OPERATOR'S MANUAL

700 SERIES

AMERICAN ALFCO LAFRANCE

MODEL

REG. No.

AMERICAN-LAFRANCE-FOAMITE Corporation

ELMIRA · NEW YORK · U.S.A.

INSTRUCTIONS
FOR
OPERATION AND MAINTENANCE
700 SERIES

MANUAL - 200C9600
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MODEL _____

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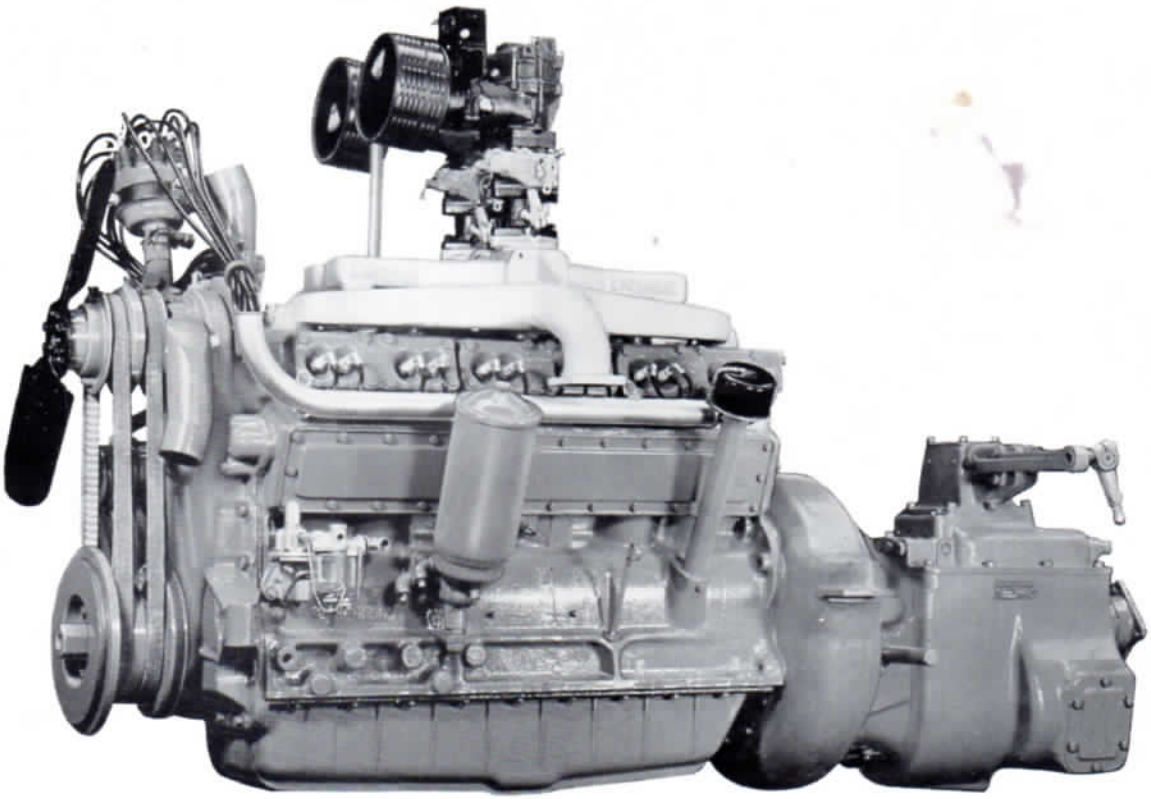
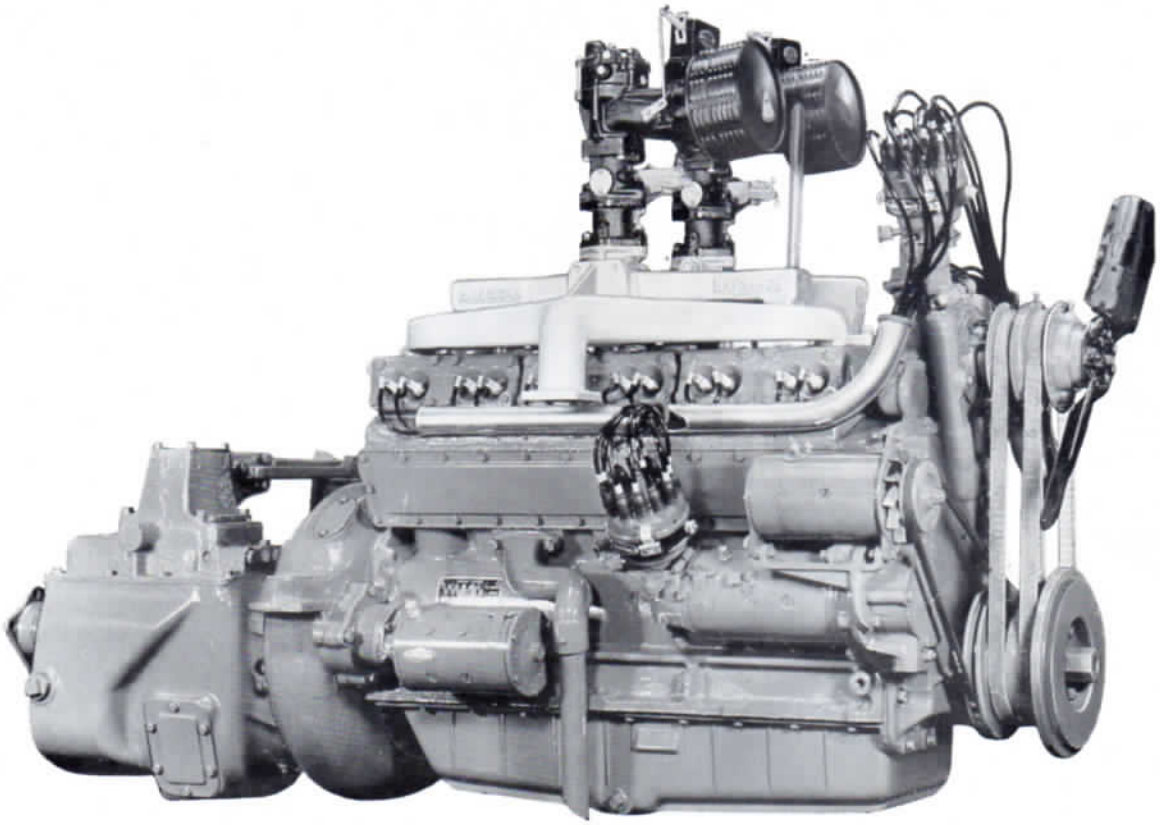
AMERICAN-LAFRANCE-FOAMITE Corporation
ELMIRA-NEW YORK-U.S.A.

LAFRANCE FIRE ENGINE AND FOAMITE LTD.
TORONTO, 9, ONTARIO CANADA

215 H. P. ENGINE
INDEX



LEFT SIDE VIEW OF ENGINE
FIG. 1



RIGHT SIDE VIEW OF ENGINE
FIG. 2

215 H. P.
ENGINE DATA

NUMBER OF CYLINDERS	12
ANGLE IN DEGREES BETWEEN CYLINDER BANKS	45
BORE	3.625
STROKE	4.25
DISPLACEMENT (cubic inches)	527
COMPRESSION RATIO	7.2:1
H. P. MAXIMUM BRAKE (at 3550 RPM)	215
OIL CAPACITY (New Engine)	12 Qts.
OIL CAPACITY (Crankcase Drain)	10 Qts.
OIL VISCOSITY	SAE 30
RADIATOR CAPACITY	13½ Gal.

1. ENGINE LUBRICATION INSTRUCTIONS (See Lubrication Diagram

A. Use S. A. E. No. 30 Engine Oil.

B. Check oil level with a bayonet gage on left side of engine. Keep level at full mark.

C. Drain and refill crankcase every 1000 miles or 3 months.

D. Give distributor grease cups one full turn of light cup grease monthly, or every 1000 miles.

E. Remove cap from fitting and lubricate water pump shaft with light cup grease weekly or every 500 miles and replace cap.

F. Fill fan hub with medium cup grease every three months, depending on the amount of service.

G. Add 8 to 10 drops of engine oil to starting motor oil cups monthly or every 1000 miles.

H. Add 8 to 10 drops of light engine oil to generator oil cups monthly or every 1000 miles.

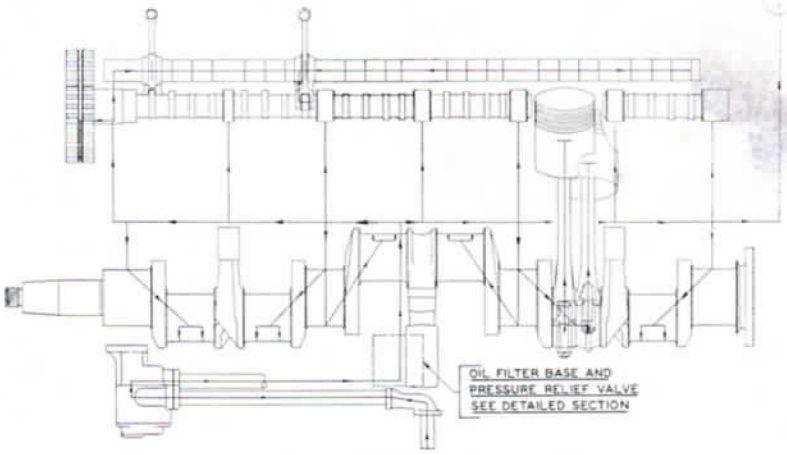


FIG. 3
LUBRICATION SYSTEM

2. To correctly lubricate the engine, it is essential the oil be of high quality, (v. i. 100 min.) with proper body and characteristics to meet the severe operating conditions. Poor oil breaks down easily under severe service, and shows less pressure after short use. Do not mix two brands when adding or changing oil.

OIL PRESSURES

R.P.M.	Oil Hot 170°F.- 190°F
1000	25 - 35
1500	37 - 42
2000	42 - 46
2800	45 - 50

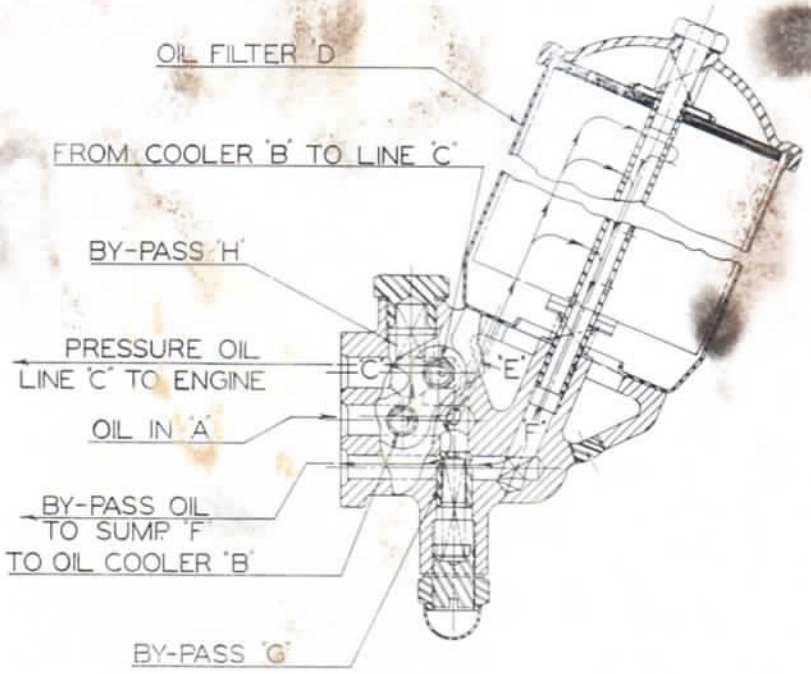


FIG. 4
OIL FILTER BASE AND BYPASS VALVES

3. OIL BY-PASS AND FILTER BASE

The oil from the pump enters the base at "A" Fig. 4, flows thru gallery to oil cooler "B", thru cooler to engine pressure line at "C". Oil entering at "A" may also go direct to oil filter "D" thru line "E", flowing thru filter and returning to crankcase sump thru line "F". When the engine oil has reached a predetermined pressure, the pressure relief valve "G" opens and by-passes a percentage of oil, directly returning it to sump thru line "F".

When starting an engine, the oil being cold and viscous, pressure relief valve "G" opens, also by-pass valve "H" at a slightly higher pressure, by-passing the oil directly from line "A" to line "C". This protects the cooler coil and filter from oil at high pressure, also the cooler coil would only retard the engine in "warming up". When the engine has reached its normal operating temperature, by-pass valve "H" closes causing the oil to flow thru the cooler and filter.

With the filter base removed from the engine, by-pass valve "H", and pressure relief valve "G" may be removed for inspection. Release pressure relief valve locknut, remove screw and piston. Clean parts and check piston seat for scoring. If there are indications the piston is not seating it may be ground in with valve grinding compound. Care must be taken that parts are thorougly cleaned and free of grinding compound before reassemblying.

The pressure relief spring should be checked for proper tension. A 17 pound load should compress the spring to 1-27/32 approximate height. Should it be less than this, it is an indication the spring is too weak and will by-pass at a lighter pressure resulting in insufficient oil to the engine.

Remove the by-pass valve nut. Clean ball and spring. Spring should compress to 1-11/32 inches under a 2-3/4 pound load.

Reassemble valves, plug the filter holes, blow thru the intake hole to check the valves for seating.

4. FUEL

The engine is designed to be successfully operated on standard grades of gasoline having an octane rating of 70 minimum. The use of ethyl blend is of no advantage except in case of excess accumulation of carbon. The ethyl blend will minimize the tendency to knock until such time the carbon can be removed. This should be done at the earliest opportunity.

5. CARBURETORS

The carburetors are of the down-draft type, which have been calibrated to give good economy with maximum power and to provide easy starting and rapid acceleration.

6. MAIN METERING SYSTEM

Fuel enters the carburetor at gasoline inlet, flowing thru the float needle valve and seat 8 and 9, Fig. 5, into the float bowl. Here it is maintained at constant level by float 7. Air, which enters the carburetor thru the air entrance at the top, places suction on the main discharge jet 4, or idle discharge holes 16, depending on the amount of throttle opening. The main metering jet 14 is of the fixed type.

7. IDLE SYSTEM

Fuel for idle speeds is drawn thru idle tube 6, Fig. 5 into a passage where it is mixed with air from the idle air bleeder 21. This mixture passes thru the idle channel and is then discharged thru the holes 16. On closed throttle, fuel is drawn only from the lower idle discharge hole, due to the high suction at this point. As the throttle is opened, suction is also placed on the upper idle discharge hole to feed additional fuel until the throttle is opened to the position where the main discharge jet comes into operation.

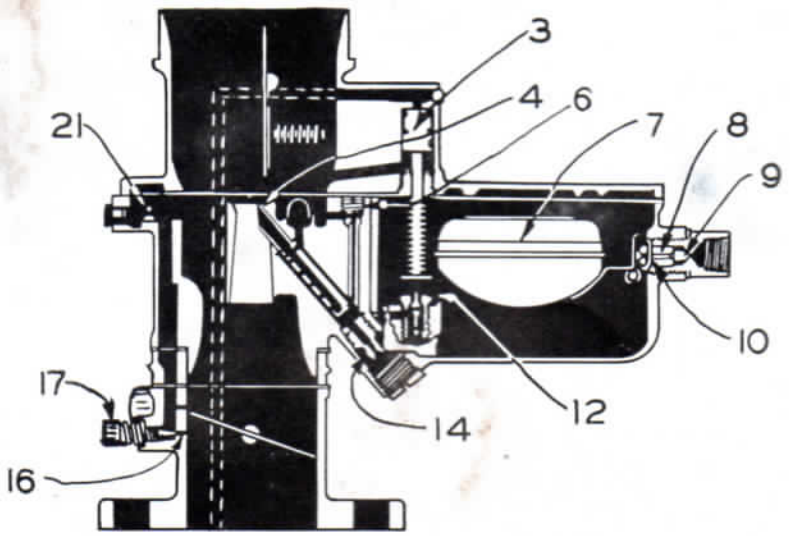


FIG. 5
SECTION THRU CARBURETOR

8. IDLE ADJUSTMENT

When adjusting the idle needle valve, have the engine well warmed up so that the intake manifold is warm to the hand and the throttle stop screw is on slow idle. The idle speed of the engine should be set at a speed of approximately 500 to 550 rpm. Idle needle valve 17, Fig. 5 controls the gas for low speed adjustment. Turning "OUT" the needle gives a richer mixture, and "IN" a leaner mixture. Turn the idle adjustment in slowly until the engine begins to run irregularly, then slowly turn out until the engine begins to "Roll". Finally, very slowly, turn in the adjustment again just enough so that the engine runs smoothly for this throttle opening. It may be necessary after completing this adjustment to cut down the engine speed slightly.

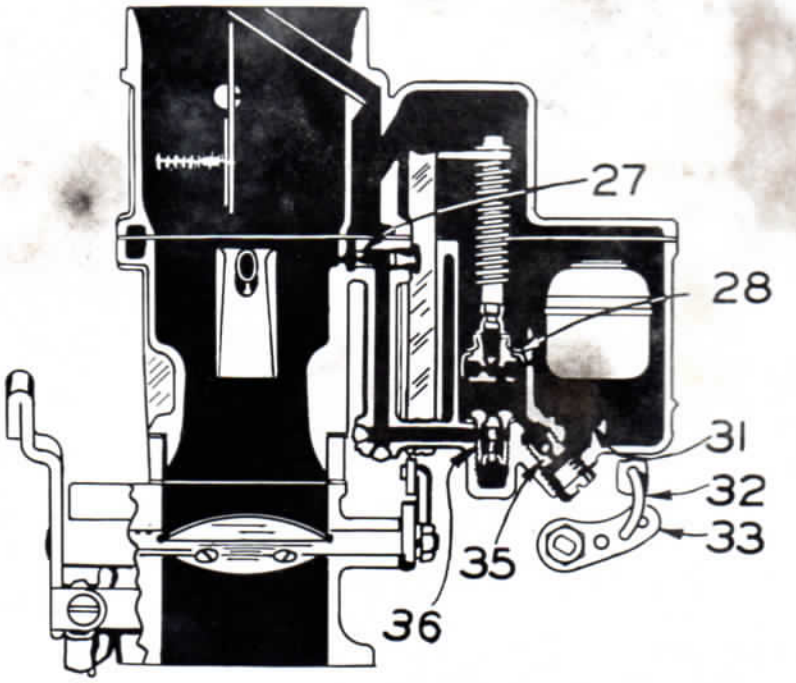


FIG. 6
SECTION THRU CARBURETOR

9. ACCELERATING SYSTEM

For smooth, rapid acceleration and flexibility, it is necessary to supply momentarily an extra amount of fuel when the throttle is opened. The pump piston being connected to the throttle moves in conjunction with it. On the up stroke of the pump piston 28, Fig. 6 fuel is drawn thru the strainer 31 and the inlet check valve 35 into the piston chamber. On the down stroke, the compression of the fuel closes the check valve and forces open the by-pass valve 36. The fuel is then discharged thru pump discharge nozzle 27. When the throttle is opened part way only, a small amount of fuel is discharged and the spring in the by-pass valve returns the valve to its seat. Note: Remove strainer and clean at regular intervals. There are three adjustments for the pump, namely; summer, normal and winter. During the summer months less pump discharge is required and pump link 32 should be placed in the hole on the shorter radius in the pump lever 33. During the winter season, more discharge is required, and the rod should be placed in the hole on the long radius. The center hole is for normal operating conditions.

MAXIMUM POWER

For maximum power or high speed running, a richer mixture is required than that necessary for normal throttle opening. Accordingly, when the car reaches the speed of approximately 65 miles an hour, the vacuum economizer comes into operation. Below this speed, the manifold has sufficient vacuum to hold piston 3, Fig. 5 in its "UP" position. When this approximate speed is reached, the manifold vacuum decreases sufficiently so that the vacuum piston spring is the dominant force and moves the piston assembly downward to open the by-pass jet 12 to feed the additional fuel that is required.

11. FUEL LEVEL

The fuel level in the float chamber is maintained by float 7, Fig. 5. The level is set at the factory at $\frac{5}{8}$ inch below the top surface of the float chamber with the gasket removed and the engine idling. It is not necessary to reset the float unless someone has tampered with it or if the carburetor has been handled roughly. When necessary, it can be corrected by bending the float level arm, where it meets the float, up or down to give the desired position. The float fulcrum pin is held in position by clip 10. When reassemblying the float parts, make certain the clip is properly positioned in the notches provided for it. In checking the fuel level make certain that the pressure of the fuel pump is not excessive as this will have a tendency to force the needle valve off its seat.

12. CARE OF CARBURETORS

The only care carburetors require is to be kept free of dirt and water. If the carburetors are taken apart for cleaning be sure the gasket between the main castings is in good condition. A leaky gasket at this point will result in a rich mixture and a waste of fuel. Never use wire or hard instruments to clean the jets. If this is done calibration may be destroyed. The best way is to blow out the jets with compressed air in the opposite direction to which the gas flows. Normal wear takes place in any carburtor. When parts are badly worn, the carburetor does not function properly and the worn parts should be replaced.

13. SYNCHRONIZING CARBURETORS

Before attempting to synchronize the carburetors all cylinders must be firing properly.

The engine should be equipped with Champion H-10 spark plugs, or equivalent.

Check the ignition timing as described in paragraph 17.

Remove the upper half of both carburetors, check the fuel levels to make certain they are $\frac{5}{8}$ inch from the casting surface in accordance with paragraph 11. Make sure the float valves are not leaking.

Start the engine, close the fuel line valve to the left hand carburetor and disconnect the throttle control rod from both carburetors, then wait until the left engine bank cuts out.

Turn the right hand carburetor idle adjusting screw 17, Fig. 5 all the way in, then back out $\frac{1}{2}$ turn at a time until maximum engine speed is obtained. Set the right hand carburetor lever stop screw to obtain 350 rpm.

Open the left hand fuel line valve and open throttle until both banks have cleared out thoroughly.

Close the fuel line valve to the right hand carburetor and wait until the right bank cuts out.

Turn the left hand carburetor idle adjusting screw 17, Fig. 5 all the way in, then back out $\frac{1}{2}$ turn at a time until maximum engine speed is obtained. Set the left hand carburetor lever stop screw to obtain 350 rpm.

Properly adjust the length of the throttle control linkage and assemble to both carburetors. After assembly make certain both carburetor throttle levers are against the stop screws.

Open the right fuel line valve and open the throttle until both banks are cleared out thoroughly.

The engine should now idle, both sides firing, at a speed of 500 to 550 rpm. If the engine is running above or below these figures, the throttle linkage should be disconnected from the carburetors, close the valve to the left hand carburetor and wait until the carburetor cuts out, then adjust the idling speed up or down as required. Repeat this operation on the right hand carburetor to obtain the same rpm.

Check the fuel pump with pressure gage which should read $2\frac{3}{4}$ to $4\frac{1}{4}$ pounds.

Unless an inexperienced operator or mechanic attempts to change the above adjustments, this engine should give satisfactory performance for a long period of time. In case of a "Scout" or "Challenger" engine see paragraph 10.

14. FUEL PUMP

The fuel is drawn from the gas tank and delivered to the carburetors by a fuel pump mounted on the left side of the engine. The pump is driven by a plunger off the oil pump shaft. The carburetors are interconnected and the main supply line runs from a tee between the carburetors to the fuel pump giving each carburetor an equal amount of gasoline.

15. FUEL PUMP OPERATION

The relative position of the moving parts and the flow of gasoline is shown in the cross section Fig. 7. The delivery of the gasoline to the carburetor is controlled by the carburetor float valve, as this shuts off the gasoline when the carburetor float bowl is full. When this occurs and the air dome pressure reaches $2\frac{3}{4}$ to $4\frac{1}{4}$ lbs. the pump diaphram automatically stops pumping and remains in the down position. This is because the pressure in the gas line equals that of the diaphram spring. The plunger however, continues moving with the oil pump shaft with tension from the spring under the heel to prevent noise or slap until the diaphram again starts to operate. As soon as the back pressure at the carburetor needle is relieved, the diaphram is forced up by the spring pressure and pulled down by the lever starting the flow of gasoline to the carburetor.

Wh the fuel pump cannot be made to operate take it apart and examine the diaphra pring and clamping nut. Make sure the nut is tight. A torn diaphram or v eak st will cause complete pump failure. To correct, replace the diaphram or spring must be done very carefully and the following instructions must be carnsure proper operation of the new diaphram.

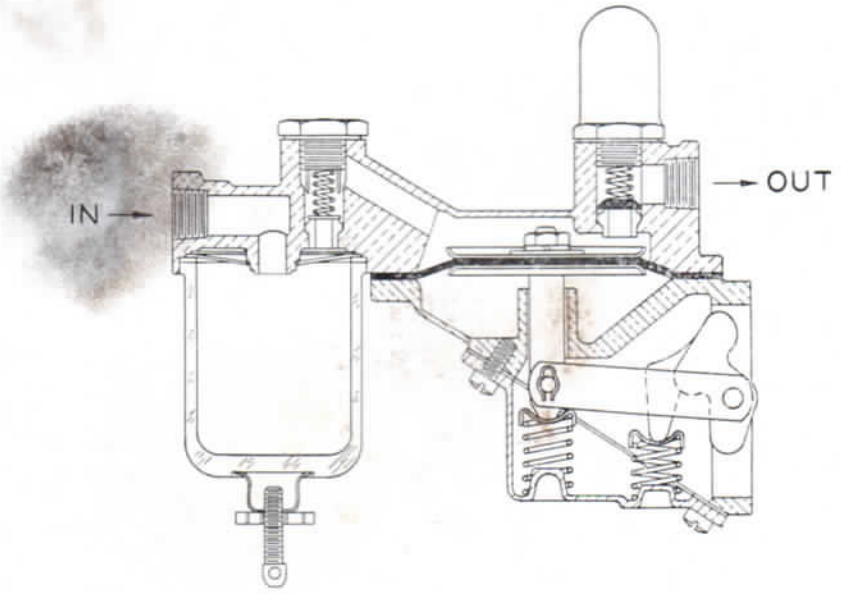


FIG. 7
SECTION THRU FUEL PUMP

Remove the pump cover, this will make the nut that clamps the diaphram accessible. Hold the diaphram from turning while unscrewing the nut. Clamp the pump body in a vise. Lay four pieces of diaphram material on top of the spring retainer. Insert two screws in the diaphram material to line up those holes with the others. Lay the two washers on top of the diaphram. All these parts have two keyways in the center hole. Turn the parts so that the key ways are in line with each other and the key on the connecting plunger stud. Make sure the key enters the key way. Then while holding the diaphram in this position, screw on the retaining nut, first by hand then tighten with a wrench. Set the cover on top of the diaphram and push it down just far enough to allow entering the screw approximately three threads. Then pull the diaphram down by pushing the operating cam as far back as it will go. Hold it there until all screws are securely tightened. Test the pump and if it functions properly replace on engine.

16. IGNITION

Two 6 volt batteries are connected in series making a 12 volt, single wire, positive ground, return type system. See Fig. 8.

The engine has dual ignition, each cylinder has two spark plugs and a corresponding spark plug on each cylinder is controlled by an independent distributor and coil. The engine may be operated on either set or both sets simultaneously, giving one or two sparks per cylinder as desired. In normal operation both systems are used.

The distributors are fully automatic and require no mechanical operation. The spark is automatically advanced as the engine speed increases. This assures firing at the most efficient spark advance and requires no attention from the operator.

Two 12 cylinder distributors are supplied, one mounted on top of the engine and one on the rear of the generator on the right hand side of the engine.

Both distributors have two pair of contact points operated by a six lobe cam. Rotation of the cam and rotor arm is clockwise.

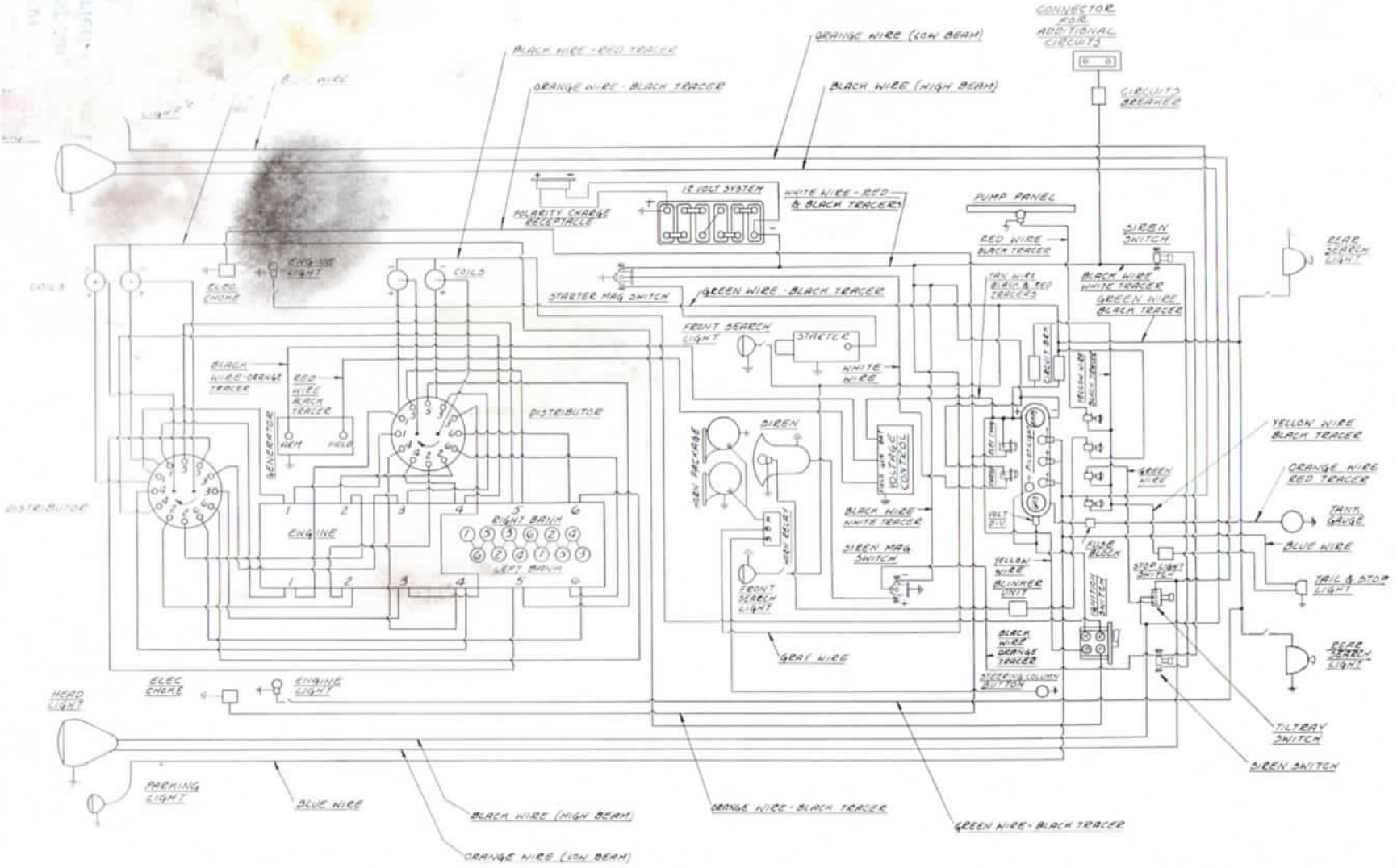


FIG. 8
CHASSIS WIRING DIAGRAM

17. DISTRIBUTOR TIMING

Before timing the ignition, be sure the valves are properly timed, and the breaker contact points are clean, free of pits, set squarely to each other and the gaps set accurately to a gage .018 to .022 thick. To set the gap loosen screw "A" Fig. 9, turn the eccentric adjusting screw "B," to the right or left as required to obtain the proper gap. Tighten lock screw "A" after adjustment.

Both distributors are timed at the same time.

The breakers are placed in such relation to each other as to give the proper firing in each bank. The breakers which is carried on the moveable plates for purpose of synchronizing, must always fire the left bank, while the fixed breakers must always fire the right bank.

The firing order is 1L - 2R - 5L - 4R - 3L - 1R - 6L - 5R - 2L - 3R - 4L - 6R.

To set the timing remove a spark plug from each cylinder and turn the crankshaft until the ignition mark, located 5° ahead of mark 1-6R on flywheel, is in line with the pointer on the flywheel housing. See Fig. 11.

The exhaust valve should just close in No. 6 R. H. cylinder to make certain No. 1 cylinder is on compression stroke.

Centralize both distributors by loosening clamping screw on octane selectors. Move pointer to "O" position on scale and lock clamp screw. See Fig. 10. Loosen long screw at the side of octane selector so the distributor body can be turned without moving octane selector.

Insert a piece of paper .003 maximum thickness between points and find open and closed position. Paper will be held tightest in exact closed position.

With both distributor arm rotors pointing toward the front and rear of the engine and the flywheel set as instructed above, the contact points on the fixed plate should just be starting to open. If the points are open, rotate the distributor bodies clockwise until the points close, then rotate slowly anti-clockwise until the points just start to open. Lock the clamp bolt on both dial arms so the distributor will not move from this point.

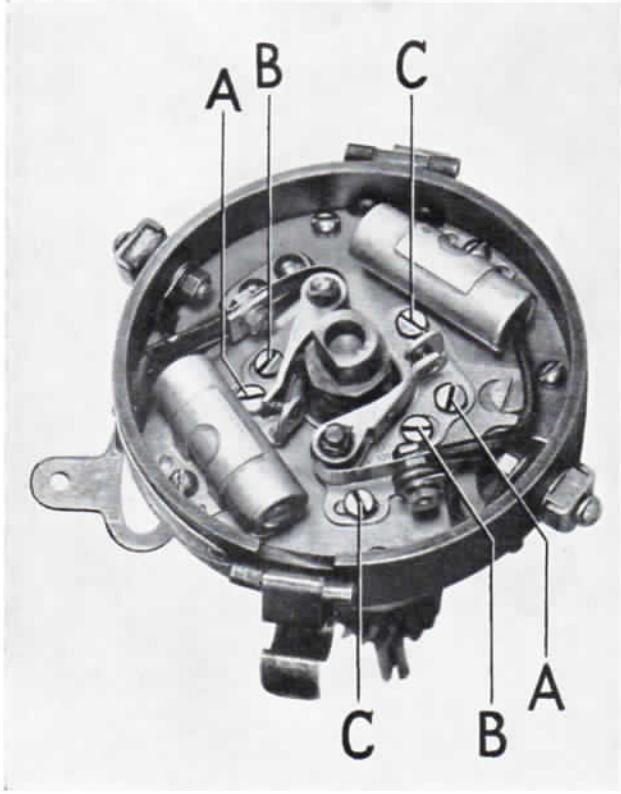


FIG. 9
DISTRIBUTOR WITH CAP REMOVED

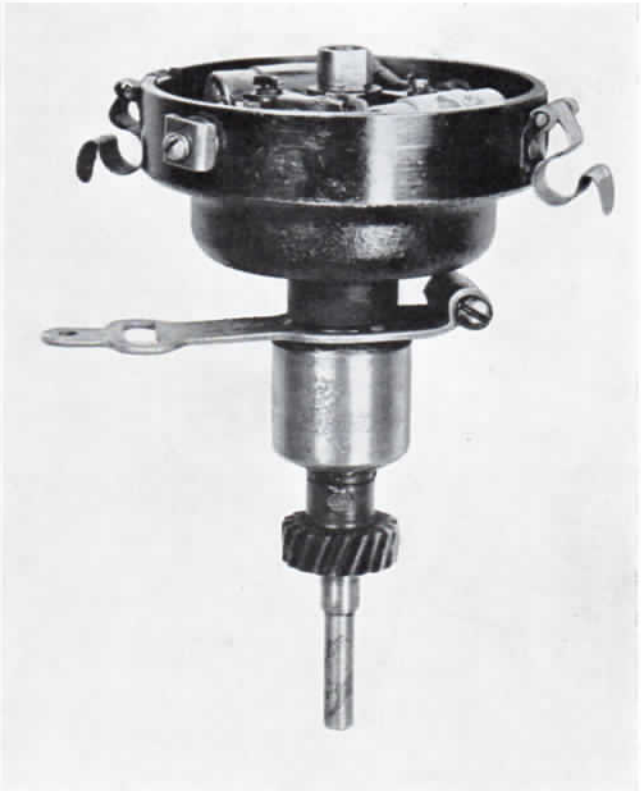


FIG. 10
DISTRIBUTOR SIDE VIEW

The high tension cable from the front coil connects in the socket on the cap toward the front of the engine. The low tension terminal from the coil connects to the terminal on the rear side of the distributor body. The high tension cable to No 1 spark plug connects in the socket at the forward end of the distributor rotor arm. The balance of the high tension wires to the spark plugs on the right hand side connect into every second socket in a clockwise direction in firing order 1, 5, 3, 6, 2, 4.

Rotate the crankshaft 45° bringing the ignition mark, located 5° ahead of mark 1-6L on flywheel, in line with the pointer on the flywheel housing.

The contacts on the movable breaker should now just start to open. If closed or open, the screw "C" Fig. 9 should be loosened and the plate moved clockwise or anti-clockwise, on both distributors, until the points just start to open. Lock the screws, "C" tightly and the distributor is corretly set for firing No. 6 left hand cylinder.

The high tension cable from the rear coil of each pair goes into the center socket of the distributor cap. The low tension wire from each rear coil in each pair connects to the terminal on the forward side of the distributor.

As a final check it is recommended that a timing light be used.

18. SERVICING DISTRIBUTORS

Every 1000 miles or once a month, if the mileage is not obtained, the distributor covers should be removed and a light film of petroleum jelly applied to the breaker cams. A drop of light engine oil should be used to lubricate the breaker arm pivots. Examine contact points and if rough or pitted, smooth with No. 000 emery cloth or a fine magneto file. This must be done and the points must close squarely so a full contact is obtained. Be sure rotor arm is in place before replacing cover. Give the grease cups one full turn, they should be kept full of light cup grease. Extreme care should be taken that no oil is on the breaker points.

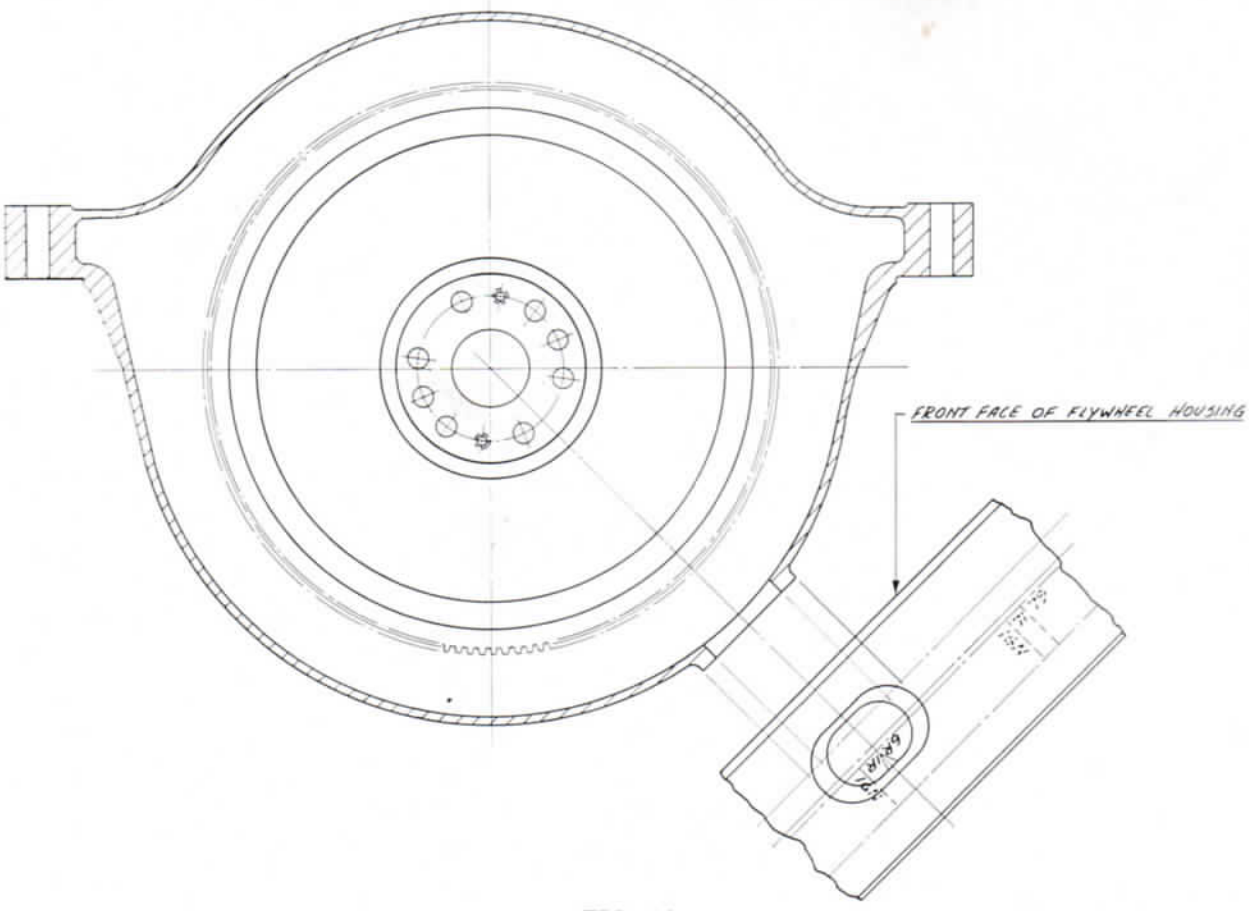


FIG. 11
TIMING DIAGRAM

19. GENERATOR

The generator is ventilated for cool operation and the output is voltage regulated. This method protects the batteries from over-charging and yet charges at the rate that will maintain the batteries in the fully charged condition. The exception to this condition is only where the connected load exceeds the charging capacity of the generator and the engine does not operate for a sufficient period to recharge the batteries.

The generator will start to charge at about 500 rpm and full output is obtained at about 1100 rpm.

If the batteries are fully charged, no charge will be obtained from generator regardless of the engine speed. This is important, as lack of charge might be mistaken as a faulty generator. If in doubt about the generator charging always check the batteries with a hydrometer. The normal charging rate of the generator is 18 amperes at an engine speed of 1100 rpm, however, if the batteries are in a discharged condition the charging rate may go to 30 amperes.

20. REVERSED GENERATOR POLARITY

If the polarity of the generator is reversed, the contact points of the cut out relay will vibrate and burn. To eliminate any doubt as to the polarity, momentarily connect a lead from the "Gen" to the "Bat" terminals of the regulator, after all the connections have been made and before the engine is started. This will automatically give the generator the correct polarity.

The generator is correctly polarized at the factory, and it is necessary to observe the following instructions, to avoid reversing the generator polarity.

It is important to first ground the regulator unit. That is, to be certain that the screws which attach the regular box to the dash are making a positive ground contact. (This is accomplished thru the screws holding the regulator on the left side when it is viewed from the front of the instrument and with the terminals at the lower side.) All paint, rust or corrosion should be removed at points where the screws attach to the dash.

After the ground connection has been made, connect the wiring harness to the regulators, as shown in the wiring diagram.

WARNING: Connect the "F" terminal last. In the event it is necessary to disconnect the regulator harness, the "F" terminal should be disconnected FIRST, and the ground connection LAST, to prevent reversing the polarity of the generator.

21. VOLTAGE AND CURRENT CONTROL

External regulation of the voltage and current is maintained by the regulator unit in the apparatus box Fig. 11, mounted on the dash.

The regulator will safely limit the output of the generator in accordance with battery requirements and connected loads such as siren, warning lights, etc.

If the battery is charged, there is no electrical load except ignition and gasoline gage, the regulator reduces the output of the generator to a low value to just meet the ignition requirements and to compensate for the current used in starting. If the electrical load is increased, such as turning on the lights, or the battery is partially discharged, the regulator unit automatically allows the output to increase up to the rated output of the generator to meet the added load and to keep the battery in a charged condition.

The regulators are adjusted and sealed at the Factory and should not be changed.

The cut-out relay is assembled in the apparatus box with the voltage and current regulators. It serves as an automatic switch between generator and battery. When the generator speed is increased and the generator voltage exceeds the battery voltage, the contact points close thereby completing the circuit. When the engine is operating at idling speed or is stopped, the reverse current from the battery opens the contact preventing the battery discharging through the generator.

22. OVERLOAD CIRCUIT BREAKER

The overload circuit breaker is installed in the system for the protection of the lighting circuit in case a short circuit develops in the wiring. The construction and operation is very similar to the cut-out relay described in paragraph 21.

When the short circuit develops, sufficient current flows thru a coil to set up a magnetic attraction for the armature, which is attracted with sufficient force to overcome the spring with the result that contact points are repeatedly opened and closed causing a buzzing noise, also making a flicker in the lights if the switch is on, indicating to the operator a short exists. To restore normal conditions, it is necessary to turn off all lights then correct the short circuit, after which the overload circuit breaker automatically closes.

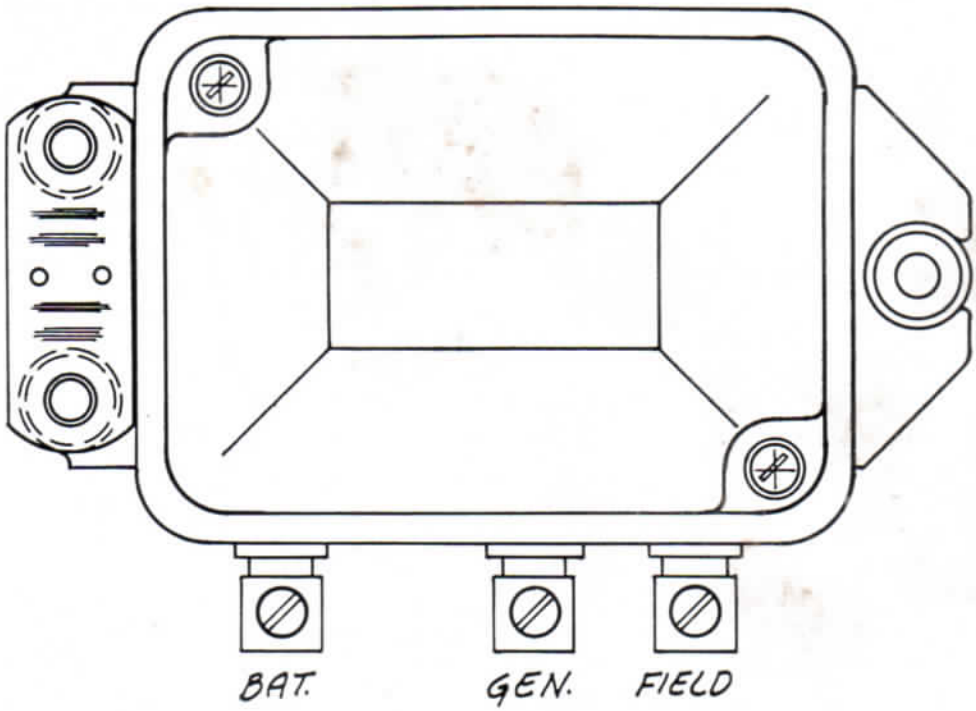


FIG. 12
APPARATUS BOX

23. STARTING MOTOR

The starting motor is engaged and disengaged with the flywheel by means of the Bendix type starter drive. When the starting motor circuit is closed, the pinion is engaged with the flywheel without any mechanical shift movement being required. When the engine fires the pinion is released from the flywheel teeth by the over-running effect produced by the flywheel on the pinion and the pinion cannot be held in mesh with the flywheel.

The Bendix drive mechanism requires no lubrication, the presence of oil on the threaded sleeve may cause gumming and this should be kept free from oil or grease.

24. STORAGE BATTERY

The battery should be tested, each cell individually, on the 1st and 15th of every month with a hydrometer. Fully charged cells should read 1.280 and 1.300. If any cells are below 1.250 on two successive testing dates, the battery should be removed from the car and recharged. In taking the reading, care must be exercised to return the electrolite from the hydrometer syringe to the same battery cell from which it was taken.

All cells should be kept filled with distilled water to a height of 3/8 inch above the top of the insulators. Never fill above this level. When filling, if one cell takes considerable more water than the others, it indicates a leaky cell and the battery should be removed from the car and taken to a battery service station for examination.

Keep the batteries and compartments clean and dry. The wires and terminals should be frequently inspected. Keep the terminals tight and well covered with vaseline to prevent corrosion.

Particular attention should be given the batteries during long pumping operations to see that the batteries do not become heated from over-charging. If the top connectors feel more than blood warm to the touch, turn on all the lights to hold the charging rate down. If the temperature reaches 120°F., the battery may be ruined.

In order to prevent freezing in cold weather, test your battery frequently and see that the gravity is kept up to at least 1.275. A discharged battery will freeze at a little below 32° F.

25. SPARK PLUGS

The engine is equipped with Champion H-10 plugs, and should be inspected each 2000 miles or every six months. Clean preferably with a sandblast type cleaner and set the gap at .025 inch. If the electrodes are badly burned, or if the porcelains are cracked or show indications of leaking, the spark plug should be replaced.

26. COOLING SYSTEM

The engine cooling system is of conventional design. The capacity is 13½ gallons which is ample for all purposes. The water supply should be maintained at the full level to assure proper operation, otherwise over-heating may occur, causing a loss in power and may result in seizure of the pistons and failure of the bearings.

An auxiliary coil is provided in the top radiator tank on pumpers. In case of over-heating when pumping, a steady flow of water from the fire pump discharge manifold may be directed thru this coil and back to the fire pump, this will reduce the radiator to normal operating temperature. Likewise in the bottom radiator tank an oil cooling coil is provided for cooling the oil during a prolonged pumping period.

An emergency line is provided between the fire pump discharge manifold and the radiator so the operator may add water, should a loss occur during a pumping operation.

The most efficient operation of the engine with the best power output is obtained when the water temperature is maintained at 160° to 175° F.

Circulation thru the system is caused by a large capacity centrifugal pump mounted on the front of the engine. The use of anti-freeze is recommended during the winter months. No loss of anti-freeze will occur unless the system is filled to the radiator over-flow tube, so the normal expansion during operation would cause a slight loss. This may be over-come by making a slight allowance for expansion. A good commercial anti-freeze is recommended.

Tighten water connections, gaskets, etc., whenever a slight leak develops. Should a leak develop in the radiator, it should be removed and given to an experienced radiator man for soldering. Do not use an anti-leak compound, as it may clog the radiator and cause over-heating.

A steaming radiator indicates the water is low, or in cold weather it may be frozen. In the latter case, place the apparatus in a warm building and allow the radiator to thaw out gradually. Care must be used in removing filler cap as boiling water may gush out. Do not fill with cold water when engine is hot, this may cause a cracked cylinder.

To completely drain the system proceed as follows: 1. Open the drain cock on the side of radiator. 2. Open the drain cocks on the left and right side of the cylinder block near the center. 3. Drain auxiliary cooling coil, in case of a pumper.

27. GENERAL INSTRUCTIONS FOR THE CARE OF ENGINE:

When starting an engine in cold weather, turn it over three revolutions with choke on and ignition switch off. Turn ignition switch on and start engine. This will eliminate flooding and will prove a satisfactory way to start. Let it warm up slowly, never race it and do not drive with choke on, as this allows raw gasoline to enter the cylinders, pass the pistons and dilute the oil.

Keep the engine clean, oil or moisture should never be allowed to collect on the wires or electrical equipment.

If the engine knocks on hard pulling, check the spark plugs, timing etc., if knock continues change to ethyl gasoline until the heads can be taken off and carbon removed.

Do not let the engine labor in high gear; drop into a lower gear, the transmission is there for that purpose. A laboring engine is a sign of a poor operator—shift down and save your engine.

28. DIAGNOSIS OF ENGINE TROUBLE

BACK-FIRING UNDER LOAD

Carbuertor adjusted too lean.
Has dirt or water in gasoline line or in float chamber of carburetor.
Gasoline supply low.
Engine not properly warmed up.
Spark plug wires mixed.
Valve sticking or not seating properly.
Ignition or valve timing incorrect.
Air leak in intake manifold or gasket.
Broken spark plug.

ENGINE LOADS, SLOW PICK-UP, BLACK EXHAUST

Carburetor set too rich.
Choke is closed or partly so.
Carburetor float is stuck open—watch for flooding.

ENGINE STALLS AT IDLING SPEED.

Cold engine.
Carburetor set too lean.
Throttle stop screw not properly adjusted, allowing throttle to close too far.
Spark weak, retarded too far, or spark plug gap too great.
Leaky valves.
Air leak in inlet gaskets.

ENGINE OVERHEATS

Check ignition timing.
Carburetor set too lean, or too rich.
Radiator needs cleaning.
Loose or greasy fan belt.

ENGINE HARD TO START

Dirt or water in carburetor or gasoline lines.
Weak spark, burned or pitted breaker points.
Defective spark plug wires.
Spark plug gaps too wide or plugs fouled.
Air leaks in intake manifold.
Carburetor choke not adjusted to obtain full choke.
Cylinders flooded with gasoline.

SPARK ADVANCED TOO FAR

Overheating of engine.
Excessive spark knock.
Engine kicks back when cranking.
Slight loss of power.

SPARK RETARDED TOO FAR

Overheating of engine.
Considerable loss of power.
Stalling of engine at low speeds.
Slow pick-up.

29. ADJUSTING FAN BELT

The fan belt should be adjusted periodically. If loose it can be very easily adjusted and the tension of the two belts equalized. Loosen the lock nut and screw in the fan pulley between the belts, See Fig. 13 and rotate the center section which adjusts the rear belt. Reset the lock screw and nut which holds the center flange in position. Loosen the locknut and screw in the front flange, rotate to adjust as with the center flange. Reset the lock screw and nut.

The fan belts should deflect about ½ inch between the pulleys, otherwise it will cause excessive wear on the belts and will result in serious damage to the fan shaft bearings.

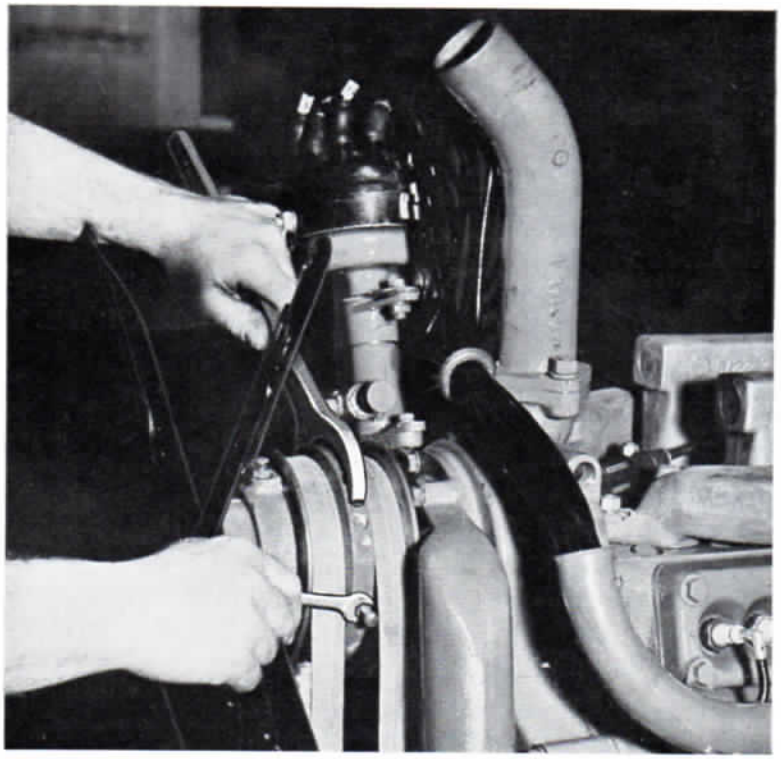


FIG. 13
ADJUSTING FAN BELT

30. TIMING CHAIN INSPECTION AND ADJUSTMENT

To insure long life, the timing chain should be periodically adjusted. If it is necessary to remove the chain case for inspection it is first necessary to remove the radiator, vibration damper, generator and water pump.

To remove the radiator, drain, and disconnect the hose couplings. Remove 2 screws from the bottom of the radiator support bracket, see Fig. 14, and loosen the top tie support. The radiator may now be lifted out.

With the radiator out of the way, the water pump may be removed by loosening attaching screws on the front face.

The vibration damper is held in place by the starting crank jaw. This may be released by turning anti-clockwise, the damper is then free to slide off the shaft. Use puller if necessary, holes are provided.

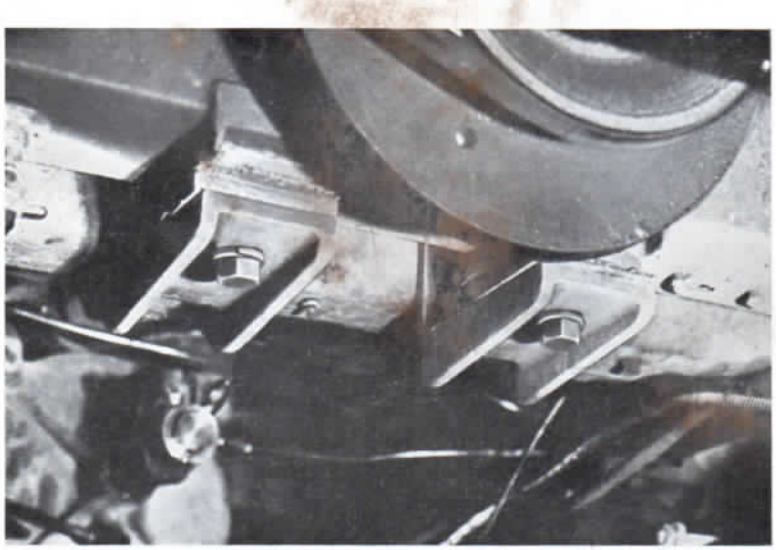


FIG. 14
REMOVING RADIATOR

To remove the generator first loosen screws and take off inspection plate in front of the generator. Loosen generator attaching screws and swing generator in a position making timing chain as loose as possible. Release chain from generator sprocket and remove generator.

Place a jack under the front of the engine, see Fig. 15, for support when removing the front motor support screws. Loosen chain case screws and remove chain case from engine. If it is necessary to replace the sprocket on the camshaft, the bolt should be taken out of the camshaft and the sprocket pulled. If a crankshaft sprocket is to be removed, it is only necessary to take off the oil slinger, after which the sprocket may be pulled from the crankshaft. When replacing the chain on the sprocketets, the crank and cam sprockets should be in such a position that with the No. 1 left hand piston near the top center there will be 21 chain rivets between the timing marks on the cam and crankshaft sprockets. When assembling the chain case use new gasket throughout, place case in position upon the dowels, then draw up screws. The opening in front of the generator will provide space for assembling the chain on the generator gear.

To adjust the timing chain, swing generator to its maximum out position with the engine running, until a light grinding noise occurs, which indicates the chain is too tight. Release until the noise just disappears. Tighten screws and lock in place.

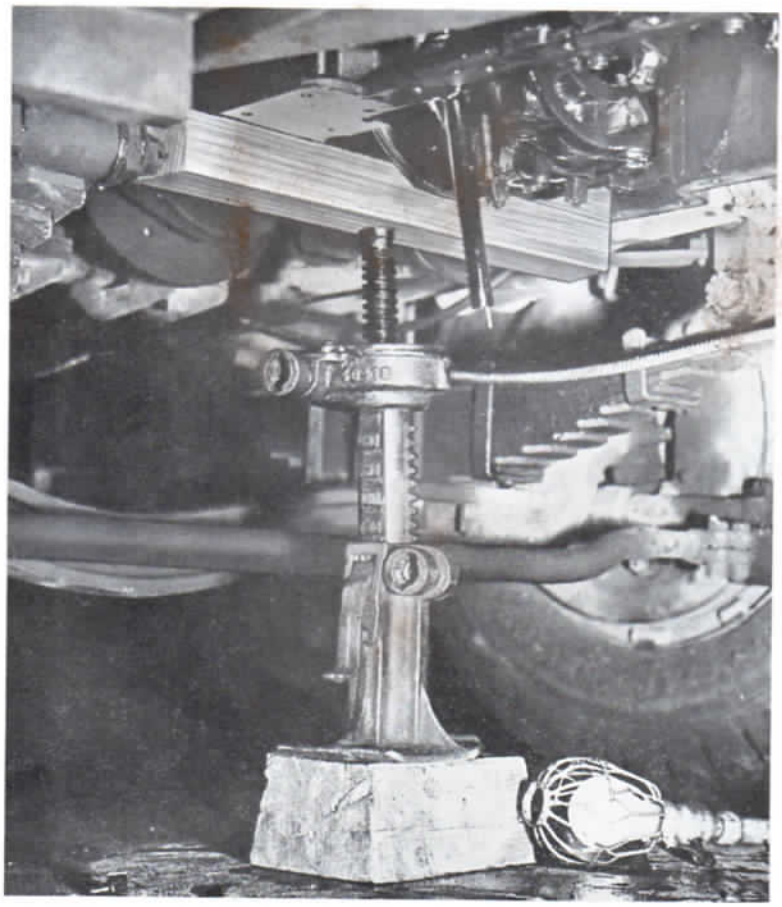


FIG. 15
JACK UNDER FRONT OF ENGINE

31. VALVE GRINDING AND TIMING

It is necessary the valves be reground in their respective seats whenever they become scored or pitted to the extent they cause a loss in the compression. If it is only required to grind valves, this may be done by removing only the valve cover in the center of the vee, and the cylinder head covers. However, if carbon is to be removed it is advisable to remove the cylinder head.

After grinding the valves, be sure all traces of grinding compound are removed. If any valves are badly warped or burned, replace with new ones. Badly damaged valve seats can be reseated to a better advantage by a reseating tool than by grinding.

In preparing to grind the valves and remove carbon, proceed as follows: Drain water from radiator and remove bolts attaching water outlet connections to front face of cylinder head. Disconnect spark plug wires and remove plugs. Disconnect carburetor lines and controls and remove bolts attaching water outlet connections to front face of cylinder head. Disconnect spark plug wires and remove plugs. Disconnect carburetor lines and controls and remove carburetors. Remove screws and lift off valve cover in center of vee. Remove cylinder head covers. Disconnect exhaust outlet flanges. Remove nuts and screws and lift off both manifolds. Remove the cap screws and lift off cylinder heads.

With a valve lifter, compress the springs until the two halves of the split retainer lock can be lifted out. See Fig. 20. The valve, springs and washers are now free to be removed. Repeat this operation on all valves, and place the valves in a numbered rack for identification, so they may be returned to their respective cylinders.

When grinding valves, place a spring under the valve head of sufficient tension to hold the valve away from its seat when not under pressure from the valve tool. Place some coarse grinding compound on the valve face and with an oscillating movement of the valve it should be worked into the seat, always bearing lightly on the valve and being careful not to make more than one-half revolution of the valve before reversing the direction of motion, otherwise it will result with grooves in the valve face. When all pits and dark spots have been removed, and the valve presents a dull silvery appearance, finish grinding with a fine compound. The valve face should have a uniform surface, free of grooves and pits. Each valve should be ground in its own respective seat.

Thoroughly remove all carbon from the heads and valve stems.

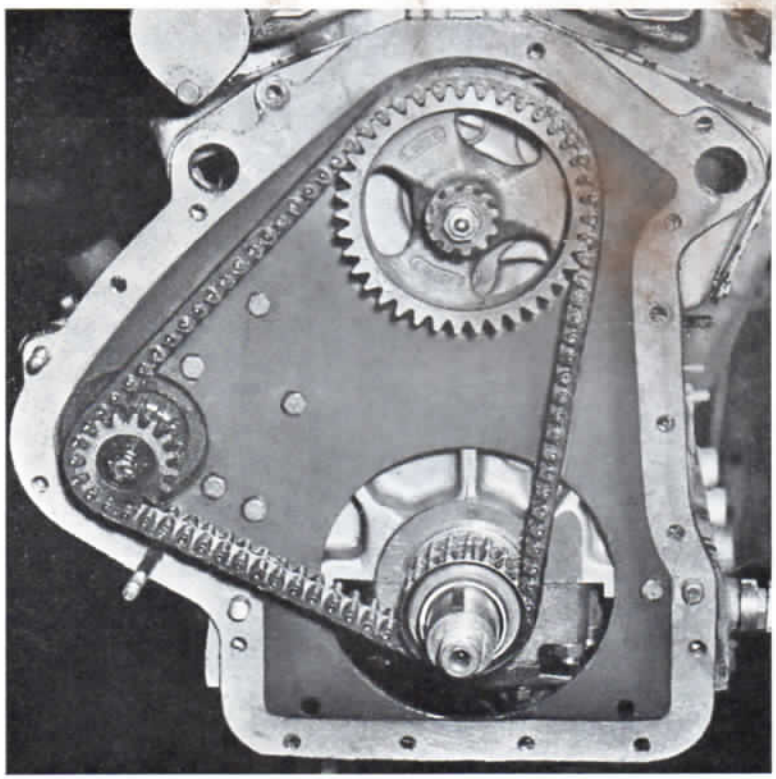


FIG. 16
TIMING CHAIN

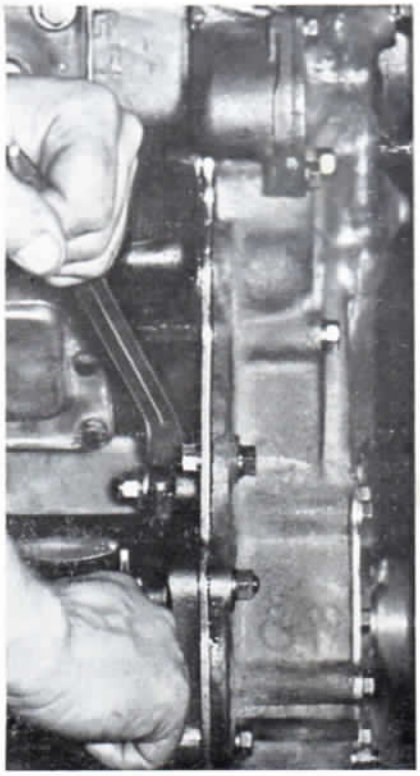


FIG. 17
ADJUSTING TIMING CHAIN

TORQUE VALUES

TABLE I

	Foot Pounds
Connecting Rod Bolts	58 - 62
Main Bearing Studs	56 - 60
Cylinder Head Bolts	48 - 52
Cylinder Head Cover Bolts	38 - 42
Vibration Damper Bolts	35 - 40
Flywheel Bolts	68 - 72

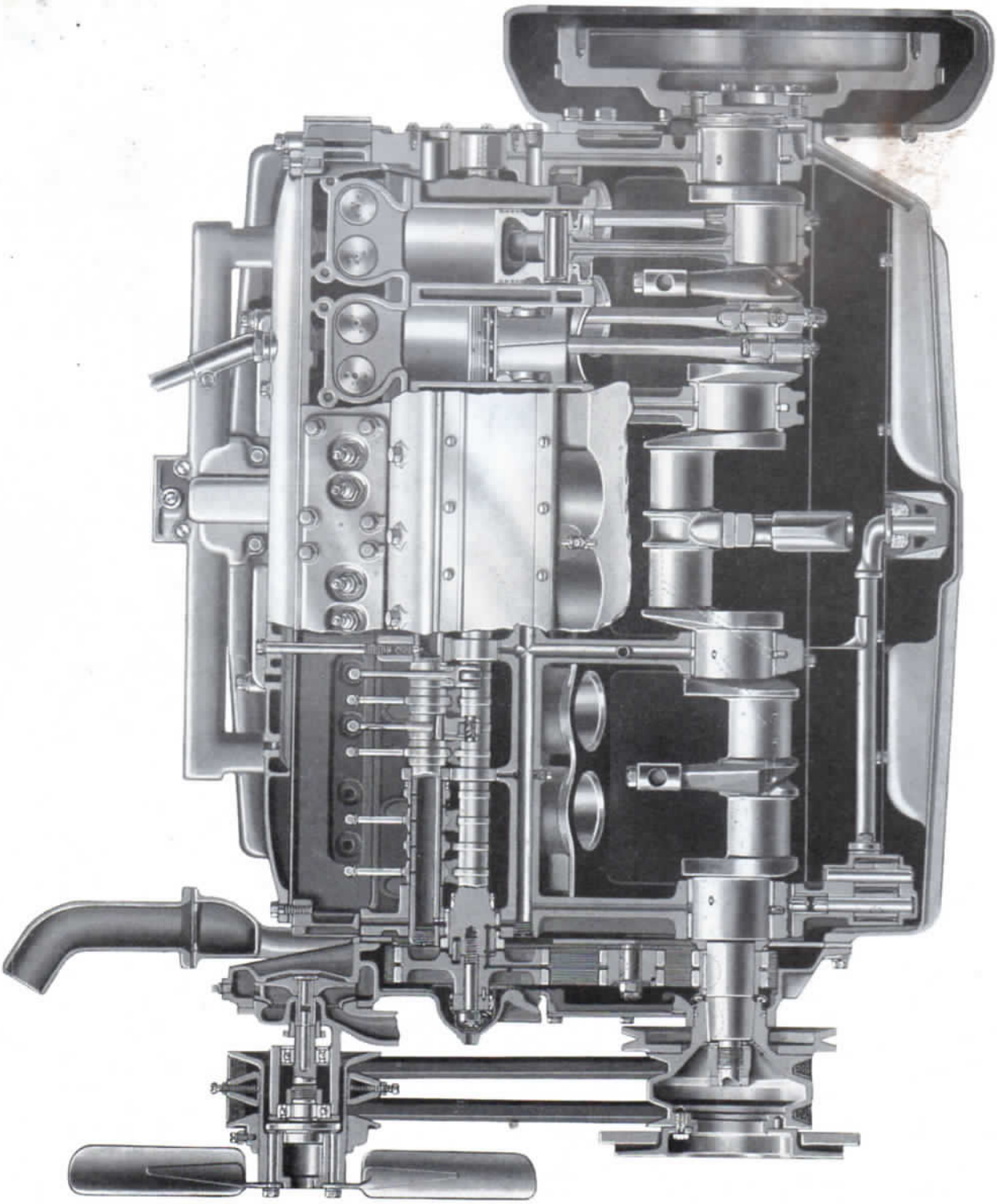


FIG. 18
LONGITUDINAL SECTION THRU ENGINE

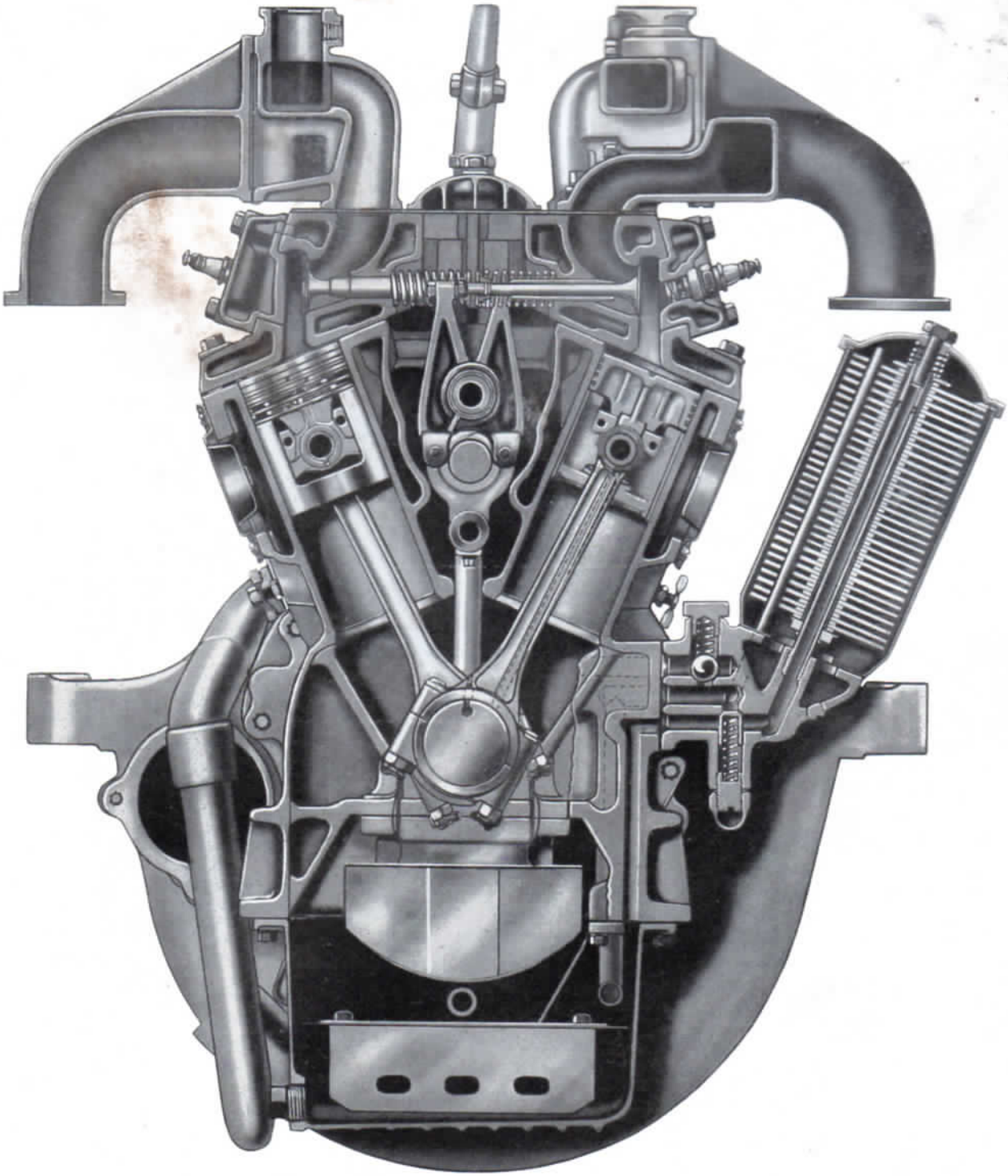


FIG. 19

TRANSVERSE SECTION THRU ENGINE

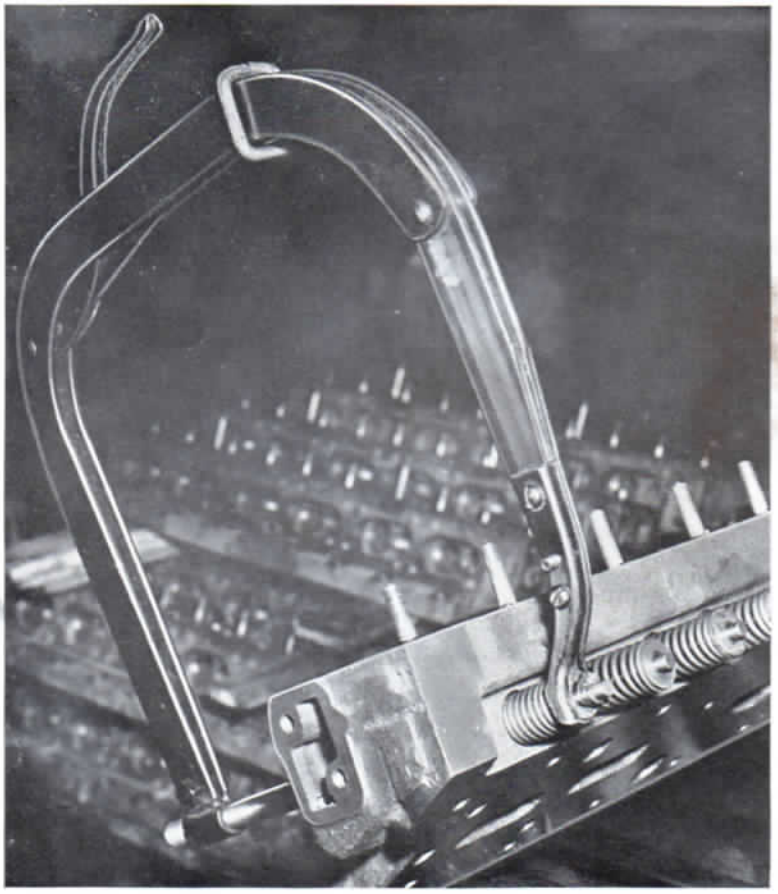


FIG. 20
REMOVING VALVES

32. REASSEMBLING CYLINDER HEADS

When reassembling cylinder heads be sure the gasket faces of heads and cylinder block are clean, and dowels are in place. Use new gaskets and coat each side with a thin film of non-hardening gasket cement. After placing heads on cylinder blocks, the bolts should be tightened gradually and in such a manner as to insure their pressure being equally distributed throughout the entire head. After partially tightening bolts, those in the center of the head should be finally drawn up, (see Table I) working both ways toward the ends. This is important and will insure freedom from strains in the cylinder head casting.

33. ADJUSTING VALVES

On the "Spartan" and "Invader" engine the valves may be adjusted with the valve cover removed and the engine running at a slow idle speed. With the "Scout" and "Challenger" engines, the carburetor, intake and exhaust manifolds must be removed. See Figs. 21 and 22. Loosen the lock nut on the first rocker arm. Slip a .010"-.012" feeler gage between the valve stem and rocker arm and rotate the adjusting screw until the feeler can just be slipped back and forth when the valve closes. Hold the screw in this position and tighten the locknut. The adjustment should be checked again to be sure it did not change when tightening the locknut. The balance of the valves are adjusted in the same manner.

36. CHECKING PISTON CLEARANCE IN CYLINDER

Measure the cylinder diameter, with inside micrometers at several points to termine if standard or over-size rings are required. The original bore diameter stamped on each cylinder. If the bores are tapered, out of round, scored o shouldered in excess of .005 - .008, the cylinders should be rebored and oversize pistons and rings installed. If the bore is straight and true within .003 of its original size, standard pistons and rings may be used.

Pistons are machined oversize .010, .020, .030 and .040.

Pistons are fitted to the bore using a .005 feeler strip ½ inch wide between the bore and the piston opposite the saw slot in the skirt. The feeler is oiled and is withdrawn at a tension of 12 to 18 pounds recorded on a spring scale to produce a satisfactory running clearance. The pistons must be at room temperature during this operation. See Fig. 25.

FIG. 25

CHECKING PISTON CLEARANCE WITH FEELER AND SPRING SCALE

INSPECTION AND REPLACEMENT OF MAIN AND CONNECTING ROD BEARINGS

When main or connecting rod bearings become worn or burned out to the extent they knock, it is necessary they be immediately replaced before any serious damage occurs to the crankshaft. The proper procedure is the same as for inspecting pistons. All main and connecting rod bearing repairs can be made from the bottom of the engine. Remove the cotter pins and nuts holding the connecting rod caps in place. The caps and rods are identified 1R, 3L, etc., such that they may be assembled in their proper cylinder. The connecting rod bearings are made in pairs which are interchangeable and require no shimming or fitting. On each half there is a lip which registers in a groove in the rod or cap. See Fig. 24. To remove the upper half from the rod it is only necessary to push the rod up away from the crankpin, lift out the bearing and replace with new one.

When replacing bearings, care should be taken that no dirt is under the bearing shell and the crankshaft oil holes are free of foreign matter. If the shaft is rough it must be smoothed with fine emery or crocus cloth. Before polishing the shaft it is advisable to pack the oil holes with a long strip of tape as every precaution must be exercised to keep the oil passages free of emery dust. The tape can be removed with a wire after polishing the shaft.

Before replacing bearing the shaft diameter should be checked with micrometers for out of roundness. If the shaft is out of round in excess of .001 inch on both main or connecting rod journals the new bearings will not have any appreciable length of life and should be considered as only a temporary repair, pending the time the shaft can be removed from the engine, reground and special bearings installed or replace with a new crankshaft and standard bearings.

FIG. 26
CHECKING CONNECTING ROD BEARINGS WITH BALL MICROMETERS

When inspecting or replacing connecting rod bearings, it is necessary to check the bearing thickness with ball micrometers as in Fig. 26. The bearing shell thickness should be .063 - .06325.

If ball micrometers are not available an alternate method is to use a feeler gage .0005 x $\frac{1}{2}$ x $1\frac{1}{8}$ inside the bearing cap on the vertical center. If this method is used, all other connecting rods should be removed. This is to eliminate all unnecessary drag when rotating the crankshaft. With one piston, (less rings) and connecting rod assembled to the crankshaft, rotate the shaft and note the amount of drag. Remove the cap and place the feeler gage lengthwise in the center of the cap and reassemble, see Figs. 27 and 28, draw up the nuts to the required torque. When the shaft is rotated, the drag should be the same to slightly greater. This same inspection should be repeated using an .0015 feeler gage. When rotating the shaft, there should be a slight to heavy drag.

The side clearance between adjacent connecting rods on one crankpin may be checked by placing a feeler gage between the rod bearings. This clearance should be .006 minimum to .010 maximum. See Fig. 29.

When inspecting main bearings the same method is used. First remove the oil pump, suction pipe and header. It is also advisable to remove the rods and pistons, to eliminate any additional drag when checking the main bearings with feelers. Check one bearing at a time. With the cap removed, the lower main bearing half is doweled to the cap to prevent rotation or endwise movement. The upper bearing half is prevented from endwise movement by the flanged crankshaft, and from rotating by the lower bearing half. See Fig. 30. To remove the upper bearing, push on the end of the bearing and it will rotate around the shaft as in Fig. 31. This method makes it unnecessary to disturb the crankshaft when when replacing the main bearing.

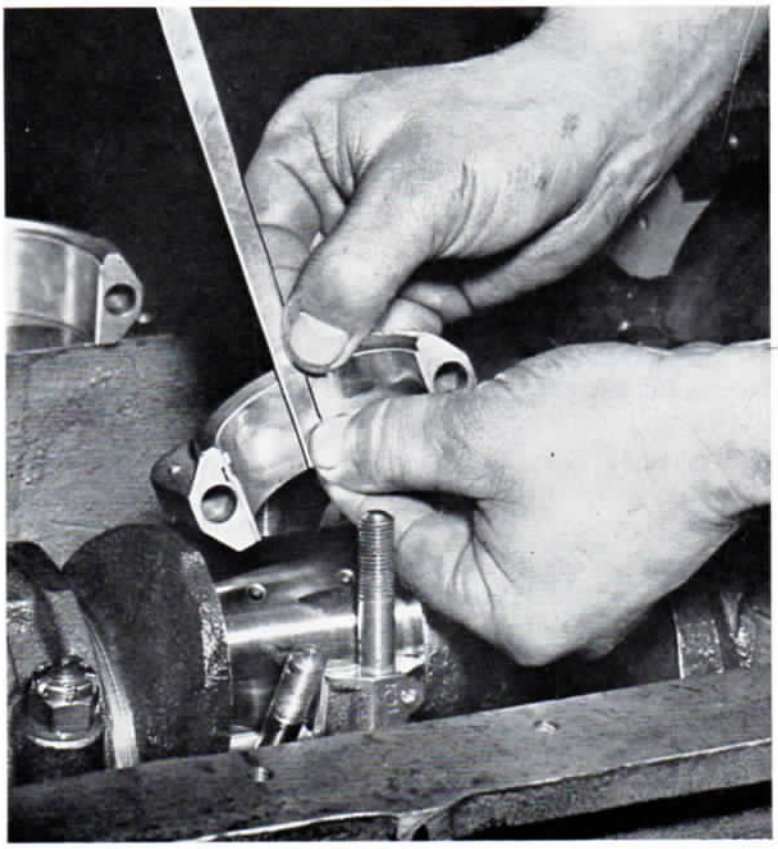


FIG. 27
PLACING FEELER IN CONNECTING ROD BEARING CAP

After replacing a main bearing, to check for clearance, place an .003 x 1/2 x 1 3/4 gage in cap and assemble, drawing the nuts up to their required torque. See [illegible]. Rotate the shaft. The drag should be the same as before replacing to slight- [illegible]. This procedure should be repeated using a .004 feeler and should produce a [illegible] heavy drag.

The crankshaft end thrust should be checked at No. 3 main bearing with a feeler as shown in Fig. 33. This clearance should be .004 inch minimum to .009 maximum.

When replacing the rear main bearing, two square cork gaskets are inserted with the cap. See Fig. 34.

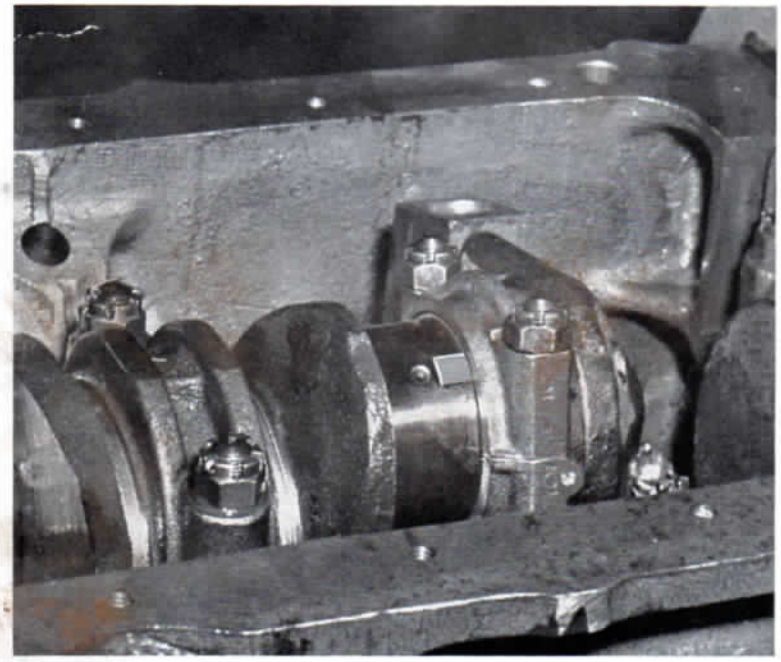


FIG. 28
CHECKING CONNECTING ROD BEARING WITH FEELER

38. INSPECTION OF OIL PUMP

With the pump removed from engine, loosen screws attaching the header and suction pipe. Remove screws attaching cover to pump body, the gears and shafts are now free to be removed. See Fig. 35.

Clean the pump thoroughly and check the bearings. The pump drive bearing should be .002" to .003" loose. Inspect the bearings and shaft for wear and scoring. The idler gear and shaft have a tolerance of .0015" to .0025" loose.

To check the clearance between the gear teeth and pump case, place the gears on their respective shafts, slide a .006 x 1/4 feeler between the teeth and case. This should be a tight fit. The end clearance may be checked with an indicator, if this exceeds .006 inch, the case should be lapped until the amount is reduced to a minimum of .002.

The oil pump header and suction pipe should be inspected for cracks around the welded flanges.

The pump unit may now be reassembled in the crankcase. New gaskets should be used, all nuts must be drawn up tight and properly cottered.

FIG. 29
CHECKING CONNECTING ROD SIDE CLEARANCE

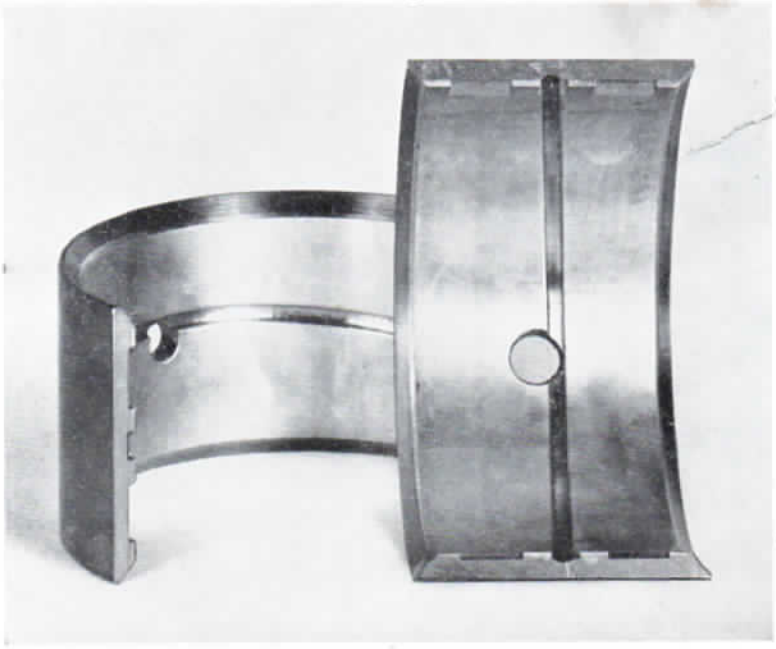


FIG. 30
MAIN BEARING SHELLS

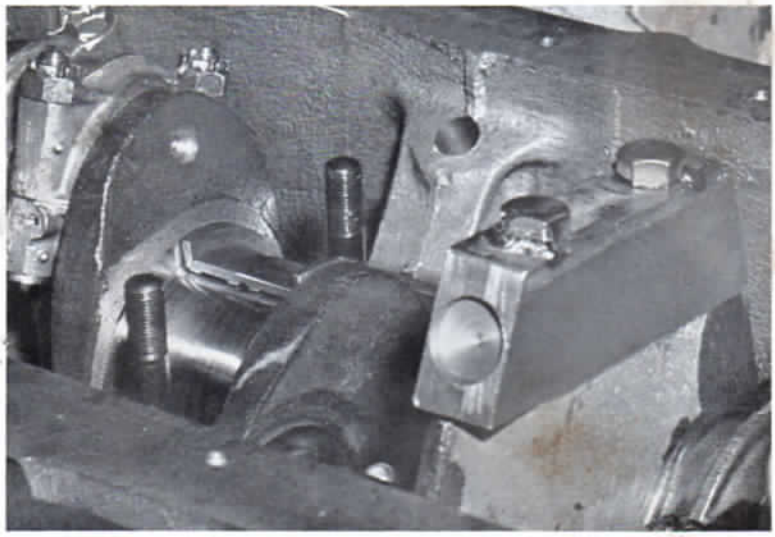


FIG. 31
MAIN BEARING ROTATING AROUND CRANKSHAFT

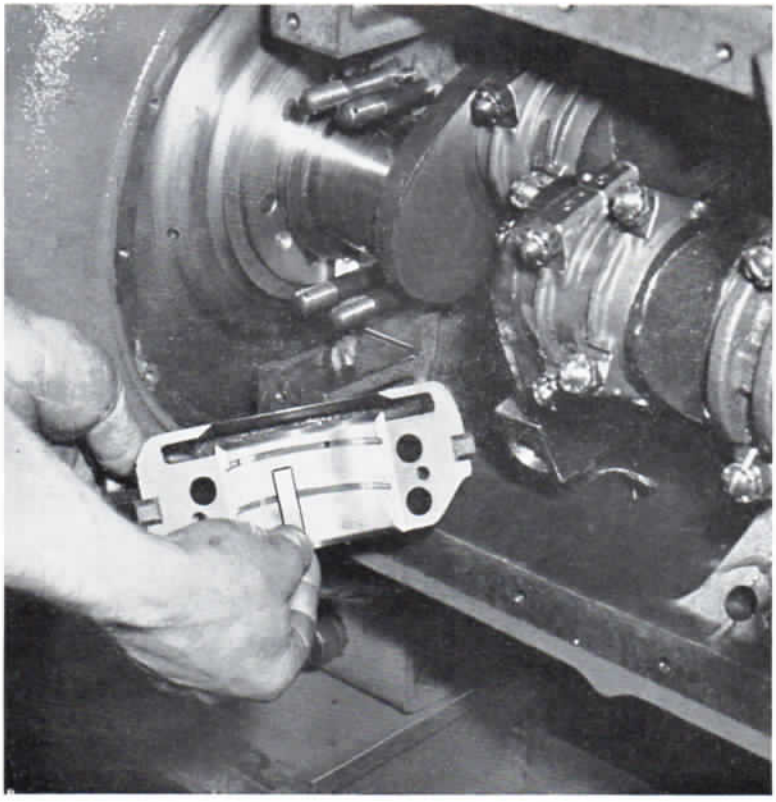


FIG. 32
PLACING FEELER IN MAIN BEARING CAP

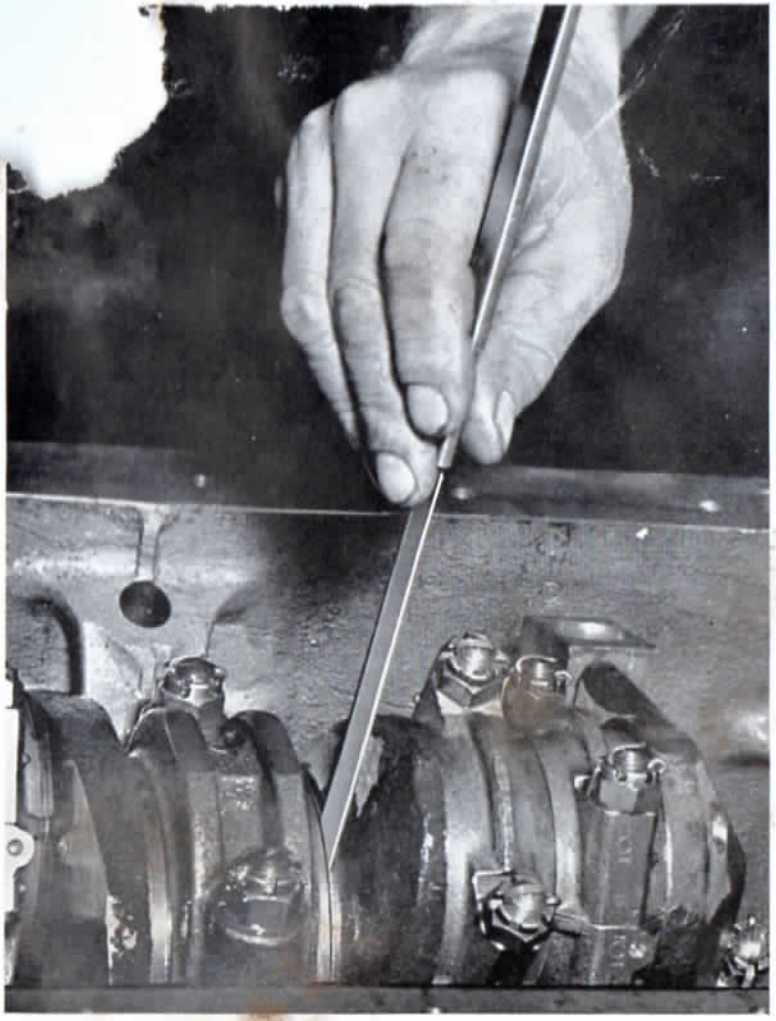


FIG. 33
CHECKING THRUST BEARING END CLEARANCE

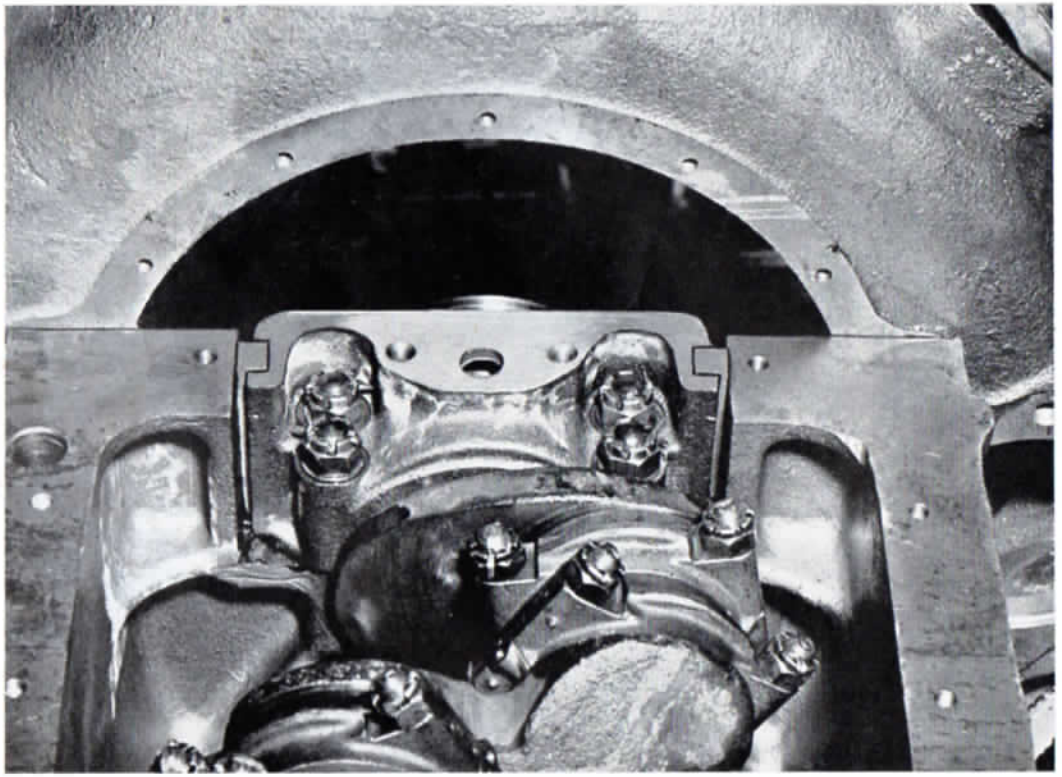


FIG. 34
PACKING AT REAR MAIN BEARING

AND INSPECTION OF WATER PUMP

water pump, after releasing fan belts, loosen screws in fan hub. Remove fan belt pulleys. Loosen screws in pump bracket and remove bracket assembly from engine. Remove lockscrew from rear of impeller, slide impeller off shaft. Loosen front bearing retainer and slide shaft and bearings from bracket. Remove packing nut and packing. Thoroughly wash the bearings and shaft in kerosene, inspect and replace if necessary. Reassemble in the reverse manner repack the pump bracket gland using graphite packing. After assemblying, pack bearings with medium cup grease, until grease flows from the hole in the shaft in front of the packing gland nut. Replace and adjust fan belts.

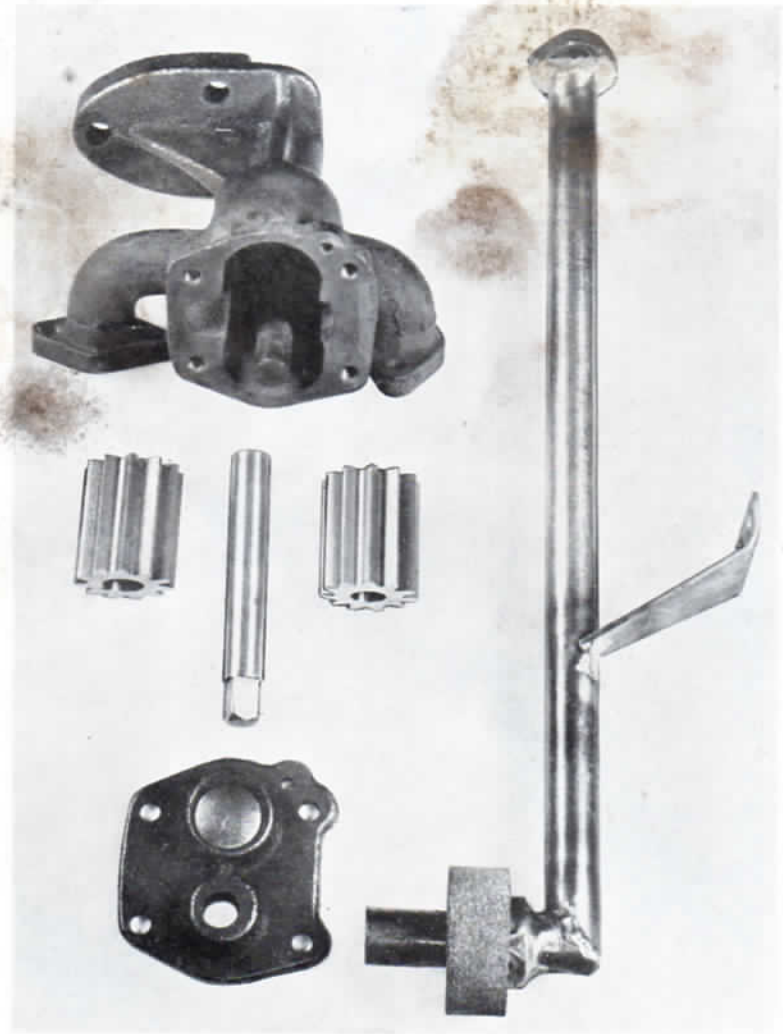


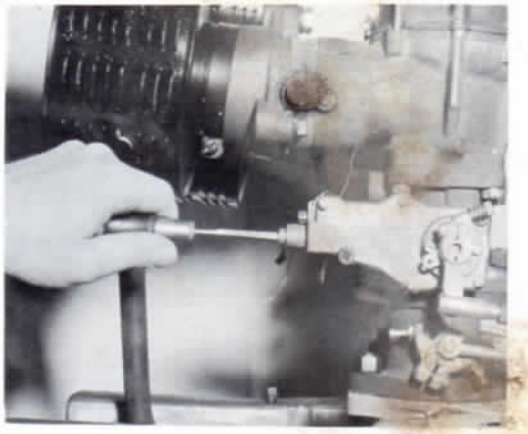
FIG. 35
OIL PUMP ASSEMBLY

40. REMOVAL AND INSPECTION OF TOP DISTRIBUTOR

To remove the top distributor and shaft, it is necessary to remove the timing chain cover and fuel pump. With the timing chain cover removed as previously explained, remove the distributor by releasing the octane selector screw and lifting up from the front face, the pin through the fuel pump cam may be driven out, releasing the top shaft. See Fig. 19. The bottom shaft is attached to the oil pump coupling and has clearance requiring no inspection. Inspect the top shaft bearing for scoring and wear. Reassemble in the reverse order.

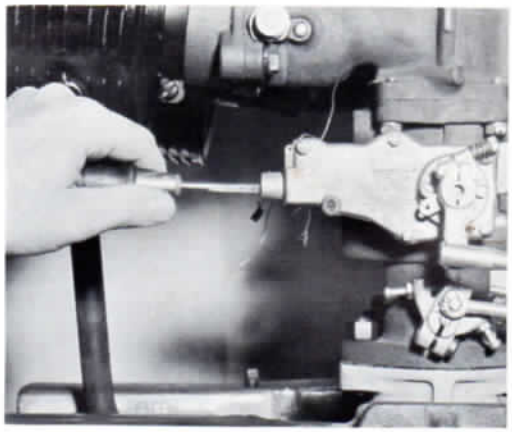
" J " ENGINE VELOCITY GOV[illegible]

ADJUSTING

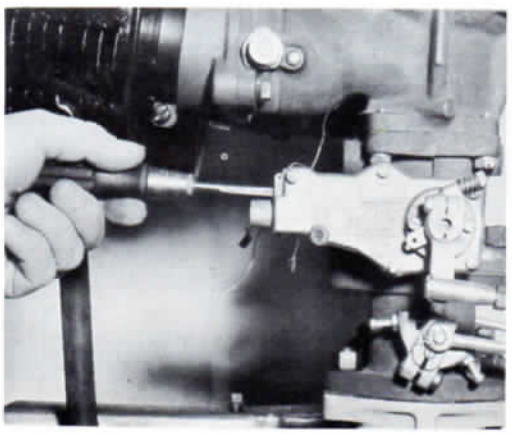


1 Break seals and remove seal plugs from each of the governors.

2 Start engine and permit it to idle. After sufficient warm-up period, turn off fuel supply to one cylinder bank.

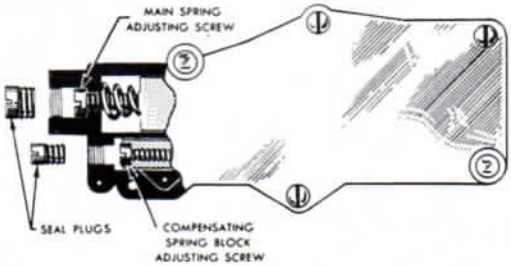


3 With a small screw driver, turn main spring adjusting screw (speed regulating screw) clockwise to the extent of its travel. Back the adjusting screw off by turning counterclockwise 65 notches. Gradually open throttle taking note that engine speed does not exceed 3200 to 3300 RPM. If engine speed exceeds 3200 to 3300 RPM, close the throttle and turn main spring adjusting screw counterclockwise four (4) notches at a time to reduce maximum engine speed. If engine speed is less than 3100 RPM turn main spring adjusting screw clockwise four (4) notches at a time to raise engine speed, checking the speed by opening the throttle after each adjustment until 3200 to 3300 RPM is obtained.



4 At this point engine surge will probably occur. If the governor surges, turn compensating adjusting screw with a narrow screw driver, one-quarter turn counterclockwise until surge is overcome. This will provide maximum degree of desirable "sharpness". In the event that engine does not surge, compensating adjusting screw should be turned clockwise until surge occurs, then proceed as above. These sensitivity adjustments may disturb the speed adjustment so the speed setting should be rechecked and corrected as described in 3 above as necessary. If surge reoccurs, it should be readjusted and control speed rechecked.

5 Open fuel supply to both banks, increase engine speed to approximately 2000 RPM and close fuel supply to other bank. When engine speed begins to fall, permit engine to idle and repeat steps 3 and 4 on the second bank.

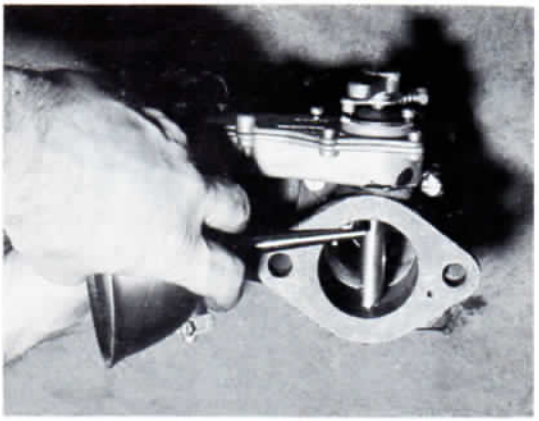


6 Vehicle should now be taken on the road. With truck in second gear on a level road, depress the throttle fully, noting maximum engine RPM. This should be 3100 to 3200 RPM. Adjustments for speeds over or under this can now be made by turning both adjusting screws in or out an equal number of notches to obtain the 3100 to 3200 RPM figure.

7 With both governors set as described, the cut-out speed should be between 3100 and 3200 RPM. In setting governors where the apparatus is equipped with a pump required to maintain high pressure (500 PSI and above) follow the procedure outlined above with both banks in operation, the cut-out speed should be between 3300-3400 RPM.
When the correct speed has been attained the governors should be resealed and a red tag attached.

8 LUBRICATION

Most governor failures are due to accumulation of carbon on the throttle shaft bearings. Often these can be temporarily corrected without complete disassembly of the carburetor and governor by application of a good penetrating oil to the throttle shaft bearings. These can be reached by removing the carburetor from the engine and applying penetrating oil to the throttle shaft openings on the inside of the throttle body bore. The penetrating oil must be used and applied cautiously using the minimum amount needed to eliminate friction. Excessive use of lubricant or use of standard engine oil will increase carbon formation when the unit is reinstalled on the engine. Complete disassembly and proper cleaning of bearings and races is necessary for permanent correction of this trouble.



750, 1000, 1250 AND 1500 GPM PUMP

INDEX

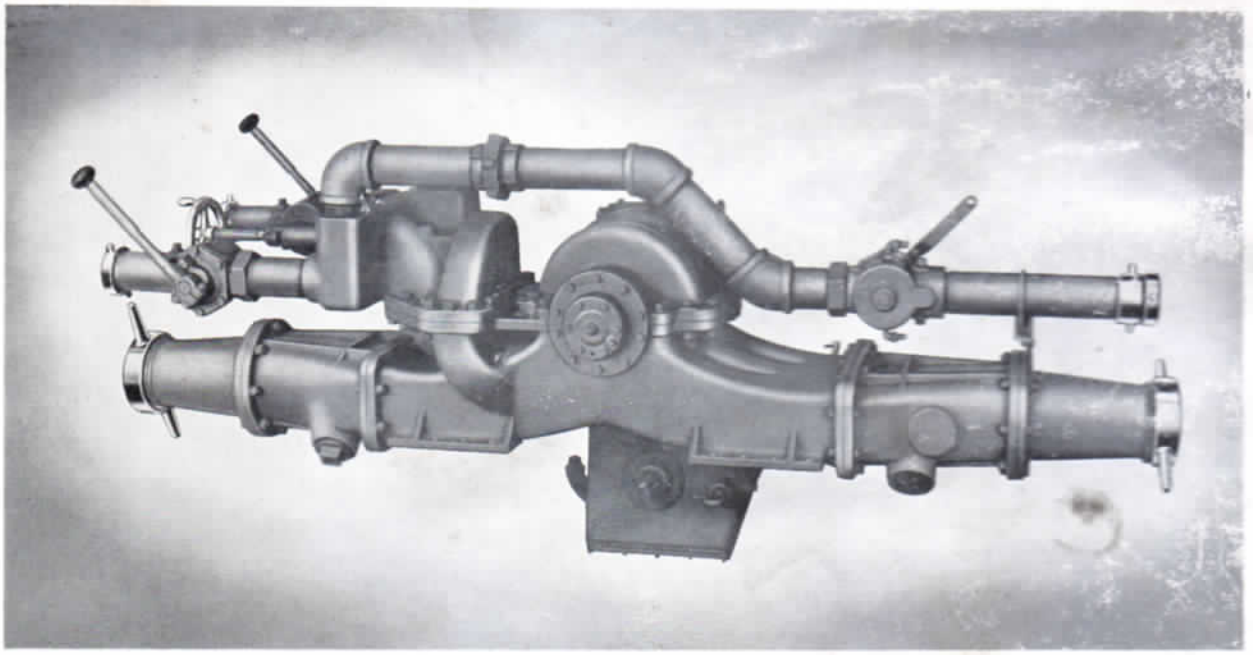


FIG. 1
FRONT VIEW OF PUMP

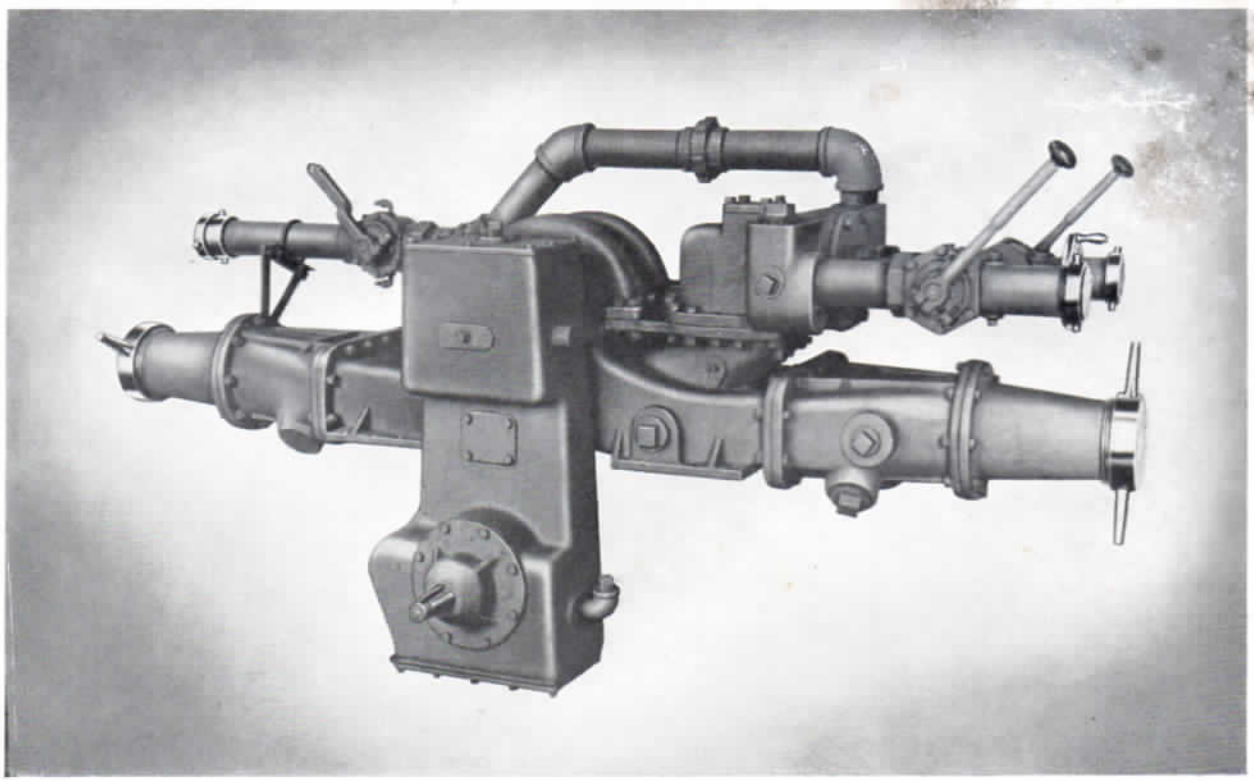


FIG. 2
REAR VIEW OF PUMP

PUMP

1. The pump is a two stage parallel series centrifugal with volute type discharges. The drive shaft is supported by heavy duty ball bearings. See Fig. 3. The two impellers are mounted on the shaft between the bearings, separated by an interstage spacer. The impellers are keyed to the shaft and are located endwise by stainless steel snap rings. The impellers, interstage spacer and pump case are fitted with wear rings so no machining is necessary to compensate for wear.

The impeller shaft is driven thru a gear train. See Fig. 3 and 4. The drive gear and clutch are mounted in the chassis drive shaft. The clutch is a single ring, positive engagement type. One movement of the clutch disengages the rear axle and engages the pump. Axle and pump cannot be engaged at the same time.

The idler gear is straddle mounted on needle bearings. The one piece transmission case assures both bearings are in perfect alignment.

The pump driven gear is mounted on the impeller shaft next to the heavy duty ball bearing.

On each end of the shaft, inboard from the bearings are three packing seals. The inside seal faces the impeller and protects against water leaks to the outside. The center seal faces the end and acts as a vacuum seal when priming the pump. Between the center and end seal there is a chamber which is vented to atmosphere. If after long usage the seals become worn to the extent they leak, the water passing the seals enters the chamber at atmospheric pressure and flows out on the ground. This is perfect assurance that no pressure can be built up to cause a water leak to the bearing. The outboard seal on the rear end restricts the flow of oil from the transmission case, on the front end the flow of grease from the bearing.

There is an "O" ring on the shaft in the high pressure stage between the packing and the impeller. Water passing the "O" ring is returned thru an outside line to the suction side of the pump.

The impeller shaft at the front end has a hardened sleeve pressed on to compensate for any wear the seals might impose.

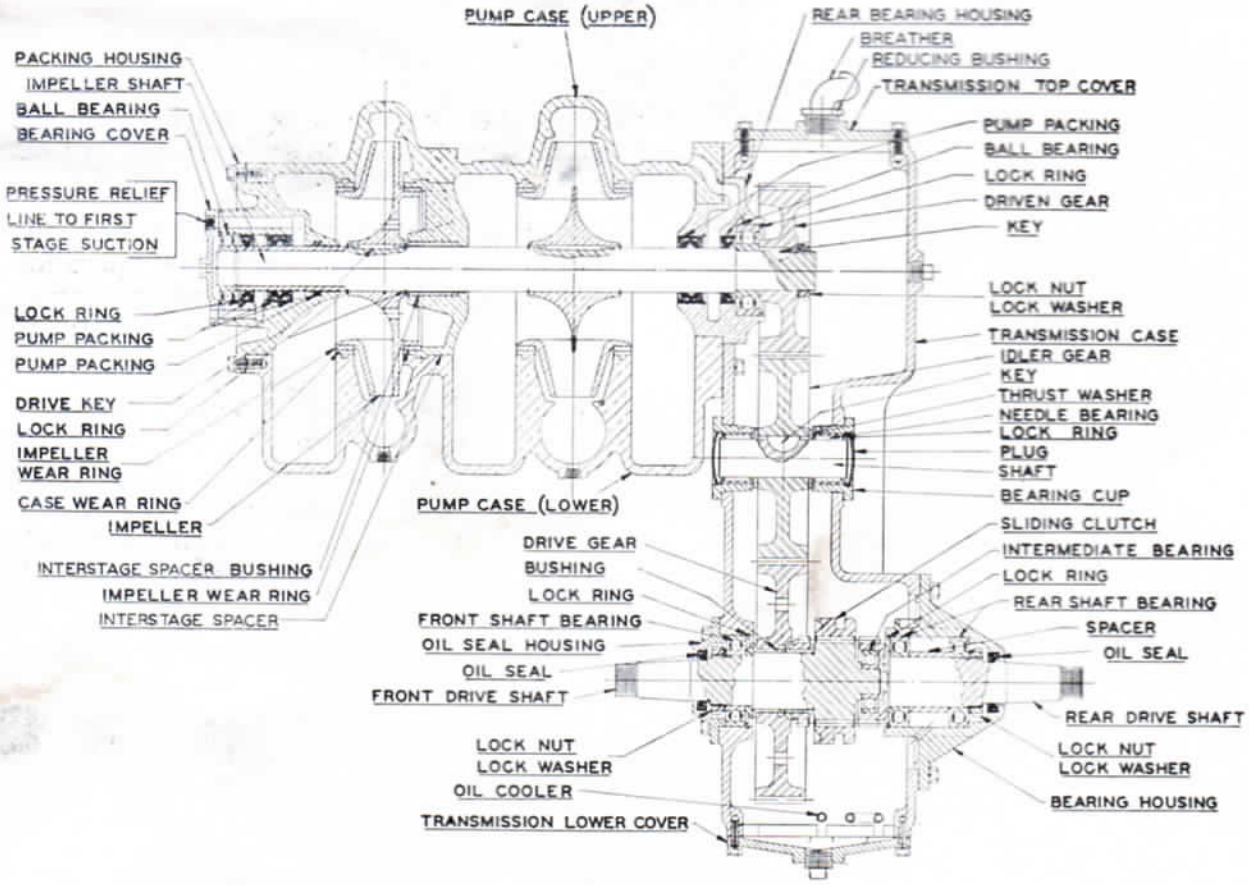


FIG. 3
SECTION THRU PUMP

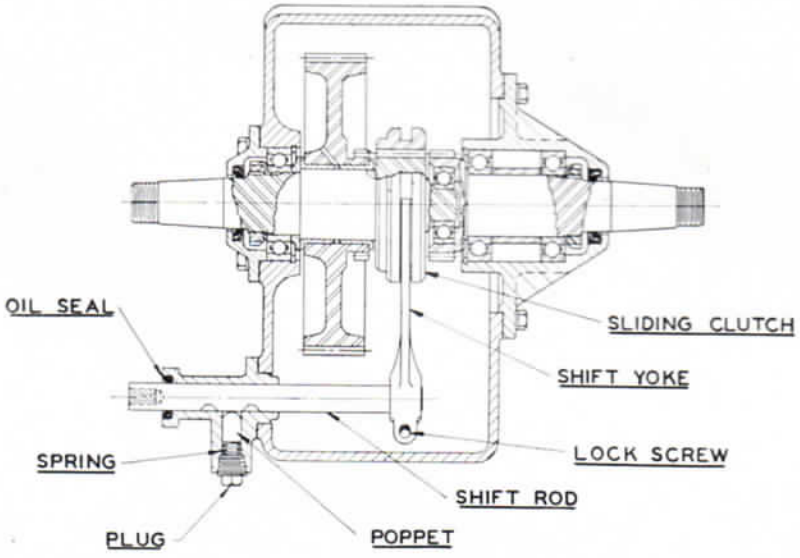


FIG. 4
SECTION THRU PUMP SHIFT MECHANISM

2. OPERATING FROM DRAFT

A. To operate from draft, upon arriving at the source of water supply, place the pumper in such a position that the shortest suction hose will be required, and set the hand brake.

B. Release the clutch, shift the road transmission to direct drive and engage the pump by moving the pump shift lever to the extreme "up" position. This operation also disengages the rear axle. Engage the clutch and lock the road transmission in direct drive by turning the locking lever to the left and up, to its full extent of travel. Lock the pump shift lever by turning down on the locking lever. See Fig. 5.

C. Check the position of the "change-over valve" hand wheel. The pump should be operated in "capacity" for pressures up to 175 lbs. per square inch. The valve is in "capacity" when turned clockwise to the limit of its travel. This is the proper setting for either large or small volumes of water. If discharge pressures in excess of 175 lbs. per square inch are required, momentarily retard the hand throttle and turn the "change-over valve" anti-clockwise to the full extent of travel. This operation changes the pump from "capacity" to "pressure." See Fig. 6.

D. Connect the suction hose. Make certain the intake end has a strainer attached and is submerged at least two feet below the water surface. This eliminates the possibility of air entering the hose causing the pump to loose its prime. The strainer must be kept free of foreign matter which may restrict the flow of water. All connections in the suction line must be air tight. Do not use gaskets that are worn or cut, only gaskets in good condition will prove satisfactory.

E. Connect the discharge hose to the desired outlets.

F. Make certain all discharge gates and bleeder valves are closed.

G. Pull out the priming lever located at the bottom of the pump panel. Pull out the priming throttle until the engine R. P. M. is 1500 to 2000 and in a matter of seconds the pressure gage will indicate the pump is primed. Open the discharge gates. After the pressure has stabilized at 40 pounds per square inch or above, close the priming throttle and open the hand throttle. Close the priming lever.

H. Pull out the governor control handle and lock in the "out" position by clockwise rotation of the hand lock nut. Open the "governor pressure valve." Set the governor after the desired discharge pressure is obtained, by releasing the lock nut and pushing in the control handle. IMPORTANT: Governor pressure line valve must be open before control handle is set.

I. After governor has been "set," to change the discharge pressure it is necessary to pull out the control handle then change the throttle control to the position that gives the desired pressure. Push in and lock the control handle which sets the governor for the new conditions.

J. If for any reason it is necessary to shut down, close the throttle and discharge gates. With the gates closed, the pump will hold its prime. To resume pumping, open the discharge gates and throttle.

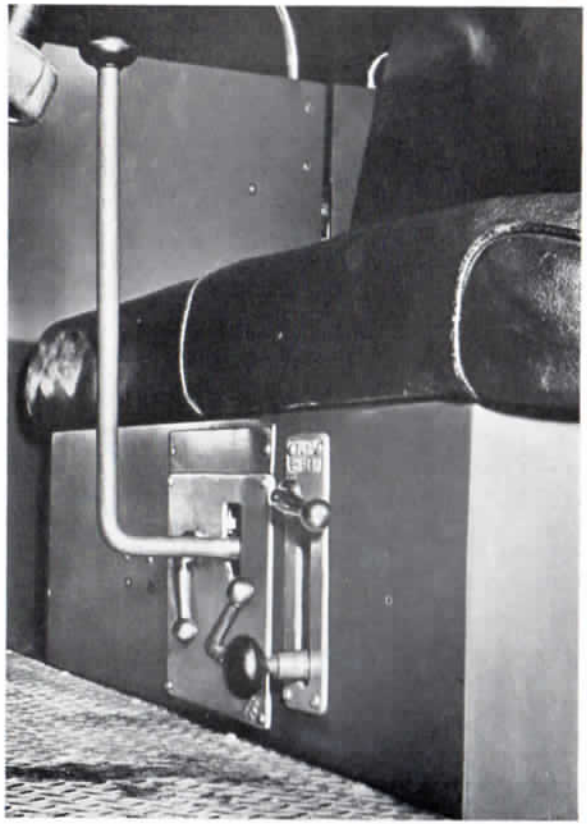


FIG. 5
PUMP AND TRANSMISSION SHIFT LOCKS

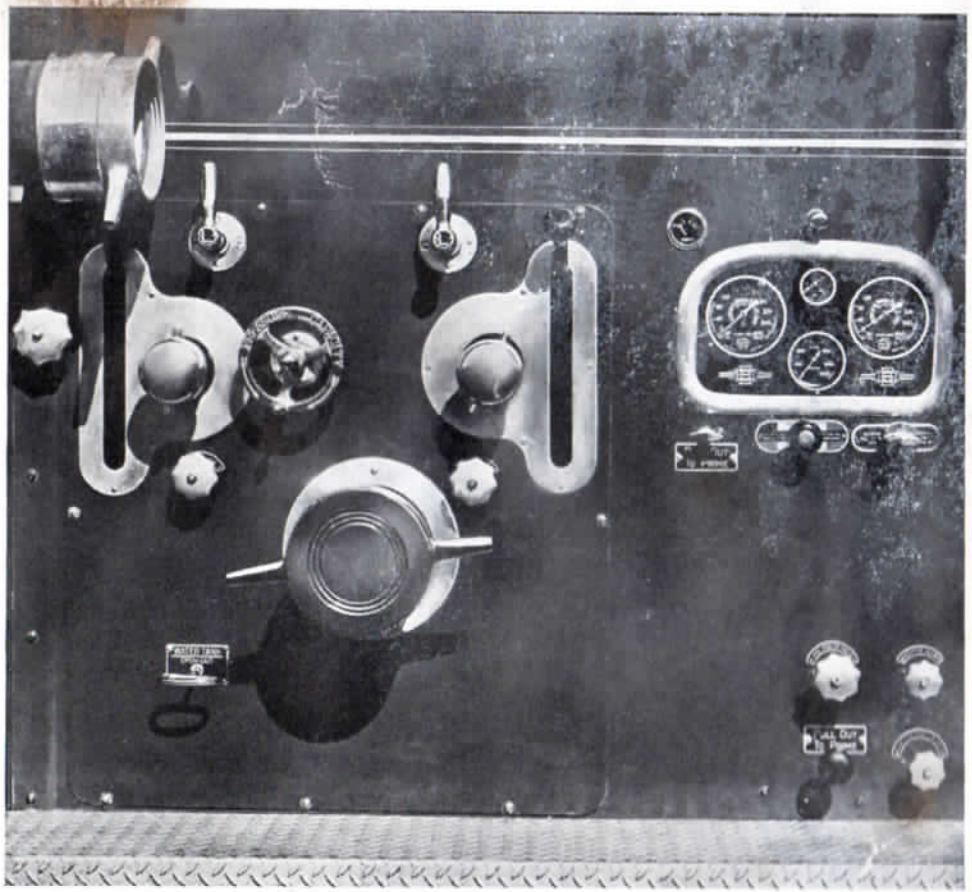


FIG. 6
CONTROL PANEL

3. OPERATING FROM HYDRANT

A. To operate from hydrant, upon arriving at the source of water supply, place the pumper in such a position that the shortest suction hose will be required and set the hand brake.

B. Release the clutch, shift the road transmission to direct drive and engage the pump by moving the pump shift lever to the extreme "up" position. This operation also disengages the rear axle. Engage the clutch and lock the road transmission in direct drive by turning the locking lever to the left and up, to its full extent of travel. Lock the pump shift lever by turning down on the locking lever. See Fig. 5.

C. Make certain that the priming lever located on the pump panel is in the "in" position.

D. Check the position of the "change-over valve" hand wheel. The pump should be operated in "capacity" for pressure up to 175 lbs. per square inch. The valve is in "capacity" when turned clockwise to the limit of its travel. This is the proper setting for either large or small volumes of water. If discharge pressures in excess of 175 lbs. per square inch are required, momentarily retard the hand throttle and turn the "change-over valve" anti-clockwise to the full extent of travel. This operation changes the pump from "capacity" to "pressure." See Fig. 6.

E. Connect the suction hose from the hydrant to the suction inlet of the pump.

F. Connect the discharge hose to the desired outlets.

G. Make certain all bleeder valves are closed.

H. Pull out the governor control handle and lock in the "out" position by clockwise rotation of the hand lock nut. Open the "governor pressure valve." Set the governor after the desired discharge pressure is obtained, by releasing the locknut and pushing the control handle in.

IMPORTANT: Governor pressure line valve must be open before control handle is set.

I. After the governor has been "set," to change the discharge pressure it is necessary to pull out the control handle then change the throttle control to the position that gives the desired pressure. Push in and lock the control handle which sets the governor for the new conditions.

4. OPERATING AS A BOOSTER

A. Place the pumping engine in position and set the hand brake.

B. Release the clutch, shift the road transmission to direct drive and engage the pump by moving the pump shift lever to the extreme "up" position. This operation also disengages the rear axle. Engage the clutch and lock the road transmission in direct drive by turning the locking lever to the left and up, to its full extent of travel. Lock the pump shift lever by turning down on the locking lever. See Fig. 5.

C. Check the position of the "change-over valve" hand wheel. The pump should be operated in "capacity" for pressures up to 175 lbs. per square inch. The valve is in "capacity" when turned clockwise to the limit of its travel. This is the proper setting for either large or small volumes of water. If discharge pressures in excess of 175 lbs. per square inch are required, momentarily retard the hand throttle and turn the "change-over valve" anti-clockwise to the full extent of travel. This operation changes the pump from "capacity" to "pressure." See Fig. 6.

D. Open the "tank valve" in the line from the booster or water tank to the pump.

E. Make certain all discharge gates and bleeder valves are closed.

F. Pull out the priming lever located at the bottom of the pump panel. Pull out the priming throttle until the engine R. P. M. is 1500 to 2000 and in a matter of seconds the pressure gage will indicate the pump is primed. Open the booster valve discharge line (hose reel). After the pressure has stablized at 40 lbs. per square inch or above, close the priming throttle and open the hand throttle. Close the priming lever.

G. Pull out the governor control handle and lock in the "Out" position by clockwise rotation of the hand lock nut. Open the "governor pressure valve." Set the governor after the desired discharge pressure is obtained, by releasing the locknut and pushing in the control handle.

IMPORTANT: Governor pressure line valve must be open before control handle is set.

H. After governor has been "set," to change the discharge pressure it is necessary to pull out the control handle then change the throttle control to the position that gives the desired pressure. Push in and lock the control handle which sets the governor for these new conditions.

I. Due to the fact that only small quantities of water are pumped during booster operation, the nozzle may be shut off without setting the governor.

5. PRIMER:

A. Priming a pump is the operation of removing the air from the pump and suction hose. The priming system used on the American - LaFrance centrifugal pumps provides quick priming from draft, is reliable, and is simple in design.

The exhaust gases flow from the engine to atmosphere through the exhaust pipe "A" Fig. 7. In the exhaust pipe is a valve "B" which stops the normal exhaust flow by means of the butterfly "C," diverting the entire flow thru the conejector priming unit "D." The exhaust outlet area of the conejector "D" is greatly reduced which causes an engine back pressure. At full throttle with valve "C" closed (in priming position) this back pressure causes an ejector velocity at ejector outlet "E" just beyond the conecal jet. This in turn creates vacuum in chamber "F." The vacuum chamber is connected to hydrant conejector "G," but separated by swing check "H" and to the pump through draft—hydrant valve "J."

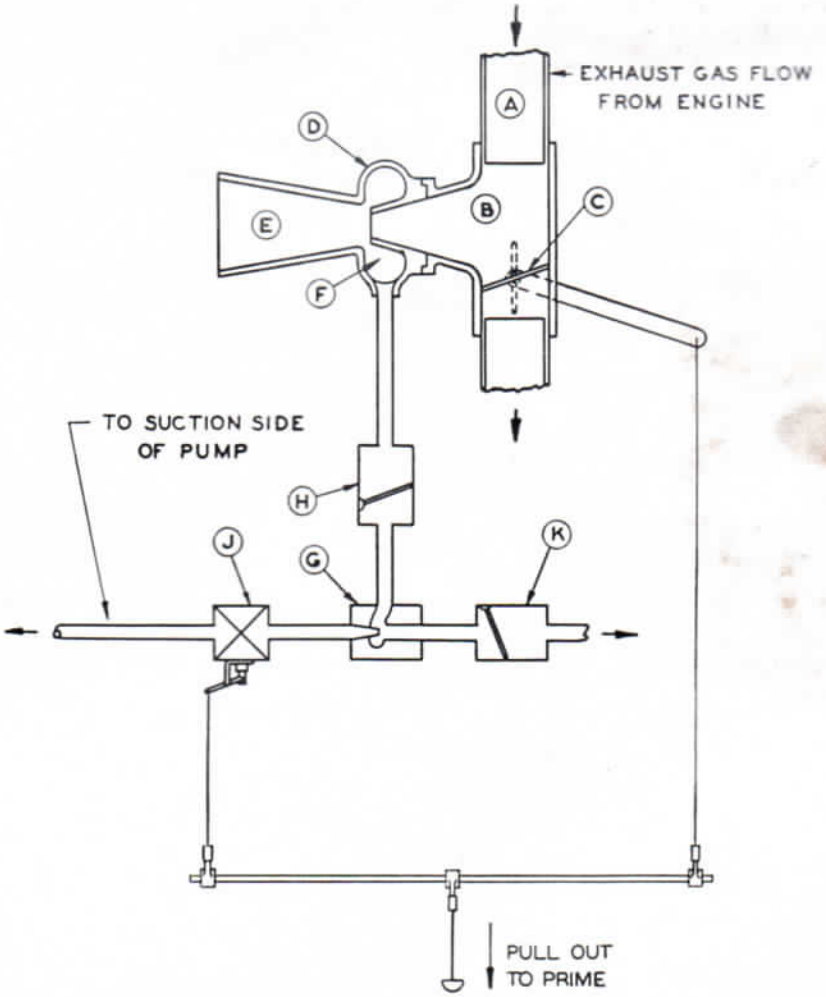


FIG. 7
PRIMER DIAGRAM

B. DRAFT OPERATION

When the primer is put into operation by pulling out the priming lever, on the panel, thereby closing the butterfly valve "C" and opening draft-hydrant valve "J," swing check "K" closes and swing check "H" opens to vacuum chamber "F." After the pump is primed, push in the priming lever which returns the valves to their normal operating positions.

C. HYDRANT OPERATION

When pumping hydrant the primer "B" is not used, however, if priming lever remains out, water at hydrant pressure will flow thru the hydrant conejector "G," swing check "K" and to the ground, indicating to the operator that the draft-hydrant valve "J" should be closed. If for any reason the operator fails to close the draft-hydrant valve, the water flowing thru the hydrant conejector "G" creates a vacuum and closes swing check "H," consequently no water flows to the exhaust conejector unit.

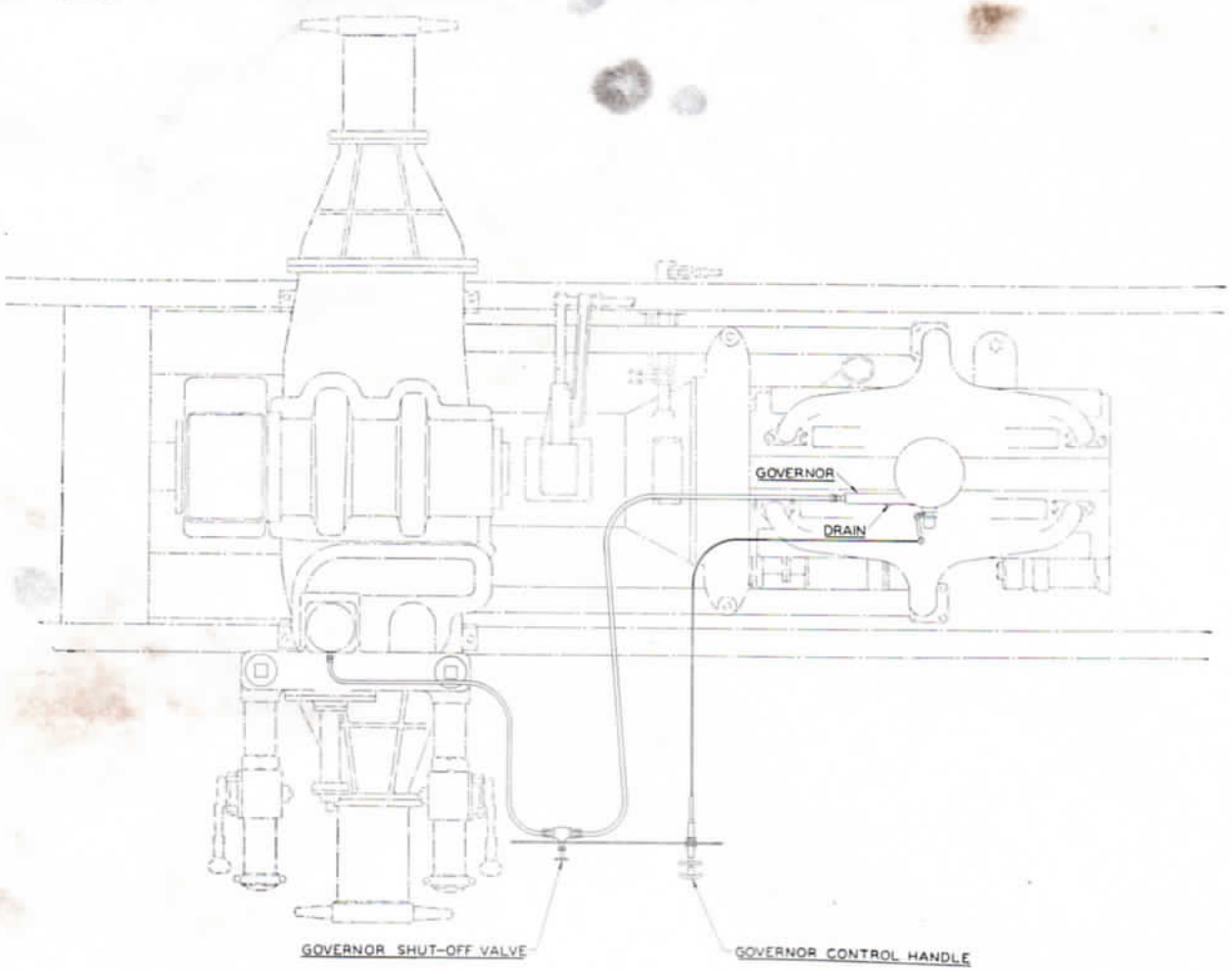


FIG. 8
GOVERNOR SYSTEM

6. GOVERNOR

When operating a pump which has several discharge lines, it is necessary to have a governor to control the pressure as one or more lines are turned on or off. A control of engine speed is necessary to meet these conditions.

Fig. 8 shows a governor of this type, which once set at the desired pressure requires no adjustment or attention by the operator.

Two auxiliary butterfly valves are provided in the motor intake system independent of the carburetor such that the governor control is entirely separate from the throttle control. A cross shaft at the rear of the engine is connected to a butterfly valve in each manifold which provides synchronized control. The governor acts directly on this cross shaft.

The control unit is mounted on the front pump enclosure panel. A sectional view of the governor control is shown in Fig. 9.

Before starting to pump, the operator pulls out handle "A" Fig. 9. This disengages serrated face of plunger "D" and shaft "H," permitting piston "P" to move with any change in pump pressure. With the desired pump pressure, handle "A" is released, reengaging plunger "D" and shaft "H." Any change in pump pressure causes piston "P" to move, transfering the movement thru shaft "H" to the vertical lever on the cross shaft. When the large lever moves, the cross shaft rotates which moves the levers connected to the butterfly valves. This controls the engine speed and maintains a constant pump discharge pressure. Any water leaking by piston "P" is drained to the ground.

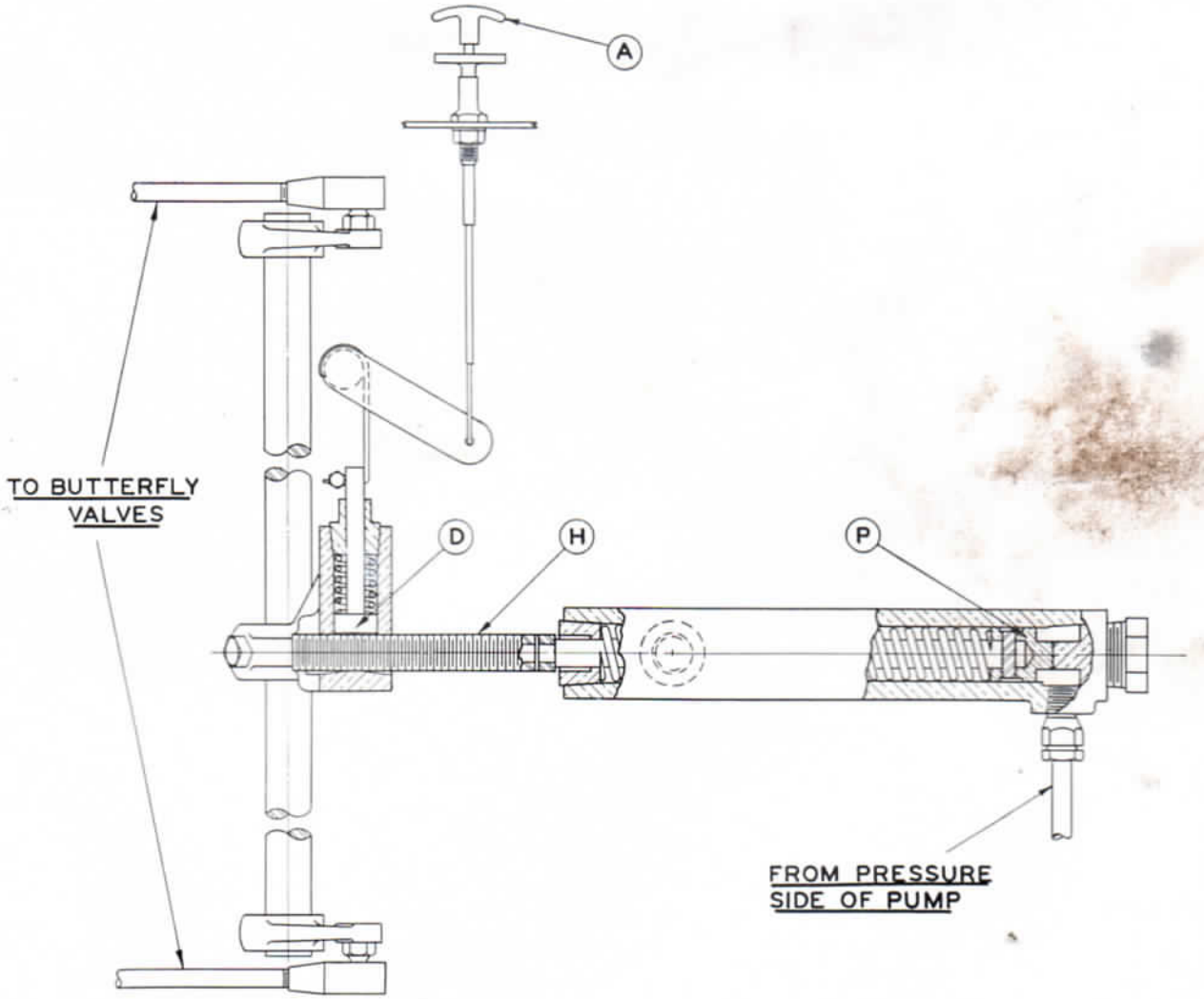


FIG. 9
GOVERNOR

7. REMOVAL OF IMPELLER SHAFT ASSEMBLY

To remove the impeller shaft assembly, first loosen screws attaching the transmission top cover. See Fig. 3. Release the lock and remove the hex nut from the impeller shaft, slide impeller gear off shaft. Remove screws attaching front and rear bearing housings to pump body and slide housing off end of shaft. Use puller if necessary, holes are provided in gear and housing. Remove screws from the top pump cover and lift off cover. The impeller shaft assembly is now free to be removed.

After removing the impeller shaft assembly it is advisable to remove the snap rings and slide the impellers off the shaft. Inspect the impeller and pump case wear rings. Inspect the shaft for wear and grooving at the rear water seal. A hardened wear bushing is provided on the shaft and if conditions warrant this bushing may be removed and a new one pressed in place.

8. INSTALLING PUMP PACKINGS

To remove the pump packings in the front bearing housing, first remove the screws attaching the front bearing cover, withdraw bearing from housing. With a pair of special plyers remove the snap ring in front of the first packing. With a hook or special tool remove the packing from the bore. The second snap ring and the next two packings are removed in the same manner. The "O" ring may be removed with a piece of wire.

When installing new packings make sure the packings are square with the bore then press in place just far enough to replace the snap rings. The inboard and outboard packings face the pump and the center packing faces the front. Slide the "O" ring in place.

The packings in the rear bearing housing are removed and replaced in the same manner. With the bearing and snap rings removed, the rear packing may be pulled out. The center and front packings may be pressed forward without removing the snap ring.

When replacing the packings, the inboard packing faces the pump, the center faces the gear and the end faces the pump.

When the housings are reassembled on the shaft it is necessary to use a tapered bushing on the shaft to avoid tearing the packings.

9. REMOVAL OF PUMP DRIVE AND CLUTCH

To remove the pump drive shaft it is first necessary to remove the chassis drive shaft both forward and aft of the pump transmission case. The aft section disassembles by removing the four screws in the companion flange at the transmission case. The shaft will then telescope and can be lowered out of position. The front shaft must be uncoupled in the same manner at both the pump and chassis transmissions, and may be lowered out of position. Remove the cotter pin and nut from each end of the transmission drive shaft and remove the companion flanges. The drive shaft and clutch are now ready for disassembly. Remove drain-plug and drain oil from case. Remove screws attaching bottom cover and remove the cover and gasket. Remove screws holding the front packing housing and slide housing off shaft. Remove the front bearing locknut.

Remove screws attaching the rear bearing housing and slide out the housing, bearings and shaft as a complete assembly. To remove the clutch shift yoke, first remove the plug, spring and poppet in shift rod housing. See Fig. 4. Loosen the screw in the shift yoke, and slide the shift rod forward, out of the housing. The shift yoke

is now free to be removed. Slide the clutch off the shaft. Draw front shaft out of gear, and lower gear out of case. The front bearing may be pressed out of case for inspection.

The rear shaft and bearing may be disassembled by removing the internal snap ring at the front bearing. This requires a special ring plier. With the ring removed the shaft and bearings are free to slide out of the housing.

The idler gear rear bearing and cap may be disassembled by removing the screws and pulling out the cap and bearing assembly. The front bearing is removed in the same manner, but it is first necessary to remove the transmission case from the lower pump housing and may be accomplished by loosening the remaining screws at the top of the case, and removing case from lower pump housing. If the gear and shaft are to be removed which is a remote possibility, the shaft must be pressed from the gear and the gear removed thru the bottom of the case.

When reassembling bearing caps, use new gaskets, makes certain the oil holes are at the top and are open and free of sludge.

When reassembling the drive shaft and clutch, care must be taken that the necked diameter of the front bearing spacer is toward the bearing, also the oil slinger portion of the clutch is toward the gear. Use new gaskets throughout.

10. CHANGE-OVER VALVE

In the event foreign matter is brought in thru the suction strainer, a cover is provided on top of the change-over valve for cleaning. Remove the (4) screws attaching the cover and with a wire hook remove any foreign matter which may collect.

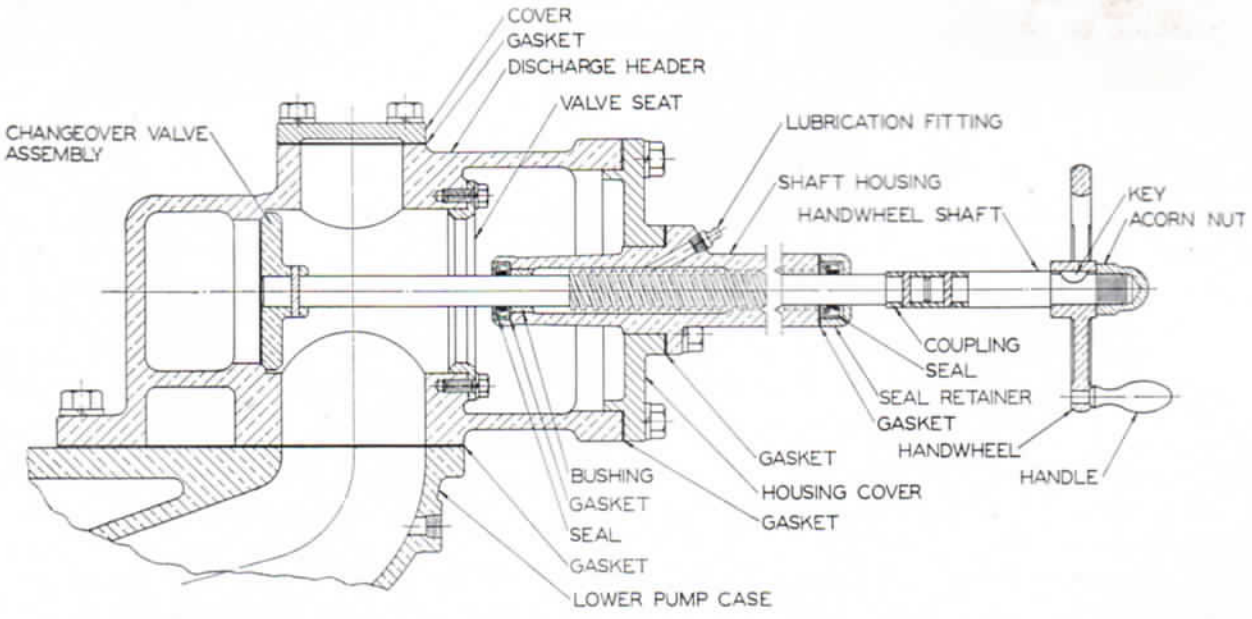


FIG. 10
SECTION THRU CHANGE-OVER VALVE

11. INSPECTION OF CHANGE-OVER VALVE

Disconnect coupling on change-over valve shaft. See Fig. 10. Remove screws attaching change-over valve shaft housing to the pump header. Rotate housing anti-clockwise until sufficiet room is available to remove the screws attaching the change-over valve seat to the pump header. With these screws removed, the entire assembly is free to slide out.

At each end of the shaft housing is a packing seal. The inside seal protects the shaft against water leaks and the outside seal acts as a grease retainer.

To remove the outside seal, release the screws attaching seal housing to shaft housing and slide the assembly off shaft. If the seal shows wear it may be pressed from housing and a new seal installed. The inside seal may be replaced by removing valve from shaft then unscrewing shaft from housing and removing old seal and pressing new seal in place. Upon assembly use new gaskets throughout. Apply grease gun to fitting on shaft housing and fill reservoir.

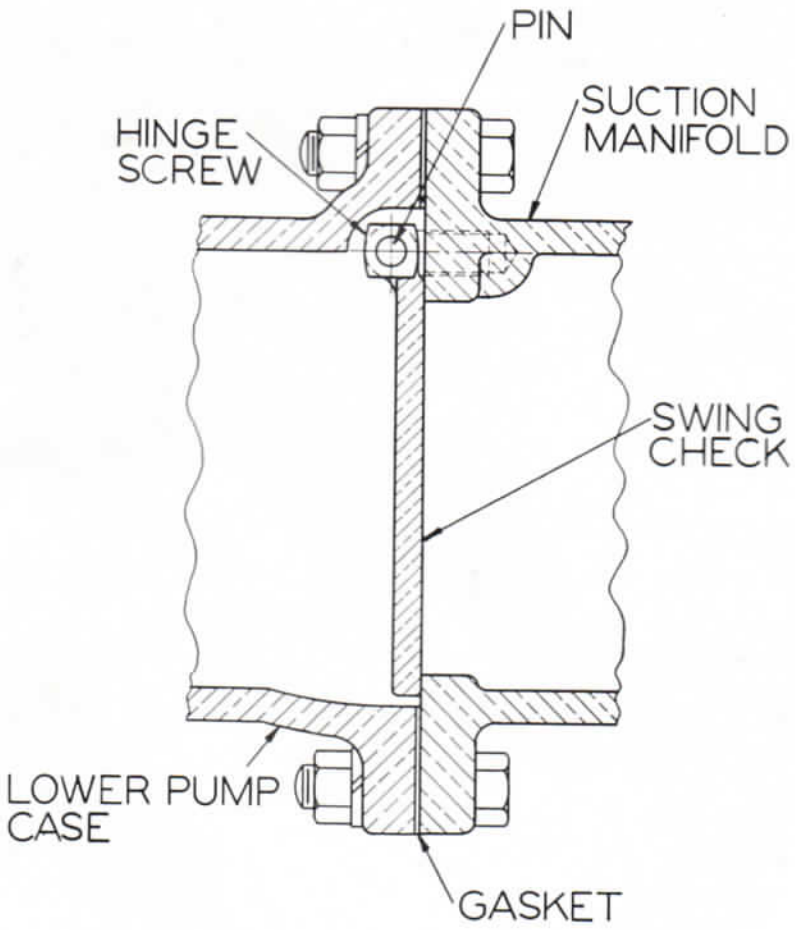


FIG. 11
SWING CHECK

12. SWING CHECK

To remove the swing check it is first necessary to remove bolts attaching the suction extension. Remove bolts attaching suction header to pump lower half. The swing check is located on the inside flange of the suction header. See Fig. 11. To remove the swing check it is only necessary to pull out the hinge pin. No locking is necessary as it is inserted in a pocket in the pump body which restricts the end movement of the pin.

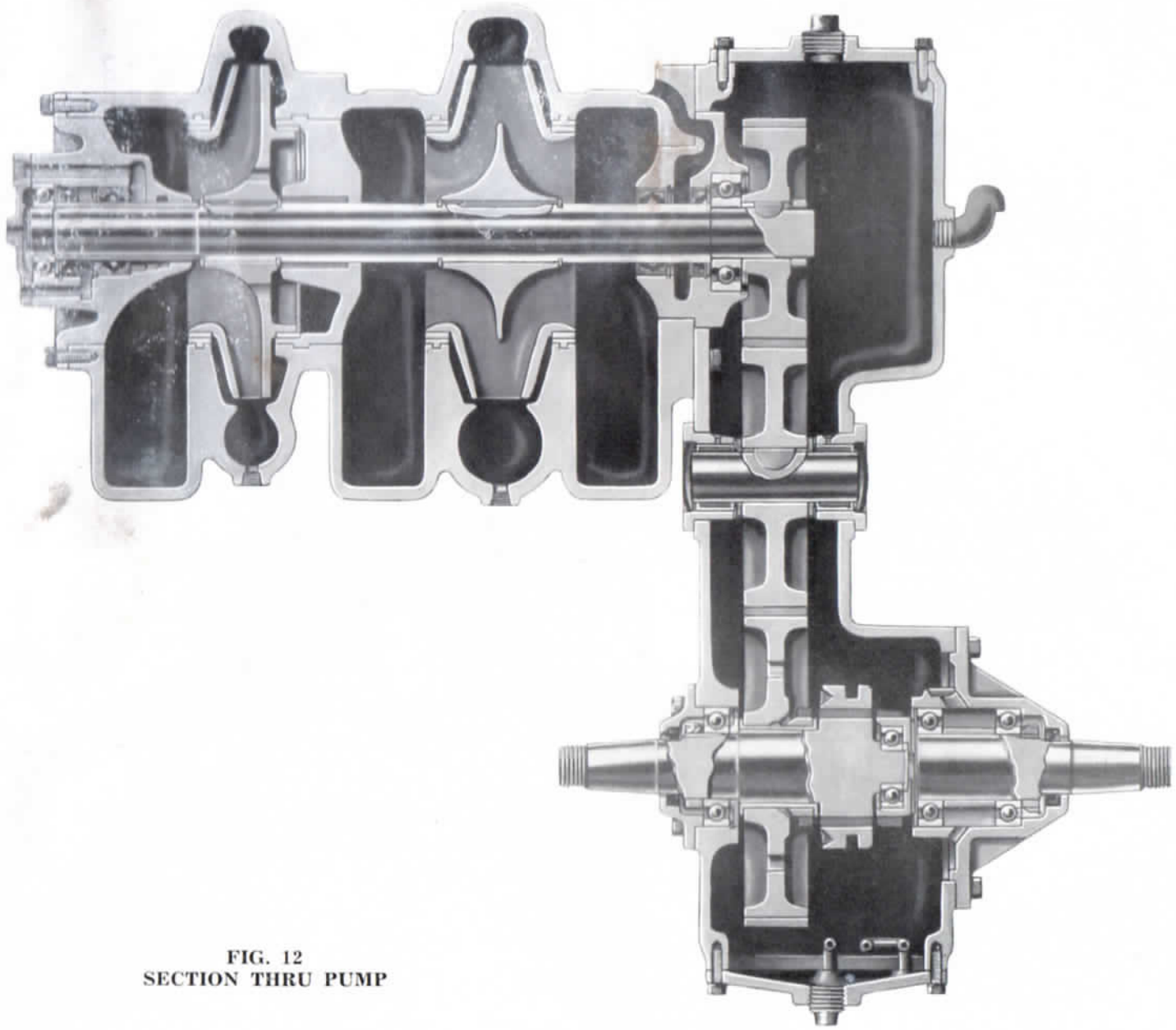


FIG. 12
SECTION THRU PUMP

TROUBLE DIAGNOSIS IN PUMP OPERATION

(Supplementary to Sections on Pump Operation in Operator's Manual)

I OPERATING FROM DRAFT

If the pump fails to prime the following items should be checked in the order listed to correct the condition:

1. Be sure pump is in gear. Check both the road transmission and pump transmission making sure both are in the proper gear.

2. Check bleeder valves and drain valves to be sure they are closed. Air can enter the pump through these and prevent priming.

3. Make sure suction line gaskets are in place and are in good condition. Also be sure all couplings are tight. Air entering the system at these points will prevent priming.

4. Be sure suction intake strainer is completely submerged and free from foreign material.

5. Check the internal strainer between the pump and the suction hose to be sure it is not plugged causing a restriction to flow.

6. Check the primer. (A) Look at the right hand tail pipe when the priming lever on the bottom of the pump panel is pulled out to be sure the exhaust gas is being diverted through the ejector. Little or no exhaust gas should leave the tail pipe with the lever out. If the butterfly valve in the exhaust pipe is not closed, inspect the operating shaft and rod linkage to determine and correct the cause of the trouble. (B) Check linkage to be sure the draft hydrant valve (J) Fig. 7 is open when priming lever is pulled out. If this valve is not open, readjust linkage to cause the valve to open when the lever is pulled out.

7. Be sure the gage shut-off valve is open and that the gage is functioning properly.

II OPERATING FROM HYDRANT

If insufficient water is delivered when pumping from a hydrant, the following items should be checked in the order listed to correct the condition:

1. Be sure the pump is shifted into gear and that the road transmission is in direct.

2. The hydrant must be completely open.

3. All drain valves must be closed.

4. Bleeder valves must be closed or water will leak on the ground.

5. Suction gaskets must be tight or leaks will result.

II OPERATING FROM DRAFT (Cont'd from page 1)

6. Check the governor.

(a) Pull out the governor control and set for the pressure desired.

(b) The governor butterfly shaft in the intake riser should have the slot in the vertical position when the governor is not in operation.

7. Check the strainer in the pump suction extension making sure that it is clean and not restricting flow.

8. Be sure the proper discharge gates are opened when ready to pump.

9. Be sure the gage shut-off valve is open and that the gage is functioning properly.

III OPERATING AS A BOOSTER

If insufficient water is delivered or the pressure gage does not register when operating as a booster, check the following items in the order listed:

1. Be sure the pump is in gear. Check both the road transmission and the pump transmission making sure they are in the proper gear.

2. Make sure the tank valve in the line from the booster tank to the pump is completely open. (Also valve in line from pump to reel.)

3. Check the bleeder and drain valves making sure they are closed. Air can be drawn into the pump through the drain valves preventing proper flow.

4. Make sure the pump is properly primed. Close the booster line valve and reprime as described in "F" above.

5. Check the governor.

(a) Pull out the governor handle and lock in the "OUT" position.

(b) Look at the governor butterfly shaft (in intake manifold) making sure that slot is in the vertical position. Pulling the governor rod toward the rear of the vehicle will open the governor if the slot is not vertical.

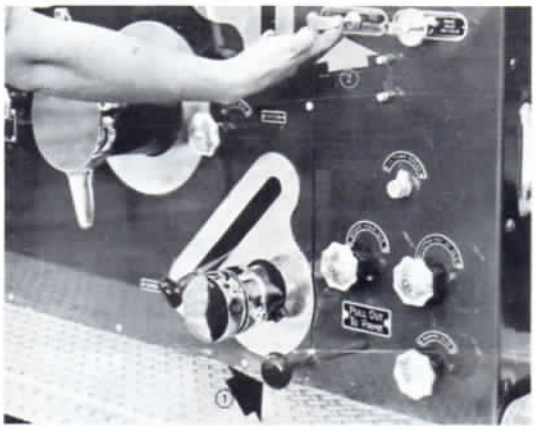
6. Check the booster line to be sure no obstructions exist in the line.

7. Be sure the gage shut-off valve is open and that the gage is functioning properly.

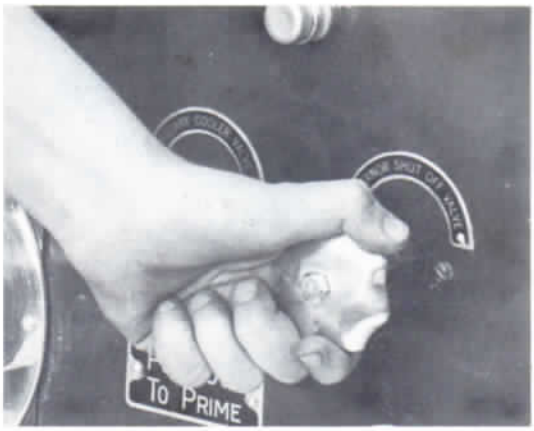
FLOOR TEST PROCEDURE (ONCE ...

1 Put change over valve (1) in capacity position by turning clockwise to full extent of its travel.

2 Pull out water tank valve control handle.



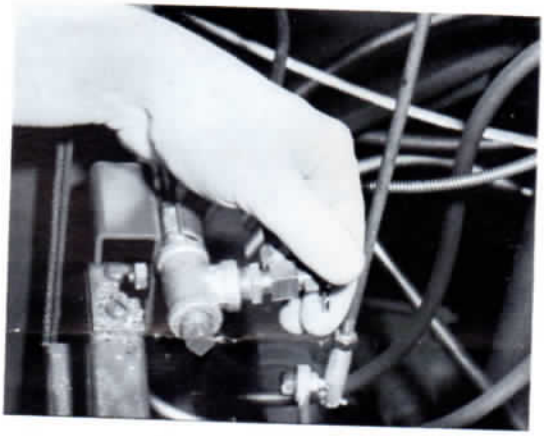
3 Start engine, place pump in gear, and prime by pulling out priming levers 1 and 2 on the pump panel.



4 Open governor shut-off valve.

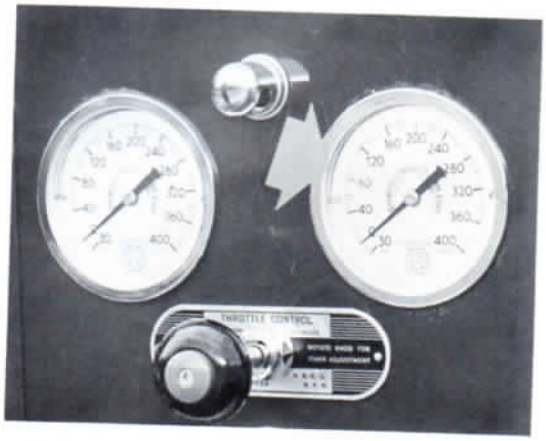
Make sure tha[illegible] and the [illegible] dre[illegible]

6 With engine idling engage pump governor by unlocking and pushing in [illegible] control.



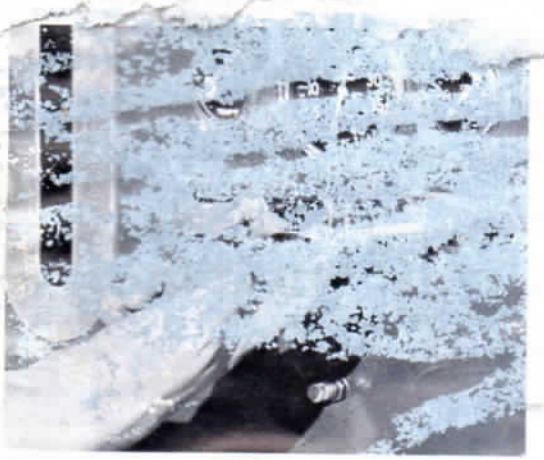
7 Be sure pressure gauge throttle cock is open.

8 Watch pressure gauge and gradually open throttle. If pressure exceeds 100-110 PSI governor is not functioning. Close throttle and service governor as outlined below. If when the throttle is opened slowly the governor limits the maximum pressure to 80 to 100 PSI and the throttle can be fully opened, the governor is functioning properly.



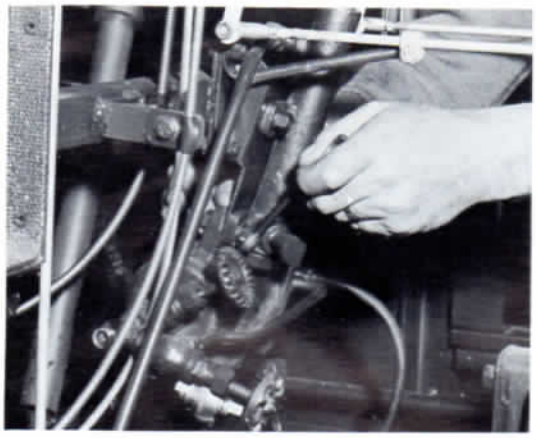
"L" ENGINE PUMP GOVERNOR

(SEE WEEKLY)

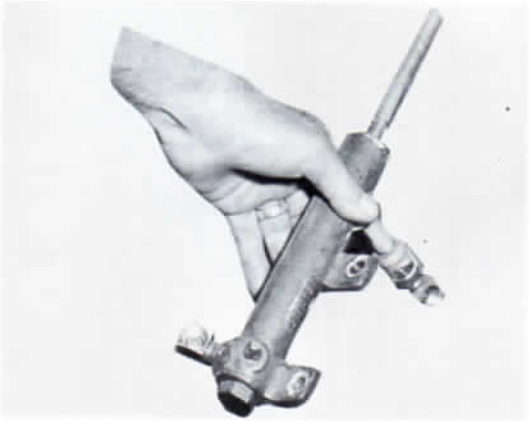


9 Disengage governor by pulling out governor control and locking.

10 Disconnect copper tubing fittings at top and bottom of governor body.



11 Remove the four (4) governor mounting bolts.

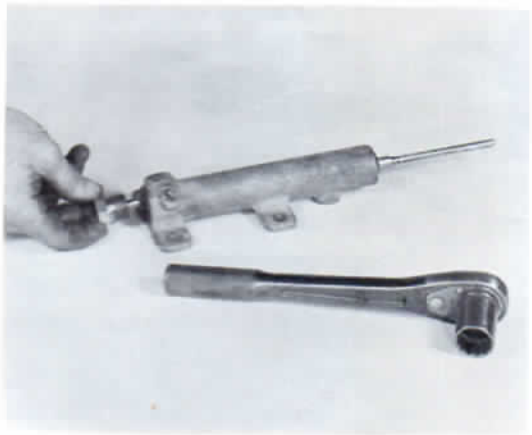


12 Lift governor assembly from truck.

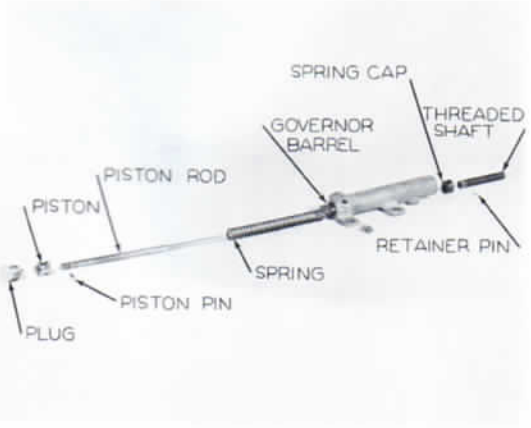
13 Drive out threaded shaft retainer pin using [illegible].

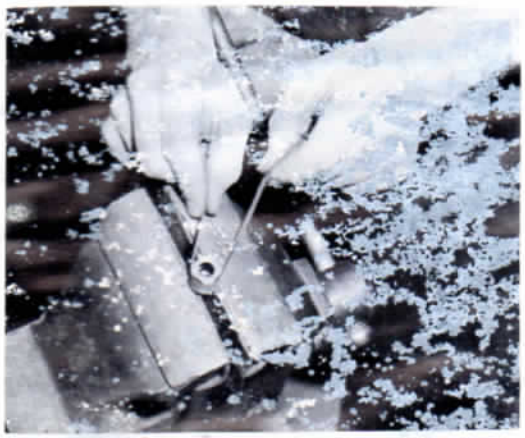
14 Pull threaded shaft off piston rod.

15 Remove threaded plug from end of governor body.



16 Pull out piston, piston rod, and governor spring assembly being careful not to lose piston rod retaining pin. Remove spring. Push out piston pin. Remove piston from rod.

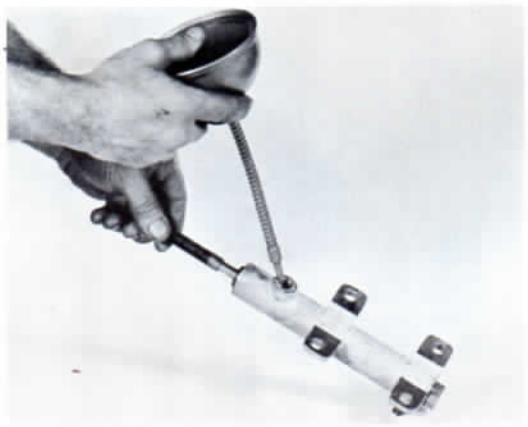




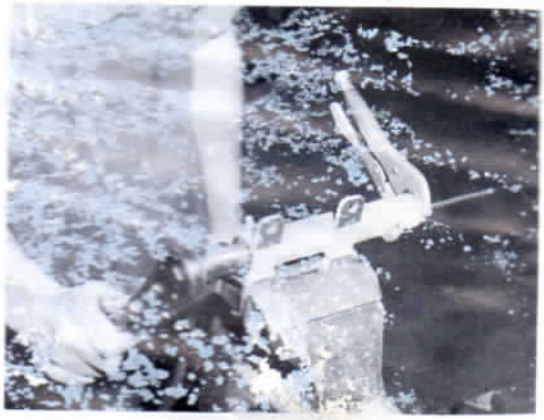
17 Clean and polish piston with crocus cloth. Clean piston ring and ring groove thoroughly.

18 Wrap some crocus cloth about a small wooden stick and clean inside of governor barrel.

19 Clean dirt and rust deposits from spring and piston rod with a wire brush.



20 Assemble governor in the reverse order of disassembly. Be sure to lubricate liberally all parts within the governor body with SAE #10 motor oil.

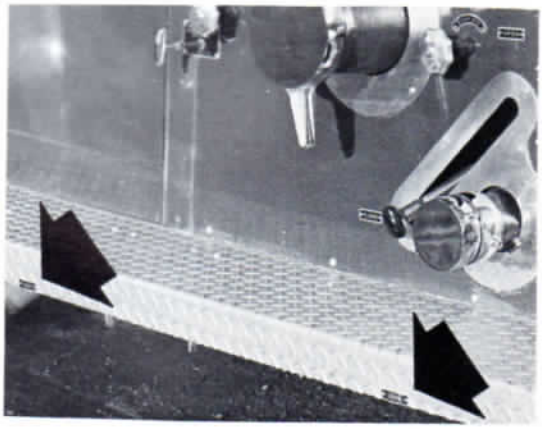


21 When installing the threaded plug at the outlet of the governor body place the governor body in a vise and pull the piston rod against the spring, compressing the spring, to permit starting of the plug threads.

22 When installing governor on apparatus, make certain no binding exists between either side of threaded shaft and governor adjusting lever.

23 Recheck operation of governor as described in operations 1 through 5.

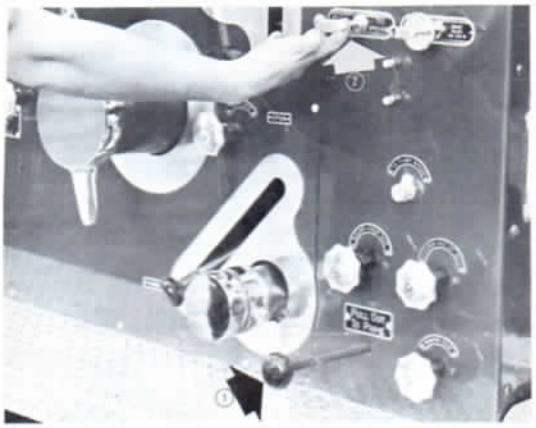
GOVERNOR FILTER REVERSE FLUSHING



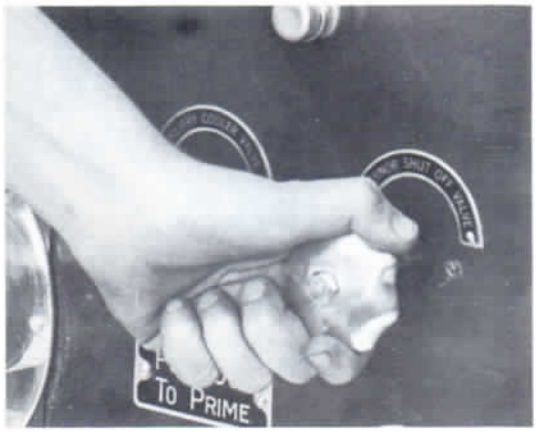
24 It is important that only clean water be used during flushing operation, therefore pump drains should be open to make sure any dirty water is drained from the pump.

25 Close pump drains.

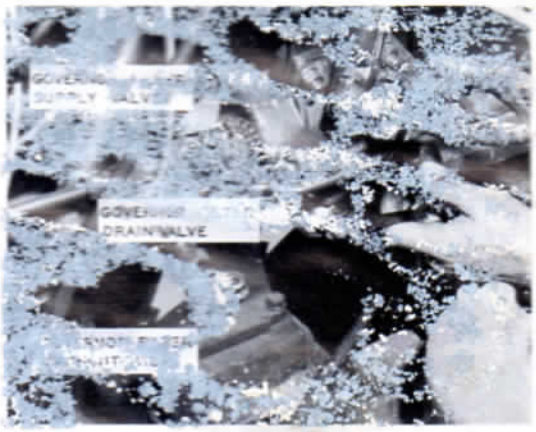
26 Pull out water tank valve control handle.



27 Start engine, place pump in gear, and prime by pulling out priming levers 1 and 2 on the pump panel.

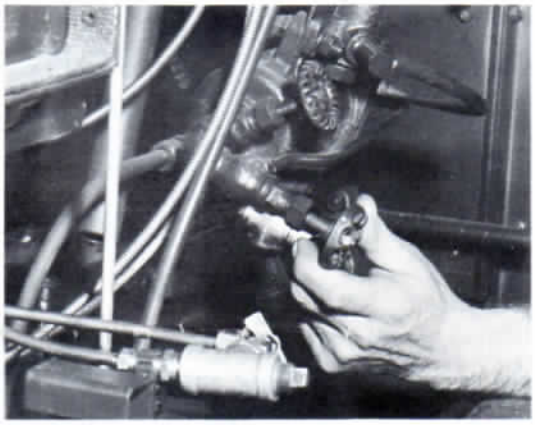


28 Open governor shut-off valve.

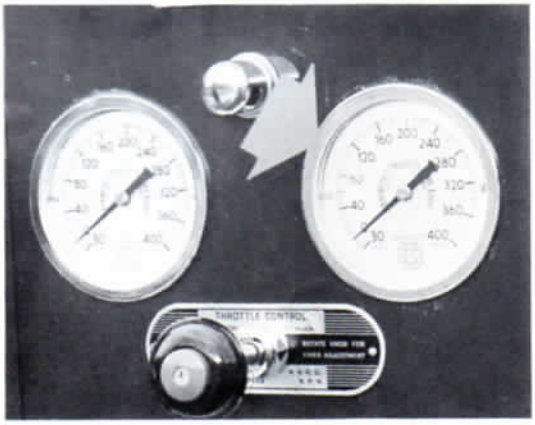


29 Open governor filter drain valve.

30 Close governor filter shut-off valve.



31 Open governor filter wash-out valve.

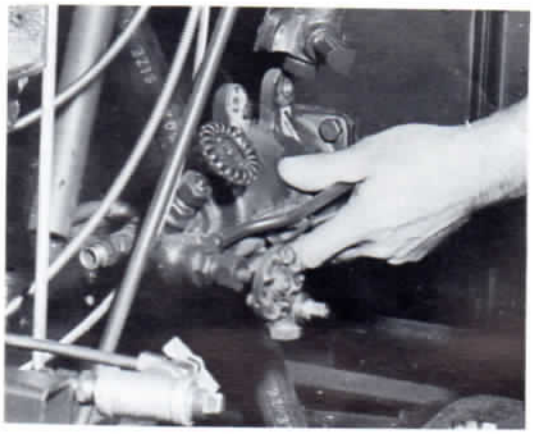


32 Raise pump pressure to approximately 70 to 100 PSI for 2 to 3 minutes. Close throttle, wash-out, and drain valves.

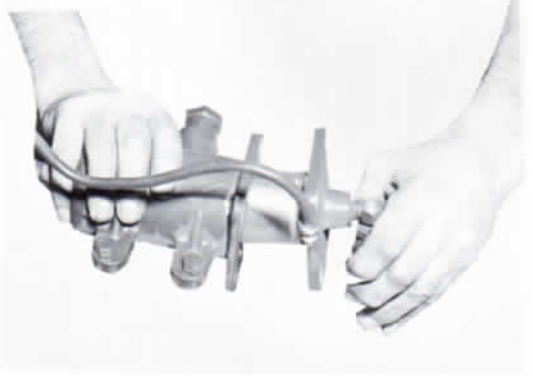
GOVERNOR FILTER DISASSEMBLY.
(Disassemble only when cleaning flushing tool is not available)

33 Disconnect the [illegible] bolts of the filter [illegible].

34 Remove the two (2) filter mounting bolts.



35 Remove filter assembly as a unit.



36 Disconnect by pass tube fitting and remove filter element.

37 Thoroughly wash out filter element and case with cleaning solvent, and dry thoroughly with compressed air. Assemble filter in reverse order of disassembly.

150″ WHEELBASE CHASSIS

INDEX

CLUTCH

1. OPERATION

Smooth and positive engagement of the clutch is obtained by operating the clutch pedal slowly. An abrupt release of the pedal is a mark of poor driving and imposes the greatest strain on the driving parts.

Some drivers have the habit of starting the apparatus in second or third gear, slipping the clutch until speed picks up. This practice causes very rapid wear of the clutch facings and the heat generated in this manner may damage the discs. Use the proper gears in starting and when driving; they are supplied for that purpose.

2. LUBRICATION

The clutch does not require lubrication except for the throwout bearing. A pressure lubrication fitting is provided in the lower clutch housing hand hole cover. The throw-out bearing should be lubricated at intervals of three months for average service. See Lubrication Diagram Fig. 16.

The pilot bearing in the flywheel is packed with grease when assembled, and will require no further attention until the clutch is disassembled for facing renewal, then the bearing should be repacked with a medium grease.

3. ADJUSTMENT

Never wait until the clutch slips before adjusting it. It is then too late to make adjustment. Facings soon disintegrate once they have become burned thru slippage, and are short lived thereafter.

As the facing wears, the clutch sleeve moves toward the release bearing, reducing the clearance between the bearing and the sleeve (clutch in engaged position). This reduced clearance results in a reduction of the pedal "lash," (first easy movement of the pedal). When the lash is reduced to ½ inch the clutch should be adjusted. Do not adjust pedal linkage, adjust the clutch to obtain the "A" dimension in Fig. 7, between the back of the clutch sleeve and adjusting plate.

To adjust, block the pedal in the "released" position see Fig. 1. This is necessary otherwise the adjusting straps and studs may become bent or the threads stripped.

Back off each of the six adjusting strap nuts five full turns. See Fig. 2.

Engage the clutch by removing the block shown in Fig. 1. This permits the adjusting plate to move out of contact with the adjusting shims. See Fig. 3.

Removing one shim from under each adjusting strap (see Fig. 3) will reduce the "A" dimension Fig. 6, approximately 1/16 inch. Remove a sufficient number of shims from each strap to obtain the desired "A" dimension given in Fig. 7. Shims are removed by using sharp nosed pliers or inserting cotter pin puller in small hole. Be sure no portion of shim is torn off and remains under flange of adjusting plate; also that the same number of shims are removed from each strap. Check to be sure equal number of shims remain under each strap.

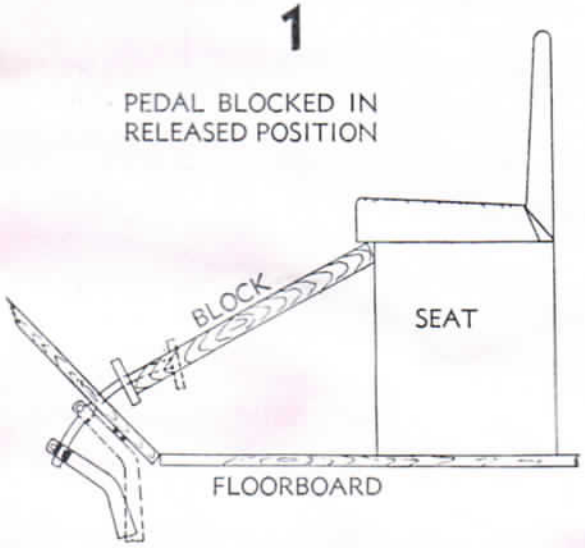
Release the clutch as illustrated in Fig. 1, then tighten all adjusting strap nuts. See Fig. 5.

Measure the distance from machined surface which supports the shims to face of clutch sleeve, against which the throwout bearing acts. This can best be done by means of straight edge and scale, holding the straight edge in place by pushing the release bearing into contact with the straight edge. See Fig. 6.

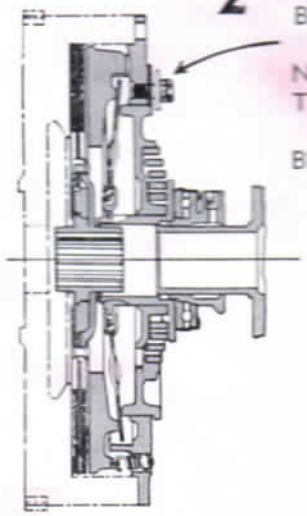
When the dimension "A," illustrated in Fig. 6, is correct, check the dimension from the release bearing to the clutch sleeve. See Fig. 7. This should be not less than ⅛ inch or more than 5/32 inch. It may be necessary to adjust the pedal linkage to obtain this proper clearance, because of wear or improper initial adjustment, otherwise, do not adjust the pedal linkage.

1

PEDAL BLOCKED IN RELEASED POSITION

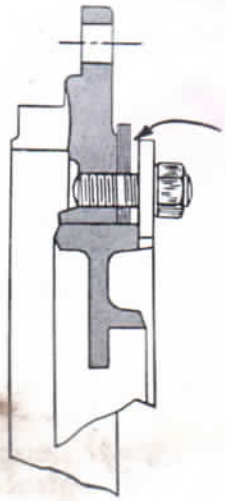


2



BACK OFF ALL ADJUSTING NUTS **5** FULL TURNS WHILE CLUTCH IS BEING HELD IN RELEASED POSITION

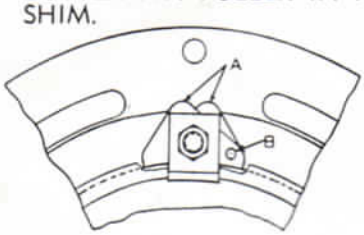
3



REMOVE BLOCK SHOWN IN ILLUSTRATION NO. 1. ADJUSTING PLATE BACKS AWAY FROM SHIMS.

4

TO REMOVE SHIM, APPLY SHARP NOSED PLIERS TO LIP OF SHIM "A", OR INSERT COTTER PIN PULLER IN HOLE "B" OF SHIM.

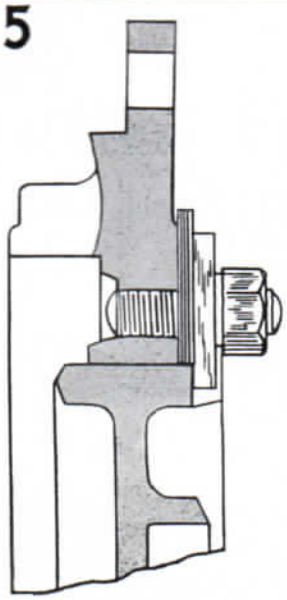


SHIM

SPLIT FOR EASY REMOVAL

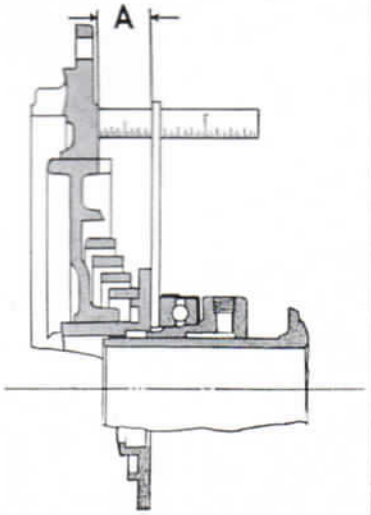
5

BLOCK PEDAL IN RELEASE POSITION SAME AS IN ILLUSTRATION NO. 1. THIS MOVES ADJUSTING PLATE INTO CONTACT WITH SHIMS. TIGHTEN EACH ADJUSTING STRAP NUT FIRMLY.



6

SEE CHART FOR ADJUSTMENTS. HOLD STRAIGHT EDGE FIRMLY BETWEEN CLUTCH SLEEVE AND RELEASE BEARING, SO IT WILL NOT DROP INTO TRANSMISSION CASE, WHEN TAKING MEASUREMENT. CLUTCH ENGAGED FOR THIS OPERATION.



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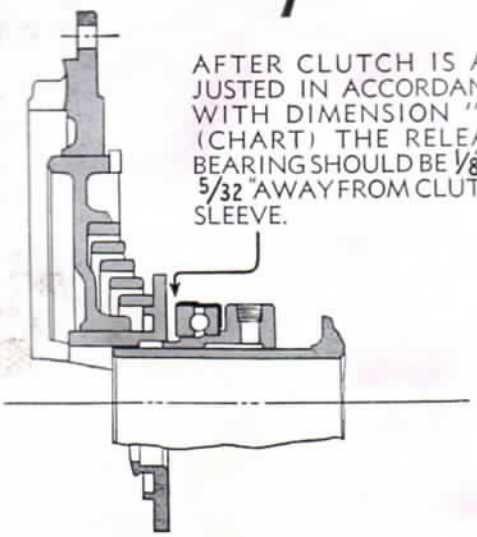


AFTER CLUTCH IS ADJUSTED IN ACCORDANCE WITH DIMENSION "A" (CHART) THE RELEASE BEARING SHOULD BE 1/8" TO 5/32" AWAY FROM CLUTCH SLEEVE.

SIZE	A	NO. SHIMS
14"	1¼	6
15"	1⅛	7

4. INSTALLING NEW CLUTCH DRIVEN DISC

Before installing a new driven disc assembly, the adjusting straps should be removed and shims placed under each strap (see Fig. 7 for quantity) otherwise the clutch will not release properly after the new disc is installed.

It is advisable to use the original equipment for those clutches since replacement discs may not possess the proper materials and their use often results in too low a coefficient of friction and thermal capacity. It is further advised to replace the entire driven disc assembly, since refaced plates are often bent and results in poor clutch action.

The use of a spare splined shaft for centering the driven disc while bolting clutch in place is advised. This procedure facilitates assembling the transmission in place.

The pressure plate end of each driven disc hub has chamfered splines to assist the insertion of the transmission drive shaft.

If the clutch does not release properly when assembled with a new driven disc, check clutch adjustment and release bearing clearance in accordance with instructions given with Fig. 6 and 7 and make necessary corrections. Bent driven discs, tight fitting or damaged pilot bearing and tight splines also cause "Drag" (incomplete releasing).

5. ASSEMBLING CLUTCH TO ENGINE

Make sure release bearing and flywheel or pilot bearing are in usable condition. Pilot bearing should be only finger press fit in flywheel and on transmission drive shaft.

Try cover plate assembly in flywheel before inserting driven disc so as to make sure it is a free fit in the flywheel.

Use spare spline to align disc.

Friction face of flywheel should be smooth and clean.

When bolting clutch assembly to flywheel, screw in each bolt until it contacts cover plate assembly. Then gradually tighten opposite bolts until assembly is drawn tight to flywheel.

6. TRANSMISSION

The transmission is the sliding gear type, five speeds forward and one reverse. Direct drive is in fourth speed and fifth speed being an over-drive. The heavy duty design and construction requires no adjustment. Fig. 8 shows a cross section of the transmission.

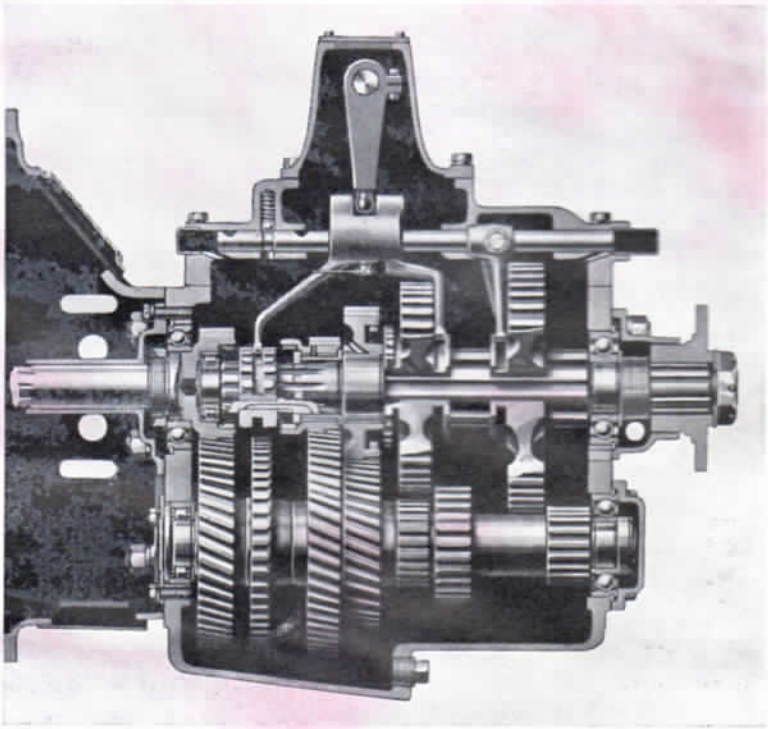


FIG. 8
TRANSMISSION

7. LUBRICATION

All shafts and bearings are lubricated by the oil in the transmission case and regular inspection should be made to keep the oil at the proper level. See lubrication diagram Fig. 16.

The oil capacity is 12 quarts.

8. DISASSEMBLY

If it becomes necessary to replace any of the parts in the transmission, it may be disassembled in the following manner: See Fig. 8.

A. Disconnect the universal joint.

B. Disconnect the brake rod from the emergency hand brake lever, also the speedometer cable from the transmission case.

C. Disconnect the remote control shift rod mechanism.

D. Remove the cap screws from the top cover, lift off the cover containing the shift bars and remote control shift mechanism.

E. To remove the main shaft and gears, loosen the nut and slide off the universal joint flange.

F. Remove screws from main shaft rear bearings.

G. Slide the main shaft to the rear, remove the ball bearing when it is free of the case and the sliding clutch and gears as they become free of the shaft.

H. To remove the lower shaft, loosen screws and remove lower rear bearing cover.

I. Remove the lower rear bearing from shaft by releasing the cap screw and washer.

J. Slide the shaft to the rear and by lifting up on the front end of the shaft the complete assembly can be lifted out thru the top.

K. Reassembly of the transmission is in reverse order.

9. STEERING GEAR

The steering gear is the twin lever roller mounted type with a very high efficiency for easy steering. Fig. 9 shows the general construction and the points of adjustment.

10. ADJUSTING STEERING GEAR

When making adjustments, free the steering gear of all load, preferably by disconnecting the drag link from the steering arm, and loosen instrument board bracket clamp on steering gear jacket tube.

If the ball bearings on the cam must be adjusted, make the adjustment "A" before making the side adjustment "B."

A. ADJUSTMENT OF BALL THRUST BEARING ON CAM

Adjust to a bare perceptible drag but allow the steering wheel to turn freely (with the thumb and fore-finger lightly griping the rim.)

Before making this adjustment loosen the housing side cover adjusting screw 9 and 10 to free the studs in the cam groove.

To adjust, loosen the nuts 3 and move up the housing upper cover 4 to permit removal of shims 5. Shims are of .002, .003 and .010 thickness.

Clip and remove a thin shim or more as required. Tighten all four nuts. Test adjustment and if necessary remove or replace shims until adjustment is correct.

B. ADJUSTMENT FOR MINIMUM BACK LASH OF TAPERED STUDS IN CAM GROOVE

Adjust so that a very slight drag is felt thru the mid-position when turning the steering wheel slowly from one extreme position to the other.

Backlash of the studs in the grooves shows up as backlash at steering wheel and at ball on steering arm.

The groove is purposely cut shallower, therefore narrower, in the mid-position range of travel of each stud to provide close adjustment where usually the straight-ahead driving action takes place. It also makes this close adjustment possible after normal wear occurs without causing a bind elsewhere. Therefore adjust thru the mid-position. Do not adjust in positions off mid-position as backlash at these points is normal and not objectionable.

To adjust, tighten side cover adjusting screw 10 until adjustment is correct and tighten the locknut 9 to hold it. Then give the gear a final test.

Secure the gear at all points loosened prior to making the adjustment. Also check tightness of mounting bracket bolts and nuts, and of steering arm on lever shaft and nut and lock washer 7. With all supporting brackets clamped tight, turn steering wheel to see if any stiffness exists. If so, the column is probably out of alignment and needs correcting.

C. COLUMN ALIGNMENT

Alignment of the column is of paramount importance. The steering column must not spring in any direction from its free position. To determine whether misalignment exists, release upper column brackets and note whether the column moves to a different position, its free position. If it does, it has been out of line and should be reclamped in the new position.

D. ADJUSTING STUD ROLLER BEARING UNITS

The forgoing adjustment will suffice in nearly every instance, but in some cases it may be necessary to adjust the stud roller bearing units in the lever shaft.

The roller bearings should be preloaded at all times. Adjust to a heavy drag. Used units should be set lighter than new replacements but never under the low limits given below. Factory adjustments on new units are within the following limits:

UNIT	TORQUE IN INCH LBS. TO REVOLVE STUD
in 1⅜ and 1½ Dia. Shaft	3 to 4
in 1⅝ Diameter Shaft	4 to 8
in 1¾ Diameter Shaft	5 to 11

A. Wash bearings in kerosene and lubricate with light oil.

B. Straighten out prong of lock washer. Read Step "E" and if necessary replace washer now.

C. Tighten nut as required (while holding stud from turning by using spanner wrench on washer, or by clamping but do not nick or burr stud surface.)

D. Turn stud back and forth and test adjustments.

E. Lock adjustment by bending a prong of the washer against the side of the nut. Do not use a washer twice unless prong used before has been removed.

F. Lubricate with lubricant used in gear.

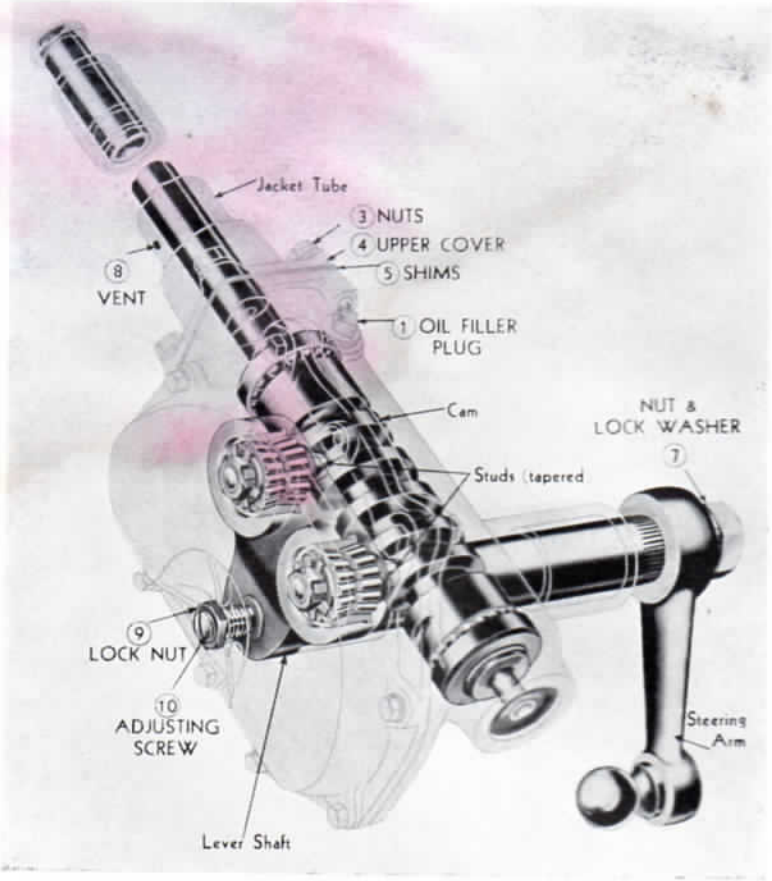


FIG. 9
STEERING GEAR

11. LUBRICATION

Lubricate thru the pipe plug hole or fitting in top of the housing. Fill housing slowly until lubricant begins to run out of vent hole 8 in the jacket tube. Keep housing full by adding lubricant periodically according to usage, every few thousand miles or at least spring and fall. See Lubrication Diagram Fig. 16.

12. STEERING GEAR CONNECTIONS WITH FRONT WHEELS

Normally the steering gear should be in approximately its mid-position when the front wheels are straight ahead. To check, (the drag link must be disconnected from the steering gear arm) turn the steering gear to the right as far as possible, then rotate the wheel to the left as far as possible and note the total number of turns. Turn wheel back one-half of the total movement thus placing the gear in mid-position. Place the wheel straight ahead. The ball on the steering gear arm should now line up, or nearly so, with the ball socket of the drag link. If necessary, the steering arm can be shifted on the splines of the lever shaft to change the ball position. Shifting one spline will shift the ball 10°. The drag link can be adjusted in length to take up some variation.

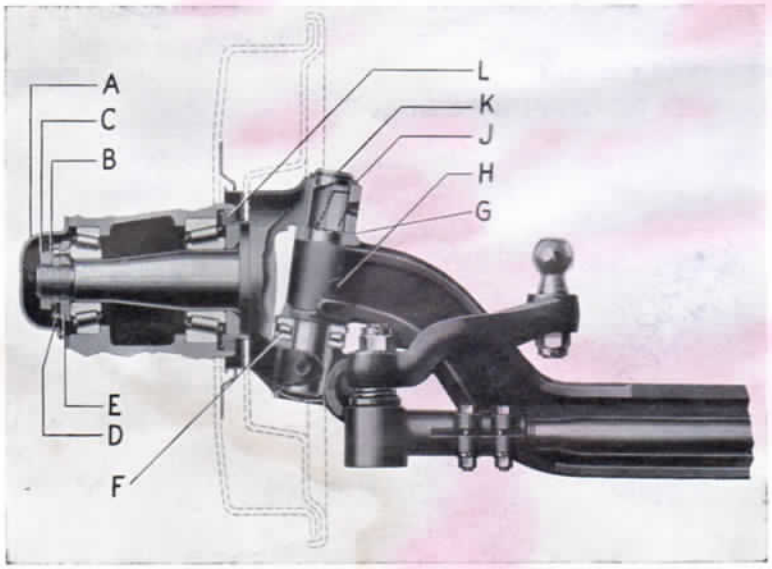


FIG. 10
FRONT AXLE

13. FRONT AXLE

The axle is reverse elliott type. Load thrust is taken on a special roller thrust bearing. Pivot pins are keyed to axle and steering knuckles rotate about ends of same on bronze bushings, which are replaceable. All bearings are provided with lubrication fittings, and oil seals are provided to prevent the escape of oil or the entrance of foreign matter.

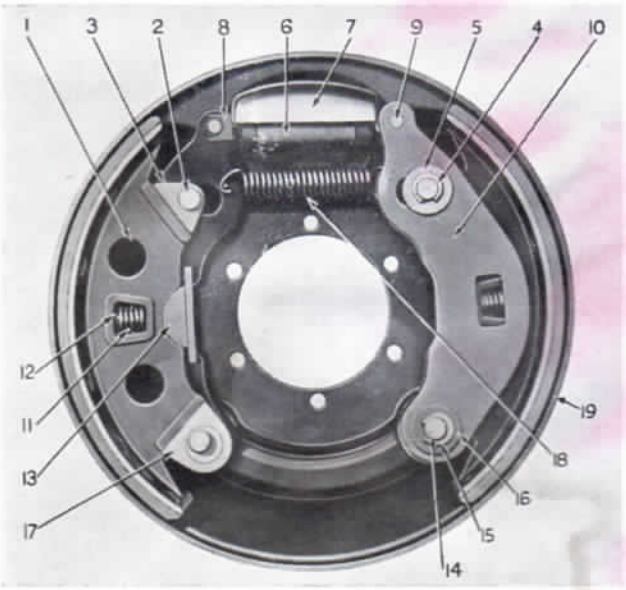
The upper end of the pivot pin is inclined 8° toward the center of the chassis to provide proper road ability. Steering knuckle is set so that wheels are inclined outward at the top 1° and steering tie rod is adjustable so as to have the wheels closer together at the front side than at the rear side.

Backward inclination of pivot pin is caster and tends to cause vehicle to travel in a straight line. Outward inclination of the wheels is called camber and is to compensate for bearing clearances. Front axle caster tends to throw wheels further apart at the forward side than at the rear. To offset this, wheels are adjusted with a slight toe-in.

The tie-rod is of a tubular section and is connected to steering arm by means of ball and socket type joints. The joints are of a self-adjusting type. Two eccentric sockets inclose ball; a loose spring is inserted in holes and held in place when plug is installed. The spring exerts a spreading tendency on sockets, causing them to creep around ball and automatically compensate for wear. This tie rod end needs no attention except regular lubrication.

17. UNIVERSAL JOINT AND PROPELLER SHAFT

The propeller shaft is a tubular section with universal joints at both ends, the axle end being splined. The joints are cross type with hardened and ground pins operating in needle bearings. If properly lubricated monthly, see Lubrication Diagram Fig. 16, these assemblies will require no further attention and will last the life of the apparatus.



1. Brake Shoe and Lining Assembly.
2. Brake Shoe Anchor Pin—Stationary.
3. Brake Shoe Anchor Pin Abutment Block.
4. Brake Shoe Anchor Pin "C" Washer.
5. Brake Shoe Anchor Pin Washer—Plain.
6. Wheel Cylinder Assembly.
7. Wheel Cylinder Cover.
8. Wheel Cylinder Push Rod.
9. Wheel Cylinder Push Rod Pin.
10. Brake Shoe Lever Assembly.
11. Brake Shoe and Lever Spring.
12. Brake Shoe and Lever Spring Retainer.
13. Brake Shoe and Lever Pressure Block.
14. Brake Shoe Anchor Pin-Lower-Adjustable.
15. Brake Shoe Anchor Pin "C" Washer.
16. Brake Shoe Anchor Pin Washer Plain.
17. Brake Shoe Abutment Block Lower.
18. Brake Shoe and Lever Spring Upper.
19. Brake Dust Shield Assembly.

FIG. 11
INSIDE VIEW OF DRUM

18. BRAKE SYSTEM

The brakes are of the two shoe internally expanding type, hydraulically operated on all wheels. They have simple positive adjustment and are fully enclosed to keep out mud and water.

The hydraulic brake system consists of a master cylinder in which the hydraulic pressure is originated: A hydrovac which is operated by the master cylinder: Individual wheel cylinders operated by the hydrovac.

Hydraulic pressure being equal on all surfaces. The brakes are then self equalizing and require no adjustment other than to compensate for lining wear.

The master cylinder is fitted with a piston, and the wheel cylinders are each fitted with two opposing pistons: All of which are provided with two cup packings which act as a seal to maintain pressure and to prevent the escape of brake fluid.

When the brake pedal is depressed, the piston is moved within the master cylinder forcing the fluid to the hydrovac. The hydrovac acts as a booster, multiplying the energy to the wheel cylinders. The brake fluid enters the wheel cylinders between the opposing pistons, causing them to move outward against the brake shoes and consequently the shoes against the brake drum.

19. BLEEDING THE BRAKE LINE

Whenever a part of the system has been disconnected it is necessary to "Bleed" the line in order to remove the air. Be sure the supply tank is full before starting and is at least half full throughout this operation.

Remove the cap screw from the bleeder connection, see Fig. 12, located at the top of the brake drum above the hydraulic line and screw in the bleeder drain connection, which is a brass fitting with a rubber tube attached. Allow tube to hang in a container of clear water. Unscrew bleeder connection $\frac{3}{4}$ of a turn and depress the foot pedal slowly, allowing the return spring to return the pedal to its "Off" position. This gives a pumping action forcing fluid thru the tubing and out the wheel cylinders, carrying with it any air that may be present. Bubbles in the water will indicate the exit of the air. When brake fluid starts to flow from the tube the line is properly bled. Approximately ten strokes of the foot pedal are required to bleed each wheel.

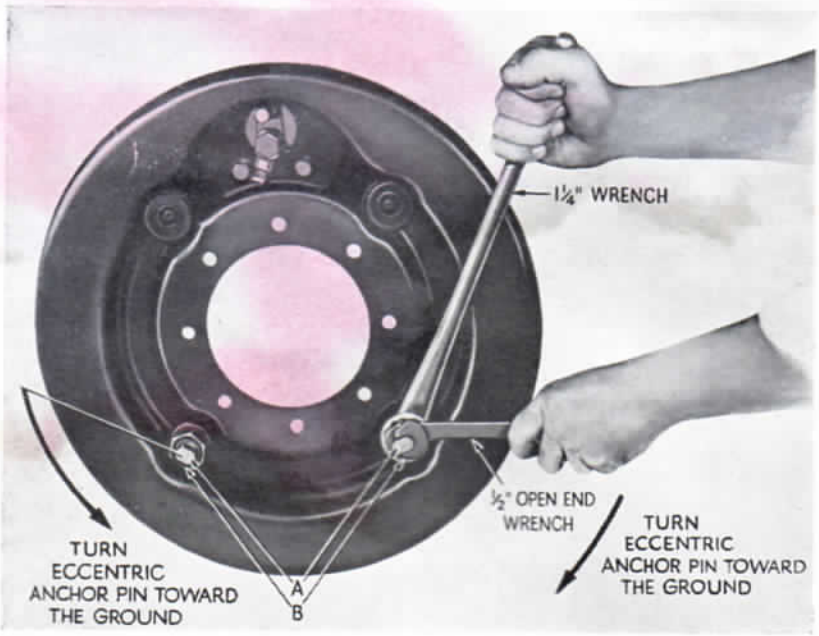


FIG. 12
ADJUSTING BRAKE SHOES

20. CARE AND ADJUSTMENT

The simplicity of design of the hydraulic brake provides easy inexpensive maintenance not complicated by special tools or heel and toe adjustments. As illustrated in Fig. 11, the shoes are fitted with liners of equal length and identical material and are not anchored but "Float" in the lever arms. The single straight bore hydraulic wheel cylinder actuates the lever arms which in turn apply pressure at the center of the shoes by means of the movable pressure blocks. The shoes are self centered at the time of contact with the drums. Shoe rotation is prevented by the self aligning abutment blocks which bear against the angled face of the shoes.

19. BLEEDING THE BRAKE LINE

Whenever a part of the system has been disconnected it is necessary to "Bleed" the line in order to remove the air. Be sure the supply tank is full before starting and is at least half full throughout this operation.

Remove the cap screw from the bleeder connection, see Fig. 12, located at the top of the brake drum above the hydraulic line and screw in the bleeder drain connection, which is a brass fitting with a rubber tube attached. Allow tube to hang in a container of clear water. Unscrew bleeder connection ¾ of a turn and depress the foot pedal slowly, allowing the return spring to return the pedal to its "Off" position. This gives a pumping action forcing fluid thru the tubing and out the wheel cylinders, carrying with it any air that may be present. Bubbles in the water will indicate the exit of the air. When brake fluid starts to flow from the tube the line is properly bled. Approximately ten strokes of the foot pedal are required to bleed each wheel.

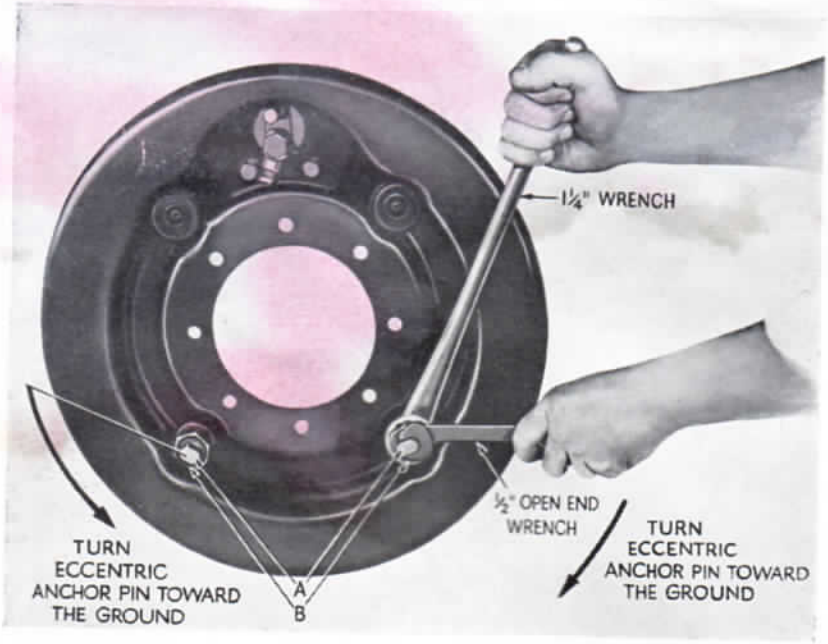


FIG. 12
ADJUSTING BRAKE SHOES

20. CARE AND ADJUSTMENT

The simplicity of design of the hydraulic brake provides easy inexpensive maintenance not complicated by special tools or heel and toe adjustments. As illustrated in Fig. 11, the shoes are fitted with liners of equal length and identical material and are not anchored but "Float" in the lever arms. The single straight bore hydraulic wheel cylinder actuates the lever arms which in turn apply pressure at the center of the shoes by means of the movable pressure blocks. The shoes are self centered at the time of contact with the drums. Shoe rotation is prevented by the self aligning abutment blocks which bear against the angled face of the shoes.

21. SHOE AND DRUM CLEARANCE ADJUSTMENT

Item "A" Fig. 12, is the eccentric anchor pins that control the shoe movement toward or away from the drum. To decrease the lining to drum clearance proceed as follows:

A. Make sure wheel bearing adjustment is correct before attempting brake adjustment.

B. Make sure the adjustment is securely locked.

C. Make sure liners are not worn permitting rivets to contact drums.

D. Raise vehicle so wheels are free to rotate.

E. Loosen nut "B."

F. With a wrench on anchor pin "A," rotate toward the ground until shoe contacts drum, then back off to a minimum running clearance.

G. Lock adjusting nut "B" and rotate wheel in both directions to check for free running clearance.

H. Each brake is equipped with two brake shoes and eccentric adjusting pins, adjust each shoe in the same manner.

This adjustment pertains to the rear brakes. The front brakes are adjusted in like manner except the adjusting cams are at the top of the backing plate.

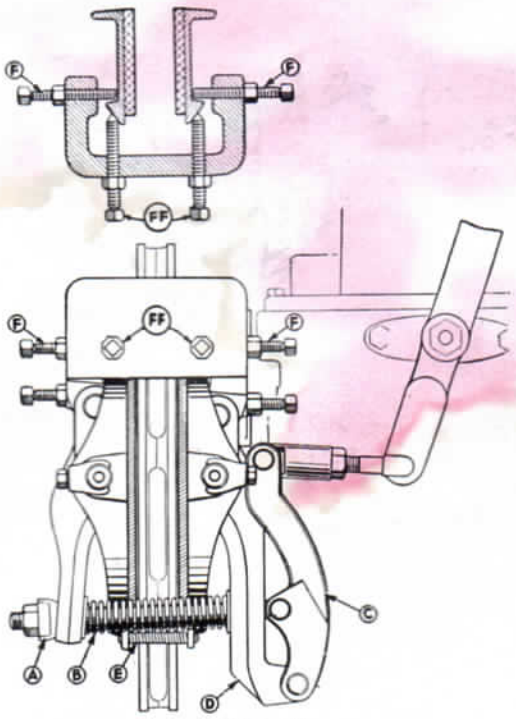


FIG. 13
EMERGENCY BRAKE

22. EMERGENCY BRAKE

The emergency brake is operated independent of the hydraulic brake system. As the operator pulls the hand lever a pair of brake shoes in segment form, located on each side of the brake disc, are forced against the rotating, flat disc mounted on the propeller shaft. The action of the shoes against this disc retard the rotation of the disc between them and bring the vehicle to a smooth stop. The discs are designed so that a flow of air is drawn between the disc plates carrying off the heat developed during a stop.

23. ADJUSTMENT

A. Disconnect pull rod from lever "C" Fig. 13.

B. Tighten nut "A" so that spring "B" exerts enough pressure to bring lever "C" to stop solidly against lever arm "D."

C. Insert 1/32 inch shim between front shoe lining and disc.

D. Tighten nut "A" so rear lining has 1/32 inch clearance with disc.

E. See that tension spring "E" is in place, then adjust screws "F" or "FF" so that linings are parallel with disc.

F. Remove shims.

G. Be sure hand lever is in full released position, then adjust pull rod to proper length and make final connections.

Important: Adjustments should always be made according to the instructions given above.

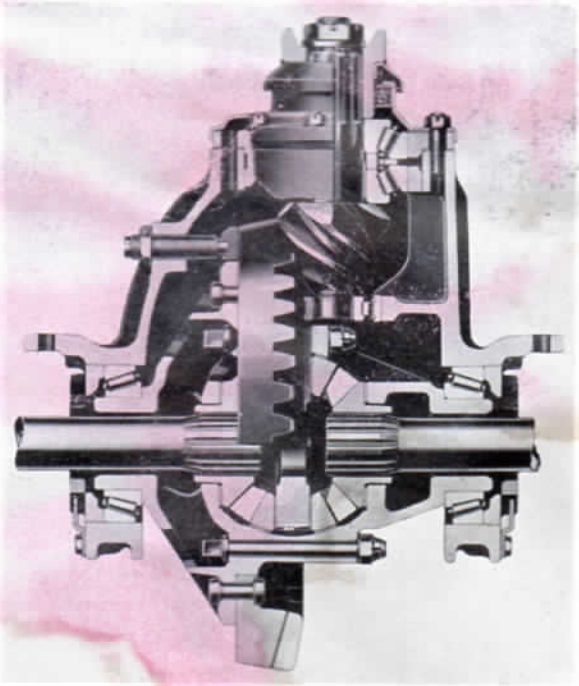


FIG. 14
DIFFERENTIAL HOUSING ASSEMBLY

24. REAR AXLE

The rear axle is a full floating type with bevel drive gears. In the front of the differential housing is a backing screw to support the driving gear when under heavy loads. Normally this screw and gear have a clearance of .005 to .010 inch. The load is carried on roller bearings on the axle tube, relieving the drive shaft, allowing the axle shafts to deliver the driving torque without the additional dead weight of the vehicle.

The drive gear and differential units are mounted in a carrier attached to the forward side of the housing. The carrier unit may be removed by withdrawing the axle shafts and removing four nuts.

The pinion and shaft are intrical, bearings are provided on each side of the pinion. The forward bearings are double and absorb fore and aft thrust as well as radial load. The rear bearing is a straight radial and is pressed on the shaft. The shaft and bearing are carried in a sleeve which also provides a dust shield and oil seal. This assembly being bolted to the front of the housing. The ring gear is riveted to the differential carrier, which is supported by roller bearings. The ring gear may be adjusted laterly by means of adjusting nuts to obtain the desired backlash.

26. ADJUSTING REAR WHEEL BEARINGS

To adjust the rear wheel bearings, remove the drive cap nuts, the cap and shaft may now be pulled out as a unit, exposing the locking nut on the end of the axle tube. The nut may now be removed and the locking ring slipped off, exposing the inner adjusting ring. This ring should be moved in or out until the proper adjustment has been made. Reassemble in the reverse order, make sure the axle shaft driving cap nuts are locked securely in place.

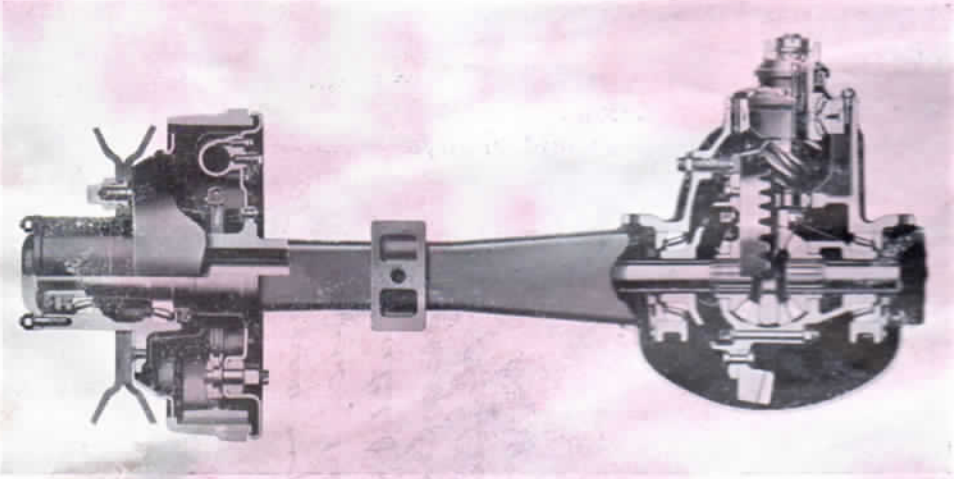


FIG. 15
REAR AXLE

25. ADJUSTMENT

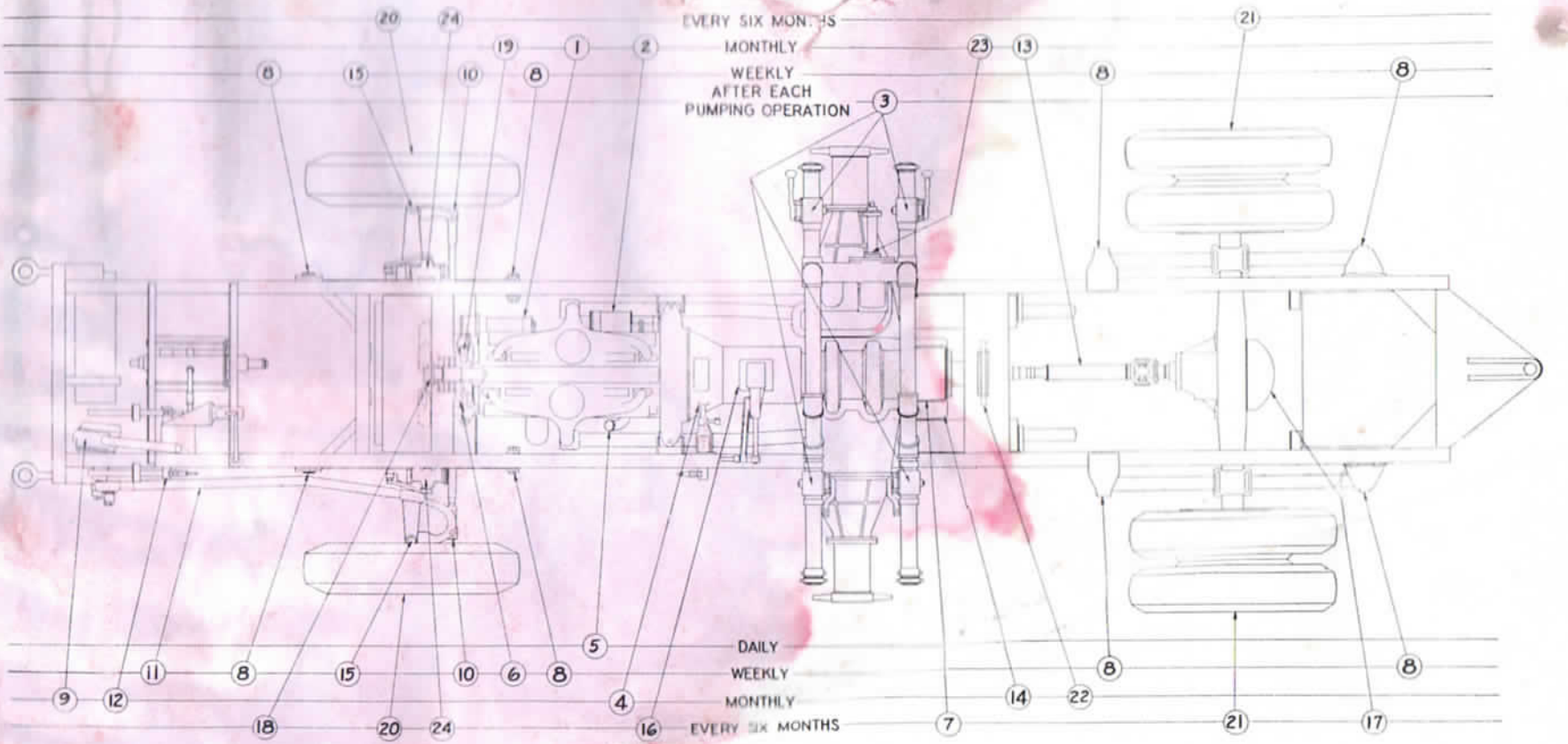
No other phase of axle maintenance is more important than the adjustment of bevel gears and pinions in carrier type driving axles to secure proper tooth contact. Correct tooth contact should be thoroughly understood, for when contact is incorrect, the gear and pinion are noisy and fail after a short period of service. When checking tooth contact no load is to be on the gear set.

Two other points to keep in mind are: First, the factory adjustment of the bevel drive gear and pinion set is as correct as special equipment and years of experience can make it and should not be disturbed unless absolutely necessary. If it is necessary to tear down the driving unit to replace some part other than the gear and pinion, do not disturb the pinion shim adjustment, leave the pinion shim pack "as is" and adjust only the bevel gear when reassembling. In addition, the backlash should be checked so the gear can be returned to its original position when making the final adjustment. Second: the gear and pinion are matched at the factory, never replace one without replacing the set, this is necessary, to have quiet running gears.

If axle is noisy, with engine pulling, the pinion and gear have insufficient backlash. The pinion should move forward by adding more shims to the pack. If the axle is noisy while coasting, the gears have too much backlash and should move to the rear by removing shims from the shim pack. If this does not solve the noise problem, further adjustment in the form of the ring gear can be made. To adjust the ring gear, unlock and loosen the backing screw about two turns. Remove the rear axle cover, take out adjuster lock fingers and shift ring gear to right or left as required to establish .005 to .010 backlash.

Replace the lock finger on adjusting screw. Screw in the backing screw, allowing .010 clearance between screw and ring gear. Replace cover. If further adjustment is necessary, do this with the pinion as previously instructed.

When assembling gears in carrier, place large end of pinion flush with outside of ring gear and adjust the backlash to .005 to .010. This will be very near to correct and if further adjustment is necessary it can be made at the pinion. Make adjustments for wear only on the right side.



SAE 140 SCL OIL
- 9—Steering Gear
- 13—Universal Joints
- 23—Change-Over Valve
- 6—Engine Water Pump
- 8—Spring Shackle Pins
- 10—Steering Cross Rod
- 11—Drag Link
- 4—Clutch Release
- 12—Clutch and Brake Shaft
- 14—Pump Bearings
- 15—Axle Knuckle Pivots
- 22—Emergency Brakes

HEAVY CUP GREASE
- 20—Front Wheel Bearings
- 21—Rear Wheel Bearings

LIGHT CUP GREASE
- 18—Fan
- 19—Distributors

SAE 140 SCL OIL APRIL 1 - SEPTEMBER 15
SAE 90 SCL OIL SEPTEMBER 15 - APRIL 1
- 16—Road Transmission
- 17—Rear Axle

SAE 30 OIL
- 5—Engine
- 7—Pump Transmission

SAE 20 OIL
- 1—Generator
- 2—Starter
- 19—Distributors

SAE 10 OIL
- 3—Discharge Gates

HYDRAULIC BRAKE FLUID
- 24—Shock Absorber and Hydraulic Brake System

FIG. 16
LUBRICATION DIAGRAM