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OIL PURIFYING DEVICE FOR INTERNAL COMBUSTION ENGINES

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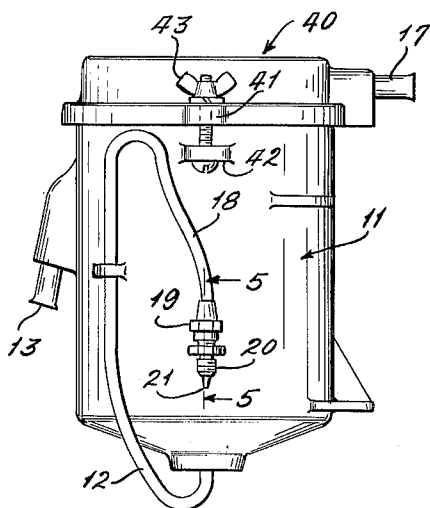


FIG. 1

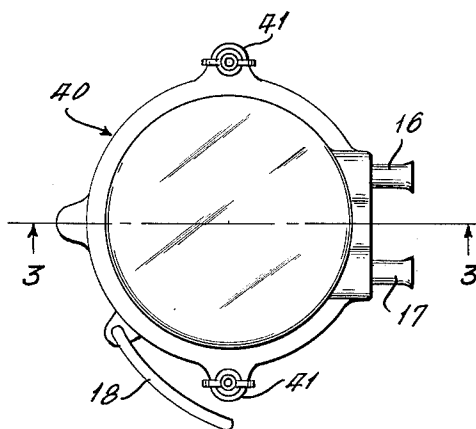


FIG. 2

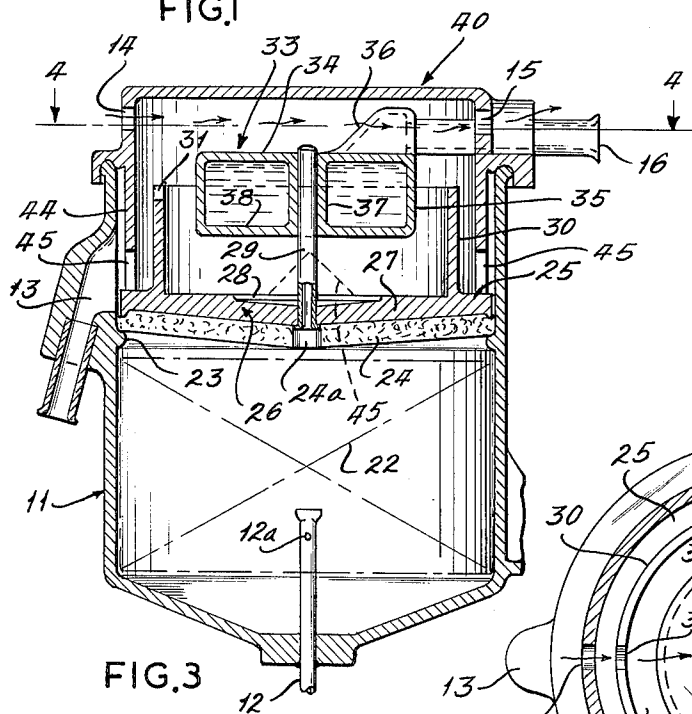


FIG. 3

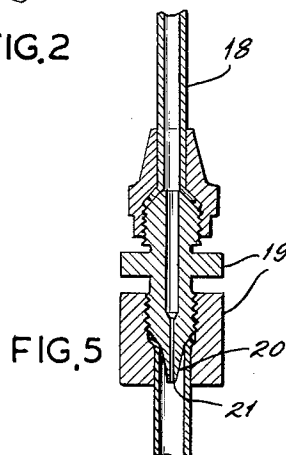


FIG. 5

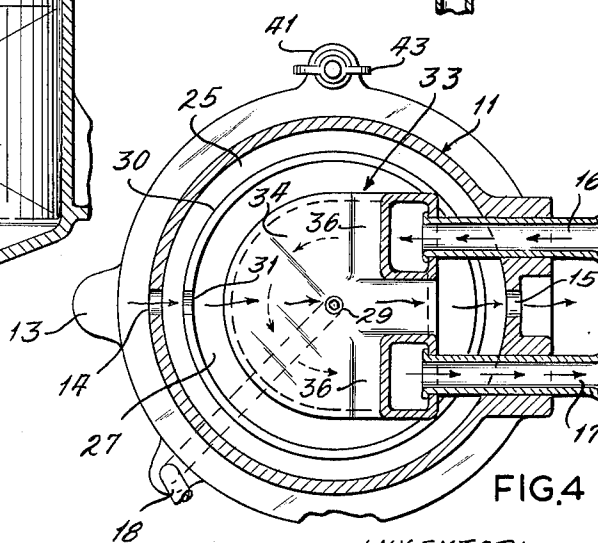


FIG. 4

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OIL PURIFYING DEVICE FOR INTERNAL COMBUSTION ENGINES

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5 Claims. (Cl. 210—180)

The present invention relates to oil purifying devices for internal combustion engines, and particularly to the removal from crankcase oil of water and low-temperature precipitable impurities.

The problem of removing water from crankcase oil has been the subject of numerous efforts. While no one of these can be said to be wholly representative of the prior art, somewhat typical effort is shown in the patent to Schwalge, No. 2,839,196, on an oil reclaimer. This device utilizes the radiant heat of an electric heater element to heat, from above, what is referred to as a vaporizing chamber. Oil is forced through orifices over a grid-like plate which forms the bottom of such chamber. Whatever heat reaches the grid-like plate does so only from above. After being exposed within the chamber, the oil is collected at the level of the plate and flows back into the circulating system of the automobile. No oil reservoir is provided.

The purpose of the present invention is to more effectively vaporize water and low-temperature hydrocarbons from crankcase oil, and at the same time precipitate other low-temperature precipitable impurities such as those of the nature of gums, shellac, varnish and sludge. Another purpose is to carry out such an operation effectively at a temperature which can be supplied by the liquid coolant of the engine.

These, and further purposes as will be apparent from the specification, are accomplished in the present case by utilizing not a hot, relatively confined, vaporization chamber, but a chamber which is continuously purged of heat and vapors by a continued flow of outside air. The heater top is bathed in a thin film of oil in such purged atmosphere, while the lower part of the heater is submerged in a reservoir which receives the oil after it flows over the top plate. This aids in low-temperature precipitation of impurities as hereinafter discussed.

The superiority of the present device over prior art is believed to be due to the continued purging of the chamber in which the vaporization takes place. Essentially, only the oil is heated.

To heat the oil while the air in the vaporization chamber is kept changed and its temperature kept down substantially to that of the outside air, brings markedly favorable results. The following reasons are believed to be responsible, in large measure, for these results.

The vapor pressure of water at 30° C. (approximately 86° F.) is only 31.8 mm. of mercury. The vapor pressure of water at 90° C. (approximately 193° F.) is 525.8 mm. of mercury—about 16½ times as great. Assuming that the temperature of the oil film is raised to 193° F. while the atmosphere in the vaporization chamber is at only 86° F. and is constantly changing, the pressure of water vapor developed on heating the oil, in seeking equilibrium with the vapor pressure in the atmosphere, will cause the vapor to burst forth from the thin oil film at a much enhanced rate.

Such rapid evaporation of water makes possible the treatment of only a small quantity of oil at a time. It has been found adequate, for a relatively small automobile engine of say 100 H.P. to treat only about 2.5 cubic inches of oil per minute. This permits the use of a fairly small heater element, whose flat plate area over which the oil flows in a film may be approximately one square

inch for each cubic inch of oil admitted to the device per minute.

I provide also a heated settling reservoir, in which the lower portion of the heater is submerged, so that the precipitation of low-temperature precipitable impurities can continue for an appreciable period of time, with ample opportunity to settle out. Approximately four cubic inches of reservoir capacity is adequate for each cubic inch of oil per minute to be admitted to the purifier. This permits settling of precipitated impurities for an average "reservoir rest" period of approximately four minutes.

The preferred embodiment in the present invention is shown in the accompanying drawings in which:

FIGURE 1 is an elevational view of an oil purifying device embodying the present invention.

FIGURE 2 is a plan view thereof.

FIGURE 3 is an elevational cross-section taken along lines 3—3 of FIGURE 2.

FIGURE 4 is a horizontal cross-section taken along line 4—4 of FIGURE 3.

FIGURE 5 is a fragmentary cross-section taken along line 5—5 of FIGURE 1.

In its preferred embodiment illustrated, the oil purifying device of the present invention comprises a metal vessel generally designated 11, of generally hollow cylindrical or somewhat barrel-like shape. Oil is supplied to its central bottom by means of an oil inlet tube 12, which may continue upwardly into the lower part of the vessel 11 and discharge oil laterally therein through side ports 12a. The vessel 11 further has an upper side oil outlet 13, and upper front and rear air vents 14, 15. A hot water inlet 16 and a hot water outlet 17 project through the vessel 11 to a heater, hereafter described.

The vessel is connected preferably in a by-pass line in an oil circulation system by means of an oil inlet tube 18 having a coupling 19 within which is contained the nozzle-like projection 20 of a flow control constriction 21. The constriction 21 is drilled to establish a slow inlet flow rate, controlling the capacity of the purifying device as hereinafter set forth. In the particular device illustrated the drilled opening of the constriction 21 is .04 inch diameter, which provides an inlet flow of oil, under the average pressure of the oil pump, of the general order of 2½ cubic inches per minute. The nozzle-like projection 20 extends upstream into the flowing oil; the annular space around the nozzle-like projection 20 within the coupling 19 serves as a trap for solid particles which might otherwise partly block the flow control constriction 21.

Oil entering through the tube 18 passes through the central bottom oil inlet 12 into a lower chamber (as hereinafter defined) of the vessel 11. This chamber is equipped with filtering material 22 of any familiar type suitable for oil filtration, such as is commonly used in oil filters of automotive vehicles. Such filtering material 22 does not constitute a novel element of the present invention.

Above the level of the filtering material 22, and located slightly above the mid-height of the vessel 11, is an internal shoulder 23 on which rests a circular yieldable seal 24, having a central flow aperture 24a. The shoulder 23, thus sealed, supports the diametrically enlarged support flange 25 of a reservoir element generally designated 26. This reservoir element 26 includes a reservoir bottom 27 including a central precipitation sump 28 which forms a depressed annulus about a central upward extending oil flow tube 29, which communicates between the lower filtering chamber device and the upper chamber used for the purifying operations of the present invention.

Inwardly of its support flange 25 but outwardly of the sump 28, the reservoir element has an upstanding outer wall 30. The upper edge of the wall may itself define the flow escape level of the reservoir; but in certain installations one or more notches 31 in the upper edge of the wall 30 may define the flow escape level, as well as pattern the direction of flow escape. Such patterning is not absolutely necessary to the operation of the invention; for the function of the reservoir is to provide a period in which the oil remains at rest. The annular space outwardly of the reservoir outer wall 30 and above its diametrically enlarged support flange 25 serves as an annular passage to the oil outlet 13.

A vessel cap generally designated 40 closes the upper portion of the vessel 11. Diametrically opposed lugs 41 on the cap 40 in vertical registration with complementary lugs 42 on the outer side of the vessel 11, and thumb screws 43 through the lugs 41, 42, hold the cap 40 firmly in place. An inner depending cap flange 44, spaced inwardly of the vessel wall 11, bears downwardly against the inner portion of the reservoir bottom support flange 25, holding it sealedly in place against the shoulder 23. Oil escaping at the flow escape level of the wall 30 and into the annular space between it and the depending cap flange 44, flows outwardly through escape ports 45 formed in the lower edge of the cap flange 44, and returns through the oil outlet 13 to the circulation system of the engine.

The hot water inlet 16 and the outlet 17 are rigid tubes mounted through the wall of the cap 40 and supporting, at the center of the depending flange 44, a heater element generally designated 33. Except in the region where said rigid tubes connect to it (in which region the heater element 33 may be conveniently elevated and formed to the flat-sided shape shown) the heater is preferably in the form of relatively low, erect, somewhat nearly cylindrical water chamber including a vaporizing top surface portion 34 elevated above the escape level of the reservoir wall 30. The heater element 33 has a major portion of the depth of its sidewall 35 below the level of the wall overflow notch 31. While the major portion of the depth of the heater element 33 is thus immersed in the oil in the reservoir, the heater inlet and outlet tubes 16, 17 which support it must extend above the level of the reservoir wall 30. Hence, at its side which receives the tubes 16, 17 there are upwardly and aft, gently curved top surface portions 36, up which some portion of the oil film may be induced to flow by the air passing above; thus aiding somewhat in the vaporizing function.

A tube-like central wall 37 through the center of the heater is of sufficient diameter to admit the upstanding oil flow tube 29. A heater bottom wall 38 extending from the tube-like central wall 37 to the heater side wall 35 completes the enclosed chamber of the heater element 33.

In the embodiment illustrated the vaporizing top wall surface 34 is provided with an area in square inches of the same general order of magnitude as the oil admission rate in cubic inches. In the present case, approximately $2\frac{1}{2}$ square inches of vaporizing top surface is provided. The volume of the reservoir, measured in cubic inches beneath its escape level notch 31, and allowing for the space occupied by the submerged portion of the heater element 33, is preferably of the general order of about four times the oil admission rate of cubic inches per minute. This means that on the average, oil will tend to stand, substantially at rest, within the reservoir for approximately four minutes.

It is to be recognized that all dimensions and proportions herein given are relative. The unique law of action of the vaporizing and precipitating operations of the present device will exist to a greater or less extent even though the given proportions be substantially varied from.

Oil passing through the filtering material 22 in the

lower portion of the vessel 11 is delivered through the flow tube 29 to flow slowly in a thin film across the heated vaporizing top surface portion 34 at the controlled rate herein described. Heat for the vaporizing surface portion 34 is obtained from the engine coolant, heated by the engine to a temperature whose minimum is defined by the engine thermostat.

In a closed or substantially closed vessel an atmosphere, into which some fluid is introduced, an equilibrium of vapor pressure tends to be established. As vapor in the atmosphere increases, the rate at which molecules of the vapor strike the surface of and re-enter the fluid will tend to equal the rate at which they leave the fluid.

The precise arrangement of elements described continuously purges the atmosphere above the vaporizing surface portion 34 of such vapors. The flow of air through the upper portion of the vessel 11, as between the front air vent 14 and the rear air vent 15, accomplishes this effect. The vents 14 and 15 are not mere pressure-vents, but air-flow directing vents, which cause the purging air to move constantly across the vaporizing surface 34 as shown by the arrows in FIGURE 3.

If the oil be heated by the vaporizing top surface 34 to only 176°F. , the vapor pressure of water within it will rise to 355.1 mm. of mercury, many times in excess of that in the constantly purged atmosphere. Flowing the oil slowly in a thin film exposed to such purged atmosphere, maintains in effect a gradient of vapor pressures favorable to rapid vaporization. Agitation within the oil film, which accompanies rapid vaporization, seems to aid in gathering together the molecules of those low-temperature precipitable impurities which have been mentioned.

Water will therefore be rapidly evaporated from this thin film; likewise any gasoline which has mixed with the oil. The ensuing, relatively prolonged rest period in the reservoir, as the oil is maintained heated by the side wall 35 and bottom wall 38 of the heater element 33, results in the deposit in the sump 28 of substantial quantities of the low-temperature precipitable impurities. This favorable result was not fully anticipated when the device was first constructed.

Variations in details of construction and adaptation to modified uses may be made without departing from the present invention. Accordingly, this invention is not to be construed narrowly but instead as fully co-extensive of the claims hereof.

I claim:

1. For use in the oil circulation system of an engine, an oil purifying device comprising,
 - a vessel containing an oil filter,
 - a settling reservoir having a wall within the vessel and an outlet therein spaced substantially above the bottom thereof and defining a flow escape level and an oil level in said reservoir at said flow escape level,
 - a heater element positioned within the reservoir, said heater element having a portion positioned below the reservoir flow escape level and having a surface elevated above its flow escape level,
 - means to admit oil from the circulation system at a controlled flow rate to direct it in film flow over the elevated surface of the heater element and then into the reservoir,
 - means to return oil, escaping at the flow escape level of the reservoir, to the circulation system, and
 - means to maintain a flow of outside air through the vessel above the elevated surface of the heater element and flow escape level of the reservoir,
 - whereby to purge it continuously of heated vapors and thereby accelerate the vaporization of water and volatile hydrocarbons from the oil into such flowing air.
2. For use in the oil circulation system of the fluid-cooled, internal combustion engine,
 - an oil purifying device as defined in claim 1,

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together with means to direct the fluid engine coolant, after being heated by the engine, through the heater element, whereby to heat the film of oil and the oil in the reservoir to a temperature approaching that of the heated fluid engine coolant. 5

3. An oil-purifying device as defined in claim 1, the elevated surface of the heater element having an area in square inches approximately equal to the oil admission rate in cubic inches per minute. 10

4. An oil purifying device as defined in claim 1, the capacity of the reservoir in cubic inches being approximately four times the oil admission rate in cubic inches per minute, whereby an approximate four minute period is provided in the reservoir for settlement of precipitables. 15

5. For use in the oil circulation system of fluid-cooled engines, an oil purifying device comprising a vessel having a side wall, a bottom wall and a top wall, 20

a settling reservoir received within the vessel and including a reservoir bottom dividing the vessel sealedly into an upper portion and a lower portion, filter means in said vessel below said reservoir, said reservoir bottom including a central, upward-extending oil flow tube and a precipitation sump portion annularly about said tube, 25

the reservoir further having an upstanding outer wall including overflow-permitting means located spacedly above its bottom and inwardly of the side wall of the vessel defining an oil level in said reservoir at said overflow-permitting means, 30

there being an oil flow outlet in the lower portion of the reservoir outwardly of and below the level of the overflow-permitting means, 35

an oil flow inlet into the lower portion of the vessel and

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into the filter means and having a flow-control constriction smaller than the oil flow outlet, and means to flow purging air from the atmosphere continuously above the level of the reservoir overflow permitting means,

together with a heater element located within the reservoir and at least partially below said overflow-permitting means and having a water flow inlet and water flow outlet through which heated engine cooling fluid may circulate,

said heater element having a central tube-like opening through its mid-portion in which said upstanding central oil-flow tube is received,

the heater element having a vaporizing top surface elevated above the overflow-permitting means and positioned in flow-receiving relationship to the upward extending tube,

whereby flow of engine oil from said tube, at a rate limited by the flow-control constriction, is directed over the top plate-like portion in a thin film for vaporization of water into the air, and is then received within the reservoir for continued heating and precipitation of low-temperature-precipitable impurities.

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