OPERATORS MANUAL

PAYLOADER®
TRACTOR-SHOVEL

model H-90
4-wheel-drive

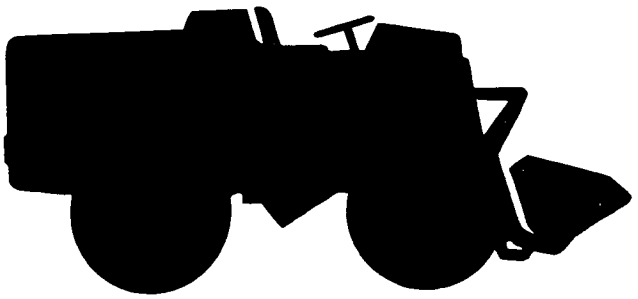
BEGINNING WITH SERIAL NUMBERS

26AB-1027 & UP: GASOLINE, HERCULES

27AC-1001 & UP: DIESEL, CUMMINS

27AU-1001 & UP: DIESEL, CUMMINS TURBO

27AG-1001 & UP: DIESEL, GENERAL MOTORS



PRICE $1.00

FORM
OM-H-90

January 1959

SAY "HUFF"

PAYLOADER®

MANUFACTURED BY
THE FRANK G. HOUGH CO. · LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

IT IS THE POLICY OF THE FRANK G. HOUGH CO. TO IMPROVE ITS PRODUCTS WHEN EVER POSSIBLE AND PRACTICAL TO DO SO. WE RESERVE THE RIGHT TO MAKE CHANGES OR ADD IMPROVEMENTS AT ANY TIME WITHOUT INCURRING ANY OBLIGATION TO MAKE SUCH CHANGES ON MODELS PREVIOUSLY SOLD.

If you should need information not given in this manual, or require the services of a trained mechanic, we urge you to use the extensive facilities offered by The Frank G. Hough Co. "PAYLOADER" dealers. Dealers are kept informed on the best methods of servicing and are equipped to provide prompt, high class service in the field or in an up-to-date service shop.

Dealers carry ample stocks of The Frank G. Hough Co. essential "PAYLOADER" parts.

Listed below you will find the name of The Frank G. Hough Co. dealer with whom your parts orders should be placed and who should be called upon for any required information concerning proper operating and maintenance procedure.

OUR "PAYLOADER" DEALER IS: _____

_____

_____

When ordering parts, always give The Frank G. Hough Co. "PAYLOADER" dealer both the name and part number of the part required, and also the SERIAL NUMBER OF THE "PAYLOADER".

SO THAT YOU MAY HAVE IT BEFORE YOU, WRITE THE "PAYLOADER", POWER UNIT, TRANSMISSION, HYDRAULIC PUMP AND HYDRAULIC VALVE SERIAL NUMBERS HERE:

PAYLOADER SERIAL NO: _____
(Stamped on plate on frame)

POWER UNIT SERIAL NO: _____
(Stamped on engine block)

REAR AXLE SERIAL NO: _____
(Stamped on differential housing)

HYDRAULIC PUMP SERIAL NO: _____
(Stamped on pump body)

HYDRAULIC VALVE SERIAL NO: _____
(Stamped on valve body)

POWER TAKE-OFF SERIAL NO: _____
(Stamped on inspection plate)

TABLE OF CONTENTS

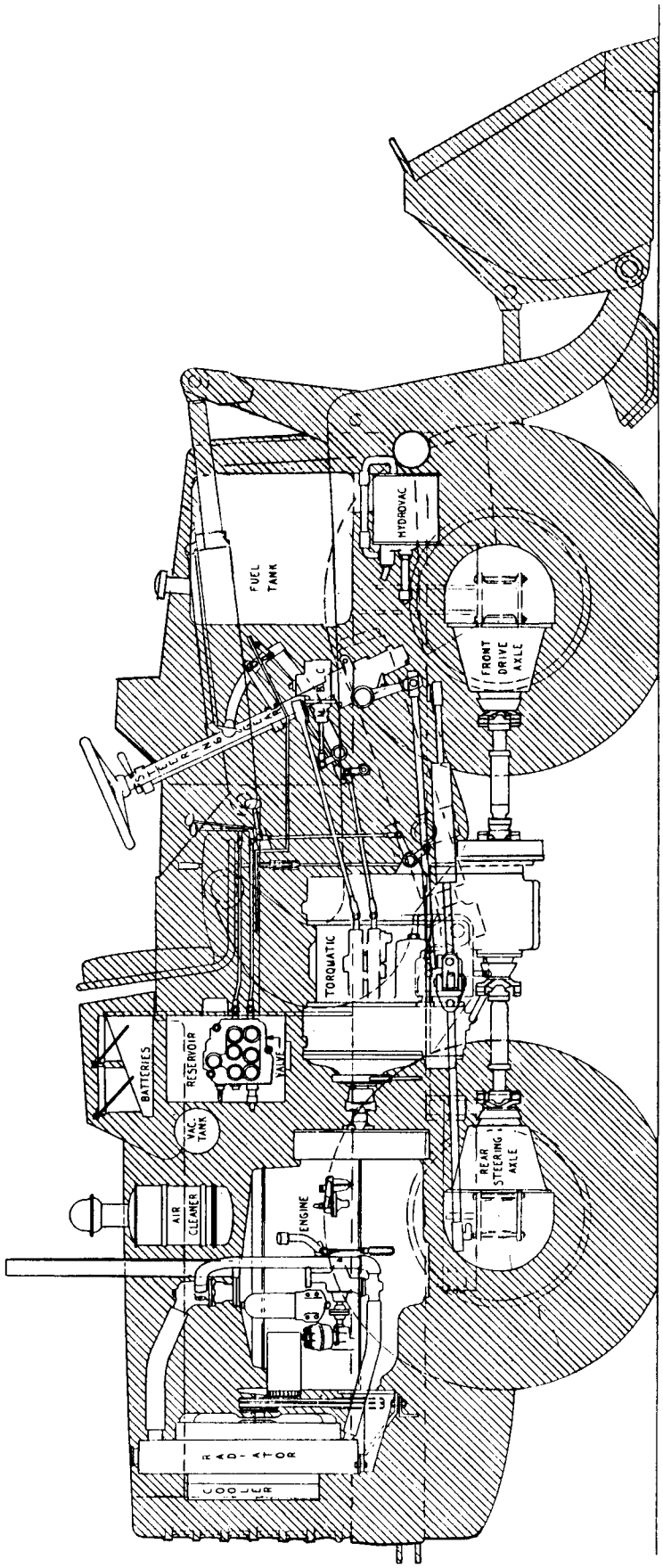


Figure 1. General Arrangement

OPERATOR'S MANUAL

FOR

MODEL H-90 PAYLOADER

SECTION I

PRINCIPLES OF OPERATION

The most satisfactory performance can be expected from Model H-90 "PAYLOADER" units when the operation and maintenance procedures are based upon a clear understanding of the loader working principles. Each compound of the loader affects the operation of every other working component, and of the loader as a whole.

Model H-90 "PAYLOADER" unit discussed in this manual are equipped with six cylinder, in-line, internal combustion gas or diesel engines; full power hydraulic shift transmission; torque converter drive; four wheel planetary final drives; vacuum over hydraulic four wheel brakes; power booster steering; and a closed, pressure-controlled main hydraulic system.

An understanding of the main hydraulic system and the other component systems that make up the H-90 "PAYLOADER" unit will assist in making most effective use of the loader and decrease the amount of major maintenance.

MAIN HYDRAULIC SYSTEM.

Oil to lubricate and operate the component parts of the main hydraulic system is stored in a reservoir that is sufficiently large to hold an adequate amount of oil to supply the hydraulic system in operation. A double element gear type pump mounted on the transmission draws oil from the reservoir and causes the oil to flow to the main control valve of the hydraulic system and the steering booster control valve.

Movement of the double acting boom and bucket cylinders is regulated by the main control valve assembly. The action of the steering booster assembly. The action of the steering booster assembly is controlled by the steering booster control valve assembly on the steering gear.

A pneumatic accumulator circuit is included in the boom hydraulic circuit to minimize the amount of shock loading imposed on the boom circuit when the loader is operated on rough terrain. The shock absorbing qualities of the accumulator are effective only when the accumulator control valve is open so the hydraulic oil of the boom circuit can act against the gas precharge of the accumulator.

The operating pressure of the main hydraulic system is regulated by an adjustable relief valve that is integral with the main control valve assembly. Pressure in the steering booster system is regulated by an adjustable relief valve mounted near the base of the steering column. Both relief valves are set during manufacture of the loader and should not be adjusted unless they are removed for cleaning or replacement purposes.

RESERVOIR.

The reservoir is a completely enclosed self-contained tank that is mounted directly behind the operator's seat. The reservoir also acts as a major collecting point of oil contaminates so that oil circulated through the system will not carry with it foreign matter that could cause damage to system components.

Vacuum and pressure build-up in the reservoir is prevented by the vacuum breaker and the pressure check assemblies in the top of the tank. It permits the tank to breath in order to compensate for normal fluctuation of the oil level. A clean-out hole in the top of the reservoir provides accessibility to the internal surfaces of the reservoir for the purpose of cleaning. A seal at the opening makes it air and oil tight. All oil in the reservoir can be drained when necessary by means of the drain plug in the bottom of the reservoir.

PUMP.

The hydraulic pump is a vane type pump incorporating two pumping elements in tandem on a common drive shaft. The drive shaft is driven off the transmission implement take-off. The pump has three ports, one inlet and two discharge. The large

pumping element, closest to the transmission, pumps oil to the main control valve assembly. The smaller pump, furthest from the transmission, pumps oil to the steering control valve assembly in the steering gear. Between the two pumps is a common inlet body which has one port connected by hose to the hydraulic reservoir and forms a common suction for the large and small pumps.

MAIN CONTROL VALVE.

The main control valve is mounted on the right side of the reservoir and consists basically of a valve housing, two mechanically actuated control plungers and an integral pilot-type relief valve that regulates the pressure of the main hydraulic system. A preset relief valve that protects one side of the bucket circuit is screwed into the back of the valve body and protrudes into the reservoir. The flow of oil to and from the double acting hydraulic cylinders is controlled by the two control plungers.

STEERING BOOSTER CONTROL VALVE.

The steering control valve is mounted on the end of the steering gear and is actuated by a force differential between the integral centering springs of the valve and the torque exerted on the steering cam. The purpose of the valve is to direct the flow of oil to and from the double acting steering booster cylinder.

HYDRAULIC CYLINDERS.

The steering booster, bucket and boom cylinders are double acting. They consist primarily of a piston and rod assembly, a cylinder cap assembly and a cylinder. Two ports are provided so that oil, under pressure, may be forced against either side of the cylinder piston. The side of the piston acted upon by the pressurized oil is determined by the position of the control valve plungers in the system.

In addition to the basic components of the cylinder assemblies, the cylinders contain suitable packing and seals both on the circumference of the piston and around the piston rod to prevent leakage of the hydraulic oil through the clearances between the stationary and moving parts of each cylinder assembly.

ACCUMULATOR (Accessory).

The accumulator is a hydro-pneumatic separator type unit that acts as a shock absorber in the boom circuit of the hydraulic system. It consists of a cylinder that contains a free floating piston. The piston acts as a separator between the gas precharged end of the cylinder and the portion of the cylinder that connects to the hydraulic system.

ENGINE.

Power to operate the Model H-90 "PAYLOADER" is developed by either a gasoline or diesel type in-line, liquid cooled, internal combustion engine. Both engine types are similar in operation but differ chiefly in the method of fuel induction and ignition. The fuel-air mixture in gasoline engines is ignited by an electrical spark. In diesel type units the fuel is ignited by heat generated during compression of the air intake charge.

Each type of engine requires four elements of operation to complete a cycle. The four elements of a cycle are: Intake, Compression, Power and Exhaust.

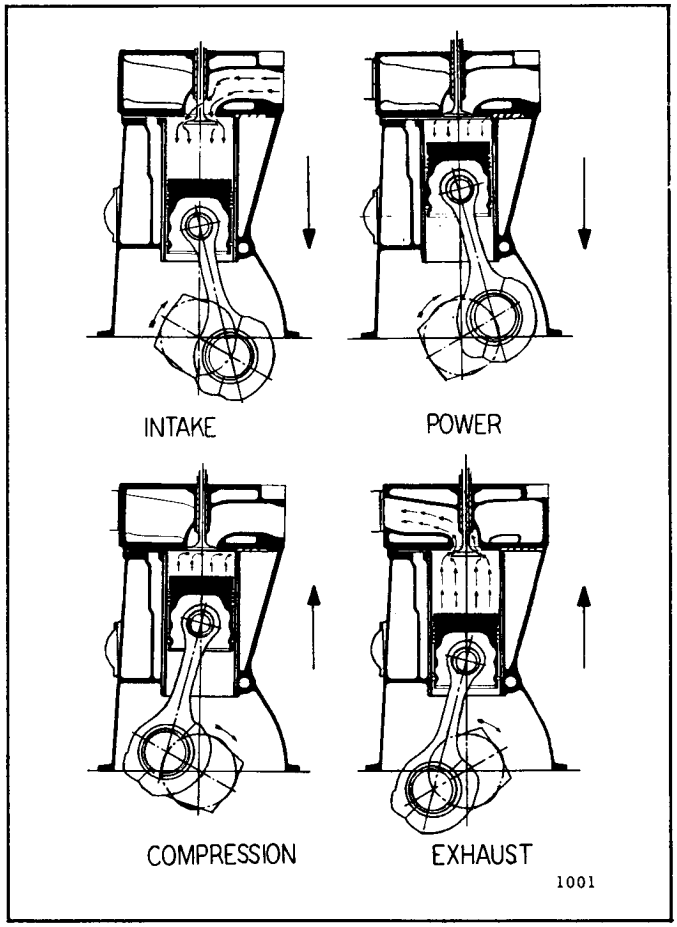


Figure 2. Engine Operating Cycle

INTAKE.

During the intake portion of the cycle, the intake valve (or port) is open and the piston travels downward. The exhaust valve is closed.

The downstroke of the piston causes a decrease of pressure in the air volume above the piston and permits atmospheric or compressed air to be forced through the intake manifold and through the open intake port. In gasoline engines, the intake charge consists of a mixture of fuel and air. The intake charge of diesel engines consists of air only.

COMPRESSION.

At the end of the intake portion of the cycle, the intake valve (or port) closes and the piston starts upward and compression occurs. The exhaust valve remains closed.

As the piston travels its full length, it compresses the air mass above it in the cylinder. During the last part of the comprssion stroke and the early part of the power stroke, a small metered charge of fuel is injected into the combustion chamber of the diesel engine. The compressed fuel-air mixture of the gasoline engine is ignited by an electrical spark. The fuel in the diesel engine is ignited almost immediately by the heat generated in the charge of compressed air.

POWER.

As the fuel mixture of both the gasoline and diesel type engine burns, the piston is forced downward and transmits the force of the burning fuel to the engine crankshaft. The amount of pressure exerted against the piston is proportionate to the amount of fuel contained in the intake charge. The more fuel contained in the charge, the greater the pressure caused by the burning fuel. Both the intake valve or port and the exhaust valve are closed during this stroke.

EXHAUST.

At the end of the power portion of the cycle, the exhaust valve opens and the piston starts moving upward to purge the burned gases from the cylinder. The gases leave the cylinder through the open exhaust port.

From the preceding discription, it is apparent that proper operation of either a gas or a diesel engine is dependent upon compression, fuel-air mixture and timed ignition. A gas engine requires that an electrical spark occurs at the proper time whereas the diesel engine is dependent upon the timing of fuel injection.

FUEL SYSTEM.

Fuel for gasoline engines is combined with air before the air enters the intake manifold. The incoming air passes through a carburetor and picks up droplets of gasoline as it passes through the venture, or throat of the carburetor. The fuel-air mixture is then drawn into the engine cylinders through the intake manifold.

Diesel engines receive their supply of fuel from a fuel pump which draws fuel from a supply tank and delivers it to individual injectors for each cylinder by means of fuel distribution lines.

LUBRICATING SYSTEM.

The working parts of both the gas and diesel engines are pressure lubricated by a gear-type lubricating pump that is gear driven off the crankshaft. The engine lubricating oil is held in the oil pan sump and drawn up from the sump to all the working parts of the engine by the pump. Various drillings through the engine block, cylinder head, crankshaft, connecting rods and rocker levers circulate the oil from the pump throughout the engine. Filters, strainers, screens and a pressure relief are provided in the lubricating system to provide clean oil at a controlled pressure.

COOLING SYSTEM.

An efficient engine operating temperature is maintained by the thermostat, a radiator and a pump.

The gear driven pump circulates cooling fluid through the jackets around each cylinder, the cylinder head and the engine radiator. Heat picked up by the fluid as it circulates through the engine is dissipated to the air when the fluid passes through the radiator.

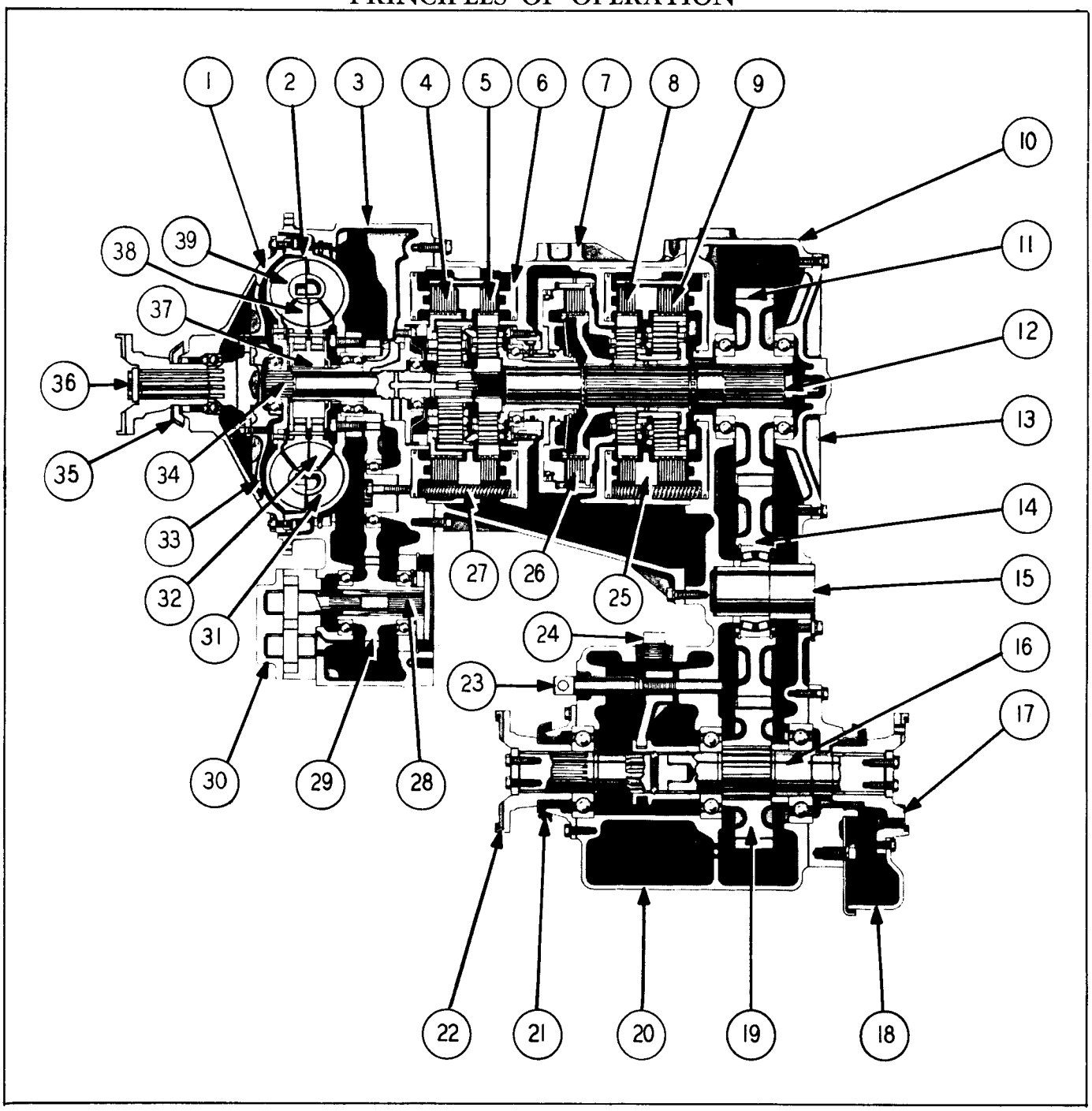
TRANSMISSION.

The transmission consists of a four element torque converter coupled to planetary gearing and a constant mesh output gear train. The direction and the speed at which the transmission output shafts turn are controlled by a selector valve assembly, hydraulically actuated clutch pack assemblies and the planetary gearing.

The oil used to apply the clutch packs, charge the torque converter and lubricate the transmission is held in the lower part of the transmission transfer gear housing and pumped through the transmission by a gear type pump located in the torque converter housing. Pressure relief valves, a strainer and an externally mounted oil cooler and oil filter supply the transmission and converter with clean oil at regulated pressures and temperature.

CONTROL VALVE.

The transmission control valve is mounted on the side of the transmission housing and contains two mechanically operated plungers. Oil from the transmission pump is directed to the transmission clutch packs by means of the two control valve plungers. The valve assembly also contains a clutch disconnect plunger that is actuated by the hydraulic brake system of the "PAYLOADER". When in the applied position, the disconnect plunger interrupts the flow of high pressure oil to the transmission range clutch packs.



1. Transmission Cover
2. Converter Assembly
3. Converter Housing
4. Reverse Clutch
5. Forward Clutch
6. Clutch Piston
7. Transmission Housing
8. High Range
9. Low Range
10. Transfer Housing
11. Transfer Drive Gear
12. Transmission Shaft
13. Transfer Cover
14. Transfer Idler Gear
15. Spindle
16. Output Shaft
17. Front Output Yoke
18. Brake
19. Transfer Driven Gear
20. Sump
21. Dust Shield
22. Rear Output Yoke
23. Disconnect Shaft
24. Fill Plug
25. Hi-Low Anchor
26. Intermediate Clutch
27. Piston Return Spring
28. Hydraulic Pump Drive
29. Pump Drive Gear
30. Transmission Pump
31. Converter Pump
32. Second Stator
33. Converter Cover
34. Turbine Shaft
35. Dust Shield
36. Transmission Input
37. Turbine Race
38. First Stator
39. Converter Turbine

Figure 3. Transmission

CLUTCH PACKS.

The transmission contains five clutch packs; one for reverse, one for forward, one for intermediate speed, one for high and one for low. In order for the transmission to transmit power to its output shafts, one directional (forward or reverse) and one range pack must be hydraulically engaged. The flow of oil used to engage the clutch packs is controlled by the control valve assembly.

TORQUE CONVERTER.

A multi-phase, four element torque converter unit is used in the transmission to act as a coupler and torque multiplier between the engine and the transmission planetary gearing. The converter consists of a pump, a turbine and two stator assemblies. A drive shaft connects the engine to the converter pump.

Power transmitted to the converter pump by means of the drive shaft causes the pump to turn and move the oil supply contained within the converter unit. The movement of oil is toward the outer perimeter of the pump because of the centrifugal force imparted to it by the rotary motion of the pump. At the perimeter of the pump, the direction of oil flow is changed so that the centrifugal force of the oil acts against the vanes of the turbine and causes it to turn. The turbine is splined to the transmission planetary gearing.

The flow of oil in the turbine portion of the converter is toward the center of the assembly. This flow is known as "vortex" flow. When the oil reaches the center of the turbine, its direction of flow is again changed so that it flows through the two stator assemblies to the pump portion of the converter.

Vortex flow in the converter turbine is greatest when the turbine is stopped and the pump speed is high. This phase of converter operation is known as converter stall. In this phase, the unit acts as a torque multiplier and exerts maximum available torque on the planetary gearing. As turbine speed increases and approximates the speed of the pump, the vortex flow is decreased and a minimum amount of torque multiplication takes place. This is called the converter coupling phase.

FINAL DRIVES.

The final drives consist primarily of a single reduction and differential assembly, an axle housing and axles, and a planetary gear set at the end of each axle. Primary reduction of the final drives is accomplished in the carrier housing by means of a hypoid pinion and a bevel ring gear. The secondary reduction takes place in the wheel hubs. By making the final reduction at the wheel hubs, less strain is imposed on the differential assembly and axle shafts because a majority of the working stresses are carried by the planetary gearing in the wheel hubs.

The hub assembly of each final drive consists of a sun gear which is splined to the axle, a planetary gear spider and a hub and brake drum assembly. The hub contains an internal ring gear that meshes with the planetary gear spider and the spider assembly meshes with the sun gear on the axle. When torsional force is applied to the axles by the differential assembly, the sun gear in the wheel hub turns and transmits the force to the hub gear through the planetary spider and causes the wheel hub to turn.

The gears and bearings in the wheel hubs and the carrier housing are lubricated by running in a supply of oil contained in each assembly. Check plugs are provided in the hub caps and carrier housing of each final drive for the purpose of checking that a sufficient supply of oil is available for safe operation of the drive.

When it is necessary to inspect or service a set of brake linings, it is necessary to remove the planetary gearing and the hub and brake drum assembly. The complete final drive should be removed from the vehicle when it is necessary to disassemble and service the carrier housing and replace axle seals.

ELECTRICAL SYSTEM.

The electrical system consists basically of six circuits; starting, instrument, lighting, charging, horn and ignition. All circuits but the charging are connected in series with the ignition switch and a bi-metal type circuit breaker mounted on the rear of the dash panel.

The components of each circuit are precision built and their operation must be kept within close tolerances. To adequately service these electrical devices requires a thorough understanding of the units themselves and of the equipment with which they operate. If faulty operation of an electrical device such as a voltage regulator or generator is suspected, it is recommended that a dealer of THE FRANK G. HOUGH CO. be contacted.

STARTING CIRCUIT.

The starting circuit includes the battery, ignition-starter switch, starter solenoid, starting motor, wiring and the loader frame. It provides electrical power for cranking the gasoline or diesel internal combustion engine and converts the electrical power into mechanical energy by means of the starter motor. Mechanical energy developed by the starter is transmitted to the engine through a drive pinion gear and the engine flywheel ring gear. The starting switch controls operation of the starter motor by breaking the circuit between the battery and motor.

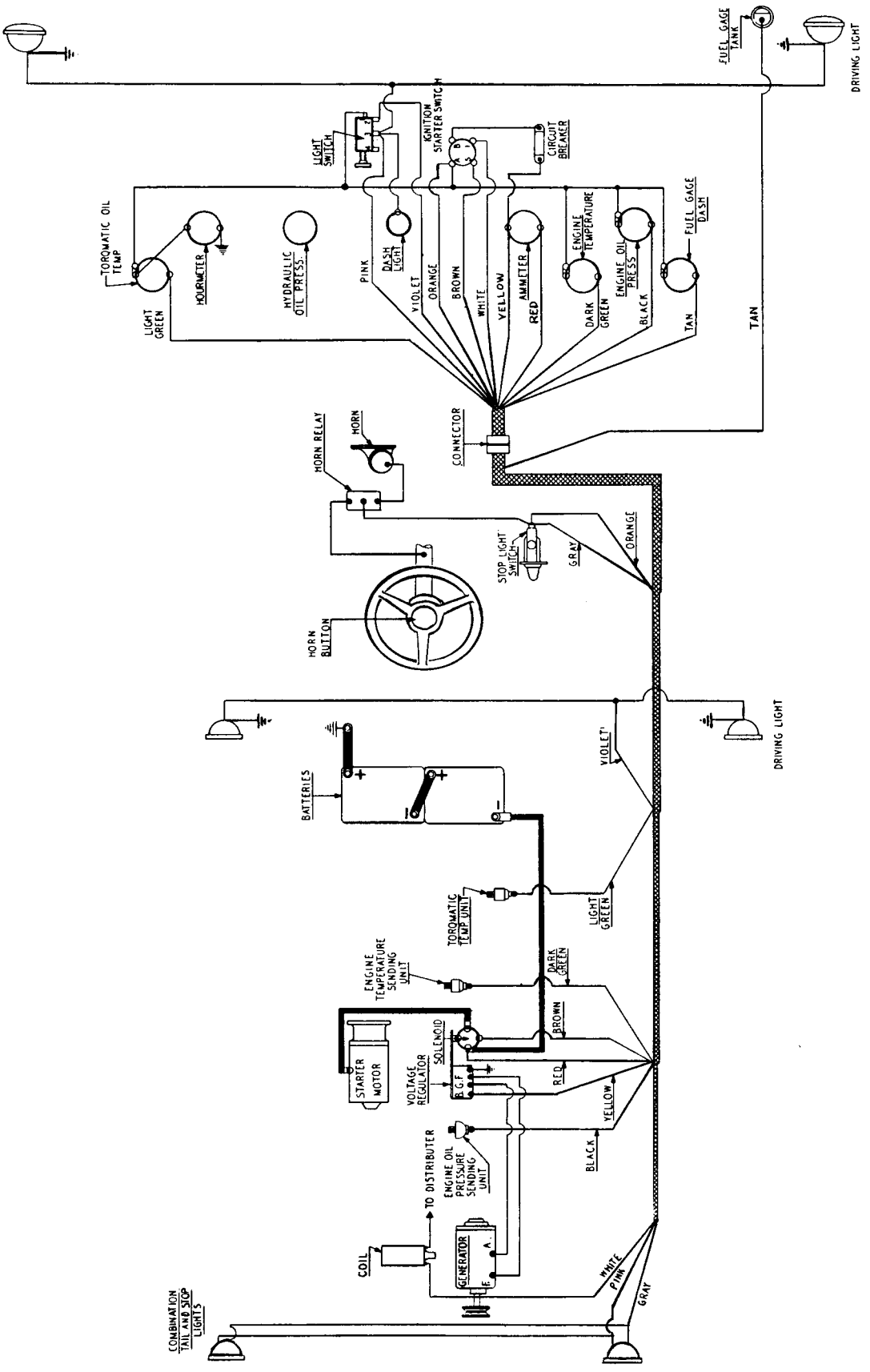


Figure 4. Gas Wiring Diagram

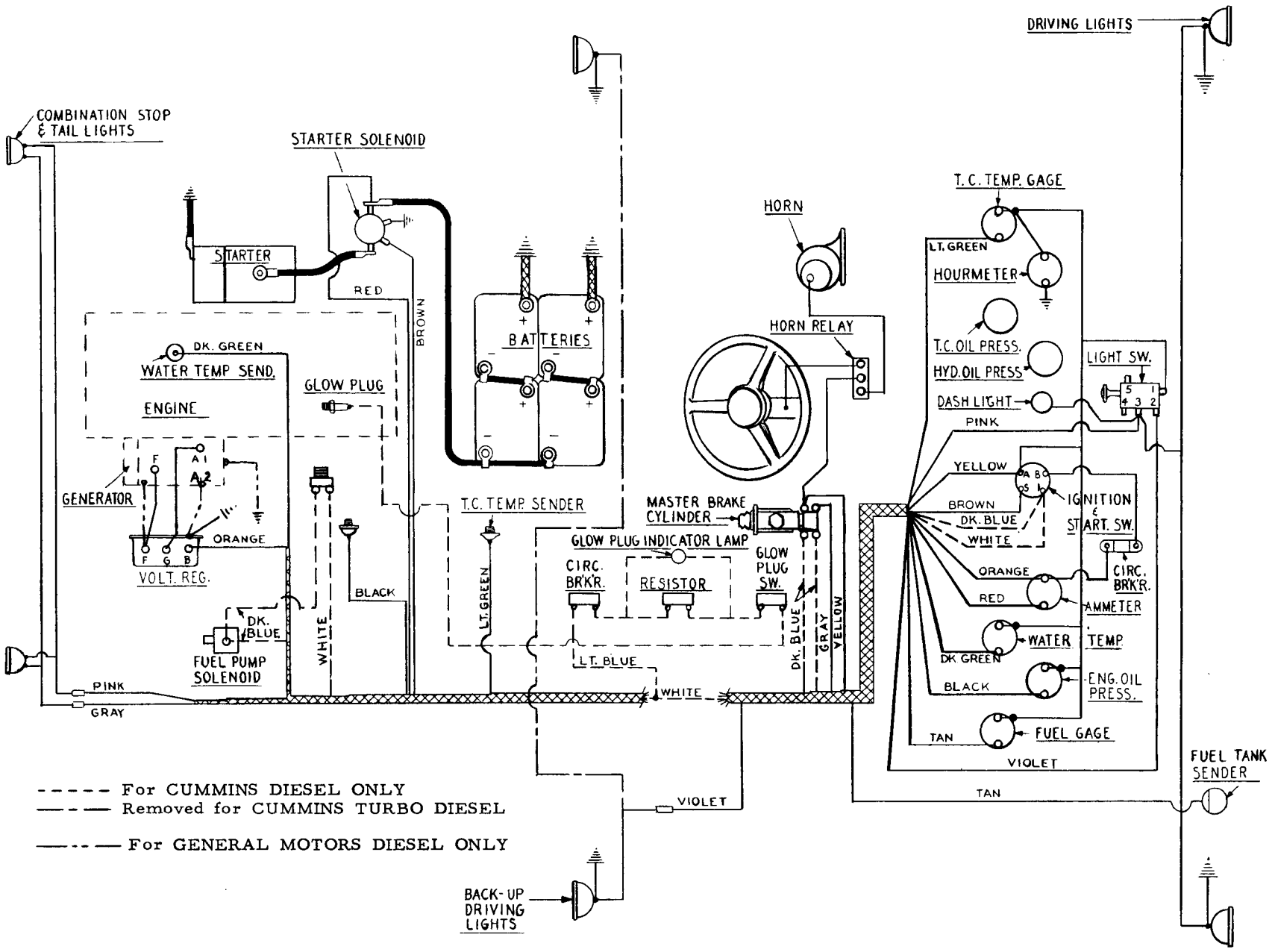


Figure 5. Diesel Wiring Diagram

When the starter is at rest, the starter pinion is disengaged. It engages the flywheel ring gear when the starter armature is energized by battery current and disengages when the engine speed exceeds that of the starter pinion.

Cummins Diesel units have a safety and a bypass switch to control operation of the fuel pump solenoid. These switches safe guard the engine cylinders against fuel "feed-back" through the fuel pump solenoid. See "Starting The Engine" for additional information.

INSTRUMENT CIRCUIT.

The electrical instrument panel gauges include the ammeter, hourmeter, fuel gauge, engine temperature gauge, torque converter temperature gauge and engine pressure gauge. The ammeter is a part of several other circuits whereas the other electrical panel gauges are part of individual circuits. These gauges indicate, the operating condition of the engine, transmission and the main hydraulic system.

The ammeter indicates whether the battery is being charged or discharged and gives an approximate indication of the amount of current flow. The other gauges also give approximations but do not tell the complete story of any one condition; for example, the engine oil pressure gauge indicates the pressure of the oil as it leaves the lube pump but it is not capable of indicating the amount of oil delivered or the quality of the oil being pumped.

LIGHTING CIRCUIT.

The lighting circuit includes the battery, ammeter, panel and service lights, the light switch, wiring and the loader frame. The complete lighting circuit can be broken down into individual circuits each having one or more lights which are controlled by the ignition and three-position light switches. In each separate lighting circuit, the lights are connected in series between the battery and the rest of the circuit.

CHARGING CIRCUIT.

The charging circuit consists of the generator, regulator, ammeter, battery and the inter-connecting wiring. The output of the generator is dependent upon the engine speed. When the engine is running fast enough, the generator supplies all of the electricity needed by the electrical devices and batteries of the loader. The regulator controls the generator output so it does not exceed the requirements of the battery and electrical circuits; prevents high voltage damage to the generator and keeps the battery charged unless the demands of the electrical circuit exceed the generator capacity.

BATTERY.

In the charging circuit, the battery acts as a ballast tank and helps hold the generator voltage at the proper level. It is able to help regulate the generator output voltage because its voltage is constant except for the variations caused by either a charging or discharging flow of current. It does not, however, hold the voltage within close limits.

GENERATOR.

The generator is a machine which converts mechanical energy into electrical energy and serves the purpose of supplying current for lights, other electrical equipment, and keeps the battery in a charged condition by replacing the electrical energy used. It is belt driven off the engine fan hub. A current regulator, voltage regulator and a cut-out relay operate together to provide control of the generator under all conditions of operation.

REGULATOR.

The regulator is composed of three controls; the cut-out relay, the voltage regulator and the current regulator. The cut-out relay protects the generator from a back surge of energy from the battery by remaining open until the generator develops enough voltage to force a charge into the battery. The voltage regulator prevents the line voltage from exceeding a predetermined value and thus protects the battery and other components of the electrical system. The current regulator operates when the generator output has reached its safe maximum and prevents the generator from exceeding this valve.

IGNITION CIRCUIT.

The ignition circuit of Model H-90 "PAY-LOADER" units equipped with gasoline engines consists of the battery, ammeter, ignition switch, ignition coil, distributor, spark plugs, low tension wiring, high tension wiring and the loader frame. The battery, ammeter, ignition switch, primary winding of the ignition coil, distributor contacts and condenser, loader frame and the primary wiring comprise the low tension portion of the circuit. The high tension part of the circuit, which develops and delivers the electrical energy to the spark plugs, consists of the secondary winding of the ignition coil, the distributor cap and rotor, the spark plugs, the loader frame and the high tension wiring.

In operation, a primary current flows from the battery, through the ammeter and ignition switch to the primary winding of the coil and then to ground through the distributor contacts. By interrupting the current flow through the primary coil winding, a very high voltage is induced into the secondary winding and carried through the high tension part of the circuit. The flow of current through the primary circuit is interrupted when the distributor contacts are

separated. A condenser connected to the distributor primary terminal prevents arcing at the contacts and hastens the collapsing of the magnetic field in the primary coil winding.

The high voltage induced in the secondary winding is carried by a high tension wire to the center of the distributor cap where it is distributed to the spark plugs. At the spark plug, this high tension current jumps the gap between the center spark plug electrode and the plug shell electrode. The resulting electrical flash ignites the fuel in the cylinder.

This process is repeated for every power stroke of the engine. At high speeds, an impulse may be required as often as 300 times per second. If any one part of the primary or secondary circuit fails to function, there is a failure of the entire ignition system.

GLOW PLUG.

Model H-90 "PAYLOADER" units equipped with diesel engines do not require an ignition system but some are provided with a glow plug circuit for use as an intake air preheater. The glow plug circuit consists of an indicator and load resistor, a manual switch, a circuit breaker, a glow plug, the ignition switch and the batteries.

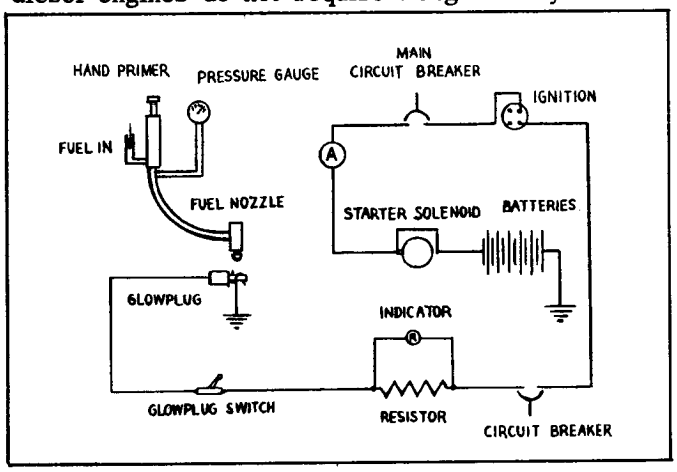


Figure 6. Glow Plug Diagram

The plug is energized by the batteries through the ignition switch and the glow plug toggle switch. Circuit protection is provided by the circuit breaker which is connected in series with the load resistor and the toggle switch. When the flow of current exceeds the rated capacity of the glow plug circuit, the circuit breaker opens and interrupts the current flow.

HORN CIRCUIT.

The horn is an electrical warning device that is controlled by the horn relay. The circuit consists of the horn assembly, horn relay, horn button, wiring and loader frame. When the button is depressed, the horn relay is energized and completes the electrical circuit of the electromagnet in the horn assembly. With a relay in the horn circuit, only the relay current, which is relatively small compared to the current that passes through the horn electromagnet, is carried by the horn button. This helps decrease arcing at the horn button contacts.

The horn assembly consists of a diaphragm that is vibrated by an electromagnet. When the electromagnet is energized, it pulls on an armature that is attached to the horn diaphragm. Movement of the armature flexes the diaphragm and opens a set of contacts in the horn assembly. This opens the electromagnetic circuit and the armature moves back to its original position, closes the contacts and completes the electromagnetic circuit, which again causes the diaphragm to flex. The intermittent flexing of the diaphragm produces the horn sound.

CONDENSED SPECIFICATIONS

ENGINE.

Manufacturer (Gasoline)	Hercules Motor Corporation
Model	WXLC-3
Manufacturer (Diesel)	Cummins Engine Company
Model	JN-6-BI
Manufacturer (Diesel)	General Motors Corporation
Model	4-71

	Hercules Gasoline	Cummins Diesel	G.M.C. Diesel
Number of Cylinders	6	6	4
Bore	4.25 in.	4.13 in.	4.25 in.
Stroke	4.75 in.	5.00 in.	5 in.
Displacement	404 cu. in.	401 cu. in.	284 cu. in.
Max Governed Speed	2300 rpm	2300 rpm	2200 rpm
Horsepower (Max Governed Speed)	125	122	147
Fuel Tank Capacity	40 gal.	40 gal.	40 gal.
Fuel Grade	80 Octane	Grade 2D	Grade 2D

TORQMATIC DRIVE.

OIL SYSTEM

Pump	Gear Type
Filter	Full Flow (Replaceable Element)
Cooler	Oil to Air Type
Lubricant	Hydraulic Transmission Fluid Type "C" or SAE 10 HD Motor Oil
Capacity	23 qts.

CONVERTER

Type	Single Stage, Multi-Phase, Four Element
Max Multiplication Ratio	3.5 to 1

GEARING

Range	Constant Mesh Planetary
Transfer	Constant Mesh Inline

CONTROLS

Speed Range	Power Shift
Directional	Power Shift
Drive Disconnect	Manually Operated
Clutch Cut Off	Hydraulically Operated

FINAL DRIVE.

Front Axle	Heavy Duty Hypoid Differential Gearing plus Planetary Final Drives in Wheel Hubs; Double Reduction
Rear Axle	Heavy Duty Hypoid Differential Gearing plus Planetary Final Drives in Wheel Hubs; Double Reduction

BRAKES.

Service	Internal Expanding, 2 shoe, Hydraulic, Vacuum Boosted, 4 Wheel
Parking	Internal Expanding, 2 Shoe, Mechanical Forward Drive Shaft

STEERING SYSTEM.

Steering Gear	Cam and Lever Type
Control Valve	Integral with Steering Gear, Remote Mounted Relief

ELECTRICAL SYSTEM.

Gasoline	Two XF19 Batteries, Twelve Volt
Diesel	Four XF19 Batteries, Twelve Volt

STANDARD TIRES.

Front and Rear	16:00 x 24, 12 Ply Rating

HYDRAULIC SYSTEM.

Type	Sealed, Pressure Controlled
Boom Rams	6 inch Diameter, Chrome Plated, Double Acting
Bucket Rams	4 inch Diameter, Chrome Plated, Double Acting
Shock Absorber	Gas Compression Type (Accessory)
Pump	Double Element Vane Type; 36 gpm and 5 gpm Delivery
Control Valve	Two Spool, Integral Relief
Reservoir	Baffled, Electrically Welded; Oil Dipstick, Access Hole, Pressure Relief Valve and Vacuum Breaker Provided.
Hydraulic Fluid	SAE 10 DG
Capacity	26 gal.

WORKING CAPACITY.

Breakout Force	21,000 lb.
Maximum Carry Capacity (4 mph)	9,000 lb.
Maximum Lifting Capacity (0 mph)	15,000 lb.
Maximum Dumping Clearance	112 in.
Clearance under Bucket Hinge pin	151 in.
Angle of Breakout at Ground Level	44 deg.
Maximum Tipback	54 deg.
Boom Raising Time	10 sec.
Boom Lowering Time	4.5 sec.
Digging Depth	12 in.

"PAYLOADER" DIMENSIONS.

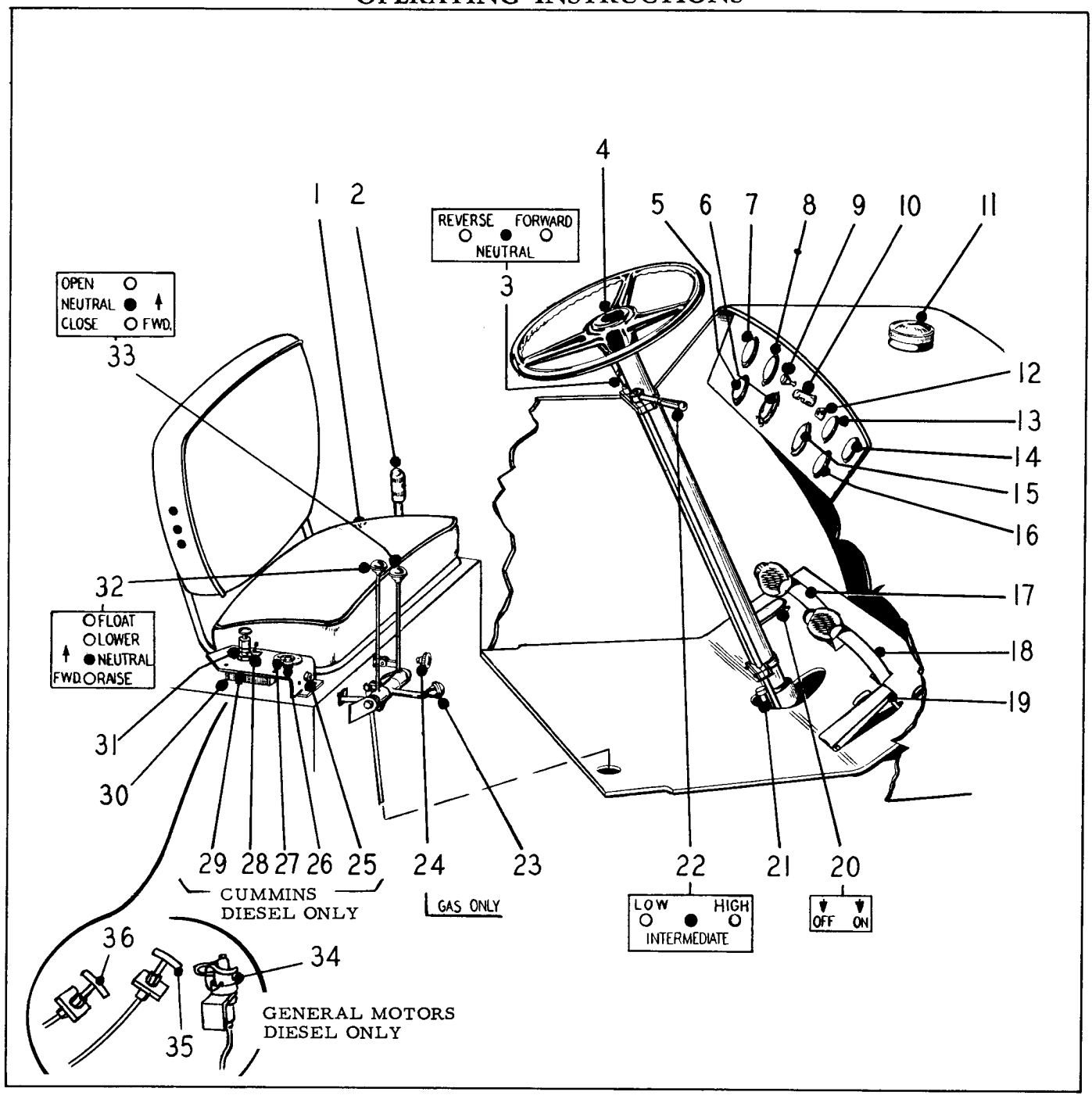
Height (Overall)	90 in.
Height (Over Average Operator)	108 in.
Width (Front and Rear Tires)	95 in.
Width (Front and Rear Hubs)	93.5 in.
Length (Bucket on Ground)	238 in.
Length (Bucket at Carry)	232 in.
Wheel Base	91 in.
Ground Clearance	16 in.

TURNING RADII.

Outside Corner of Bucket (Carry Position)	271 in.
Outside Rear Hub	278 in.
Outside Rear Corner (Grille)	273 in.
Aisle Operational Width (Bucket in Carry Position)	159 in.

WEIGHT. (Approximate Shipping).

	GAS	DIESEL
Total	23,220	24,070
Front Axle	11,370	11,395
Rear Axle	11,850	12,675



1. Seat Control
2. Parking Brake
3. Directional Lever
4. Horn
5. Transmission Temperature
6. Transmission Pressure
7. Hourmeter
8. Hydraulic Pressure
9. Light Switch
10. Dash Light
11. Fuel Filter Cap
12. Starter and Ignition Switch
13. Ammeter Gauge
14. Engine Pressure Gauge
15. Engine Temperature Gauge
16. Fuel Gauge
17. Transmission Disconnect and Brake
18. Brake
19. Accelerator
20. Accumulator Pedal
21. Steering Gear Filler
22. Range Lever
23. Axle Disengage
24. Gas Choke
25. Reset Button
26. Indicator
27. Pressure Gauge
28. Glow Plug Switch
29. Primer Assembly
30. Load Resistor
31. Primer Pump
32. Boom Control Lever
33. Bucket Control Lever
34. Pressure Priming Tool
35. Engine Shut-Down Cable
36. Emergency Shut-Down

Figure 7. Operator's Compartment

SECTION II

OPERATING INSTRUCTIONS

The operator of the "PAYLOADER" assumes the responsibility of its care while it is worked. This job is important and one that will determine to a large degree the extent of profit from an operation.

There are comparatively few rules which the operator must observe to get maximum service from the "PAYLOADER" unit. However, a neglect of any of these rules will cause a decrease in the loader's efficienty or result in costly down-time and repairs as a result of premature failure.

When learning to use a machine of this type, it is well for the operator to work carefully, and to gradually become accustomed to the operating techniques. Maximum operating speed and skill will be achieved easiest by slowly acquiring the "PAYLOADER" feel.

The time required to understand the basic principles of operation and to learn to use the loader will be well spent, since such training will minimize machine failures and safeguard personnel. The main factor in the performance and safe operation of any industrial machine of this type lies with the operator.

The terms "right hand" and "left hand" are determined from the operator's position facing the dash panel. The bucket end is the front of the loader.

OPERATOR'S COMPARTMENT.

By operating the control levers and pedals and observing the dash panel in the operator's compartment before starting the engine and with the bucket on the ground, the operator will become familiar with the location and the operation of the various controls. The loader should not be operated before the operator is thoroughly acquainted with, and knows how to use the controls and gauges found in the operator's compartment.

HAND LEVERS.

BOOM AND BUCKET.

The boom and bucket levers are grouped together on the right side of the seat support. The longer lever near the side of the compartment is the boom control and the shorter lever, almost adjacent to it, is the bucket control lever.

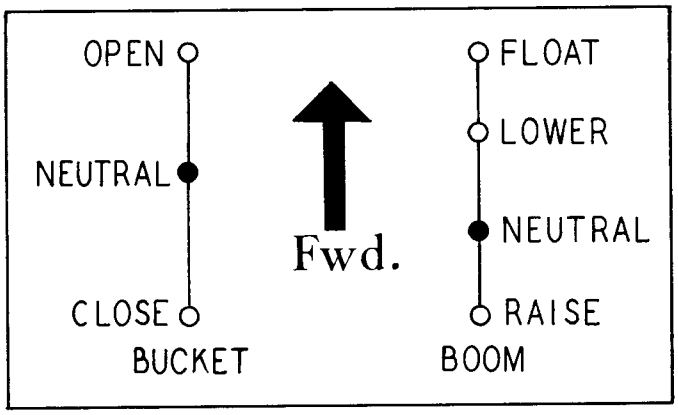


Figure 8. Control Lever Positions

The boom lever is mechanically linked to one plunger in the main hydraulic control valve assembly and controls the flow of hydraulic oil to and from the boom cylinders. The lever has four positions that can be distinctly felt. When the lever is back as far as it will go, the plunger in the control valve will be positioned so hydraulic oil can be used to raise the boom. In operation, the boom will raise in direct proportion to the engine speed. The next position forward of the "RAISE" position is "HOLD" or "NEUTRAL". In this position, no oil flows through the boom circuit of the main hydraulic system and the boom remains stationary because the oil on both sides of the pistons is trapped. By operating the boom lever one position forward of "HOLD" the plunger in the control valve assembly is moved to a position that will permit a flow of hydraulic oil in the boom circuit to lower the boom.

WARNING

The boom can be lowered anytime the control lever is operated to "LOWER". Avoid operating the hydraulic control levers when the loader engine is shut down to prevent the possibility of personnel injury or damage to the loader.

The extreme forward position of the boom lever

is "FLOAT". In this position oil is free to flow in either direction in the boom circuit and permits the boom to be raised or lowered independent of the flow of oil from the hydraulic pump by application of external forces.

The bucket lever is mechanically linked to the second plunger in the main control valve assembly and controls the flow of oil in the bucket circuit of the main hydraulic system. The lever is spring loaded to its center position, "HOLD". In this position the flow of oil in the bucket circuit is stopped and the bucket will hold in any position of its dumping arc. When the lever is pulled back off its center position to "CLOSE", the plunger in the control valve moves so that oil from the hydraulic pump is used to tip the bucket backward or close it. Operating the bucket lever forward positions the control valve plunger so the oil flow in the circuit will tip the bucket forward, or open it. A bucket position indicator on both bucket cylinders shows the operator the angular position of the bucket.

AXLE DISENGAGEMENT LEVER.

The axle disengage lever is mounted between the boom and bucket control levers. It controls operation of the rear transmission output shaft through a mechanical linkage and a shifter fork and disconnect coupling assembly in the transfer housing of the transmission. When the lever is pushed all the way downward, the shifter fork and disconnect clutch coupling in the transmission are moved so that the rear transmission output shaft is separated from the transmission output shaft assembly and no power can be transmitted to the rear final drives through the transmission. Pulling upward on the lever, as far as possible, moves the transmission shifter fork and coupling so the rear output shaft is joined to the transmission output shaft assembly and both final drives are powered through the transmission. Engage the rear final drive when working the loader.

The rear final drive should be engaged and disengaged while the loader is stationary, if possible. If the lever cannot be operated to engage or disengage the rear final drive while loader is stationary, the loader should be moved at a "creeping" rate of speed in either direction until the shift is completed.

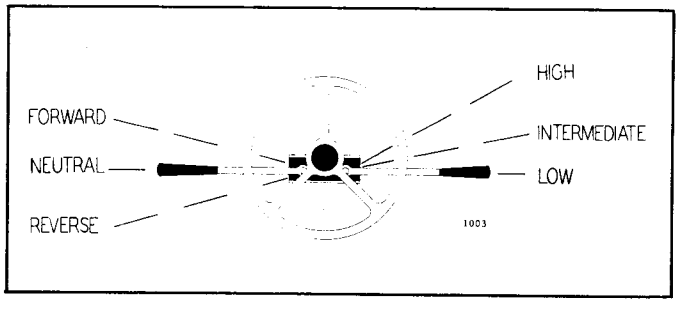


Figure 9. Transmission Control Positions

TRANSMISSION CONTROL LEVERS.

The two transmission control levers mounted on the steering column, control operation of the two plungers in the transmission control valve assembly. The lever on the left side of the steering column controls the lower, or directional, plunger of the control valve assembly. The upper or range plunger in the control valve is operated by the lever on the right side of the steering column.

DIRECTIONAL. The directional lever has three positions which can be definitely felt. In the position closest to the operator, the lever moves the directional plunger of the transmission control valve so oil flowing through the high pressure system of the transmission is directed to apply the transmission reverse clutch pack and hold the reverse planetary carrier.

The next lever position ahead of "REVERSE" is "NEUTRAL". In this position the control valve directional plunger is so positioned that no high pressure oil can be directed to engage either the reverse or forward transmission clutch packs.

In the position ahead of "NEUTRAL" the control valve directional plunger is positioned so high pressure oil is applied to the forward clutch pack and holds the forward transmission ring gear.

RANGE. The range lever is mounted on the right side of the steering column and has three positions; "HIGH", "INTERMEDIATE" and "LOW". In low range, the last lever position nearest the operator, the low range transmission clutch is applied and the transmission low range ring gear is held stationary. The next lever position ahead of "LOW" is "INTERMEDIATE". In this position, high pressure transmission oil engages the intermediate range clutch and causes the high-range planetary carrier and the intermediate range clutch-hub to move as one unit. In "HIGH", the high range clutch pack is engaged and holds the high range ring gear.

Both the directional and range levers can be shifted while the engine is developing full power, but it is suggested that for operator comfort and more efficient loader operation that the directional lever be operated at decreased loader traveling speeds and that the proper transmission range be selected, according to the type work to be done before the engine develops full power. It is necessary to engage the directional lever to transmit power through the transmission. Use "LOW" or "INTERMEDIATE" range when loading the bucket or working the unit. For highway travel or when the loader is returning to a work area, operate the transmission in "HIGH" range. Use "INTERMEDIATE" while transporting loads.

PARKING BRAKE HANDLE.

The parking brake handle on the left side of the operator's seat controls the mechanical brake on the forward transmission output shaft. Braking pressure is exerted when the handle is pulled upward. It is

recommended that the brake be applied whenever the operator leaves the loader or whenever the loader is parked on an incline. When the loader is working, the parking brake handle should be down so the mechanical brake will be in a released condition.

CONTROL PEDALS.

ACCELERATOR.

The accelerator pedal, on the right side of the floorboard, controls engine speed by controlling the flow of fuel in the engine fuel system. The amount of fuel available for engine consumption is relative to the position of the pedal, as the pedal is depressed toward the floorboard, the flow of fuel to the engine is increased and permits the engine to proportionately develop more power. The accelerator linkage is spring loaded so that when no pressure is applied to the pedal, only enough fuel to keep the engine idling will flow.

BRAKE PEDALS.

A brake pedal is located on either side of the steering column. The pedal to the right of the steering column actuates the hydraulic service brakes through the master brake cylinder, hydrovac unit and the brake lines.

The pedal to the left of the steering column also actuates the service brakes in the same manner as the other pedal, but it is linked to a selector valve. The valve permits hydraulic pressure developed in the brake master cylinder to act against the transmission hydraulic cut-out and shut off oil to the transmission range clutch packs.

ACCUMULATOR PEDAL. (Accessory).

The accumulator pedal on the left side of the floorboard actuates the accumulator valve through a mechanical linkage. Depressing the front of the pedal causes the accumulator valve plunger to move so oil in the lifting portion of the main hydraulic boom circuit can act against the gas precharge in the accumulator assembly. Lowering the pedal heel positions the valve plunger so the accumulator is cut off from the hydraulic system.

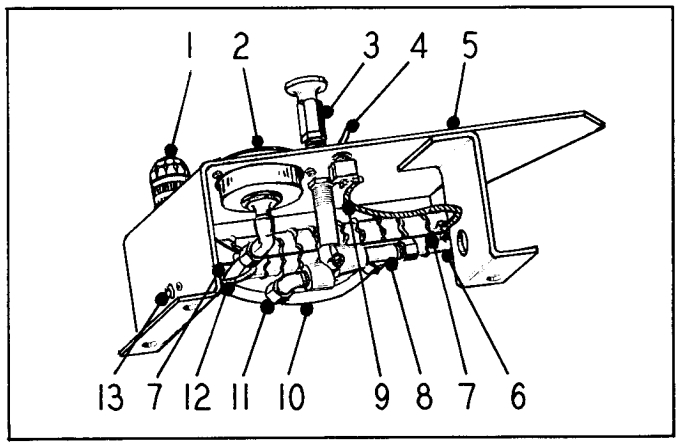
Figure 10. Accumulator Pedal Decal

It is suggested that the front of the pedal be depressed only when the boom control lever is in the "HOLD" position and the loader boom is in a suspended condition. The accumulator is normally used while transporting loads, returning to a work area or traveling on the highway.

STARTING CONTROLS.

The starting controls consist of the ignition-starter switch and a choke button or primer starting assembly.

Model H-90 "PAYLOADER" units equipped with gasoline engines have a button provided on the front of the seat support that is used to control the carburetor choke. The choke is used to start an engine that has been idle for a period of time or as an aid in starting a cold engine. By pulling the choke button forward, away from the seat support, the fuel-air mixture to the engine cylinders is changed so it contains more fuel. In effect, the engine is primed with an enriched mixture that assists starting. Once the engine has started and is running regularly, release the choke button.



1. Indicator
2. Pressure Gauge
3. Hand Primer
4. Glow Plug Switch
5. Bracket Assembly
6. Load Resistor
7. Indicator Leads
8. Primer Outlet
9. Switch Lead
10. Pressure Gauge Line
11. Primer Inlet
12. Circuit Breaker
13. Glow Plug Reset Button

Figure 11. Primer Starting Assembly

Diesel equipped units have a primer starting assembly mounted on the right side of the operator's seat. The assembly consists of a two position toggle switch, an indicator lamp, a pressure gauge, a load resistor, a circuit breaker and a priming pump. The indicator lamp, resistor, circuit breaker and toggle switch are part of the engine glow plug circuit. When the toggle switch is operated to "ON", current from the batteries powers the indicator lamp and the engine glow plug. The circuit breaker protects the glow plug circuit from overloading and must be "set" for proper operation of the circuit.

The priming pump is used in conjunction with the pressure gauge and supplies fuel to the engine intake manifold from the engine fuel pump supply line. In operation, the priming pump and glow plug are used as aids to preheat the diesel intake manifold.

The ignition-starter switch is located on the dash panel adjacent to the ammeter and controls current flow to all the major electrical circuits of both diesel and gas powered units. When the ignition switch is "ON", all electrical circuits are connected to battery power. By operating the switch to the "STARTER" position, the starter solenoid is energized so battery power can turn the starting motor and the engine. Operation of the switch to "OFF" disconnects the battery from all the electrical circuits. The flow of fuel to the diesel engine fuel injectors is also shut off by the ignition switch by means of a solenoid on the fuel pump.

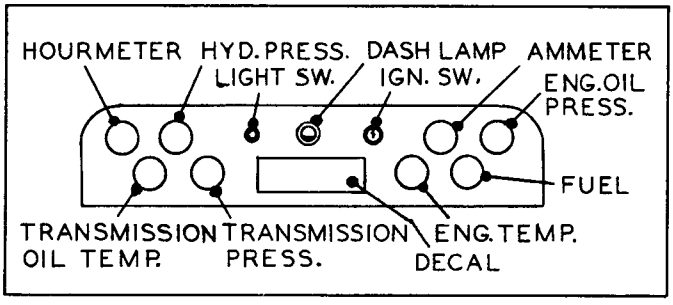


Figure 12. Dash Panel

DASH GAUGES.

The dash gauges are indicators of loader operation. The operator should be familiar with the normal operating range of such gauges as the ammeter, engine oil temperature gauge, engine oil pressure, hydraulic oil pressure, etc. and operate the loader against the gauges. Glance at the gauges frequently during loader operations. If any unusual or erratic operation of the loader is experienced, the dash gauges can be used to help isolate the malfunction.

LEFT SIDE.

The gauges for the transmission and the main hydraulic system are grouped together with the hourmeter on the left side of the dash panel.

HOURMETER. The direct reading type hourmeter indicates hours of engine operation. It starts when the ignition switch is turned "ON" and stops approximately when the switch is operated to "OFF". The meter is intermittently powered by an electric motor that winds approximately every 2-1/2 minutes. If the motor winds just before the ignition switch is operated to "OFF", the meter will continue to operate until the motor completes its operating cycle. A small indicator in the upper left quadrant of the meter shows when the meter is working.

HYDRAULIC OIL PRESSURE. The oil pressure of the main hydraulic system is indicated by the hydraulic oil pressure gauge mounted adjacent to the hourmeter. Under normal working conditions, the maximum gauge reading should not exceed 1750 psi. If the gauge indicates reading above 1750 psi, the relief valve in the control valve assembly must be adjusted to prevent possible damage to the main hydraulic system. The gauge is connected to the hydraulic system by means of an oil line from the dash panel gauge to the top of the control valve assembly.

TRANSMISSION TEMPERATURE. The temperature of oil leaving the transmission torque converter housing is indicated by the transmission temperature gauge mounted below the hourmeter. When the loader is properly operated, this gauge should indicate between 170° F and 200° F. If the gauge reading tends to be high continually during normal operation, the loader should be operated in the next lower transmission speed range. Should the transmission oil temperature rise above 220° F, shift the transmission to neutral and idle at approximately half engine speed for two to three minutes. If the oil temperature does not begin to drop off almost immediately, determine the cause and make the necessary repairs before putting the loader to work.

CAUTION

Do not disconnect hoses, remove plugs or drain the transmission if the oil temperature gauge indicates more than 150° F.

TRANSMISSION PRESSURE. The transmission pressure gauge is mounted adjacent to the transmission temperature gauge. It is connected to the high pressure circuit of the transmission hydraulic system by means of an oil line from the transmission control valve assembly and indicates the oil pressure applied to the transmission clutch assemblies. Normal operating pressure should range between 95 and 125 psi. If the clutch pressure is less than 95 psi, stop the engine and determine the cause for the low clutch pressure. Do not attempt to work the loader if the clutch pressure is low.

RIGHT SIDE.

The grouping of gauges on the right side of the dash panel is for the engine.

AMMETER. The ammeter is mounted adjacent to the ignition switch. It indicates the current flow to and from the battery and gives an approximate indication of the rate of flow. Under normal conditions with the engine stopped, the ammeter should show a discharge when one of the electrical circuits is turned on. The amount will vary depending upon the resistance in the particular electrical circuit completed. Should the ammeter move all the way to the discharge side, a ground or short is indicated and should be located and corrected. If during engine operation the ammeter

indicates a continuous discharge, the cause should be determined and corrected to avoid draining the batteries. Check that the battery connections are not reversed.

ENGINE PRESSURE. The electrically operated engine pressure gauge is adjacent to the ammeter. It indicates the pressure of the engine lubricating oil. Before working the loader, the pressure gauge should indicate an engine oil pressure that remains in the safe operating range. If the gauge indicates little or no pressure, the engine should be stopped immediately and the cause for low pressure determined and corrected.

ENGINE TEMPERATURE. The engine cooling system temperature is indicated on the engine temperature gauge. It is mounted below the ammeter. Normal engine operating temperature is between 160° F to 180° F. If the loader is operated in confined areas, the temperature gauge may indicate as high as 200° F, but the engine temperature should never exceed 210° F. Should the engine run at a high temperature continuously, check the coolant level in the engine cooling system and operation of the cooling system thermostat.

FUEL GAUGE. The fuel gauge is an electrically operated unit for measuring the supply of fuel in the tank. A variable resistance tank unit, that is actuated by a float, varies the flow of current through the dash unit to give the gauge indications. The dash unit is mounted below the engine pressure gauge.

SAFETY PRECAUTIONS.

Any piece of equipment of this type is potentially dangerous if it is not handled properly. For the benefit of the operator, other personnel and the equipment, it is suggested that safe working habits be practiced when the "PAYLOADER" is being checked or worked. The following suggestions are intended as a general outline of safety habits. They should be modified to fit the needs of each particular working condition:

a. Never get on or off the loader while it is in motion or being worked.

b. Never leave the loader without first lowering the bucket and boom so that they rest on the ground.

c. Never operate the boom or bucket levers if the engine is shut down and the bucket is in a raised position.

d. Do not work the loader to full capacity during the first fifteen minutes of operation.

e. Always perform a visual and an operational check of the loader before putting it to work.

f. Never transport loads with the bucket raised to its full height. When traveling over rough or sloping ground, transport loads about two or three feet above the ground level.

g. Never stand or work under any part of the boom or bucket if they are not properly blocked.

h. When starting the engine, make sure all controls are in neutral.

i. Look in the intended direction of travel to make sure there are no personnel or obstructions in the way. Check that sufficient clearance exists on all sides of the machine.

j. When traveling down a steep grade, operate the loader in the low speed range so control can be maintained if the brakes should fail.

k. Raise the bucket off the ground before operating the directional lever to "REVERSE".

l. Always apply the parking brake when the loader is not in operation.

PRELIMINARY AND ROUTINE CHECKS.

Before starting the engine so the loader can be unloaded or taken from storage, make a thorough inspection of the entire "PAYLOADER" unit. Check that all components on the loader are securely mounted and have been properly lubricated. Operate all the control levers in order to check operation of the control linkages. If the controls do not function properly, check for loose or damaged linkages. Inspect the complete hydraulic system, brake system, fuel system and engine cooling system for leaks and loose connections.

Battery cables have been disconnected at the factory for shipping purposes. Before connecting cables to the battery, clean filter caps and check that each battery cell is properly filled. Clean the battery terminals and the inside of the clamp terminals with sandpaper or a wire brush. Clean the top of the batteries and apply a thin coat of mineral grease to the posts and the inside of the clamps. Before tightening the clamps, check the polarity. Slip the clamps over the battery posts temporarily and turn on both the ignition and light switches. The ammeter should indicate that the battery is discharging by moving to the minus (-) side of the meter.

Remove the ground cable and connect it last. Arrange the cable clamps so as not to interfere with removal of the vent plugs and arrange the cables so that they will not rub on the battery hold-down angle or moving parts, then tighten the clamps. Check that batteries rest level in holder and check tightness of battery hold-down nuts. The hold-down nuts should be tight enough to hold the batteries secure but not so tight that the hold-down angle or the battery cases are distorted or damaged.

Open the fuel line shut-off at the fuel tank and

check the supply of fuel in the tank. Always check the levels in the hydraulic reservoir, the engine crankcase, the engine cooling system and the transmission daily. Before making checks, clean area around all filler caps, filler plugs, level plugs and drain plugs. When the transmission oil level check is made, the oil should at least be up to the level of the check plug before the engine is started. After the engine has been started, add oil to the transmission, if necessary, to bring the level up to the check hole. Refer to weekly maintenance operations for detailed checking procedures. The oil levels in the wheel hubs, axle differentials and transmission should be checked periodically.

Remove the filler cap from the master cylinder in order to check the supply of brake fluid. The master cylinder should be filled to within 1/2 to 3/8 inch of the filler opening. Operate both brake pedals to check operation of the wheel brakes and the transmission disconnect system.

STARTING THE ENGINE.

After the operator is completely familiar with the control levers and dash gauges and the loader has been checked and lubricated, start the engine so the "PAYLOADER" may be put to work. Operate all control levers to "NEUTRAL" and check that the parking brake handle is in the applied position (handle up). The loader boom should be resting on the ground during starting operations.

NORMAL START.

GASOLINE ENGINE.

Turn the ignition switch to the extreme right position to energize the starter motor and turn over the engine. It may be necessary to partially depress the accelerator and pull out the choke button during the first cranking period until the engine begins firing.

Once the engine is firing regularly, release the choke button. If the engine fails to start within the first 30 seconds of continuous cranking, release the ignition switch and wait approximately 60 seconds before attempting to start the engine again. Should it be necessary to crank the engine a second or third time, use only a minimum amount of fuel until the engine catches on and then give it only enough gas to keep it running regularly.

Once the engine has been started, allow it to idle long enough to bring the engine temperature to at least 130° F before putting the loader to work. During this time, make all necessary outside checks, tires, leaks at hose connections, transmission, engine, etc. Do not engage the transmission or operate any control levers. During the next 10 to 15 minutes, or until the cooling system temperature reaches 160° to 165° F, operate at only partial power and in intermediate or low speed range. Pay particular attention to the dash instruments during this warmup period.

DIESEL ENGINE.

CUMMINS. Units equipped with Cummins Diesel engines are normally started by depressing the foot brake pedal and turning the ignition switch to the extreme right. It may be necessary to completely depress the accelerator to get the engine started firing, since the only means of enriching the fuel mixture in the diesel engine during starting procedures is to meter a maximum amount of fuel to the fuel injectors. Once the engine begins firing regularly, ease up on the accelerator so the engine will run regular at a decreased speed.

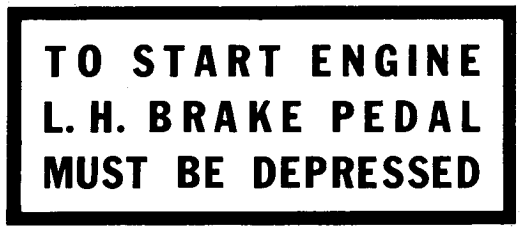


Figure 13. Starting Instructions Decal (Cummins)

The Cummins Diesel Units are equipped with an engine safety shut-down switch to prevent fuel "feed back" to the cylinders when an engine is stalled out or shut down without turning off the ignition switch.

This switch is actuated by the engine lube pressure. The function of the switch is to complete the electrical circuit between the ignition switch and the fuel pump solenoid while engine lube pressure is normal. When the engine is running, the lube pressure closes the safety switch and completes the electrical circuit between ignition key switch and solenoid.

The safety switch is located slightly below the fuel pump, and is fixed to the engine block by means of a tee connection in the lubrication line.

The "by-pass" switch is mounted in a tee connection on the master cylinder and is the same type of switch as the stop light switch. This switch is operated by hydraulic pressure when the brake pedal is depressed.

In addition to the safety shut-down feature, two additional features have been obtained:

a. Safe starts - because of brake application during starting.

b. Automatic engine shut-down when the engine lube pressure is lost.

GENERAL MOTORS. Check that both shut-down handles on the right of the operator's compartment are pushed in. Operate the ignition-starter switch to the extreme right and energize the starting motor.

Depress the accelerator pedal approximately half way until the engine starts. Do not crank the engine for periods in excess of 15 minutes. Should the engine fail to start in four attempts, refer to the TROUBLE SHOOTING CHART in the engine manufacturer's Operators Manual for series 71 engines.

DIESEL COLD START (Cummins).

To assist starting loader units equipped with diesel engines, a cold weather starting aid is provided. The aid consists of the primer starting assembly to the right of the operator's seat, a glow plub in the air intake manifold of the engine, a fuel injector in the manifold, the interconnecting fuel lines and the electrical wires. Start the engine, using the primer, as follows:

a. After checking that the boom is resting on the ground and that all the control levers are in "NEUTRAL", turn the ignition and glow plug switches "ON". The indicator lamp to the right of the operator's seat must come on to indicate that the glow plug circuit is operating properly.

CAUTION

Do not operate the hand primer if the indicator lamp does not come on.

b. Unlock the hand primer and operate it one or two times in order to prime the pump, but stop operating the pump once it is primed. Allow approximately 20 seconds for the glow plug to warm up and then begin turning the engine over with the starting motor. Operate the hand primer as the engine turns over. Maintain an 80 to 100 psi pump gauge reading.

c. Once the engine starts, maintain only enough primer pressure to keep the engine running smoothly. When the engine stops faltering between primer strokes, discontinue operating the pump and lock it in place. Operate the glow plug switch to "OFF". The glow plug indicator should go out.

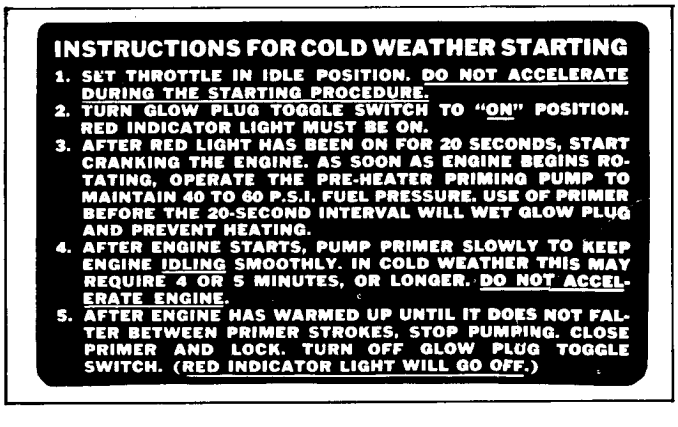


Figure 14. Primer Assembly Decal

CAUTION

The primer and glow plug are to be used as cold weather starting aids only. Do not use them when the engine is working under load conditions.

ETHER STARTING (GENERAL MOTORS).

An ether capsule puncturing tool is mounted on the right side of the operator's compartment in front of the two shut-down cables. It should only be used for starting the engine when surrounding temperatures are below 40° F. Start the engine using ether capsules as follows:

a. Check that both shut-down cables are pushed in and that all control levers are in "NEUTRAL."

b. Open the pressure priming tool and insert an ether capsule.

c. Replace the cap and fasten it securely but be sure the handle remains in the withdrawn position.

d. Operate the ignition switch to energize the starting motor. As the engine turns over, swing the handle on the priming tool cap to puncture the ether bulb. The accelerator pedal should be depressed fully. Continue cranking the engine for approximately 20 seconds.

Should the engine fall to start on one ether capsule, remove it from the puncturing tool and repeat the above starting procedure.

FAILURE TO START.

Should the engine fail to start, there are several reasons that could be causing the difficulty, but considering the problem simply, a gas internal combustion engine requires an air-fuel mixture in the combustion chambers, compression and a means of igniting the fuel mixture. To determine why the engine fails to start, a general inspection of the engine's fuel and ignition systems will usually indicate the cause. The following conditions may cause engine starting failures:

Gasoline Engine:

Fuel tank shut-off closed.

Fuel tank empty.

Battery cables disconnected or ground connection to frame loose.

Distributor breaker contacts not closing.

Distributor breaker arm grounded.

Defective distributor cap, rotor or condenser.

Defective ignition coil.

Loose terminals or ground wires on starting circuit components.

Diesel Engine:

Fuel tank shut-off closed.

Fuel tank empty.

No oil pressure.

Battery cables disconnected or ground connection to frame loose.

Loose terminals or ground wires on starting circuit components.

Clogged fuel filter, lines or screens.

Suction air leaks at fuel pump.

Suction leak between tanks and pump.

Preheater inoperative or glow plug too wet to ignite fuel.

Fuel shut-down valve closed.

Inability to crank the engine or high engine temperatures are indications of a mechanical failure.

The fuel shut-down valve on some diesel units may cause starting failure. Should the fuel pump solenoid on such units fail to operate, check that the manually operated indicator on the fuel pump solenoid is in the "O" position. When the engine is not operating, the indicator should be in the closed position.

Should the diesel engines equipped with glow plugs fail to give an indication of starting when the glow plug and the hand primer are used, check for heat at the intake manifold. If no heat is evident, check the electrical connections to the plug and the control switch in the operator's compartment.

If the wiring and connections check out, remove the pipe plug near the glow plug and check the flame in the manifold while another person performs the pre-heating procedures previously described. Should no flame be evident, discontinue priming and observe the glow plug through the pipe plug opening. After 20 to 30 seconds, the plug should be white hot.

Remove the plug if it does not function properly and connect it to a 6 volt, 30 ampere external source to check its operation. If the glow plug is alright, check the manual switch and resistor and replace if necessary.

If the glow plug circuit operates properly and the engine still fails to start, remove the fuel nozzle and clean.

WORKING THE "PAYLOADER".

OPERATIONAL CHECK.

After the preliminary checks have been made and the engine has been warmed up, make a brief operational check of the loader.

WARNING

Make sure no one is working around or standing near the loader when the operational checks are made.

Pull back on the boom control lever and raise the boom about six feet off the ground. Return the boom control to "NEUTRAL" and operate the bucket control to both the "OPEN" and "CLOSE" positions to check operation of the bucket hydraulic circuit.

Operate the boom control to "LOWER" until the bucket is about two or three feet off the ground and then place the control in "NEUTRAL". Turn the steering wheel in both directions to the extreme positions of the steering gear in order to check operation of the steering system and the steering booster hydraulic circuit. Check that the steering axle stops and the loader tires are clear when the steering gear is in its extreme positions.

Operate the transmission speed range lever to either high or intermediate, release the parking brake and engage either forward or reverse. A directional clutch must be engaged before the loader will move.

LOADING THE BUCKET.

The loader may be put to work as soon as it has been checked out and found to be in proper working condition. When the "PAYLOADER" is to be used to pick up material or dig, engage the rear final drive and approach the pile normally in the low speed range. Open the bucket until the pointers on the bucket cylinders indicate that the bucket is open far enough to allow the cutting edge to penetrate the pile as the thrust is made and lower the boom to ground level.

After the penetration has been made, operate the boom lever to "RAISE" and begin rolling the bucket back intermittently as required so the boom will raise at a near constant rate. The bucket lever will have to be operated intermittently because the bucket circuit of the main hydraulic system over-rides the boom circuit. If the initial thrust is too deep, it may be necessary to back off slightly to permit the boom to raise properly. When digging into unusually hard material, penetration of the material is assisted if, as the thrust is made, the bucket control lever is

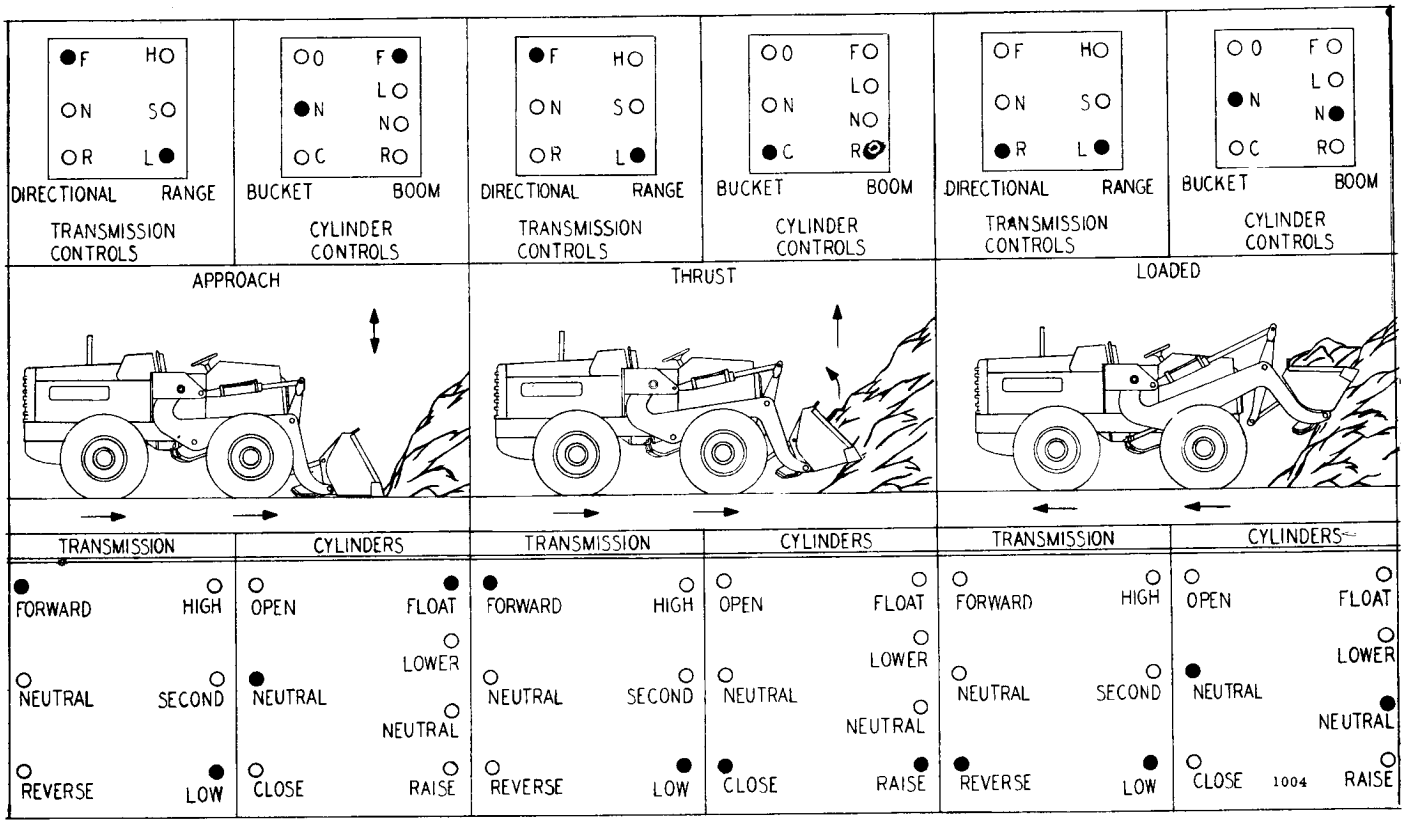


Fig. 15. Loading Procedure

operated back and forth to produce a wiggling motion of the bucket. A heaping bucket load will almost always be obtained if the control lever operations are properly coordinated. Normally this load will be obtained before the bucket has been elevated six feet.

When the bucket has been fully closed, shift the transmission directional lever to "REVERSE" and back the loader away from the pile. Boom elevation can be stopped by operating the control lever to "NEUTRAL". The position at which the boom will be stopped is dependent upon the job requirements. If the loader is to dump into a hopper that is within a short distance of the loading site, the operator may allow the boom to raise to approximately the height of the hopper, but the boom should never be allowed to travel the full length of the boom piston stroke during loading. In other types of loading operations, such as loading a truck or a railroad gondola car, the boom may be raised to a height that will clear the transporting vehicle.

CAUTION

In all loading operations avoid operating against the hydraulic system relief valves.

TRANSPORTING LOADS.

Loads should never be transported with the boom fully raised. If it is practical for the particular work operation to transport the load at a raised position before emptying the bucket, perform all steering and shifting operations as smoothly as possible and depress the toe of the accumulator control pedal so any shock loads imposed on the boom will be absorbed by the accumulator assembly.

Normally, though, when the bucket has been loaded and the loader has backed away from the pipe or bank, the boom should be lowered to within two or three feet of the ground before the load is transported.

Should it be necessary to travel over rough or sloping terrains, the load should always be carried as near the ground as possible. Use the accumulator, should the loader be so equipped, to cushion the boom while the load is being transported. This will protect the machine from shock loads, decrease spilling and provide operator comfort. Do not use the accumulator while loading the bucket.

The transporting speed of the loader from the loading site to the dumping area is dependent upon the position at which the load is being carried, the type terrain over which the load is to be carried and the distance between the loading and dumping points. Whenever the load is carried high, travel at reduced speed. When the load is carried two or three feet above the ground, travel in the intermediate speed range and adjust the engine speed according to existing conditions.

The loader may be operated in high when it is being driven to the working area or when it is returning to the point of loading from a distant dumping area. When traveling at high speed, the rear steering axle should not be engaged.

DUMPING.

As the dump area is approached, start raising the boom so the bucket will be clear and move the loader forward gradually until the bucket is above the dumping point. Stop forward motion by depressing the left brake pedal. Operate the transmission directional shift lever to "NEUTRAL" and open the bucket gradually with the bucket control until the bucket is fully opened. By gradually opening the bucket, the operator will have better control of the load as it is emptied and will minimize shock loading of the rear axle and axle supports.

After the bucket has been emptied, close the bucket until the bucket indicator lines up with the marking about half way up the bucket cylinder and back off the loader so it clears the dumping area. Lower the boom until it is about two feet above the ground and drive the loader back to the loading site.

ENGINE SHUT-DOWN.

Prior to shutting the engine down after working the loader, it should be given a chance to cool gradually so heat can escape from the bearings, pistons and liners. Idle the engine for a short period of time so the engine oil and engine cooling fluid can circulate and carry away the heat. Avoid idling the engine for excessively long periods.

The engine can be shut down by turning off the ignition switch. Diesel units equipped with two shutdown cables to the right of the operator can be stopped by pulling out on the front cable. The second cable, toward the rear of the operator's compartment, should be used for emergency engine shutdowns only. Whenever the engine is stopped, check that the boom is resting on the ground and that all control levers are in neutral. Never leave the ignition switch on when the engine is not running or the batteries will be drained. Apply the parking brake before leaving the machine.

If the loader is to stand idle for a period of time, it is suggested that the ignition switch be checked and that the key be removed before leaving the operator's compartment.

Should the loader have a failure or indications of a failure in the engine, transmission, final drives or the hydraulic system, the engine should be stopped as soon as possible. Practically all failures give some warning before the parts "let go" and ruin other components. By heading warning signs such as a sudden drop in engine oil pressure, unusual noises, etc., the consequences of most failures can be minimized. Never try to work the loader when an impending failure is evident.

BACKFILLING AND BULLDOZING.

The "PAYLOADER" can be used to do backfilling and bulldozing work if the bucket is replaced with a backfiller blade. The blade is connected to the bucket linkage and the boom in the same way as the bucket and can be controlled by the boom and bucket control levers. When the loader is used for this type of work, operate in the low transmission speed range with the rear axle engaged so maximum power is available at all four wheels.

TOWING.

Should it be necessary to tow the loader, disengage the rear axle and disconnect the front drive shaft from the front axle. This is necessary to prevent the possibility of a transmission failure due to a lack of pressurized lubrication to the transmission components.

STORAGE.

When the "PAYLOADER" is not being worked, park or store it in a warm building or in some type of enclosure that will protect it from the variations of ambient temperatures. The storage site should maintain an approximately even temperature. If it is not practical to store the loader at a controlled temperature, park it in an enclosure that will protect it from rapid temperature changes. By attempting to control variations in storage temperatures, condensation within major components within the loader will be minimized.

Normally, the loader can be stored for approximately one month without being preserved, if it is checked and operated once a week for a period of five to ten minutes. During this five to ten minute operation period, operate the boom and bucket levers through their various positions several times and perform a transmission stall check.

If the "PAYLOADER" is to stand for prolonged periods, the engine, transmission, fuel system and hydraulic system components should be preserved with filtered corrosion-preventive mixtures.

SECTION III

MAINTENANCE

All moving parts of a machine, and other parts in contact with the moving parts, wear as the machine is used. The wearing of parts eventually progresses to the point that some parts require replacement. Normal wear of the machine's components cannot be prevented but it can be retarded by good operation and a systematic method of maintenance.

A good maintenance schedule will keep the machine in first class mechanical condition and keep part failures at a minimum. If a part is allowed to fail, it is very likely that failure will result in damage to other related parts of the machine. Emergency failures of this kind are expensive in both time and money.

The maintenance of the machine must be periodic and progressive. Unless a definite system of periodic maintenance is practiced, maintenance of the machine becomes a haphazard procedure and will fail to keep the machine operating efficiently. The system of maintenance must be progressive so that the operations will be performed in proper sequence and when they are needed.

Maintenance of the machine is concerned with the cleanliness, lubrication, fuel, air, cooling, adjustments and replacement of components or parts.

Complete information concerning maintenance of component parts of the loader is obtainable, in most cases, from the manufacturer of the component. It is suggested that the "Operation and Maintenance" handbooks for the engine and transmission be obtained from the individual manufacturers and be used in conjunction with this handbook.

Whenever any work is done on or around the loader, check that the boom is resting on the ground and that the parking brake is fully applied. As an added precaution, the wheels should be blocked. All controls in the operator's compartment should be in "NEUTRAL", the ignition switch should be off and batteries disconnected.

The suggested maintenance schedules in this handbook are based upon hours of engine operation and average working conditions. A maintenance schedule that best suits any particular "PAYLOADER" unit must be based upon the type operation the machine is performing and the rate at which the machine is worked.

DAILY MAINTENANCE OPERATIONS.

These maintenance operations should be performed at the end of each day or 8 to 10 hours of operation.

ENGINE LUBRICATING OIL LEVEL CHECK. Keep the engine oil level as near the full mark on the dipstick as possible. Never operate the engine when the level of the oil in the engine crankcase is below the low mark. If it is necessary to add oil to the engine, use only the same type oil as was added to the engine at the last oil change.

FILL FUEL TANK. The fuel tank should never be allowed to run dry, especially the fuel tank of units equipped with diesel engines because air will enter the fuel lines. Whenever air is present in the fuel system it is necessary to expel it by bleeding the system.

CHASSIS LUBRICATION (Refer to Figure 16). The points on the "PAYLOADER" listed in Table I are to be lubricated with a good grade of general purpose pressure-gun or lubricator grease. Prior to applying

TABLE I

DAILY CHASSIS LUBRICATION
(Refer to Figure 16)

Figure Reference	POINT TO BE LUBRICATED	Number of Points
1	Boom to Bucket Pivot; One Fitting per Side. . . .	2
2	Bucket Link Pivots; Two Fittings per Side	4
3	Rocker Arms; Two Fittings per Side	4
4	Bucket Cylinder to Frame; One Fitting per Side.	2
5	Boom Cylinder; Two Fittings per Side	4
6	Boom to Frame; One Fitting per Side.	2
7	Hydraulic Control Valve and Rear Axle Disconnect Levers; One Fitting per Lever	3
8	Transmission Direction Control Lever.	1
9	Axle Disengagement Lever Bell Crank	1
10	Cross Shaft Pivot for Foot Pedals	1
11	Cross Shaft Pivot for Accelerator Rod; One Fitting on Each Side	2
12	Steering Linkage Pivots to Left Side of Machine at Center.	4
13	Steering Booster	4
14	Drag Link; One Fitting per Pivot Point.	2
15	Steering Axle Tie Rod; One Fitting on Each End.	2
16	Rear Axle Carrier Pivots; One Fitting per Pivot	2
17	Steering Trunnions; One Fitting per Trunnion (Lubricate Every 40-60 Hrs.)	2
18	Drive Shaft Slip Joints; One Point per a Shaft (Lubricate Every 170 Hrs.).	2
19	Drive Shafts; Two Fittings per Shaft (Lubricate Every 1000 Hrs.)	6
20	Fan Hub (Lubricate Every 1000 Hrs.).	1

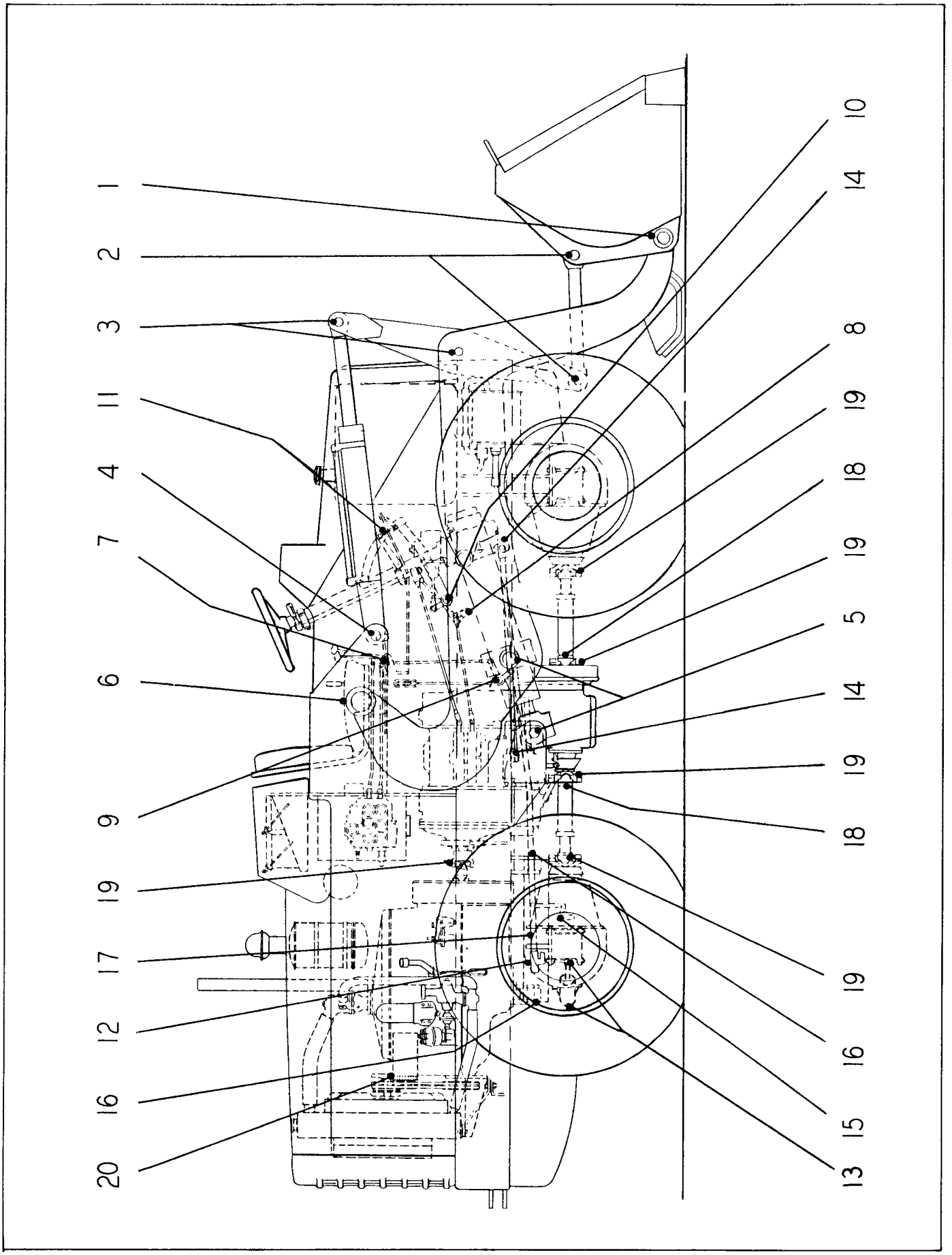


Figure 16. Daily Chassis Lubrication Chart

grease at a fitting, the fitting should be wiped clean to prevent forcing dust or foreign matter through it. Apply enough grease at each point to force out old grease. It is not necessary to change the type of chassis grease used because of temperature change. Lubricate the steering trunnions, drive shafts and the fan hub at the maintenance period indicated in parenthesis on the table.

Check the pin lock plates at every chassis lubrication for fractures or loose bolts. Keep the lock plate bolts tight and replace a plate if it is defective.

HYDRAULIC OIL LEVEL CHECK. Keep the hydraulic reservoir oil level as near the fuel mark on the dipstick as possible. Never operate the engine when the oil level in the hydraulic reservoir is below the low level mark. Whenever a check of the reservoir oil level is made, the machine's engine must be off and the bucket must be on the ground. If it is necessary to add oil to the reservoir, use only an SAE 10 HD Motor oil.

CHECK OIL OR FUEL LEAKS. After the rest of the daily maintenance operations have been performed, check that all control levers are in neutral and that the parking brake is set. Start the engine and permit it to idle until the oil temperature is within the normal operating range. Then increase engine speed gradually to the full throttle. Check all fuel and lubricating oil lines for leaks and correct as necessary.

Decrease the engine speed and operate the bucket lever to the "CLOSE" position. Increase the engine speed gradually to full throttle and note the reading of the hydraulic gauge. It should indicate approximately 1500 psi at full throttle. Decrease engine rpm gradually until hydraulic pressure starts to decrease with an additional decrease in engine rpm. This drop off should level off to approximately 1400 psi at half engine throttle. Release bucket control lever and allow engine speed to decrease to idle rpm.

Operate the boom lever to the "RAISE" position and increase engine speed to raise the boom. After the boom is fully raised, gradually increase engine rpm to full throttle. The hydraulic gauge should indicate approximately the same reading as was noted during the check of the bucket circuit. Decrease the engine speed gradually and note when the pressure drop begins. Operate the boom lever to "LOWER" and continue decreasing the engine speed. When the bucket rests on the ground, operate the lever to "NEUTRAL" and shift the transmission directional and range levers through the various positions momentarily. Return both levers to neutral and shut down the engine.

Make an inspection of the hydraulic connections at the transmission, the transmission oil filter, the boom and bucket cylinders and the hydraulic control valve. Check for leaks and correct as needed. Clean any accumulations of foreign matter from the caps of the boom and the bucket cylinders and check the area around the packing gland for signs of wear or leakage. Correct for leakage at the gland by removing shims and tightening the gland so that only a small amount of oil adheres to the piston rod.

CHECK TIRES. Inspect the tires for cuts and check for proper pressure. Suggested normal working pressure is 45 psi.

EMPTY DRY AIR CLEANER CUP. Diesel units equipped with dry type air cleaners should be serviced frequently. The frequency, depending on working conditions, will range from 4 to 120 working hours. Do not allow dust deposits to build up past a 2 inch level in the dust cup.

WEEKLY MAINTENANCE OPERATIONS.

These maintenance operations should be performed at 40 to 60 hour intervals. Operations performed each day should also be performed in this maintenance check.

CHANGE ENGINE LUBRICATING OIL. The kind of oil used, the efficiency of the filtering system and the condition of the engine must be considered, in determining whether the oil needs changing more often. An analysis of the drained oil for dilution, sludge, etc., will serve as a good record of past engine performance.

Drain the oil from the engine crankcase while it is still warm because it will flow more freely and carry out a large amount of the sludge and dirt that has collected in the engine oil pan. Do not flush the crankcase with kerosene.

After draining, fill the crankcase to the full marking on the dipstick with the type of lubricant required for existing working conditions. The weight oil to use when operating various air temperatures is suggested in Table II.

TABLE II

ENGINE LUBRICATION CHART

TYPE ENGINE	LOWEST EXPECTED TEMPERATURE		
	Above 40° F	40° F to 0° F	Below 0° F
Gas	SAE No. 30MS		SAE No. 20W
Diesel	SAE No. 30DG	SAE No. 20W	SAE No. 10W

A fixed brand of oil for crankcase lubrication cannot be given. However, it is recommended that only the oils manufactured by a recognized concern and the best quality obtainable be used and that the SAE numbers given in Table II be adhered to closely.

The term "best quality" as used here refers to lubricating characteristics rather than to premium grades of high additive oils. If the fuel used in units equipped with diesel engines contains less than 0.5 per cent sulphur and if recommended operating temperatures are maintained, oils that conform to specification MIL-L-2104 may be used in the diesel engine as well as in the gasoline engine. Use Supplement 1 or S-1 type oils if diesel fuel contains more than 0.5 per cent sulphur.

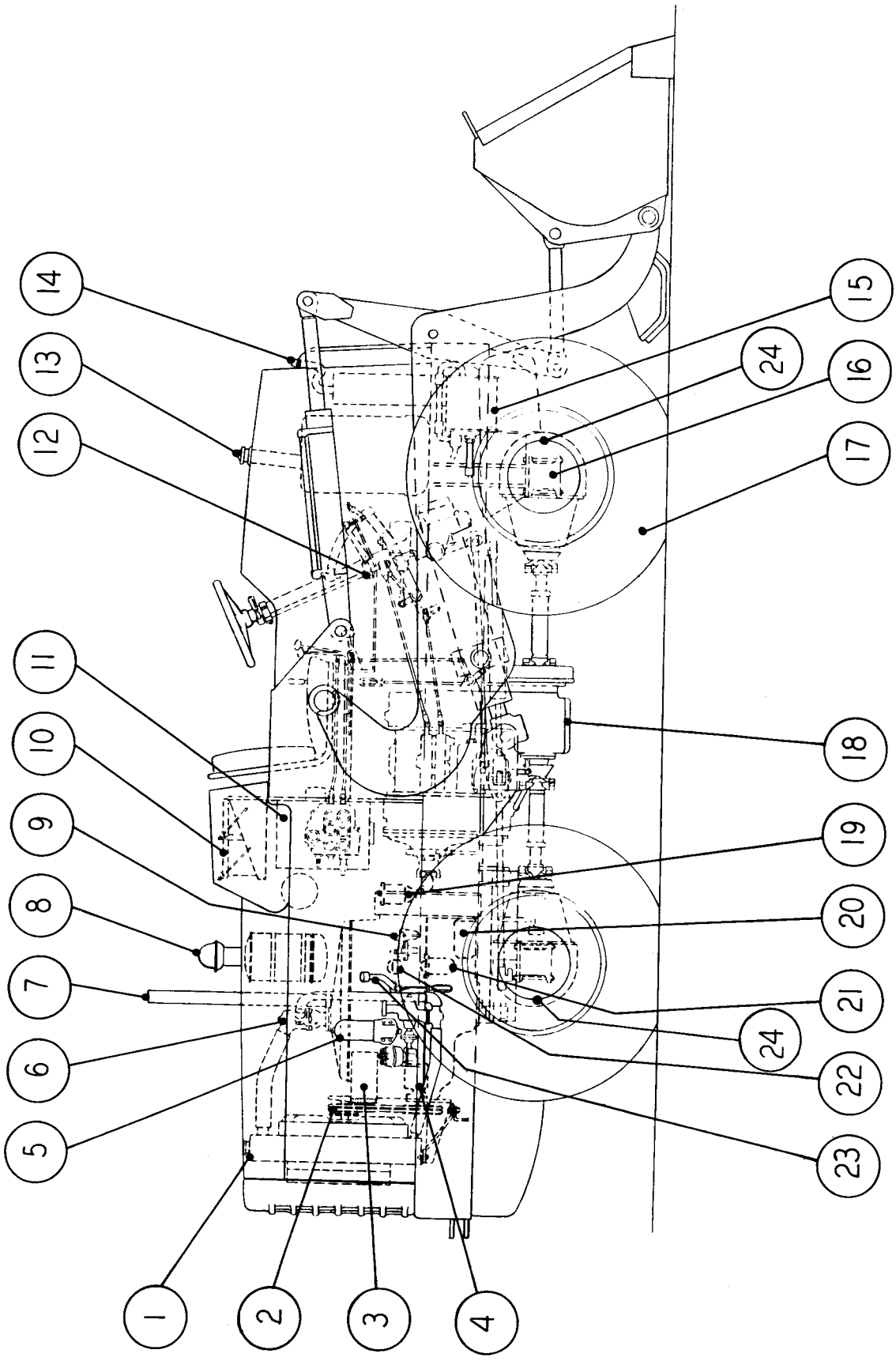


Figure 17. Preventive Maintenance Chart

TABLE III
PREVENTIVE MAINTENANCE

ITEM	CAPACITY	OPERATION PERIOD (Hrs. Oper.)				TYPE REFILL	ILLUST. REF. FIG. 17
		CHECK	REFILL	CHANGE	CLEAN		
Engine Crankcase (Hercules Gas and Cummins Diesel)	Gas: 8.5 qt. (Less Filter) Diesel: 22 qt. (Less Filter)	8-10	40-60		180-220	Refer to Daily, Weekly and Monthly Maintenance	23
Fuel Tank	Gas: 40 gal. Diesel: 40 gal.		8-10 or *AR			Gas: 70-72 Octane Diesel: Grade 2D	13
Hydraulic System	26 gal.	8-10	1000		1000	SAE 10 DG	11
Tires	Average: 45 psi	8-10	*AR	*AR		Air	17
Crankcase Breather	*AR	40-60	40-60		40-60	Refer to Weekly Maintenance	22
Air Cleaner	Gas: 3 pt. Diesel: 5 pt.	40-60	40-60		40-60	Refer to Weekly Maintenance	8
Engine Oil Filter	*AR		40-60	90-110	40-60	Refer to Weekly and Bi-Weekly Maintenance	5
Diesel Fuel Filter	*AR	40-60	40-60	180-220	40-60	Cartridge	21
Gas Sediment Bowl	*AR	40-60	40-60		40-60	Gasoline	9
Transmission	23 qts.	40-60	1000		1000	Type C Fluid	18
Transmission Filter	*AR	500	500	1000		Cartridge	19
Front & Rear Axles	62 pt. (each)	40-60	1000			SAE 90 EP	16 & 24
Cooling System	Gas: 11 gal. Diesel: 9 gal.	90-110	1000		1000	Refer to Bi-Weekly and 1000 hr. Maintenance	1
Cranking Motor	*AR	90-110			180-220	Refer to Bi-Weekly & Monthly Maintenance	20
Diesel Injector Inlet Screens		90-110			90-110	Refer to Bi-Weekly Maintenance	Ref. to Manufacturer's Manual
Diesel Fuel Pump Screen					90-110	Refer to Bi-Weekly Maintenance	4
Drive Belts		90-110		*AR		Refer to Bi-Weekly Maintenance	2
Batteries	Gas: two 6V Diesel: Four 6V	90-110		*AR	90-110 90-110	Distilled Water	10
Electrical Wiring	Gas: 12 V dc Diesel: 12 V dc	180-220			180-220	Refer to Monthly Maintenance	Ref. to Figures 4 & 5
Thermostat	Gas: One Diesel: One	180-220		*AR	180-220	Refer to Monthly Maintenance	6
Accumulator	418 cu. in	180-220	*AR			Dry Nitrogen	14
Steering Gear	*AR	1000	*AR			SAE 140 EP	12
Air & Exhaust Systems		180-220			1000	Refer to 1000 hr. Maintenance	7
Hydrovac Unit	*AR	1000	1000			Bendix Vacuum Cylinder Oil	15
Generator	*AR	90-110			180-220	Refer to Bi-Weekly & Monthly Maintenance	3

* As Required.

CLEAN CRANKCASE BREATHER. Service the crankcase breather whenever the engine oil is changed. Remove any accumulations of dirt from around the breather and remove the breather cap. Clean the cap in oil and fill the breather cup to the level indicated with oil of the same grade as used in the engine.

CHANGE OIL IN AIR CLEANER. The oil bath type air cleaner will normally require servicing at least once a week. Under certain working conditions, however, it may be necessary to clean the filter as often as every eight hours of operation.

Fill the filter cup to the level of the indicator on the side of the cup with clean, fresh oil and assemble the filter assembly. An oil of the same grade as that in the crankcase should be used, however, in extremely cold weather a lighter grade may be necessary. Some detergent (additive) oils tend to foam in the air cleaner. The additives are of no advantage in the cleaner so it is suggested that a straight mineral oil be used.

CLEAN LUBRICATING OIL FILTER ELEMENT. Remove the filter case (5, figure 17) and the filter element from the engine and inspect the element for the amount of dirt or sludge collected and metal particles, bearing metal, etc. If the element is packed full of dirt and sludge, it has probably been inoperative. This is a definite indication of poor operating conditions or inadequate maintenance. If the dirty element contains any bearing metal, it is an indication of a possible bearing failure in the near future. The connecting rod and main bearing shells should be inspected for wear.

Clean the filter element and the filter case thoroughly in trichloroethylene or some other satisfactory solvent. Drain or blow off cleaning fluid with compressed air. Check that the gasket (or seal ring) between the case and engine is in good condition. Install the cleaned element and case on the engine.

After cleaning the oil filter, the engine should be started and allowed to run until the filter becomes filled with oil. Stop the engine and add oil to the crankcase to bring the level up to the full marking on the dipstick. Inspect the oil filter for leaks at the drain plug and around the case.

DRAIN FUEL FILTER. The fuel filter (21, figure 17) of "PAYLOADER" units equipped with diesel engines should be cleaned after every 40 to 60 hours of operation. To clean the filter, open the drain on the bottom of the filter case and allow any accumulated water and sediment to drain.

CLEAN FUEL SEDIMENT BOWL. The fuel sediment bowl (9, figure 17) of units equipped with gasoline engines should be cleaned weekly. Remove the bowl and screen from the engine's fuel pump housing and rinse them thoroughly in clean gasoline. Dry both screen and bowl with compressed air and carefully seat filter screen into bowl recess. Install bowl gasket and bowl. Tighten wire loop against bowl so only enough pressure is exerted to hold the bowl securely in place.

CHECK OIL LEVEL IN TRANSMISSION. Prior to making a check of the actual oil level, remove the level check plug (18, figure 17) on the side of the transfer gear housing to make sure a sufficient amount of oil is present to make it safe to start the engine. Add Hydraulic Fluid Type "C" if necessary.

Replace plugs in transfer gear housing, check that all operating controls are in neutral and that hand brake is set. Start engine and allow it to run at idle speed until its temperature is within normal operating range and the transmission oil is warm.

Operate the range and the directional control levers momentarily through their various positions and then return the directional lever to neutral. Allow the engine to continue idling and remove the fill and level plugs. The oil in the transfer gear housing should be level with the upper check plug hole. Add Oil (Hydraulic Transmission Fluid Type "C") to the transmission, if necessary, at the filler hole on the side of the transfer gear housing. Replace plugs and stop engine.

CHECK OIL LEVEL IN DIFFERENTIALS. Clean area on differential carrier of each axle around level check plug (24, figure 17). The oil level in the differentials should be even with the check plug hole. Add SAE 90 EP oil, if necessary, through the filler hole on the back of each differential.

CHECK OIL LEVEL IN WHEEL HUBS. Before checking the oil level in each wheel hub, it is necessary that the check plugs (16, figure 17) be at their lowest point of travel. Clean cover and remove check plug. The oil in each housing should be level with the check plug hole. Add SAE 90 EP oil, if necessary, through the filler-drain plug hole in the wheel hub.

BI-WEEKLY MAINTENANCE OPERATIONS.

These maintenance operations should be performed at 90 to 110 hour intervals. Daily and weekly operations should also be included in this maintenance check.

CHANGE LUBRICATING OIL FILTER ELEMENT. Remove the filter case (5, figure 17) and the filter element from the engine. Clean the case thoroughly in trichloroethylene or some other satisfactory solvent. Drain or blow off cleaning fluid with compressed air. Replace the seal between the case and the engine, if necessary and install a new filter element and case on the engine.

After installing a new filter element, the engine should be started and allowed to run until the filter becomes saturated with oil. Stop the engine and add oil to the crankcase to bring the level up to the full marking on the dipstick. Inspect the filter for leaks around the case and at the drain-plug.

CHECK ENGINE COOLANT. Check corrosion inhibitor and/or antifreeze concentration in engine coolant

and add protective solution in accordance with the product manufacture's instructions.

Add to the cooling system only when the engine is running. If a quantity of coolant solution is not readily available, use only fresh water to bring the coolant to its proper level.

LUBRICATE CRANKING MOTOR. Add a few drops of clean SAE 20 motor oil to the bearings of the cranking motor.

LUBRICATE GENERATOR. Use SAE 20 motor oil to lubricate the battery charging generator bearings. Avoid over oiling which is detrimental to electrical wire insulation and will decrease the efficiency of the generator.

CLEAN FUEL INLET CONNECTION SCREEN. On "PAYLOADER" units equipped with diesel engines, each fuel inlet connection to the fuel injectors has a fine mesh screen at the large end (cage) of the connector. This screen is the last protection against dirt entering the injector and since it is very fine mesh, it will soon collect enough dirt from dirty fuel to restrict fuel delivery from the fuel pump to the injector. Clogged or dirty connection screens will result in loss of engine power or in uneven fuel charges and a rough running engine.

Clean by removing the cage, gasket and strainer screen. Wash the screen in solvent and clean with compressed air. Direct the jet of air in the reverse direction to fuel flow.

Inspect the threaded end of the connection. Damaged threads will leak fuel and damage the mating thread inside the injector body. Reassemble as removed.

CLEAN DIESEL FUEL PUMP SCREEN. A fine mesh filter screen is located under the large cap on top of Cummins fuel injection pumps. It can be removed by loosening the cap and lifting out the spring and screen assembly. The screen can be separated from one of the retainers for easy cleaning, the other retainer is soldered to the screen. Install the screen and retainer (retainer with hole down) after cleaning. Insert the spring and install the cap. Tighten the cap to 20/25 ft. lb. with a torque wrench; excessive tightening is not required.

CHECK BATTERIES. Use a hydrometer to check the battery's state of charge. The actual reading of the hydrometer will vary with the temperature of the electrolyte. The hydrometer reading of an electrolyte above 80° F will be less than a reading taken of an electrolyte that is below 80° F. Electrolyte temperature readings should be taken from the center battery cell in order to get a true temperature reading. Refer to the temperature correction chart, Table IV in order to correct indicated hydrometer readings to actual readings.

The fluid level in the batteries should be maintained above the battery plates of each cell. If it is necessary to add to the battery fluid, use only fresh,

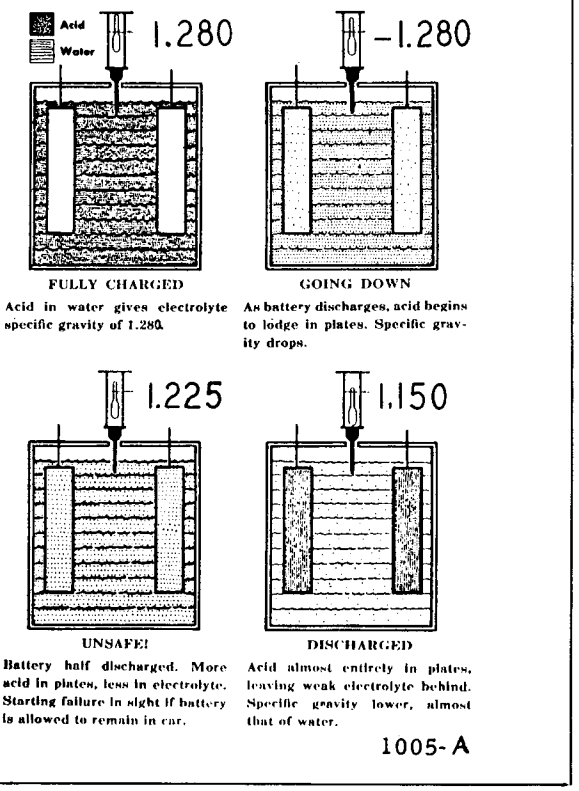


Figure 18. Battery State of Charge

TABLE IV
SPECIFIC GRAVITY TEMPERATURE CORRECTION CHART

ELECTROLYTE TEMP. (DEGREES FARENHEIT)	SPECIFIC GRAVITY CORRECTION FIGURE
145	+.026
140	+.024
135	+.022
130	+.020
125	+.018
120	+.016
115	+.014
110	+.012
105	+.010
100	+.008
95	+.006
90	+.004
85	+.002
80	.000
75	-.002
70	-.004
65	-.006
60	-.008
55	-.010
50	-.012
45	-.014
40	-.016
35	-.018
30	-.020

distilled water or water that is approved for battery use. Do not add to the battery fluid in cold weather unless the engine is to be run immediately after maintenance operations are performed, otherwise the water added may freeze before mixing with the electrolyte. Do not add acid to the battery.

Check that the air vent holes in the cell caps are cleared, and that the grounding strap is securely fastened. Remove corrosion from and around terminals, then coat with Vaseline.

CHECK AND ADJUST BELTS. The tension at which belts are set is often neglected because a poorly adjusted belt does not cause an immediate effect to the engine. A belt which is too tight puts a strain on gears, shaft and belt grooves. Loose belts slip, overheat and wear out more quickly. The cooling efficiency of the radiator is reduced if the water pump belts are slipping and the output of the generator is decreased if the drive belts are not properly tightened.

Adjust tension on the belts so they can be flexed approximately 3/4 inch with hand pressure applied mid-way between the pullies. Replace worn belts with ones that are properly shaped to fit the groove of the hubs and are accurate and uniform in length to assure efficient operation. Where two belts are used they must be replaced as a pair.

Always loosen the adjusting device before installing belts. Never stretch a belt by prying or rolling it onto the pulley because the belt cord is liable to break or greatly reduce the belt life. If the machine is to stand idle for a prolonged period of time, remove the tension on the belts.

MONTHLY MAINTENANCE OPERATIONS.

These operations are to be performed at 180 to 220 hour intervals. Maintenance operations previously described should be considered as part of these operations.

STEAM CLEAN THE "PAYLOADER". Dirt accumulated on the engine, transmission, hydraulic cylinders, axles and hydraulic connections will find its way into these components when the check plugs and covers are removed unless the dirt is removed first.

Steam is the most satisfactory method of cleaning a dirty piece of equipment, however, if steam is not available, use a spray of mineral spirits or some other solvent to wash down the "PAYLOADER" unit.

Generator and cranking motor openings and wiring should be protected from the full force of the steam jet. If a spray of solvent is used, it must not be injurious to the hydraulic hoses.

IF NEEDED, FLUSH THE ENGINE CRANKCASE. During this lubricating oil drain, inspect the condition of the upper rockers and crankcase for sludge. Normally, if a good grade of heavy duty oil has been used and operating temperatures have been kept in the correct range, there should be no sludge and crankcase flushing will not be needed. If the inspection shows a large amount of sludge, the crankcase should be flushed with a mixture of five gallons of clean fuel oil and one gallon clean lubricating oil, or as much more flushing oil as is needed to maintain the level within the operating range.

The lubricating oil strainer bag on diesel equipped units, should be cleaned before and after flushing or use a special strainer bag saved just for flushing operations. When flushing the crankcase of "PAYLOADER" units equipped with gasoline engines the felt pad type element should be cleaned or changed before and after flushing.

During flushing operations, the radiator should be covered while running the engine at low idle speed for approximately 15 minutes to bring the water temperature up to about 190° F. Most sludge deposits are heavy and gummy and in order to cut them thoroughly, the flushing oil must be hot.

Allow the flushing oil to drain at least 30 minutes. Unless all flushing oil is drained from the engine, oil pan and filter, it will dilute the new lubricating oil. A gooseneck tube attached to a hand suction pump should be inserted through the oil pan drain plug hole to pump all flushing oil from the oil pan. Oil and sludge trapped in the base of the filter of gasoline equipped units can be drained by removing the large hex head nut on the under side of the assembly.

Install a new or clean filter element and fill the crankcase with the proper type of lubricating oil. Run the engine until the oil has been completely distributed throughout the engine; then add oil to bring it up to the full indication on the dipstick.

CHANGE DIESEL ENGINE FUEL FILTER ELEMENTS. Remove the filter element and shell (21, figure 17), clean the shell and insert a new filter element.

BLOW DUST FROM GENERATOR AND CRANKING MOTOR. Dirt and dust, if allowed to accumulate in the generator and cranking motor, will cause excessive wear of bearings, brushes and commutator.

Remove the cover band and blow out any accumulations of dust and dirt with a jet of dry compressed air.

If the commutators are to be cleaned, use No. 00 sandpaper; never use emery cloth. Blow the sand out with compressed air.

Replace worn and oil soaked brushes. If brushes wear rapidly, check for correct brush spring tension or high mica on the commutator. The brushes should slide freely in their holders. Check generator output and the action of the dash panel ammeter after brush replacement. Shorts and incorrect polarization can be detected at the ammeter. Incorrect polarization is indicated by minus readings when the generator is turned. Quick correction of the condition can be made at an electric service station.

CHECK HYDRAULIC RESERVOIR STRAINER. Accumulations of matter on the reservoir strainer will restrict the flow of oil in the hydraulic system. Check the strainer when monthly preventive maintenance checks are made as described in detail in "General Maintenance" of the "Hydraulic System".

CHANGE RESERVOIR FILTER CARTRIDGE. Remove the filter cover from the left side of the reservoir and replace the filter cartridge after the first 20 hours of operation. Replace the cartridge every 500 hours thereafter. At the same time the cartridge is replaced, the inside of the filter shell and the relief ball check in the center tube of the shell should also be cleaned.

LUBRICATE SLIP JOINTS. The slip joints (18, figure 16) of the front and rear drive shafts should be lubricated every month with a good grade of chassis lubricant. Remove the plug from the slip yoke, install a grease fitting and apply lubricant till old grease is forced out of joint along splines of stub shaft. Following lubrication, remove grease fitting and install plug.

CHECK ELECTRIC WIRING. Avoid poor starting conditions by inspecting battery and plug connections. Remove and replace corroded leads. Check for loose connections at the battery, the generator and the regulator. A loose connection will overwork both the generator and regulator and shorten their life.

Apply a small amount of magneto grease sparingly to the distributor cam of units equipped with gasoline engines. Check the gap settings of the distributor points (.018 to .020 inch) and spark plugs (.025 inch). Replace frayed or oil soaked wires and defective spark plug moisture covers. Clean leads to plugs and distributor and check tightness of plugs.

TIGHTEN MANIFOLD NUTS. Exhaust, intake and water manifold nuts should be checked for tightness.

TIGHTEN OIL PAN MOUNTING BOLTS. Check for leaks at oil pan gasket. Replace all lost or broken bolts and check tightness of all oil pan bolts.

TIGHTEN HYDRAULIC BRAKE SYSTEM CONNECTIONS. Check that connections in the hydraulic brake system at the master cylinder, hydrovac unit, transmission disconnect valve and wheel cylinders are tight.

TIGHTEN MOUNTING BOLTS. Mounting bolts will occasionally work loose and, if they do, the supports and brackets will wear rapidly. Tighten all mounting bolts or nuts and replace any broken or lost bolts, capscrews or nuts.

CHECK THERMAL CONTROLS. Check openings and closing of cooling system thermostat. This can be done by immersing the thermostat in water and slowly bringing the water temperature to thermostat operating temperature.

The thermostat should be fully open at 170° F to 175° F. A defective thermostat of this type must be replaced as it cannot be repaired.

CHECK GAS PRESSURE IN ACCUMULATOR. The gas pressure should be 300 to 400 lbs. when the engine is off and the boom control lever is in "LOWER" or "FLOAT" position. Use commercial dry nitrogen, if it is necessary to add gas to increase the pressure. Gauge kits for testing accumulator pressure are available through your distributor.

CHECK ENGINE BLOW-BY. Engine blow-by can be detected by running the engine and observing the gas escape from the lubricating oil filler hole with the cap removed. There will always be some gas escape at the filler hold when the lubricating oil is up to operating temperature due to heat and piston movement, but distinct puffs indicate blow-by. Experience and comparison with other units operating at the same engine speed are needed to make a conclusion as to the extent of blow-by. Real blow-by is always accompanied by excessive lubricating oil consumption. The condition can only be corrected by installing new rings and pistons and by reboring the cylinder walls.

CLEAN DRY AIR CLEANER. Excessive exhaust smoke and/or loss of power in diesel units equipped with dry type air cleaners may indicate the need for filter element service. Check air flow through the filter by installing a vacuum gauge or a water manometer, if available, at the tap plug on the side of the air cleaner or in the intake pipe to the engine. Air cleaner element service is required when the air restriction has increased to 20 inches of water.

Service the cleaner while the engine is stopped. Clean the cover and upper portion of the cleaner and loosen the cover hold-down clamps. Remove the cover, unscrew the wing bolt holding the element in place and lift the element from the cleaner. Dislodge dust entrapped in the element by first tapping it along its bottom rim with the palm of the hand and then, if compressed air is available, blow out the element from the clean air side.

Having removed as much dust as possible by tapping and blowing air through the element, remove remaining accumulations by washing the element in a solution of non-sudsing detergent and warm water. Flush the element with a gentle stream of fresh water until the drain water is clear. Then dry the element with compressed air before using it again.

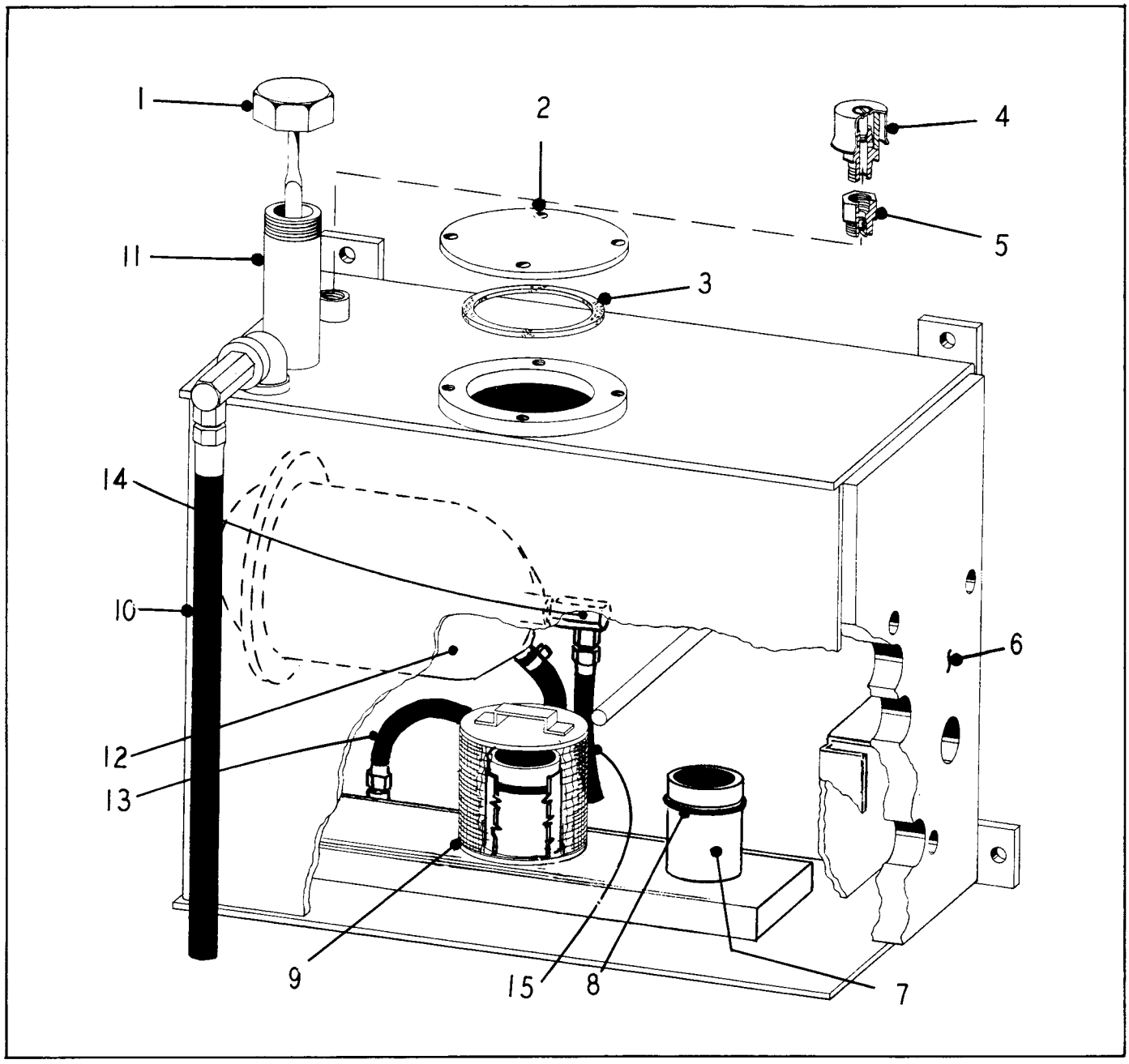
Whenever the element is cleaned or replaced, the dust cup should be emptied and the tubes in the cleaner base should be cleaned. Dust deposits in the tubes can be removed with a stiff fiber brush.

The required service frequency for the cleaner element should be established according to existing work conditions. It is recommended, however, that after 1,000 hours of operation a new cleaner element be installed.

1000 HOUR MAINTENANCE OPERATIONS.

These operations are to be performed usually at 1000 hour intervals. Unlike the other periodic preventive maintenance operations, these operations need not be performed solely on the basis of period of service. Excessive oil consumption, low oil pressure at idling speed, faulty operation of the hydraulic system, transmission and other machine components should be taken into consideration before starting these operations.

CHANGE TRANSMISSION OIL. Under normal operating conditions, the transmission oil need not be changed oftener than 1000 hour intervals.



1. Cap and Dip Assembly
2. Clean-Out Cover
3. Cover Seal
4. Air Filter Assembly
5. Vacuum Breaker Assembly
6. Valve Mounting Surface
7. Reservoir Standpipe
8. "O" Ring
9. Strainer Screen
10. Overflow Hose
11. Filler Pipe
12. Oil Filter Assembly
13. Filter Inlet
14. Filter Check Valve
15. Filter Outlet

Figure 19. Hydraulic Reservoir

If the oil shows traces of contamination by dirt or the effects of high operating temperature (discoloration or strong odor) as evidenced by a 500 hour check of the filter assembly, it will be necessary to change oil more frequently. Metal contamination of the oil requires that all components of the transmission must be thoroughly cleaned. Metal particles in the oil are evidence of a part failure.

Drain the oil from the transmission while it is still warm because it will flow more freely and carry out a maximum amount of the foreign matter that has collected in the transmission sump.

In order to completely drain the transmission hydraulic system, open the bleeder and drain valves on the oil cooler. Remove the transmission filler plug, drain plug and the filter drain plug. After the oil has drained, remove the transmission strainer from the sump of the transfer gear housing. Clean the strainer with mineral spirits and a soft bristle brush. Remove the used filter element and clean the case thoroughly. Install a new element in the case.

When the transmission has been completely drained, close the oil cooler drain, install removed drain plugs and install cleaned strainer in transfer gear housing. The oil cooler bleeder must remain open until after the transmission is completely filled.

Add approximately 5-1/2 gallons of Type "C" Transmission fluid to the transmission through the oil filler hole on the side of the transfer gear housing. Start the engine and allow the engine to operate at idle speed with the transmission direction control lever in neutral. After the engine has been run for at least two minutes, add oil to the transmission through the filler hole to bring the oil level up to the "FULL" check plug hole on the side of the transmission sump. If the transmission has been completely disassembled and reassembled, approximately 7-1/2 gallons of oil will be needed for a refill.

CHANGE OIL IN HYDRAULIC SYSTEM. Raise booms to nearly full height and operate bucket to the full "OPEN" position. Block or support the booms in this position until the oil in the system has been thoroughly drained. Drain the oil from the hydraulic system while it is warm and will flow more freely.

Take out the battery over the clean-out cover and remove the cover from the reservoir tank. Remove the strainer screen in the bottom of the tank and clean it thoroughly in trichloroethylene or some other satisfactory solvent. Drain or blow off cleaning fluid with compressed air.

Place a large container beneath the reservoir. Remove the tank's drain plug and allow the reservoir to drain completely. The reservoir oil can be drained off into the container much easier if its flow is directed through a funnel and a length of hose. Clean the magnetic drain plug in trichloroethylene or equal.

Remove the vacuum breaker and filter assembly and clean in trichloroethylene or equal. Drain or blow off cleaning fluid with compressed air. Check that the vacuum breaker spring is clean and can work freely.

Disconnect the pressure relief hose from the check valve and blow it out with compressed air. Inspect the hose to be sure it is free of any obstructions. Remove the ball and spring of the check valve assembly and wash in trichloroethylene or equal. Thoroughly clean the interior of the check valve housing. Reassemble check valve assembly and connect the pressure relief hose to the check valve.

Wash down the exterior of the tank with a spray of mineral spirits or some other suitable solvent and install the vacuum breaker assembly and the check valve. Wash the inside of the tank with a flushing solution of five gallons of clean fuel oil to one gallon clean lubricating oil. The flushing oil should be warm enough that it will flow freely and carry out a maximum amount of sludge through the drain hole. Allow the oil to drain at least 30 minutes. Unless all flushing oil is drained from the reservoir tank, it will dilute the new oil. A hand suction pump with a piece of tubing should be inserted through the clean-out hole to pump all flushing oil from the tank.

Break the suction and the steering booster lines at the reservoir and the suction and pressure lines at the pump. After the pump and the lines have drained, prevent dirt from entering the system by re-connecting the lines. The suction hose should be flushed with clean SAE 10 motor oil before it is connected to the pump and the reservoir.

Break all line connections at the control valve body and allow the lines sufficient time to drain thoroughly. Empty oil trapped in the control valve body by operating the hydraulic control levers in the operator's compartment through all positions several times. Connect all lines again at the control valves. Take precautions to prevent dirt from entering the lines and the valve body.

Disconnect the cylinder hoses at the lowest point and drain the cylinders. When the oil has stopped flowing, couple the hoses again to the cylinders.

Install the reservoir drain plug and the strainer screen. Fill the reservoir with SAE 10 GD motor oil to the top of the tank and start the engine. Allow it to operate at the idle speed with the boom and bucket control levers in neutral. After the engine has been run for at least two minutes, add oil to the tank through the hand hole cover to bring the oil level up to the full mark on the reservoir dipstick. Take precautions to prevent dirt from entering the tank.

Operate the boom control ever to the "RAISE" position to pump oil into the boom cylinders. Operate the bucket lever to the "CLOSE" position in order to fill the bucket cylinders.

Check for oil leaks at the oil line connections to the cylinders, pump, and control valve. Remove the support used to hold the booms up but do not stand or work under the booms once the support has been taken away.

Continue to circulate oil through the hydraulic system by raising and lowering the boom and opening and closing the bucket until the oil in the reservoir tank ceases to foam. Add oil to bring the level up to the full marking on the dipstick. Replace the "O" ring in the cleanout hole recess and install the clean-out cover.

GREASE DRIVE SHAFTS. Apply a good grade of general purpose pressure-gun or lubricator grease to each drive shaft spline and universal joint. Prior to applying grease at a fitting, it should be wiped clean to prevent forcing dirt into the bearing retainers of the universal joints. Use a low pressure gun to prevent seal damage.

GREASE FAN HUB. Fill the fan hub with sodium-soap-base ball bearing grease through the fitting provided.

GREASE STEERING TRUNNIONS. Lubricate the two steering trunnions on the rear axle with two or three shots of general purpose chassis grease.

CHANGE OIL IN DIFFERENTIALS. Drain the differ-

ential oil when it is warm. Remove the drain, filler and carrier housing check plug and wash them in a clean solvent. Allow the oil to drain at least 30 minutes and clean all axle breathers.

After draining, replace drain plug and fill the differential through the filler hole in the axle housing to the level of the check plug hole in the carrier housing. Use the type lubricant required for existing working conditions.

A fixed brand of oil for differential lubrication cannot be given. However, it is recommended that only the oils manufactured by a recognized concern and of the best quality obtainable be used. Use an SAE 90 EP oil in the differential when the "PAYLOADER" unit is operated in temperatures of 90° F or less. Above 90° F use an SAE 140 EP oil.

CHANGE OIL IN WHEEL HUBS. Rotate each wheel so the hub can be thoroughly drained. Draining of the hub will be assisted if the level check plug is removed. Wash both plugs in clean solvent.

After draining, rotate the wheel so oil can be added through the drain hole. Fill the hub to the level of the check plug hole in the hub cap with the type lubricant required for existing working conditions. Use an SAE 90 EP oil in the wheel hubs when the temperature is below 90° F. Above 90° F use SAE 140 EP oil.

CHECK THE OIL LEVEL IN THE STEERING GEAR. Remove the pipe cap on the steering gear filler pipe (at floor board near steering column) and check the oil level in the tube. Add a mild SAE 140 EP oil, if necessary, to bring the oil level up to the top of the tube.

CLEAN COOLING SYSTEM. Effective and safe cleaning of the cooling system depends upon the use of reliable cleaning compounds that are used according to the instructions of the manufacturer. The use of acid type cleaners is satisfactory for general use but must be followed by the use of a neutralizer to end any action of undrainable cleaner solution.

Inspect the engine, radiator and hose connections for signs of leakage that may have been caused by vibration, deterioration of the hoses and accumulations of rust in the cooling system. Thoroughly clean the radiator openings of all obstructions with a jet of air. Do not damage the radiator core by attempting to push obstructions through the core openings.

Tighten all connections and completely drain the radiator and the engine block. Close drain and add the cleaner compound according to the manufacturer's instructions. Fill the system with water.

Run the engine at a fast idle speed for approximately 30 minutes after the cleaning solution has heated up to 180° F. Do not allow the solution to boil.

Completely drain the cleaning solution and add the neutralizer solution. Run the engine at a fast idle speed for approximately five minutes after the neutralizer solution is heated.

Drain the neutralizer solution and fill the system with water. Run the engine at a fast idle for approximately five minutes after the water temperature reaches 180° F then completely drain the cooling system.

During the periods of engine idling, it is important to maintain a temperature of 180° to 200° F. Under a no-load condition the engine developes so little heat that the thermostat is partially or fully closed. By covering the radiator, the thermostat will open quickly and remain open. If the flow to the radiator is restricted by partial opening of the thermostat, cleaning, neutralizing and flushing of the system are only partially effective.

Each time after stopping the engine and draining the system, the engine temperature should be below 200° F before cold water is added. As part of the cleaning procedure, sediment and foreign matter should be removed from the radiator pressure cap valves, the overflow pipe, radiator, air passages, and the grille.

Following the final flushing operation, replace all hoses that show external signs of deterioration and damaged clamps. Fill the system with a coolant solution and inspect the system for leaks.

The type coolant used in the system depends upon the expected operating temperatures. If the "PAYLOADER" unit is to operate in temperatures above 50° F, fill the cooling system with a 96 per cent water and four per cent soluble oil mixture. When operating in cooler temperatures use a permanent type antifreeze containing a rust inhibitor.

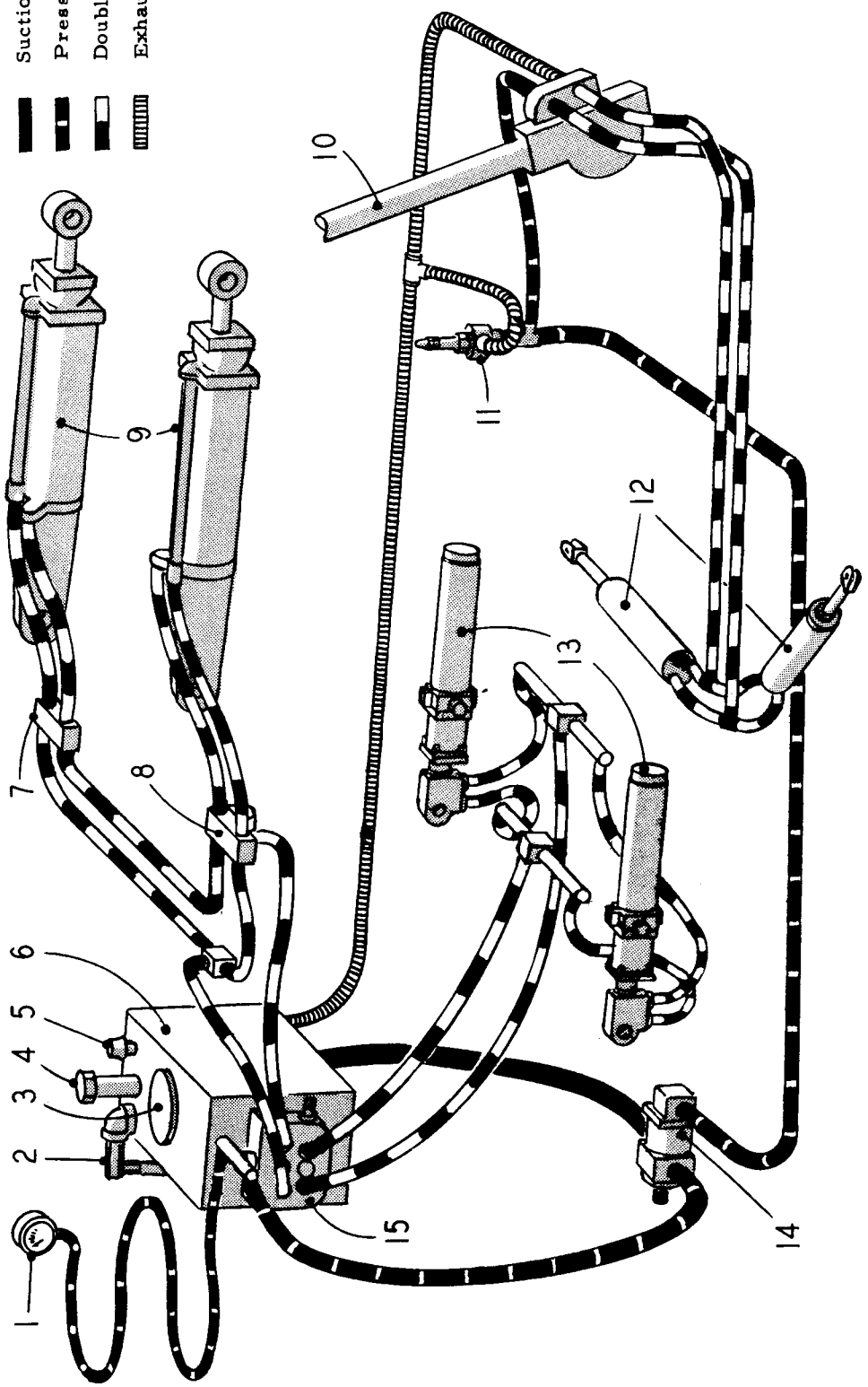
When antifreeze is used, it must be drained out of the system in the spring after the danger of freezing weather is past. Flush the system thoroughly and clean if necessary. Then fill with fresh water and soluble oil solution.

In a cooling system that was clean originally, the appearance of rust in the coolant is an indication that the inhibitor is weak or has been exhausted. In either case, the solution should be drained, the cooling system flushed and a fresh coolant solution added.

CLEAN AIR INTAKE AND EXHAUST SYSTEMS. Thoroughly clean the intake manifold and the interior of all intake air piping to prevent any build up of dirt which will restrict air flow.

Check the exhaust manifold and exhaust piping for restrictions that would prevent the free escape of exhaust gases.

INSPECT THE HYDROVAC UNIT. Check for loose vacuum connections at the hydrovac end plate. Inspect the hydraulic connections at the inlet and outlet ports for fluid leakage past the copper gaskets. If leaks appear around the slave cylinder tube, either the copper gasket in the end cap or the rubber seals



1. Hydraulic Gauge
2. Overflow
3. Access Cover
4. Dipstick
5. Breather
6. Reservoir
7. L. H. Block
8. R. H. Block
9. Bucket Cylinders
10. Steering Gear
11. Relief Valve
12. Steering Booster Cylinders
13. Boom Cylinders
14. Hydraulic Pump
15. Control Valve

Figure 20. Hydraulic System

in the end plate are defective. Check that bleed screws are tight.

Lubricate the hydrovac unit through the 1/8 inch tapped hole in the end of the unit. Add Bendix Vacuum Cylinder oil, or equal, to the level of the tapped hole. Replace pipe plug securely after lubricating unit.

GENERAL MAINTENANCE.

HYDRAULIC SYSTEM.

The closed hydraulic system illustrated in figure 20 is used to operate the double acting boom and bucket cylinders of the "PAYLOADER" unit. Hydraulic pressure to assist steering the loader is also developed in the system.

All moving parts in the system are lubricated by the SAE 10 GD oil contained in the reservoir and system. It is important, therefore, that the oil used in the system be kept as clean as possible at all times. Before breaking a hose connection, the fittings must be thoroughly cleaned and after the hose is disconnected the openings should be plugged or capped to minimize the possibility of dirt entering the system.

Oil added to the hydraulic reservoir should be free of dirt and water. Any appreciable amount of dirt in the oil will clog the strainer in the bottom of the reservoir tank and restrict the flow of oil to the hydraulic pump. If the oil is kept clean, there will be no more than traces of solid material on the strainer when it is cleaned. Protect the hydraulic system by cleaning the reservoir strainer at 180 to 220 hour intervals of operation. To clean the strainer, it is necessary to remove the reservoir cleanout cover and the strainer. Exercise caution while removing the strainer so none of the matter collected on the screen will be disturbed. Examine the particles imbedded in the screen. If large amounts of fibrous material are found on the screen, the boom and bucket cylinder packing sets should be checked.

CAUTION

Do not operate the engine or the hydraulic controls while the strainer is removed from the reservoir.

Never hold the control levers or the steering wheel in a position that causes the oil to be forced through the relief valves at high pressures for any length of time. Such practice causes overheating of pump parts and may result in their failure. Other parts of the hydraulic system may also be damaged by such procedures.

Drain the system at regular intervals, as suggested in the Preventive Maintenance section and refill it with an SAE 10 DG oil having high stability and, therefore, high resistance to oxidation and sludging.

The entire system should be checked frequently for leaks so air will not be drawn in and cause rough operations and chattering. Frequent checking for tight hose connections and properly adjusted packing glands will minimize the possibility of air entering the system.

Whenever boom or bucket cylinders are removed from the machine, care should be exercised during their installation. The pivot pins used should be checked for cracks and signs of excessive wear. Defective pins should be replaced. Check that the mounting holes on the main frame are not elongated.

Prior to making hydraulic connections, check that all threads are clean and free of burrs. If compound is used to make line connections, use an acceptable compound and use it carefully. Cover only 2/3 of the male thread and never the 1/3 closest to the end of the line. Never apply compound to the female thread and never use shellac as a sealing compound. Always check the hydraulic system oil level after replacing any of the components of the system.

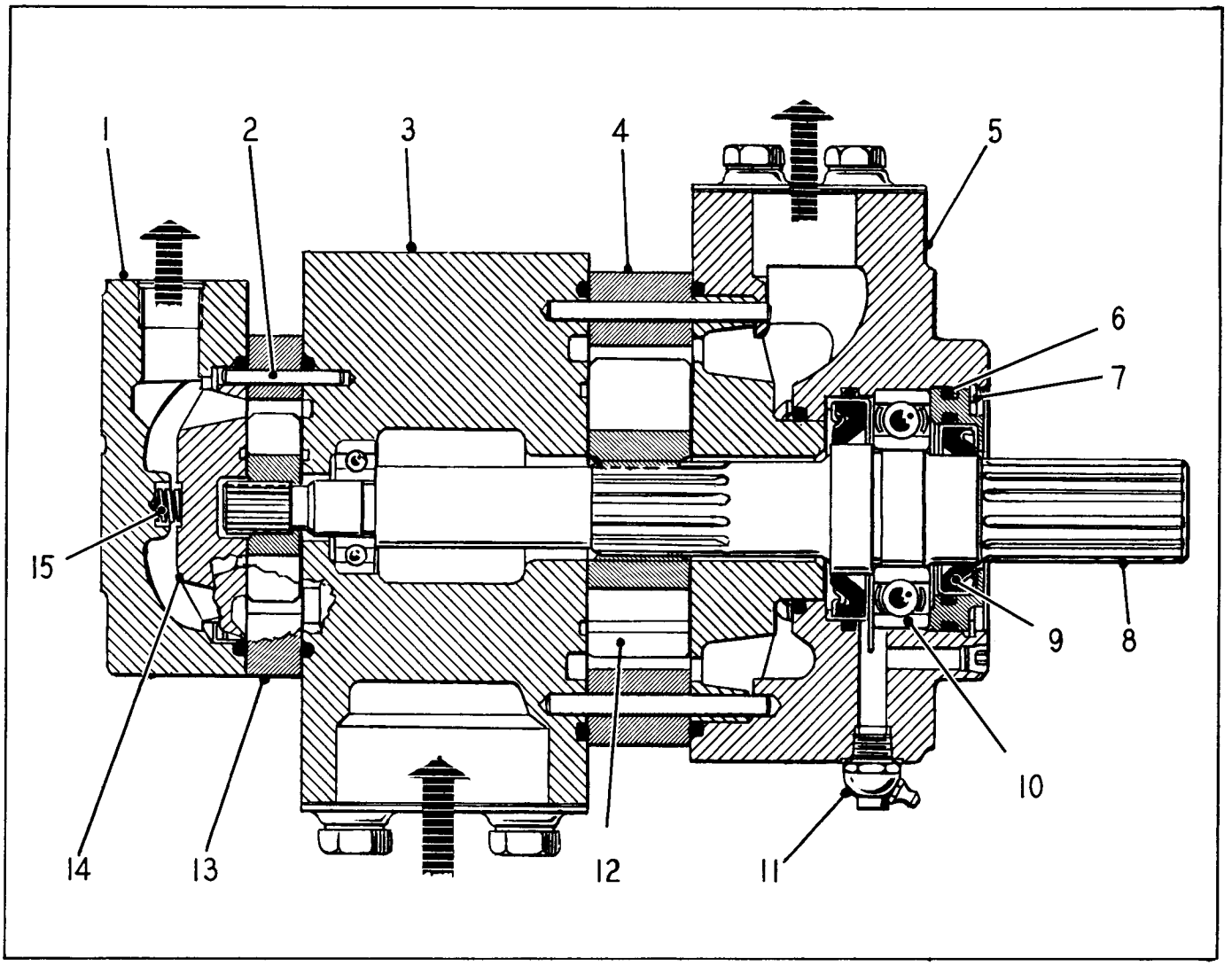
HYDRAULIC PUMP.

The double element vane type hydraulic pump (figure 21) is spline driven off the transmission. Oil used in the steering booster and the main hydraulic systems is drawn from the reservoir tank and delivered through hydraulic lines to the control valve body and steering hydraulic control valve by the pump. The two pump elements have a common inlet but the outlet of each element is a separate port. Rotation of the pump is clockwise when viewed from the drive end.

Construction of each pump element consists basically of a rotor mounted within a housing between closely fitting end plates. Vanes are held in slots in each rotor periphery and slide in and out as the rotors revolve. The sliding action of the vanes is produced by rotating each rotor in a cam-like ring.

As the rotors revolve, centrifugal action is set up on the pump vanes and causes them to move outward so they track the inside cam surface of the rings. Once hydraulic pressure is developed, the vanes are held to the cam contours by fluid pressure in the vane slots.

REMOVAL AND DISASSEMBLY. Prior to removing the pump assembly (figure 21) from the transmission for purpose of inspection, break the hose connections to the input and output sides of the pump and plug or cap the hose openings. It is advisable that the reservoir be drained prior to breaking hose connections. Remove the bolts holding the pump on the transmission and slide the pump free of the transmission implement drive.



1. End Plate
2. Alignment Pin
3. Inner Body
4. Large Volume Ring
5. Outer Body
6. Seal
7. Snap Ring
8. Rotor Shaft
9. Shaft Seal
10. Front Bearing
11. Bearing Lubricant Fitting
12. Rotor Vanes
13. Small Volume Ring
14. Pressure Plate
15. Plate Spring

Figure 21. Hydraulic Pump

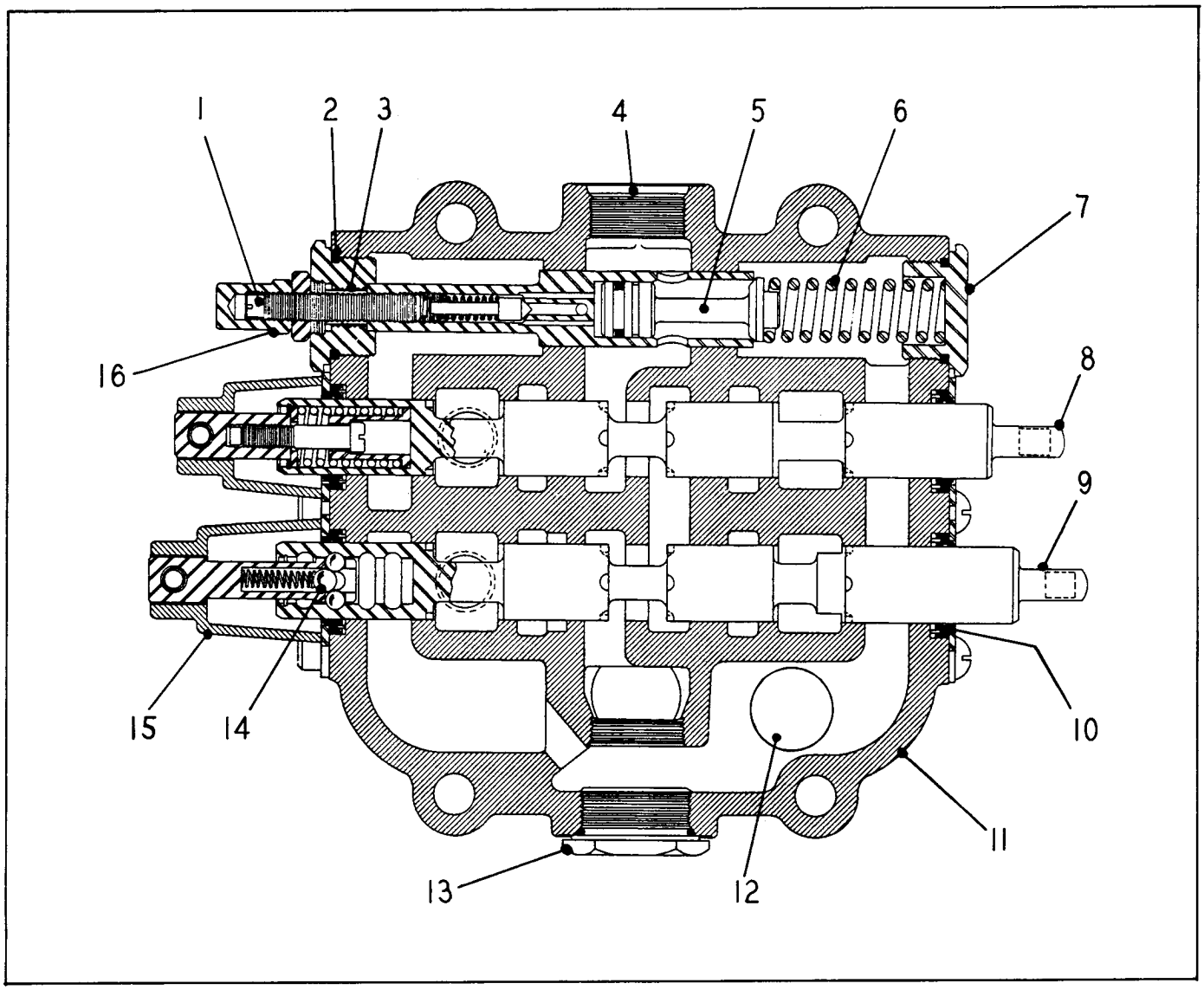
Disassemble the pump on a clean work table. Note the relative positions of the end caps, pressure plates, cam rings and the pump body during disassembly so the pump can be properly reassembled. If replacement of the front seal is necessary, remove the seal retaining ring and press both seals, the bearing and the front seal retainer from their bore in the outer pump body with an arbor press. Do not remove the pump seals unless replacement is necessary.

Should new seals be installed, replace the "O" rings in the front seal retainer and outer pump body. Press the inner seal into the pump body so it faces toward the inside of the pump and its back surface is flush with the bearing recess. Install the spacer and the front bearing. Pack the pump bearing with a high temperature grease (NLGI Grade 1).

Press the front seal into the seal retainer so it faces toward the outside of the pump and install the retainer in the pump body. Secure the retainer in place with the retaining ring.

CLEANING. After the pump has been disassembled, all parts except the seals should be washed in a cleaning solvent. Dry the parts with dry compressed air and inspect pump parts for wear.

Check each pump cartridge for signs of wear. A pump cartridge consists of the rotor, vanes and the proper cam ring. Inspect the elliptical surface of both cam rings for possible scoring marks. Check the related vanes for corresponding score marks. All vanes should slide freely in the rotor slots without any side play. Each rotor should also be inspected for wear at the vane slots.



1. Adjusting Screw
2. Seal
3. Adjusting Plug
4. Pressure Gauge Port
5. Relief Poppet
6. Main Relief Spring
7. Relief Spring Plug
8. Bucket Control Plunger
9. Boom Control Plunger
10. Plunger Seal
11. Control Valve Body
12. Exhaust Port
13. Blocked Low Pressure Port
14. Plunger Detent Assembly
15. End Cover
16. Adjusting Screw Cover

Figure 22. Control Valve Assembly

Do not repair or "tough up" any parts contained in the pump cartridge because they are machined to close tolerances which can easily be destroyed. Minor scoring marks on the pressure plates can be lapped out without seriously affecting pump operation. Replacement of the complete pumping cartridge is necessary if its parts are found to be excessively worn.

HYDRAULIC CONTROL VALVE.

Oil flow from the pump to the components of the hydraulic system is directed by two valve plungers in the hydraulic control valve. Refer to figure 22. When the valve plungers are in their "NEUTRAL" position, the flow of oil passes through the control valve and enters the reservoir tank. In other plunger positions, the oil is directed into the selected cylinders and their related hydraulic lines. Displaced oil from the cylinders is circulated through hydraulic lines to the control valve and passes through the valve body, to the reservoir tank.

It is essential that the moving parts of the control valve assembly be kept in good working order if satisfactory performance of the system as a whole is to be maintained. Small amounts of dirt, lint, rust or oil oxidation products such as gum or sludge, if allowed to collect in the assembly, will cause malfunctions and possible damage to the system. Contamination of the hydraulic oil may be eliminated if

care is exercised to keep dirt out of the system, and if an oil is used which contains additives to prevent rusting and sludge or gum formations.

During normal "PAYLOADER" operation, it may be necessary to replace the springs and seals in the assembly. The control valve plungers should not be replaced independent of the assembly body because the two have been fitted during manufacture to each other in order to maintain close tolerances.

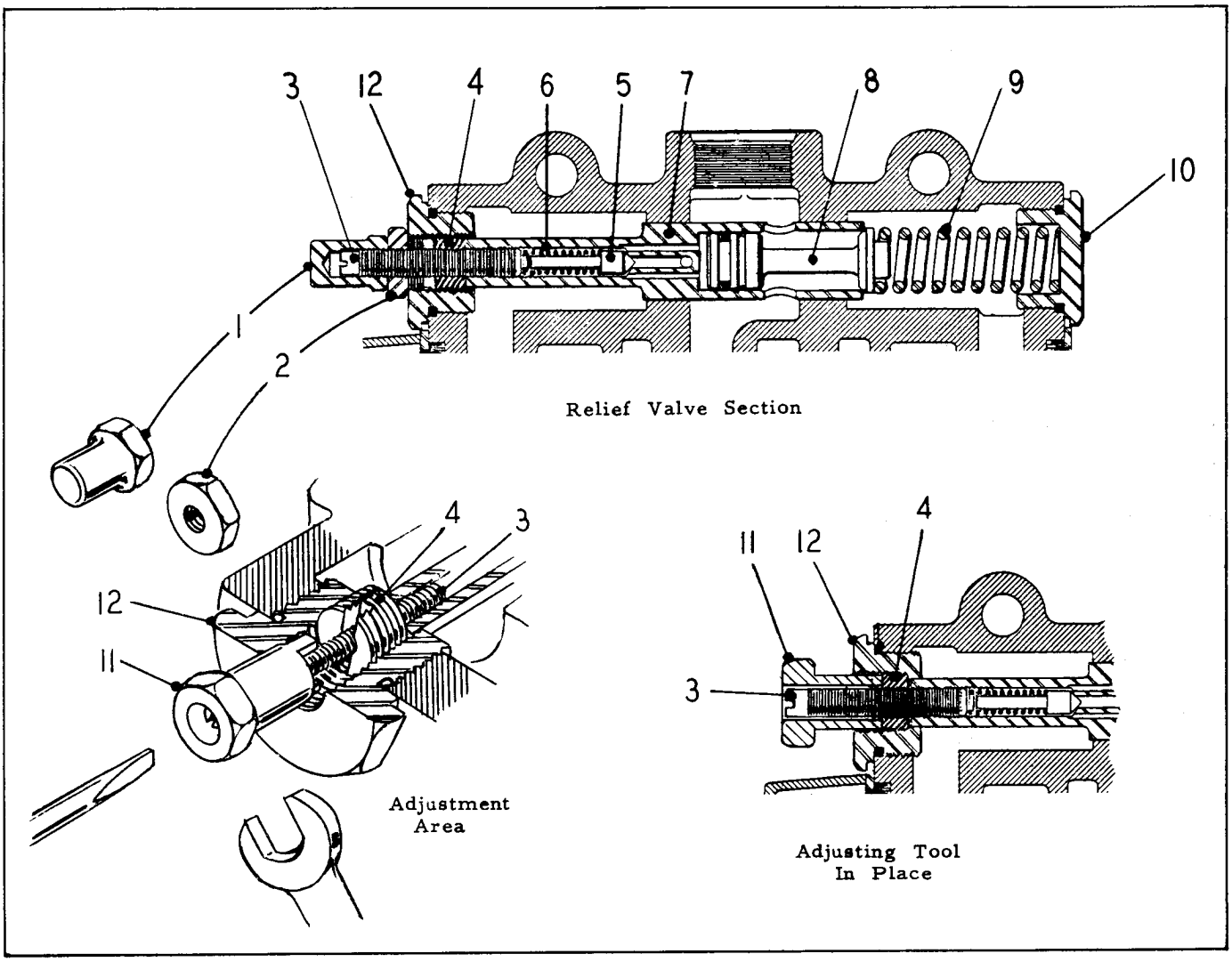
Adjustment of the hydraulic system operating pressure is made at the main relief valve assembly which is an integral part of the control valve. Normally it is not necessary to change the setting of this valve because it is set during manufacture of the loader unit so it will operate satisfactorily with a minimum amount of pressure. Pressure settings above 1750 psi will cause damage and/or rapid wear of the pump and other system components.

The valve assembly should be washed in clean solvent whenever the hydraulic tank is cleaned, usually every 1000 hours. To clean the valve assembly, it is necessary to remove it from the reservoir tank.

REMOVAL AND INSPECTION. After the reservoir has been drained, break all hose connections to the control valve assembly and plug the open end of all hoses so dirt will not enter the hydraulic system. Disconnect the mechanical linkage at the control valve spools and remove the three bolts securing the valve assembly to the reservoir.

Draw the valve assembly straight away from the reservoir so the relief valve in back of the assembly will clear the tank. Clean the mounting surface on the reservoir tank and mask it so it will not become marred while the valve assembly is removed.

Disassemble the valve assembly and wash the parts in a clean solvent. Inspect the parts of the valve and replace those parts found to be defective.



1. Acorn Nut
2. Jam Nut
3. Adjusting Screw
4. Inner Adjusting Nut
5. Pilot Poppet
6. Pilot Poppet Spring
7. Sleeve
8. Relief Poppet
9. Relief Poppet Spring
10. Plug
11. Adjusting Tool
12. End Cap

Figure 23. Relief Valve Assembly

Replace the relief valve sleeve if signs of chipping or cracking are found.

After all parts have been cleaned and inspected, rinse them in a rust-inhibiting hydraulic oil to prevent the possibility of rusting. Exercise caution during assembly of the control valve to keep all parts clean and check operation of the valve spools in their bores. During assembly of the control valve, all "O" rings should be replaced. If necessary, replace the wiper seal on each spool.

MOUNTING. When mounting the valve assembly on the tank, use new "O" rings around the openings and relief valve in back of the valve assembly and be sure there is no distortion. The usual causes of distortion are uneven tension on the mounting bolts and uneven mounting surfaces. Either of these causes of distortion may result in the valve spools binding. Attach the control lever linkage and check operation of the spools. Make adjustments in the linkage, if necessary, to provide full movement of the spools.

After the valve assembly has been properly mounted on the reservoir tank, connect the hoses. Use the "O" rings for each hose and be sure the hose connections are tight so they will not leak oil or suck air. Fill the hydraulic system as previously described in "Change Oil in Hydraulic System".

ADJUST MAIN RELIEF VALVE. The maximum working pressure of the hydraulic system is limited to 1750 psi by the adjustable relief valve in the hydraulic control valve assembly. Should the system working pressure drop below 1750 psi, normally only minor adjustment of the valve is necessary.

To make minor corrections in hydraulic pressure, remove the acorn nut over the end of the adjusting screw and loosen the jam nut on the screw. After warming up the engine and hydraulic system oil, accelerate the engine to top governed speed. Hold the bucket lever back in its "close" position and observe the hydraulic pressure gauge reading.

If the reading is low, gradually turn the adjusting screw clockwise to increase pressure to 1750 psi. Should the pressure be too high, back off the screw counter-clockwise until the proper system pressure is attained. Upon completing the adjustment, hold the screw and tighten the jam nut. Then replace the acorn nut. Refer to the decal on the inside of the reservoir side cowling.

CAUTION

Do not lock the acorn nut on the adjusting screw by drawing it down too tight.

Alignment of the complete relief valve assembly is made during manufacture. This adjustment will not normally need to be repeated unless the relief valve assembly is removed from the control valve housing or major repairs are made in the components of the hydraulic system.

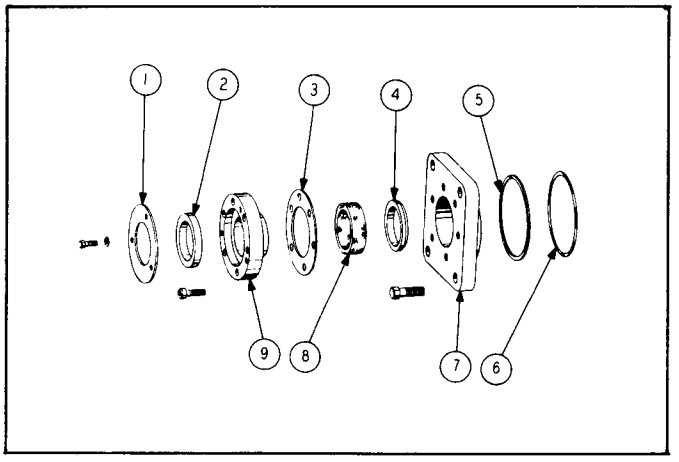
When the relief assembly has been removed from the control valve housing for inspection or repair, it is necessary to align the assembly in the control valve after installation and adjust its setting. Install the valve assembly in place and gently turn the adjusting screw clockwise until it bottoms against the pilot poppet. Then back out counter-clockwise on the inner adjusting nut until it is flush with the end cap.

Start the engine and maintain a speed of about 1000 rpm. After both the engine and hydraulic oils are warm, hold the bucket lever back in its "close" position and turn in clockwise on the inner adjusting nut until the dash gauge indicates 1950 psi. Hold the inner adjusting nut with the special tool provided and back out the adjusting screw counter-clockwise six full turns. Then accelerate the engine to full governed speed and set the adjusting screw as previously described for "minor adjustment."

PACKING AND SEAL REPLACEMENT.

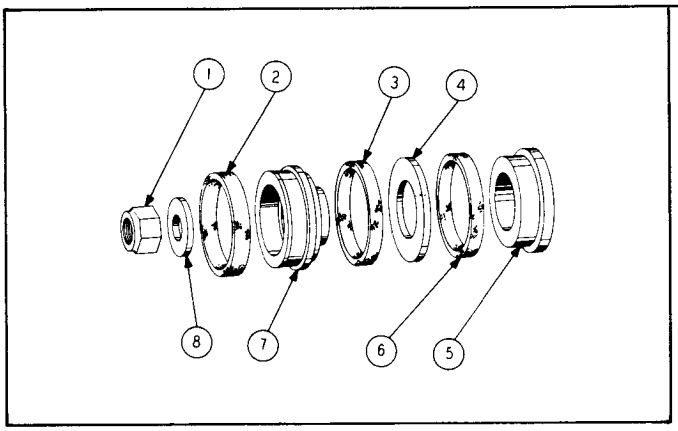
The boom and bucket cylinder assemblies (figures 26 and 27) contain packing and seals which are used to prevent leakage of the hydraulic oil through the clearances between the moving and stationary parts. Packing is used in the boom and bucket assemblies to prevent external leakage around the piston rods and internal leakage around the piston of each assembly.

When the packing and seals start to wear, they should be replaced otherwise parts of the packing will contaminate the oil. Hydraulic oil contaminated by packing material will clog the flow of oil to the hydraulic pump and tend to increase pump wear because of cavitation. Eventually the contaminated oil will work into the pump or the control valve



1. Retainer
2. Wiper Seal
3. Gland Shim
4. Spacer
5. Backing Ring
6. "O" Ring Seal
7. Cylinder Cap
8. Packing Set
9. Packing Gland

Figure 24. Boom Cylinder Head Assembly



1. Piston Head Nut
2. Wear Ring
3. Packing Set
4. Pressure Barrier
5. Piston Retainer
6. Packing Set
7. Piston Head
8. Washer

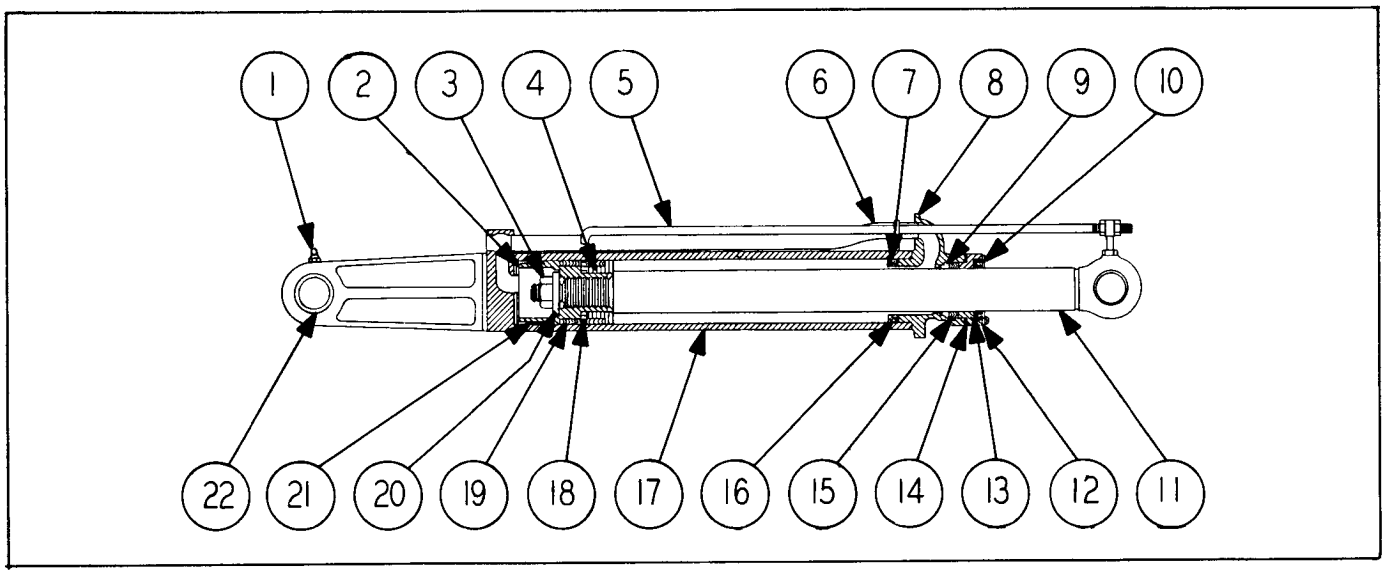
Figure 25. Bucket Piston Assembly

assembly and cause damage to components of the hydraulic System. Wear of the packing sets and seals will be evidenced by a decrease in lifting power and/or loss of oil past the packing in the head of each cylinder.

To replace the piston ring seals, and the piston rod wiper seal and/or the piston rod packing in the head assembly of a cylinder, it is necessary to drain the cylinder and remove it from the machine so it can be disassembled. Before installing the packing seals in the cylinder cap assembly or on the piston assembly, inspect the piston rod assembly and the inside of the cylinder for scratches or abrasions. Remove any rough or sharp surfaces before installing new packing or seals. The closer the metal surfaces are to a mirror finish, the more efficiently the packing will operate. If it is not possible to refinish a metal surface that is abraded or scratched, the part should be replaced.

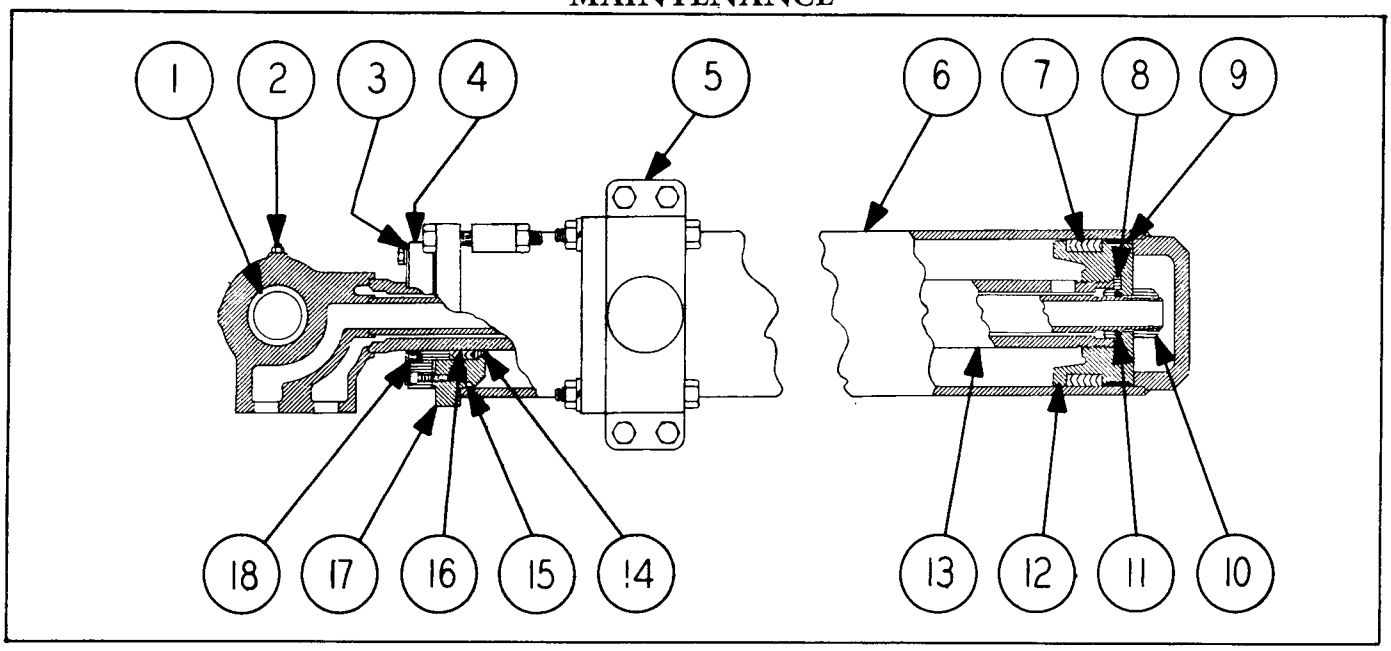
Prior to installing any packing or seals, they should be carefully inspected for nicks, cuts or possible flaws. Do not install faulty packing. Soak the new packing and seal rings in SAE 10 DG oil before installing them in the cylinder assembly so it will not be necessary to stretch them excessively during installation. Press new packing or seal rings into place with a wooden stick having rounded edges and fit the packing in place evenly and snugly without using undue force. Each ring of a packing set should be installed separately. The rings used on the piston are a split type. Make sure the split in these rings is located 180 degrees apart from each other. Use rolled shim stocks over the piston when installing the packing rings, then pull it off the piston after the packing has been put in place. Be sure to seat all packing rings properly.

During assembly of the boom and bucket cylinders, the packing glands in the cylinder caps should be tightened evenly and only enough to prevent leakage of hydraulic oil. A light film of oil, however, should adhere to the piston rods at all times. Packing, which is too tight, will wear out rapidly and possibly abrade the chrome finish on the piston rod assemblies. Adjust for packing wear by removing shims from under the packing gland. Remove only



1. Grease Fitting
2. Piston Head
3. Piston Nut
4. Piston Retainer
5. Bucket Indicator
6. Distributor Tube
7. Backing Ring
8. Cylinder Cap
9. Packing Spacer
10. Seal Retainer
11. Piston Rod
12. Packing Gland
13. Wiper Seal
14. Shim Stock
15. Rod Packing
16. Cap Seal
17. Bucket Cylinder
18. Pressure Barrier
19. Piston Packing
20. Washer
21. Wear Ring
22. Bushing

Figure 26. Bucket Cylinder



1. Bushing
2. Set Screw
3. Retainer
4. Packing Gland
5. Trunnion
6. Boom Cylinder
7. Piston Packing
8. Sleeve Adapter
9. Wear Ring
10. Piston Nut
11. Adapter Seal
12. Piston
13. Piston Rod Assembly
14. Spacer
15. Cap Seal
16. Packing Set
17. Cylinder Cap
18. Wiper Seal

Figure 27. Boom Cylinder

enough shim stock to maintain the proper squeeze on the piston rod packing.

BUCKET CYLINDER REMOVAL AND DISASSEMBLY.

If a bucket cylinder is to be removed from the machine, check that the bucket is resting on the ground and that all hydraulic controls are in "NEUTRAL". It is possible to dismantle the bucket cylinder assembly without removing it from the "PAYLOADER", however, it is recommended that the complete assembly be removed when packing and seals are to be replaced.

After removing the bucket cylinder from the machine, plug the open end of the hoses. Disassemble the bucket cylinder as follows:

a. Remove the position indicator.

b. Remove the capscrew anchoring the retainer pipe to the cylinder and those securing the cylinder cap to the cylinder.

c. Draw the entire piston rod and cap assembly away from the cylinder and remove the piston from the rod. Slide the cylinder cap assembly off the piston rod so it may be disassembled and inspected.

Wash the cylinder in clean solvent and dry with compressed air. Inspect the inside of the cylinder for scratches or pitted areas that would contribute to rapid wear of the piston packing rings. Refinish the inside of the cylinder if such conditions are found or replace the cylinder. The cylinder walls should be kept as smooth as possible. Coat the inside of the cylinder with a film of hydraulic oil and seal all openings to keep dirt out.

Remove the piston ring seals and the piston wear ring. Clean the parts of the piston assembly in clean solvent and dry with compressed air. Do not install new ring seals or the wear ring until the cylinder is ready to be assembled. Keep the parts of the piston in a clean place.

Disassemble the cylinder cap by removing the wiper seal retainer so the packing gland can be removed. After removing the packing gland and shim stock, remove the spacer and rod packing from the cap. Remove the "O" ring from the recess in the cap. Wash all parts of the cap assembly, except the packing and seals, in clean solvent. Clean the cap thoroughly and flush the cap pipe with clean SAE 10 oil.

BUCKET CYLINDER ASSEMBLY.

Begin assembly of the cylinder by inserting the spacer in the cap. Install a new set of rod packing, that has been soaked in oil, in the cap. Check that the packing is free of nicks and flaws and properly installed ("V" shaped rings point toward packing gland). Insert approximately 0.060 inch shim stock between the gland and the cylinder cap before install-

ing the packing gland on the cap. Insert a new wiper seal in the gland. Do not tighten the packing gland screws until after the cylinder cap has been installed on the cylinder.

Place the wiper seal retainer and the cap assembly onto the piston rod. Insert a new "O" ring in the recess on the cylinder cap. Prior to inserting the "O" ring, check that the teflon backing ring is in good condition. If the backing ring is fractured, it should be replaced. Coating the inside of the wiper seal and the packing set will make it easier to install the cap assembly on the rod.

Install the piston ring seals on the piston and assemble the piston on the piston rod. Secure the piston assembly in place with the washer and stop nut. If a 1/4 inch washer is used under the nut, torque the stop nut to 200 - 225 ft. lb. If a 5/16 inch washer is used, torque the nut to 300 - 325 ft. lb.

Coat the piston with a film of oil and insert the piston and rod assembly into the cylinder. Do not damage the piston seal rings when the piston enters the cylinder. It is suggested that shim stock be used to protect the piston packing as it enters the cylinder. Slide the cap assembly into the cylinder and bolt the cap in place. Be sure the "O" ring and the backing ring are in place on the cap and are not damaged when the cylinder cap is installed.

Tighten the packing gland to the cylinder cap in order to seat the packing against the piston rod. Attach the wiper seal retainer to the packing gland. Install the position indicator and secure the cylinder cap pipe to the cylinder.

BOOM CYLINDER REMOVAL AND DISASSEMBLY.

It is necessary to partially raise the boom assembly mechanically in order to remove a boom cylinder from the machine. Therefore, a suitable lifting device, such as a hydraulic jack or a crane and a cylinder support should be available when removing a cylinder. In preparation for removing a boom cylinder, check that the machine's bucket is resting on the ground and that the boom and bucket control levers are in the "NEUTRAL" position. Remove the boom cylinder as follows:

a. Disconnect the hydraulic lines at the cylinder and plug the lines. Raise the boom until the cylinder is at approximately a 40 degree angle to the lower channel of the main frame and allow the cylinder to drain completely.

b. Remove the pivot pin securing the piston rod to the main frame and position the cylinder support. Remove the bolts securing the cylinder to the trunnion and ease the cylinder onto the support. If the cylinder is held fixed by the trunnion, loosen the four bolts that hold the halves of the trunnion together.

c. Disassemble the cylinder assembly by removing the cylinder cap nuts and bolts. Draw the entire piston rod and cap assemblies away from the cylinder and remove the piston retainer sleeve and "O" ring from the rod. Slide the cap assembly off the rod so it may be disassembled and inspected.

Clean and inspect the components of the cylinder assembly as previously described for the bucket cylinder. The piston rod assembly should be flushed with fresh hydraulic oil.

BOOM CYLINDER ASSEMBLY AND INSTALLATION.

The cylinder cap assembly should be put together the same as the bucket cylinder cap. Slide the wiper seal retainer and the cap assembly onto the piston rod. Check the backing ring in the recess of the head and install a new "O" ring. Insert the sleeve adapter and a new "O" ring over the end of the piston rod. Install new ring seals and a new wear ring on the piston and install the piston on the piston rod.

Slide the piston and rod assembly into the cylinder and bolt the cylinder cap to the cylinder. Do not damage the "O" ring and backing ring in the cap. Tighten the packing gland and fasten the wiper seal retainer to the packing gland.

Raise the boom sufficiently to feed the cylinder head through the trunnion. Position the trunnion so its machined surface will mate with the cylinder flange. Slide the cylinder into position and bolt it to the trunnion. Check the tightness of the trunnion clamping bolts. Rotate the trunnion so the piston rod can be pinned to the main frame and connect the hydraulic lines. After connecting the lines, lower the boom until the bucket rests on the ground.

ACCUMULATOR. (Accessory)

Replacement of the accumulator piston seal rings is the only maintenance to be anticipated on the accumulator. Periodic (monthly) checking of the accumulator precharge pressure will indicate if the piston seals are in good condition. Allowing for temperature difference, if any, from time of previous checking, the precharge pressure will rise if oil leaks into the gas end of the accumulator and it will fall if gas leaks into the oil end.

CHECKING. Operate the boom control lever to the "LOWER" or "FLOAT" position and depress the accumulator pedal so all oil in the accumulator can be discharged and the piston will bottom against the hydraulic end cap. Attach a gauge assembly at the accumulator port on the front of the "PAYLOADER" and read the accumulator precharge pressure. Use a wrench to tighten the gauge assembly to the accumulator port. The gauge should indicate between 300 and 400 psi.

If there is a major change in the precharge pressure, the accumulator must be removed from the machine and disassembled so the piston seal rings can be replaced. It is recommended that the seal rings in both end caps be replaced at this time.

Prior to removing the accumulator, check that all oil has been expelled. After the oil is expelled, allow the gas to discharge from the charging port. Remove the valve core to release the gas, do not depress the valve core. Depressing the valve stem to reduce the precharge may cause the rubber valve seat to become damaged by the jet of escaping gas.

TRANSMISSION.

The transmission consists of a four element, single-stage torque converter and planetary and constant-mesh gearing. Depending upon the differences in load conditions and engine power, the torque converter in the transmission acts as either a hydraulic torque multiplier or a fluid coupling. When the loads imposed on the transmission by the axles are high in relation to the developed engine power the converter acts as a torque multiplier. As developed engine power approximates axle loading the converter approaches its fluid coupling stage where practically no torque multiplication takes place. The torque converter also assists in protecting the engine in that it eliminates harmful engine lugging and decreases the amount of shock loading that would normally be imposed on the engine by the axles.

Hydraulically applied clutch assemblies are used to load portions of the planetary gearing. Operation of a clutch piston and a clutch assembly is selected by a spool in the transmission control valve assembly. Two spools are contained in the valve assembly.

Oil used to charge the torque converter, lubricate the transmission and apply the clutch pistons is delivered to the transmission hydraulic system by a gear type pump mounted on the converter end of the transmission converter housing. The pump is spline driven through a gear train by the converter pump assembly.

TRANSMISSION MAINTENANCE.

Most of the transmission maintenance is concerned with oil replenishment and oil cleanliness because the transmission depends upon oil to keep the torque converter charged, lubricate the moving parts of the unit, cool the clutch assemblies and actuate the clutch pistons. The area around the oil filler hole must be clean and any containers used to handle transmission oil must be free of dirt, water and similar harmful foreign matter if satisfactory transmission operation is to be maintained.

The majority of oil used in the transmission is stored in the transfer gear housing sump. Any residue and/or metal particles which are picked up by the oil as it passes through the transmission are deposited in the sump. A wire strainer in the sump keeps most of this sediment in the sump so it will not be recirculated through the transmission. Any sediment that does pass through the strainer is caught by a remote mounted filter.

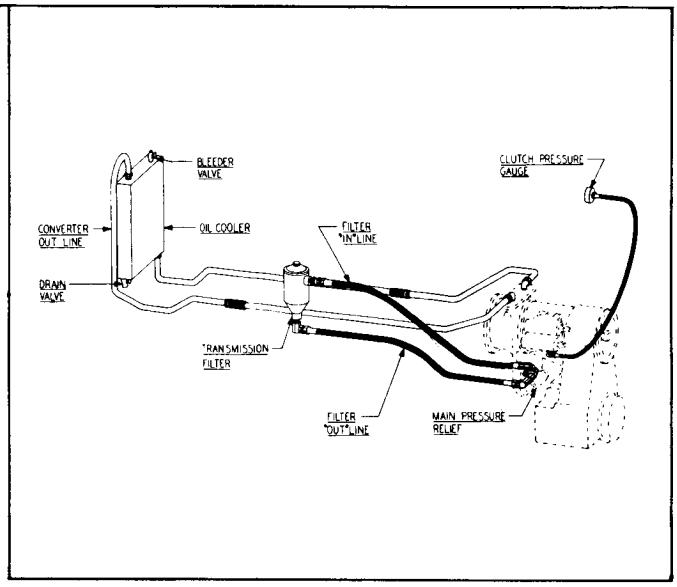


Figure 28. Transmission External Lines

Because these two elements of the hydraulic system protect the transmission from recirculation of contaminated oil, it is important that at each oil change the filter element be replaced with a new one and that the sump strainer be thoroughly cleaned. It is suggested that the filter be checked after 500 hours of operation for oil contamination. Remove any remaining deposits of sediment from the transmission and filter by washing out the sump and the filter case with fresh transmission oil.

Keep the transmission full of oil at all times. Under some working conditions the regular oil level check interval may necessarily be less than the 40-60 hour interval previously suggested in Preventive Maintenance.

Always check the oil level at operating temperature. To perform an accurate check, the engine should be operating and the transmission controls must be in neutral. Prior to making a "HOT" oil check, remove the "FULL" check plug on the side of the transmission. The oil should at least be level with the plug hole before starting the engine.

An oil change interval should be relative to the working condition encountered. The interval suggested in the Preventive Maintenance section is based upon average working conditions. Use Type "C" Hydraulic Transmission fluid which has a high resistance to oxidation and sludging in the transmission. Do not mix the types of oil used.

Air in the transmission oil will cause the oil to foam and decrease the operating efficiency of the transmission. Regular, periodic checking of the oil line connections will minimize the possibility of air being sucked into the transmission.

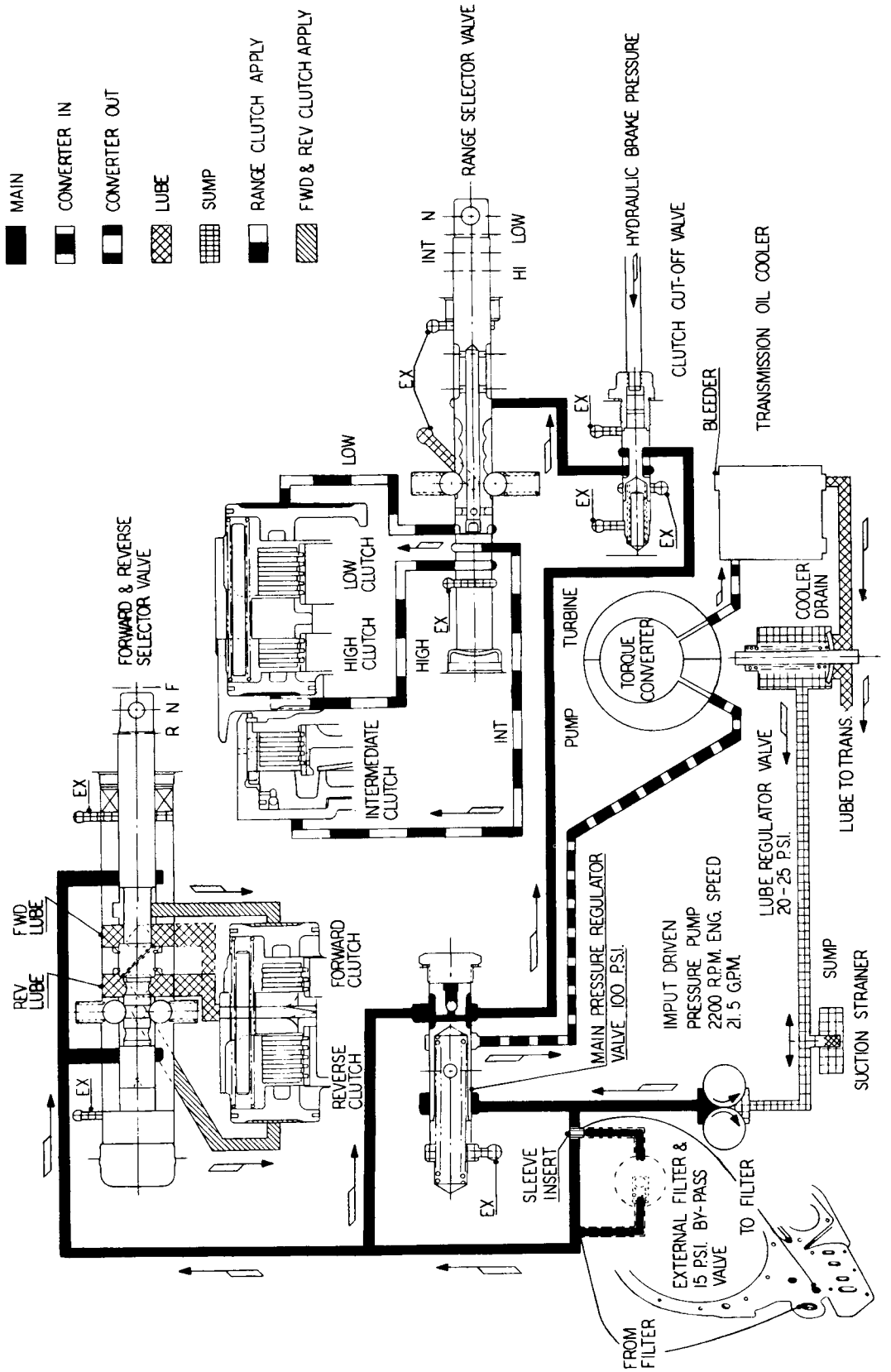


Figure 29. Transmission Flow Diagram

CONVERTER STALL CHECK.

The following dash gauge readings indicate normal engine converter operation under stall conditions:

Engine Temperature	175-180° F
Transmission Temperature	180-235° F
Transmission Clutch Pressure	110-125 psi

Engine speed during the stall check should be checked as accurately as possible so the results of the check can be analyzed correctly and proper preventive maintenance measures taken if necessary. Perform the stall check as follows:

a. Check that all controls are in neutral. Start the engine and allow it to idle until the engine temperature is approximately 165° F.

b. Apply the hand brake and block the wheels. Do not operate the foot brake.

c. Shift the transmission into high, forward and gradually increase the engine speed to full throttle. Do not permit the transmission temperature to exceed 250° F.

Record the engine speed, transmission oil temperature and clutch pressure. Operate the transmission to neutral and decrease engine speed. The engive stall speed should approximate 2200 rpm. Maximum no-load engine speed should approximate 2300 rpm.

The transmission converter and the engine are connected by a drive shaft and act as a unit in the power train. Performance of the engine or the torque converter assembly can be partially checked by stalling the converter output while the engine is operated at full throttle. It is suggested that a stall check of the engine-converter combination be performed regularly at the monthly preventive maintenance interval.

The results of each stall check should be analized so that improper performance of the engine-converter combination can be isolated to a component of the combination and corrected. Improper performance will be indicated by an engine speed that is either above or below the normal stall speed.

If the engine stall speed is below 2200 rpm, the engine, the transmission torque converter or both may not be performing properly. A decrease of approximately 150 rpm below the normal stall speed indicates that probably the engine needs servicing.

Check that the engine's air system is clean and free of obstructions that would decrease the normal supply of air to the engine combustion chambers. Other causes for low engine power are incorrect adjustment of the throttle linkage, improper combustion or excessive blow-by. If the "PAYLOADER" unit is powered by a gasoline engine, low engine stall speed may be caused by a defective ignition system.

A converter failure of some type is indicated when the engine speed is 300-400 rpm below normal stall speed. Check the transmission sump for metal particles whenever a converter failure is suspected.

If the engine speed at stall should be above 2200 rpm, check for a low oil level or oil leaks at the external transmission lines. Check that the sump screen is not clogged. It may also be necessary to remove the main pressure and the lube pressure regulators to ensure they are operating properly.

CHECK FOR LOCKED STATORS.

Upon completing the stall check, stall the converter again until the transmission temperature reaches 230° F. Shift the transmission to neutral and momentarily release the throttle. Check the rate of temperature drop immediately. The temperature should start to drop after 15 seconds. If the temperature drop rate is slow, either one or both stators may be locked. Normal stator operation is indicated by a rapid temperature drop.

SERVICING THE TRANSMISSION.

Use the applicable Allison Service Manual to obtain more detailed information concerning operating principles of the transmission and complete preventive maintenance procedures. If transmission trouble is encountered, it is suggested that a "PAYLOADER" dealer of THE FRANK G. HOUGH CO. be contacted so a complete analysis of the transmission can be made.

TRANSMISSION OIL COOLER.

The transmission oil from the torque converter is cooled before it enters the sump in an externally mounted heat exchanger, on the rear of the engine radiator. In order to operate efficiently, the air fins of the cooler must be clean and straight and the air passages unobstructed. Flying dust, sand, grass, leaves, and other debris may clog the air passages in a short period of time. Air fins are easily bent and damaged by the impact of small stones and from other accidental causes. Therefore, constant attention to the condition of all air passages and restrictions is required to avoid the danger of overheating. In extreme cases, cleaning may be required daily or oftener.

BRAKE SYSTEM.

The brake system (figure 30) is vacuum assisted and hydraulically operated. Each wheel brake is a floating shoe hydraulic brake. Actuation permits the shoes to center themselves in the drum with equal effectiveness in either direction. The hydraulic pressure developed by physical application of the master brake cylinder is increased by the action of a hydrovac unit in the system. The increased pressure

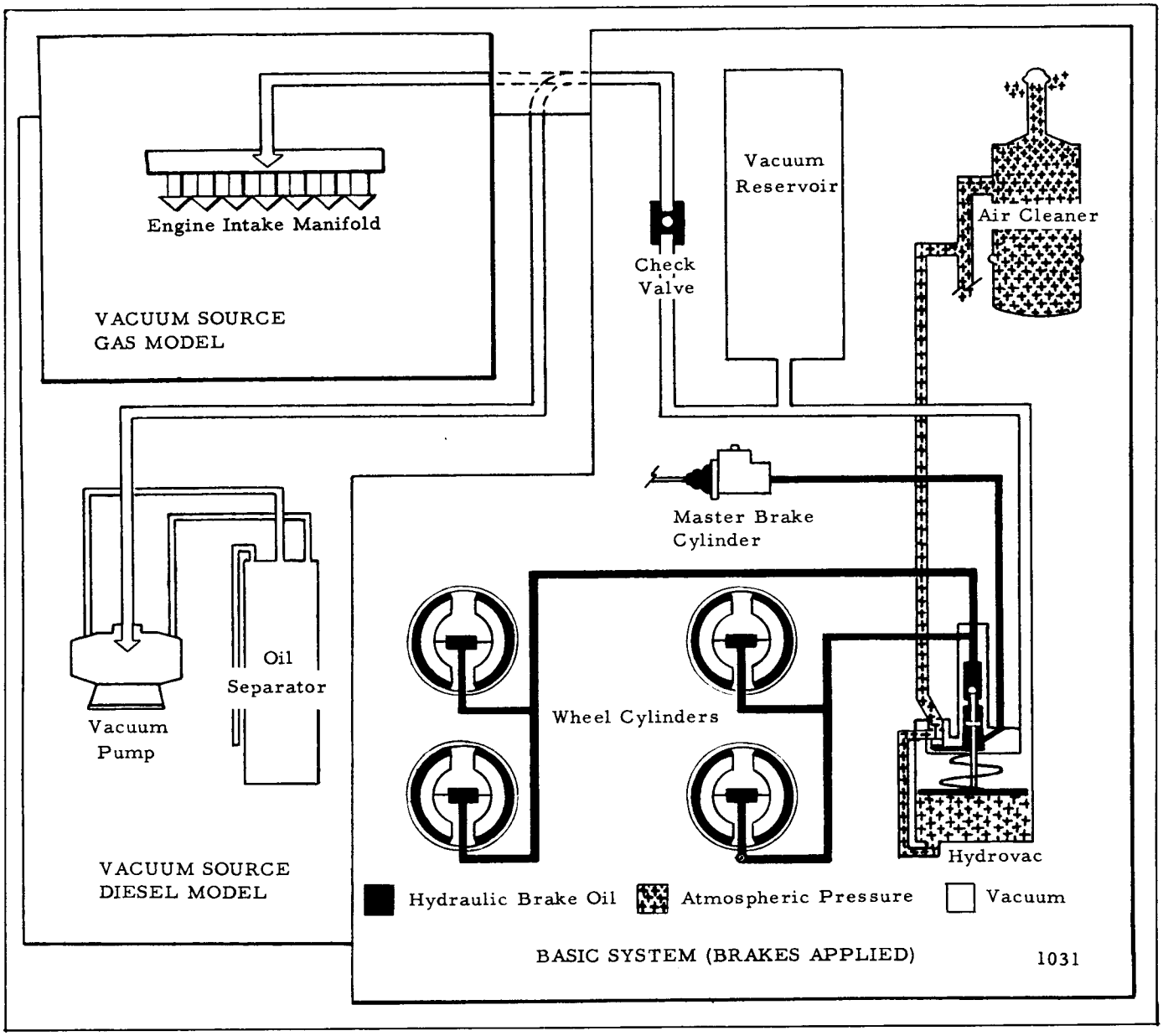


Figure 30. Brake System Diagram

is used to apply the wheel cylinders. A vacuum reservoir is included in the brake system so that in the event the engine should stall, the reservoir will provide enough vacuum to make at least five power brake stops possible. Construction of the hydrovac unit is such that when no vacuum is available, the brakes will function as in a conventional brake system.

Periodically check the lines, the cut-off valve assembly at the transmission and adjust the components of the brake system. Whenever air gets into the system through a leak or a loose connection, full braking power is not available and it is necessary to bleed the system. The hydraulic brake system should be free of air at all times. Keep the brake shoes properly adjusted to maintain satisfactory operation and maximum safety. Brake adjustments should provide uniform clearance between the linings and the brake drums.

BRAKE CARE.

The brakes should be cleaned, inspected, lubricated and adjusted each time the hubs are removed. During a major overhaul, the following parts should be carefully checked and replaced if necessary:

a. Check the backing plates of the front wheels for distortion and for loose or sheared rivets.

b. The anchor pins should be checked for excessive wear or misalignment.

c. Check the shoes for wear at the anchor pin holes and at the cam contact areas.

d. Check the cylinder boots for cracks or signs of deterioration.

e. All shoe return springs should be replaced at the time of overhaul.

f. Check all linings for grease saturation, wear and loose rivets. Do not allow the linings to wear to the point that the rivets are flush with the lining surface.

g. Inspect the brake drums for cracks, scoring or other damage. If the drums are badly scored, it is not recommended that they be rebored. Excessive reboring will reduce the strength of the refaced drum and give the brake assembly only a limited amount of additional service life.

h. Check that dust shields (if provided) are in good condition.

i. Check the inlet port and the bleeder screw for damaged fittings and leaks.

Prior to reassembling the brake, lubricate all the bearing surfaces on the shoes with a high temperature, water resistant, fibrous grease. Do not over-lubricate.

BRAKE SYSTEM CHECKS. If the foot pedals fall away very slowly from the foot upon application, the brake system has developed a hydraulic leak. Check the basic hydraulic system by passing the hydraulic line from the master cylinder past the hydrovac unit and re-bleed the system if necessary. Apply brake pedal firmly and check for a leak in the basic system. If the pedals fall away, inspect all hydraulic lines and fittings until the leak is located. After checking the basic brake system, reconnect the hydraulic lines to the hydrovac unit and re-bleed the system.

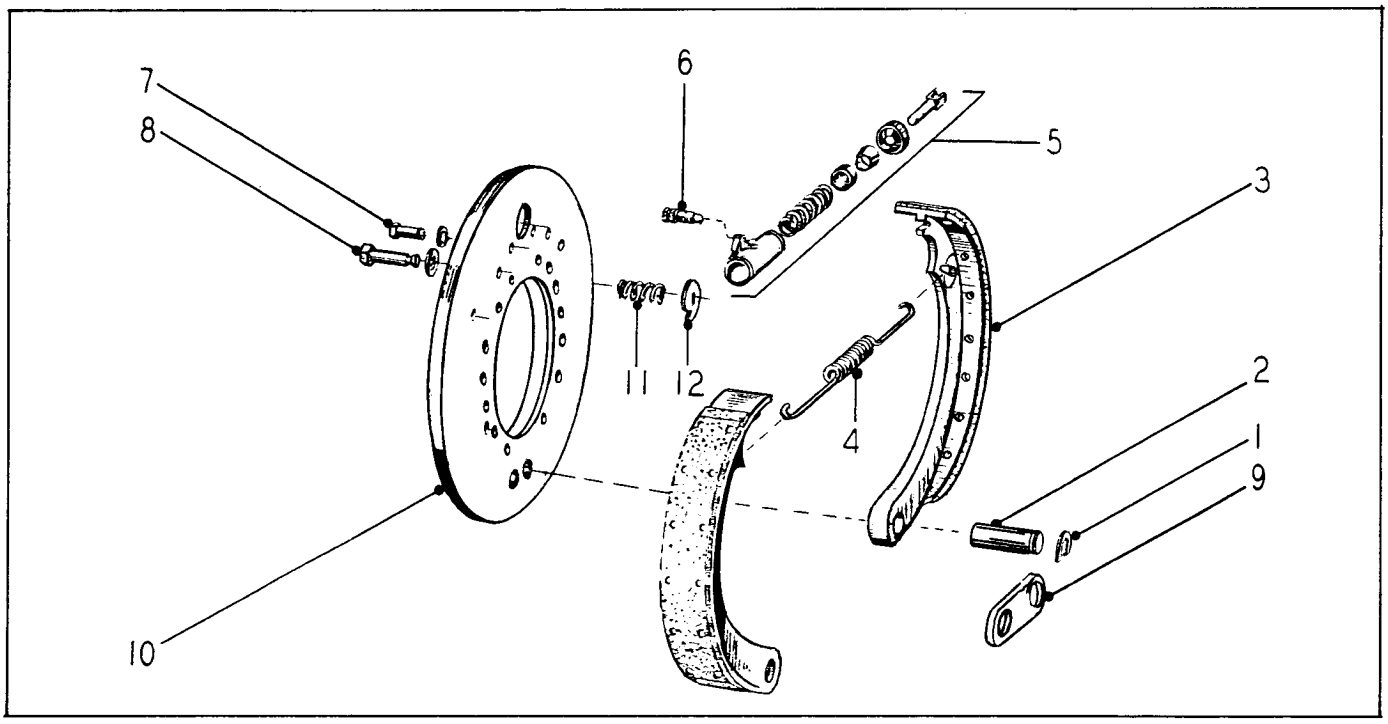
With the engine running, apply the brake pedal again. If it moves slowly toward the floor while maintaining a constant foot pedal pressure, hydraulic leakage within the hydrovac unit is apparent. If a pedal "return movement" or "kick-back" is felt, a leak past the hydraulic piston in the slave cylinder is indicated and is caused by a faulty piston cup or piston ball check valve. Remove a defective hydrovac unit and service or replace it with a new unit.

CHECK VACUUM.

Check the source of vacuum used to operate the hydrovac unit and the vacuum check valve by disconnecting the vacuum line at the vacuum check valve on the end of the valve nearest the vacuum reservoir. Connect a vacuum gauge to the check valve opening. Start the engine and run it at idle speed for at least a minute, then note the gauge reading.

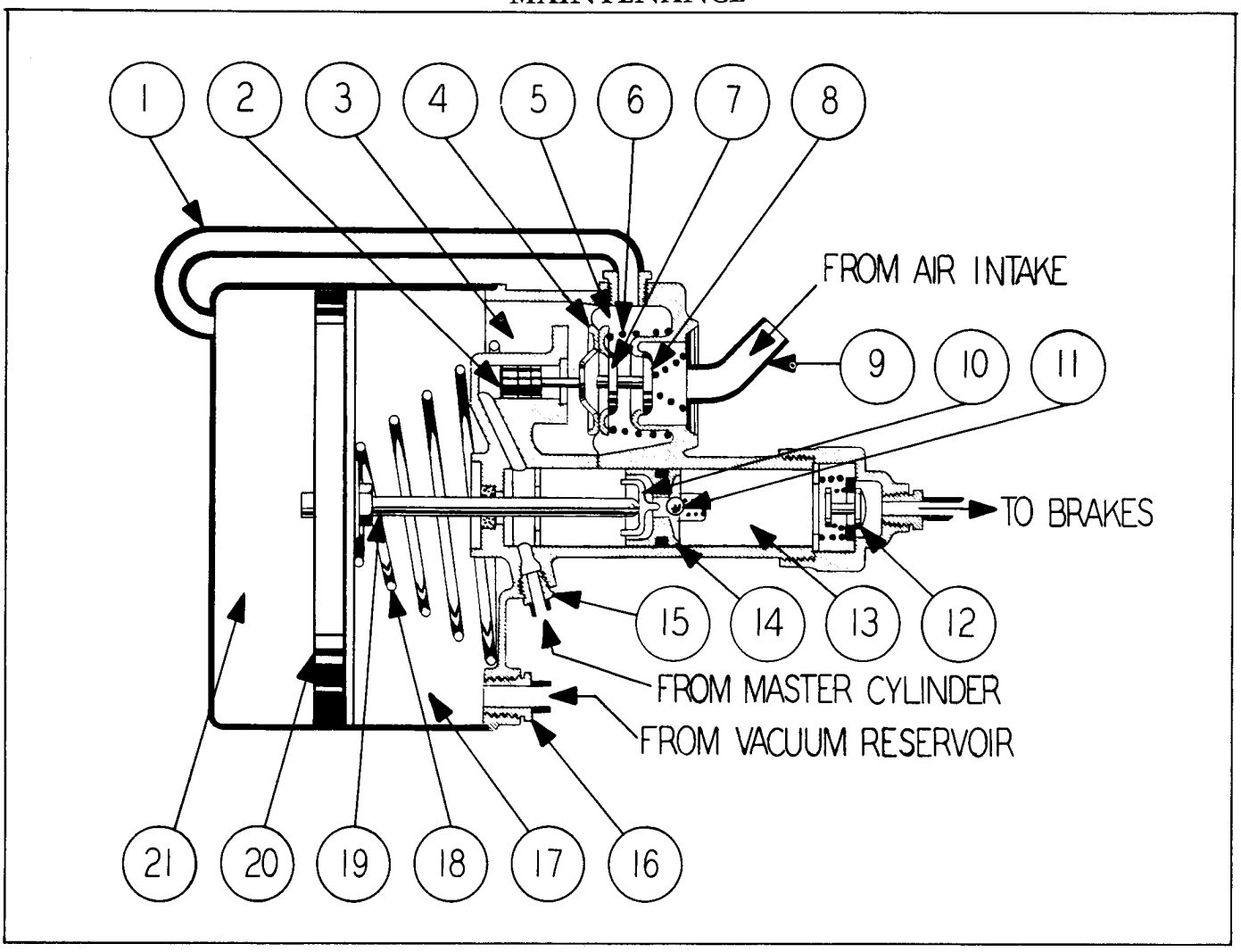
If the gauge registers less than 16 inches of mercury vacuum, inspect the connections to the vacuum source and check valve for restriction or obstruction. If the engine intake manifold is the vacuum source, the engine may require servicing.

Stop the engine and observe the rate of vacuum drop. If the vacuum is exhausted at a rate greater than one inch of mercury in 15 seconds, a leak past the check valve is indicated. Service or replace the valve. Remove the vacuum gauge from the check valve and connect the vacuum line to the valve.



1. Anchor Pin "C" Washer
2. Brake Shoe Anchor Pin
3. Brake Shoe & Lining
4. Brake Shoe Return Spring
5. Wheel Cylinder Assembly
6. Bleeder Screw
7. Cylinder Mounting Screw
8. Adj. Cam Bolt Assembly
9. Anchor Pin Link
10. Spider-Brake Assembly
11. Cam Spring
12. Adjusting Cam

Figure 31. Front Brake Assembly



1. Control Tube
2. Valve Piston
3. Valve Chamber
4. Diaphragm
5. Valve Chamber
6. Diaphragm Spring
7. Vacuum Poppet
8. Atmosphere Poppet
9. Atmosphere Tube
10. Yoke
11. Check Valve
12. Residual Pressure Check
13. Slave Cylinder Chamber
14. Hydraulic Piston
15. Hydraulic Port
16. Vacuum Reservoir
17. Right Cylinder Chamber
18. Return Spring
19. Piston Rod
20. Power Piston
21. Cylinder Chamber

Figure 32. Hydrovac Diagram

ADJUST BRAKE PEDAL "FREE-PLAY".

The amount of brake pedal "free-play" at the beginning of pedal travel must be adjusted whenever any repairs have been made to the pedal linkage or parts are replaced in the master brake cylinder. Free pedal play is the amount of pedal travel that takes place before the operating rod of the master cylinder engages the hydraulic plunger in the cylinder. Lack of "free-play" may cause brake shoe drag and rapid wearing of the brake linings.

Adjust the brake pedal assembly to obtain the proper amount of "free-play" by loosening the lock nuts on the master cylinder operating rod and adjusting the rod to obtain 1/8 to 3/16 inch play between the end of the operating rod and the hydraulic plunger in the master cylinder. After making the adjustment, flip the pedal lightly by hand several times to ensure that proper clearance exists between the rod and plunger. When the proper adjustment has been made, tighten the locknuts.

Check the pedal return spring tension frequently to make sure it is strong enough to keep the weight of the pedal assembly from closing the clearance between the end of the operating rod and the plunger in the master cylinder.

ADJUST WHEEL BRAKES.

The brake linings and drums are subject to a great deal of wear. To compensate for this wear, the brakes should be adjusted as frequently as required to keep a good pedal reserve. Adjust the brakes when

new shoe linings are installed or when the brake pedals can be depressed to within 2 inches of the floorboard upon hard application. Before making brake adjustments, check that the wheel bearings are properly adjusted.

The wheel brakes on the front axle are adjusted from the back face of the backing plate. Prior to adjusting the brakes, lift the front of the tractor to permit hand rotation of the wheels.

Each brake shoe must be adjusted to keep the brake shoe arc centered with relation to the brake drum. Adjustment of the brakes is accomplished by turning the brake cam bolts to bring the brake linings out against the brake drum until a slight drag can be felt when the wheel is rotated. While adjusting each brake shoe, rotate the wheel in the direction which makes the shoe being adjusted forward acting. Adjust each brake set when the brake drum is cool. After setting each shoe, back off the cam bolt slightly to permit free wheel rotation.

In preparation for adjusting the rear wheel brakes, lift the rear of the "PAYLOADER" unit. Adjust one shoe at a time. Turn the cam to bring the brake lining into contact with the drum. Then rotate the anchor pin sufficiently to relieve drag on the drum. Continue alternately adjusting the cam and backing off the anchor pin until additional rotation of the anchor pin will no longer relieve the drag. Tighten the anchor pin lock nut to fix the pin adjustment and back off the cam sufficiently to permit free wheel rotation.

Subsequent adjustments to allow for lining wear are made at the eccentric cam only. Turn the cam to bring the brake lining into contact with the drum. Then back off sufficiently to permit the drum to roll freely. Make this adjustment on both shoes of each wheel.

BLEEDING THE BRAKES.

The hydraulic brake system must be "bled" whenever air is introduced into the system. Air is most likely to enter the brake system through a leak, when a line is disconnected or when there is an insufficient amount of brake fluid in the system. Should the brake system loose fluid and no external leakage is evident, check that the transmission cutoff valve cup is properly positioned.

Pressure bleeding of the brake system is preferable, but since bleeder tanks are not always available, the system can be manually bled. The engine should be off and the brakes completely released before brake bleeding operations are started. Apply the brakes several times so all vacuum will be destroyed in the hydrovac system. The proper sequence for bleeding the system is to start at the master cylinder and then bleed the hydrovac unit, rear wheels, transmission cutoff valve and the front wheels in succession.

The following general procedure may be followed:

a. Clean accumulations of dirt from around the cap of the master cylinder reservoir, remove the cap and fill the reservoir to within about 1/2 inch of the filler hole with clean brake fluid. Keep the reservoir filled with fluid during bleeding operation.

b. Install a bleeder hose, if available, on the bleeder screw in the valve cover of the hydrovac unit. Have the loose end of the bleeder hose submerged in brake fluid in a glass jar.

c. Open the bleeder screw one turn and slowly depress the left brake pedal to limit of stroke. Repeat until no bubbles escape from the bleeder hose, then close the bleeder screw.

d. Repeat the bleeding procedure described in steps b. and c. at each bleeder screw, taking them in proper rotation (hydrovac slave cylinder, rear wheels, transmission cutoff valve then front wheels).

Check the fluid level in the reservoir periodically. It must be kept at least half full of fluid at all times, otherwise air will enter the system and make rebleeding necessary. After bleeding the system, make sure the master cylinder is filled to within 1/2 to 3/8 inch of the filler hole.

FLUSHING THE BRAKE SYSTEM.

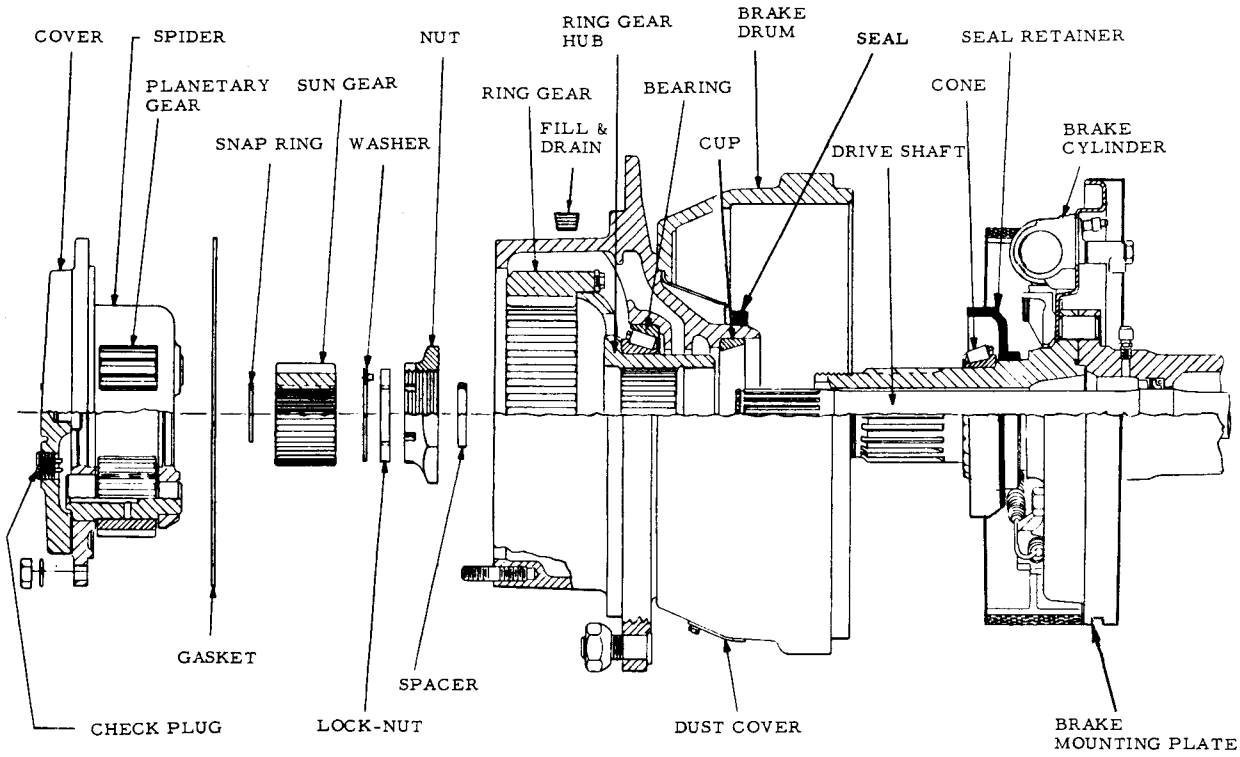
Brake fluid should be changed if, in comparison to fresh fluid, it appears materially darker in color, watery in consistency, comparatively odorless or lacks a thin lubricating film when rubbed between the fingers. Drain the system by opening the bleeder screw at each rear wheel and pumping the brake pedal slowly until fluid is no longer forced from the screw. Next drain the line to the transmission cutoff valve, then the front wheel lines and finally the hydrovac lines.

Before refilling with new fluid, thoroughly flush the hydraulic system with clean denatured alcohol. Do not use fluids for this purpose that contain mineral oil, kerosene, gasoline, carbon tetrachloride, etc. Even traces of these agents in the system will cause rubber parts to swell and soften.

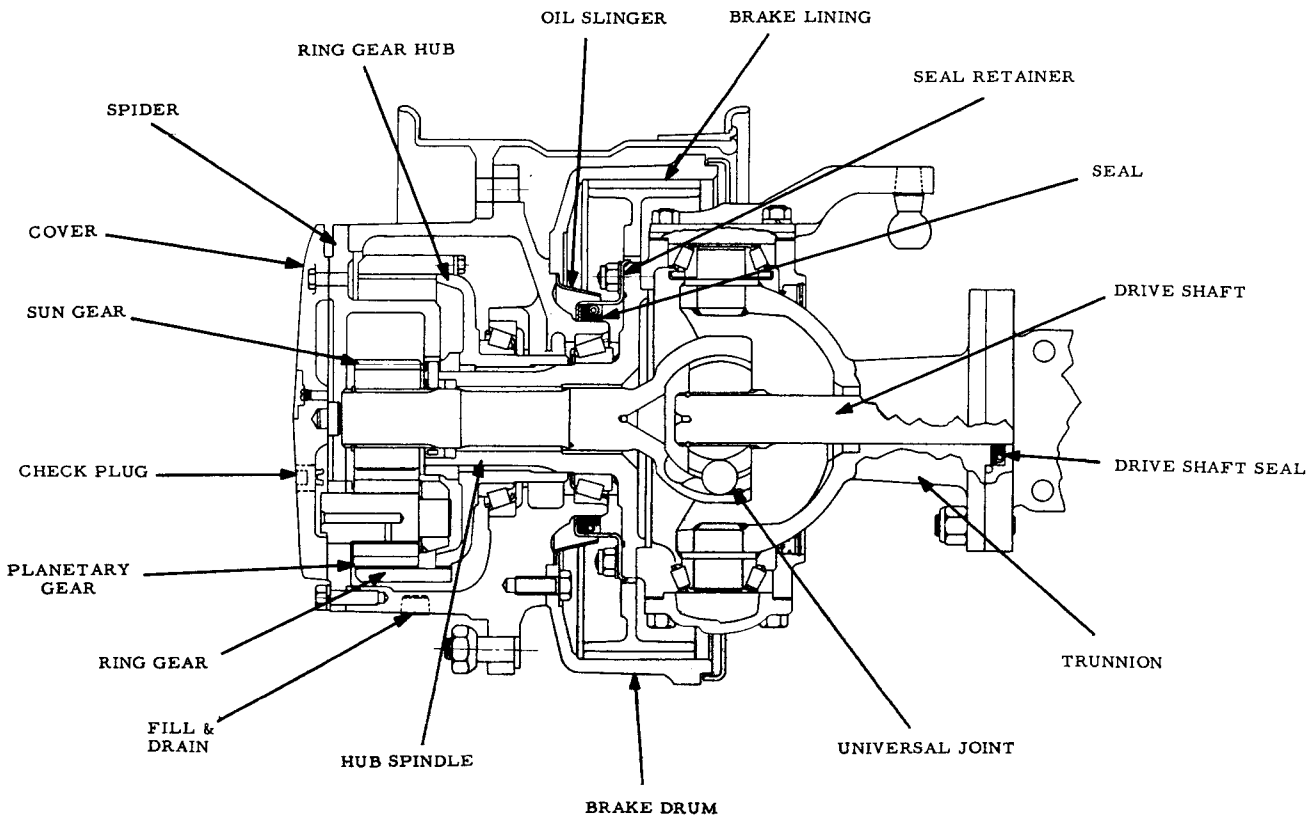
To flush, remove the master cylinder filler cap and fill the reservoir with a flushing agent. As in draining, open each bleeder screw in turn and pump the brake pedal slowly until the passage of clean fluid indicates a clean system. After flushing, repeat the process with clean brake fluid to force all of the flushing agent from the system. Fill the master cylinder with brake fluid to the proper level (1/2 to 3/8 inch of reservoir top) and bleed the brake system as previously described.

PARKING BRAKE ADJUSTMENT.

The parking brake is mechanically operated from



FRONT AXLE



REAR AXLE

Figure 33. Planetary Drives

the operator's compartment. Minor adjustments should be made frequently by turning the cap on the brake handle. After several adjustments have been made at the brake lever cap, the adjusting device should be backed off completely and the control rods at the brake shoe on the transmission output shaft should be adjusted to take up the slack. Adjustments made at the brake handle are for minor adjustments only.

DRIVE AXLES.

Both axles of the "PAYLOADER" unit employ a heavy duty hypoid pinion and bevel gear for a first reduction and planetary gear sets in each wheel hub for a second reduction. The gear reduction at the wheel hubs makes it possible to transmit maximum power to the tires of all four wheels with a minimum amount of strain on the axle shafts and differential assemblies.

The front axle is considered the primary driving axle since it is always operative when the transmission is engaged. The rear axle is the steering axle and can be disconnected from the transmission output.

Under normal operation, parts of the axle such as seals and brake linings are subject to wear and will require periodic inspection. To inspect wheel hub parts or the brake shoes, it is necessary to remove the hub and brake drum assembly. Should it be necessary to inspect or replace parts in the differential assemblies, it is recommended that the services of a trained mechanic be obtained through a dealer of THE FRANK G. HOUGH CO.

WHEEL HUB AND BRAKE DRUM REMOVAL.

Prior to removing the wheel hub, engage the rear steering axle and set the parking brake. Remove the tires and rims after jacking up the "PAYLOADER" unit. Place the jack near the axle housing and directly under the main frame channel.

Remove the cover and spider assembly so the sun gear can be removed. Remove the sun gear snap ring and pull the sun gear and the thrust washer from the axle shaft. Remove the nut lock and hub nut. The hub and brake drum assembly can now be removed from the wheel spindle. Pull the assembly away from the axle in a straight line so the hub seal retainer and the inner wheel bearing are not damaged. Remove the hub oil seal from its retainer and the sleeve from the spindle.

CLEANING AND INSPECTION. Clean all parts removed from the planetary hub in a clean solvent and dry with compressed air. Examine the wheel bearing cups and rollers for ridges or signs of pitting. Check that the thrust end of the rollers is not excessively worn. Inspect the teeth of the planetary system for cracks, chips or scoring and check the brake drum for a runout that is true within 0.010 inch of the total indicator reading. If the drums are scored, they should be resurfaced or replaced. Check that the brake linings are not oil soaked or glazed and have not been worn to the extent that the lining rivets are exposed to the inner surface of the drum. Check that drum bolts are tight.

WHEEL HUB AND BRAKE DRUM INSTALLATION.

Assembly and installation of the hub is essentially the reverse of the removal procedure. Prior to installing the hub assembly on the spindle, insert a new seal in the hub seal retainer and apply a coating of oil on the inner and outer wheel bearing cones and the spindle. Slide the hub assembly onto the spindle and install the spindle sleeve.

Thread the hub nut on the spindle and draw it up tight enough to produce a slight wheel drag. Back the nut off slightly until the notches in the head of the nut coincide with the recesses in the spindle and install the nut locks. It may be necessary to repeat this procedure several times to obtain the correct wheel bearing adjustment. The setting is correct when there is no end play and only a slight bearing drag.

Install the sun gear thrust washer and the sun gear on the axle and secure them in position with a snap ring. Mount the hub gasket on the hub and install the planetary spider assembly. Complete the assembly by filling the housing with SAE 90 EP oil to the level of the check plug located in the hub cover.

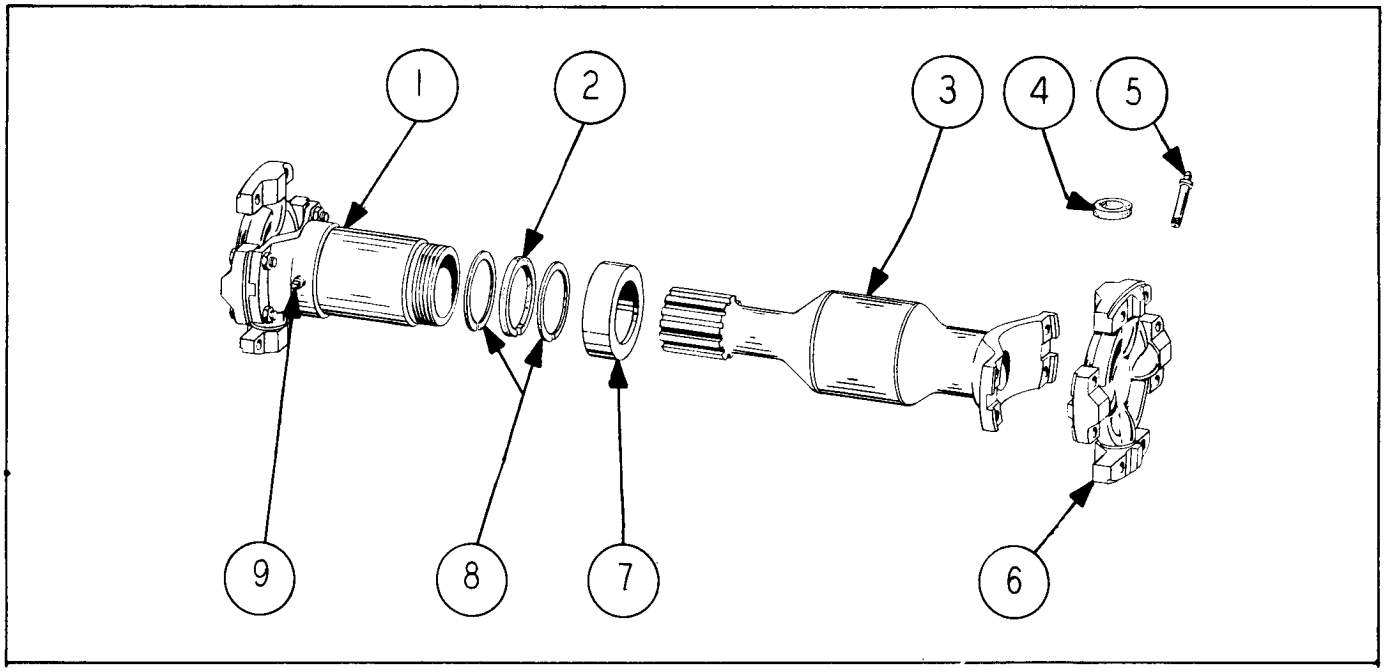
DRIVE SHAFTS.

The axles undergo considerable vertical movement because of surface irregularities and varying axle loadings during normal "PAYLOADER" operation. Each time these conditions are encountered, a proportional change in the overall length of the drive shaft assemblies takes place.

The drive shaft slip joint accommodates these variations in length by telescoping in order to eliminate the forces of tension and compression that would be present in a drive shaft without a slip joint. Failure to lubricate the drive shaft slip joints as recommended will produce galling and eventual seizure of the joint and the drive shaft assemblies, which for all practical purposes, will become a solid shaft.

Under these conditions, the tension and compression forces imposed on the drive shafts will be transferred to the differentials, universal joints and the transmission where serious damage could be caused to the bearings and gears.

The universal bearings and the shaft slip joint should be thoroughly cleaned and inspected whenever the "PAYLOADER" unit undergoes a general overhaul. If upon inspection of the slip joint it is found to be tight or there are indications of slight galling at the splines, they should be lapped with a fine valve



1. Slip Yoke Assembly
2. Felt Washer
3. Stub Shaft
4. Cork Washer
5. Grease Fitting
6. Spider and Bearing Assembly
7. Retainer
8. Retainer Washer
9. Lube Plug

Figure 34. Drive Shaft

grinding compound and oil. Nicks and burrs should be removed with a stone. If galling is severe, the assembly should be replaced.

The joint should be a smooth, free fit. Test the fit by lifting the drive shaft by one end. If the slip joint comes apart of its own weight without any resistance when the shaft is in a vertical position, the joint is a free fit and suitable for further service.

DRIVE LINE NOISE.

Two general types of noise originate in the axles and drive line transmitting systems. One is caused by axle drive units and may be due to slight changes in gear set tooth contactor bearing adjustment. The other noise is caused by universal joint and drive shaft assemblies. Drive shaft noise may arise from universal flange or yoke misalignment, out of balance parking brake drum, out of balance drive shaft assemblies or the universal joint cross assemblies may not be parallel to each other.

When axle gear and bearing noise exists, it is usually present throughout the vehicle's speed range. Noise or vibration caused by universal joints and drive shaft assemblies is evident only at certain speeds and generally comes and goes as these critical vibration speeds are encountered.

When drive shaft assembly noise becomes excessive, it is accompanied with extreme vibration that can be felt throughout the chassis, principally at the steering wheel. If left unchecked, this vibration may cause axle pinion bearing failure.

The most common causes of drive shaft vibration are:

a. Universal joint flange or yoke misalignment.

b. Parking brake disc or drum out of balance.

c. Drive shaft assembly out of balance.

d. Excessive flange runout or distorted yokes.

e. Loose flange or yoke nut.

TIRES.

The H-90 "PAYLOADER" unit is equipped with four 16.00 x 24, 12 ply rated tires as standard equipment. Under normal working conditions, all the tires should be inflated to 45 psi. If the machine is to encounter near maximum rated loads during the majority of its working time or is operated on a hard, dry footing, the tire pressure may be increased by 5 psi. To obtain the most effective traction and adequate flotation in a very soft footing, the pressure may be decreased by a much as 10 psi.

CAUTION

Never operate the loader on a hard footing with tires that are not properly inflated.

Alternate tires may be used that will adapt the loader to special working conditions. The Alternate Tire Table below lists the tire sizes that can be used and the pressure to which they should be inflated for proper flotation under normal working conditions.

TABLE V
ALTERNATE TIRES

TIRE SIZE	PLY RATING	PRESSURE
16.00 x 24	16	40
14.00 x 24	16	40
14.00 x 24	12	50

STEERING SYSTEM.

The steering system is comprised of a conventional steering gear of the cam and lever type to which has been added a hydraulic control valve; steering booster cylinders; a hydraulic pump; and the steering linkage and hydraulic lines. All principal adjustments to the system are made at the steering gear.

The action provided by the steering gear assembly is both mechanical and hydraulic in effect. As the steering wheel is turned, it rotates the steering cam which causes the stud, riding in the cam groove, to move. This movement is transmitted through a steering lever assembly to the steering arm which is connected to a drag link. Movement of the drag link produces a corresponding mechanical movement of the steering linkage.

The hydraulic control action of the steering gear assembly is accomplished when the effort exerted on the steering cam exceeds the preload pressure on the centering plunger springs on the end of the cam shaft. This causes the valve spool to move axially away from its neutral position. When no load is exerted on the steering cam, the valve spool is held in neutral by the springs and the force exerted by the flow of oil through the valve assembly.

In the neutral position, the flow of oil from the system pump passes around the valve spool and is channeled through two large ports that join at the outlet port of the control valve assembly. The oil is then directed to the hydraulic reservoir.

Axial movement of the valve spool opens one cylinder port in the assembly to the flow of oil from the pump and opens the other cylinder port in the assembly to the valve assembly outlet. Oil from the system pump is then directed to one side of each booster cylinder piston while the oil on the opposite side of the cylinder pistons is free to exhaust through the outlet port of the valve assembly.

The immediate effect is high hydraulic pressure on one side of the booster piston which is transmitted through the booster piston rod to the steering arm on the wheel hubs. Full hydraulic pressure at the booster cylinders is obtained by the slightest axial movement of the spool in the steering control valve assembly. Whenever the effort on the steering gear cam is less than the preload pressure of the centering springs, the valve spool remains in neutral and the action of the steering system is manual in effect.

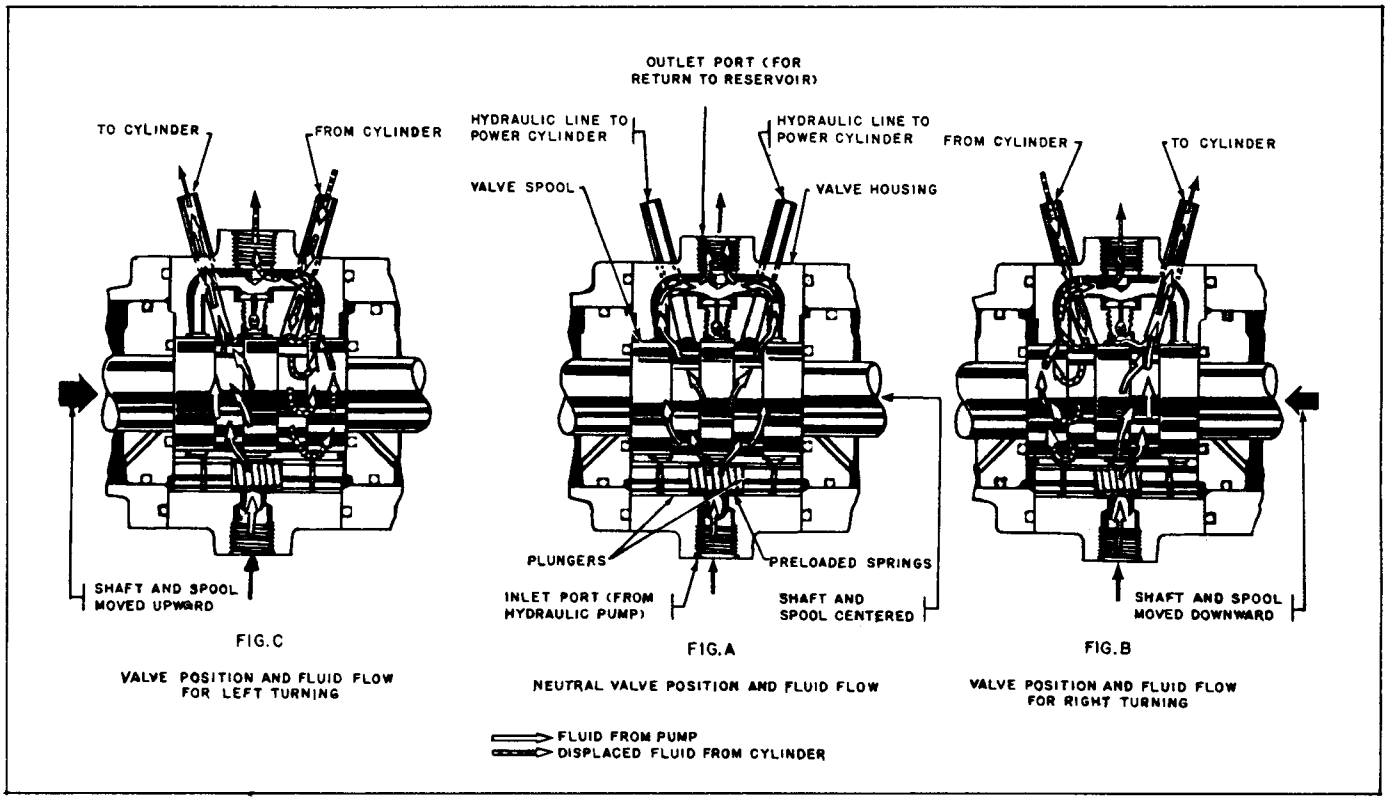


Figure 35. Hydraulic Steering Valve Flow Diagram

Should the steering wheels encounter shock loads that would tend to turn the wheels, the force acts against the linkage and steering cam which in turn causes the starting control valve spool to move axially so hydraulic pressure will resist such force. This blocking action prevents kickbacks at the steering wheel.

The pressure in the hydraulic portion of the steering system is regulated by an adjustable relief valve mounted in the relief valve block assembly. On the top of the block is a 1/4 inch plug which can be removed to accommodate the installation of a pressure gauge for testing purposes. Ports are also provided in the block valve to direct oil flow to and from the steering control.

STEERING ADJUSTMENTS.

The steering gear and control valve will seldom need adjustment in the field. Should field adjustment be necessary, it is recommended that these adjustments be limited to checking the steering lever shaft stud clearance in the steering cam groove. To make additional gear adjustments, the steering unit should be removed from the loader.

Prior to making any steering gear adjustments, the gear should be freed of all external loading by disconnecting the drag link from the steering gear pitman arm and unfastening the column tube at the dash panel support.

CAM AND STUD ADJUSTMENT. The cam and stud adjustment is made with the stud at the mid-position of the cam. The cam groove is cut shallower and is, therefore, narrower at the middle of the steering cam. The purpose of the shallow, narrow cut at the mid-position of the cam is to provide minimum clearance between the stud and the cam at the point on the cam where straight ahead driving action usually takes place. This type of steering cam design also makes it possible to obtain close cam adjustment after normal wear occurs without causing the steering gear to bind at some other point.

Turn the steering wheel to its mid-position before adjusting the side cover screw. The mid-position can be located by turning the steering wheel half the number of turns required for full travel of the stud in the steering cam.

Determine the stud position by first turning the steering wheel all the way in one direction and then count the number of turns required to turn the wheel all the way in the opposite direction. Turn the wheel back half the number of turns and the stud should be at the mid-point on the steering cam.

Loosen the adjusting screw locknut and turn it in until a slight drag can be felt at the steering wheel as the wheel turns the cam through its mid-position. After obtaining the proper adjustment, hold the position of the adjusting screw and tighten the jam nut.

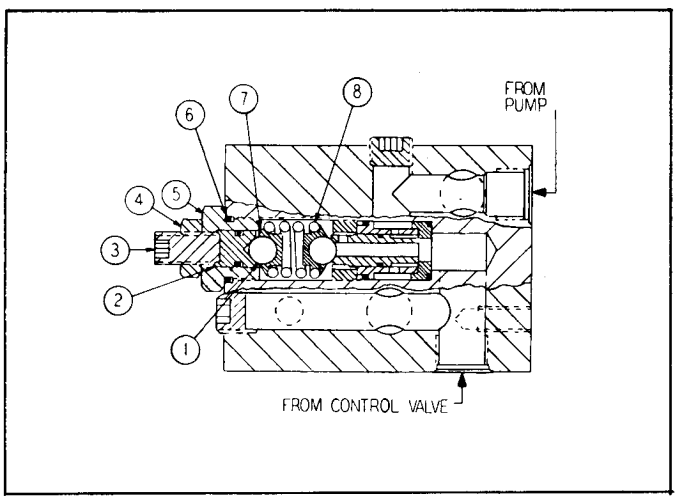
Check the cam adjustment through its full travel. Very little or no drag should be felt in the end cam positions. Resistance at the cam mid-position should be very slight.

Place the steering wheels in the straight ahead position and the steering gear in its mid-position. The ball on the steering pitman arm should line up, or nearly so, with the ball socket of the drag link. If necessary, the steering arm can be shifted on the splines of the lever shaft to change the ball position. Check the tightness of the steering gear mounting bolts after the gear has been properly adjusted.

RELIEF VALVE ADJUSTMENT. The hydraulic portion of the steering system is regulated by an adjustable relief valve that should be set at 1000 psi. The valve setting can be checked with the aid of a 3000 psi reading hydraulic gauge.

The valve is located near the end of the steering column under the floorboard. Remove the 1/4 inch socket head plug in the top of the valve and insert the hydraulic gauge. Check that the gauge face is visable from the operator's compartment through the openings in the floorboard. Before checking the valve setting, make sure the boom is fully lowered and the bucket cutting edge is resting on the ground. With the parking brake set and the transmission and hydraulic controls in neutral, start the engine and allow it to run at idling speed for a few minutes.

When the engine has warmed up and is running regularly, increase the engine speed slightly and turn the steering wheel back and forth. The pressure gauge should indicate approximately 1000 psi. If the valve is not properly set, loosen the lock nut on the valve adjusting screw and turn the screw until the proper setting is obtained.



1. Relief Ball
2. Piston
3. Adjusting Screw
4. Lock Nut
5. Plug
6. Seal
7. Spring End
8. Relief Spring

Figure 36. Steering Relief Valve

ELECTRICAL SYSTEM.

This portion of the Maintenance Section is concerned primarily with "PAYLOADER" units equipped with gasoline engines. Some of the maintenance information, however, is applicable to units equipped with diesel engines.

STARTING CIRCUIT MAINTENANCE.

Every two weeks to one month check that the cable terminals are tight and free of corrosion. Wash corroded terminals with a solution of baking soda and water, then coat the terminals with vaseline. If the terminals are loose on the battery stud, they should be tightened.

Inspect the cables to be sure they are not partially broken where they enter the terminals. Replace cables if any breaks are found. Check for damaged or chaffed insulation on the battery to switch and switch to motor cables and replace the cable if the insulation is not in good condition. Make sure the terminals are not corroded and that all terminal nuts or screws are tight.

Due to the location and construction of the starting motor, no maintenance operations are possible while the motor is installed on the engine except for periodic lubrication, cleaning of the outside of the motor and checking for loose mounting attachment. The starting motor will normally perform without attention, however, dirt, dust, water and frequent starting cause more rapid wear and deterioration and may make an overhaul necessary.

Do not remove the starter for an overhaul unless it is definitely known that it requires attention. If necessary, substitute a battery source known to be fully charged and in good condition. Then check the starter operation by disconnecting the battery cable from the starting solenoid and hold the cable terminal firmly against the starting motor cable terminal on the solenoid. The motor should crank the engine at a normal speed.

CHARGING CIRCUIT MAINTENANCE.

GENERATOR CARE. At regular intervals (monthly), the outside of the generator should be wiped clean and both the ventilating holes and the fan should be inspected for any accumulations of dirt which would obstruct the flow of air through the generator. The cover band should be removed and the commutator and brush holders inspected for excessive dirt and oil which may cause poor performance. The brushes should be inspected and if they are cracked, oil soaked or worn to 1/2 their original length, they should be replaced. Only the most accessible brush need be inspected because it will give a fairly good indication of the other. If the generator brush holders are dirty or if the commutator or brushes are worn, the generator should be removed from the engine and overhauled.

In general, if the battery is kept charged except when an unusually severe load is placed upon it and if it does not require more than the usual amount of water, it is an indication that the generator and regulator are functioning in their proper manner and require no more than periodic checking.

IGNITION CIRCUIT MAINTENANCE.

WIRING. Clean all primary and secondary wiring between the spark coil, distributor, spark plugs and ignition switch whenever the plugs are checked. Use a dry greaseless cloth and if a grease solvent is needed, use it very sparingly on the cloth. Too much solvent will cause deterioration and ultimate failure of the wire covering.

Remove the high tension wires one at a time from the distributor cap and from the spark plugs. Inspect for loose terminals and corrosion. Check the wires for broken or cracked insulation, especially where they are clamped. Inspect for an oil soaked condition and abraded insulation. Any of these insulation conditions may cause a partial or complete ground and result in a weak spark. Replace wires found to be in poor condition.

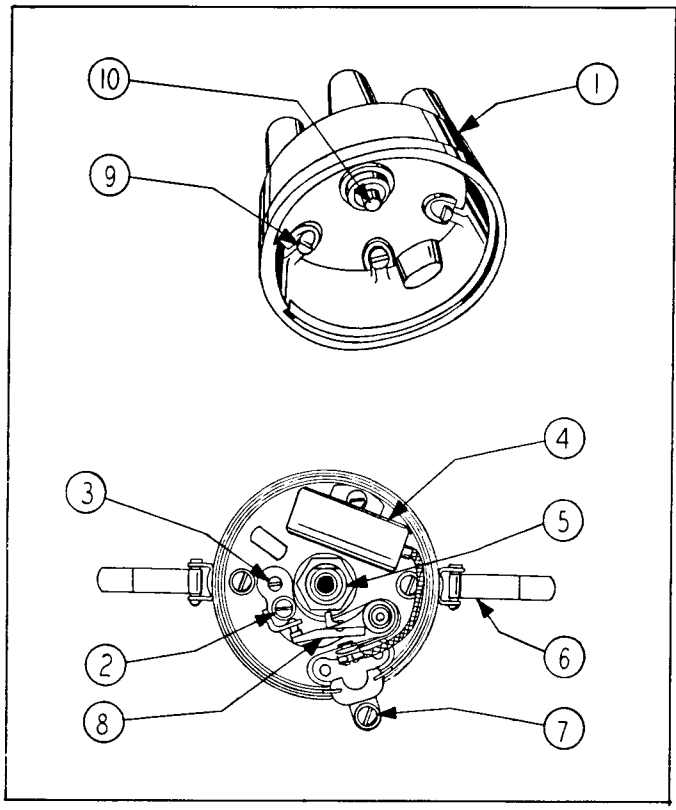
Check the wiring at the primary terminals of the ignition coil. Model H-90 "PAYLOADER" units are wired with a positive ground so the lead between the coil and the distributor should be connected to the positive (+) primary coil terminal. If the wires to the coil are not properly connected, disconnect them and reverse the connections so that the correct polarity will exist at the spark plugs. The primary coil terminal connected to the distribution points should be of the same polarity as the battery ground.

DISTRIBUTOR. The breaker contact points in the distributor should be inspected periodically (monthly) to ensure proper operation of the ignition circuit. Contact points that show grayish color and are only slightly pitted need not be replaced. If the contacts are pitted excessively, they should be replaced.

As an emergency measure, the contacts can be smoothed with a very fine emery stone and then thoroughly cleaned. The greatest wear is caused by excessive idling or operation at slow speeds and by high voltages which may be caused by improper regulator adjustments or some other falt in charging system.

At the monthly inspection period, the distributor cap should be removed from the distributor without taking the wires from the cap terminals. The cap, rotor, breaker plate and high tension contacts should be inspected for wear. The breaker plate and condenser leads should be checked for loose terminals and frayed insulation. The condenser lead, when replaced, should be installed so it will not interfere with rotor movement.

Inspect the cap for cracks, carbon runners, evidence of arcing and for corroded high tension terminals. Check the distributor cap inserts. After a



1. Distributor Cap
2. Contact Lock Screw
3. Contact Adjusting Cam
4. Ignition Condenser
5. Cam
6. Hold Down Strap
7. Primary Terminal
8. Breaker Arm
9. Cap Inserts
10. High Tension Contact

Figure 37. Distributor and Breaker Plate

period of normal use, the cap inserts will become slightly burned on the inside tip. If these inserts are badly burned or the cap is otherwise defective, the cap should be replaced.

The end of the rotor contact strip will become burned in normal use. If this burning is not excessive and is found only on the end of the strip, the rotor need not be replaced. If burning is evident on the top of the rotor, it indicates the rotor is too short and needs replacing. When this condition is found, usually the distributor cap inserts will be burned on their horizontal face and the cap will also need replacing.

SPARK PLUGS. The spark plugs should be cleaned and gapped at each monthly inspection. Clean the area surrounding the plugs prior to removing them so there is less possibility of dirt entering the engine.

Check the spark plugs to determine whether they are performing efficiently by analyzing the appearance of the firing end of the plug. Most spark plug troubles are generally caused by misapplication (too hot or too cold), improper installation and/or trouble in the engine, ignition system or carburetion.

If the side electrode on the plug is excessively worn, it may be caused by a high ignition coil voltage output or too hot a plug for the particular application. Occasionally the center electrode will also show excessive wear, while the insulator firing tip will show no signs of excessive heat. The condition can be remedied by using the next colder plug and checking that the engine is equipped with a coil for a 12 volt system.

If the plugs are "badly burned", the insulator firing tip will be swollen, blistered, fused or broken, and both the center electrode and the side electrode will be excessively worn with definite signs of disintegration. The condition is caused usually by an overheated exhaust valve, excessive spark advance, too hot a plug for the application, carbon in the combustion chamber or inadequate cooling of the plug due to defective cooling system operation.

Usually a "badly turned" plug will be caused by faulty engine operation. To correct the condition, refer to engine manufacturer's Operation and Maintenance Manual. If too hot a plug is being used, install the next colder plug. The cooling system should be cleaned periodically as previously described in this section.

After prolonged operation at high speed or under heavy load, the plugs will frequently show a coating of rusty-brown oxide on the insulator firing tip. This coating is caused by some types of fuel and may, in time, interfere with the proper performance of the plugs. Periodic cleaning of the plugs will remedy the condition.

Plugs that are too cold for the particular engine application will usually have a black coating on the insulator firing tip or carbon accumulations between the insulator nose and the plug shell. A temporary remedy may be obtained by cleaning the plugs but to maintain consistently good performance, a hotter plug should be used. Adjust the carburetor to lean the fuel mixture and still maintain a proper engine idle speed (600 to 650 rpm).

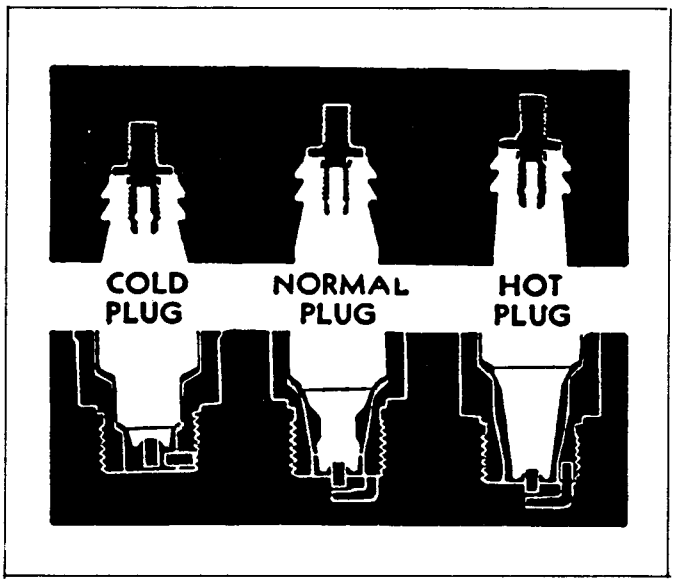


Figure 38. Spark Plug Diagram

If the engine is pumping oil due to worn cylinder bores, defective piston rings or too thin an oil for the particular application, the plugs may also show the signs of a cold plug. To remedy the condition, the engine should be checked as specified in the engine manufacturer's Operation and Maintenance Manual and the type of oil recommended for the particular operation should be used.

The presence of grayish black streaks on the insulator top, just above the plug body, is evidence of blow-by between the plug body and insulator. Usually plugs showing signs of blow-by are also "badly burned". Such plug conditions indicate that the plug is damaged or is operating at an abnormally high temperature. If the plug is damaged, it should be replaced. If faulty engine operation is the source of trouble, refer to the engine manufacturer's Operation and Maintenance Manual.

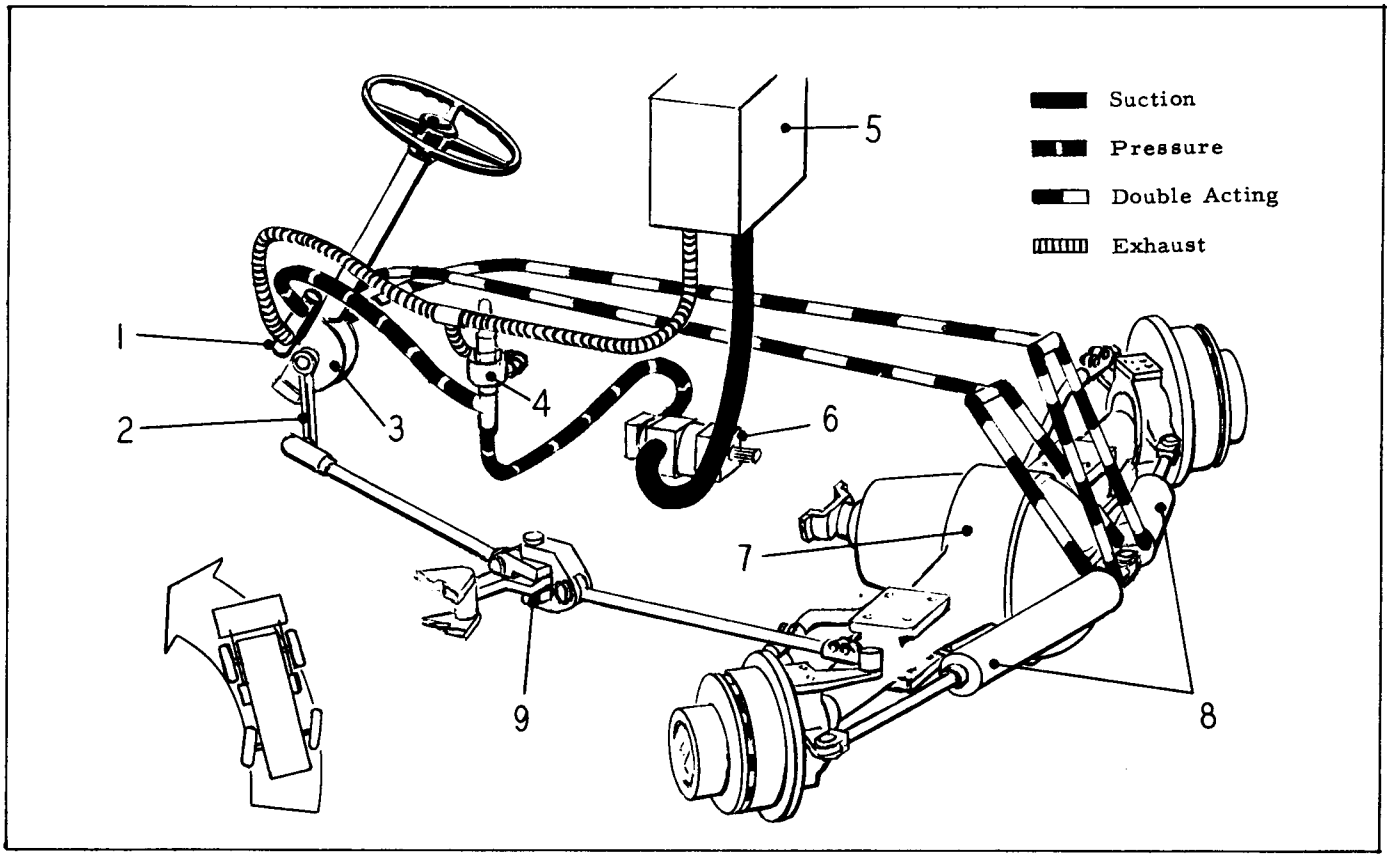
GLOW PLUG. Model H-90 "PAYLOADER" units equipped with diesel engines are provided with a glow plug. If the glow plug is suspected of faulty operation, it should be removed from the air intake manifold and connected to an external six volt battery source, known to be fully charged and in good condition. Check that the plug draws at least a 30 amp current. The glow plug should become white hot if it is operating properly.

ENGINE REMOVAL.

It is recommended that the engine be removed after 2000 hours operation and rebuilt in accordance with the specifications of the engine manufacture. Unlike other forms of preventive maintenance, engine overhaul or rebuilding need not necessarily be performed solely on the basis of period of service. Oil consumption, oil pressure at idling, dilution of engine oil and other signs of wear should be taken into consideration before removing the engine. The sole purpose of this maintenance procedure is to prevent on-the-job failures. Very few engine components will be worn badly, and engine rebuilding costs will be low if all parts which are not worn beyond replacement limits are re-used.

To remove the engine, it is necessary to remove the rear grille, the engine hood and all engine compartment side panels. The engine air cleaner and exhaust stack should be removed from the engine so that they will not interfere with the removal of the engine. Before disconnecting any wiring to the engine, remove the battery ground cable.

Disconnect all wiring to the engine and its accessories and tie it back to frame members so it will not interfere with engine removal. Unfasten all fuel lines and control linkages at the engine and move them away from the engine. Break the connection of



1. Steering Control Valve
2. Pitman Arm
3. Steering Gear
4. Steering Relief Valve
5. Hydraulic Reservoir
6. Hydraulic Pump
7. Rear Steering Axle
8. Steering Booster Cylinders
9. Bellcrank

Figure 39. Steering Hydraulic Diagram

the transmission input yoke and the upper drive shaft. Disconnect the radiator and oil cooler tubing.

Units equipped with gasoline engines can be hoisted from the engine compartment by means of the two hoisting eyes in the top of the engine block. Remove gasoline engines with radiator and oil cooler attached. Diesel equipped units require that the radiator and oil cooler assembly be removed prior to removing the engine. It is also necessary to install lifting eyes (one at each end of engine) in the holes provided. In order to install the front lifting eye on diesel engines, remove the vacuum pump drive belt and lay the pump back so the front hole will be accessible.

FUEL AND OIL HANDLING.

Refiners and distributors of hydraulic oils and fuels are particularly careful to assure that petroleum products are absolutely clean when they are delivered. The "PAYLOADER" operator, or maintenance man, should likewise exercise equal care to assure that the oil and fuel are just as clean when installed in the hydraulic system and the fuel tank. Contamination by such materials as dust, water and lint can easily be prevented by observing a few simple rules:

a. Store drums on their sides and indoors if possible. In any event they should be stored under a shelter of some sort.

b. Before opening a drum, clean the top so that no dirt can fall into the oil or fuel.

c. Any containers or hoses used in transferring the oil from the drum into the reservoir should be thoroughly clean.

d. The oil or fuel should be filtered as it enters the reservoirs of the "PAYLOADER". If a funnel must be used, it should be equipped with a mesh screen that will provide sufficient filtration.

Although these precautions are common sense and should be second nature to anyone handling oils or fuels, negligence in the storage and handling of petroleum products can cause serious damage in hydraulic and fuel systems. It is always easier and cheaper to remove dirt before it finds its way into the fuel and hydraulic systems. Straining or filtering the oil and fuel before it is installed will improve the life of seals, filters and component parts of the fuel and hydraulic systems. All filters and strainers should be cleaned or changed whenever they become dirty.

REPLACEMENT OF CUTTING EDGE.

The parts which make up the type B bucket are shown in the first section of figure 40. Section two illustrates the removal of an old cutting edge and section three illustrates how to install a new cutting edge on type B buckets.

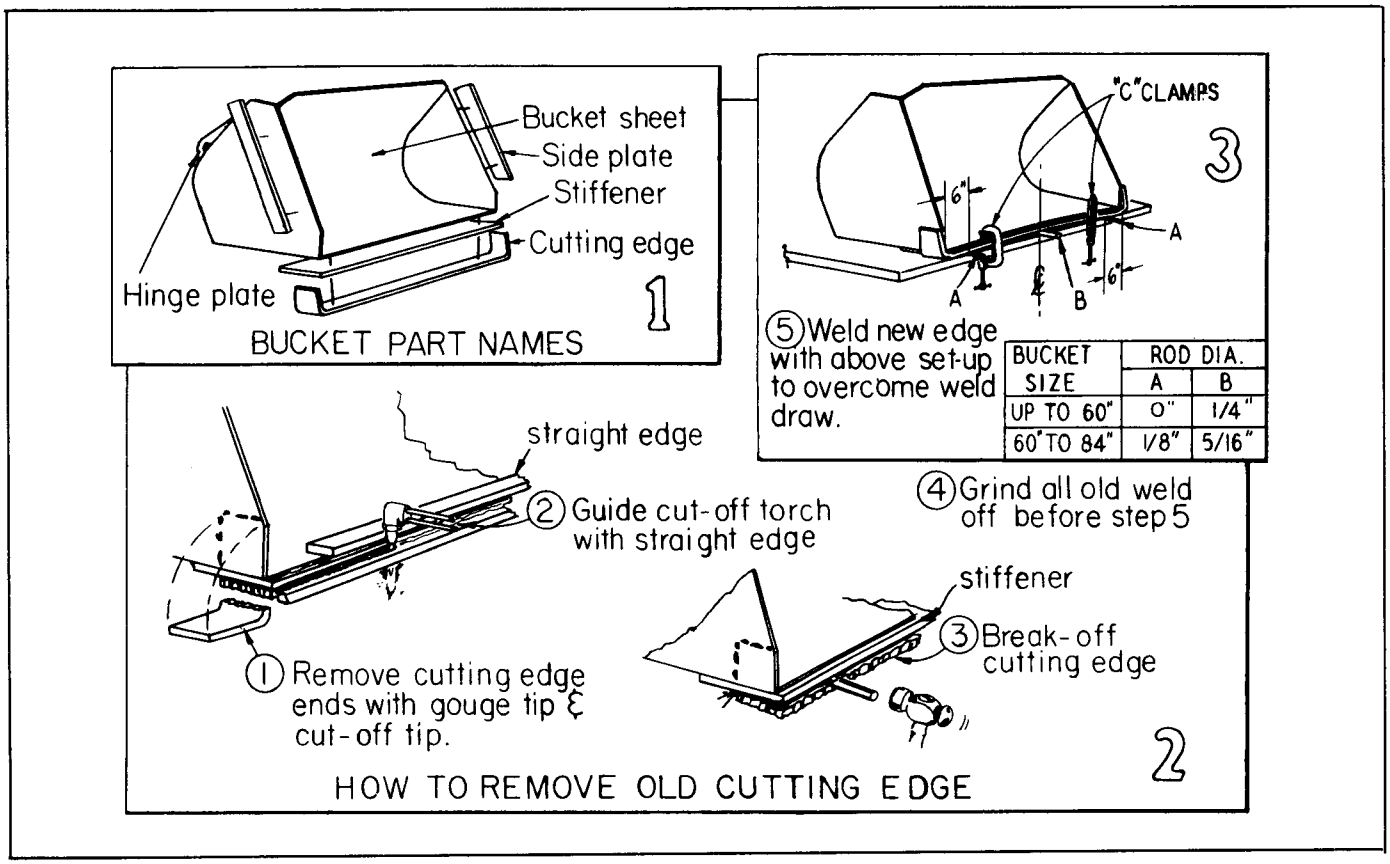


Figure 40. Cutting Edge Replacement on Type B Bucket

Cutting edges are made of steel with a very high carbon content. Because of the carbon content, the steel hardens and becomes brittle when it is welded. The use of dry "low-hydrogen" iron-powder type electrodes, therefore, is necessary when a new cutting edge is welded to the bucket. This type of electrode is manufactured by all major suppliers of welding rods.

A 7/32 inch diameter electrode at 200 amperes works best for welding. AC current is satisfactory or DC straight polarity may be used. Deep penetration should be avoided to minimize extensive dilution of the electrode with the cutting edge material.

To repair a cracked cutting edge, a chamfer is recommended at the edges of the crack. This chamfer may be obtained with a portable grinding wheel or a cutting torch. Pre-heating the blade to about 200-300° F will reduce the possibility of further cracking. When correct dry electrodes are available for welding, pre-heating is not considered absolutely necessary.

Cutting edges may be removed from the bucket and replaced as follows:

a. Remove the cutting edge ends on type B buckets with a gouge tip and a cut-off tip.

b. Lay a straight edge in the bucket so that it lines up with the front edge of the stiffener plate and clamp it in place. If there is no stiffener plate on the bottom of the bucket, line up the straight edge with the front edge of the bucket sheet. Guide the burning torch along the straight edge and cut through the cutting edge along the front of the weld.

c. Drive a cold chisel or wedge between the stiffener plate and the cutting edge on type B buckets to break the back weld.

d. Grind the remaining welds flush.

e. Position the new cutting edge. The top of the edge should be clamped flush with the bucket sheet or clamp the front of the cutting edge 1-1/2 inch ahead of the stiffener plate on type B buckets. Tack weld the ends of the cutting edge.

f. Cutting edges for type B buckets should be pre-stressed before welding. For 60 inch to 84 inch buckets, place a 1/8 inch rod under and 6 inches from the ends of the cutting edge and place a 5/16 inch rod under the center of the cutting edge. Then clamp the bucket to a table. For buckets up to 60 inches, use only a 1/4 inch rod under the center of the cutting edge. This procedure will lower the edge enough to overcome weld draw which tends to bow the edge downward. Cutting edges welded flush with bucket sheets need not be pre-stressed before welding.

g. Use a 1/4 inch fillet weld and weld the front of the cutting edge to the stiffener plate or bucket sheet. Start a weld 6 inches in from either end of the cutting edge and work toward the side plate. Skip 6 inches from the opposite end and weld backward toward the other side plate. Continue this process until the weld is completed at the center of the cutting edge. Finish welding the cutting edge to the bucket by welding it to the side plates.

h. Join the back of the cutting edge and stiffener plate or bucket sheet with a 1/4 inch fillet weld, the length of the cutting edge.

BUCKET SHEET AND HINGE PLATE REPAIR.

If at anytime it should become necessary to repair cracks or breaks in the bucket sheet or hinge plates, use the type rod recommended for welding cutting edges. Selection of rod size and amperes should be governed by the discretion of the welder.