OPERATOR'S MANUAL

FOR

MODEL HA PAYLOADER®

BEGINNING WITH SERIAL NUMBER
2A-27401 GAS
3A-1002 DIESEL

FORM HA-2D OPER.

MANUFACTURED BY

THE FRANK G. HOUGH CO.

LIBERTYVILLE, ILLINOIS

LITHO. IN U. S. A.

JAN. 1955

REVISED AUG. 1956
REISSUED JULY 1958

TO THE OWNER

It has been our aim to build the most reliable and serviceable shovel on the market.

Hough shovels have, since 1920, built a reputation for dependable and economical service in the material handling field. This "PAYLOADER" includes all these features which have made possible long, dependable service, together with the latest engineering knowledge and design.

The purpose of this manual is to explain maintenance requirements and routine adjustments which are necessary for the most efficient operation of your "PAYLOADER". To protect your "PAYLOADER" investment, study this manual before starting or operating your "PAYLOADER".

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, dependable 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".

IT IS THE POLICY OF THE FRANK G. HOUGH CO. TO IMPROVE ITS PRODUCTS WHENEVER 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.

TABLE OF CONTENTS

CONDENSED SPECIFICATIONS

ENGINE	Gasoline	Diesel
Waukesha	FC	180 - DLC
Number of Cylinders	4	4
Bore (inches)	3.25	3.50
Stroke (inches)	4.00	3.75
Displacement (cu in.)	133	144
Governed rpm	2,000	2,000
Horsepower (stripped at governed rpm)	33	38
Fuel Tank Capacity (US gal.)	6.5	6.5

TORQUE CONVERTER

2.1 to 1 stall ratio; Single Stage, two phase

TRANSMISSION	1st	2nd
Speeds Forward (mph)	0 - 3	0 - 6.3
Speeds Reverse (mph)	0 - 4.8	0 - 10.2

BRAKES

Service	Internal expanding, 2 shoe, hydraulic, 2 wheel (front)
Parking	External clamping, 2 shoe, mechanical, drive shaft

STEERING GEAR

Heavy duty, recirculating ball type steering mechanism

BATTERIES

Gasoline	One, 6 volt
Diesel	Two, 6 volt (12 volt system)

TIRES

Front (Standard)	7:50 x 16, 9 ply rating
Rear (Standard)	6:00 x 9, 6 ply rating

HYDRAULIC SYSTEM

Sealed, pressure controlled, with vacuum relief

Boom Rams	4 inch diameter chrome plated piston rods
Bucket Rams	3 inch diameter chrome plated piston rods
Shock Absorber	Gas compression type
Pump	Gear type; driven by engine crankshaft; 18 gpm at 2,000 rpm
Valve	Two spool with relief
Reservoir	Electrically welded, pressure controlled

BUCKET

Struck Capacity (cu ft.)	14
Payload Capacity (cu ft.)	18
Width (inches)	48
Breakout Force (lbs.)	3100
Maximum Carry Capacity at 4 mph (lbs.)	2000
Maximum Lift Capacity at 0 mph (lbs.)	3000
Maximum Dump Clearance (ft. and inches)	5-2.5
Maximum Clearance under Bucket Hinge (ft. and in.)	6-6
Angle of Breakout at Ground (degrees)	40
Maximum Angle of Dump at Maximum Height (degrees)	40
Boom Raising Time (seconds)	6.25
Boom Lowering Time (seconds)	5.50
Digging Depth (inches)	6

"PAYLOADER" DIMENSIONS

Overall Height (ft. and in.)	4-10
Height Over Average Operator (ft. and in.)	6-7
Width at Front Tires (ft. and in.)	4-2
Width at Rear Tires (ft. and in.)	3-8
Length with Bucket on Ground (ft. and in.)	10-3
Length with Bucket at Carry Position (ft. and in.)	10-0
Wheel Base (ft. and in.)	4-0
Ground Clearance (in.)	5
Maximum Width (ft. and in.)	4-2.25

TURNING RADII

Outside Corner of Bucket at Carry (ft. and in.)	6-3.5
Outside Rear Wheel (ft. and in.)	6-2
Outside Rear Corner of Grille (ft. and in.)	6-6.5
Aisle Operation Width, Bucket at Carry (ft. and in.)	6-0

WEIGHT	Gasoline	Diesel
Front Axle	2225	2270
Rear Axle	2825	3015
Total	5050	5285

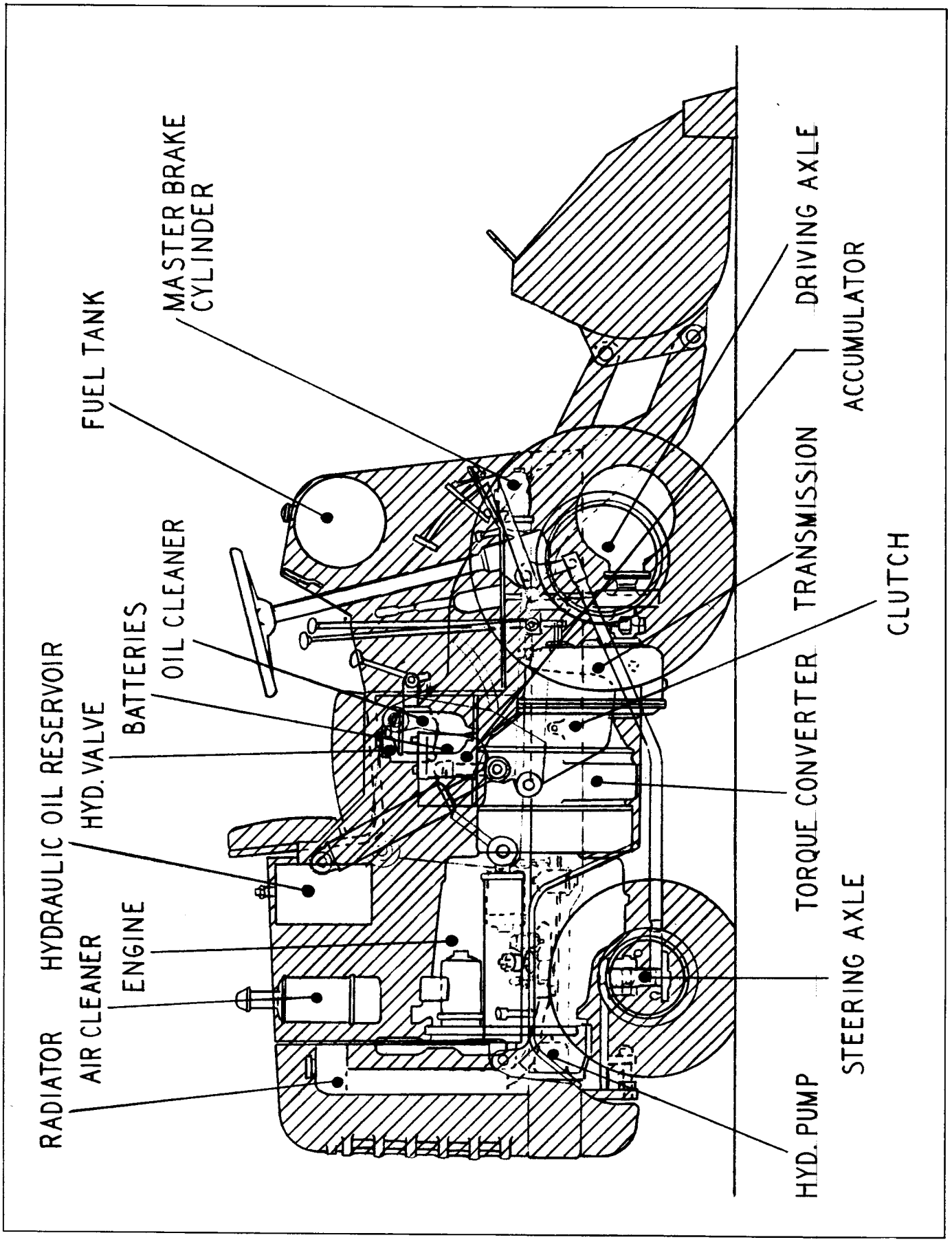

Figure 1. General Arrangement

PREPARATION OF THE "PAYLOADER" FOR OPERATION

Before operating this "PAYLOADER", even to unload, check the entire unit to make sure nothing has become loose or damaged in transit or storage.

Battery cables have been disconnected at the factory, and the fuel line shut-off cock has been closed before shipment. Machines sent outside the United States are shipped with a dry battery and with the fuel tank and fuel lines drained.

DO NOT ATTEMPT TO START THE ENGINE BEFORE THE FOLLOWING POINTS HAVE BEEN CHECKED OR DAMAGE MAY RESULT.

Refer to the Service Charts to locate the following points.

a. Check the oil level in the hydraulic system reservoir to make sure it is up to the full mark on the dipstick. The engine MUST NOT be started without oil in the hydraulic system. Use SAE 10 motor oil to refill. Drain the hydraulic system after the first 32 to 48 hours of operation and refill with clean oil. Be sure to clean the suction outlet strainer at this time.

b. Check the oil level in the engine crankcase by removing the oil dipstick from the side of the engine.

c. Check the oil level in the transmission to be sure it is to the height of the level plug.

d. Check the oil level in the differential and both final drive gear cases. Differential oil level plug is located in the rear of the housing. Final drive gear case level plugs are located on the inside surfaces of both rear wheel housings.

e. Check the oil in the air cleaner cup. Clean and refill daily or oftener as required.

f. Check the master brake cylinder to make sure it is filled with brake fluid.

g. Be sure that all hoses and connections are tight to prevent hydraulic oil from leaking out, and to keep air or water from entering the system. Water entering the system will cause pump erosion at high velocities. Air or water in the system will cause the oil to foam and the hoist to operate in a slow jerky manner.

h. Be sure all drain plugs, drain cocks, filler openings and fuel line connections are tight and do not leak.

i. Check the oil level in the torque converter to see that it is up to the "full" mark on the dipstick. Remove the breather cap to read the dipstick.

j. Check the tire pressures. Be sure that they are up to pressures recommended in the Specifications and Service Data Lists.

k. Check the cooling system. Refill with clean soft water that is free from alkaline. Never run the engine without the full quantity of cooling fluid in the radiator. Add a permanent type antifreeze solution to the cooling system during freezing weather.

l. Be sure to open the fuel line shut-off cock on the fuel line, under the front cowl. Use gasoline of minimum octane rating of 70-72. For diesel engines use a No. 1 grade diesel fuel. The fuel containers must be clean.

m. Connect battery cables and check the dash instruments to be sure that they function properly. Check the batteries to be sure the plates are covered with water. If not, add distilled water or clean rain water.

n. Do not operate the "PAYLOADER" to capacity during the first weekly period of operation. Operate the machine with light loads for the first 36 to 50 hours of actual use.

o. Carefully read the instructions as set forth in this book before attempting to operate this "PAYLOADER". The functions and application of hand levers, foot pedals and other controls differ between various types of similar machines. Their uses should be understood by the operator before he attempts to start the engine.

p. Grease the "PAYLOADER" daily (every 8 to 10 hours of operation). Use the Service Charts and the engine manual as guides. When the machine has been properly serviced and checked, and its method of operating is understood, it can be put to work.

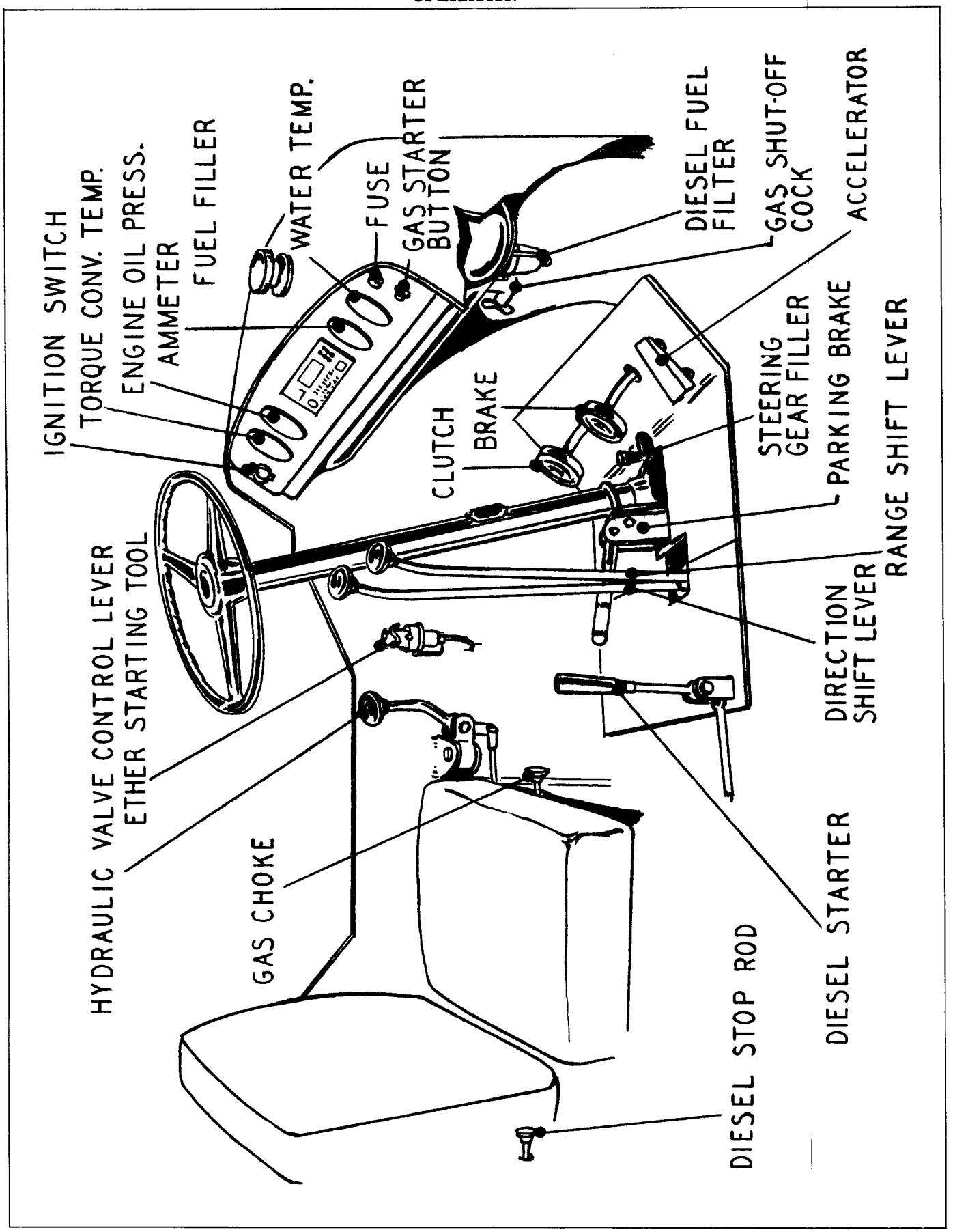

Figure 2. Operator's Compartment

OPERATING THE "PAYLOADER"

GENERAL

When learning to use a machine of this type, it is well for the operator to work carefully, taking his time to gradually become accustomed to the machine. Operating speed and skill will be attained easier by slowly acquiring the "feel" of the "PAYLOADER". The time used in learning will be well spent in preventing possible accidental damage to the machine or operator and in safeguarding other personnel. The main factor in the performance of any machine of this type is the operator.

A study of the following pages should be made by the operator before attempting to start the engine. This will acquaint him with the functions of the various controls and their uses. Refer to the Operator's Compartment illustration to note location of the levers and pedals.

The terms "RH" (right hand) and "LH" (left hand) as used in these pages are determined by the operator's position when sitting in the seat facing the bucket.

HAND LEVERS

This "PAYLOADER" is equipped with a two speed forward and two speed reverse transmission. The speed and direction of travel is selected by shifting a RANGE LEVER and a DIRECTIONAL LEVER. These levers are located at the right side of the steering column. See the Operating Controls picture.

The DIRECTIONAL LEVER is the longer lever adjacent to the right side of the steering column. Shift this lever to drive the machine in a forward or reverse direction. Push it forward to shift the transmission into forward gear. Pull it backward to shift the transmission into reverse gear. This lever is in neutral when in its central position.

The RANGE LEVER is the shorter lever next to the directional lever on the right side of the steering column. The speed of travel is selected by shifting the range lever. The transmission is in neutral when this lever is in its central position. Push this lever forward, ahead of neutral, to shift the transmission gears into low speed range. Pull it backward from neutral to shift into high speed range. The low speed range is used for working conditions in which more power is needed. The high speed range is used primarily for transporting loads to various locations.

Always be sure that the range lever is in neutral before the engine is started or when leaving the machine.

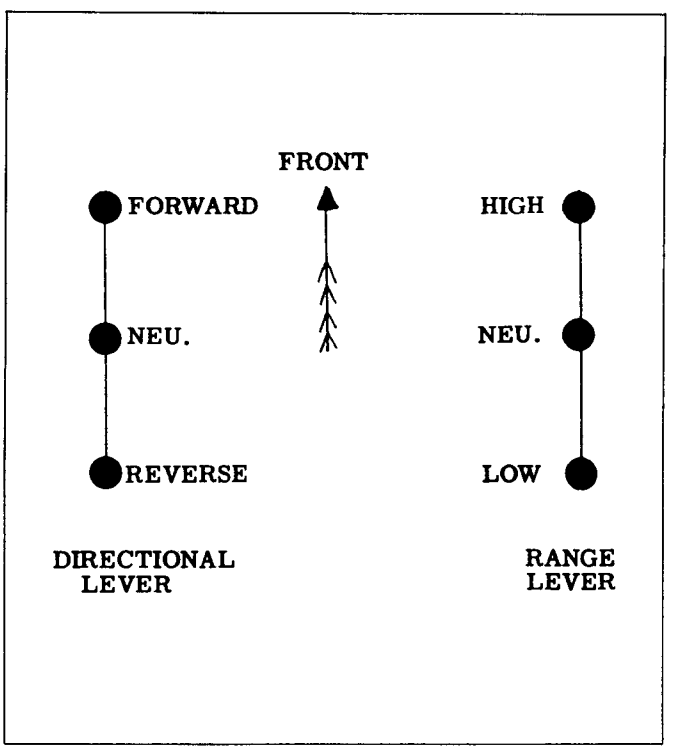

Figure 3. Gearshift Diagram

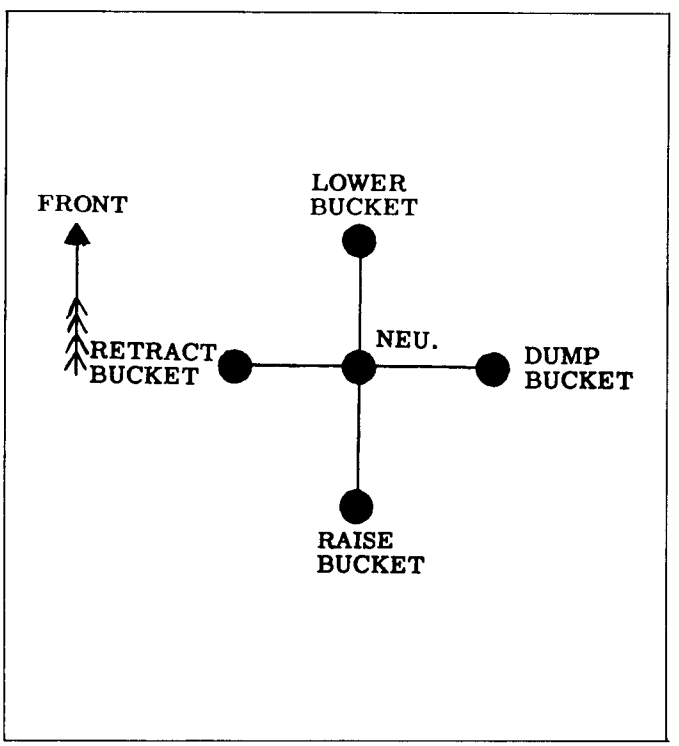

Figure 4. Control Lever Positions

NOTE

Always depress the clutch pedal when shifting either the range lever or the directional lever. Do not attempt to shift the transmission gears while the machine is in motion.

The HYDRAULIC CONTROL LEVER is located on the left hand side of the seat. By use of this lever, the operator controls a valve which regulates the flow of oil to the hoist cylinders to activate the bucket. Never reach under the boom or guide bars to operate this lever as the bucket can be lowered even though the engine is shut off.

The valve control lever has five positions: RAISE, LOWER, HOLD (or neutral), DUMP, and RETRACT. The valve spools are spring loaded and cause the lever to automatically return to neutral when the lever is released.

Pull the valve control lever backward, toward the operator, and the boom and bucket will raise, in direct proportion to the engine speed. Release the lever to stop and hold the bucket at any height of its travel.

Move the valve control lever inward, toward the operator, to dump the bucket. Release the lever to stop and hold the bucket in any point of its dumping arc.

Move the valve control lever outward, away from the operator, to retract or close the bucket. When the bucket is fully retracted, allow the lever to return to NEUTRAL.

Move the valve control lever forward, away from the operator to lower the bucket.

The faster the engine speed, the faster the bucket will raise and/or close.

The PARKING BRAKE HAND LEVER is located on the left hand side of the steering column. This hand brake operates independently of the foot brake. Push the lever downward to release the hand brake.

Raise this lever to its vertical position to set the brake.

Set the hand brake whenever the "PAYLOADER" is being parked for a time. Always have the hand brake set whenever the operator leaves the machine and always be sure to release it before putting the machine in operation.

Minor adjustment of the parking brake can be made by turning the knob on the hand brake lever.

FOOT PEDALS

The CLUTCH PEDAL is located on the left side of the floorboard. When pushed down, the transmission is disengaged from the engine. Always keep the clutch pedal depressed when shifting either the range lever or the directional lever. Do not engage the clutch suddenly and cause the "PAYLOADER" to jerk with the load. Frequent habitual declutching to diminish drive thrust into the face of the cut results in rapid clutch wear.

CAUTION

Do not drive the "PAYLOADER" with the foot resting on the clutch pedal. This will cause undue wear on the clutch facing and throwout bearing.

The BRAKE PEDAL is located on the right side at the floorboard and is used to bring the "PAYLOADER" to a stop. Depress the brake firmly when braking. It is good practice to keep the clutch engaged until the "PAYLOADER" has been slowed down and nearly brought to a halt by depressing the brake. Then disengage the clutch and stop the motion of the machine completely. This allows the engine compression to assist the brakes and saves wear on the brake linings.

The ACCELERATOR PEDAL is mounted on the floorboard to the right of the brake pedal. Applying pressure on this pedal increases the flow of fuel to engine cylinders. This increases the engine speed, thereby accelerating "PAYLOADER" operation. Apply a slight increasing pressure on the accelerator pedal while releasing pressure on the clutch pedal to allow the machine to start evenly, without jerking. Decrease pressure on the accelerator pedal to diminish drive thrust on the bucket when loading, instead of declutching.

The raising speed of the booms and bucket is also governed by the accelerator.

DASH INSTRUMENTS

The AMMETER indicates whether the battery is being charged or discharged. If the needle registers in the discharge range continuously while the engine is running, or when the ignition switch is in OFF position, the cause should be investigated to avoid draining the battery.

The TEMPERATURE GAUGE indicates the temperature of the cooling fluid circulating through the engine. Never operate the engine when this gauge registers the temperature of the engine coolant to be at the boiling point (210° F). Shut off the engine and check the water system to prevent damage to the engine.

The OIL PRESSURE GAUGE indicates the pounds pressure used to circulate the lubricating oil through the engine. If this gauge fails to register, stop the engine IMMEDIATELY and determine the cause or damage to the engine may result.

The FUSE RETAINER is located on the right side of the dash, and provides a fuse to protect the wiring system. Inspect this fuse if the ignition system fails to operate.

The TORQUE CONVERTER TEMPERATURE GAUGE is mounted below the dash panel on the right hand side of the machine and registers the temperature of the oil in the torque converter. This gauge is in no way related to the engine temperature. When there is danger of the torque converter oil being overheated the horn will emit a continuous sound. This warning signal is operated by a thermal couple switch on the torque converter and is wired to the horn relay.

WARNING

Do not attempt to remove any plugs or connections from the converter system if the gauge registers above 150° F as the hot oil may be forcibly ejected causing personal injury.

Do not allow the torque converter gauge indication to exceed 280 F. If the horn blows automatically the converter is in danger of being overheated. Remove the load from the machine and idle the engine until the oil temperature gauge registers below 225° F.

The HORN BUTTON is located in the hub of the steering wheel. The horn can be operated manually by depressing the button or electrically by a thermal couple switch on the torque converter. If the horn sounds a continuous note automatically, the converter oil is in danger of being overheated.

STARTING CONTROLS

GAS ENGINES

The CHOKE ROD for units equipped with a gasoline engine is located below the seat. Pull out this rod to close the choke valve and thereby enrich the fuel mixture to make starting easier. Open the choke valve by pushing in the rod as soon as the engine starts. Do not run the engine with the choke valve closed. When starting a hot engine, do not use the choke because it will make starting difficult.

The STARTER BUTTON for gas engine units is located at the right side of the dash and, when pressed in, it completes the electrical circuit to the starting motor. Release pressure on this button as soon as the engine starts. Do not run the starting motor more than 1/2 minute at a time, alternating between 1/2 minute intervals of rest.

The IGNITION SWITCH is located on the left side of the dash panel. Operating this switch to the right turns the machine's electrical system on. When the machine is to sit idle, be sure that the key in the switch is operated to OFF (straight up) so that the battery power does not drain off. Operating the ignition switch to OFF will not stop a "PAYLOADER" equipped with a diesel engine.

DIESEL ENGINES

The STARTER LEVER is located to the right of operator's compartment and at the rear of the floorboard. When the lever is operated forward, it completes the electrical circuit that energizes the starting motor. As soon as the engine starts, release the lever so that the starter can become disengaged. Do not run the starting motor for more than 30 seconds at a time. Allow 60 seconds between each cranking period.

A PRESSURE PRIMING SYSTEM (Figure 5) is provided on all HA "PAYLOADER" Units equipped with diesel engines as a cold-weather starting aid. The system consists of a receptacle, a distribution tube and a nozzle in the intake manifold. The purpose of the system is to introduce a controlled quantity of pressurized ether into the manifold. The ether is mixed with air in the manifold and the mixture is drawn into the cylinders of the diesel engine to be ignited by the engine's compression. Because an ether-air mixture can be readily combusted, it is

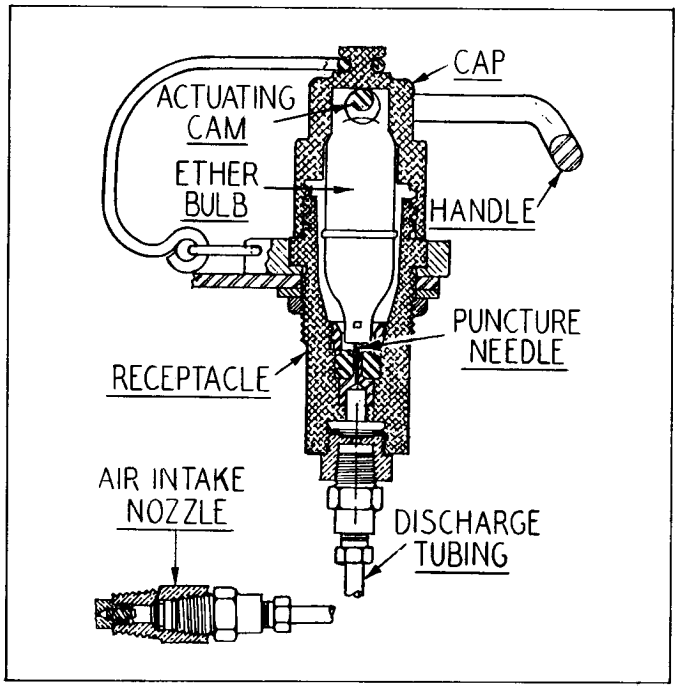

Figure 5. Pressure Priming System

necessary to have the engine turning over before any ether is introduced into the air intake manifold. If this procedure is ignored, there is good possibility that a mixture of ether and air will collect in a few engine cylinders and cause damage to them when a starting attempt is made.

The RECEPTACLE of the pressure priming system (Figure 5) is attached to the left side panel of the operator's compartment immediately before the lever that operates the hydraulic control valve. Refer to DIESEL ENGINE STARTING for instructions that pertain to how and when this receptacle is to be used.

The DIESEL ENGINE SHUTOFF CONTROL handle is mounted to the right and rear of the operator's seat. When the control handle is fully extended, the flow of fuel to the engine is shut off. Push the handle all of the way in when starting the engine.

NOTE

The ignition switch will not stop the diesel engine.

PREPARATION FOR STARTING

Before attempting to start the engine of the Model HA "PAYLOADER", check that the following conditions exist:

a. Engine crankcase oil is up to FULL marking on dipstick.

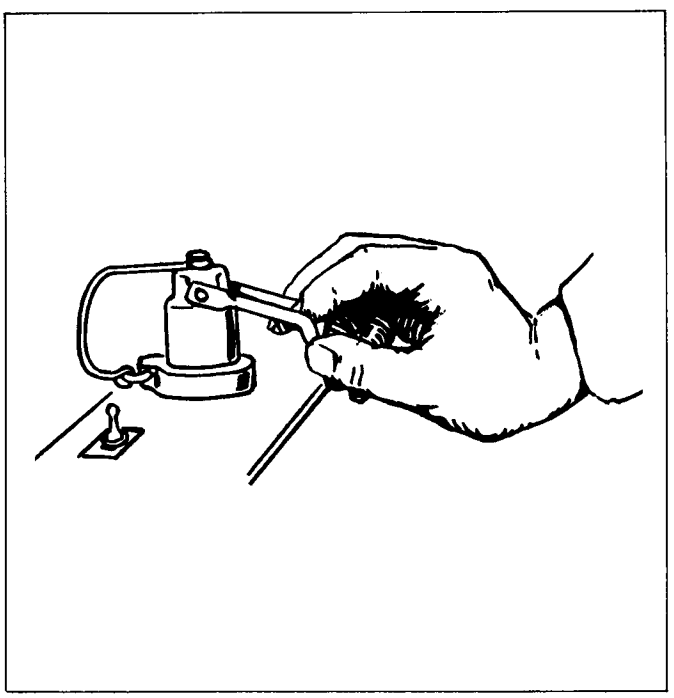

Figure 6. Receptacle Handle in Withdrawn Position

b. Torque converter oil level is within the FULL range on the dipstick.

c. Cooling system is full.

d. Hydraulic reservoir oil is full.

e. Fuel tank is full and shutoff valve is open.

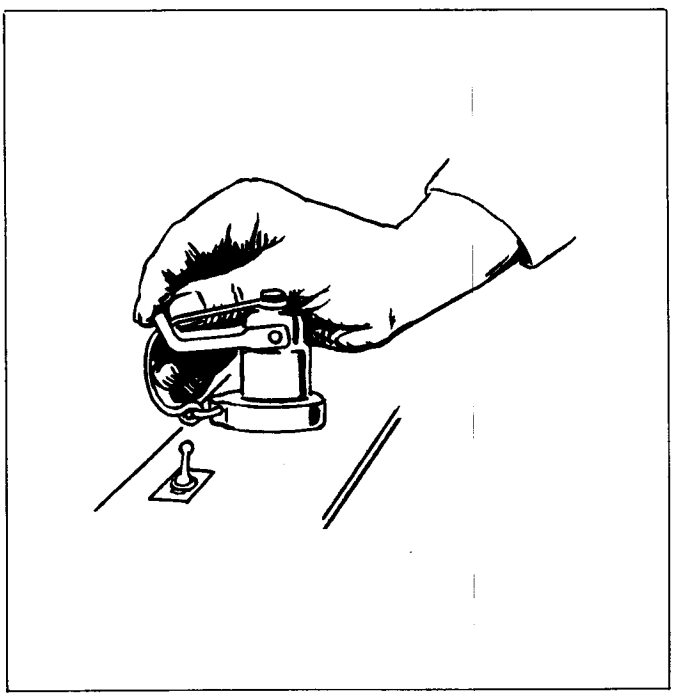

Figure 7. Receptacle Handle in Puncture Position

GAS ENGINE STARTING

After checking that the "PAYLOADER" is ready to be operated, start units equipped with gas engines as follows:

a. Place the gear shift levers in NEUTRAL. Check the valve control lever to be sure that it is in NEUTRAL.

b. Operate the ignition switch to "on".

c. If the engine is cold, pull out the choke rod slightly (about 1/4) to close the choke valve so that starting will be easier. Do not use the choke when starting a hot engine.

d. Press the starter button. Release the starter button as soon as the engine starts.

When the engine has started, allow it to run at idle speed, without load, until it becomes warmed up.

Watch the engine oil pressure gauge and the engine coolant temperature gauge to be sure that they are registering. Push in the choke rod to open the choke valve as soon as the engine runs smoothly on a less enriched mixture. Follow this procedure whenever the engine is started.

STOPPING THE GAS ENGINE

To stop the gasoline engine, operate the ignition switch to OFF. Place the gearshift levers in neutral and set the hand brake before leaving the operator's seat.

DIESEL ENGINE REGULAR STARTING

After checking that the "PAYLOADER" is ready for operation, start machines equipped with diesel engines as follows:

a. Place gearshift levers in NEUTRAL and check that hydraulic valve control lever is in NEUTRAL.

b. Check that fuel shutoff cable is pushed in as far as it will go.

c. Operate the ignition switch to ON so that dash instruments will indicate operating condition of unit's electrical system, engine and torque converter.

d. Push the starter lever forward. Assist starting by pumping the accelerator pedal slowly while cranking the engine. Care, however, must be exercised when this procedure is used so that the cylinders do not become flooded with fuel.

e. Release the starter lever as soon as the engine starts.

DIESEL ENGINE COLD WEATHER STARTING

Cold weather starting (40° F or less) will be accomplished easily if, in preparation for starting, the engine oil and cooling system fluid are heated and then poured into the engine. If continuous cold weather operation is expected, the engine cooling system and the engine crankcase should be drained upon completion of a day's operation. The battery should be fully charged at all times. After preliminary preparations for starting have been made, start engine as follows:

a. Push the engine fuel shutoff cable all of the way in.

b. Operate transmission control levers to NEUTRAL.

c. Unscrew and remove cap on pressure priming system receptacle.

d. Insert ether bulb (neck down) into receptacle.

e. Replace cap and screw down tightly. Be sure that handle remains in withdrawn position. Refer to Figure 6.

f. Operate ignition switch to ON and depress accelerator.

g. Push the starting lever and begin cranking the engine.

h. After engine has made several revolutions, swing the handle of the receptacle as far as it will go in the direction opposite its withdrawn position. Refer to Figure 7.

NOTE

Do not operate starting motor more than 30 seconds at a time. After each 30 seconds of continuous cranking, allow at least a 60 second recovery period.

i. Release starter lever as soon as engine starts.

If engine fails to start on one ether bulb, remove the discharged bulb from the receptacle and insert a fresh bulb (steps c., d. and e.). Repeat steps f., g. and h. as soon as possible after the first attempt at cold weather starting.

Allow the engine to run at idle speed without imposing external loads on it until the engine temperature gauge indicates approximately 130° F. Normal no-load temperature is approximately 180° F. Observe the engine oil pressure gauge after the engine has idled for a few minutes to be sure that oil is being properly distributed within the engine.

STOPPING THE DIESEL ENGINE

The diesel engine shutoff cable is located just back of the right hand side of the operator's seat.

To stop the diesel engine, pull out cable and shut off the flow of fuel to the engine. The cable is spring-

loaded so that it will automatically return to its open position when the handle is released.

SHOCK ABSORBER

A hydraulic shock absorber (accumulator) is incorporated in the hydraulic system of the Model HA "PAYLOADER" to prevent shock loading the booms and the machine when loads are carried over rough terrain. The shock absorbing unit consists of a free floating piston within a closed cylinder. One face of the piston is acted upon by the oil in the boom hydraulic circuit and its other face acts against a volume of gas trapped in the end of the cylinder. Refer to Maintenance section for Shock Absorber filling procedures.

DRIVING THE "PAYLOADER"

When the engine has been running long enough to warm up partially, and oil pressure has been built up as indicated on the dash gauge, the "PAYLOADER" can be put to work.

Draw backward on the valve control lever to raise the boom and bucket about two or three feet above the ground, depress the clutch and shift the directional lever and the speed range lever into the desired positions. Release the pressure on the clutch pedal, increase pressure on the accelerator pedal and drive to the working area.

Skill in the use of the machine is acquired by practice and by intelligent observation of the performance of the machine.

LOADING THE BUCKET

Load the bucket by approaching the stockpile with the bucket cutting edge at digging level and the transmission in low, forward gear. Cut into the pile at a steady rate after the forward movement of the machine initiates the thrust. After the bucket cutting edge has penetrated the pile, move the machine forward at a steady rate by varying the speed of the engine with the accelerator pedal. Roll the bucket back before raising the boom.

Keep the clutch engaged throughout the loading operation. Vehicle speed and the amount of thrust should be regulated by the accelerator pedal. If the bucket should become "crowded" in the bank or the face of the cut, decrease the engine speed by letting up on the accelerator. Avoid riding the clutch to vary speed and thrust. The clutch should be used only when the transmission is shifted.

TRANSPORTING LOADS

After the bucket has been filled, operate the valve lever to raise the boom and bucket. The bucket should be raised sufficiently to clear the terrain over which the load will be transported. Never transport loads with the bucket fully raised. The nearer the ground the bucket is held, the better the stability especially on side slopes or when turning the machine.

To transport the load, shift the gears into position for speed and direction of travel desired. Travel speed depends upon the length of haul and the type of surface over which the tractor must pass. Rough terrain calls for slow speed.

DUMPING THE BUCKET

When dumping into a truck or bin, raise the bucket so that it clears the top edge safely. Move the machine up so that the bucket is inside the dumping area. With the valve control lever in the hold or neutral position, push forward slowly on the lever, thus causing the bucket to tip forward and spill its load. The load may be dumped entirely or partially, by manipulating the bucket lever. Dumping the load slowly will ease the shock of suddenly added weight to a truck body. Releasing pressure on the bucket control lever will allow it to return to neutral and hold the bucket in a dumped position. Pull backward on the control lever until the bucket is closed; then back the machine away from the dumping area. Back the machine well away from the truck or bin and lower the bucket to carry position before returning to the loading site.

COLD WEATHER OPERATION

If possible when it is not in use, park or store the "PAYLOADER" in a warm garage or building during freezing weather. In starting any engine, particularly a cold engine, do not allow it to run up to governed speed or apply a load until the oil has become warm enough to circulate properly. Refer to "Cold Weather Starting" in the Waukesha engine manual.

When operating the "PAYLOADER" in temperatures of 32° F (0° C) or lower, there is danger of the water freezing in the cooling system. It is therefore recommended that an antifreeze solution be used in the cooling system to protect the engine. To avoid freeze-ups, use a permanent type antifreeze solution, such as distilled glycerine or ethylene glycol. There are several standard reliable antifreeze solutions on the market which can be used. They should be added to the system according to the manufacturer's instructions found on the container.

Do not use a calcium chloride solution, an alkaline solution, fuel oil or kerosene as an antifreeze because they are injurious to the cooling system components.

Avoid the use of alcohol as an antifreeze solution because it tends to boil away at average "PAY-LOADER" operating temperatures. If alcohol should be used, test the strength of the solution with a hydrometer several times a day. It will be necessary to add alcohol frequently to replace that lost by evaporation.

Never pour cold fluid into a hot engine because the sudden contraction of metal may cause the engine block to crack.

In cold weather, condensation may increase the amount of water in the crankcase and the hydraulic system. Small amounts of water will evaporate when the engine lube oil and the oil in the hydraulic system become warm. However, large amounts of water are not readily disposed of and should be removed from the engine and hydraulic system to protect their operating parts.

DRAINING THE COOLING SYSTEM

To drain the cooling system, remove the radiator cap and then open the radiator drain cock and the engine block drain cock. The radiator cap is a pressure sealing type and must be removed when the system is draining.

The cooling system should be flushed out seasonally, before and after adding any antifreeze solution, to avoid accumulations of dirt and gum in the radiator tubes.

ROUTINE SERVICE

The operating life of the "PAYLOADER" may be considerably extended and fewer shutdowns will be experienced if the unit is properly serviced at regular intervals. Often, major repairs or shutdowns can be avoided by regular inspections and trouble can be corrected while it is of a minor nature.

The operator's job does not consist of merely working the "PAYLOADER". The mechanical and operating condition, as well as the general appearance and maintenance of the machine, is part of his responsibility. It is to the operator's advantage to become familiar with the functions of each working part of the machine and to study the information and suggestions in this manual.

Refer to the Service Charts for major points requiring periodic service and inspection.

Refer to the Waukesha engine operation and maintenance manual for suggestions in the care and operation of the engine. Many important points, pertinent to the life and service of the engine, which have not been covered in this manual, are thoroughly covered and discussed in detail in the Waukesha engine manual. This manual should be read and studied by the operator.

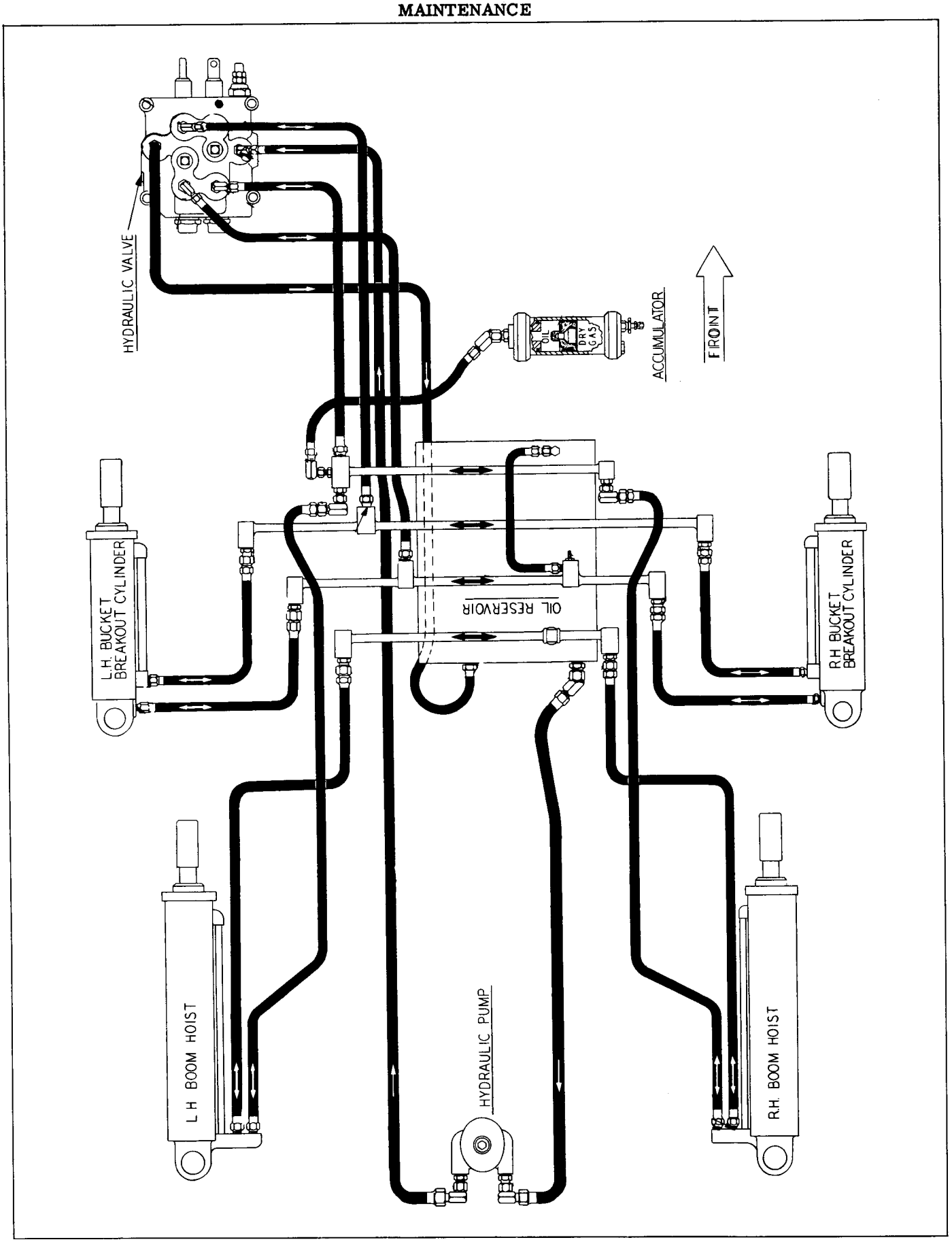

Figure 8. Hydraulic Diagram

MAINTAINING THE "PAYLOADER"

GENERAL

Regardless of the care used in the design and construction of any type of equipment, there are many conditions that cannot be completely safeguarded against without interfering with reasonable accessibility and efficient operation. The complete observance of one simple rule would prevent serious injuries each year. That rule is

"NEVER ATTEMPT TO CLEAN, OIL, OR ADJUST A MACHINE WHILE IT IS IN MOTION".

(National Safety Council)

NEVER WORK UNDER THE BOOMS OR BUCKET UNLESS THEY ARE BLOCKED AND CANNOT BE ACCIDENTLY LOWERED.

The following paragraphs are not intended to cover all repair problems that may confront the operator. They are merely intended to assist the mechanic or operator in routine adjustments and maintenance which can be done in the field to keep the machine operating efficiently.

For major repairs requiring the services of trained mechanic, refer your problems to THE FRANK G. HOUGH CO. dealer.

HYDRAULIC SYSTEM

The closed hydraulic system consists of an oil reservoir, a gear type pump, a control valve, the hydraulic hoist cylinders, a shock absorber system and the connecting hoses and fittings.

Low oil level in the hydraulic reservoir will cause the hoist cylinders to operate in a slow, jerky manner and the pump and valve will be noisy. Incorrect relief valve pressure setting will cause poor performance of the unit.

Air being sucked into the hydraulic system through a faulty connection or hose between the reservoir and the pump will cause the oil to foam and retard circulation. The hoist cylinders will chatter and operate in a slow jerky manner. The pump may be noisy and howl. A faulty connection may allow air to be sucked into the system although oil may not leak out.

Excessive water drawn into the hydraulic system will cause damage to the pump and to the hoist cylinders and, therefore must be removed by draining the system. Small amounts of water, from condensation, will evaporate when the "PAYLOADER" has been worked for a time and the oil becomes warm.

Wherever standard pipe fittings are used, a good clean grade of white lead, aviation Permatex or insoluble plastic lead seal should be applied, on the male threads only, when reconnecting a joint. Do not allow the thread sealer to enter the pump or valve.

DRAINING THE HYDRAULIC SYSTEM

If excessive amounts of water are evident in the system, or it becomes necessary to repair the control valve or pump or if it is necessary to clean the reservoir, drain the hydraulic system as follows:

a. Raise the boom and bucket to nearly full height with bucket in DUMP position. Securely block or chain the booms and bucket. Then shut the engine off.

b. Place a large container under the machine and locate it under the reservoir drain. Using a funnel and a length of hose, drain the reservoir by removing the magnetic type drain plug.

c. After the reservoir is completely drained, break the suction hose connection at the reservoir and disconnect the pump pressure hose at the control valve so that the pump and pump hoses can drain. Operate the valve control lever to thoroughly drain the valve.

d. Disconnect the hoist cylinder hoses at their lowest points and drain the cylinders.

e. Remove the reservoir cleanout cover and reach into the reservoir to remove the suction line strainer. Wash the strainer in a clean solvent to remove all particles of dirt and lint. Blow dry with dry compressed air.

f. Flush out the overflow pipe with a clean, lightweight oil.

g. Clean all dirt and sludge from the bottom of the reservoir. Be careful not to force dirt into the hydraulic lines or the control valve. If any dirt is in the control valve, the valve must be removed and cleaned.

h. After the oil has stopped draining from the reservoir, pump, hoist cylinders, control valve and lines and the sludge and dirt have been cleaned out of the reservoir, reconnect all hoses and unions. Clean the reservoir drain plug and replace it in the bottom of the tank.

i. Replace the suction line strainer in the reservoir.

j. Fill reservoir with SAE 10 HD motor oil until level of oil is near hand hole cover.

k. Check that all control levers are in NEUTRAL and start the engine.

l. After the engine is warmed up, open and close the bucket several times and lower and raise the booms several times to purge all air from the hydraulic system. After the oil in the reservoir ceases to foam, add oil to bring the level up to the proper dipstick level.

m. Check for leaks at all connections.

n. Replace hand hole cover.

Always drain the hydraulic system after working the "PAYLOADER", when the oil is warm and will flow more freely.

HYDRAULIC HOIST CYLINDERS

The hydraulic cylinders (See Figure 9) are so constructed that no adjustments are necessary other than tightening the packing if an excessive amount of oil escapes. When the packing is tightened, it should be adjusted so that this compensates for packing wear and allows the wiper seal to remove dirt and other foreign matter from the rod as it is drawn into the cylinder.

The hydraulic hoist packing is the chevron type, made up in sets of special rings. When the packing and wiper seals become worn, as evidenced by oil escaping excessively, they must be replaced. To replace proceed as follows:

a. Disconnect the hoses to the hoist and cork the hoses on the valve side so that excessive amounts of oil will not escape from the system.

b. Remove the hoist cylinder from the machine by disconnecting the pivot pins.

c. If the piston rod packing is to be replaced, it is good practice to inspect the piston head packing, the "o" ring oil seals and the guide ring wiper seal and replace them, if necessary, at this time.

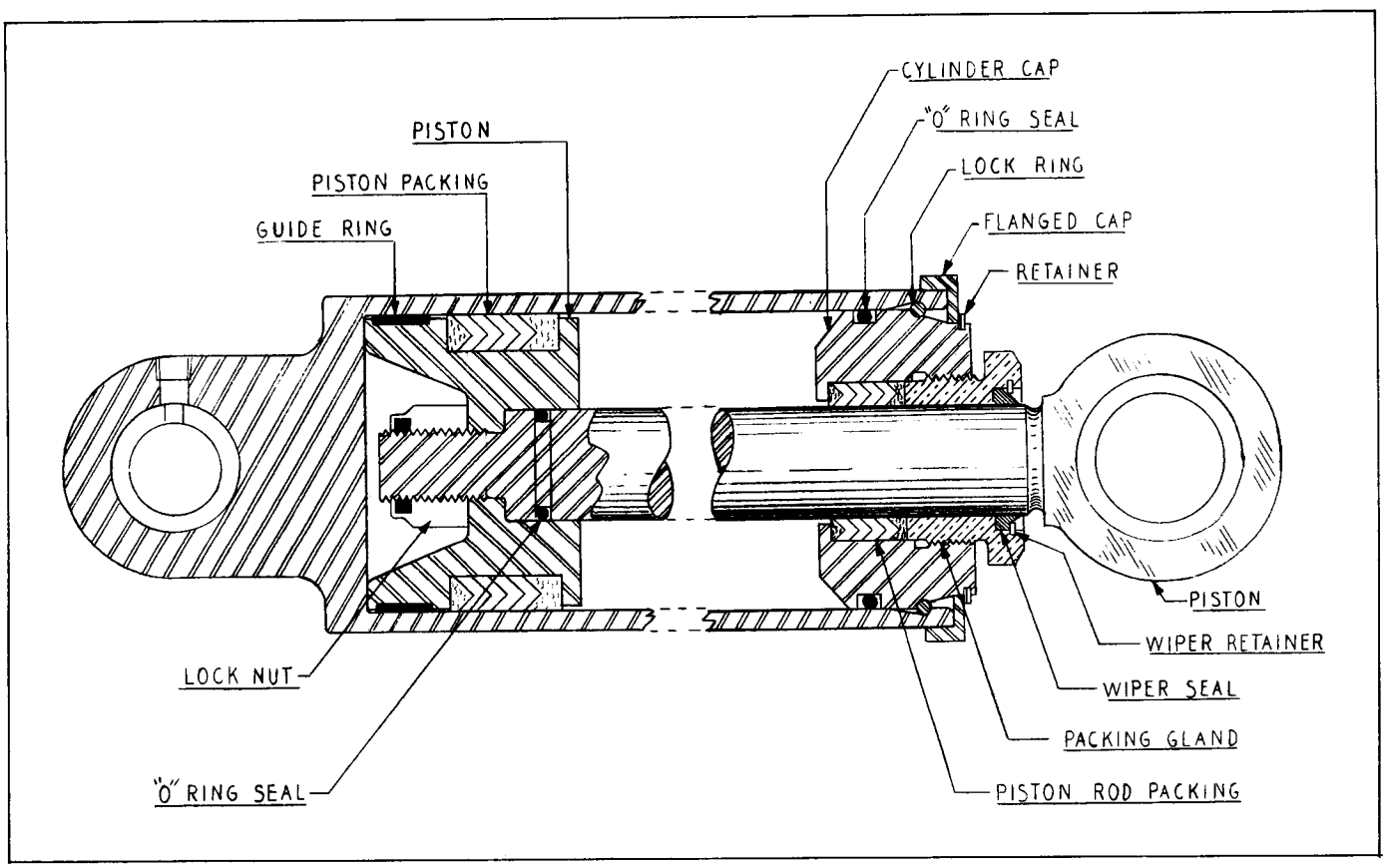

Figure 9. Cylinder Packing and Seals

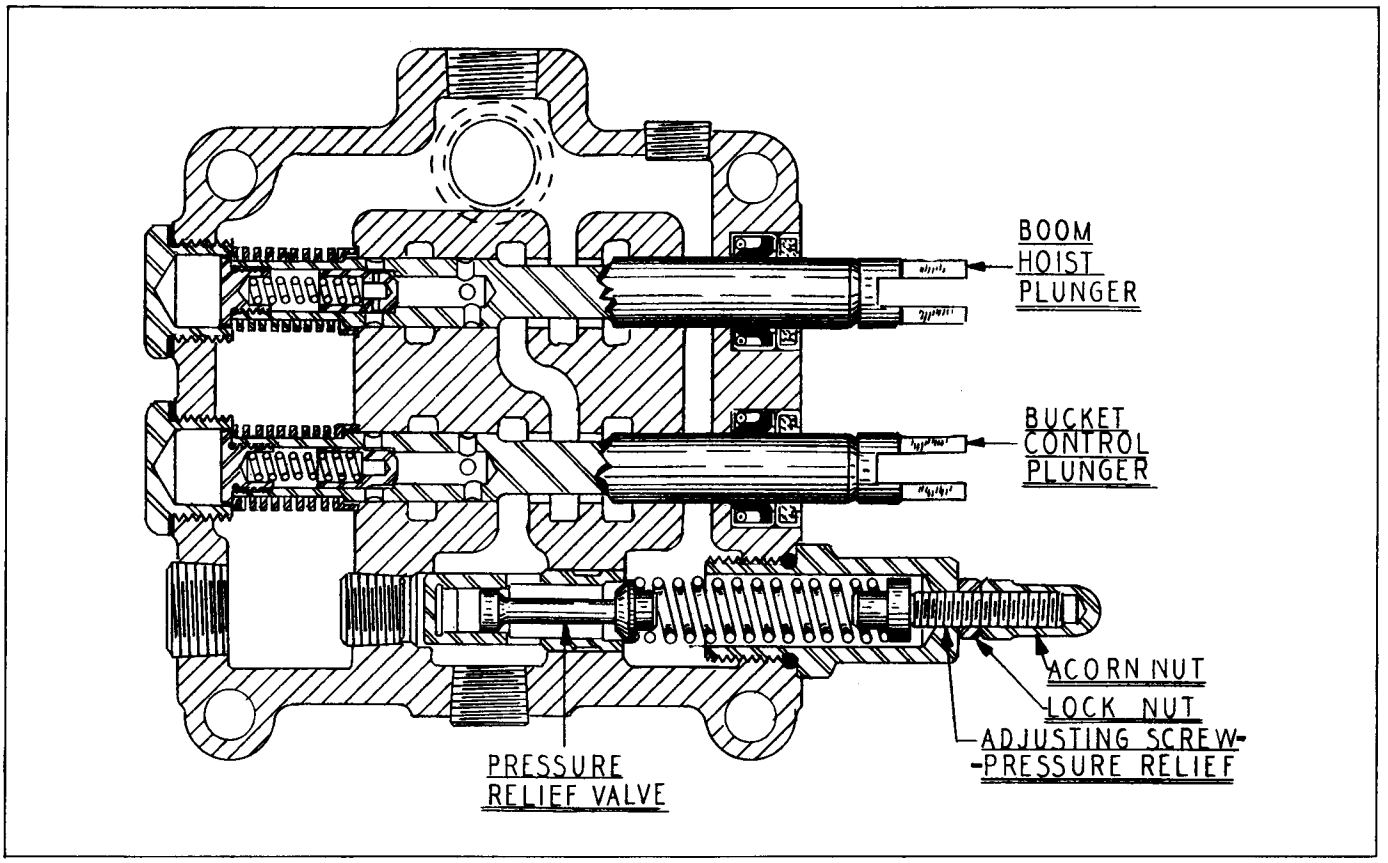

Figure 10. Hydraulic Control Valve Section

d. With the hoist cylinder removed from the machine, draw out the piston rod to extend it 10 or 12 inches; then unscrew the packing nut from the cylinder cap. It is then possible to remove the old piston rod packing by use of a slender, blunt hooked instrument. Be careful not to damage the interior of the packing recess or to scratch the piston rod surface when removing the old packing. Pay special attention to the order in which the original packing was arranged, so that the new packing can be placed in the recess similarly. Replace new packing carefully. Damaged rings must be discarded.

e. With the packing nut removed from the cylinder cap, remove the flanged cap retainer and then the flanged cap itself from the cylinder. Next, push the cylinder cap inward, down into the hoist cylinder, sufficiently to expose the cap lock ring. Using a probe or pick, remove the lock ring. The entire piston and piston rod assembly can now be pulled out of the cylinder and the piston packing, the piston guide ring and the "o" ring oil seals can be inspected and replaced if necessary.

f. To inspect and replace the piston head "o" ring seals and the packing nut wiper seal, it is necessary to unscrew the locknut from the end of the piston rod. Then slide the piston head, the cylinder cap and the packing nut off the end of the piston rod. The piston head "o" ring will be found on the piston rod.

g. Replace the wiper seal in the packing nut by removing its retainer ring and then the wiper seal.

h. Inspect the cylinder cap "o" ring seal and inspect the piston head guide ring at this time. Damaged rings must be replaced.

i. After the packing and the seals have been replaced, reassemble the piston rod in the reverse order of removal. Be sure that the "o" ring seals will not be pinched during reassembly.

j. After the piston rod assembly is replaced in the cylinder and the piston rod packing is replaced, screw the packing nut down into the cap until there is a snug fit.

k. There should be 1/16 to 3/32 inch compression when the packing nut is screwed in tightly. A properly adjusted nut will allow a slight film of oil to remain on the rod each time it emerges from the hoist cylinder.

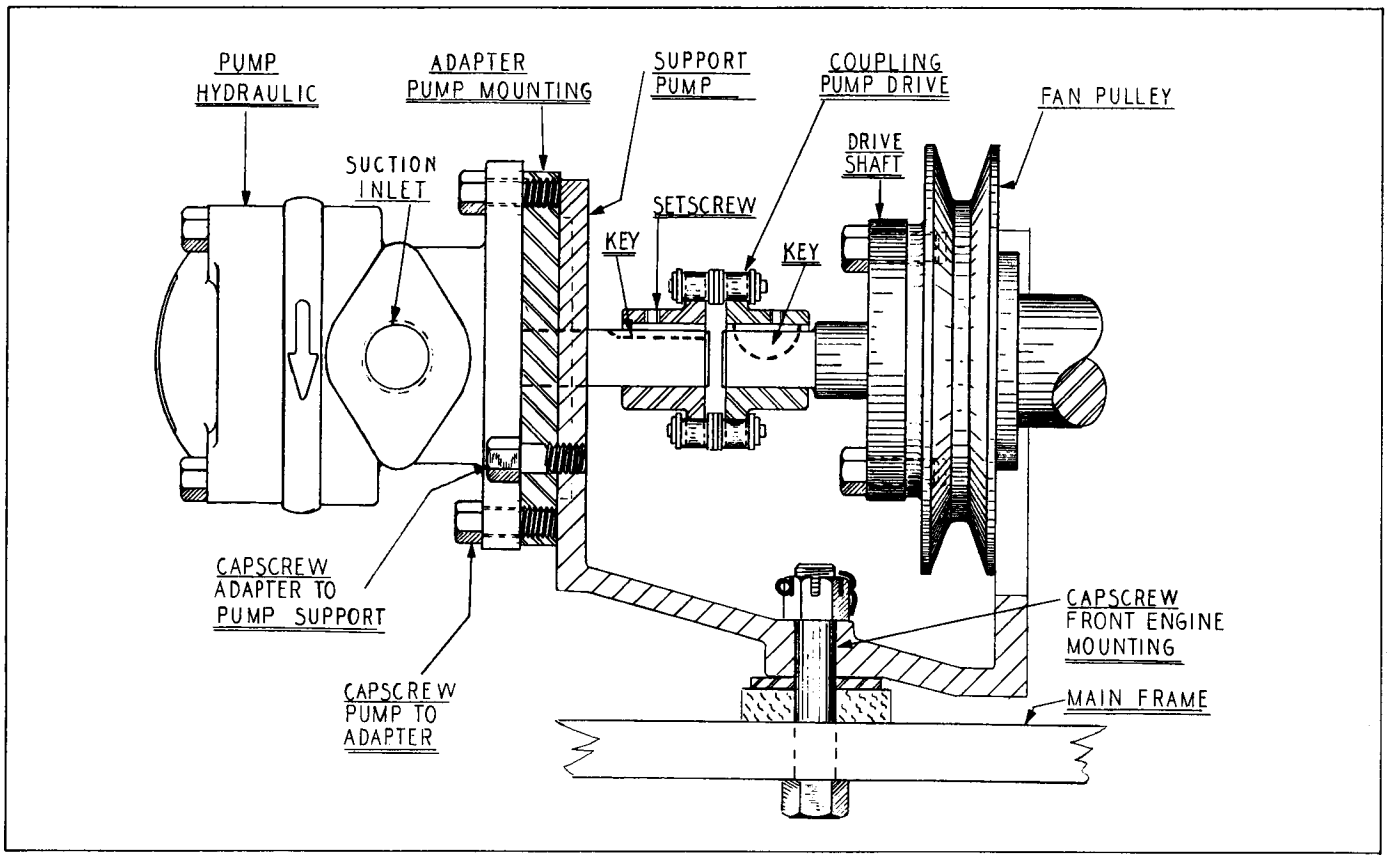

Figure 11. Hydraulic Pump Mounting

l. Reassemble the hoist cylinders to the machine; make sure that all hose connections are tight.

m. Fill the oil reservoir with SAE 10 HD motor oil and start the engine. Let it run at idle speed for a time and bleed the system of air by raising and lowering the boom and opening and closing the bucket.

n. After all work is completed, lower the bucket to the ground and check the oil level in the reservoir to see that it is to the correct level before putting the machine to work.

HYDRAULIC CONTROL VALVE

The hydraulic control valve (Figure 10) receives oil under pressure from the pump and directs it to the boom and bucket cylinders. When the control valve plungers are in "hold" position, the oil already in the hoists is retained, but oil from the pump flows through the valve back to the reservoir. In "raise" and "close" positions, the oil from the pump is directed into the respective cylinders. In "lower" or "dump" positions, the oil returns from an end of the cylinder, through the valve and into the reservoir along with oil that has passed through the hydraulic relief valve.

No adjustments are to be made other than to adjust the pressure relief and to remove the control valve and wash it out with a clean solvent every 1000 hours of operation. Whenever the oil in the reservoir is very dirty or dirt is forced into the control valve when cleaning the reservoir, the control valve must be removed and washed out. Premature valve failure or excessive wear is frequently the result of foreign matter getting into the valve because of dirty oil.

Springs and seals can be replaced when necessary, but the manufacturer does not recommend replacement of the plungers as they have been fitted to the body at the factory to maintain close tolerances.

HYDRAULIC OIL RESERVOIR

The oil reservoir is located just back of the operator's seat. The oil level in it must be maintained up to the full mark on the dipstick (bucket on the ground).

There are no adjustments on the reservoir; however, it should be drained, cleaned of dirt and sludge and refilled with clean oil every 1000 hours or oftener if working conditions are very dirty and dusty. The

suction line strainer is inside the tank at the suction line outlet to the pump. This strainer must be kept clean. A dirty strainer will retard the flow of oil to the pump, causing the pump to howl, and the boom will raise in a slow, jerky manner. Remove the hand hole cover to reach into the tank to remove the strainer. Inspect the "o" ring seal on the dipstick cap to be sure that it provides a tight seal.

The hydraulic control valve is mounted on the left hand side of the machine adjacent to the operator's seat. To remove the valve, proceed as follows:

a. Disconnect the hoses from the control valve and plug openings. Disconnect the control lever linkage at the valve.

b. Unscrew the capscrews holding the valve to the frame and the control valve will come away.

c. After the valve is rebolted in place, connect the hoses. Refer to the hydraulic diagram to note the proper connection points. Be sure that the connections are tight and will not leak oil. Reconnect the valve lever linkage. Refill the reservoir with SAE 10 HD oil to the full mark on the dipstick. Operate the boom and bucket several times. Shut off the engine with the bucket on the ground. Inspect the connection points for leaks and then recheck the oil level in the reservoir.

PRESSURE RELIEF VALVE CHECK

To safeguard the pump and to maintain efficient operation of the machine, the control valve pressure relief must be set to operate at 1500 PSI at full throttle. Check the control valve pressure relief setting at each monthly inspection period as follows:

a. Insert a hydraulic gauge (2500 psi rating) into the high pressure line, pump to control valve.

b. Remove the acorn nut from the valve to expose the relief valve adjusting screw and loosen the hex lock nut.

c. Start the engine and run it at low idle speed. Raise the bucket and booms to nearly full height. Hold the control lever in RAISE and gradually increase the engine speed. Note the increase in oil pressure as the engine rpm increases. Do not allow the oil pressure to exceed 1500 PSI.

If the oil pressure tends to reach correct pressure before the engine is running at full throttle, decrease the engine speed and turn the relief adjusting screw counter-clockwise to lower pressure. Repeat this process of gradually increasing the engine speed while adjusting the relief screw until the gauge registers the correct pressure at full governed engine rpm while the booms are raised and the control lever is held in the raise position.

When the pressure relief reaches correct pressure consistently, under conditions as instructed, the adjuster screw can be locked in place and the acorn nut replaced.

HYDRAULIC PUMP

The gear type hydraulic pump (Figure 11) is coupled directly to the engine crankshaft by a flexible chain coupling and is mounted directly under the machine's radiator. It draws oil from the hydraulic reservoir and pumps it under pressure into the hydraulic control valve. The machine's engine should not be operated unless there is a sufficient amount of oil in the hydraulic system because the moving parts of the pump are lubricated by the oil of the hydraulic system. The efficiency of the dump depends almost entirely upon minimum clearance of a few thousandths of an inch between the pumping parts; therefore, to keep wear at a minimum, the pump must always be well lubricated.

If the pump does not develop sufficient pressure for the hydraulic system and the cause cannot be determined, contact a dealer of THE FRANK G. HOUGH CO. to obtain information on the repair or replacement of pump parts. The pump's rated capacity at 2000 rpm is 18 gpm.

PUMP REMOVAL. The hydraulic pump can be removed from the HA "PAYLOADER" Unit as follows:

a. Remove pump cover from the grille casting by loosening the cover nut and turning the cover clamp with a screw driver. The cover clamp can be turned by means of the slot cut in the end of the clamp's stud.

b. Drain hydraulic reservoir and disconnect pump hoses at the pump. Plug open ends of hoses.

c. Remove pump mounting bolts from mounting plate.

d. Pull pump free of coupling. The pump must be withdrawn from the coupling in a straight line to prevent the possibility of the coupling becoming jammed on the shaft.

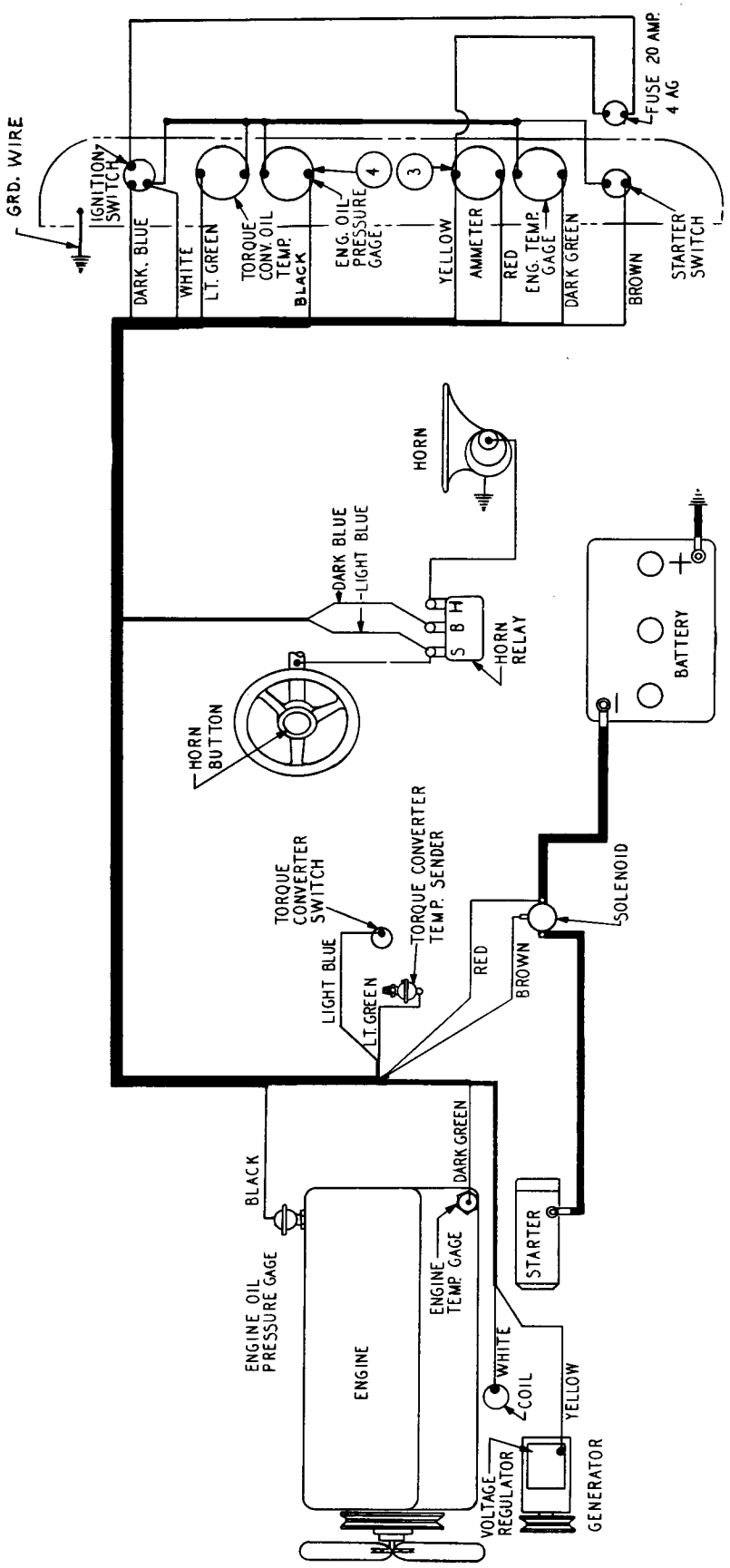

Figure 12. Gas Wiring Diagram

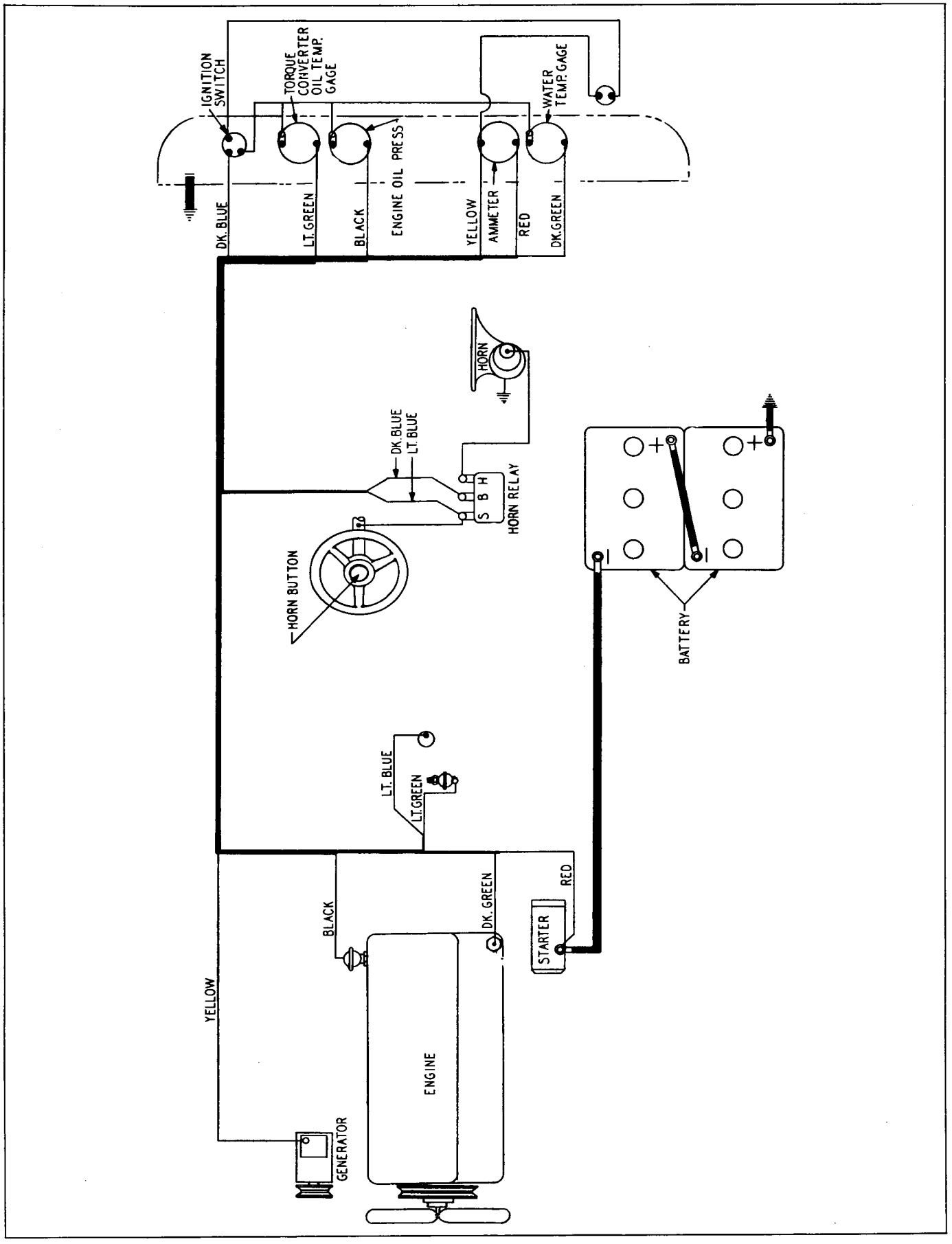

Figure 13. Diesel Wiring Diagram

PUMP INSTALLATION. The hydraulic pump is installed in the same manner as that in which it was removed. During installation procedures, the key in the pump's drive shaft must be seated and in line with the key slot in the coupling.

SHOCK ABSORBER

The hydraulic system's shock absorber (accumulator) should be checked periodically with a reliable gas gauge to ensure that a sufficient amount of gas pressure exists in the shock absorber cylinder. To function properly, the pressure in the shock absorber cylinder should be approximately 250 psi when no hydraulic pressure is exerted against the shock absorber piston. If the gas pressure is less than 150 psi, charge the shock absorber as follows:

a. Check that boom is resting on ground.

b. Remove cap from end of shock absorber cylinder so that charging valve will be exposed.

c. Attach a gauge assembly to the charging valve. An Accumulator Charging Kit that includes a gauge, adapter and hose assembly can be obtained through a dealer of THE FRANK G. HOUGH CO.

d. Check that no gas can bypass the gauge and then open the accumulator charging valve. The "no load" gas pressure in the shock absorber should be approximately 250 psi.

e. If the gas pressure is less than 150 psi, connect a hose between the gauge assembly and a standard bottle of dry nitrogen. The bottle must be equipped with a shutoff valve and, if possible, a pressure regulator.

CAUTION

An inert gas, such as dry nitrogen, must be used in the shock absorber to prevent the possibility of an explosion caused by the high pressure and heat generated in the presence of combustible oil when the shock absorber operates under normal conditions.

f. Open the bottle shutoff valve gradually and regulate the gas pressure to 270 psi for a short period of time. The boom control lever must be operated to LOWER while gas is being added to the shock absorber.

g. Close the bottle shutoff valve and disconnect hose from gauge assembly.

h. Open shock absorber charging port with gauge shutoff valve and check the gas pressure in the shock absorber.

i. Repeat steps e. through h., if necessary, to bring the shock absorber pressure up to 250 psi.

j. If gas pressure exceeds 250 psi, bleed it off through the gauge assembly shutoff valve.

k. Remove gauge assembly and install protective cap over end of shock absorber charging valve.

Before initial filling or whenever it is necessary to purge the shock absorber cylinder, all gas should be removed from the cylinder before nitrogen is added. To purge the shock absorber, it is necessary to remove the protective cap from the gas chamber of the cylinder. Start the engine and raise the boom until a maximum hydraulic pressure reading is indicated on the dash gauge. Operate the control lever to NEUTRAL and open (or remove) shock absorber charging valve. The hydraulic pressure acting on the shock absorber piston will force it to the end of the cylinder and expel all gas and any accumulation of oil. (Caution must be exercised while performing this operation because it may allow the boom to drop slowly.) Close (or replace) charging port and lower boom to ground. Then charge the shock absorber as previously described.

ENGINE

The HA "PAYLOADER" is powered with either a diesel or gasoline engine.

The gasoline powered machine is equipped with a Waukesha F.C. Industrial engine. The diesel powered machine is fitted with a Waukesha 180DLC engine.

Refer to the Waukesha Engine Operating and Maintenance Manuals pertaining to the gas or diesel models for complete maintenance information.

The engine, radiator, pump, torque converter, clutch and transmission can all be removed as a single unit. To remove this assembly, proceed as follows:

a. Remove the engine hood top, the rear grille casting, the seat cushions, the hydraulic reservoir, the seat support frame and the hydraulic control valve.

b. Disconnect the accelerator rod at the engine, the clutch operating rod at the clutch, the gear shift linkage at the transmission, the engine control rods at

the engine and the fuel lines at the engine. Remove the muffler and the air cleaner. Disconnect and remove the batteries and the battery hold downs. Disconnect the wiring connections at the engine.

c. The engine is mounted to the frame at three points, two at the flywheel housing and one at the rear of the machine under the engine fan.

d. Pass cable slings under each end of the engine. Remove the bolts retaining the engine to the frame, remove the engine supports from the flywheel housing and then remove the engine from the frame.

When engine is replaced or a new engine is installed, do not run it unless the hydraulic pump has been disconnected or until the hydraulic pump is again connected to the hydraulic system with a sufficient supply of oil.

Be sure that a sufficient supply of oil is in the engine crankcase and that the radiator is full before running the engine.

To reassemble the engine to the machine, it will save time if the drive shaft is separated beforehand. While the engine can be removed without unbolting the drive shaft yokes, it will be difficult to slide the yoke on the shaft when the engine is reassembled to the "PAYLOADER".

FAN BELT

Untimely shutdowns or damaged radiators can be avoided by frequent replacement of the fan belt. The fan belt should be inspected at each monthly service period and replaced if it shows signs of deterioration. If the machine is laid up for a time, it is good practice to ease the fan belt tension because belts will deteriorate if allowed to remain taut for prolonged periods. The belt is properly stressed when the center of the belt can be pressed inward, by hand, to approximately 3/4 inch.

FAN BELT REMOVAL

The diesel fan belt is removed by slipping it from the lower pulley, then from the upper pulley and passing it over the fan blades.

Whenever the fan belt is being replaced, also inspect the generator belt since it can only be replaced after the fan belt is removed.

To replace the generator belt on machines equipped with diesel engines, loosen the generator mounting bolts and push the generator inward to relieve the belt tension. Remove the belt by passing it over and around the fan blades.

The gasoline engine fan belt can be removed only after the hydraulic pump is disconnected from the crankshaft. To remove the fan belt from machines equipped with gas engines, proceed as follows:

a. Loosen the hydraulic pump adapter from the pump bracket and pull the pump away from the bracket as far as it will go. It is not necessary to disconnect the pump hoses.

b. From inside the engine shrouding, loosen the generator bracket adjusting screw and push the generator in toward the engine and retighten the screw slightly.

c. Remove the fan belt from the generator pulley and the lower fan belt pulley; then slip the belt over the fan.

Install a new fan belt by reversing the method of removal. Replace the pump. The pump drive shaft keys must be in place and in line. The pump can then be pushed in place easily. Bolt the pump securely. Adjust the fan belt tension. Replace the pump cover in the grille.

AIR CLEANER SERVICE

A regularly serviced and properly working air cleaner contributes considerably to the long life of an engine. Large amounts of foreign particles are present in most atmospheres and the abrasive action of such foreign matter causes rapid wear on the valves, bearings and cylinder walls when it is carried into the engine. The purpose of the air cleaner is to collect grit and dirt before they reach the engine. For most effective operation, the cleaner itself must be cleaned as often as dirt accumulations start to build up. Sometimes the cleaner must be cleaned and the oil in it changed several times a day if conditions are especially bad. Proper servicing of the air cleaner is important.

Remove the oil cup, wash it out in clean gasoline and refill the cup to the oil level bead with clean oil of the same grade as that used in the engine crankcase.

NOTE

It is very important to examine the air cleaner tubing periodically for defective connections and leaks. Considerable amounts of abrasive material can be drawn into the engine through minute openings or loose connections in the tubing between the air cleaner and the engine.

OIL FILTER

The crankcase oil filter retards dilution of the engine oil and removes abrasive particles which may have gotten into the oil. The sump in the bottom of the filter should be thoroughly cleaned of sediment and the element should be replaced whenever the crankcase oil is drained.

Read and follow instructions on the box containing the new filter element when replacing the used element.

After replacing a filter element, tighten the cover securely, start the engine and let it operate for about 10 minutes to fully saturate the new filter element; then shut off the engine and inspect the filter cover for leaks. Always check the crankcase oil level after the element has been replaced, since oil drawn into the replacement filter element will reduce the oil level in the engine crankcase.

TRANSMISSION

The transmission is a two speed forward and reverse type gear case. When major repairs to the transmission are necessary, use the extensive facilities offered by THE FRANK G. HOUGH CO. dealers.

Check and service the transmission regularly as specified in the Service Charts. Breathers must be cleaned and kept open to protect grease seals and gaskets. The greases used in the transmission should not be mixed. Use the same grade when adding grease. Refer to the Service Charts for recommended lubricant.

TRANSMISSION REMOVAL

a. Remove the seat cushion and seat frame.

b. Remove the side shields, the rear portion of the floorboard, the battery and the battery box.

c. Disconnect the gearshift levers at the transmission. Disconnect the clutch operating rod at the clutch. It may be necessary to release the clutch return spring to disconnect the rod. Free the pump hose and wiring harness from the clutch housing.

d. Break the universal joint drive shaft at one of the yokes by removing the bolts holding the yoke to the center cross.

e. Remove all bolts holding the clutch housing to the converter reservoir housing. Use a hoisting device to support the transmission when removing the bolts. Pull the transmission away from the engine carefully to avoid damage to the clutch disc. The clutch discs and the engine flywheel will then be exposed.

CLUTCH

Proper use of the clutch pedal during loader operation will save considerable wear on the clutch release bearing and the clutch disc. "Riding" the clutch causes rapid wear on the clutch release bearing and the tendency to "feather" the clutch results in premature wear on the clutch disc. The clutch pedal should never be depressed except during the time required to shift gears. Work requiring numerous short runs brings the clutch into constant use which increases the rate of wear on the clutch facings.

The clutch release fingers are adjusted and locked at the factory and are NOT to be adjusted to compensate for facing wear. An adjustment for facing wear and free pedal play is provided in the clutch operating rod.

CLUTCH REMOVAL

Remove the clutch from the machine as follows:

a. Remove transmission. The power take-off shaft with the release bearing and sleeve, will be withdrawn from the clutch when the transmission is pulled away from the engine.

b. Remove the capscrews holding the clutch pressure plate to the torque converter flywheel and lift the complete pressure plate assembly out of the flywheel housing to free the clutch drive plate. Do not mix the capscrews used in the flywheel with ordinary capscrews. Remove the throwout bearing and clean it and the bearing recess on the bearing support. Apply a small amount of high temperature grease to the bearing before replacing it on its support.

CLUTCH INSTALLATION

When installing the clutch to the flywheel, make sure that the cover plate will fit freely before inserting the driven disc; then follow the suggested procedure below:

a. Place the driven disc assembly against the torque

converter flywheel and the cover assembly over the facing disc. Screw in each bolt, finger tight. Insert a spare splined pilot shaft through the clutch to position the facing disc hub. The bolts in the flywheel can be tightened by alternately drawing up opposite bolts until the clutch is securely and evenly fastened; then the spare splined shaft can be withdrawn. Care must be used to avoid bending or misaligning the disc. The clutch will drag if the facing plate is not properly aligned.

b. Bring the clutch housing into position carefully, so that the transmission power take-off shaft can be slipped gently into place through the clutch and the driven disc and into the pilot bearing, without bending the driven disc or otherwise disturbing the alignment of the assembly.

c. Bolt the clutch housing securely in place, replace the clutch operating rod to the clutch arm and reassemble the drive shaft. Install the oil reservoir, seat and seat frame. Replace the hose, wiring clips and the clutch grease hose.

d. After all parts are reassembled properly, the clutch rod must be adjusted to obtain the correct amount of free clutch pedal play.

CLUTCH FREE PEDAL PLAY

Free pedal play is the amount of movement of the clutch pedal before the clutch release bearing contacts the clutch release levers. Lack of free pedal play causes undue wear on the clutch facings and the release bearing. The clutch pedal must have 1 to 1-1/2 inches of free play. Clutch wear decreases this clearance. It is imperative that the pedal be readjusted at frequent intervals to retain this clearance.

To readjust the clutch pedal, remove the clevis pin at the lever arm and turn the clevis on the clutch control rod until the necessary free movement at the pedal is obtained. It may be necessary to adjust the clevis several times to obtain the proper amount of free play.

Tighten the lock nut against the clevis after the adjustment has been made and connect rod to lever arm.

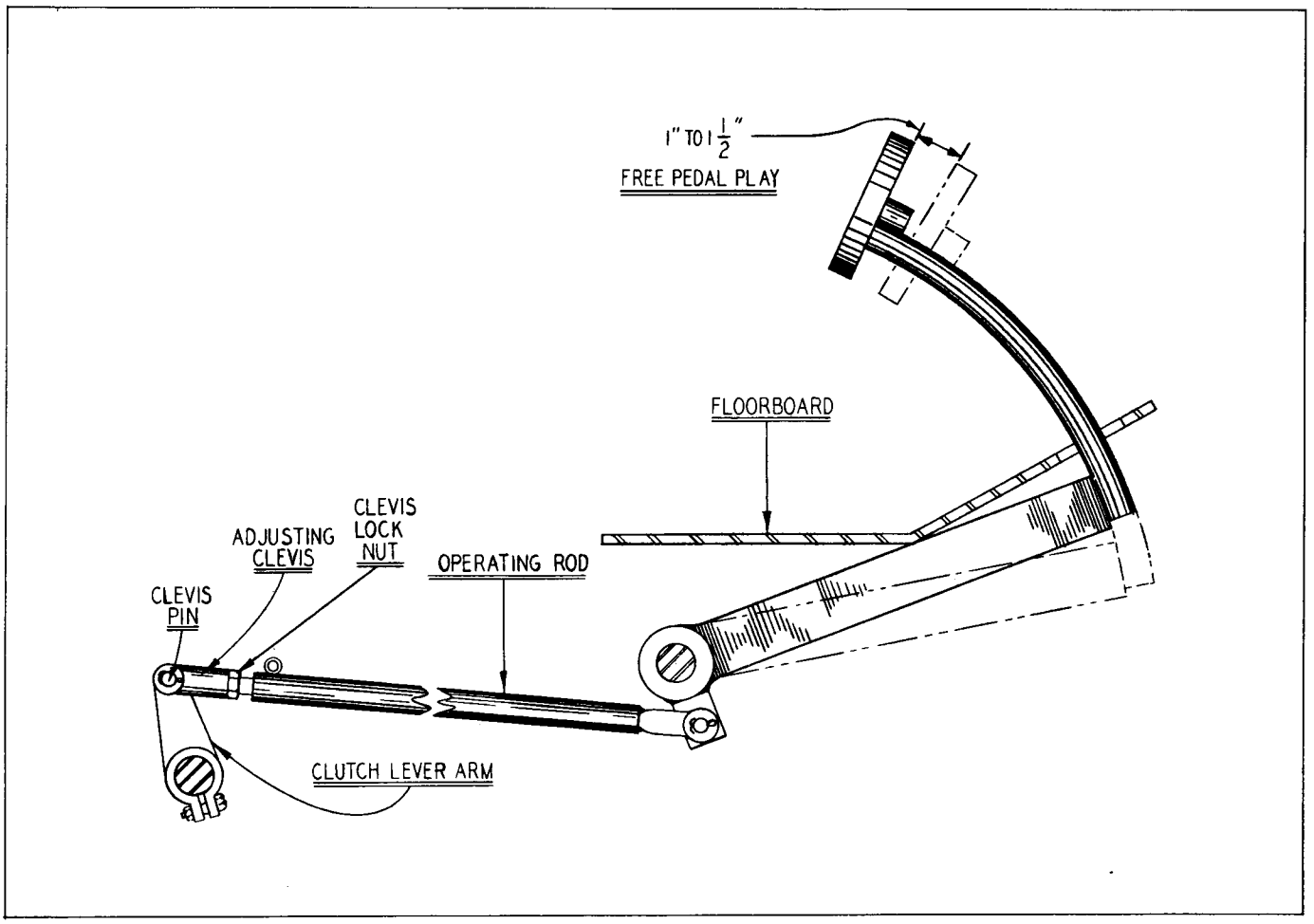

Figure 14. Clutch Pedal Free Play

TORQUE CONVERTER

The purpose of the torque converter is to increase, within itself, the torque generated by the engine, and transmit this increased torque through the transmission to the final drive. It also reduces the amount of shock normally imposed upon the gear train by sudden surges of power.

The torque converter consists of an impeller, a turbine and a single stator. These parts, with the necessary bearings and seals, activate the converter runner shaft which transmit the increased torque through the clutch into the transmission gear train.

In operation, the impeller is driven by the engine flywheel and pumps oil into the converter assembly. The impeller forces this oil, by centrifugal action, against the turbine and the stator.

Under load, the action of the oil against the turbine and the stator multiplies the engine torque. The resulting power is transmitted to the transmission gear train.

At a constant engine torque input, the torque multiplication of the converter varies with the load imposed. When full load is imposed upon the tractor, the torque converter develops maximum torque multiplication. As the tractor load diminishes (such as breaking away from the cut), the torque multiplication proportionately diminishes.

A thermal switch is attached to the torque converter and wired to the horn relay which causes the horn to automatically sound a continuous note when the torque converter oil is in danger of being overheated.

A temperature gauge sending unit is coupled to the converter and wired to the dash torque converter gauge to indicate the temperature of the oil in the converter. Do not allow the gauge to exceed 285° F. As it approaches this reading, remove the load from the machine and idle the engine until the oil temperature gauge registers 225° F.

TORQUE CONVERTER REMOVAL

Removal of the torque converter from the machine is accomplished as follows:

a. Remove the seat cushions, batteries, seat support and floorboard.

b. Disconnect the clutch operating rod and the gearshift lever linkage.

c. Unbolt the transmission from the torque converter housing and withdraw the transmission with the clutch power take off assembly from the converter housing.

d. Unbolt the torque converter housing from the engine flywheel housing and unbolt the converter impeller from the flywheel. Support the converter by means of a chain hoist when removing it from the engine.

DRIVE AXLE

Service the drive axle periodically as specified in the lubrication and service charts. Each differential carrier and wheel housing must be serviced independently. There is no provision made in the axle to permit oil to pass from the differential carrier to either of the final drive wheel housings. Oil filler plugs are located at three points, one in each of the wheel housings and one for the differential housing.

Breathers must be cleaned and kept open to protect the grease seals and gaskets.

For major repairs to the drive axle, refer your problems to the "PAYLOADER" dealer, to obtain the services of a trained mechanic.

DRIVE AXLE REMOVAL

a. Raise the boom and bucket to almost full height. Block them in this elevated position and shut off the engine.

b. Disconnect the brake fluid lines at the wheels. Break the universal joint by removing the bolts holding the yoke to the center cross bearings. Remove the bolts holding the axle housing to the frame. Hoist the machine up so that the axle will be clear of the frame. Block the machine in this position securely and roll the axle out from under the machine.

DRIVE SHAFTS

The drive shaft is a double universal joint of roller bearing design. Each bearing retainer in the joint is held in place by an integral key and pilot and two capscrews. The roller bearings are protected by cork dirt seals which are held in place by steel retainer rings. The cork seals and retainers act as grease seals to keep lubrication in the bearings and prevent dirt from entering. There are no adjustments

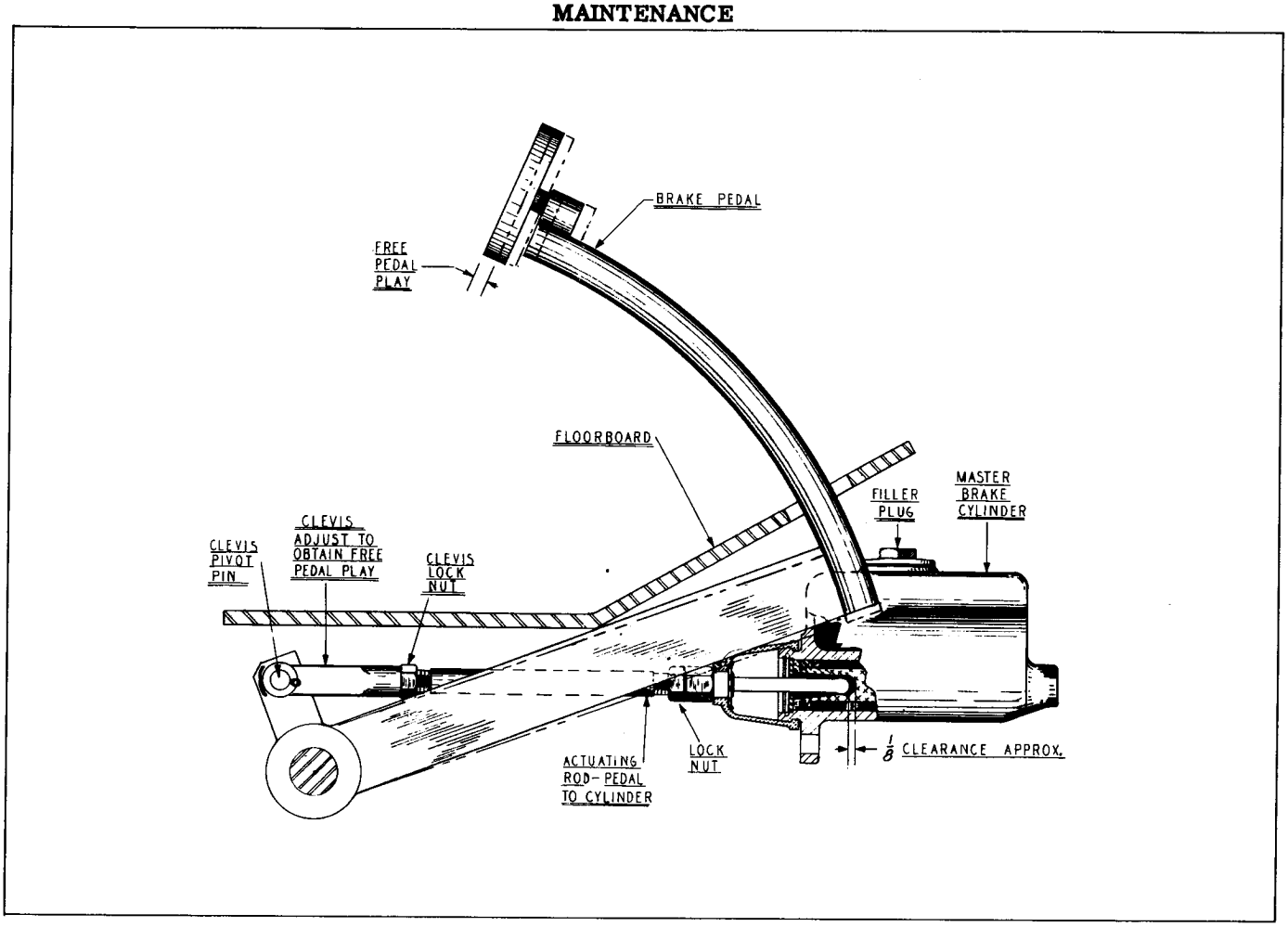

Figure 15. Brake Pedal Free Play

to be made on the drive shaft. Lubricate shaft as instructed in the Service Charts.

To "break" or separate the joint, remove the capscrews and the lock holding the center cross bearings to the yoke and tap apart. The needle bearings and the cork seals can then be inspected. The transmission yoke slides onto the splined transmission output shaft, whereas the drive axle yoke is keyed and tapered to fit into the drive axle pinion shaft.

When bolting the bearing assemblies to the yoke, always use the special capscrews provided with the joints. Ordinary heat treated capscrews may prove inadequate. Use a torque wrench to tighten the capscrews to a 20 to 30 lb. torque reading. Periodically, check the capscrews and the yoke nut for tightness.

HAND BRAKE

The hand brake holding tension may be adjusted by turning the knurled cap on the handle of the brake lever. Adjust the holding tension as necessary to make minor compensations for brake shoe lining wear.

This brake acts upon the brake drum on the universal drive shaft and is not affected by the operation of the foot brake pedal or by adjustments made to the wheel brakes.

BRAKE PEDAL ADJUSTMENTS

Adjustment of the brake pedal for free play must be made periodically to compensate for normal brake lining wear or whenever repairs have been made on the brake mechanism. Free play is the amount of movement of the pedal before the brake activating rod contacts the plunger in the master cylinder. Lack of free play results in the master cylinder plunger being depressed prematurely which induces rapid wear of the brake linings. Free pedal play must always be apparent at the top of the brake pedal stroke.

To adjust the brake pedal (Figure 15) disconnect

the master cylinder operating rod at the brake pedal lever. Loosen the clevis locknut and adjust the operating rod clevis so that 1/8 to 3/16 inch clearance is obtained between the end of the rod and the plunger in the master cylinder. The brake pedal must be up against the floorboard to ensure that clearance is measured from the top of the pedal stroke. Replace the clevis pivot pin and flip the pedal lightly by hand to determine free play. When the adjustment is satisfactory tighten the locknut against the clevis to maintain this clearance.

Always check the brake return spring tension to be sure it is strong enough to hold the weight of the brake pedal up against the bottom of the floorboard.

BLEEDING THE BRAKES

Air trapped in the system gives a "spongy" feel to the brake pedal and does not allow pressure applied to the brake pedal to be transmitted most effectively through the lines to the brakes. The hydraulic brake system must be "bled" whenever air gets into the system through a leak or when a line has been disconnected. Bleed the brakes as follows:

a. The longest line from the master cylinder should be bled first. Proper sequence is to bleed the left wheel and then the right. Clean off all dirt from around the master cylinder plug before removing it. Fill the master cylinder with brake fluid before bleeding the lines.

b. Loosen the wheel cylinder bleeder valve about 1/8 turn. Have one man pump the brake pedal slowly while another man opens the bleeder screw each time the pedal is pushed down and closes the screw before the pedal is returned upward. Opening the screw on the down stroke of the brake pedal causes air and fluid to be ejected from the line. Closing the screw before the return stroke of the pedal prevents air from being sucked back into the line.

c. Continue this procedure until air bubbles are no longer seen escaping with the brake fluid from the bleeder hole. Whenever necessary, add fluid to the master cylinder.

d. Repeat steps b. and c. on the right wheel.

e. When both brake lines have been bled of air, refill the master brake cylinder with brake fluid and screw plug in tightly.

BRAKE SHOE ADJUSTMENT

When the brake lining has become worn, as evidenced by the brake pedal nearly reaching the floorboard when depressed, the shoes must be adjusted.

Adjust the shoes by removing the pipe plug from the outside of the drive hub. Insert a feeler gauge of 0.010 thickness through this opening to pass between the forward brake lining and the surface of the brake drum. Adjust the eccentric screw found on the back of the brake dust shield until 0.010 clearance is felt between the lining and the shoe. By turning the wheel, the feeler gauge slot can be made to pass along the entire arc of the brake shoe. Turning the eccentric screw outward and downward will decrease the clearance. Turn it opposite to increase the clearance. When the forward shoe has been adjusted, swing the feeler gauge slot to the rear brake shoe and insert the feeler gauge. Turn the rear shoe eccentric adjusting screw outward and down to decrease the clearance, opposite to increase it. When properly adjusted, this wheel should turn freely without any brake shoe "drag" being felt as the wheel is turned. Repeat above procedure on the opposite wheel. The brake lining clearance should be adjusted the same for each shoe so that the pressure will be equal in each wheel when the brake pedal is depressed; otherwise a sudden stop will tend to draw the machine sideways slightly when the brakes are applied.

BRAKE SHOE INSPECTION

Good brakes are an important factor in the safe operation of any vehicle and they should be kept in good repair. The brake linings should be inspected periodically. Operations requiring short runs with the "PAYLOADER" increase the rate of wear on the linings.

To expose and inspect the brake shoes inside the wheel, proceed as follows:

a. Jack up the front end of the "PAYLOADER" and block it in position so that the front drive wheel tires just clear the floor.

b. Loosen the tire rim lugs and remove the tire and rim from the drive hub.

c. Remove the cotter pin and nut holding the drive hub to the drive axle. It may be necessary to apply pressure on the brake pedal to hold the wheel stationary in order to loosen the hub nut.

d. Remove the drive hub from the axle. Two tapped holes are provided in the hub to mount a wheel

puller to start the hub off the splined end of the drive wheel axle shaft. The brake drum is located on the drive hub by the rim lug studs and will come off with the hub. A tap with a soft hammer on the ends of opposite studs will separate the brake drum from the hub.

After the hub and brake drum are taken off the drive axle, the brake shoes and brake cylinder will be exposed so that the linings can be inspected and work can be done on the brake mechanism.

It is good practice to overhaul the brake wheel cylinders and the master brake cylinder whenever the brake shoes are relined.

STEERING ADJUSTMENTS

STEERING GEAR

Two adjustments are provided on the steering gear to keep it in proper operating condition. Refer to Figure 16 and make steering gear adjustment as follows:

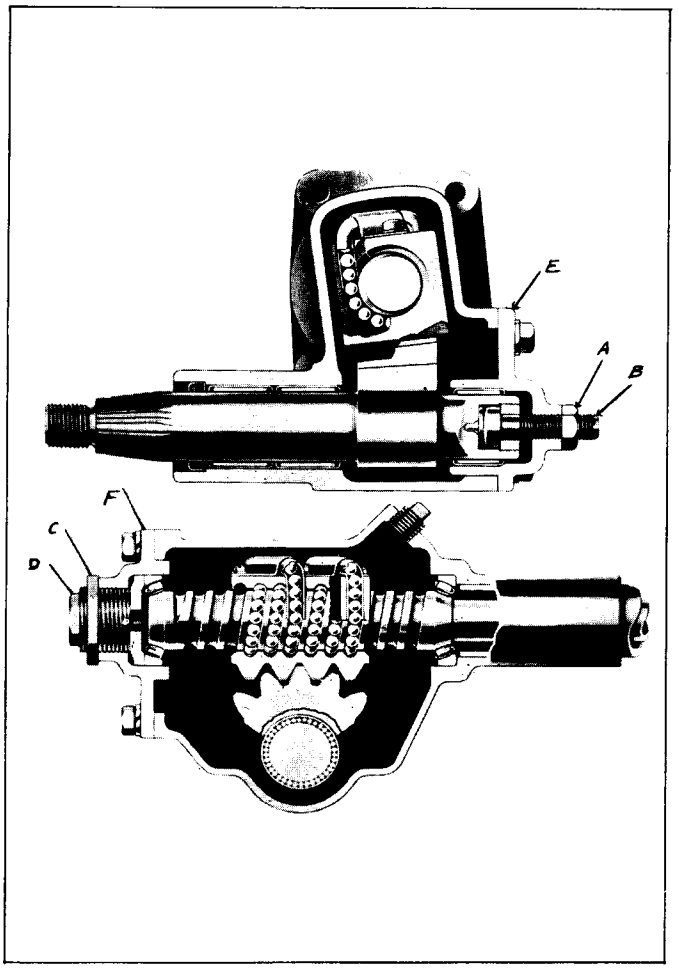

Figure 16. Steering Gear

a. Disconnect drag link from pitman arm. Take care to note relative position of drag link to pitman arm, before separating them.

b. Disconnect upper steering column brace so that there will be no bind in the column.

c. Loosen lock nut (A) and turn adjusting screw (B) a few turns counterclockwise. This will relieve the load upon the steering gear bearings. Turn steering wheel GENTLY in one direction until stopped by gear; then turn it back one turn. Do not turn steering wheel hard against stops when gear is disconnected or damage to the ball guides may result.

d. Measure the pull required at the rim of the wheel to keep the wheel in motion. This pull can be measured by attaching a spring scale to the rim of the wheel with a piece of cord and then pulling on the spring scale to turn the wheel. The line to the scale should be kept tangent to the rim of the wheel. The proper value of the pull at the wheel rim under these conditions is 1-1/2 to 2 lbs. If the value does not lie within these limits adjustment of the steering gear bearings is necessary.

e. To adjust the bearings, loosen locknut (C) and turn adjusting screw (D) clockwise until there is no perceptible end play in the gear. Check pull at wheel rim as above and adjust as necessary to obtain proper pull. Draw up locknut (C) and recheck pull after the locknut is drawn up. If gear feels "lumpy" after making adjustments, the bearings or bearing guides are probably damaged and the gear must be torn down for replacement of damaged parts.

f. After this adjustment is completed, connect in place and secure upper steering column brace in place. Then adjust for proper steering gear lash by first turning steering wheel GENTLY from one stop all the way to the other and carefully counting the total number of turns between stops. Then turn wheel back exactly halfway to the center position. Mark wheel at top or bottom center with piece of tape. Turn adjusting screw (B) clockwise to take out all lash in steering gear teeth and tighten locknut (A). Check pull at wheel rim as before, taking the highest reading of the spring scale as the wheel is turned through its center position. Proper value of pull is 2-1/2 to 3 lbs. Adjust as necessary and check pull after drawing up locknut (A).

g. Reassemble steering connecting rod to pitman arm.

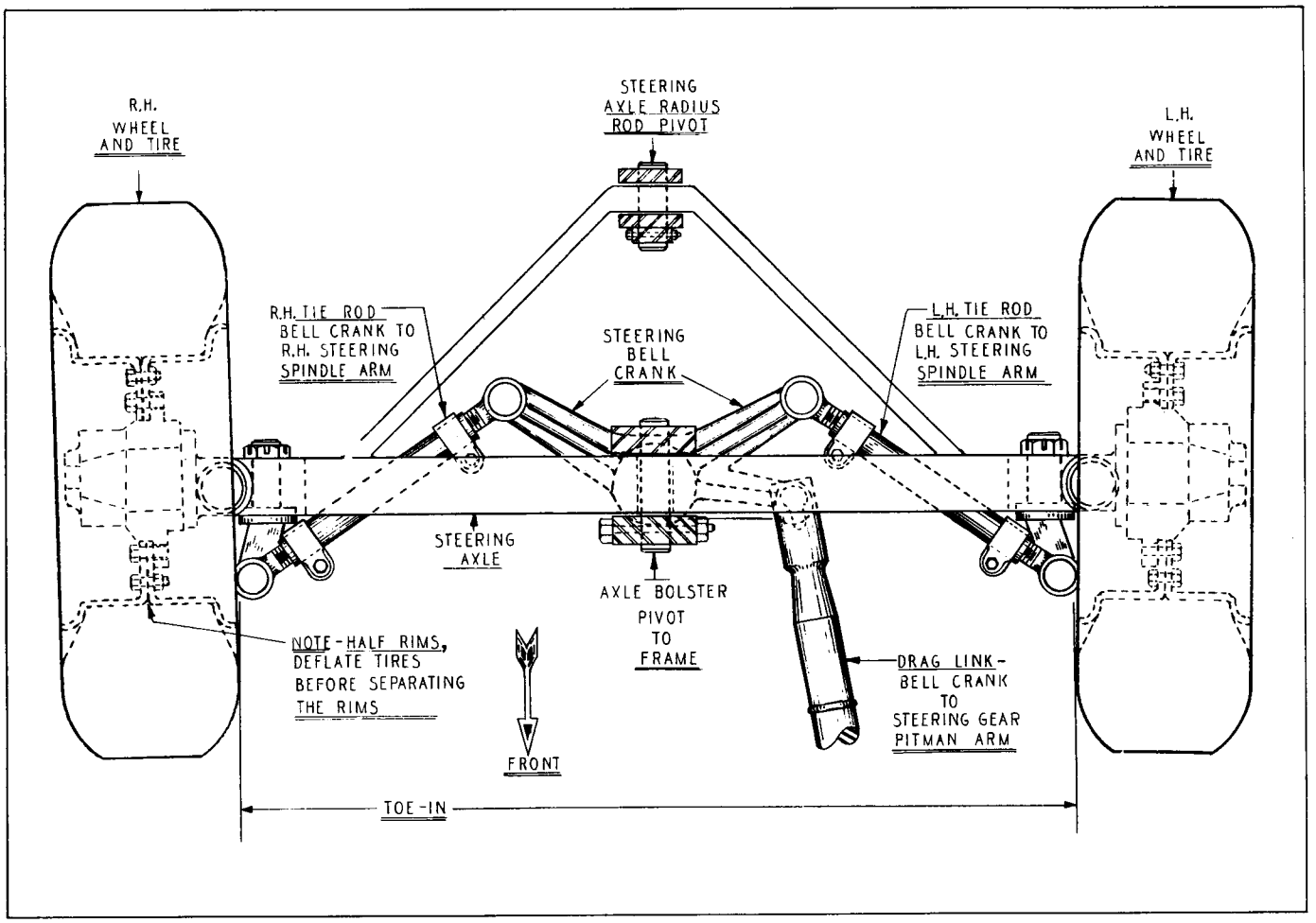

Figure 17. Steering Wheel Linkage

LUBRICATION: The steering gear is filled at the factory with a lubricant that is equal to an SAE 90 EP oil. Seasonal change of lubricant is not necessary.

TOE-IN ADJUSTMENT

The steering assembly (Figure 17) is a twin tie rod type. The steering axle wheel toe-in should be adjusted to best suit the kind of service to which the machine is normally subjected.

For continuous work, requiring the machine to be operated as much in reverse gear as in forward, the steering axle wheel toe-in should be adjusted to zero so that the steering axle wheels are straight in line with the drive wheels. For work which includes long hauls in forward gear, the steering axle wheels may be adjusted to 1/8 inch toe-in for each wheel. Care must be used to adjust the toe-in equally for each wheel.

Make toe-in adjustment by loosening the nuts clamping the tie rods to the tie rod ends. Center the ends of the axle bell crank tie rod arms equidistant from the axle. Keep the bell crank arms centered while turning the tie rods so the steering axle wheels are exactly at right angles to the axle bar. This should place the steering axle wheels in line with the drive wheels. With the bell crank arms properly centered, the distance measured at front and rear points between the wheel rims should be the same when the adjustment is complete. If 1/8 inch toe-in is desired, adjust as instructed above, except the distance measured at the front and rear points between the wheels should be 1/4 inch shorter at the front point than the measurement at the back point.

TURNING RADIUS ADJUSTMENT

If, for any reason, the steering gear pitman arm must be removed, put match marks on both the pitman arm and the end of the pitman shaft so the arm can be relocated in its original position.

Care must be exercised in locating a new pitman arm. Under no circumstances should the pitman be located on the serrated pitman shaft so that the turning of the front wheels is stopped by resistance within the steering gear. The turning arc of the

wheels is limited by axle stop blocks which safeguard the steering gear. Should it become necessary to install a pitman arm on the pitman shaft of the steering gear, proceed as follows:

a. Connect the drag link to the steering arm ball and the pitman arm ball of the new pitman arm.

b. Place the machine on a level floor. Center the steering axle wheels in the straight away position. If the toe-in adjustment has been properly made, the ends of the steering bell crank tie rod arms will be equidistant from the axle bar.

c. Center the steering gear. This can be done by turning the steering gear hand wheel gently, all the way to the right until stopped by resistance within the gear. Place a chalk mark or piece of string on the rim of the hand wheel. Now, carefully counting the number of revolutions, turn the hand wheel gently all the way to the left until stopped by resistance within the gear. Then turn the hand wheel back to the right one-half the total turns. This should place the steering gear in its midposition.

d. With the steering bell crank centered, the axle wheels in straightaway position and the steering gear centered, attach the pitman arm to the serrated end of the pitman shaft extending from the end of the steering gear and tighten the pitman arm nut securely.

e. Check the turning radius adjustment by jacking up the steering end of the machine so that the steering axle wheels are free to be turned easily. Turn the steering axle wheels gently all the way to the right, as in making a right turn. Check to see that contact is made against the axle stop block. Then turn the axle wheels all the way to the left and again check that the turning motion of the axle wheels is stopped by the stop blocks. Check the turning radius adjustment at each monthly inspection period.

CAUTION

Under no circumstances should the turning motion of the steering axle wheels be interrupted by steering gear resistance.

TIRES

Tires and tubes are not sold by THE FRANK G. HOUGH CO. for replacement, but must be purchased from a local authorized tire dealer.

Proper inflation of the tires is a considerable aid to traction and enhances the life of the tire.

The front or drive wheels are equipped with 7:50 x 16 - 8 ply, non-directional tread type. Tubes are fitted with hand bendable valve stems. Inflate the drive tires to 50 lbs. air pressure.

The rear, or steering, wheels are equipped with 6:00 x 9 - 6 ply pneumatic, industrial type tires. Tubes are fitted with a hand bendable valve stem of 3/8 inch offset. Inflate the rear tires to 55 lbs. air pressure.

CHANGING TIRES

To change a rear wheel tire, raise the rear end of the machine and remove the hub cap. Deflate the tire and remove the grease cap.

NOTE

Do not attempt to take the rear wheel apart until the tire is deflated.

The rear tire is mounted on a wheel which consists of two half rims bolted together. After the tire is deflated, remove the five bolts holding the wheel to the axle hub; then remove the bolts holding the rim halves of the wheel together.

To change the drive (front) wheel tires, merely jack up the front wheel, deflate the tire, and remove the lug nuts and rim lugs. Then remove the tire.

REPLACEMENT OF CUTTING EDGE

To replace the cutting edge of the bucket, refer to Figure 18 and follow the procedure outlined below.

a. Lay a straight edge in the bucket so that it lines up with the front edge of the stiffener and clamp it into place. If there is no stiffener on the bottom of the bucket, line the straight edge with the front edge of the bucket sheet.

b. Guide the burning torch along the straight edge to cut through the cutting edge and the weld along the front edge.

c. Follow a similar method for the upright ends of the cutting edge. Burn through the width of the cutting edge at the bends. Burn off the top weld of the ends with a gouging tip.

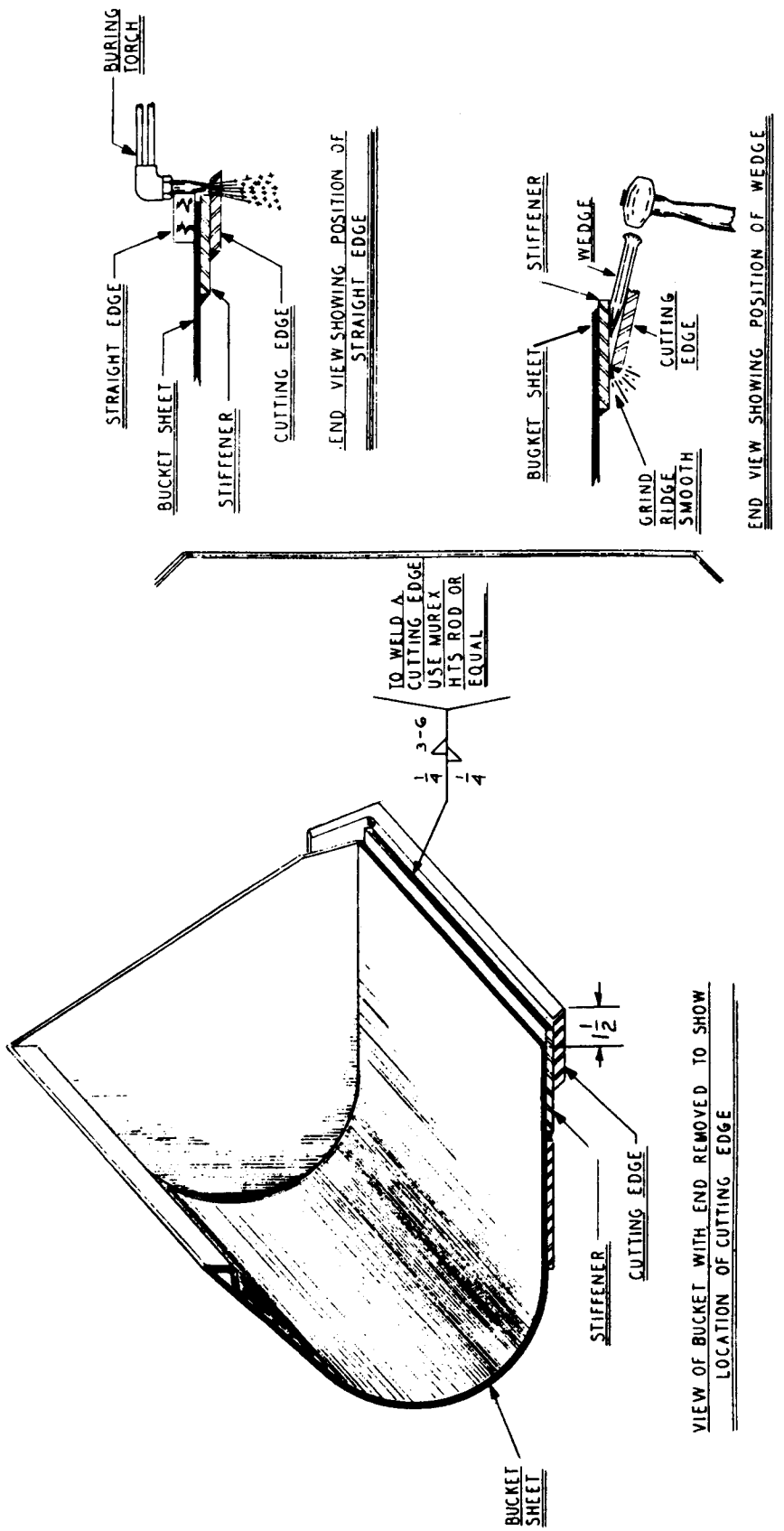

Figure 18. Cutting Edge Replacement

d. Drive a cold chisel or wedge between the stiffener and the cutting edge to break the back weld. Force the chisel between the bucket sides and the side portion of the cutting edge to remove the remaining ends.

e. Clamp the new cutting edge in place 1-1/2 inches beyond the edge of the bucket sheet as shown in the illustration. Tack weld only the ends of the cutting edge to the bucket, to hold it in place, and remove the clamps. Before finish welding the edge to the sheet, bow the cutting edge and the bucket sheet upwards 1/4 inch for every 4 feet of bucket length. This must be done to overcome the weld pull which will draw the edge in a downward bow. To bow the bucket upward, place blocks in the corners of the bucket and lay a stout bar on the blocks so that it lies parallel to the outer edge of the bucket sheet. By means of "C" clamps, draw the center of the cutting edge and the bucket sheet upward against the bar; then proceed to finish weld the cutting edge.

f. Backstep a continuous 1/4 inch fillet weld on the front, joining the cutting edge to the stiffener and to the bucket sides. If bucket has no stiffener, weld the edge to the bucket sheet. Join the back edge to the stiffener or bucket sheet with 1/4 inch fillet welds 3 inches long on 6 inch centers. Use "Murex" 7/32 HTS rod or equal at no more than 200 amperes. Try to get most of the weld penetration into the bucket sheet so as not to upset the temper of the cutting edge.

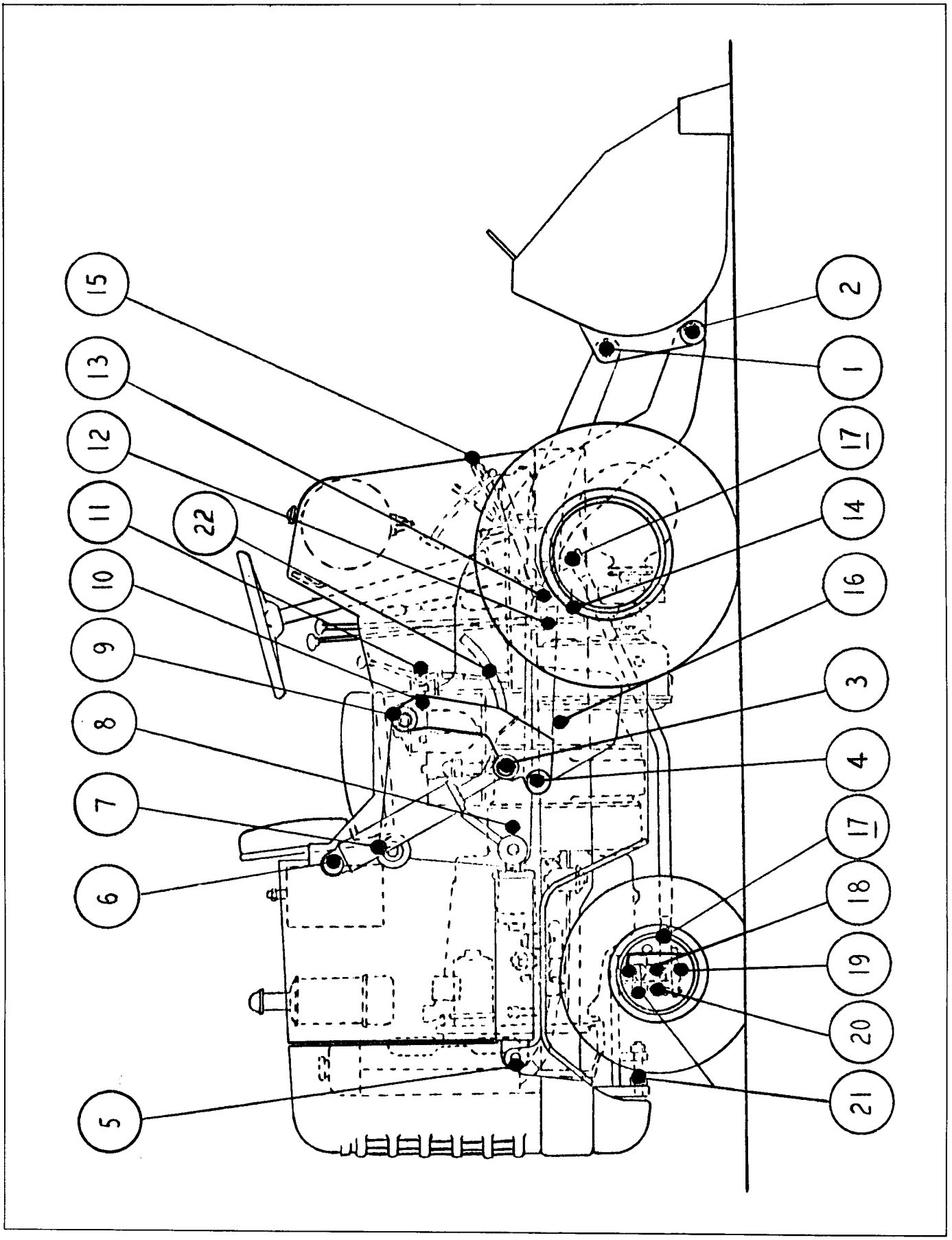

Figure 19. Daily Service Chart

SERVICING THE "PAYLOADER"

DAILY MAINTENANCE

Refer to Figure 19 to locate the following points which are to be lubricated, serviced or checked daily. Only those points which are not evident are identified by a number on the illustration. Each number on the illustration identifies a portion of text that briefly discusses the type of daily maintenance to be performed.

LUBRICATION CHECKS: The following should be checked daily to ensure that a sufficient supply of oil is present.

ENGINE CRANKCASE: Check the engine crankcase oil level daily or oftener if necessary. Add oil to keep the oil level up to the full mark on the dipstick. Do not check the crankcase oil level while the engine is running.

AIR CLEANER: Clean and refill daily or oftener if necessary. To clean, remove the cup and wash it out in clean kerosene. Replace the cup and fill it with clean oil up to the oil level bead. Use the same oil as is used in the engine crankcase. Inspect air cleaner connections and tubing for minute openings or leaks.

LUBRICATION: Use a good grade of general purpose pressure gun grease every 8 to 10 hours of operation to lubricate the following points. Apply three or four shots at each point to force out old grease.

1. Guide to bucket; one each side ..... 2 points
2. Boom to bucket; one each side ..... 2 points
3. Breakout cylinder to link; one each side ..... 2 points
4. Link to guide; one each side ..... 2 points
5. Boom cylinder to frame; one each side. 2 points
6. Breakout cylinder to frame; one each side ..... 2 points
7. Boom to frame; one each side. ..... 2 points
8. Boom cylinder to boom; one each side . 2 points
9. Link to boom; one each side ..... 2 points
10. Hydraulic control lever swivel ..... 1 point
11. Hydraulic control lever ..... 1 point
12. Gearshift levers at floorboard ..... 2 points
13. Foot pedals at floorboard. ..... 2 points
14. Parking brake bell crank under floorboard. ..... 1 point
15. Accelerator pedal cross shaft. ..... 2 points
16. Clutch cross shaft; one each side of housing ..... 2 points
17. Steering drag link; one each side. ..... 2 points
18. King pin bushings; two each spindle ... 4 points
19. Steering axle bell crank; at center of axle ..... 1 point
20. Tie rods; one each end ..... 4 points
21. Steering axle pivot to frame; front and rear pins. ..... 2 points

SERVICE CHECKS: Before starting the "PAYLOADER", check the following:

RADIATOR (located at rear end of machine): Check the level of the cooling fluid daily. Do not run the engine if the cooling system is not full. Use clean, soft water, free from alkaline in the cooling system or use a permanent type antifreeze solution when there is danger of freezing temperature (40° F or below). The antifreeze should be a reliable brand. It can be expected to protect and cool the engine only if it is used in accordance with the manufacturer's instructions.

HYDRAULIC RESERVOIR (located in back of operator's seat): Check the oil level in the hydraulic reservoir with the engine off and the

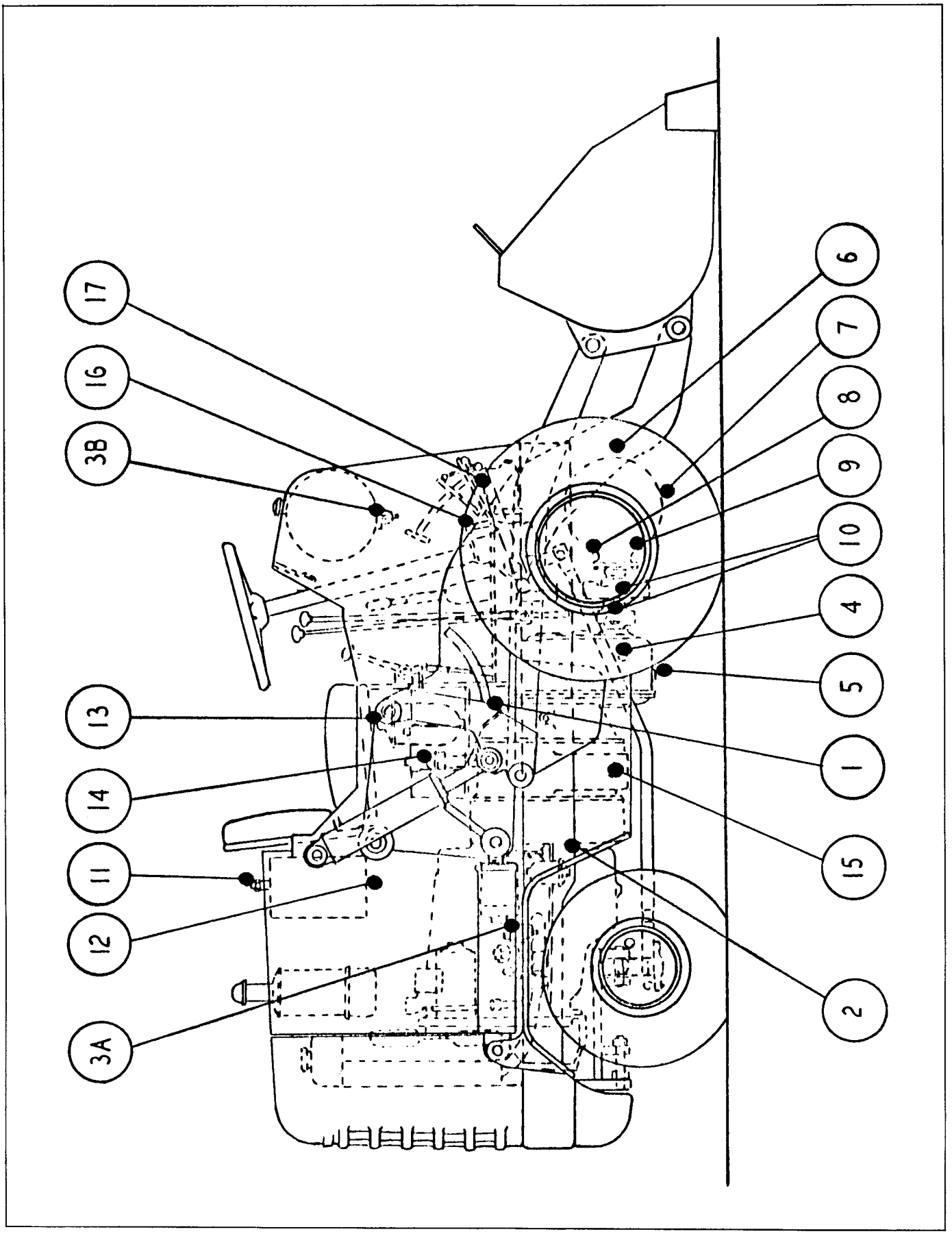

Figure 20. Periodic Service Chart

bucket on the ground. Add oil to keep the reservoir oil up to the oil level petcock. This is necessary to insure proper operation of the hydraulic system. Do not operate machine if reservoir oil level is low.

SERVICE: Service the following daily.

FUEL TANK (located at front of machine): Fill with a clean, acid-free fuel that has been purchased from a reliable company. Use a 70 to 72 octane rating gasoline in machines equipped with gas engines and diesel fuel equal to ASTM Grade 1-D with a minimum cetane rating of 45 in machines equipped with diesel engines.

PERIODIC MAINTENANCE

Refer to Figure 20 to locate the following points. These points are to be lubricated within the specified time period. The type of lubricant should be the same as that specified in the text.

LUBRICATION: Lubricate and check the following points as specified.

1. CLUTCH RELEASE BEARING: Apply two or three shots of the best obtainable high temperature grease every 40 to 60 hours of operation. The grease fitting is on the upper surface of the clutch housing and is connected to the clutch release by a grease hose. It can be reached through an opening under the front seat frame. Never overlubricate or use a pressure gun to service the clutch release bearing.

DISTRIBUTOR CUP (gasoline engine): Lubricate the distributor (1 point) on the right side of the engine with 2 or 3 drops of a lightweight lubricating oil every 40 to 60 hours.

GENERATOR CUPS: Lubricate the generator (2 cups) with 2 or 3 drops of a lightweight lubricating oil every 40 to 60 hours.

STARTING MOTOR: Lubricate the starting motor (1 cup) with 2 or 3 drops of a lightweight lubricating oil every 40 to 60 hours.

ENGINE CRANKCASE: Drain the oil from the engine crankcase while the oil is warm because warm oil will flow freely and carry more dirt and sludge along with it. It is suggested that the oil be drained after 40 to 60 hours of operation.

NOTE

Do not use kerosene to flush out the crankcase because traces of it will remain and dilute any clean oil added to the engine.

After the oil has been completely drained, refill the engine to the mark on the engine dipstick with a good grade lubricant equal to that specified by the Waukesha engine operating manual. In general, use SAE 30 motor oil when operating in hot summer temperatures; SAE 20 motor oil in moderate temperatures and SAE 10 motor oil when operating in cold winter temperatures. The diesel engine filler is located on the right side of the machine and the gas engine filler is on the left.

NOTE

Use clean containers to handle any oil added to the engine.

CRANKCASE BREATHER: Clean the crankcase breather every 40 to 60 hours (when the crankcase oil is changed) in clean kerosene. It may be necessary to "free" the breather oftener in dusty or dirty working conditions. The gas engine breather is located on one of the valve doors. The diesel engine breather is on top of the engine.

2. CRANKCASE FILTER: Replace the oil filter cartridge every 40 to 60 hours of operation. Clean the filter shell whenever the cartridge is replaced and properly install a new cartridge in the shell by following the manufacturer's instructions.

After the new cartridge is properly installed, replace the filter cover. Check that the cover gasket is properly positioned. Start the engine and let it run at low speed for about 10 minutes in order to saturate the new cartridge with oil. Stop the engine and then check the engine oil level. Add oil to obtain a "full" reading on the dipstick.

3A. FUEL LINE STRAINER: Clean the gas engine's sediment bowl and filter element every 40 to 60 hours of operation.

3B. FUEL LINE FILTER: Remove and clean filter on the fuel tank of machines equipped with diesel engines as often as necessary.

4. TRANSMISSION FILL-CHECK PLUG: Keep the level of the transmission oil up to the fill-check plug located on the left side of the housing. Check

the transmission oil level every 40 to 60 hours. Drain the transmission every 500 hours of operation and clean breather vents. Clean the drain plug (5) before replacing it securely and fill transmission with an SAE 90 oil. Periodically check for signs of loose plugs.

6. DIFFERENTIAL FILL-CHECK PLUG: Keep the oil level in the differential housing up to the height of the fill-check plug located on the side of the differential housing. Check the differential oil level every 40 to 60 hours of operation. Drain the differential every 500 hours of operation. Clean the differential vents whenever the oil is drained and replace the drain plug (7) securely before refilling the differential housing. Use SAE 90 oil in the winter and SAE 140 for summer operation.

8. FINAL DRIVE FILL-CHECK PLUG: Keep the oil level in the two final drive housings up to the height of the fill-check plug located on the inside face of the final drive gear reduction housing. Check the oil level in the final drives every 40 to 60 hours of operation. Clean the vent on each housing whenever the oil is drained and replace the drain plug (9) securely before refilling the final drive housings. Use SAE 90 oil in winter and SAE 140 for summer operation.

10. UNIVERSAL DRIVE SHAFT: Lubricate the universal drive shaft every 1000 hours of operation. The shaft, located between the transmission and the differential, can be lubricated at two points (one on each spider and bearing assembly). The yoke splines are lubricated by the oil in the transmission. It is recommended that the spider and bearing assemblies be disassembled and greased by hand in order to prevent damaging the dirt seals of assemblies.

Disassemble the drive shaft by removing the capscrews holding the universal shaft together. Be sure to use the same capscrews provided with the drive shaft when reassembling it. The capscrews must be tightened with a torque wrench to 20 to 30 ft. lb.

11. HYDRAULIC RESERVOIR: Drain the hydraulic reservoir and system after every 1000 hours of operation. Remove the drain plug (12), the hand hole cover and the suction line filter from the reservoir. Remove any accumulations of foreign matter in the reservoir and wash the filter in clean gasoline. While cleaning the reservoir, exercise care not to force dirt or sludge into any of the hoses.

After the reservoir and filter have been thoroughly cleaned and the hoses that were disconnected during cleaning operations have been reconnected, replace the filter and drain plug and refill the hydraulic system with SAE 10 HD motor oil as specified in "Draining the Hydraulic System".

NOTE

Performance of the hydraulic system in hot temperatures (above 90° F) may be improved if an SAE 20 motor oil is used in the system. Use only SAE 10 oil in the system when the machine is operated in temperatures below 90° F.

13. TORQUE CONVERTER FILTER: Change the element in the filter after every 500 hours of operation. Do not change the element while the engine is running or if the temperature of the oil in the converter system is above 150° F (as indicated by torque converter temperature dash gauge). Clean the filter container whenever the element is replaced. Install the new element into the filter according to the instructions accompanying the element. Access to the filter is gained by removing the operator's seat.

After the new element is properly installed, replace the filter cover and the cover gasket. Start the engine and let it run at low speed for about 10 minutes in order to saturate the new element with oil. Stop the engine and check the filter for leaks. Add oil to the converter reservoir housing to bring the oil level up to the "full" mark on the dipstick of the breather-filler cap.

14. TORQUE CONVERTER RESERVOIR: Drain and refill the converter reservoir with SAE 10 HD motor oil after every 1000 hours of operation. Do not remove the drain plug (15) or drain oil from the converter reservoir while the engine is running or if the temperature of the oil in the converter system is above 150° F (as indicated by torque converter temperature dash gauge). Access to the reservoir breather-filler cap is gained by removing the operator's seat.

Check the converter reservoir oil level frequently with the dipstick part of the breather-filler cap. Always attempt to keep the converter reservoir oil level within the "full" and "low" markings on the dipstick. Keep the breather-filler cap clean so that it will pass air freely at all times.

16. REAR WHEEL HUBS: Repack the rear wheel hubs, after every 200 hours of operation, with a good grade of wheel bearing grease.

STEERING GEAR: Keep filled with a good grade of SAE 90 EP oil up to the height of the housing

filler cap. Check every 500 hours of operation and refill when necessary.

SERVICE: Periodically service and check the following points as specified.

17. MASTER BRAKE CYLINDER: Keep filled with hydraulic brake fluid. Check after every 500 hours of operation.

COOLING SYSTEM: Drain and refill the engine cooling system seasonally. Flush the system each time that it is drained to decrease the accumulation of dirt and gum in the water passages and the radiator. To drain the system thoroughly, it is necessary to remove the filler cap from the radiator and open both the radiator and engine block drain cocks.

BATTERY: Keep the plates in each cell of the battery covered with electrolyte. When it is necessary to raise the level of the electrolyte in a cell, add clean rain water or distilled water. Check the battery fluid level after every 40 to 60 hours of operation. The batteries are accessible when the operator's seat is removed.

SHOCK ABSORBER (ACCUMULATOR): The gas pressure in the accumulator should be checked at least every 200 hours of operation. When checking the gas pressure, all pressure on the hydraulic system should be relieved (boom resting on ground) so that the free floating piston in the shock absorber cylinder will be held in the end of the cylinder where oil enters it. Use dry nitrogen gas in the accumulator.

FUEL FILTER: The element in the fuel filter of machines equipped with diesel engines should be replaced after approximately every 500 hours of operation. Clean the filter shell whenever the element is replaced. After the element is replaced, it will be necessary to purge all air from the fuel system.

NOMENCLATURE	CHECK (Hrs. Operation)	CHANGE (Hrs. Operation)	RECOMMENDED LUBRICANT			CAPACITY
			Above 60°F	60°F to 32°F	Below 32°F	
Engine Crankcase	8 to 10	40 to 60	SAE 30	SAE 20	SAE 10	5 qt (gas) 6 qt (diesel)
Air Cleaner	*AR	8 to 10	SAE 30	SAE 20	SAE 10	*AR
Transmission	40 to 60	500	SAE 90			4.3 pt
Torque Converter	*AR	1000	SAE 10 HD			15 qt
Steering Gear	500	*AR	SAE 90 EP			*AR
Differential	40 to 60	500	SAE 140		SAE 90	5.5 pt
Final Drive	40 to 60	500	SAE 140		SAE 90	1.5 pt
Drive Shaft	1000	1000	Short Fiber Grease (MIL-G-2108)			*AR
Brake System	500	*AR	Hydraulic Brake Fluid			*AR
Cooling System	8 to 10	*AR	Water		Antifreeze	14 qt
Hydraulic Reservoir	8 to 10	1000	SAE 20 HD	SAE 10 HD		3.2 gal
Fuel Tank (Diesel)	*AR		Grade 1-D			6.5 gal
Fuel Tank (Gas)	*AR		70 - 72 Octane			6.5 gal

* As Required

SERVICE CHART