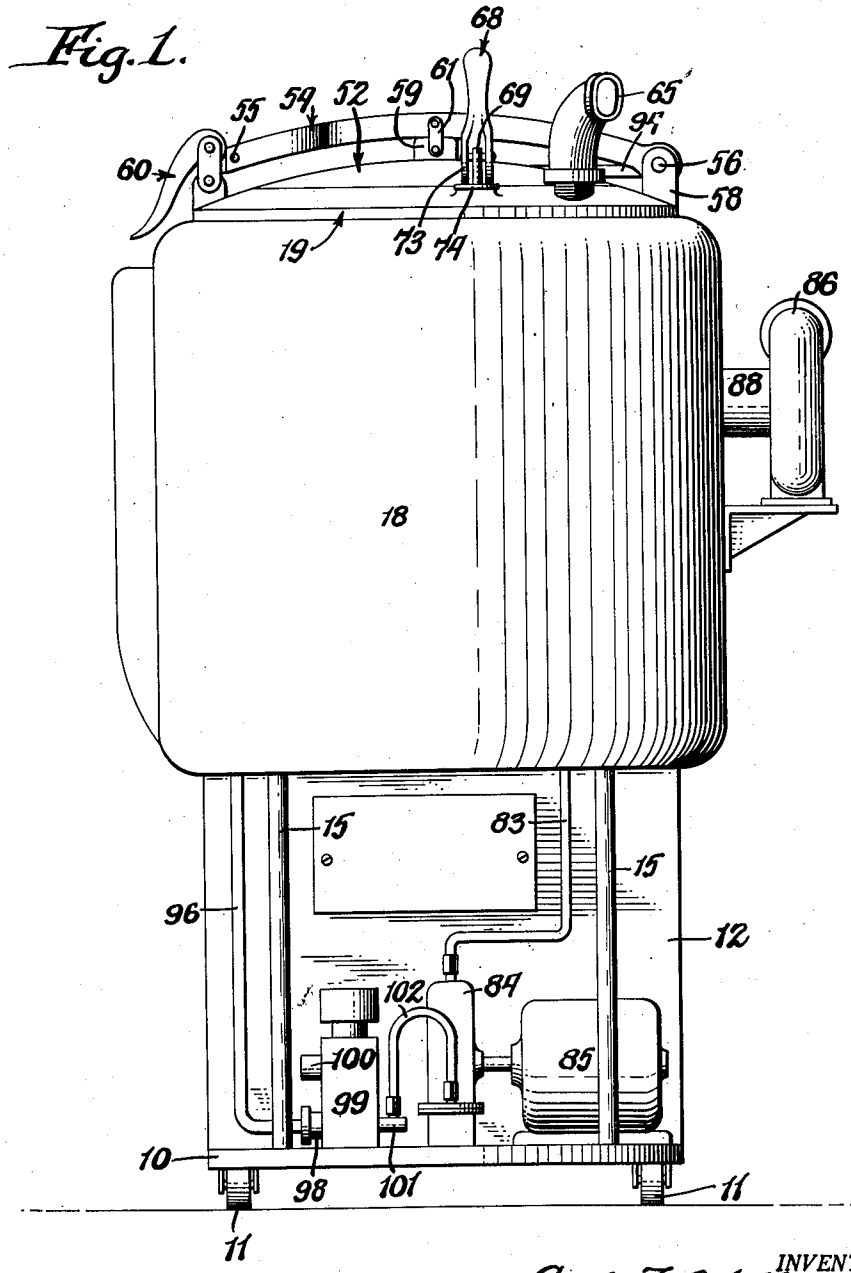
Jan. 20, 1953 C. F. MILLER ET AL 2,626,229

APPARATUS FOR REFINING USED LUBRICATING OIL

Filed Oct. 22, 1948 5 Sheets-Sheet 1

Fig. 1.




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Fig. 2

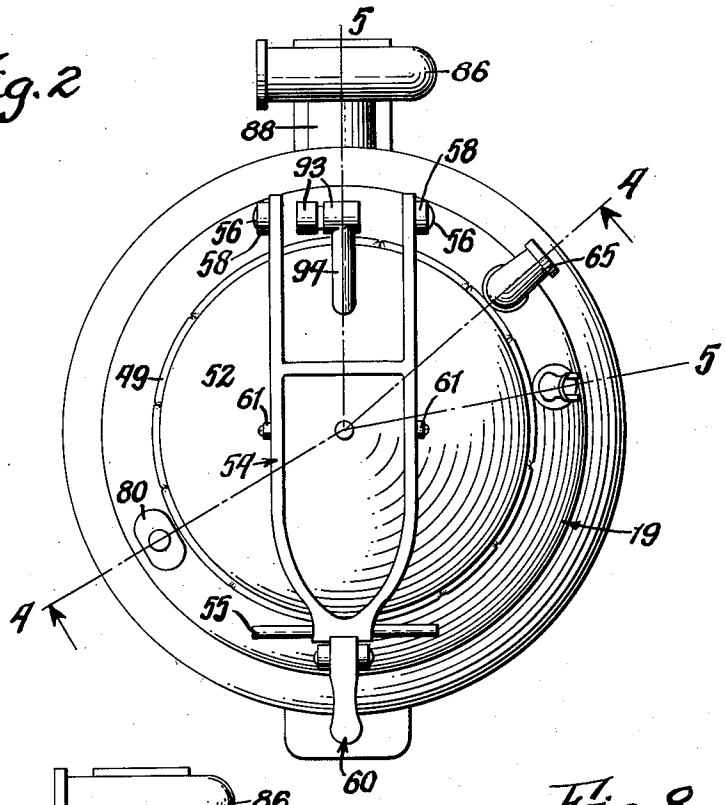



Fig. 3.

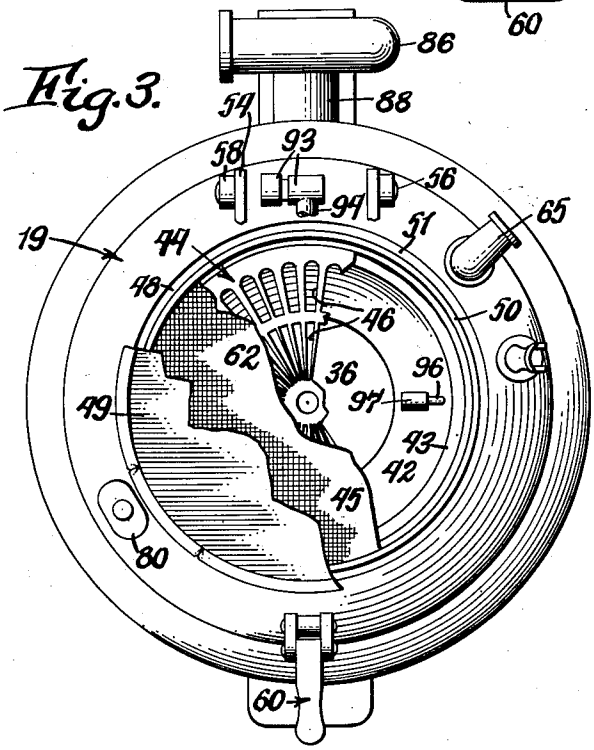
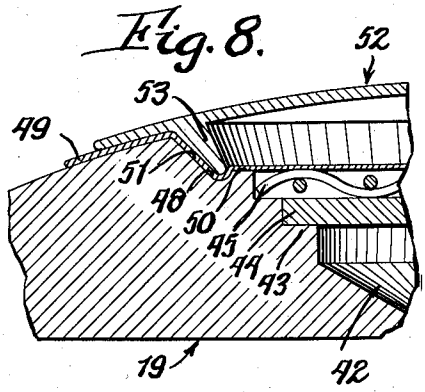



Fig. 8.



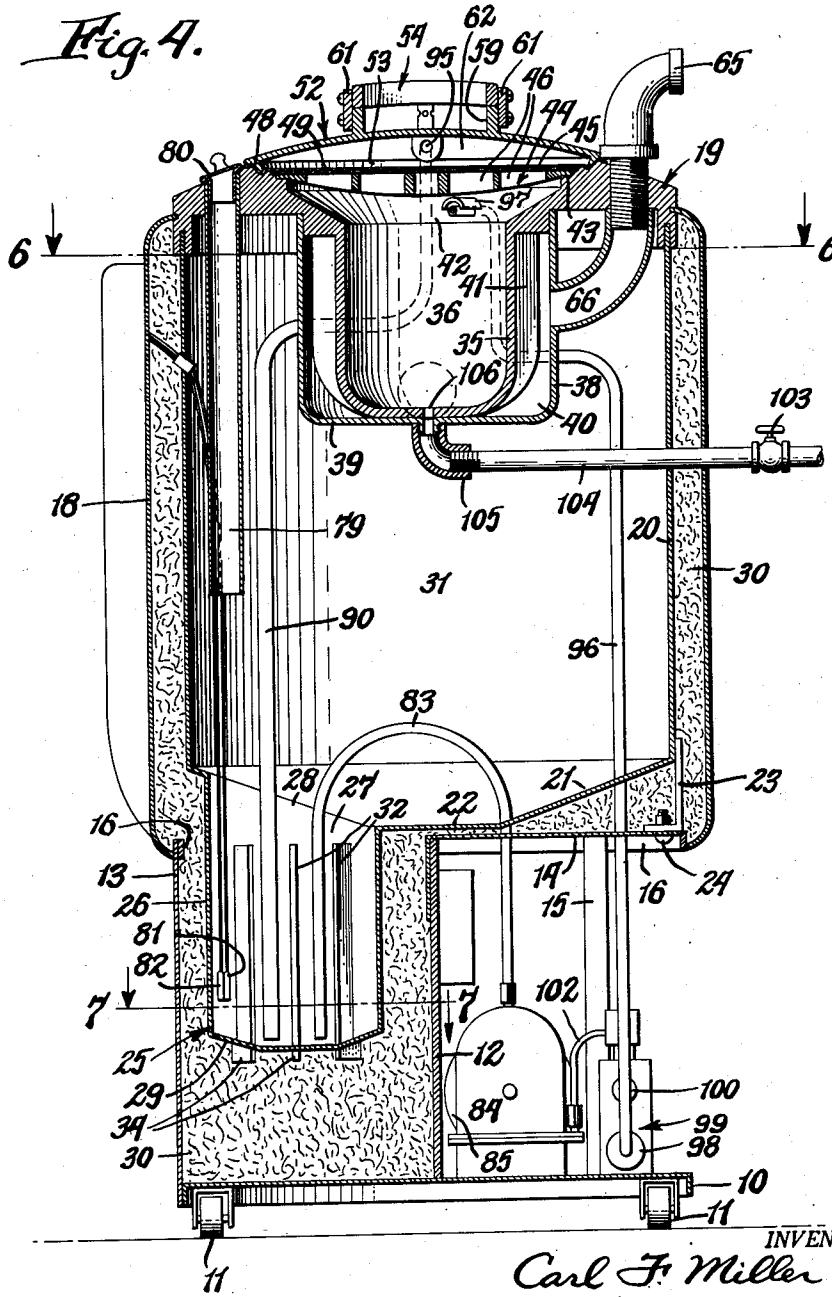

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APPARATUS FOR REFINING USED LUBRICATING OIL

Filed Oct. 22, 1948 5 Sheets-Sheet 3

Fig. 4.




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APPARATUS FOR REFINING USED LUBRICATING OIL

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Fig. 5.

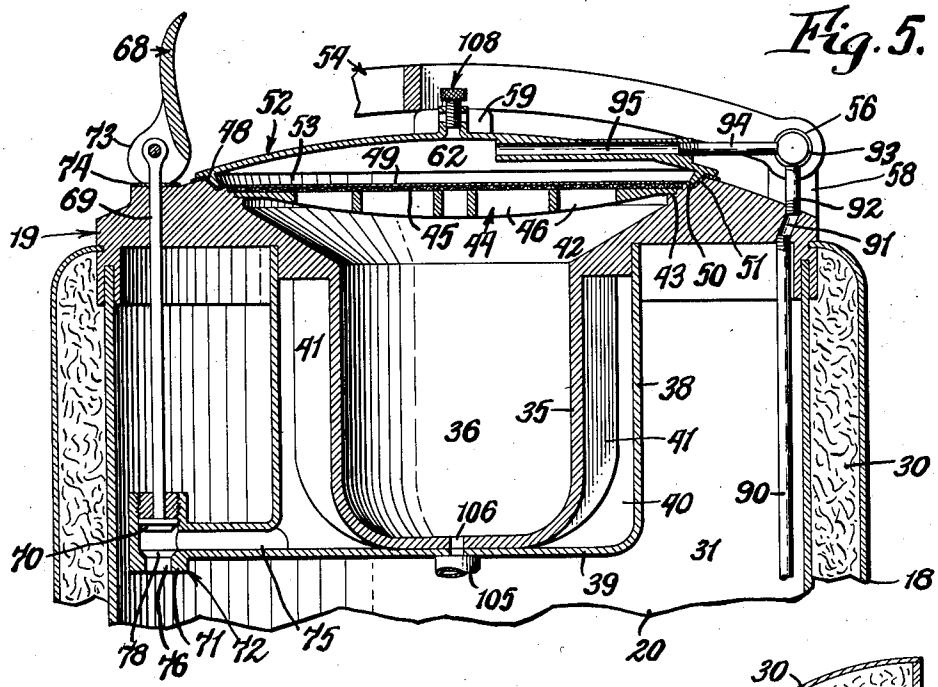



Fig. 6.

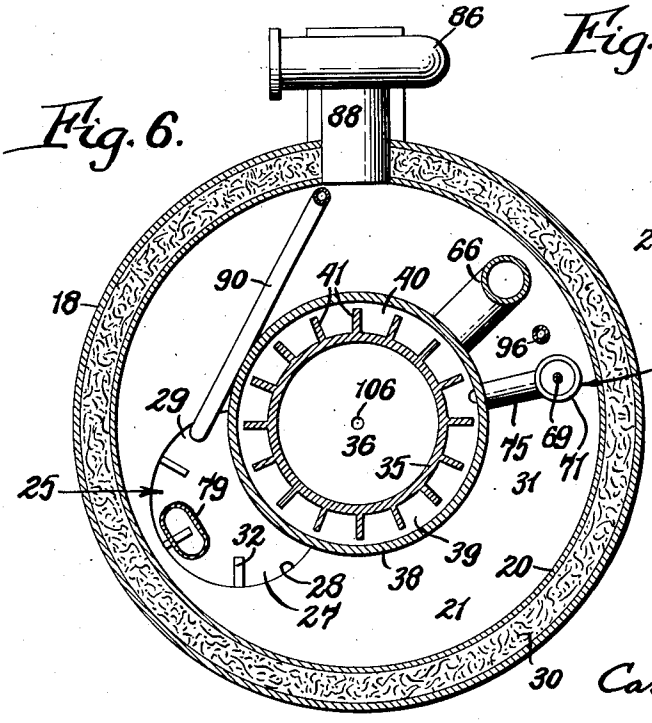
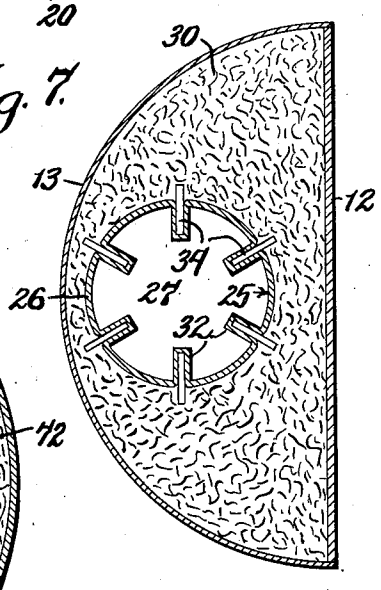



Fig. 7.



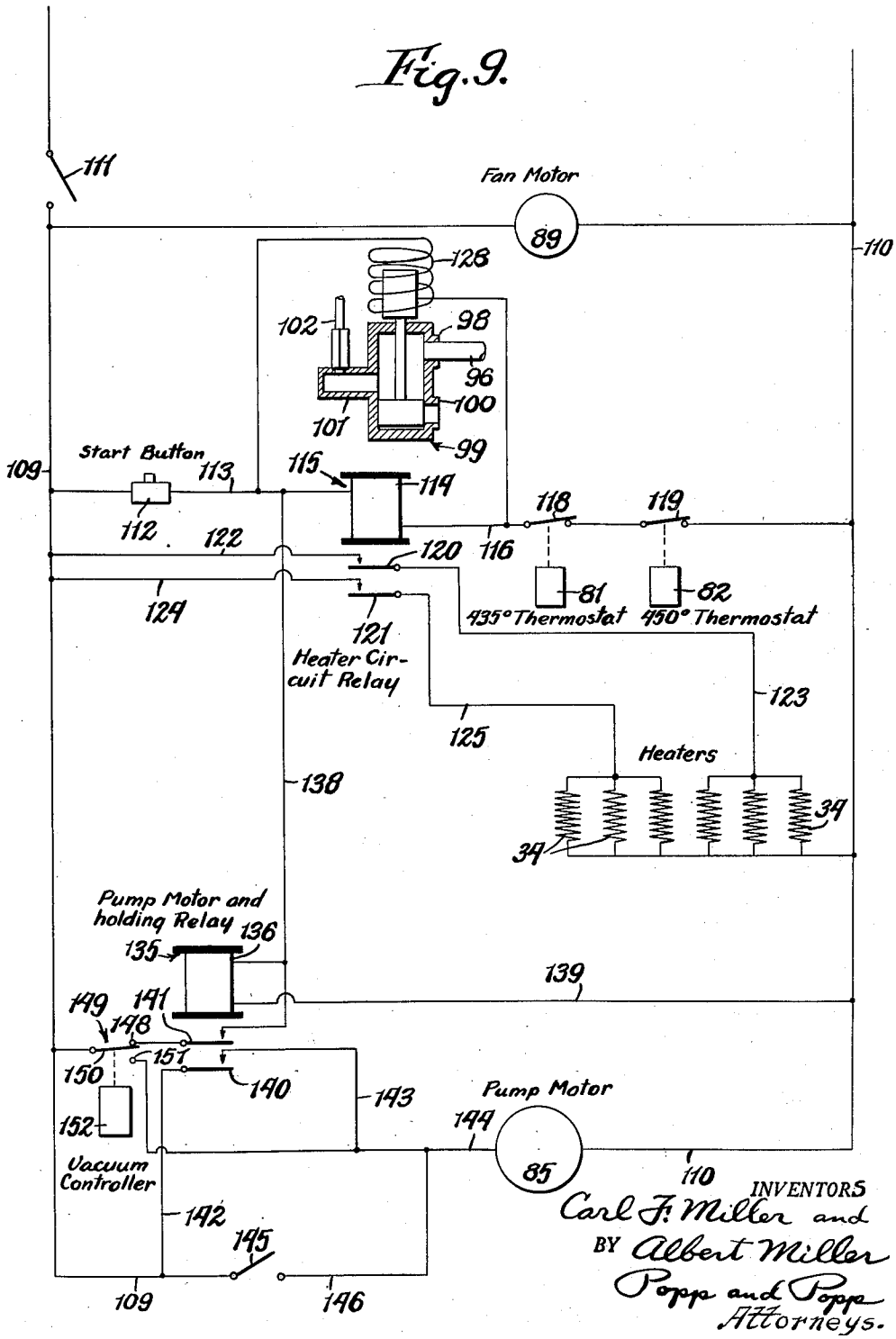

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Fig. 9.




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# UNITED STATES PATENT OFFICE

2,626,229

## APPARATUS FOR REFINING USED LUBRICATING OIL

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Orchard Park, N. Y.

Application October 22, 1948, Serial No. 55,926

5 Claims. (Cl. 196—16)

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This invention relates to apparatus for refining used lubricating oil and more particularly to the agitation of the oil being refined and to the automatic electrical control of the full sequence of operation so that the operator is relieved from the necessity of supervising the operation after starting the refining sequence.

The invention is directed to apparatus designed to refine used lubricating oil which usually contains not only particles of metal, dirt and discoloring matter but also lighter fractions of gasoline, kerosene, acids, water or the like all of which must be removed to restore the lubricating oil to its original condition. The present invention is directed to apparatus in which a charge of the used oil is preheated through heat derived from the outgoing charge of refined oil and is admitted, together with a charge of refining solids, such as fuller's earth which acts to bleach, neutralize acids and absorb impurities and discoloring matter, into a distillation chamber. In this distillation chamber the charges of used lubricating oil and refining solids are heated to a temperature to vaporize the lighter fractions which are drawn off by an exhaust fan. After the predetermined distillation temperature is reached the charges of lubricating oil and refining solids are transferred to a filtering chamber where these charges are passed through a filter paper to remove the refining solids and remaining impurities, the filtration being under vacuum. After the finished oil has been brought into heat exchange relation with an incoming charge of used lubricating oil it is withdrawn from the apparatus.

The present invention is directed to an improved means for agitating the charges of used lubricating oil and refining solids while being distilled and to the electrical control for automatically effecting a complete sequence of operation in response to the closing of a start switch by the operator.

Accordingly one of the principal objects of the invention is to provide for the simple and effective agitation of the oil and refining solids in the still, which agitation not only maintains the refining solids in suspension and increases heat transfer between the walls of the still and the oil being distilled and increases the effective contact between the oil and the refining solids but also aerates the oil being distilled to accelerate the release of the lighter fractions.

Another object is to provide a simple, reliable, accurate and rugged electrical control for the refining sequence which insures the heating of the used oil and refining solids to the proper distillation temperature, the transfer of the distilled oil and refining solids to an overhead filtering chamber and the restoration of the electrical components to their original condition for a repetition of the sequence of operation. Other objects and advantages will appear from the following description and drawings in which:

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Fig. 1 is a side elevational view of apparatus for refining used lubricating oil and constructed in accordance with the present invention.

Fig. 2 is a top plan view thereof.

Fig. 3 is a top plan view similar to Fig. 2 showing parts broken away to disclose parts of the operating mechanism.

Fig. 4 is a vertical section taken generally on line 4—4, Fig. 2.

Fig. 5 is a fragmentary enlarged vertical section taken generally on line 5—5, Fig. 2.

Fig. 6 is a horizontal section taken generally on line 6—6, Fig. 4.

Fig. 7 is a horizontal section taken generally on line 7—7, Fig. 4.

Fig. 8 is a fragmentary enlarged view similar to Fig. 5 and showing in greater detail the clamping fit of the filter paper disk between the upper end head and cover of the apparatus.

Fig. 9 is a wiring diagram illustrating the electric components and the electrical circuit of the apparatus.

The apparatus forming the subject of the present invention is particularly adapted for use by garages and the like in refining used lubricating oil in successive batches of several gallons or so and to this end the apparatus includes a circular base plate 10 mounted on casters or rollers 11 so that the entire apparatus can be moved from place to place as conditions may require. A vertical central plate 12 is mounted on the base plate 10 so as to extend diametrically from one side thereof to the other and the vertical edges of this diametrically extending plate 12 are connected to the edges of a semicylindrical sheet metal shell 13 which extends around and is supported at its lower edge by the margin of the base plate 10. A semicircular, horizontal plate 14 is suitably secured along its straight edge to the upper edge of the diametrically extending vertical plate 12 and extends over the half of the base plate 10 not embraced by the semicylindrical shell 13. For strength, this semicircular horizontal plate 14 is preferably supported from the base plate 10 by one or more posts 15, two being shown.

For additional strength, a circular band 16 extends around and is secured, as by welding, to the circular edge of the semicircular horizontal plate

14 and upper extremity of the semicylindrical shell 13. The apparatus includes an upper cylindrical sheet metal outer shell 18, the lower part of which preferably curves inwardly as shown. On the corresponding side of the apparatus, the lower edge of this outer sheet metal shell 18 is shown as welded to that part of the circular band 16 secured to the semi-circular horizontal plate 14, and on the other side of the apparatus the lower edge of this outer sheet metal shell is shown as welded directly to the outer face of the semicylindrical sheet metal shell 13.

The upper extremity of this outer sheet metal shell 18 also preferably curves inwardly and has its edge suitably secured to an upper end head 19 which is preferably in the form of a casting and made of a relatively light weight aluminum alloy. An inner cylindrical sheet metal shell 20 is arranged within and in spaced relation to the outer cylindrical sheet metal shell 18 and has its upper edge suitably secured to the rim of the upper end head 19. The lower edge of this inner cylindrical sheet metal shell 20 is joined to the margin of a frustoconical bottom 21 terminating in a horizontal circular central plate 22. The frustoconical bottom 21, 22 is arranged immediately above the horizontal semicircular plate 14 and the inner cylindrical shell 20, together with its bottom and the upper end head 19 are preferably additionally supported by a plurality of L-shaped brackets 23 welded to the sides of the inner cylindrical sheet metal shell 20 and secured, as by bolts 24, to the horizontal semicircular plate 14.

The inner shell 20, 21, 22 is provided with a sump 25 which extends downwardly into the space defined by vertically diametrically extending plate 12 and the semicylindrical shell 13 and in spaced relation thereto. This sump 25 is shown as comprising a cylindrical sheet metal shell 26 forming a distillation chamber 27, the upper end of this shell 26 extending through an opening 28 through the corresponding side of the frustoconical bottom 21 of the inner cylindrical shell 20 and being secured thereto in any suitable manner as by welding. The sump is provided with a circular bottom wall 29 which encloses the same. It will therefore be seen that the apparatus as described generally includes an outer wall formed by the base plate 10, the diametrically extending vertical plate 12, the semicylindrical shell 13, the semicircular horizontal plate 14 and the outer cylindrical sheet metal shell 18 and an inner shell comprising the inner cylindrical sheet metal shell 20, its bottom 21, 22 and its sump 25. The space between these inner and outer shells is filled with a suitably thermal insulating material indicated at 30.

The charge of used lubricating oil is received in the distillation chamber 27 of the sump 25 and is subjected therein to heat to drive off the lighter fractions, these lighter fractions escaping as vapor into the vapor chamber 31 formed by the inner cylindrical sheet metal shell 20 and its bottom 21, 22 to be thence exhausted to the atmosphere, as hereinafter described. For the purpose of bringing the used lubricating oil contained within the sump 25 up to the proper distillation temperature, the sides of this sump are formed in part by an annular series of vertical hollow fins 32 projecting radially into the sump and forming vertical recesses on the exterior of this sump. In each of these recesses is arranged an electrical heating element 34 of any suitable form, the arrangement of these heating elements in these hollow radial fins of the sump 25 insuring a rapid rate of heat transfer to the batch of oil contained within this sump thereby to accelerate bringing each batch of oil to the desired distillation temperature.

The round upper end head 19 of the apparatus, which is preferably in the form of a light weight alloy casting, is formed to provide a sump or depending shell 35 which is disposed coaxially within the upper part of the inner cylindrical sheet metal shell 20 and which forms a chamber 36 for receiving the charge of oil after it has been refined or processed. This refined oil receiving shell 35 is enclosed by a cylindrical shell 38 having a horizontal bottom 39 and the upper edge of which is suitably secured to the upper end head 19. The space 40 between the refined oil receiving shell 35 and this surrounding cylindrical shell 39 forms a preheating chamber for receiving the initial charge of used lubricating oil. To achieve heat transfer between the finished oil in the refined oil chamber 36 and the incoming charge of used lubricating oil in the preheating chamber 40, the cylindrical wall of the sump 35 is provided with fins 41 projecting radially into the preheating chamber 40.

The refined oil chamber 36 receiving the finished oil is enlarged at its upper end by the provision of the outwardly and upwardly enlarging face 42 provided in the upper end head 19 and around the rim of this conical enlargement 42 of the chamber 26 the head 19 is provided with a circular seat 43 in which the rim of a supporting grid 44 is disposed. This grid can be of any suitable form to support a foraminous metal screen disk 45, the grid being shown as being in the form of a skeleton casting having suitable circular and radial ribs to provide large openings 46 which the foraminous disk 45 covers.

Immediately outside of the seat 43 for the grid 44 and the screen disk 45 the head 19 is formed to provide a seat 48 for a disk 49 of filter paper. In cross section this seat has a generally horizontal inner portion 50 and a frustoconical outer portion 51 of upwardly enlarging form. The margin of the filter paper 49 is firmly clamped against this outer upwardly enlarging frustoconical portion 51 by a circular dome shaped cover 52, this cover having a depending rim 53 for this purpose which conforms to the shape of the frustoconical outer part 51 of the filter paper seat 50.

This cover can be secured in tightly clamping and sealing relation with the filter paper 49 in any suitable manner, as by the bifurcated holddown bar 54 having handle bars 55 at its free end. The bifurcated ends of this holddown bar 54 are shown as pivoted, as at 56, to a pair of upstanding lugs 58 secured to one side of the upper end head 19, the central part of this holddown bar being arranged to bear downwardly upon a pair of lugs 59 provided centrally on the cover 52. The free end of the holddown bar is shown as engageable with a cam lever 60 mounted on the side of the upper end head 19 opposite from the hinge for the holddown lever. This cam lever, together with its mounting, can be of any usual and well known construction to be brought into engagement with the free end of the holddown bar and force it downwardly to effect pressure sealing of the cover 52. As the details of this cam lever 60 and its mounting form no part of the present invention, it is not illustrated in detail.

Upon releasing the cam lever 60 the bifurcated

holddown bar 54 can be raised, this bar swinging around its pivots 56 for this purpose. To facilitate raising the cover 52 this cover is shown as connected to the holddown bar so as to be lifted therewith. For this purpose, a pair of links 61 are shown, each of which is shown as pivoted at its upper end to one arm of the bifurcated holddown bar 54 and at its lower end to the corresponding lug 59 upon the cover. The pivotal connections of these links are preferably sufficiently loose as not to interfere with direct engagement between the holddown bar 54 and the lugs 59 of the cover 52 in pressing the cover downwardly against its seat but insure lifting of the cover 52 when the holddown bar 54 is released from the cam lever 60 and manually elevated.

The domed shape of the cover 52 and its rim form, in combination with the disk 49 of filter paper, provide a filtering chamber 62 into which the distilled lubricating oil and the refining solids entrained therein are drawn by vacuum as hereinafter described.

The batch of used lubricating oil to be refined is introduced through an elbow fitting 65 having a threaded stem extending through the upper end head 19 and to the lower end of which an elbow 66 is secured, this elbow being arranged in the upper part of the vapor chamber 31 and connecting with the side wall 38 forming the preheating chamber 40 so as to discharge the used lubricating oil into this preheating chamber 40. In this chamber the batch of oil is preheated through heat derived from the finished or refined oil in the chamber 36. After the incoming charge of used lubricating oil has been so preheated, the operator lifts the lever 68 shown in Fig. 5 which is connected by a rod 69 extending through the upper end head 19 and the lower end of which connects with a valve head 70 within the valve housing 71 of a dump valve indicated generally at 72. The manual valve lever 68 has its lower part formed to provide a cam surface 73 which engages a plate 74 on the head 19 and the pivotal connection between this hand lever and the rod 60 is such that when the hand lever 68 is rotated to the generally upright position shown in Fig. 5, the cam surface 73 cooperates to lift the rod 69. The housing 71 of the dump valve 72 has an inlet conduit 75 communicating with the preheating chamber 40 formed between the sump 25 and the shell 38 and its outlet 76 is surrounded by a valve seat 78 against which the valve head 70 seats when the handle 68 is brought to its horizontal position. It will therefore be seen that upon lifting the manual dump valve handle 68 the valve head 70 is removed upwardly from its seat 78 thereby to permit the charge of preheated used lubricating oil to flow from the preheating chamber 40 into the vapor chamber 31.

This charge of oil so dumped by manipulation of the dump valve lever 68 flows to the bottom 21, 22 of this chamber and thence into the distillation chamber 27 in the sump 25. The refining operation of the present invention also involves the use of refining solids such as fuller's earth which is mixed with the batch of preheated used lubricating oil so dumped itno the sump 25 by opening the dump valve 72. To introduce the fuller's earth, a tube 79 extends through the upper end head 19 and has its lower open end arranged directly above the sump 25 as best shown in Fig. 4. The upper open end of this tube is closed by a manually removable cover 80 of any suitable form. After the operator has opened the dump valve 72 he removes the cover 80 and pours a charge of fuller's earth into the tube 79. This charge of fuller's earth flows down through the tube 79 and drops into the distillation chamber 27 formed by the sump 25 to join the batch of preheated used lubricating oil contained therein.

In this distillation chamber 27 the oil, together with the refining solids, is subjected to the heating action of the electrical heating elements 34 contained within the exterior pockets of the hollow radially projecting fins 32 of the wall 26 of this chamber. This heating is continued until the charge of oil is brought up to a temperature which drives off the undesirable lighter fractions of the used lubricating oil and for this purpose the maximum temperature of the oil within the sump 25 is under thermostatic control. This control is derived from two thermostats immersed in the oil within the sump 25, one of these thermostats designated at 81 being set to operate at 435° F., and the other of these thermostats, designated at 82 being set to operate at 450° F. These thermostats operate through the electrical circuit hereinafter described.

While the batches of used lubricating oil and refining solids are so being heated within the distillation chamber 27 they are subjected to agitation and aeration to provide improved heat transfer and more rapid heating of the oil as well as to accelerate the release of the lighter fractions as vapor from the lubricating oil. This agitation also operates to keep the fuller's earth or other refining solids in suspension and to insure intimate contact between the used lubricating oil and the fuller's earth. To provide this agitation and aeration a goose neck tube 83 has its open outlet end disposed in the bottom of the sump 25 and its arching portion arranged in the vapor space 31, with its other end extending through the bottom 21, 22 of this vapor space and the horizontal semicircular plate 14 of the shell and connecting with the outlet of a pump 84. This pump is suitably mounted on the base plate 10 alongside the diametrically extending vertical plate 12 and is driven by an electric motor 85 which is actuated as hereinafter described. The lighter fractions driven off of the batch of used lubricating oil contained within the sump 25 by the combined action of the heating elements 34 and the agitation provided by the discharge of compressed air from the goose neck tube 83 rise into the vapor space 31 and are exhausted therefrom by an exhaust fan 86. As best shown in Fig. 6 the inlet 88 for this exhaust fan extends through the inner and outer cylindrical shells 20 and 18 so as to communicate with the vapor space 31 and the outlet of this fan is arranged to discharge the vapors to the atmosphere. This exhaust fan is driven by an electric motor 89 arranged in circuit as hereinafter described.

After the batch of used lubricating oil has been treated in the sump 25 at the temperature necessary to drive off the undesirable lighter fractions it is drawn by vacuum into the filtering chamber 62 for filtration to remove the fuller's earth, together with the remaining impurities. For this purpose a transfer tube 90 has its lower end arranged in the bottom of the sump 25 and extends upwardly therefrom and is secured in a bore 91 extending through the head 19, as best shown in Fig. 5. In the upper end of this bore is fitted a pipe 92 which connects with a rotary slip joint 93 arranged coaxially with the hinge pivots 56. The other part of this rotary slip joint con-

nects with a pipe 94 which communicates with a horizontal bore 95 through the cover 52, the inner open end of this bore being arranged to discharge the oil centrally into the filtering chamber 62 on top of the disk 49 of filter paper which is clamped in position by this cover.

The vacuum for inducing the flow of oil from the sump 25 up through the transfer tube 90, slip joint 93, pipe 94 and conduit 95 is applied to the finished oil chamber 36 by the pump 84. For this purpose a suction line 96 is provided, the inlet end of which, as best shown in Fig. 4, extends through the upper end head 19 into the finished oil chamber 36 and thence downwardly through the vapor space 31. This inlet of the suction line 96 can be protected by an overhanging cap 97 of any suitable form and from the vapor space 31 this vacuum line 96 extends downwardly through the bottom 21, 22 of this vapor space and through the semicircular horizontal plate 14 to the exterior of the casing. The lower end of this suction line 96, as best shown in Figs. 1 and 9 connects with one inlet 98 of a three way solenoid valve 99. The other inlet 100 of the three way solenoid valve is open to the atmosphere. The outlet 101 of this three way solenoid valve connects, through a suction line 102, with the inlet of the pump 84. In the de-energized condition of the three way solenoid valve 99 the inlet of the pump is connected, through the line 102, with the valve inlet 98 connecting with the suction line 96 and under these conditions a vacuum is applied, through this line 96, to the finished oil chamber 36. This vacuum, through the disk 49 of the filter paper, serves to draw the charge of oil and fuller's earth contained within the sump 25 up through the line 90, slip joint 93, and conduit 95 through the cover 52 to be discharged into the filtering chamber 62 on top of the disk 49 of filter paper. The fuller's earth, together with the remaining impurities within the batch of oil, is retained on this disk of filter paper. The purified oil passes through the filter paper into the finished oil chamber 36. After the refined oil within the chamber 36 has been utilized to preheat an incoming charge of used lubricating oil, the operator opens the discharge valve 103 shown in Fig. 4. This discharge valve is arranged in a pipe 104 extending through the inner and outer shells 20, 18 of the casing and connecting through an elbow 105 with a discharge orifice 106 through the bottoms 39 of the shells 35 and 38.

In the energized condition of the three way solenoid valve 99 the inlet of the pump is connected, through the line 102, with the valve inlet 100, this valve inlet 100 being open to the atmosphere.

To relieve the vacuum in the filtering chamber 62 and finished oil chamber 36, and thereby permit the cover 52 to be raised, a vent valve 108 is provided in the cover 52.

The apparatus is semi-automatic in its operation and for this purpose is provided with the electrical control circuit shown in Fig. 9. In this circuit the numeral 109 represents one side of a main power line and the numeral 110 represents the other side of this main power line, this main power line being under control of a line switch 111. The fan motor 89 is connected directly across the main power line 109, 110 so as to be energized when this line switch 111 is closed. Each cycle of operation is initiated by a manual start button switch 112 which is connected to the side 109 of the main power line and connects with a line 113 leading to the winding 114 of a heater circuit relay 115. The other end of this winding 114 is connected by a line 116 with a normally closed switch 118 actuated by the 435° thermostat 81. The other terminal of this switch 118 connects with a normally closed switch 119 actuated by the 450° thermostat 82. The other terminal of this switch 119 is connected with the other side 110 of the main power line.

The relay 115 is provided with two normally open armatures 120 and 121. When the relay is energized the armature 120 closes a circuit from the side 109 of the main power line through lines 122 and 123 through one group of the heating elements 34 to the other side 110 of the main power line. Similarly, when the relay 115 is energized the armature 121 closes the circuit from the side 109 of the main power line through lines 124 and 125 and another group of the heating elements 34 to the other side 110 of the main power line.

The winding 128 of the solenoid valve 99 is connected to parallel with the winding 114 of the heater circuit relay 115 and for this purpose one end of the solenoid valve winding 128 is connected by a line 129 to the line 113 and the other end of this winding 128 is connected by a line 130 with the line 116. It will therefore be seen that the heater circuit relay 115 and the solenoid valve 99 are energized and de-energized simultaneously.

The numeral 135 represents a pump motor and holding relay, one end of the winding 136 of which is connected by a line 138 with the wire 113 to the winding 114 of the relay 115 and the other end of which winding 136 is connected by a line 139 with the other side 110 of the main power line. This relay 135 is provided with two normally open armatures 140 and 141.

The armature 140 of the relay 135 is connected by a line 142 with the side 109 of the main power line and is drawn into engagement with a fixed contact of a line 143 connecting with the line 144 of the pump motor 135. The other terminal of the motor 85 is connected to the other side 110 of the main power line. This armature 140 of the relay 135 is bypassed by a manual switch 145 which, when closed, connects the side 109 of the main power line through a line 146 with the line 144 of the pump motor 85.

The armature 141 of the relay 135 forms a part of the holding or locking circuit for the relays 115 and 135 and the solenoid valve 99 and for this purpose is drawn into engagement with a fixed contact connected with the line 138. This armature is connected with the fixed contact 148 of a switch indicated generally at 149. The movable contact 150 of this switch is connected with the side 109 of the main power line and is also arranged to engage a fixed contact 151. This fixed contact 151 is connected with the line 144 of the pump motor 85. The movable contact 150 of the switch 149 is actuated by a controller 152 which is responsive to the vacuum within the finished oil chamber 36. When atmospheric pressure obtains within the finished oil chamber 36, the vacuum controller 152 actuates the movable contact 150 of the switch 149 to engage the fixed contact 148. When the vacuum in the finished oil chamber 36 is built up to a predetermined value, the vacuum controller 152 actuates the movable contact 150 of the switch 149 to engage the fixed contact 151.

In the following description of the operation of the apparatus for refining used lubricating oil it will be assumed that the main switch 111 is closed so that the motor 89 of the exhaust fan or blower 86 is operating to exhaust any vapors developing in the vapor chamber 31 of the still, this exhaust fan operating continuously and so withdrawing vapors from the vapor chamber 31 through its inlet 88 communicating therewith. It will also be assumed that a charge of oil has been refined and is retained in the chamber 36 of the refined oil shell 35. This oil has been distilled and hence is at high temperature, this heat being available for preheating the charge of used lubricating oil. This charge of used lubricating oil of, say, several gallons, is admitted through the inlet pipe 65 and flows into the preheating chamber 40 formed between the shells 35 and 38 and hence is preheated through heat derived from the charge of hot refined oil in the refined oil chamber 36, this heat exchange being accelerated by the fins 41. After the desired preheating has taken place the charge of used oil to be refined is dumped from the preheating chamber 40 and the discharge valve 103 is opened to discharge the finished oil from the refined oil chamber 36 following which this discharge valve 103 is closed to permit vacuum to be built up in this refined oil chamber 36 as hereinafter described.

This dumping of the preheated oil from the preheating chamber 40 is effected by lifting the dump valve handle 68, this camming the rod 69 upwardly to lift the dump valve head 70 from its seat 78. Accordingly the preheated charge of oil to be refined can flow from the preheating chamber 40 through the conduit 75 and through the dump valve 72, dropping from its outlet 76 to the frustoconical bottom 21 of the vapor chamber 31 and flowing thence into the vapor distillation chamber 27 of the sump 25.

The operator then momentarily closes the start button 112 and pours a charge of fuller's earth into the batch of oil in the sump 25. This charge of fuller's earth is admitted by lifting the cover 80 at the upper open end of the vertical tube 79 and pouring the fuller's earth therein. This fuller's earth flows down this tube 79 and drops therefrom directly into the charge of oil contained in the sump 25.

This momentary closing of the start button 112 starts the cycle of operation by energizing the heater circuit relay 115; the three way solenoid valve 99; and the pump motor relay 135 which also serves as a holding relay. The heater circuit relay is energized from the side 109 of the main power line, closed start button 112, line 113, winding 114 of this relay, line 116 and closed contacts 118 and 119 of the thermostats 81 and 82 to the other side 110 of the main power line since the winding 128 of the solenoid valve 99 is in parallel with the winding of this relay 115, this solenoid valve is likewise energized. The pump motor relay 135 is energized from the side 109 of the main power line, closed start button 112, lines 113 and 138 and winding 136 through the line 139 to the other side 110 of the main power line.

The energization of the relay 135 serves both to energize the pump motor 85 and to lock or hold the heater circuit relay 115 and the solenoid valve 99 in an energized condition. This locking or holding of the heater circuit relay 115 and solenoid valve 99 is accomplished through the armature 141 of the energized relay 135, this armature establishing a circuit from the side 109 of the main power line, closed switch 149 of the vacuum controller 152 and closed armature 141 to the line 138. Since this line 138 connects with the winding 136 of the relay 135 this relay is held energized until broken by the movable contact 150 of the switch 149 and since this line 138 connects, through the line 113, with the winding 114 of the relay 115 this relay is held energized until broken by either of the switches 118 or 119. Since the winding 128 of the solenoid valve 99 is in parallel with the winding 114 of the relay 115 this solenoid valve 99 is energized during this continued energization of the relay 115.

Energization of the pump motor relay 135 pulls up its armature 140 to establish a circuit from the side 109 of the main power line through line 142, closed armature 140 of this relay 135, line 143, 144 and pump motor 85 to the other side 110 of the main power line. This starts operation of the pump 84 and since at this time the solenoid valve 99 is energized its outlet 102 is connected to atmosphere through the inlet 100. In consequence, the pump 84 draws atmospheric air from the inlet 100 of the solenoid valve 99 through this valve and its outlet 101 and through the line 102 connecting with the inlet of the pump. This air is discharged by pump through the line 83 and escapes from the open end thereof arranged at the bottom of the distillation chamber 27. Since this distillation chamber is filled with a charge of the used lubricating oil containing fuller's earth, this escaping compressed air serves to agitate the charge of oil and to keep the fuller's earth in suspension and in intimate moving contact with the oil so as to adsorb the impurities therefrom in a minimum length of time. Further, as this batch of oil within the distillation chamber 27 is heated to distil the lighter fractions therefrom, the compressed air escaping from the submerged end of the tube 83 serves to aerate the body of oil and aid the separation of the lighter fractions as vapor therefrom.

This heat for raising the temperature of the body of used lubricating oil within the distillation chamber 27 to the proper distillation temperature, is provided through the energization of the heater circuit relay 115. Since at this time this heater circuit relay is energized its normally open armatures 120 and 121 are drawn up to close circuits through the two groups of heating coils 34. These heating coils are arranged in the external recesses provided in the wall of the sump 25 and hence the heat developed by these elements is transmitted to the body of used lubricating oil contained within this sump.

The rising temperature and compressed air agitation of the charge of used lubricating oil within the distillation chamber 27 of the sump 25 serves to drive off the lighter fractions, these escaping as vapor into the vapor space 31. Since this vapor space is continuously being exhausted by the exhaust fan 86, these vapors are continuously being discharged to the atmosphere. This heating of the charge of used lubricating oil in the sump 25 continues until the temperature of this charge of oil reaches 435° F. When this temperature is reached the thermostat 81 immersed in this body of oil opens the switch 118. Opening the switch 118 opens the circuit through the winding of the heater circuit relay 115 and hence releases its two armatures 120 and 121 to their normally open position. This opens the electrical circuit through the heater elements 34 and hence the heating of the charge of used lubricating oil in the sump 25 is discontinued when its temperature reaches

435° F. This opening of the switch 118 by the thermostat 81 also deenergizes the solenoid valve 99 inasmuch as the winding of this solenoid valve is in parallel with the winding 114 of the heater circuit relay 115. This causes the solenoid valve to assume the position shown in Fig. 9, in which its atmospheric air inlet 100 is cut off and instead its outlet 101 is connected with its inlet 98. With the solenoid valve 99 so deenergized air is withdrawn from the finished oil chamber 36 so as to build up a vacuum therein, this air passing from this finished oil chamber 36 through the vacuum line 96, inlet 98 of the solenoid valve 99, outlet 101 and line 102 to the inlet of the pump 84. The air so withdrawn is discharged from the outlet of this pump 84 through the goose neck tube 83 to escape into and agitate the body of used lubricating oil and fuller's earth contained within the sump 25.

As the vacuum in the finished oil chamber 36 builds up, the charge of used lubricating oil and fuller's earth within the distillation chamber 27 in the sump 25 is sucked out of this sump and brought to the filtering chamber 62 for filtration. This oil flows upwardly through the tube 90, bore 91, pipe 92, rotary slip joint 93, horizontal pipe 94 and horizontal bore 95 into the filtering chamber 62 formed by the cover 52. This stream of used lubricating oil and fuller's earth so sucked up escapes from the open end of the horizontal bore 95 in the cover 52 and spreads over the disk 49 of filter paper which is clamped in place over the finished oil chamber 36 by the cover 52. The fuller's earth, together with the impurities absorbed therein, are retained within the cover 52 by the disk 49 of filter paper. The distilled and filtered oil passes through this disk 49 of filter paper and flows down into the finished oil chamber 36.

When the vacuum within the finished oil chamber 36 has been reduced to a predetermined low value by the pump 84, this following the transfer of the entire charge of used lubricating oil from the sump 25 to the upper part of the apparatus, the vacuum controller 152, which is responsive to the vacuum in the finished oil chamber 36, actuates the switch 149 to move its movable contact 150 out of engagement with the fixed contact 148 and into engagement with the fixed contact 151. Breaking this circuit between the movable contact 150 and the fixed contact 148 breaks the circuit through the winding 136 of the relay 135, thereby deenergizing this relay and placing it in the condition assumed at the start of the cycle of operation. At the same time, the operation of the motor 85 of the pump 84 is continued inasmuch as the movable contact 150 is brought into engagement with the fixed contact 151 thereby to supply current from the side 109 of the main power line, movable contact 150 of the switch 149, fixed contact 151 and pump motor line 114 and pump motor 85 to the other side 110 of the main power line.

The operator then breaks the vacuum within the filtering chamber 62 and finished oil chamber 36 by opening the vent valve 108 in the top of the cover 52. Breaking this vacuum causes the vacuum controller 152 to move the movable contact 150 of the switch 149 back into engagement with the fixed contact 148, thereof, thereby to restore this switch to the condition assumed at the start of the cycle of operation. Breaking the vacuum within the finished oil chamber 36 also permits the cover 52 to be opened for the purpose of removing the disk 49 of filter paper, together with the filtrate thereon, and replace it with a fresh disk of filter paper. To so lift the cover 52, the operator lifts the lever 60, thereby to uncouple the free end of the holddown bar 54. The operator, through the handles 55 on this holddown bar then lifts the same, this holddown bar swinging about the hinge pivots 56. So lifting this holddown bar 54 also lifts the cover 52 inasmuch as this cover is centrally connected to this holddown bar by the links 61.

With the cover open the operator removes the disk 49 of filter paper from the screen 45 and throws the same away. He then places a fresh disk of filter paper 49 on this screen and with its margin extending over the seat 51 provided around the opening which receives the cover 52. Accordingly, when the operator lowers the holddown bar 54 the angular rim of the cover 52 is brought itno clamping engagement with the margin of the fresh filter paper 49 and firmly clamps it against the upper end head 19. This clamping engagement is then maintained by forcing the lever 60 downwardly thereby to cam the holddown bar 54 downwardly and effect a firm seal of the cover 52. The operator has then made a complete cycle of operation and admits a fresh charge of used lubricating oil through the inlet line 65 as previously described. Before vacuum is again applied to the finished oil chamber 36 the operator, of course, closes the vent valve 108.

Referring particularly to the electrical wiring diagram, Fig. 9, the second or 450° thermostat 82 is purely a safety device so that if the 435° thermostat 81 should fail to operate, the 450° thermostat will open the circuit. Also, the manual switch 145 around the relay 135 is provided so that the pump motor 85 can be operated manually at any time desired.

From the foregoing it will be seen that the present invention provides for the simple and effective agitation and aeration of the mixture of used lubricating oil and refining solids, such as fuller's earth, being distilled and also provides a simple and reliable electrical control for automatically cycling each operation of the apparatus.

We claim:

1. In apparatus for refining used lubricating oil having a heated distillation chamber adapted to receive a charge of the used oil to be refined and a charge of refining solids, an overhead enclosed filtering chamber, and a transfer line having its inlet communicating with the bottom of said distillation chamber and its outlet communicating with the upper part of said overhead filtering chamber, the combination therewith of apparatus agitating said charges in said distillation chamber and transferring said charges from said distillation chamber to said filtering chamber, comprising a pump, an outlet line for said pump and discharging into the bottom of said distillation chamber to agitate and aerate said charges therein, a three-way solenoid valve arranged when de-energized to connect one of its inlets with its outlet and when energized to connect the other of its inlets with its outlet, a line connecting said outlet of said solenoid valve with the inlet of said pump, a conduit connecting said one of said valve inlets with said enclosed filtering chamber to reduce the pressure in said enclosed filtering chamber below the pressure of said distillation chamber and thereby draw said charges of used lubricating oil and refining solids from said distillation chamber up said transfer line and into said filtering chamber, and a thermostat having its sensitive parts in heat exchange

relation with said charges in said distillation chamber and arranged to de-energize said three-way solenoid valve.

2. In apparatus for refining used lubricating oil having a distillation chamber heated by electrical heating elements and adapted to receive a charge of the used oil to be refined and a charge of refining solids, an overhead filtering chamber, and a transfer line having its inlet communicating with the bottom of said distillation chamber and its outlet communicating with the upper part of said overhead filtering chamber, the combination therewith of apparatus agitating said charges in said distillation chamber, transferring said charges from said distillation chamber to said filtering chamber and rendering said electrical heating elements inoperative, comprising a pump, a solenoid valve arranged, when de-energized, to connect the inlet of said pump with said enclosed filtering chamber to reduce the pressure in said enclosed filtering chamber below the pressure of said distillation chamber and thereby draw said charges of used lubricating oil and refining solids from said distillation chamber up said transfer line and into said filtering chamber and, when energized, to connect the inlet of said pump with the atmosphere, a switch in series with said heating elements, and a thermostat having its sensitive parts in heat exchange relation with said charges in said distillation chamber and arranged to open said switch and to de-energize said solenoid valve means.

3. In apparatus for refining used lubricating oil having a distillation chamber heated by electrical heating elements and adapted to receive a charge of the used oil to be refined and a charge of refining solids, an overhead filtering chamber, and a liquid transfer line having its inlet communicating with the bottom of said distillation chamber and its outlet communicating with the upper part of said overhead filtering chamber, the combination therewith of an electrical control apparatus for a cycle of operations initiated by closing a start switch and including agitating the said charges in said distillation chamber, transferring said charges to said filtering chamber, and restoring the control elements to their initial condition, comprising a pump, a motor driving said pump, a line connected with the outlet of said pump and discharging into the bottom of said distillation chamber to agitate and aerate the said charges therein, a start switch in series with the winding of a normally open relay and a normally closed thermostat switch, a thermostat having its sensitive parts in heat exchange relation with said charges in said distribution chamber and opening said thermostat switch in response to a rising temperature of the charges in said distillation chamber, a three-way solenoid valve in parallel with the winding of said relay and having its outlet connected with the inlet of said pump, a first inlet connected with the atmosphere and a second inlet, said solenoid valve when energized connecting its outlet with said first inlet, a vacuum line connecting said second inlet with said filtering chamber to establish a vacuum therein and draw said charges from said distillation chamber, up through said transfer line and into said filtering chamber, and electric lines connecting said heating elements in series with the armature of said relay.

4. In apparatus for refining used lubricating oil having a distillation chamber heated by electrical heating elements and adapted to receive a charge of the used oil to be refined and a charge of refining solids, an overhead filtering chamber, and a liquid transfer line having its inlet communicating with the bottom of said distillation chamber and its outlet communicating with the upper part of said overhead filtering chamber, the combination therewith of an electrical control apparatus for a cycle of operations initiated by closing a start switch and including transferring said charges to said filtering chamber and restoring the control elements to their initial condition comprising a start switch in series with the windings of a normally open relay and a normally closed thermostat switch, a thermostat having its sensitive parts in heat exchange relation with said charges in said distribution chamber and opening said thermostat switch in response to a rising temperature of said charges in said distillation chamber, a pump, an electrical motor actuating said pump, a solenoid valve in parallel with the winding of said relay and having its outlet connected with the inlet of said pump, a vacuum line connecting an inlet of said solenoid valve with said filtering chamber to establish a vacuum therein and draw said charges from said distillation chamber, up through said transfer line and into said filtering chamber, said solenoid valve, when de-energized, connecting its outlet with said inlet, electric lines connecting said heating elements in series with the armature of said relay, a normally open holding relay having its winding in series with said start switch and in parallel with sad first relay and thermostat switch and its armature in parallel with said start switch in series with the winding of said holding relay and in series with the winding of said first relay and thermostat switch and said holding relay having a second normally open armature in series with said pump motor.

5. In apparatus for refining used lubricating oil having a distillation chamber heated by electrical heating elements and adapted to receive a charge of the used oil to be refined and a charge of refining solids, an overhead filtering chamber, a liquid transfer line having its inlet communicating with the bottom of said distillation chamber and its outlet communicating with the upper part of said overhead filtering chamber, the combination therewith of an electrical control apparatus for a cycle of operations initiated by closing a start switch and including transferring said charges to said filtering chamber and restoring the control elements to their initial condition comprising a start switch in series with the winding of a normally open relay and a normally closed thermostat switch, a thermostat having its sensitive parts in heat exchange relation with said charges in said distribution chamber and opening said thermostat switch in response to a rising temperature of said charges in said distillation chamber, a pump, an electrical motor actuating said pump, a solenoid valve in parallel with the winding of said relay and having its outlet connected with the inlet of said pump, a vacuum line connecting an inlet of said solenoid valve with said filtering chamber to establish a vacuum therein and draw said charges from said distillation chamber, up through said transfer line and into said filtering chamber, said solenoid valve, when de-energized, connecting its outlet with said inlet, electric lines connecting said heating elements in series with the armature of said relay, a normally open holding relay hav-

ing its winding in series with said start switch and in parallel with said first relay and thermostat switch and its armature in parallel with said start switch in series with the winding of said holding relay and in series with the winding of said first relay and thermostat switch, said holding relay having a second normally open armature in series with said pump motor, a vacuum switch having a movable contact connected to one side of said line and normally engaging a fixed contact placing said vacuum switch in series with said first armature of said holding relay and having a fixed contact engageable with said movable contact and connected to place said vacuum switch directly in series with said pump motor, and a vacuum controller arranged to move said movable contact of said vacuum switch from engagement with said first fixed contact into engagement with said second fixed contact in response to a high vacuum in said filtering chamber.

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