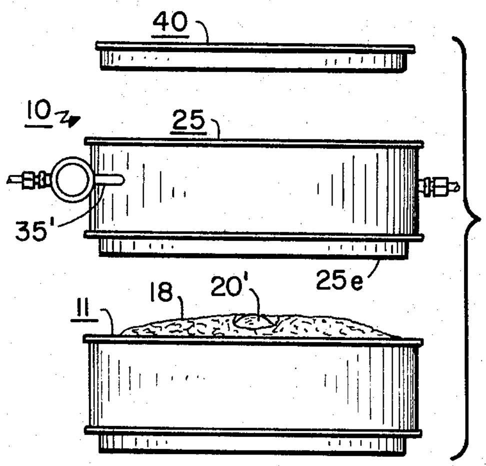

Fig. 1

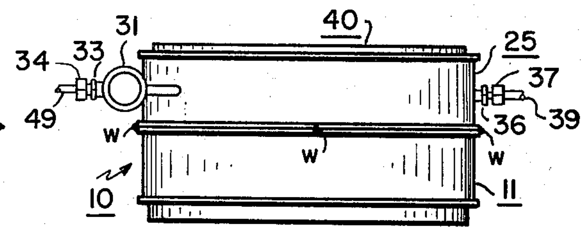

Fig. 2

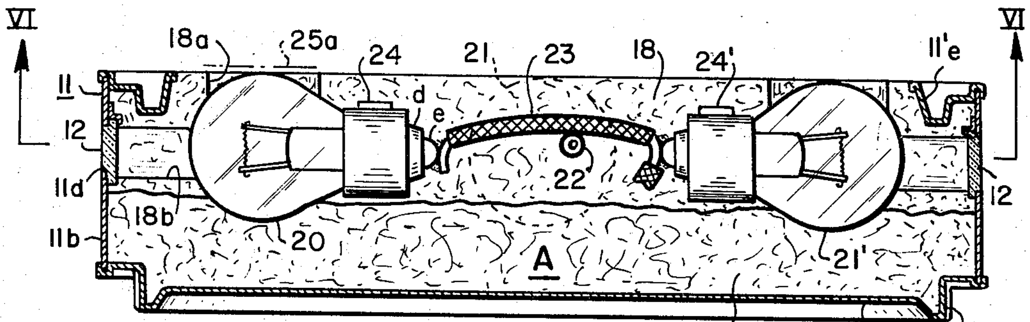

Fig. 3

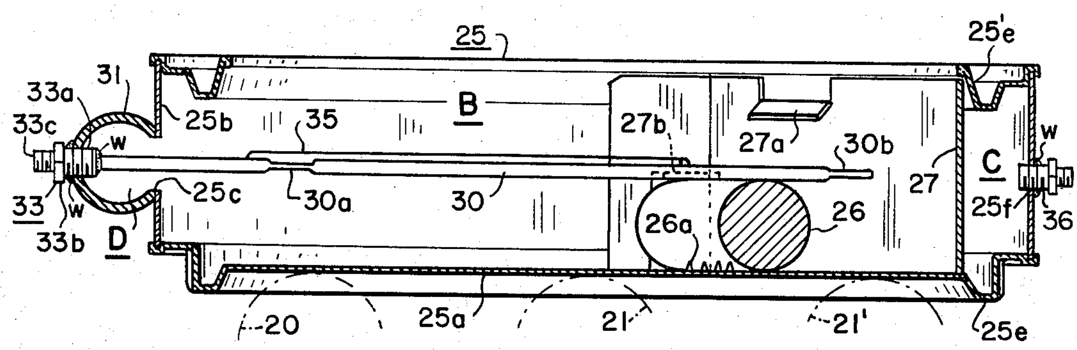

Fig. 4

INVENTORS.
Luther Robinson
Edgar G. Roland
BY
Green, McCallister & Miller
THEIR ATTORNEYS

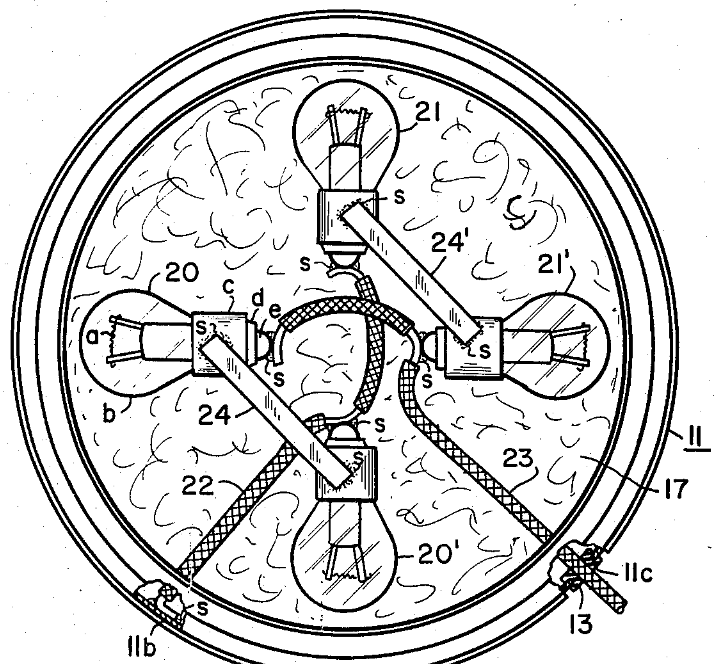

Fig. 5

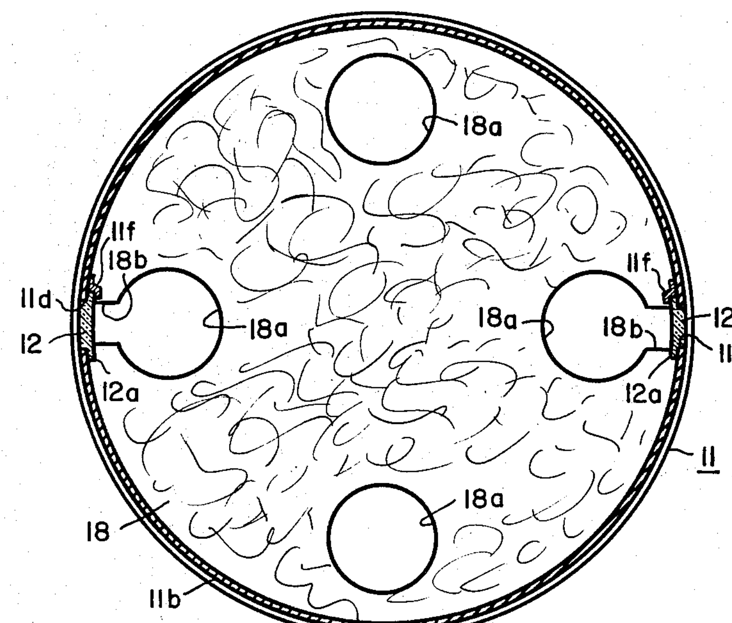

Fig. 6

INVENTORS.
Luther Robinson
Edgar G. Roland
BY
Green, McCallister & Miller
THEIR ATTORNEYS

ENGINE OIL CONDITIONER AND METHOD OF CONTINUOUSLY RECONDITIONING LUBRICATING OIL

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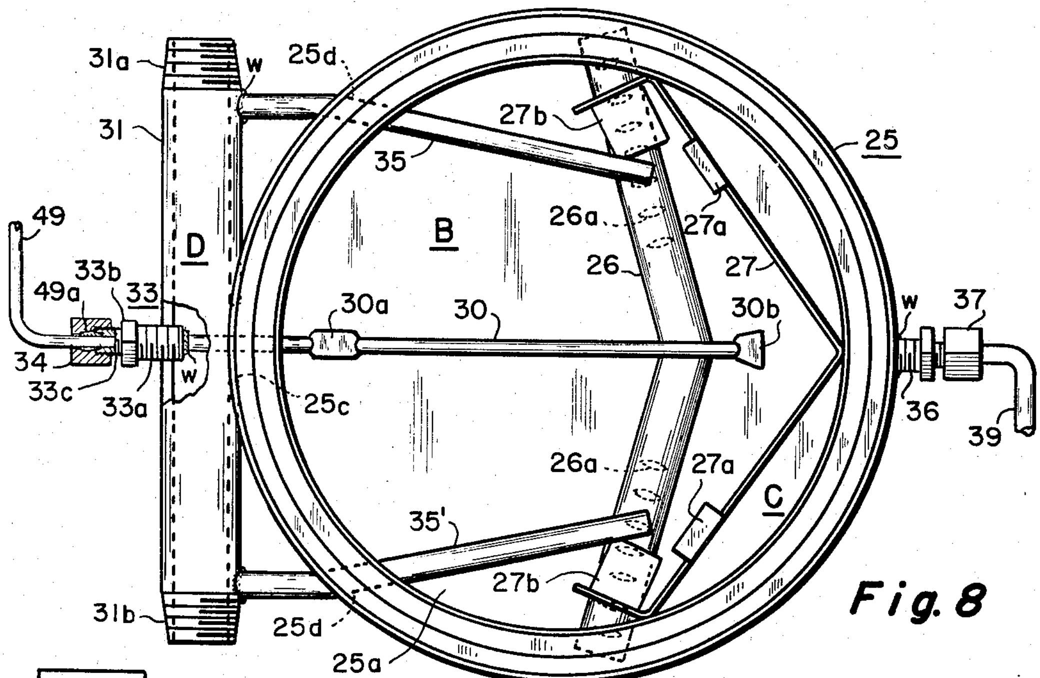

Fig. 8

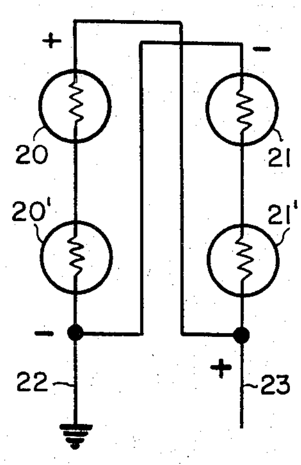

Fig. 7

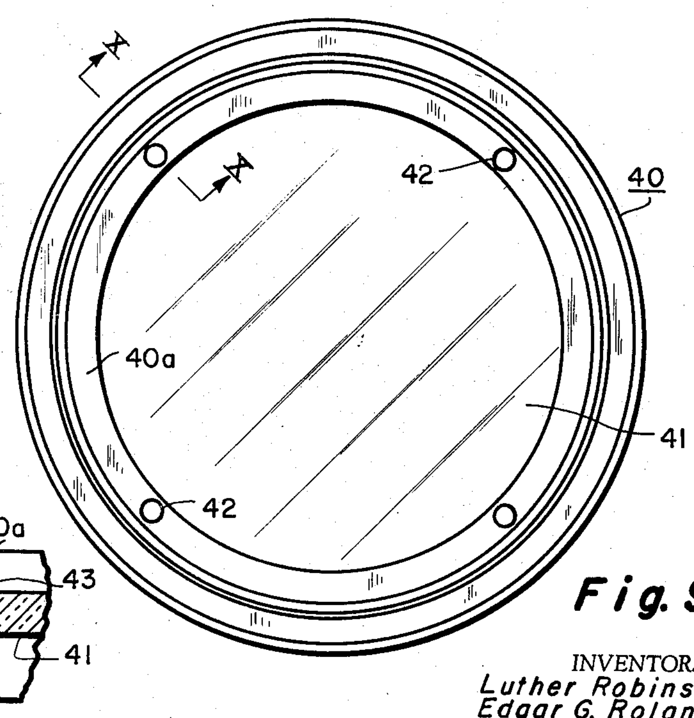

Fig. 9

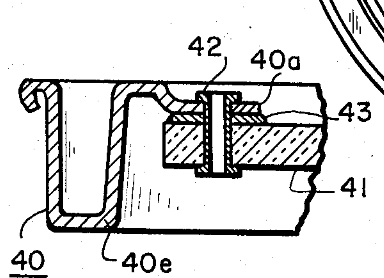

Fig. 10

INVENTORS.
Luther Robinson
Edgar G. Roland
BY
Green, McCallister & Miller
THEIR ATTORNEYS

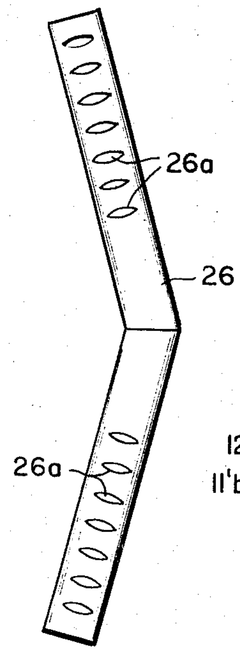

Fig. 11

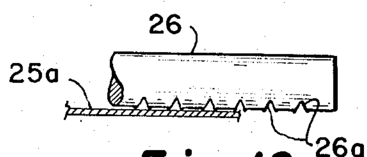

Fig. 12

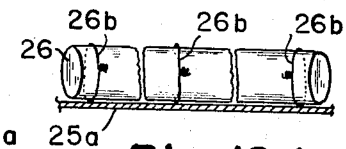

Fig. 12A

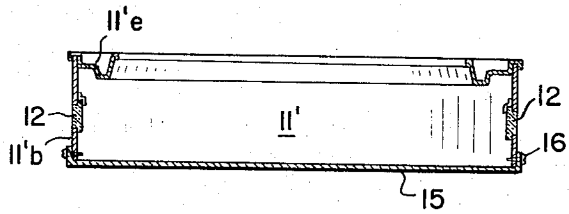

Fig. 13

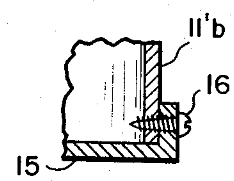

Fig. 14

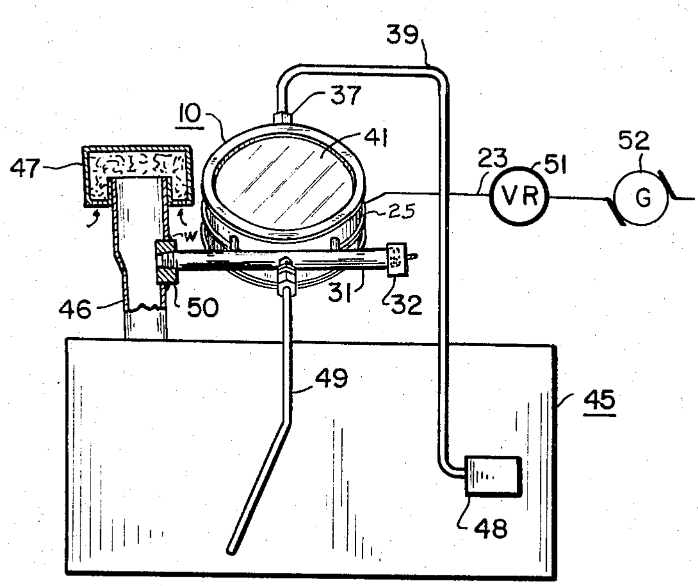

Fig. 15

INVENTORS.
Luther Robinson
Edgar G. Roland
BY Green, McCallister & Miller
THEIR ATTORNEYS

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3,356,182
Patented Dec. 5, 1967

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3,356,182

ENGINE OIL CONDITIONER AND METHOD OF CONTINUOUSLY RECONDITIONING LUBRICATING OIL

Luther Robinson, 509 Bellaire Ave., Pittsburgh, Pa. 15226, and Edgar G. Roland, Box 383, Grand Ave., Mars, Pa. 16046

Filed July 7, 1964, Ser. No. 380,871
24 Claims. (Cl. 184—6)

This invention relates to procedure and apparatus for conditioning or reconditioning lubricating oil during the operation of a combustion engine and particularly, for continuously maintaining crankcase oil in good condition for lubricating the engine.

A phase of the invention relates to procedure and apparatus for eliminating sludge formation in the lubricating system of an engine and for eliminating the need for making oil changes.

The present-day trend has been toward the provision of better quality oils, of better engine wearing surfaces, and of improved oil filters in order to permit a longer period of oil usage before it has to be changed. However, we have determined that these approaches do not fully meet the problem and that excessive engine wear may occur where full reliance is placed upon them. In the first place, sulfur is present at least in minimum amounts in lubricating oil of a petroleum, mineral, or hydrocarbon type. It is present in varying amounts in crude oil and may also be introduced during the refining process. Some engineers are of the opinion that when sulfur is present in its elemental form it improved the lubricating properties of the oil; however, moisture condensation, oxygen and gasoline are introduced into the crankcase oil of an engine, due to the heating and cooling of the motor when not in operation, due to the use of an atmospheric-open oil filler and breather tube, and due to leakage from the combustion chambers during the operation of the pistons.

The moisture which is formed by condensation and moisture which is introduced along with oxygen through the oil filler tube of the engine tend to cause the elemental sulfur in the oil to, during the operation of the engine, change into a more complex or acid form. The acid form is corrosive of the wear parts of the engine, tends to lower the lubricating properties of the oil, and, importantly, tends to cause the formation of a gummy sludge which may contain acid, some sulfur trioxide, etc. This sludge quickly fills the pores of the oil filter which causes the oil to merely by-pass the filter, making it ineffective for removing dirt impurities. An oil filter used for an ordinary internal combustion engine will, after a few thousand miles, collect a heavy coating of sticky sludge, thus necessitating its change if the engine is to be protected.

In endeavoring to find a solution to the problem involved, we found that the proper approach was to effectively condition or recondition the oil during its usage and that if this is properly done, sludge formation will be eliminated, making the oil filter continuously effective and maintaining the oil at its top lubricating efficiency. We have been able to carry out such an approach by continuously taking-off or bleeding oil from the engine during its operation and continuously and progressively conditioning the oil as thus taken-off, and then continuously returning it to the crankcase of the engine. This is done with a by-pass system in such a manner that the acid content of the oil is, in effect, neutralized, and contaminating volatiles, including moisture and gasoline as well as sulfur and carbon oxides, are progressively taken-off from and removed from the oil before it is returned to the engine. Employing this approach, we have found that oil in hard usage for tens of thousands of miles in an automobile is effectively as good in its lubricating qualities as the original oil, and that the oil filter when removed is free of sludge deposits, so that it may effectively collect bits of metal, dirt, and other solid contaminants that might otherwise damage the engine.

Briefly, in accordance with our invention, the oil is conditioned during its usage by subjecting it progressively and effectively to continuous treatment in a relatively simple apparatus in which it is flowed as a film over a heated surface and in contact with a metal catalyst in such a manner that the catalyst acts to neutralize the acid or convert the acid content into an innocuous content and particularly, one which can be volatilized-off. At the same time, heating is effected during the flow of the oil as a film over the heated surface so as to drive-off moisture, gasoline, and carbon and sulfur oxides into the atmosphere. This is accomplished in such a manner that the volatiles are drawn-off under negative pressure into the vacuum system of the engine where they can be mixed with the gasoline in the carburetor and discharged as exhaust. The treated or conditioned oil flows back into the crankcase without in any way adversely effecting the normal operation of the engine, since our by-pass system in no way is connected with moving parts of the engine.

It has thus been an object of our invention to devise a solution to the problem of lubricating oil contamination in an engine and in a simplified and practical manner without disturbing the normal operating efficiency of the engine;

Another object of our invention has been to eliminate the formation of sludge in a lubricating system and particularly, to eliminate the collection and clogging of the oil filter with sludge;

A further object of our invention has been to provide a procedure and apparatus which need only operate during the operation of the engine and will incorporate the normal components of the engine without requiring a special electrical or filtering system;

A further object of our invention has been to devise a sludge eliminating and oil conditioning system for an internal combustion engine which will be fully safe and foolproof in its operation and which will utilize any suitable source of electrical current, such as provided by the generator of an ordinary ignition system of an internal combustion engine, without producing any adverse drain on the storage battery;

A still further object of our invention has been to devise a system which will be fully safe in its operation, without danger of fire hazards;

These and other objects of our invention will appear to those skilled in the art from the illustrated embodiments, the description thereof, and the appended claims.

In the drawings:

FIGURE 1 is an exploded vertical view showing the construction of an oil conditioning device devised in accordance with our invention, and particularly from the standpoint of interfitting parts which may be employed in its construction;

FIGURE 2 is a vertical view in elevation on the scale of FIGURE 1 showing the parts of the construction assembled and in a position ready for use;

FIGURE 3 is a full size side section in elevation through one part of the device of FIGURE 2, namely, a heater compartment part or container, showing details of its construction;

FIGURE 4 is a view similar to and on the scale of FIGURE 3 but showing the construction of a treating compartment part or container of the device of FIGURE 2;

FIGURE 5 is a top plan view of the heater compartment part of FIGURE 3 on a three-quarter scale as to such figure; this view shows a heating element assembly positioned on a bottom insulating pad with an outer pad shown in FIGURE 6 removed,

FIGURE 6 is a horizontal section on the scale of FIGURE 5 and taken along the line VI—VI of FIGURE 3 showing the bottom half of the container construction of FIGURES 3 and 5;

FIGURE 7 illustrates a suitable electric circuit diagram for heating elements or unit of the container part of FIGURES 3, 5 and 6;

FIGURE 8 is a top plan view of the treating container part of FIGURE 2 showing its attendant fluid inlet-outlet and mounting connections;

FIGURE 9 is a top plan view on the scale of FIGURES 5 and 6 of a top enclosure of panel part of the construction of FIGURES 1 and 2;

FIGURE 10 is an enlarged vertical fragmental section taken along line X—X of FIGURE 9;

FIGURE 11 is a bottom plan view on the scale of FIGURE 8 showing details of the consrtuction of a metal catalyst bar or member used in the container part of FIGURE 8;

FIGURE 12 is a fragmental view in elevation showing the mounted relationship of the metal bar of FIGURE 11 on the scale of such figure and with respect to a heated grid, flow plate or back wall member of the container part of FIGURE 8;

FIGURE 12A is a broken fragmental view on the scale of FIGURE 12, showing a modified spacing means for the metal bar;

FIGURE 13 is a vertical sectional view in elevation of a scale intermediate between the scale of FIGURES 2 and 3 showing a modified construction of a heater container part;

FIGURE 14 is an enlarged sectional fragment in elevation showing the details of the mounting assembly of the construction of FIGURE 13; and

FIGURE 15 is a somewhat diagrammatic view in elevation illustrating a typical mounting of the device of our invention with respect to the motor of an automobile, beneath its hood.

With references to FIGURES 1 and 2 of the drawings, we have illustrated an oil conditioning device **10** embodying our invention which is made up or employs container or can parts **11** and **25** and a face plate or front closure part **40**. The three parts have interfitting or complementary peripheral tongue and groove flanges for facilitating their assembly in a sealed-off relation and for permitting their disassembly. FIGURE 1 shows the parts in an exploded relationship and FIGURE 2 shows them in a fully assembled unitary relationship. Although any suitable means, such as metal screws, may be employed for securing them together, we have shown brazing spots *w* in FIGURE 2 by way of illustration as to the container parts **11** and **25**, and have utilized a friction fit between the front closure part **40** and the container part **25**.

FIGURE 15 somewhat diagrammatically illustrates how the device **10** may be mounted above the cylinder head of an internal combustion engine of an automobile, underneath its hood. In this connection, the unit **10** has a transverse pipe member **31** which is threaded at its opposite ends (see FIGURE 8), so that one end **31***a* may be used for mounting it to project horizontally from a conventional oil filler and air breathing pipe **46** of an engine **45** of a car or truck, such as manufactured by Ford or Chrysler. The other threaded end **31***b* may be used for mounting it on the oil filler and breathing pipe of General Motors cars. The opposite threaded end which is not thus mounted is provided with an internally-threaded closure fitting or cap **32** to close it off (see FIGURE 15).

The connecting and mounting pipe **31** is shown mounted below a conventional removable filler cap **47** by side-tapping the tube **46** and brazing or welding in an internally-threaded fitting **50**. It will be noted that the cap **47** has air breathing openings so that the tube **46** is, in effect, always at atmospheric pressure. The device **10** of our invention may, however, be connected at its oil delivery end to any suitable crankcase opening.

Contaminated oil from the engine **45** is fed or bled-off from its crankcase by metal tubing **49** which passes centrally-upwardly through the pipe **31** along an inlet tube **30** into a threating chamber B provided by the part **25** of the device **10**. The tubing **49** is connected by a screw coupler part **34** to a male fitting part **33** within which the lower end of the inlet tube **30** is secured, as by brazing metal *w* (see FIGURE 4). As shown in FIGURES 4 and 8, the fitting part **33** has an enlarged threaded end portion **33***a* for screwing it in position within a threaded, centrally-located opening in the pipe **31**, has a wrench flat **33***b*, and has a smaller threaded end portion **33***c* for securing it against pressure sealing sleeve **49***a* within a threaded end portion of the coupler **34**. It will be noted that screw coupler part **37** is of similar construction to the coupler part **34** and that negative pressure fitting part **36** is similar in construction to the fitting part **33**. Negative or vacuum pressure is applied to a top vacuum chamber C of the container part **25** which has a threaded male fitting **36** that is connected by a screw coupler **37** and metal tubing **39** to the vacuum system of the engine or directly to their air intake of its carburetor **48**. Although the pipe connection **31** serves as a secure main mounting for the unit **10**, the parts **33**, **34** and **36**, **37** provide supplemental mounting in the sense of securing the device to the motor in such a manner that it does not vibrate independently thereof. It will be noted that an adaptor fitting **50** (see FIGURE 15) is constructed for securing, as by brazing metal *w*, to the filler tube **46**. It thus serves as a secure mounting for the pipe **31** and the unit **10**. We also contemplate employing U or L-shaped brackets (not shown) that may be mounted on the engine block and secured or clamped over the fitting parts **33** and **36** to provide further stability to the unit or device **10**, when desirable.

Referring particularly to FIGURES 1, 2 and 3, of the drawings, the container **11** represents a bottom or back container of the device whose housing defines a heating chamber A. The housing of the front or outer container **25** (see FIGURES 4 and 8) defines an oil treating chamber B and with a baffle or partition member **27** further defines vacuum chamber C. The cross-extending pipe **31** which is connected through an open central outlet orifice **25***c* to the treating chamber B thus defines a collecting and return chamber D for conditioned oil and, in view of its atmospheric type of connection, serves as a pressure-equalizing chamber from the standpoint of the vacuum chamber C and with respect to the treating chamber B.

The container or can **11**, as shown particularly in FIGURES 3, 5, and 6, is adapted to receive a heating unit assembly which is made up of a group, shown as two pairs of electric heating elements **20**, **20′** and **21**, **21′**. Each heating unit or element, as shown particularly in FIGURE 5, has a resistance wire or filament *a* that is adapted to be illuminated when electric current is applied thereto. An enclosing envelope *b*, preferably of glass or a transparent resin is employed to hermetically seal-off the heating element *a* from the atmosphere and to thus enable the evacuation of air so as to greatly increase the operating life of the heating filament or resistance *a*. The envelope *b* is secured and sealed within a metal sleeve *c* to which one end of the resistance *a* is connected and, at its back end, is closed-off by a resin seal *d* which centrally supports a metal base contact or tip *e* to which the other side of the resistance *a* is connected.

We have found that the heating elements can be provided inexpensively and satisfactorily by the use of conventional electric light bulbs, such as used in lighting the dash and other accessories of an automobile or truck. Employing four elements in a twelve volt system, each unit or element may have a rating of about 20 to 25 watts for a 12 volt source of current. Although the heating elements may be electrically energized by connection in series or parallel to any suitable source, as through the ignition switch of an automobile, we prefer to connect pairs of elements, such as **20** and **20'**, in series with each other, to connect the other pair of elements **21** and **21'** in series with each other, and to connect the two groups or pairs of heating elements in parallel with the source (see FIGURE 7), such as between a ground connection of the vehicle and the positive side of a generator or alternator **52** of an automobile engine **45** or through its voltage regulator **51** (see FIGURE 15). This provides the beneficial effect of lowering the voltage applied to each individual heating element in half to greatly increase the operating life of the elements. For example, if the engine employs a twelve volt electrical system, each heating element will have six volts impressed individually thereon; if it employs a six volt system, then each element will have three volts impressed thereon.

The illustrated circuit diagram has a further advantage that it enables us to employ only two viewing lenses or windows **12** in the container **11** for indicating if either one of the heating elements of each pair has burned out. For example, if the element **21** is burned out, then the element **21'** will not illuminate, and if the element **20'** is burned out, then the element **20** will not illuminate. In this way, we provide sufficient voltage for the required heating temperature of the device and at the same time, provide the heating elements with a relatively unlimited effective period of operating life.

Referring particularly to FIGURES 5 and 7, one lead or wire connection **22** may be grounded to the automobile frame by soldering it to the casing **11**. It will be noted that this connection **22** is secured by solder metal *s* to the base contacts *e* of one heating element of each pair, shown as **20'** and **21**. The so-called hot or positive side of the source, such as of the generator **52** or battery is connected through a wire lead **23** from ignition switch, passes through a side opening **11***c* in the container **11**, as protected by an insulating bezel or sleeve **13**, and is electrically-connected, as by solder metal *s*, to the end lug terminals *e* of the other heating elements **20** and **21'** of the two pairs. The pairs of heating elements are electrically-connected together and secured in a radially-spaced apart relation with each other by an electrically-conductive, strap metal pieces **24** and **24'** which are secured at their ends, as by solder metal *s*, to the metal sleeves *c*.

A bottom pad **17** of a suitable nonflammable insulating material or fabric, such as fiberglass (see FIGURES 3 and 5) is positioned to support the heating element assembly on one side thereof, and a second or outer or upper pad **18** (see also FIGURE 6) supports the heating assembly from its opposite side. As shown particularly in FIGURES 3 and 6, the upper pad **18** has open portions or holes **18***a* therein to receive the envelope *b* of each electrical heating element. An opposite pair of the open portions **18***a* have end-projecting sight passageways or openings **18***b* extending therefrom in alignment with side openings **11***d* in circular side wall **11***b* of the container **11**. Each opening **11***d* has a clear or transparent glass or resin lens or window member **12** secured therein, so that the illumination of the heating element or unit positioned in the opposite hole may be viewed from outside the device **10**. As shown in FIGURE 6, each lens **12** has an inner peripheral flange portion **12***a*; a clip portion **11***f* projects from the side wall **11***b* to extend over the flange **12***a* and hold the lens in position within the opening **11***d*.

The containers **11** and **25** as well as the front closure part **40** may be of sheet metal construction, such as of tin or tin-coated carbon steel or lightweight stainless steel. The back or heating element housing part or container part or can **11** is provided with a back or bottom closure wall **11***a*, a circular side wall **11***b*, a channeled back rim or connecting flange **11***e*, and a front tongue and groove-shaped or channeled, encircling, peripheral front flange or rim wall portion **11'***e*. In a like manner, the main or treating chamber container part or can **25** (see FIGURE 4) is provided with a flow plate, back oil-heating wall or grid member **25***a* of plate-like construction which serves as a partition member between heating chamber A and treating chamber B, is shown smooth on its inner or flow surface, is of a good heat-conducting nature, and preferably has an inner flow face that is reflective. It will be noted that the heating elements **20**, **20'** and **21**, **21'** are adapted to abut or rest in a heat transferring relation against the back face or side of the plate or partition member **25***a* between the two containers **11** and **25** (see FIGURE 3). The container **25** is shown provided with a circular side wall **25***b* and, like the container **11**, with a front peripheral or encircling inwardly-projecting tongue and groove or channel-shaped flange portion **25'***e*. The back wall **25***a* has, adjacent its outer periphery, a channel-shaped or tongue and groove type of peripheral flange connection **25***e* to the side wall **25***a* which provides a complementary interfitting fit with the flange **11'***e* of the container part **11**.

The front closure part **40**, as shown particularly in FIGURES 1, 9 and 10, has a tongue and groove or channel-shaped outer flange portion **40***e* and an inwardly-projecting, substantially flat, peripheral flange or rim portion **40***a*. The portion **40***e* is adapted to form a complementary interfit with the flange portion **25'***e* of the container **25** (see FIGURE 4). The portion **40***a* serves as a mounting for a transparent glass or resin face plate or window member **41** which is shown of circular construction. As illustrated particularly in FIGURE 9, the face plate **41** enables the operator to view the flow and treatment of the oil within the treatment chamber B of the container part **25**. It may be secured in a protected and insulated relation to the underside of the flange portion **40***a* by a layer of sealing cement **43**. Both the flange portion **40***a* and the face plate member **41** may have complementary openings therethrough to receive rivets **42**.

In FIGURES 13 and 14, we have disclosed a modified container construction **11'** wherein its side wall **11'***b* is open at its back end, and a cup-shaped back closure member **15** is employed instead of the integral back wall **11***a*. Side portions of the closure member **15** are removably-secured to the side wall **11'***b* as by metal screws **16**. This permits easy access to the interior of the container **11'**.

As shown particularly in FIGURE 15, the container **25** is adapted to be mounted in a vertically-backwardly tilted position from its top portion which, as an optimum, is about 45° with respect to the horizontal, but may have a slope within a range of about 40° to 75°. It also has a slight tilt towards the side or end of the transverse pipe member **31** which is connected to the oil filler tube **46**, so as to provide a gravity return flow of conditioned or treated oil back to the crankcase of the engine **45**. The upper-backward or vertical tilt of the device **10** controls the rate of flow of a film of oil over the front or flow face of the plate member **25***a*.

A metal baffle **27** of angle-shape (see FIGURES 4 and 8) of somewhat flexible strap-like metal material is shown positioned within the upper portion of the chamber B to separate the treating chamber B from the vacuum chamber C. It will be noted that the apex of the baffle **27** is substantially in line with the apex or extreme top end of the container **25**. Since the bottom edge of the baffle **27** rests tightly upon the face of the plate **25***a*, it serves as a segregating partition between the two chambers to keep the oil out of the vacuum chamber. The baffle **27** also has a pair of downwardly and forwardly slit tabs **27***a*, adjacent its opposite end portions, to define two air circulating passageways between the two chambers so as to pass vapors from the treating chamber B into the vacuum chamber C and to equalize pressure in the treating chamber B as between the negative pressure of the vacuum chamber C and the positive atmospheric pressure of the collecting chamber D.

A metal cathode bar or member **26** of angle-shape is positioned to extend across the chamber B and to project through openings provided by end tabs **27*b*** of the baffle **27**. It will be noted that the bar **26** is positioned with its end portions extending downwardly from its centrally-located apex. The end tabs **27*b*** serve to hold the cathode bar **26** along its length in position on the face of the heating plate member **25*a***. The oil inlet tube **30** of suitable metal, such as copper, is adapted to extend through the pipe **31** and outlet opening **25*c*** in the bottom of the container **25**. The connector **33** has a smaller threaded end **33*c*** for receiving internal threading **49*a*** of a mounting sleeve or collar **34** of the tubing **49** which may be connected to the pressure pump in the crankcase of an automobile. Thus, contaminated oil may be continuously bled or taken-off from the crankcase of the engine **45** as a pressure flow through the tubing **49** and the inlet tube **30**.

By way of example, the tube **30** may have a diameter along its main length portion of about 1/16 or .0625 of an inch. However, it is provided with a restricted flow passage at **30*a***. The portion **30*a*** may be formed by first inserting a wire in the tube of the desired diameter and crimping or flattening the tube thereon. This provides a small flow control passageway to limit the flow of oil to an amount which can be fully conditioned within the device. This restricted opening may have a diameter of about .020 of an inch to provide a flow rate of about one gallon of oil for about eight minutes of operation.

The upper end of the inlet tube **30** is positioned to deliver the oil into the upper portion of the chamber B above the cathode bar **26**, below and against the baffle member **27**. If desired a flat spray end or nozzle **30*b*** may be provided. The desired type of oil delivery is substantially equal from the standpoint of both vertical halves of the chamber B. The baffle **26** serves to confine the oil to the treating chamber and to spread it substantially over the full width of the face of the plate **25*a***. To further assure the desired type of flow, the cathode bar **26** has spaced portions with respect to the face of the heating plate member **25*a***, such as provided by cross-slots **26*a*** and the slight projection of their side edges(shown in FIGURES 11 and 12 of the drawings), or as provided by spacer wire rings **26*b*** of FIGURE 12A. If the rings **26*b*** are used, one may be positioned at the apex of the bar **26** and one may be positioned adjacent each end thereof. These cross-cuts **26*a*** on the underside of the bar **26** have a slight raised relationship along their side edges, as by forming them by pressing-in the metal of the bar. Another way of providing this same spacing is to employ central and end cross ribs on the underside of the member **26**. Such spacing as an optimum should be about .023 of an inch, but may be within a range of about .020 to .026 of an inch.

Since the contaminated oil being introduced in the treating chamber B falls upon the cathode bar **26** and flows thereunder through the spacing between it and the plate member **25*a***, this provides a thin film of heated oil which follows downwardly substantially uniformly over the entire width of the surface of the plate member **25*a***, as may be witnessed by inspection through the front face plate or window **41**. In this manner, the oil is fully subjected to a neutralizing reaction as to its acid content by the cathode bar **26** and to the heating effect of the plate member **25*a***, so that if the engine is operating at a normal temperature of about 180° for a gasoline engine, the oil will be additionally heated about 70° to 120°. That is, the oil being treated has a temperature during its downward flow from the cathode bar **26** within a range of about 250° to 300° F.

The treated or conditioned oil flows out through the outlet opening **25*c*** and the pipe **31** to return to the crankcase of the engine, as through its filler tube, such as **46** of FIGURE 15. A pair of upwardly-projecting pressure equalizing pipes or tubes **35** and **35′** extend along opposite sides of the container part **25**, and their lower ends are open to adjacent end portions of the pipe **31**. The tubes are shown sealed-off and secured to the container **25** and the pipe **31**, by brazing metal *w*. The tubes **35**, **35′** may have an inside diameter of about 3/16 or .1875 of an inch. When the threaded end portion **31*a*** is, as shown in FIGURE 15, connected to the filler tube **46** of the engine, then the tube **35** functions as the pressure equalizing tube. On the other hand, when the opposite threaded end **31*b*** is secured to the oil filler tube of the engine, the tube **35′** serves as the pressure equalizing tube. Thus, there is no danger of oil being drawn into the vacuum chamber C and drawn off in the vacuum tubing **39** of the system if the vacuum should become excessive.

The tubes or pipes **35** and **35′** are shown mounted in tight abutment with the front side of the bar **26** and thus serve to hold it securely in position within the treating chamber B. Since the tubes **35** and **35′** and the pipe **31** are connected to the crankcase of the engine, they also serve to conduct vapors or moisture from the crankcase (as a counterflow to the return of the reconditioned oil) into the treating chamber B, where they are removed along with vapors produced by the heating plate **25*a***.

Although other suitable catalytic materials may be suitable for the purpose of our invention, we have found that a bar of magnesium metal, such as sold commercially by Dow Chemical Corporation of Lyndhurst, N.J., and designated as AZ–61A is highly satisfactory. As previously indicated, it serves generally as a catalyzer for the acid content of the oil which may be in the form of sulfuric acid (H_2SO_4) or sulfurous acid (H_2SO_3) or both, and which may contain some crystals of sulfur trioxide (SO_3). The bar **26** functions as a true catalyst which furthers chemical breakdown reactions of the acid content of the heated contaminated oil film and, as such, has an indefinite period of operative life, since it does not, itself, enter into the reactions. In this connection, it will be noted that the acids present in the contaminated oil are of a diluted, as distinguished from a concentrated type. This catalyst enables the acid sludge forming content of the oil to be neutralized by converting its acid content into water and sulfur dioxide gas which are, in turn, vaporized out of the oil in the chamber B along with carbon dioxide gas, moisture and gasoline. The vacuum or negative pressure provided by the chamber C is sufficient to draw-off these volatiles, as by conducting them to the vacuum system of the automobile where they may be discharged, for example, through the carburetor to the exhaust. Thus, the oil which reaches the bottom end of the plate **25*a*** is fully purified or treated ready for reuse.

Since the device **10** only operates during the operation of the engine and its electrical heating elements are energized, as by turning the ignition switch, it is apparent that it is economical and uses energy generated by the generator only during the operation of the vehicle. It progressively and continuously conditions and reconditions the oil during its use. By this method, we remove the sludge making constituents or contaminants in the oil so as to always maintain it in good working or lubricating condition. Sulfur which, as previously pointed out, may be contained in the oil as supplied or may be introduced during the operation of the engine, combines with water of condensation and oxygen, and particularly under the pressure circulation through the crankcase to create an emulsion which will, later turn into a sludge. Using the device of our invention, the emulsion never turns into a sludge, in that the contaminants which produce it and which lower the lubricating value of the oil are continuously eliminated before they can be converted into a sludge. This not only results in a substantially unlimited period of effective utilization of a given crankcase filling of oil, but gives the oil filter a useful and effective life that extends into thousands of miles. The filter need only be replaced periodically, for example, after 20,000 or 30,000 miles by reason of dirt accumulations, as distinguished from oil sludge accumulations which normally accumulate within a couple thousand miles depending upon the condition of the motor and the dust content from road operation. The oil filter now will fully effectively remove grit, dirt, small pieces of metal, etc., that would otherwise damage the engine if the filter was by-passed by reason of sludge accumulated therein. Our device also serves as a protection to the engine if water leaks into the crankcase due to a defective gasket, since the water is vaporized-off and does not remain in the oil, giving the false impression that the crankcase is filled with an operating content of oil.

We also contemplate using a suitable adaptor or connector, such as **46**, that may be of previously formed unitary or one-piece construction with the fitting **50** to facilitate the mounting of our device **10** without the need to later braze-on the fitting. The connector or adaptor may thus be furnished with the device for ready mounting. It will be of a type suitable for the particular use, for example, it may be constructed for connection in the crankcase return line of a diesel engine. In FIGURE 15, we have shown the cap **32** provided with an endwise-projecting threaded stud for use with an engine-mounted bracket, if further mounting stability is required for the device **10**.

Although for the purpose of illustration, we have described our invention as applied to an internal combustion engine, such as a gasoline engine of the type used for motor vehicles, it will be apparent that it may also be employed with diesel and other types of engines, whether for vehicular or stationary utilizations. The source of current for heating the device can be a conventional ignition or glow tube supply source or any other suitable supply source. Also, although we have illustrated exemplary constructions embodying the principles of our invention, it will be apparent to those skilled in the art that various modifications and changes and adaptations may be made in accordance with the principles thereof without departing from its spirit and scope as indicated by the appended claims.

What we claim is:

1. A method of continuously reconditioning lubricating oil that is contaminated by usage in an internal combustion engine during the operation of the engine which comprises, providing a treating chamber having a side wall defined by a metal plate member, providing a vacuum chamber above the treating chamber, continuously taking off contaminated oil from the engine during its operation and introducing it into the treating chamber, flowing all the contaminated oil upon and progressively spreading it in the form of a thin film transversely and substantially uniformly on a front face of an upper portion of the plate member, continuously flowing the oil film downwardly along the width of the plate member in a sloped vertical plane that defines an angular relation of about 40° to 75° to the horizontal; applying sufficient heat from the plate member to heat the downwardly flowing oil film to and maintain it at a minimum temperature of 250° F. and fully vaporize contaminants therein that are more volatile than the lubricating oil, while catalizing and neutralizing its acid content and driving-off volatilized contaminants therefrom; maintaining a substantial pressure equilibrium in the treating chamber, flowing the volatilized contaminants into the vacuum chamber and withdrawing them therefrom, vacuum oil in a fully reconditioned state from the oil film adjacent a bottom portion of the plate member, and continuously returning the collected reconditioned oil to the engine; all, while controlling the flow of contaminated oil into the treating chamber and the temperature of the oil film during its movement downwardly along the plate member to fully and continuously recondition the oil being taken off from the engine.

2. A method as defined in claim **1** wherein, the flow of the contaminated oil into the treating chamber is con-

trolled by moving it into the treating chamber through a restricted passageway upon the front face of the plate member at an upper end portion thereof.

3. A method as defined in claim **1** wherein pressure equalization is accomplished in the treating chamber by applying positive atmospheric pressure to the treating chamber adjacent the vacuum chamber.

4. A method as defined in claim **1** wherein the volatilized contaminants are withdrawn from the vacuum chamber by the application of negative pressure thereto.

5. A method as defined in claim **1** wherein the contaminated oil is flowed downwardly along the plate member at an upper portion of the treating chamber through a plurality of restricted passageways and thereafter, as a continuous thin film downwardly along the plate member.

6. An oil reconditioning device for an internal combustion engine which comprises, a housing defining an enclosed oil treating chamber, a housing defining an enclosed heating chamber, a heat-transfer partition member between said chambers, means for mounting said chambers in a vertically-sloped position with respect to the horizontal, electric heating element means positioned in said heating chamber in an effective heat-transfer relationship with respect to a back side of said partition member, means in said treating chamber for introducing contaminated oil from the engine to an upper end portion thereof, a baffle adjacent the upper end portion of said treating chamber defining a vacuum chamber above said treating chamber, at least one flow passageway from said treating to said vacuum chamber, means in said treating chamber for flowing the oil introduced thereto by said inlet means downwardly as a film along said partition member and for neutralizing the acid content thereof, said heating means supplying sufficient heat energy to said partition member to volatilize-off contaminants from the oil film flowing downwardly thereon, a vacuum inlet connection to said vacuum chamber for drawing-off volatilized contaminants introduced through said flow passageway from said treatment chamber, and a collecting means open to a bottom end portion of said treating chamber for receiving reconditioned oil therefrom and having a gravity flow outlet for returning the reconditioned oil from said collecting chamber back to the engine.

7. An oil reconditioning device as defined in claim **6** wherein said collecting means and outlet comprise, a transverse pipe securely-mounted and connected centrally to said first-mentioned housing to receive the reconditioned oil by gravity flow therefrom and to flow the reconditioned oil by gravity flow to the engine, said transverse pipe has opposite open ends whereby either one of said ends may be connected to the engine, and cap means is provided for closing-off the unconnected open end of said transverse pipe.

8. An oil reconditioning device as defined in claim **7** wherein, at least one pressure equalizing tube is connected at its lower end to said transverse pipe and extends upwardly along said treating chamber to terminate in a downwardly-spaced relation with respect to said baffle to equalize pressure in said treating chamber in view of the negative pressure within said vacuum chamber, and said pressure equalizing tube is connected to flow vapors from the engine into said treating chamber.

9. An oil reconditioning device as defined in claim **7** wherein said means for introducing contaminated oil from the engine is an inlet tube having a restricted portion along its length defining an oil flow opening of about .020 of an inch in diameter.

10. An oil reconditionng device as defined in claim **7** wherein, viewing windows are provided in the housing defining said heating chamber to indicate the operating condition of said heating means, a face plate means is provided for closing-off a front portion of said treating chamber, said face plate means and said housings have interfitting flange portions for assembling them in a cooperating relation as a unit, and said face plate means has a viewing window to indicate the flow of oil over said partition member.

11. An oil reconditioning device as defined in claim **7** wherein, said means for flowing oil as a film along said partition means comprises a metal cathode bar of angular shape positioned within said treating chamber with the apex of its angle extending centrally-upwardly thereof and in a downwardly-spaced relation with said baffle, said means for introducing the contaminated oil comprises an oil inlet tube projecting at its upper end into the spacing between said cathode bar and said baffle to introduce the oil into said treating chamber above said cathode bar towards said baffle, said baffle is constructed to spread the oil thus introduced over said partition member, means positions said cathode bar in close adjacency with said partition member in a spaced relationship therealong within a range of about .020 to .026 of an inch to flow the oil from said inlet tube as a transversely spread-out film between said cathode bar and said partition member and downwardly along said partition member, and at least one pressure equalizing tube is connected at its lower end to said transverse pipe and projects upwardly along said treating chamber and terminates at its upper end between said cathode bar and said baffle for equalizing pressure in said treating chamber in view of the negative pressure in said vacuum chamber.

12. An oil reconditioning device as defined in claim **11** wherein, said pressure equalizing tube abuts said cathode bar to hold it in position within said treating chamber, and said gravity flow outlet has means for rigidly-securing said housings on the engine.

13. An oil reconditioning device for a combustion engine which comprises, vertically extending housing means for the device, a heat-transfer partition member in said housing means dividing it into a vertically extending heating chamber and a vertically extending oil treating chamber, said partition member having a vertically-sloped flow face for flowing oil downwardly thereon within said treating chamber, heat generating means within said heating chamber in a cooperating heat-applying relation with said partition member, said partition member defining an oil down flow face within said treating chamber, an oil inlet extending within said treating chamber to project contaminated oil from the engine upon an upper portion of said flow face, transversely positioned means within the upper portion of said treating chamber and extending across said flow face for transversely spreading the oil introduced by said inlet tube as an oil film thereon, said heat generating means being constructed and positioned to apply sufficient heat through said partition member to the oil film during its down flow on said flow face to neutralize the acid content of and vaporize-off volatile contaminants therefrom, and means for returning reconditioned oil from a lower portion of said treating chamber to the engine.

14. An oil reconditioning device as defined in claim **13** wherein, said transversely positioned means comprises a catalyst bar defining a restricted flow spacing with said flow face, and said oil inlet is open to said treating chamber above said bar to apply contaminated oil on said flow face for downward flow through the flow spacing towards the lower portion of said treating chamber.

15. An oil reconditioning device as defined in claim **13** wherein, said means for returning the reconditioned oil to the engine is a pipe member open centrally to a lower portion of said treating chamber and mounted on and extending transversely of said housing, and said pipe member has opposite threaded ends for alternate connection to an oil filler tube of the engine for returning reconditioned oil thereto.

16. An oil reconditioning device as defined in claim **13** wherein, a baffle is positioned on said partition member at the upper portion of said treating chamber above said transversely positioned means to provide an upper vacuum chamber within said housing, said baffle member has passageway means connected to said treating chamber, said baffle cooperates with said transversely-extending means for spreading the oil being introduced as an oil film over said flow face, and an atmospherically connected pressure equalizing tube extends within said housing and is open at its inner end to said treating chamber adjacent said baffle for equalizing pressure in said treating chamber.

17. An oil reconditioning device as defined in claim **13** wherein said heat generating means comprises at least one electric heating element operatively positioned in said heating chamber for applying heat energy to said partition member.

18. An oil reconditioning device for a combustion engine which comprises, an enclosed vertical mounting housing for the device, a centrally-extending plate-like partition member within said housing and having a front side providing an oil treating chamber within and along said housing, said partition member having a back side providing a back heating chamber within and along said housing, baffle means extending across an upper portion of said front side and providing a vacuum chamber for drawing off volatiles, said front side being adapted to be positioned to slope vertically-downwardly and define an oil down flow face therealong from said baffle means, transversely positioned means within said treating chamber and extending across said front side in an adjacent and downwardly spaced relation with respect to said baffle means to define a plurality of restricted down flow passageways with said front side, means for introducing contaminated oil from the engine into an upper portion of said treating chamber upon said front side between said baffle means and said transversely positioned means, said baffle means and said transversely positioned means being adapted to spread contaminated oil being introduced into a thin wetting oil film substantially uniformly along the full width of said front side for downward flow movement therealong, means in said heating chamber for applying heat energy to said partition member for reacting and vaporizing contaminants in the oil film during its downward flow movement along said front side to recondition the oil film, vapor flow passageways between said treating and vacuum chambers for passing vaporized contaminants into said vacuum chamber, and means for collecting reconditioned oil from a lower portion of said front side to return it to the engine.

19. A device as defined in claim **18** wherein said transversely positioned means is a metal catalyst bar having offset portions therealong to define said plurality of restricted down-flow passageways with said front side.

20. A device as defined in claim **18** wherein pressure equalizing means having an atmospheric air inlet is positioned to extend along said treating chamber and has an outlet to said treating chamber adjacent said transversely positioned means.

21. A device as defined in claim **20** wherein said means for introducing contaminated oil from the engine comprises a tube extending into and upwardly along said treating chamber and has an outlet positioned to flow the oil between said transversely positioned means and said baffle means.

22. A device as defined in claim **21** wherein said tube has an oil-flow restricting passageway and has means for spraying the contaminated oil into said treating chamber.

23. A device as defined in claim **22** wherein said pressure equalizing means is a tube extending into and along said treating chamber.

24. A device as defined in claim **23** wherein, both of said tubes have a substantially parallel extending relation with each other, and means on said housing positions said oil introducing tube substantially centrally of said front face and positions said pressure equalizing tube in a sidewise spaced relation with respect to said oil introducing tube.

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SAMUEL ROTHBERG, *Primary Examiner.*

E. J. EARLS, *Assistant Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,356,182 December 5, 1967

Luther Robinson et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 9, for "threating" read -- treating --; line 27, for "their" read -- the --; column 9, line 65, for "vacuum" read -- collecting --.

Signed and sealed this 7th day of January 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents