Dec. 28, 1937. DE WITT H. PALMER 2,103,635

APPARATUS FOR PURIFYING OIL

Filed Jan. 2, 1934 2 Sheets-Sheet 1

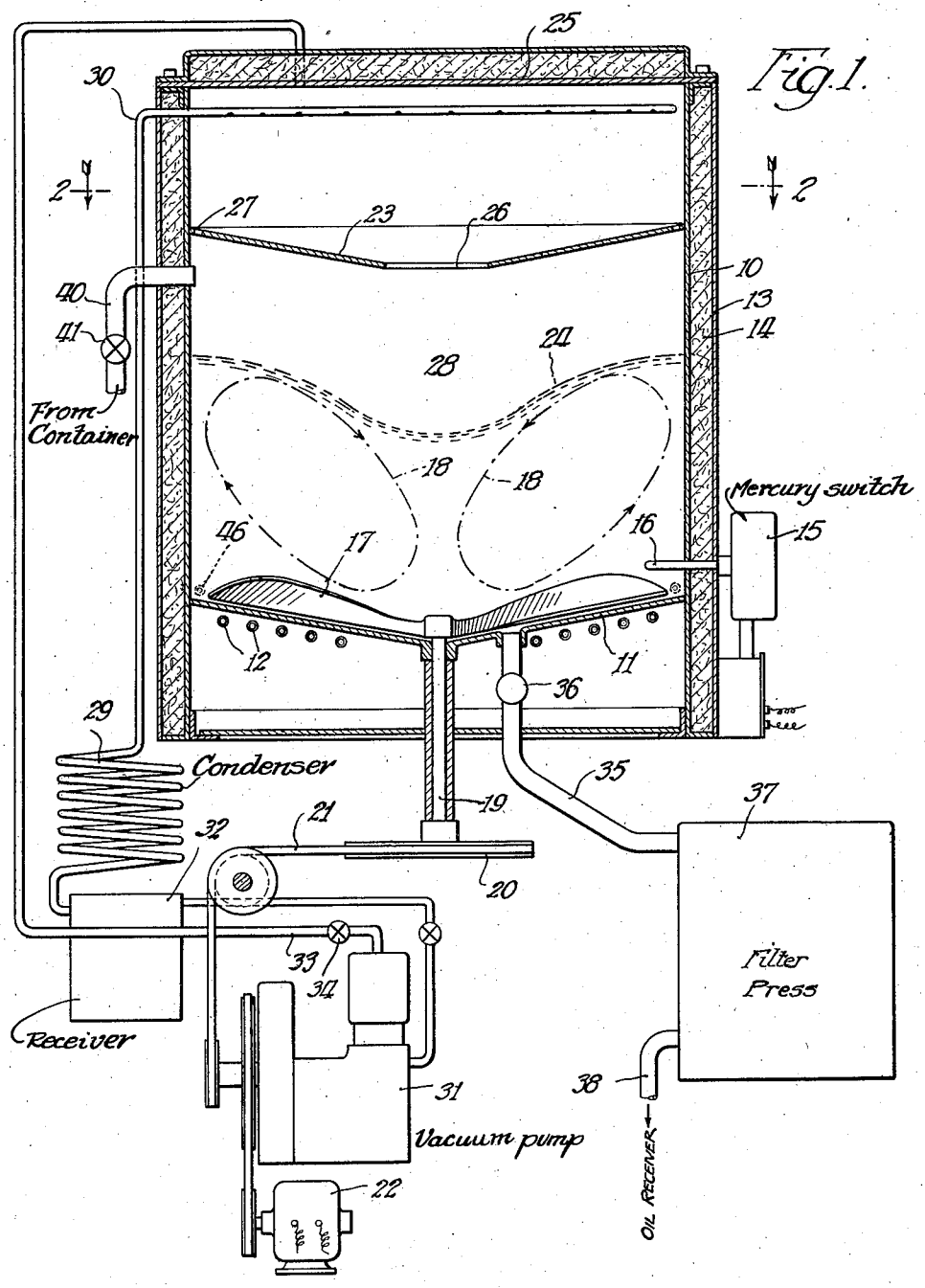


Fig. 1.

Inventor
DeWitt H. Palmer
Roland C. Rehm Atty.

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Fig. 3.

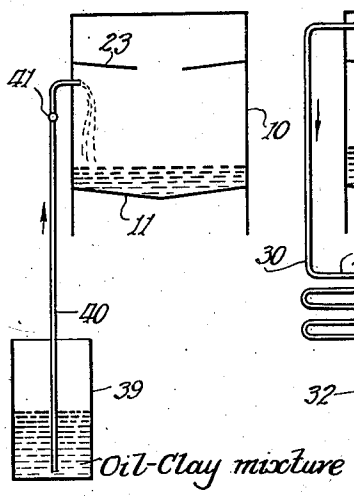


Fig. 4.

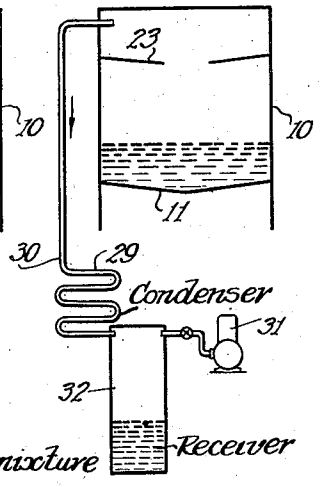


Fig. 5.

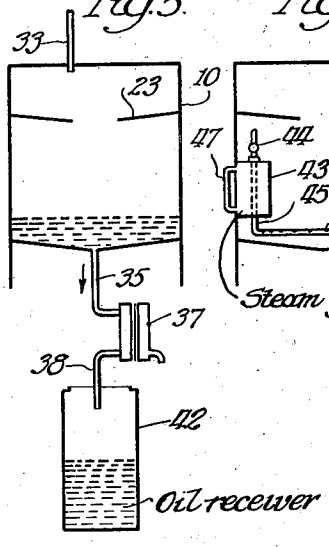


Fig. 6.

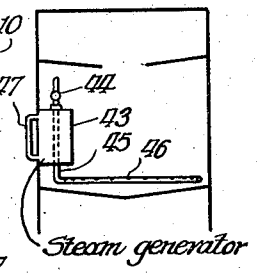
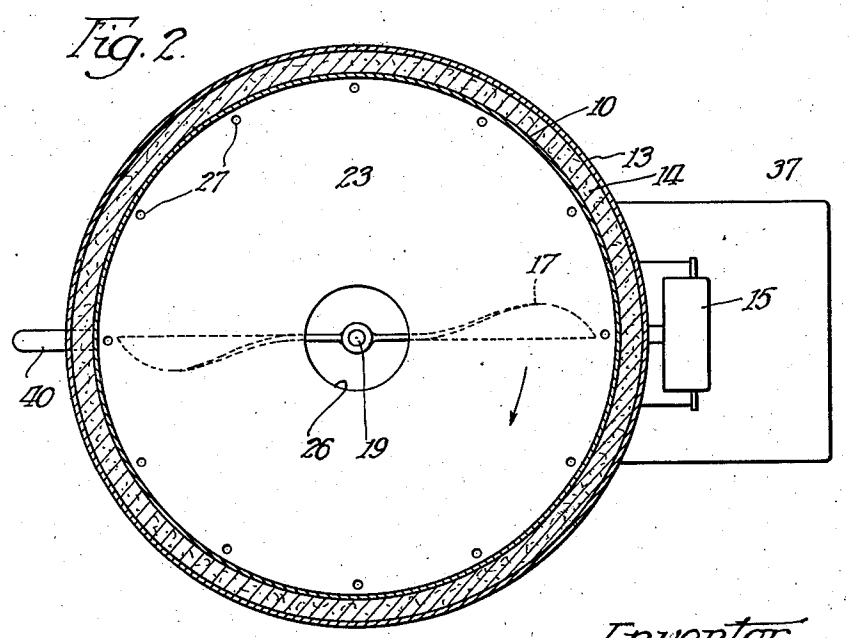


Fig. 2.



Inventor
DeWitt H. Palmer
Roland C. Rehm Atty.

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UNITED STATES PATENT OFFICE

2,103,635

APPARATUS FOR PURIFYING OIL

De Witt H. Palmer, Elkhart, Ind.

Application January 2, 1934, Serial No. 704,934

1 Claim. (Cl. 196—16)

This invention relates to refining of lubricating oil and the like, and among other objects aims to provide an improved method of and apparatus for refining oil, which are particularly adapted for re-refining crank case drainage oil.

The nature of the invention may be readily understood by reference to one method and apparatus embodying the invention and illustrated in the accompanying drawings.

In said drawings:

Fig. 1 is a sectional elevation of a refining still associated with certain accessory apparatus illustrated in diagrammatic form;

Fig. 2 is a plan section taken on the plane 2—2 of Fig. 1;

Figs. 3, 4, and 5 are diagrammatic views illustrating successive stages of the illustrative method; and

Fig. 6 is a view of the refining still equipped with accessory apparatus for passing steam through the oil.

The illustrative method is particularly adapted for re-refining of relatively small quantities of crank case drainage oil such as may accumulate from the operation of fleets of automotive vehicles. The capacity of the apparatus varies from five gallons upward, in which amounts it is important that the apparatus be as nearly as possible automatic in character so as to eliminate the necessity for constant attention which would be impracticable for re-refining oil in such small quantities and moreover would largely or wholly neutralize the economic advantage of re-refining.

In addition to economic advantages, re-refined lubricating oil is generally more stable and durable than the original lubricant, inasmuch as the light fractions of lubricant which tend to crack and break down in service are removed in the re-refining process, producing a lubricating oil which has been able to resist cracking or break-down in service.

Oil drained from crank cases of automobiles, trucks and other internal-combustion engines is petroleum lubricating oil which has become (actually or relatively) unfit for further use in the engine, as the result of dilution and contamination. Dilution results in part from the seepage of unconsumed fuel past the pistons and rings and in part from cracking of the oil itself under the heat and agitation to which it is subjected in engine operation. Contamination consists generally of road dust, liberated carbon and some trifling metallic wear.

Elimination of the diluent is effected by distillation at temperatures equaling or exceeding the end point of the heaviest fractions of the diluent. The contamination is advantageously eliminated by treatment with a purifying substance such as fuller's earth or suitable clays.

In the present process the purifying clay or earth is mixed with the oil to be re-refined at the beginning of the distillation process. While the amount of clay or earth required varies with the character of both the oil and the purifying substance, in round numbers from one to two pounds of purifying material are used per gallon of oil.

The lubricant with the purifying material is placed in a closed receptacle and gradually heated. Agitation is advantageously employed to maintain the purifying material in suspension in the oil, since its purifying efficiency depends upon the effectiveness with which the particles of purifying material are brought into contact with the impurities in the oil, so that the latter may adhere to or be adsorbed on the particles of purifying material. The temperature is elevated until the last fraction of diluent is distilled off. The maximum temperature ranges from 425° F. to 500° F. when distillation takes place in a vacuum, and relatively higher if a vacuum be not employed. Preferably suction is applied to the vessel to carry off the distilled vapors.

The efficiency of earth or clay in purifying and decoloring lubricating oil is enhanced by its use under a rising temperature as compared with a falling temperature, as would be the case if earth or clay were added after completion of the distillation process. For that reason the earth or clay is advantageously added at the beginning of the distillation process, so that it may function during a continuously rising temperature. The precise explanation of this increased efficiency is not known with certainty. Probably the escape of moisture from the particles of earth or clay results in the presentation of fresh surfaces (either by breaking up of the particles or otherwise) for the adsorption of additional suspended matter and color.

All earths and clays commercially available contain moisture in varying percentages. Since the distillation temperature of petroleum lubricating oils greatly exceeds the boiling point of water, the moisture contained in the earth or clay is converted into steam when the boiling point of water is reached. The volume of steam thus released produces considerable foam in the still. The difficulties presented by foaming require either personal attention during distillation or, as in the present instance, a design of apparatus which automatically prevents any objectionable

consequences as a result of the foaming, such as the carrying over of oil with the diluent, which results not only in a waste of oil but spoils the diluent as a by-product.

After distillation and purification, the oil is passed through a filter which removes the purifying earth or clay. The re-refined oil thus produced is restored or enhanced (depending on the top temperature of distillation) as regards specifications of "flash", "fire", viscosity, carbon residue, acidity and resistance to emulsion. Clarity, giving visual evidence of purity, results; and the color may be fully restored or even lightened depending upon the amount of color adsorbing earth or clay employed.

In the drawings is illustrated an apparatus adapted to subject the oil to the foregoing treatments. This particular apparatus is designed for use by the owners of fleets of automotive (and similar) equipment, public garages and the like which accumulate drainage oil.

After being charged with oil, the apparatus operates without requiring the attention of an attendant. The final stage of filtering requires but a short time, and may be attended to when most convenient to do so.

As here shown, the still is represented by a container 10 having a conical or concave bottom 11. An electrical heating element 12 is preferably employed because of convenience and simplicity of control. The use of electricity for heating is made economical by efficient insulation against heat loss provided in this instance by an outer casing 13 separated from the still and an intervening layer of insulation 14. The heating element 12 is controlled by a thermostatic switch which may advantageously be a mercury switch 15 having a thermostat 16 which projects into the still and serves to actuate the switch to break the circuit when the oil in the still is brought to a predetermined maximum temperature. The maximum temperature obviously depends first upon the amount of vacuum (if any) used in the still and second, upon the end point of the least volatile diluent or fraction which it is desired to drive off. The thermostatic mercury switch itself is procurable on the open market and its details form no part of the present invention.

To maintain the purifying earth or clay in suspension, an agitator is provided in the form of a multi-bladed impeller 17 whose blades are pitched (with reference to the direction of rotation) so as to create an upward current to maintain the suspension. The resulting circulation of oil and clay in the still is represented by the dot and dash line 18. The impeller is driven by a shaft 19 which extends through appropriate packing boxes at the bottom of the still and carries a driving pulley 20 which is driven by appropriate belting 21 from electric motor 22.

To eliminate the objectionable results of foaming, the still is provided with a conical baffle or diaphragm 23 located a substantial distance above the oil level 24 and also a substantial distance below the cover 25. The baffle is provided with an opening or openings (in this case a central opening 26) which is relatively small compared with the diameter of the still. Trifling openings 27 are provided at the edges of the baffle to permit the escape of vapors which otherwise would be trapped in the pocket formed by the downwardly inclined baffle.

When the foaming in the oil reaches a somewhat violent stage, it fills the space 28 below the baffle and above the oil level and then gradually passes through the opening 26 in the diaphragm and spreads out harmlessly and at greatly reduced velocity over the large surface of the diaphragm, thereby affording time for the bubbles comprising the foam to break and allowing the resultant liberated oil to flow down the inclined face of the diaphragm back into the oil. The diaphragm thus prevents the undisturbed generation of foam in such quantities as would (except for the baffle) carry it over into the condenser 29 which is connected by pipe 30 to the upper portion of the still. The diaphragm requires the foam to travel over it in such small quantities that bubbles are successively broken down (and the liberated oil returned to the still) before any large volume of foam can accumulate above the diaphragm.

The motor 22 which drives the agitator is advantageously employed to drive other accessories such as the combined compressor and vacuum pump 31, the latter being connected through the receiver 32 with the condenser 29 and the still. The compressor side of the pump is connected by pipe 33 with the still. A two-way valve 34 is placed in this pipe line either to connect the compressor to the still or to close the still side of the pipe 33 and open the compressor side to the atmosphere when the pump is operating as a vacuum pump. A similar valve may also be placed in the vacuum line to close the latter and open the suction side of the pump to atmosphere when the latter is used as a compressor.

It will be understood that upon completion of the distilling and purifying process the compressor may be employed to force the oil and clay through pipe 35 connected with the bottom of the still (the valve 36 having in the meanwhile been opened) into the conventional filter-press 37 from which it issues through pipe 38 into the oil receiver. After completion of the filtering process air may advantageously be forced through the filter to dry the filter cake and assist in removing the oil therefrom. The used clay is advantageously collected in the filter-press upon a sheet of paper which is inserted for this purpose into the filter and by means of which the clay may be completely and easily removed from the filter, leaving it ready for filtration of another batch.

In Figs. 3, 4 and 5 the various steps of the above described process are diagrammatically illustrated. Fig. 3 represents the charging of the still with oil from the container 39 in which it is initially mixed with the required amount of purifying earth or clay. Suction pipe 40 leading to the still has its lower end in close proximity with the lowest point of container 39. A vacuum is developed in the still by vacuum pump 31, and upon opening cock 41 the oil to be processed, together with purifying earth or clay suspended in it, is drawn into the still by vacuum, whereupon the cock is closed and remains closed during the balance of the process.

Fig. 4 illustrates the removal of volatile diluents from the oil during the distillation and purifying process. Vacuum pump 31 functions not only to withdraw the diluents but to maintain the still at sub-atmospheric pressure.

Fig. 5 illustrates the filtration during which the air pressure on pipe 34 assists in passing the oil through the filter and into the oil receiver 42.

Steam may advantageously be used as a solvent for removing fluid or vaporous impurities, particularly where the crank case drainage contains impurities of an unknown origin such as may

occur in garages where the lubricant employed comes from various unknown sources. For that purpose steam is injected into the oil during the distillation process to wash the oil and take out non-solid impurities. For that purpose the still may advantageously be provided with an accessory in the form of a small steam generator 43 (see Fig. 6) which contains enough water to supply an adequate quantity of steam. The hot oil in the tank itself is employed to generate steam in the generator, since the temperature of the oil throughout a considerable period of the process is greatly above the boiling point of water. Preferably the steam injected into the oil is at a temperature less than that of the oil in order to prevent any condensation of the steam in the oil. This is conveniently effected in the present instance by arranging the steam generator so that it is only partly submerged in the oil. The temperature of the steam will therefore be somewhat less than the temperature of the oil. A relief valve 44 is provided for controlling the steam outlet and is set so as to permit the steam to issue when the pressure in the tank reaches from fifteen to twenty pounds gauge. From the relief valve the steam is carried downwardly through pipe 45 and issues through small openings in a circular distributing pipe 46 at the bottom of the tank. A gauge glass 47 serves to indicate the water level in the steam generator. It will be understood that the treatment of the oil by the steam takes place during the driving off of the diluents.

Where the lubricant comes from a known source and is carefully handled so as to exclude grease and other liquid impurities, treatment by steam is generally not necessary.

Obviously the invention is not limited to the details of the illustrative process and apparatus since these may be variously modified. Moreover it is not indispensable that all features of the invention be used conjointly since various features may be used to advantage in different combinations and sub-combinations.

Having described my invention, I claim:

Apparatus for purifying oil comprising in combination a closed vessel for heating batches of oil with a purifying agent, said vessel being substantially deeper than the level of a batch of oil, means for heating the oil to a temperature above the boiling point of water, an agitator for keeping the purifying substance in suspension in said oil, a baffle across the vessel substantially above the oil level and substantially below the top of the vessel, said baffle having a relatively small opening therein to cause the foam formed on heating the oil to spread slowly over the baffle so as to break up the bubbles of foam and being inclined slightly to cause the liberated oil to flow back into said vessel, a condenser connected to said vessel, said baffle being otherwise imperforate except for small openings adjacent its upper edge to allow the escape of trapped vapors, and a vacuum pump for drawing off the distillate into a condenser and for maintaining the oil at sub-atmospheric pressure during the heating process.

DE WITT H. PALMER.