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GENERAL DESCRIPTION

The Model "HD-7" tractor is a track-type tractor powered with 68.2 horsepower, 3 cylinder, 2 cycle diesel engine. Power from the engine is transmitted through a single plate over-center type clutch to the top shaft of the transmission, then through the transmission to the bevel gear, and from the bevel gear to the steering clutches, thence through the steering clutches to the final drives and the track drive sprockets.

The transmission provides 4 forward speeds and one reverse speed. At full governed engine speed (under load) of 1500 R.P.M., the speeds range from 1.59 M.P.H. in first gear, to 5.00 M.P.H. in 4th gear and the reverse speed is 1.89 M.P.H.

The tractor is equipped with electrical starting and lighting equipment, muffler, full width crankcase guard, positive seal truck wheels and track idlers, guards for the truck wheels, track idlers and sprockets, an hour meter, and an adjustable radiator shutter.

GENERAL SPECIFICATIONS (STANDARD TRACTOR)

General:

Weight:
- (52" tread) ..... 13,830 lbs.
- (63" tread) ..... 14,000 lbs.

Overall Length:
- (With Bumper) ..... 10 ft. 7¼ in.
- (Without Bumper) ..... 10 ft. 4¾ in.

Overall Width:
- (52" tread) ..... 5 ft. 10 in.
- (63" tread) ..... 6 ft. 9 in.

Overall Height:
- (From face of Track Shoes, without stacks) 5 ft. 6-9/16 in.

Tread Width — Center-to-Center of Tracks:
- (Narrow tread) ..... 52 in.
- (Wide tread) ..... 63 in.

Turning Radius:
- (52" tread) ..... 7 ft.
- (63" tread) ..... 7 ft. 4 in.

Length of Track on Ground:
- (Center of Sprocket to Center of Track Idler) 5 ft. 7 in.

Track Shoe Width:
- Standard Shoes (52" and 63" tread) ..... 16 in.

Maximum Width Track Shoes:
- (52" tread) ..... 16 in.
- (63" tread) ..... 28 in.

Maximum Width Track Shoes available:
- (52" tread) ..... 16 in.
- (63" tread) ..... 24 in.

Ground Contact Area:
- Standard Shoes ..... 2144 sq. in.

Ground Pressure — Standard Shoes:
- (52" tread) ..... 6.45 lbs. sq. in.
- (63" tread) ..... 6.53 lbs. sq. in.

Ground Clearance:
- (From face of Track Shoes) ..... 9-13/16 in.

Lateral Movement of Drawbar ..... 19½ in.

Drawbar Height:
- (From face of Track Shoes to Center Line of jaws) ..... 11⅜ in.

Maximum Speeds:

1st gear	1.59 M.P.H.
2nd gear	2.19 M.P.H.
3rd gear	2.97 M.P.H.
4th gear	5.00 M.P.H.
Reverse	1.89 M.P.H.

Engine:

Make	General Motors
Type	2-Cycle Diesel
Number of Cylinders	3
Bore and Stroke	4¼ x 5 in.
Piston Displacement	213 cu. in.
Full Governed Speed: (Under load)	1500 R.P.M.
Engine Speed: High Idle	1625 ± 15 R.P.M.
Engine Speed: Low Idle	500 ± 15 R.P.M.
Maximum Torque	254 ft. lb.
Drawbar Horsepower: (at rated speed of 2.19 M.P.H.)	54.87
Belt Horsepower	64.8
Fuel Used	No. 1 or No. 2 Diesel
Fuel Injection System	Unit Injectors
Lubrication	Forced feed

Capacities (Approximate)— U. S. Standard Measure:

Cooling System	5¾ gals.
Engine Crankcase	2¾ gals.
Transmission Case	6½ gals.
Final Drives (each)	1¾ gals.
Fuel tank	31 gals.
Track Release Housing (each)	1 gal.
Air Cleaner	2½ qts.
Truck Wheel (each) (grease)	⅞ lb.
Support Roller (each) (grease)	1 lb.
Track Idler (each) (grease)	1¼ lbs.

The Allis-Chalmers Manufacturing Company reserves the right to make changes in the above specifications or to add improvements at any time without notice or obligation.

TRACTOR AND ENGINE SERIAL NUMBERS

On all parts orders and in all correspondence relative to the tractor, it is necessary that both the tractor and the engine serial numbers be given. This will properly identify the particular machine and will insure obtaining the correct replacement parts for it.

The Tractor Serial Number is stamped in the rear face along the right hand side of the transmission case (Fig. No. 1). The Engine Serial Number is stamped on a plate located behind the governor housing on the blower side of the cylinder block or it may be stamped in the cylinder block in the same relative location (Fig. No. 2).

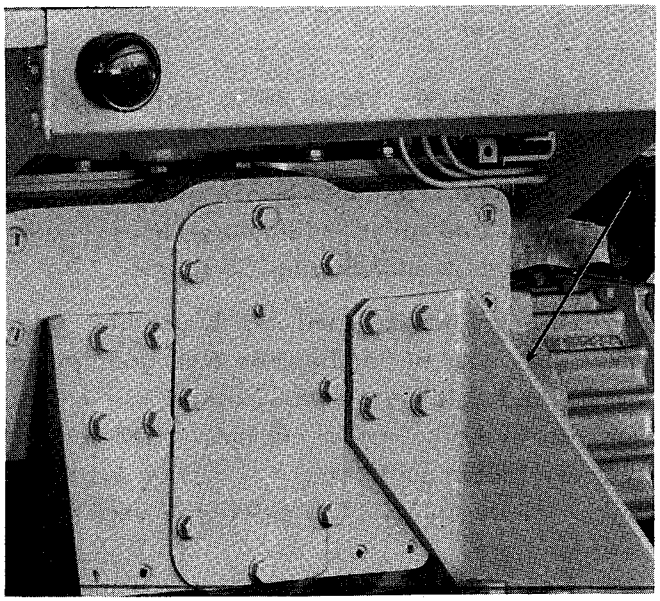


FIG. 1

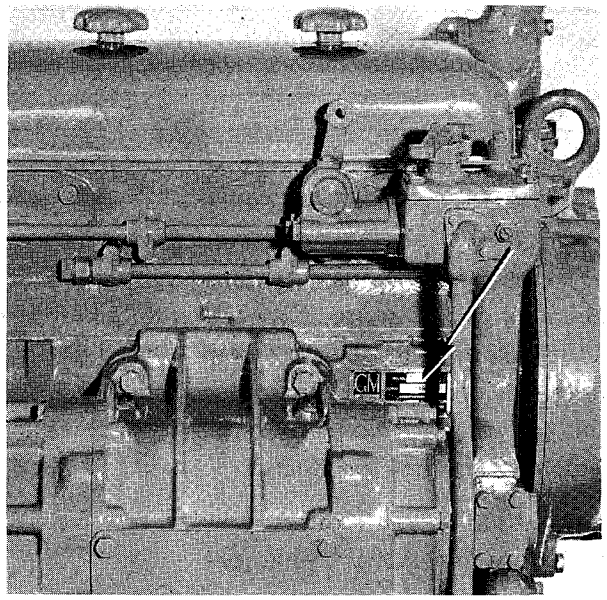


FIG. 2

SPECIFICATIONS OF LUBRICANTS

A. Engine Crankcase Lubricant.

USE NON-CORROSIVE DIESEL ENGINE LUBRICATING OIL CONTAINING ADDITIVES WHICH WILL PREVENT SLUDGE OR GUM DEPOSITS. UNDER NO CIRCUMSTANCES SHOULD A CORROSIVE DIESEL ENGINE LUBRICATING OIL EVER BE USED.

Use oil of the following viscosities:

Atmospheric Temperature	Viscosity
Above 32° F.	Use SAE 30
0° F. to 32° F.	Use SAE 20
0° F. and below	Use SAE 10

Manufacturers of lubricants recognize the importance of the qualities required for use in our equipment and they are cooperating fully to insure the use of only those oils which fulfill these requirements. The oil distributor and oil manufacturer are to be held responsible for the results obtained from their products.

The outstanding lubricating requirements for efficient operation of the engine are:

The maintaining of piston rings in a clean, free condition; absence of hard carbon and "varnish" deposits on or within engine parts; the prevention of bearing corrosion and the promotion of general cleanliness within the engine.

Proper operation and maintenance of the engine is necessary to obtain the desired results from the lubricating oil. Operating and maintenance factors can be effectively controlled by the engine user.

B. Transmission, Final Drive, and Track Release Housing Lubricant.

Lubricate these assemblies with any good grade of motor oil purchased from a reputable oil company.

Use oils with the following viscosity:

Atmospheric Temperature	Viscosity
Above 32° F.	Use SAE 50
32° F. and below	Use SAE 30

C. Truck Wheel, Track Idler and Track Support Roller Lubricant.

Lubricate these assemblies with a grease that has been tested and found satisfactory for use by the Allis-Chalmers Manufacturing Company.

The type of grease used for lubricating these assemblies was selected because of its good pumpability and cold temperature characteristics and because of its having a minimum effect on the synthetic rubber seal boots. It is also an extremely stable grease and will not deteriorate excessively with long use.

A revised list of tested greases is issued every six months and greases which have been tested during each period are added to the list. Ask your nearest Allis-Chalmers authorized dealer for the latest list.

D. Pressure Gun Lubricant.

Use a pressure gun lubricant with a minimum melting point of 300° F. This lubricant should be in a viscosity range so as to insure easy handling in the pressure gun at prevailing air temperatures.

SPECIFICATIONS OF FUEL OIL

Use No. 1 Diesel Fuel Oil purchased from a reputable oil company. In warm weather, No. 2 Diesel Fuel Oil may be used. This fuel must be within the classification limits as established by the American Society for Testing Material. Tentative Diesel Fuel Oil Specifications (ASTM-D975).

For satisfactory engine life and performance, fuel oil requirements must comply with four basic qualifications:

1. Physical cleanliness.
2. Absence of chemical contamination.
3. Proper burning characteristics.
4. Cold starting ability.

Physical cleanliness means freedom from water, dirt and other incombustible ingredients. Since all present day high speed engine fuels are completely distilled, they leave the refinery in clean condition. Transport and subsequent storage account for the addition of most foreign matter found in the fuel.

Proper burning characteristics are dependent upon ignition quality and volatility.

The fuel should have a cetane number of at least 40, and should be free from alkali, acids, gum, and water. The sulphur content should not exceed 0.5% for summer operation and 0.3% for winter operation. Fuel oils having these specifications are available from most oil companies. *The use of fuels having more than the specified sulphur content is conducive to harmful engine deposits, rapid wear of engine parts, and sticking rings and valves.*

Volatility is determined by the boiling temperature range. Fuels having a low final boiling point will vaporize and burn more completely than fuels with a high final boiling point.

The preferred high speed diesel fuels range in color from white to light amber.

FUEL STORAGE

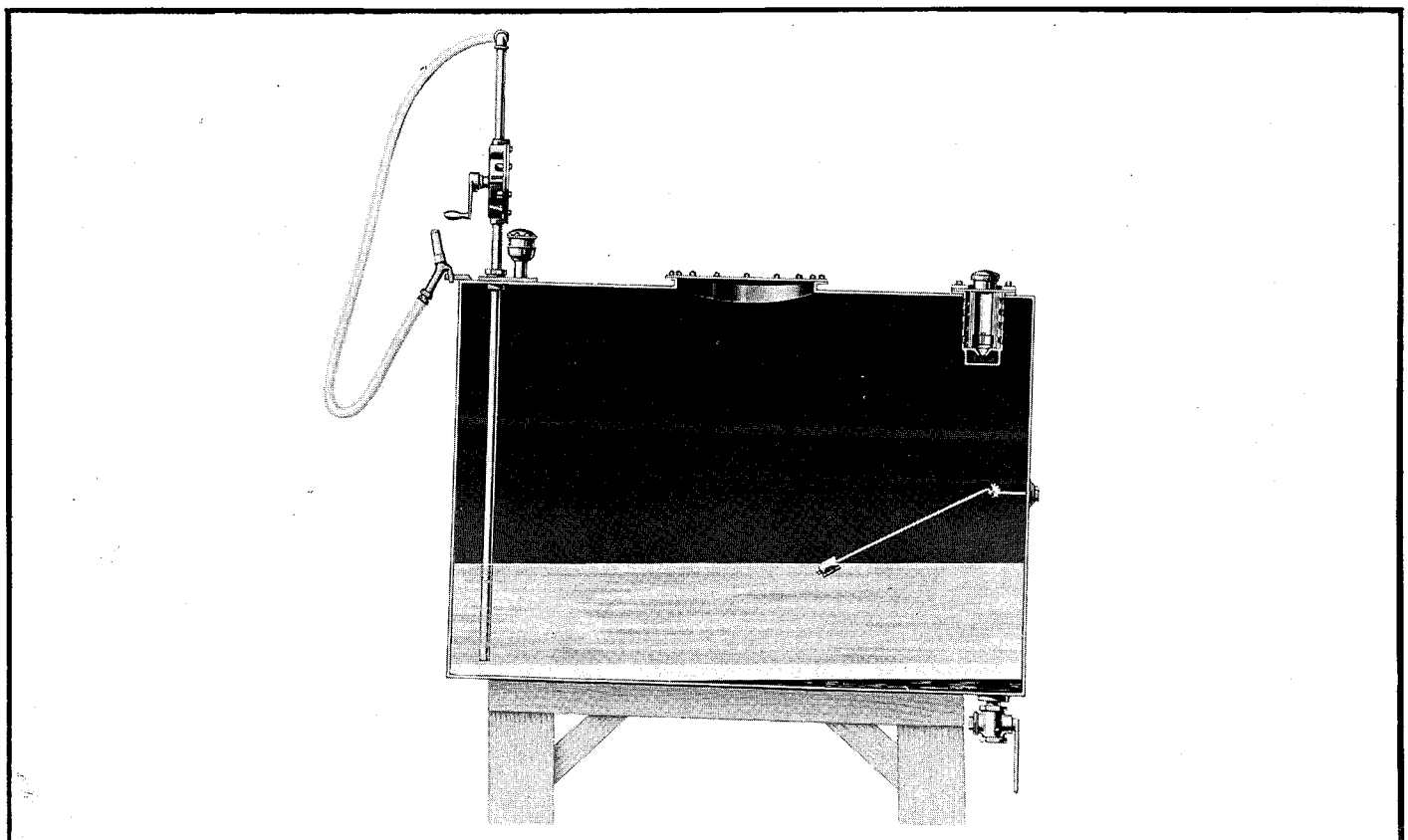
The importance of proper storage of fuel cannot be too strongly stressed. Storage tanks, drums or service tanks must be free from rust, scale, sediment or any other foreign matter which will contaminate the fuel. Contaminated fuel will clog the filters and eventually damage the fuel pump and injectors.

A portable storage tank provides the best method for storing fuel on the job. In a tank, the sediment and water can easily be drained and the fuel can be pumped into the tractor fuel tank with a minimum of handling. Consult your nearest "Allis-Chalmers" Dealer for details about this type of storage tank. Since condensation will occur in the tank, it is very important that a sediment sump be provided in the bottom of the storage tank where the water and settlings can be drained daily.

Fuel should be allowed to settle at least 48 hours in the storage container before it is put in the fuel tank of the tractor. It is advisable to use a pump and draw the fuel from the tank or barrel rather than from the bottom of the container by means of a faucet or through the bung hole.

Where conditions are such that drums must be used to supply fuel, it is advisable to have enough drums to allow sufficient time for the fuel to settle. The fuel should be used only to within about three inches from the bottom of the drums. The fuel thus left in a number of drums can be collected into one drum and used after the usual time allowed for settling. In this manner, the sediment and foreign matter will be disposed of and no fuel will be wasted. Whenever drums are used for storage, they should be covered or placed under shelter so that the fuel will not become contaminated by water which will enter through the filler plugs when it rains, even though the plugs are tight.

The fuel tank of the tractor should be filled at the end of the day's run rather than in the morning. This will reduce the water content, as a full tank is less subject to condensation. The tractor fuel tank is provided with two sediment sumps equipped with drain cocks. Sediment will settle in these sumps and can be drained.



FUEL OIL STORAGE TANK

PERIODIC LUBRICATION AND PREVENTIVE MAINTENANCE

Lubrication is an essential part of preventive maintenance, controlling to a great extent the useful life of the tractor. Different lubricants are needed and some units in the tractor require more frequent lubrication than others. Therefore, it is important that the instructions regarding types of lubricants and the frequency of their application, as given on the following pages, be explicitly followed. Periodic lubrication of the moving parts reduces to a minimum the possibility of mechanical failures.

To prevent minor irregularities from developing into serious conditions that might involve shut-down and major repair, several other services are recommended for the same intervals as the periodic lubrication. The purpose of these services, or inspections, which require only a few minutes, is to assure the uninterrupted operation of the tractor by revealing the need for adjustment caused by normal wear. The need for some minor adjustment, if neglected, could result in failure and shut-down. Refer to the lubrication and service chart for relative location of the various units to be serviced.

ROUTINE SERVICE

For added convenience, listed below are the lubrication points, adjustments, service items and inspections to be made at each of the intervals (10-50-200-400-1000-HOURS) shown on the Lubrication and Service Chart.

10-HOUR SERVICE

Lubricate.

All button head fittings (Stabilizer Crank Assembly)
- a. Stabilizer Link
- b. Stabilizer Link Shaft
- c. Stabilizer Crank Support

Engine Clutch Shifter Bearing
Steering Clutch Throwout Bearings

Inspect.

Crankcase Oil Level
Air Cleaner — Oil Cup
Air Pre-Cleaner
Radiator
Fuel Tank Sediment Sumps
Fuel Tank
First Stage Fuel Filter
Second Stage Fuel Filter
Inspect Tractor for loose nuts and bolts
Steering Clutch Throwout Bearing Adjustment
Engine Clutch Adjustment
Steering Brake Adjustment
Track Adjustment

50-HOUR SERVICE

Inspect.

Oil Level of Final Drives
Oil Level of Transmission

Service.

Engine Crankcase — Change Oil
Clean Primary Lubricating Oil Filter if engine is so equipped.
Engine Oil Filter — Install new filter element
Batteries — Check level of electrolyte

200-HOUR SERVICE

Service.

Final Drives — Drain, Flush and Refill

Lubricate.

Starting Motor
Fan Bearings
Generator

400-HOUR SERVICE

Service.

Transmission — Drain, Flush, and Refill
Track Release Housing — Drain, Flush, and Refill

1000-HOUR SERVICE

Lubricate.

Truck Wheels
Track Idlers
Support Rollers
} Lubricate with Truck Wheel Grease

PERIODIC SERVICE

Fuel Filters.

When either filter becomes clogged (indicated by insufficient supply of fuel to the engine), remove the old element from the filter shell, wash the shell, and install a new element kit.

Engine Clutch.

When the engine clutch slips or does not engage with a distinct over-center snap, adjust as explained in "Engine Clutch Adjustment."

Steering Clutches.

Check the adjustment of the steering clutches and adjust if necessary as explained in "Steering Clutch Adjustment."

Tracks.

When the tracks develop excessive sag, adjust as explained in "Track and Track Idler Adjustment."

Fan and Generator Drive Belts.

When slippage of the belts is evident, adjust as explained in "Generator Belt" and "Fan Belt Adjustment."

Throttle Lever Disc.

Remove the pipe plug from the side of the throttle lever disc, install a grease fitting, and lubricate sparingly with pressure gun lubricant for ease of operation.

LUBRICATION AND SERVICE CHART

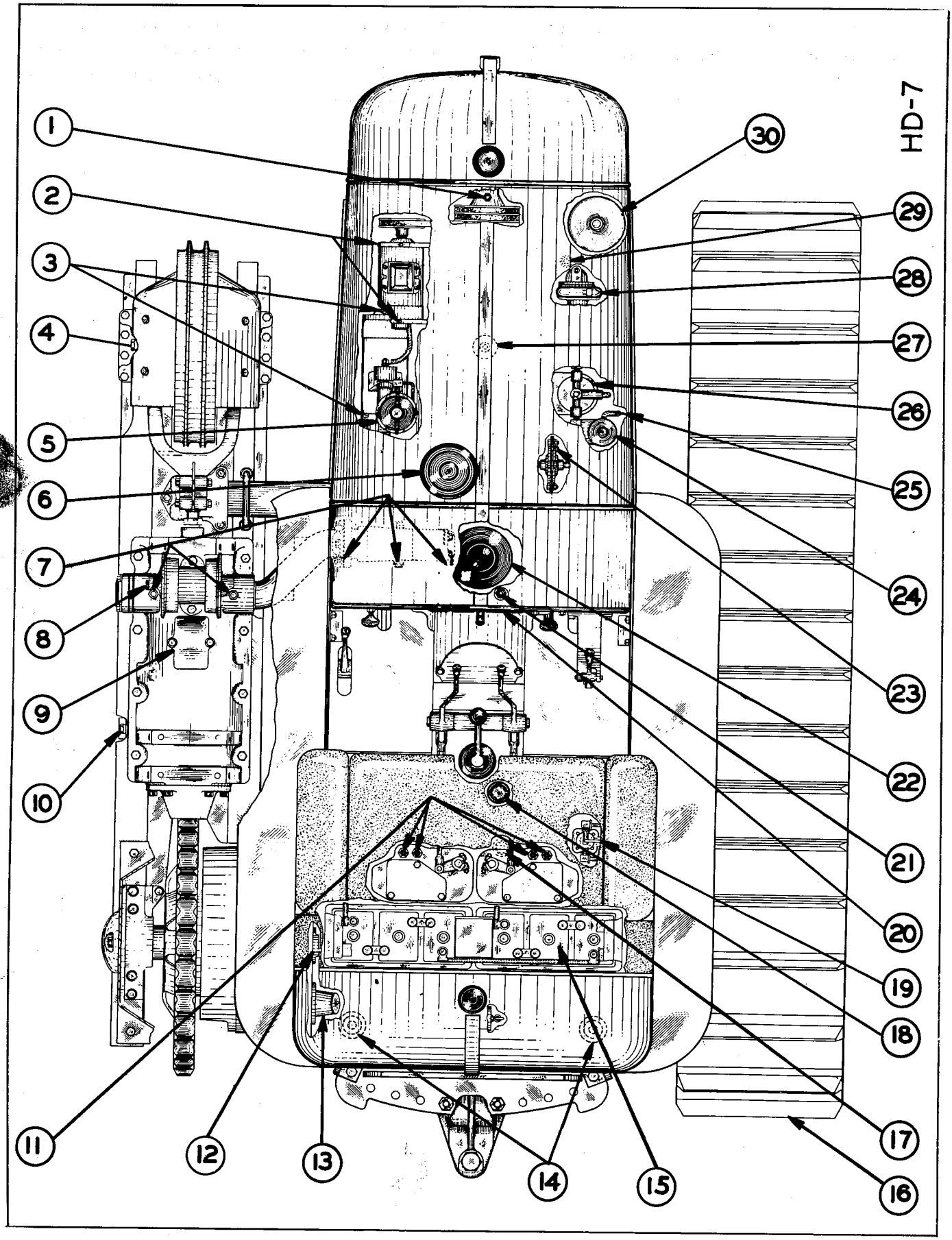


FIG. 4

LUBRICATION AND SERVICE CHART

Refer to Lubrication and Service Illustrations.

1. Fan.

One lubrication point — Lubricate every 200 hours of operation. Use pressure gun lubricant. Fig. A.

2. Generator.

Two lubrication points — Lubricate every 200 hours with 10 drops of light engine oil in each of the two oil cups. Fig. B.

3. Starter.

Two lubrication points — Lubricate every 200 hours with 10 drops of light engine oil in each of the two oil cups. Fig. B.

4. Track Idlers.

Two lubrication points (one each side) — Lubricate every 1000 hours of operation with truck wheel grease. Fig. D.

Refer to "Truck Wheels, Track Idlers, and Track Support Rollers."

5. Secondary Oil Filter.

Drain the filter shell, remove the old element, wash the shell and install a new element kit every 50 hours of operation or at each crankcase oil change. Fig. B.

6. Air Pre-Cleaner.

The pre-cleaner has a round inspection glass and must be emptied as often as the dirt level reaches half way up the glass. To empty, remove cap from shell, lift shell from body, and dump dirt out of shell. See that louvers in body are not bent or clogged with leaves or other material before replacing the shell. Make sure the gasket is in good condition. Tighten cap firmly with the fingers. Do not use a wrench. Fig. H.

7. Stabilizer Crank Assembly.

Ten lubrication points — Lubricate every 10 hours of operation with pressure gun lubricant. Figures D and E.

8. Track Support Rollers.

Two lubrication points (one each side) — Lubricate every 1000 hours of operation with truck wheel grease. Fig. D.

Refer to "Truck Wheels, Track Idlers, and Track Support Rollers."

9. Track Release Housing.

Two lubrication points (one each side) — Inspect oil level every 200 hours of operation. Keep filled to level plug with same viscosity oil as used in transmission and final drives. Drain, flush, and refill every 400 hours of operation. Fig. D.

10. Truck Wheels.

Ten lubrication points (five each side) — Lubricate every 1000 hours of operation with truck wheel grease. Fig. D.

Refer to "Truck Wheels, Track Idlers, and Track Support Rollers."

11. Steering Clutch Throwout Bearing.

Four lubrication points (two each side) — Lubricate every 10 hours of operation with pressure gun lubricant. Fig. C.

Refer to "Specifications of Lubricants."

12. Final Drive Drain Plugs.

Two lubrication points (one each side) — Drain, flush, and refill every 200 hours of operation. Fig. E.

Refer to "Specifications of Lubricants."

13. Final Drive Filler Plugs.

Two lubrication points (one each side) — Inspect the oil level every 50 hours of operation. Keep filled even with level plug. Fig. E.

Refer to "Specifications of Lubricants."

14. Fuel Tank Sediment Sumps.

Open drain cocks daily, before the engine is started at the beginning of the day's operation in warm weather or shortly after the end of the day's operation in freezing weather, and allow the water or sediment to drain. Close the drain cocks when clean fuel runs out. Fig. J.

15. Batteries.

Maintain electrolyte level 3/8" above plates by adding clean, distilled water. Also test specific gravity of each cell. Check every 50 hours of op-

eration or more frequently if conditions warrant. Fig. C.

Refer to "Batteries."

16. Tracks.

When tracks develop excessive sag, adjust as explained in "Track and Track Idler Adjustment."

17. Transmission Drain Plug.

Drain, flush, and refill every 400 hours of operation. Fig. E.

Refer to "Specifications of Lubricants."

18. Transmission Case Filler Plug and Oil Level Bayonet Gauge.

Inspect oil level every 50 hours of operation. Keep oil level to "FULL" mark on bayonet gauge. Fig. C.

Refer to "Specifications of Lubricants."

19. First Stage Fuel Filter.

Install new element kit when necessary. Fig. C.

20. Lubricating Oil Pressure Gauge.

With the engine running at full throttle, the pressure should be between 25 and 35 pounds at normal engine operating temperature.

CAUTION: If no pressure registers on the gauge, the engine must be stopped immediately and the cause determined.

21. Engine Clutch Shifter Bearing.

Lubricate every 10 hours of operation with pressure gun lubricant. Fig. F.

Refer to "Specifications of Lubricants."

22. Air Cleaner.

Remove the oil cup from the bottom of the cleaner every 10 hours of operation. Inspect the oil level and condition of the oil. If the oil is discolored or if there is a layer of dirt in the cup, empty and wash the cup and refill it with new oil to the top of the cone in the center of the oil cup. Fig. F.

Refer to "Air Cleaner."

23. Throttle Lever Disc.

Lubricate sparingly with pressure gun lubricant for ease of operation. Do not over-lubricate. Fig. A.

24. Crankcase Filler Cap.

One filler point. Drain the crankcase and refill with new oil every 50 hours of operation. Fig. A.

Refer to "Specifications of Lubricants."

25. Crankcase Bayonet Gauge.

Inspect crankcase oil level every 10 hours of operation. Keep oil level to "FULL" mark on bayonet gauge. Fig. A.

Refer to "Specifications of Lubricants."

26. Second Stage Fuel Filter.

Install new element kit when necessary. Fig. A.

27. Crankcase Drain Plug.

One drain point. Drain the crankcase and refill with new oil every 50 hours of operation.

Refer to "Specifications of Lubricants."

28. Water Pump Drain.

Periodically drain and flush cooling system. Fig. I.

Refer to "Cooling System."

29. Radiator Drain.

Periodically drain and flush cooling system. Fig. I.

Refer to "Cooling System."

30. Primary Oil Filter.

This filter used on early models only. Clean the oil filter at each crankcase oil change if engine is equipped with this filter. Fig. A.

Refer to "Engine Lubrication System."

"HD 7" LUBRICATION & SERVICE PICTURES

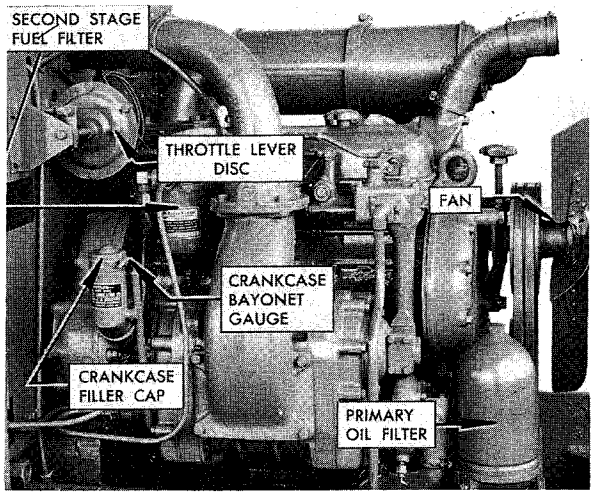


FIG. A

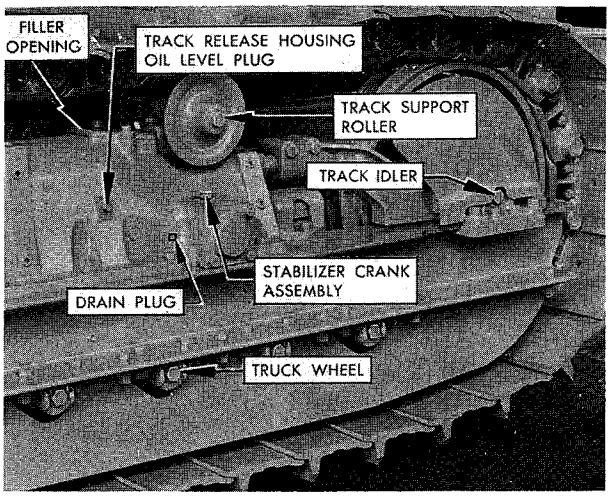


FIG. D

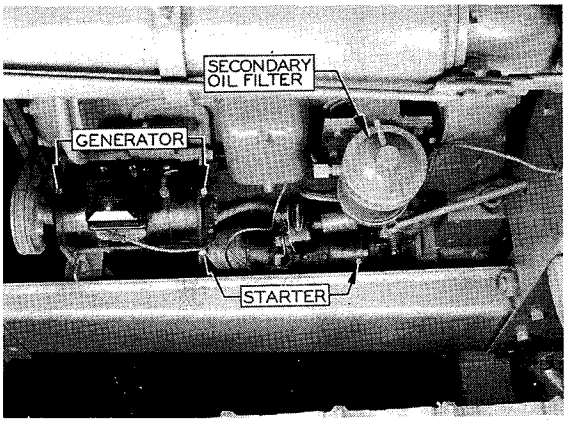


FIG. B

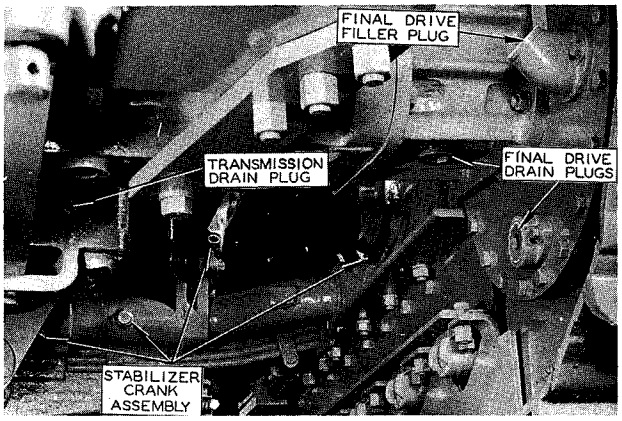


FIG. E

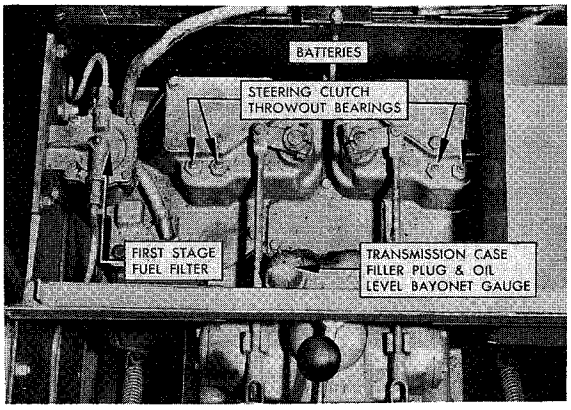


FIG. C

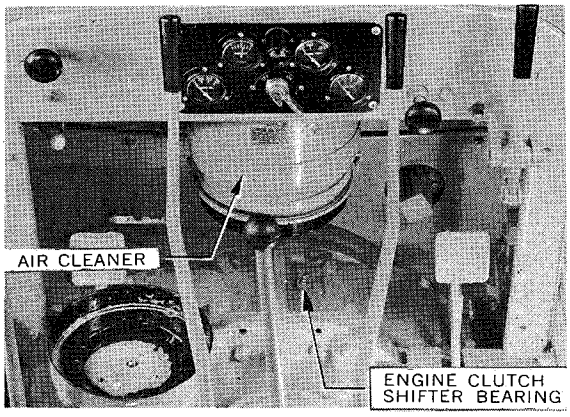


FIG. F

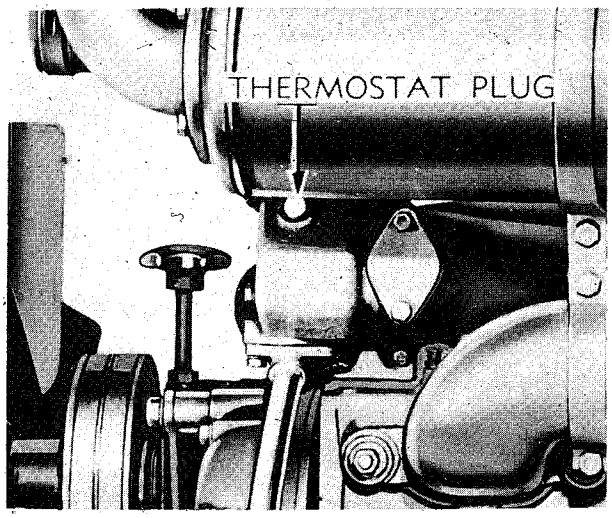


FIG. G

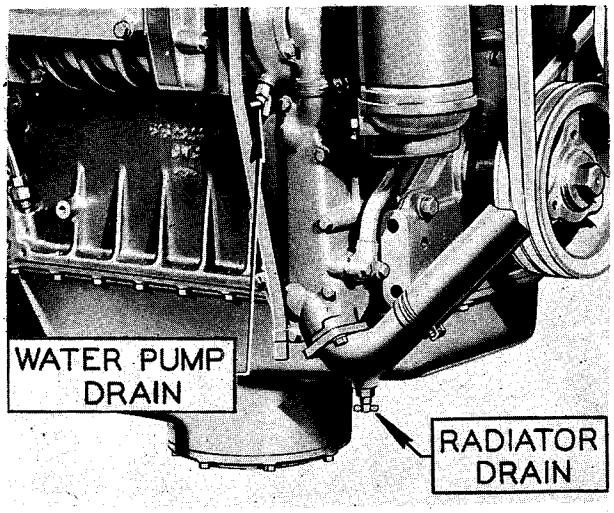


FIG. I

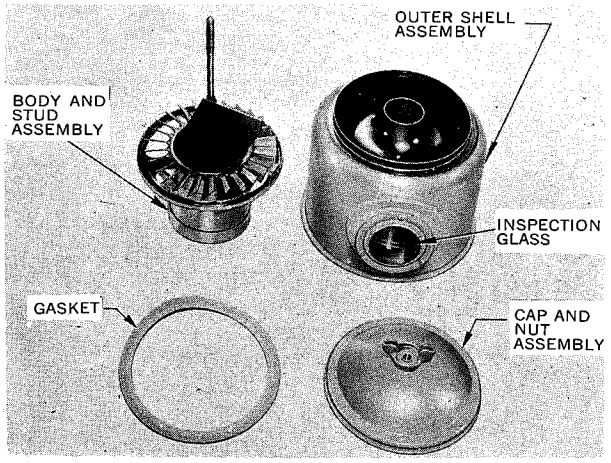


FIG. H

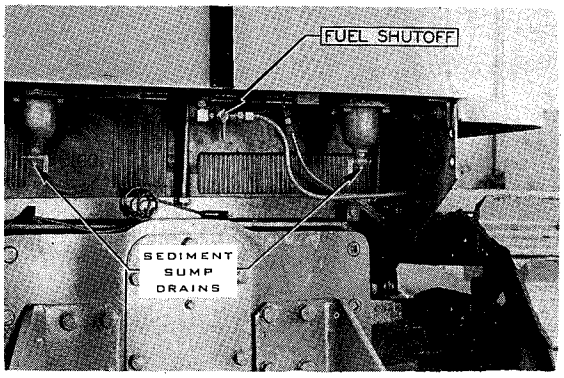


FIG. J

LUBRICATION OF TRUCK WHEELS, TRACK IDLERS, AND TRACK SUPPORT ROLLERS

After every 1000 hours of operation, the truck wheels, track idlers, and track support rollers must be lubricated. Refer to "Specifications of Lubricants" for the approved lubricant.

Lubricate with truck wheel grease. A hand grease gun and special lubricating nozzle is included in the tool equipment shipped with each tractor. The hand grease gun and lubricating nozzle must be used to inject grease into the truck wheels, track idlers and track support rollers, as the use of high pressure equipment would cause injury to the seal boots which are a part of the positive seal assemblies. Pump the hand grease gun slowly when servicing.

Lubricate the above assemblies as follows:

1. Wash the outer ends of the wheel shafts and the lubricating nozzle thoroughly so that no dirt will enter the wheels with the grease.
2. Remove the plug and copper washer from the end of the shaft.
3. Insert the lubricating nozzle into the shaft as far as it will go (approximately 6") and hold the nozzle in tightly against the seat in the shaft. Refer to Figure No. 5.
4. Using hand grease gun attached to nozzle, pump grease slowly into the wheel until clean grease is forced out the end of the shaft around the nozzle. This will indicate the wheel is full of clean grease.
5. Remove the nozzle and install the shaft plug and copper gasket. Tighten securely.

   NOTE: Do not allow the plugs to remain out of the ends of the shafts any longer than is necessary. Keep dirt and dust out of the lubricant.

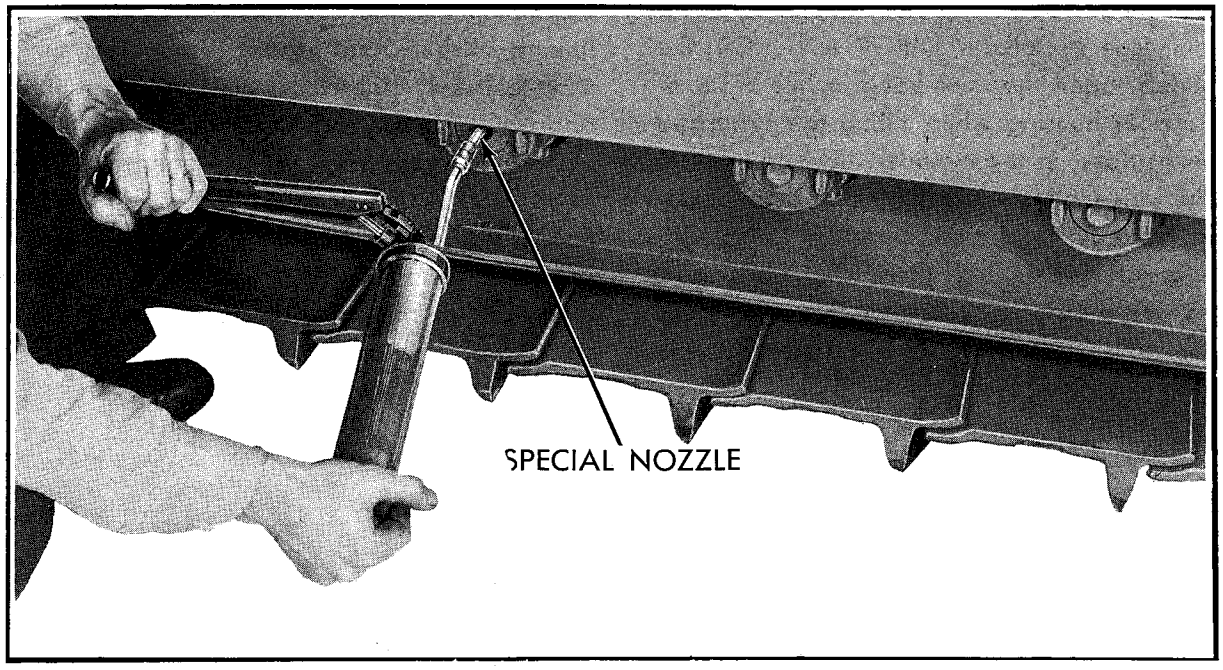


FIG. 5

PREPARATION OF TRACTOR FOR USE

Make a complete inspection of the tractor to be sure that no parts have been lost or damaged while the tractor was in transit or storage.

Fill the fuel tank with the correct grade of fuel oil. Refer to "Specifications of Fuel Oil." Use care to prevent the entrance of dirt or foreign matter while filling the tank.

Check the oil levels in the engine crankcase, transmission and final drive compartments and lubricate all points where fittings are provided for use of a pressure grease gun (refer to lubrication chart). Be sure the truck wheels, track idlers and track support rollers are completely filled with grease (refer to "Truck Wheel, Track Idler and Track Support Roller Lubricant").

Remove the oil cup from the air cleaner to make sure the oil in the cup is at the prescribed level. Refer to "Air Cleaner." See that the air pre-cleaner is properly installed.

Fill the cooling system with clean water which is free from lime or alkali. IMPORTANT: On the later models, open the vent valve in the front of the thermostat housing while filling the system to allow air trapped in the cylinder block to escape. Close the valve after the system has been filled. Turn the valve out to open it, turn it in to close it. On the early models, the thermostat housing is provided with a pipe plug. Remove this plug when filling the system to allow the air trapped in the cylinder block to escape, then reinstall the plug and continue to fill radiator.

Operate the tractor with a light load for the first 60 hours. Bring the engine temperature to the normal operating range of 160° F. to 185° F. as soon as possible after each starting period and maintain this temperature. Maintaining the normal operating temperature is one of the most important factors in "running in" a new or rebuilt engine. Low engine temperature leads to the formation of gum or sludge within the engine, both highly detrimental to an engine. The radiator shutters aid in maintaining the proper engine temperature and are adjusted by means of the lever under the left hand side of the cowl. The shutters are fully open when the control lever is moved forward as far as it will go and are closed when the lever is moved back as far as it will go.

Inspect the entire tractor after the first 10 hours of operation. Tighten all loose bolts and check the adjustment of the engine clutch, steering clutch linkage, brakes and tracks. Tighten all the track shoe bolts. By tightening these bolts at this time and again at the end of 60 hours, the possibility of their becoming loose and enlarging the bolt holes will be eliminated. Check the engine for proper adjustment of valves, for timing and equalizing of injectors and make any other adjustments that may be necessary as explained in pertinent sections of this book.

OPERATING CONTROLS AND INSTRUMENTS

The operator of the tractor must familiarize himself with the various controls and instruments provided for its operation. Although many of these controls are similar to those of other tractors, there are important differences, and it is not wise, regardless of previous experience, to operate the tractor before fully understanding the purpose of each control and instrument.

A. OPERATING CONTROLS AND INSTRUMENTS.

1. Engine Shut-Off. The engine shut-off controls the governor shut-off lever and the air valve in the blower air inlet elbow. Push the shut-off knob all the way in against the dash when the engine is to be started; pull it all the way back to stop the engine.

2. Starter Pedal. Push on the starter pedal to operate the starter switch and to engage the starter pinion with the flywheel ring gear. Each time the starter pedal is depressed it must be allowed to return to its original position (all the way out), and the starter given time to cease spinning before it can be used again. Otherwise, the starter motor will run, but the starter pinion will not engage the flywheel ring gear.

3. Throttle. The throttle lever is connected to the variable speed control lever on the governor. The engine will run at idling speed with the lever all the way forward. Pull the lever back to increase the engine speed.

4. Engine Clutch Operating Lever. The clutch operating lever controls the engine clutch which transmits the power from the engine to the transmission. Push the lever forward to disengage the clutch, pull it back to engage the clutch.

5. Gear Shift Lever. The gear shifting lever is used to select the proper transmission gear ratio for the desired power or speed.

6. Steering Levers. The steering levers control the two steering clutches which connect the transmission with the final drive gears and track drive sprockets. These levers are used to steer the tractor by disengaging the left or right steering clutch. Pull the right hand lever back to make a right turn, pull the left hand lever back to make a left turn. Refer to "Driving Instructions."

7. Brake Pedals. The brakes are used to retard the tractor ground speed, or to facilitate turning the tractor. To turn the tractor to the right press on the right brake pedal and to turn to the left press on the left brake pedal with the corresponding steering clutch full disengaged.

CAUTION: Never use the brakes to turn the tractor without first pulling the steering clutch lever back as far as possible on the side toward which the turn is to be made.

8. Brake Pedal Lock Lever. The brake locks are used to hold the brakes in their locked position.

To hold the brakes in the locked position, tilt the top of the brake pedal pad forward when the brake is applied. To release the brake, press on the bottom of the brake pedal pad.

9. Starting Aids. Tractors prior to Serial No. HD-7-16697 are equipped with an Engine Air Heater. Tractors Serial No. HD-7-16697 and above are equipped with a Cold Weather Engine Primer. Both are used as engine starting aids in cold weather.

Air Heater Push Button Switch.

The air heater push button switch completes the circuit between the dash light switch and the air heater coil. To operate, turn ON the dash light switch and press in on the push button switch while operating the air heater pump.

Air Heater Pump.

The air heater pump delivers the fuel oil under pressure to the air heater for cold weather starting. It is NOT to be used or considered as a means of "Priming" the engine. Refer to "Starting Engine" for full instructions on the use of the air heater and pump.

Cold Weather Engine Primer Dispenser.

The dispenser, located on the cowl (to the right of the instrument panel), is used to puncture a capsule containing starting fluid used for cold weather starting.

Cold Weather Engine Primer Pump.

The primer pump, mounted in the right side of the cowl, is used to force the starting fluid through a small nozzle into the air inlet elbow of the blower. Refer to "Starting Engine" for full instructions on the use of the Cold Weather Engine Primer.

10. Dash Light and Air Heater Switch. The dash light and engine air heater switch complete the circuit between the battery and the air heater push button switch. Turn the switch lever to the left for the ON position and to the right for the OFF position.

11. Radiator Shutter Control Lever. The radiator shutters aid in maintaining proper engine temperature (160° F. to 185° F.) and are adjusted by means of the lever under the left hand side of the cowl. The shutters are fully open when the control lever is moved forward as far as it will go. To close the shutters, pull the lever back.

12. Head Light Switch. To turn headlights on move head light switch lever to the right.

13. Engine Oil Pressure Gauge. This gauge indicates the pressure at which the oil is circulated through the engine. At full throttle the pressure should be between 25 and 35 pounds at normal engine operating temperature. CAUTION: If no pressure registers on the gauge, the engine must be stopped immediately and the cause determined.

14. Fuel Oil Pressure Gauge. This gauge indicates the pressure at which the fuel oil is circulated through the fuel system. Under normal conditions, with the engine operating at full governed speed, the pressure should be from 25 to 65 pounds. CAUTION: Do not operate the engine when the pressure is above or below this range. Investigate for clogged filters, clogged or leaking fuel lines or connections, or improper operation of fuel pump pressure relief valve. Refer to "Fuel System."

15. Engine Temperature Gauge. This gauge registers the engine temperature, which should be maintained between 160° F. and 185° F. at all times. Use radiator shutters to maintain the proper temperature.

16. Ammeter. The ammeter registers the charging rate of the generator. When the batteries are in a discharged condition, the ammeter should register 4 to 8 amperes until the batteries approach the charged condition. When the batteries are fully charged the ammeter will register nearly zero through the action of the generator regulator

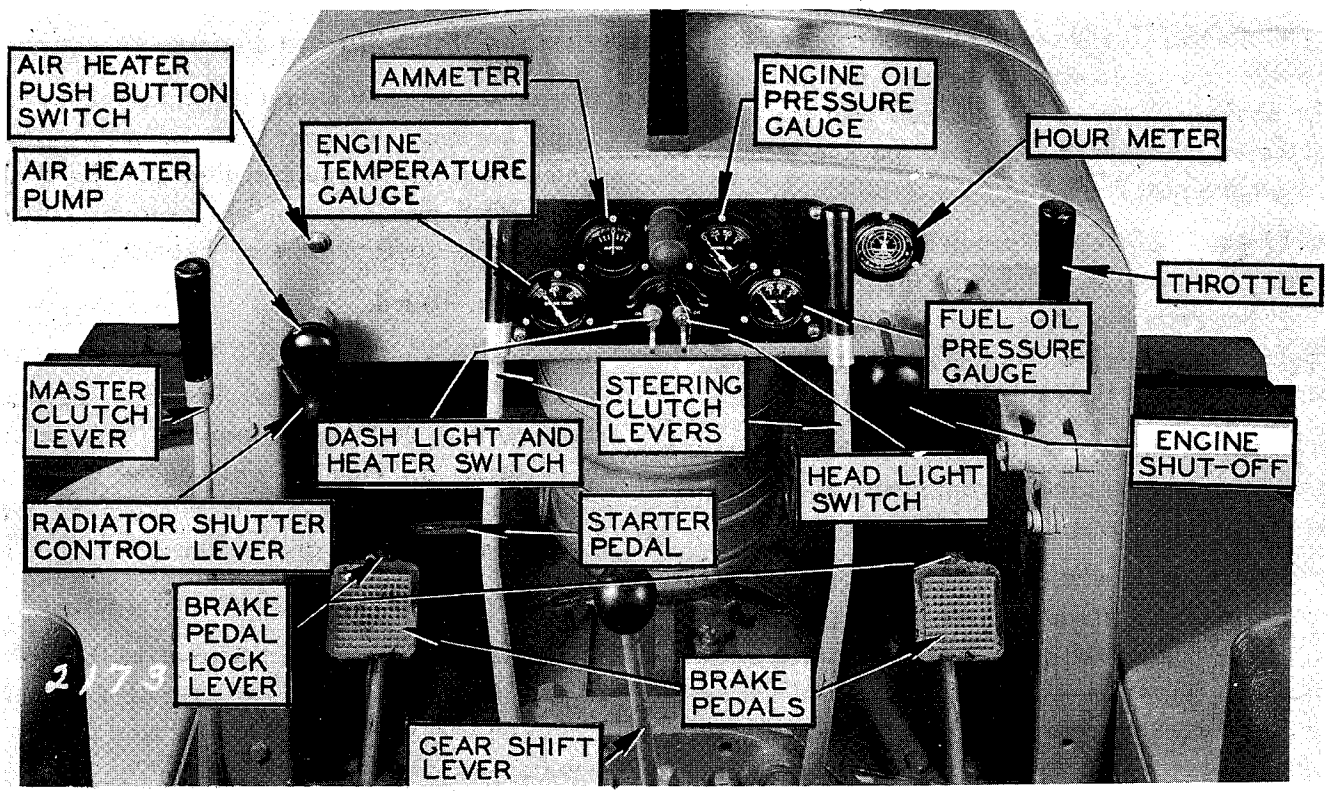


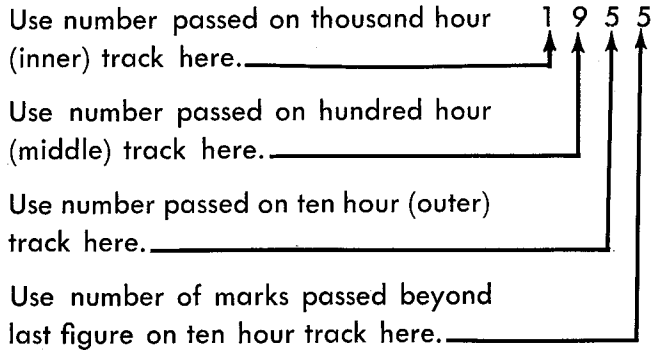
FIG. 6

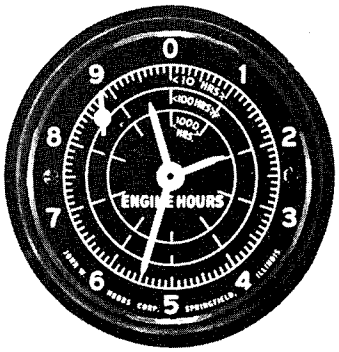
except for a short time after the starter has been used.

17. Hour Meter. The hour meter registers the number of hours that the engine has operated.

All hands move clockwise. The small indicator (upper left) visibly turns when meter is recording.

The meters record up to 10,000 hours and repeat. The four figures of the hours of operation are read from the three hands as follows:





HOUR METER

FIG. 7

STARTING AND STOPPING ENGINE

A. STARTING ENGINE.

1. Before starting the engine, check the fuel supply, crankcase oil level and the level of the water or anti-freeze solution in the cooling system. If repairs have been made since the last operating period, be sure all nuts and bolts affected by the repairs have been securely tightened and the parts have been properly adjusted.

2. Push the engine clutch operating lever forward and place the gear shifting lever in its neutral position.

3. Close the radiator shutter by pulling on the shutter control lever.

4. Push the engine shut-off knob all the way in, (against stop).

5. Pull the throttle lever all the way back (wide open).

6. Press forward on the starter pedal. If the starter motor spins but the starting pinion does not engage the flywheel to turn the engine, pull the pedal back to its original position (all the way back) and wait until the starter stops spinning before pressing on the pedal again. CAUTION: If the engine does not start within 30 seconds, allow the starter to cool for 2 minutes before using it again.

7. As soon as the engine begins to run, close the throttle enough to slow the engine down to about 3/4 of full speed and allow the engine to warm up. When the engine temperature reaches 160° F. open the shutter. The shutter should be adjusted so that an operating temperature of 160° F. to 185° F. is maintained at all times.

8. Observe the engine oil pressure indicated on the gauge. At full governed speed and with the engine heated to normal operating temperature (160° F. to 185° F.), the oil pressure should be between 25 and 35 pounds. If the oil is cold, no pressure may register for about 15 seconds after the engine starts, but if the pressure does not then rise to normal or above, the engine should be stopped and the cause determined.

9. Observe the fuel pressure indicated on the gauge. With the engine operating at full governed speed the pressure should be between 25 and 65 pounds. DO NOT OPERATE THE ENGINE WITH PRESSURE ABOVE OR BELOW THIS RANGE.

10. In cold weather, when it is necessary to use a starting aid in starting the engine, proceed as stated above in the first six operations, then proceed as follows:

Air Heater (Used on Tractors prior to Serial No. 16697):

Turn the dash light switch on, press on the air heater switch button, pump the air heater pump handle slowly and press on the starter pedal all at the same time. In this manner air passing from the blower to the cylinders is heated by the flame from the air heater. Follow instructions beginning with step 7 above after the engine starts. Refer to "Air Heater" for complete information on the unit.

Cold Weather Engine Primer (Used on Tractor Serial No. 16697 and above):

a. Unscrew the upper chamber of the dispenser.

b. Place a capsule of fluid, small or large depending upon the air temperature and the requirements established by trial, in the lower chamber or body of the dispenser. In extremely low temperatures, one large and one small capsule may be necessary.

c. Pull the plunger to the top of the upper chamber and screw chamber tightly into body.

d. Push plunger to bottom, thus puncturing capsule and releasing fluid so it can be picked up by primer pump.

e. Push engine shut-off knob all the way in (operating position) and pull throttle wide open.

f. Depress starter pedal to crank engine, and at the same time use primer pump to pump fluid into the air system until engine starts and runs normally on regular fuel. Use capsule only of size required to start engine and after engine has started continue pumping slowly until all fluid in the dispenser has been injected into engine.

g. While the engine is warming up, unscrew the upper chamber and remove the empty capsule.

Replace the upper chamber.

CAUTION: The starting fluid contained in the capsule is essentially ethyl ether, highly inflammable and should be treated with the same caution as high octane gasoline. Gelatine capsules dissolve in water and soften at high temperatures. Therefore, the following precautions must be taken:

1. Avoid breathing large quantities of the fumes from the fluid.
2. Avoid cutting of hand by barbs on puncturing plunger.
3. Avoid proximity of fluid and capsules to open flames, sparks or hot surfaces.
4. Avoid contact of capsules with water.
5. Avoid subjection of capsules to high temperatures (above approximately 120° F.).

B. Stopping Engine.

Close the throttle and allow the engine to idle for a few minutes so that the engine temperature will level off, then pull the engine shut-off knob all the way out to stop the engine. Cover the exhaust pipe at the end of each day's operation to prevent rain from entering while the tractor is idle.

AVOID UNNECESSARY ENGINE IDLING

Prolonged engine idling will result in the temperature of the engine coolant falling below the specified operating range of 160° F. to 185° F. Low operating engine temperature causes the development of conditions detrimental to engine operation and life. Incomplete combustion of fuel in a cold engine causes crankcase dilution and forms lacquer and other gummy deposits on valves, pistons, rings, etc. It also causes rapid accumulation of sludge within the engine.

Since starting the engine is accomplished with no more effort than starting the average automobile engine, there should be no reason for prolonged engine idling. Stop the engine, as you would your automobile engine when prolonged idling periods would otherwise occur.

DRIVING INSTRUCTIONS

A. Starting Tractor.

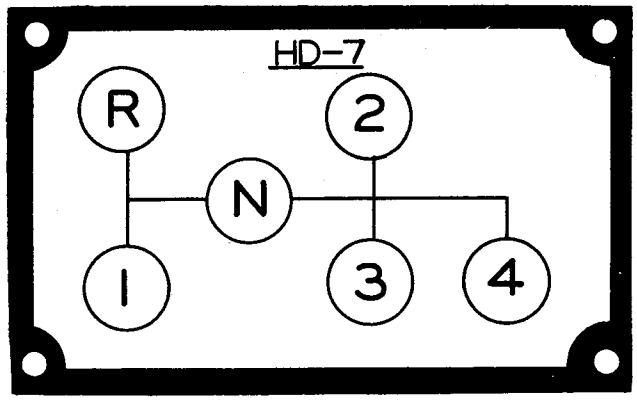
Start the engine and allow it to warm up. Then close the throttle to slow the engine down to idling speed. If the engine clutch has been engaged, disengage it and push forward on the clutch operating lever to force the clutch shifter yoke against the clutch brake to stop rotation of the transmission gears. Move the gear shifting lever into the required position for the desired speed or power. Open the throttle about half-way and pull back steadily on the clutch operating lever until all slack is taken up between the tractor and the load, then snap the lever back quickly to fully engage the clutch. After the clutch is engaged, open the throttle to meet the operating requirements. Engagement of the clutch with the engine running at half throttle and picking up the load in the above manner will prevent excessive slippage of the clutch, thus prolonging clutch life. It will also prevent "shock loading" the tractor.

To shift gears, push the engine clutch lever forward and shift gears to the desired speed. When the lever is pushed forward it forces the release bearing against the clutch brake, which stops the rotation of the transmission input shaft. Stopping the input shaft rotation enables the operator to shift without clashing the gears.

The gear shift lever is provided with a locking device to hold it in the desired gear.

The following chart shows the position of the gear shift lever to obtain any of the forward and reverse speeds.

GEAR SHIFT CHART



Gear	*Gear Shift Lever*
First	Left and Back
Second	Right and Forward
Third	Right and Back
Fourth	Extreme Right and Back
Reverse	Left and Forward

FIG. 8

Satisfactory and efficient operation depends largely on the operator's judgment in selecting the proper gear ratio and speed for the various loads or operation. Always work the tractor in the gear that will permit the engine to operate at full speed. This will not only insure the most power from the engine but will also allow the engine to operate at its highest efficiency.

DO NOT SLIP THE CLUTCH IN AN EFFORT TO PULL AN OVERLOAD. SHIFT TO A LOWER GEAR.

The engine clutch should engage with a definite overcenter "snap" and should require an appreciable pull on the lever for its engagement. If this "snap" is not evident or if the clutch slips when picking up the load, adjustment must be made immediately. Refer to "Engine Clutch Adjustment."

B. Steering Tractor.

Steer the tractor by disengaging the steering clutch on the side of the tractor toward which the turn is to be made. This is done by means of the steering levers located directly in front of the operator. To make a right turn, pull back the right hand steering lever; to make a left turn, pull back the left hand steering lever. With the left steering clutch disengaged, the power is removed from the left track and the track will slow down or stop. Since the power is still being delivered to the right track it will keep turning and cause the tractor to turn to the left. Pulling back the right hand steering lever will cause the tractor to turn to the right in the same manner.

If a short turn is to be made, pull back the steering lever and press down the brake pedal on the side toward which the turn is to be made. This will stop and hold the disengaged track stationary.

Always pull the lever all the way back when turning. When the tractor has turned as desired, return the lever immediately to its forward position. Disengage and engage the steering clutches smoothly and completely to avoid excessive wear on the clutch friction discs.

When steering the tractor down steep grades with the load pushing the tractor, the use of the steering levers is opposite to that when pulling a load. In this case, the left hand steering lever is used to

make a right turn and the right hand lever to make a left turn. Disengaging either steering clutch will allow the track on that side to travel faster, since the braking power of the engine is released from it, while the steering clutch remaining engaged will act as a brake for the opposite track.

During operation, observe the amount of free travel of the steering levers (the distance the levers move before pressure is felt and disengagement of clutch begins). This free travel, which insures complete engagement of the steering clutches, should be from 3 to 5 inches, measured at the tops of the levers. When the free travel of either lever becomes less than 3 inches, the steering clutch requires adjustment. Refer to "Steering Clutch Adjustment."

C. Stopping Tractor.

To stop the tractor, close the throttle and disengage the engine clutch by pushing the clutch lever forward, then press down on the brake pedals to apply the brakes. If the tractor is parked on a grade where there is a possibility of its rolling, lock the brakes in applied position by tilting the top of the brake pedal pads forward. DO NOT "RIDE" THE BRAKE PEDALS WHILE OPERATING TRACTOR.

IMPORTANT: ALWAYS SHUT OFF THE ENGINE WHEN STOPPING even if the tractor is to remain idle only a few minutes. This will not only save fuel and unnecessary wear on the engine but will also avoid operating the engine below normal temperature. If it is necessary to keep the engine running it should be run with the throttle opened far enough to maintain the normal engine oil and fuel oil pressure.

While operating the tractor, observe the action of the brakes. The brakes are correctly adjusted when the brake pedals come within 1" of striking the engine spacer housing when they are fully applied.

When steering brakes do not hold properly because of oil on the linings, they must be washed. Refer to "Brakes" for instructions on adjusting the brakes and to "Washing Steering Clutches" for instructions on washing the brakes and steering clutches.

OPERATING IN MUD OR WATER

The engine clutch and steering clutch compartments are dry compartments provided with drain holes to allow drainage of any oil that might leak into them. These drain holes should be left open (plugs removed) during normal operation. When operating in mud, water or extremely dusty or sandy conditions, the plugs furnished with the tractor should be installed to prevent the entrance of dirt or water. The drain holes in the bottom rear of the steering clutch compartments are located a few inches to the right and left of the drawbar support plates; the engine clutch compartment drain hole is located at the bottom on the front side of the engine flywheel housing.

If operating conditions are such that the tractor must be operated with the drain plugs in place, they should be removed daily to drain any water, oil or grease that might have accumulated, thus preventing it from getting on the brake linings or clutch facings. If the tractor remains idle at night, it is good practice to remove the plugs at the end of the day and install them again before starting the tractor the next day.

Inspect the oil in the final drive housings frequently and drain, flush and refill the housings as often as the oil shows the presence of any mud or water.

COLD WEATHER OPERATION

When atmospheric temperature drops to the freezing point or below, the engine crankcase, air cleaner and other oil compartments must be drained and refilled with oil of lighter viscosity. Refer to "Specifications of Lubricants."

The cooling system must be checked for leaks and filled with an anti-freeze solution to protect it from freezing. Refer to "Engine Cooling System." All leaking or damaged hoses or gaskets should be replaced, all leaks corrected and all connections tightened to prevent loss of anti-freeze solution.

Test and prepare the "Engine Starting Aid" for use as soon as lowering atmospheric temperature indicates aid in engine starting will be required. Provide covers for the sides of the engine compartment if the thermostat and radiator shutter prove inadequate to maintain operating temperature of 160° F. to 185° F. If the engine is operated below this range sludge will build up, engine efficiency will drop and conditions may develop to cause damage to engine parts.

Dependable starting of a diesel engine, by any means, can be obtained only with adequate cranking speed. For this reason the batteries, cables, generator, and generator regulator should be inspected and put in first class condition at the onset of cold weather. If the tractor is to be operated in Arctic Temperature, consult your nearest authorized dealer or write to the factory for information regarding availability of special cold weather equipment.

ENGINE COOLING SYSTEM

A. Description of System.

The cooling system consists of the water pump, radiator, oil cooler, thermostat, cooling fan and water passages in the cylinder block and head. The pump draws the water from the bottom of the radiator and circulates it through the oil cooler housing, then through the water passages in the engine. It then passes from the cylinder head of the engine, through the thermostat, and is conducted through the upper radiator hose to the upper part of the radiator. The water is cooled as it passes from the top to the bottom of the radiator, by air drawn through the radiator core by the cooling fan.

The bellows-type thermostat, located in the front of the water manifold, operates automatically to maintain normal operating temperature (160° F. to 185° F.) as shown and explained in Figures 9 and 10.

B. General Maintenance.

Keep cooling system filled with clean water that is free from lime or alkali. The use of water containing lime can result in the lime depositing in the cylinder head and block causing hot spots in the engine and eventually restricting the water passages. Alkali in the water will cause a corrosive action detrimental to the engine.

In winter weather use an ethylene glycol anti-freeze solution to protect the cooling system against damage from freezing. This type of anti-freeze has a much higher boiling point than water. After any addition of water or anti-freeze compound, test solution after the added quantity has been thoroughly mixed to make sure it will withstand the prevailing or anticipated temperature. A mixture of 60% anti-freeze compound and 40% water will provide maximum protection. Do not use more than 60% anti-freeze compound in the solution as this will raise the freezing point and provide less protection against freezing.

Keep the radiator air passages free from leaves and other debris which will restrict the flow of air through the radiator. All leaks in the cooling system must be corrected as soon as they are evident and the fan belts must be kept in proper adjustment. The most efficient engine operation is obtained with the temperature held within a range

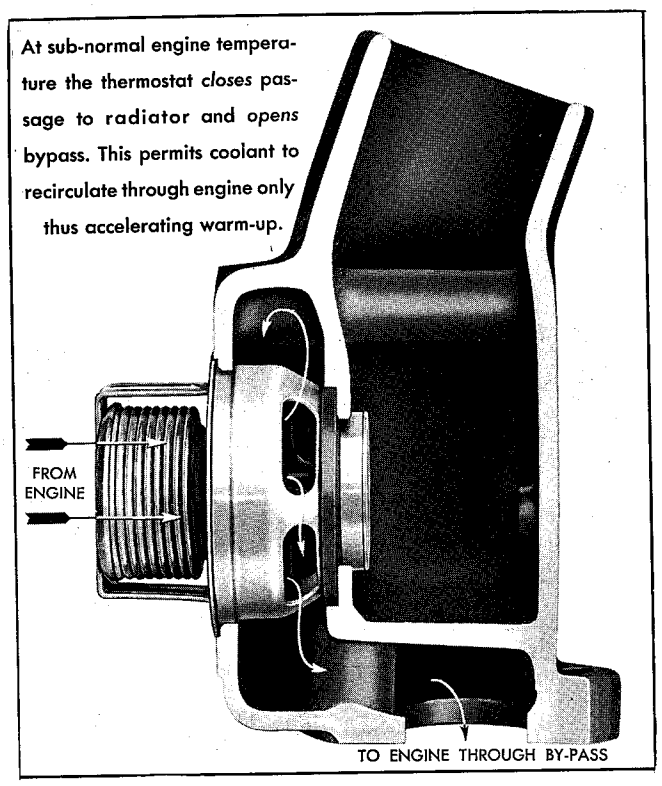


FIG. 9

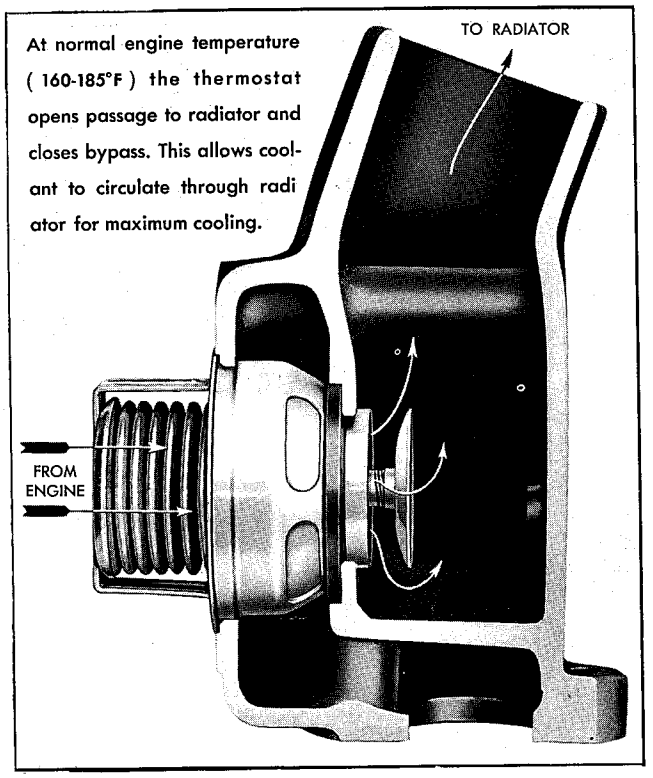


FIG. 10

of 160° F. to 185° F. Operating the engine with the temperature below this range will result in incomplete combustion of fuel, higher fuel consumption with less power, and will cause harmful deposits within the engine.

Maintaining the normal engine temperature (160° F. to 185° F.) depends mostly on proper functioning of the thermostat. If the engine temperature remains consistently below normal, the thermostat should be removed and inspected. If the thermostat is corroded and stuck or if the bellows of the unit leaks, install a new unit.

With the manual operation of the radiator shutters and the automatic operation of the thermostat, combined, proper engine operating temperature should be maintained.

C. Fan Belt Adjustment.

The fan belts are correctly adjusted when one side of the belts can be pressed inward approximately 1¼ inches at a point half-way between the two pulleys.

Loosen the large nut at the rear end of the fan shaft and the lock nut on the adjusting screw to adjust the belts. Refer to Figure No. 11. Turn the adjusting screw clockwise to tighten the belts or counter-clockwise to loosen them. When the belts have been adjusted, tighten the large nut securely, then tighten the adjusting screw lock nut. CAUTION: Bearing failure will develop when fan belts are set too tight.

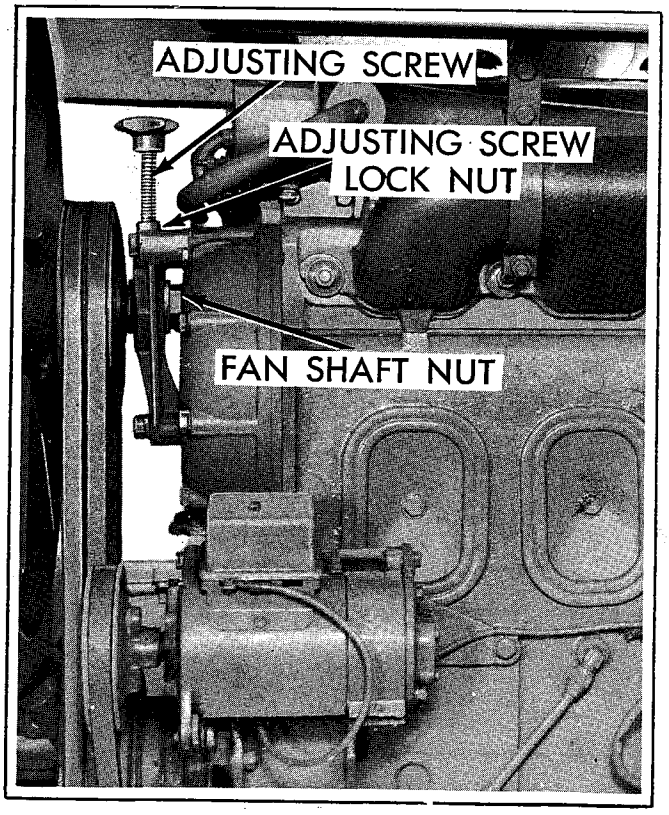


FIG. 11

D. Filling Cooling System.

Fill the cooling system with clean water free from lime or alkali. IMPORTANT: On the later model tractors, open the vent valve in the front of the thermostat housing while filling the system to allow air trapped in the engine by the closed thermostat to escape. Close the vent valve after the system is filled. If the valve is left open, it will prevent proper engine warm-up and regulation of engine temperature by the thermostat. Since the valve is enclosed in the thermostat housing, the only way to tell whether the valve is open or closed is to turn the handle. The valve is opened by turning it out and closed by turning it in.

On the early models, the thermostat housing is provided with a vent plug. Remove this vent plug when filling the system to allow air trapped in the engine by the closed thermostat to escape. Fill the system until coolant flows from the vent hole, then reinstall the plug and complete the filling of the system.

E. Draining Cooling System.

To drain the cooling system, open the drain cock in the bottom of the water pump housing and the drain cock in the bottom of the lubricating oil cooler assembly. Refer to Figure No. 12. Also open the vent valve or remove the vent plug in the thermostat housing to allow the water trapped in the upper radiator hose, above the thermostat, to drain.

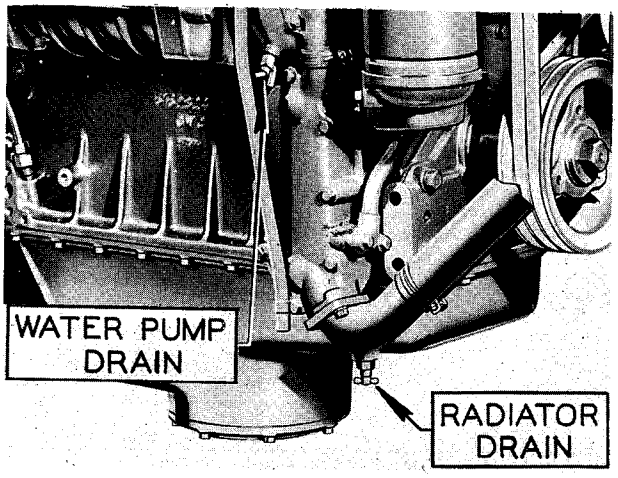


FIG. 12

A. Description of System.

The fuel system consists of the fuel tank, first stage and second stage fuel filters, fuel pump, injectors and fuel lines. The fuel is drawn from the bottom of the fuel tank and through the first stage fuel filter by the fuel pump. The pump then circulates the fuel under pressure through the second stage fuel filter and into the inlet manifold and through the injectors. As the fuel enters each injector it passes through a small porous metal filter in the injector body. The amount of fuel required for operation of the engine is injected into the cylinders by the injectors. The surplus fuel leaves each injector through another porous metal filter, enters the return manifold and is returned to the fuel tank.

A pressure of 25 to 65 pounds is maintained within the fuel system by a restricted fitting located in the rear of the fuel return manifold. The continuous circulation of fuel helps to cool the injectors and eliminates the possibility of air pockets in the system.

B. Fuel Tank and Sediment Sumps.

Two (2) sediment sumps are provided on the bottom of the fuel tank to allow sediment and water to collect and be drained. The drain cock in the bottom of each sump should be opened before the start of the day's operation in warm weather and shortly after the end of the day's operation in freezing weather. Close the drain cocks when clean fuel runs out. Drain and flush the fuel tank if an accumulation of rust and scale is evident.

C. First Stage Fuel Filter.

This filter, located under the seat on the right hand side, contains a replaceable element. Dirt and sediment in the fuel is collected by this filter and prevented from passing on to the fuel pump. A drain screw in bottom of the filter shell is provided for draining the filter.

Service.

Remove the filter drain screw daily, before the engine is started at the beginning of the day's operation in warm weather or shortly after the end of the day's operation in freezing weather, and allow the water or sediment to drain. Reinstall the filter drain screw when clean fuel runs out. Discard the old element and install a new one after every 300 to 500 hours of operation (more often if conditions warrant) or when the filter becomes clogged. A clogged filter is usually indicated by irregular engine performance.

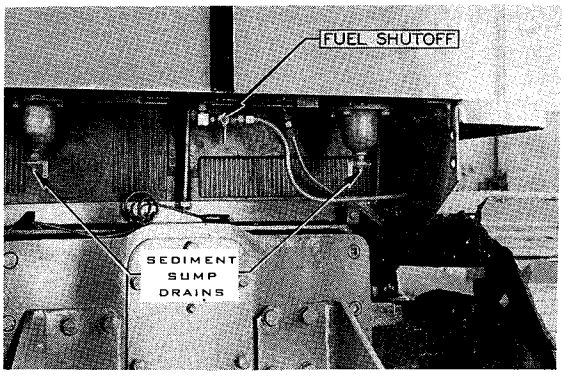


FIG. 13

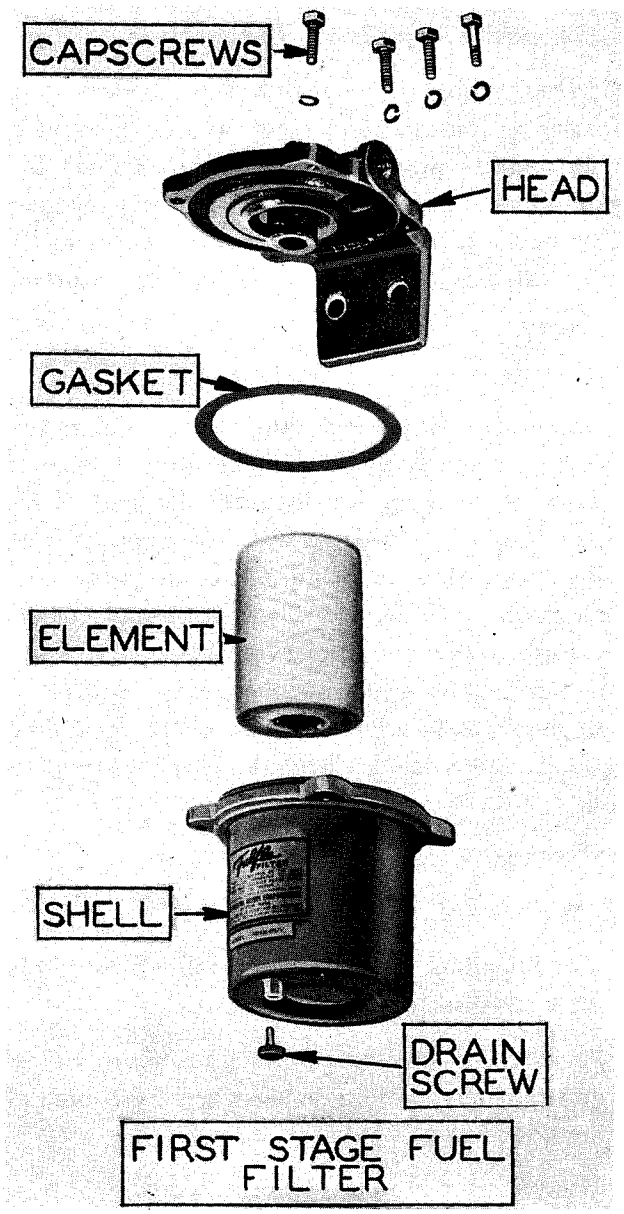


FIG. 14

To Change Filter Element.

1. Close the fuel tank shut-off valve.
2. Remove the capscrews attaching the filter shell to the filter head and remove the shell. Discard the element.
3. Wash the inside of the shell.
4. Discard the old gasket used between the shell and head and install the new gasket furnished in the element kit.
5. Place the new element in the shell and install the shell on the head. Tighten the attaching capscrews evenly and securely.
6. Open the fuel tank shut-off valve and start the engine, then check for fuel leakage around the filter head and shell.

D. Second Stage Fuel Filter.

This filter, mounted on the right side of the engine, contains a replaceable element. Any small particles of dirt, which may have passed through the first stage filter, are caught by this filter and prevented from reaching the injectors. A drain cock, in the bottom of the filter shell is provided for draining the filter.

Service.

Open the filter drain cock daily, before the engine is started at the beginning of the day's operation in warm weather or shortly after the end of the day's operation in freezing weather, and allow the water or sediment to drain. Close the drain cock when clean fuel runs out. Discard the old element and install a new one after every 300 to 500 hours of operation (more often if conditions warrant) or when the filter becomes clogged. A clogged filter is usually indicated by irregular engine performance.

To Change Filter Element.

1. Close the fuel tank shut-off valve.
2. Open the filter drain cock and drain filter. Close the cock after draining.
3. Remove the filter case from filter head, by removing the retaining screw from the center of the filter head.
4. Discard the old element and gasket.

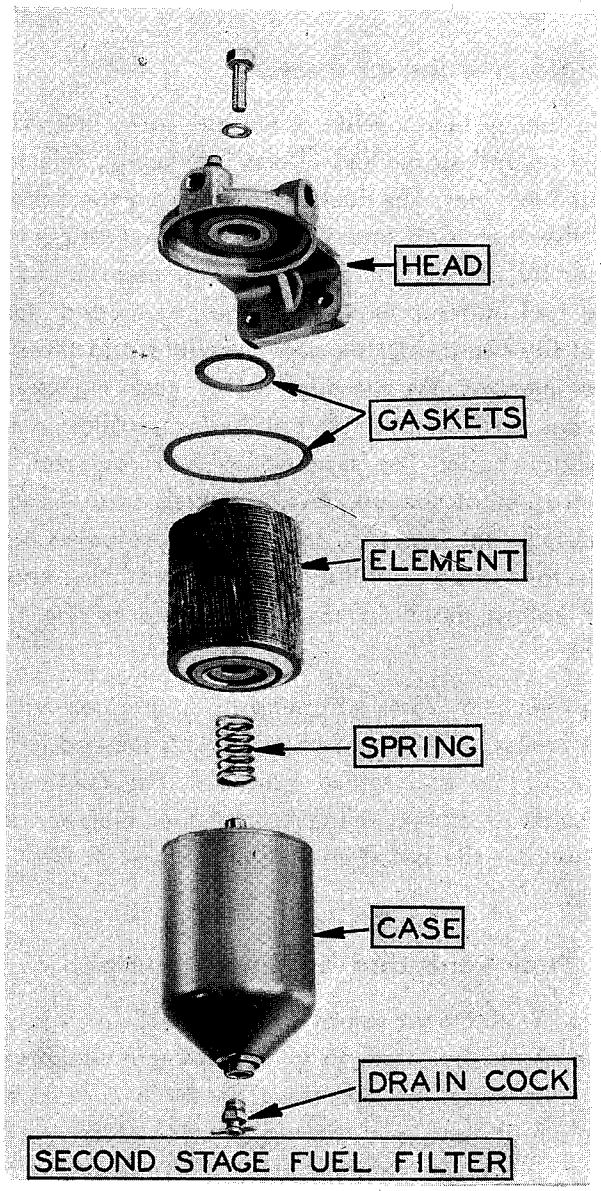


FIG. 15

5. Remove the spring from the case and wash the inside of the case. Replace the spring after washing the case.
6. Install a new element in the case. Install the large gasket (furnished with kit) in the filter head.
7. Position the case under the filter head and tighten the retaining screw.
8. Open the fuel tank shut-off valve and start the engine, then check for fuel leakage around the filter head and case.

E. Checking Fuel System.

Under normal conditions with engine operating at full throttle, 25 to 65 pounds pressure will be indicated on the fuel pressure gauge. Fuel pressure

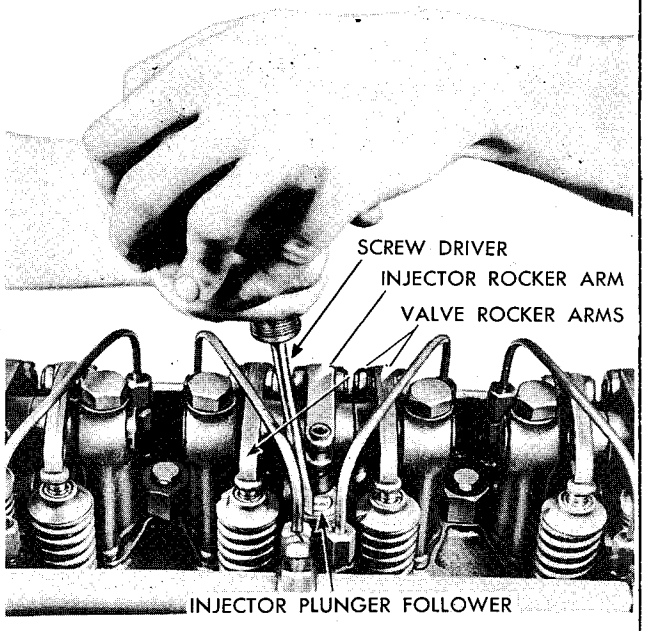
below normal, uneven running of the engine, excessive vibration, stalling when idling and loss of power are indications of insufficient fuel supply to the injectors. If any of the above conditions exist the system must be checked as follows to determine the reason for improper operation:

Air being drawn into the system.
Clogged fuel filter elements.
Partially clogged fuel lines.
Clogged injector fuel filters.
Inoperative fuel pump.

Pressure below normal will occur when air is being drawn into the system on the suction side of the pump, when filters or lines are clogged or when the fuel pump is worn or damaged.

Pressure above normal will occur when the restricted fitting in the fuel return line clogs or when the pressure relief valve in the fuel pump fails to open.

To check the flow of fuel through the system, remove the return line from the fuel tank. With the engine operating at full throttle, the system will be functioning properly when a full stream of fuel having considerable pressure is observed returning to the fuel tank through the fuel return line. If only a small stream is observed returning to the fuel tank, all the causes listed above must be checked and eliminated in turn.



Locating Missing Cylinder

FIG. 16

1. Check for Admission of Air Into the System and for Clogged Filter Elements.

With the engine running, loosen a pipe plug in second stage filter head. If air is entering into the fuel system, foam or bubbles will be observed in the fuel that emerges from the loosened pipe plug. Correct this condition by tightening any loose filter lines and filter connections or by replacing any damaged parts. Test for smooth engine operation and full flow of fuel.

If the fuel lines or filters are clogged, clean the first stage or second stage fuel filter or both and install new elements. Blow out the lines while they are disconnected. This should eliminate the difficulty. Check for full flow of fuel after engine is again started.

2. Check for Clogged Injector Filters.

If engine still runs "ragged" with suitable fuel return, the injector filters for one or more cylinders may be partially clogged. Locate the faulty injector as follows: Run the engine at idling speed and cut out each injector in turn by holding the injector follower down with screwdriver or small block of wood while the engine is running, as illustrated in Figure No. 16.

CAUTION: Do not allow screwdriver to slip from the follower as damage to the valve assemblies can easily result.

A decrease in engine speed with the follower held down indicates that the injector for that cylinder is functioning properly. If the engine continues to run with no decrease in speed, the injector is inoperative and should be removed for further inspection.

Stop engine and remove the fuel line that connects the injector to the return fuel manifold. Hold a finger over the injector fuel outlet and crank engine with starter. If fuel gushes from injector while the starter is cranking the engine, an ample fuel supply is indicated.

3. Check for Inoperative Pump.

If all the possible causes for insufficient supply of fuel as explained in the above paragraphs have been eliminated, the fuel pump will be considered inoperative and must be repaired or replaced.

4. Excessively High Fuel Pressure.

A relief valve is installed in the fuel pump to prevent high fuel pressure. When the relief valve sticks, high pressure will develop and will be indicated on the fuel pressure gauge.

When this occurs, the valve in the fuel pump should be inspected and the reason for its sticking eliminated. The second stage fuel filter, the restricted fitting in the fuel return line at rear end of cylinder head and all fuel lines should be inspected for clogged passages.

Continued operation with excessively high pressure (over 65 pounds) may result in damage to the fuel system.

ENGINE LUBRICATION SYSTEM

A. Description of System.

The engine lubrication system includes the gear driven oil pump, oil cooler, oil filter, pressure regulator valve and the drilled oil passages in the engine block.

The oil pump draws the oil from the crankcase and circulates it under pressure through the oil cooler, oil filter, and the engine. Stabilized pressure is maintained by the oil pressure regulator valve located between the pump and the oil cooler. A spring loaded by-pass valve in the oil cooler adapter by-passes the oil directly from the pump to the lubricating system in the engine if the oil passages in the cooler become clogged or, if in cold weather, the oil is too thick to circulate freely through the cooler.

The oil discharged from the pump passes through oil passages in the cylinder block and through the oil cooler, then into the main oil gallery and vertical passages leading to the various engine bearings and operating parts.

The early model tractors are equipped with two (2) oil filters, a "primary" and a "secondary" oil filter. The "primary" oil filter on the early models is located in the lubricating system between the oil pump and the oil cooler. All the oil from the pump passes through this filter and the oil cooler. Refer to "Lubrication and Service Pictures," Figure A, showing the location of the "primary" oil filter.

The "secondary" oil filter on the early models is located on the left side of the engine. The inlet line at the top of the filter body is connected to the main oil gallery in the cylinder block and the outlet line from the filter drains the oil back into the crankcase. Only a portion of the oil flows through this filter. Refer to "Lubrication and Service Pictures," Figure B, showing the location of the "secondary" oil filter.

On the later model tractors, the "primary" oil

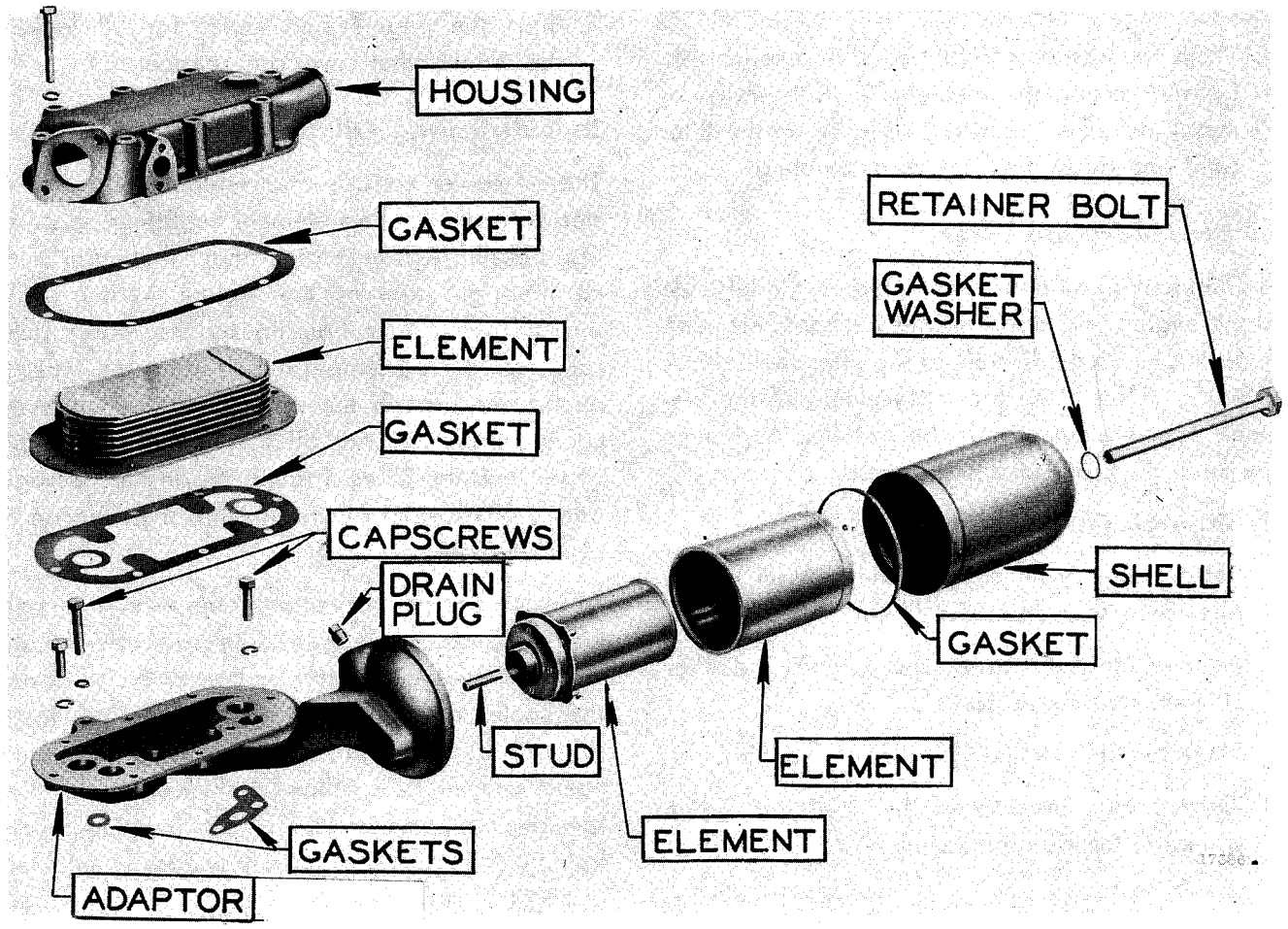


FIG. 17

filter mentioned above is discontinued; however, the "secondary" oil filter mentioned above is retained.

B. Primary Oil Filter *(used on Early Models only).*

This oil filter removes all larger particles from the oil and collects a portion of the sludge from the oil on two (2) metal screen elements. The filter removes particles from the oil larger than .005" in diameter. If the filter should become clogged, the by-pass valve will open and allow the oil to flow directly from the pump to the main oil gallery of the engine. This condition should not be allowed to continue since oil flowing through the by-pass will not be filtered or cooled. The filter screen elements must be cleaned each time the oil in the crankcase is changed.

To Clean Primary Filter Elements.

1. Remove filter drain plug.
2. Remove the oil filter shell retainer bolt.
3. Remove the oil filter shell and filter elements from the oil filter and cooler adapter housing.
4. Wash the elements in fuel oil with a soft brush. Do not scrape the elements with a sharp or metal instrument or wire brush. Wash the filter base and outer shell before assembling.

C. Secondary Oil Filter.

The lubricating oil filter is mounted on the left side of the engine and contains a replaceable element. A drain plug in the bottom of the filter shell allows draining of the filter for replacement of the element. A new element must be installed each time the oil in the crankcase is changed.

To Change Filter Element.

1. Remove the drain plug in the bottom of the filter shell and drain the filter.
2. Remove the filter cover and discard the filter element and cover gasket.
3. Wash the filter shell and replace the drain plug.
4. Place a new element in the shell and place spring on top of the element.
5. Install a new cover gasket (furnished with kit) in the cover and install cover.

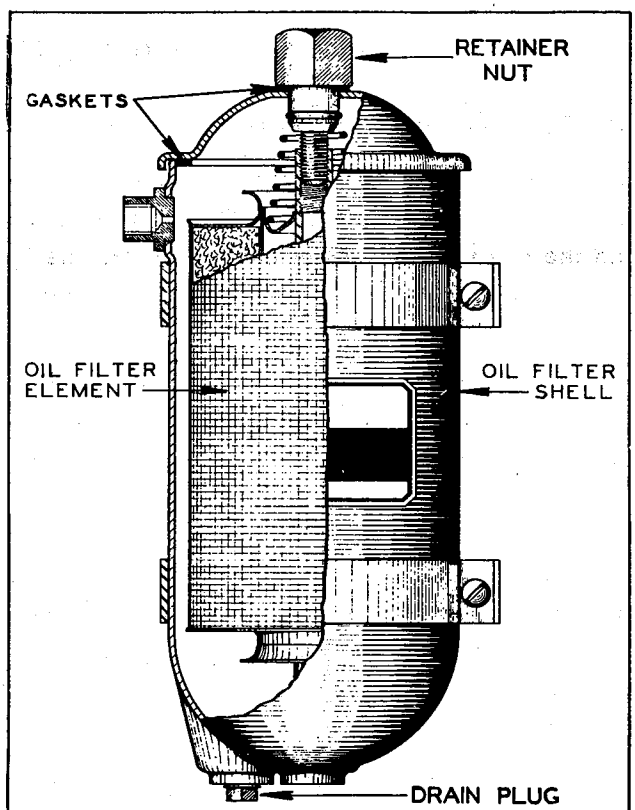


FIG. 18

6. Tighten the cover retainer nut securely.
7. Start the engine and check for oil leakage around the filter cover and retainer nut.

D. Lubricating Oil Cooler.

The oil cooler consists of a multiple plate, corrosion resistant cooling element contained in a cast iron housing and is located under the water pump on the right side of the engine. Water drawn through the cooler housing by the water pump regulates the oil temperature during the time the oil travels through the small passages within the cooling unit. The hot oil enters the cooling unit at the bottom, flows through the inside passages, and is discharged at the top into a gallery in the cylinder block.

To insure engine lubrication in the event the cooler element becomes clogged, a by-pass valve located in the oil cooler adapter, by-passes the oil around the cooler and directly to the oil gallery in the cylinder block. If proper lubricating oil maintenance procedure is followed, the cooler will function efficiently. However, if oil is allowed to become laden with impurities, they will deposit in the cooler and cause restriction or clogging of the oil passages in the cooler element.

Clogging of the cooler is usually indicated by a drop in oil pressure. If this occurs, the oil cooler element must be cleaned or a new one installed, to avoid excessive heating of the oil. Refer to Figure No. 17.

To remove the cooler element, disconnect the hoses and pipes from the cooler housing, remove the attaching capscrews and remove the housing and element. Scrape all of the old gasket from the oil cooler.

Cleaning Oil Cooler.

Cleaning of the element requires the use of special solvents. The following solvents have been found effective when used according to the manufacturer's directions:

Excello Floor Cleaning Compound
Turco Cleaning Compound
No. 70 Stripper
Mixture of 3 parts Oakite No. 7 and 5 parts fuel oil.

Bendix Cleaning Compound.

To use the last named solvent, merely submerge the element in the solution for a sufficient length of time to allow the chemical action of the solvent to dissolve or loosen the sludge or other foreign matter from the cooler.

Flush the element thoroughly with live steam or spirits after cleaning, regardless of type of cleaner used.

Cement gaskets to both sides of the cooler element flange and coat both sides of gaskets with cement when the element and housing are installed after cleaning.

AIR PRE-CLEANER AND AIR CLEANER

A. Description and Purpose.

The life of the engine depends largely upon the efficiency of the air pre-cleaner and air cleaner. Fast wear on cylinder liners, pistons and rings will result if these cleaners are not kept in good condition and properly serviced.

The air enters through the pre-cleaner mounted on the top of the air cleaner extension pipe. The pre-cleaner is designed to impart a rotary motion to the air. This causes the heavy particles of dirt to be thrown to the outside of the bowl and deposited therein. Approximately 85% of the dirt in the air is thus removed.

After passing through the pre-cleaner the air enters the air cleaner through the pipe that extends down through the center of the air cleaner body. An oil cup filled to a specified level with engine oil is suspended on the lower end of the air cleaner body. As the air is drawn through the cleaner, a portion of this oil is whipped up into screen mats in the main body of the cleaner. Dust still remaining in the air collects on these oily mats as the air passes through them. The oil, dripping back into the cup, carries this dust with it and deposits it in the cup. Thus, only clean air enters the blower for delivery to the cylinders.

A defective hose, loose hose clamp, damaged blower gasket or leak of any kind that allows air to enter the cylinders without first passing through the cleaners will defeat their purpose. Therefore, extreme care should be taken to prevent leaks.

B. Air Pre-Cleaner Service.

Empty the pre-cleaner whenever the dirt level rises halfway up on inspection glass. Remove and clean

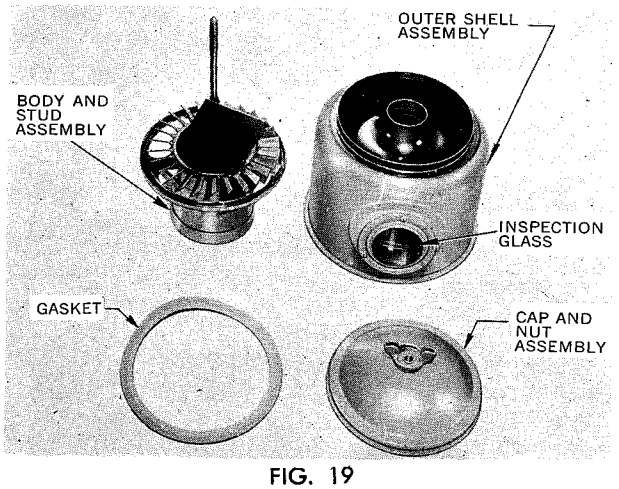


FIG. 19

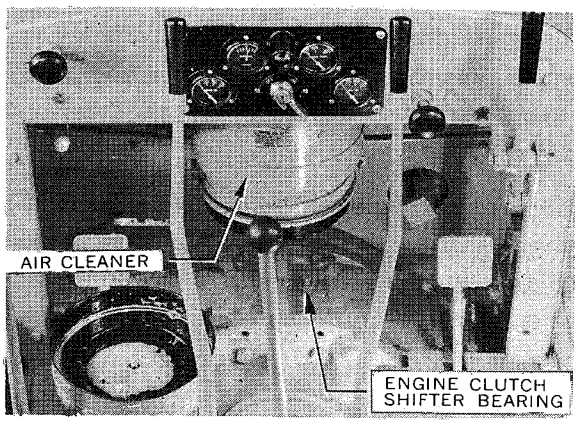


FIG. 20

as follows:

1. Unscrew wing nut, lift off cap and remove shell.
2. Shake dirt out of shell and wipe inside of shell with a dry cloth. Make sure fins of pre-cleaner are not bent, damaged or clogged.
3. Wipe dust off cap gasket and cap. Then reassemble. Replace gasket if not in good condition. Tighten wing nut with fingers. *Do not use a wrench.*

C. Air Cleaner Service.

The filtering oil in the cup must be inspected daily or more often when operating under extremely dusty conditions. Keep filled with clean oil to level of top of cone in center of baffle plate. Empty and wash the cup whenever the oil becomes discolored, then refill with clean oil.

Use same viscosity of oil as is used in the engine at prevailing temperatures. NOTE: SOME DIESEL LUBRICATING OILS MAY FOAM WHEN USED IN THE AIR CLEANER. DO NOT USE AN OIL THAT FOAMS AS IT REDUCES AIR CLEANER EFFICIENCY AND IN SOME CASES ALLOWS THE OIL TO BE PULLED OVER INTO THE ENGINE, CAUSING SERIOUS DAMAGE.

Service the air cleaner as follows:

1. Remove the oil cup from bottom of cleaner body. Remove baffle ring and baffle, then empty oil from cup.
2. Wash baffle and cup with clean fuel oil or solvent. Swab out the air inlet pipe in center of cleaner body.
3. Install baffle and baffle ring in cup and fill to top of cone in center of baffle with clean oil. Replace cup on bottom of cleaner body.

ELECTRICAL SYSTEM

A. Description of System.

The electrical system, which includes the starter, generator, generator regulator, batteries, head lights, tail light, and wiring is a 12-volt system throughout.

Current is supplied by the two 6-volt wet cell storage batteries located under the seat. Electrical energy drained from the batteries through the operation of the electrical equipment is replaced by the generator. The output of the generator is controlled by the generator regulator to prevent overcharging of the batteries.

B. Batteries.

Check the level of the electrolyte in the batteries every 50 hours of operation or as often as operating conditions prove it necessary. Maintain the level of the solution 3/8" above the plates by the addition of clean distilled water. Keep the battery and cable terminals tight and clean. If corrosion occurs, clean the battery posts and terminals with a strong soda solution and coat the terminals lightly with vaseline before connecting them again. The vaseline will prevent further corrosion.

When air temperature is below the freezing point, special attention should be given to hydrometer readings of the batteries. The electrolyte in full charged batteries will have a hydrometer reading of 1.280 to 1.300 specific gravity when corrected to 77° F. Specific gravity readings without correction for temperature are practically meaningless. For each 30 degrees that the temperature of the electrolyte is above 77° F., add 10 points to the hydrometer reading and for each 30 degrees below 77° F., subtract 10 points to get the true specific gravity. For example, if the hydrometer reading is 1.250 and the electrolyte temperature is 17° F. (60 degrees below 77° F.) 1.250 minus 20 points equals 1.230 — the true specific gravity.

If the corrected readings are below 1.240, the batteries are not receiving sufficient charge. This might indicate that the generator or generator regulator requires attention. If these units prove satisfactory, inspect the system for short circuits and loose or corroded connections. In zero weather there is danger of batteries freezing if the specific gravity is below 1.175. Batteries with a specific gravity of 1.225 will freeze at 35° below zero F.

During freezing weather, any addition of water to the cells should be made after the engine is started at the beginning of an operating period to make certain that the water and electrolyte solution will be thoroughly mixed; otherwise it may freeze.

The filler caps must be kept tight at all times and the tops of the batteries kept clean and dry.

C. Generator, Generator Regulator and Starter.

The generator and generator regulator are set to charge the batteries at the rate of 4 to 8 amperes. Under normal conditions the ammeter should indicate this rate of charge for a short time after the starting of the engine or until the generator replaces the energy drained from the batteries during cranking, then it will show little or no charge. This is sufficient to keep the batteries fully charged under normal conditions.

It is important that the generator be maintained in good condition so that the batteries will be kept charged and provide the necessary cranking speed for starting the engine. This is especially important in cold weather when battery efficiency drops in proportion to the drop in temperature.

Any authorized United Motors Service Station is equipped to test or rebuild the generator, generator regulator, or starter.

D. Wiring.

Heavy cables connect the batteries and the starter; wires assembled in a harness connect the remaining electrical units. A 20-ampere fuse, introduced in the wires leading to the head lights and the tail light, prevents burning out of the lights in the event of a short circuit.

Inspect the wiring frequently to detect any loose connections or frayed insulation. Tighten the connections and wrap any frayed spots on wires with friction tape to prevent short circuits.

E. Generator Belt Adjustment.

The generator belt is correctly adjusted when one side of the belt can be pressed inward approxi-

mately 1¼ inches at a point halfway between the crankshaft and generator pulleys.

To Adjust Generator Belt.

Loosen the capscrew in the adjusting arm at the front end of the generator and loosen the generator hinge bolts, then move the generator in or out until the correct tension on the belt is obtained. Tighten the adjusting arm capscrew and the generator hinge bolts.

ENGINE STARTING AIDS

Purpose.

In warm weather, sufficient heat is generated by the compression of the air in the cylinders to ignite the fuel and start the engine within a very short cranking period. However, in cold weather the "drag" caused by the cold oil between the pistons and cylinder walls and in the bearings reduces the cranking speed of the engine. A large part of the heat generated by compression of the air is absorbed by the pistons and cylinder walls. This loss of heat and the reduced cranking speed may result in the temperature of the air in the cylinders being too low to ignite the fuel. A starting aid must then be used in starting the engine.

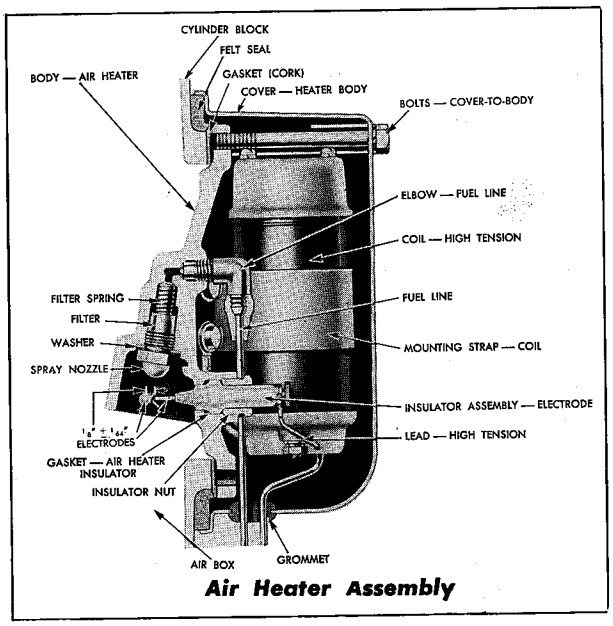
On tractors prior to Serial No. 16697 an Air Heater is used as an engine starting aid. All tractors Serial No. 16697 and above, except those sold in foreign countries, are equipped with a Cold Weather Engine Primer as an engine starting aid.

AIR HEATER.

A. Description.

The air heater is essentially a small oil burner with electric ignition, mounted on the left side of the cylinder block. It is supplied with fuel by a combination suction and pressure pump mounted in the cowl. A push button switch is provided to close the electric circuit to furnish current to the electrodes of the burner unit. Fuel is pumped from the fuel tank to the burner unit and out through the heater spray nozzle. A high tension current, built up by the coil in the burner unit, provides a continuous hot spark between the electrodes of the burner. This spark ignites the fuel as it comes out through the spray nozzle. A large flame is thus produced in the air box to heat the air.

CAUTION: The air heater can be used only to heat ingoing air while cranking the engine. *It has no other function.* Confusion has been created in the past by referring to the air heater as a "Flame Primer" and some operators have considered it a means of priming the engine with fuel. Refer to "Starting and Stopping of Engine."



Air Heater Assembly

FIG. 21

B. Air Heater Trouble Shooting and Adjustments.

If the engine is cranked with the throttle wide open and does not start after two or three strokes of the air heater pump, it is advisable to stop cranking and inspect the air heater for possible causes of failure. If an adequate cranking speed of 80 R.P.M. or over is obtained, and fuel is getting to the cylinders (usually indicated by a light blue smoke from the exhaust), the trouble is probably due to improper functioning of the air heater.

The ignition system to the electrodes may be considered in working order if a buzzing sound is heard when the dash light switch is turned on and the heater switch is pressed in. However, the same buzzing sound will be produced by a spark shorting across the insulator assembly instead of arcing at the electrodes as it should.

Check the electrodes by removing the handhole cover on the left side of the engine and operating the air heater switch and pump. If no flame occurs, it is probable that carbon or sludge has accumulated on the electrodes causing a short circuit. Occasionally, holding the push button switch in and allowing the unit to "buzz" will burn away this accumulation and the spark will occur at the electrodes. However, this should be done for a brief period only.

For further inspection, the air heater cover or entire burner must be removed from the cylinder block.

1. Failure of Ignition.

With the dash light switch turned on and the air heater push button switch pressed in, the coil points should vibrate rapidly and continuous hot sparks should occur between the ignition electrodes. If not, inspect points beneath the cover on top of coil for dirt or carbon and be sure all wiring and connections are in good condition. The points may be cleaned with fine sandpaper or a point file. Reset the points after cleaning to allow .018" gap with the vibrator arm held against coil body.

2. Spark Jumps Across Porcelain of Electrode.

Check the gap between the electrodes. Adjust for a 1/8" gap if necessary by bending the wire electrode. Do not attempt to bend the electrode on the insulator assembly. If the gap is correct, remove the electrode insulator by removing the insulator retaining nut and withdrawing the assembly. Do not lose the small insulator gasket from under the insulator. Scrape off any accumulated carbon and wash the electrode insulator with a cleaning fluid. Re-assemble the insulator and test it for proper operation.

3. Spray Nozzle Clogged.

This condition will usually be indicated by excessive resistance on the air heater pump. A partially clogged nozzle will not properly "fog" the fuel. To clean the nozzle, first remove the wire electrode and the electrode insulator and unscrew the nozzle assembly from the heater body, using a thin-walled 5/8" socked wrench. Remove the spray nozzle, filter and spring from the body, then unscrew the swirl pin from the center of the nozzle. Wash and clean these parts thoroughly and dry them.

CAUTION: Do not use wire or a drill to clean the nozzle orifices as the size and shape of the orifices and grooves are very important and any damage to them will render the nozzle useless. After cleaning, re-assemble the nozzle assembly by first placing the spring and filter in the heater body. Then screw the swirl pin in the spray nozzle, using care not to damage the slotted passages in the end of the pin by overtightening. Place the washer on the nozzle and screw the nozzle into the body against the filter. Re-install the wire electrode and the electrode insulator, spacing the electrodes for a 1/8" gap. Operate the pump to check for proper fuel spray through the nozzle.

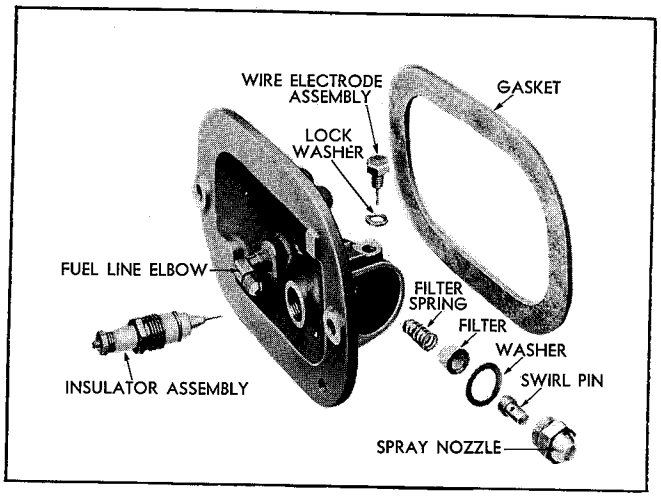


FIG. 22

4. Inoperative Pump.

Failure of the pump to function properly may be caused by worn or damaged piston "leathers," clogged fuel lines, or "frozen" or clogged check valves. The piston "leathers" on the plunger are molded of a special oil-resistant composition and must be replaced by duplicate parts if worn or broken. To replace these "leathers," unscrew nut (under knob) from pump body and pull plunger out of body. Remove retaining screw from end of plunger then remove "leathers" and separator from plunger. Install new "leathers" on plunger with separator between them and install retaining screw. Coat the "leathers" with light oil to facilitate entering them into the cylinder of the pump body. Insert plunger assembly into pump body, taking care that the edge of the first "leather" is not turned back in the operation.

5. Outlet Check Valve.

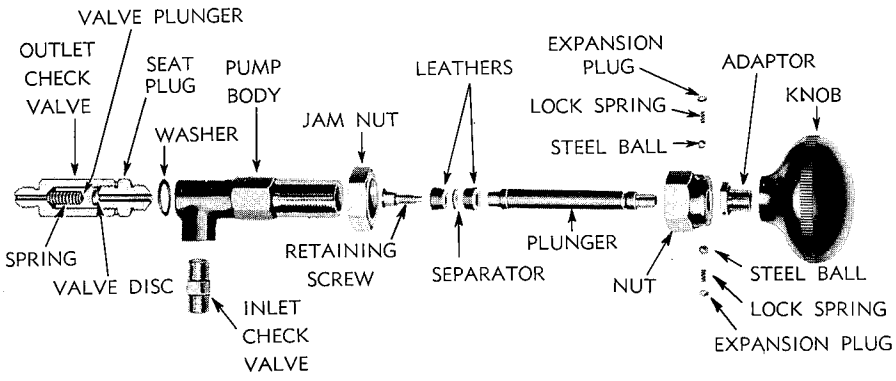
This valve is provided to prevent the passage of fuel through the air heater and into the engine air box when the heater is not being used. It is a one way valve consisting of a spring, valve plunger and valve disc enclosed in a body and installed on the end of the pump body. In

the event of clogging or fuel seeping into the air box, disconnect the outlet fuel line from the valve and unscrew the valve from the pump body. Unscrew the seat plug from the valve body and remove the valve disc, valve plunger and spring. Clean these parts thoroughly. If the valve disc is corroded or scored, install a new one. Re-assemble the valve and test it to be sure it will not allow fuel to pass through it in a direction opposite to the arrow stamped on the body of the valve. After installing the valve and connecting the fuel lines, test the operation of the pump.

ambient temperatures with the aid of the primer if the starter will crank the engine even at a very low cranking speed. The starting fluid capsules, available in 7 c.c. and 17 c.c. sizes, can be obtained from Allis-Chalmers Dealers.

B. Cold Weather Engine Primer Trouble Shooting.

If the engine is cranked with the throttle wide open and does not start after two or three strokes of the primer pump, it is advisable to stop cranking and inspect the primer system for possible causes of failure:



Air Heater Pump Details

FIG. 23

COLD WEATHER ENGINE PRIMER.

A. Description.

The cold weather engine primer consists of a dispenser assembly, which punctures a capsule containing ethyl ether fluid, a primer pump to force the fluid through a small nozzle into the air inlet elbow near the engine blower, a primer elbow assembly, and the necessary lines to complete the system. The dispenser and primer pump are located in the cowl (to the right of the instrument panel). The vaporized starting fluid is forced through the primer elbow assembly into the air inlet elbow, where it is picked up by the engine blower and is blown into the cylinders. Since the fluid is highly combustible, it is easily ignited by compression in the cylinders. The engine will start quickly at low

1. Primer Elbow Assembly Clogged.

This condition will usually be indicated by excessive resistance on the primer pump. A partially clogged primer assembly will prevent the delivery of sufficient starting fluid to the air inlet system. To clean the primer elbow assembly, remove the assembly from the air inlet elbow and remove the small nozzle from the primer elbow assembly. Remove and clean the nozzle swirl pin and open the hole in the end of the nozzle, if clogged.

CAUTION: Do not enlarge the hole in the end of the nozzle.

After cleaning, re-assemble the primer assembly and install the assembly in the air inlet elbow.

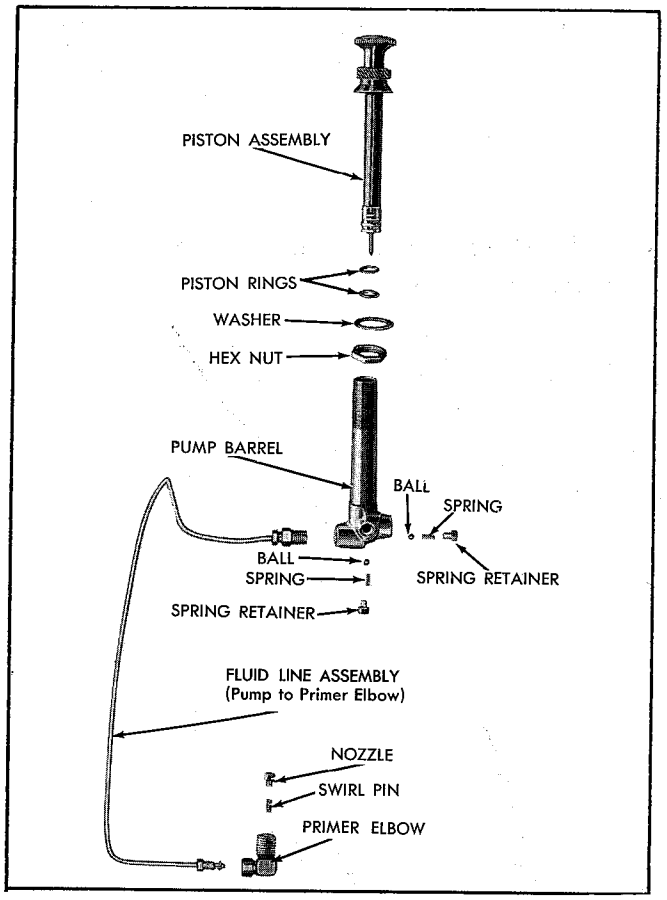


FIG. 24

2. Inoperative Primer Pump.

Failure of the primer pump to function properly may be due to worn or damaged packing rings, a clogged dispenser filter screen, clogged fluid lines or "frozen" or worn check valve balls. The packing rings on the plunger are made of a special rubber composition and must be replaced by duplicate parts if worn or damaged.

To replace the packing rings, remove the knurled nut (under knob) from the pump barrel and withdraw the piston assembly from the barrel. Remove the packing rings from the grooves of the piston assembly and install new rings. Lubricate the rings and piston with light engine oil and install the piston assembly in the pump.

3. Ball Check Valves.

The two spring loaded ball check valves, located on the inlet and outlet openings of the pump, are provided to close the pump openings at the proper time. When the pump piston is pulled out (suction stroke, drawing fluid from dispenser) the ball check valve at the inlet port opens, allowing the fluid to be drawn from the dispenser. When the pump piston is pushed in (delivery stroke, supplying fluid to the primer elbow assembly), the ball check valve at the outlet port opens, allowing the pump to force the fluid to the primer assembly.

Worn or "frozen" ball check valves or broken springs will prevent the pump from operating properly. When this occurs, remove the spring retainers, springs, and balls from the inlet and outlet ports of the pump. Inspect the balls, ball seats, and springs for wear or damage. Clean the pump body and all its components thoroughly and reassemble, using new parts where necessary.

4. Clogged Dispenser Strainer Screen.

This screen is soldered to the inner end of the connector assembly located in the bottom of the dispenser. If the gelatin capsules are not removed soon after puncturing, the gelatin will melt and plug the strainer screen in the dispenser body. To clean the dispenser body and the strainer screen, remove the connector assembly from the dispenser body and wash in hot water. Remove the plunger knob from the plunger assembly and the upper capsule chamber from the

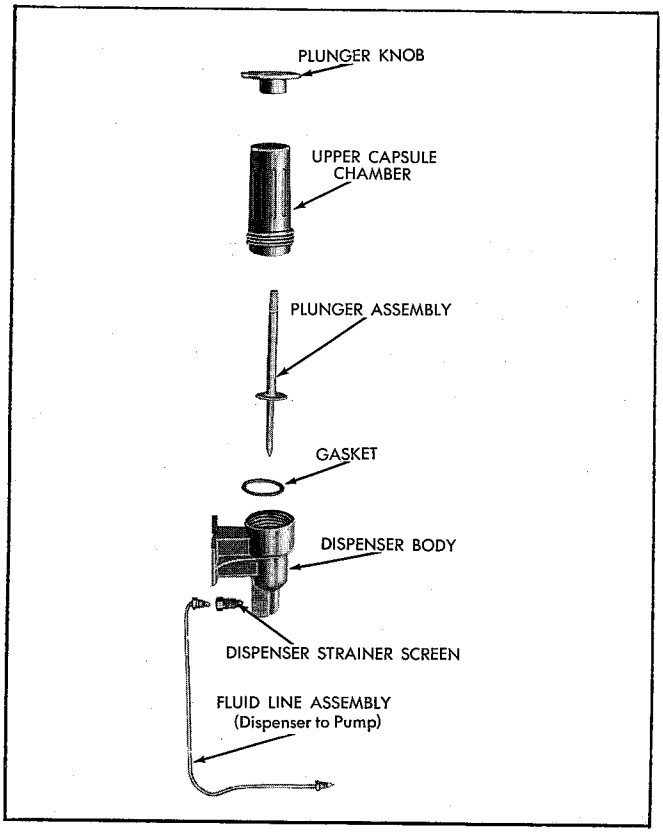


FIG. 25

dispenser body; the body may then be cleaned with hot water. Re-assemble the dispenser assembly and connector assembly by direct reversal of the disassembly procedure.

VALVE ADJUSTMENT

The correct clearance between the ends of the valve stems and the rocker arms is very important in a Diesel Engine because of the high compression pressures developed. Insufficient valve clearance will cause loss of compression, misfiring, and will eventually burn the valves and valve seats.

Too much clearance will result in faulty engine operation and rapid wear on valve operating mechanism. The proper valve lash is .009" with the engine at operating temperature.

After any mechanical work has been done which would disturb the valve setting, the valves may be set "cold" to .012" clearance so that the engine may be run and allowed to warm up to operating temperature in preparation to the final correct valve adjustment.

To Adjust Valves.

1. Remove engine hood and rocker arm cover.
2. Crank the engine with the starter until the injector rocker arm for one cylinder is down and injector plunger is at the bottom of its stroke; the valves for that cylinder will then be closed and the valve rocker arms will be raised off the valve stems.
3. Check clearance between valve stems and rocker arms (Fig. 26). When adjusted properly a .009" thickness gauge should pass between them with a slight drag when the engine is at normal operating temperature. With the engine at ambient temperature, the .012" feeler ribbon furnished with the tool kit may be used and the valves adjusted to .012" clearance — cold. Adjust each valve by loosening the lock nut and turning the push rod into the push rod clevis to increase the clearance or out of the push rod clevis to decrease the clearance.

   When proper clearance is obtained, tighten the lock nut. Recheck the clearance to be sure it was not changed by tightening the lock nut.
4. Crank the engine with the starter and repeat above operation on valves for the other cylinders. Replace rocker arm cover and hood. CAUTION: If for any reason a push rod was disconnected from a rocker arm, be sure when it is reinstalled that the upper end of the push rod is flush with inside of the clevis yoke before engine is turned. If it is not, it is possible that the valve will be opened too far and the piston will strike the valve and damage valve or piston.

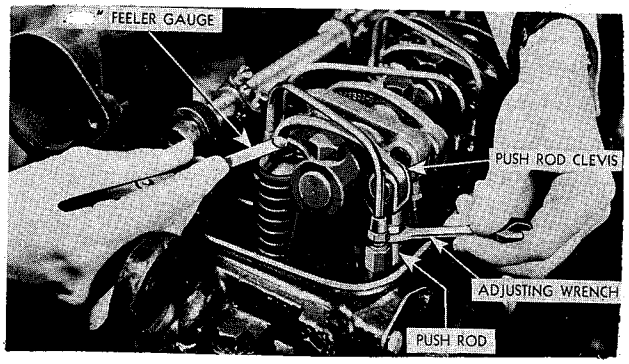


FIG. 26

INJECTOR TIMING

This model tractor is equipped with 60 cu. mm. injectors which require that the top of the follower be set 1.484 inches above the injector body so that the fuel will be injected into the cylinders at the proper time. This is done with the injector installed in the engine.

Timing of each injector consists of properly locating the top of the plunger follower in relation to the injector body.

To Time Injector.

1. Remove the engine hood and rocker arm cover.
2. Rotate engine with the starter until the two valve rocker arms for the same cylinder are down and the valves are fully opened.
3. Place the timing gauge in the hole in injector body; be sure the shoulder on the stem end of gauge rests on the injector body and is not held up by the copper washers under the fuel connectors or by dirt in the hole. Turn the sleeve on timing gauge until it is raised as far as it will go.
4. Hold the gauge in vertical position with a small screwdriver and turn the sleeve down until bottom of sleeve contacts follower. If the injector is properly timed, the marks on the sleeve and pin will be in line. If not, loosen the lock nut on the injector rocker arm push rod and turn the push rod counter-clockwise to raise follower or clockwise to lower follower until proper timing is obtained.
5. Tighten the lock nut and re-check to be sure timing was not changed by tightening lock nut. Replace rocker arm cover and hood.

NOTE: The timing instructions above apply to the use of the latest type (micrometer) gauge. This gauge is marked for both the 1.484" setting (for 60 cu. mm. injectors), and the 1.460" setting (for 70 cu. mm. injectors). On the 1.484" setting the knurled sleeve is flush to the center pin. On the 1.460" setting, the center pin extends through the sleeve. The gauge must be used at the 1.484" setting for these injectors.

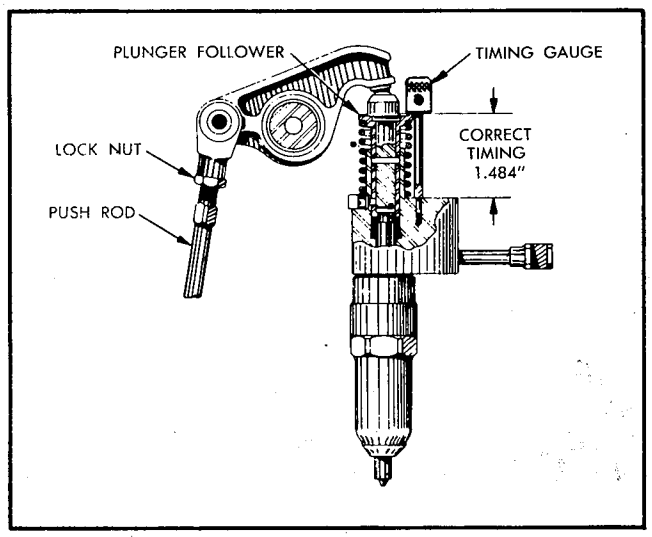


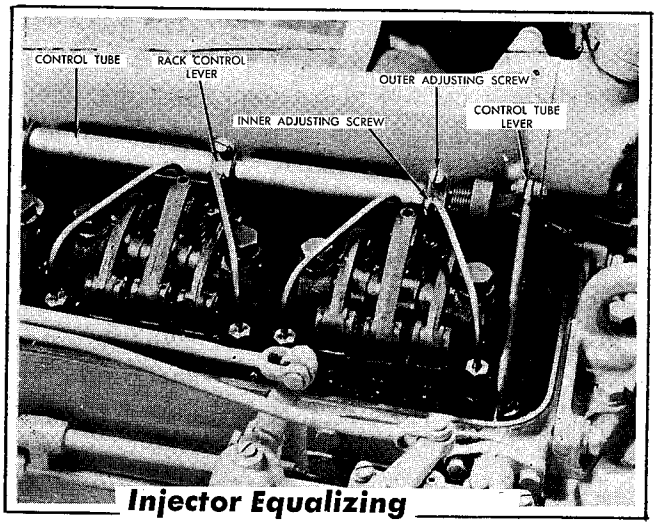
FIG. 27

INJECTOR EQUALIZING

Equalizing of the injector consists of adjusting the injector rack control levers so that an equal amount of fuel is delivered to each cylinder. The greatest amount of fuel is injected into the cylinder when the injector racks are moved all the way in. No fuel is injected when the racks are moved all the way out. The engine will run unevenly or detonate (knock) if the injectors are not equalized.

To Equalize Injectors.

1. Remove hood and rocker arm cover.
2. Be sure injectors are properly timed.
3. Loosen both adjusting screws on all the rack control levers. Be sure the screws do not bind, that the levers are free on the rack control tube and the tube rotates freely in bearings at the ends of the tube.
4. Push the engine shut-off knob all the way in (run position) and pull the throttle lever all the way back (wide open).
5. Push control tube lever toward water manifold as far as possible and hold it firmly in that position.
6. Use a medium sized screwdriver and turn down the inner adjusting screw on No. 1 rack control lever until No. 1 control rack moves in as far as it will go. At this point a slight pressure will be felt on the control tube lever. Roll the screwdriver back and forth with the finger tips to set the screw at the exact point where pressure starts (control rack just "bottoming" in injector — full open position).
7. Repeat this process on remaining control racks.
8. Still holding control tube lever firmly, as in paragraph 5, check each control rack to see that none have been missed in making the adjustments and that each rack is gently held in the full open position.
9. Now tighten each outer adjusting screw to lock the rack control levers in place on the control tube. This will also move the injector racks outward a few thousandths of an inch to prevent "bottoming" of the injector racks in the injectors during full load operation of the engine.
10. Replace rocker arm cover and hood.



Injector Equalizing

FIG. 28

ENGINE CONTROL ADJUSTMENTS

The engine shut-off control opens and closes the air valve in the blower air inlet elbow and moves the governor fuel shut-off lever to its opened and closed positions. When the shut-off knob is pushed in (forward) as far as it will go (running position), the air valve and fuel shut-off lever should move to their full open position. When the knob is pulled out, the air valve should close tightly and the fuel shut-off lever should move to its full closed position. Improper adjustment will result in loss of engine speed or power, failure of the engine to start with the shut-off knob pushed in, or failure of the engine to stop when the knob is pulled out.

If the shut-off control fails to operate as stated above, first be sure the linkage and levers are properly lubricated and the condition is not due to binding or broken springs.

Check and make adjustments as follows:

1. Air Shut-Off Control.

Push the engine shut-off rod into running position (all the way in) and check the air shut-off valve lever to see if the ball in the lever stop assembly is centered in the hole in the shut-off lever. If not, lengthen or shorten the rod as necessary by removing the yoke pin "A" and turning the rod in or out of the shut-off valve lever. The ball is used to hold the shut-off lever in position.

2. Governor Fuel Shut-Off Control.

NOTE: The earlier model engine governors are equipped with a cast type cover. On this type governor, the movement of the governor fuel shut-off lever is limited by a cam type lever stop located on the top of the cover assembly. The later model engine governors are equipped with a stamped type cover and movement of the governor fuel shut-off lever is limited by a slot spotfaced in the under side of the cover.

3. Early Models.

Push the engine shut-off control rod into running position (all the way in), check to see if the pin on the bottom of the governor fuel shut-off lever contacts the rear end of the slot in the governor shut-off lever stop. Pull the shut-off control rod into OFF position (as far out as it will go), check to see if the pin on the bottom of the governor fuel shut-off lever contacts the front end of the slot in the governor shut-off lever stop. If the pin does not contact the end of the slot (in running and OFF positions) adjust the nuts on the rear of the shut-off rod and loosen the clamp screw on the lever to re-locate the lever on the governor shaft.

4. Late Models.

Push the engine shut-off control rod into running position (all the way in) and remove the yoke pin connecting the governor fuel shut-off rod to the governor fuel shut-off lever. Hold the fuel shut-off lever back as far as it will go and check to see if the hole in the fuel shut-off rod lines up with the hole in the fuel shut-off lever. The

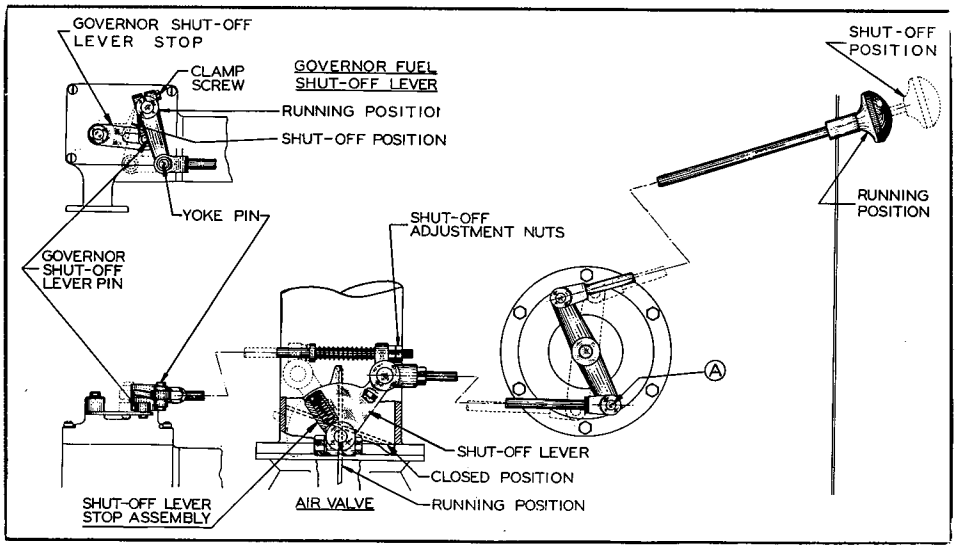


FIG. 29

rod when properly adjusted should pull the lever back as far as it will go. If the shut-off rod does not pull the lever back as far as it will go adjust the nuts on the rear of the shut-off rod and loosen the clamp screw on the lever to re-locate the lever on the shaft.

GOVERNOR ADJUSTMENT

The governor is adjusted at the factory to provide the full governed speed (under load) of 1500 R.P.M. and an idling speed of 500 R.P.M. The governor very seldom gets out of working order. If the engine speed is irregular, check the fuel system and all other engine adjustments before changing the governor setting.

1. Checking Engine Speed.

Operate the engine until the normal operating temperature (160° F. to 185° F.) is indicated on the temperature gauge. Hold a tachometer against the front end of the crankshaft. With the throttle all the way forward (idling position) and the engine clutch disengaged, the engine speed should be 500 R.P.M. With the throttle lever all the way back (wide open) the engine speed should be approximately 125 R.P.M. above the full load governed speed, or 1625 R.P.M.

NOTE: If equipment on the tractor prevents the use of a tachometer at the front end of the crankshaft, remove the small cover plate at the rear end of the generator and hold the tachometer against the rear end of the armature shaft. The generator runs at 1.7 times the engine speed. Therefore, generators with speeds of 850 R.P.M. and 2762 R.P.M. will correspond with engine speeds of 500 R.P.M. and 1625 R.P.M.

CAUTION: Be sure that the generator belt is properly adjusted when checking the engine speed at the generator.

2. Spring Plunger Gap Adjustment.

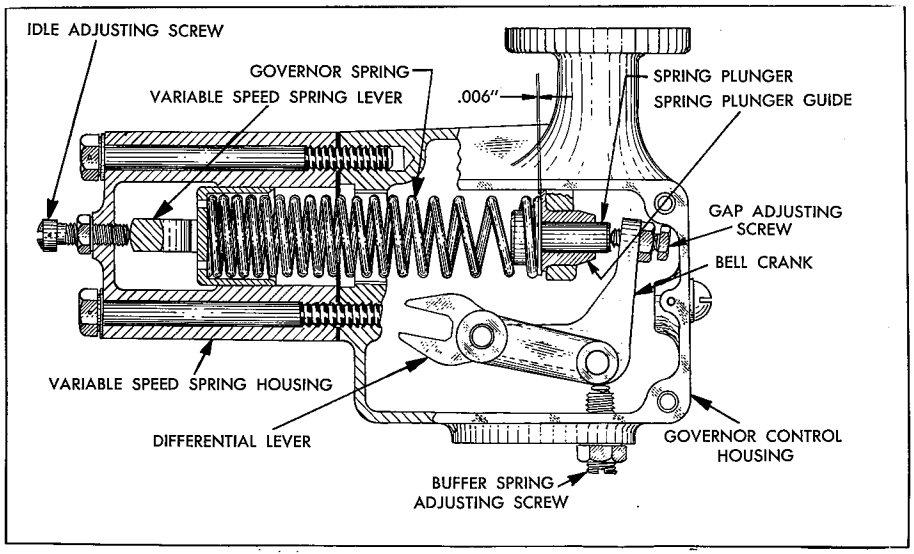
A clearance of .006" must be maintained between the variable speed spring plunger and guide. To adjust, remove control housing cover and pull throttle lever half way back. Loosen the lock nut on the adjusting screw and turn the screw in or out until a .006" gap is obtained between the spring plunger and guide. Tighten the lock nut after proper adjustment has been made and replace the cover. Refer to Fig. 30.

3. High Idle Speed Adjustment.

NOTE: In most cases, the cause for the engine not reaching the proper high idle speed (1625 R.P.M.) will be found due to loose, or incorrectly adjusted throttle linkage and not due to the governor being out of adjustment. For this reason, before changing the adjustment of the governor, check the following:

a. Be sure that the governor fuel shut-off lever on the governor control housing moves to its rear position (as far back as it will go) when the engine shut-off control rod is pushed into running position.

b. Remove the pipe plug in the top of the governor variable speed spring housing, and check to be sure that the setscrew in the variable speed spring lever has not loosened, permitting the lever to turn on the shaft. Tighten the screw firmly so that the screw is drawn down tightly on the seat in the shaft.



Governor Adjustment

FIG 30

Replace the pipe plug. If the injectors have been properly timed and equalized and all adjustments and inspections listed above have been made and the engine still fails to attain its proper high idle speed of 1625 R.P.M. (2762 R.P.M. of generator) addition of adjusting washers between the variable speed spring and the spring retainer will be required.

The adjusting washers are installed by removing the variable speed spring housing from the governor control housing, lifting the spring from the spring retainer and inserting additional adjusting washers in the spring retainer. Each .010" thick washer will increase the high idle engine speed approximately 20 R.P.M.

To decrease the high idle speed, remove the necessary amount of adjusting washers.

4. Low Idle Speed Adjustment.

After adjusting the governor for the correct high idle engine speed, the low idle speed should be checked and adjusted if necessary. Loosen the lock nut on the buffer spring adjusting screw (Fig. 30) and back the screw out (away from the differential lever) so that there is approximately 1/8" clearance between the spring and the differential lever. With the throttle control lever in "low idle" position, loosen the lock nut on the idle adjusting screw (Fig. 30) and turn the screw in to raise the low idle speed or out to lower the low idle speed. Tighten the lock nut when the correct low idle speed is obtained.

With the engine running at low idle turn the buffer spring adjusting screw in until a very slight increase (not to exceed an increase of 20 R.P.M.) in the low idle speed is noted, then tighten the adjusting screw lock nut.

ENGINE CLUTCH AND CLUTCH BRAKE

A. Description.

The engine clutch is a single plate, dry clutch with an over-center, cam-engaging action. A shifting sleeve and bearing mechanism, carried on the clutch shaft and connected by linkage to the clutch actuating levers, is operated by the clutch operating lever to engage and disengage the clutch. A cam adjustment between the pressure plate and actuating levers of the clutch provides a means of maintaining the necessary adjustment to compensate for normal wear on the clutch facings.

A clutch shaft brake assembly, clamped to the clutch shaft behind the clutch shifting sleeve bearing, is provided for stopping the rotation of the clutch shaft when shifting the transmission gears. The clutch brake is applied by pressing forward on the clutch operating lever after disengaging the clutch.

B. Engine Clutch Adjustment.

When the clutch is properly adjusted, approximately 68 to 72 pounds pull is required on the lever for its engagement (engine stopped). A lesser pull is required with the engine running. This adjustment of 68 to 72 pounds pull on the clutch lever should be maintained to obtain maximum clutch life.

The clutch must engage with a distinct over-center snap.

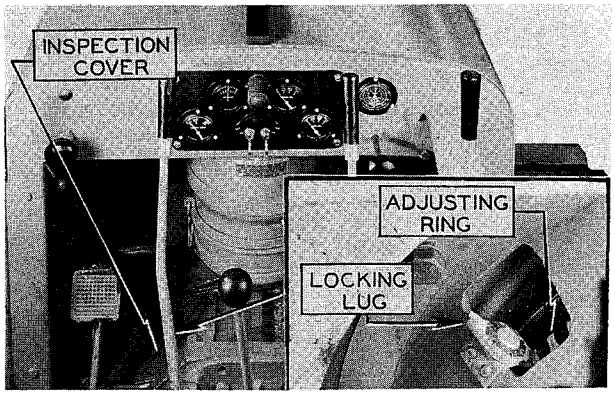


FIG. 31

To Adjust Clutch.

1. Remove the engine spacer housing inspection cover.
2. Disengage the clutch and turn the engine until the locking lug may be reached through the inspection hole. Pry locking lug from slot in adjusting ring.
3. Using a short pry bar, turn the clutch adjusting ring clockwise to tighten. Rotating the adjusting ring, 3/4" to 1" is generally sufficient movement to make proper adjustment.
4. When proper clutch adjustment has been made (68 to 72 pounds lever pull), lock the adjusting ring in place by engaging the locking lug into the nearest slot in the adjusting ring.

C. Washing Engine Clutch.

Oil leaks or over-lubrication of the clutch shifting bearing may cause the clutch facings to become coated with oil or grease. This will cause the clutch to slip even though it is properly adjusted. In this event, the clutch must be washed.

Install the clutch housing drain plug in the front of the flywheel housing and remove the inspection cover from the engine spacer housing.

Pour cleaning solvent into the housing until the level is approximately 1¼ inches below the clutch shaft. Re-install the inspection cover and operate the engine at low idle for approximately 5 minutes with the clutch disengaged. Drain the solvent, and, if it is excessively "oily," refill the housing and repeat the process.

CAUTION: LUBRICATE THE CLUTCH SHIFTING BEARING THOROUGHLY AFTER THE CLUTCH HAS BEEN WASHED AND THE HOUSING DRAINED AS THE LUBRICANT WILL BE WASHED OUT OF THIS BEARING IN THE WASHING PROCESS.

Operate the tractor with a light load in low gear for a short period until the clutch dries to prevent slippage due to the presence of solvent on the clutch parts.

D. Engine Clutch Brake Adjustment.

After each adjustment of the engine clutch, the setting of the clutch brake should be checked. Proper setting of the clutch brake must be maintained to avoid gear clashing when shifting. The clutch brake is properly set when there is a clearance of 1⅛" to 1¼" between the brake facing and

the clutch shifting sleeve bearing yoke with the clutch in its engaged position.

Inspect the clutch brake facing periodically and replace the facing when badly worn.

To Adjust Clutch Brake.

1. Remove the locking wire and loosen the locking screw and clamping bolts.
2. Engage the engine clutch.
3. Position the clutch brake assembly on the clutch shaft so that there is 1⅛" to 1¼" clearance between the brake facing and the clutch shifting sleeve bearing yoke, then tighten the clamping bolts and the locking screw.
4. Lock the locking screw in position with the locking wire.

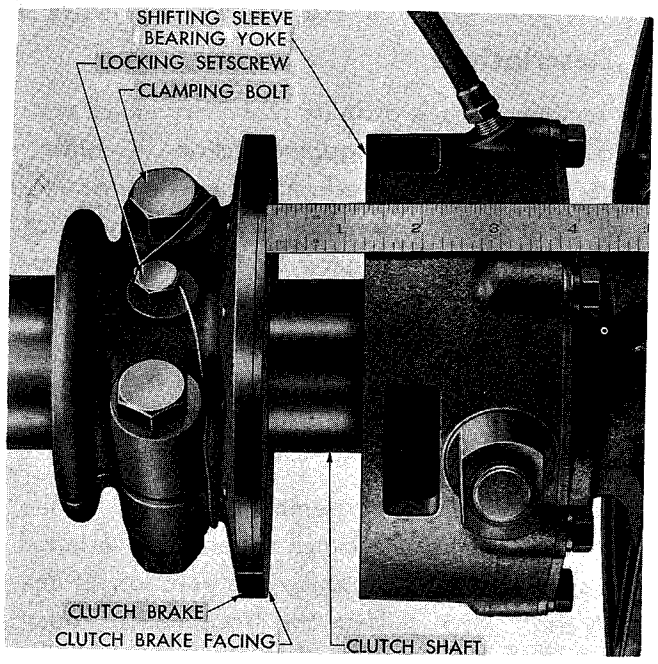


FIG. 32

STEERING CLUTCHES

A. Description.

The two steering clutches are multiple disc clutches, each clutch containing 11 friction discs and 11 steel discs assembled alternately. Springs hold the steel and friction discs tightly together. Pulling back on each steering lever releases the corresponding clutch by forcing a throwout fork against a throwout plate in the clutch assembly and compressing the springs, thereby allowing the steel discs and friction discs to separate.

B. Steering Clutch Adjustment.

The steering clutches are properly adjusted when the steering levers each have 5" of free travel, measured at the tops of the levers. As the clutch discs wear, the free travel of the levers decreases. When the free travel has decreased to less than 3", an adjustment is required.

To Measure the Free Travel of Either Steering Lever.

Place one end of a ruler or scale against the cowl so that it projects horizontally past the top of the steering lever.

Holdina the lever forward against its stop, measure the distance from the cowl to the top of the lever. Pull the lever back until pressure is felt, which is the point where disengagement of the clutch begins. Note the distance between the cowl and the top of the lever. The difference between the two measurements is the free travel of the lever. If this distance is less than 3", an adjustment must be made.

To Adjust Each Steering Clutch.

1. Remove the steering clutch inspection cover. The clearance at "H," Figure No. 33, should be 1/8" with the steering clutch lever in its forward position. To make this adjustment, remove the yoke pin, loosen the jam nut and turn the adjusting rod in the direction necessary to get this measurement. Tighten the jam nut and reinstall the yoke pin.

2. Loosen the lock nut on the locking bolt and turn the adjusting screw until the top of the steering lever has 5" free travel. Tighten the nut on the locking bolt and reinstall the inspection cover.

NOTE: As the steering clutches wear, the free motion of the thrust pin diminishes. Unless proper adjustment at this point is maintained, the throwout bearings will ride against the shifter

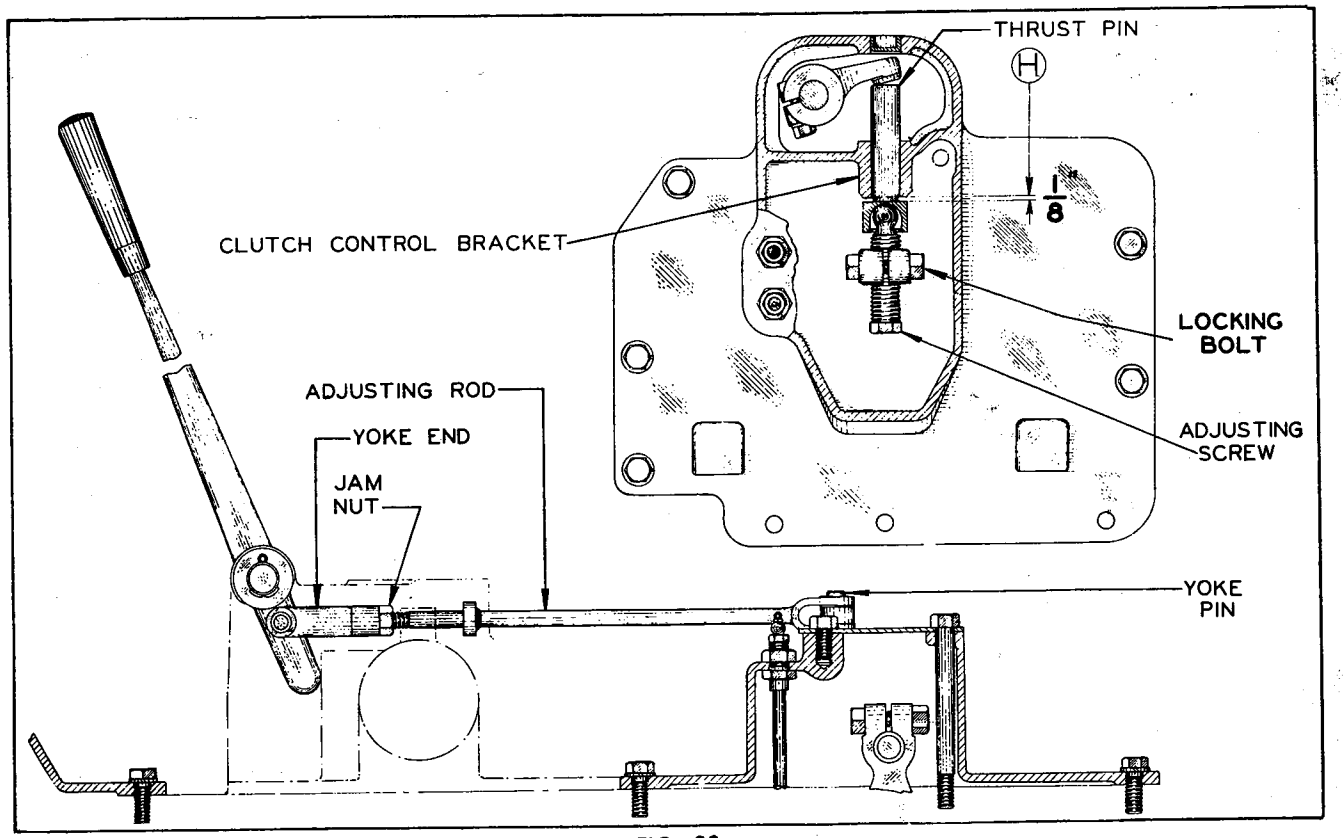


FIG. 33

plate and, consequently, will become overheated and wear rapidly. Also, the pressure on the shifter plate will allow the steering clutch to slip, developing excessive heat and wear.

C. Washing Steering Clutches.

Oil leaking into the steering clutch compartments may get on the clutch discs and cause the clutches to slip. If this occurs, wash the clutches in the following manner:

1. Install pipe plugs in the two drain holes in the bottom rear or the steering clutch compartments. The drain holes are located a few inches to the right and left of the drawbar support plates.
2. Remove the steering clutch inspection covers and pour about three gallons of solvent into each compartment. Drive the tractor back and forth in a straight line for approximately five minutes, leaving the steering clutches engaged. The oil on the exterior of the clutches and brakes will be washed off in this operation.
3. Drain the compartments and refill with the same amount of solvent, then drive the tractor back and forth for approximately another five minutes, disengaging one clutch and then the other continually during this period. Disengaging the clutches allows the clutch discs to separate so that the solvent can get in between them to wash the oil from their friction surfaces.
4. Drain the compartments and allow the clutches a short time to dry. Operate the tractor with a light load in low gear until the clutches become thoroughly dry, otherwise they may slip due to the presence of solvent on the discs.

STEERING BRAKES

The brakes are properly adjusted when the brake pedals come within 1" of striking the engine spacer housing when they are fully applied. As the brake linings wear, the pedals will move farther forward and eventually will strike the engine spacer housing before the brakes are fully applied. The brakes will then require adjustment. If the brakes are in proper adjustment, yet fail to hold, this condition may be due to oil on the linings and can be corrected by washing the brakes in the same manner as washing the steering clutches. Refer to "Washing Steering Clutches" and follow steps 1 and 2, then drain the compartments.

To Adjust Each of the Brakes.

1. Remove the brake adjustment hole cover located on the front side of the steering clutch compartment.
2. Tighten the brake adjusting nut so that the brake pedal will come within 1" of striking the engine spacer housing when the brake is fully applied.

   CAUTION: Always turn the adjusting nut 1/2 or 1 full turn at a time to lock the nut in position.
3. Loosen the jam nut on the brake band supporting screw located in the bottom of the housing under the brake band. Turn the screw in until it presses the brake band against the brake drum, then back it out 1 2 turn to allow clearance between the band and the drum. Tighten the jam nut.

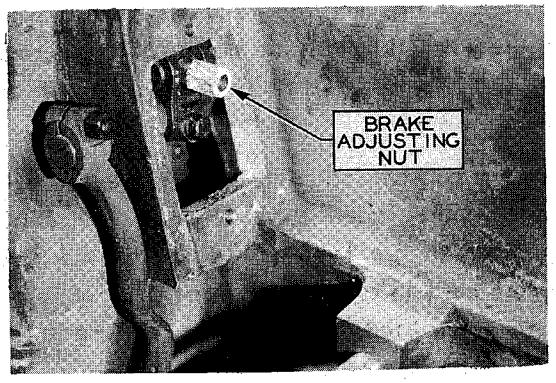


FIG. 34

TRACK AND TRACK IDLER ADJUSTMENT

The tracks are correctly adjusted when the upper part of the tracks can be lifted 1½" to 2" above the support rollers with the use of a bar. Proper track adjustment is important because rapid wear of the tracks and other affected parts will occur if the tracks are too tight. The tracks may drag on the final drive housing if they are too loose.

To adjust each track, loosen the clamp bolts in the track release yoke, then turn the adjusting screw out of the track release yoke to force the idler ahead and tighten the track, or turn the screw into the yoke to loosen the track. When the correct track adjustment is obtained, tighten the clamp bolts.

Shims are provided between the track release yokes and the track idler brackets for adjusting the alignment of the track idlers. If the track idlers are not kept in alignment, the tracks will contact on one side of the idler flange more than the other and cause rapid wear.

To adjust the alignment of each track idler, loosen the clamp bolts for the track adjusting screw and turn the adjusting screw into the yoke to loosen the track. Remove shims from one side and insert in the other side as required in order to bring the idler into proper alignment with the track.

NOTE: When loosening the clamp bolts, loosen them only enough so that the adjusting screw can be turned with the track wrench. If the clamp bolts are loosened too much, the threads on screw and in the idler yoke will become damaged and the track cannot be held in proper adjustment.

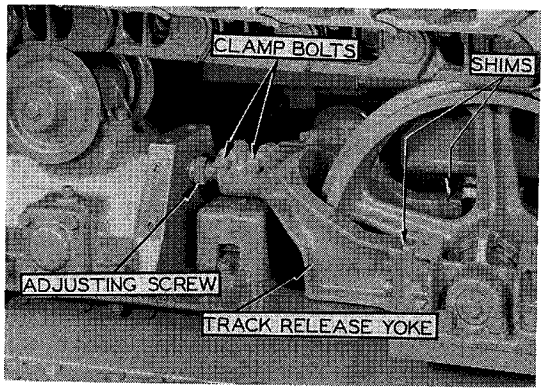


FIG. 35

FINAL DRIVE SHAFT BEARINGS

The final drive shaft bearings should be adjusted after 800 hours of operation. If the tractor is working under abnormal conditions such as in mud, water or dust, the bearings should be adjusted after every 400 hours of operation.

If the bearings are allowed to become loose, the sprocket will not run in line and will cause serious damage to the final drive shaft bearings and final drive oil seals.

To Adjust Bearings in Each Final Drive.

1. Remove the final drive shaft cover. Loosen the clamp screw in the clamp nut only enough so that the nut can be turned.
2. Using a four foot extension on the clamp nut wrench, tighten the nut until the bearings are tight, then loosen the nut 1/6 of a turn for bearing clearance and re-tighten the clamp screw securely.
3. Examine the final drive shaft cover gasket and replace if necessary. Install the final drive shaft cover.

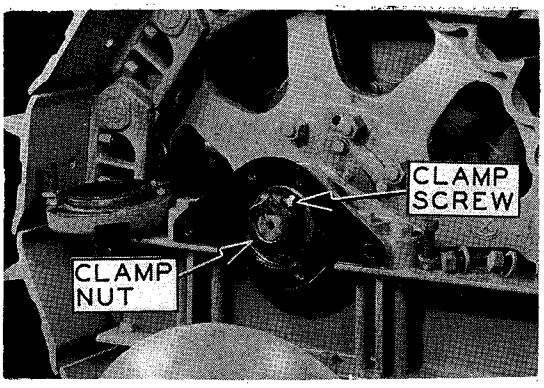


FIG. 36

PREPARATION OF TRACTOR FOR STORAGE

When the tractor is to be stored during the winter or slack season, make a complete inspection of the machine for loose, worn or damaged parts and make the necessary repairs before it is stored.

Drain the engine crankcase and all other oil compartments, flush and refill them with new oil. To protect the fuel injection system, drain the fuel tank, then pour about 10 gallons of a mixture of 40% mineral seal oil and 60% Perfection Kerosene in the tank and run the engine for 15 minutes to circulate this mixture through the entire system. This will leave the fuel system filled with the mixture and will prevent corrosion or gumming of working parts.

Major oil companies can supply this storage fuel mixture.

After the tractor has been stored, fill the tank with regular diesel fuel oil to minimize condensation in the tank. NOTE: This fuel need not be drained when the tractor is again placed in service.

Remove the batteries, clean and store them in a cool, dry place. Test them once a month and recharge them if the specific gravity of the electrolyte falls below 1.250. Keep the specific gravity of the electrolyte above 1.250 to prevent the batteries from freezing.

Drain the cooling system or fill it with an anti-freeze solution that will withstand the lowest anticipated temperature. Cover the exhaust pipe.