swing lock meshes with the swing gear teeth at any point of rotation. The pin type turntable lock will only lock the turntable in a straight ahead position over the front of machine. Both swing locks are operated from the cab.

Theory of Operation

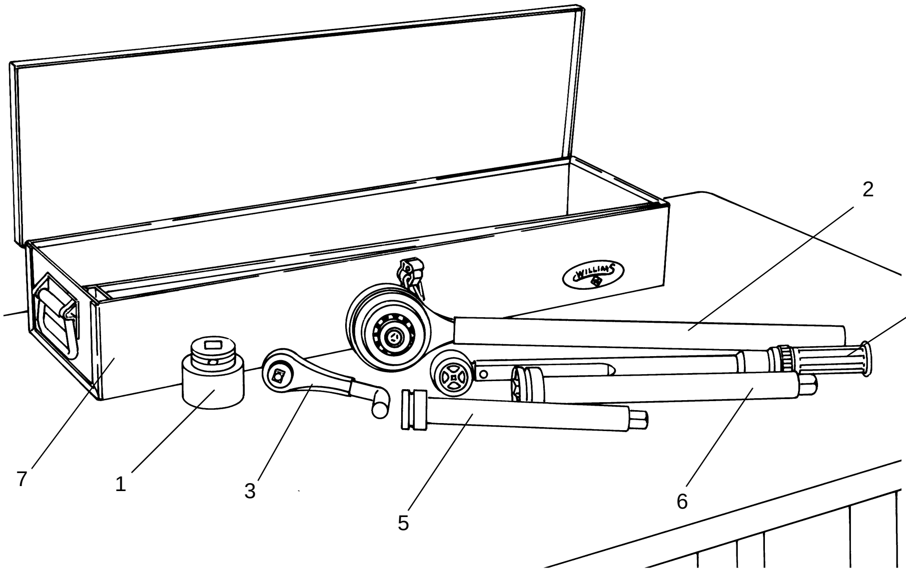
Swing Drive

The hydraulic power for the swing drive (Figure 6-1) is supplied by the engine driven hydraulic pump. Oil flows from the pump to the hydraulic Port 5 swivel. Flow from the swivel is routed to the service brake dual accumulator charge valve. Bypass flow from the dual accumulator charge valve is routed to the front steering flow divider valve in the swing directional control valve. Bypass flow from the flow divider valve is used to supply the swing directional control valve.

When the hydraulic remote control is positioned to select right or left swing, the flow through the control valve is directed to the swing motor. If the SWING BRAKE selector switch is in the OFF position, the superstructure will rotate in the desired direction. Shifting the control to neutral and depressing the brake pedal will stop the swing.

Swing Brake

The hydraulic power for the swing brake is supplied by the pressure reducing/sequence valve in the swing brake and armrest lockout manifold. With the SWING BRAKE selector switch positioned to ON, the swing brake release valve blocks the regulated flow to the brake release port and spring pressure in the swing brake applies the brake. When the SWING BRAKE selector switch is positioned to OFF, the regulated flow is directed from the pressure reducing/sequence valve to the brake release port, overcoming the brake spring pressure and releasing the swing brake. Regulated flow from the pressure reducing/sequence valve is also provided to the power brake valve where it is available for the activation of the swing brake when the pedal is depressed.



Orders for special tools shall be referred to:

Manitowoc/Grove CraneCARE
1565 Buchanan Trail East
Shady Grove, PA 17256-0021
Phone: (717) 597-8121
Fax: (717) 593-5929

	Description	Grove Part Number	Quantity Required
1.	1 1/2” Socket 3/4” Drive	9-999-100143	1
2.	4 to 1 Torque Multiplier (1/2” Input 3/4” Output)	9-999-100134	1
3.	Backlash Adapter	9-999-100141	1
4.	1/2” Drive Torque Wrench	9-999-100136	1
5.	10” Extension 3/4” Drive	9-999-100138	A/R
6.	13” Extension 3/4” Drive	9-999-100137	A/R
7.	Tool Box (Optional)	9-999-100146	1

Special Turntable Bolt Torquing Tools

FIGURE 6-3

Removal

1. Fully extend and set the outriggers enough to take up the slack in the pads.

NOTE: Do not raise the machine on the outriggers.

2. Ensure the boom is in the travel position and the turntable lock pin is engaged.

3. Elevate the boom slightly and shut down the engine.

4. Tag and disconnect the battery cables from the batteries.

NOTE: The boom assembly weighs approximately 5792 kg (12,769 pounds) with stowed boom extension. Removal of the swingaway boom extension will simplify boom removal, therefore, the above weight is for the boom without the swingaway boom extension attached. The lift cylinder weighs approximately 578 kg (1274 pounds).

5. Remove the boom and lift cylinder following the procedures outlined in Section 4, BOOM.

NOTE: The counterweight/auxiliary hoist and structure weighs approximately 4841 kg (10,672 pounds).

6. Remove the counterweight and auxiliary hoist following procedures outlined in Section 5 - HOIST and COUNTERWEIGHT.

7. Tag and disconnect all water and oil lines from the bottom of the swivel. Cap or plug all lines and openings.

8. Locate the connectors and ground wire that joins the swivel wiring harness to the receptacles and ground stud on the carrier.

9. Disconnect the swivel wiring harness connectors from the carrier wiring receptacles. Remove the ground wire from the ground stud.

10. Remove the clamp securing the swivel wiring harness to the retainer plate on the bottom of the hydraulic swivel assembly.

11. Coil the wiring harness and secure it to the swivel to prevent damage to the harness during turntable removal.

12. On the bottom of the hydraulic swivel, bend the retainer tabs away from the capscrew heads. Remove the capscrews securing the two retainer plates to the spool.

SECTION 7
POWER TRAIN

TABLE OF CONTENTS

7

AIR INTAKE SYSTEM

Description

The engine air intake system consists of an air cleaner and associated piping for channelling the air from the atmosphere to the engine turbocharger intake.

The air cleaner is the dry-type with a replaceable element and is located on the left rear fender assembly. A service indicator, designed to indicate red when servicing is required, is installed at the air cleaner outlet.

On the Cummins QSB6.7 engine there are electric air heating elements that are located in the engine's intake air stream. These elements heat the intake air when starting the engine in cold ambient conditions. Startability and white smoke control are enhanced by the use of an intake air heater. A WAIT-TO-START lamp is located on the center front console to indicate when to crank the engine.

Maintenance

Air Cleaner Checks

Dust passing the air cleaner can cause rapid engine wear. All connections between the air cleaner and the engine must be tight and sealed. If these connections are well sealed, and there is still evidence of dust leakage, check the following places for possible trouble (Figure 7-4).

NOTE: Dust that gets by the air cleaner system can often be detected by looking for dust streaks on the air transfer tubing or just inside the intake manifold inlet.

1. Inspect the air cleaner outlet tube for damage.
2. Ensure the element gasket washer is not damaged and the washer's rubber face seals against the element.
3. Inspect the element gasket for damage.
4. Check for structural failures and replace damaged parts.
5. Inspect the restriction indicator tap for leaks.

Check For Filter Restriction

As a dry cleaner element becomes loaded with dust, the vacuum on the engine side of the air cleaner (at the air cleaner outlet) increases.

The vacuum is generally measured as restriction in kilopascals or inches of water. The engine manufacturer places a recommended limit on the amount of restriction the engine will stand without loss in performance before the element must be cleaned or replaced. Cummins allows a vacuum of 6.2 kPa (25 inches of water) maximum with a dirty air cleaner at maximum governed RPM.

A service indicator on the air cleaner housing will indicate when the filter needs to be cleaned or replaced. Reset the indicator each time the air cleaner is serviced. If the indicator's accuracy is suspect, a water manometer is the most accurate and dependable method of measuring vacuum.

To use the manometer, hold it vertically and fill both legs approximately half full with water. One of the upper ends is connected to the restriction tap on the outlet side of the air cleaner by means of a flexible hose. The other end is left open to the atmosphere.

Maximum restriction in the air cleaner occurs at maximum air flow. On this turbocharged diesel engine, the maximum air flow occurs only at maximum engine power.

With the manometer held vertically and the engine drawing maximum air, the difference in the height of the water columns in the two legs, measured in inches or centimeters, is the air cleaner restriction. Restriction indicators are generally marked with the restriction at which the red signal flag locks up.

If the initial restriction on a new or clean filter reads above the maximum allowed for the engine, check the following items.:

1. Ensure the air cleaner inlet is not plugged.
2. Inspect the air cleaner outlet to be sure it is not plugged by paper, rags, etc.
3. Ensure the correct size connections are used between the air cleaner and the engine.
4. Ensure all inlet accessories are the correct size and are not plugged by any foreign object.

DRIVE TRAIN

Description

The drive train consists of the transmission/torque converter assembly and three drive lines.

The transmission/torque converter is mounted on and driven by the engine. The torque converter assembly provides for mounting and driving the pumps. The transmission is a powershift with six forward speeds and six reverse speeds. The transmission is controlled electrically by a shift lever/knob located on the right side of the steering column and an axle drive mode selector rocker switch located on the left side of the front console.

The transmission/torque converter oil is cooled by passing the oil through an externally mounted transmission cooler. The cooler is part of the radiator. An oil filter is located on the left side of the frame bottom rail.

Three drive lines are used. Two drive lines are connected between the transmission/torque converter and the front axle and the other drive line is connected between the transmission/torque converter and the rear axle.

Maintenance

Drive Lines

CAUTION

Do not disassemble drive lines when removing them from the crane. Dirt can enter the spline and cannot be purged. In addition, the drive lines are assembled in a specific orientation when manufactured and can easily be incorrectly reassembled.

Removal

1. Support the drive line being removed so it does not fall when disconnected.
2. Remove the bolts from the bearing cap on each end of the drive line.
3. Remove the drive line.

Installation

1. Position the drive line, install the bearing cap bolts and tighten bolts securely.
2. Torque the inboard bearing cap bolts on the drive line to 85 to 112 Nm (63 to 83 pounds-foot) and outboard bearing caps to 122 to 149 Nm (90 to 110 pounds-foot).

Lubrication

The drive line slip joints require lubrication. Refer to Section 9 - Lubrication.

Transmission/Torque Converter

Description

The transmission/torque converter assembly is mounted to the engine and is connected to the front and rear axles by two drive shafts. The main hydraulic pump is mounted on the torque converter.

Theory of Operation

The transmission and torque converter function together and operate through a common hydraulic system. Therefore, it is necessary to consider both units in discussing operation.

With the engine running, the converter charging pump draws oil from the transmission sump through the removable oil suction screen and directs it through the pressure regulating valve and oil filter.

The pressure regulating valve maintains pressure to the transmission control for actuating the direction and speed clutches. This requires a small portion of the total volume of oil used in this system. The remaining volume of oil is directed through the torque converter circuit to the oil cooler and returns to the transmission for positive lubrication. This regulator valve consists of a hardened valve spool operating in a closely fitted bore. The valve spool is spring loaded to hold the valve in a closed position. When a specific pressure is achieved, the valve spool works against the spring until a port is exposed along the side of the bore. This sequence of events provides the proper system pressure.

After entering the converter housing, the oil is directed through the reaction member support to the converter blade cavity and exits in the passage between the turbine shaft and reaction member support. The oil then flows out of the converter to the oil cooler. After leaving the cooler, the oil is directed to a fitting on the transmission. Then, through a series of tubes and passages, lubricates the transmission bearings and clutches. The oil then gravity drains to the transmission sump.

The torque converter consists basically of three elements and their related parts to multiply engine torque. The engine power is transmitted from the engine flywheel to the impeller element through the impeller cover. This element is the pump portion of the hydraulic torque converter and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump, in that it picks up fluid at its center and discharges at its outer diameter.

The torque converter turbine is mounted opposite the impeller and is connected to the output shaft of the torque converter. This element receives fluid at its outer diameter and discharges at its center. Fluid directed by the impeller out into the particular design of blading in the turbine and

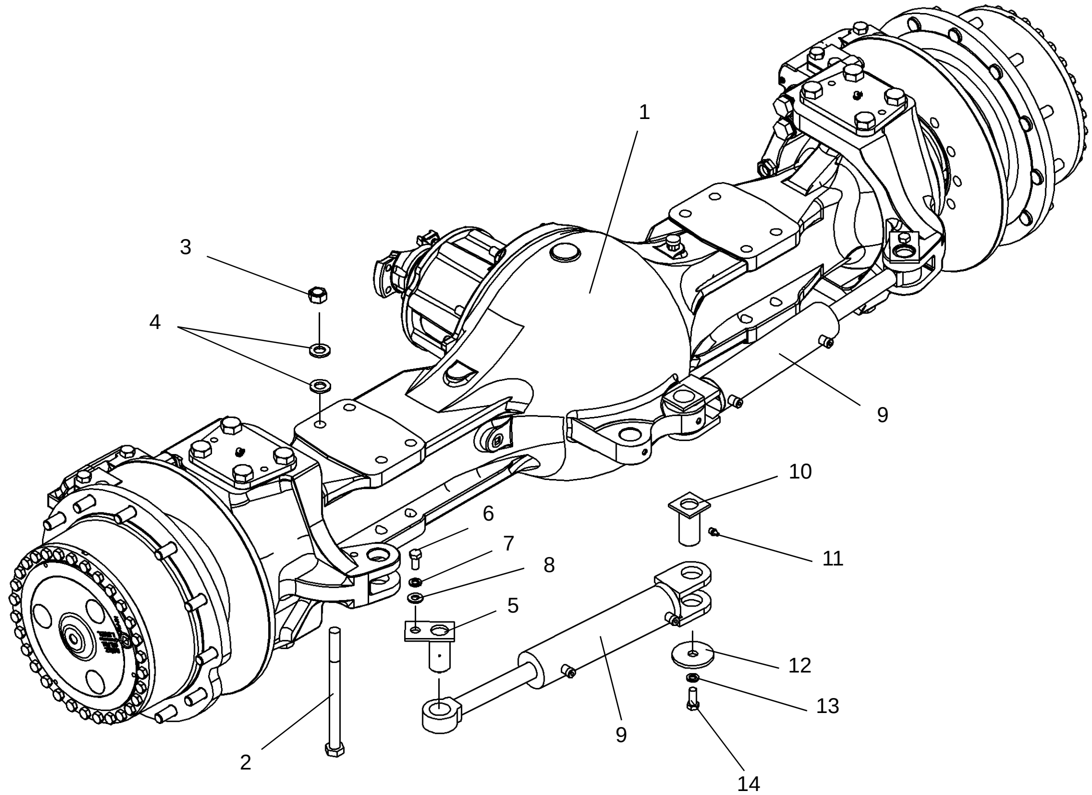


FIGURE 8-2

Item	Description
1	Front Axle
2	Capscrew
3	Hex Nut
4	Washer
5	Pin Weld
6	Capscrew
7	Lockwasher

Item	Description
8	Flatwasher
9	Steer Cylinder
10	Pin Weld
11	Grease Fitting
12	Flatwasher
13	Lockwasher
14	Capscrew

BRAKE SYSTEM

Description

The brake system includes all the components necessary for the application of the service brakes and the parking brake.

Service Brakes

The service brakes are full power hydraulic disc brakes which are hydraulically controlled and are used to apply the brake assemblies on all four wheels. The system consists of the tandem brake valve with treadle pedal, the dual accumulator charge valve, two hydraulic accumulators, the brake assemblies, and all the associated hoses and tubing. The operator depresses the pedal on the tandem brake valve, located on the cab floor, and the valve modulates the brake line pressure to the brake assemblies at each wheel. The full powered brake system supplies a high brake system pressure with relatively low reactive pedal forces, while controlling the maximum brake line pressure. The service brake dual accumulator charge valve regulates flow to the hydraulic accumulators to provide fully powered independently separate, primary (front) and secondary (rear), service brake circuits. Hydraulic pressure is constantly maintained in the brake circuits by the accumulators and the charging valve.

Parking Brake

The parking brake is a hydraulic release, spring apply, disc-type brake, located on the transmission. The system consists of a two-position switch, a three-way solenoid valve, actuator, two brake assemblies, and all the associated hardware and tubing. The selector switch, located on the front console in the cab, is used to activate the solenoid valve which controls the park brake actuator, which applies and releases the park brake.

NOTE: For Description and Maintenance of the tandem brake valve with treadle pedal, the accumulators, and the dual accumulator charge valve, refer to VALVES in Section 2 - HYDRAULIC and PRESSURE SETTINGS.

Theory of Operation

Service Brakes

Braking begins when the operator depresses the brake pedal in the cab. Mechanical linkage transfers the force created by the lever action of the brake pedal to the hydraulic brake valve which modulates the brake line pressure to the brake assemblies at each wheel.

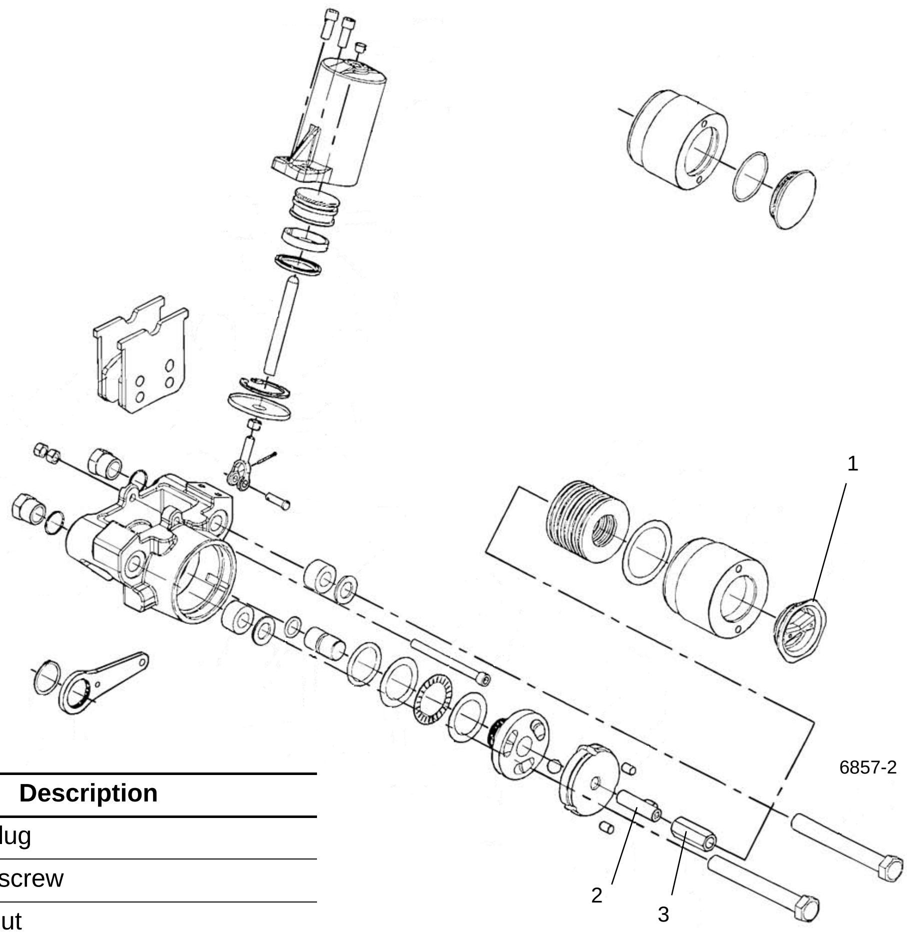
Hydraulic oil from hydraulic pump number 2 flows to swivel port 9 to the dual accumulator charge valve. The dual accumulator charge valve charges the accumulators from the open center circuit upon demand and within its present operating charge rate and the high limit pressure setting. However, when the open center circuit pressure reaches the brake relief setting, which is higher than the high accumulator charge limit, then the accumulators will be charged to the regulated maximum pressure setting. The dual accumulator charge valve regulates flow to the hydraulic accumulators to provide fully powered independently separate, primary (front) and secondary (rear), service brake circuits. Hydraulic pressure is constantly maintained in the brake circuits by the accumulators and the charging valve. The charged accumulators supply pressurized fluid to the closed tandem brake valve.

After the accumulators are fully charged, the high limit check opens and all of the pump flow is directed to the excess flow port and on to the front steer and swing circuits. When pressure to the steering or swing circuit becomes greater than accumulator pressure, the main check valve opens and charges the accumulator without the aid of the charging valve. In this condition, the maximum accumulator pressure is the brake circuit relief valve setting of 20 MPa (2900 psi).

Once the operator depresses the brake pedal, the tandem brake valve modulates fluid out to the brakes to provide the means of braking. The tandem brake valve will modulate the pressure in the brake system by increasing or decreasing pressure as required in proportion to the input force from the operator via the brake pedal. The hydraulic force acts within the brake assemblies to force the brake pads against the brake discs, acting to slow wheel rotation. Fully powered separate primary (front) and secondary (rear) braking circuits are provided with independent accumulators. A low pressure warning switch is used to sense the accumulator pressures and warn the operator through visual brake warning indicator light on the cab console in the event the pressure in the accumulators drops to an unsafe operating level. In the event of engine failure, the accumulators are pre-charged with dry nitrogen gas and properly sized to provide power-off stopping capacity for secondary braking.

Parking Brake

Hydraulic flow from the transmission charge pump is routed to the parking brake control valve. When the PARK BRAKE switch is in the ON position, the parking brake solenoid valve shifts to route flow from the hydraulic parking brake actuator back to the transmission sump. The actuator spring pulls on the lever on the brake assembly, applying the parking brake.



Item	Description
1	Screw-in Plug
2	Socket Setscrew
3	Coupling Nut

FIGURE 8-21

PARK BRAKE VALVE

Description

The range shift/parking brake valve controls the flow of oil to the parking brake, hi-low range and axle disconnect actuators by the use of two solenoid valves. The valve is located on the center of the frame. Pressure is supplied to the valve from the transmission charge pump.

The parking brake solenoid valve is a two position three-way valve. In its de-energized position, the inlet port is blocked and the parking brake actuator is drained to the reservoir. When the solenoid is energized, the reservoir port is blocked and pressurized oil is directed to the actuator, engaging the parking brake.

The range shift solenoid valve is a two position four-way valve. In its de-energized position, pressurized oil flows to the “A” port of the range shift actuator, while the “B” port is drained to the reservoir along with the axle disconnect actuator for two wheel drive/high range. When the solenoid is energized, pressurized oil is directed to the “B” port of the range shift actuator and the axle disconnect actuator while port “A” of the range shift actuator is drained to the reservoir for four wheel drive/low range.

Removal

1. Tag and disconnect the electrical connectors to the valve.
2. Tag and disconnect the hydraulic hoses from the valve. Cap or plug the lines and ports.
3. Remove the capscrews, lockwashers, flatwashers and nuts securing the valve to the frame. Remove the valve.

Installation

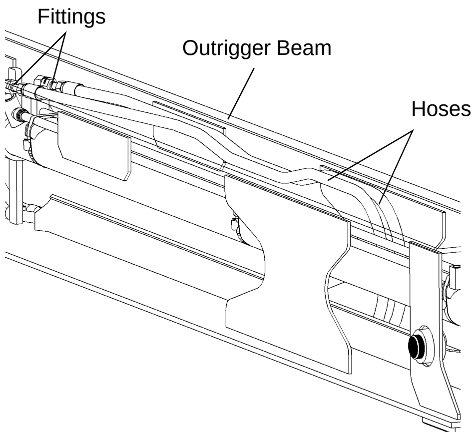
1. Secure the valve to the frame with the nuts, flatwashers, lockwashers and capscrews. Torque the capscrews 25 to 27 Nm (18 to 20 pounds-foot).
2. Connect the hydraulic hoses to the ports on the valve as tagged during removal.

8

Installation

1. Place the cylinder in the beam.

NOTE: Keep hydraulic fittings and hoses close to angles shown (Figure 8-25) and as low as possible to prevent rubbing with the beam top plate and side plate, and for proper tracking during beam extension and retraction.



NOTE: Keep hydraulic fittings and hoses close to angles shown and as low as possible to prevent rubbing with the beam top plate and side plate, and for proper tracking during beam extension and retraction.

FIGURE 8-25

2. Position the extension cylinder so the hydraulic ports on the rod end of the cylinder can be accessed. Connect the hydraulic hoses to the ports as tagged during removal.
3. Push the cylinder into the outrigger beam. Align the cylinder rod with the clevis in the beam. Apply anti-seeze to the clevis pin and secure in place with the clevis pin and cotter pin.
4. Install the outrigger beam. Refer to OUTRIGGER BEAM - INSTALLATION in this section.

Functional Check

1. Activate the hydraulic system; extend and retract the outrigger.
2. Observe the operation of the outrigger beam.
3. Check the hydraulic connections for any evidence of leakage.

Stabilizer Cylinder

Description

Four stabilizer cylinders are used on the crane, one at the end of each outrigger beam. The stabilizer cylinders provide the force for the outrigger beam's vertical movement. The cylinder weighs approximately 64.6 kg (142.4 pounds).

Maintenance

NOTE: Refer to CYLINDERS in Section 2 - HYDRAULIC and PRESSURE SETTINGS for Disassembly and Assembly of the cylinders.

Removal

1. Extend the outrigger beam slightly for improved access to the stabilizer cylinder; shut down the engine.
2. Tag and disconnect the hydraulic hoses from the stabilizer cylinder. Remove the fittings from the ports. Cap or plug all openings.
3. Remove the nut and washer and remove the cylinder cap.
4. Place a jack capable of supporting the weight of the stabilizer cylinder at the base of the cylinder barrel. Jack up the cylinder just enough to relieve any pressure on the cylinder retaining pin.
5. Remove the cotter pins securing the cylinder retaining pin and remove the cylinder retaining pin and cylinder cap retaining bracket.
6. Jack the stabilizer cylinder up just enough to insert the retaining pin back into the cylinder. Insert the retaining pin into the lugs on the cylinder and secure the pin in place with the cotter pins.

CAUTION

Use a nylon strap to remove the cylinder. This will ensure the retaining pin is not damaged.

7. Fasten a nylon strap onto the cylinder retaining pin and use an adequate lifting device to lift the stabilizer cylinder out of the tube on the beam assembly.

Installation

1. Apply grease (EPMPG) to the ID of the stabilizer cylinder support tube.
2. If removed, install wear ring in groove in bottom of support tube and in groove at top on stabilizer cylinder.
3. Place a jack beneath the cylinder tube on the outrigger beam. Using the same method as described under REMOVAL, lower the stabilizer cylinder into the cylinder tube on the outrigger beam until the retaining pin is just above the tube. Position the jack so that it will support the cylinder in this position. Remove the lifting device from the cylinder.
4. Remove the retaining pin and cotter pins from the cylinder.

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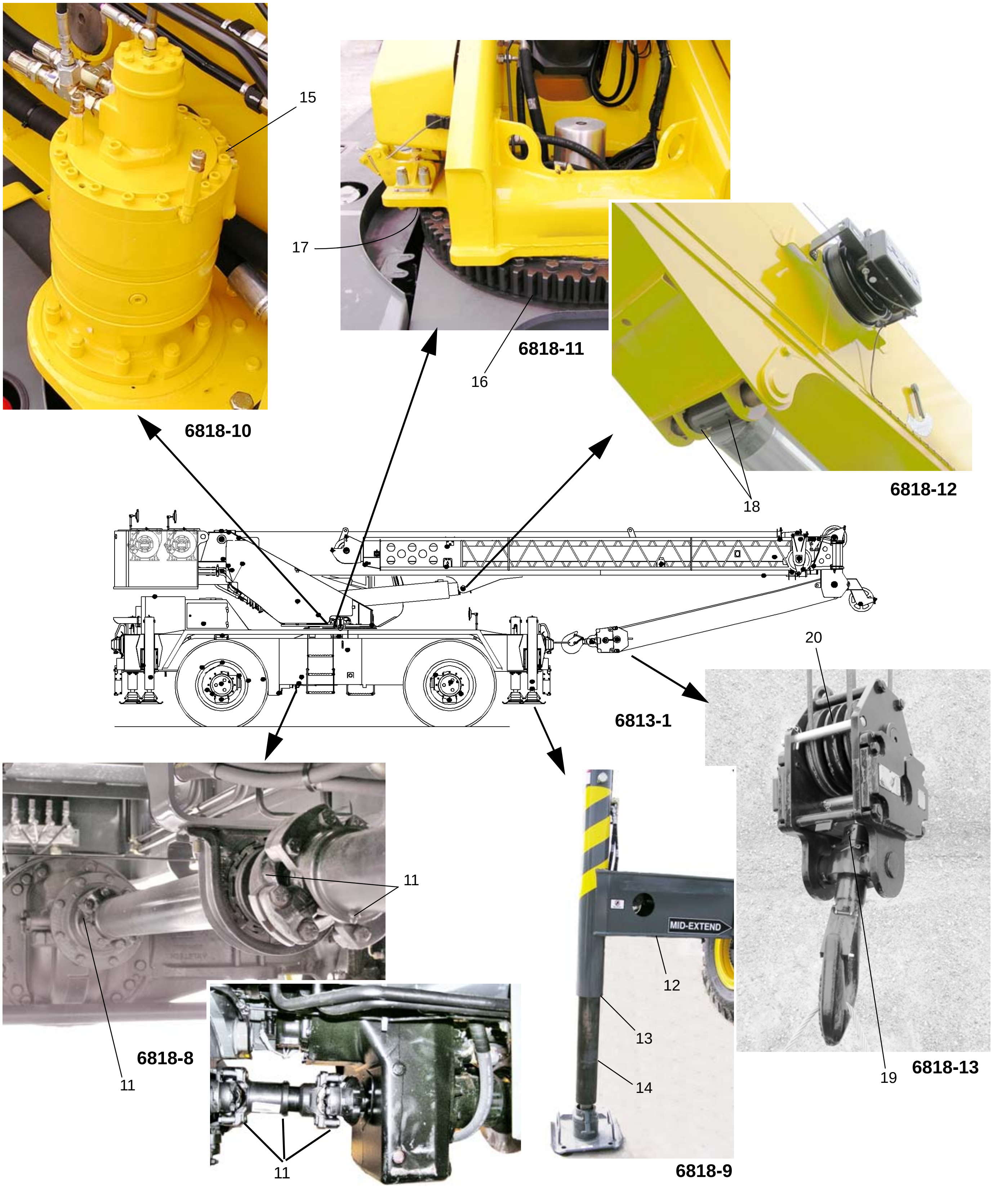
15
17
6818-11
16
6818-10
6818-12
18
20
6813-1
11
MID-EXTEND
12
13
14
6818-8
11
19
6818-13
11
6818-9
6818-6

FIGURE 9-2

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