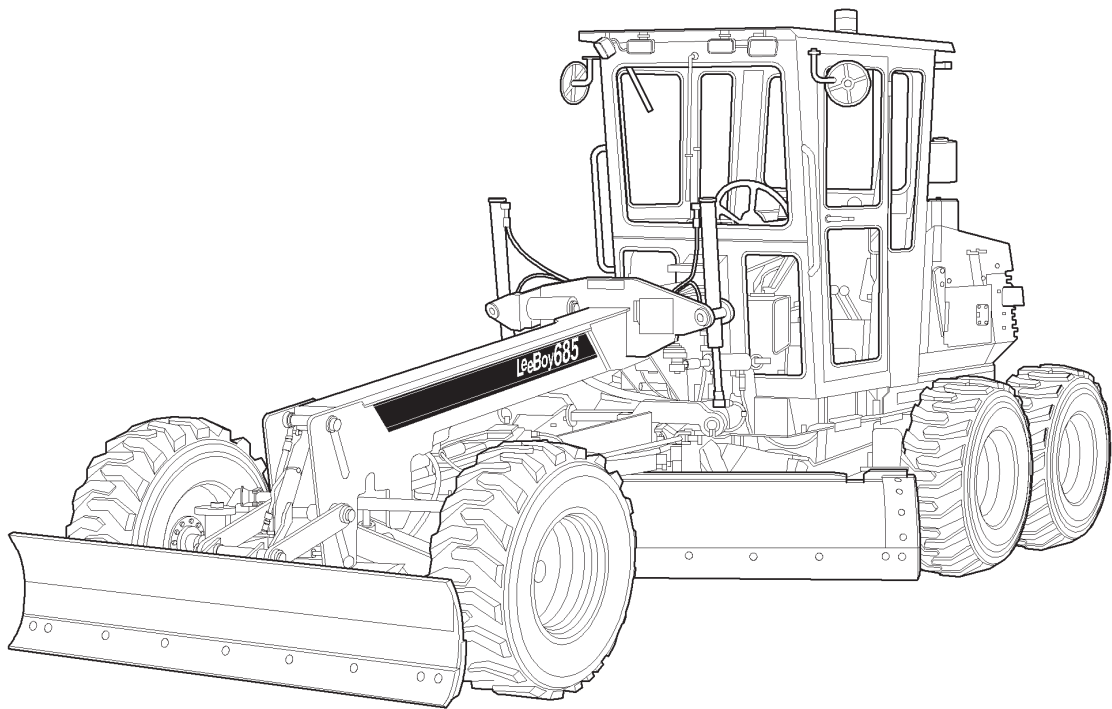




OPERATIONS, SERVICE AND PARTS MANUAL



685B MOTOR GRADER MANUAL

Manual No. 985685

For Units With Serial #400 and higher



LIMITED WARRANTY POLICY AND PROCEDURES

WARRANTY

1. If a defect in material or workmanship is found and the authorized dealer is notified during the warranty period, LeeBoy will repair or replace any part or component of the unit or part that fails to conform to the warranty during the warranty period.
2. The warranty date will begin upon the completion of the warranty form by the initial customer and will expire after twelve (12) months have passed. The Warranty Card should be filled out within (10) days of delivery of the unit.
3. Engines are warranted by their manufacturers and may have warranty coverage that differs from that of LeeBoy.
4. Replacement parts furnished by LeeBoy are covered for the remainder of the warranty period applicable to the unit or component in which such parts are installed.
5. LeeBoy has the right to repair any component or part before replacing it with a new part.
6. All new replacement parts purchased by a LeeBoy dealer will carry a six (6) month warranty. Remanufactured parts purchased by a LeeBoy dealer will carry a ninety (90) day warranty.

ITEMS NOT COVERED

LeeBoy is not responsible for the following:

1. Charges for travel time, mileage, or overtime.
2. Charges related to transporting the product to and from the place at which warranty work is performed.
3. Airfreight charges related to transporting repair parts to the place at which warranty work is performed.
4. All used units or used parts of any kind.
5. Repairs due to normal wear and tear, or brought about by abuse or lack of maintenance of the equipment, except for premature failures, conveyor chains, polytrack pads, and track rails.
6. Attachments not manufactured or installed by LeeBoy.

7. Liability for incidental or consequential damages of any type including, but not limited to lost profits or expenses of acquiring replacement equipment.
8. Miscellaneous charges.

LIMITATIONS

LeeBoy has no obligation under this warranty for:

1. Any defects caused by misuse, misapplication, negligence, accident or failure to maintain or use in accordance with the most current operating instructions.
2. Unauthorized alterations.
3. Defects or failures caused by any replacement parts or attachments not manufactured by or approved by LeeBoy.
4. Failure to conduct normal maintenance and operating service, including without limitation, providing lubricants, coolant, fuel, tune-ups, inspections or adjustments.
5. Unreasonable delay, as established by LeeBoy, in making the applicable units or parts available upon notification of a service notice ordered by LeeBoy.
6. The warranty responsibility on all engines rests with the respective manufacturer.
7. LeeBoy may have support agreements with some engine manufacturers for warranty and parts support.

OTHER WARRANTIES

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESSED STATUTORY AND IMPLIED WARRANTIES APPLICABLE TO UNITS ENGINES, OR PARTS WITHOUT LIMITATION, ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR USE OR PURPOSE. IN NO EVENT, WHETHER AS A RESULT OF BREACH OF CONTRACT OR WARRANTY, OR ALLEGED NEGLIGENCE OR LIABILITY WITHOUT FAULT, SHALL LEEBOY BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOSS OF PROFIT OR REVENUE, COST OF CAPITAL, COST OF SUBSTITUTED EQUIPMENT, FACILITIES OR SERVICES DOWNTIME COSTS, LABOR COSTS OR CLAIMS OF CUSTOMERS, PURCHASERS OR LESSEES FOR SUCH DAMAGES.



USER'S REFERENCE GUIDE

DELIVERY DATE _____

UNIT SERIAL NUMBER _____

ENGINE TYPE _____

ENGINE NUMBER _____

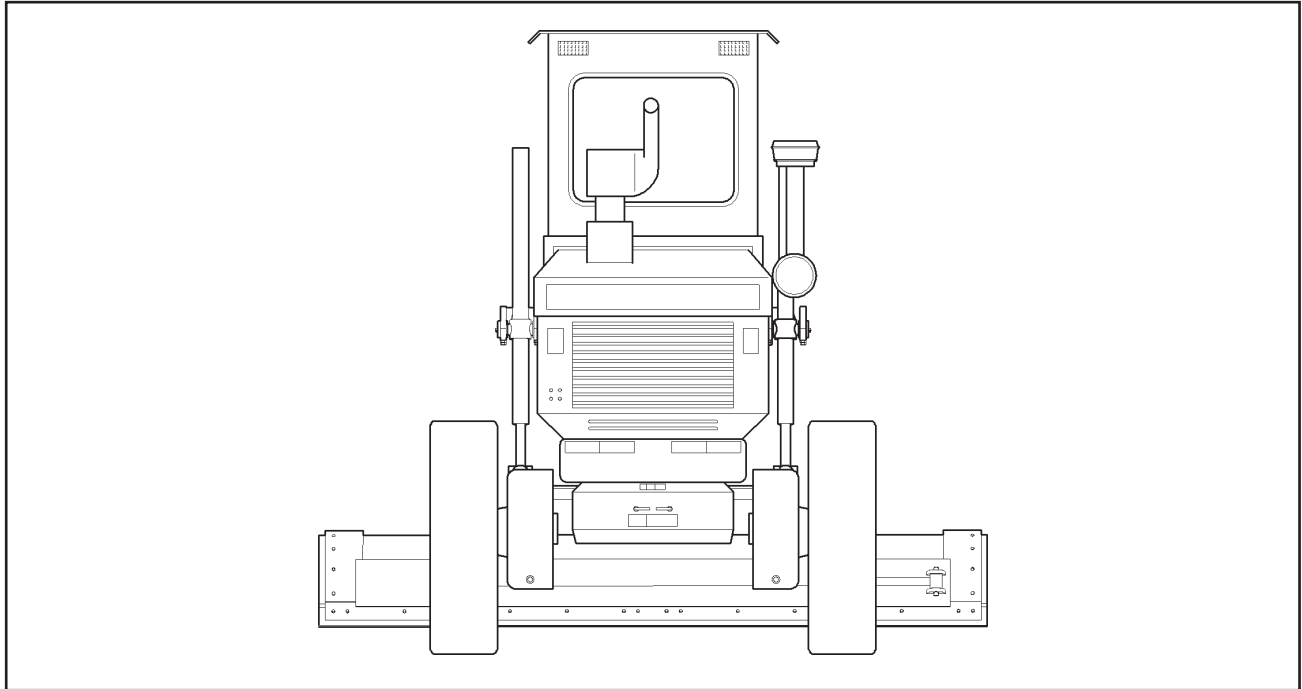
DEALER'S NAME AND ADDRESS

PHONE NUMBER _____

EQUIPMENT HOURS _____

SERVICE MANAGER _____

500 Lincoln County Parkway Ext. Lincolnton, North Carolina 28092 www.LeeBoy.com

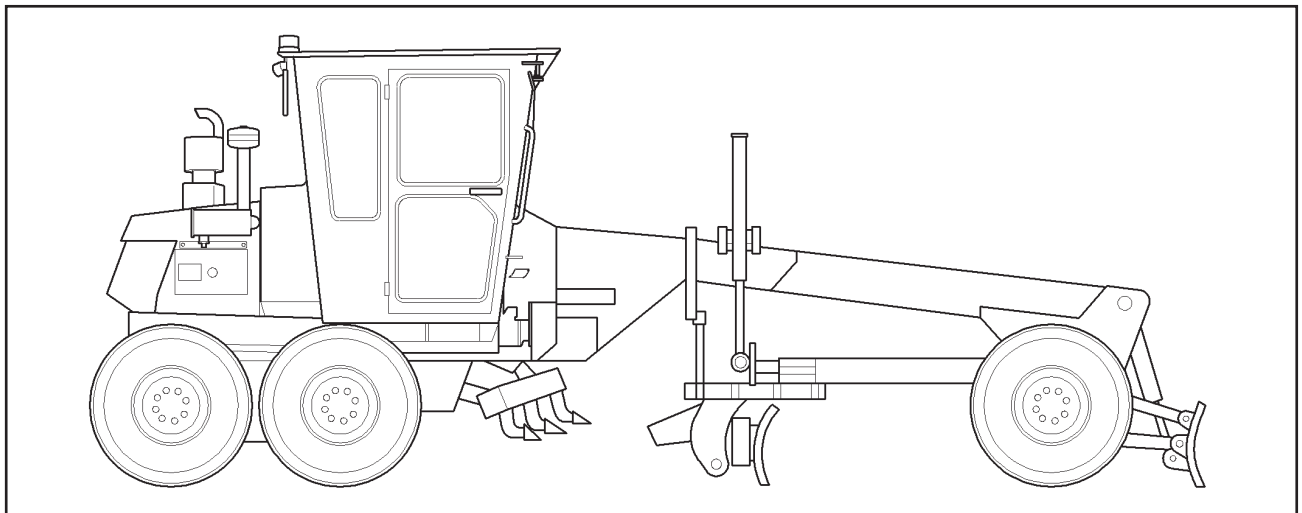
**MODEL 685 MOTOR GRADER
OPERATORS, MAINTENANCE AND PARTS MANUAL****REAR VIEW**

This manual should be used with all related supplemental books, engine and transmission manuals, and parts books. Related Service Bulletins should be reviewed to provide information regarding some of the recent changes.

If any questions arise concerning this publication or others, contact your local

LeeBoy Distributor for the latest available information.

Contents of this manual are based on information in effect at the time of publication and are subject to change without notice.

**SIDE VIEW**

IMPORTANT

SAFETY INSTRUCTIONS

This manual provides important information to familiarize you with safe operating and maintenance procedures. Even though you may be familiar with similar equipment, you **MUST** read and understand this manual before operating this unit.

Safety is everyone's business and is one of your primary concerns. Knowing the guidelines covered in the following paragraphs and in Section 1 will help

provide for your safety, for the safety of those around you, and for the motor grader's proper operation.

LOOK FOR THESE SYMBOLS WHICH POINT OUT ITEMS OF EXTREME IMPORTANCE TO YOU AND YOUR COWORKERS SAFETY. READ AND UNDERSTAND THOROUGHLY. HEED THE WARNINGS AND FOLLOW THE INSTRUCTIONS.

DANGER

YOU MUST FOLLOW ALL DANGER SAFETY NOTES. IF YOU DO NOT FOLLOW THE INSTRUCTIONS, YOUR MISTAKE MIGHT LIKELY RESULT IN VERY SERIOUS INJURY OR DEATH.

WARNING

WARNING safety notes must ALSO be followed. Your mistake might result in SERIOUS INJURY to yourself or others.

CAUTION

CAUTION safety notes are ALSO very important. They point out to you where your mistakes could cause PHYSICAL HARM to you or others, or damage to the machine.

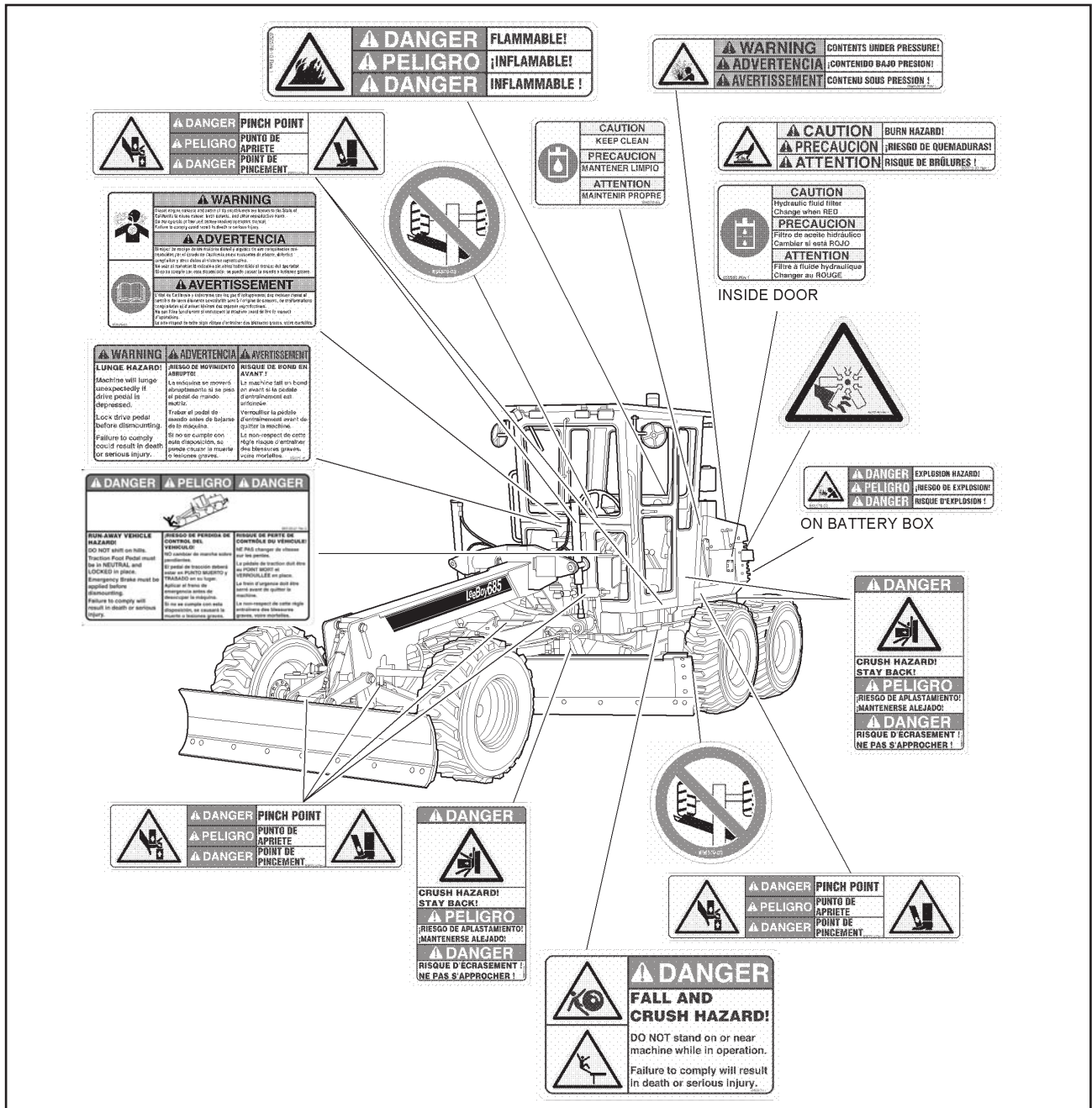
SAFETY PRECAUTIONS

If your motor grader has been repainted, it is extremely important that all the decals referring to CAUTION, WARNING, and DANGER be replaced in their proper locations. The illustrations on this page will aid you in determining the proper locations; however, for additional help, you should refer to the parts listing in the parts section of this manual and note the

description column. Under this column, a description of location is provided for each decal. If you need more explicit instructions, contact your dealer.

NOTE

It is the responsibility of the owner and operator to make sure that all decals are readable and located on motor grader as designated by the manufacturer.



685 DECALS and DECAL LOCATIONS

PRE-START INSPECTION

INSPECT machine. Have any malfunctioning, broken or missing parts repaired or replaced before using the grader.

CHECK hydraulic hoses daily for wear and leaks. Replace if damaged.

CHECK that all the instruction and safety labels are in place and readable. These are as important as any other equipment on the machine.

READ and FOLLOW all instruction decals.

WEAR OSHA required safety equipment when running the motor grader.

CHECK engine, transmission, and hydraulic oil levels. Fill to the correct level as necessary.

FILL the fuel tank with the engine off. NEVER fill fuel tank near an open flame or when smoking.

CHECK for frayed or worn electrical wires and loose or corroded connections.

CHECK tires for wear, cuts, and damage. CHECK air pressure. INSPECT wheels for loose, damaged, or missing hardware.

CHECK the parking brake to make sure it is operating properly.

CHECK pedals and levers for freedom of movement. MAKE SURE operator's compartment is free of debris.

CHECK steps and supports for damage. Repair as necessary.

CHECK protective devices, cab, ROPS, canopy, shields and seat belt for wear or damage. MAKE SURE all protective devices operate correctly.

OPERATING SAFETY

WEAR OSHA required safety equipment when running the motor grader.

ALWAYS be seated with seat belt on when operating equipment.

ALWAYS make sure no person or object is in your line of travel BEFORE starting.

WORK slowly in tight areas.

DO NOT run engine in a closed building for long periods of time.

AVOID steep hills and sharp turns if possible.

REDUCE speed before turning or swinging loads.

ALWAYS look BEFORE changing your direction of travel.

DO NOT leave the engine running without operator present.

NEVER shift the low to high lever on any incline.

ALWAYS lower moldboard, scarifier, bucket, and front blade when leaving the machine unattended.

DO NOT start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.

NEVER start engine while standing on the ground. Start engine only from operator's seat, with traction foot pedal in neutral.

STOPPING SAFETY

ALWAYS park the grader on solid, level ground. If this is not possible, always park the grader at a right angle to the slope.

ALWAYS return traction foot pedal to neutral position and lock it in neutral with the traction foot pedal lock lever.

ALWAYS lower moldboard, scarifier, bucket, and front blade when leaving the machine unattended.

ALWAYS engage parking brake.

USE proper flags, barriers and warning devices, especially when parking in areas of traffic.

MAINTENANCE SAFETY

NEVER work on the grader with the engine running.

NEVER fill the fuel tank with the engine running.

DO NOT change the engine governor settings.

ALWAYS replace damaged or lost decals.

DISCONNECT battery cables when working on the electrical system or when welding on the unit.

MAKE SURE safety stop cable is attached when pulling the battery tray out to disconnect cables.

IF battery needs a charge, be sure battery charger is off when making connections.

BE SURE the correct battery polarity is observed [negative (-) to negative (-) and positive (+) to positive (+)], when connecting a battery charger or jumper cable.

DO NOT use hands to find hydraulic leaks. High-pressure fluid can penetrate the skin, causing severe injury.

DO NOT service or repair the grader blades, scarifier, or moldboard in a raised position unless supported by approved jacks and jack stands.

CHECK parking brake to assure it is operating correctly.



TABLE OF CONTENTS

	Page
GENERAL INFORMATION	1-2
DESCRIPTION AND SPECIFICATIONS	1-2
CONTROLS	1-2
OPERATION	1-2
MAINTENANCE	1-2
REPLACEMENT PROCEDURES	1-2
NAMEPLATE	1-2
RECEIVING THE MOTOR GRADER	1-2

Section 1 INTRODUCTION



GENERAL INFORMATION

This manual contains a description of the motor grader and its major components, specification information, a description of the controls, operating procedures, maintenance, and replacement procedures, and parts lists for the Model 685 Motor Grader.

DESCRIPTION AND SPECIFICATIONS

Refer to Section 2 - SPECIFICATIONS in this manual for all major system descriptions and specifications and for typical torque value tables.

CONTROLS

Refer to Section 3 - OPERATING CONTROLS, INDICATORS, AND GAUGES in this manual for a description of all controls, gauges, and indicators used to control operation of the motor grader.

OPERATION

Refer to Section 3 - OPERATION in this manual for information needed to safely operate the motor grader. The operator of this equipment should READ, UNDERSTAND, and FOLLOW the operating instructions, Cautions, and safety instructions provided in the front of this manual and in the OPERATION section.

WARNING: Do not attempt to operate the Model 685 Motor Grader unless fully trained in machine operation. Only authorized personnel should operate the Model 685 Motor Grader. All instructions provided in this manual and on the machine decals must be followed to prevent damage to the equipment and/or injury to operating personnel.



MAINTENANCE

Refer to Section 4 - MAINTENANCE in this manual for all maintenance procedures.

CAUTION: All maintenance instructions provided in this manual should be followed to insure safety of the personnel performing the maintenance and to prevent damage to the machine.



REPLACEMENT PROCEDURES

Refer to Section 4 - REPLACEMENT PROCEDURES in this manual for instructions to replace damaged parts.

CAUTION: All maintenance instructions provided in this manual should be followed to insure safety of the personnel performing the maintenance and to prevent damage to the machine.



NAMEPLATE

The nameplate, Figure 1-1, contains the serial number and basic data used to identify the specific model on the motor grader. The nameplate is mounted on the right side of the cab/canopy support frame.

RECEIVING THE MOTOR GRADER

CAUTION: Always set parking brake and lock the traction foot pedal using the traction foot pedal lock lever before leaving the machine. Check parking brake before placing machine back in service.



The motor grader was inspected thoroughly at the factory. However, road hazards or vandalism may occur during transport and result in damage. Inspect the machine as outlined below and perform necessary repairs before placing the machine in service.

1. Check engine oil level as shown in the manufacturer's manual.
2. Check fuel tank, cooling system, chain boxes, engine oil, and hydraulic reservoir for proper levels and contaminants. If contaminants are suspected, flush and fill the system.
3. Check chain boxes for proper level (approximately 4 to 5 inches or 7 gallons of 50 weight motor oil). Make sure chains, sprockets and spline areas are flushed and cleaned.
4. Read this manual and understand the contents.
5. Check all hydraulic functions and repair or adjust as necessary. Have any repairs or adjustments performed by a qualified mechanic or consult local dealer.

6. Check for missing parts. If parts are missing or motor grader is damaged, consult the local dealer.
7. Check the parking brake to make sure it is operating properly.
8. Check the seat belt to make sure it is operating properly.

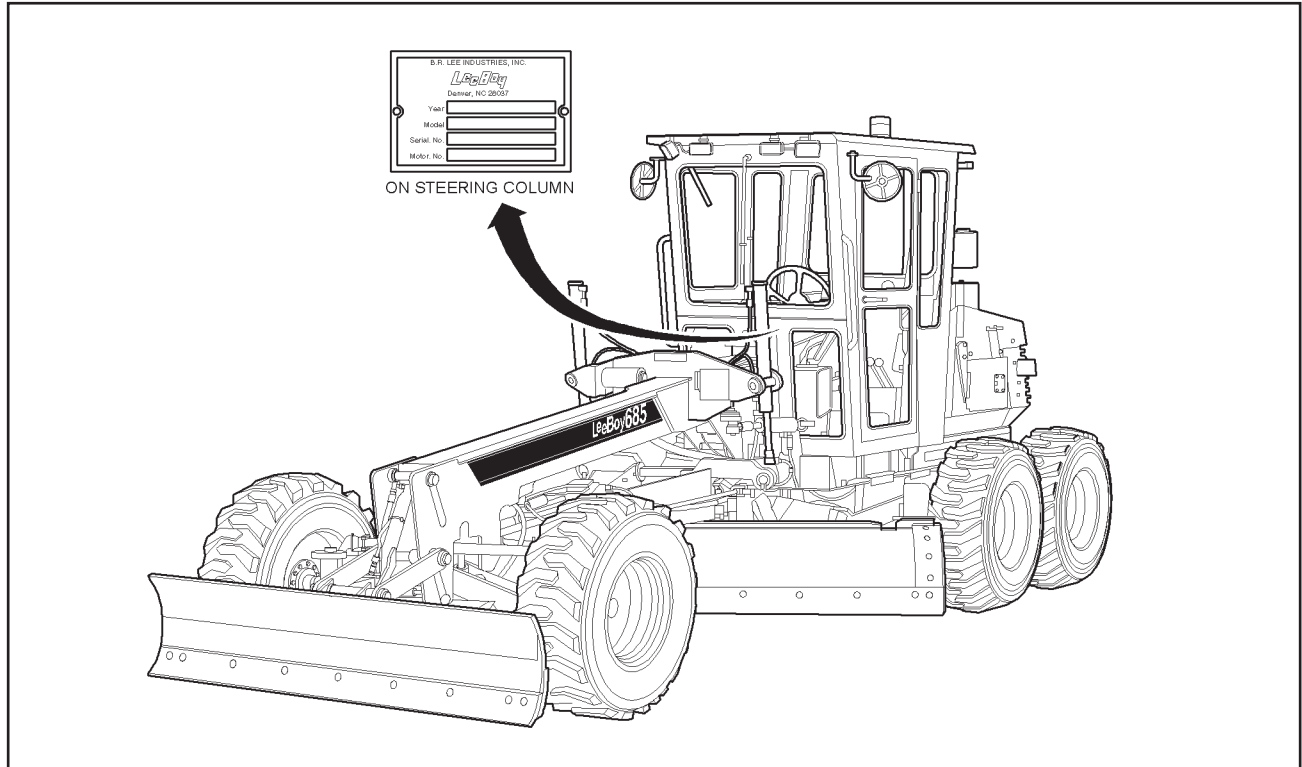


FIGURE 1-1. NAME PLATE

Section 1 INTRODUCTION



NOTES

TABLE OF CONTENTS

	Page
GENERAL INFORMATION	2-2
ENGINE	2-2
ELECTRICAL SYSTEM	2-4
HYDRAULIC SYSTEM	2-4
Drive System	2-4
Brakes	2-5
Steering	2-5
Moldboard	2-6
Scarifier	2-6
Front Blade	2-6
OPTIONS	2-6
SPECIFICATIONS	2-6
TABLE 2-1. ENGINE SPECIFICATIONS	2-6
TABLE 2-2. ELECTRICAL SPECIFICATIONS	2-6
TABLE 2-3. MACHINE DIMENSIONS	2-7
TABLE 2-4. MOLDBOARD DIMENSIONS	2-7
TABLE 2-5. FRONT BLADE DIMENSIONS	2-8
TABLE 2-6. SCARIFIER DIMENSIONS	2-8
TABLE 2-7. STEERING SPECIFICATIONS	2-8
TABLE 2-8. HYDRAULIC SPECIFICATIONS	2-8
TABLE 2-9. DRIVE SYSTEM SPECIFICATIONS	2-9
TABLE 2-10. MACHINE SYSTEM CAPACITY SPECIFICATIONS	2-9
TABLE 2-11. FUEL AND LUBRICANT SPECIFICATIONS	2-9
TABLE 2-12. TORQUE SPECIFICATIONS FOR STANDARD INCH FASTENERS	2-10
TABLE 2-13. TORQUE SPECIFICATIONS FOR METRIC FASTENERS	2-11

Section 2 SPECIFICATIONS



GENERAL INFORMATION

The description and specifications given in this section are applicable to the Model 685 Motor Grader. This section contains a description of how the major components operate. It also includes the hydraulic, electrical, performance, and fluid specifications and torque values for both standard and metric fasteners used on this machine.

ENGINE

The 685 Motor Grader uses a Cummins 4B 3.9 four-cylinder diesel engine to drive the hydraulic traction pump, function pump and steering pump. The engine is mounted to the rear of the operating platform and accessible through doors in the engine cover.

A fuel lift pump mounted on the engine draws diesel fuel from the fuel tank. The fuel tank is mounted behind the operator's platform on the right side of the grader. The fuel tank has a shutoff valve installed on the fuel outlet to shut off the fuel during service. See Figure 2-1.

An air cleaner mounted on the right side of the engine filters intake air before use by the engine. The air cleaner removes fine particles such as dust, sand, chaff and lint from the air. See Figure 2-2.

A pre-cleaner mounted on top of the air cleaner assembly removes larger particles of dirt and debris before the air enters the air filter elements.

The pre-cleaner relieves the load on the air filter elements and allows longer intervals between servicing. The materials trapped by the pre-cleaner are deposited in the pre-cleaner bowl.

As air is taken into the air cleaner assembly, a cyclone type action deposits some of the fine particles in the evacuator mounted on the bottom of the air cleaner housing. The evacuator is held closed during engine operation by suction. When the engine is shut off the weight of the debris helps to open the rubber flaps allowing the debris to fall out.

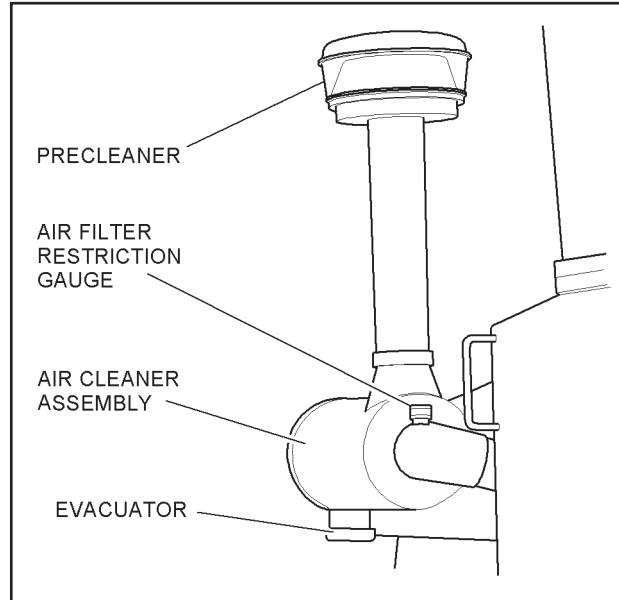


FIGURE 2-2. AIR CLEANER ASSEMBLY

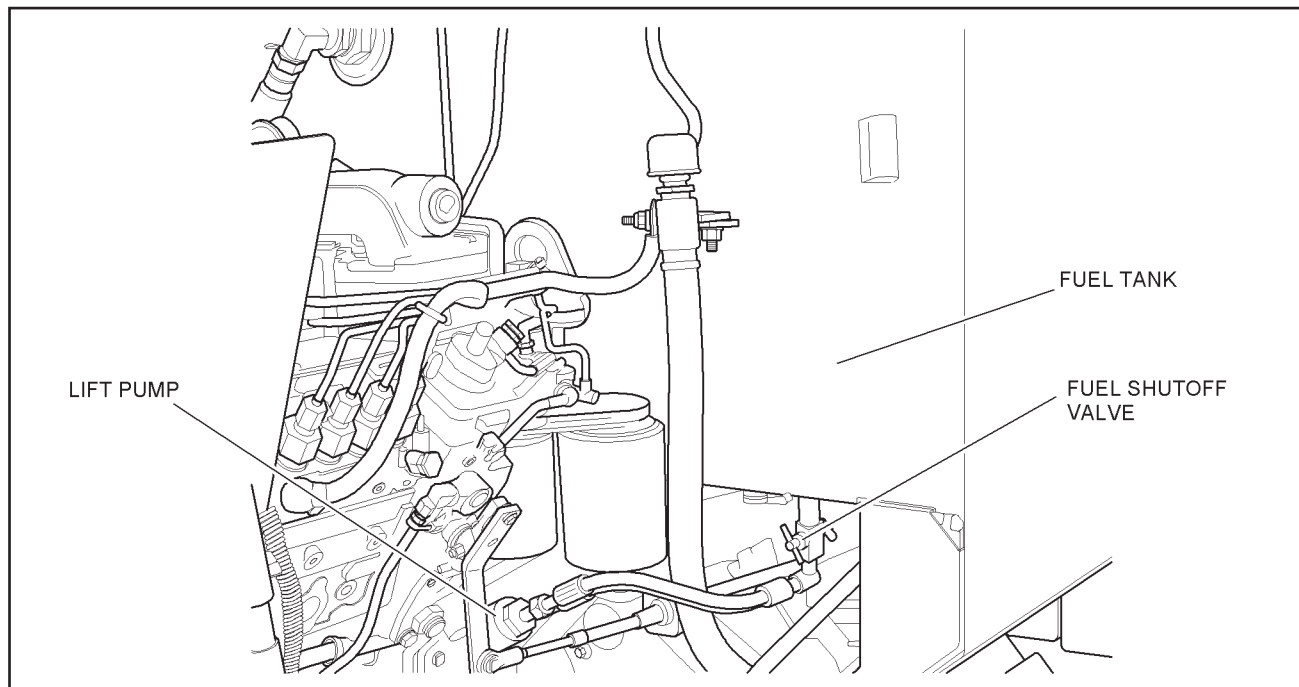


FIGURE 2-1. FUEL SUPPLY

The rubber flaps can also be squeezed together for cleaning.

Primary and secondary fuel filters remove contaminants from the diesel fuel before the fuel flows to the injection pump for injection into the engine combustion chamber. See Figures 2-3 and 2-4 for location of engine fuel and oil filters.

A radiator mounted at the rear of the grader cools the engine. As coolant flows through the radiator, airflow from the engine-driven fan removes heat from the coolant.

Refer to the engine owner's Operation and Maintenance Manual for a complete description of the engine.

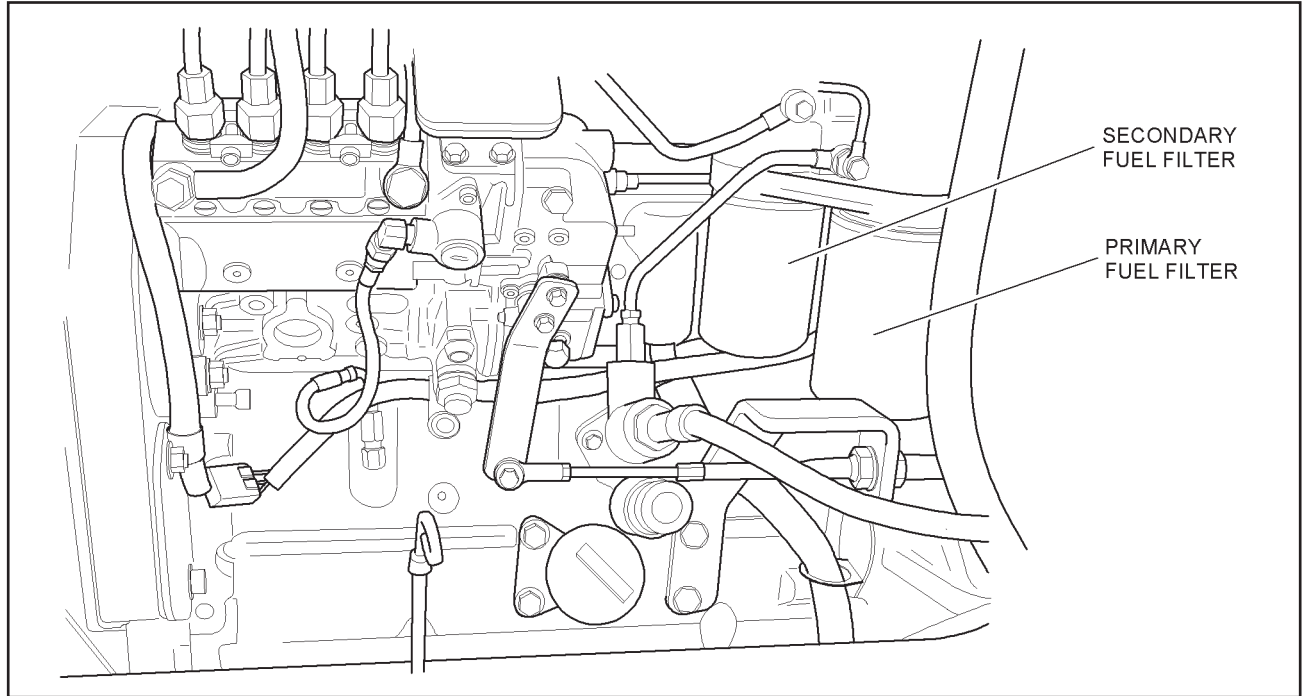


FIGURE 2-3. FUEL FILTERS

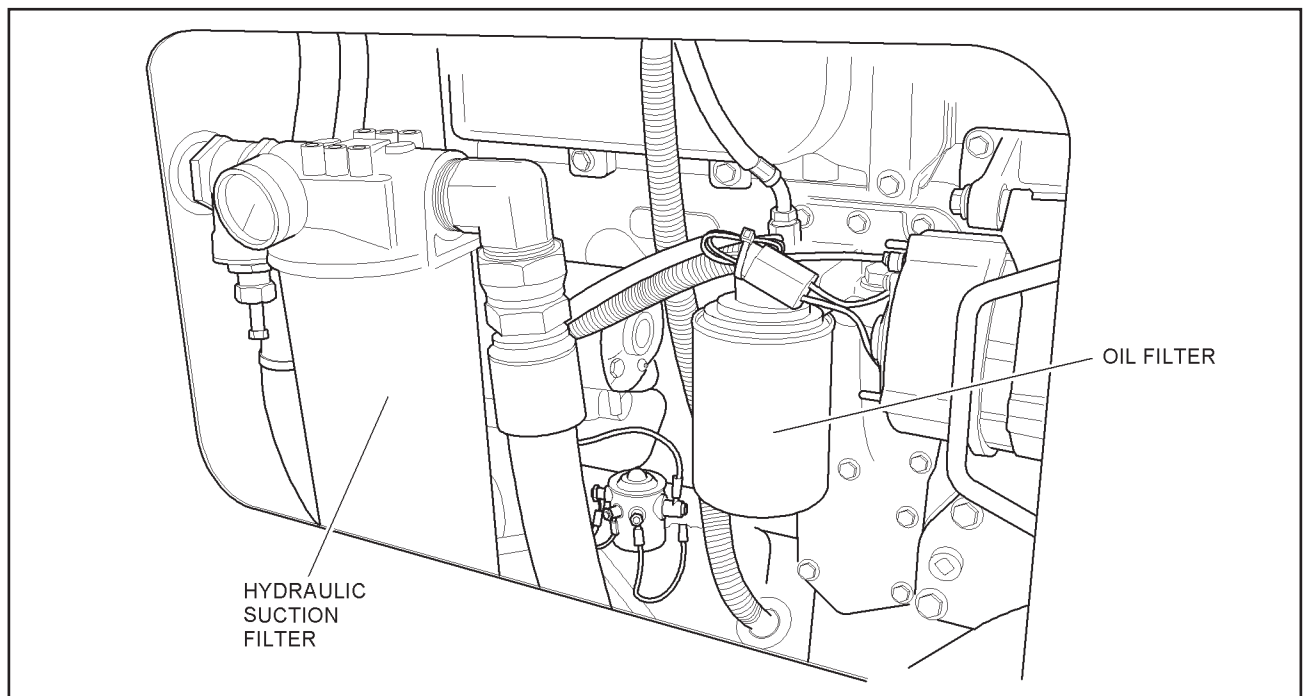


FIGURE 2-4. ENGINE OIL FILTER

Section 2 SPECIFICATIONS



ELECTRICAL SYSTEM

The electrical system is powered by two 12-volt batteries mounted in the battery compartment located at the rear of the machine. See Figure 2-5.

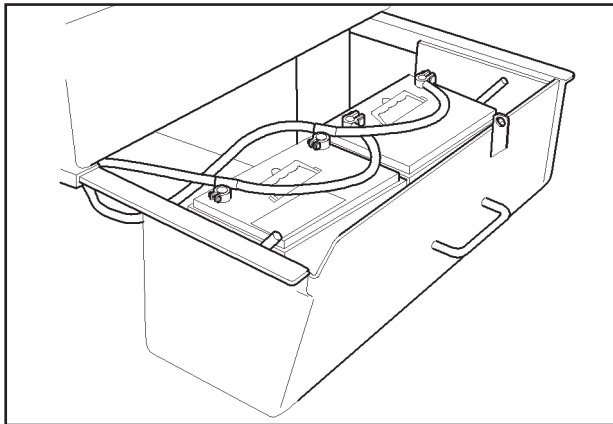
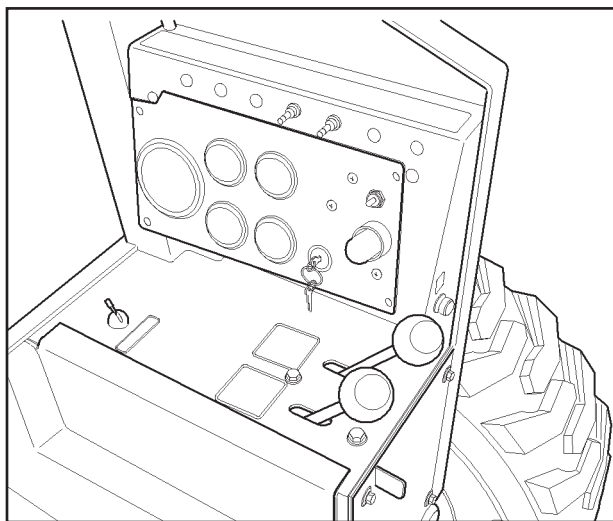


FIGURE 2-5. BATTERY BOX

The batteries are connected in parallel, producing 12 volts DC and maintaining 950 cold cranking amperes (CCA). An engine-mounted alternator capable of 105 amperes charging capacity keeps the batteries charged during normal operation.

The battery charge rate can be monitored using a voltmeter mounted in the instrument panel. See Figure 2-6.

FIGURE 2-6. INSTRUMENT PANEL



HYDRAULIC SYSTEM

The hydraulic system includes three hydraulic pumps driven by the engine (see Figure 2-7). A traction pump driven directly by the engine is mounted with an adapter plate at the rear engine output shaft. This pump is described in detail in the section entitled Drive System.

The function pump is mounted on the rear of the traction pump and driven by the traction pump output shaft. This gear type pump provides hydraulic pressure and flow to operate all the hydraulic cylinders used to control the grader functions.

The pump draws hydraulic oil from the reservoir using a common inlet with the steering pump. The pressurized oil flows to the hydraulic control valve mounted in the operator's platform.

The steering pump is mounted on the rear of the function pump and driven by the traction pump output shaft. This gear type pump provides hydraulic pressure and flow to operate the steering cylinder.

The pump draws hydraulic oil from the reservoir using a common inlet with the function pump. The pressurized oil flows to the steering motor mounted in the steering console located in the operator's compartment.

Drive System

The model 685 Motor Grader drive system includes a hydrostatic traction pump, variable speed hydraulic motor, two speed transfer cases, rear axle carrier assembly, and chain drive assembly.

The hydrostatic traction pump is a variable piston type pump. A swash plate controls the direction and flow of hydraulic drive pressure. A traction foot pedal and linkage in the operator's compartment and pump controller mounted on the pump are used to control the direction of travel and output pressure by tilting the swash plate.

The variable drive motor also uses a swash plate to control machine speed. A lever located in the operator's compartment is used to control swash plate tilt and piston stroke. A longer piston stroke increases hydraulic oil pressure, oil flow, and drive motor output speed.

A two-speed transfer case mounted between the drive motor and rear axle carrier provides high and low gear selection. A gear selector lever in the operator's compartment allows the operator to shift gears.

NOTE: When shifting the two-speed lever from low to high (or high to low) make sure the brake is engaged and the moldboard is on the ground.

DANGER:



Shift lever must be in low or high at all times. Machine must be on level ground and at full stop when shifting.

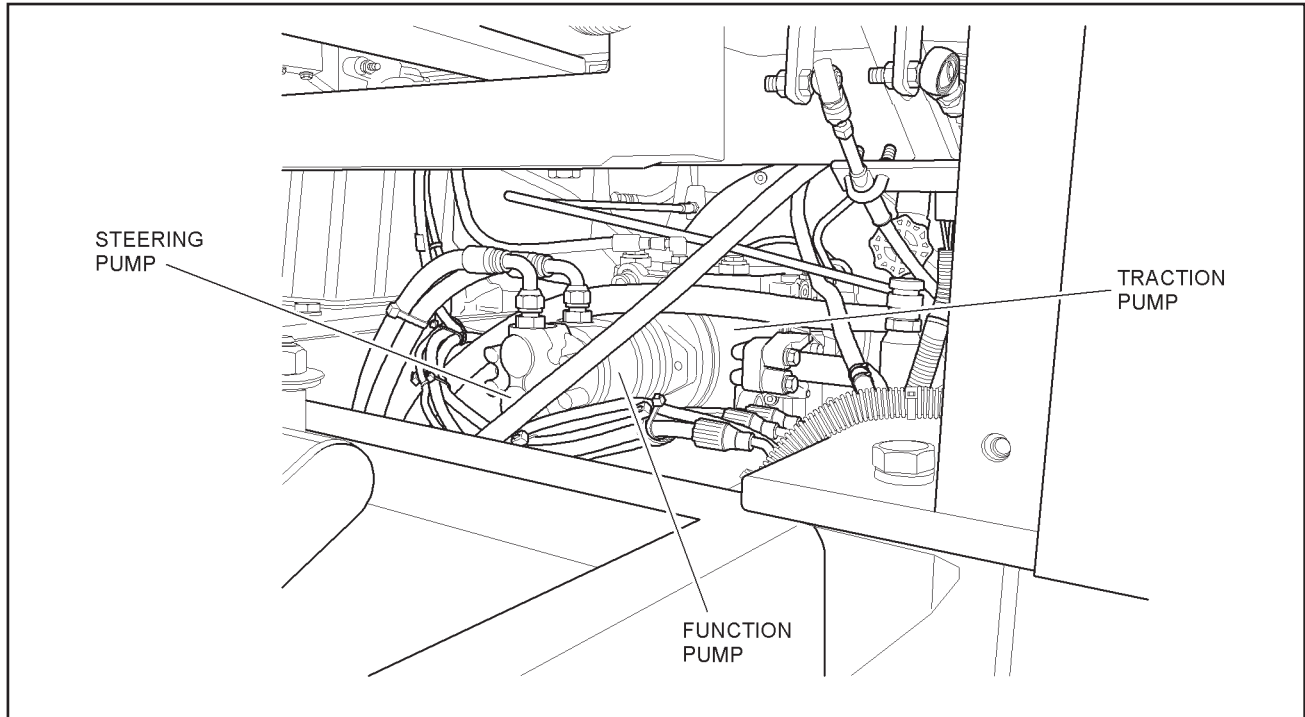


FIGURE 2-7. HYDRAULIC PUMPS

The rear axle carrier assembly is used to convert input rotation to axle shaft output rotation. The left and right axle shafts drive the chain drive assembly.

The chain drive assembly uses axle shaft rotation to drive the chain and sprocket assemblies. The sprockets are mounted on splined axle shafts used for mounting two wheels on each side.

Brakes

Machine braking is controlled by the flow of hydraulic oil in the drive system. When the traction foot pedal is returned to the neutral from the forward or reverse position, the flow of hydraulic oil to the drive motor stops rotating the rear axle carrier assembly allowing the machine to slow and stop.

A disc brake drive assembly mounted on the rear of the rear axle housing prevents the rear axle shafts and chain drive assembly from moving. The disc brake drive assembly includes a brake disc and caliper. Brake pads mounted in the caliper prevent rotation of the final drive until the parking brake selector valve is released.

The engine must be running to release the parking brake. The fail-safe brake is actuated by spring pressure and requires constant hydraulic pressure for release. If the engine is not running or a hydraulic failure occurs the parking brake can be manually released as described in the section enti-

led Motor Grader Towing.

Steering

The 685 Motor Grader can be steered using the steering wheel and motor, the wheel lean control lever, or the articulate lever.

The steering wheel controls the steering motor, which controls the flow of hydraulic oil to the steering cylinder. The steering cylinder is mounted between the front axle support and the right hand spindle. The left and right spindles are connected by a tie rod, which forces the left wheel to turn when the right wheel is actuated.

The wheel lean lever controls the flow of hydraulic oil to the wheel lean cylinder. The wheel lean cylinder is mounted between the front axle support and the right hand spindle support. The left and right spindle supports are connected by a tie rod, which forces the left wheel to lean when the right wheel is actuated.

CAUTION: The moldboard assembly will contact the drive wheels during articulation. Make sure the turning radius and moldboard position do not result in drive wheel damage caused by improper steering.



The articulate lever controls the flow of hydraulic oil

Section 2 SPECIFICATIONS



to the articulate cylinders. The articulate cylinders are mounted between the mainframe assembly and the boom assembly. The boom assembly is mounted on the main frame using an articulator shaft and bearing assembly. The assembly allows the machine to pivot right and left when the articulate cylinders are actuated.

The steering can be controlled using one or all of the steering systems.

An optional dead engine steering system is available, which allows steering if the engine will not run or certain hydraulic failures occur. The system includes an electric motor and auxiliary hydraulic pump combination. When activated, the auxiliary hydraulic pump provides hydraulic pressure for steering.

Moldboard

The moldboard assembly is mounted underneath the boom assembly and supported by a drawbar and turntable assembly. The moldboard is the primary tool used to move grading materials.

The moldboard position is controlled by hydraulic cylinders, which allow the moldboard to be tilted from front to rear, tilted from side to side, raised for transport, rotated, and lowered for penetration. The moldboard assembly can also be side-shifted up to three feet.

Scarifier

The scarifier assembly is mounted underneath the mainframe assembly. Five replaceable teeth and tooth supports are used to penetrate the grading

surface. The tooth supports are adjustable and secured with pin locks inserted between the support frame slot and tooth support.

The scarifier is raised and lowered using a hydraulic lift cylinder.

Front Blade

The front blade assembly is mounted on the front of the boom assembly. The front blade is bolted to the front blade support assembly. The front blade is used in conjunction with the moldboard and scarifier for leveling and backfilling.

The front blade assembly is raised and lowered using a hydraulic lift cylinder.

OPTIONS

The Model 685 Motor Grader can be equipped with the following options:

1. Full fabricated cab with heater, air conditioner and light package.
2. Front loader bucket and front blade assembly.
3. Front traction assist, allowing the operator to actuate hydraulic front drive hubs for additional traction during work.
4. Dead engine steering, allowing machine steering during steering pressure failure.

SPECIFICATIONS

Tables 2-1 through 2-11 list the engine and system specifications for the Model 685 Motor Grader.

TABLE 2-1. ENGINE SPECIFICATIONS

ITEM	SPECIFICATION
Model	Cummins 4B3.9 Cummins 4BT3.9 (Turbo)
H.P.	110 HP @ 2500
Displacement	238 cubic inches (3.9 L)

NOTE: See the manufacturers Operation Manual for additional information and specifications.

TABLE 2-2. ELECTRICAL SPECIFICATIONS

ITEM	SPECIFICATION
Batteries	2 - 12VDC Maintenance Free
Cold Cranking Amps (CCA)	950 CCA
System Voltage	12 VDC
Charging System	Alternator 12 VDC, 105 Amps

TABLE 2-3. MACHINE DIMENSIONS (see Figure 2-8)

ITEM	SPECIFICATION
Overall Weight	15,200 pounds (6895 kg)
Overall Length	21 feet 8 inches (6.6 m)
Overall Width	7 feet (2.1 m)
Overall Height8 feet 6 inches (2.6 m) with Canopy 9 feet (2.7 m) with Cab

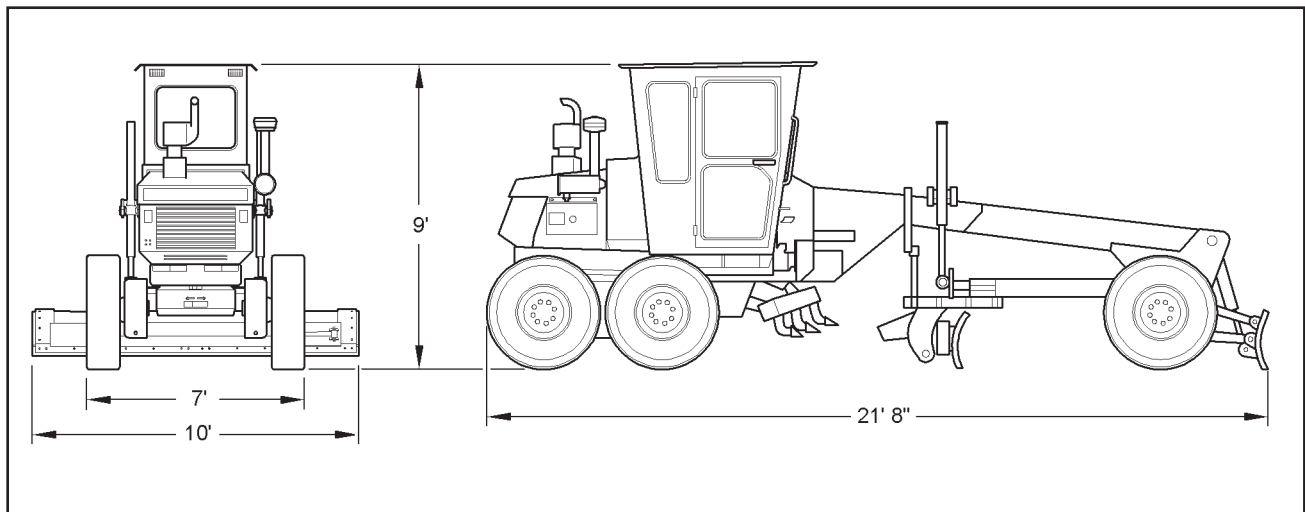


FIGURE 2-8. OUTLINE DIMENSIONAL DRAWING

TABLE 2-4. MOLDBOARD DIMENSIONS

ITEM	SPECIFICATION
Width	10 feet (3 m)
Height	18 inches (457 mm)
Side Shift	3 feet (914 mm)
Tilt	30 degrees
Raised Clearance	13.5 inches (343 mm)
Penetration	12 inches (305 mm)
Rotation	120 degrees

Section 2 SPECIFICATIONS



TABLE 2-5. FRONT BLADE DIMENSIONS

ITEM	SPECIFICATION
Width	.7 feet (2.1 m)
Height	.18 inches (457 mm)
Raised Clearance	.13 inches (330 mm)
Penetration	.3 inches (76 mm)

TABLE 2-6. SCARIFIER DIMENSIONS

ITEM	SPECIFICATION
Width	.38 inches (965 mm)
Number Teeth	.5 on-center
Raised Clearance	.12 inches (305 mm)
Penetration	.9 inches (229 mm)

TABLE 2-7. STEERING SPECIFICATIONS

ITEM	SPECIFICATION
Steering	Hydraulic
Articulation	.10 feet 6 inch (3.2 m) radius
Wheel Lean	.26 degrees
Tires	(2) 15/38.5-15 lt

NOTE: Refer to the tire manufacturers brochures for additional information on tire size and requirements.

TABLE 2-8. HYDRAULIC SPECIFICATIONS

ITEM	SPECIFICATION
Traction Pump	Variable piston type 4.26 cu. in./rev. (69.8 cu. cm)
Function Pump	Gear type 0.8 cu. in./rev. (13.1 cu. cm)
Steering Pump	Gear type 0.8 cu. in./rev. (13.1 cu. cm)
Drive Motor	Variable volume 5.43 cu. in. (89 cu. cm)
Operating Pressure	0 - 4500 psi (0 - 310 bar)
Hydraulic Filters	Suction filter in-line, spin-on type Mesh screen return
Oil Cooler	Radiator/oil cooler, engine fan cooling

TABLE 2-9. DRIVE SYSTEM SPECIFICATIONS

ITEM	SPECIFICATION
Drive	Hydraulic
Transfer case	2 speed, 0 - 20 mph (32 kph)
Differential	Single carrier
Final Drive	Chain drive 4 axle output [42 in. (1.06 m) on-center]
Tires	15/38.5-15 lt

NOTE: Refer to the tire manufacturers brochures for additional information on tire size and requirements.

TABLE 2-10. MACHINE SYSTEM CAPACITY SPECIFICATIONS

ITEM	SPECIFICATION
SYSTEM CAPACITIES	
Fuel	40 U.S. gallons (151 L)
Engine Lubrication Oil	11.6 quarts (11 L)
Coolant	5.5 U.S. gallons (21 L)
Hydraulic Oil Reservoir	32 U.S. gallons (121 L)

TABLE 2-11. FUEL AND LUBRICANT SPECIFICATIONS

ITEM	SPECIFICATION
Engine Oil	15W-40
Hydraulic Oil5W20 AWAT OIL
Coolant	Ethylene/glycol or propylene glycol
Fuel	Diesel, local low-sulphur blend
Transfer Case (2 Speed)	50 WT Motor Oil
Differential Oil	50 WT Motor Oil
Chain Box	50 WT Motor Oil
Grease	Shell Avania EP Grease or Equivalent

Section 2 SPECIFICATIONS



TABLE 2-12. TORQUE SPECIFICATIONS FOR STANDARD INCH FASTENERS

WARNING: The following Table lists torque values for standard hardware and are intended as a guide for average application involving typical stresses and machined surfaces. Values are based on physical limitations of clean, plated and lubricated hardware. In all cases, when an individual torque value is specified, it should be followed instead of values given in this table.



CAUTION: Replace original equipment with hardware of equal grade.



		CAPSCREWS: SAE GRADE 5				CAPSCREWS: SAE GRADE 8			
SIZE	THREAD	TORQUE FT. LBS.		TORQUE N•m		TORQUE FT. LBS.		TORQUE N•m	
		Dry	Lubed	Dry	Lubed	Dry	Lubed	Dry	Lubed
1/4	20 UNC	8	6	11	9	12	9	16	12
	28 UNF	10	7	13	10	14	10	19	14
5/16	18 UNC	17	13	24	18	25	18	33	25
	24 UNF	19	14	26	20	27	20	37	28
3/8	16 UNC	31	23	42	31	44	33	59	44
	24 UNF	35	26	47	36	49	37	67	50
7/16	14 UNC	49	37	67	50	70	52	95	71
	20 UNF	55	41	75	56	78	58	105	79
1/2	13 UNC	75	57	100	77	105	80	145	110
	20 UNF	85	64	115	86	120	90	165	120
9/16	12 UNC	110	82	145	110	155	115	210	155
	18 UNF	120	91	165	125	170	130	230	175
5/8	11 UNC	150	115	205	155	210	160	285	215
	18 UNF	170	130	230	175	240	180	325	245
3/4	10 UNC	265	200	360	270	375	280	510	380
	16 UNF	295	225	405	300	420	315	570	425
7/8	9 UNC	430	320	580	435	605	455	820	615
	14 UNF	475	355	640	480	670	500	905	680
1	8 UNC	645	485	875	655	910	680	1230	925
	14 NF	720	540	980	735	1020	765	1380	1040
1-1/8	7 UNC	795	595	1080	805	1290	965	1750	1310
	12 UNF	890	670	1210	905	1440	1080	1960	1470
1-1/4	7 UNC	1120	840	1520	1140	1820	1360	2460	1850
	12 UNF	1240	930	1680	1260	2010	1500	2730	2050
1-3/8	6 UNC	1470	1100	1990	1490	2380	1780	3230	2420
	12 UNF	1670	1250	2270	1700	2710	2040	3680	2760
1-1/2	6 UNC	1950	1460	2640	1980	3160	2370	4290	3210
	12 UNF	2190	1650	2970	2230	3560	2670	4820	3620

TABLE 2-13. TORQUE SPECIFICATIONS FOR METRIC FASTENERS

WARNING: The following Table lists torque values for standard hardware and are intended as a guide for average application involving typical stresses and machined surfaces. Values are based on physical limitations of clean, plated and lubricated hardware. In all cases, when an individual torque value is specified, it should be followed instead of values given in this table.

CAUTION: Replace original equipment with hardware of equal grade.

NOMINAL SIZE & PITCH	CLASS 8.8 [GRADE 5 EQUIVALENT]				CLASS 10.9 [GRADE 8 EQUIVALENT]			
	TORQUE FT. LBS.		TORQUE N•m		TORQUE FT. LBS.		TORQUE N•m	
	Dry	Lubed	Dry	Lubed	Dry	Lubed	Dry	Lubed
M4 x 0.7	2.27	1.70	3.07	2.30	2.27	2.31	4.17	3.13
M5 x 0.8	4.58	3.43	6.20	4.65	6.22	4.67	8.43	6.33
M6 x 1	7.75	5.83	10.5	7.90	10.60	7.97	14.3	10.8
M8 x 1.25	18.89	14.17	25.6	19.2	18.95	19.26	34.8	26.1
M10 x 1.25	39.11	29.52	53.0	40.1	53.87	40.59	73.0	55.0
M12 x 1.75	64.94	48.71	88.0	66.0	88.56	66.42	120.0	90.0
M14 x 2	103.32	77.49	140.0	105.0	140.22	107.01	190.0	145.0
M16 x 2	162.36	121.77	220.0	165.0	221.40	166.05	300.0	225.0
M20 x 2.5	317.34	236.16	430.0	320.0	428.04	321.03	580.0	435.0
M24 x 3	516.12	409.59	740.0	555.0	754.38	557.19	1010.0	755.0
M27 x 3	797.04	597.78	1080.0	810.0	1084.86	811.80	1470.0	1100.0
M30 x 3.5	1084.86	811.80	1470.0	1100.0	1476.00	1107.00	2000.0	1500.0

**Section 2
SPECIFICATIONS**



NOTES

TABLE OF CONTENTS

	Page
GENERAL INFORMATION	3-3
OPERATING CONTROLS, INDICATORS, AND GAUGES	3-3
TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND GAUGES	3-3
SAFETY	3-8
OPERATING SAFETY	3-8
STOPPING SAFETY	3-8
MAINTENANCE SAFETY	3-8
PRELIMINARY PROCEDURES	3-9
ADJUSTING CONSOLE	3-9
ADJUSTING SEAT	3-9
HEATER	3-9
DEFROSTER FAN	3-9
OPENING WINDSHIELD	3-9
CAB DOOR RELEASE	3-9
BREAK-IN PROCEDURES	3-9
PRE-START INSPECTION	3-10
ENGINE OPERATION	3-10
STARTING THE ENGINE	3-10
Preliminary	3-10
Engine Start Up	3-10
Engine Warm Up	3-11
Cold Weather Engine Start Up	3-11
Cold Weather Engine Warm Up	3-11
Using Booster Batteries - 12 Volt System	3-11
STOPPING THE ENGINE	3-11
EMERGENCY STOPPING	3-11
ADJUSTING ENGINE FOR HIGH ELEVATION	3-12
DRIVING THE MACHINE	3-12
DIRECTIONAL CONTROL	3-12
TRAVEL SPEEDS	3-12
THROTTLE CONTROL	3-12
BRAKING	3-12
PARKING BRAKE	3-12
PARKING THE MACHINE	3-12

TABLE OF CONTENTS (Continued)

	Page
OPERATING THE MACHINE	3-12
MOLDBOARD LIFT CONTROL	3-13
MOLDBOARD SIDE SHIFT CONTROL	3-13
MOLDBOARD PITCH CONTROL	3-13
MOLDBOARD ANGLE CONTROL	3-13
WHEEL LEAN CONTROL	3-13
OPTIONAL FRONT TRACTION ASSIST CONTROL	3-13
SCARIFIER CONTROL	3-13
HIGH/LOW TRANSFER CASE	3-13
ARTICULATION AND STEERING CONTROL	3-14
FRONT BLADE CONTROL	3-14
SPREADING PILES	3-14
BACKFILLING	3-14
VEE DITCHING	3-14
DITCH CLEANING	3-14
ROAD CROWNING	3-15
BANK CUTTING	3-15
SLOPE WORK	3-15
TABLE OF CONTENTS	3-15
CUL-DE-SACS	3-15
TRANSPORTING	3-15
MOTOR GRADER TOWING	3-17

GENERAL INFORMATION

This section provides the Operating instructions for the Model 685 Motor Grader. It is important to read, understand, and follow all "Precautions, Operating Instructions, and Warnings" written in this manual before starting or operating the machine.

DANGER: Failure to observe the "Operating Precautions and WARNING Instructions" provided in this manual can cause serious injury or death. Only authorized personnel, who are fully trained in the machine operation, can operate the Model 685 Motor Grader.



This machine should be kept in good mechanical condition at all times.

WARNING: Do not operate a machine needing repair. Put an information tag on the instrument panel that says, "DO NOT OPERATE". Remove the key from the ignition switch. Repair all damage at once. Minor damage can result in major system failures.



OPERATING CONTROLS, INDICATORS, AND GAUGES

The operating controls for the Model 685 Motor Grader are shown in Figures 3-1 through 3-4 and listed in Table 3-1. All of the controls, indicators and

gauges are mounted in the operator's compartment.

The control panel located to the left of the seat contains gauges for monitoring engine operation, ignition switch, system control switches and lights (see Figure 3-1).

The variable speed control, throttle control and main shut off switch are located on the left hand panel next to the seat (see Figure 3-1).

The hydraulic control valve, steering wheel console, console control lever, and optional control switches are mounted in front of the operator (see Figure 3-2).

The parking brake control and two-speed gear selector are mounted on the right hand panel next to the seat (see Figure 3-3).

The traction foot pedal and traction foot pedal lock are mounted on the floor (see Figure 3-4).

WARNING: Do not start or operate the Model 685 Motor Grader before reading, understanding, and following all information given in this section and shown on the machine. The operator must read and understand the function of all controls, indicators, and gauges before starting the engine. Serious injury or death can result if these procedures are not followed.



Refer to Table 3-1 for a list of the controls and a description of their functions.

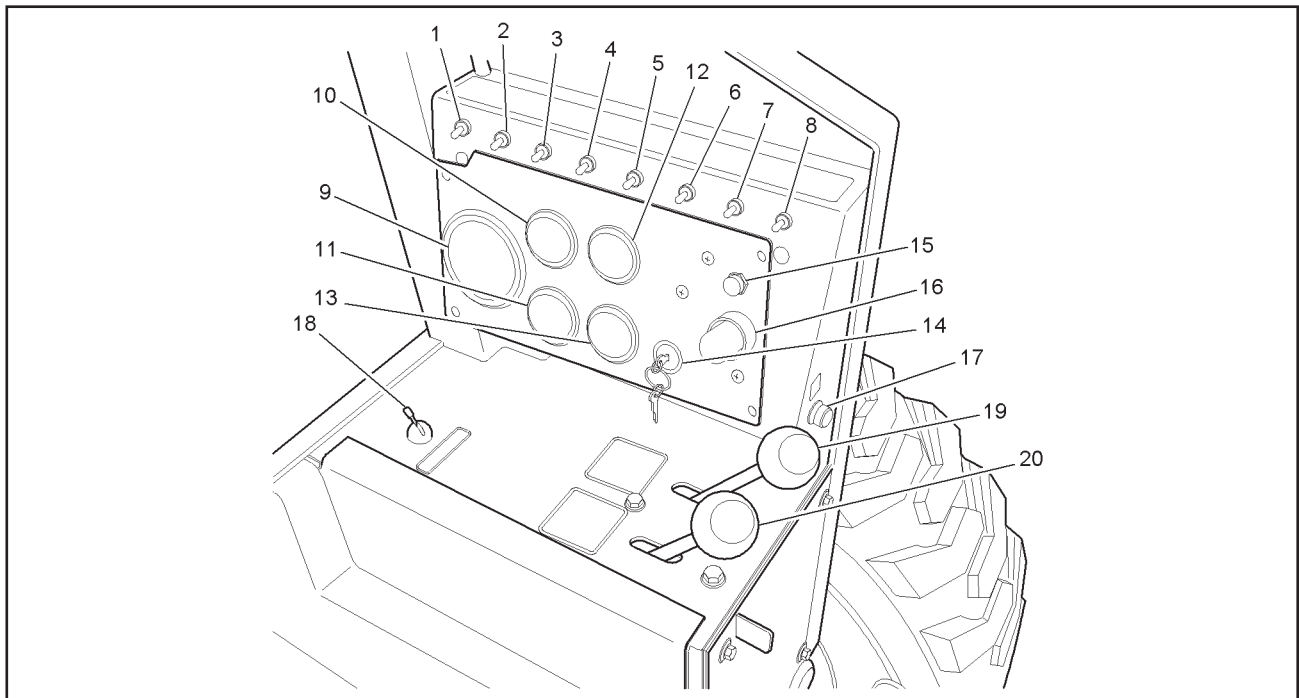


FIGURE 3-1. CONTROL PANEL AND LEFT HAND OPERATOR'S PANEL

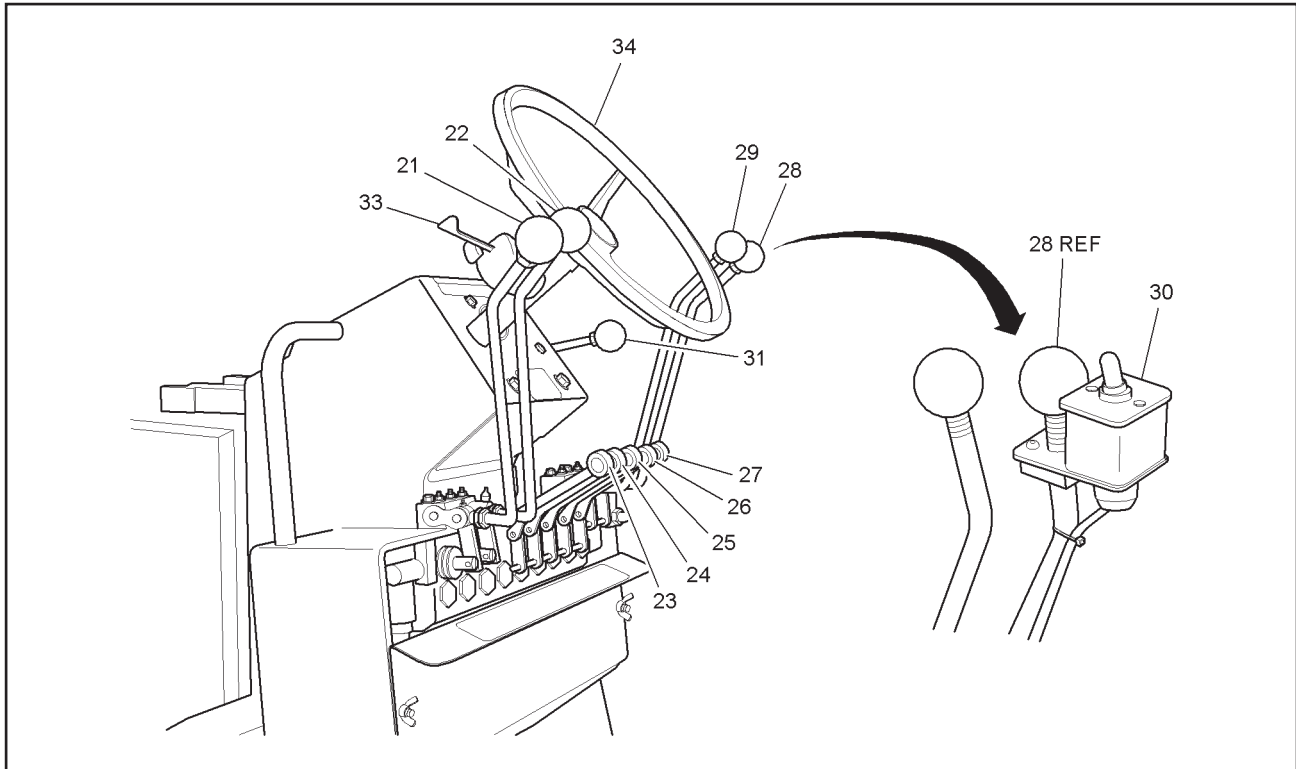


FIGURE 3-2. STEERING CONSOLE

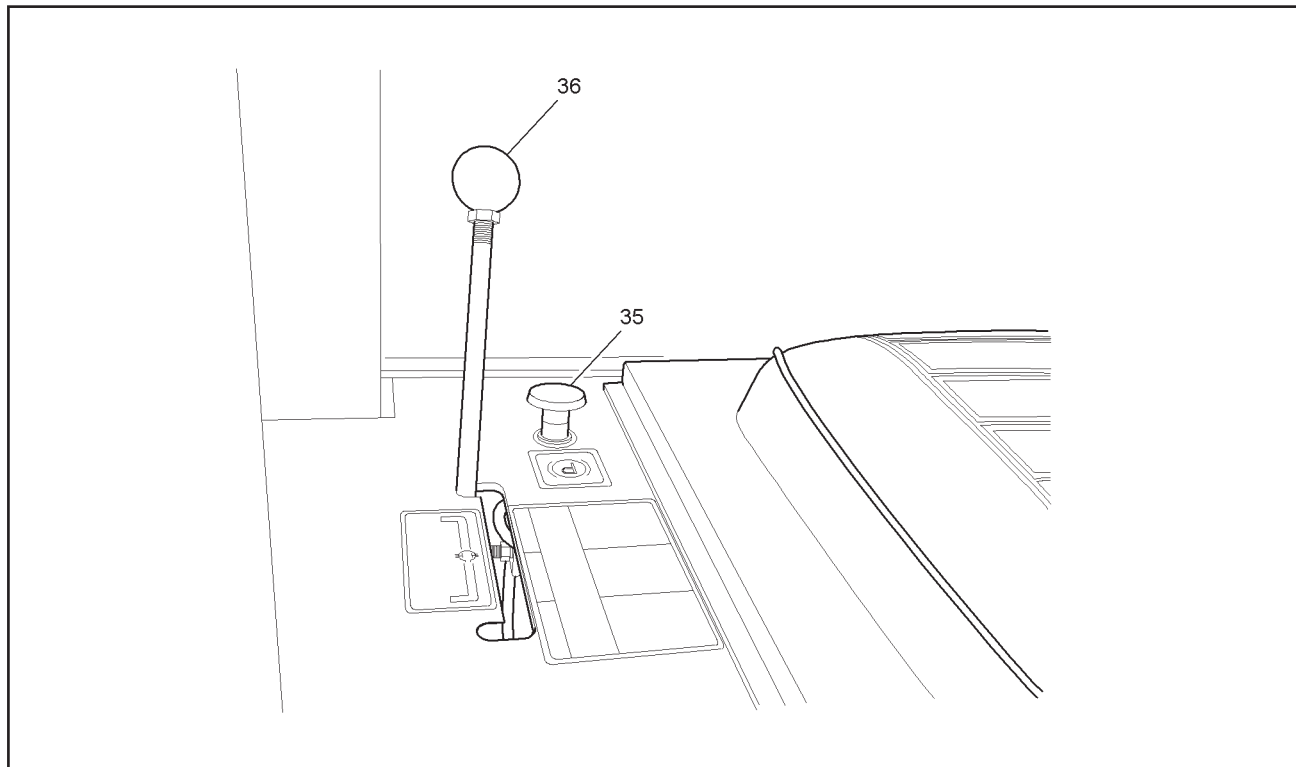


FIGURE 3-3. RIGHT HAND OPERATOR'S PANEL

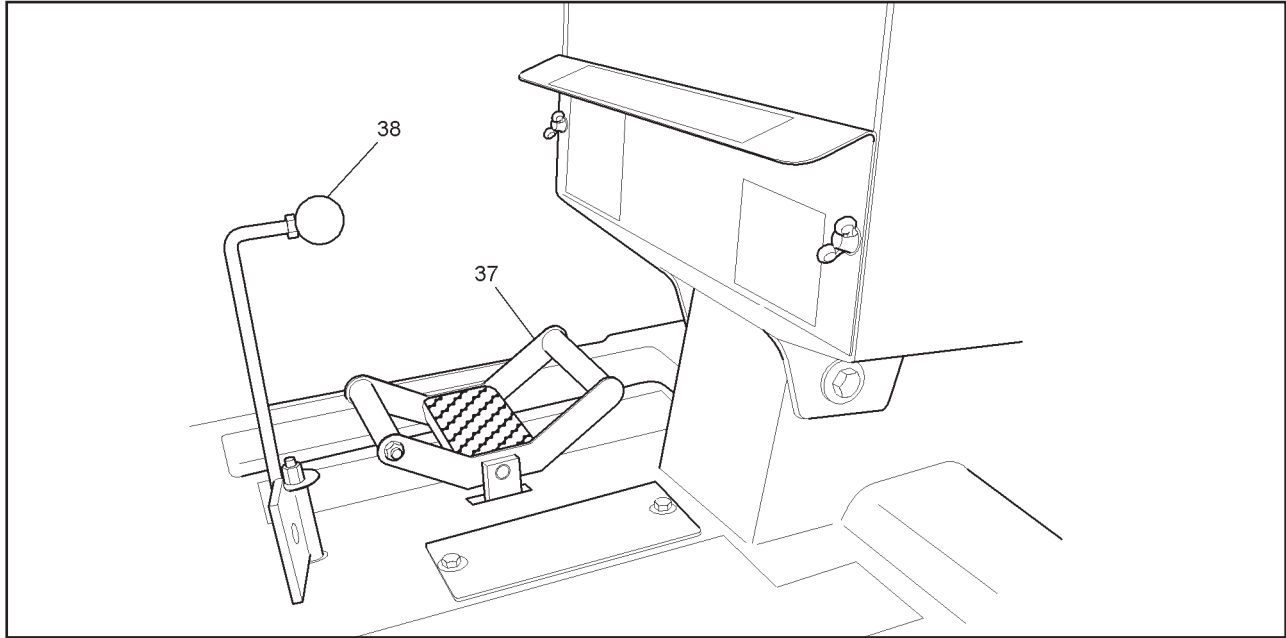


FIGURE 3-4. TRACTION FOOT PEDAL AND LOCK

TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND GAUGES

FIG. REF	ITEM	CONTROL NAME	TYPE	FUNCTION
3-1	1	Rotating Beacon Light	ON/OFF 2-position toggle	Controls operation of the safety flashing light on top of the cab or canopy. This light warns traffic of slow moving equipment.
3-1	2	Rear Window Wiper	ON/OFF 2-position toggle	Controls operation of the optional cab rear window wiper motor.
3-1	3	Windshield Defroster	ON/OFF 2-position toggle	Controls operation of the optional cab windshield defroster.
3-1	4	Heater	HIGH/LOW 2-position toggle	Controls operation of the optional cab heater fan.
3-1	5	Work Lights	ON/OFF 2-position toggle	Controls operation of the work lights mounted on the cab or canopy. These lights are used to illuminate the work area when working at night.
3-1	6	Headlights	ON/OFF 2-position toggle	Controls operation of the headlights. These lights are used to illuminate the road or area in front of the machine during operation or transport.
3-1	7	Windshield Wipers	ON/OFF 2-position toggle	Controls operation of the windshield wipers.
3-1	8	Dome Light	ON/OFF 2-position toggle	Controls operation of the optional cab interior light.

Section 3 OPERATION



TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND GAUGES (Continued)

FIG. REF	ITEM	CONTROL NAME	TYPE	FUNCTION
3-1	9	Tachometer		Displays engine speed in revolutions per minute (RPM).
3-1	10	Voltmeter		Displays the condition of the battery charging system.
3-1	11	Fuel Gauge		Displays fuel level in the diesel fuel tank.
3-1	12	Oil Pressure Gauge		Displays engine oil pressure in pounds per square inch (psi).
3-1	13	Temperature Gauge		Displays engine coolant temperature.
3-1	14	Ignition Switch		Used to start and stop the engine and activate the switched power circuits.
3-1	15	Circuit Breaker Reset		Resets ignition circuit breaker after circuit breaker is tripped.
3-1	16	Murphy-Engine Shut Down Warning	Warning Light	The low oil pressure and high water temp warning light for the Murphy shut down system. This light illuminates 20 seconds before engine shut down. The engine can be restarted and run for 20 additional seconds in emergency situations.
3-1	17	Horn Switch	ON/OFF (Push Button)	Sounds the horn when pressed.
3-1	18	Main Battery Switch	ON/OFF	Controls flow of battery current to the machine electrical system.
3-1	19	THROTTLE Lever	Fast/Slow	Controls engine speed (RPM).
3-1	20	VARIABLE SPEED Control Lever	Fast/Slow	Controls the output speed (RPM) of the variable drive motor.
3-2	21	Moldboard Blade Angle Lever	RIGHT/LEFT lever	Controls operation of the moldboard blade angle cylinders.
3-2	22	Moldboard Slide Lever	RIGHT/LEFT lever	Controls operation of the moldboard side shift cylinder. Allows up to 3 feet of moldboard side shift.
3-2	23	Front Blade Lever	UP/DOWN lever	Controls operation of the front blade lift cylinder.
3-2	24	Wheel Lean Lever - RIGHT/LEFT	RIGHT/LEFT lever	Controls operation of the wheel lean cylinder. Allows up to 26 degrees front wheel lean.

TABLE 3-1. OPERATING CONTROLS, INDICATORS, AND GAUGES (Continued)

FIG. REF	ITEM	CONTROL NAME	TYPE	FUNCTION
3-2	25	Moldboard Tilt Lever	Lever	Controls operation of the moldboard tilt cylinder. Allows up to 30 degrees of moldboard tilt.
3-2	26	Scarifier	UP/DOWN lever	Controls operation of the scarifier lift cylinder.
3-2	27	Articulate Lever	RIGHT/LEFT lever	Controls operation of the articulation cylinders. Used to articulate the front portion of the machine right and left.
3-2	28	Moldboard Right Lift Lever	UP/DOWN lever	Controls operation of the right hand moldboard lift cylinder.
3-2	29	Moldboard Left Lift Lever	UP/DOWN lever	Controls operation of the left hand moldboard lift cylinder.
3-2	30	Front Traction Assist Lever	ON/OFF lever	Controls operation of the optional front traction motors.
3-2	31	Console Tilt Lock Lever	Lever	Locks/unlocks console for adjustment.
3-2	32	Not Used		
3-2	33	Directional Indicator	RIGHT/LEFT lever	Controls operation of the right and left turn signals.
3-2	34	RIGHT STEER/ LEFT STEER Wheel	Rotary control or steering wheel	Controls right and left steering function of the front wheels.
3-3	35	Parking Brake	ON/OFF knob	Push to apply and pull to release the parking brake.
3-3	36	Gear Selector	HIGH & LOW lever	Controls two speed transfer case shifting. DANGER: Shift lever must be in low or high at all times. Machine must be on level ground and at full stop when shifting. NEVER shift the low to high lever on any incline.
3-4	37	Traction Foot Pedal	FORWARD/ REVERSE pedal	Controls forward and reverse operation and variable speed of the traction pump.
3-4	38	Traction Foot Pedal Lock Lever	Lever	Locks/unlocks the traction foot pedal in neutral.

Section 3

OPERATION



SAFETY

OPERATING SAFETY

WEAR OSHA required safety equipment when running the motor grader.

ALWAYS be seated in the operator's seat with the seat belt on when operating the equipment.

ALWAYS make sure no person or object is in your line of travel BEFORE starting.

WORK slowly in tight areas.

DO NOT run engine in a closed building for long periods of time.

AVOID steep hills and sharp turns if possible.

REDUCE speed before turning or swinging loads.

ALWAYS look BEFORE changing your direction of travel.

DO NOT leave the engine running without operator present.

ALWAYS lower moldboard, scarifier, bucket, and front blade when leaving the machine unattended.

DO NOT start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.

NEVER start engine while standing on the ground. Start engine only from operator's seat, with traction foot pedal in neutral.

NEVER shift the low to high lever on any incline.

CHECK the parking brake to make sure it is operating properly.

DANGER: Shift lever must be in low or high at all times. Machine must be on level ground and at full stop when shifting.



STOPPING SAFETY

ALWAYS park the grader on solid, level ground. If this is not possible, always park the grader at a right angle to the slope.

ALWAYS return traction foot pedal to neutral position and lock it in neutral with the traction foot pedal lock lever.

ALWAYS lower moldboard, scarifier, bucket, and front blade when leaving the machine unattended.

ALWAYS engage parking brake.

USE proper flags, barriers and warning devices especially when parking in areas of traffic.

MAINTENANCE SAFETY

NEVER work on the grader with the engine running.

NEVER fill the fuel tank with the engine running.

DO NOT change the engine governor settings.

ALWAYS replace damaged or lost decals.

DISCONNECT battery cables when working on the electrical system or when welding on the unit.

MAKE SURE safety stop cable is attached when pulling the battery tray out to disconnect cables.

IF battery needs a charge, be sure battery charger is off when making connections.

BE SURE the correct battery polarity is observed [negative (-) to negative (-) and positive (+) to positive (+)], when connecting a battery charger or jumper cable.

DO NOT use hands to find hydraulic leaks. High-pressure fluid can penetrate the skin causing severe injury.

DO NOT service or repair the grader blades, scarifier, or moldboard in a raised position unless supported by approved jacks and jack stands.

PRELIMINARY PROCEDURES

ADJUSTING CONSOLE

Adjust the console by releasing the console tilt lock lever (Figure 3-2, Item 30) located to the right of the console. After placing the console in a comfortable position place tilt lock firmly in the locked position.

ADJUSTING SEAT

WARNING: Always adjust the seat belt and use it during operation of the motor grader. The seat belt is designed to provide safe operator retention if the machine is involved in an accident or rollover incident.



The seat can be adjusted for individual comfort. The seat suspension (Figure 3-5, Item A) provides operator comfort by absorbing some of the machine movements during operation. The seat position lever (B) allows the operator to move the seat from front to rear for easy access to the steering wheel and hydraulic controls. The comfort control knob (C) can be adjusted from soft ride to firm ride as needed for variable operational situations. The seat belt provides safe operator retention if the machine is involved in an accident

or rollover incident. Adjust the seat belt for comfortable machine operation.

HEATER

1. Open heater hose shut off valve.
2. Turn blower speed knob clockwise to increase blower speed.

DEFROSTER FAN

If needed, place the switch in the high or low position for window defrosting.

OPENING WINDSHIELD

1. Hold windshield.
2. Release latch.
3. Push windshield outward.

CAB DOOR RELEASE

Push door latch button to open the door from outside of the cab.

Pull knob down to open the door from inside the cab.

BREAK-IN PROCEDURES

NOTE: Make every effort to become familiar with the feel and sound of the machine.

1. Observe engine operation carefully.

2. Check the engine oil and coolant frequently.
3. Operate engine at normal loads.
4. Check indicators and gauges frequently during operation.
5. Avoid excessive engine idling.
6. Perform 10 hour or daily service.
7. Watch for fluid leaks and repair immediately.
8. Lubricate pivots every 10 hours for first 100 hours.
9. Check and tighten wheel lug nuts. Tighten to 180 - 200 ft. lbs. (244 - 271 Nm).
10. Perform service intervals as shown in this section.
11. Change the engine oil and filter after 100 hours of engine operation.
12. Check engine manufacturer's operation and maintenance manual for additional information of engine break-in.
13. Check the parking brake to make sure it is operating properly.

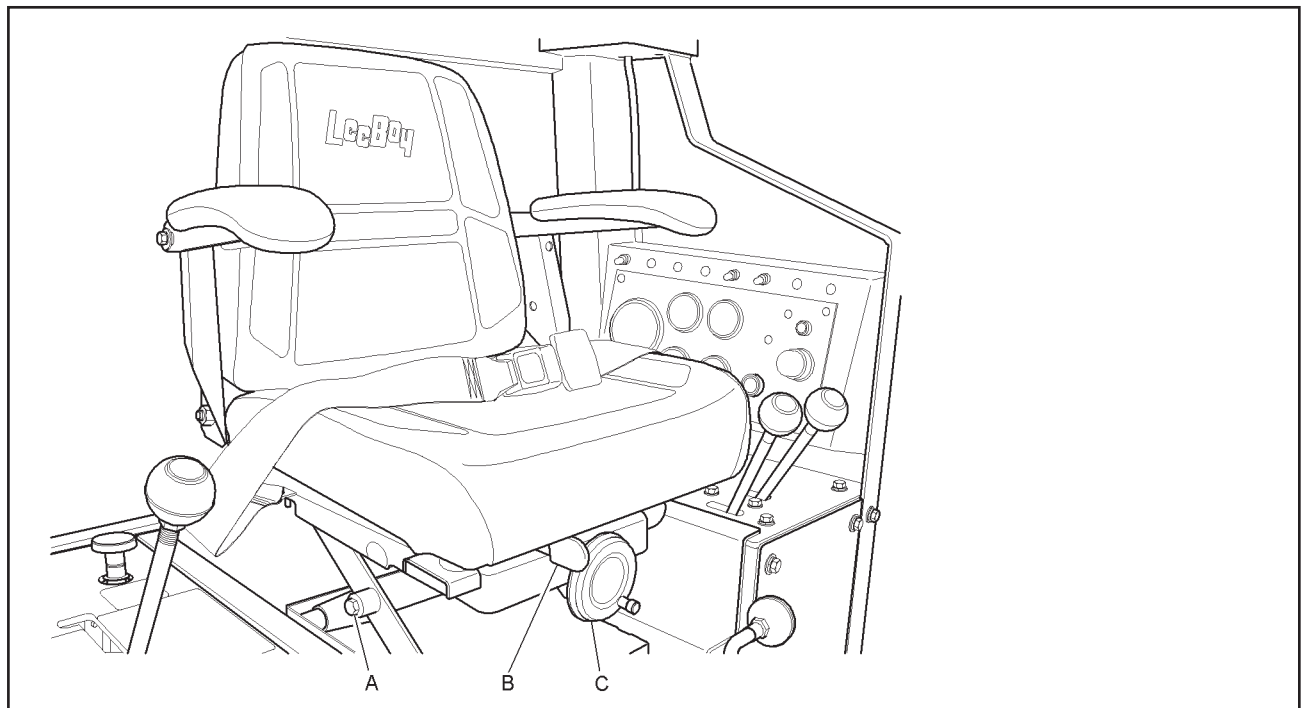


FIGURE 3-5. OPERATORS SEAT

Section 3

OPERATION



PRE-START INSPECTION

INSPECT machine. Have any malfunctioning, broken or missing parts repaired or replaced before using the grader.

CHECK hydraulic hoses daily for wear and leaks. Replace if damaged.

CHECK that all the instruction and safety labels are in place and readable. These are as important as any other equipment on the machine.

CHECK parking break to insure it's working properly.

READ and FOLLOW all instruction decals.

WEAR OSHA required safety equipment when running the motor grader.

CHECK engine, transmission, and hydraulic oil levels. Fill to the correct level as necessary.

FILL the fuel tank with the engine off. NEVER fill fuel tank near an open flame or when smoking.

CHECK for frayed or worn electrical wires and loose or corroded connections.

CHECK tires for wear, cuts, and damage. CHECK air pressure. INSPECT wheels for loose, damaged, or missing hardware.

CHECK pedals and levers for freedom of movement. MAKE SURE operator's compartment is free of debris.

CHECK steps and supports for damage. Repair as necessary.

CHECK protective devices, cab, ROPS, canopy, shields and seat belt for wear or damage.

MAKE SURE all protective devices operate correctly.

ALWAYS be seated in the operator's seat with the seat belt on when operating the equipment.

ENGINE OPERATION

STARTING THE ENGINE

Preliminary

Before starting the engine:

1. Check the fuel level.
2. Check the fuel lines and tank for leaks.
3. Check the oil level.

CAUTION: Failure to maintain correct engine oil level is the greatest single cause of engine failures.



4. Check the hydraulic oil level.

5. Fasten seat belt.
6. Place traction foot pedal in NEUTRAL and lock.
7. Engage parking brake.
8. Refer to engine operator's manual for instructions when starting engine for the first time. Follow engine manufacturer's recommendations for fuel and oil.

Engine Start-up

CAUTION: Traction foot pedal must be in the NEUTRAL position.



1. Place throttle control to 1/3 position.

CAUTION: Do not operate the starter longer than 20 seconds. If the engine does not start, allow the starter to cool for 2 to 3 minutes.



2. Insert key into the ignition switch and turn ignition switch to START position. Release key when engine starts.
3. Run engine at 1/3 speed for 30 seconds.
4. Check indicator and gauge operation.

Engine Warm Up

NOTE: Allow the engine to warm up for several minutes before moving the grader. The warm up will give the hydraulic oil time to warm, providing for more efficient operation.

1. Start engine and run at 1/3 throttle for several minutes. Do not accelerate rapidly during warm-up.
2. Operate engine at less-than-normal loads and speeds until engine reaches normal operating temperatures.

Cold Weather Engine Start Up

CAUTION: The improper use of starting aids (starting fluid) can cause severe engine damage and personal injury. Read and understand the engine manufacturer's Operation and Maintenance manual before attempting to start the engine using cold weather starting aids. Engines equipped with glow plugs and some turbocharged engines will be damaged when using



starting fluid for starting purposes.

See engine manufacturer's operation and maintenance manual for information about cold weather starting, starting aids, and other engine operation information.

Cold Weather Engine Warm Up (40°F or below)

NOTE: If hydraulic oil is cold, hydraulic functions move slowly. Do not attempt machine operations until hydraulic functions operate normally.

1. Run engine at 1/3 throttle for five minutes.
2. Operate all hydraulic functions before moving machine.

Using Booster Batteries - 12 Volt System

1. Make sure the traction foot pedal is in neutral and locked before using booster batteries to start the engine. Set the parking brake.

CAUTION: Charging batteries produces explosive gases. Keep flames and sparks away from battery area. Charge batteries in a well ventilated area.



NOTE: The electrical system is 12 volts with negative (-) ground. Use only 12-volt booster batteries.

CAUTION: Improperly connected jumper cables can produce sparks and explosion. Make sure negative terminals are connected and positive terminals are connected. Never connect negative terminal to a positive terminal. Do not allow vehicles to touch.



2. Connect the positive (red) jumper cable to the positive battery post on the booster battery and machine batteries.
3. Connect the negative jumper cable to the booster battery negative post and a good ground (frame, bracket or support) away from the battery and moving engine components.
4. After starting, remain in the operator's seat and have a helper remove the jumper cables from the machine.

STOPPING THE ENGINE

685B Motor Grader

1. Park machine on a level surface.
2. Place traction foot pedal in neutral and lock using traction foot pedal lock lever.
3. Lower all equipment to ground level.
4. Engage parking brake.

NOTE: Turbocharged engines may be damaged if engine is not shut down properly.

5. Run engine at 1/2 speed without load for 3 to 5 minutes.
6. Place throttle in low idle.
7. Place ignition switch in the OFF position and remove key.

EMERGENCY STOPPING

1. In an emergency, place traction foot pedal in neutral.
2. Reduce engine speed to slow idle.

NOTE: After using the parking brake for emergency stopping, inspect and adjust the brake and brake operation.

3. Engage parking brake.
4. Lower components to the ground if engine is running.

ADJUSTING ENGINE FOR HIGH ELEVATION

NOTE: Do not change engine settings to compensate for elevation. An authorized service dealer must service the injection pump.

Refer to the engine manufacturer's operation and maintenance manual for information on engine specifications and settings. See the local authorized dealer for engine settings and modifications.

DRIVING THE MACHINE

Before driving on public roads, check state and local laws that may apply to tractors, self-propelled machines, and towed equipment. Additional lights, mirrors, SMV emblems, or reflectors may be required.

DIRECTIONAL CONTROL

The Model 685 Motor Grader is equipped with a forward/reverse variable speed, hydrostatic transmission and variable hydraulic motor. The transmission and hydraulic motor are controlled

Section 3

OPERATION



separately.

A control lever controls the hydraulic motor speed. A directional traction foot pedal controls the hydraulic flow and direction of flow through the hydrostatic transmission. The traction foot pedal is used to control forward/reverse movement, acceleration and braking.

1. To move forward, release the parking brake and unlatch traction foot pedal lock.
2. Advance throttle to working speed (RPM).
3. Using a foot, push the traction foot pedal forward to move the machine forward. Push the traction foot pedal to the rear to move the machine in reverse.

TRAVEL SPEEDS

Increasing throttle lever, shifting hydraulic motor to high, and increasing toe or heel pressure on the traction foot pedal will increase travel speeds.

THROTTLE CONTROL

NOTE: The 685 Motor Grader hydraulic system is designed to operate between 0 to 4500 PSI (0 to 310 Bar). When the hydraulic operating pressure exceeds 4500 PSI (310 Bar), the relief valve remains open causing excessive heat resulting in damage and wear.

A throttle control lever is mounted on the left side of the operator's seat. The lever is used to control the speed (RPM) of the engine. A tachometer located on control panel to the left of the operator's seat provides an indication of engine speed.

Move the throttle lever to the rear to increase engine speed (RPM) and toward the front of the machine to decrease engine speed (RPM).

BRAKING

To brake, return the traction foot pedal to the neutral position. In an emergency the parking brake can be used for braking. Check the parking brake daily to make sure it is functioning properly.

NOTE: After using the parking brake for emergency stopping, inspect the brake and operation.

PARKING BRAKE

A fail-safe hydraulic parking brake mounted to the right of the operator's seat uses a button to engage the parking brake. Push the button down to engage the parking brake and pull the button upward to release the parking brake. Check the parking brake

daily to make sure it is functioning properly.

PARKING THE MACHINE

Before leaving the operator's seat, perform the following procedures:

1. Park machine on a level surface.
2. Return traction foot pedal to neutral position.
3. Lock the traction foot pedal in neutral using the traction foot pedal lock lever.
4. Lower all equipment to ground level.
5. Engage parking brake.
6. Place variable speed control lever in the low position.
7. Make sure gear selector in the low position. Lever must be in low or high at all times.
8. Idle engine for 3 - 5 minutes at 1/2 speed (RPM).
9. Place throttle lever in low (forward).
10. Place ignition switch in the OFF position and remove key.

OPERATING THE MACHINE

NOTE: See Section 3, OPERATING CONTROLS, INDICATORS, AND GAUGES for location and illustration of controls and uses.

This manual does not attempt to teach actual grading techniques. A qualified motor grader operator trained in all types of grading applications should do the grading. The operator must thoroughly understand the mechanical characteristics of the motor grader and varying elements and terrain for safe operation.

MOLDBOARD LIFT CONTROL

The moldboard can be raised and lowered using the moldboard left and right control levers. The levers are mounted on the hydraulic control valve. Push the levers forward to lower the moldboard. Pull the levers to raise the moldboard.

Push the levers all the way forward to place the moldboard in the float position. The float position allows the moldboard to "float" over hard surfaces. Push the levers forward to release the float detent.

The moldboard float position can be used to remove snow, remove loose material from a hard packed surface, and to match loose material to a hard packed surface.

MOLDBOARD SIDE-SHIFT CONTROL

The moldboard can be shifted up to three feet from

left to right. Use the moldboard slide lever mounted on the hydraulic control valve to move the moldboard right and left. Pull the lever to shift the moldboard to the left and push the lever to move the moldboard to the right.

When the machine is pushing a load with the moldboard set at an angle, the movement of the load tends to swing the front of the machine toward the toe of the blade. The toe of the blade is the end of the moldboard closest to the front of the machine.

Counteract side thrust of the machine by leaning the top of the wheels toward the heel (discharge side) of the blade. Articulate the machine slightly toward blade toe to help control side thrust.

MOLDBOARD PITCH CONTROL

The moldboard can be tilted using the moldboard tilt lever mounted on the hydraulic control valve. Push the lever forward to tilt the moldboard forward and pull the lever to tilt the moldboard to the rear. Tilting the moldboard changes the moldboard blade to provide varying cutting angles.

For normal grading, use the blade in the upright position. The blade should be positioned with the top vertical or slightly ahead of the bottom edge.

When greater cutting action is needed, use backward pitch on the moldboard causing the blade to suck in. Dirt can build up and contact the circle due to a lack of rolling action. Adjust blade as necessary.

For better mixing and rolling action, pitch the moldboard ahead of vertical position.

When spreading material or maintaining roads, moldboard should be tipped forward. This tends to compact material and fill low spots. Use only as much forward tip as needed for compacting or filling.

MOLDBOARD ANGLE CONTROL

The angle of the moldboard can be changed using the moldboard blade angle lever. Pull the lever to angle the moldboard right. Push the lever to angle the moldboard left. The moldboard discharges material from the side of the moldboard closest to the rear of the machine.

WHEEL LEAN CONTROL

The steering wheels can be leaned for material movement control and shorter turning radius. The wheel can be leaned using the wheel lean lever mounted on the hydraulic control lever. Pull the lever to lean the wheels to the right. Push the lever to lean the wheels to the left.

Lean the wheels toward the windrow when making a heavy cut. Lean the wheels to make a shorter turn.

OPTIONAL FRONT TRACTION ASSIST CONTROL

Optional front traction drive motors can be engaged using the front traction switch mounted on the moldboard right lift lever. The front traction motors are designed to assist traction in heavy materials.

SCARIFIER CONTROL

The scarifier is used to break up packed surfaces. The support teeth should penetrate the surface. Do not allow the teeth to drag the surface, which creates excessive wear on the teeth.

The scarifier can be raised and lowered using the scarifier lever mounted on the hydraulic control valve. Push the lever to lower the scarifier. Pull the lever to raise the scarifier.

HIGH/LOW TRANSFER CASE

The high/low transfer case allows the driver to operate in two speed ranges. The transfer case can be shifted using the gear selector mounted to the right of the operator's seat. Push the selector lever forward for low gear and pull the selector to rear for high gear.

The shifter lever must be in low or high gear at all times.

NEVER shift the low to high lever on any incline.

CHECK the parking brake to make sure it is operating properly.

DANGER: When shifting the two-speed lever from low to high (or high to low) make sure the brake is engaged and the moldboard is on the ground. Lever must be in low or high at all times.



ARTICULATION AND STEERING CONTROL

Steering the motor grader is accomplished using a combination of devices. The steering wheel is used for general steering. The articulation lever mounted on the hydraulic control valve is used to articulate the front section of the machine for tighter turns. The steering wheel and articulation can be used with the wheel lean lever for tight turns. Articulation is also used to maintain a straight path when working with a windrow.

Push the articulation lever to move the front end to the left. Pull the lever to move the front end to the right.

FRONT BLADE CONTROL

The front blade is used for moving materials and backfilling. The front blade lever is mounted on the hydraulic control valve. Push the lever to lower the blade. Pull the lever to raise the blade.

Section 3

OPERATION



SPREADING PILES

By using articulation (offsetting front wheels to edge of pile) and positioning drive wheels behind moldboard, piles of material or large windrows can be easily spread or moved without having to run front wheels into the material.

NOTE: The amount of material spread in each pass will be limited by the power and traction of the machine.

1. Shift moldboard toward pile.
2. Set moldboard nearly square to direction of travel and side shift toward pile.
3. Lean front wheels slightly away from pile and tilt moldboard slightly forward.
4. Position moldboard high enough above surface to obtain desired depth.

BACKFILLING

Positioning the moldboard to discharge a pile into a trench and placing the rear wheels over the filled trench backfills the trench and compacts the material at the same time.

VEE DITCHING

1. First Pass: Center moldboard, place toe of moldboard blade just outside edge of front tire, tilt blade pitch forward until top of blade is in line with center of front tire, and raise heel of blade just ahead of rear wheels so dirt will spill out between the rear tires.
2. Lean front wheels slightly toward discharge end of blade.
3. Traveling in low gear, make first pass very light in order to establish line of ditch.
4. Second Pass: Position wheels in vee ditch made in first pass to compensate for side thrust. This allows the machine to make a deeper cut at higher speeds during second pass.
5. Clean-Up Pass: As the dirt builds up between the rear tires, a cleanup pass must be made as follows:
 - a. Side-shift moldboard blade toward ditch and position front wheels outside windrow.
 - b. Set blade at an angle with heel between rear wheels and blade pitched slightly forward.
 - c. Position toe of blade well beyond windrow to minimize spillage back into vee ditch.

- d. Articulate machine slightly to deposit windrow between rear tires.

6. Use straight-frame position to spread windrow left from cleanup pass. Position circle and moldboard to deposit material evenly. Use material to establish roadbed and shoulder.
7. Cut the back slope as follows:
 - a. Side shift moldboard blade toward bank.
 - b. Position heel of blade in centerline of rear tire and pitch blade slightly forward.
 - c. Blade angle is toward direction of travel, depending upon degree and height of slope.
 - d. Drive wheels of machine in established vee ditch. The dirt will be deposited from back slope slightly up onto shoulder slope where a cleanup pass will put the dirt onto roadbed for spreading.
8. To finish the vee ditch, pull windrow up from shoulder slope, clean away from edge of ditch and spread dirt.

DITCH CLEANING

1. If ditch is soft and will not support full weight of machine or if ditch is wet, offset rear wheels to allow the tires to ride on shoulder of road. Lift material from ditch and discharge to the outside of the rear wheels.
2. By articulating rear wheels on road and front wheels into ditch, back machine up until toe of blade is at end of culvert.
3. Start the cut, windrowing material onto shoulder or roadbed.
4. When filling washouts on existing back slopes, the moldboard can be angled back and side-shifted enough for material to roll up slope.

ROAD CROWNING

1. Blade material inward from shoulder of ditches. Cut top of crown with blade at 0° angle, or at a slight angle, to cast material to the side needing fill.
2. Spread windrows by placing blade 10° to 25° toward center. Keep blade above graded surface to avoid solid objects such as rocks in roadbed.
3. Perform crowning operation at relatively high speed. Increased speed throws loose material from the blade, feathers the material, and

blends the top.

4. Any ridges left in the center can be spread at high speed with a straight blade.

BANK CUTTING

1. Make a first pass at base of bank to level and smooth a platform for the machine.
2. Shift top of blade forward and place heel in front of rear wheel center.
3. Tilt blade forward and lean wheels slightly toward bank.
4. Position machine frame straight with all wheels at base of bank or, if more reach is needed, articulate slightly to position front inside wheel on bank.

NOTE: There are three methods for setting depth of cut: maneuvering lift cylinders, changing blade pitch, and leaning wheels.

5. After first bank cut, clean any loose material from bottom of bank.

SLOPE WORK

1. If possible, make a first pass from above slope to establish angle as follows:
 - a. Side-shift moldboard toward slope.
 - b. Set blade angle slightly toward rear of machine with a slight forward tilt.
 - c. Position blade as far down slope as possible and make first pass.

NOTE: The machine can be straight frame or articulated for extra reach.

2. On second pass, lean front wheels toward slope and position upper front wheel above windrow to prevent front end from drifting down. Articulate rear wheels down slope to increase stability of machine.
3. Position toe of blade forward and angled so materials are spilled off heel slightly between rear wheels. Set blade pitch ahead of vertical plane and side shift toward the uphill side. Repeat procedure until dirt is deposited at toe of slope.
4. Establish toe of slope by cleaning windrow away from bottom.
5. When working on steep slopes, a rollover with the machine articulated is unlikely; however,

extreme caution should be used when working on slopes steeper than three to one.

CUL-DE-SACS

1. Articulate machine to inside, shift moldboard to outside, and side shift blade slightly to inside.
2. Tilt blade forward 5° to 10°.
3. Travel in low gear; fast idle with front wheels leaned toward direction of turn.
4. After curb is poured, backfill against the outside of curb for support.
5. For finish grading as turns become shorter, the moldboard can be shifted toward the center. Any excess material deposited in the center can be removed.

Section 3 OPERATION

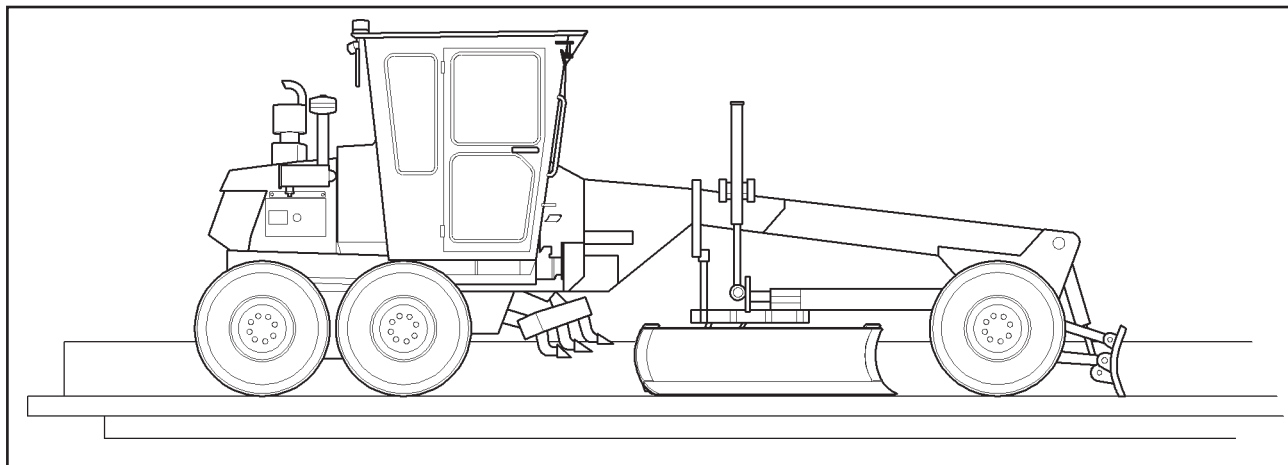


FIGURE 3-6. MOTOR GRADER ON TRANSPORT

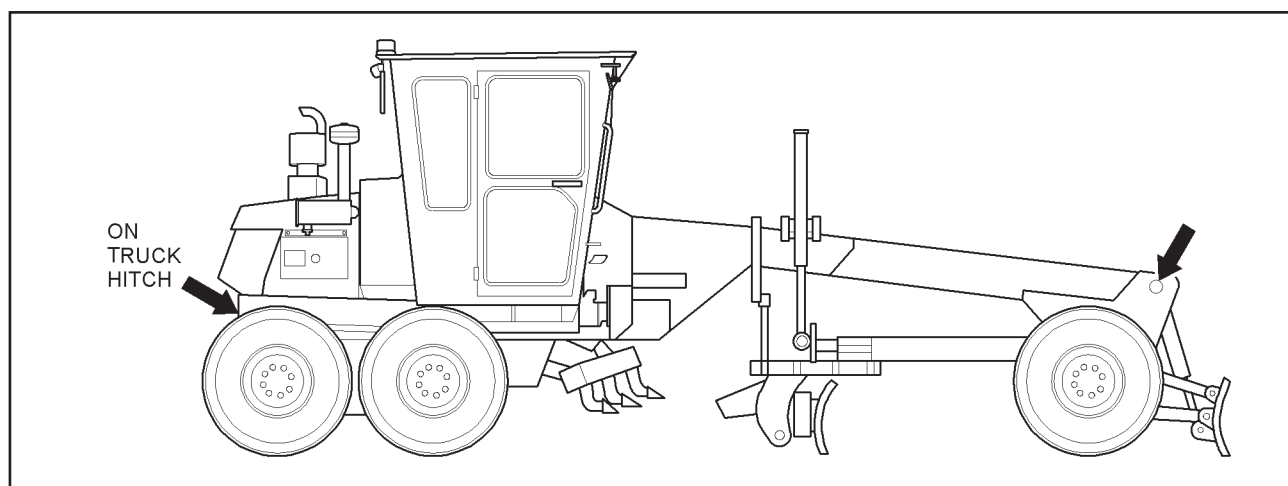


FIGURE 3-7. TIE DOWN POINTS

TRANSPORTING

When transporting the machine on a flat bed vehicle, the vehicle must be capable of carrying the machine safely in all driving situations.

1. Thoroughly clean the machine using a pressure washer. Remove all loose gravel, mud or debris from moldboard, tires or frame.
2. Make sure the combined height of the truck, trailer and loaded grader meet height restrictions for the local area including bridges, overpasses, and overhead obstructions.
3. Park transport vehicle on a level surface.
4. Place traction foot pedal in neutral and engage neutral lock lever.
5. Engage towing vehicle parking brake.
6. Install chocks or blocks against truck and trailer wheels.
7. Load machine on the flat bed. Block motor grader wheels in both directions to prevent rolling.
8. Position moldboard as shown in Figure 3-6.
9. Lower moldboard, scarifier and front blade to flat bed surface. Secure machine with chains strong enough to prevent machine movement without failure (see Figure 3-7).
10. Idle engine at 1/2 speed (RPM) for 3 to 5 minutes.
11. Place throttle lever at slow idle.
12. Place ignition switch in the OFF position and remove key.

CAUTION: Fasten chains or cables to machine frame. Do not place chains or cables over or against hydraulic line, hoses or electrical harness.



Use chains, cables and binders of sufficient capacity to secure the motor grader without breaking, shifting or slipping.

13. Obey all local laws concerning local laws concerning loading, unloading, and transport of equipment.

NOTE: Keep the trailer bed clean.

14. Use a ramp or loading dock. Make sure the ramp weight capacity will support the grader and has a low angle of rise to the trailer bed.
15. Load the machine on the trailer bed by driving straight on and centered on the trailer. The motor grader centerline must be over the centerline of the trailer.
16. Lower the moldboard length under the motor grader onto wooden blocks to protect trailer bed. Do not apply down pressure.
17. Lower all attachments, such as front blade or scarifier.
18. Shut down the motor grader and engage parking brake.
19. Cover the exhaust opening with heavy gauge plastic to prevent dust and moisture entering the engine.

NOTE: Remove the plastic cover from the exhaust before operating the motor grader.

20. Secure motor grader to the trailer with tie-down cables or chains.

MOTOR GRADER TOWING

It is recommended that all towing operations be performed by a professional towing service. If the machine must be towed for loading or clearing a work area the machine can be towed as follows:

WARNING: Improper towing methods and equipment can result in severe personal injury or death. Read and understand towing instructions and precautions.



CAUTION: The operator must be in the operator's seat to control steering and brakes. Steering, brakes, and transmission may be operational depending on type of failure and options available.



NOTE: Do not tow machine faster than 5 mph (8 km/h).

Towing or pushing cannot start the engine.

Do not tow grader long distance. Transport the machine instead.

1. Lift and secure the scarifier, front blade or bucket, and moldboard.
2. Move the traction foot pedal to the neutral position and engage the traction foot pedal lock lever.
3. If equipped with all-wheel drive, deactivate front axle drive option.

CAUTION: Shift two-speed transfer case gears only while stopped on level ground.



4. Place the two-speed transfer case in the neutral position.
5. Fasten a chain or tow bar to the machine.

NOTE: Some state and local laws prohibit or limit the use of tow chains on highways. Check state and local regulations.

6. Run the engine for steering and braking power, if possible.
7. Activate all warning lights, including four way flashers and revolving lights.
8. Install the articulation lock pin using the articulation controls to align the machine for pin insertion.

NOTE: If the engine will not run or a hydraulic failure occurs, the fail-safe parking brake caliper must be released manually before the machine can be towed.

Do not tow grader if final drive damaged is suspected.

Section 3 OPERATION



9. If the engine will not run or a hydraulic failure occurred, block the wheels front and rear to prevent machine movement.

WARNING: The towing vehicle must have sufficient braking to stop the towed vehicle. If the towed vehicle cannot be braked, use a tow bar or two tow vehicles. If using two tow vehicles, position one in front and one behind the towed vehicle for braking.



10. Remove the bolt and concave washer from the center of the brake caliper (see Figure 3-8). Invert the washer and install with the bolt back into the caliper. Tighten the bolt to release spring tension on the brake pads.

WARNING: Stay clear of a tow chain or cable when tension is applied. Do not allow bystanders to enter the path between towing vehicles. Protect the operators from broken chains or cables. A broken chain or cable can cause severe injury or death. Make sure the towline, chain, or tow bar is in good condition and strong enough to tow the machine. Mark the center of the towline with a flag or brightly colored cloth.



WARNING: Make sure a SMV (Slow Moving Vehicle) plate is attached to the rear of the grader. Make sure the towline angle is less than 20 degrees with respect to horizontal plane. Do not allow the towline to contact any grader components.



11. Remove any wheel chocks or blocking. Slowly apply tension to the tow chain or bar. Sudden machine movement can cause the towline, chain or tow bar to break.
12. When turning, keep the tow angle and speed to a minimum.

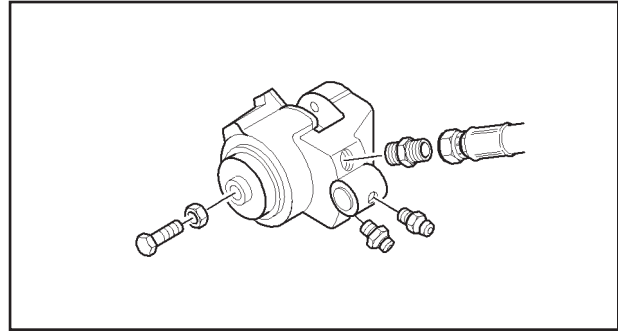


FIGURE 3-8. FAIL SAFE BRAKE CALIPER

TABLE OF CONTENTS

	Page
GENERAL INFORMATION	4-5
ROUTINE MAINTENANCE	4-5
GENERAL INFORMATION	4-5
MACHINE LUBRICATION	4-5
MAINTENANCE SCHEDULE	4-8
General Information	4-8
Preparing Machine for Maintenance	4-8
10 Hour or Daily Routine Maintenance	4-8
After the First 50 Hours and Weekly Routine Maintenance	4-9
100 Hour or Monthly Routine Maintenance	4-9
250 Hour or Quarterly Routine Maintenance	4-9
500 Hour or Semi-Annual Routine Maintenance	4-9
1000 Hour or Annual Routine Maintenance	4-10
2000-Hour Routine Maintenance	4-10
CHECKS AND ADJUSTMENTS	4-10
Checking Oil Lines And Fittings	4-10
Checking and Cleaning Precleaner	4-10
Checking Air Intake Hoses	4-10
Checking the Drive Belt	4-10
Checking and Adjusting Moldboard Blade Side Shift Assembly	4-11
Checking Drawbar Ball and Socket	4-11
Checking and Adjusting Toe-In	4-11
Checking Parking Brake Operation	4-11
How to Adjust the Brakes	4-11
Bleeding the Failsafe Brake System	4-11
Checking Gearbox Breathers	4-12
Cleaning, Packing, and Adjusting Front Wheel Bearings	4-12
Checking Neutral Start System	4-12
BATTERY MAINTENANCE	4-13
Cleaning and Tightening Battery Terminals	4-13
Checking Battery Electrolyte Level	4-14
TIRE MAINTENANCE	4-14
Filling Tire with Air	4-14
Changing Tires	4-14

TABLE OF CONTENTS (Continued)

	Page
ENGINE MAINTENANCE	4-15
GENERAL INFORMATION	4-15
ENGINE LUBRICATION OIL	4-15
Checking the Engine Lubrication Oil Level	4-15
Changing the Engine Lubrication Oil and Replacing Filter	4-15
TRANSFER CASE OIL	4-16
Checking Transfer Case Oil Level	4-16
Draining, Flushing, and Filling Transfer Case	4-16
RADIATOR AND COOLANT SYSTEM	4-16
Checking Radiator and Coolant Level	4-16
Draining, Flushing, and Filling Engine Coolant System	4-16
CLEANING ENGINE VENTILATION TUBE (BLOW-BY TUBE)	4-17
CHECKING ENGINE SPEED	4-17
FUEL SYSTEM	4-17
Draining Fuel Tank Sump	4-17
Changing Engine Fuel Filters	4-17
Checking and Cleaning Fuel Filler Cap	4-18
Checking Engine Air Cleaner Assembly	4-19
Replacing Engine Air Filter Elements	4-19
HYDRAULIC SYSTEM	4-19
Checking Hydraulic Oil Level	4-19
Changing Hydraulic Suction Filter	4-20
Checking and Cleaning the Hydraulic Reservoir Filler Cap	4-20
Draining, Flushing, and Filling Hydraulic Oil Reservoir	4-20
DRIVE CHAINS, CHAIN BOX HOUSING, AND REAR DRIVE HOUSING	4-20
Servicing Chain Box Housing	4-20
Checking Drive Chains and Replacing Cover Gaskets	4-20
Draining, Flushing, and Filling Chain Boxes	4-20
Checking Rear Drive Housing Oil Level	4-21
ELECTRICAL SYSTEM	4-21
Fuses and Circuit Breakers	4-21
COMPONENT REPLACEMENT PROCEDURES	4-22
GENERAL INFORMATION	4-22
REPLACING BATTERIES	4-22

Removal	4-22
Installation	4-22
REPLACING SCARIFIER TOOTH SUPPORT	4-22
Removal	4-22
Installation	4-22
REPLACING SCARIFIER TOOTH	4-23
Removal	4-23
Installation	4-23
REPLACING ARTICULATE CYLINDERS	4-23
Removal	4-23
Installation	4-23
REPLACING WHEEL STEERING CYLINDER	4-23
Removal	4-23
Installation	4-23
REPLACING WHEEL LEAN CYLINDER	4-24
Removal	4-24
Installation	4-24
REPLACING FRONT BLADE LIFT CYLINDER	4-24
Removal	4-24
Installation	4-24
REPLACING SCARIFIER LIFT CYLINDER	4-24
Removal	4-24
Installation	4-25
REPLACING MOLDBOARD SLIDE CYLINDER	4-25
Removal	4-25
Installation	4-25
REPLACING MOLDBOARD TILT CYLINDERS	4-25
Removal	4-25
Installation	4-25
REPLACING MOLDBOARD ANGLE CYLINDER	4-25
Removal	4-25
Installation	4-26
REPLACING MOLDBOARD LIFT CYLINDER	4-26
Removal	4-26
Installation	4-26
REPLACING MOLDBOARD BLADE	4-26
Removal	4-26

TABLE OF CONTENTS (Continued)

	Page
Installation	4-26
REPLACING HYDRAULIC SUCTION FILTER	4-26
Removal	4-26
Installation	4-27
REPLACING EXHAUST SYSTEM	4-27
Removal	4-27
Installation	4-27
REPLACING RADIATOR/OIL COOLER ASSEMBLY	4-27
Removal	4-27
Installation	4-27
REPLACING AIR CLEANER ASSEMBLY	4-27
Removal	4-27
Installation	4-28
REPLACING CONTROL VALVE ASSEMBLY	4-28
Removal	4-28
Installation	4-28
TROUBLESHOOTING	4-29
GENERAL INFORMATION	4-29
TROUBLESHOOTING CHART	4-29
STORAGE	4-39
GENERAL INFORMATION	4-39
REPAIRING MACHINE FOR LONG-TERM STORAGE	4-39
SCHEMATICS	4-40
FIGURE 25. WIRING DIAGRAM (INSTRUMENT PANEL)	4-40
FIGURE 26. WIRING DIAGRAM (ENGINE)	4-41
FIGURE 27. HYDRAULIC DIAGRAM, W/FRONT WHEEL ASSIST	4-42
FIGURE 28. HYDRAULIC DIAGRAM, PUMPS, MOTORS, COOLER, & RESERVOIR	4-43
FIGURE 29. HYDRAULIC DIAGRAM CYLINDER FUNCTIONS PLUS STEERING MOTOR ...	4-44

GENERAL INFORMATION

This section gives the necessary procedures for routine and general maintenance on the Model 685 Motor Grader.

Follow all the Maintenance Schedules and Maintenance Procedures to maintain the machine in top operating order.

ROUTINE MAINTENANCE

GENERAL INFORMATION

MAINTENANCE must be a planned program that includes periodic machine inspection and lubrication procedures.

The MAINTENANCE program must be done, based on the machine "Operating Hours", recorded on the hour meter, or based on the "Periodic Schedule", which is done at time intervals of weekly, monthly, quarterly, semi-annually, or yearly.

MACHINE LUBRICATION

Proper lubrication is necessary to maintain the machine at top efficiency. Refer to the lubrication information in Table 4-1 Lubrication Chart. All lubrication points are shown in Figure 4-1.

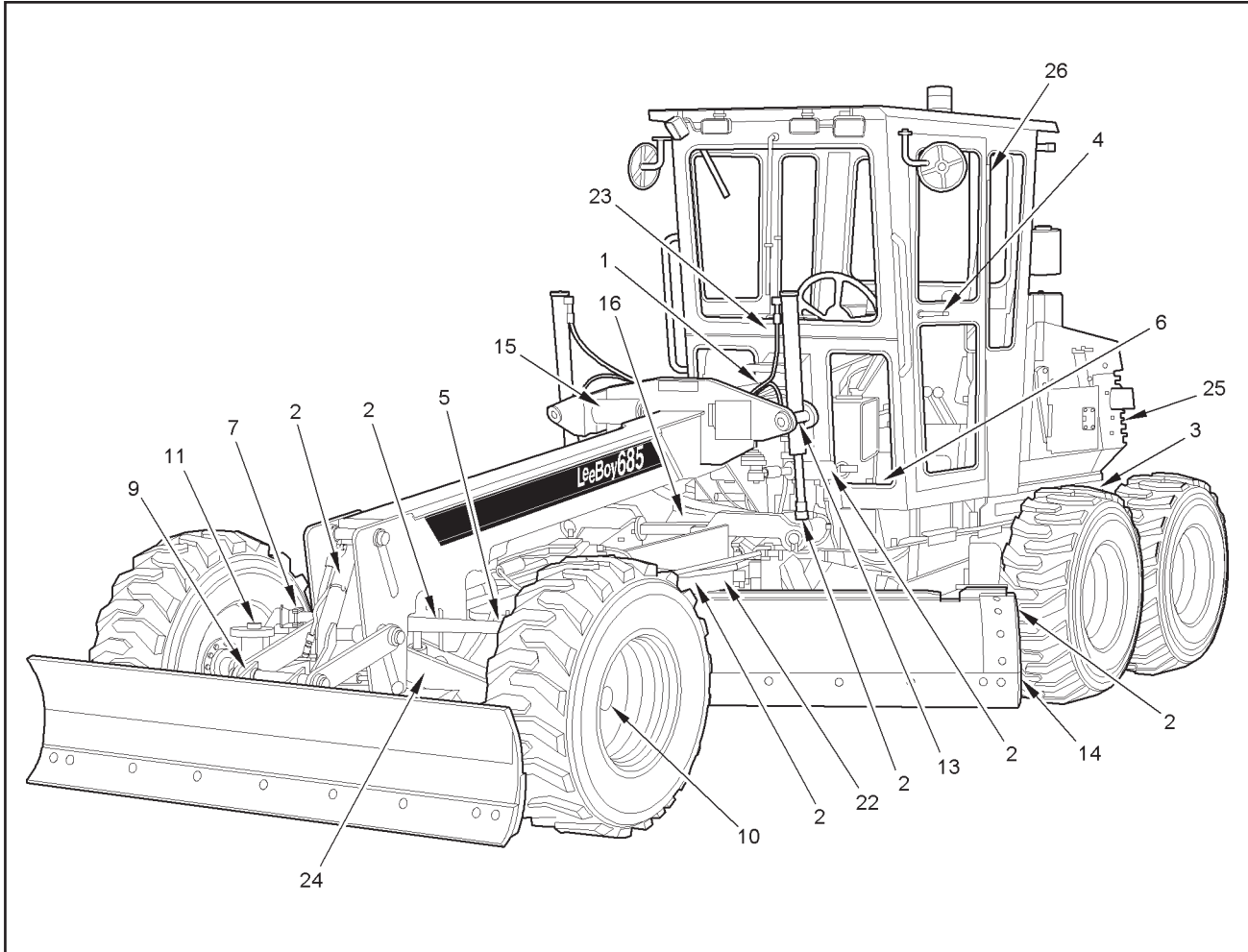


FIGURE 4-1. LUBRICATION POINTS

TABLE 4-1. LUBRICATION CHART

ITEM NO.	TYPE LUBE	DESCRIPTION AND LOCATION	INTERVAL
1	A	ARTICULATE JOINT (Until grease escapes from the upper and lower joints)	Monthly
2	A	CYLINDER ENDS (All) (Until grease escapes from the clevis joints)	Weekly
3	A	CHAIN BOX PIVOTS	Monthly
4	B	DOOR HANDLES	Monthly
5	A	BALL DRAWBAR (Until grease escapes from the ball joint)	Daily
6	A	PEDAL, DRIVE (Until grease escapes from the pedal joint)	Weekly
7	A	STEERING RODS AND TIE RODS (Until grease escapes from the king pin joints)	Daily
8		Not Used	
9	A	FRONT BLADE PIVOTS	Weekly
10	A	BEARINGS, FRONT WHEEL (See instructions for cleaning, packing and adjusting the wheel bearings)	1000 Hours
11	A	KING PIN BEARINGS	Monthly
12		Not Used	
13	A	TRUNIONS (Until grease escapes from the trunnion joints)	Daily
14	A	PINS, MOLDBOARD PIVOT (Until grease escapes from the pin joints)	Weekly
15	A	TRUNION HOUSING	Daily
16	A	STABILIZER ROD ENDS, Moldboard (Until grease escapes from rod end joints)	Weekly
17		Not Used	
18		Not Used	
19		Not Used	
20		Not Used	
21		Not Used	
22	A	TURNTABLE (Until grease is visible underneath and around turntable mounting)	Weekly
23	A	LEVERS, CONTROL	Weekly
24	A	AXLE PIVOT	Weekly
25	A	BRAKE CALIPER ASSEMBLY	Monthly
26	A	DOOR HINGES	Monthly

LEGEND

- A GREASE WITH SHELL AVANIA EP GREASE OR EQUIVALENT
- B SPRAY WITH OIL OR CHAIN LUBRICANT

Section 4

MAINTENANCE



MAINTENANCE SCHEDULE

General Information

The Maintenance Schedule lists the recommended time intervals between machine maintenance inspections and lubrication procedures. Table 4-1 gives inspection and lubrication information for the Model 685 Motor Grader.

The "Hour" and "Periodic" time periods list most service intervals. The maintenance schedule begins with ten hours, or daily, maintenance intervals and continues through the 1,000 hours, or annual, maintenance schedule intervals.

NOTE: If the machine is operated more than ten hours per day, follow the "Hour" schedule. If the machine is operated less than ten hours per day, follow the "Periodic" schedules, where they apply.

Preventive maintenance on the 685 Motor Grader will provide years of trouble-free operation. Adjustment can be performed in the field with ordinary hand tools. Engine preventative maintenance, other than oil, air, and fuel filter changes, is not covered in this section. Refer to engine operator's manual for engine service information.

IMPORTANT NOTICE!

The changing of oil and cleaning of the grader should only be done in a designated area that can contain the oil and chemicals involved in any maintenance requirement. These by-products should be discarded in accordance with environmental regulations.

CAUTION: Do not substitute fasteners of any kind unless the fasteners are equal in size and grade as original equipment.



NOTE: When performing any routine maintenance, such as 50, 100, 250, 500, 1000 or 2000 hours, always include previous routine maintenance hours to the higher hourly schedule.

Preparing Machine for Maintenance

Before performing maintenance, perform the following steps before leaving the operator's seat unless the maintenance procedure contains additional instructions.

1. Park the machine on a flat even surface.

2. Lower all attachments to ground level.
3. Place traction foot pedal in neutral and engage the neutral lock lever.
4. Engage parking brake.
5. Run engine at 1/2 speed (RPM) without load for 3 to 5 minutes.
6. Reduce engine speed (RPM) to slow idle.
7. Place ignition switch in the OFF position. If maintenance must be performed with engine running, do not leave machine unattended.

10 Hour or Daily Routine Maintenance

1. Check the fuel level. Keep the fuel tank full to keep condensation from forming. Fill at end of day.
 2. Perform engine preventative maintenance as described in your engine operator's manual. Any engine preventative maintenance should always begin with an engine oil check.
 3. Check the hydraulic oil level and fill as required.
 4. Check the radiator coolant level and fill as required.
 5. Lubricate the following parts (see Figure 4-1 and Table 4-1).
 - a. Drawbar ball
 - b. Steering rods and tie rods
 - c. Lift trunions and trunion housing
 6. Clean the air precleaner bowl.
 7. Check for damaged, loose, or missing decals. Replace decals as required.
 8. Check lights for burned out bulbs. Replace bulbs as required.
 9. Check parking brake operation.
 10. Check battery cables and connections.
 11. Check for loose, damaged, missing or corroded parts. Repair or replace as required.
 12. Check tires and wheels for low air pressure, cuts, bubbles, damaged rims, or missing lug bolts or nuts.
 13. Check the parking brake daily to make sure it is functioning properly.
- To check, apply brake and lower attachments. Shift two-speed lever to high and try to move the machine forward. If brake is functioning correctly,

the machine will not move. If the machine moves forward, adjust the caliper. See maintenance section for more detail.

After The First 50 Hours and Weekly Routine Maintenance

1. Lubricate the following parts (see Figure 4-1 and Table 4-1).
 - a. Hydraulic cylinder ends (all)
 - b. Traction foot pedal
 - c. Front blade pivots, moldboard pivot pins, and axle pivot
 - d. Stabilizer rod ends
 - e. Turntable
 - f. Control levers

WARNING: Do not smoke when observing battery electrolyte level. The fumes can explode. Electrolyte is an acid that can burn if it contacts skin or eyes. If contact is made, flush area immediately with water.



2. Check all battery connections and remove any corrosion that is present. (Check cables daily.)
3. Perform any other engine preventative maintenance as described in the engine operator's manual.

100 Hour or Monthly Routine Maintenance

1. Check air filters. Clean or replace as required.
2. Check gearbox breathers. Replace as required.
3. Check transfer case oil level and fill as required.
4. Lubricate the following parts (see Figure 4-1 and Table 4-1).
 - a. Articulate joint
 - b. Chain box pivots
 - c. Door handles and door hinges
 - d. King pin bearings
 - e. Brake caliper assembly
5. Perform engine preventative maintenance as described in the engine operator's manual.

250 Hour or Quarterly Routine Maintenance

WARNING: Do not smoke when observing battery electrolyte level. The fumes can explode. Electrolyte is an acid that can burn if it contacts skin or eyes. If contact is made, flush area immediately with water.



1. Check battery electrolyte level. Check battery terminals for corrosion. Perform battery maintenance as required.
2. Change engine oil. To assure complete removal of contaminants in the oil, perform the oil change while engine is warm.
3. Change air filters.
4. Check rear drive housing oil level and fill as required.
5. Perform the 250-hour preventative maintenance as described in the engine operator's manual.

500 Hour or Semi-Annual Routine Maintenance

1. Perform the 500-hour preventative maintenance as described in the engine operator's manual.
2. Change fuel filters.
3. Change hydraulic suction filter.
4. Check fuses and circuit breakers. Replace if required.
5. Check neutral start system. Repair as required.
6. Adjust blade side-shift guides.
7. Check drawbar ball and socket for damage. Repair or replace as required.
8. Check and adjust toe-in as required.
9. Check parking brake operation. Adjust parking brake as required.

WARNING: Hydraulic oil under pressure can cause serious personal injury. Check for oil leaks with a piece of cardboard. Do not expose hands to possible high-pressure oil. Shut down engine before attempting to tighten oil lines and fittings.



10. Check oil lines and fittings for leakage or damage. Replace parts as required.

Section 4 MAINTENANCE



1000 Hour or Annual Routine Maintenance

1. Clean engine ventilation tube.
2. Check engine speed.
3. Clean, pack and adjust front wheel bearings.
4. Check air intake hoses for damage. Replace damaged parts.
5. Clean and check fuel filler cap.
6. Clean and check hydraulic reservoir filler cap.
7. Drain, flush, and fill transfer case with oil.
8. Check drive chains. Replace damaged drive chains and cover gasket.

2000-Hour Routine Maintenance

1. Drain, flush, and fill chain boxes with oil.
2. Drain, flush, and fill rear drive housing with oil.
3. Drain, flush, and fill hydraulic reservoir with oil.
4. Drain, flush, and fill engine coolant system with coolant.

CHECKS AND ADJUSTMENTS

Checking Oil Lines and Fittings

1. Refer to PREPARING MACHINE FOR MAINTENANCE and park machine.
2. Check the machine for indications of oil leakage around oil lines, hoses, and fittings.
3. Tighten fittings as necessary. Replace hoses and fittings as needed.

Checking and Cleaning Precleaner

Empty the precleaner bowl when dust, dirt, debris, or snow reaches level A (see Figure 4-2). Clean the bowl thoroughly and dry with lint free cloths.

Checking Air Intake Hoses

Check air intake hoses from the engine to the air cleaner assembly and from the air cleaner assembly to the precleaner. Check for cracked, dry rotted, loose, worn, or damaged hoses, tubes, and clamps. Tighten, repair, or replace parts as needed.

Checking the Drive Belt

Belt drive systems equipped with automatic (spring) belt tensioners cannot be adjusted or repaired. The automatic belt tensioner is designed to maintain proper belt tension over the life of the belt. If tensioner spring tension is not within specifications, replace tensioner assembly. See the engine manufacturer's operation and maintenance manual for information on checking tensioner spring.

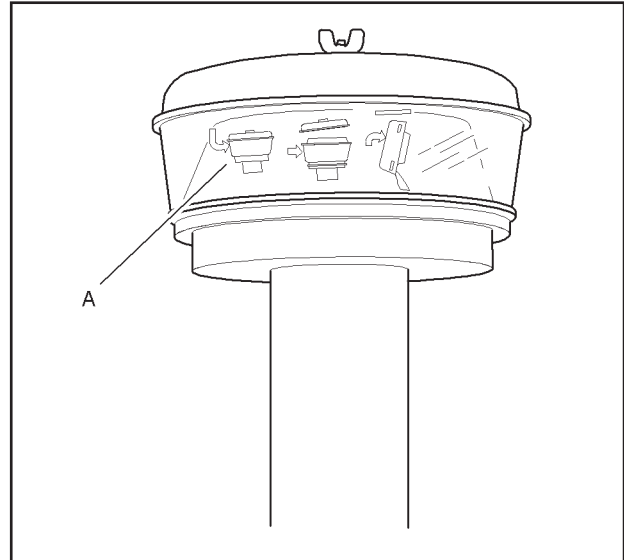


FIGURE 4-2. PRECLEANER

NOTE: Refer to the engine manufacturer's operation and maintenance manual for additional information on checking and adjusting drive belts.

1. Inspect the belt frequently and replace the belt if stretched, cracked, or dry rotted.
2. Check belt tension (see Figure 4-3, Item A). See the engine manufacturer's operation and maintenance manual for tension specifications.
3. If belt is not within specifications, replace the belt.

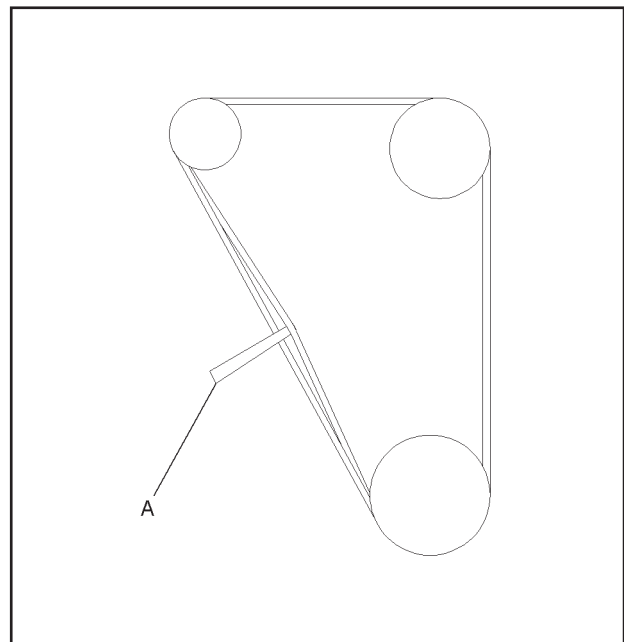


FIGURE 4-3. FAN BELT TENSION CHECK

Checking and Adjusting Moldboard Blade Side-Shift Assembly

1. Lower the moldboard to rest lightly on ground. Raise and lower blade slightly to check guide tightness. Blade should slide easily.
2. Remove the upper and lower clamps.
3. Add or remove shims as needed.
4. Install clamps.

Checking Drawbar Ball and Socket

1. Lower moldboard to ground. Check the drawbar and socket assembly for wear and damage.
2. Move moldboard lift cylinders without load. Ball should move freely.
3. Check for excessive movement in ball and socket.
4. Add or remove shims as necessary.

Checking and Adjusting Toe-In

1. Park machine on a flat, even surface.
2. Straighten front wheels to vertical position.
3. Lower moldboard enough to raise front wheels slightly. Block front axle.
4. Allow engine to run at 1/2 speed (RPM) for 3 to 5 minutes.
5. Reduce engine speed to slow idle.
6. Place traction foot pedal in neutral and engage traction foot pedal lock lever.
7. Engage parking brake.
8. Shut down engine and remove ignition key.
9. Mark the center of the tire tread front and rear left and right tires.
10. Measure distance between marks on the front of tires.
11. Measure distance between marks on rear of tires.
12. If distance between front tire marks and rear tire marks is more or less than 1/8 inch (3.2 mm), loosen the tie rod jam nuts. Turn the tie rod center tube to adjust toe-in to 1/8 inch (3.2 mm). Tighten jam nuts.
13. Turn wheels completely left and right and check for binding or obstruction. Repair or adjust as necessary.

Checking Parking Brake Operation

1. Place machine at one half throttle.
2. Place transmission in high gear.
3. Set parking brake.
4. Engage drive pedal.
5. If the machine moves, allow engine to run at 1/2 speed (RPM) for 3 to 5 minutes.
6. Reduce engine speed to slow idle.
7. Place traction foot pedal in neutral and engage traction foot pedal lock lever.
8. Engage parking brake.
9. Shut down engine and remove ignition key.
10. Inspect parking brake pads for wear and damage. Repair or replace as necessary.

How to Adjust the Brakes

1. Place machine on level ground.
2. Lower attachments.
3. Scotch or block wheels.
4. Place high/low lever in neutral.
5. Start engine (idle position).
6. Pull brake knob up to release parking brake.
7. Loosen jam nut on brake caliper adjusting screw. (See Figure 3-8)
8. Using a .012 Feeler Gauge between the rotor and the rear brake pad, turn adjusting bolt out or in until the brake pad and rotor are snug against the Feeler Gauge.
9. Lock the jam nut.
10. Put in high gear and see if the machine will move using the drive pedal, with the park brake set with knob in the down position.
11. If it will not hold the machine from moving, bleed the brake system and perform the process again.

Bleeding the Failsafe Brake System

1. Place the machine on level ground.
2. Lower all implements.
3. Scotch or block the wheels.
4. Place high/low lever in neutral.
5. Plug hose #15 as shown on page IPL-56.

Section 4

MAINTENANCE



6. Start engine.
7. Loosen bleeder on caliper until all air escapes.
8. Tighten bleeder.
9. Reconnect hose #15.
10. Go through brake adjustment procedure outlined above.
11. Test Brakes.


Checking Gearbox Breathers

Check the gearbox breathers mounted on the hoses on each side of the engine compartment. If clogged with dirt, clean or replace as necessary.

Cleaning, Packing, and Adjusting the Front Wheel Bearings

NOTE: Refer to the illustrated parts listing for an illustration of the front wheel and bearing assembly.

1. Refer to PREPARING MACHINE FOR MAINTENANCE and park machine.
2. Raise and block machine.
3. Deflate and remove tire and wheel assembly. Refer to TIRE MAINTENANCE.
4. Remove the grease cap from the center of the wheel hub.
5. Remove lock nuts and locking washer.
6. Remove flat washer and outer cone bearing.
7. Pull the wheel hub, with inner bearing and seal, off the axle spindle assembly.
8. Remove the seal from the hub.
9. Remove the inner bearing from the hub.


WARNING:  Wear eye protection and chemical resistant gloves when using solvent for cleaning purposes. Some solvent can cause skin irritation and eye damage.

Wear eye protection when using compressed air for drying or cleaning components. Never point the nozzle at another individual. Use a safety reduction valve to reduce air pressure to a safe level. Compressed air can cause serious personal injury if misused.

10. Using solvent, thoroughly clean the wheel hub, bearings, cap, and mounting hardware. Dry using compressed air.
11. Inspect the wheel bearings and cups for pitting, scoring, wear, and damage. Inspect bearing for loose or damaged cage. Replace as necessary.
12. Using clean wheel bearing grease, pack the bearings. Apply grease to the inner hub and cup areas.
13. Place the inner bearing in the inner cup. Carefully install seal over inner bearing.
14. Install hub over spindle and insert outer bearing. Secure bearing with flat washer and one mounting nut.
15. Refer to TIRE MAINTENANCE and install tire and wheel assembly. Using all precautions, inflate tire to 40 PSI.
16. Tighten mounting nut while rotating wheel assembly. When wheel becomes hard to turn, back nut off 1/6 of a turn. Secure wheel with locking washer and other mounting nut.
17. Install bearing cap.
18. Tighten the wheel lug nuts alternately in a star pattern 180 to 200 ft. lbs. (244 to 271 Nm).
19. Raise machine and remove blocking. Lower machine.

Checking Neutral Start System

1. Engage parking brake.
2. Place traction foot pedal in the forward or reverse position.
3. Turn ignition switch to START position. Starter must not crank the engine. If starter cranks engine, release key. Do not operate machine.
4. Repeat test with the traction foot pedal in the opposite direction.

CAUTION:  Do not operate machine if starter cranks engine with traction foot pedal in any gear except neutral. See local dealer for neutral start system troubleshooting and repair.

5. Place traction foot pedal in neutral and turn ignition switch to the START position. Starter should crank engine.

BATTERY MAINTENANCE

WARNING: Batteries contain sulfuric acid and normally produce explosive gases that can cause serious injury.



Therefore, do not allow flames or sparks to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately.

WARNING: When servicing batteries, always remove the ground cable first followed by the positive cable.



Generally, if the negative cable is grounded during removal, sparks will not occur. If the positive cable is grounded during removal, sparks will occur and could ignite explosive gases.

The motor grader electrical system is a 12-volt negative ground system. Keep sparks and flames away from the batteries, as electrolyte gas is highly flammable.

NOTE: When replacing the batteries, discard the old batteries properly. Open cover at front of hood standing in hopper to access batteries

CAUTION: When servicing the electrical system or welding on the machine, always turn the MASTER switch to the OFF position to disconnect the ground from the batteries to prevent damage to the machine electrical system.



Before connecting the batteries, turn off the Master Switch. Be certain that the terminals and battery posts are thoroughly cleaned and that the battery cable terminals are tight. Dirty or loose connections can create high electrical resistance and permit arcing, which will quickly burn and pit terminals and posts.

NOTE: The electrical system is a negative ground system. Connect the positive (+) cable to the positive (+) post of both batteries. Connect the ground (-) cable

to the negative (-) post of both batteries. It is advisable to disconnect the negative (-) cable first and connect it last. Reversed polarity can damage the electrical system.

Keep the battery clean by washing it off whenever dirt build-up is excessive. If corrosion is present around terminal connections, remove them and wash with ammonia solution or a solution consisting of 1/4 lb. (0.11 kg) baking soda added to one quart of warm water. Make certain the vent caps are tight to prevent solution from entering the cells. After cleaning, pour clean water over the battery and surrounding area to wash the solution away. Check vent cap breather openings to make sure they are open.

Be sure to keep the battery fully charged during cold weather to keep it from freezing. Freezing weather has little effect on a fully charged battery.

When connecting a booster battery, if necessary for cold weather starting, connect one end of the first jumper cable to the positive (+) terminal of the dead battery and the other end to the positive (+) terminal of the booster battery. Connect one end of the second jumper cable to the negative (-) terminal of the booster battery and the other end to the frame of the machine with the dead battery.

The alternator supplies electrical current for charging the battery and ample electrical power to the electronic controls. The built-in regulator in the alternator controls the voltage output. If for any reason the wires must be disconnected from the alternator, mark them so that they can be reconnected properly. Use the following precautions to prevent damage to the alternator and/or regulator:

1. An alternator is never to be polarized. Never ground any alternator terminals or circuits.
2. Always disconnect the battery before disconnecting or connecting the alternator. Never disconnect the alternator with it operating. Be certain the wiring is properly connected before connecting the battery.
3. Always connect a booster battery in the proper polarity [negative (-) to negative (-) and positive (+) to positive (+)].

Cleaning and Tightening Battery Terminals

1. Remove battery box lock bolt and pull battery tray out.
2. Disconnect battery clamps, grounded clamp first.

Section 4

MAINTENANCE



3. Clean terminals with a stiff brush or battery service tool.
4. Apply grease at the base of the battery terminal to prevent gas from escaping.
5. Install and tighten battery clamps, grounded clamp last.
6. Push battery box in and install lock bolt.

Checking Battery Electrolyte Level

1. Remove lock bolt and pull battery box out.

NOTE: If water is added to batteries during freezing weather the battery must be charged immediately to prevent freezing. Charge battery using a battery charger or by running the engine.

2. If using serviceable batteries, fill each cell to specified range with distilled water. Do not overfill.
3. Push battery box in and install lock bolt.
4. Check battery charge and charging rate.
5. Shut down engine and remove ignition key.
6. Using a multimeter, check the battery charge by placing the positive (red) multimeter lead on the positive (+) battery terminal and the negative (black) multimeter lead on the grounded (-) battery terminal. With the multimeter set at the 12 VDC setting the battery must show a charge of at least 12 volts. If necessary, charge the battery or perform a load test.
7. Start the engine. With an operator in the operator's seat, check the battery charge level, the multimeter should read at least 13.5 volts. If multimeter does not indicate minimum charge, check the machine charging system.

TIRE MAINTENANCE

Filling Tire with Air

DANGER: Explosive separation of a tire and rim parts can cause serious injury or death.



Never cut or weld on inflated tire/rim assembly. Heat from welding can cause an increase in pressure and may result in tire explosion.

NOTE: Use proper tire mounting equipment and experienced personnel for tire repair service. If equipment and qualified personnel are not available, contact a qualified repair service.

NOTE: Carefully inspect any tire and rim assembly run flat or severely underinflated before inflating tire. The tire and rim may have damage. Contact the local distributor or qualified repair service to inspect the tire and rim.

NOTE: Use an accurate gauge to check tire pressure. Use a gauge with 1-psi (0.07 bar, 6.9 kPa) graduations.

1. Shut off air supply to air hose.
2. Limit air pressure for tire inflation to proper level.
3. Install lock on air chuck or stand off gauge on valve stem.
4. Turn on air supply. Stand to one side of tire during inflation.
5. After proper inflation (40 PSI) release chuck or stand off gauge.
6. Inspect tire for bulges, bubbles, cracks, and other damage. If damaged, deflate tire immediately.
7. When installing the tire on the machine, tighten lug nuts alternately in a star pattern to 180 - 200 ft. lbs. (244 - 271 Nm).

Changing Tires

DANGER: Explosive separation of a tire and rim parts can cause serious injury or death.



1. If inflated, deflate tire.
2. Loosen, but do not remove, the wheel lug nuts.
3. Raise and block the machine.
4. Remove lug nuts and tire.
5. Install replacement tire on the machine; tighten lug nuts alternately in a star pattern 180 to 200 ft. lbs. (244 to 271 Nm).

ENGINE MAINTENANCE

GENERAL INFORMATION

The following engine maintenance information will cover engine general maintenance procedures most often required.

For additional, very specific, engine maintenance information, see the current "OPERATION AND MAINTENANCE MANUAL" - Cummins engine.

ENGINE LUBRICATION OIL

Checking the Engine Lubrication Oil Level

The engine lubrication oil must be kept at a level above the "ADD" mark, but not above the "FULL" mark, on the engine lubrication oil dipstick.

WARNING: Stop the engine before checking the engine lubrication oil level. With the engine running, hot oil can be thrown causing serious injury.



To accurately check the engine lubrication oil level, put the machine in a "level" position and stop the engine. Clean the area around the engine lubrication oil dipstick before removing the dipstick from the engine. Wait five minutes, after engine shutdown, before removing the dipstick from the engine and checking the oil level. Remove the filler cap and add oil as necessary.

NOTE: The above procedure will help to remove the possibility of filling the engine with too much lubrication oil, by allowing the oil to return to the oil pan.

WARNING: Stop the engine before checking the engine lubrication oil level. With the engine running, hot oil can be thrown causing serious injury.



Changing the Engine Lubrication Oil and Replacing Filter

The engine lubrication oil must be changed according to the interval given in the current Cummins Diesel engine "OPERATION AND MAINTENANCE MANUAL".

NOTE: The color of the engine lubrication oil cannot be used as an indication of the need for an engine lubrication oil change. The use of engine lubrication

oil "analysis service" is the only alternate reason for not following the required engine lubrication oil change schedule.

CAUTION: Do not change the engine lubrication oil with the engine "running". Serious engine damage, or failure will occur. Clean the area around the engine lubrication oil dipstick and oil filler cap before removing the dipstick, or oil filler cap.



Refer to the engine manufacturer's operation and maintenance manual for additional information on engine service. Use manufacturer's recommendations for engine oil and filter replacement.

NOTE: If fuel sulfur content exceeds 0.5 percent, change engine oil at one-half normal interval.

1. Run engine to warm oil.
2. Before leaving operator's seat, refer to PREPARING MACHINE FOR MAINTENANCE and park the machine.
3. Open the right hand engine compartment door.
4. Remove the oil pan drain plug and drain oil into a suitable container. Dispose of oil properly.
5. Clean area surrounding filter and filter head.
6. Turn filter counterclockwise to remove filter. Clean mounting surface.
7. Fill replacement filter with clean engine oil.
8. Apply clean engine oil lightly to replacement filter seal.
9. Install new filter. Turn filter clockwise until gasket contacts mounting surface.
10. Tighten filter a 1/2 to 3/4 additional turn.
11. Remove engine oil filler cap. Fill engine with oil (approximately 11.6 quarts [10.9 L]). Install filler cap.

NOTE: Before starting engine after a filter change, disconnect fuel shut-off solenoid wire and crank engine for 10 seconds to fill filter element and pre-lube turbocharger if equipped.

12. Disconnect fuel shut-off solenoid wire on injection pump so engine will not start. Crank engine for 10 seconds using starter motor.

Section 4

MAINTENANCE



13. Install shut-off solenoid wire. Start and run engine at slow idle.

NOTE: If engine oil pressure does not build on oil pressure gauge immediately, stop engine and check engine.

14. Check filter for leaks. Tighten or replace to stop leaks.
15. Shut down engine. Check oil level. Add oil as needed.

TRANSFER CASE OIL

Checking Transfer Case Oil Level

Remove the transfer case fill plug. The transfer case is full when oil runs from the fill plug opening. Add oil as necessary.

Draining, Flushing, and Filling Transfer Case

1. Refer to PREPARING MACHINE FOR MAINTENANCE and park the machine.
2. Allow the transfer case to cool. Remove the drain plug and drain oil into a suitable container. Dispose of oil properly.
3. Remove the oil level plug on the side of the transfer case.

WARNING: Wear eye protection and chemical resistant gloves when using solvent for cleaning purposes. Some solvents can cause skin irritation and eye damage.



4. Flush the transfer case with solvent and drain completely.
5. Install drain plug and fill with oil until oil flows from the oil level plug opening.
6. Install oil level plug.
7. Start engine and check operation.

RADIATOR AND COOLANT SYSTEM

Checking Radiator and Coolant Level

CAUTION: Check the coolant freeze protection level before the start of cold weather. Check with the local authorized dealer for information of freeze protection.



CAUTION: Hot engine coolant can cause serious personal injury. Shut off engine. Remove radiator filler cap



when cool enough to touch with bare hands. Slowly loosen filler cap to first stop to relieve pressure before removing cap completely.

1. Refer to PREPARING MACHINE FOR MAINTENANCE and park the machine.
2. Shut down engine and allow radiator to cool.
3. Open the left hand engine compartment door.
4. Check coolant level in radiator recovery reservoir located on the left side of the radiator.
5. Add coolant to the reservoir as needed to the cold level when the engine is cold and to the hot level when the engine is hot.

Draining, Flushing, and Filling Engine Coolant System

See the engine manufacturer's operation and maintenance manual for information on draining and replacing engine coolant, coolant levels, and coolant specifications. Use engine manufacturer's recommendations for coolant service.

The motor grader is filled with a 50/50 mixture of antifreeze and water at the factory with protection to -34°F (-37°C). Some geographical areas may require special antifreeze or coolant practices. Contact the local authorized dealer for additional information.

WARNING: Hot engine coolant causes severe burns. Shut engine off and allow radiator to cool to touch before removing the radiator cap. After cooling, turn the cap to the first stop and allow pressure to relieve before removing cap.



1. Refer to PREPARING MACHINE FOR MAINTENANCE and park the machine.
2. Shut down engine and remove ignition key.
3. Inspect radiator for leaks, dents, cracks and damaged cooling fins. Repair or replace as necessary.
4. Allow engine to completely cool before removing radiator cap.

NOTE: Dispose of used coolant properly. Check with local environmental officials for information of disposal procedures. Coolant is extremely poisonous and will cause death if ingested by people and animals.

5. Open radiator petcock and drain coolant into a suitable container. Dispose of coolant properly.
6. Open engine block drain plugs (see engine manufacturer's Operation and Maintenance manual). Drain coolant into a suitable container.
7. Using a good quality coolant system flush product, flush the cooling system using the product directions.
8. Close petcock and engine drains. Fill radiator to full level with 50/50 mixture of antifreeze and water. Contact the local authorized dealer for information on local coolant protection levels.
9. Inspect radiator cap for wear and damage. Perform pressure/temperature test if necessary. Replace cap as necessary.
10. Start engine and run for 15 to 30 minutes to purge air from the engine block. Check coolant recovery tank and fill as necessary.
11. Check recovery tank frequently for proper coolant level.

CLEANING ENGINE VENTILATION TUBE (BLOW-BY TUBE)

Refer to the engine manufacturer's operation and maintenance manual for additional information on engine service. Use manufacturer's recommendations for engine ventilation tube cleaning.

CHECKING ENGINE SPEED

Refer to the engine manufacturer's operation and

maintenance manual for additional information on engine service. Use manufacturer's recommendations for engine speed and adjustments.

Check the illustrated parts listing (IPL) for illustrations of the throttle lever needed for adjustment.

FUEL SYSTEM

Draining Fuel Tank Sump

WARNING: Diesel fuel is highly flammable. Keep all sparks and flames away when draining fuel. Do not smoke when filling fuel tank or working on fuel system.



1. Remove fuel tank filler cap.
2. Remove fuel tank drain plug (see Figure 4-4).
3. Allow water and sediment to drain from fuel tank into a suitable container. Dispose of fuel properly.
4. Install drain plug.

Changing Engine Fuel Filters

Refer to the engine manufacturer's operation and maintenance manual for additional information on engine service. Use manufacturer's recommendations for engine fuel filter replacement and bleeding the fuel system.

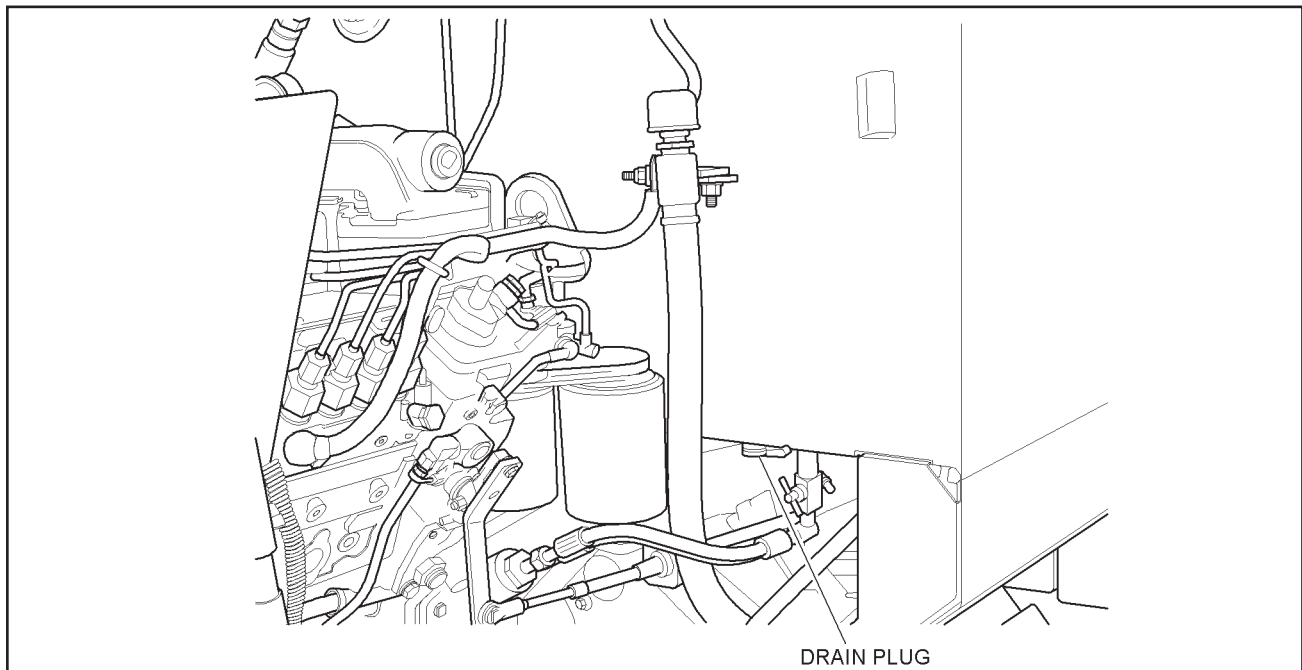


FIGURE 4-4. DRAINING FUEL TANK SUMP

Section 4 MAINTENANCE



1. Refer to PREPARING MACHINE FOR MAINTENANCE and park the machine.
2. Allow the engine to cool completely.

WARNING: Diesel fuel is highly explosive. Do not expose fuel to sparks or flames. Do not smoke while performing maintenance on the engine fuel system.



3. Thoroughly clean and dry the area surrounding the fuel filter.
4. Shut off the fuel supply needle valve located on the bottom of the fuel tank.
5. Open the right hand engine compartment door.
6. Turn the primary fuel filter (see Figure 4-5) counterclockwise to remove. Clean the mounting surface and remove any loose filter seals in the filter head-mounting surface.
7. Turn the secondary fuel filter (see Figure 4-5) counterclockwise to remove. Clean the mounting surface and remove any loose filter seals in the filter head-mounting surface.
8. Fill the replacement fuel filters with clean diesel fuel.
9. Lightly lubricate the secondary filter seal with clean engine oil. Turn the filter clockwise until

seal contacts filter head. Tighten filter 1/2 to 3/4 additional turn.

10. Lightly lubricate the primary filter seal with clean engine oil. Turn the filter clockwise until seal contacts filter head. Tighten filter 1/2 to 3/4 additional turn.
11. Open the fuel tank needle valve.
12. Using the priming plunger (see Figure 4-5) and instructions in the engine manufacturer's operation and maintenance manual, fill the filters with fuel and bleed the fuel system.
13. Start engine and check for leaks. Tighten or replace filter as necessary.

Checking and Cleaning Fuel Filler Cap

WARNING: Wear eye protection and chemical resistant gloves when using solvent for cleaning purposes. Some solvent can cause skin irritation and eye damage.



Wear eye protection when using compressed air for drying or cleaning components. Never point the nozzle at another individual. Use a safety reduction valve to reduce air pressure to a safe level. Compressed air can cause serious personal injury if misused.

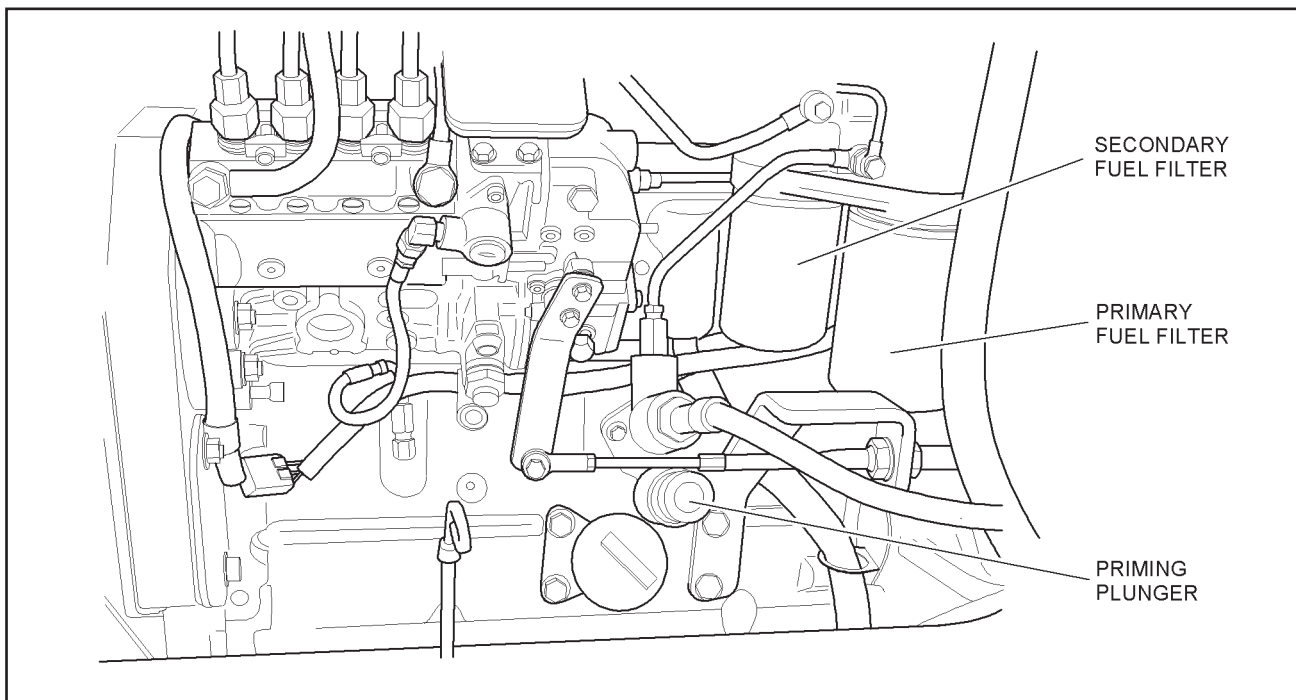


FIGURE 4-5. LOCATION OF FUEL FILTERS

1. Remove filler cap and inspect for damage. Check cap for dirt and clogging.
2. Using solvent, clean cap thoroughly and dry with compressed air.
3. Check cap for free air flow. Replace as necessary.
4. Install cap.

Checking Engine Air Cleaner Assembly

NOTE: Do not open the air cleaner assembly unless the air filter restriction gauge indicates an air filter restriction or engine operation indicates possible air filter restriction.

Check the air cleaner restriction gauge. The gauge is mounted on the air cleaner outlet. If the gauge indicates air filter restriction, replace the air filter elements.

Replacing Engine Air Filter Elements

NOTE: Do not open the air cleaner assembly unless the air filter restriction gauge indicates an air filter restriction or engine operation indicates possible air filter restriction.

1. Refer to PREPARING MACHINE FOR MAINTENANCE and park machine.
2. Thoroughly clean air cleaner assembly.

3. Remove the air cleaner end cover.
4. Remove the primary filter element (see Figure 4-6).
5. Remove the safety filter element wing nut. Remove the safety filter element.
6. Clean the air cleaner housing thoroughly. Dry using lint-free cloths.
7. Inspect hose clamps and tighten as necessary.
8. Install new safety filter element and secure with wing nut.
9. Install new primary filter element.
10. Install end cover and secure with wing nut.
11. Reset restriction gauge by pushing the button on the end.

HYDRAULIC SYSTEM

Checking Hydraulic Oil Level

NOTE: With all attachments at ground level, roll the moldboard back. Front wheels must be straight up and machine-aligned front to rear.

1. Refer to PREPARING MACHINE FOR MAINTENANCE and park machine.
2. Make sure all cylinders are retracted.
3. Wait ten minutes for oil to drain after engine has been shut down.

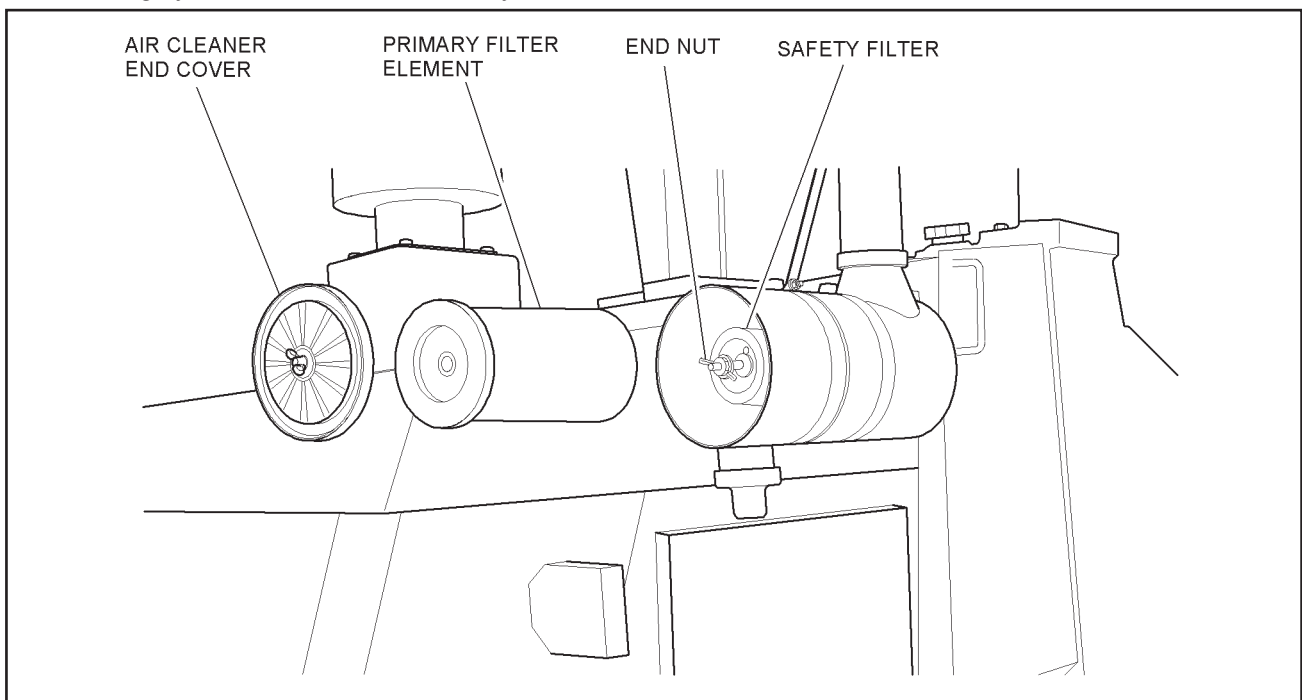


FIGURE 4-6. AIR CLEANER ASSEMBLY

Section 4

MAINTENANCE



4. Check hydraulic tank sight gauge. The hydraulic oil level should be in the upper half of the sight gauge but never above the upper fill line.
5. Add hydraulic oil as needed.

Changing Hydraulic Suction Filter

1. Refer to PREPARING MACHINE FOR MAINTENANCE and park machine.
2. Open the left hand engine compartment door.
3. Thoroughly clean the suction filter and filter head.
4. Allow the engine to cool completely.
5. Turn off the hydraulic tank gate valve located on the bottom right side of the tank.
6. Turn the filter counterclockwise to remove. Clean the mounting surface and remove any loose filter seals in the filter head mounting surface.
7. Turn the filter clockwise until the seal contacts the mounting surface. Tighten the filter 1/2 to 3/4 additional turn.
8. Turn on the hydraulic tank gate valve.
9. Start engine and check for leaks. Tighten or replace filter as necessary.

Checking and Cleaning Hydraulic Reservoir Filler Cap

WARNING: Wear eye protection and chemical resistant gloves when using solvent for cleaning purposes. Some solvent can cause skin irritation and eye damage.



Wear eye protection when using compressed air for drying or cleaning components. Never point the nozzle at another individual. Use a safety reduction valve to reduce air pressure to a safe level. Compressed air can cause serious personal injury if misused.

1. Remove filler cap and inspect for damage. Check cap for dirt and clogging.
2. Using solvent, clean cap thoroughly and dry with compressed air.
3. Check cap for free air flow. Replace as necessary.
4. Install cap.

Draining, Flushing, and Filling Hydraulic Oil Reservoir

1. Refer to PREPARING MACHINE FOR MAINTENANCE and park machine.
2. Close the hydraulic reservoir gate valve located on the bottom of the hydraulic reservoir.
3. Remove reservoir filler cap.
4. Remove drain plug and drain the hydraulic oil into a suitable container. Dispose of oil properly.
5. Flush hydraulic reservoir completely.
6. Install drain plug.
7. Replace the suction filter.
8. Fill hydraulic oil reservoir to proper level.
9. Install filler cap.
10. Open reservoir gate valve.
11. Start engine and operate hydraulic control levers several times. Check hydraulic oil sight gauge and fill as necessary.

DRIVE CHAINS, CHAIN BOX HOUSING, AND REAR DRIVE HOUSING

Servicing Chain Box Housing

Remove chain box filler cap. Remove oil level plug. Chain box oil should be approximately 5 inches from bottom or until oil runs from oil level plug. Add oil as needed. Replace filler cap.

Checking Drive Chains and Replacing Cover Gaskets

1. Remove chain box service covers and gaskets.
2. Inspect drive chains, sprockets, axle shafts, and housing for wear and damage. Repair or replace as necessary.
3. Inspect chain box housing for oil leaks. Repair as necessary.
4. Clean service cover surface of dirt and gasket material. Replace gaskets and covers.

Draining, Flushing, and Filling Chain Boxes

1. Remove chain box filler cap.
2. Remove drain plug from end of chain box.
3. Drain oil into a suitable container. Dispose of oil properly.
4. Flush the chain box.
5. Install drain plug.

6. Remove oil level plug.
7. Fill chain box until oil runs from oil level plug opening.
8. Install oil level plug.

Checking Rear Drive Housing Oil Level

1. Refer to PREPARING MACHINE FOR MAINTENANCE and park machine.
2. Remove differential fill plug. Oil level is correct if oil runs from oil level plug. Add oil as needed.

ELECTRICAL SYSTEM

WARNING: When servicing the electrical system, always remove the ground cable from the battery first, followed by the positive cable. Generally, if the negative cable is grounded during removal, sparks will not occur. If the positive is grounded during removal, sparks will occur and could ignite explosive gases.



When batteries are connected, follow these rules:

1. Disconnect negative (-) battery cable when working on or near the alternator.
2. Do not attempt to polarize alternator.
3. Make sure alternator wires are correctly connected before connecting battery terminals.
4. Do not ground alternator output terminal.
5. Do not disconnect or connect alternator wires while batteries are connected or while alternator is operating.
6. Connect batteries or booster battery in the correct polarity [positive (+) to positive (+), negative (-) to negative (-)].
7. Do not disconnect batteries when engine is running and alternator is charging.
8. Disconnect battery cables before connecting battery charger to batteries. Charge batteries separately.

Fuses And Circuit Breakers

The fuse block is mounted inside the instrument control panel to the left of the operator's seat. The blade-type fuse color codes are listed in Table 4-2. See Figure 4-7 for the fuse block schematic. Circuit breakers are mounted on the back of the ignition control panel.

CAUTION: Replace fuses and circuit breakers with correct amperage to prevent damage from system overload.



When a circuit breaker opens due to short circuit or overloading, turn off lights and place ignition switch in the OFF position. Wait one minute before starting machine or turning on lights. The circuit breaker will automatically reset. If the circuit breaker continues to trip (open), check the electrical system for short circuits and defective components. Replace the circuit breaker as necessary.

TABLE 4-2. BLADE TYPE FUSE COLOR CODES

AMPERAGE RATING	COLOR
1	BLACK
3	VIOLET
4	PINK
5	TAN
7-1/2	BROWN
10	RED
15	LIGHT BLUE
20	YELLOW
25	NATURAL (WHITE)
30	LIGHT GREEN

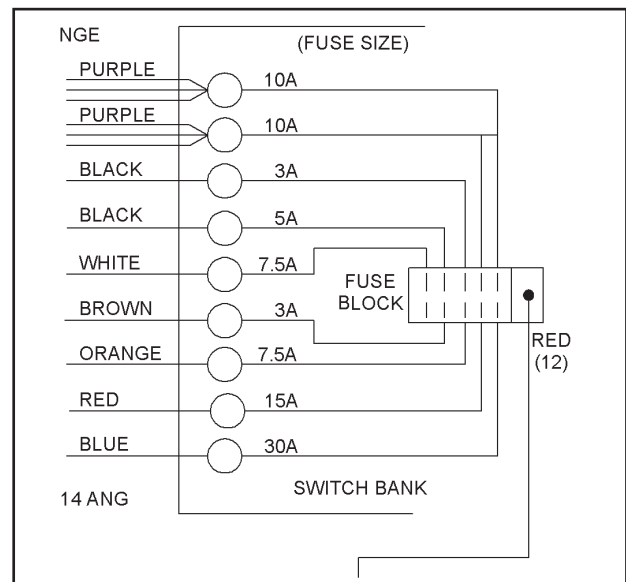


FIGURE 4-7. FUSE BLOCK SCHEMATIC

Section 4

MAINTENANCE



COMPONENT REPLACEMENT PROCEDURES

GENERAL INFORMATION


This section provides instructions for replacing motor grader components during maintenance.

The following instructions can be used in conjunction with the illustrations in the (IPL) Illustrated Part Listing to remove and replace motor grader components.


NOTE: Make sure the motor grader is parked correctly before performing the replacement procedures. Refer to instructions in SECTION 4, Preparing Machine for Maintenance.

REPLACING BATTERIES

Removal

 **WARNING:** Batteries create explosive gases when charging. Do not expose these gases to sparks or open flame during maintenance. Always perform battery service in a well-ventilated area or outside. Serious injury can occur from exploding batteries.

1. Remove the lock bolt and pull the battery tray out.

 **WARNING:** When servicing batteries, always remove the ground cable first followed by the positive cable. Generally, if the negative cable is grounded during removal, sparks will not occur. If the positive cable is grounded during removal, sparks will occur and could ignite explosive gases.

2. Remove the ground cable from the negative battery terminal followed by the positive cable from the positive terminal.
3. Remove the hold down bar.
4. Inspect the batteries for cracks, wear and damage that could result in leaks.
5. Carefully remove the batteries from the battery tray. Take note of the battery position during removal.


WARNING: Do not dry batteries using compressed air. Allow the batteries and surrounding area to air dry. Battery acid can cause severe injury if blown into the face or other areas of the body. If injury occurs, seek medical attention immediately. Flush eyes and skin for 30 minutes with clean fresh water.



6. Make sure the battery cells are sealed and clean the batteries, battery tray, cables, and brackets with baking soda and warm water. Allow to air dry.

Installation


1. Place the batteries in proper position in the battery tray.
2. Install hold down bar. Tighten bar to retain battery but not so tight as to damage battery.

 **WARNING:** When installing batteries, always install the positive cable first followed by the negative cable. Reversed polarity can damage the electrical system.

3. Install positive (+) battery cable to positive (+) battery terminal.
4. Install negative (-) battery cable to negative (-) battery terminal.
5. Close battery tray and install lock bolt.

REPLACING SCARIFIER TOOTH SUPPORT

Removal

 **WARNING:** Wear eye protection when using a hammer on metal structures to prevent damage from flying metallic objects. Flying metallic objects can cause serious eye injuries.

1. Raise and support the scarifier frame.
2. Using a pry bar or lock pin tool, remove the lock from between the scarifier support and the tooth support.
3. Remove the tooth support from the scarifier support.


Installation

Position the new tooth support in the scarifier support in the desired position. Secure with the lock pin.

REPLACING SCARIFIER TOOTH

Removal

1. Raise and support the scarifier frame.

WARNING:  **Wear eye protection when using a hammer on metal structures to prevent damage from flying metallic objects. Flying metallic objects can cause serious eye injuries.**

1. Refer to REPLACING SCARIFIER TOOTH SUPPORT and remove the scarifier tooth support from the support frame.
2. While supporting the tooth support, drive the tooth from the tooth support.

Installation

1. While supporting the tooth support, drive the new tooth on the tooth support.
2. Refer to REPLACING SCARIFIER TOOTH SUPPORT and install the tooth support in the support frame.

REPLACING ARTICULATE CYLINDERS

Removal

1. Thoroughly clean the articulate cylinder, especially in the area surrounding the hydraulic hoses and fittings.
2. Tag and disconnect hydraulic hoses from the articulate cylinder. Immediately plug the hoses and cylinder to prevent contamination of the hydraulic system.
3. Remove the cotter pins from the end yoke pins.
4. While supporting the cylinder, remove the pins from the end yokes.
5. Remove the cylinder.
6. Inspect the bushings in the end yokes and frame mounts. Replace as necessary.
7. Inspect the hydraulic fittings. Replace if necessary. Remove fittings for reuse on replacement cylinder.

Installation

1. Install hydraulic fittings on replacement cylinder.
2. Position the cylinder on the frame mounts and install pins through the end yokes. Secure the pins with new cotter pins.
3. Using tags created during removal, remove

plugs and connect the hydraulic hoses to the cylinder fittings.

4. Using a grease gun, lubricate cylinder swivel joints.
5. Start the motor grader and check operation. Repair leaks as necessary.

REPLACING WHEEL STEERING CYLINDER

Removal

1. Thoroughly clean the steering cylinder, especially in the area surrounding the hydraulic hoses and fittings.
2. Tag and disconnect the hydraulic hoses. Immediately plug the hoses and cylinder ports to prevent contamination of the hydraulic system.
3. While supporting the cylinder, remove the cotter pins and end connector-mounting nuts and washers.
4. While supporting the cylinder, use a ball joint removal tool to remove the end connectors from the frame mounts.
5. Inspect the end connectors for excessive wear, loose ball joints, and damage.

NOTE: **When removing the end connectors, count the number of turns needed for removal. The end connector or replacement can be threaded into the new steering cylinder the same number of turns, providing a close match for mounting the cylinder.**

6. Loosen the jam nuts and remove the end connectors from the rod and cylinder ends. Count the number of turns needed to remove the end connector.
7. Inspect the hydraulic fittings. Replace if necessary. Remove fittings for reuse on replacement cylinder.

Installation

1. Install end connectors on the new steering cylinder using the same number of turns noted during removal.
2. Install hydraulic fittings on replacement fittings.
3. Position the steering cylinder for installation on the frame mounts. Adjust the end connectors to mate with the frame and position the cylinder for hose installation. Secure the end connectors by tightening the end connector jam nuts.

Section 4

MAINTENANCE



4. Install the end connector mounting nuts, pulling the ball joints through the mount and securing cylinder installation. Move the nut to the nearest through hole and install cotter pin.
5. Using tags created during removal, remove plugs and connect steering cylinder hydraulic hoses.
6. Using a grease gun, lubricate cylinder swivel joints.
7. Start motor grader and check operation. Repair leaks as necessary.

REPLACING WHEEL LEAN CYLINDER

Removal

NOTE: Before shutting down the engine, make sure the wheel lean cylinder is retracted.

1. Thoroughly clean the wheel lean cylinder, especially in the area surrounding the hydraulic hoses and fittings.
2. Tag and disconnect the hydraulic hoses. Immediately plug the hoses and cylinder ports to prevent contamination of the hydraulic system.
3. Raise front of machine enough to tilt axle to remove inside pin.
4. Support front of machine with approved jack stands.
5. While supporting the wheel lean cylinder, remove cotter pins and mounting pins from the cylinder.
6. Inspect the hydraulic fittings. Replace if necessary. Remove the fittings for reuse on the replacement cylinder.

Installation

1. Install hydraulic fittings on replacement cylinder.
2. Place the new or rebuilt cylinder in position between the front axle spindle and the front axle support. Secure with mounting pins. Install new cotter pins in the mounting pins.
3. Using tags created during removal, install hydraulic hoses on the cylinder fittings.
4. Using a grease gun, lubricate cylinder swivel joints.
5. Remove supports and lower machine.

6. Start motor grader and check operation. Repair leaks as necessary.

REPLACING FRONT BLADE LIFT CYLINDER

Removal

1. Thoroughly clean the lift cylinder, especially in the area surrounding the hydraulic hoses and fittings.
2. Support the bottom portion of the blade to prevent the blade from falling.
3. Tag and disconnect the hydraulic hoses. Immediately plug the hoses and cylinder ports to prevent contamination of the hydraulic system.
4. While supporting the lift cylinder, remove the cotter pins, flat washers and mounting pins.
5. Remove the lift cylinder.
6. Inspect the hydraulic fittings. Replace as necessary. Remove the fittings for reuse in the replacement cylinder.

Installation

1. Install the fittings on the replacement cylinder.
2. Position the lift cylinder between the upper frame mounting and lower front blade mount. Secure the cylinder with mounting pins.
3. Install new cotter pins.
4. Using tags created during removal, connect the hydraulic hoses to the fittings.
5. Using a grease gun, lubricate cylinder swivel joints.
6. Start the motor grader and check operation. Repair leaks as necessary.

REPLACING SCARIFIER LIFT CYLINDER

Removal

1. Thoroughly clean the scarifier lift cylinder, especially in the area surrounding the hydraulic hoses and fittings.
2. Tag and disconnect the hydraulic hoses. Immediately plug the hoses and cylinder ports to prevent contamination of the hydraulic system.
3. Either support or lower the scarifier.
4. While supporting the lift cylinder, remove the cotter pins, flat washers, and mounting pins.

5. Remove the lift cylinder.
6. Inspect the hydraulic fittings. Replace as necessary. Remove the fittings for reuse in the replacement cylinder.

Installation

1. Install the fittings on the replacement cylinder.
2. Position the lift cylinder between the upper frame mounting and scarifier support frame mount. Secure the cylinder with mounting pins.
3. Install flat washers and new cotter pins.
4. Using tags created during removal, connect the hydraulic hoses to the fittings.
5. Using a grease gun, lubricate cylinder swivel joints.
6. Start the motor grader and check operation. Repair leaks as necessary.

REPLACING MOLDBOARD SLIDE CYLINDER

Removal

1. Extend slide cylinder.
2. Remove outer cylinder pin.
3. Retract moldboard slide cylinder before shutting down engine.
4. Thoroughly clean the slide cylinder, especially in the area surrounding the hydraulic hoses and fittings.
5. Tag and disconnect the hydraulic hoses. Immediately plug the hoses and cylinder ports to prevent contamination of the hydraulic system.
6. While supporting the slide cylinder, remove the cotter pins, flat washers, and mounting pins.
7. Remove the slide cylinder.
8. Inspect the hydraulic fittings. Replace as necessary. Remove the fittings for reuse in the replacement cylinder.

Installation

1. Install the fittings on the replacement cylinder.
2. Position the slide cylinder between the moldboard support frame mount and moldboard mount. Secure the cylinder with inside mounting pin.
3. Install flat washers and new cotter pins.
4. Using tags created during removal, connect the hydraulic hoses to the fittings.

5. Start motor grader and extend slide cylinder. Install outer mounting pin.
6. Using a grease gun, lubricate cylinder swivel joints.
7. Start the motor grader and check operation. Repair leaks as necessary.

REPLACING MOLDBOARD TILT CYLINDERS

NOTE: With moldboard on the ground, extend the tilt cylinder before shutting down the engine.

Removal

1. Thoroughly clean the tilt cylinder, especially in the area surrounding the hydraulic hoses and fittings.
2. Tag and disconnect the hydraulic hoses. Immediately plug the hoses and cylinder ports to prevent contamination of the hydraulic system.
3. While supporting the tilt cylinder, remove the cotter pins, flat washers, and mounting pins.
4. Remove the tilt cylinder.
5. Inspect the hydraulic fittings. Replace as necessary. Remove the fittings for reuse in the replacement cylinder.

Installation

1. Install the fittings on the replacement cylinder.
2. Position the tilt cylinder between the moldboard support frame mount and turntable support frame mount. Secure the cylinder with mounting pins.
3. Install flat washers and new cotter pins.
4. Using tags created during removal, connect the hydraulic hoses to the fittings.
5. Using a grease gun, lubricate cylinder swivel joints.
6. Start the motor grader and check operation. Repair leaks as necessary.

REPLACING MOLDBOARD ANGLE CYLINDERS

NOTE: With moldboard on the ground, center angle cylinders before shutting down the engine.

Removal

1. Thoroughly clean the angle cylinder, especially in the area surrounding the hydraulic hoses and fittings.

Section 4

MAINTENANCE



2. Tag and disconnect the hydraulic hoses. Immediately plug the hoses and cylinder ports to prevent contamination of the hydraulic system.
3. While supporting the angle cylinder, remove the cotter pins, flat washers, and mounting pins.
4. Remove the angle cylinder.
5. Inspect the hydraulic fittings. Replace as necessary. Remove the fittings for reuse in the replacement cylinder.

Installation

1. Install fittings on the replacement cylinder.
2. Position the angle cylinder between the drawbar mount and turntable mount. Secure the cylinder with mounting pins.
3. Install flat washers and new cotter pins.
4. Using tags created during removal, connect the hydraulic hoses to the fittings.
5. Using a grease gun, lubricate cylinder swivel joints.
6. Start the motor grader and check operation. Repair leaks as necessary.

REPLACING MOLDBOARD LIFT CYLINDER

Removal

1. Thoroughly clean the lift cylinder, especially in the area surrounding the hydraulic hoses and fittings.
2. Tag and disconnect the hydraulic hoses. Immediately plug the hoses and cylinder ports to prevent contamination of the hydraulic system.
3. While supporting the lift cylinder, remove the cotter pin, nut, and flat washer from the lift cylinder rod end.
4. Using a ball joint removal tool, remove the ball joint.
5. Support the lift cylinder and remove the bolts and flat washers from the lift cylinder mount.
6. Remove the side plate.
7. Remove the lift cylinder.
8. Inspect the hydraulic fittings, replace as necessary. Remove the fittings for reuse in the replacement cylinder.

9. Inspect the rod end for excessive wear, play, and damage. Replace if necessary or remove for installation on new lift cylinder.
10. Inspect upper mounting bushings. Replace if worn, broken, or damaged.

Installation

NOTE: Rod end fittings have small orifice holes to slow down drop speed.

1. Install the fittings on the replacement cylinder.
2. Install rod end on new cylinder.
3. If removed, install upper mounting bushings.
4. Position the lift cylinder in the upper mount and secure with side plate, flat washers, and bolts.
5. Install rod end in tow bar mount and secure with flat washer, nut, and new cotter pin.
6. Using tags created during removal, connect the hydraulic hoses to the fittings.
7. Using a grease gun, lubricate cylinder swivel joints.
8. Start the motor grader and check operation. Repair leaks as necessary.

REPLACING MOLDBOARD BLADE

NOTE: Raise moldboard and support with jack stands before shutting down the engine.

Removal

1. While supporting blade, remove blade mounting screws, lock washers, and nuts.
2. Remove worn blade.
3. Clean the blade mounting surface thoroughly.

Installation

1. Position replacement blade on moldboard.
2. Secure with mounting screws, lock washers, and nuts.

REPLACING HYDRAULIC SUCTION FILTER

Removal

1. Close the supply line gate valve.
2. Thoroughly clean and dry the suction filter assembly.
3. Turn the filter element counterclockwise to remove.

4. Clean the filter head mounting surface and inspect for dislodged seals from the old filter element.

Installation

1. Lightly lubricate element with clean hydraulic oil.
2. Install element on the filter head hand tight plus one-half turn.
3. Open supply line gate valve.
4. Check hydraulic tank sight gauge and fill as necessary. Refer to Section 4, MAINTENANCE.
5. Start engine and check operation. Repair leaks as necessary.

REPLACING EXHAUST SYSTEM

NOTE: Allow engine to cool completely.

Removal

1. Remove flex pipe to muffler exhaust clamp.
2. Remove muffler to hood mounting bolts and lock washers.
3. Remove muffler.
4. Remove muffler extension exhaust clamp.
5. Remove exhaust extension.

Installation

1. Install exhaust extension on muffler. Secure with exhaust clamp.
2. Install exhaust clamp on flex pipe.
3. Place muffler in position on the hood and over the flex pipe. Secure muffler with lock washers and bolts.

REPLACING RADIATOR/OIL COOLER ASSEMBLY

NOTE: Allow engine to cool completely.

Removal

1. Remove engine access panels, hood, and grill.

NOTE: Dispose of engine coolant in an environmentally safe manner. Contact local recycling centers or environmental officials for coolant disposal instructions.

2. Drain the engine coolant system. Dispose of coolant properly.

3. Thoroughly clean the radiator and oil cooler assembly especially the area surrounding hydraulic hoses and fittings.
4. Tag and disconnect hydraulic hoses from the oil cooler. Immediately plug hoses and oil cooler ports to prevent contamination of the hydraulic system.
5. Remove the radiator upper and lower radiator hoses.
6. Disconnect the radiator overflow hose.
7. While supporting the radiator, remove the radiator mounting bolts and washers.
8. Remove the radiator/oil cooler.

Installation

1. Position the replacement radiator/oil cooler and secure with mounting bolts and washers.
2. Install overflow hose and secure with clamp.
3. Install upper and lower radiator hoses and secure with hose clamps.
4. Using tags created during removal, connect hydraulic hoses to oil cooler fittings.
5. Fill radiator with coolant mixture consisting of at least 50/50 mix of anti-freeze and water.
6. Inspect and test radiator cap. Replace if necessary.
7. Install grill, hood, and engine access panels.
8. Start engine and check operation. Repair leaks as necessary.

REPLACING AIR CLEANER ASSEMBLY

NOTE: Allow engine to cool completely.

Removal

1. Thoroughly clean and dry the air cleaner assembly.
2. Disconnect the air outlet hose clamp.
3. Loosen the precleaner clamp and precleaner.
4. Loosen the stack intake extension clamp and extension.
5. Remove the air cleaner end cover, primary element, and safety element.
6. Remove screws from the band clamp.
7. Remove the air cleaner housing.

Section 4 MAINTENANCE



8. Inspect the evacuator for wear and damage. Replace as necessary.
9. Inspect the air filter restriction indicator for wear, damage, and proper function. Replace if necessary.
10. Inspect engine intake hoses and replace if excessively soft, worn, damaged, or cracked.
11. Inspect hose clamps, precleaner clamps, and band clamps for wear and damage. Replace if necessary.
12. Inspect precleaner for cracks, wear and damage. Replace if necessary.
13. Inspect all rubber hoses and elbows for cracks and wear. Replace as necessary.
14. Thoroughly clean all components inside and outside. Dry using lint free cloths.

Installation

1. Install air cleaner housing and secure with band clamps.
2. Install stack intake extension and secure with mounting clamp.
3. Assemble and install precleaner and secure with mounting clamp.
4. Install outlet hose and secure with hose clamp.
5. Install new safety filter element and primary filter element.
6. Install end cover.
7. Start engine and check hoses for leaks. Tighten or replace hoses as necessary.

REPLACING CONTROL VALVE ASSEMBLY

Removal

1. Remove valve bank access cover.
2. Thoroughly clean the control valve and surrounding area, especially around the hydraulic hoses and fittings.
3. Tag and disconnect hydraulic hoses. Immediately plug the hoses and control valve ports to prevent contamination of the hydraulic system.
4. Support the control valve and remove the control valve mounting bolts and washers
5. Remove the control valve assembly.
6. Inspect the control valve levers and linkages for wear and damage. Replace linkage and lever if necessary.
7. Remove control levers and linkage.
8. Inspect hydraulic fittings for wear and damage. Replace if necessary. Remove fittings for installation in replacement valve.

Installation

1. Install fittings in replacement valve.
2. Insert control valve and secure with mounting bolts and washers.
3. While supporting valve and using tags created during removal, connect hydraulic hoses to fittings.
4. Install control levers and linkage.
5. Start engine and check operation. Repair leaks as necessary.
6. Install valve bank access cover and secure with flat washers and wing nuts.

TROUBLESHOOTING

GENERAL INFORMATION

The troubleshooting chart below identifies the most common symptoms of failure. Use this chart to help identify the failed component.

NOTE: The following troubleshooting solutions include common problems encountered with diesel engines. For additional information and troubleshooting procedures, see the Engine Manufacturer's Operation and Maintenance manual.

TROUBLESHOOTING CHART

SYMPTOM	CAUSE	REMEDY
Engine cranks but does not start, or starts hard.	Fuel tank empty.	Check fuel level and fill as required.
	Fuel shut-off valve closed.	Open valve.
	Water in fuel or water frozen in fuel lines. Water frozen in fuel filter.	Thaw and/or drain water from fuel tank sump. Thaw ice in fuel lines and drain. Install new fuel filter.
	Fuel tank cap vent clogged.	Remove cap. Listen for air entering tank suddenly. Clean and replace cap.
	Debris or dirt in fuel.	Drain small amount of fuel from tank sump into clean container. Inspect for debris. Drain and flush fuel system and change fuel filter.
	Wrong grade fuel for low ambient temperature.	Fuel "jelled" in tank or lines. Warm machine. Drain fuel system and change fuel filter. Refill tank with correct fuel.
	Air entering suction side of fuel system.	Check for bubbles in fuel filter. Tighten connections. Inspect fuel lines for damage.
	Fuel transfer pump malfunctions.	Repair or replace fuel transfer pump.
	Air filter elements restricted with dirt, snow, or water.	Clean or replace filter elements.
	Injection pump malfunctions.	See your authorized dealer.
	Injection nozzle(s) malfunctions.	See your authorized dealer.
Engine cranks slowly.	Worn piston rings or low compression.	See your authorized dealer.
	Blown head gasket.	See your authorized dealer.
	Wrong weight oil for low ambient temperature.	Drain and refill with correct weight oil. Change oil filter.
	Loose or dirty connections at batteries.	Clean battery posts and cable ends. Reinstall cables.
	Loose or dirty connections at starter.	Clean connections at start relay and starter.
Batteries discharged or failing to take a charge.	Disconnect batteries from machine and each other. Recharge batteries separately. Replace both batteries if either fails to charge. Check alternator output (28 volts), wiring for shorting to ground, and alternator tension. Repair or replace components as required.	

Section 4 MAINTENANCE



TROUBLESHOOTING CHART (Continued)

SYMPTOM	CAUSE	REMEDY
Engine cranks slowly (continued).	Starter motor malfunctions.	Seized bushings, bent armature shaft, worn bushings, and armature "dragging". Check starter current draw. See your authorized dealer for starter repair.
Engine surges or stalls frequently.	Air entering suction side of fuel system. Fuel tank cap vent clogged. Water or debris in fuel. Fuel "jelled" due to low ambient temperature. Fuel filter clogged. Return line from injection pump to tank restricted. Air filter elements clogged. Fuel transfer pump clogged. Injection pump or nozzle(s) malfunctions. Basic engine malfunction. Leaking head gasket, sticking or burnt valves, valve clearance or valve timing incorrect, or worn or broken piston rings.	Check fuel filter for air bubbles. Tighten fittings and connections. Inspect lines for damage. Remove cap. Listen for air entering tank suddenly. Clean and replace cap. Drain water from sump in fuel tank. Check drained fuel for debris. Drain and flush fuel system. Replace fuel filter. Drain fuel system. Refill engine with correct grade fuel. Replace fuel filter. Check for debris in fuel system. Replace filter. Check line for kinks or damage. Check line for debris. Clean with compressed air. Clean or replace air filter elements. Repair or replace pump. See your authorized dealer. See your authorized dealer. Refer to Cummins engine manual.
Engine misses, operates erratically, or operates poorly at low speed.	Air entering suction side of fuel system. Water or debris in fuel. Fuel tank cap vent clogged. Return line from injection pump to tank restricted. Slow idle speed set too low. Fuel transfer pump malfunctions. Injection pump or nozzle(s) malfunctions.	Check fuel filter for air bubbles. Tighten fittings. Inspect lines for damage. Drain water from sump in fuel tank. Check drained fuel for debris. Drain and flush fuel system. Replace fuel filter. Remove cap. Listen for air entering tank suddenly. Clean and replace cap. Check line for kinks or damage. Check line for debris. Clean with compressed air. Check for bent, worn, or loose speed control linkage. Repair as needed. Adjust linkage and reset slow idle speed. Repair or replace fuel transfer pump. See your authorized dealer.

TROUBLESHOOTING CHART (Continued)

SYMPTOM	CAUSE	REMEDY
Engine misses, operates erratically, or operates poorly at low speed (continued).	<p>Incorrect valve clearance.</p> <p>Basic engine malfunction. Leaking head gasket, sticking or burnt valves, valve clearance or valve timing incorrect, or worn or broken piston rings.</p>	<p>Adjust clearance.</p> <p>Refer to Cummins engine manual.</p>
Engine not developing full power.	<p>Fuel filter clogged.</p> <p>Air filter elements clogged.</p> <p>Water in fuel or wrong grade of fuel used.</p> <p>Exhaust system restriction.</p> <p>Fast idle speed set too low.</p> <p>Incorrect valve clearance.</p> <p>Fuel line or injection pump line restricted.</p> <p>Park brake dragging.</p> <p>Service brakes dragging.</p> <p>Fuel shut-off cable binding or linkage out of adjustment.</p> <p>Fuel transfer pump malfunctions.</p> <p>Injection pump or nozzle(s) malfunctions.</p> <p>Internal hydraulic system leakage.</p> <p>Turbocharger gasket leakage.</p> <p>Basic engine malfunction. Leaking head gasket, sticking or burnt valves, valve clearance or valve timing incorrect, or worn or broken piston rings.</p>	<p>Check for debris in fuel system. Replace filter.</p> <p>Clean or replace air filter elements.</p> <p>Drain water from fuel tank sump or drain and flush fuel tank and refill with correct fuel. Replace fuel filter.</p> <p>Check condition of muffler interior.</p> <p>Check for bent, worn, or loose speed control linkage. Repair as needed. Adjust linkage and reset fast idle speed.</p> <p>Adjust clearance.</p> <p>Clear restriction with compressed air. Replace line.</p> <p>Adjust linkage. Check park brake disc for warping or scoring. Check park brake cable for binding. Overheating of park brake disc indicates dragging. Repair or replace park brake disc and/or park brake cable as required.</p> <p>Check brake linkage for damage. Check brake valve for leakage. Check brake discs for warping or scoring. Dragging brakes could cause overheating of transmission/ hydraulics or engine.</p> <p>Free cable or replace it. Check linkage for worn or damaged parts. Replace damaged parts and/or adjust linkage.</p> <p>Repair or replace fuel transfer pump.</p> <p>See your authorized dealer.</p> <p>Repair linkage. See your authorized dealer.</p> <p>Repair or replace. See your authorized dealer.</p> <p>Refer to Cummins engine manual.</p>

Section 4 MAINTENANCE



TROUBLESHOOTING CHART (Continued)

SYMPTOM	CAUSE	REMEDY
Engine emits excessive black or gray exhaust smoke.	<p>Restricted air filter element.</p> <p>Incorrect grade of fuel.</p> <p>Engine overloaded.</p> <p>Turbocharger gasket leakage.</p> <p>Incorrect injection pump timing.</p> <p>Excessive fuel delivery. Injection pump or nozzle(s) malfunctions.</p>	<p>Check, clean or replace air filter elements.</p> <p>Drain and flush fuel tank and fill with correct grade of fuel. Replace fuel filter.</p> <p>Remove load. Run at fast idle to clear the engine.</p> <p>Repair or replace. See your authorized dealer.</p> <p>Repair or replace pump. See your authorized dealer.</p> <p>See your authorized dealer.</p>
Excessive blue or white exhaust smoke.	<p>Engine will not start.</p> <p>Incorrect grade of fuel used.</p> <p>Injection pump or nozzle(s) malfunctions.</p> <p>Basic engine malfunction Excessive oil consumption.</p>	<p>Cranking speed too slow.</p> <p>Drain and flush fuel tank and refill with correct grade of fuel. Replace fuel filter.</p> <p>See your authorized dealer.</p> <p>Refer to Cummins engine manual.</p>
Detonation (excessive engine knock).	<p>Stuck starting aid solenoid or switch.</p> <p>Injection pump timing or pump advance faulty.</p> <p>Incorrect fuel (gasoline mixed with diesel fuel).</p>	<p>Repair or replace solenoid or switch.</p> <p>See your authorized dealer.</p> <p>Drain and flush fuel tank and refill with correct fuel. Replace fuel filter.</p>
Abnormal engine noise (rattle, knock, or squeal). and repair leaks.	<p>Low engine oil level.</p> <p>Oil viscosity too low for high ambient temperatures.</p> <p>Fuel in engine oil.</p> <p>Loose or worn hydraulic pump drive coupling.</p> <p>Injection pump timing incorrect.</p> <p>Turbocharger bearing or turbine damaged.</p> <p>Excessive valve clearance.</p> <p>Internal engine component wear.</p>	<p>Fill reservoir to correct level.</p> <p>Drain and refill reservoir with correct weight oil.</p> <p>Drain and refill reservoir with correct oil. Check fuel system to find le</p> <p>Repair or replace damaged coupling.</p> <p>See your authorized dealer.</p> <p>Remove turbo air inlet hose and check vertical movement of shaft. Repair or replace shaft. See your authorized dealer.</p> <p>Adjust clearance.</p> <p>Refer to Cummins engine manual.</p>

TROUBLESHOOTING CHART (Continued)

SYMPTOM	CAUSE	REMEDY
<p>Low engine oil pressure (oil pressure indicator light ON, Red STOP light flashing, and alarm ON).</p>	<p>Low oil level.</p> <p>Low viscosity (using winter oil in summer).</p> <p>Oil diluted with fuel.</p> <p>Oil pressure sensor faulty.</p> <p>Oil pressure control valve faulty.</p> <p>Oil pump intake screen clogged.</p> <p>Loose oil pump drive gear or worn pump housing.</p> <p>Internal engine component wear.</p>	<p>Check oil level. Fill reservoir to correct level. Check for leaks. Repair leaks.</p> <p>Drain, flush, and fill reservoir with correct weight oil.</p> <p>Drain and refill reservoir with correct oil. Check fuel system to find leakage and repair leaks.</p> <p>Replace oil pressure sensor.</p> <p>Repair or replace valve. See your authorized dealer.</p> <p>See your authorized dealer.</p> <p>See your authorized dealer.</p> <p>Refer to Cummins engine manual.</p>
<p>Engine overheats.</p>	<p>Low coolant level.</p> <p>Loose, worn, or broken fan belt.</p> <p>Worn pulley grooves, allowing belt slippage.</p> <p>Radiator dirty or clogged.</p> <p>Radiator shroud missing or damaged.</p> <p>Engine overloaded.</p> <p>Radiator cap not sealing.</p> <p>Fan on backwards or damaged.</p> <p>Injection pump timing incorrect.</p> <p>Excessive brake drag.</p> <p>Hydraulic system overheating due to internal leakage.</p> <p>Thermostats stuck or missing.</p> <p>Cooling system interior coated with lime deposits.</p> <p>Water pump leaking.</p> <p>Excessive fuel delivery or injection pump malfunctions.</p>	<p>Fill radiator with coolant to correct level and check for leaks.</p> <p>Tighten or replace fan belt. Refer to Cummins engine manual.</p> <p>Replace pulleys and belt. Refer to Cummins engine manual.</p> <p>Check airflow. Clean radiator and recheck airflow.</p> <p>Replace radiator shroud. Refer to Cummins engine manual.</p> <p>Reduce load. Operate in lower gear.</p> <p>Replace radiator cap.</p> <p>Inspect and reinstall or replace fan. Refer to Cummins engine manual.</p> <p>See your authorized dealer.</p> <p>Refer to Cummins engine manual.</p> <p>Check for clogged hydraulic oil cooler. See your authorized dealer.</p> <p>Replace thermostats. Refer to Cummins engine manual.</p> <p>Flush the cooling system with cleaner. Refill with water/antifreeze solution.</p> <p>Repair or replace water pump. Refer to Cummins engine manual.</p> <p>See your authorized dealer.</p>

Section 4 MAINTENANCE



TROUBLESHOOTING CHART (Continued)

SYMPTOM	CAUSE	REMEDY
Oil in coolant or coolant in oil.	Leaking cylinder head gasket or liner packings. Cracked cylinder or block.	Refer to Cummins engine manual.
Excessive fuel consumption.	Air system restricted. Fuel system leakage. Incorrect grade of fuel. Internal leakage in hydraulic system.	Clean or replace air filter elements. Refer to Cummins engine manual. Drain and flush fuel tank and refill with correct grade of fuel. Replace fuel filter. Check for clogged hydraulic oil cooler. See your authorized dealer.
No hydraulic power.	Low hydraulic/transmission oil level. Hydraulic filter clogged. Hydraulic pumps or pump drive coupling damaged or excessive leakage in hydraulic system.	Add oil to the hydraulic oil reservoir to the correct level. Replace filter element. See your authorized dealer.
All hydraulic systems function slowly.	Low oil level. Air in hydraulic oil (foamy appearance). Engine rpm low. Hydraulic filter clogged. Low pump flow or excessive leakage in system.	Add oil to the hydraulic oil reservoir to the correct level. Inspect suction side hoses and fittings to pump for leakage. Tighten fittings or replace hoses and fittings as required. Inspect speed control linkage for damage. Repair or replace parts as required and adjust linkage. Replace filter element. See your authorized dealer.
Hydraulic functions make "chattering" noise.	Low oil level. Hydraulic filter restricted. Hydraulic filter relief valve stuck open or setting is too low.	Add oil to the hydraulic oil reservoir to the correct level. Replace filter element. See your authorized dealer.
Hydraulic functions drift or settle.	Cylinder or control valve leakage. Control valve linkage binding or out of adjustment.	See your authorized dealer. Repair and/or adjust linkage.
Control valve sticks or is hard to operate.	Control valve linkage binding Broken return spring in control valve. Contamination in valve bore, scored valve bore, or bent valve spool.	Repair linkage. See your authorized dealer.

TROUBLESHOOTING CHART (Continued)

SYMPTOM	CAUSE	REMEDY
Hydraulics overheat.	<p>Excessive load.</p> <p>Oil cooler clogged.</p> <p>Low oil level.</p> <p>Using low viscosity oil in summer.</p> <p>Transmission or hydraulic internal leakage.</p>	<p>Reduce load.</p> <p>Clean oil cooler and measure air flow.</p> <p>Fill the hydraulic oil reservoir to the correct level.</p> <p>Drain, flush, and fill the hydraulic oil reservoir with the correct oil. Replace the oil filter.</p> <p>See your authorized dealer.</p>
Foaming oil.	<p>Oil level is too high or too low.</p> <p>Incorrect type of oil.</p> <p>Pump suction screen restricted.</p> <p>Air leakage on suction side of pump.</p>	<p>Adjust oil level to full mark on dipstick.</p> <p>Drain, flush, and fill the hydraulic oil reservoir with the correct oil. Replace the oil filter.</p> <p>Clean the screen.</p> <p>Tighten fittings and inspect hoses for damage. Replace damaged hoses.</p>
Hydraulic pump leaking.	<p>Cap screws holding pump housing together are loose.</p> <p>Worn shaft seal.</p>	<p>Tighten screws to torque specification.</p> <p>See your authorized dealer.</p>
Excessive pump noise.	<p>Low oil level.</p> <p>Transmission or hydraulic filter restricted.</p> <p>Aeration of oil - suction side leaking.</p> <p>Oil lines contacting operator's station or frame (clamps or isolators).</p> <p>Worn transmission pump, loose pump drive coupling, loose pump attaching hardware, leakage in hydraulic system (pump remains in stroke), or misalignment between pump and engine.</p>	<p>Fill the hydraulic oil reservoir to the correct level.</p> <p>Replace filter.</p> <p>Tighten fittings and inspect hoses for damage. Replace damaged hoses.</p> <p>Inspect lines, clamps, and isolators. Repair or replace as required.</p> <p>See your authorized dealer.</p>

Section 4 MAINTENANCE



TROUBLESHOOTING CHART (Continued)

SYMPTOM	CAUSE	REMEDY
Starter motor will not turn.	Batteries not charged or bad.	Charge or replace batteries.
	Battery connections.	Clean and tighten battery connections at battery and starter solenoid.
	Starter motor.	Listen for starter solenoid to click when key is placed in the start position. If solenoid clicks, repair or replace starter motor.
	Starter solenoid.	Check for 12 volts at small solenoid connections when key is placed in the start position. If 12 volts is present, replace solenoid.
	Start relay.	Listen for relay to click when key is placed in the start position. If relay does not click, check wiring. Repair or replace as necessary.
	Start system circuit breaker.	Check for 12 volts at both sides of the circuit breaker. If 12 volts is not present on either side, check wiring. If 12 volts is available on one side, replace circuit breaker.
	Key switch.	Check for 12 volts at ignition switch terminal "st" when key is placed in start position. If 12 volts is available, check wiring harness.
	Neutral start switch on pump. replace switch.	Check for 12 volts on both sides of switch with machine in neutral. If 12 volts is available, check wiring harness. If 12 volts is available on one side
	Major engine malfunction.	See authorized dealer.
Starter solenoid chatters.	Bad connections at batteries or solenoid.	Clean and tighten connections.
	Batteries discharged or bad.	Charge or replace batteries.
	Bad solenoid.	Replace solenoid.
Starter motor turns but will not crank engine.	Starter pinion gear not engaging flywheel ring gear.	Pinion shift mechanism jammed. Repair or replace starter motor.
	Pinion gear teeth broken.	Repair or replace starter motor.
	Flywheel ring gear teeth broken.	Replace ring gear.
Engine cranks slowly.	Batteries discharged or bad.	Charge or replace batteries.
	Battery or starter connections loose or corroded.	Clean and tighten connections.
	Battery cables damaged or broken.	Replace cables.
	Starter dragging.	Repair or replace starter motor.

TROUBLESHOOTING CHART (Continued)

SYMPTOM	CAUSE	REMEDY
Starter motor continues to turn after engine starts.	Starter solenoid stuck.	Gently tap solenoid. Replace solenoid.
	Starter pinion gear not disengaging from flywheel.	Gently tap starter motor. Repair or replace starter motor.
	Ignition switch malfunction.	Check for 12 volts at "st" terminal with ignition switch in the ON position. If 12 volts available, replace ignition switch.
Excessive noise when cranking engine.	Broken teeth on flywheel ring gear or starter pinion gear.	Replace starter motor or ring gear.
	Major engine malfunction.	See authorized dealer.
Battery uses too much water.	Battery overcharged.	With batteries fully charged, check alternator charging rate. Repair or replace alternator.
	Cracked or broken battery case.	Replace battery.
Cracked battery case.	Battery hold down clamps too tight, loose or missing.	Replace battery and install hold down clamps properly.
	Frozen batteries.	Keep battery fully charged during cold weather. Replace batteries.
Low battery output.	Low water level.	Fill with distilled water and charge.
	Corroded or loose battery cable connections.	Clean and tighten all connections.
	Broken or loose battery posts.	Replace battery.
	Loose, slipping alternator belt.	Replace alternator belt.
	Low alternator output.	Test and replace alternator.
Alternator warning light stays on or voltmeter shows low charge.	Alternator.	Load test alternator and replace as necessary.
Alternator charging rate to high (batteries hot or boiling).	Alternator.	Load test alternator and replace as necessary.
Noisy alternator.	Alternator bearings.	Remove alternator belt and turn alternator by hand. If pulley turns rough, repair or replace alternator.
	Worn drive belt.	Check and replace belt.
	Internal alternator malfunction.	Repair or replace alternator.
Horn will not sound.	Horn fuse.	Check and replace fuse.
	Horn ground connection.	Check and repair ground connection.
	Horn connection.	Check and repair horn connection.
	Horn is inoperable.	Replace horn.

Section 4 MAINTENANCE



TROUBLESHOOTING CHART (Continued)

SYMPTOM	CAUSE	REMEDY
Machine will not move forward or reverse.	Low hydraulic oil level. Parking brake engaged. Traction foot pedal linkage broken Traction pump malfunctions.	Check and fill reservoir. Release parking brake. Repair or replace linkage. See authorized dealer.
traction foot pedal engaged	Machine jumps when Parking brake sticking. Traction pump malfunction. Transfer case malfunction. Differential (final drive) malfunction. Drive chain malfunction.	Repair parking brake. See authorized dealer. See authorized dealer. See authorized dealer. See authorized dealer.
Machine creeps.	Traction foot pedal misaligned.	Adjust traction foot pedal linkage.
Traction pump responds slowly.	Low hydraulic oil level. Traction pump boost pump malfunction. Traction pump malfunction. Cold oil.	Check and fill reservoir. See authorized dealer. See authorized dealer. Allow machine to warm completely.
Drive selector levers or pedal do not move freely.	Bent, damaged, corroded linkage.	Bent, damaged, corroded Clean, straighten and adjust linkage.
Excessive noise in drive system.	Worn transfer case. Worn traction pump. Worn differential (final drive). Worn drive chains or chain drive. Parking brake dragging.	See authorized dealer. See authorized dealer. See authorized dealer. See authorized dealer. Check parking brake operation.

STORAGE

GENERAL INFORMATION

This section contains instructions to prepare the machine for long-term storage. It also contains the procedures necessary to inspect the machines monthly during storage.

PREPARING MACHINE FOR LONG-TERM STORAGE

1. Inspect the machine thoroughly and repair worn or damaged parts.
2. Retract all hydraulic cylinders, if possible.
3. Shut down engine and remove ignition key.
4. Remove alternator belt.
5. Check air filter restriction gauge. Clean the air cleaner assembly and precleaner. Replace air filter elements if restricted.
6. Clean the machine. Paint chipped or rusty areas to prevent rusting. Replace worn or damaged decals.
7. Cover seat with plastic.
8. Place a "DO NOT OPERATE" tag on the steering wheel.

NOTE: Some rust inhibitors can destroy painted surfaces. Do not spray rust inhibitor on painted surfaces.

9. Coat exposed cylinder rods with rust inhibitor.
10. Lubricate all grease points. Refer to Section 4, MAINTENANCE.
11. Check engine oil level and fill as necessary.
12. Check hydraulic oil sight gauge and fill as necessary.
13. Perform specific gravity test on engine coolant. Drain and replace or fill coolant reservoir as needed to prevent freeze damage.
14. If possible, raise and support machine with tires off the ground or park machine on a hard surface to prevent tires from freezing to ground.
15. Store machine in a dry, protected area. If stored outside, cover with waterproof material.

Section 4 MAINTENANCE

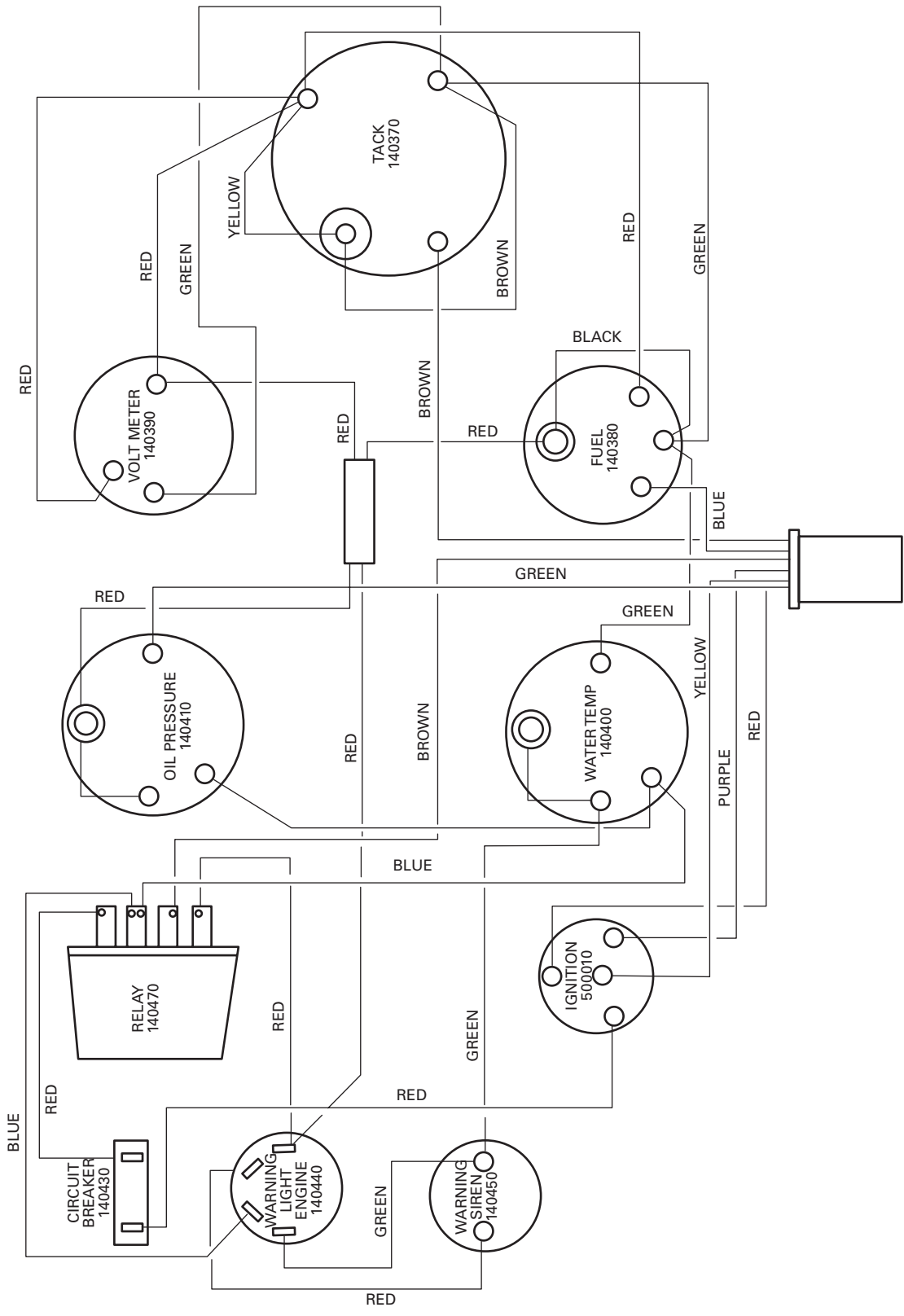


FIGURE 25. WIRING DIAGRAM (INSTRUMENT PANEL)

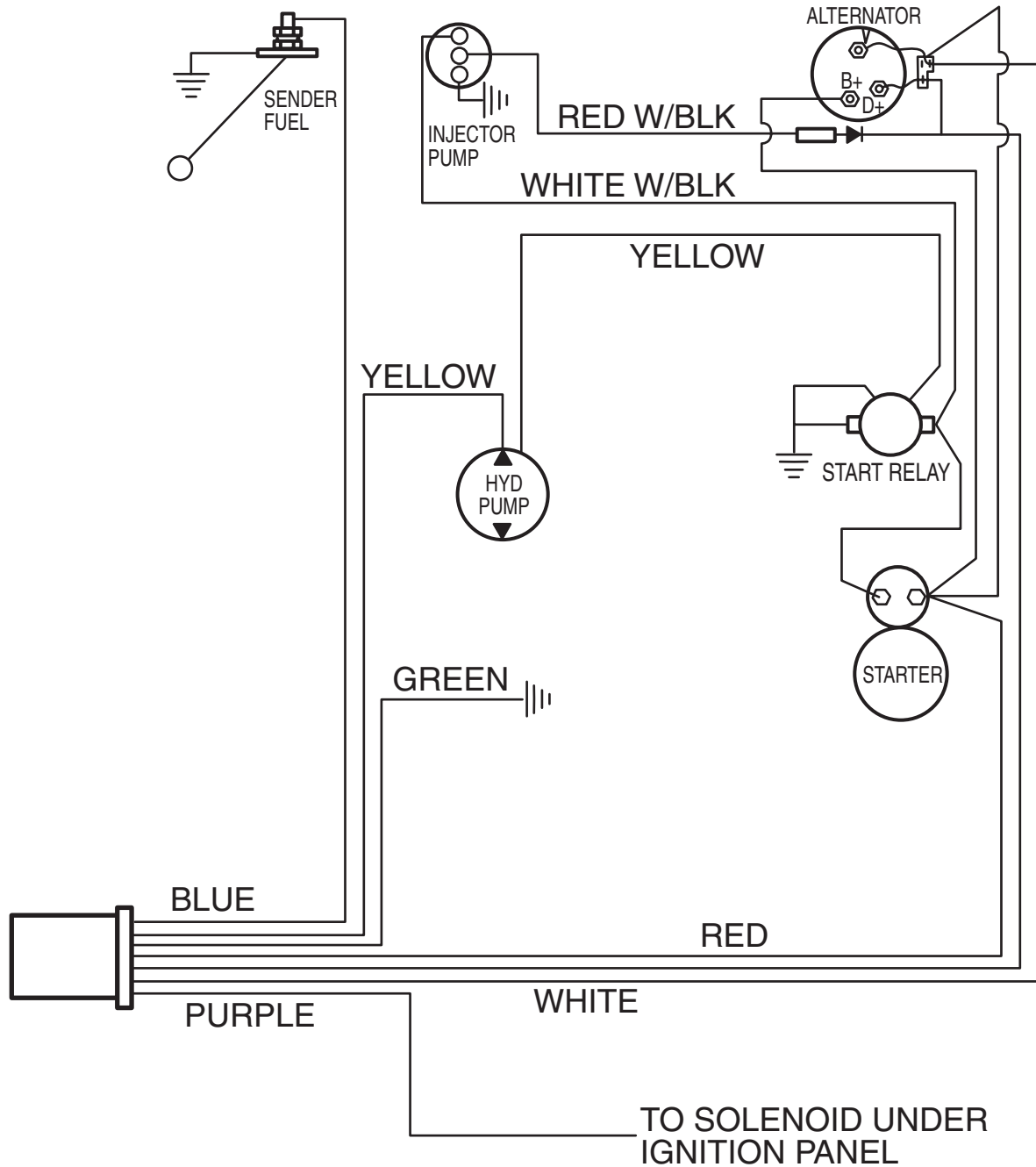


FIGURE 26. WIRING DIAGRAM (ENGINE)

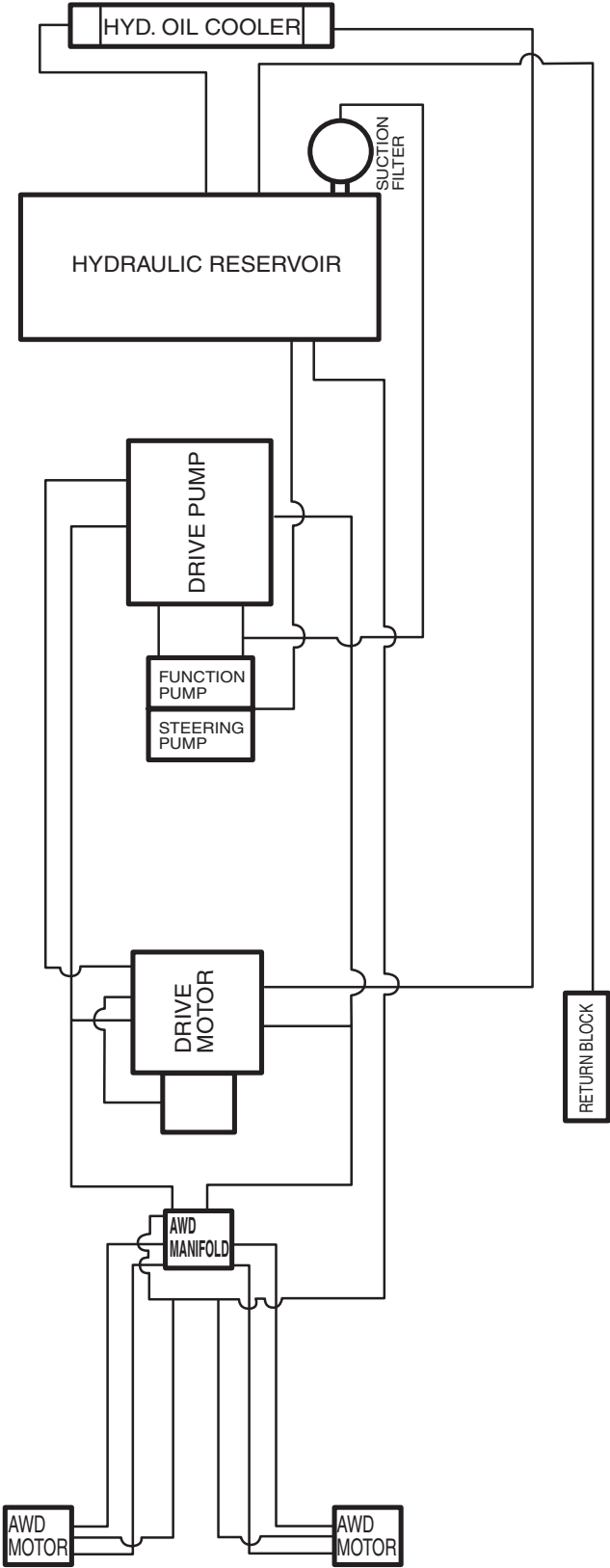


FIGURE 27. HYDRAULIC DIAGRAM, W/FRONT WHEEL ASSIST

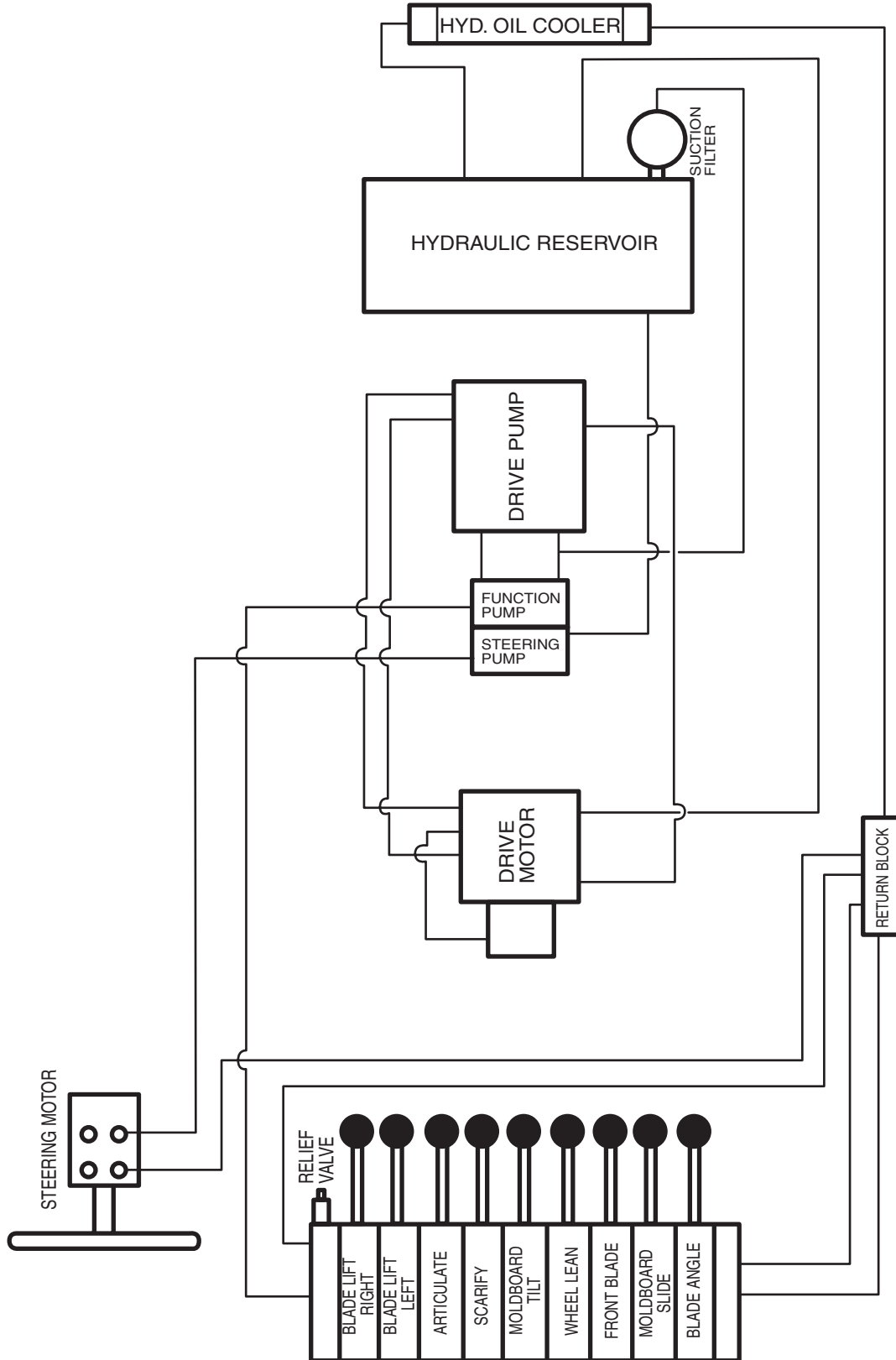


FIGURE 28. HYDRAULIC DIAGRAM, PUMPS, MOTORS, COOLER, & RESERVOIR

Section 4 MAINTENANCE

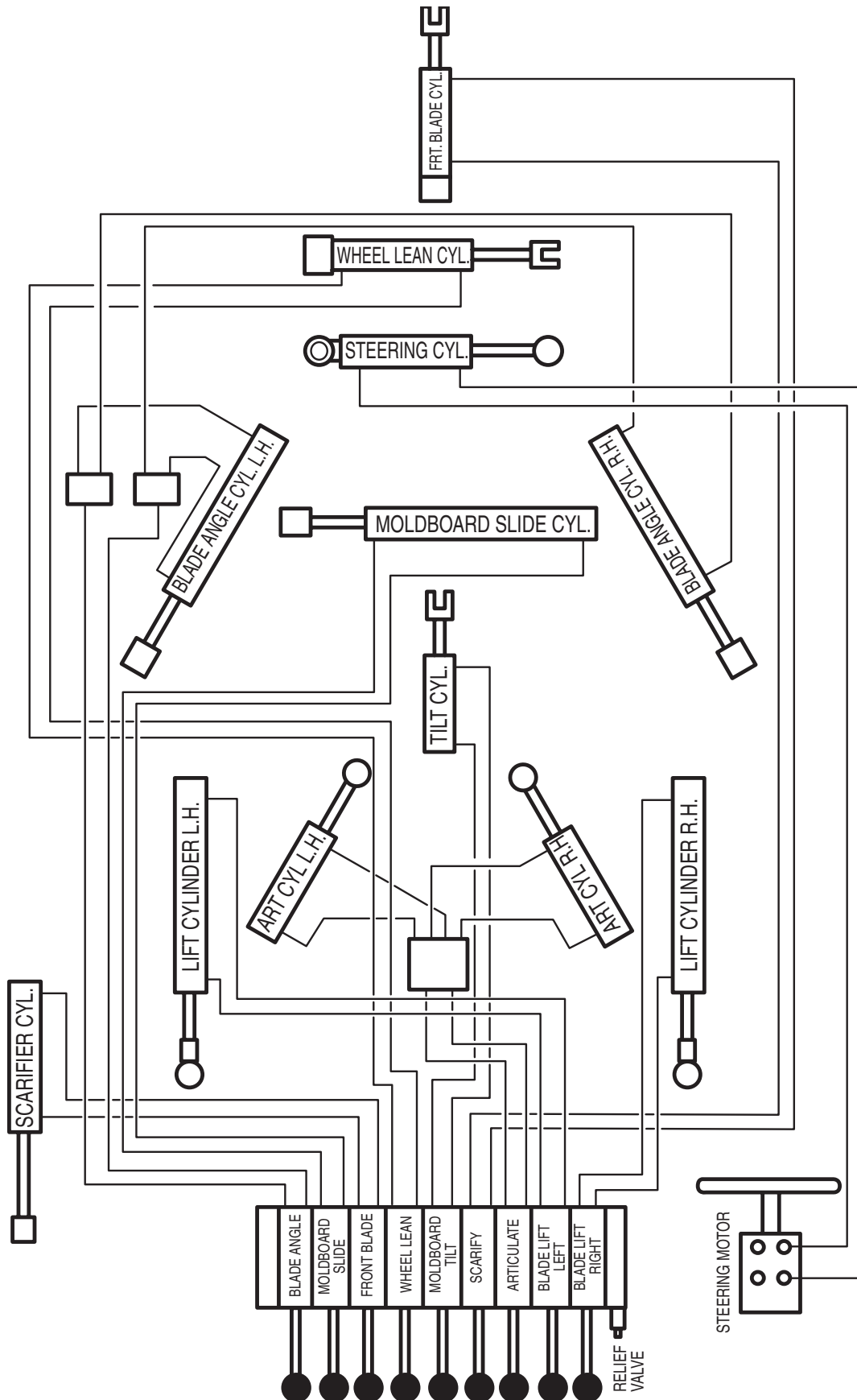


FIGURE 29. HYDRAULIC DIAGRAM CYLINDER FUNCTIONS PLUS STEERING MOTOR

TABLE OF CONTENTS

	Page
FIGURE 1. MAIN FRAME AND BOOM	IPL-2
FIGURE 2. FRONT AXLE ASSEMBLY	IPL-6
FIGURE 3. FRONT WHEEL ASSIST	IPL-10
FIGURE 4. CHAIN BOX ASSEMBLY	IPL-14
FIGURE 5. TURNTABLE AND MOLDBOARD ASSEMBLY	IPL-18
FIGURE 6. FRONT BLADE AND SCARIFIER	IPL-22
FIGURE 7. CAB ASSEMBLY	IPL-24
FIGURE 8. BUCKET LOADER ASSEMBLY	IPL-26
FIGURE 9. HOOD, GRILLE, BATTERY BOX, BATTERY AND TANK	IPL-28
FIGURE 10. CATERPILLAR HOOD, GRILLE, BATTERY BOX, BATTERY AND TANK	IPL-30
FIGURE 11. HOOD, MUFFLER AND COMPONENTS	IPL-32
FIGURE 12. RADIATOR AND HYDRAULIC OIL COOLER	IPL-34
FIGURE 13. AIR CLEANER ASSEMBLY	IPL-36
FIGURE 14. STEERING WHEEL, CONTROL CONSOLE AND SEAT	IPL-38
FIGURE 15. WIRING CONTROL PANEL	IPL-40
FIGURE 16. CONTROL LEVERS AND INSTRUMENTATION	IPL-42
FIGURE 17. ENGINE, ENGINE MOUNTING, HYDRAULIC PUMPS PLUS OTHER ENGINE COMPONENTS	IPL-44
FIGURE 18. CATERPILLAR ENGINE	IPL-46
FIGURE 19. VALVE BANK ASSEMBLY	IPL-48
FIGURE 20. TWO SPEED RANGE BOX ASSEMBLY	IPL-50
FIGURE 21. CARRIER ASSEMBLY	IPL-52
FIGURE 22. DISC BRAKE DRIVE ASSEMBLY	IPL-54
FIGURE 23. SERVICE BRAKE COMPONENTS	IPL-56
FIGURE 24. FAIL SAFE BRAKE	IPL-58
FIGURE 25. DEAD ENGINE STEERING	IPL-60
FIGURE 26. DECAL PLACEMENT	IPL-62
FIGURE 27. DECALS	IPL-64
FIGURE 28. WIRING DIAGRAM (INSTRUMENT PANEL)	IPL-66
INDEX OF PARTS BY NAME	IPL-68

ILLUSTRATED PARTS LIST

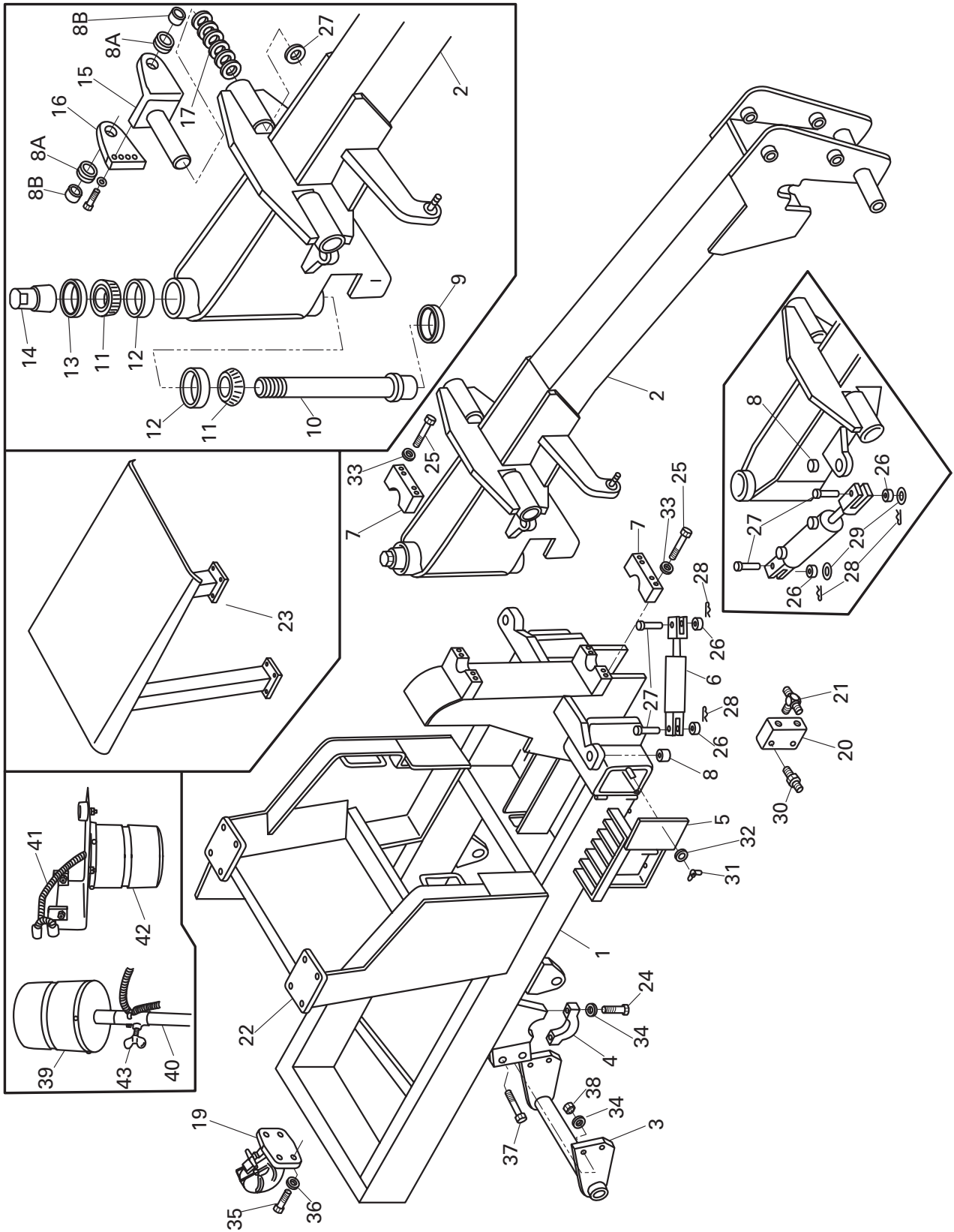


FIGURE 1. MAIN FRAME & BOOM

FIGURE 1. MAIN FRAME & BOOM

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	100014	MAIN FRAME ASSEMBLY(SHOWN WITH CANOPY CAB ATTACHED)	1
2	100024	BOOM ASSEMBLY	1
3	100032	GUARD, DIFFERENTIAL	1
4	100042	CLAMP HALF, REAR AXLE	2
5	100051	DOOR, TOOL BOX	1
6	100060	CYL, HYD, ARTICULATION	2
6A	100060-1	SEAL KIT, HYD. CYL.	1
7	100071	CLAMP HALF, ARTICULATING SHAFT	2
8	220360	BUSHING	4
8A	100080A	BUSHING	4
8B	100080B	BUSHING	4
9	100090	SEAL	2
10	100102	SHAFT, ARTICULATION	1
11	100110	BEARING CONE	2
12	100120	BEARING CUP	2
13	100090	SEAL	1
14	100141	NUT, ARTICULATING SHAFT	1
15	100152	MOUNT, LIFT CYLINDER	2
16	100161	RETAINER, LIFT CYLINDER	2
17	100170	BUSHING, CYLINDER LIFT	12
18	100250	WASHER, FLAT	2
19	100180	PINTLE HOOK	1
20	100190	CHECK VALVE, ARTICULATION LOCK	1
21	35494	FITTING, HYD.	1
22	100214	CAB, CANOPY (USED WITH CANOPY ONLY)	1
23	100204	CANOPY, CAB	1
24	100230	CSHH, .750-16 X 3.75 GR8	4
25	100240	CSHH, .625-18 X 4.50 GR8	8
26	930041	BUSHING, HYD. CYL. CLEVIS	2
27	210060	PIN, CLEVIS	4
28	80338	PIN, COTTER	4
29	80706	WASHER, FLAT	4
30	859443	ADAPTER, HOSE, W/.063 ORIFICE	2
31	920070	SCREW, WING, .375-16 X 1.00	1
32	119-3	WASHER, FLAT, SAE, .375	1
33	118-7	WASHER, LOCK, .625	4
34	118-8	WASHER, LOCK, .750	8
35	102-407-1A	CSHH, .500-13 X 1.50	4

THIS PAGE
INTENTIONALLY
LEFT BLANK

FIGURE 1. MAIN FRAME & BOOM CONT.

FIG ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASSY
		123456	
36	118-5	WASHER, LOCK, .500	4
37	102-713-1A	CSHH, .750-10 X 3.50	4
38	116-8	NUT, HEX, .750-10	4
39	211748-02	BEACON (CAB)	1
40	981133	PIPE (CAB)	1
41	981159SRV	BEACON LIGHT BRACKET (CANOPY)	1
42	210893	BEACON LIGHT (CANOPY)	1
43	981135	SLIDE BRACKET (CAB)	1
	851438	FUSE PANEL (8 GANG)	1

ILLUSTRATED PARTS LIST

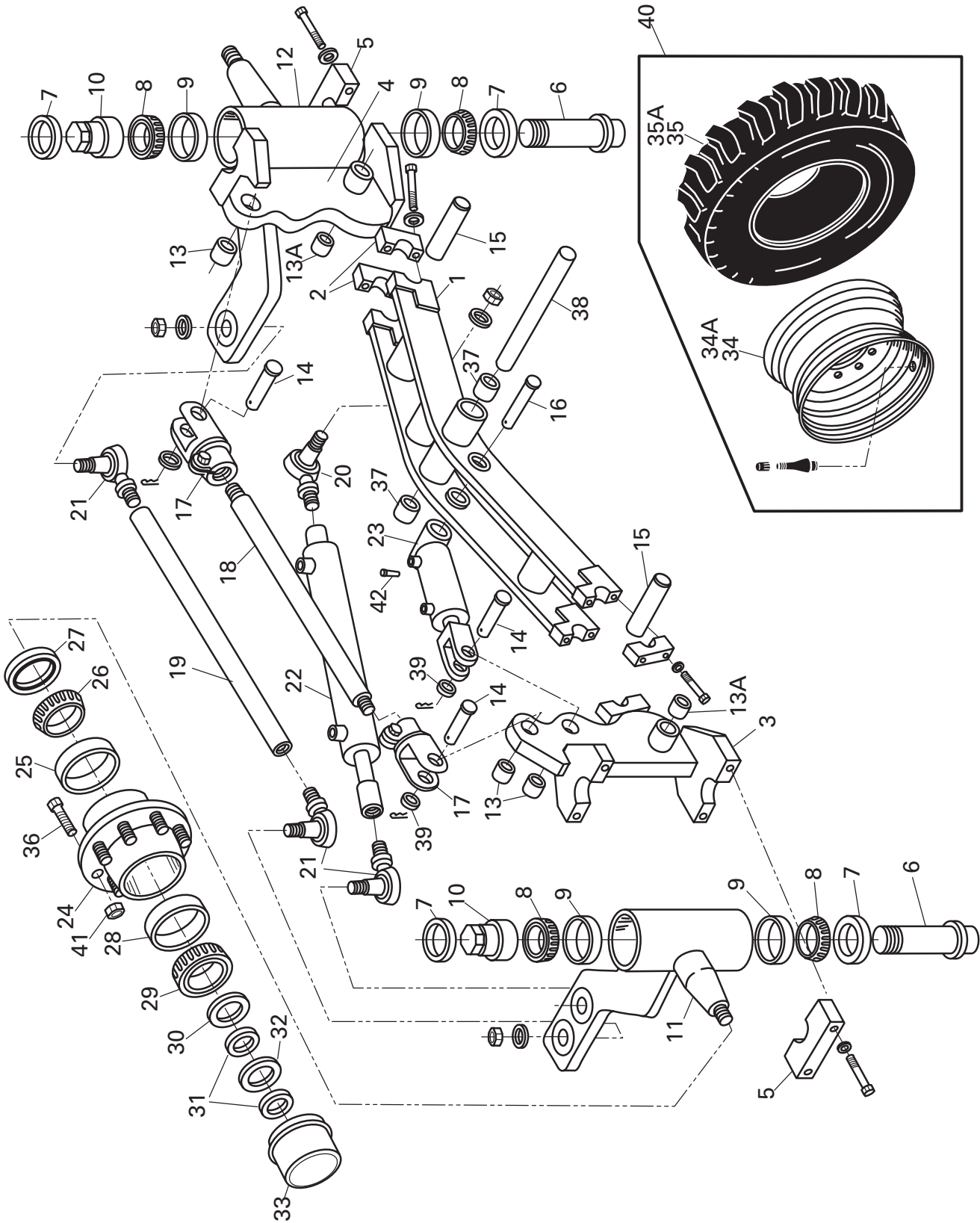


FIGURE 2. FRONT AXLE ASSEMBLY

FIGURE 2. FRONT AXLE ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	110014	AXLE ASSY, FRONT	1
2	110021	CLAMP HALF, SPINDLE MOUNT	4
3	110033SRV	SPINDLE MOUNT, FRONT, RH	1
4	110043SRV	SPINDLE MOUNT, FRONT, LH	1
5	852827	CLAMP HALF, KING PIN	4
6	110061	KING PIN	2
7	210240	SEAL	4
8	210180	BEARING CONE	4
9	210190	BEARING CUP	4
10	110101	NUT, ADJUSTMENT	2
11	110112SRV	SPINDLE ASSY, RH	1
12	110122SRV	SPINDLE ASSY, L.H	1
13	110130	BUSHING	3
13A	110130A	BUSHING	4
14	110141	PIN	3
15	110151	SHAFT, FRONT WHEEL LEAN	2
16	110161	PIN	1
17	110170	CLEVIS	2
18	110182	ROD, WHEEL LEAN TIE	2
19	110192	ROD, WHEEL LEAN TIE	1
20	110200	BALL JOINT, L.H.	3
21	110210	BALL JOINT, R.H.	1
22	110220	CYL, HYD, STEERING	1
22A	130050-1	SEAL KIT, HYD. CYL.	1
23	110230	CYL, HYD, WHEEL LEAN	1
23A	110230-1	SEAL KIT, HYD. CYL.	1
24	110240A	HUB, FRONT WHEEL	1
25	110250	BEARING CUP, INNER	1
26	110260	BEARING CONE, INNER	1
27	110270	SEAL	1
28	610200	BEARING CUP, OUTER	1
29	610210	BEARING CONE, OUTER	1
30	110300	WASHER, HEAVY	1
31	110310	NUT, FRONT SPINDLE	1
32	110320	WASHER, LOCKING	1
33	110330	GREASE CAP	1
34	120330	RIM, 12" X 19.5"	2
34A	120330A	RIM, 15" X 10"	

THIS PAGE
INTENTIONALLY
LEFT BLANK

FIGURE 2. FRONT AXLE ASSEMBLY CONT.

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
35	110340	TIRE	2
35A	110340A	TIRE, GOOD YEAR SOFTRAC 36" X 13.5" X 15"	
36	110350A	STUD, FRONT HUB	8
37	210010	BUSHING, CENTER PIVOT	4
38	110361	SHAFT, CENTER PIVOT	1
39	110130B	BUSHING, CLEVIS	2
40	A120330R	ASSY TIRE & WHEEL RIGHT SIDE	3
41	120350A	NUT, LUG	16
42	72161	ROLL PIN, .375 X 3.00	1
	A120330L	ASSY. TIRE & WHEEL LEFT SIDE	3

ILLUSTRATED PARTS LIST

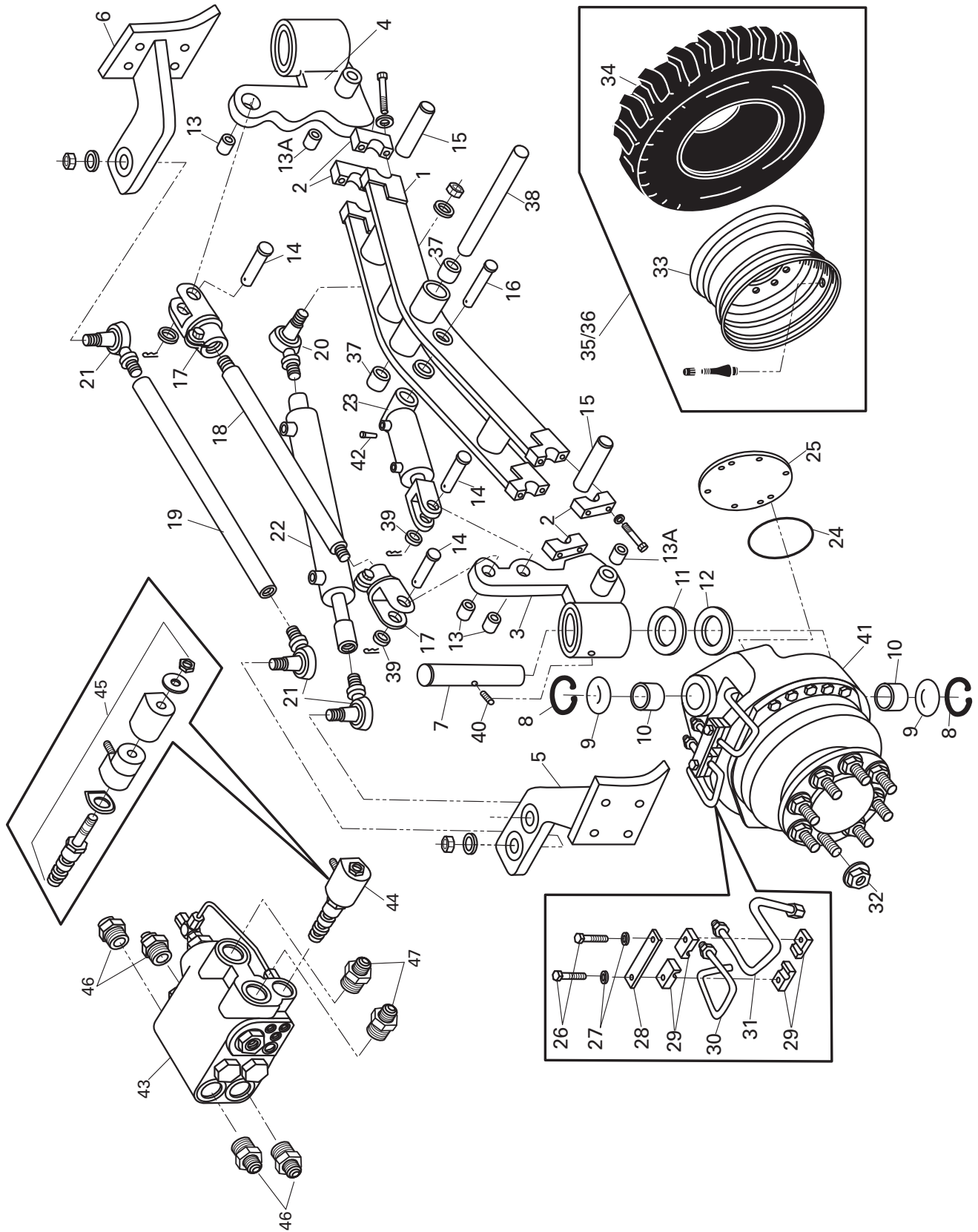


FIGURE 3. FRONT WHEEL ASSIST

FIGURE 3. FRONT WHEEL ASSIST

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	986369	AXLE ASSY, FRONT, AWD	1
2	857377	CLAMP HALF, SPINDLE MOUNT, AWD	4
3	986366	SPINDLE MOUNT, RH	1
4	986365	SPINDLE MOUNT, LH	1
5	986364	STEERING ARM ASSY, RH	1
6	986363	STEERING ARM ASSY, LH	1
7	BL30000-06	SHAFT, KING PIN	2
8	BL30000-04	SNAP RING	4
9	BL30000-05	PLUG	4
10	BL30000-07	BUSHING, KING PIN	4
11	BL30000-08	WASHER THRUST	2
12	BL30000-09	WASHER, FLAT	2
13	110130	BUSHING	3
13A	110130A	BUSHING	4
14	110141	PIN	3
15	857368	SHAFT, FRONT WHEEL LEAN	2
16	110161	PIN	1
17	110170	CLEVIS	2
18	859375	ROD, WHEEL LEAN TIE	2
19	110192	ROD, WHEEL LEAN TIE	1
20	110200	BALL JOINT, LH	3
21	110210	BALL JOINT, RH	1
22	110220	CYL, HYD, STEERING	1
22A	130050-1	SEAL KIT, HYD. CYL. (NOT SHOWN)	1
23	110230	CYL, HYD, WHEEL LEAN	1
23A	110230-1	SEAL KIT, HYD. CYL.	1
24	BL30000-01	O-RING	2
25	BL30000-02	COVER	2
26	102-109-1A	CSHH, .312 - 18 X 2.00	4
27	118-2	WASHER, LOCK, .312	4
28	BL30000-11	BAR, TUBE CLAMP	2
29	BL30000-12	CLAMP HALF	8
30	BL30000-13	TUBE	2
31	BL30000-14	TUBE	2
32	120350A	NUT, LUG	16
33	120330B	WHEEL RIM	2
34	110340	TIRE, STANDARD	2
34A	110340A	TIRE, OPTIONAL TURF	2

THIS PAGE
INTENTIONALLY
LEFT BLANK

FIGURE 3. FRONT WHEEL ASSIST CONT.

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
35	A120330AL	TIRE & WHEEL ASSY, LH	1
35A	110340A	TIRE, GOOD YEAR SOFTRAC 36" X 13.5" X 15"	2
36	A120330AR	TIRE & WHEEL ASSY, RH	1
37	210010	BUSHING, CENTER PIVOT	4
38	110361	SHAFT, CENTER PIVOT	1
39	110130B	BUSHING, CLEVIS	2
40	BL30000-15	SET SCREW	2
41	BL30000-10	MOTOR, HYD, FRONT WHEEL DRIVE ASSIST	2
42	72161	ROLL PIN, .375 X 3.00	1
43	BL30000-16	MANIFOLD, EQUA-TRAC, AWD	1
44	BL30000-17	SOLENOID VALVE, EQUA-TRAC	1
45	BL30000-18	COIL, SOLENOID VALVE	1
46	X280	FITT, STR, 10MJ-12MB	4
47	71775	FITT, 90, 12MJ-12MB	2

ILLUSTRATED PARTS LIST

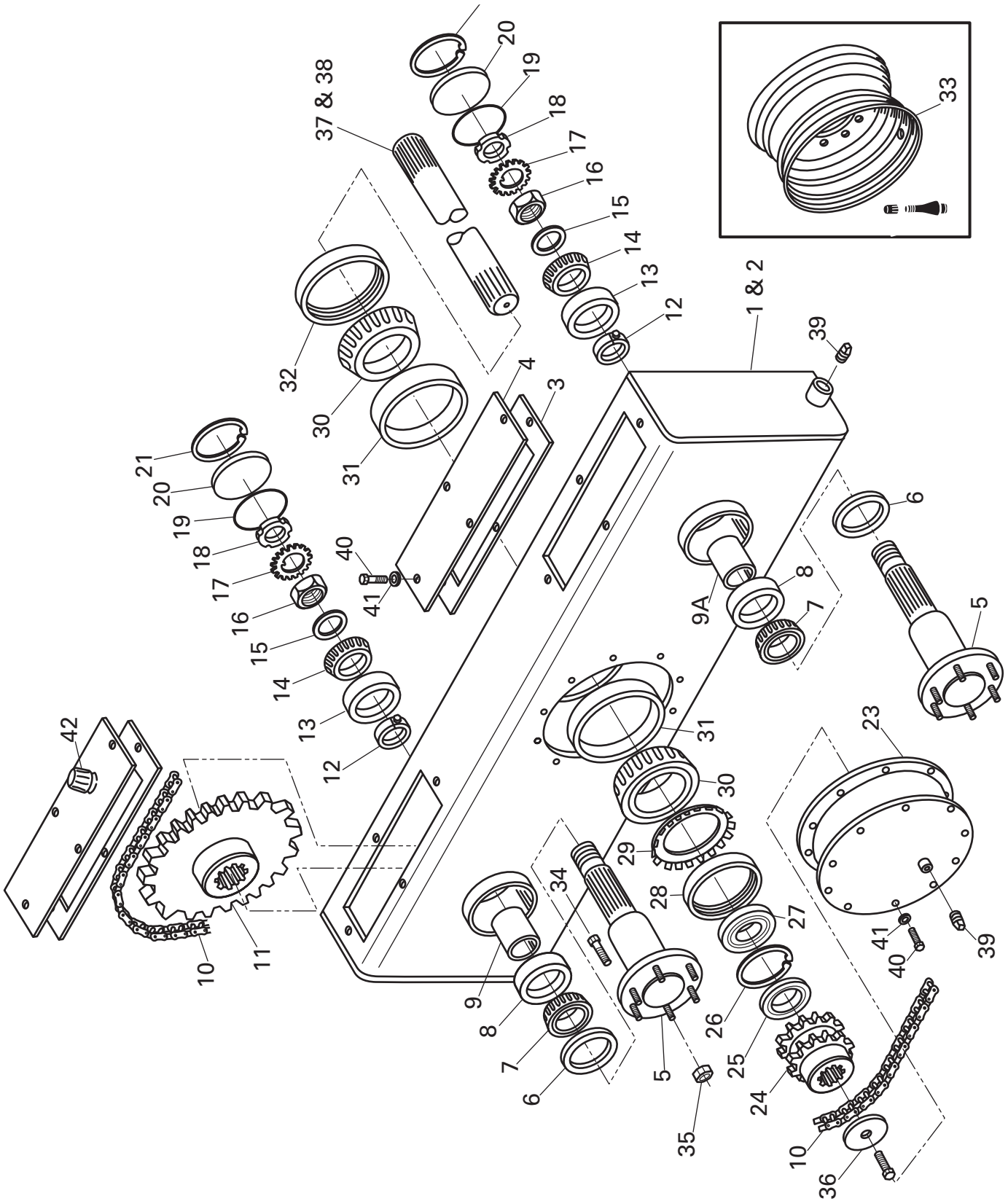


FIGURE 4. CHAIN BOX ASSEMBLY

FIGURE 4. CHAIN BOX ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	120014R	CHAIN BOX, RH	1
2	120024L	CHAIN BOX, LH	1
3	120030	GASKET, SERVICE COVER	2
4	120041	COVER, SERVICE	2
5	120052A	AXLE ASSY, TANDEM, 685B, FROM SERIAL #487	2
6	120060A	SEAL, TANDEM AXLE, FROM SERIAL #82	8
7	210180A	BEARING CONE	2
8	210190A	BEARING CUP	2
9	120091L	SPACER, 5"	1
9A	120091S	SPACER, 4 5/16"	1
10	120100A	CHAIN, #120 FROM, SERIAL #82	A/R
11	120110A	SPROCKET, 30 TOOTH, FROM SERIAL #82	2
12	120120	COLLAR, LOCK	2
13	620090	CUP, AXLE INNER	2
14	620080	CONE, AXLE INNER	2
15	210020	THRUST WASHER	2
16	120310	NUT, HEX	2
17	210170	WASHER, LOCK	2
18	210160	LOCK NUT	2
19	120160	'O' RING	2
20	120171	CAP	2
21	120180	RING, SNAP	2
22	120191	COVER, INSPECTION	2
23	120200	GASKET, INSPECTION COVER	2
24	120210A	SPROCKET, DOUBLE SINGLE FROM SERIAL #82	1
25	120220	SEAL	1
26	120230	SNAP RING	1
27	120240	BEARING, SEALED	1
28	120250	NUT, LOCK	1
29	120260	WASHER, LOCK	1
30	120270	BEARING CONE	1
31	120280	BEARING CUP	1
32	120290	SEAL	1
33	120330	RIM, 12" X 19.5"	1
34	110350A	STUD, WHEEL	8
35	120350A	NUT, LUG	8
36	120360	WASHER, FLAT	1
37	120301L	AXLE, MAIN DRIVE L.H. (LONG) 25 1/4" LONG	1

THIS PAGE
INTENTIONALLY
LEFT BLANK

FIGURE 4. CHAIN BOX ASSEMBLY CONT.

FIG ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASSY
		123456	
38	120301R	AXLE, MAIN DRIVE R.H. (SHORT) 24 1/4" LONG	1
39	99537	PIPE PLUG, .500	2
40	102-205-1A	CSHH, .375-16 X 1.00	18
41	118-3	WASHER, LOCK, .375	18
42	620050	BREATHER	2

ILLUSTRATED PARTS LIST

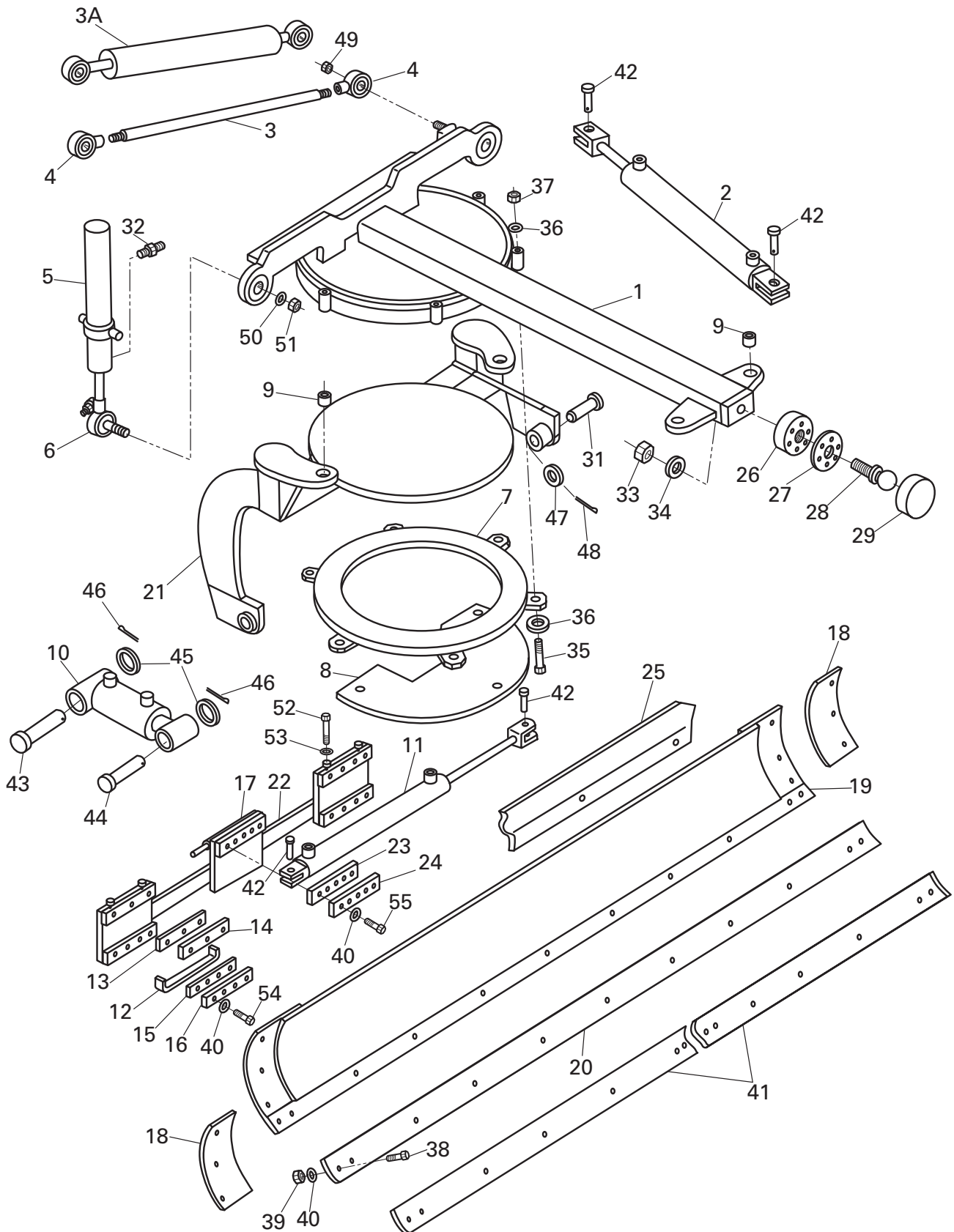


FIGURE 5. TURNTABLE AND MOLDBOARD ASSEMBLY

FIGURE 5. TURNTABLE AND MOLDBOARD ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	130014-1	DRAWBAR ASSEMBLY, TURNTABLE	1
2	130020	CYL, HYD, MOLDBOARD ANGLE	2
2A	130050-1	SEAL KIT, HYD CYL	1
3	130031	ROD, STABILIZER	1
3A	852620	CYL, HYD, MOLDBOARD CIRCLE SHIFT (OPT.)	1
4	130040	BALL JOINT, MOLDBOARD STABILIZER	2
5	130050	CYL, HYD, MOLDBOARD LIFT	2
5A	130050-1	SEAL KIT, HYD, CYL.	1
6	130060	BALL JOINT, MOLDBOARD LIFT CYLINDER	2
7	130073	TURNTABLE	1
8	130083	COVER, TURNTABLE BOTTOM	1
9	220360	BUSHING	6
10	130100	CYL, HYD, MOLDBOARD TILT	1
10B	130100-1	SEAL KIT, HYD,CYL.	1
11	130110	CYL, HYD, MOLDBOARD SLIDE	1
12	130121	SPACER	2
13	130130	SHIM, 3 HOLE UPPER	2
14	130141	CLAMP, UPPER	2
15	130150	SHIM, 4 HOLE LOWER	2
16	130161	CLAMP, LOWER	2
17	857599	BLOCK, SPACER	1
18	130180	END BIT, L.H. & R H	1
19	130204	MOLDBOARD ASSY, 10'	1
20	130210	CUTTING EDGE, MOLDBOARD, 10'	1
21	130224	MOUNTING ASSEMBLY, TURNTABLE, MOLDBOARD	1
22	130243	SLIDE ASSEMBLY, MOLDBOARD SUPPORT	1
23	130251	SHIM	1
24	130261	CLAMP, SPACER BLOCK	1
25	130172	ROCK/DIRT SHIELD, MOLDBOARD	1
26	130101	HOUSING, BALL SWIVEL	1
27	130104	SHIM, .030, DRAWBAR PULL BALL	3
27A	130103	SHIM, .023, DRAWBAR PULL BALL	3
27B	130105	SHIM, .055, DRAWBAR PULL BALL	3
28	130106	BALL, DRAWBAR PULL	1
29	130102	SOCKET HALF, DRAWBAR PULL BAR	1
31	130231	PIN, TURNTABLE TO SLIDE	2
32	859443	FITTING, W/.063 ORIFICE	2
33	115-11	NUT, HEX 1-1/8"-12	1

THIS PAGE
INTENTIONALLY
LEFT BLANK

FIGURE 5. TURNTABLE AND MOLDBOARD ASSEMBLY CONT.

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
34	118-11	WASHER, LOCK, 1-1/8"	1
35	102-616-1A	CSHH, .625-11 X 3.75	6
36	119-7	WASHER, FLAT, SAE, .625	12
37	143-7	NUT, LOCK, .625-11	6
38	130220	PLOW BOLT, .625-11 X 2.00	A/R
38A	130210-1	BOLT KIT, 10' MOLDBOARD	1
39	116-7	NUT, HEX, .625-11	A/R
40	118-7	WASHER, LOCK, .625	A/R
41	853860	CUTTING EDGE, 6' (12' MOLDBOARD OPT.)	2
42	210060	PIN, CLEVIS, 1.00 X 2.625	6
43	857591	PIN, MOLDBOARD TILT CYL, REAR	1
44	857585	PIN, MOLDBOARD TILT CYL, REAR	1
45	855002	WASHER	2
46	930039	PIN, COTTER, .188 X 2.00	2
47	100250	WASHER	2
48	130232	PIN, COTTER, .250 X 2.25	2
49	143-12	NUT, LOCK, 1.25-7	2
50	81059	WASHER, FLAT, SAE, .875	2
51	80132	NUT, HEX, CASTLE, .875-14	2
52	130120	SET SCREW, SQ. HD., .625-11 X 3.00	4
53	116-7-1	NUT, HEX, JAM, .625-11 X 2.00	4
54	102-609-1A	CSHH, .625-11 X 2.00	4
55	102-615-1A	CSHH, .625-11 X 3.50	16

ILLUSTRATED PARTS LIST

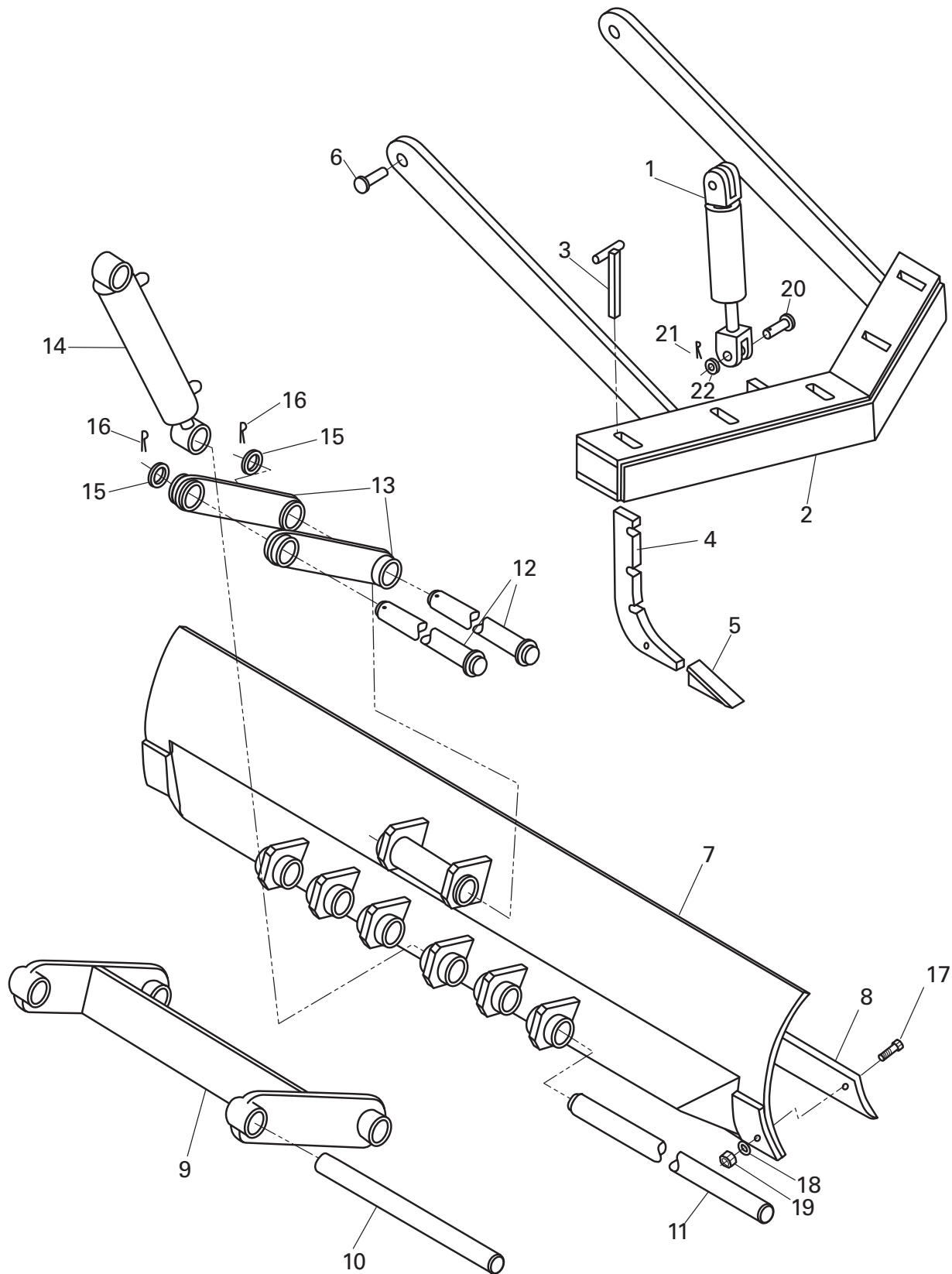


FIGURE 6 .FRONT BLADE AND SCARIFIER

FIGURE 6 .FRONT BLADE AND SCARIFIER

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	132010	CYL, HYD, SCARIFIER LIFT	1
1A	132010-1	SEAL KIT, HYD. CYL.	1
2	132024	FRAME, SCARIFIER	1
3	132031SRV	PIN, LOCK, SCARIFIER SHANK	5
4	132040	SHANK W/ TOOTH, SCARIFIER	5
5	132050	TOOTH, SCARIFIER	5
6	132060	PIN, SCARIFIER FRAME MOUNT	2
7	131014	ASSY, FRONT DOZER BLADE	1
8	131020	CUTTING EDGE, 7', FRONT BLADE	1
9	131033SRV	FRAME, FRONT BLADE LOWER	1
10	131041	SHAFT, LOWER REAR PIVOT	1
11	131051SRV	SHAFT, LOWER FRONT PIVOT	1
12	131061SRV	SHAFT, UPPER PIVOT	2
13	859363SRV	ARM, UPPER PIVOT	2
14	131090	CYL, HYD, FRONT BLADE LIFT	1
14A	130050-1	SEAL KIT, HYD. CYL.	1
15	100250	WASHER, FLAT	2
16	984892	PIN, COTTER, .188 X 2.00	2
17	130220	PLOW BOLT, .625-11 X 2.00	A/R
18	118-7	WASHER, LOCK, .625	A/R
19	116-7	NUT, HEX, .625-11	A/R
20	210060	PIN, CLEVIS, 1.00 X 2.625	2
21	930039	PIN, COTTER, .188 X 2.00	2
22	119-10	WASHER, FLAT, SAE, 1.00	2
-23	982027SRV	FRONT BLADE (OPTION)	AR

ILLUSTRATED PARTS LIST

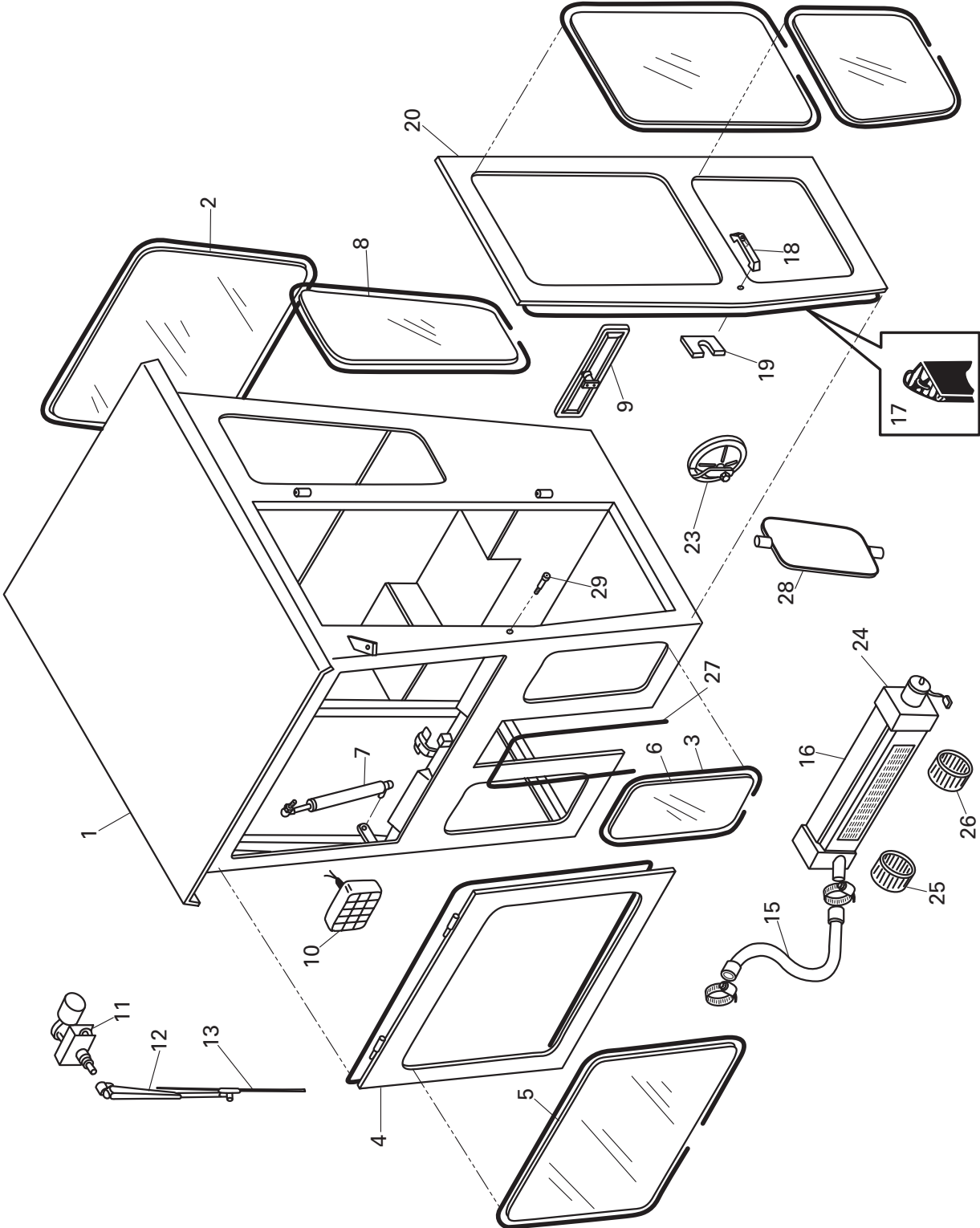


FIGURE 7. CAB ASSEMBLY

FIGURE 7. CAB ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	151000	FRAME, CAB	1
4	151221	FRAME, FRONT WINDSHIELD	1
7	853610	CYL, GAS SPRING SHOCK, WINDSHIELD	2
9	720260	MIRROR, INSIDE REAR VIEW	2
10	160040	HEAD LAMP	2
11	151170	MOTOR, WINDSHIELD WIPER	1
12	151180	ARM, WINDSHIELD WIPER	1
13	151190	BLADE, WINDSHIELD WIPER	1
15	151290	HOSE, DEFROST	2
16	151300	HEATER, CAB	A/R
17	151310	SEAL, DOOR TO CAB WEATHER STRIP	2
18	983220	HANDLE, DOOR	2
19	983219	LATCH, DOOR, LH	1
19A	983423	LATCH, DOOR, RH	1
20	151343	DOOR, SPECIFY L. H. OR R. H.	2
23	151370	MIRROR, OUTSIDE REAR VIEW	2
24	151380	MOTOR, ELECTRIC FAN (HEATER/DEFROST)	2
25	151300-2	FAN BLADE, DEFROSTER	1
26	151300-3	FAN BLADE, HEATER	1
27	720100	SEAL, EDGE TRIM (CAB TO FRAME)	1
28	852570	WEST COAST MIRROR (CAB ONLY)	2
29	983221	BOLT, DOOR LATCH STRIKER	2
		NOT SHOWN	
	211748-02	BEACON LIGHT CAB MACHINE ONLY	A/R
	983221	STRIKER BOLT	A/R
	685060	FUSE PANEL (18 GANG)	A/R
	852560	SNOW PLOW LIGHT KIT CAB MACHINE ONLY	A/R
	853090	WIPER WASHER SWITCH	A/R
	160040A	WORK LIGHT	A/R

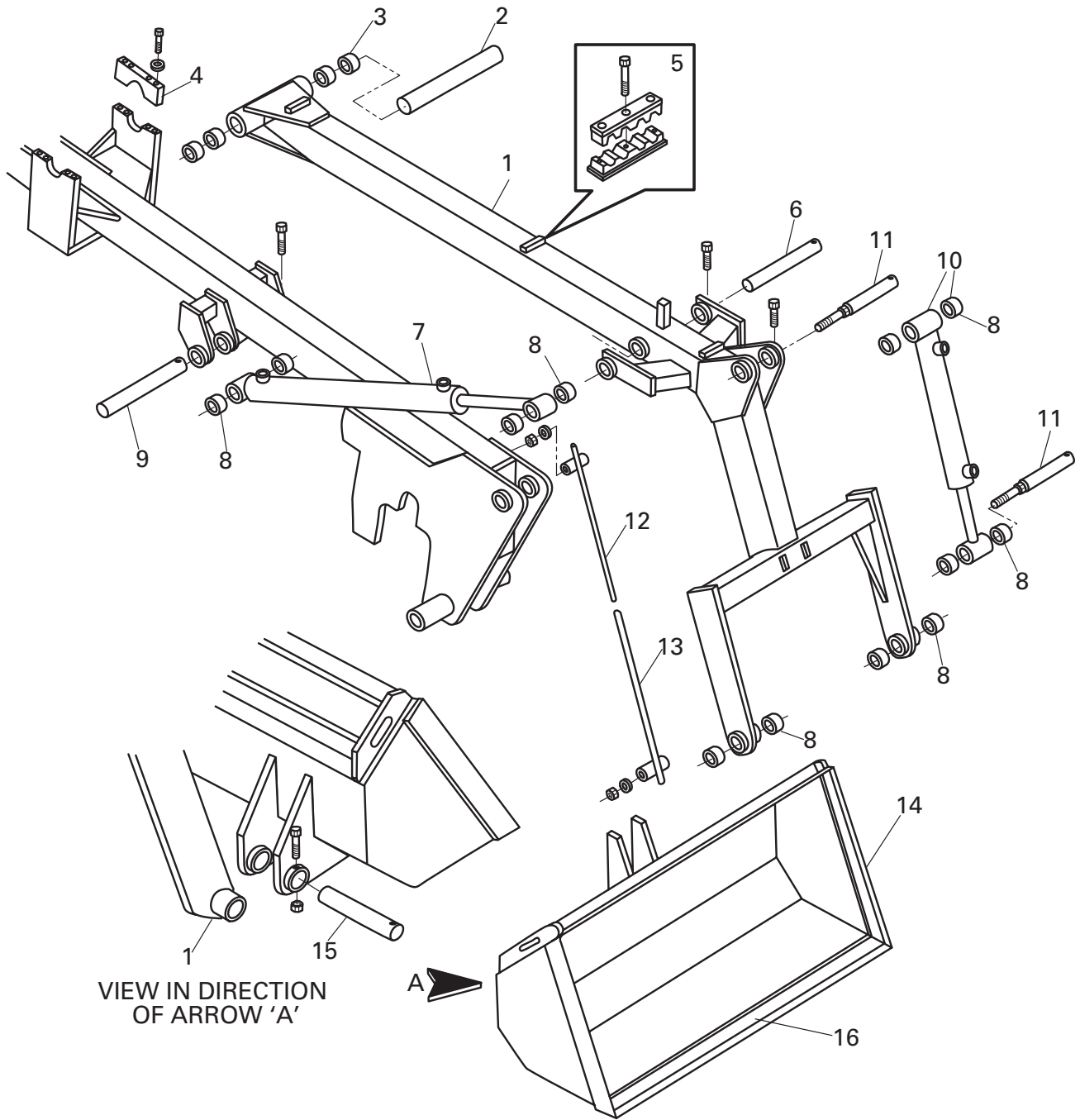


FIGURE 8. BUCKET LOADER ASSEMBLY

FIGURE 8. BUCKET LOADER ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	131100	BOOM	1
2	131111	PIN, BOOM PIVOT	1
3	131120	BUSHING	4
4	131131	SHACKLE, BOOM PIVOT	2
5	131140	CLAMP, HYDRAULIC LINES	2
6	131151	PIN, UPPER END LIFT	1
7	131160	CYL, HYD, BOOM LIFT	2
7A	131160-1	SEAL KIT, HYD. CYL.	1
8	110130A	BUSHING	12
9	131171	PIN, LOWER END LIFT	1
10	131180	CYL, HYD, BUCKET TILT	1
10A	131180-1	SEAL KIT, HYD. CYL.	1
11	131191	PIN, BUCKET TILT	2
12	131201	ROD, BUCKET ANGLE	1
13	131211	TUBE, BUCKET ANGLE	1
14	131224	BUCKET	1
15	131231	PIN, BUCKET PIVOT	2
16	131240	CUTTING EDGE, BUCKET (WELD ON)	1

ILLUSTRATED PARTS LIST

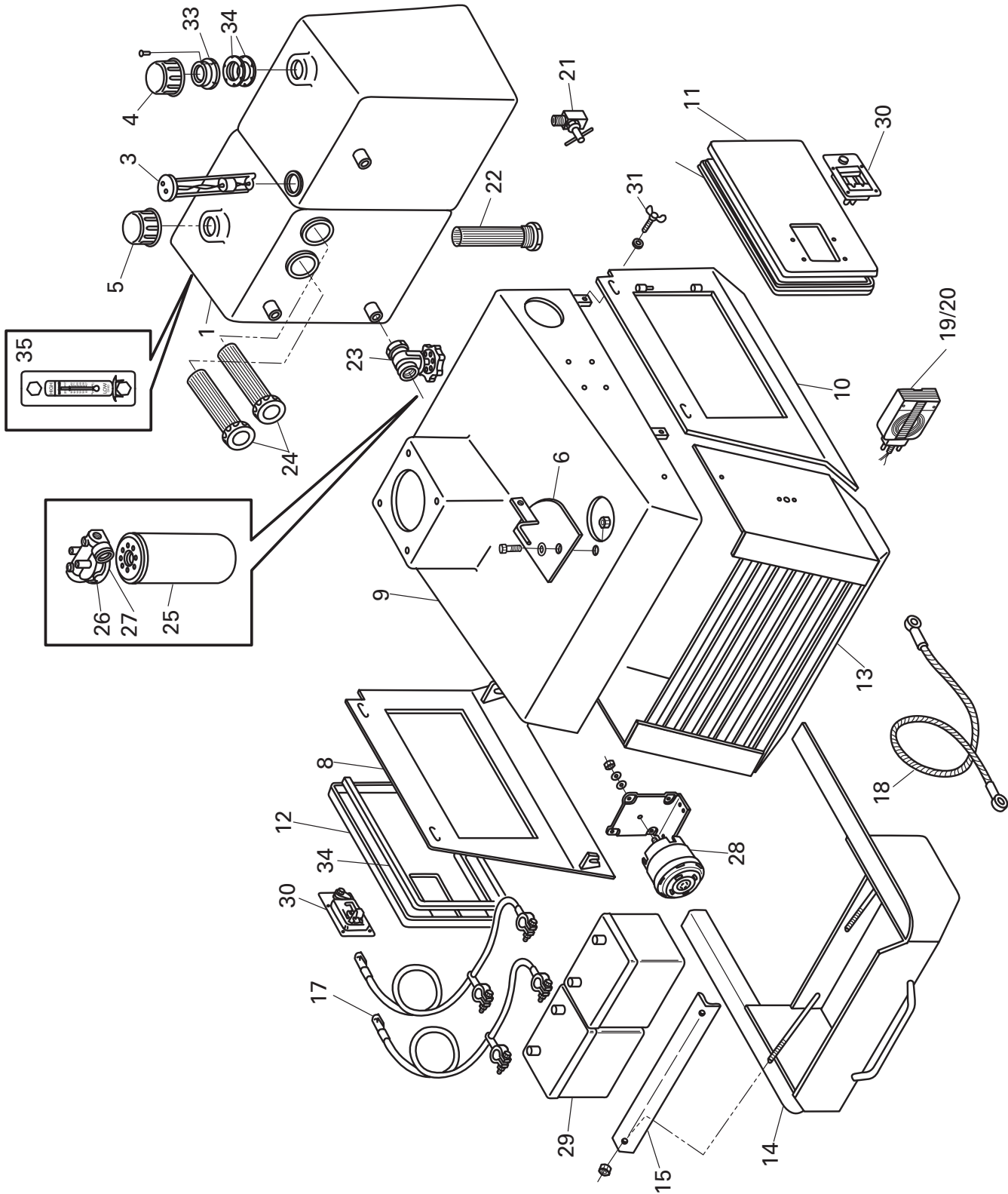


FIGURE 9. HOOD, GRILLE, BATTERY BOX, BATTERY AND TANK

FIGURE 9. HOOD, GRILLE, BATTERY BOX, BATTERY AND TANK

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	853153	TANK ASSY, FUEL & HYD (SN475 AND UP)	1
3	140040	SENDER UNIT, FUEL LEVEL	1
4	140030FL	CAP, FUEL TANK	2
5	140030HL	CAP, HYD. OIL TANK	2
6	160460	LATCH, RADIATOR ACCESS	4
8	140262	PANEL, ENGINE ACCESS L.H.	1
9	140014	HOOD	1
10	140272	PANEL, ENGINE ACCESS R.H.	1
11	140330	DOOR, R.H. ENGINE ACCESS	1
12	140340	DOOR, L.H. ENGINE ACCESS	1
13	150024	GRILLE	1
14	150033	BATTERY TRAY	1
15	150042	BAR, BATTERY HOLD DOWN	1
16	140290	BATTERY CABLE, NEGATIVE	1
17	140300	BATTERY CABLE, POSITIVE	1
18	140310	CABLE, BATTERY TRAY	2
19	160030L	LAMP, L.H. TURN SIGNAL	2
20	160030R	LAMP, R.H. TURN SIGNAL	2
21	230070	NEEDLE VALVE	1
22	910020	STRAINER, HYD. SUCTION	1
23	140640	VALVE, GATE, 1.250	1
24	685010	DIFFUSER, HYD. TANK RETURN	2
25	160060	FILTER ELEMENT, HYD. SUCTION	1
26	160050	FILTER ASSY, HYD. SUCTION	1
27	160070	GAUGE, FILTER RESTRICTION	1
28	160320	HORN, BACK UP ALARM INCLUDES BRACKET	1
29	920152	BATTERY, 12 VOLT 750 CCA GROUP 24	2
30	160450	LATCH, ENGINE ACCESS PANEL	1
31	920070	BOLT, WING	1
32	720100	GASKET, ENGINE ACCESS	2
33	140030FN	FILLER NECK, HYD. / FUEL TANK	2
34	140030GK	BASKET/STRAINER W/GASKETS	2
35	500070	SIGHT GAUGE, HYD. TANK	1

ILLUSTRATED PARTS LIST

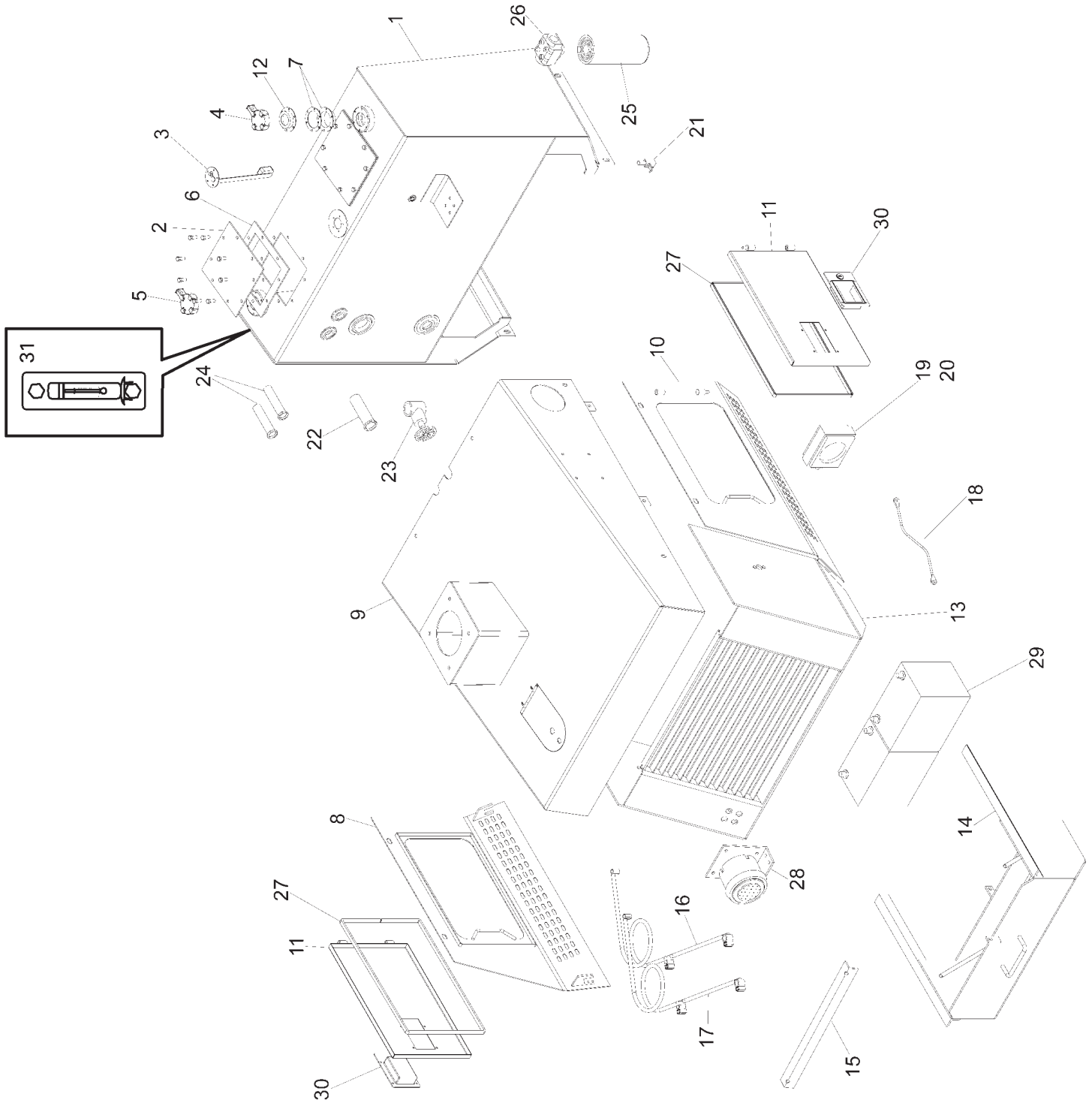


FIGURE 10. CATERPILLAR HOOD, GRILLE, BATTERY BOX, BATTERY AND TANK

FIGURE 10. CATERPILLAR HOOD, GRILLE, BATTERY BOX, BATTERY AND TANK

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	986703	W/M, FUEL/HYD TANK	1
2	853161	TANK, FUEL/HYD, ACCESS COVER	2
3	140040	SENDING UNIT, FUEL LEVEL	1
4	140030FL	CAP, FUEL TANK	1
5	140030HL	CAP, HYD. OIL TANK	1
6	853162	TANK, FUEL/HYD., ACCESS GASKET	2
7	140030GK	BASKET/STRAINER W/GASKETS	2
*8	986717	PLATE, LH, ENGINE COVER	1
*9	986722	ASSY, HOOD, 685 MULTI-ENGINE	1
*10	986716	PLATE, RH, ENGINE COVER	1
11	986711	W/M, DOOR, ENGINE, COVER	2
12	140030FN	FILLER NECK, HYD/FUEL TANK	2
13	150024	GRILLE	1
14	150033	BATTERY TRAY	1
15	150042	BAR, BATTERY HOLD DOWN	1
16	140290	BATTERY CABLE, NEGATIVE	1
17	140300	BATTERY CABLE, POSITIVE	1
18	140310	CABLE, BATTERY TRAY	1
19	160030L	LAMP, LH. TURN SIGNAL	1
20	160030R	LAMP, RH. TURN SIGNAL	1
21	230070	NEEDLE VALVE	1
22	910020	STRAINER, HYD. SUCTION	1
23	140640	VALVE, GATE, 1.250	1
24	685010	DIFFUSER, HYD. TANK RETURN	1
25	290030	FILTER ELEMENT, HYD. CHARGE	1
26	290010	FILTER HEAD, HYD CHARGE/RETURN	1
27	720100	GASKET, ENGINE ACCESS	2
28	160320	HORN, BACK UP ALARM W/BRACKET	1
29	920152	BATTERY, 12 VOLT, 750CCA, GROUP 24	2
30	160450	LATCH, ENGINE ACCESS PANEL	2
31	500070	SIGHT GAUGE, HYD. TANK	1

* SERIAL NUMBER NEEDED FOR THESE PARTS

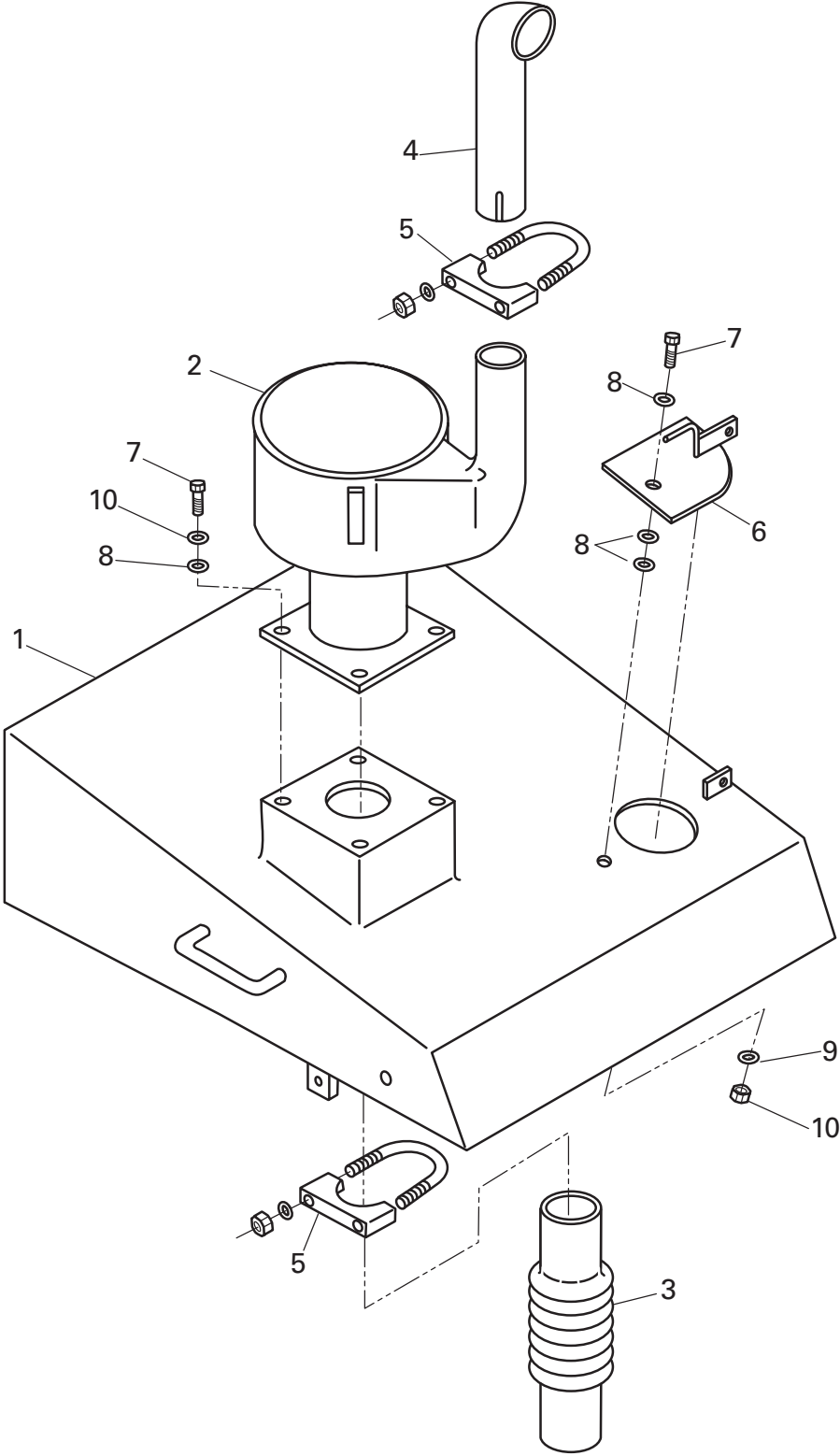


FIGURE 11. TURBO HOOD PACKAGE, MUFFLER AND COMPONENTS

FIGURE 11. TURBO HOOD PACKAGE, MUFFLER AND COMPONENTS

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	140014	HOOD	1
2	988408	MUFFLER, EXHAUST	1
3	160240-12	PIPE, FLEXIBLE EXHAUST (TURBO)	1
4	160010	ELBOW, EXH, 90, 3.00	1
5	161250	CLAMP, MUFFLER, 3.00	3
6	160261	COVER, RADIATOR FILL	1
7	102-205-1A	CSHH, .375-16 X 1.00	5
8	119-3	WASHER, FLAT, SAE, .375	8
9	118-3	WASHER, LOCK, .375	4
10	143-3	NUT, LOCK, .375	1

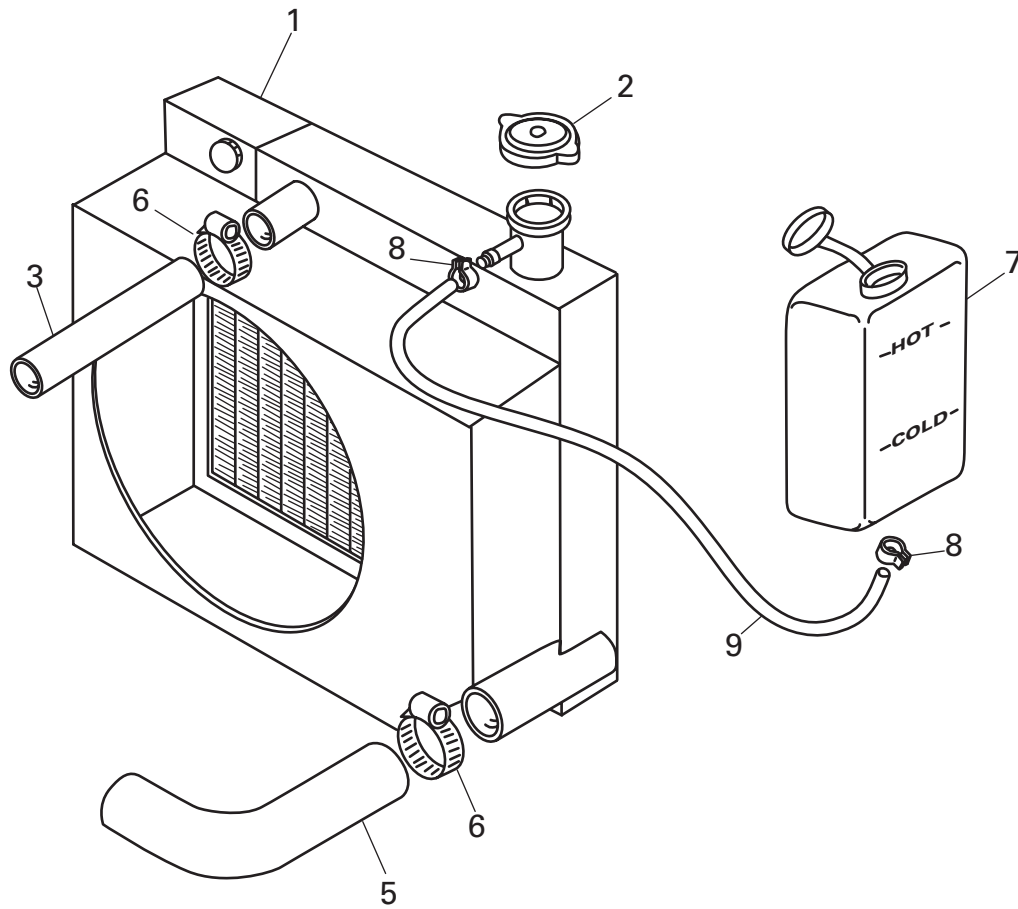


FIGURE 12. RADIATOR AND HYDRAULIC OIL COOLER

FIGURE 12. RADIATOR AND HYDRAULIC OIL COOLER

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	980280	RADIATOR, COOLER	1
2	170120	CAP, RADIATOR	1
3	170071A	HOSE, RADIATOR	1
5	170100A	HOSE, RADIATOR LOWER	1
6	500230	CLAMP, HOSE	2
7	983273	TANK, RADIATOR OVERFLOW	1
8	984130	CLAMP, HOSE	2
9	5LOLA	HOSE	1

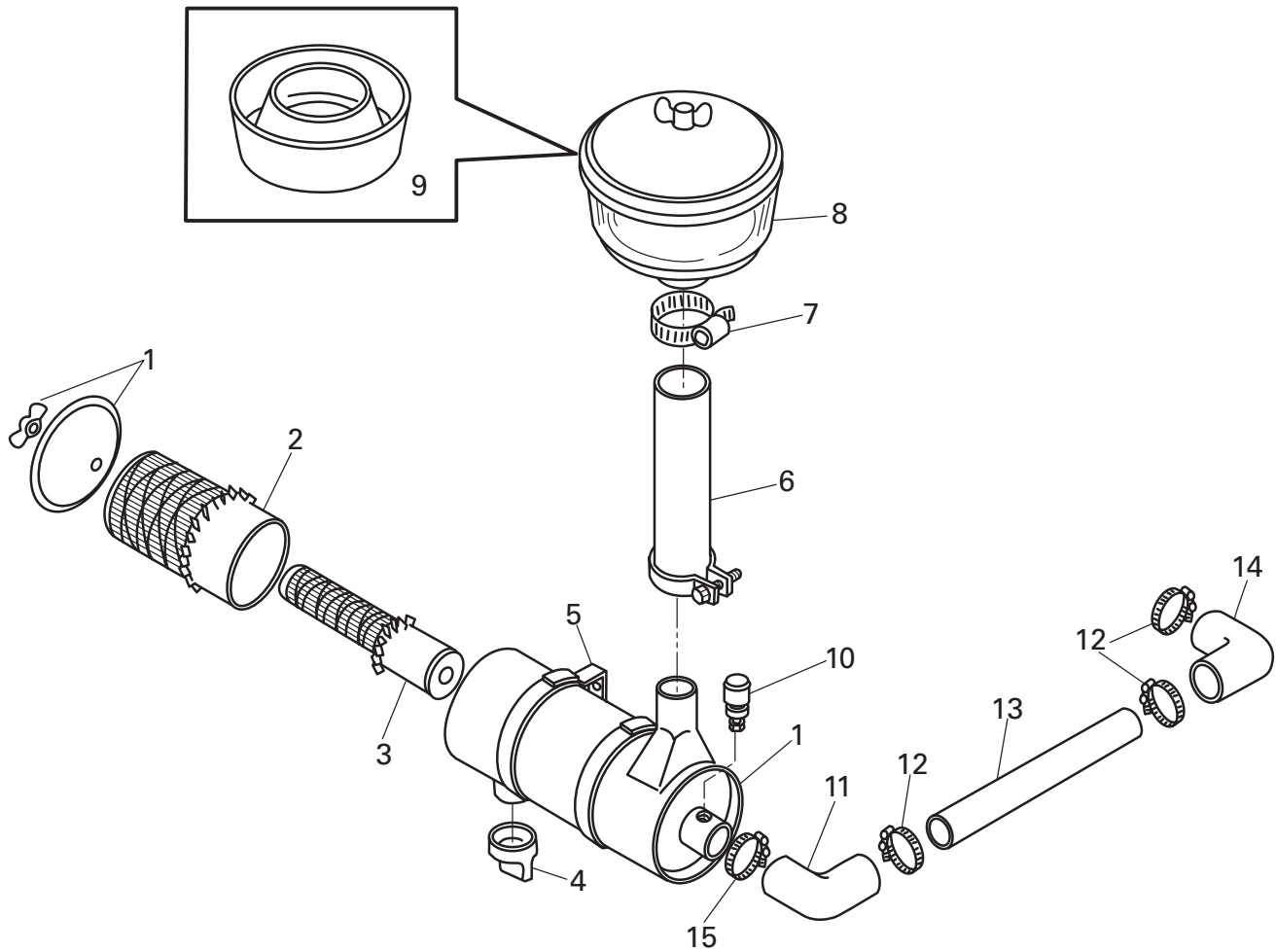


FIGURE 13. AIR CLEANER ASSEMBLY

FIGURE 13. AIR CLEANER ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	171130	AIR CLEANER ASSY.	1
2	171140	ELEMENT, PRIMARY	1
3	171150	ELEMENT, SAFETY	1
4	171040	VACUATOR VALVE	1
5	171100	CLAMP, BAND MOUNTING	2
6	37081	PIPE, AIR INLET, 3.75	1
7	983577	CLAMP, HOSE, SIZE 64	2
8	171160	PRE-CLEANER ASSY.	1
9	171160-1	BOWL, PRE-CLEANER	1
10	171220	INDICATOR,AIR FILTER RESTRICTION	1
11	171170	ELBOW, 3.00 X 3.50	1
12	171090	CLAMP, T-BOLT, 3.00	3
13	171180-28	TUBE, AIR INTAKE, 30D X 27.5, ALUM.	1
14	34031	ELBOW, 3.00	1
15	171190	CLAMP, T-BOLT, 3.50	1

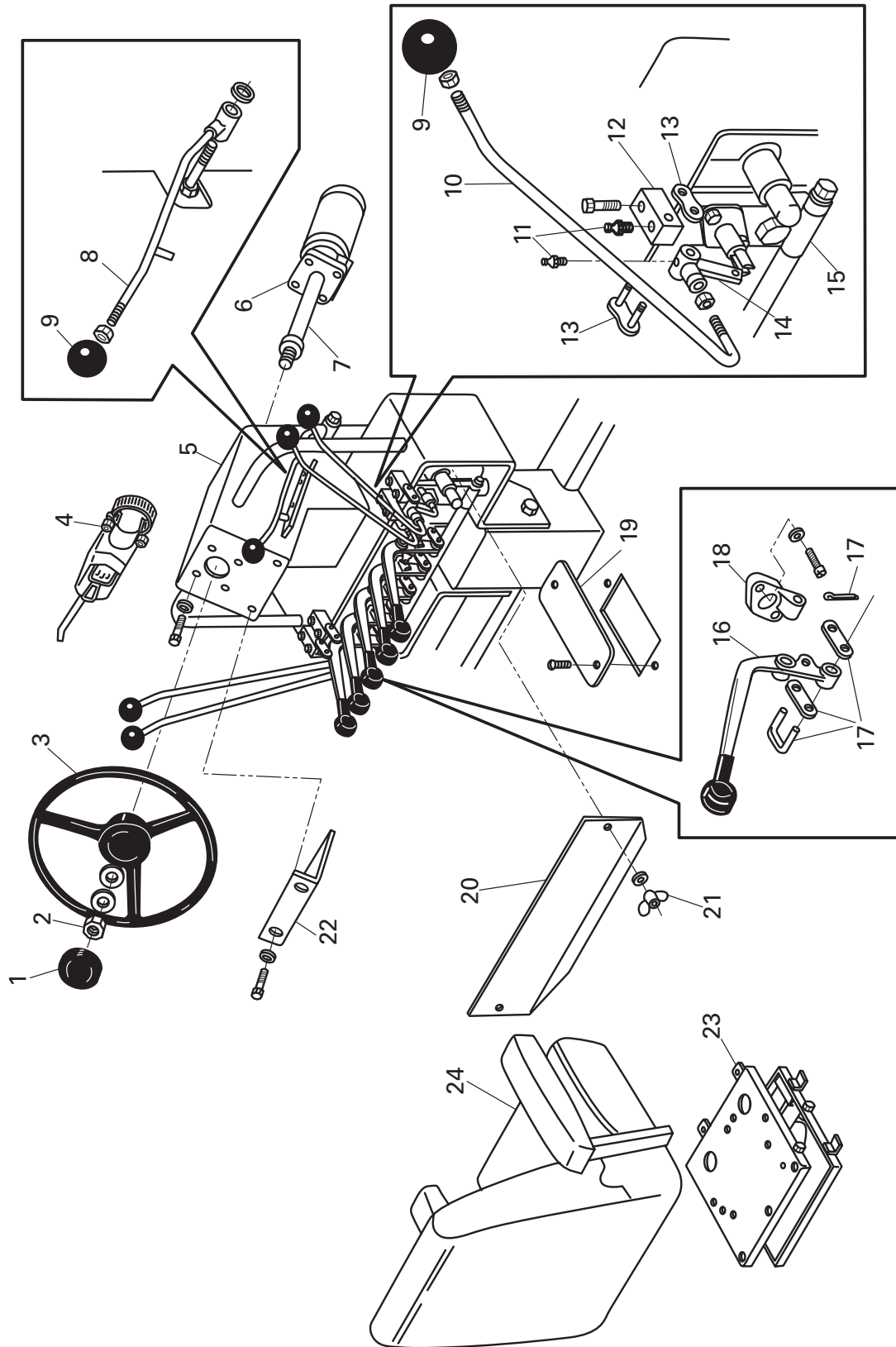


FIGURE 14. STEER WHEEL, CONTROL CONSOLE AND SEAT

FIGURE 14. STEER WHEEL, CONTROL CONSOLE AND SEAT

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	300010	CAP, STEERING WHEEL	1
2	300020	NUT, HEX	1
3	300030	STEERING WHEEL	1
4	140480	SWITCH, TURN SIGNAL	1
5	140492	CONSOLE, STEERING	1
6	140500	MOTOR, HYD, POWER STEERING	1
7	300040	COLUMN, STEERING	1
8	140511	LEVER, CONSOLE LOCK	4
9	981746	KNOB, CONSOLE LEVER	13
10	140531	LEVER, CONTROL (SPECIFY FUNCTION)	4
11	140610	FITTING, GREASE	1
12	140551	BLOCK, VALVE LEVER MOUNT	1
13	140560	LINK, LEVER TO BLOCK	1
14	140571	ARM, ACTUATOR VALVE LEVER	1
15	141000	VALVE BANK (SEE FIGURE 16 FOR FURTHER BREAKDOWN)	1
16	140630	LEVER, CONTROL (SPECIFY FUNCTION)	5
17	901010	LINK ASSY., VALVE LEVER	1
18	910058	BRACKET, HANDLE	1
19	140591	COVER, HYDRAULIC HOSES ROUTING ACCESS	1
20	140641	COVER, VALVE BANK ACCESS	1
21	140650	NUT, WING	1
22	140661	PLATE, CONSOLE, LOWER COVER	1
23	140600	SUSPENSION, SEAT	1
24	360010B	SEAT, OPERATOR	1
	SW29	BATTERY DISCONNECT SWITCH	N/S
	PDCA-5-4M	WORK LOAD PRESSURE SWITCH (UNDER SEAT)	N/S

ILLUSTRATED PARTS LIST

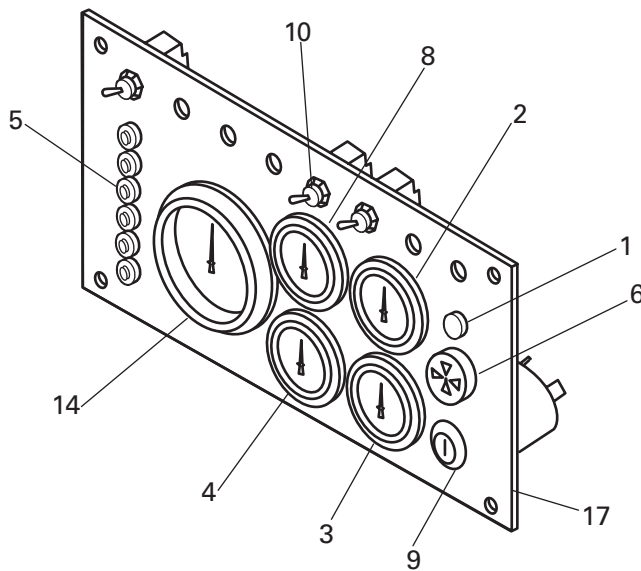
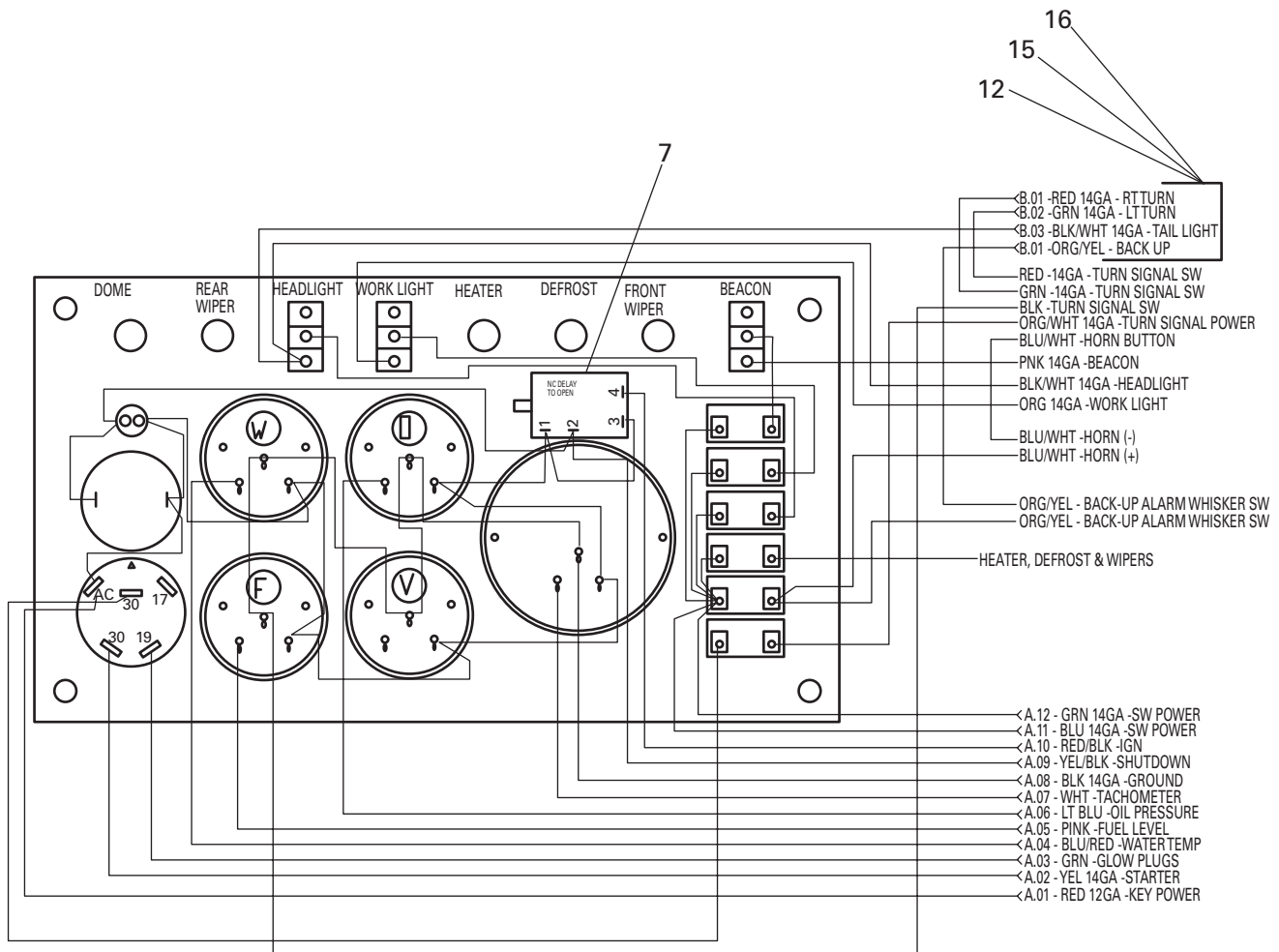


FIGURE 15. WIRING CONTROL PANEL

FIGURE 15. WIRING CONTROL PANEL

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	31983	LIGHT, RED DASH .50 HOLE	1
2	35364	GAUGE. TEMP., WATER	1
3	35366	GAUGE, FUEL	1
4	35668	GUAGE, VOLTMETER, 8-18 V DC	1
5	35701	CIRCUIT BREAKER, 25 AMP	6
6	36208	BUZZER, 12 VDC, CONTINUOUS TONE	1
7	37780	RELAY, TD, NC, 1-60SEC, 12VDC	1
8	39080	GAUGE, OIL PRESS, 150PSI, 240 OHM	1
9	39146-14	SWITCH, IGNITION, PERKINS 3.3	1
10	851391	SWITCH, TOGGLE, SPDT, 2-POS	3
11	982446	CONN. PLUG, DT06-12SA, DEUTSCH	1
12	982448	TERM, SOC, DEUTSCH, 14-16AWG	16
13	982453	CONN, WEDGE, PLUG, 12P, DEUTSCH	1
14	35630	GAUGE, TACH/HOUR METER	1
15	983203	CONN, PLUG, DTO6-4S, DEUTSCH	1
16	983212	CONN, WEDGE, PLUG, 4PM DEUTSCH	1
17	986631	PLATE INST PANEL	1

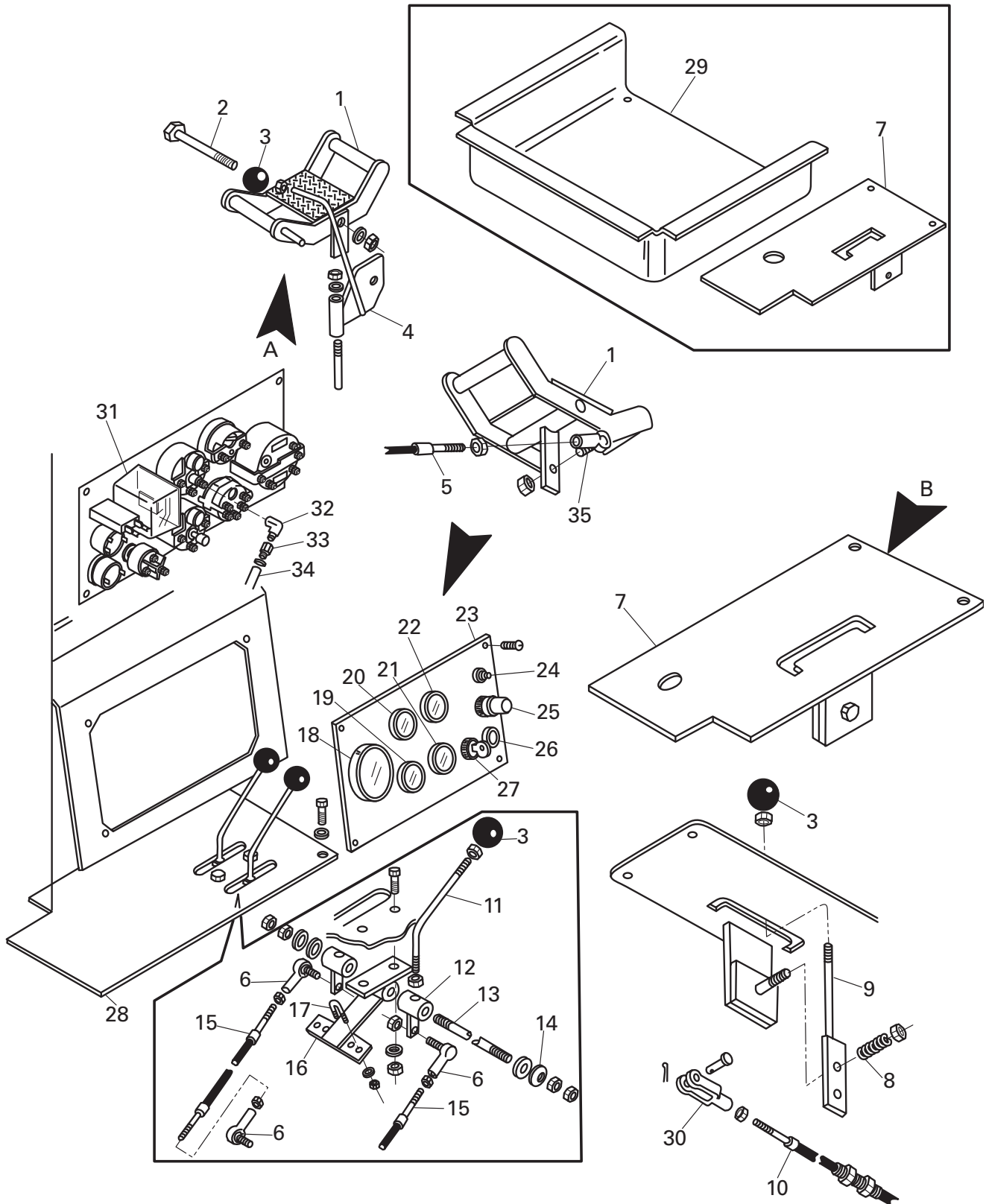


FIGURE 16. CONTROL LEVERS AND INSTRUMENTATION

FIGURE 16. CONTROL LEVERS AND INSTRUMENTATION

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	140231	PEDAL, FOOT	1
2	140240A	ROD, 635 FOOT PEDAL PIVOT	1
3	140250	KNOB	1
4	140261	LEVER, NEUTRAL SAFETY, LOCK, 685 PEDAL	1
5	140270	ROD, FORWARD & REVERSE	1
6	920090	BALL JOINT	2
7	140621	PANEL, R.H.	1
8	670060	SPRING, PRESSURE RELEASE	1
9	986616	LEVER, SHIFTER	1
10	160100	CABLE, HIGH/LOW SHIFTER	1
11	140320	LEVER, V.V. MOTOR OR THROTTLE	2
12	140331SRV	ACTUATOR ARM, THROTTLE OR MOTOR CONTROL	3
13	859361	SHAFT, LEVER MOUNT	6
14	490080	SPRING WASHER, 5/8"	1
15	160090	CABLE, V.V. MOTOR OR THROTTLE	4
16	140361	BRACKET	2
17	350060	U-BOLT, .375	2
18	140370	TACH/HOUR METER, MURPHY	1
19	140380	GAUGE, FUEL LEVEL MURPHY	2
20	35668	GAUGE, VOLTMETER MURPHY	2
21	140400	GAUGE, WATER TEMP. MURPHY	4
22	140410	GAUGE, OIL PRESSURE MURPHY	1
23	140420	PANEL, IGNITION CONTROL MURPHY	2
24	140430	CIRCUIT BREAKER	2
25	140440	WARNING LIGHT, ENGINE SHUT DOWN MURPHY	1
26	140450	WARNING BUZZER, ENGINE SHUT DOWN MURPHY	1
27	500010	SWITCH, IGNITION MURPHY	1
27A	500010-1	IGNITION KEY MURPHY	AR
28	140471	PANEL, L.H.	1
29	859216	SUPPORT, CENTER SEAT (USED WITH BOTH CAB & CANOPY CAB ARRANGEMENT)	1
30	810050	CLEVIS	1
31	140470	RELAY, ENGINE SHUT DOWN SWITCH	1
32	140490	ADAPTER, PIPE TO HOSE MURPHY	1
33	140510	ADAPTER, PIPE TO HOSE MURPHY	1
34	140520	HOSE 3/16" X 8' MURPHY	1
35	670350	BALL JOINT, 3/8" -24, W/STUD	2
	33964	BACK-UP ALARM SWITCH	N/S
	720290	SOLONOID (EXTRA)	N/S
	720110	HORN	N/S
	982250	HEAD LIGHT SWITCH	N/S

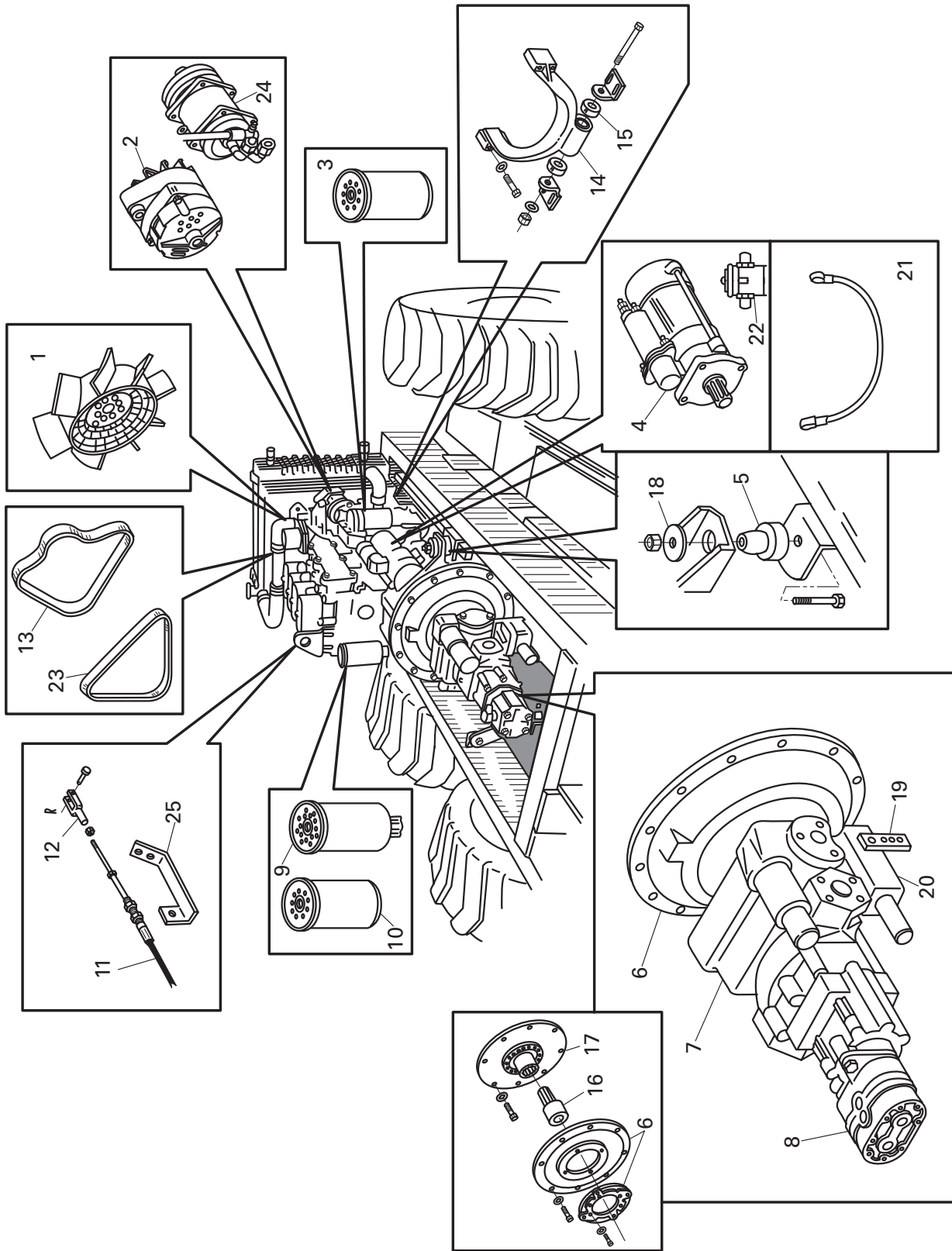


FIGURE 17. ENGINE, ENGINE MOUNTING, HYDRAULIC PUMPS PLUS OTHER ENGINE COMPONENTS

FIGURE 17. ENGINE, ENGINE MOUNTING, HYDRAULIC PUMPS
PLUS OTHER ENGINE COMPONENTS

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	983454	FAN BLADE	1
2	160220	ALTERNATOR, 105 AMP	1
3	34881	FILTER ELEMENT, OIL	1
4	160310	STARTER MOTOR, 12V	1
5	160190	MOUNT, REAR ENGINE, PAD	2
6	160240	ADAPTER PLATE, PUMP TO ENGINE	1
7	160250	PUMP, HYD, 685 DRIVE (NOTE PUMP BRAND) & SERIAL#	1
8	160260	TANDEM PUMP, CYLINDER & STEERING	1
9	34883	FILTER ELEMENT, FUEL, PRIMARY	1
10	72078	FILTER ELEMENT, FUEL, SECONDARY	1
11	160090	CABLE, THROTTLE	1
12	920080	BALL JOINT, 1/4"	1
13	160200	FAN BELT	1
14	160270	MOUNT, ENGINE FRONT	1
15	160280	SHIM, SIDE LOAD	2
16	160300-1	SHAFT, FLYWHEEL, PUMP DRIVE	1
17	160300	PLATE, DRIVE	1
18	120360	WASHER, FLAT	2
19	S77435	LEVER, PUMP CONTROL	1
20	160340	PUMP CONTROLLER (SUNDSTRAND "90"SERIES)	1
21	5804	CABLE, ENGINE GROUND, BAT NEG 12"	1
22	720290	SOLENOID, 12V	1
23	685070	V BELT, AIR COND.	1
24	P204324	COMPRESSOR, AIR COND.	1
25	980593	MOUNT, THROTTLE CABLE	1
	685990	ENGINE WIRING HARNESS	N/S
	P79315	NEUTRAL SAFETY SWITCH (SUNSTRAND)	N/S

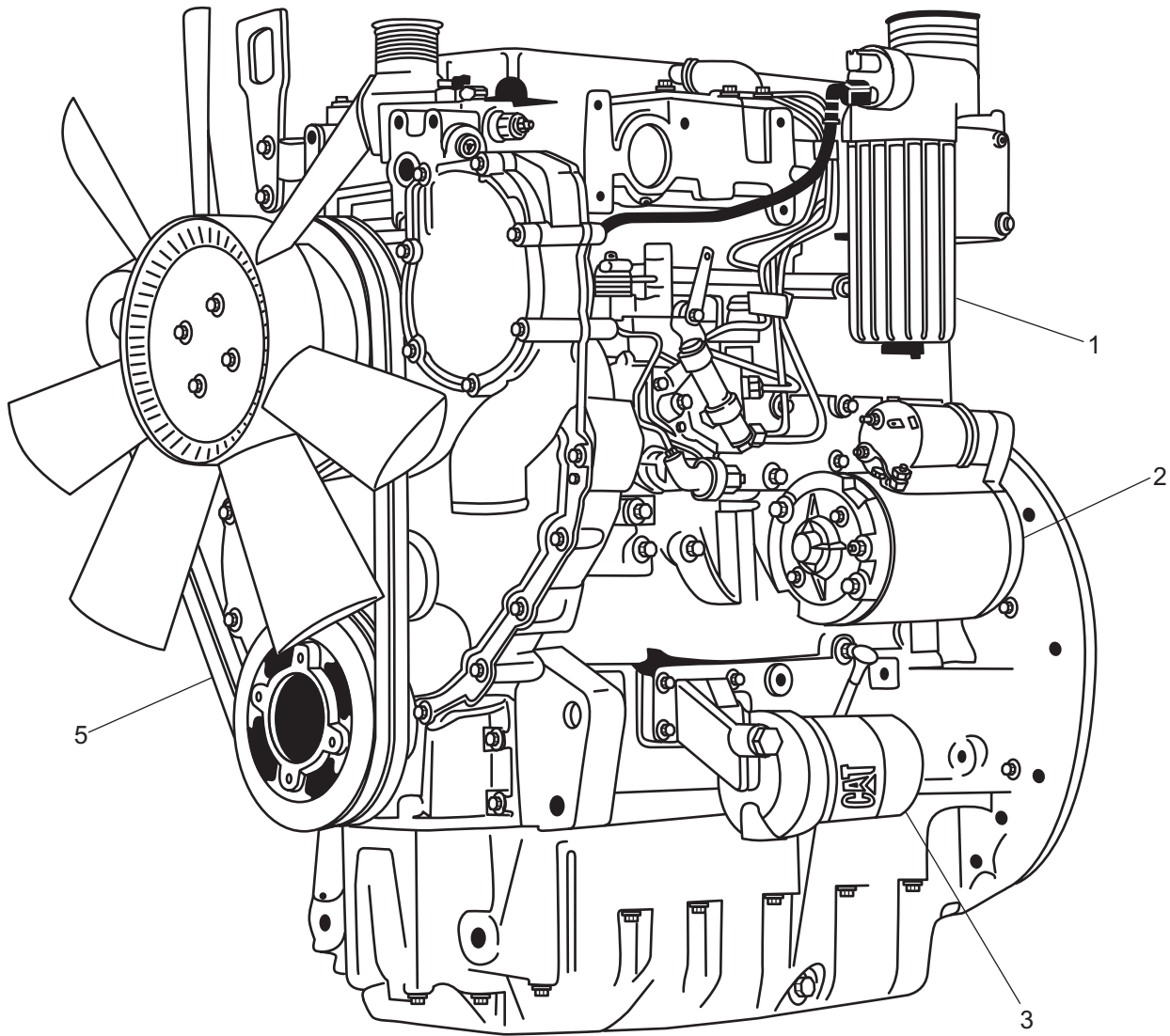


FIGURE 18. CATERPILLAR ENGINE

FIGURE 18. CATERPILLAR ENGINE

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	984909-01	FUEL FILTER	1
2	984909-03	STARTER	1
3	984909-02	OIL FILTER	1
4	984909-04	ALTERNATOR	1
5	984909-05	BELT SET	1

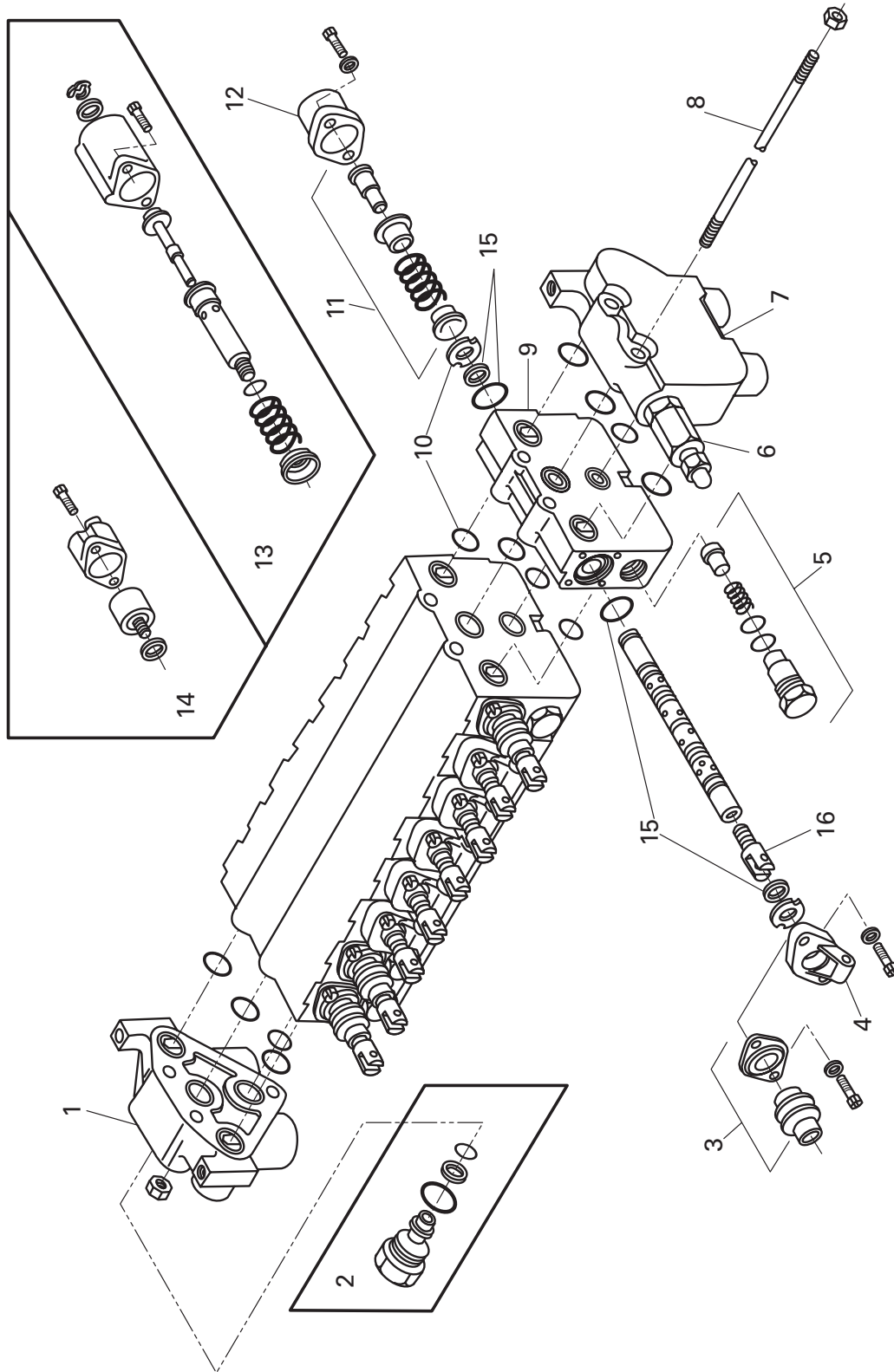


FIGURE 19. VALVE BANK ASSEMBLY

FIGURE 19. VALVE BANK ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
	141000	VALVE ASSY, 9 SECTION	1
1	910056	COVER, OUTLET	1
2	901002	VALVE, POWER BEYOND (OPTIONAL)	1
3	141010	DUST BOOT & CAP, VALVE SPOOL	1
4	910058	BRACKET, VALVE LEVER	1
5	141020	VALVE ASSY., ANTI-CAVITATION	1
6	901009	RELIEF VALVE	1
7	910055	COVER, INLET	1
8	853590	ROD KIT, 10 SECTION	3
9	910054	VALVE SECTION	10
10	910062	SEAL KIT, VALVE SECTION	1
11	901014	SPRING RETURN KIT	1
12	141040	END CAP, VALVE SPOOL	1
13	141050	FLOAT ASSEMBLY	1
14	901007	DETENT KIT	1
15	910059	SEAL KIT, VALVE SPOOL	1
16	141060	CLEVIS, VALVE SPOOL END	1

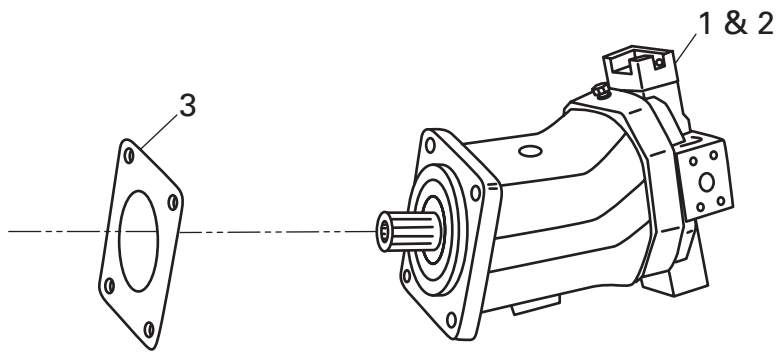


FIGURE 20. TWO SPEED RANGE BOX ASSEMBLY

FIGURE 20. TWO SPEED RANGE BOX ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASSY
		123456	
1	160370	MOTOR, HYD, DRIVE (SAUER DANFOSS - NOTE PUMP BRAND)	1
2	750578-1	MOTOR, HYD, DRIVE (REX ROTH - NOTE PUMP BRAND)	1
3	P77494	GASKET, S.A.E. "C" 2/6 BOLT	1

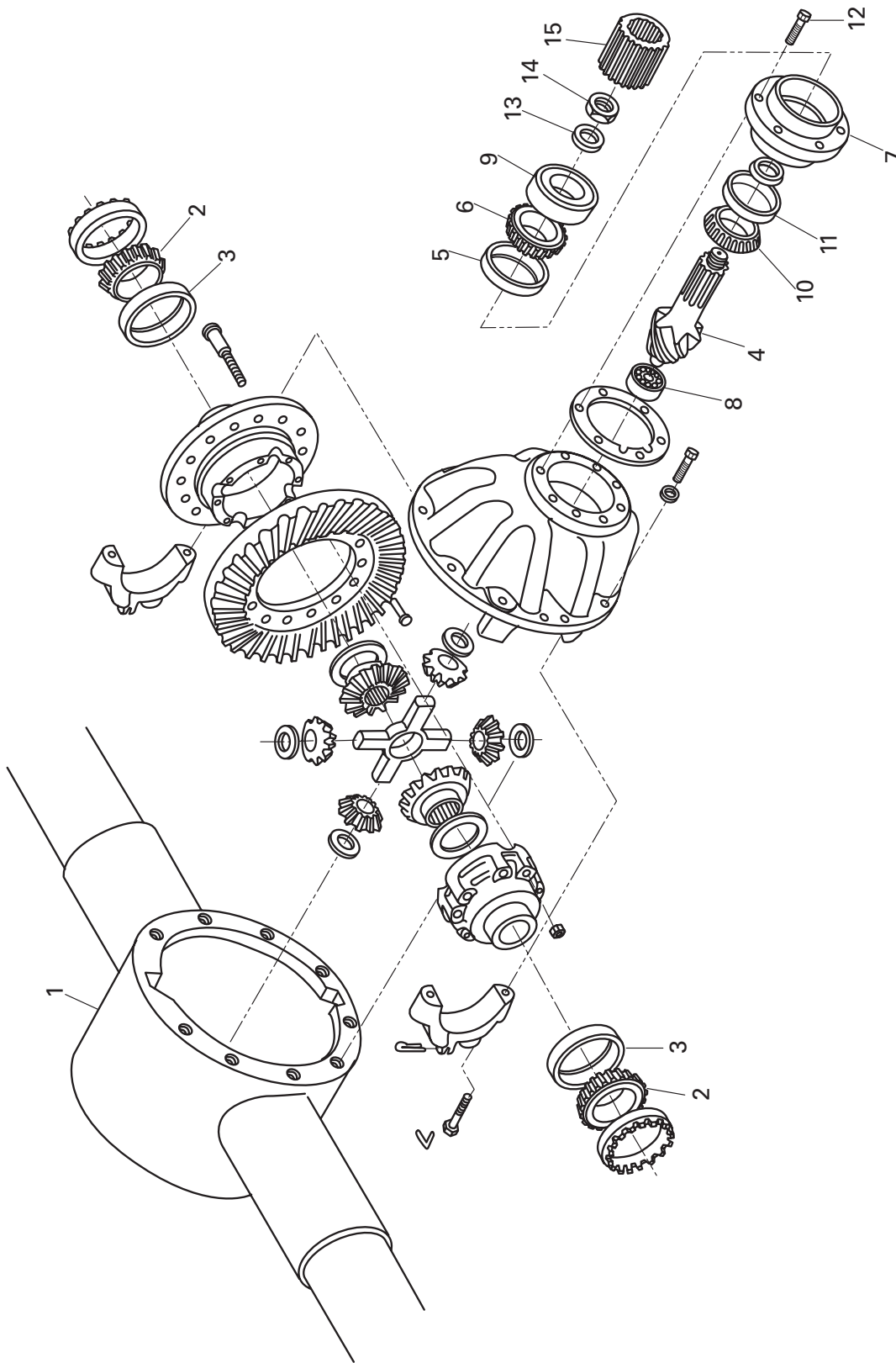


FIGURE 21. CARRIER ASSEMBLY

FIGURE 21. CARRIER ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1		HOUSING, REAR AXLE	1
2	ST2007A	BEARING, CONE (DIFFERENTIAL)	1
3	565919-1	BEARING, CUP (DIFFERENTIAL)	1
4		GEAR, RING AND PINION	1
5	917217R1	BEARING, CUP (PINION OUTER)	1
6	306276C91	BEARING, CONE (PINION OUTER)	1
7		CAP, BEARING RETAINER	1
8	69023R92	BEARING ASSEMBLY (STRAIGHT ROLLER)	1
9	454755C1	SEAL, OIL	1
10	306276C91	BEARING, CONE (PINION INNER)	1
11	917217R1	BEARING, CUP (PINION INNER)	1
12	584255C1	BOLT, HEX (STANDARD)	1
13	54557H	WASHER, FLAT	1
14	077HN103	NUT, HEX	1
15	R30SS101	SLEEVE, TRANSMISSION SHAFT	1

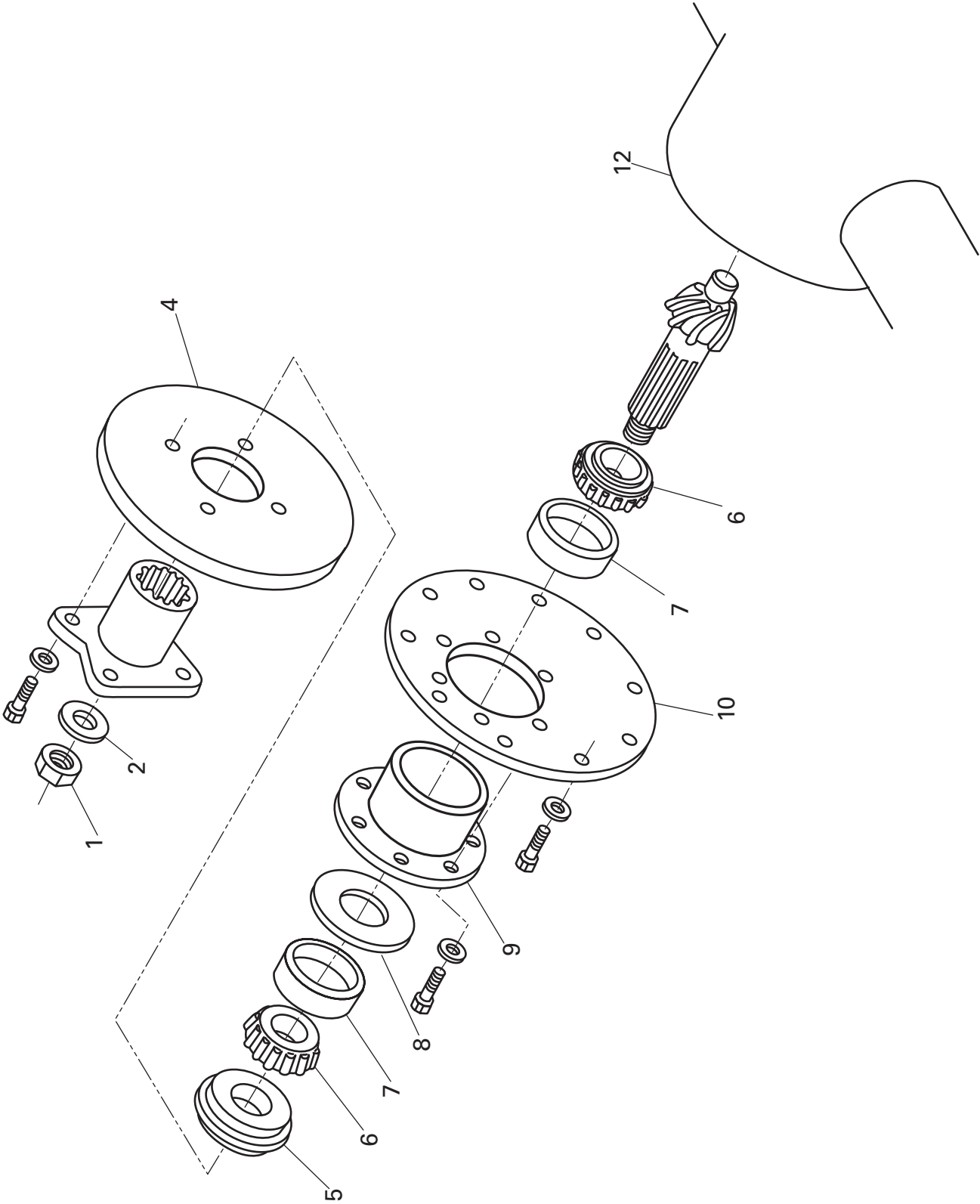


FIGURE 22. DISK BRAKE DRIVE ASSEMBLY

FIGURE 22. DISK BRAKE DRIVE ASSEMBLY

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	077HN103	NUT, HEX	1
2	4557H	WASHER, LOCK	1
4	120652	DISC, BRAKE	1
5	312051	SEAL	1
6	306276C91	BEARING, CONE	2
7	917217R1	BEARING, CUP	2
8	R30HS101-1	SPACER	1
9	120653	CAP, BEARING RETAINER	1
10	120651	COVER, REAR CARRIER	1
12		CARRIER ASSEMBLY	

ILLUSTRATED PARTS LIST

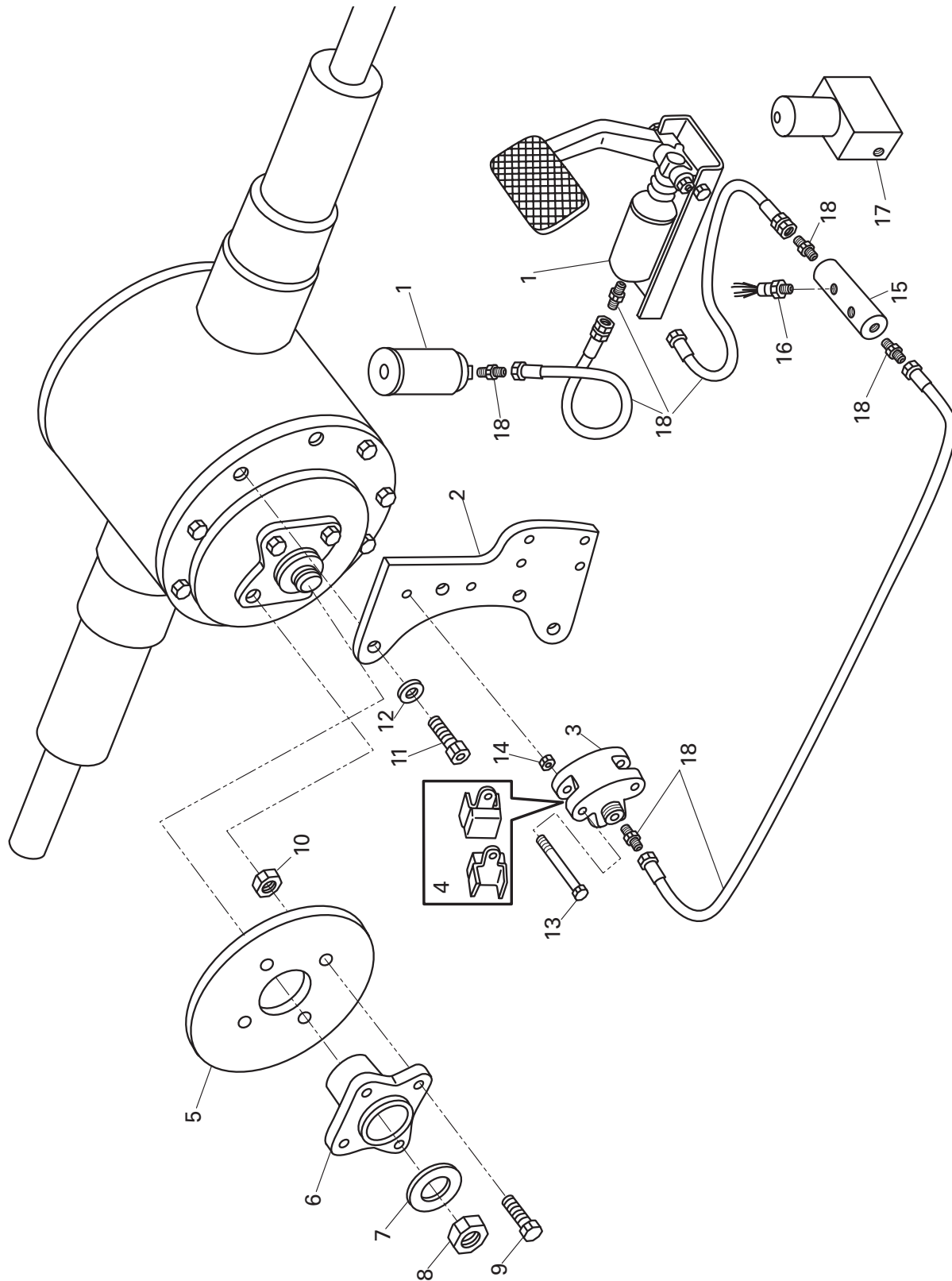


FIGURE 23. SERVICE BRAKE COMPONENTS

FIGURE 23. SERVICE BRAKE COMPONENTS (OPTIONAL)

FIG ITEM	PART NUMBER	NOMENCLATURE		UNITS PER ASSY
		123456		
1	120640	BRAKE ACTUATOR, FOOT OPEN		1
2	859293	MOUNT, BRAKE		1
3	120650	BRAKE CALIPER, HYD, FOOT OPEN		1
4	120650-1	BRAKE PAD KIT		1
5	312051	ROTOR, BRAKE		1
6	120652	COMPANION FLANGE, PINION/ROTOR		1
7	4557H	WASHER, FLAT		1
8	077HN103	NUT, LOCK, PINION SHAFT		1
9	102-407-1A	CSSH, .500-13 X 1.50		4
10	143-5	NUT, LOCK, .500-13		4
11	120520	CSSH, .437-14 X 2.00		4
12	118-4	WASHER, LOCK, .437		4
13	102-317-1A	CSSH, .437-14 X 4.00		2
14	116-4	NUT, HEX, .437-14		2
15	858854	MANIFOLD, SERVICE BRAKE		1
16	853190	SWITCH, PUMP DESTROKE		1
17	160380	VALVE, SOLENOID, PUMP DESTROKE		1
18	99MG685FBK	HOSE KIT, FOOT BRAKE		1
19	984642	KIT, PUMP DESTROKE/685		AR

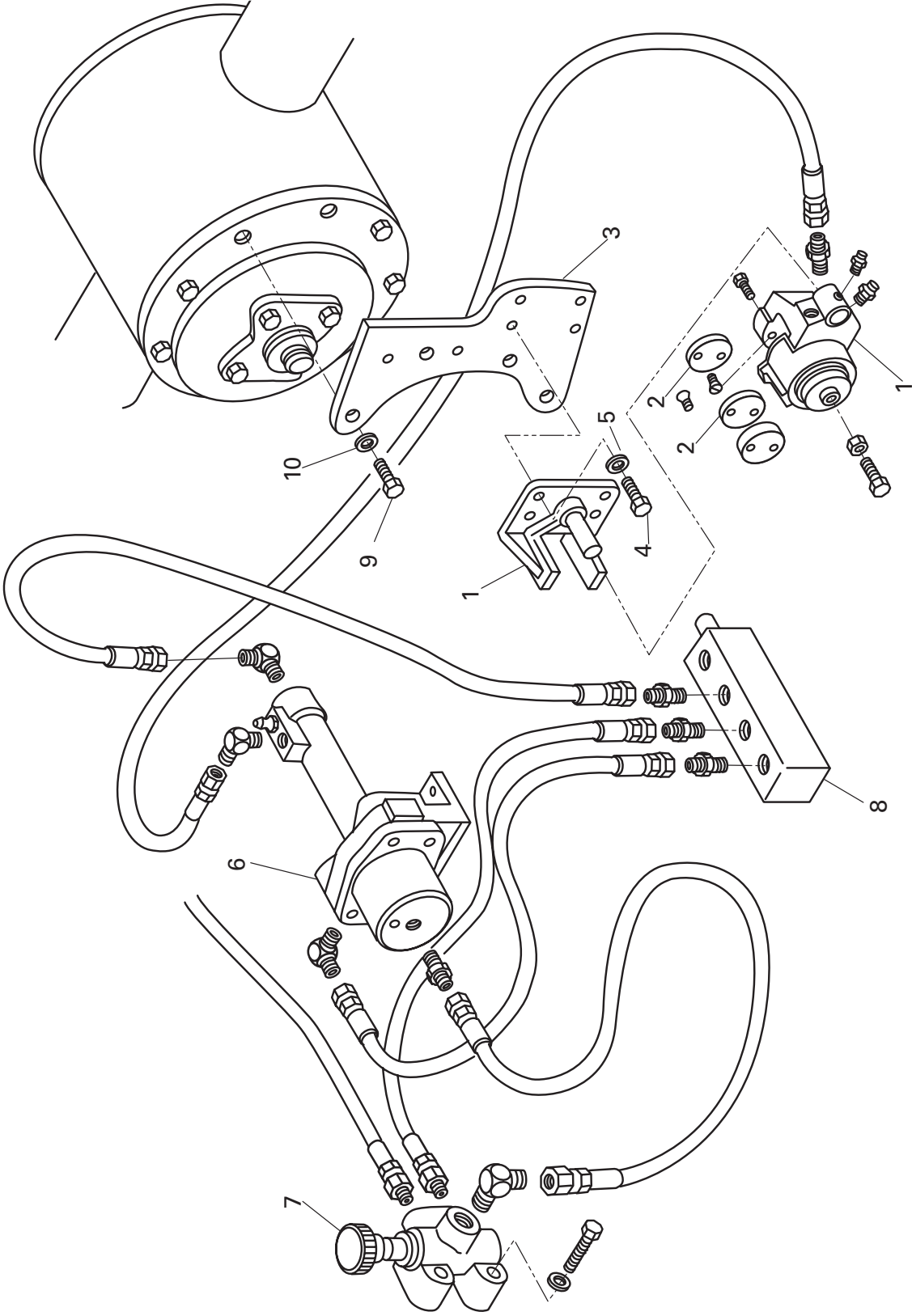


FIGURE 24. FAIL SAFE BRAKE

FIGURE 24. FAIL SAFE BRAKE

FIG ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASSY
		123456	
1	120480	BRAKE CALIPER, FAIL SAFE	1
2	120490	PAD KIT, BRAKE CALIPER	1
3	859293	BRACKET, BRAKE CALIPER MOUNTING	1
4	102-407-1A	CSHH, .500-13 X 1.50	4
5	118-5	WASHER, LOCK, .500	4
6	120570	PRESS INTENSIFIER, FAIL SAFE BRAKE (5:1 RATIO)	1
7	910080	SELECTOR VALVE, BRAKE	1
8	120630	MANIFOLD, TANK DRAIN	1
9	120520	CSSH, .437-14 X 2.00	4
10	118-4	WASHER, LOCK, .437	4

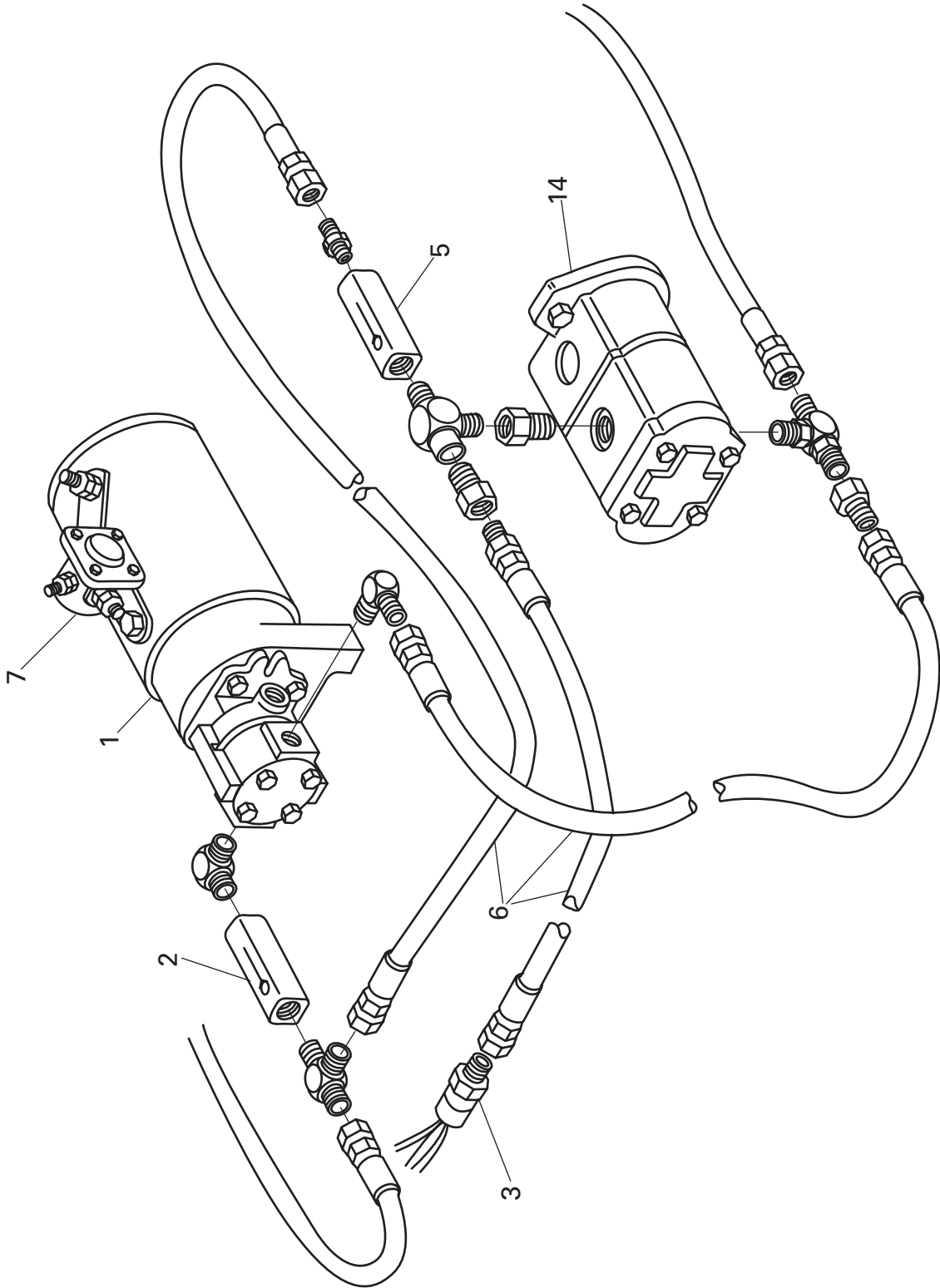


FIGURE 25. DEAD ENGINE STEERING

FIGURE 25. DEAD ENGINE STEERING

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
1	685020	PUMP, MOTOR & RELAY, DEAD ENGINE STEERING	1
2	160510	CHECK VALVE, DEAD ENGINE STEERING PUMP	1
3	160520	SWITCH, LOW PRESS	1
4	160260	TANDEM HYD. PUMP, STEERING & IMPLEMENT	1
5	160530	CHECK VALVE, TANDEM HYD. PUMP	1
6	99MG685DES	HOSE KIT, DEAD ENGINE STEERING	1
7	720290	SOLENOID, STARTING	1

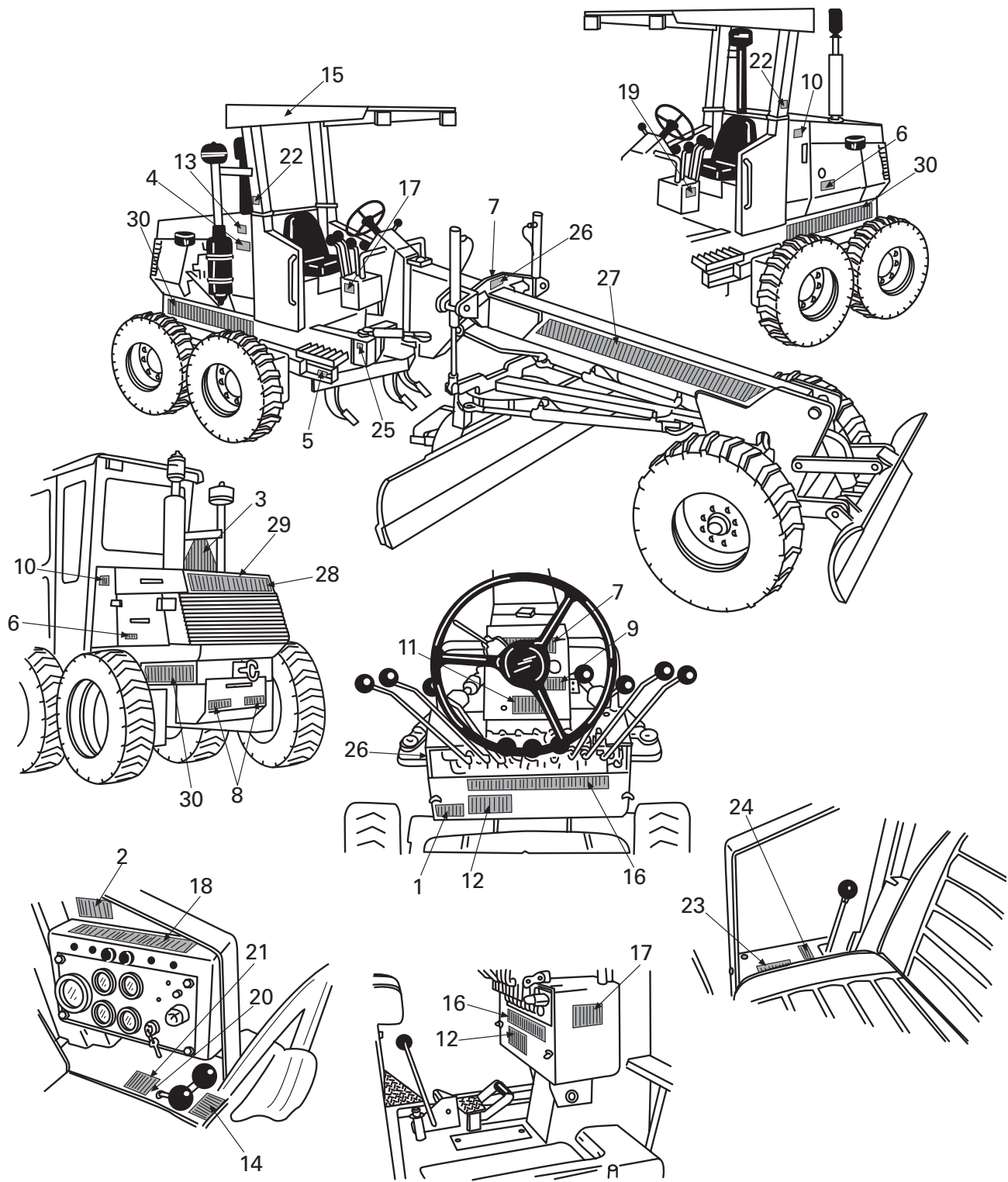


FIGURE 26. DECAL PLACEMENT

FIGURE 26. DECAL PLACEMENT

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
	160210SRV	DECAL KIT	
1		BELOW VALVE BANK ON LEFT SIDE	1
2		INSIDE CAB, LEFT SIDE AGAINST OUTSIDE PANEL	1
3		ON LEFT SIDE OF THE HOOD	1
4		ON RIGHT SIDE, CENTERED & ONE QUARTER DISTANCE FROM TOP	1
5		ON TOP PLATE OF SCARIFIER, Y2" FROM EDGE, BOTH SIDES	1
6		LEFT SIDE HOOD PANEL, BELOW FILTER VIEWING HOLE	1
7		ON SADDLE LIFT CYLINDER SUPPORT, CENTERED FACING OPERATOR, ALSO CENTERED ON TOP OF CONSOLE	1
8		ON THE REAR FRAME, RED TO OUTSIDE COMERS	1
9		RIGHT SIDE OF CONSOLE, BELOW WARNING LIGHT	1
10		LEFT SIDE, UPPER LEFT COMER OF HYDRAULIC TANK	1
11		CENTERED BELOW STEERING WHEEL ON CONSOLE	1
12		BELOW VALVE BANK, ON LEFT LOWER SIDE OF VALVE COVER PANEL	1
13		RIGHT SIDE, CENTERED AND CLOSE TO TOP OF FUEL TANK	1
14		INSIDE CAB, AHEAD OF LEFT SIDE CONTROL LEVERS	1
15		ON CANOPY CROSS SUPPORT, MOUNTED TO CENTER PLATE	1
16		INSIDE CAB, ON VALVE COVER PANEL ALIGNED TO CORRECT VALVES	1
17		RIGHT SIDE, ON VALVE BANK SUPPORT HOUSING	1
18		INSIDE CAB, ON TOP OF INSTRUMENT PANEL	1
19		LEFT SIDE, MOUNTED TO VALVE BANK SUPPORT HOUSING	1
20		INSIDE CAB, LEFT SIDE OF SEAT TO THE REAR OF CONTROL LEVER	1
21		INSIDE CAB, LEFT SIDE OF SEAT TO THE REAR OF CONTROL LEVER	1
22		BOTH SIDES ON CANOPY SUPPORT COLUMNS, AS SHOWN	1
23		RIGHT SIDE OF SEAT AHEAD OF PARKING LEVER	1
24		RIGHT SIDE OF SEAT TO THE RIGHT OF CONTROL LEVER	1
25		RIGHT SIDE CENTERED TO TOOL BOX DOOR	1
26		ON LIFT CYLINDER SUPPORT, CENTERED FACING FRONT	1
27		RIGHT BOOM FROM GUSSET OF LIFT CYLINDER SUPPORT FORWARD	1
27A		LEFT BOOM FROM GUSSET OF LIFT CYLINDER SUPPORT FORWARD	1
28		UNDER "POWERED BY CUMMINS" ON DECAL NO.	1
29		REAR PANEL OF HOOD	1
30		ON FRAME FROM REAR COMER TOWARD FRONT, BOTH SIDES	1

ILLUSTRATED PARTS LIST

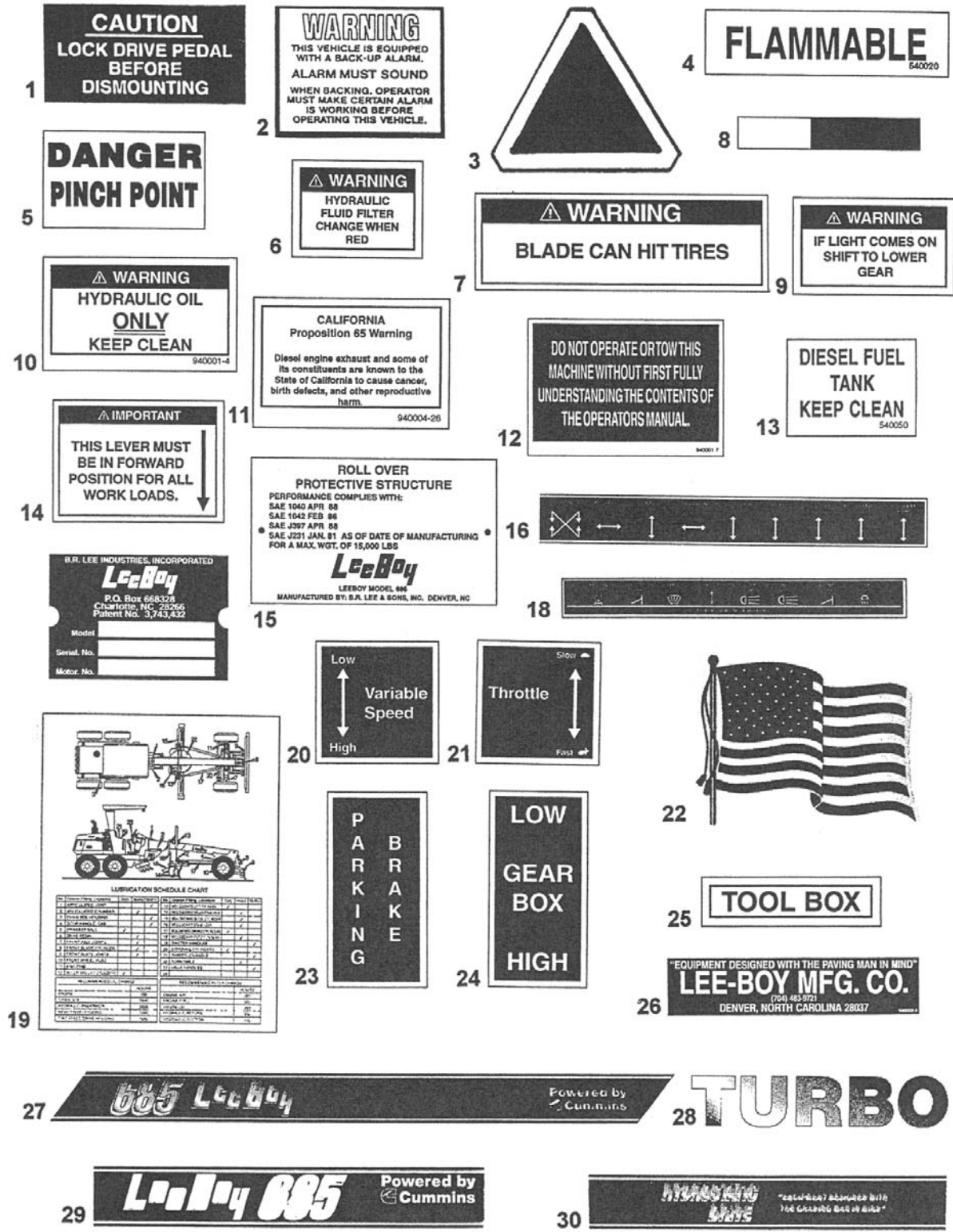


FIGURE 27. DECALS

FIGURE 27. DECALS

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	UNITS PER ASSY
	160210	DECAL KIT	
1		BELOW VALVE BANK ON LEFT SIDE	1
2		INSIDE CAB, LEFT SIDE AGAINST OUTSIDE PANEL	1
3		ON LEFT SIDE OF THE HOOD	1
4		ON RIGHT SIDE, CENTERED & ONE QUARTER DISTANCE FROM TOP	1
5		ON TOP PLATE OF SCARIFIER, Y2" FROM EDGE, BOTH SIDES	1
6		LEFT SIDE HOOD PANEL, BELOW FILTER VIEWING HOLE	1
7		ON SADDLE LIFT CYLINDER SUPPORT, CENTERED FACING OPERATOR, ALSO CENTERED ON TOP OF CONSOLE	1
8		ON THE REAR FRAME, RED TO OUTSIDE COMERS	1
9		RIGHT SIDE OF CONSOLE, BELOW WARNING LIGHT	1
10		LEFT SIDE, UPPER LEFT COMER OF HYDRAULIC TANK	1
11		CENTERED BELOW STEERING WHEEL ON CONSOLE	1
12		BELOW VALVE BANK, ON LEFT LOWER SIDE OF VALVE COVER PANEL	1
13		RIGHT SIDE, CENTERED AND CLOSE TO TOP OF FUEL TANK	1
14		INSIDE CAB, AHEAD OF LEFT SIDE CONTROL LEVERS	1
15		ON CANOPY CROSS SUPPORT, MOUNTED TO CENTER PLATE	1
16		INSIDE CAB, ON VALVE COVER PANEL ALIGNED TO CORRECT VALVES	1
17		RIGHT SIDE, ON VALVE BANK SUPPORT HOUSING	1
18		INSIDE CAB, ON TOP OF INSTRUMENT PANEL	1
19		LEFT SIDE, MOUNTED TO VALVE BANK SUPPORT HOUSING	1
20		INSIDE CAB, LEFT SIDE OF SEAT TO THE REAR OF CONTROL LEVER	1
21		INSIDE CAB, LEFT SIDE OF SEAT TO THE REAR OF CONTROL LEVER	1
22		BOTH SIDES ON CANOPY SUPPORT COLUMNS, AS SHOWN	1
23		RIGHT SIDE OF SEAT AHEAD OF PARKING LEVER	1
24		RIGHT SIDE OF SEAT TO THE RIGHT OF CONTROL LEVER	1
25		RIGHT SIDE CENTERED TO TOOL BOX DOOR	1
26		ON LIFT CYLINDER SUPPORT, CENTERED FACING FRONT	1
27		RIGHT BOOM FROM GUSSET OF LIFT CYLINDER SUPPORT FORWARD	1
27A		LEFT BOOM FROM GUSSET OF LIFT CYLINDER SUPPORT FORWARD	1
28		UNDER "POWERED BY CUMMINS" ON DECAL NO.	1
29		REAR PANEL OF HOOD	1
30		ON FRAME FROM REAR COMER TOWARD FRONT, BOTH SIDES	1

ILLUSTRATED PARTS LIST

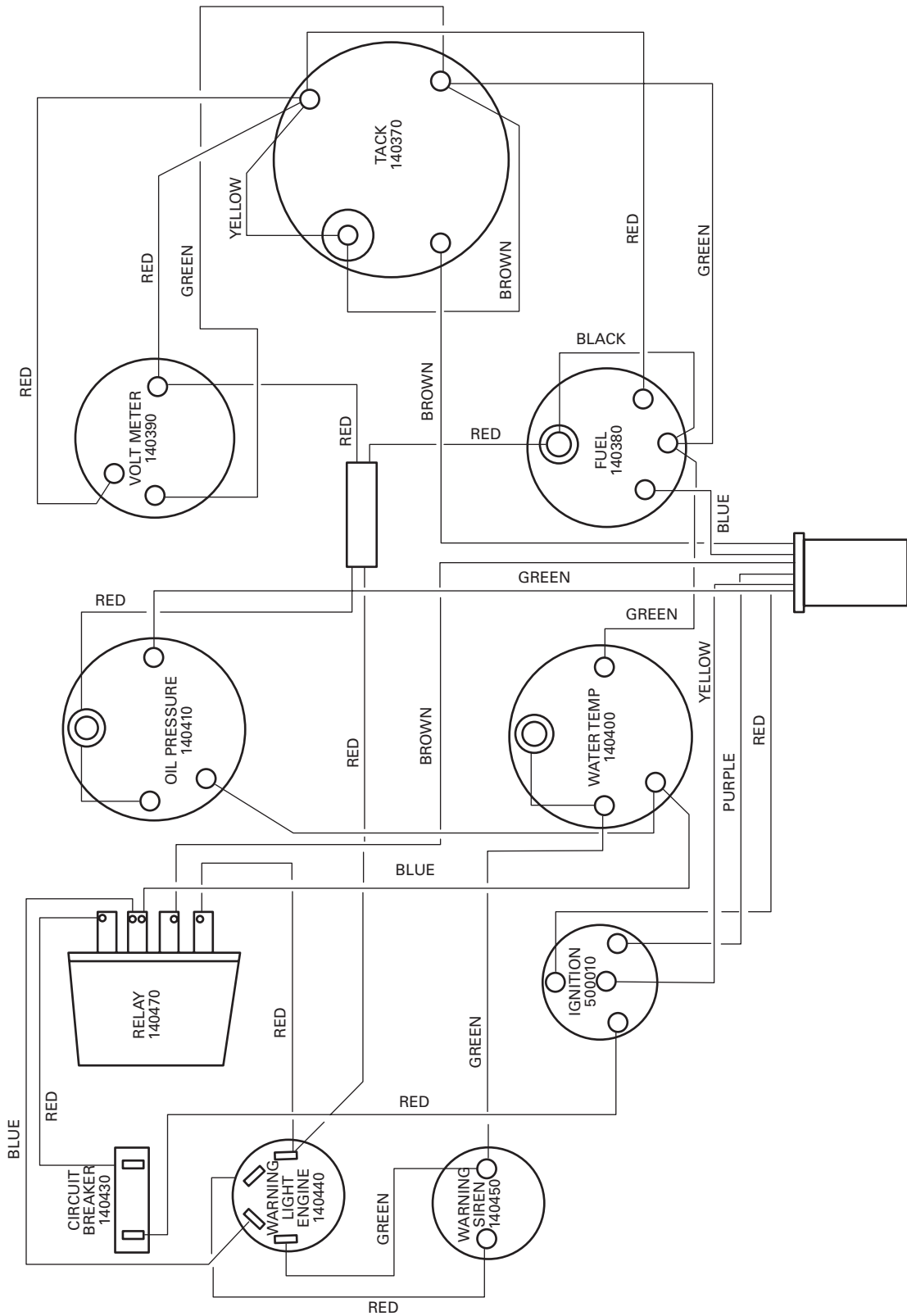


FIGURE 28. WIRING DIAGRAM (INSTRUMENT PANEL)

FIGURE 28. WIRING DIAGRAM (INSTRUMENT PANEL)

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	UNITS PER ASSY
	982449	CONNECTOR FOR WIRING HARNESS MURPHY PANEL SIDE	
	685990	WIRING HARNESS	
	140430	CIRCUIT BREAKER, PUSH BUTTON	
	140470	RELAY	
	140410	GAUGE, OIL PRESSURE	
	140390	GAUGE, VOLT METER	
	140370	TACHOMETER/HOUR METER	
	140380	GAUGE, FUEL	
	140400	GAUGE, WATER TEMP	
	500010	IGNITION SWITCH	
	140450	WARNING BUZZER, LOW OIL/HIGH WATER	
	140440	WARNING LIGHT, LOW OIL/HIGH WATER	

ILLUSTRATED PARTS LIST



INDEX OF PARTS BY NAME

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
1	110014	AXLE ASSY, FRONT	IPL-7
1	986369	AXLE ASSY, FRONT, AWD	IPL-11
11	140320	LEVER, V.V. MOTOR OR THROTTLE	IPL-43
17	210170	WASHER, LOCK	IPL-15
19	120160	'O' RING	IPL-15
12	140331SRV	ACTUATOR ARM, THROTTLE OR MOTOR CONTROL	IPL-43
6	160240	ADAPTER PLATE, PUMP TO ENGINE	IPL-45
30	859443	ADAPTER, HOSE, W/.063 ORIFICE	IPL-3
32	140490	ADAPTER, PIPE TO HOSE MURPHY	IPL-43
33	140510	ADAPTER, PIPE TO HOSE MURPHY	IPL-43
1	171130	AIR CLEANER ASSY.	IPL-37
4	984909-04	ALTERNATOR	IPL-47
2	160220	ALTERNATOR, 105 AMP	IPL-45
14	140571	ARM, ACTUATOR VALVE LEVER	IPL-39
13	859363SRV	ARM, UPPER PIVOT	IPL-23
12	151180	ARM, WINDSHIELD WIPER	IPL-25
40	A120330R	ASSY TIRE & WHEEL RIGHT SIDE	IPL-9
7	131014	ASSY, FRONT DOZER BLADE	IPL-23
*9	986722	ASSY, HOOD, 685 MULTI-ENGINE	IPL-31
	A120330L	ASSY. TIRE & WHEEL LEFT SIDE	IPL-9
5	120052A	AXLE ASSY, TANDEM, 685B, FROM SERIAL #487	IPL-15
37	120301L	AXLE, MAIN DRIVE L.H. (LONG) 25 1/4" LONG	IPL-15
38	120301R	AXLE, MAIN DRIVE R.H. (SHORT) 24 1/4" LONG	IPL-17
	33964	BACK-UP ALARM SWITCH	IPL-43
6	920090	BALL JOINT	IPL-43
12	920080	BALL JOINT, 1/4"	IPL-45
35	670350	BALL JOINT, 3/8" -24, W/STUD	IPL-43
20	110200	BALL JOINT, L.H.	IPL-7
20	110200	BALL JOINT, LH	IPL-11
6	130060	BALL JOINT, MOLDBOARD LIFT CYLINDER	IPL-19
4	130040	BALL JOINT, MOLDBOARD STABILIZER	IPL-19
21	110210	BALL JOINT, R.H.	IPL-7
21	110210	BALL JOINT, RH	IPL-11
28	130106	BALL, DRAWBAR PULL	IPL-19
15	150042	BAR, BATTERY HOLD DOWN	IPL-29
15	150042	BAR, BATTERY HOLD DOWN	IPL-31
28	BL30000-11	BAR, TUBE CLAMP	IPL-11
34	140030GK	BASKET/STRAINER W/GASKETS	IPL-29
7	140030GK	BASKET/STRAINER W/GASKETS	IPL-31
16	140290	BATTERY CABLE, NEGATIVE	IPL-29
16	140290	BATTERY CABLE, NEGATIVE	IPL-31
17	140300	BATTERY CABLE, POSITIVE	IPL-29
17	140300	BATTERY CABLE, POSITIVE	IPL-31
	SW29	BATTERY DISCONNECT SWITCH	IPL-39
14	150033	BATTERY TRAY	IPL-29
14	150033	BATTERY TRAY	IPL-31
29	920152	BATTERY, 12 VOLT 750 CCA GROUP 24	IPL-29
29	920152	BATTERY, 12 VOLT, 750CCA, GROUP 24	IPL-31
39	211748-02	BEACON (CAB)	IPL-5
42	210893	BEACON LIGHT (CANOPY)	IPL-5
41	981159SRV	BEACON LIGHT BRACKET (CANOPY)	IPL-5
	211748-02	BEACON LIGHT CAB MACHINE ONLY	IPL-25
8	69023R92	BEARING ASSEMBLY (STRAIGHT ROLLER)	IPL-53
11	100110	BEARING CONE	IPL-3
30	120270	BEARING CONE	IPL-15
8	210180	BEARING CONE	IPL-7
7	210180A	BEARING CONE	IPL-15
26	110260	BEARING CONE, INNER	IPL-7

INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
29	610210	BEARING CONE, OUTER	IPL-7
12	100120	BEARING CUP	IPL-3
31	120280	BEARING CUP	IPL-15
9	210190	BEARING CUP	IPL-7
8	210190A	BEARING CUP	IPL-15
25	110250	BEARING CUP, INNER	IPL-7
28	610200	BEARING CUP, OUTER	IPL-7
6	306276C91	BEARING, CONE	IPL-55
2	ST2007A	BEARING, CONE (DIFFERENTIAL)	IPL-53
10	306276C91	BEARING, CONE (PINION INNER)	IPL-53
6	306276C91	BEARING, CONE (PINION OUTER)	IPL-53
7	917217R1	BEARING, CUP	IPL-55
3	565919-1	BEARING, CUP (DIFFERENTIAL)	IPL-53
11	917217R1	BEARING, CUP (PINION INNER)	IPL-53
5	917217R1	BEARING, CUP (PINION OUTER)	IPL-53
27	120240	BEARING, SEALED	IPL-15
1		BELOW VALVE BANK ON LEFT SIDE	IPL-63
1		BELOW VALVE BANK ON LEFT SIDE	IPL-65
12		BELOW VALVE BANK, ON LEFT LOWER SIDE OF VALVE COVER PANEL	IPL-63
12		BELOW VALVE BANK, ON LEFT LOWER SIDE OF VALVE COVER PANEL	IPL-65
5	984909-05	BELT SET	IPL-47
13	151190	BLADE, WINDSHIELD WIPER	IPL-25
17	857599	BLOCK, SPACER	IPL-19
12	140551	BLOCK, VALVE LEVER MOUNT	IPL-39
38A	130210-1	BOLT KIT, 10' MOLDBOARD	IPL-21
29	983221	BOLT, DOOR LATCH STRIKER	IPL-25
12	584255C1	BOLT, HEX (STANDARD)	IPL-53
31	920070	BOLT, WING	IPL-29
1	131100	BOOM	IPL-27
2	100024	BOOM ASSEMBLY	IPL-3
22		BOTH SIDES ON CANOPY SUPPORT COLUMNS, AS SHOWN	IPL-63
22		BOTH SIDES ON CANOPY SUPPORT COLUMNS, AS SHOWN	IPL-65
9	171160-1	BOWL, PRE-CLEANER	IPL-37
16	140361	BRACKET	IPL-43
3	859293	BRACKET, BRAKE CALIPER MOUNTING	IPL-59
18	910058	BRACKET, HANDLE	IPL-39
4	910058	BRACKET, VALVE LEVER	IPL-49
1	120640	BRAKE ACTUATOR, FOOT OPEN	IPL-57
1	120480	BRAKE CALIPER, FAIL SAFE	IPL-59
3	120650	BRAKE CALIPER, HYD, FOOT OPEN	IPL-57
4	120650-1	BRAKE PAD KIT	IPL-57
42	620050	BREATHER	IPL-17
14	131224	BUCKET	IPL-27
13	110130	BUSHING	IPL-11
13	110130	BUSHING	IPL-7
3	131120	BUSHING	IPL-27
9	220360	BUSHING	IPL-19
8	220360	BUSHING	IPL-3
8A	100080A	BUSHING	IPL-3
8B	100080B	BUSHING	IPL-3
13A	110130A	BUSHING	IPL-11
8	110130A	BUSHING	IPL-27
13A	110130A	BUSHING	IPL-7
37	210010	BUSHING, CENTER PIVOT	IPL-13
37	210010	BUSHING, CENTER PIVOT	IPL-9
39	110130B	BUSHING, CLEVIS	IPL-13
39	110130B	BUSHING, CLEVIS	IPL-9
17	100170	BUSHING, CYLINDER LIFT	IPL-3

ILLUSTRATED PARTS LIST



INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
26	930041	BUSHING, HYD. CYL. CLEVIS	IPL-3
10	BL30000-07	BUSHING, KING PIN	IPL-11
6	36208	BUZZER, 12 VDC, CONTINUOUS TONE	IPL-41
22	100214	CAB, CANOPY (USED WITH CANOPY ONLY)	IPL-3
18	140310	CABLE, BATTERY TRAY	IPL-31
18	140310	CABLE, BATTERY TRAY	IPL-29
21	5804	CABLE, ENGINE GROUND, BAT NEG 12"	IPL-45
10	160100	CABLE, HIGH/LOW SHIFTER	IPL-43
11	160090	CABLE, THROTTLE	IPL-45
15	160090	CABLE, V.V. MOTOR OR THROTTLE	IPL-43
23	100204	CANOPY, CAB	IPL-3
20	120171	CAP	IPL-15
9	120653	CAP, BEARING RETAINER	IPL-55
7		CAP, BEARING RETAINER	IPL-53
4	140030FL	CAP, FUEL TANK	IPL-29
4	140030FL	CAP, FUEL TANK	IPL-31
5	140030HL	CAP, HYD. OIL TANK	IPL-31
5	140030HL	CAP, HYD. OIL TANK	IPL-29
2	170120	CAP, RADIATOR	IPL-35
1	300010	CAP, STEERING WHEEL	IPL-39
12		CARRIER ASSEMBLY	IPL-55
11		CENTERED BELOW STEERING WHEEL ON CONSOLE	IPL-63
11		CENTERED BELOW STEERING WHEEL ON CONSOLE	IPL-65
2	120024L	CHAIN BOX, LH	IPL-15
1	120014R	CHAIN BOX, RH	IPL-15
10	120100A	CHAIN, #120 FROM, SERIAL #82	IPL-15
20	100190	CHECK VALVE, ARTICULATION LOCK	IPL-3
2	160510	CHECK VALVE, DEAD ENGINE STEERING PUMP	IPL-61
5	160530	CHECK VALVE, TANDEM HYD. PUMP	IPL-61
24	140430	CIRCUIT BREAKER	IPL-43
5	35701	CIRCUIT BREAKER, 25 AMP	IPL-41
	140430	CIRCUIT BREAKER, PUSH BUTTON	IPL-67
29	BL30000-12	CLAMP HALF	IPL-11
7	100071	CLAMP HALF, ARTICULATING SHAFT	IPL-3
5	852827	CLAMP HALF, KING PIN	IPL-7
4	100042	CLAMP HALF, REAR AXLE	IPL-3
2	110021	CLAMP HALF, SPINDLE MOUNT	IPL-7
2	857377	CLAMP HALF, SPINDLE MOUNT, AWD	IPL-11
5	171100	CLAMP, BAND MOUNTING	IPL-37
6	500230	CLAMP, HOSE	IPL-35
8	984130	CLAMP, HOSE	IPL-35
7	983577	CLAMP, HOSE, SIZE 64	IPL-37
5	131140	CLAMP, HYDRAULIC LINES	IPL-27
16	130161	CLAMP, LOWER	IPL-19
5	161250	CLAMP, MUFFLER, 3.00	IPL-33
24	130261	CLAMP, SPACER BLOCK	IPL-19
12	171090	CLAMP, T-BOLT, 3.00	IPL-37
15	171190	CLAMP, T-BOLT, 3.50	IPL-37
14	130141	CLAMP, UPPER	IPL-19
17	110170	CLEVIS	IPL-11
17	110170	CLEVIS	IPL-7
30	810050	CLEVIS	IPL-43
16	141060	CLEVIS, VALVE SPOOL END	IPL-49
45	BL30000-18	COIL, SOLENOID VALVE	IPL-13
12	120120	COLLAR, LOCK	IPL-15
7	300040	COLUMN, STEERING	IPL-39
6	120652	COMPANION FLANGE, PINION/ROTOR	IPL-57
24	P204324	COMPRESSOR, AIR COND.	IPL-45



ILLUSTRATED PARTS LIST

INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
14	620080	CONE, AXLE INNER	IPL-15
15	983203	CONN, PLUG, DTO6-4S, DEUTSCH	IPL-41
13	982453	CONN, WEDGE, PLUG, 12P, DEUTSCH	IPL-41
16	983212	CONN, WEDGE, PLUG, 4PM DEUTSCH	IPL-41
11	982446	CONN. PLUG, DT06-12SA, DEUTSCH	IPL-41
	982449	CONNECTOR FOR WIRING HARNESS MURPHY PANEL SIDE	IPL-67
5	140492	CONSOLE, STEERING	IPL-39
25	BL30000-02	COVER	IPL-11
19	140591	COVER, HYDRAULIC HOSES ROUTING ACCESS	IPL-39
7	910055	COVER, INLET	IPL-49
22	120191	COVER, INSPECTION	IPL-15
1	910056	COVER, OUTLET	IPL-49
6	160261	COVER, RADIATOR FILL	IPL-33
10	120651	COVER, REAR CARRIER	IPL-55
4	120041	COVER, SERVICE	IPL-15
8	130083	COVER, TURNTABLE BOTTOM	IPL-19
20	140641	COVER, VALVE BANK ACCESS	IPL-39
26	102-109-1A	CSHH, .312 - 18 X 2.00	IPL-11
40	102-205-1A	CSHH, .375-16 X 1.00	IPL-17
7	102-205-1A	CSHH, .375-16 X 1.00	IPL-33
35	102-407-1A	CSHH, .500-13 X 1.50	IPL-3
4	102-407-1A	CSHH, .500-13 X 1.50	IPL-59
54	102-609-1A	CSHH, .625-11 X 2.00	IPL-21
55	102-615-1A	CSHH, .625-11 X 3.50	IPL-21
35	102-616-1A	CSHH, .625-11 X 3.75	IPL-21
25	100240	CSHH, .625-18 X 4.50 GR8	IPL-3
37	102-713-1A	CSHH, .750-10 X 3.50	IPL-5
24	100230	CSHH, .750-16 X 3.75 GR8	IPL-3
11	120520	CSSH, .437-14 X 2.00	IPL-57
9	120520	CSSH, .437-14 X 2.00	IPL-59
13	102-317-1A	CSSH, .437-14 X 4.00	IPL-57
9	102-407-1A	CSSH, .500-13 X 1.50	IPL-57
13	620090	CUP, AXLE INNER	IPL-15
41	853860	CUTTING EDGE, 6' (12' MOLDBOARD OPT.)	IPL-21
8	131020	CUTTING EDGE, 7', FRONT BLADE	IPL-23
16	131240	CUTTING EDGE, BUCKET (WELD ON)	IPL-27
20	130210	CUTTING EDGE, MOLDBOARD, 10'	IPL-19
7	853610	CYL, GAS SPRING SHOCK, WINDSHIELD	IPL-25
6	100060	CYL, HYD, ARTICULATION	IPL-3
7	131160	CYL, HYD, BOOM LIFT	IPL-27
10	131180	CYL, HYD, BUCKET TILT	IPL-27
14	131090	CYL, HYD, FRONT BLADE LIFT	IPL-23
2	130020	CYL, HYD, MOLDBOARD ANGLE	IPL-19
3A	852620	CYL, HYD, MOLDBOARD CIRCLE SHIFT (OPT.)	IPL-19
5	130050	CYL, HYD, MOLDBOARD LIFT	IPL-19
11	130110	CYL, HYD, MOLDBOARD SLIDE	IPL-19
10	130100	CYL, HYD, MOLDBOARD TILT	IPL-19
1	132010	CYL, HYD, SCARIFIER LIFT	IPL-23
22	110220	CYL, HYD, STEERING	IPL-11
22	110220	CYL, HYD, STEERING	IPL-7
23	110230	CYL, HYD, WHEEL LEAN	IPL-11
23	110230	CYL, HYD, WHEEL LEAN	IPL-7
	160210	DECAL KIT	IPL-65
	160210SRV	DECAL KIT	IPL-63
14	901007	DETENT KIT	IPL-49
24	685010	DIFFUSER, HYD. TANK RETURN	IPL-29
24	685010	DIFFUSER, HYD. TANK RETURN	IPL-31
4	120652	DISC, BRAKE	IPL-55

ILLUSTRATED PARTS LIST



INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
12	140340	DOOR, L.H. ENGINE ACCESS	IPL-29
11	140330	DOOR, R.H. ENGINE ACCESS	IPL-29
20	151343	DOOR, SPECIFY L. H. OR R. H.	IPL-25
5	100051	DOOR, TOOL BOX	IPL-3
1	130014-1	DRAWBAR ASSEMBLY, TURNTABLE	IPL-19
3	141010	DUST BOOT & CAP, VALVE SPOOL	IPL-49
14	34031	ELBOW, 3.00	IPL-37
11	171170	ELBOW, 3.00 X 3.50	IPL-37
4	160010	ELBOW, EXH, 90, 3.00	IPL-33
2	171140	ELEMENT, PRIMARY	IPL-37
3	171150	ELEMENT, SAFETY	IPL-37
18	130180	END BIT, L.H. & R H	IPL-19
12	141040	END CAP, VALVE SPOOL	IPL-49
	685990	ENGINE WIRING HARNESS	IPL-45
13	160200	FAN BELT	IPL-45
1	983454	FAN BLADE	IPL-45
25	151300-2	FAN BLADE, DEFROSTER	IPL-25
26	151300-3	FAN BLADE, HEATER	IPL-25
33	140030FN	FILLER NECK, HYD. / FUEL TANK	IPL-29
12	140030FN	FILLER NECK, HYD/FUEL TANK	IPL-31
26	160050	FILTER ASSY, HYD. SUCTION	IPL-29
9	34883	FILTER ELEMENT, FUEL, PRIMARY	IPL-45
10	72078	FILTER ELEMENT, FUEL, SECONDARY	IPL-45
25	290030	FILTER ELEMENT, HYD. CHARGE	IPL-31
25	160060	FILTER ELEMENT, HYD. SUCTION	IPL-29
3	34881	FILTER ELEMENT, OIL	IPL-45
26	290010	FILTER HEAD, HYD CHARGE/RETURN	IPL-31
47	71775	FITT, 90, 12MJ-12MB	IPL-13
46	X280	FITT, STR, 10MJ-12MB	IPL-13
11	140610	FITTING, GREASE	IPL-39
21	35494	FITTING, HYD.	IPL-3
32	859443	FITTING, W/.063 ORIFICE	IPL-19
13	141050	FLOAT ASSEMBLY	IPL-49
1	151000	FRAME, CAB	IPL-25
9	131033SRV	FRAME, FRONT BLADE LOWER	IPL-23
4	151221	FRAME, FRONT WINDSHIELD	IPL-25
2	132024	FRAME, SCARIFIER	IPL-23
23	982027SRV	FRONT BLADE (OPTION)	IPL-23
1	984909-01	FUEL FILTER	IPL-47
	685060	FUSE PANEL (18 GANG)	IPL-25
	851438	FUSE PANEL (8 GANG)	IPL-5
32	720100	GASKET, ENGINE ACCESS	IPL-29
27	720100	GASKET, ENGINE ACCESS	IPL-31
23	120200	GASKET, INSPECTION COVER	IPL-15
3	P77494	GASKET, S.A.E. "C" 2/6 BOLT	IPL-51
3	120030	GASKET, SERVICE COVER	IPL-15
27	160070	GAUGE, FILTER RESTRICTION	IPL-29
3	35366	GAUGE, FUEL	IPL-41
	140380	GAUGE, FUEL	IPL-67
19	140380	GAUGE, FUEL LEVEL MURPHY	IPL-43
8	39080	GAUGE, OIL PRESS. 150PSI, 240 OHM	IPL-41
	140410	GAUGE, OIL PRESSURE	IPL-67
22	140410	GAUGE, OIL PRESSURE MURPHY	IPL-43
14	35630	GAUGE, TACH/HOUR METER	IPL-41
	140390	GAUGE, VOLT METER	IPL-67
20	35668	GAUGE, VOLTMETER MURPHY	IPL-43
	140400	GAUGE, WATER TEMP	IPL-67
21	140400	GAUGE, WATER TEMP. MURPHY	IPL-43

INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
2	35364	GAUGE, TEMP., WATER	IPL-41
4		GEAR, RING AND PINION	IPL-53
33	110330	GREASE CAP	IPL-7
13	150024	GRILLE	IPL-29
13	150024	GRILLE	IPL-31
4	35668	GUAGE, VOLTMETER, 8-18 V DC	IPL-41
3	100032	GUARD, DIFFERENTIAL	IPL-3
18	983220	HANDLE, DOOR	IPL-25
10	160040	HEAD LAMP	IPL-25
	982250	HEAD LIGHT SWITCH	IPL-43
16	151300	HEATER, CAB	IPL-25
9	140014	HOOD	IPL-29
1	140014	HOOD	IPL-33
	720110	HORN	IPL-43
28	160320	HORN, BACK UP ALARM INCLUDES BRACKET	IPL-29
28	160320	HORN, BACK UP ALARM W/BRACKET	IPL-31
9	5LOLA	HOSE	IPL-35
34	140520	HOSE 3/16" X 8' MURPHY	IPL-43
6	99MG685DES	HOSE KIT, DEAD ENGINE STEERING	IPL-61
18	99MG685FBK	HOSE KIT, FOOT BRAKE	IPL-57
15	151290	HOSE, DEFROST	IPL-25
3	170071A	HOSE, RADIATOR	IPL-35
5	170100A	HOSE, RADIATOR LOWER	IPL-35
26	130101	HOUSING, BALL SWIVEL	IPL-19
1		HOUSING, REAR AXLE	IPL-53
24	110240A	HUB, FRONT WHEEL	IPL-7
27A	500010-1	IGNITION KEY MURPHY	IPL-43
	500010	IGNITION SWITCH	IPL-67
10	171220	INDICATOR,AIR FILTER RESTRICTION	IPL-37
14		INSIDE CAB, AHEAD OF LEFT SIDE CONTROL LEVERS	IPL-63
14		INSIDE CAB, AHEAD OF LEFT SIDE CONTROL LEVERS	IPL-65
2		INSIDE CAB, LEFT SIDE AGAINST OUTSIDE PANEL	IPL-63
2		INSIDE CAB, LEFT SIDE AGAINST OUTSIDE PANEL	IPL-65
20		INSIDE CAB, LEFT SIDE OF SEAT TO THE REAR OF CONTROL LEVER	IPL-63
21		INSIDE CAB, LEFT SIDE OF SEAT TO THE REAR OF CONTROL LEVER	IPL-63
20		INSIDE CAB, LEFT SIDE OF SEAT TO THE REAR OF CONTROL LEVER	IPL-65
21		INSIDE CAB, LEFT SIDE OF SEAT TO THE REAR OF CONTROL LEVER	IPL-65
18		INSIDE CAB, ON TOP OF INSTRUMENT PANEL	IPL-63
18		INSIDE CAB, ON TOP OF INSTRUMENT PANEL	IPL-65
16		INSIDE CAB, ON VALVE COVER PANEL ALIGNED TO CORRECT VALVES	IPL-63
16		INSIDE CAB, ON VALVE COVER PANEL ALIGNED TO CORRECT VALVES	IPL-65
6	110061	KING PIN	IPL-7
19	984642	KIT, PUMP DESTROKE/685	IPL-57
3	140250	KNOB	IPL-43
9	981746	KNOB, CONSOLE LEVER	IPL-39
19	160030L	LAMP, L.H. TURN SIGNAL	IPL-29
19	160030L	LAMP, LH. TURN SIGNAL	IPL-31
20	160030R	LAMP, R.H. TURN SIGNAL	IPL-29
20	160030R	LAMP, RH. TURN SIGNAL	IPL-31
19	983219	LATCH, DOOR, LH	IPL-25
19A	983423	LATCH, DOOR, RH	IPL-25
30	160450	LATCH, ENGINE ACCESS PANEL	IPL-29
30	160450	LATCH, ENGINE ACCESS PANEL	IPL-31
6	160460	LATCH, RADIATOR ACCESS	IPL-29
27A		LEFT BOOM FROM GUSSET OF LIFT CYLINDER SUPPORT FORWARD	IPL-63
27A		LEFT BOOM FROM GUSSET OF LIFT CYLINDER SUPPORT FORWARD	IPL-65
6		LEFT SIDE HOOD PANEL, BELOW FILTER VIEWING HOLE	IPL-63
6		LEFT SIDE HOOD PANEL, BELOW FILTER VIEWING HOLE	IPL-65

ILLUSTRATED PARTS LIST



INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
19		LEFT SIDE, MOUNTED TO VALVE BANK SUPPORT HOUSING	IPL-63
19		LEFT SIDE, MOUNTED TO VALVE BANK SUPPORT HOUSING	IPL-65
10		LEFT SIDE, UPPER LEFT COMER OF HYDRAULIC TANK	IPL-63
10		LEFT SIDE, UPPER LEFT COMER OF HYDRAULIC TANK	IPL-65
8	140511	LEVER, CONSOLE LOCK	IPL-39
10	140531	LEVER, CONTROL (SPECIFY FUNCTION)	IPL-39
16	140630	LEVER, CONTROL (SPECIFY FUNCTION)	IPL-39
4	140261	LEVER, NEUTRAL SAFETY, LOCK, 685 PEDAL	IPL-43
19	S77435	LEVER, PUMP CONTROL	IPL-45
9	986616	LEVER, SHIFTER	IPL-43
1	31983	LIGHT, RED DASH .50 HOLE	IPL-41
17	901010	LINK ASSY., VALVE LEVER	IPL-39
13	140560	LINK, LEVER TO BLOCK	IPL-39
18	210160	LOCK NUT	IPL-15
1	100014	MAIN FRAME ASSEMBLY(SHOWN WITH CANOPY CAB ATTACHED)	IPL-3
43	BL30000-16	MANIFOLD, EQUA-TRAC, AWD	IPL-13
15	858854	MANIFOLD, SERVICE BRAKE	IPL-57
8	120630	MANIFOLD, TANK DRAIN	IPL-59
9	720260	MIRROR, INSIDE REAR VIEW	IPL-25
23	151370	MIRROR, OUTSIDE REAR VIEW	IPL-25
19	130204	MOLDBOARD ASSY, 10'	IPL-19
24	151380	MOTOR, ELECTRIC FAN (HEATER/DEFROST)	IPL-25
2	750578-1	MOTOR, HYD, DRIVE (REX ROTH - NOTE PUMP BRAND)	IPL-51
1	160370	MOTOR, HYD, DRIVE (SAUER DANFOSS - NOTE PUMP BRAND)	IPL-51
41	BL30000-10	MOTOR, HYD, FRONT WHEEL DRIVE ASSIST	IPL-13
6	140500	MOTOR, HYD, POWER STEERING	IPL-39
11	151170	MOTOR, WINDSHIELD WIPER	IPL-25
2	859293	MOUNT, BRAKE	IPL-57
14	160270	MOUNT, ENGINE FRONT	IPL-45
15	100152	MOUNT, LIFT CYLINDER	IPL-3
5	160190	MOUNT, REAR ENGINE, PAD	IPL-45
25	980593	MOUNT, THROTTLE CABLE	IPL-45
21	130224	MOUNTING ASSEMBLY, TURNTABLE, MOLDBOARD	IPL-19
2	988408	MUFFLER, EXHAUST	IPL-33
21	230070	NEEDLE VALVE	IPL-29
21	230070	NEEDLE VALVE	IPL-31
	P79315	NEUTRAL SAFETY SWITCH (SUNSTRAND)	IPL-45
10	110101	NUT, ADJUSTMENT	IPL-7
14	100141	NUT, ARTICULATING SHAFT	IPL-3
31	110310	NUT, FRONT SPINDLE	IPL-7
16	120310	NUT, HEX	IPL-15
2	300020	NUT, HEX	IPL-39
14	077HN103	NUT, HEX	IPL-53
1	077HN103	NUT, HEX	IPL-55
33	115-11	NUT, HEX 1-1/8"-12	IPL-19
14	116-4	NUT, HEX, .437-14	IPL-57
39	116-7	NUT, HEX, .625-11	IPL-21
19	116-7	NUT, HEX, .625-11	IPL-23
38	116-8	NUT, HEX, .750-10	IPL-5
51	80132	NUT, HEX, CASTLE, .875-14	IPL-21
53	116-7-1	NUT, HEX, JAM, .625-11 X 2.00	IPL-21
28	120250	NUT, LOCK	IPL-15
10	143-3	NUT, LOCK, .375	IPL-33
10	143-5	NUT, LOCK, .500-13	IPL-57
37	143-7	NUT, LOCK, .625-11	IPL-21
49	143-12	NUT, LOCK, 1.25-7	IPL-21
8	077HN103	NUT, LOCK, PINION SHAFT	IPL-57
32	120350A	NUT, LUG	IPL-11

INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
41	120350A	NUT, LUG	IPL-9
35	120350A	NUT, LUG	IPL-15
21	140650	NUT, WING	IPL-39
3	984909-02	OIL FILTER	IPL-47
15		ON CANOPY CROSS SUPPORT, MOUNTED TO CENTER PLATE	IPL-63
15		ON CANOPY CROSS SUPPORT, MOUNTED TO CENTER PLATE	IPL-65
30		ON FRAME FROM REAR COMER TOWARD FRONT, BOTH SIDES	IPL-63
30		ON FRAME FROM REAR COMER TOWARD FRONT, BOTH SIDES	IPL-65
3		ON LEFT SIDE OF THE HOOD	IPL-63
3		ON LEFT SIDE OF THE HOOD	IPL-65
26		ON LIFT CYLINDER SUPPORT, CENTERED FACING FRONT	IPL-63
26		ON LIFT CYLINDER SUPPORT, CENTERED FACING FRONT	IPL-65
4		ON RIGHT SIDE, CENTERED & ONE QUARTER DISTANCE FROM TOP	IPL-63
4		ON RIGHT SIDE, CENTERED & ONE QUARTER DISTANCE FROM TOP	IPL-65
7		ON SADDLE LIFT CYLINDER SUPPORT, CENTERED FACING OPERATOR,	IPL-63
7		ON SADDLE LIFT CYLINDER SUPPORT, CENTERED FACING OPERATOR,	IPL-65
8		ON THE REAR FRAME, RED TO OUTSIDE COMERS	IPL-63
8		ON THE REAR FRAME, RED TO OUTSIDE COMERS	IPL-65
5		ON TOP PLATE OF SCARIFIER, Y2" FROM EDGE, BOTH SIDES	IPL-63
5		ON TOP PLATE OF SCARIFIER, Y2" FROM EDGE, BOTH SIDES	IPL-65
24	BL30000-01	O-RING	IPL-11
2	120490	PAD KIT, BRAKE CALIPER	IPL-59
8	140262	PANEL, ENGINE ACCESS L.H.	IPL-29
10	140272	PANEL, ENGINE ACCESS R.H.	IPL-29
23	140420	PANEL, IGNITION CONTROL MURPHY	IPL-43
28	140471	PANEL, L.H.	IPL-43
7	140621	PANEL, R.H.	IPL-43
1	140231	PEDAL, FOOT	IPL-43
14	110141	PIN	IPL-11
14	110141	PIN	IPL-7
16	110161	PIN	IPL-11
16	110161	PIN	IPL-7
2	131111	PIN, BOOM PIVOT	IPL-27
15	131231	PIN, BUCKET PIVOT	IPL-27
11	131191	PIN, BUCKET TILT	IPL-27
27	210060	PIN, CLEVIS	IPL-3
42	210060	PIN, CLEVIS, 1.00 X 2.625	IPL-21
20	210060	PIN, CLEVIS, 1.00 X 2.625	IPL-23
28	80338	PIN, COTTER	IPL-3
46	930039	PIN, COTTER, .188 X 2.00	IPL-21
21	930039	PIN, COTTER, .188 X 2.00	IPL-23
16	984892	PIN, COTTER, .188 X 2.00	IPL-23
48	130232	PIN, COTTER, .250 X 2.25	IPL-21
3	132031SRV	PIN, LOCK, SCARIFIER SHANK	IPL-23
9	131171	PIN, LOWER END LIFT	IPL-27
44	857585	PIN, MOLDBOARD TILT CYL, REAR	IPL-21
43	857591	PIN, MOLDBOARD TILT CYL, REAR	IPL-21
6	132060	PIN, SCARIFIER FRAME MOUNT	IPL-23
31	130231	PIN, TURNTABLE TO SLIDE	IPL-19
6	131151	PIN, UPPER END LIFT	IPL-27
19	100180	PINTLE HOOK	IPL-3
40	981133	PIPE (CAB)	IPL-5
39	99537	PIPE PLUG, .500	IPL-17
6	37081	PIPE, AIR INLET, 3.75	IPL-37
3	160240-12	PIPE, FLEXIBLE EXHAUST (TURBO)	IPL-33
17	986631	PLATE INST PANEL	IPL-41
22	140661	PLATE, CONSOLE, LOWER COVER	IPL-39
17	160300	PLATE, DRIVE	IPL-45

ILLUSTRATED PARTS LIST



INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
*8	986717	PLATE, LH, ENGINE COVER	IPL-31
*10	986716	PLATE, RH, ENGINE COVER	IPL-31
38	130220	PLOW BOLT, .625-11 X 2.00	IPL-21
17	130220	PLOW BOLT, .625-11 X 2.00	IPL-23
9	BL30000-05	PLUG	IPL-11
8	171160	PRE-CLEANER ASSY.	IPL-37
6	120570	PRESS INTENSIFIER, FAIL SAFE BRAKE (5:1 RATIO)	IPL-59
20	160340	PUMP CONTROLLER (SUNDSTRAND "90"SERIES)	IPL-45
7	160250	PUMP, HYD, 685 DRIVE (NOTE PUMP BRAND) & SERIAL#	IPL-45
1	685020	PUMP, MOTOR & RELAY, DEAD ENGINE STEERING	IPL-61
1	980280	RADIATOR, COOLER	IPL-35
29		REAR PANEL OF HOOD	IPL-63
29		REAR PANEL OF HOOD	IPL-65
	140470	RELAY	IPL-67
31	140470	RELAY, ENGINE SHUT DOWN SWITCH	IPL-43
7	37780	RELAY, TD, NC, 1-60SEC, 12VDC	IPL-41
6	901009	RELIEF VALVE	IPL-49
16	100161	RETAINER, LIFT CYLINDER	IPL-3
27		RIGHT BOOM FROM GUSSET OF LIFT CYLINDER SUPPORT	IPL-63
27		RIGHT BOOM FROM GUSSET OF LIFT CYLINDER SUPPORT	IPL-65
25		RIGHT SIDE CENTERED TO TOOL BOX DOOR	IPL-63
25		RIGHT SIDE CENTERED TO TOOL BOX DOOR	IPL-65
9		RIGHT SIDE OF CONSOLE, BELOW WARNING LIGHT	IPL-63
9		RIGHT SIDE OF CONSOLE, BELOW WARNING LIGHT	IPL-65
23		RIGHT SIDE OF SEAT AHEAD OF PARKING LEVER	IPL-63
23		RIGHT SIDE OF SEAT AHEAD OF PARKING LEVER	IPL-65
24		RIGHT SIDE OF SEAT TO THE RIGHT OF CONTROL LEVER	IPL-63
24		RIGHT SIDE OF SEAT TO THE RIGHT OF CONTROL LEVER	IPL-65
13		RIGHT SIDE, CENTERED AND CLOSE TO TOP OF FUEL TANK	IPL-63
13		RIGHT SIDE, CENTERED AND CLOSE TO TOP OF FUEL TANK	IPL-65
17		RIGHT SIDE, ON VALVE BANK SUPPORT HOUSING	IPL-63
17		RIGHT SIDE, ON VALVE BANK SUPPORT HOUSING	IPL-65
34	120330	RIM, 12" X 19.5"	IPL-7
33	120330	RIM, 12" X 19.5"	IPL-15
34A	120330A	RIM, 15" X 10"	IPL-7
21	120180	RING, SNAP	IPL-15
25	130172	ROCK/DIRT SHIELD, MOLDBOARD	IPL-19
8	853590	ROD KIT, 10 SECTION	IPL-49
2	140240A	ROD, 635 FOOT PEDAL PIVOT	IPL-43
12	131201	ROD, BUCKET ANGLE	IPL-27
5	140270	ROD, FORWARD & REVERSE	IPL-43
3	130031	ROD, STABILIZER	IPL-19
18	110182	ROD, WHEEL LEAN TIE	IPL-7
19	110192	ROD, WHEEL LEAN TIE	IPL-11
19	110192	ROD, WHEEL LEAN TIE	IPL-7
18	859375	ROD, WHEEL LEAN TIE	IPL-11
42	72161	ROLL PIN, .375 X 3.00	IPL-13
42	72161	ROLL PIN, .375 X 3.00	IPL-9
5	312051	ROTOR, BRAKE	IPL-57
31	920070	SCREW, WING, .375-16 X 1.00	IPL-3
9	100090	SEAL	IPL-3
13	100090	SEAL	IPL-3
27	110270	SEAL	IPL-7
25	120220	SEAL	IPL-15
32	120290	SEAL	IPL-15
7	210240	SEAL	IPL-7
5	312051	SEAL	IPL-55
2A	130050-1	SEAL KIT, HYD CYL	IPL-19



ILLUSTRATED PARTS LIST

INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
5A	130050-1	SEAL KIT, HYD, CYL.	IPL-19
10B	130100-1	SEAL KIT, HYD,CYL.	IPL-19
6A	100060-1	SEAL KIT, HYD. CYL.	IPL-3
23A	110230-1	SEAL KIT, HYD. CYL.	IPL-11
23A	110230-1	SEAL KIT, HYD. CYL.	IPL-7
14A	130050-1	SEAL KIT, HYD. CYL.	IPL-23
22A	130050-1	SEAL KIT, HYD. CYL.	IPL-7
7A	131160-1	SEAL KIT, HYD. CYL.	IPL-27
10A	131180-1	SEAL KIT, HYD. CYL.	IPL-27
1A	132010-1	SEAL KIT, HYD. CYL.	IPL-23
22A	130050-1	SEAL KIT, HYD. CYL. (NOT SHOWN)	IPL-11
10	910062	SEAL KIT, VALVE SECTION	IPL-49
15	910059	SEAL KIT, VALVE SPOOL	IPL-49
17	151310	SEAL, DOOR TO CAB WEATHER STRIP	IPL-25
27	720100	SEAL, EDGE TRIM (CAB TO FRAME)	IPL-25
9	454755C1	SEAL, OIL	IPL-53
6	120060A	SEAL, TANDEM AXLE, FROM SERIAL #82	IPL-15
24	360010B	SEAT, OPERATOR	IPL-39
7	910080	SELECTOR VALVE, BRAKE	IPL-59
3	140040	SENDER UNIT, FUEL LEVEL	IPL-29
3	140040	SENDING UNIT, FUEL LEVEL	IPL-31
40	BL30000-15	SET SCREW	IPL-13
52	130120	SET SCREW, SQ. HD., .625-11 X 3.00	IPL-21
4	131131	SHACKLE, BOOM PIVOT	IPL-27
10	100102	SHAFT, ARTICULATION	IPL-3
38	110361	SHAFT, CENTER PIVOT	IPL-13
38	110361	SHAFT, CENTER PIVOT	IPL-9
16	160300-1	SHAFT, FLYWHEEL, PUMP DRIVE	IPL-45
15	110151	SHAFT, FRONT WHEEL LEAN	IPL-7
15	857368	SHAFT, FRONT WHEEL LEAN	IPL-11
7	BL30000-06	SHAFT, KING PIN	IPL-11
13	859361	SHAFT, LEVER MOUNT	IPL-43
11	131051SRV	SHAFT, LOWER FRONT PIVOT	IPL-23
10	131041	SHAFT, LOWER REAR PIVOT	IPL-23
12	131061SRV	SHAFT, UPPER PIVOT	IPL-23
4	132040	SHANK W/ TOOTH, SCARIFIER	IPL-23
23	130251	SHIM	IPL-19
27A	130103	SHIM, .023, DRAWBAR PULL BALL	IPL-19
27	130104	SHIM, .030, DRAWBAR PULL BALL	IPL-19
27B	130105	SHIM, .055, DRAWBAR PULL BALL	IPL-19
13	130130	SHIM, 3 HOLE UPPER	IPL-19
15	130150	SHIM, 4 HOLE LOWER	IPL-19
15	160280	SHIM, SIDE LOAD	IPL-45
35	500070	SIGHT GAUGE, HYD. TANK	IPL-29
31	500070	SIGHT GAUGE, HYD. TANK	IPL-31
15	R30SS101	SLEEVE, TRANSMISSION SHAFT	IPL-53
22	130243	SLIDE ASSEMBLY, MOLDBOARD SUPPORT	IPL-19
43	981135	SLIDE BRACKET (CAB)	IPL-5
26	120230	SNAP RING	IPL-15
8	BL30000-04	SNAP RING	IPL-11
	852560	SNOW PLOW LIGHT KIT CAB MACHINE ONLY	IPL-25
29	130102	SOCKET HALF, DRAWBAR PULL BAR	IPL-19
44	BL30000-17	SOLENOID VALVE, EQUA-TRAC	IPL-13
22	720290	SOLENOID, 12V	IPL-45
7	720290	SOLENOID, STARTING	IPL-61
	720290	SOLENOID (EXTRA)	IPL-43
12	130121	SPACER	IPL-19
8	R30HS101-1	SPACER	IPL-55

ILLUSTRATED PARTS LIST



INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER.	NOMENCLATURE 123456	PAGE
9A	120091S	SPACER, 4 5/16"	IPL-15
9	120091L	SPACER, 5"	IPL-15
12	110122SRV	SPINDLE ASSY, L.H	IPL-7
11	110112SRV	SPINDLE ASSY, RH	IPL-7
4	110043SRV	SPINDLE MOUNT, FRONT, LH	IPL-7
3	110033SRV	SPINDLE MOUNT, FRONT, RH	IPL-7
4	986365	SPINDLE MOUNT, LH	IPL-11
3	986366	SPINDLE MOUNT, RH	IPL-11
11	901014	SPRING RETURN KIT	IPL-49
14	490080	SPRING WASHER, 5/8"	IPL-43
8	670060	SPRING, PRESSURE RELEASE	IPL-43
11	120110A	SPROCKET, 30 TOOTH, FROM SERIAL #82	IPL-15
24	120210A	SPROCKET, DOUBLE SINGLE FROM SERIAL #82	IPL-15
2	984909-03	STARTER	IPL-47
4	160310	STARTER MOTOR, 12V	IPL-45
6	986363	STEERING ARM ASSY, LH	IPL-11
5	986364	STEERING ARM ASSY, RH	IPL-11
3	300030	STEERING WHEEL	IPL-39
22	910020	STRAINER, HYD. SUCTION	IPL-29
22	910020	STRAINER, HYD. SUCTION	IPL-31
	983221	STRIKER BOLT	IPL-25
36	110350A	STUD, FRONT HUB	IPL-9
34	110350A	STUD, WHEEL	IPL-15
29	859216	SUPPORT, CENTER SEAT	IPL-43
23	140600	SUSPENSION, SEAT	IPL-39
27	500010	SWITCH, IGNITION MURPHY	IPL-43
9	39146-14	SWITCH, IGNITION, PERKINS 3.3	IPL-41
3	160520	SWITCH, LOW PRESS	IPL-61
16	853190	SWITCH, PUMP DESTROKE	IPL-57
10	851391	SWITCH, TOGGLE, SPDT, 2-POS	IPL-41
4	140480	SWITCH, TURN SIGNAL	IPL-39
18	140370	TACH/HOUR METER, MURPHY	IPL-43
	140370	TACHOMETER/HOUR METER	IPL-67
4	160260	TANDEM HYD. PUMP, STEERING & IMPLEMENT	IPL-61
8	160260	TANDEM PUMP, CYLINDER & STEERING	IPL-45
1	853153	TANK ASSY, FUEL & HYD (SN475 AND UP)	IPL-29
2	853161	TANK, FUEL/HYD, ACCESS COVER	IPL-31
6	853162	TANK, FUEL/HYD., ACCESS GASKET	IPL-31
7	983273	TANK, RADIATOR OVERFLOW	IPL-35
12	982448	TERM, SOC, DEUTSCH, 14-16AWG	IPL-41
15	210020	THRUST WASHER	IPL-15
35	110340	TIRE	IPL-9
35	A120330AL	TIRE & WHEEL ASSY, LH	IPL-13
36	A120330AR	TIRE & WHEEL ASSY, RH	IPL-13
35A	110340A	TIRE, GOOD YEAR SOFTRAC 36" X 13.5" X 15"	IPL-13
35A	110340A	TIRE, GOOD YEAR SOFTRAC 36" X 13.5" X 15"	IPL-9
34A	110340A	TIRE, OPTIONAL TURF	IPL-11
34	110340	TIRE, STANDARD	IPL-11
5	132050	TOOTH, SCARIFIER	IPL-23
30	BL30000-13	TUBE	IPL-11
31	BL30000-14	TUBE	IPL-11
13	171180-28	TUBE, AIR INTAKE, 30D X 27.5, ALUM.	IPL-37
13	131211	TUBE, BUCKET ANGLE	IPL-27
7	130073	TURNTABLE	IPL-19
17	350060	U-BOLT, .375	IPL-43
28		UNDER "POWERED BY CUMMINS" ON DECAL NO.	IPL-63
28		UNDER "POWERED BY CUMMINS" ON DECAL NO.	IPL-65
23	685070	V BELT, AIR COND.	IPL-45

INDEX OF PARTS BY NAME CONT..

FIG ITEM	PART NUMBER	NOMENCLATURE 123456	PAGE
4	171040	VACUATOR VALVE	IPL-37
	141000	VALVE ASSY, 9 SECTION	IPL-49
5	141020	VALVE ASSY., ANTI-CAVITATION	IPL-49
15	141000	VALVE BANK (SEE FIGURE 16 FOR FURTHER BREAKDOWN)	IPL-39
9	910054	VALVE SECTION	IPL-49
23	140640	VALVE, GATE, 1.250	IPL-29
23	140640	VALVE, GATE, 1.250	IPL-31
2	901002	VALVE, POWER BEYOND (OPTIONAL)	IPL-49
17	160380	VALVE, SOLENOID, PUMP DESTROKE	IPL-57
11	986711	W/M, DOOR, ENGINE, COVER	IPL-31
1	986703	W/M, FUEL/HYD TANK	IPL-31
26	140450	WARNING BUZZER, ENGINE SHUT DOWN MURPHY	IPL-43
	140450	WARNING BUZZER, LOW OIL/HIGH WATER	IPL-67
25	140440	WARNING LIGHT, ENGINE SHUT DOWN MURPHY	IPL-43
	140440	WARNING LIGHT, LOW OIL/HIGH WATER	IPL-67
47	100250	WASHER	IPL-21
45	855002	WASHER	IPL-21
11	BL30000-08	WASHER THRUST	IPL-11
29	80706	WASHER, FLAT	IPL-3
15	100250	WASHER, FLAT	IPL-23
18	100250	WASHER, FLAT	IPL-3
18	120360	WASHER, FLAT	IPL-45
7	4557H	WASHER, FLAT	IPL-57
13	54557H	WASHER, FLAT	IPL-53
12	BL30000-09	WASHER, FLAT	IPL-11
36	120360	WASHER, FLAT	IPL-15
32	119-3	WASHER, FLAT, SAE, .375	IPL-3
8	119-3	WASHER, FLAT, SAE, .375	IPL-33
36	119-7	WASHER, FLAT, SAE, .625	IPL-21
50	81059	WASHER, FLAT, SAE, .875	IPL-21
22	119-10	WASHER, FLAT, SAE, 1.00	IPL-23
30	110300	WASHER, HEAVY	IPL-7
29	120260	WASHER, LOCK	IPL-15
2	4557H	WASHER, LOCK	IPL-55
27	118-2	WASHER, LOCK, .312	IPL-11
41	118-3	WASHER, LOCK, .375	IPL-17
9	118-3	WASHER, LOCK, .375	IPL-33
12	118-4	WASHER, LOCK, .437	IPL-57
10	118-4	WASHER, LOCK, .437	IPL-59
36	118-5	WASHER, LOCK, .500	IPL-5
5	118-5	WASHER, LOCK, .500	IPL-59
40	118-7	WASHER, LOCK, .625	IPL-21
18	118-7	WASHER, LOCK, .625	IPL-23
33	118-7	WASHER, LOCK, .625	IPL-3
34	118-8	WASHER, LOCK, .750	IPL-3
34	118-11	WASHER, LOCK, 1-1/8"	IPL-21
32	110320	WASHER, LOCKING	IPL-7
28	852570	WEST COAST MIRROR (CAB ONLY)	IPL-25
33	120330B	WHEEL RIM	IPL-11
	853090	WIPER WASHER SWITCH	IPL-25
	685990	WIRING HARNESS	IPL-67
	160040A	WORK LIGHT	IPL-25
	PDCA-5-4M	WORK LOAD PRESSURE SWITCH (UNDER SEAT)	IPL-39