

OPERATING INSTRUCTIONS AFTER STARTING

After the engine has started an inspection of the whole engine unit should be made to make sure all parts are functioning properly.

1. Look at lubricating oil gauge. If no pressure shows after engine has run 10 or 12 seconds shut down the engine and ascertain what the trouble may be. With bearings in good condition and proper grade of oil the pressure should be 15 to 20 pounds at full engine speed. If the oil is very cold or heavy this pressure may be much higher. As the oil heats up the pressure will reduce. Check oil gauge.
2. Check water circulation. If no water is flowing shut down engine and ascertain what the trouble may be. Never operate with the water boiling as this heat on the cylinder walls breaks down the oil film and also causes considerable water loss due to evaporation.
3. See that no loose tools or parts are lying on or near the unit as they might fall into a place where they would cause damage or personal injury.
4. Observe engine operation for smoothness, quietness and exhaust condition. If the fuel is up to specifications and has the proper ignition qualities the engine may still run raggedly because a cylinder or two is firing irregularly due to being cold. As the engine begins to warm up, however, all cylinders should fire regularly. If they do not, trace out the trouble, some hints of which will be found starting on Page 15.
5. See that there is an adequate supply of fuel in the tank and that fuel is being delivered to the carburetor. The delivery can be checked by slightly loosening the nut connecting the supply pipe to the carburetor and if a good quantity of fuel appears it is an indication that the fuel pump is being supplied with sufficient fuel. If no fuel or very little appears, shut down the engine and check the supply tank again. If the fuel supply is adequate, check fuel line from tank to pump, for leaks from loose connections, broken nuts and cracked or broken lines. Also check lines for obstructions inside or having been pinched closed or nearly so. If lines are found satisfactory, check pump for broken diaphragm, springs and worn or broken valves.
6. Check and see that there are no oil or water leaks.
7. Clean lubricating oil filter often. This will insure maximum efficiency from this unit and does not require much time or energy to accomplish.
8. Keep all fuel filters clean and give them regular attention.
9. Observe fan and belt operation. Loose fan belts allow slippage which reduces the efficiency of the fan and wears belts out rapidly. Never allow fan to run without any lubricant but do not over-lubricate as it will throw off the excess on the surrounding parts.
10. See that the radiator, if one is used, is free of obstructions between fins or tubes as they will obstruct air flow and reduce the cooling efficiency of the radiator unit.

STOPPING THE ENGINE

1. Stopping is generally effected by turning ignition switch to off position.
2. If atmospheric temperature is below freezing and no anti-freeze solution is used the complete water circulating system should be drained. This includes engine water jackets, water pump, radiator and all water pipes.
3. If anti-freeze solution is used the solution should be checked with a hydrometer to make sure the solution will not freeze. It is best to have a solution that will not freeze at temperatures far below those then being experienced.
4. Do not fill batteries with water when shutting down as this makes them more liable to freezing. Fill batteries just before starting up for the day's run.

NOTE:—If engine is kept in warm storage or is located in a warm building where freezing is not liable, 2, 3 and 4 can be disregarded.

LUBRICATION

DESCRIPTION OF LUBRICATING SYSTEM

The lubricating system on this engine is the forced feed type to all main and connecting rod bearings by means of a gear type pressure pump. The oil pump is driven through a suitable gear arrangement at the center of the camshaft. The pump picks up the oil from the center sump of the oil pan and delivers it to a drilled passage in the block. From there it flows through an oil manifold and through various leads to the main bearings. From the main bearings the oil flows through suitable drilled holes in the crankshaft to the connecting rod bearings. The bypass type pressure regulator consisting of a spring loaded piston is incorporated in the oil pump body. The idler shaft and accessory shaft are pressure lubricated. The cam bearings, valve tappets, valve stems and cylinders are lubricated by the mist of oil thrown off by the main and connecting rod bearings.

LUBRICATION INSTRUCTIONS

Oil Level. The level of the oil in the crankcase is determined by a bayonet or depth stick type of gauge. Wipe off gauge and reinsert to determine oil level accurately. The oil level should be maintained at or near the 4/4 mark on gauge. See Illustration No. 7.

Oil Changing. Drain the crankcase and refill with fresh oil frequently. How often this should be done depends on the operating conditions, the kind of service to which the engine is applied and whether or not the engine is equipped with a suitable oil filter. After changing the oil several times at 1000 mile or 30 hour intervals and by observing the condition of the old oil it can be determined whether the oil should be changed more frequently or less frequently. Oil should be changed more frequently when an engine is new than after it is well run in. This is because initial wearing in of various parts will result in minute metal particles in the oil which frequent draining will help to remove. The oil should also be changed more frequently in cold weather or where the engine is frequently started when cold as choking and cold running will tend to dilute the oil with unburned fuel and water. Water vapor is a product of normal combustion and this vapor will condense to form drops of water when it comes in contact with cold surfaces. Traces of water in the crankcase will therefore result from cold running and frequent oil changing will help to remove this water.

When changing oil it is not advisable to flush out the crankcase with kerosene as it is impossible to drain all the kerosene out of pockets and passages without dropping the pan and traces of kerosene will remain to dilute the fresh oil. Oil should be drained when the engine is hot as after a day's run, as the oil will then be agitated and will also run more freely and carry off more sediment.

Frequent and regular oil changing together with the use of good oil is low cost insurance against expensive repairs.

Use Good Oil. The difference in cost between cheap oil and the best obtainable is money well invested as this cost will be multiplied many times when repairs are necessary due to using cheap oil. Some oils contain traces of sulphur which in itself is not harmful but when in the presence of certain products of combustion will combine to form acids which will attack the metal surfaces. It is difficult to judge the true quality of a lubricating oil except by use of elaborate equipment and prolonged tests. Therefore the best practice is to buy oil of some well known and established brand or from a company who have a reputation to maintain. The use of H. D. (Heavy Duty) oils is recommended.

Weight of Oil. In deciding what weight of oil to use it is well to obtain the recommendation of the oil company as to what weight to use for the working conditions under which the engine is operating. A suitable oil of one brand might be designated as an SAE 30 while a similar suitable oil of some other brand would have some other designation.

A lighter weight of oil should be used in a new engine during the breaking in period of 2,000 miles or fifty hours operation than can be used after the engine has been run for some time. For breaking in a new engine we suggest an SAE 20 oil for normal conditions and a lighter oil if cold weather or cold climate conditions prevail.

After the breaking in period and for normal conditions of climate and load we suggest an SAE 30 oil. For warm weather or climate conditions where the temperatures average above 75° F. an SAE 40 oil can be used. For cold weather or climate use an oil having a pour point at least ten degrees F. below the temperature to be encountered. For example if a temperature of zero degrees F. is to be encountered the oil used should flow or pour at 10° F. below zero. Such an oil as 20W will be suitable for such conditions.

Quantity of Oil. When changing oil, approximately four to ten quarts U. S. liquid measure are required for the "IX" engine. (Depending on type of oil pan used.) When engines are equipped with an oil filter the filter should be cleaned at the same time the oil is changed in the crankcase and about one quart more than the above mentioned quantity will be required to refill the oiling system. In such cases the oil level should be rechecked after the engine has been run long enough to refill the filter. Always use bayonet gauge when replenishing the oil supply and fill to the 4/4 mark, Illustration No. 7.

ACCESSORIES

Accessories mounted on the engine should carry their own lubricating instructions which should be followed. However, if these are not available, the following may be used as a guide.

Lubrication of Accessories. Check fan hub for oil at least once per week or fifty hours operation and fill with regular engine oil. Remove the slotted plug from fan hub and fill until oil drips from fan shaft. If the engine is equipped with a governor the lubrication of this accessory is automatically taken care of by the engine oiling system. The electrical units, either magneto or starter and generator, should be lubricated with a few drops of light oil every 400 or 500 hours of operation. When these engines are equipped with a water pump, having a grease cup: use cup grease, "hard oil" or special water pump grease. Give grease cup a slight turn once or twice daily: keep grease cup clean and full. Auto Seal type water pumps require only a little oil on the carbon ring of the seal when installing at time pump is being repaired.

OIL PRESSURE

Refer to Illustration No. 61 and discussion of this subject under "Oil Pressure" starting on Page 61.

LUBRICATION is your biggest asset to offset your greatest liability

UNNECESSARY REPAIRS Use only the BEST OIL obtainable.

ENGINE TROUBLE SHOOTING

This section is devoted to giving the operator and maintenance crew some hints in tracing trouble, these suggestions being based on actual experience of servicing a great number of engines in various types of operation over a long period of time.

In order to locate trouble under different headings, refer to "Index," Page 78.

A. ENGINE MISSES INTERMITTENTLY

- Cause: Spark plugs dirty, cracked or shorted by moisture on electrodes.
Correction: Clean if dirty. Replace if cracked. Dry if wet or damp.
- Cause: High tension wires broken or shorted.
Correction: Replace wires.
- Cause: High tension wires corroded in distributor cap.
Correction: Clean terminals.
- Cause: Faulty distributor points, spark plug points, condensor or coil.
Correction: Clean and adjust or replace if necessary from spares.
- Cause: Valve tappets adjusted too close.
Correction: Readjust valve tappets to correct clearance. See Illustration No. 79.
- Cause: Badly worn valve guides.
Correction: Replace valve guides.
- Cause: Leaking head gasket.
Correction: Tighten cylinder head screws or nuts to proper tension or replace gasket if necessary.
- Cause: Warped or cracked cylinder head usually due to overheating or pouring cold water in an overheated engine.
Correction: Replace cylinder head.
- Cause: Cracked valve seat or water jacket usually indicated by overheating and loss of cooling solution.
Correction: Replace cylinder block.
- Cause: Air leak in intake manifold.
Correction: Replace gaskets or manifold if necessary.

B. LOSS OF POWER

- Cause: Motor missing intermittently.
Correction: See part A above for cause and correct.
- Cause: Motor out of time.
Correction: Retime ignition system, see Pages 54, 55 and 56.
- Cause: Valves or valve seats worn and leaking.
Correction: Re grind valves. See section starting on Page 69.
- Cause: Piston rings broken, stuck in grooves or worn.
Correction: Replace rings and clean ring grooves in piston.
- Cause: Tappets sticking or set too close.
Correction: Readjust tappets or if sticking, remove and clean.
- Cause: Worn pistons, rings, et cetera.
Correction: Replace worn parts or rebuild engine.
- Cause: Spark plugs leaking.
Correction: Tighten spark plugs in head.

HERCULES MOTORS CORPORATION

- Cause: Worn cylinders.
Correction: Rebore cylinders and install new oversize pistons and rings.
- Cause: Worn valve stems or guides.
Correction: Replace valves or guides.
- Cause: Valve springs weak or broken.
Correction: Replace springs.
- Cause: Valve timing incorrect.
Correction: Correct timing, see Page 30.
- Cause: Poor carburetor action.
Correction: Clean or repair carburetor.
- Cause: Water or sediment in fuel tank or filter.
Correction: Clean fuel system.
- Cause: Air cleaner clogged.
Correction: Wash element in suitable cleaning solution such as gasoline, fuel oil, et cetera.
- Cause: Exhaust pipes or muffler restricted.
Correction: Clean or replace exhaust pipe, muffler or tail pipe.

C. ENGINE KNOCKING

- Cause: Loose or worn main bearings.
Correction: Replace main bearings.
- Cause: Loose or worn connecting rod bearings.
Correction: Adjust or replace bearings.
- Cause: Loose piston pins.
Correction: Replace pins with oversize pins or piston and pin assembly.
- Cause: Worn cylinder bores and pistons.
Correction: Rebore cylinders and install new oversize pistons.
- Cause: Tight piston pins.
Correction: Fit pins to proper clearance. See Page 63.
- Cause: Tight pistons.
Correction: Fit pistons to proper clearance. See Page 63.
- Cause: Overheated engine.
Correction: Allow engine to cool, then determine cause of overheating. See paragraph E-1, Page 18.
- Cause: Lack of lubricating oil.
Correction: Fill crankcase with proper grade and quantity of oil. If engine still knocks, check and replace bearings.
- Cause: Loose flywheel.
Correction: Tighten in place; if worn excessively by running loose, replace.
- Cause: Excessive end play in camshaft.
Correction: Adjust with screw in gear cover. See Page 49.
- Cause: Idler gear shaft has excessive end play.
Correction: Adjust with screw in gear cover. See Page 49.
- Cause: Bent connecting rod.
Correction: Check and straighten or replace if necessary.

TROUBLE SHOOTING

D. FUEL SYSTEM

1. **Excessive fuel consumption.** This is usually accompanied by increased lubricating oil consumption due to dilution of the oil.
 - Cause: Carburetor worn or not properly adjusted. Indicated by black smoke in exhaust.
 - Correction: Check and repair carburetor.
 - Cause: Fuel leaks.
 - Correction: Check fuel tank, lines, connections, et cetera.
 - Cause: Sticking controls.
 - Correction: Lubricate controls and eliminate binding.
 - Cause: Excessive idling of engine.
 - Correction: Shut off engine when not in operation.
 - Cause: Excessive use of choke.
 - Correction: Warm engine to operating temperature before applying load if possible; also keep choke mechanism properly adjusted.
 - Cause: Dirty air cleaner accompanied by lack of power.
 - Correction: Clean air cleaner.
 - Cause: Engine overheating.
 - Correction: See Overheating under "Cooling System," paragraph E-1, Page 18.
 - Cause: Engine in poor condition and adjustment.
 - Correction: Overhaul engine.
 - Cause: Poor or weak ignition indicated by engine misfiring and puffs of smoke from the exhaust.
 - Correction: See "Ignition System," paragraph G-3, Page 21.
 - Cause: Dirty and improperly adjusted spark plugs.
 - Correction: Clean and adjust.
 - Cause: Engine over-cooling.
 - Correction: See "Cooling System," paragraph E-2, Page 18.
2. **Fuel pressure too low.**
 - Cause: Air leak in system.
 - Correction: Tighten connections and check supply lines for leaks, replace if necessary.
 - Cause: Fuel pump diaphragm out of order also causing increased lubricating oil consumption due to oil dilution.
 - Correction: Replace diaphragms. See "Fuel Pump," section starting on Page 44.
 - Cause: Fuel pump rocker arm linkage worn.
 - Correction: Rebuild the fuel pump, see Page 44, or replace from spares.
 - Cause: Fuel pump check valves and springs not functioning properly.
 - Correction: Clean or replace valves and springs.
3. **Lack of fuel at carburetor.**
 - Cause: Empty fuel tank.
 - Correction: Fill tank with fuel.
 - Cause: Bent, kinked or broken fuel lines.
 - Correction: Straighten or replace lines.
 - Cause: Dirty filtering screens.
 - Correction: Clean the filter screen. When replacing element in fuel filter, tightening the clamp nut finger-tight is sufficient.
 - Cause: Fuel leaks.
 - Correction: Check tank, lines, connections, et cetera.
 - Cause: Broken fuel pump diaphragm.
 - Correction: Replace diaphragm. See "Fuel Pump," Page 44.

HERCULES MOTORS CORPORATION

Cause: Sticking fuel valve in carburetor.

Correction: Replace fuel valve and seat.

Cause: Loose fuel pump cover plate screws.

Correction: Tighten screws.

4. Improper idling.

Cause: Sticking control rods or linkage.

Correction: Oil connections and eliminate binding.

Cause: Idling screw not properly adjusted.

Correction: Adjust screw for even idling.

Cause: Carburetor fuel and air mixture not properly adjusted.

Correction: Adjust carburetor.

E. COOLING SYSTEM

1. Overheating.

Cause: Lack of cooling solution, water, anti-freeze, et cetera.

Correction: Refill system with proper solution.

Cause: Fan belt not properly adjusted.

Correction: Adjust fan belt for approximately 1" deflection.

Cause: Carburetor choke valve partly closed.

Correction: Adjust choke valve or controls.

Cause: Thermostat sticking in closed position.

Correction: Clean and test or replace.

Cause: Coating of calcium salts on cylinders and inside of cooling system.

Correction: Clean and flush cooling system. The use of a good commercial type inhibitor may be recommended by the manufacturer of the radiator.

Cause: Dirt or insects in radiator air passages.

Correction: Clean or blow out with compressed air.

Cause: Hoses deteriorated. Cannot always be determined by condition of outside covering.

Correction: Replace hose.

Cause: Inlet or outlet hoses collapsing.

Correction: Replace hoses, using hose with an inner support if necessary.

Cause: Water pump not functioning.

Correction: Check and replace drive shaft, impeller, supply lines, et cetera.

Cause: Exhaust pipes restricted, usually noted by hissing sound in exhaust.

Correction: Clean pipes and remove restriction.

2. Over-cooling.

Cause: Thermostat sticking open.

Correction: Clean and test or replace thermostat.

Cause: Weather or climatic conditions too cold to allow thermostat to hold temperature

Correction: Cover radiator sufficiently to bring water temperature into proper range or use winter front.

3. Loss of cooling water.

Cause: Leaks in radiator core.

Correction: Repair or replace.

TROUBLE SHOOTING

- Cause: Defective hose connections.
Correction: Tighten clamps or replace hose or clamps.
- Cause: Radiator tubes clogged.
Correction: Clean or replace.
- Cause: Water pump seals defective.
Correction: Replace seals. See section starting on Page 71.
- Cause: Loose freeze plugs (core plugs) in cylinder block.
Correction: Tighten or replace plugs.
- Cause: Cracked cylinder head or block. Blown cylinder head gasket.
Correction: Replace.

F. CLUTCH ASSEMBLY

1. Slipping.

- Cause: Improper adjustment.
Correction: Adjust.
- Cause: Weak pressure spring.
Correction: Replace spring.
- Cause: Sticking release sleeve.
Correction: Check sleeve and pressure spring.
- Cause: Worn facings on driven disc assembly.
Correction: Replace facings or disc assembly.
- Cause: Facings saturated with oil.
Correction: Clean facings and correct cause. Check oil seal in bellhousing, also pilot on flywheel. Do not over-lubricate clutch shafts, bearings, et cetera.

2. Chattering.

- Cause: Oil on facings.
Correction: Clean or replace facings.
- Cause: Sticking release sleeve.
Correction: Check pull back spring. If broken, replace.

3. Rattling.

- Cause: Loose release fork.
Correction: Tighten fork.
- Cause: Weak or broken pull back spring.
Correction: Replace spring.
- Cause: Improper pedal adjustment.
Correction: Adjust pedal.

G. ELECTRICAL SYSTEM

1. Starting motor.

(a) Slow cranking speed may be caused by

- Cause: Crankcase lubricating oil too heavy or cold.
Correction: Change to correct grade of oil or heat the oil before attempting to start the engine, see Page 13.
- Cause: Loose or dirty cable connections.
Correction: Clean and tighten.

HERCULES MOTORS CORPORATION

Cause: Worn brushes.
Correction: Replace brushes.

Cause: Dirty or worn armature.
Correction: Clean, repair or replace armature.

Cause: Armature rubbing field coils.
Correction: Replace starter shaft bushings.

Cause: Low battery voltage.
Correction: Check generator and regulator then recharge battery.

(b) Starter failing to operate may be caused by

Cause: Battery discharged.
Correction: Recharge battery.

Cause: Burned circuit breaker.
Correction: Replace circuit breaker.

Cause: Broken battery cables.
Correction: Replace cable.

Cause: Poor connections.
Correction: Clean and tighten.

Cause: Burned commutator bars.
Correction: Recut commutator.

Cause: Open or short circuits in armature or fields.
Correction: Check and repair.

Cause: Defective starter switch (Push button or Solenoid).
Correction: Check and repair contacts or replace switch.

2. Generator.

(a) Low or no output.

Cause: Fully charged battery.
Correction: None. Check output when battery is slightly discharged.

Cause: Dry battery.
Correction: Refill cells with distilled water.

Cause: Burned contacts on regulator units.
Correction: Clean or replace contacts.

Cause: Grounded armature wires or terminal posts.
Correction: Replace wires and insulate terminals.

Cause: Burned commutator bars.
Correction: Recut commutator.

Cause: Worn or sticking brushes.
Correction: Clean or replace brushes.

Cause: Open circuits in field or armature.
Correction: Repair or replace defective parts.

Cause: Brush springs weak or improperly adjusted.
Correction: Adjust or replace springs.

Cause: Rough, dirty or greasy commutator bars.
Correction: Clean commutator bars.

Cause: High mica on commutator.
Correction: Undercut mica.

TROUBLE SHOOTING

Cause: Commutator out of round.
Correction: Recut commutator.

(b) Noisy generator.

Cause: Loose mountings.
Correction: Tighten mounting bolts.

Cause: Worn or loose drive pulley.
Correction: Tighten or replace pulley.

Cause: Worn bearings.
Correction: Replace bearings.

(c) Excessive output.

Cause: Generator field grounded.
Correction: Check wires, et cetera for external ground.

Cause: Regulator circuit breaker closed.
Correction: Adjust or repair circuit breaker. Check generator for damage.

Cause: Defective regulator.
Correction: Replace the regulator.

3. Ignition system—distributor, coil and spark plugs.

(a) Engine will not start.

Cause: Breaker points not closing.
Correction: Check and adjust.

Cause: Breaker points defective.
Correction: Check and replace, if necessary.

Cause: Breaker arm grounded.
Correction: Replace arm.

Cause: Defective cap or rotor.
Correction: Check and replace.

Cause: Defective coil.
Correction: Replace coil.

Cause: Defective condenser.
Correction: Replace condenser.

Cause: Loose terminals or grounded wires.
Correction: Check and tighten or replace.

(b) Engine misses at low speed.

Cause: Breaker point gap too small.
Correction: Check and adjust gap to proper setting. See Pages 55 and 56.

(c) Engine misses at high speed.

Cause: Breaker arm spring tension too weak.
Correction: Replace spring or spring and arm.

Cause: Breaker point gap too large.
Correction: Adjust gap.

HERCULES MOTORS CORPORATION

- (d) Engine pings excessively under load at high speed.
Cause: Timing too far advanced or incorrectly set.
Correction: Check and properly adjust. See Pages 54, 55 and 56.
Cause: Inferior grade of fuel.
Correction: If it is impossible to obtain the proper grade of fuel, it may be necessary to retard the spark or distributor timing somewhat to overcome the pinging noise.
- (e) Weak spark at plugs.
Cause: Breaker contact points worn or defective.
Correction: Examine, repair or replace the points.
Cause: Condenser disconnected or defective.
Correction: Test connection or replace condenser.
Cause: Breaker cam worn.
Correction: Install new cam and stop plate assembly.
- (f) Engine lacks speed and overheats.
Cause: Breaker cam retarded.
Correction: Readjust distributor and advance arm.
- (g) Timing incorrect or irregular.
Cause: Breaker cam loose.
Correction: Examine distributor governor weights, pivots, springs, shaft, et cetera. Replace as necessary.
- (h) Breaker points pitted or burnt.
Cause: Grease or dirt on points.
Correction: Clean, repair or replace.
Cause: Defective condenser.
Correction: Replace condenser.
- (i) Engine misses at all speeds.
Cause: Distributor points set too far apart.
Correction: Check and adjust.
Cause: Condenser defective or disconnected.
Correction: Check connection, replace condenser if necessary.
Cause: Breaker point screw lock nut loose.
Correction: Adjust points and tighten.
Cause: Breaker points burnt, oxidized or unevenly spaced.
Correction: Check, clean and adjust; replace if necessary.

H. EXCESSIVE SMOKE FROM EXHAUST

- Cause: Too much oil in crankcase.
Correction: Fill only to 4/4 mark on bayonet gauge.
Cause: Carburetor float sticking or fuel valve leaking.
Correction: Adjust or replace fuel valve and seat. Examine float for leaks.
Cause: Worn pistons, rings or cylinders.
Correction: Replace worn parts or overhaul engine.

TROUBLE SHOOTING

I. EXCESSIVE OIL CONSUMPTION

- Cause: Oil leaks at gaskets, screws, oil seals, et cetera.
Correction: Tighten or replace gaskets, et cetera.
- Cause: Inferior grade of oil.
Correction: Use a good quality oil. See specifications.
- Cause: Overheating.
Correction: Refer to Item 1 under E.
- Cause: Ring gaps too great or lined up.
Correction: Install new rings. If ring gaps are lined up, the condition will correct itself.
- Cause: Worn or broken rings.
Correction: Replace rings.
- Cause: Cylinder bores out of round or excessive taper.
Correction: Rebore cylinders, install new pistons, rings, et cetera.
- Cause: Main or connecting rod bearings loose.
Correction: Adjust or replace bearings.
- Cause: Oil ring slots clogged with carbon.
Correction: Clean rings. Replace if necessary.
- Cause: Carburetor fuel mixture too rich.
Correction: Replace worn jets and adjust.
- Cause: Piston improperly fitted or installed.
Correction: Correct or replace piston. See Page 63.
- Cause: Piston rings improperly fitted in piston grooves or cylinder bores.
Correction: Fit rings properly in grooves and cylinders. See Page 64.
- Cause: Air cleaner not clean, allowing dirt to enter combustion chamber with resultant wear.
Correction: Keep air cleaner clean.

J. BEARING FAILURES

- Cause: Continuous overspeeding of the engine.
Correction: Continuous operation at maximum speed or close to it is to be avoided. Exercise caution when going down grade. Do not allow vehicular speed to exceed same speed obtainable in same gear on level terrain.
- Cause: Lack of oil.
Correction: Keep oil level at 4/4 mark on bayonet gauge.
- Cause: Inferior grade of oil or oil of improper viscosity.
Correction: Use good quality oil of proper viscosity.
- Cause: Low oil pressure.
Correction: Adjust oil pressure. See Page 61.
- Cause: Bent connecting rod.
Correction: Replace connecting rod.
- Cause: Crankshaft rough or out of round.
Correction: Regrind or replace shaft.
- Cause: Restricted oil passages.
Correction: Clean oil lines and passages.
- Cause: Bearings loose or improperly fitted.
Correction: Adjust or replace main or connecting rod bearings.

HERCULES MOTORS CORPORATION

Cause: Dirt or other matter in lubricating oil.
Correction: Use clean oil and service breather air filter regularly. Replace oil filter cartridges or elements.

K. LOW OIL PRESSURE

Cause: Oil pump strainer screen in oil pan clogged.
Correction: Clean screen.

Cause: Oil too hot, resulting in low viscosity.
Correction: Correct cause of overheating.

Cause: Pressure regulator piston worn or clogged with carbon.
Correction: Clean and adjust properly.

Cause: Excessive main and connecting rod bearing clearance.
Correction: Adjust or replace bearings.

Cause: Oil pressure gauge defective.
Correction: Replace gauge.

Cause: Oil pressure gauge line bent or clogged.
Correction: Clean, straighten or replace line.

L. RAPID CYLINDER OR PISTON WEAR

Cause: Breather and air cleaner not properly serviced, allowing dirt and abrasives to enter combustion chambers.
Correction: Clean frequently and at regular intervals.

Cause: Inferior grade of lubricating oil.
Correction: Use good quality oil. See specifications.

Cause: Lack of oil.
Correction: Keep oil level at 4/4 mark on bayonet gauge.

Cause: Dirty oil.
Correction: Replace or change oil and replace oil filter elements.

Cause: Piston rings not properly fitted to cylinders.
Correction: Replace piston rings. See Page 64.

Cause: Carburetor fuel mixture too rich.
Correction: Replace worn jets.

Cause: Cold operation of engine.
Correction: Check thermostat. Warm engine before applying load.

M. VALVES STICKING

Cause: Incorrect valve tappet clearance.
Correction: Adjust clearance correctly. See Page 71.

Cause: Valve springs weak or broken.
Correction: Replace springs.

Cause: Valve stems or guides scored, dirty or gummy.
Correction: Clean, polish or replace.

Cause: Incorrect clearance between valve stem and guide.
Correction: Fit valve stems to correct clearance in guides.

N. BURNT VALVES OR VALVE SEATS

Cause: Valve tappet clearance adjusted too close.
Correction: Adjust valves to proper clearance.

TROUBLE SHOOTING

- Cause: Weak valve springs.
Correction: Replace springs.
- Cause: Excessive carbon.
Correction: Remove carbon deposits.
- Cause: Camshaft not timed correctly.
Correction: Retime camshaft. See Page 30.
- Cause: Lean fuel mixture.
Correction: Clean and adjust carburetor.
- Cause: Valve seats too narrow.
Correction: Cut seats to correct width.
- Cause: Low grade fuel.
Correction: Use good quality fuel.
- Cause: Valve heads cut too thin when refacing.
Correction: Replace valve.

O. SPARK KNOCK OR PING

- Cause: Excessive accumulation of carbon in combustion chamber.
Correction: Clean or remove carbon deposits.
- Cause: Hot spot in combustion chamber due to carbon deposit or clogged water passage.
Correction: Remove carbon and open water passage.
- Cause: Motor operating too hot.
Correction: See "Cooling System," E-1.
- Cause: Inferior type fuel.
Correction: Use good quality fuel.
- Cause: Ignition timing incorrect.
Correction: Correct or reset timing.
- Cause: Carburetion or fuel mixture incorrect.
Correction: Check carburetor.
- Cause: Spark plug gaps too wide.
Correction: Adjust gaps correctly.

P. EXPLOSION IN MUFFLER

- Cause: Ignition too late.
Correction: Correct ignition timing.
- Cause: Weak spark.
Correction: Check condenser, distributor, coils, wires, et cetera.
- Cause: Exhaust valve holding open.
Correction: Check tappet clearance, springs, guides. et cetera.
- Cause: Exhaust valves warped.
Correction: Reface or replace.

Q. EXPLOSION IN CARBURETOR OR AIR CLEANER

- Cause: Fuel mixture too lean.
Correction: Clean carburetor, check fuel level in bowl.
- Cause: Intake valve holding open.
Correction: Check tappet clearance, springs, guides. et cetera.
- Cause: Intake manifold leaking.
Correction: Tighten manifold nuts or replace gaskets.

DESCRIPTION AND MAINTENANCE

This section covers a brief description and function of the various parts of the engine along with complete instructions covering the repair, disassembly and reassembly of these various component parts of the IX series engine.

This section has the various subjects arranged alphabetically for convenience in locating.

ACCESSORY DRIVE

The accessory drive, Illustration No. 2, is used to drive the magneto or distributor, on the IX-5 engine when no water pump is used.

This unit consists of a gear driven shaft which rotates in a bushing that is pressed into a sleeve which is fastened to the cylinder block with cap screws.

TO REMOVE FROM ENGINE

1. Remove magneto or distributor.
2. Remove accessory drive attaching screws and pull drive out to rear.

TO DISASSEMBLE

(Reference letters refer to Illustration No. 3)

1. Remove magneto drive coupling and woodruff key.
2. Pull shaft E and gear C forward out of sleeve A.
3. Press bushing F out of sleeve. A special tool (13234-A) may be purchased from Hercules Motors Corporation to remove this bushing.
4. Remove oil seal retainer I and seal H.
5. If necessary, press shaft E out of gear C.
6. Although it is seldom necessary to remove the thrust plunger from the shaft, it may

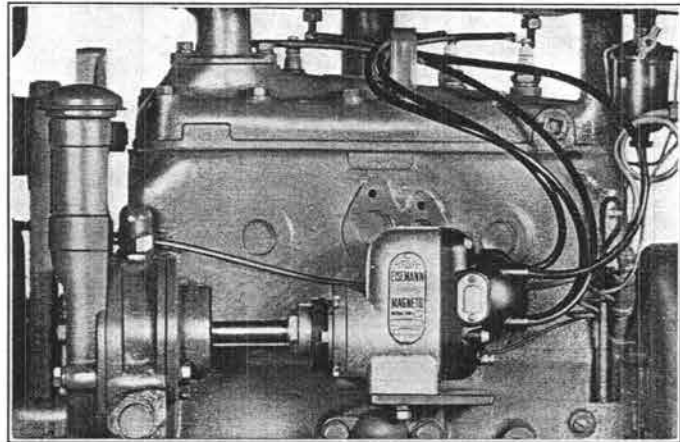


Illustration No. 2

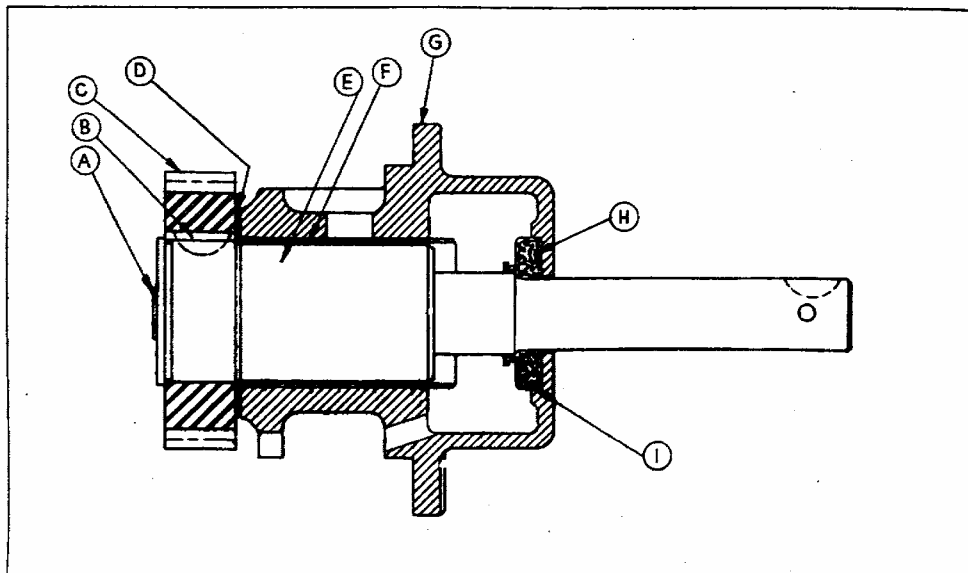


Illustration No. 3

DESCRIPTION AND MAINTENANCE

be removed in the following manner. With a torch quickly heat the plunger to anneal it. Allow the plunger to cool, then drill through the plunger with a $\frac{5}{16}$ " diameter drill and tap the hole with a $\frac{3}{8}$ " - 16 tap. Using a $\frac{3}{8}$ " cap screw of suitable length the plunger may be pulled from the shaft.

TO REASSEMBLE

1. Insert seal H in retainer I and press into housing.
2. Press bushing F into housing. The same tool (13234-A) may be used to replace the bushing. These bushings are machined to provide the correct shaft clearance. However, the shaft should be tried in the bushing. See Clearance Table, Page 77.
3. Insert Woodruff key B in shaft, then press shaft into gear and press thrust plunger A into shaft.
4. Place thrust washer D on shaft, oil shaft and bushing, then insert shaft in sleeve.

TO INSTALL ON ENGINE

1. Place new gasket on sleeve and assemble sleeve to engine and fasten in place with cap screws as removed.
2. Install magneto coupling key and magneto drive coupling, if magneto is used.
3. Retime ignition system. See magneto or distributor ignition timing, Page 54, 55 or 56.

AIR CLEANER

Since dirt is the greatest enemy of any internal combustion engine, it is necessary to take every precaution to prevent it from entering the engine. Therefore one of the most essential preventative measures is proper maintenance of the carburetor air intake air filter. These units should be cleaned at least once a day or if operating in very dusty conditions it should be cleaned every six or eight hours. All connections between the air cleaner and carburetor must be air tight. It is possible, under certain conditions, for enough abrasive laden air to be drawn into the engine through a loose connection to cause rapid wear of the pistons, piston rings and upper cylinder surfaces.

The screen type air cleaner should be removed and washed in gasoline or kerosene, then dipped in clean lubricating oil and replaced on the engine.

The oil bath type air cleaner should have the oil cup removed, washed, and filled to the proper level with clean lubricating oil and replaced on the air cleaner.

Each 100 or 150 hours or until a satisfactory schedule can be worked out, depending on actual operating conditions, the complete air cleaner should be removed from the engine and thoroughly washed and cleaned. (This operation should not be necessary if the oil cup or screen has been cleaned daily.) A dirty, clogged air cleaner causes loss of power, excessive fuel consumption and dilution of the lubricating oil from the excess fuel.

Illustration No. 4 shows a typical oil bath type air cleaner installation. Illustration No. 5 shows the oil cup removed for cleaning and also shows the instructions for filling with oil when servicing the air cleaner. Illustration No. 6 shows the filtering element. This element must be clean to allow free passage of air or the air cleaner will act as a choke which would cause a rich carburetor mixture and excessive crankcase dilution and loss of power.

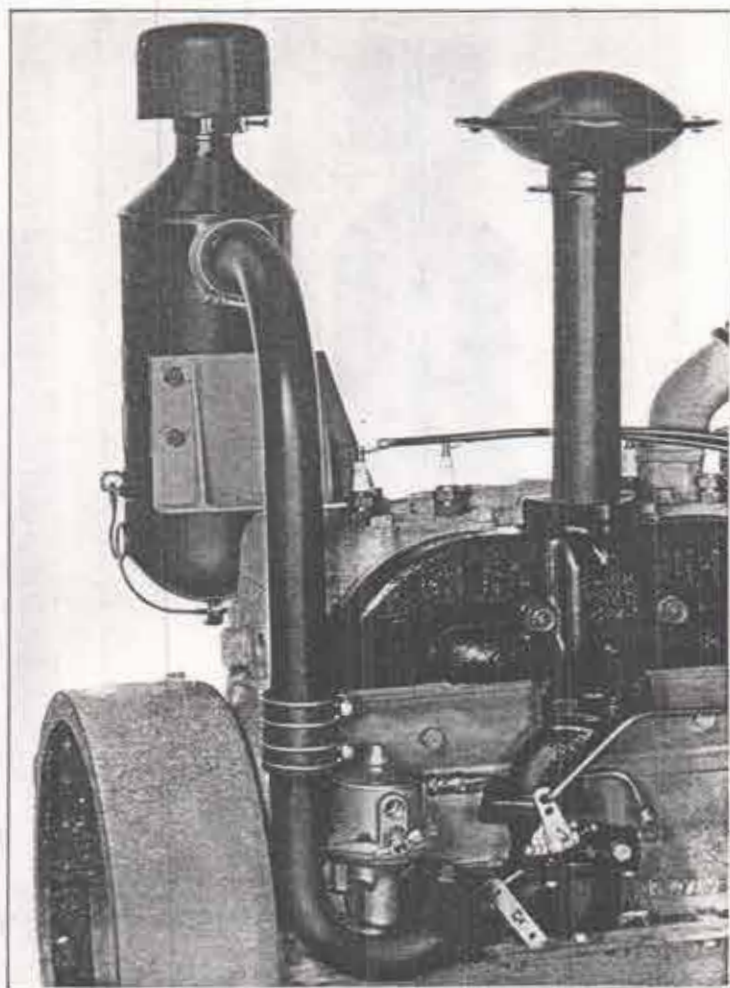


Illustration No. 4

BATTERY IGNITION DISTRIBUTOR DRIVE

(See Water Pump)

BAYONET GAUGE

The bayonet gauge is used to determine the amount of oil in the oil pan and is readily accessible. See Illustration No. 7. The oil level in the oil pan should always be maintained at or near the 4/4 mark, Illustration No. 7. Never allow level to go below 2/4 mark.

BELLHOUSING OR FLYWHEEL HOUSING

The bellhousing is a casting which not only covers the rear end of the block and oil pan but also forms a housing for the flywheel and clutch. It also is the rear motor support and to it the transmission is fastened.

REMOVING BELLHOUSING

1. Drain crankcase oil.

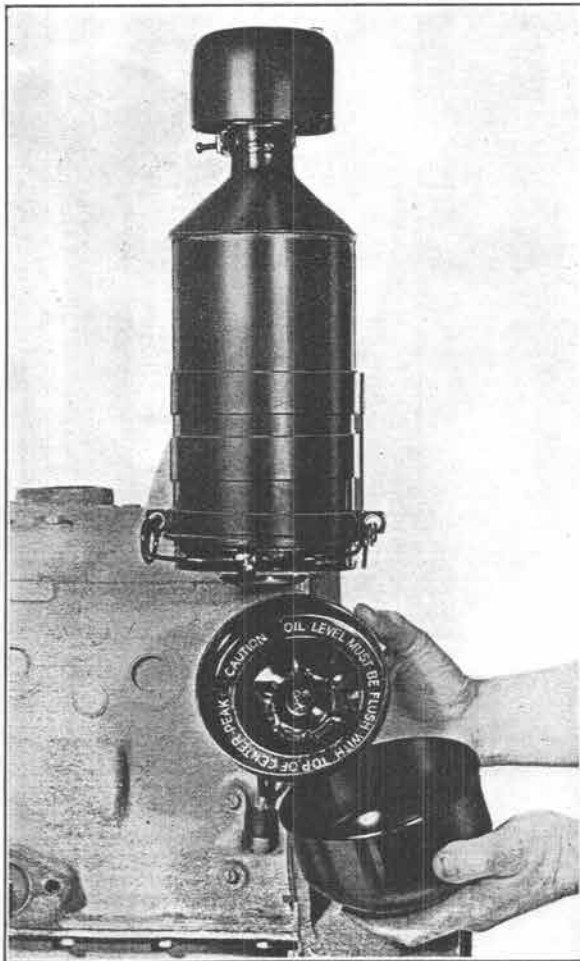


Illustration No. 5

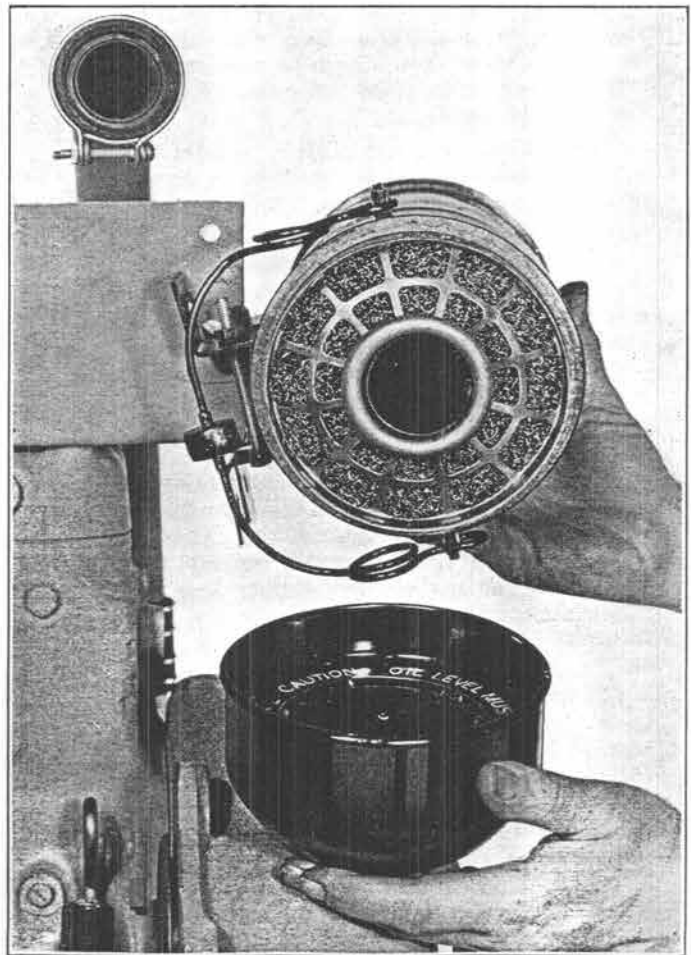


Illustration No. 6