Lull®

Service and Maintenance Manual

Models
522
522/4
622
622/4
824

10709972
June 1990

ANSI

JLG®

LULL SERVICE MANUAL

MODELS 522, 522/4, 622, 622/4, 824

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This Service Manual provides instructions for correct maintenance, adjustment and troubleshooting of Lull Model 522, 522/4, 622, 622/4 and 624 Forklifts. This manual also provides information for overhaul of hydraulic valves, hydraulic cylinders, boom frame tilt, oscillation, power brake valve and power assist motor. However, procedures for overhauling the hydraulic pump, engine, transmission, axles, steer control unit component and power assist wheel motor have been intentionally omitted. This information is completely detailed in repair and overhaul manuals published by the manufacturers of the individual components and are available from either the manufacturer or Lull Corporation.

The information provided is for machines being manufactured at the time of the manual's publication. Because of Lull's on-going commitment to product excellence, improvements to production machines can be expected. As a result, updated information in the form of revised pages will be periodically available to keep your manual current.

For instructions about operating your Lull forklift (Safety Precautions, Starting, Operating Procedures, Etc.), refer to the Owner/Operator Manual supplied with your machine.

For visual breakdowns of forklift assemblies into their separate parts and part numbers, refer to the Lull Parts Book supplied with your machine.

In case a defect or failure should occur to your machine, take it out of service immediately. Under no circumstances must the machine continue to operate, for safety reasons and because serious damage to the machine or property may result.

Attach a warning tab to the steering wheel of the disabled forklift. If the forklift should not be started, remove the ignition key.

Before doing any maintenance or repair work, get permission. DO NOT perform any maintenance without authorization. If you have been authorized to do maintenance, READ THE SERVICE MANUAL. Study the instructions; check the lubrication charts; examine all the instruction messages on the machine.

INTRODUCTION

IDENTIFICATION (MODEL 522, 522/4)

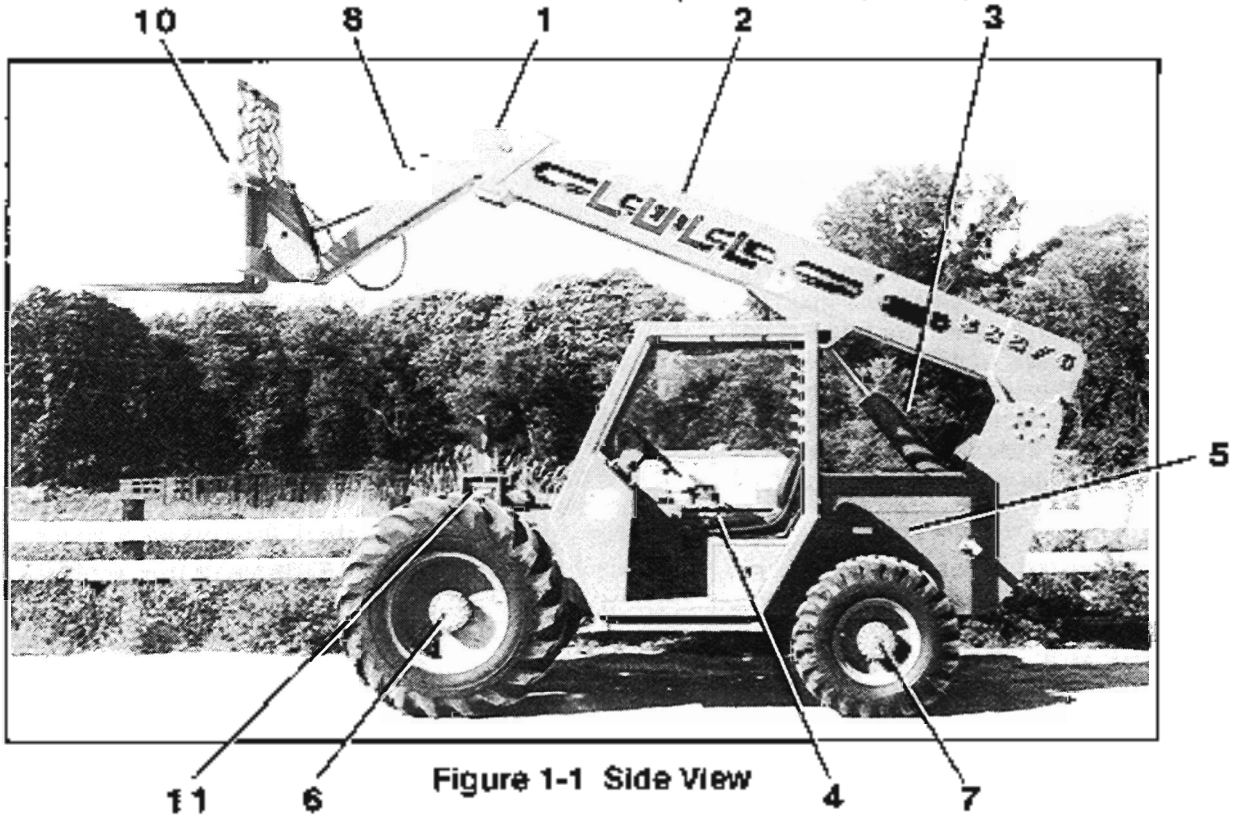

Figure 1-1 Side View

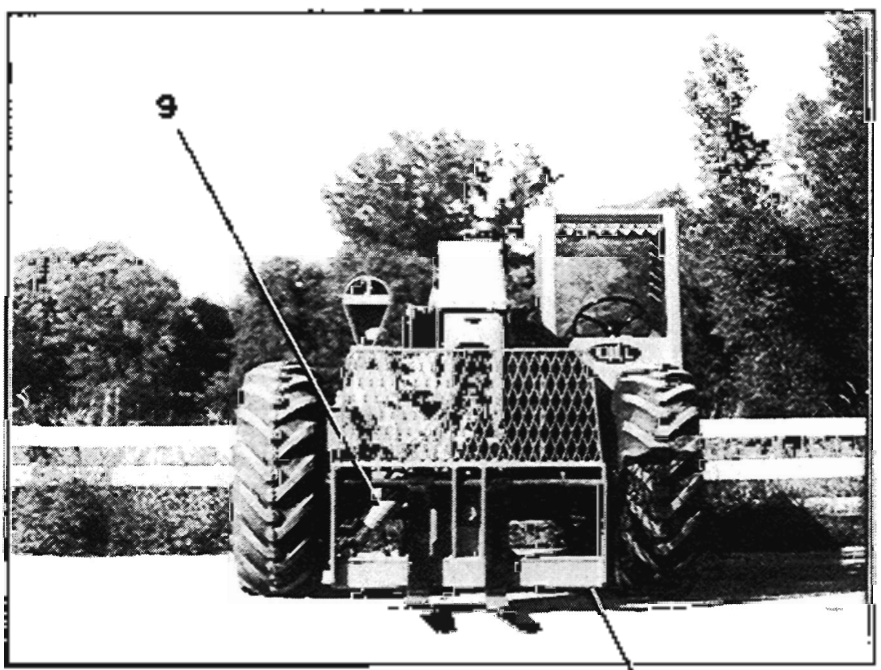

Figure 1-2 Front View

1 - Inner Boom
2 - Outer Boom
3 - Boom Hoist Cylinder
4 - Operators Compartment
5 - Engine Compartment
6 - Front Axle
7 - Rear Axle
8 - Carriage Tilt Cylinder
9 - Carriage Side Tilt Cylinder
10 - Fork Carriage
11 - Frame Tilt Cylinder

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IDENTIFICATION (MODEL 622, 622/4)

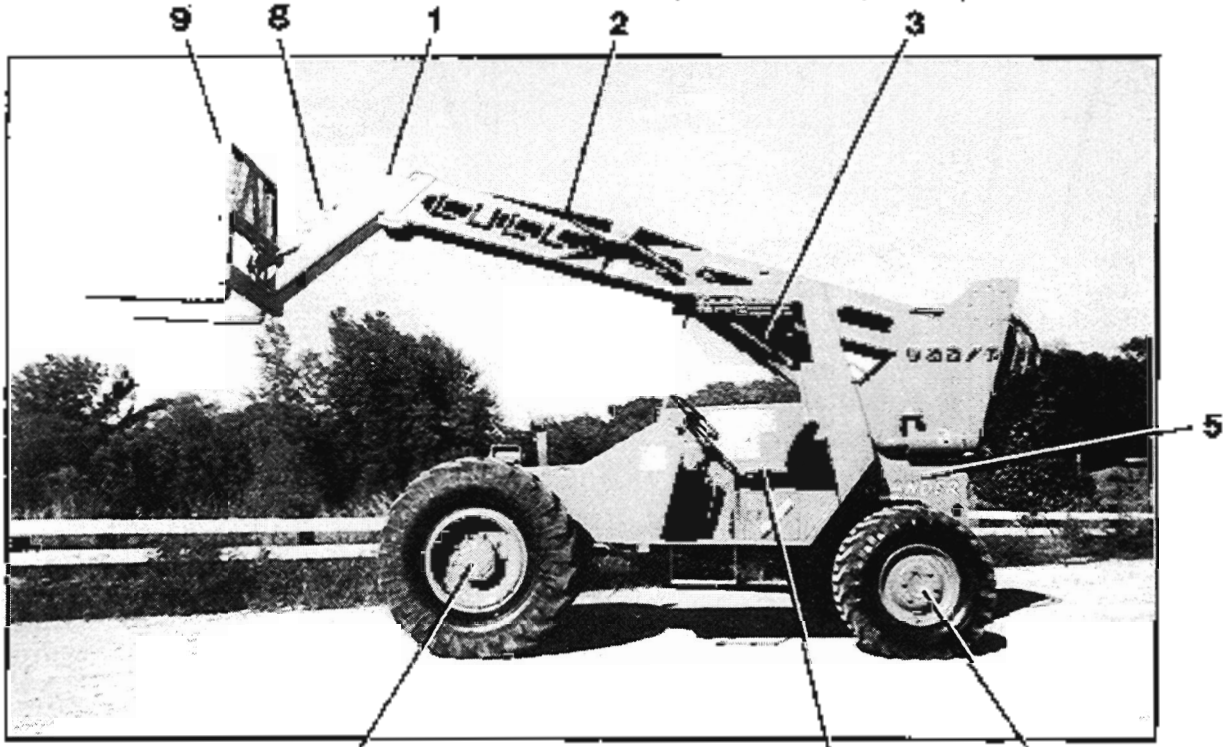

Figure 1-3 Side View

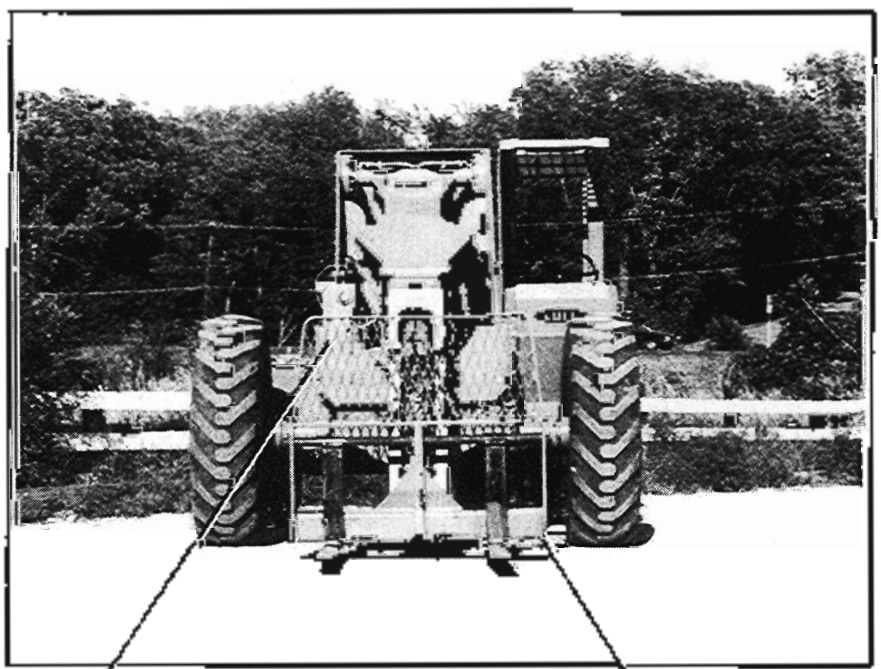

Figure 1-4 Front View

1 - Inner Boom
2 - Outer Boom
3 - Boom Hoist Cylinders
4 - Operators Compartment
5 - Engine Compartment
6 - Front Axle
7 - Rear Axle
8 - Carriage Tilt Cylinder
9 - Fork Carriage
10 - Frame Tilt Cylinder

INTRODUCTION

IDENTIFICATION (MODEL 624)

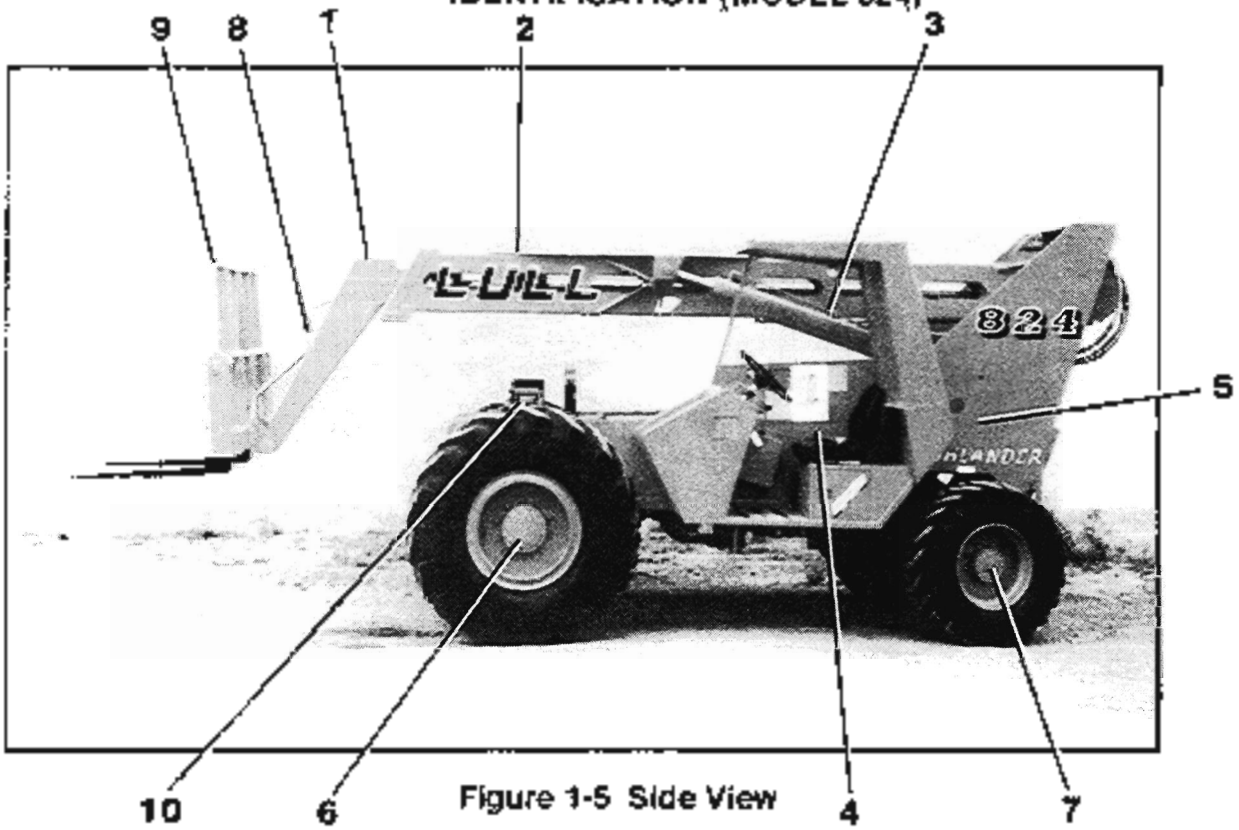

Figure 1-5 Side View

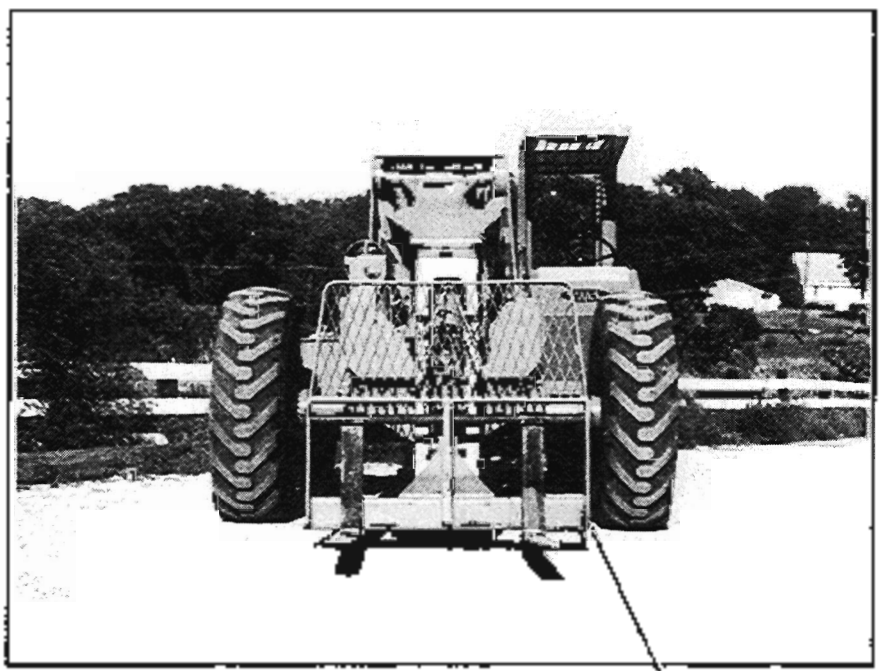

Figure 1-6 Front View

1 - Inner Boom
2 - Outer Boom
3 - Boom Hoist Cylinder
4 - Operators Compartment
5 - Engine Compartment
6 - Front Axle
7 - Rear Axle
8 - Carriage Tilt Cylinder
9 - Fork Carriage
10 - Frame Tilt Cylinder

INTRODUCTION

SPECIFICATIONS

MODELS 522, 522/4

General

Rated Capacity	5,000 lbs (see Load Chart)
Drive	Front Wheel (522)
	Front Wheel w/Rear Wheel Assist (522/4)
Steer	Rear Wheel
Empty Vehicle Weight	Approx. 14,000 lbs

Travel Speed (Forward and Reverse)

1st Gear	6.1 mph.
2nd Gear	10.6 mph.
3rd Gear	19.4 mph.

Dimensions

Note: Dimensions listed are for a forklift with all components fully retracted in the travel mode.

Wheel Base	92"
Overall Length	18'-1" w/42" Forks
Overall Width	8'-0"
Overall Height	7'-1"
Outside Turning Radius	13'-6"
Ground Clearance	14"
Frame Leveling	8° Right or Left

Capacities

Hydraulic Tank and System	42 gals
Fuel Tank	37 gals
Cooling System	18 qts
Transmission	20 qts
Drain and Refill	7.5 qts
Differential	9 qts
Planetary Hub	1.5 pts
Power Assist Hub (522/4)	1 pt
Engine Oil	11 qts

Engine

Manufacturer	Perkins
Model	4.236
Cooling	Liquid
Fuel	Diesel
Horsepower	81 at 2600 rpm
Maximum Torque	197 lb-ft at 1400 rpm
Piston Displacement	236 cu. in.
No. of Cylinders	4 Vertical In-Line
Cycle	4 Stroke
Combustion System	Direct Injection
Compression Ratio	16:1

INTRODUCTION

SPECIFICATIONS

MODELS 522, 522/4 (cont.)

Engine (cont.)

Oil Filter	Spin On
Air Cleaner	Dry Cartridge
High RPM	2500
Low Idle RPM	700 - 800

Transmission

Manufacturer	Clark
Type	3 Speed Powershift with Torque Converter
Speeds	3 Forward, 3 Reverse
Filter	Spin On

Axle - Front

Manufacturer	Hurth
Model	172
Type	Off-Highway with Planetary Drive and Differential Lock

Wheels/Tires - Front

Lugs	8
Tire Size	16.90 x 24 - 10 ply
Water Fill	52 gal
Calcium Fill	182 lbs
Pressure	28 psi

Wheels/Tires - Rear

Lugs	8 (522), 6 (522/4)
Tire	
Size	14.00 x 17.5 - 8 ply
Water Fill	19 gal
Calcium Fill	67 lbs
Pressure	60 psi

Brakes

Manufacturer	Hurth
Type	Wet Discs, Internal to Front Axle
Service Brakes	Power, Hydraulically Actuated
Parking Brake	Manually Actuated

Power Steering

Manufacturer	Char-Lynn Model 213-1006
Type	Hydrostatic

SPECIFICATIONS

MODELS 522, 522/4 (cont.)

Hydraulic Pump (522)

Manufacturer	Vickers
Model	G20-30
Type	Gear
Sections	One
GPM at 2600 RPM	27
Maximum PSI	3300

Hydraulic Pumps (522/4)

Manufacturer	Vickers
Model	GT20
Type	Gear
Sections	One
GPM at 2600 RPM	32
Maximum PSI	3300

Manufacturer	Vickers
Model	PVE19
Type	Piston
Sections	One
GPM at 2600 RPM	27
Maximum PSI	3300

Telescoping Boom - Two Section

Elevation	-11° to 60°
Maximum Lift Height	23' - 7"
Reach at 24" Load Center	12' - 10" from Tires
Power	Full

Electrical System

Type	Single Wire Ground Return (Chassis)
System Voltage	12
Starting Voltage	12
Batteries	Two - 6 Volt
Fuses	30 amp

Pressures

Transmission	Refer to Manufacturer's Service Manual
Hydraulic	
Boom Hoist & Extend Relief	2600 psi
Carriag Tilt Valve Section - Up	2000 psi
Carriage Tilt Valve Section - Down	2100 psi
Steering	2000 psi
Service Brakes	700 psi
Differential Lock	285 psi

SPECIFICATIONS

MODELS 522, 522/4 (cont.)

Pressures (cont.)

Rear Wheel Assist (Model 522/4)

System Off Pressure	250 psi
System On Pressure	2600 - 3000 psi
Signal Pressure	2600 - 3000 psi
Return Line Pressure	100 psi

Hoist Cylinder Cycle Time (Up or Down) - No Load, Full RPM

Model 522	11 seconds
Model 522/4	10 seconds

INTRODUCTION

SPECIFICATIONS

MODELS 622, 622/4

General

Rated Capacity	6,000 lbs (see Load Chart)
Drive	Front Wheel (622)
	Front Wheel w/Rear Wheel Assist (622/4)
Steer	Rear Wheel
Empty Vehicle Weight	Approx. 20,400 lbs

Travel Speeds (Forward and Reverse)

1st Gear	3.1 mph
2nd Gear	8.1 mph
3rd Gear	17.3 mph

Dimensions

Note: Dimensions listed are for a forklift with all components fully retracted in the travel mode.

Wheel Base	110.5"
Overall Length	22'-0" w/42" Forks
Overall Width	8'-0"
Overall Height	8'-8"
Outside Turning Radius	13'-0"
Ground Clearance	14.5"
Frame Tilt	10° Right or Left

Capacities

Hydraulic Tank and System	45 gals
Fuel Tank	40 gals
Cooling System (John Deere)	18 qts
Transmission	18 qts
Drain and Refill	10 qts
Differential	9 qts
Planetary Hubs	1.5 pts
Power Assist Hubs (thru Ser/No. 605)	1 pt
Engine Oil (John Deere)	9 qts
Engine Oil (Deutz)	10 qts

Engine

Manufacturer	John Deere
Model	4239D
Fuel	Diesel
Cooling	Liquid
Horsepower	80 at 2500 rpm
Maximum Torque	208 lb-ft at 100 rpm
Piston Displacement	239 cu. in.
No. of Cylinders	4 Vertical In-Line
Cycle	4 Stroke
Combustion System	Direct Injection

INTRODUCTION

SPECIFICATIONS

MODELS 622, 622/4 (cont.)

Engine (cont.)

Compression Ratio	17.6:1
Oil Filter	Spin On
Air Cleaner	Dry Cartridge
High rpm	2500
Low Idle rpm	700 - 800
Manufacturer	Deutz
Model	F4L912
Fuel	Diesel
Cooling	Air
Horsepower	70 at 2500 rpm
Maximum Torque	162 lb-ft. at 1500 rpm
Piston Displacement	230 cu. in.
No. of Cylinders	4 Vertical In-Line
Cycle	4 Stroke
Combustion System	Direct Injection
Compression Ratio	17:1
Oil Filter	Spin On
Air Cleaner	Dry Cartridge
High rpm	2500
Low Idle rpm	700 - 800

Transmission

Manufacturer	Funk
Model	4013
Type	3-Speed Powershift with Torque Converter
Speeds	3 Forward, 3 Reverse
Filter	Spin On

Axle - Front

Manufacturer	Hurth
Model	174
Type	Off-Highway with Planetary Drive and Differential Lock

Wheels/Tires - Front

Lugs	10
Tire Size	21L x 24 - 12 ply
	18.4 x 24 - 10 ply
Water Fill	74 gals (21L x 24)
	64 gals (18.4 x 24)
Calcium Fill	259 lbs (21L x 24)
	224 lbs (18.4 x 24)
Pressure	35 psi

SPECIFICATIONS

MODELS 622, 622/4 (cont.)

Wheels/Tires - Rear

Lugs	8 (622), 6 (622/4)
Tire Size	15.00 x 19.5 - 10 ply
Water Fill	25 gals
Calcium Fill	87 lbs
Pressure	70 psi

Brake - Service

Manufacturer	Hurth
Type	Wet Discs, Internal to Front Axle, Power, Hydraulically Actuated

Brake - Parking

Manufacturer	Funk
Type	Disc and Caliper at Transmission Output, Manually Actuated

Power Steering

Manufacturer	Char-Lynn
Model	213-1006
Type	Hydrostatic

Hydraulic Pump (622)

Manufacturer	Tyrone
Model	PVP16
Type	Gear
Sections	One
GPM	31 at 2500 rpm
Maximum psi	3300

Hydraulic Pumps (622/4)

Manufacturer	Vickers
Model	GT20
Type	Gear
Sections	One
GPM	31 at 2500 rpm
Maximum psi	3300

Manufacturer	Vickers
Model	PVE19
Type	Piston
Sections	One
Maximum GPM	26 at 2500 rpm
Maximum psi	3300

INTRODUCTION

SPECIFICATIONS

MODELS 622, 622/4 (cont.)

Telescoping Boom - Two Section

Elevation	-12° to 67°
Maximum Lift Height	35' - 0"
Reach at 24" Load Center	19' - 3" From Tires
Power	Full

Electrical System

Type	Single Wire Ground Return (Chassis)
System Voltage	12
Starting Voltage	12
Batteries	Two 6-Volt
Fuses	30 amp

Pressures

Transmission	Refer to Manufacturer's Service Manual
Hydraulic	
Boom Hoist & Extend Valve Relief	2900 psi
Carriage Tilt Valve Section-Up Relief	2000 psi
Carriage Tilt Valve Section-Down Relief	2500 psi
Steering	2000 psi
Brakes	700 psi
Differential Lock Valve Relief	285 psi

Rear Wheel Assist (Model 622/4)

System Off Pressure	250 psi
System On Pressure	2600 - 3000 psi
Signal Pressure	2600 - 3000 psi
Return Line Pressure	100 psi

Hoist Cylinder Cycle Time (Up or Down) - No Load, Full rpm

Model 622	10 seconds
Model 622/4	17 seconds

Hydraulic Oil Working Temperatures	140° - 180°

INTRODUCTION

SPECIFICATIONS

MODEL 824

General

Rated Capacity	8,000 lbs (see Load Chart)
Drive	Front Wheel w/ Rear Wheel Assist
Steer	Rear Wheel
Empty Vehicle Weight	Approx. 21,100 lbs

Travel Speeds (Forward and Reverse)

1st Gear	3.1 mph
2nd Gear	8.1 mph
3rd Gear	17.3 mph

Dimensions

Note: Dimensions listed are for a forklift with all components fully retracted in the travel mode.

Wheel Base	110.5"
Overall Forklift Length	22' - 0" w/42" Forks
Overall Forklift Width	8'-0"
Overall Forklift Height	8'-8"
Outside Turning Radius	14'-0"
Ground Clearance	14.5"
Frame Tilt	10° Right or Left

Capacities

Hydraulic Tank and System	45 gals
Fuel Tank	40 gals
Cooling System	18 qts
Transmission	16 qts
Transmission Drain & Refill	10 qts
Differential	9 qts
Planetary Hubs	1.5 pts
Power Assist Hubs (thru Ser/No. 180, 182 - 187)	1 pt
Engine Oil (John Deere)	15 qts

Engine

Manufacturer	John Deere
Model	4239T
Fuel	Diesel
Cooling	Liquid
Horsepower	109 at 2500 rpm
Maximum Torque	278 lb-ft at 1400 rpm
Piston Displacement	239 cu. in.
No. of Cylinders	4 Vertical In-Line
Cycle	4 Stroke
Aspiration	Turbocharged
Combustion System	Direct Injection
Compression Ratio	17.8:1

SPECIFICATIONS

MODEL 824 (cont.)

Engine (cont.)

Oil Filter	Spin On
Air Cleaner	Dry Cartridge
High rpm	2500
Low Idle rpm	700 - 800

Transmission

Manufacturer	Funk
Model	4013E4PFA
Type	3 Speed Powershift with Torque Converter
Speeds	3 Forward, 3 Reverse
Filter	Spin On

Axle - Front

Manufacturer	Hurth
Model	174
Type	Off-Highway with Planetary Drive and Differential Lock

Wheels/Tires - Front

Lugs	10
Tire Size	16.00 x 24 - 12 ply
Water Fill	59 gals
Calcium Fill	207 lbs
Pressure	32 psi

Wheels/Tires - Rear

Lugs	6
Tire Size	15.00 x 19.5 - 10 ply
Water Fill	25 gals
Calcium Fill	87 lbs
Pressure	70 psi

Brakes - Service

Manufacturer	Hurth
Type	Wet Discs, Internal to Front Axle, Power, Hydraulically Actuated

Brake - Parking

Manufacturer	Funk
Type	Disc and Caliper at Transmission Output, Manually Actuated

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SPECIFICATIONS

MODEL 824 (cont.)

Power Steering

Manufacturer	Char-Lynn
Model	213-1006
Type	Hydrostatic

Hydraulic Pumps

Manufacturer	Vickers
Model	GT20
Type	Gear
Sections	One
GPM	31 at 2500 rpm
Maximum psi	3300

Manufacturer	Vickers
Model	PVE19
Type	Piston
Sections	One
GPM	25 at 2500 rpm
Maximum psi	3300

Telescoping Boom - Two Section

Elevation	-12° to 67°
Maximum Lift Height	35'-0"
Reach at 24" Load Center	19'-3" From Tires
Power	Full

Electrical System

Type	Single Wire Ground Return (Chassis)
System Voltage	12
Starting Voltage	12
Batteries	Two 6-Volt
Fuses	30 amp

Pressures

Transmission	Refer to Manufacturer's Service Manual
Hydraulic	
Boom Hoist & Extend Valve Relief	2900 psi
Carriage Tilt Valve Section-Up Relief	2000 psi
Carriage Tilt Valve Section-Down Relief	2500 psi
Outrigger Valve Relief	2600 psi
Steering	2000 psi
Service Brakes	700 psi
Differential Lock Valve Relief	285 psi

SPECIFICATIONS

MODEL 824 (cont.)

Pressures (cont.)

Rear Wheel Assist

System Off Pressure	250 psi
System On Pressure	2600 - 3000 psi
Signal Pressure	2600 - 3000 psi
Return Line Pressure	100 psi

Hoist Cylinder Cycle Time (Up or Down)

No Load, Full rpm	17 Seconds

Hydraulic Oil Working Temperatures	140° - 180°

INTRODUCTION

SPECIFICATIONS

Bolt Torque Specifications

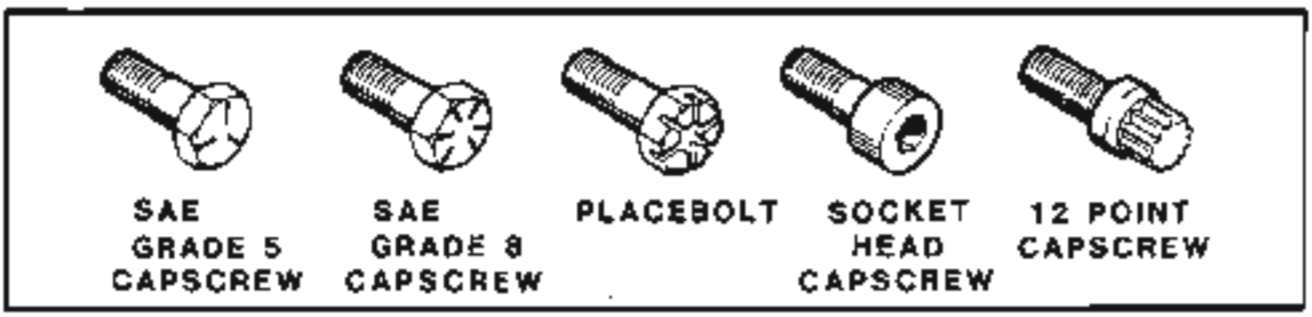

Figure 1-7 Types of Bolts

Carbon Steel Hex Head Capscrews (SAE Grade 5)

TORQUE (FT/LBS)			TORQUE (FT/LBS)		
SIZE	UNC	UNF	SIZE	UNC	UNF
1/4	6	7	9/16	82	91
5/16	13	14	5/8	115	130
3/8	23	25	3/4	200	225
7/16	37	41	7/8	320	355
1/2	57	64	1	485	540

Placebolts, Socket Head, 12 Point and Hex Head Capscrews (SAE Grade 8)

TORQUE (FT/LBS)			TORQUE (FT/LBS)		
SIZE	UNC	UNF	SIZE	UNC	UNF
1/4	9	10	9/16	115	130
5/16	18	20	5/8	160	180
3/8	33	37	3/4	280	315
7/16	52	58	7/8	455	500
1/2	80	80	1	680	765

NOTE: This table lists torque values for standard bolts and is intended as a guide for average applications involving typical stresses and machined surfaces. Values are based on the physical limitations of clean, plated and lubricated bolts. In all cases, when a individual torque value is specified, it should take priority over values given in this table. When installing a new bolt, the replacement bolt must be the same grade as the original bolt.

Table 1-1 Bolt Torque Specifications

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SPECIFICATIONS

Torque Specifications for Hydraulic Line Connections

An undertightened fitting may leak, but this can be overcome by additional tightening. An overtightened fitting may result in overstressing and/or cracking. The values shown below are maximum values that the fittings are designed to withstand. It is recommened that the fitting be tightened to a point approximately 10% below the maximum, and then tightened further only if leakage occures. NOTE: Use two wrenches when tightening hydraulic line fittings.

MAXIMUM TORQUE VALUES
J.I.C. and S.A.E. Swivel (Female Nuts)

SIZE	FT/LBS
4	11
5	16
6	19
8	38
10	56
12	79
16	104
20	138
24	173
32	243

Table 1-2 Hydraulic Fitting Torque Specifications

INTRODUCTION

SAFETY NOTATIONS

The following safety notations are used throughout this manual to call attention to special information or operating procedures.

NOTE: A NOTE points out general reference information regarding proper operation and maintenance of this machine.

IMPORTANT: An IMPORTANT statement indicates specific procedures or information that is required to prevent damage to the machine or attachments.

THE SAFETY ALERT SYMBOL MEANS ATTENTION! BECOME ALERT! PERSONAL SAFETY IS INVOLVED! WHEN THIS SYMBOL APPEARS, CAREFULLY READ THE MESSAGE THAT FOLLOWS AND BE ALERT TO THE POSSIBILITY OF PERSONAL INJURY OR DEATH.

CAUTION: A CAUTION identifies safe operating practices or indicates unsafe conditions that could cause personal injury.

WARNING: A WARNING describes a serious safety hazard. Failure to follow the instructions COULD result in severe personal injury or death.

DANGER: Failure to follow DANGER instructions WILL result in severe personal injury or death.

INTRODUCTION

SAFETY PRECAUTIONS

* Do not operate engine without proper ventilation.
* Lower boom, apply the parking brake, stop the engine and turn the key off before adjusting, servicing, or fueling the machine.
* When airing tires, stand away to the side of lock ring.
* The machine must be stopped and cool before checking fluids. Use extreme caution in removing radiator caps, drain plugs, grease fittings, or pressure taps.
* Wear gloves when handling cables.
* Use safety glasses when pounding with a hammer. Many machine parts are hardened and will chip.
* Do not smoke while fueling.
* Do not open pressurized lines. Hydraulic fluid under pressure could penetrate the skin, cause severe burns, eye injury, or skin irritation. Use a piece of cardboard or wood, not your hands, to search for leaks. If anyone is injured by hydraulic fluid under pressure, contact a physician immediately.
* Release all pressure before working on systems which have an accumulator.
* Re-pressurize accumulators only with nitrogen.
* Block and support securely when working under machine.
* When changing attachments or other components, be sure that blocking and lifting devices are adequate for the purpose.
* Properly support boom before disassembly or cylider repair/replacement.
* Never stand on or under boom during assembly or disassembly.
* Keep machine free of dirt, oil, snow and ice.
* Keep the controls and foot pedals clean and dry.
* Keep engine clean of flammable material.
* Use nonflammable solvents for cleaning metal parts; do not use such flammable substances as gasoline or kerosene.
* Dispose of drained fluids properly.
* Keep all tools and small parts in tool box when not is use.
* Store flammable or combustable liquids in closed containers specifically designed for that purpose.
* Keep body, loose objects and clothing away from electrical contacts, moving parts, hot parts and exhaust.

INTRODUCTION

SAFETY PRECAUTIONS

* Lead acid batteries produce flammable and explosive gases. Keep arcs, sparks, flames and lighted tobacco away from the battery.
* Battery acid causes severe burns. If acid contacts eyes, skin or clothing, flush well with water. For contact with eyes, get immediate medical attention.
* Do not modify machine or add attachments not approved by manufacturer.
* Never set a relief valve to a pressure higher than that recommended by the manufacturer. Don't close off overflow or bypass lines.
* After making any repairs or adjustments, always check the function of the machine.
* Do not attempt any repairs you do not understand. There is no disgrace in asking for help.

Remember: safety is your business AND your responsibility.

Safety is important to you because:

* Accidents disable and kill
* Accidents cost
* Accidents can be avoided

INTRODUCTION

SAFETY SIGNS

General

Lull forklifts are furnished with various decals and plates which provide safety instructions for the safe operation of the machines.

These safety signs are shown on pages 1.11-2 through 1.11-7 with instructions for locating and attaching the signs to the machines.

It is important that all safety signs be in place and legible at all times.

Clean signs with mild soap if soiled with dirt, or clean with a mild alcohol solution if soiled with grease.

Replace all damaged, missing or painted-over signs, plates and decals, which cannot be read.

On refurbished equipment, any missing signs must be replaced.

Order replacement signs by contacting the Lull Corporation. When ordering, be prepared to give the title and part number of the sign, or signs, desired.

Lull Corporation
3045 Highway 13
St. Paul, MN 55121
Phone (612) 454-4300

INTRODUCTION

SAFETY SIGNS

Attaching Decals and Plates

Attaching Decals

The surface on which a decal is to be attached must be clean (free of all dirt and grease) and must be dry. Remove the backing from the decal and apply decal in the location shown in Figures 1-15 and 1-16. Once in place, rub entire surface of the decal with your thumb, applying sufficient pressure to insure good adhesion of the decal to the mounting surface.

Attaching Plates

Locate plates as shown in Figures 1-15 and 1-16. Attach plates with the drive screws provided. If new mounting holes are required, use the place as a guide to mark and drill new holes. Use a No. 37 drill.

Attaching the Slow Moving Vehicle Sign

Locate the sign as shown in Figure 1-17 and 1-18. The sign is attached with No. 10 - 24 machine screws and locknuts.

Figure 1-8 Carriage Safety - Decal
Part No.: P27565
Models used on: All

Signs

Figure 1-9 Don't be Careless - Decal
Part No.: P24705
Models used on: All

Figure 1-10 Carry Load Low - Decal
Part No.: P24704
Models used on: All

INTRODUCTION

SAFETY SIGNS

Signs (cont.)

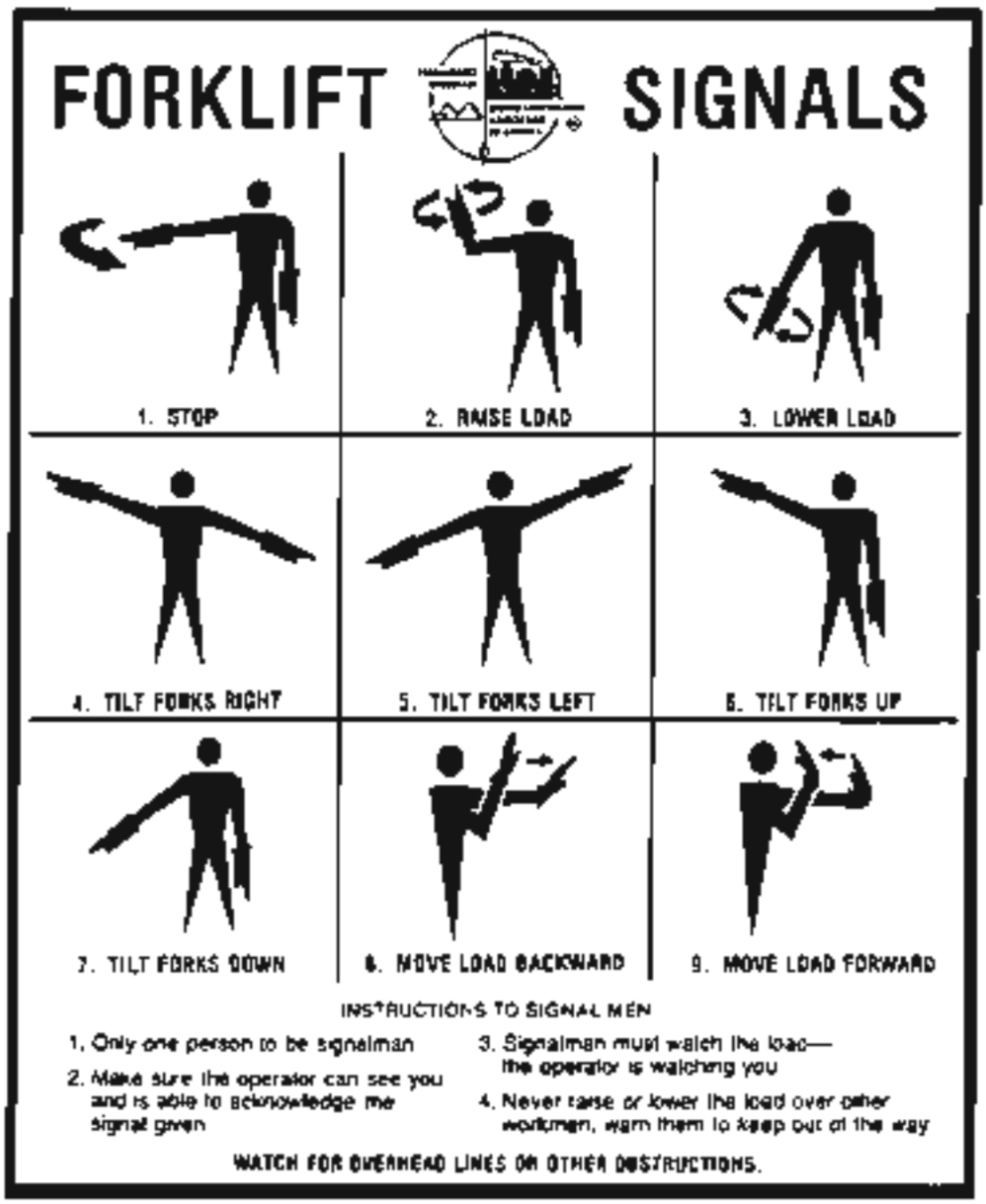

Figure 1-11 Forklift Signals
Part No.: P21406
Models used on: All

INTRODUCTION

SAFETY SIGNS

Signs (cont.)

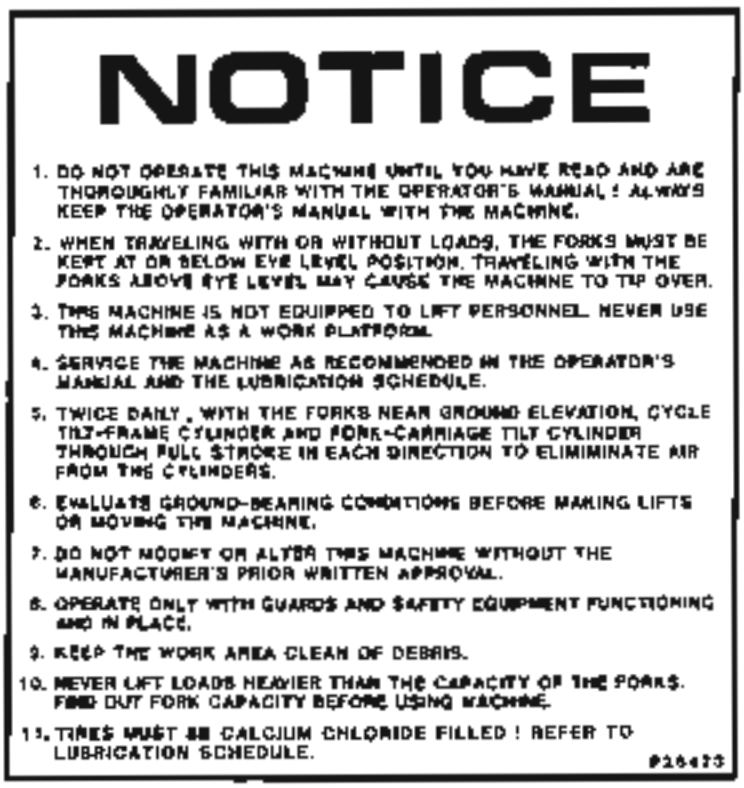

Figure 1-12 Notice - Decal
Part No.: P26473
Models used on: All

Figure 1-13 Caution - Plate
Part No.: P26474
Models used on: All

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SAFETY SIGNS

Signs (cont.)

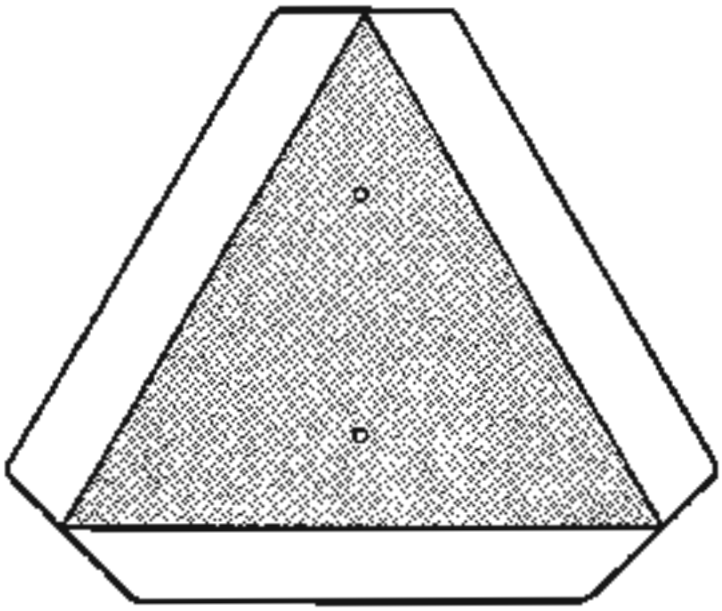
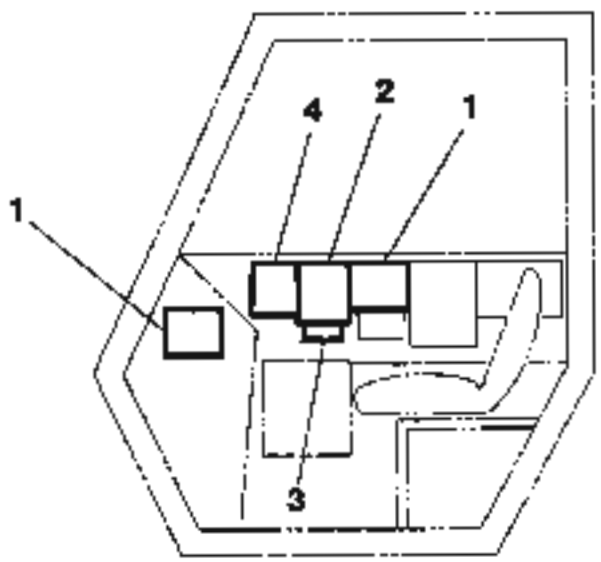


Figure 1-14 Slow Moving Vehicle - Plate
Part No.: P19841
Models used on: All

Locations

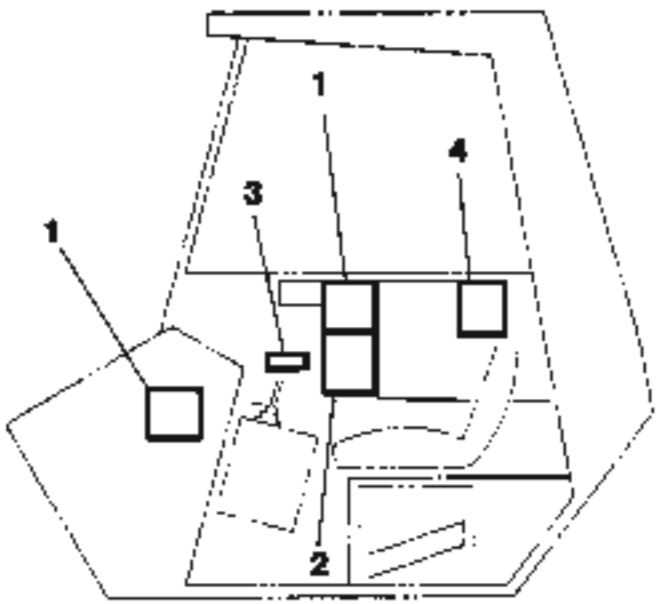


1-Caution
2-Notice
3-Carry Load Low
4-Forklift Signals

Figure 1-15 Sign Locations (Model 522, 522/4)

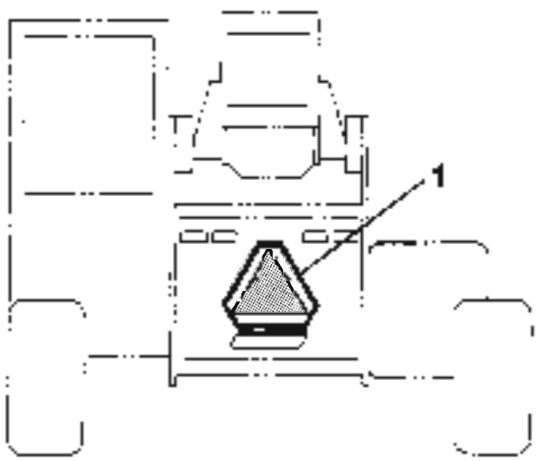
SAFETY SIGNS

Locations (cont.)



1-Caution
2-Notice
3-Carry Load Low
4-Forklift Signals

Figure 1-16 Sign Locations (Model 622, 622/4, 624)



1-Slow Moving Vehicle

Figure 1-17 Sign Locations (Model 522, 522/4)

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SAFETY SIGNS

Locations (cont.)

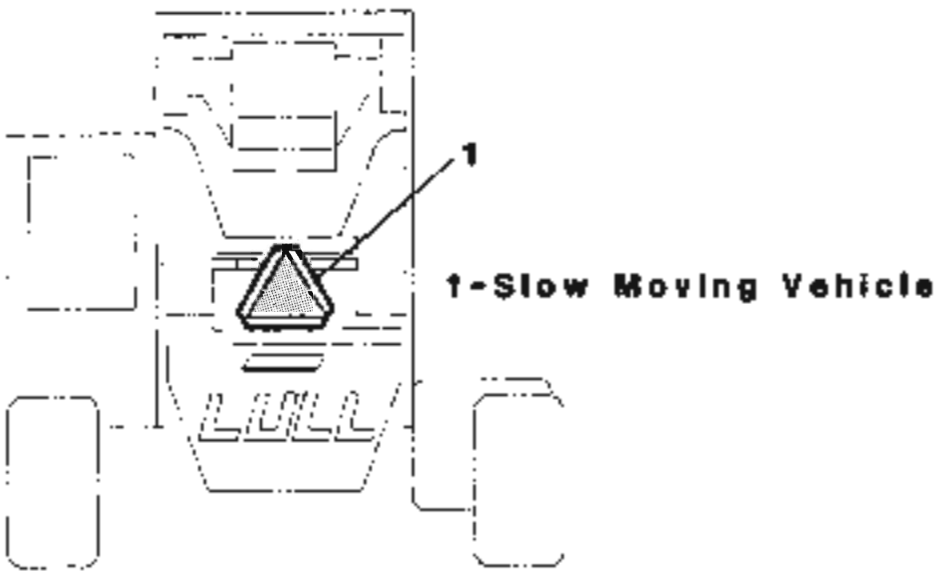

Figure 1-18 Sign Locations (Model 622, 622/4, 824)

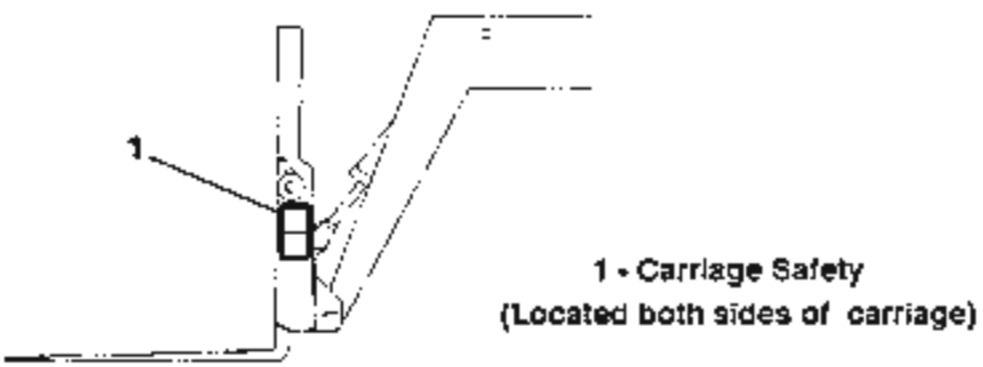

Figure 1-19 Sign Locations (Model 622, 622/4, 824)

General Maintenance

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GENERAL INSTRUCTIONS

Performance of your machine is dependent on proper maintenance and lubrication at designated intervals. (see Service Schedules, this section.) Following a regularly scheduled maintenance and lubrication program, coupled with correct operating procedures, will increase the life of machine components and reduce machine down time.

Should a defect or failure occur to your machine, take it out of service immediately. Under no circumstances must the machine continue to operate, because serious damage to the machine or personal injury may result.

Attach a warning tag to the steering wheel of the disabled forklift. If the forklift should not be started, remove the ignition key.

Before doing any maintenance or repair work, receive permission. Do not perform any maintenance without authorization.

If you have been authorized to do maintenance, READ THE SERVICE MANUAL. Study the instructions, check the lubrication charts, examine all the instruction messages on the machine.

Whenever performing any inspection, maintenance, lubrication, or adjustments to the machine, be alert to any indication - including odors and noises - of excessive wear, damage, malfunction, or other maintenance problems.

SERVICE PREPARATION PROCEDURES

* Choose a clean, level work area. Make sure you have sufficient room. Check clearances. Make certain there is adequate light and ventilation.

* Clean the walking and working surfaces. Remove oil, grease and water to eliminate slippery areas. Sand remaining slippery areas.

* Make sure you have the correct tools. Keep tools clean. Inspect power cords.

* Make sure jacks and hoists are available and in good condition. Never use jacks with cracked, bent or twisted parts. Never use frayed, twisted or pinched cables. Never use bent or distorted hooks.

* Make use of mechanical assists. Use proper lifting methods. Save your back!

SERVICE AND REPAIR PROCEDURES

CAUTION: Lower the boom to the ground, apply the parking brake and stop the engine before servicing, adjusting or repairing the machine, unless specifically told not to.

WARNING: Release all hydraulic pressure before doing any maintenance or repairs on the hydraulic system.

WARNING: Liquid cooling systems build up pressure as the engine gets hot. Before removing the radiator cap, stop the engine and let the system cool. Remove the radiator cap only after the coolant is cold.

* Use only approved or recommended parts and fluids.

* Be careful not to damage machined and polished surfaces.

* Tighten all bolts, fittings and connections to specifications.

* Avoid fires and explosive hazards:

a. Handle all solvents and dry chemicals according to procedures identified on manufacturers' containers. Work in a well-ventilated area. Make sure you know where fire extinguishers are kept and how to use them.

b. Use an approved solvent to clean parts. Never use gasoline or diesel fuel.

c. Shut off the engine and electrical equipment while filling the fuel tank. Use extra caution when fueling while the engine is hot. Always ground the fuel nozzle against the filler neck to avoid sparks.

WARNING: Never smoke while handling fuel or working on the fuel system. The fumes in an empty fuel container are explosive. Never cut or weld on fuel lines, tanks or containers.

General Maintenance

SERVICE SCHEDULE (MODELS 522, 522/4)

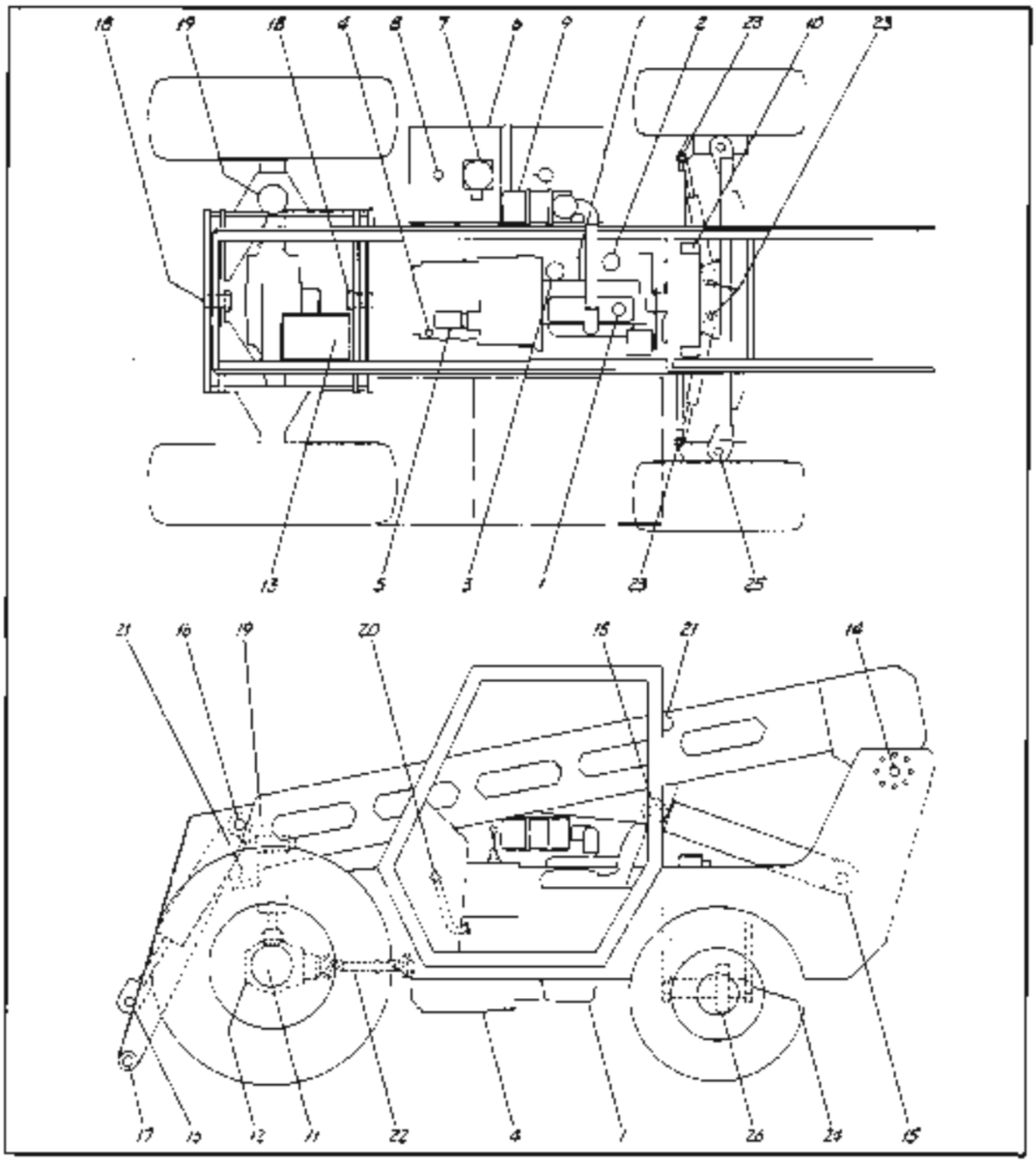

Figure 2-1 Lube and Service Locations

General Maintenance

SERVICE SCHEDULE (MODEL 522, 522/4)

ITEM	DESCRIPTION	DAILY	WEEKLY	HOURS OF OPERATION						
				20	50	100	200	500	1000	2000
1	Engine Oil	C			*CR	CR				
2	Engine Oil Filter				*CR	CR				
3	Fuel Filter							CR		
4	Transmission Fluid	C			*CR			CR		
5	Transmission Filter				*CR	*CR		CR		
6	Hyd. Reservoir Fluid	C							CR	
7	Hydraulic Filter				*CR				CR	
8	Hydraulic Breather						CLN		CR	
9	Air Cleaner Element					CLN				CR
10	Radiator Coolant					C				CR
11	Battery						C			
12	Axle Differential				*CR		C		CR	
13	Planetary Hubs				*CR		C	CR		
14	Power Assist Hub (Early Models)				*CR		C		CR	
15	Boom Pivot	Lube		Grease Fittings per Item						2
16	Hoist Pivots	Lube								2
17	Tilt Cylinder Pivots	Lube								2
18	Carriage Pivot	Lube								1
19	Boom Rollers	Lube								4
20	Steer Axle Pivot	Lube								2
21	Oscillation Pivot	Lube								2
22	Frame Tilt Cylinder	Lube								2
23	Steer Cylinders		Lube							4
24	Steer Spindles		Lube							4
25	Tie Rod Ends		Lube							2
26	Steer Wheel Hubs		Lube							2
27	Brake Pedal Pivots		Lube							2
28	Drive Shaft Universals	Lube								2

C = Check fluid levels and add fluid as necessary
CR = Change fluid or replace filter
CLN = Clean item with care to dislodge dust, etc.

* First hours of operation

UNDER DUSTY OR SEVERE OPERATING CONDITIONS-
SHORTEN SERVICE INTERVALS ACCORDINGLY

Table 2-1 Service Schedule

General Maintenance

SERVICE SCHEDULE (MODELS 522, 522/4)

ITEM	TYPE OF FLUID	QUANTITY
Hydraulic Tank & System	Amoco Rykon MV or Equivalent	42 Gallons
Fuel Tank	Diesel Fuel	37 Gallons
Cooling System	Ethylene Glycol Permanent Coolant	18 Quarts
Transmission & Cooler	Allison C-3 (MIL-L-2104 Grade 10)	14 Quarts Capacity 7.5 Quarts (Drain & Refill + Filter)
Differential (Front Axle)	SAE-90 Mobile Lub 46	9 Quarts
Planetary Hub (Front Axle)	SAE-90-API-GL5	1.5 Pints (each)
Power Assist Hub (Early Model)	SAE-90-API-GL5	1 Pint (each)
Engine Crank Case Oil (With Filter)	See Engine Manual	9 - 11 Quarts

Table 2-2 Lubricants and Capacities

General Maintenance

SERVICE SCHEDULE (MODELS 622, 622/4)

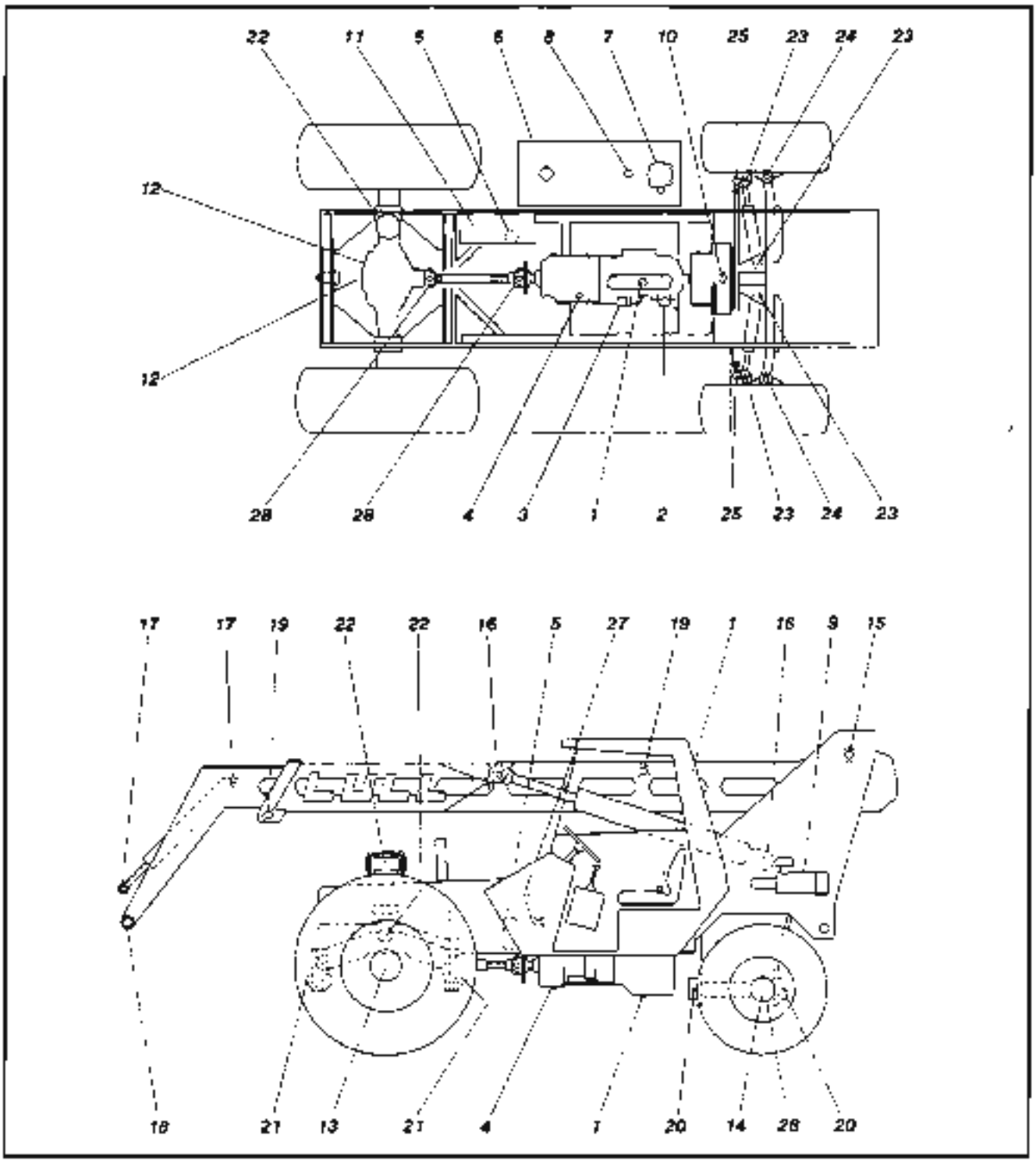

Figure 2-2 Lube and Service Locations

General Maintenance

SERVICE SCHEDULE (MODELS 622, 622/4)

ITEM	DESCRIPTION	DAILY	WEEKLY	HOURS OF OPERATION						
				20	50	100	200	500	1000	2000
1	Engine Oil	C			*CR	CR				
2	Engine Oil Filter				*CR	CR				
3	Fuel Filter							CR		
4	Transmission Fluid	C		*CR				CR		
5	Transmission Filter			*CR			*CR	CR		
6	Hyd. Reservoir Fluid	C							CR	
7	Hydraulic Filter				*CR				CR	
8	Hydraulic Breather						CLN		CR	
9	Air Cleaner Element					CLN				CR
10	Radiator Coolant					C				CR
11	Battery						C			
12	Axle Differential				*CR		C		CR	
13	Planetary Hubs				*CR		C	CR		
14	Power Assist Hub (Early Models)				*CR		C		CR	
15	Boom Pivot	Lube		Grease Fitting per Item						2
16	Hoist Pivots	Lube								4
17	Tilt Cylinder Pivots	Lube								2
18	Carriage Pivot	Lube								1
19	Boom Rollers	Lube								4
20	Steer Axle Pivot	Lube								2
21	Oscillation Pivot	Lube								2
22	Frame Tilt Cylinder	Lube								2
23	Steer Cylinders		Lube							4
24	Steer Spindles		Lube							4
25	Tie Rod Ends		Lube							2
26	Steer Wheel Hubs		Lube							2
27	Brake Pedal Pivots		Lube							2
28	Drive Shaft Universals	Lube								2

C = Check fluid levels and add fluid as necessary
CR = Change fluid or replace filter
CLN = Clean item with care to dislodge dust, etc.

* First hours of operation

UNDER DUSTY OR SEVERE OPERATING CONDITIONS-
SHORTEN SERVICE INTERVALS ACCORDINGLY

Table 2-3 Service Schedule

General Maintenance

SERVICE SCHEDULE (MODELS 622, 622/4)

ITEM	TYPE OF FLUID	QUANTITY
Hydraulic Tank & System	Amoco Rykon MV or Equivalent	45 Gallons
Fuel Tank	Diesel Fuel	40 Gallons
Cooling System	Ethylene Glycol Permanent Coolant	18 Quarts
Transmission & Cooler	Allison C-3 (MIL-L-2104 Grade 10)	18 Quarts Capacity 7.5 Quarts (Drain & Refill + Filter)
Differential (Front Axle)	SAE-90-Mobile Lub 46	9 Quarts
Planetary Hub (Front Axle)	SAE-90-API-GL5	1.5 Pints (each)
Planetary Hub (Early Models)	SAE-90-API-GL5	1 Pint (each)
Engine Crank Case Oil (With Filter)	See Engine Manual	Deere - 10 Quarts Duetz - 12.5 Quarts

Table 2-4 Lubricants and Capacities

General Maintenance

SERVICE SCHEDULE (MODEL 824)

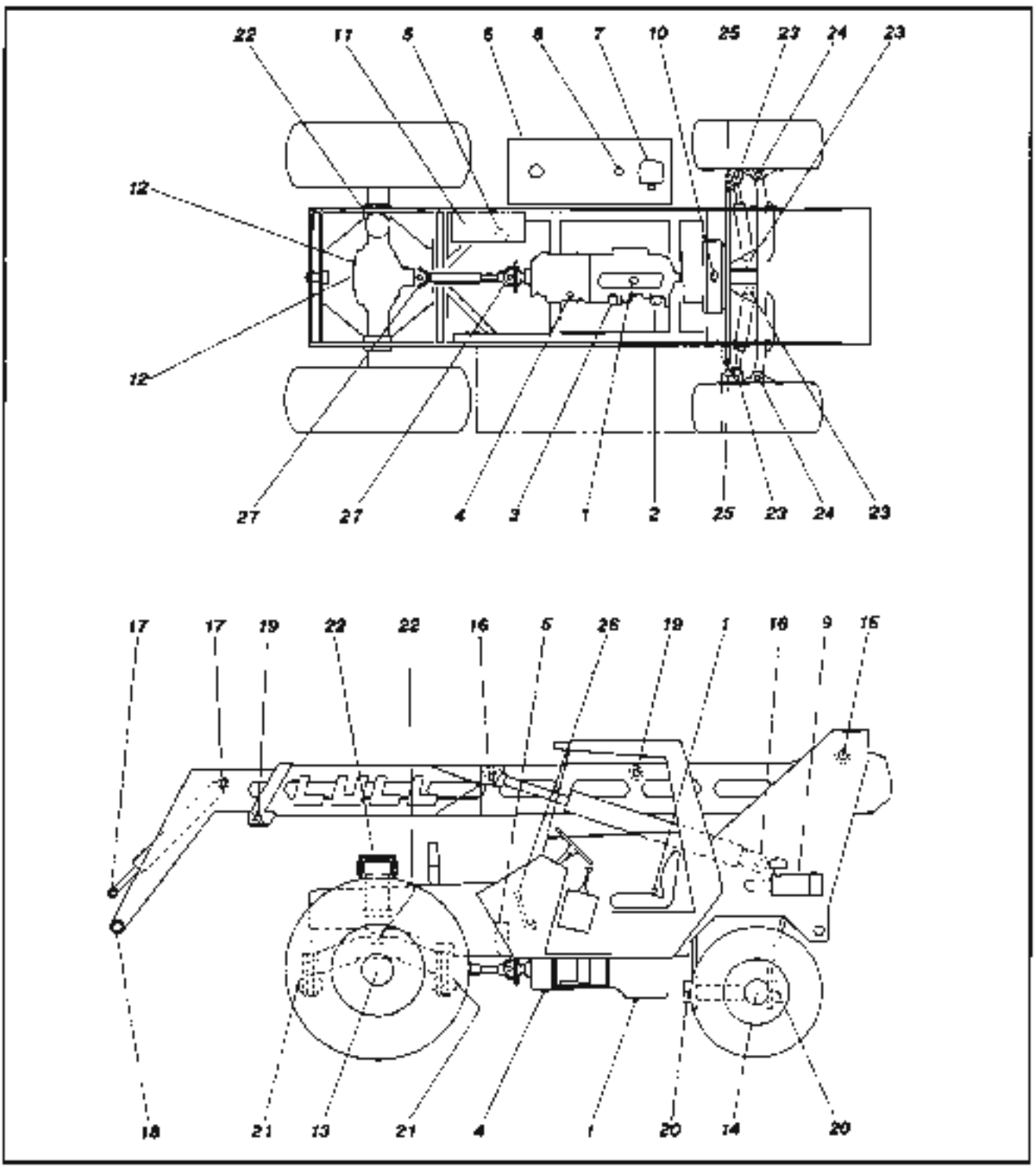

Figure 2-3 Lube and Service Locations

General Maintenance

SERVICE SCHEDULE (MODEL 824)

ITEM	DESCRIPTION	DAILY	WEEKLY	HOURS OF OPERATION						
				20	50	100	200	500	1000	2000
1	Engine Oil	C			*CR	CR				
2	Engine Oil Filter				*CR	CR				
3	Fuel Filter							CR		
4	Transmission Fluid	C		*CR				CR		
5	Transmission Filter			*CR			*CR	CR		
6	Hyd. Reservoir Fluid	C							CR	
7	Hydraulic Filter				*CR				CR	
8	Hydraulic Breather						CLN		CR	
9	Air Cleaner Element					CLN				CR
10	Radiator Coolant					C				CR
11	Battery						C			
12	Axle Differential				*CR		C		CR	
13	Planetary Hubs				*CR		C	CR		
14	Power Assist Hub (Early Models)				*CR		C		CR	
15	Boom Pivot	Lube		Grease Fittings per Item						2
16	Hoist Pivots	Lube								4
17	Tilt Cylinder Pivots	Lube								2
18	Carriage Pivot	Lube								1
19	Boom Rollers	Lube								4
20	Steer Axle Pivot	Lube								2
21	Oscillation Pivot	Lube								2
22	Frame Tilt Cylinder	Lube								2
23	Steer Cylinders		Lube							4
24	Steer Spindles		Lube							4
25	Tie Rod Ends		Lube							2
26	Brake Pedal Pivots		Lube							2
27	Drive Shaft Universals	Lube								2

C = Check fluid levels and add fluid as necessary
CR = Change fluid or replace filter
CLN = Clean item with care to dislodge dust, etc.

* First hours of operation

UNDER DUSTY OR SEVERE OPERATION CONDITIONS-
SHORTEN SERVICE INTERVALS ACCORDINGLY

Table 2-5 Service Schedule

General Maintenance

SERVICE SCHEDULE (MODEL 624)

ITEM	TYPE OF FLUID	QUANTITY
Hydraulic Tank & System	Amoco Rykon MV or Equivalent	45 Gallons
Fuel Tank	Diesel Fuel	40 Gallons
Cooling System	Ethylene Glycol Permanent Coolant	18 Quarts
Transmission & Cooler	Allison C-3 (MIL-L-2104 Grade 10)	18 Quarts Capacity 7.5 Quarts (Drain & Refill + Filter)
Differential (Front Axle)	SAE-90-Mobile Lub 46	9 Quarts
Planetary Hub (Front Axle)	SAE-90-API-GL5	1.5 Pints (each)
Planetary Hub (Early Models)	SAE-90-API-GL5	1 Pint (each)
Engine Crank Case Oil (With Filter)	See Engine Manual	Deere - 15 Quarts Duetz - 10 Quarts

Table 2-6 Lubricants and Capacities

General Maintenance

LUBRICATION INSTRUCTIONS

GENERAL

Service the machine as specified on pages 2.3-1 through 2.5-3, Service Schedule, for best machine performance.

* See Figures 2-1 through 2-3 for lubrication and fluid locations.

* See Tables 2-1 through 2-6 for lubrication and fluid requirements.

* Clean around all oil fill holes before checking or adding oil.

* Keep all lubricants and lubricating equipment clean and free of foreign matter both while in use and while in storage.

* Wipe off any excess lubricants that spill or overflow. Oily or greasy surfaces tend to collect dirt and foreign matter which can work its way into bearings and gears.

GREASE

* Use a lithium base grease with E.P. additives and rust inhibitors. A #2 grade should be used at temperatures above 32°F (0 C) and #1 grade at or below 32°F (0 C).

* Wipe off all fittings before applying grease. Dirt on the fitting can be forced through the opening in the fitting and cause premature bearing failure.

* Lubricate all grease fittings with the proper grease. Apply grease until extra shows. Wipe off excess.

HYDRAULIC OIL

Hydraulic oil selected for use with Lull forklifts should be a premium quality anti-wear hydraulic oil. Characteristics of the oil selected should include:

* Viscosity: Maximum at cold start temperature 6000SUS.
  Minimum at high temperature operation 60SUS.

* Viscosity Index: Minimum - 100
  Optimum - greater than 200

* Oxidation inhibited

* Rust inhibited

* Anti-wear additive

* Anti-foam additive

* Seal conditioning (compatible with Buna-1)

Lull Corporation recommends Amoco Rykon MV or its equivalent.

Your best assurance of a quality product is the assistance that can be offered in its selection by a fluid supplier. Most of the major oil companies are capable of providing suitable products if you provide them with the specifications above.

TRANSMISSION FLUID

Use any oil which meets Allison type C3 hydraulic fluid specifications.

NOTE: When oils are changed or added, ensure that oils of different manufacturers are of the same specifications. Otherwise a chemical reaction may occur, causing a breakdown of the oil's lubricating qualities, resulting in damage to hydraulic components.

ENGINE OIL

Refer to the engine manufacturer's manual for oil requirements.

FRONT AXLE DIFFERENTIAL LUBE

Refer to Service Schedules, this section.

FRONT AXLE PLANETARY HUB LUBE

Refer to Service Schedules, this section.

POWER ASSIST HUB LUBE

Refer to Service Schedules, this section.

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HYDRAULICS

GENERAL INSTRUCTIONS

Regular inspection and maintenance of the hydraulic system is critical to maintaining the high level performance expected from its components. A program of periodic maintenance is the best insurance against cavitation, aeration, oxidation, contamination, and other system failures or damage.

Refer to the Service Schedules, Section 2, for recommended service intervals for the hydraulic system and its components.

Refer to Lubrication Instructions, Section 2, for hydraulic oil recommendations and specifications.

WARNING: The hydraulic system is under pressure whenever the engine is running and may hold pressure even after shutdown. Release all pressure from the hydraulic system before doing any maintenance or repair of the system or its components.

Use the following procedure to release pressure from the hydraulic system:

1. Place blocks under the boom, or lower the boom to the ground.

2. Stop the engine and apply the parking brake.

3. Fully stroke each hydraulic control lever through all its functions at least three times. This will release any remaining pressure from the system.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

CAUTION: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.

WARNING: Do not remove counterbalance valves from cylinders on the machine while the cylinder is under load (extended). If a counterbalance valve must be removed, first retract the cylinder and remove all hydraulic pressure in the circuit. Wear eye protection when removing counterbalance valves.

WARNING: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder even after the cylinder is removed from the machine. If a counterbalance valve must be removed, carefully do so while wearing eye protection.

HYDRAULICS

CLEANLINESS

Cleanliness is critical when servicing hydraulic systems. KEEP DIRT AND OTHER CONTAMINANTS OUT OF THE SYSTEM! Small particles can score valves, seize pumps and clog orifices, causing expensive repair jobs.

Steam clean or use solvents to clean the area of the machine around a hydraulic component before it is removed.

IMPORTANT: When steam cleaning or using water to clean a machine, be sure the reservoir breather filter is protected from possible entry of water into the system.

Use caps or plugs to cover ends of disconnected lines, or to plug openings when working on a hydraulic system

When removing parts for service, clean them with a suitable solvent and store them in plastic bags or other clean containers until they are installed again.

Thoroughly rinse the cleaned parts, and dry them using compressed air. Protect the parts immediately with a coating of rust preventive oil.

A clean work bench is an absolute must when servicing hydraulic components. An industrial-type vacuum cleaner is a valuable aid in removing dust, dirt, and tiny metal particles from the work area.

Check the condition of the tools you use - they should be clean. Always use hammers made of plastic or leather so there is no danger of metal chips getting into components.

Despite all the precautions you take when working with a hydraulic system, some contaminants will get into the system anyway. Good hydraulic oils keep these contaminants in suspension and the filters will collect them as the oil passes through. A good hydraulic oil contains many additives which work to keep contaminants from damaging the system. However, these additives lose their effectiveness after a period of time. Therefore, change the oil at recommended intervals to make sure the additives do their job.

The system filter can absorb only a limited amount of dirt particles and other contaminants from the oil. Therefore, replace the filter element at the recommended intervals so the cleaning process can be maintained.

HYDRAULICS

HYDRAULIC SYSTEM

DESCRIPTION (MODELS 522, 622) See Figures 3-1 & 3-2

The hydraulic system consists of the following circuits:

- Boom Extension
- Boom Hoist
- Carriage Tilt
- Frame Tilt
- Auxiliary
- Steering
- Service Brakes
- Differential Lock

These circuits are supplied by a single gear-type hydraulic pump driven directly from the transmission power take off. Flow to the service brake valve is via a brake priority valve which incorporates a pressure relief valve (522). (Model 622 brake priority is an internal function of the pump.) Flow to all other circuits is via a steer priority valve which receives bypass flow from the brake priority valve (522) or pump (622). The steer priority valve incorporates a pressure relief valve.

The boom extension and hoist circuits are controlled by a two spool valve which incorporates a pressure relief valve. The frame tilt, carriage tilt, and auxiliary circuits are controlled by a three spool valve which has a pressure relief valve. The boom hoist and carriage tilt circuits work in combination with a flow divider (Fork Leveling Valve). The steering circuit is controlled by a hydraulic steering control unit. The service brake circuit is controlled by a hydraulic brake valve. The differential lock function of the front axle is controlled by a manually operated (foot actuated) single spool valve which incorporates a pressure relief valve.

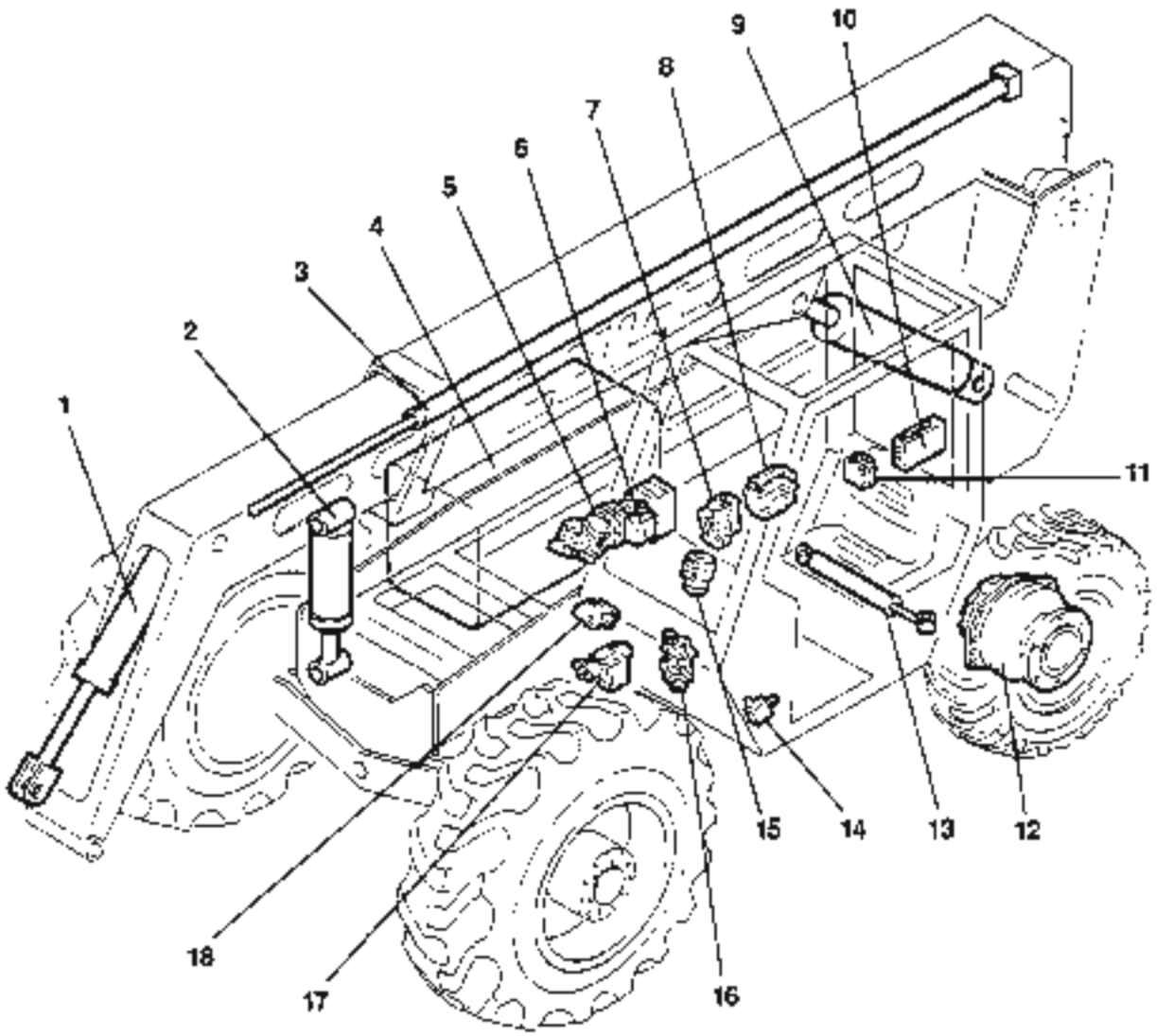
The boom extension, boom hoist, carriage tilt, and frame tilt cylinders are equipped with externally mounted counterbalance valves. The counterbalance valves prevent movement of the cylinders in event of downstream hydraulic line failure, leakage through the main control valve or fittings. The counterbalance valves prevent movement of the cylinders when the engine is off, even if the control valve levers are operated. The counterbalance valves also provide over load relief protection.

The hydraulic reservoir is mounted on the right-hand side of the machine. The hydraulic system return filter/magnetic separator is located at the top of the reservoir. The strainer and suction line is located at the bottom on the back side of the reservoir.

HYDRAULICS

HYDRAULIC SYSTEM

DESCRIPTION (MODELS 522, 622) (cont.)



1 - Carriage Tilt Cylinder
2 - Frame Tilt Cylinder
3 - Boom Extension Cylinder
4 - Hydraulic Reservoir
5 - Hydraulic Pump
6 - Brake Priority Valve
7 - Boom Control Valve
8 - Three Spool Valve
9 - Boom Hoist Cylinder
10 - Fork Leveling Valve
11 - Equatrac Valve (522/4)
12 - Power Assist Drive (522/4)
13 - Steer Cylinder (2)
14 - Differential Lock Valve
15 - Steer Control Unit
16 - Brake Valve
17 - Power Assist Selector Valve
18 - Steer Priority Valve

Figure 3-1 Hydraulic Components (Models 522, 522/4)

HYDRAULICS

HYDRAULIC SYSTEM

DESCRIPTION (MODEL 522/4)
See Figure 3-1

The hydraulic system consists of the following circuits:

* Boom Extension
* Boom Hoist
* Carriage tilt
* Frame Tilt
* Auxiliary
* Steering
* Service Brakes
* Differential Lock
* Power Assist

These circuits are supplied by a two-section hydraulic pump driven from the transmission power-take-off through an offset gearbox (pump drive). The first pump, a gear-type, supplies flow to all circuits (except power assist) via a brake priority valve and steering priority valve (each incorporating a pressure relief valve). The second pump, a variable displacement piston-type with load sensing and pressure limiter control, supplies flow to the rear wheel power assist motors via a solenoid operated selector valve and equatrac valve.

The boom extension and hoist circuits are controlled by a manually operated two spool valve which incorporates a pressure relief valve. The carriage tilt, frame tilt and auxiliary circuits are controlled by a manually operated three spool valve which incorporates two work port pressure relief valves in the carriage tilt circuits. The boom hoist and carriage tilt circuits work in combination with a flow divider (Fork Leveling Valve).

The two rear axle hydraulic power assist motors work in combination with a flow divider (Equatrac Valve). The steering circuit is controlled by a hydraulic steering control unit which receives hydraulic flow from the steer priority valve. The service brake circuits are controlled by a hydraulic brake valve which receives hydraulic flow from the brake priority valve. The differential lock function of the front axle is controlled by a manually operated (foot actuated) single spool valve which incorporates a pressure relief valve.

The boom extension, boom hoist, carriage tilt, and frame tilt cylinders are equipped with externally mounted counterbalance valves. The counterbalance valves prevent movement of the cylinders in event of downstream hydraulic line failure, leakage through the main control valve or fittings. The counterbalance valves prevent movement of the cylinders when the engine is off even if the control valve levers are operated. The counterbalance valves also provide over load relief protection.

The hydraulic reservoir is mounted on the right-hand side of the machine. The hydraulic system return filter/magnetic separator is located at the top of the reservoir. The strainer and suction line are located at the bottom on the back side of the reservoir.

HYDRAULICS

HYDRAULIC SYSTEM

DESCRIPTION (MODELS 622/4, 824)
See Figure 3-2

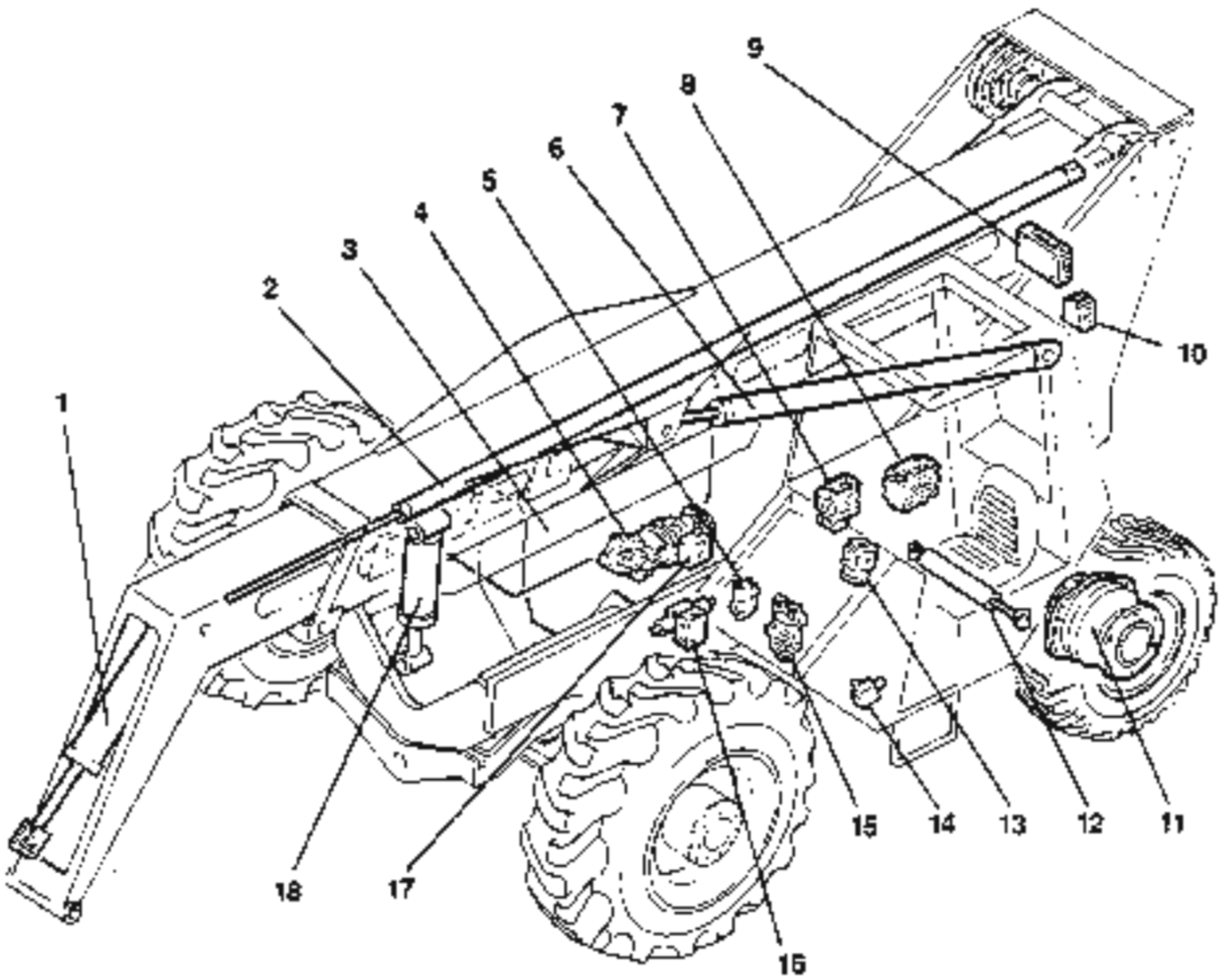
For a description of the Model 622/4 and 824 hydraulic circuits, refer to the description of the hydraulic circuit for the Model 522/4 forklift on page 3.6-1.

NOTE: The pumps on the Model 622/4 and 824 forklifts are driven directly from the transmission power take off. (There is no offset gear box.)

HYDRAULICS

HYDRAULIC SYSTEM

DESCRIPTION (MODELS 622/4, 624)(cont.)



1 - Carriage Tilt Cylinder
2 - Boom Extension Cylinder
3 - Hydraulic Reservoir
4 - Hydraulic Pump
5 - Steer Priority Valve
6 - Boom Hoist Cylinder
7 - Boom Control Valve
8 - Three Spool Valve
9 - Fork Leveling Valve
10 - Equatrac Valve (622/4, 624)
11 - Power Assist Drive (622/4, 624)
12 - Steer Cylinder (2)
13 - Steer Control Unit
14 - Differential Lock Valve
15 - Brake Valve
16 - Power Assist Selector Valve (622/4, 624)
17 - Brake Priority Valve (622/4, 624)
18 - Frame Tilt Cylinder

Figure 3-2 Hydraulic Components (Models 622, 622/4, 624)

HYDRAULICS

HYDRAULIC SYSTEM

CHECKING HYDRAULIC LINES

Inspect hydraulic lines and fittings for gouges, nicks, kinks, leaks, and collapsed or deteriating hoses.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

NOTE: Even small leaks can be detected by oil stains or build-up of dirt or other foreign material in a suspect area.

Replace any tube lines that are pinched or dented.

Replace a hose if any of the following conditions exist:

* Any evidence of hydraulic oil leakage at the surface of the hose or its junction with the metal end couplings.

* Any blistering or abnormal deformation to the outer covering of the hose.

* Hydraulic oil leakage at any threaded or clamped joint that cannot be eliminated by normal tightening.

* Evidence of excessive abrasion or scrubbing on the outer surface of hose or hoses

IMPORTANT: When tightening loose lines or connections, use two wrenches to avoid twisting hose or tubes. Tighten loose connections only until the leak stops. An over-tightened fitting may result in over-stressing and/or cracking. Replace any connectors that continue to leak. See "Torque Specifications For Hydraulic Line Connections" for maximum torque values on page 1.8-1 of Section 1.

CHECKING AND ADJUSTING CIRCUIT PRESSURE

(FOR MACHINES WITH DIAGNOSTIC PORTS)

Later production model forklifts are equipped with diagnostic ports for checking hydraulic operating pressure of circuits (See Tables 3-1 through 3-5). For forklifts not equipped with diagnostic ports, see page 3.9-12 for checking and adjusting circuit pressure.

DIAGNOSTIC PORT LOCATIONS:

(Model 522)
1. Hydraulic Pump
2. Fork Leveling Valve
3. Under Cab Floor at Diff. Lock
4. Steer Priority Valve
5. Brake Priority Valve

(Model 522/4)
1. Inboard Hydraulic Pump
2. Outboard Hydraulic Pump
3. Fork Leveling Valve
4. Under Cab Floor at Diff. Lock
6. Steer Priority Valve
6. Brake Priority Valve
7. Equatrac Valve

(Model 622)
1. Hydraulic Pump (Brake Priority Port)
2. Steer Priority Valve ("P" port)
3. Steer Priority Valve ("PP" port)
4. Fork Leveling Valve
5. Front Axle (Diff. Lock)

(Models 622/4, 624)
1. Inboard Pump
2. Outboard Pump
3. Fork Leveling Valve
4. Front Axle (Diff. Lock)
5. Steer Priority Valve
6. Brake Priority Valve
7. Equatrac Valve

Order Lull test gauge kit #26231C for checking hydraulic brake pressure and differential lock pressure.

Order Lull test gauge kit #26232C for checking all other circuits.

HYDRAULICS

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

(FOR MACHINES WITH DIAGNOSTIC PORTS) (cont.)

Diagnostic port nipples are also compatible with Parker Senso Control Electronic Gauge Transducers.

Recommended test gauge capacities are 1500 psi for the brake and 5000 psi for all other circuits.

WARNING: Before attaching or detaching a test gauge to or from a diagnostic port, lower the boom, apply the parking brake, stop the engine, place transmission in neutral, and release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section).

NOTE: Checking and adjusting circuit pressures is a two-man operation. One man must be stationed in the operators cab to operate the controls while the other man monitors the test equipment.

CHECKING AND ADJUSTING PROCEDURES (MODEL 522)

1. Use the following procedure to check and adjust hydraulic pressure for the boom hoist, boom extend, frame tilt, and auxiliary circuits:

   A. Follow procedure under "Warning" on this page and attach an appropriate test gauge to the diagnostic port located on the pump.

   B. Start the engine and retract the boom.

   C. While holding the boom control handle in the retracted position, and with the engine running at full rpm, note the test gauge pressure reading.

   D. If the pressure reading is not correct (see Table 3-1), adjust the main pressure relief valve of the three spool control valve to the correct pressure: Refer to "Adjusting Pressure Relief Valves" on page 3.9-15.

   E. Follow procedure under "Warning" on this page (be sure the test gauge pressure reads "0" psi before detaching the test gauges).

2. Use the following procedure to check and adjust hydraulic pressure for the carriage tilt (boom lowering) circuit:

   A. Follow procedure under "Warning" on this page and attach an appropriate test gauge to the diagnostic port located on the fork leveling valve.

   B. Start the engine. Raise the boom to approximately six feet above the ground and fully tilt the fork carriage back.

   C. While running the engine at full rpm, lower the boom. While lowering the boom note the test gauge pressure reading.

   D. If the pressure reading is not correct (see Table 3-1), adjust the work port relief valve on top of the 3 spool control valve: Refer to "Adjusting Pressure Relief Valves" on page 3.9-15.

   E. Follow procedure under "Warning" on this page (be sure the test guage pressure reads "0" psi before detaching the test gauge).

3. Use the following procedure to check and adjust hydraulic pressure for the Differential Lock circuit:

   A. Follow procedure under "Warning" on this page and attach an appropriate test gauge to the diagnostic port under the cab floor.

   B. Start the engine and, while running the engine at full rpm, depress the differential lock control valve actuator.

   C. Note the test gauge pressure reading.

   D. If the pressure reading is not correct (see Table 3-1), adjust the pressure relief valve on the differential lock control valve: Refer to "Adjusting Pressure Relief Valves" on page 3.9-15.

HYDRAULICS

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

(FOR MACHINES WITH DIAGNOSTIC PORTS) (cont.)

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge).

4. Use the following procedure to check and adjust hydraulic pressure for the steering circuit:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the steer priority valve.

B. Start the engine.

C. Turn the steering wheel full left and, with the engine running at full rpm, note the test gauge reading.

D. If the pressure reading is not correct (see Table 3-1), adjust the pressure relief valve on the steering priority valve: refer to "Adjusting Pressure Relief" under "Steering Priority Valve" on page 3.49-1.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge reads "0" psi before detaching the test gauge).

5. Use the following procedure to check and adjust hydraulic pressure for the service brake circuit:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the brake priority valve.

B. Start the engine.

C. While running the engine at full rpm, apply the service brakes and hold. Note the test gauge pressure reading.

D. If the pressure reading is not correct (see Table 3-1), adjust the pressure relief valve on the brake priority valve: refer to "Adjusting Pressure Relief" under "Brake Priority Valve" on page 3.46-1.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge).

CHECKING AND ADJUSTING PROCEDURES (MODEL 622)

1. Use the following procedure to check and adjust hydraulic pressure for the boom hoist, boom extend, frame tilt, and auxiliary circuits:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the steer priority valve ("P" Port).

B. Start the engine and retract the boom.

C. While holding the boom control handle in the retracted position, and with the engine running at full rpm, note the test gauge pressure reading.

D. If the pressure reading is not correct (see Table 3-2), adjust the main pressure relief valve of the three spool control valve to the correct pressure: refer to "Adjusting Pressure Relief Valves" on page 3.9-15.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauges).

2. Use the following procedure to check and adjust hydraulic pressure for the carriage tilt (boom lowering) circuit:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the fork leveling valve.

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

(FOR MACHINES WITH DIAGNOSTIC PORTS) (cont.)

B. Start the engine. Raise the boom to approximately six feet above the ground and fully tilt the fork carriage back.

C. While running the engine at full rpm, lower the boom. While lowering the boom note the test gauge pressure reading.

D. If the pressure reading is not correct (see Table 3-2), adjust the work port relief valve on bottom of the 3 spool control valve: Refer to "Adjusting Pressure Relief Valves" on page 3.9-15.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test guage pressure reads "0" psi before detaching the test gauge).

3. Use the following procedure to check and adjust hydraulic pressure for the differential lock circuit:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port at the front axle.

B. Start the engine and, while running the engine at full rpm, depress the differential lock control valve actuator.

C. Note the test gauge pressure reading.

D. If the pressure reading is not correct (see Table 3-2), adjust the pressure relief valve on the differential lock control valve: Refer to "Adjusting Pressure Relief Valves" on page 3.9-15.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge).

4. Use the following procedure to check and adjust hydraulic pressure for the steering circuit:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the steer priority valve (port "PP").

B. Start the engine.

C. Turn the steering wheel full left and, with the engine running at full rpm, note the test gauge reading.

D. If the pressure reading is not correct (see Table 3-2), adjust the pressure relief valve on the steering priority valve: refer to "Adjusting Pressure Relief" under "Steering Priority Valve" on page 3.49-1.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge reads "0" psi before detaching the test gauge).

5. Use the following procedure to check and adjust hydraulic pressure for the service brake circuit:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the hydraulic pump (priority circuit).

B. Start the engine.

C. While running the engine at full rpm, apply the service brakes and hold. Note the test gauge pressure reading.

D. If the pressure reading is not correct (see Table 3-2), adjust the pressure relief valve on the brake priority valve: refer to "Adjusting Pressure Relief" under "Brake Priority Valve" on page 3.46-1.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge)

HYDRAULICS

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

(FOR MACHINES WITH DIAGNOSTIC PORTS) (cont.)

CHECKING AND ADJUSTING PROCEDURES (MODELS 522/4, 622/4, 624)

1. Use the following procedure to check and adjust hydraulic pressure for the boom hoist, boom extend, frame tilt, auxiliary, and outrigger (624) circuits:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the inboard pump.

B. Start the engine and retract the boom.

C. While holding the boom control handle in the retract position, and with the engine running at full rpm, note the test gauge pressure reading.

D. If the pressure reading is not correct (see Tables 3-3 through 3-5), adjust the main pressure relief valve of the three spool control valve to the correct pressure: refer to "Adjusting Pressure Relief Valves" on page 3.9-15.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge)

2. Use the following procedures to check and adjust hydraulic pressure for the rear wheel power assist at the pump:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the outboard pump.

B. Start the engine and note test gauge reading with power assist disengaged.

C. See Tables 3-3 through 3-5 for correct pressure. If pressure reading varies more than 100 psi under or over recommended pressure, replace the pump compensator.

D. Apply the parking brake and block the tires. Place transmission selector in 1st or reverse gear and engage the power assist.

E. Note test gauge pressure reading (check against Tables 3-3 through 3-5). If pressure reading is less than 2500 psi - replace the pump. [See "Removal - Piston Pump" on page 3.28-1 (522/4), 3.31-1 (622/4, 624).]

F. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge).

3. Use the following procedure to check and adjust hydraulic pressure for the rear whee power assist at the equatrac valve:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the equatrac valve.

B. Start the engine and note test gauge reading with power assist disengaged

C. See Tables 3-3 through 3-5 for correct pressure. If pressure exceeds 30 psi - replace the power assist selector valve.

D. Apply the parking brake and block the tires. Place transmission selector in 1st or reverse gear and engage the power assist.

E. Note test gauge pressure reading (check against Tables 3-3 through 3-5). If no pressure, inspect check ball and check seats in power assist selector valve subplate

F. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge).

4. Use the following procedure to check and adjust hydraulic pressure for the carriage tilt (boom lowering) circuit:

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

(FOR MACHINES WITH DIAGNOSTIC PORTS) (cont.)

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the fork leveling valve.

B. Start the engine. Raise the boom to approximately six feet above the ground and fully tilt the fork carriage back.

C. While running the engine at full rpm, lower the boom. While lowering the boom note the test gauge pressure reading.

D. If the pressure reading is not correct (see Table 3-3 through 3-5), adjust the work port relief valve on top (522/4), or bottom (622/4, 824) of the 3 spool control valve: refer to "Adjusting Pressure Relief Valves" on page 3.9-15.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge).

5. Use the following procedure to check and adjust hydraulic pressure for the differential lock circuit:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port under the cab floor (522/4), or front axle (622/4, 824).

B. Start the engine and, while running the engine at full rpm, depress the differential lock control valve actuator.

C. Note the test gauge pressure reading.

D. If the pressure reading is not correct (see Tables 3-3 through 3-5), adjust the pressure relief valve on the differential lock control valve: refer to "Adjusting Pressure Relief Valves" on page 3.9-15.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge).

6. Use the following procedure to check and adjust hydraulic pressure for the steering circuits:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the steer priority valve.

B. Start the engine.

C. Turn the steering wheel full left and, with the engine running at full rpm, note the test gauge reading.

D. If the pressure reading is not correct (see Tables 3-3 through 3-5), adjust the pressure relief valve on the steering priority valve: refer to "Adjusting Pressure Relief" under "Steering Priority Valve" on page 3.49-1

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge reads "0" psi before detaching the test gauge).

7. Use the following procedure to check and adjust hydraulic pressure for the service brake circuit:

A. Follow procedure under "Warning" on page 3.9-2 and attach an appropriate test gauge to the diagnostic port located on the brake priority valve.

B. Start the engine.

C. While running the engine at full rpm, apply the service brakes and hold. Note the test gauge pressure reading.

D. If the pressure reading is not correct (see Tables 3-3 through 3-5), adjust the pressure relief valve on the brake priority valve: refer to "Adjusting Pressure Relief" under "Brake Priority Valve" on page 3.46-1.

E. Follow procedure under "Warning" on page 3.9-2 (be sure the test gauge pressure reads "0" psi before detaching the test gauge).

HYDRAULICS

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

DIAGNOSTIC PORT LOCATION	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
1. Hydraulic Pump	2600	Main Pressure Relief Valve (Boom Control Valve)	Boom Hoist Boom Extend Frame Tilt Auxiliary
2. Fork Leveling Valve	2000	Bottom Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Raising)
	2100	Top Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Lowering)
3. Under Cab Floor at Differential Lock	295	Pressure Relief Valve (Differential Lock Valve)	Differential Lock
4. Steer Priority Valve	2000	Pressure Relief Valve (Steer Priority Valve)	Steering
5. Brake Priority Valve (Hydraulic Gear Pump)	700	Pressure Relief Valve (Brake Priority Valve)	Service Brakes

Table 3-1 Checking and Adjusting Circuit Pressure (Model 522)

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

DIAGNOSTIC PORT LOCATION	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
1. Steer Priority Valve ("P" Port)	2900	Main Pressure Relief Valve (Boom Control Valve)	Boom Hoist Boom Extend Frame Tilt Auxiliary
2. Fork Leveling Valve	2000	Top Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Raising)
	2500	Bottom Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Lowering)
3. Front Axle	285	Pressure Relief Valve (Differential Lock Valve)	Differential Lock
4. Steer Priority Valve ("PP" Port)	2000	Pressure Relief Valve (Steer Priority Valve)	Steering
5. Hydraulic Pump (Priority Circuit)	700	Pressure Relief Valve (Hydraulic Pump)	Service Brakes

Table 3-2 Checking and Adjusting Circuit Pressure (Model 622)

HYDRAULICS

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

DIAGNOSTIC PORT LOCATION	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
1. Inboard Hydraulic Pump	2500	Main Pressure Relief Valve (Boom Control Valve)	Boom Hoist Boom Extend Frame Tilt Auxiliary
2. Outboard Hydraulic Pump	2600-3000 (System On) 250 (System Off)	None (see Text) None (see Text)	Rear Wheel Power Assist
3. Equatrac Valve	2600-3000 (System On) 0-30 (System Off)	None (see Text) None (see Text)	Rear Wheel Power Assist
4. Fork Leveling Valve	2000	Bottom Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Raising)
	2100	Top Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Lowering)
5. Under Cab Floor at Differential Lock	285	Pressure Relief Valve (Differential Lock Valve)	Differential Lock
6. Steer Priority Valve	2000	Pressure Relief Valve (Steer Priority Valve)	Steering
7. Brake Priority Valve	700	Pressure Relief Valve (Brake Priority Valve)	Service Brakes

Table 3-3 Checking and Adjusting Circuit Pressure (Model 522/4)

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

DIAGNOSTIC PORT LOCATION	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
1. Inboard Hydraulic Pump	2900	Main Pressure Relief Valve (Boom Control Valve)	Boom Hoist Boom Extend Frame Tilt Auxiliary
2. Outboard Hydraulic Pump	2500-3000 (System On) 250 (System Off)	None (see Text) None (see Text)	Rear Wheel Power Assist
3. Equatrac Valve	2500-3000 (System On) 0-30 (System Off)	None (see Text) None (see Text)	Rear Wheel Power Assist
4. Fork Leveling Valve	2000	Top Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Raising)
	2500	Bottom Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Lowering)
5. Front Axle	285	Pressure Relief Valve (Differential Lock Valve)	Differential Lock
6. Steer Priority Valve	2000	Pressure Relief Valve (Steer Priority Valve)	Steering
7. Brake Priority Valve	700	Pressure Relief Valve (Brake Priority Valve)	Service Brakes

Table 3-4 Checking and Adjusting Circuit Pressure (Model 622/4)

HYDRAULICS

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

DIAGNOSTIC PORT LOCATION	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
1. Inboard Hydraulic Pump	2600	Main Pressure Relief Valve (Boom Control Valve)	Boom Hoist Boom Extend Frame Tilt Auxiliary
2. Outboard Hydraulic Pump	2600-3000 (System On) 250 (System Off)	None (see Text) None (see Text)	Rear Wheel Power Assist
3. Equatrac Valve	2600-3000 (System On) 0-30 (System Off)	None (see Text) None (see Text)	Rear Wheel Power Assist
4. Fork Leveling Valve	2000	Top Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Raising)
	2500	Bottom Work Port Pressure Relief Valve (3 Spool Valve)	Carriage Tilt (Boom Lowering)
5. Front Axle	285	Pressure Relief Valve (Differential Lock Valve)	Differential Lock
6. Steer Priority Valve	2000	Pressure Relief Valve (Steer Priority Valve)	Steering
7. Brake Priority Valve	700	Pressure Relief Valve (Brake Priority Valve)	Service Brakes

Table 3-5 Checking and Adjusting Circuit Pressure (Model 824)

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

FOR MACHINES WITHOUT DIAGNOSTIC PORTS

Use the following procedure to check the hydraulic operating pressure for each circuit. (Refer to Section 10, "Brakes", for checking and adjusting brake line pressure and to Section 7, "Rear Wheel Power Assist", for checking power assist pressure.)

1. Lower the boom, apply the parking brake and stop the engine.

2. Release all hydraulic pressure in the system. See warning and procedure on page 3.2-1 of this section.

3. Disconnect a hose from one end of the cylinder for the circuit to be checked (see Tables 3-6 and 3-7). Plug opening.

4. Connect a 5000 psi hydraulic pressure gauge to the disconnected hose (see Figure 3-3).

5. Start the engine and run at full operating speed.

6. Have a person in the operator's cab operate the function that will pressurize the hose connected to the gauge.

7. If the circuit pressure is not correct (see Tables 3-6 and 3-7), adjust the pressure relief valve to the specified pressure for that circuit. See "Adjusting Pressure Relief Valves" on page 3.9-16. (For steering, See "Adjusting Pressure Relief" under "Steering Priority Valves", page 3.49-1)

8. Stop the engine and release all hydraulic pressure in the system.

9. Remove the hydraulic pressure gauge and reconnect the hose to the cylinder.

10. Repeat steps 1 - 9 for each circuit to be checked.

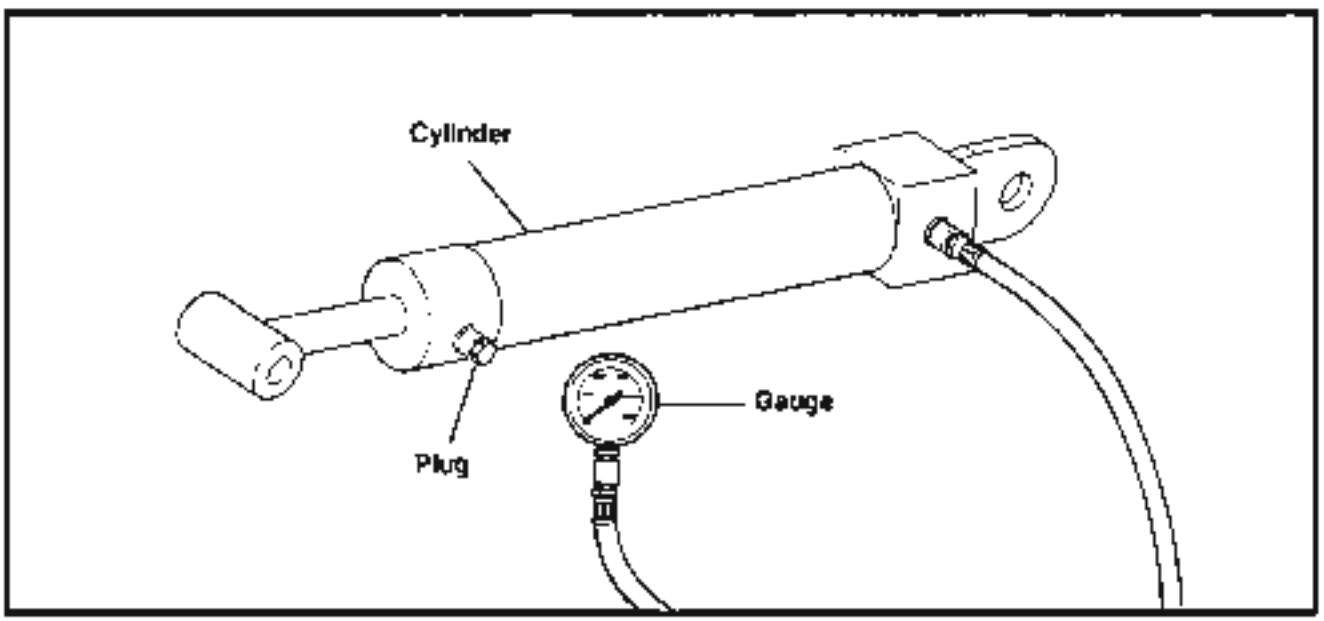


Figure 3-3 Checking Circuit Pressure

HYDRAULICS

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

CHECK CYLINDER	TEST PROCEDURE	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
Frame Tilt (Top Port)	Tilt Frame Tilt to full	2600	Main Pressure Relief (Boom Control Valve)	Boom Hoist Boom Extend Frame Tilt Auxiliary
Fork Tilt (Top Port)	Tilt Carriage Rearward, Lower Boom from 6' Elevation	2100	Top Port Pressure Relief (3 Spool Valve)	Carriage Tilt (Boom Lowering)
Left Rear Steer Cyl. (Outer Port)	Wheels Turned to Left	2000	Pressure Relief (Steer Priority Valve)	Steering
Diff. Lock Hose at Front of Front Axle	Engage Differential Lock	265	Pressure Relief (Differential Lock Valve)	Differential Lock

Table 3-6 Checking and Adjusting Circuit Pressure (Models 522, 522/4)

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

CHECK CYLINDER	TEST PROCEDURE	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
Frame Tilt (Top Port)	Tilt Frame Tilt to left	2900	Main Pressure Relief (Boom Control Valve)	Boom Hoist Boom Extend Frame Tilt Auxiliary
Fork Tilt (Top Port)	Tilt Carriage Rearward, Lower Boom from 6' Elevation	2500	Bottom Port Pressure Relief (3 Spool Valve)	Carriage Tilt (Boom Lowering)
Left Rear Steer Cyl. (Outer Port)	Wheels Turned to Left	2000	Pressure Relief (Steer Priority Valve)	Steering
Diff. Lock Hose at Top Center of Front Axle	Engage Differential Lock	285	Pressure Relief (Differential Lock Valve)	Differential Lock

Table 3-7 Checking and Adjusting Circuit Pressure (Models 622, 622/4, 624)

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

ADJUSTING PRESSURE RELIEF VALVES

EXTERNALLY ADJUSTED (Figure 3-4)

NOTE: Some externally adjusted relief valves have cap nuts over the adjusting screw and some have jam nuts which lock the adjusting screw.

Turn the adjusting screw clockwise to increase pressure and counterclockwise to reduce pressure.

If the relief valve does not adjust to correct pressure, stop the engine and release all hydraulic pressure in the system (see warning and procecure on page 3.2-1 of this section). Remove the relief valve, clean and inspect, reinstall or replace if necessary.

SHIM ADJUSTED (Figure 3-5)

Make note of the incorrect pressure reading. Stop the engine and release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section). Remove hex cap, spring and shim(s). Add the correct thickness shims to increase pressure, remove the correct thickness shims to reduce pressure (see Lull Parts Book for shim thicknesses available).

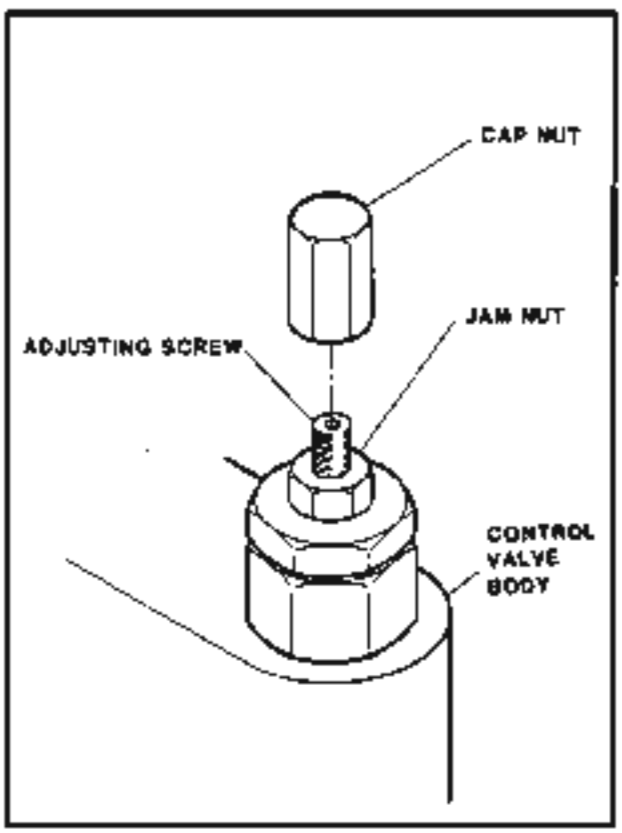


Figure 3-4 Pressure Relief Valve - Externally Adjusted

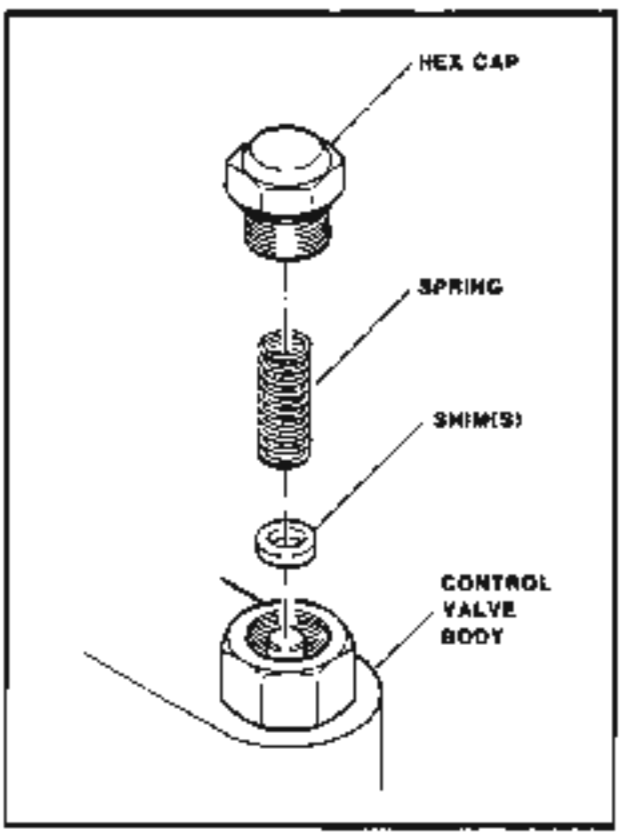


Figure 3-5 Pressure Relief Valve - Shim Adjusted

HYDRAULICS

HYDRAULIC SYSTEM

CLEANING AND FLUSHING SYSTEM

If there has been a component failure in the hydraulic system which has caused a significant amount of contamination to enter the system, the return filter may plug, other components may be damaged, or both.

If the filter plugs as a result of contamination from a failed component, the oil will go over the filter by-pass valve and contaminate the entire hydraulic system.

When a hydraulic system has been contaminated to this extent it must be drained, cleaned, and flushed.

Use the following procedure to clean and flush the hydraulic system:

1. Perform steps 1 - 15 of "Reservoir Drain and Refill" on page 3.19-1 of this section.

2. If there has been a component failure or normal operation of a component has been affected by contamination, the component must be disassembled, cleaned and repaired, or replaced.

   a. Inspect and clean main relief valves, port relief valves and counterbalance valves.

   b. Dismantle and clean affected hydraulic cylinders and replace packing.

3. Connect the ends of both hoses for each cylinder together, causing an open loop in each circuit, which eliminates the cylinders (Figure 3-12).

4. Perform steps 16 - 22 of "Reservoir Drain and Refill"

5. Start the engine and run at approximately 1000 rpm.

NOTE: The return filter indicator gauge (Figure 3-7) should be watched closely during this procedure. (Order P/N P24961 for indicator gauge if your machine is not so equipped.) If the filter plugs, the engine should be shut off and the filter element changed immediately. The flushing procedure will do no good if the oil is not being filtered.

6. Actuate each hydraulic control valve function in each direction for 15 seconds.

7. Stop the engine.

8. Release all hydraulic pressure from the system. See warning and procedure on page 3.2-1 in this section.

9. Reconnect the hoses to the cylinders

10. Start the engine and cycle each cylinder to both ends of its stroke at least five times. Check for leaks.

NOTE: If a component is not operating properly or is making noise, locate and correct the problem before continuing. See "System Troubleshooting" on page 3.13-1 in this section.

11. Replace the return filter element. See "Replacing Return Filter Element" on page 3.18-1 in this section.

12. Replace the return filter element again after 50 hours of operation, after 100 hours of operation, and at 1000 hour intervals thereafter.

HYDRAULICS

HYDRAULIC SYSTEM

CLEANING AND FLUSHING SYSTEM (cont.)

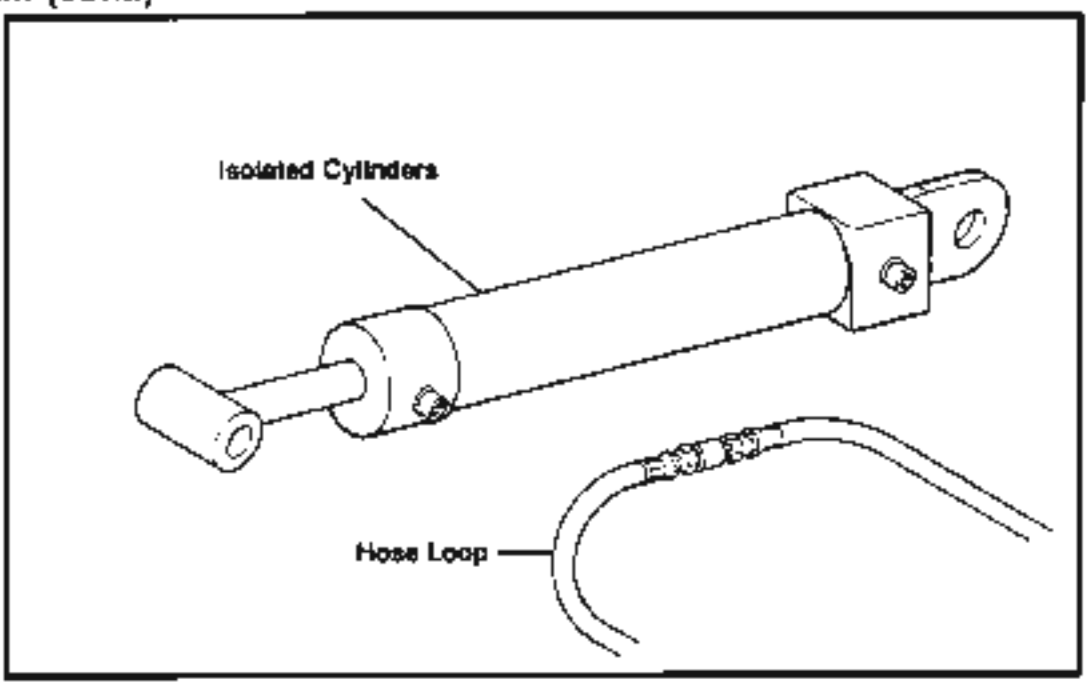


Figure 3-6 Hose Loop

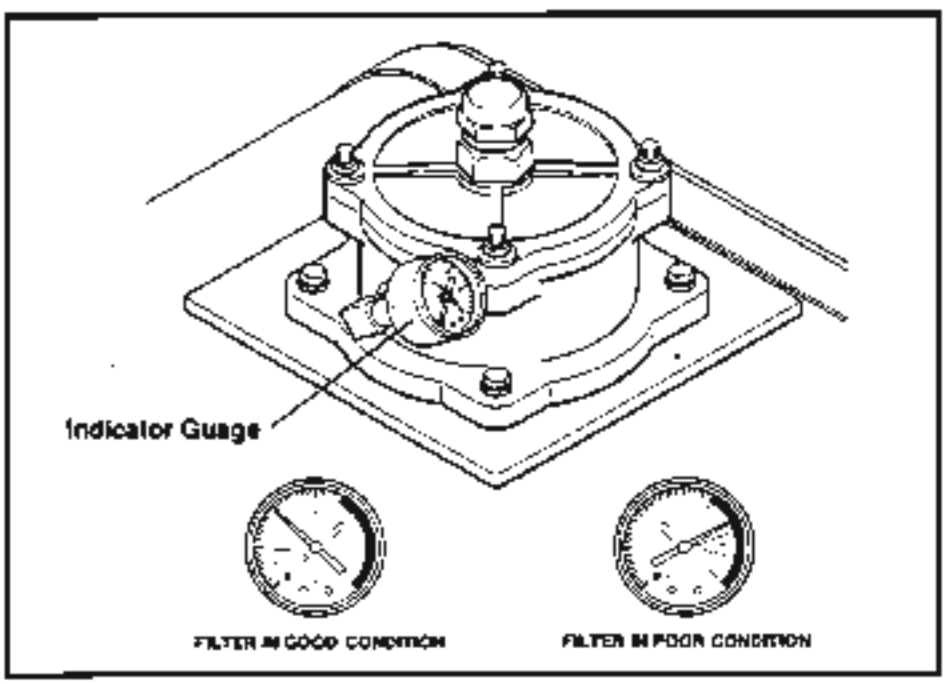


Figure 3-7 Indicator Gauge

HYDRAULICS

HYDRAULIC SYSTEM

SYSTEM TROUBLESHOOTING

The greatest aid to troubleshooting is the confidence of knowing the system. The construction and operating characteristics of each circuit should be understood.

Know the capabilities of the system. Each component in the system has a maximum rated speed, torque, or pressure. Loading the system beyond the specifications only increases the possibility for failure.

When troubleshooting a hydraulic system problem, determine the possible causes in the order of sequence. Start at the reservoir and proceed through the suction, pressure, and return side of each circuit. The following guide has the causes listed in sequential order for proper troubleshooting.

PROBLEM
* = Possible cause.
- = Correction.

NO MOVEMENT

* Control linkage disconnected.
- Check linkage and repair.

* No hydraulic oil.
- Check oil level in reservoir and add if necessary.

* Hydraulic oil too thick.
- Let system warm up, or replace oil with oil of correct viscosity.

* Plugged suction strainer.
- Remove and clean or replace strainer.

* Damaged pump.
- Check pump and repair or replace. Check for problems causing pump wear, such as contamination or cavitation.

* Pump not operating.
- Check pump drive.

* Relief valve defective.
- Test relief valves to make sure they are opening at their rated pressure. Clean, adjust, or repair relief valve.

* Damaged or worn components.
- Examine and test valves, motors, cylinders, etc. for external and internal leaks. Repair or replace components. If wear is abnormal, try to locate the cause.

SLOW MOVEMENT

* Control linkage out of adjustment.
- Check linkage and adjust or repair.

* Hydraulic oil is too thick.
- Let system warm up, or replace oil with oil of correct viscosity.

* Hydraulic oil level is too low.
- Check oil level in reservoir and add if necessary. Check system for leaks which could cause loss of oil.

* Suction strainer partially plugged.
- Remove and clean or replace filter.

* Damaged pump.
- Check pump and repair or replace. Check for problems causing pump wear, such as contamination or cavitation.

* Insufficient engine speed.
- Governor may need adjustment, or engine is not working properly.

* Relief valves not properly set or leaking.
- Test relief valves to make sure they are opening at their rated pressure. Examine valves for damaged seats that could leak. Clean, adjust, or replace relief valve.

* Damaged or worn components.
- Examine and test valves, cylinders, etc. for external and internal leaks. Repair or replace components. If wear or damage is abnormal, try to locate the cause.

ERRATIC MOVEMENT

* Hydraulic oil level is low.
- Check oil level in reservoir and add if necessary. Check system for leaks which could cause loss of oil.

* Damaged pump.
- Check pump and repair or replace. Check for problems causing pump wear, such as contamination or cavitation.

HYDRAULICS

HYDRAULIC SYSTEM

SYSTEM TROUBLESHOOTING (cont.)

ERRATIC MOVEMENT (cont.)

* Relief valve sticking.
- Clean and adjust or replace relief valve. This may indicate a contaminated hydraulic system. Oil samples should be analyzed. Find source of contamination.

* Damaged or worn components.
- Examine and test valves, cylinders, etc. for damage or leakage. Repair or replace component. If wear is abnormal, try to locate the cause.

* Air in cylinders.
- Stroke cylinders to both ends several times. If this condition is recurrent, locate and repair air leak in hydraulic system.

* Components sticking or binding.
- Check and repair or replace worn or damaged bearings or pins.

MOVEMENT TOO FAST

* Excessive flow.
- Adjust engine speed.

* Flow control valve relief set too high.
- Adjust flow control valve relief.

OVERHEATING

* Operator holds control valves in power position too long, causing relief valve to open.
- Return control lever to neutral position when not in use.

* Using incorrect oil.
- Use recommended oil. Be sure oil viscosity is correct.

* Hydraulic oil level is too low.
- Check oil level in reservoir and add if necessary. Check system for leaks which could cause loss of oil.

* Excessive flow.
- Adjust engine speed.

* Restriction in hydraulic system.
- Replace any damaged tube lines and hoses or other restricting component.

* Heat disalpation is restricted.
- Clean dirt and debris from hydraulic reservoir, oil lines and components.

* Worn hydraulic motor.
- Check and repair or replace motor.

EXTERNAL LEAKS

* Damaged or loose hoses, tubelines, or fittings.
- Check and tighten or replace component.

* Damaged pump shaft seal.
- Replace seal. Trouble may be caused by contaminated oil. Check oil for abrasives. Try to locate cause of contamination. Check the pump drive shaft. Misalignment could cause the seal to wear. If the shaft is not aligned, check the pump for other damage.

* Loose or broken pump or motor parts.
- Make sure all bolts and fittings are tight. Check gaskets. Examine casting for cracks.

* Control valve tie bolts too loose.
- Tighten the tie bolts equally.

* Worn or damaged valve o-rings.
- Replace o-rings (especially between valve sections). If contamination has caused o-rings to wear, find source of contamination.

* Cylinder rod seal leaking.
- Replace seal. If contamination has caused seal to wear, look for source. Wear may be caused by external, as well as internal, contamination. Check piston rod for scratches.

* Cylinder gland seal leaking.
- Replace seal. Look for cause of seal damage.

PUMP MAKES NOISE

* Low oil level.
- Check oil level in reservoir and add if necessary.

* Oil viscosity too high.
- Change to a lighter oil.

SYSTEM TROUBLESHOOTING (cont.)

PUMP MAKES NOISE (cont.)

* Reservoir breather filter plugged.
- Replace reservoir breather filter.

* Suction line pinched.
- Replace line between reservoir and pump.

* Air in oil.
- Tighten or replace suction line. Check system for leaks. Replace pump shaft seal.

* Pump speed too fast.
- Adjust engine speed.

* Worn or damaged pump parts.
- Check pump and repair or replace. Check for problems causing pump wear such as contamination or cavitation.

LOAD DROPS WITH CONTROL IN NEUTRAL

* Control lever not centering when released.
- Check linkage for binding. Make sure valve has no broken or binding parts.

* Oil leaking past control valve or relief valves.
- Clean or replace relief valves. Wear may be caused by contamination. Have oil samples analyzed. Find source of contamination.

* Leaking or broken oil lines from control valve to cylinder.
- Check for leaks. Tighten or replace lines.

* Cylinder leaking internally.
- Test and repair or replace cylinder. Wear may be caused by contamination. Oil samples should be analyzed. Find source of contamination.

BOOM WON'T GO UP

* No mechanical link to valve.
- Check control linkage.

* Spool won't move.
- Disassemble valve and address defective components.

* No hydraulic pressure or flow.
- Check hydraulic pressure (system), check pump, fluid level, suction strainer.

* Relief stuck open.
- Remove, clean or replace.

* Cylinder(s).
- Disassemble and address defective components.

* Load too heavy.
- Refer to load chart.

BOOM WON'T GO DOWN

* No mechanical link to valve.
- Check control linkage.

* Spool won't move.
- Disassemble valve and address defective components.

* No hydraulic pressure or flow.
- Check hydraulic pressure (system), check pump, fluid level, suction strainer.

* Relief stuck open.
- Disassemble

* No pilot pressure.
- Check hydraulic lines.

* Port relief (carriage tilt).
- Increase pressure.

BOOM WON'T EXTEND

* No mechanical link to valve.
- Check linkage.

* Spool won't move.
- Disassemble valve.

* No hydraulic pressure or flow.
- Check pump, suction strainer.

* Orifice plugged
- Remove and clean

* Boom shimmed too tight.
- Remove shim(s).

HYDRAULICS

HYDRAULIC SYSTEM

SYSTEM TROUBLESHOOTING (cont.)

BOOM WON'T EXTEND (cont.)

* No pilot pressure.
- Check hydraulic line.

* Counterbalance valve.
- Remove and check.

BOOM WON'T RETRACT

* No mechanical link to valve.
- Check control linkage.

* Spool won't move.
- Disassemble valve and address defective components.

* No hydraulic pressure or flow.
- Check hydraulic pressure, pump, fluid level, suction strainer.

* Boom shimmed too tight.
- Remove as required.

* Counterbalance valve.
- Remove and check.

* Packing.
- Remove cylinder and repack.

CARRIAGE WON'T TILT FORWARD

* No mechanical link to valve.
- Check linkage.

* Leaking packing.
- Remove cylinder and repack.

* Counterbalance valve stuck shut.
- Remove and inspect.

* No hydraulic pressure or flow.
- Check pump, reservoir.

* Spool stuck.
- Disassemble valve.

CARRIAGE WON'T TILT REARWARD

* No mechanical link to valve.
- Check linkage.

* Leaking Packing.
- Remove cylinder and repack.

* No hydraulic pressure or flow.
- Check pump, reservoir.

* Spool stuck.
- Disassemble valve.

FORKS WON'T LEVEL

* Fork levelling valve improperly adjusted
- Adjust

FRAME TILT DRIFTS TO ONE SIDE

* Check valve leaking.
- Remove, clean or replace.

* Packing leaking.
- Remove cylinder and repack.

* No hydraulic pressure.
- Check valve control linkage.

POWER STEERING DOES NOT WORK, STEERS HARD, OR IS SLOW.

* Air in system.
- Turn completely right and left several times to get air out of system. Check for air leaks.

* Internal leakage in system.
- Parts may be worn or broken. Check for cause of wear.

* Insufficient pressure
- Check pump and relief valves. Contamination could cause valves to leak or pump to wear.

SYSTEM TROUBLESHOOTING (CONT.)

POWER BRAKES MALFUNCTION

* Air in system (pedal kicks back).
- Bleed brake system. Find out where air is coming from.

* Contaminated oil.
- This may cause components to wear or jam. Clean and repair system and check for cause of contamination.

* Accumulator not working.
- Check accumulator precharge. If accumulator is defective, repair or replace it.

HYDRAULICS

HYDRAULIC SYSTEM

SYSTEM SCHEMATICS

(Pages 1a through 9a)

HYDRAULIC CIRCUIT SYMBOLS

U.S.A.S.I. (United States of America Standards Institute)
J.I.C. (Joint Industry Council)

Pumps

HYDRAULIC PUMP: FIXED DISPLACEMENT	
VARIABLE DISPLACEMENT	

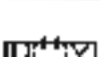
Motors and Cylinders

HYDRAULIC MOTOR; FIXED DISPLACEMENT	
VARIABLE DISPLACEMENT	
CYLINDER, SINGLE ACTING	
CYLINDER, DOUBLE ACTING	
SINGLE END ROD	
DOUBLE END ROD	
ADJUSTABLE CUSHION ADVANCE ONLY	
DIFFERENTIAL PISTON	

Miscellaneous Units

ELECTRIC MOTOR	
ACCUMULATOR, SPRING LOADED	
ACCUMULATOR, GAS CHARGED	
HEATER	
COOLER	
TEMPERATURE CONTROLLER	
FILTER, STRAINER	
PRESSURE SWITCH	
PRESSURE INDICATOR	
TEMPERATURE INDICATOR	
DIRECTION OF SHAFT ROTATION (ARROW ON NEAR SIDE OF SHAFT)	

Valves

CHECK	
ON-OFF (MANUAL SHUT-OFF)	
PRESSURE RELIEF	
PRESSURE REDUCING	
FLOW CONTROL, ADJUSTABLE-NON-COMPENSATED	
FLOW CONTROL, ADJUSTABLE (TEMPERATURE AND PRESSURE COMPENSATED)	
TWO POSITION TWO CONNECTION	
TWO POSITION THREE CONNECTION	
TWO POSITION FOUR CONNECTION	
THREE POSITION FOUR CONNECTION	
TWO POSITION IN TRANSITION	
VALVES CAPABLE OF INFINITE POSITIONING (HORIZONTAL BARS INDICATE INFINITE POSITIONING ABILITY)	

Methods of Operation

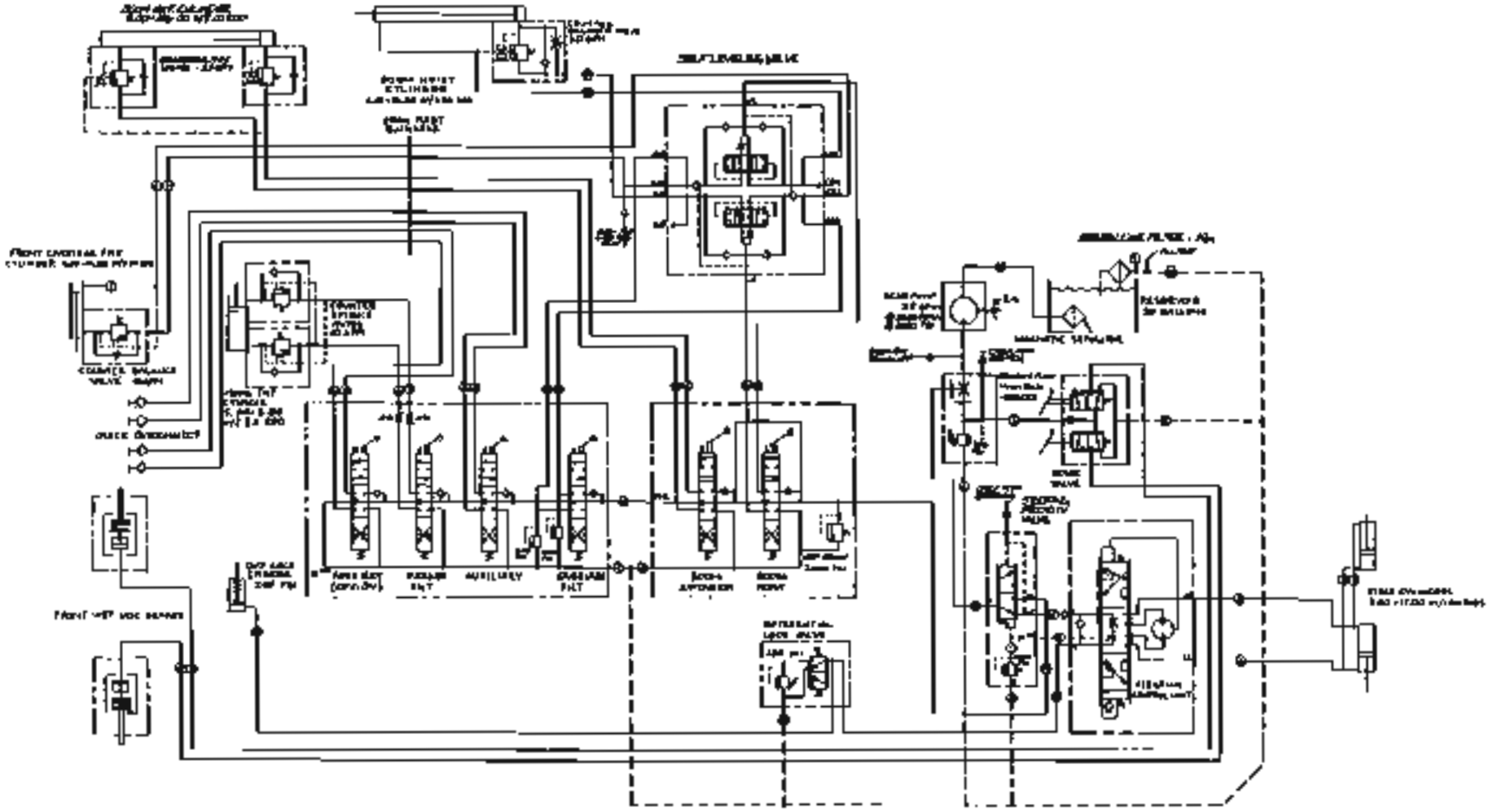
SPRING	
MANUAL	
PUSH BUTTON	
PUSH-PULL LEVER	
PEDAL OR TREADLE	
MECHANICAL	
DETENT	

PRESSURE COMPENSATED	
SOLENOID, SINGLE WINDING	
REVERSING MOTOR	
PILOT PRESSURE REMOTE SUPPLY	
INTERNAL SUPPLY	

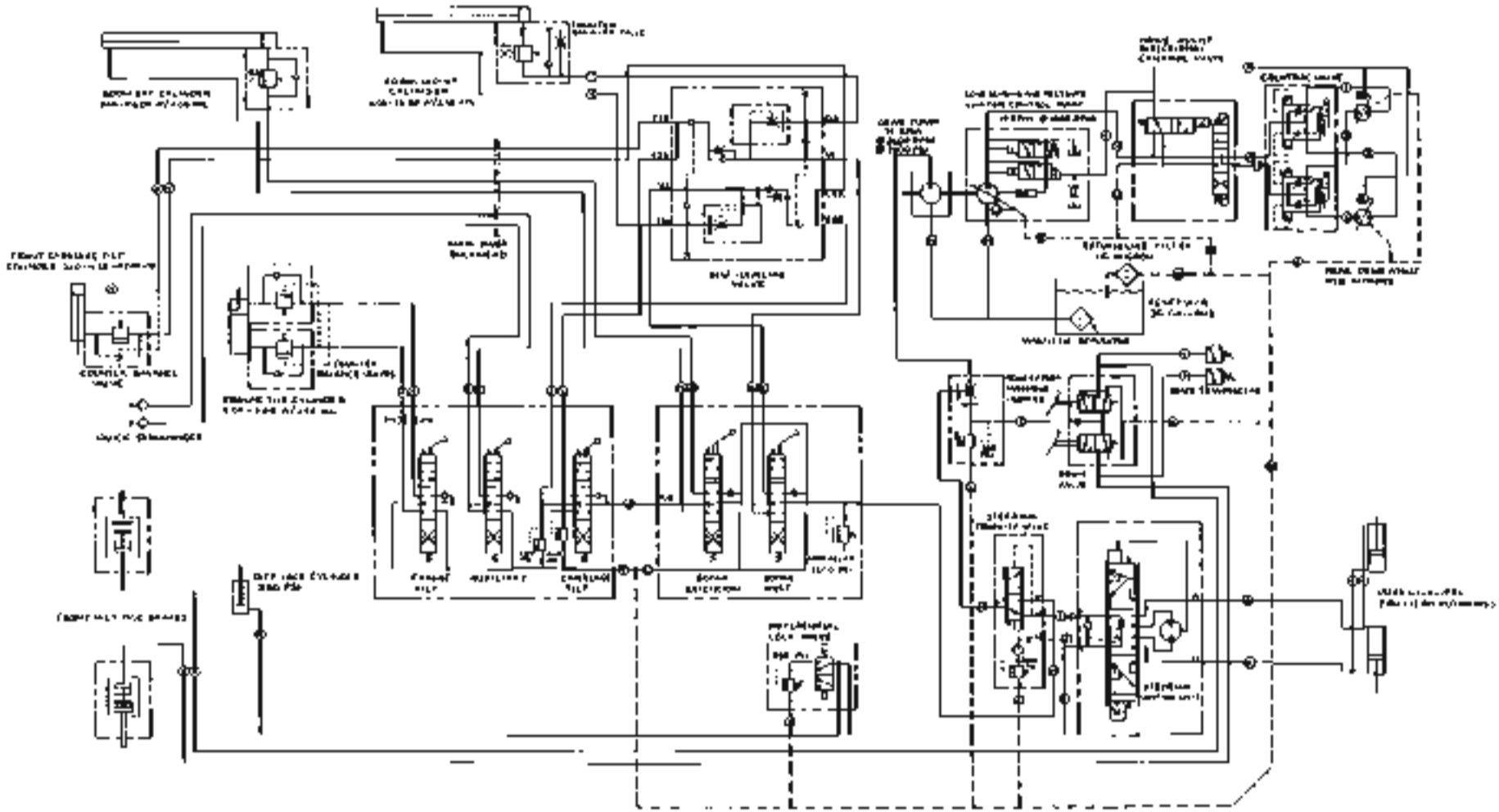
Lines

LINE, WORKING (MAIN)	
LINE, PILOT (FOR CONTROL)	
LINE, LIQUID DRAIN	
FLOW, DIRECTION OF HYDRAULIC	
FLOW, DIRECTION OF PNEUMATIC	
LINES CROSSING	
LINES JOINING	
LINE WITH FIXED RESTRICTION	
LINE, FLEXIBLE	
STATION, TESTING, MEASUREMENT OR POWER TAKE-OFF	
VARIABLE COMPONENT (RUN ARROW THROUGH SYMBOL AT 45 deg.)	
PRESSURE COMPENSATED UNITS (ARROW PARALLEL TO SHORT SIDE OF SYMBOL)	
TEMPERATURE CAUSE OR EFFECT	
RESERVOIR VENTED	
RESERVOIR PRESSURIZED	
LINE TO RESERVOIR ABOVE FLUID LEVEL	
BELOW FLUID LEVEL	

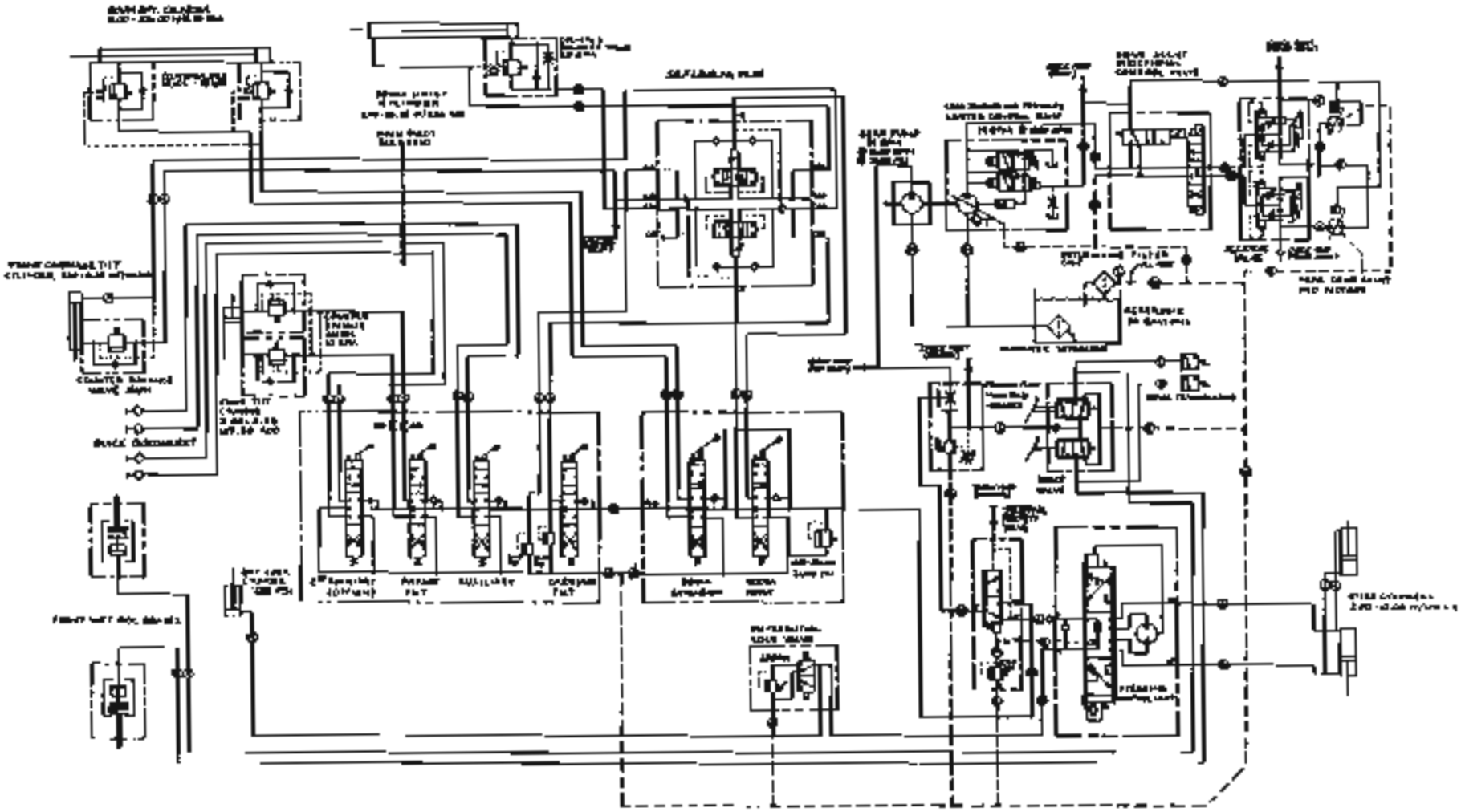
J3409



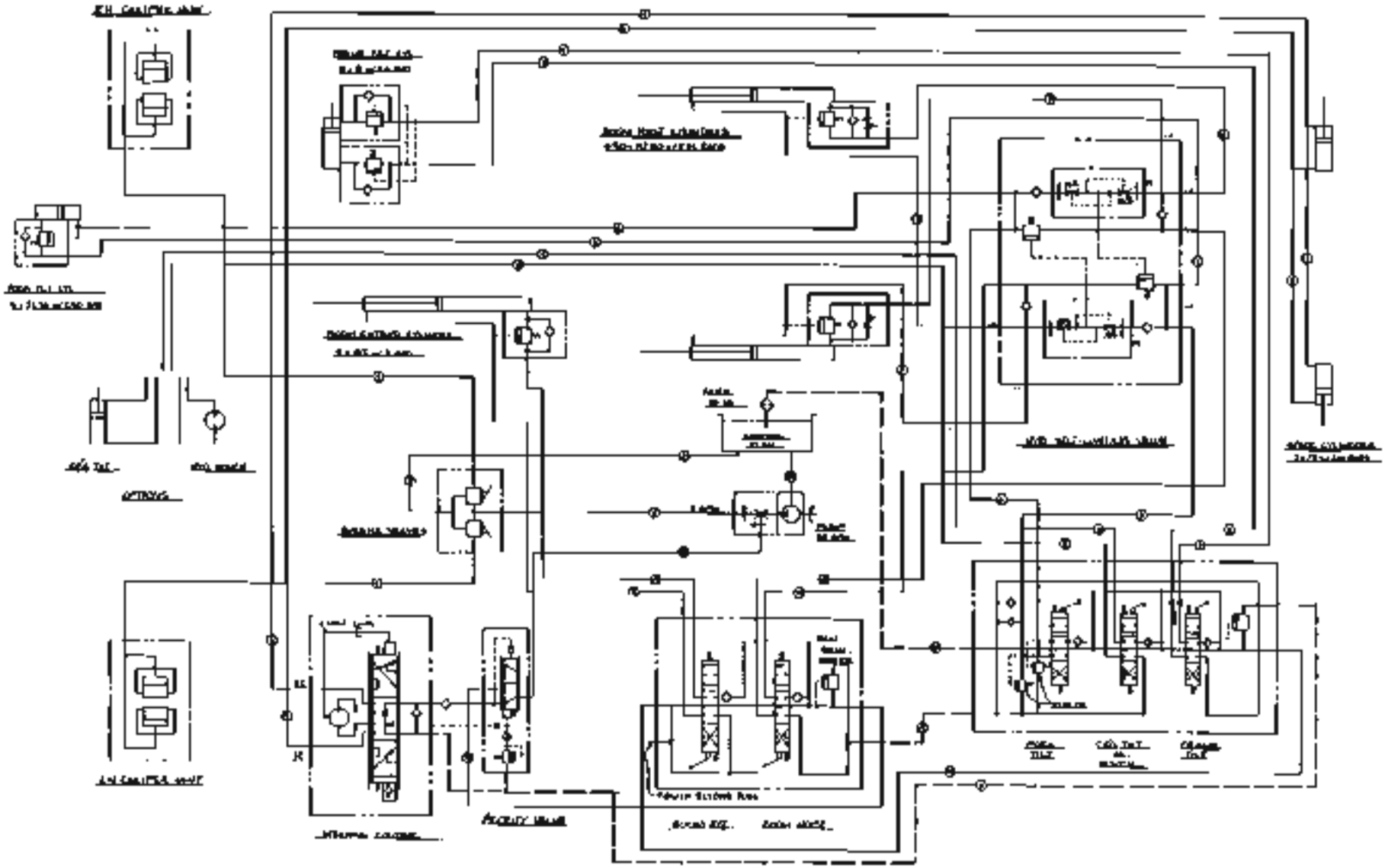
Model 522



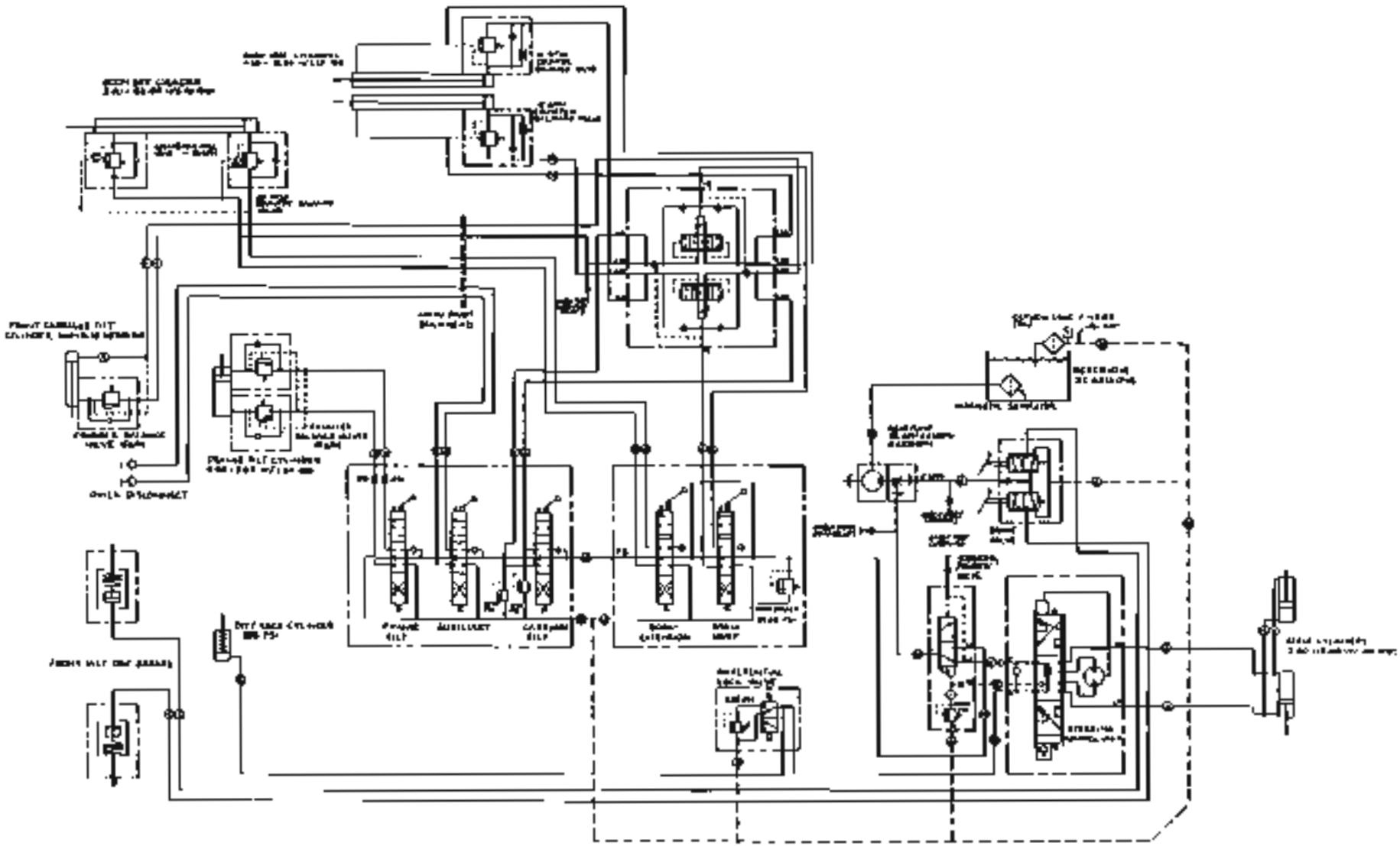
Early Model 522/4



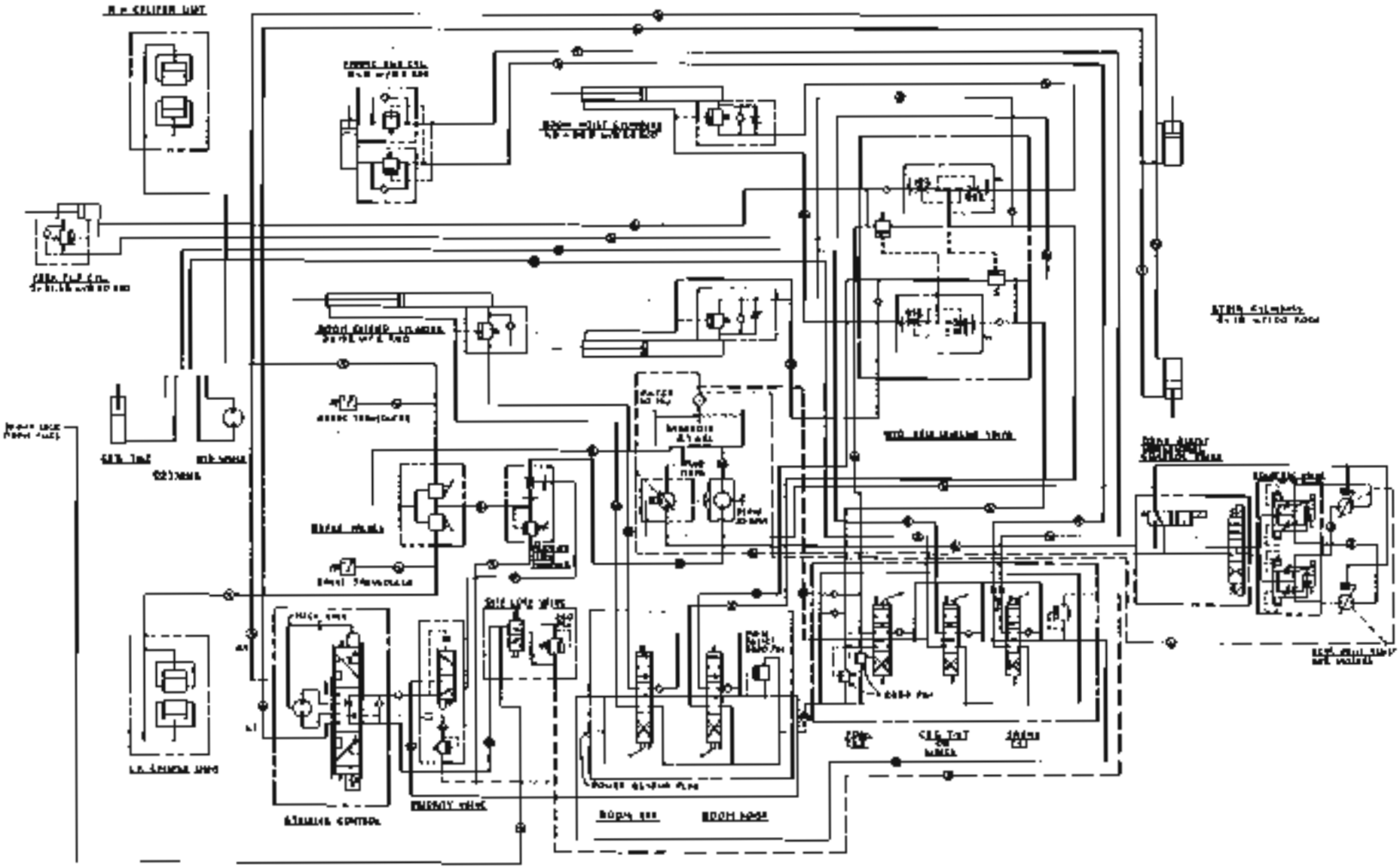
Late Model 522/4



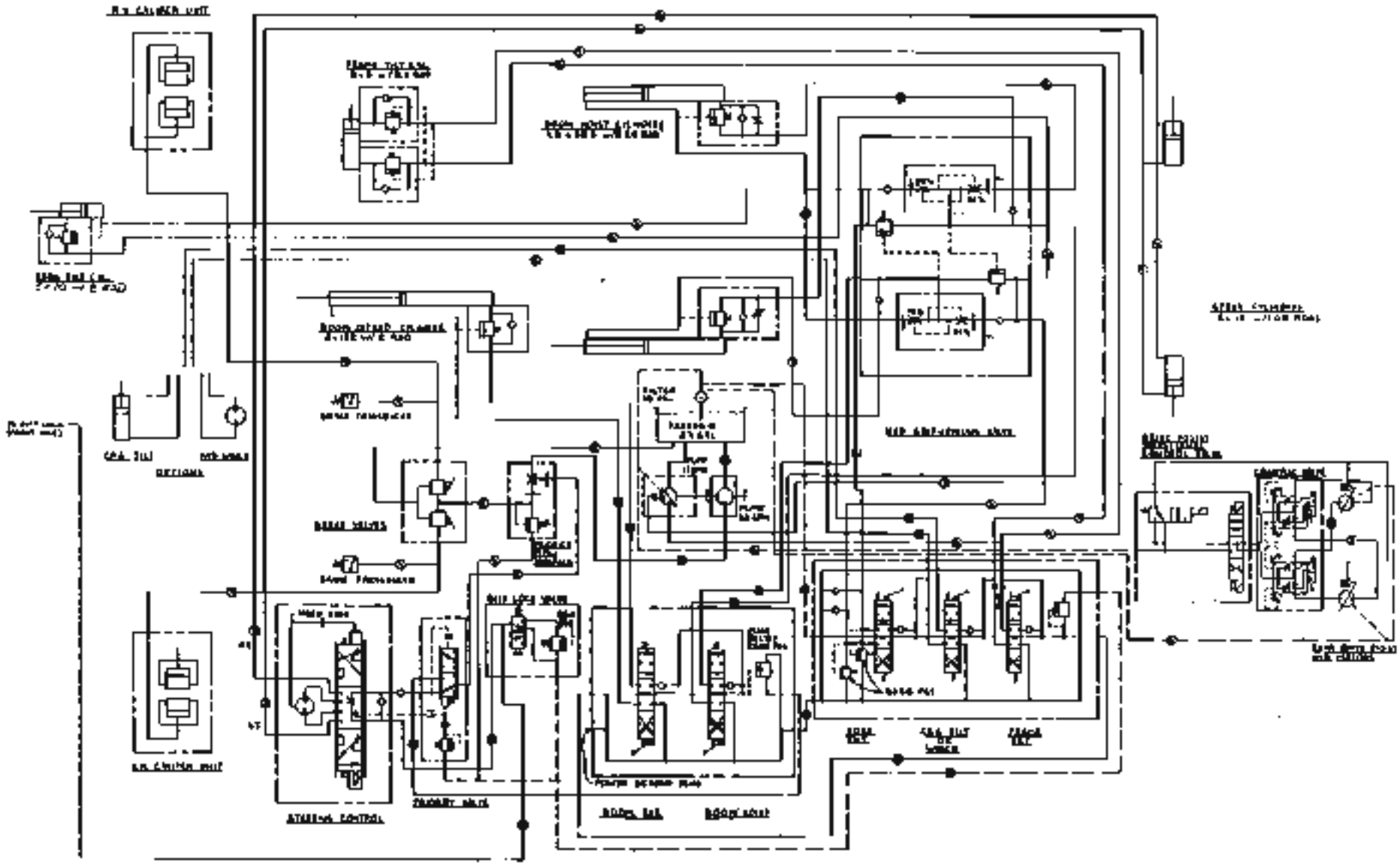
Early Model 622



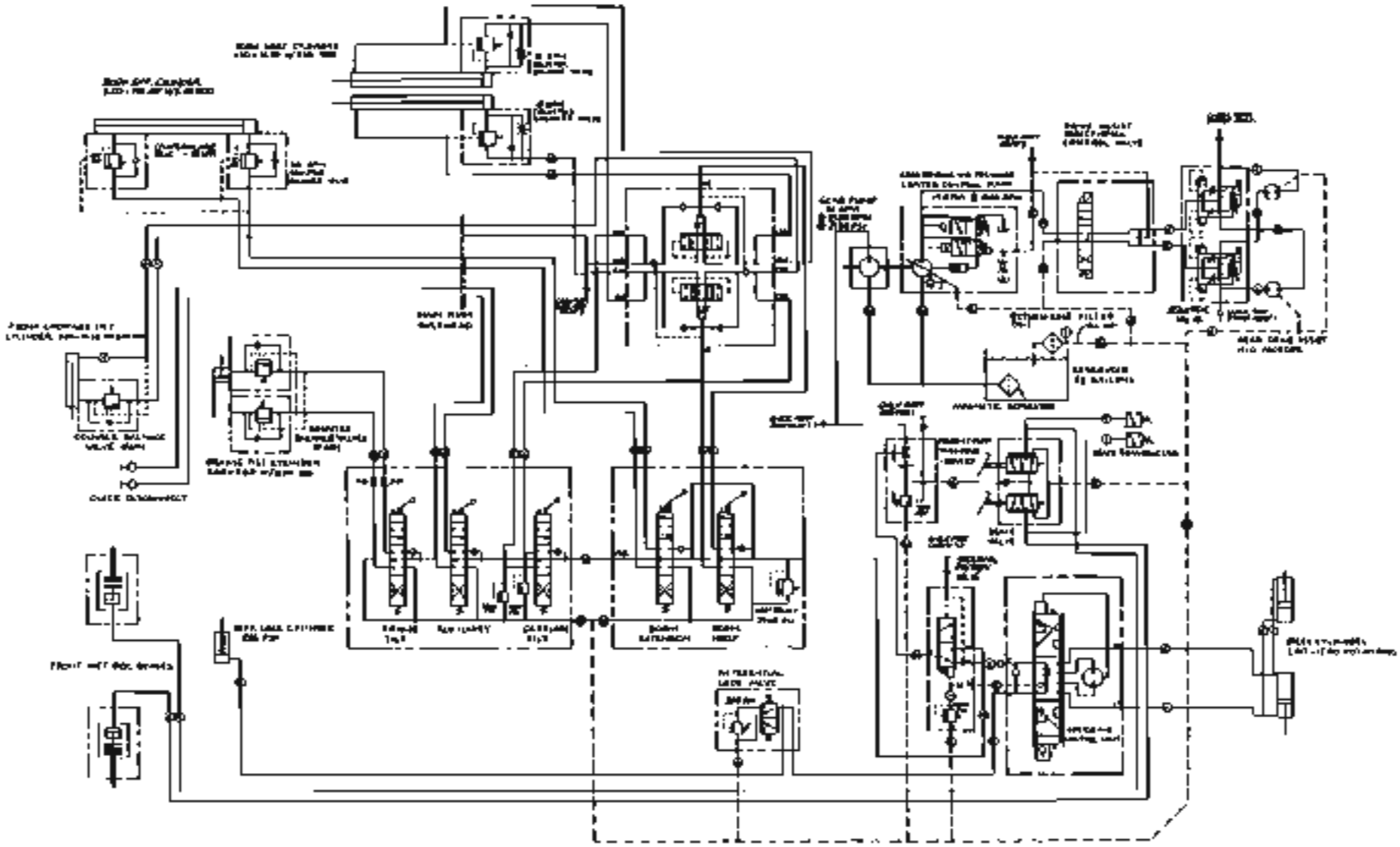
Lale Model 622



Early Model 622/4



Early Model 824



Late Model 622/4 & 624

HYDRAULICS

HYDRAULIC RESERVOIR

GENERAL

The hydraulic reservoir (Figure 3-8, Item 1) is mounted on the right-hand side of the machine. The hydraulic system return filter/magnetic separator is located within the return filter housing (Item 2), located at the top of the reservoir. The strainer (Item 3) and suction line (Item 4) are located at the bottom of the back side of the reservoir.

A pressure differential gauge (Item 5) is fitted to the return filter housing to monitor filter condition.

A breather filter assembly (Item 6) is threaded into the top of the reservoir. It allows for expansion of fluid and prevents vacuum in the tank.

Check the hydraulic reservoir daily for the proper oil level. Maintain oil level at the full mark on the sight gauge (Item 7) with all cylinders retracted.

IMPORTANT: Do not operate the machine if the oil level falls below the low mark on the sight gauge. Low oil level could damage the pump and other components.

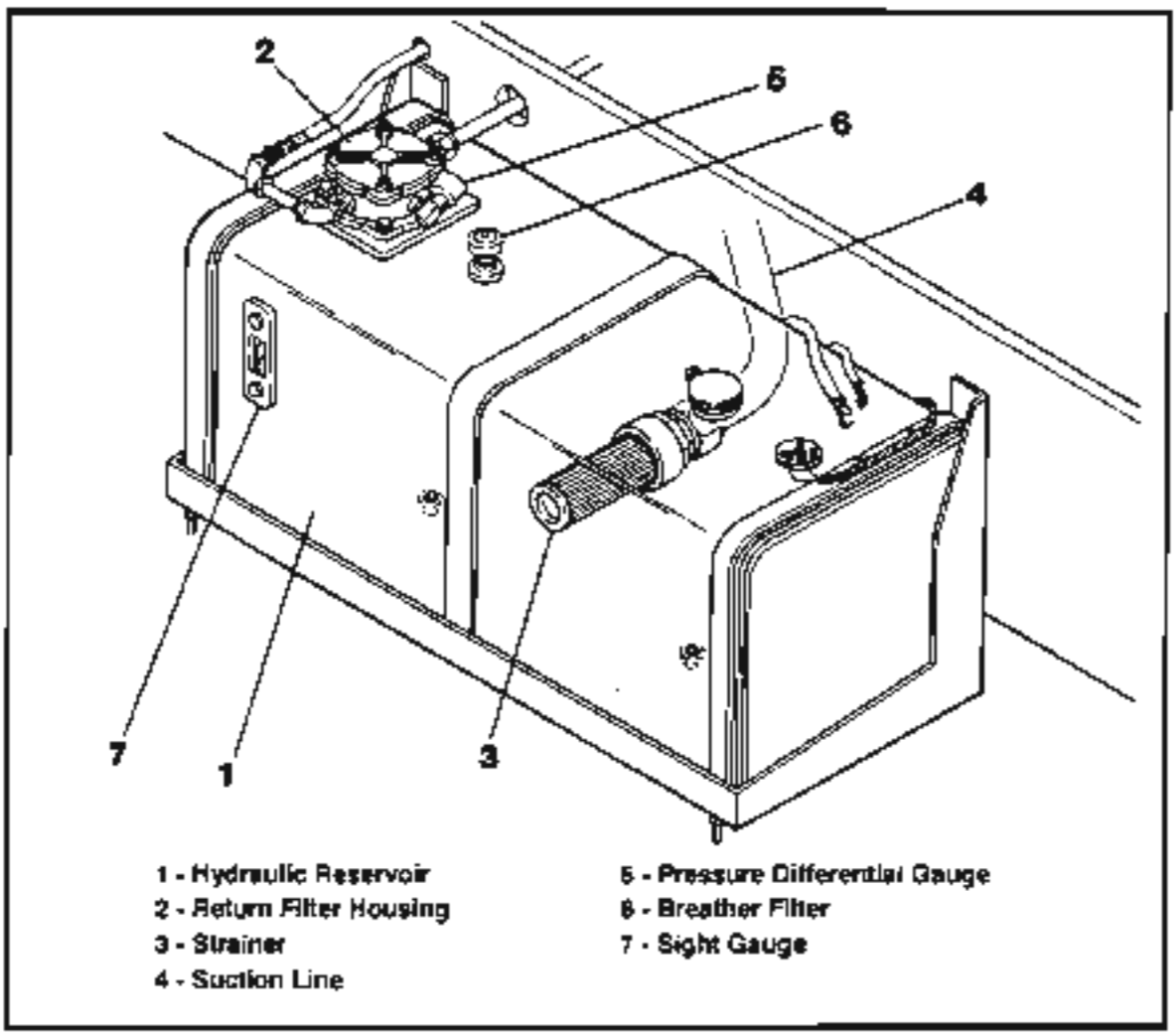


Figure 3-8 Hydraulic Reservoir

HYDRAULICS

HYDRAULIC RESERVOIR

FILLING THE RESERVOIR

Use the following procedure to fill the hydraulic reservoir (Figure 3-9):

1. Retract all cylinders, apply the parking brake, and stop the engine.

2. Clean area around the hex cap (Item 1) on the return filter housing cover (Item 2). Loosen the hex cap and remove.

3. Provide a hydraulic hose (Item 3) of suitable length to run between the hydraulic oil pump source and the male JIC (37%) filler fitting (Item 4), in the cover of the return filter housing. The reservoir end of the hose must be fitted with a 1-1/16-12 JIC (37%) female hose fitting.

4. Assemble the hose to the reservoir filler fitting and tighten. Fill the reservoir until the oil level in the sight gauge (Figure 3-8, Item 7) is at the full mark.

(Use hydraulic oil as specified for your model forklift under "Service Schedules" and "Lubrication Instructions" in Section 2.)

5. Start the engine and allow the hydraulic system to warm-up. Operate controls to fully extend and retract each cylinder of the entire system, including the steering cylinders. This procedure will remove air from the system.

6. Retract the cylinders and stop the engine. Recheck the oil level and, if low, fill to full mark on the sight gauge.

7. Loosen and remove the hose from the reservoir filler fitting. Reassemble the hex cap.

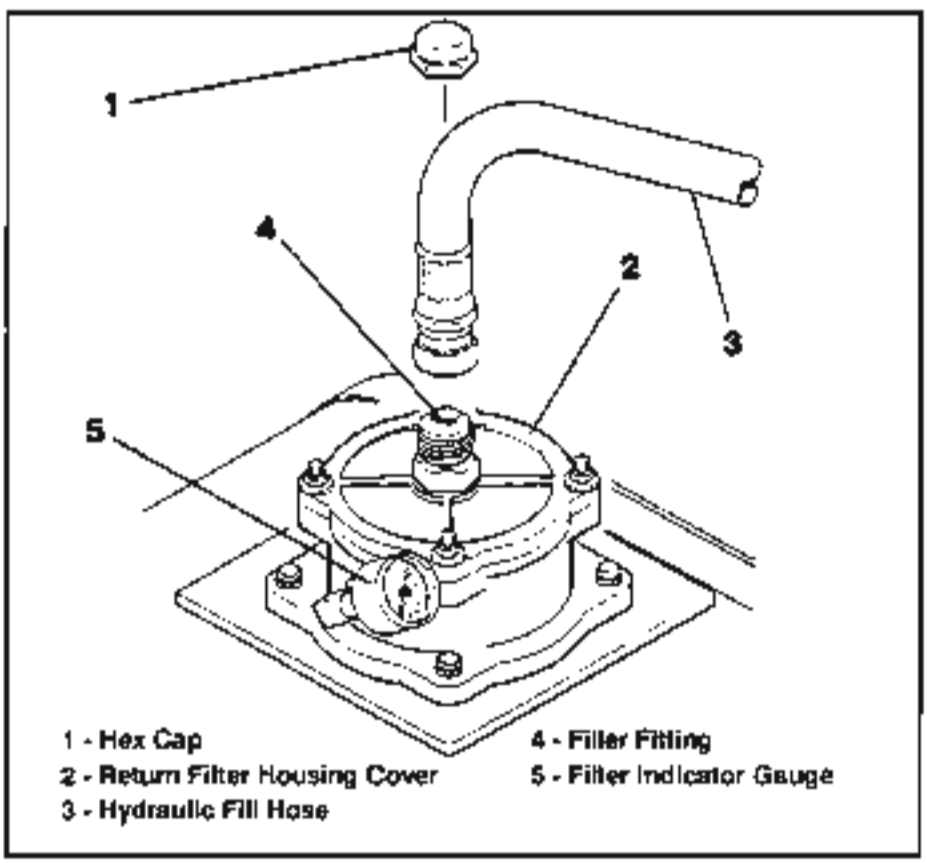


Figure 3-9 Filling the Reservoir

HYDRAULICS

HYDRAULIC RESERVOIR

CHECKING RETURN FILTER CONDITION

Use the following procedure to check the condition of the return filter:

1. The hydraulic return filter housing must be fitted with a pressure differential gauge (Figure 3-9, Item 5). (Order P/N P24981 for indicator gauge if your machine is not so equipped.)

2. The hydraulic oil should be at operating temperature and the engine running at full rpm.

3. If the gauge indicator needle falls within the green zone of the guage - the filter condition is good (see Figure 3-10).

4. If the gauge indicator needle falls within the orange or red zones of the gauge - filter condition is not good and the filter must be replaced. See "Replacing Return Filter Element" on page 3.17-1, this section, for filter replacement procedure.

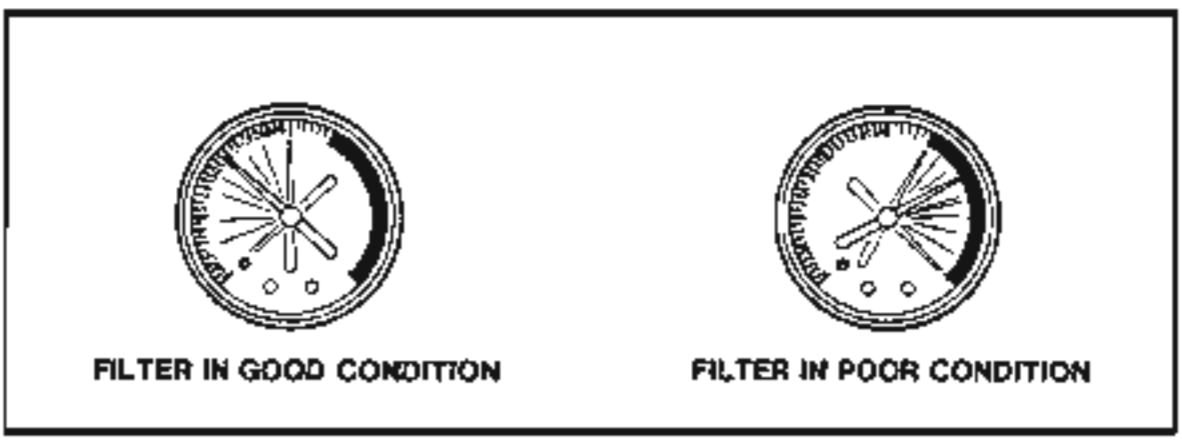


Figure 3-10 Return Filter Indicator Gauge

HYDRAULICS

HYDRAULIC RESERVOIR

REPLACING RETURN FILTER ELEMENT

Use the following procedure to replace the return filter element (Figures 3-11 and 3-12):

1. Lower the boom to the ground, apply the parking brake, and stop the engine. Allow the hydraulic system to cool.

2 Clean area around return filter housing (item 1) and housing cover (item 2).

3. Loosen and remove hex nuts (item 3) and washers (item 4), which attach the housing cover to the filter housing.

4. Remove housing cover and compression spring (item 5), lift filter assembly (item 6) from housing. Place parts on clean paper or cloth, to avoid getting them dirty.

IMPORTANT. Do not allow dirt or contamination into the hydraulic reservoir.

5. Insert a hex key at the diverter end of shaft (item 7); loosen and remove the hex nut/spring (item 8) from opposite end.

6. Remove filter element (item 9) and discard.

7. Clean magnetic column (item 10) of any particles.

8. Inspect o-rings (items 11, 12, & 13) and replace if necessary.

9. Install a new filter element (item 9). Assemble hex nut/spring (item 8) to shaft and tighten until snug.

10. Install filter assembly (item 6) into filter housing (item 1) making sure diverter o-ring (item 12) is properly seated.

11. Assemble compression spring (item 5).

12. Assemble housing cover (item 2) to filter housing and tighten hex nuts and washers (items 3 and 4) until snug. Do not over-tighten.

HYDRAULICS

HYDRAULIC RESERVOIR

REPLACING RETURN FILTER ELEMENT (cont.)

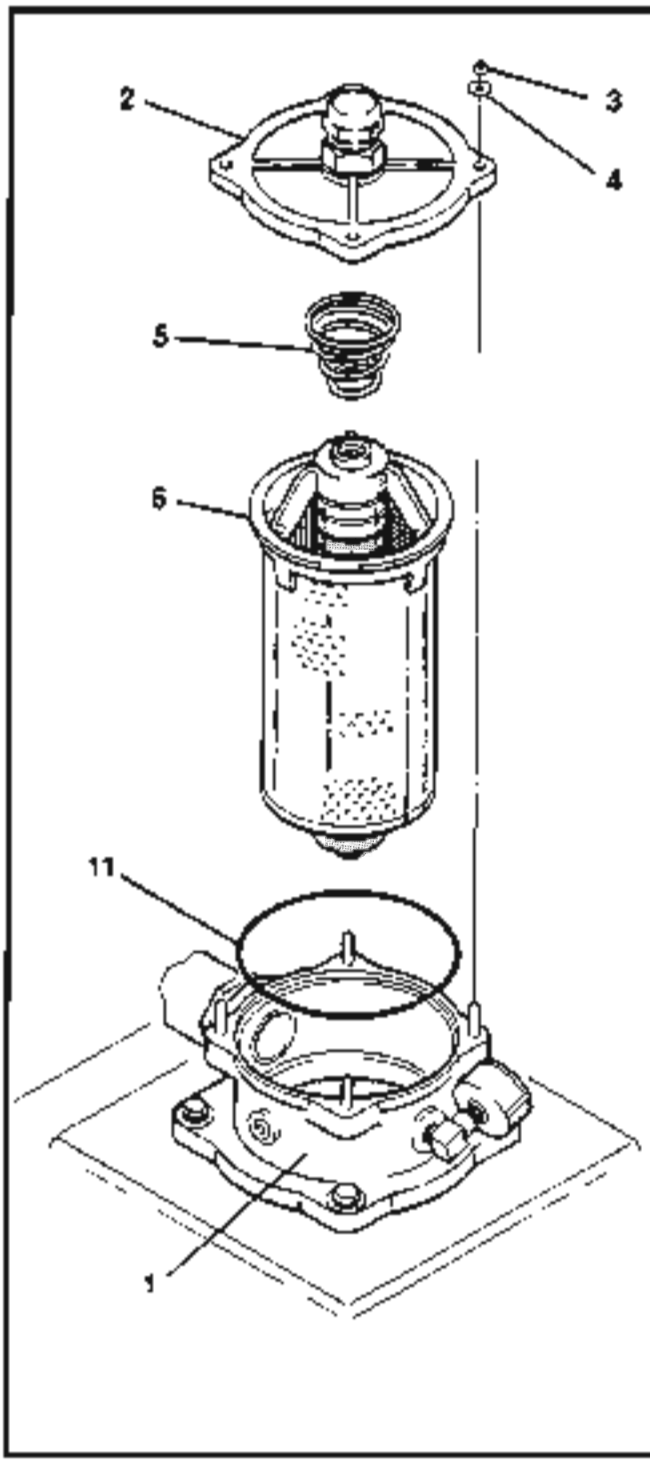
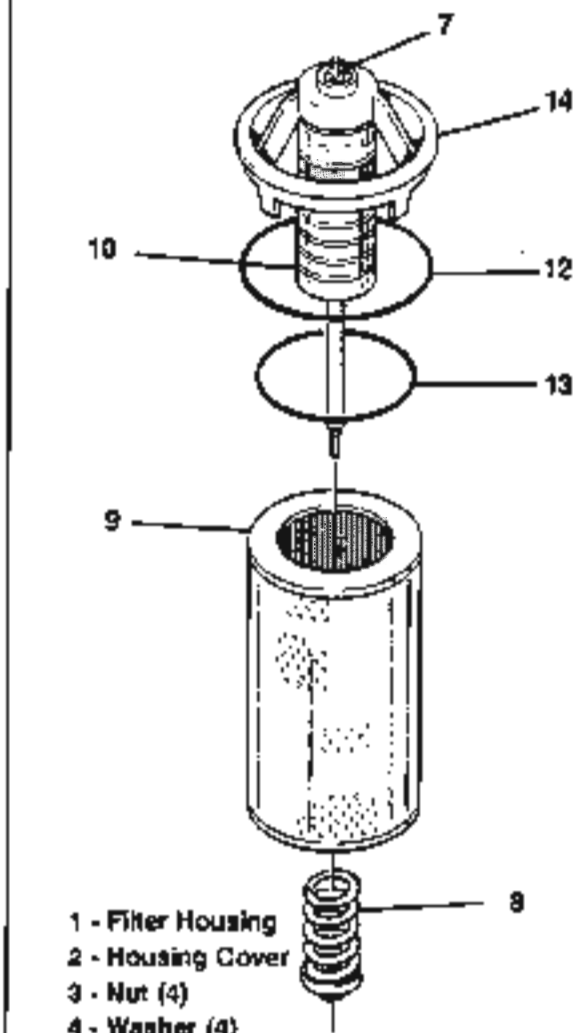


Figure 3-11 Return Filter Housing



1 - Filter Housing
2 - Housing Cover
3 - Nut (4)
4 - Washer (4)
5 - Compression Spring
6 - Filter Assembly
7 - Hex Key Location
8 - Nut/Spring
9 - Filter Element
10 - Magnetic Column
11 - O-Ring
12 - O-Ring
13 - O-Ring
14 - Diverter

Figure 3-12 Return Filter Element

HYDRAULICS

HYDRAULIC RESERVOIR

RESERVOIR DRAIN AND REFILL

Use the following procedure to drain and refill the hydraulic reservoir (Figures 3-13, 3-14 and 3-15)

1. Lower the boom to the ground, apply the parking brake, and stop the engine. Release all hydraulic pressure in the system (See warning and procedure on page 3.2-1 of this section).

CAUTION: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.

2. Remove the hydraulic reservoir drain plug (Item 1) and drain the hydraulic oil into a suitable container. Dispose of the drained oil properly. Don't pollute!

3. Clean area around the return filter housing (Item 2).

4. Loosen and remove the hydraulic return pipe (Item 3) from the hydraulic filter housing.

NOTE: On certain models the return pipe must be separated, instead, from the return line hose.

5. Loosen and remove the hex head capscrews and washers (Items 4, 5, & 6) attaching the filter housing to the reservoir.

6. Remove the return filter housing (Item 7). Inspect the rubber seal (Item 8) and replace if necessary. Place all parts on clean paper or cloth, to avoid getting them dirty.

7. Remove the diffuser (Item 9) and clean.

8. Loosen and remove the hex nut/spring (Item 10) from the filter shaft.

9. Remove the filter element (Item 11) and discard.

10. Clean the magnetic column (Item 12) of all particles.

11. Inspect the o-ring (Item 13) and replace if necessary.

12. Install a new filter element (Item 11). Assemble the hex nut/spring (Item 10) to the shaft and tighten until snug.

13. Loosen and disassemble the hydraulic suction pipe (Item 14) from the strainer (Item 15).

14. Loosen and remove the strainer from the reservoir. Clean the strainer by back flushing with diesel fuel and blow dry.

15. Clean the inside of the reservoir of rust, sludge, scale, metallic particles, deposits, and other residue with high pressure jet spray of diesel fuel. Hand wipe clean with dry rags.

16. Install the cleaned strainer (Item 15) and reassemble the hydraulic suction pipe (Item 14). Use thread sealant.

17. Install the drain plug (Item 1). Use thread sealant.

18. Install the cleaned diffuser (Item 9).

19. Install the filter housing (Item 7) and its rubber seal (Item 8). Assemble plain washers, lockwashers, and tighten hex head capscrews until snug.

20. Reassemble the hydraulic return pipe (Item 3). Use thread sealant.

21. Install a new breather filter assembly (Item 16).

22. Perform steps 2 through 7 of "Filling the Reservoir" on page 3.15-1 of this section.

HYDRAULICS

HYDRAULIC RESERVOIR

RESERVOIR DRAIN AND REFILL (cont.)

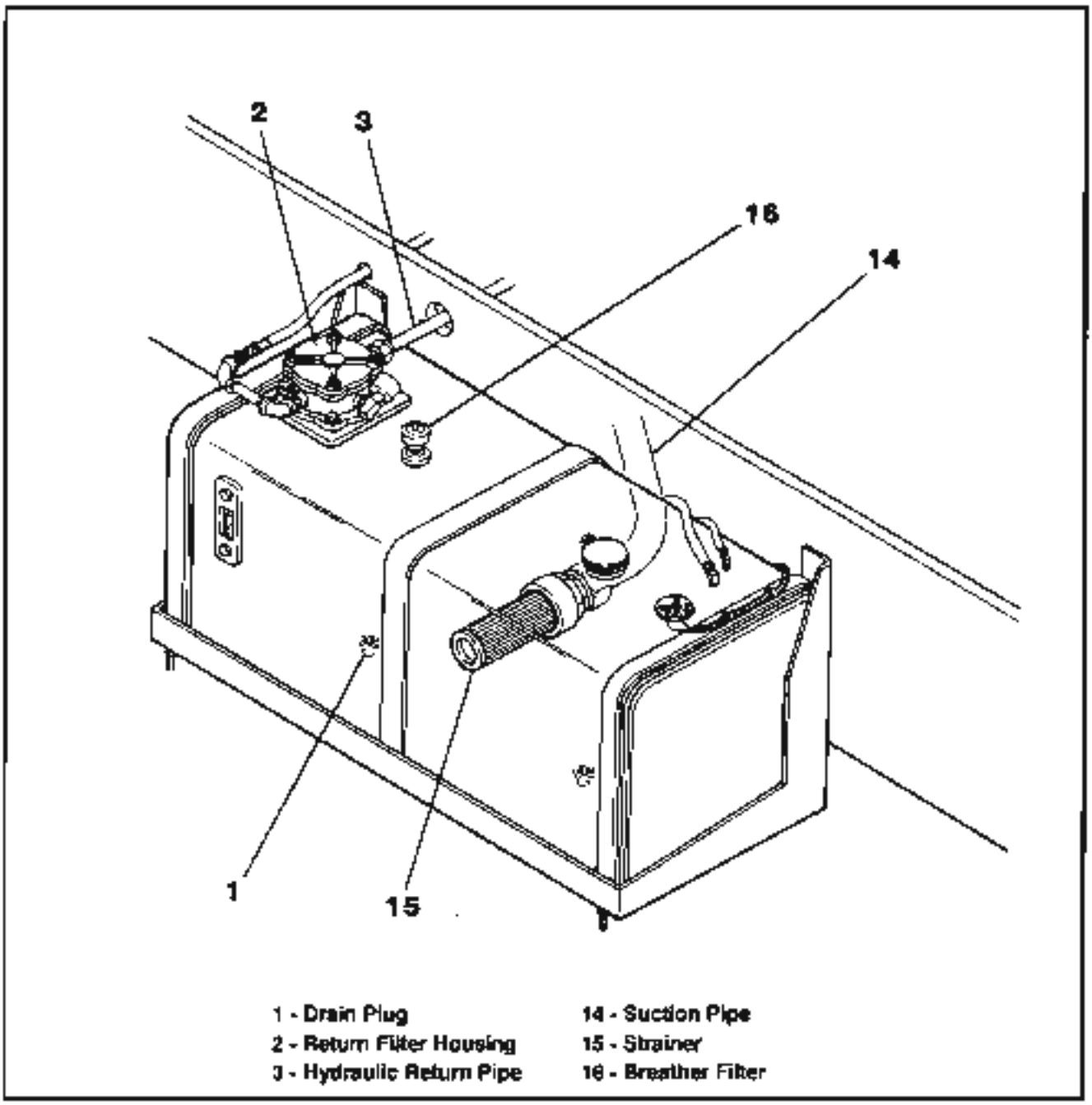


Figure 3-13 Hydraulic Reservoir - Drain and Refill

HYDRAULICS

HYDRAULIC RESERVOIR

RESERVOIR DRAIN AND REFILL (cont.)

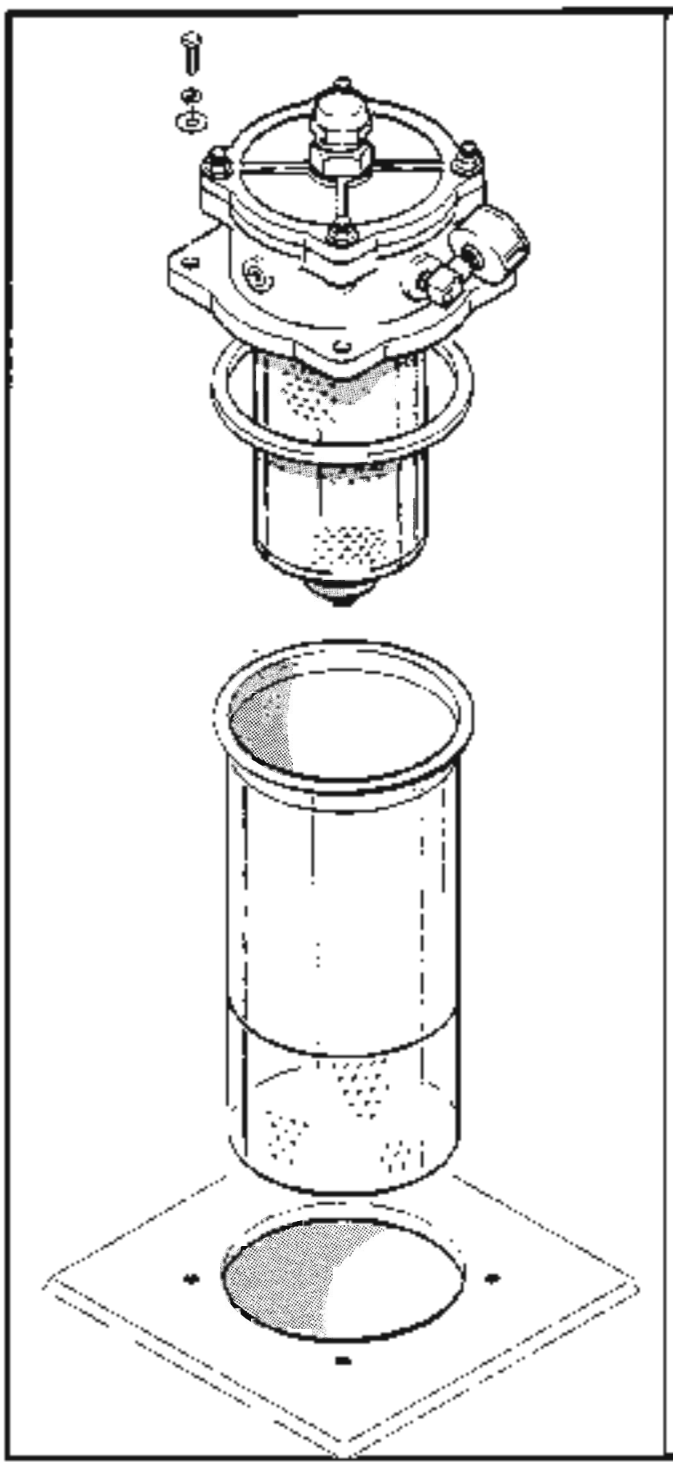


Figure 3-14 Filter Housing Assembly

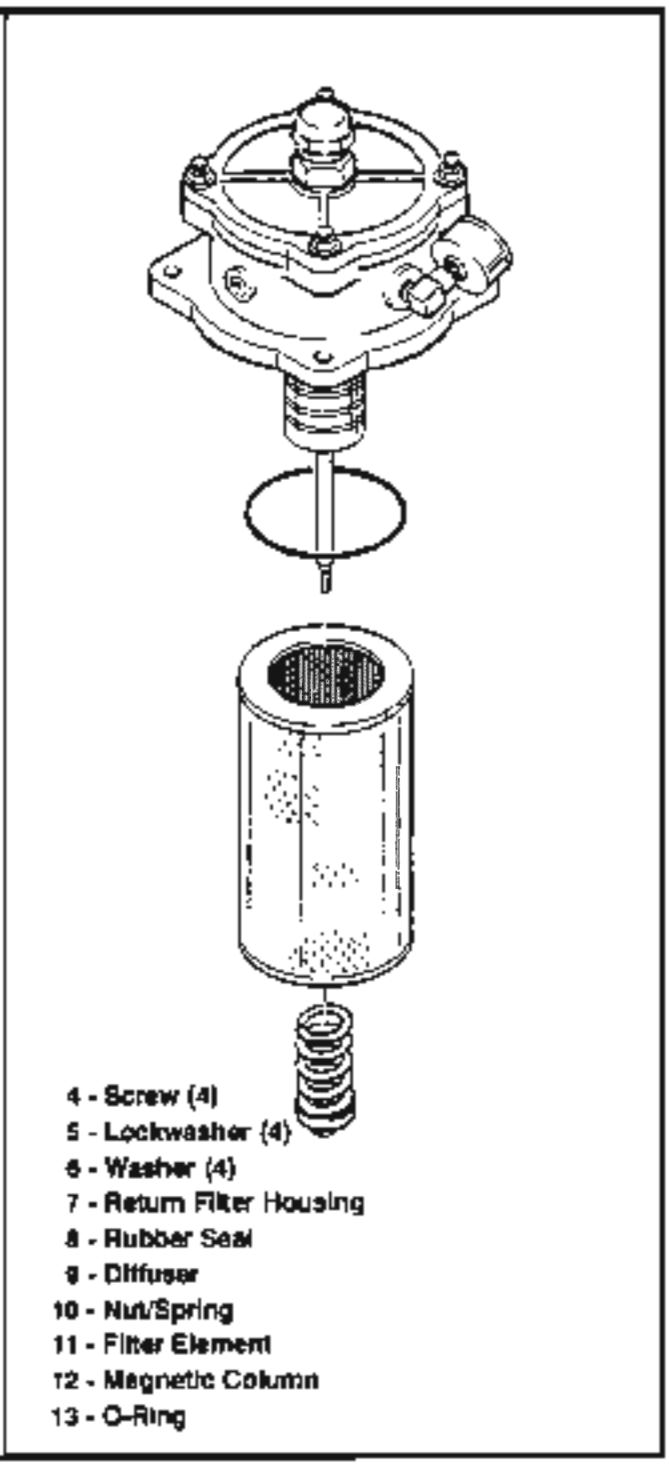


Figure 3-15 Filter Element Assembly

HYDRAULICS

HYDRAULIC CYLINDERS

DESCRIPTION

All hydraulic cylinders used on Lull forklifts are a double acting, non cushioned type with chromed rods. (Refer to Figures 3-1 and 3-2 for locations of hydraulic cylinders on the machines.)

The boom extension, boom hoist, carriage tilt, and frame tilt cylinders are equipped with externally mounted counterbalance valves. The counterbalance valves prevent movement of the cylinders in event of downstream hydraulic line failure or leakage through the control valves or fittings. The counterbalance valves prevent movement of the cylinders when the engine is off, even if the control valve levers are operated. The counterbalance valves also provide over relief protection.

WARNING: Do not remove counterbalance valves from cylinders on the machine while the cylinder is under load (extended). If a counterbalance valve must be removed, first retract the cylinder and remove all hydraulic pressure in the circuit. Wear eye protection when removing counterbalance valves.

WARNING: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder even after the cylinder is removed from the machine. If a counterbalance valve must be removed, do so carefully while wearing eye protection.

CHECKING CYLINDER CONDITION

Use the following procedures for checking the condition of hydraulic cylinders:

Exposed piston rods can be damaged by impact with hard objects. If the smooth surface of the rod is marred, the rod seal may be damaged.

EXTERNAL LEAKAGE - If the cylinder end caps are leaking or if the cylinder leaks around the rod, the seals must be replaced.

INTERNAL LEAKAGE - Leakage past the piston seals inside the cylinder can cause sluggish movement or settling under load. Piston leakage can be caused by worn piston seals or scored cylinder walls. The latter may be caused by contamination in the hydraulic oil.

Use the following procedure to check the hydraulic cylinders for internal leakage:

1. Lower the boom to the ground, apply the parking brake, retract the cylinder, and stop the engine. Release all hydraulic pressure in the system. See warning and procedure on page 3.2-1 of this section.

2. Remove the hose at the base end of the cylinder and plug the hose.

3. Start the engine and activate the control that will supply hydraulic oil to the rod end of the cylinder.

4. If there is leakage from the disconnected end of the cylinder, remove the cylinder and make repairs.

5. If there is no leakage, connect the hose and tighten.

NOTE: . Periodically inspect cylinders for excessive play at the cylinder pivot ends. Excessive play indicates worn bushings - replace bushings when worn.

NOTE: When the machine or cylinders are stored, retract the cylinder rods to protect them.

CYLINDER OVERHAUL

Use the following procedure to repair a hydraulic cylinder:

1. Lower the boom to the ground, apply the parking brake, retract the cylinder and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section).

2. Remove and plug the hoses from the cylinder.

3. Drain and remove the cylinder from the machine.

CAUTION: Use suitable blocking and lifting devices when removing heavy machine components.

CYLINDER OVERHAUL (cont.)

4. Carefully remove counterbalance valve(s) if so equipped (see Figure 3-16).

WARNING: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder even after the cylinder is removed from the machine. If a counterbalance valve must be removed, do so carefully while wearing eye protection.

5. Refer to the Lull Parts Book for your model forklift to see the order of cylinder disassembly.

6. Wash all parts in solvent. Dry with compressed air. Discard old seals.

7. Inspect parts for scratches, nicks, etc. Replace as needed. If the piston has scratches, replace it.

8. Clean and inspect the cylinder housing bore. If it has scratches less than .020 inches (.5mm) deep, it can be reconditioned with a cylinder hone.

9. Install new pivot bushings, as required, using a hydraulic press. Refer to the Lull Parts Book for bushing part numbers.

10. Install all new seals. Refer to the Lull Parts Book for seal kit part number.

11. Put oil or petroleum jelly on all seals.

12. Refer to the Lull Parts Book for order of cylinder assembly.

13. If the cylinder is equipped with a rod bearing retainer, temporarily place a piece of cardboard or a rag between the retainer and the rod so the rod will not be damaged.

14. Install the piston using a new locknut (if so equipped) and tighten to torque specifications (see Table 3-8)

15. Install new setscrew nylon plugs (if so equipped).

16. Install the assembly in the cylinder housing.

IMPORTANT: Be careful not to damage the piston and rod bearing seals when they are installed into the cylinder housing. If the cylinder housing is held vertically during this procedure, there is less chance of damaging the seals.

IMPORTANT: If a cylinder was damaged and repaired or replaced, contaminants from the damaged components will be in the hydraulic system. The system must be clean before installing new or rebuilt components. (See "Cleaning and Flushing System" on page 3.11-1 of this section.)

17. Install counterbalance valve(s) if so equipped.

18. Install the cylinder on the machine and connect the hoses to the cylinder.

NOTE: See Torque Specification Table in Section 1 for tightening hydraulic line fittings.

19. Start the engine and actuate the control to move the cylinder to both extremes several times. This will force air from the cylinder.

20. Stop the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

21. Check the hydraulic reservoir. Add hydraulic oil as needed.

CYLINDER OVERHAUL (cont.)

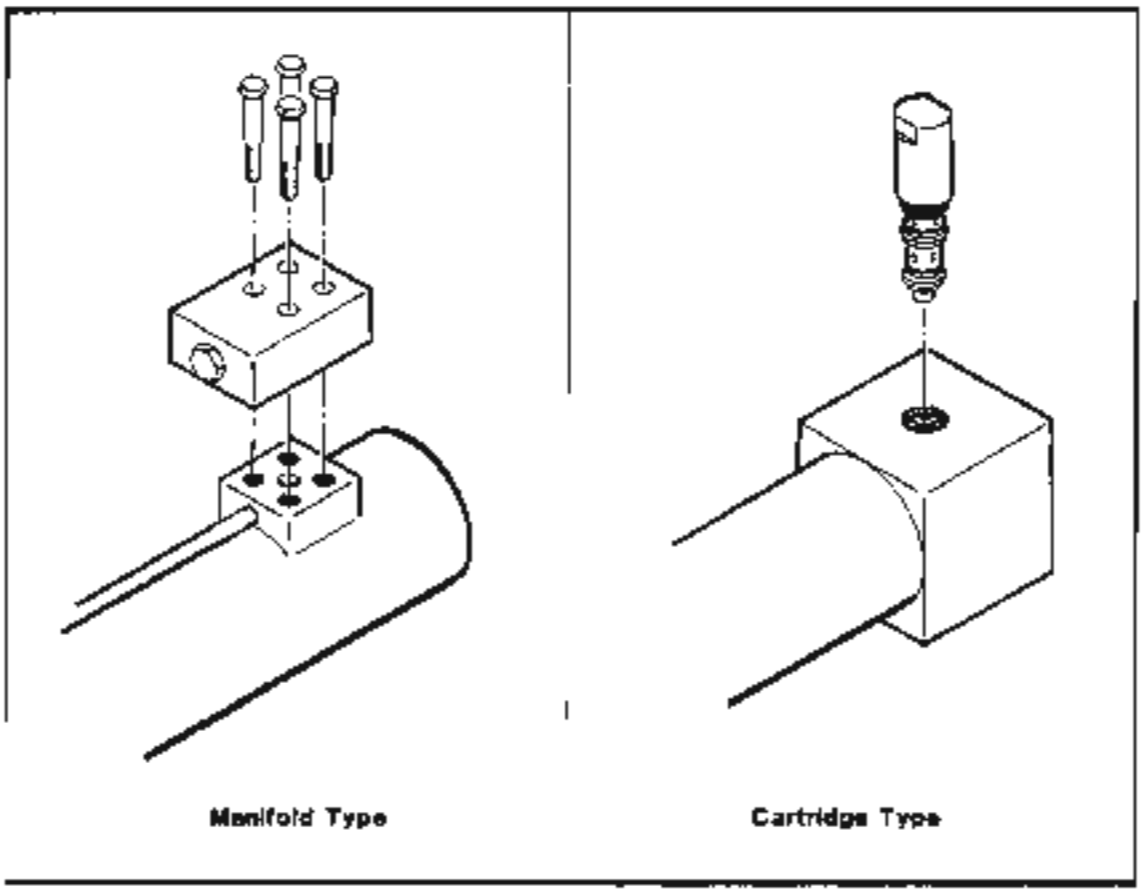
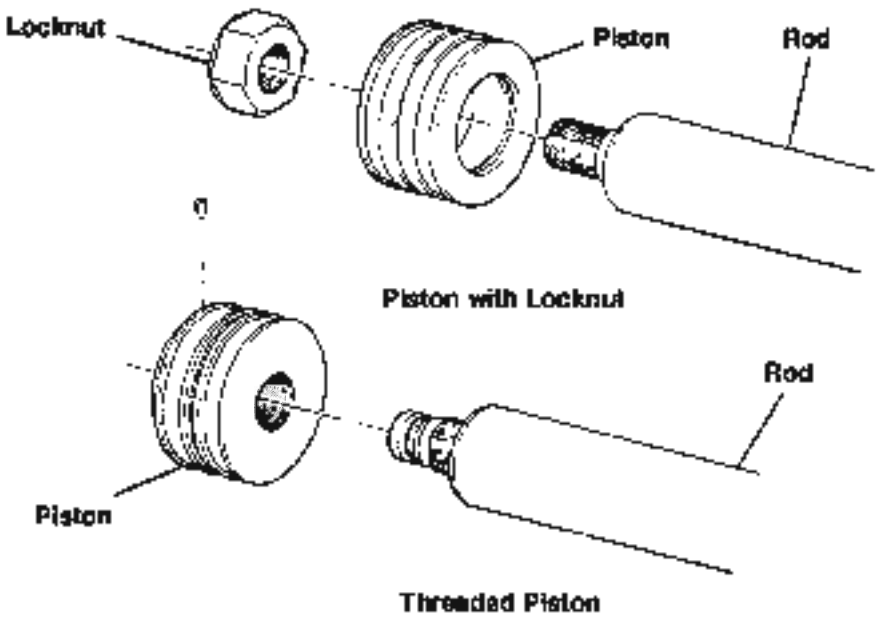


Figure 3-16 Counterbalance Valve Removal

HYDRAULICS

HYDRAULIC CYLINDERS

CYLINDER OVERHAUL (cont.)



THREAD	TORQUE
3/4-16UN	112 FT/LBS
1-14UN	265 FT/LBS
1 1/4-12UN	507 FT/LBS
1 1/2-12UN	915 FT/LBS
1 3/4-12UN	1460 FT/LBS
2-12UN	2187 FT/LBS
2 1/4-12UN	3127 FT/LBS

Table 3-8 Hydraulic Cylinder Piston and Piston Locknut Torque Specifications

HYDRAULICS

HYDRAULIC PUMPS

MAINTENANCE

Hydraulic pumps do not require periodic maintenance. They are, however, dependent on the care given to the rest of the system. Contamination, low hydraulic oil level, restricted oil passages, or faulty or improperly adjusted relief valves can all cause premature pump failure.

During the daily maintenance inspection, examine the pumps for signs of leakage. With the engine running, listen for unusual pump noise that could indicate pump cavitation or overheating.

TROUBLESHOOTING

Refer to page 3.21-2 for procedures for troubleshooting hydraulic pump problems.

PUMP OVERHAUL

Refer to the pump manufacturer's literature for detailed overhaul procedures (obtainable from the Lull Corporation).

HYDRAULICS

HYDRAULIC PUMPS

TROUBLESHOOTING

Problem	Possible Cause	Correction
I. Excessive pump noise.	Low oil level in the reservoir.	Fill reservoir to proper level with the recommended transmission fluid. DO NOT over fill.
	Air in the system.	1. Operate hydraulic system until purged. 2. Check inlet (suction) lines and fittings for air leaks. 3. Replace pump shaft seal.
	Vacuum condition.	1. Check inlet (suction) lines and fittings for restrictions. 2. Check reservoir breather filter conditions.
	Oil too thick.	Be certain correct type of oil is used for refilling or adding to the system.
	Cold weather.	Run hydraulic system until unit is warm to the touch and noise disappears.
II. Pump overheating.	Internal leakage.	If established that excessive internal leakage exists, return vehicle to maintenance shop for evaluation and repair.
	Fluid level low.	Add oil to operating level.
III. System not developing pressure.	Relief valve open.	Replace or repair.
	Loss of fluid internally (slippage).	Return vehicle to maintenance shop for repair of hydraulic system.
IV. Loss of fluid.	1. Ruptured hydraulic lines.	1. Check all external connections, tubing and hoses. Tighten connections, replace ruptured tube or hose.
	2. Loose fittings.	2. Observe mating sections of pump for leaks.
	3. Leaking gaskets or seals in pump or circuit.	3. Replace seals or gaskets if possible.
V. Miscellaneous.	Disconnected or broken drive mechanisms.	Locate and repair.

HYDRAULICS

HYDRAULIC PUMPS

CHECKING PUMP FLOW RATE

If the pump(s) is suspected of delivering below rated capacity, use the following procedure to check pump flow rate (Figure 3-17):

1. Lower the boom to the ground, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (See warning and procedure on page 3.2-1 of this section).

2. Loosen and remove the pressure line hose (Item 1) from the pressure port of the pump (Item 2) to be tested.

3. Loosen and remove the hex cap (Item 3) from the top of the return filter housing (Item 4).

4 Assemble a hydraulic tester (Item 5) in a test loop between the pump and return filter. Use hydraulic hose (Item 6) with a minimum burst pressure rating of 12,000 psi. Hose end fittings for the pump and return filter must be 1 1/16-12 JIC (37°) female.

5. Determine the system's maximum rated pressure (which is the specified relief setting for the boom hoist and extend control valve). See "Fluid Pressures" under "Specifications" for your model forklift in Section 1.

6. Adjust the pressure relief valve setting to 100 psi over that of the system's maximum rated pressure.

IMPORTANT: Be sure the load valve is open before starting the engine.

7. Start the engine and, when it is at normal operating temperature, open the throttle control all the way. Slowly close the load valve to load the system. (Do not exceed the system's maximum rated pressure). Continue loading until the normal operating temperature of the system is reached (see "Hydraulic Oil Working Temperature" under "Specifications" for your model forklift in Section 1).

8. Open the load valve. Record the maximum pump flow at zero pressure

9. Slowly close the load valve until the system is at the maximum rated pressure. Record the pump flow.

10. Open the load valve until the pump pressure is again at zero.

11. Shut off the engine.

12. Disconnect the test loop from the pump and the return filter housing. Reconnect the pump pressure hose (Item 1) and install the hex cap (Item 3) atop the return filter housing.

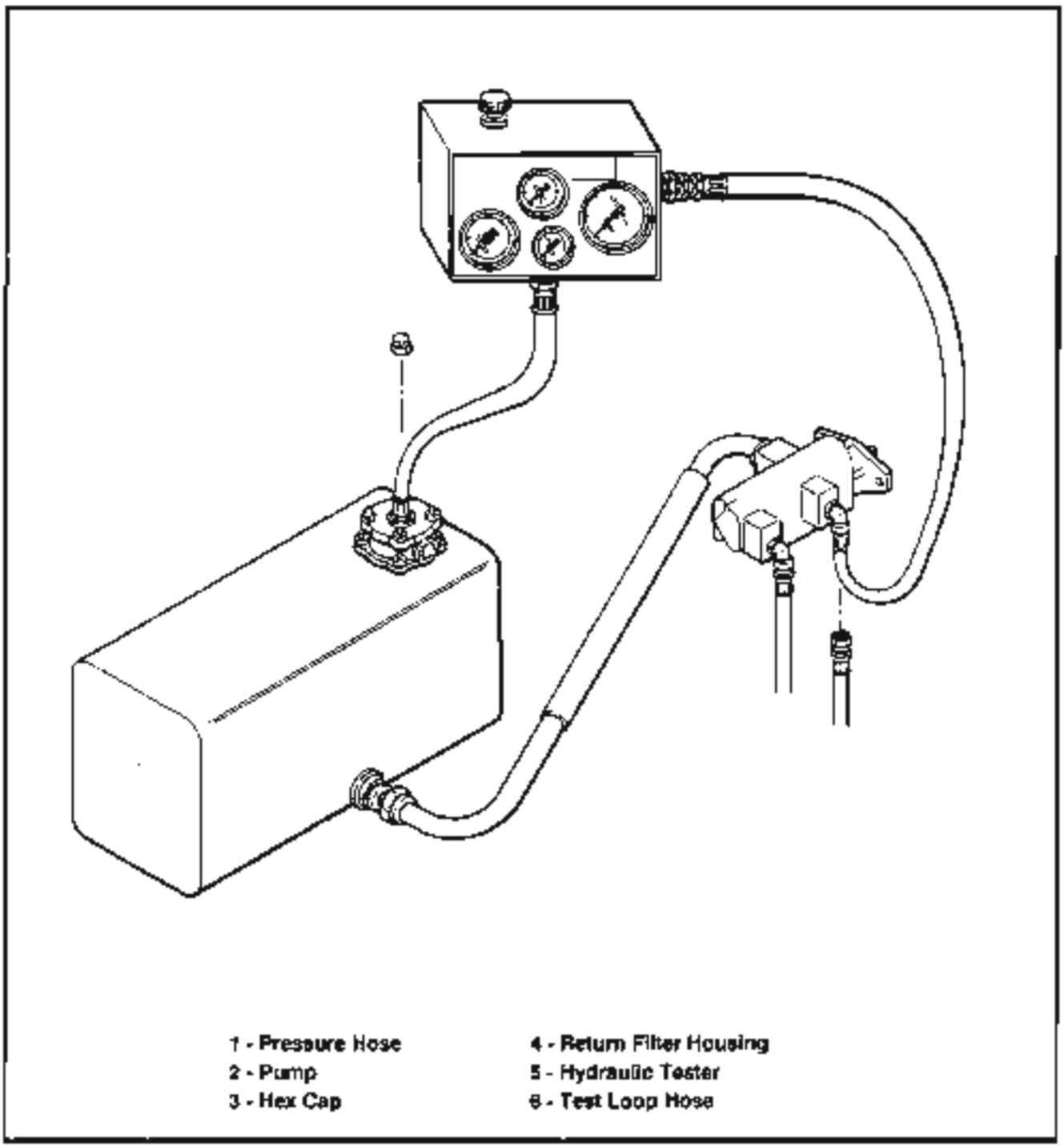
Pump flow at maximum pressure should be at least 75 percent of the rated pump flow. For rated pump flow, see "Hydraulic Pump", under "Specifications", in Section 1.

Repair or replace the pump if the pump flow rate is less than 75 percent of the rated capacity.

HYDRAULICS

HYDRAULIC PUMPS

CHECKING PUMP FLOW RATE (cont.)



1 - Pressure Hose
2 - Pump
3 - Hex Cap
4 - Return Filter Housing
5 - Hydraulic Tester
6 - Test Loop Hose

Figure 3-17 Checking Pump Flow Rate

HYDRAULICS

HYDRAULIC PUMPS

PUMP (MODEL 522)

DESCRIPTION

The hydraulic pump used on the Model 522 forklift is a single gear-type, driven directly from the transmission power take off.

PUMP SPECIFICATIONS:

Type	Gear
Manufacturer	Vickers
Model	G20
GPM	27 at 2600 RPM
Approx. Weight	13 lbs

REMOVAL (Figure 3-18)

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this Section).

2. Clean the pump and surrounding area before removing the pump. Use steam cleaning equipment if available. Do not allow water into the system (be sure hose fittings are tight).

WARNING: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.

3. Remove the half flange assembly (item 1). Detach and position the suction line (item 2) out of the way and cap.

4. Remove the o-ring (item 3) and cap the pump opening.

5. Remove the four bolts (item 4) and lockwashers (item 5) mounting the priority valve (item 6) to the pump. Remove the priority valve, with hoses attached, and position out of the way. Remove O-Ring (item 7) Cap priority valve and pump openings.

6. Remove the two bolts and lockwashers (items 8 & 9) mounting the pump to the transmission power take off.

7. Remove the pump (item 10). Pulling straight back until the splined drive shaft of the pump is free, and lift from machine.

8. Cover the transmission power take off opening to prevent dirt from entering the drive unit.

INSTALLATION

1. Reverse steps 3 through 8 above.

NOTE: Install new o-rings (items 3,7) in step 4 and 5 above (see Parts Book).

NOTE: Refer to "Bolt Torque Specification" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

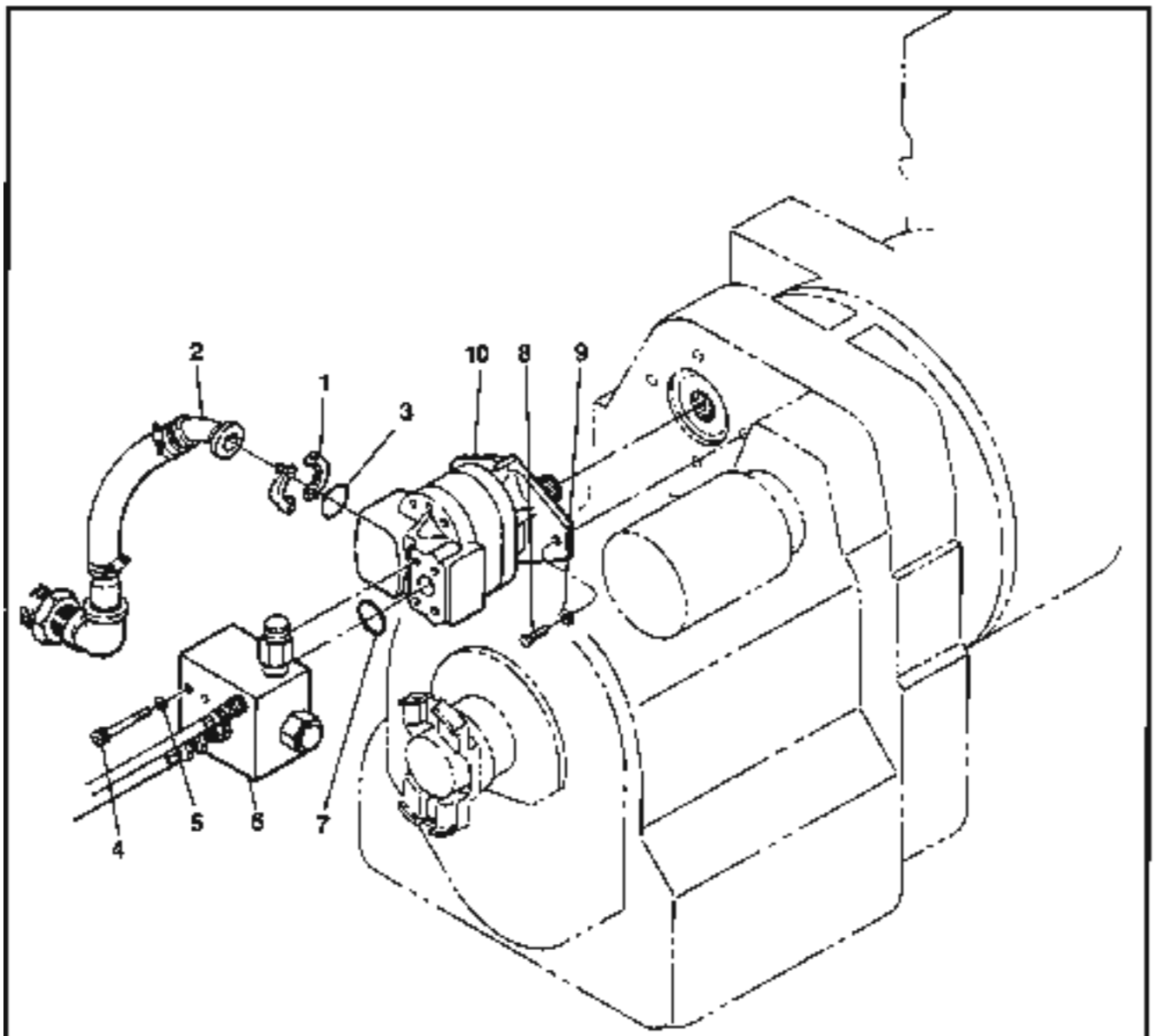
IMPORTANT: To avoid damaging a new or rebuilt hydraulic pump, run the pump at zero pressure (controls in neutral) for at least five minutes before putting the pump under load. Check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

HYDRAULICS

HYDRAULIC PUMPS

PUMP (MODEL 522) (cont.)



1 - Half Flange Assembly
2 - Suction Line
3 - O-Ring
4 - Bolt, 3/8" (4)
5 - Lockwasher, 3/8" (4)
6 - Brake Priority Valve
7 - O-Ring
8 - Bolt, 1/2" (2)
9 - Lockwasher, 1/2" (2)
10 - Pump

Figure 3-18 Hydraulic Pump Removal

HYDRAULICS

HYDRAULIC PUMPS

PUMP (MODEL 522/4)

DESCRIPTION (Figures 3-19, 3-20)

The two hydraulic pumps used on the Model 522/4 forklift are driven from the transmission power take off through an offset gearbox (Pump Drive) (Item 25) with a 1:1 ratio. The first pump is a gear-type and is coupled to the second pump (Item 13) which is a variable displacement piston-type with a load sensing and pressure limiter control. (The load sensing control is designed to automatically adjust the pump flow in reponse to a remote pressure signal from the rear wheel power assist selector valve; it will adjust the pump displacement to maintain outlet pressure at a level of approximately 160 psi above the load pressure. The pressure limiter control overrides the load sensing control thus reducing pump displacement.)

PUMP SPECIFICATIONS:

First Pump	Gear-Type
Manufacturer	Vickers
Model	GT 20
GPM	32 at 2600 RPM
Approx. Weight	42 lbs
Second Pump	Piston-Type
Manufacturer	Vickers
Model	PVE 19
GPM	27 at 2600 RPM
Approx. Weight	35 lbs

REMOVAL - PISTON PUMP (FIGURE 3-19)

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in this section).

2. Clean the pump and surrounding area before removing the pump. Use steam cleaning equipment if available. Do not allow water into the system (be sure hose fittings are tight).

WARNING: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.

3. Loosen the suction hose clamp and remove the suction hose (Item 1) and cap.

4. Remove fitting (Item 2) and cap the pump opening.

5. Tag, remove and cap three hoses (Items 3, 4 & 5).

6. Remove three fittings (Items 6) and cap the pump openings.

7. Support the pump and remove the two mounting bolts, flat washers, lockwashers and nuts (Items 7, 8, 9, & 10).

8. Pull the pump straight back, separating it from the gear pump and the splined coupling (Item 11) and lift from machine.

9. Remove the O-Ring (Item 12) and cover the drive opening of the gear pump to prevent dirt from entering.

INSTALLATION - PISTON PUMP

1. Reverse steps 3 through 9 above.

NOTE: Install a new O-Ring (Item 12) in Step 9 above (see Parts Book).

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

NOTE: To avoid damaging a new or rebuilt hydraulic pump, run the pump at zero pressure (controls in neutral) for at least five minutes before putting the pump under load. Check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

REMOVAL - GEAR PUMP (FIGURE 3-20)

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section).

PUMP (MODEL 522/4)(cont.)

REMOVAL- GEAR PUMP (cont.)

2. Clean the pump and surrounding area before removing the pump. Use steam cleaning equipment if available. Do not allow water into the system (be sure hose fittings are tight).

WARNING: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.

3. Remove the piston pump from the machine: perform steps 3 through 9 under Removal of Piston Pump. Cover the shaft end of the piston pump to prevent dirt from entering.

4. Remove the hall flange assembly (Item 14). Detach and move the suction line (Item 15) out of the way and cap.

5. Remove the O-Ring (Item 16) and cap the pump opening.

6. Remove the four bolts and lockwashers (Items 17 & 18) mounting the priority manifold (Item 19) to the pump.

7. Separate the priority manifold from the gear pump and, with hoses attached, position out of the way. Remove O-Ring (Item 20). Cap priority manifold and pump openings.

8. Remove the two bolts and lockwashers (Items 21 & 22) and two nuts and flatwashers (Items 23 & 24) mounting the gear pump to the pump drive (Item 25).

9. Support the gear pump and pull it straight back separating the gear pump from the pump drive, and lift pump from machine.

10. Remove the O-Ring (Item 26). Cover the pump drive opening to prevent dirt from entering.

INSTALLATION - GEAR PUMP

1. Reverse steps 3 through 10 above.

NOTE: Install new O-Rings (Items 12, 16, 20, & 26) in steps 3, 5, 7 and 10 above (see Parts Book).

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

NOTE: To avoid damaging a new or rebuilt hydraulic pump, run the pump at zero pressure (controls in neutral) for at least five minutes before putting the pump under load. Check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

PUMP (MODEL 522/4)(cont.)

1 - Suction Line
2 - Hydraulic Fitting
3 - Pressure Line to Power Assist Sel. Valve
4 - Line to Tank
5 - Compensator Line to Power Assist Sel. Valve
6 - Hydraulic Fittings
7 - Bolt (2)
8 - Plain Washer (2)
9 - Lockwasher (2)
10 - Nut (2)
11 - Coupling
12 - O-Ring
13 - Piston Pump

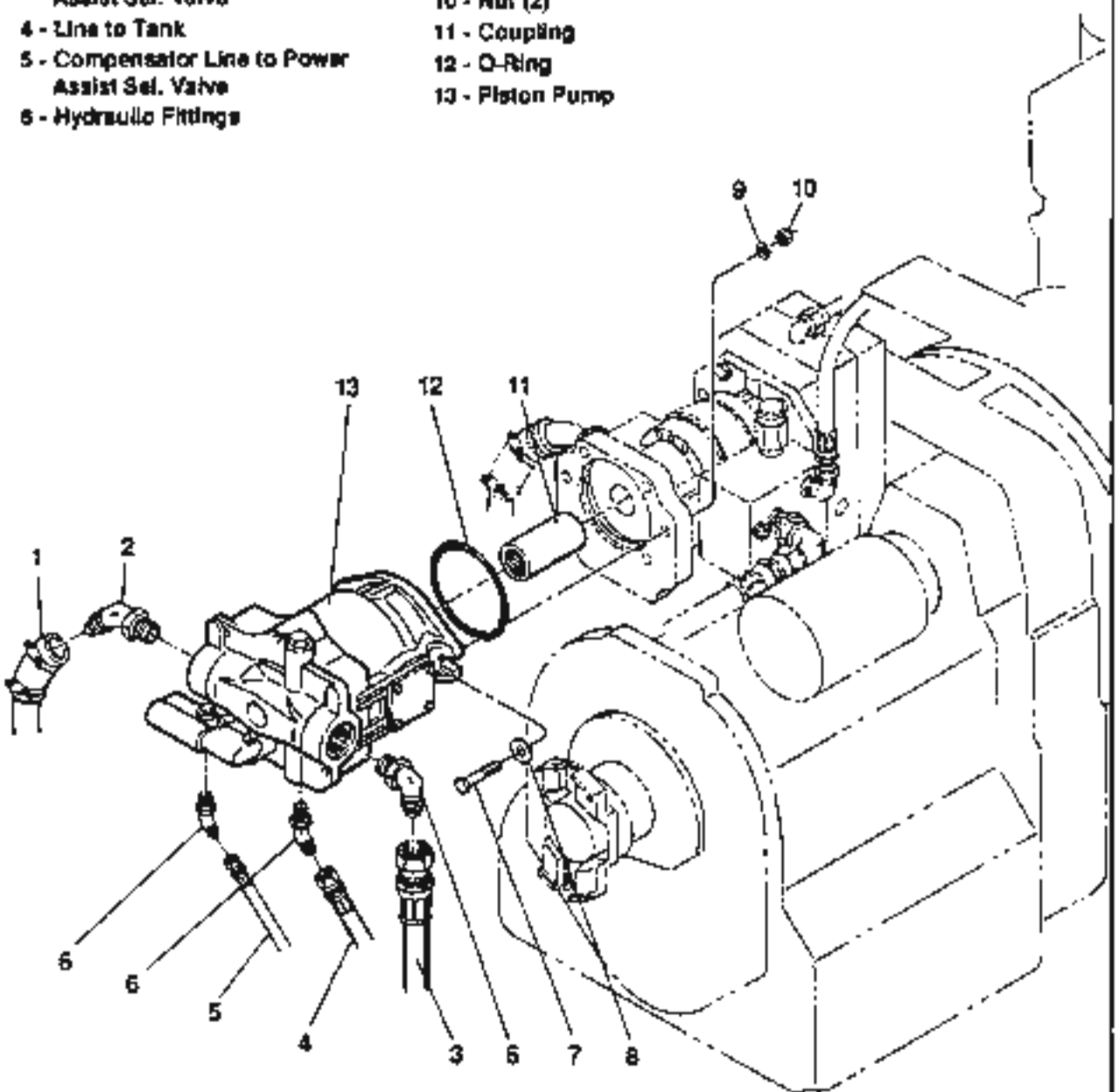
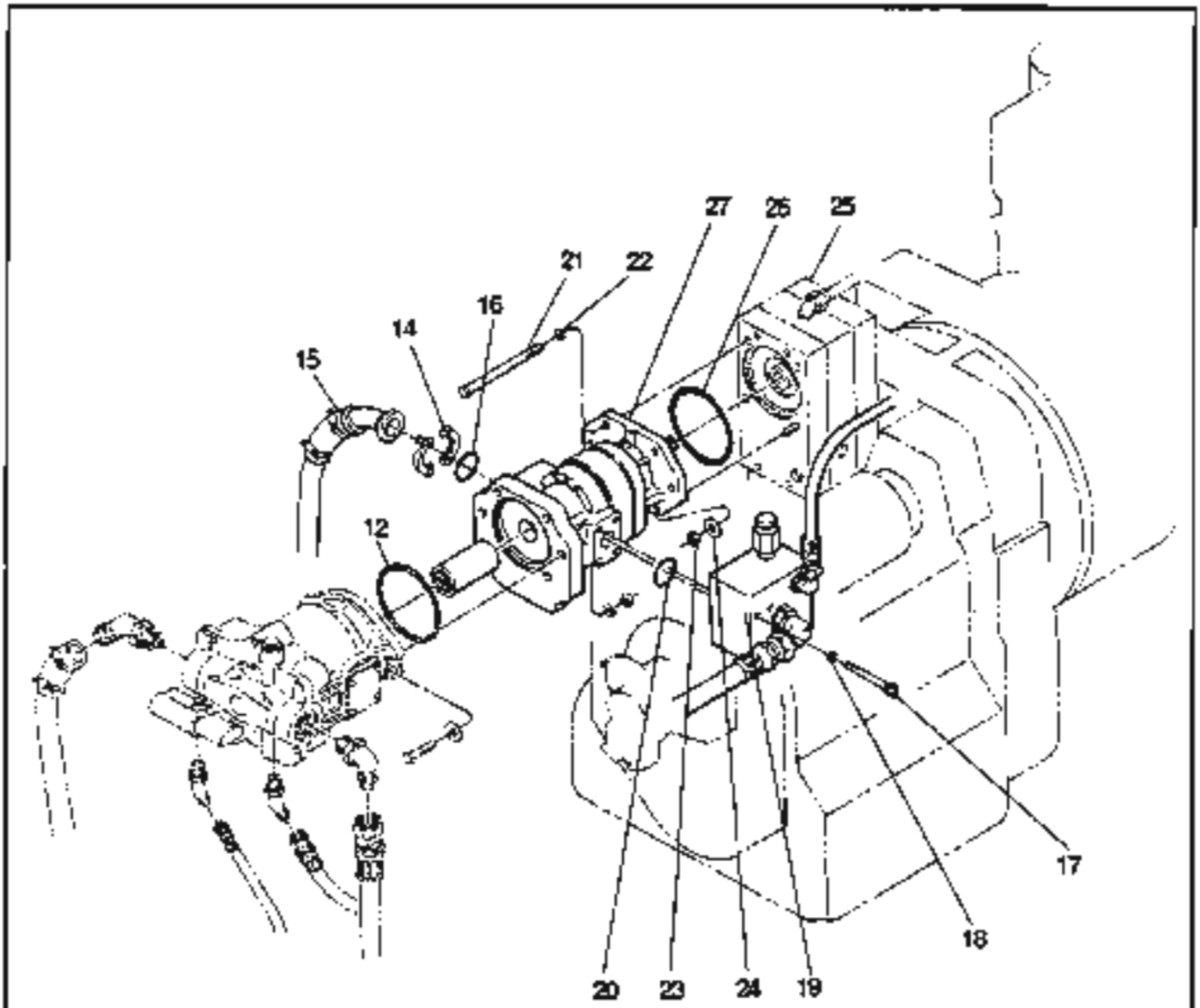


Figure 3-19 Piston Pump Removal

HYDRAULICS

HYDRAULIC PUMPS

PUMP (MODEL 522/4)(cont.)



12 - O-Ring
14 - Half Coupling
15 - Suction Line
16 - O-Ring
17 - Bolt, 3/8" (4)
18 - Lockwasher, 3/8" (4)
19 - Brake Priority Valve
20 - O-Ring
21 - Bolt, 1/2" (2)
22 - Lockwasher, 1/2" (2)
23 - Nut, 1/2" (2)
24 - Flatwasher, 1/2" (2)
25 - Pump Drive
26 - O-Ring
27 - Gear Pump

Figure 3-20 Gear Pump Removal

HYDRAULICS

HYDRAULIC PUMPS

PUMP DRIVE (MODEL 522/4)

MAINTENANCE

The pump drive is lubricated with transmission fluid through a small port in the top of the housing (the fluid returns to the transmission through the bottom bearing). Periodically check the port to make certain it is open and not restricted by contaminates.

REMOVAL (Figure 3-21)

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section).

2. Clean the pump drive area before removing the pump drive. Use steam cleaning equipment if available. Do not allow water into the system (be sure hose fittings are tight).

> **WARNING: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.**

3. Loosen the suction hose clamps and remove the suction hoses (Item 1) and cap the hoses and pump fittings.

4. Tag, remove and cap five hoses (Item 2).

5. Cap pump (Item 3) and priority manifold (Item 4) fittings.

6. Remove the two bolts and lockwashers (Items 5 & 6) and two nuts and flatwashers (Items 7 & 8) mounting the pumps to the pump drive.

7. Support and remove the pumps as one unit, pulling pumps straight back until spearated from the pump drive, and lift from machine.

8. Remove O-Ring (Item 9) and cover shaft and of pumps to prevent dirt from entering.

9. Remove tube (Item 10) and fitting (Item 11) from pump drive and cap tube and pump drive openings.

10. Remove two bolts and lockwashers (Items 12 & 6) mounting the pump drive to the transmission power take off.

11. Support pump drive (approximate weight 50 lbs.) and pull it straight back until separated from transmission and lift from machine.

12. Remove O-Ring (Item 13) and cover the pump drive openings to prevent dirt from entering.

INSTALLATION

1. Reverse steps 3 through 12 above.

NOTE: Install new O-Rings (Items 9 & 13) in steps 8 and 12 (see Lull Parts Book).

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

2. Before start-up remove the fill plug (Item 14) and fill the pump drive with 12 fluid ounces of transmission fluid. Install plug

NOTE: For transmission fluid specifications refer to "Transmission Fluid" on page 2.6-1 in Section 2.

3. Bleed the hydrauylic brake system (see Brake Bleeding Procedure on page 10.2-5 in Section 10).

OVERHAUL (Figure 3-22)

1. Disassemble the pump drive on a clean bench area. Place on clean paper or cloth to avoid getting the parts dirty.

2. Remove four socket head screws (Items 9).

3. Separate housing at seam. Pry apart at notches (Items 11), top and bottom.

4. Once disassembled, wash all parts in a clean mineral oil solvent (or other non-corrosive cleaner). Dry parts with compressed air.

5. Inpsect bearings, gears, shafts, etc. for wear. Replace as necessary.

6. Assemble parts as illustrated. NOTE: Bearings are light press fitted into the housing halves.

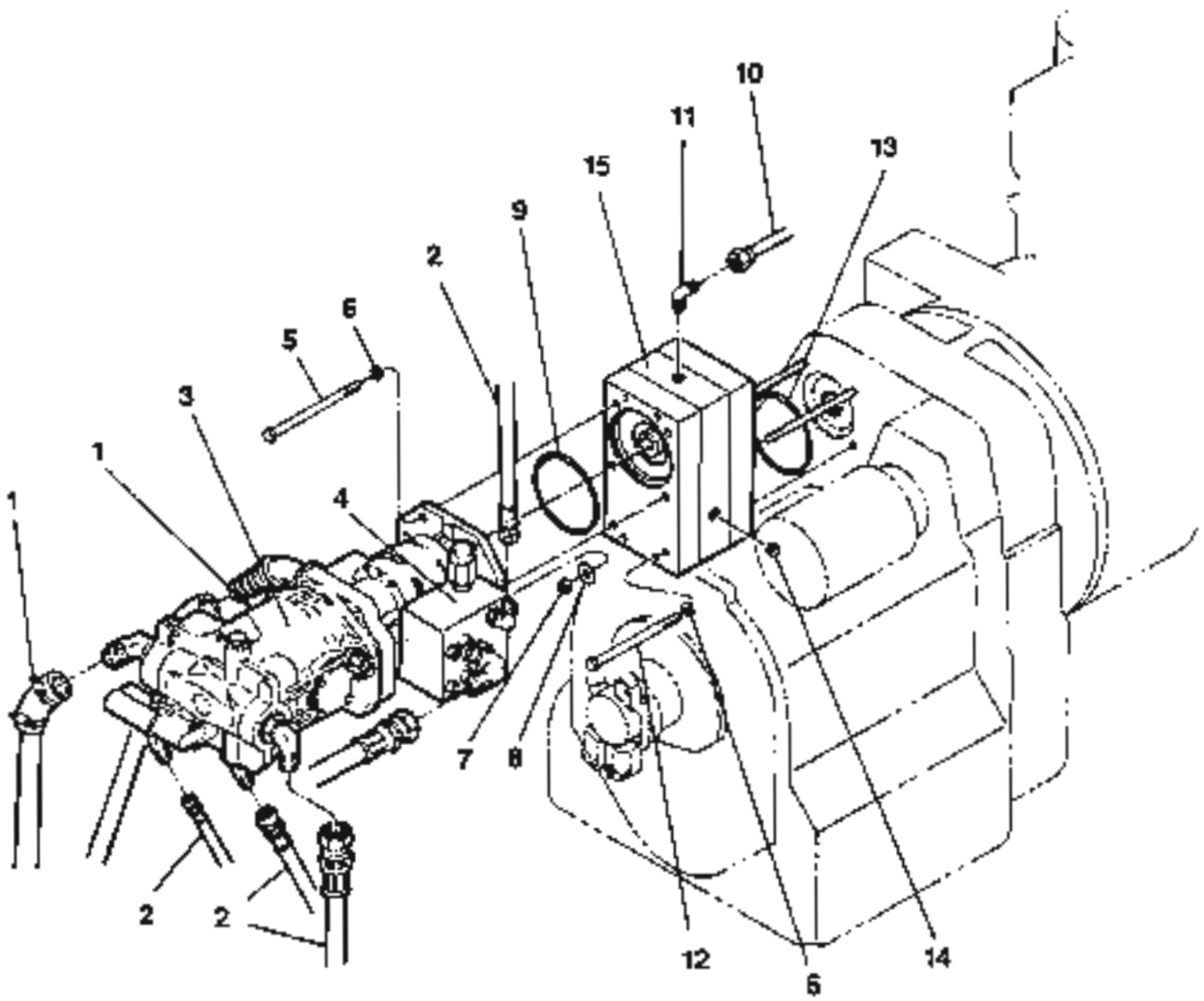
7. Apply silicone sealant to cleaned mating surface of one housing half only, before assembly.

8. Install the four socket head screws (Items 9) and torque to 110 in/lbs each.

HYDRAULICS

HYDRAULIC PUMPS

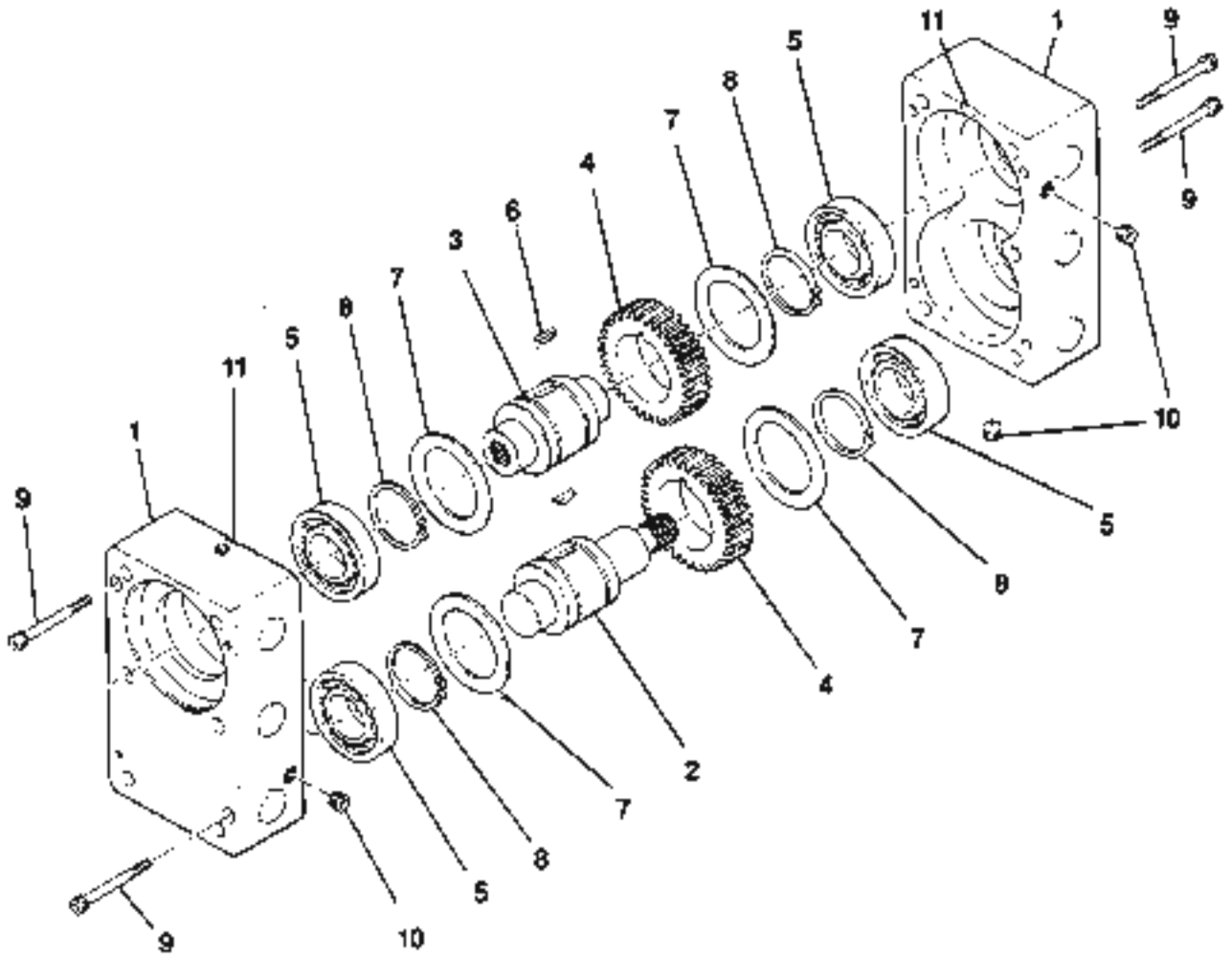
PUMP DRIVE (MODEL 522/4) (cont.)



1 - Suction Lines (2)
2 - Hydraulic Hoses (5)
3 - Pump
4 - Priority Manifold
5 - Bolt, 1/2" x 6 1/2" (2)
6 - Lockwasher, 1/2" (4)
7 - Nut, 1/2" (2)
8 - Flatwasher, 1/2" (2)
9 - O-Ring
10 - Transmission Fluid Line
11 - Hydraulic Fitting
12 - Bolt, 1/2" x 5 3/4" (2)
13 - O-Ring
14 - Fill Plug
15 - Pump Drive

Figure 3-21 Pump Drive Removal

PUMP DRIVE (MODEL 522/4) (cont.)



1 - Housing, Hall (2)

2 - Shaft, Transmission Drive

3 - Shaft, Pump Drive

4 - Spur Gear (2)

5 - Ball Bearing (4)

6 - Key (2)

7 - Washer (4)

8 - Retaining Ring (4)

9 - Socket Head Screw (4)

10 - Plug (3)

11 - Notch (2)

Figure 3-22 Pump Drive Disassembly

HYDRAULICS

HYDRAULIC PUMPS

PUMP (MODEL 622)

DESCRIPTION

The hydraulic pump used on the model 622 forklift is a single gear-type, driven directly from the transmission power take off. The pump incorporates an externally adjusted pilot relief valve on a priority circuit.

PUMP SPECIFICATIONS:

Type	Gear
Manufacturer	Tyrone
Model	PVP16
GPM	31 at 2500 RPM
Approx. Weight	10 lbs

REMOVAL (Figure 3-23)

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section).

2. Clean the pump and surrounding area before removing the pump. Use steam cleaning equipment if available. Do not allow water into the system (be sure hose fittings are tight).

WARNING: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.

3. Remove the two half coupling assemblies (Items 1). Remove three hoses (Items 2, 3 & 4) and cap. Remove hydraulic fitting (Item 5).

4. Remove two O-Rings (Items 6) and cap the pump openings.

5. Remove two bolts, lockwashers and nuts (Items 5, 6 & 7) mounting the pump to the transmission power take off.

6. Remove the pump (Item 10) pulling straight back until the pump's splined shaft is free, and lift from machine.

7. Cover the transmisson power take off opening to prevent dirt from entering the drive unit.

INSTALLATION

1. Reverse steps 3 through 7.

NOTE: Install new O-Rings (Items 4) in step 4 (see Parts Book).

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

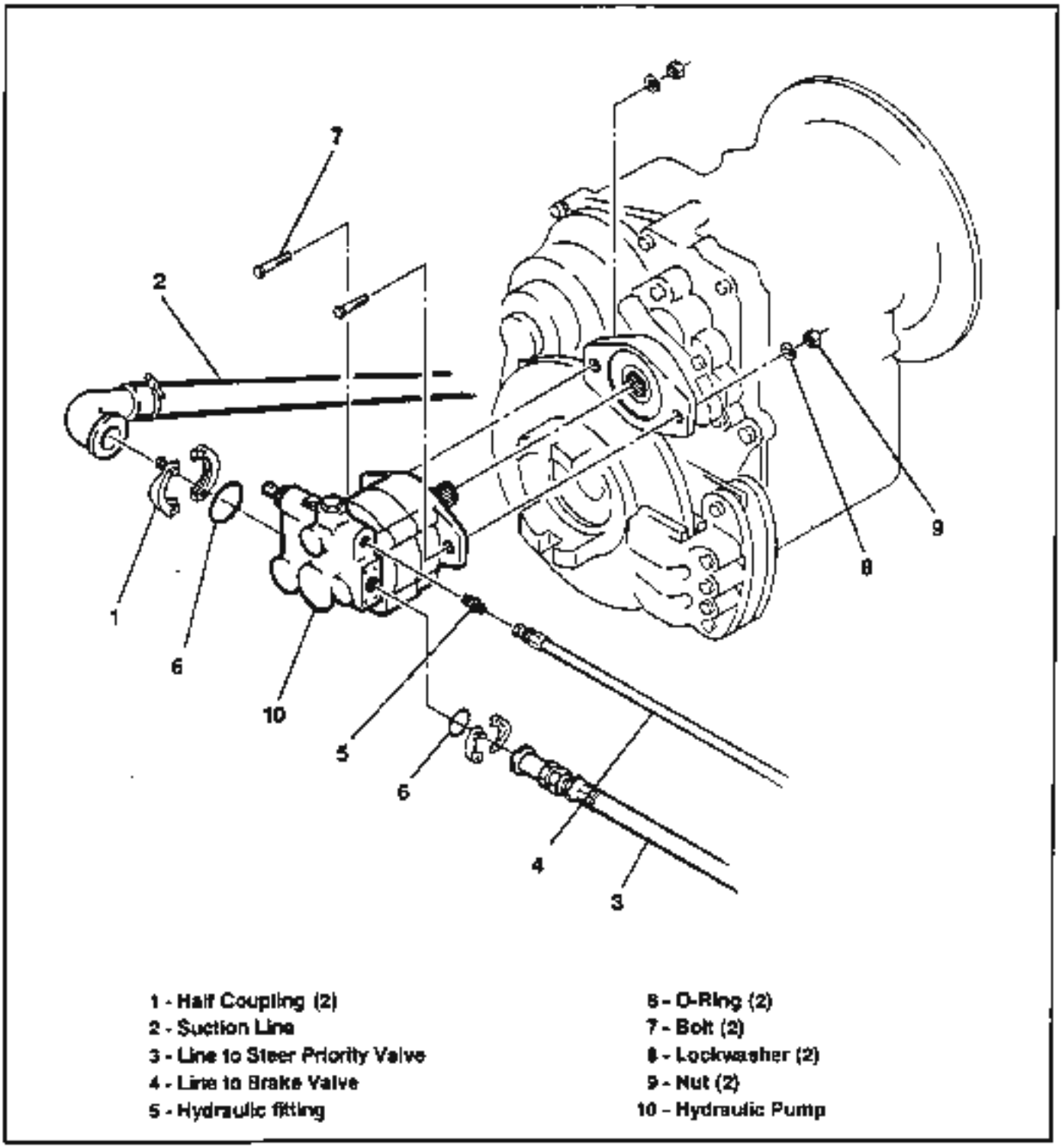
NOTE: To avoid damaging a new or rebuilt hydraulic pump, run the pump at zero pressure (controls in neutral) for at least five minutes before putting the pump under load. Check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

HYDRAULICS

HYDRAULIC PUMPS

PUMP (MODEL 622) (cont.)



1 - Half Coupling (2)
2 - Suction Line
3 - Line to Steer Priority Valve
4 - Line to Brake Valve
5 - Hydraulic fitting
6 - O-Ring (2)
7 - Bolt (2)
8 - Lockwasher (2)
9 - Nut (2)
10 - Hydraulic Pump

Figure 3-23 Hydraulic Pump Removal

HYDRAULICS

HYDRAULIC PUMPS

PUMP (MODELS 622/4, 824)

DESCRIPTION (Figures 3-24 & 3-25)

The two hydraulic pumps used on the model 622/4 and 824 forklifts are driven directly from the transmission power take off. The first pump (item 21) is a gear-type and is coupled to the second pump (item 9) which is a variable displacement piston-type incorporating a load sensing and pressure limiter control. (The load sensing control is designed to automatically adjust the pump flow in response to a remote pressure signal from the rear wheel power assist selector valve; it will adjust the pump displacement to maintain outlet pressure at a level of approximately 150 psi above the load pressure. The pressure limiter control overrides the load sensing control thus reducing pump displacement.)

PUMP SPECIFICATIONS:

First Pump	Gear-Type
Manufacturer	Vickers
Model	GT20
GPM	31 at 2500 RPM
Approx. weight	42 lbs
Second Pump	Piston-Type
Manufacturer	Vickers
Model	PVE19
GPM	25 at 2500 RPM
Approx. weight	35 lbs

REMOVAL - PISTON PUMP (Figure 3-24)

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section).

2. Clean the pump and surrounding area before removing the pump. Use steam cleaning equipment if available. Do not allow water into the system (be sure hose fittings are tight).

WARNING: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.

3. Loosen the suction hose clamp and remove the suction hose (item 1) and cap.

4. Remove fittings (item 2) and cap the pump opening.

5. Remove (3) hydraulic hoses (items 3) and fittings (items 4). Cap pump openings.

6. Support the pump (item 5) and remove two mounting bolts, flatwashers, lockwashers and nuts (items 6, 7, 8 & 9).

7. Pull the pump straight back, separating it from the gear pump and the splined coupling (item 10), and lift from machine.

8. Remove the O-Ring (item 11) and cover the drive opening of the gear pump to prevent dirt from entering.

INSTALLATION - PISTON PUMP

1. Reverse steps 3 through 8 above.

NOTE: Install a new O-Ring (item 11) in step 8 above (see Parts Book).

NOTE: Refer to 'Bolt Torque Specifications' and 'Torque Specifications for Hydraulic Line Connections' in Section 1.

NOTE: To avoid damaging a new or rebuilt hydraulic pump, run the pump at zero pressure (controls in neutral) for at least five minutes before putting the pump under load. Check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

HYDRAULICS

HYDRAULIC PUMPS

PUMP (MODEL 622/4, 824) (cont.)

1 - Suction Hose
2 - Hydraulic Fittings
3 - Pressure Line to Power Assist Selector Valve
4 - Line to Tank
5 - Compensator Lint to Power Assist Selector Valve
6 - Hydraulic Fittings (3)
7 - Piston Pump
8 - Bolt (2)
9 - Flatwasher (2)
10 - Lockwasher (2)
11 - Nut (2)
12 - Coupling
13 - O-Ring

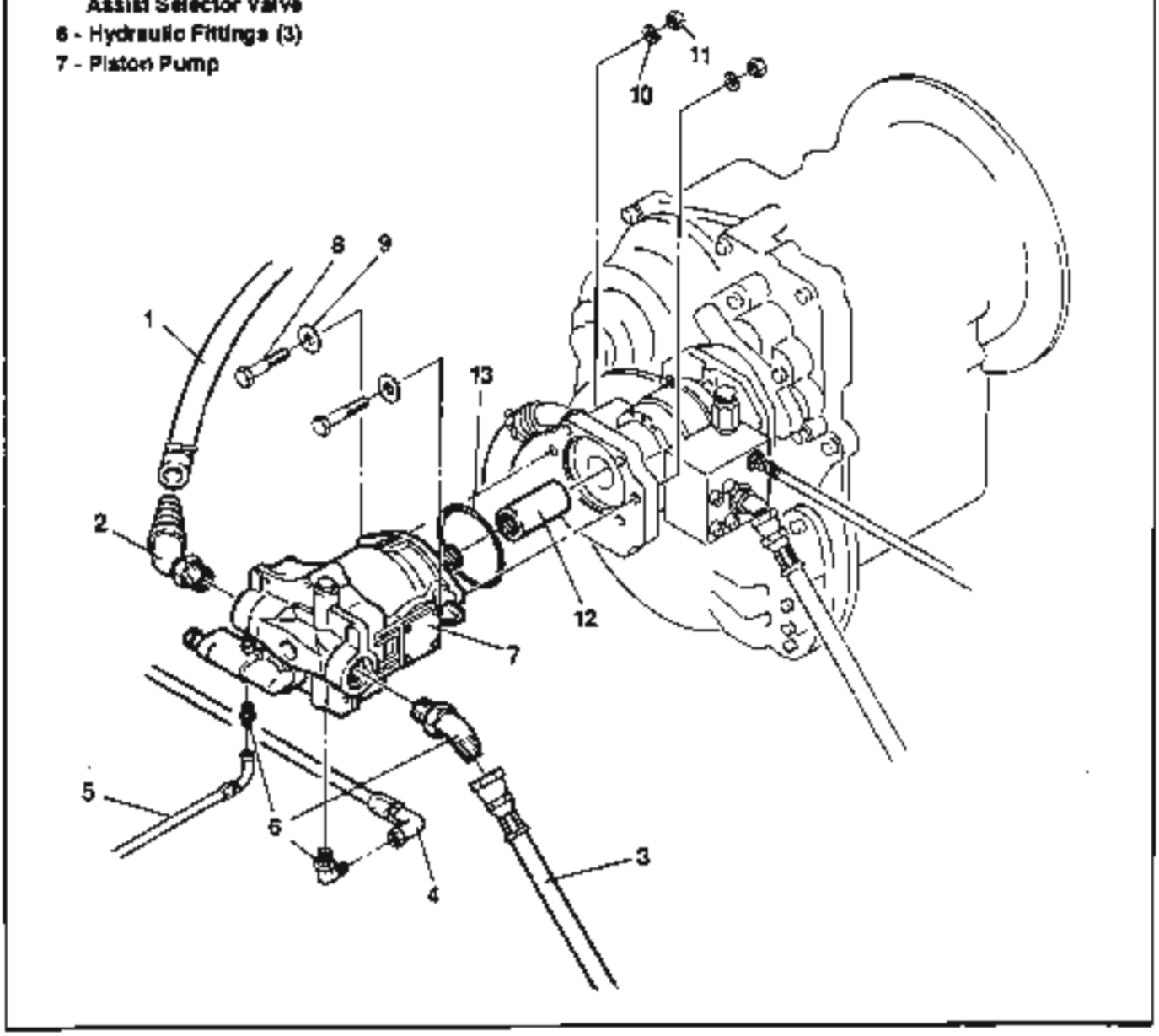


Figure 3-24 Piston Pump Removal

PUMP (MODELS 622/4, 824)(cont.)

REMOVAL - GEAR PUMP (Figure 3-25)

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section).

2. Clean the pumps and surrounding area before removing the pumps. Use steam cleaning equipment if available. Do not allow water into the system (be sure hose fittings are tight).

> **WARNING: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.**

3. Remove the piston pump (Item 7) from the machine: Perform steps 3 through 8 under Removal of Piston Pump and cap all ports to prevent dirt from entering.

4. Remove the half flange assembly (Item 15). Detach and position suction line (Item 16) out of the way and cap.

5. Remove O-Ring (Item 17) and cap the pump opening.

6. Remove four bolts and lockwashers (Items 18 & 19) mounting the priority valve (Item 20) to the gear pump (Item 21).

7. Separate the priority valve from the gear pump and, with hoses attached, position out of the way. Remove O-Ring (Item 22). Cap priority valve and pump openings.

8. Remove the two bolts, lockwashers and nuts (Items 23, 24 & 25) mounting the gear pump to the transmission P.T.O. Flange.

9. Support the gear pump and pull it straight back, separating the gear pump from the pump drive, and lift pump from machine.

10. Remove O-Ring (Item 26) and cover the transmission P.T.O. opening to prevent dirt from entering.

INSTALLATION - GEAR PUMP

1. Reverse steps 3 through 10 above.

NOTE: Install new O-Rings (Items 13, 17, 22 & 26) in steps 3, 5, 7 and 10 above (see Parts Book).

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

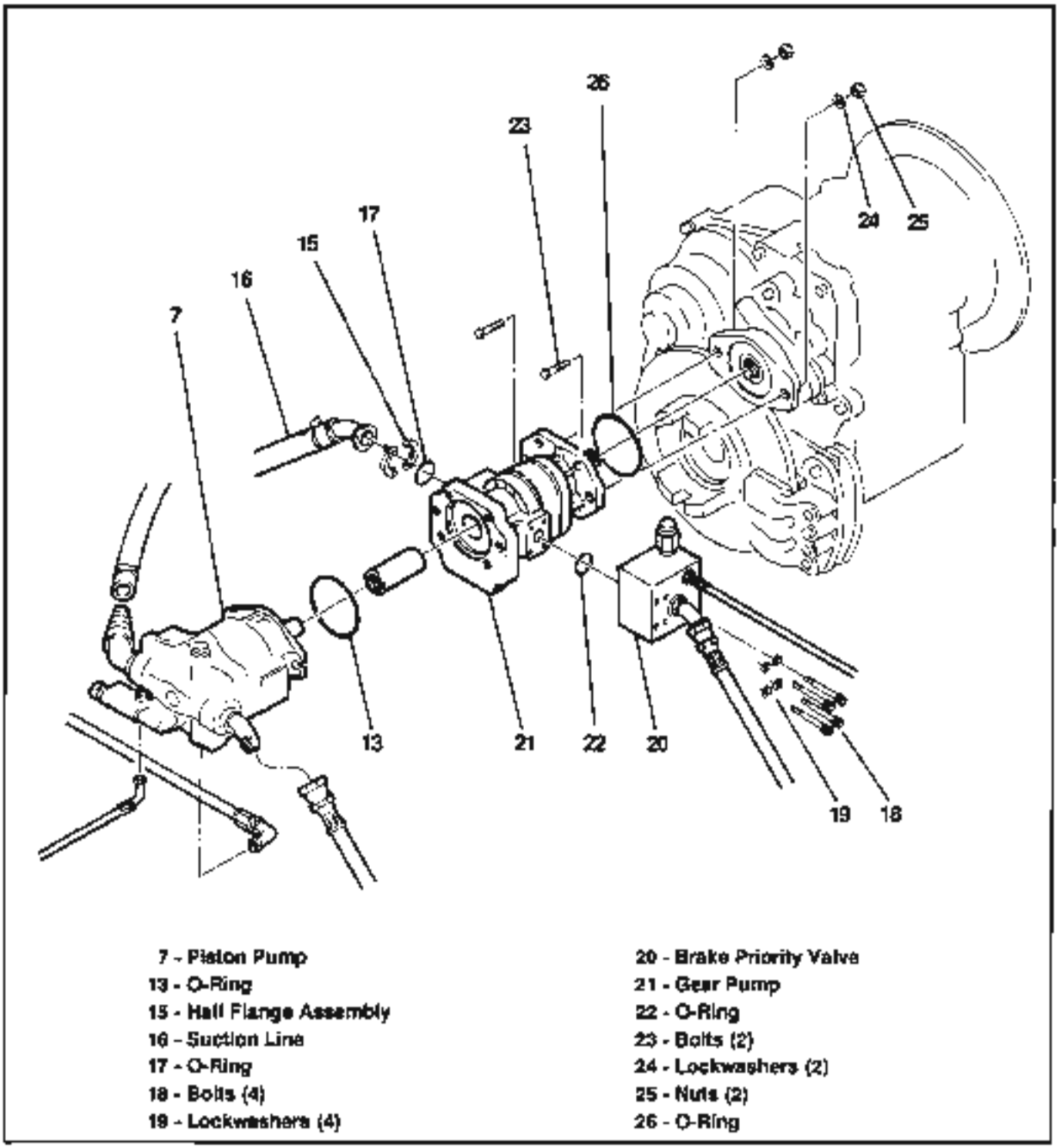
NOTE: To avoid damaging a new or rebuilt hydraulic pump, run the pump at zero pressure (controls in neutral) for at least five minutes before putting the pump under load. Check for leaks.

> **WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.**

HYDRAULICS

HYDRAULIC PUMPS

PUMP (MODEL 622/4, 824) (cont.)



7 - Piston Pump
13 - O-Ring
15 - Half Flange Assembly
16 - Suction Line
17 - O-Ring
18 - Bolts (4)
19 - Lockwashers (4)
20 - Brake Priority Valve
21 - Gear Pump
22 - O-Ring
23 - Bolts (2)
24 - Lockwashers (2)
25 - Nuts (2)
26 - O-Ring

Figure 3-25 Gear Pump Removal

HYDRAULICS

DIRECTIONAL CONTROL VALVES

LOCATION

Refer to Figure 3-1 and 3-2 on pages 3.4-2 and 3.7-2 for locations of the various directional control valves on the machines.

MAINTENANCE

Hydraulic valves do not require periodic maintenance other than checking for leakage and proper operation. If a pressure relief valve is suspected of operating improperly: Refer to "Checking and Adjusting Circuit Pressure" on page 3.9-1 of this section for checking and adjusting for correct operating pressure.

TROUBLESHOOTING

Refer to "System Troubleshooting" on page 3.12-1 of this section for probable causes and remedies for improper valve operation.

OVERHAUL

Use the following procedures when disassembling valves:

* Do not perform hydraulic valve internal service work on the shop floor, on the ground, or where there is danger of dust or dirt being blown into parts. USE ONLY A CLEAN BENCH AREA. Be certain all tools are clean and free of grease and dirt.

* During disassembly, be careful to identify the parts for reassembly. Spools are selectively fitted to valve bodies and must be returned to the same bodies from which they were removed. Valve sections must be reassembled in the same order.

* When it is necessary to clamp a valve housing in a vise, use extreme caution. Do not damage the component. If possible, use a vise equipped with lead or brass jaws or protect the component by wrapping it in a protective covering.

* All valve housing openings should be sealed when components are removed during service work. This will prevent foreign material from entering the housing.

* Wash all valve components in a clean mineral oil solvent (or other non-corrosive cleaner). Dry parts with compressed air and place on a clean surface for inspection. Do not wipe valves with waste paper or rags. Lint deposited on any parts may enter the hydraulic system.

* DO NOT USE CARBON TETRACHLORIDE as a cleaning solvent as it causes deterioration of rubber seals.

* After parts are cleaned and dried, coat them immediately with a rust-inhibiting hydraulic oil. Then be sure to keep the parts clean and free of moisture until they are installed.

* Carefully inspect valve springs during valve disassembly. Replace all springs that show signs of being cocked or bent, or contain broken, fractured or rusty coils.

NOTE: Directional control valve spools are installed in the valve housing by a select hone fit. This is done to provide the closest possible fit between housing and spool for MINIMUM internal leakage and MAXIMUM holding qualities. Therefore, valve spools and bodies are furnished for service only in matched sets and are not available individually for replacement.

Use the following procedures when assembling valves:

* When assembling valves, be sure that they are kept absolutely clean. Wash parts in a clean mineral oil solvent, blow dry with air, then dip in hydraulic oil with rust inhibitor to prevent rusting. This will also aid in assembly and provide initial lubrication. Petroleum jelly can also be used to hold sealing rings in place during assembly, but use sparingly as it can plug the system filters.

* Double check at this time to be sure that valve mating surfaces are free of burrs and paint.

* Replace all seals and gaskets when repairing a valve assembly (refer to the Lull Parts Book). Coat new seals and gaskets with clean hydraulic oil prior to assembly. This will prevent damage and help seal the valve parts.

OVERHAUL (cont.)

* Be sure to insert valve spools in their matched bores. Valve sections must also be assembled in their correct order.

* When mounting valves, be sure there is no distortion. This may be caused by uneven tension on the mounting bolts and oil line flanges, uneven mounting surfaces, improper location of the valve, or insufficient allowance for line expansion when oil temperature rises. Any of these may result in valve spool binding.

* After tightening bolts, check the action of the valve spools. If there is any sticking or binding, adjust tension of mounting bolts.

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (Models 522, 522/4, 622, 622/4, 824)

DESCRIPTION

The two-spool boom control valve is a Husco Model #4172-5 which is located to the right of the operator in the operator's cab. The valve is a four way, three position, open center type, with the two spools controlled by one "Joystick" handle.

The valve incorporates an externally adjusted pressure relief valve (main relief). The relief valve limits system pressure, protecting the system from excessive pressure. Hydraulic oil flow that would exceed the set pressure is routed to the hydraulic oil reservoir.

The engine must be operating before there can be any valve function. With the control handle in the neutral position, hydraulic oil will flow through the valve and continue on through the system, returning eventually to the reservoir. Movement of the control handle, however, will direct hydraulic oil flow to the desired circuit, resulting in hydraulic cylinder movement.

Moving the handle to the right will extend the boom; to the left will retract the boom; rearward will raise the boom; forward will lower the boom (Figures 3-30 through 3-37). Two functions may be actuated at one time, to varying degrees, depending on placement of the control handle between the two functions. The spools are spring loaded, which will return the handle to the neutral position when released.

ADJUSTING PRESSURE RELIEF

To adjust the pressure relief valve, follow the instructions under "Checking Circuit Pressure" on page 3.9-1 of this section.

REMOVAL

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section).

2. Remove knob (Item 1), boot plate (Item 2), and boot (Item 3). Remove valve cover (Item 4) and clean the valve (Item 5) and surrounding area. Use steam cleaning equipment if available. Do not allow water into the system (be sure hydraulic line connections are tight).

3. Tag and remove all the hydraulic lines (Items 6) connected to the valve. Cap the lines.

4. Remove the three mounting bolts, nuts and lockwashers (Items 7). Remove three spacers (Item 8).

5. Remove the valve from the machine and cap valve openings.

INSTALLATION

1. Reverse steps 2 through 5 above, and replace the valve cover.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

OVERHAUL (Figure 3-28)

Refer to "Overhaul" on page 3.33-1 for valve overhaul procedures.

When assembling valve, use the following torque specifications:

(Items 8) - Apply loctite and torque to 84 - 96 in/lbs
(Items 10) - Lube threads and torque to 4 1/2 - 5 1/2 ft/lbs
(Item 18 & 26) - Lube threads and torque to 60 - 80 ft/lbs
(Item 12 & 14) - Torque to 8 1/2 - 11 1/2 ft/lbs
(Item 21) - Lube threads and torque to 90 ft/lbs
(Items 25) - Lube threads and torque to 60 ft/lbs

BOOM CONTROL VALVE (ALL MODELS)

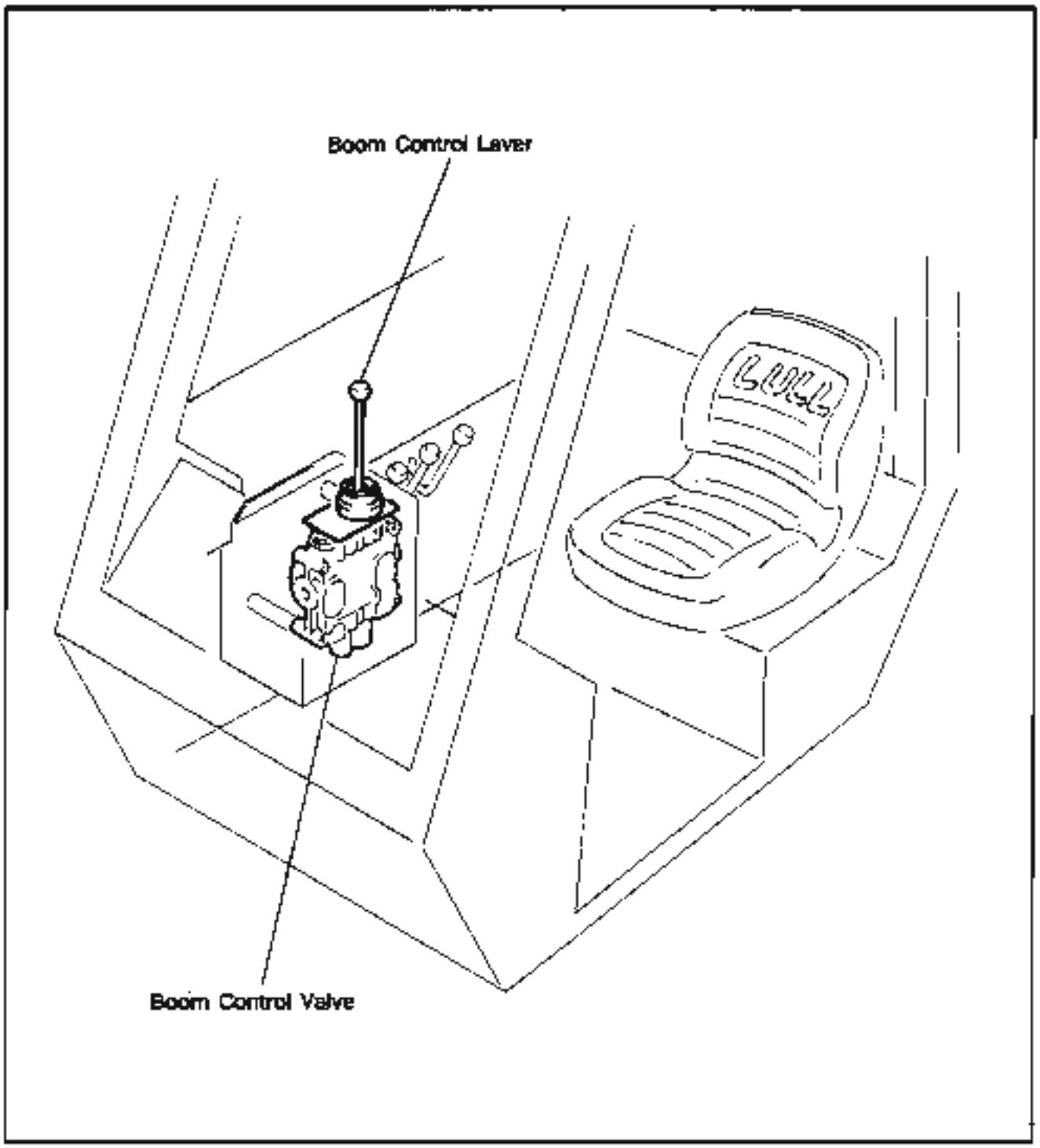
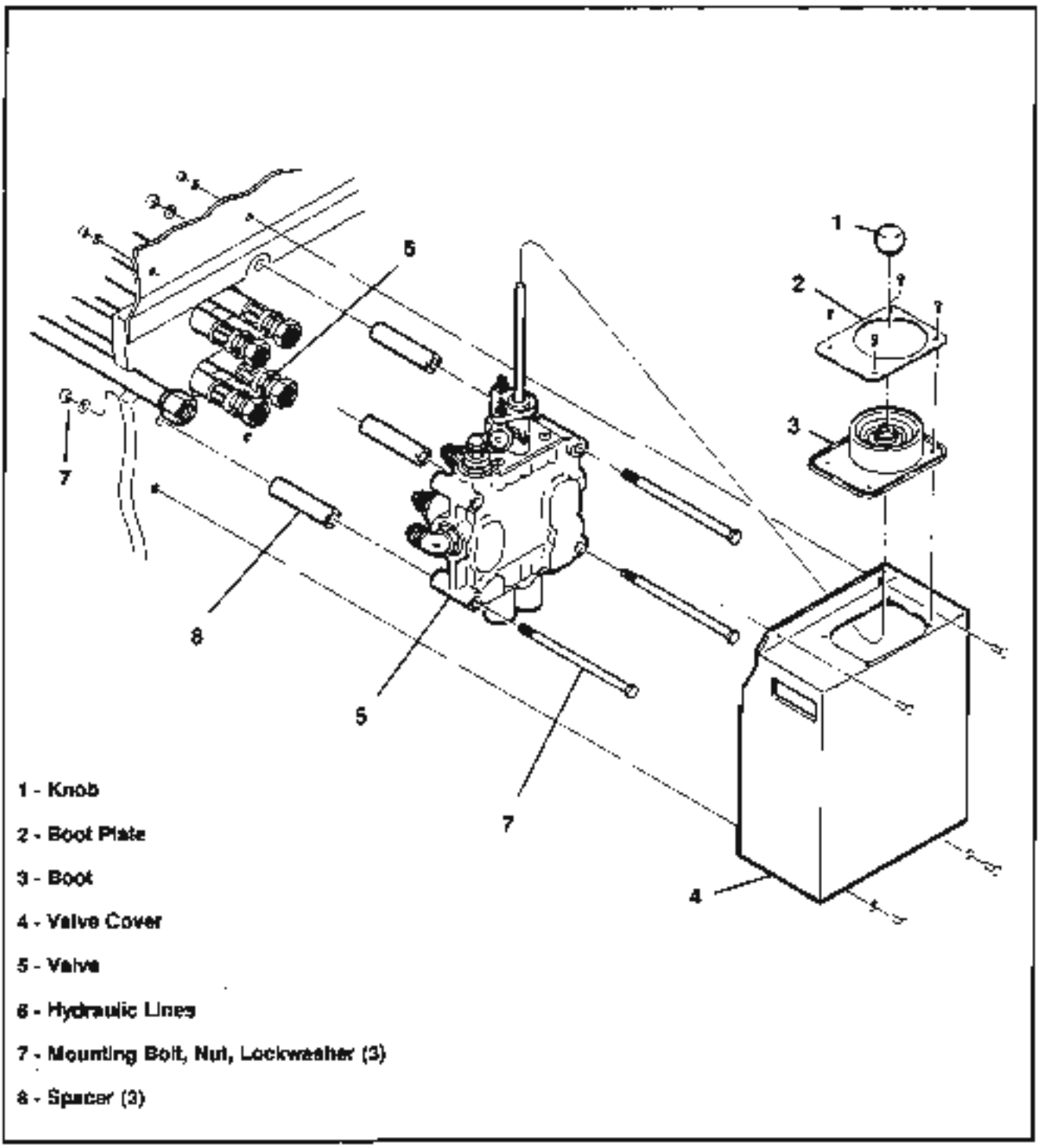


Figure 3-26 Boom Control Valve Arrangement (Model 522 Shown)

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)



1 - Knob

2 - Boot Plate

3 - Boot

4 - Valve Cover

5 - Valve

6 - Hydraulic Lines

7 - Mounting Bolt, Nut, Lockwasher (3)

8 - Spacer (3)

Figure 3-27 Boom Control Valve Removal (Model 522 Shown)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)

1 - Valve Body
2 - Spool (2)
3 - Wiper (4)
4 - O-Ring (4)
5 - Seal Plate (2)
6 - Spring Seat (4)
7 - Spring (2)
8 - Spool End (2)
9 - Spool Cap (2)
10 - Soc. Hd. Screw (4)
11 - Pressure Plug
12 - Cap
13 - O-Ring (2)
14 - Locknut
15 - Adjusting Screw
16 - Spring
17 - Plunger
18 - Relief Body
19 - O-Ring (2)
20 - O-Ring
21 - Plug
22 - Poppet (2)
23 - Spring (2)
24 - O-Ring (2)
25 - Plug (2)
26 - Plug

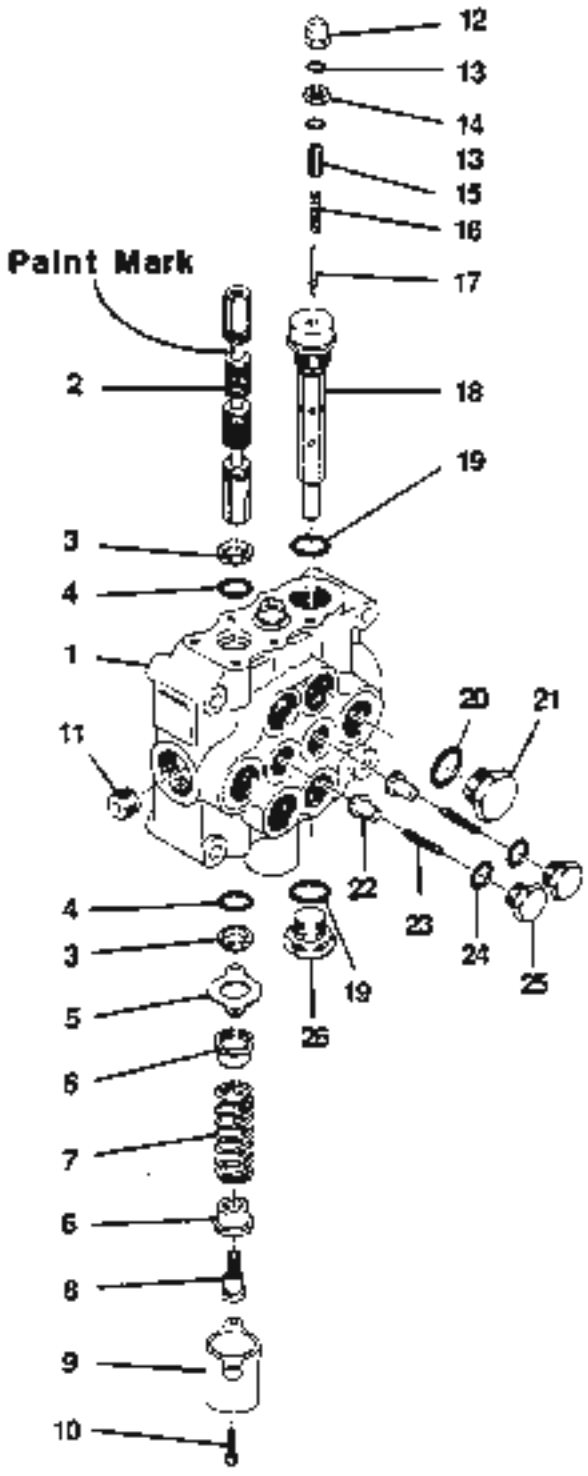


Figure 3-28 Boom Control Valve Disassembly

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)

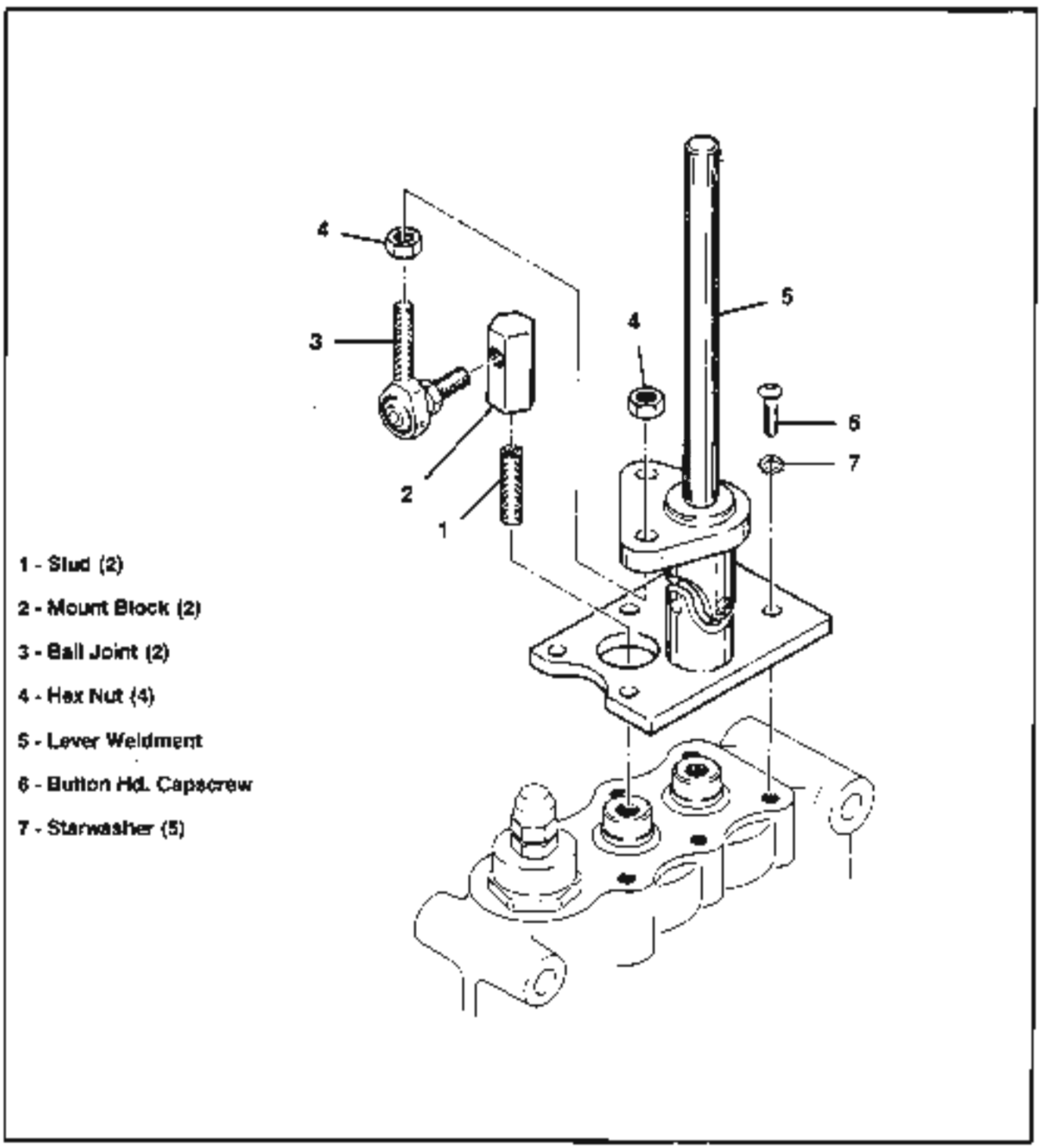


Figure 3-29 Boom Control Lever Disassembly

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)

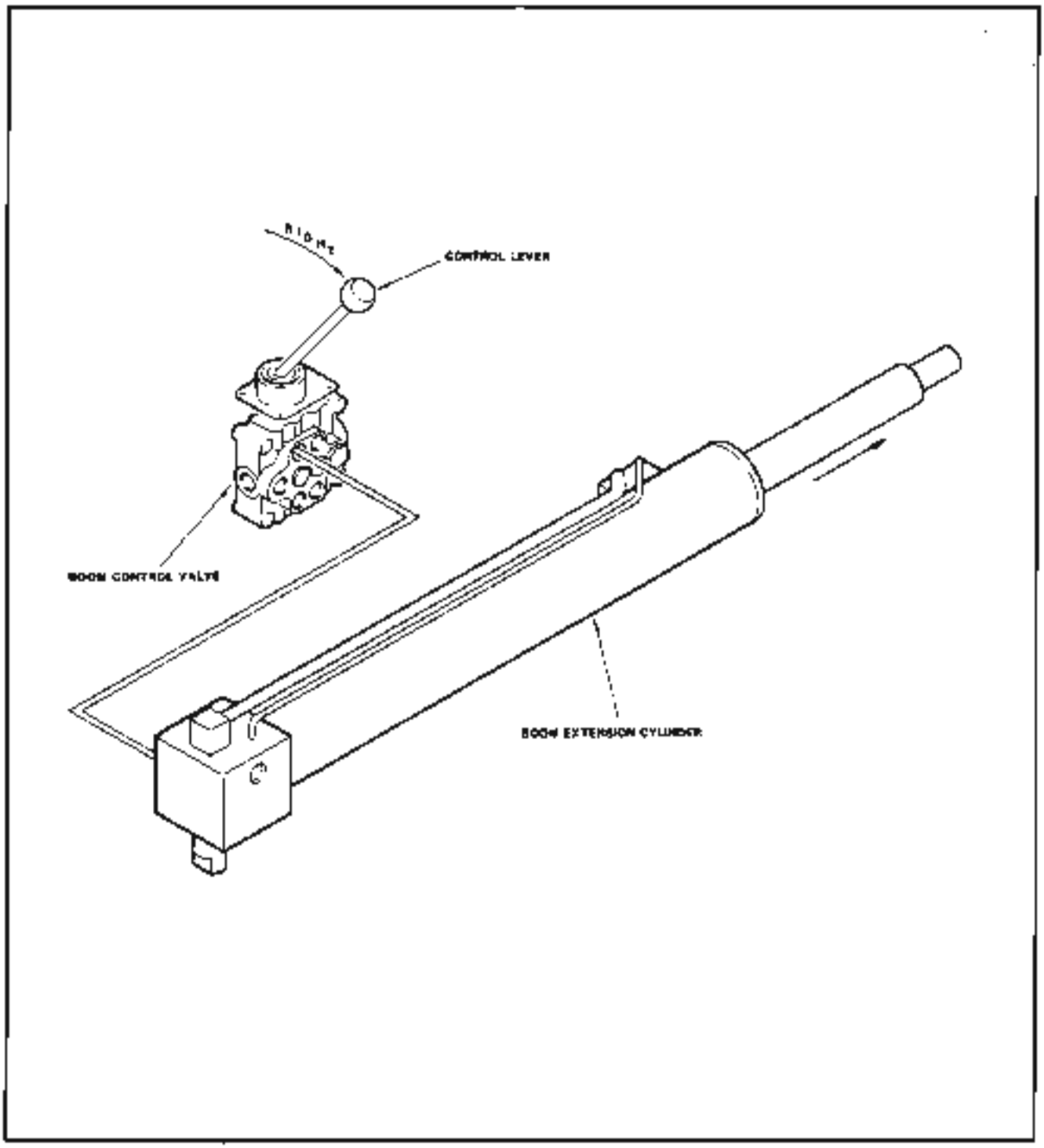


Figure 3-30 Flow Diagram - Boom Extend (Model 522)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)

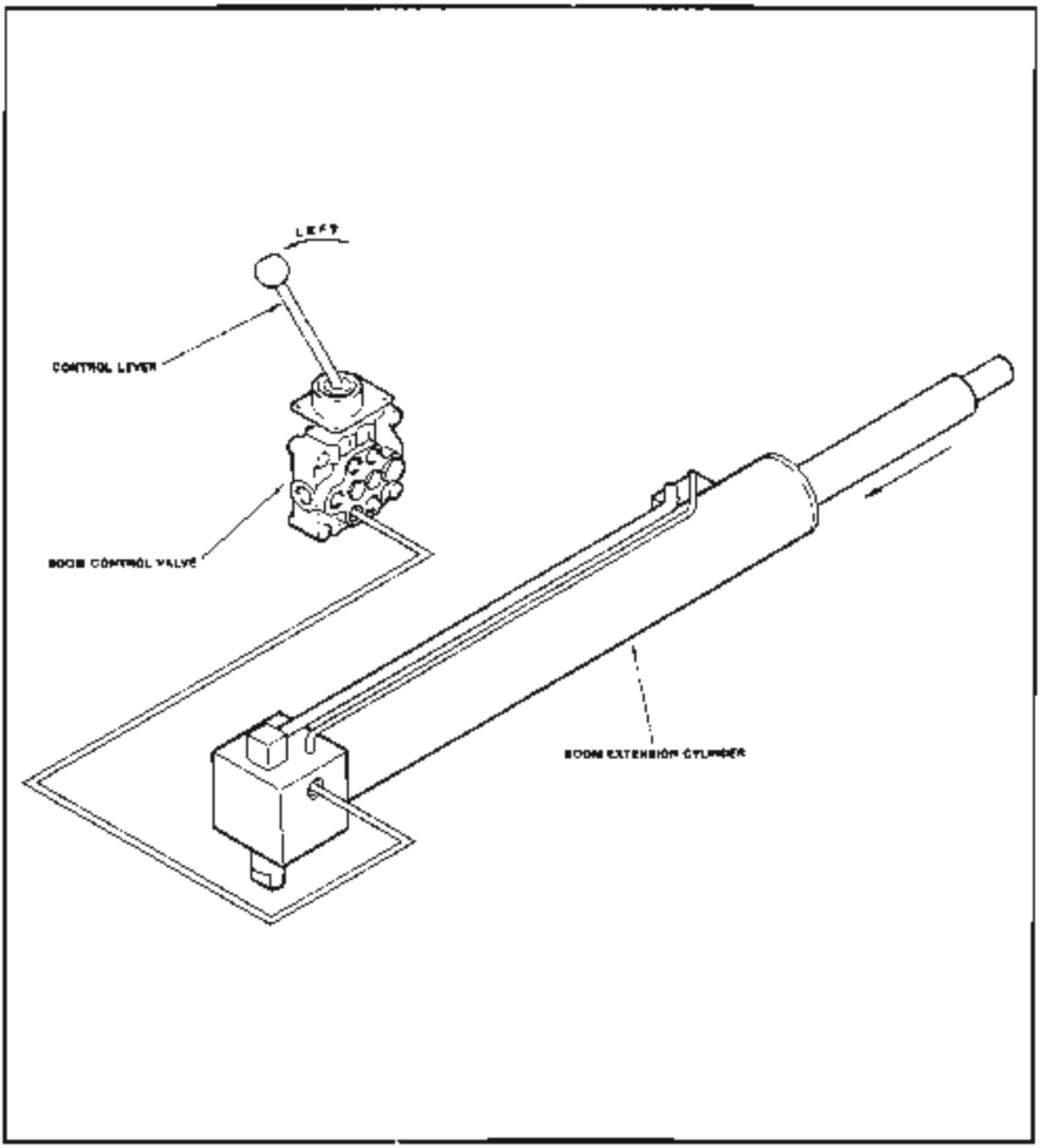


Figure 3-31 Flow Diagram - Boom Retract (Model 522)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)

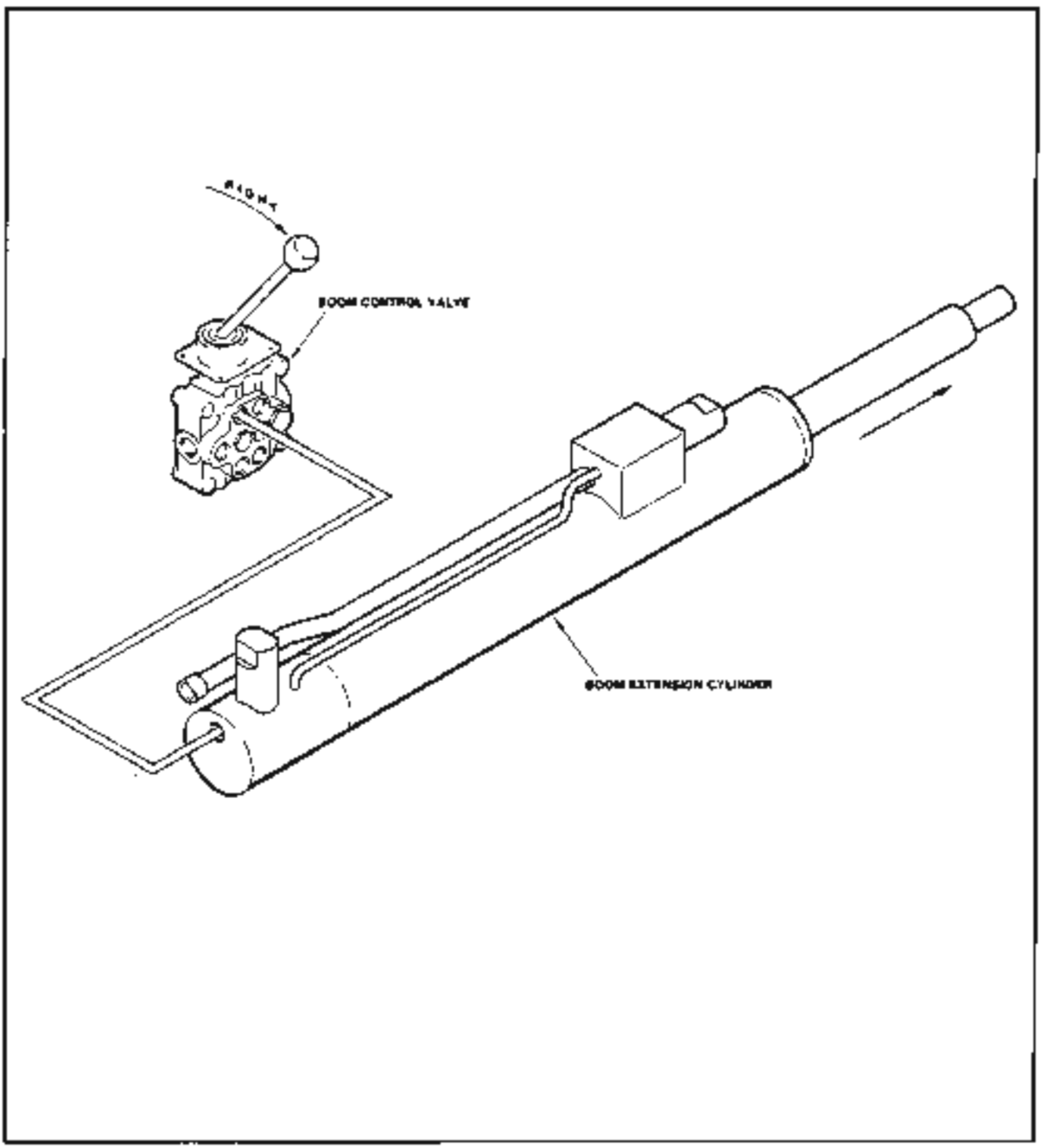


Figure 3-32 Flow Diagram - Boom Extend (Models 622, 824)

BOOM CONTROL VALVE (ALL MODELS)

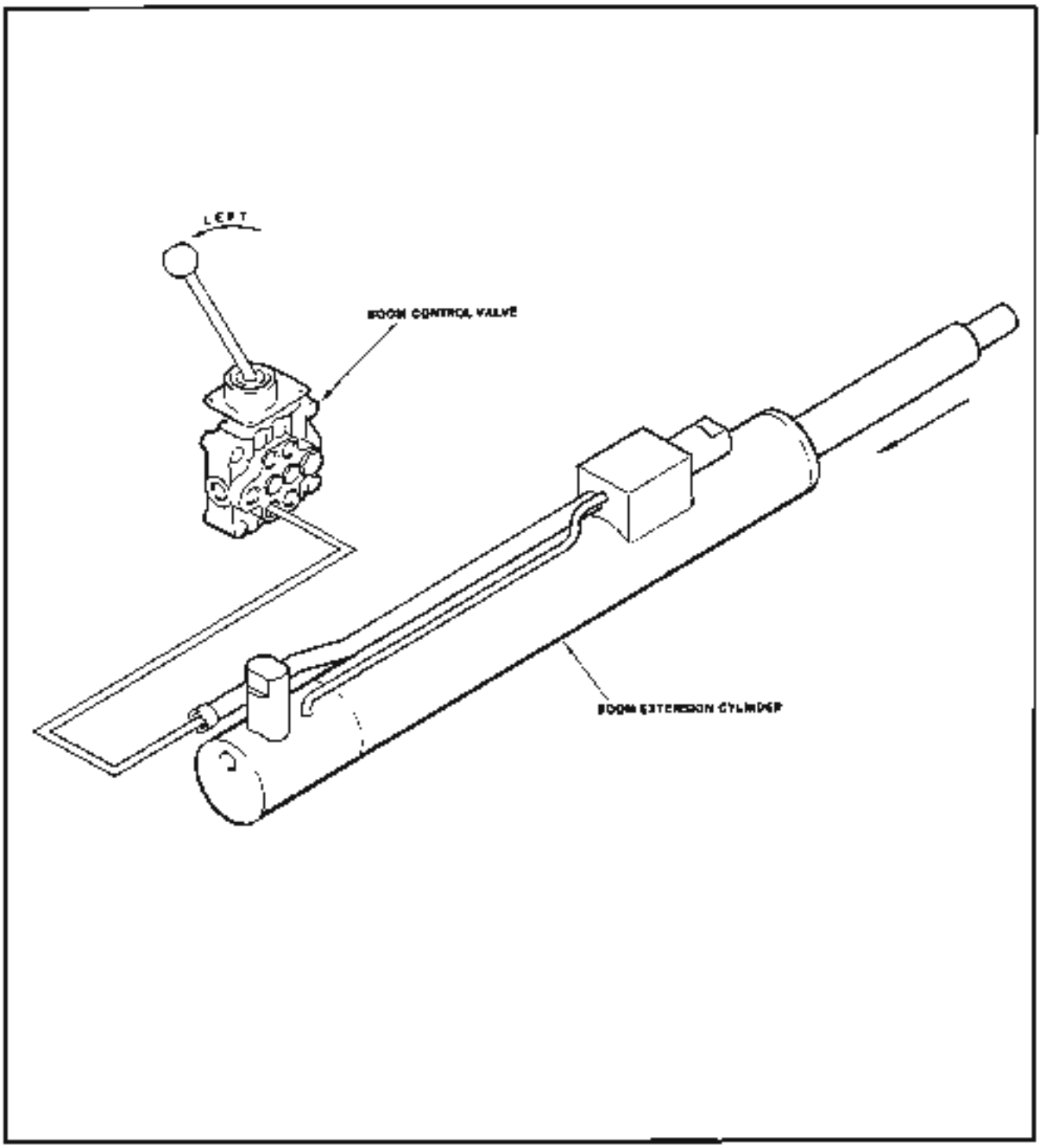


Figure 3-33 Flow Diagram - Boom Retract (Models 622,824)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)

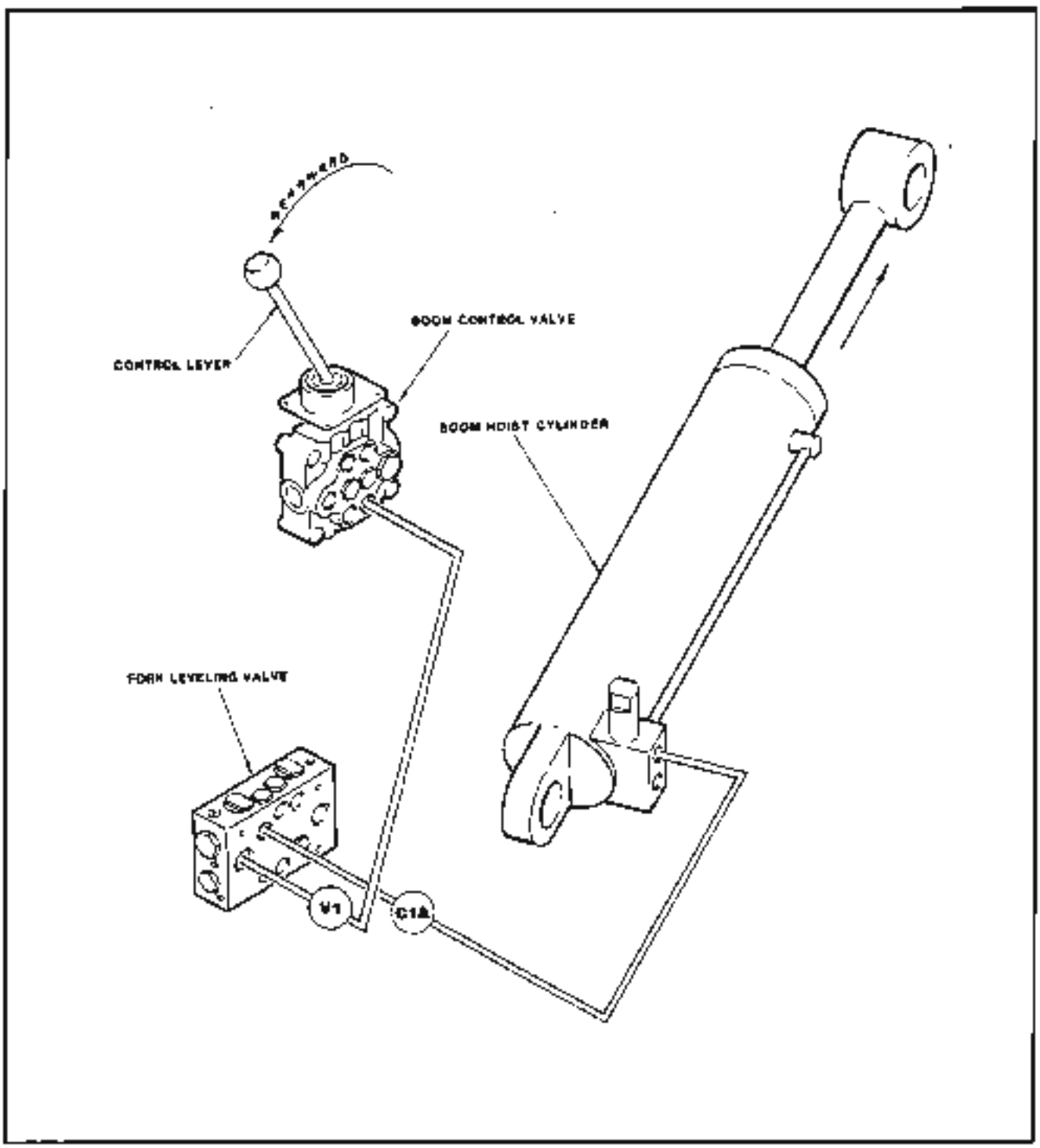


Figure 3-34 Flow Diagram - Boom Raising (Model 522)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)

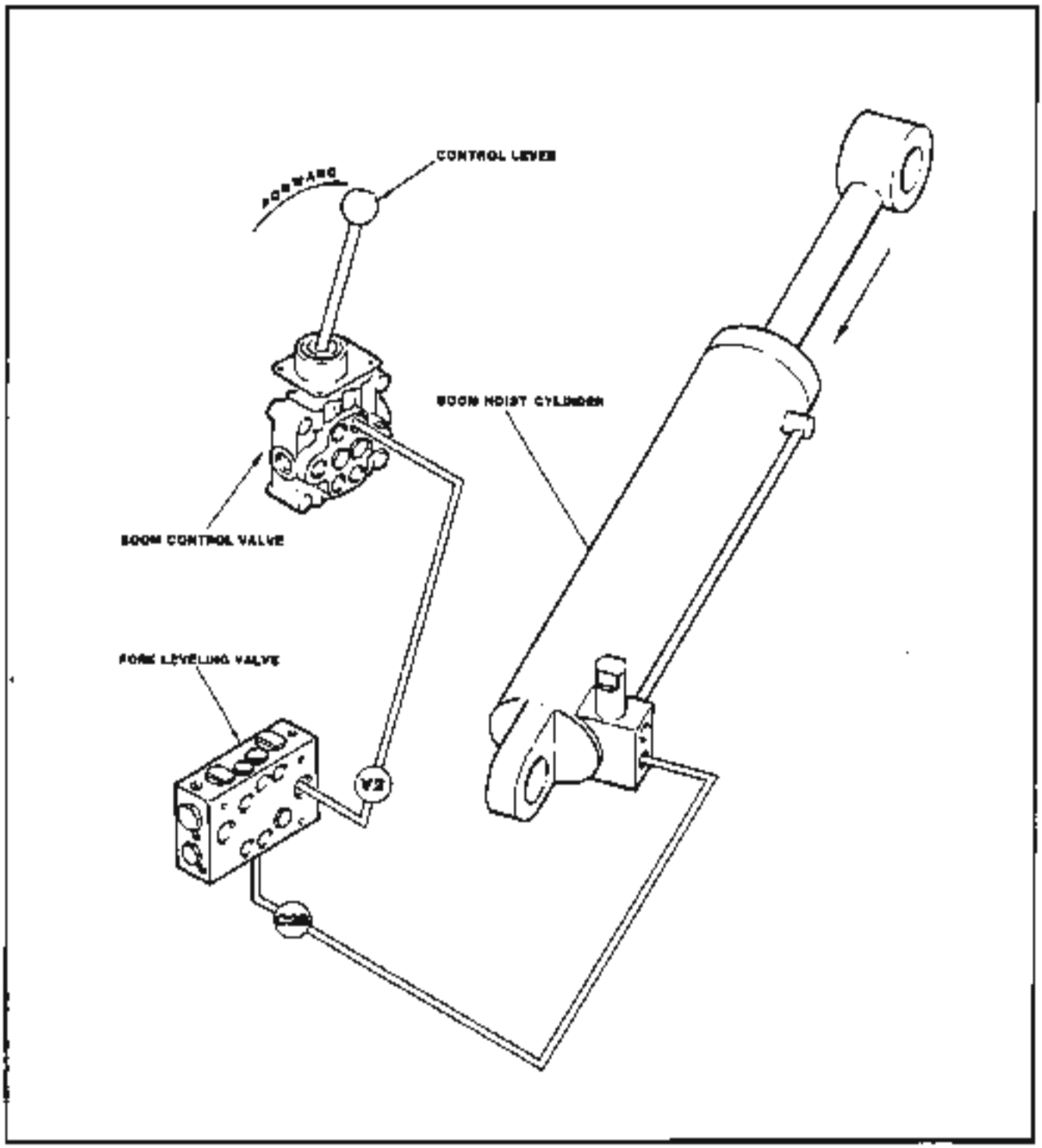


Figure 3-35 Flow Diagram - Boom Lowering (Model 522)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)

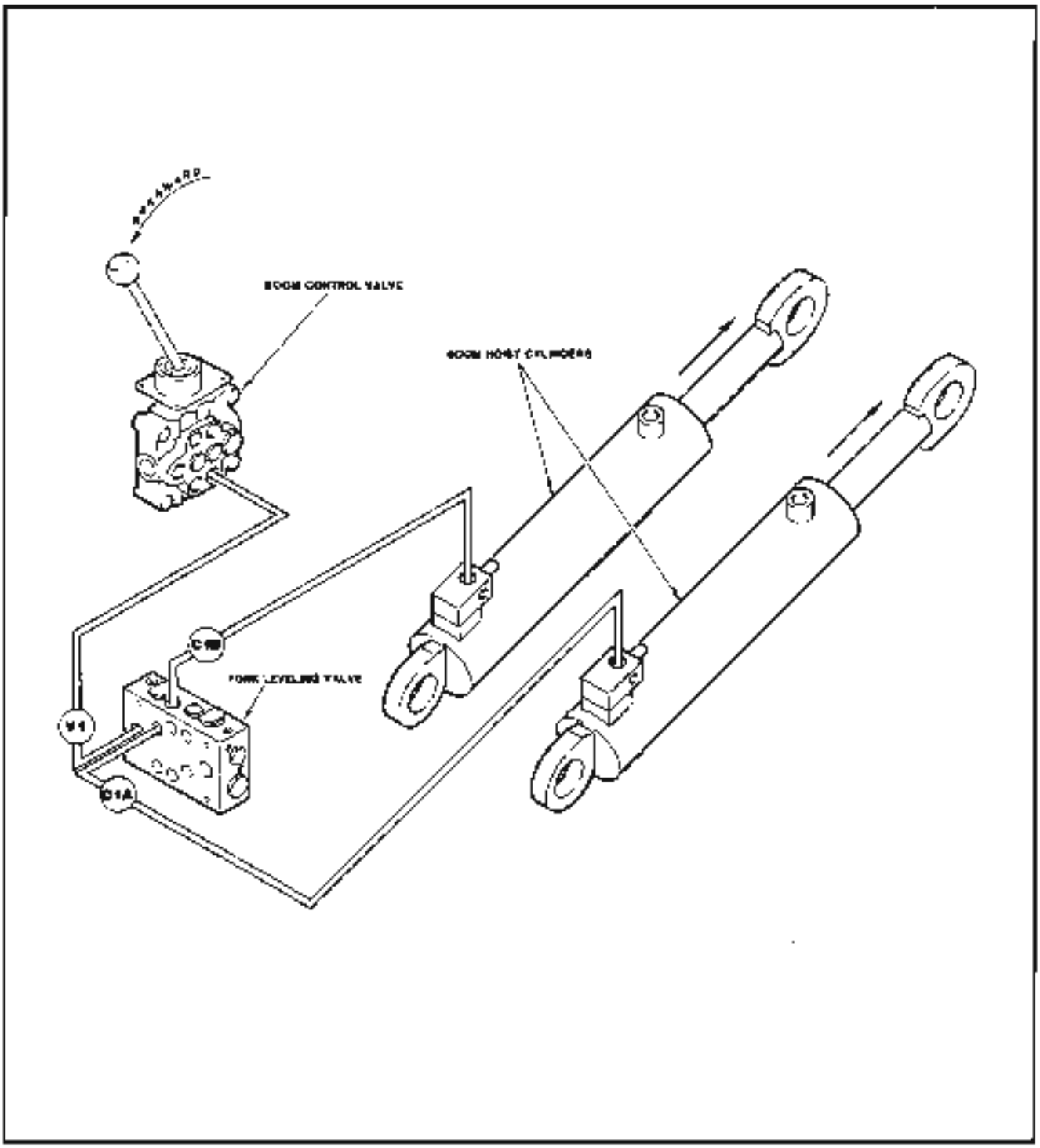


Figure 3-36 Flow Diagram - Boom Raising (Models 822, 824)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (ALL MODELS)

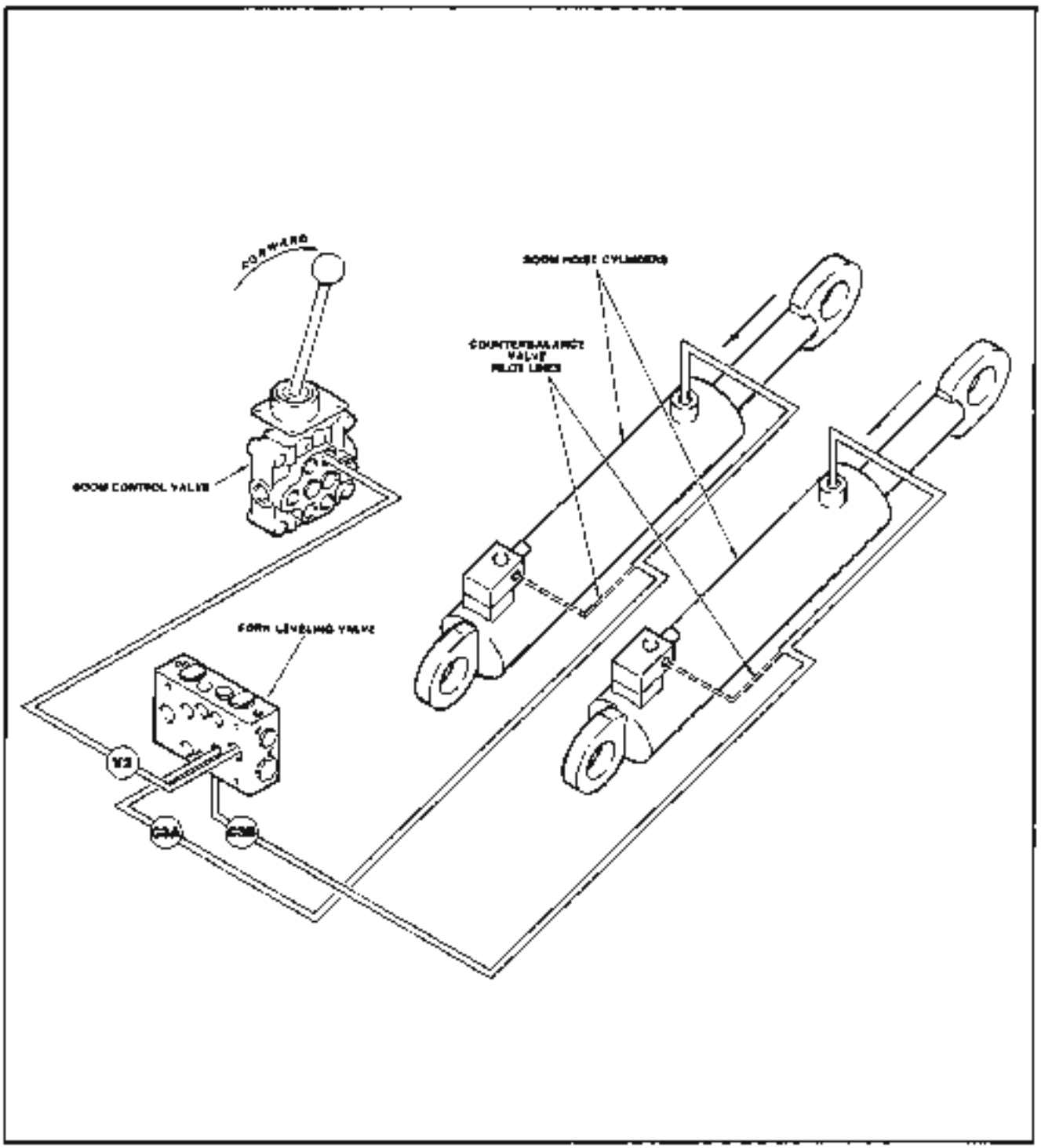


Figure 3-37 Flow Diagram - Boom Lowering (Models 622, 824)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

DESCRIPTION (Figure 3-38)

The three-spool valve is a Gresen Model #V20 which is located to the right of the operator on the back side of the main frame, with three control handles extending into the cab area. The valve is a four way, three position, open center type, with each spool controlled by a separate control handle.

NOTE: When a machine is equipped with outriggers, the three spool valve is provided with two additional spools and control handles.

The engine must be operating before there can be any valve function. With the control handles in the neutral position, hydraulic oil will flow through the valve and continue on through the system returning eventually to the reservoir. Movement of a control handle, however, will direct hydraulic oil flow to the desired circuit, resulting in cylinder or motor response.

Handle (Figure 3-38, Item 1) controls the fork carriage tilt: Pushing the handle up will tilt the fork carriage back; pulling the handle down will tilt the fork carriage forward. Handle (Item 2) controls one of several options available, such as carriage side tilt, fork side shift, winch, etc., or is otherwise a dead handle. Handle (Item 3) controls the machine frame tilt: Pushing the handle up will tilt the machine to the right; pulling the handle down will tilt the machine to the left. The valve spools are spring loaded, which will return the handles to the neutral position when released.

NOTE: When a machine is equipped with outriggers the control valve has a fourth and fifth control handle. The forth handle controls the left outrigger: Pushing the handle up will raise the outrigger; pulling the handle down will lower the outrigger. The fifth handle controls the right outrigger: Pushing the handle up will raise the outrigger; pulling the handle down will lower the outrigger.

The valve spool for the carriage tilt circuit incorporates two work-port pressure relief valves which are adjusted by adding or subtracting shims to arrive at the specified relief pressure.

The pressure relief valves are provided to maintain sufficient pressure to keep the carriage forks from tipping when carrying a load which is within the rated capacity of the machine (the forks will tip if the rated capacity of the machine is exceeded). The pressure relief valves also provide a relief for the carriage tilt cylinder circuit after the required cylinder pressure has been reached.

ADJUSTING PRESSURE RELIEF

To adjust the pressure relief valves, follow the instructions under "Checking Circuit Pressure" on page 3.9-1 in this section.

REMOVAL (Figure 3-39)

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 of this section).

2. Clean the valve and surrounding area. Use steam cleaning equipment if available. Do not allow water into the system (be sure hydraulic line connections are tight).

3. Tag and remove all the hydraulic lines (Items 1) connected to the valve. Cap the lines.

4. Remove the three handles (Items 2).

5. Remove the three mounting bolts and lockwashers (Items 3 & 4). Remove the valve from the machine and cap valve openings.

INSTALLATION

1. Reverse steps 3 through 5 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.)

THREE-SPOOL VALVE (ALL MODELS)

INSTALLATION (cont.)

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

OVERHAUL (Figure 3-40)

Refer to "Overhaul" on page 3.33-1 for valve overhaul procedures. Tighten tie bolts to 29 - 35 ft/lbs.

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

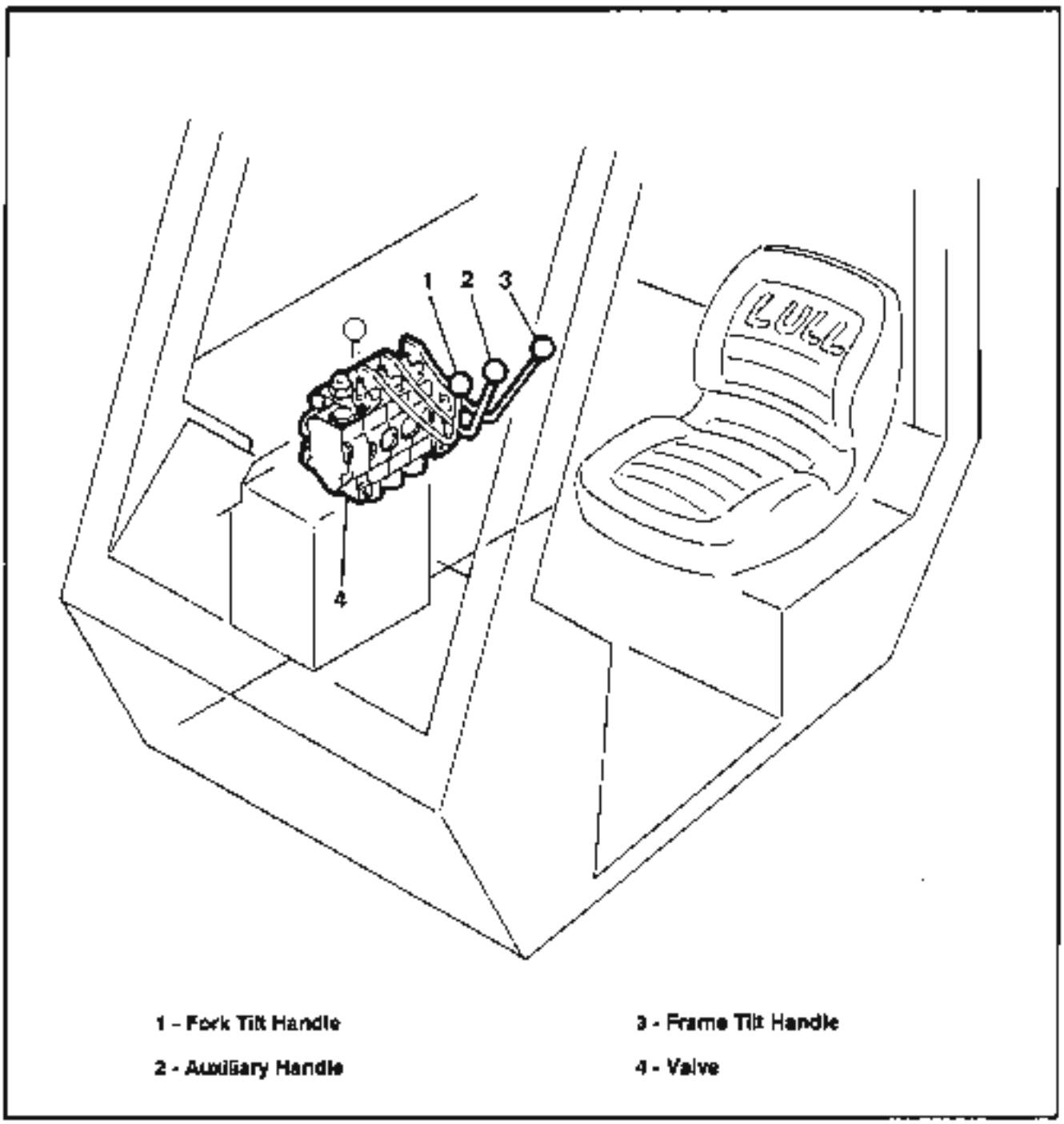
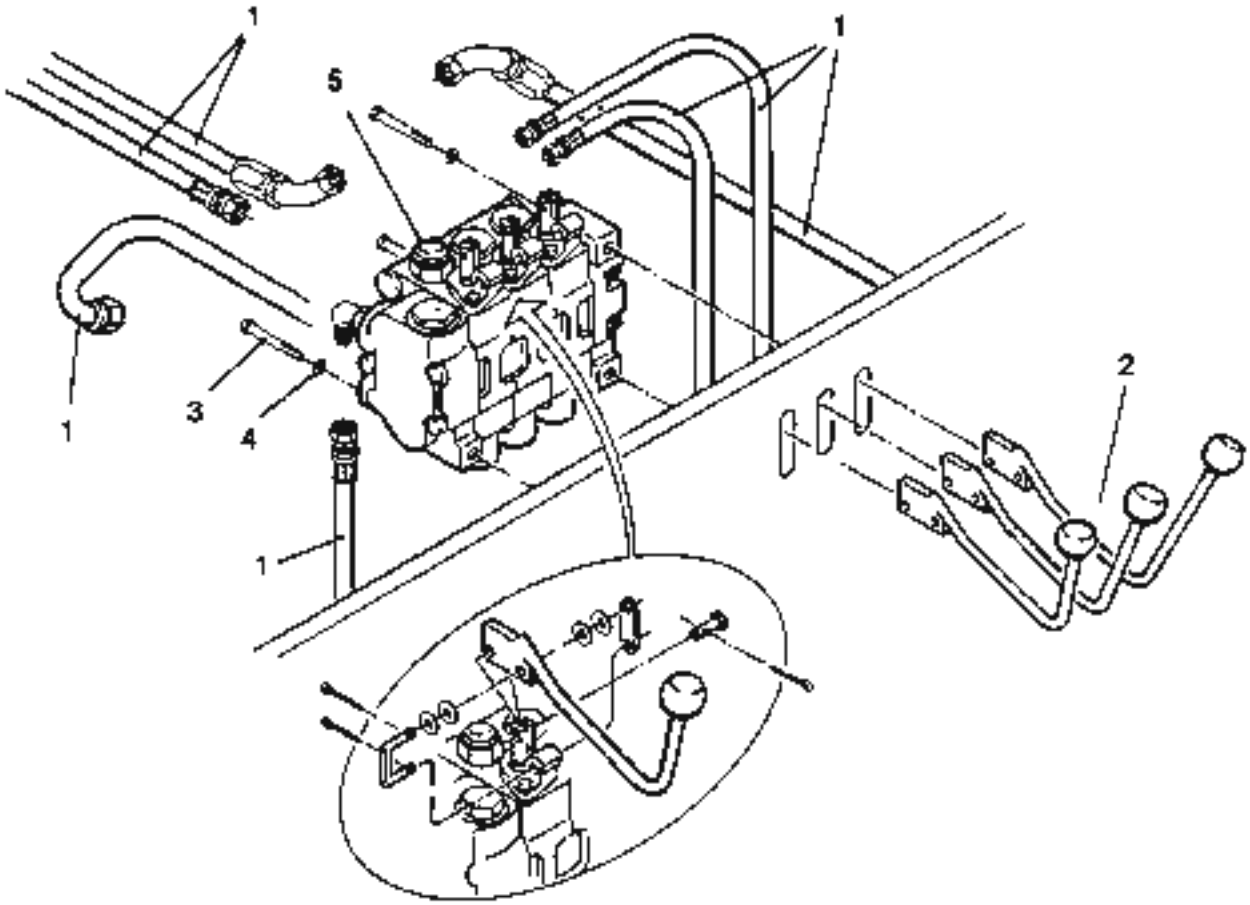


Figure 3-38 Three Spool Valve Arrangement (Model 522 Shown)

THREE-SPOOL VALVE (ALL MODELS)



1 - Hydraulic Lines

2 - Handles

3 - Bolt (3)

4 - Lockwasher (3)

5 - Valve

Figure 3-39 Three Spool Valve Removal (Model 522 Shown)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

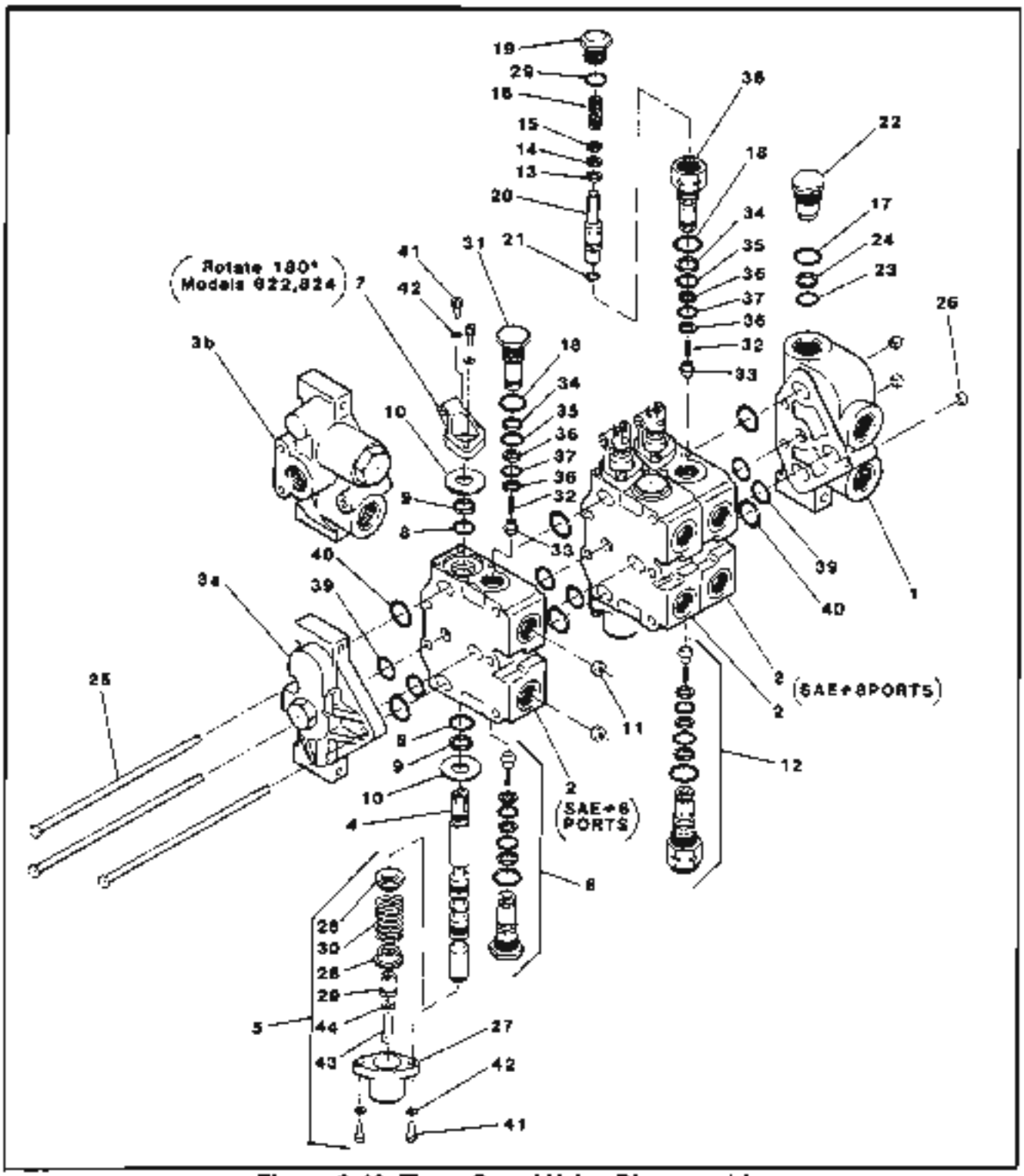


Figure 3-40 Three Spool Valve Disassembly
(Five Spool Valve Similar)

THREE-SPOOL VALVE (ALL MODELS)

1 - Cover Plate, LE
2 - Valve Section (3)
3a - Cover Plate, RE (Model 522)
3b - Cover Plate, RE (Models 622, 824)
4 - Spool (3)
5 - Positioner Assembly (3)
6 - Load Check Assembly (4)
7 - Handle Pivot (3)
8 - O-Ring
9 - Back-Up Ring (6)
10 - Retainer Plate (6)
11 - Restrictor (2)
12 - Relief Assembly (2)
13 - Shim, .0418" (as reqd.)
14 - Shim, .0209" (as reqd.)
15 - Shim, .0097" (as reqd.)
16 - Relief Spring (2)
17 - O-Ring
18 - O-Ring (9)
19 - Relief Cap (2)
20 - Poppet (2)
21 - O-Ring (2)
22 - Plug
23 - O-Ring
24 - Back-Up Ring
25 - Tie Bolt (3)
26 - Tie Bolt Nut (3)
27 - Positioner Bonnet (3)
28 - Spring Collar (6)
29 - Seat (3)
30 - Positioner Spring (3)
31 - Load Check Plug (4)
32 - Load Check Spring (6)
33 - Load Check Poppet (6)
34 - Back-Up Ring (6)
35 - O-Ring (6)
36 - Back-Up Ring (12)
37 - O-Ring (6)
38 - Relief Body (2)
39 - O-Ring (8)
40 - O-Ring (8)
41 - Socket Hd. Screw, 1/4 (12)
42 - Lockwasher, 1/4 (12)
43 - Socket Hd. Screw, 5/16 (3)
44 - Lockwasher, 5/16 (3)

Table 3-9 Material List for Figure 3-40

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

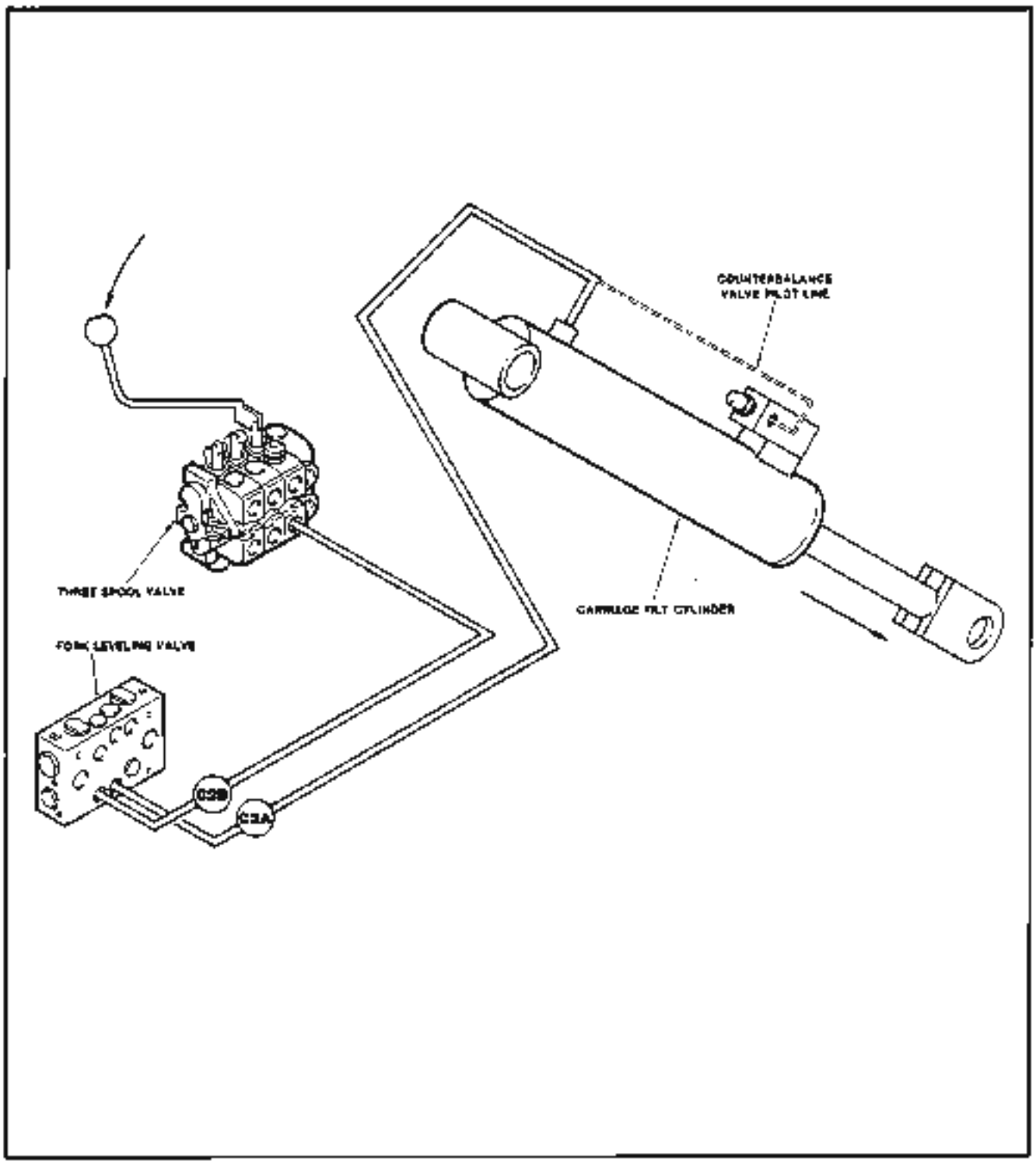


Figure 3-41 Flow Diagram - Carriage Tilt Forward (Model 522)

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

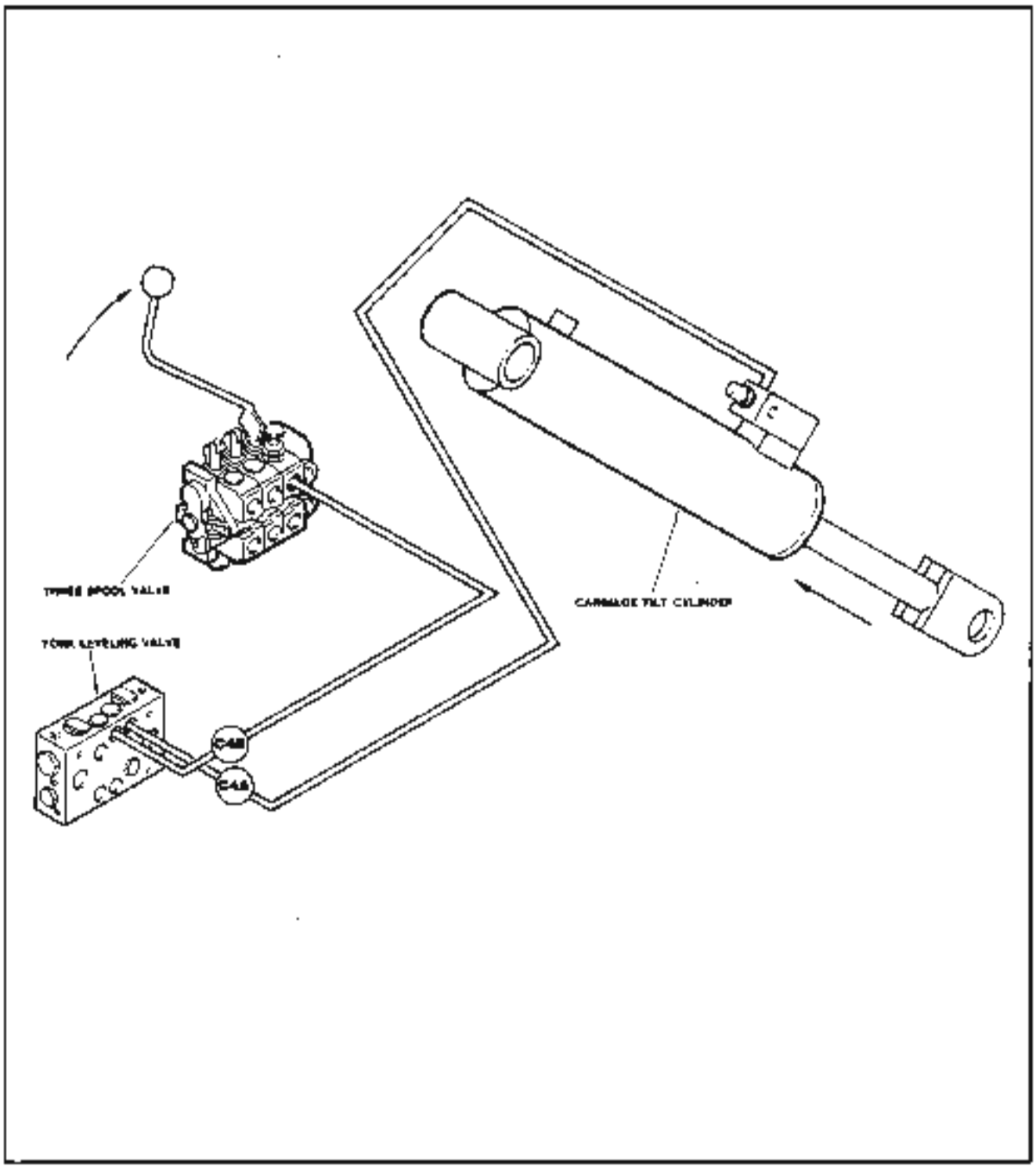


Figure 3-42 Flow Diagram - Carriage Tilt Back (Model 522)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

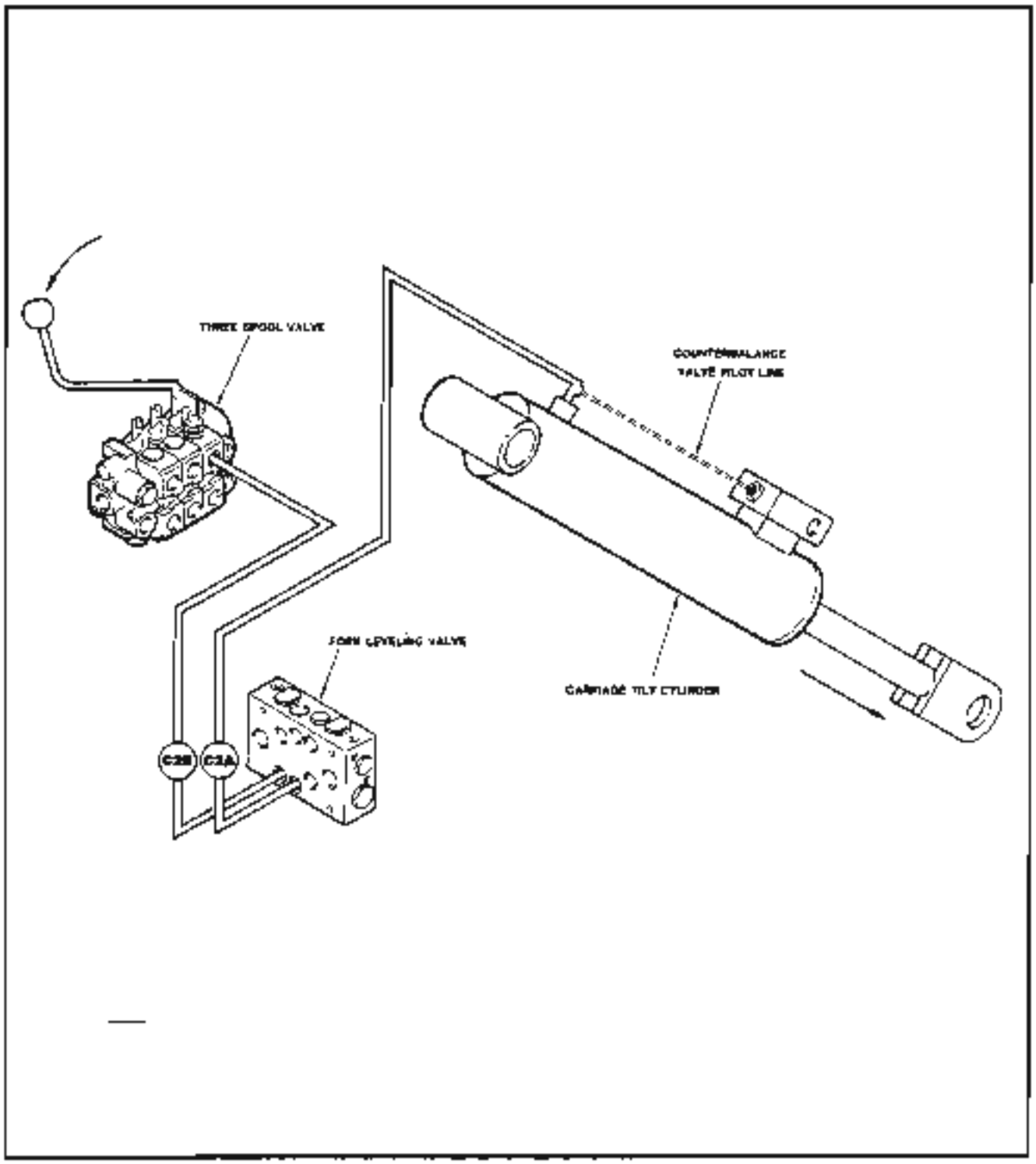


Figure 3-43 Flow Diagram - Carriage Tilt Forward (Models 622, 624)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

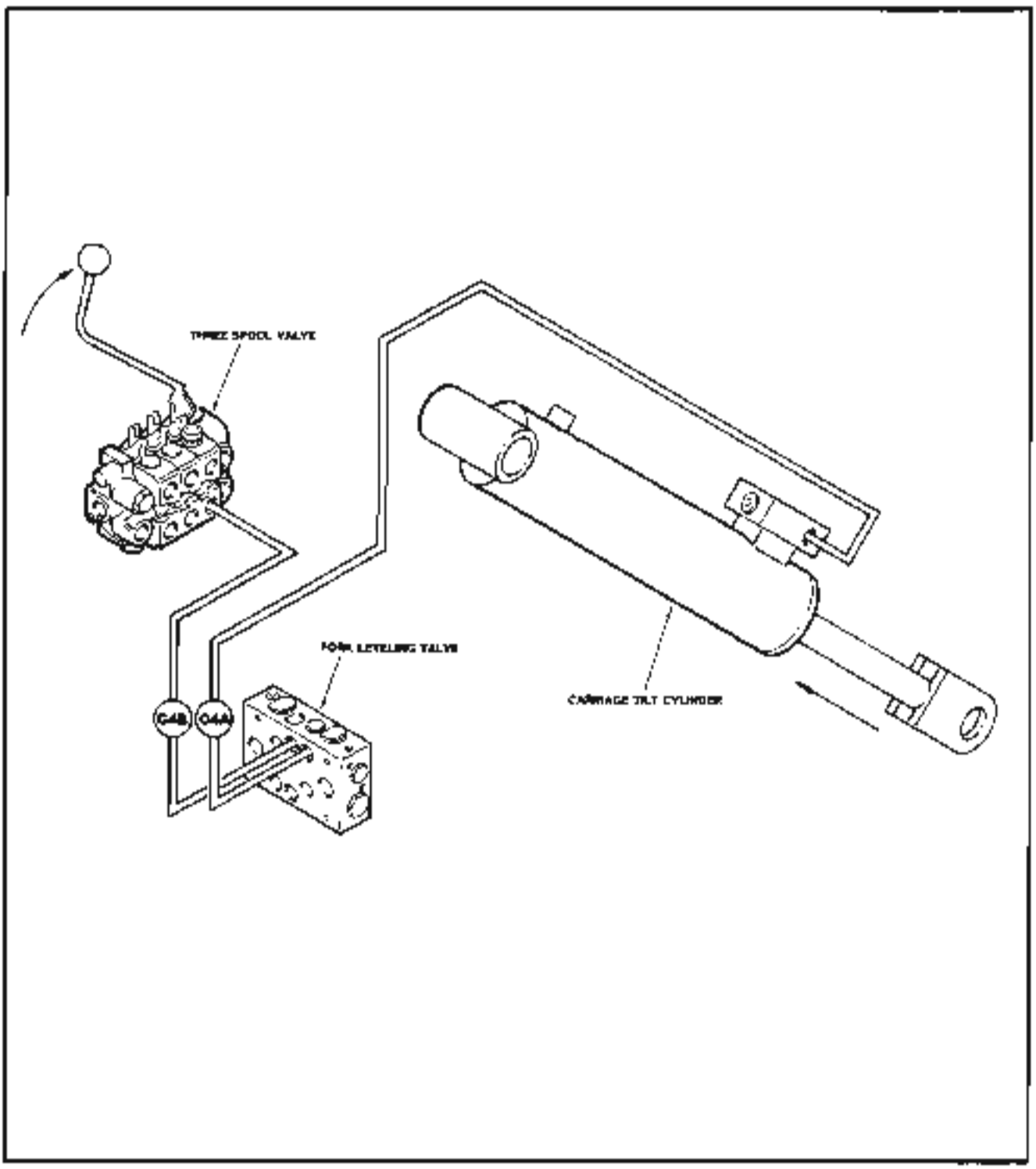


Figure 3-44 Flow Diagram - Carriage Tilt Back (Models 622, 824)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

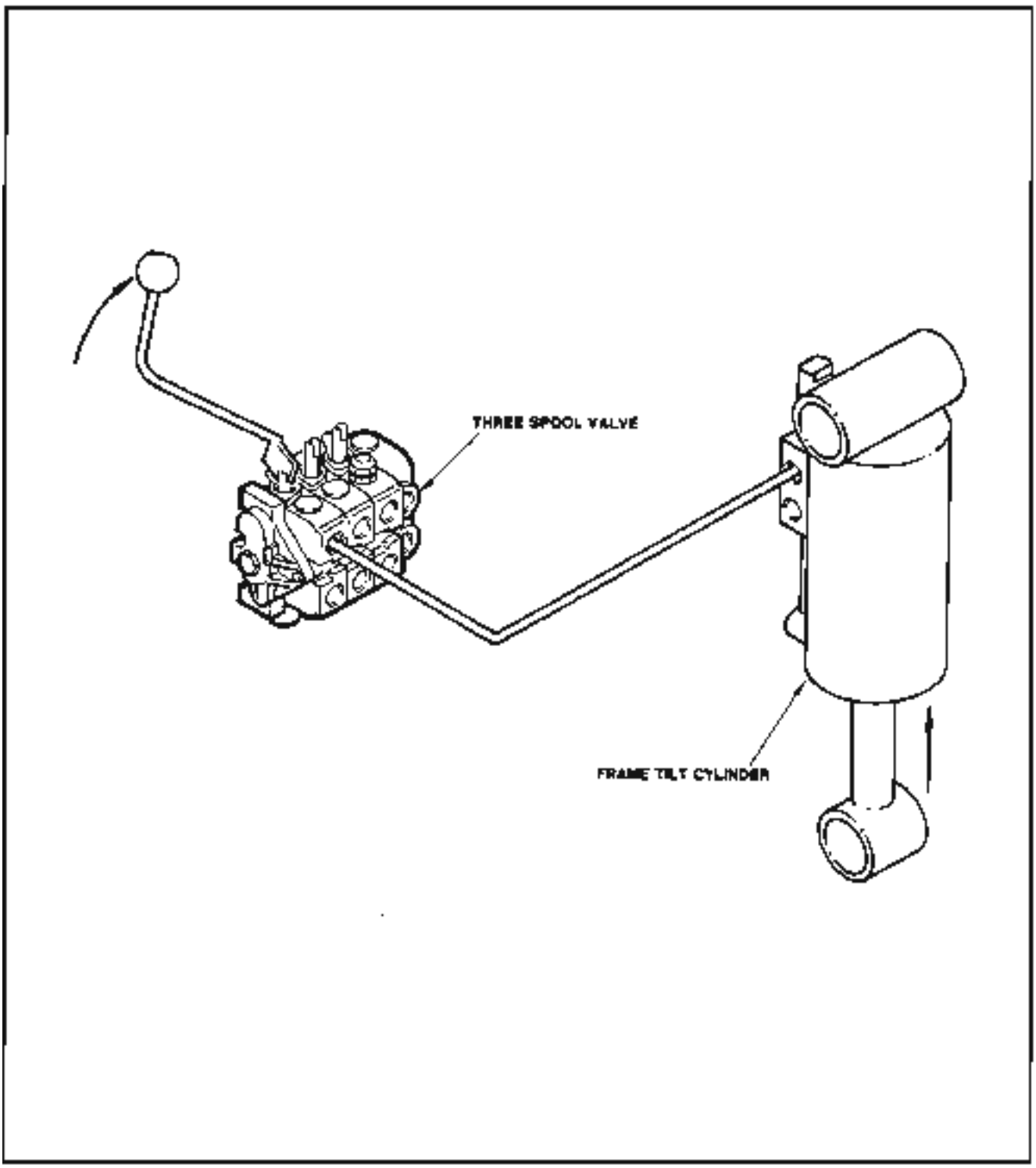


Figure 3-45 Flow Diagram - Frame Tilt Right (Model 522)

THREE-SPOOL VALVE (ALL MODELS)

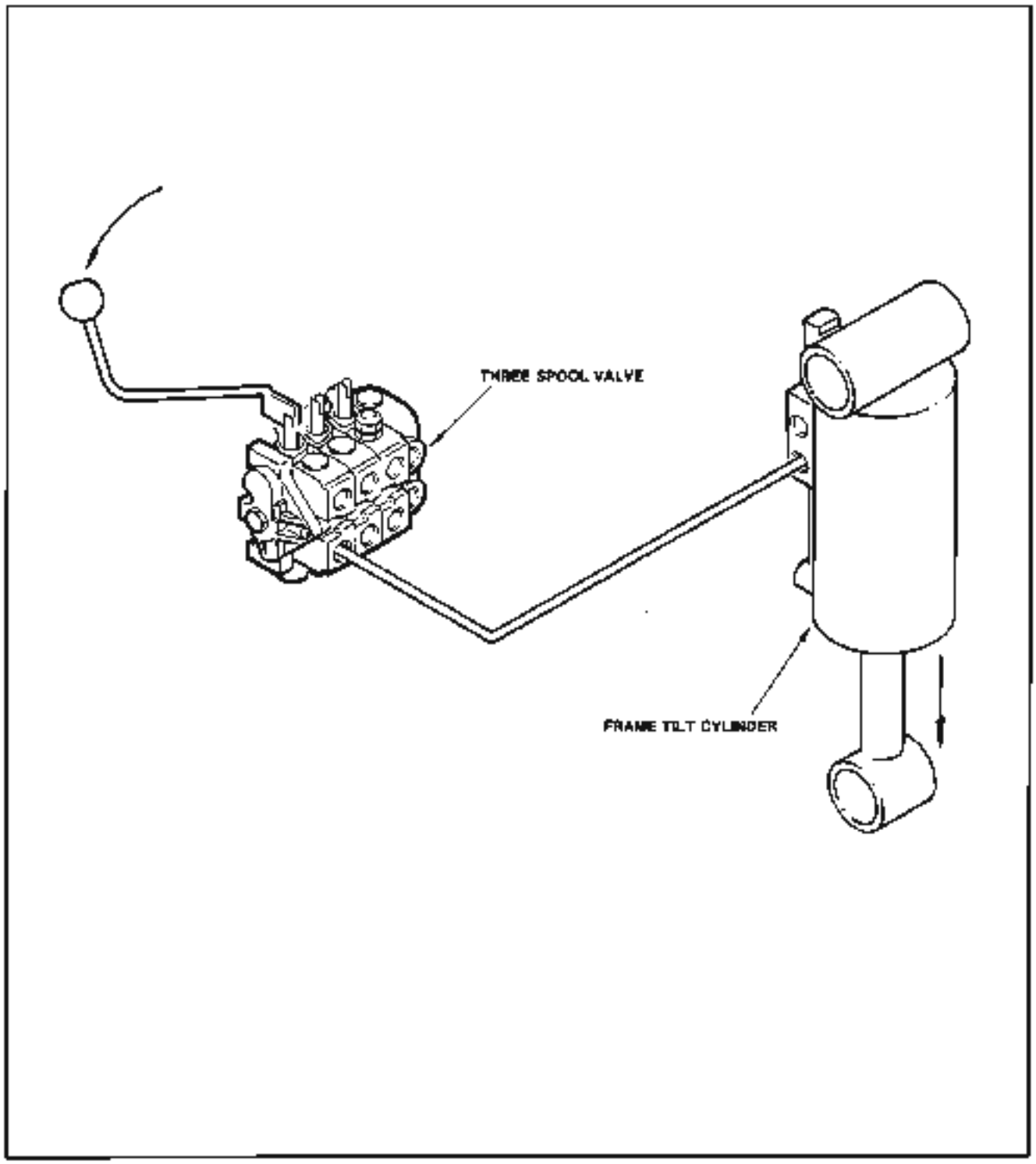


Figure 3-46 Flow Diagram - Frame Tilt Left (Model 522)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

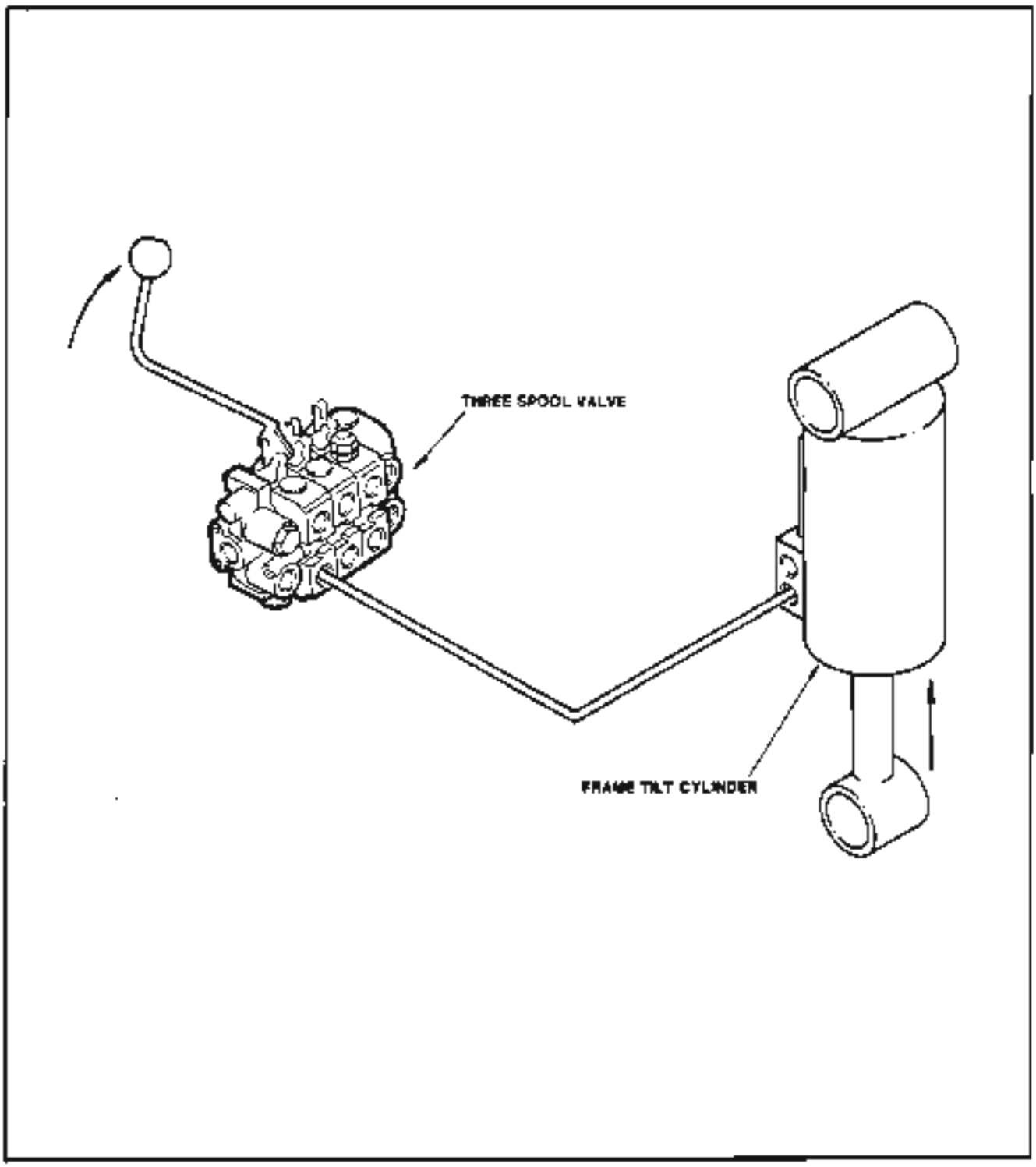


Figure 3-47 Flow Diagram - Frame Tilt Right (Models 622, 824)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

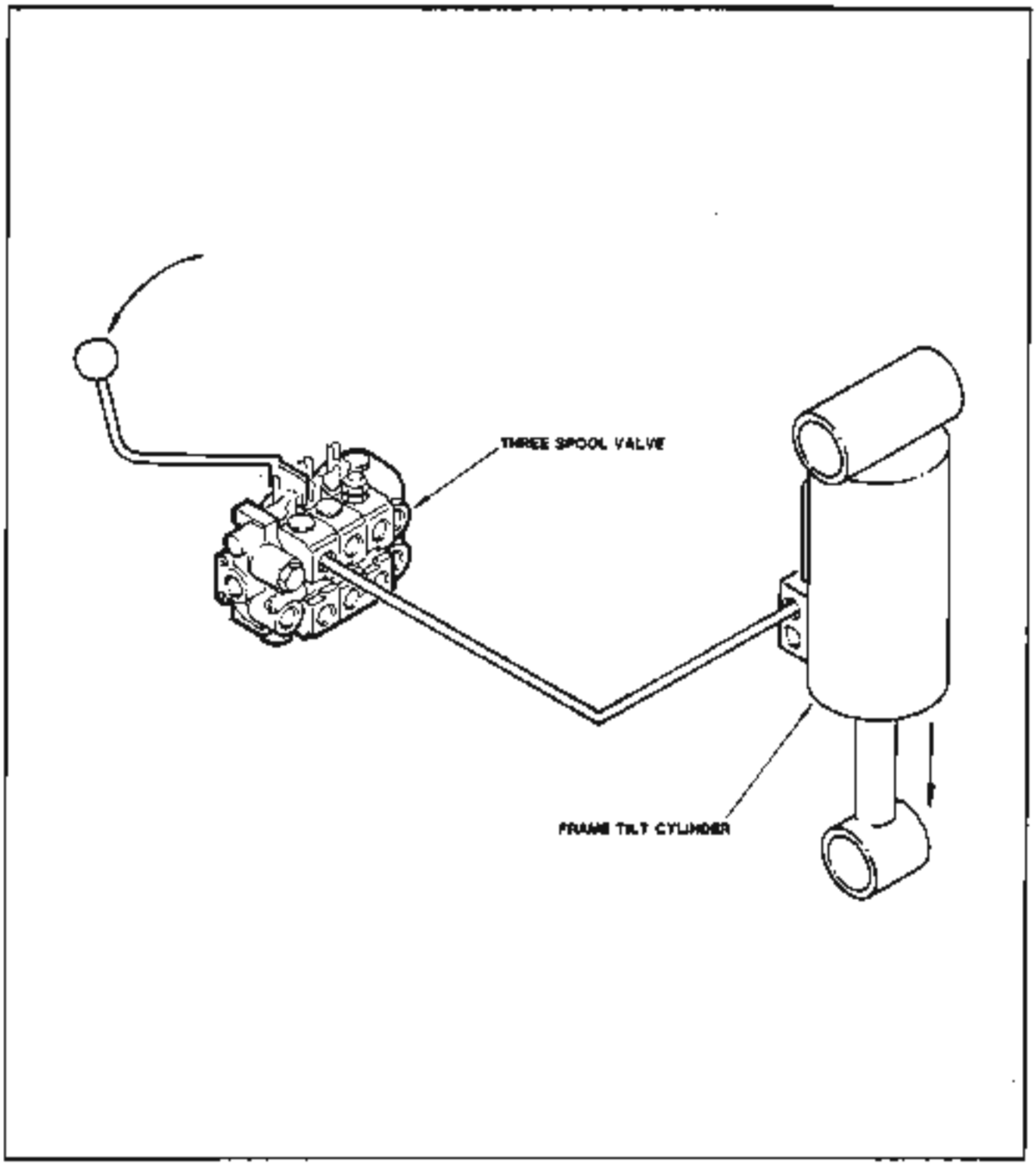


Figure 3-48 Flow Diagram - Frame Tilt Left (Models 622, 824)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

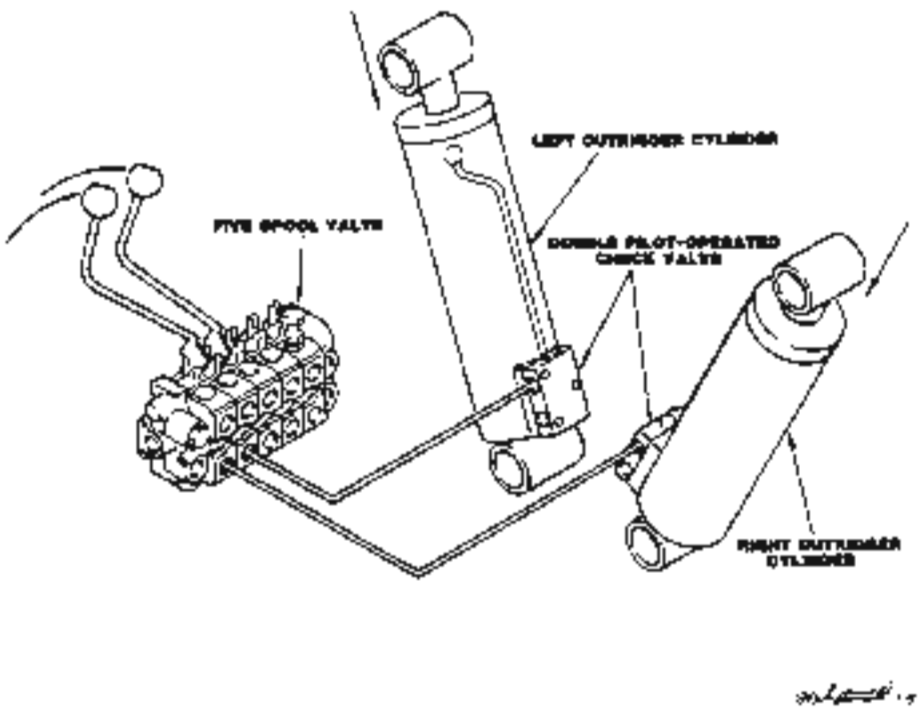


Figure 3-49 Flow Diagram - Outriggers Raising (Opt. 622, 624)

DIRECTIONAL CONTROL VALVES

THREE-SPOOL VALVE (ALL MODELS)

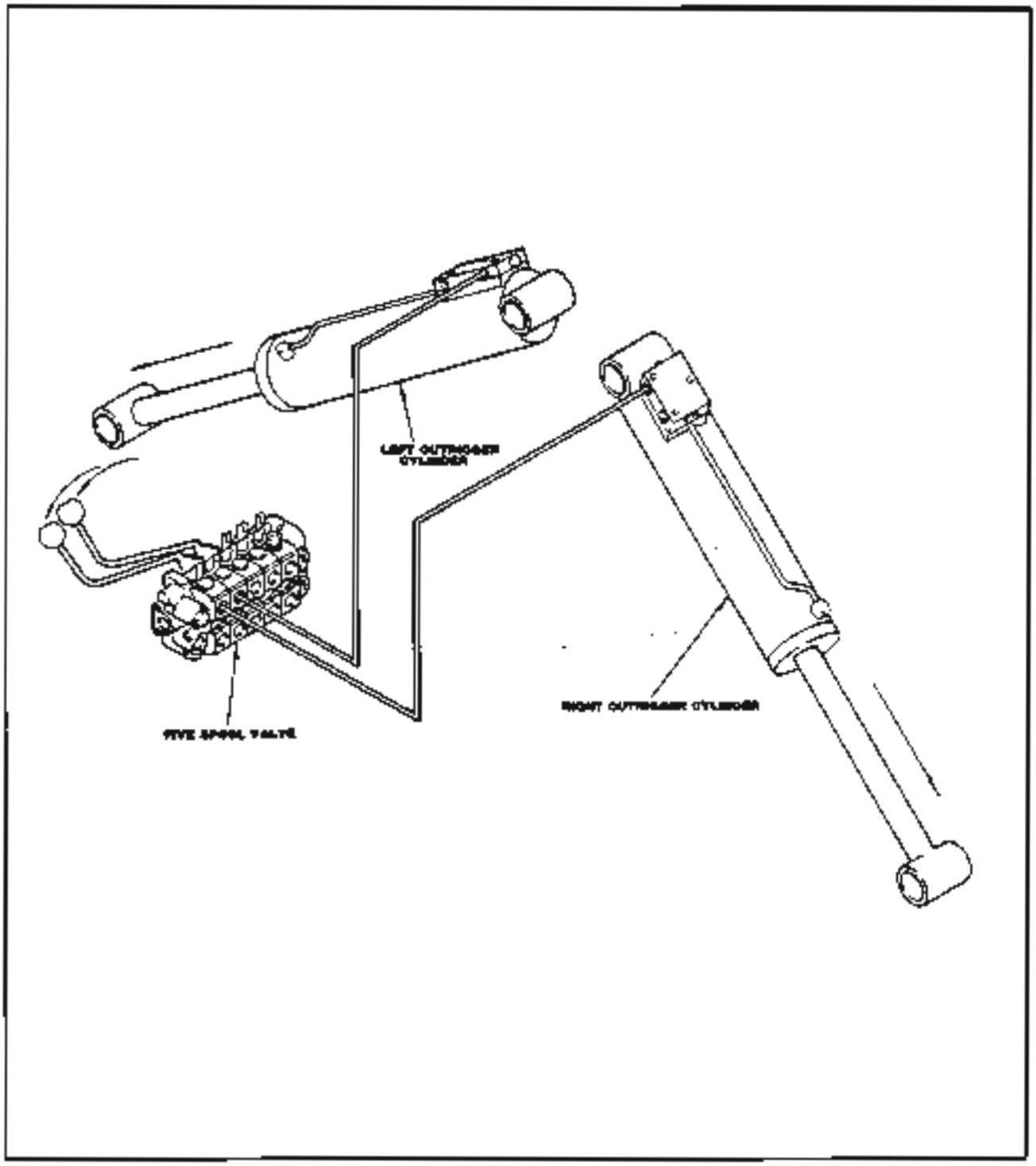


Figure 3-50 Flow Diagram - Outriggers Lowering (Opt. 622, 624)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

DIFFERENTIAL LOCK VALVE (ALL MODELS)

DESCRIPTION (Figure 3-51)

The differential lock valve is a two-position, foot actuated type mounted on the floor of the operator's cab. The valve is operated by depressing its actuator with the operator's left foot, thereby directing hydraulic flow to the differential lock cylinder, engaging the differential lock function of the front axle.

The valve is spring loaded, requiring that the actuator remain under pressure while it is engaged. Once pressure is released, the valve spool will automatically return, disengaging the differential lock.

ADJUSTING PRESSURE RELIEF

The valve incorporates an externally adjusted relief valve. To adjust the pressure relief valve, follow instructions under "Checking and Adjusting Circuit Pressure" on page 3.9-1 of this section.

REMOVAL

1. Lower the boom to the ground, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in this section).

2. Clean the valve and surrounding area. Use steam cleaning equipment if available. Do not allow water into the system (be sure hydraulic line connections are tight).

3. Tag and remove all hydraulic lines from the valve. Cap the lines.

4. Remove the four mounting bolts, lockwashers and nuts.

5. Remove the valve from the mounting bracket and cap the openings.

INSTALLATION

1. Reverse steps 3 through 5 above.

NOTE: See Torque Specification Tables in Section 1 for tightening hydraulic lines. Use two wrenches when tightening hydraulic line fittings.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

OVERHAUL (Figure 3-52)

Refer to "Overhaul" on page 3.33-1 for valve overhaul procedures.

BLEEDING PROCEDURE

Use the following procedure to remove air from the differential lock hydraulic line to the front axle.

1. Start the engine.

2. Open differential lock bleeding screw at front axle.

3. Slowly engage differential lock.

4. Keep differential lock engaged until all air is bled from line.

5. Close bleeder screw.

6. Disengage differential lock.

DIFFERENTIAL LOCK VALVE (ALL MODELS)

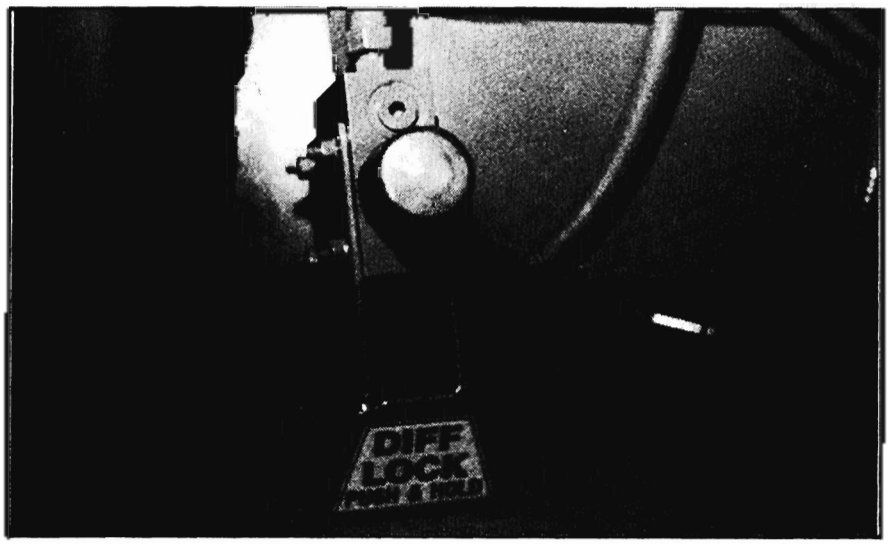


Figure 3-51 Differential Lock Valve

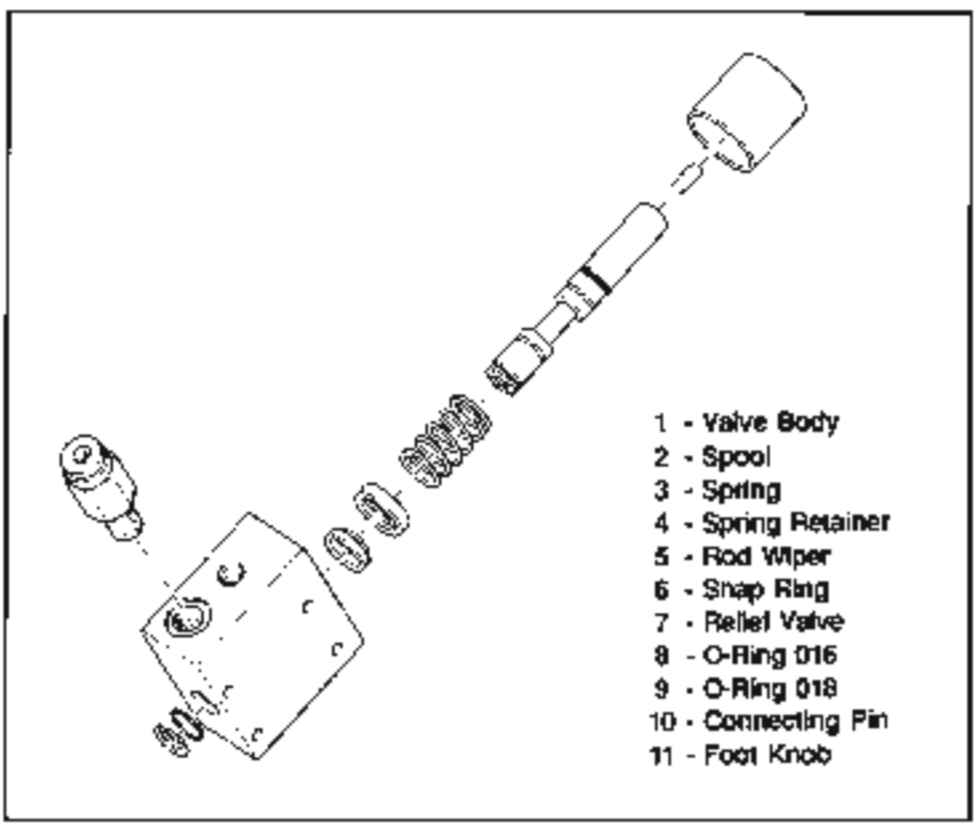


Figure 3-52 Differential Lock Valve Disassembly

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BRAKE PRIORITY VALVE (ALL MODELS)

DESCRIPTION

The brake priority valve is mounted to the outlet port of the hydraulic gear pump (see Figures 3-1 and 3-2 in this section). (On Model 622, the brake priority function is an internal part of the hydraulic pump.)

The brake priority valve (pump priority circuit on Model 622) provides hydraulic flow to the brake valve at the rate of two gallons per minute (while the engine is running) at pressure determined by the priority valve's pressure relief valve setting (pump's priority pressure relief setting on Model 622). Correct pressure relief setting is 700 psi.

Excess hydraulic flow to the brake priority valve is diverted from the brake priority valve (pump priority on Model 622) to the steer priority valve.

TROUBLESHOOTING

Slow response or excessive pedal kickback when braking could indicate low or high hydraulic flow which would be the result of a contaminated or otherwise faulty priority flow regulator.

Brakes that are slow to respond or are too aggressive could indicate low or high hydraulic pressure, the result of an improperly adjusted pressure relief valve.

TESTING FLOW

1. Lower the boom, apply the parking brake, and stop the engine. Release all hydraulic pressure in the system.

2. Disconnect hydraulic pressure line at the brake valve and place hose end in clean five gallon container.

3. Start the engine. Allow it to run one minute and shut off.

4. Volume of hydraulic oil in container should measure between seven and nine quarts (all except 622); between eight and twelve quarts (622).

5. If volume is correct:

   a. Reconnect hose.
   b. Return oil to reservoir.
   c. Start the egine.
   d. Check for leaks.
   e. Bleed the brakes.

If volume is not correct:

   a. Replace priority flow regulator (Figure 3-53, Item 4) (All Models except 622). Replace flow regulator spring (Figure 3-54, Item 11) if flow is too high (622); Remove and clean spool (Item 12) if flow is too low (622).
   b. Reconnect hose.
   c. Return oil to reservoir.
   d. Start the engine.
   e. Check for leaks.
   f. Bleed the brakes.

ADJUSTING PRESSURE RELIEF

Before adjusting the pressure relief valve, first follow the instructions for checking brake hydraulic pressure under "Checking and Adjusting Circuit Pressure" on page 3.9-1 in this section and, if pressure relief valve requires adjustment, perform the following:

For all Models except 622

1. Remove pressure relief cap (Figure 3-53, Item 3).

2. Insert 1/4 inch hex key (Item 6).

3. Turn key clockwise to increase pressure; counterclockwise to reduce pressure.

NOTE: Every 1/4 turn of the key results in a pressure difference of approximately 35 psi.

For Model 622:

1. Remove pressure relief valve cap (Figure 3-55, Item 15).

2. Loosen locknut (Item 16) and, with screw driver, turn adjusting screw (Item 17) clockwise to increase pressure, counterclockwise to reduce pressure.

3. While holding screw in position, tighten nut. Replace cap.

BRAKE PRIORITY VALVE (ALL MODELS)

REMOVAL - All Models except 622 (Figure 3-53)

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in this section).

2. Clean the valve (Item 1) and surrounding area. Use steam cleaning equipment if available. Do not allow water into the system (be sure hydraulic lines are tight).

3. Remove hydraulic lines (Items 8, 9 & 10) from the valve. Cap the lines.

4. Remove the four screws and lockwashers (Items 7) mounting the priority valve to the pump and remove the valve.

5. Remove the O-Ring (Item 5) and cap the pump opening.

INSTALLATION

1. Reverse steps 3 through 5 above, installing a new O-Ring.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

2. Start the engine and check for leaks.

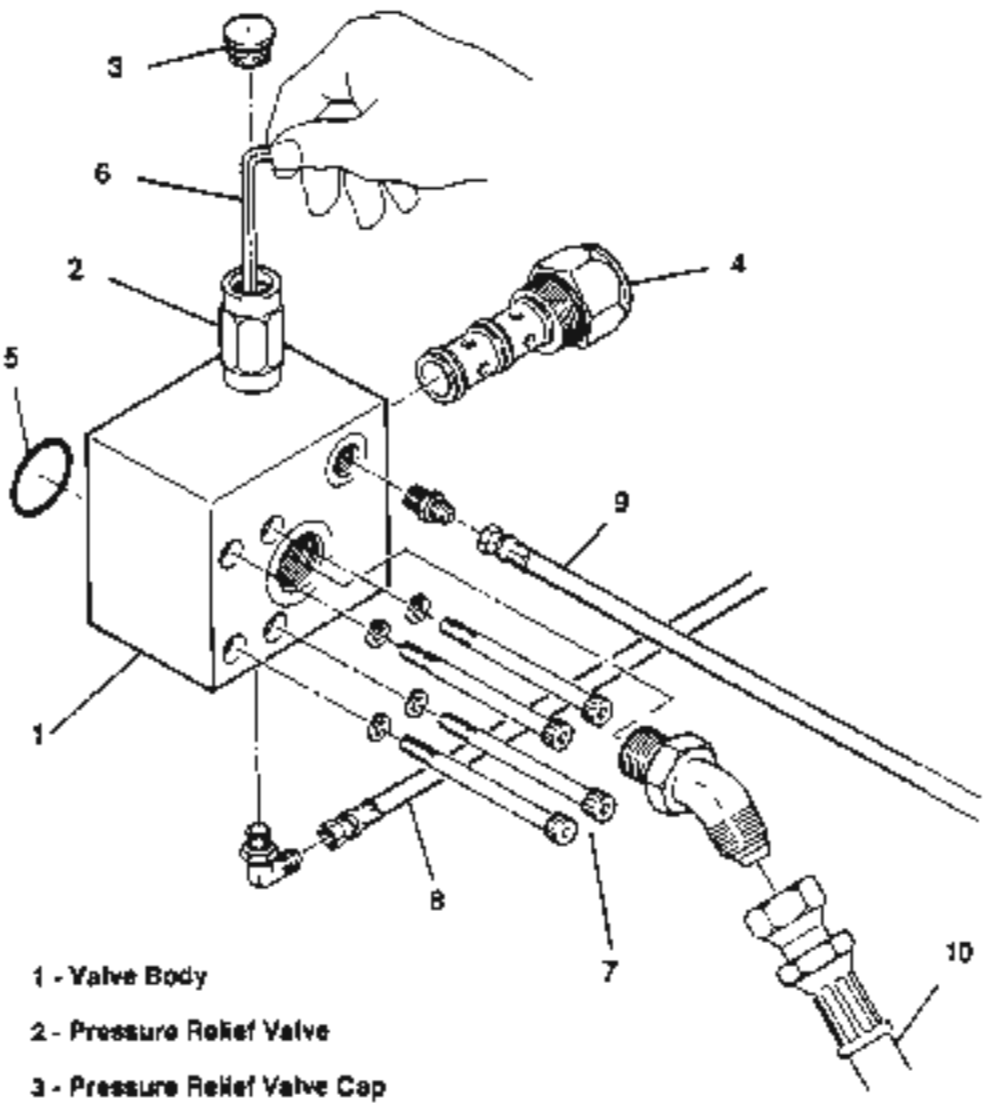
WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Bleed the brakes before putting machine in service.

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BRAKE PRIORITY VALVE (ALL MODELS)



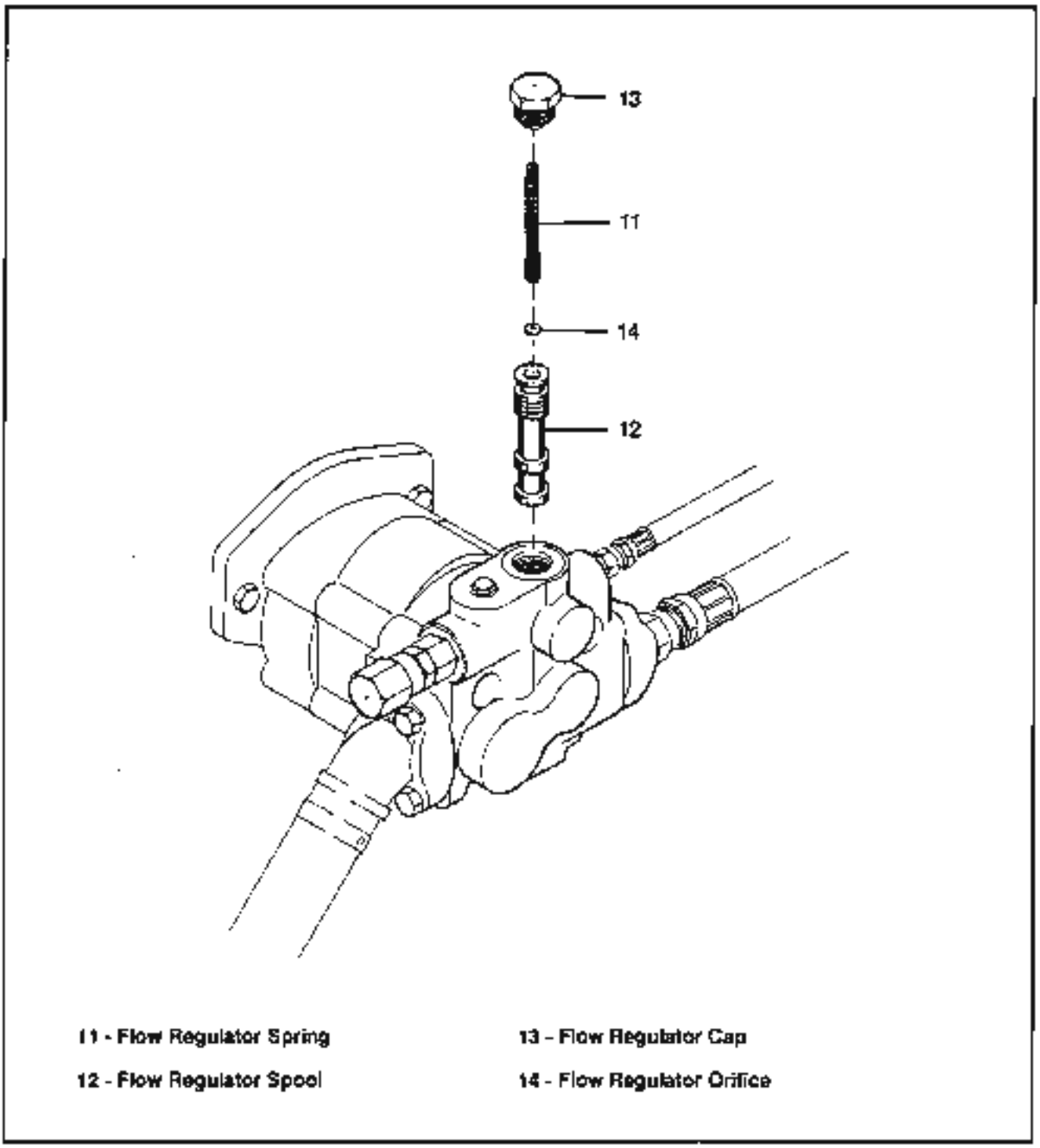
1 - Valve Body
2 - Pressure Relief Valve
3 - Pressure Relief Valve Cap
4 - Priority Flow Regulator
5 - O-Ring
6 - Priority Relief Valve Adjusting Key
7 - Mounting Screws
8 - Line to Brake Valve
9 - Return Line to Tank
10 - Bypass Line to Steer Priority Valve

Figure 3-53 Brake Priority Valve Assembly
(All Models except 622)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

BRAKE PRIORITY VALVE (ALL MODELS)



11 - Flow Regulator Spring

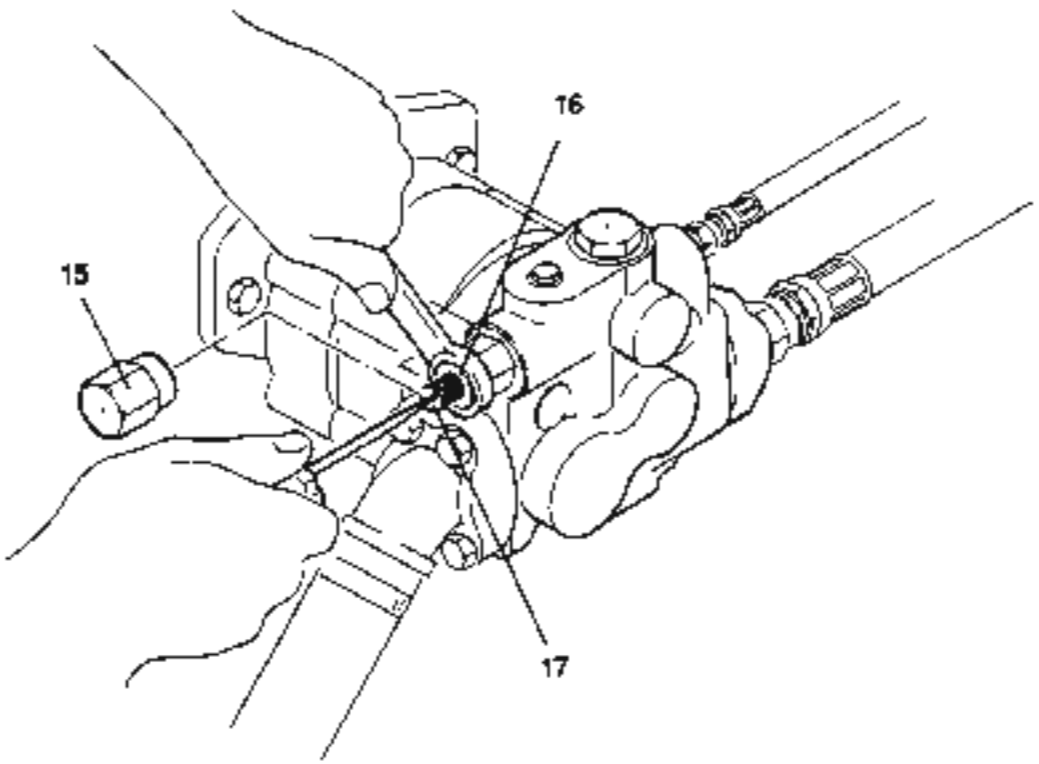
12 - Flow Regulator Spool

13 - Flow Regulator Cap

14 - Flow Regulator Orifice

Figure 3-54 Priority Flow Regulator Assembly
(Model 622)

BRAKE PRIORITY VALVE (ALL MODELS)



15 - Pressure Relief Valve Cap

16 - Pressure Relief Valve Locknut

7 - Pressure Relief Valve Adjusting Screw

Figure 3-55 Pressure Relief Adjustment (Model 622)

HYDRAULICS

DIRECTIONAL CONTROL VALVES

STEERING PRIORITY VALVE (ALL MODELS)

DESCRIPTION

The steering priority valve directs hydraulic flow from the second (outboard) pump. It automatically provides metered priority flow to the steering control unit at the required steering pressure. The flow not required for steering is available to secondary circuits.

For location of the valve on the machine see Figures 3-1 and 3-2 on pages 3.4-2 and 3.7-2 in this section.

TROUBLESHOOTING

Steering that is heavy, and steer cylinders which do not extend or retract fully when under load, could indicate the steering priority valve pressure relief is adjusted for too low a pressure. The correct pressure relief setting is 2000 psi.

Refer to "Checking and Adjusting Circuit Pressure" on page 3.9-1 for procedure to determine the pressure relief setting of the steering priority valve.

ADJUSTING PRESSURE RELIEF

If, after performing the above procedure, it has been determined the pressure relief setting is incorrect, use the following procedure to adjust the setting.

1. Lower the boom to the ground, apply the parking brake and stop the engine. Release all hydraulic pressure in the circuit (the test gauge in the circuit must read 0 psi).

2. Clean the valve and surrounding area. Use steam cleaning equipment if available. Do not allow water into the system (be sure hydraulic line connections are tight).

3. Disassemble hose from valve relief port (Port 'T') and cap end.

4 Using a 7/32" hex key, push in and turn the adjusting screw within the relief port (Figure 3-56):

NOTE: Turning the screw clockwise increases pressure, counterclockwise reduces pressure.

NOTE: Every 1/4 turn of the screw results in a pressure difference of approximately 250 psi.

5. Reassemble hose to valve relief port.

6. Return to procedure under "Checking and Adjusting Circuit Pressure" to check adjusted pressure setting.

REMOVAL

1. Lower the boom, apply the parking brake, and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in this section).

2. Clean the steering priority valve and surrounding area. Use steam cleaning equipment if available. Do not allow water into the system (be sure hydraulic line connections are tight).

3. Tag and remove the five hydraulic lines connected to the valve. Cap the lines.

4. Remove the two mounting bolts, lockwashers and nuts.

5. Remove the valve.

INSTALLATION

1 Reverse steps 3 through 5 above.

NOTE: See Torque Specification Tables in Section 1 for tightening bolts and hydraulic lines. Use two wrenches when tightening hydraulic line fittings.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

HYDRAULICS

DIRECTIONAL CONTROL VALVES

STEERING PRIORITY VALVE (ALL MODELS)

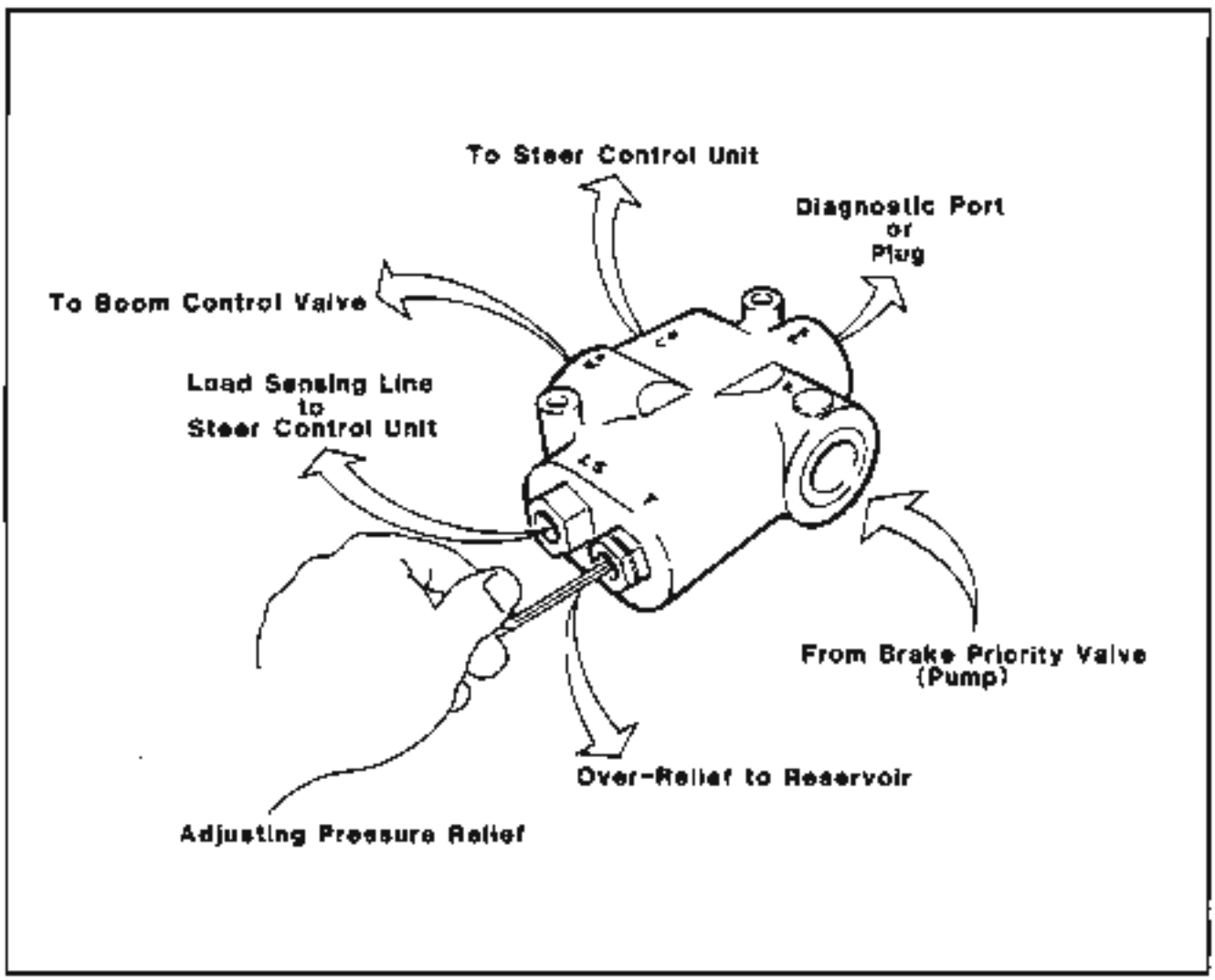


Figure 3-56 Steer Priority Valve

HYDRAULICS

DIRECTIONAL CONTROL VALVES

FORK LEVELING VALVE (ALL MODELS)

DESCRIPTION

The fork leveling valve (Figure 3-57) is a pressure compensating valve positioned within the boom hoist and carriage tilt hydraulic circuits. The purpose of the valve is to maintain fork levelness throughout the raising and lowering cycles of the boom.

For location of the valve on the machine see Figure 3-1 and 3-2 on pages 3.4-2 and 3.7-2 in this section.

TROUBLESHOOTING

Forks that tip forward or rearward during the raising or lowering cycles of the boom could indicate the fork leveling valve is improperly adjusted. If, after performing the following adjusting procedures, the forks will not maintain levelness throughout the raising and lowering of the boom, replace the fork leveling valve (see "Removal" and "Installation").

ADJUSTING

Before performing adjusting procedure, boom must be retracted and outriggers (if so equipped) deployed.

Adjusting procedure must be performed with the fork carriage loaded to the rated capacity.

The hydraulic flow used for fork leveling is split into two individual circuits: V1 and V2. V1 controls fork leveling when raising the boom; V2 controls fork leveling when lowering the boom.

Use the following procedure to adjust the fork leveling valve (Figure 3-57):

To determine the direction of tilt in the V1 circuit, the boom must be down and the forks leveled. Raise the boom full up and verify direction of fork tilt. (To make adjustments, a 1/8 inch hex key will be required.)

1. If the forks point downward when being checked, the V1 adjusting screw must be turned in (clockwise) until forks are level.

2. If the forks point upward when being checked, the V1 adjusting screw must be turned out (counterclockwise) until forks are level.

To determine the direction of fork tilt in the V2 circuit, the boom must be raised full up and the forks leveled at the top. (See steps 1 and 2 above.) Lower the boom and inspect forks at the bottom for direction of tilt.

3. If the forks point downward when being checked, the V2 adjusting screw must be turned out until forks are level.

4. If the forks point upward when being checked, the V2 adjusting screw must be turned in until forks are level.

REMOVAL

1. Lower the boom to the ground, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in this section.)

2. Remove (4) screws and lockwashers and remove leveling valve cover.

3. Clean the valve and surrounding area. Use steam cleaning equipment if available. Do not allow water into the system (be sure hydraulic line connections are tight).

4. Tag and remove the ten hydraulic hoses attached to the fork leveling valve and cap the hose ends.

5. Remove the two valve mounting screws and lockwashers and remove the leveling valve.

INSTALLATION

1. Reverse steps 2 through 5 above.

NOTE: See Torque Specification Tables in Section 1 for tightening hydraulic lines. Use two wrenches when tightening hydraulic line fittings.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

HYDRAULICS

DIRECTIONAL CONTROL VALVES

FORK LEVELING VALVE (ALL MODELS)

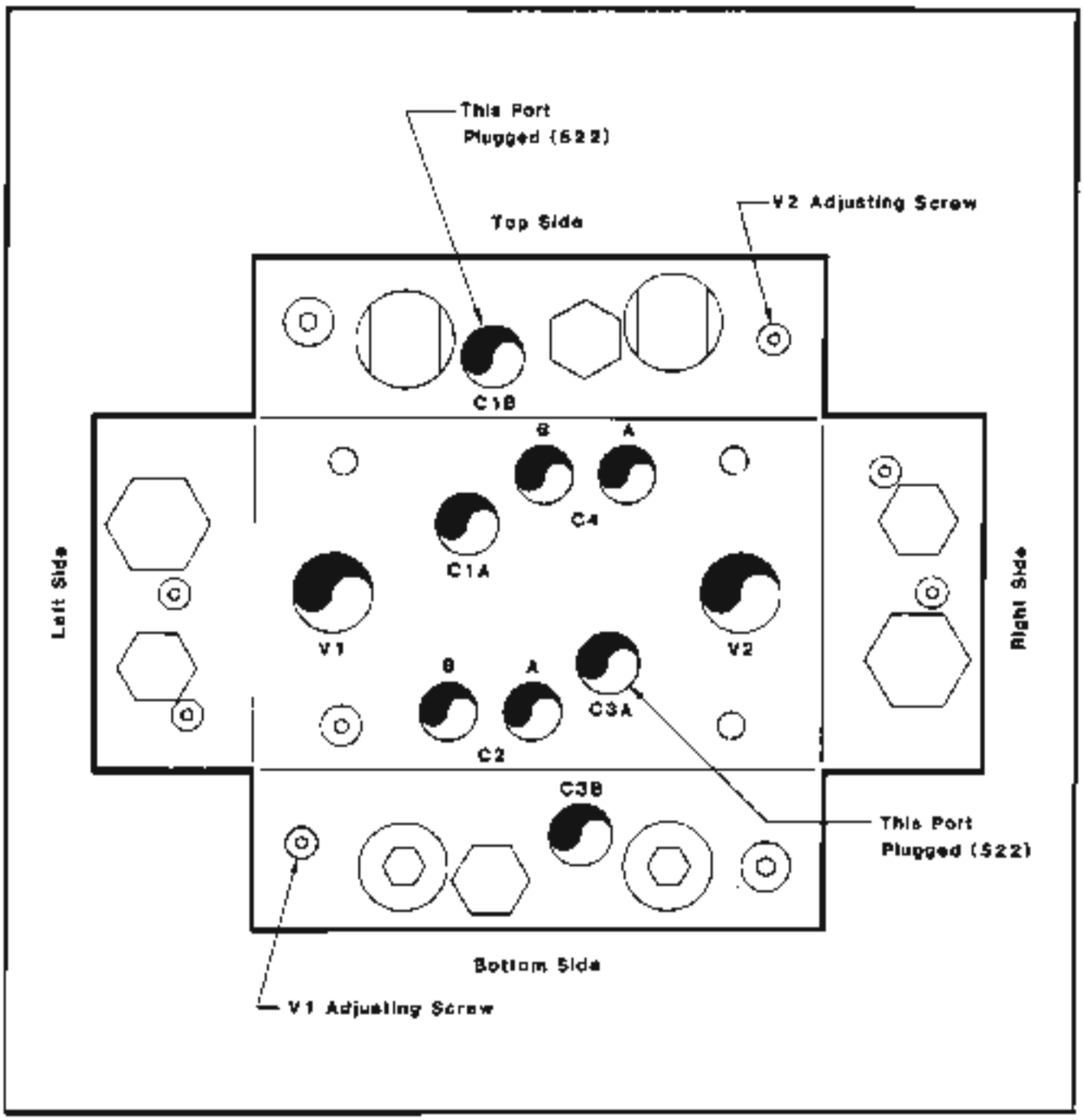


Figure 3-57 Fork Leveling Valve Port Locations

HYDRAULICS

DIRECTIONAL CONTROL VALVES

POWER ASSIST SELECTOR VALVE (MODELS 522/4, 622/4, 824)

NOTE: Refer to Section 7, "Rear Wheel Power Assist", for detailed information concerning operation and maintenance of the Power Assist Selector Valve.

HYDRAULICS

DIRECTIONAL CONTROL VALVES

EQUATRAC VALVE (MODELS 522/4, 622/4, 824)

NOTE: Refer to Section 7, "Rear Wheel Power Assist", for detailed information concerning operation and maintenance of the Equatrac Valve.

HYDRAULICS

DIRECTIONAL CONTROL VALVES

CYLINDER COUNTERBALANCE VALVES

DESCRIPTION

Certain hydraulic cylinders on Lull forklifts are equipped with one or two counterbalance valves which are externally mounted to the cylinder. The counterbalance valves prevent movement of the cylinder in event of downstream hydraulic line failure or leakage through the control valve or fittings. The counterbalance valves prevent movement of the cylinders when the engine is off, even if the control levers are operated. The counterbalance valves also provide over load relief protection, allowing the cylinders to "give" (extend or retract) when subjected to an excessive load.

The following cylinders are equipped with counterbalance valves:

Boom Extension - Two counterbalance valves each
Boom Hoist - One counterbalance valve each
Carriage Tilt - One counterbalance valve each
Frame Tilt - Two counterbalance valves each

The counterbalance valves are of two types (Figure 3-58):

1. Cartridge integral with a manifold, bolted to the cylinder.

2. Cartridge only, threaded into the cylinder housing.

TROUBLESHOOTING

Any cylinder movement, caused by moving the control lever after the engine is shut off, may indicate a faulty counterbalance valve. It may also indicate faulty hydraulic cylinder seals.

1. Check for internal cylinder leakage (refer to "Internal Leakage" under "Checking Cylinder Condition" on page 3.19-1 in this section).

2. If the cylinder checks in good condition, replace the counterbalance valve.

REMOVAL AND INSTALLATION

Use the following procedure to replace the counterbalance valve:

1. Lower the outriggers (if so equipped) until they touch the ground. Lower the boom to the ground, apply the parking brake, and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in this section).

WARNING: Cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder. The pressure may be in excess of 250 psi and will be released when removing the counterbalance valve.

WARNING: Wear eye protection when removing counterbalance valves.

2. Manifold mounted:

   a. Tag and carefully remove two hydraulic hoses.
   b. Remove four screws and lockwashers.
   c. Remove the counterbalance valve/manifold.
   d. Install new counterbalance valve/manifold.
   e. Install screws, lockwashers and hoses.
   NOTE. See Torque Specification Tables in Section 1 for tightening bolts and hydraulic lines. Use two wrenches when tightening hydraulic line fittings.

   Cartridge only:

   a. Carefully remove counterbalance valve cartridge from cylinder housing.
   b. Install new counterbalance valve cartridge.
   c. When installing cartridge, be sure to use a new o-ring.
   d. Tighten cartridge to 400 in/lbs torque.

3. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

CYLINDER COUNTERBALANCE VALVES

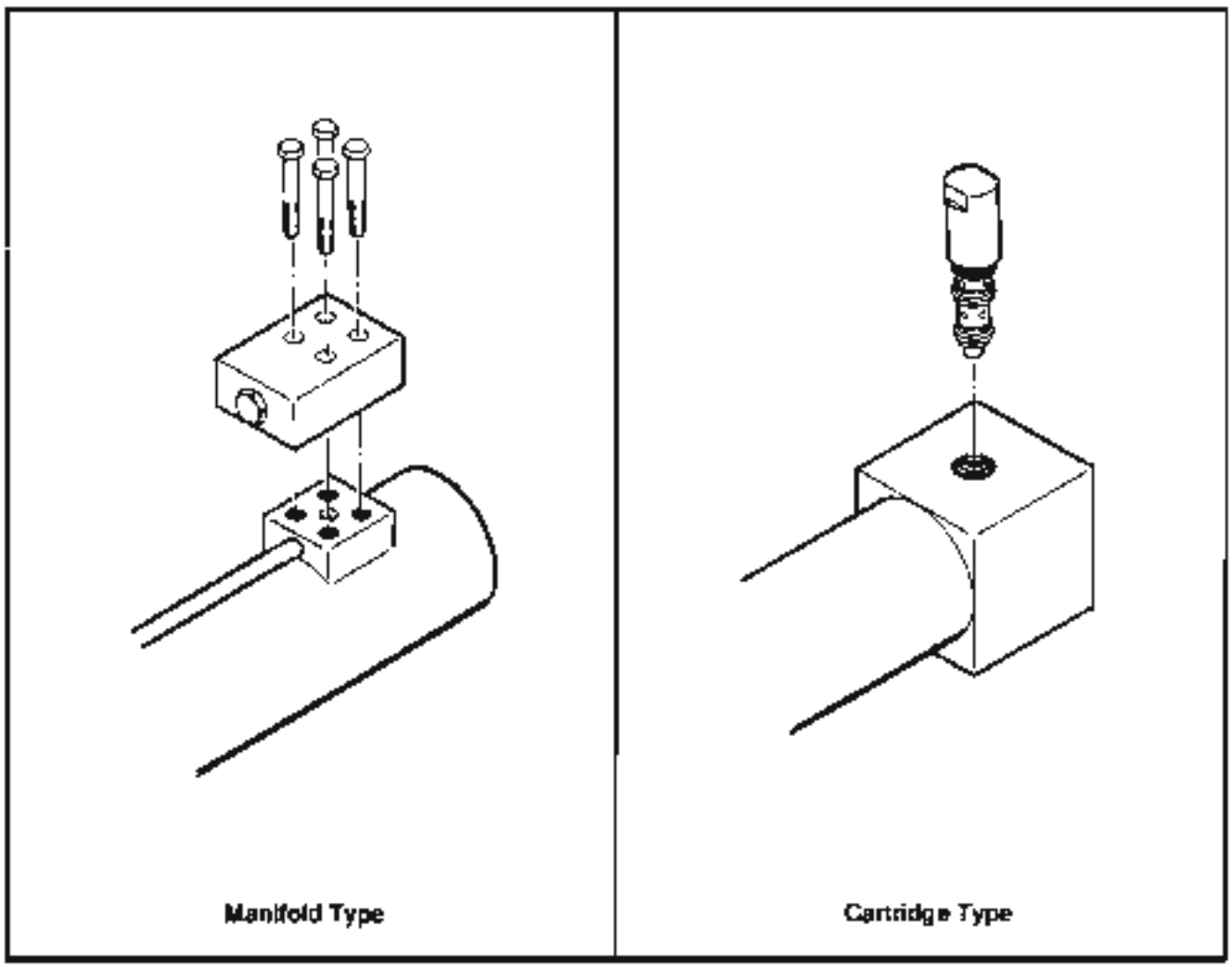


Figure 3-58 Cylinder Counterbalance Valves

HYDRAULICS

DIRECTIONAL CONTROL VALVES

CYLINDER LOAD CHECK VALVE

DESCRIPTION

Outrigger hydraulic cylinders are equipped with load check valves. The valves are in the "up" and "down" outrigger hydraulic circuits. The check valves prevent movement of the cylinders in event of downstream hydraulic line failure or leakage through the control valve or fittings. The check valves prevent movement of the cylinders when the engine is off, even if the control levers are operated.

TROUBLESHOOTING

Any cylinder movement, caused by moving the control lever after the engine is shut off, may indicate a faulty load check valve. It may also indicate faulty hydraulic cylinder seals.

1. Check for internal cylinder leakage (refer to "Internal Leakage" under "Checking Cylinder Condition" on page 3.19-1 in this section).

2. If the cylinder checks in good condition, replace the load check valve.

REMOVAL AND INSTALLATION (Figure 3-59)

Use the following procedure to replace the outrigger check valve:

1. Lower the outriggers just until they touch the ground. Lower the boom to the ground, apply the parking brake, and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in this section).

WARNING: Cylinders equipped with load check valves may have hydraulic pressure stored within the cylinder. The pressure may be in excess of 250 psi and will be released when removing the check valve.

WARNING: Wear eye protection when removing cylinder check valves.

2. a. Tag and carefully remove two hydraulic hoses.
   b. Remove three screws and lockwashers.
   c. Remove the check valve.
   d. Install new check valve.
   e. Install screws, lockwashers and hoses.
   NOTE: See Torque Specification Tables in Section 1 for tightening bolts and hydraulic lines. Use two wrenches when tightening hydraulic line fittings.

3. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

CYLINDER LOAD CHECK VALVE

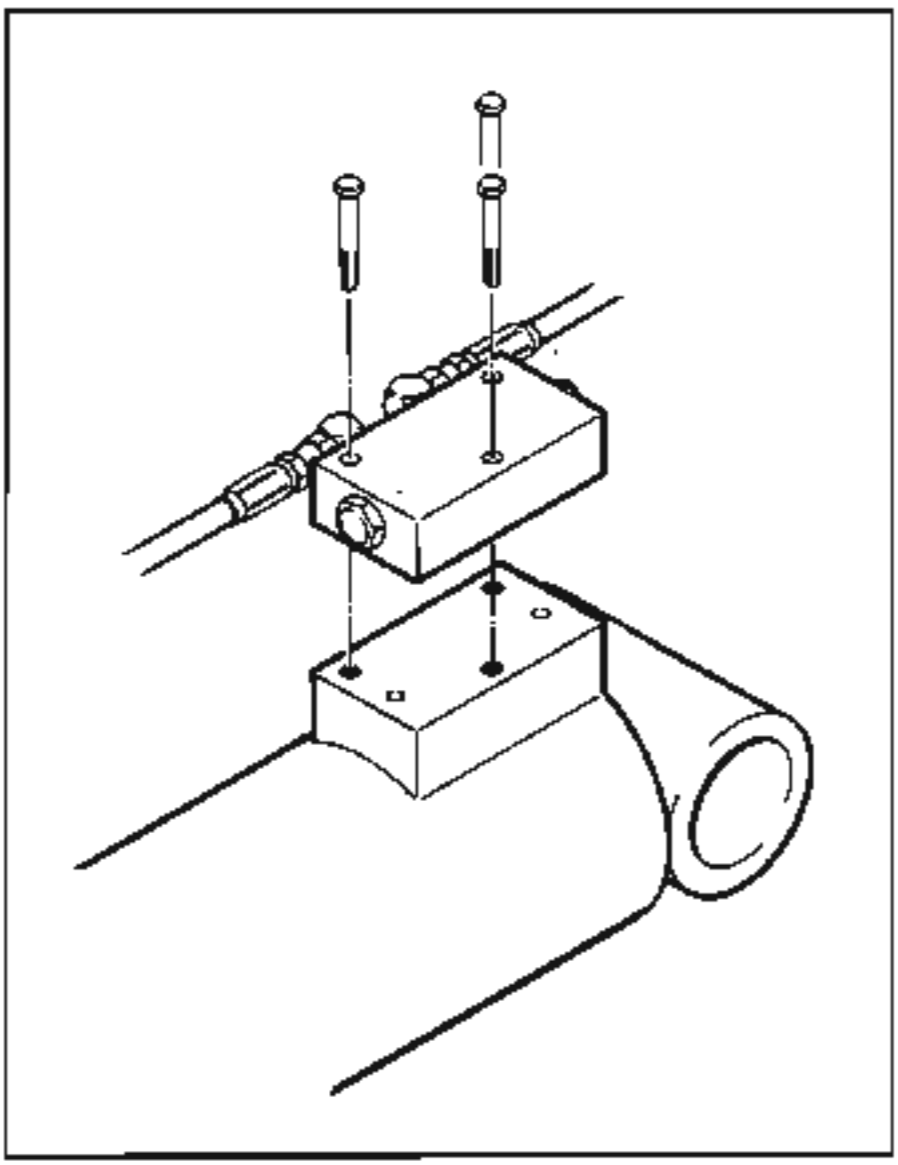


Figure 3-59 Outrigger Load Check Valve

BOOM AND FORK CARRIAGE

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BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

DESCRIPTION

The boom for the model 522 forklift is comprised of two sections (inner and outer) which are constructed of high strength steel tubing and incorporate a series of openings along both sides for access to boom internals. A double acting hydraulic boom extension cylinder, located within the boom, extends and retracts the inner boom section. The base end of the boom extension cylinder is mounted to the rear of the outer boom. The rod end of the cylinder is connected to the forward portion of the inner boom.

Raising and lowering of the boom is accomplished by one double acting hydraulic boom lift cylinder, with the base end pivot connected to the main frame and the rod end pivot connected to the boom. The boom pivots vertically about a pivot pin, through two bearings which are mounted to eccentric mounts, connecting the rear of the boom to the main frame.

The boom incorporates a carriage tilt cylinder, located within the nose of the boom, which controls the forward and rearward tilt of the carriage and attached forks (refer to "Carriage Tilt Cylinder" on page 4.5-1).

Rollers, located at the top rear of the inner boom and front bottom of the outer boom, and slide plates, located at the rear bottom of the inner boom and front top of the outer boom, provide the bearing surfaces between the inner and outer boom sections.

The four hydraulic hoses located within the boom move with the inner boom as it extends and retracts, by use of a hose carrier tube and tray. The four hydraulic hoses attach to tubes at the rear of the inner boom. The tubes extend to the nose cone.

MAINTENANCE

Maintenance of the boom requires:

1. Periodic greasing of hydraulic cylinder end pivot and boom pivot (see "Service Schedules" in Section 2).

2. Periodic greasing of boom rollers (see "Service Schedules" in Section 2).

IMPORTANT: DO NOT GREASE BOOM SLIDE RAILS.

3. Periodic inspection of cylinders for wear (see "Checking Cylinder Condition" on page 3.18-1 in Section 3).

4. Periodic inspection of boom bushings for wear.

5. Periodic inspection of boom rollers for wear.

6. Periodic inspection of slide plates for wear. Inspect slide plates at front of extension cylinder, bottom rear of inner boom, and top front of outer boom for wear. Slide plates are initially 1/2" thick. Condemning thickness is 5/16". As plates wear, shim at 1/16" increments to maintain proper slide plate clearances. NOTE: Refer to the Lull Parts Book for 1/16" and 1/8" shims available.

7. Periodic inspection of hydraulic hoses for wear.

BOOM REMOVAL (Figure 4-1)

Use the following procedure to remove the boom from the machine:

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Remove the fork carriage.

3. Position the machine on a level surface; level and retract the boom; apply the parking brake and stop the engine.

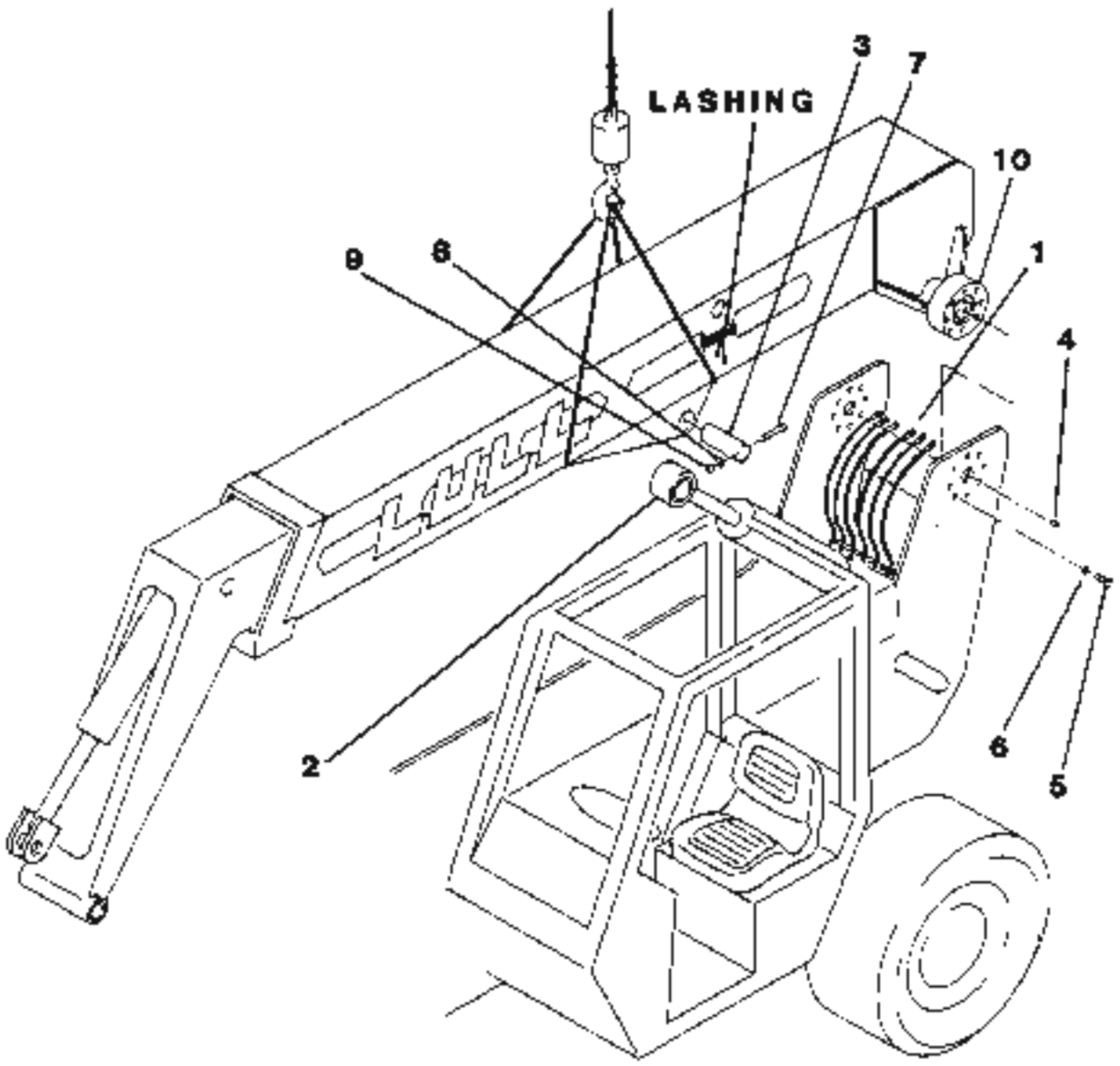
4. Support the boom from above with an overhead hoist. (Approximate weight of the boom is 2 tons.)

5. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

6. Tag and remove hydraulic hoses (items 1) from boom

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)



1 - Hydraulic Hoses (8)
2 - Hoist Cylinder
3 - Cylinder Pivot Pin
4 - Grease Fitting (2)
5 - Screw 5/8 - 11 x 2 1/2" (16)
6 - Lockwasher 5/8" (16)
7 - Bolt 5/8 - 11 x 5"
8 - Lockwasher 5/8"
9 - Hex Nut 5/8 - 11
10 - Bearing Eccentric (2)

Figure 4-1 Boom Removal

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

BOOM REMOVAL (cont.)

7. Support the hoist cylinder (Item 2). Approximate weight 350 lbs. Remove the top pivot pin (Item 3) and lower the cylinder.

8. Using rope or chain, lash inner and outer booms together through windows.

9. Remove grease fittings (Item 4).

10. Match mark bearing eccentrics (Item 10) and main frame for reference when later reassembling boom to the main frame.

11. Remove (16) screws and lockwashers (Items 5 & 6).

12. Lift the boom clear of the machine.

BOOM INSTALLATION

Use the following procedure to install the boom on the machine:

1. With overhead support, position the boom on the machine. (Boom must be retracted.)

2. Assemble (4) screws (equally spaced), mounting each bearing eccentric (Item 10) to the main frame, and tighten.

NOTE: Initially mount bearing eccentrics so the "X" mark, located on the face of the eccentric circumference, is at the bottom.

3. Lower the boom.

4. Check to make sure boom is centered on the machine and the boom nose is vertical.

A. To check if the boom is centered – measure from sides of main frame to sides of boom nose. Dimensions must be within 1/4" of each other.

B. To check if the nose is vertical – with a level, check main frame verticalness against boom nose verticalness. Level readings must be the same.

C. To adjust boom centering – adjust eccentrics by removing screws and rotating eccentrics one bolt hole at a time – alternating from side to side. Reinstall and tighten screws before rechecking.

a. To move boom nose to the right (as viewed from the cab) – rotate eccentrics clockwise (as viewed from sides of machine)

b. To move the boom nose to the left – rotate eccentrics counterclockwise.

D. To adjust boom verticalness – rotate eccentrics and retighten screws before rechecking.

a. Rotating the eccentric so the "X" mark moves upwards will raise the boom on that side.

b. Conversely, rotating the eccentric so the "X" mark moves downwards will lower the boom on that side.

E. Recheck boom for centering and levelness and readjust eccentrics as necessary. Once boom is centered and level, install all mounting screws for eccentrics and tighten to 160 ft/lbs torque.

5. Install grease fittings (Item 4).

6. Reassemble rod end of hoist cylinder to boom.

7. Reinstall hydraulic hoses.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

8. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

9. Grease boom pivots.

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

BOOM INSTALLATION (cont)

10. Extend the boom fully and hold for 15 seconds; retract boom fully and hold for 15 seconds; tilt carriage forward fully and hold for 15 seconds. Repeat. (These procedures will remove air from the circuits.)

BOOM SEPARATION

The boom may be separated into its two individual sections while mounted to the machine or after removal from the machine.

A. PREPARATION

1. If boom is mounted to the machine, use the following procedure to prepare boom for separation:

   a. Remove fork carriage.

   b. Position machine on level surface, retract and level the boom, apply the parking brake, shut off engine, and release all pressure in hydraulic system (see warning and procedure on page 3.2-1 in Section 3).

2. If boom is removed from the machine, place the boom on a level surface.

B. SEPARATION OF BOOM (Figure 4-2)

1. Remove rear boom cover (Item 1).

2. Tag and remove (4) hydraulic hoses (Items 2) from bulkhead.

3. Remove (2) hydraulic hoses (Items 3) from boom extension cylinder (Item 4).

4. Remove counterbalance valve (Item 5).

CAUTION: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder. If a counterbalance valve is to be removed, do so carefully while wearing eye protection.

5. Support the rear of the extension cylinder and remove (2) screws and lockwashers (Items 6 & 7) mounting extension cylinder to support bracket (Item 8).

6. Remove (2) screws and lockwashers (Items 9 & 10) mounting hose tray (Item 14) to outer boom.

7. Remove outer boom front slide plate (see "Slide Plate/Shim Removal and Installation").

8. Remove outer boom front rollers (see "Roller/Shim Removal and Installation").

9. Using sufficient means to support and pull the inner boom from the outer boom, separate the inner boom from the outer boom.

NOTE: The extension cylinder, hoses, gantube and hose tray remain within the inner boom.

NOTE: Be careful not to damage the rear slide plates of the inner boom as they pass over the front of the outer boom, by assuring sufficient clearance is provided.

NOTE: Reverse Steps 1-9 above to reassemble boom. Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

EXTENSION CYLINDER REMOVAL (Figure 4-3)

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface, level the boom (rest the boom upon a substantial support), apply the parking brake and stop the engine.

3. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

4. Remove setscrew, nut and washer (Items 1) from cylinder rod end.

5. Loosen bolt on collar of support mount. (Item 2) Spread collar so extension cylinder (Item 3) will clear it when removed.

6. Remove screws and lockwashers (Items 4) and remove rear cover (Item 5).

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

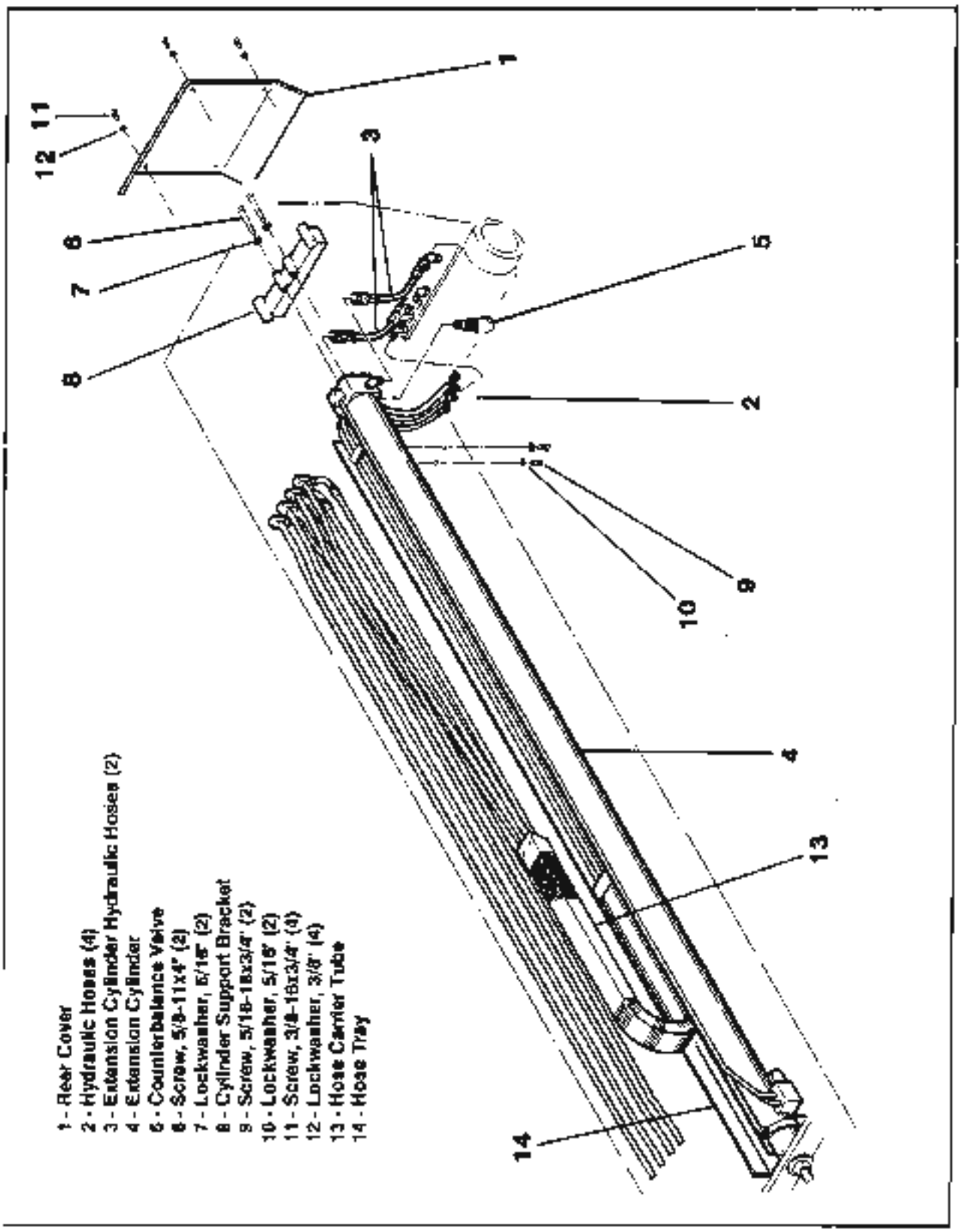


Figure 4-2 Preparing Boom for Separation

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

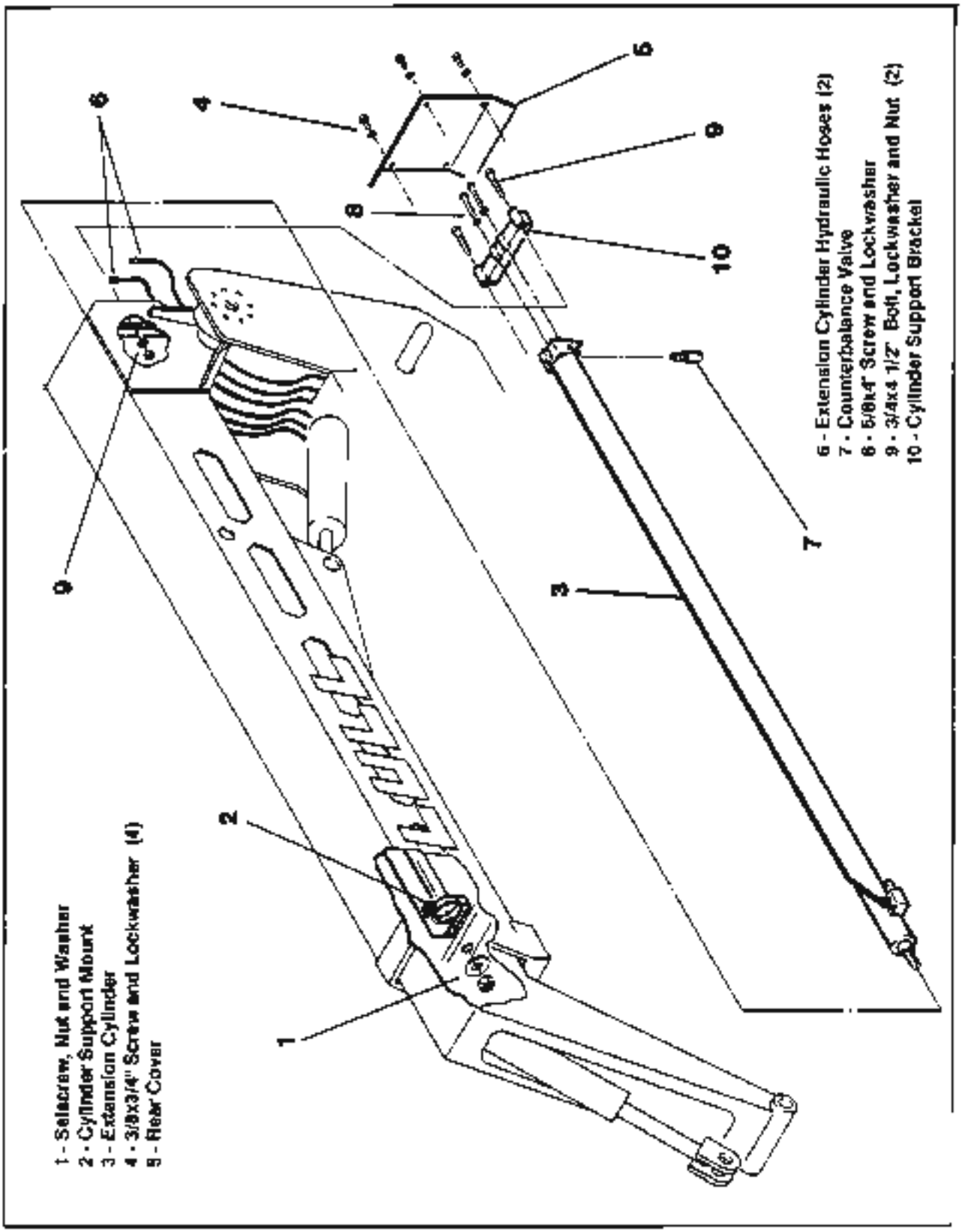


Figure 4-3 Extension Cylinder Removal

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

EXTENSION CYLINDER REMOVAL (cont.)

7. Tag and disconnect two hydraulic hoses (Items 6) from rear of extension cylinder.

8. Remove counterbalance valve (Item 7) from extension cylinder.

CAUTION: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder. If a counterbalance valve is to be removed, do so carefully while wearing eye protection.

9. Support rear of cylinder, remove screws and lockwashers (Items 8).

10. Remove bolts, nuts and lockwashers (Items 9) and remove cylinder support bracket (Item 10).

11. Slide extension cylinder out from rear of boom. (Approximate weight of cylinder is 300 lbs.)

EXTENSION CYLINDER INSTALLATION

1. Reverse steps 4 through 11 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Extend the boom fully and hold for 15 seconds; retract boom fully and hold for 15 seconds; tilt fork carriage down fully and hold for 15 seconds; tilt fork carriage back fully and hold for 15 seconds. Repeat. (These procedures will remove air from the circuits.)

HOSE REMOVAL (Figure 4-4)

1. Position the machine on a level surface. Level and fully extend the boom, resting the end of the boom on a substantial support.

2. Apply the parking brake and stop the engine.

3. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

4. Tag and remove hose ends (Items 1) from hydraulic tube ends (Items 2) at top rear of inner boom.

5. Remove screws and lockwashers (Items 3), attaching hose carrier tube (Item 4) to bracket of inner boom (Item 5) and to hose tray (Item 6).

6. Remove screws and lockwashers (Items 7) and remove rear cover (Item 8).

7. Tag and remove hose ends (Items 9) from bulkhead fittings at rear of outer boom.

8. Remove nuts and lockwasher (Items 10) and remove hose hold down (Item 11).

9. Pull hoses and hose tube carrier, complete, out from rear of the boom.

HOSE INSTALLATION

1. Reverse steps 4 through 9 above.

NOTE: Tube carrier and hoses can be rolled back once they are placed within the boom.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

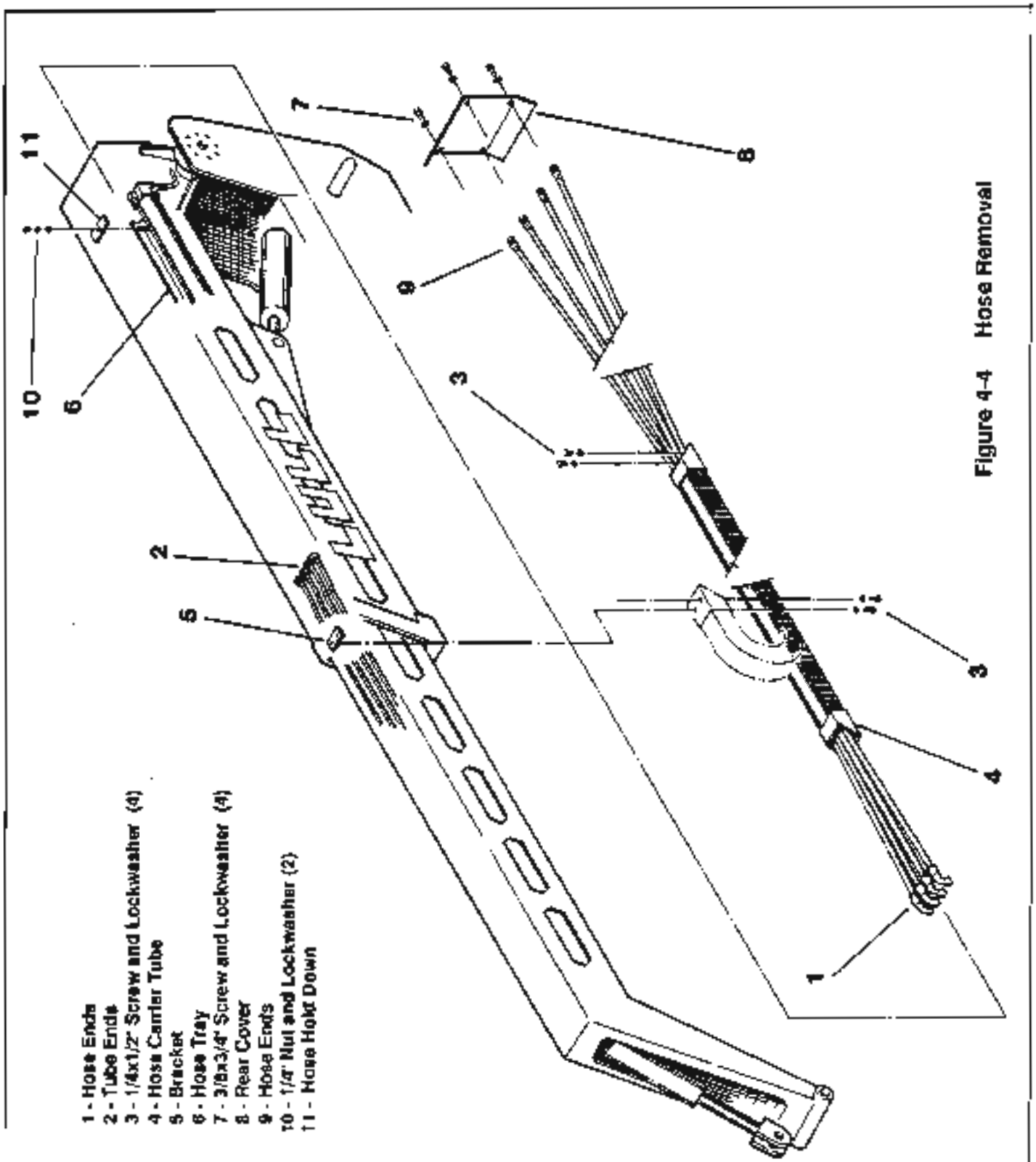


Figure 4-4 Hose Removal

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

HOSE INSTALLATION (cont.)

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Tilt the fork carriage fully forward and hold for 15 seconds. tilt the fork carriage fully back and hold for 15 seconds; move auxiliary control handles fully both directions and hold for 15 seconds each direction. Repeat. These procedures will remove air from the circuits.

ROLLER/SHIM REMOVAL AND INSTALLATION (Figure 4-5)

REAR OF INNER BOOM

1. Extend inner boom until rollers align with access holes in outer boom.

2. Lower the boom to the ground, apply the parking brake and stop the engine.

3. Loosen set screw (Item 26).

4. Push pin (Item 14) through access hole in outer boom. NOTE: Be careful not no lose shims (Items 24).

5. Remove rollers (Items 25) through boom side openings (windows).

6. Install rollers, reversing steps 3 through 5.

NOTE: Clearance between roller flange and rail is to be 1/16" per side. Shim accordingly

7. Grease rollers.

FRONT OF OUTER BOOM

1. Lower the boom to the ground, apply the parking brake and stop the engine.

2. Remove bolt (Item 28).

3. Remove roller pins (Items 15).

4. Remove rollers (Items 25) and shims (Items 24).

5. Install rollers, reversing steps 2 through 4.

NOTE: Clearance between roller flange and rail is to be 1/16" per side. Shim accordingly.

6. Grease rollers.

SLIDE PLATE/SHIM REMOVAL AND INSTALLATION (Figure 4-5)

REAR OF INNER BOOM

1. Position the machine on level surface, place transmission in neutral and apply the parking brake. Lower the boom near surface.

2. Extend inner boom until wear plate screw heads (Item 29) align with outer boom access holes.

3. Remove screws (Item 29).

4. Extend boom an additional 3" until rear screw heads align with access holes.

5. With boom lowered near surface, shut off the engine and remove all hydraulic pressure from the system (see warning and procecure on page 3.2-1 in Section 3).

6. Remove rear screws.

7. Remove slide plate(s) and shims (Items 9, 10 & 11).

NOTE: Before installing slide plate(s) measure the distance between the top rail and inside bottom of the outer boom, midway along the outer boom's length (see Figure 4-6). (This is the narrowest portion of the outer boom.) Subtract 1/16" from dimension to allow for clearance. This adjusted dimension must match the distance from the top of the rear roller and bottom of the wear plate of the inner boom. Measurements must be taken on side of boom where slide plate is to be installed.

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

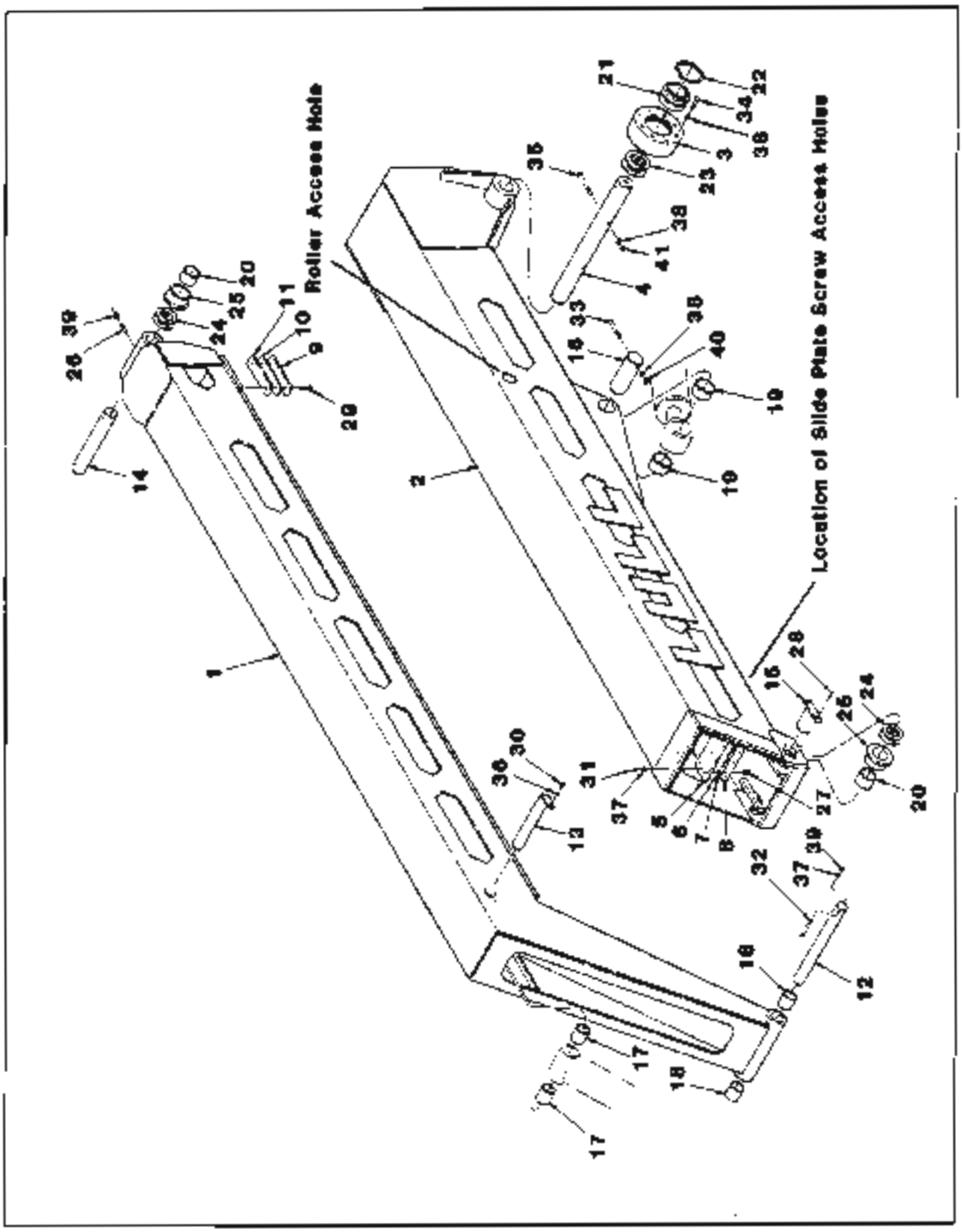


Figure 4-5 Rollers, Shims, Bushings and Slide Plates Removal

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

1 - Inner Boom
2 - Outer Boom
3 - Eccentric (2)
4 - Shaft, Boom Pivot
5 - Base, Slide Plate
6 - .05" Shim (A/R)
7 - .12" Shim (A/R)
8 - Slide Plate, Front
9 - Slide Plate, Rear (2)
10 - .12" Shim (A/R)
11 - .06" Shim (A/R)
12 - Pin, Carriage Tilt
13 - Pin, Carriage Tilt Cylinder
14 - Pin, Rear Rollers
15 - Pin, Front Rollers (2)
16 - Pin, Hoist Cylinder
17 - Bushing, Carriage Tilt Cylinder (2)
18 - Bushing, Carriage Tilt Pin (2)
19 - Bushing, Hoist Cylinder (2)
20 - Bushing, Rollers (4)
21 - Bushing, Boom Pivot (2)
22 - Retaining Ring (2)
23 - 14 ga. Shim (A/R)
24 - 14 ga. Shim, Rollers (A/R)
25 - Roller (4)
26 - 1/2" x 1 1/4" Setscrew
27 - 1/2" x 3/4" Brass Screw (4)
28 - 3/8" x 1" FL. Soc. Hd. Screw (4)
29 - 1/2" x 1 1/4" FL. Soc. Hd. Screw (4)
30 - 3/8" x 3/4" Hx. Hd. Screw
31 - 1/2" x 3/4" Hx. Hd. Screw (3)
32 - 1/2" x 4 1/2" Hx. Hd. Bolt
33 - 5/8" x 5" Hx. Hd. Bolt
34 - 5/8" x 2 1/2" Hx. Hd. Screw (16)
35 - 5/8" x 6" Hx. Hd. Bolt (2)
36 - 3/8" Lockwasher
37 - 1/2" Lockwasher (4)
38 - 5/8" Lockwasher (16)
39 - 1/2" Nut (2)
40 - 5/8" Nut
41 - 5/8" - 18 Nut (2)

Table 4-1 List of Material For Figure 4-5

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODEL 522)

SLIDE PLATE/SHIM REMOVAL AND INSTALLATION (cont.)

REAR OF INNER BOOM

8. Install slide plate(s) and shims according to measurements above, reversing steps 3 through 7.

FRONT OF OUTER BOOM

1. Position the machine on level surface, lower the boom near the ground, apply the parking brake and stop the engine.

2. Remove three bolts and lockwashers (Items 31 & 37).

3. Remove slide plate assembly.

4. Remove slide plate (Item 6) from base plate (Item 5) by removing two brass screws and washers (Items 27).

5. Install new slide plate, reversing steps 2 through 4. Shim slide plate so there is 1/16" clearance between slide plate and top of inner boom

BOOM PIVOT SHIM REMOVAL AND INSTALLATION

1. Follow steps 1 through 11 under "Boom Removal".

2. Slide bearing eccentrics (Figure 4-1, Items 10) from boom pivot shaft.

3. Remove shims (Figure 4-5, Items 23).

4. Replace shims, being sure there is approximately 1/16" clearance per side after assembly.

5. Follow steps 1 through 10 under "Boom Installation".

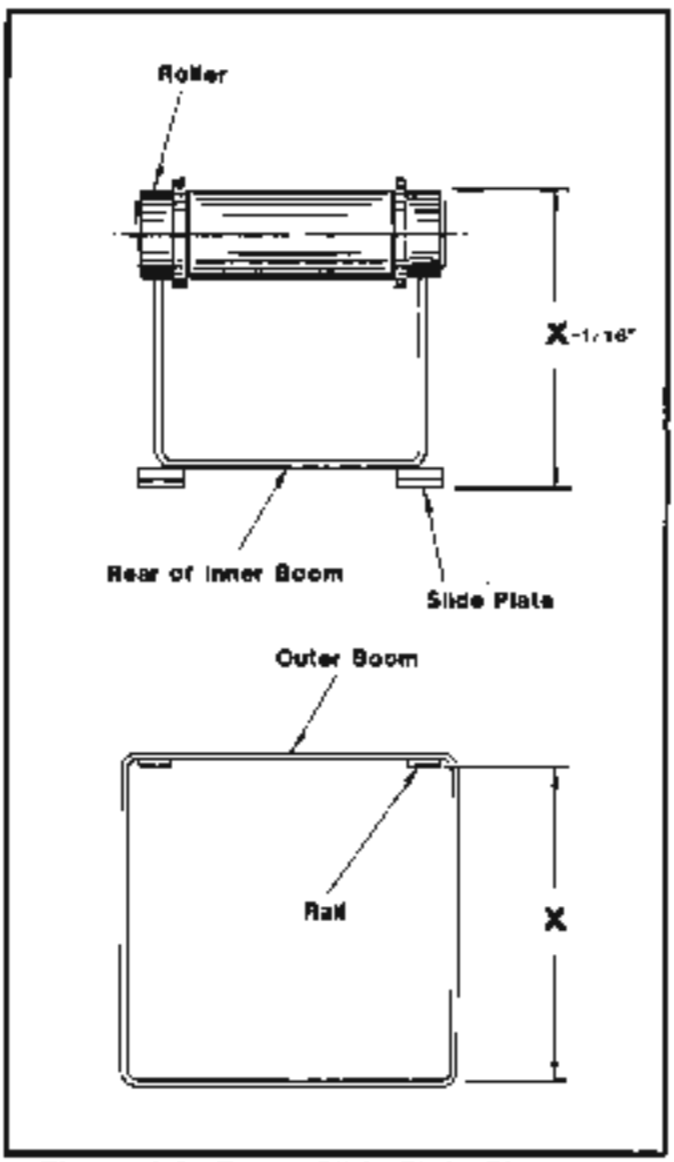


Figure 4-6 Boom Slide Plate Clearance

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 522, 624)

DESCRIPTION

The boom for the model 622 and 624 forklifts is comprised of two sections (inner and outer) which are constructed of high strength steel tubing and which incorporate a series of openings along both sides for access to boom internals. A double-acting hydraulic cylinder, located within the boom, extends and retracts the inner boom section. The base end of the boom extension cylinder is mounted to the rear of the outer boom. The rod end of the cylinder is connected to the forward portion of the inner boom.

Raising and lowering of the boom is accomplished by two double-acting hydraulic boom lift cylinders with the base end pivots connected to the main frame and the rod end pivots connected to the boom. The boom pivots vertically about pivot pins, through two bearings which are mounted to eccentric mounts, connecting the rear of the boom to the main frame of the machine.

The boom incorporates a carriage tilt cylinder, located within the nose of the boom, which controls the forward and rearward tilt of the carriage and attached forks (refer to "Carriage Tilt Cylinder" on page 4.5-1).

Rollers, located at the top rear of the inner boom and front bottom of the outer boom, and Fabreka slide plates, located at the rear bottom of the inner boom and front top of the outer boom, provide the bearing surfaces between the inner and outer boom sections.

The four hydraulic hoses located within the boom and which extend the nose cone, move with the inner boom as it extends and retracts, by using a hose reel trolly which is guided along the extension cylinder housing as the boom moves, and a cable and sheave system which provides for synchronized movement of hoses with boom movement.

MAINTENANCE

Maintenance of the boom requires:

1. Periodic greasing of hydraulic cylinder end pivots and boom pivot (see "Service Schedules" in Section 2).

2 Periodic greasing of boom rollers (see "Service Schedules" in Section 2).

IMPORTANT: DO NOT GREASE BOOM SLIDE RAILS.

3. Periodic inspection of cylinders for wear (see "Checking Cylinder Condition" on page 3.18-1 in Section 3)

4. Periodic inspection of boom bushings for wear.

5. Periodic inspection of boom rollers for wear.

6. Periodic inspection of slide plates for wear. Inspect slide plates at front of extension cylinder, bottom rear of inner and center boom, and top front of outer and center boom for wear. Slide plates are initially 1/2" thick. Condemning thickness is 5/16". As plates wear, shim at 1/16" increments to maintain proper slide plate clearances. NOTE: Refer to the Lull Parts Book for 1/16" and 1/8" shims available.

7. Periodic inspection of hydraulic hoses for wear.

8. Periodic inspection of hose tension inside of boom with boom fully extended. Hoses must not sag more than 3 to 4 inches. Adjust tension at the tension adjustment bulkhead bracket.

9. Periodic inspection of cables for wear.

BOOM REMOVAL (Figure 4-7)

Use the following procedure to remove the boom from the machine:

1. Carefully read "General Instructions" on page 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Remove the fork carriage.

3. Position the machine on a level surface; level and retract the boom; apply the parking brake and stop the engine.

4. Support the boom from above with an overhead hoist. Approximate weight of the boom is 2 tons.

5. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 824)

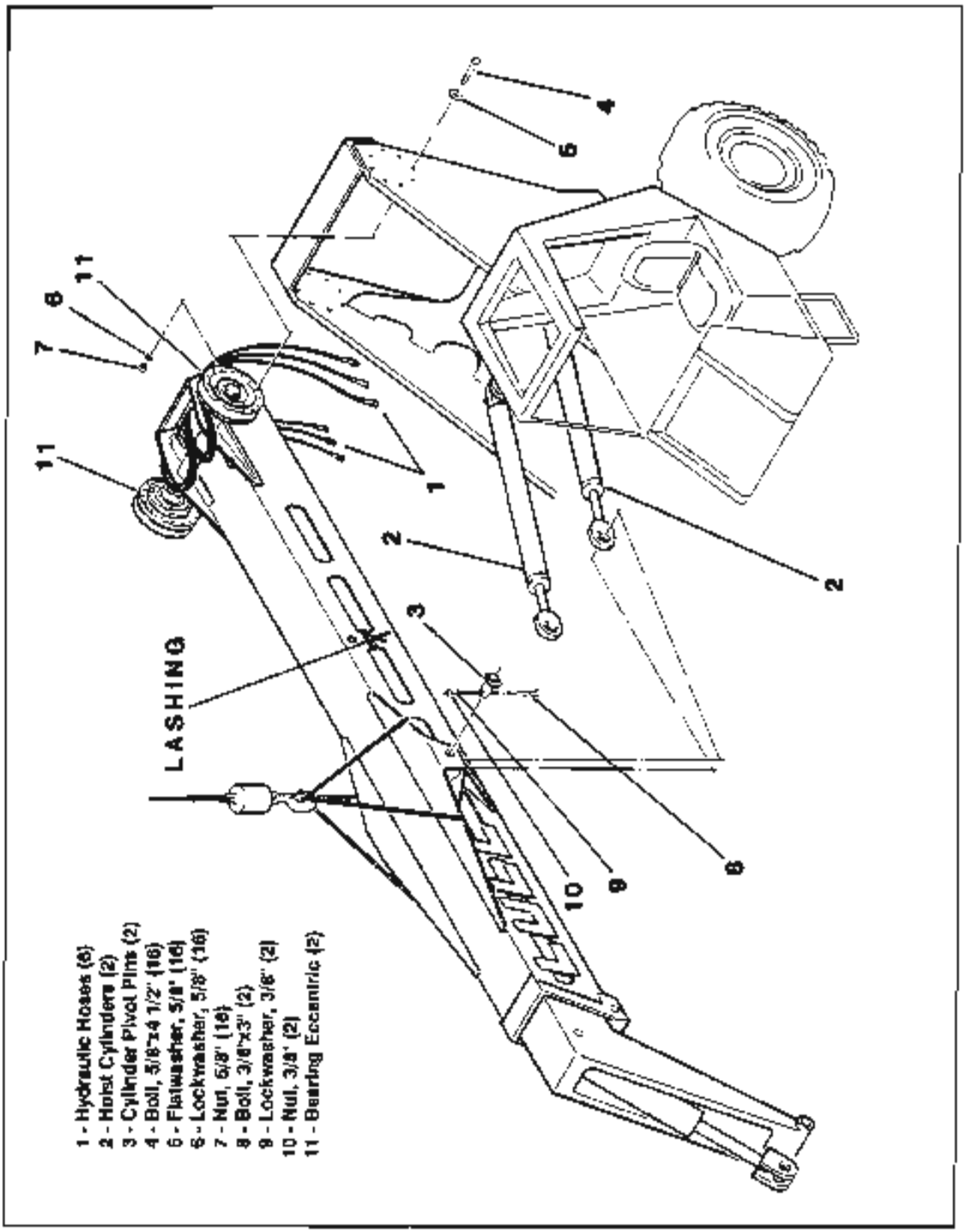


Figure 4-7 Boom Removal

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 624)

BOOM REMOVAL (cont.)

6. Tag and remove hydraulic hoses (Items 1) from bulkheads at the rear of the main frame

7. Support the hoist cylinder (Item 2). Approximate weight 250 LBS. Remove the top pivot pins (Item 3) and lower the cylinders.

8. Using rope or chain lash inner and outer booms together through windows.

9. Remove (16) bolts (Items 4, 5, 6, & 7).

10. Lift the boom clear of the machine.

BOOM INSTALLATION

Use the following procedure to install the boom on the machine:

1. With overhead support, position the boom on the machine (boom must be retracted).

2. Assemble 4 bolts (equally spaced), mounting each bearing eccentric (Item 11) to the main frame. and tighten.

NOTE: Initially mount bearing eccentrics so hole pattern is as shown in Figure 4-8.

3. Lower the boom.

4. Check to make sure boom is centered on the machine and the boom nose is vertical:

A. To check if the boom is centered -- measure from sides of main frame to sides of boom nose. Dimensions must be within 1/4" of each other.

B. To check if the nose is vertical – with a level, check main frame verticalness against boom nose verticalness. Level readings must be the same.

C. To adjust boom centering -- adjust eccentrics by removing screws and rotating eccentrics one bolt hole at a time – alternating from side to side. Reinstall and tighten bolts before rechecking.

a. To move boom nose to the right (as viewed from the cab) – rotate eccentrics clockwise (as viewed from sides of machine).

b. To move the boom nose to the left – rotate eccentrics counterclockwise.

D. To adjust boom verticalness – rotate eccentrics and retighten bolts before rechecking.

a. Rotating the eccentric upwards will raise the boom on that side.

b. Conversely, rotating the eccentric downwards will lower the boom on that side.

E. Recheck boom for centering and levelness and readjust eccentrics as necessary.

5. Reassemble rod ends of hoist cylinders to boom.

6. Reinstall hydraulic hoses (Items 1).

NOTE: Refer to "Torque Specifications for Hydraulic Line Connections' in Section 1.

7. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

8. Remove overhead support from boom.

9. Slowly raise boom until rod ends of hoist cylinders are fully extended.

NOTE: Cylinder rod ends must fully extend at the same rate to prevent the boom from shifting or "Racking" when fully raised. Carefully observe to see if any "Racking" occurs.

10. If no "Racking" is observed:

A. Install bolts (16 equally spaced per side), mounting the bearing eccentrics to the main frame and tighten to 16 ft/lbs torque.

B. Grease boom pivots.

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 624)

BOOM INSTALLATION (cont)

C. Mount fork carriage to boom.

D. Extend the boom fully and hold for 15 seconds; retract boom fully and hold for 15 seconds; tilt carriage forward fully and hold for 15 seconds; tilt carriage rearward fully and hold for 15 seconds. Repeat. (These procedures will remove air from the circuits.)

11. If "Racking" is observed:

NOTE: It is important that "Racking" does not occur. And, this being more important than centering of the boom, will require that the boom centering be readjusted off center to the extent needed to prevent boom "Racking" (see Item C under Step 4).

A. Readjust boom centering (see Note above).

CAUTION: To prevent the boom from tipping when adjusting eccentrics, be sure to adjust one side at a time being sure the opposite side is first tightened.

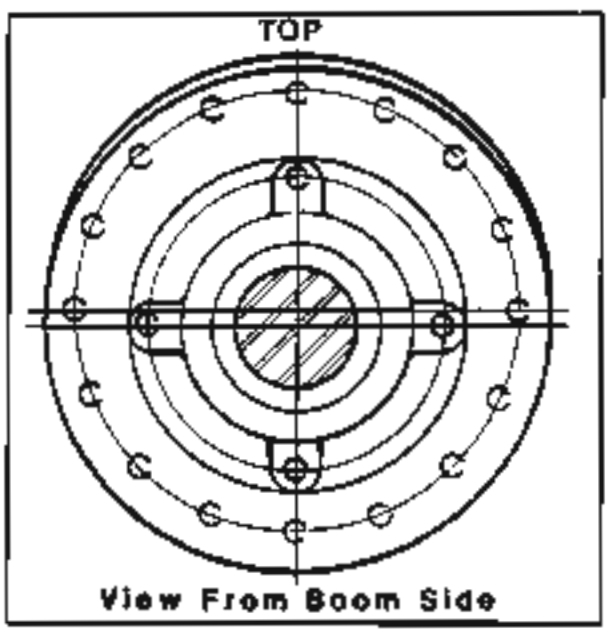


Figure 4-8 Initial Eccentric Positioning

B. Boom nose must be vertical (refer to Item 1 Step 4).

C. Raise boom to check for "Racking" and readjust boom centering as required, keeping nose vertical.

D. When no "Racking" is observed while raising the boom – proceed to and follow Items A through D under Step 10.

BOOM SEPARATION

The boom may be separated into its two individual sections while mounted to the machine or after removal from the machine.

A. PREPARATION

1. If boom is mounted to the machine, use the following procedure to prepare boom for separation:

a. Remove fork carriage.

b. Extend boom two to three feet to gain access to bulkhead fittings at top rear of inner boom.

c. Position machine on level surface, level the boom, apply the parking brake, shut off engine, and release all pressure in hydraulic system (see warning and procedure on page 3.2-1 in Section 3).

2. If boom is removed from the machine, preparation involves placing the boom on a level surface and pulling the inner boom away from the outer boom two to three feet to provide access to bulkhead fittings at top rear of inner boom.

B. SEPARATION OF BOOM (Figure 4-9)

1. Disconnect twin-line hoses (Items 1) from bulkhead bracket at top rear of inner boom.

2. Remove cable (Item 2) (see "Cable Removal").

3. Remove rear sheave bracket (Item 3).

4. Remove two hydraulic tubes (Items 4).

5. Remove counterbalance valve (Item 5).

CAUTION: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder.

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 824)

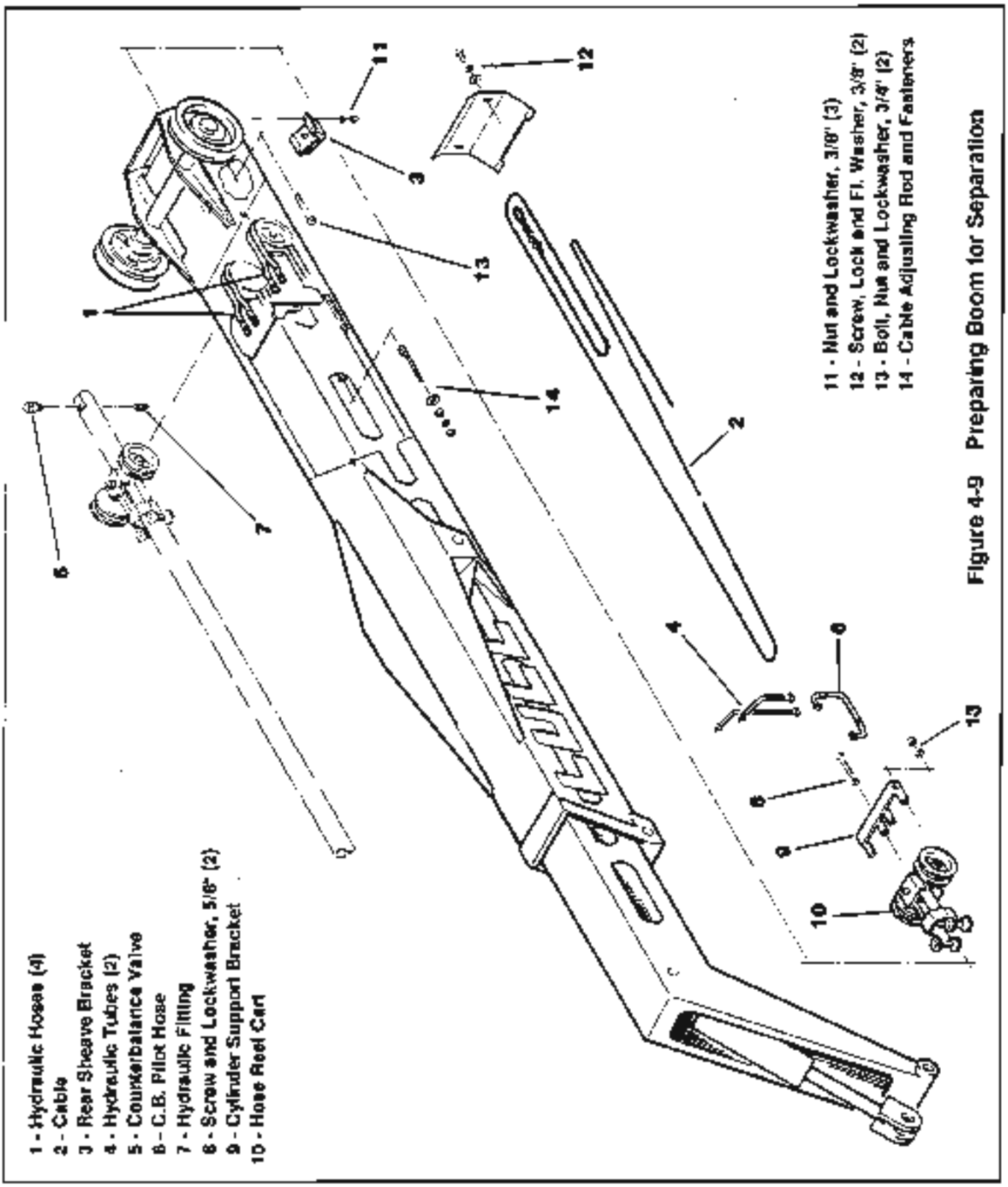


Figure 4-9 Preparing Boom for Separation

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 824)

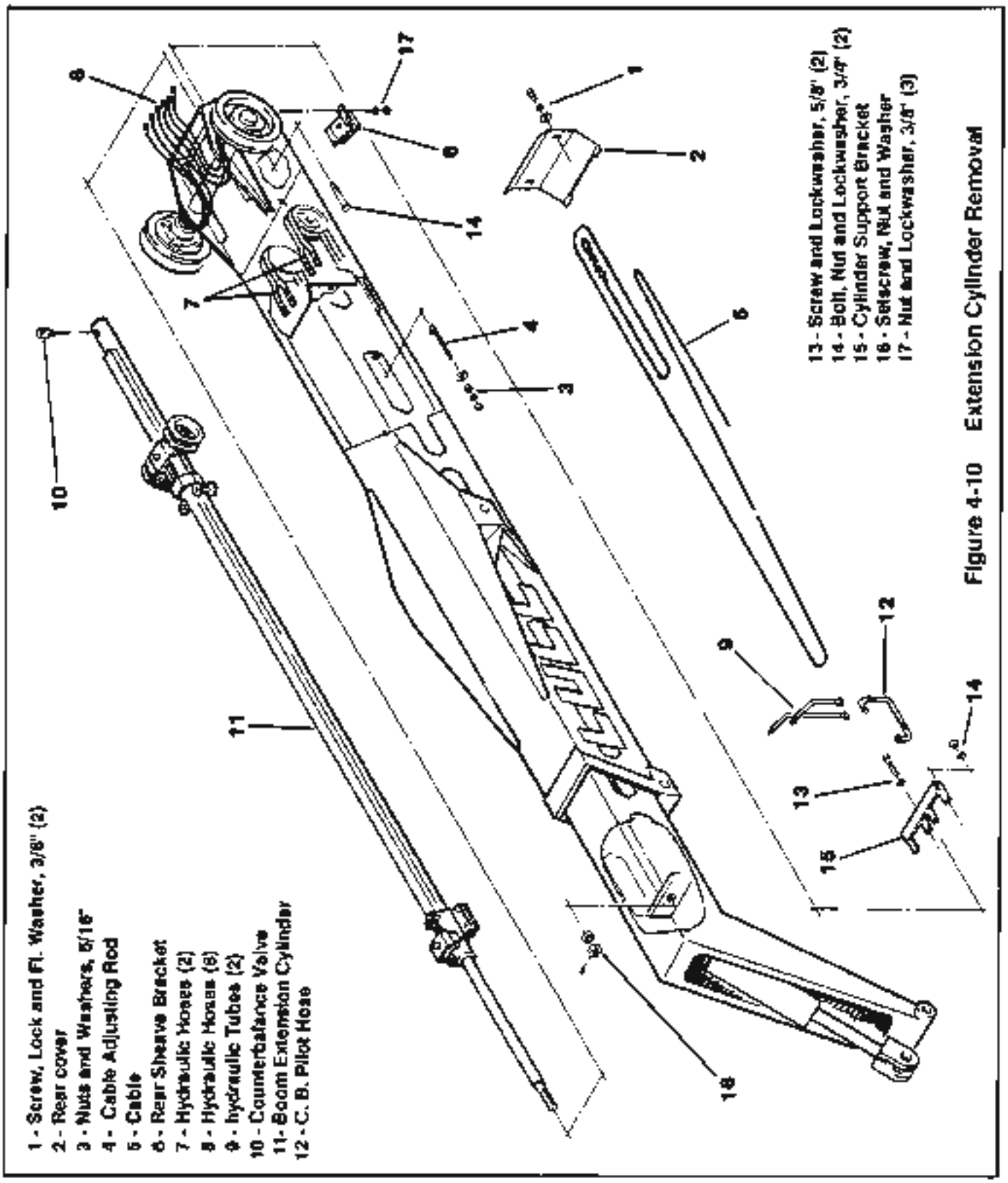


Figure 4-10 Extension Cylinder Removal

BOOM SEPARATION (cont)

B. SEPARATION OF BOOM

6. Remove counterbalance valve pilot hose (Item 6).

7. Remove hydraulic fitting (Item 7) from bottom rear of extension cylinder.

8. Remove two screws and lockwashers (Item 8), mounting extension cylinder to support bracket (Item 9).

9. Remove support bracket. (The hose reels will support the rear of the cylinder).

10. Pull hose reel cart (Item 10) toward rear of cylinder. Place block under cylinder to support it and remove hose reel cart out back of boom.

11. Remove outer boom front slide plate (see "Slide Plate/Shim Removal and Installation").

12. Remove outer boom front rollers (see "Roller/Shim Removal and Installation").

13. Using sufficient means to support and pull the inner boom from the outer boom, separate the inner boom from the outer boom.

NOTE: The extension cylinder remains within the inner boom.

NOTE: Be careful not to damage the rear slide plates of the inner boom as they pass over the front of the outer boom, by assuring sufficient clearance is provided.

EXTENSION CYLINDER REMOVAL (Figure 4-10)

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface, level the boom (rest the boom upon a substantial support), apply the parking brake and stop the engine.

3. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

4. Remove screws and washers (Item 1) and remove rear cover (Item 2).

5. Remove cable adjusting nuts and washers (Item 3) and remove cable adjusting rod (Item 4).

6. Remove cable (Item 5).

7. Remove rear cable sheave bracket (Item 6).

8. Disconnect twin-line hoses (Item 7) from bulkhead bracket at top rear of inner boom, and lay flat.

9. Tag and disconnect hoses (Items 8) at rear of boom.

10. Tag and remove (2) hydraulic tubes (Item 9).

11. Remove counterbalance valve (Item 10) from hydraulic cylinder (Item 11).

CAUTION: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder until the counterbalance valves are carefully removed. The stored pressure may exceed 250 PSI. Wear eye protection when removing counterbalance valves.

12. Remove counterbalance valve pilot hose (Item 12).

13. Remove bolts, nuts and washers (Items 13 & 14), and remove rear cylinder support bracket (Item 15).

14. Remove setscrew, nut and washer (Items 16) from cylinder rod end.

15. Slide extension cylinder out rear of boom. (Approximate weight of cylinder is 300 lbs.)

EXTENSION CYLINDER INSTALLATION

1. Reverse steps 4 through 15 above.

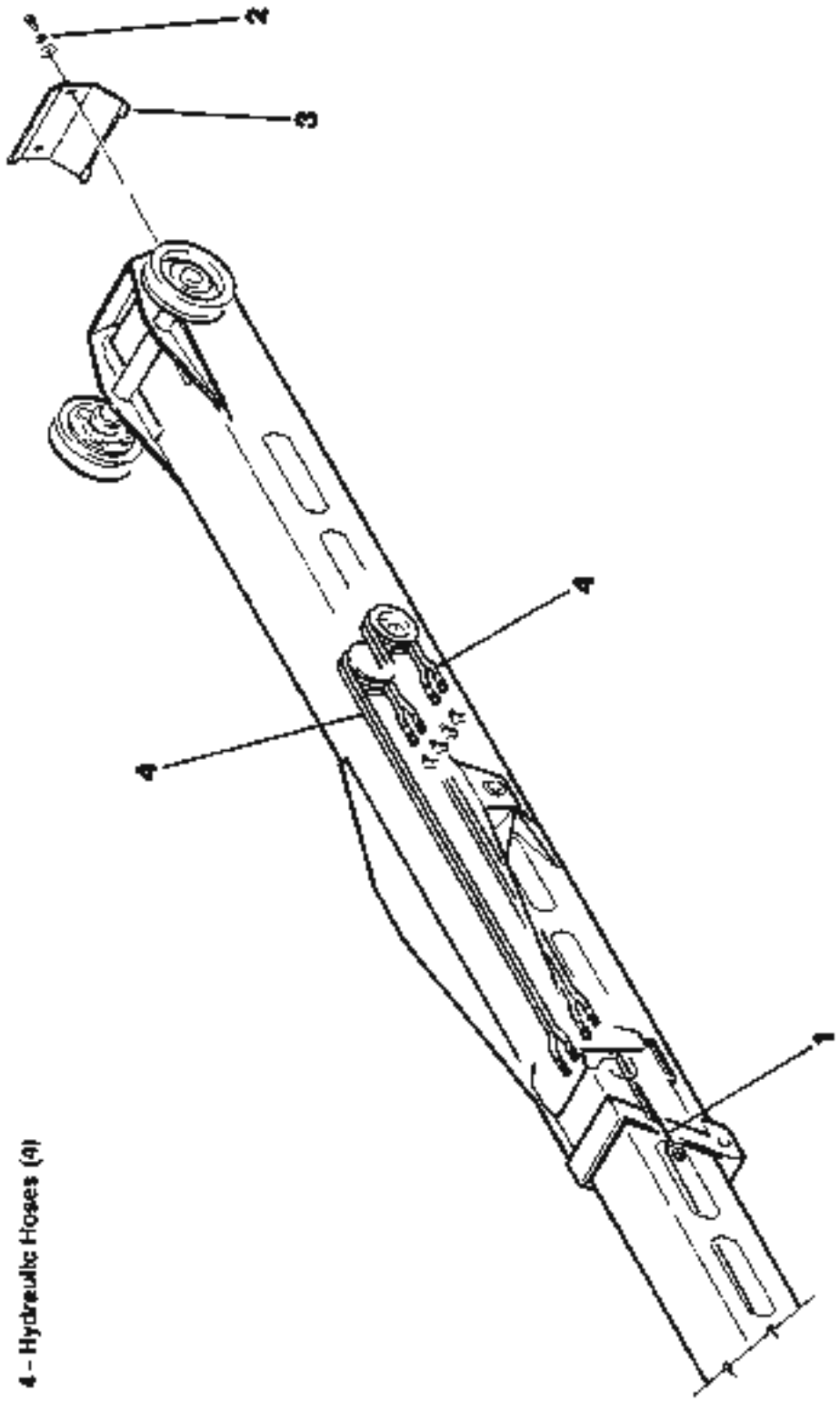
NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

2. Start the engine and check for leaks.

3. Extend the boom fully and hold for 15 seconds; retract boom fully and hold for 15 seconds; tilt fork carriage down fully and hold for 15 seconds; tilt fork back fully and hold for 15 seconds. Repeat. (This procedure will remove air from the hydraulic circuit.)

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODELS 622, 824)



1 - Cable Adjusting Rod

2 - Screw, Lock and Fl. Washer, 3/8" (2)

3 - Rear Cover

4 - Hydraulic Hoses (4)

Figure 4 - 11 Hose Removal

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODEL 622, 824)

HOSE REMOVAL (Figure 4-11)

1. Position the machine on a level surface and fully extend the boom. Allow end of boom to rest on the ground or other substantial support.

2. Apply the parking brake and stop the engine.

3. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

4. Loosen cable adjusting rod (Item 1).

5. Loosen and detach twin hydraulic hose ends (8 places).

6. Remove bolts and washers (Items 2) and remove boom rear cover (Item 3).

7. Remove hoses (Items 4) from rear of boom.

HOSE INSTALLATION

1. Reverse steps 4 through 7 above.

NOTE: When replacing twin-hoses, replace hoses on both sides. By replacing both hoses it is assured that the hoses will tighten evenly. When re-tightening the hoses, adjust rod (Item 1) so there is no more than 1/2" sag in hoses.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Tilt the fork carriage fully forward and hold for 15 seconds; tilt the fork carriage fully back and hold for 15 seconds; move auxiliary control handles fully both directions and hold for 15 seconds each direction. Repeat. (These procedures will remove air from the circuits.)

HOSE SHEAVE REMOVAL

1. Position the machine on a level surface and extend inner boom until hose sheaves are located within the second window of the outer boom.

2. Rest the boom upon the ground or other substantial support.

3. Apply the parking brake and stop the engine.

4. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

5. Loosen cable adjusting rod.

6. Tag and detach twin hydraulic hose ends from bottom bulkhead fittings.

7. Pull hoses back.

8. Remove retaining ring from sheave shaft.

9. Slide hose sheave out window.

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 624)

HOSE SHEAVE INSTALLATION

1. Reverse steps 5 through 9 above.

NOTE: Refer to "Torque Specification for hydraulic lines in Section 1.

NOTE: When re-tightening hoses, adjust rod (Figure 4-11, Item 1) so there is no more than 1/2" sag in hoses with boom fully extended.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Tilt the fork carriage fully forward and hold for 15 seconds; tilt the fork carriage fully back and hold for 15 seconds; move auxiliary control handles fully both directions and hold for 15 seconds each direction. Repeat. (These procedures will remove air from the circuits.)

CABLE REMOVAL

1. Position the machine, lower the boom to the ground, apply the parking brake and stop the engine.

2. Remove rear cover.

3. Loosen and remove cable adjusting rod.

4. Loosen, remove and save (2) cable clips from loosened end of cable.

5. Remove and save (3) thimbles.

6. Remove cable from rear of boom.

CABLE INSTALLATION

1. Reverse steps 2 through 6 above.

NOTE: Refer to Figure 4-12 for routing of cable through sheaves.

2. Tighten cable adjusting rod so there is no more than 1/2" sag in the hoses with boom fully extended.

ROLLER/SHIM REMOVAL AND INSTALLATION (Figure 4-14)

REAR OF INNER BOOM

1. Extend inner boom until rollers align with access holes on outer boom.

2. Lower the boom to the ground, apply the parking brake and stop the engine.

3. Loosen setscrew (Item 53)

4. Push pin (Item 3) through access hole in outer boom. NOTE: Be careful not to lose shims (Items 20).

5. Remove rollers (Items 4) through boom side openings (windows).

6. Install rollers, reversing steps 3 through 5 above.

NOTE: Clearance between roller flange and rail is to be 1/16 inch per side. Shim accordingly.

7. Grease rollers.

FRONT OF OUTER BOOM

1. Lower the boom to the ground, apply the parking brake and stop the engine.

2. Remove bolt (Item 21).

3. Remove roller pin (Item 5).

4. Remove roller (Item 4) and shims (Item 20).

5. Install rollers, reversing steps 2 through 4.

NOTE: Clearance between roller flange and rail is to be 1/16" per side. Shim accordingly.

6. Grease rollers.

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 624)

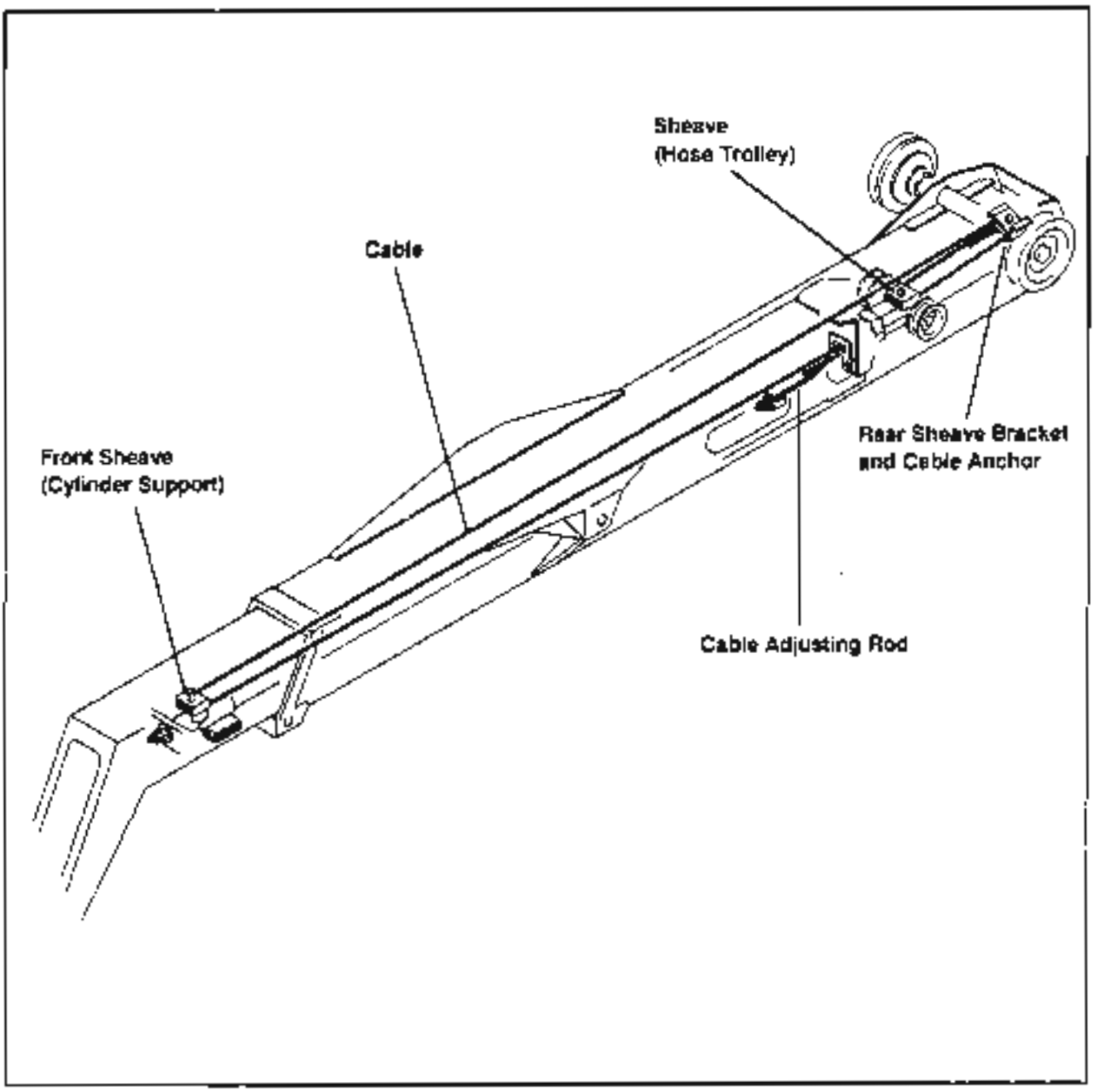


Figure 4-12 Cable Routing

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 624)

SLIDE PLATE/SHIM REMOVAL AND INSTALLATION (Figure 4-14)

REAR OF INNER BOOM

1. Position the machine on level surface, place transmission in neutral and apply the parking brake. Lower the boom near surface.

2. Extend inner boom until wear plate screw heads (Item 57) align with outer boom access holes.

3. Remove screws (Item 57).

4. Extend boom an additional 3" until rear screw heads (Item 22) align with access holes.

5. With boom lowered near surface, shut off the engine and remove all hydraulic pressure from the system (see warning and procedure on page 3.2-1 in Section 3.

6. Remove screws (Item 22).

7. Remove slide plate(s) and shims (Items 13, 17 & 18).

NOTE: Before installing slide plate(s) measure the distance between the top rail and inside bottom of the outer boom, midway along the outer boom's length (see Figure 4-13). (This is the narrowest portion of the outer boom.) Subtract 1/16" from dimension to allow for clearance. This adjusted dimension must match the distance from the top of the rear roller and bottom of the wear plate of the inner boom. Measurements must be taken on side of boom where slide plate is to be installed.

8. Install slide plate(s) and shims according to measurements above, reversing steps 3 through 7.

FRONT OF OUTER BOOM

1. Position the machine on level surface, lower the boom near the ground, apply the parking brake and stop the engine.

2. Remove three bolts and lockwashers (Items 46 & 56).

3. Remove slide plate and shims (Items 14, 16 & 19).

4. Remove slide plate (Item 14) from base plate (Item 15) by removing two brass screws and washers (Items 23).

5. Install new slide plate, reversing steps 2 through 4. Shim slide plate so there is 1/16" clearance between slide plate and top of inner boom.

BOTTOM OF FRONT SHEAVE SUPPORT BRACKET

1. Position the machine on a level surface, lower the boom to approximately six inches off the ground and rest on support. Apply the parking brake and stop the engine.

2. Remove carriage tilt cylinder (see "Removal of Tilt Cylinder" on page 4.5-4).

3. Remove extension cylinder, setscrew, nut and boss (Figure 4-10, Items 15).

4. Pull inner boom forward approximately two feet.

5. Loosen hose sheave cable tension and pull adjusting end of cable through and free of front cable sheave. Place cable end aside.

6. Loosen clamp on front sheave support bracket (Item 40).

7. Slide front sheave support bracket off extension cylinder and remove through boom side of window.

8. Replace slide plates as required.

9. Reassemble by reversing steps 2 through 7 above.

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODEL 622, 824)

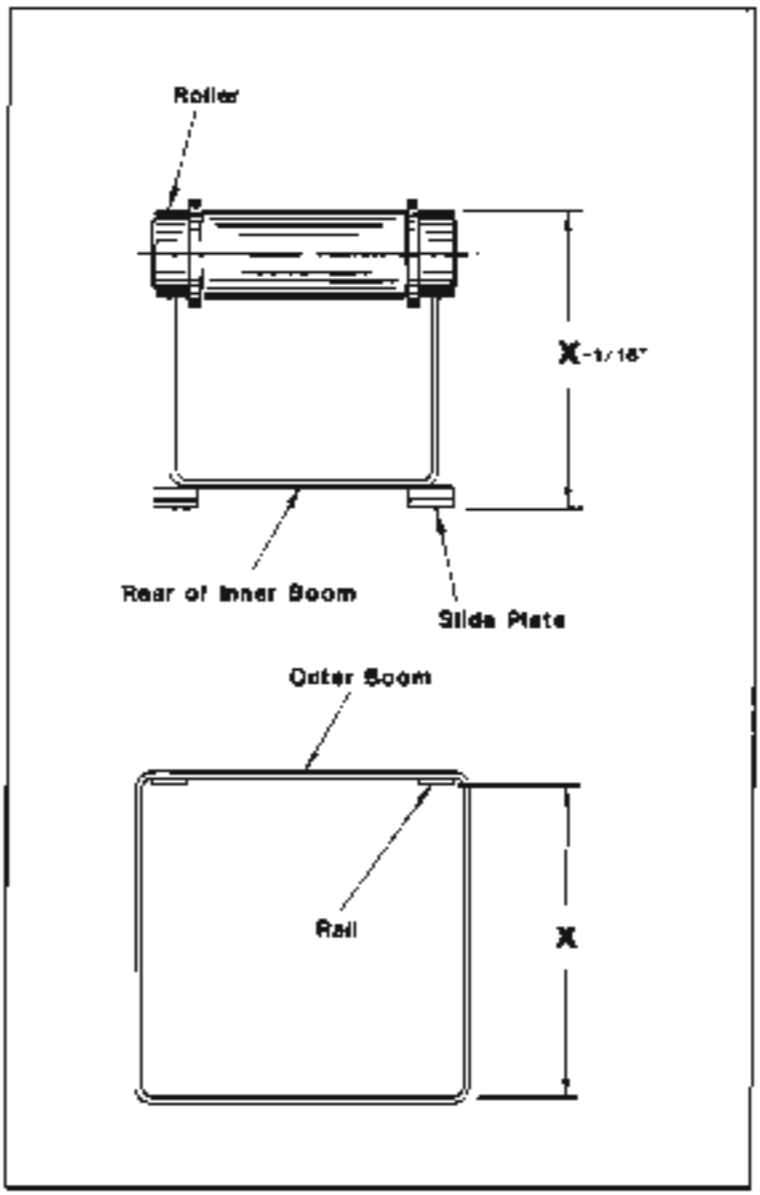


Figure 4-13 Boom Slide Plate Clearance

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 624)

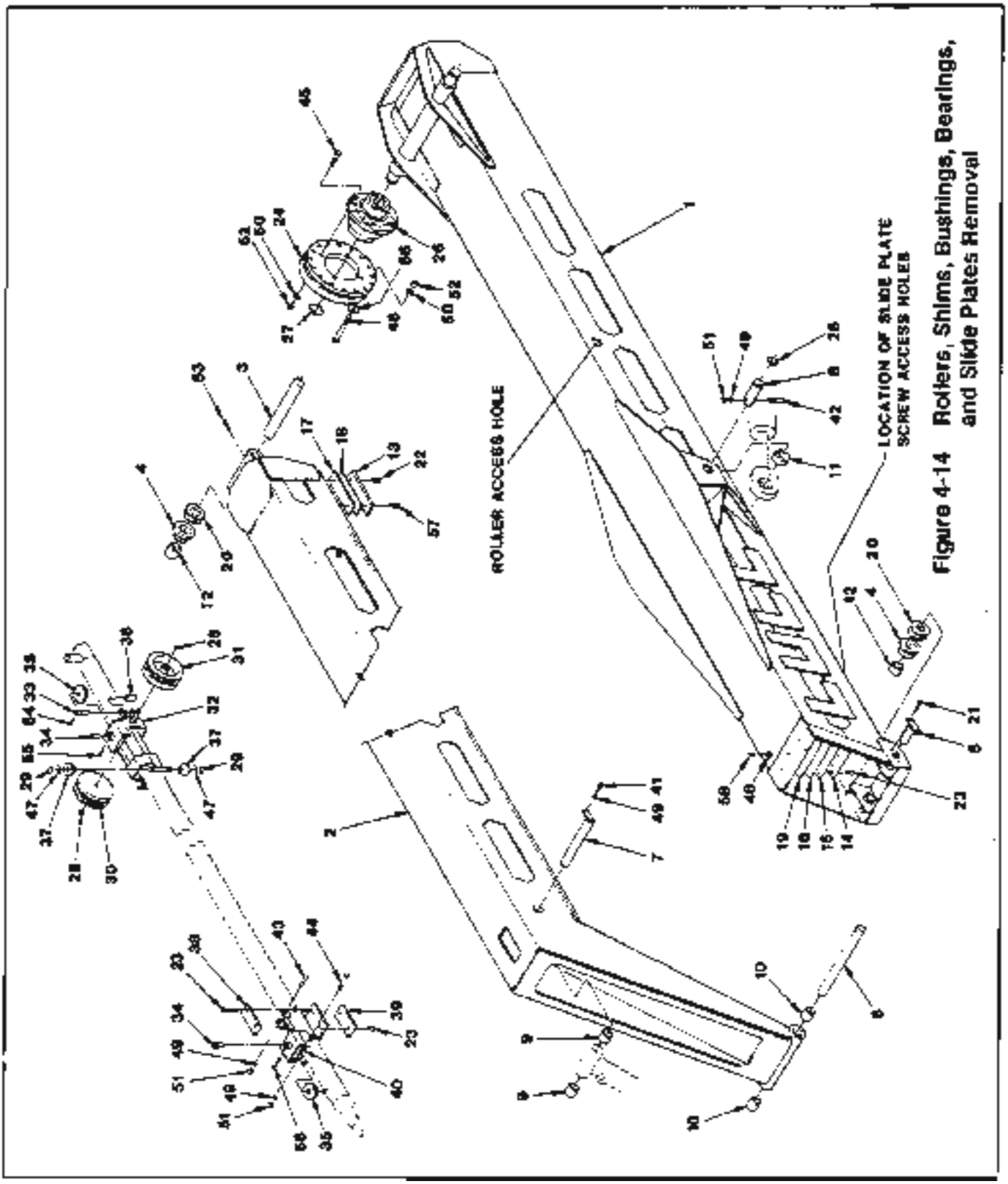


Figure 4-14 Rollers, Shims, Bushings, Bearings, and Slide Plates Removal

BOOM AND FORK CARRIAGE

TWO SECTION BOOM (MODELS 622, 824)

1 - Outer Boom
2 - Inner Boom
3 - Roller Shaft
4 - Boom Roller (4)
5 - Pin, Front Roller (2)
6 - Pin, Carriage
7 - Pin, Carriage Tilt Cylinder
8 - Pin, Hoist Cylinder (2)
9 - Bushing (2)
10 - Bushing (2)
11 - Bushing (2)
12 - Bushing (4)
13- Slide Plate, Rear (2)
14 - Slide Plate, Front
15 - Shim, .06" (A/R)
16 - Shim, .12" (A/R)
17 - Shim, .12" (A/R)
18 - Shim, .06" (A/R)
19 - Base, Slide Plate
20 - Spacer Washer (A/R)
21 - Screw, Fl. Hd. Soc. (4)
22 - Screw, Fl. Hd. Soc. (2)
23 - Screw, Brass (12)
24 - Eccentric Bearing Mount (2)
25 - Snap Ring (2)
26 - Bearing (2)
27 - Snap Ring (2)
28 - Snap Ring (2)
29 - Snap Ring (4)
30 - Hose Reel
31 - Hose Reel, Auxiliary
32 - Hose Reel Housing
33 - Shaft, Rear Roller (2)
34 - Shaft, Sheave Mount (3)
35 - Sheave (3)
36 - Roller, Rear (2)
37 - Roller, Front (4)
38 - Slide Plate, Upper (2)
39 - Slide Plate, Lower (2)
40 - Front Support Bracket
41 - Bolt, 3/8" x 3/4"
42 - Bolt, 3/8" x 3" (2)
43 - Bolt, 3/8" x 3 1/2"
44 - Bolt, 3/8" x 5"
45 - Bolt, 5/8" x 2 1/2" (8)
46 - Bolt, 5/8" x 4 1/2" (16)
47 - Flatwasher, 5/8" (4)
48 - Starwasher, 1/2" (3)
49 - Lockwasher, 3/8" (5)
50 - Lockwasher, 5/8" (24)
51 - Nut, 3/8" (3)
52 - Nut, 5/8" (24)
53 - Setscrew, 1/2" x 1 1/4
54 - Cotter Pin, 1/8" x 1" (2)
55 - Cotter Pin, 1/4" x 1 3/4" (3)
56 - Flatwasher, 5/8" (16)
57 - Screw, Fl. Hd. Soc. (2)
58 - Bolt, 1/2" x 3/4" (3)

Table 4-2 List of Material for Figure 4-14

BOOM AND FORK CARRIAGE

CARRIAGE TILT CYLINDER (ALL MODELS)

DESCRIPTION

The carriage tilt cylinder is located in the nose cone of the boom. The cylinder has one pivot end connected to the boom and the other pivot end connected to the carriage mount.

The carriage tilt cylinder tilts the fork carriage forward or rearward depending on the operator's manipulation of the manually operated carriage tilt control lever located in the operator's cab.

Once the fork carriage is leveled or tilted, that tilted or leveled carriage attitude will be maintained throughout the raising or lowering of the boom (this capability is called automatic fork leveling). Automatic fork leveling is accomplished by a fork leveling valve (see page 4.6-1)

MAINTENANCE

Maintenance of the carriage tilt cylinder requires periodic greasing of the cylinder pivot ends (refer to the "Service Schedules" in Section 2) and periodic inspection of cylinder condition (refer to "Checking Cylinder Condition" on page 3.19-1 in Section 3).

REMOVAL OF TILT CYLINDER

1. Lower the boom, apply the parking brake and stop the engine.

2. Remove fork carriage.

3. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

4. Tag and disconnect two hydraulic hoses from the cylinder and cap the openings.

5. Support the cylinder (approximate weight 140 lbs).

6. Remove cylinder top pivot pin.

7. Remove cylinder.

CAUTION: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder until the counterbalance valves are carefully removed. Stored pressure may exceed 250 psi. Wear eye protection when removing counterbalance valves.

INSTALLATION OF TILT CYLINDER

1. Reverse steps 3 through 7 above

NOTE: Refer to "Hydraulic Fitting Torque Specifications" table in Section 1 for tightening hydraulic line fittings.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

TILT CYLINDER OVERHAUL

For cylinder overhaul procedures, refer to "Cylinder Overhaul" on page 3.19-1 in Section 3.

BOOM AND FORK CARRIAGE

FORK LEVELING VALVE (ALL MODELS)

FORK LEVELING VALVE

Refer to page 3.53-1 in Section 3 for information regarding operation and servicing of the fork leveling valve.

FRAME TILT & OSCILLATION

INDEX

LIST OF FIGURES

FRAME TILT & OSCILLATION

DESCRIPTION

The frame tilt feature on Lull forklifts permits the operator to control the levelness of the machine when traveling on, or when stationed on, an uneven or sloped surface. To accomplish this, the front and rear axles pivot independently about the longitudinal center-line of the forklift. The front axle pivot is controlled by a hydraulic cylinder; the rear axle pivots freely.

A level indicator, located on the instrument panel of the cab, allows the operator to monitor machine levelness. A hydraulic control valve (see "Three-Spool Valve" on page 3.40-1 in Section 3), located with its control lever to the right of the operator, allows the operator to manually control the extent of frame tilt, to the right or left.

The frame tilt (Figures 5-1 and 5-2) is comprised of a hydraulic cylinder (item 1) which is attached at the top by a pivot pin (item 2) to a support (item 3) on the main frame (item 4) and which is attached at the bottom by a pivot pin (item 5) to the oscillation frame (item 6).

There is one oscillation frame only, located at the front of the machine, to which the front axle is bolted. The oscillation frame pivots about the main frame on two in-line pivot pins (items 7).

NOTE: The rear axle is not mounted to a separate oscillation frame but is instead attached to a pivot pin which pivots within the main frame (see "Axles", Section 6).

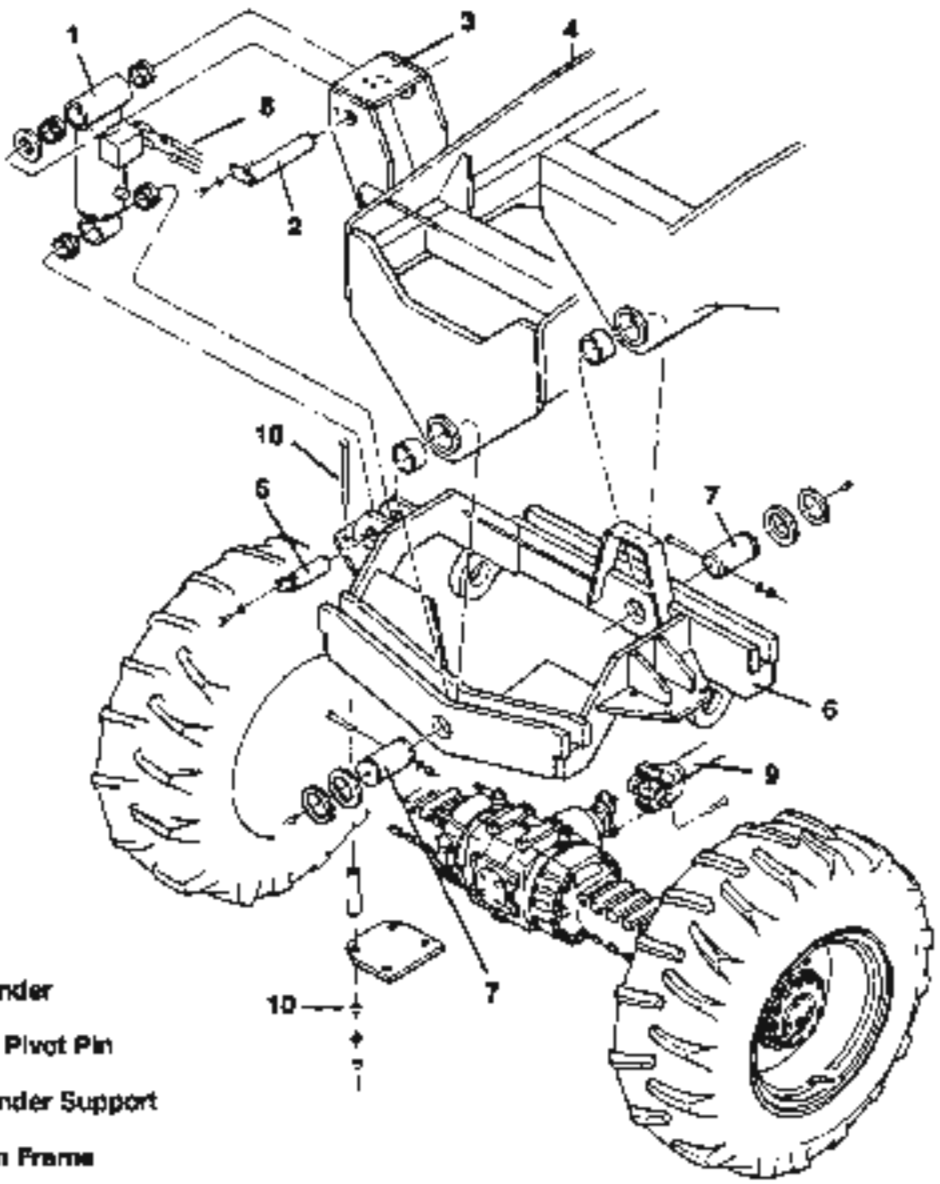
MAINTENANCE

Maintenance of the frame tilt and oscillation involves periodic greasing of the pivots for the hydraulic cylinder and the oscillation frame (refer to the Service Schedules in Section 2).

TROUBLESHOOTING

For troubleshooting refer to pages 3.12-1 through 3.12-3 "System Troubleshooting" under "Hydraulic System" in Section 3.

FRAME TILT & OSCILLATION



1 - Cylinder
2 - Top Pivot Pin
3 - Cylinder Support
4 - Main Frame
5 - Lower Pivot Pin
6 - Oscillation Frame
7 - Oscillation Frame Pivot Pins
8 - Hydraulic Hoses (2)
9 - Drive Shaft
10 - Oscillation Frame to Axle Mtg. Hardware

Figure 5-1 Frame Tilt & Oscillation - Front Axle (Model 522)

FRAME TILT & OSCILLATION

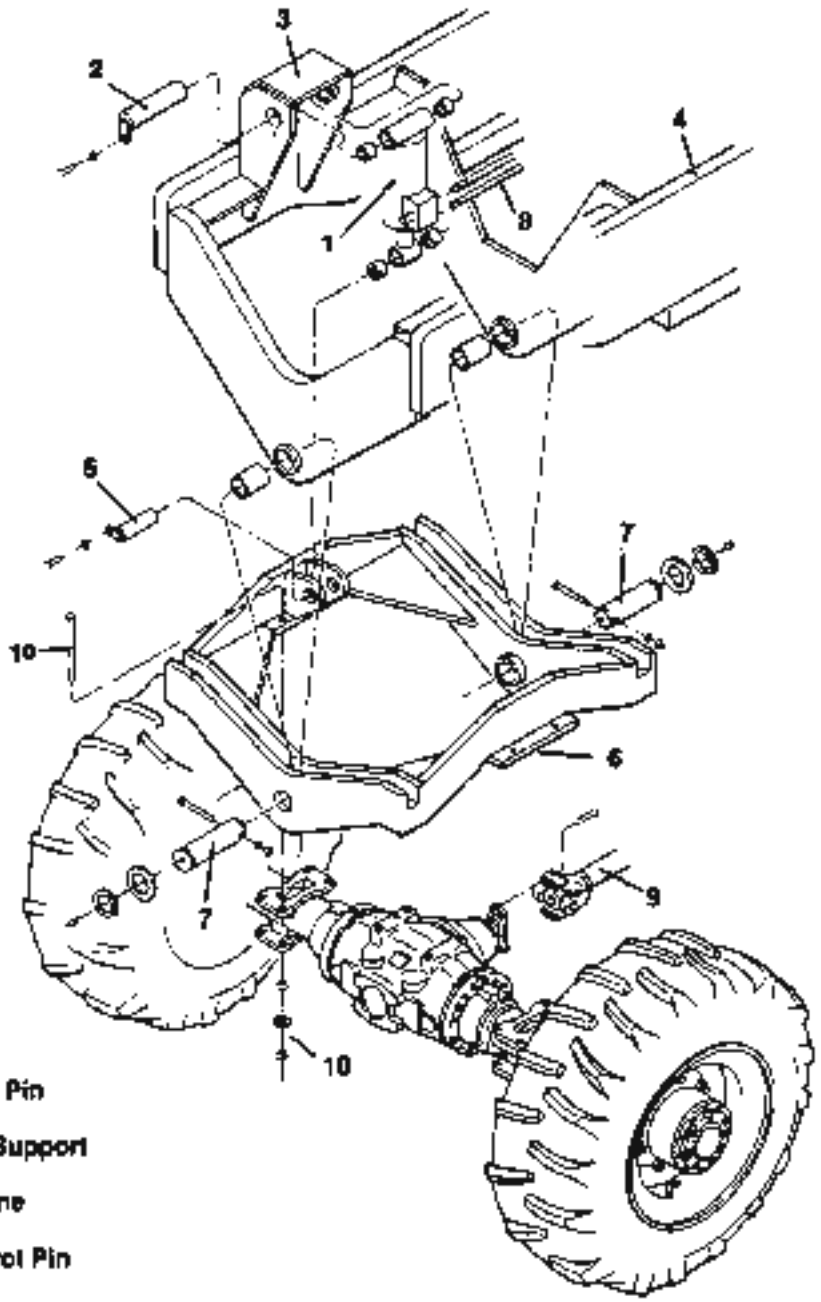


Figure 5-2 Frame Tilt & Oscillation - Front Axle (Models 622, 622/4, 624)

FRAME TILT & OSCILLATION

REMOVAL OF FRAME TILT CYLINDER

1. Models 522, 522/4: Lower the boom to the ground. Models 622, 622/4, 824: Lower the boom to within approx. three feet of the ground, resting the nose of the boom upon a substantial support.

2. Apply the parking brake and stop the engine.

3. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

4. Block both sides of the main frame against the oscillation frame (Figure 5-3).

5. Remove two hydraulic hoses (Figures 5-1 & 5-2, Item 8) and cap.

6. Remove the bottom pin (Item 5) and, while supporting the cylinder (Item 1) (approx. weight 100 LBS), remove the top pin (Item 2).

7. Remove the Cylinder.

CAUTION: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder until the counterbalance valves are carefully removed. Wear eye protection when removing counterbalance valves.

INSTALLATION OF FRAME TILT CYLINDER

1. Reverse steps 4 through 7 above.

NOTE: Refer to "Torque Specifications for Hydraulic Line Connections" in Section 1.

2. Start the engine and check for leaks

WARNING: Hydraulic fluid under pressure can penetrate the skin or damage eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks but do not use bare hand. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Cycle the frame tilt cylinder full right and hold for 15 seconds; cycle the cylinder full left and hold for 15 seconds. Repeat. This procedure will remove air from the circuit.

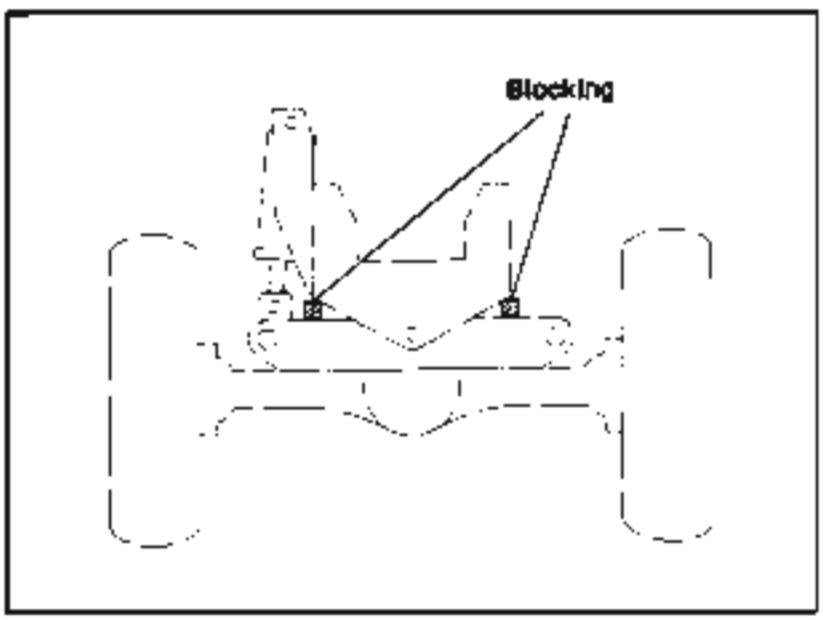


Figure 5-3 Blocking the Main Frame

FRAME TILT & OSCILLATION

REMOVAL OF FRONT OSCILLATION FRAME

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface. Lower the boom to the ground, lower the outriggers (if so equipped), apply the parking brake, and stop the engine. Block the rear tires.

3. Remove outriggers (if so equipped). (Refer to "Outriggers" under "Attachments" in Section 12.)

4. Detach the brake line and diff. lock hydraulic hoses and cap the openings (Figures 5-4 and 5-5, Item 1).

5. Remove parking brake bracket and linkage (522, 522/4)

6. Position two 5 ton hydraulic jacks under the front axle at the mounting pads. Raise the machine until weight is off the front tires. Carefully support the machine using 5 ton stands, or with timbers, positioned under both sides of the main frame just behind the oscillation frame.

7. Remove tires from the axle - approx. weight each:
14.00 x 24 - 820 lbs. (622B, 824B)
16.90 x 24 - 960 lbs. (522, 522/4)
16.00 x 24 - 1350 lbs. (824)
21L x 24 - 1550 lbs. (622, 622/4)

8. Disconnect the drive shaft (Figures 5-1 and 5-2, Item 9) from the axle.

9. Remove the tilt cylinder bottom pin (Item 5).

10. Remove the oscillation pivot pins (Items 7).

11. Lower the axle until the oscillation frame (Item 6) clears the main frame (Item 4).

12. Remove bolts, nuts and lockwashers (Items 10) attaching the oscillation frame to the axle.

13. Remove the oscillation frame.

INSTALLATION OF FRONT OSCILLATION FRAME

1. Reverse steps 3 through 13 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

Torque wheel lug nuts to 240 FT/LBS. (522, 522/4)
Torque wheel lug nuts to 450 FT/LBS. (622, 622/4, 824)

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Bleed the brakes (see "Bleeding Procedure" under "Service Brakes" in Section 10).

4. Cycle the frame tilt, diff. lock, and outrigger cylinders fully in one direction and hold for 15 seconds; cycle fully in the opposite direction and hold for 15 seconds. Repeat. This procedure will remove air from the circuits.

FRAME TILT & OSCILLATION

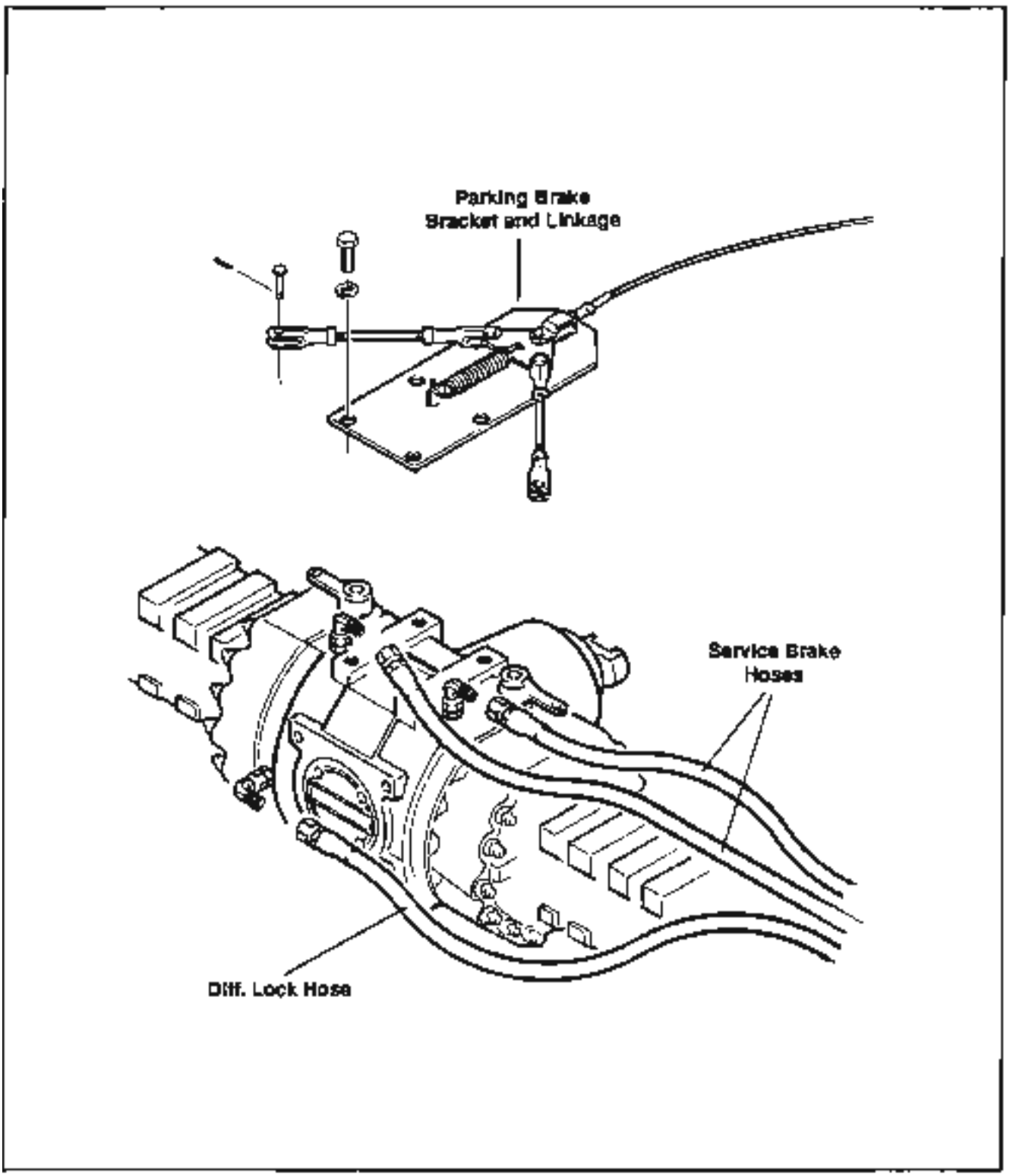


Figure 5-4 Hydraulic Hose and Parking Brake Assembly - Front Axle (Model 522, 522/4)

FRAME TILT & OSCILLATION

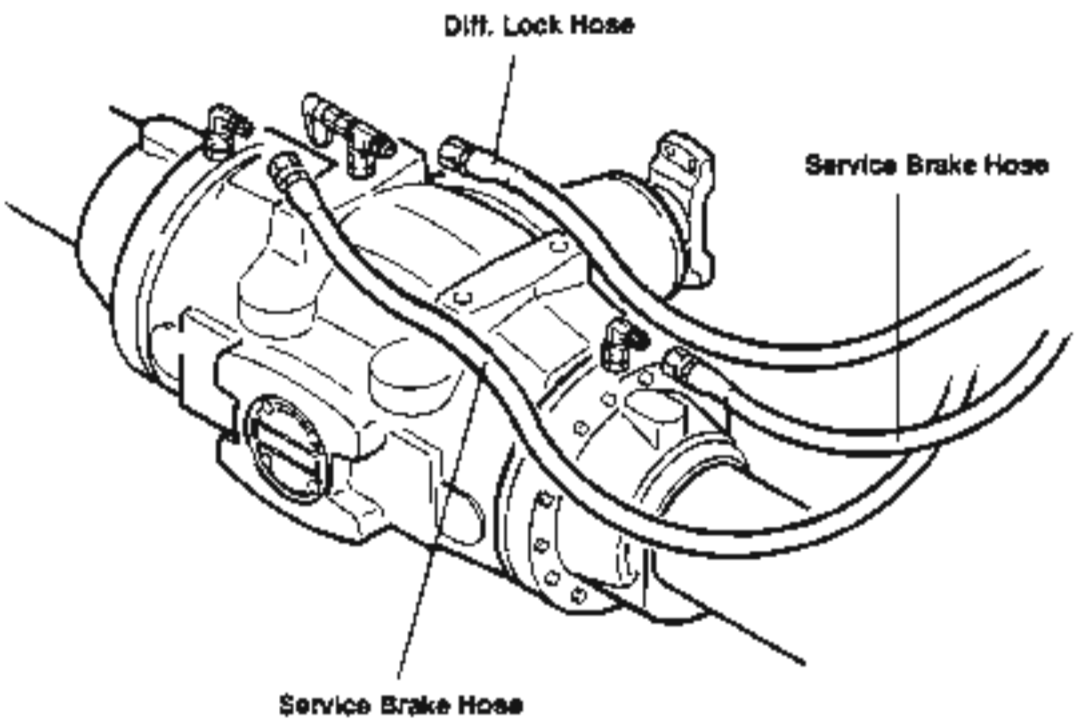


Figure 5-5 Hydraulic Hose Assembly - Front Axle (Models 622, 622/4, 624)

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DRIVE AXLE (MODELS 522, 522/4)

DESCRIPTION

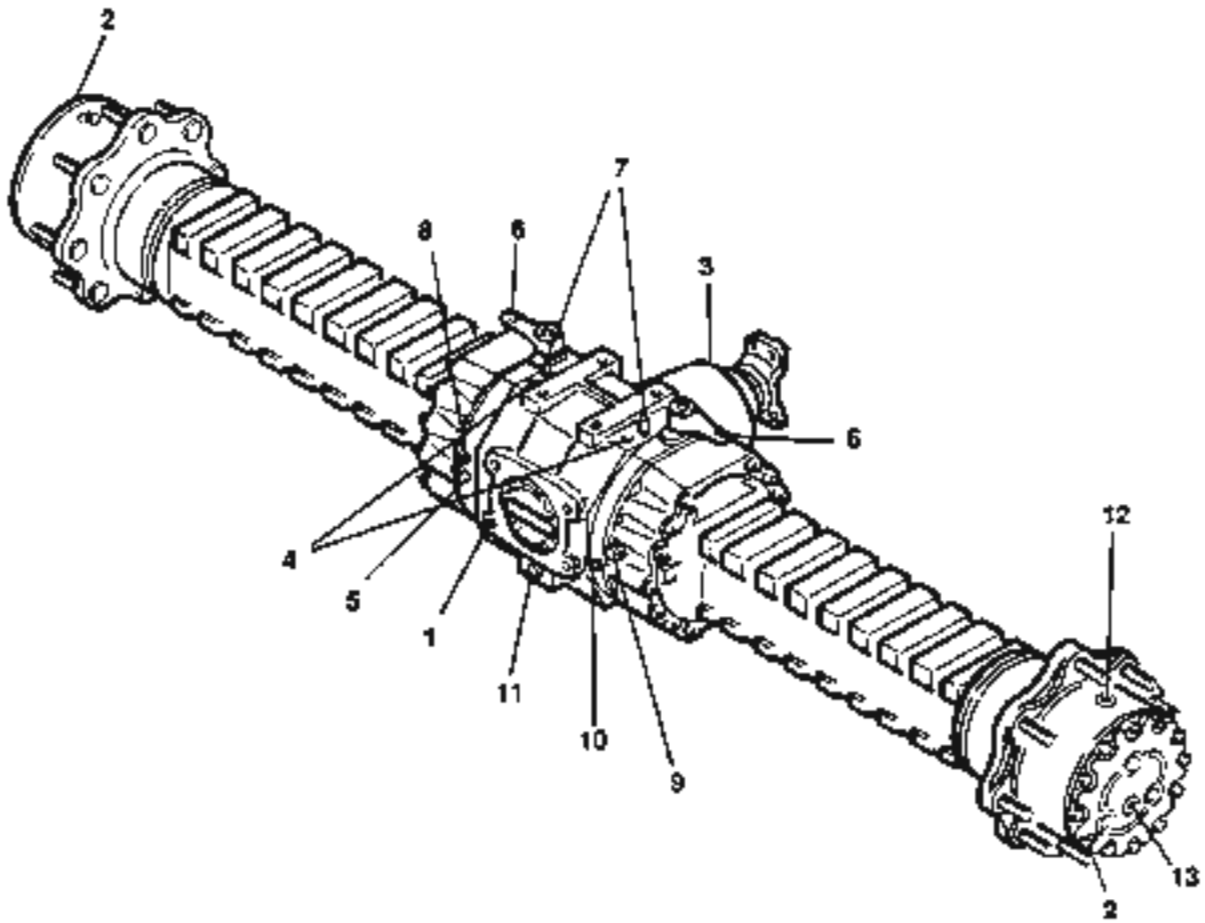
The Drive Axle on the Model 522 and 522/4 is a Hurth Model 172 which is an off-highway type - featuring planetary drive hubs, internal wet disc brakes (manually operated parking, hydraulically operated - service), and "on-demand" differential lock. The axle is mounted directly to the oscillation frame. This allows the axle to pivot about the longitudinal center line of the forklift to the extent to which the operator-controlled frame tilt is tilted (see "Frame Tilt and Oscillation" in Section 5).

MAINTENANCE

Maintenance of the drive axle requires scheduled checking of differential and planetary hubs for correct fluid levels, and scheduled changing of fluids. (Refer to the Service Schedules in Section 2 for recommended lubricants and service intervals.)

AXLES

DRIVE AXLE (MODELS 522, 522/4)



1 - Differential
2 - Planetary Gear Hub
3 - Pinion Support
4 - Service Brake Ports
5 - Differential Lock Port
6 - Parking Brake Lever
7 - Brake Bleeder Screws
8 - Diff. Lock Bleeder Screw
9 - Differential Fill
10 - Differential Level
11 - Differential Drain
12 - Planetary Hub Drain
13 - Planetary Hub Fill & Level

Figure 6-1 Hurth Model 172 Axle

AXLES

DRIVE AXLE (MODELS 522, 522/4)

TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	CORRECTION
Noise on Drive	1. Excessive pinion to ring gear backlash.	1. Adjust
	2. Worn pinion and ring gear.	2. Replace
	3. Worn pinion bearings.	3. Replace
	4. Loose pinion bearings.	4. Adjust
	5. Excessive pinion end play.	5. Adjust
	6. Worn differential bearings.	6. Replace
	7. Loose differential bearings.	7. Adjust
	8. Excessive ring gear run-out.	8. Replace
	9. Low lubricant level.	9. Replenish
	10. Wrong or poor grade lubricant.	10. Replace
	11. Bent axle housing.	11. Replace
Noise on Coast	1. Axle noises heard on drive will usually be heard on coast, although not as loud.	1. Adjust or replace (See above)
	2. Pinion and ring gear too tight (audible when decelerating and disappears when driving).	2. Adjust
Intermittent Noise	1. Warped ring gear.	1. Replace
	2. Loose differential case bolts.	2. Tighten
Constant Noise	1. Flat spot on pinion or ring gear teeth.	1. Replace
	2. Flat spot on bearings.	2. Replace
	3. Worn pinion splines.	3. Replace
	4. Worn axle shaft dowel holes.	4. Replace
	5. Worn hub studs.	5. Replace
	6. Bent axle shaft.	6. Replace
Noisy on Turns	1. Worn differential side gears and pinions.	1. Replace
	2. Worn differential spider.	2. Replace
	3. Worn differential thrust washers.	3. Replace
	4. Worn axle shaft splines.	4. Replace

AXLES

DRIVE AXLE (MODELS 522, 522/4)

REMOVAL (Figure 6-2)

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface. Lower the boom to the ground and stop the engine. Block tires on the rear axle.

3. Position two 5 ton hydraulic jacks under the mounting pads (Item 7) of the axle. Raise the machine until tires clear the floor. Carefully support the machine using 5 ton stands, or with timbers, positioned under both sides of the main frame (Item 1) just behind the oscillation frame (Item 2).

4. Detach parking brake linkage and mounting plate assembly (Item 3).

5. Detach the differential lock hydraulic hose and the brake line hoses (Items 4) and cap the openings.

6. Disconnect the drive shaft (Item 5) from the axle.

7. Remove tires from the axle. (Weight approx. 950 LBS each).

8. Remove (8) bolts, nuts, lockwashers, and spacers (Items 6) attaching the axle to the oscillation frame.

9. Lower and remove the axle from the machine.

INSTALLATION

1. Reverse steps 3 through 9 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1. Torque wheel lug nuts to 240 Ft/LBS.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Bleed the brakes (see "Bleeding Procedure" under "Service Brakes" in Section 10).

4. Bleed the diff. lock line (See "Bleeding Procedure" under "Differential Lock Valve" in Section 3.)

OVERHAUL

Axle overhaul procedures are detailed in the Axle Maintenance And Repair Manual available from the axle manufacturer or the Lull Corporation

AXLES

DRIVE AXLE (MODELS 522, 522/4)

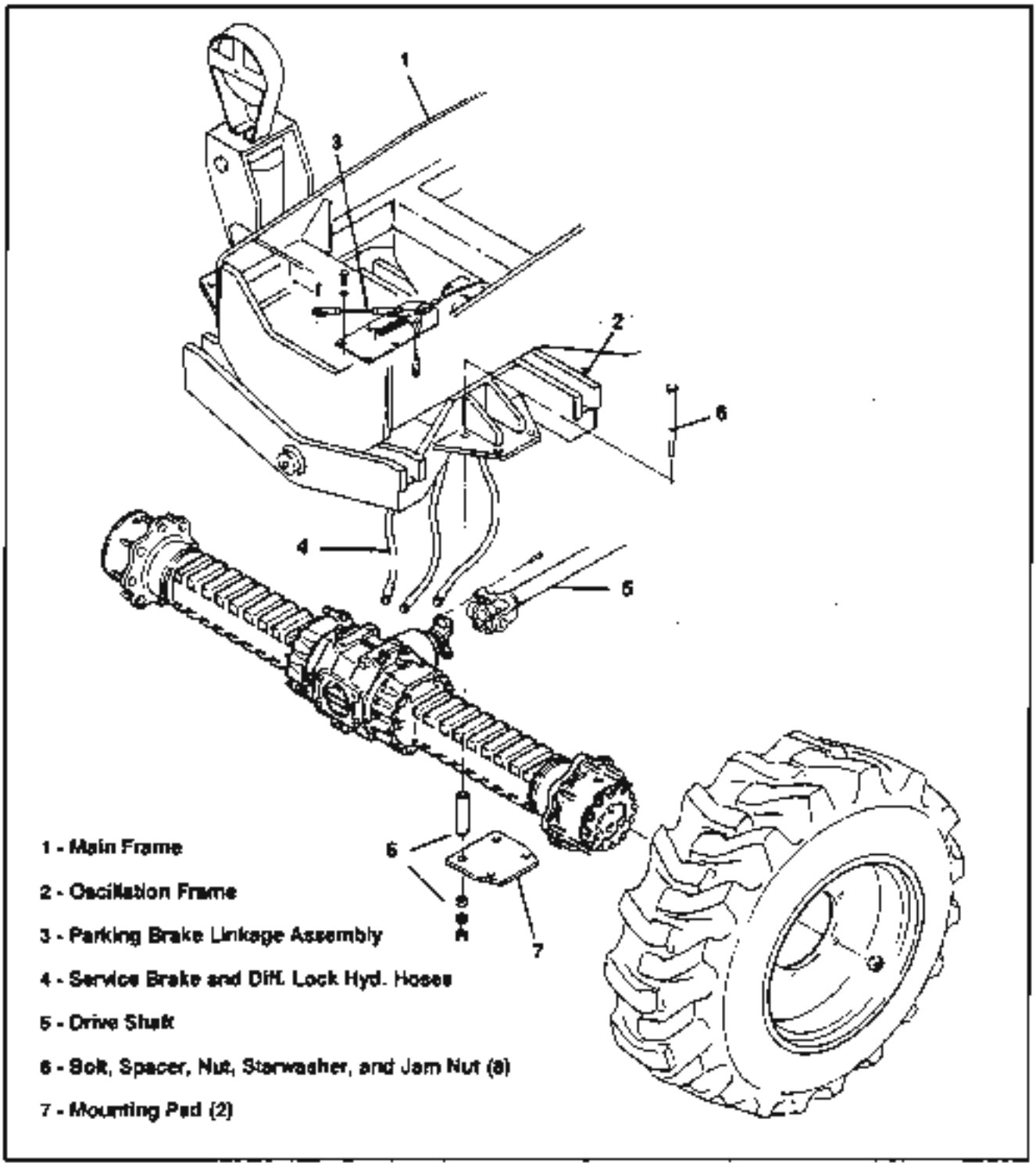


Figure 6-2 Front Axle Removal/Installation

AXLES

DRIVE AXLE (MODELS 622, 622/4, 824)

DESCRIPTION (Figure 6-3)

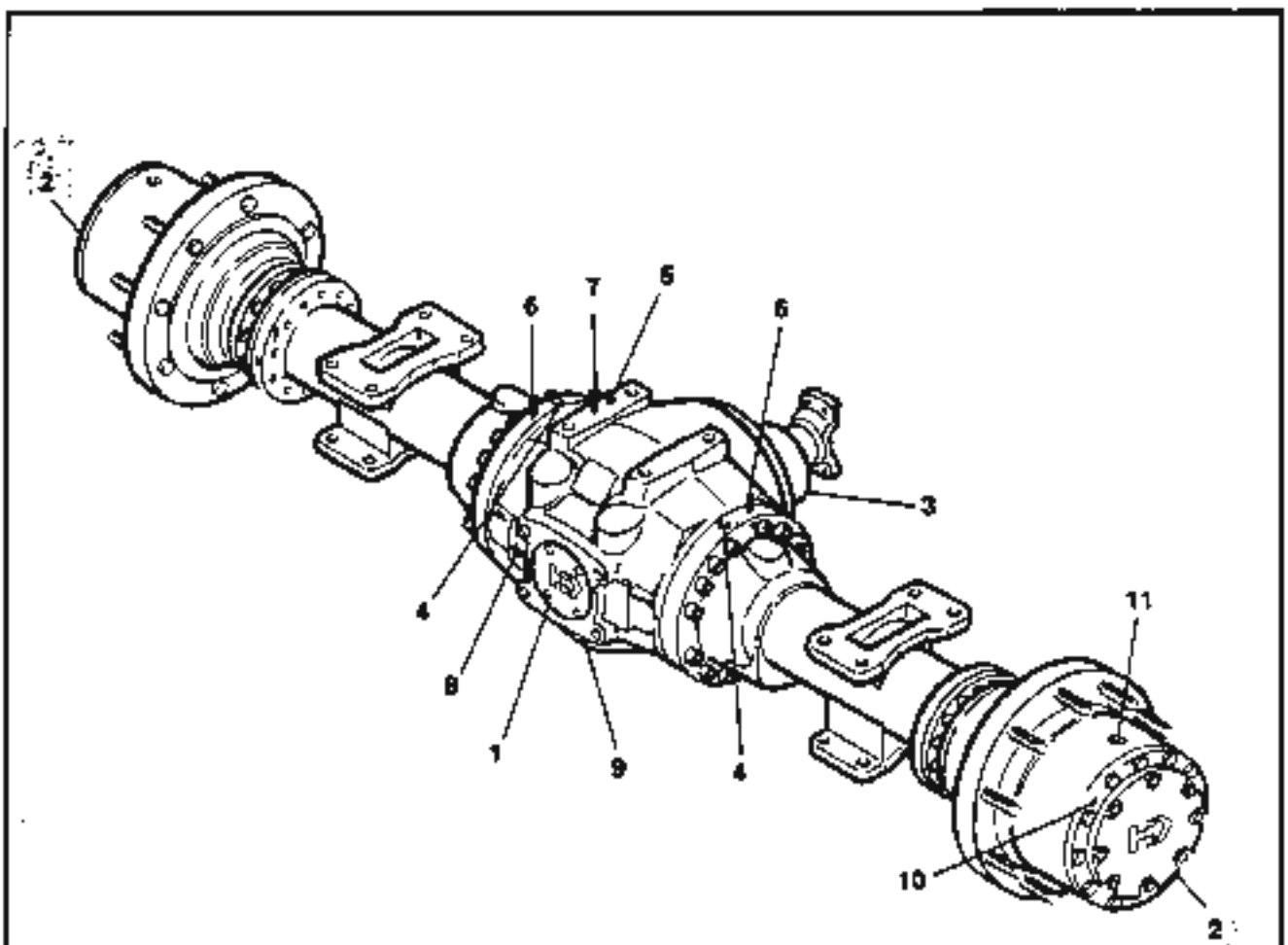
The Drive Axle on the Models 622, 622/4, and 824 forklifts is a Hurth Model 174 which is an Off-Highway type featuring planetary drive hubs, internal wet disc service brakes, and "on-demand" differential lock. The axle is mounted directly to the oscillation frame. This allows the axle to pivot about the longitudinal center line of the forklift to the extent to which the operator-controlled frame tilt is tilted (see "Frame Tilt and Oscillation" in Section 5).

MAINTENANCE

Maintenance of the axle requires scheduled checking of differential and planetary hubs for correct fluid levels and scheduled changing of fluids. (Refer to the Service Schedules in Section 2 for recommended lubricants and service intervals.)

AXLES

DRIVE AXLE (MODELS 622, 622/4, 624)



1 - Differential

2 - Planetary Gear Hub

3 - Pinion Support

4 - Service Brake Port

5 - Differential Lock Port

6 - Brake Bleeder Screw

7 - Diff. Lock Bleeder Screw

8 - Differential Fill & Level

9 - Differential Drain

10 - Planetary Hub Fill & Level

11 - Planetary Hub Drain

Figure 6-3 Hurth Model 174 Axle

AXLES

DRIVE AXLE (MODELS 622, 622/4, 624)

TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	CORRECTION
Noise on Drive	1. Excessive pinion to ring gear backlash.	1. Adjust
	2. Worn pinion and ring gear.	2. Replace
	3. Worn pinion bearings.	3. Replace
	4. Loose pinion bearings.	4. Adjust
	5. Excessive pinion end play.	5. Adjust
	6. Worn differential bearings.	6. Replace
	7. Loose differential bearings.	7. Adjust
	8. Excessive ring gear run-out.	8. Replace
	9. Low lubricant level.	9. Replenish
	10. Wrong or poor grade lubricant.	10. Replace
	11. Bent axle housing.	11. Replace
Noise on Coast	1. Axle noises heard on drive will usually be heard on coast, although not as loud.	1. Adjust or replace (See above)
	2. Pinion and ring gear too light (audible when decelerating and disappears when driving).	2. Adjust
Intermittent Noise	1. Warped ring gear.	1. Replace
	2. Loose differential case bolts.	2. Tighten
Constant Noise	1. Flat spot on pinion or ring gear teeth.	1. Replace
	2. Flat spot on bearings.	2. Replace
	3. Worn pinion splines.	3. Replace
	4. Worn axle shaft dowel holes.	4. Replace
	5. Worn hub studs.	5. Replace
	6. Bent axle shaft.	6. Replace
Noisy on Turns	1. Worn differential side gears and pinions.	1. Replace
	2. Worn differential spider.	2. Replace
	3. Worn differential thrust washers.	3. Replace
	4. Worn axle shaft splines.	4. Replace

AXLES

DRIVE AXLE (MODELS 622, 622/4, 624)

REMOVAL (Figure 6-4)

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface. Lower the boom to the ground and stop the engine. Block tires on the rear axle.

3. Position two 5 ton hydraulic jacks under the mounting pads (item 6) of the axle. Raise the machine until weight is off the tires. Carefully support the machine using 5 ton stands, or with timbers, positioned under both sides of the main frame (item 1) just behind the oscillation frame (item 2).

4. Detach the differential lock hydraulic hose and the brake line hoses (items 3) and cap the openings.

5. Disconnect the drive shaft (item 4) from the axle.

6. Remove tires from the axle. (Weight approx. 800 LBS each 14.00 x 24; 1340 LBS each - 16.00 x 24; 1530 LBS each - 21L x 24).

7. Remove (8) bolts, nuts, lockwashers, and spacers (items 5) attaching the axle to the oscillation frame.

8. Lower and remove the axle from the machine.

INSTALLATION

1. Reverse steps 3 through 8 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1. Torque wheel lug nuts to 450 Ft/LBS.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Bleed the brakes (see "Bleeding Procedure" under "Service Brakes" in Section 10).

4. Bleed the diff. lock line. (See "Bleeding Procedure" under "Differential Lock Valve" in Section 3.)

OVERHAUL

Axle overhaul procedures are detailed in the Axle Maintenance And Repair Manual available from the axle manufacturer or the Lull Corporation.

AXLES

DRIVE AXLE (MODELS 622, 622/4, 824)

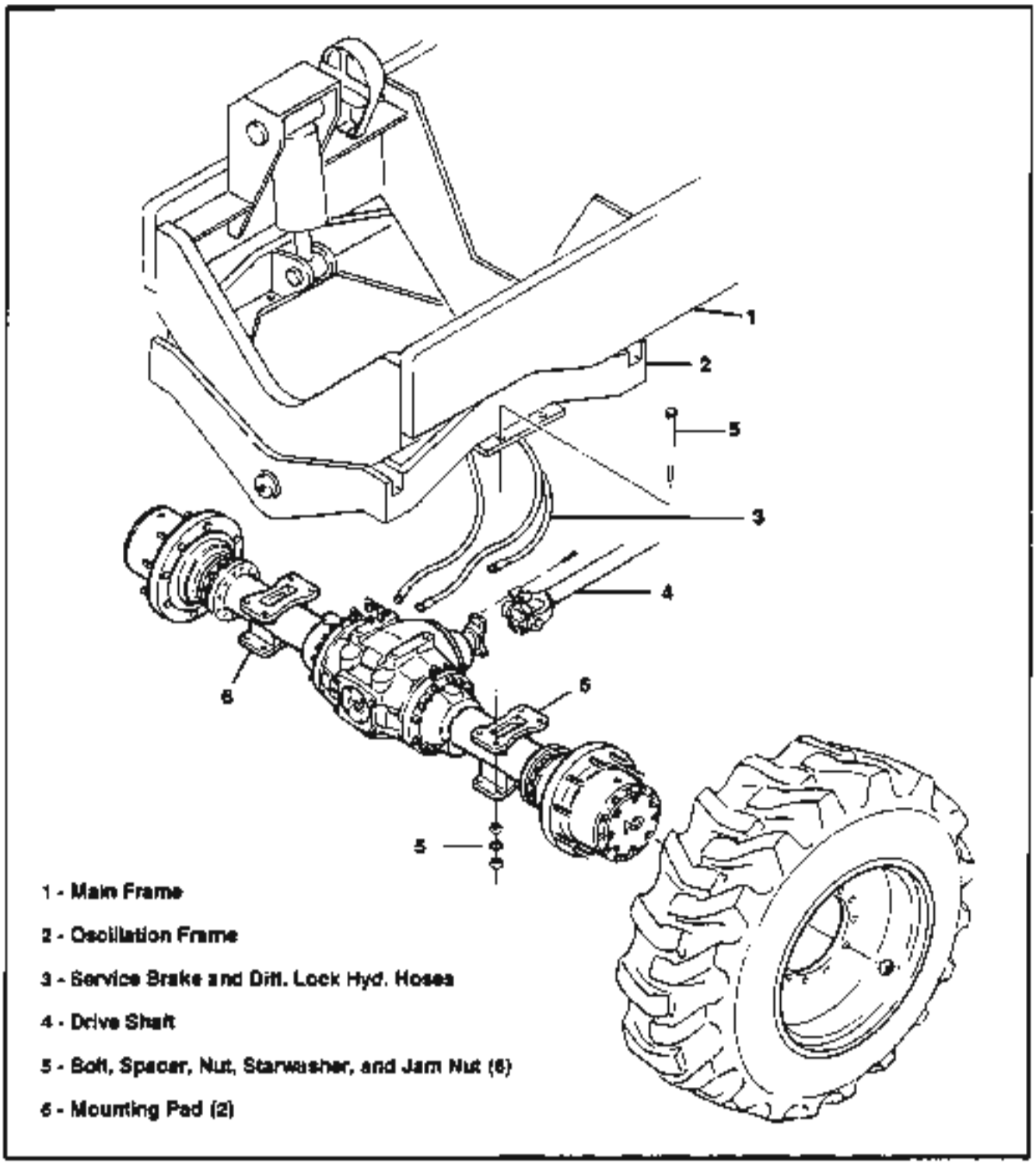


Figure 6-4 Front Axle Removal/Installation

AXLES

STEER AXLE (MODELS 522 AND 622)

DESCRIPTION (Figure 6-5 & 6-6)

The rear axle on Model 522 and 622 forklifts is a non-powered, non-braking axle which provides steering for the machine. The axle is mounted to the forklift by a pivot pin which passes through the axle at its center and extends through axle mounts which are part of the main frame. The axle can thus pivot about the longitudinal center line of the forklift, as required, when negotiating uneven surfaces.

MAINTENANCE

Maintenance of the axle requires scheduled greasing of spindle pivots, steer cylinder pivots, tie rod pivots, axle pivot, and hubs (see Service Schedules and Lubrication Instructions in Section 2).

Routinely inspect cylinder pivot ends, tie rod ends and spindles for wear, evidenced by excessive play. Replace worn parts as required.

REMOVAL

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface. Lower the boom, apply the parking brake and stop the engine. Block tires on the front axle.

3. Detach the hydraulic hoses from the steer cylinders and cap openings.

4. Position two 5 ton hydraulic floor jacks under the rear main frame. Raise the machine until the tires clear the floor. Carefully support the machine using 5 ton stands, or with timbers, positioned under both sides of the main frame.

5. Remove tires from the axle. (Approx. weight 350 LBS each - Model 522; 520 LBS each - Model 622.)

6. With two floor jacks supporting the axle, remove the axle pivot pin.

7. Lower and remove the axle from the machine.

INSTALLATION

1. Reverse steps 3 through 7 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1. Torque wheel lug nuts to 180 - 200 Ft/LBS.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Cycle the steering cylinders fully in one direction and hold for 15 seconds; cycle fully in the opposite direction and hold for 15 seconds. Repeat. This procedure will remove air from the steering circuit.

AXLES

STEER AXLE (MODELS 522 AND 622)

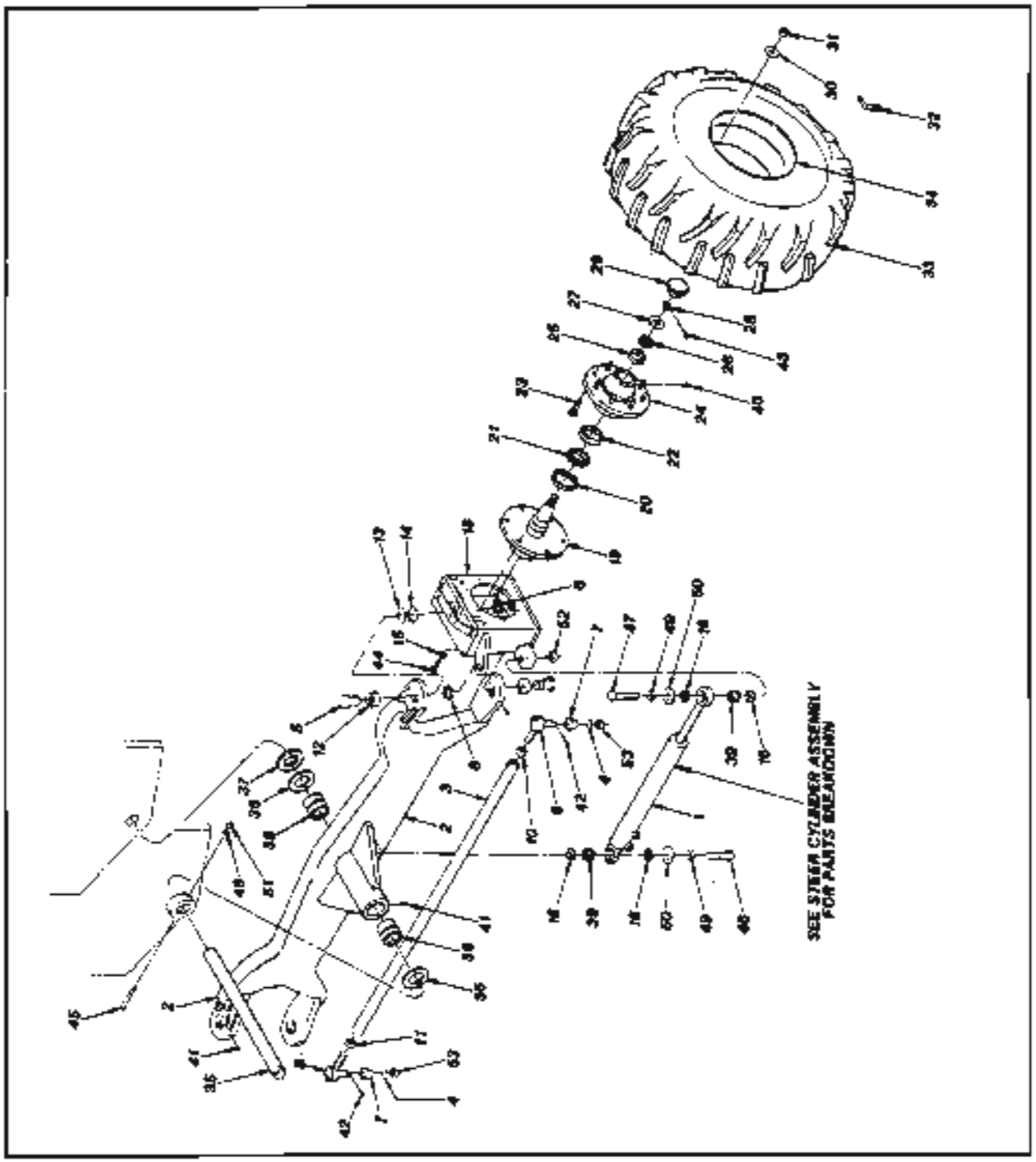


Figure 6-5 Steer Axle (Model 522)

AXLES

STEER AXLE (MODELS 522 AND 622)

1 - Steer Cylinder (2)
2 - Steer Axle
3 - Tie Rod
4 - Washer (2)
5 - Pivot Pin (4)
6 - Jam Nut (4)
7 - Rubber Seal (2)
8 - Tie Rod End (L.H. Thread)
9 - Tie Rod End (R.H. Thread)
10 - Jam Nut (L.H. Thread)
11 - Jam Nut (R.H. Thread)
12 - Spherical Bearing (4)
13 - Thrust Washer (2)
14 - Thrust Washer (2)
15 - Machinery Bushing (12)
16 - Spacer (8)
17* - Spindle Housing (R.H.)
18 - Spindle Housing (L.H.)
19 - Spindle (2)
20 - Oil Seal (2)
21 - Inner Bearing (2)
22 - Inner Cup (2)
23 - Wheel Lug Bolt (16)
24 - Wheel Hub (2)
25 - Outer Cup (2)
26 - Outer Bearing (2)
27 - Bearing Washer (2)
28 - Hub Retainer Nut (2)
29 - Wheel Hub Cap (2)
30 - Lug Nut Washer (16)
31 - Lug Nut (16)
32 - Valve Stem (2)
33 - Tire
34 - Wheel Rim
35 - Pivot Pin
36 - Shim, 3/16" (2)
37 - Shim, 14 GA. (A/R)
38 - Axle Pivot Bushing (2)
39 - Self - Align Bushing (4)
40 - Grease Fitting (2)
41 - Grease Fitting (6)
42 - Cotter Pin, 1/8" x 1 1/2" (2)
43 - Cotter Pin, 3/16" x 2 1/2" (2)
44 - Bolt, 5/8"-11 x 1 1/2" (12)
45 - Bolt, 5/8"-18 x 6"
46 - Bolt, 1"-14 x 3 1/4" (2)
47 - Bolt, 1"-14 x 4" (2)
48 - Lockwasher, 5/8"
49 - Lockwasher, 1" (4)
50 - Flatwasher, 1" (4)
51 - Nut, 5/8"-18
52 - Jam Nut, 1"-14 (2)
53 - Castle Nut, 5/8"-18 (2)

* Not Shown

Table 6-1 Material List for Figure 6-5

AXLES

STEER AXLE (MODELS 522 AND 622)

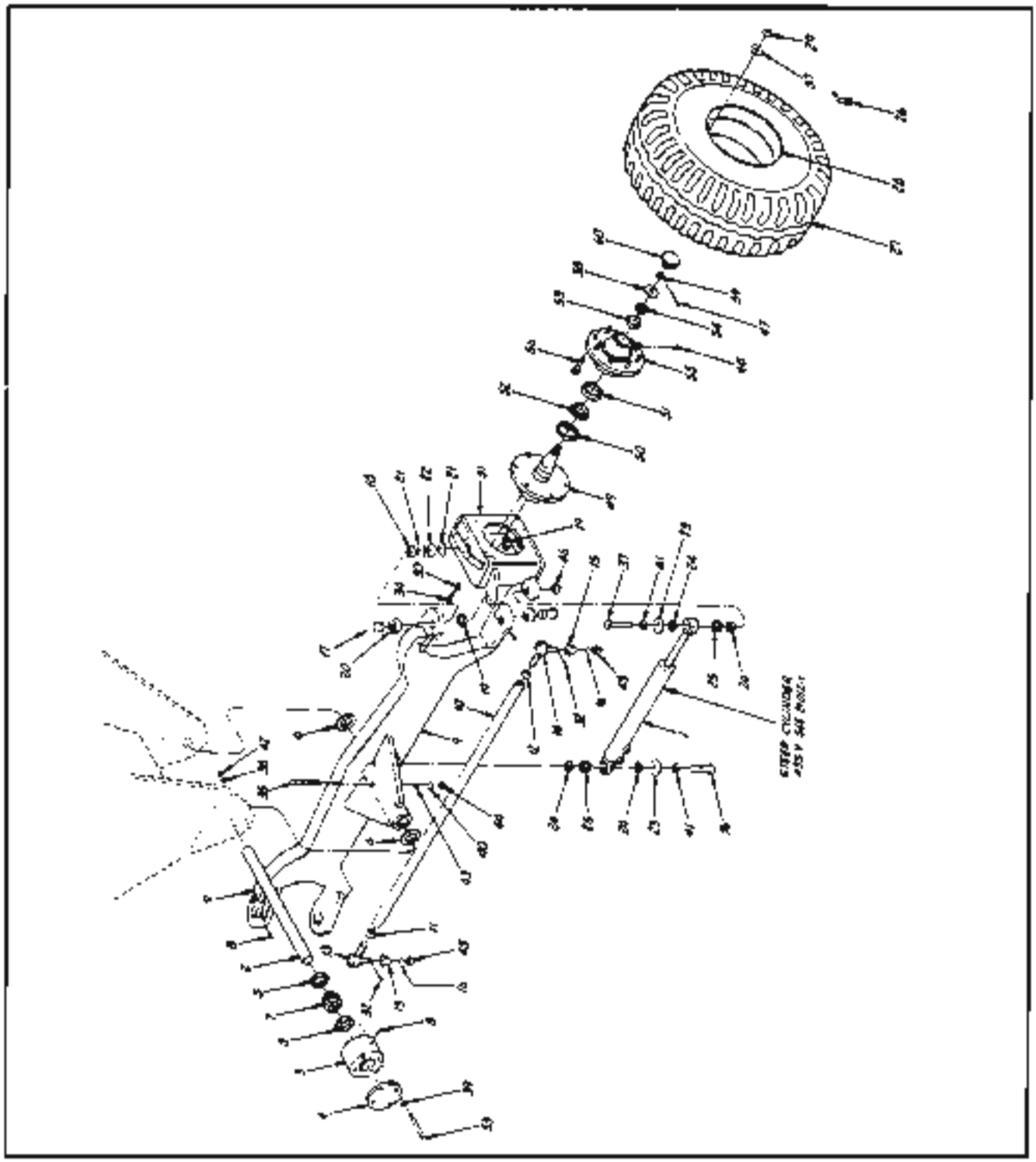


Figure 6-6 Steer Axle (Model 622)

AXLES

STEER AXLE (MODELS 522 AND 622)

1 - Steer Cylinder (2)
2 - Pivot Pin
3 - Bearing Housing (2)
4 - Bearing Cover (2)
5 - Bearing Spacer (4)
6 - Shim (2)
7 - Self - Align Bearing (4)
8 - Grease Fitting (6)
9 - Steer Axle
10 - Tie Rod
11 - Jam Nut (R.H. Thread)
12 - Jam Nut (L.H. Thread)
13 - Tie Rod End (R.H. Thread)
14 - Tie Rod End (L.H. Thread)
15 - Rubber Seal (2)
16 - Washer (2)
17 - Pivot Pin (4)
18 - Spacer (2)
19 - Pivot Pin Jam Nut (4)
20 - Spherical Bearing (4)
21 - Thrust Washer (2)
22 - Thrust Washer (2)
23 - 1" Flat Washer (4)
24 - Spacer (8)
25 - Self - Align Bushing (4)
26 - Valve Stem (2)
27 - Tire
28 - Wheel Rim
29 - Lug Nut (16)
30 - Bushing (12)
31 - Spindle Housing (L.H.)
* - Spindle Housing (R.H.)
32 - Cotter Pin, 1/8" x 1 1/2" (2)
33 - Bolt, 1/2"-13 x 5 1/4" (8)
34 - Bolt, 5/8"-11 x 1 1/2" (12)
35 - Bolt, 5/8"-18 x 5"
36 - Bolt, 1"-14 x 3 1/4" (2)
37 - Bolt, 1"-14 x 4" (2)
38 - Lockwasher, 1/2" (8)
39 - Flatwasher, 1/2" (8)
40 - Starwasher, 5/8"
41 - Lockwasher, 1" (4)
42 - Nut, 1/2"-13 (8)
43 - Nut, 5/8"-18
44 - Jam Nut, 5/8"-18
45 - Castle Nut, 5/8"-18 (2)
46 - Jam Nut, 1"-14 (2)
47 - Cotter Pin, 3/16" x 2 1/2" (2)
48 - Grease Fitting (2)
49 - Spindle (2)
50 - Oil Seal (2)
51 - Inner Cup (2)
52 - Inner Bearing (2)
53 - Outer Cup (2)
54 - Outer Bearing (2)
55 - Wheel Hub (2)
56 - Wheel Lug Bolt (16)
57 - Lug Nut Washer (16)
58 - Bearing Washer (2)
59 - Hub Retainer Nut (2)
60 - Wheel Hub Cap (2)

* Not Shown

Table 6-2 Material List for Figure 6-6

AXLES

STEER AXLE (MODELS 522 AND 622)

OVERHAUL

Use Loctite Threadlocker 242 on threads of all (4) spindle pins and spindle pin jam nuts; torque spindle pins and spindle pin jam nuts to 500 - 550 Ft/LBS.

Torque the steer cylinder bolt nuts to 100 Ft/LBS.

Tie rod adjustment (see Figure 6-7) attempt to maintain equal amounts of exposed threads on both tie rod ends. Torque tie rod stud nuts to 100 Ft/LBS. Tighten tie rod end jam nuts.

Wheel Hub Assembly to Axle: Tighten bearing castle nut until snug, then back off nut until cotter pin aligns with hole in spindle. Before inserting cottee pin, be sure wheel rotates freely without binding, while maintaining very little or no wheel end play.

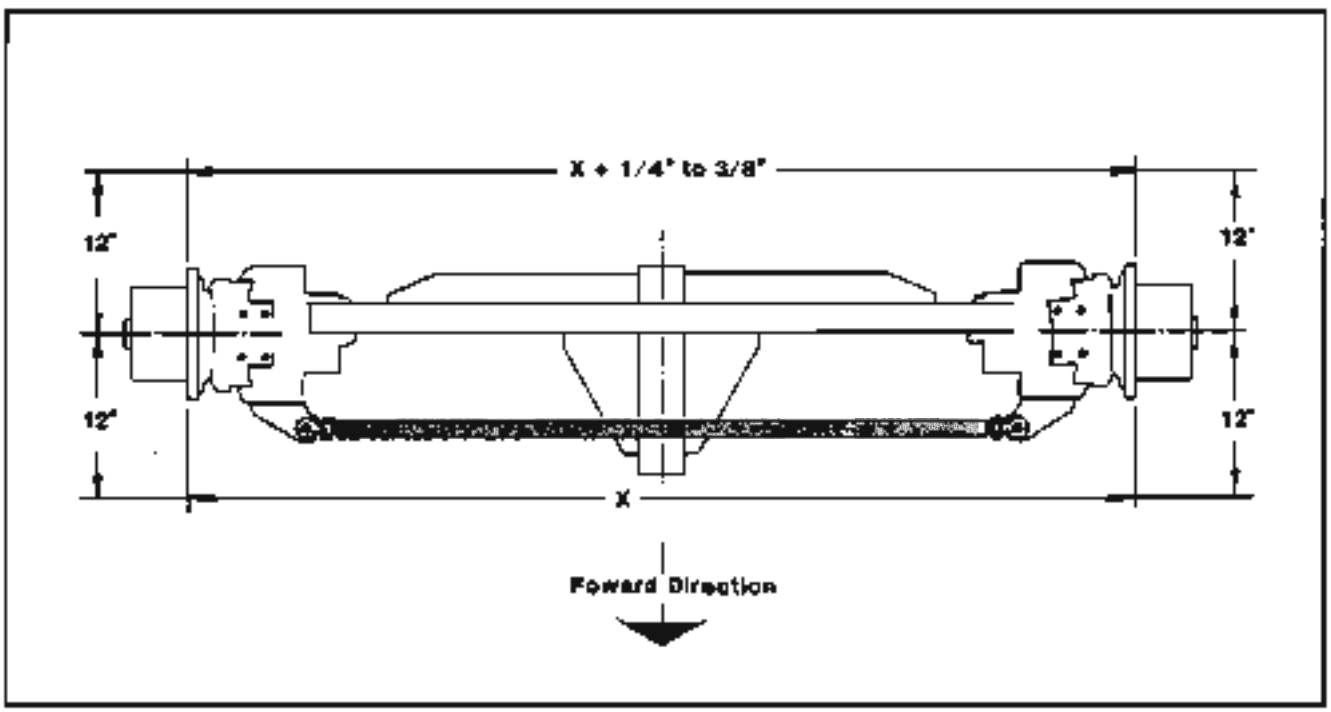


Figure 6-7 Adjusting Tie Rod Length

AXLES

STEER AXLE WITH POWER ASSIST (MODELS 522/4, 622/4, 824)

DESCRIPTION (Figures 6-8 & 6-9)

The rear axle on Model 522/4, 622/4 and 824 forklifts is a non-braking, steering axle which features a hydraulic motor at each wheel for "on-demand" rear wheel power assist (see "Rear Wheel Power Assist" in Section 7).

The axle is mounted to the forklift by a pivot pin which passes through the axle at its center and extends through axle mounts which are part of the main frame. The axle can thus pivot about the longitudinal center line of the forklift, as required, when negotiating uneven surfaces.

MAINTENANCE

Maintenance of the axle requires scheduled greasing of king pin pivots, steer cylinder pivots, tie rod pivots, and axle pivot (see Service Schedules and Lubrication Instructions in Section 2).

Routinely check cylinder pivot ends, tie rod ends and spindles for wear, evidenced by excessive play. Replace worn parts as required.

AXLES

STEER AXLE WITH POWER ASSIST (MODELS 522/4, 622/4, 824)

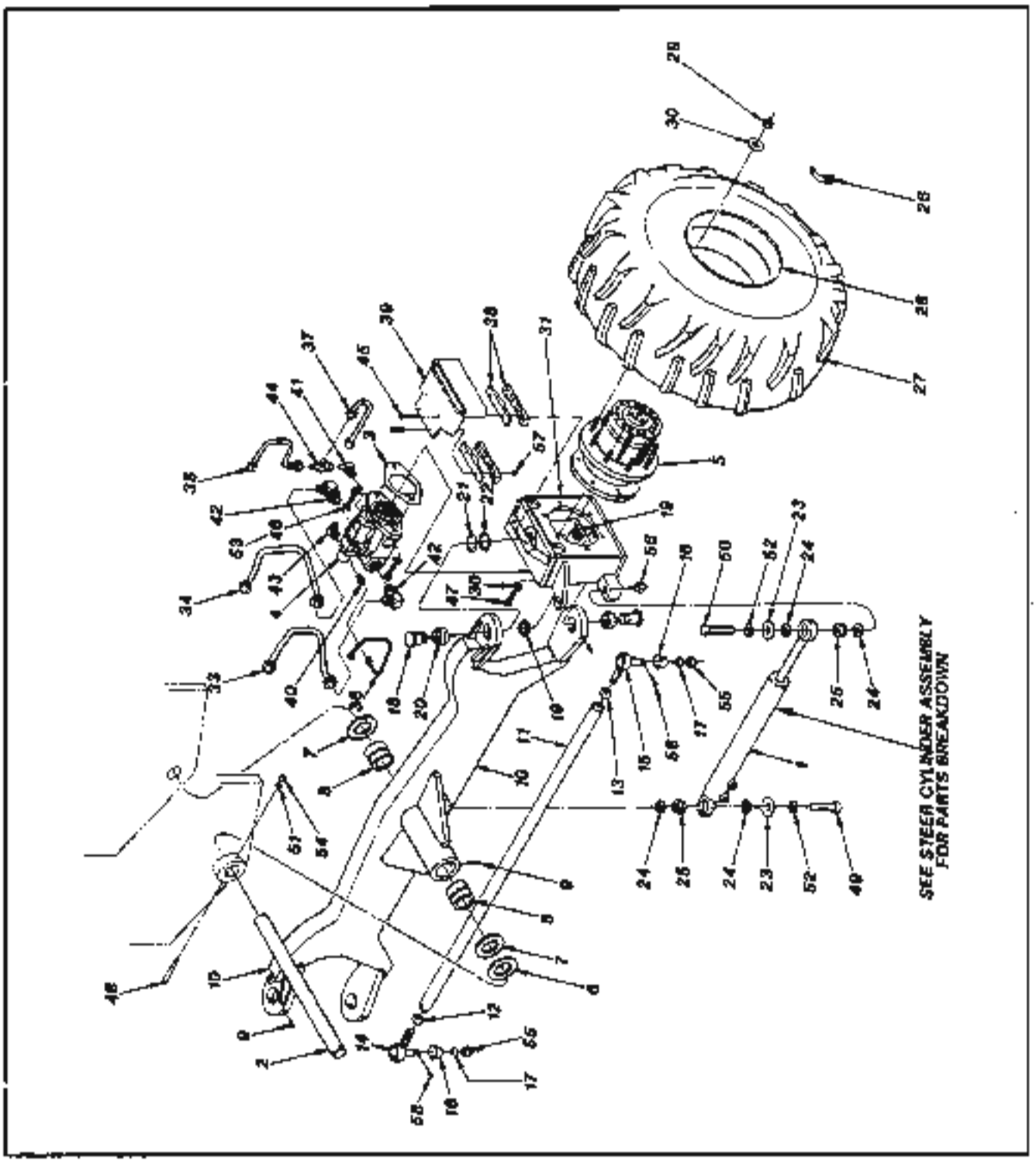


Figure 6-8 Early Production Steer Axle with Power Assist

AXLES

STEER AXLE WITH POWER ASSIST (MODELS 522/4, 622/4, 824)

1 - Steer Cylinder
2 - Trunion Pin
3 - Gasket, Motor (2)
4 - Variable Motor (2)
5 - Planetary Gear Box (2)
6 - Shim, 14 GA (A/R)
7 - Shim, 3/16" (2)
8 - Bushing (2)
9 - Grease Zerk (6)
10 - Steer Axle
11 - Tie Rod
12 - Jam Nut
13 - Jam Nut (L.H. Thread)
14 - Tie Rod End
15 - Tie Rod End (L.H. Thread)
16 - Rubber Seal (2)
17 - Hardened Washer (2)
18 - Pivot Pin (4)
19 - Pivot Pin Jam Nut (4)
20 - Spherical Bearing (4)
21 - Thrust Washer (2)
22 - Thrust Washer (2)
23 - Flatwasher, 1" SAE (4)
24 - Spacer (8)
25 - Self - Align Bushing (4)
26 - Valve Stem (2)
27 - Tire, Rear 14.0 x 17.5 (2)
28 - Wheel Rim (2)
29 - Lug Nut (18)
30 - Machinery Bushing (30)
31 - Box Frame, L.H.
32* - Box Frame, R.H.
33 - Hyd. Tube, 1/2" (2) (L.F. & R.R.)
34 - Hyd. Tube, 1/2" (2) (R.F. & L.R.)
35 - Hyd. Tube, 3/8" (2)
36 - Hyd. Tube, 1/4" (2)
37 - Hyd. Tube, 3/8" (2)
38 - Tube Clamp (4)
39 - Tube Guard (2)
40 - Connector, O-Ring (2)
41 - 90° Elbow, O-Ring (2)
42 - 90° Elbow, O-Ring (4)
43 - 90° Elbow, O-Ring (2)
44 - Tee, Swivel (2)
45 - Bolt, 3/8"-16 x 1 3/4" (8)
46 - Bolt, 1/2"-13 x 1 1/2" (4) GR 8
47 - Bolt, 5/8"-11 x 1 1/2" (12)
48 - Bolt, 5/8"-18 x 5"
49 - Bolt, 1"-14 x 3 1/4" (2)
50 - Bolt, 1"-14 x 4" (2)
51 - Lockwasher, 5/8"
52 - Lockwasher, 1" (4)
53 - Flatwasher, 1/2" SAE (4)
54 - Nut, 5/8"-18
55 - Castle Nut, 5/8"-18 (2)
56 - Jam Nut, 1"-14 (2)
57 - Locknut, 5/8"-16 (4)
58 - Cotter Pin, 1/8"x 1 1/2" (2)

* Not Shown

Table 6-3 Material List for Figure 6-8

AXLES

STEER AXLE WITH POWER ASSIST (MODELS 522/4, 622/4, 824)

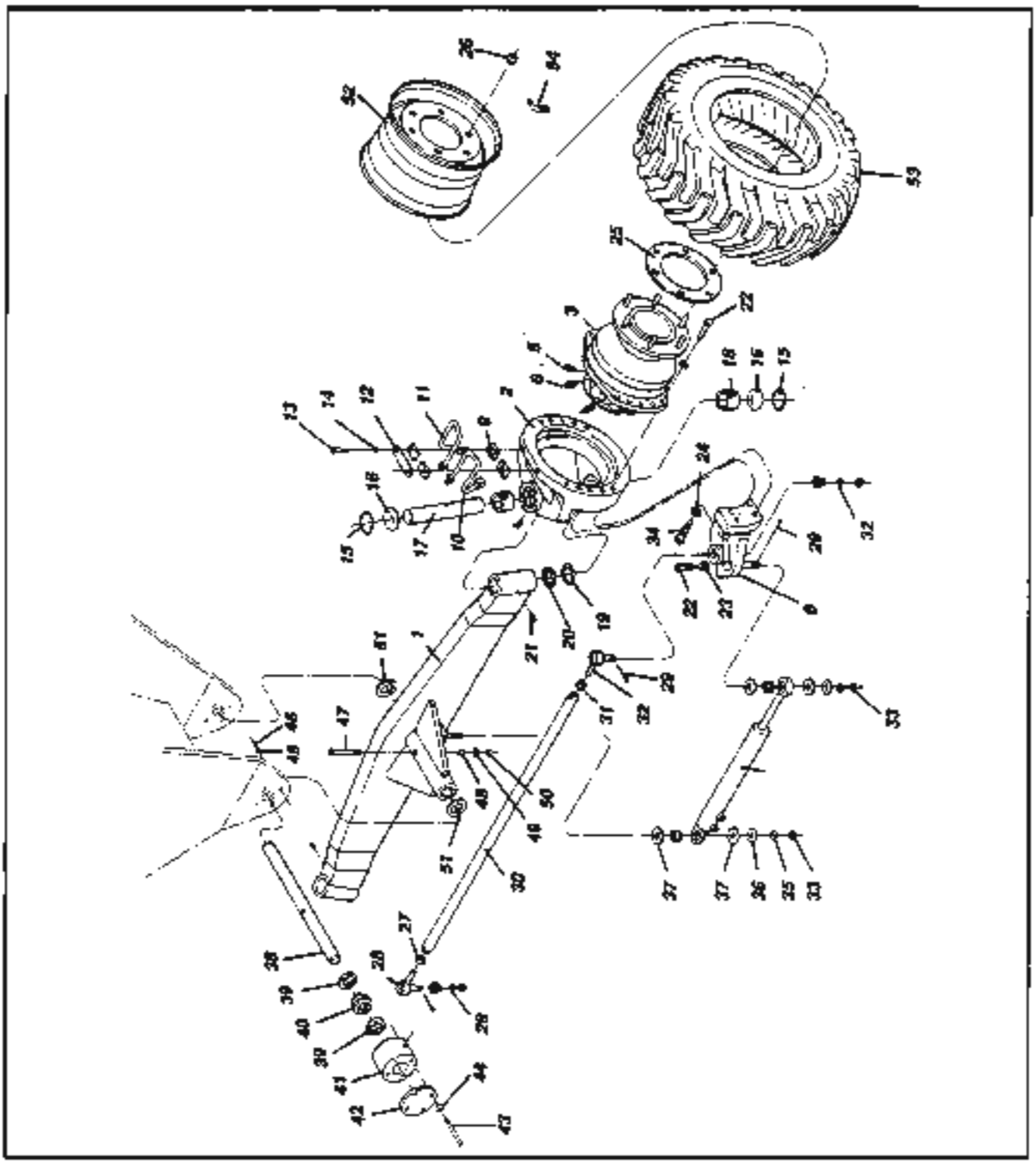


Figure 6-9 Late Production Steer Axle with Power Assist

AXLES

STEER AXLE WITH POWER ASSIST (MODELS 522/4, 622/4, 824)

1 - Axle
2 - Wheel Motor Frame (L.H.)
3 - Wheel Motor (2)
4* - Wheel Motor Frame (R.H.)
5 - Adapter (4)
6 - Adapter (2)
7* - Steer Bracket (R.H.)
8 - Steel Bracket (L.H.)
9 - Tube Clamp (2)
10 - Tube, R.R. & L.F. (2)
11 - Tube, R.F & L.R. (2)
12 - Tube Clamp Plate (2)
13 - Bolt, 5/16" x 2 1/4" (4) GR 8
14 - Lockwasher, 5/16" (4)
15 - Snap Ring (4)
16 - Expansion Plug (4)
17 - King Pin (2)
18 - King Pin Bushing (4)
19 - Steel Washer (2)
20 - Thrust Washer (2)
21 - Set Screw (2)
22 - Bolt, 5/8" x 1 3/4" (12) GR 8
23 - Jam Nut, 5/8" (2)
24 - Bushing (18)
25 - Clamp Ring (2)
26 - Lug Nut (12)
27 - Jam Nut, 1 1/8" (R.H.)
28 - Tie Rod End (R.H.)
29 - Cotter Pin (6)
30 - Tie Rod
31 - Jam Nut, 1 1/8" (L.H.)
32 - Tie Rod End (L.H.)
33 - Slotted Nut, 1" (4)
34 - Bolt, 5/8" x 2 1/4" (8) GR 8
35 - Lockwasher, 1" (4)
36 - Flatwasher, 1" (4)
37 - Spacer (8)
38 - Trunnion Pin
39 - Bearing Spacer (4)
40 - Self - Align Bearing (2)
41 - Bearing Housing (2)
42 - Bearing Cover (2)
43 - Bolt, 1/2" x 5 1/2" (8)
44 - Flatwasher, 1/2" (8)
45 - Lockwasher, 1/2" (8)
46 - Nut, 1/2" (8)
47 - Bolt, 5/8" x 5"
48 - Nut, 5/8"
49 - Starwasher, 5/8"
50 - Jam Nut, 5/8"
51 - Shim (2)
52 - Rear Wheel (2)
53 - Rear Tire (2)
54 - Valve Stem (2)

* Not Shown

Table 6-4 Material List for Figure 6-9

AXLES

STEER AXLE WITH POWER ASSIST (MODELS 522/4, 622/4, 624)

REMOVAL

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface. Lower the boom, apply the parking brake and stop the engine. Block tires on the front axle.

3. Detach the two hydraulic lines atop the equa-trac valve and one hydraulic line atop the tee just behind the valve and cap the openings (early production models).

Tag and detach hydraulic lines at hydraulic motors (3 lines each motor) and cap the openings (late production models)

4. Detach the four hydraulic lines from the steer cylinders and cap the openings.

5. Position two 5 ton hydraulic floor jacks under the rear main frame. Raise the machine until the tires clear the floor. Carefully support the machine using 5 ton stands, or with timbers, positioned under both sides of the main frame.

6. Remove tires from the axle. (Approx. weight 350 LBS each - Models 522/4; 520 LBS each - Models 622/4, 624.)

7. With two floor jacks supporting the axle, remove the axle pivot pin.

8. Lower and remove the axle from the machine. (Approx. weight of axle is 1000 LBS.)

INSTALLATION

1. Reverse steps 3 through 8 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1. Torque wheel lug nuts to 280 - 300 Ft/LBS.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Cycle the steering cylinders fully in one direction and hold for 15 seconds; cycle fully in the opposite direction and hold for 15 seconds. Repeat. This procedure will remove air from the steering circuit.

OVERHAUL

See Figure 6-7 for Tie Rod Adjustment.

Torque the steer cylinder bolt nuts and tie rod stud nuts to 100 Ft.LBS.

Drive motor and hub overhaul procedures are completely detailed in service manuals available from the motor or hub manufacturer or Lull Corporation.

REAR WHEEL POWER ASSIST

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REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM DESCRIPTION

The rear wheel power assist provides temporary four wheel drive by hydrostatically powering the rear wheels when the operator determines additional traction is required and engages the rear wheel assist. The rear wheel power assist will engage while the engine is running, the gear selector is in first gear, and the control button is pushed (the "on" indicator light will go on). The power assist will disengage when the control button is once again pushed (the "on" indicator light will go off). The power assist will also disengage when the gear selector is moved to second or third gear, or when both brake pedals are depressed (the rear wheel drive will re-engage when one or both brake pedals are released).

The system is comprised of the following components:

1. Hydraulic Piston Pump: For Description and Service Procedures see page 3.28-1 (522/4) and page 3.31-1 (622/4, 824).

2. 12 Volt Power Source: 8 amp fuse at fuse block located under the instrument panel.

3. Control Module and Magnetic Arm Assembly: See "Control Module" in this section.

4. Selector Valve: See "Selector Valve" in this section.

5. Equatrac Valve: See "Equatrac Valve" in this section.

6. Hydraulic Motor: See "Hydraulic Motor" in this section.

7. Planetary Hub: See "Planetary Hub" in this section.

8. Transmission "Forward" and "Reverse" Pressure Switches: Located at the transmission. When the transmission is placed in the forward mode, the pressure switch in the transmission forward position pressure port sees pressure causing its contacts to close which energizes, through the electrical circuit, the "Forward" solenoid on the selector valve which opens the selector valve port that directs hydraulic flow to the "Forward" port on the equatrac valve and from the equatrac valve to the "Forward" port on each wheel motor.

The "Reverse" pressure switch works in the same way except it causes flow to the "Reverse" port of the wheel motors from the selector valve through the equatrac valve.

9. Brake Line Left and Right Pressure Switches: Located in the brake lines under the control panel. Application of both brake pedals will cause both pressure switches to see pressure causing the switch contacts to open, which, through the electrical circuit and selector valve will cause the pump to relieve pressure to the rear wheel assist.

10. Control Button: Located on the control panel. Push button to engage rear wheel assist; push again to disengage.

11. "On" Indicator Light: Located on the control panel. Light will go on when the rear wheel assist is engaged; will go off when dis-engaged - except when system is temporarily disengaged while braking with both brake pedals (the light will remain on).

NOTE: See Figure 7-1 for "System Arrangement".

NOTE: See Figure 7-2 for "Electrical Wiring Diagram".

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM DESCRIPTION (cont.)

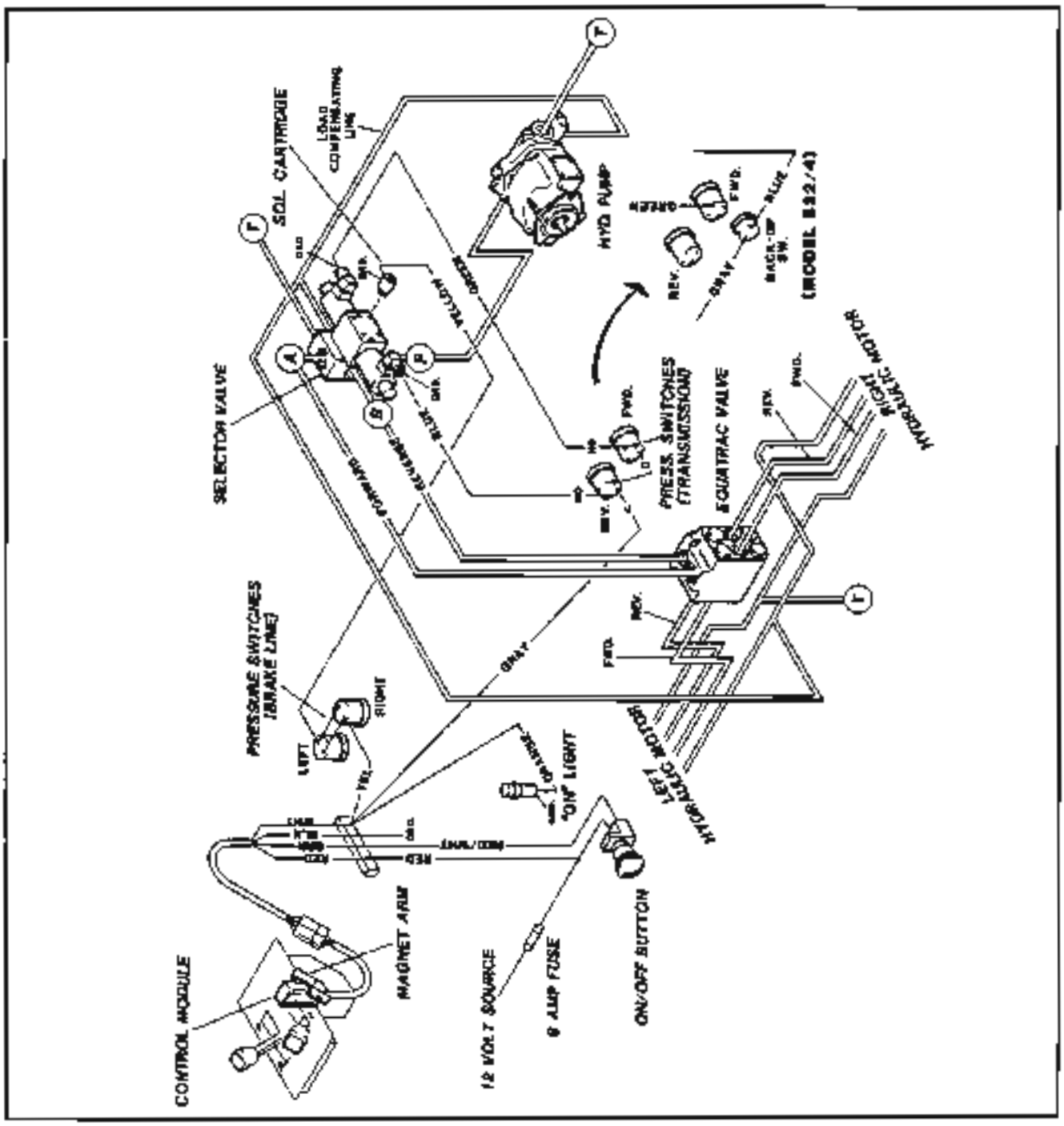


Figure 7-1 System Arrangement

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM DESCRIPTION (cont.)

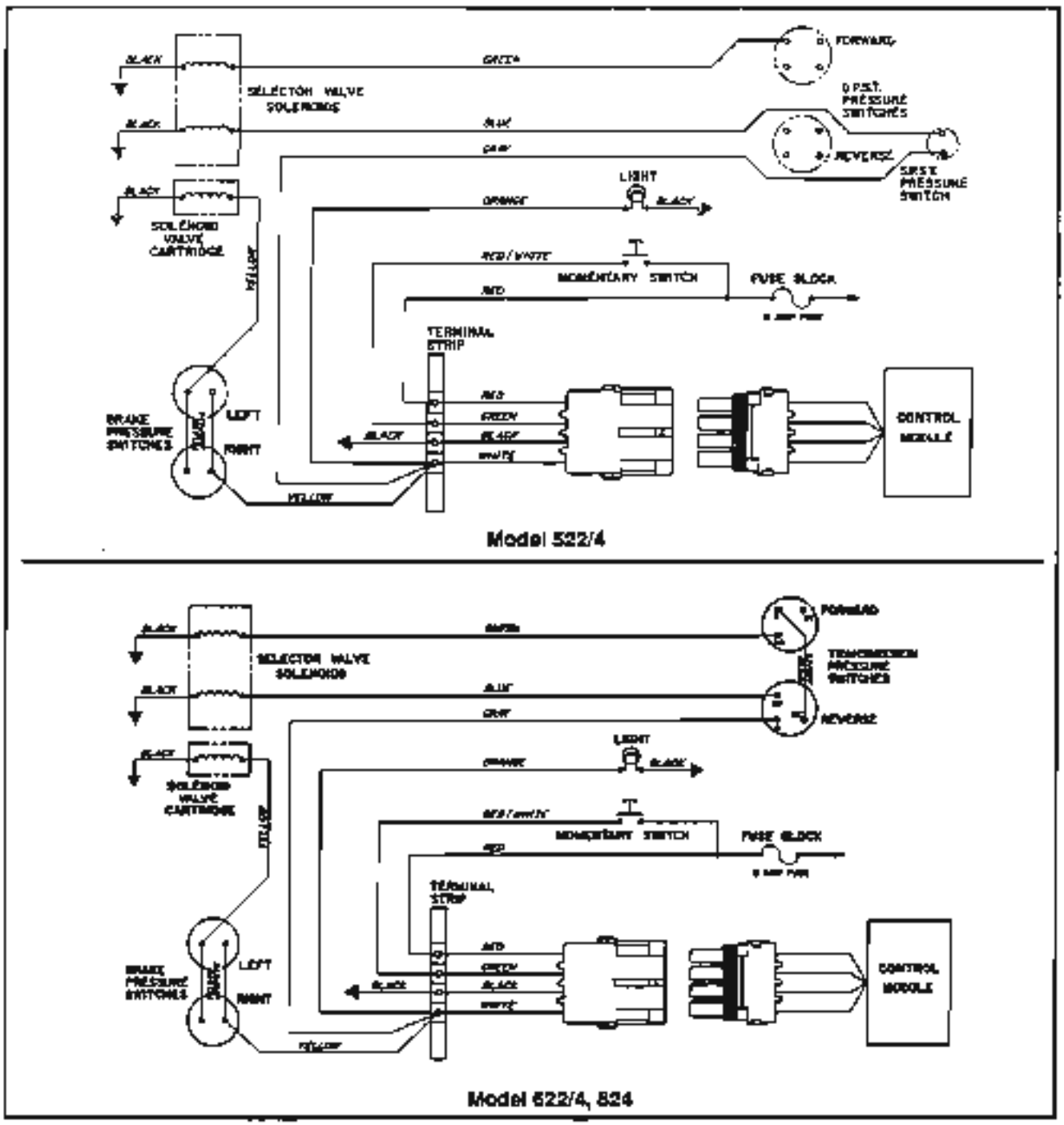


Figure 7-2 Electrical Wiring Diagram

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM DESCRIPTION (cont.)

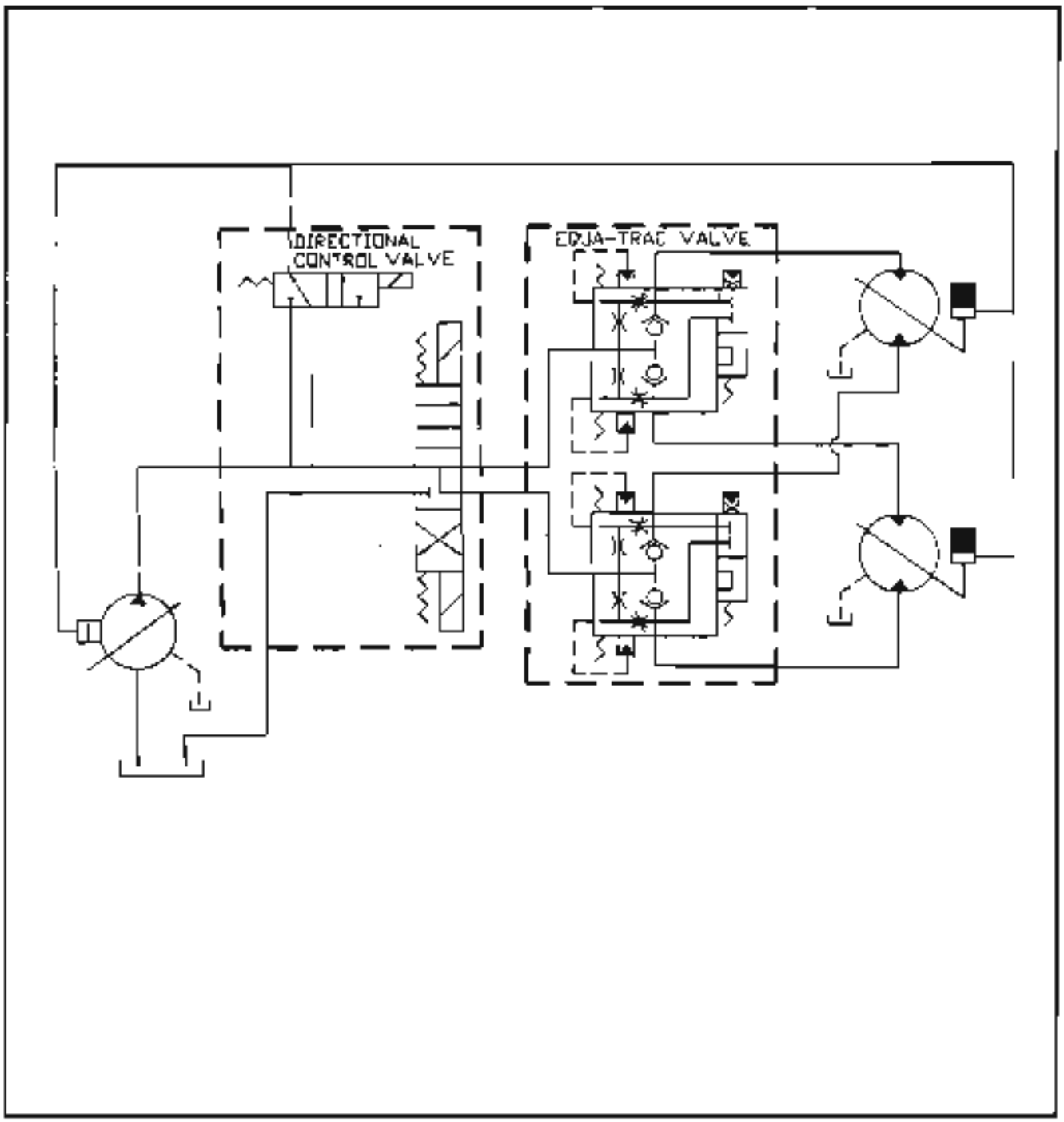


Figure 7-3 Hydraulic Circuit Diagram

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 624

SYSTEM MAINTENANCE

Maintenance of the rear wheel power assist requires scheduled checking of the planetary hubs for correct oil level and changing the hub oil at the recommended intervals. Maintenance also requires that the hydraulic fluid be properly maintained (the filter and fluid be checked and changed at the recommended intervals see Service Schedules in Section 2.)

SYSTEM TROUBLESHOOTING

I. INTRODUCTION

The rear wheel power assist requires minimum service and maintenance. Although when problems do occur, experience has shown 80% to be electrical with the remaining 20% mostly hydraulic.. A "walk-around" visual inspection will many times reveal the source of the problem.

II. SPECIAL TOOLS AND EQUIPMENT

Item	Quantity	Description
1.	1	3/4" crowfoot wrench (to remove hydraulic motor)
2.	1	Electronic harness test kit
3.	1 min. (2 preferred)	5000 psi gauge

4.Hydraulic Adapter Kit -- Adapters to be compatible with gauge fittings.

Test port locations and/or sizes are as follows:

A) -02 O-Ring Boss (1 location)

B) -04 O-Ring Boss (3 locations)

III. THE WALK-AROUND INSPECTION

A) Situations to look for

1. Hydraulic
   a. Oil leaks
   b. Fluid level in reservoir
   c. Filter condition
2. Planetaries
   a. Hubs engaged or disengaged
   b. Gear oil leakage around spindle or cover plate
3. Wheel Motors and Tubes
   a. Bent or damaged tubes
4. Selector Valve Assembly
   a. Broken or hanging wires
   b. Physical damage to solenoids

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM TROUBLESHOOTING (cont.)

IV. ELECTRICAL

A. Fuses and Loose Wires
   1. Repair or replace

B. Bulb in Indicator Light
   1. Replace

C. Magnet attached to Control Lever
   1. Replace if missing
   2. Reposition (Must be next to module in low gear only)

D. Valve Solenoids
   1. Audible click when activated
      a. Test for electric signal
      b. If signal present and does not click
         1a. replace solenoid

E. Electronic Control Module
   1. Unplug module and plug in harness test kit
      a. Green light appears
         1a. replace module
      b. Yellow light appears
         1a. trace harness to find circuit interruption
      c. No light
         1a. determine problem with hot lead to module

V. HYDRAULIC

A. Oil level in reservoir
   1. Low
      a. Find leak in system
      b. Refill to proper level

B. Pump
   1. Attach 5000+ psi gauge to port marked "PTP" on selector valve subplate.
      a. System "OFF" - read approx. 250 psi
         1a. If plus or minus more than 100 psi - adjust or replace pump compensator
      b. System "ON" - read 2600 - 3000 psi
         1a. Less than 2500 psi - service or replace pump

C. Directional Control Valve
   1. Install gauge adapters in Equatrac valve
      a. Remove -04 plugs and install adapters-Top (Forward) and Bottom (Reverse) - on front spool of Equatrac valve.
   2. System "ON" - read system pressure: 2600+ psi
      a. No pressure - replace selector valve

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 624

SYSTEM TROUBLESHOOTING (cont.)

V. HYDRAULIC (cont.)
- D. Solenoid Cartridge Valve (on selector valve subplate)
  1. Install gauge
     - a. Tee into 1/4" line at selector valve
  2. System "ON" - read system pressure: 2600 – psi
     - a. No Pressure - replace valve
  3. System "OFF" - read 0 - 40 psi
     - a. Pressure exceeds 40 psi - replace valve
- E. Hydraulic Motors
  1. Internal leakage
     - a. Disconnect case drain line at reservoir
       - 1a. catch and measure fluid
  2. System "ON" - (machine moving)
     - a. Flow rate below 2.5 GPM - good
     - b. Flow rate above 2.5 GPM
       - 1a. check individual motor case drain hoses
         - i. flow less than 1.5 GPM - good
         - ii. flow greater than 1.5 GPM - change motor

VI. SPECIAL PROBLEMS
- A. One wheel locks up while in operation
  1. Lift wheel off ground - try to rotate tire by hand
     - a. tire rotates
       - 1a. Equatrac valve spool stuck - service valve
     - b. tire does not rotate
       - 1a. disengage Torque Hub
         - i. if rotates - change hydraulic motor
         - ii. no rotation - inspect and service hub

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 624

CONTROL MODULE

DESCRIPTION

The Control Module is located within the transmission selector. The purpose of the Control Module is to allow a vehicle operator to selectively engage or disengage the hydrostatic drive axle only if the engine is running and the powershift lever is in first gear. The Module automatically disengages the axle if either second or third gear are selected, or if power is turned off.

Figures 7-2 shows the schematic of the vehicle wiring for the Rear Wheel Assist Control System.

The Control Module controls power to the solenoids which: 1) bring the hydrostatic assist pump to pressure, and 2) select forward or reverse drive direction. Control Module logic is as follows:

a) Whenever power is turned on to the Module, it starts up in the "Disengaged" state.

b) The module "Engages" only if
- it is powered up,
- first gear has been selected,
- and, the control button is pushed once. (The "ON" lamp will light.)

c) The Module "Disengages" if
- the control button is pushed again,
- the shift lever is taken out of first gear,
- or, the power is turned off. (The "ON" lamp will go off.)

Application of both vehicle brakes simultaneously will relieve the Rear Wheel Assist drive pressure by turning off the pump solenoid. The Assist "ON" lamp will remain lighted because the drive will be re-engaged after the brakes are released.

Pressure switches mounted on the powershift transmission detect whether the transmission is in forward or reverse (or neutral if neither pressure is sensed). These switches control whether the Rear Wheel Assist is engaged in forward or reverse. Note that the Control Module does not directly control the forward-neutral-reverse operation of the Rear Wheel Assist.

ABNORMAL CONNECTIONS

Survival of the module under abnormal wiring conditions depends upon the proper installation of an 8 amp fuse in the power line as shown in Figure 7-2.

1. Reversing the Black (GND) and Red (B+) wires causes the 8 amp fuse to blow but no permanent damage to the module.

2. Reversing the Red (B+) and White (output) wires causes the solenoid to turn on all the time but no permanent damage to the module.

3. Reversing the Black (GND) and White (output) wires while in first gear and pressing the momentary switch causes the 8 amp fuse to blow, but no permanent damage.

4. Reversing ABCD completely to DCBA does nothing.

5. Applying 20 to 45 volts to Red (B+) causes the output to turn on but no permanent damage.

INSTALLATION AND TESTING PROCEDURE

1. Remove Control Handle assembly from Panel.

2. Install Magnet assembly on 1-2-3 gear shift lever by placing the assembly against the flat bottom portion of the lever such that the Magnet faces toward the F-N-R lever.

3. Use one screw and lock washer provided to fasten Magnet assembly.

4. Insert Module and bracket assembly between side supports on the Control Handle assembly such that the Module is on the left side of the magnet.

5. Use three screws with lock washers to fasten, two on the left and one on the right side.

6. When the gear shift lever is in 1st, the magnet should be beside the Control Module. The gap should be less than 3/16 inch, but more than 1/16 inch.

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

CONTROL MODULE (cont.)

INSTALLATION AND TESTING PROCEDURE (cont.)

7. Put Control Handle assembly back into panel but do not connect the Module to the harness.

8. Check the wiring harness before connecting the Module as follows:

A. Connect the Test Box to the harness.

B. Turn the Key to "ON" but do not start engine.

C. The Green light on the Test Box should be ON.

If it is NOT On, do NOT continue this procedure until the problem is fixed. Check the 8 amp fuse in the Test Box if no harness problem can be found.

D. Press and hold the Selector button on the Control Panel. The Yellow lamp on the Test Box should come On. If it does NOT come On, do NOT continue this procedure until the problem is fixed.

E. Push and hold the momentary switch on the Test box. Notice the Rear Wheel Assist "ON" Lamp remains On while the switch is held. Release the switch and notice the Rear Wheel Assist "ON" Lamp is Off.

CAUTION: The following tests must be performed with the engine running. THE WHEELS OF THE VEHICLE WILL BE TURNING.

CAUTION: JACK THE VEHICLE UP AND BLOCK SECURELY WITH ALL FOUR WHEELS CLEAR BEFORE STARTING ENGINE.

CAUTION: KEEP ALL PERSONNEL CLEAR OF VEHICLE WHILE ENGINE IS RUNNING.

F. Place transmission in NEUTRAL and start the engine. Press and Hold the momentary switch on the Test Box. IF THE ASSIST WHEELS TURN, LOOK FOR A SHORTED FORWARD OR REVERSE PRESSURE SWITCH.

The green light on the Test Box should be On. If it is NOT, the fuse in the Box is blown and a short to ground exists in the harness from the brake switches. Repair before proceeding.

G. Place transmission in FORWARD. Press and Hold momentary switch. THE WHEELS SHOULD MOVE IN THE FORWARD DIRECTION. Step on both brakes and note the wheels stop turning. Release momentary switch on the Test Box.

The green light on the Test Box should be On. If is is NOT, the fuse in the Box is blown and a short to ground exists in the harness from the forward pressure switch. Repair before proceeding.

H. Place transmission in REVERSE. Press and Hold momentary switch. THE WHEELS SHOULD MOVE IN THE REVERSE DIRECTION. Release momentary switch.

The green light on the Test Box should be On. If it is NOT on the fuse in the Box is blown and a short to ground exists in the harness from the reverse pressure switch. Repair before proceeding.

9. TURN OFF the vehicle and remove the Test Box.

10. Connect up the Control Module and verify that the control operates in FIRST GEAR ONLY (transmission must be in forward or reverse) . To do this, turn the key on, push the Selector button twice and see that the Rear Wheel Assist "ON" lamp goes On and Off in first gear. Place gear select in second, push Selector button, and see that the Rear Wheel Assist "ON" lamp does not go On. Also check third gear to make sure the Rear Wheel Assist "ON" lamp does not go On.

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

SELECTOR VALVE

DESCRIPTION

The Selector Valve is a dual solenoid activated, spring return, open center, 3-way valve. A solenoid valve cartridge is assembled to the selector valve subplate. See Figures 3-1 and 3-2 in Section 3 for location of the selector valve on the machine.

When the rear wheel assist is engaged, the solenoid corresponding to either the forward or reverse position of the gear selector will activate, pulling the valve spool to one side, causing hydraulic flow through the valve to the rear wheel assist.

The solenoid valve cartridge, which is ported to the load compensator line, will cause the pump to work up to, and maintain, hydraulic pressure equivalent to the pressure (3000 psi) set by the load sensing control of the piston pump so that pressure becomes balanced between the pump pressure line and the load compensator line, while the rear wheel assist is engaged.

When the rear wheel assist is disengaged, the activated solenoid becomes de-activated, causing the valve spool to return to center, resulting in a drop in pump pressure (to 200 psi) through the system.

MAINTENANCE

The Selector Valve requires no scheduled maintenance.

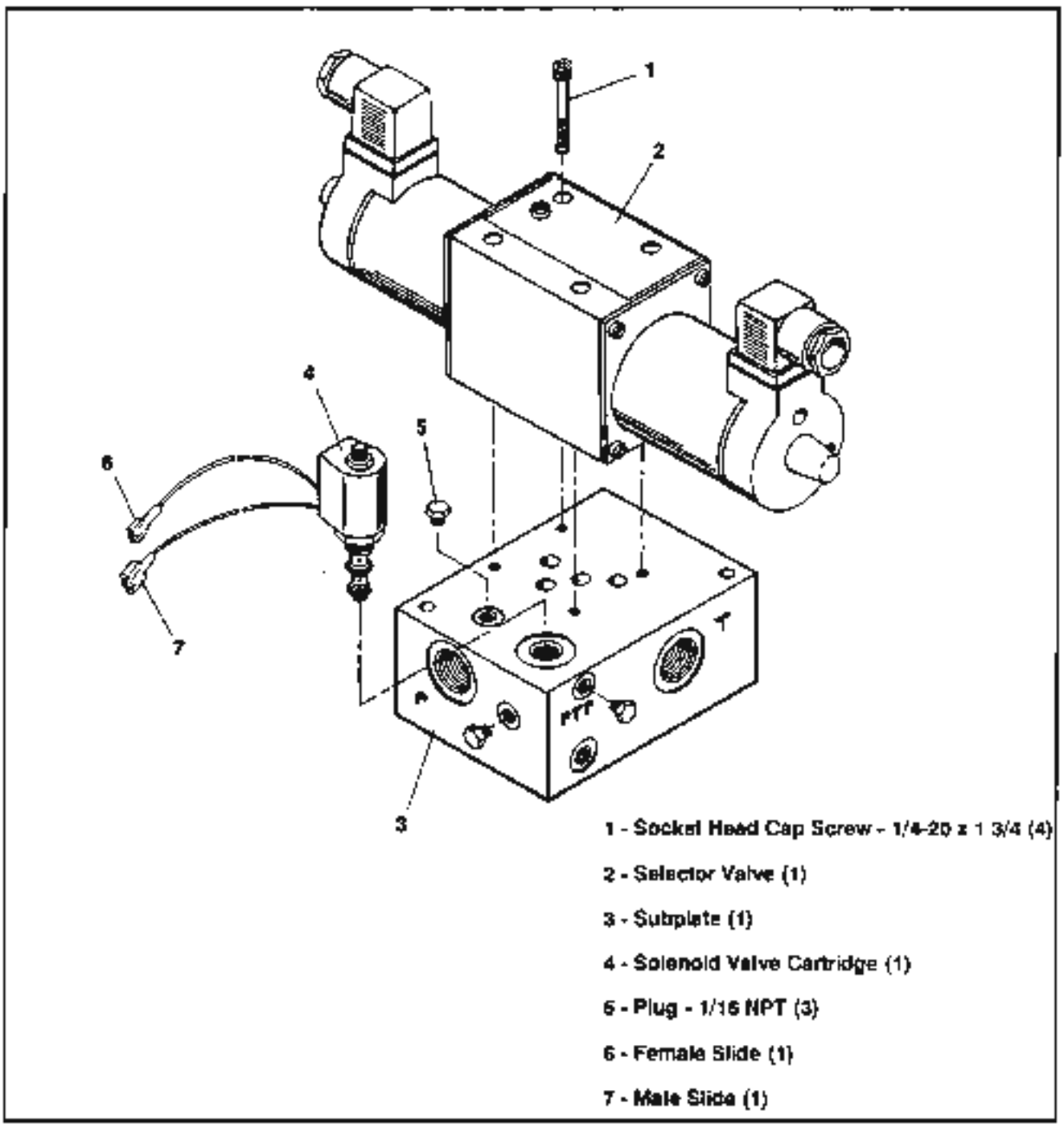
OVERHAUL (Figure 7-5)

Refer to "Overhaul" on page 3.33-1 in Section 3 for Valve Overhaul Procedures.

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

SELECTOR VALVE (cont.)



1 - Socket Head Cap Screw - 1/4-20 x 1 3/4 (4)

2 - Selector Valve (1)

3 - Subplate (1)

4 - Solenoid Valve Cartridge (1)

6 - Plug - 1/16 NPT (3)

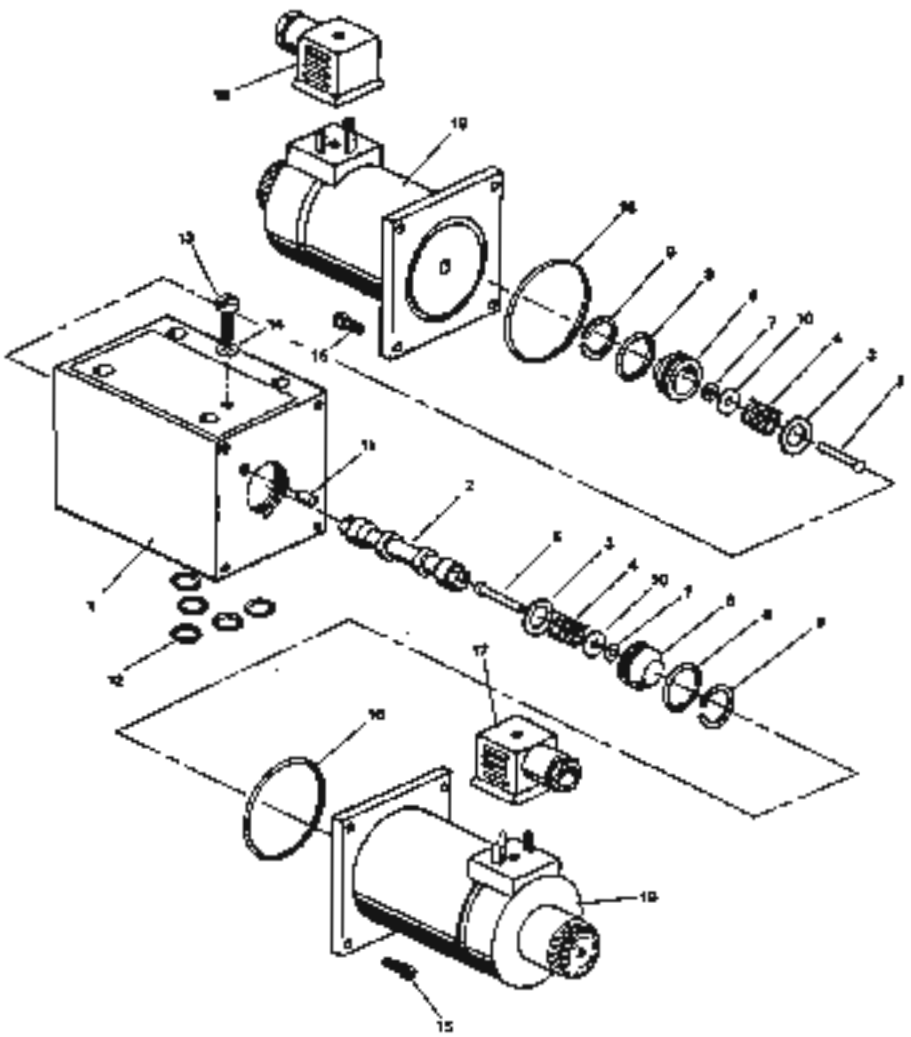
6 - Female Slide (1)

7 - Male Slide (1)

Figure 7-4 Selector Valve Subassembly

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824



1 - Valve Housing (1)	8 - O-Ring (2)	14 - Seal Ring (1)
2 - Spool (1)	9 - Snap Ring (2)	15 - Cap Screw (6)
3 - Stop Washer (2)	10 - Back-Up Washer (2)	16 - Seal Ring (Solenoid) (2)
4 - Compression Spring (2)	11 - Plug (1)	17 - Connector, Right-Hand (Gray) (1)
5 - Pin (2)	12 - O-Ring, Mtg. Surface (5)	18 - Connector, Left-Hand (Black)(1)
6 - Centering Ring (2)	13 - Cap Screw (1)	19 - Solenoid Assembly (2)

Figure 7-5 Selector Valve Disassembly

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

EQUATRAC VALVE

DESCRIPTION

The equatrac valve is essentially a hydraulic flow divider which, when the rear wheel assist is engaged, provides equal hydraulic flow (pressure and volume) to the input port of each rear wheel assist drive motor. For location of the Equatrac Valve on the machine, see Figure 3-1 and 3-2 in Section 3.

MAINTENANCE

Maintenance requires only that the system's hydraulic oil be properly maintained.

OVERHAUL (Figure 7-6)

Refer to "Overhaul" on page 3.33-1 for valve overhaul procedures.

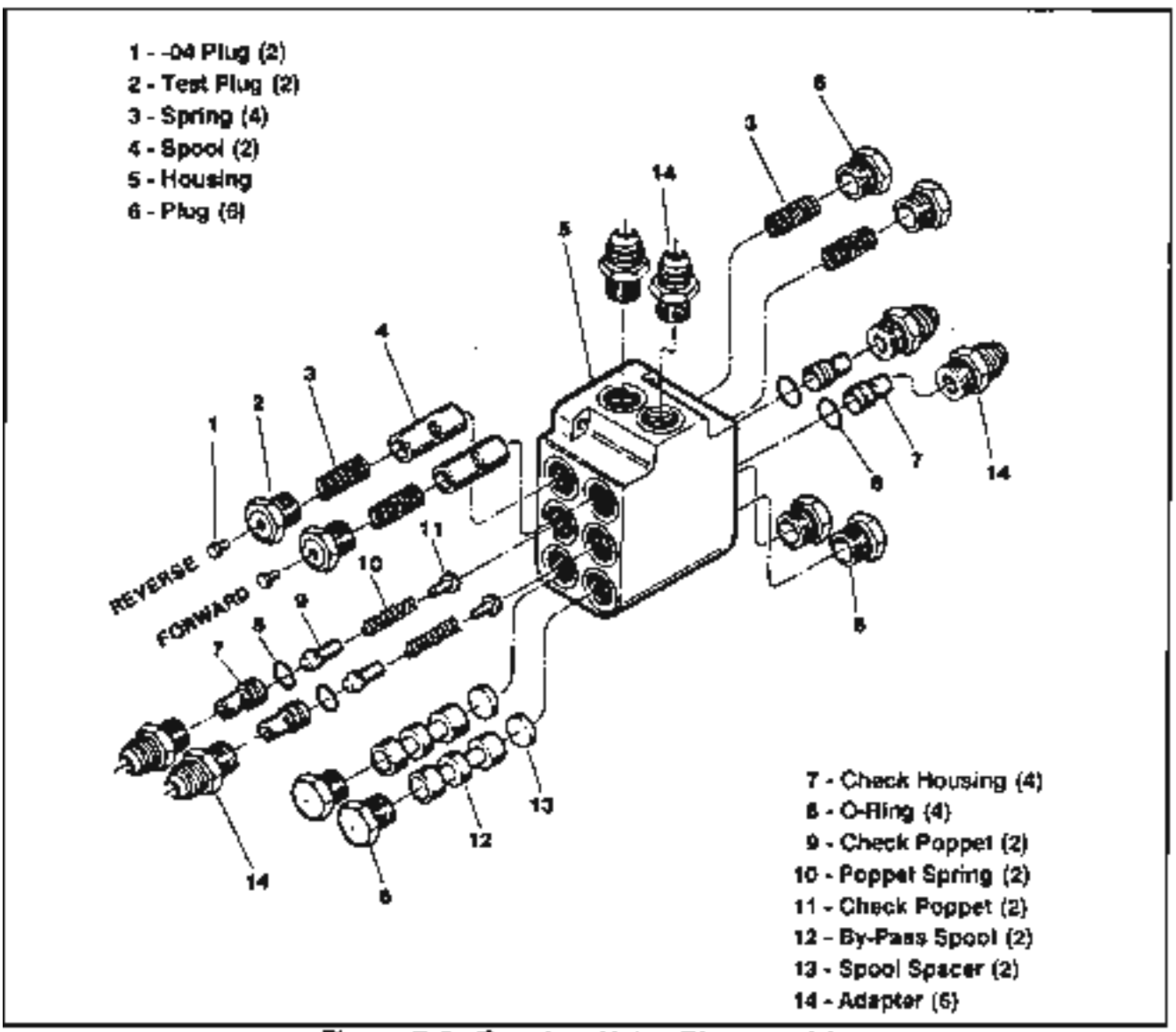


Figure 7-6 Equatrac Valve Disassembly

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 624

HYDRAULIC MOTOR

DESCRIPTION

The rear wheel assist hydraulic motor is a variable displacement, piston type. There are two motors, one at each rear wheel. The motor's splined shaft is mounted to, and directly drives the power assist hub.

MAINTENANCE

Periodically check for any leaks and periodically check the motor mountings .

TROUBLESHOOTING

NOTE: In troubleshooting a pump-motor system it is necessary to isolate the pump from the motor to determine which unit is actually malfunctioning. A worn pump or worn motor will both give the same system indication. Therefore, it is advisable to first run a pressure and flow check on the pump to make sure it is performing within its operating specifications. The following troubleshooting suggestions are based on the assumption that the pump has been flow and pressure checked and has been found within operating specifications.

PROBLEM	POSSIBLE CAUSE	CORRECTION
1. Motor turns while unloaded but slows down or stops when load is applied.	A. Scored back plate.	A. Remove back plate and examine surface condition of flat area; if scored, replace back plate. Do not lap.
	B. Scored or worn piston shoes.	B. Disassemble motor, examine condition of shoes on pistons; replace pistons as a complete set if necessary.
	C. Low relief valve pressure.	C. Check relief valve for proper pressure setting; adjust or replace relief valve.
2. Motor will not turn	A. Severely scored back plate	A. Disassemble motor completely. Inspect all parts, clean all parts, replace all worn parts and flush hydraulic system.
3. Motor free wheels.	A. Oil flow and pressure shut off going to motor.	A. When the hydraulic system is shut off, the motor will free wheel after it has leaked off. This is inherent in the design. The motor will not free wheel as long as charge pressure is maintained to and from the motor.
4. Excessive case drain flow.	A. Excessive internal wear in motor	A. Disassemble motor, inspect parts and replace as necessary. Case drain flow should not exceed 1.5 GPM at full pressure

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

HYDRAULIC MOTOR (cont.)

OVERHAUL

DISASSEMBLY

1 Clean outside of unit thoroughly.

2. Clamp shaft in a protected jaw vise with backplate end up.

3 Remove the six capscrews (Item 23) from backplate (Item 22).

4 Use a plastic mallet and tap the backplate (Item 22) to loosen it; then pull the backplate straight out.

5. Remove O-Ring (Item 21) from backplate.

6. Remove the complete piston block assembly from the housing assembly.

7. Remove piston assemblies (Item 11), spider (Item 12), and pivot (Item 13) from piston block assembly.

8. The piston block assembly need not be disassembled unless the pins (Item 16) or spring (Item 18) is damaged.

CAUTION: The following procedure should be used if the spring is to be removed from the piston block. The spring (Item 18) is highly compressed and the snap ring (Item 19) should not be removed without compressing the spring.

The following parts will be required to disassemble the piston block:

2 ea. 3/8 I.D. x 1-1/8 O.D. flat washer
2 ea. 3/8 x 3-1/4 N.C. capscrew, and
1 ea. 3/8 N.C. nut

Place one of the flatwashers over the 3/8 x 3-1/4 capscrew and place this through the center of the piston block. Place the other washer over the capscrew and let it rest on the three pins (Item 16). Screw nut on and compress the spring inside the piston block. Use a pair of snap ring pliers and remove the internal snap ring (Item 19). Remove the bolt and two washers. Remove the two washers (Item 17), spring (Item 18), three pins (Item 16), and pin keeper (Item 15).

9. Remove thrust race (Item 10) from housing.

10. Remove snap ring (Item 1) from housing.

11. Remove shaft seal (Item 2) from housing.

12. Remove washer (Item 3) from housing.

13. Remove drive shaft (Item 7) from housing.

14. Remove the two snap rings (Item 4), thrust washers (Item 5), and thrust bearing (Item 6), from drive shaft.

INSPECTION

1. Wash all parts thoroughly in a suitable solvent.

2. Examine needle bearings (Items 8 and 20) in housing (Item 9) and backplate (Item 22). If the needles are free of excessive play and remain in the bearing cage there is no need to replace the bearing.

3. Inspect thrust washers (Item 5) and thrust bearing (Item 6). All surfaces should be free of any signs of wear or fretting.

4. Inspect spider (Item 12) and pivot (Item 13); conical surfaces should be free of wear and score marks.

5. Inspect the pistons (Item 11); the O.D. surface should be smooth and free of scoring. The shoes should be snug fit to the piston. The face of the shoes should be flat and free of scoring and flaking. Do not lap piston shoes.

6. Inspect the piston block (Item 14); the bores should be free of scoring. The surface that contacts the backplate should be smooth and free of grooves or metal build-up.

7. Inspect the thrust race (Item 10); the surface should show no signs of scoring or grooves.

8. Inspect the flat surface on the backplate (Item 22); it should be free of excessive scoring or metal build-up.

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 624

HYDRAULIC MOTOR (cont.)

OVERHAUL (cont.)

INSPECTION (cont.)

9. Inspect the drive shaft (Item 7) for fretting in the bearing areas. Check spline area for twisted or broken teeth. If keyed shaft, check for cracked or chipped keyway.

REASSEMBLY

1. Use STP to lubricate all critical moving parts before assembly.

2. Install one snap ring (Item 4) in rear groove on drive shaft (Item 7). Install one thrust washer (Item 5), thrust bearing (Item 6), and second thrust washer (Item 5) on drive shaft (Item 7). Install second snap ring (Item 4) in front groove on drive shaft.

3. Replace needle bearing (Item 8) in housing (Item 9) if necessary. Install shaft in housing assembly (Item 9) and install washer (Item 3). Oil I.D. of new shaft seal (Item 2) and press into position. Retain with snap ring (Item 1).

4. Compress pin keeper (Item 15) and install in the spline area of the piston block (Item 14).

5. Install the three pins (Item 16) in the special grooves of the spline and with head end of pin toward inside of block.

6. Install one washer (Item 17), spring (Item 18), and second washer (Item 17). Use the two 3/8 I.D. washers and the 3/8 x 3-1/4 capscrew to compress the spring and retain with snap ring (Item 19). Remove the 3/8 x 3-1/4 capscrew and two washers.

7. Install the pivot (Item 13), spider (Item 12), and the piston assemblies (Item 11) in the piston block assembly.

8. Lubricate thrust race (Item 10) and install in housing assembly.

9. Install piston block assembly in housing assembly. The piston shoes must contact the thrust race (Item 10). Be sure all parts are in their proper position.

10. Install new needle bearing (Item 20) in backplate (Item 22) if necessary.

11. Install new O-Ring (Item 21) on backplate (Item 22).

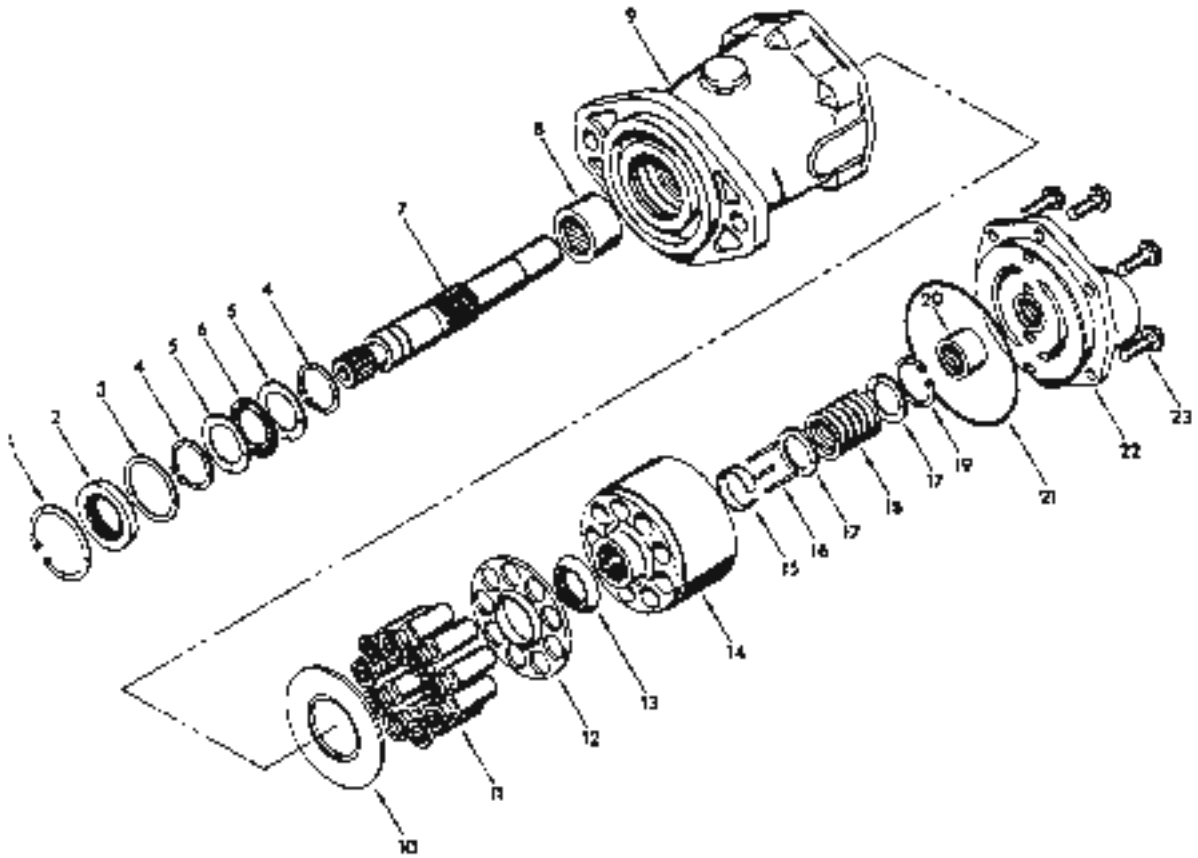
12. Install backplate (Item 22) on housing.

13. Install six capscrews (Item 23) and torque 15 - 18 ft. lbs.

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

HYDRAULIC MOTOR (cont.)



1 - Snap Ring
2 - Shaft Seal
3 - Washer
4 - Snap Ring
5 - Thrust Washer
6 - Thrust Bearing
7 - Drive Shaft
8 - Needle Bearing
9 - Housing Assembly
10 - Thrust Race
11 - Piston Assembly
12 - Spider
13 - Pivot
14 - Piston Block
15 - Pin Keeper
16 - Pin
17 - Washer
18 - Spring
19 - Snap Ring
20 - Needle Bearing
21 - O-Ring, 3/32 x 4 I.D.
22 - Backplate Assembly
23 - Capscrew

Figure 7-7 Hydraulic Motor Disassembly

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

POWER ASSIST HUB

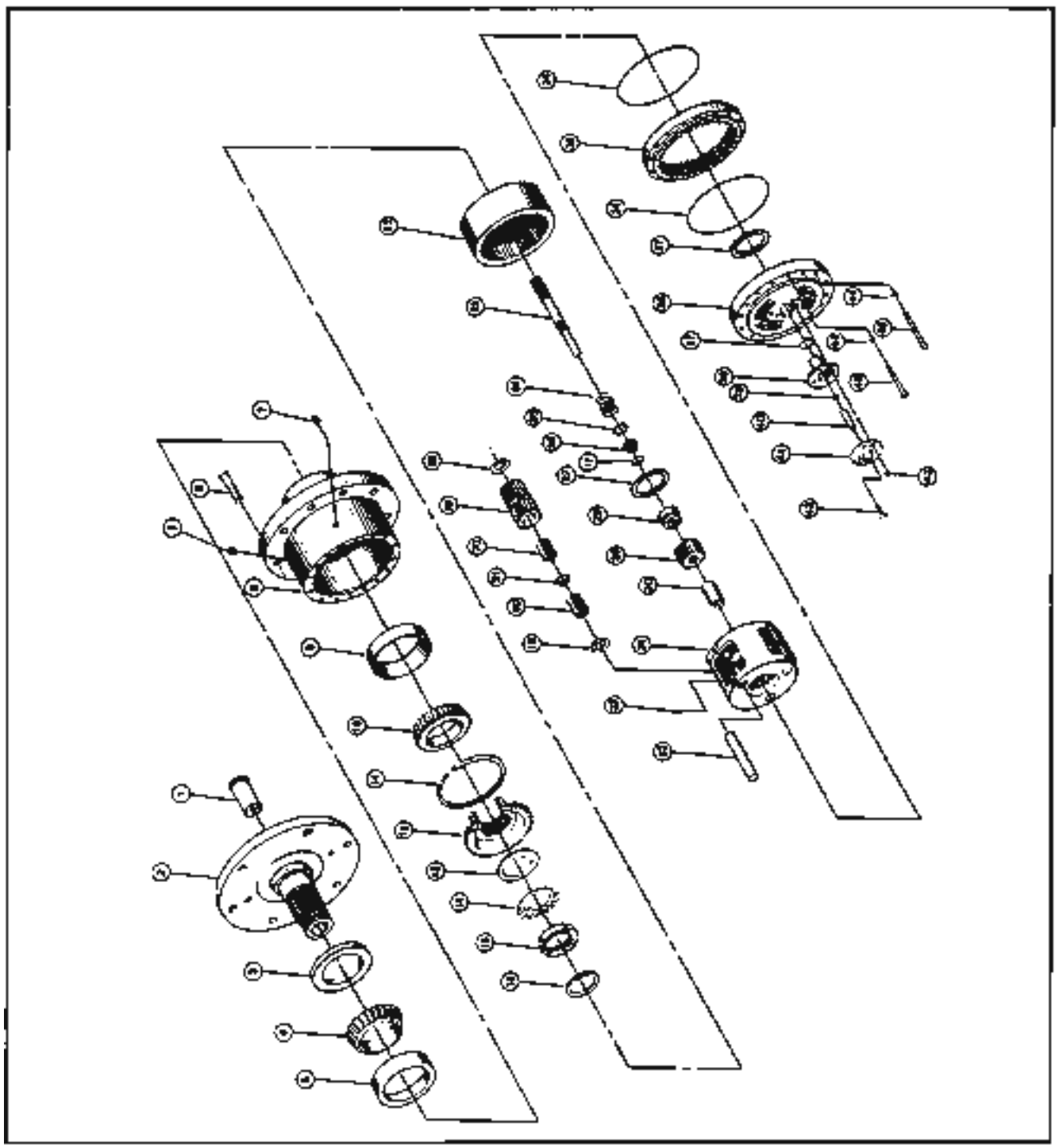


Figure 7-8 Power Assist Hub Disassembly

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 824

1 - Coupling
2 - Spindle
3 - Spindle Seal
4 - Bearing Cone
5 - Bearing Cup
6 - Stud (9)
7 - Pipe Plug (2)
8 - Hub
9 - Bearing Cup
10 - Bearing Cone
11 - Retaining Ring
12 - Internal Gear Hub
13 - Tongued Washer
14 - Lockwasher
15 - Locknut
16 - Retaining Ring
17 - Retaining Ring
18 - Thrust Washer (5)
19 - Cluster Gear (3)
20 - Needle Roller (96)
21 - Spacer (3)
22 - Internal Gear
23 - Input Shaft
24 - Spring
25 - Spacer
26 - Thrust Spacer
27 - Thrust Washer
28 - Input Spacer
29 - Input Gear
30 - Thrust Spacer
31 - Carrier
32 - Roll Pin (3)
33 - Planet Shaft (3)
34 - O-Ring (2)
35 - Ring Gear
36 - Cover
37 - O-Ring
38 - Cover Cap
39 - O-Ring
40 - Disconnect Rod
41 - Disconnect Cap
42 - Bolt, 1/4-20 x 3/4 (4)
43 - Pipe Plug
44 - Flatwasher, 5/16 (16)
45 - Bolt, 5/16-18 x 2 1/4 (12)
46 - Shoulder Bolt (4)

Table 7-1 Material List for Figure 7-8

REAR WHEEL POWER ASSIST

EARLY PRODUCTION MODELS 522/4, 622/4, 624

POWER ASSIST HUB

DESCRIPTION

The power assist hub is a planetary gear type drive hub. There are two hubs, one at each rear wheel. Each hub is driven directly from a drive motor. The hubs are filled with oil as prescribed under Service Schedules in Section 2.

MAINTENANCE

Maintenance requires scheduled checking and maintaining of fluid levels and changing fluid when required. See Service Schedules in Section 2.

OVERHAUL (Figure 7-8)

Planetary hub overhaul procedures are detailed in the Torque-Hub Final Drives Service Manual available from the hub manufacturer or Lull Corporation.

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM DESCRIPTION

The rear wheel power assist provides temporary four wheel drive by hydrostatically powering the rear wheels when the operator determines additional traction is required and engages the rear wheel assist. The rear wheel power assist will engage while the engine is running, the gear selector is in first gear, forward and reverse, and the control button is pushed (the "on" indicator light will go on). The power assist will disengage when the control button is once again pushed (the "on" indicator light will go off). The power assist will also disengage when the gear selector is moved to second or third gear, or when both brake pedals are depressed (the rear wheel drive will re-engage when one or both brake pedals are released); or when the F-N-R selector is placed in the neutral position (the rear wheel drive will re-engage when the selector is again placed in the forward or reverse position).

The system is comprised of the following components.

1. Hydraulic Piston Pump: For Description and Service Procedures see page 3.28-1 (522/4) and page 3.31-1 (622/4, 824).

2. 12 Volt Power Source: 8 amp fuse at fuse block located under the instrument panel.

3. Control Module and Magnetic Arm Assembly: See "Control Module" in this section.

4 Selector Valve: See "Selector Valve" in this section.

5. Equatrac Valve: See "Equatrac Valve" in this section.

6. Wheel Motor: See "Wheel Motor" in this section.

7. Transmission "Forward" and "Reverse" Pressure Switches: Located at the transmission. When the transmission is placed in the forward mode, the pressure switch in the transmission forward position pressure port sees pressure causing its contacts to close which energizes, through the electrical circuit, the "Forward" solenoid on the selector valve which opens the selector valve port that directs hydraulic flow to the "Forward" port on the equatrac valve and from the equatrac valve to the "Forward" port on each wheel motor.

The "Reverse" pressure switch works in the same way except it causes flow to the "Reverse" port of the wheel motors from the selector valve through the equatrac valve.

NOTE: The Model 522/4 is wired differently than the 622/4 and 824 models: see System Arrangement and Wiring Diagrams.

8. Brake Line Left and Right Pressure Switches: Located in the brake lines under the control panel. Application of both brake pedals will cause both pressure switches to see pressure causing the switch contacts to open, which, through the electrical circuit and selector valve will cause the pump to relieve pressure to the rear wheel assist.

9. Control Button: Located on the control panel. Push button to engage rear wheel assist; push again to disengage

10. "On" Indicator Light: Located on the control panel. Light will go on when the rear wheel assist is engaged; will go off when dis-engaged - except when system is temporarily disengaged while braking with both brake pedals, or when F-N-R selector is placed in neutral (the light will remain on).

NOTE: See Figure 7-9 for "System Arrangement".

NOTE: See Figure 7-10, 7-11 for "Electrical Wiring Diagram".

NOTE: See Figure 7-12 for "Hydraulic Circuit Diagram".

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM DESCRIPTION (cont.)

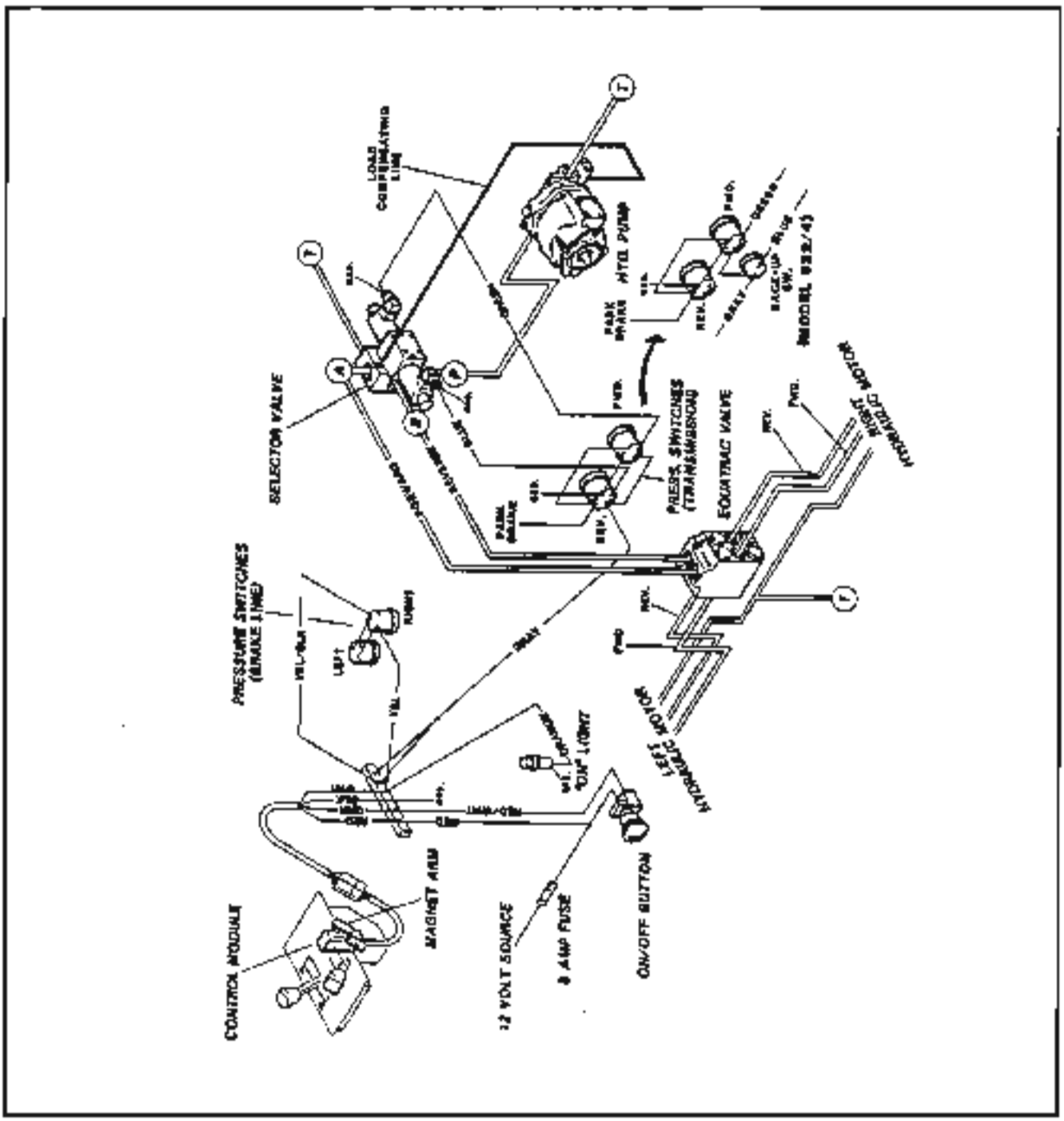


Figure 7-9 System Arrangement

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

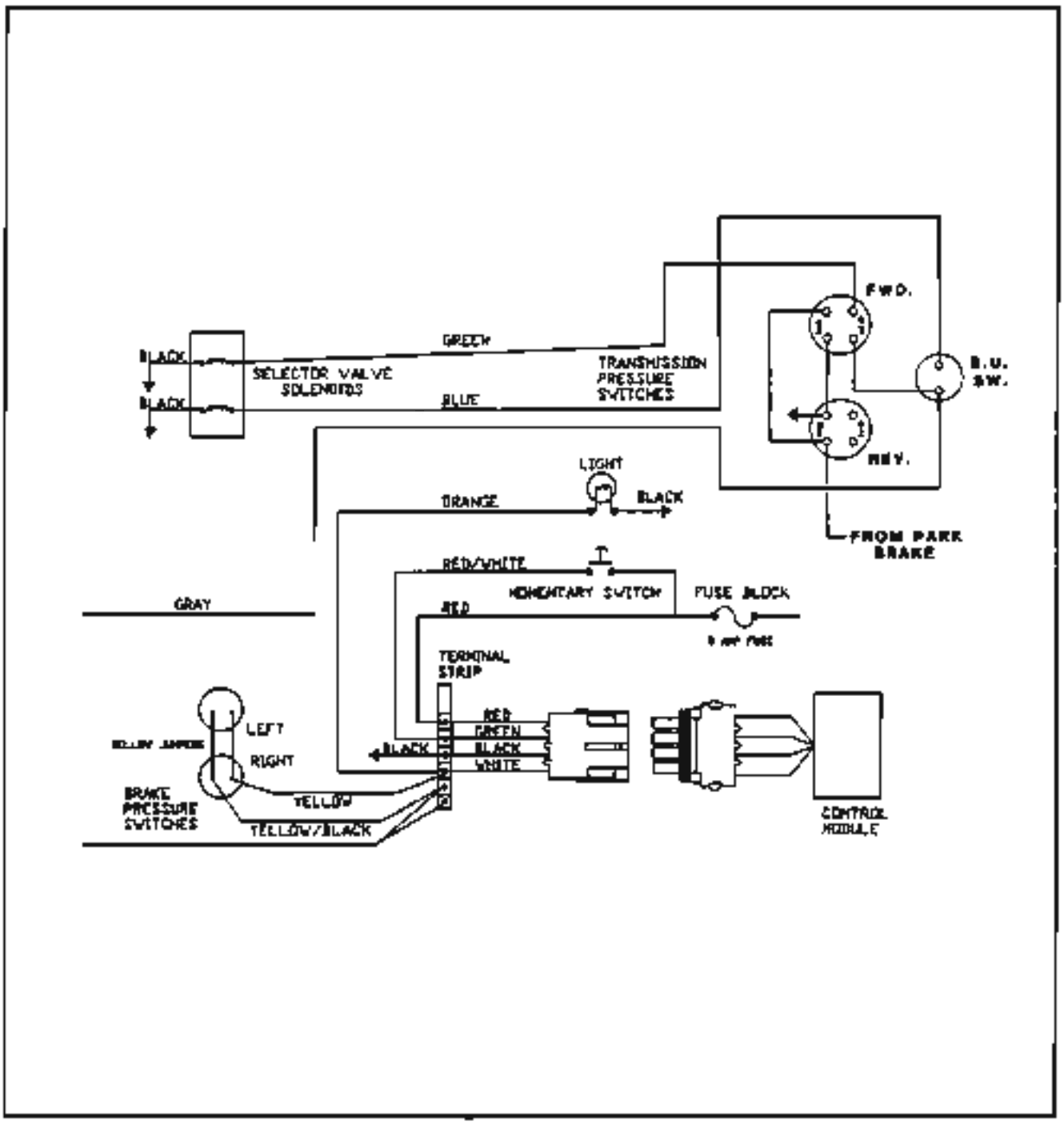


Figure 7-10 Electrical Wiring Diagram (Model 522/4)

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM DESCRIPTION (cont.)

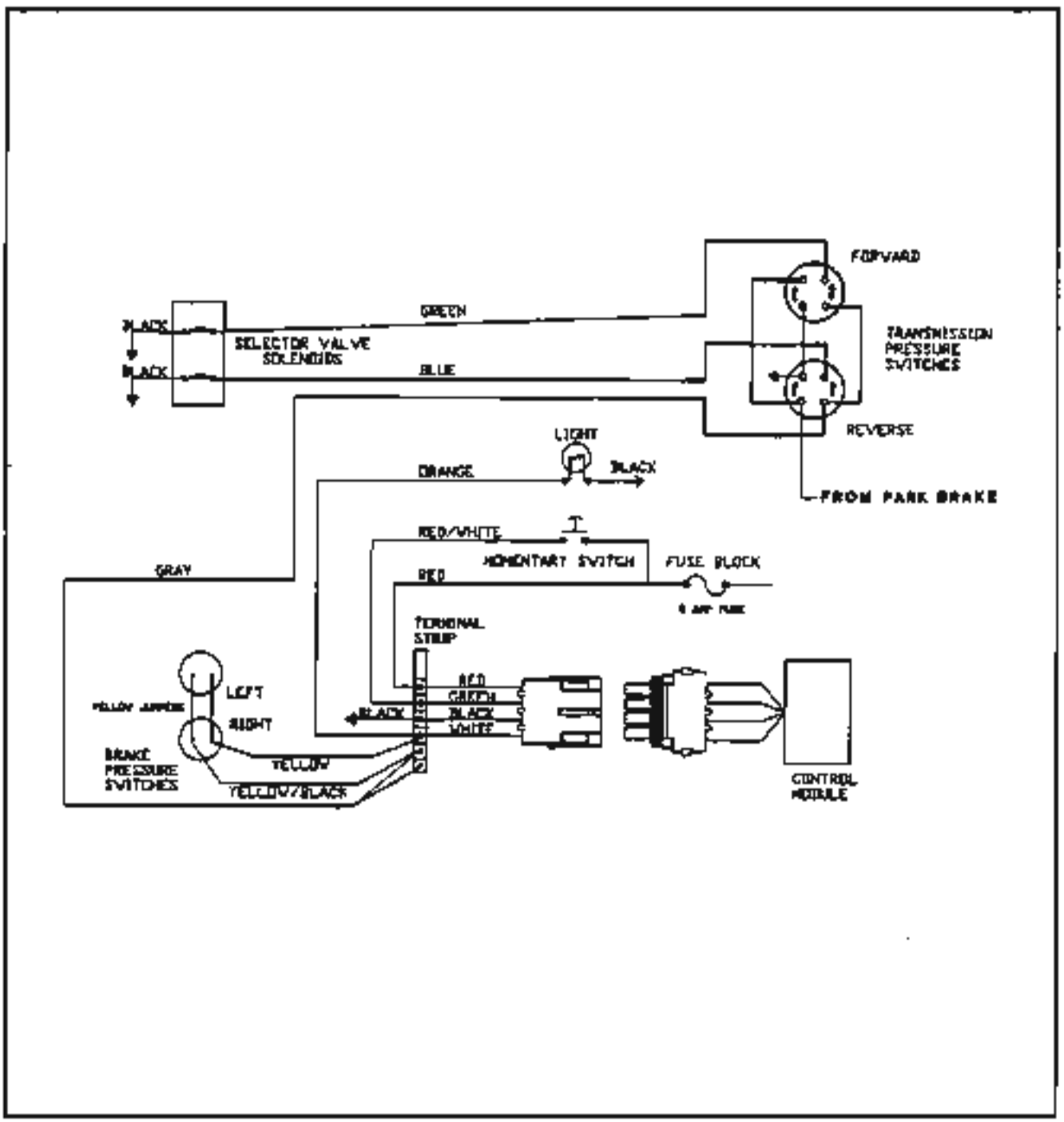


Figure 7-11 Electrical Wiring Diagram (Models 622/4, 824)

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM DESCRIPTION (cont.)

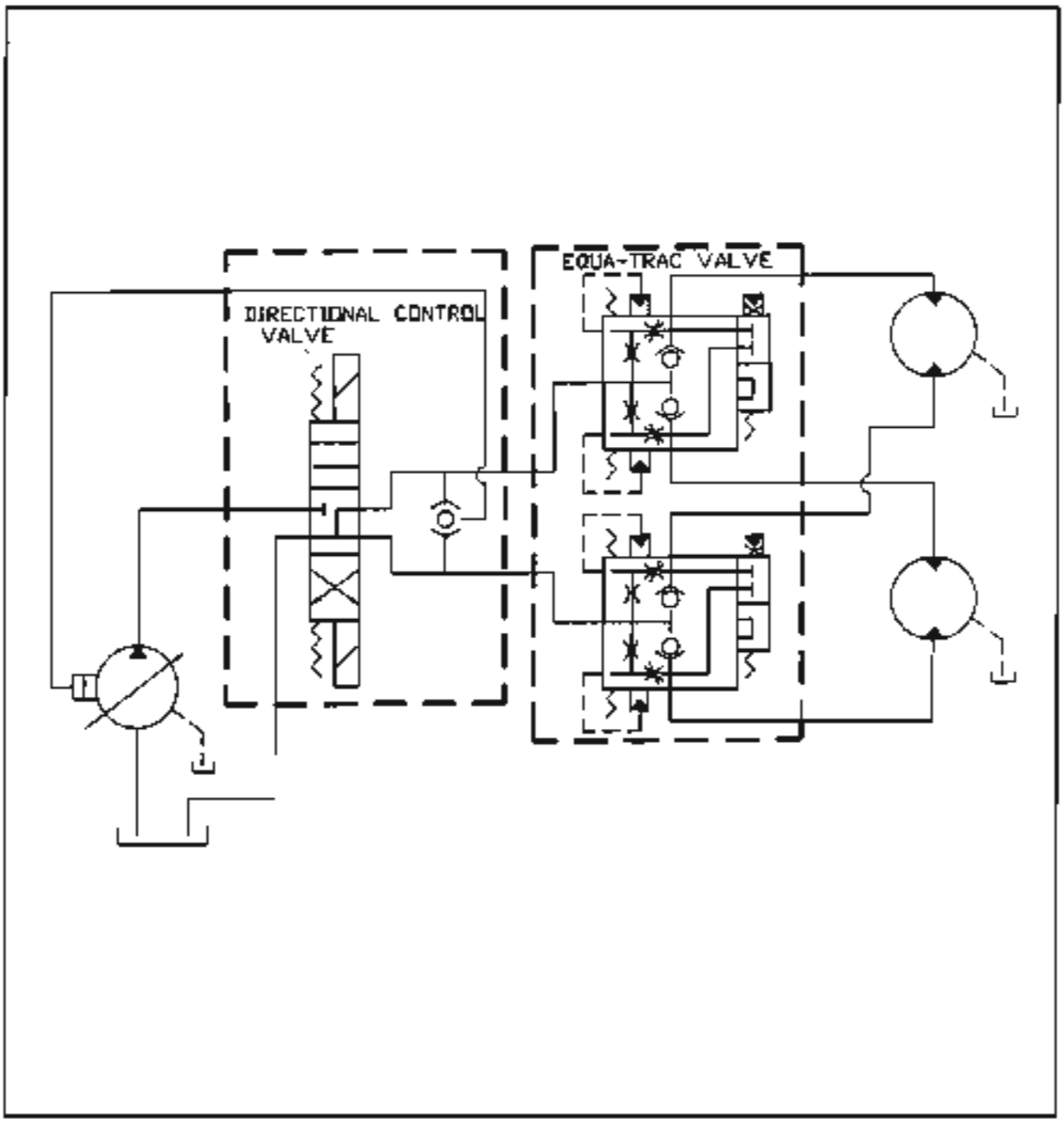


Figure 7-12 Hydraulic Circuit Diagram

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 624

SYSTEM MAINTENANCE

Maintenance of the rear wheel power assist requires the hydraulic fluid to be properly maintained (the filter and fluid be checked and changed at the recommended intervals - see Service Schedules in Section 2).

SYSTEM TROUBLESHOOTING

I. INTRODUCTION

The rear wheel power assist requires minimum service and maintenance. Although when problems do occur, experience has shown 80% to be electrical with the remaining 20% mostly hydraulic. A "walk-around" visual inspection will many times reveal the source of the problem.

II. SPECIAL TOOLS AND EQUIPMENT REQUIRED TO SERVICE THE UNIT

A. -12 O-Ring Boss (ORB) x -12 JIC Male Tee fitting with reducer fittings for pressure gauge installation.

B. 12 Volt Electrical Test Light.

C. Electronic Harness Test Kit.

D. Pressure Gauge(s) - 5000 psi rated.

E. Adapter fittings for gauge installation in -04 ORB Test Ports.

NOTE: Adapters should be compatible with gauge fittings.

III. THE WALK-AROUND INSPECTION

A) Situations to look for

1. Hydraulic
   a. Oil leaks
   b. Fluid level in reservoir
   c. Filter condition
2. Wheel Motors and Tubes
   a. Bent or damaged tubes
3. Selector Valve Assembly
   a. Broken or hanging wires
   b. Physical damage to solenoids

IV. ELECTRICAL

A. Fuses and Loose Wires
   1. Repair or replace

B. Bulb in Indicator Light
   1. Replace

C. Magnet attached to Control Lever
   1. Replace if missing
   2. Reposition (Must be next to module in low gear only)

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM TROUBLESHOOTING (cont.)

IV. **ELECTRICAL (cont.)**

D. Valve Solenoids

1. Audible click when activated
   a. Test for electric signal
   b. If signal present and does not click
      1a. replace solenoid

E. Electronic Control Module

1. Unplug module and plug in harness test kit
   a. Green light appears
      1a. replace module
   b. Yellow light appears
      1a. trace harness to find circuit interruption
   c. No light
      1a. connect 'hot' lead to module

V. **HYDRAULIC**

A. Oil level in reservoir

1. Low
   a. Find leak in system
   b. Refill to proper level

B. Pump

1. Attach 5000 + psi gauge to port marked "P" on selector valve subplate.
   a. System "OFF" - read approx. 250 psi
      1a. If plus or minus more than 100 psi - replace pump compensator
   b. System "ON" - read 2500 - 3000 psi
      1a. Less than 2500 psi - service or replace pump

C. Directional Control Valve

1. Install gauge adapters in Equatrac valve
   a. Remove -04 plugs and install adapters. Install gauges.
2. System "ON" - read system pressure: 2600 + psi
   a. No pressure - replace selector valve

D. Hi-pressure Shuttle (in selector valve subplate)

1. Install gauge
   a. Tee into 1/4" ID pressure line at selector valve
2. System "ON" - read system pressure: 2600 + psi
   a. No Pressure - inspect check ball and check seats
3. System "OFF" - read 0 - 30 psi
   a. Pressure exceeds 30 psi - replace selector valve

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

SYSTEM TROUBLESHOOTING (cont.)

V. HYDRAULIC (cont.)

E. Hydraulic Wheel Motors

1. Internal leakage
   - a. Disconnect case drain line at reservoir
     - 1a. catch and measure fluid
2. System "ON" - (machine moving)
   - a. Flow rate below 2.0 GPM - good
   - b. Flow rate above 2.0 GPM
     - 1a. check individual motor case drain hoses
       - I. flow less than 1.0 GPM - good
       - II. flow greater than 1.0 GPM - change motor

VI. SPECIAL PROBLEMS

A. One wheel locks up while in operation

1. Lift wheel off ground - try to rotate tire by hand
   - a. tire rotates
     - 1a. Equatrac valve spool stuck - replace valve

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

CONTROL MODULE

DESCRIPTION

The purpose of the Control Module is to allow a vehicle operator to selectively engage or disengage the hydrostatic drive axle only if the engine is running the powershift lever is in first gear and the forward/neutral/reverse selector is in either forward or reverse position. The Module automatically disengages the axle if either second or third gear are selected, or if power is turned off.

Figures 7-10 and 7-11 shows the schematic of the vehicle wiring for the Rear Wheel Assist Control System.

The Control Module controls power to the solenoids through the transmission pressure switches which: 1) bring the hydrostatic assist pump to pressure, and 2) select forward or reverse drive direction. Control Module logic is as follows:

a) Whenever power is turned on to the Module, it starts up in the "Disengaged" state.

b) The module "Engages" only if
- It is powered up,
- first gear has been selected,
- F-N-R Selector is in forward or reverse position
- and, the control button is pushed once. (The "ON" lamp will light.)

c) The Module "Disengages" if
- the control button is pushed again,
- the shift lever is taken out of first gear,
- or, the power is turned off. (The "ON" lamp will go off.)

Application of both vehicle brakes simultaneously will relieve the Rear Wheel Assist drive pressure by turning off the selector valve solenoid. The Assist "ON" lamp will remain lighted because the drive will be re-engaged after the brakes are released.

Moving the F-N-R selector to the neutral position will relieve the Rear Wheel Assist Drive pressure by turning off the selector valve solenoid. The Assist "ON" lamp will remain lighted.

Pressure switches mounted on the powershift transmission detect whether the transmission is in forward or reverse (or neutral if neither pressure is sensed). These switches control whether the Rear Wheel Assist is engaged in forward or reverse. Note that the Control Module does not directly control the forward-neutral-reverse operation of the Rear Wheel Assist.

ABNORMAL CONNECTIONS

Survival of the module under abnormal wiring conditions depends upon the proper installation of an 8 amp fuse in the power line as shown in Figure 7-10 & 7-11.

1. Reversing the Black (GND) and Red (B+) wires causes the 8 amp fuse to blow but no permanent damage to the module.

2. Reversing the Red (B+) and White (output) wires causes the solenoid to turn on all the time but no permanent damage to the module.

3. Reversing the Black (GND) and White (output) wires while in first gear and pressing the momentary switch causes the 8 amp fuse to blow, but no permanent damage.

4. Reversing ABCD completely to DCBA does nothing.

5. Applying 20 to 45 volts to Red (B+) causes the output to turn on but no permanent damage

INSTALLATION AND TESTING PROCEDURE

1. Remove Control Handle assembly from Panel.

2. Install Magnet assembly on 1-2-3 gear shift lever by placing the assembly against the flat bottom portion of the lever such that the Magnet faces toward the F-N-R lever.

3. Use one screw and lock washer provided to fasten Magnet assembly.

4. Insert Module and bracket assembly between side supports on the Control Handle assembly such that the Module is on the left side of the magnet.

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

CONTROL MODULE (cont.)

INSTALLATION AND TESTING PROCEDURE (cont.)

5. Use three screws with lock washers to fasten, two on the left and one on the right side.

6. When the gear shift lever is in 1st, the magnet should be beside the Control Module. The gap should be less than 3/16 inch, but more than 1/16 inch.

7. Put Control Handle assembly back into panel but do not connect the Module to the harness.

8. Check the wiring harness before connecting the Module as follows:

A. Connect the Test Box to the harness.

B. Turn the Key to "ON" but do not start engine.

C. The Green light on the Test Box should be ON.

If it is NOT On, do NOT continue this procedure until the problem is fixed. Check the 8 amp fuse in the Test Box if no harness problem can be found.

D. Press and hold the Selector button on the Control Panel. The Yellow lamp on the Test Box should come On. If it does NOT come On, do NOT continue this procedure until the problem is fixed.

E. Push and hold the momentary switch on the Test box. Notice the Rear Wheel Assist "ON" Lamp remains On while the switch is held. Release the switch and notice the Rear Wheel Assist "ON" Lamp is Off.

CAUTION: The following tests must be performed with the engine running. THE WHEELS OF THE VEHICLE WILL BE TURNING.

CAUTION: JACK THE VEHICLE UP AND BLOCK SECURELY WITH ALL FOUR WHEELS CLEAR BEFORE STARTING ENGINE.

CAUTION: KEEP ALL PERSONNEL CLEAR OF VEHICLE WHILE ENGINE IS RUNNING.

F. Place transmission in NEUTRAL and start the engine. Press and Hold the momentary switch on the Test Box. IF THE ASSIST WHEELS TURN, LOOK FOR A SHORTED FORWARD OR REVERSE PRESSURE SWITCH.

The green light on the Test Box should be On. If it is NOT, the fuse in the Box is blown and a short to ground exists in the harness from the brake switches. Repair before proceeding.

G. Place transmission in FORWARD. Press and Hold momentary switch. THE WHEELS SHOULD MOVE IN THE FORWARD DIRECTION. Step on both brakes and note the wheels stop turning. Release momentary switch on the Test Box.

The green light on the Test Box should be On. If is is NOT, the fuse in the Box is blown and a short to ground exists in the harness from the forward pressure switch. Repair before proceeding.

H. Place transmission in REVERSE. Press and Hold momentary switch. THE WHEELS SHOULD MOVE IN THE REVERSE DIRECTION. Release momentary switch.

The green light on the Test Box should be On. If it is NOT on the fuse in the Box is blown and a short to ground exists in the harness from the reverse pressure switch. Repair before proceeding.

9. TURN OFF the vehicle and remove the Test Box.

10. Connect up the Control Module and verify that the control operates in FIRST GEAR ONLY (transmission must be in forward or reverse) . To do this, turn the key on, push the Selector botton twice and see that the Rear Wheel Assist "ON" lamp goes On and Off in first gear. Place gear select in second, push Selector button, and see that the Rear Wheel Assist "ON" lamp does not go On. Also check third gear to make sure the Rear Wheel Assist "ON" lamp does not go On.

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

SELECTOR VALVE

DESCRIPTION

The Selector Valve is a dual solenoid activated, spring return, open center, 3-way valve. A solenoid valve cartridge is assembled to the selector valve subplate. See Figures 3-1 and 3-2 in Section 3 for location of the selector valve on the machine.

When the rear wheel assist is engaged the solenoid corresponding to either the forward or reverse position of the gear selector will activate, pulling the valve spool to one side, causing hydraulic flow through the valve to the rear wheel assist.

The solenoid valve cartridge, which is ported to the load compensator line, will cause the pump to work up to, and maintain, hydraulic pressure equivalent to the pressure (3000 psi) set by the load sensing control of the piston pump so that pressure becomes balanced between the pump pressure line and the load compensator line, while the rear wheel assist is engaged.

When the rear wheel assist is disengaged, the activated solenoid becomes de-activated, causing the valve spool to return to center, resulting in a drop in pump flow.

MAINTENANCE

The Selector Valve requires no scheduled maintenance.

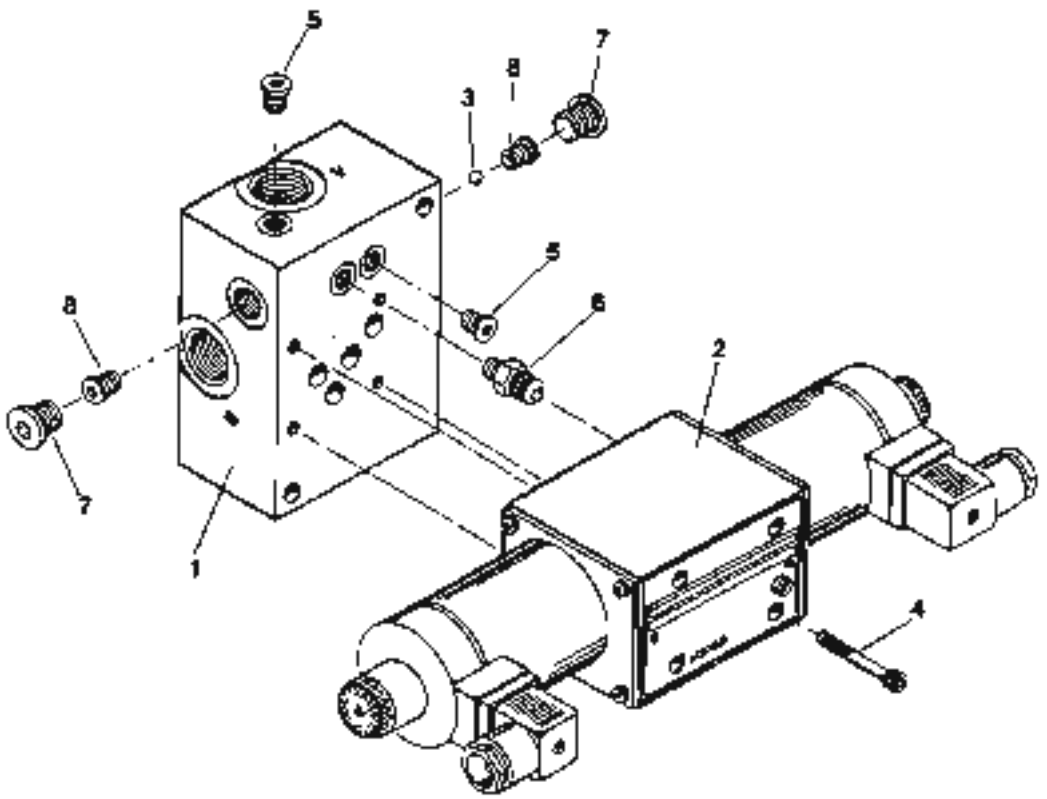
OVERHAUL (Figure 7-5)

Refer to "Overhaul" on page 3-33-1 in Section 3 for Valve Overhaul Procedures.

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

SELECTOR VALVE (cont.)



1 - Valve Subplate

2 - Selector Valve

3 - Ball Bearing, 1/4" Dia.

4 - Socket Head Cap Screw, 1/4-20 x 1 3/4 (4)

5 - Plug, 02 ORB-M (3)

6 - Adapter, 02 ORB-M x 04 JIC-M

7 - Plug, 06 ORB-M (2)

8 - Plug, Check Valve (2)

Figure 7-13 Selector Valve Subassembly

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

EQUATRAC VALVE

NOTE: The Equatrac Valve for early and late production models is the same. See "Equatrac Valve" on page 7.5-1 for description, maintenance, and overhaul.

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

WHEEL MOTOR

DESCRIPTION (Figures 7-14 & 7-15)

The hydraulic wheel motors used on the auxiliary drive are of a cam lobe design which, in general, utilize pressurized hydraulic oil to force pistons and their matching rollers against machine-formed lobes to produce mechanical power under full displacement.

The components of the wheel motor that transform hydraulic power (pressure, flow) into mechanical power (torque, rotation) consist of the cylinder block and cam lobe ring.

The cylinder block houses 10 radially-spaced pistons (and rollers). The block is mounted to the splined wheel shaft and is positioned inside the cam ring. The pistons within the cylinder block are fitted with piston rings to ensure high (volumetric) efficiency.

The hydraulic oil provided to the pistons is routed through a distributor which supplies the pressurized oil to the pistons in the proper timing sequence. A bladder-type rubber accumulator mounted within the cylinderical opening of the distributor, absorbs any sudden high pressure surges which may be experienced within the wheel motor.

When the rear wheel drive system is engaged, hydraulic oil under high system pressure is delivered from the control valve and supplied equally, through the Equatrac Valve, to the high pressure ports at the wheel motors.

To change the direction of rotation of the motor, the input supply of high pressure oil is directed through the (reverse) high pressure port and is diverted through the distributor of the motor in a manner opposite that of the forward rotation of the motor.

When the rear wheel drive system is disengaged, the selector valve spool returns to neutral, stopping oil flow through the valve

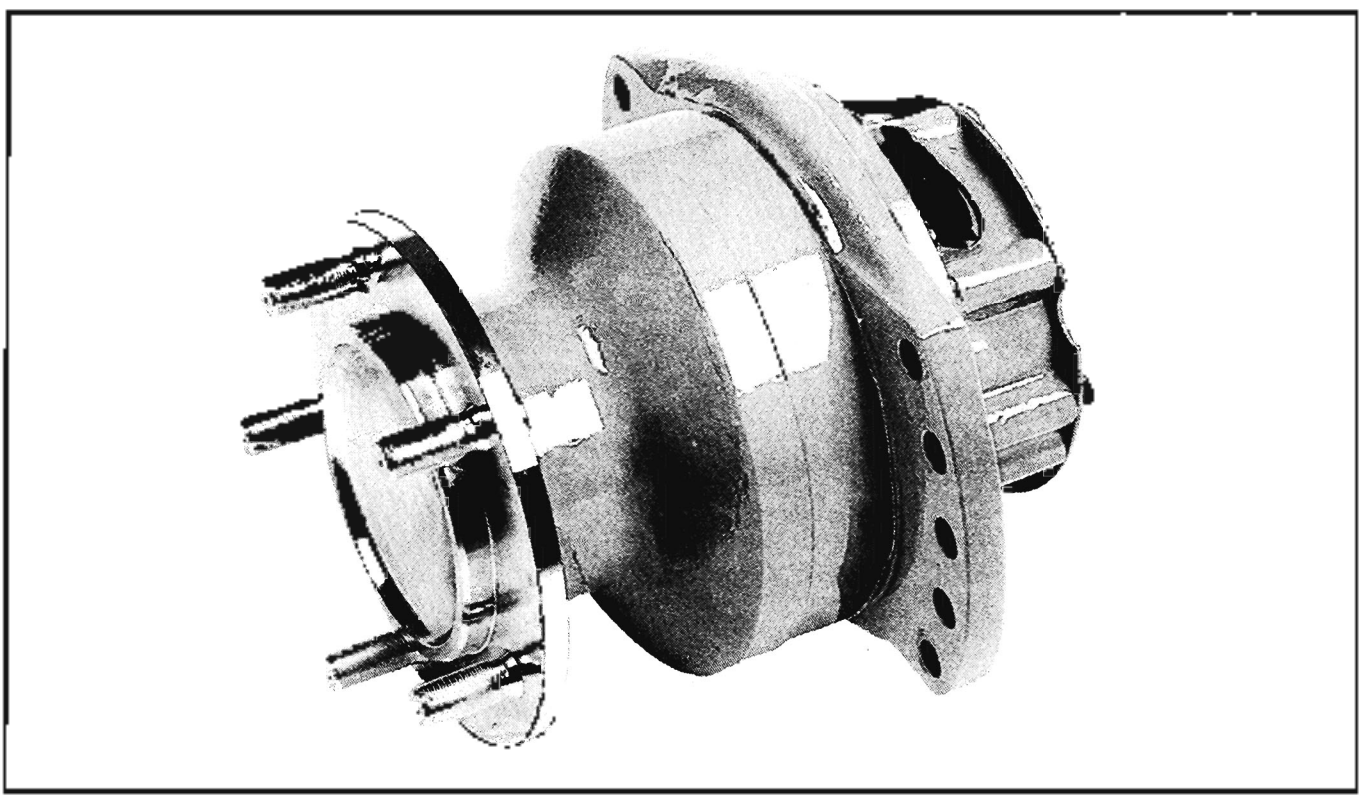


Figure 7-14 Wheel Motor

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 824

WHEEL MOTOR (cont.)

DESCRIPTION (cont.)

Motors Basic Working Principle

Breakdown of the piston/lobe sequences:

First piston position

To start the cycle, oil is led under pressure to the valve assembly, passes through it and pushes the piston. Moved by the pressure, the roller pushes down on the cam lobe and causes the cylinder block to rotate.

Second piston position

As the piston descends, supply pressure passes through a maximum opening, then diminishes.

Third piston position

When the piston reaches the bottom of the lobe, the oil supply is cut off. Drive power stops. This is neutral position. Another piston must take over the first one and make it climb the following lobe.

Fourth piston position

When the piston starts its climb, oil can excape to the reservoir through a port being opened in the valve assembly. This is the beginning of the discharge cycle.

Fifth piston position

A piston continues its climb, port in the valve assembly progressively enlarges, then a progressive closing of the discharge hole takes place. When it has reached the top of the lobe (neutral position), the piston wil repeat the previous cycle. The direction of rotation of the motor can be changed by reversing the input of the supply.

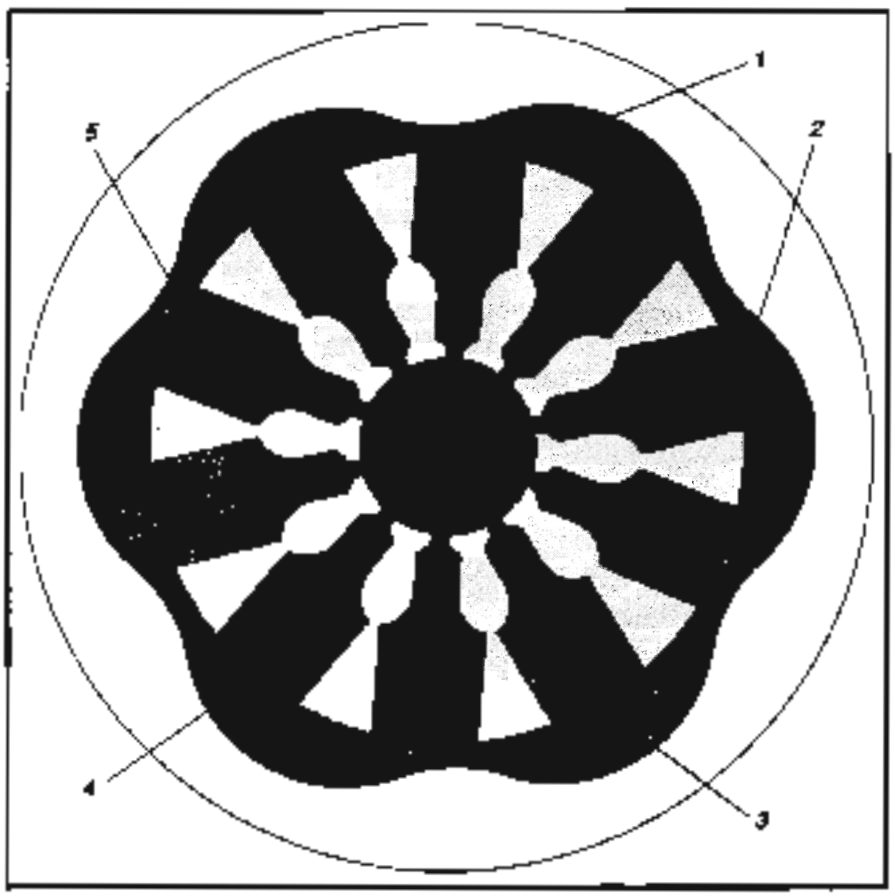


Figure 7-15 Motor Diagram

MAINTENANCE

The wheel motor assembly requires no scheduled maintenance, except that its performance will rely on a properly maintained hydraulic system. Periodically check motor mountings and check for leaks.

REAR WHEEL POWER ASSIST

LATE PRODUCTION MODELS 522/4, 622/4, 624

WHEEL MOTOR (cont.)

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
1. Motor does not rotate or rotates sluggishly.	No pressure	Equatrac Valve damaged
	Excessive internal damage	Check condition of cylinder block assembly and distributer
2. External oil leaks	Motor case pressure too high	a. Check to make sure that case drain lines to motors and drain line to reservoir are NOT blocked, pinched or kinked. b. Seals within motor damaged by pressure spikes, elevated operating temperature, use of fluid not approved or contaminants in oil. c. Check condition of accumulator in motor. d. Wheel motor incorrectly assembled or defective.

OVERHAUL

Wheel motor overhaul procedures are detailed in the

Technical Manual available from the wheel motor manufacturer or Lull Corporation.

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ENGINE MAINTENANCE

Engine maintenance procedures are detailed in the Engine Operator's Manual supplied by the engine manufacturer. Refer to the manufacturer's service literature for specifications, maintenance, lubrication, tune-ups and adjustments.

Lull's recommended service intervals are given in the Service Schedules in Section 2.

ENGINE OVERHAUL

Engine overhaul procedures are detailed in the Engine Workshop Manual available from the engine manufacturer or Lull Corporation.

ENGINE TROUBLESHOOTING

The following is to be used as a guide for determining the possible cause of engine trouble.

HARD TO START OR WILL NOT START

* Improper starting prodecure.
* No fuel.
* Crankcase oil too heavy.
* See "Low Battery Output", "Low Battery Charge", "Sluggish Starting Motor Operation" and "Starting Motor Will Not Operate" in Section 13: ELECTRICAL TROUBLESHOOTING.

RUNS IRREGULARLY OR STALLS FREQUENTLY

* Low coolant temperature.
* Clogged fuel filter.
* Water, dirt, or air in fuel system.
* Dirty or faulty injection nozzles.
* Improper type of fuel.

KNOCKS

* Insufficient oil.
* Injection pump out of time.
* Low coolant temperature.
* Engine overheating.

HIGH FUEL CONSUMPTION

* Improper type of fuel.
* Clogged or dirty air cleaner.
* Engine overloaded.
* Improper valve clearance.
* Injection nozzles dirty
* Injection pump out of time.
* Engine not at proper temperature.

BELOW NORMAL COOLANT TEMPERATURE

* Defective thermostat.

LACK OF POWER

* Engine overloaded.
* Intake air restriction.
* Clogged fuel filter.
* Improper type of fuel.
* Overheated engine.
* Below normal engine temperature.
* Improper valve clearance.
* Dirty or faulty injection nozzles.
* Injection pump out of time.

OVERHEATING

* Engine overloaded.
* Low coolant level.

TROUBLESHOOTING (cont.)

OVERHEATING (cont.)

* Loose or defective fan belts.
* Dirty cooling system or radiator core.
* Cooling system needs flushing.
* Defective thermostat.
* Defective temperature gauge.

LOW OIL PRESSURE

* Low oil level.
* Improper type of oil.
* Partially plugged oil filter.

HIGH OIL CONSUMPTION

* Crankcase oil too light.
* Oil leaks.
* Engine overheats.

EMITS BLACK OR GRAY EXHAUST SMOKE

* Clogged or dirty air cleaner.
* Defective muffler.
* Improper fuel.
* Engine overloaded.
* Injection nozzles dirty.
* Engine out of time.

EMITS WHITE EXHAUST SMOKE

* Improper fuel.
* Cold engine.
* Defective thermostat.
* Engine out of time.

ENGINE

PERKINS (MODELS 522, 522/4)

DESCRIPTION (Figure 8-1, 8-2)

For description of engine, refer to "Engine", under "Specifications", for your model forklift in Section 1.

REMOVAL

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface. Lower the boom, apply the parking brake, and stop the engine.

3. Remove air filter inlet pipe.

4. Remove exhaust pipe.

5. Drain coolant from engine through block drain cock.

WARNING: Liquid cooling systems build up pressure as the engine gets hot. Before removing coolant caps, plugs or hoses, stop the engine and let the system cool. Remove caps, plugs or hoses after the coolant is cold.

6. Drain radiator through radiator drain cock.

7. Remove upper and lower radiator hoses at the engine.

8. Disconnect transmission cooling lines at the cooler. Plug lines to prevent loss of transmission fluid.

9. Remove radiator and shroud.

10. Disconnect battery cable from starter and battery.

11. Disconnect engine ground cable.

12. Disconnect cold start wire and ether tube.

13. Disconnect wire harness.

14. Disconnect fuel line to fuel pump and plug line end to prevent air from entering.

15. Disconnect return fuel line and plug line end to prevent air from entering.

16. Disconnect throttle cable.

17. Support the engine from above with suitable hoist and chains. Engine weight: Approximately 850 LBS.

18. Remove engine mount(s).

19. Remove transmission to engine mounting bolts.

20. Carefully pull engine away from transmission until torque converter clears transmission drive shaft and bell housing.

21. Raise engine clear of machine.

INSTALLATION

1. Reverse steps 3 through 21 above
NOTE: Follow 'Bolt Torque Specifications' in Section 1.

2. Refill systems with approved or recommended fluids.

3. Bleed the fuel system of air. Refer to the engine manufacturer's service literature for information on bleeding the fuel system.

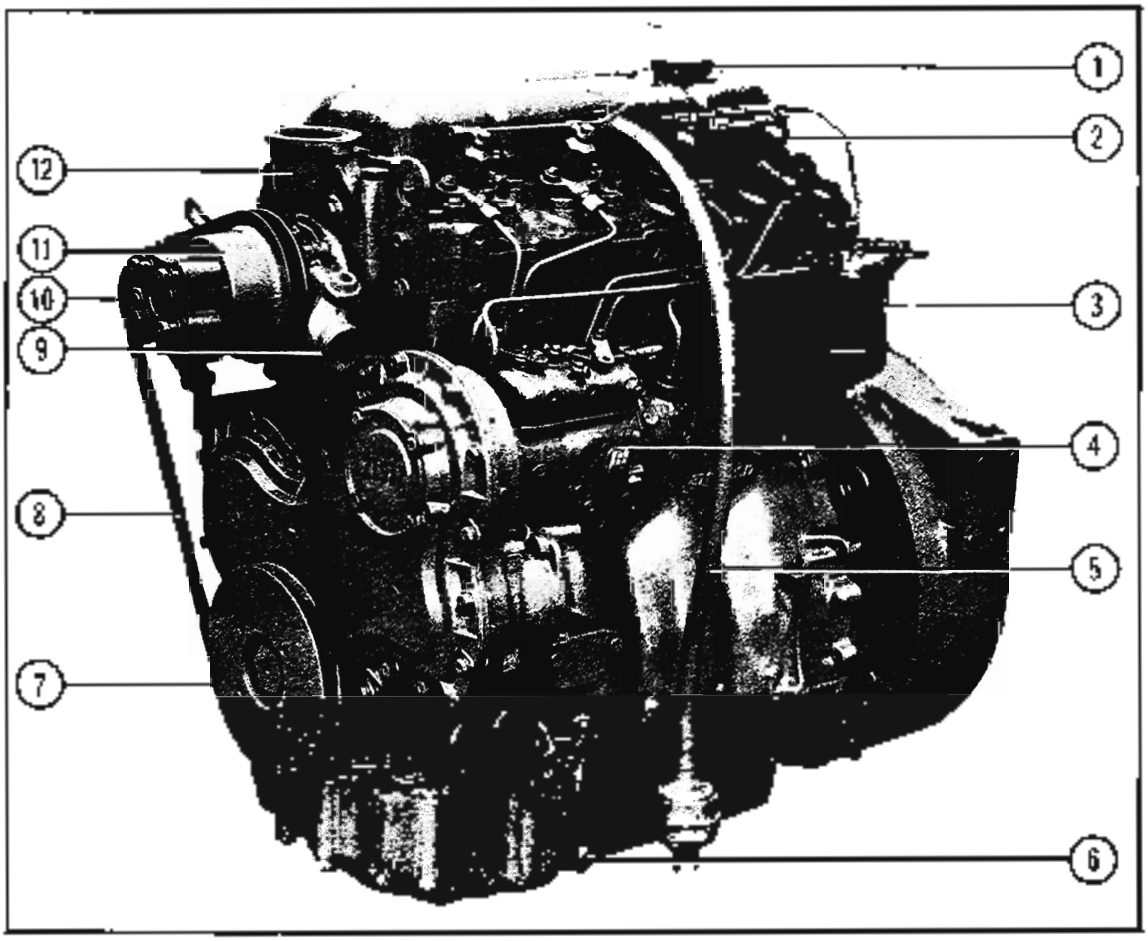
4. Start the engine and check for leaks.

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

5. Operate all controls and make sure the forklift is functioning properly. Road test the machine if necessary. After testing, shut down and recheck the work performed. Recheck all fluid levels before releasing machine for operation.

ENGINE

PERKINS (MODELS 522, 522/4)

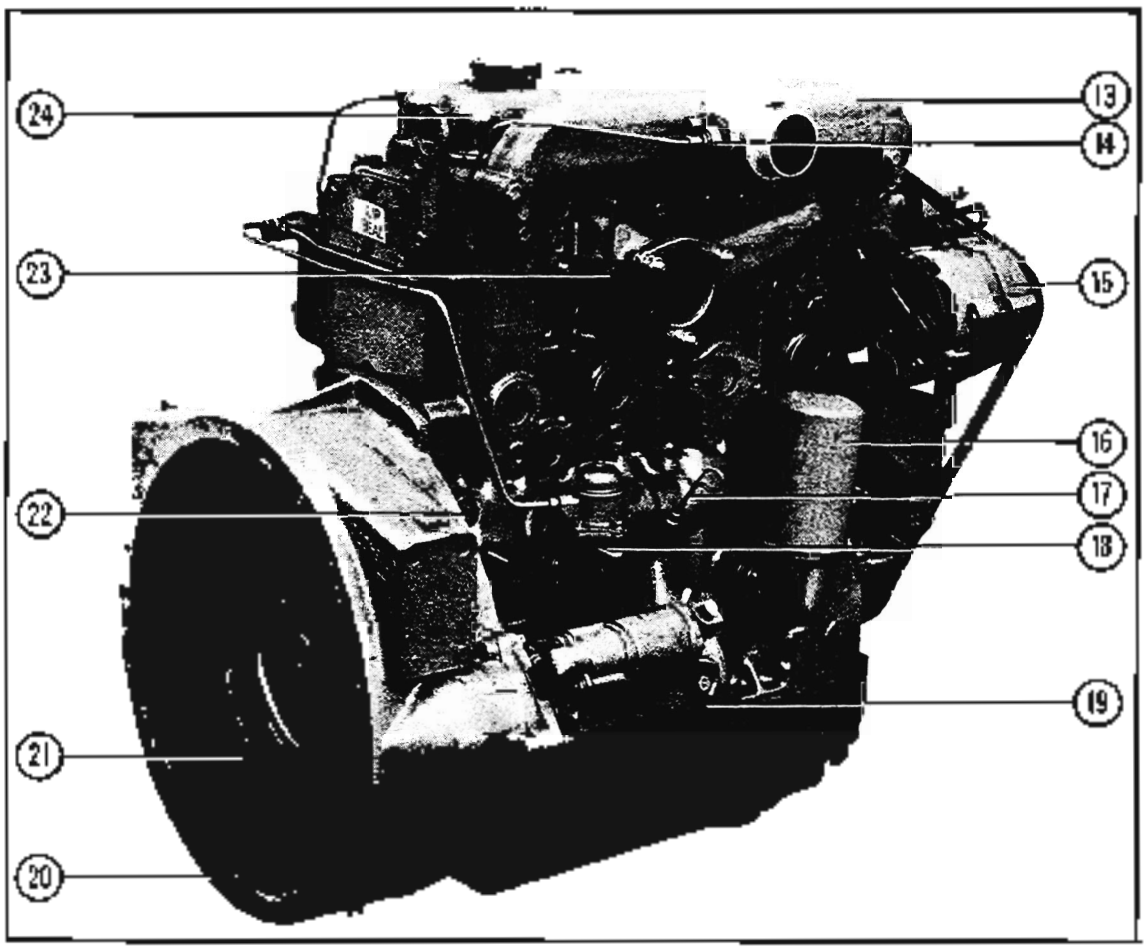


1 - Lubricating Oil Filler Cap
2 - Atomiser
3 - Fuel Filter
4 - Fuel Injection Pump
5 - Breather Pipe
6 - Sump Drain Plug
7 - Crankshaft Pulley
8 - Fan Belt
9 - Water Inlet
10 - Alternator Pulley
11 - Water Pump Pulley
12 - Thermostat Housing

Figure 8-1 Perkins 4.236 (Right Side)

ENGINE

PERKINS (MODELS 522, 522/4)



13 - Induction Manifold
14 - Thermostart
15 - Alternator
16 - Lubricating Oil Filter
17 - Dipstick
18 - Fuel Lift Pump
19 - Starter Motor
20 - Flywheel Housing
21 - Flywheel
22 - Cylinder Block Drain Plug (Right Hand Side)
23 - Exhaust Manifold
24 - Cylinder Head Cover

Figure 8-2 Perkins 4.236 (Left Side)

ENGINE

JOHN DEERE (MODELS 622, 622/4, 824)

DESCRIPTION (Figure 8-3; 8-4)

For description of engine, refer to "Engine", under "Specifications", for your model forklift in Section 1.

REMOVAL

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface. Lower the boom, apply the parking brake, and stop the engine.

3. Remove air filter inlet pipe.

4. Remove exhaust pipe.

5. Drain coolant from engine through block drain cock.

WARNING: Liquid cooling systems build up pressure as the engine gets hot. Before removing coolant caps, plugs or hoses, stop the engine and let the system cool. Remove caps, plugs or hoses after the coolant is cold.

6. Drain radiator through radiator drain cock.

7. Remove upper and lower radiator hoses at the engine.

8. Disconnect transmission cooling lines at the cooler. Plug lines to prevent loss of transmission fluid.

9. Remove radiator and shroud.

10. Disconnect battery cable from starter and battery.

11. Disconnect engine ground cable.

12. Disconnect cold start wire and ether tube.

13. Disconnect wire harness.

14. Disconnect fuel line to fuel pump and plug line end to prevent air from entering.

15. Disconnect return fuel line and plug line end to prevent air from entering.

16. Disconnect throttle cable.

17. Assemble (2) 1/2"-8 UNC lifting eyes at the two locations provided on the engine block.

18. Support the engine from above with suitable hoist and chains. Engine weight: Approximately 900 LBS.

19. Remove engine mount(s).

20. Remove transmission to engine mounting bolts.

21. Carefully pull engine away from transmission until torque converter clears transmission drive shaft and bell housing.

22. Raise engine clear of machine.

INSTALLATION

1. Reverse steps 3 through 22 above.
NOTE: Follow "Bolt Torque Specifications" in Section 1.

2. Refill systems with approved or recommended fluids.

3. Bleed the fuel system of air. Refer to the engine manufacturer's service literature for information on bleeding the fuel system.

4. Start the engine and check for leaks.

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

5. Operate all controls and make sure the forklift is functioning properly. Road test the machine if necessary. After testing, shut down and recheck the work performed. Recheck all fluid levels before releasing machine for operation.

ENGINE

JOHN DEERE (MODELS 622, 622/4, 824)

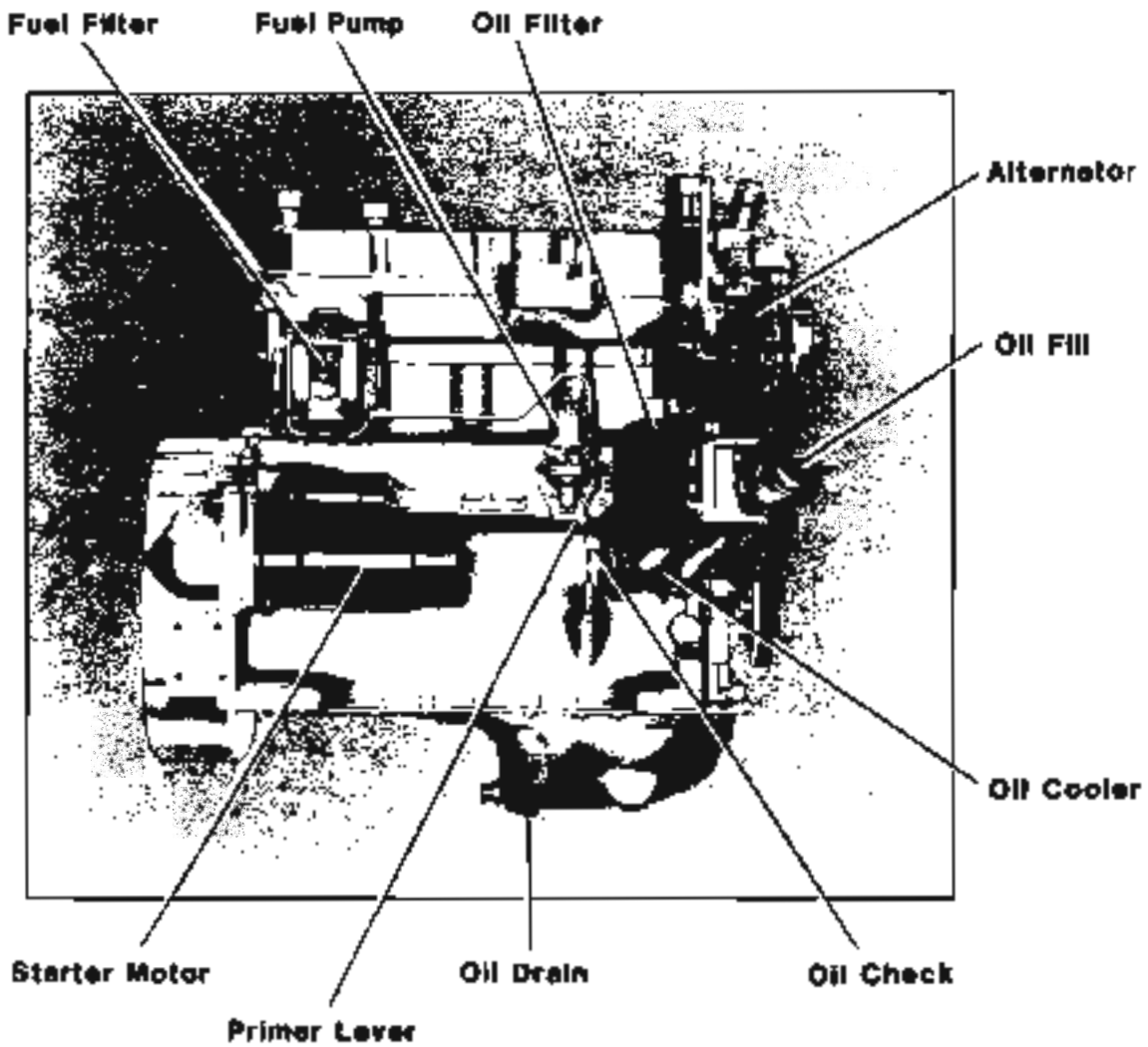


Figure 8-3 John Deere 4239D (Models 622, 622/4)

ENGINE

JOHN DEERE (MODELS 622, 622/4, 824)

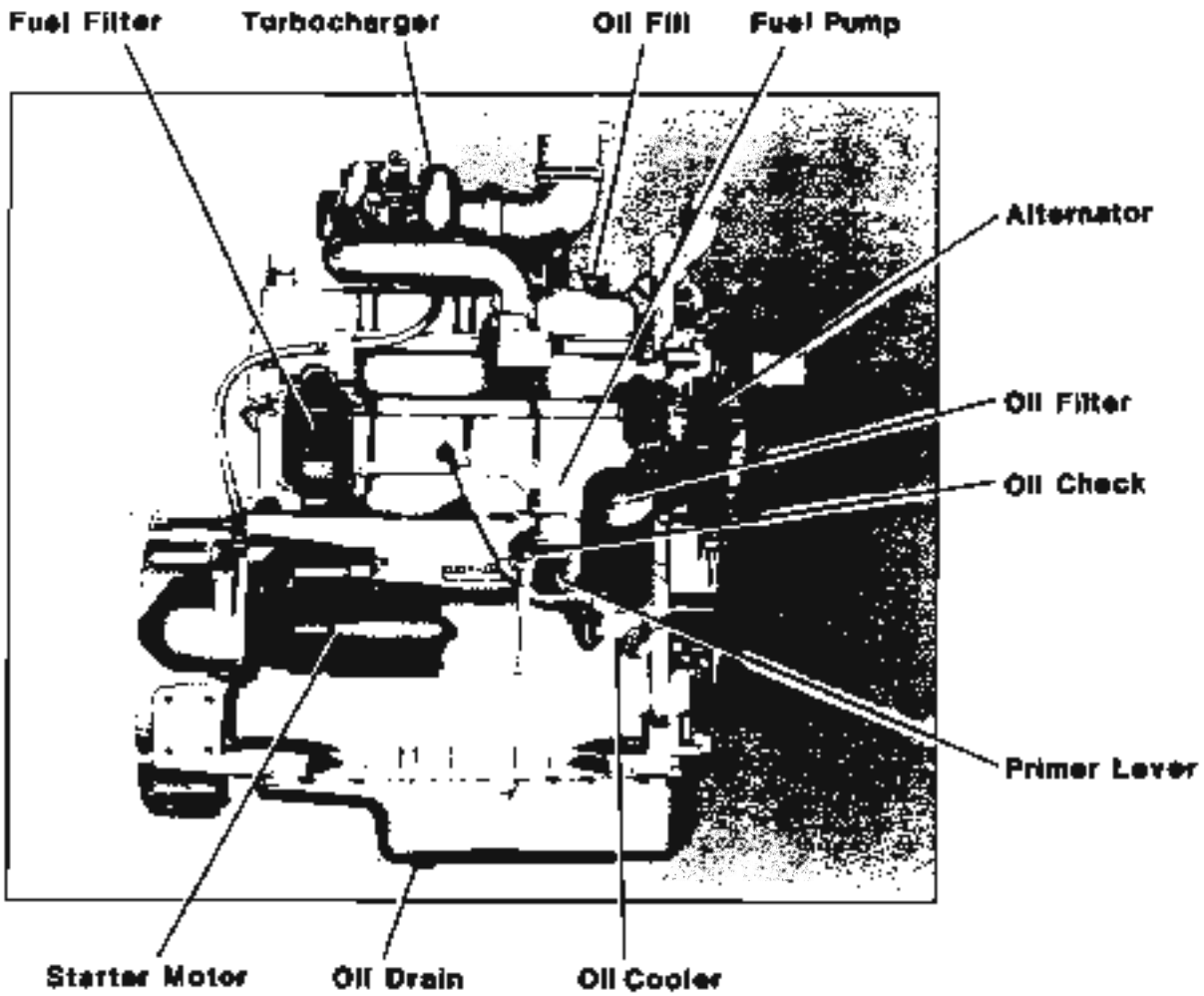


Figure 8-4 John Deere 4239T (Model 824)

ENGINE

DEUTZ (MODELS 622, 622/4)

DESCRIPTION (Figure 8-5)

For description of engine, refer to "Engine", under "Specifications", for your model forklift in Section 1.

REMOVAL

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine on a level surface. Lower the boom, apply the parking brake, and stop the engine.

3. Remove air filter inlet pipe.

4. Remove exhaust pipe.

5. Disconnect transmission cooling lines at the transmission cooler. Plug lines to prevent loss of transmission fluid.

6. Remove transmission cooler and shroud.

7. Disconnect battery cable from starter and battery.

8. Disconnect engine ground cable.

9. Disconnect cold start wire and ether tube.

10. Disconnect wire harness.

11. Disconnect fuel line to fuel pump and plug line end to prevent air from entering.

12. Disconnect return fuel line and plug line end to prevent air from entering.

13. Disconnect throttle cable.

14. Assemble (2) 1/2"-8 UNC lifting eyes at the two locations provided on the engine block.

15. Support the engine from above with suitable hoist and chains. Engine weight is approximately 900 LBS.

16. Remove engine mount.

17. Remove transmission to engine mounting bolts.

18. Carefully pull engine away from transmission until torque converter clears transmission drive shaft and bell housing.

19. Raise engine clear of machine.

INSTALLATION

1. Reverse steps 3 through 19 above.

NOTE: Follow "Bolt Torque Specifications" in Section 1.

2. Refill systems with approved or recommended fluids.

3. Start the engine and check for leaks.

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

4. Operate all controls and make sure the forklift is functioning properly. Road test the machine. After testing, shut down and recheck the work performed. Recheck all fluid levels before releasing machine for operation.

ENGINE

DEUTZ (MODELS 622, 622/4)

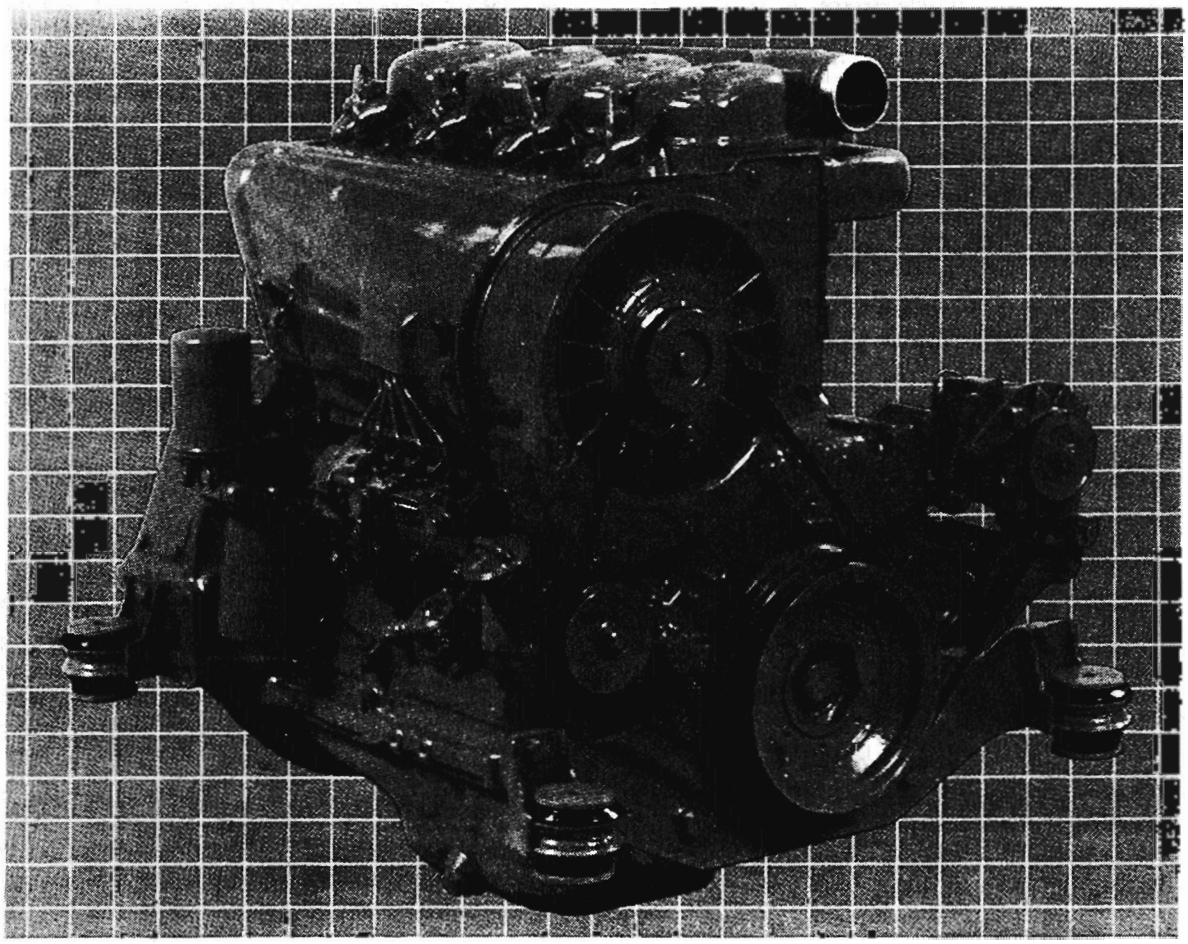


Figure 8-5 Deutz F4L912 (Models 622, 622/4)

ENGINE

COOLING SYSTEM

DESCRIPTION

The cooling system consists of a radiator, pressure cap, fan, water pump, thermostat, coolant hoses, drive belts and pulleys. The purpose of the cooling system is to transfer heat from the engine to the radiator to dissipate the heat to the outside air. Coolant is circulated in the engine water jacket and through the radiator by the water pump which is of the centrifugal vane impeller type. The thermostat opens and closes to control the flow of coolant to the radiator. The hoses carry the coolant to and from the radiator. The belt-driven fan draws cool air through the radiator to dissipate coolant heat. The pressure cap is designed to hold a pressure above atmospheric pressure in the cooling system.

MAINTENANCE

RADIATOR

The radiator must be cleaned if it becomes clogged to the point where light cannot be seen through any portion of the radiator core. Blow out thoroughly with compressed air, then steam clean radiator if facilities are available. Apply the air or steam to the side opposite normal air flow. Be careful not to bend the radiator fins. If fins are bent, straighten carefully. This is important.

The radiator cap gasket and filler neck seat must also be checked to be sure that they are providing the proper coolant seal. If the rubber face of the valve is damaged, a new radiator cap having a 7 PSI pressure rating must be installed. Always inspect the overflow tube for restrictions. A plugged or damaged tube may prevent the cap from venting excess pressure.

HOSES

Inspect hoses every 500 hours for cracks, hardening, softening and swelling. Replace hoses that show any signs of deteriation.

CHECKING THE COOLING SYSTEM FOR AIR LEAKS

Remove the radiator cap and start the engine. Look down the filler neck with the engine running at idle speed. Air leaks in the system will cause bubbles to rise to the surface of the coolant. If bubbles are present, check the lower hose and water pump seal for leakage. Make sure that all defective components are replaced.

CHECKING THE COOLING SYSTEM FOR WATER LEAKS

Pressurize the radiator to 7 PSI. If pressure remains steady for five minutes, with no water leaks, the system is properly sealed. Be sure to inspect hose connections, water pump and all radiator surfaces for coolant leaks with the system pressurized.

FLUSHING THE SYSTEM

Rust in the radiator or coolant indicates that the corrosion inhibitor has lost its effectiveness. This can be avoided by draining and flushing the system at 1000 hour intervals. For effective flushing, remove the radiator hoses and the thermostat. Open the engine drain cock and allow block to drain. Close the drain cock and reverse flush the block as shown in Figure 8-6. Reverse flush the radiator as shown in Figure 8-7 then add coolant as required.

ENGINE

COOLING SYSTEM

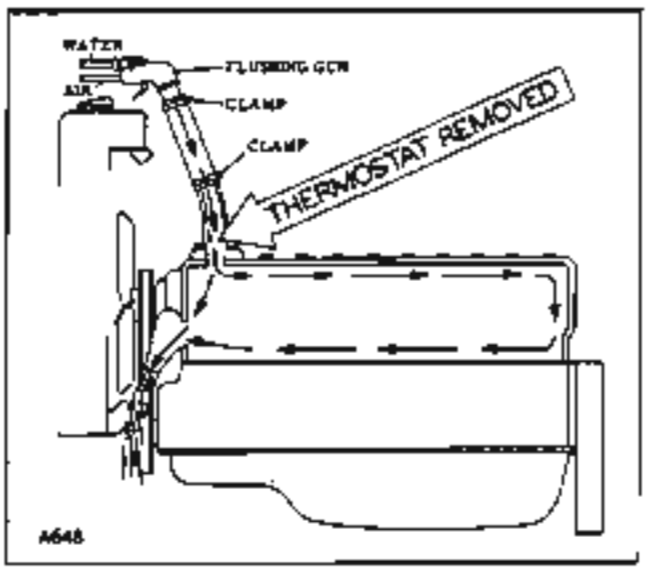


Figure 8-5 Reverse Flushing Engine

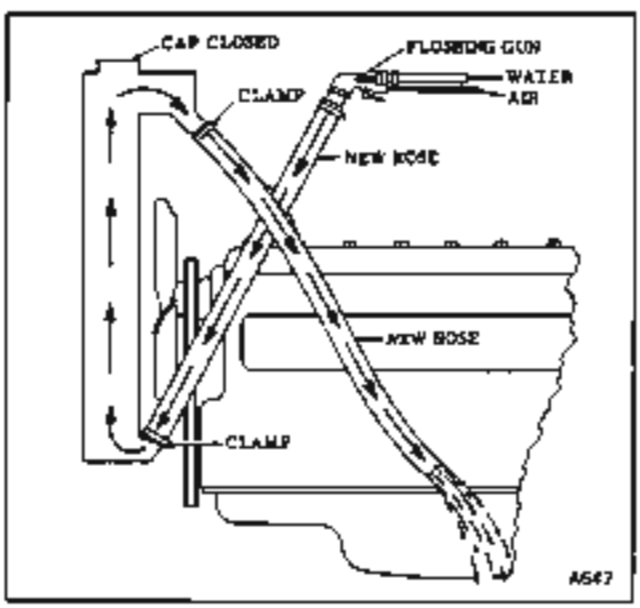


Figure 8-7 Reverse Flushing Radiator

ENGINE

FUEL SYSTEM

DESCRIPTION

The fuel system consists of the fuel tank, filter, fuel pump, and the fuel injectors. All components except the fuel tank are installed on the engine.

FUEL TANK

The steel fuel tank/hydraulic reservoir is located on the right side of the machine. Two connections on top of the tank provide for fuel supply to the engine and return of surplus fuel from the engine. The tank is equipped with a lock-type filler cap and a fuel quantity sender unit which provides a signal to a quantity indicator on the instrument panel in the cab.

FUEL PUMP

The John Deere engine has a fuel transfer pump and a fuel injector pump. The transfer pump supplies fuel to the injector pump which supplies the fuel under high pressure to the injectors.

The Deutz engine has a fuel lift pump and a fuel injector pump. The lift pump supplies fuel to the injector pump which supplies the fuel under high pressure to the injectors.

The diesel fuel is finely atomized as it is injected into the cylinder and ignited by the heat of the compression. It is metered also, before injection, to meet the load requirements imposed upon the engine.

Surplus fuel, returning from the injectors, is bypassed back to the fuel tank. The continuous flow of fuel through the injectors helps to cool the injectors and to bypass air from the system.

FUEL FILTER-WATER SEPARATOR

The fuel filter-water separator removes water from the fuel before it reaches the engine.

The fuel mixture passes through the outer wrap of the first stage of the filter paper, where large droplets of water are formed as it is stripped from the fuel. The water falls out into the void between the two paper elements and goes to the reservoir in the bottom of the housing, where it can be drained through a petcock at the bottom of the housing.

FUEL FILTERS AND STRAINER

The John Deere engine uses a replaceable element type filter in the fuel system to remove impurities from the fuel. This filter is installed in the system between the pump and fuel injectors and operates under pressure.

The Deutz engine uses a spin-on type fuel filter. The spin-on filter cartridge consists of a shell, element, and gasket combined into a unitized-replacement assembly. The filter is installed in the system between the pump and fuel injectors and operates under pressure.

MAINTENANCE

The fuel system requires very little maintenance if the fuel is clean when placed in the fuel tank. The filter used in the fuel system should be changed at 500 hour intervals. The fuel tank should be drained and cleaned periodically to keep it free of water and sediment. Refer to the applicable engine manual for procedure for changing fuel filters and strainers.

CAUTION: Fill the fuel tank in a well ventilated area, away from smoking materials, open flames or exposed heater parts, with the engine off.

The machine is shipped with fuel in the tank. The reason for this is to eliminate the need to bleed the injector system of air. With the system full of fuel, the chances of air entering the system are almost non-existent, unless the engine is allowed to stand for a long period of time.

If the engine runs roughly for the first hour of operation, the problem will likely be air in the fuel system. Refer to the engine manufacturer's service literature for information on bleeding the fuel system of air.

The fuel tank should be kept filled, especially overnight, to reduce condensation to a minimum.

ENGINE

AIR INTAKE SYSTEM

DESCRIPTION (Figure 8-8)

The engine air intake system consists of an air cleaner and associated piping for channeling the air from the atmosphere to the engine intake manifold. The intake pipe also provides a service indicator to indicate a dirty air cleaner.

The air cleaner is the dry-type with a replaceable element. A service indicator, designed to indicate red when servicing is required, is used on this system.

TROUBLESHOOTING

Dust passing the air cleaner, even through small holes, can cause rapid engine wear. Ensure all connections between the air cleaner and the engine are tight and sealed. If these connections are all well sealed, and there is still evidence of dust leakage, check the following places for possible trouble.

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. Any damaged parts must be replaced.

5. Inspect the restriction indicator tap for leaks.

If the initial restriction on a new or clean filter reads above the maximum allowed for the engine (service indicator shows red) 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.

FILTER ELEMENT REPLACEMENT

When the service indicator shows red it will most likely indicate a filter element that requires cleaning or replacement. Otherwise, clean filter element at 100 hour intervals and replace at 1000 hour intervals.

IMPORTANT: NEVER SERVICE THE AIR CLEANER WHILE THE ENGINE IS RUNNING.

1. Loosen the hex head bolt on the clamp band and remove the clamp band and baffle.

2. Remove the thumbscrew and washer; then withdraw the element.

3. Clean the element as outlined in ELEMENT CLEANING.

4. Inspect all parts of the intake system and air cleaner.

5. Install the cleaned or new element into the air cleaner body, securing it with the washer and thumbscrew.

6. Ensure the O-ring around the air leaner body is in place and not damaged.

7. Install the baffle on the air cleaner body with the two arrows pointing up. Secure with the clamp band and tighten the hex head bolt.

ELEMENT CLEANING

Washing in a water-detergent solution or blowing out with compressed air are two accepted methods for cleaning the element of the air cleaner. If the element contains substantial amounts of soot or oil fumes, washing in water works better than compressed air. If the contaminant is found to be mostly loose dust, either method works equally well.

ENGINE

AIR INTAKE SYSTEM

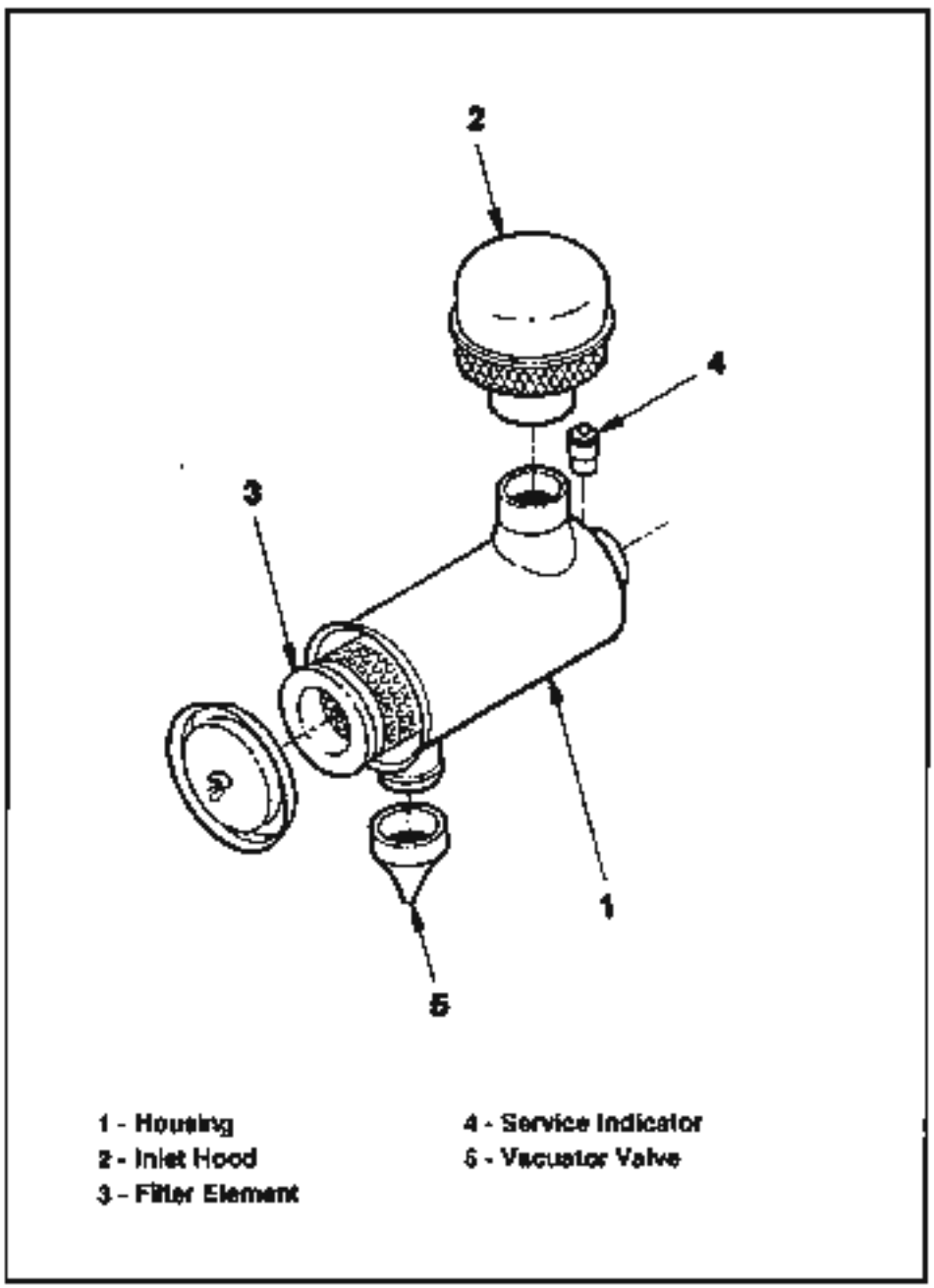


Figure 8-8 Air Filter Arrangement

ENGINE

AIR INTAKE SYSTEM

FILTER ELEMENT REPLACEMENT (cont.)

If cleaned with compressed air, elements can be put back into service immediately; however, if cleaned by washing, elements must be dried before returning them to service.

NOTE: Some elements are partially covered by a plastic sleeve with fins. The covered portion can be cleaned with water or air without removing the sleeve. Use a stiff fiber (not wire) brush to remove oil and grease deposits from the sleeve and fins. Never remove the sleeve and fins from the element

CLEANING WITH COMPRESSED AIR

IMPORTANT: PRESSURE AT THE AIR NOZZLE MUST NOT EXCEED 100 PSI.

1. Direct a jet of clean, dry air from the inside of the filter element, perpendicular to the pleats.

2. Move the air jet up and down along the pleats, slowly rotating the element, until no more dust is being removed. Do not rupture the element with the nozzle or the air jet.

CLEANING WITH WATER

1. The elements can be cleaned by washing with water and a good non-sudsing detergent. Direct a jet of clean, dry air from the inside of the filter element. When the loose dust and soot have been removed, the element is ready to be washed.

IMPORTANT: NEVER USE GASOLINE OR SOLVENTS TO CLEAN THE ELEMENTS.

2. Dissolve the detergent in a small amount of cool water.

3. Add warm water (approximately 100° F. [38° C]) to get the proper porportions of detergent and water (about one cup of detergent to five gallons of water).

4. Soak the element in the solution for at least 15 minutes.

5. Agitate the element for about two minutes to loosen the dirt.

IMPORTANT: WATER PRESSURE FROM A HOSE OR TAP SHOULD NOT EXCEED 40 PSI.

6. Rinse the element with clean water until the water coming through the element is clean. Air-dry the element thoroughly before using.

IMPORTANT: HEATED AIR (MAXIMUM TEMPERATURE 160° F.) MUST HAVE CIRCULATION. DO NOT USE LIGHT BULBS FOR DRYING ELEMENTS.

7. Mechanized drying methods can be used.

INSPECTION

IMPORTMENT: DO NOT TOUCH THE INSIDE OF THE FILTER WITH A BARE LIGHT BULB

After cleaning the filter element, inspect the element for damage. Look for dust on the clean air side, the slightest rupture, or damaged gaskets. A good method to use to detect ruptures in the element is to place a light inside the element and look toward the light from the outside. Any hole in the element, even the smallest, will pass dust to the engine and cause unnecessary engine wear. Element replacement is recommended if such holes are evident.

AIR CLEANER BODY

Before installing the filter element, remove any foreign material (leaves, lint or other foreign matter) that may have collected inside the air cleaner body. Inspect the inside of the body for dents or other damage that would interfere with air flow or with the fins on the element or inside the body. Repair any body dents, being careful not to damage the sealing surfaces.

VACUATOR VALVE

Vacuator valves are designed to expel loose dust and dirt accumulations from the air cleaner body automatically, thus lengthening the element service life. The valve lips must point straight down to operate effectively, and must be kept free from debris. Mud and chaff can lodge in these lips periodically and hold them open during engine operation.

ENGINE

AIR INTAKE SYSTEM

FILTER ELEMENT REPLACEMENT (cont.)

VACUATOR VALVE (cont.)

Check the condition of the valve and lips frequently and keep them clean. The valve lips should be open only when the engine is shut down, or running at low idle speed. If the valve is turned inside out, check for a clogged air cleaner inlet. Malfunction of this valve does not reduce the air cleaner effectiveness, but does allow the element to get dirty faster and reduces serviceable life. If a valve is lost or damaged, replace it with a new valve of the same part number.

DUCT WORK

1. Check the intake pipe cap and screen for accumulation of leaves, trash, and other debris that could restrict air flow. Repair the screen or replace the cap if any large holes are found in the screen.

2. Check all mounting hardware for security to eliminate possible vibration of intake piping. Such vibration leads to early failure of hoses, clamps, and mounting parts, and can cause hoses to slip off the connecting pipes, allowing unfiltered air into the engine air intake.

3. Check hoses for cracks, chafing, or deterioration, and replace at the first sign of possible failure.

TRANSMISSION

INDEX

LIST OF FIGURES

TRANSMISSION

CLARK TRANSMISSION (MODELS 522, 522/4)

DESCRIPTION

The HR-1600 Model consists of a torque converter and powershifted transmission in one package mounted directly to the engine.

The shift control valve assembly is mounted directly on the side of the converter housing. The function of the control valve assembly is to direct oil under pressure to the desired directional and speed clutch. The speed and direction clutch assemblies are mounted inside the transmission case and are connected to the output shaft of the coverter by direct gearing. The purpose of the speed or directional clutches is to direct the power flow through the gear train to provide the desired speed range and direction.

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 cover for actuating the direction and speed clutches. This requires a small portion of the total volume of oil used in the 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 stator support to the converter blade cavity and exits in the passage between the turbine shaft and converter support. The oil then flows out of the converter to the oil cooler. After leaving the cooler, the oil is directed to a lubricating fitting on the transmission and through a series of tubes and passages lubricates the transmission bearings and clutches. The oil then gravity drains to the transmission sump.

The hydraulic 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 reaction member is the means by which the hydraulic torque converter multiplies torque.

The reaction member of the torque converter is located between and at the center or inner diameters of the impeller and turbine elements. Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element.

The torque converter will multiply engine torque to its designed maximum multiplication ratio when the output shaft is at zero RPM. Therefore, we can say that as the output shaft is decreasing in speed the torque multiplication is increasing.

The shift control valve assembly consists of a valve body with selector valve spools. A detent ball and spring in the selector spool provides one position for each speed range. A detent ball and spring in the direction spool provides three positions, one each for forward, neutral and reverse.

With the engine running and the directional control lever is neutral position, oil pressure from the regulating valve is blocked at the control valve, and the transmission is in neutral. Movement of the forward and reverse spool will direct oil, under pressure to either the forward or reverse direction clutch as desired.

When either directional clutch is selected the opposite clutch is relieved of pressure and vents back through the direction selector spool. The same procedure is used in the speed selector.

TRANSMISSION

CLARK TRANSMISSION (MODELS 522, 522/4)

DESCRIPTION (cont.)

The direction or speed clutch assembly consists of a drum with internal splines and a bore to receive a hydraulically actuated piston. The piston is "oil tight" by the use of sealing rings. A steel disc with external splines is inserted into the drum and rests against the piston. Next, a friction disc with splines at the inner diameter is inserted. Discs are alternated until the required total is achieved. A heavy back-up plate is then inserted and secured with a snap ring. A Hub with O.D. splines is inserted into the splines of discs with teeth on the inner diameter. The discs and hub are free to increase in speed or rotate in the opposite direction as long as no pressure is present in that specific clutch.

To engage the clutch, as previously stated, the control valve is placed in the desired position. This allows oil under pressure to flow from the control valve, through a passageway, to a chosen clutch shaft. This shaft has a drilled passageway for oil under pressure to enter the shaft. Oil pressure sealing rings are located on the clutch shaft. These rings direct oil under pressure to a desired clutch. Pressure of the oil forces the piston and discs against the heavy back-up plate. The discs, with teeth on the outer diameter, clamping against discs with teeth on the inner diameter, enables the hub and clutch shaft to be locked together and allows them to drive as a unit.

There are bleed balls or bleed orifices, depending upon the model, in the clutch piston which allow quick escape for oil when the pressure to the piston is released.

SPECIFICATIONS AND SERVICE DATA - POWER SHIFT TRANSMISSION AND TORQUE CONVERTER (SERIES HR-1800)

CONTERTER OUT PRESSURE

Conterter outlet oil temp. 180° - 200° F. [82,3° - 93,3° C]
Transmission in NEUTRAL.
Operating specifications:
25 P.S.I. [1,76 Kg/cm$_2$] minimum pressure at 2000 R.P.M. engine speed AND a maximum of 70 P.S.I. [4,92 Kg/cm$_2$] outlet pressure with engine operating at no-load governed speed.

CONTROLS

Forward and Reverse - Manual
Speed Selection - Manual

CLUTCH TYPE

Multiple discs, hydraulically actuated, spring released, automatic wear compensation and no released, automatic wear compensation and no adjustment. All clutches oil cooled and lubricated.

CLUTCH INNER DISC

Friction.

CLUTCH OUTER DISC

Steel.

OIL FILTRATION

Full flow oil filter safety by-pass, also strainer screen in sump at bottom of transmission case.

CLUTCH PRESSURE

180 - 200 p.s.i. [12,7 - 15,4 kg/cm$_2$] - With parking brake set (see note), oil temperature 180 - 200°F (82.2-93.3°C), engine at idle (400 to 600 RPM), shift thru direction and speed clutches. All clutch pressure must be equal within 5 psi [0,4 kg/cm$_2$]. If clutch pressure varies in any one clutch more than 5 psi [0,4 kg/cm$_2$] repair clutch.

NOTE: Never use service brakes while making clutch pressure checks. Units having brake actuated declutching in forward and/or reverse will not give a true reading.

WARNING : ALWAYS USE PARKING BRAKE WHEN MAKING CLUTCH PRESSURE CHECKS.

TRANSMISSION

CLARK TRANSMISSION (MODELS 522, 522/4)

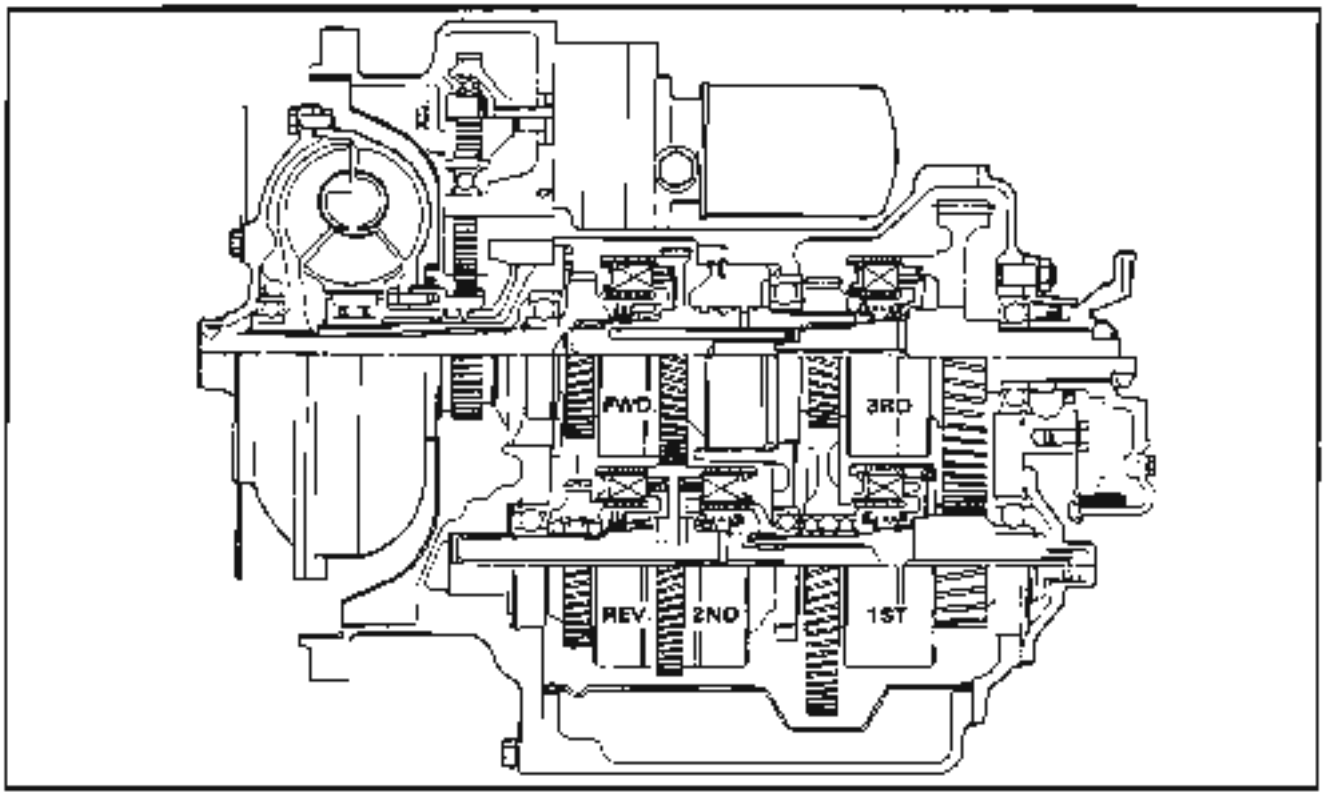


Figure 9-1 Clark Series HR-1800 - Basic Design

MAINTENANCE

1. The oil level must be checked daily with the engine running at idle and at operating temperature and the transmission in neutral. Fill to proper level.

2. Follow the recommended oil and filter change intervals as shown in the Service Schedule in Section 2. (It is recommended the oil and oil filter be changed whenever the oil shows traces of contamination, or the effects of high operating temperature evidenced by discoloration or strong odor.)

3. When changing the oil, the dirty oil should be drained while the unit is warm, examining for contamination as described above.

If the oil in the system has become contaminated with metal particles, all the components of the system (oil lines, oil pump, oil filter, control valve, clutches, converter, heat exchanger) must be thoroughly cleaned. Generally this means a tear down of the unit. The metal particles in the oil are evidence of failure of some part.

4. Fill the transmission using only approved oil per Service Schedule instructions in Section 2.

5. When servicing the unit for the first time after vehicle installation and/or after repair, the unit is filled as follows:

   a. Fill unit with the recommended fluid to LOW mark on dipstick.

   b. Start engine and run at idle speed for two minutes.

   c. With the engine at idle speed, add quantity necessary to bring oil level to FULL mark on dipstick.

6. Keep all controls properly lubricated.

7. If the radiator on the vehicle is drained for winter storage, the heat exchanger for transmission must also be drained.

TRANSMISSION

CLARK TRANSMISSION (MODELS 522, 522/4)

TROUBLESHOOTING

The following data is presented as an aid to locating the source of difficulty in a malfunctioning unit. It is necessary to consider the torque converter, charging pump, transmission, oil cooler, and connecting lines as a complete system when running down the soure of trouble since the proper operation of any unit therein depends greatly on the condition and operations of the others. By studying the principles of operation together with data in this section, it may be possible to correct any malfunction which may occur in the system.

TROUBLESHOOTING PROCEDURE BASICALLY CONSISTS OF TWO CLASSIFICATIONS: MECHANICAL AND HYDRAULIC

MECHANICAL CHECKS

Prior to checking any part of the system from a hydraulic standpoint, the following mechanical checks should be made:

1. A check should be made to be sure all control lever linkage is properly connected and adjusted at all connecting points.

2. Check shift levers and rods for binding or restrictions in travel that would prevent full engagement. Shift levers by hand at control valve, if full engagement cannot be obtained, difficulty may be in control cover and valve assembly.

HYDRAULIC CHECKS

Before checking on the torque converter, transmission, and allied hydraulic system for pressures and rate of oil flow, it is essential that the following preliminary checks be made:

Check oil level in transmission. This should be done with oil temperatures of 160 to 200° F [62.2-93.3° C]. DO NOT ATTEMPT THESE CHECKS WITH COLD OIL. To bring the oil temperature to this specification it is necessary to either work the machine or "stall" out the converter. Where the former means is impractical, the latter means should be employed as follows:

Engage shift levers in forward and high speed and apply brakes. Accelerate engine half to three-quarter throttle.

Hold stall until desired converter outlet temperature is reached.

IMPORTANT: FULL THROTTLE STALL SPEEDS FOR AN EXCESSIVE LENGTH OF TIME WILL OVERHEAT THE CONVERTER.

TRANSMISSION

CLARK TRANSMISSION (MODELS 522, 522/4)

TROUBLESHOOTING (cont.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
1. Low clutch pressure	A. Low oil level.	A. Fill to proper level.
	B. Clutch pressure regulating valve spool stuck open.	B. Clean valve spool and housing.
	C. Faulty charging pump.	C. Replace pump.
	D. Broken or worn clutch shaft or piston sealing rings.	D. Replace sealing rings.
	E. Clutch piston bleed valve stuck open.	E. Clean bleed valves thoroughly.
2. Low converter charging pump output	A. Low oil level.	A. Fill to proper level.
	B. Suction screen plugged.	B. Clean suction screen.
	C. Defective oil pump.	C. Replace pump.
3. Overheating	A. Worn oil sealing rings.	A. Remove, disassemble, and rebuild converter assembly.
	B. Worn oil pump.	B. Replace.
	C. Low oil level.	C. Fill to proper level.
4. Noisy converter	A. Worn oil pump.	A. Replace.
	B. Worn or damaged bearings.	B. A complete disassembly will be necessary to determine what bearing is faulty.
5. Lack of power	A. Low engine RPM at converter stall.	A. Tune engine check governor.
	B. See "Overheating" and make some checks.	B. Make corrections as explained in "Overheating".

TRANSMISSION

CLARK TRANSMISSION (MODELS 522, 522/4)

TROUBLESHOOTING (cont.)

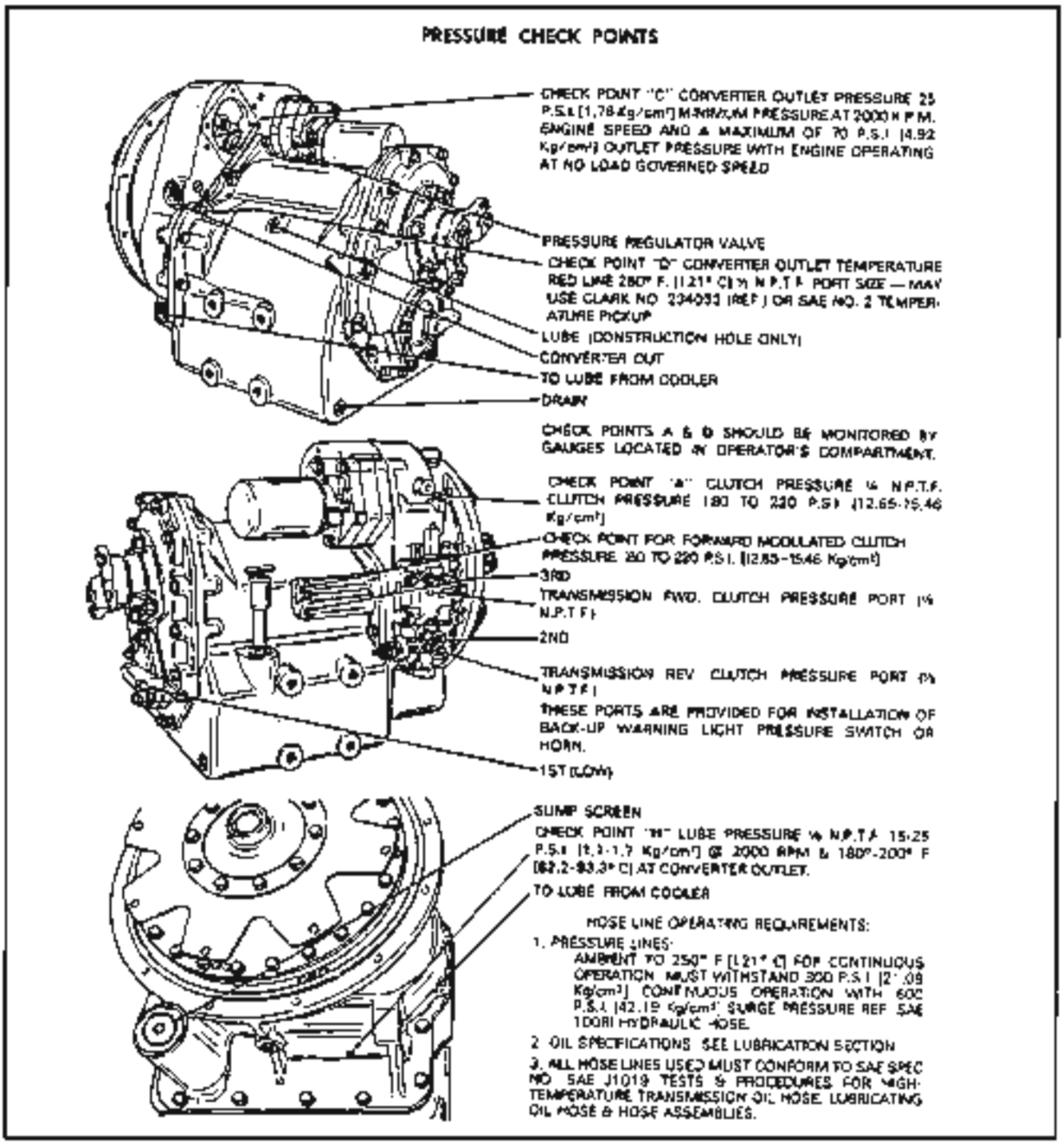


Figure 9-2 Clark Series HR-1800

TRANSMISSION

CLARK TRANSMISSION (MODELS 522, 522/4)

REMOVAL

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine, raise boom to allow for transmission removal and installation hoist.

3. Place transmission control lever in neutral, shut off the engine and block the tires.

4. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3.

NOTE: During Transmission Removal, cap all hoses and plug all ports to prevent contamination.

5. Drain transmission oil.

6. Drain hydraulic tank.

7. Disconnect 4 hoses from boom control valve and lay aside.

8. Disconnect throttle cable from engine fuel pump and lay aside.

9. Disconnect suction hose(s) from pump(s)

10. Disconnect all other hydraulic lines from pump(s) and transmission.

11. Remove piston pump (522/4).

12. Remove steering priority valve and bracket.

13. Remove hydraulic tube going to boom control valve.

14. Remove return manifold tube.

15. Remove the drive shaft.

NOTE: Remove the fastening hardware mounting the drive shaft to axle and transmission yokes. Then, loosen the drive shaft retaining collar and spearate the drive shaft in two. (Drive shaft aligning arrows must be realigned at assembly to insure proper balance.) This will allow the drive shaft to be removed from the transmission, axle and main frame.

16. Disconnect parking brake cable at axle and pull aside.

17. Disconnect ground strap (grounded to transmission bell housing).

18. Disconnect transmisison shift cables at transmission.

19. Remove shift linkage bracket from transmission.

20. Remove pressure switches from transmission.

21. Place a support under engine bell housing.

22. Connect overhead hoist to transmission at drive shaft yoke and at torque converter housing (use lifting eye).

23. Pull up slack on hoist connection.

24. Remove bolts connecting transmission to engine bell housing.

25. Remove (8) bolts holding transmisslon to mounting brackets.

26. Work transmission away from engine bell housing (approx. 4 1/2").

27. Lift transmission from machine.

INSTALLATION

1. Reverse steps 5 through 27 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Lines" in Section 1.

2. Refill systems with approved or recommended fluids.

3. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

CLARK TRANSMISSION (MODELS 522, 522/4)

INSTALLATION (cont.)

4. Operate all controls to make sure the forklift is functioning properly. Road test the machine. After testing, shut down and recheck the work performed. Recheck all fluid levels before releasing machine for operation

OVERHAUL

Transmission overhaul procedures are detailed in the transmission Assembly Manual available from the transmission manufacturer or Lull Corporation.

TRANSMISSION

FUNK SHORT DROP TRANSMISSION (MODELS 622, 622/4, 824)

DESCRIPTION (Figure 9-3)

The Series 4000 powershift is a forward and reverse transmission, with three speeds in either direction. Forward motion, reverse motion, and the three speeds are obtained through the use of hydraulically actuated multiple disc clutches. These clutches are power absorbing members that can be engaged at full engine power. Shifting under full power makes this model a full power shift for the forward and reverse motion in all three speeds.

The clutches in this unit are hydraulically applied and spring released. Because the clutches are hydraulically controlled, there is automatic compensation for normal wear which eliminates the need for adjustment. Each clutch uses paper graphitic friction plates and polished steel reaction plates.

The power from the engine is transmitted to the transmission through a torque converter. The use of the torque converter has two distinct advantages; (1) The converter is essentially a fluid drive, there being no direct mechanical connection through it. This feature creates a very smooth and shock-free drive eliminating engine stalling and lugging. (2) The converter multiplies torque during heavy pull down loads. When loads are light the converter transmits the engine power directly at almost engine speeds, and there is no torque multiplication. The net result is an action like a transmission, with infinitely variable and automatic speed ratios. The need for shifting gears, although present, is greatly reduced.

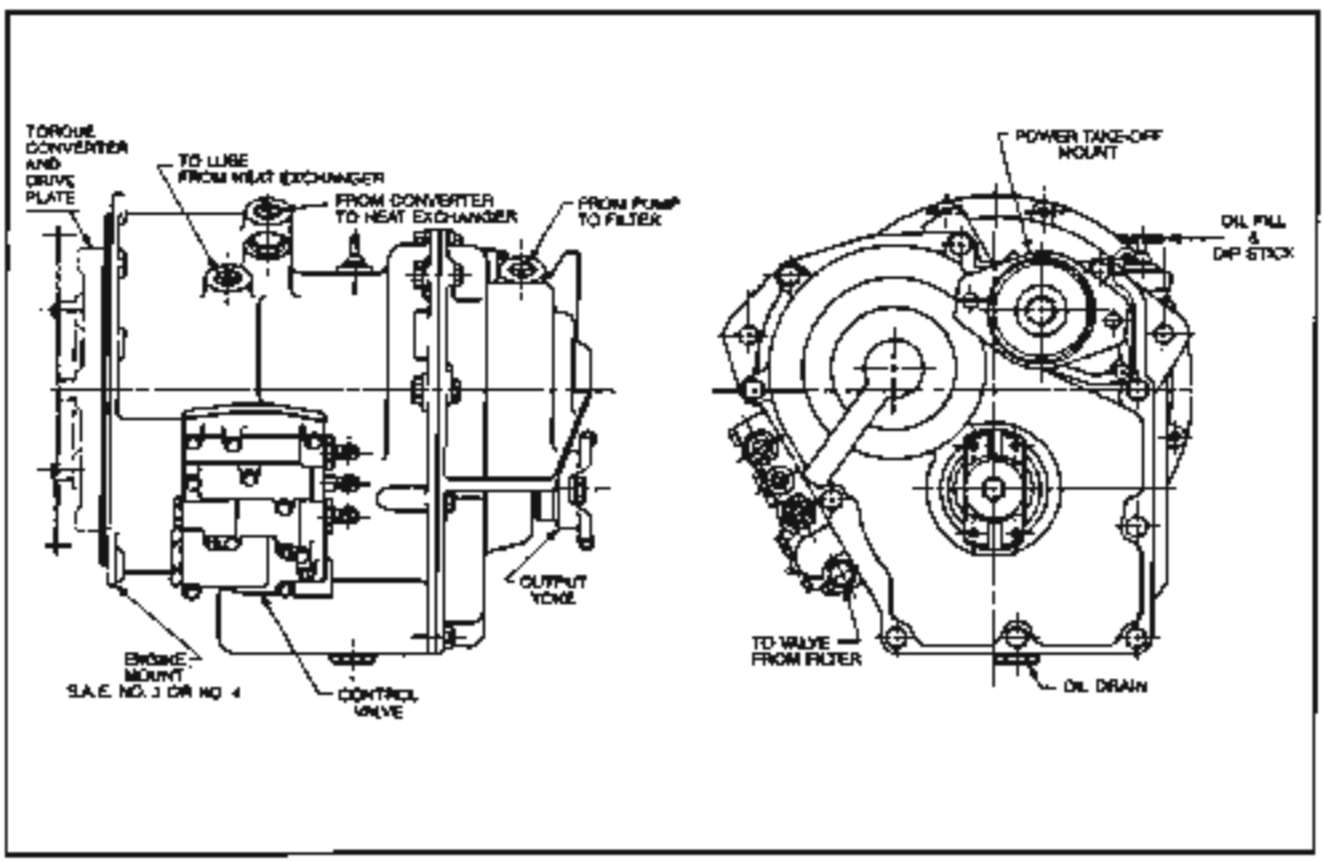


Figure 7-3 Funk Series 4000 Short Drop

TRANSMISSION

FUNK SHORT DROP TRANSMISSION (MODELS 622, 622/4, 624)

MAINTENANCE

1. The oil level must be checked daily with the engine running at idle and at operating temperature and the transmission in neutral. Fill to proper level.

2. Follow the recommended oil and filter change intervals as shown in the Service Schedule in Section 2. (It is recommended the oil and oil filter be changed whenever the oil shows traces of contamination, or the effects of high operating temperature evidenced by discoloration or strong odor.)

3. When changing the oil, the dirty oil should be drained while the unit is warm, examining for contamination as described above.

If the oil in the system has become contaminated with metal particles, all the components of the system (oil lines, oil pump, oil filter, control valve, clutches, converter, heat exchanger) must be thoroughly cleaned. Generally this means a tear down of the unit. The metal particles in the oil are evidence of failure of some part.

4. Fill the transmission using only approved oil per Service Schedule Instructions in Section 2.

5. When servicing the unit for the first time after vehicle installation and/or after repair, the unit is filled as follows:

   A. Fill unit with the recommended fluid to LOW mark on dipstick.

   B. Start engine and run at idle speed for two minutes.

   C. With the engine at idle speed, add quantity necessary to bring oil level to FULL mark on dipstick.

6. Keep all controls properly lubricated.

7. If the radiator on the vehicle is drained for winter storage, the heat exchanger for transmission must also be drained.

TRANSMISSION

FUNK SHORT DROP TRANSMISSION (MODELS 622, 622/4, 624)

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
1. Erratic oil pressure	A. Low oil level	A. Add oil to proper level
	B. Oil strainer cover gasket not sealing	B. Replace gasket
	C. Oil sump tube cracked	C. Replace oil sump tube and clean screen
	D. "O" ring on sump tube not sealing	D. Replace "O" ring and cover gasket
	E. Oil passage cover plate leaking	E. See parts or assembly manual
2. Excessive oil pressure at high speeds	A. Sticking main regulator valve	A. Check main regulator for contamination and clean orifice
	B. Faulty spring	B. Change spring
	C. Main regulator valve orifice plugged	C. Clean orifice hole in main regulator valve
3. Low oil pressure in all gears	A. Sticking main regulator valve	A. Check main regulator valve spring
	B. Oil pressure set too low	B. Add adjusting washers
	C. Faulty main regulator valve spring	C. Replace spring
	D. Control valve body cracked	D. Replace control valve body
	E. Primary pump defective	E. Replace pump
	F. "O" ring on primary pump mount defective	F. Replace "O" ring
4. Low oil pressure in one gear but alright in other gears	A. Broken seal ring on input end of clutch weld assembly piston shaft.	A. Replace seal ring
	B. Outer or inner piston seal not sealing	B. Replace piston seals
5. Low converter pressure	A. Converter bypass valve defective	A. Inspect converter bypass valve Replace if necessary
	B. Converter hub seal ring not sealing	B. Replace seal ring
6. Remote filter oil lines blow-out	A. Hose bends too sharp in routing	A. Re-route hoses
	B. Defective hose	B. Replace hose
	C. Low pressure hose	C. Use high pressure hose
	D. Hoses not connected correctly	D. Connect hose correctly
	E. Main regulator valve orifice plugged	E. Clean main regulator valve orifice

TRANSMISSION

FUNK SHORT DROP TRANSMISSION (MODELS 622, 622/4, 624)

TROUBLESHOOTING (cont.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
7. Clutch selected pressure does not return to normal	A. Excessive internal leakage to clutch	A. Complete tear down of transmission
	B. Main regulator valve spring weak	B. Replace main regulator spring
	C. Accumulator spring too strong	C. Replace spring
	D. Primary pump defective	D. Replace primary pump
8. Clutch does not release when brake cut-off valve is activated	A. No brake line pressure	A. Check brake system
	B. Brake cut-off pision sticking	B. Inspect and replace if necessary
9. Excessive noise at engine idle	A. Primary pump defective	A. Replace pump
	B. Excessive back-lash in gear train	B. Replace bearings and inspect for defective gears
10. Excessive gear noise at high speed (R.P.M.)	A. Same as item #10	A. Same as item #10
11 Transmission mounted filter blows out or "O" ring on filter blows out	A. Orifice on main regulator valve plugged	A. Clean orifice on main regulator valve
	B. "O" ring faulty	B. Replace filter
12. Blows oil out of breather on top of transmission	A. Converter seal ring broken	A. Remove transmission and install new seal ring on converter hub
13. Transmission Overheating	A. Converter stalling	A. Shift to lower gear
	B. Oil level too high	B. Drain to proper level
	C. Engine overheating	C. Check engine coolant
	D. Water lines defective on heat exchanger	D. Replace water lines
	E. Heat exchanger dirty	E. Flush and clean heat exchanger
	F. Low clutch oil pressure	F. Check clutch oil pressure
14. Transmission pressure check okay, but unit has no power	A. Converter sprag clutch jammed	A. Disassemble converter and inspect
	B. Converter sprag clutch installed wrong	B. See parts manual or assembly manual for correct information

TRANSMISSION

FUNK SHORT DROP TRANSMISSION (MODELS 622, 622/4, 824)

TROUBLESHOOTING (cont.)

Pump pressure is 245 PSI (1688 kPa) to 255 PSI (1757 kPa) at 2000 RPM.
The converter by-pass pressure is 30 PSI (207 kPa) to 40 PSI (276 kPa) at 2000 RPM.

TRANSMISSION CONTROL VALVE FUNCTION AND PRESSURE CHECK

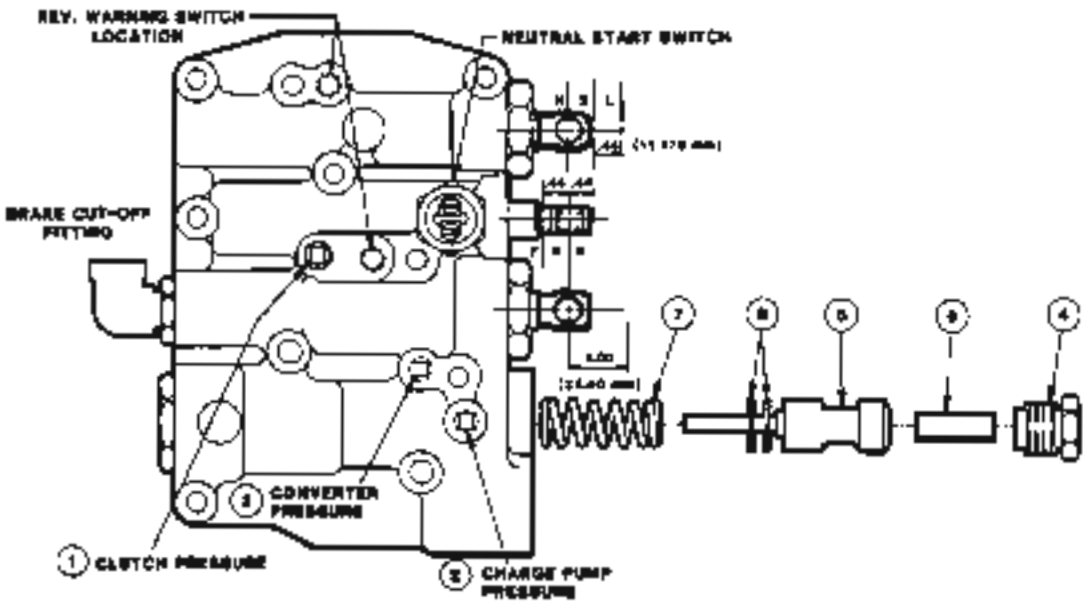


Figure 9-4 4000 Transmission Control Valve

The pressure checks are to be made with the transmission oil temperature at 170°F. or (76.7°C.) to 185°F. (85°C.)

STEP 1 - CLUTCH PRESSURE

A. Install a 300 PSI (2067 kPa) gauge in Port (Item 1).

B. Run engine at approximately 2000 RPM.

C. Engage each speed clutch forward and reverse, the clutch pressure should be within the span of 240 (1654 kPa) to 255 PSI (1757 kPa) for all clutches.

D. If all clutches have low pressure, the pressure regulator valve should be checked, and adjusted if necessary.

1. Remove cap (Item 4) and remove the pressure regulator valve (Item 5) dowel pin (Item 6) and spring (Item 7).
2. Check valve to be sure it works freely in the valve body.
3. The pressure can be raised by adding the #4004245 spacer ring (Item 8) as required, on the end of the valve next to the spring.

STEP 2 - CONVERTER CHARGE PRESSURE

A. Install a 100 PSI (689 kPa) gauge in Port (Item 3).

B. Run engine at approximately 2000 RPM.

C. The pressure should be within the span of 50 PSI (345 kPa) warm to 90 PSI (620 kPa) cold.

TRANSMISSION

FUNK SHORT DROP TRANSMISSION (MODELS 622, 622/4, 624)

REMOVAL

1. Carefully read "General Instructions" on pages 2.2-1 through 2.2-2 in Section 2. Follow all warnings and procedures to assure you are working with safe and efficient methods and conditions.

2. Position the machine, raise boom to allow for transmission removal and installation hoist.

3. Place transmission control lever in neutral, shut off the engine and block the tires.

4. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3.

5. Disconnect the emergency brake cable at the brake caliper actuating arm by removing the clevis pin.

6. Remove the drive shaft.

NOTE: Remove the fastening hardware mounting the drive shaft to axle and transmission yokes. Then, loosen the drive shaft retaining collar and separate the drive shaft in two. (Drive shaft aligning arrows must be realigned at assembly to insure proper balance.) This will allow the drive shaft to be removed from the transmission, axle and main frame.

7. Loosen the suction line hose clamps at the hydraulic reservoir and at the pump(s), and remove hose(s).

8. At the brake priority valve remove:

   a. The EF (Excess Flow) hose from the steering priority valve.

   b. The T (Tank) hose from the steering priority valve.

9. On rear wheel assist models, remove the following hoses at the piston pump:

   a. Pressure hose to rear wheel assist control valve subplate.

   b. Case drain hose.

   c. Pressure compensator signal hose.

10. At the valve section of the transmission, remove shift cables from valve and shift control bracket.

11. Tag and remove wire leads from reverse alarm sending unit.

12. Tab and remove wire leads from forward and reverse pressure switches (rear wheel assist models).

13. Drain transmission and reinstall the plug.

14. Remove pump support mounting bracket (rear wheel assist models).

15. Remove pump(s) and brake priority valve as one unit.

16. Remove wire lead and small tube from cold start unit. Then remove cold start unit and mounting bracket.

17. Remove wire lead from the transmission temperature sending unit.

18. At the transmission, remove both hoses going to the transmission cooler.

19. At the transmission, remove both hoses going to the transmission filter.

20. Remove the transmission filter and attached hoses from mounting bracket.

21. Using transmission removal bracket or hoist ring, support transmission from above with hoist. (NOTE: approx. weight of transmission is 550 lbs.)

22. Remove bolts which secure transmission mounting brackets to the main frame.

23. Hoist transmission approximately 1/2 inch. Position a block or floor jack under the engine bell housing to support the engine once the transmission is removed.

24. Remove transmission mounting bracket from transmission by removing four bolts each side.

25. Remove transmission to engine mounting bolts.

26. Carefully separate transmission from engine bell housing so as not to damage splines, torque convertor or torque convertor seal.

27. Lower transmission to floor.

TRANSMISSION

FUNK SHORT DROP TRANSMISSION (MODELS 622, 622/4, 624)

INSTALLATION

1. Reverse steps 5 through 27 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Lines" in Section 1.

2. Refill systems with approved or recommended fluids.

3. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

4. Operate all controls to make sure the forklift is functioning properly. Road test the machine. After testing, shut down and recheck the work performed. Recheck all fluid levels before releasing machine for operation.

OVERHAUL

Transmission overhaul procedures are detailed in the transmission Assembly Manual available from the transmission manufacturer or Lull Corporation.

BRAKES

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BRAKES

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BRAKES

SERVICE BRAKES (ALL MODELS)

DESCRIPTION (Figure 10-1)

The service brakes are hydraulically operated. When the power brake valve pedal, or pedals, are depressed, hydraulic flow from the power brake valve is directed through brake lines to the front axle. There is a right and left brake line which provides braking to either the right or left wheel, or both, depending on which brake pedals are engaged. Pistons within the axle extend under hydraulic pressure, compressing brake friction discs within the axle, which stop axle shaft rotation.

A brake priority valve, located at the hydraulic pump, provides consistent flow (2 gallons per minute at 700 psi) to the power brake valve (see "Brake Priority Valve" on page 3.46-1 in Section 3).

The power brake valve is a dual pedal type. The pedals may be operated independently by depressing either the right or left pedal; or by depressing the right and left pedals simultaneously. With the pedal lock in the locked position, both pedals will engage at the same time, using one foot.

NOTE: Single brake pedal travel is approximately double that of dual pedal travel when applying the brakes.

NOTE: On vehicles equipped with Rear Wheel Power Assist: The power assist will disengage when both brake pedals are depressed. This is accomplished when a brake pressure switch, or switches, which is or are teed into the brake lines, switch contacts when the pressure switch detects brake line pressure, disconnecting the power source to the power assist solenoid valve cartridge, resulting in power assist disconnect

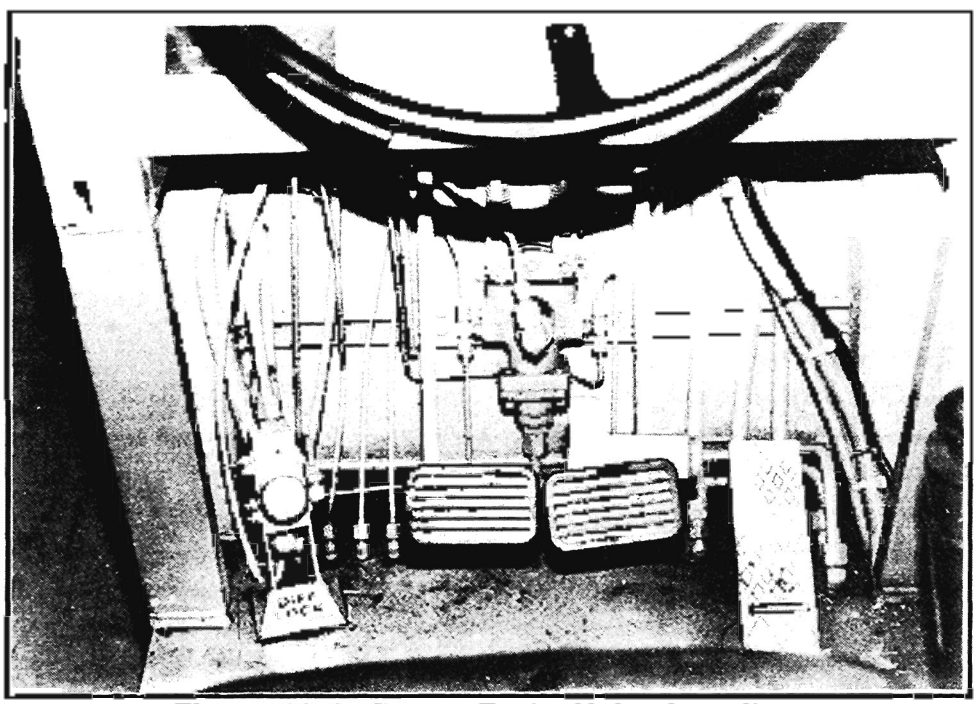


Figure 10-1 Power Brake Valve Location

BRAKES

SERVICE BRAKES (ALL MODELS)

DESCRIPTION (Cont.)

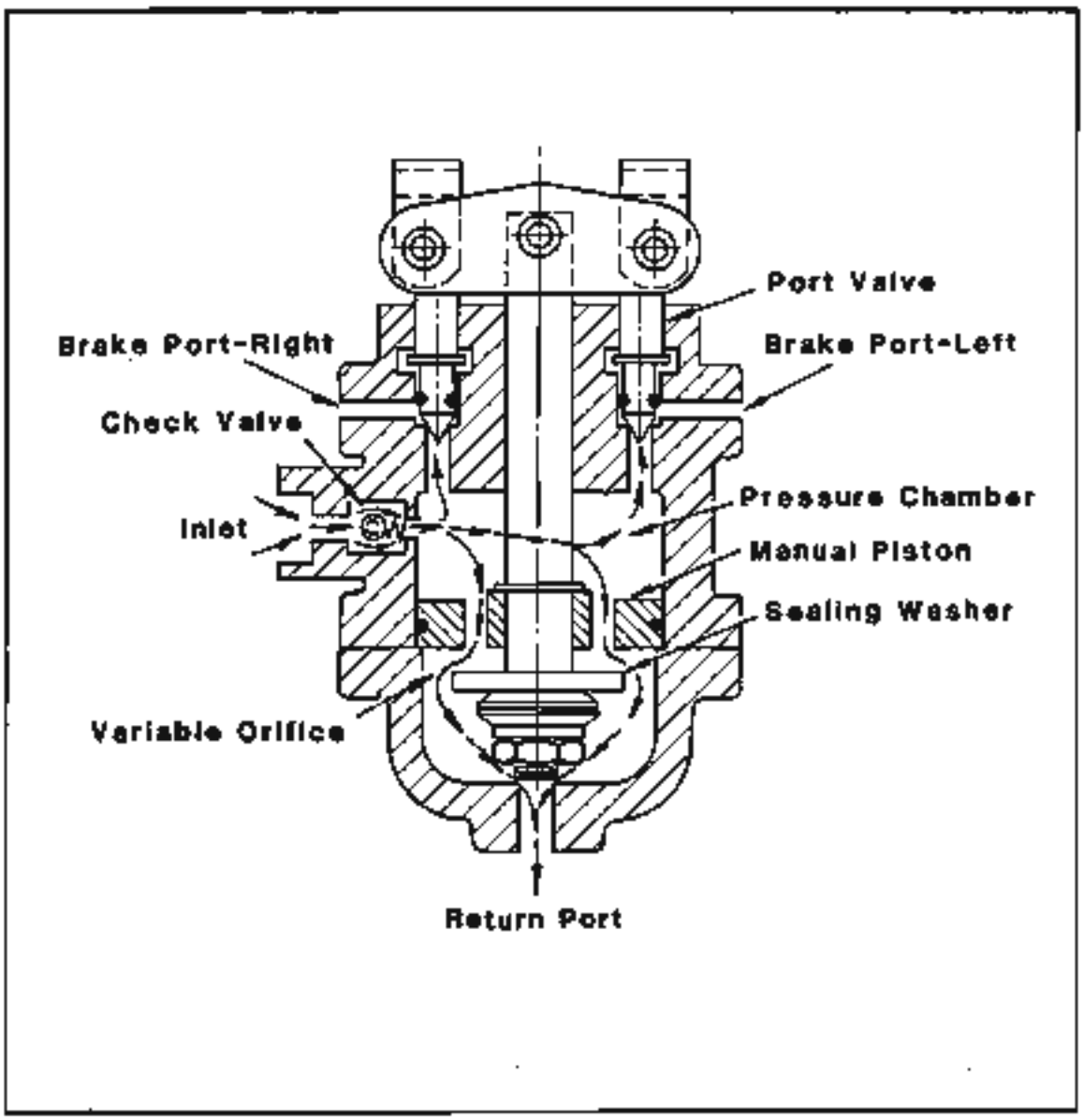


Figure 10-2 Flow with Brakes Not Engaged

BRAKES

SERVICE BRAKES (ALL MODELS)

DESCRIPTION (Cont.)

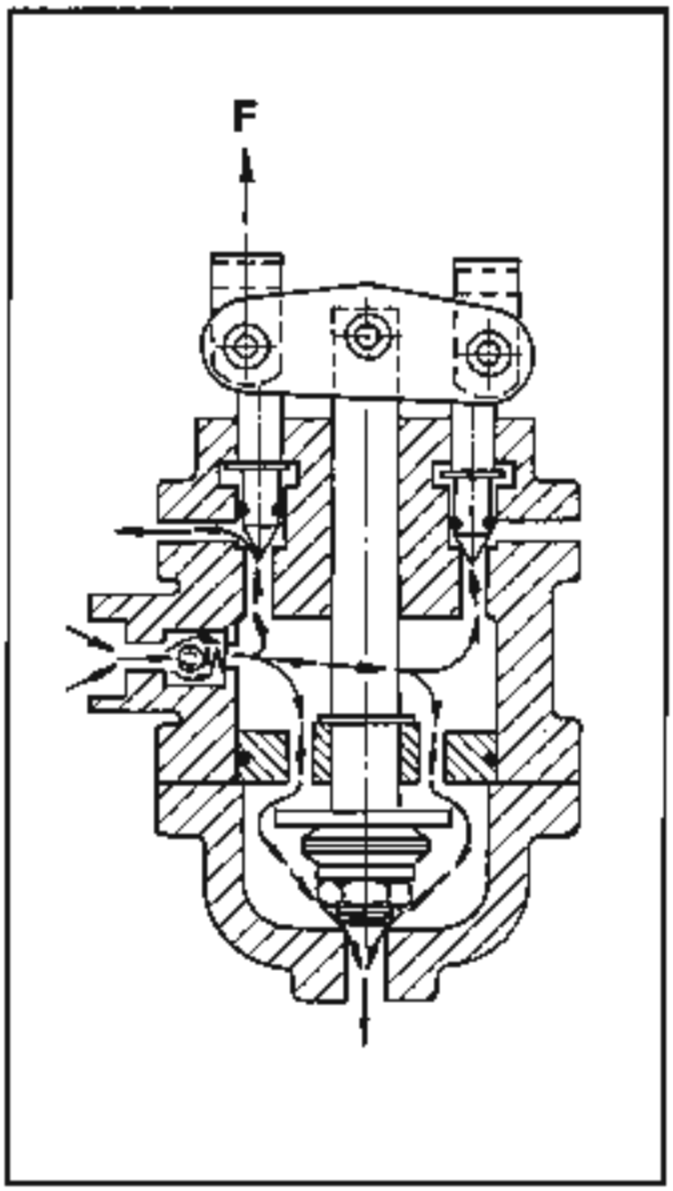


Figure 10-3 Power Mode to One Brake Line

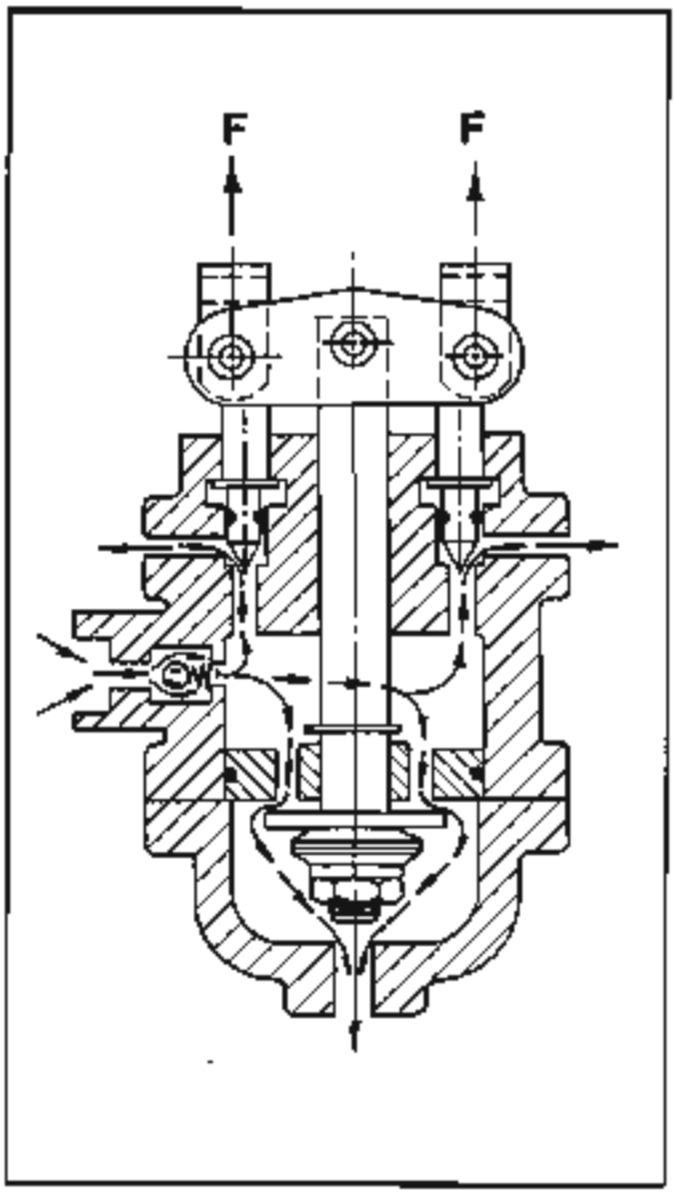


Figure 10-4 Power Mode to Both Brake Lines

SERVICE BRAKES (ALL MODELS)

DESCRIPTION (Cont.)

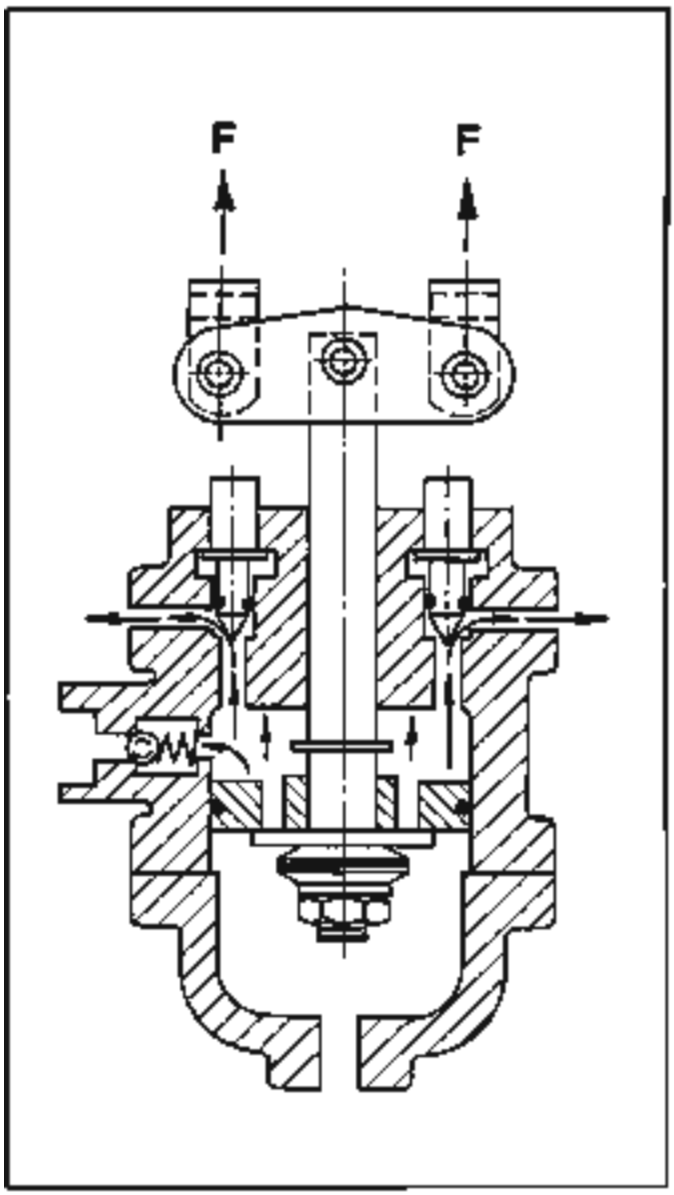


Figure 10-5 Manual Mode

How The Power Brake Valve Works:

The power brake is an open center type (which means hydraulic fluid flows through the valve whenever the engine is running).

When the engine starts, hydraulic flow causes the check valve to open. Hydraulic fluid flows into the valve body through the check valve into the pressure chamber, then flows through holes in the manual piston, past the variable orifice, out the return port to the reservoir. The variable orifice is an adjustable gap between the manual piston and the sealing washer. The service brake ports are connected to the pressure chamber (see Figure 10-2).

When a brake pedal is depressed, a needle valve to the brake port opens at the same time. The movement of the brake pedal reduces the gap between the sealing washer and the manual piston which restricts the flow through the valve, resulting in a pressure increase in the pressure chamber. Since this pressure increase is directly proportional to the force applied to the brake pedal, a definite 'Feel' is experienced by the operator (see Figure 10-3). When both brake pedals are depressed, both brake port valves open, resulting in equalized pressure to the right and left brakes (see Figure 10-4).

In the event of a "Dead" engine, with one or both pedals actuated, the power brake valve converts to a manual brake valve. Manually developed hydraulic pressure is ported to right or left brake or equalized pressure is ported to both brakes, depending on which brake pedals are actuated (see Figure 10-5).

MAINTENANCE

Maintenance of the service brakes requires that the hydraulic oil in the vehicle's system and the fluid in the front axle be properly maintained. Maintenance also requires that the brake lines and fittings be periodically inspected for leaks, wear or damage and be repaired or replaced as necessary.

BRAKES

SERVICE BRAKES (ALL MODELS)

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
1. Both brakes come on when one pedal is applied.	Internal Leakage: Worn or dirty brake port needle valve seat on opposite brake port.	1. Clean the port needle valve and seat. 2. Replace the port needle valve if worn.
2. Pedal falls to floor in manual mode.	1. Air in brake lines. 2. Internal Leakage: Faulty inlet check valve. 3. Internal Leakage: Dirty or damaged sealing washer.	1. Bleed brake lines. 2. Clean or replace check valve. 3. Clean or replace sealing washer.
3. External Leakage.	Faulty O-Ring seal at location of leakage.	Replace faulty O-Ring seal.

BLEEDING PROCEDURE

1. Start the engine, place transmission in neutral, apply the parking brake, and raise boom to allow for access to bleeder screws (2) on top of front axle.

2. Open the right-side bleeder screw and slowly depress the right-side brake pedal until pedal reaches the floor. Before releasing pedal be sure bleeder screw is closed. Repeat this procedure until there is no sign of air in hydraulic fluid being bled.

3. Perform procedure at left-side brake bleeding screw, depressing left-side brake pedal.

BRAKE VALVE REMOVAL (Figure 10-6)

1. Lower the boom, shut off the engine and apply the parking brake.

2. Remove the six hydraulic lines from the brake valve and cap the lines.

3. Remove four mounting screws and lockwashers (Items 1 & 2) and remove brake pedal housing assembly (Item 3).

4. Remove two cotter pins and clevis pins (Items 4 & 5)

5. Remove two mounting screws and lockwashers (Items 6 & 7).

6. Remove power brake valve (Item 8).

BRAKE VALVE INSTALLATION

1. Reverse steps 2 through 6 above.

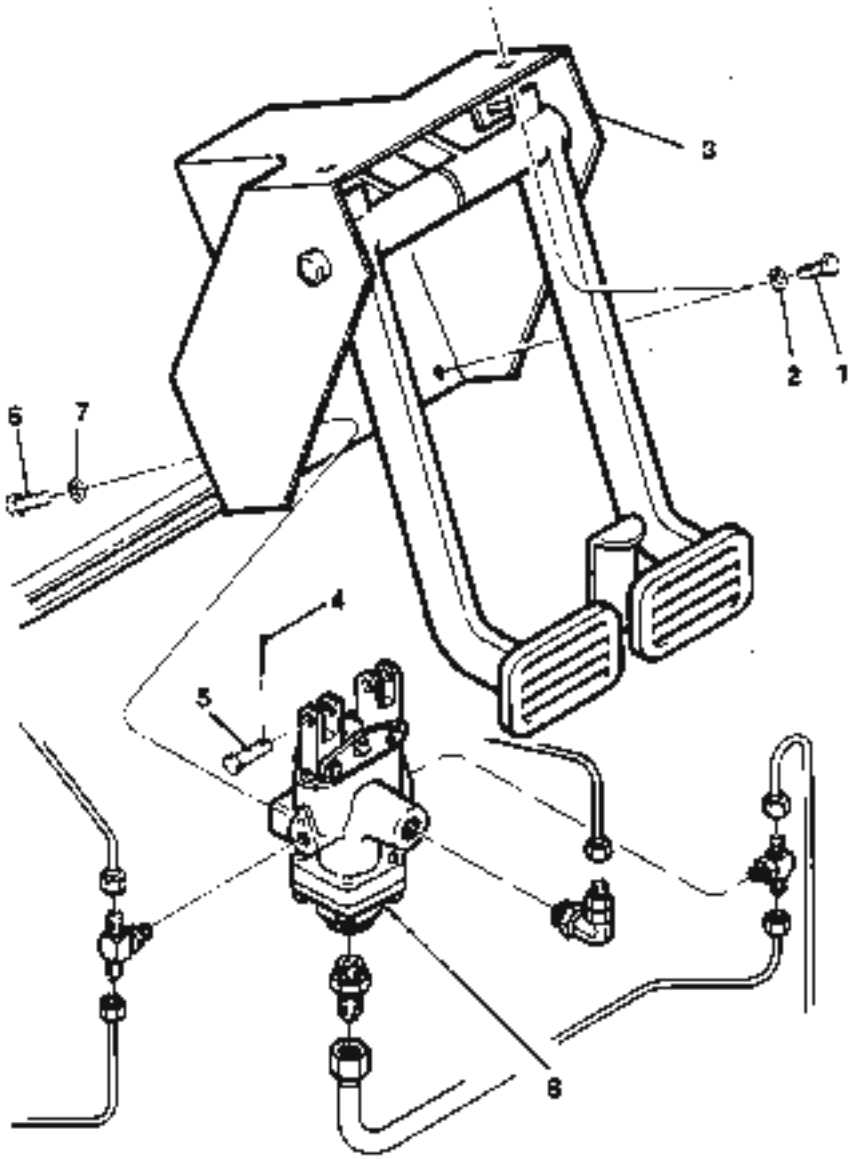
2. Start engine and check for leaks.

3. Bleed brake lines (see "Bleeding Procedure").

BRAKES

SERVICE BRAKES (ALL MODELS)

BRAKE VALVE REMOVAL (cont.)



1 - Screw, 3/8 x 3/4" (4)
2 - Lockwasher, 3/8" (4)
3 - Brake Pedal Housing
4 - Cotter Pin (2)
5 - Clevis Pin (2)
6 - Screw, 5/16 x 3/4" (2)
7 - Lockwasher, 5/16" (2)
8 - Power Brake Valve

Figure 10-6 Brake Valve Removal

BRAKES

SERVICE BRAKES (ALL MODELS)

BRAKE VALVE OVERHAUL

GENERAL

Cleanliness and care during overhaul is imperative. Before removing any components, plug all port holes and thoroughly wash the outside of the valve with petroleum solvent to remove grit and dirt. When removing internal components, care must be taken so that the sealing surfaces are not scratched or otherwise damaged. Inspect all O-ring grooves and mating surfaces for severe wear or other damage. Any metal parts showing severe wear whould be replaced.

DISASSEMBLY PROCEDURE

1. After removing valve from vehicle, plug port holes and thoroughly wash the outside of the valve with petroluem solvent to remove grit and dirt.

2. Remove linkage (items 25, 26, 27, & 28) by removing Retaining Ring (Item 25) from Center Pin (Item 26). Remove center pin and place linkage to the side.

3. Remove Cap (Item 3) by removing four bolts (Item 1) and four Washers (Item 2)

4. Push out spool assembly and remove from housing.

5. Disassemble spool assembly, being careful not to mar, scratch or nick spool. A round pin may be placed in the hole through the spool and held in a vise when removing Cotter Pin (Item 5) and Hex Slotted Nut (Item 6).

6. Remove O-Ring (Item 9) from Piston (Item 10) being careful not to scratch piston.

7. Remove O-Ring (Item 19) and Wiper Seal (Item 24) from housing (Item 17) being careful not to scratch grooves in housing.

8. From Cap (Item 3) remove O-Ring (Item 4).

9. Remove Valve Retainers (Item 23). A tool is required that fits in retainer slots and has relief for Plunger (Item 22).

10. Remove Plungers (Item 22) and Needle Valves (Item 21). A needle nose pliers is required for removing the needle valves.

11. Remove O-Rings (Item 20) from Needle Valves (Item 21) being careful not to scratch needle valves.

12. Remove Retaining Washer (Item 15) from Housing (Item 17). A tool that fits in the retainer slots is required.

13. Remove Check Valve (Item 16). This valve has a slip fit in the housing and can be removed by pushing out with a blunt tool from inside the housing.

14. Discard all parts which are being replaced by items in above repair kit.

CLEANING PROCEDURE

15. Wash all metal parts in clean petroleum solvent, being especially thorough with the parts and sealing surfaces of the housing. Dry each part with compressed air if possible.

REASSEMBLY PROCEDURE

See Lull Parts Book for available Power Brake Valve Seal Kit.

16. The inner components of the valve must not be assembled dry; coat these items, internal surfaces of housing and groove in cap, with clean petroleum oil.

17. Install O-Ring (Item 19) into Housing (Item 17) center bore (second groove).

18. Install wiper seal (Item 24) into housing (Item 17) center bore (first groove). Lip of wiper seal must be placed toward outside of housing.

NOTE: The Wiper Seal is not included in early models and there is no groove in the housing for this seal. For these models replace only the O-Ring (Item 19) and disregard the wiper seal (Item 24).

19. Install O-Ring (Item 4) into Cap (Item 3).

20. Install O-Ring (Item 9) into Piston (Item 10).

SERVICE BRAKES (ALL MODELS)

BRAKE VALVE OVERHAUL (cont.)

REASSEMBLY PROCEDURE (cont.)

21. Holding spool (Item 13) with threaded end up, install Return Spacer (Item 12), spacer (Item 11), Piston (Item 10)(chamfer up), Sealing Washer (Item 8)(radius down), Sealing Washer (Item 7) and Nut (Item 6). Torque nut to 15 - 20 lb. in. and install Cotter Pin (Item 5). When performing this operation, precautions should be taken to prevent damaging the surface finish of the Spool (Item 13). A round pin may be placed in the hole through the spool and held in a vise when tightening Nut (Item 6). Replace spool if scratches are visible.

22. Push spool assembly into housing (Item 17) with a gentle twisting motion. Care should be taken not to nick O-ring or Wiper Ring in housing.

23. With four Lock Washers (Item 2) on four Bolts (Item 1), secure cap to housing with 30 - 35 lb. ft. torque.

24. Install O-Rings (Item 20) into grooves of Needle Valves (Item 21).

25. Install Needle Valve assembly, Valve Plunger (Item 22) and Valve Retainer (Item 23) into needle valve cavities. Torque valve retainers to 15 - 20 lb. ft.

26. Insert Check Valve (Item 16) into Housing (Item 17) and seat to bottom of bore. Screw Retaining Washer (Item 15) into housing and torque to 50 - 70 lb. in.

27. Install linkage to end of Spool (Item 13).

After valve is rebuilt, care should be taken to keep contaminants out of internal components. This can be done by placing plugs in all hydraulic ports or by enclosing valve in a polyethlene bag.

1 - Bolt (4)	13 - Spool	27 - Rocker Arm (2)
2 - Lockwasher (4)	15 - Retaining Washer	28 - Link (2)
3 - Cap, Valve Housing	16 - Check Valve	
4 - O-Ring	17 - Valve Housing	
5 - Cotter Pin	19 - O-Ring	
6 - Castle Nut	20 - O-Ring (2)	
7 - Sealing Washer	21 - Needle Valve (2)	
8 - Sealing Washer	22 - Plunger (2)	
9 - O-Ring	23 - Retainer (2)	
10 - Piston	24 - Wiper Seal	
11 - Spacer Sleeve	25 - Retaining Ring (6)	
12 - Spacer Return	26 - Pin (3)	

Table 10-1 Material List for Figure 10-7

SERVICE BRAKES (ALL MODELS)

BRAKE VALVE OVERHAUL (cont.)

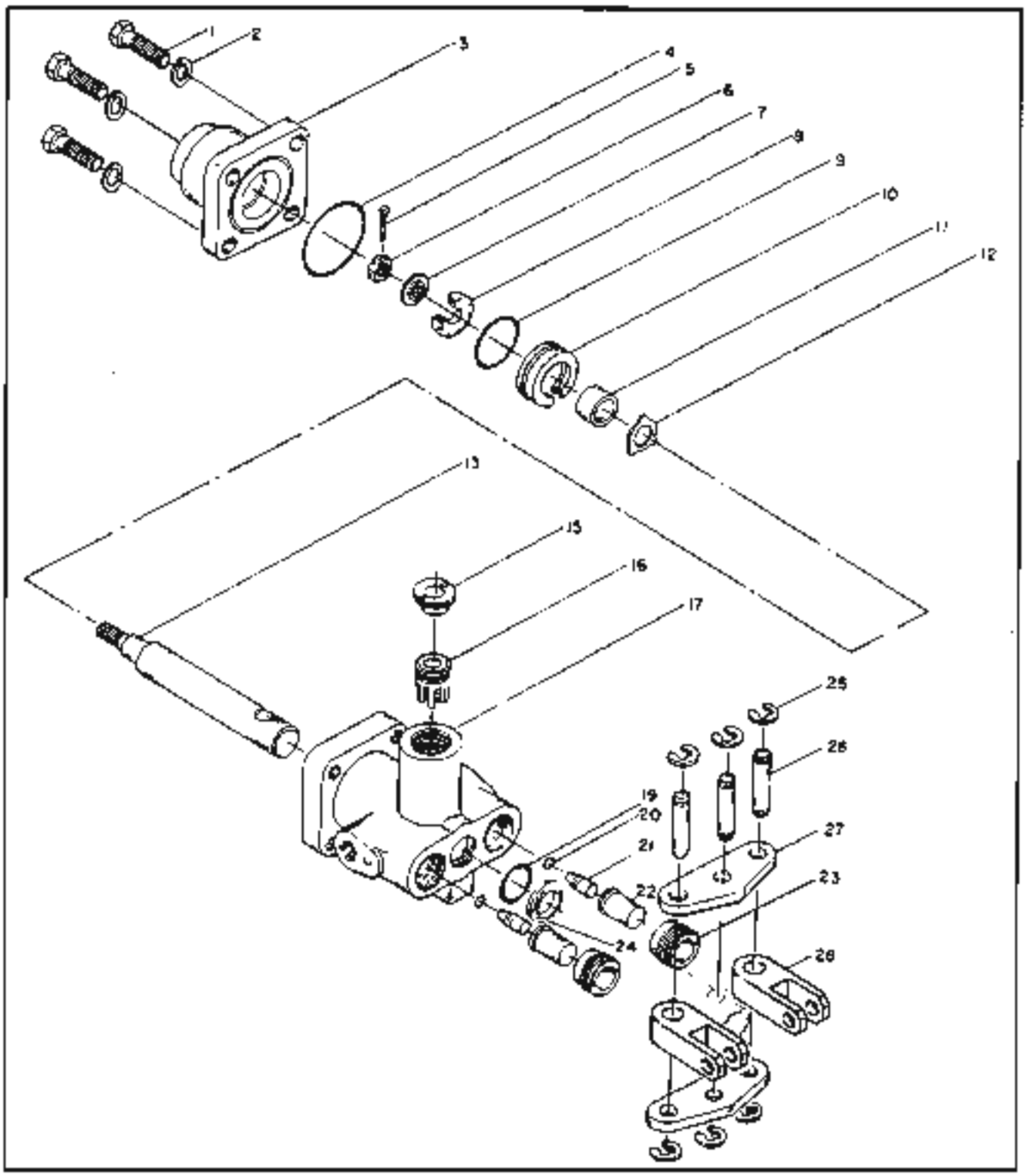


Figure 10-7 Power Brake Valve Disassembly

BRAKES

SERVICE BRAKES (ALL MODELS)

BRAKE DISC OVERHAUL

Overhaul or the Disc Brakes requires axle removal and disassembly. For detailed overhaul information refer to the Drive Axle Overhaul Manual available from the axle manufacturer or Lull Corporation.

BRAKES

PARKING BRAKE (MODELS 522, 522/4)

DESCRIPTION

Service and parking brake functions are performed by engaging disc brakes which are internal to the front axle. The service brake application is accomplished hydraulically, the parking brake application is accomplished mechanically. The parking brake is controlled by a hand lever, cable and linkage which extend to two control levers which are integral with the axle (see Figures 10-8, 10-9). The hand lever (Item 1) is located to the right of the operator's seat. It is an over-center type with a tension adjusting knob (Item 2) provided at the top of the handle. Turning the knob clockwise increases cable tension, counterclockwise reduces cable tension.

MAINTENANCE

Every 100 hours inspect cable and linkage for damage or wear. Adjust, tighten or replace as required.

Brake disc maintenance requires axle disassembly (see Axle Manufacturer's Service Manual).
After replacing brake discs adjust parking brake as follows:

1. Release the parking brake handle.

2. Turn adjusting knob on parking brake handle fully counterclockwise to release all cable tension.

3. Equally adjust (shorten length of) connecting rods until brakes just engage. Cable should be taut.

4. Mark cable at end of cable shield.

5. Equally adjust (increase length of) connecting rods to provide cable slack that is 5/8" to 3/4" as measured from cable mark to end of cable shield while pulling on cable end.

6. Apply the hand brake, checking to be sure parking brake sufficiently holds the machine against movement when on an incline.

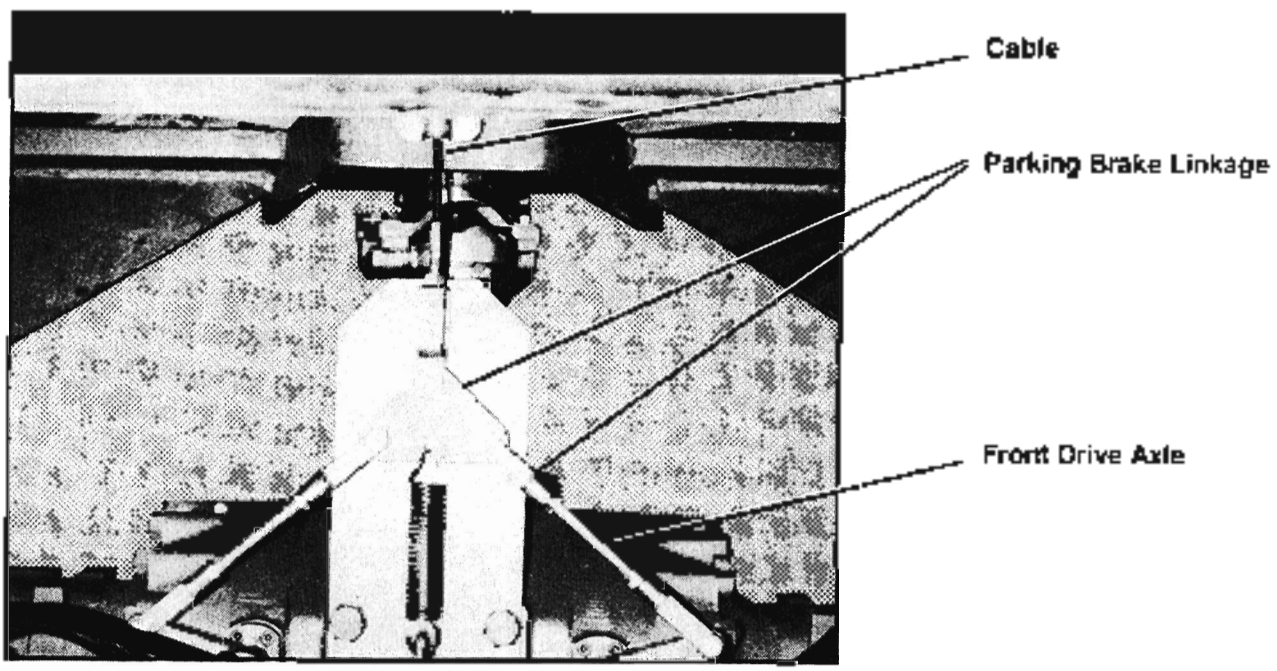


Figure 10-8 Parking Brake Linkage Models (522, 522/4)

BRAKES

PARKING BRAKE (MODELS 522, 522/4)

MAINTENANCE (cont.)

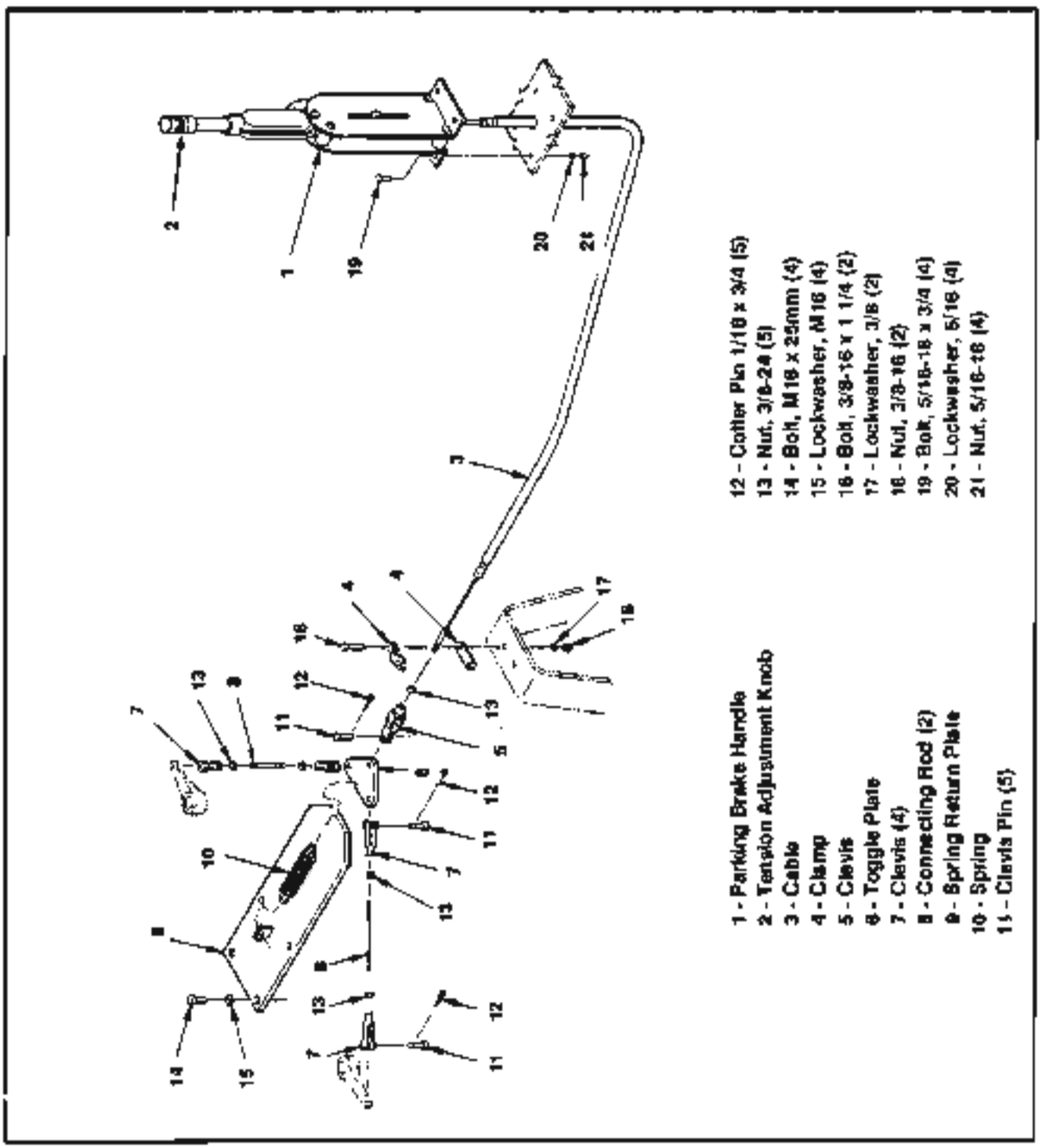


Figure 10-9 Parking Brake Assembly (522, 522/4)

BRAKES

PARKING BRAKE (MODELS 622, 622/4,824)

DESCRIPTION

The parking brake is a disc and caliper type located on the output shaft at the rear of the transmission (Figure 10-10). The parking brake is controlled by a hand lever and cable (Figure 10-11) with the hand lever located to the right of the operator's seat. The hand lever (Item 1) is an over-center type with a tension adjusting knob (Item 2) provided at the top of the handle: Turning the knob clockwise increases cable tension, counterclockwise reduces cable tension.

MAINTENANCE

Every 100 hours inspect the cable, caliper, brake pads and disc for damage or wear. Adjust, tighten or replace as required.

CAUTION: Be sure to lower the boom, shut off the engine and block the tires when servicing the parking brake.

Replace brake pads when pad thickness is 1/8" or less.

After replacing the brake pads adjust as follows:

1. Release the parking brake control handle.

2. Turn adjusting knob on parking brake handle fully counterclockwise to release all cable tension.

3. Adjust castle nut until pads contact the disc, then back-off nut approximately 1/4 turn and insert a new cotter pin.

4 Apply the parking brake control handle. Adjust the knob atop the handle until the parking brake sufficiently holds the machine against movement when on an incline.

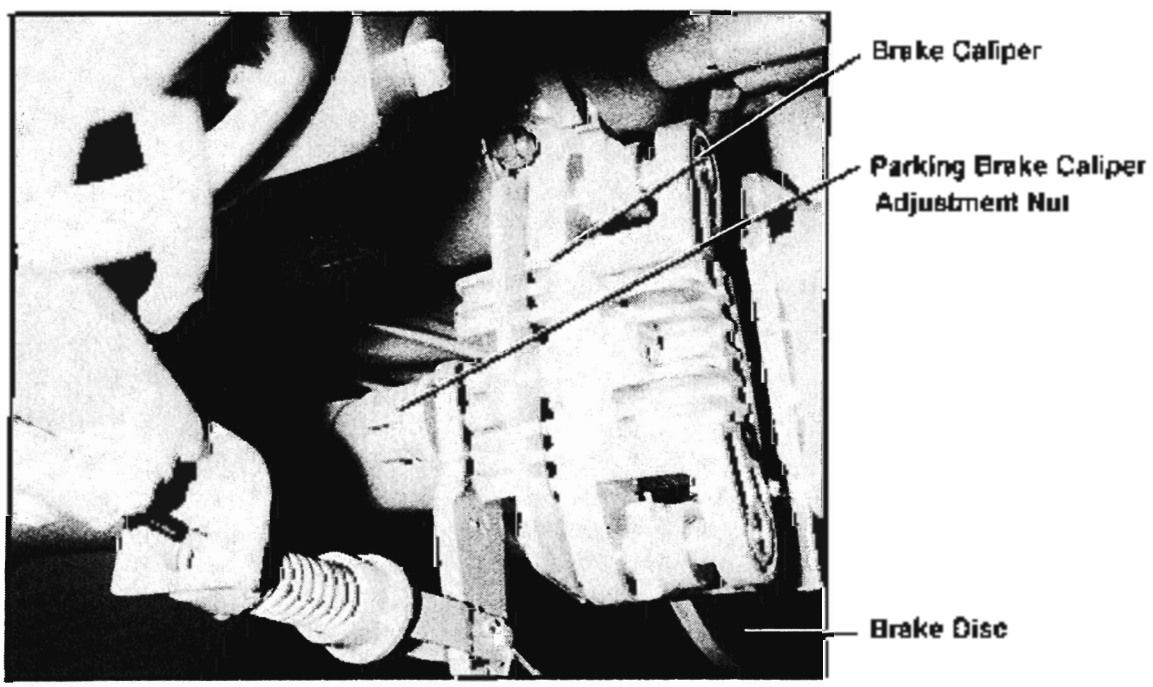


Figure 10-10 Parking Brake Caliper & Disc (622, 622/4, 824)

BRAKES

PARKING BRAKE (MODELS 622, 622/4, 824)

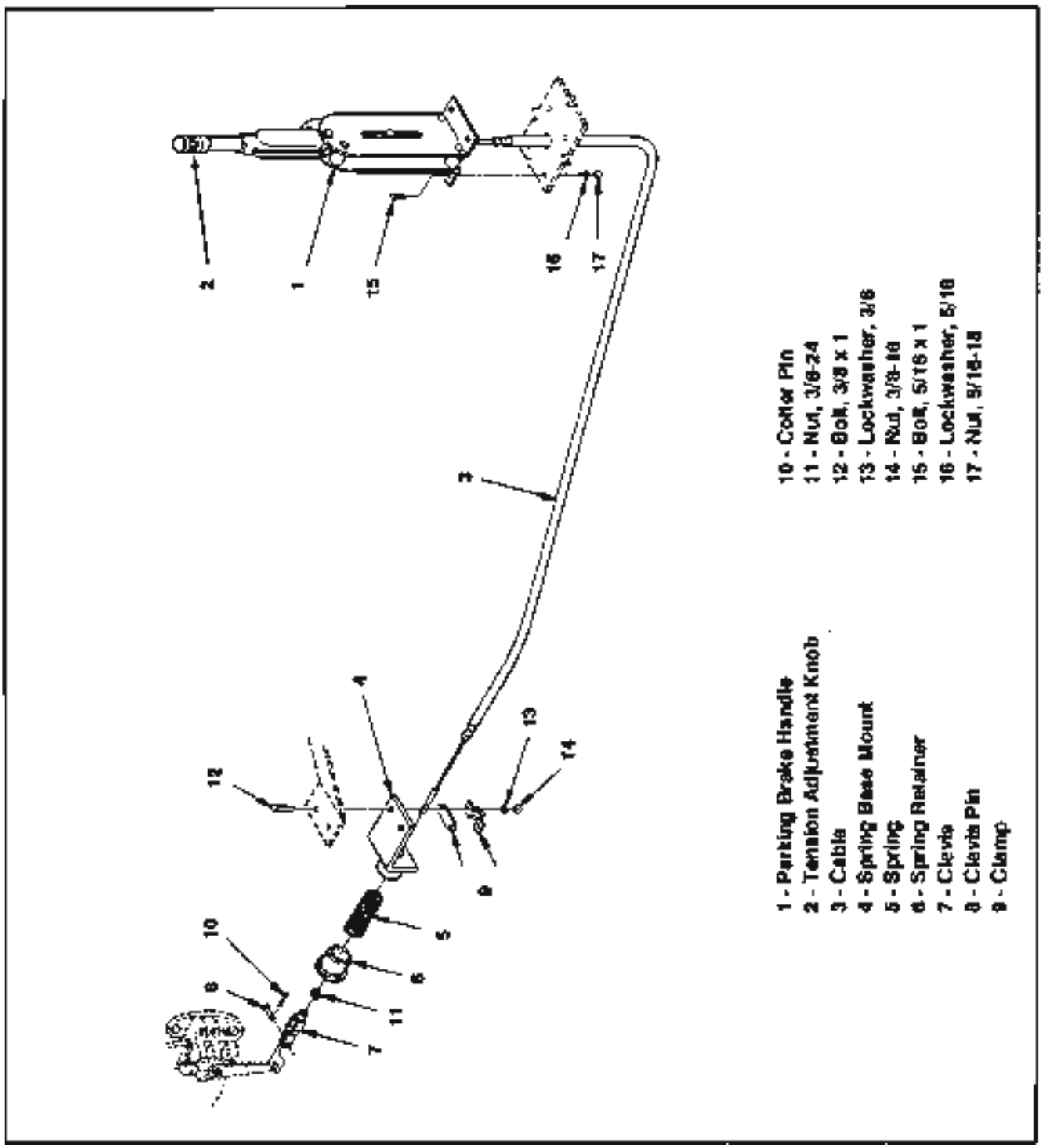


Figure 10-11 Parking Brake Assembly (622, 622/4, 824)

STEERING

INDEX

STEERING

LIST OF FIGURES

STEERING

STEERING SYSTEM (ALL MODELS)

DESCRIPTION (Figures 11-1 & 11-2)

The steering system is hydraulically powered as part of the forklift's hydraulic system. The power steering control unit is fully fluid linked (there is no mechanical connection between the steering unit, the pump and the steering cylinders). The steering circuit is provided with hydraulic flow from the steer priority valve. (NOTE: Refer to page 3.49-1 in Section 3 for Description, Troubleshooting, Adjusting, Removal and Installation of the steer priority valve.) Flow is provided at 2000 psi through the (CF) line in response to any pressure differential detected by the priority valve in the load sensing (LS) line. Flow is directed through the steer control unit and to the steer hydraulic cylinders. In case of hydraulic failure, the control unit allows the machine to be steered manually.

There are two steer cylinders per axle which are actuated depending on direction of steer wheel rotation.

Refer to flow diagrams (Figures 11-1 & 11-2) for hydraulic operation.

MAINTENANCE

Maintenance of the steering system requires periodic greasing of cylinder ends, tie rod ends and spindles (refer to Service Schedules in Section 2). Periodically inspect steer cylinder ends, tie rod ends and steer hoses for wear. Replace cylinder and tie rod ends if they exhibit excessive play; replace hoses if they show any signs of deteriation. Performance and reliability of steering system components will depend on a properly maintained hydraulic system

STEERING

STEERING SYSTEM (ALL MODELS)

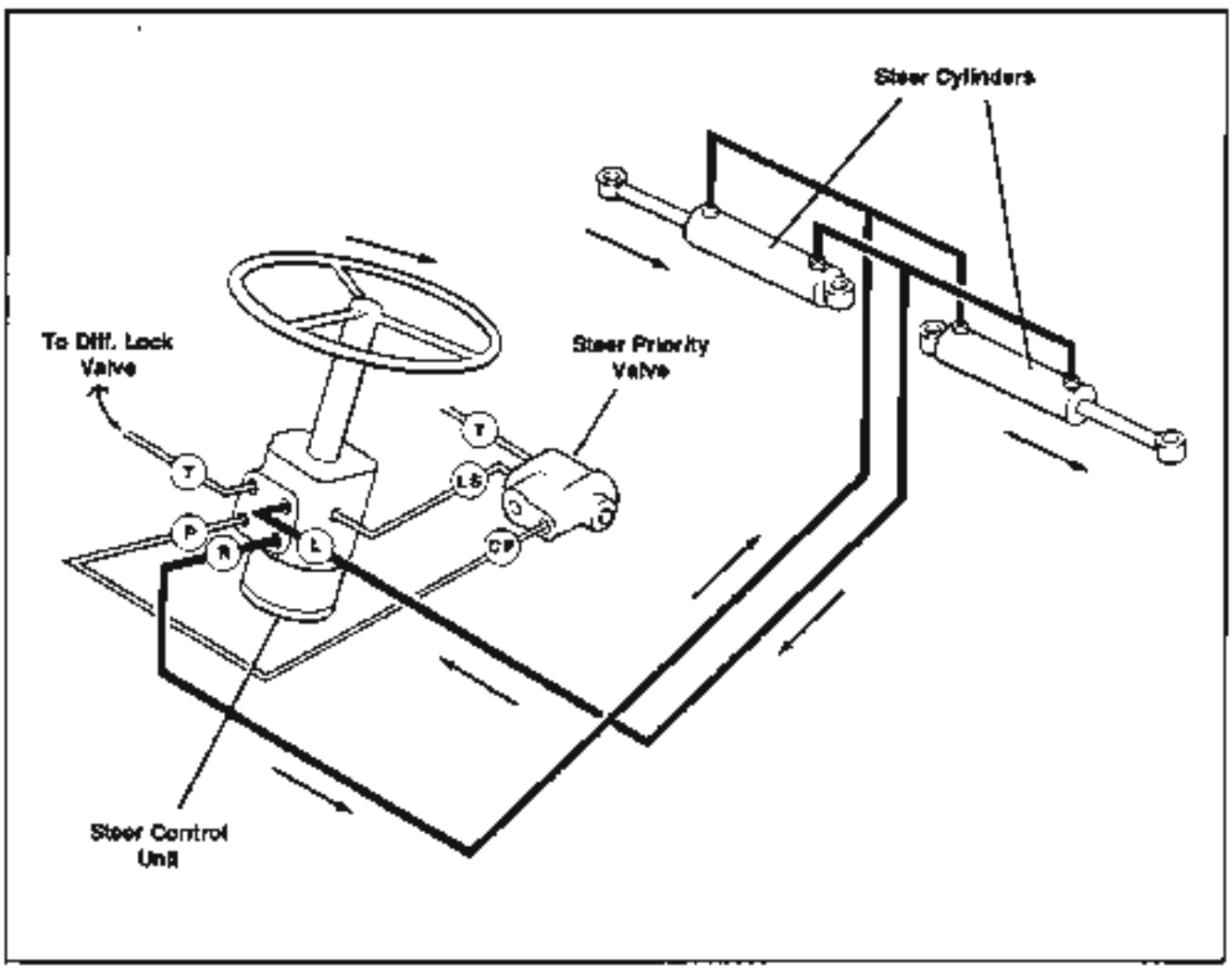


Figure 11-1 Flow Diagram - Right Steer

STEERING

STEERING SYSTEM (ALL MODELS)

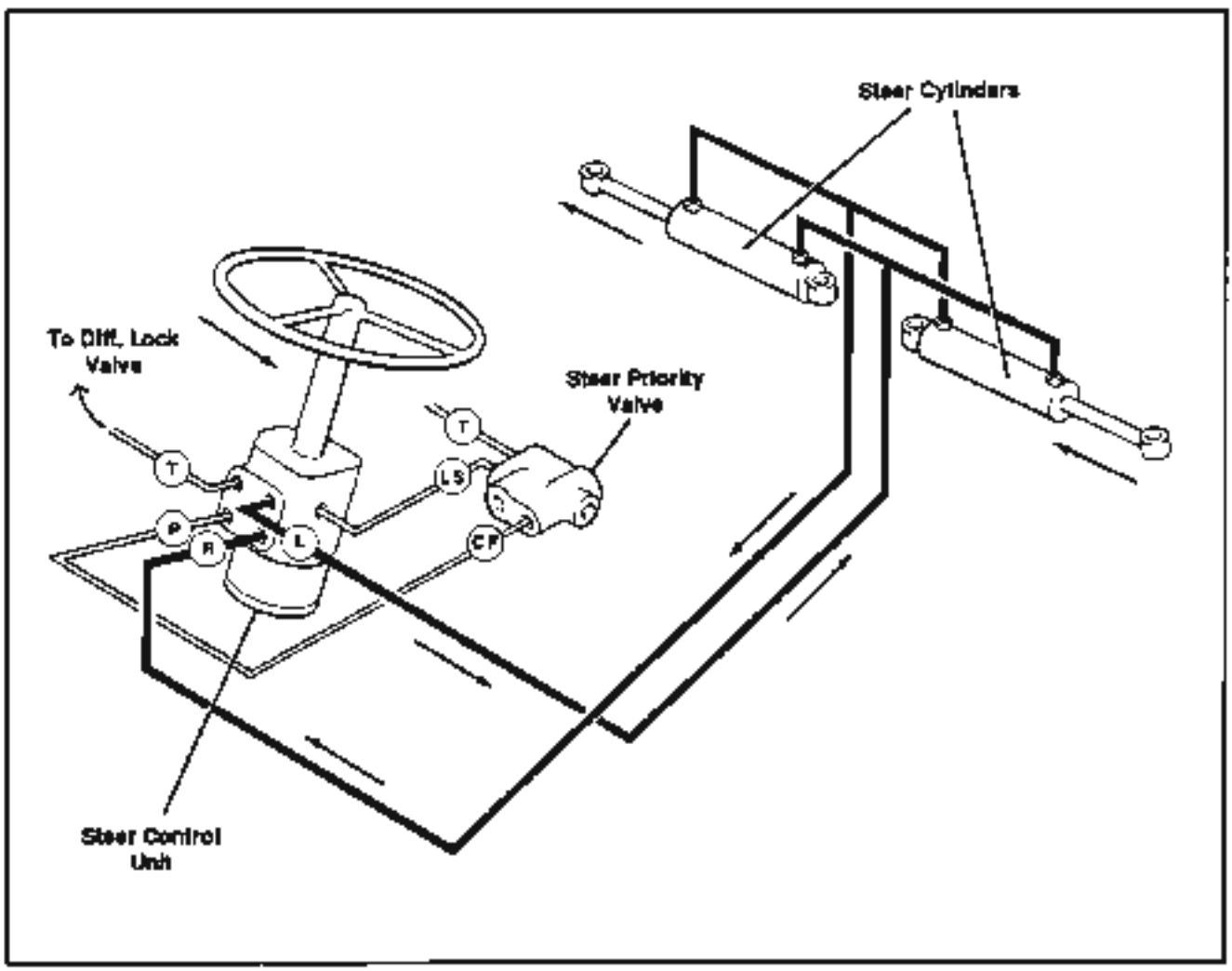


Figure 11-2 Flow Diagram - Left Steer

STEERING

STEERING SYSTEM (ALL MODELS)

TROUBLESHOOTING

Most steering problems can be corrected if the problem is properly defined. The entire steering system should be evaluated before removing any components. The steering control unit is generally not the cause of most steering problems. The following is a list of steering problems along with possible causes and suggested corrections.

PROBLEM	POSSIBLE CAUSE	CORRECTION
1. Slow steering, hard steering, or loss of power assist.	Worn or malfunctioning pump.	Replace pump.
	Stuck flow divider piston.	Replace flow divider.
	Worn pump compensator allowing the system pressure to be less than specified.	Replace pump and compensator.
	Malfunctioning relief valve allowing the system pressure to be less than specified.	Replace the relief valve.
	Overloaded steer axle.	Reduce load.
	If load sensing system 1. Leaking or kinked load sensing signal line. 2. Malfunctioning priority valve.	Correct Check spring and sticking spool. Check damping orifices in both ends of main bore for debris. Check system pressure at SCU inlet for proper system pressure. If not correct replace priority valve relief cartridge.
2. Wander - Tendency of vehicle path to deviate from course defined by operator input.	Air in the system due to low level of oil, cavitation pump, leaky fitting, pinched hose, etc.	Correct condition and add fluid.
	Worn mechanical linkage.	Repair or replace.
	Bending of linkage or cylinder rod.	Repair or replace.
	Loose cylinder piston.	Repair or replace.
	Severe wear in steering control unit.	Replace the steering control unit.

STEERING

STEERING SYSTEM (ALL MODELS)

TROUBLESHOOTING (cont.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
3. Drift - Deviation of vehicle path, without operator input from normally expected continuing course.	Single rod end cylinder slowly extends without turning the steering wheel.	A small rate of extension may be normal on a closed center system.
	Worn or damaged steering linkage.	Replace linkage and align front end.
4. Slip - A slow movement of steering wheel fails to cause any movement of steered wheels.	Leakage of cylinder piston seals or accessory valve between cylinder lines or ports.	Replace seals or accessory valve.
	Worn steering control unit meter.	Replace steering control unit.
5. Temporary hard steering or hang-up - A momentary increase in steering wheel torque during steering reversal or initial input.	* Thermal Shock	Check unit for proper operation and cause of thermal shock.
6. Erratic steering.	Air in system due to low level of oil, cavitating pump, leaky fitting, pinched hose, etc.	Correct condition and add fluid.
	Loose cylinder piston.	Replace cylinder
	*Thermal shock damage.	Replace steering control unit.
	Sticking flow control spool.	Replace flow control valve.
7. "Spongy" or soft steering.	Air in hydraulic system. Most likely air trapped in cylinders or lines.	Bleed air out of system. Placing ports on top of the cylinder will help prevent air trapping.
	Low fluid level.	Add fluid and check for leaks.

* Thermal shock - A condition caused when the hydraulic system is operated for some time without turning the steering wheel so that fluid in the reservoir and system is hot and the steering control unit is relatively cool (more that 50°F temperature differential). When the steering wheel is turned quickly the result is temporary seizure and possible damage to internal parts of the steering control unit. The temporary seizure may be followed by total free wheeling. This applies to closed center and load sensing units only.

STEERING

STEERING SYSTEM (ALL MODELS)

TROUBLESHOOTING (cont.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
8. Free Wheeling - Steering wheel turns freely with no feeling of pressure and no action on steered wheels.	Steering column upper shaft is loose or damaged.	Tighten steering wheel nut.
	Lower splines of column may be disengaged or broken.	Repair or replace column.
	Steering control unit meter has a lack of oil. This can happen on start-up, after repair, or long periods of non use.	Usually starting engine will cure problem.
	No flow to steering unit can be caused by: 1. Low fluid level. 2. Ruptured hose. 3. Internal steering control unit damage due to thermal shock*.	 Add fluid and check for leaks. Replace hose. Replace the unit.
9. Free Wheeling - Steering wheel turns with slight resistance but results in little or no steered wheel action.	Piston seal blown out.	Determine cause. Correct and replace seal.
10. Excessive free play at steering wheel.	Loose steering wheel nut. Steering column shaft worn or damaged. There should be very little free play in the unit itself.	Repair or replace steering wheel connection or column.
11. Excessive free play at steered wheels.	Broken or worn linkage between cylinder and steered wheels.	Check for loose fitting bearings and anchor points in steering linkage between cylinder and steered wheels.
	Leaky cylinder seals.	Replace cylinder seals.

* Thermal shock definition bottom of page 11.2-10.

STEERING

STEERING SYSTEM (ALL MODELS)

TROUBLESHOOTING (cont.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
12. Binding or poor centering of steering wheel.	Binding or misalignment in steering column or splined input connection. High back pressure in tank line can cause slow return to center. Should not exceed 300 psi.	Align column pilot and spline to steering control unit. Revise circuit return line.
	Large particles can cause binding between the spool and sleeve.	Clean the unit and filter the oil. If another component has failed generating contaminents, flush the system while bypassing the steering control unit.
13. Steering unit locks up.	Large particles in meter section.	Clean the unit.
	Insufficient hydraulic power (units over 15 cu. in./rev.)	Check hydraulic power supply.
	Severe wear and/or broken pin.	Replace the unit.
	*Thermal shock.	Replace the unit.
14. Steering wheel oscillates or turns by itself, either side of neutral, after operator has removed input.	Parts assembled wrong. Steering unit improperly timed.	Correct timing.
	Lines connected to wrong ports.	Reconnect lines correctly.
15. Steered wheels turn in wrong direction when operator activates steering wheel.	Lines connected to wrong cylinder ports.	Reconnect lines correctly.
16. Kick - Momentary kick back of steering wheel at start of steering.	No inlet check valve on steering control unit.	Install a check valve.

*Thermal shock definition bottom of page 11.2-10.

STEERING

STEERING SYSTEM (ALL MODELS)

TROUBLESHOOTING (cont.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
17. Instability - Fluid-born oscillation.	Air in lines.	Check pump inlet. Bleed sensing lines.
	Plumbing	Bleed all lines. Pilot lines should be tubing. Lines to cylinder should be tubing. If 2 pilot lines are used go to 1.
	Relief Setting	Pump relief should be 300 psi above priority relief.
	Priority Valve	Bleed by holding against stop for 30 seconds on models w/built in relief only. Increase spring rate (this will raise the standby pressure).

STEERING

STEER CONTROL UNIT (ALL MODELS)

DESCRIPTION (Figure 11-3)

The steer control unit is a Char-Lynn Model #213-1006 which is located at the base of the steering column under the instrument panel. The unit consists of a manually operated, close coupled, rotary action directional control valve and servo feedback meter element in a single body. The unit is "load sensing" which provides the following:

1. Pressure variations in the steering circuit do not affect steering response or maximum steering rate.

2. Only the flow required by the steering maneuver goes to the steering circuit. Excess flow is available for other circuits.

3. The steering circuit always has flow priority.

The unit provides "non load reaction" which blocks the steer cylinder ports in neutral, holding the axle steer position whenever the operator releases the steering wheel.

The steer control unit is lubricated and protected by the hydraulic fluid in the system.

MAINTENANCE

The steer control unit does not require routine maintenance, except that, as in the case of all hydraulic components, performance and reliability will depend on a properly maintained hydraulic system.

REMOVAL (Figure 11-4)

Use the following procedure to remove the steer control unit:

1. Lower the boom to the ground, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

2. Tag and remove the five hydraulic hoses (Item 4) from the steer control unit (Item 1) and cap the openings.

3. Disconnect horn wire by removing two screws (Items 5). Move horn wire and bracket (Item 6) aside.

4. Support the steer control unit and remove four bolts and lockwashers (Items 2).

5. Separate steer control unit from steering column (Item 3). Carefully allow steering column to drop through the opening in the instrument panel until the steering wheel rests against the panel.

INSTALLATION

Use the following procedure to install the steer control unit:

1. Reverse steps 2 through 5 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Lines" in Section 1.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Cycle the steering cylinder fully in one direction and hold for 15 seconds; cycle fully in the opposite direction and hold for 15 seconds. Repeat. This procedure will remove air from the circuit.

OVERHAUL (Figure 11-5)

For overhaul of the steer control unit, refer to the Repair Information manual available from the manufacturer.

STEERING

STEER CONTROL UNIT (ALL MODELS)

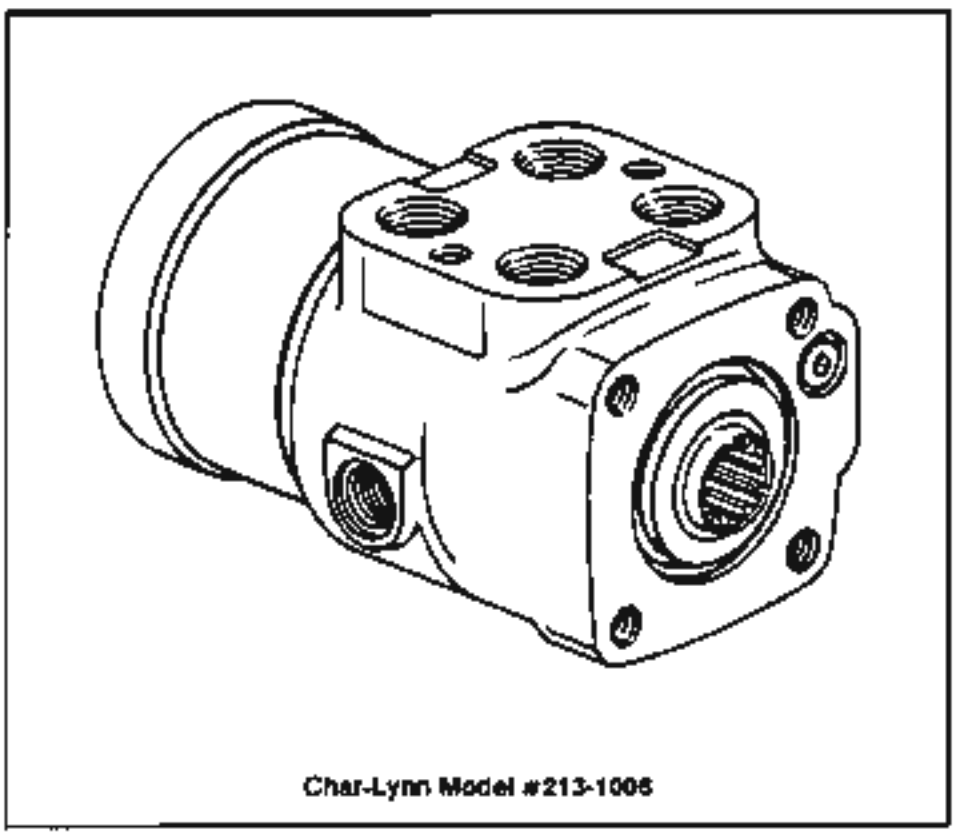
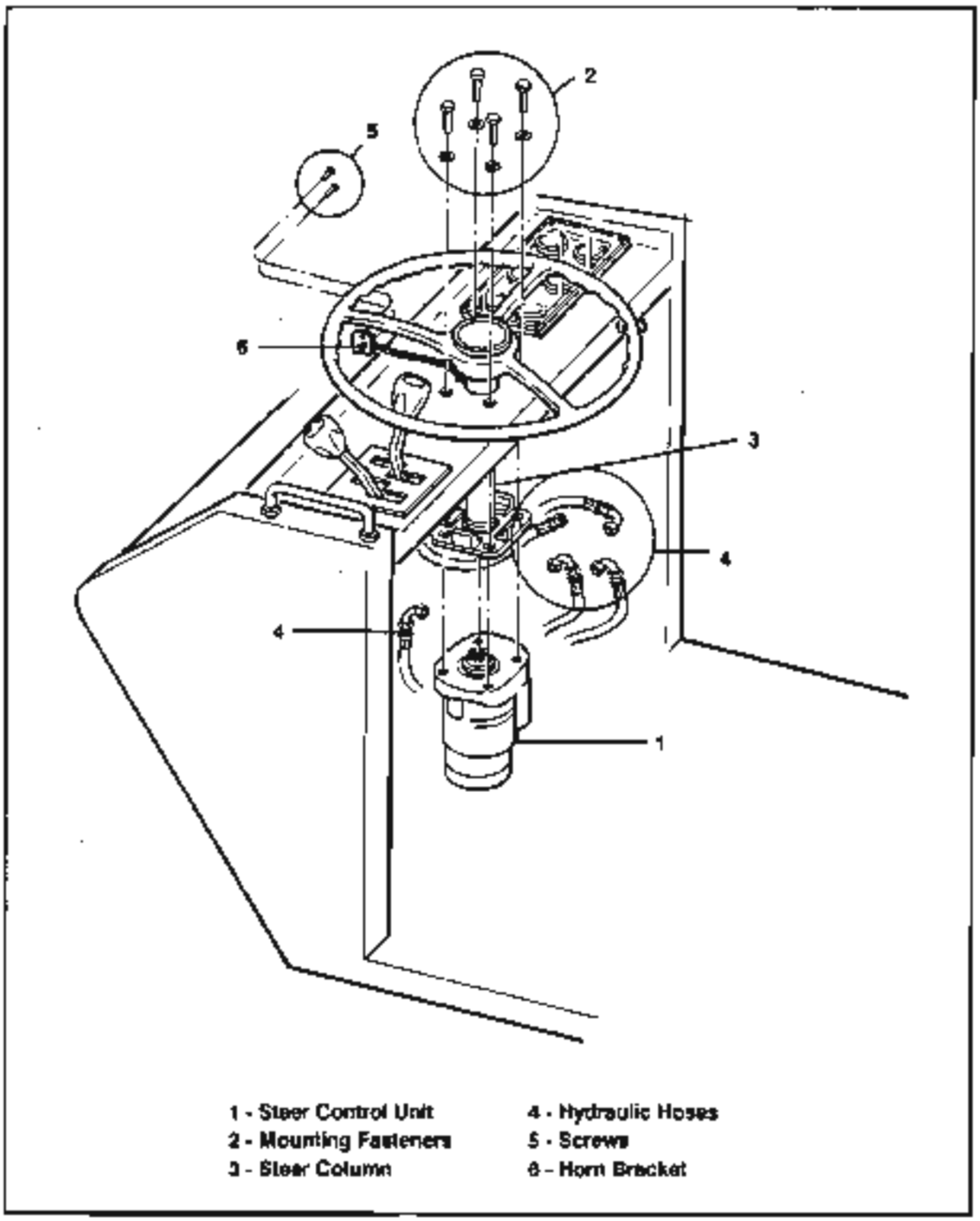


Figure 11-3 Steer Control Unit

STEERING

STEER CONTROL UNIT (ALL MODELS)

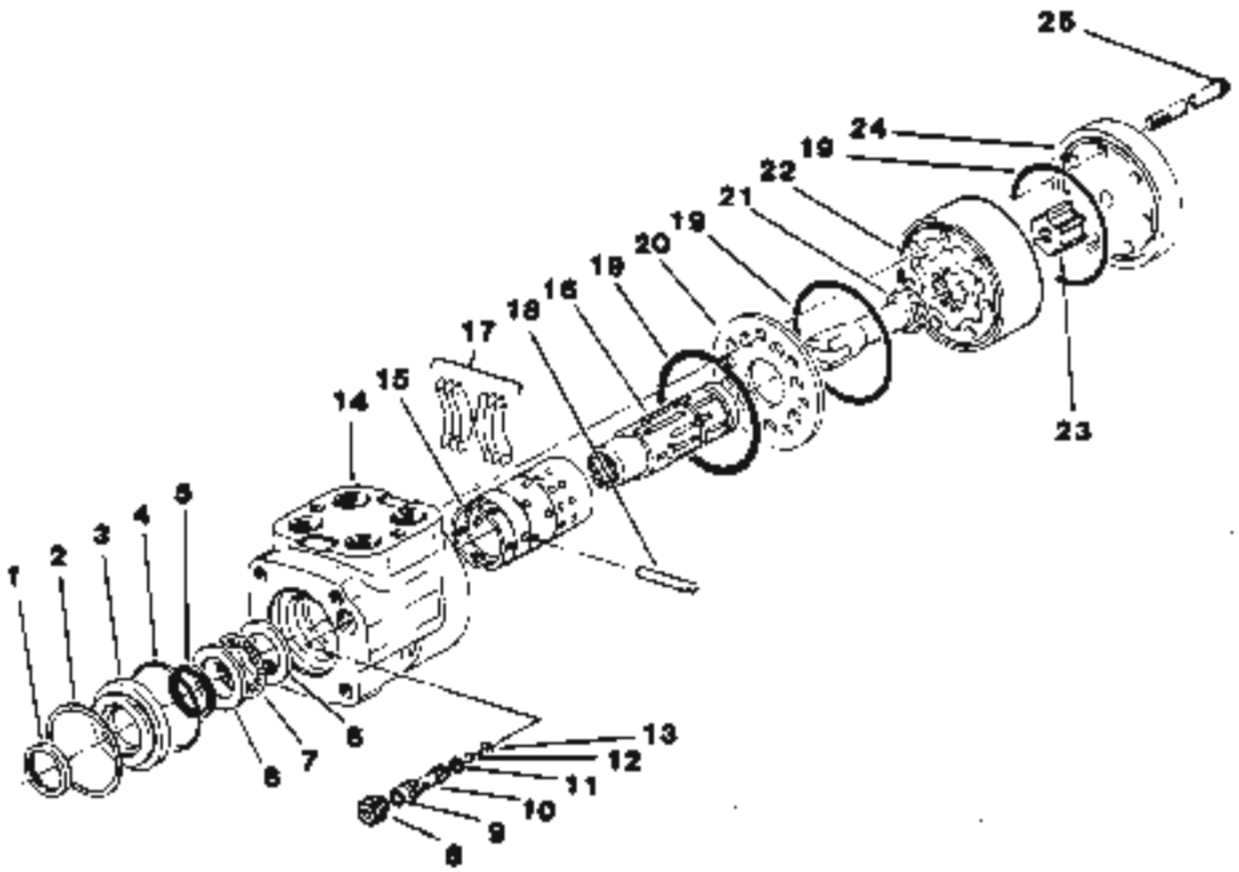


1 - Steer Control Unit
2 - Mounting Fasteners
3 - Steer Column
4 - Hydraulic Hoses
5 - Screws
6 - Horn Bracket

Figure 11-4 Steer Control Unit Removal

STEERING

STEER CONTROL UNIT (ALL MODELS)



1 - Seal, 1" ID
2 - Ring, Retaining
3 - Bushing, Seal Gland
4 - Seal, 1 7/8" ID
5 - Seal, Quad Ring 1 1/16" ID
6 - Race, Bearing (2)
7 - Bearing, Needle Thrust
8 - Screw, Set
9 - Seal, 3/8" ID
10 - Seat, Check Ball
11 - Seal, 5/16" ID
12 - Ball, Check
13 - Retainer, Check Ball
14 - Housing
15 - Sleeve, Control
16 - Spool, Control
17 - Spring, Centering (6)
18 - Pin, Centering
19 - Seal (3)
20 - Plate, Spacer
21 - Drive
22 - Gerotor
23 - Spacer
24 - Cap, End
25 - Screw, Cap (7)

Figure 11-5 Steer Control Unit Disassembly

STEERING

STEER CONTROL UNIT (ALL MODELS)

DESCRIPTION

The steer cylinders are provided by the axle manufacturer as part of the axle assembly.

MAINTENANCE

The steer cylinders require periodic greasing of their pivots (see Service Schedules in Section 2). No other maintenance is required, except that, as in the case of all hydraulic components, cylinder performance and reliability will depend on a properly maintained hydraulic system.

REMOVAL

Use the following procedure to remove a steer cylinder:

1. Lower the boom, apply the parking brake and stop the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

2. Remove hydraulic hoses and cap ends.

3. Remove cylinder.

INSTALLATION

Use the following procedure to install a steer cylinder:

1. Assemble cylinder to axle.
Torque cylinder pivot bolts to 100 FT/LBS minimum (See Note).

NOTE: If cotter pin cannot be installed after minimum torque is attained, the nut must be advanced until cotter pin can be installed.

2. Assemble hoses to cylinder.

NOTE: Refer to "Torque Specifications for Hydraulic Line connections" in Section 1.

3. Start the engine and check for leaks while turning steering wheel to full right and full left.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

4. Cycle the steering cylinders fully in one direction and hold for 15 seconds; cycle fully in the opposite direction and hold for 15 seconds. Repeat. This procedure will remove air from the circuit.

OVERHAUL

For overhauling the steer cylinders, refer to "Cylinder Overhaul" on page 3.19-1 in Section 3

ATTACHMENTS

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LIST OF FIGURES

ATTACHMENTS

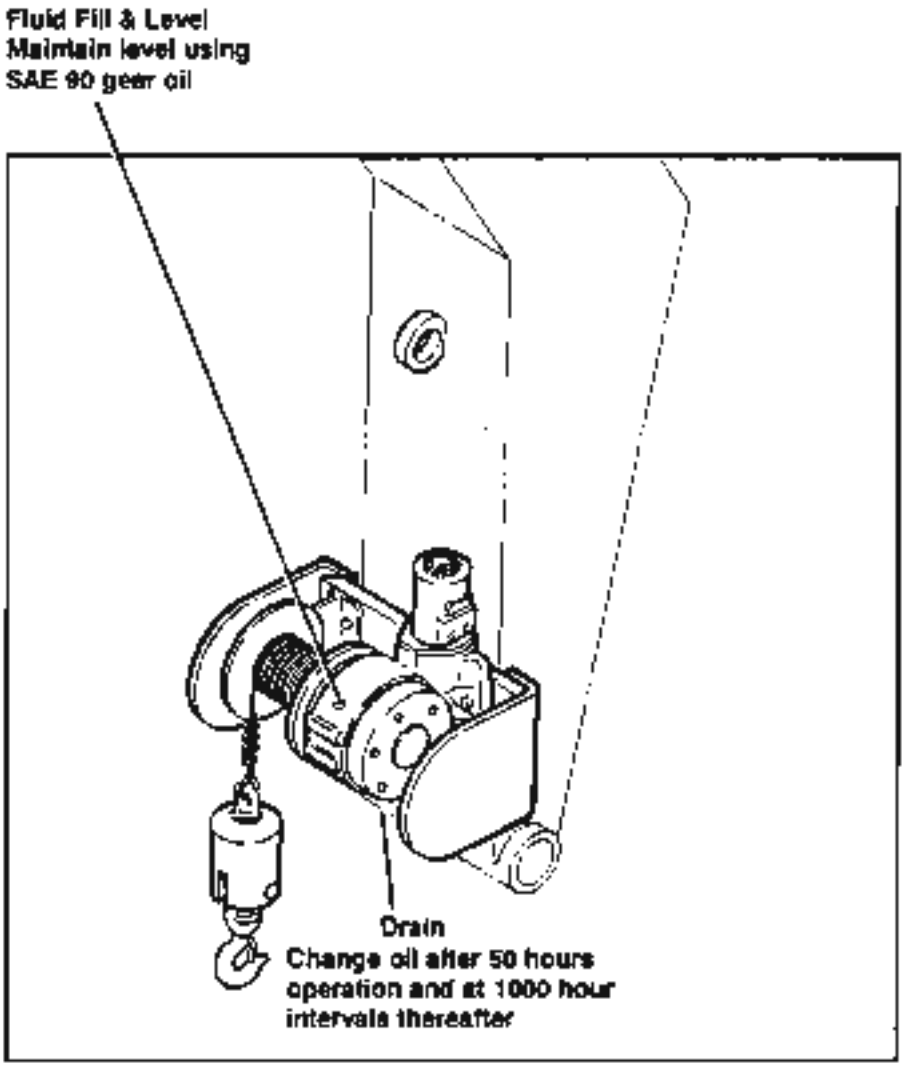

Figure 12-1 Winch

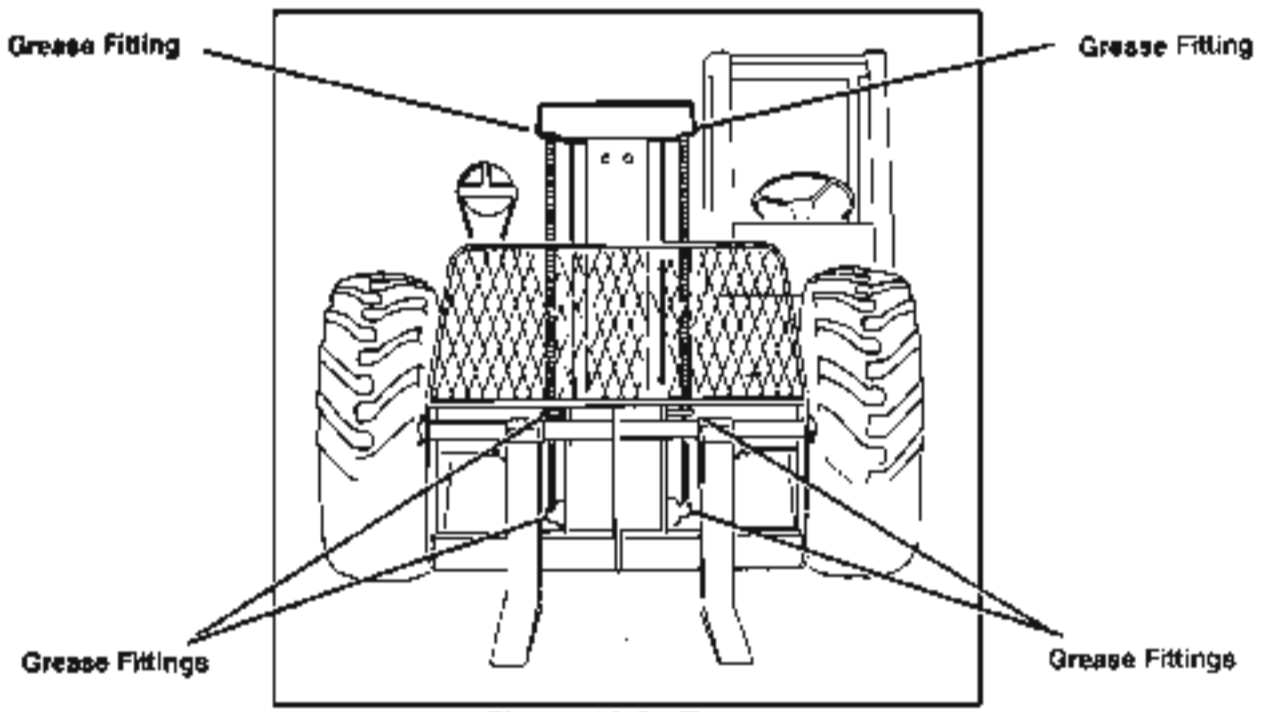

Figure 12-2 Tower

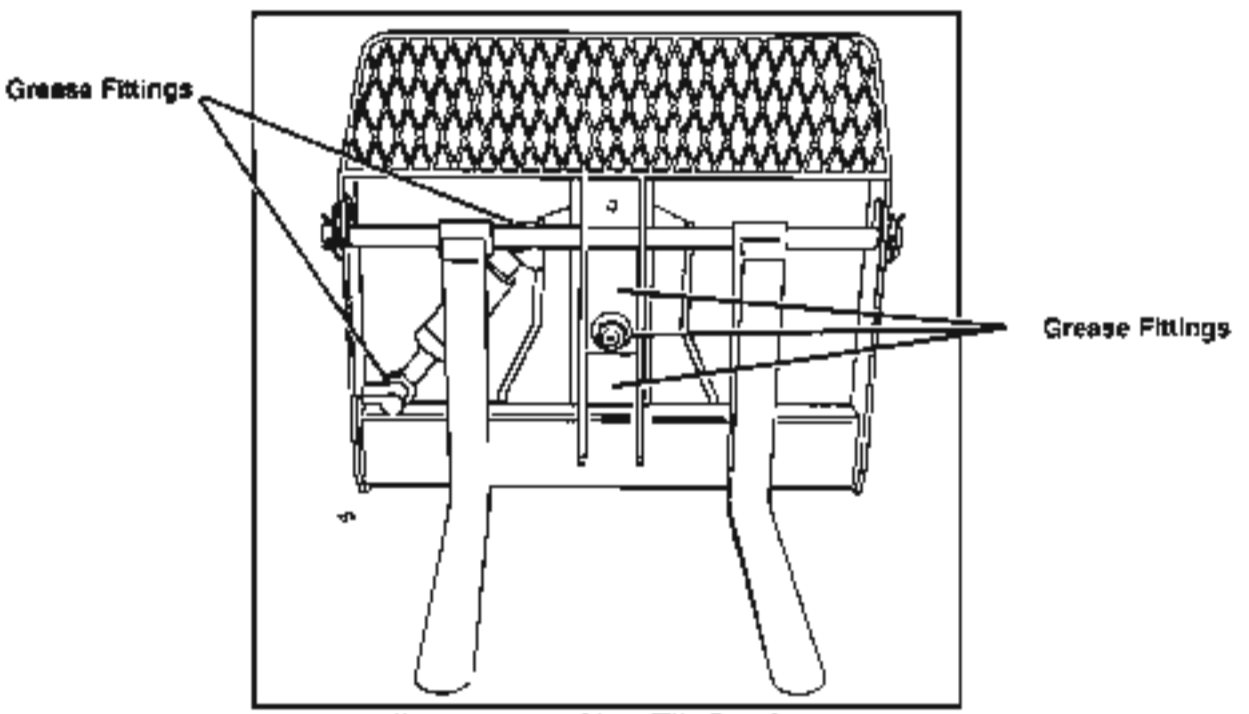

Figure 12-3 Side Tilt Carriage

ATTACHMENTS

OUTRIGGERS

DESCRIPTION

The outrigger assembly is bolted to the front oscillation frame and consists of a frame, two legs, two foot pads, two hydraulic cylinders, pivot pins, two load check valves, hoses, and hydraulic fittings (see the Lull Parts Book for detailed parts breakdown).

A valve located in the cab controls the lowering and raising of the outriggers, with each outrigger cylinder controlled by an individual valve spool and control lever (see "Three Spool Valve" on page 3.40-1 in Section 3).

Each hydraulic cylinder is equipped with a load check valve which prevents movement of the cylinder once it is extended (outrigger is lowered) unless, or until, the outrigger control lever is actuated. (See "Cylinder Load Check Valves" on page 3.62-1 in Section 3.)

The check valve also prevents raised outriggers from lowering unless, or until, the outrigger control lever is actuated.

MAINTENANCE

Maintenance requires daily lube at grease fittings (see Figure 12-4). Periodically check for bushing condition and replace when wear is indicated, evidenced by excessive play at pivots. Periodically inspect hoses and replace if they show wear or damage. Periodically inspect cylinders and hydraulic fittings for wear, damage or leaks and replace or tighten as necessary.

TROUBLESHOOTING

Refer to "Troubleshooting" under "Cylinder Load Check Valve" on page 3.62-1and under "Hydraulic Cylinders" on page 3.18-1 in Section 3.

CYLINDER REMOVAL

Use the following procedure to remove an outrigger cylinder:

1. Lower outrigger until it just rests on the ground.

2. Level the boom and place a substantial support under it.

3. Place the transmission in neutral, apply the parking brake and shut off the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

4. Remove the cylinder rod end pin.

5. Lift the cylinder rod end and place a support under it.

6. Disconnect two hydraulic hoses at cylinder.

7. Support cylinder and remove cylinder base end pin.

8. Remove cylinder.

CAUTION: Hydraulic cylinders equipped with load check valves may have hydraulic pressure stored within the cylinder until the check valves are carefully removed. The stored pressure may exceed 250 PSI. Wear eye protection when removing load check valves.

CYLINDER INSTALLATION

1. Reverse steps 4 - 8 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Lower outriggers fully and hold for 15 seconds; raise outriggers fully and hold for 15 seconds. Repeat. These procedures will remove air from the circuits

ATTACHMENTS

OUTRIGGERS (cont.)

OUTRIGGER REMOVAL

Use the following procedure to remove the complete outrigger assembly.

1. Outriggers may be raised or lowered.

2. Raise boom enough to allow access to outriggers. Place a substantial support under boom.

3. Place the transmission in neutral, apply the parking brake and shut off the engine. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

4. With overhead crane, or with pallet on forks, support the outrigger assembly.

5. Disconnect (4) hydraulic hoses from vehicle bulkhead.

6. Remove (16) bolts attaching outrigger frame to vehicle's oscillation frame.

7. Remove outrigger assembly.

OUTRIGGER INSTALLATION

1. Reverse steps 4 through 7 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1."

2. Start the engine and check for leaks.

WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

3. Lower outriggers fully and hold for 15 seconds; raise outriggers fully and hold for 15 seconds. Repeat. These procedures will remove air from the circuits.

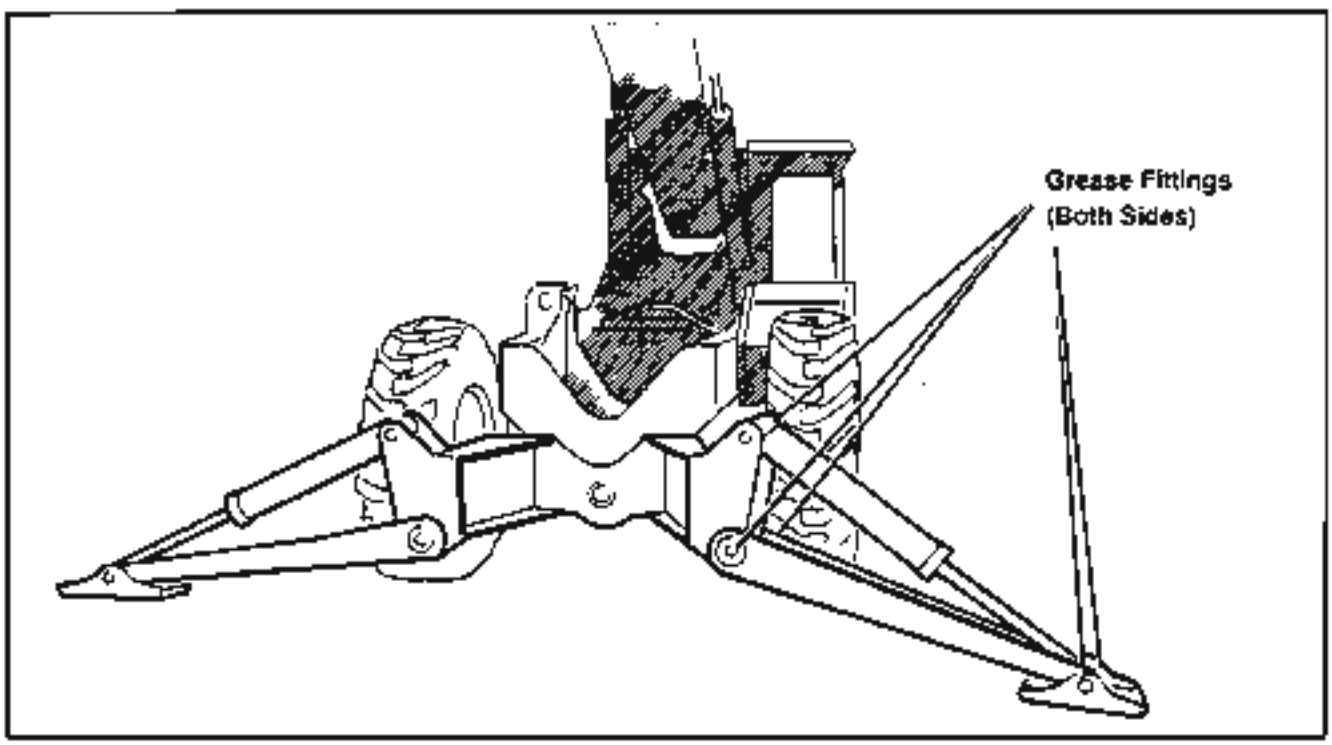

Figure 12-4 Outriggers

ELECTRICAL

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LIST OF TABLES

ELECTRICAL

DESCRIPTION

Two 6 volt batteries connected in series serve the 12 volt electrical system. The batteries are a wet-charged, lead-acid type and are located in a battery box at the rear of the forklift engine compartment. They perform the following functions: (1) supply current for the starter motor, (2) supplement the alternator output when the demands of the electrical system exceed the output of the alternator and (3) act to stabilize the voltage in the electrical system.

The electrical system is a single wire, ground return type, utilizing the machine's structure as ground. All electrical circuits are protected by 30 amp fuses.

Battery 6 Volt - 2 Each	900 AMP (Total)
Ground	Negative
Alternator	12 Volt
Headlights - 12 Volt	#4913 Seal Beam
Tail/Brake Lights - 12 Volt	#1157 Bulb
Front Turn Signals - 12 Volt	#1156 Bulb
Rotating Beacon - 12 Volt	#4916 Seal Beam
Work Lights - 12 Volt	#4913 Seal Beam
Fuses	30 AMP

Table 13-1 Electrical Components

BATTERIES

The forklift is provided with two 6 volt batteries located in a battery box at the front of the engine compartment.

WARNING: Lead-acid batteries contain sulfuric acid which will damage eyes or skin on contact. Always wear a face shield to avoid acid in eyes. If acid contacts eyes, flush immediately with clean water and get medical attention. Wear rubber gloves and protective clothing to keep acid off skin. If acid contacts skin, wash off immediately with clean water.

WARNING: Lead-acid batteries produce flammable and explosive gases. Keep arcs, sparks, flames and lighted tobacco away.

WARNING: Never check a battery by placing a metal object across the posts. Serious burns or an explosion can result.

CAUTION: Disconnect the battery before working on the electrical system. Remove the ground terminal first. When reconnecting the battery, reconnect the ground terminal last.

NOTE: Do not add water to a battery in freezing weather unless the engine is to be run for two or more hours.

NOTE: Damage to the alternator will occur if: The engine is operated with the battery cables disconnected; the cables are connected when using a fast charger; welding on the forklift (remove both cables from the battery); booster battery cables are connected wrong.

MAINTENANCE

Check the battery electrolyte level at 200 hour intervals. Fill the battery cells to the bottom of the filler neck using distilled or soft water.

Check to see that battery cables are clean and tight. Remove any acid or corrosion from the battery and cables with a baking soda and water solution. Be sure vent plugs are tight. After cleaning, flush the outside of the battery and surrounding areas with water. Cover the terminals with grease to prevent corrosion.

ELECTRICAL

JUMP STARTING

If it is necessary to use an extra battery to start the engine, BE CAREFUL! This is a two person operation. There must be one person in the operator's seat and one person to connect and disconnect the cables.

WARNING: Do not charge a frozen battery, because it can explode. Let the battery warm to 60 F(16° C) before putting it on a charger.

WARNING: Lead-acid batteries produce flammable and explosive gases. Keep arcs, sparks, flames, and lighted tobacco away from the battery. When connecting extra battery for "jump" starting, always make the last connection (negative cable) to the engine or frame, never at battery. When removing the jump start cables, always remove the negative (-) cable from the engine or frame first.

Use the following procedure to jump start the engine:

1. The ignition switch must be in the OFF position.

2. The battery to be used must be of the same voltage.

3. Connect the end of the first cable to the positive terminal (+) of the booster battery. Connect the other end of the same cable to the positive terminal (+) of the forklift battery.

4. Connect the end of the second cable to the negative terminal (-) of the booster battery. Connect the other end of the second cable to the engine or frame of the forklift. DO NOT connect the cable directly to the negative terminal (-) of the forklift battery.

5. Start the engine.

6. After the engine has started, remove the cable connected to the engine, or forklift frame.

7. Then remove the cable from the positive terminal (+) of the forklift battery.

TROUBLESHOOTING

PROBLEM
* = Probable cause
- = Correction

LOW BATTERY OUTPUT

* High resistance in circuit.
- Check for resistance with voltmeter.

* Low electrolyte level.
- Add distilled water to proper level.

* Low specific gravity
- See "Low Battery Charge".

* Defective battery cell.
- Replace battery.

* Cracked or broken battery case.
- Replace battery.

* Low battery capacity.
- Always replace battery with one of adequate capacity.

BATTERY USES TOO MUCH WATER

* Cracked battery case.
- Replace battery.

* Overcharged battery.
- See "High Charging Circuit Voltage"

LOW BATTERY CHARGE

* Excessive loads from added accessories.
- Remove excessive loads.

* Excessive engine idling.
- Idle engine only when necessary.

* Lights or accessories left on.
- Be sure electrical switches are off before leaving machine.

* Continuous drain on battery.
- Check for leakage on dirty battery top. Disconnect battery ground and connect voltmeter between the ground battery terminal and a good ground.

ELECTRICAL

TROUBLESHOOTING (cont.)

LOW BATTERY CHARGE (cont.)

* Faulty charging operation.
- See "Low Charging Circuit Voltage" or "Low Charging Circuit Output".

LOW CHARGING CIRCUIT VOLTAGE

* High resistance in charging circuit connections.
- Check voltage drop to locate resistance. Be sure to use pin connector at battery to locate resistance between battery post and battery cable.

* Defective wiring.
- Check voltage drop in wire to locate broken wire strands or undersized replacement wire.

* Low amperage output of alternator.
- See "Low Charging Circuit Output."

* Defective regulator.
- Replace regulator.

* Open-circuited isolation diode in alternator.
- Replace isolation diode assembly.

LOW CHARGING CIRCUIT OUTPUT

* Slipping drive belts.
- Adjust belt tension.

* Excessively worn or sticking brushes.
- Repair or replace. Check commutator or slip rings.

* Dirty or out-of-round slip rings.
- Clean slip rings.

* Dirty current regulator contact points.
- Clean points or replace regulator.

* Defective diodes in alternator.
- Replace diode or diode plate assembly.

* Defective electrical windings in alternator.
- Repair or replace windings. (If alternator stator windings are defective, be sure regulator will control alternator voltage.)

HIGH CHARGING CIRCUIT VOLTAGE

* Defective voltage regulator.
- Replace regulator.

NOISY ALTERNATOR

* Defective or badly worn drive belt.
- Replace belt. Adjust to proper tension.

* Worn or defective bearings.
- Replace bearings.

* Loose mounting or loose drive pulley
- Tighten mounting and pulley.

* Misaligned drive belt or pulley
- Check pulley condition. Align pulley.

* Alternator rectifier shorted or open.
- Replace diode or diode plate assembly.

SLUGGISH STARTING MOTOR OPERATION

* Low battery charge.
- Charge battery and check specific gravity. If battery does not respond to charging, install a new one.

* High resistance in circuit.
- Clean and tighten all connections. Repair or replace faulty wiring.

* Defective starting motor.
- Service and repair starting motor where necessary.

* Starting motor bearings dry.
- Lubricate bearings with oil of proper viscosity.

* Excessive engine drag due to tight bearings.
- Recheck engine overhaul procedures. If problem still exists after break-in period, test and service starting circuit.

* Extremely cold weather.
- Warm up battery before starting the engine.

* Too-high engine oil viscosity.
- Drain oil and replace with lower viscosity oil as recommended.

* Hydraulic pump load too high.
- Disengage pump drive clutch.

ELECTRICAL

TROUBLESHOOTING (cont.)

STARTING MOTOR WILL NOT OPERATE

* Low battery charge.
- Charge battery and check specific gravity. If battery does not respond to charging, install a new battery.

* Neutral safety switch open.
- Put shift lever in neutral position.

* Improperly adjusted or defective neutral safety switch.
- Adjust or replace switch.

* Defective starting switch.
- Replace switch

* High resistance in starting circuit or defective wiring.
- Clean and tighten all connections and replace faulty wiring.

* Faulty solenoid switch on starting motor.
- Repair or replace switch.

* Faulty starting motor.
- Service and repair motor.

STARTING MOTOR SOLENOID SWITCH FLUTTERS

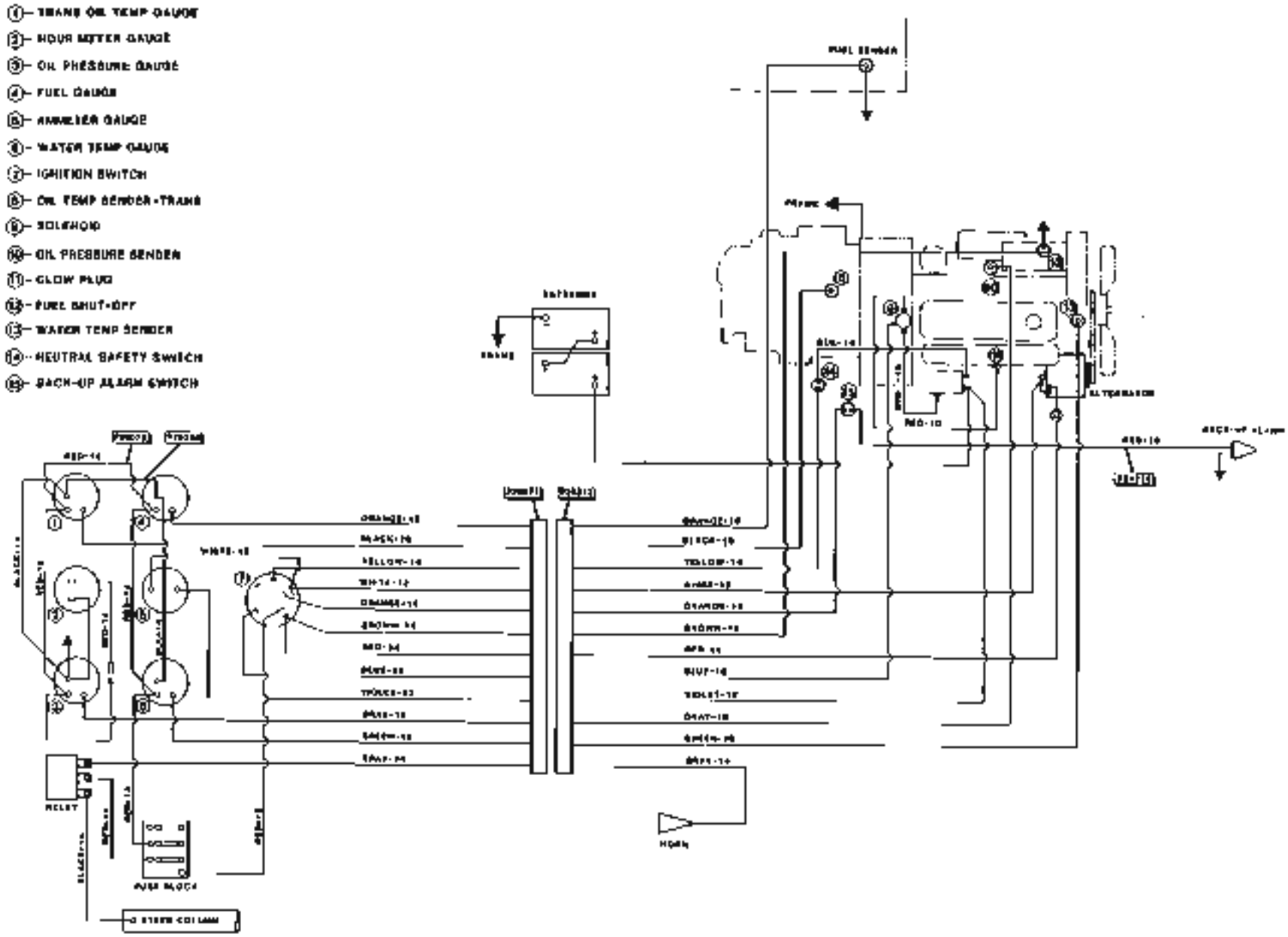
* Low battery charge.
- Charge battery and check specific gravity. If battery does not respond to charging, install a new battery.

* High resistance in circuit.
- Clean and tighten all connections and replace faulty wiring.

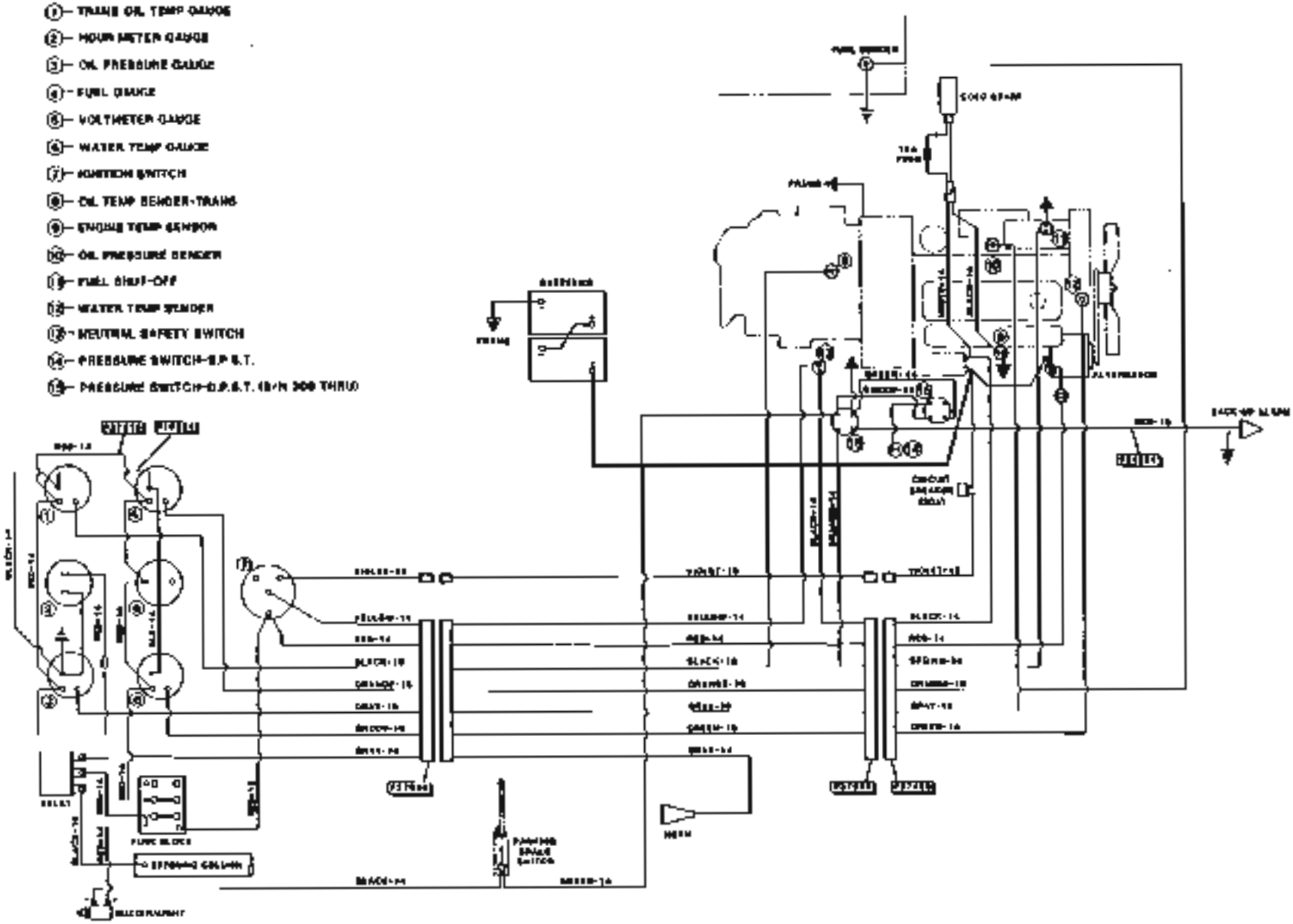
* Open circuit in starter solenoid hold-in winding circuit.
- Repair or replace solenoid or wires.

ELECTRICAL SCHEMATICS

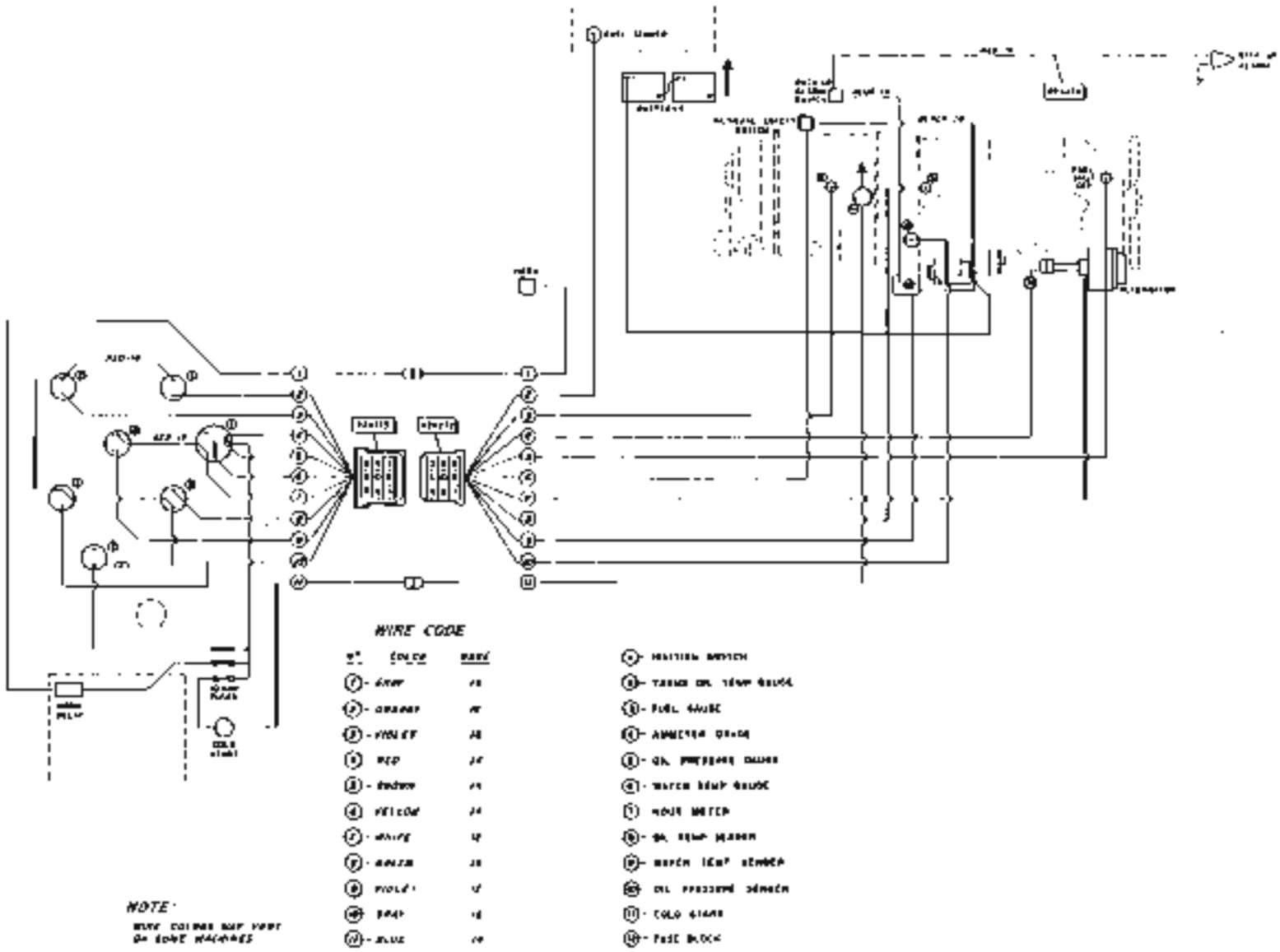
(Pages 1b through 12b)



Wiring Diagram (Models 522, 522/4 - S/N 101 thru 297)

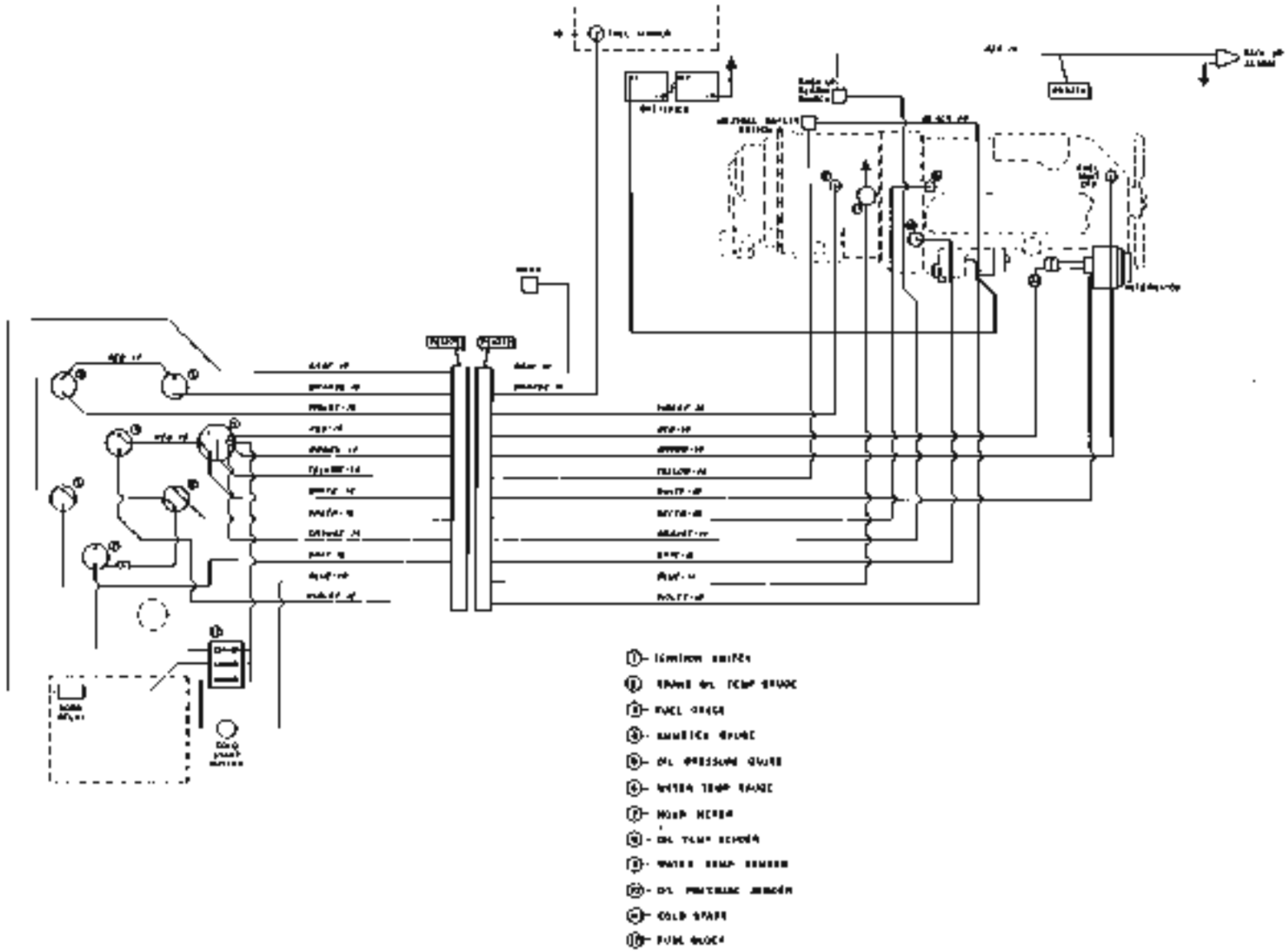


Wiring Diagram (Models 522, 522/4 - S/N 298 thru)



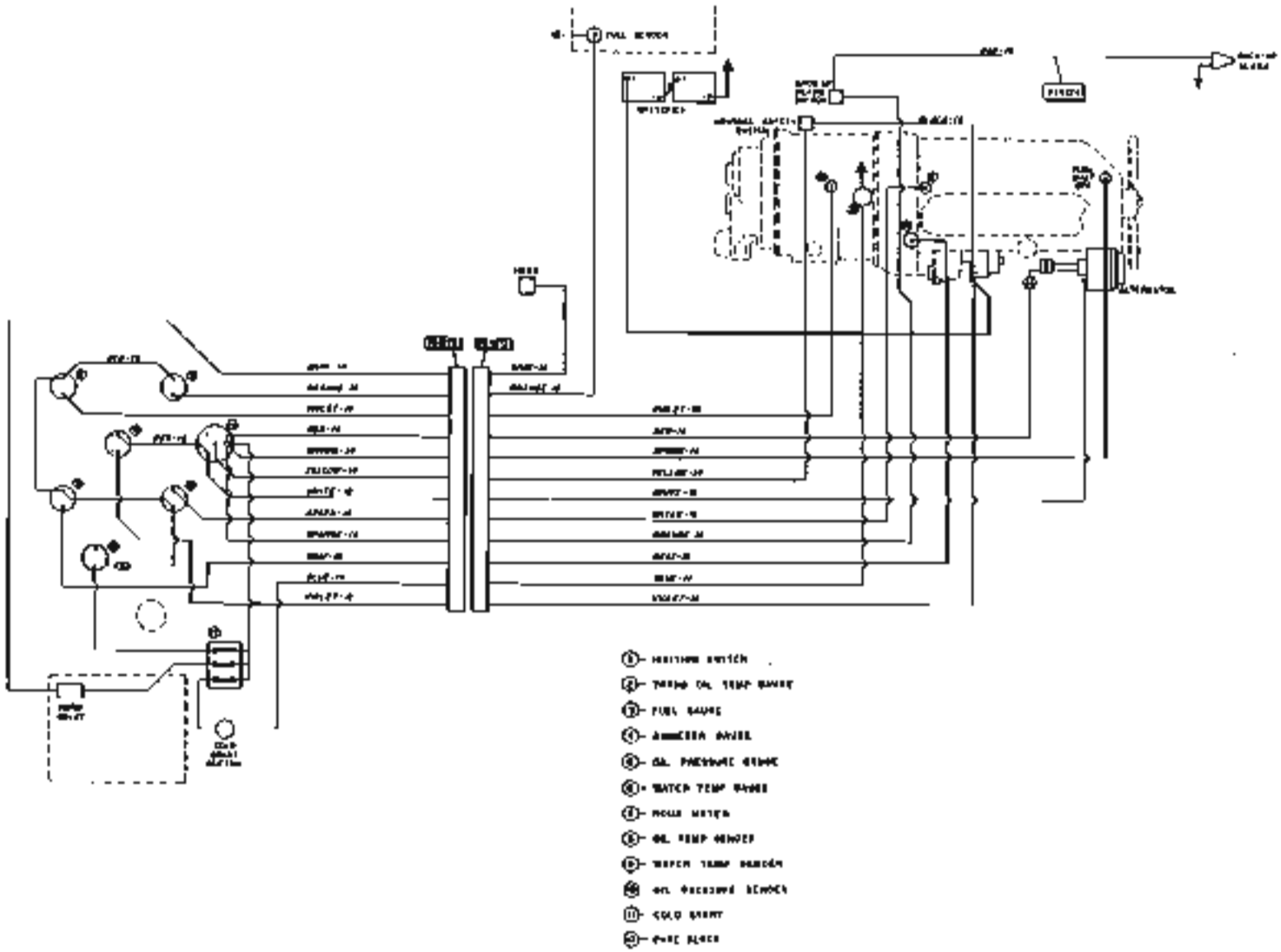
Deere Engine

Wiring Diagram (Models 622, 622/4 - S/N 101 thru 286)

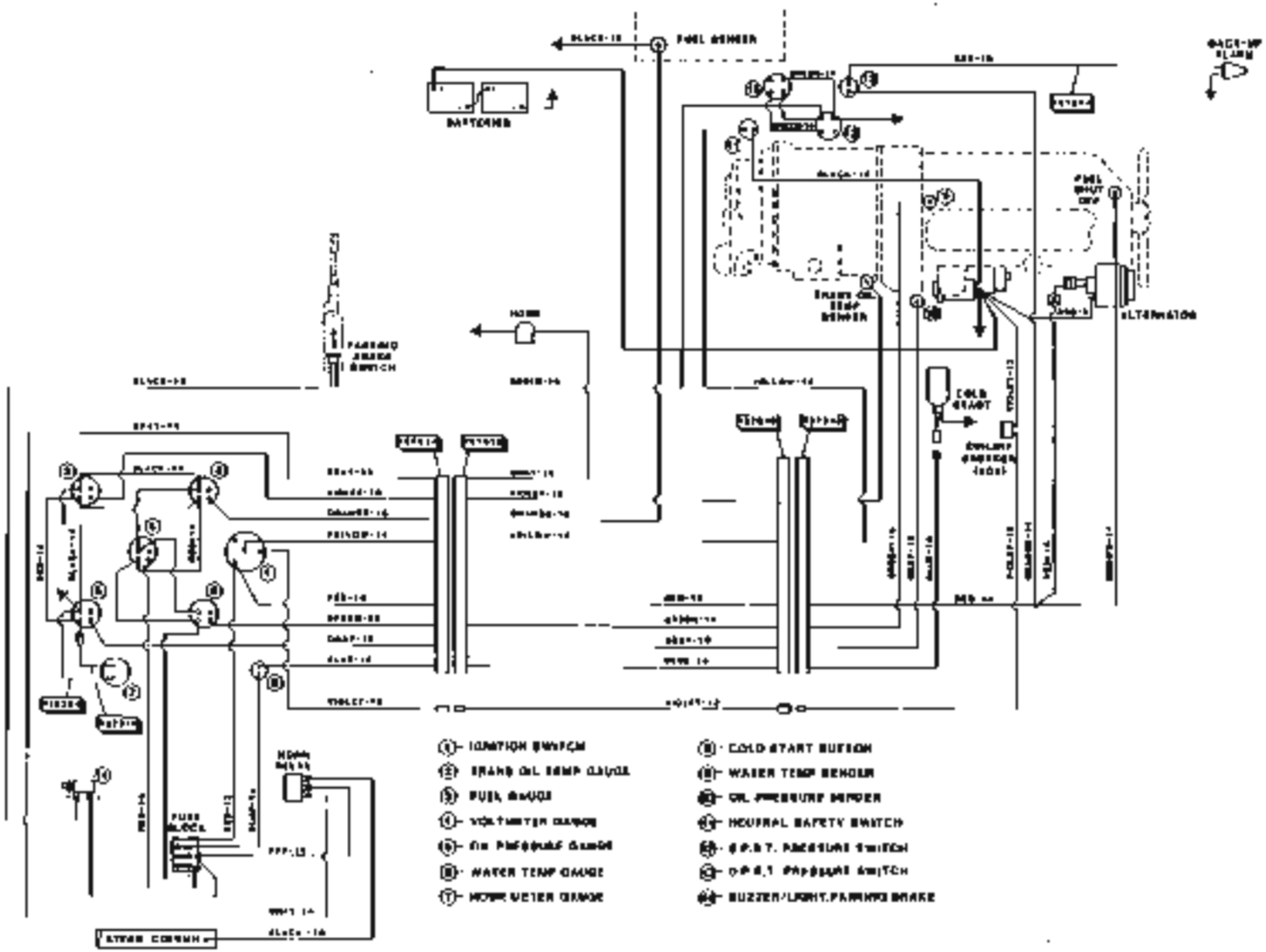


Deere Engine

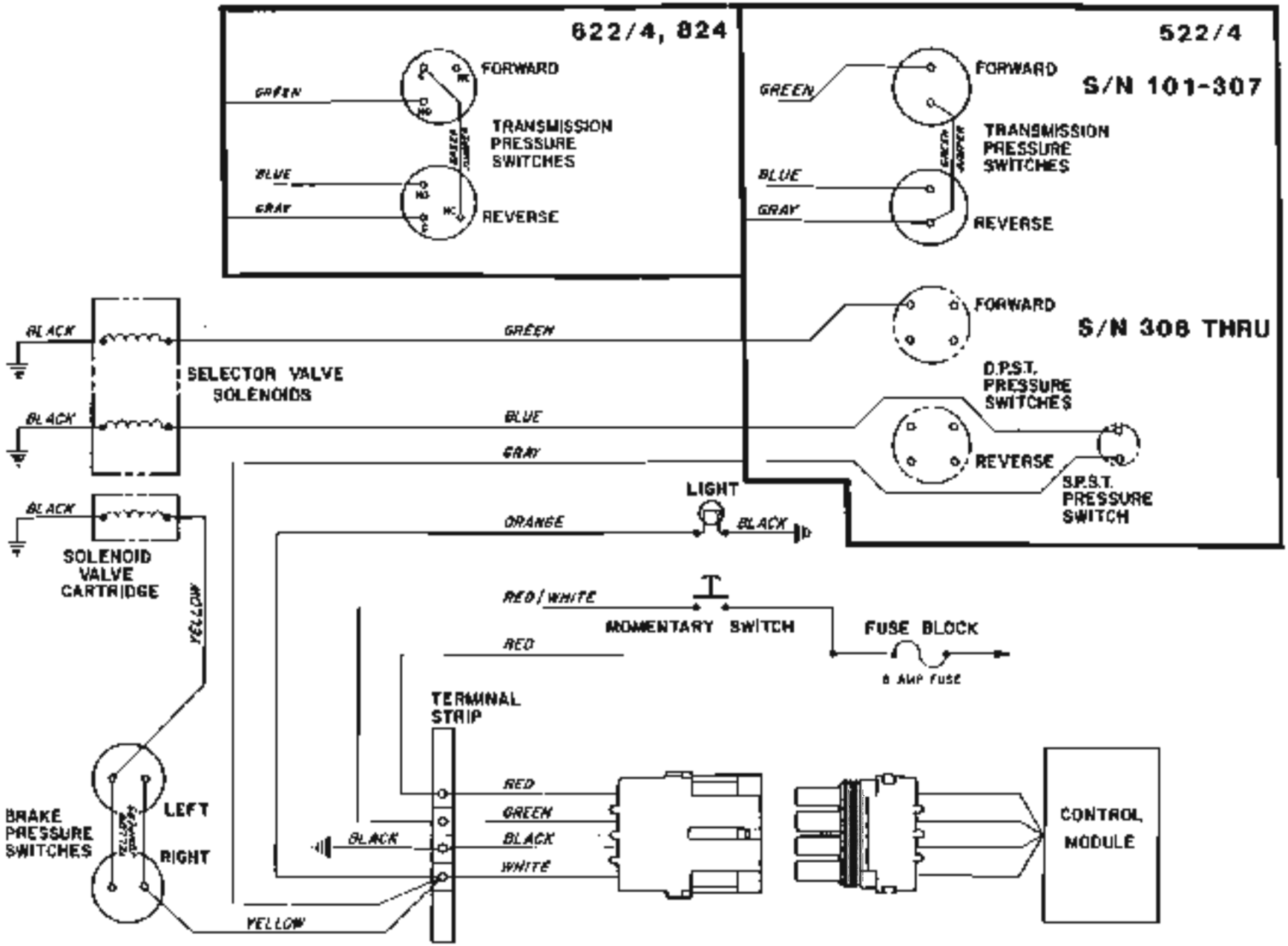
Wiring Diagram (Models 622, 622/4 - S/N 287 thru 648)



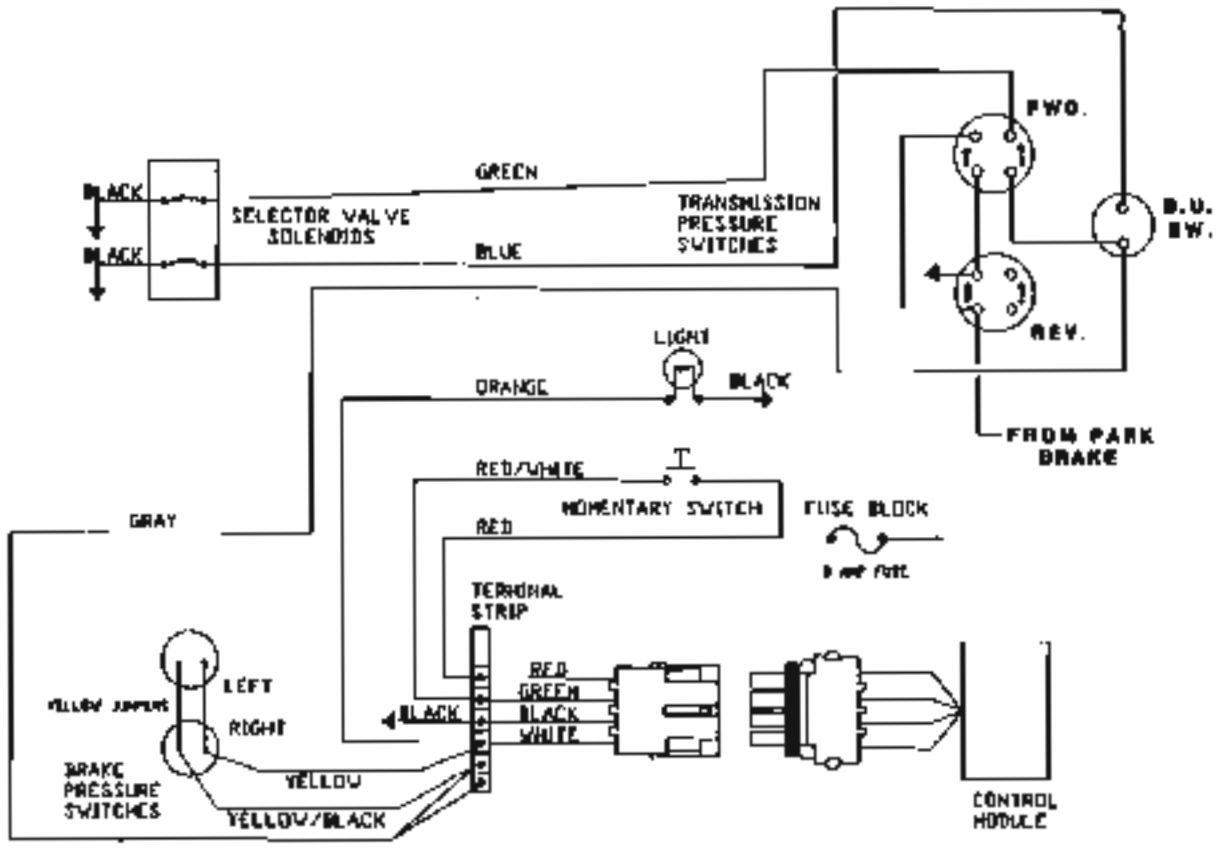
Wiring Diagram (Model 824 - S/N 101 thru 216)



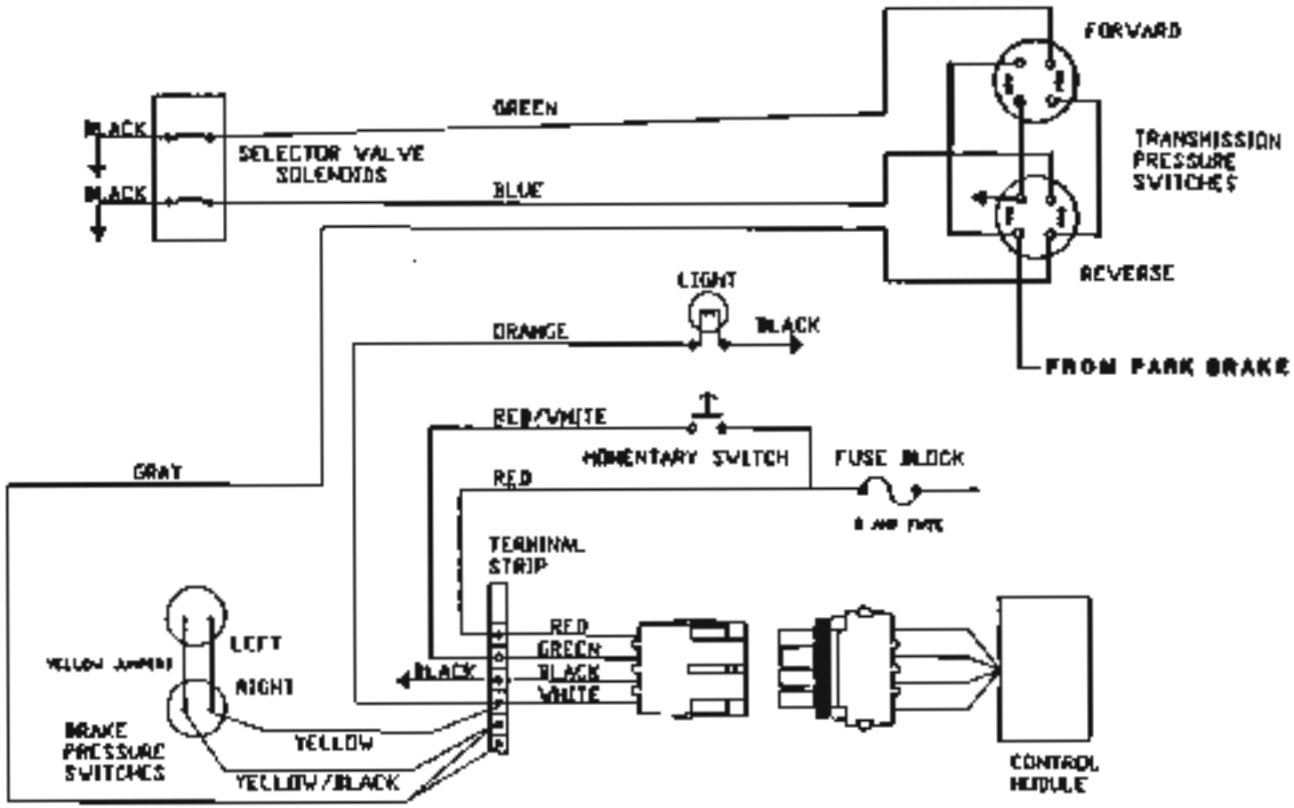
Wiring Diagram (Models 622, 622/4 - S/N 649 thru)
(Model 624 - S/N 217 thru)



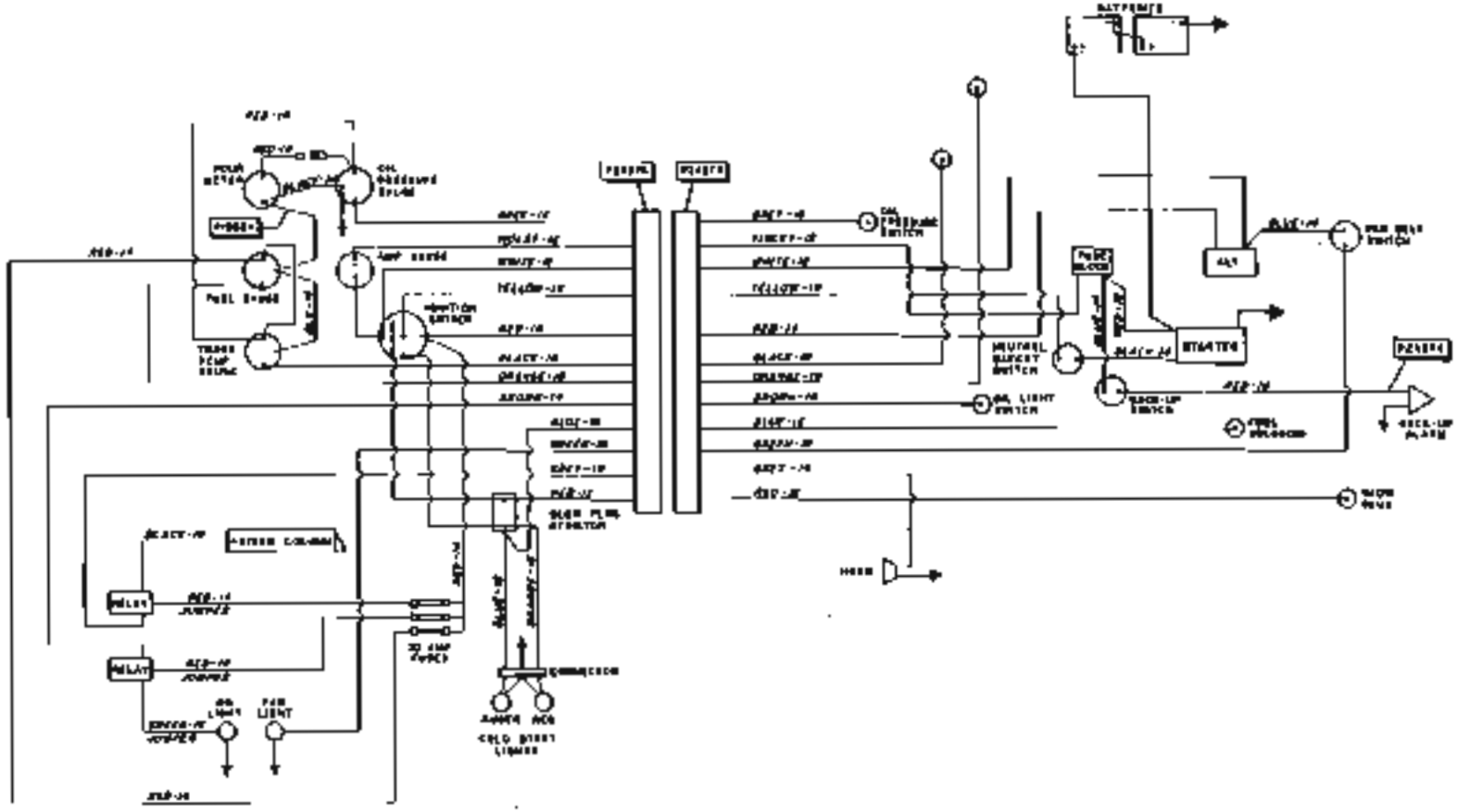
Wiring Diagram - Rear Wheel Power Assist
(Early Production Models 522/4, 622/4, 824)



Wiring Diagram - Rear Wheel Power Assist
(Late Production Model 522/4)

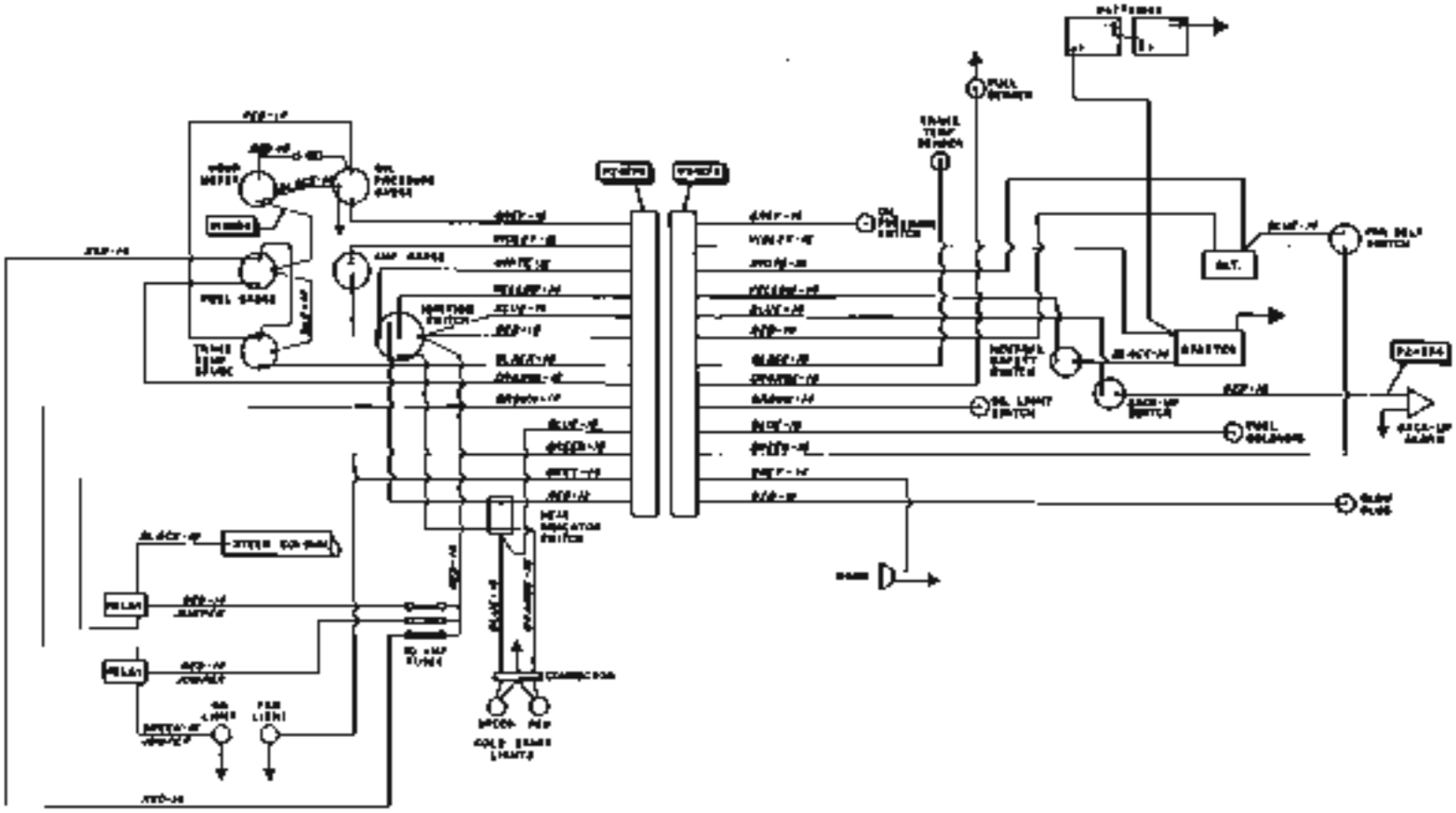


Wiring Diagram - Rear Wheel Power Assist
(Late Production Models 622/4, 624)



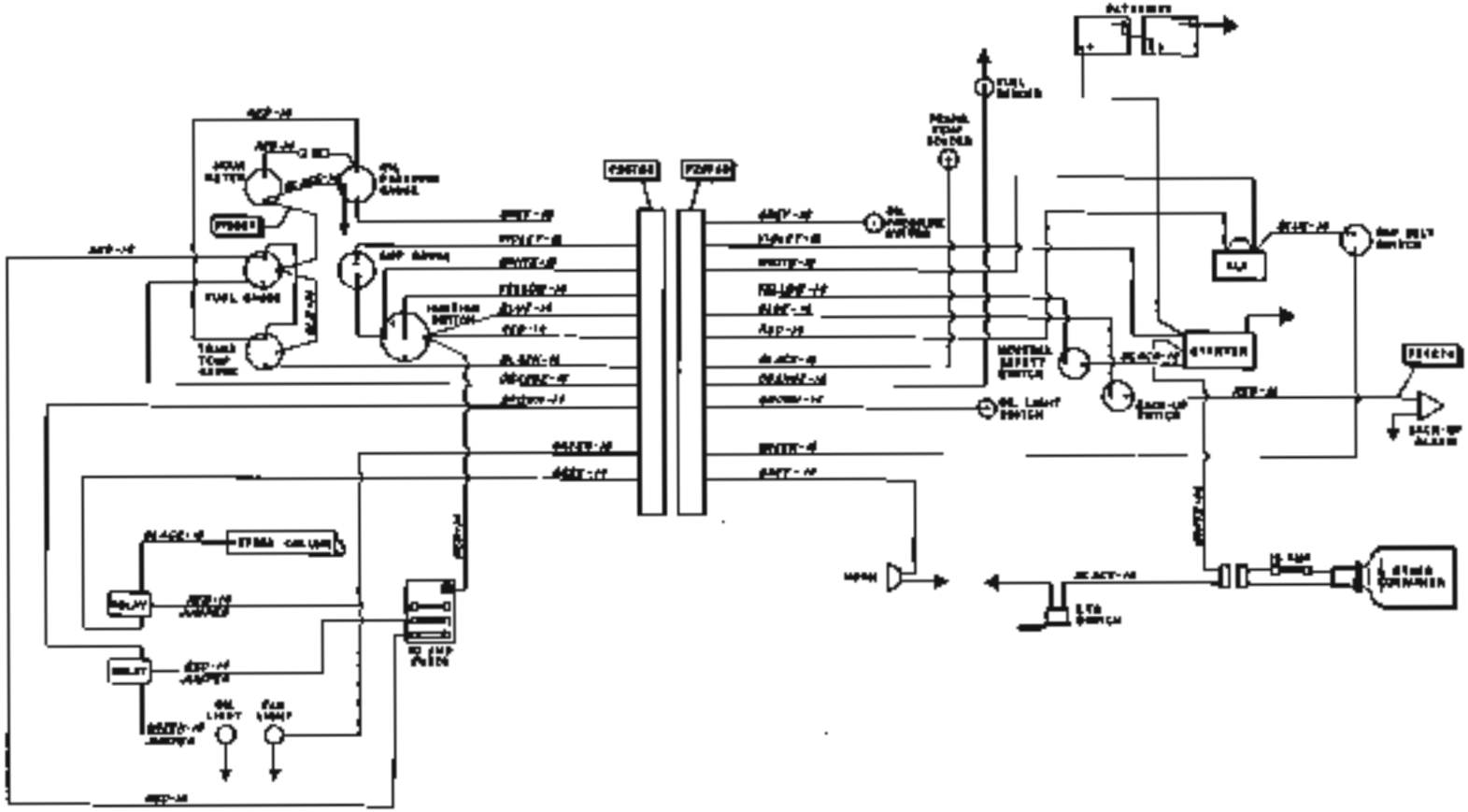
Deutz Engine

Wiring Diagram (Models 622, 622/4 - S/N 101 thru 266)



Deutz Engine

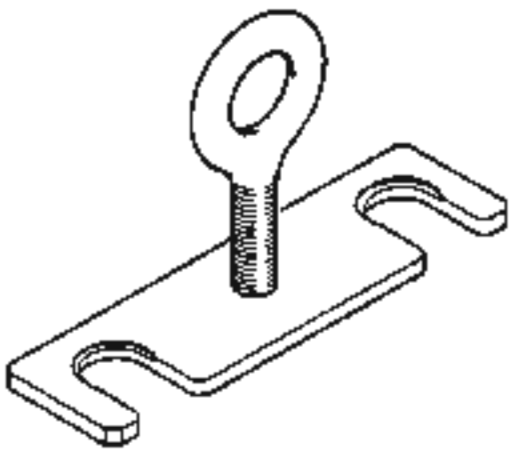
Wiring Diagram (Models 622, 622/4 - S/N 267 thru 538)



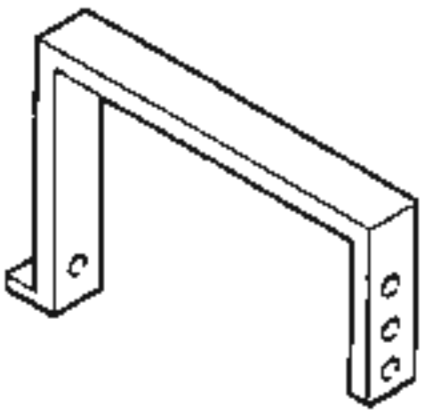
Deutz Engine

Wiring Diagram (Models 622, 622/4 - S/N 539 thru)

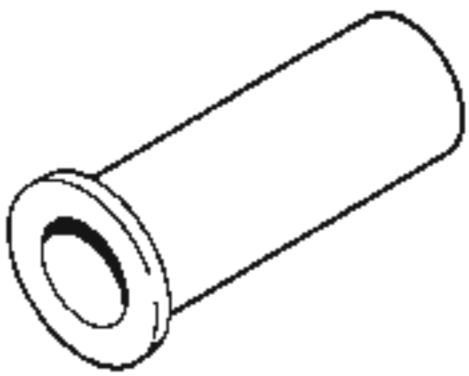
SERVICE TOOLS



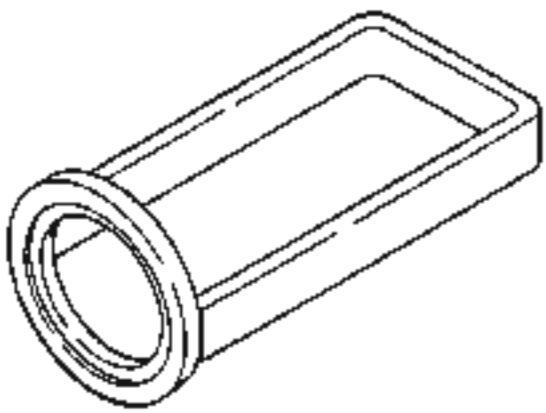
30317A
Clutch Pack Lifting Tool - 622, 824



30309A
Transmission Lifting Bracket - 622, 824

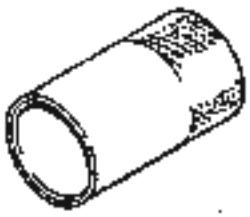


30311A for 1.82" I.D. x 2.62" O.D.
30312A for 1.81" I.D. x 2.94" O.D.
30313A for 1.81" I.D. x 3.25" O.D.
Bearing Driver - 622, 824
Used to install bearing on clutch pack shafts.



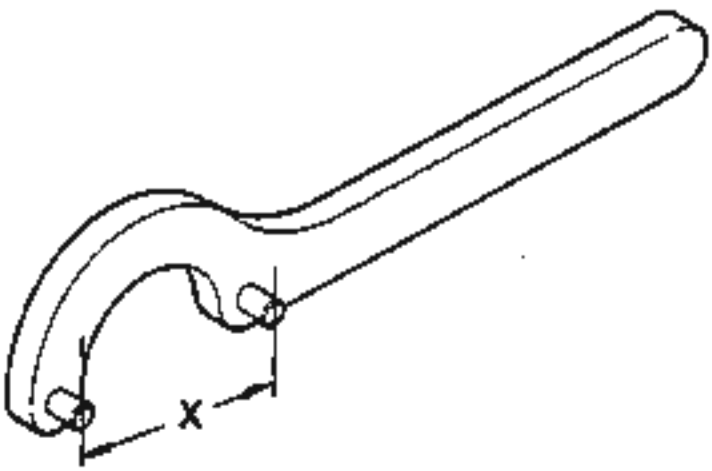
30314B
Clutch Spring Compressor Tool - 622, 824
Used to disassemble and assemble clutch release springs for transmission.

SERVICE TOOLS

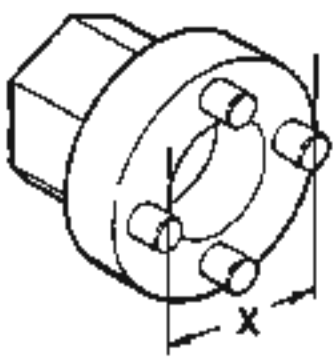


25326A
Seal Compression Sleeve - 622, 824

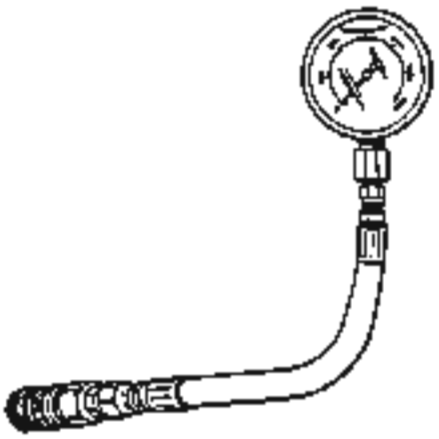
Spanner Wrench
for Hydraulic Cylinder Rod Bearings
P26253 (x = 4 1/4")
P26252 (x = 3 3/4")
P26251 (x = 3")



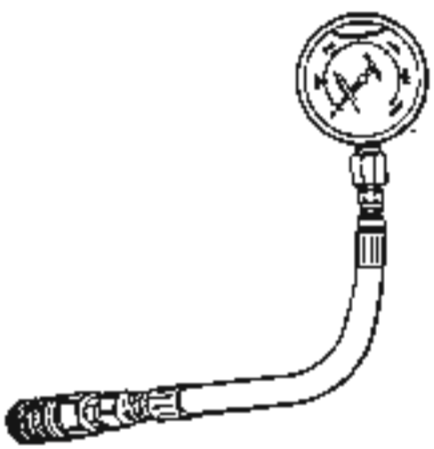
Peg Spanner
for Hydraulic Cylinder Piston Heads
P26254 (x = 2 3/8")
P26255 (x = 3")



SERVICE TOOLS



26231C
Test Gauge Kit (0 - 1500 P.S.I.)
for Brake Priority Valve &
Diff. Lock Diagnostic Port



26232C
Test Gauge Kit (0 - 5000 P.S.I.)
for Hydraulic Diagnostic Ports

The parts information in this publication is based on data available at the time it was printed. Because of continual improvement and advancing product design, your vehicle may not be identical to the parts information shown. Whenever there is a question, obtain the latest parts information available from your local dealer. JLG Industries, Inc. continually updates these publications electronically within our *OnLine Services*.

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- Identify parts using graphical parts manuals.
- Enter orders using part numbers, or order by selecting from graphical parts manuals.
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