Lull®

Service and Maintenance Manual

Models
644
844
1044

10709970
April 1, 1989

ANSI

ISO9001
REGISTERED COMPANY
UKAS
QUALITY
MANAGEMENT
015

JLG®

LULL SERVICE MANUAL

MODELS 644, 844, 1044

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Publication No. P09970 Date 04/01/89

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This Service Manual provides instructions for correct maintenance, adjustment and troubleshooting of Lull Model 644, 844 and 1044 Forklifts. This manual also provides information for overhaul of hydraulic valves, hydraulic cylinders, boom, transfer carriage, frame tilt, oscillation, and power brake accumulator. However, procedures for overhauling the hydraulic pump, engine, transmission, axles, power brake valve, and steer control unit 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 Industries.

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 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, 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 644

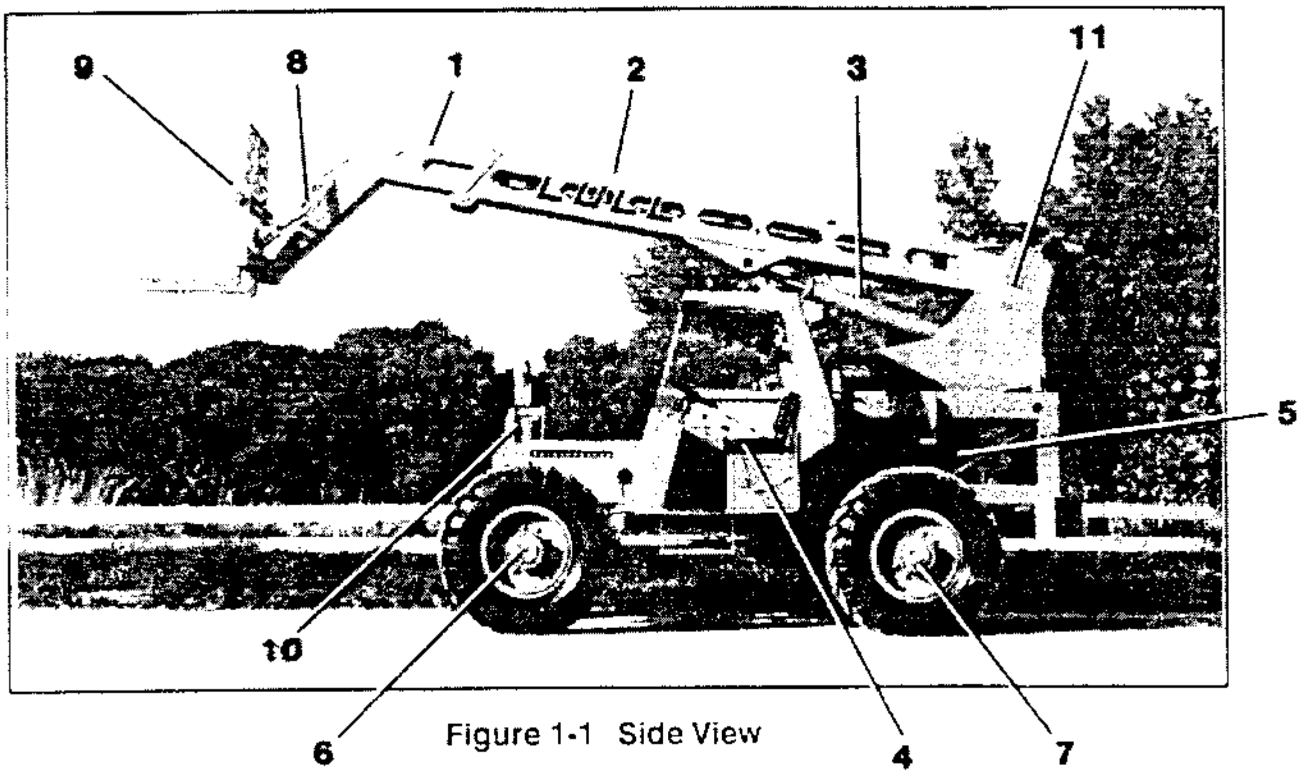

Figure 1-1 Side View

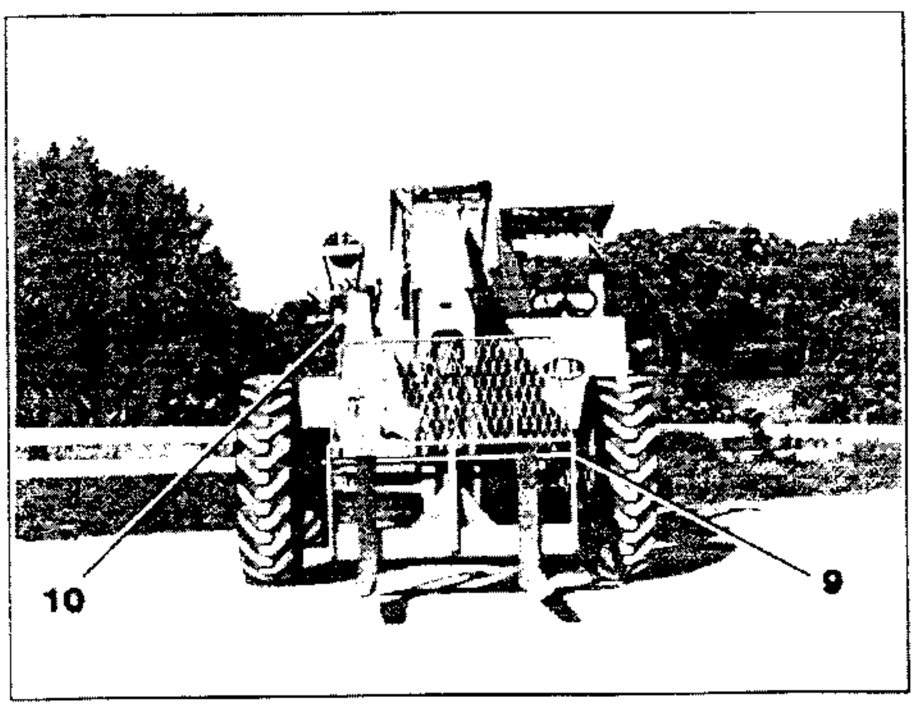

Figure 1-2 Front View

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

IDENTIFICATION (MODEL 844)

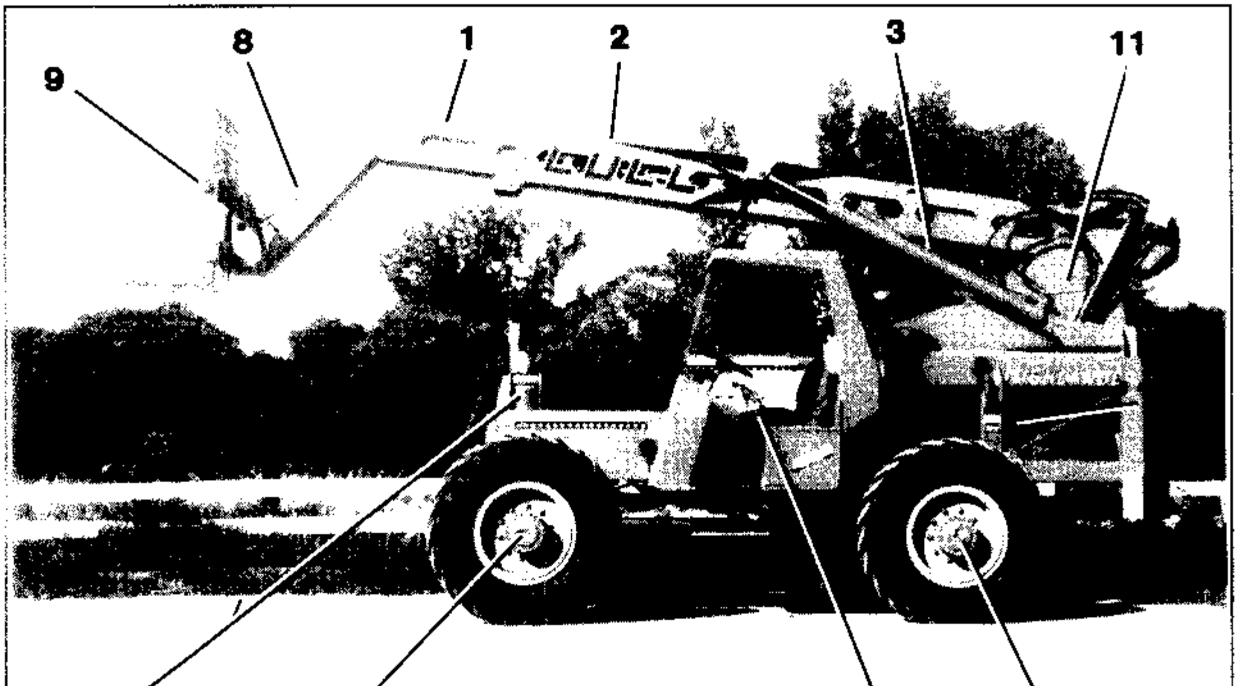

Figure 1-3 Side View

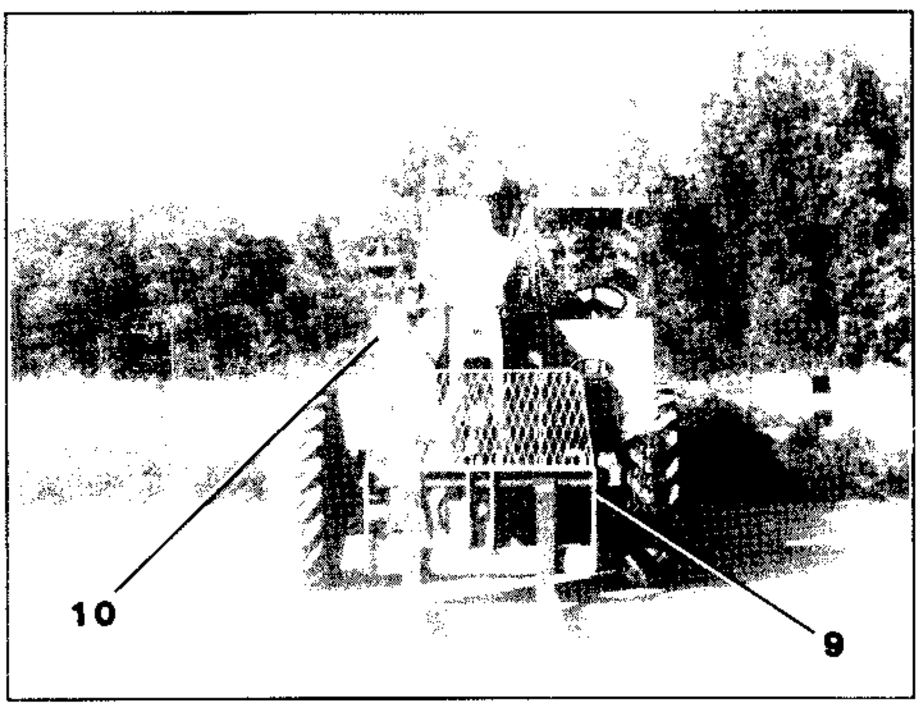

Figure 1-4 Front View

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

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IDENTIFICATION (MODEL 1044)

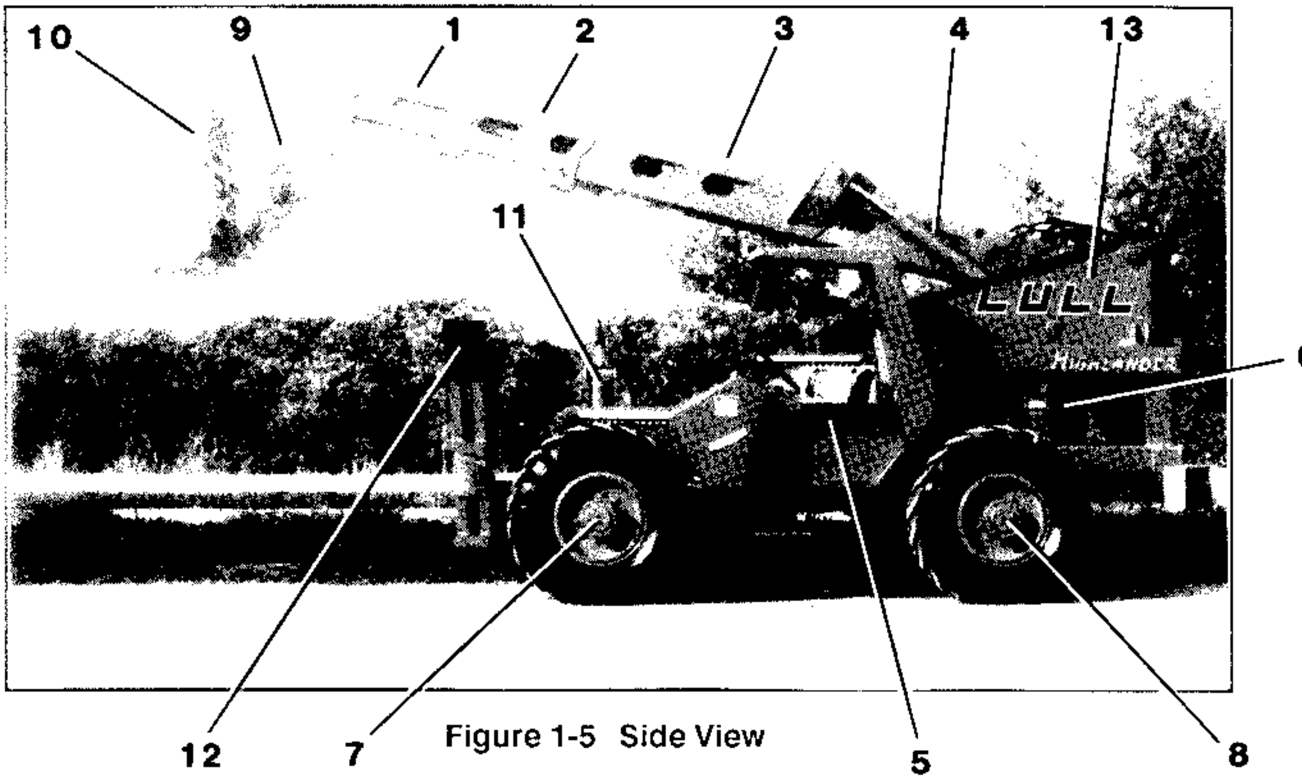


Figure 1-5 Side View

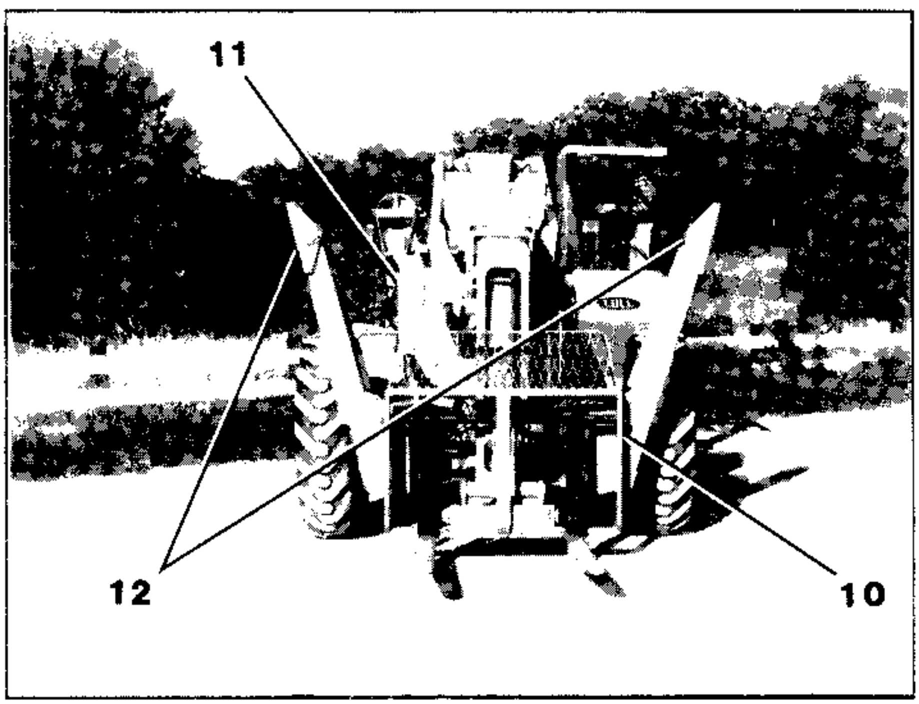


Figure 1-6 Front View

1 - Inner Boom
2 - Center Boom
3 - Outer Boom
4 - Boom Hoist Cylinder (2)
5 - Operators Compartment
6 - Engine Compartment
7 - Front Axle
8 - Rear Axle
9 - Carriage Tilt Cylinder
10 - Fork Carriage
11 - Frame Tilt Cylinder
12 - Outriggers
13 - Transfer Carriage

INTRODUCTION

SPECIFICATIONS

MODEL 644

General

Rated Capacity . . . . 6,000 LBS (See Load Chart)
Drive 4-Wheel
Steer . . . . Front Wheel
4-Wheel Round
4-Wheel Crab
Empty Vehicle Weight . . . . Approx. 20,300 LBS

Travel Speeds (Forward and Reverse)

1st Gear . . . . 3.2 mph
2nd Gear . . . . 8.3 mph
3rd Gear . . . . 20 mph

Dimensions

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

Wheel Base . . . . 112"
Overall Length . . . . 21'-5" w/42" Forks
Overall Width . . . . 8'-0"
Overall Height . . . . 9'-11"
Outside Turning Radius . . . . 17'-5"
Ground Clearance . . . . 14"
Frame Tilt . . . . 12.5° Right and Left

Capacities

Hydraulic Tank and System . . . . 47 gals
Fuel Tank . . . . 40 gals
Cooling System (John Deere) . . . . 18 qts
Transmission . . . . 18 qts
Drain and Refill . . . . 12 qts
Differentials . . . . 12.8 qts
Planetary Hubs . . . . 3.6 pts
Friction Modifier . . . . 5 ozs
Engine Oil (John Deere) . . . . 9 qts
Engine Oil (Deutz) . . . . 10 qts

INTRODUCTION

SPECIFICATIONS

Model 644 (cont.)

Engine

Manufacturer .... John Deere
Model 4239D
Fuel .... Diesel
Cooling .... Liquid
Horsepower .... 80 at 2500 rpm
Maximum Torque .... 208 lb-ft. at 1000 rpm
Piston Displacement .... 239 cu. in.
No. of Cylinders .... 4 Vertical In-Line
Cycle .... 4 Stroke
Combustion System .... Direct Injection
Compression Ratio 17.8:1
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 4023
Type .... 3-Speed Powershift with Torque Converter
Speeds .... 3 Forward, 3 Reverse
Filter .... Spin On

Axles - Front and Rear

Manufacturer .... Spicer
Model PS-1350
Type .... Off-Highway with Drive and Steering Functions

INTRODUCTION

SPECIFICATIONS

Model 644 (cont.)

Wheels/Tires - Front and Rear

Lugs	10
Tire Size	12.00 x 24 - 8 ply
	13.00 x 24 - 8 ply
Water Fill	28 gals (12.00 x 24)
	33 gals (13.00 x 24)
Calcium Fill	100 lbs (12.00 x 24)
	116 lbs (13.00 x 24)
Pressure	50 psi

Service Brakes

Manufacturer	Spicer
Type	Wheel End Wet Disc, Power, Hydraulically Actuated,

Parking Brake

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

Power Steering

Manufacturer	Char-Lynn
Model	213-1006
Type	Hydrostatic

Hydraulic Pump

Manufacturer	Vickers
Model	G2020
Type	Gear
Sections	Two
GPM at 2500 rpm	18 - Each Section
Maximum PSI	3300

Telescoping Boom - Two Section

Elevation	-17° to +63°
Maximum Lift Height	35'-0"
Maximum Reach at 24" Load Center	23'-6" From Tires
Power	Full
TransAction	72"

INTRODUCTION

SPECIFICATIONS

Model 644 (cont.)

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	2800 psi
4 or 5 Section Valve Relief	2800 psi
Carriage Tilt Valve Section-Up Relief	2400 psi
Carriage Tilt Valve Section-Down Relief	2400 psi
Outrigger Valve Relief	2600 psi
Steering S/N 101-1694	1800 psi
S/N 1695-Current	2000 psi
Brakes S/N 101-1694	400-500 psi
S/N 1695-Current	330 psi
Differential Lock Valve Relief	285 psi

Accumulator Pre-charge (Brakes)

Dry Nitrogen	400 psi

Hoist Cylinder Cycle Time (Up or Down)

No Load, Full rpm	9 Seconds

Hydraulic Oil Working Temperatures	140° -180°

SPECIFICATIONS

Model 844

General

Rated Capacity	8,000 lbs (See Load Chart)
Drive	Front Wheel or 4-Wheel
Steer	Front Wheel 4-Wheel Round 4-Wheel Crab
Empty Vehicle Weight	Approx. 21,300 lbs

Travel Speeds (Forward and Reverse)

1st Gear	2.5 mph
2nd Gear	4.8 mph
3rd Gear	8.8 mph
4th Gear	20.0 mph

Dimensions

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

Wheel Base	112"
Overall Length	22' 4" with 42" Forks
Overall width	8' 0"
Overall Height	9' 11"
Outside turning radius	17' 5"
Ground Clearance	16"
Frame Tilt	12.5° Right and Left

Capacities

Hydraulic Tank and System	50 gals
Fuel Tank	40 gals
Cooling System (John Deere)	18 qts
Transmission (Manual) — Total Capacity	21 qts
Drain and Refill	15 qts
Transmission (Electric) — Total Capacity	17 qts
Drain and Refill	11 qts
Differential	12.8 qts
Planetary Hubs	3.6 pts
Friction Modifier	5 oz
Engine Oil (John Deere)	10 qts
Engine Oil (Deutz)	12.5 qts

SPECIFICATIONS

Model 844 (cont.)

Engine

Manufacturer	John Deere
Model	4276D
Fuel	Diesel
Cooling	Liquid
Horsepower	82 @ 2,500 rpm
Maximum Torque	236 lb/ft @ 1,000 rpm
Piston Displacement	276 cubic inches
Number of Cylinders	4 Vertical In-Line
Cycle	4 Stroke
Combustion System	Direct Injection
Compression Ratio	16.8:1
Oil Filter	Spin-On
Air Cleaner	Dry Cartridge
High rpm	2,500
Low Idle rpm	700–800

Manufacturer	Deutz
Model	F5L912
Fuel	Diesel
Cooling	Air
Horsepower	87 @ 2,500 rpm
Maximum Torque	201 lb/ft @ 1,500 rpm
Piston Displacement	287 cubic inches
Number of Cylinders	5 Vertical In-Line
Cycle	4 Stroke
Combustion System	Direct Injection
Compression Ratio	17.0:1
Oil Filter	Spin-On
Air Cleaner	Dry Cartridge
High rpm	2,500
Low Idle rpm	700–800

Transmission

Manufacturer	Funk
Model	1724
Type	4-Speed Powershift with Torque Converter
Speeds	4 Forward, 4 Reverse
Filter	Spin-On

Manufacturer	ZF
Model	4 WG-100
Type	4-Speed Electric Powershift with Torque Converter
Speeds	4 Forward, 3 Reverse
Filter	Cartridge

SPECIFICATIONS

Model 844 (cont.)

Axles — Front and Rear

Manufacturer . . . . Spicer
Model. PS-1350
Type. . . . . Off-Highway with Drive and Steering Functions

Wheels/Tires — Front and Rear

Lugs. 10
Tire size . . . . 12.00 x 24 – 8 ply
13.00 x 24 – 8 ply
Water Fill . . . . 28 gals (12.00 x 24)
33 gals (13.00 x 24)
Calcium Fill . . . . 100 lbs (12.00 x 24)
116 lbs (13.00 x 24)
Pressure . . . . 50 psi

Service Brakes

Manufacturer . . . . Spicer
Type. . . . . Wheel End Wet Disc,
Power, Hydraulically Actuated

Parking Brake

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

Manufacturer . . . . ZF
Type. . . . . Drum at Transmission Output,
Manually Actuated, Hydraulically Released

Power Steering

Manufacturer . . . . Char-Lynn
Model. 213-1006
Type. . . . . Hydrostatic

Hydraulic Pump

Manufacturer . . . . Vickers
Model. G2020
Type. . . . . Gear
Sections. . . . . Two
GPM @ 2,500 rpm . . . . 26 — Shaft End
18 — Cover End
Maximum PSI 3,300

SPECIFICATIONS

Model 844 (cont.)

Telescoping Boom — Two Section

Elevation . . . . . -17° to +63°
Maximum Lift Height . . . . . 34' 0", 42' 0" w/Tower
Maximum Reach at 24" Load Center. . . . . 23' 2" from Tires
Power . . . . . Full
TransAction . . . . . 80"

Electrical System

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

Pressures

Transmission . . . . . Refer to Manufacturer's Service Manual
Hydraulic
Boom Hoist & Extend Valve relief . . . . . 2600 psi
4 or 5 Section Valve relief . . . . . 2600 psi
Carriage Tilt valve Section — Up Relief. . . . . 2400 psi
Carriage Tilt valve Section — Down Relief . . . . . 2400 psi
Outrigger Valve Relief . . . . . 2600 psi
Steering S/N 101 – 1722 . . . . . 1800 psi
S/N 1723 – Current . . . . . 2000 psi
Brakes S/N 101 – 1722 . . . . . 400–500 psi
S/N 1723 – Current . . . . . 330 psi
Differential Lock Valve Relief . . . . . 285 psi
Accumulator Pre-Charge (Brakes)
Dry Nitrogen. . . . . 400 psi

Hoist Cylinder Cycle Time (Up or Down)

No Load, Full rpm . . . . . 11 seconds

Working Temperatures

Hydraulic Oil . . . . . 140°–180° F

SPECIFICATIONS

Model 1044

General

Rated Capacity	10,000 lbs (See Load Chart)
Drive	Front Wheel or 4 Wheel
Steer	Front Wheel 4-Wheel Round 4-Wheel Crab
Empty Vehicle Weight	Approx. 28,000 lbs

Travel Speeds (Forward and Reverse)

1st Gear	2.5 mph
2nd Gear	4.8 mph
3rd Gear	8.8 mph
4th Gear	20.0 mph

Dimensions

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

Wheel Base	112"
Overall Length	21'-8" w/42" Forks
Overall Width	8'-1"
Overall Height	8'-11.5"
Outside Turning Radius	16'-9"
Ground Clearance	16"
Frame Tilt	12.5° Right and Left

Capacities

Hydraulic Tank and System	65 gals
Fuel Tank	40 gals
Cooling System (John Deere)	18 qts
Transmission	21 qts
Drain and Refill	15 qts
Differentials	12.8 qts
Planetary Hubs	3.6 qts
Friction Modifier	5 ozs
Engine Oil (John Deere)	15 qts
Engine Oil (Deutz)	10.5 qts

INTRODUCTION

SPECIFICATIONS

Model 1044 (cont.)

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

Manufacturer	Deutz
Model	BF4L913
Fuel	Diesel
Cooling	Air
Horsepower	106 at 2500 rpm
Maximum Torque	252 lb-ft. at 1650 rpm
Piston Displacement	250 cu. in.
No. of Cylinders	4 Vertical In-Line
Cycle	4 Stroke
Aspiration	Turbocharged
Combustion System	Direct Injection
Compression Ratio	15.5:1
Oil Filter	Spin On
Air Cleaner	Dry Cartridge
High rpm	2500
Low Idle rpm	700-800

Transmission

Manufacturer	Funk
Model	1724
Type	4 Speed Powershift with Torque Converter
Speeds	4 Forward, 4 Reverse
Filter	Spin On

Axles - Front and Rear

Manufacturer	Spicer
Model	PS1350
Type	Off-Highway with Drive and Steering Functions

INTRODUCTION

SPECIFICATIONS

Model 1044 (cont.)

Wheels/Tires - Front and Rear

Lugs	10
Tire Size	14.00 x 24 - 10 ply
Water Fill	38 gals
Calcium Fill	134 lbs
Pressure	60 psi

Service Brakes

Manufacturer	Spicer
Type	Wheel End Wet Disc, Power, Hydraulically Actuated

Parking Brake

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

Power Steering

Manufacturer	Char-Lynn
Model	213-1006
Type	Hydrostatic

Hydraulic Pump

Manufacturer	Vickers
Model	G2020
Type	Gear
Sections	Two
GPM at 2500 rpm	26-Shaft End 18-Cover End
Maximum PSI	3300

Telescoping Boom - Three Section

Elevation	-10° to +63°
Maximum Lift Height	42'-0"
Maximum Reach at 24" Load Center	35'-0" from Tires
Power	Full, Cable Synchronized
TransAction	80"

SPECIFICATIONS

Model 1044 (cont.)

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 . . . . 3200 psi
5 Section Valve Relief . . . . 3200 psi
Carriage Tilt Valve Section-Up Relief . . . . 2400 psi
Carriage Tilt Valve Section-Down Relief . . . . 2400 psi
Pump Tee Relief . . . . 3300 psi
Outrigger Valve Relief . . . . 3200 psi
Steering . . . . 2000 psi
Brakes . . . . 330 psi
Differential Lock Valve Relief . . . . 285 psi

Accumulator Pre-charge (Brakes)

Dry Nitrogen . . . . 400 psi

Hoist Cylinder Cycle Time (Up or Down)

No Load, Full rpm . . . . 14 Seconds

Hydraulic Oil Working Temperature . . . . 140° -180°

INTRODUCTION

SPECIFICATIONS

Bolt Torque Specifications

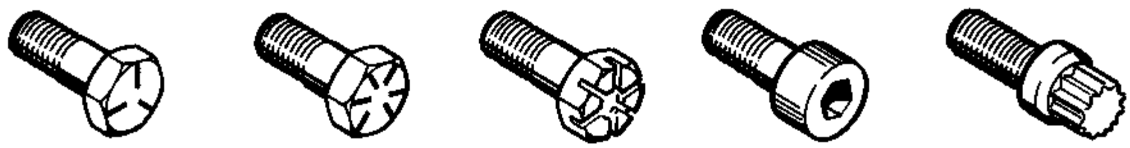


Figure 1-7 Types of Bolts

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	90	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 an individual torque value is specified, it shoud 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

INTRODUCTION

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 recommended that the fitting be tightened to a point approximately 10% below the maximum, and then tightened further only if leakage occurs. 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	15
6	19
8	38
10	56
12	78
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.
* When airing tires, do not over-inflate.
* 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 cylinder 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.

SAFETY PRECAUTIONS

* Keep all tools and small parts in tool box when not in 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.
* 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 writing or phoning 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

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 1-16 through 1-18. 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 1-16 through 1-18. Attach plates with the drive screws provided. If new mounting holes are required, use the plate 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 1-19. The sign is attached with No. 10 - 24 machine screws and locknuts.

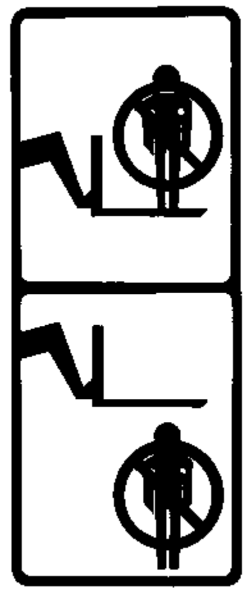


Figure 1-8 Carriage Safety - Decal
Part No.: P27585
Models used on: All

Signs

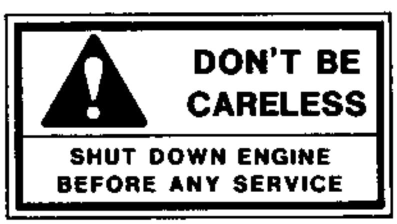


Figure 1-9 Don't be Careless - Decal
Part No.: P24705
Models used on: All

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

SAFETY SIGNS

Signs (cont.)

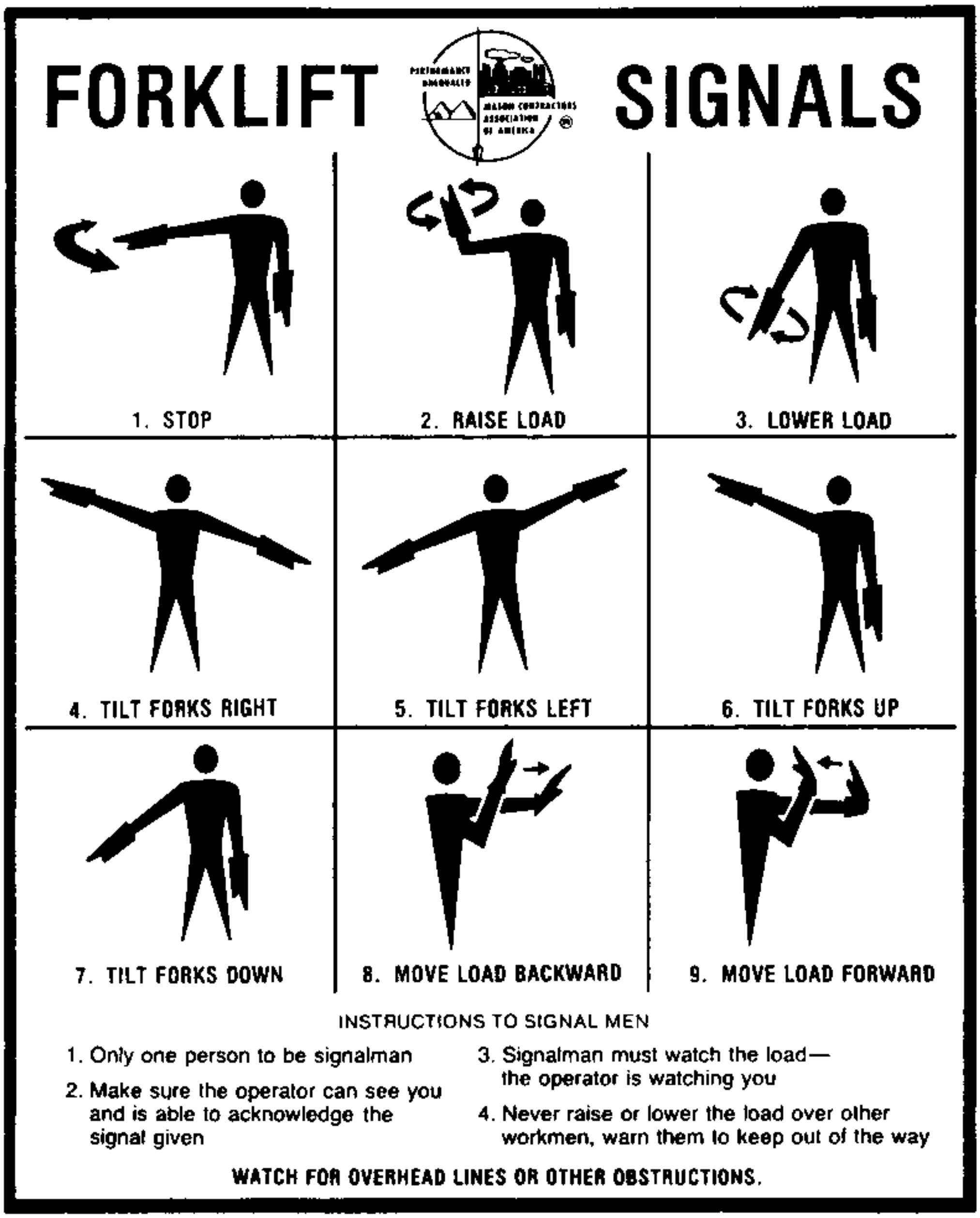


Figure 1-11 Forklift Signals
Part No.: P21406
Models used on: All

SAFETY SIGNS

Signs (cont.)

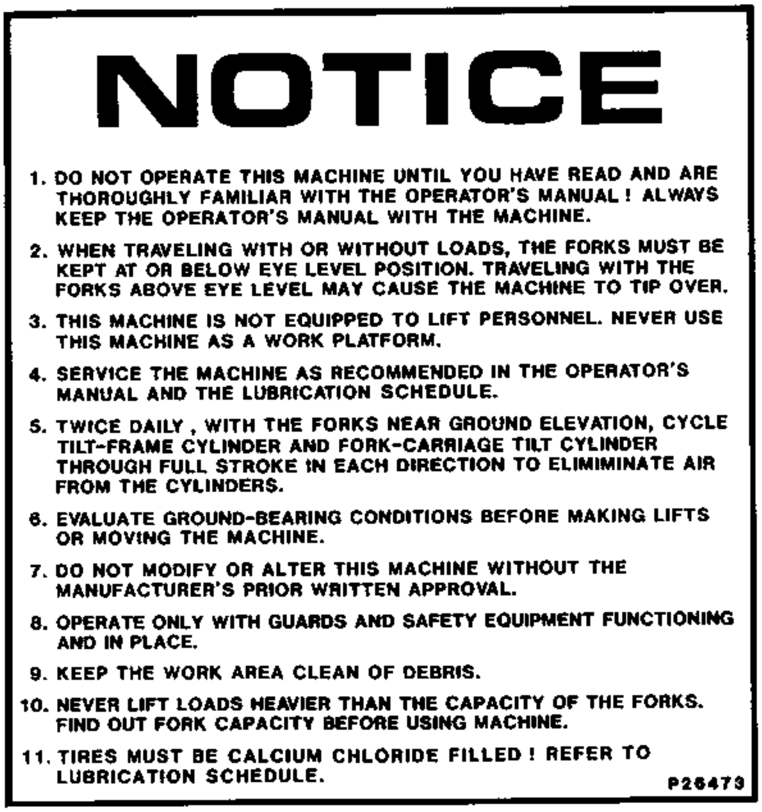


Figure 1-12 Notice - Decal
Part No.: P26473
Models used on: All

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

SAFETY SIGNS

Signs (cont.)

DO NOT OPERATE MACHINE WHEN LOW BRAKE PRESSURE LIGHT IS ON.

Figure 1-14 Low Brake Pressure - Decal
Part No.: P26787
Models used on: All

WARNING

OPERATE MACHINE ONLY WHEN GREEN QUICK ATTACH FLAGS ARE FULLY VISIBLE.

Figure 1-15 Quick Attach Warning - Decal
Part No.: P27557
Model used on: 1044

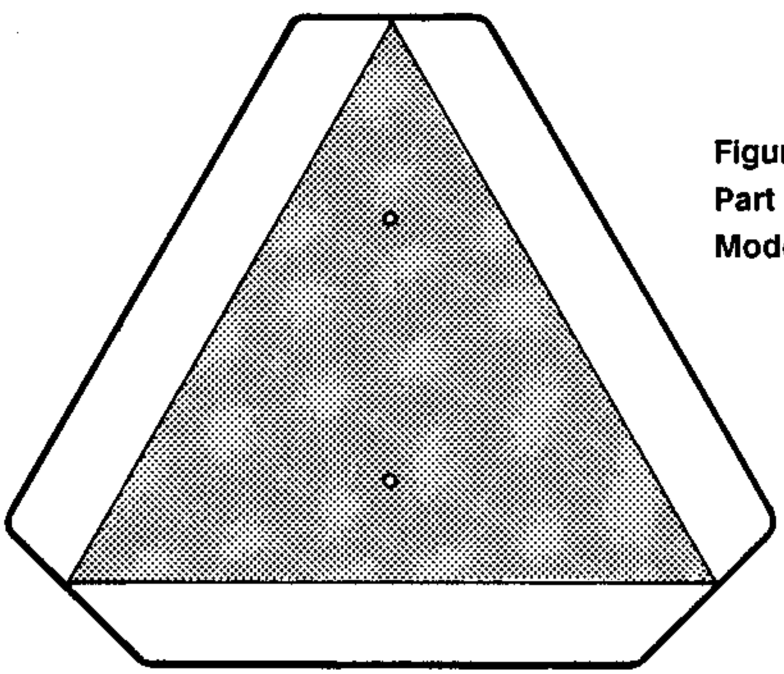
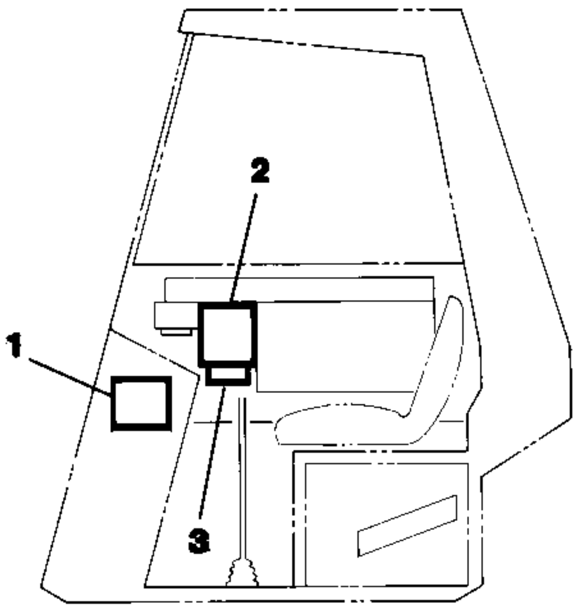


Figure 1-16 Slow Moving Vehicle - Plate
Part No.: P19841
Models used on: All

INTRODUCTION

SAFETY SIGNS

Locations



1 - Caution
2 - Notice
3 - Carry Load Low

Figure 1-17 Sign Locations
(Models 644, 844)

1 - Carriage Safety
(Located both sides of carriage)

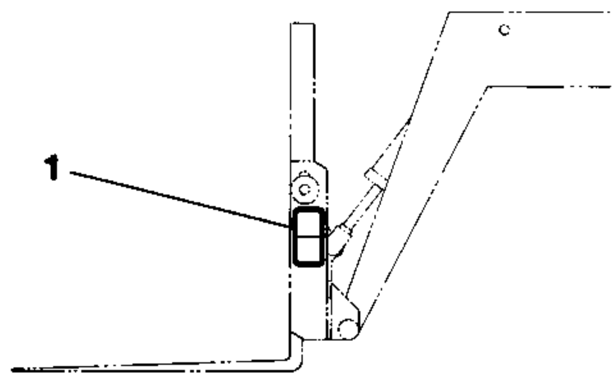
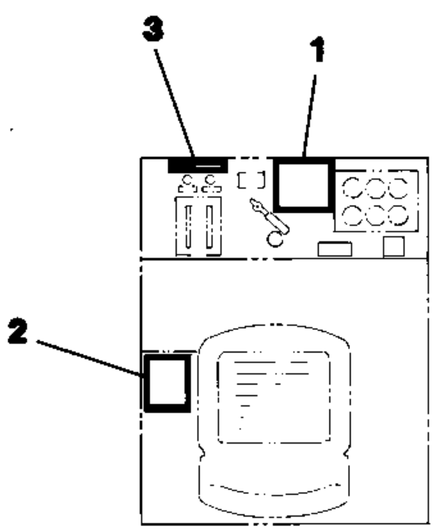


Figure 1-18 Sign Locations
(Models 644, 844, 1044)



1 - Caution (644, 844)
2 - Forklift Signals (644, 844)
3 - Low Brake Pressure (644, 844, 1044)

Figure 1-19 Sign Locations
(Models 644, 844, 1044)

SAFETY SIGNS

Location (cont.)

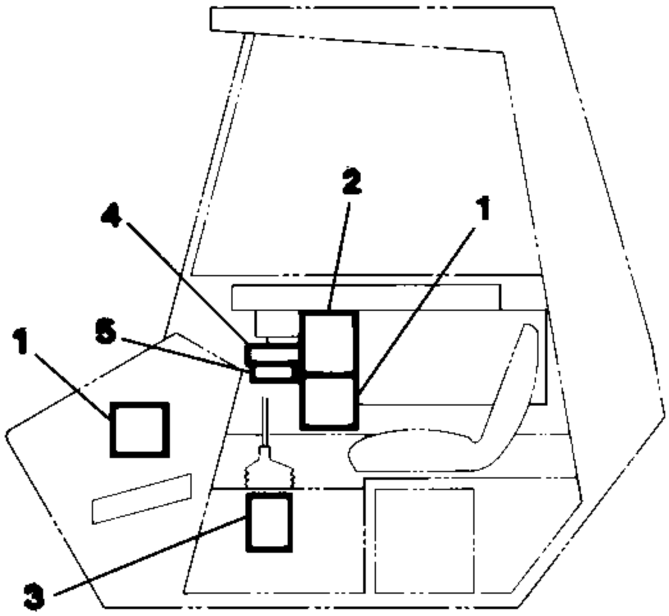


Figure 1-20 Sign Locations
(Model 1044)

1 - Caution
2 - Notice
3 - Forklift Signals
4 - Quick Attach Warning
5 - Carry Load Low

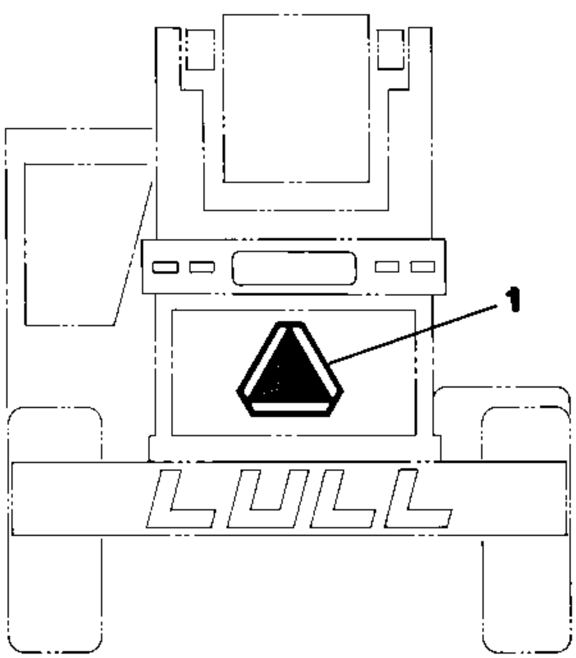


Figure 1-21 Sign Locations
(Models 644, 844, 1044)

1 - Slow Moving Vehicle

General Maintenance

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General Maintenance

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, 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.

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 problem.

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.

SERVICE AND REPAIR PROCEDURES - (cont.)

d. Avoid spilling fuel. If a spill occurs, wipe it up immediately.

* Never weld on forks, boom, support frame or overhead guard without written consent from the Lull Corporation.

* Install all guards, covers and shields after servicing. Repair or replace any that are damaged.

* Refill systems with approved or recommended fluids. 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.

* 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 you performed. Recheck all fluid levels before releasing machine for operation.

General Maintenance

SERVICE SCHEDULE (MODEL 644)

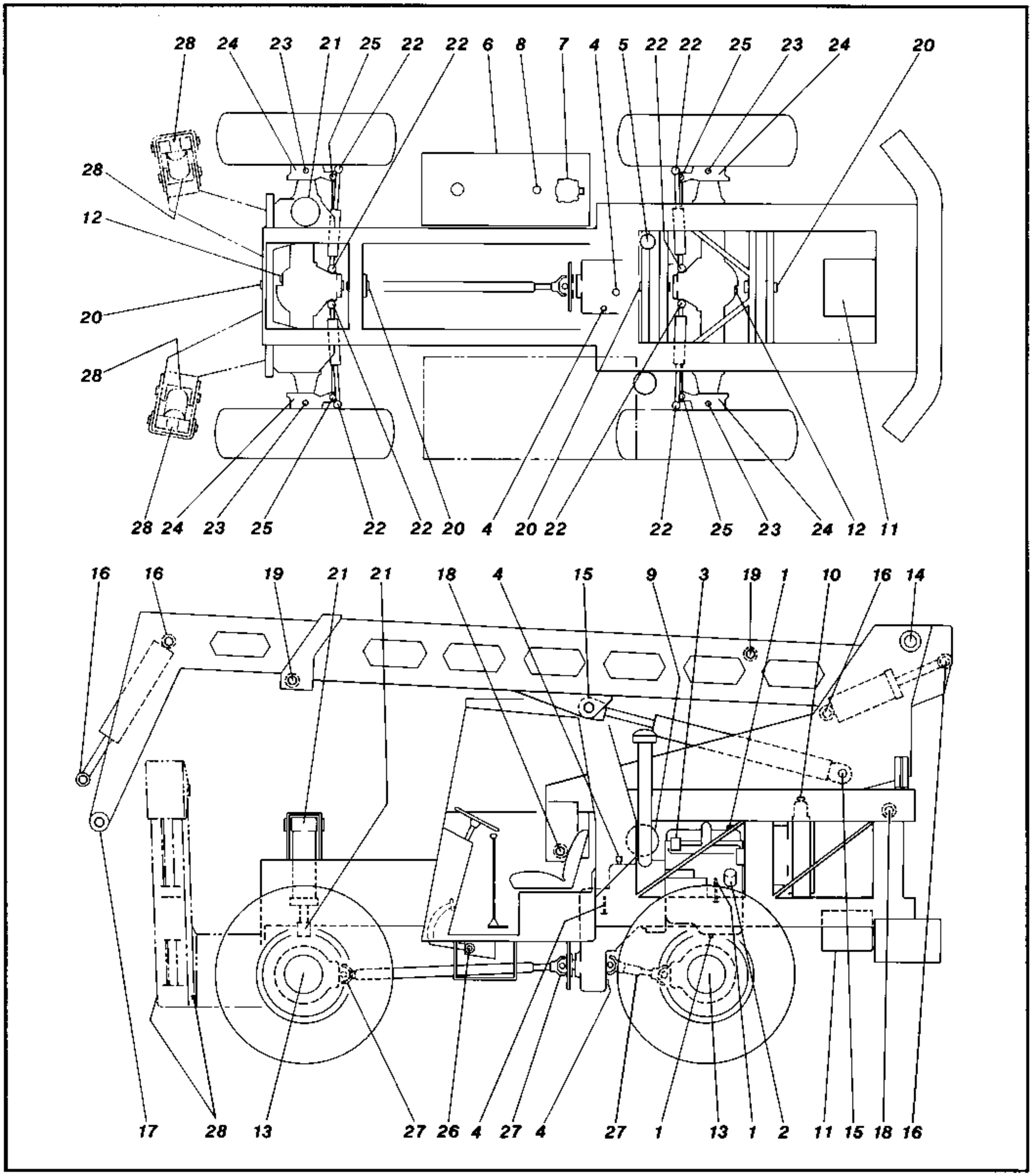

Figure 2-1 Lube and Service Locations

SERVICE SCHEDULE (MODEL 644)

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	Boom Pivot	Lube		Grease Fittings per Item						2
15	Hoist Pivots	Lube								2
16	Tilt Cylinder Pivots	Lube								4
17	Carriage Pivot	Lube								1
18	Transfer Rollers	Lube								4
19	Boom Rollers	Lube								4
20	Oscillation Pivots	Lube								4
21	Frame Tilt Cylinder	Lube								2
22	Steer Cylinders		Lube							8
23	Steer Spindles		Lube							8
24	Steer Universals		Lube							4
25	Tie Rod Ends		Lube							4
26	Brake Pedal Pivot		Lube							1
27	Drive Shaft Universals		Lube							6
28	Outrigger Pivots	Lube								8

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 (MODEL 644)

ITEM	TYPE OF FLUID	QUANTITY
Hydraulic Tank & System	Amoco Rykon MV or Equivalent	47 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 12 Quarts (Drain & Refill & Filter)
Differential (Front & Rear)	SAE-90 API-GL5	12.8 Quarts
Planetary Hub	P09962 Wheel End Oil	54 Ounces per Hub
Engine Crank Case Oil (With Filter)	See Engine Manual	Deere - 9 Quarts Duetz - 10 Quarts

Table 2-2 Lubricants and Capacities

GENERAL MAINTENANCE

SERVICE SCHEDULE

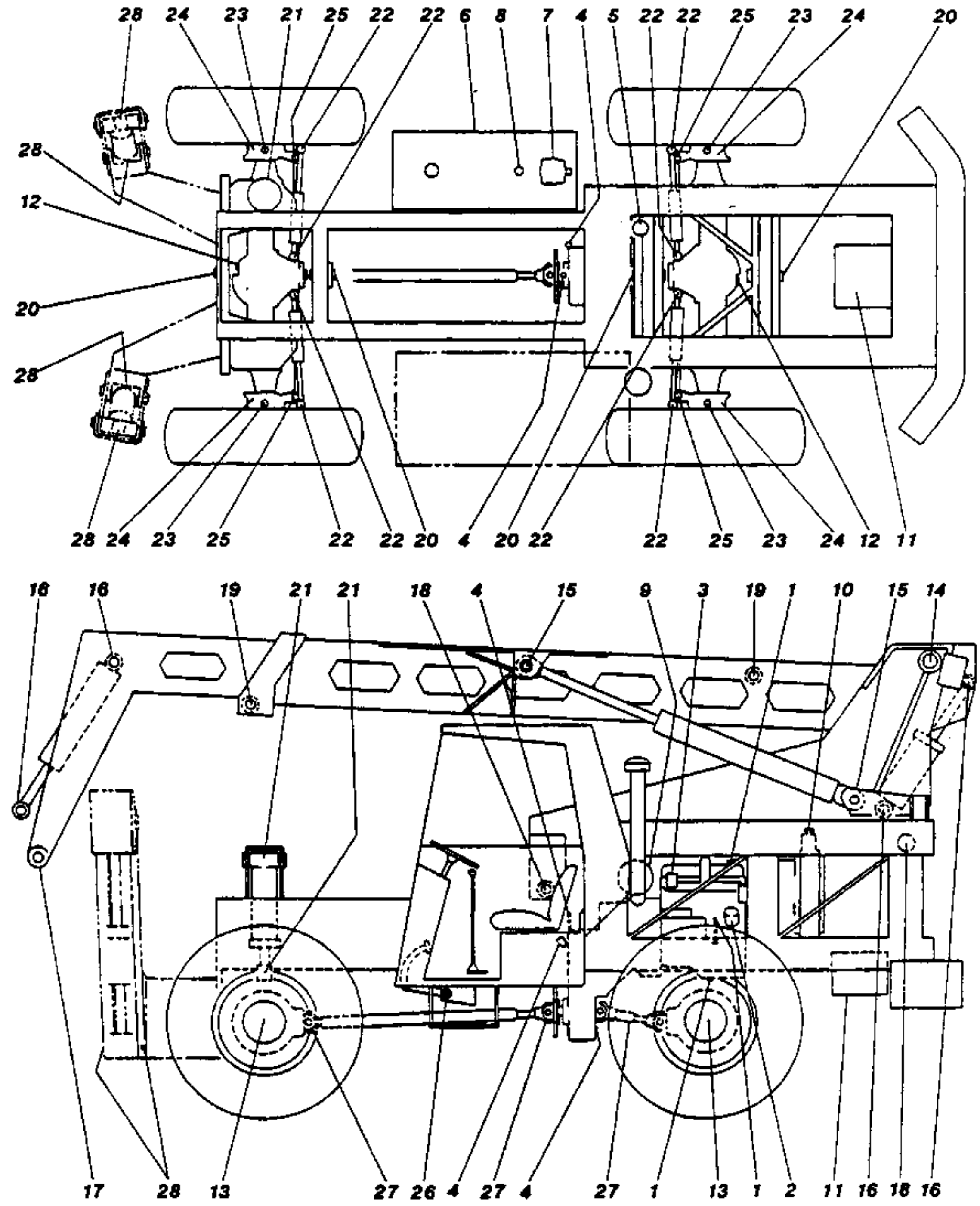

Figure 2-2 Model 844 Lube and Service Locations

GENERAL MAINTENANCE

SERVICE SCHEDULE

Model 844

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

C = Check fluid levels and add fluid as necessary
CF = Change fluid
R = Replace Filter
CLN = Clean item carefully

* First hours of operation

SHORTEN SERVICE INTERVALS ACCORDINGLY WHEN
OPERATING UNDER DUSTY OR SEVERE CONDITIONS

Table 2-3 Model 844 Service Schedule

SERVICE SCHEDULE

Model 844

ITEM	TYPE OF FLUID	QUANTITY
Hydraulic Tank & System	Amoco Rykon MV or Equivalent	50 Gallons
Fuel tank	Diesel Fuel	40 Gallons
Cooling System	Ethylene Glycol Permanent Coolant	18 Quarts
Manual Transmission and Cooler	Allison C-3 (MIL-L-2104 Grade 10)	21 Quarts Capacity 14 Quarts Drain, Refill, and Filter
Electric Transmission and Cooler	Amoco 320 or SAE 20W Motor Oil	17 Quarts Capacity 11 Quarts Drain, Refill, and Filter
Differential (Front & Rear)	SAE-90API-GL5	12.8 Quarts
Planetary Hub — Axle No's. R30BP121-4 & R30BP122-7	LULL P09962 Wheel End Oil	54 Ounces per Hub
Planetary Hub — Axle No's. R30BP121-4 & R30BP122-7 with Graphitic Brake Disc Conversion	SAE-90API-GL5 Preferred Brands: B.P., Chevron, Citco, Mobile	54 Ounces per Hub
Planetary Hub — Axle No's. R30BP121-6 & R30BP122-19	SAE-90API-GL5 Preferred Brands: B.P., Chevron, Citco, Mobile	54 Ounces per Hub
Engine Crank Case Oil (with Filter)	See Engine Manual	Deere — 10 Quarts Deutz — 12.5 Quarts

Table 2-4 Model 844 Lubricants and Capacities

GENERAL MAINTENANCE

SERVICE SCHEDULE

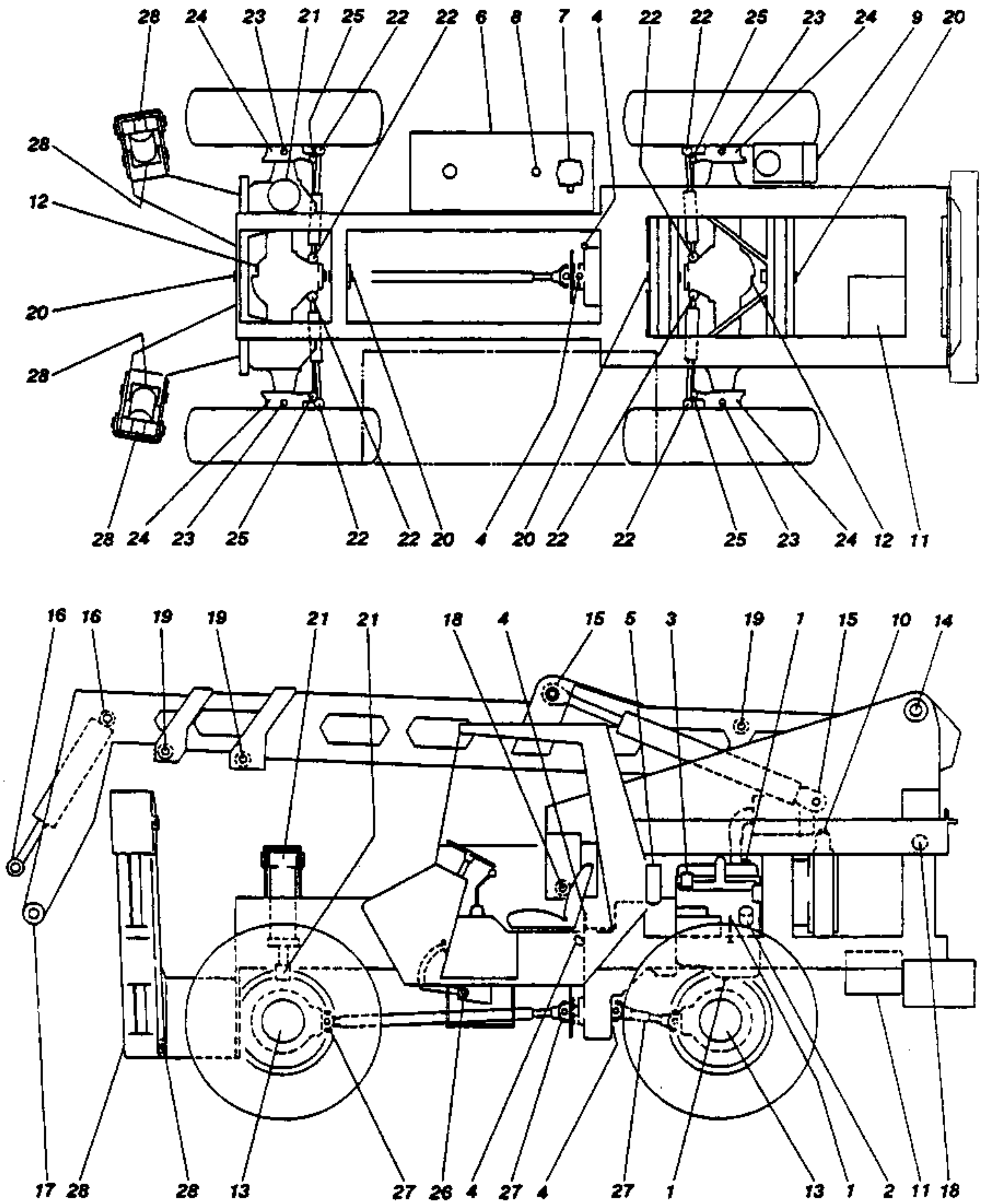

Figure 2-3 Model 1044 Lube and Service Locations

GENERAL MAINTENANCE

SERVICE SCHEDULE

Model 1044

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

C = Check fluid levels and add fluid as necessary
CF = Change fluid
R = Replace Filter
CLN = Clean item carefully

* First hours of operation

SHORTEN SERVICE INTERVALS ACCORDINGLY WHEN OPERATING UNDER DUSTY OR SEVERE CONDITIONS

Table 2-5 Model 1044 Service Schedule

GENERAL MAINTENANCE

SERVICE SCHEDULE

Model 1044

ITEM	TYPE OF FLUID	QUANTITY
Hydraulic Tank & System	Amoco Rykon MV or Equivalent	65 Gallons
Fuel tank	Diesel Fuel	40 Gallons
Cooling System	Ethylene Glycol Permanent Coolant	18 Quarts
Manual Transmission and Cooler	Allison C-3 (MIL-L-2104 Grade 10)	21 Quarts Capacity 14 Quarts Drain, Refill, and Filter
Electric Transmission and Cooler	Amoco 320 or SAE 20W Motor Oil	17 Quarts Capacity 11 Quarts Drain, Refill, and Filter
Differential (Front & Rear)	SAE-90API-GL5	12.8 Quarts
Planetary Hub — Axle No's. R30BP121-4 & R30BP122-7	LULL P09962 Wheel End Oil	54 Ounces per Hub
Planetary Hub — Axle No's. R30BP121-4 & R30BP122-7 with Graphitic Brake Disc Conversion	SAE-90API-GL5 Preferred Brands: B.P., Chevron, Citco, Mobile	54 Ounces per Hub
Planetary Hub — Axle No's. R30BP121-6 & R30BP122-19	SAE-90API-GL5 Preferred Brands: B.P., Chevron, Citco, Mobile	54 Ounces per Hub
Engine Crank Case Oil (with Filter)	See Engine Manual	10 Quarts

Table 2-6 Model 1044 Lubricants and Capacities

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 50SUS.
- 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 Industries 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

Manual Transmission:
Use an oil which meets Allison type C3 hydraulic fluid specifications.

Electric Transmission:
Use Amoco 320 or an oil which meets SAE 20W specification.

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.

AXLE 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.

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.

HYDRAULIC SYSTEM

DESCRIPTION (MODELS 644, 844)

The hydraulic system consists of the followint circuits:

* Boom Extension
* Boom Hoist
* Carriage Tilt
* Transfer Carriage
* Frame Tilt
* Auxiliary - (1) Standard, (2) Optional
* Steering
* Service Brakes
* Differential Lock
* Outriggers (Optional)

These circuits are supplied by a two-section, gear-type hydraulic pump, driven directly from the transmission power take off. The first pump supplies flow to all circuits except steering and differential lock. The second pump supplies flow to all circuits via the steering priority valve.

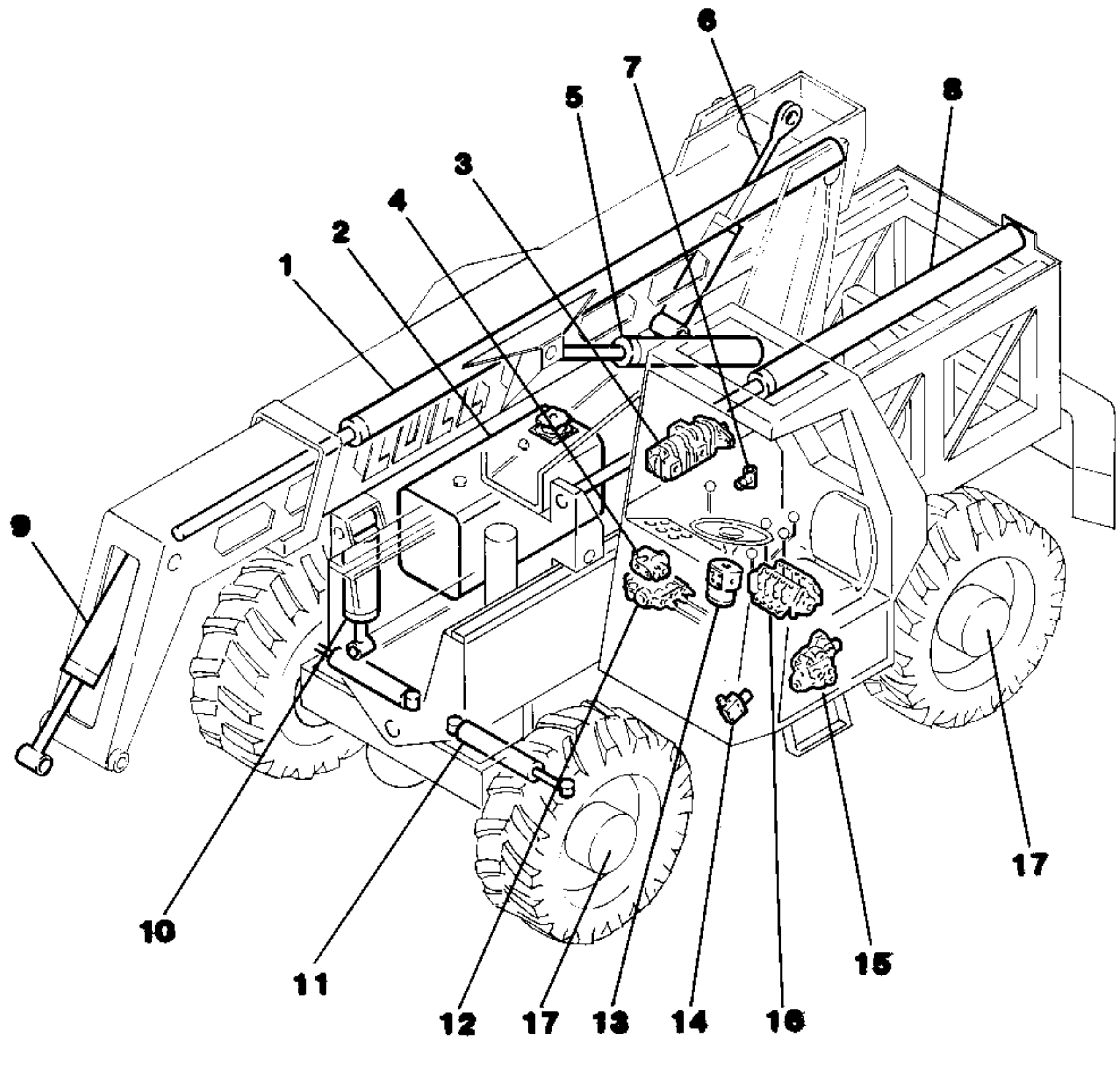
The boom extension and hoist circuits are controlled by a two spool valve with a pressure relief valve. The frame tilt, carriage tilt, transfer carriage, and auxiliary circuits are controlled by a four spool valve (five spool optional) with a relief valve. The carriage tilt circuits are also equipped with two work port relief valves. The optional outrigger circuit is controlled by an additional two spool valve with a no-relief plug. The steering circuit is controlled by a steering control unit and steering mode selector valve. The service brake circuit is controlled by a hydraulic power brake valve and includes an accumulator. The differential lock is controlled by a single spool valve with a pressure relief valve.

The boom extension, boom hoist, carriage tilt, outrigger, 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 of the back side of the reservoir.

HYDRAULIC SYSTEM

DESCRIPTION (MODELS 644, 844) (cont.)



1 - Boom Extension Cylinder	7 - Tee Relief Valve	13 - Steer Control Unit
2 - Hydraulic Reservoir	8 - Transfer CarriageCylinder	14 - Differential Lock Valve
3 - Hydraulic Pump	9 - Carriage Tilt Cylinder	15 - Brake Valve
4 - Steer Priority Valve	10 - Frame Tilt Cylinder	16 - Four Spool Valve
5 - Boom Hoist Cylinder(s)	11 - Steer Cylinder (4)	17 - Service Brakes
6 - Carriage Tilt Cylinder	12 - Boom Control Valve	

Figure 3-1 Hydraulic Components (Models 644, 844)

HYDRAULIC SYSTEM

DESCRIPTION (MODEL 1044)

The hydraulic system consists of the following circuits:

* Boom Extension
* Boom Hoist
* Carriage Tilt
* Transfer Carriage
* Frame Tilt
* Quick Attach/Auxiliary
* Auxiliary
* Outriggers
* Steering
* Service Brakes
* Differential Lock

These circuits are supplied by a two-section, gear-type hydraulic pump, driven directly from the transmission power take off. The first pump supplies flow to all circuits except steering and differential lock. The second pump supplies flow to all circuits via the steering priority valve.

The boom extension and hoist circuits are controlled by a two spool valve with a pressure relief valve. The frame tilt, carriage tilt, transfer carriage, quick attach/auxiliary, and auxiliary circuits are controlled by a five section valve with a pressure relief valve. The carraige tilt circuits are also equipped with two work port relief valves. The boom hoist and carriage tilt circuits work in combination with a flow divider (self leveling valve). The outrigger circuit is controlled by a two spool valve. The steering circuit is controlled by a steering control unit and steering mode selector valve. The service brake circuit is controlled by a hydraulic power brake valve and includes an accumulator. The differential lock is controlled by a single spool valve with a pressure relief valve.

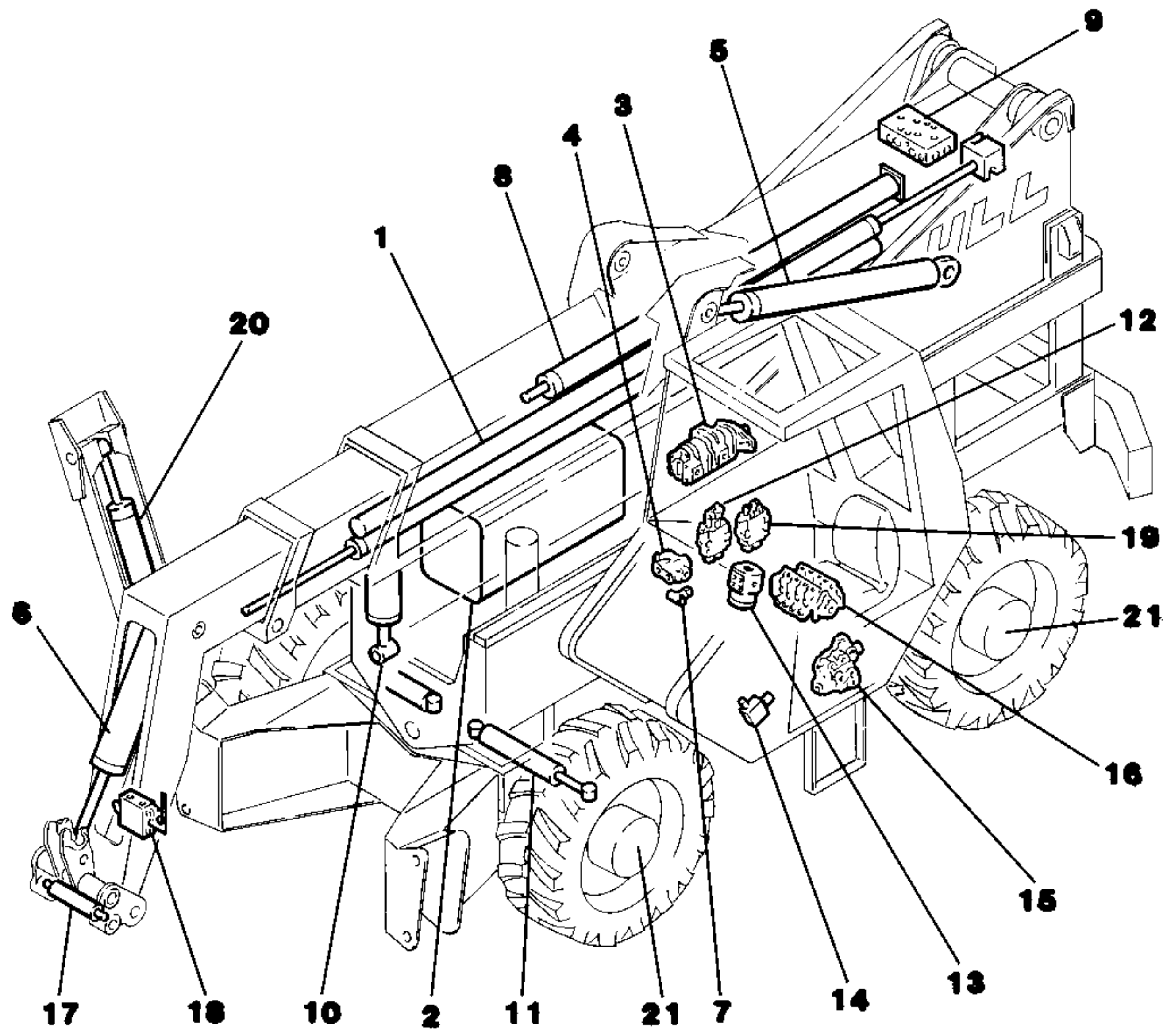
The boom extension, boom hoist, carriage tilt, outrigger and frame tilt cylinders are equipped with externally mounted counterbalance valves. The counterbalance valves prevent movement of the cylinders in event of downstream hydraulic line failure, leakage through the main control valve or fittings. 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 reservior 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 of the back side of the reservoir.

HYDRAULICS

HYDRAULIC SYSTEM

DESCRIPTION (MODEL 1044)(cont.)



1 - Boom Extension Cylinder
2 - Hydraulic Reservoir
3 - Hydraulic Pump
4 - Steer Priority Valve
5 - Boom Hoist Cylinder (2)
6 - Carriage Tilt Cylinder
7 - Tee Relief Valve
8 - Transfer Carriage Cylinder
9 - Fork Leveling Valve
10 - Frame Tilt Cylinder
11 - Steer Cylinder (4)
12 - Boom Control Valve
13 - Steer Control Unit
14 - Differential Lock Valve
15 - Brake Valve
16 - Five Spool Valve
17 - Quick Attach Cylinder
18 - Attachment Selector Valve
19 - Outrigger Valve
20 - Outrigger Cylinder (2)
21 - Service Brakes

Figure 3-2 Hydraulic Components (Model 1044)

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 644, 844, and 1044 forklifts are equipped with six diagnostic ports for checking hydraulic operating pressure of circuits (See Tables 3-1 through 3-3). For forklifts not equipped with diagnostic ports, see page 3.8-12 for checking and adjusting circuit pressure.

DIAGNOSTIC PORT LOCATIONS:

1. Inboard Pump (Figure 3-3)
2. Outboard Pump (Figure 3-3)
3. Boom End (Figure 3-4) - (Models 644, 844)
3. Level Control Valve (Figure 3-5) - (Model 1044)
4. Front Axle (Figure 3-6)
5. Brake Valve (Figure 3-7)
6. Under cab front (Figure 3-7a) - (Models 644, 844)
6. Near Diff. Lock Valve (Figure 3-7b) - (Model 1044)

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.

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

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

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

CAUTION: 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.

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

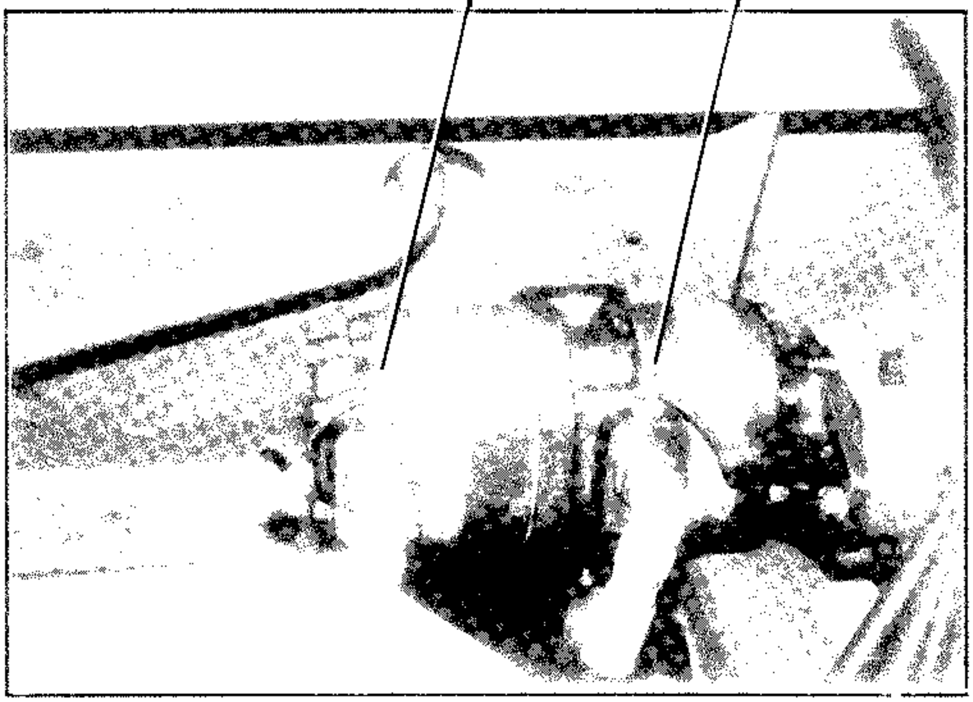


Figure 3-3 Diagnostic Ports - Hydraulic Pumps

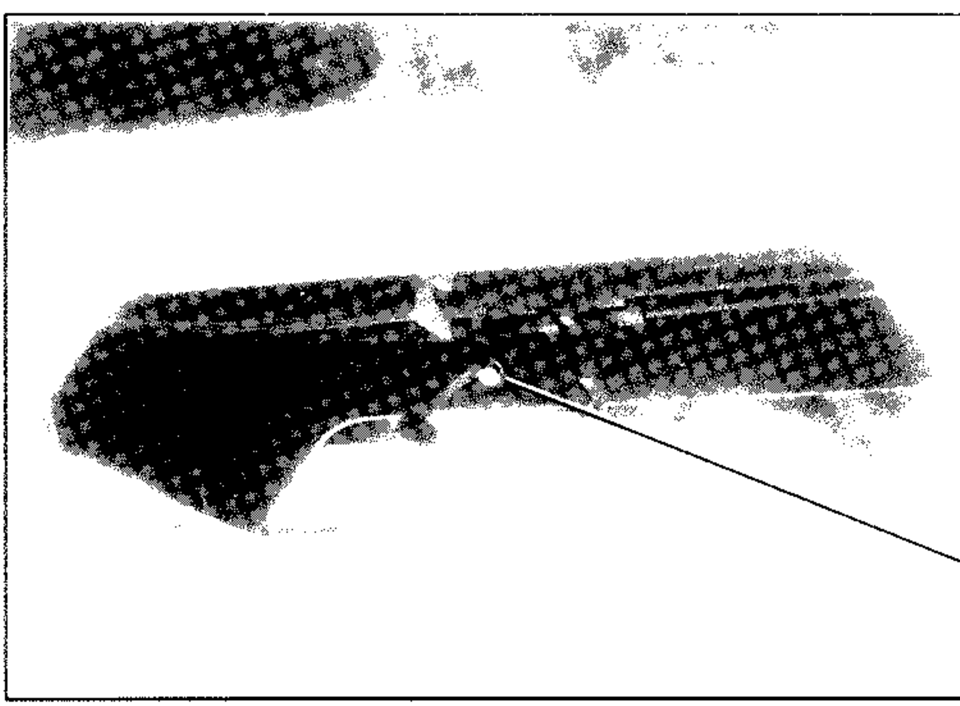


Figure 3-4 Diagnostic Port - Boom End (Models 644, 844)

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

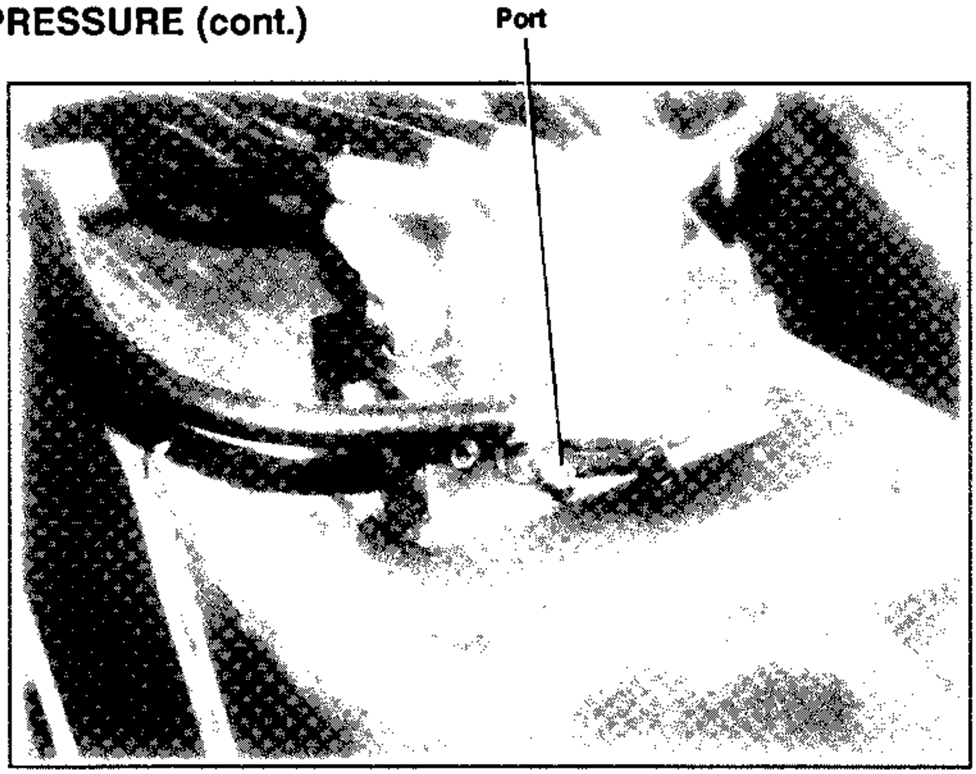


Figure 3-5 Diagnostic Port - Level Control Valve (Model 1044)

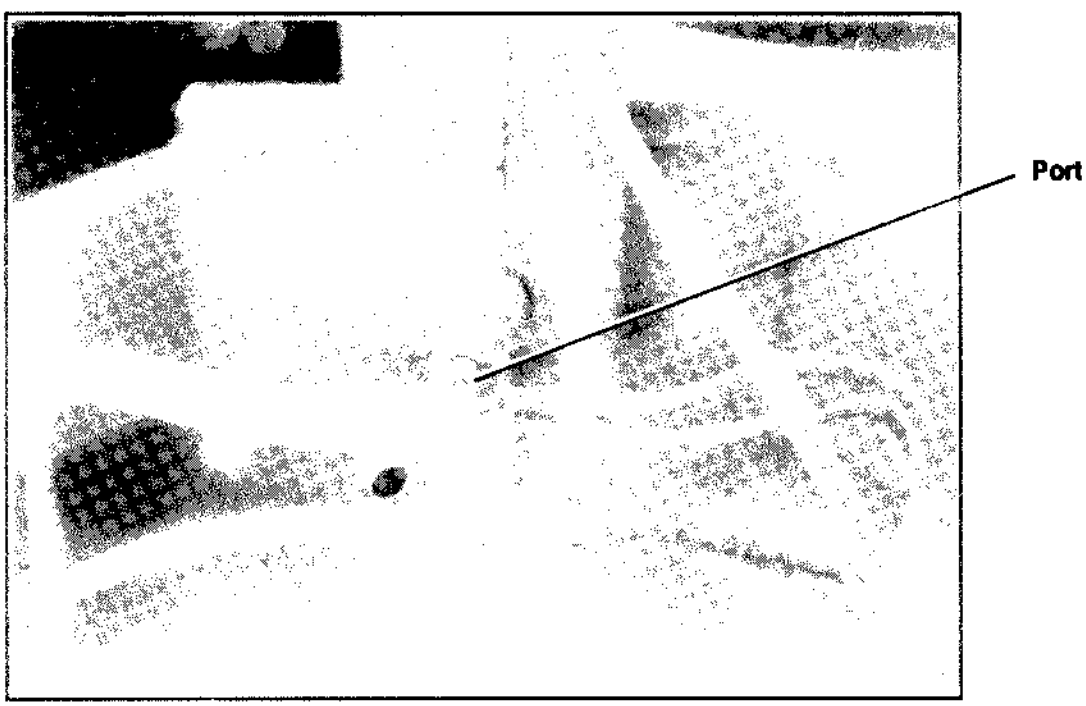


Figure 3-6 Diagnostic Port - Front Axle

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

Figure 3-7 Diagnostic Port - Brake Valve

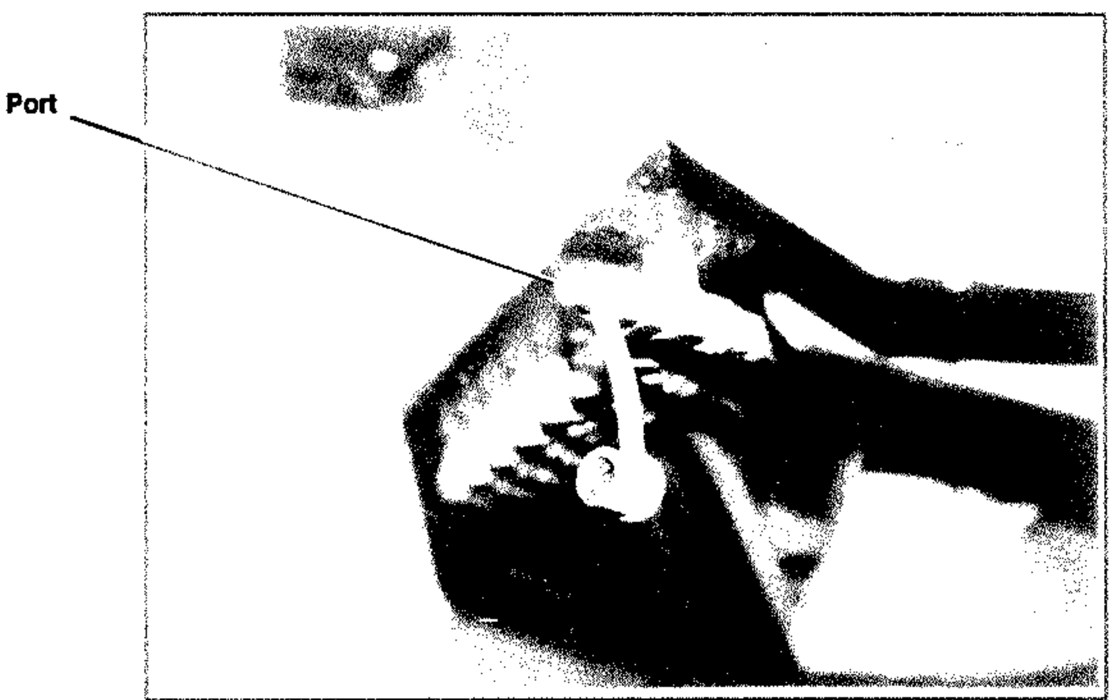


Figure 3-7a Diagnostic Port - Diff. Lock (Models 644, 844)

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

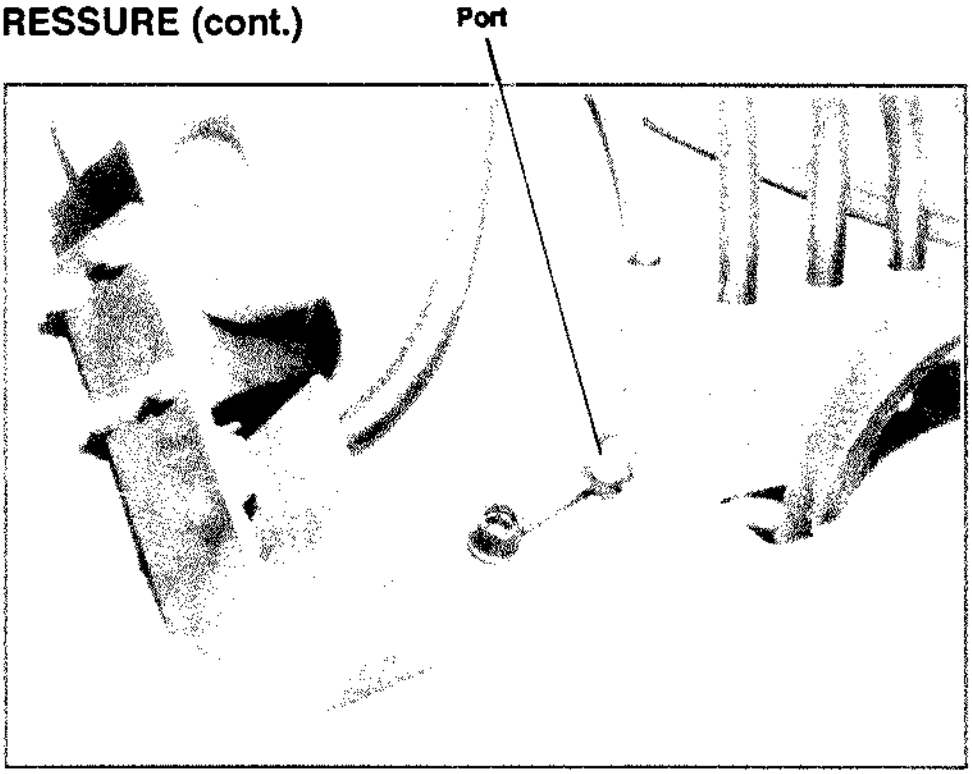


Figure 3-7b Diagnostic Port - Diff. Lock (Model 1044)

1. Use the following procedure to check and adjust hydraulic pressure for the frame tilt, transfer carriage and auxiliary circuits:

A. Follow procedure under "Warning" on page 3.8-1 and attach an appropriate test gauge to the diagnostic port located on the inboard pump.

B. Start the engine and retract the transfer carriage.

C. While holding the transfer carriage 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 3-1 through 3-3), adjust the main pressure relief valve of the four or five spool control valve to the correct pressure: Refer to "Adjusting Pressure Relief Valves" on page 3.8-16.

E. Follow procedure under "Warning" on page 3.8-1 and detach the test gauge. (Be sure the test gauge pressure reads "0 psi" before removing.)

2. Use the following procedure to check and adjust hydraulic pressure for the boom hoist and extend circuits:

A. Follow procedure under "Warning" on page 3.8-1 and attach an appropriate test gauge to the diagnostic port located on the outboard pump.

B. Start the engine and retract the transfer carriage and boom.

C. While running the engine at full rpm, simultaneously hold the transfer carriage and boom control handles in full retracted position. Note the test gauge pressure reading.

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

D. If the pressure reading is not correct (see Tables 3-1 through 3-3), adjust the main pressure relief valve of the boom hoist and extension control valve to the correct pressure: Refer to "Adjusting Pressure Relief Valves" on page 3.8-16.

E. Follow procedure under "Warning" on page 3.8-1 and detach the test gauge. (Be sure the test gauge pressure reads "0 psi" before removing.)

3. Use the following procedure to check hydraulic pressure at the diagnostic port located within the boom end (Models 644, 844), or located on the self-leveling valve (Model 1044).

A. Follow procedure under "Warning" on page 3.8-1 and attach an appropriate test gauge to the diagnostic port.

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 Tables 3-1 through 3-3), adjust the work port relief valve on top of the four or five spool control valve: Refer to "Adjusting Pressure Relief Valves" on page 3.8-16.

E. Follow procedure under "Warning" on page 3.8-1 and detach the test gauge. (Be sure the test gauge pressure reads "0 psi" before removing.)

4. Use the following procedure for checking and adjusting hydraulic pressure for the steering circuit:

A. Follow procedure under "Warning" on page 3.8-1 and attach an appropriate test gauge to the diagnostic port located atop the front axle.

B. Start the engine.

C. Place the steer selector control in the front wheel steer mode.

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

E. If the pressure reading is not correct (see Tables 3-1 through 3-3), adjust the pressure relief valve on the steering priority valve: Refer to "Adjusting Pressure Relief" under "Steering Priority Valve" on page 3.50-1.

F. Follow procedure under "Warning" on page 3.8-1 and detach the test gauge. (Be sure the test gauge pressure reads "0 psi" before removing.)

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

A. The accumulator must be charged.

B. The engine must be running.

C. Attach an appropriate test gauge to the diagnostic port located at the brake valve.

D. Slowly apply pressure to the brake pedal and hold. Note the test gauge reading.

E. If the pressure reading is not correct (see Tables 3-1 through 3-3) perform the following procedure (Figure 3-8):

a. After noting incorrect brake line pressure, shut off the engine and release brake line pressure: Repeatedly pump (push, hold, release) the brake pedal until all hydraulic pressure is gone. The test gauge must read "0 psi". This procedure may require approximately 25-35 pumps of the brake pedal.

b. Remove test gauge and disassemble brake valve (Figure 3-8, Item 1) from bracket (Item 2). DO NOT REMOVE HOSES.

c. Pry ring (Item 3) away from valve housing (Item 1).

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

d. Remove boot (Item 4) and piston (Item 5).

e. Add or remove shims (Item 6) as required. NOTE: Adding shims (thickness) will increase pressure. Removing shims (thickness) will reduce pressure. Shims are provided in the following thicknesses and pressure results:

SHIM THICKNESS	LULL P/NO.	PRESSURE
.032	P27319	65 PSI
.018	P27318	37 PSI
.007	P27317	14 PSI
.004	P27316	8 PSI

f. Add or remove the necessary shims calculated to arrive at correct brake line pressure.

g. Reassemble brake valve piston (Item 5) boot (Item 4) and ring (Item 3).

h. Reassemble brake valve (Item 1) to bracket (Item 2).

i. Perform steps (A) through (D) above to check adjusted pressure.

NOTE: If correct brake line pressure cannot be achieved, shut off the engine and replace the brake valve (see "Brake Valve Removal" and "Brake Valve Installation" in Section 10).

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

A. Follow procedure under "Warning" on page 3.8-1 and attach an appropriate test gauge to the diagnostic port.

B. Start the engine.

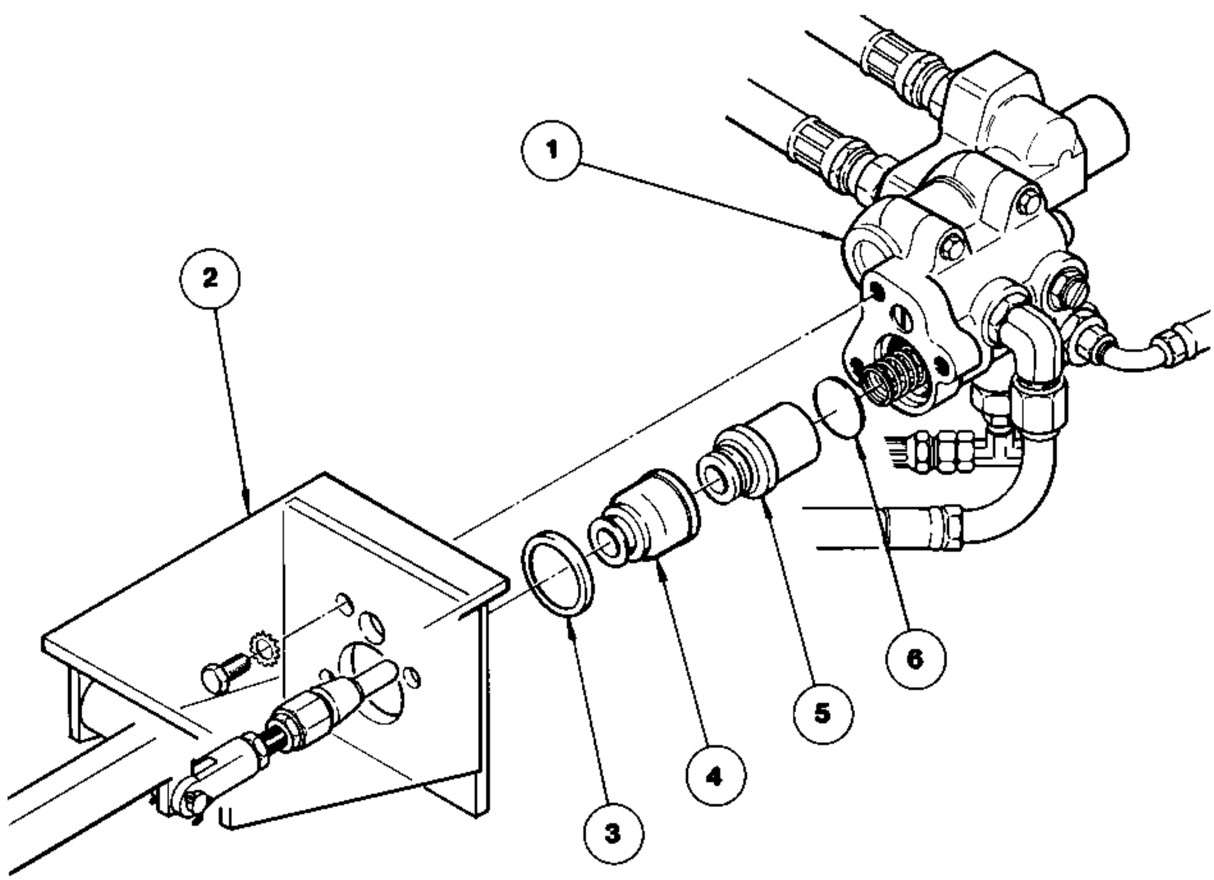
C. Engage the differential lock valve and, while running the engine at full rpm, note the test gauge pressure reading.

D. If the pressure reading is not correct (see Tables 3-1 through 3-3), adjust the pressure relief valve on the differential lock valve: Refer to "Adjusting Pressure Relief Valves" on page 3.8-16.

E. Follow procedure under "Warning" on page 3.8-1 and detach the test gauge. (Be sure the test gauge pressure reads "0 psi" before removing.)

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)



1 - Brake Valve
2 - Bracket
3 - Retaining Ring
4 - Boot
5 - Piston
6 - Shims

Figure 3-8 Brake Valve Assembly

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

DIAGNOSTIC PORT LOCATION	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
1. Inboard Pump (Shaft End) See Figure 3-3	2800	Main Pressure Relief (4 or 5 Spool Control Valve)	Frame Tilt Transfer Carriage Auxiliary
2. Outboard Pump (Cover End) See Figure 3-3	2800	Main Pressure Relief (Boom Hoist & Extend Control Valve)	Boom Hoist Boom Extend/Retract
3. End of Boom See Figure 3-4	2400	Work Port Pressure Relief - Handle Side (4 or 5 Spool Control Valve)	Carriage Tilt
4. Front Axle See Figure 3-6	2000	Pressure Relief (Steer Priority Valve)	Steering
5. Brake Valve See Figure 3-7	300 - 330	Brake Valve	Service Brakes
6. Diff. Lock See Figure 3-7a	285	Diff. Lock Valve	Diff. Lock

Table 3-1 Checking and Adjusting Circuit Pressure (Model 644)

HYDRAULICS

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

DIAGNOSTIC PORT LOCATION	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
1. Inboard Pump (Shaft End) See Figure 3-3	2600	Main Pressure Relief (4 or 5 Spool Control Valve)	Frame Tilt Transfer Carriage Auxiliary
2. Outboard Pump (Cover End) See Figure 3-3	2600	Main Pressure Relief (Boom Hoist & Extend Control Valve)	Boom Hoist Boom Extend/Retract
3. End of Boom See Figure 3-4	2400	Work Port Pressure Relief - Handle Side (4 or 5 Spool Control Valve)	Carriage Tilt
4. Front Axle See Figure 3-6	2000	Pressure Relief (Steer Priority Valve)	Steering
5. Brake Valve See Figure 3-7	300 - 330	Brake Valve	Service Brakes
6. Diff. Lock See Figure 3-7a	285	Diff. Lock Valve	Diff. Lock

Table 3-2 Checking and Adjusting Circuit Pressure (Model 844)

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

DIAGNOSTIC PORT LOCATION	HYDRAULIC PRESSURE REQUIRED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
1. Inboard Pump (Shaft End) See Figure 3-3	3200	Main Pressure Relief (5 Spool Control Valve)	Frame Tilt Transfer Carriage Quick Attach Auxiliary
2. Outboard Pump (Cover End) See Figure 3-3	3200	Main Pressure Relief (Boom Hoist & Extend Control Valve)	Boom Hoist Boom Extend/Retract
3. Self Leveling Valve See Figure 3-5	2400	Work Port Pressure Relief - Handle Side (5 Spool Control Valve)	Carriage Tilt
4. Front Axle See Figure 3-6	2000	Pressure Relief (Steer Priority Valve)	Steering
5. Brake Valve See Figure 3-7	300 - 330	Brake Valve	Service Brakes
6. Diff. Lock See Figure 3-7b	285	Diff. Lock Valve	Diff. Lock

Table 3-3 Checking and Adjusting Circuit Pressure (Model 1044)

HYDRAULIC SYSTEM

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):

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 3-4 through 3-6). Plug opening.

4. Connect a 5000 psi hydraulic pressure gauge to the disconnected hose (see Figure 3-9).

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 3-4 through 3-6), adjust the pressure relief valve to the specified pressure for that circuit. See "Adjusting Pressure Relief Valves" on page 3.8-16. (For steering, See "Adjusting Pressure Relief" under "Steering Priority Valves", page 3.50-1)

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.

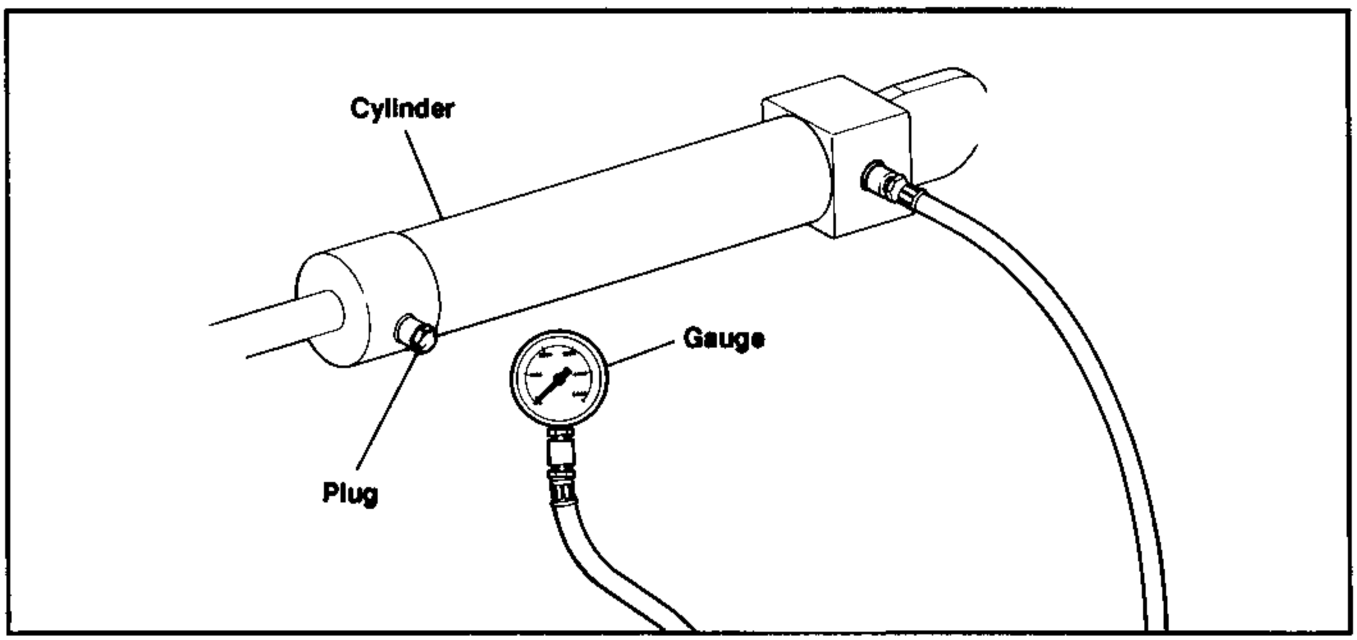


Figure 3-9 Checking Circuit Pressure

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

CHECK CYLINDER	TEST PROCEDURE	HYDRAULIC PRESSURE REQURIED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
Frame Tilt (Top Port)	Tilt Frame Tilt to left	2800	Main Pressure Relief (4 or 5 Spool Control Valve)	Frame Tilt Transfer Carriage Auxiliary
Boom Hoist (Top Port)	Simultaneously hold Transfer Carriage and Boom Extend in full retracted position	2800	Main Pressure Relief (Boom Hoist & Extend Control Valve)	Boom Hoist Boom Extend/Retract
Fork Tilt (Top Port)	Tilt Carriage Tilt Rearward, lower Boom from 6' elevation	2400	Work Port Pressure Relief (Handle Side)	Carriage Tilt Rearward
Left Front Steer Cyl. (Outer Port)	Front Steer Mode, wheels turned to left	2000	Pressure Relief (Steer Priority Valve)	Steering
Diff. Lock Cylinder	Engage Diff. Lock Valve	285	Pressure Relief (Diff. Lock Valve)	Diff. Lock

Table 3-4 Checking and Adjusting Circuit Pressure (Model 644)

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

CHECK CYLINDER	TEST PROCEDURE	HYDRAULIC PRESSURE REQURIED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
Frame Tilt (Top Port)	Tilt Frame Tilt to left	2600	Main Pressure Relief (4 or 5 Spool Control Valve)	Frame Tilt Transfer Carriage Auxiliary
Boom Hoist (Top Port)	Simultaneously hold Transfer Carriage and Boom Extend in full retracted position	2600	Main Pressure Relief (Boom Hoist & Extend Control Valve)	Boom Hoist Boom Extend/Retract
Fork Tilt (Top Port)	Tilt Carriage Tilt Rearward, lower Boom from 6' elevation	2400	Work Port Pressure Relief (Handle Side)	Carriage Tilt Rearward
Left Front Steer Cyl. (Outer Port)	Front Steer Mode, wheels turned to left	2000	Pressure Relief (Steer Priority Valve)	Steering
Diff. Lock Cylinder	Engage Diff. Lock Valve	285	Pressure Relief (Diff. Lock Valve)	Diff. Lock

Table 3-5 Checking and Adjusting Circuit Pressure (Model 844)

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

CHECK CYLINDER	TEST PROCEDURE	HYDRAULIC PRESSURE REQURIED (PSI)	PRESSURE ADJUSTMENT LOCATION	CIRCUITS AFFECTED
Frame Tilt (Top Port)	Tilt Frame Tilt to left	3200	Main Pressure Relief (5 Spool Control Valve)	Frame Tilt Transfer Carriage Auxiliary
Boom Hoist (Top Port)	Simultaneously hold Transfer Carriage and Boom Extend in full retracted position	3200	Main Pressure Relief (Boom Hoist & Extend Control Valve)	Boom Hoist Boom Extend/Retract
Fork Tilt (Top Port)	Tilt Carriage Tilt Rearward, lower Boom from 6' elevation	2400	Work Port Pressure Relief (Handle Side)	Carriage Tilt Rearward
Left Front Steer Cyl. (Outer Port)	Front Steer Mode, wheels turned to left	2000	Pressure Relief (Steer Priority Valve)	Steering
Diff. Lock Cylinder	Engage Diff. Lock Valve	285	Pressure Relief (Diff. Lock Valve)	Diff. Lock

Table 3-6 Checking and Adjusting Circuit Pressure (Model 1044)

HYDRAULIC SYSTEM

CHECKING AND ADJUSTING CIRCUIT PRESSURE (cont.)

ADJUSTING PRESSURE RELIEF VALVES

EXTERNALLY ADJUSTED (Figure 3-10)

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 procedure on page 3.2-1 of this section). Remove the relief valve, clean and inspect, reinstall or replace if necessary.

SHIM ADJUSTED (Figure 3-11)

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).

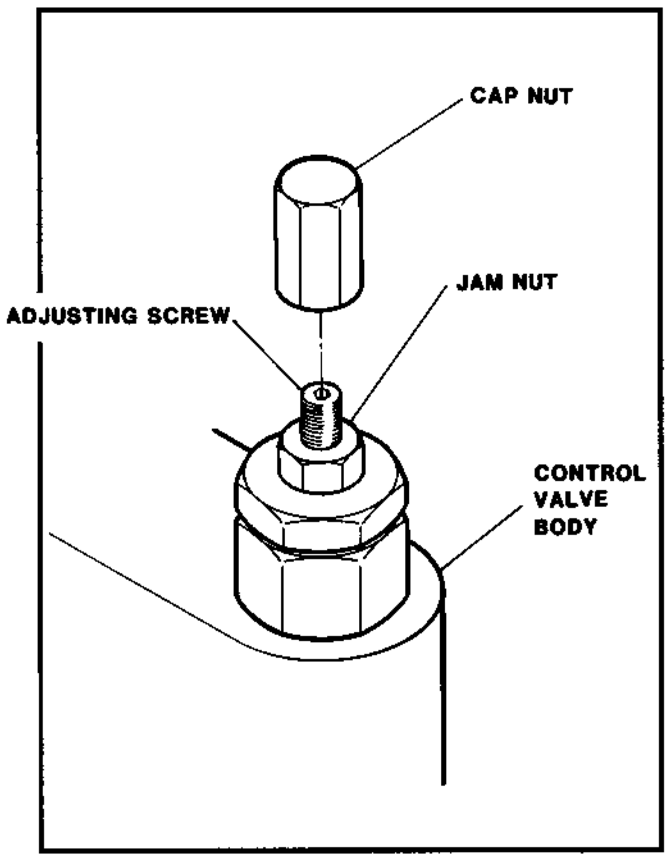


Figure 3-10 Pressure Relief Valve - Externally Adjusted

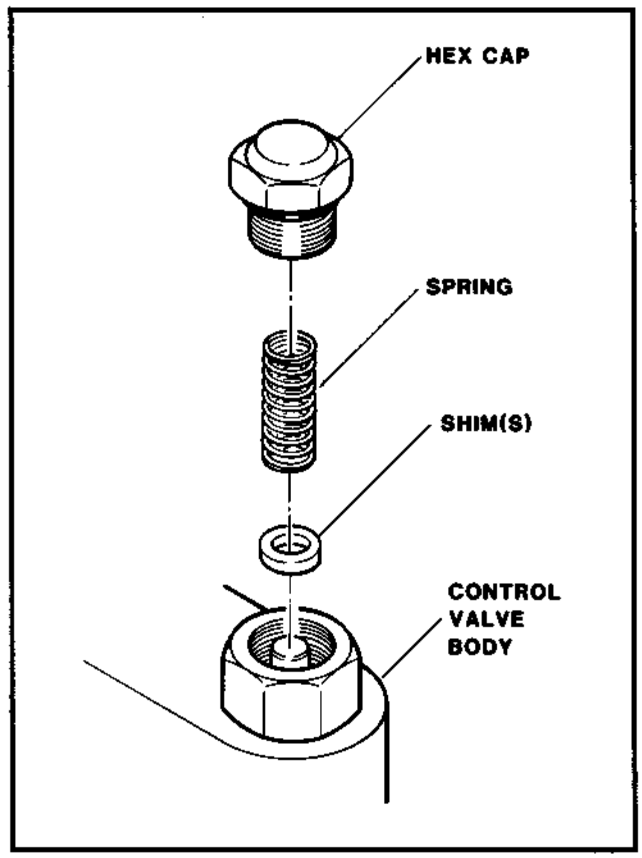


Figure 3-11 Pressure Relief Valve - Shim Adjusted

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 3.17-1 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 3-13) should be watched closely during this procedure. (Order P/N P24981 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 3.11-1 in this section.

11. Replace the return filter element. See "Replacing Return Filter Element" on page 3.16-1 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.

HYDRAULIC SYSTEM

CHECKING AND FLUSHING SYSTEM (cont.)

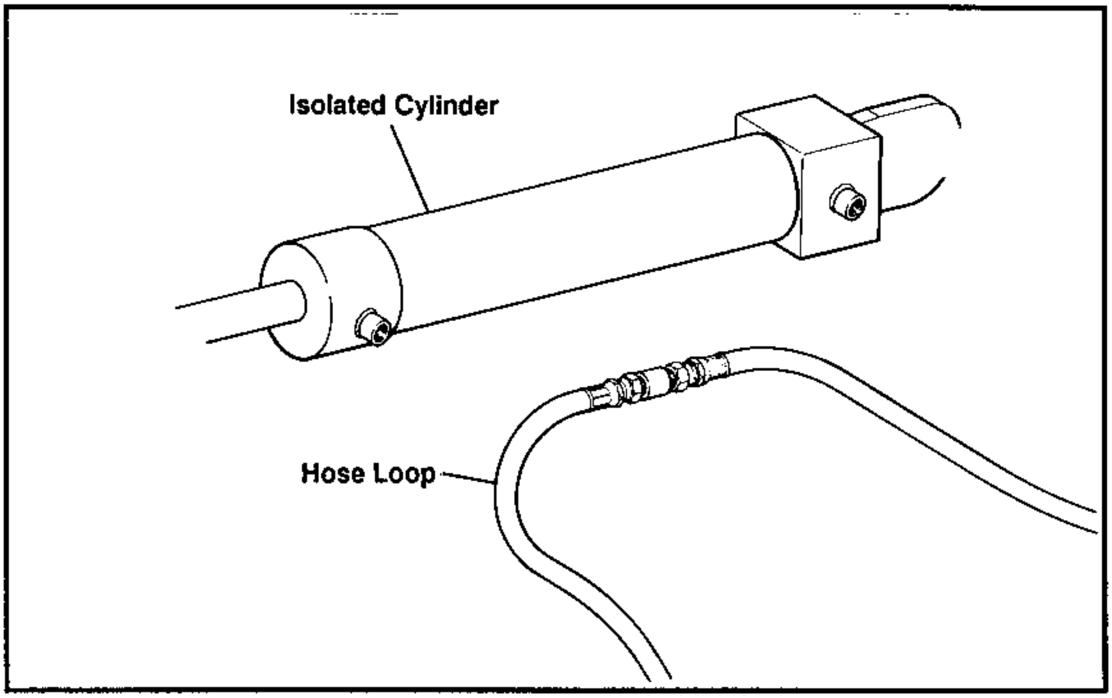


Figure 3-12 Hose Loop

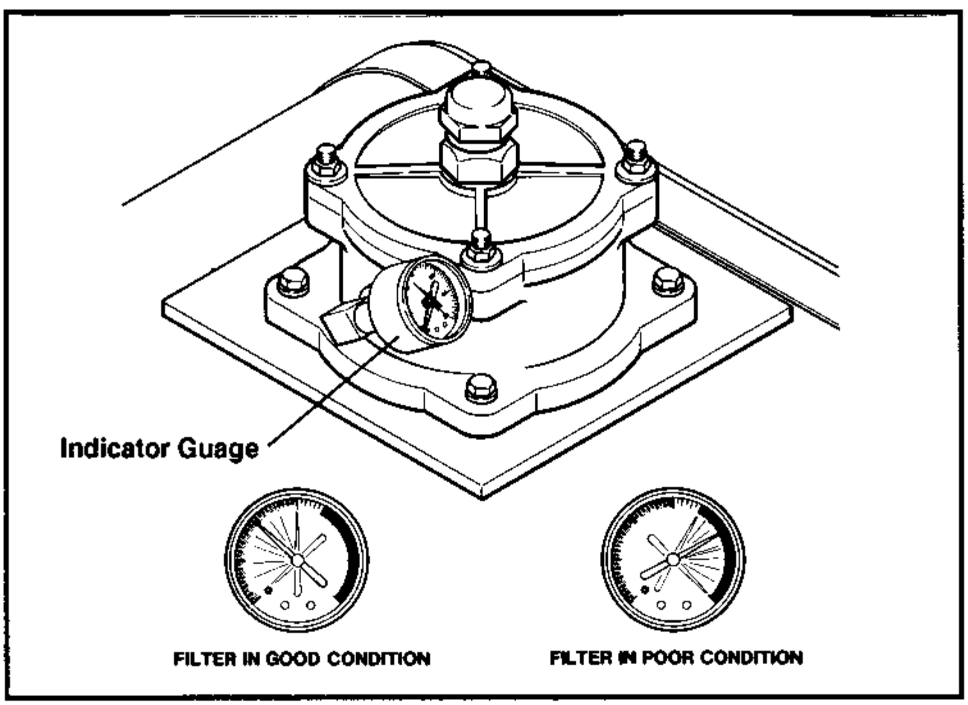


Figure 3-13 Indicator Gauge

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 dissipation 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 (expecially 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.

HYDRAULIC SYSTEM

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).

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

* Packing leaking.
- Remove cylinder and repack.

* Relief valve.
- Remove and clean or replace.

* Oil viscosity wrong or cold.
- Warm up or replace hydraulic oil.

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.

TRANSFER WON'T MOVE FORWARD

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

* No hydraulic pressure.
- Check pump.

* Leaking packing.
- Remove cylinder and repack.

* Relief valve stuck open.
- Remove and check.

HYDRAULIC SYSTEM

SYSTEM TROUBLESHOOTING (cont.)

TRANSFER WON'T MOVE BACKWARD

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

* No hydraulic pressure.
- Check pump, hydraulic lines.

* Leaking packing.
- Remove cylinder and repack.

* Relief valve stuck open.
- Remove and check.

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.

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.

HYDRAULIC SYSTEM

SYSTEM SCHEMATICS

(Pages 1a through 4a)

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 (ASSUME ARROW ON NEAR SIDE OF SHAFT)

Valves

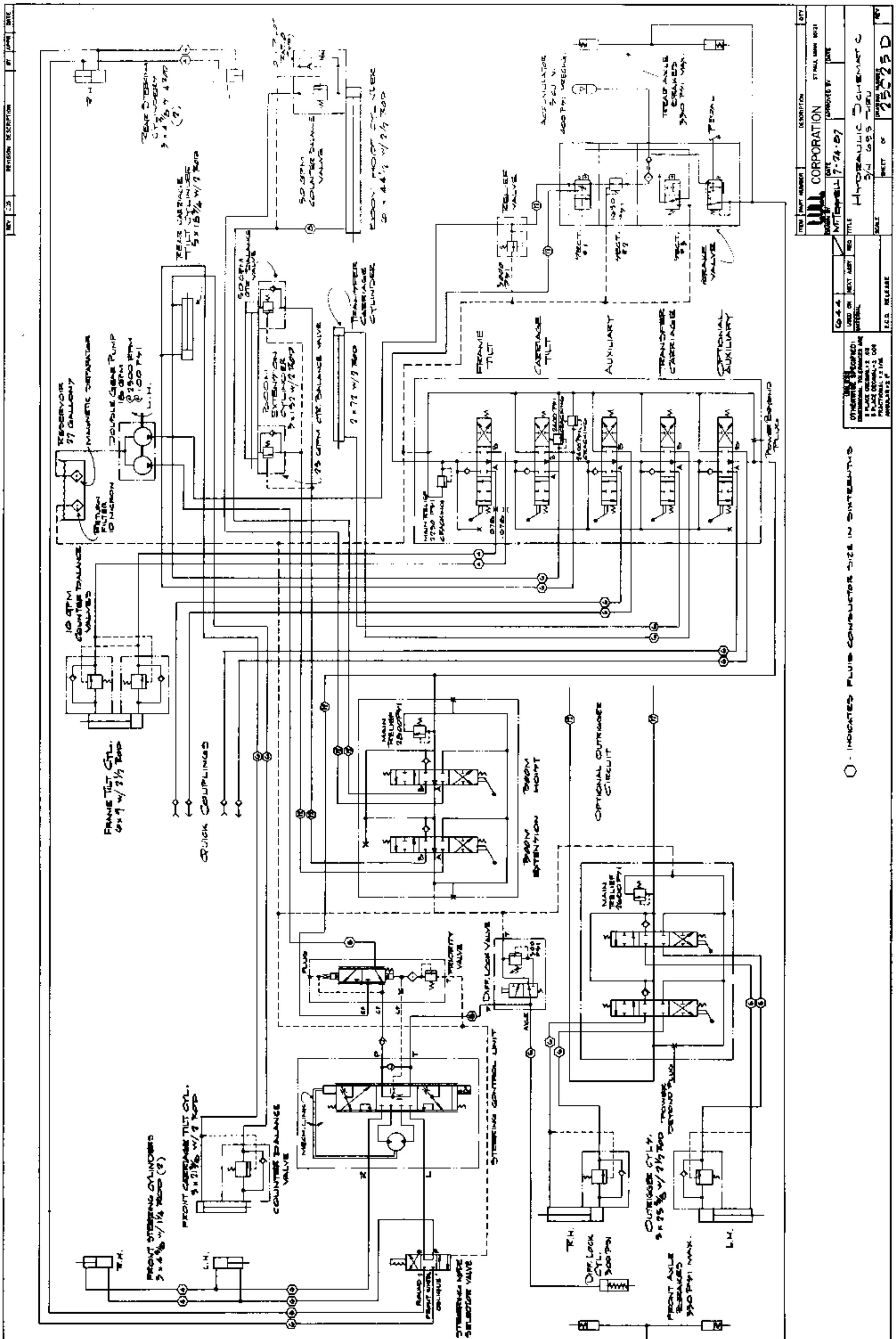
- CHECK
- ON-OFF (MANUAL SHUT-OFF)
- PRESSURE RELIEF
- PRESSURE REDUCING
- FLOW CONTROL, ADJUSTABLE-NON-COMPENSATED
- FLOW CONTROL, ADJUSTABLE (TEMPERATURE AND PRESSURE COMPENSATED)
- TWO POSITION TWO CONNECTION
- TWO POSITION THREE CONNECTION
- TWO POSITION FOUR CONNECTION
- THREE POSITION FOUR CONNECTION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

Methods of Operation

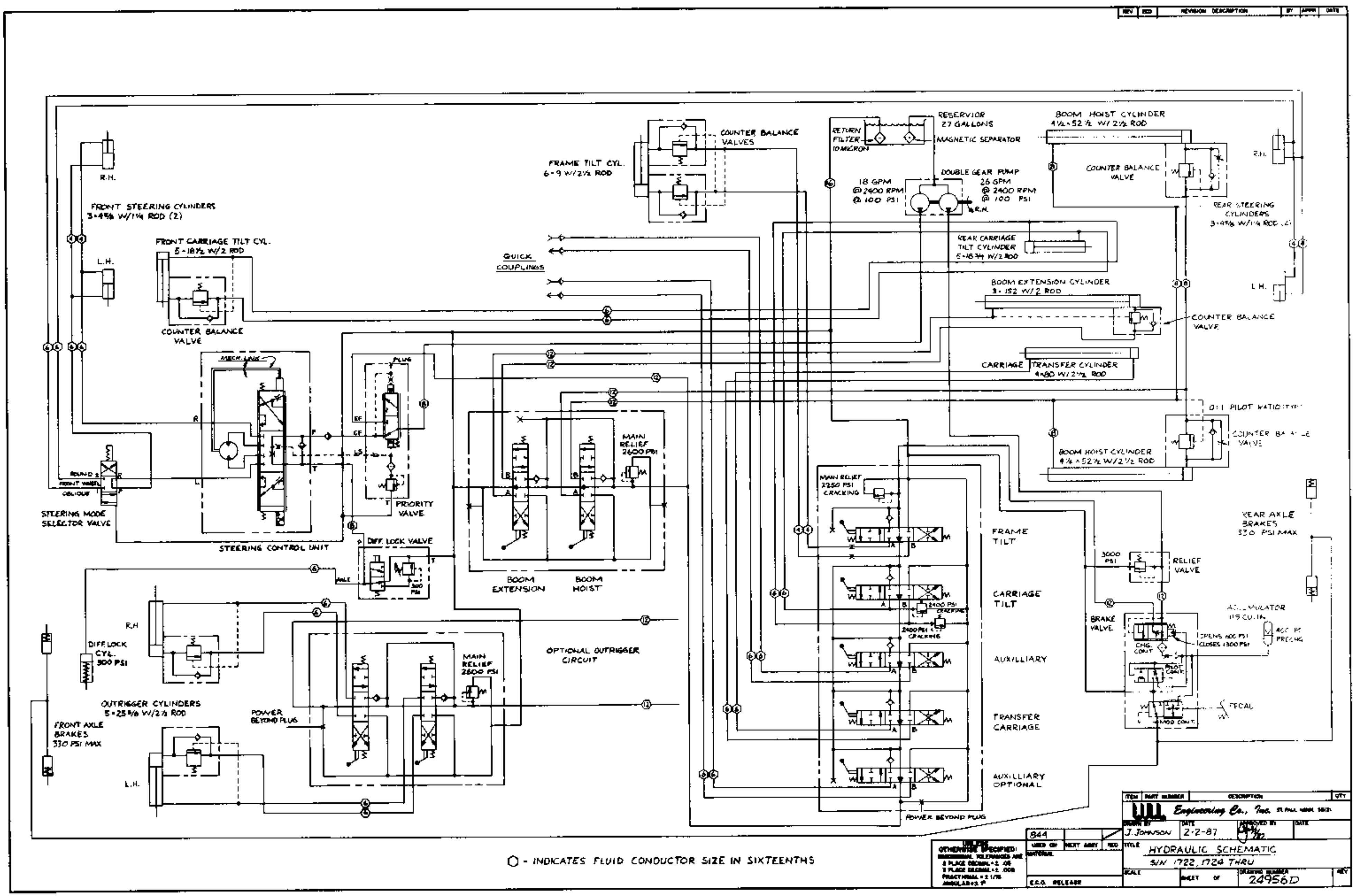
- SPRING
- MANUAL
- PUSH BUTTON
- PUSH-PULL LEVER
- PEDAL OR TREADLE
- MECHANICAL
- DETENT
- PRESSURE COMPENSATED
- SOLENOID, SINGLE WINDING
- REVERSING MOTOR
- PILOT PRESSURE REMOTE SUPPLY
- INTERNAL SUPPLY

Lines

- LINE, WORKING (MAIN)
- LINE, PILOT (FOR CONTROL)
- LINE, LIQUID DRAIN
- FLOW, DIRECTION OF HYDRAULIC
- PNEUMATIC
- LINES CROSSING (or)
- 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
- PRESSURIZED
- LINE, TO RESERVOIR ABOVE FLUID LEVEL
- BELOW FLUID LEVEL

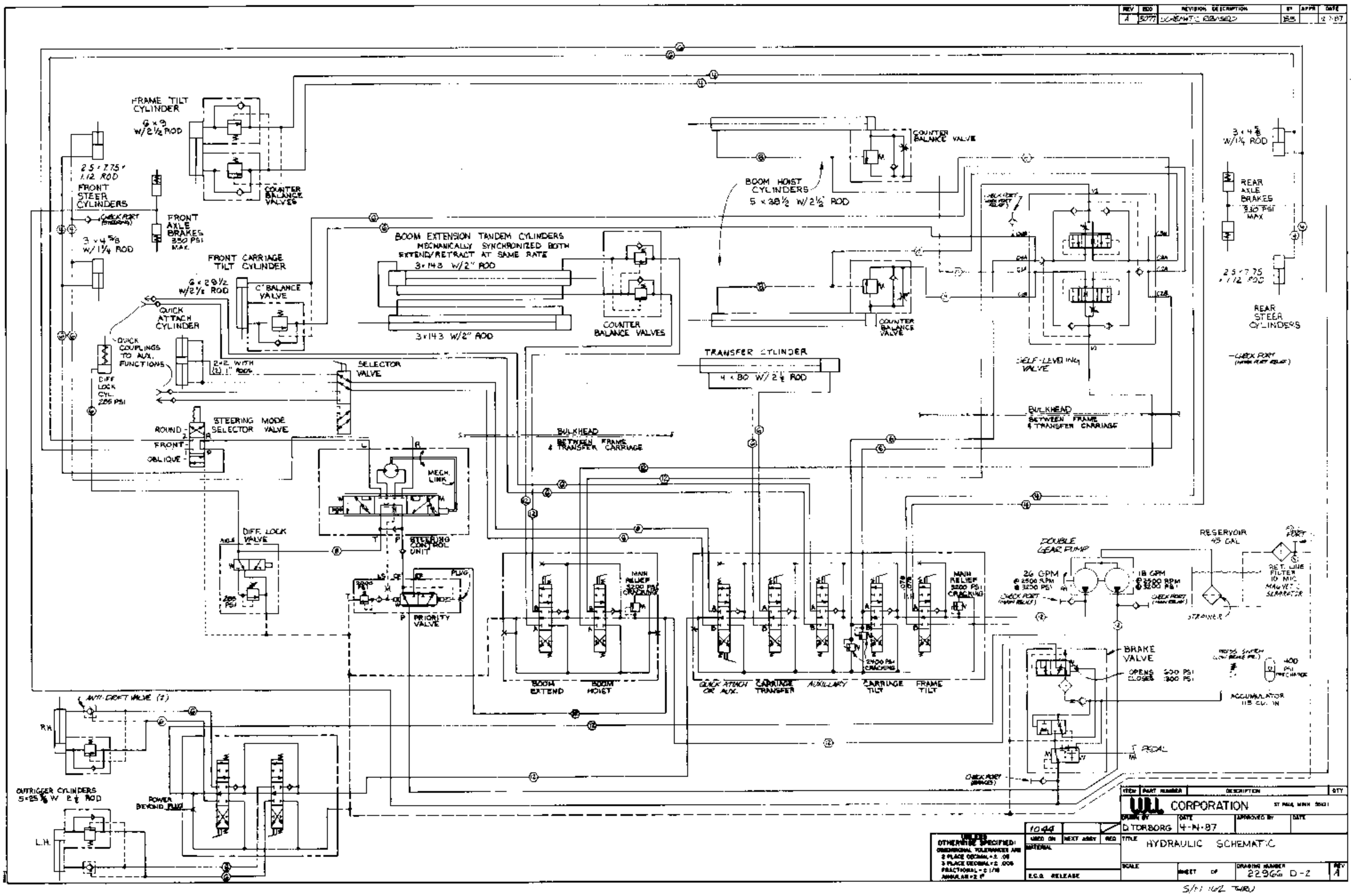

HYDRAULIC SCHEMATIC
CORPORATION
FRAME TILT
CARRIAGE TILT
AUXILIARY
TRANSFER CARRIAGE
OPTIONAL AUXILIARY
BOOM HOIST
BOOM EXTENSION
OPTIONAL OUTRIGGER CIRCUIT
QUICK COUPLINGS
PRIORITY VALVE
STEERING CONTROL UNIT
STEERING MODE SELECTOR VALVE
○ - INDICATES FLUID CONDUCTOR SIZE IN SIXTEENTHS

Model 644



FRONT STEERING CYLINDERS
3 • 4⅝ W/1¼ ROD (2)
R.H.
L.H.
FRONT CARRIAGE TILT CYL.
5 • 18½ W/2 ROD
COUNTER BALANCE VALVE
STEERING MODE SELECTOR VALVE
ROUND
FRONT WHEEL
OBLIQUE
MECH. LINK
STEERING CONTROL UNIT
PRIORITY VALVE
DIFF LOCK VALVE
FRAME TILT CYL.
6 • 9 W/2½ ROD
COUNTER BALANCE VALVES
QUICK COUPLINGS
BOOM EXTENSION
BOOM HOIST
MAIN RELIEF 2600 PSI
OPTIONAL OUTRIGGER CIRCUIT
DIFF LOCK CYL. 300 PSI
OUTRIGGER CYLINDERS
5 • 25⅝ W/2½ ROD
POWER BEYOND PLUG
FRONT AXLE BRAKES
330 PSI MAX
RESERVIOR
27 GALLONS
RETURN FILTER 10 MICRON
MAGNETIC SEPARATOR
DOUBLE GEAR PUMP
18 GPM @ 2400 RPM @ 100 PSI
26 GPM @ 2400 RPM @ 100 PSI
REAR CARRIAGE TILT CYLINDER
5 • 18¾ W/2 ROD
BOOM EXTENSION CYLINDER
3 • 152 W/2 ROD
CARRIAGE
TRANSFER CYLINDER
4 • 80 W/2½ ROD
BOOM HOIST CYLINDER
4½ • 52½ W/2½ ROD
REAR STEERING CYLINDERS
3 • 4⅝ W/1¼ ROD (2)
0:1 PILOT RATIO (TYP)
MAIN RELIEF 2250 PSI CRACKING
2400 PSI CRACKING
FRAME TILT
CARRIAGE TILT
AUXILLIARY
TRANSFER CARRIAGE
AUXILLIARY OPTIONAL
REAR AXLE BRAKES
330 PSI MAX
3000 PSI
RELIEF VALVE
BRAKE VALVE
ACCUMULATOR
115 CU. IN.
400 PSI PRECHG
OPENS 600 PSI
CLOSES 1300 PSI
PEDAL
MOD CONT.
○ - INDICATES FLUID CONDUCTOR SIZE IN SIXTEENTHS
Engineering Co., Inc.
J. JOHNSON
2-2-87
HYDRAULIC SCHEMATIC
S/N 1722, 1724 THRU
24956D
844

Model 844


FRAME TILT CYLINDER
6 x 9 W/2½ ROD
COUNTER BALANCE VALVES
2.5 x 7.75 1.12 ROD
FRONT STEER CYLINDERS
CHECK PORT (STEERING)
FRONT AXLE BRAKES 350 PSI MAX.
3 x 4⅝ W/1¼ ROD
FRONT CARRIAGE TILT CYLINDER
6 x 29½ W/2½ ROD
C' BALANCE VALVE
QUICK ATTACH CYLINDER
QUICK COUPLINGS TO AUX. FUNCTIONS
DIFF LOCK CYL. 285 PSI
2 x 2, WITH (2) 1" RODS
SELECTOR VALVE
STEERING MODE SELECTOR VALVE
ROUND
FRONT
OBLIQUE
BOOM EXTENSION TANDEM CYLINDERS MECHANICALLY SYNCHRONIZED BOTH EXTEND/RETRACT AT SAME RATE
3 x 143 W/2" ROD
3 x 143 W/2" ROD
COUNTER BALANCE VALVES
BOOM HOIST CYLINDERS 5 x 38½ W/2½ ROD
COUNTER BALANCE VALVE
COUNTER BALANCE VALVE
SELF-LEVELING VALVE
3 x 4⅝ W/1¼ ROD
REAR AXLE BRAKES 350 PSI MAX
2.5 x 7.75 1.12 ROD
REAR STEER CYLINDERS
CHECK PORT (MAIN PORT RELIEF)
TRANSFER CYLINDER
4 x 80 W/2¼ ROD
BULKHEAD BETWEEN FRAME & TRANSFER CARRIAGE
BULKHEAD BETWEEN FRAME & TRANSFER CARRIAGE
MECH. LINK
STEERING CONTROL UNIT
DIFF. LOCK VALVE
285 PSI
PRIORITY VALVE
PLUG
MAIN RELIEF 3200 PSI CRACKING
BOOM EXTEND
BOOM HOIST
MAIN RELIEF 3200 PSI CRACKING
2400 PSI CRACKING
QUICK ATTACH OR AUX.
CARRIAGE TRANSFER
AUXILIARY
CARRIAGE TILT
FRAME TILT
DOUBLE GEAR PUMP
26 GPM @ 2500 RPM @ 3200 PSI
18 GPM @ 2500 RPM @ 3200 PSI
CHECK PORT (MAIN RELIEF)
RESERVOIR 45 GAL
RET. LINE FILTER 10 MIC MAGNETIC SEPARATOR
STRAINER
BRAKE VALVE
OPENS 500 PSI
CLOSES 300 PSI
ACCUMULATOR 115 CU. IN
400 PSI PRECHARGE
PEDAL
CHECK PORT (BRAKES)
ANTI-DRIFT VALVE (2)
R.H.
L.H.
OUTRIGGER CYLINDERS 5 x 25⅝ W 2¼ ROD
POWER BEYOND PLUG
CORPORATION
D TORBORG
4-14-87
HYDRAULIC SCHEMATIC
22966 D-2
1044
A
SCHEMATIC REVISED

Model 1044

HYDRAULIC RESERVOIR

GENERAL

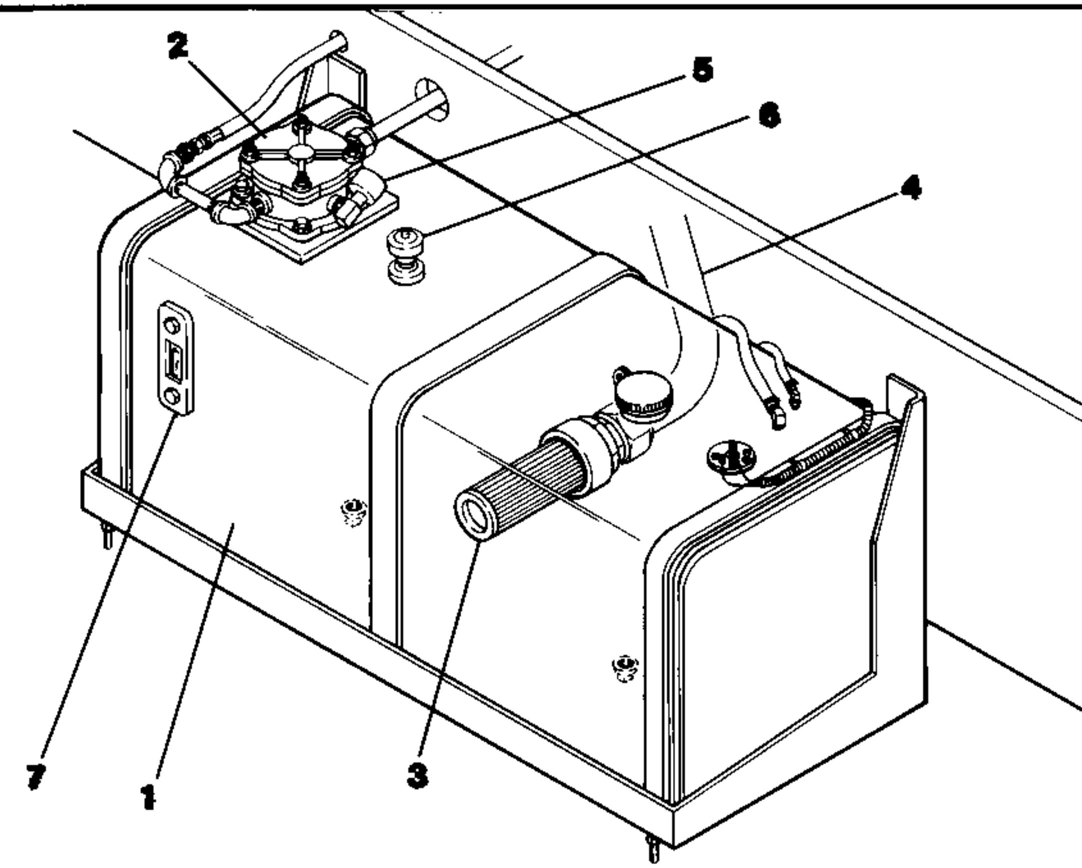
The hydraulic reservoir (Figure 3-14, Item 1) is mounted on the right-hand side of the machine. The hydraulic system return filter/magnetic separator is located within the return filter housing (Item 2), located at the top of the reservoir. The strainer (Item 3) and suction line (Item 4) are located 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.



1 - Hydraulic Reservoir
2 - Return Filter Housing
3 - Strainer
4 - Suction Line
5 - Pressure Differential Gauge
6 - Breather Filter
7 - Sight Gauge

Figure 3-14 Hydraulic Reservoir

HYDRAULICS

HYDRAULIC RESERVOIR

FILLING THE RESERVOIR

Use the following procedure to fill the hydraulic reservoir (Figure 3-15):

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.

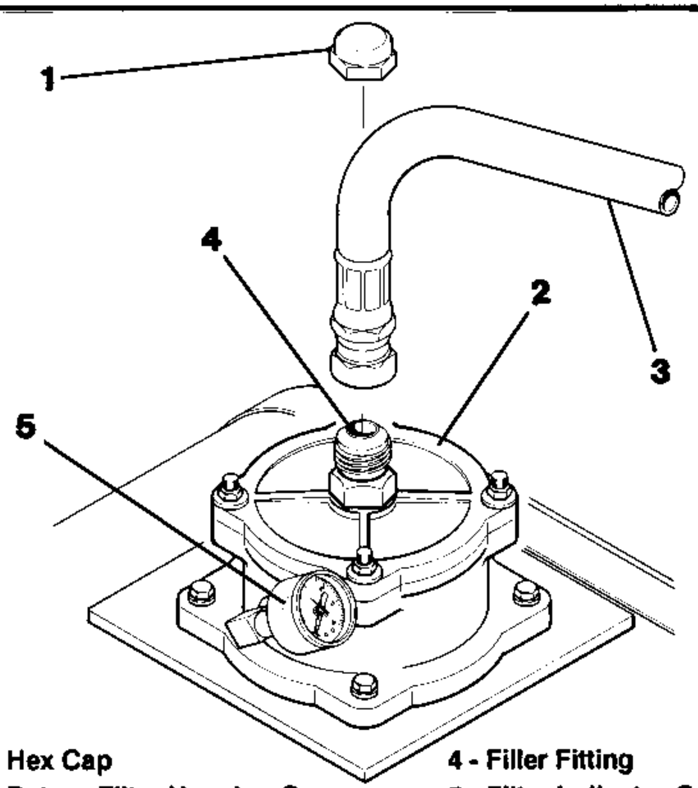
4. Assemble the hose to the reservoir filler fitting and tighten. Fill the reservoir until the oil level in the sight gauge (Figure 3-14, Item 7) is at the full mark.

(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.



1 - Hex Cap
2 - Return Filter Housing Cover
3 - Hydraulic Fill Hose
4 - Filler Fitting
5 - Filter Indicator Gauge

Figure 3-15 Filling the Reservoir

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 3-15, 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 3-16).

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 3.16-1, this section, for filter replacement procedure.

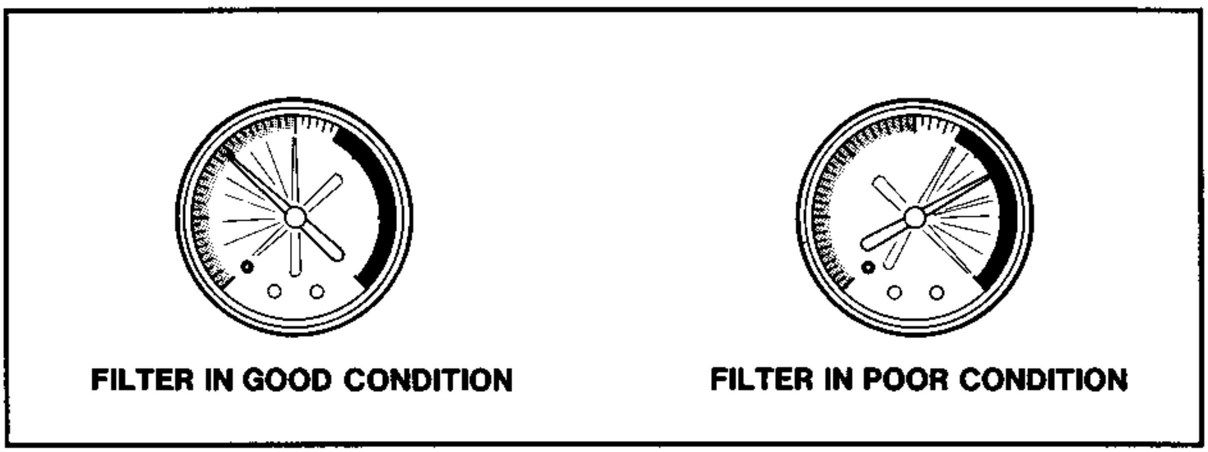


Figure 3-16 Return Filter Indicator Gauge

HYDRAULIC RESERVOIR

REPLACING RETURN FILTER ELEMENT

Use the following procedure to replace the return filter element (Figures 3-17 and 3-18):

1. Lower the boom to the ground, apply the parking brake, and stop the engine. Allow the hydrualic 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.

HYDRAULIC RESERVOIR

REPLACING RETURN FILTER ELEMENT (cont.)

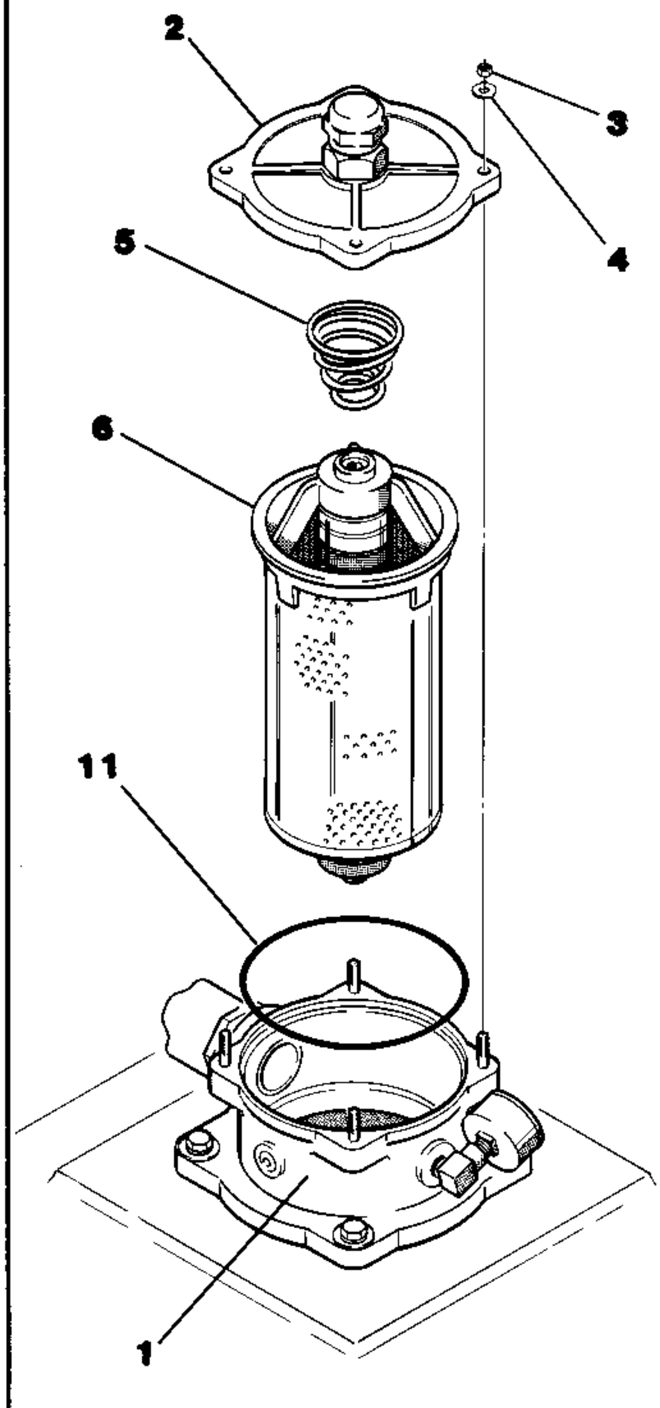
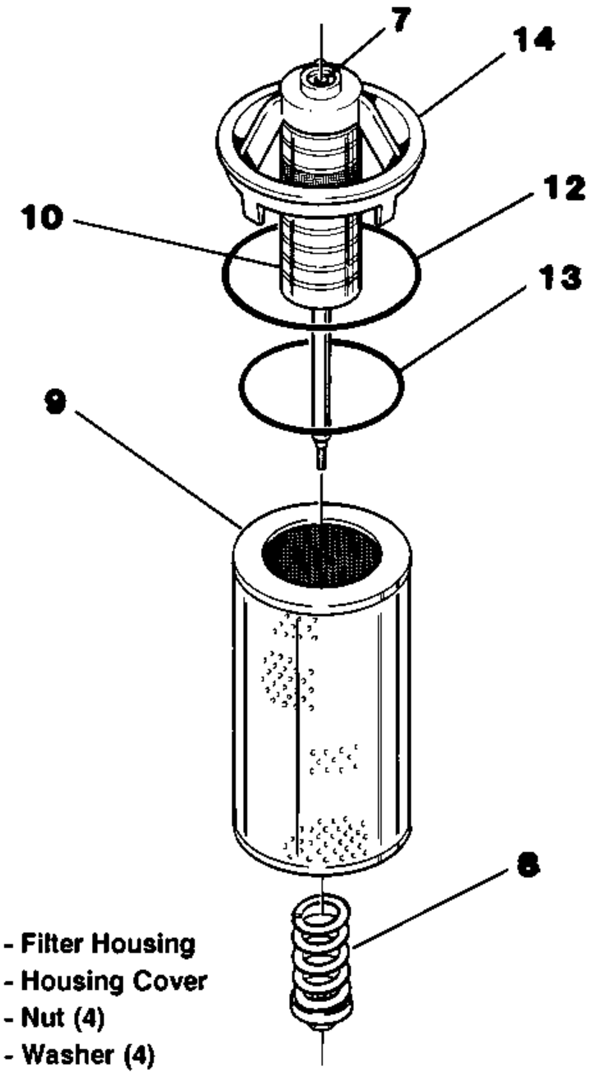


Figure 3-17 Return Filter Housing



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 3-18 Return Filter Element

HYDRAULICS

HYDRAULIC RESERVOIR

RESERVOIR DRAIN AND REFILL

Use the following procedure to drain and refill the hydraulic reservoir (Figures 3-19, 3-20 and 3-21)

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.

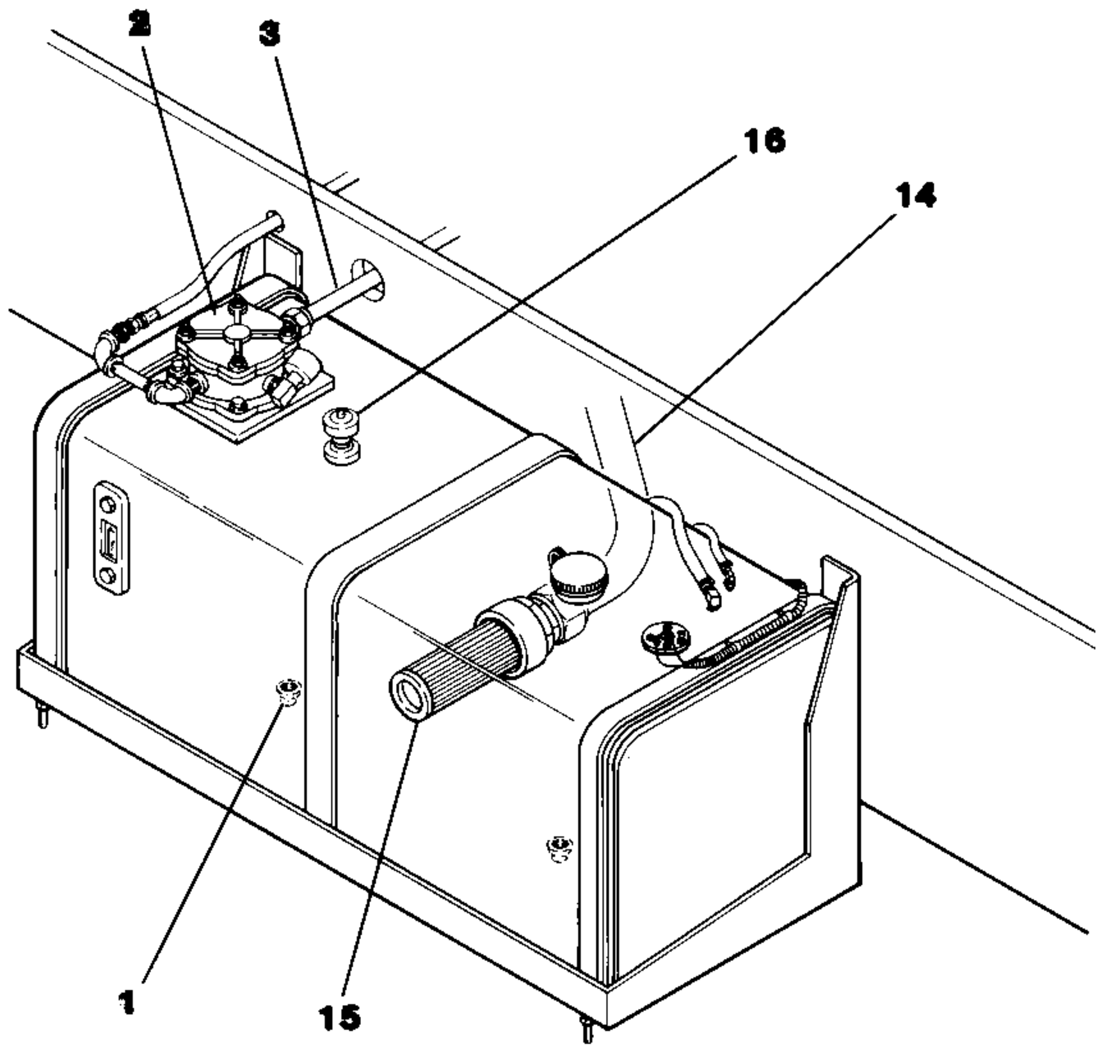
20. Reassemble the hydraulic return pipe (Item 3). Use thread sealant.

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

22. Perform steps 2 through 7 of "Filling the Reservoir" on page 3.14-1 of this section.

HYDRAULIC RESERVOIR

RESERVOIR DRAIN AND REFILL (cont.)

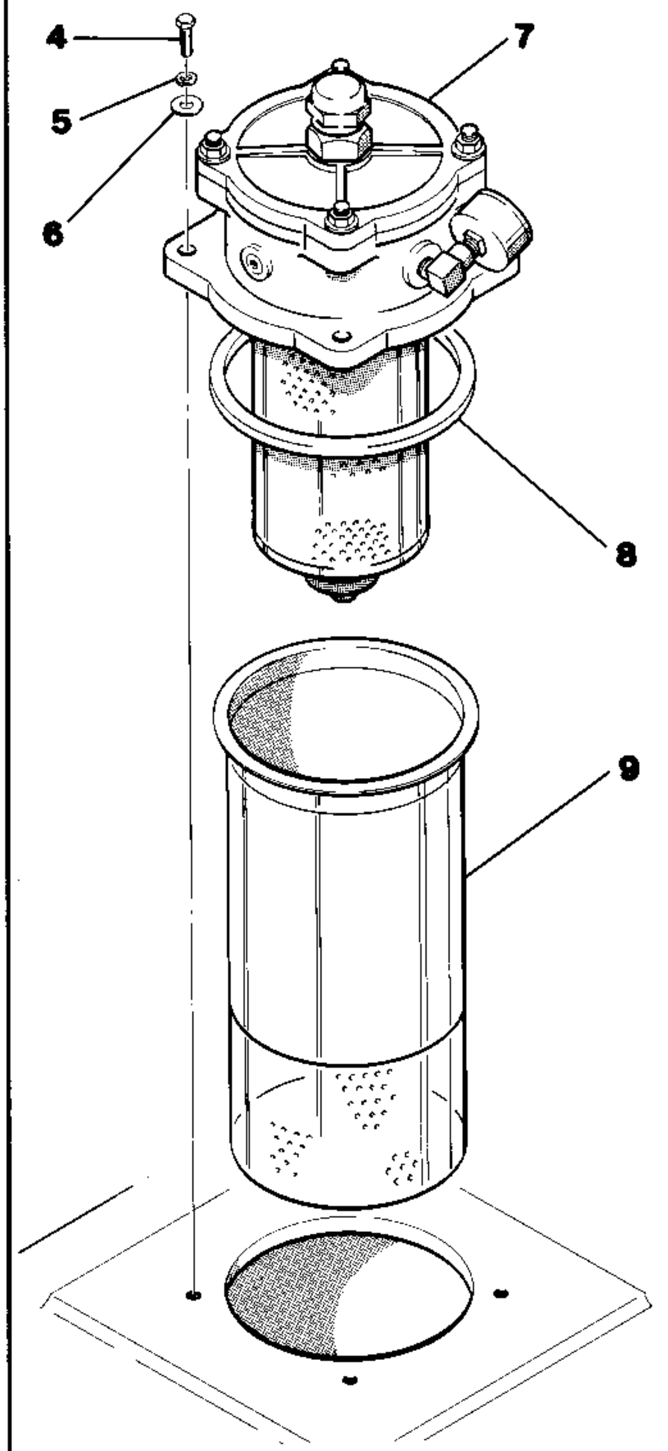


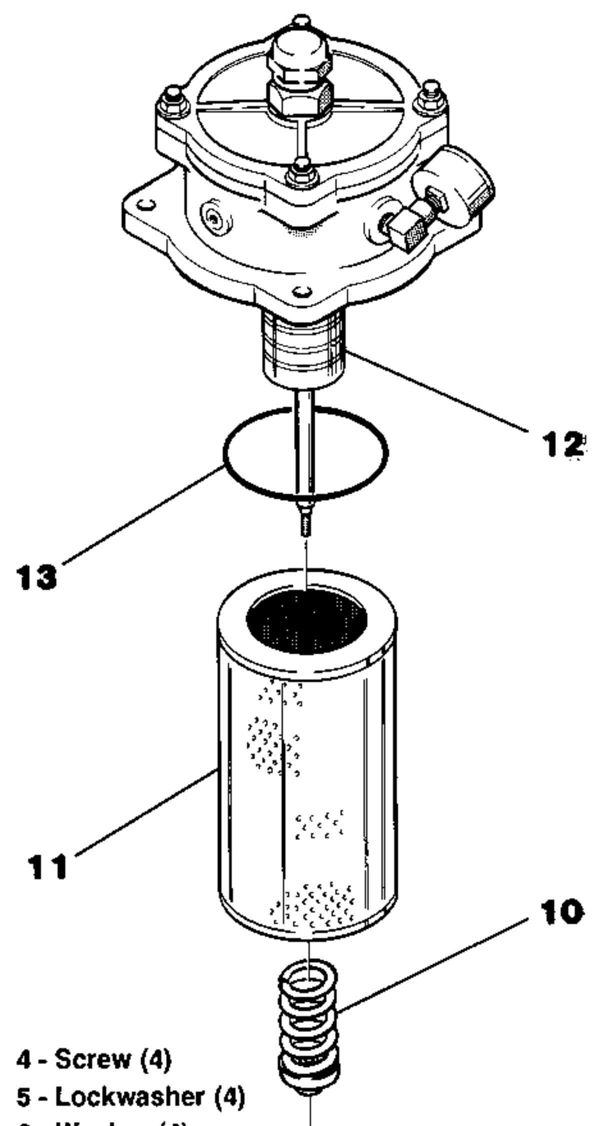
1 - Drain Plug
2 - Return Filter Housing
3 - Hydraulic Return Pipe
14 - Suction Pipe
15 - Strainer
16 - Breather Filter

Figure 3-19 Hydraulic Reservoir - Drain and Refill

HYDRAULIC RESERVOIR

RESERVOIR DRAIN AND REFILL (cont.)





4 - Screw (4)
5 - Lockwasher (4)
6 - Washer (4)
7 - Return Filter Housing
8 - Rubber Seal
9 - Diffuser
10 - Nut/Spring
11 - Filter Element
12 - Magnetic Column
13 - O-Ring

Figure 3-20 Filter Housing Assembly

Figure 3-21 Filter Element Assembly

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.

HYDRAULIC CYLINDERS

CYLINDER OVERHAUL (cont.)

4. Carefully remove counterbalance valve(s) if so equipped (see Figure 3-22).

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 3-7)

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 component will be in the hydraulic system. The system must be clean before installing new or rebuilt components. (See "Cleaning and Flushing System" on page 3.10-1 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.

HYDRAULIC CYLINDERS

CYLINDER OVERHAUL (cont.)

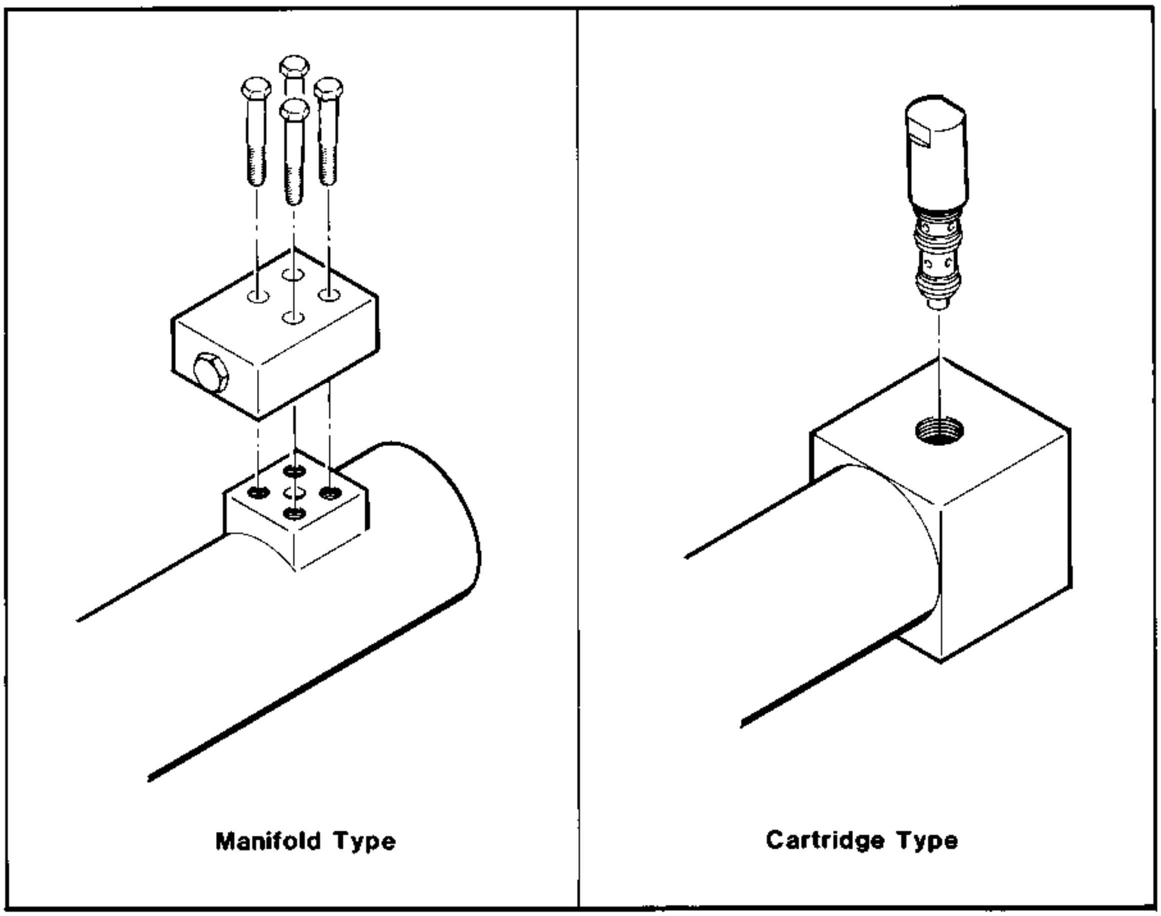
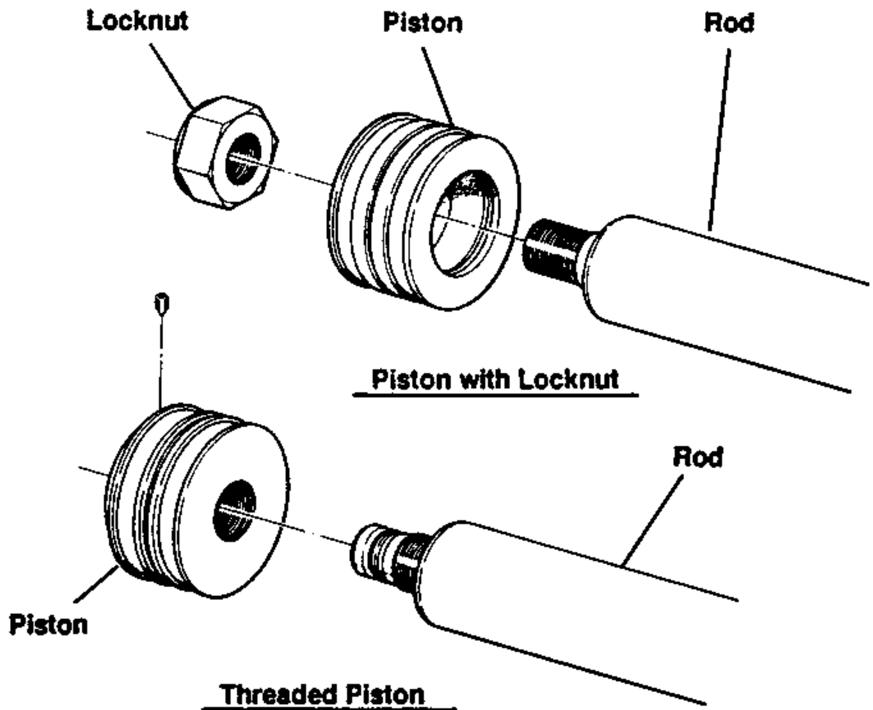


Figure 3-22 Counterbalance Valve Removal

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

Table 3-7 Hydraulic Cylinder Piston and Piston Locknut Torque Specifications

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.

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 mechanisims.	Locate and repair.

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 3-23):

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.

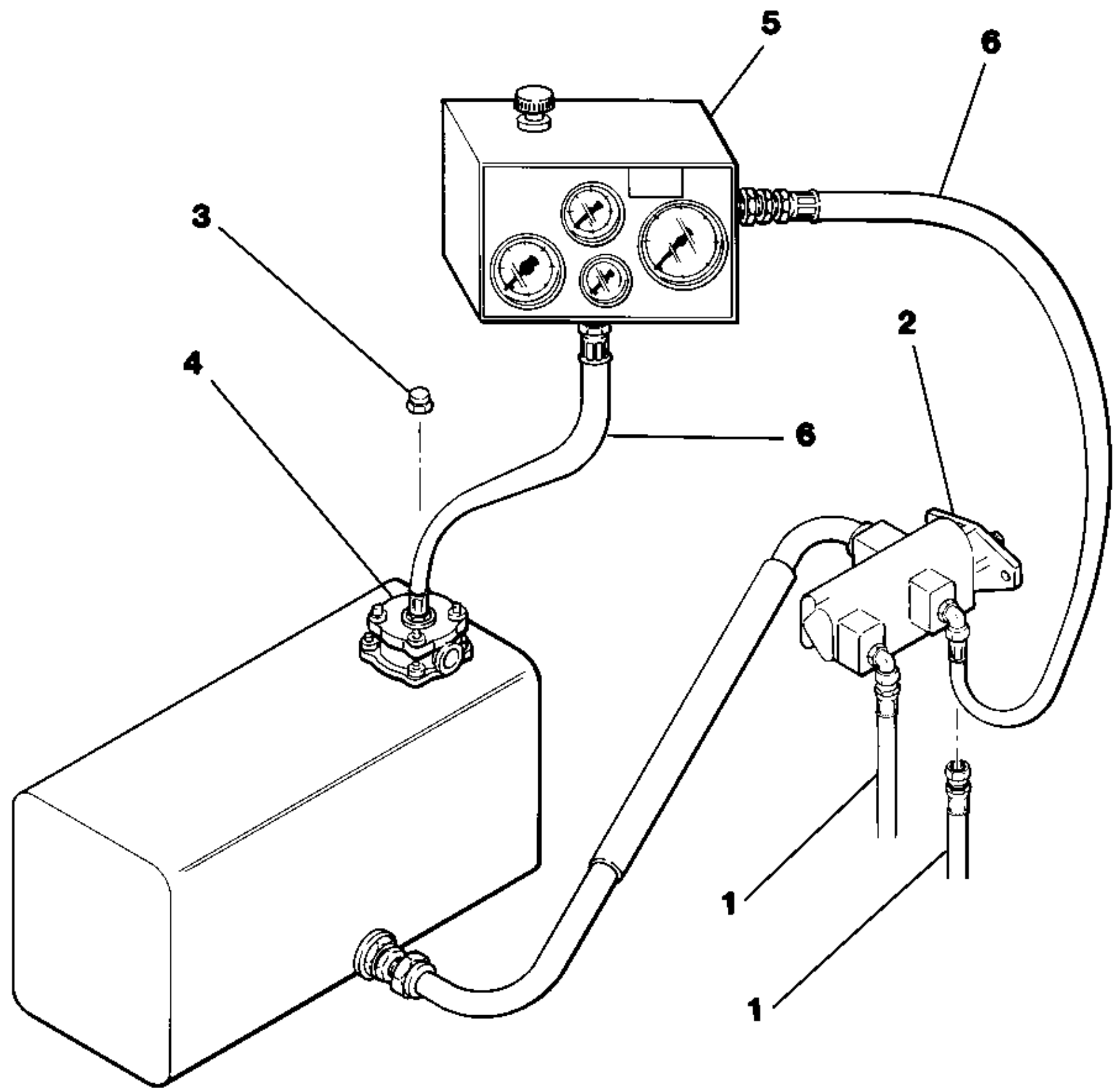
12. Disconnect the test loop from the pump and the return filter housing. Reconnect the pump pressure hose (Item 1) and install the hex cap (Item 3) atop the return filter housing.

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.

HYDRAULIC PUMPS

CHECKING PUMP FLOW RATE (cont.)



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

Figure 3-23 Checking Pump Flow Rate

HYDRAULIC PUMPS

PUMP (MODEL 644)

DESCRIPTION

The hydraulic pump used on the Model 644 forklift is a two section gear-type, driven directly from the transmission power take off.

PUMP SPECIFICATIONS:
Type - Gear
Sections - Two
Manufacturer - Vickers
Model - G2020
GPM - 18 at 2500 rpm (each section)
Approx. Weight - 25 LBS

REMOVAL (Figure 3-24)

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. Clean the pump (Item 1) 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 2). Detach and position the suction line (Item 3) out of the way and cap.

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

5. Tag and remove two hoses (Items 5) and cap.

6. Remove two fittings (Items 6) and cap pump openings.

7. Remove bolts and lockwashers (Items 7 & 8) mounting the pump to the transmission power take off.

8. Remove the pump, pulling straight back until the pump's splined shaft is free, and lift from machine.

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

INSTALLATION (Figure 3-24)

1. Reverse steps 3 through 9 above.

NOTE: Install new o-ring (Item 4) in step 4 (see Parts Book).

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

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.

PUMP (MODELS 844, 1044)

DESCRIPTION

The hydraulic pump used on the Model 844 and 1044 forklifts is a two section gear-type, driven directly from the transmission power take off.

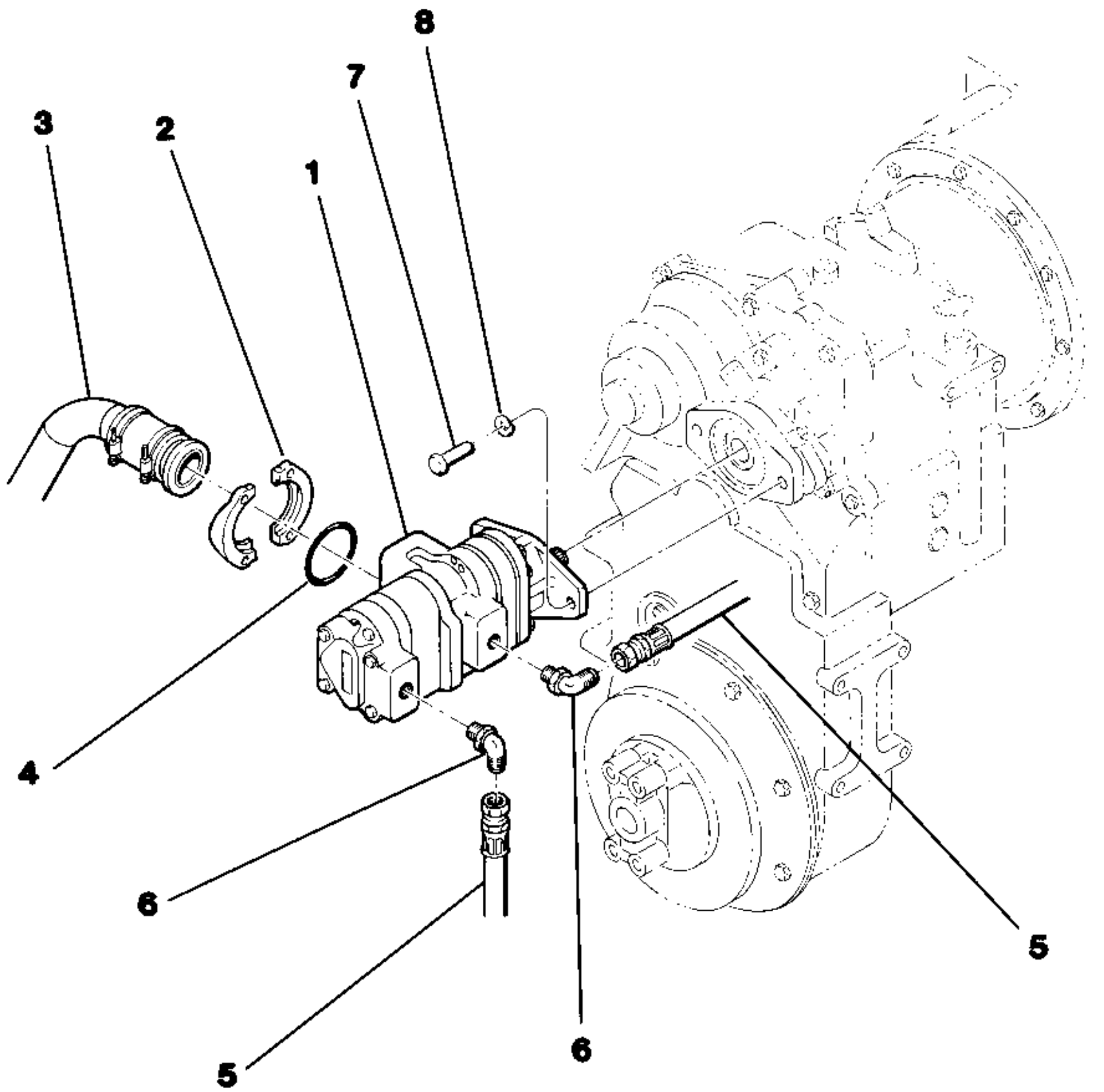
PUMP SPECIFICATIONS:
Type - Gear
Sections - Two
Manufacturer - Vickers
Model - G2020
GPM - 26 at 2500 rpm (Shaft End)
GPM - 18 at 2500 rpm (Cover End)
Approx. Weight - 25 LBS

REMOVAL AND INSTALLATION

See procedures under "Removal" and "Installation" (Model 644).

HYDRAULIC PUMPS

PUMP (MODELS 644, 844, 1044) (cont.)



1 - Hydraulic Pump
2 - Half Flange
3 - Suction Hose
4 - O-Ring
5 - Hydraulic Hose (2)
6 - Fitting (2)
7 - Bolt (2)
8 - Lockwasher (2)

Figure 3-24 Hydraulic Pump Assembly

DIRECTIONAL CONTROL VALVES

LOCATION

Refer to Figure 3-1 and 3-2 on pages 3.5-2 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 3.8-1 of this section for checking and adjusting for correct operating pressure.

TROUBLESHOOTING

Refer to "System Troubleshooting" on page 3.11-1 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 crooked, 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.

DIRECTIONAL CONTROL VALVES

OVERHAUL (cont.)

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

* 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.

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODELS 644, 844)

DESCRIPTION (Figure 3-25)

The two-spool boom control valve is a Prince Model #HC-V-K24 which is located to the right of the operator in the engine compartment of the machine. The control handle is located to the operator's right and has control linkage extending to the valve. The valve is a four way, three position, open center type, with the two spools controlled by the one "joy stick" handle. The valve incorporates an externally adjusted pressure relief valve. The relief valve limits circuit pressure, protecting the circuit from excessive pressure. Hydraulic oil flow that exceeds 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 through the systems, returning eventually to the reservoir.

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 (see Figures 3-29 through 3-32). 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 and Adjusting Circuit Pressure" on page 3.8-1 of this section.

REMOVAL (Figure 3-26)

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 (Item 1) 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 connected to the valve. Cap the lines.

4. Remove control linkage (Item 2) from the valve after removing cotter keys and clevis pins (Items 3 & 4).

5. Remove the three mounting bolts, nuts and lockwashers (Items 5, 6, &7).

6. Remove the valve from the machine.

INSTALLATION

1. Reverse steps 3 through 6 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.

OVERHAUL (Figures 3-27, 3-28)

Refer to "Overhaul" on page 3.28-1 for valve overhaul procedures.

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODELS 644, 844) (cont.)

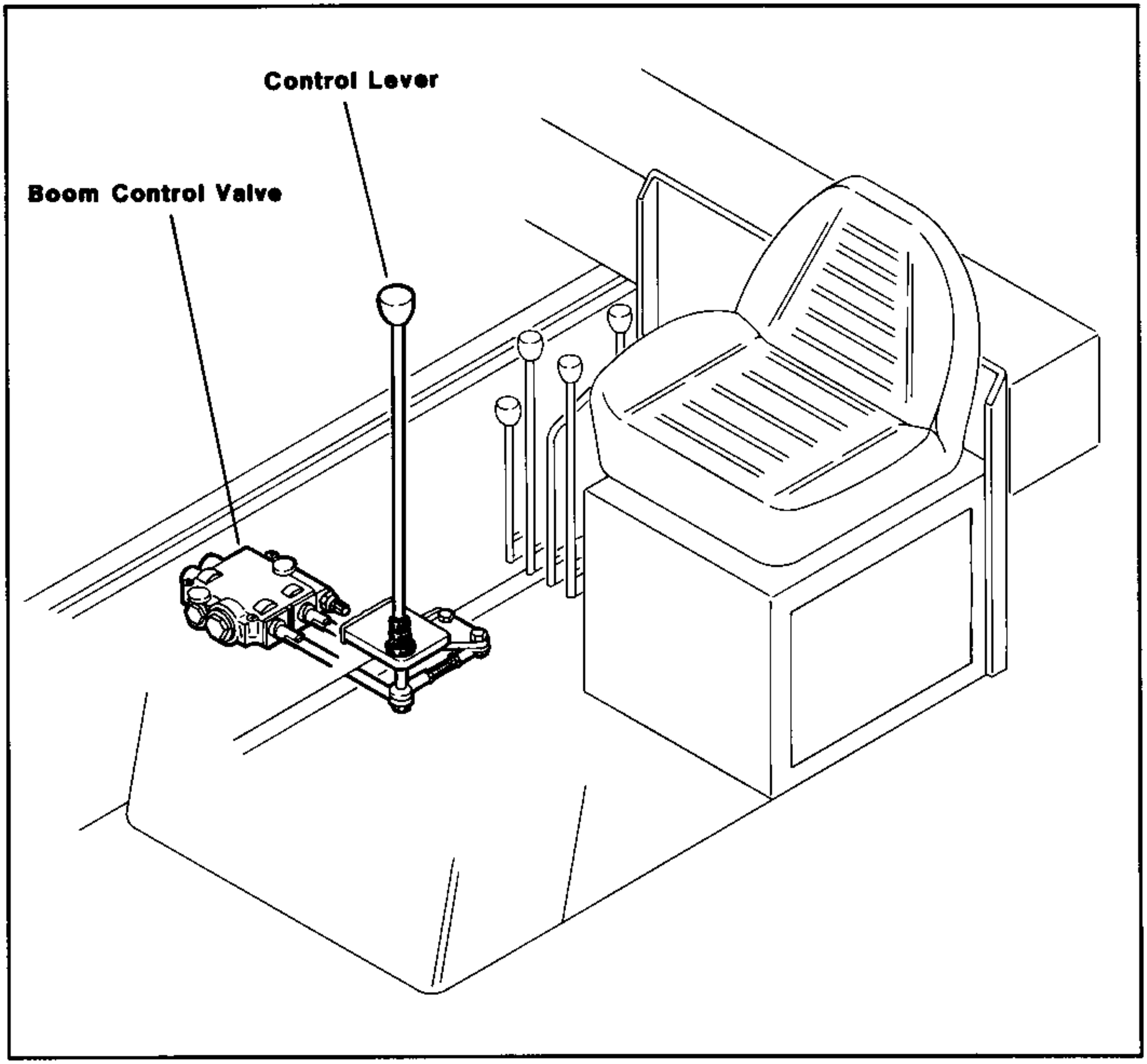
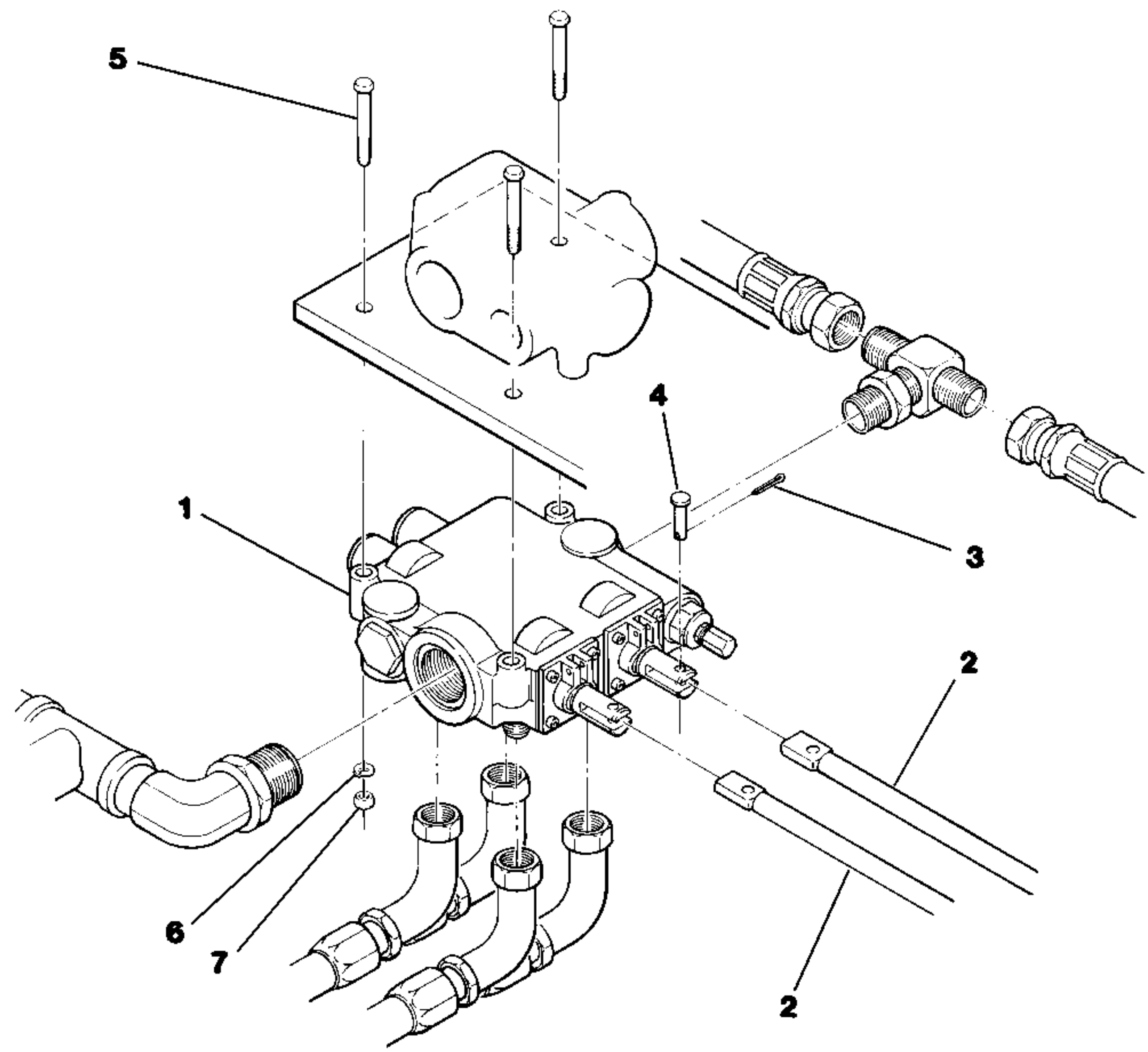


Figure 3-25 Boom Control Valve Arrangement

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODELS 644, 844) (cont.)

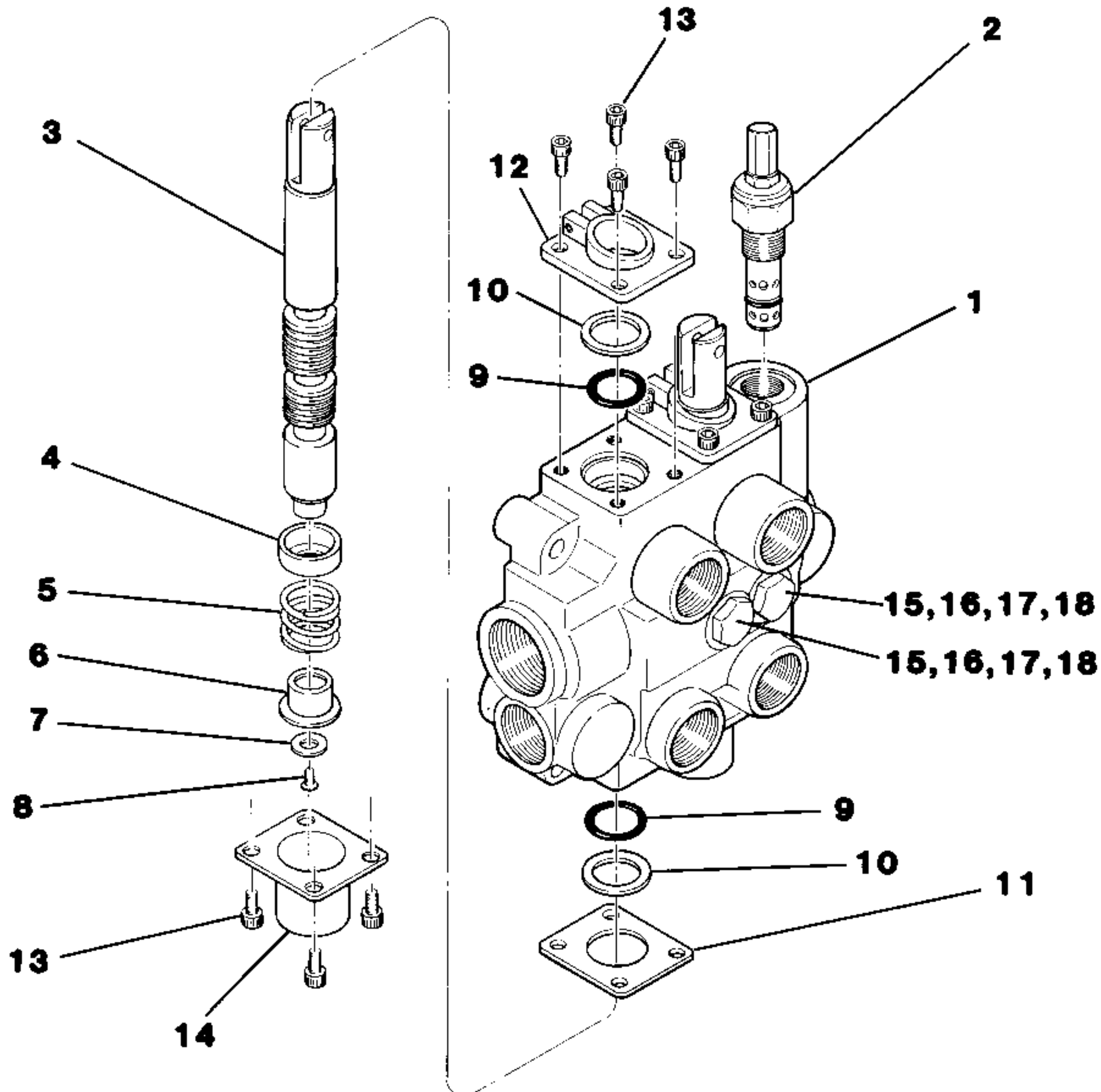


1 - Valve
2 - Linkage (2)
3 - Cotter Pin (2)
4 - Clevis Pin (2)
5 - Mounting Bolt (3)
6 - Lockwasher (3)
7 - Nut (3)

Figure 3-26 Boom Control Valve Removal

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODELS 644, 844) (cont.)

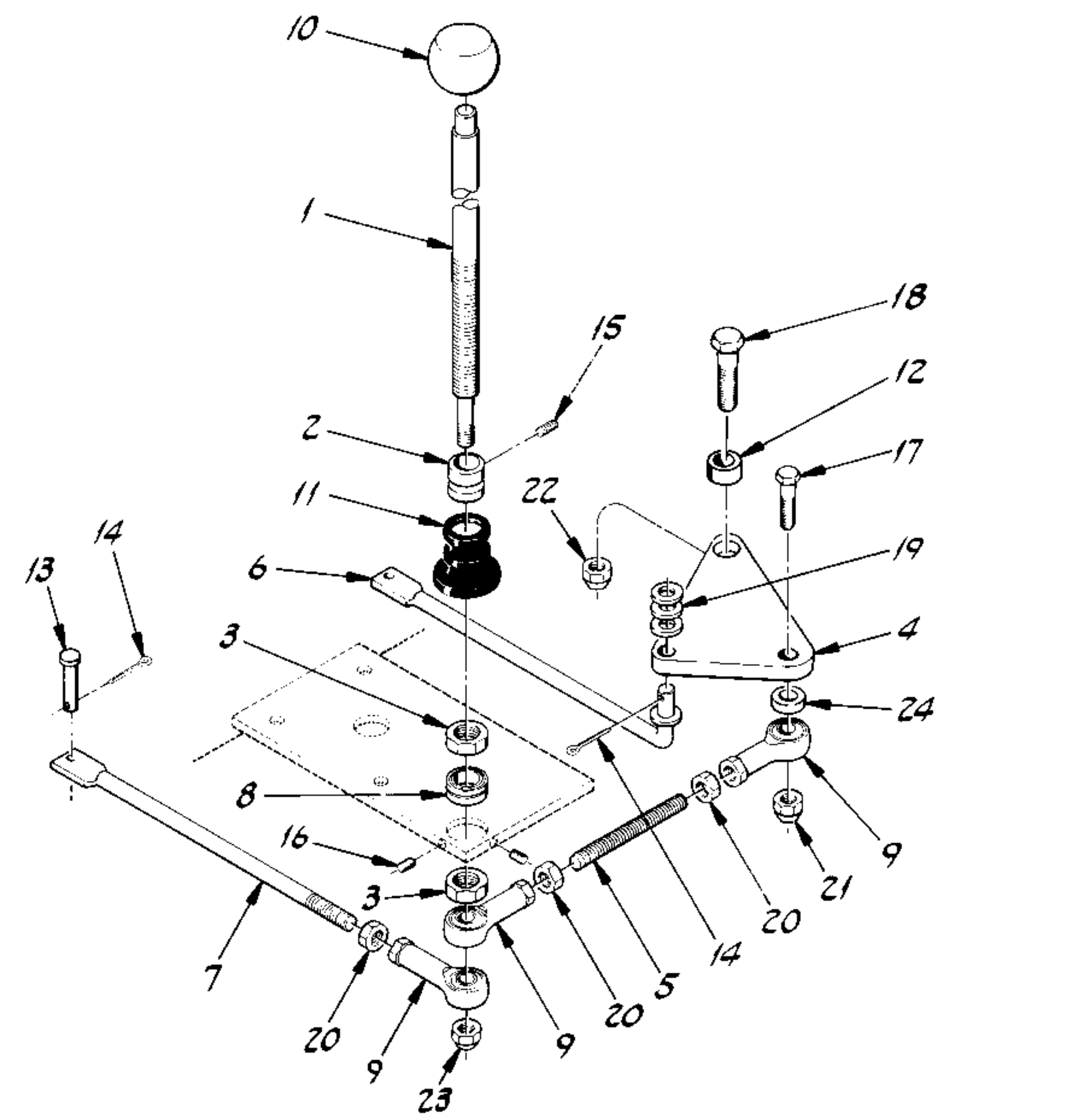


1 - Valve Body	10 - Back-up Ring (4)
2 - Relief Valve	11 - Retainer Plate (2)
3 - Spool (2)	12 - Retainer Plate (2)
4 - Stop Cup (Inner) (2)	13 - Capscrew (16)
5 - Spring (2)	14 - Spring End Cap (2)
6 - Stop Cup (Outer) (2)	15 - Load Check Plug (2)
7 - Washer (2)	16 - Load Check O-Ring (2)
8 - Screw (2)	17 - Load Check Spring (2)
9 - O-Ring (4)	18 - Load Check Poppet (2)

Figure 3-27 Boom Control Valve Disassembly

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODELS 644, 844) (cont.)



1 - Lever	7 - Control Rod	13 - Clevis Pin (2)	19 - 3/8" Flatwasher (5)
2 - Collar	8 - Self Align Bushing	14 - Cotter Pin (3)	20 - 3/8" Nut (3)
3 - Nut (Special)(2)	9 - Rod End (3)	15 - 1/4" Set Screw	21 - 3/8" Locknut
4 - Toggle Plate	10 - Knob	16 - 5/16" Setscrew (2)	22 - 1/2" Locknut
5 - Control Link	11 - Rubber Boot	17 - 3/8" x 1 3/4" Bolt	23 - 3/8" Locknut
6 - Control Rod	12 - Bushing	18 - 1/2" x 1 1/2" Bolt	24 - Spacer

Figure 3-28 Control Linkage Disassembly

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODELS 644, 844) (cont.)

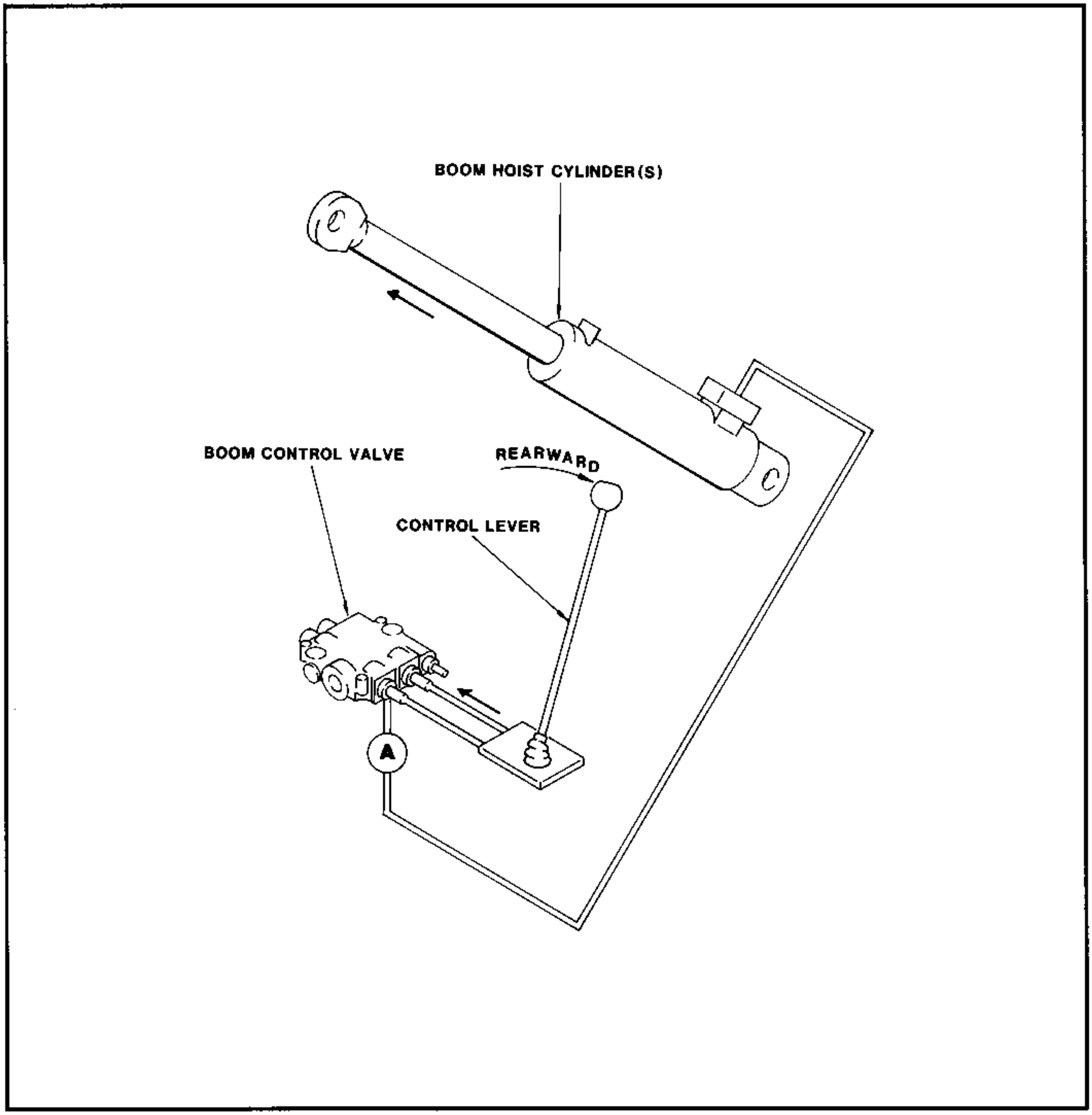


Figure 3-29 Flow Diagram - Boom Raising

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODELS 644, 844) (cont.)

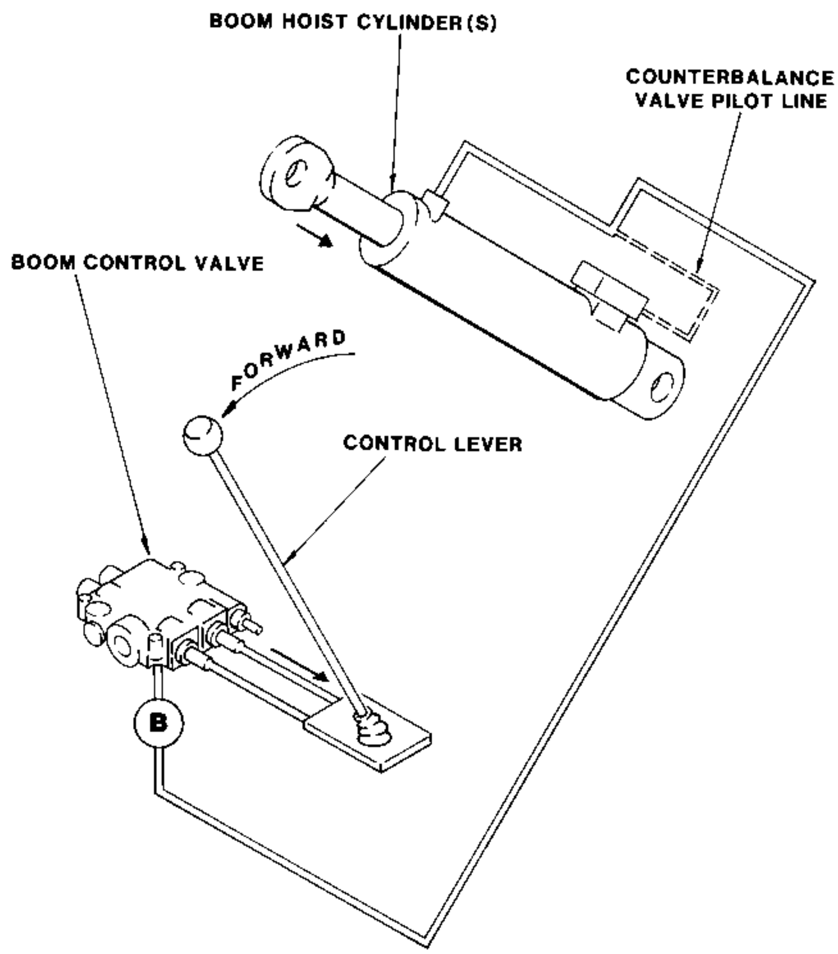


Figure 3-30 Flow Diagram - Boom Lowering

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODELS 644, 844) (cont.)

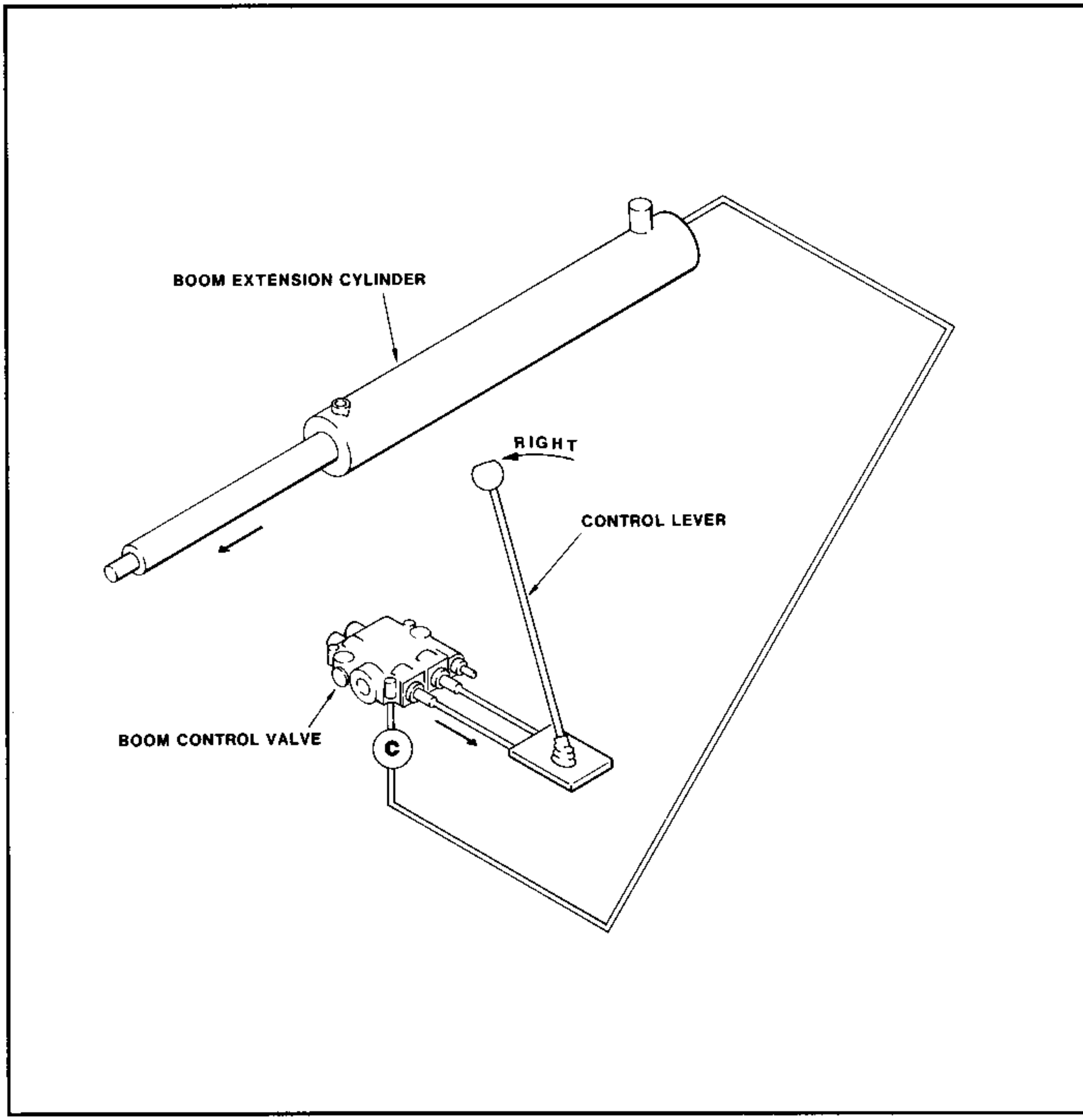


Figure 3-31 Flow Diagram - Boom Extend

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODELS 644, 844) (cont.)

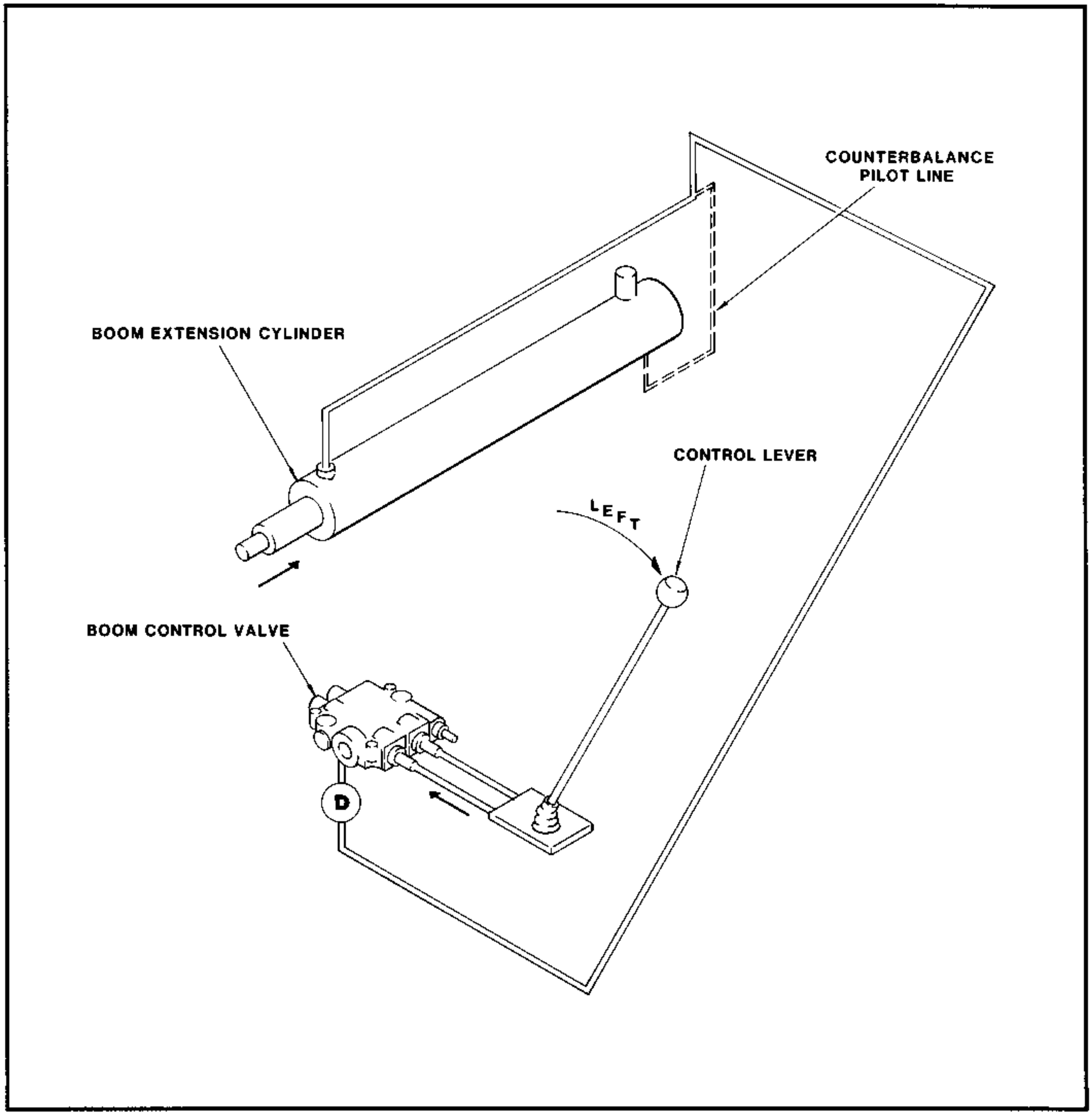


Figure 3-32 Flow Diagram - Boom Retract

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODEL 1044)

DESCRIPTION (Figure 3-33)

The two-spool boom control valve is a Prince Model #HC-V-K36 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 "joy stick" handle. The valve incorporates an externally adjusted pressure relief valve. The relief valve limits circuit pressure, protecting the circuit from excessive pressure. Hydraulic oil flow that exceeds 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 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 (see Figure 3-36 through 3-39). 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 and Adjusting Circuit Pressure" on page 3.8-1 of this section.

REMOVAL (Figure 3-34)

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. Remove the valve cover (Item 1) and clean the valve (Item 2) 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 connected to the valve. Cap the lines.

4. Remove the three mounting bolts, nuts and lockwashers (Items 3). Remove three spacers (Item 4).

5. Remove the valve from the machine.

INSTALLATION

1. Reverse steps 3 through 5 above, and replace the valve cover.

NOTE: See Torque Specification Tables in Section 1 for tightening bolts and hydraulic lines.

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 3-35)

Refer to "Overhaul" on page 3.28-1 for valve overhaul procedures.

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODEL 1044) (cont.)

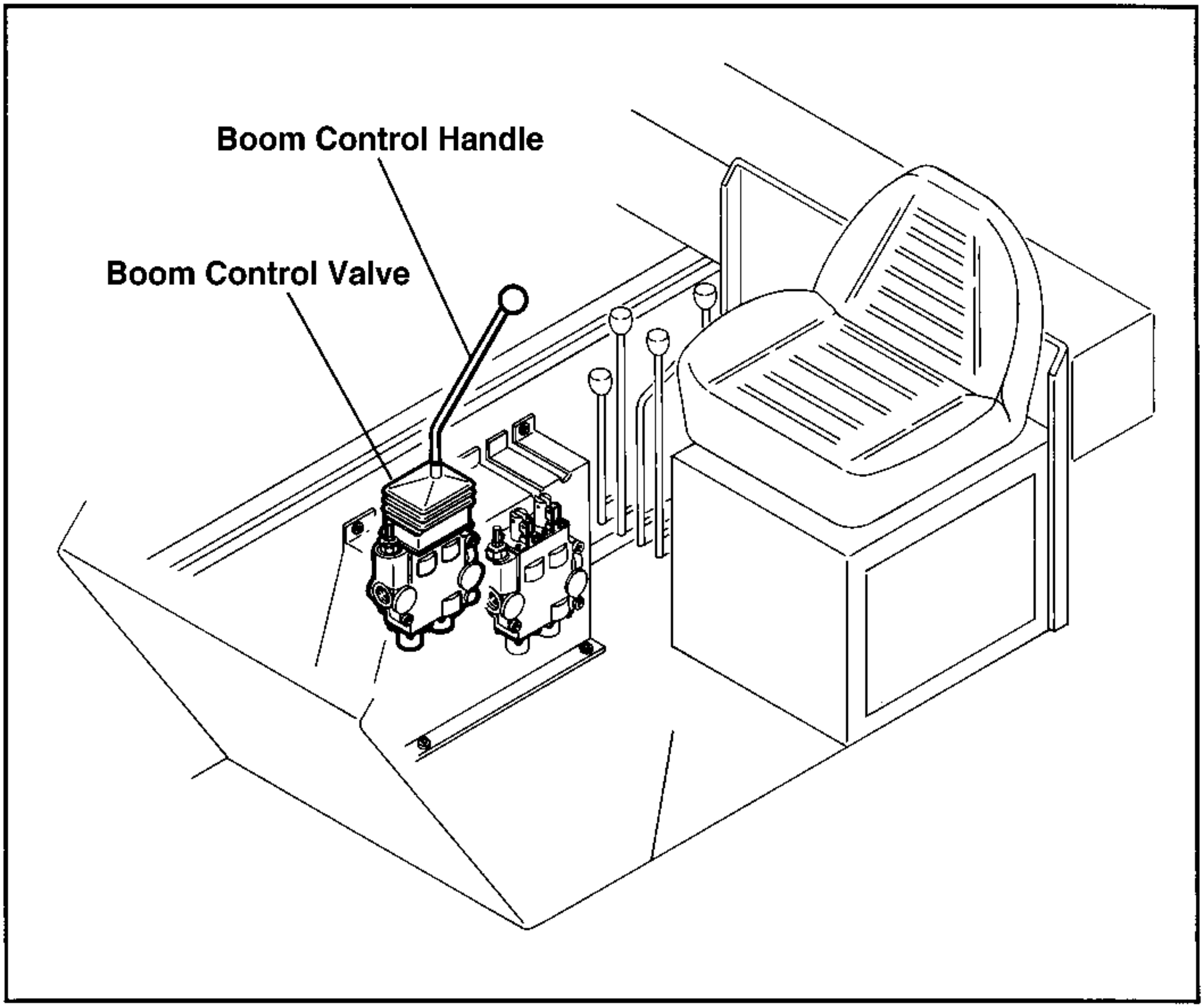


Figure 3-33 Boom Control Valve Arrangement

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODEL 1044) (cont.)

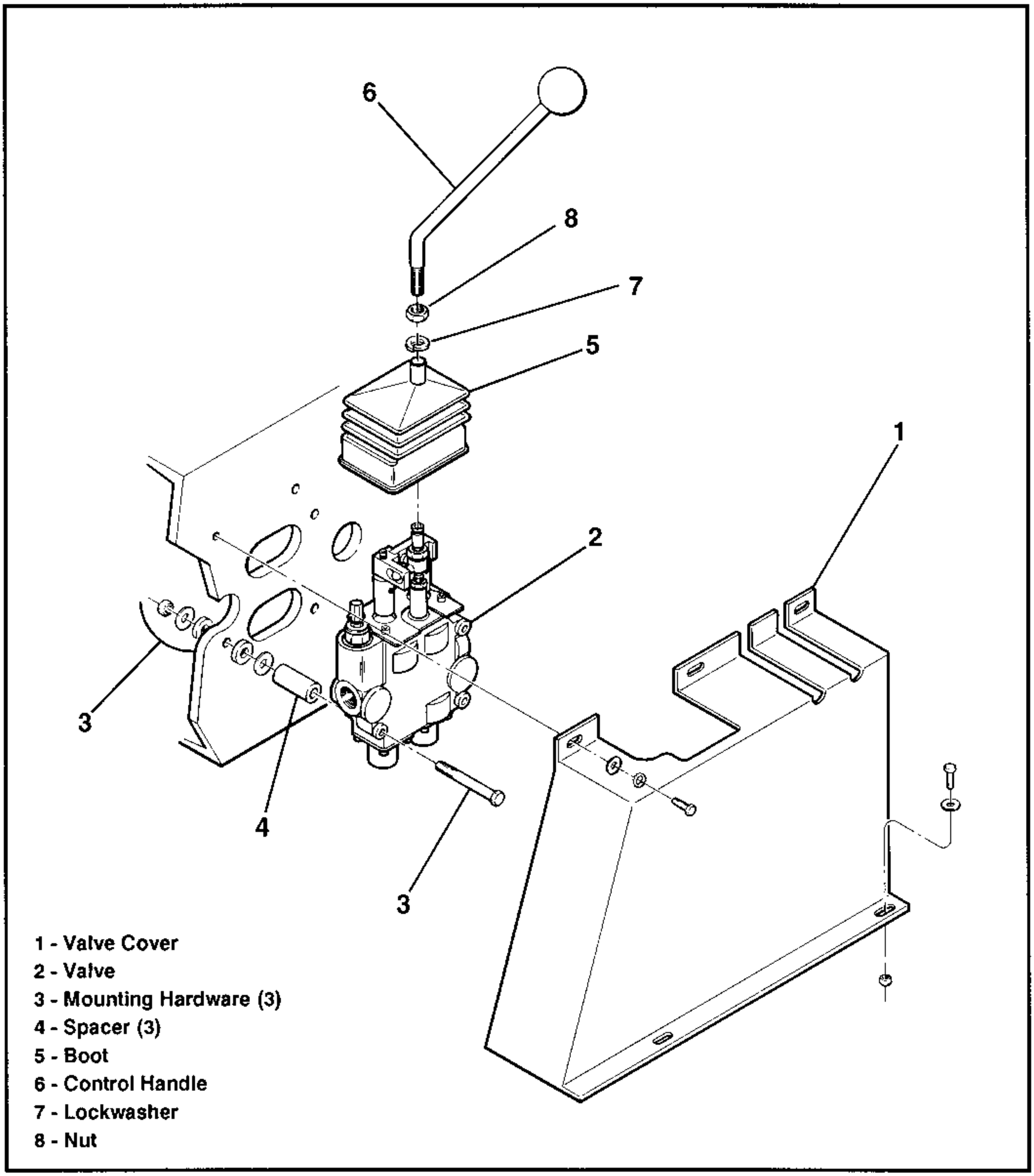


Figure 3-34 Boom Control Valve Removal

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODEL 1044) (cont.)

1 - Valve Body
2 - Spool (2)
3 - O-Ring (4)
4 - Back-up Ring (4)
5 - Stop Cup (Inner) (2)
6 - Spring (2)
7 - Stop Cup (Outer) (2)
8 - Washer (2)
9 - Screw (2)
10 - Spring End Cap (2)
11 - Retainer Plate (2)
12 - Screw (8)
13 - Screw (4)
14 - Relief Valve
15 - Retainer Plate
16 - End Plate
17 - Jam Nut
18 - Ball Center
19 - Pivot
20 - Jam Nut
21 - Handle Adapter
22 - Spring Pin (2)
23 - Slide Block
24 - Slide Block
25 - Spool Adapter (2)
26 - Lockwasher (2)
27 - Screw (2)

* Load Check Plug (2)
* Load Check O-Ring (2)
* Load Check Spring (2)
* Load Check Poppet (2)

* Not Shown

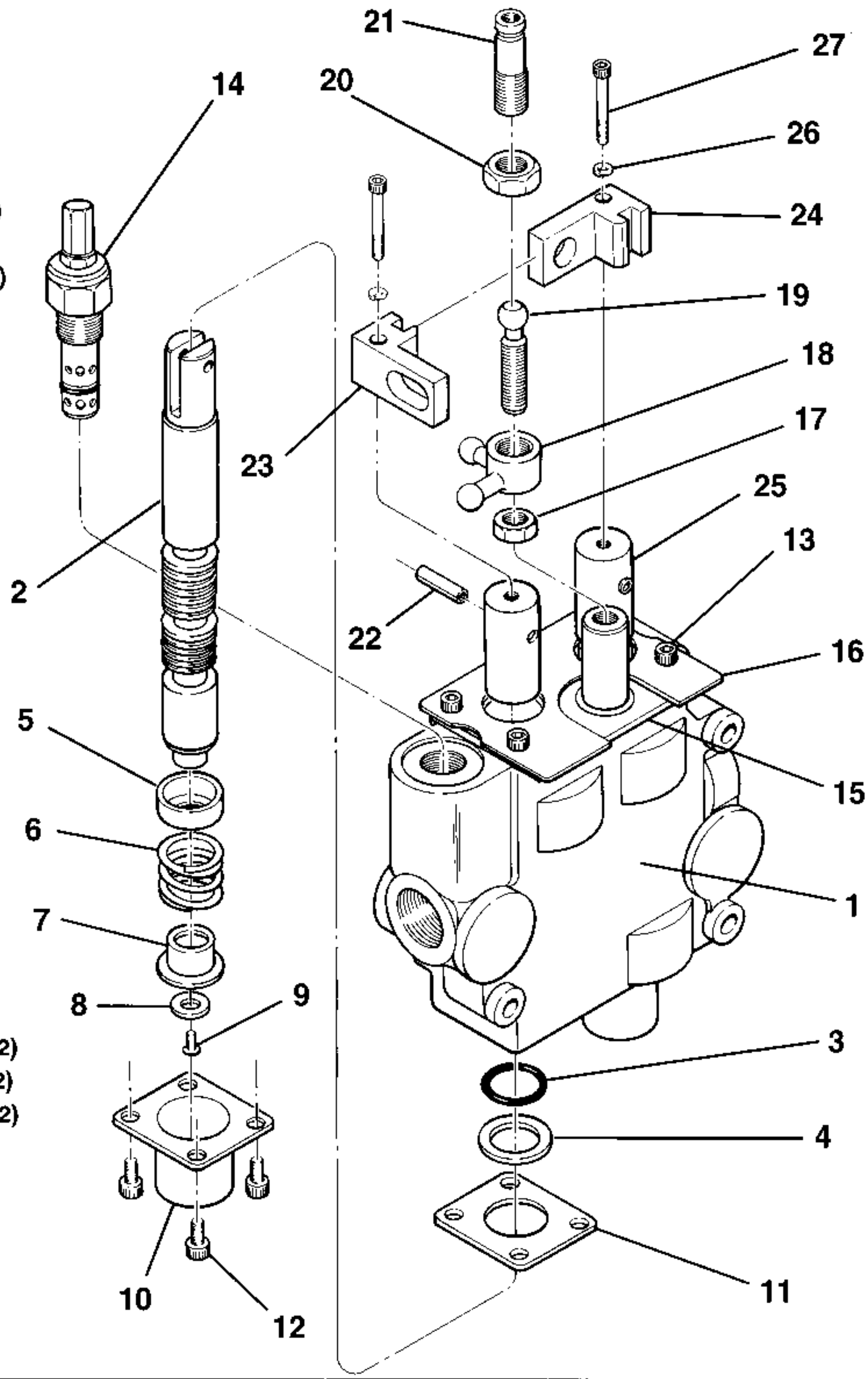


Figure 3-35 Boom Control Valve Disassembly

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODEL 1044) (cont.)

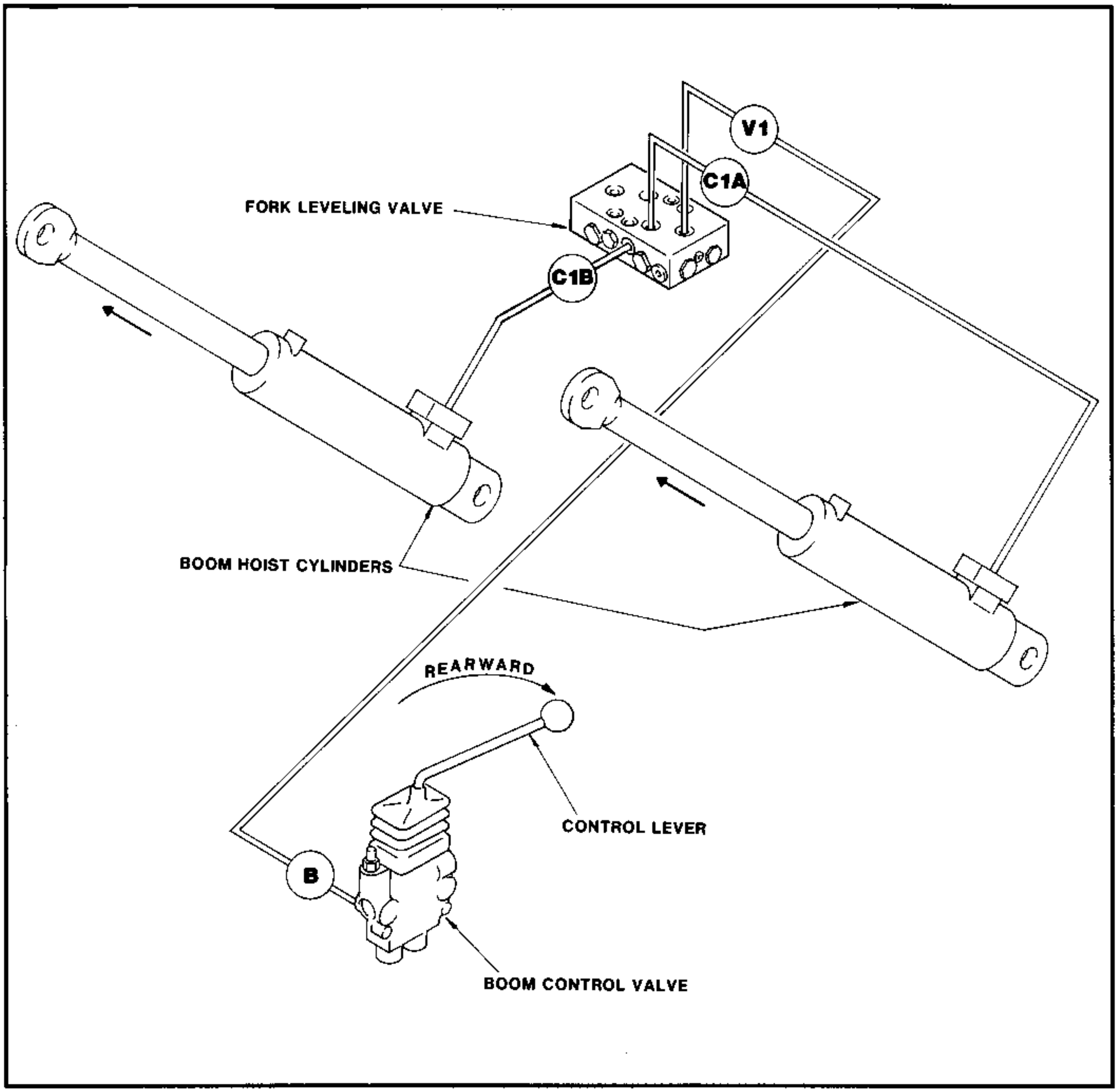


Figure 3-36 Flow Diagram - Boom Raising

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODEL 1044) (cont.)

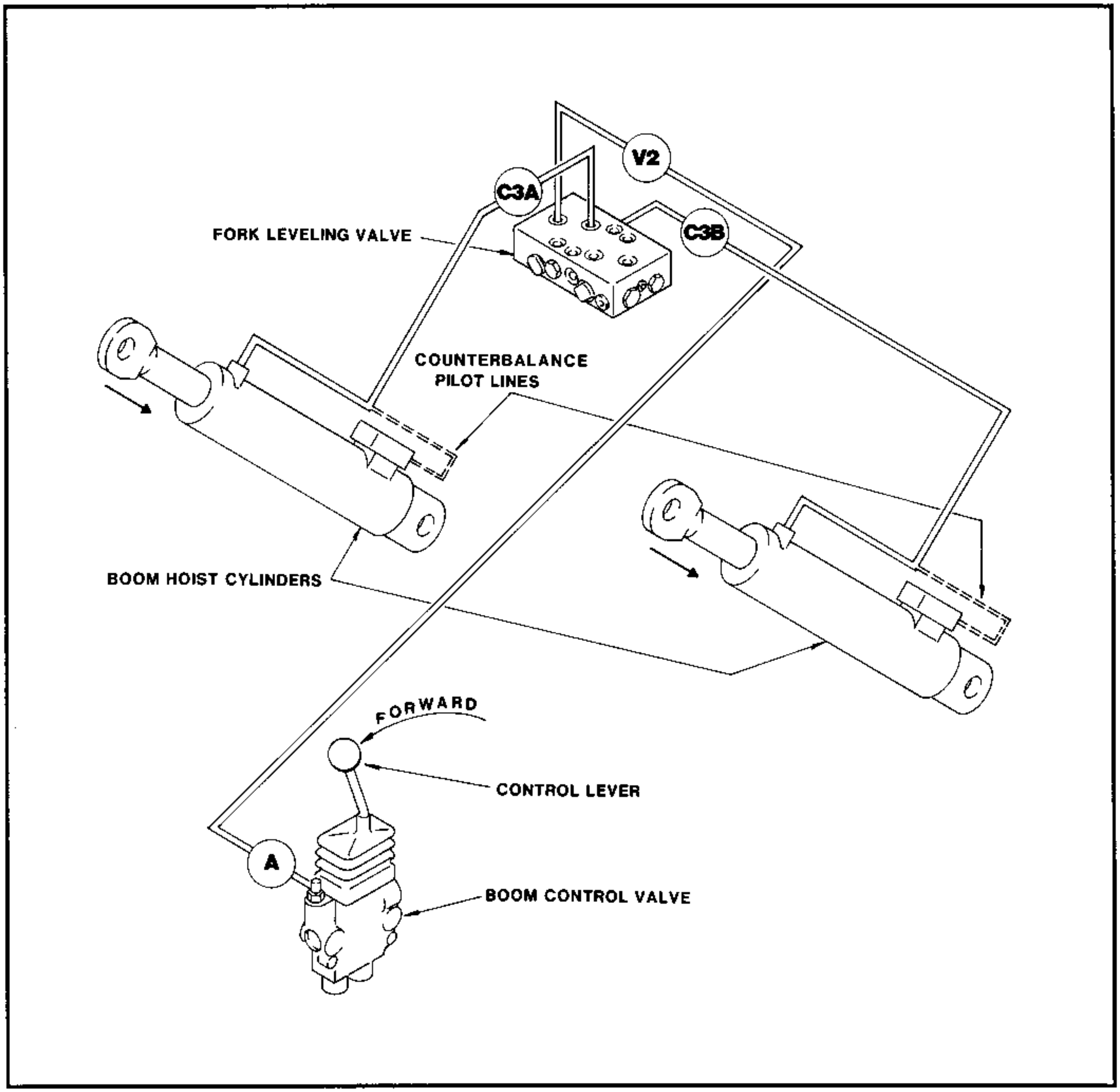


Figure 3-37 Flow Diagram - Boom Lowering

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODEL 1044) (cont.)

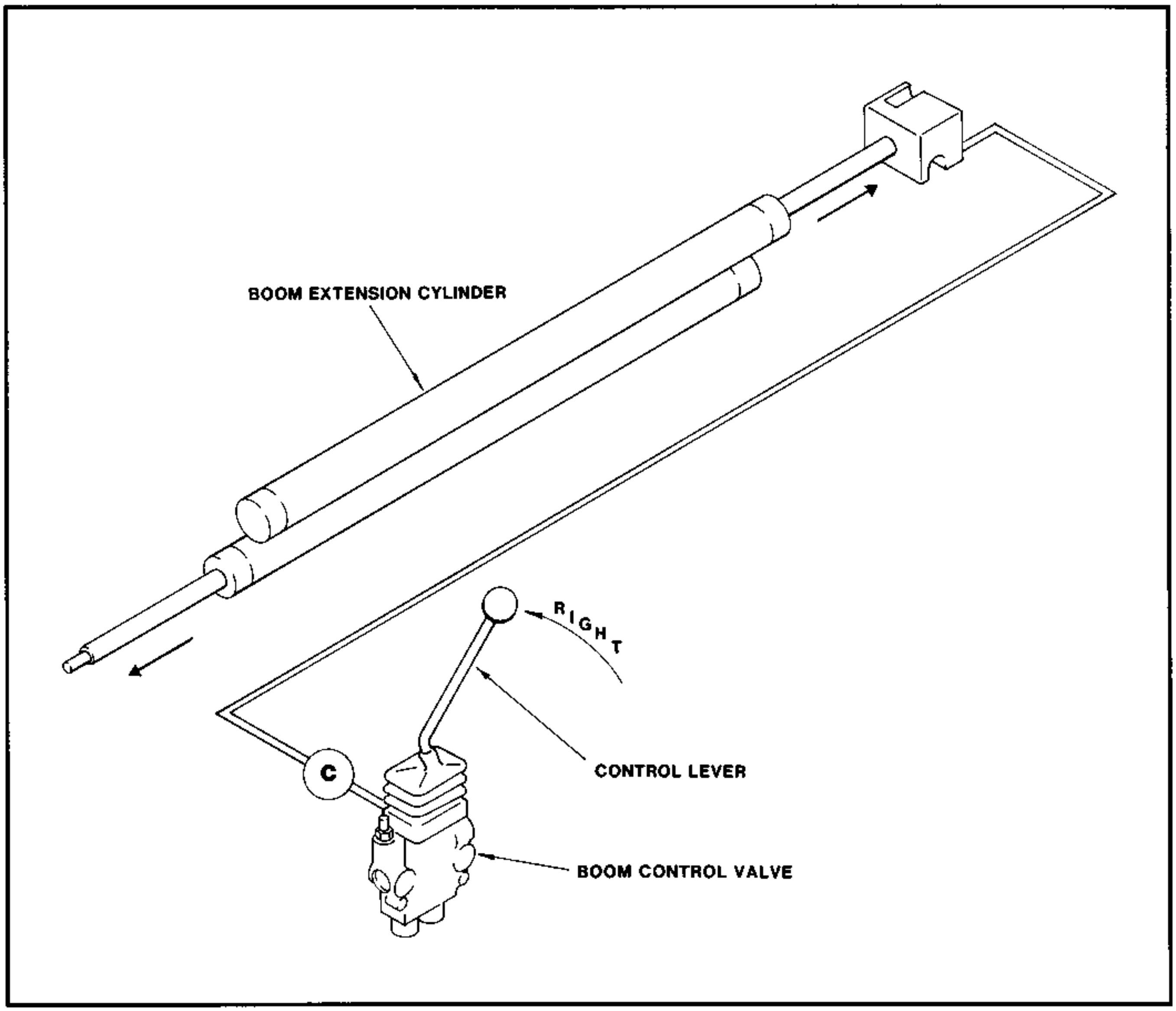


Figure 3-38 Flow Diagram - Boom Extend

DIRECTIONAL CONTROL VALVES

BOOM CONTROL VALVE (MODEL 1044) (cont.)

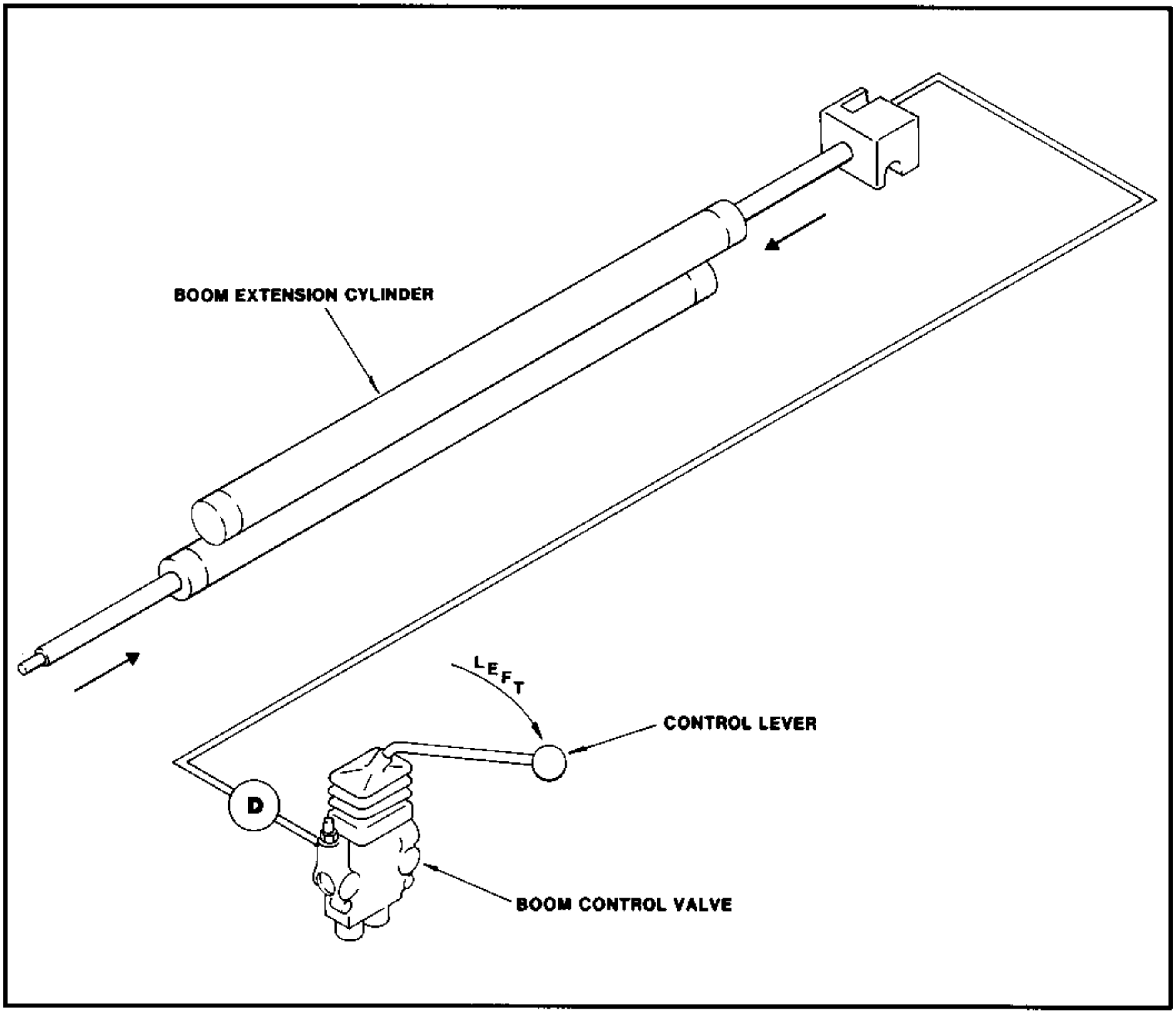


Figure 3-39 Flow Diagram - Boom Retract

DIRECTIONAL CONTROL VALVES

OUTRIGGER CONTROL VALVE (MODEL 1044)(OPT. 644,844)

DESCRITPION (Figure 3-40)

Two two-spool outrigger control valve is a Prince Model #HC-V-K24. It is a four way, three position, open center type, with each spool controlled by a separate control handle.

On Model 1044 the valve is located to the right of the operator on the side wall of the cab.

On Models 644 and 844 the valve is located to the right of the operator behind the four or five spool valve.

The valve incorporates an externally adjusted pressure relief valve. The relief valve limits circuit pressure, protecting the circuit from excessive pressure. Hydraulic oil flow that exceeds 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 handles in the neutral position, hydraulic oil will flow through the valve and continue 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 hydraulic cylinder movement.

Pulling the right outrigger handle down will lower the right outrigger; pushing the handle up will raise the outrigger; pulling the left outrigger handle down will lower the left outrigger; pushing the handle up will raise the outrigger (see Figures 3-42 and 3-43). The spools are spring loaded which will return the handles to the neutral position when released.

ADJUSTING PRESSURE RELIEF

To adjust the pressure relief valve, follow the instructions under "Checking and Adjusting Circuit Pressure" on page 3.8-1 of this section.

REMOVAL (Figure 3-41)

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 (remove protective cover before cleaning - Model 1044). 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 connected to the valve. Cap the lines.

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

5. Remove the valve from the machine.

INSTALLATION

1. Reverse steps 3 through 5 above. Replace cover (Model 1044).

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.

OVERHAUL (FIGURE 3-27)

Refer to "Overhaul" on page 3.28-1 for valve overhaul procedures.

DIRECTIONAL CONTROL VALVES

OUTRIGGER CONTROL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

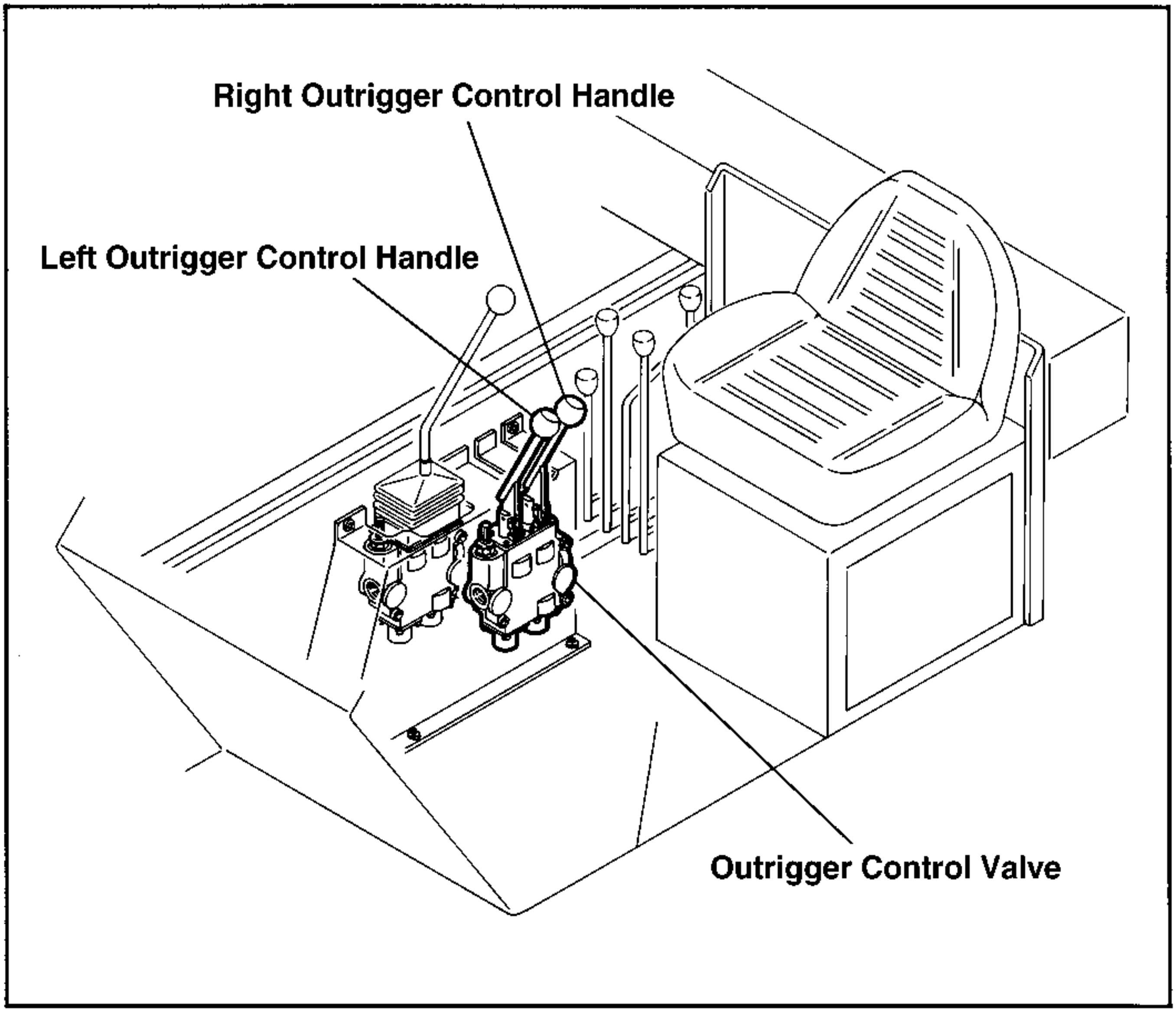


Figure 3-40 Outrigger Control Valve Arrangement

DIRECTIONAL CONTROL VALVES

OUTRIGGER CONTROL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

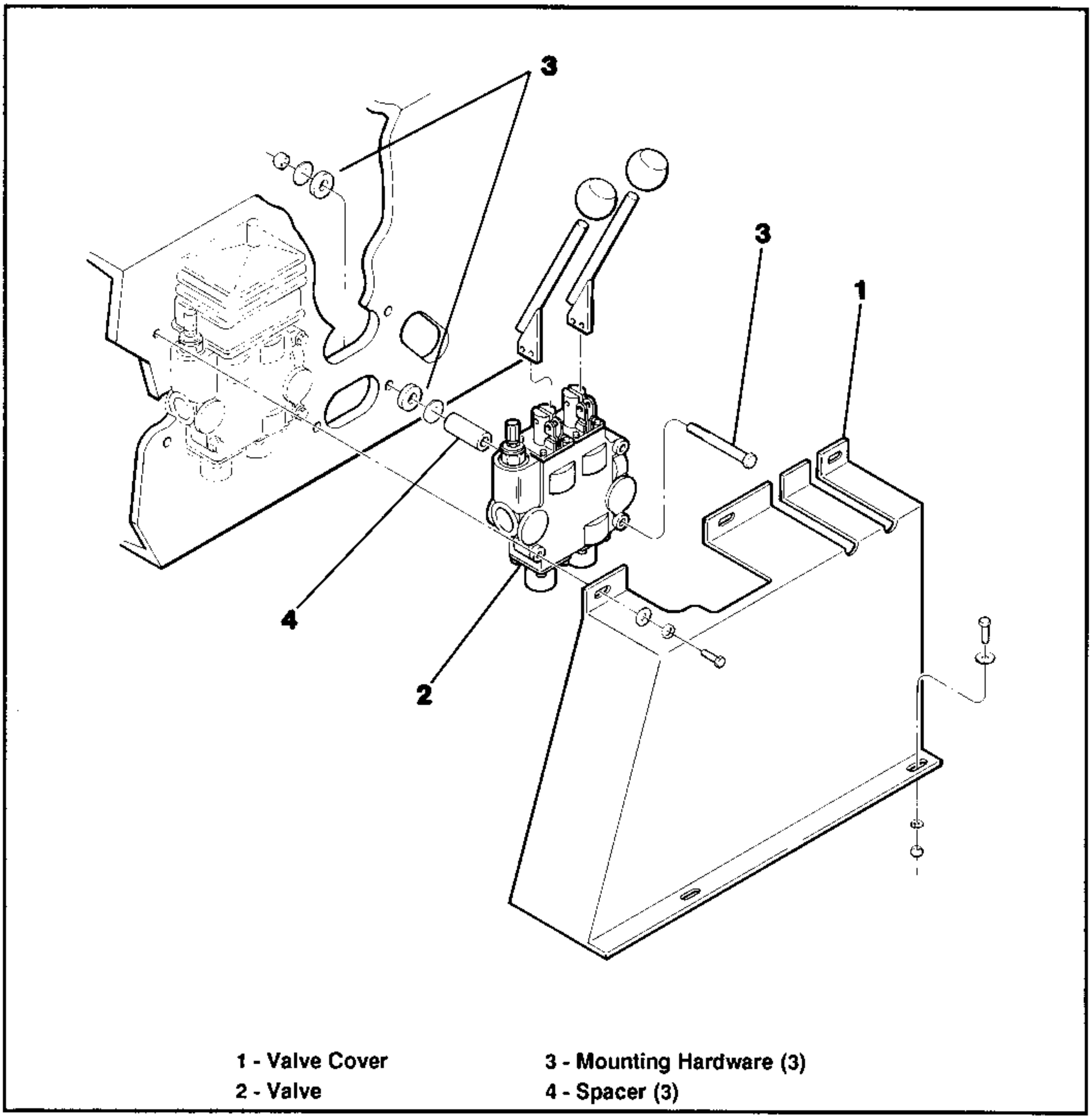


Figure 3-41 Outrigger Control Valve Removal

DIRECTIONAL CONTROL VALVES

OUTRIGGER CONTROL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

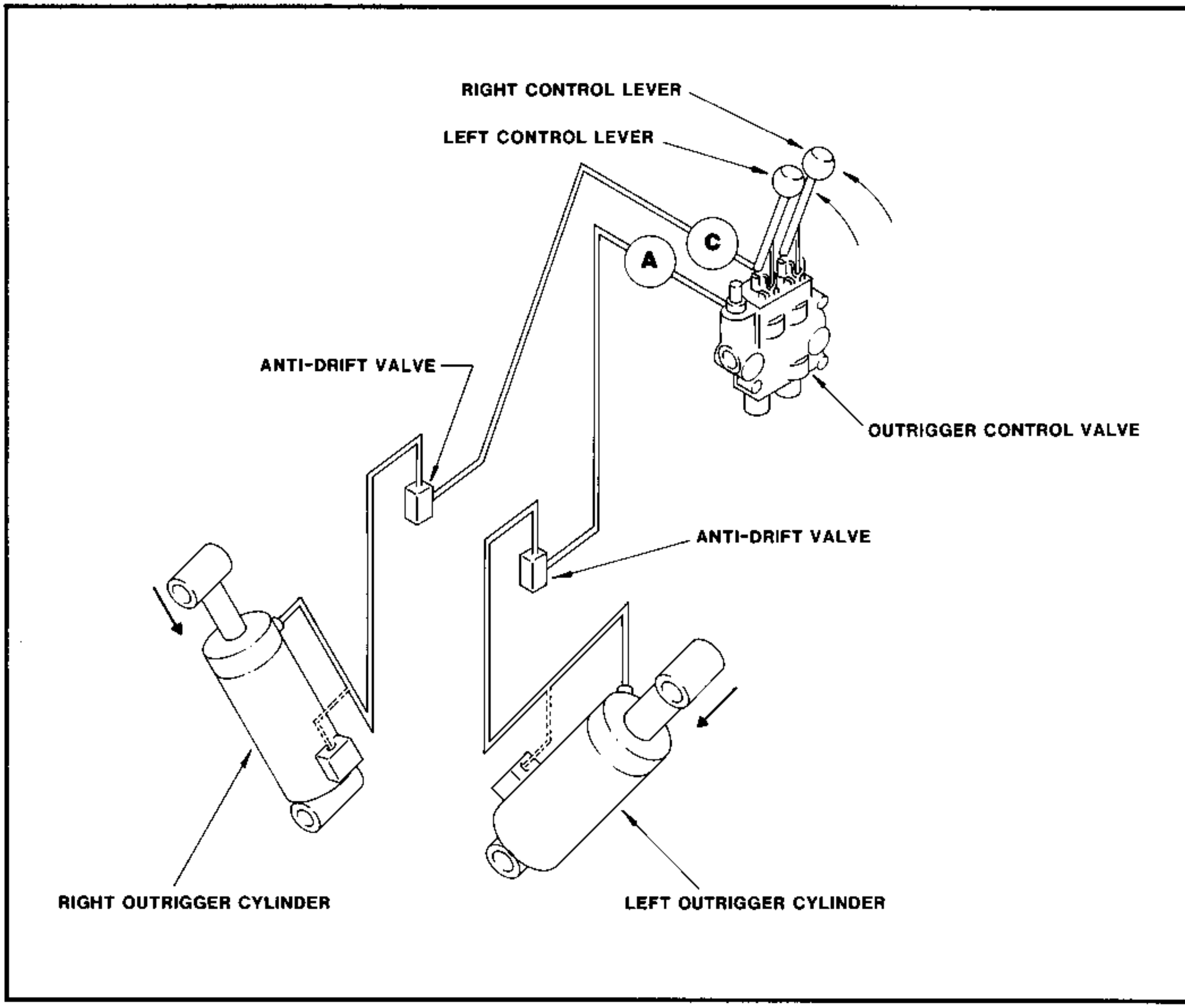


Figure 3-42 Flow Diagram - Outrigger Raising

DIRECTIONAL CONTROL VALVES

OUTRIGGER CONTROL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

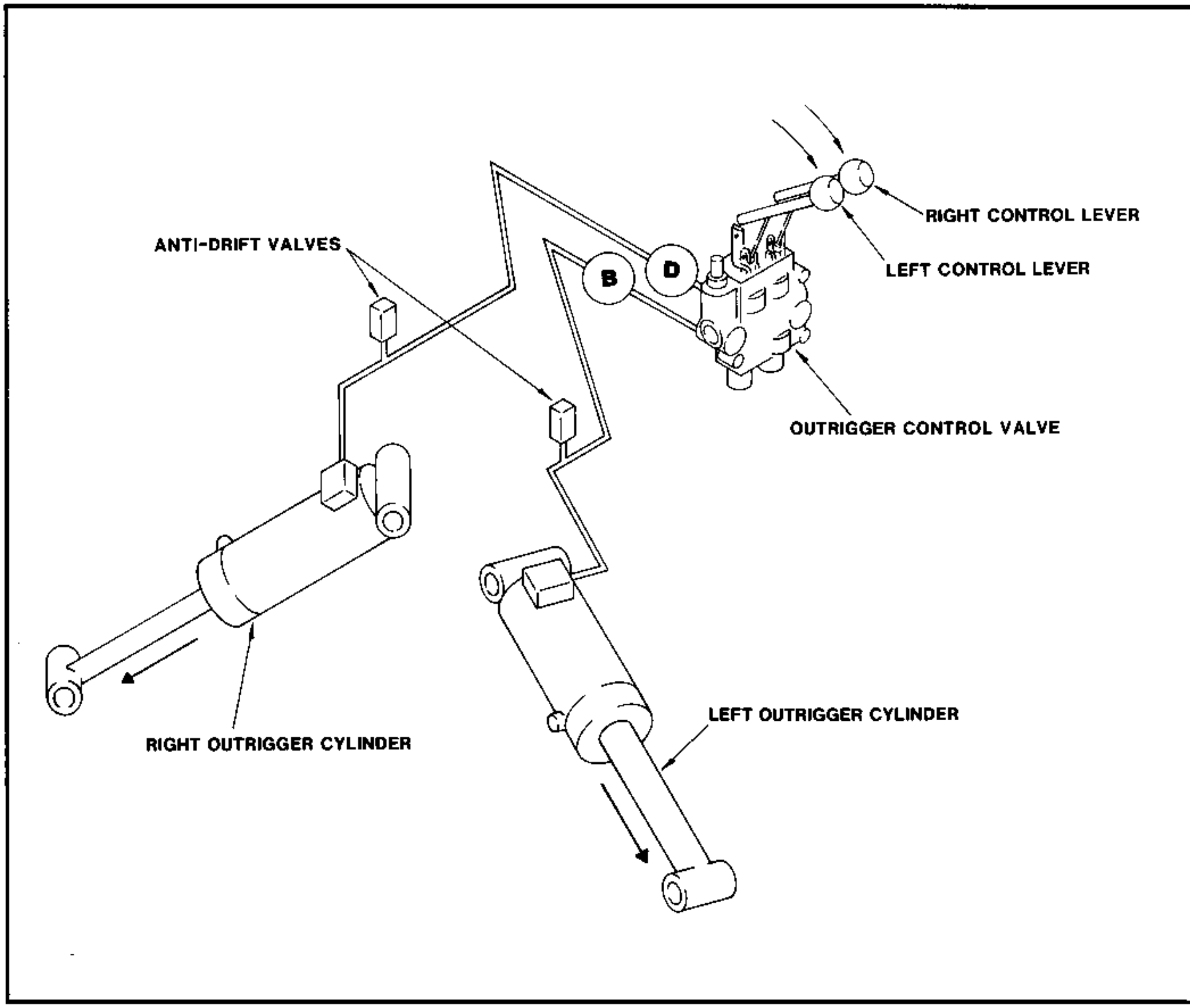


Figure 3-43 Flow Diagram - Outrigger Lowering

DIRECTIONAL CONTROL VALVES

FOUR-SPOOL VALVE (MODELS 644, 844)

DESCRIPTION (Figure 3-44)

The four-spool valve is a Gresen Model V20-410A which is located to the right of the operator's seat in the cab. It is a four way, three position, open center type, with each spool controlled by a separate control handle.

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 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 (Item 1) controls the machine frame tilt: Moving the handle forward will tilt the machine to the right; moving the handle rearward will tilt the machine to the left. Handle (Item 2) controls fork tilt: Moving the handle forward will tilt the fork carriage forward; moving the handle rearward will tilt the fork carriage back. Handle (Item 3) controls the transfer carriage: Moving the handle forward will move the transfer carriage forward; moving the handle rearward will move the transfer carriage back. (See Figures 3-47 through 3-52.) Handle (Item 4) is for the control of any of several hydraulically controlled options available, or is otherwise a dead handle.

The valve incorporates an externally adjusted main relief valve and two externally adjusted work-port relief valves. The reliefs limit circuit pressure, protecting the circuits from excessive pressure. Hydraulic oil flow that exceeds the set pressure is routed to the hydraulic oil reservoir. The work-port reliefs also 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). Additionally, the work-port reliefs provide a relief for the carriage tilt circuit after the carriage tilt cylinders have reached their required working pressure.

ADJUSTING PRESSURE RELIEF

To adjust the pressure relief valves, follow the instructions under "Checking and Adjusting Circuit Pressure" on page 3.8-1 of this section.

REMOVAL (Figure 3-45)

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. 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 connected to the valve. Cap the lines.

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

5. Remove the valve from the machine.

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.

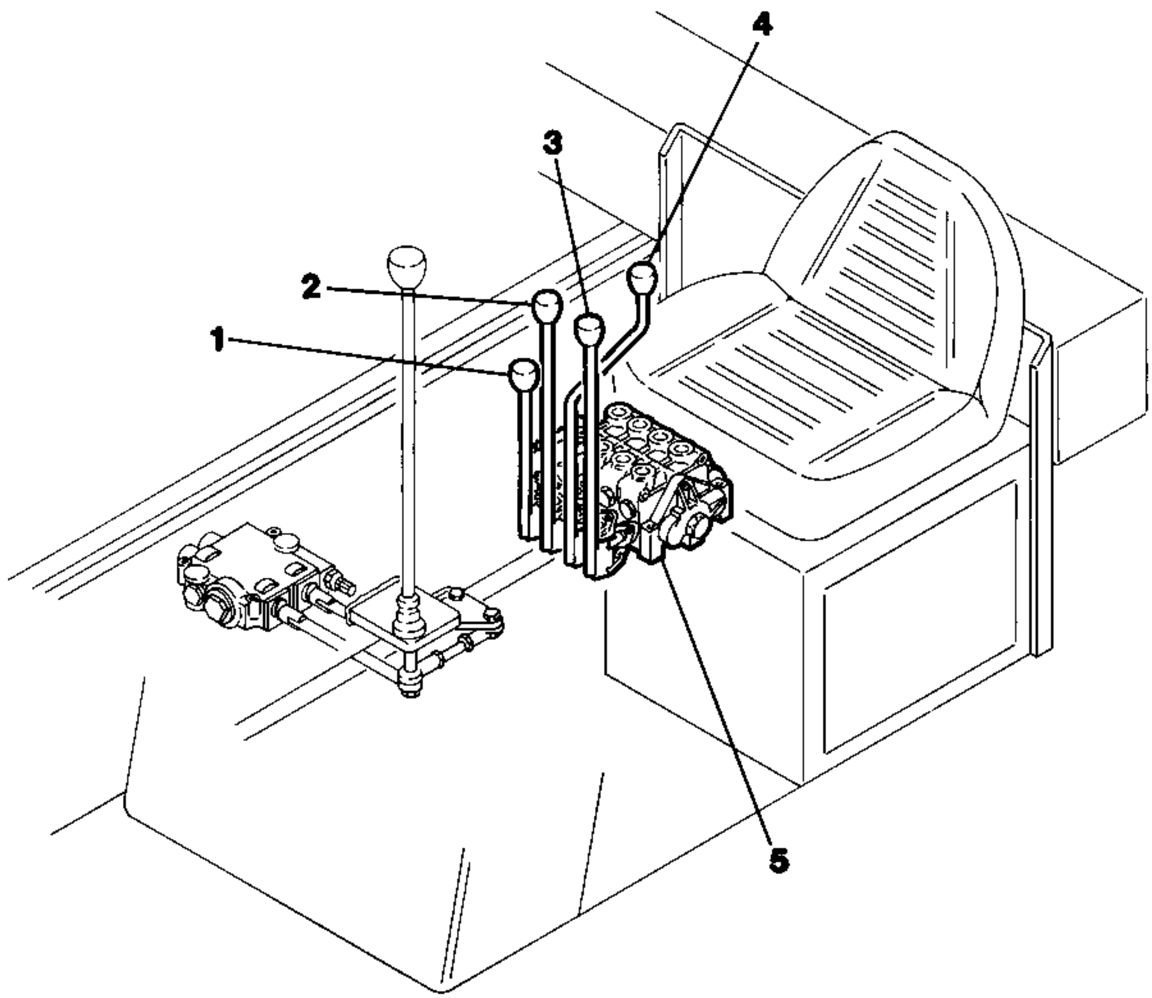
WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

OVERHAUL (Figure 3-46)

Refer to "Overhaul" on page 3.28-1 for valve overhaul procedures. When assembling valve, tighten bolts (Items 36 & 37) to 29 - 35 FT/LBS.

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)



1 - Frame Tilt
2 - Fork Tilt
3 - Transfer Carriage
4 - Auxiliary
5 - Valve

Figure 3-44 Four Spool Valve Arrangement

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)

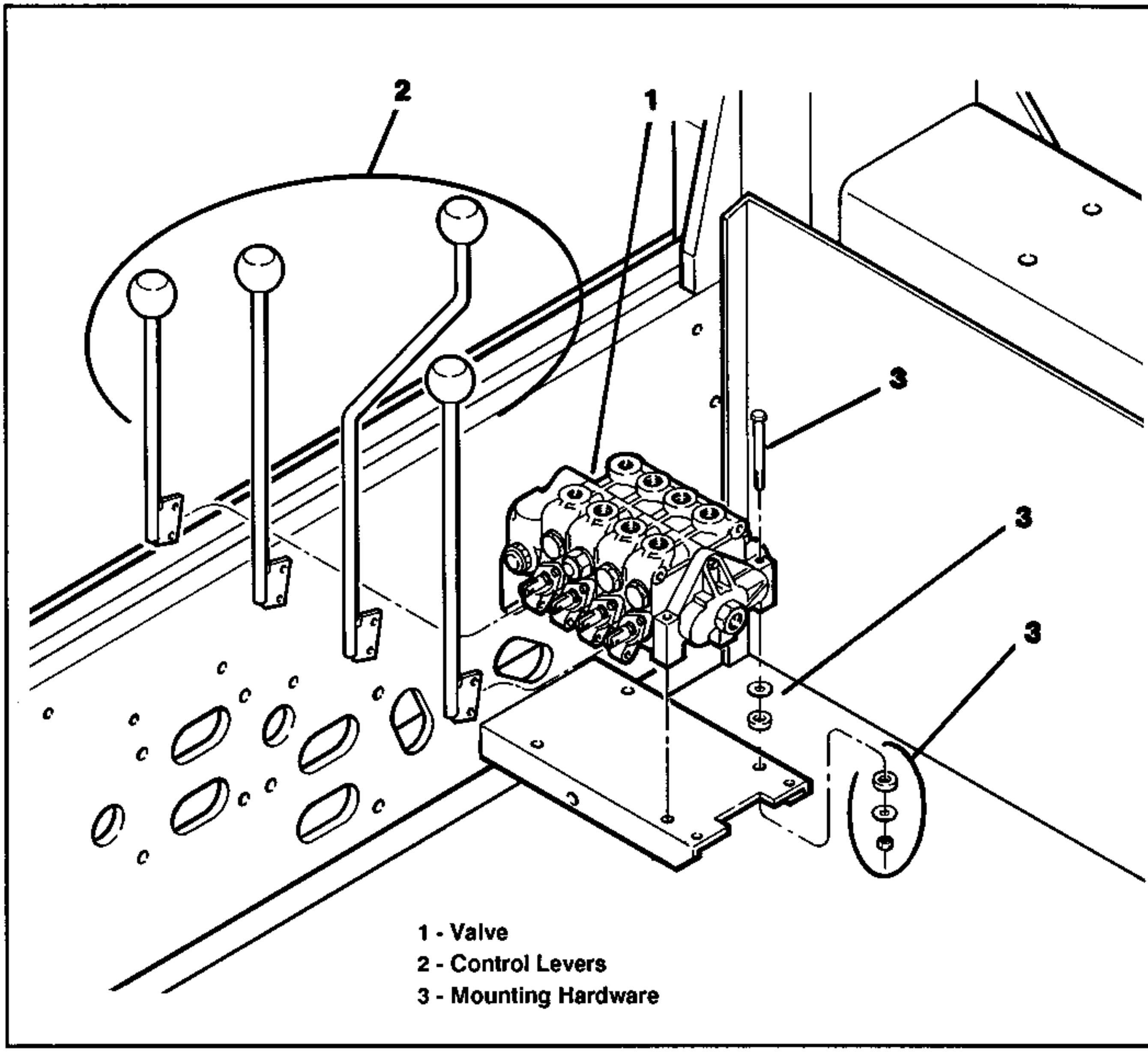


Figure 3-45 Four Spool Valve Removal

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)

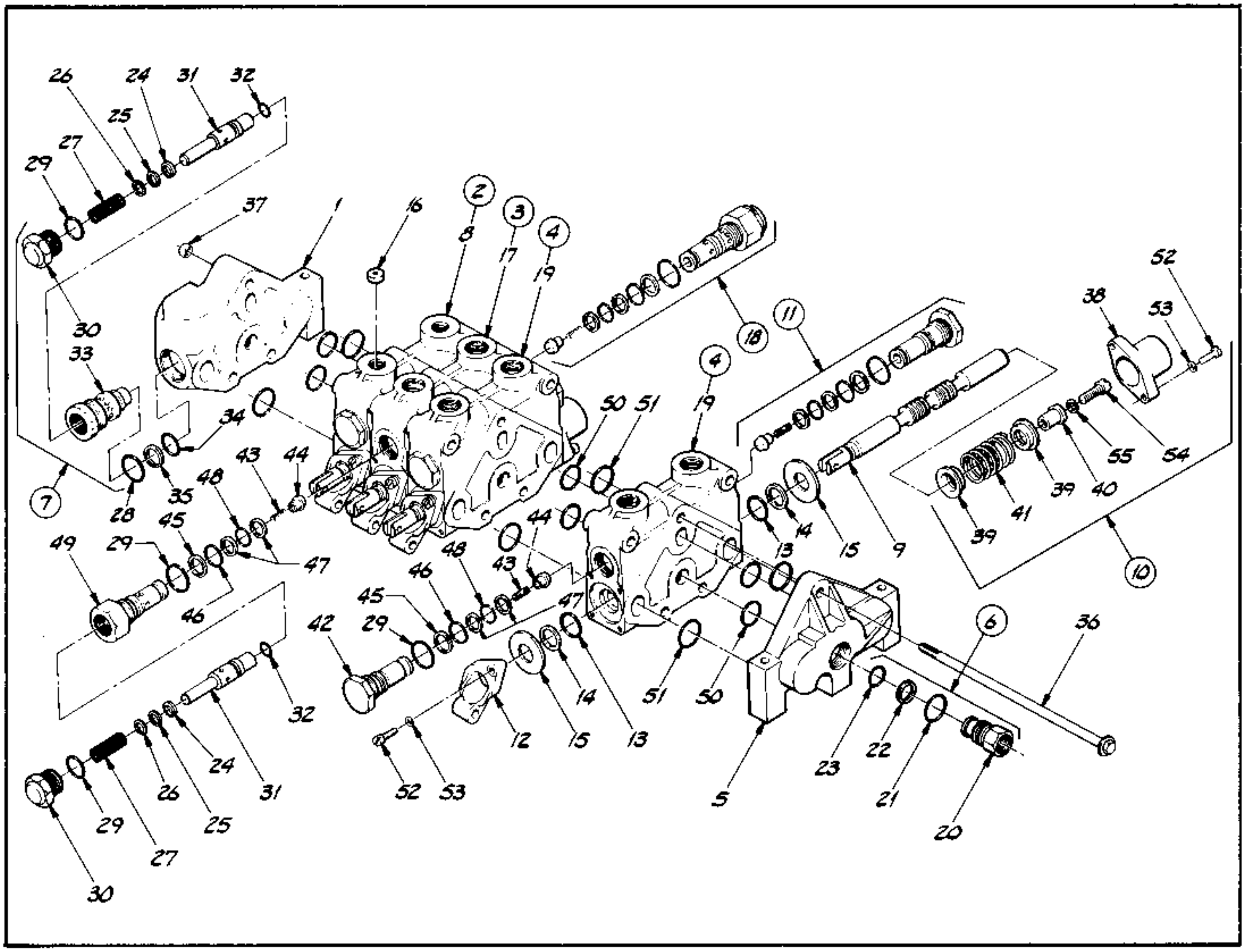


Figure 3-46 Four Spool Valve Disassembly (Five Spool Valve Similar)

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)

1 - Cover, Section	29 - Seal, O-Ring (10)
2 - Section Assembly, 4 Way	30 - Cap, Relief (3)
3 - Section Assembly, Tandem	31 - Poppet (Seal Incl.) (3)
4 - Section Assembly, 4 Way (2)	32 - Seal, Poppet (3)
5 - Cover, Section	33 - Body, Main Relief
6 - Power Beyond Assembly	34 - Seal, O-Ring
7 - Relief Assembly, Main	35 - Back-up Ring
8 - Housing, SAE #6 Port	36 - Bolt, Sections (3)
9 - Spool	37 - Locknut (3)
10 - Positioner Assembly (4)	38 - Bonnet, Positioner (4)
11 - Load Check Assembly (6)	39 - Collar, Spring (8)
12 - Link, Handle Mount (4)	40 - Seat, Capscrew (4)
13 - Seal, O-Ring (8)	41 - Spring, Positioner (4)
14 - Back-up Ring (8)	42 - Plug, Load Check (6)
15 - Seal, Retainer Plate (8)	43 - Spring, Load Check (8)
16 - Orifice Plate (2)	44 - Poppet (8)
17 - Housing, Tandem	45 - Back-up Ring (8)
18 - Relief Assembly (2)	46 - Seal, O-Ring (8)
19 - Housing, SAE #8 Port (2)	47 - Back-up Ring (16)
20 - Sleeve, Power Beyond	48 - Seal, O-Ring (8)
21 - Seal, O-Ring	49 - Body, Relief (2)
22 - Back-up Ring	50 - Seal, O-Ring (10)
23 - Seal, O-Ring	51 - Seal, O-Ring (10)
24 - Shim, .50" x .0418"	52 - Capscrew, 1/4" x 7/8" (16)
25 - Shim, .50" x .0209"	53 - Lockwasher, 1/4" (16)
26 - Shim, .50" x .0097"	54 - Capscrew, 5/16" x 3/4" (4)
27 - Spring, Relief (3)	55 - Lockwasher, 5/16" (4)
28 - Seal, O-Ring	

Table 3-8 Material List for Figure 3-46

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)

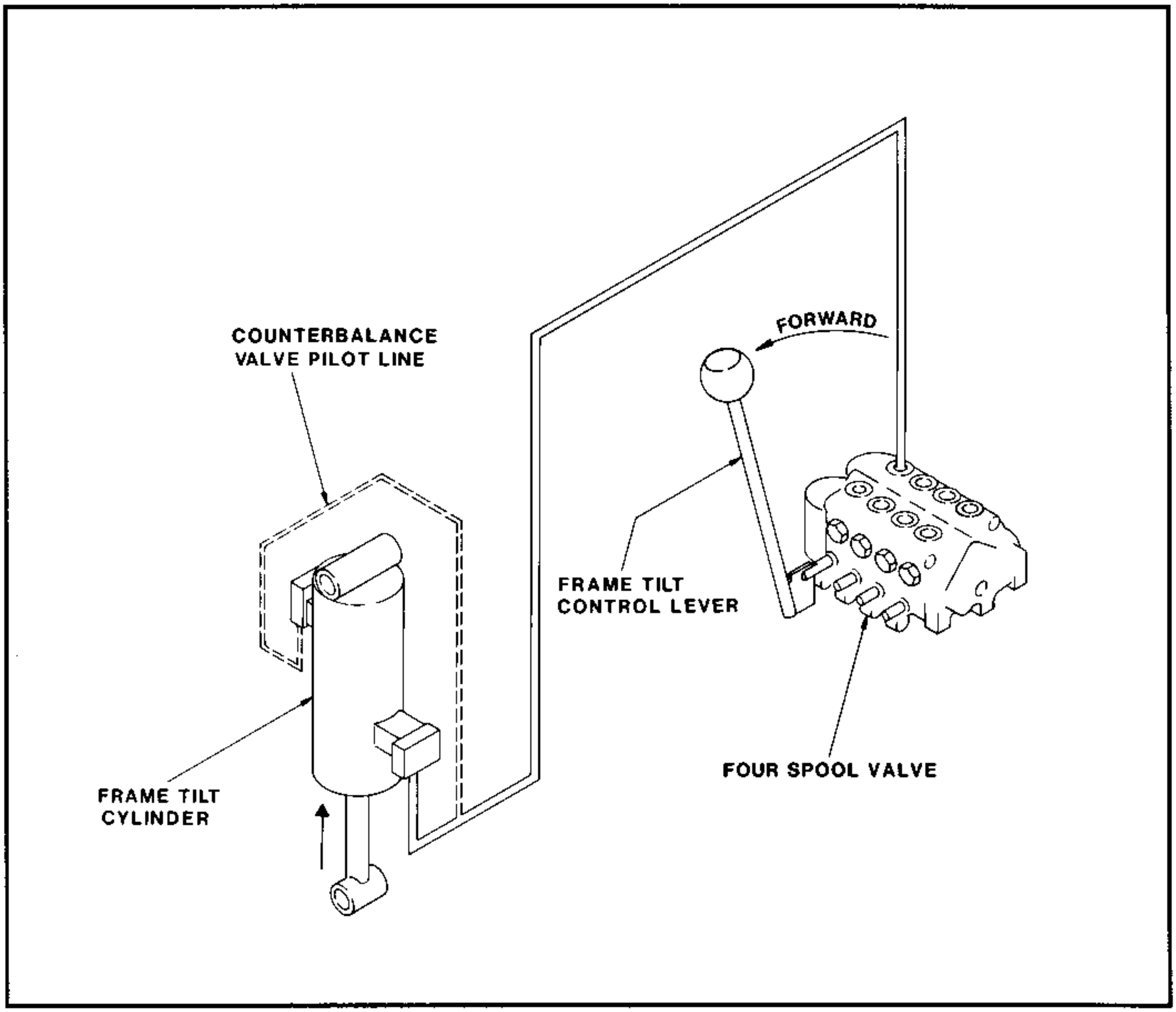


Figure 3-47 Flow Diagram - Frame Tilt Right

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)

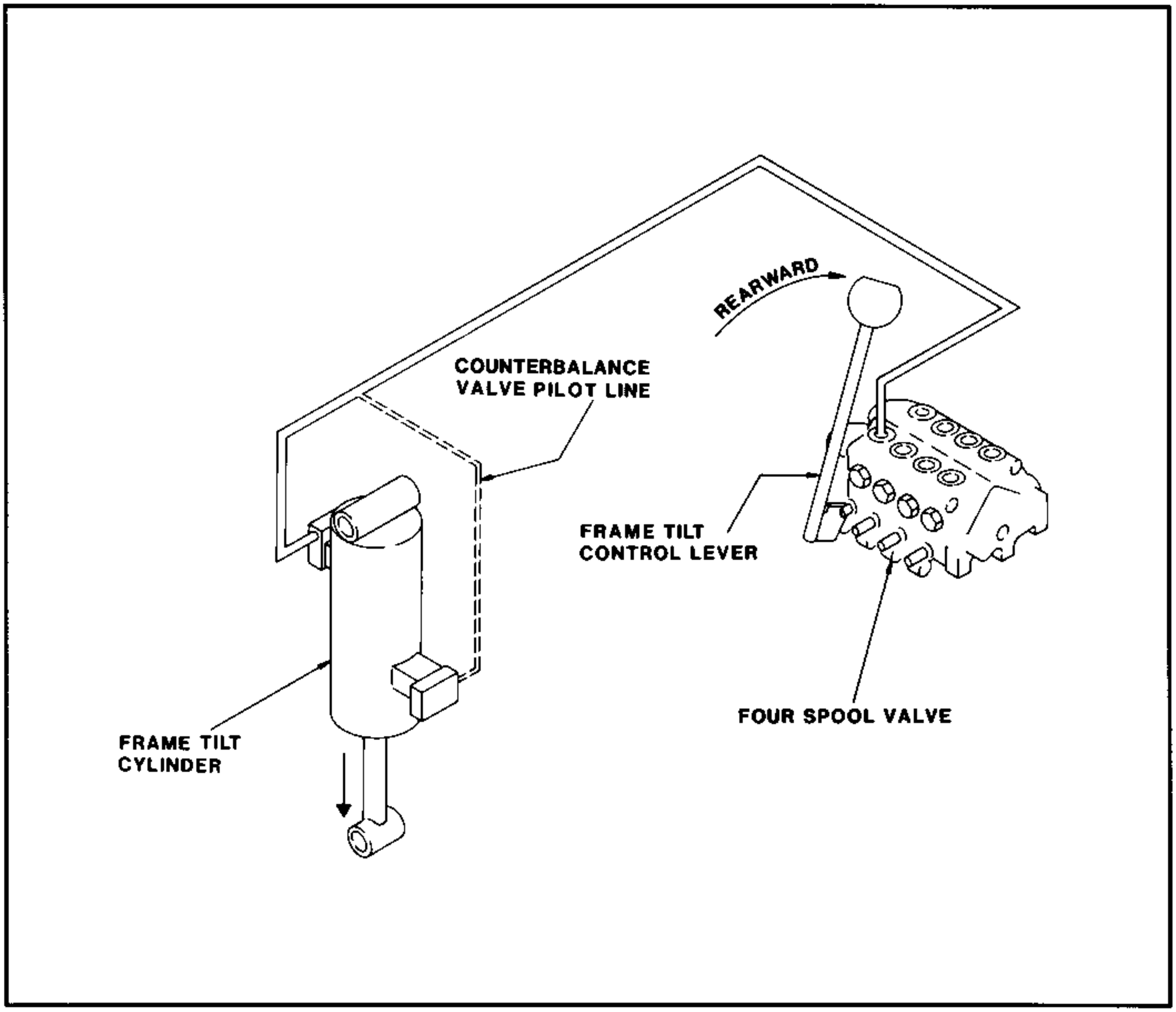


Figure 3-48 Flow Diagram - Frame Tilt Left

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)

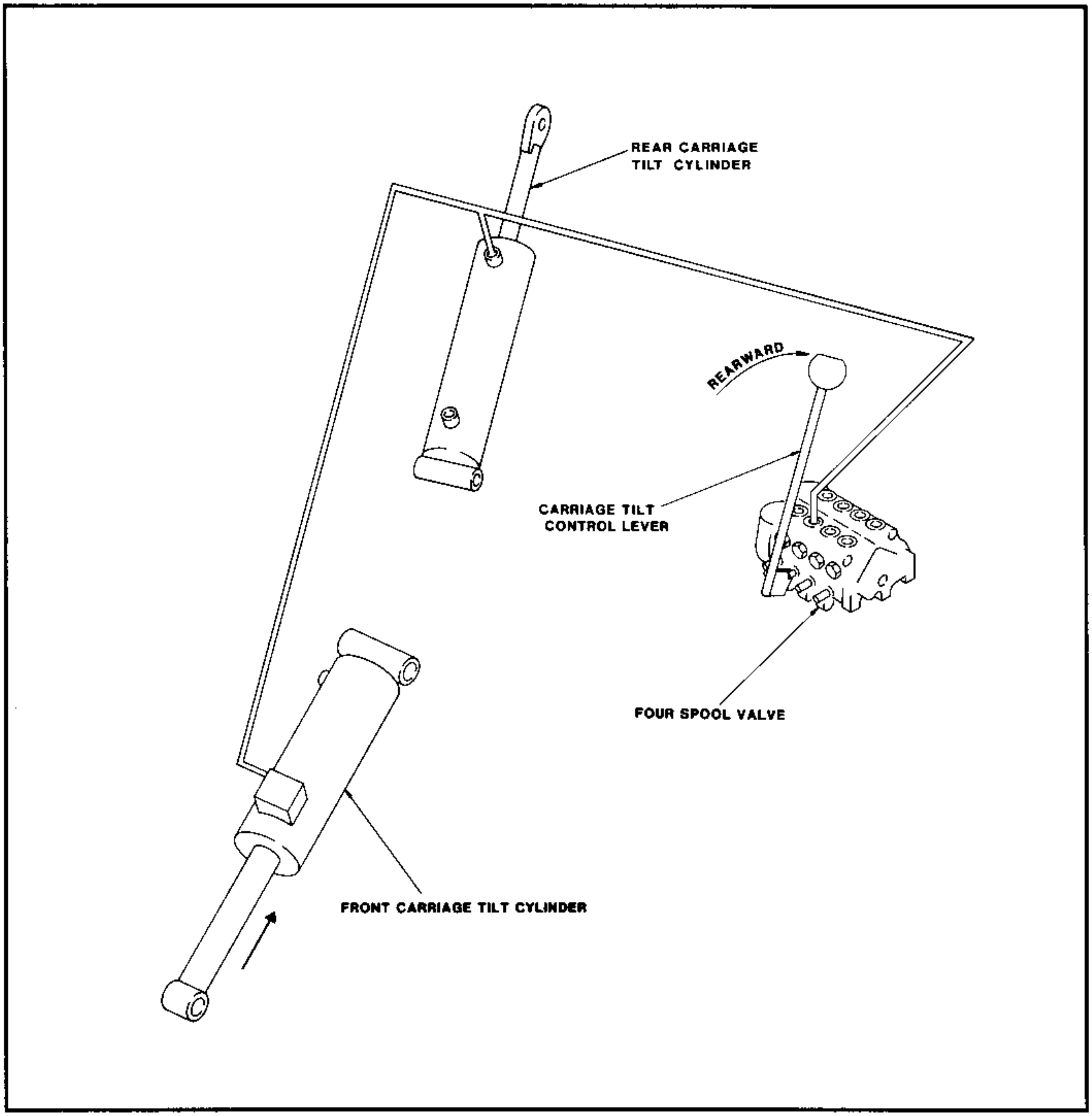


Figure 3-49 Flow Diagram - Carriage Tilt Up

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)

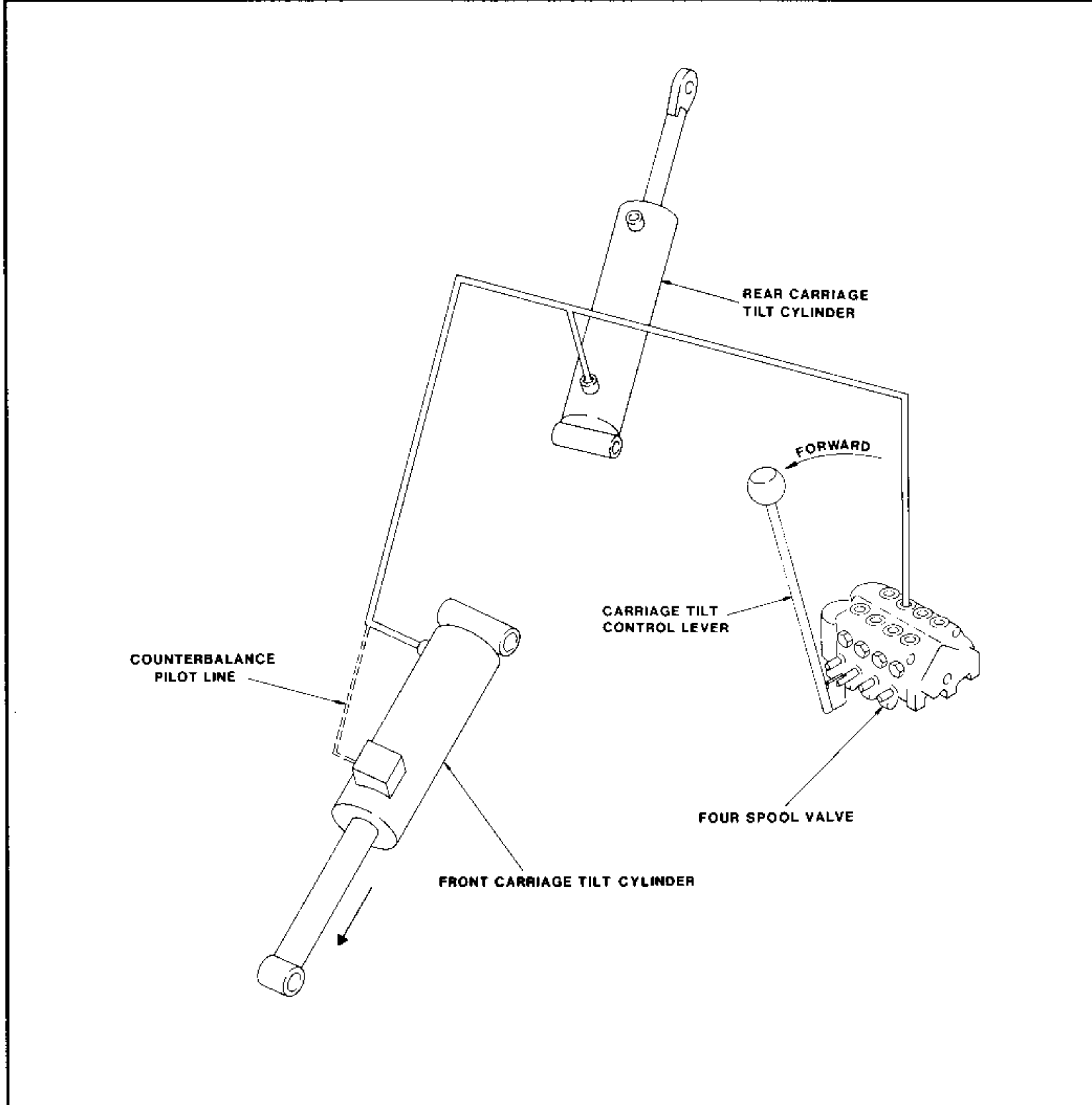


Figure 3-50 Flow Diagram - Carriage Tilt Down

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)

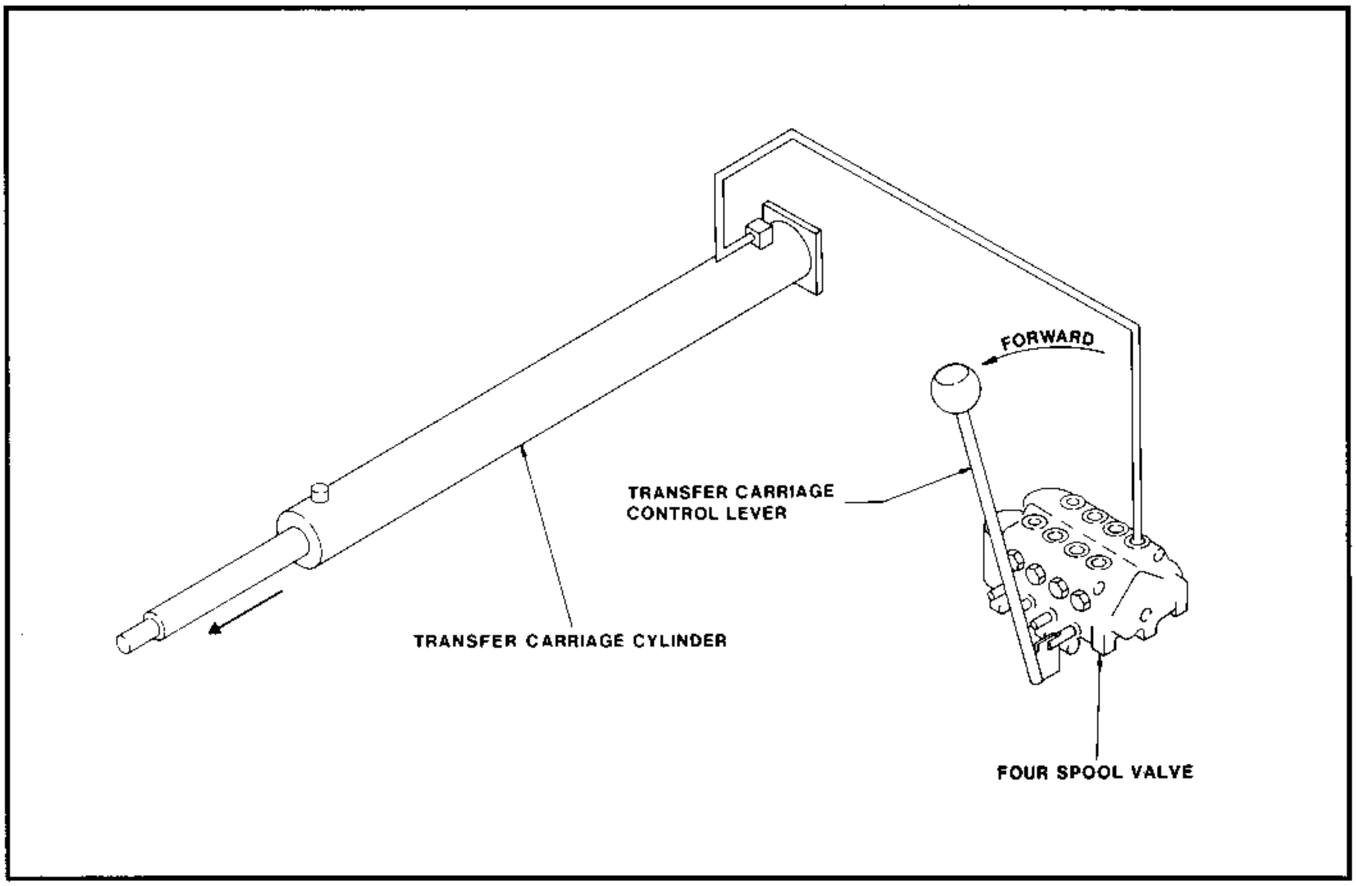


Figure 3-51 Flow Diagram - Transfer Carriage Extend

DIRECTIONAL CONTROL VALVES

FOUR SPOOL VALVE (MODELS 644, 844)(cont.)

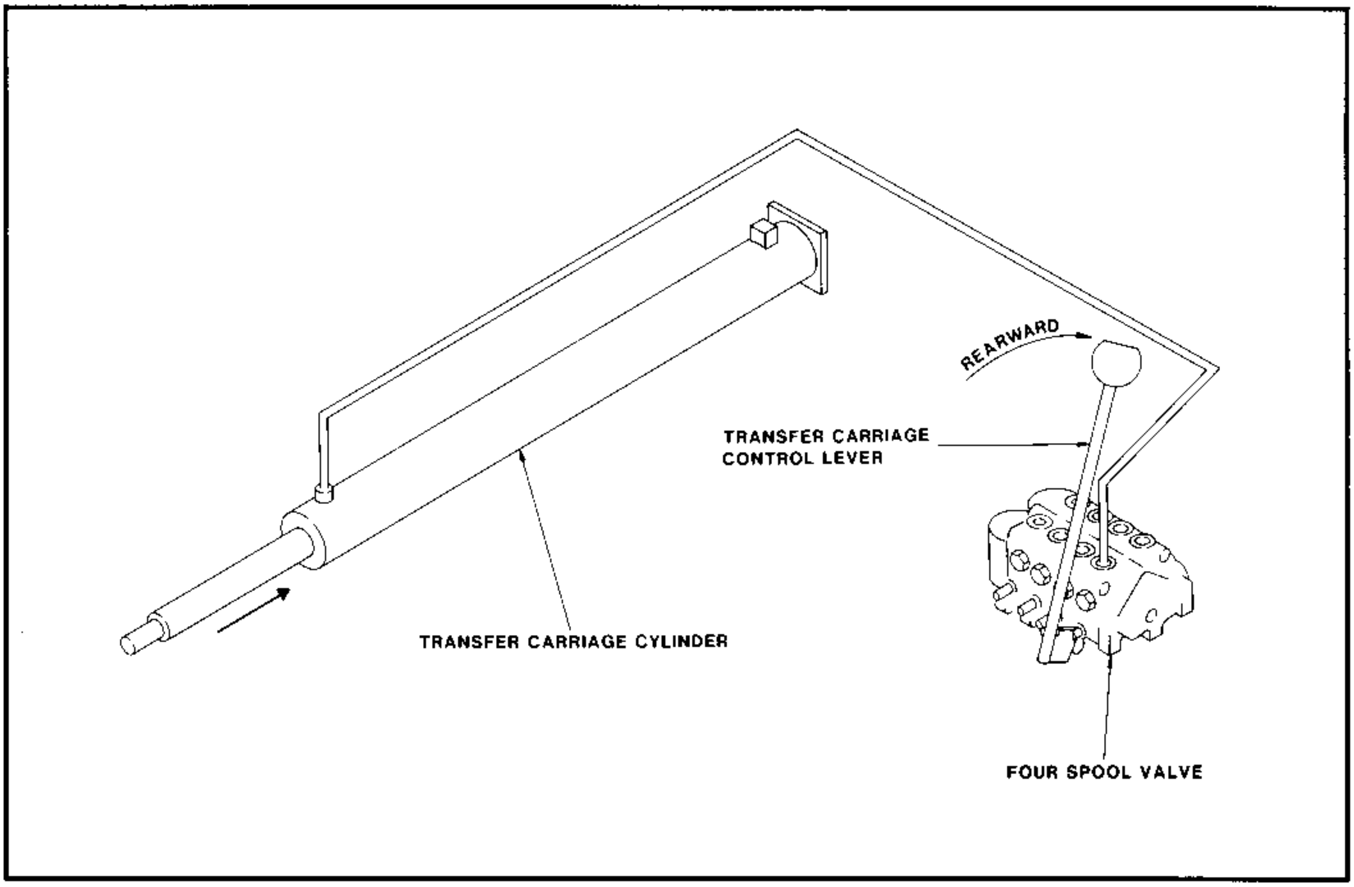


Figure 3-52 Flow Diagram - Transfer Carriage Retract

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE (MODEL 1044)(OPT. 644, 844)

DESCRIPTION (Figure 3-53)

The five-spool valve is a Gresen Model #V20-3784 (Model 1044) or Gresen Model #V20-2498 (Models 644, 844). The valve is located to the right of the operator's seat in the cab. It is a four way, three position, open center type, with each spool controlled by a separate control handle.

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 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 (Item 1) controls the machine frame tilt: Moving the handle forward will tilt the machine to the right; moving the handle rearward will tilt the machine to the left. Handle (Item 2) controls fork tilt: Moving the handle forward will tilt the fork carriage forward: Moving the handle rearward will tilt the fork carriage back. Handle (Item 3) controls the transfer carriage: Moving the handle forward will move the transfer carriage forward; moving the handle rearward will move the transfer carriage back. Handle (Item 4) is for auxiliary use only. Handle (Item 5) is the the quick attach feature and auxiliary (model 1044), or auxiliary only (Models 644, 844). (See Figures 3-55 through 3-64.) Auxiliary handles control any of several hydraulically actuated options available, or become otherwise dead handles.

The valve incorporates an externally adjusted main relief valve and two externally adjusted work-port relief valves. The reliefs limit circuit pressure, protecting the circuits from excessive pressure. Hydraulic oil flow that exceeds the set pressure is routed to the hydraulic oil reservoir. The work-port reliefs also 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). Additionally, the work-port reliefs provide a relief for the carriage tilt circuit after the carriage tilt cylinder's required pressure has been reached.

ADJUSTING PRESSURE RELIEF

To adjust the pressure relief valves, follow the instructions under "Checking and Adjusting Circuit Pressure" on page 3.8-1 of this section.

REMOVAL (Figure 3-54)

1. Lower the boom, apply the parking brake and stop the engine. Release all hyraulic 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 hydraulic lines connected to the valve. Cap the lines.

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

5. Remove the valve from the machine.

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.

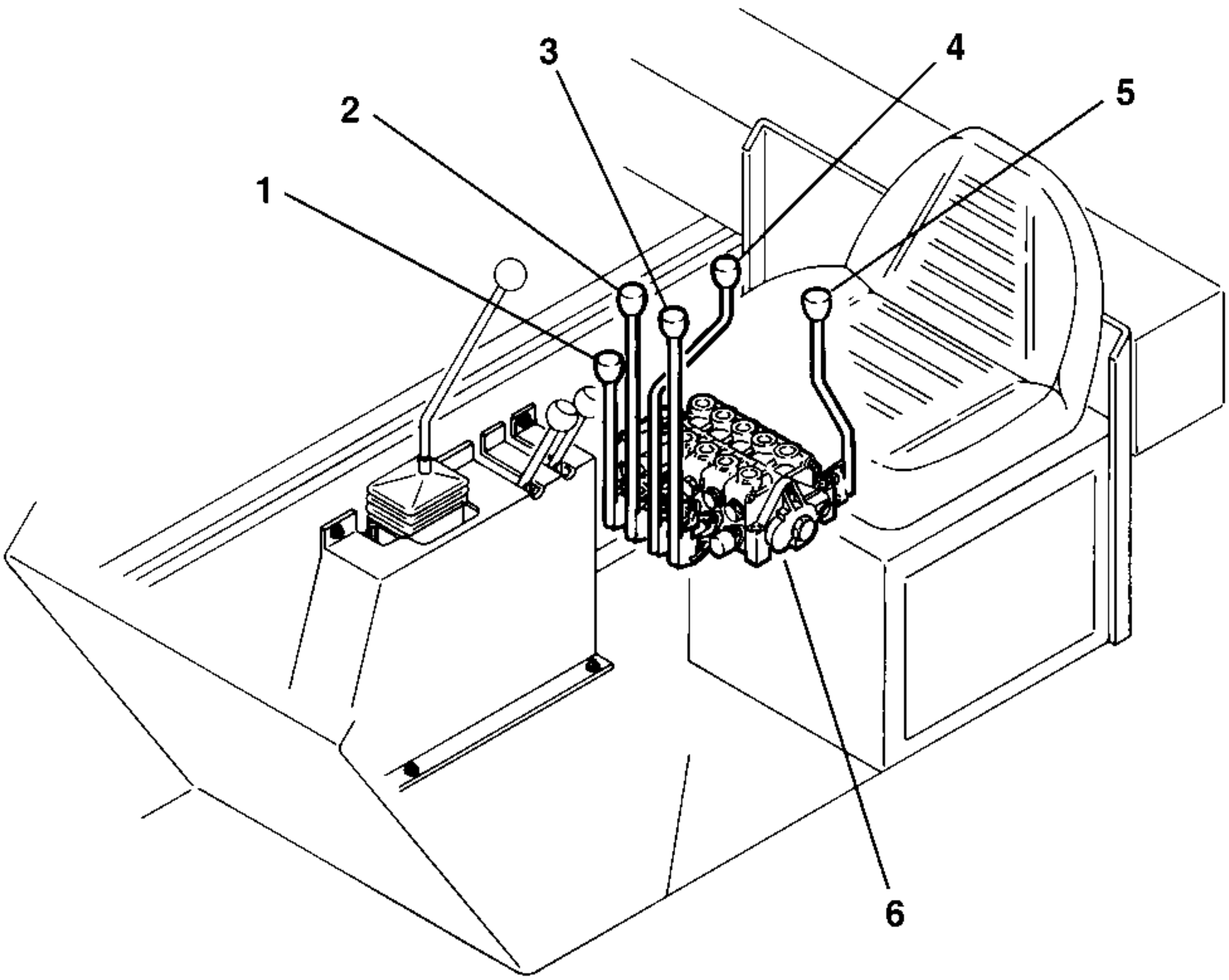
WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

OVERHAUL (Figure 3-46)

Refer to "Overhaul" on page 3.28-1 for valve overhaul procedures.

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

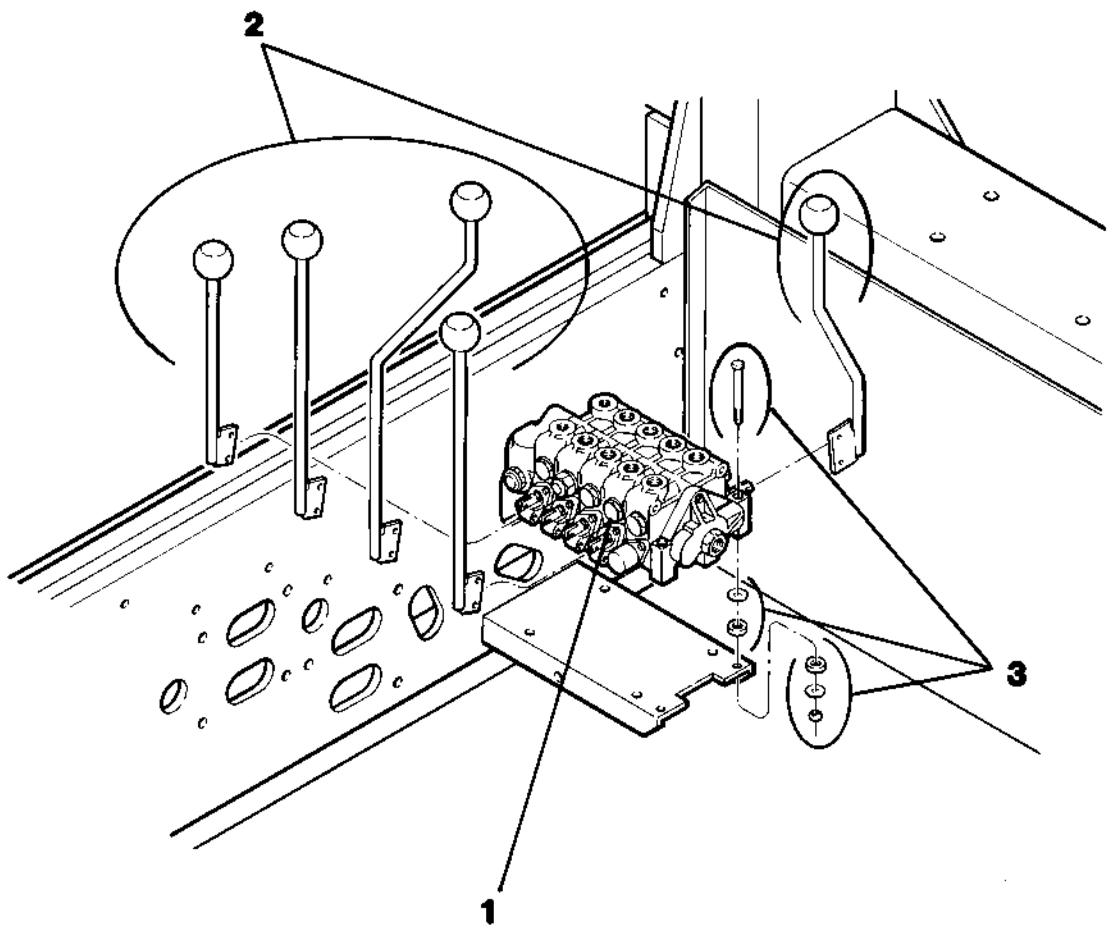


1 - Frame Tilt
2 - Fork Tilt
3 - Transfer Carriage
4 - Auxiliary
5 - Quick Attach/Auxiliary
6 - Valve

Figure 3-53 Five Spool Valve Arrangement

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)



1 - Valve
2 - Control Levers
3 - Mounting Hardware

Figure 3-54 Five Spool Valve Removal

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

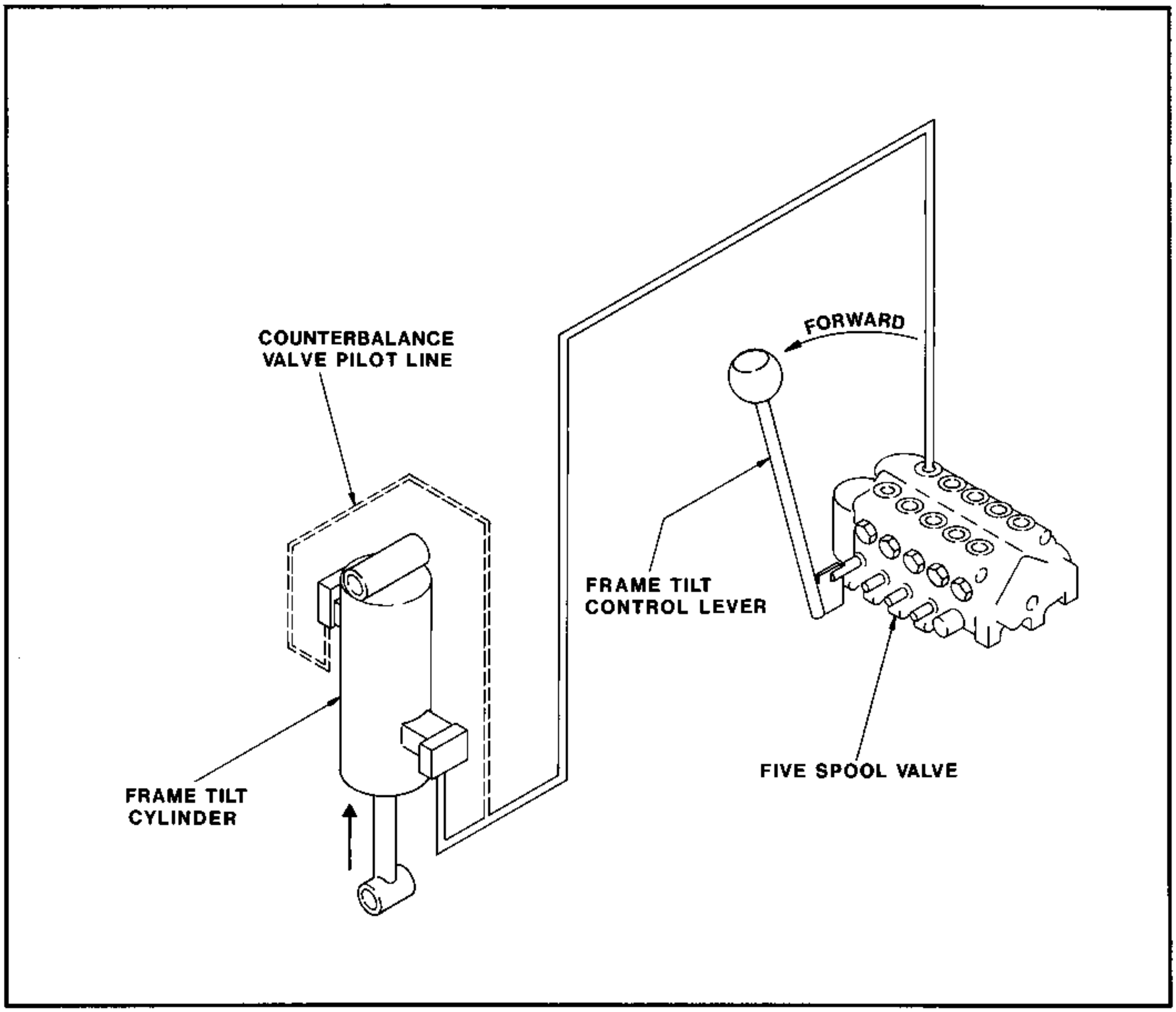


Figure 3-55 Flow Diagram - Frame Tilt Right

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

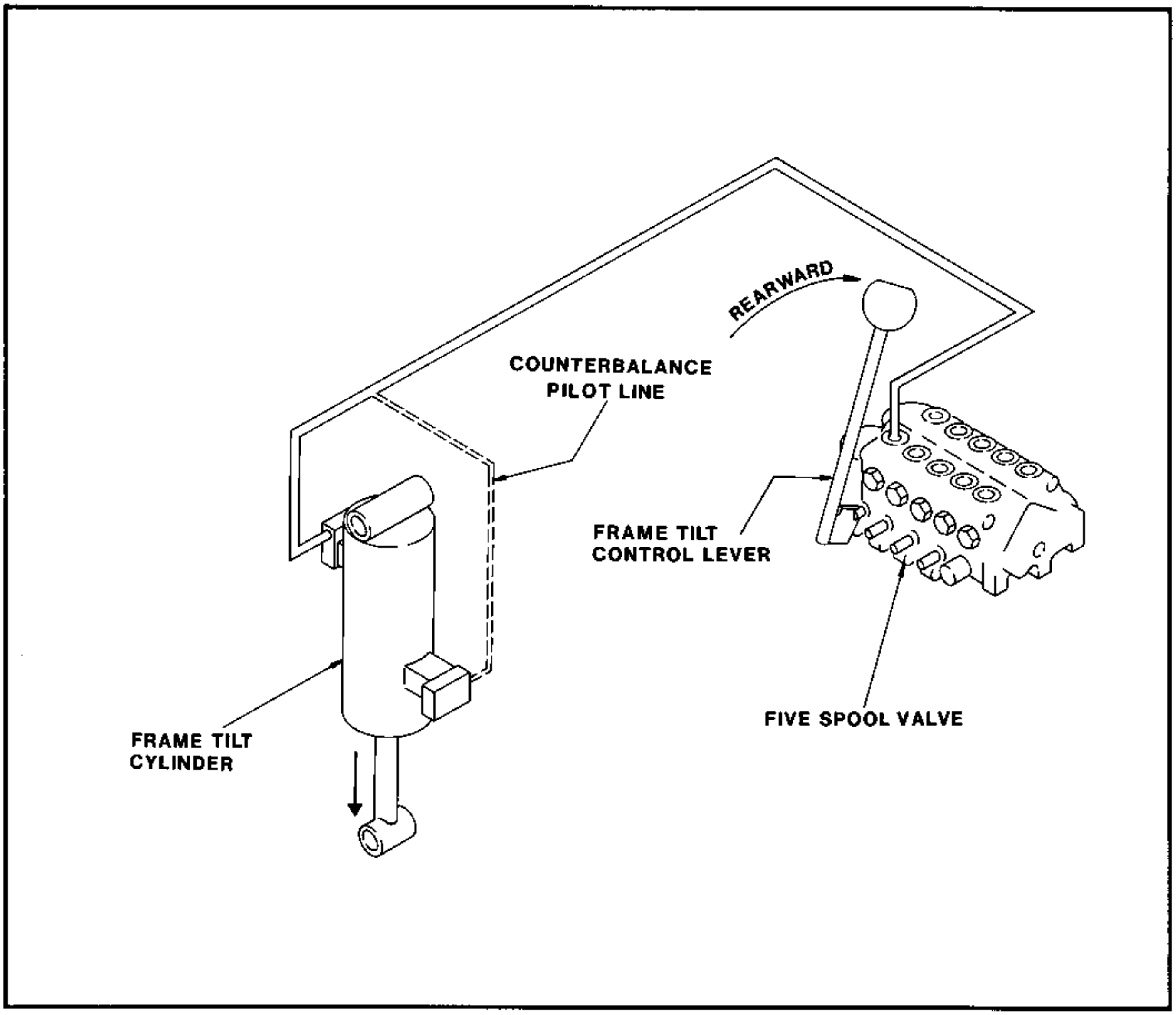


Figure 3-56 Flow Diagram - Frame Tilt Left

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE
(MODEL 1044)(OPT. 644, 844)(cont.)

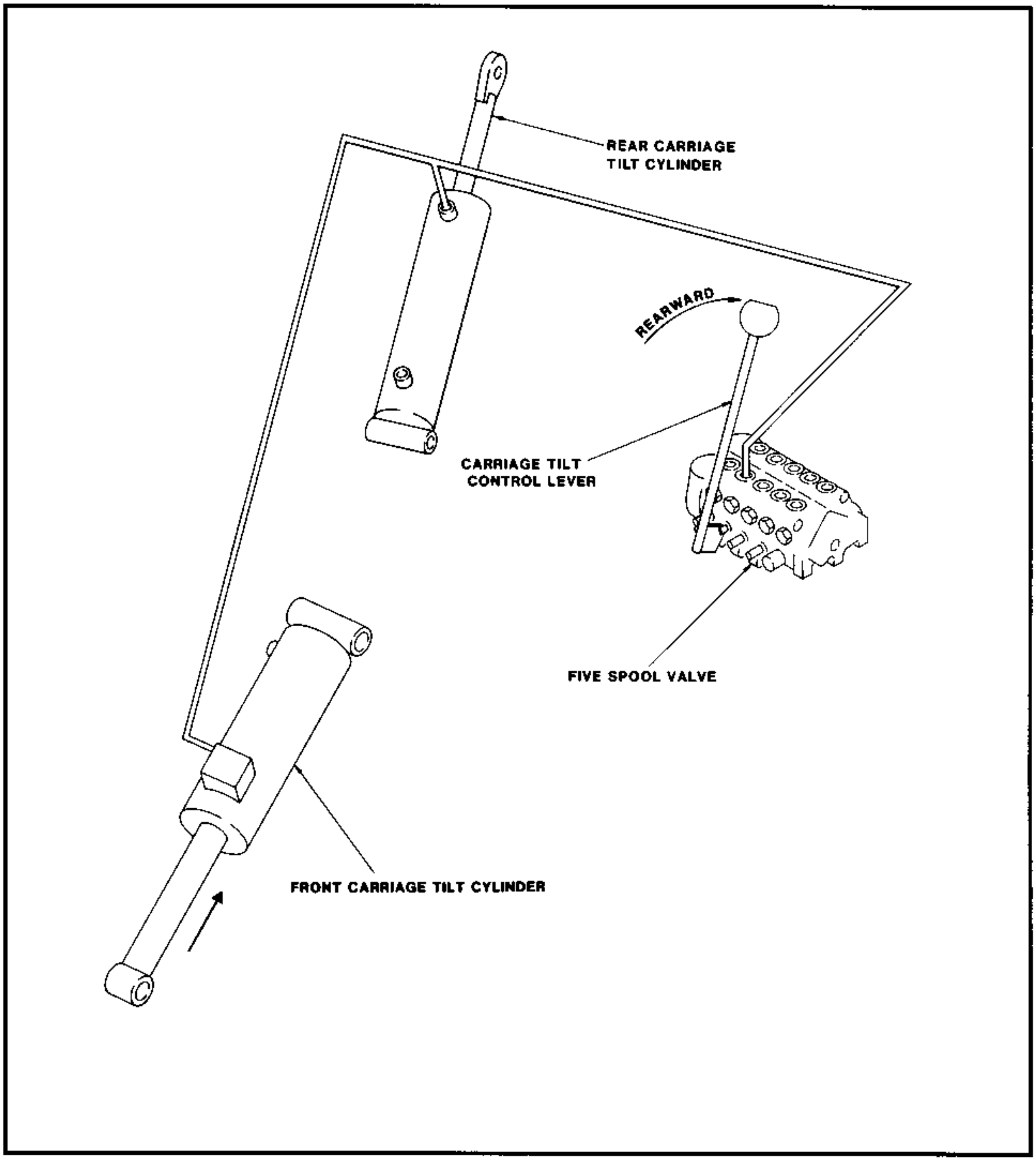


Figure 3-57 Flow Diagram - Carriage Tilt Up (644, 844 only)

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

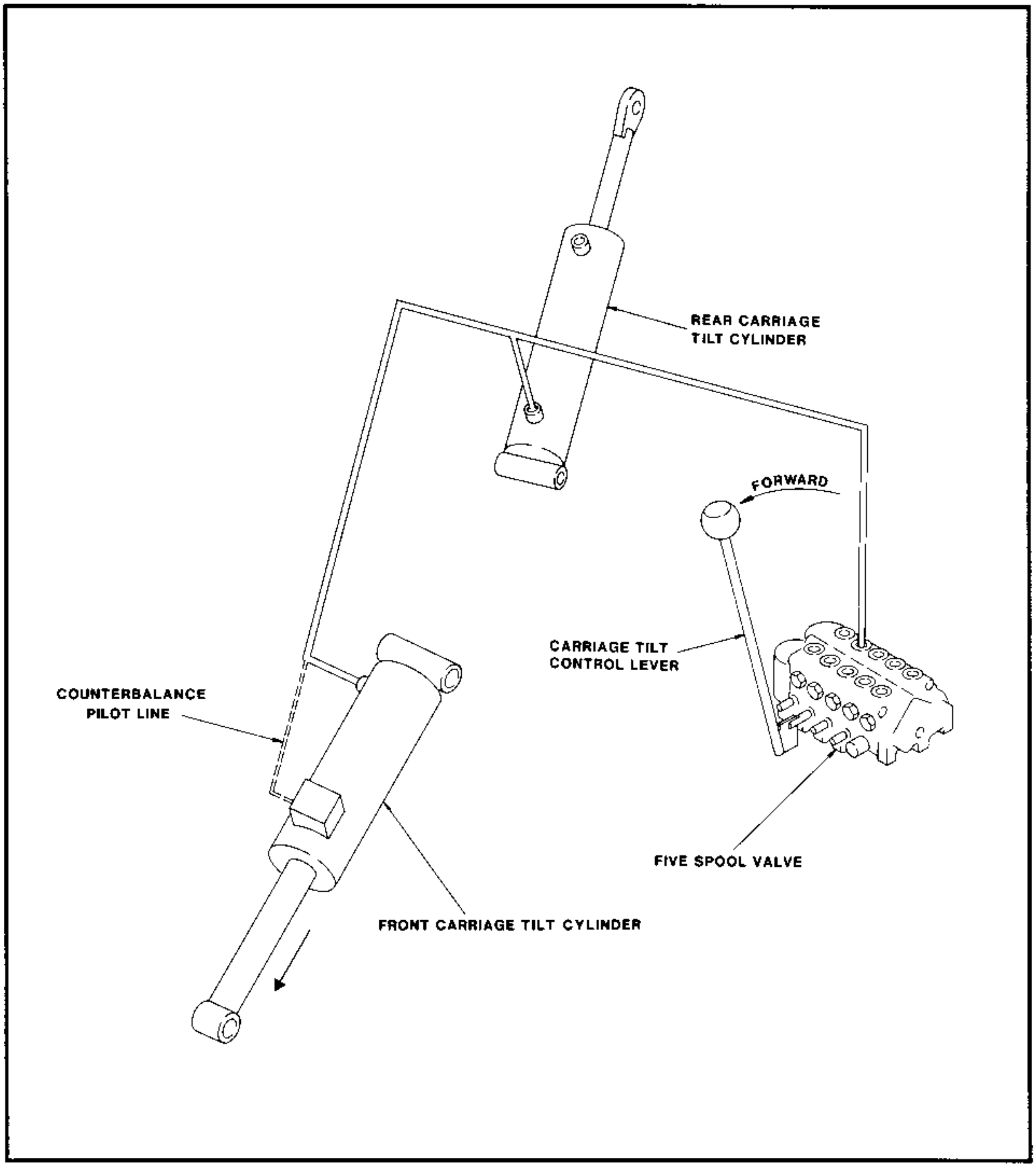


Figure 3-58 Flow Diagram - Carriage Tilt Down (644, 844 only)

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE
(MODEL 1044)(OPT. 644, 844)(cont.)

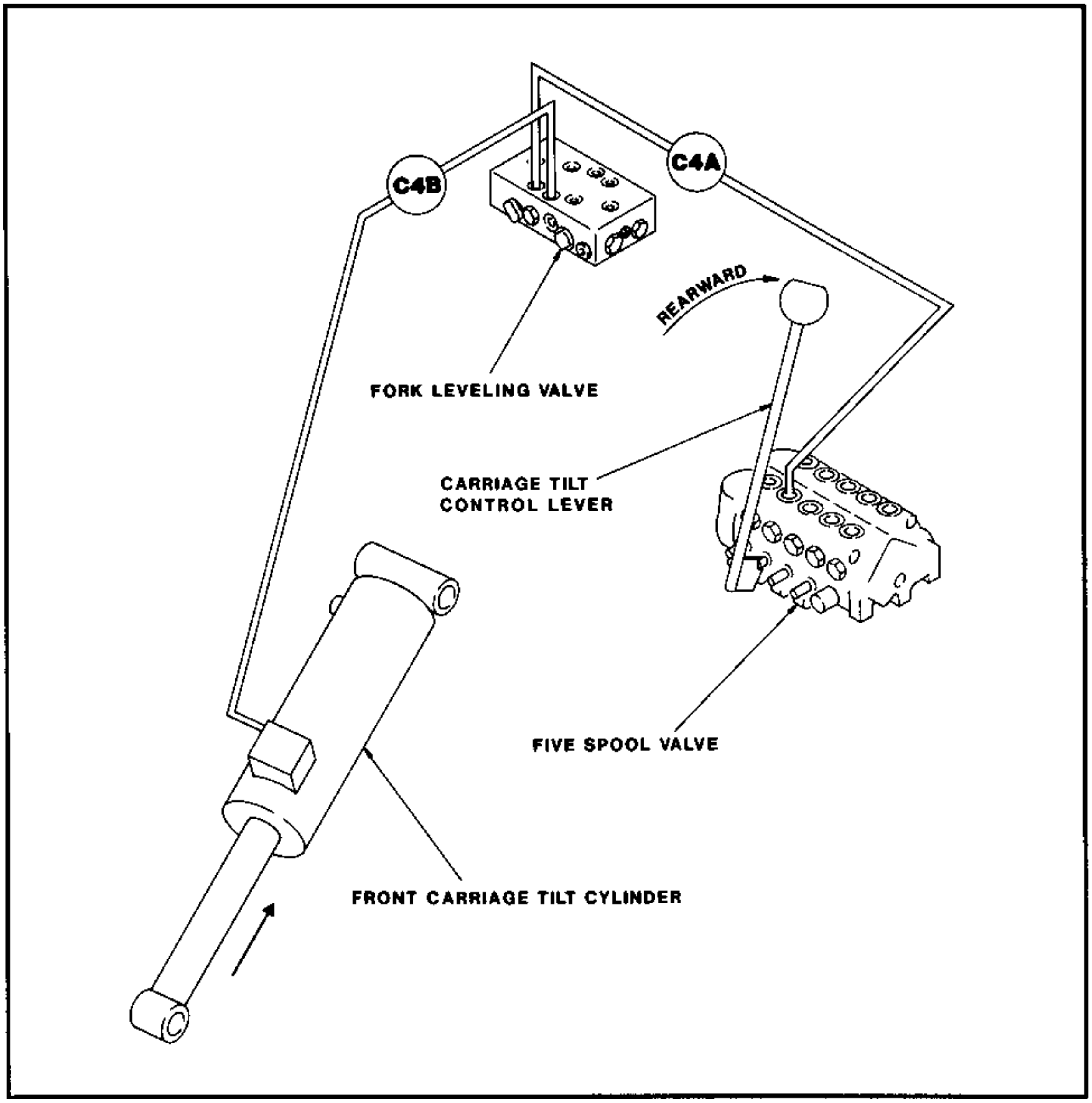


Figure 3-59 Flow Diagram - Carriage Tilt Up (1044 only)

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

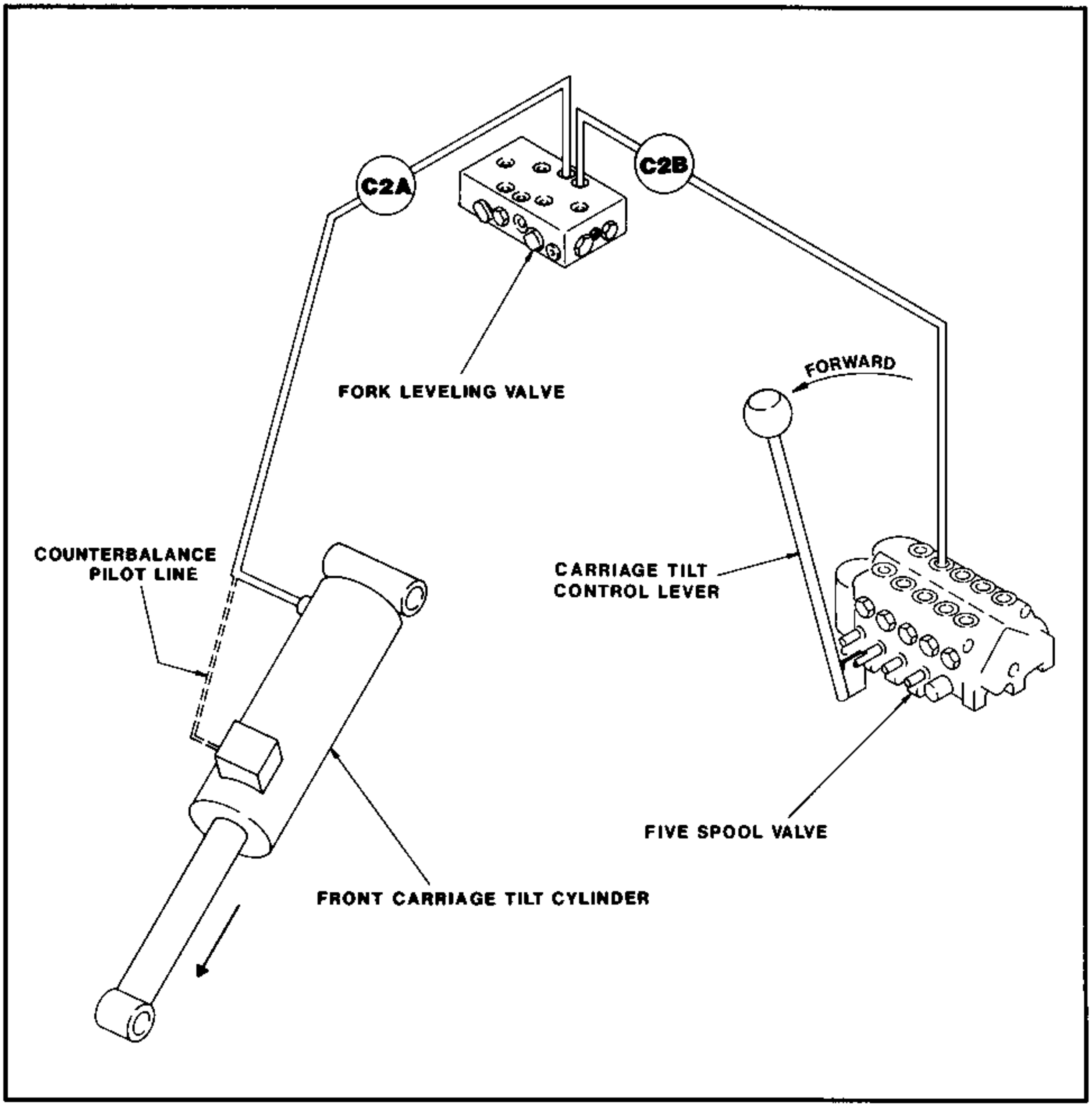


Figure 3-60 Flow Diagram - Carriage Tilt Down (1044 only)

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE
(MODEL 1044)(OPT. 644, 844)(cont.)

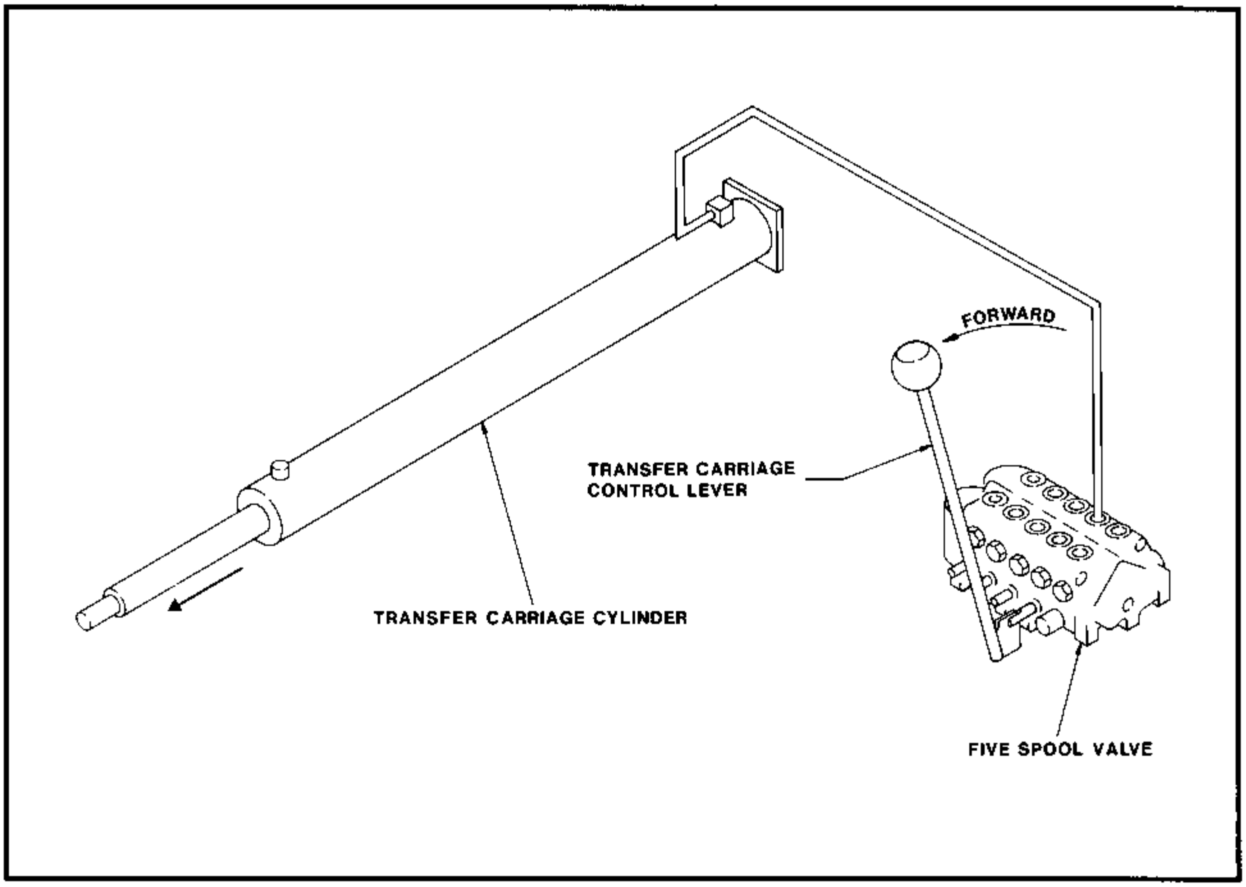


Figure 3-61 Flow Diagram - Transfer Carriage Extend

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

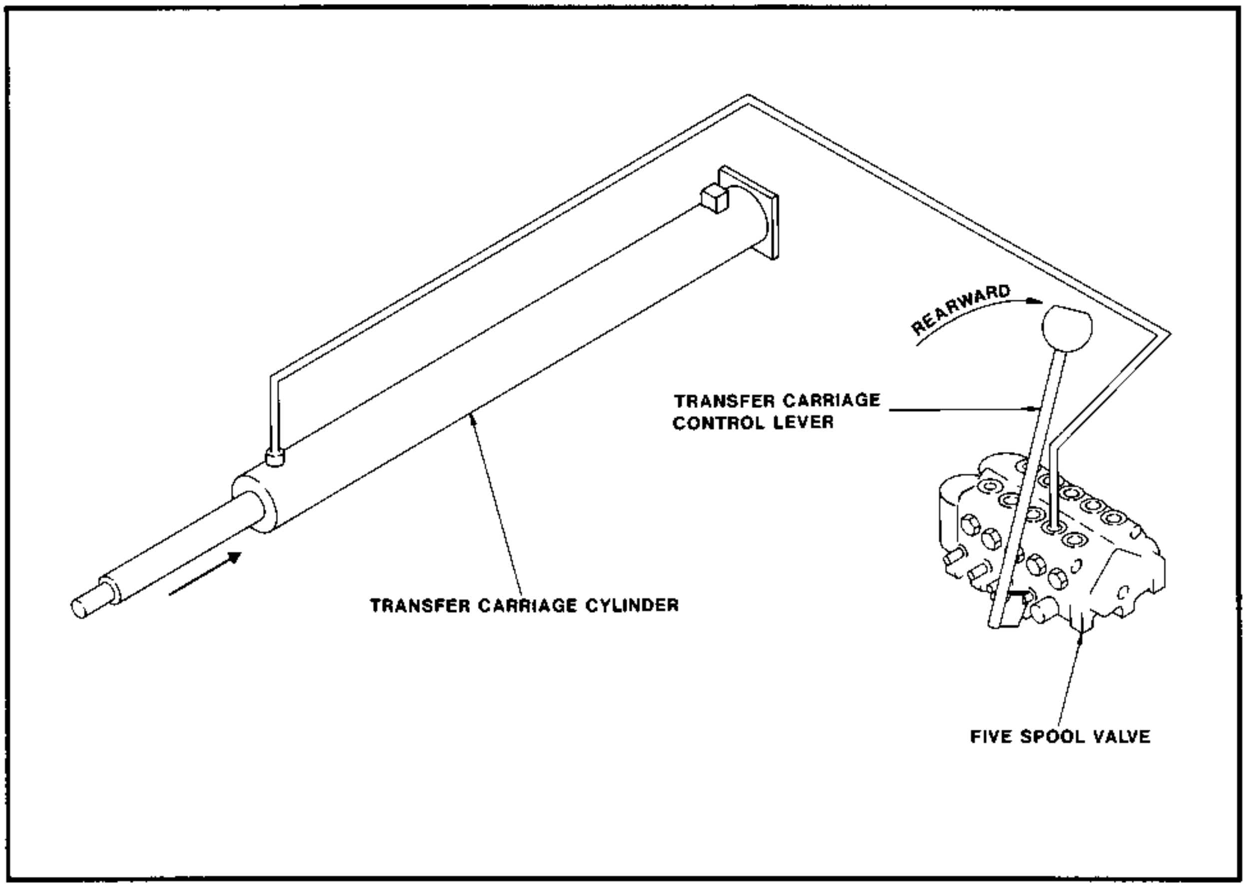


Figure 3-62 Flow Diagram - Transfer Carriage Retract

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE
(MODEL 1044)(OPT. 644, 844)(cont.)

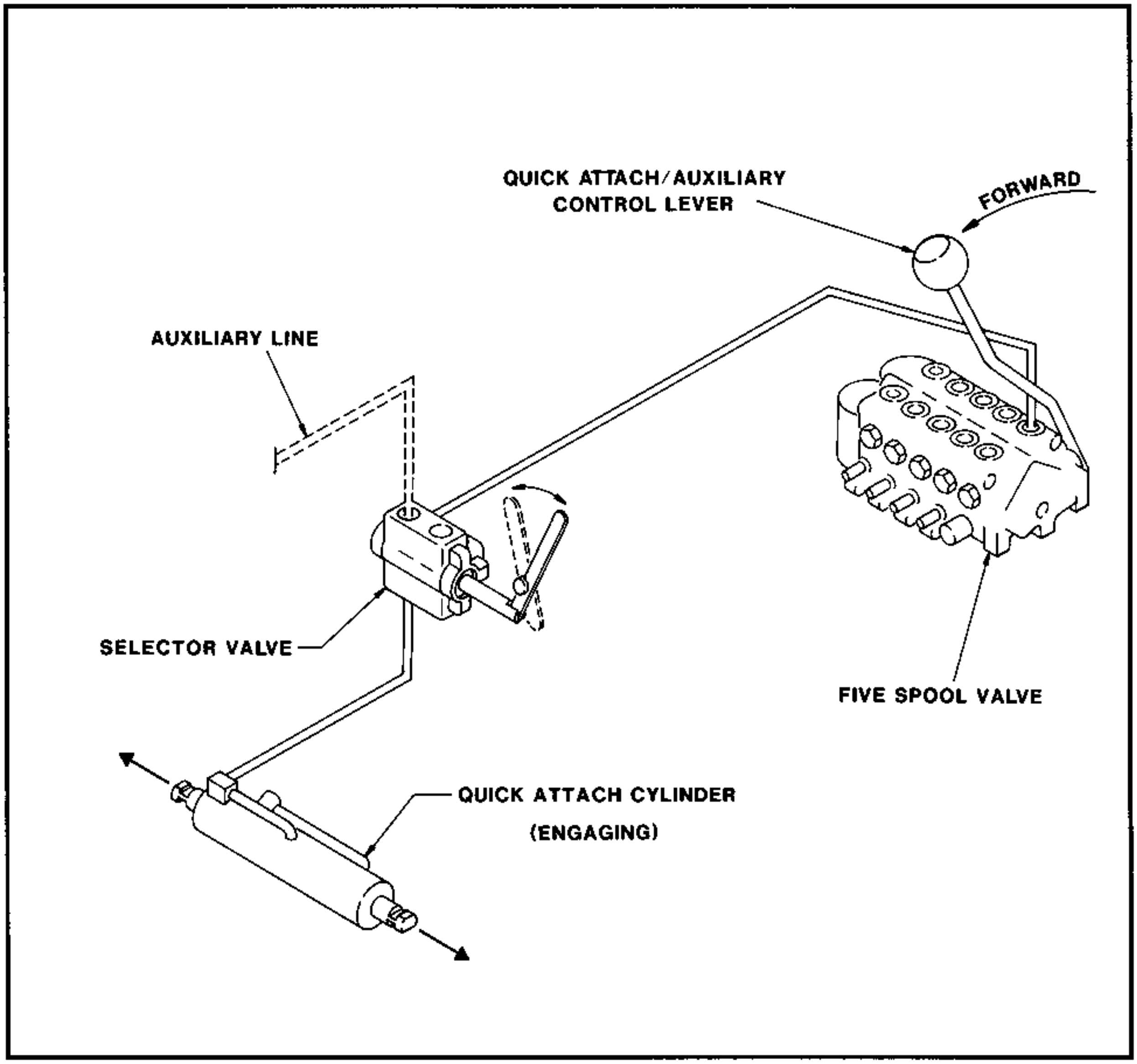


Figure 3-63 Flow Diagram - Quick Attach Engage (1044 only)

DIRECTIONAL CONTROL VALVES

FIVE SPOOL VALVE (MODEL 1044)(OPT. 644, 844)(cont.)

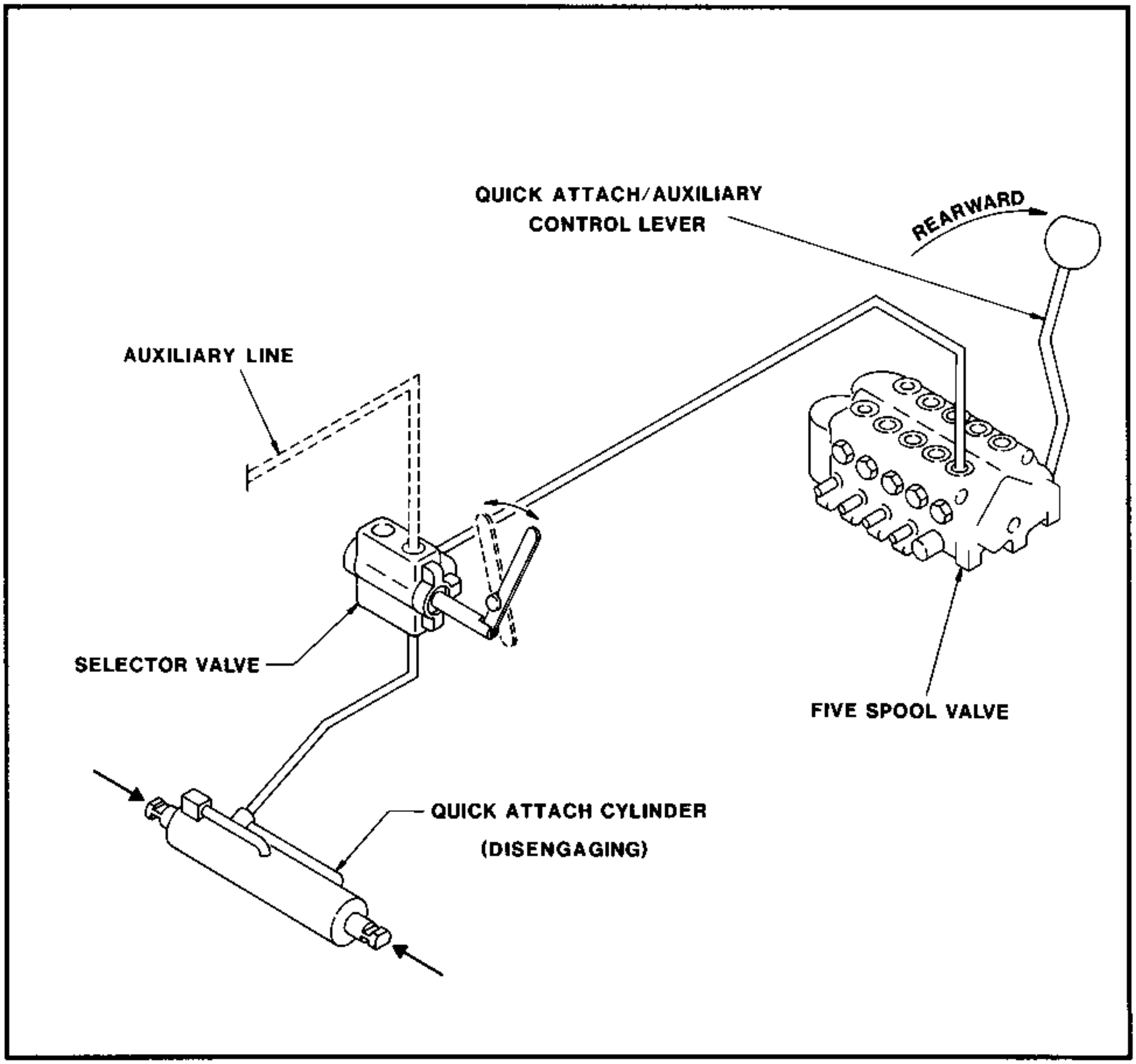


Figure 3-64 Flow Diagram - Quick Attach Release (1044 only)

DIRECTIONAL CONTROL VALVES

ATTACHMENT SELECTOR VALVE (MODEL 1044)

DESCRIPTION

The attachment selector valve is a Gresen Model DS-12, modified for mounting to the boom nose cone. It is a two-position valve which directs hydraulic flow from the quick attach/auxiliary spool of the five spool valve to either of two circuits, quick attach or auxiliary.

REMOVAL (Figure 3-65)

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. 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 cotter pin and pin, separating the handle from the valve.

5. Remove the two mounting bolts, lockwashers and nuts.

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

INSTALLATION

1. Reverse steps 3 through 6 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 3-66)

Refer to "Overhaul" on page 2.28-1 for valve overhaul procedures.

DIRECTIONAL CONTROL VALVES

ATTACHMENT SELECTOR VALVE (MODEL 1044)(cont.)

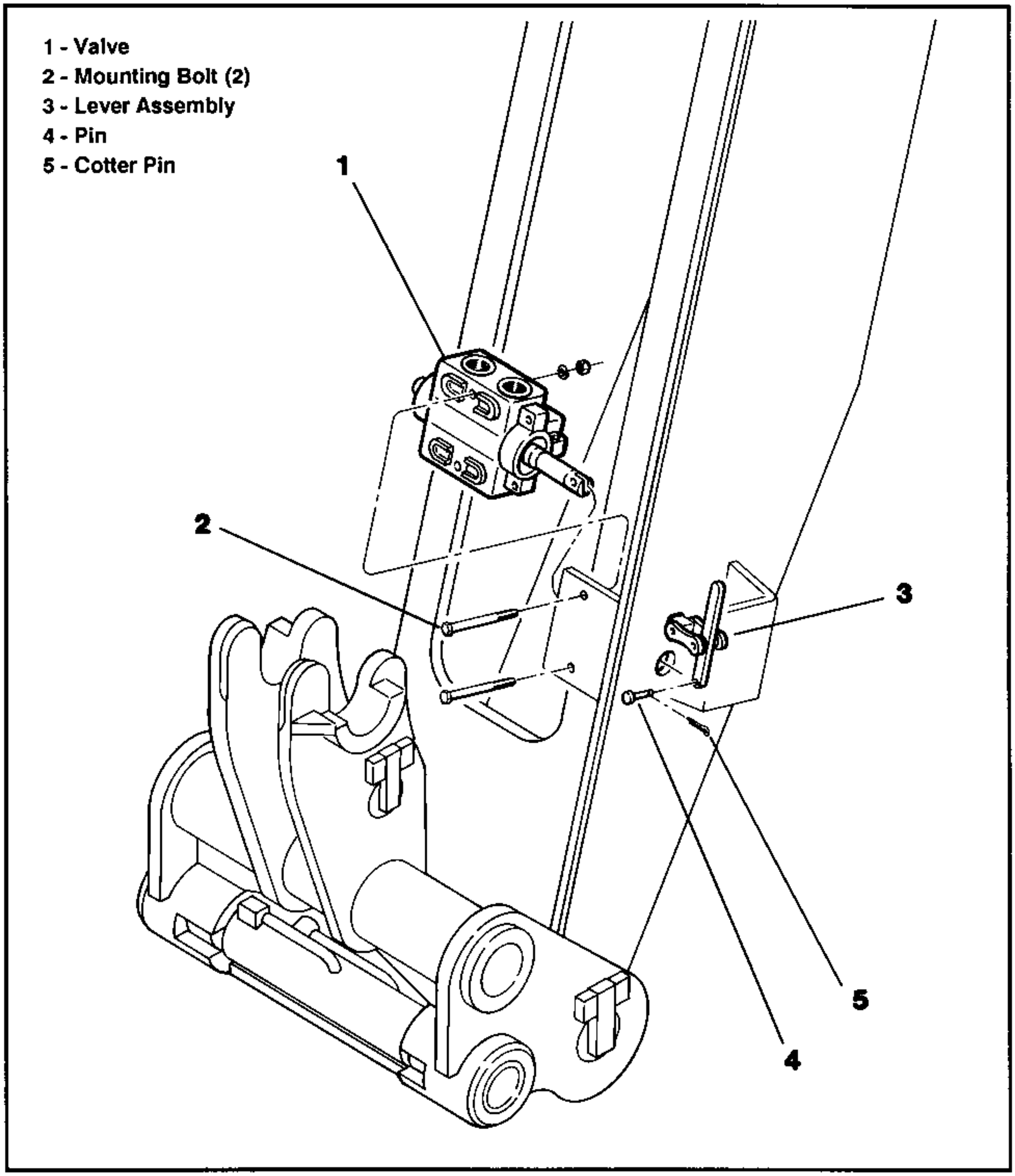


Figure 3-65 Attachment Selector Valve Removal

DIRECTIONAL CONTROL VALVES

ATTACHMENT SELECTOR VALVE (MODEL 1044)(cont.)

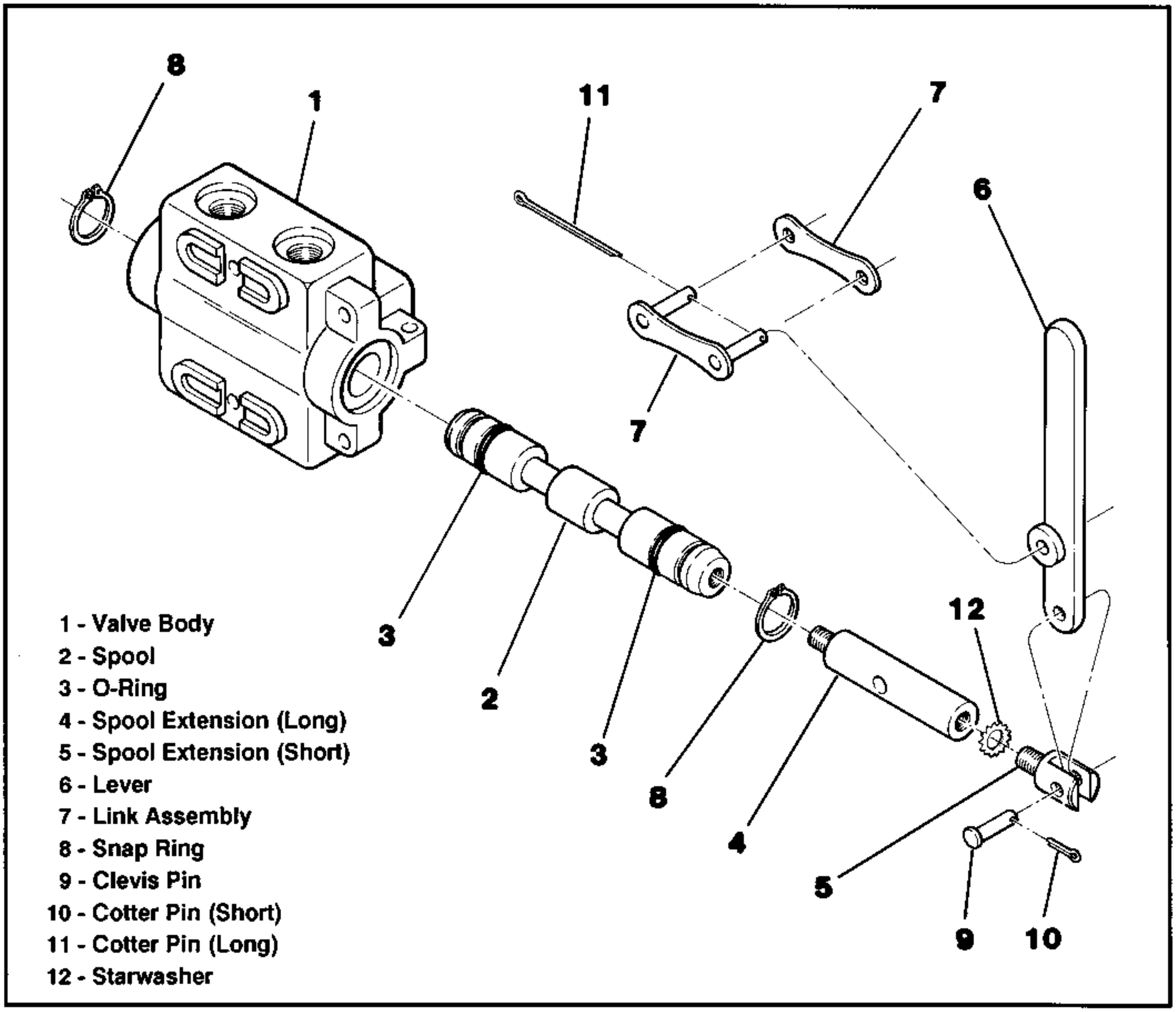


Figure 3-66 Attachment Selector Valve Disassembly

DIRECTIONAL CONTROL VALVES

DIFFERENTIAL LOCK VALVE (MODELS 644, 844, 1044)

DESCRIPTION (Figure 3-67)

The differential lock valve is a two-position, foot actuated type mounted to 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 3.8-1 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 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 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 3-68)

Refer to "Overhaul" on page 3.28-1 for valve overhaul procedures.

DIRECTIONAL CONTROL VALVES

DIFFERENTIAL LOCK VALVE (MODELS 644, 844, 1044)(cont.)

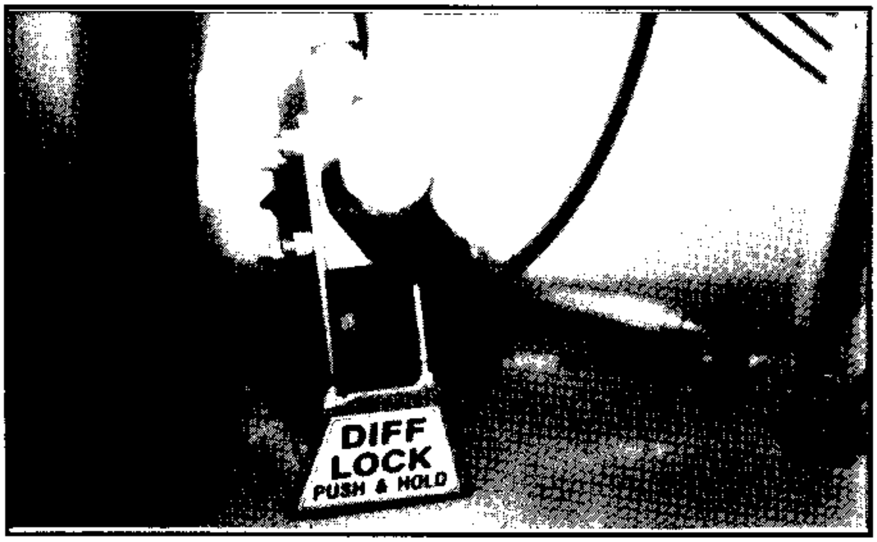


Figure 3-67 Differential Lock Valve

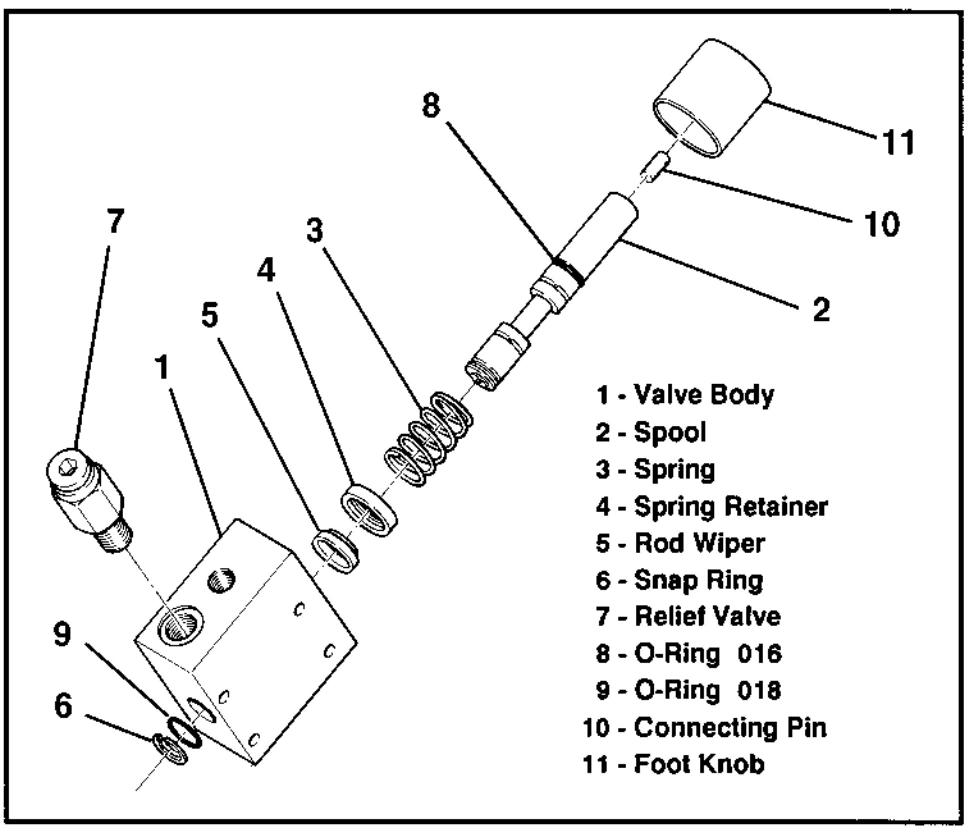


Figure 3-68 Differential Lock Valve Disassembly

DIRECTIONAL CONTROL VALVES

TEE RELIEF VALVE (MODELS 644, 844, 1044)

DESCRIPTION

The tee relief valve is an in-line pressure relief valve located in the hydraulic line between the first (inboard) pump and the service brake valve. The function of the tee relief valve is to protect the hydraulic pump from excessive pressure in event of brake valve failure. The tee relief valve would, in that case, direct oil flow of excessive pressure to the reservoir.

For location of the valve on the machine, see Figures 3-1 and 3-2 on pages 3.5-2 and 3.7-2 in this section.

TROUBLESHOOTING AND ADJUSTING

Slow or no movement of hydraulic functions, when under load, could indicate the tee relief valve is adjusted for too low a pressure (Tee relief pressure setting should be 3000 psi (644, 844) and 3300 psi (1044).

Use the following procedure to determine the tee relief valve pressure setting (Figure 3-69):

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. Disconnect the hydraulic hose which leads to the brake valve from the tee relief valve and plug. Assemble a 5,000 psi hydraulic pressure gauge and a load valve to the tee relief valve and reassemble the hydraulic hose.

WARNING: Be sure test components are rated to safely withstand 5000 psi working pressures.

CAUTION: Be sure the load valve is <u>open</u> before starting the engine.

4. Start the engine and, when it is at normal operating temperature, open the throttle to full rpm. Slowly close the load valve until maximum pressure is reached (NOTE: Do not allow pressure to exceed 3300 psi.) After noting the pressure gauge reading, shut off the engine and fully open the load valve.

WARNING: Do not attempt to disconnect the hydraulic line or the test components until all hydraulic pressure in the circuit is released. (To release pressure see warning and procedure on page 3.2-1 in this section; the pressure gauge should read 0 psi when pressure is released.)

If, after performing steps 1 through 4 above, it has been determined the pressure setting of the tee relief valve is incorrect, use the following procedure to adjust the pressure setting:

5. Release hydraulic pressure in the circuit (see "Warning" above).

6. Disassemble hose from valve relief port and cap hose end.

7. Using a 1/8" hexagon key, push in and turn the adjusting screw within the relief port (Figure 3-70): 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.

8. Reassemble hose to valve relief port.

9. Follow test procedure in step 4 above to test the adjusted pressure setting.

10. If the tee relief valve tests correctly, <u>release hydraulic pressure in the circuit</u>, disconnect test components and reassemble hose to the valve.

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

11. Start the engine and check for leaks.

DIRECTIONAL CONTROL VALVES

TEE RELIEF VALVE (MODELS 644, 844, 1044)(cont.)

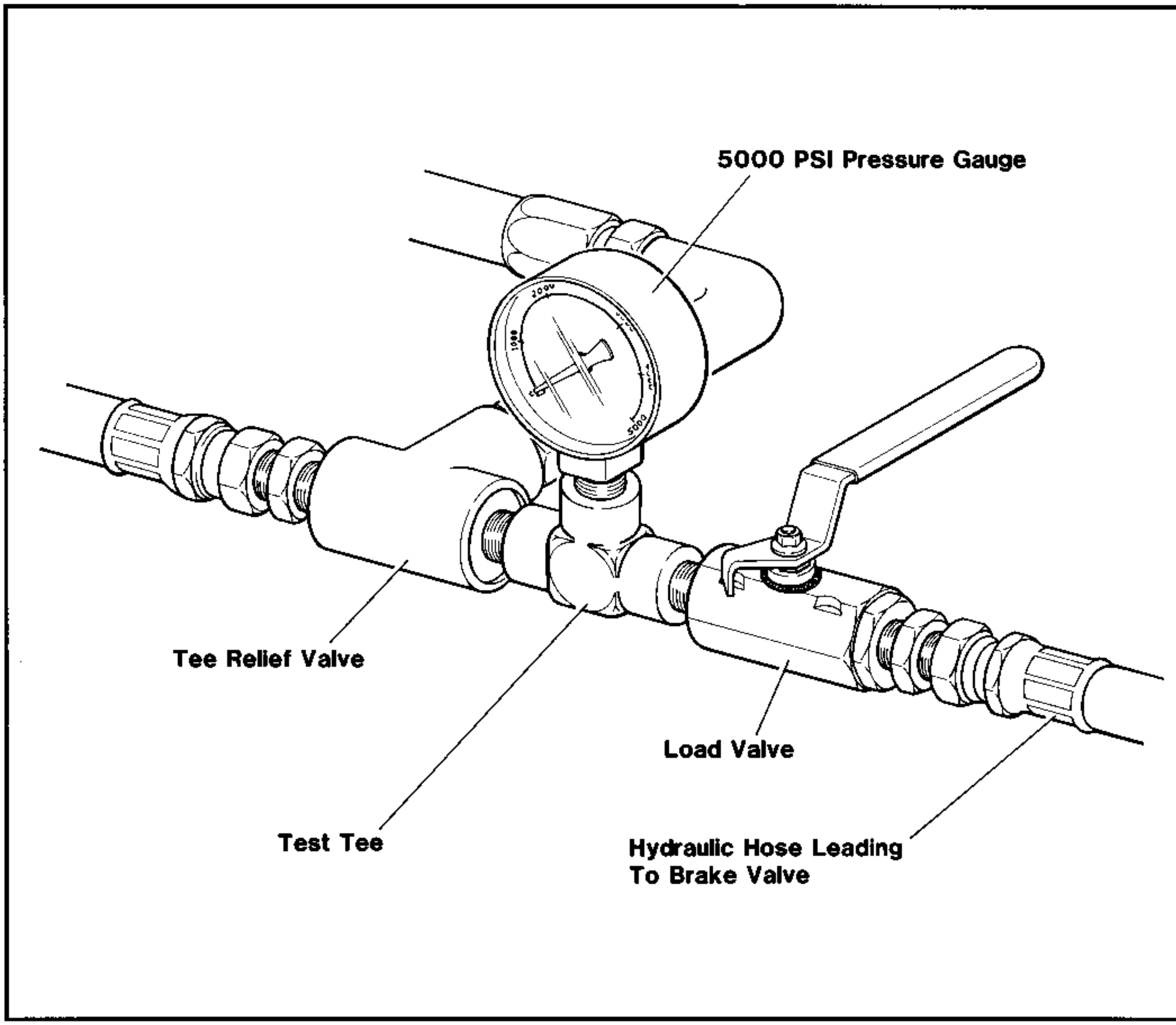


Figure 3-69 Tee Relief Valve Test Diagram

HYDRAULICS

DIRECTIONAL CONTROL VALVES

TEE RELIEF VALVE (MODELS 644, 844, 1044)(cont.)

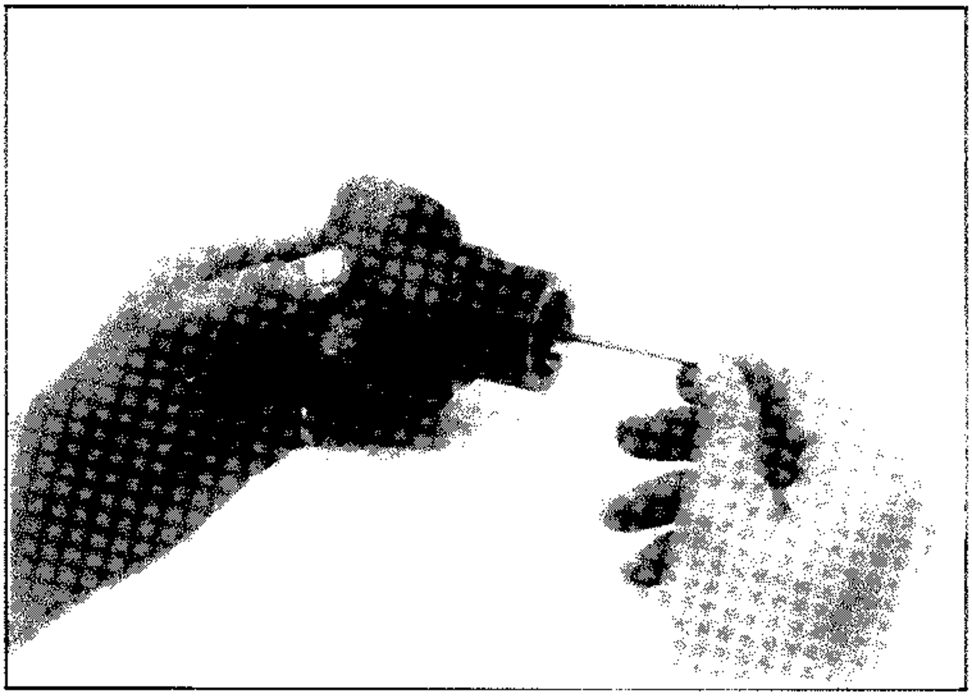


Figure 3-70 Tee Relief Valve - Adjusting

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 tee relief 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 three hydraulic lines connected to the valve. Cap the lines.

4. Remove mounting fasteners.

5. Remove valve.

INSTALLATION

1. Reverse steps 3 through 5 above.

NOTE: See Torque Specification Table 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.

3. Bleed the hydraulic brake lines (see "Bleeding Procedure" in Section 10).

DIRECTIONAL CONTROL VALVES

STEERING PRIORITY VALVE (MODELS 644, 844, 1044)

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 3.5-2 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 3.8-1 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 and cap end.

4. Using a 7/32" hex key, push in and turn the adjusting screw within the relief port (Figure 3-71):

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.**

DIRECTIONAL CONTROL VALVES

STEERING PRIORITY VALVE (MODELS 644, 844, 1044)(cont.)

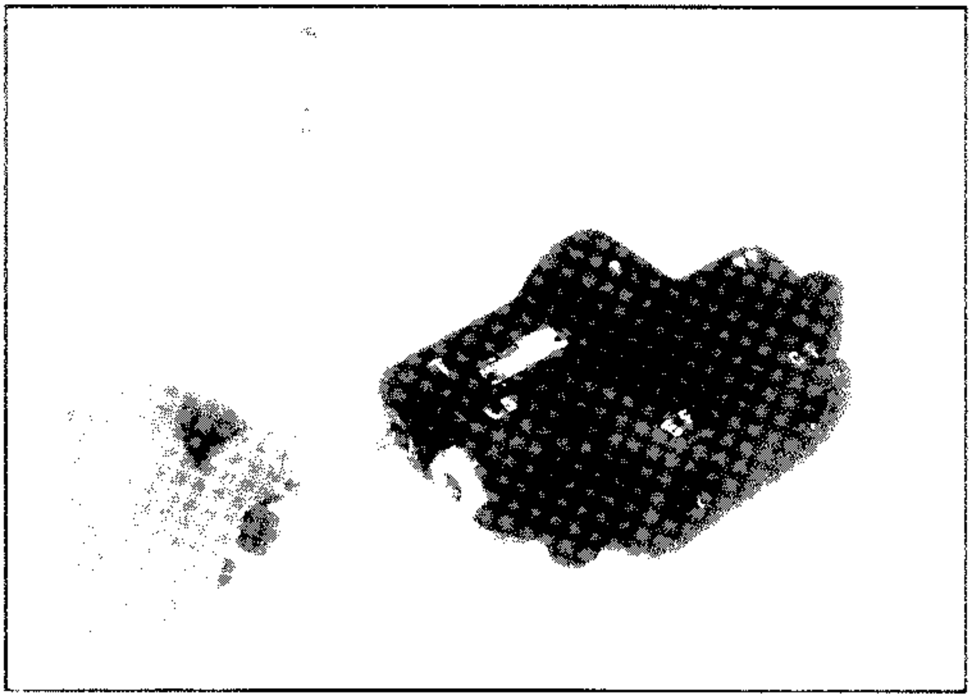


Figure 3-71 Steer Priority Valve - Adjusting

DIRECTIONAL CONTROL VALVES

FORK LEVELING VALVE (MODEL 1044)

DESCRIPTION

The fork leveling valve (Figure 3-72) 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 3-2 on page 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 througnout 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 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 3-73):

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.

DIRECTIONAL CONTROL VALVES

FORK LEVELING VALVE (MODEL 1044)(cont.)

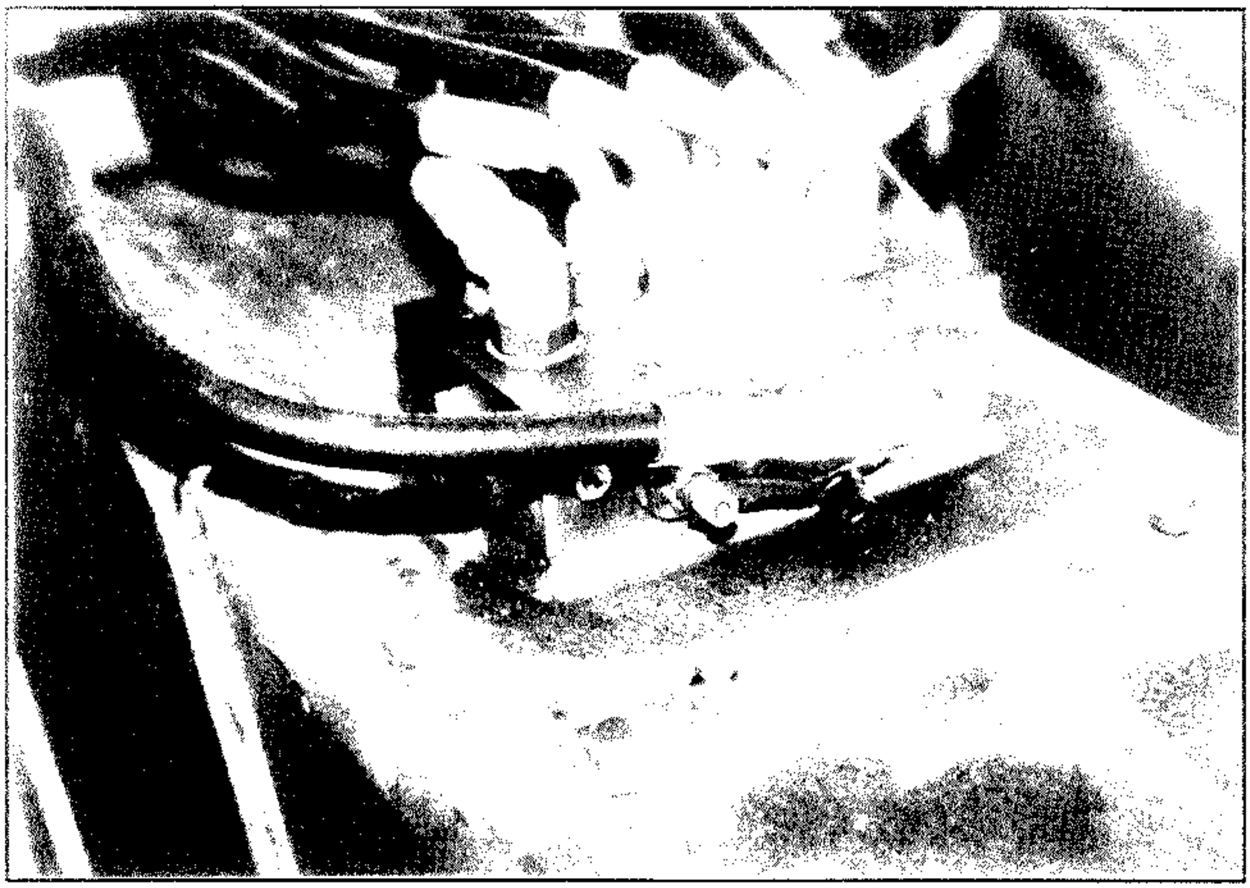


Figure 3-72 Fork Leveling Valve

DIRECTIONAL CONTROL VALVES

FORK LEVELING VALVE (MODEL 1044)(cont.)

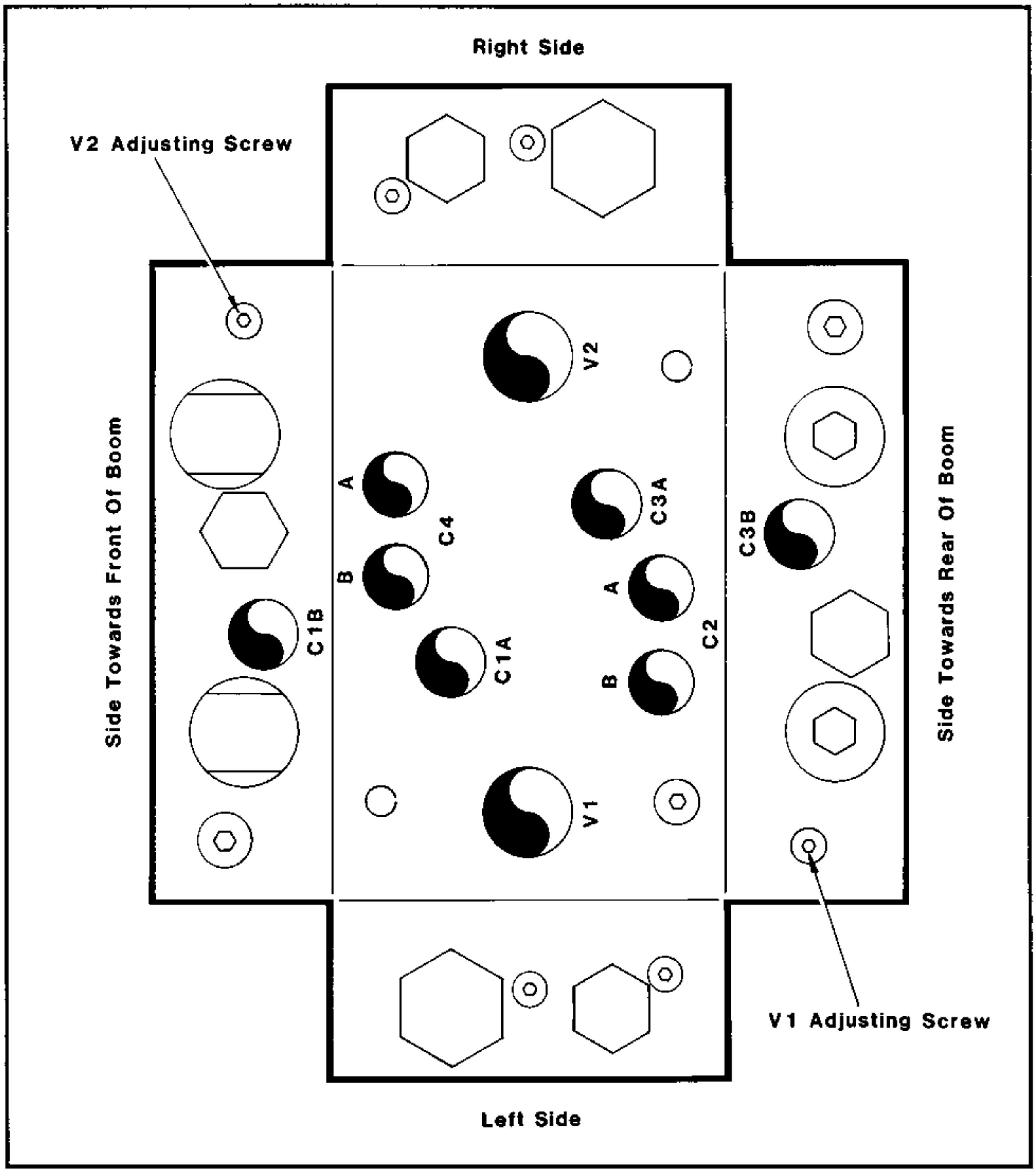


Figure 3-73 Fork Leveling Valve Port Locations

DIRECTIONAL CONTROL VALVES

CYLINDER COUNTERBALANCE VALVES (MODELS 644, 844, 1044)

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
Outrigger - One counterbalance valve each

The counterbalance valves are of two types (Figure 3-74):

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. (NOTE: The outrigger counterbalance valves are in the outrigger "up" circuit only.)

1. Check for internal cylinder leakage (refer to "Internal Leakage" under "Checking Cylinder Condition" on page 3.18-1 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: Hydrualic 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.

DIRECTIONAL CONTROL VALVES

CYLINDER COUNTERBALANCE VALVES (MODELS 644, 844, 1044)(cont.)

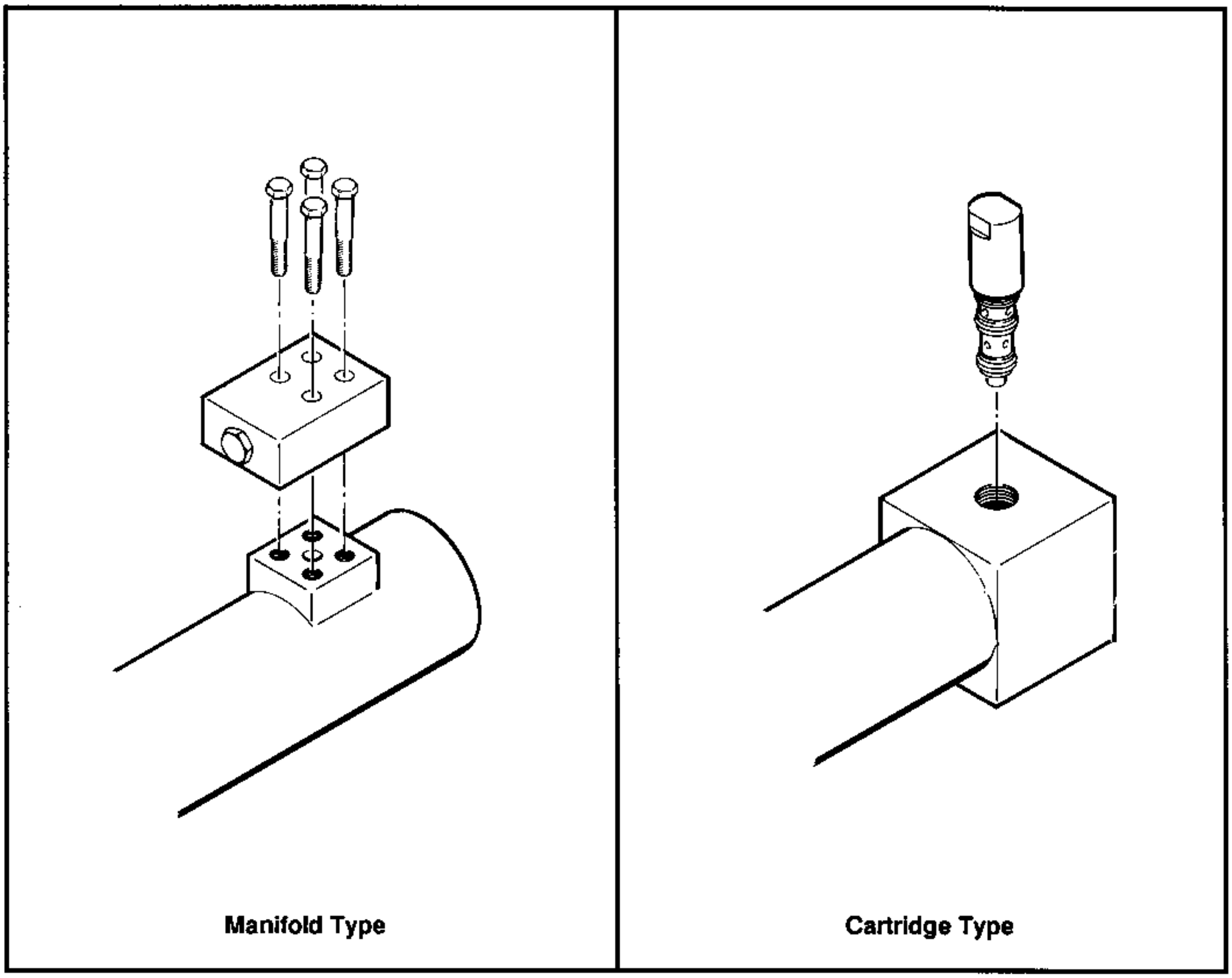


Figure 3-74 Cylinder Counterbalance Valves

DIRECTIONAL CONTROL VALVES

OUTRIGGER ANTI-DRIFT VALVE (MODELS 644, 844, 1044)

DESCRIPTION (Figure 3-75)

The anti-drift valve is an in-line pilot operated check valve. There are two anti-drift valves, one for each of the two hydraulic circuits for the outriggers. The anti-drift valves are located in the outrigger hydraulic lines at the front of the machine.

The anti-drift valves prevent the outriggers from dropping in event of a downstream hydraulic failure or leakage through the control valve or fittings. The anti-drift valve also prevents movement of the outriggers when the engine is shut off, even if the control lever is operated.

TROUBLESHOOTING

Any outrigger cylinder movement, caused by moving the outrigger control handle "down" after the engine is shut off, may indicate a faulty anti-drift valve. It may also indicate faulty cylinder seals.

1. Check for internal cylinder leakage (Refer to "Checking Cylinder Condition" on page 3.18-1 in this section).

2. If the cylinder checks in good condition, replace the anti-drift valve.

REMOVAL AND INSTALLATION

Use the following procedure to replace an anti-drift valve:

1. Lower the outriggers until they just rest on 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).

2. Tag and remove four hoses and cap their ends.

3. Remove the anti-drift valve.

4. Remove hydraulic fittings and assemble to the new anti-drift valve.

5. Assemble the four hoses to the new valve.

NOTE: See "Torque Specifications for Hydraulic Line Connections" in Section 1.

6. 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.

DIRECTIONAL CONTROL VALVES

OUTRIGGER ANTI-DRIFT VALVE (MODELS 644, 844, 1044)(cont.)

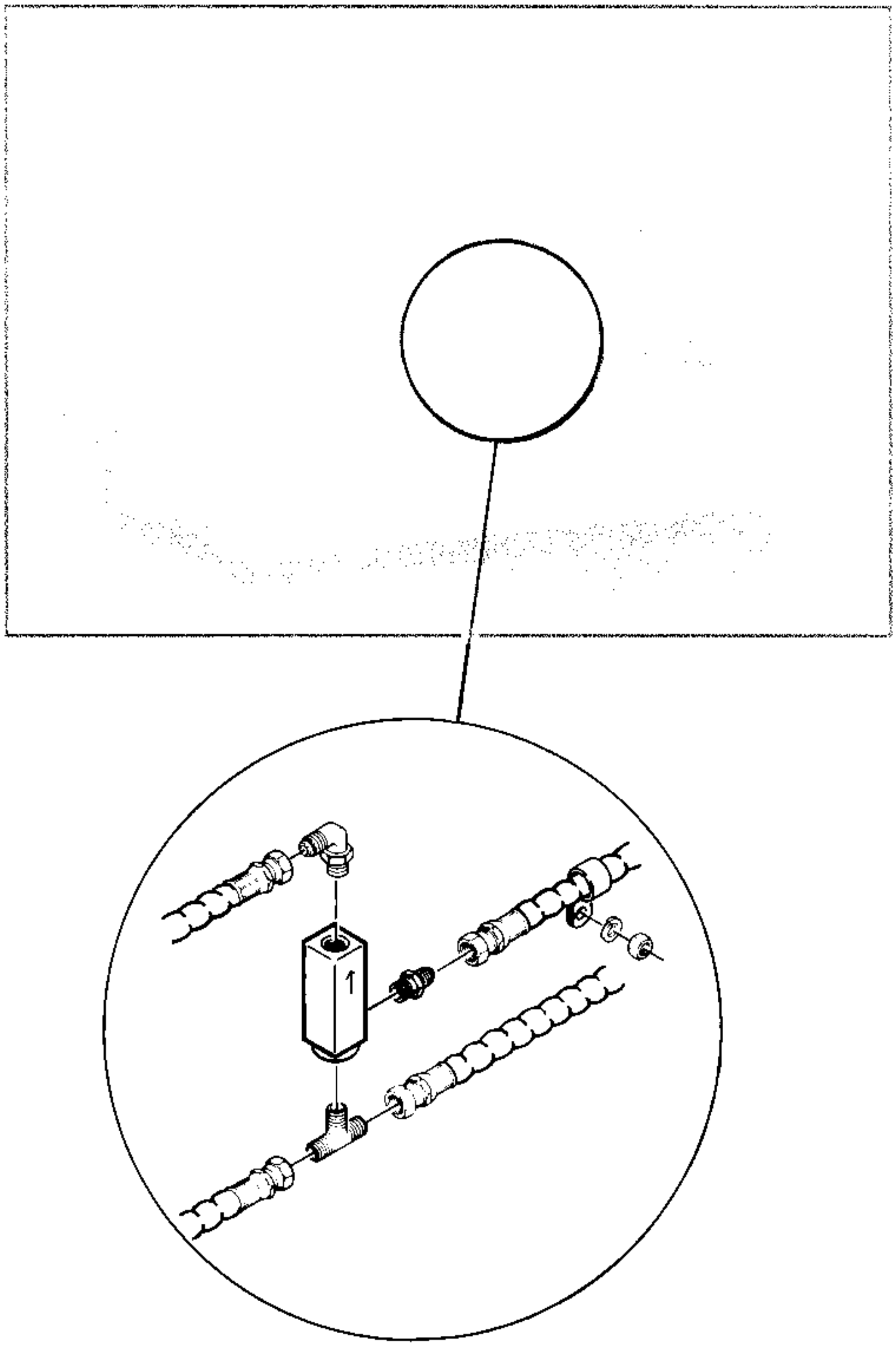


Figure 3-75 Outrigger Anti-Drift Valve

BOOM AND TILT CARRIAGE

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BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODELS 644, 844)

DESCRIPTION

The boom for the model 644 and 844 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 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 (644) or two (844) double acting hydraulic boom lift cylinder(s), with the base end pivot(s) connected to the transfer carriage and the rod end pivot(s) connected to the boom. The boom pivots vertically about a pivot pin located at the rear of the boom, connecting the boom to the transfer carriage (see Section 5 for Transfer Carriage).

The boom incorporates two (front and rear) carriage tilt cylinders which control the forward and rearward tilt of the carriage and attached forks (refer to "Carriage Tilt Cylinders" 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 to 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 the 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 Fabreka 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.

8. Periodic inspection of hose tension inside of boom with boom fully extended. Hoses must not sag more than 1/2". Adjust tension at cable adjusting screw.

9. Periodic inspection of cable 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 the boom, apply the parking brake and stop the engine.

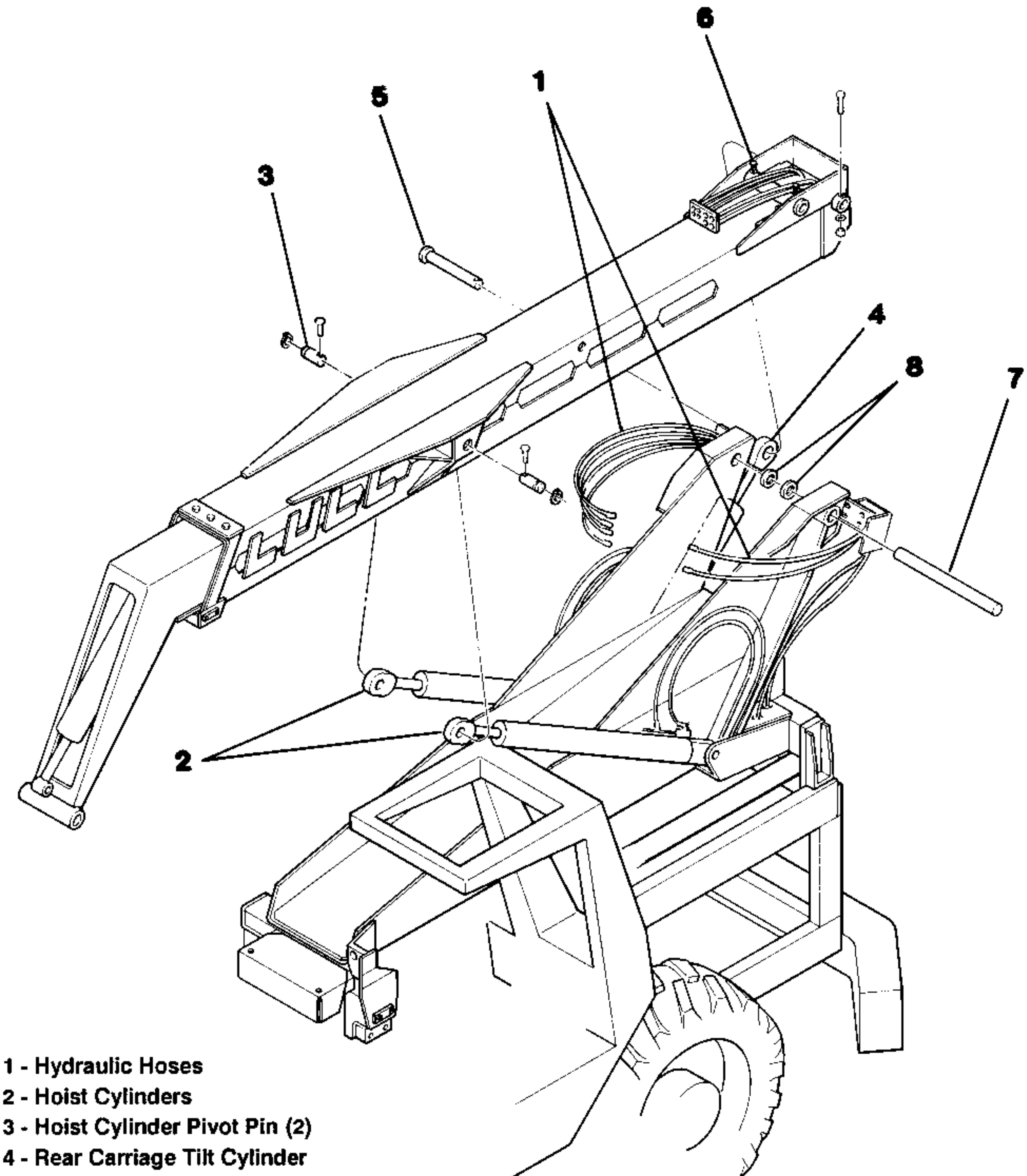
4. Support the boom from above with an overhead hoist. (Approximate weight of the boom is 2 tons.)

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 TILT CARRIAGE

TWO SECTION BOOM (MODELS 644, 844)



1 - Hydraulic Hoses
2 - Hoist Cylinders
3 - Hoist Cylinder Pivot Pin (2)
4 - Rear Carriage Tilt Cylinder
5 - Rear Tilt Cylinder Pivot Pin
6 - Setscrew (4)
7 - Boom Pivot Pin
8 - Boom Pivot Shims

Figure 4-1 Boom Removal (Model 844 Shown)

TWO SECTION BOOM (MODELS 644, 844)

BOOM REMOVAL (cont.)

7. Support the hoist cylinder(s) (Item 2). Approximate weight 260 LBS (844), 340 LBS (644). Remove the top pivot pin(s) (Item 3) and lower the cylinder(s).

8. Support the rear carriage tilt cylinder (Item 4) (approximate weight 100 LBS). Remove the top pivot pin (Item 5) and lower the cylinder.

9. Loosen the four boom pivot set screws (Item 6).

10. Remove the boom pivot pin (Item 7).

11. Remove shims (Items 8) keeping left and right side shims separate.

12. Lift the boom clear of the machine.

BOOM INSTALLATION

Use the following procedure to install the boom on the machine:

1. Reverse steps 5 through 12 above, installing pivot shims (Items 8) on same side from which they were removed..

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 and adjust hydraulic hose tension. Hoses must not sag more than 1/2". Adjust tension at cable adjusting screw (Figure 4-2, Item 4).

4. 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.)

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 transfer carriage so overhead guard and air cleaner do not inhibit accessibility.

   c. Extend boom two to three feet to gain access to bulkhead fittings at top rear of inner boom.

   d. 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

1. Disconnect hoses (Figure 4-3, Items 4) from bulkhead bracket at top rear of inner boom.

2. Remove cable (Figure 4-2, Item 5) (see "Cable Removal").

3. Remove rear sheave bracket (Figure 4-2, Item 6).

4. Remove two hydraulic tubes (Figure 4-2, Items 9).

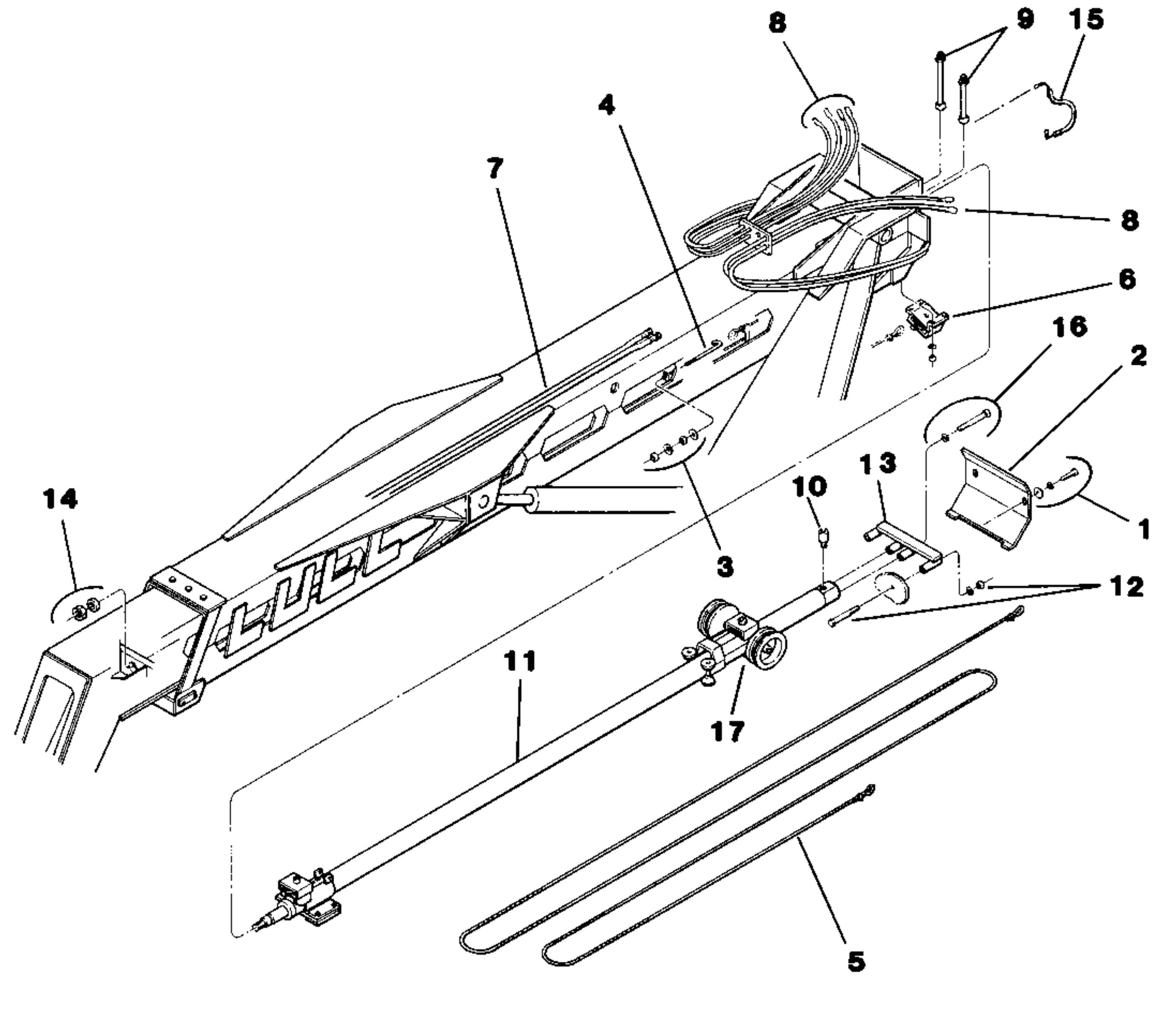
5. Remove counterbalance valve (Figure 4-2, Item 10).

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.

6. Remove counterbalance valve pilot hose (Figure 4-2, Item 15).

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODELS 644, 844)



1 - Bolt & Washers (2)
2 - Rear Cover
3 - Cable Adjusting Nuts & Washers
4 - Cable Adjusting Rod
5 - Cable
6 - Rear Cable Sheave Mount
7 - Twin Line Hydraulic Hose (2)
8 - Hydraulic Hoses
9 - Hydraulic Tubes (2)
10 - Counterbalance Valve
11 - Boom Extension Cylinder
12 - Bolt, Nut & Washer (2)
13 - Rear Cylinder Support Bracket
14 - Setscrew, Nut & Boss
15 - Pilot Hose
16 - Screw, Lockwasher (2)
17 - Hose Reel Cart

Figure 4-2 Extension Cylinder Removal (Model 844 Shown)

TWO SECTION BOOM (MODELS 644, 844)

BOOM SEPARATION (cont.)

B. SEPARATION OF BOOM (cont.)

7. Remove hydraulic fitting (Figure 4-3, Item 39) from bottom rear of extension cylinder.

8. Remove two screws and lockwashers (Figure 4-2, Item 16), mounting extension cylinder to support bracket (Item 13).

9. Remove support bracket. (The hose reels will support the rear of the cylinder.)

10. Pull hose reel cart (Figure 4-2, Item 17) 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 4-2)

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, 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 bolts 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 mount (Item 6).

8. Remove twin-line hoses (Item 7) from both sides of boom.

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 15)

13. Remove bolts, nuts and washers (Items 12) and remove rear cylinder support bracket (Item 13).

14. Remove setscrew, nut and boss (Items 14) 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.

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODELS 644, 844)

EXTENSION CYLINDER 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. 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 4-3)

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 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 in both directions and hold for 15 seconds each direction. Repeat. These procedures will remove air from the circuits.

HOSE SHEAVE REMOVAL (Figure 4-3)

1. Position the machine on a level surface and extend inner boom until hose sheaves (Items 6) 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 (Item 1).

6. Tag and detach twin hydraulic hose ends from bulkhead fittings (Items 7).

7. Pull hoses back.

8. Remove retaining ring (Item 5) from sheave shaft.

9. Slide hose sheave (Item 6) out window.

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODELS 644, 844)

HOSE SHEAVE INSTALLATION

1. Reverse steps 5 through 9 above.

NOTE: Refer to "Torque Specifications for Hydraulic Lines" in Section 1.

NOTE: When re-tightening hoses, adjust rod (Item 1) so there is no more then 1/2" sag in hoses.

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 in both directions and hold for 15 seconds each direction. Repeat. These procedures will remove air from the circuits.

CABLE REMOVAL (Figure 4-3)

1. Position the machine, lower the boom to the ground, apply the parking brake and stop the engine.

2. Remove bolts and washers (Items 2) and remove rear cover (Item 3).

3. Loosen and remove nuts and washers (Items 8) and remove cable adjusting rod (Item 1).

4. Loosen, remove and save (4) cable clips (Items 9).

5. Remove and save (3) thimbles (Items 10).

6. Pull cable (Item 11) from rear of boom.

CABLE INSTALLATION

1. Reverse steps 2 through 6 above.

NOTE: Refer to Figure 4-4 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 4-3)

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 12).

4. Push pin (Item 13) through access hole in outer boom. NOTE: Be careful not no lose shims (Items 14).

5. Remove rollers (Items 15) 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 16).

3. Remove roller pin (Item 17).

4. Remove roller (Item 18) and shims (Item 19).

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODELS 644, 844)

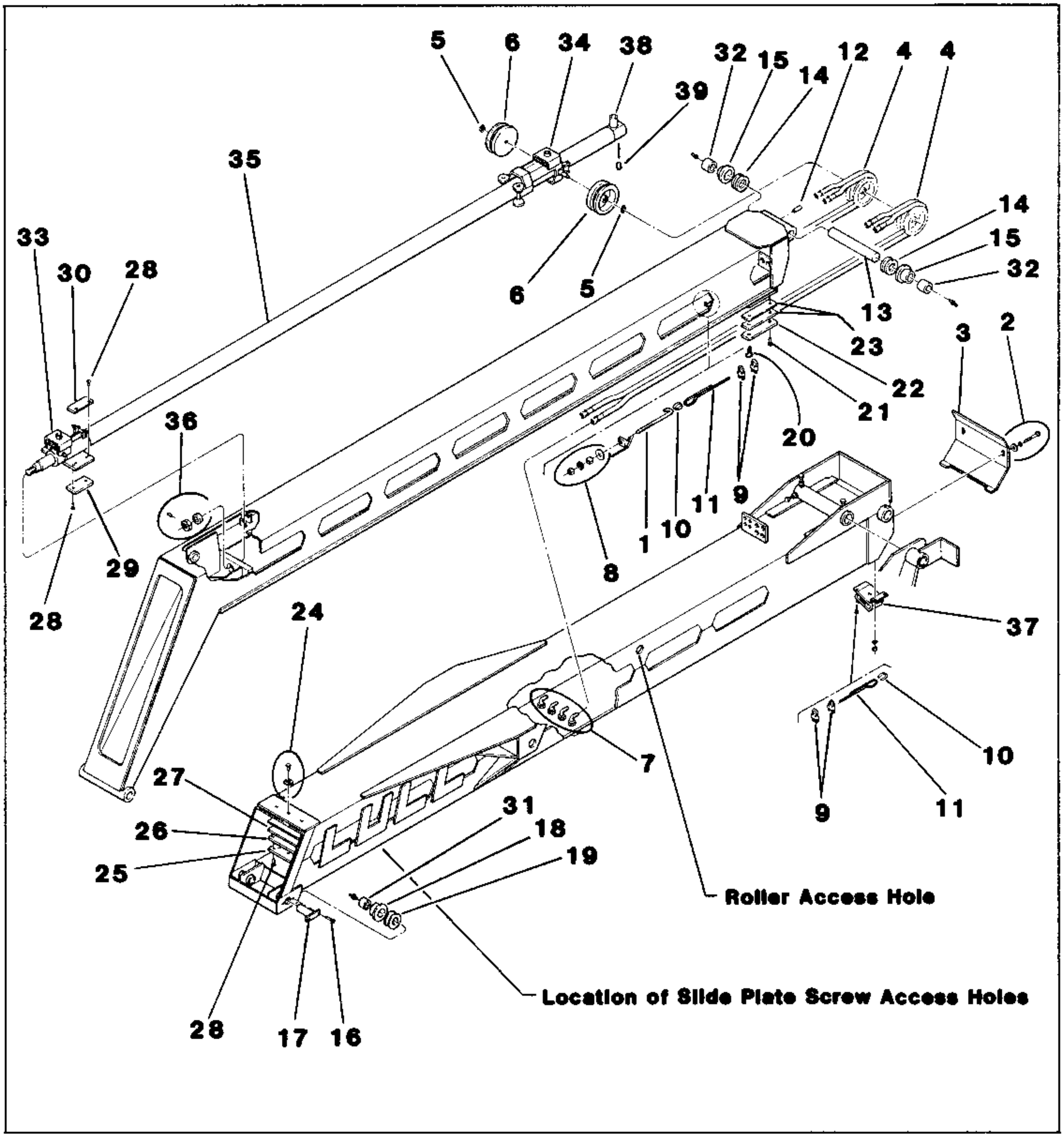


Figure 4-3 Hoses, Hose Sheaves, Cable, Rollers, Shims, Bushings, and Slide Plates Removal (Models 644, 844)

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODELS 644, 844)

1 - Cable Adjusting Rod	14 - Shims (as reqd.)	27 - Base Plate
2 - Bolts and Washers (2)	15 - Roller (2)	28 - Brass Screw & Washer (2)
3 - Rear Cover	16 - Bolt (2)	29 - Slide Plate - Lower
4 - Twin Hydraulic Hose (2)	17 - Roller Pin (2)	30 - Slide Plate - Upper
5 - Retaining Ring	18 - Roller (2)	31 - Roller Bushing (2)
6 - Hose Sheave (2)	19 - Shims (as reqd.)	32 - Roller Bushing (2)
7 - Bulkhead Fittings (4)	20 - Screws (2)	33 - Front Sheave Bracket
8 - Nuts and Washers (2)	21 - Screws (2)	34 - Hose Reel Bracket
9 - Cable Clips (4)	22 - Slide Plate (2)	35 - Extension Cylinder
10 - Thimbles (3)	23 - Shims (as reqd.)	36 - Setscrew, Nut & Boss
11 - Cable	24 - Bolts & Lockwashers (3)	37 - Rear Sheave Bracket
12 - Setscrew	25 - Slide Plate	38 - Counterbalance Valve
13 - Roller Pin	26 - Shims (as reqd.)	39 - Hydraulic Fitting

Table 4-1 Material List for Figure 4-3

TWO SECTION BOOM (MODELS 644, 844)

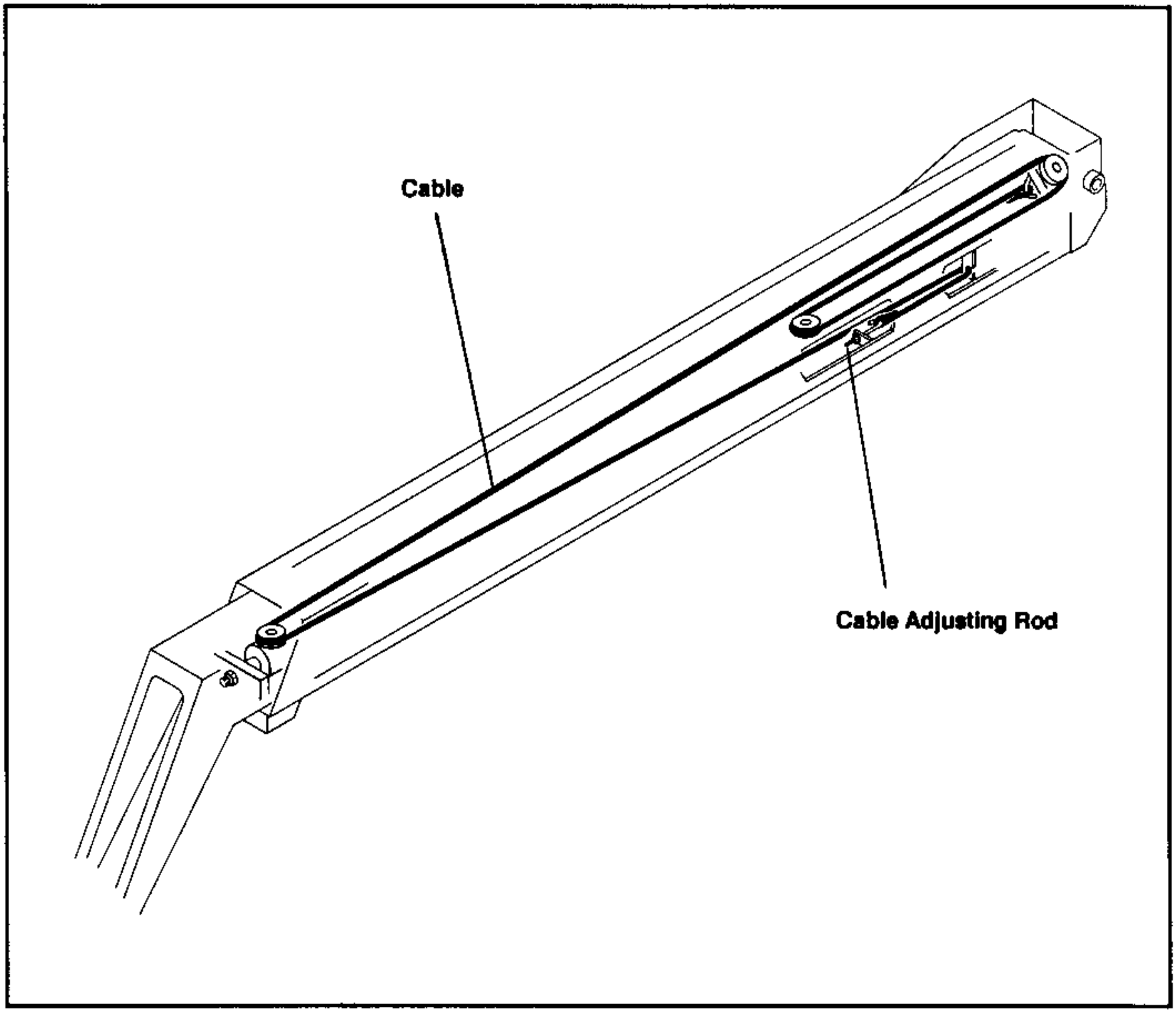


Figure 4-4 Cable Routing (Models 644, 844)

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODELS 644, 844)

ROLLER/SHIM REMOVAL AND INSTALLATION (cont.)

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 4-3)

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 20) align with outer boom access holes.

3. Remove screws (Item 20).

4. Extend boom an additional 3" until rear screw heads (Item 21) 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 21).

7. Remove slide plate(s) and shims (Items 22 & 23).

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 4-5). (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 24).

3. Remove slide plate and shims (Items 25 & 26)).

4. Remove slide plate (Item 25) from base plate (Item 27) by removing two brass screws and washers (Item 28).

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 shut off the engine.

2. Remove carriage tilt cylinder (see "Removal of Front Tilt Cylinder" on page 4.5-4).

3. Remove extension cylinder, setscrew, nut and boss (Items 36).

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 33).

7. Slide front sheave support bracket off extension cylinder and remove through boom side window.

8. Replace slide plates as required.

9. Reassemble by reversing steps 2 through 7 above.

BOOM AND TILT CARRIAGE

TWO SECTION BOOM (MODELS 644, 844)

BOOM PIVOT SHIM REMOVAL AND INSTALLATION (Figure 4-1)

1. Position the machine on level surface, fully retract boom and transfer carriage, and rest fork carriage on the ground.

2. Apply the parking brake and stop the engine.

3. Loosen (4) setscrews (Items 6) securing the main boom pivot pin (Item 7) to the boom.

4. Secure overhead hoist chain to outer boom just behind the mounting brackets for the rod end of the hoist cylinder(s). (Weight of boom is approximately 2 tons.) This chain location should approximate the balancing point of the boom.

5. Detach hoist cylinder(s) (Item 2) from outer boom. Weight of hoist cylinders are approximately 260 LBS (844), 340 LBS (644). Lower hoist cylinder(s) to rest.

6. Lift boom until weight is off the pivot pin.

7. Drive the pivot pin free from boom and transfer carriage.

NOTE: Adding or removing one shim would not require complete removal of the pivot pin.

8. Remove shims (Items 8).

9. Replace shims, reversing steps 3 through 8.

10. Grease boom pivot shaft bushings.

NOTE: To assist aligning of transfer carriage and boom pivot shaft holes, start the engine and operate the frame tilt.

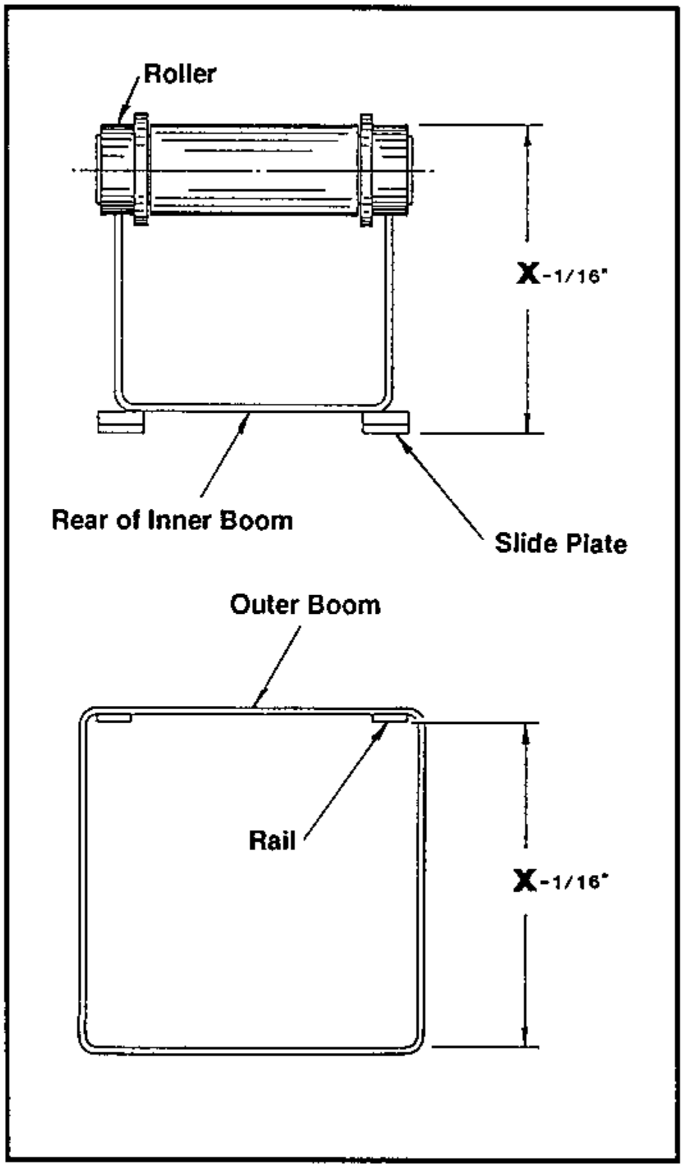


Figure 4-5 Boom Slide Plate Clearance

BOOM AND TILT CARRIAGE

THREE SECTION BOOM (MODEL 1044)

DESCRIPTION

The boom for the model 1044 forklift is comprised of three sections (outer, center, and inner) which are constructed of high strength steel tubing and which incorporate a series of openings along both sides for access to boom internals. A tandem double-acting hydraulic cylinder, located within the boom, extends and retracts the boom. One rod end of the cylinder is connected to the rear of the outer boom and the other rod end is connected to the forward portion of the inner boom. The rear of the cylinder housing is attached to the rear of the center boom. A cable and pulley system provides synchronized movement of the three boom sections so that the inner boom extends and retracts at twice the rate of the center boom.

Raising and lowering of the boom is accomplished with two double-acting hydraulic boom lift cylinders which have their base end pivots connected to the transfer carriage and their rod end pivots connected to the boom. The boom pivots vertically about a pivot pin located at the rear of the boom, connecting the boom to the transfer carriage (see "Transfer Carriage" in Section 5).

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 Cylinders" on page 4.5-1).

Bearing surfaces between the boom sections are provided by rollers, located at the top rear of the inner and center booms and front bottom of the center and outer booms, and Fabreka slide plates, located at the front top of the center and outer booms and bottom rear of the inner and center booms.

The boom contains six hydraulic lines. The lines consist initially of hoses routed along the underside of the outer boom to a tension adjustment bulkhead bracket. From the bulkhead bracket, hoses continue between the center and outer booms to two hose reels located within the rear of the center boom; from the reels, the hoses continue to two bulkhead brackets located within the rear of the inner boom; from the bulkhead brackets, tubing extends to two bulkhead brackets located within the forward portion of the inner boom; from the forward bulkhead brackets, hoses continue to the carriage tilt cylinder, to the selector valve, and two to accessories, if used (otherwise these two lines are capped at the forward bulkhead bracket).

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 Fabreka 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.

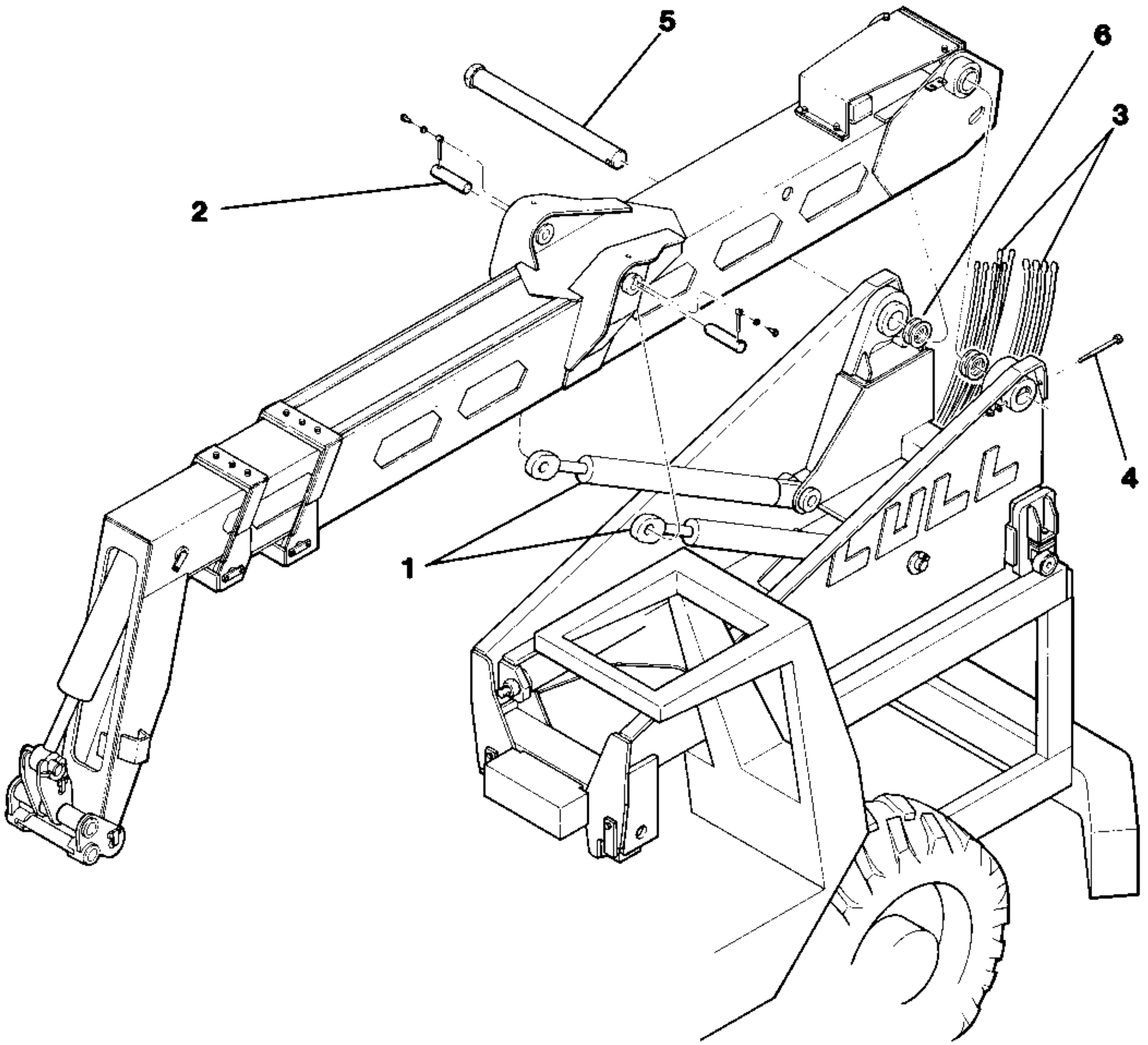
BOOM REMOVAL (Figure 4-6)

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.

BOOM AND TILT CARRIAGE

THREE SECTION BOOM (MODEL 1044)



1 - Hoist Cylinders
2 - Pivot Pin (2)
3 - Hydraulic Hoses
4 - Bolt
5 - Boom Pivot Pin
6 - Shims

Figure 4-6 Boom Removal (Model 1044)

THREE SECTION BOOM (MODEL 1044)

BOOM REMOVAL (cont.)

2. Remove the fork carriage.

3. Position the machine on a level surface, retract and level 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 1/4 tons.

5. Release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

6. Support the hoist cylinders (Items 1) (approximate weight 200 LBS each). Remove the top pivot pins (Items 2) and lower the cylinders.

7. Tag and remove hydraulic hoses (Items 3) from the boom.

8. Remove bolt (Item 4) and remove boom pivot pin (Item 5).

9. Remove shims (Items 6) keeping left and right side shims separate.

10. Lift boom clear of the machine.

BOOM INSTALLATION

Use the following procedure to install the boom on the machine:

1. Reverse steps 4 through 10 above, installing pivot shims (Items 6) on same side from which they were removed..

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 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.)

BOOM SEPARATION

The boom may be separated into its three 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 transfer carriage so overhead guard and air cleaner do not inhibit accessibility.

   c. Extend boom until center boom rear roller shaft aligns with service access openings in outer boom.

   d. Level the boom.

   e. Shut off engine, set parking brake and remove all pressure in the hydraulic system (see warning and procedure of 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 until the center boom rear roller shaft aligns with service access openings in outer boom.

B. SEPARATION OF INNER BOOM

1. Remove lower cable (see "Cable Removal - Lower", steps 4 through 8).

2. Remove upper cable (see "Cable Removal - Upper", steps 4 through 8).

3. Remove hoses and hose sheaves internal to boom (see "Hose Removal", steps 4 through 10).

THREE SECTION BOOM (MODEL 1044)

BOOM SEPARATION (cont.)

4. Remove front sheave bracket from boom extension cylinder (see "Extension Cylinder Removal", step 11).

5. If boom is mounted to machine, start engine and retract extension cylinder rod fully. Shut off engine. This procedure is done to protect the hydraulic cylinder rod from damage when separating the boom.

6. Lift inner boom off front rollers of center boom.

7. Remove rollers from front of center boom (see "Roller/Shim Removal and Installation" - "Front of Center Boom", steps 4 through 6).

8. Lower inner boom until it rests on center boom.

9. Remove slide plate at front of center boom (see "Slide Plate/Shim Removal and Installation" - "Front of Center Boom", steps 2 and 3).

10. Using sufficient means to support and pull the inner boom from the center boom, separate the inner boom from the center boom.

NOTE: Be careful not to damage the rear slide plates of the inner boom as they pass over the front of the center boom, by assuring sufficient clearance is provided.

C. SEPARATION OF CENTER BOOM

1. Remove (2) bolts (Figure 4-7, Items 20) securing the rod end of the extension cylinder to the base support bracket (Item 18).

2. Remove hydraulic tubes (Items 19).

3. Lift center boom off front rollers of outer boom.

4. Remove rollers from front of outer boom (see "Roller/Shim Removal and Installation" - "Front of Outer Boom", steps 4 through 6).

5. Lower center boom until it rests on outer boom.

6. Remove slide plate at front of outer boom.

7. Using sufficient means to support and pull the center boom from the outer boom, separate the center boom from the outer boom.

NOTE: The extension cylinder remains within the center boom.

NOTE: Be careful not to damage the rear slide plates of the center boom as they pass over the front of the outer boom, by assuring sufficient clearance is provided.

EXTENSION CYLINDER REMOVAL (Figure 4-7)

1. Level and extend the boom so the first two windows of the inner boom clear the front of the center boom. Apply the parking brake and shut off the engine.

2. Loosen setscrew (Item 1) and remove nut (Item 2) and washer (Item 3), mounting the rod end of the lower extension cylinder to the block in the inner boom.

3. Locate hose tension bulkhead bracket (Item 4) at front of outer boom. Loosen collars (Items 5) and turn take-up screw (Item 6) to reduce hose tension within the boom.

4. Remove fasteners (Items 7) securing the adjustment end of the lower cable to the front of the outer boom.

5. Remove fasteners (Items 8) securing the adjustment end of the upper cable to the cylinder block at the rear of the outer boom.

6. Remove the sheave pin (Item 9) and sheave (Item 10) for the lower cable at the rear of the center boom. Pull the detached adjustment end of the lower cable clear of the sheave mounting bracket and out the rear of the boom.

7. Pull detached adjustment end of upper cable towards the front of the boom and out boom window.

8. Secure center boom to outer boom by lashing the two sections together with chain, rope or cable, applied through two boom windows, to keep the center boom from moving within the outer boom.

9. Start the engine and slowly retract the extension cylinder until it is fully retracted (the rod end of the lower cylinder is fully retracted). This is done so the rod is protected from damage during removal. Shut off the engine.

BOOM AND TILT CARRIAGE

THREE SECTION BOOM (MODEL 1044)

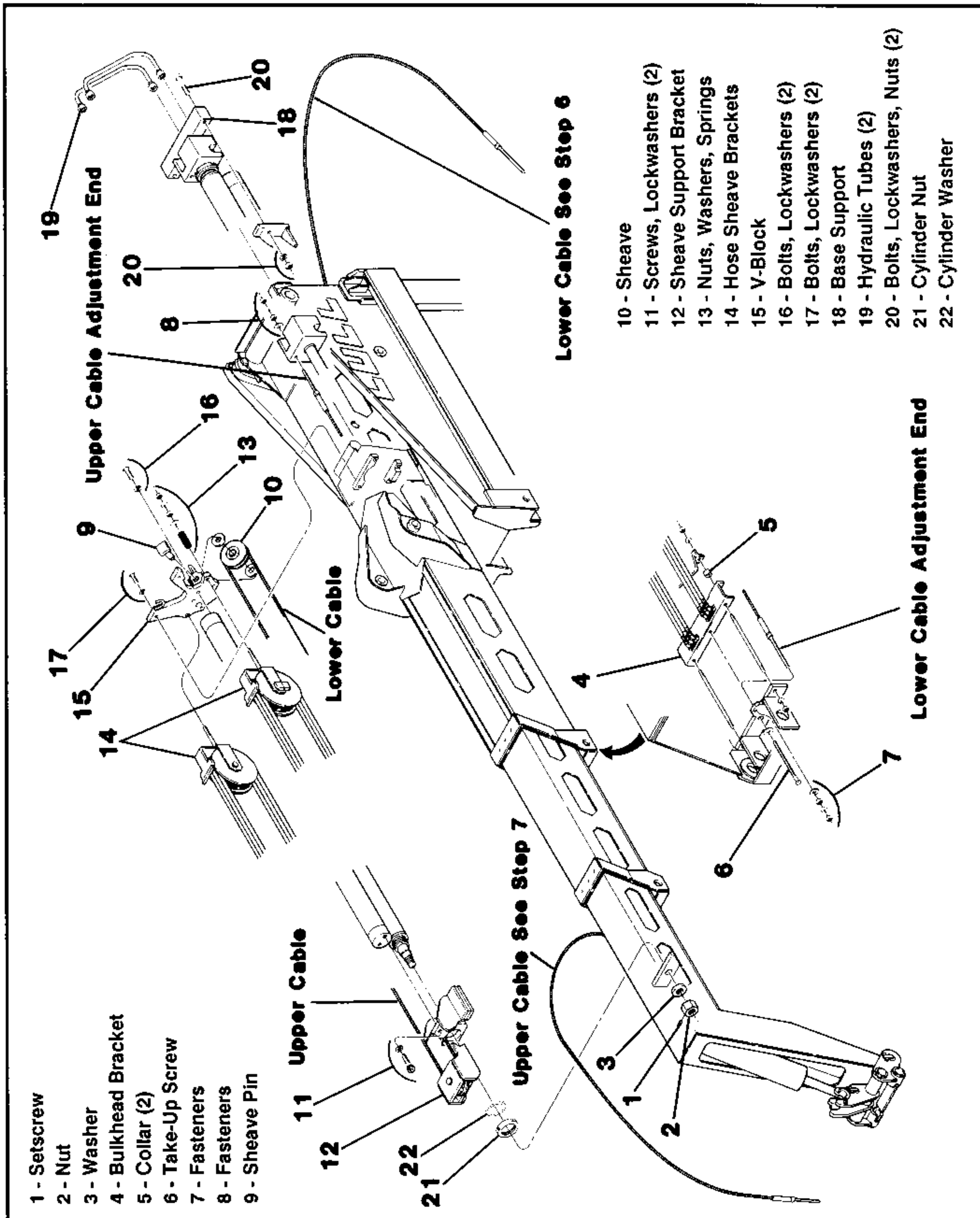


Figure 4-7 Extension Cylinder Removal (Model 1044)

THREE SECTION BOOM (MODEL 1044)

EXTENSION CYLINDER REMOVAL (cont.)

10. Remove lashing applied in step 8.

11. Place a block under the lower cylinder near the front sheave bracket. Remove two screws and lockwashers (Items 11), and cylinder nut & washer (Items 21 & 22), mounting the front sheave support bracket (Item 12) to the extension cylinder. Remove sheave bracket, allowing cylinder to rest on block

12. Remove nuts, washers, and springs (Items 13), mounting the hose sheave brackets (Item 14) to the rear extension cylinder mount (v-block) (Item 15). Allow hose and hose sheave brackets to rest on floor of boom.

13. Remove two bolts and lockwashers (Items 16) securing the extension cylinder to the v-block.

14. Remove four bolts and lockwashers (Items 17) securing the v-block to the rear of center boom and slide v-block out of the back of the outer boom.

NOTE: It may be necessary to spread or disconnect certain hoses at the rear of boom to allow clearance for v-block removal.

15. Start the engine and slowly retract the extension cylinder until it is fully retracted (the rod end of the upper cylinder is fully retracted). Shut off the engine and remove all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

16. Remove two hydraulic tubes (Items 19) connected to rear of cylinder.

CAUTION: Provide blocking on both sides of boom extension cylinder to prevent cylinder from rotating when fasteners (Items 20) in step 17 are removed.

17. Secure a hoist to the base support (Item 18) and remove two bolts, lockwashers and nuts (Items 20), mounting the base support to the rear of the boom.

18. Remove extension cylinder from rear of boom (approximate weight of cylinder is 500 LBS).

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.

EXTENSION CYLINDER INSTALLATION

1. Reverse steps 2 through 18 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 penetract 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. Repeat. This procedure will remove air from the hydraulic circuit.

HOSE REMOVAL (Figure 4-8)

1. Raise boom parallel to the ground and move transfer carriage full forward.

2. Extend boom until center boom's rear roller aligns with service access hole in outer boom.

3. Apply the parking brake, shut off the engine and release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

THREE SECTION BOOM (MODEL 1044)

HOSE REMOVAL (cont.)

4. Remove fastening hardware (Item 1) and springs (Item 2) from both hose sheave yoke adjusting rods.

CAUTION: These assemblies are under tension.

5. Disconnect hoses (Item 5) from bulkhead fittings (Item 6) in inner boom.

6. Remove mounting hardware (Item 7) and drop hose tension adjustment bulkhead bracket (Item 8).

7. Disconnect hoses from bulkhead bracket.

NOTE: There is no need to loosen bulkhead fittings on bracket or to disconnect the short hoses which connect tubes to bracket.

8. Remove the left and right sheave and yoke assemblies (Items 3 and 4) from boom.

NOTE: Pulling on the hoses coming off the top of the sheaves will cause the sheave and yoke assemblies to move forward towards an access window. Lift up and swing lower half of assembly through the window and remove.

9. Separate hoses from sheave and yoke assembly by removing snap ring (Item 9) on pin (Item 10) and removing pin from yoke. The sheave will drop away and the hoses will be free.

10. Pull hoses free from boom.

HOSE INSTALLATION (Figure 4-8)

1. Insert new hoses from rear of outer boom, so hoses reach tension adjustment bracket and lay between the center and outer boom.

NOTE: Tag hose ends to avoid crossing hoses.

2. Fasten hoses to hose tension adjustment bracket bulkhead fittings (Item 11).

NOTE: See "Torque Specifications for Hydraulic Line Connections" in Section 1. Use two wrenches when tightening hydraulic line fittings.

3. Reassemble tension adjustment bulkhead bracket (Item 8) to boom.

4. Reassemble new hose sheaves to hoses and yokes.

5. Replace hoses and sheave and yoke assemblies in boom and work yoke adjustment rods back through mounting holes.

6. Add spacers (Item 12) springs (Item 2) and fastening hardware (Item 1).

NOTE: When assembling fastening hardware do not compress springs (final adjustment will be done in step 8).

7. Connect hose ends (Item 5) to bulkhead fittings (Item 6) in inner boom.

NOTE: Hoses will stretch.

8. Compress springs (Item 2) on yoke adjusting rods to expose 1.25 inches of threaded rod past both jam nuts and tighten jam nuts securely.

9. Increase tension on hoses at hose tension adjustment assembly so bulkhead bracket (Item 8) nears center of it's travel.

10. Visually check for crossed hoses.

11. To assure proper hose tension, hoses should not sag more than three to four inches when boom is fully extended.

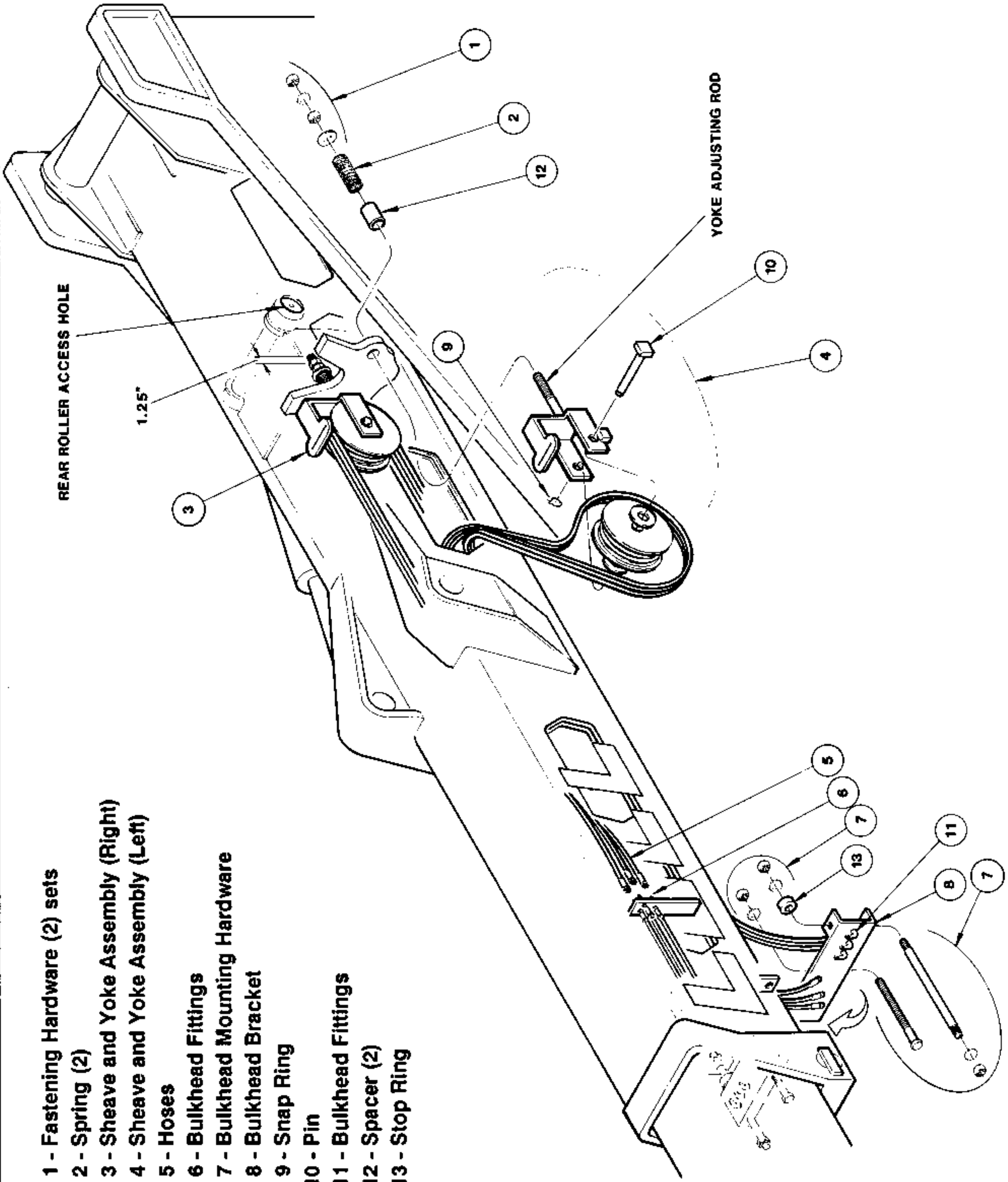
12. Secure stop rings (Item 13) behind tension bulkhead bracket.

13. 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.

BOOM AND TILT CARRIAGE

THREE SECTION BOOM (MODEL 1044)



1 - Fastening Hardware (2) sets
2 - Spring (2)
3 - Sheave and Yoke Assembly (Right)
4 - Sheave and Yoke Assembly (Left)
5 - Hoses
6 - Bulkhead Fittings
7 - Bulkhead Mounting Hardware
8 - Bulkhead Bracket
9 - Snap Ring
10 - Pin
11 - Bulkhead Fittings
12 - Spacer (2)
13 - Stop Ring

Figure 4-8 Hose and Hose Sheave Removal (Model 1044)

THREE SECTION BOOM (MODEL 1044)

HOSE INSTALLATION (cont.)

14. Cycle boom carriage tilt and auxiliary functions fully in one direction and hold for 15 seconds; cycle fully in opposite direction and hold for 15 seconds. Repeat. This procedure will remove air from the hydraulic circuits.

HOSE SHEAVE REMOVAL (Figure 4-8)

1. Raise boom parallel to the ground and move transfer carriage full forward.

2. Extend boom until center boom's rear roller aligns with service access hole in outer boom.

3. Apply the parking brake, shut off the engine and release all hydraulic pressure in the system (see warning and procedure on page 3.2-1 in Section 3).

4. Remove fastening hardware (Item 1) and springs (Item 2) from both hose and sheave yoke adjusting rods.

CAUTION: These assemblies are under tension.

5. Tag and disconnect hoses (Item 5) from bulkhead fittings (Item 6) in inner boom.

6. Remove the left and right sheave and yoke assemblies (Items 3 and 4) from boom.

NOTE: Pulling on the hoses coming off the top of the sheaves will cause the sheave and yoke assemblies to move forward towards an access window. Lift up and swing lower half of assembly through the window and remove.

7. Separate hoses from sheave and yoke assembly by removing snap ring (Item 9) on pin (Item 10) and removing pin from yoke. The sheave will drop free.

NOTE: Left and right yokes are not interchangeable.

HOSE SHEAVE INSTALLATION (Figure 4-8)

1. Reassemble new hose sheaves to hoses and yokes.

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

2. Replace hoses and sheave and yoke assemblies in boom and work yoke adjustment rods back through mounting holes.

3. Add spacers (Item 12) springs (Item 2) and fastening hardware (Item 1).

NOTE: When assembling fastening hardware do not compress springs (final adjustment will be done in step 5).

4. Connect hose ends (Item 5) to bulkhead fittings (Item 6) in inner boom.

NOTE: Hoses will stretch.

5. Compress springs (Item 2) on yoke adjusting rods to expose 1.25 inches of threaded rod past both jam nuts and tighten jam nuts securely.

6. Increase tension on hoses at hose tension adjustment assembly so bulkhead bracket (Item 8) nears center of its travel.

7. Visually check for crossed hoses.

8. To assure proper hose tension, hoses should not sag more than three to four inches when boom is fully extended.

9. 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.

BOOM AND TILT CARRIAGE

THREE SECTION BOOM (MODEL 1044)

HOSE SHEAVE INSTALLATION (cont.)

10. Cycle boom carriage tilt and auxiliary functions fully in one direction and hold for 15 seconds; cycle fully in opposite direction and hold for 15 seconds. Repeat. This procedure will remove air from the hydraulic circuits.

CABLE REMOVAL - LOWER (Figure 4-9)

1. Extend the boom to align the center boom rear roller pin with the service access hole in the outer boom.

2. Note the position of the service access hole in relation to air cleaner and cab. Position the transfer carriage so the air cleaner and cab do not inhibit access to the rear of the center boom. Access to the rear of the center boom is necessary to remove the lower cable.

3. Raise or lower the boom to improve work accessibility. Apply the parking brake and turn the engine off.

4. Remove fastening hardware (Item 1) from the adjusting rod end of the lower cable (Item 2) located on the bottom side at the front of the outer boom. Remove cable from mounting hole.

5. Remove snap ring (Item 3) sheave mounting pin (Item 4) sheave (Item 5) and thrust washers (Item 6) from mounting bracket (Item 7) at the rear of the center boom.

6. Pull detached cable end towards the rear of the outer boom, clearing the sheave mounting bracket.

7. Locate the lower cable anchor block (Item 8) at the rear of the inner boom (on the bottom). Unthread the cable end rod from the anchor.

8. Pull the cable through the hole in the extension cylinder mounting bracket and out the rear of the outer boom.

CABLE INSTALLATION - LOWER

1. Install lower cable, reversing steps 4 through 8 above.

NOTE: Thread the cable shorter rod end into the anchor block in inner boom so threads on the rod bottom out. The adjustment end of the cable (longer rod end) has enough length to start the fastening hardware.

NOTE: A cord fastened to the adjustment end of the cable, and routed between the center and outer booms, can help pull the adjustment end to its mounting bracket.

NOTE: When tightening fastening hardware, be sure not to twist the cable.

NOTE: Avoid crossing cables and hoses.

2. Check cable adjustment (fully extend the boom and note cable tension):
   a. Cable is taut - O.K.
   b. Cable sags - tighten cable
   c. Cable is excessively tight (full boom extension is hindered) - readjust cable tension.

CABLE REMOVAL - UPPER (Figure 4-9)

1. Extend the boom to align the center boom rear roller pin with the service access hole in the outer boom.

2. Note the position of the service access hole in relation to air cleaner and cab. Position the transfer carriage so the air cleaner and cab do not inhibit access to the rear of the center boom.

3. Raise or lower the boom to improve work accessibility. Apply the parking brake and turn the engine off.

4. Remove fastening hardware (Item 9) from the adjusting rod end of the upper cable (Item 10) where it is fastened to the cylinder block (Item 11) located at the back of the outer boom.

BOOM AND TILT CARRIAGE

THREE SECTION BOOM (MODEL 1044)

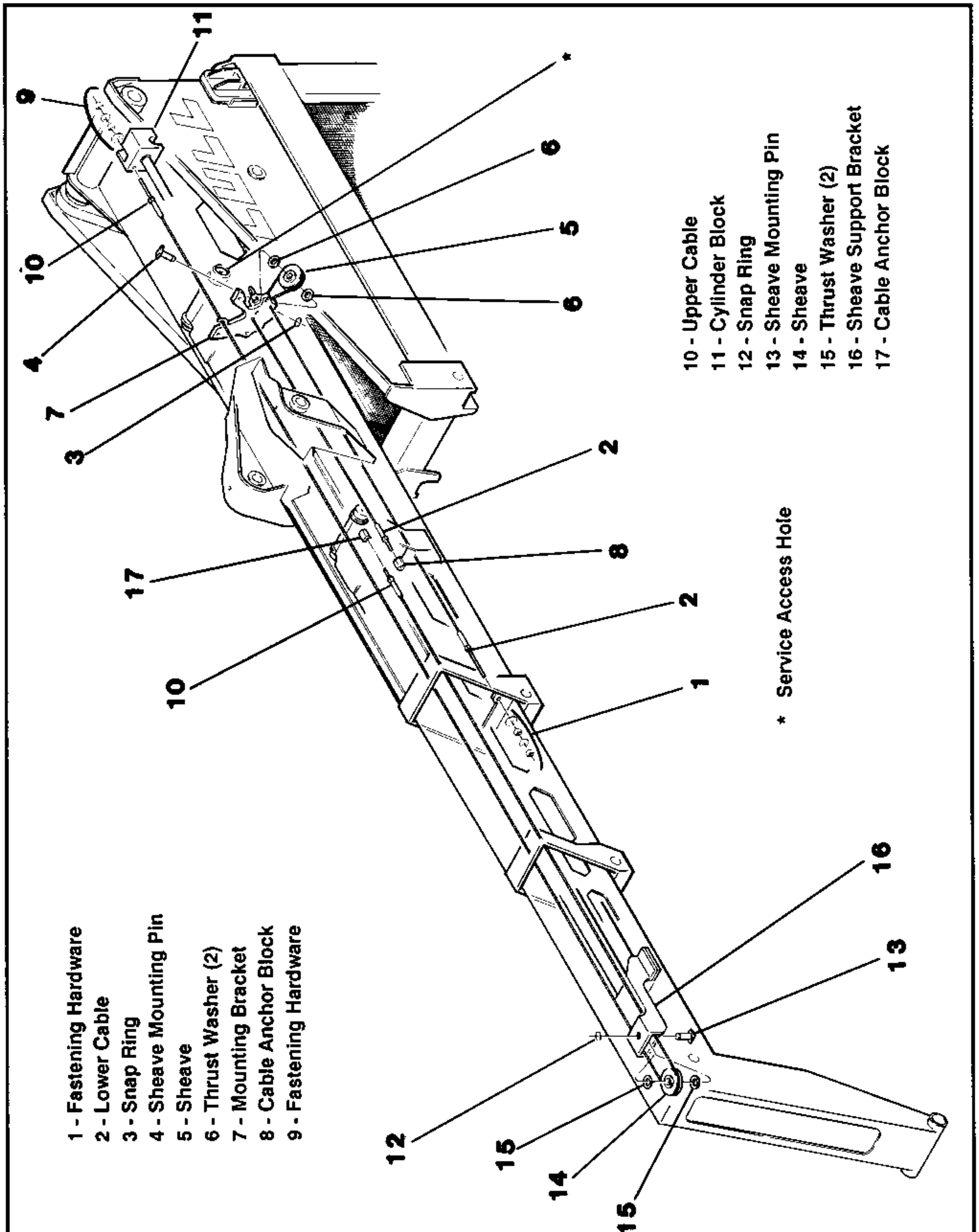


Figure 4-9 Cable Removal (Model 1044)

THREE SECTION BOOM (MODEL 1044)

CABLE REMOVAL - UPPER (cont.)

5. Remove snap ring (Item 12) sheave mounting pin (Item 13) sheave (Item 14) and thrust washers (Item 15) from front sheave support bracket (Item 16).

6. Pull detached cable end towards the front of the inner boom, clearing the sheave support bracket.

7. Locate the upper cable anchor block (Item 17) at the rear top of the inner boom. Unthread the cable end rod from the anchor.

8. Pull the cable from the front of the inner boom.

CABLE INSTALLATION - UPPER

1. Install upper cable, reversing steps 4 through 8 above.

NOTE: The shorter cable rod end threads into the anchor block within the inner boom. The longer cable rod end is for cable adjustment at the rear of the outer boom.

NOTE: When tightening fastening hardware, be sure not to twist the cable.

2. Check cable adjustment (fully extend the boom and note cable tension):
   a. Cable is taut - O.K.
   b. Cable sags - tighten cable.
   c. Cable is excessively tight (full boom extension is hindered) - readjust cable tension.

ROLLER/SHIM REMOVAL AND INSTALLATION (Figure 4-10)

REAR OF INNER BOOM

1. Level and extend boom until roller shaft is aligned with service access holes on center boom.

2. Relieve force holding rollers against tracking rails by performing one of the following procedures:

   a. Tap a wedge between the inner and center boom directly above the roller shaft.

   b. Lift the front of the inner boom with hoist.

   c. Lower the nose of the inner boom until front tires are just off the ground.

3. Apply the parking brake and stop the engine before working on the boom.

4. Loosen jam nut (Item 50) and setscrew (Item 38).

5. Push pin (Item 21) through service hole until rollers (Items 11) drop free. NOTE: Be careful not to lose shims (Items 12).

6. Remove rollers through boom side openings (windows).

7. Install rollers, reversing steps 2 through 6.

NOTE: Clearance between roller flange and rail is to be 1/16 inch per side. Shim accordingly.

8. Grease rollers.

REAR OF CENTER BOOM

1. Lower and extend boom until roller shaft is aligned with service access holes in outer boom.

2. Relieve force holding rollers against tracking rails by performing one of the following procedures:

   a. Lift the front of inner boom with hoist.

   b. Lower the nose of the inner boom until front tires are just off the ground.

NOTE: Should neither procedure work effectively, it may be necessary to remove the upper wear plate between the center and outer boom.

3. Apply the parking brake and stop the engine before working on the boom.

4. Loosen jam nut (Item 50) and setscrew (Item 38).

5. Push pin (Item 20) through service hole until rollers drop free. NOTE: Be careful not to lose shims (Items 12).

6. Remove rollers (Items 11) through boom side openings (windows).

THREE SECTION BOOM (MODEL 1044)

ROLLER/SHIM REMOVAL AND INSTALLATION (cont.)

REAR OF CENTER BOOM (cont.)

7. Install rollers, reversing steps 2 through 6.

NOTE: Clearance between roller flange and rail is to be 1/16 inch per side. Shim accordingly.

8. Grease rollers.

FRONT OF CENTER BOOM

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

2. Remove screws and lockwashers (Items 43 & 47) securing the upper wear plate (Item 31) between the inner and center booms.

3. Remove slide plate and shims (Items 26, 27, 30, 31).

4. With hoist, lift inner boom off center boom front rollers.

5. Remove screws (Item 40) securing roller pins to boom.

6. Tap pins (Item 19) out until rollers drop free. NOTE: Be careful no to lose shims (Items 12).

7. Install rollers, reversing steps 2 through 6.

NOTE: Clearance between roller flange and rail is to be 1/16 inch per side. Shim accordingly.

8. Grease rollers.

FRONT OF OUTER BOOM

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

2. Remove screws and lockwashers (Item 43 & 47) securing the upper slide plate (Item 26, 27, 28, 29) between the center and outer booms.

3. Remove slide plate and shims.

NOTE: If slide plate is difficult to remove, notice the two threaded holes on top of the outer boom just behind the three wear plate mounting holes. By providing two screws for these holes, and tightening them against the top of the center boom, clearance will be provided allowing for easier wear plate removal.

4. With hoist, lift inner and center booms off the outer boom front rollers.

5. Remove screws (Item 40) securing roller pins to boom.

6. Tap pins (Item 19) out until rollers drop free. NOTE: Be careful not to lose shims (Items 12).

7. Install rollers, reversing steps 2 through 6.

NOTE: Clearance between roller flange and rail is to be 1/16 inch per side. Shim accordingly.

8. Grease rollers.

SLIDE PLATE/SHIM REMOVAL AND INSTALLATION (Figure 4-10)

FRONT OF CENTER BOOM

1. Position the machine on level surface, lower the boom, apply the parking brake and stop the engine.

2. Remove (3) screws and lockwashers (Items 43,47).

3. Remove slide plate (Item 31) base plate (Item 26) and shim(s) (Item 27).

4. Remove (4) screws (Item 39), separating the slide plate from the base plate.

5. Install slide plate and shims, reversing steps 2 through 4. Shim slide plate so there is 1/16 inch clearance between slide plate and top of inner boom.

FRONT OF OUTER BOOM

NOTE: Procedure is the same as that for front of center boom.

BOOM AND TILT CARRIAGE

THREE SECTION BOOM (MODEL 1044)

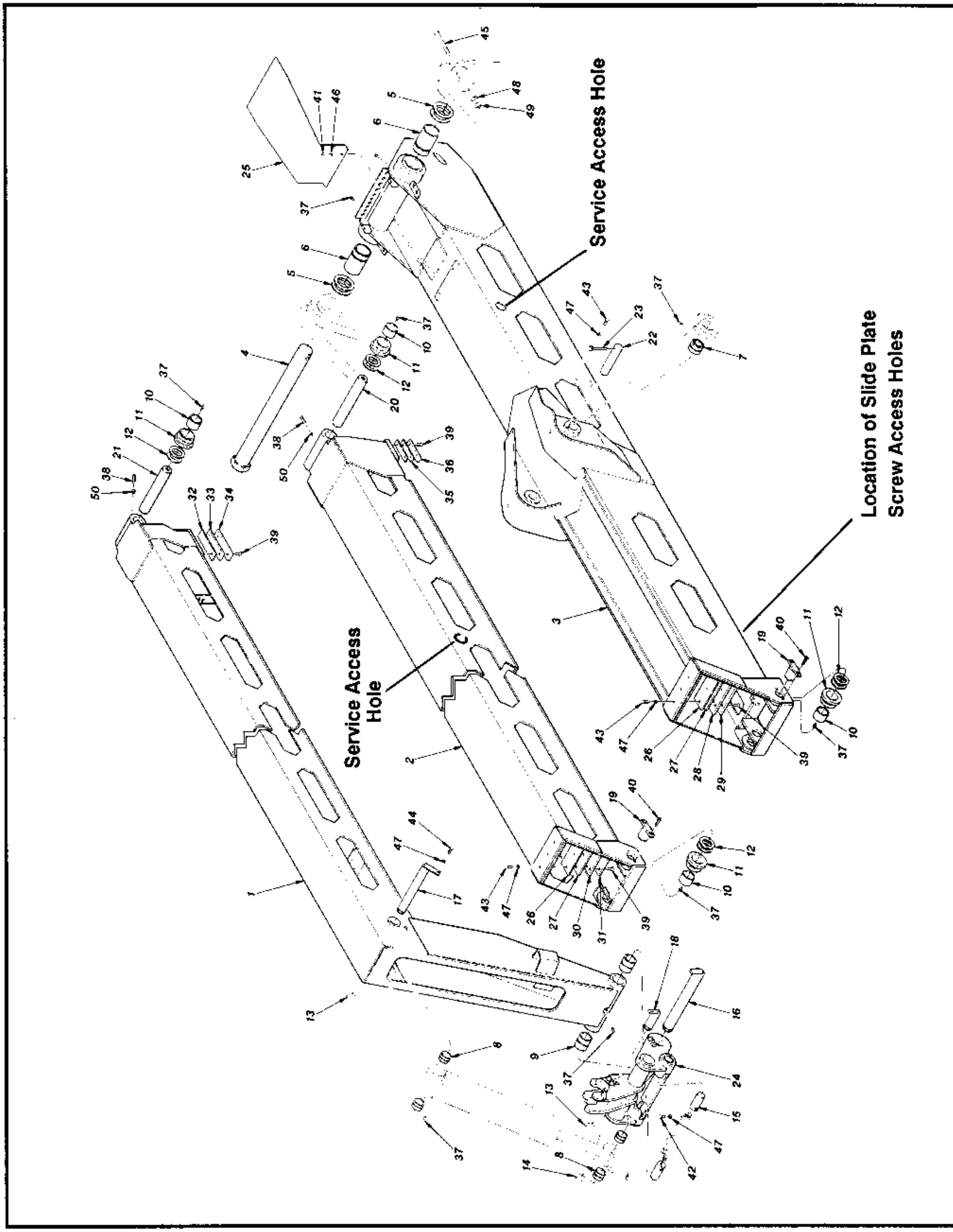


Figure 4-10 Rollers, Slide Plates, Shims and Bushings Removal

BOOM AND TILT CARRIAGE

THREE SECTION BOOM (MODEL 1044)

1 - Inner Boom	31 - Slide Plate, Center Boom-Front
2 - Center Boom	32 - Shim, 1/16", Inner Boom-Rear
3 - Outer Boom	33 - Shim, 1/8", Inner Boom-Rear
4 - Pin, Boom Pivot	34 - Slide Plate, Inner Boom-Rear
5 - Shim, Boom Pivot	35 - Shim, 1/8", Center Boom-Rear
6 - Bushing, Boom Pivot	36 - Slide Plate, Center Boom-Rear
7 - Bushing, Hoist Cylinder	37 - Grease Zerk
8 - Bushing, Carriage Tilt Cylinder	38 - Setscrew, 1/2" x 1"
9 - Bushing, Quick Attach Pivot	39 - Screw, Socket Fl. Hd., 1/2" x 3/4"
10 - Bushing, Roller	40 - Screw, Socket Fl. Hd., 1/2" x 1 1/2"
11 - Roller	41 - Bolt, 3/8" x 3/4"
12 - Spacer Washer	42 - Bolt, 1/2" x 3/4"
13 - Snap Ring, Tilt Cylinder Pin	43 - Bolt, 1/2" x 1 1/4"
14 - Sanp Ring, Quick Attach Pin	44 - Bolt, 1/2" x 2"
15 - Pin, Quick Attach Cylinder	45 - Bolt, 5/8" x 7"
16 - Pin, Quick Attach Pivot	46 - Lockwasher, 3/8"
17 - Pin, Tilt Cylinder - Upper	47 - Lockwasher, 1/2"
18 - Pin, Tilt Cylinder - Lower	48 - Lockwasher, 5/8"
19 - Pin, Front Roller	49 - Nut, 5/8"
20 - Pin, Center roller	50 - Jam Nut, 1/2"
21 - Pin, Inner Roller	
22 - Pin, Hoist Cylinder	
23 - Lock Pin, Hoist Cylinder	
24 - Quick Attach	
25 - Cover, Leveling Valve	
26 - Shim, 1/16", Center & Outer Boom-Front	
27 - Shim, 1/8", Center & Outer Boom-Front	
28 - Base, Slide Plate, Outer Boom-Front	
29 - Slide Plate, Outer Boom-Front	
30 - Base, Slide Plate, Center Boom-Front	

Table 4-2 Material List for Figure 4-10

THREE SECTION BOOM (MODEL 1044)

SLIDE PLATE/SHIM REMOVAL AND INSTALLATION (cont.)

REAR OF INNER BOOM

1. Position the machine on level surface, fully extend and lower the boom, apply the parking brake and stop the engine.

2. Remove inner boom from center boom (see "Boom Separation").

3. Remove screws (Item 39).

4. Remove slide plate(s) (Item 34) and shim(s) (Items 32, 33).

5. Measure and note the smallest vertical dimension on the right and left side of the center boom, along the length of the boom, from rail in boom ceiling to floor of boom (See Figure 4-11). Subtract 1/16 inch from each dimension to allow for clearance. The two adjusted dimensions must match the distance from the top of the rear roller and bottom of the slide plate of the inner boom. Right side dimension applies only to right side shim adjustment and left side dimension applies only to left side shim adjustment.

6. Install slide plates and shims according to measurements above, reversing steps 3 through 4.

7. Install inner boom into center boom.

REAR OF CENTER BOOM

1. Position the machine on level surface, place transmission in neutral and apply the parking brake. Lower the boom near surface.

2. Extend center boom until slide plate screw heads align with outer boom access holes.

3. Remove screws (Item 39).

4. Extend boom an additional 3 inches until rear screw heads align with access holes.

5. With boom lowered near surface, shut off the engine.

6. Remove screws (Item 39).

7. Remove slide plate(s) (Item 3) and shim(s) (Item 35) through boom opening.

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 4-11). (This is the narrowest portion of the outer boom.) Subtract 1/16 inch from dimension to allow for clearance. This adjusted dimension must match the distance from the top of the rear roller and bottom of the slide plate of the center boom. Measurement must be taken on side of boom where slide plate is to be installed.

8. Install slide plate(s) and shim(s) according to measurements above, reversing steps 3 through 7.

BOTTOM OF FRONT SHEAVE SUPPORT

1. Position the machine on a level surface, lower the boom, apply the parking brake and stop the engine.

2. Loosen upper cable tension from rear so front cable sheave pin can be removed and sheave and cable can be placed aside.

3. Support front of extension cylinder housing with block.

4. Remove extension cylinder rod end nut and washer (Figure 4-7, Items 1, 2 & 3).

5. Remove cylinder nut and washer (Items 21 & 22).

6. Remove fasteners (Items 11).

7. Pull inner boom out as far as necessary to remove front sheave support bracket (Item 12) from cylinder.

8. Turn front sheave support on side to gain access to slide plate fasteners. Slide plates and shims through boom window.

9. Replace slide plates and shims so as to provide 1/16" total clearance when installed.

10. Reverse steps 2 through 8 above for reassembly.

THREE SECTION BOOM (MODEL 1044)

BOOM PIVOT SHIM REMOVAL AND INSTALLATION (Figure 4-10)

1. Position the machine on level surface. Fully retract boom and transfer carriage and rest fork carriage on the ground.

2. Apply the parking brake and stop the engine.

3. Remove bolt, lockwasher and nut (Items 45.48.49) securing the main boom pivot pin (Item 4) to the transfer carriage.

4. Secure overhead hoist chain to outer boom just behind the mounting brackets for the rod end of the hoist cylinders. (Weight of boom is approximately 2 1/4 tons.) This chain location should approximate the balancing point of the boom.

5. Detach hoist cylinders from outer boom. (Weight of hoist cylinders are approximately 200 LBS.) Lower hoist cylinders to rest.

6. Lift boom until weight is off the pivot pin.

7. Drive the pivot pin free from boom and transfer carriage.

NOTE: Adding or removing one shim would not require complete removal of the pivot pin.

8. Remove shims (Items 5).

9. Replace shims, reversing steps 3 through 8.

10. Grease boom pivot pin bushings.

NOTE: To assist alignment of transfer carriage and boom pivot pin holes, start the engine and operate the frame tilt.

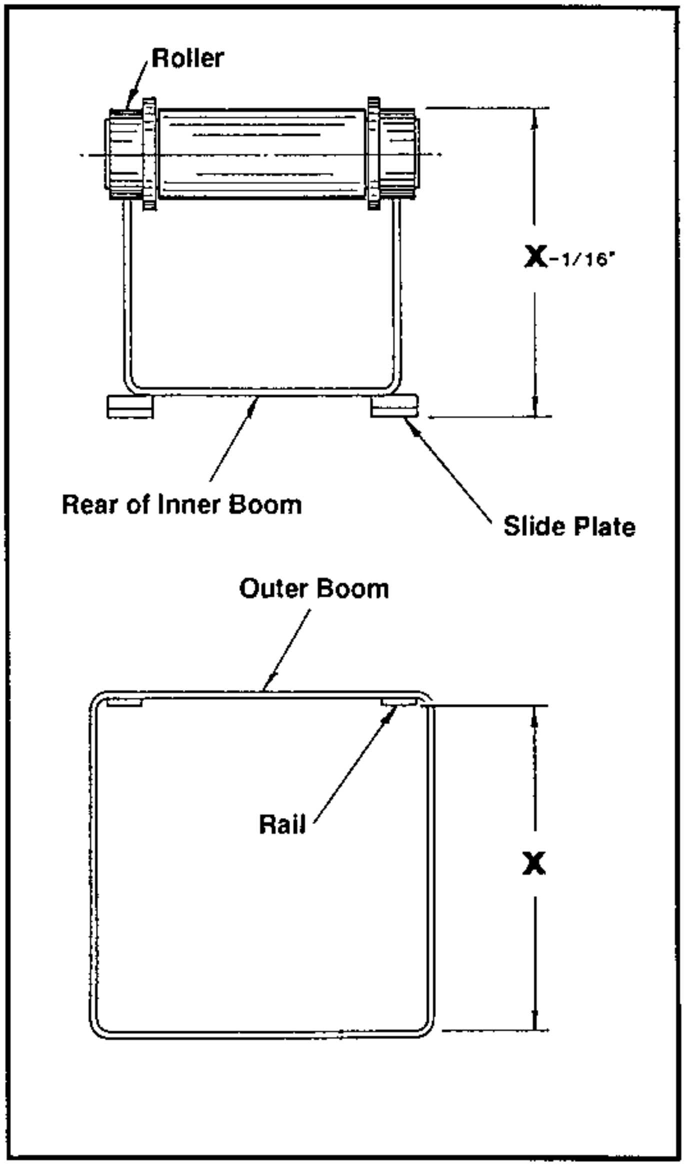


Figure 4-11 Boom Slide Plate Clearance

CARRIAGE TILT CYLINDERS (MODELS 644, 844, 1044)

DESCRIPTION

The model 644 and 844 forklifts are equipped with two carriage tilt cylinders - front and rear. The front carriage tilt cylinder is located in the nose of the boom. It has one pivot end attached to the boom and the other pivot end attached to the fork carriage. The rear carriage tilt cylinder is located at the rear of the boom and has one pivot end attached to the boom and the other pivot end attached to the transfer carriage. (See Figure 3-1 in Section 3 for tilt cylinder locations.)

The model 1044 forklift is equipped with a front carriage tilt cylinder only, 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 quick attach assembly (see Figure 3-2 in Section 3.)

The front carriage tilt cylinder tilts the fork carriage forward or rearward depending on the operator's manipulation of the manually operated carriage tilt control valve 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 on models 644 and 844 by hydraulic interaction between the front and rear carriage tilt cylinders; automatic fork leveling is accomplished on model 1044 by a fork leveling valve (see page 4.8-1).

AUTOMATIC FORK LEVELING (MODELS 644, 844)

BOOM DOWN MODE (Figure 4-12)

As the boom is lowered, pressure and flow develop at the rod end of the expanding rear tilt cylinder which is directed to the rod end of the front tilt cylinder through its counterbalance valve. This pressure and flow forces the front tilt cylinder to retract. Oil at the base end of the front tilt cylinder displaces to the base end of the rear tilt cylinder. Oil, trapped by the neutral position of the carriage tilt control valve, moves between cylinders. Flow is proportional and leveling is maintained as the boom is lowered. Protection to the circuit is provided by port reliefs at the control valve.

BOOM UP MODE (Figure 4-13)

As the boom is raised, pressure and flow developing at the base end of the compressing rear tilt cylinder is directed to the base end and the counterbalance valve of the front tilt cylinder. This pressure and flow opens the counterbalance valve at the rod end of the front tilt cylinder, allowing extension of the cylinder. Oil at the rod end of the front tilt cylinder displaces to the rod end of the rear tilt cylinder. Oil, trapped by the neutral position of the carriage tilt control valve, moves between cylinders. Flow is proportional and fork leveling is maintained as the boom is raised. Protection to the circuit is provided by port reliefs at the control valve.

TROUBLESHOOTING FORK LEVELING (MODELS 644, 844)

For information regarding the solving of automatic fork leveling problems see "System Troubleshooting" on page 3.11-1 in Section 3.

MAINTENANCE

Maintenance of the carriage tilt cylinders 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 3.18-1 in Section 3).

BOOM AND TILT CARRIAGE

CARRIAGE TILT CYLINDERS (MODELS 644, 844, 1044)

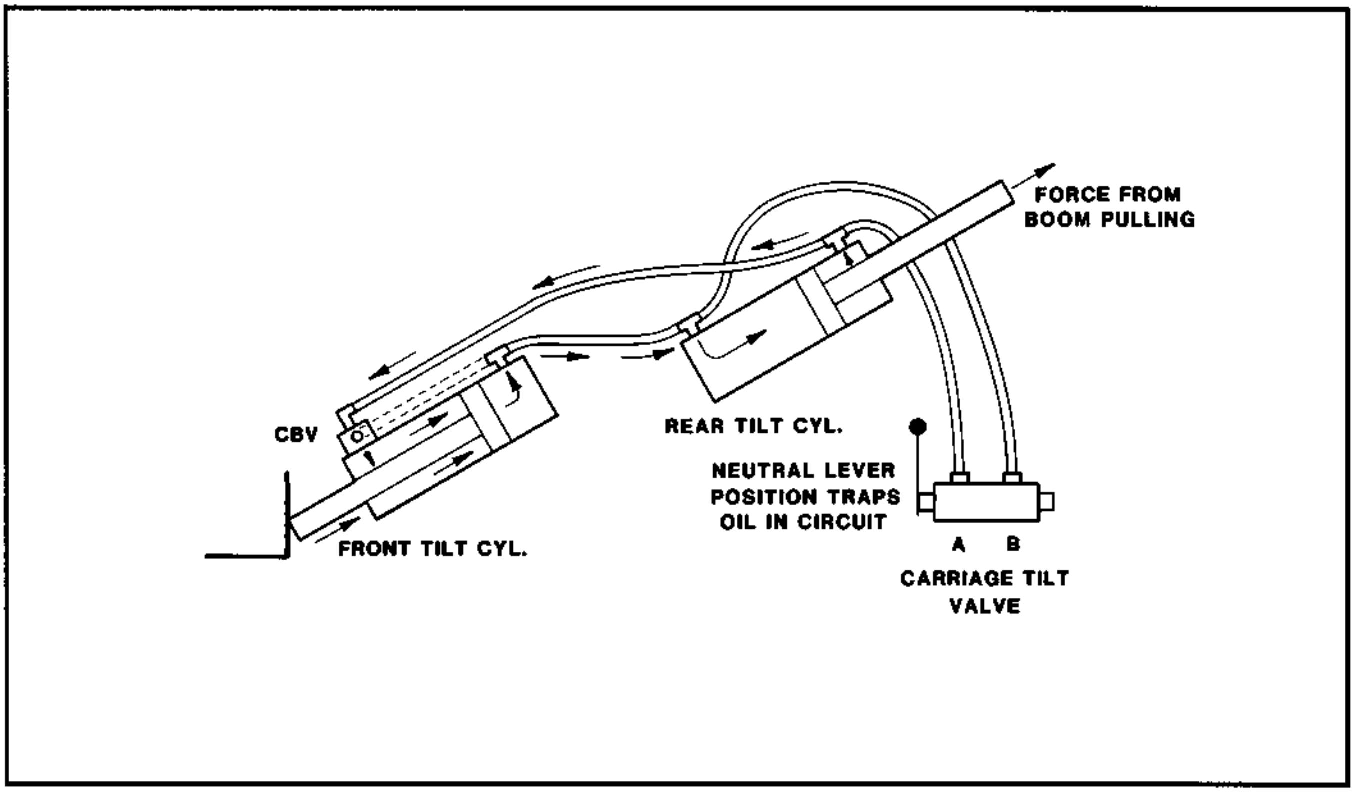


Figure 4-12 Flow Diagram-Automatic Fork Leveling (Boom Down Mode)

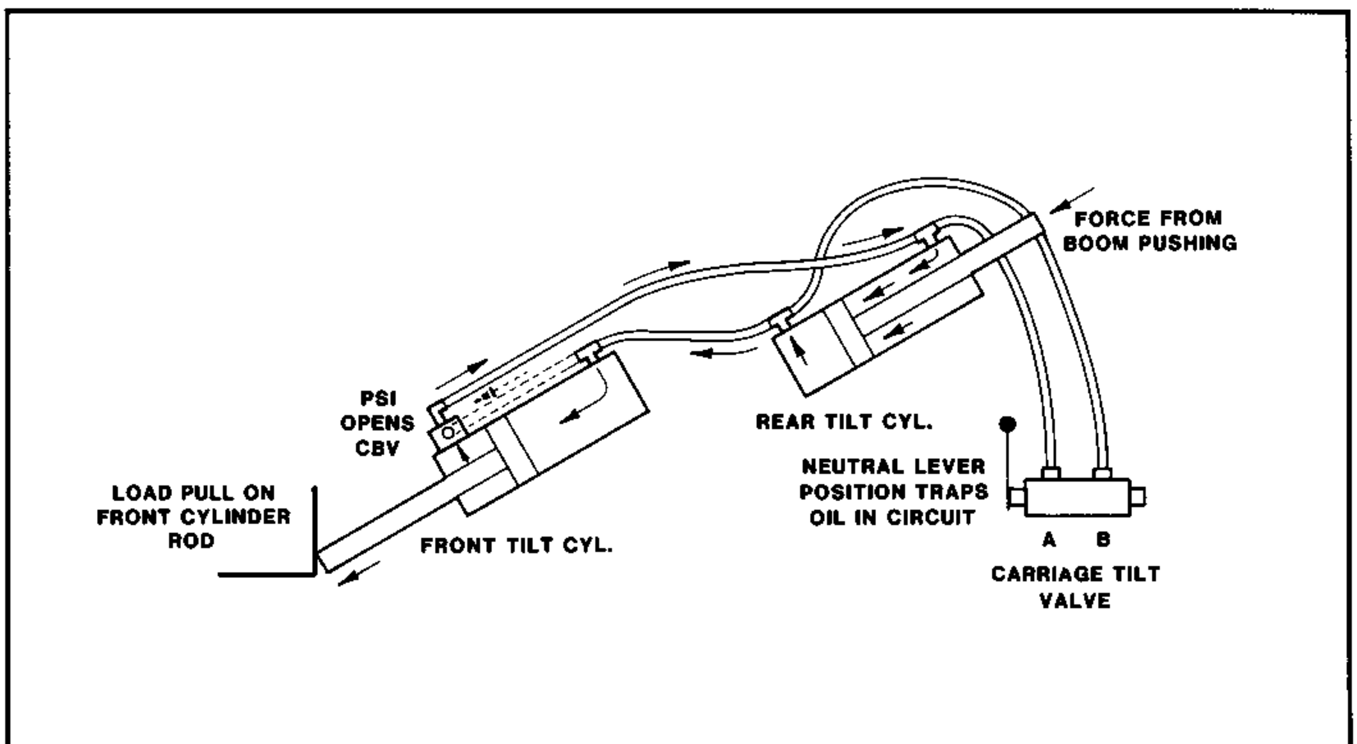


Figure 4-13 Flow Diagram-Automatic Fork Leveling (Boom Up Mode)

CARRIAGE TILT CYLINDERS (MODELS 644, 844, 1044)

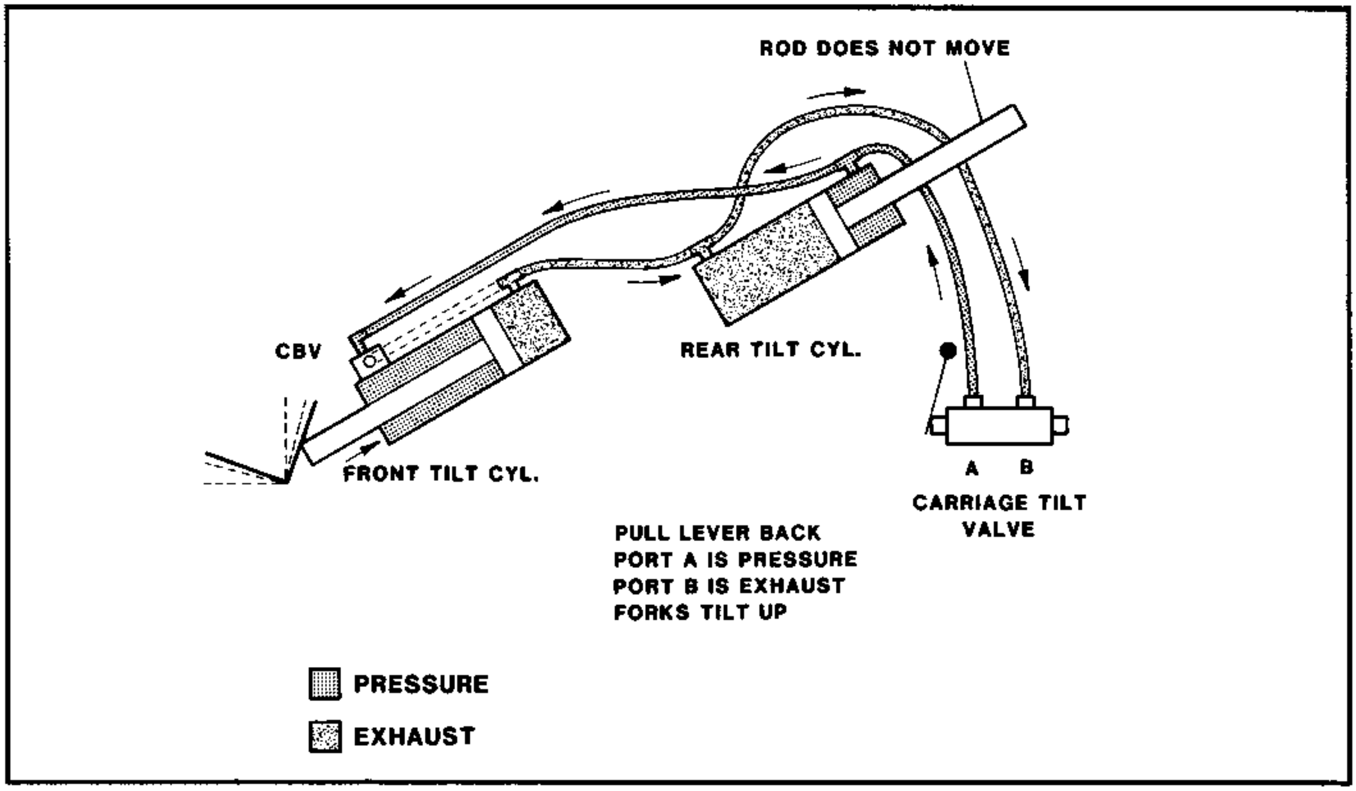


Figure 4-14 Flow Diagram-Manual Fork Tilt (Up)

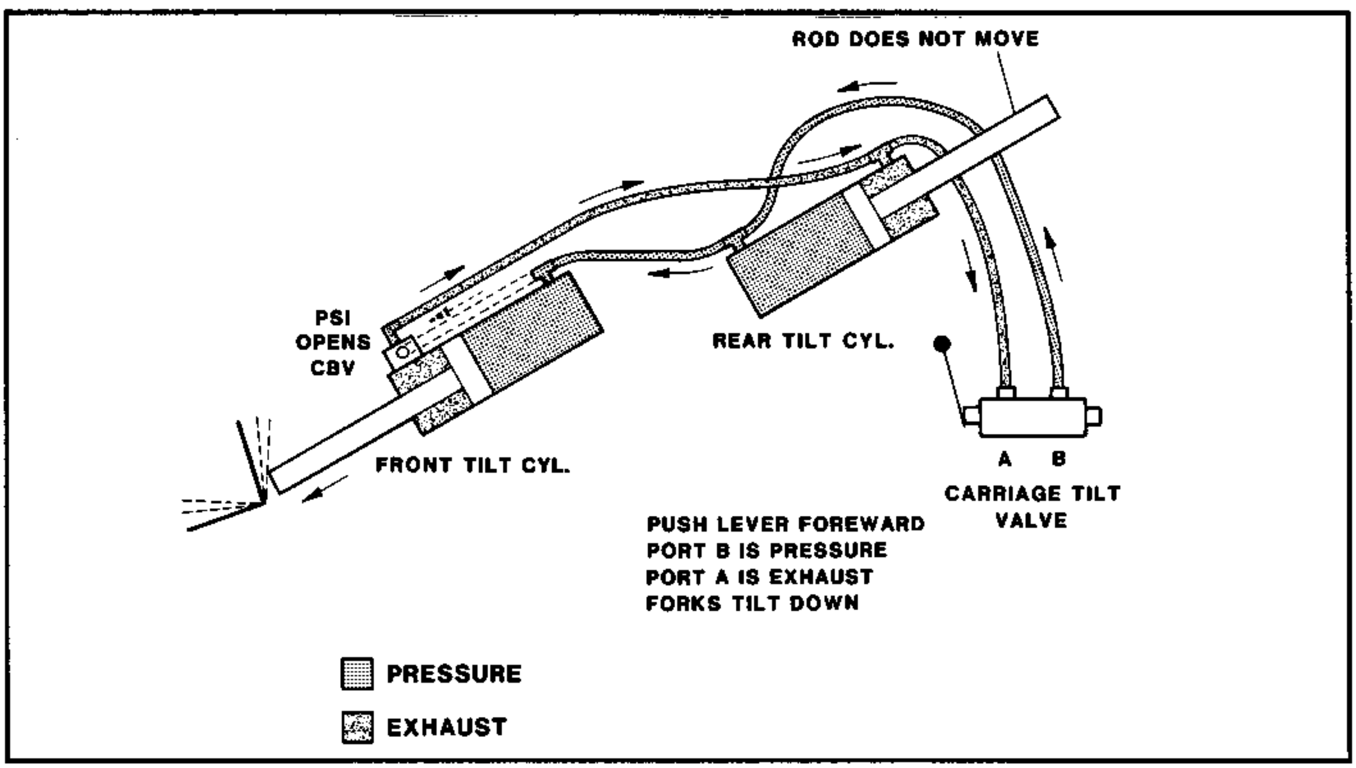


Figure 4-15 Flow Diagram-Manual Fork Tilt (Down)

CARRIAGE TILT CYLINDERS (MODELS 644, 844, 1044)

REMOVAL OF FRONT 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 (Models 644, 844), 195 LBS (Model 1044).

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 FRONT 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.

REMOVAL OF REAR TILT CYLINDER (MODELS 644, 844)

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 in Section 3).

3. Tag and disconnect four hydraulic hoses from the cylinder and cap the openings.

4. Support the cylinder (approximate weight 105 LBS).

5. Remove bottom pivot pin.

6. Remove top pivot pin.

7. Remove cylinder.

INSTALLATION OF REAR TILT CYLINDER (MODELS 644, 844)

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 3.18-1 in Section 3.

FORK LEVELING VALVE (MODEL 1044)

FORK LEVELING VALVE

Refer to page 3.53-1 in Section 3 for information regarding operation and servicing of the fork leveling valve.

TRANSFER CARRIAGE

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LIST OF FIGURES

TRANSFER CARRIAGE (MODELS 644, 844, 1044)

DESCRIPTION (Figures 5-1, 5-2, and 5-3)

The Lull model 644, 844, and 1044 forklifts incorporate a patented transfer carriage which provides additional boom reach when placing a load, after the forklift is positioned, without requiring movement of the forklift itself. The transfer carriage supports the boom and rides upon rails by way of rollers as the carriage moves forward and rearward, powered by a hydraulic cylinder. Total travel distance of the transfer carriage is 72 inches (644), 80 inches (844 and 1044).

MAINTENANCE

Maintenance of the transfer carriage requires periodic greasing of the rollers (see Service Schedules in Section 2). Periodically check cylinder condition (see "Checking Cylinder Condition" in Section 3) and check hoses for chafing, cracks and other signs of wear and replace when wear is indicated.

IMPORTANT: DO NOT GREASE TRANSFER CARRIAGE RAILS.

REMOVAL WITH BOOM ATTACHED

Use the following procedure to remove the transfer carriage and boom, as a complete assembly, 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 procedures.

2. Remove the fork carriage.

3. Position the machine on a level surface, level the boom, apply the parking brake and stop the engine.

4. Support the boom and transfer carriage from above with an overhead hoist. Approximate weight of boom and transfer carriage is 3 1/4 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 lines and hoses at the transfer carriage which lead from the lower part of the machine.

7. Remove set screw, nut and spacer from transfer cylinder rod end.

8. Remove front slide shoes.

9. Lift the boom and transfer carriage assembly until weight is off rear rollers. Remove rear rollers.

10. Lift the complete boom and carriage assembly from the machine.

INSTALLATION WITH BOOM ATTACHED

1. Reverse steps 4 through 10 above.

NOTE: Torque transfer carriage cylinder nut to 900 Ft/LBS and insert set screw.

NOTE: Refer to "Torque Specifications for Hydraulic Line Connections" in Secion 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 various boom functions fully in each direction and hold for 15 seconds. Repeat. This procedure will remove air from the hydraulic circuits.

TRANSFER CARRIAGE (MODELS 644, 844, 1044)

REMOVAL WITHOUT BOOM ATTACHED

Use the following procedure to remove the transfer carriage with the boom already removed:

1. Follow steps 1 through 12 on pages 4.2-1 and 4.2-3, "Boom Removal", for removing the boom from the machine (Models 644 and 844). Follow steps 1 through 10 on pages 4.4-1 and 4.4-3, "Boom Removal", for removing the boom from the machine (Model 1044).

2. Support the transfer carriage from above with an overhead hoist. Approximate weight of transfer carriage is 1500 LBS.

3. Remove hoist cylinder(s). Approximate weight each: 340 LBS (644), 260 LBS (844), 200 LBS (1044).

4. Remove the rear carriage tilt cylinder (644, 844), approximate weight 100 LBS.

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 lines and hoses at the transfer carriage which lead from the lower part of the machine.

7. Remove set screw, nut and spacer from transfer cylinder rod end.

8. Remove front slide shoes.

9. Lift the transfer carriage assembly until weight is off rear cam rollers. Remove rear cam rollers.

10. Lift the transfer carriage from the machine.

INSTALLATION WITHOUT BOOM ATTACHED

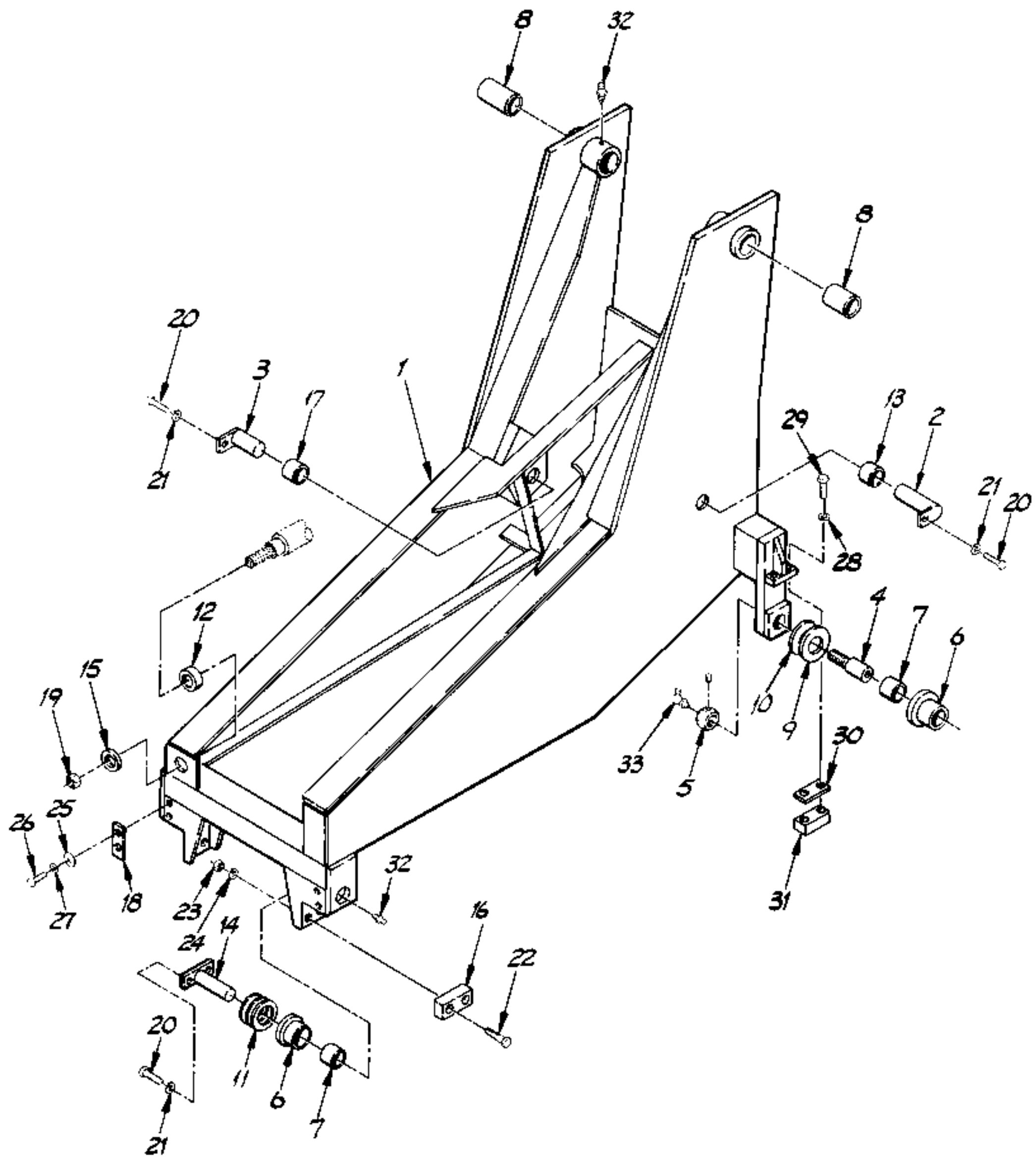
1. Reverse steps 1 through 10 above.

NOTE: Torque transfer carriage cylinder nut to 900 Ft/LBS and insert set screw.

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

2. Follow steps 1 through 4 on page 4.2-3, "Boom Installation", for installing boom (Models 644, 844). Follow steps 1 through 3 on page 4.4-3, "Boom Installation", for installing boom (Model 1044).

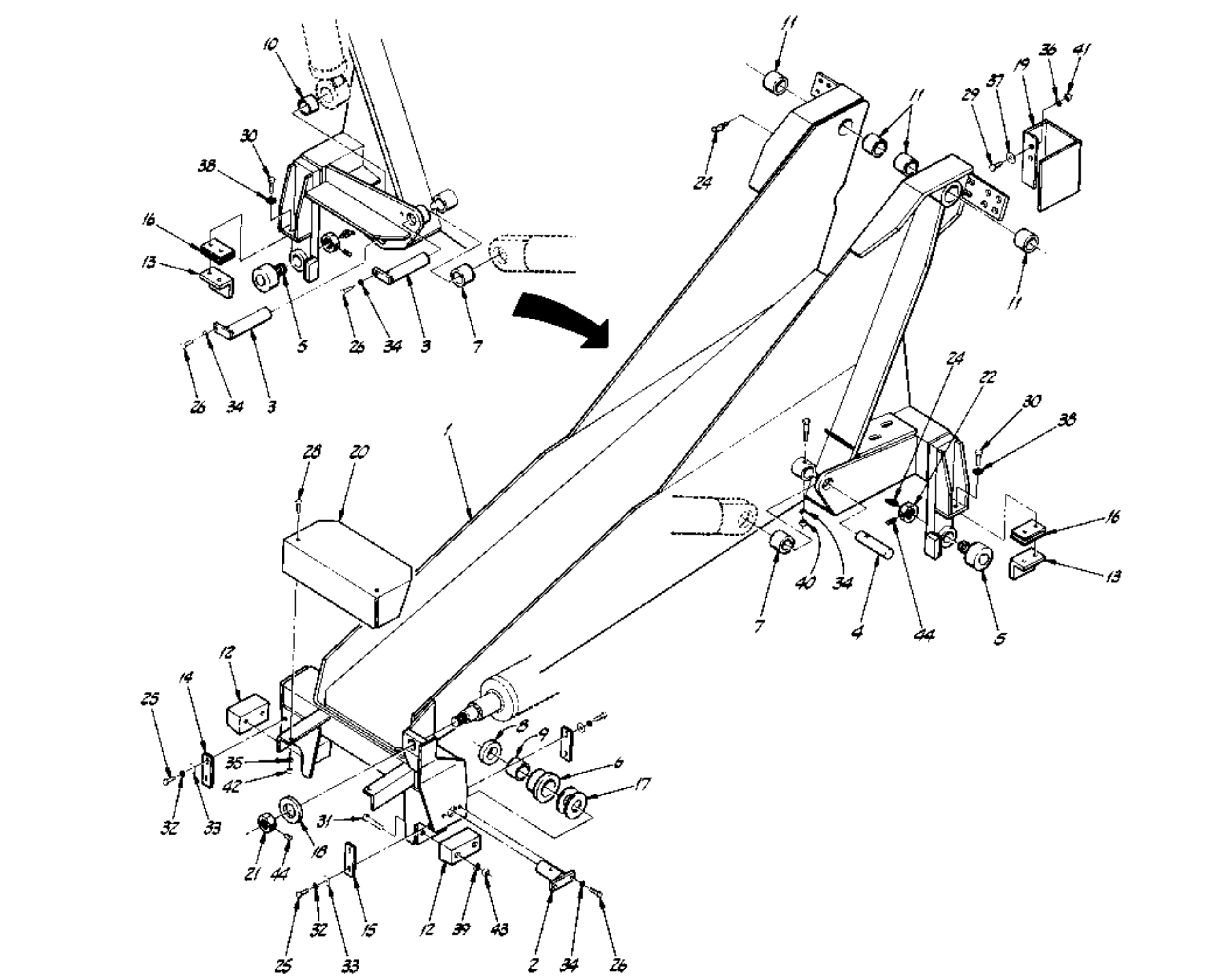
TRANSFER CARRIAGE



1 - Transfer Carriage
2 - Pin, Hoist Cylinder
3 - Pin, Tilt Cylinder
4 - Spindle, Rear Roller (2)
5 - Nut, Special (2)
6 - Roller (4)
7 - Bushing, Bronze (4)
8 - Bushing
9 - Thrust Washer (2)
10 - Spacer (A/R)
11 - Spacer Washer (A/R)
12 - Spacer, Thick
13 - Self-Aligning Bushing
14 - Front Roller Shaft (2)
15 - Spacer, Thin
16 - Slide Shoe, Front, (2)
17 - Self-Aligning Bushing
18 - Scraper Plate (4)
19 - Nut, Hx., 1 1/2"
20 - Bolt, Hx., 3/8" x 3/4" (6)
21 - Lockwasher, 3/8" (6)
22 - Bolt, Hx., 3/4" x 3 1/2" (4)
23 - Nut, Hx., 3/4" (4)
24 - Lockwasher, 3/4" (4)
25 - Flatwasher, 5/16" (8)
26 - Bolt, Hx., 5/16" x 3/4" (8)
27 - Lockwasher, 5/16" (8)
28 - Lockwasher, 1/2" (4)
29 - Bolt, Hx., 1/2" x 1" (4)
30 - Shim (2)
31 - Slide Shoe, Rear, (2)
32 - Grease Zerk (5)
33 - Grease Zerk, 45° (2)

Figure 5-1 Transfer Carriage (Model 644)

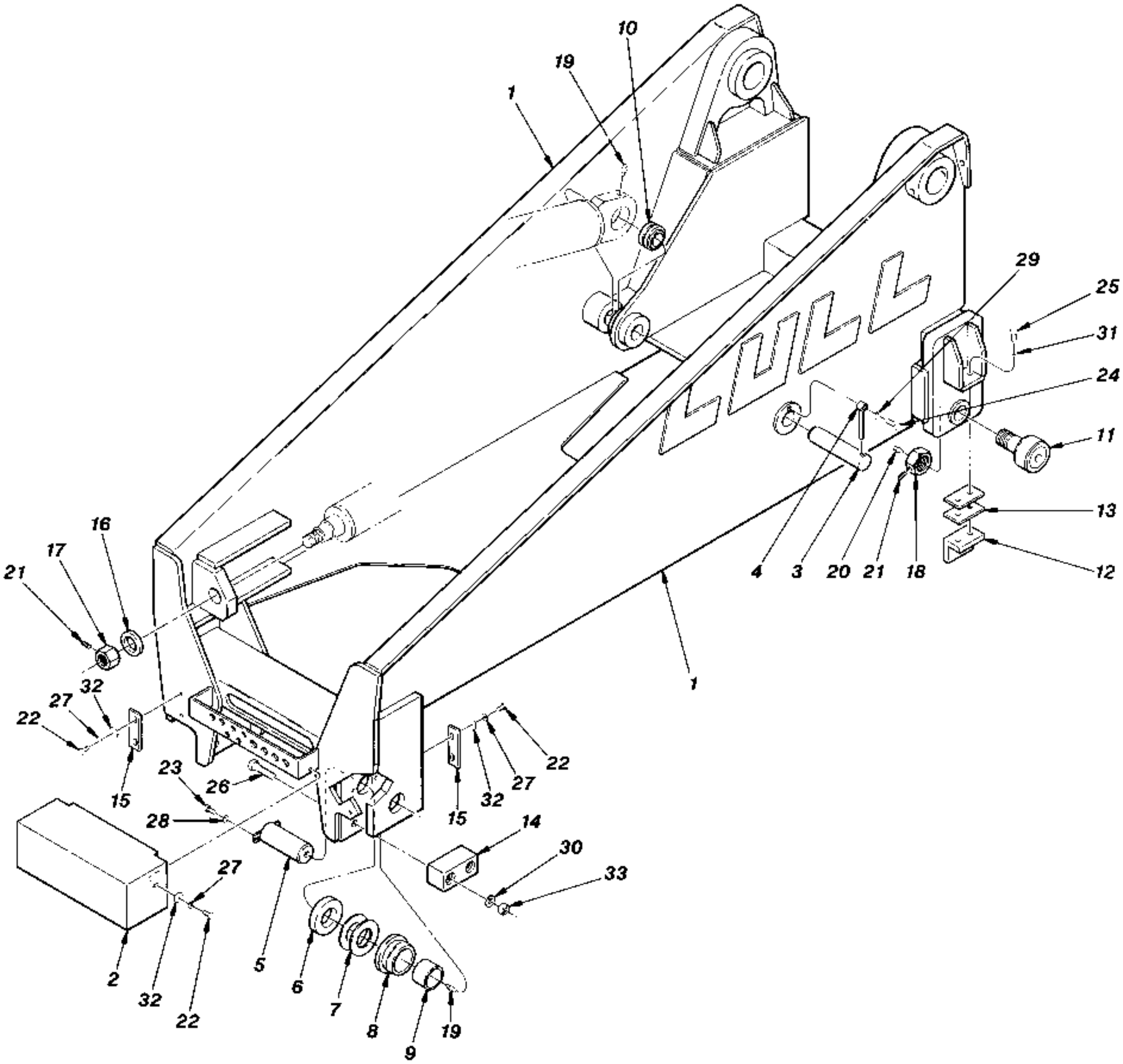
TRANSFER CARRIAGE



1 - Transfer Carriage
2 - Roller Shaft (2)
3 - Pin, Hoist & Tilt Cylinder (2)
4 - Pin, Hoist Cylinder Base
5 - Rear Roller (2)
6 - Front Roller (2)
7 - Bushing, Self-Align (2)
8 - Spacer, Roller (2)
9 - Bushing, Roller (2)
10 - Bushing, Tilt Cylinder
11 - Bushing, Pivot (4)
12 - Slide Shoe, Front (2)
13 - Slide Shoe, Rear (2)
14 - Scraper Plate, R.H. (2)
15 - Scraper Plate, L.H. (2)
16 - Shim, Rear Slide Shoe (A/R)
17 - Spacer Washer (6)
18 - Spacer, Cylinder Rod End
19 - Hose Guard, Rear
20 - Hose Guard, Front
21 - Nut, Hex Special
22 - Nut, Hex Special (2)
23 - Grease Zerk (2)
24 - Grease Zerk, 45° (4)
25 - Bolt, Hx., 5/16" x 3/4" (8)
26 - Bolt, Hx., 3/8" x 3/4" (6)
27 - Bolt, Hx., 3/8" x 3 3/4"
28 - Bolt, Hx., 7/16" x 1 1/4" (2)
29 - Bolt, Hx., 1/2" x 1 1/2" (2)
30 - Bolt, Hx., 5/8" x 1" (4)
31 - Bolt, Hx., 3/4" x 3 1/2" (4)
32 - Lockwasher, 5/16" (5)
33 - Flatwasher, 5/16" (5)
34 - Lockwasher, 3/8" (7)
35 - Lockwasher, 7/16" (2)
36 - Lockwasher, 1/2" (2)
37 - Flatwasher, 1/2" (2)
38 - Starwasher, 5/8" (4)
39 - Lockwasher, 3/4" (4)
40 - Nut, Hx., 3/8"
41 - Nut, Hx., 1/2" (2)
42 - Nut, Hx., 7/16" (2)
43 - Nut, Hx., 3/4" (4)
44 - Set Screw, 3/8" (3)

Figure 5-2 Transfer Carriage (Model 844)

TRANSFER CARRIAGE



1 - Transfer Carriage	12 - Slide Shoe, Rear (2)	23 - Bolt, Hx., 1/8" x 3/4" (4)
2 - Cover, Bulkhead Junction	13 - Shim, Rear Slide Shoe (A/R)	24 - Bolt, Hx., 1/2" x 1 1/4" (2)
3 - Pin, Hoist Cylinder, Lower (2)	14 - Slide Shoe, Front (2)	25 - Bolt, Hx., 5/8" x 1" (4)
4 - Lock Pin (2)	15 - Scraper Plate (4)	26 - Bolt, Hx., 3/4" x 3 1/2" (4)
5 - Roller Shaft (2)	16 - Spacer, Cylinder Rod End	27 - Lockwasher, 5/16" (10)
6 - Spacer, Roller (2)	17 - Nut, Special	28 - Lockwasher, 3/8" (4)
7 - Spacer Washer (A/R)	18 - Nut, Special (2)	29 - Lockwasher, 1/2" (2)
8 - Front Roller (2)	19 - Grease Zerk (4)	30 - Lockwasher, 3/4" (4)
9 - Bushing, Roller (2)	20 - Grease Zerk (2)	31 - Starwasher, 5/8" (4)
10 - Bushing, Self-Aligning (2)	21 - Set Screw, Soc., 3/8" x 1/2" (3)	32 - Flatwasher, 5/16" (10)
11 - Rear Roller (2)	22 - Bolt, Hx., 5/16" x 3/4" (10)	33 - Nut, Hx., 3/4" (4)

Figure 5-3 Transfer Carriage (Model 1044)

FRAME TILT & OSCILLATION

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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 (Figure 6-1).
A level indicator located on the instrument panel of the cab allows the operator to monitor machine levelness.
A hydraulic control valve (see "Four-Spool Valve" and "Five -Spool Valve" in Section 3), located with its handle 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 is comprised of a hydraulic cylinder (Figure 6-2, 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 front oscillation frame (Item 6). There are two oscillation frames, a front and rear (Figures 6-2, 6-5, Items 6), which are attached to the main frame by two pivot pins each (Items 7).

Figure 6-1 Frame Tilt

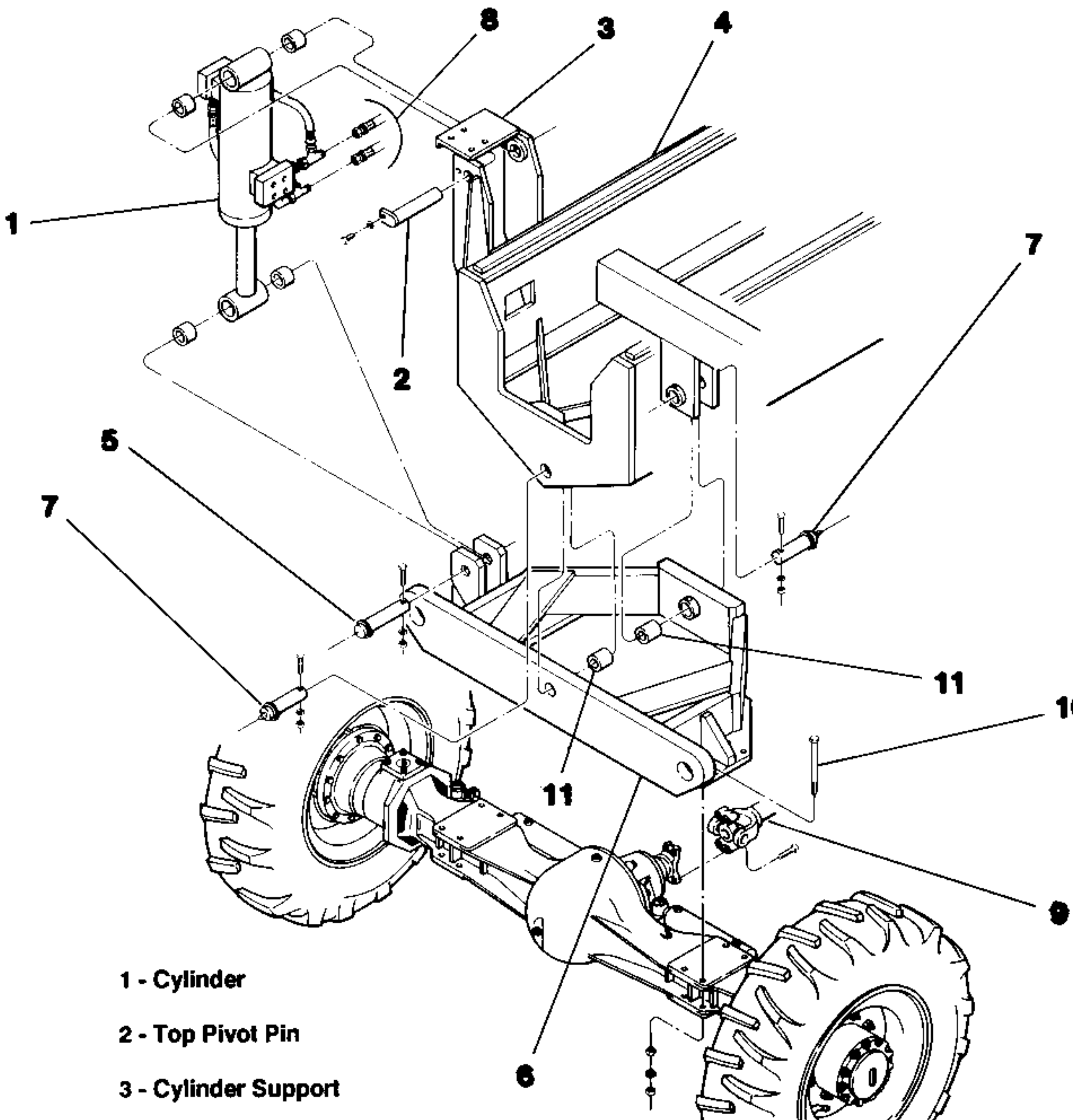
MAINTENANCE

Maintenance of the frame tilt and oscillation involves periodic greasing of the pivots for the hydraulic cylinder and the oscillation frames (refer to the Service Schedules in Section 2).

TROUBLESHOOTING

For troubleshooting refer to pages 3.11-1 through 3.11-3 "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 (2)

8 - Hydraulic Hoses (2)

9 - Drive Shaft

10 - Axle Mounting Bolts (8)

11 - Oscillation Pivot Bushings (2)

Figure 6-2 Frame Tilt & Oscillation Assembly (Front Axle)

FRAME TILT & OSCILLATION

REMOVAL OF FRAME TILT CYLINDER

1. Lower the boom to the ground, 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 in Section 3).

3. Block both sides of the main frame against the oscillation frame (Figure 6-3).

4. Remove two hydraulic hoses (Figure 6-2, Item 8) and cap.

5. Remove the bottom pin (Item 5) and, while supporting the cylinder (Item 1) (approx. wieght 140 LBS), remove the top pin (Item 2).

6. 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 3 through 6 above.

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

2. Start the engine and check for leaks (see "Checking Cylinder Condition" on page 3.18-1 in Section 3).

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 purge air from the circuit.

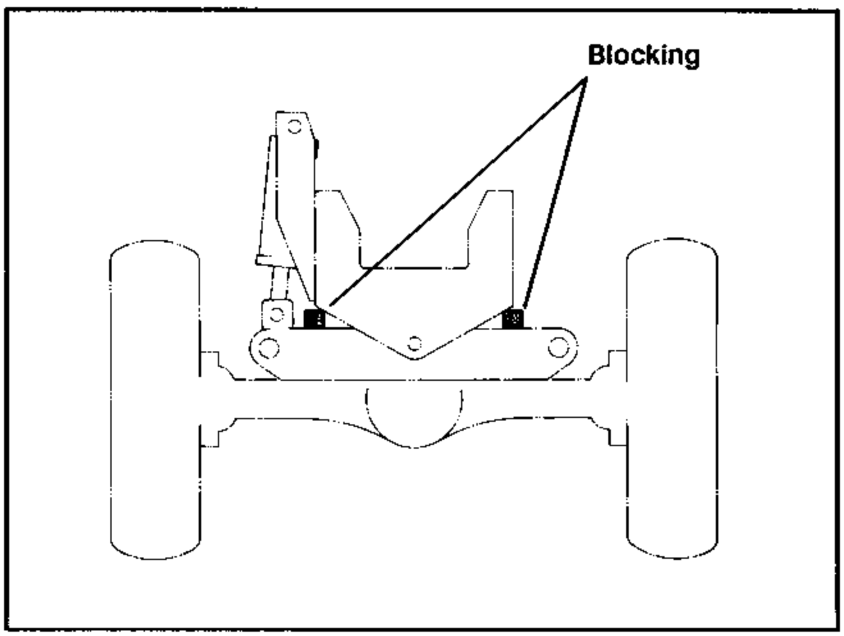


Figure 6-3 Blocking the Main Frame

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. Remove brake hydraulic line pressure: Repeatedly pump (push, hold, release) the brake pedal until brake line pressure is gone, indicated by a definite "bottoming out feel" to the pedal.

5. Detach the diff. lock hydraulic hose and cap the openings (Figure 6-4, Item 1). Disconnect the diff. lock electrical control wire (Item 2).

6. Detach the brake line hose (Item 3) and steer hoses (Items 4) from the bracket atop the front axle and cap the openings.

7. 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.

8. Remove tires from the axle (approx. weight 750 LBS each). (NOTE: Duals weigh approx. 1000 LBS per set.)

9. Disconnect the drive shaft (Figure 6-2, Item 9) from the axle.

10. Remove the tilt cylinder bottom pin (Item 5).

11. Remove the oscillation pivot pins (Items 7).

12. Lower the axle until the oscillation frame (Item 6) clears the main frame (Item 4).

13. Remove bolts, nuts and lockwashers (Items 10) attaching the oscillation frame to the axle.

14. Remove the oscillation frame.

INSTALLATION OF FRONT OSCILLATION FRAME

1. Reverse steps 5-14 above and reassemble outriggers (if so equipped).

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

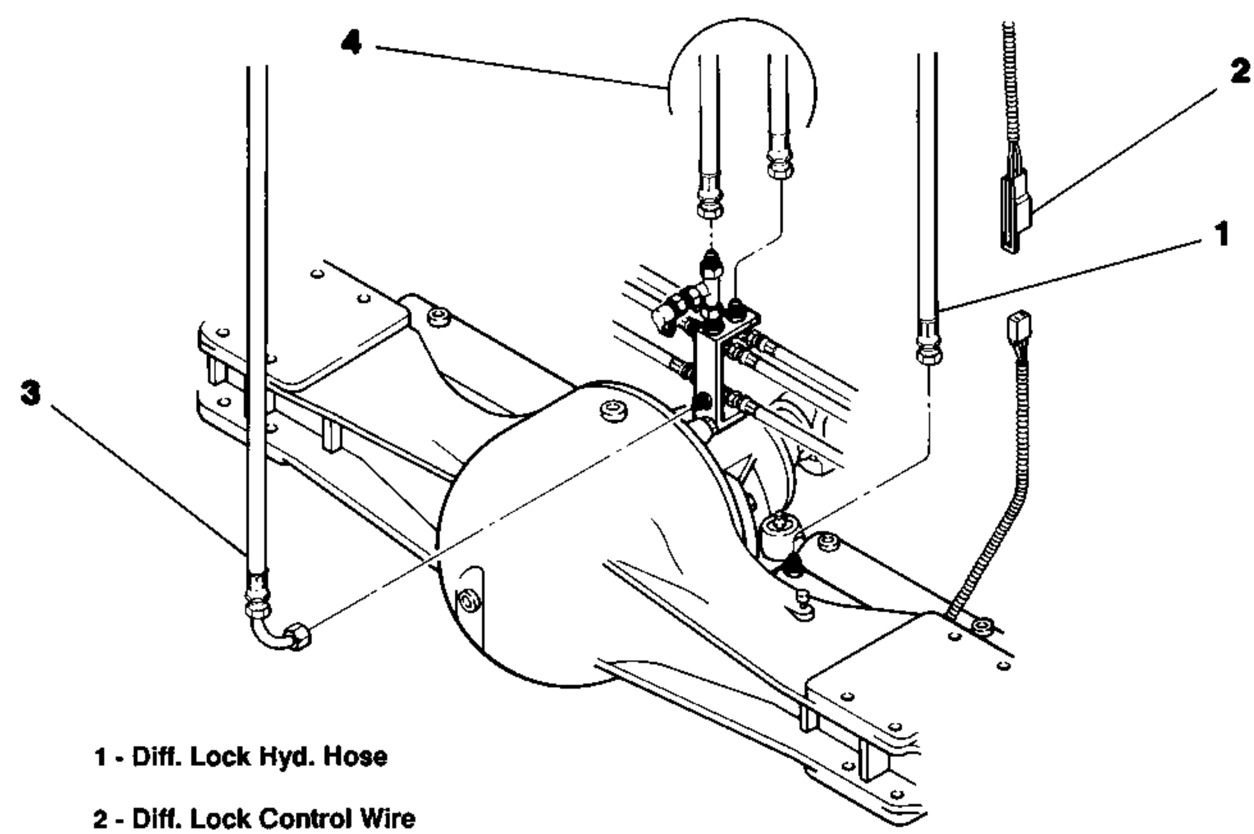
Torque wheel lug nuts to 450 - 500 FT/LBS.

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. Cycle the frame tilt, diff. lock, steering 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.



1 - Diff. Lock Hyd. Hose

2 - Diff. Lock Control Wire

3 - Brake Line Hyd. Hose

4 - Steer Hyd. Hoses (2)

Figure 6-4 Hydraulic Hose Assembly (Front Axle)

FRAME TILT & OSCILLATION

REMOVAL OF REAR 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, apply the parking brake, and stop the engine. Block the front tires.

3. Remove brake hydraulic line pressure: Repeatedly pump (push, hold, release) the brake pedal until brake line pressure is gone, indicated by a definite "bottoming out feel" to the pedal.

4. Detach the brake line hose (Figure 6-5, Item 1) and steer hoses (Items 2) from the bracket atop the rear axle and cap the openings.

5. Position two 5 ton hydraulic jacks under the rear axle at the mounting pads. Raise the machine until weight is off the rear 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.

6. Remove tires from the axle (approx. weight 750 LBS each). (NOTE: Duals weigh approx. 1000 LBS per set.)

7. Disconnect the drive shaft (Item 3) from the axle.

8. Remove the oscillation pivot pins (Items 7).

9. Lower the axle until the oscillation frame (Item 6) clears the subframe (Item 5).

10. Remove bolts, nuts and lockwashers (Items 4) attaching the oscillation frame to the axle.

11. Remove the oscillation frame.

INSTALLATION OF REAR OSCILLATION FRAME

1. Reverse steps 4-11 above.

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

Torque wheel lug nuts to 450 - 500 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. 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.

FRAME TILT & OSCILLATION

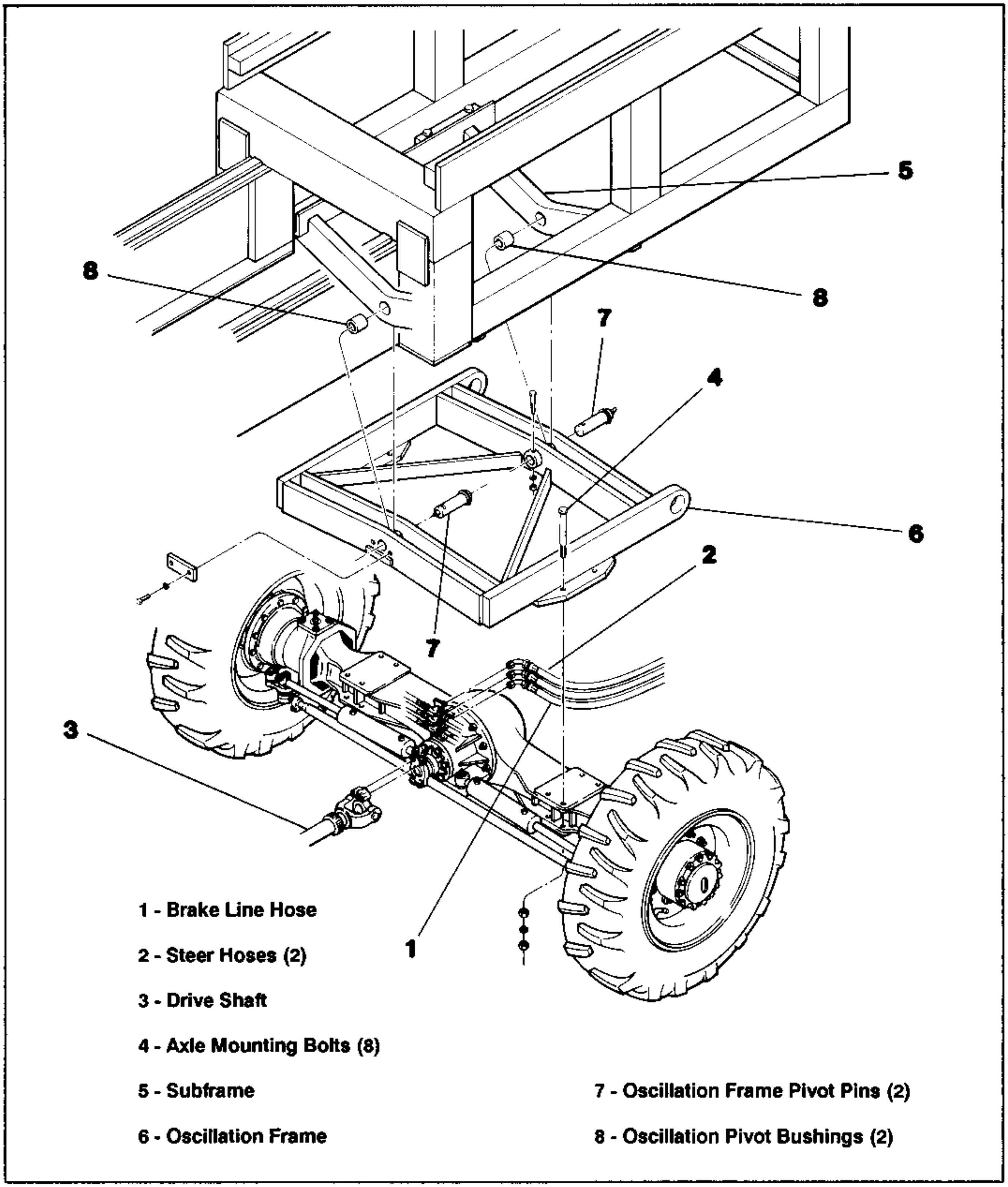


Figure 6-5 Oscillation Assembly (Rear Axle)

REMOVAL AND INSTALLATION OF OSCILLATION BUSHINGS

The front oscillation bushings are pressed into the oscillation frame; the rear oscillation bushings are pressed into the subframe of the machine (Figures 6-2, 6-5).

To replace the front oscillation bushings:

1. Lower the front oscillation frame away from the main frame (follow steps 1 thru 12 of "Removal of Front Oscillation Frame", page 6.2-4).

2. Remove the old bushings (Figure 6-2, Items 11) from the frame (Item 6).

3. Press the new bushings in place.

4. Follow steps 1 thru 4 of "Installation of Front Oscillation Frame" on page 6.2-4.

To replace the rear oscillation bushings:

1. Lower the rear oscillation frame away from the main frame (follow steps 1 thru 9 of "Removal of Rear Oscillation Frame", page 6.2-6).

2. Remove the old bushings (Figure 6-5, Items 8) from the subframe (Item 5).

3. Press the new bushings in place.

4. Follow steps 1 thru 4 of "Installation of Rear Oscillation Frame" on page 6.2-6.

ENGINE

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ENGINE

LIST OF FIGURES

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.

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

JOHN DEERE (MODELS 644, 844, 1044)

DESCRIPTION (Figure 7-1, 7-2, 7-3)

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. Move the transfer carriage full forward, 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 644, 844, 1044)

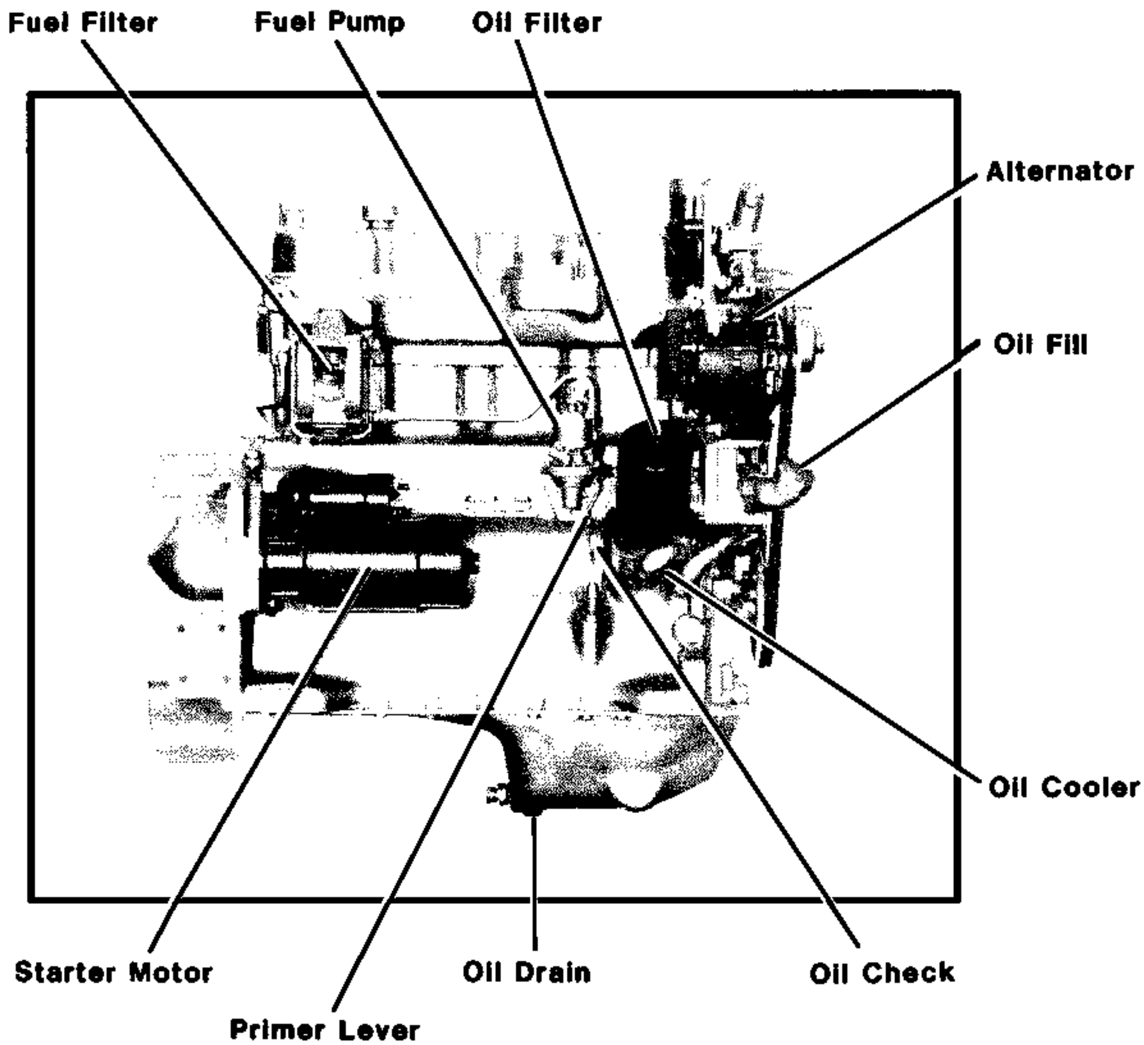


Figure 7- 1 John Deere 4239D (Model 644)

ENGINE

JOHN DEERE (MODELS 644, 844, 1044)

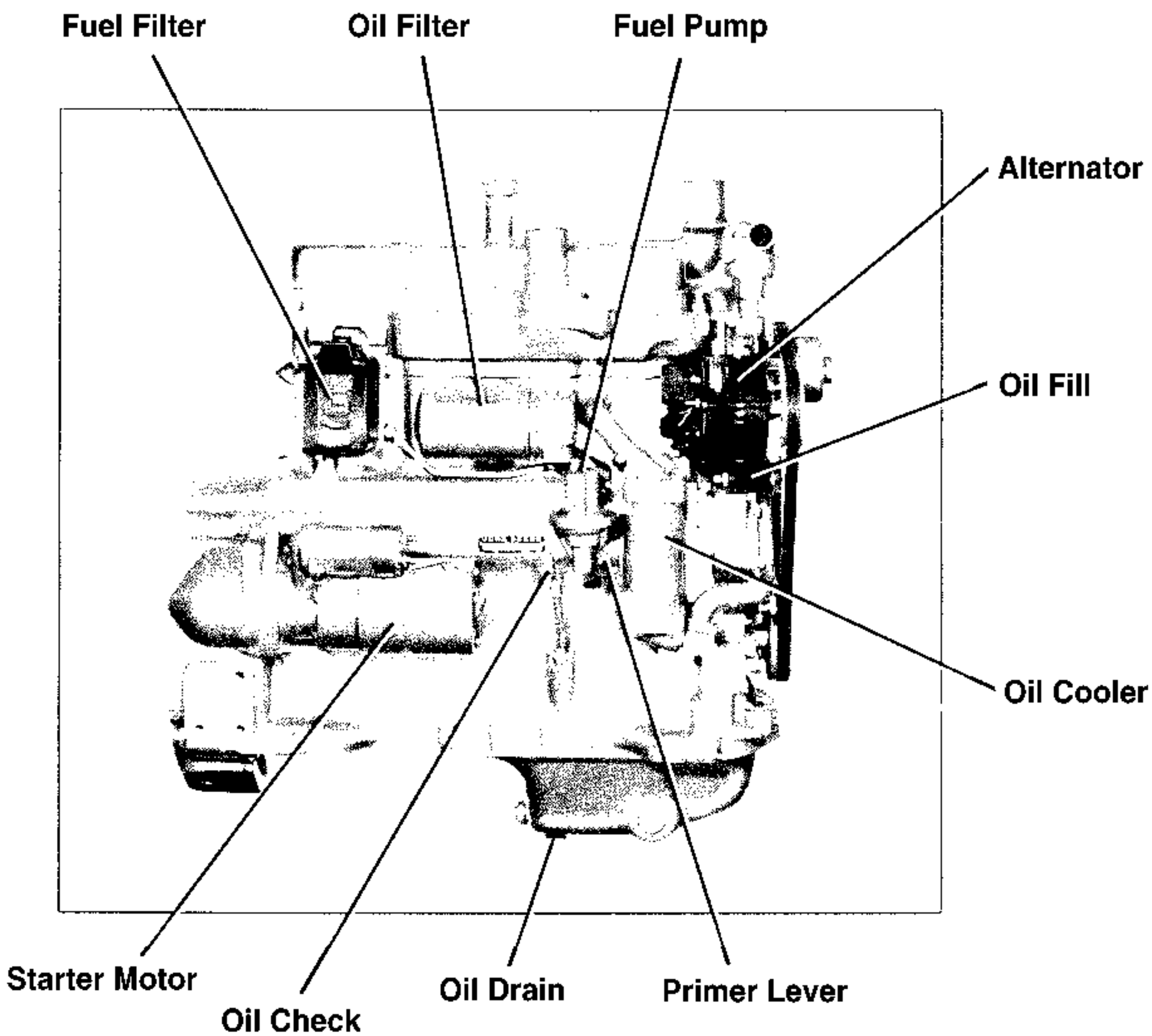


Figure 7- 2 John Deere 4276D (Model 844)

JOHN DEERE (MODELS 644, 844, 1044)

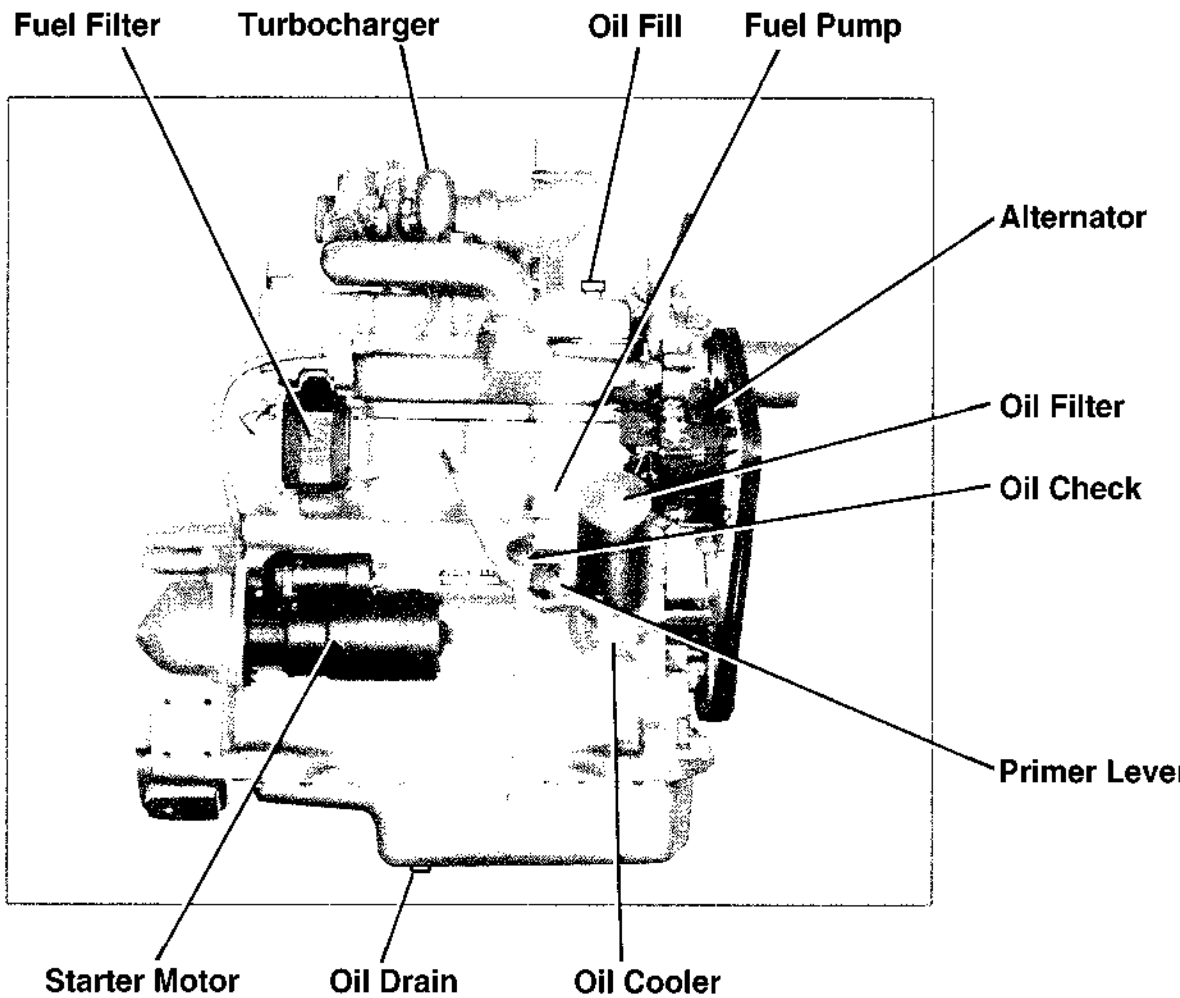


Figure 7- 3 John Deere 4239T (Model 1044)

DEUTZ (MODELS 844, 1044)

DESCRIPTION (Figures 7-4, 7-5)

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. Move the transfer carriage full forward, 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 approximatly 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 844, 1044)

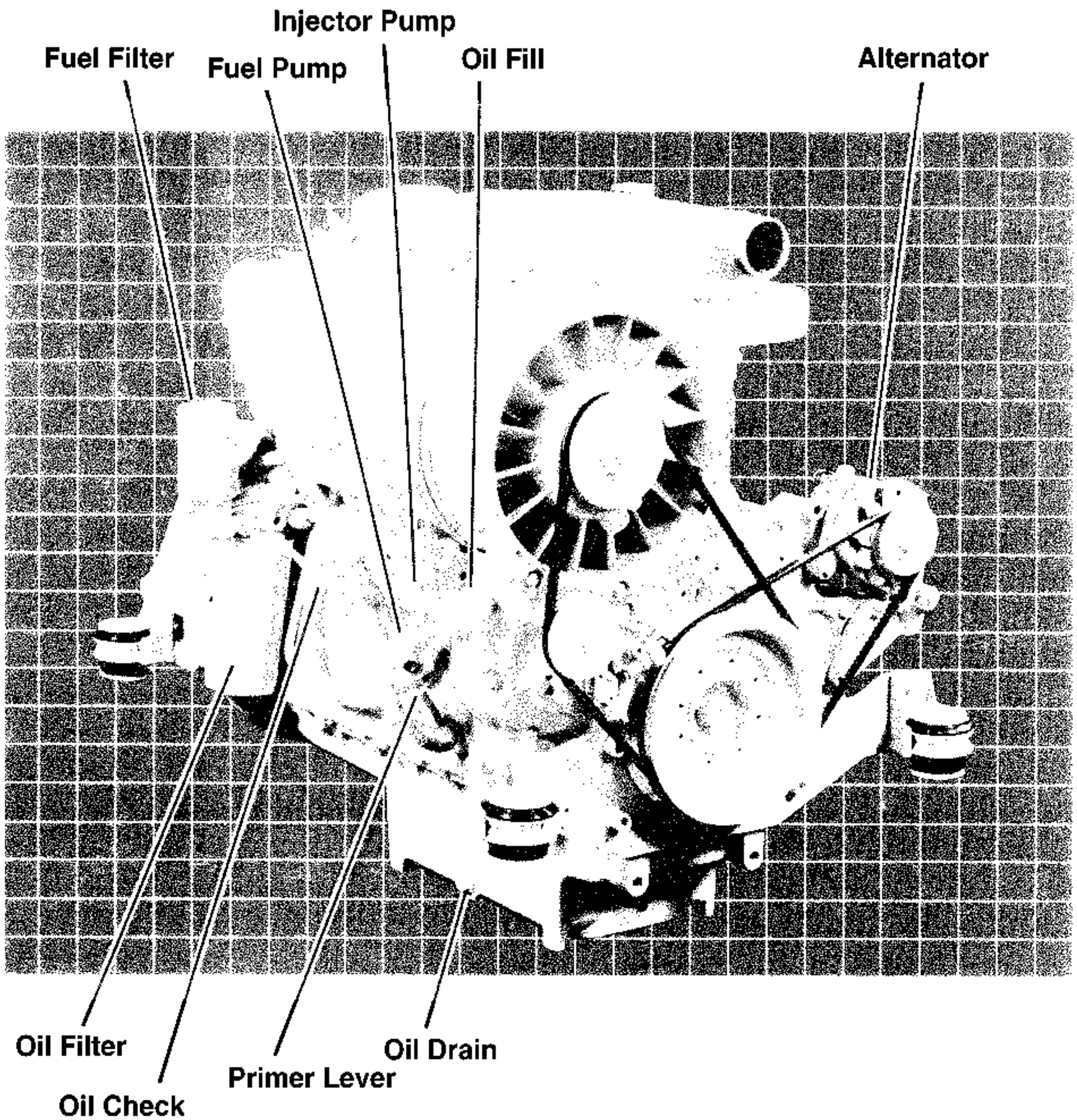


Figure 7- 4 Deutz F5L912 (Model 844)

ENGINE

DEUTZ (MODELS 844, 1044)

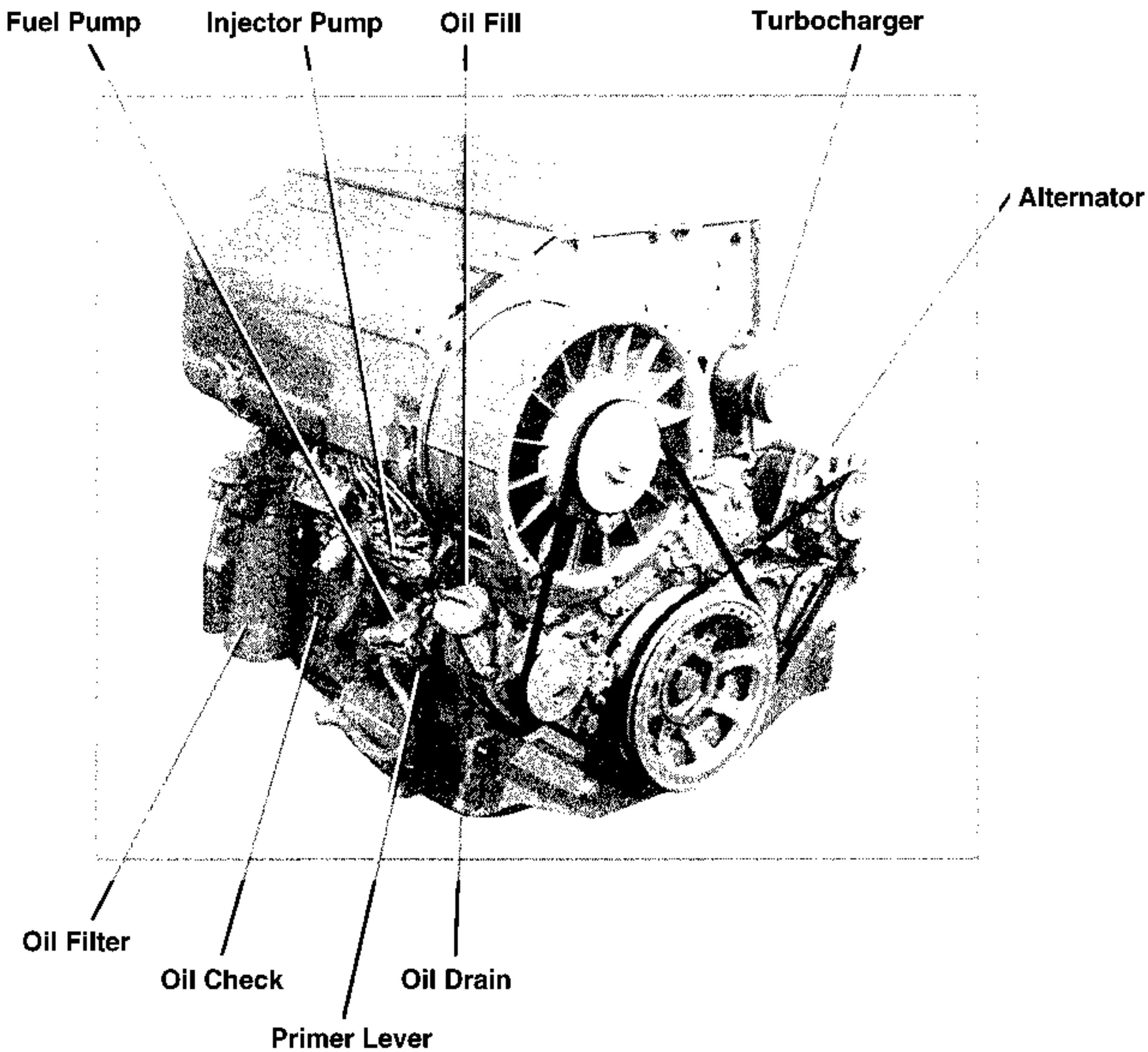


Figure 7- 5 Deutz BF4L913 (1044)

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 thremostat. Open the engine drain cock and allow block to drain. Close the drain cock and reverse flush the block as shown in Figure 7-6. Reverse flush the radiator as shown in Figure 7-7 then add coolant as required.

COOLING SYSTEM

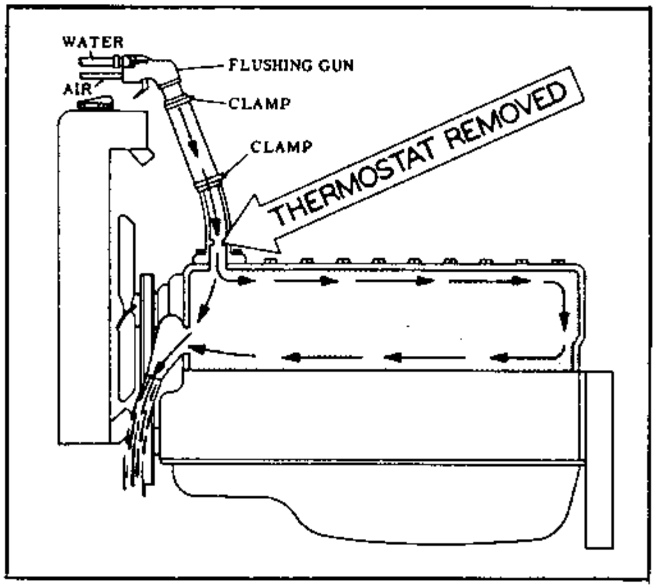


Figure 7-6 Reverse Flushing Engine

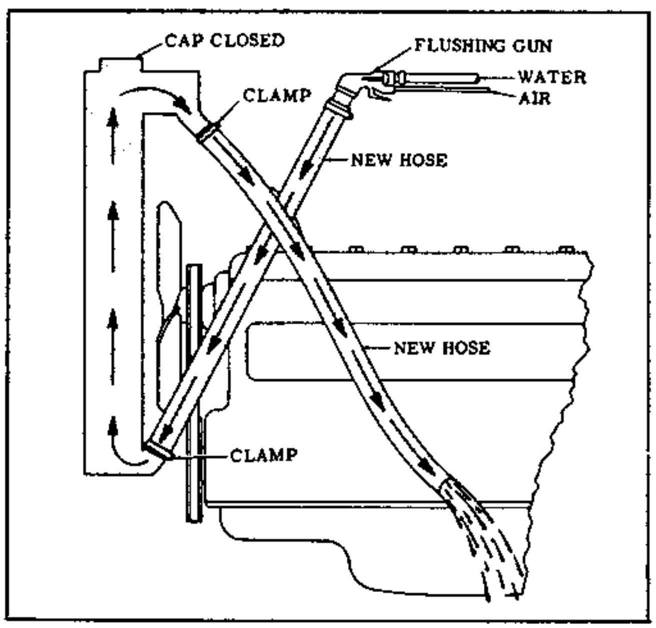


Figure 7-7 Reverse Flushing Radiator

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.

AIR INTAKE SYSTEM

DESCRIPTION (Figure 7-8)

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.

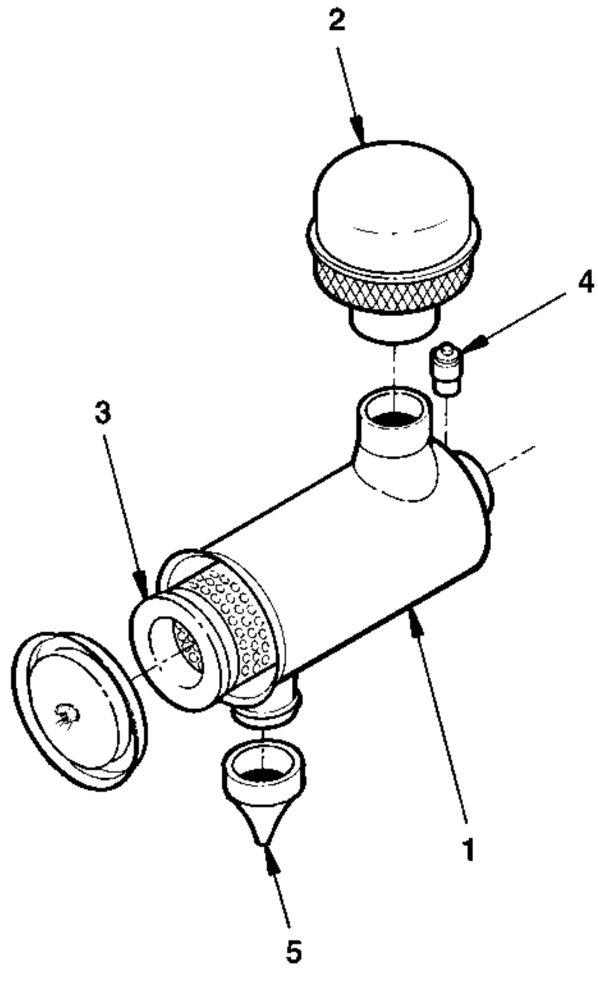
6. Ensure the O-ring around the air leaner body is in place and not damaged.

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.

AIR INTAKE SYSTEM



1 - Housing
2 - Inlet Hood
3 - Filter Element
4 - Service Indicator
5 - Vacuator Valve

Figure 7-8 Air Filter Arrangement

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 gòod 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 lift. 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.

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

FUNK SERIES 4000 LONG DROP (MODEL 644)

DESCRIPTION (Figure 8-1)

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 varible and automatic speed ratios. The need for shifting gears, although present, is greatly reduced.

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 SERIES 4000 LONG DROP (MODEL 644)

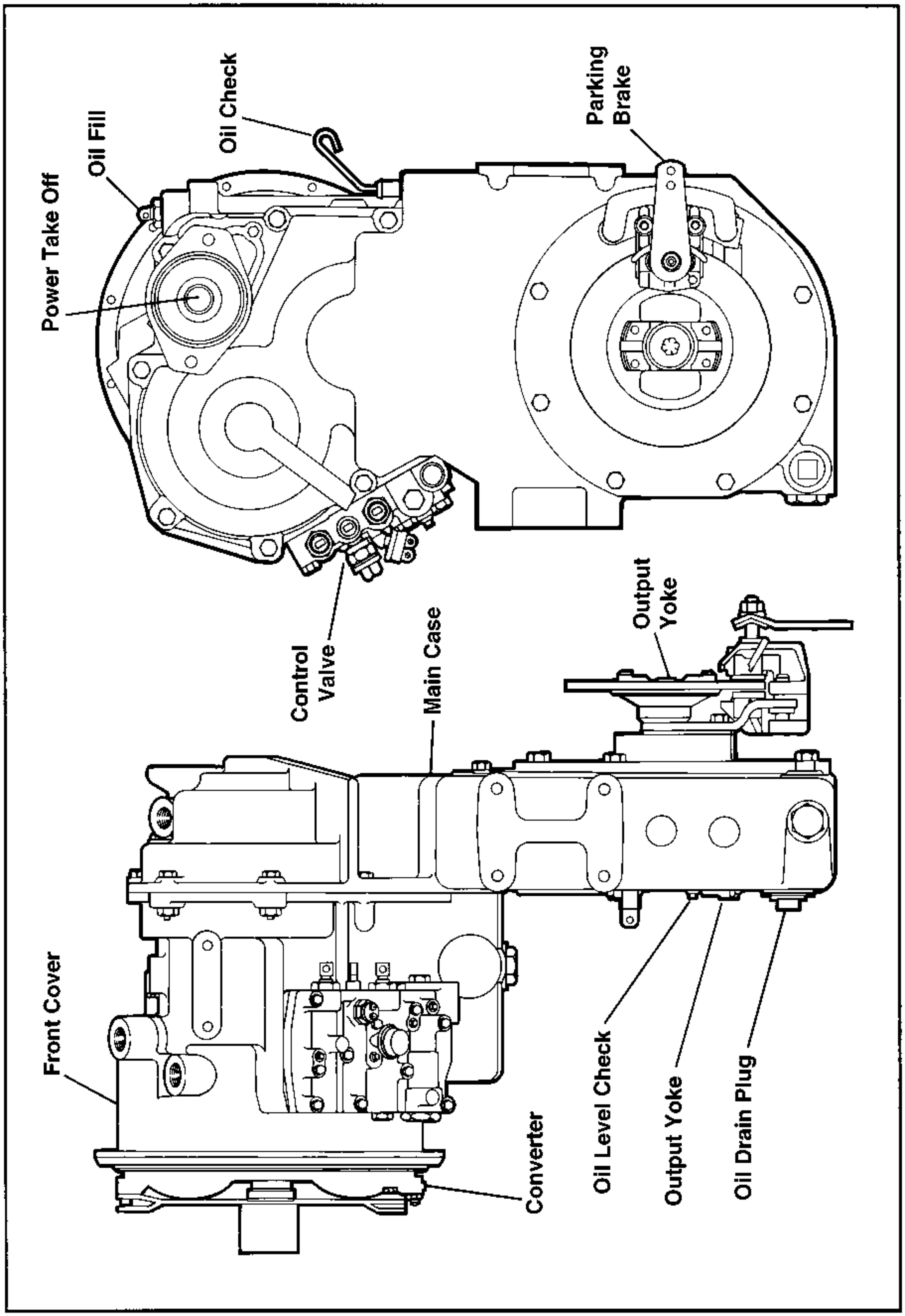


Figure 8-1 Funk Series 4000 Long Drop (Model 644)

FUNK SERIES 4000 LONG DROP (MODEL 644)

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 SERIES 4000 LONG DROP (MODEL 644)

TROUBLESHOOTING (cont.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
7. Clutch selected pressure does not return to normal	A. Excessive internal leakage to clutch B. Main regulator valve spring weak C. Accumulator spring too strong D. Primary pump defective	A. Complete tear down of transmission B. Replace main regulator spring C. Replace spring D. Replace primary pump
8. Clutch does not release when brake cut-off valve is activated	A. No brake line pressure B. Brake cut-off piston sticking	A. Check brake system B. Inspect and replace if necessary
9. Clutch does not release when feathering valve is activated	A. Feathering stem not pulled to full travel B. Feathering valve sticking C. Feathering valve spring too strong	A. Adjust linkage B. Clean valve C. Replace spring
10. Excessive noise at engine idle	A. Primary pump defective B. Excessive back-lash in gear train	A. Replace pump B. Replace bearings and inspect for defective gears
11. Excessive gear noise at high speed (R.P.M.)	A. Same as item #10	A. Same as item #10
12. Transmission mounted filter blows out or "O" ring on filter blows out	A. Orifice on main regulator valve plugged B. "O" ring faulty	A. Clean orifice on main regulator valve B. Replace filter
13. 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
14. Transmission Overheating	A. Converter stalling B. Oil level too high C. Engine overheating D. Water lines defective on heat exchanger E. Heat exchanger dirty F. Low clutch oil pressure	A. Shift to lower gear B. Drain to proper level C. Check engine coolant D. Replace water lines E. Flush and clean heat exchanger F. Check clutch oil pressure
15. Transmission pressure check okay, but unit has no power	A. Converter sprag clutch jammed B. Converter sprag clutch installed wrong	A. Disassemble converter and inspect B. See parts manual or assembly manual for correct information

FUNK SERIES 4000 LONG DROP (MODEL 644)

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

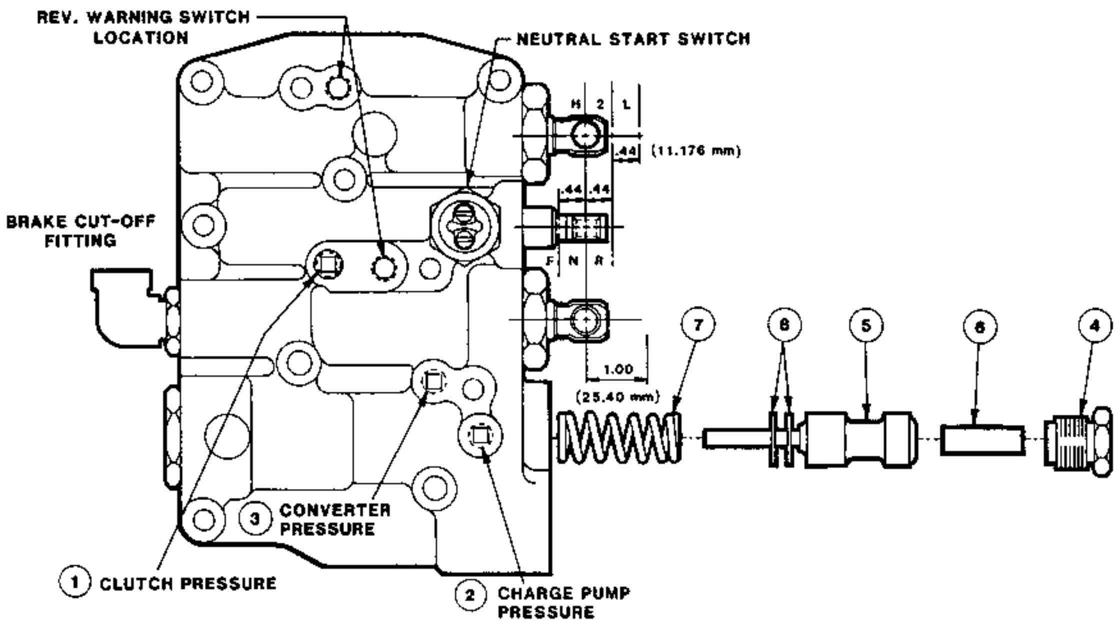


Figure 8-2 4000 Transmission Control Valve

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 SERIES 4000 LONG DROP (MODEL 644)

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, and move transfer carriage forward approximately two feet.

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 two drive shafts from transmission by removing four bolts each.

6. Remove transmission drain plug. Drain transmission and replace plug.

7. Disconnect emergency brake actuating cable: Remove cotter pin, clevis pin, and place cable assembly out of the way.

8. Tag and remove the four hydraulic lines from the boom control valve and cap the openings.

9. Remove all hose clamps and hoses from hose support bracket.

10. Remove hose support bracket by removing six mounting bolts.

11. Remove suction line hose from pump after loosening hose clamps. Rotate hose out of the way.

12. Disconnect two pressure lines hoses from outlet side of pump and cap the openings.

13. Remove bolts mounting pump to transmission.

14. Rotate pump counterclockwise to drain excess oil from pump.

15. Remove pump (approx. weight 25 LBS).

16. Disconnect transmission filter lines from transmission and cap the ends.

17. Remove transmission filter from mounting bracket by removing bolts. Remove filter and hose from the machine.

18. Separate two transfer carriage cylinder hoses from mounting stud and place out of the way.

19. Remove wire to neutral start switch.

20. Remove wire to transmission temperature sending unit.

21. Remove reverse alarm pressure switch.

22. Remove three bolts from shift bracket.

23. Remove cotter pins and clevis pins from transmission shifting spools. Position cables and bracket out of the way.

24. Disconnect transmission cooler lines from transmission.

25. Using transmission removal bracket, support transmission from above with hoist. (NOTE: Approx. weight of transmission is 650 LBS.)

26. Support transmission from below with jack positioned under transmission.

27. Remove cotter pins and castellated nuts from transmission brackets on each side.

28. Remove transmission mounting bracket from transmission by removing four bolts each side.

29. Raise transmission enough to place a block of wood between engine bell housing and cradle to support rear of engine after transmission removal.

30. Lower transmission and engine until wooden block is supporting the assembly.

31. Remove transmission to engine mounting bolts.

32. Carefully separate transmission from engine bell housing so as not to damage splines, torque convertor or torque convertor seal.

33. Lower transmission to floor.

FUNK SERIES 4000 LONG DROP (MODEL 644)

INSTALLATION

1. Reverse steps 5 through 33 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Sprcifications 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.

TRANSMISSION

FUNK SERIES 1700 LONG DROP (MODELS 844, 1044)

DESCRIPTION (Figure 8-3)

The 1700 series powershift is a forward and reverse transmission with 4 speeds in either direction. Forward motion, reverse motion, and the 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 engine power makes these models a full power shift for the forward and reverse motion in all speeds.

The clutches in these units 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 a paper graphitic friction plate and a polished steel reaction plate.

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 not 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.

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.

FUNK SERIES 1700 LONG DROP (MODELS 844, 1044)

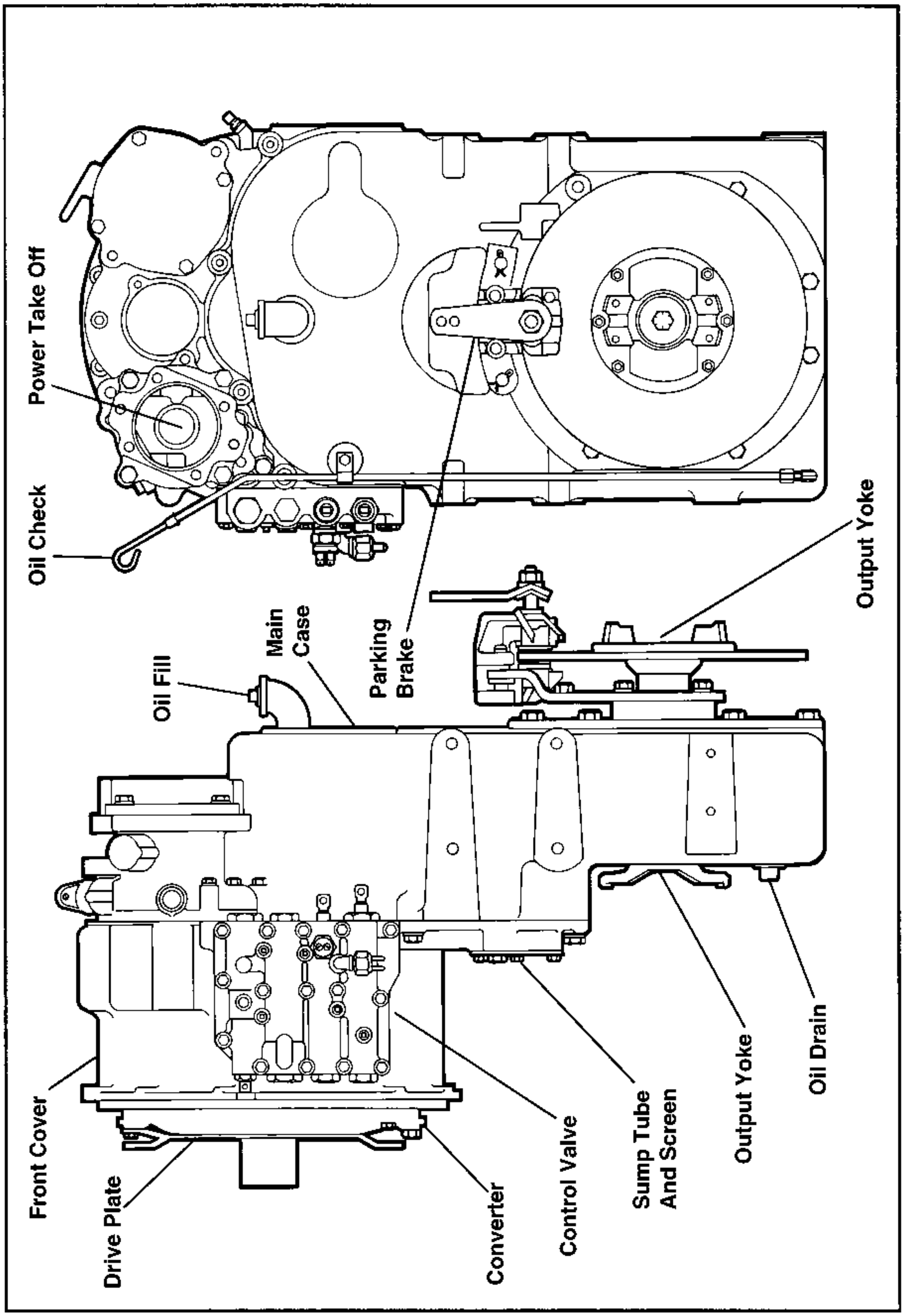


Figure 8-3 Funk Series 1700 Long Drop (Models 844, 1044)

FUNK SERIES 1700 LONG DROP (MODELS 844, 1044)

TROUBLESHOOTING

Refer to Troubleshooting on page 8.2-3.

TRANSMISSION CONTROL VALVE FUNCTION AND PRESSURE CHECK

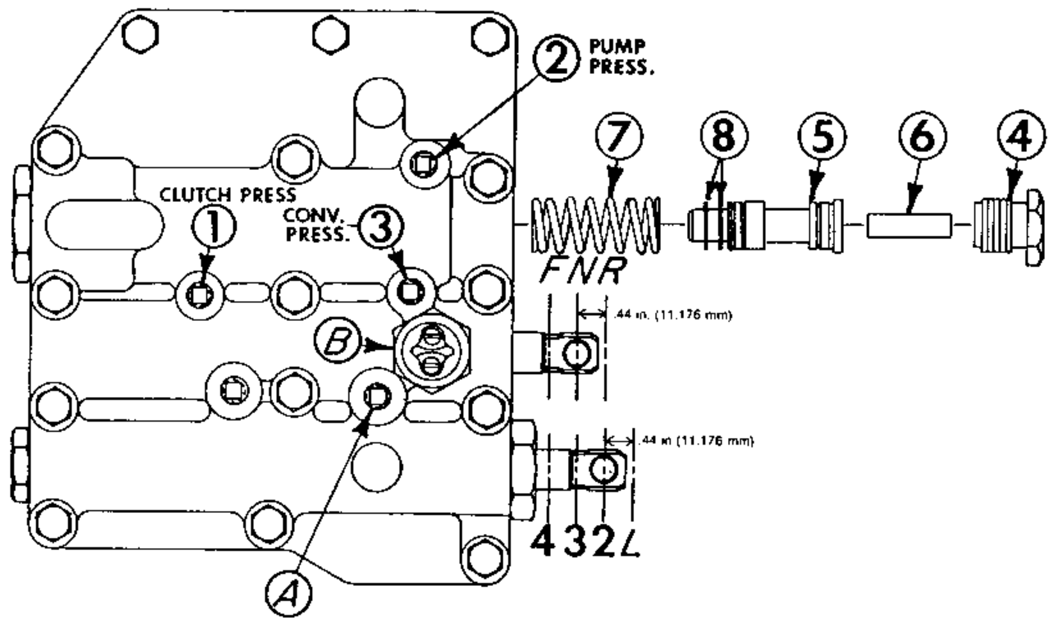


Figure 8-4 1700 Transmission Control Valve

The pressure checks are to be made with the transmission oil temp at 100° F. (37.7° C.) to 140° F. (60° C.)
STEP 1 - CLUTCH PRESSURE

A. Install a 200 PSI (1378 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 155 (1068 kPa) to 180 (1240 kPa) PSI 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 #4001651 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 (689 kPa) PSI gauge in Port (Item 3).
B. Run engine at approximately 2000 RPM.
C. The pressure should be within the span of 80 (551 kPa) to 90 (620 kPa) PSI.

PORT A. Reverse warning switch for long (18 5/8) drop.
PORT B. Neutral start switch.

FUNK SERIES 1700 LONG DROP (MODELS 844, 1044)

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 the boom to allow for transmission removal and installation hoist, and move the transfer carriage forward approximately two feet.

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 two drive shafts from transmission by removing four bolts each.

6. Remove transmission drain plug. Drain transmission and replace plug.

7. Disconnect emergency brake actuating cable at transmission: Remove cotter pin, clevis pin, and place cable assembly out of the way.

8. Disconnect two wheel/four wheel actuating linkage from transmission: Remove cotter pin, clevis pin, and place linkage out of the way.

9. Remove hose tray after removing four mounting bolts.

10. Disconnect suction line elbow from pump after loosening clamps. Rotate elbow out of the way.

11. Disconnect two pressure line hoses from outlet side of pump and cap the openings.

12. Remove bolts mounting pump to transmission.

13. Rotate pump counterclockwise to drain excess oil from pump.

14. Remove pump (approx. weight 25 LBS).

15. Disconnect transmission filter lines from transmission and cap the ends.

16. Remove transmission filter from filter mounting bracket by removing bolts. Remove filter and hoses from machine.

17. Remove wire to transmission neutral start switch.

18. Remove wire to transmission temperature sending unit.

19. Remove reverse alarm pressure switch from transmission.

20. Remove bolts and two clamps mounting shift control cables to bracket on frame.

21. Remove cotter pins and clevis pins from transmission shifting spools. Position transmission control cables out of the way.

22. Disconnect transmission cooler lines from transmission.

23. Using transmission removal bracket, support transmission from above with hoist. (NOTE: Approx. weight of transmission is 750 LBS.)

24. Support transmission from below with jack positioned under transmission.

25. Remove cotter pins, castellated nuts and bolts from the transmission mounting bracket to frame, each side.

26. Remove transmission mounting brackets from transmission by removing four mounting bolts each side.

27. Raise transmission enough to place a block of wood between engine bell housing and cradle, to support rear of engine after transmission removal.

28. Lower transmission and engine until wooden block is supporting the assembly.

29. Remove transmission to engine mounting bolts.

30. Carefully separate transmission from engine bell housing so as not to damage splines, torque convertor or torque convertor seal.

31. Lower transmission to floor.

FUNK SERIES 1700 LONG DROP (MODELS 844, 1044)

INSTALLATION

1. Reverse steps 5 through 33 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.

TRANSMISSION

ZF 4 WG-100 (MODELS 844 & 1044)

Description (Figure 8-5)

The ZF 4 WG-100 electric powershift transmission has 4 speeds forward and 3 speeds reverse. The transmission has a total of six hydraulically actuated, spring released, multiple disc clutch packs. Each speed is obtained by the use of these clutches.

An electric shift selector mounted to the steering column allows the operator to select the desired speed. The shift selector is electrically connected to a microprocessor control unit. The control unit monitors signals from the shift selector and transmission and controls the electrohydraulic gearshift valve on the transmission. Hydraulic flow and pressure inside the transmission are controlled by the gearshift valve.

Power from the engine is sent to the transmission through a torque converter. The torque converter acts as a fluid drive. This helps eliminate vibration, engine stalling and lugging. Under heavy loads the converter multiplies the torque from the engine. Under light loads the converter transmits the engine power at nearly the same speed as the engine.

Maintenance

- 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.

⚠ WARNING!

When checking transmission oil level, vehicle must be on level surface, parking brake must be set and shift selector locked in the NEUTRAL position.

- 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.)
- 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.
- Fill the transmission using only approved oil per Service Schedule instructions in Section 2.
- When servicing the unit for the first time after vehicle installation and/or after repair, the unit is filled as follows:
  1. Fill unit with recommended fluid to LOW mark on dipstick.
  2. Start engine and run at idle speed for two minutes.
  3. With the engine at idle speed, add fluid as necessary to bring oil level to FULL mark on dipstick.
- Keep all controls properly lubricated.
- If the radiator on the vehicle is drained for winter storage, the heat exchanger for transmission must also be drained.

Troubleshooting

Refer to manufacturer's workshop manual for troubleshooting procedures and required test equipment.

Overhaul

Refer to manufacturer's workshop manual for overhaul procedures and required special tools.

ZF 4 WG-100 (MODELS 844 & 1044)

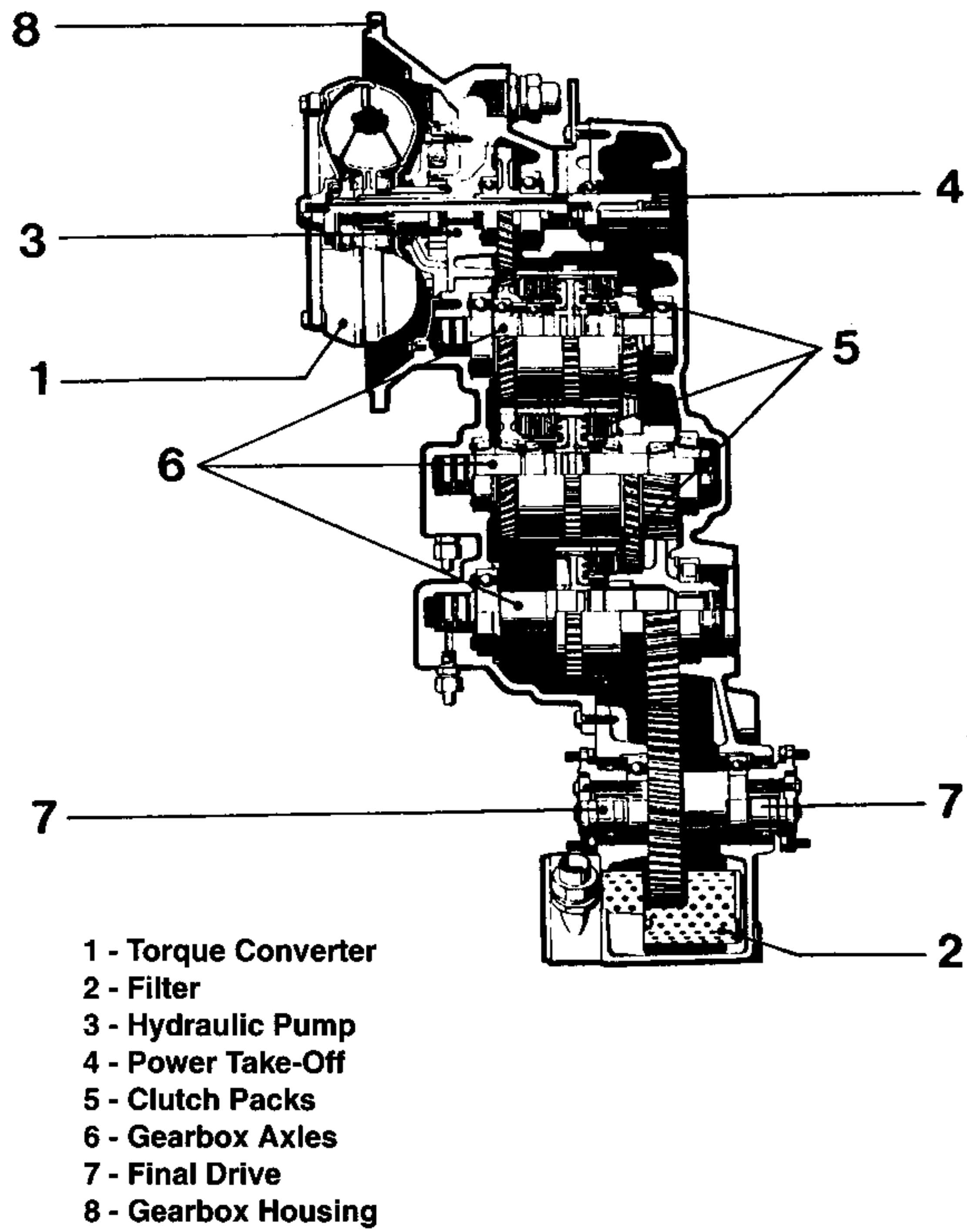


Figure 8-5 ZF 4 WG-100 Transmission (Models 844 & 1044)

AXLES

INDEX

LIST OF FIGURES

AXLES

DESCRIPTION (Figure 9-1)

The front and rear axles for the model 644, 844, and 1044 forklifts are identical, except the front axles incorporate a differential lock feature. The axles are a Spicer Model PS-1350 which is an off-highway type that provides drive and steering functions. The axles consist of the following:

1. Ring and Pinion Carrier Assembly
2. Differential
3. Differential Lock (Front Axle)
4. Planetary Gear Hubs
5. Wheel End Wet Disc Brakes
6. Steer Universals
7. Steer Spindles
8. Dual Steer Cylinders
9. Tie Rod

MAINTENANCE

Maintenance of the axle requires periodic checking of differential and planetary hubs for fluid levels; periodic changing of fluids; periodic greasing of steer cylinder and tie rod pivots. Periodic greasing of spindles and universals. (Refer to the Service Schedules in section 2 for recommended lubricants and service intervals.)

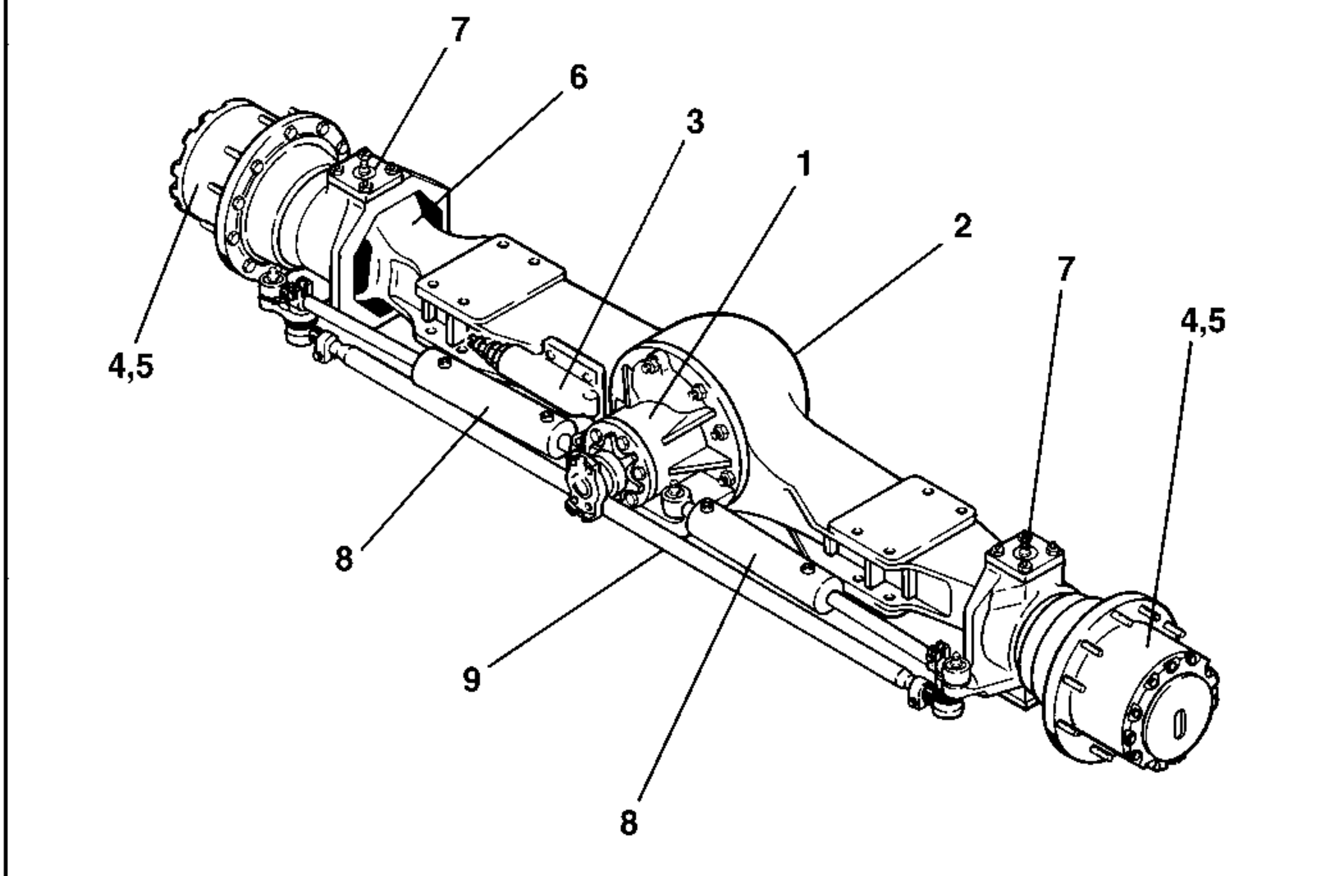


Figure 9-1 Spicer Model PS-1350 Axle

MAINTENANCE (cont.)

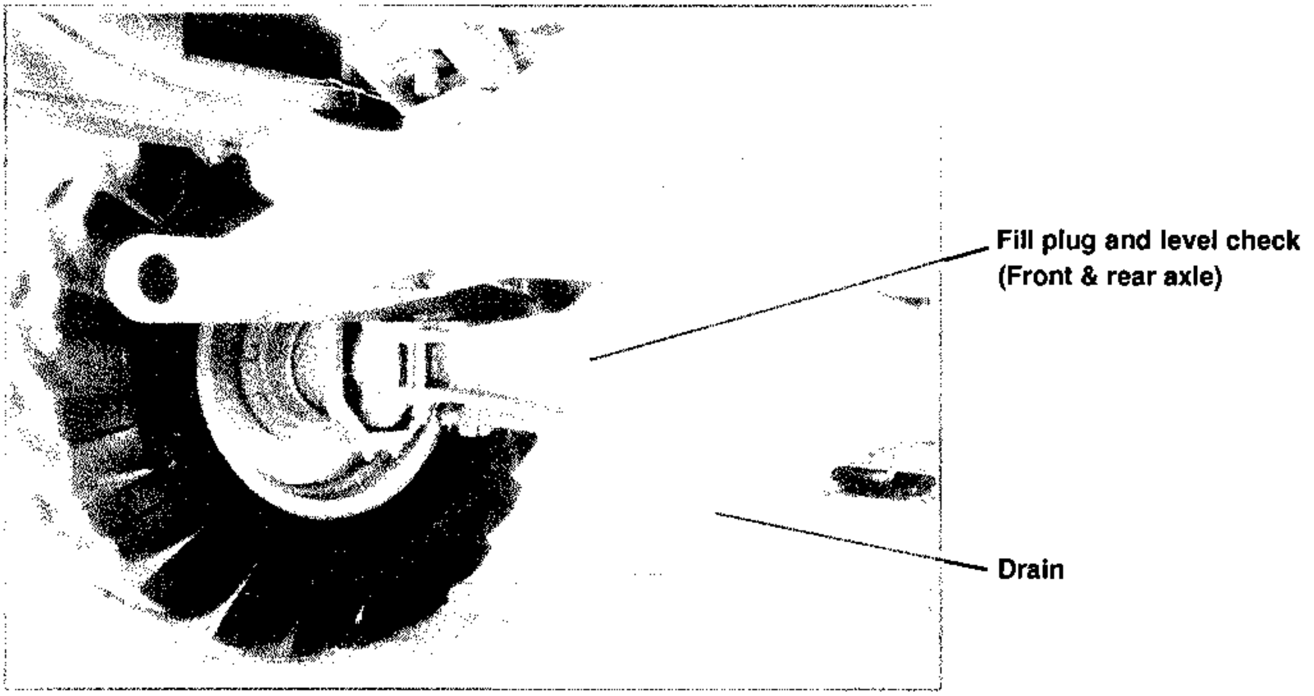


Figure 9-2 Differential Oil Check

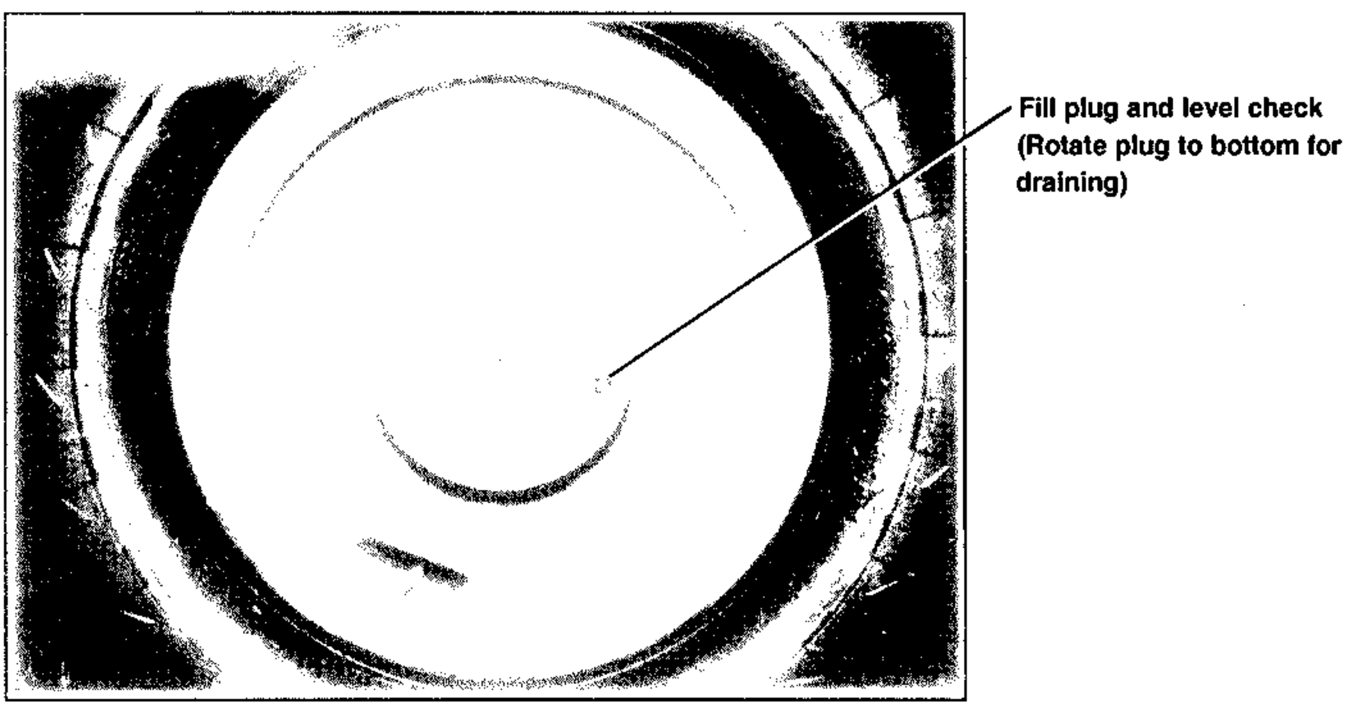


Figure 9-3 Planetary Hub Oil Check

MAINTENANCE (cont.)

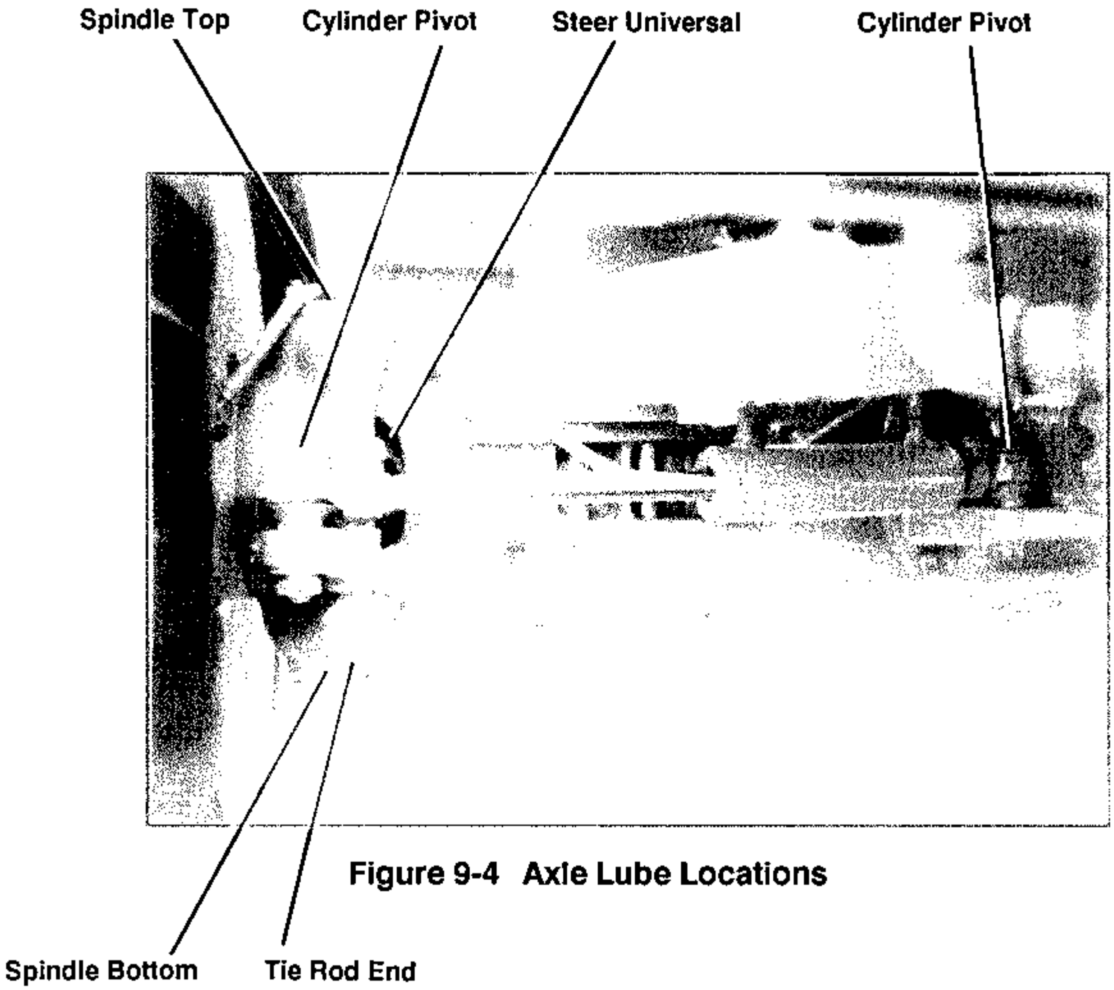


Figure 9-4 Axle Lube Locations

AXLES

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

REMOVAL OF AXLE (Figures 9-5 and 9-6)

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, apply the parking brake and stop the engine. Block tires on the opposite axle.

3. Remove brake line pressure: Repeatedly pump (push, hold, release) the brake pedal until brake line pressure is gone, indicated by a definite "bottoming out feel" to the pedal. This procedure may require approximately 25 - 35 pumps of the brake pedal.

4. Remove differential lock hydraulic line pressure (front axle): Apply and release differential lock foot actuated control valve three times.

5. Remove steering hydraulic line pressure: Rotate steering wheel in both directions three times.

6. Position two 5 ton hydraulic jacks under the mounting pads (Item 9) of the axle to be removed. 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)

7. Detach the differential lock hydraulic hose (Item 3) and cap the openings (front axle). Disconnect the differential lock electrical control wire (Item 4) (front axle).

8. Detach the brake line hose (Item 5) and steer hoses (Item 6) from the bracket atop the axles and cap the openings.

9. Disconnect the drive shaft (Item 7) from the axle.

10. Remove tires from the axle. (Weight approx. 750 LBS each). NOTE: Dual weight approx. 1000 LBS per set.

11. Remove (8) bolts, nut and lockwashers (Items 8) attaching the axle to the oscillation frame.

12. Lower and remove the axle from the machine.

INSTALLATION OF AXLE

1. Reverse steps 6 through 12 above.

NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1. Torque wheel lug nuts to 450 - 500 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.

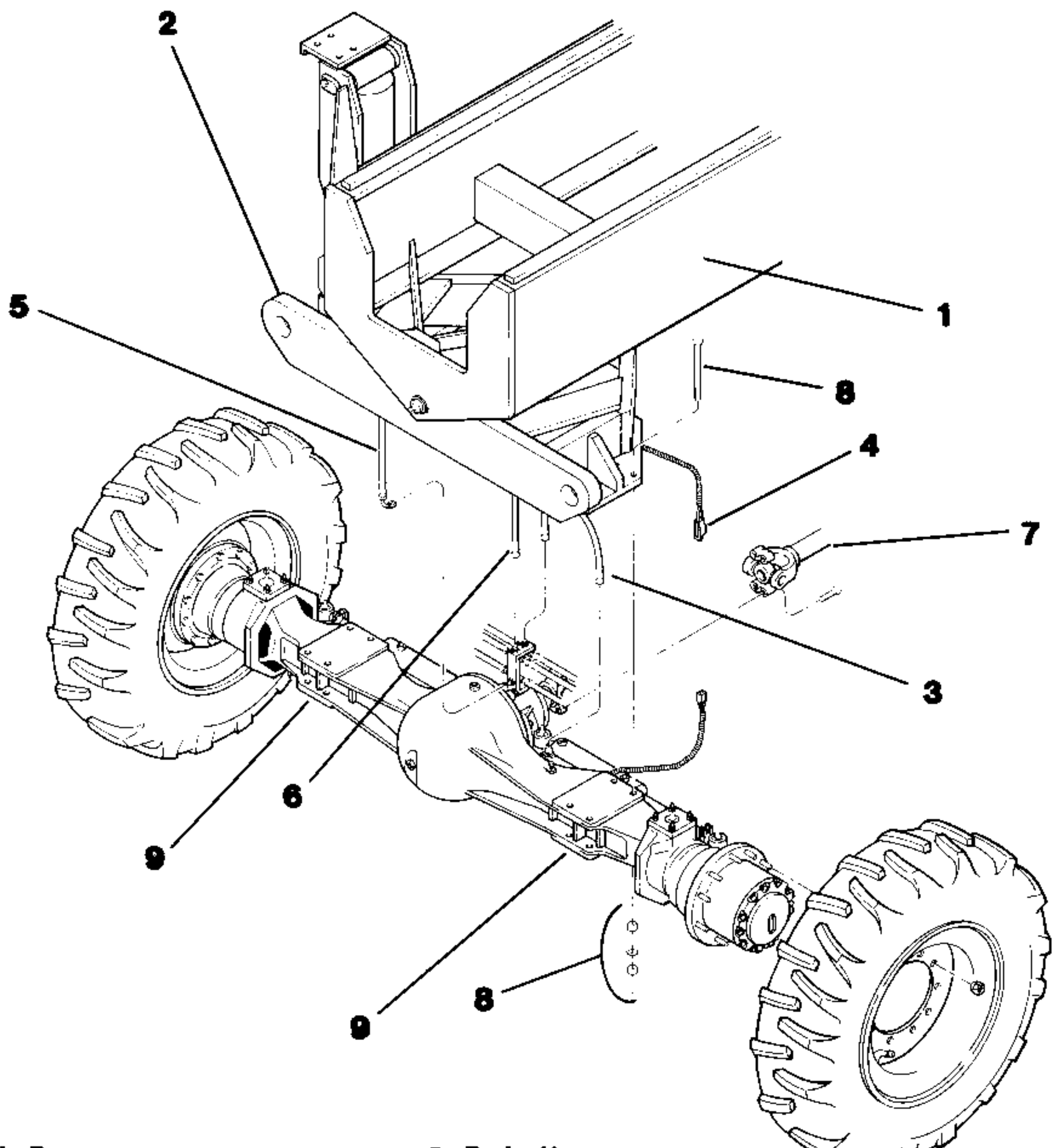
3. Bleed the brakes (see "Bleeding Procedure" under "Service Brakes" in Section 10).

4. 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.

5. Apply the differential lock control valve and hold for 15 seconds. Release and repeat. This procedure will remove air from the differential lock circuit (front axle).

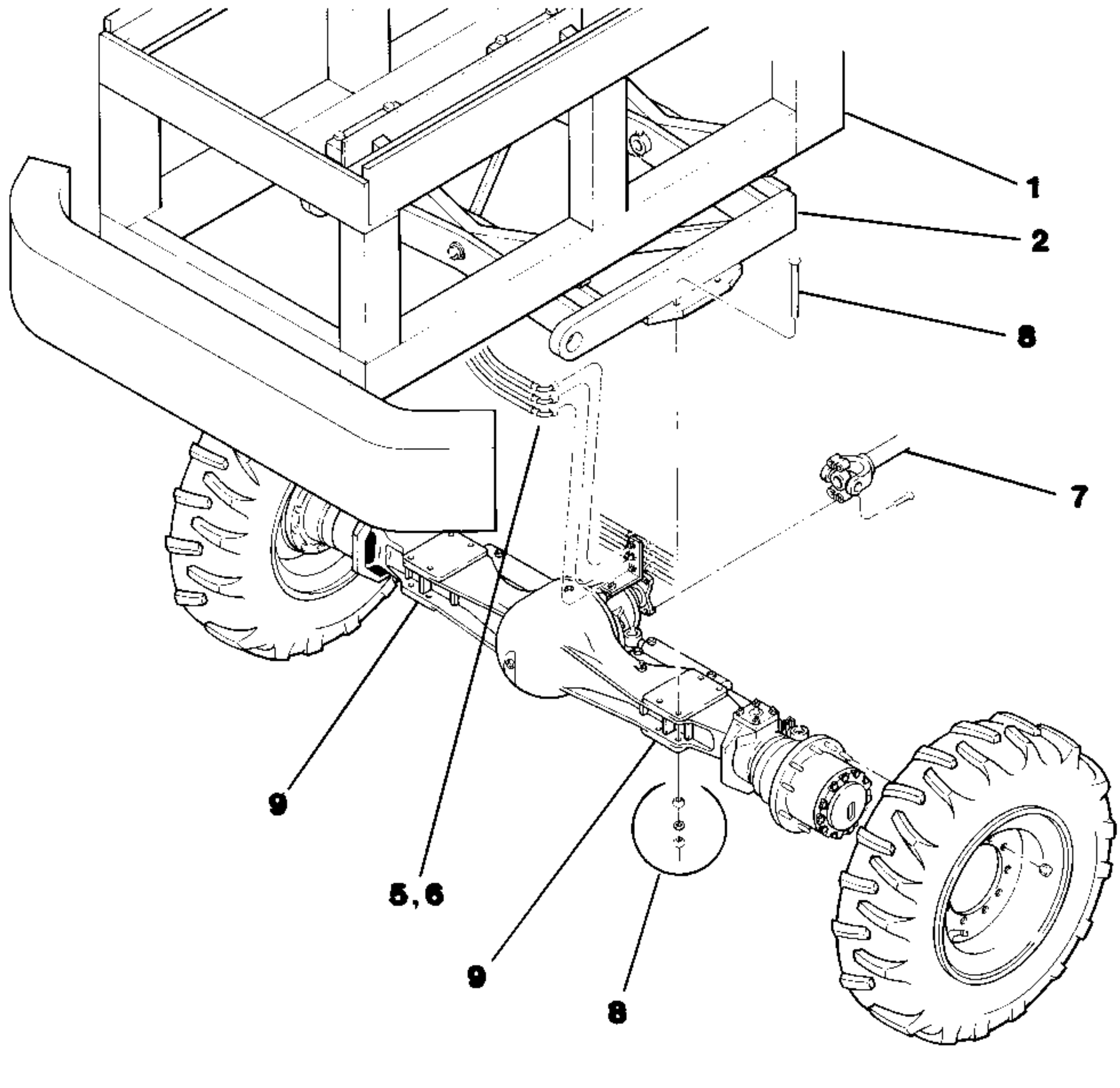
OVERHAUL

Axle overhaul procedures are detailed in the Axle Maintenance And Repair Manual available from the axle manufacturer.



1 - Main Frame
2 - Oscillation Frame
3 - Diff. Lock Hose
4 - Diff. Lock Elect. Control Wire
5 - Brake Hose
6 - Steer Hoses
7 - Drive Shaft
8 - Mounting Hardware
9 - Mounting Pads

Figure 9-5 Front Axle Removal/Installation



1 - Main Frame
2 - Oscillation Frame
5 - Brake Hose
6 - Steer Hoses
7 - Drive Shaft
8 - Mounting Hardware
9 - Mounting Pads

Figure 9-6 Rear Axle Removal/Installation

AXLES

TORQUE SPECIFICATIONS

POSITION	THREAD	WRENCH TORQUE (FT/LBS)
Brake Drum and Rotor Mounting Capscrews	5/8-11	174 - 191
Tie Rod and Steer Cylinder Socket Assembly Clamp Nuts	5/8-11	60 - 70
Tie Rod and Steer Cylinder Socket Assembly Stud Nuts	5/8-18	140 Min. (Note: A)
Tie Rod Jam Nuts	1-1/8-12	250 - 300
Spindle Mounting Nuts	9/16-18	80 - 100
Drive Flange Capscrews	7/16-14	90 - 100
King Pin Cap Studs	1/2-13	40 - 60 (Note: B)
King Pin Cap Nuts	1/2-20	94 - 103
Wheel Lug Nuts	3/4-16	450 - 500

A) If cotter pin cannot be installed after minimum torque is attained, the nut must be advanced until cotter pin can be installed.

B) For non-interference fit (Class 2) threaded studs installed with Loctite #271 or equivalent.

BRAKES

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LIST OF FIGURES

SERVICE BRAKES (MODELS 644, 844, 1044)

DESCRIPTION (Figure 10-1)

The service brakes are operated and controlled by hydraulic oil from the vechicle's hydraulic system.

Components of the service brake system consist of:

1. Power Brake Valve
2. Brake Pedal
3. Accumulator
4. Disc Brakes

The power brake valve is located under the floor of the operator's cab with an attached lever and brake pedal extending into the cab. The accumulator is located on the right-hand side of the machine's main frame. The disc brakes are internally located in an oil bath within the ends of the axles. (The axles must be disassembled to service the brake discs. Refer to the axle manufacturer's Maintenance Manual for overhaul procedures.)

The power brake valve consists of two valves within an integral unit:

1. A valve which charges the accumulator from the vehicle's hydraulic system.

2. A valve which controls the brakes with hydraulic power stored in and furnished by the accumulator. (Aside from charging the accumulator, the braking function is unrelated to the vehicle's hydraulic system.)

When force is applied to the brake pedal, oil flows from the accumulator into the brakes. Pressure is then held in the brake system until such time as the force on the brake pedal is either increased, reduced or released. If increased or reduced, the new brake line pressure is maintained (effort applied to the brake pedal is directly proportional to the brake line pressure which provides "feel" when braking the vehicle).

The energy stored in the accumulator permits full hydraulic power braking even when the vehicle's hydraulic system is not functioning. The number of brake applications after the engine is stopped is limited only by the accumulator vs. the flow and pressure required per brake application.

An internal filter is incorporated in the brake valve through which all the oil must flow that is used in the accumulator and brake system.

MAINTENANCE

Once the power brake valve has been properly adjusted, the accumulator precharge corrected and the brake lines bled, maintenance of the service brakes requires that the hydraulic oil in the vehicle's system and the fluid in the axle planetary hubs 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 (MODELS 644, 844, 1044)

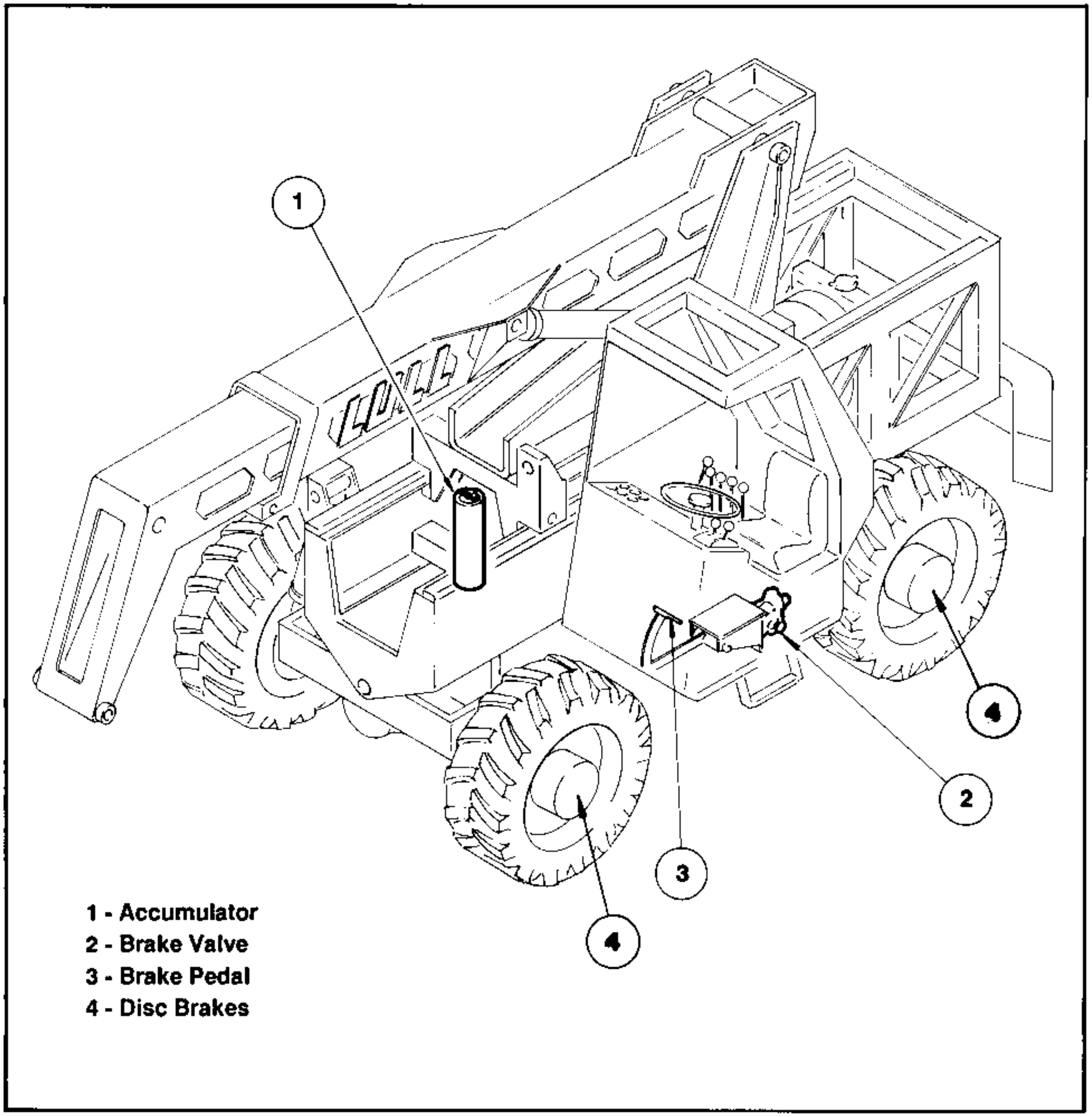


Figure 10-1 Service Brake Components

SERVICE BRAKES (MODELS 644, 844, 1044)

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
1. Aggressive brakes.	1. Accumulator precharge too low.	1. Check precharge pressure.
	2. Excessive brake line pressure.	2. Remove shim(s) behind brake pedal piston.
2. Frequent brake to accumulator chargine cycle.	1. Accumulator precharge too low.	1. Check precharge pressure.
	2. Accumulator precharge too high.	2. Check precharge pressure.
	3. Hose to accumulator is plugged.	3. Replace hose.
	4. Leaking fittings or hoses.	4. Tighten fittings or hoses.
	5. Defective brake valve.	5. Replace brake valve.
3. Brakes chatter or noisy.	1. Wheel end lubrication level is low.	1. Fill to proper level. (refer to Service Schedule)
	2. Wheel end lubrication is contaminated.	2. Drain, clean, and refill. (refer to Service Schedule)
	3. Wheel end lubrication is incorrect.	3. Drain, clean, and refill with correct lubricants. (refer to Service Schedule)
	4. Warped brake discs.	4. Replace discs.
	5. Misaligned piston.	5. Realign piston, replace any damaged components.
4. Brake line pressure low (below 200 psi).	1. Insufficient shims in brake valve.	1. Add shim(s) behind brake pedal piston.
	2. Low or no hydraulic fluid in reservoir.	2. Fill reservoir to proper level.
	3. Partial brake line restriction.	3. Replace hose.
5. Low brake pressure, indicators come on (red light & buzzer).	1. Hydraulic pump weak.	1. Check pump pressure and flow.
	2. Main relief pressure too low.	2. Adjust relief to proper pressure.
	3. Main pressure relief stuck open.	3. Remove, clean, and replace.
	4. Tee relief pressure too low.	4. Increase pressure to 3000 PSI.
	5. Tee relief stuck open.	5. Remove, clean, and replace.
	6. Tee relief.	6. Remove from system.
	7. Defective brake valve.	7. Replace valve.

SERVICE BRAKES (MODELS 644, 844, 1044)

TESTING PROCEDURE

1. a. Place transmission selector control in neutral.
   b. Apply the emergency brake.
   c. Shut off engine.
   d. Check hydraulic oil level.
   e. Hydraulic pump must be in good operating order.

TESTING ACCUMULATOR PRECHARGE -
2. Locate the accumulator (Item 1) on vehicle (see Figure 10-1) and remove its protective cap (Item 4) and stem cap (Item 9) (see Figure 10-2).

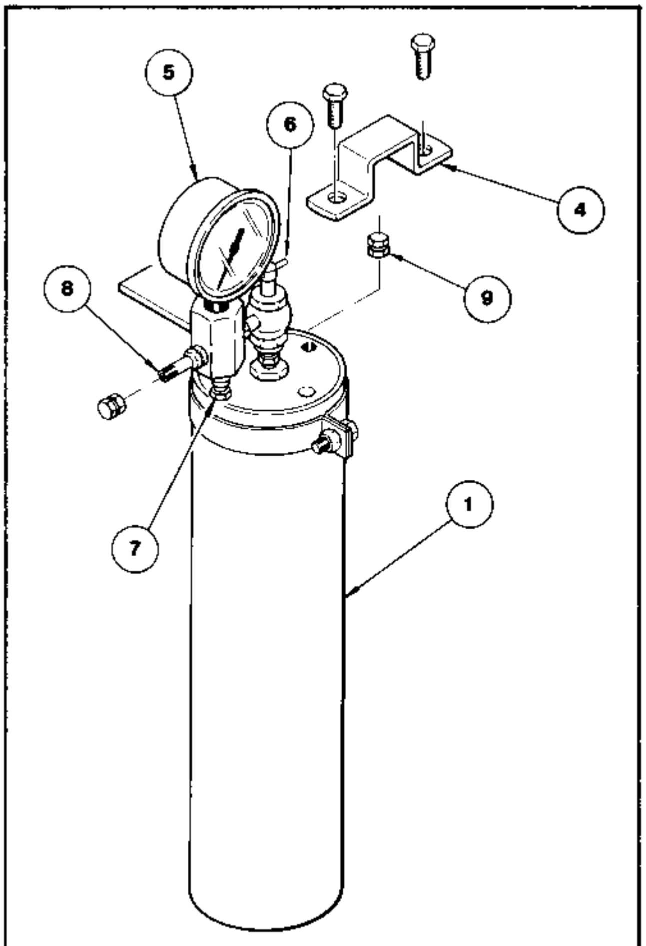


Figure 10-2 Test Gauge - Accumulator

3. a. Mount an appropriate pressure gauge (Item 5) to the accumulator (see Figure 10-2). The gauge must be of 2500 PSI capacity (correctly calibrated) with 5/16-32 UNEF mounting nut threads (Lull Part No. P26749).

b. The bleed screw (Item 7) must be tightly closed (turned in).

c. The tee handle/needle valve (Item 6) must be turned out.

d. Be sure of an air-tight connection when mounting gauge.

e. Turn-in the tee handle/needle valve after gauge is mounted.

4. **For machines with diagnostic ports:** Attach an appropriate test gauge (Item 21) (Lull Part No. 26231C) to the diagnostic port (Item 22) located at the power brake valve (see Figure 10-3).

For machines without diagnostic ports: Mount an appropriate test gauge (Item 10) (Lull Part No. 24905B) and brake line test tee (Item 11) (Lull Part No. P27399) in the brake line at the left front wheel (see Figure 10-4).

5. Repeatedly pump (push, hold, release) the brake pedal until all brake line pressure is gone. The test gauge (Item 10 or 21) must read 0 PSI. This procedure may require approximately 25 - 35 pumps of the brake pedal.

6. a. At this time the pressure testing gauge (Item 5) must read 400 - 415 PSI (accumulator precharge) (see Figure 10-2).

b. If pressure is correct, proceed to step 7.

c. If pressure is incorrect, proceed to step 12.

7. Start the engine and allow it to run (idle) throughout the remainder of the testing procedure. This will allow the accumulator to maintain operating pressure.

8. **TESTING BRAKE LINE PRESSURE-**

For machines with diagnositc ports: Refer to and follow step (5) under "Checking and Adjusting Circuit Pressure" on page 3.8-5 in Section 3.

SERVICE BRAKES (MODELS 644, 844, 1044)

TESTING PROCEDURE (cont.)

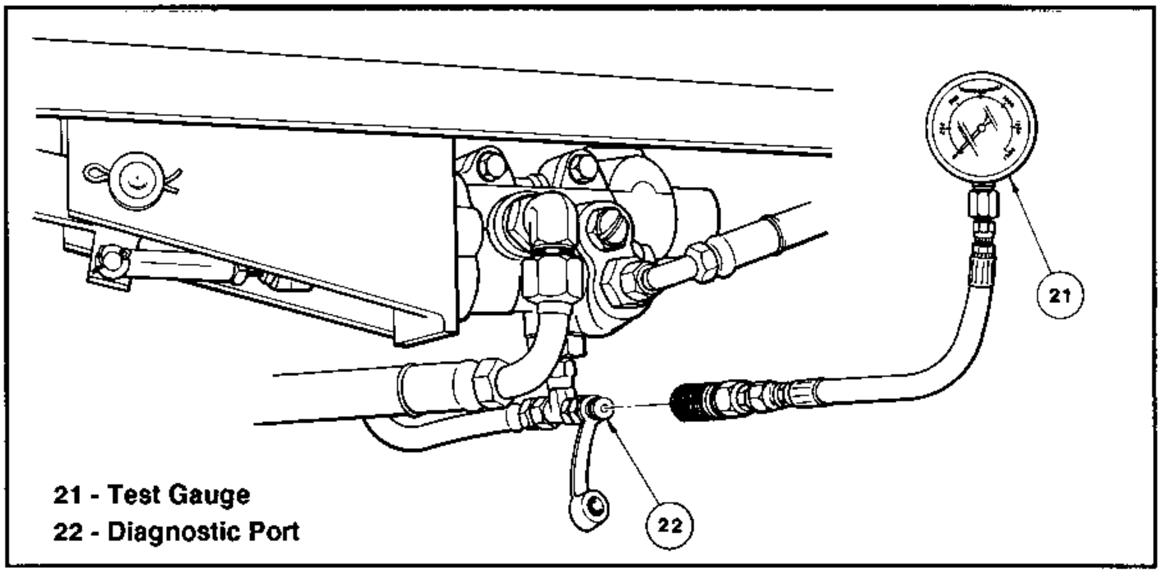


Figure 10-3 Test Gauge - Brake Valve

8. **TESTING BRAKE LINE PRESSURE (cont.)**

For machines without diagnostic ports: Perform the following steps, a through e.

a. Apply brake pedal pressure and hold.

b. Note gauge pressure reading at left front wheel (see Figure 10-4).

c. Gauge must indicate 300 to 330 PSI.

d. If pressure is correct:

1. Release brake pedal pressure.

2. Disassemble gauge (Item 10) and tee (Item 11) from brake line.

3. Reassemble brake line.

4. Bleed left front wheel.

5. Proceed to step 9.

e. If pressure is incorrect, proceed to step 13.

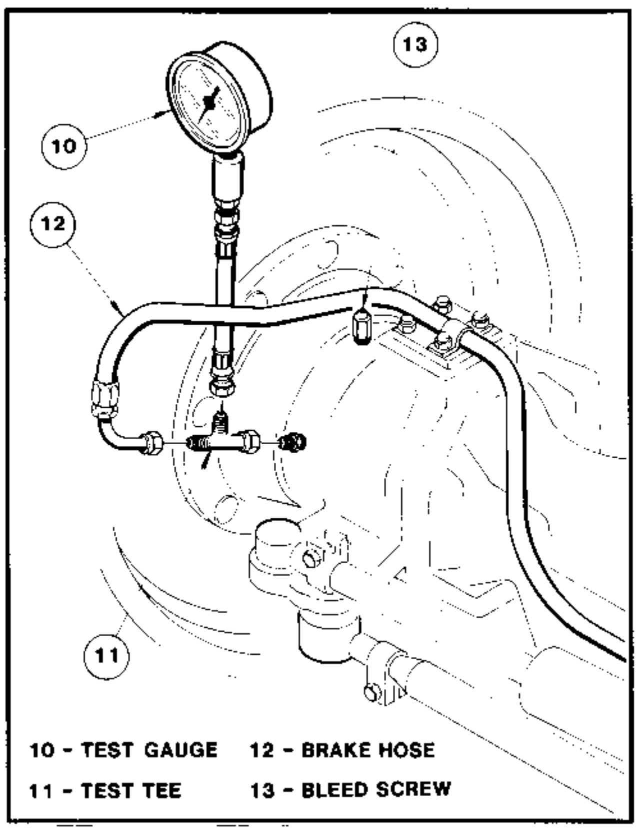


Figure 10-4 Test Gauge - Brake Line

SERVICE BRAKES (MODELS 644, 844, 1044)

TESTING PROCEDURE (cont.)

9. **TESTING ACCUMULATOR HIGH LIMIT -**
   a. Allow accumulator to reach full charge (high limit) pressure.

   b. The test gauge (Item 5) must read between 1150 and 1250 PSI (see Figure 10-2).

   c. If pressure is correct, proceed to step 10.

   d. If pressure is incorrect, proceed to step 14

10. **TESTING ACCUMULATOR LOW LIMIT -**
   a. Repeatedly pump (push, hold, release) the brake to allow accumulator pressure to drop.

   b. While watching the test gauge (Item 5) (see Figure 10-2) note lowest pressure indicated before accumulator begins to recharge (pressure begins to rise).

   c. Perform steps (a) and (b) three (3) times.

   d. Lowest pressure (low limit) must read between 550 and 650 PSI.

   e. If pressure is correct, proceed to step 11.

   f. If pressure is incorrect, shut off the engine, replace the brake valve (see "Brake Valve Removal and Installation" on page 10.2-8) and return to step 7 and continue.

11.
   a. Turn out tee handle/needle valve (Item 6) on testing gauge (Item 5) (see Figure 10-2).

   b. Release any remaining air in gauge through bleed screw (item 7) and tighten.

   c. Remove gauge from accumulator and replace accumulator stem cap (Item 9) and protective cap (Item 4.)

TESTING PROCEDURE IS COMPLETED.

12. **Adjusting accumulator precharge (from step 6):**

   a. If test gauge pressure reads too high, slowly turn out gauge bleed screw (Item 7) to release pressure and tighten when 400 PSI is indicated (see Figure 10-2).

   b. If test gauge pressure reads too low, charge the valve stem (Item 8) on the gauge with dry nitrogen until gauge indicates 400 PSI (see Figure 10-2).

   c. If correct pressure cannot be achieved, replace accumulator (see "Accumulator Removal and Installation" on page 10.2-10). Reinstall test gauge and adjust accumulator to correct pressure.

   d. Return to step 7 and continue.

13. **Adjusting the brake valve for correct brake line pressure (from step 8):**

   a. After noting incorrect brake line pressure, shut off the engine, remove brake line pressure (see step 5), DO NOT REMOVE HOSES (see Figure 10-5)

   b. Pry ring (Item 17) away from valve housing (Item 2).

   c. Remove boot (Item 18) and piston (Item 19).

   d. Add or remove shims (Item 20) as required. NOTE: Adding shims (thickness) will increase pressure. Removing shims (thickness) will reduce pressure. Shims are provided in the following thickness and pressure results:

SHIM THICKNESS	PRESSURE
.032	65 PSI
.018	37 PSI
.007	14 PSI
.004	8 PSI

   e. Add or remove the necessary shims calculated to arrive at correct brake line pressure.

   f. Reassemble brake valve piston (Item 19), boot (Item 18) and ring (Item 17).

   g. Reassemble brake valve (Item 2) to bracket (Item 14) (See "Brake Valve Installation" on page 10.2-8).

   h. Restart engine, return to step 8 and continue.

NOTE: If, after completing steps 8 and 13, correct brake line pressure cannot be achieved, shut off the engine and replace the brake valve (see "Brake Valve Removal and Installation" on page 10.2-8).

SERVICE BRAKES (MODELS 644, 844, 1044)

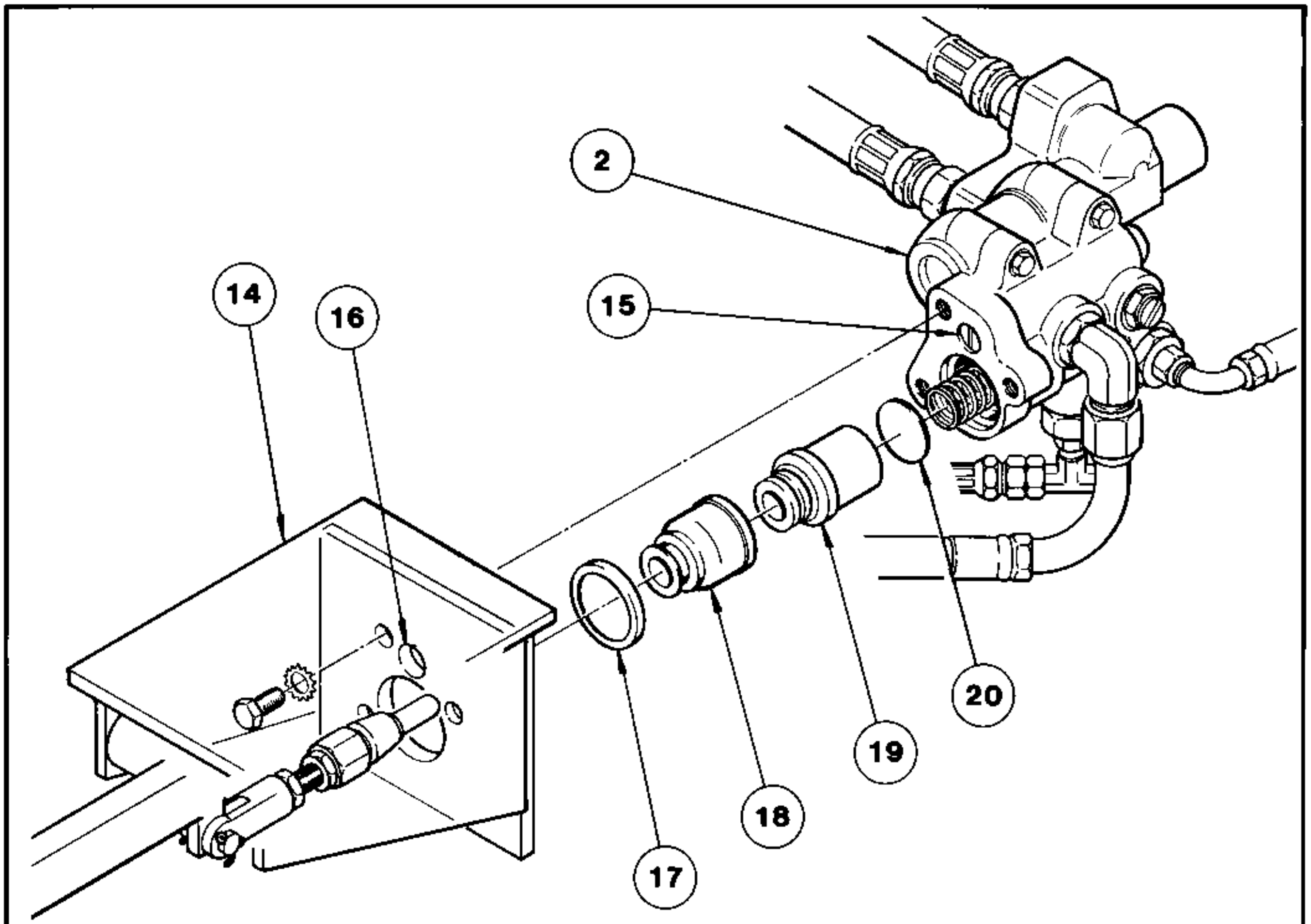
TESTING PROCEDURE (cont.)

14. **Checking and adjusting the brake valve for high limit pressure (from step 9):**
    a. If test gauge pressure reads too high or too low, adjust screw (Item 15) on brake valve (Item 2) to arrive at 1200 PSI (see Figure 10-5). The adjusting screw is accessible through access hole (Item 16) in bracket.

NOTE: Pressure is raised by turning screw in and lowered by turning screw out.

b. If correct pressure is achieved, return to step 10 and continue.

c. If correct pressure cannot be achieved, shut off the engine and replace the brake valve (See "Brake Valve Removal and Installation" on page 10.2-8). Return to step 7 and continue.



2 - Brake Valve
14 - Bracket
15 - Adjusting Screw
16 - Adjusting Access Hole
17 - Retaining Ring
18 - Boot
19 - Piston
20 - Shims

Figure 10-5 Adjusting Brake Valve

SERVICE BRAKES (MODELS 644, 844, 1044)

BLEEDING PROCEDURE

1. Start the engine, place the transmission in neutral and apply the parking brake.

2. Open the bleeder screw at left rear wheel and slowly apply brake pedal pressure until air is bled out of the line, then close bleeder screw.

Perform this step at each wheel in the following sequence:

(As viewed from operator's cab)

(1) Left Rear
(2) Right Rear
(3) Right Front
(4) Left Front

BRAKE VALVE REMOVAL (Figure 10-6)

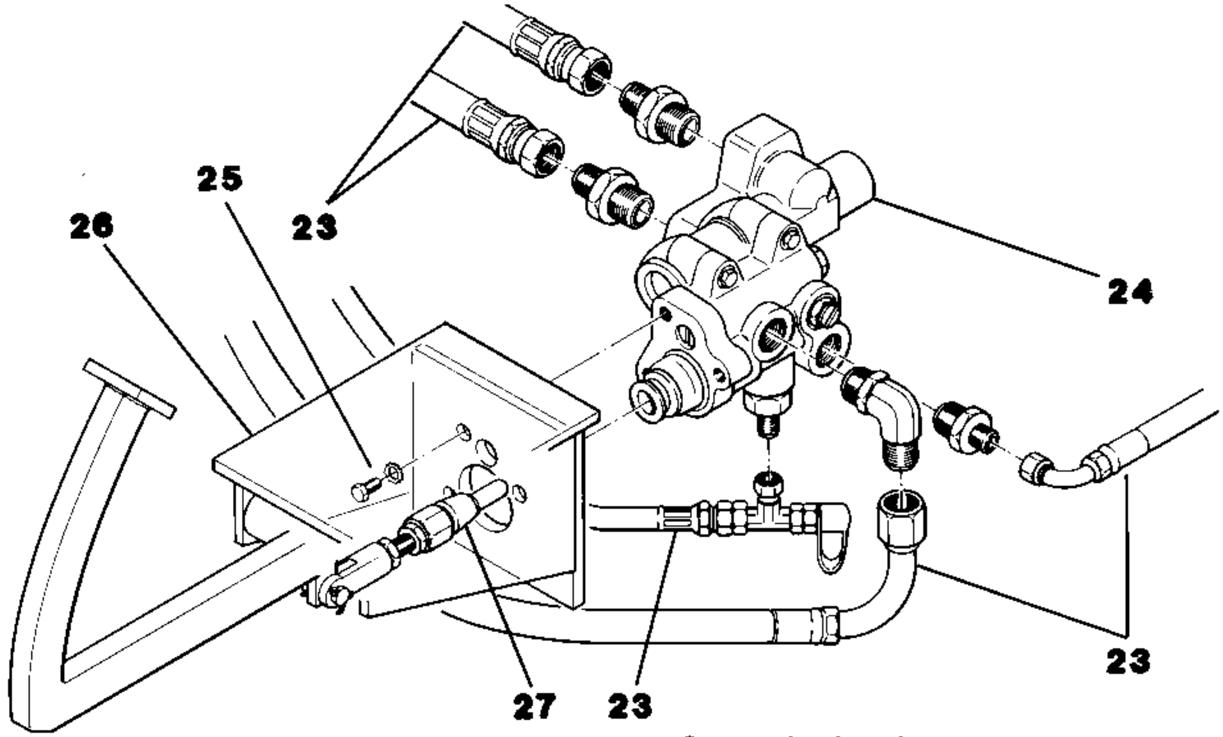
1. Lower the boom, shut off the engine and apply the parking brake.

2. Repeatedly pump (push, hold, release) the brake pedal until brake line pressure is gone. This procedure may require approximately 25 - 35 pumps of the brake pedal. There will be a definite "bottoming out" feel to the brake pedal when brake line pressure is depleted. (If a pressure gauge is installed in the brake line it must read 0 PSI.)

3. Remove the five hydraulic hoses (Item 23) from the brake valve (Item 24) and cap.

4. Remove the three screws and lockwashers (Item 25) mounting the brake valve to its bracket (Item 26).

5. Remove the brake valve.



23 - Hoses
24 - Brake Valve
25 - Screws, Lockwashers
26 - Bracket
27 - Push Rod

Figure 10-6 Brake Valve Removal/Installation

SERVICE BRAKES (MODELS 644, 844, 1044)

BRAKE VALVE INSTALLATION

1. Mount brake valve (Item 22) to bracket (Item 24) with three screws and washers (Items 23). NOTE: Be sure push rod (Item 27) is correctly assembled to brake valve when mounting.

2.. Perform steps 1 through 11 of "Testing Procedure" on page 10.2-4 and steps 1 through 2 of "Bleeding Procedure".

BRAKE VALVE OVERHAUL

Refer to the brake valve manufacturer's Service Manual for detailed overhaul procedures.

ACCUMULATOR DESCRIPTION

The pneumatic accumulator is operated by compressed gas. Gas and hydraulic oil occupy the same container. When oil pressure rises, incoming oil compresses the gas. When oil pressure drops, the gas expands, forcing out oil. The gas is separated from the oil by a piston or bladder, depending on type of accumulator. This prevents mixing of gas and oil and keeps gas out of the hydraulic system.

The piston-type accumulator (Figure 10-7) has a "free floating" piston separating the gas from the oil.

The piston fits into a smooth bore and uses packings to separate the gas from the oil. With double packings, a bleed hole is needed as shown to relieve pressure of any oil seeping into the center area between the two packings.

The accumulator can be "precharged" with gas before use in a system. This is done by filling the gas chamber to a desired pressure with dry nitrogen.

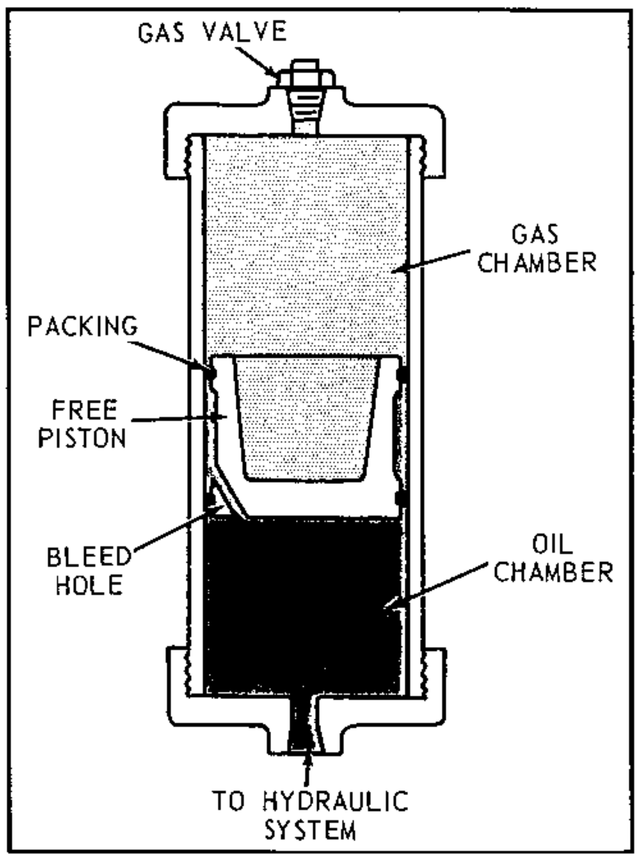


Figure 10-7 Accumulator - Piston Type

SERVICE BRAKES (MODELS 644, 844, 1044)

ACCUMULATOR DESCRIPTION (cont.)

The bladder-type accumulator (Figure 10-8) has a flexible bag or bladder made of synthetic rubber which contains gas and separates the gas from the oil. The bladder is molded to the gas charging stem located at the top of the accumulator.

To prevent damage to the bladder, a protective button is used at the bottom. This button prevents the bladder from being drawn into the oil port when the bladder expands. Otherwise, the bladder might be cut or torn.

The accumulator has a spring-loaded orifice which admits a free flow of oil, but meters oil coming out for a slower, gauged action.

Bladder-type accumulators can be precharged before use.

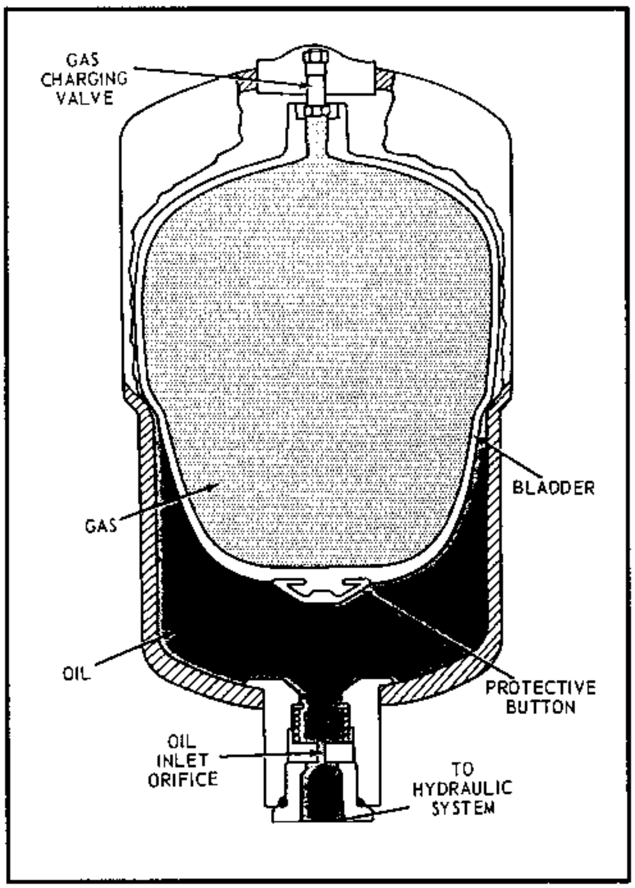


Figure 10-8 Accumulator - Bladder Type

ACCUMULATOR PRECAUTIONS

Observe the following precautions when working on pneumatic accumulators.

1. WARNING: NEVER FILL AN ACCUMULATOR WITH OXYGEN! An explosion could result if oil and oxygen mix under pressure.

2. Never fill an accumulator with air. When air is compressed, water vapor in the air condenses and can cause rust. This in turn may damage seals and ruin the accumulator. Also, once air leaks into the oil, the oil becomes oxidized and breaks down.

3. Always fill an accumulator with dry nitrogen. This gas is free of both water vapor and oxygen; this makes it harmless to parts and safe to use.

4. Never charge an accumulator to a pressure more than that specified. See "Specifications" in Section 1.

5. Before removing an accumulator from a hydraulic system, release all hydraulic pressure.

6. Before you disassemble an accumulator, release both gas and hydraulic pressures.

7. When you disassemble an accumulator, make sure that dirt and abrasive material does not enter any of the openings.

CHECKING PRECHARGED ACCUMULATOR

1. If you suspect external gas leaks, apply soapy water to the gas valve and seams on the tank at the "gas" end. If bubbles form, there is a leak.

2. If you suspect internal leaks, check for foaming oil in the system reservoir and/or no action of the accumulator. These signs usually mean a faulty bladder or piston seals inside the accumulator.

SERVICE BRAKES (MODELS 644, 844, 1044)

ACCUMULATOR REMOVAL

1. Lower the boom, shut the engine off and apply the parking brake.

2. Repeatedly pump (push, hold, release) the brake pedal until brake line pressure is gone. There will be a definite "bottoming out" feel to the brake pedal when brake line pressure is depleted (if a pressure gauge is installed in the brake line it must read 0 PSI).

3. Remove hydraulic hose from bottom of accumulator.

4. Remove screw and lockwasher from bottom of mounting bracket.

5. Remove screw, nut and lockwasher from mounting bracket clamp.

6. Remove accumulator.

ACCUMULATOR INSTALLATION

1. Reverse steps 3 through 6 above.

2. Perform steps 1 through 11 of "Testing Procedure" on page 10.2-4 and steps 1 through 2 of "Bleeding Procedure" on page 10.2-8.

ACCUMULATUR OVERHAUL

1. Before dismantling accumulator, release all gas pressure. Normally unscrew the gas valve very slowly. Install the charging valve first if necessary and use bleed screw. Never release the gas by depressing the valve core, as the core might be ruptured.

2. Disassemble the accumulator on a clean bench area.

3. Check all parts for leaks or other damage.

4. Plug the openings with plastic plugs or clean towels as soon as parts are removed.

5. Check bladder or piston seals for damage and replace if necessry.

6. If gas valve cores are replaced, be sure to use the recommended types.

7. Carefully assemble the accumulator.

BRAKES

PARKING BRAKE (MODELS 644, 844, 1044)

DESCRIPTION

The parking brake is a disc and caliper type located on the output shaft at the rear of the transmission (Figure 10-9 and 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.

Replace brake pads when pad thickness is 1/8" or less.

CAUTION: Be sure to lower the boom, shut off the engine and block the tires when servicing the parking brake.

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 10-9 Parking Brake Caliper & Disc (Model 644)

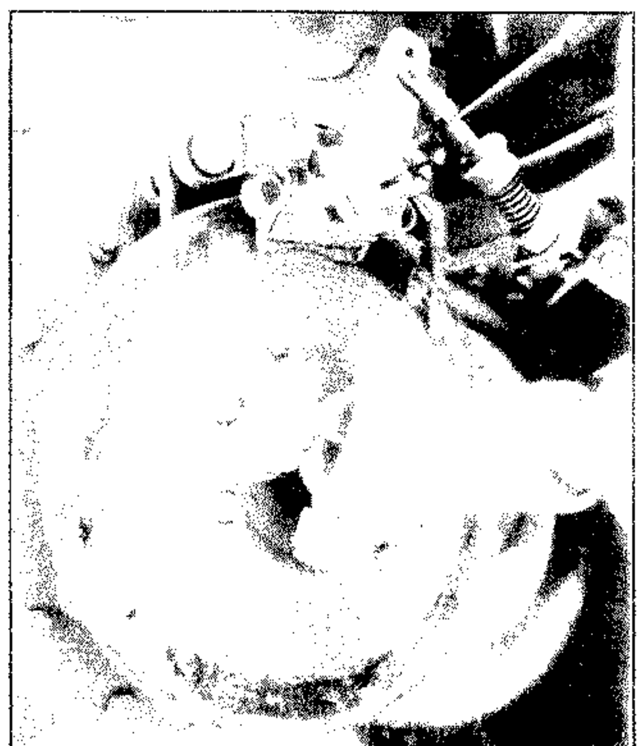
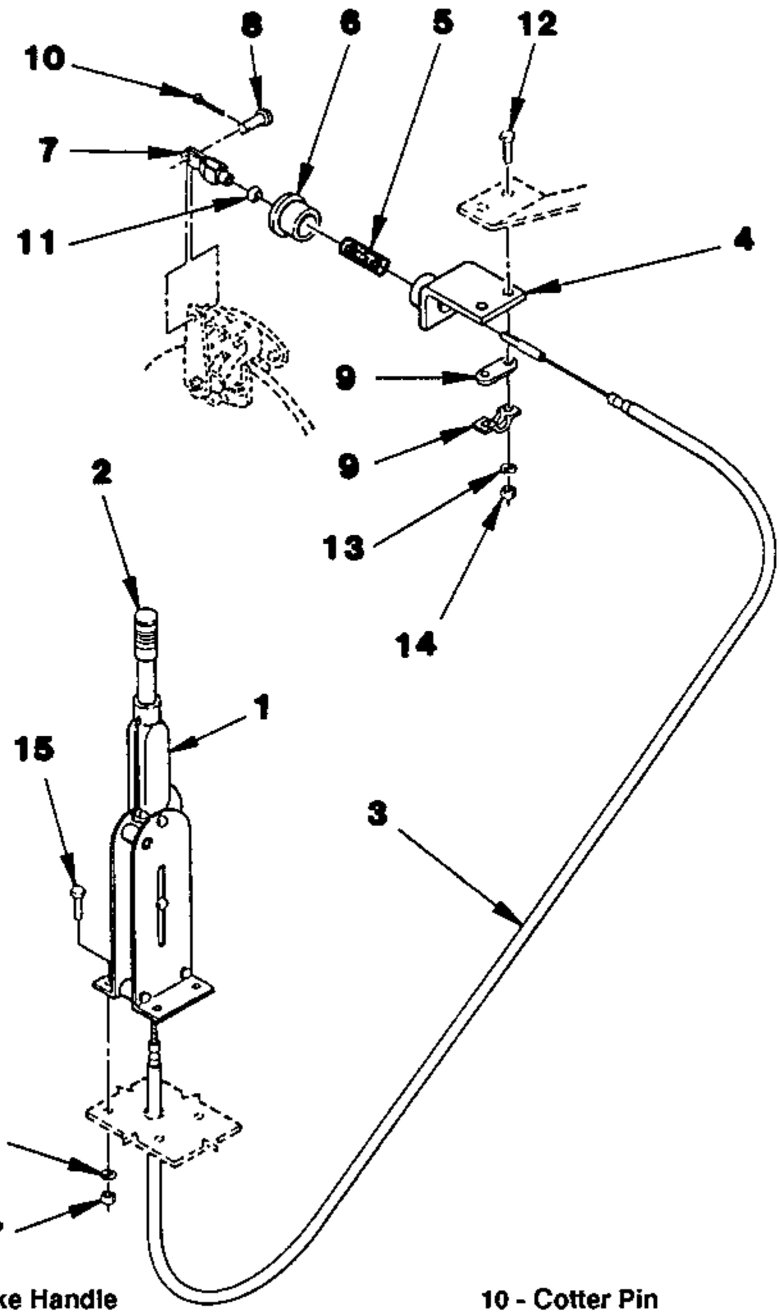


Figure 10-10 Parking Brake Caliper & Disc (Models 844 and 1044)

PARKING BRAKE (MODELS 644, 844, 1044)



1 - Parking Brake Handle
2 - Tension Adjustment Knob
3 - Cable
4 - Spring Base Mount
5 - Spring
6 - Spring Retainer
7 - Clevis
8 - Clevis Pin
9 - Clamp
10 - Cotter Pin
11 - Nut, 3/8-24
12 - Bolt, 3/8 x 1
13 - Lockwasher, 3/8
14 - Nut, 3/8-16
15 - Bolt, 5/16 x 1
16 - Lockwasher, 5/16
17 - Nut, 5/16-18

Figure 10-11 Parking Brake Assembly

PARKING BRAKE (MODELS 844 & 1044 — ELECTRIC TRANSMISSION)

Description

The parking brake is a drum type located on the output shaft at the rear of the transmission (Figure 10-12). A hydraulic cylinder with an internal compression spring actuates the parking brake through a mechanical bell crank and link (Figure 10-13). The parking brake valve, located in the operator's cab, controls the action of the cylinder. When the valve handle is pulled out, hydraulic system pressure is routed to the cylinder. The hydraulic pressure overcomes the spring force and the parking brake is released. When the handle is pushed in, the hydraulic pressure in the cylinder is released to the return side of the hydraulic system. The spring force in the cylinder then sets the parking brake. In the event that hydraulic system pressure is lost, the parking brake can still be set.

Maintenance

Inspection

1. Inspection interval is every 100 hours of operation.
2. Check all hydraulic lines and fittings for leaks and damage.
3. Inspect hydraulic cylinder and mechanical linkages for condition and wear. Check condition of breather port on hydraulic cylinder.
4. Repair or replace items as needed.

Adjustment

1. As brake shoes wear, adjust mechanical system by removing pin securing adjustable link at bell crank.
2. Use a suitable hole location in adjustable link to remove excess play in system.
3. Attach adjustable link to bell crank with pin. Secure pin with washer and new cotter pin.

⚠ CAUTION!

Park vehicle on level surface, lower boom to ground, shut off engine, and block all tires before servicing the parking brake.

Replacement

Refer to manufacturer's workshop manual for parking brake replacement procedures.

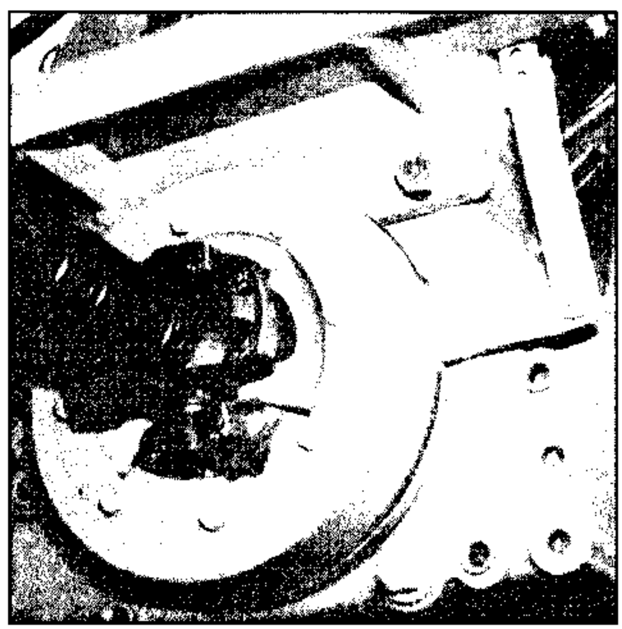
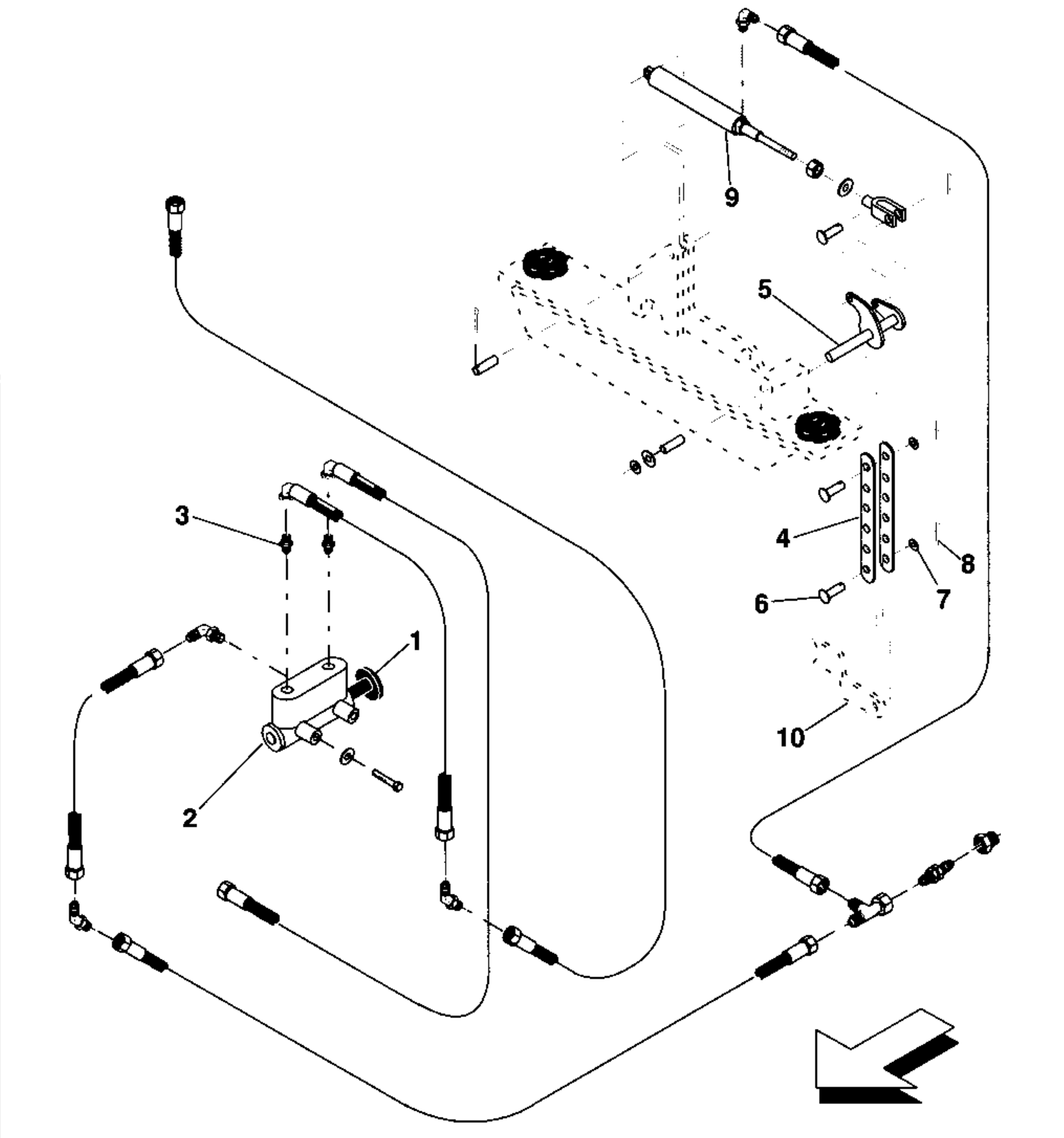


Figure 10-12 Parking Brake

PARKING BRAKE (MODELS 844 & 1044 — ELECTRIC TRANSMISSION)



1 - Parking Brake Handle
2 - Parking Brake Valve
3 - Check Valve
4 - Adjustable Link
5 - Bell Crank
6 - Pin
7 - Washer
8 - Cotter Pin
9 - Cylinder
10 - Parking Brake Arm

Figure 10-13 Parking Brake Assembly

STEERING

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STEERING

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LIST OF FIGURES

STEERING SYSTEM (MODELS 644, 844, 1044)

DESCRIPTION (Figure 11-1)

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 priority valve. (NOTE: Refer to page 3.50-1 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, through the selector valve, 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 steer selector mode and direction of steer wheel rotation. There are three steering modes, controlled by the steer selector valve located on the instrument panel:

(1) Round (4 Wheel) Steer
(2) Front Wheel Steer
(3) Oblique (Crab) Steer

Refer to flow diagrams (Figures 11-2 through 11-7) for hydraulic operation under the various steer modes.

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 (MODELS 644, 844, 1044)

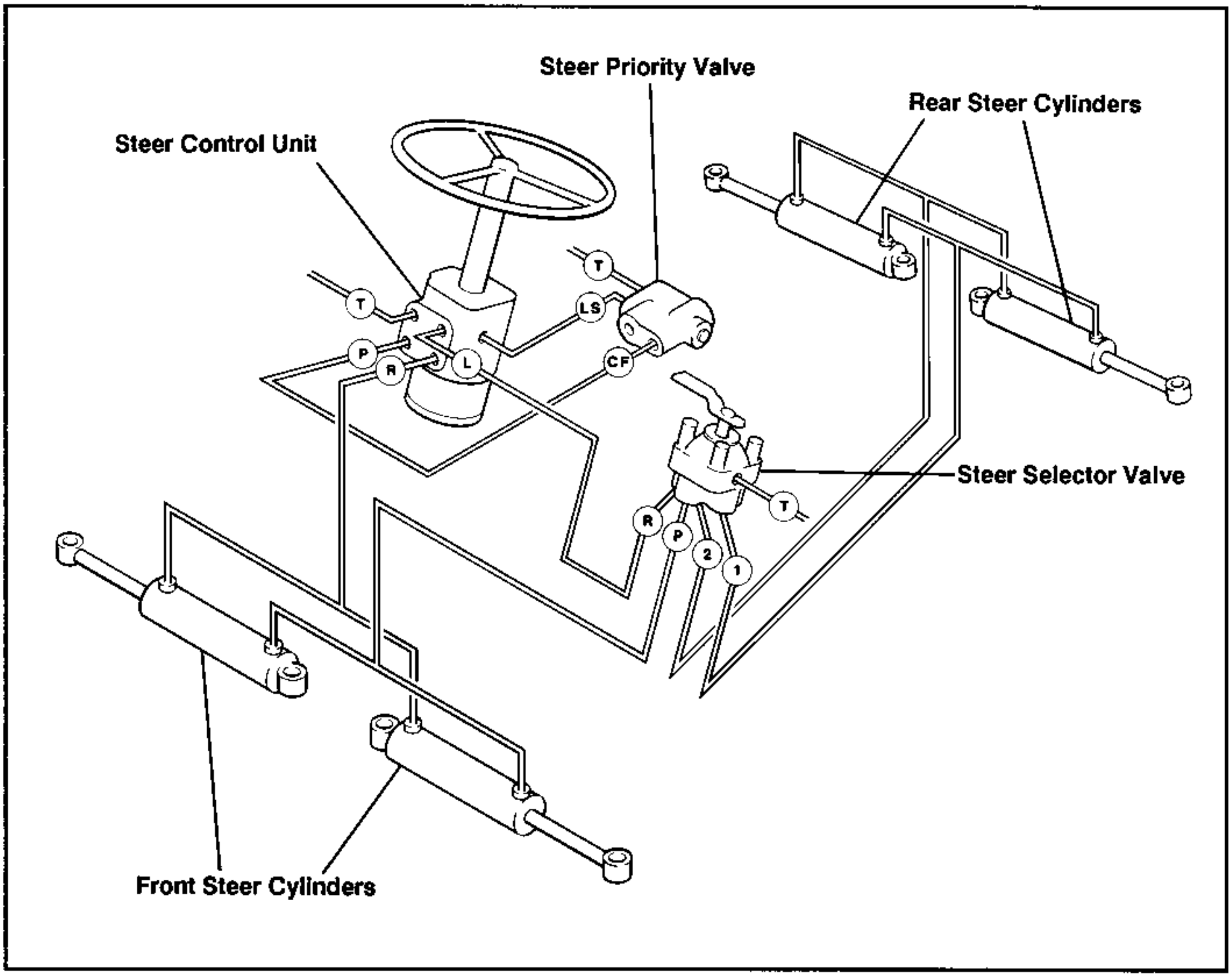


Figure 11-1 Steer Hydraulic Diagram

STEERING SYSTEM (MODELS 644, 844, 1044)

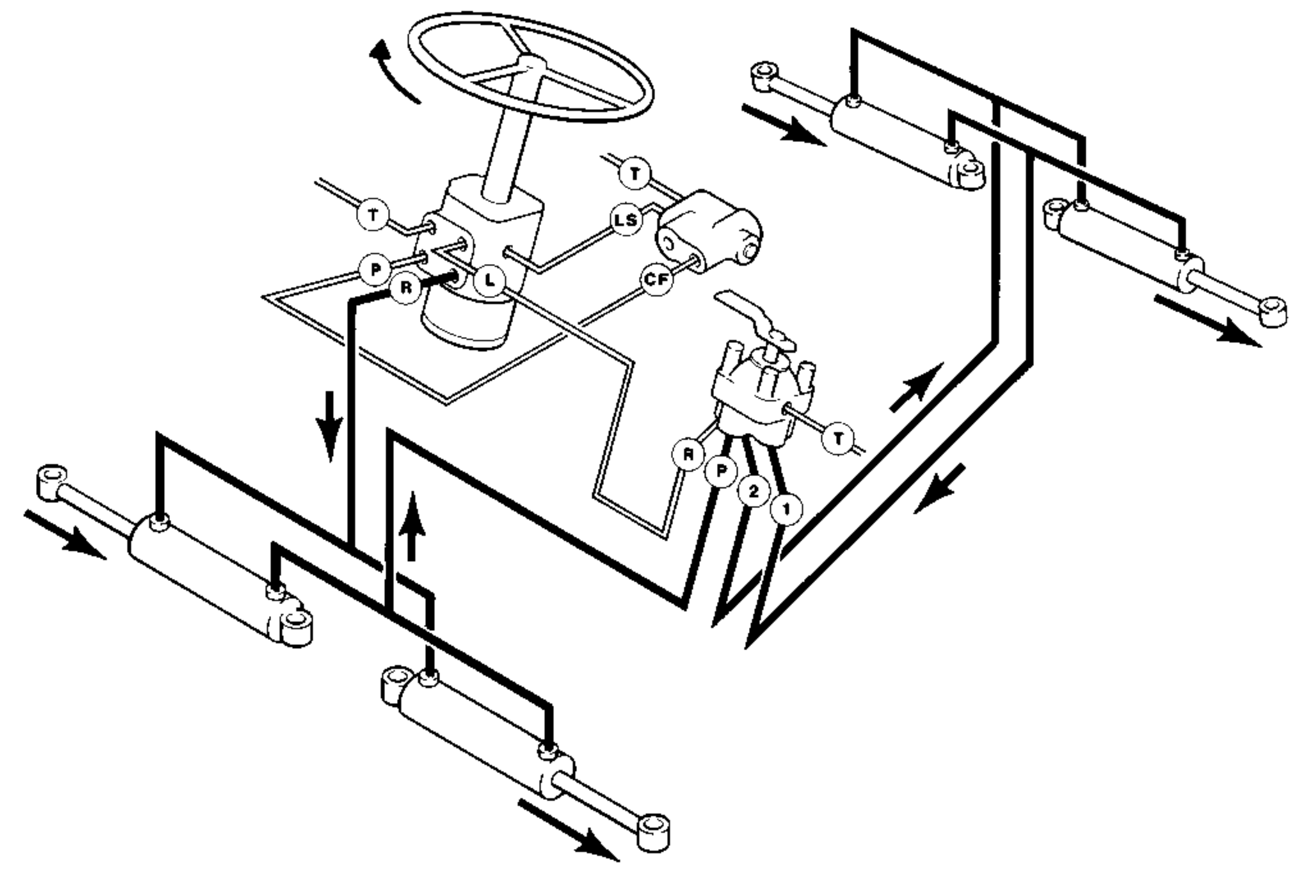


Figure 11-2 Flow Diagram - Round Right Steer

STEERING SYSTEM (MODELS 644, 844, 1044)

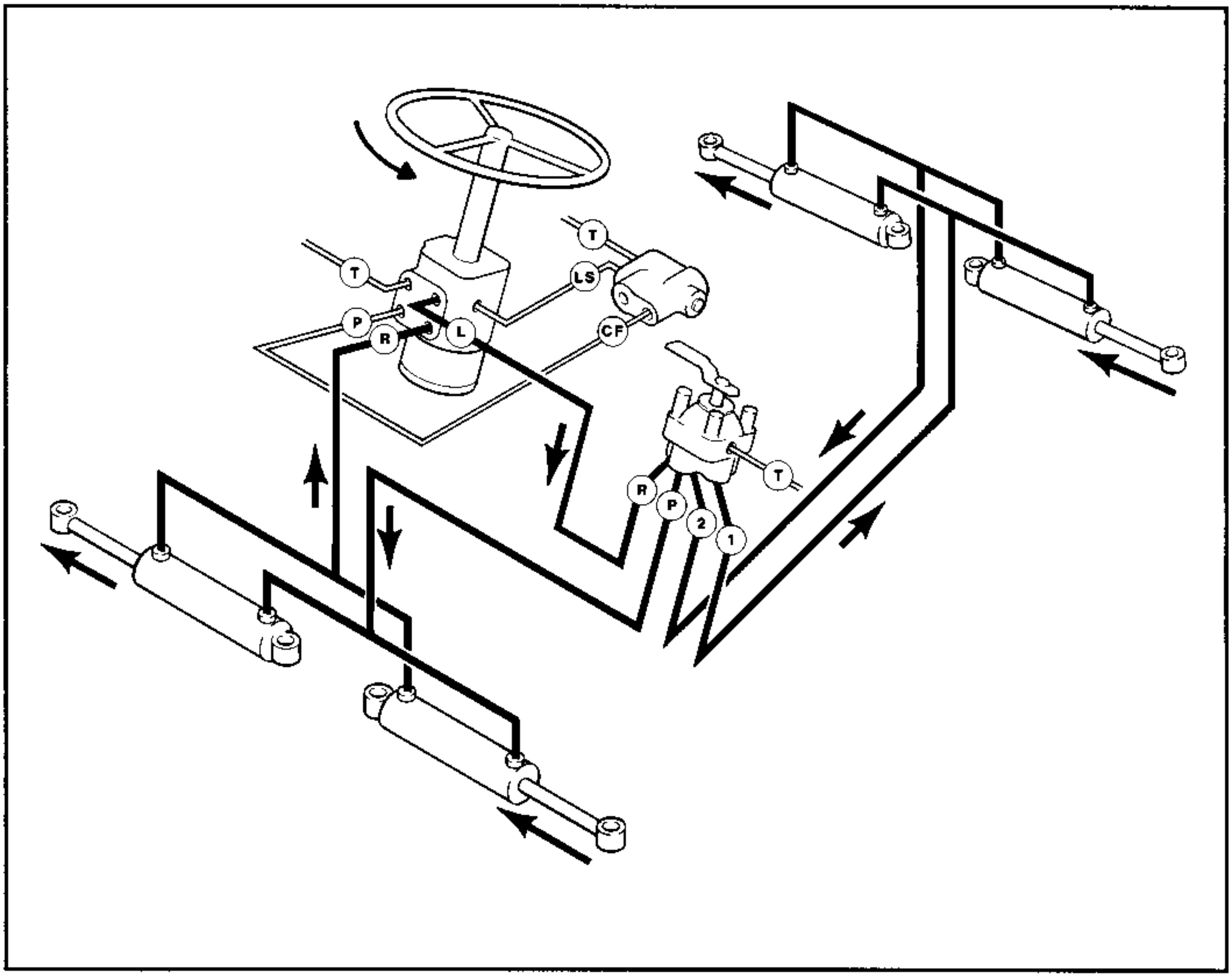


Figure 11-3 Flow Diagram - Round Left Steer

STEERING

STEERING SYSTEM (MODELS 644, 844, 1044)

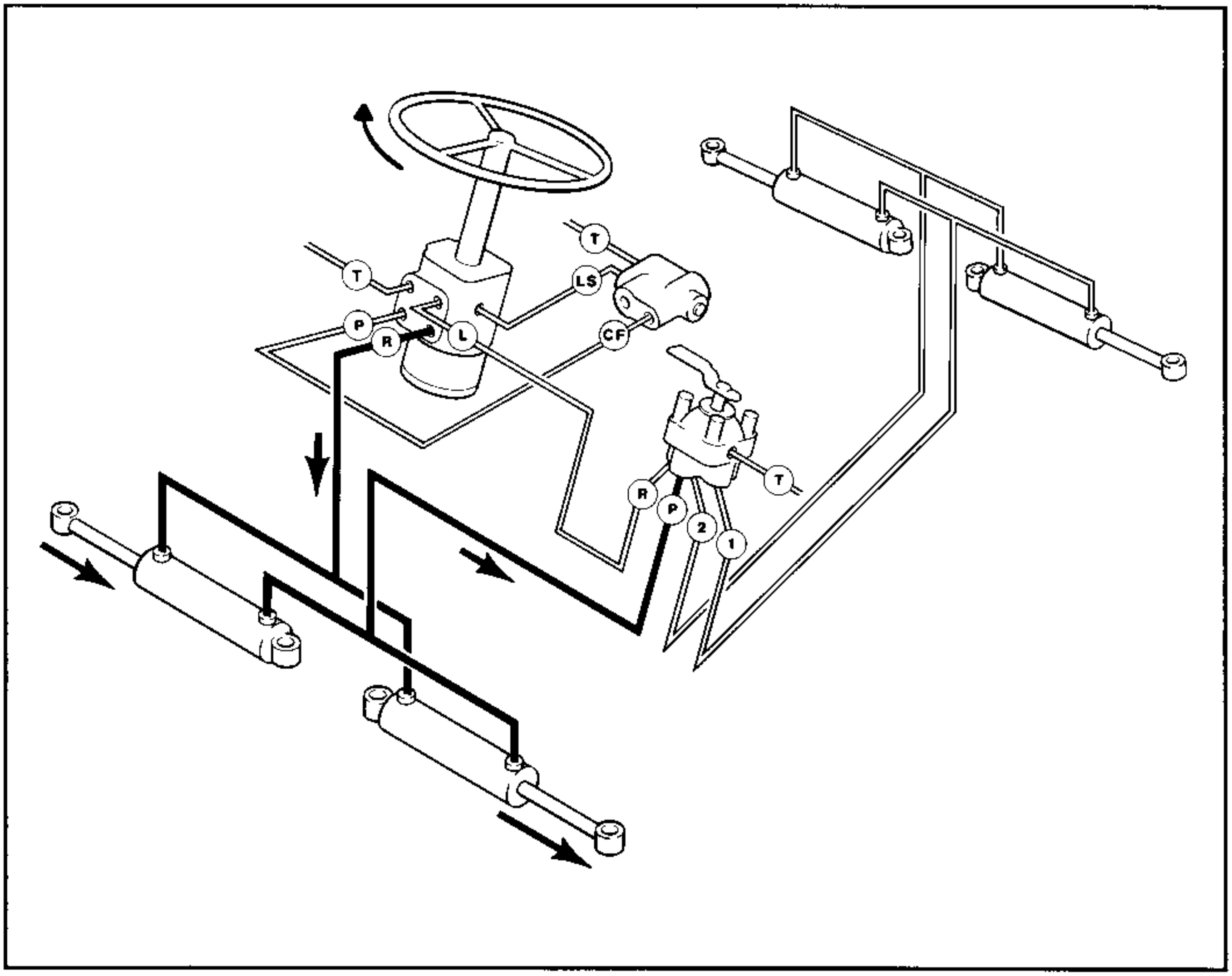


Figure 11-4 Flow Diagram - Front Right Steer

STEERING SYSTEM (MODELS 644, 844, 1044)

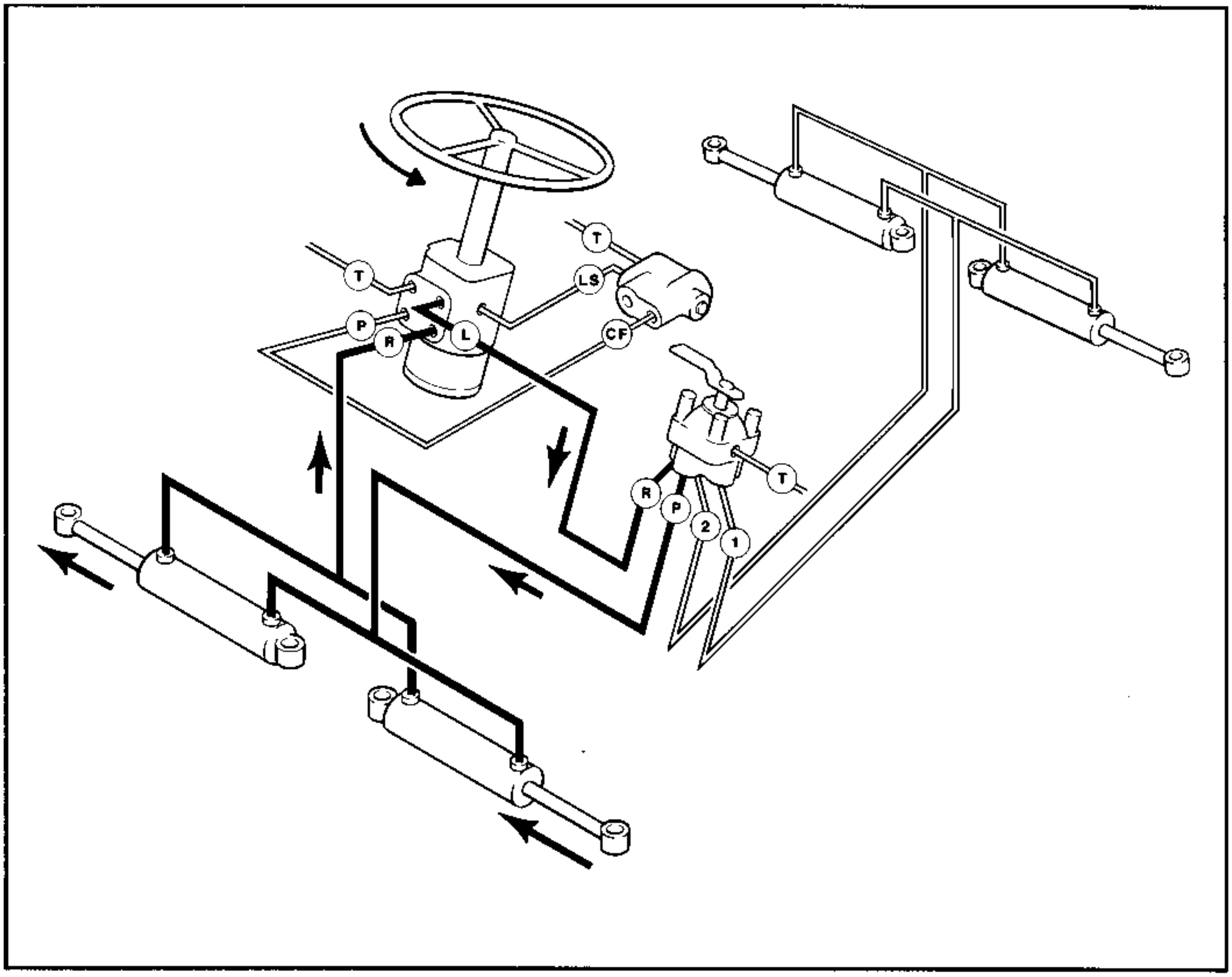


Figure 11-5 Flow Diagram - Front Left Steer

STEERING SYSTEM (MODELS 644, 844, 1044)

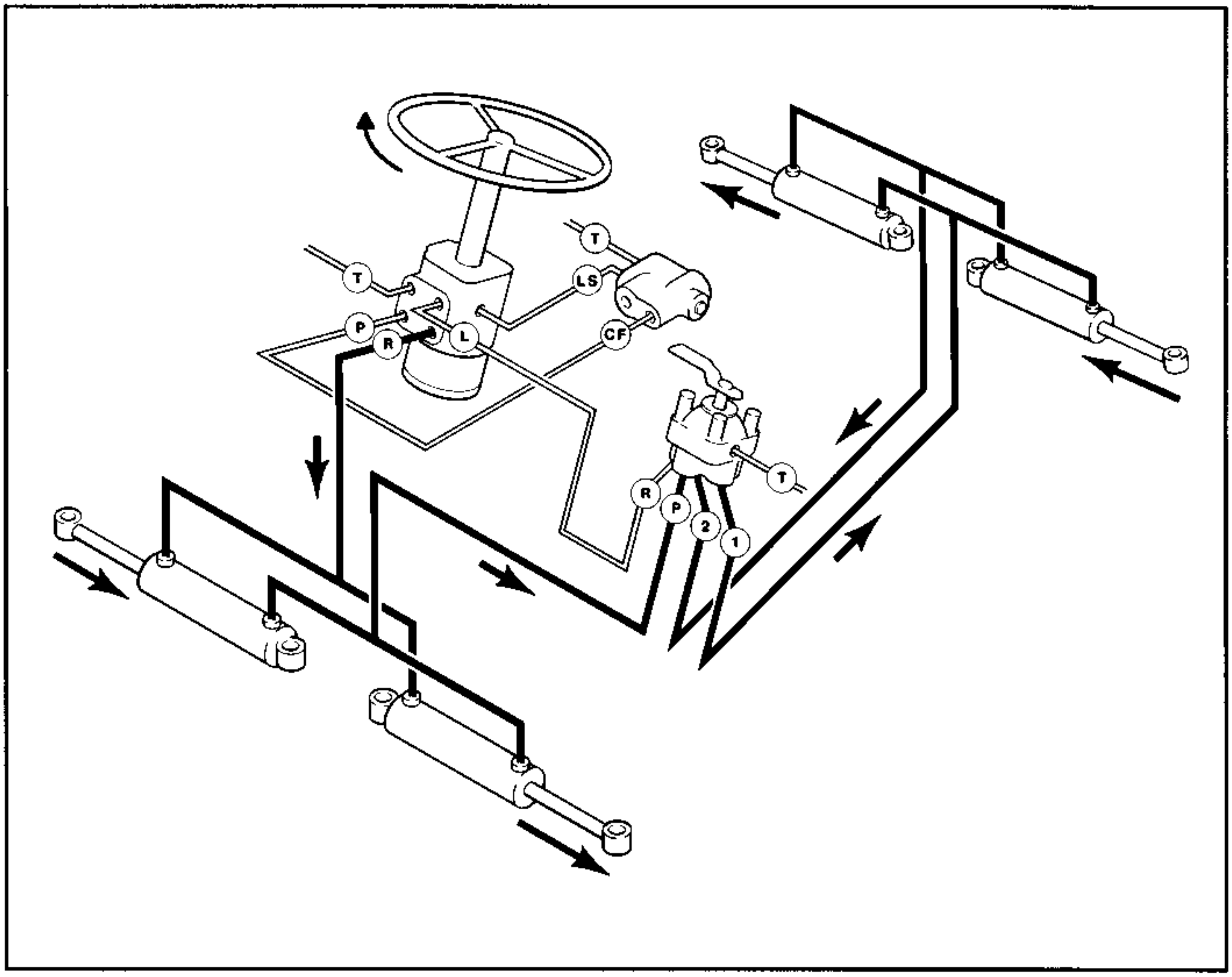


Figure 11-6 Flow Diagram - Oblique Right Steer

STEERING SYSTEM (MODELS 644, 844, 1044)

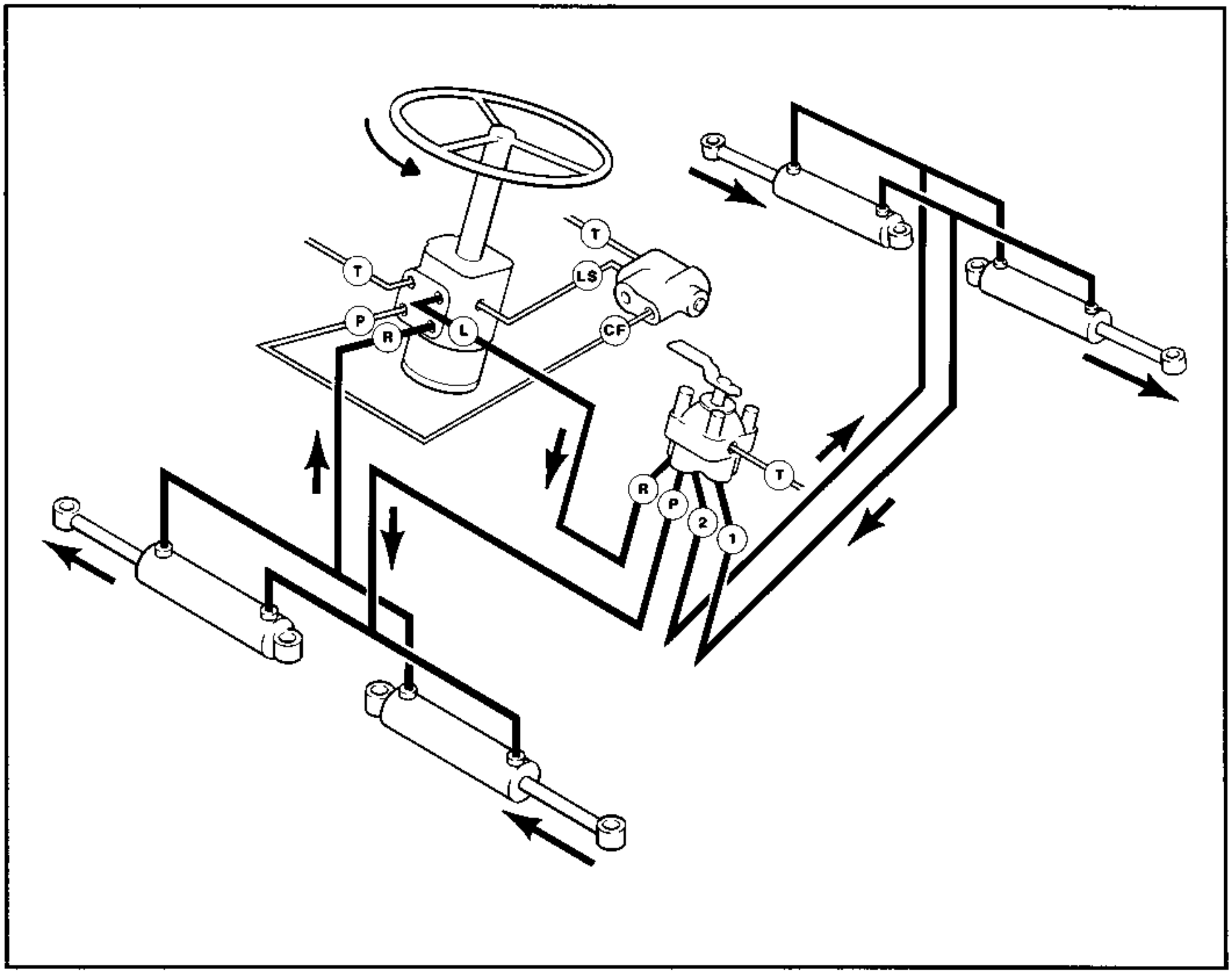


Figure 11-7 Flow Diagram - Oblique Left Steer

STEERING SYSTEM (MODELS 644, 844, 1044)

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.	Correct
	2. Malfunctioning priority valve.	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 SYSTEM (MODELS 644, 844, 1044)

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 temperorary seizure and possible damage to internal parts of the steering control unit. The temperary seizure may be followed by total free wheeling. This applies to closed center and load sensing units only.

STEERING

STEERING SYSTEM (MODELS 644, 844, 1044)

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.	Add fluid and check for leaks.
	2. Ruptured hose.	Replace hose.
	3. Internal steering control unit damage due to thermal shock*.	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 SYSTEM (MODELS 644, 844, 1044)

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 SYSTEM (MODELS 644, 844, 1044)

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).

STEER CONTROL UNIT (MODELS 644, 844, 1044)

DESCRIPTION (Figure 11-8)

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

Use the following procedure to remove the steer control unit: (Figure 11-9)

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.

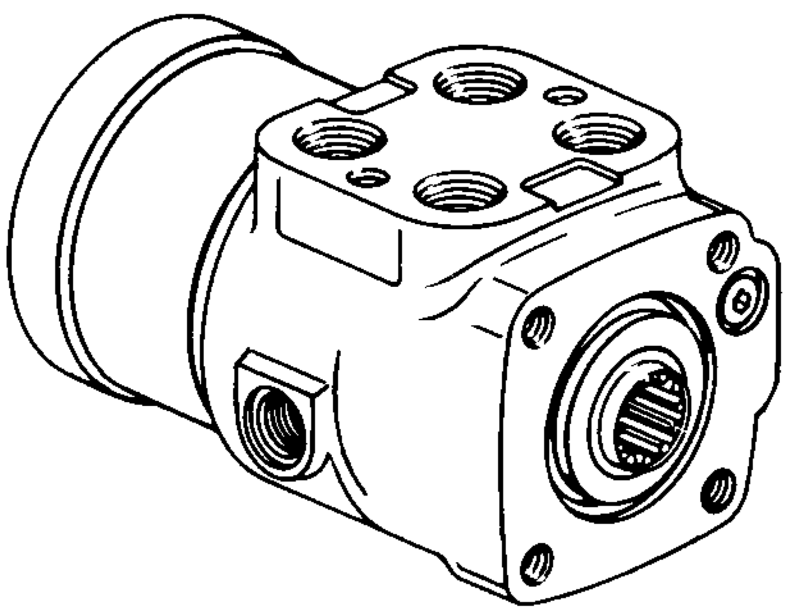
WARNING: Hydraulic fluid under pressure can penetrate the skin and damage the eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use bare hands. Wear safety goggles for eye protection. If fluid enters skin or eye, get immediate medical attention.

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 11-10)

For overhaul of the steer control unit, refer to the Repair Information manual available from the manufacturer.

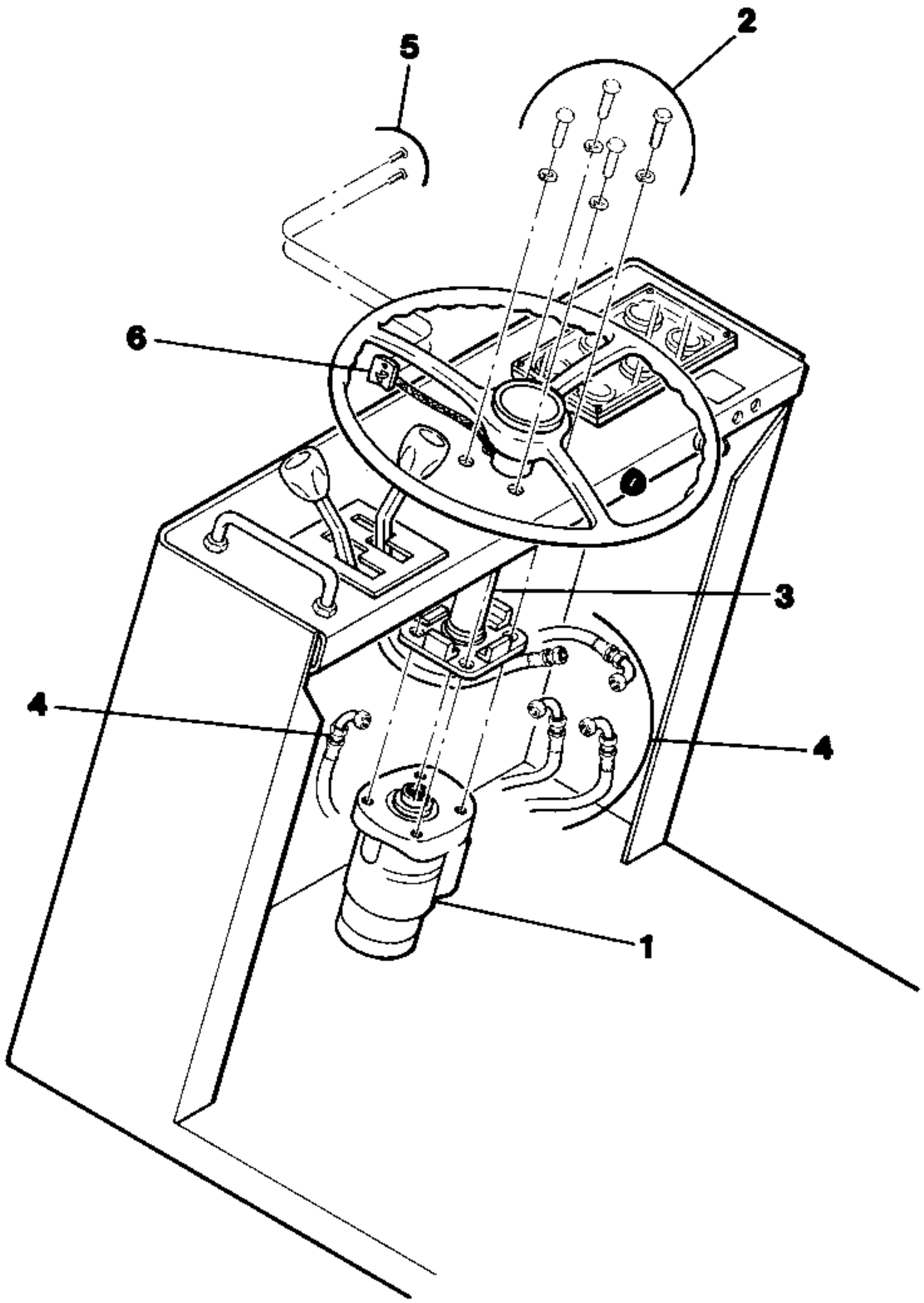
STEER CONTROL UNIT (MODELS 644, 844, 1044)



Char-Lynn Model #213-1006

Figure 11-8 Steer Control Unit

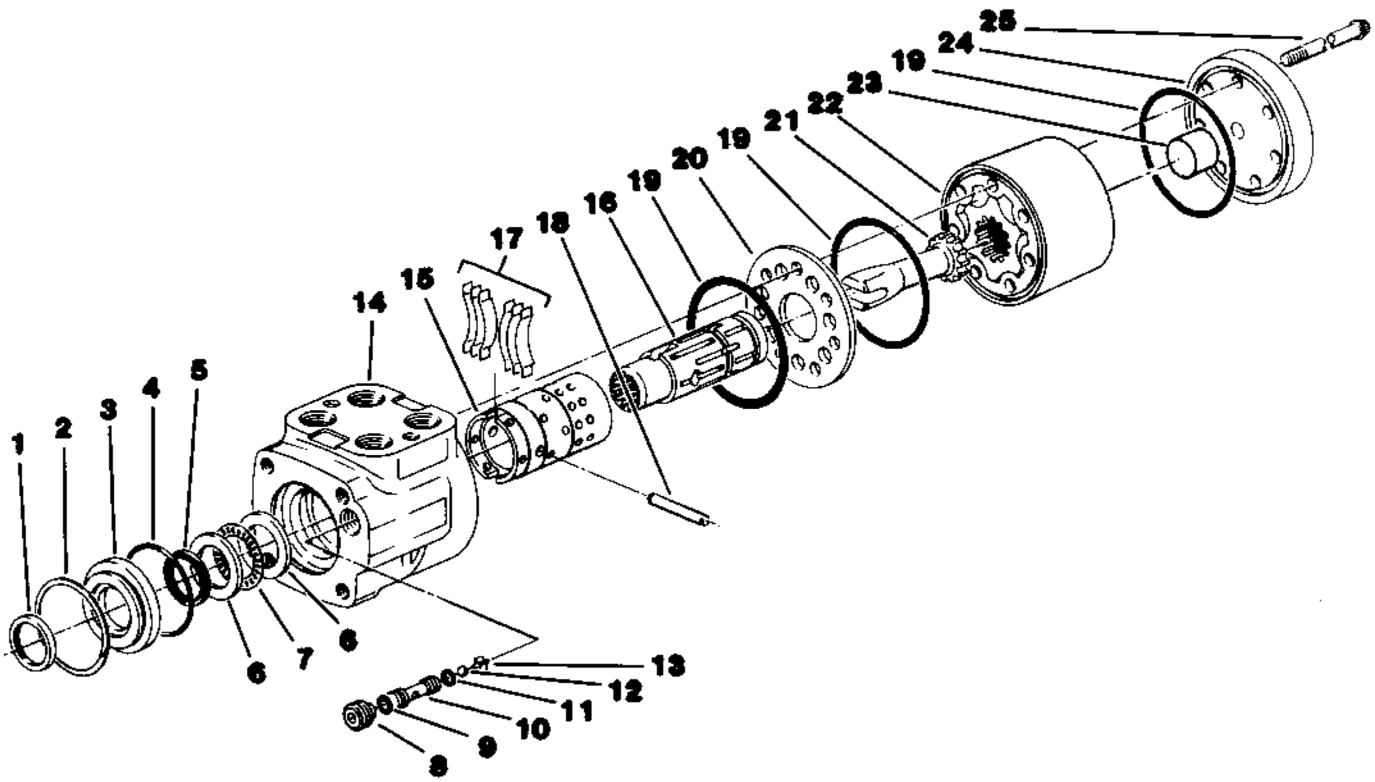
STEER CONTROL UNIT (MODELS 644, 844, 1044)



1 - Steer Control Unit
2 - Mounting Fasteners
3 - Steer Column
4 - Hydraulic Hoses
5 - Screws
6 - Horn Bracket

Figure 11-9 Steer Control Unit Removal
(Model 644 and 844 shown - Model 1044 Similar)

STEER CONTROL UNIT (MODELS 644, 844, 1044)



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 11-10 Steer Control Unit Disassembly

STEER SELECTOR VALVE (MODELS 644, 844, 1044)

DESCRIPTION (Figure 11-5)

The steer selector valve is a manual, four-way, rotary valve located under the instrument panel with its control handle positioned atop the panel. The purpose of the valve is to allow the operator to manually select any of three steer modes available:

(1) Round Steer
(2) Front Steer
(3) Oblique Steer

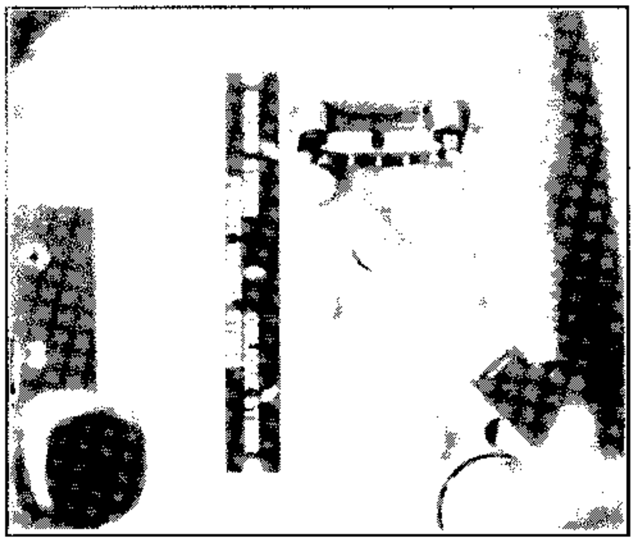


Figure 11-11 Steer Selector Valve Location

MAINTENANCE

The steer selector valve 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 11-12)

Use the following procedure to remove the steer selector valve:

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 (Items 1) from the steer selector valve (Item 2) and cap the openings.

3. Remove locknut (Item 3), washer (Item 4), handle (Item 5), and spacer (Item 6).

4. Support the steer selector valve and remove four bolts (Items 7), lockwashers (Items 8), and level indicator (Item 9).

5. Remove steer selector valve.

INSTALLATION

Use the following procedure to install the steer selector valve:

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.

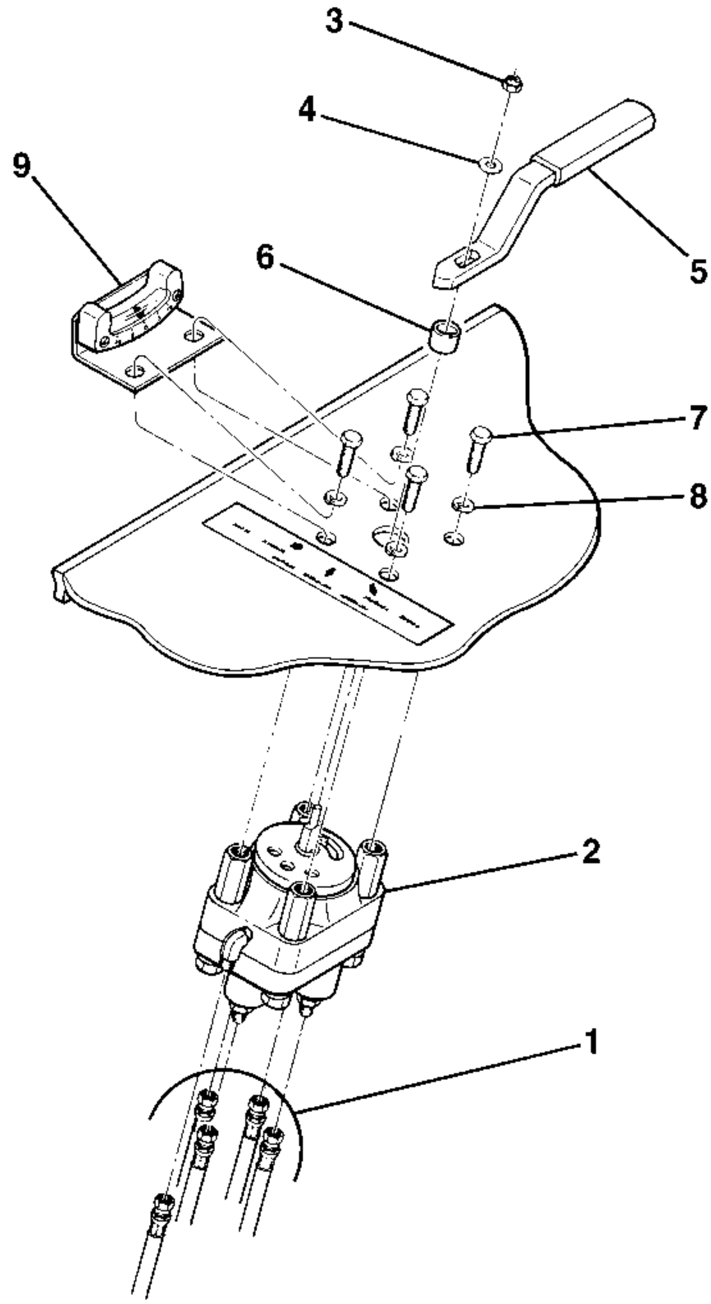
3. Cycle the steering cylinders fully in one direction and hold for 15 seconds; cycle fully in the opposite direction and hold for 15 seconds. Repeat. This procedure will remove air from the circuit.

OVERHAUL (Figure 11-13)

For overhauling the steer selector valve, refer to "Overhaul" under "Directional Control Valves" on page 3.28-1 in Section 3.

STEERING

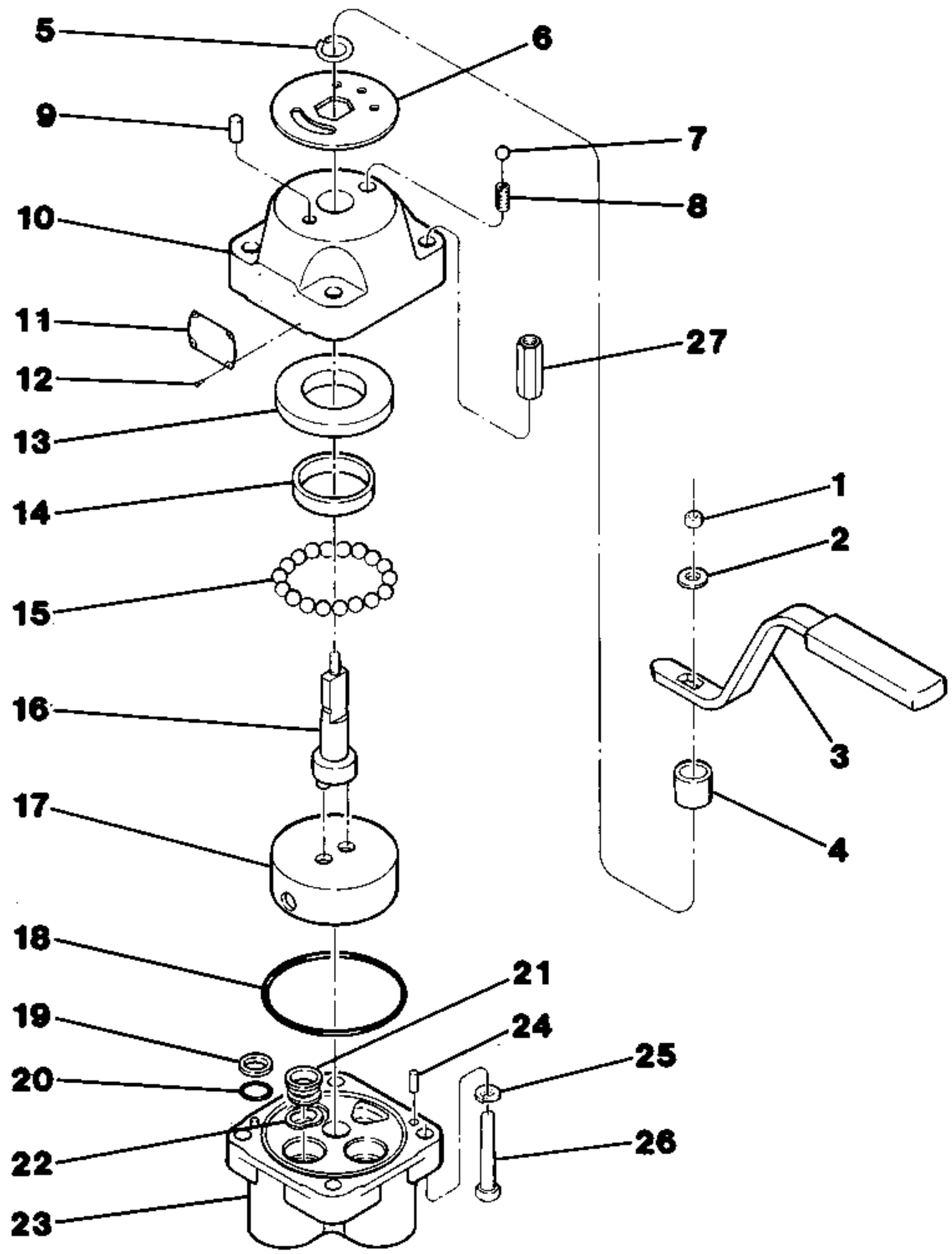
STEER SELECTOR VALVE (MODELS 644, 844, 1044)



1 - Hydraulic Hoses
2 - Steer Selector Valve
3 - Locknut
4 - Washer
5 - Handle
6 - Spacer
7 - Mounting Bolts
8 - Lockwashers
9 - Level Indicator

Figure 11-12 Steer Selector Valve Removal

STEER SELECTOR VALVE (MODELS 644, 844, 1044)



1 - Nut-Shaft	10 - Housing	19 - Back-up Ring-Shear Seal
2 - Washer-Shaft	11 - Nameplate	20 - "O" Ring-Shear Seal
3 - Handle	12 - Screw-Nameplate	21 - Shear Seal
4 - Spacer-Handle	13 - Thrust Washer	22 - Spring-Shear Seal
5 - Retaining Ring	14 - Retainer-Ball	23 - Body Casting
6 - Disc-Detent	15 - Ball Bearings	24 - Pin-Dowel
7 - Ball-Detent	16 - Shaft	25 - Lockwasher
8 - Spring-Detent	17 - Rotor	26 - Screw-Body
9 - Pin-Stop	18 - "O" Ring-Housing	27 - Stud-Panel

Figure 11-13 Steer Selector Valve Disassembly

STEERING

STEER CYLINDERS (MODELS 644, 844, 1044)

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 socket assembly clamp nut to 60 - 70 Ft/LBS.
Torque cylinder socket assembly stud nuts to 140 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 cylinder, refer to "Steering Cylinder Disassembly and Assembly" in the axle manufacturer's Maintenance Manual.

ATTACHMENTS

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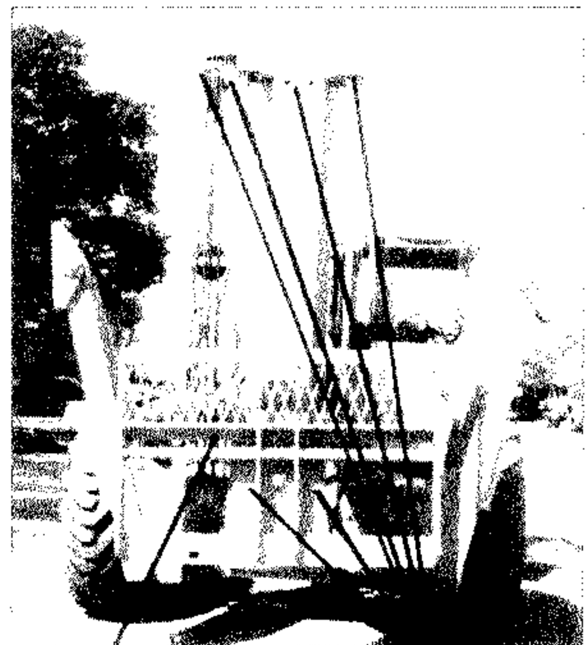
ATTACHMENTS

Figure 12-1 Winch

Fluid Fill & Level
Maintain level using
SAE 90 gear oil

Drain
Change oil after 50 hours
operation and at 1000 hour
intervals thereafter.

Figure 12-2 Tower

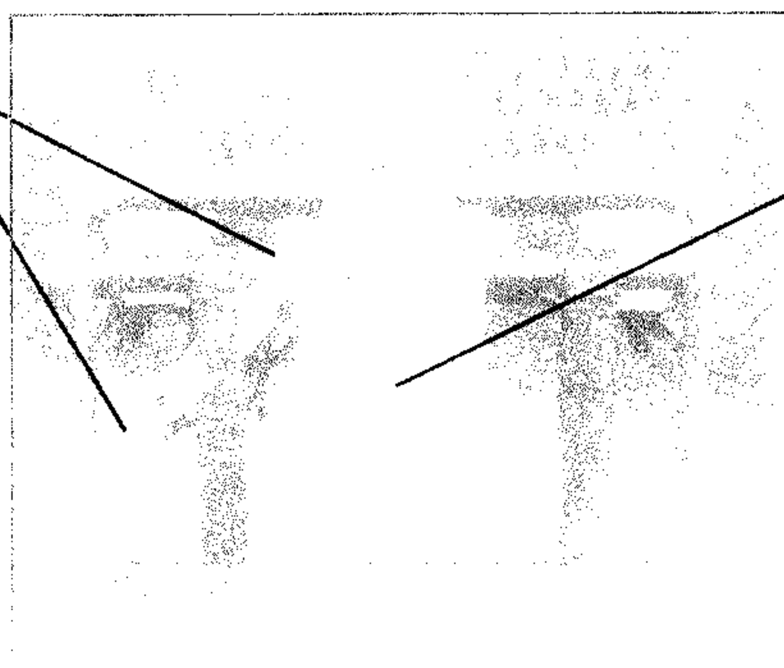


Grease Fittings
(Both Sides)

Grease Fittings

Figure 12-3 Side Tilt Carriage

Grease Fittings



Grease Fitting

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 anti-drift valves, hoses, and hydraulic fittings (see the Lull Parts Book for detailed parts breakdown).

A two-spool 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 "Outrigger Control Valve" on page 3.35-1 in Section 3).

Each hydraulic cylinder is equipped with a pilot-operated counterbalance 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 Counterbalance Valves" on page 3.54-1 in Section 3.)

The hydraulic circuit to each cylinder is equipped with an anti-drift check valve which prevents raised outriggers from lowering unless, or until, the outrigger control lever is actuated. (See "Outrigger Anit-Drift Valve" on page 3.57-1 in Section 3.)

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 Counterbalance Valves" on page 3.54-1, under "Outrigger Anti-Drift Valve" on page 3.57-1 and 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 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.

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.

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.

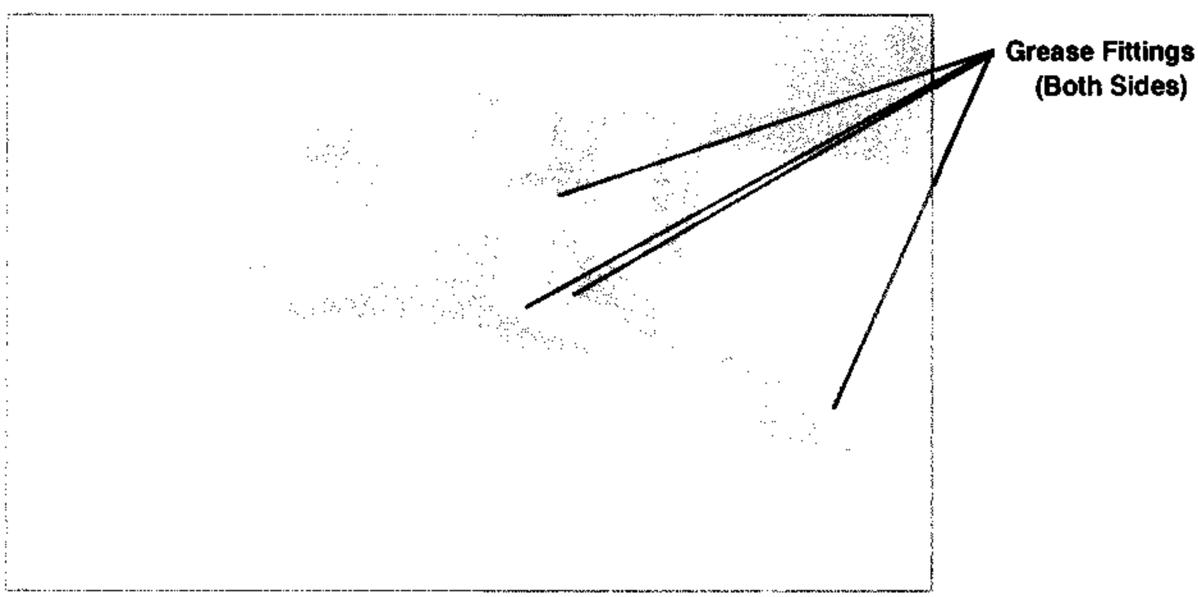
NOTE: Refer to "Bolt Torque Specifications" and "Torque Specifications for Hydraulic Line Connections" in Section 1.

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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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 rear 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.

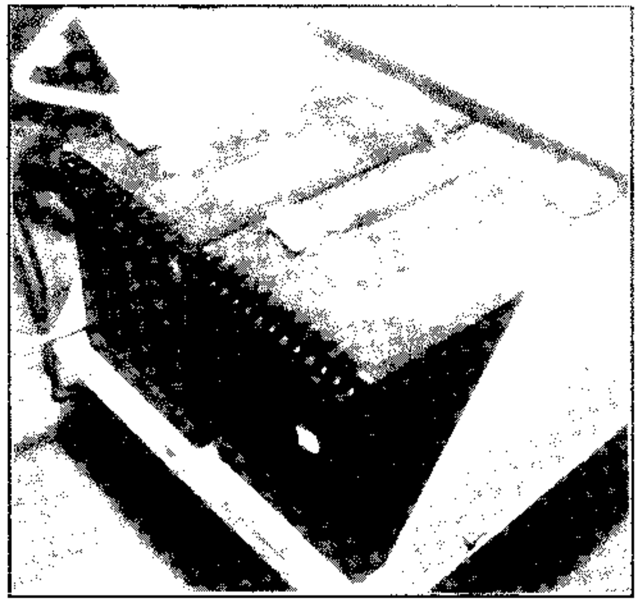


Figure 13-1 Batteries

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.

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.

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.

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

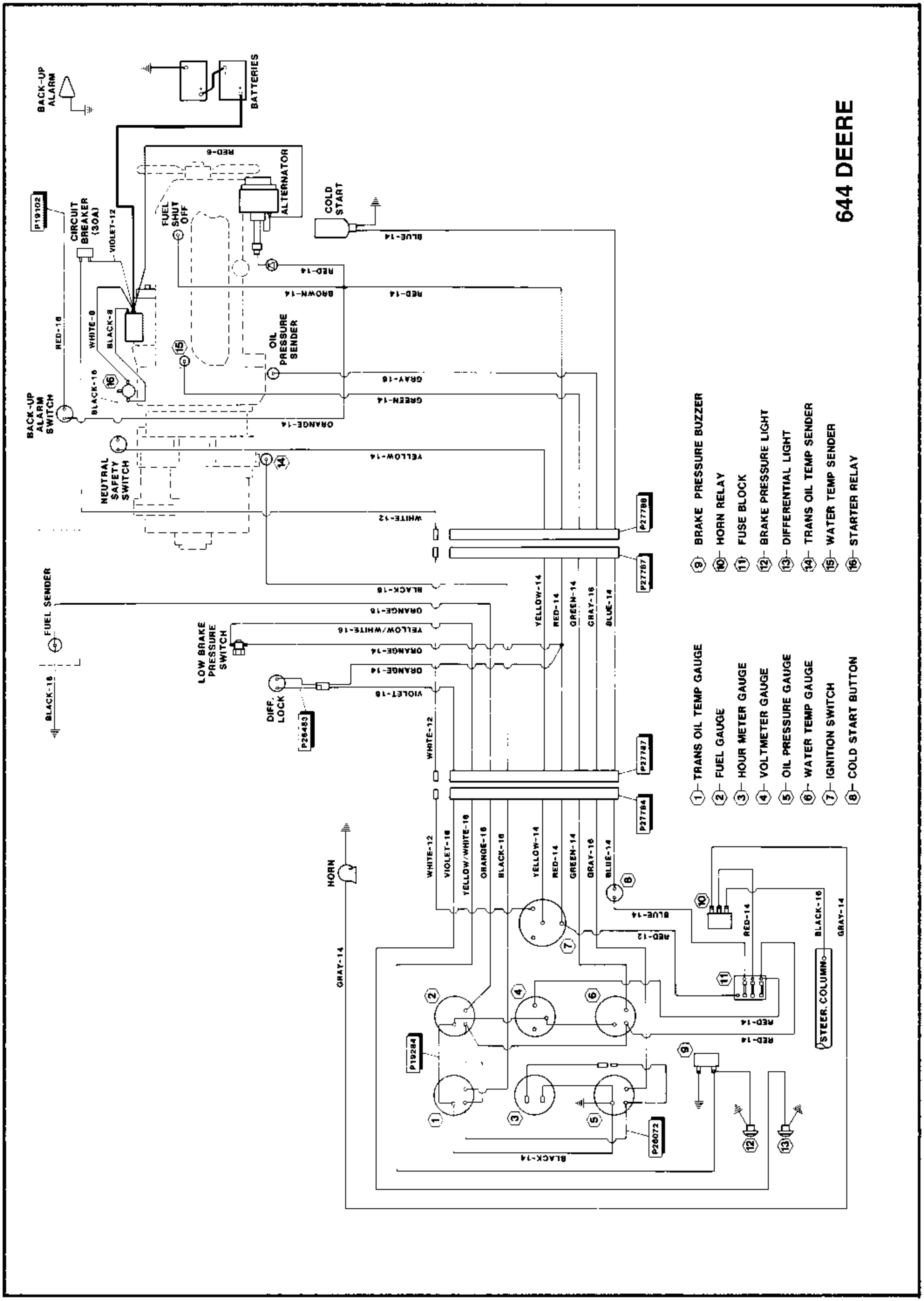
* Low battery charge.
- Charge battery and check specific gravity. If battery does not respond to charging, install a new battery.

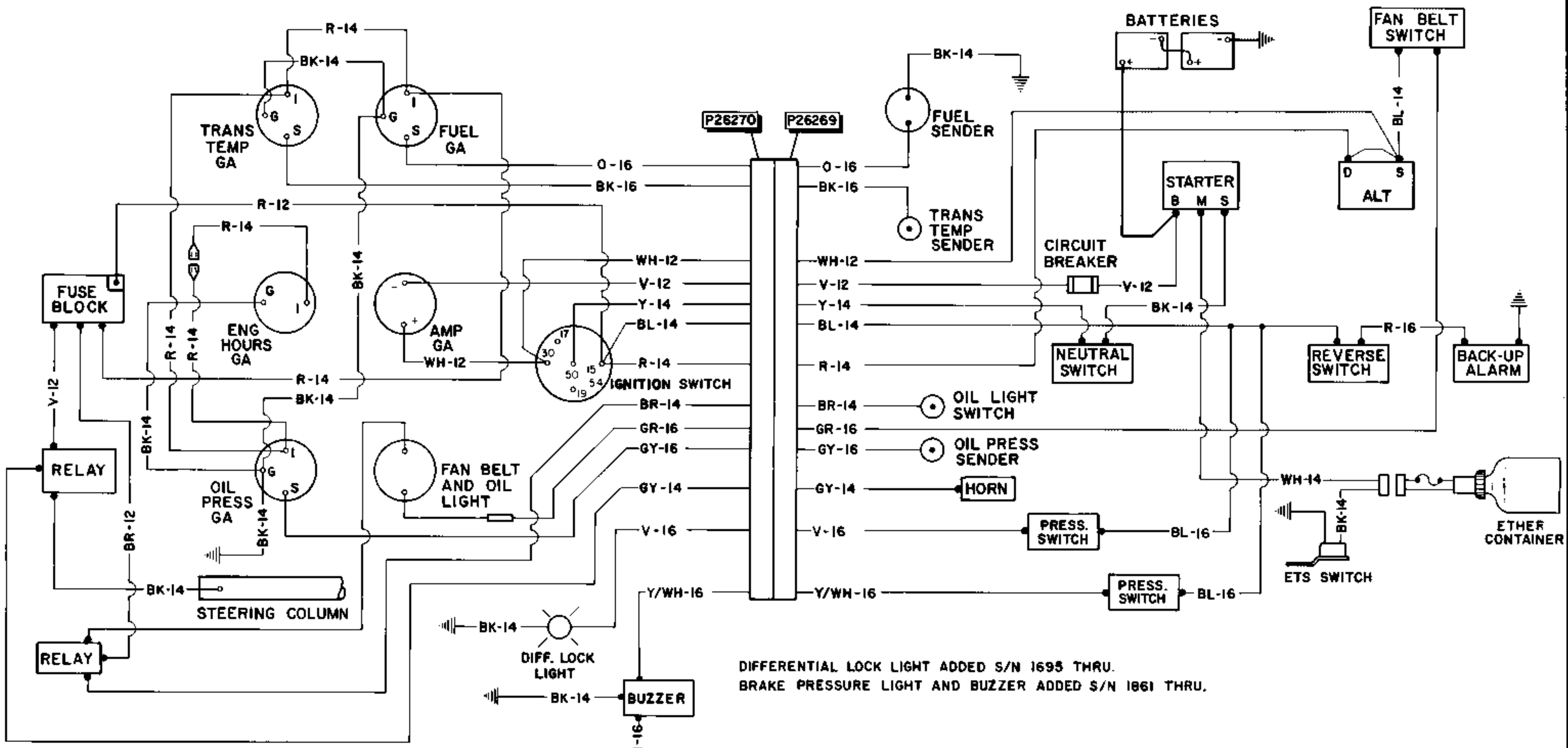
* High resistance in circuit.
- Clean and tighten all connections and replace faulty wiring.

* Open circuit in starter solenoid hold-in winding circuit.
- Repair or replace solenoid or wires.

ELECTRICAL SCHEMATICS

(Pages 1b through 6b)

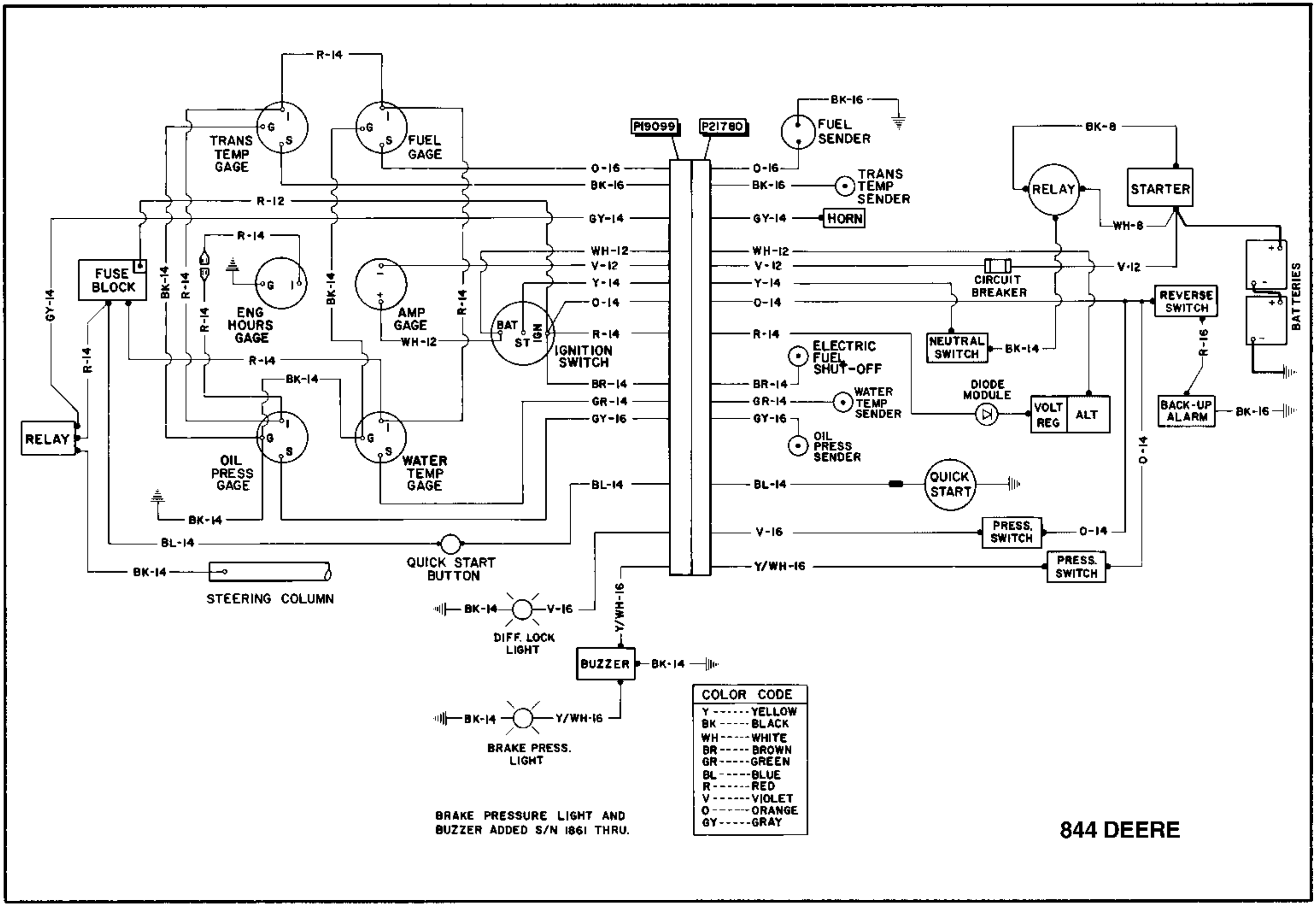

644 DEERE
1 — TRANS OIL TEMP GAUGE
2 — FUEL GAUGE
3 — HOUR METER GAUGE
4 — VOLTMETER GAUGE
5 — OIL PRESSURE GAUGE
6 — WATER TEMP GAUGE
7 — IGNITION SWITCH
8 — COLD START BUTTON
9 — BRAKE PRESSURE BUZZER
10 — HORN RELAY
11 — FUSE BLOCK
12 — BRAKE PRESSURE LIGHT
13 — DIFFERENTIAL LIGHT
14 — TRANS OIL TEMP SENDER
15 — WATER TEMP SENDER
16 — STARTER RELAY
BACK-UP ALARM
BATTERIES
ALTERNATOR
COLD START
FUEL SHUT OFF
CIRCUIT BREAKER (30A)
OIL PRESSURE SENDER
BACK-UP ALARM SWITCH
NEUTRAL SAFETY SWITCH
FUEL SENDER
LOW BRAKE PRESSURE SWITCH
DIFF. LOCK
HORN
STEER. COLUMN
P19102
P27788
P27787
P27784
P26483
P19284
P26072
RED-6
VIOLET-12
RED-16
WHITE-8
BLACK-8
BLACK-16
BLUE-14
RED-14
BROWN-14
GRAY-16
GREEN-14
ORANGE-14
YELLOW-14
WHITE-12
BLACK-16
ORANGE-16
YELLOW/WHITE-16
VIOLET-16
RED-12
GRAY-14
BLACK-14

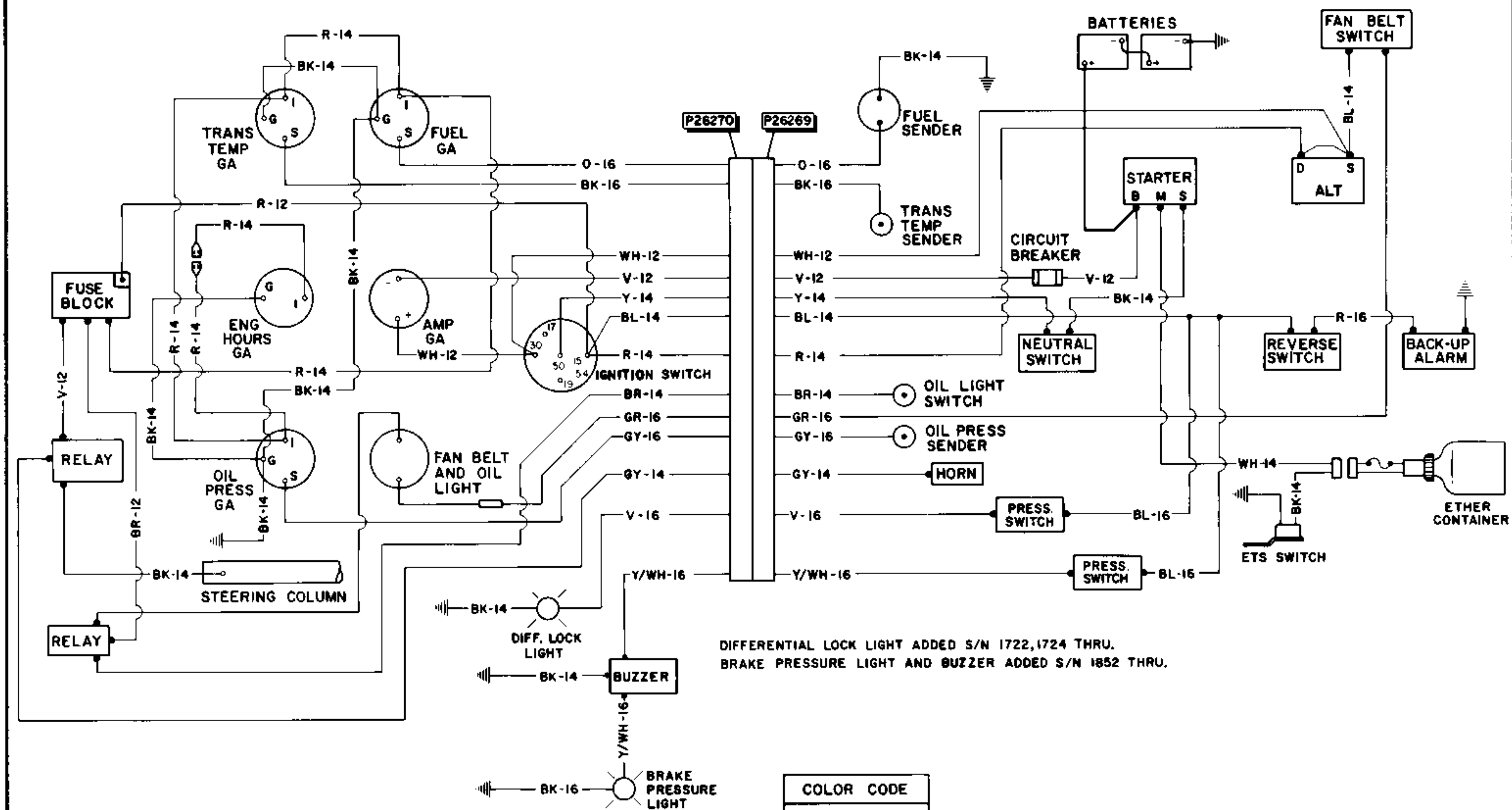


DIFFERENTIAL LOCK LIGHT ADDED S/N 1695 THRU.
BRAKE PRESSURE LIGHT AND BUZZER ADDED S/N 1861 THRU.

COLOR CODE	
BK	BLACK
BR	BROWN
R	RED
O	ORANGE
Y	YELLOW
GR	GREEN
BL	BLUE
V	VIOLET
GY	GRAY
WH	WHITE

644 DEUTZ

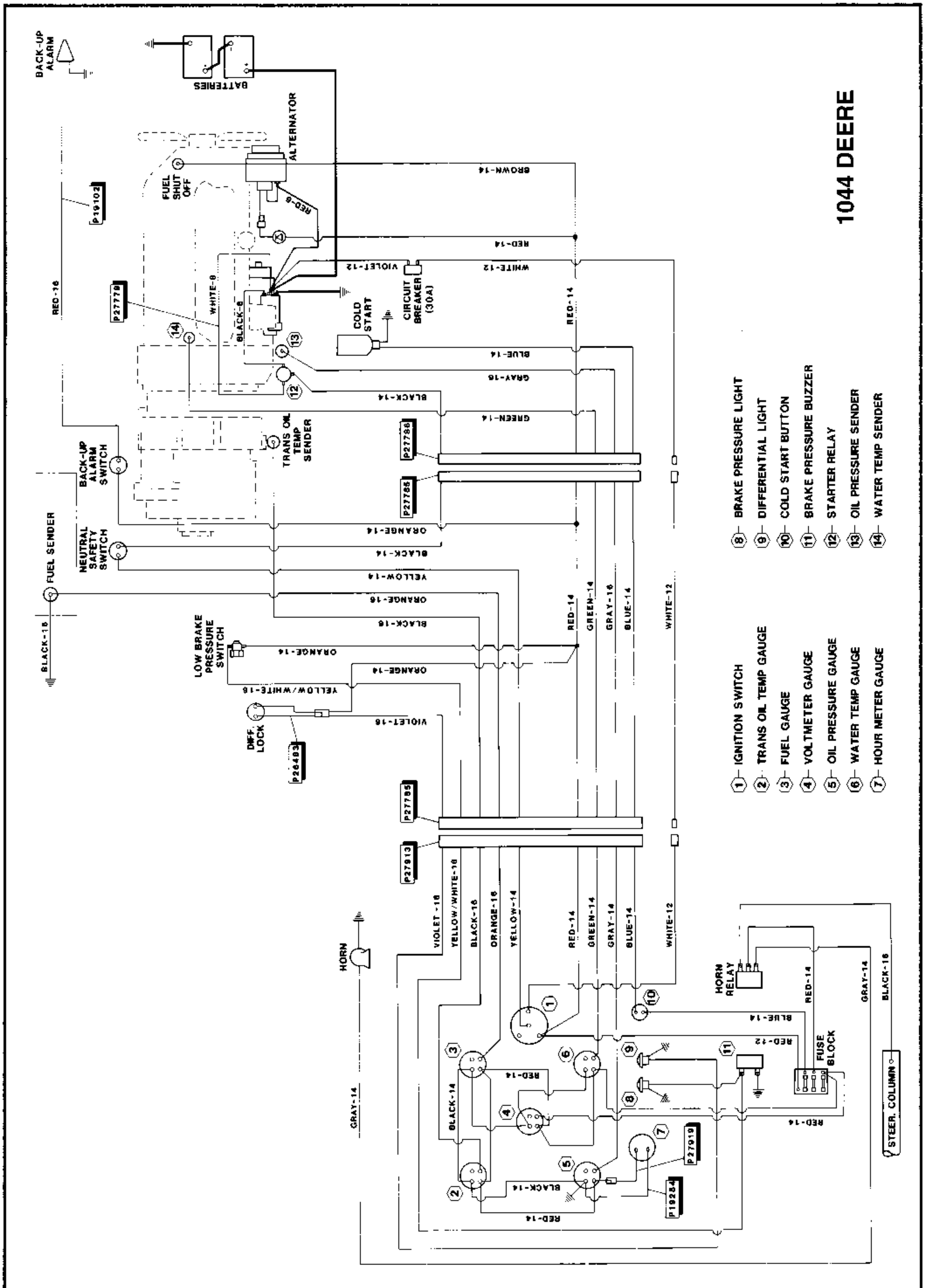

TRANS TEMP GAGE
FUEL GAGE
ENG HOURS GAGE
AMP GAGE
IGNITION SWITCH
BAT
ST
IGN
OIL PRESS GAGE
WATER TEMP GAGE
FUSE BLOCK
RELAY
QUICK START BUTTON
STEERING COLUMN
DIFF. LOCK LIGHT
BRAKE PRESS. LIGHT
BUZZER
P19099
P21780
FUEL SENDER
TRANS TEMP SENDER
HORN
ELECTRIC FUEL SHUT-OFF
WATER TEMP SENDER
OIL PRESS SENDER
QUICK START
RELAY
STARTER
BATTERIES
CIRCUIT BREAKER
NEUTRAL SWITCH
DIODE MODULE
VOLT REG
ALT
REVERSE SWITCH
BACK-UP ALARM
PRESS. SWITCH
PRESS. SWITCH
BRAKE PRESSURE LIGHT AND BUZZER ADDED S/N 1861 THRU.
COLOR CODE
Y — YELLOW
BK — BLACK
WH — WHITE
BR — BROWN
GR — GREEN
BL — BLUE
R — RED
V — VIOLET
O — ORANGE
GY — GRAY
844 DEERE

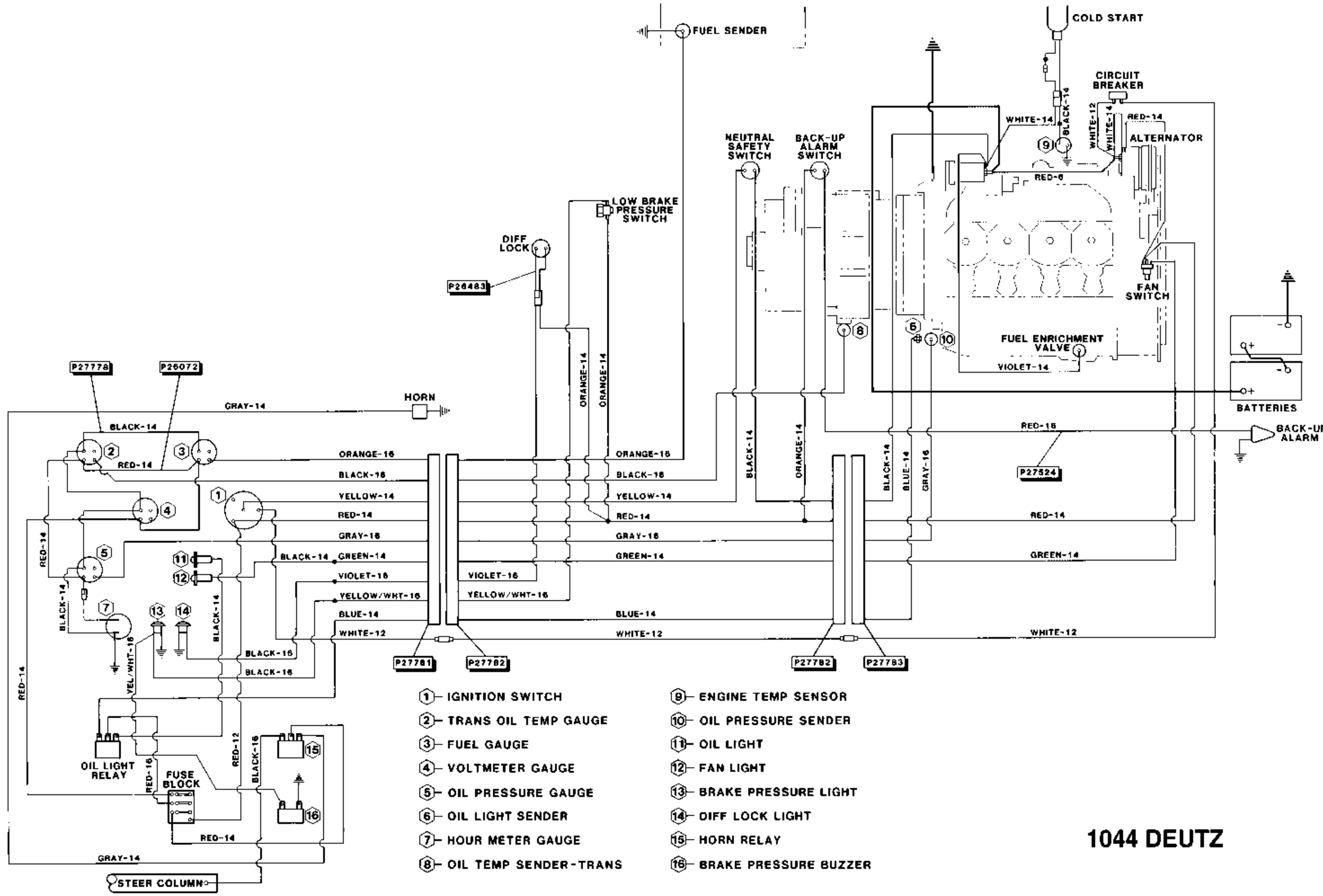


DIFFERENTIAL LOCK LIGHT ADDED S/N 1722, 1724 THRU.
BRAKE PRESSURE LIGHT AND BUZZER ADDED S/N 1852 THRU.

COLOR CODE	
BK	BLACK
BR	BROWN
R	RED
O	ORANGE
Y	YELLOW
GR	GREEN
BL	BLUE
V	VIOLET
GY	GRAY
WH	WHITE

844 DEUTZ

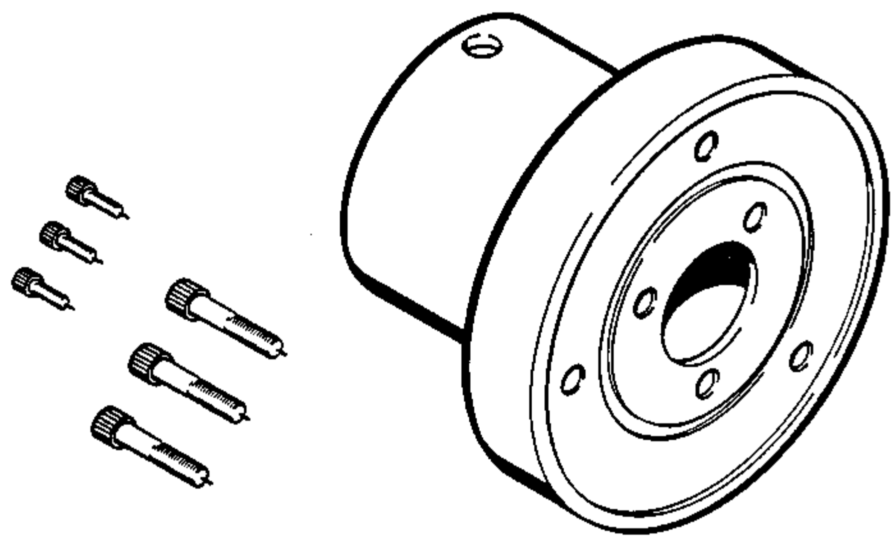

1044 DEERE
1 IGNITION SWITCH
2 TRANS OIL TEMP GAUGE
3 FUEL GAUGE
4 VOLTMETER GAUGE
5 OIL PRESSURE GAUGE
6 WATER TEMP GAUGE
7 HOUR METER GAUGE
8 BRAKE PRESSURE LIGHT
9 DIFFERENTIAL LIGHT
10 COLD START BUTTON
11 BRAKE PRESSURE BUZZER
12 STARTER RELAY
13 OIL PRESSURE SENDER
14 WATER TEMP SENDER
BACK-UP ALARM
BATTERIES
ALTERNATOR
FUEL SHUT OFF
COLD START
CIRCUIT BREAKER (30A)
TRANS OIL TEMP SENDER
BACK-UP ALARM SWITCH
NEUTRAL SAFETY SWITCH
FUEL SENDER
LOW BRAKE PRESSURE SWITCH
DIFF. LOCK
HORN
HORN RELAY
FUSE BLOCK
STEER. COLUMN
P19102
P27779
P27786
P27785
P26483
P27913
P27919
P19284
BROWN-14
RED-14
WHITE-12
VIOLET-12
BLUE-14
GRAY-16
BLACK-14
GREEN-14
ORANGE-14
YELLOW-14
ORANGE-16
BLACK-16
YELLOW/WHITE-16
VIOLET-16
RED-16
RED-8
WHITE-8
BLACK-8
GRAY-14
RED-12



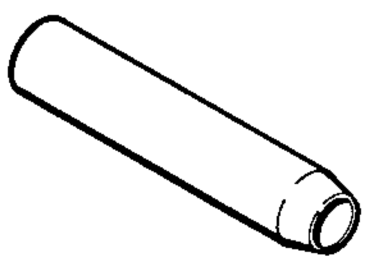
1044 DEUTZ

1. IGNITION SWITCH
2. TRANS OIL TEMP GAUGE
3. FUEL GAUGE
4. VOLTMETER GAUGE
5. OIL PRESSURE GAUGE
6. OIL LIGHT SENDER
7. HOUR METER GAUGE
8. OIL TEMP SENDER-TRANS
9. ENGINE TEMP SENSOR
10. OIL PRESSURE SENDER
11. OIL LIGHT
12. FAN LIGHT
13. BRAKE PRESSURE LIGHT
14. DIFF LOCK LIGHT
15. HORN RELAY
16. BRAKE PRESSURE BUZZER

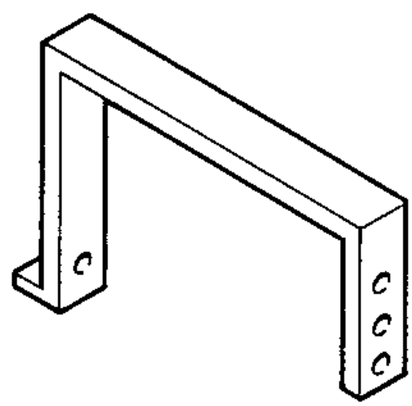
SERVICE TOOLS



25268A
Planetary Wheel End Brake Piston Remover

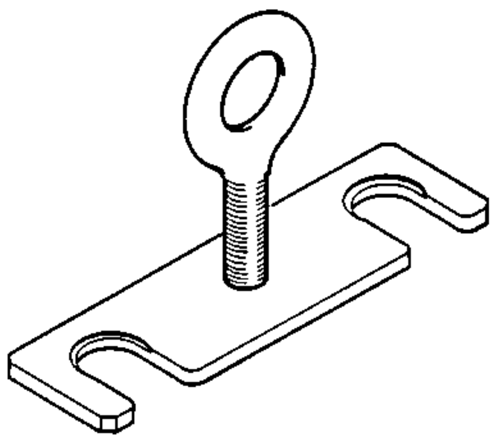


P26169
Differential Lock Piston Remover

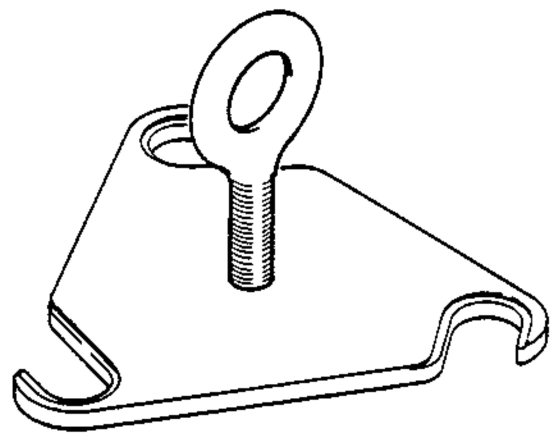


30309A
Transmission Lifting Bracket - 644

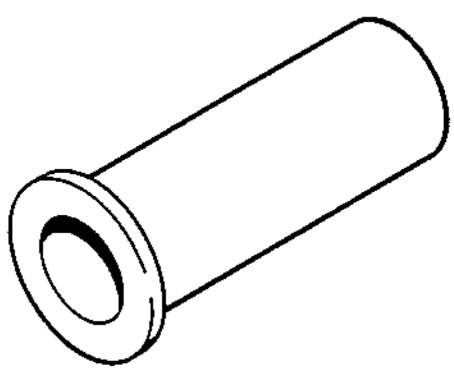
SERVICE TOOLS



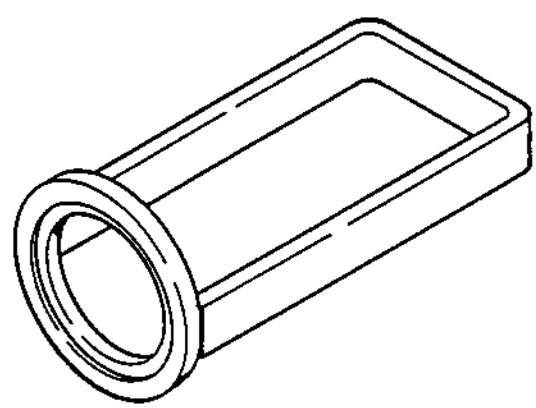
30317A
Clutch Pack Lifting Tool - 644



30318A
Clutch Pack Lifting Tool - 844/1044



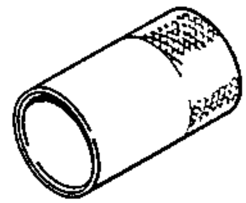
30311A for 1.62" I.D. x 2.62" O.D.
30312A for 1.81" I.D. x 2.94" O.D.
30313A for 1.81" I.D. x 3.25" O.D.
Bearing Driver
Used to install bearing on clutch pack shafts.



30314B
Clutch Spring Compressor Tool
Used to disassemble and assemble clutch release springs for transmission.

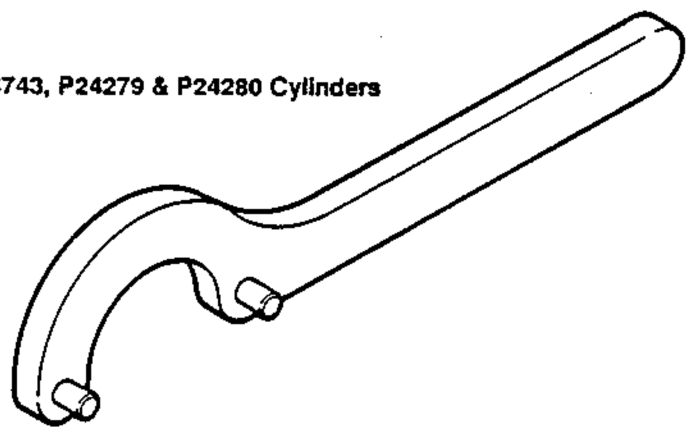
SERVICE TOOLS

30323A
Alignment Bar Set
Used to align the gears and clutch packs during bearing installation.

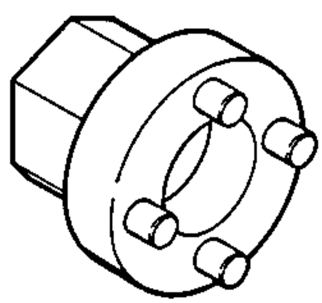


25326A
Seal Compression Sleeve

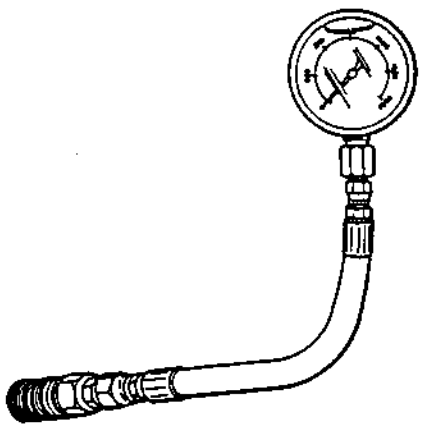
Spanner Wrench
for Hydraulic Cylinder Rod Bearings
P26253 for P24738, P24739, P24740, P24743, P24279 & P24280 Cylinders
P26252 for P24277 & P24742 Cylinders.
P26251 for P24744 & P20131 Cylinders.



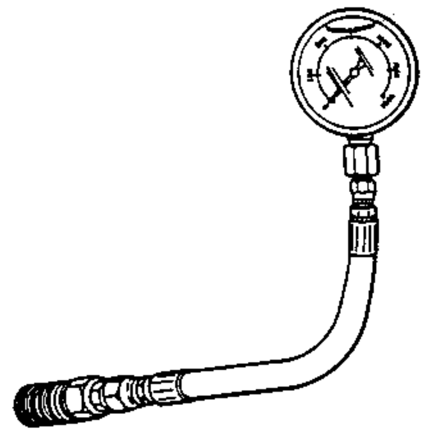
Peg Spanner
for Hydraulic Cylinder Piston Heads
P26254 for P24277 Cylinders
P26255 for P24738, P24739, P24740, P24742 & P24279 Cylinders



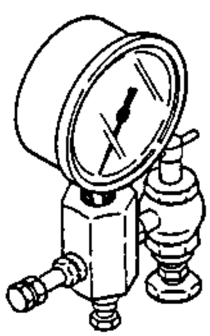
SERVICE TOOLS



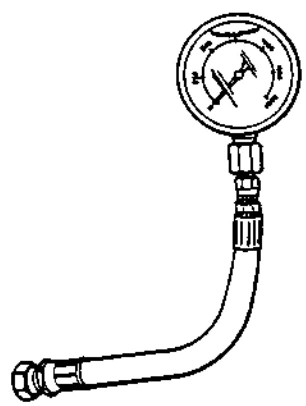
26231C
Test Gauge Kit (0 - 1500 P.S.I.)
for Brake Pressure Diagnostic Port



26232C
Test Gauge Kit (0 - 5000 P.S.I.)
for Hydraulic Diagnostic Ports



P26749
Test Gauge Kit (0 - 1500 P.S.I.)
for Accumulator



24905B
Test Gauge Kit (0 - 600 P.S.I.)
for Brake Lines

Model No. ______________________

Serial No. ______________________

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