April 4, 1944. F. L. GERIN 2,345,595

APPARATUS FOR OIL PURIFICATION

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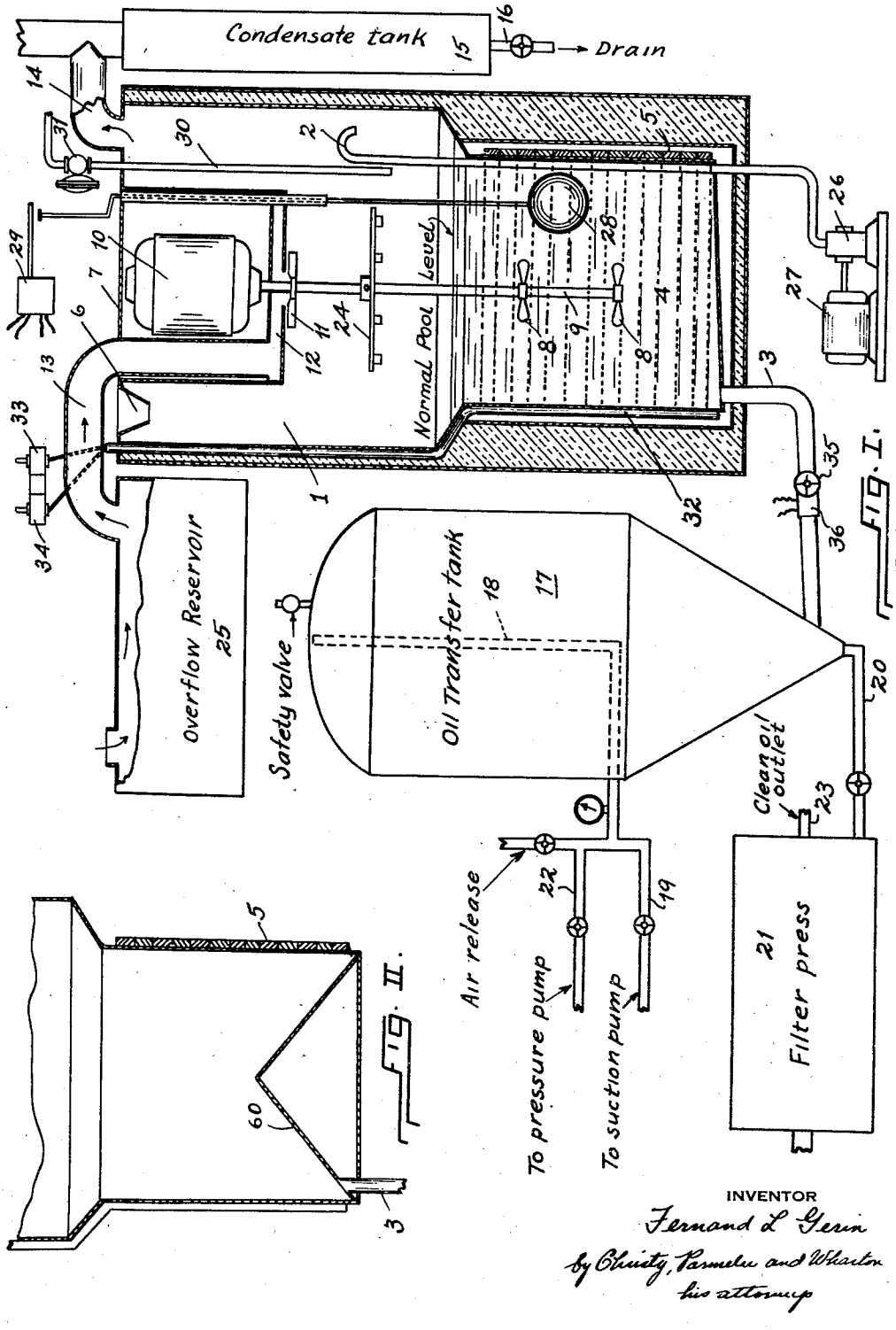


FIG. I.

FIG. II.

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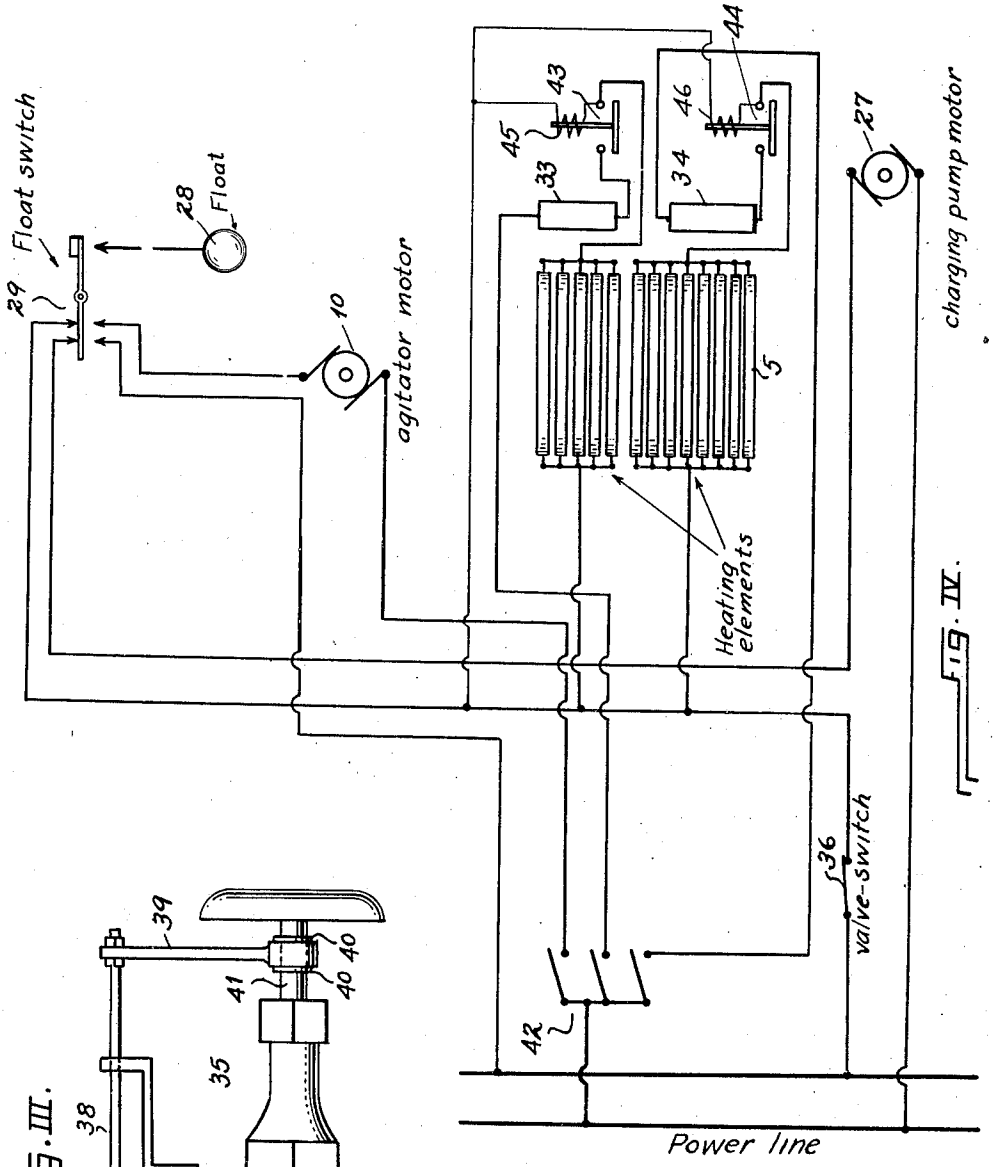


Fig. IV.

Fig. III.

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APPARATUS FOR OIL PURIFICATION

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7 Claims. (Cl. 196—16)

This invention relates to apparatus for the purification of oil, and, specifically, for the separation from oil of contaminants and deterioration products accumulated in use. While the apparatus may be employed in purifying oil that carries such impurities, regardless of its source or previous history, I specify as typical lubricating oil that has become contaminated by use in lubricating an internal combustion engine. The invention is not limited to such engines but may also be advantageously employed in connection with steam turbines, and to purify vegetable and edible oils as well as mineral hydrocarbons. The apparatus may, typically, be sold to the user of a Diesel engine, for the reclaiming of lubricating oil. The contaminated oil from a Diesel engine that is to be purified is, essentially, lubricating oil. The contaminants that are to be removed are, ordinarily, the lighter oil that is used as fuel in the Diesel engine, some of which, escaping, accumulates in the crank-case and becomes mingled with the lubricating oil; water; material of tarry nature, acids and solids. All of these and other adulterant and contaminant substances that may adventitiously be present are to be removed; and to effect removal this apparatus is designed.

In the accompanying drawings Fig. I is a diagrammatic view of the apparatus of the invention; Fig. II is a fragmentary view showing in alternate form and in vertical section one of the component parts of the apparatus; Fig. III is a view in elevation and to larger scale of a valve that controls the escape of treated oil from the treating chamber; and Fig. IV is a schematic view of the heating elements, the float, the motors, and a wiring diagram.

Referring to Fig. I, a treating chamber is indicated at 1. To this treating chamber, oil to be purified is delivered above through a lead 2; and from the treating chamber purified oil is drawn below through a lead 3. The treating chamber is advantageously of cylindrical form and stands in axially vertical position. Its lower portion is of smaller diameter than its upper; and in normal operation the pool of oil 4 under treatment fills the lower portion and rises to a level in the region of enlargement of chamber diameter. The normal level of the pool of oil is in Fig. I indicated by a legend. The oil in the pool 4 is heated by an electrical heating coil 5 that substantially but not wholly surrounds the lower portion of the chamber; and, to realize maximum economy, the chamber wall is made of heat-conducting material, while the assembly is incased in insulation. By the provision of a heating chamber of relatively small diameter in this lower portion the ratio of cubical contents to coil-surrounded heating surface is relatively small, and the heating effect correspondingly large. The volume of oil under treatment may be still further reduced in relation to the wall surface exposed to heat, by such a re-entrant construction of the bottom as is shown at 60 in Fig. II. The larger dimensions of the chamber above the level of the pool of oil is a provision that manifestly makes for facility in the control of the foam that rises as the treating operation proceeds.

Conventional treatment, to which in its essential features I adhere, involves (1) the addition to the body of oil under treatment of clay in finely divided condition, to serve as an agglomerant; (2) stirring of the body of oil with its addition of clay; and (3) heating to a temperature exceeding the boiling point of water. The clay is introduced through an orifice 6 formed in the upper head 7 of the treating chamber. The stirrer may conveniently take the form of paddles 8 carried on a shaft 9 that is axially arranged and driven by a motor 10. The motor may, as indicated, be mounted upon the upper face of the head 7. The heating means have already been specified.

In operation the treating chamber is filled with oil to the level indicated, the proper amount of clay is introduced, the heat is turned on, and the stirrer is set in rotation. At high temperature the water in the oil becomes vaporized and from the oil rendered more fluid by heat makes ready escape; the lighter oils too (the fuel oil of the Diesel engine) is distilled away; while the clay, distributed by the stirrer, agglomerates with suspended particles of solid matter.

The upper portion of the treating chamber is ventilated; it is swept by a stream of atmospheric air. To this end the chamber is closed above by the head 7. The shaft of the motor that carries the paddles 8 carries also a fan 11. This fan takes air from a chamber 12 that is supplied by a feed-pipe 13, and delivers air under pressure radially within the treating chamber, in the upper part thereof, at an interval above the surface of the pool of oil under treatment. Through the head 7 of the treating chamber a discharge pipe 14 leads, and through this pipe the fan drives a stream of air. The air, so circulated within the treating chamber above the level of the pool of oil, takes up and carries with it through the discharge pipe such vapors as in

treatment rise from the oil; and these include water vapor and the vapors of lighter oil, such as the fuel oil of the Diesel engine. A condensate tank 15 is arranged to receive liquid condensed from the out-driven stream of air, and from this tank, through a lead 16 the accumulated liquid may be drawn off.

In operation the water vapor rising from the pool of oil produces a persistent foam that tends to fill the upper part of the treating chamber. The shaft 9 of the motor is equipped with a beater also. This beater or bubble breaker may take the form of a disk 24 of sheet metal with vanes cut and bent from its substance. The beater is affixed to the shaft at a suitable height above the normal level of the oil, and this beater in rotation is effective to cut down the accumulation of foam, and keep the upper portion of the treating chamber open for the passage of the stream of air.

While the volatiles under heat and agitation rise and pass off above, the heavier oil, relieved of such lighter material, accumulates below, and with it the agglomerate of clay and other adulterants. These pass through the pipe 3 to the oil transfer tank 17. They are drawn into tank 17 by suction exerted through pipe 18 and suction-pump lead 19. In some installations the tank 17 is located below the bottom of the heater so that the flow to it is caused by gravity. From tank 17 the accumulation is from time to time driven through a lead 20 from the funnel-shaped bottom of the tank to a filter press 21. The pressure for driving the material from tank 17 is from a pressure pump through lead 22 and the pipe 18 already named. From the filter press the reclaimed oil is delivered at 23.

Provision is made for the collection of oil, in case the apparatus foams over. The air intake includes a reservoir 25, in which the escaping material will be trapped; and, manifestly, oil foaming through the delivery conduit 14 will be caught in tank 15.

Oil is pumped to the treating chamber 1 by a pump 26 driven by a motor 27. A float 28 within the pool 4 of oil in the lower portion of the treating chamber, operates a switch 29 in the circuit that energizes the motor 27; and the arrangement is such that when the pumped-in oil rises to the predetermined normal level, the circuit opens, and the pump ceases to operate.

In the operation particularly under consideration, it is advantageous to increase the water-vapor content of the atmosphere within the treating chamber and above the pool of oil under treatment. Such augmentation tends to prevent the oxidation of the oil under treatment; it tends to expedite the escape of the vapor of lighter oil; and it has also deodorizing effect. To such end a water injection pipe 30 is provided. It penetrates the upper head 7 of the chamber 1 and extends downward to termination at an interval above the normal level of oil in the pool 4. Flow through this pipe is controlled by a thermostat-valve 31; and it will be understood that the thermostat is so arranged that the valve opens and allows a continuous and properly regulated inflow of water when, but not until, the pool 4 of oil has attained the predetermined degree—ordinarily 212° F. Thus the injection of the water occurs under conditions of vaporization; and the injected water is at once converted to vapor and in such condition becomes an augmentation to the atmosphere above the pool of oil.

The temperature of the oil in pool 4, being brought by the coils 5 to the predetermined degree, is limited to that point by means of thermostatic control of the circuits that energize the coils. The thermostats extend vertically against the wall of the treating chamber in the position indicated at 32, and the continuity of the coils 5 is interrupted to give place to the thermostats. Two thermostats 33 and 34 are provided that severally control two switches 43 and 44, one for each of the circuits that severally energize the two banks of heating coils. It is obvious that the heating coils can be divided into more than or less than two controlled banks. In operation, in the particular case chosen for illustration, the optimum temperature to be attained is about 435° F. It is desirable that this temperature be gradually attained, and this for two reasons. First, that the distilling effect be more complete; and second, that the apparatus, on the completion of a run, shall itself contain a minimum of absorbed heat, and so be susceptible to more rapid cooling in anticipation of a fresh charge. Accordingly, as the optimum temperature is approached (at about 420°) one of the thermostats becomes effective, to cut out one of the two banks of coils; and, thereafter, the single bank that remains in energized condition brings the oil more gradually to peak temperature and then is de-energized.

In the line 3 of discharge from the treating chamber is placed a hand-controlled valve 35 (Figs. I and III). This valve is organized with a toggle switch 36. The operating arm 37 of the switch is, by a rod 38, connected to an arm 39 that is carried between two fixed collars 40 upon the stem 41 of the valve. The organization is such that, when the valve is opened, the switch arm 37 is swung into circuit-breaking position in the circuit that energizes the motor 27 that drives the pump 26 for charging oil to the treating chamber. Alternately, when valve 35 is closed the energizing circuit for motor 27 is completed, and the pump is set in operation for recharging the tank. Such energizing of motor 27 presupposes the shifting of the switch 29, described above, to circuit-closing position, and this is brought about by the descent of float 28 as the oil flows from the treating chamber. The valve switch 36 insures that the heating elements 5 cannot be energized when the valve 35 is open to discharge.

Co-ordination is provided, that motor 10 shall go into operation and drive stirrer 8, fan 11, and foam spreader 24, when, but not until, a full charge 4 of oil has been pumped into the treating chamber. The switch 29 is arranged in the circuit that energizes the motor 10 and the same swing of the switch-arm that interrupts the circuit of pump motor 27 closes the circuit that energizes the motor 10.

In Fig. IV a manually operated switch 42 is diagrammatically indicated. The operator by closing this switch will close the circuit for energizing the motor 10 and will establish connections through which the banks of the heating coils may be energized, when, but not until, two other switches 43 and 44 shall be manually closed. This provision requires the deliberate attention of the operator, and is a safeguard against the bringing of the heater in operation carelessly when the tank is empty. Once the heating coils have been energized, the manually closed switches 43, 44 are held in closed position by means of

locking coils 45, 46, connected in shunt across the heating coils.

While I have described the present preferred embodiment of my invention, it will be understood that the description is by way of illustration only and that the invention may be otherwise embodied and practiced within the scope of the following claims.

I claim as my invention:

1. In apparatus for purifying oil, a treating chamber adapted to receive in its lower portion a pool of oil to be treated, means for heating the pool of oil within the chamber, means for circulating a vapor-removing stream of air through the upper portion of the chamber, means in the upper part of the chamber above the normal level of the pool effective over substantially the full diameter of the chamber for cutting down foam accumulating above the surface of the pool of oil, and an overflow reservoir at one side of the treating chamber communicating with the chamber above said means for cutting down the foam.

2. In apparatus for purifying oil that includes a treating chamber adapted to receive in its lower portion a pool of oil to be treated, a rotary shaft extending from above downwardly, a stirrer borne by the shaft beneath the normal level of a pool of oil within the chamber, a fan borne by the shaft above the level of such pool, and a duct for supplying atmospheric air to said fan said fan being effective to direct air from the duct down into the chamber over the surface of the pool of oil within the chamber, said chamber being provided with an exit for vapor-laden air, the invention herein described which consists of a foam leveller, borne by the said shaft and arranged between the stirrer and the fan whereby air introduced by the fan is deflected toward the periphery of the foam leveler to intercept any rising mass of foam.

3. Apparatus for purifying oil comprising a treating tank having oil heating and agitating means, means for causing a stream of air to sweep over the surface of the oil in the chamber, means in the top of the tank for flowing water onto the surface of the oil to form steam at said surface, and a thermostatically controlled valve for the last named means whereby water may not be introduced until the oil has reached a predetermined temperature.

4. In apparatus for purifying oil, a treating chamber of greater cross-sectional area in its upper than in its lower portion, means for heating the walls of the lower portion of the chamber, the chamber having an air inlet opening in the upper portion thereof, a fan introducing air through said opening and projecting it downwardly into the chamber, a duct leading from said opening through which the air is conveyed to the opening, and an overflow trap with which the duct communicates and which in turn opens to the atmosphere.

5. A still for the purifying of used oils comprising a container having a lower oil receiving portion and an upper expansion portion, the lower portion being of a diameter less than the upper portion, and electric heating means around the said lower portion for heating the contents of the container, said electric heating means having upper and lower portions and means for separately controlling the upper and lower portions.

6. A still for the purifying of used oils comprising a still having a cylindrical lower portion adapted to receive a pool of oil to be treated, said still having a cylindrical upper portion of larger diameter than the lower portion and forming a continuation of the lower portion, the upper portion constituting an expansion chamber, and electric heating means around the sides of the lower portion of the still only, an agitator shaft in the still having an agitator thereon in the lower portion of the still, said shaft having a foam breaker thereon in the enlarged upper portion of the still, the foam breaker having a diameter greater than the radius of the lower portion of the still.

7. A still for reconditioning used oil comprising a container having a cylindrical lower portion, heating means around the side walls of said cylindrical lower portion, a cylindrical upper portion of larger diameter forming an extension of the lower portion, the lower portion approximately defining the maximum depth of the pool of oil which may be treated, the upper portion constituting an expansion chamber, a shaft in the container extending in an axial direction and having an agitator in the lower portion of the container and a foam leveler on said shaft in the upper portion of the container intermediate the top and bottom of said upper portion, the foam leveler being spaced from the side walls of the upper part of the container, the space around the periphery of the foam leveler to the walls of the container being substantially unobstructed whereby a mass of foam may be deflected by and thrown radially outward from the periphery of the foam leveler across any mass of foam that rises above the periphery of the foam leveler.

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