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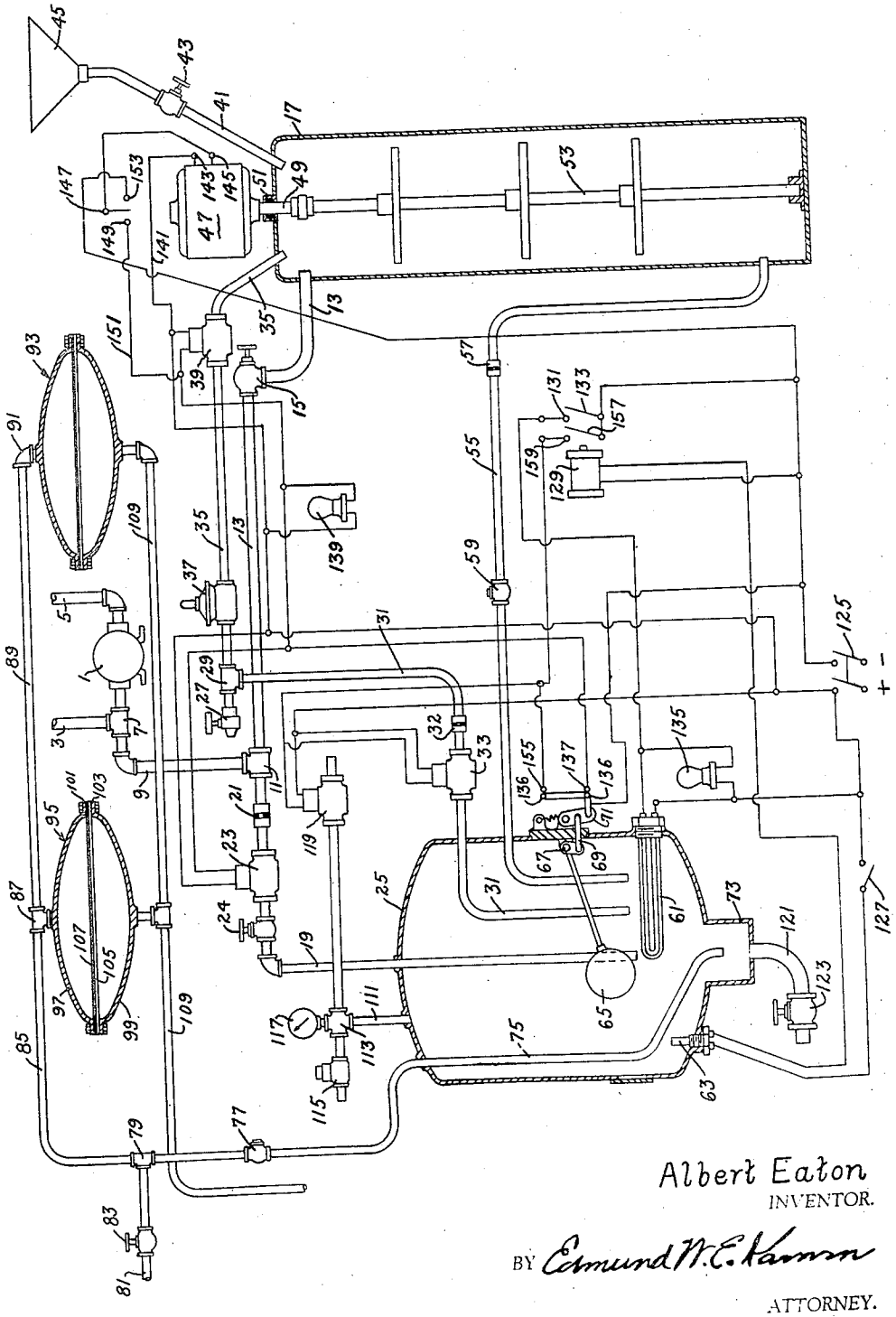

Albert Eaton
INVENTOR.

BY Edmund W. C. Kamm

ATTORNEY.

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LIQUID TREATING APPARATUS

Albert Eaton, Garden City, N. Y.

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3 Claims. (Cl. 196—16)

This invention relates to an apparatus for treating liquids, particularly petroleum products, in order to remove impurities therefrom. More specifically, it relates to the treatment of used lubricating oils in a continuous series of batches, by automatically controlled means, to remove dilutents, water, acids, carbon and other impurities so that the oil may be again used.

It is an object of the invention to provide automatically operating means which will feed a series of charges of dirty oil into and through the apparatus and which will not require the continued attention of an operator.

It is another object of the invention to provide an electric control system which will automatically cause the treating apparatus to function in a cycle of predetermined events.

It is still another object of the invention to provide a cycle of events which is controlled in accordance with the condition of the liquid being treated.

Another object of the invention is to provide a filter which can be cheaply operated.

Yet another object of the invention is to provide liquid treating means which will be fully automatic in its operation.

Another object of the invention is to provide a filter which is highly efficient and which will remove finely divided particles of carbon and other impurities from oils such as crank case oils.

Still another object of the invention is to provide a filter which has a low maintenance cost.

Another object of the invention is to provide an automatic, continuous batch filtering process.

These and other objects of the invention will become apparent from a study of the specification and the drawing which is attached hereto and made a part hereof.

The single figure in the drawing discloses the apparatus for treating the oil and has the wiring shown diagrammatically.

Treating apparatus

Referring now to the drawing, numeral 1 represents the lubricating oil pump of a piece of machinery such as a Diesel engine or the like; 3 represents the discharge line from the pump and 5 is the suction or supply line. A T is provided at 7 and a dirty oil line 9 is connected by this T to the discharge line of the pump.

The line 9 leads to a second T 11 from which one branch line 13 connects through a valve 15 into the top of an agitator or slurry tank 17 while another branch line 19 connects through an orifice 21, a normally closed, solenoid operated valve 23 and a manual valve 24 to a heating or treating tank 25. This orifice is a $\frac{5}{32}$ inch orifice for an oil pressure of forty-six pounds per square inch gage.

By stating that a solenoid valve or other piece of power operated equipment is "normally open" it is meant that the device is open when its operator is not energized. "Normally closed" is employed when the device is closed.

A source of air under a pressure of about forty pounds per square inch above atmospheric pressure is connected to valve 27 and a T connection 29 has one of its openings connected to the valve 27; another is connected to a line 31 which connects with the interior of the treating tank 25 through an orifice 32 of about one-sixteenth of an inch in diameter and a normally open, solenoid operated valve 33; while the third opening is connected to a line 35 which contains a pressure reducing valve 37 and a normally closed solenoid valve 39, and which opens into the top of the agitating tank 17. The pressure reducing valve reduces the pressure in line 35 to about two pounds per square inch above atmospheric.

The agitating tank 17 is provided at its top with an inlet pipe 41 which has a valve 43 in it and which is provided with a funnel 45 at its upper end. This line is used to introduce filter aid and reagents used in the process.

An electric motor 47 is mounted above tank 17 and has a shaft 49 which passes through a stuffing box 51 in the top of the tank and has connected to it an agitator mechanism 53 of any desired construction.

A discharge line 55 leads from near the bottom of tank 17 through an orifice fitting 57 and a check valve 59 into the heating tank 25. The check valve is adapted to prevent a flow from tank 25 into tank 17 and the orifice is proportioned so that it will admit about one gallon of slurry from tank 17 into tank 25 while five gallons of dirty oil are passing into tank 25 through the line 19. A one-fourth inch orifice has been used successfully.

Tank 25 is fitted with an electric heater 61 and with a temperature responsive switch 63 which is known to the trade as an "Aquastat." This switch is adapted to close at a temperature of about 290 degrees Fahrenheit and to open at a temperature of about 390 degrees Fahrenheit.

A float 65 is pivotally mounted at 67 and is connected to a link 69 which passes through a suitable stuffing box and is connected to operate an overcenter snap switch 71. The float is pref-

erably so disposed in the tank that it will open the switch when the tank contains six gallons of oil and slurry. It is, of course, obvious that the volume of the charge may differ from the quantity just stated depending upon the size of the machine.

The tank 25 is fitted with a sump 73 at the bottom, and a discharge pipe 75 leads from this sump, out of the tank and through a check valve 77 which opens upwardly, and thence to a T fitting 79. One branch of the T is connected to an air pressure line 81 through a manually operated valve 83 while the other branch is connected to a line 85 which leads to a T 87.

T 87 is connected by pipe 89 to an L 91 and to a filter 93 while the other branch of the T is connected to a similar filter 95.

Both filters are similarly constructed so that it is necessary to describe only one of them.

Referring to filter 95, it is comprised of complementary upper and lower shells 97 and 99 respectively, which are provided with peripheral bolt flanges 101, 103 respectively. A perforated plate or screen 105 is mounted between the shells in a manner so as to be clamped between the bolt flanges and a plurality of layers 107 of filter paper, which is preferably ordinary newsprint, is disposed on top of the screen and is also clamped between the bolt flanges. The lower shells of the filter are connected to a filtrate pipe 109 which may be connected either to the engine crank case or any other storage container.

A vent pipe 111 is connected to the top of tank 25 and is connected to a cross fitting 113. One branch of the cross is connected to a safety valve 115 which opens to atmosphere at a pressure of, for example, fifty pounds where the air pressure used is forty pounds. Another branch of the cross is connected to a pressure gage 117 while the remaining branch is connected to a normally closed, solenoid operated valve 119 which also discharges to atmosphere.

A blow-off line 121 is connected to the sump 73 through a manually controlled valve 123 and provides means for discharging sludge to a place of disposal.

Control circuits

For controlling and energizing the various power actuated devices, control circuits are provided which function automatically, upon the establishment of various conditions, to cause the required cycle to be carried out and to cause a new cycle to be started when the preceding one is completed.

A main switch 125 is connected to a source of current which for the purpose of simplicity is here designated as direct current.

One circuit extends from the positive pole of the switch 125 through a manual switch 127, through the "Aquastat" 63, thence to the winding of a magnetic relay 129 and back to the negative pole of the main switch.

A second circuit extends from the positive pole of the main switch to one lead of the heater 61, thence to a contact 131 of the relay 129, through the armature 133 and thence to the negative pole of the main switch. A signal lamp 135 is connected in parallel across the heater and serves to indicate when the circuit is closed.

A third circuit extends from the negative pole of the switch 125 to the movable contact 136 of the float actuated switch 71. In the position of the parts shown, that is with the float down, the circuit continues from the contact 137 to the normally closed, dirty oil valve 23 and back to the positive pole of the main switch.

There is an additional circuit connected in parallel with valve 23 which connects the normally closed, air valve 39 to be energized when valve 23 is energized. This circuit has a secondary parallel circuit through the signal lamp 139 which is used to indicate when the circuit is energized.

A fourth circuit or motor control circuit is connected in parallel with the air valve 39. This circuit comprises a wire 141 leading to one terminal 143 of the motor 47, a wire connecting the other terminal 145 of the motor with the movable pole 147 of a reversing switch, the contact 149 of which is connected by wire 151 to complete the parallel connection. This circuit serves to place the motor 47 under control of the float 65.

A fifth circuit, which is also a motor control circuit, comprises a lead which connects the negative pole of the main switch to the other contact 153 of the motor switch, thence through the movable pole 147 thereof, through the motor and thence through lead 141 and its connecting wires back to the positive pole of the switch. This circuit will keep the motor 47 running continuously.

A sixth circuit will be established when the float rises. This circuit passes from the negative pole of the main switch 125 to the movable pole 136 of the overcenter switch 71, to the second fixed contact 155 thereof, thence to the normally closed vent valve 119 and back to the positive pole of the main switch. The normally open air valve 33 is connected in parallel across this circuit so that both valves 119 and 33 are actuated when the circuit is energized.

A seventh circuit extends from the negative pole of switch 125 through the relay armature 157, through fixed relay contact 159 to valve 119 and back to the positive pole of the switch 125. The valve 33 is connected in parallel with valve 119 as described above.

The switch 71 which is operated by the float 65 is of the "overcenter spring" type. The contacts 136 thereof remain out of engagement with contacts 137 and 155 while the float moves from its uppermost to its lowermost position. When the lower position is reached, the contacts are instantaneously brought into engagement and remain thus until the float reaches its uppermost position when the contacts are almost instantaneously disengaged.

The relay 129 is a normally open relay.

Operation

Assuming that the apparatus is empty and ready for operation, the main switch 125 is open and the pump 1 is in operation, the operator will first place in the hopper 45 about two pounds of fuller's earth and two pounds of an activated clay commercially called "Retrol." This material is dumped into the agitator tank 17 and valve 15 is opened to admit dirty oil from pump 1 and lines 9 and 13 until the tank 17 is full, after which valves 15 and 43 are closed.

The motor control switch 147 is set to close either contact 149 or 153 and the main switch 125 is then closed. This causes the energization of the following elements with their results:

Normally closed dirty oil valve 23 is opened.
Normally open air valve 33 is closed.
Normally closed air valve 39 is opened.
Normally closed vent valve 119 is opened.
Lamp 139 is energized.
Motor 47 is energized.

After motor 47 has run for about three minutes, the manually operated dirty oil valve 24 is opened to admit dirty oil to valve 23 and manual air valve 27 is opened to apply air pressure to tank 17 and air valve 33. The pressure is reduced to about two pound gage in line 35 by valve 37 and this pressure forces the agitated slurry from tank 17 through orifice 57, check valve 59 and pipe 55 into the heating tank 25 where it is mixed with the dirty oil being discharged by pump 1 into tank 25 through valve 23 and orifice 21.

The switch 127 may be closed at this time and since the switch 63 is closed, the oil being under 390 degrees Fahrenheit, the winding of relay 129 will be energized to bring armature 133 into engagement with contact 131 to energize the heater 61.

The armature 157 also engages contact 159 to set up a second circuit through the air valve 33 and vent valve 119 so as to hold these valves energized when contacts 136, 155 are opened as will be described.

As tank 25 fills, the oil will be heated and the air which is displaced from the tank, as well as any vaporized water or dilutents including the so called "light ends," are discharged through the vent valve 119. The float 65 follows the liquid level when it rises to its uppermost position. The contacts 136, 137 and 155 are broken with the result that the dirty oil valve 23 and the air valve 39 to the mixing tank are deenergized and close. This stops the flow of oil to tank 25.

The valves 119 and 33 are maintained energized because the control circuit through them and the armature 157 and contact 159 of the relay 129 remains closed so long as the relay is energized, and this condition obtains until the mixture in tank 25 reaches a temperature of about 390 degrees Fahrenheit when the contacts in element 63 open to deenergize the relay. During the heating period the volatile impurities are driven out through the vent valve 119.

As soon as relay 129 is deenergized the armatures 133 and 157 move out of engagement with their respective contacts 131 and 159 with the result that valves 33 and 119 are deenergized and valve 33 opens while valve 119 closes.

This effects the application of air at forty pounds per square inch gage pressure to tank 25 and the mixture in this tank is forced out through the pipe 75, through the upwardly opening check valve 77 and line 85, 87, 89 and 91 to filters 93 and 95. As soon as air pressure is applied to tank 25, check valve 59 closes to prevent back flow of slurry into tank 17.

The oil which has been purged of water and other volatile substances and also deacidified by the fuller's earth and "Retrol" in heating tank 25 is now passed through the filter papers 107, screen 105, line 109 and is returned to the crank case or storage tank. The fuller's earth, "Retrol" and any other impurities in the oil is deposited on the filter papers in the form of a cake. The filter aids assist in keeping the cake open so as to greatly lengthen the filtering cycle. The news print paper affords a filtration medium of such fineness that oil which is black in color is restored in color and brilliance to that of new oil. This has been determined by actual operation of the machine. The oil also is free from dilutents and water.

As the liquid level in the tank 25 falls, the float will reach its lowermost position where it actuates the contacts 136 into engagement with contacts 137 and 155.

As explained above, when these contacts are closed, the valves 23, 33, 39 and 119 are again energized so that:

Oil valve 23 is opened to admit dirty oil to 25.
Air valve 33 is closed to cut off air to 25.
Air valve 39 is opened to admit air to 17.
Vent valve 119 is opened to connect 25 to atmosphere.

The tank is thus refilled with about five parts of dirty oil from the pump 1 and about one part of slurry from tank 17.

The element 61, when it is contacted by relatively cool oil, again closes to establish the relay circuit and that through lamp 135.

The cycle of operation is thus again begun.

It should be noted that if the motor switch 147 is in engagement with contact 149, the motor will run only so long as the switch 71 is closed, that is, during the time slurry is being fed into the tank 25.

Tank 17 holds enough slurry for at least one day's operation.

Should the pressure in tank 25 rise beyond a predetermined amount, the safety valve 115 will operate to relieve the excess pressure.

When it becomes necessary to clean the filters, the operator may open the main switch which will relieve pressure from tank 25 and he will then open air valve 83. The check valve 77 will close and the slurry in lines 85, 87, 89, 91 and filters 93 and 95 will be discharged through the filters after which air can be blown through these lines to dry the cake. When the air is shut off, the bolts may be removed from the bolt flanges, the heads 97 may be lifted and the filter cake and filter papers may be removed.

Upon placing new filter papers on the screen and upon restoration of the filter shells, the apparatus is again ready for operation.

If sludge accumulates in the tank 25, it can be blown off by opening valve 123 at any time that the tank is under pressure.

It has been found by experience that it requires thirty minutes attention from a single operator twice a day to keep the device in operation for an entire day. Its operation is entirely automatic except for the initial charging operation and the replacement of filter papers and removal of cake.

It is obvious that various changes may be made in the form, structure and arrangement of parts without departing from the spirit of the invention. Accordingly, applicant does not desire to be limited to the specific embodiment disclosed herein primarily for purposes of illustration; but instead, he desires protection falling fairly within the scope of the appended claims.

What I claim to be new and desire to protect by Letters Patent of the United States is:

1. In a liquid treating apparatus, a treating tank, a heater therefor, a filter, means for discharging liquid from said tank to said filter, and control means responsive to the attainment of a predetermined maximum temperature of said liquid and a predetermined maximum level of liquid in said tank, for actuating said discharging means.

2. In a liquid treating system, a treating tank, a heater in said tank, a conduit carrying contaminated liquid, means for filling said tank from said conduit, liquid level responsive means having upper and lower positions in which said filling means is rendered inactive and active re-

spectively, temperature responsive means, a filter, means for discharging said tank through said filter, said level responsive means being constructed and arranged to maintain said filling means active and said discharging means inactive during travel of said level responsive means from lower to upper position, said temperature responsive means being adapted to maintain said discharging means inactive until a predetermined liquid temperature is attained.

3. In a liquid treating system, a treating tank, a heater in said tank, a conduit carrying contaminated liquid, means for filling said tank from said conduit, liquid level responsive means having upper and lower positions in which said filling means is rendered inactive and active respectively, temperature responsive means, a filter, means for discharging said tank through said filter, said level responsive means being adapted to maintain said filling means active and said discharging means inactive during travel of said level responsive means from lower to upper position, said temperature responsive means being adapted to maintain said discharging means inactive until a predetermined liquid temperature is attained, said temperature responsive means including a thermostat in a circuit with a normally open relay, and a circuit controlled by the opening of said relay circuit for actuating said discharging means.

ALBERT EATON.