This can only be done by draining the crankcase at regular intervals and filling with fresh oil.

Oil does not break down or undergo any permanent thinning when it is heated. When diluted with a certain amount of fuel, however, its body may be so reduced that it will not properly separate the friction surfaces. Dilution is especially troublesome in cold weather or when a car is being driven for short distances only.

The crankcase oil also becomes contaminated with road dust drawn through the air intake of the carburetor and through the crankcase breather. Particles of worn metal or carbon which flake off the underside of the piston heads also contribute to this contamination. The accumulation of worn metal particles is greatest in a new engine, while the friction surfaces are being worn in to a permanent finish.

Drain the crankcase oil after the first 500 miles of service. Establish regular drainage periods every 1000 miles in summer and every 500 miles in winter.

To drain the oil, remove the drain plug in the bottom of the crankcase, figures 2 and 5. The best time to drain

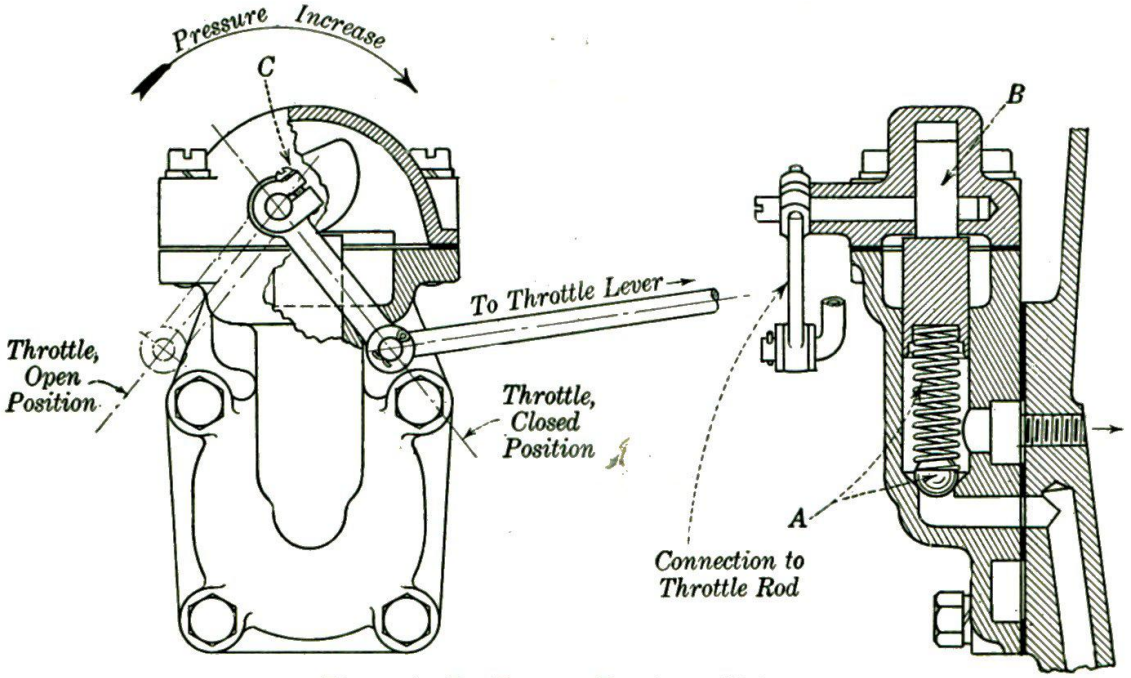

Figure 6—By-Pass or Regulator Valve.

is after a run when the engine is heated. The oil is thinner when it is hot and is also thoroughly mixed. It will, therefore, carry off more of the loose sediment.

DO NOT FLUSH WITH KEROSENE

When kerosene is used for flushing out the crankcase and lubricating system, a certain amount of it will remain in the system, collecting in pockets from which it can not readily be drained. It therefore dilutes the fresh oil which is added.

If the oil is drained while the engine is warm, it will be fluid enough to carry off sediment just as completely as could be done with any flushing material. For a thorough cleaning, the oil-pan should be removed.

TO CLEAN THE OIL SCREEN

The oil screen should be taken out and thoroughly cleaned at least once every 3000 miles or oftener. This is a very easy operation and can be accomplished by first draining the crankcase and then removing the six small nuts and the round cover, as shown in figures 4 and 7.

The screen, which is round in shape, can then be removed from the casing which surrounds it. It should be cleaned thoroughly with gasoline or kerosene and dried with compressed air. Do not attempt to dry it off by using waste. A small amount of lint or hair will quickly block a screen.

When replacing screen, it is a good plan to squeeze it slightly out of round. This will cause it to stick in place in its casing while the cover plate is being replaced.

Be sure that the spring clip is intact on bottom of screen as the cover plate presses against this clip and holds the screen tightly against the top of its case. Complete details of this screen construction are shown in figure 7.

HOW TO AVOID EXCESSIVE THINNING OF OIL OR "DILUTION"

Engine oil does not "break down" in service nor does it become permanently thinned after it has been subjected to heat. When mixed or diluted with a sufficient quantity of gasoline, however, its body is proportionately reduced. This is what takes place in the crankcase of the engine under certain conditions. To keep the oil in its normal condition so that it will properly protect the engine, excessive dilution must be avoided. It can be controlled by careful attention to the following points:

1. Engine temperature is the greatest factor influencing dilution. If the cylinders are too cold, the less volatile parts of the fuel do not vaporize and are not burned. The liquid fuel mixes with the oil on the cylinder walls or is blown or worked past the piston into the crankcase where it mixes with the oil supply. If, on the other hand, the engine is kept sufficiently warm, the fuel will vaporize and part of the diluent already collected in the oil may be distilled off. Use a radiator cover in winter and have the engine thoroughly warmed up before operating car.
2. Renew the oil regularly. The crankcase should be drained regularly—at least every 1,000 miles in summer and every 500 miles in winter.
3. Excessive use of the choke is often responsible for dilution. When the choke is used for starting, an excess of gasoline is drawn into the cylinders. This is necessary because only the lighter fractions of the fuel will vaporize in the cold engine. The part that does not vaporize will dilute the oil. An over-rich carburetor adjustment also promotes dilution for the same reason.
4. The mechanical condition of the engine is an influencing factor. If pistons and rings are worn or badly fitted, an excessive amount of fuel will leak by. If the ignition system is out of order and a

cylinder fails to fire, the fuel which should have been burned will dilute the oil.

5. Idling for long periods or at too slow speeds promotes dilution both from the fact that the mixture is rich and that the engine is cold.

HOW TO AVOID OIL PUMPING AND OBJECTIONABLE CARBON DEPOSITS

"Oil Pumping," in the common use of the term, refers to the accumulation of oil in the combustion chamber rather than to the quantity which actually passes the pistons. With adequate cylinder lubrication, there is normally a certain quantity of oil passing into the combustion chamber. If it is burned, its presence is not objectionable —but if it accumulates, fouled spark plugs, sticky valves and excessive carbon deposits are likely to result.

A hot running engine—operating under full load—will burn a heavier grade of oil than a cool running engine working at quarter load or less. Too heavy an oil in low temperature service frequently fails to burn cleanly. The result is slow decomposition of the oil to a sticky mass in which form it acts as a bed for the collection of road dust, carbon from cracked fuel, etc. It is obviously useless to try to correct an oil pumping condition by the use of a heavier oil than has been recommended with reference to working temperatures.

Wear of cylinders and pistons which has increased the normal clearance, or wear of the piston rings may be responsible for an excess of oil in the combustion chamber. Wear of the rings in their grooves will cause a definite pumping action—lifting the oil mechanically into the combustion chamber. When wear occurs, it must be remedied by renewing or refitting the parts affected. With correct lubrication, wear of this nature will be greatly reduced.

Carbon accumulation in the engine is therefore the result of incomplete combustion—either of the oil or of the fuel.

Oil pumping and excessive carbon deposits may be controlled by careful observation of the following suggestions:

1. Fill the crankcase carefully to its proper level daily. Do not over-fill. Over-filling may cause over-oiling with consequent oil pumping and carbon formation.
2. Use a high quality oil of the body and character recommended in this book. Either the incorrect grade or a poor quality may make trouble.
3. Do not try to compensate for wear by using a heavier bodied oil than has been recommended. The heavy oil when heated will pass the pistons almost as readily and will be harder to burn. The trouble will therefore be aggravated instead of corrected.
4. If the oil pressure falls off gradually, a probable cause is worn bearings, end play, etc., which allow too much oil to be sprayed from the bearing clearances to the cylinder walls. If this is the case, it is obviously wrong to try to correct the condition by increasing the pressure and feeding still more oil, or by changing to oil of a heavier grade. If the oil pressure is not what it should be, an investigation should be made by a competent service man.
5. Be sure that the carburetor is not feeding too rich a mixture. If there is not enough air to consume all the fuel, there certainly will not be enough to consume any excess of oil which passes into the combustion chamber. Incomplete combustion means lower combustion chamber temperatures, which influences carbon formation.
6. "Missing" promotes oil pumping and carbon formation because the oil normally passing into the combustion chamber is not burned. Keep the ignition system in good order and do not use the engine as a brake on long hills with the switch off.
7. Compression losses affect the efficiency of the engine and the complete combustion of oil and fuel.

Keep the valves properly ground in—the tappets properly adjusted—and the cylinder head gaskets tight.

HOW TO AVOID SLUDGE FORMATION

"Sludge" is an emulsion of oil, water and impurities which accumulate most frequently in cool running engines. Water vapor constitutes a large percentage of the exhaust gas in normal combustion. Unless the piston sealing is absolutely perfect, a small portion of this burned gas passes into the crankcase. If the crankcase is kept normally hot, the water vapor will pass off through the breather without condensing. In a cold crankcase, it will condense. The water may settle to the bottom of the case or may be continually circulated and mixed with the used oil. In either case, sludge is apt to form from the agitation of the oil, water and the finely divided matter always present in used oil.

In winter this difficulty is aggravated from the fact that crankcase temperatures are lower and condensation is more rapid. The danger is increased from the fact that the condensed water vapor may freeze and completely stop the oil circulation.

If the water has not been thoroughly mixed with the oil, this freezing may be localized at the low point in the

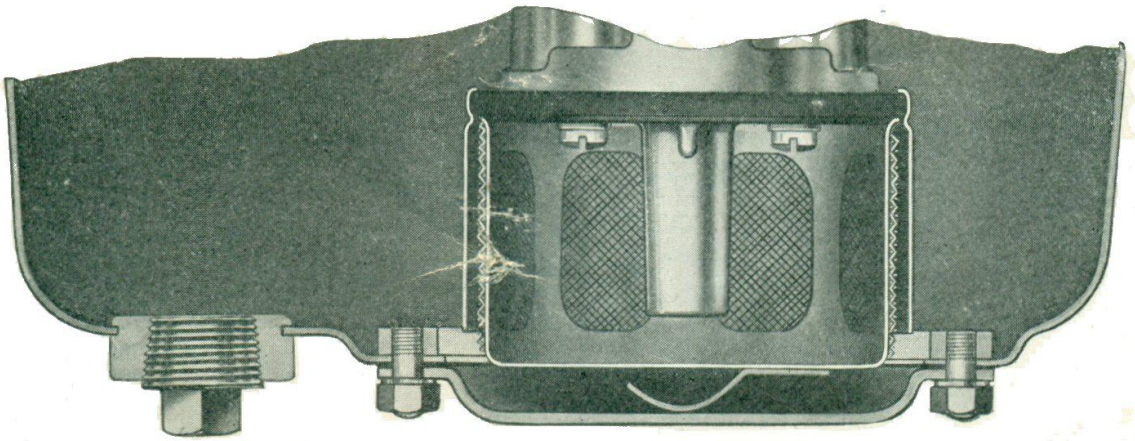

Figure 7—Showing oil screen.

crankcase. If there is a sufficient quantity, the oil circulation may be blocked with ice.

If the water is kept in constant agitation, it may freeze in crystalline form throughout the whole body of the oil, with the apparent result of thickening the oil so that it will not circulate.

This difficulty is most evident at extremely low temperatures and can only be avoided by the use of adequate means to keep the engine and crankcase normally hot.

Sludge formation can be controlled by careful attention to the following details:

1. Drain the oil at specified intervals—or oftener if the service consists of short intermittent runs in which the engine does not reach its normal temperatures. This will prevent the accumulation of too much water.

2. Use a suitable radiator cover or shield in winter. By keeping the engine normally warm the condensation of water vapor in the crankcase will be avoided.

3. Clean the oil screen regularly.

4. If traces of sludge are noted, when the crankcase is drained, remove the oil pan and clean it thoroughly with a lintless cloth. Sludge tends to increase when once started.

HOW TO AVOID CORROSION

The use of fuel containing an excessive amount of sulphur, under conditions which lend themselves to the condensation of water vapor into the crankcase, is apt to bring about the formation of injurious acids with the consequent corrosion of the bright metal parts in the engine.

In normal combustion any sulphur which is contained in the fuel burns to sulphur trioxide. Under some conditions of operation, part of this sulphur trioxide will find its way into the crankcase.

At the same time, a considerable quantity of water vapor, one of the normal products of combustion, will get by the rings and into the crankcase. If the engine is cold this water vapor will condense into liquid form, as already explained.

Sulphur trioxide and water unite very readily and form sulphuric acid. Even though the sulphuric acid in the crankcase may be in a very weak form, it is more active because it is warm and when sprayed over the bright parts of the engine, corrosion is the result.

Corrosion may be avoided by observation of the following suggestions:

1. Avoid the use of gasoline or other fuels which contain an excessive amount of sulphur.
2. Keep the engine in such a mechanical condition that the burning gases will not easily leak by the piston rings.
3. Use the correct oil and keep it in good condition so that the pistons will be sealed against leakage.
4. Keep the engine warm so that water can not form in the crankcase. There can be no acid without water.