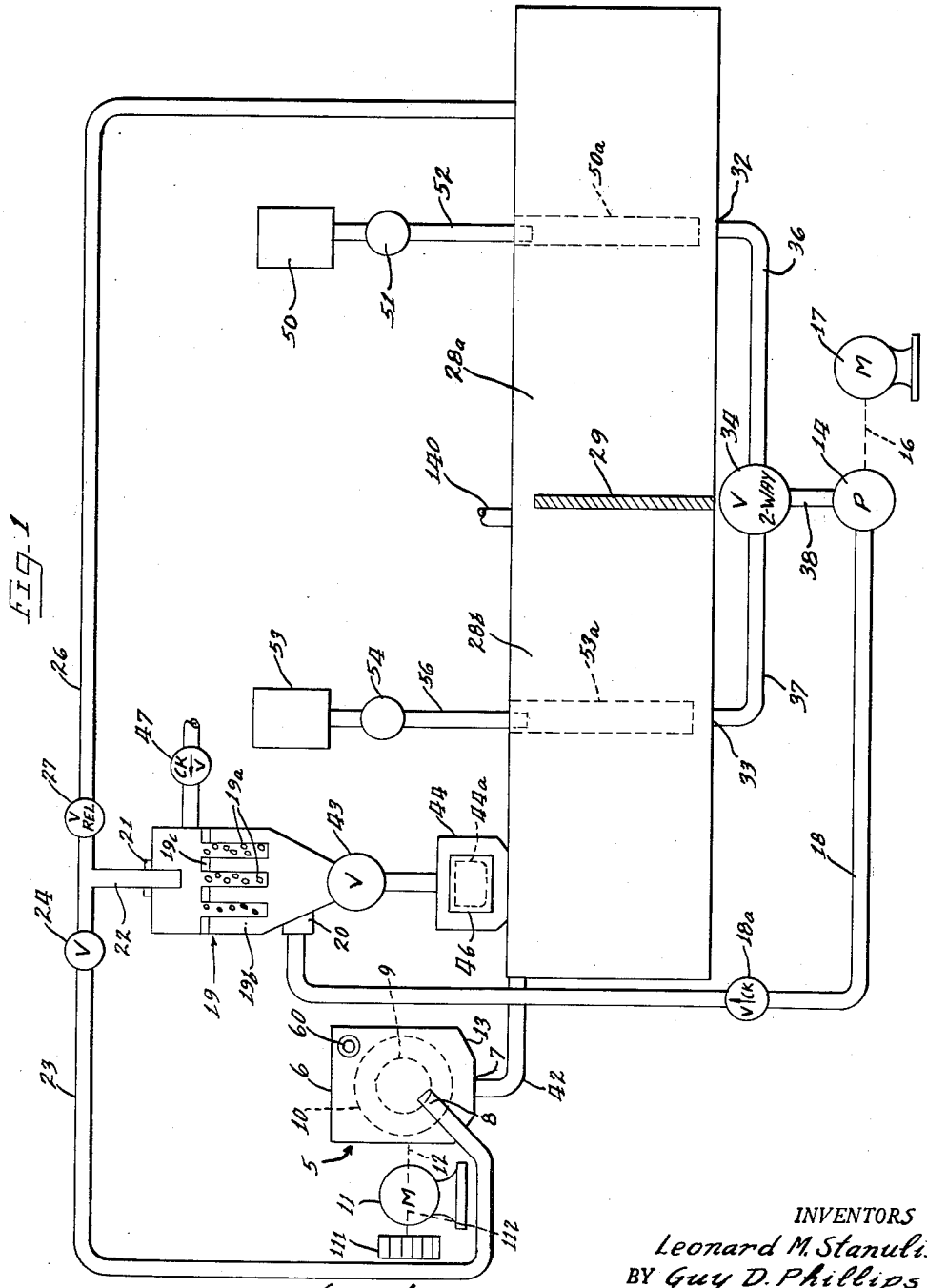
March 3, 1964 L. M. STANULIS ETAL 3,122,908

AUTOMATIC DRY CLEANING MACHINE WITH REFRIGERATION MEANS

Filed March 23, 1961 3 Sheets-Sheet 1

FIG. 1



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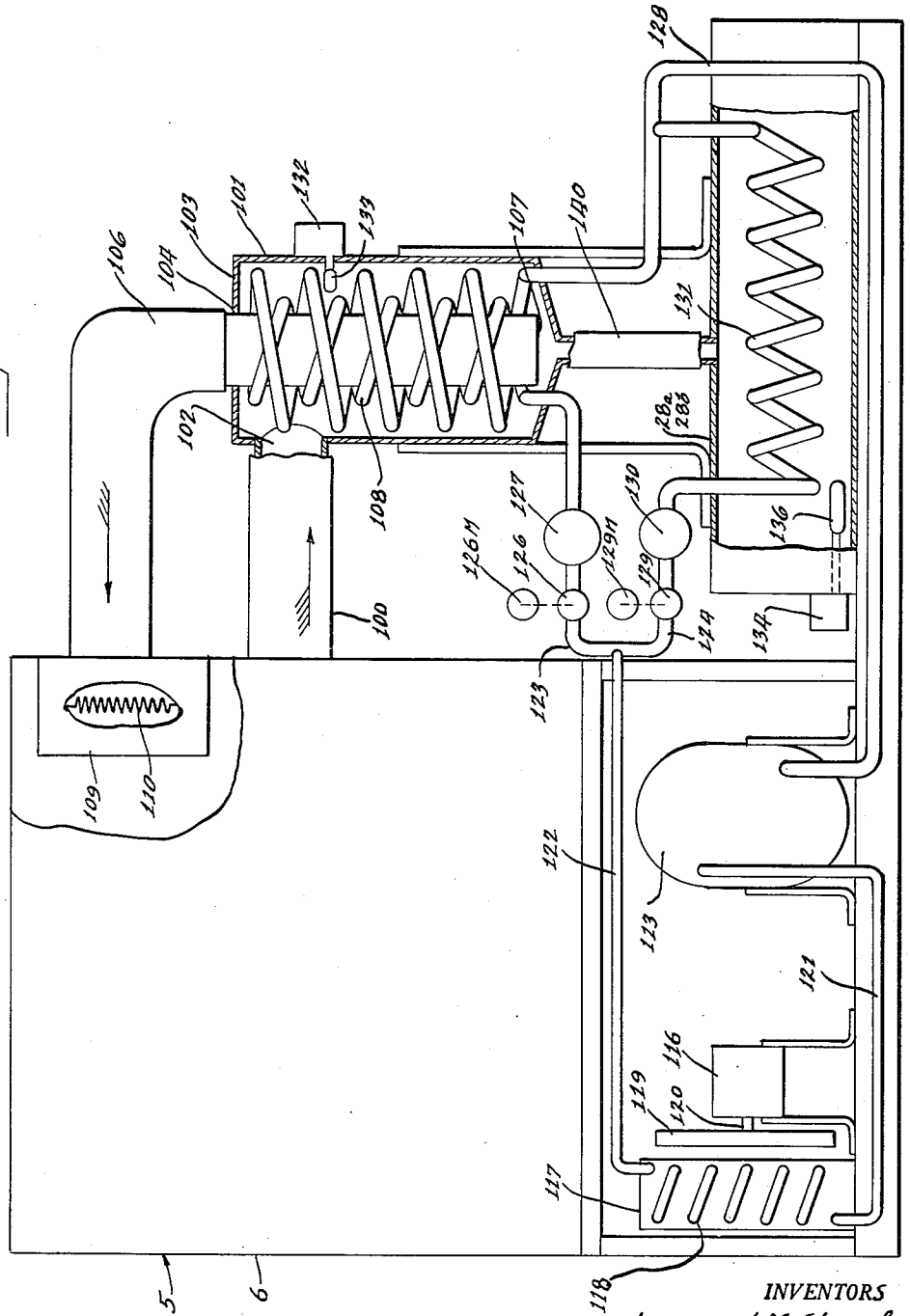
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AUTOMATIC DRY CLEANING MACHINE WITH REFRIGERATION MEANS

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Fig. 2



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AUTOMATIC DRY CLEANING MACHINE WITH REFRIGERATION MEANS

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Fig. 3

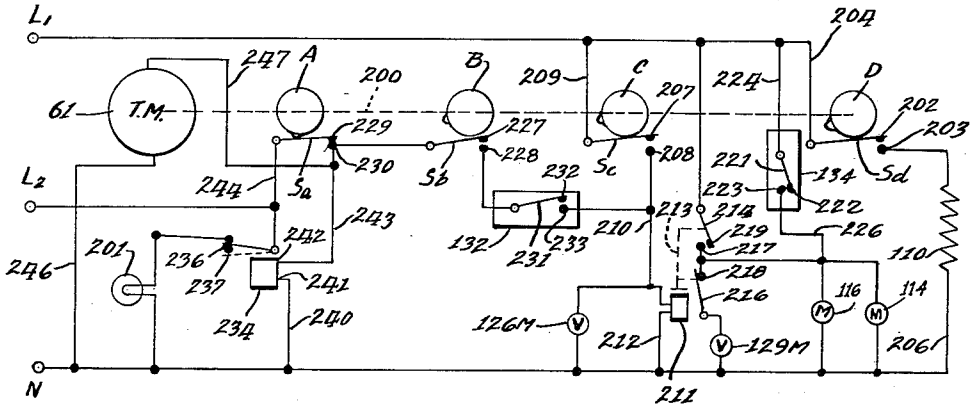
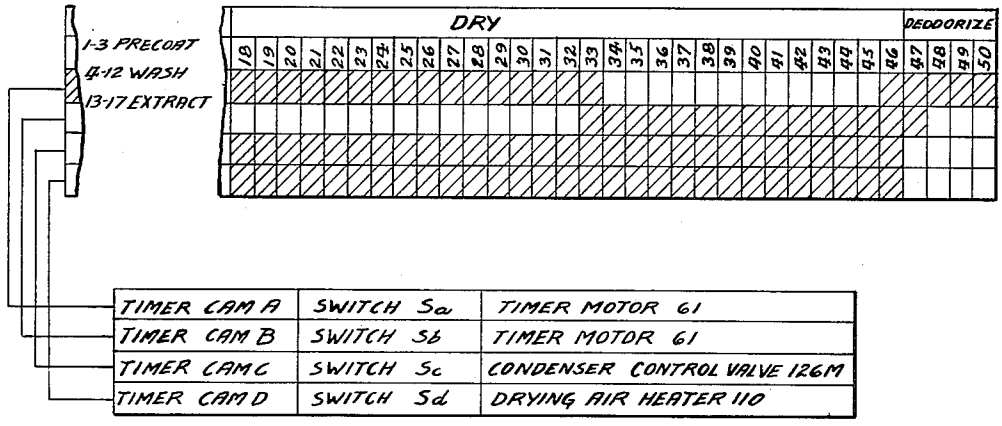


Fig. 4



TIMER CAM A	SWITCH Sa	TIMER MOTOR 61
TIMER CAM B	SWITCH Sb	TIMER MOTOR 61
TIMER CAM C	SWITCH Sc	CONDENSER CONTROL VALVE 126M
TIMER CAM D	SWITCH Sd	DRYING AIR HEATER 110

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United States Patent Office 3,122,908 Patented Mar. 3, 1964

3,122,908

AUTOMATIC DRY CLEANING MACHINE WITH REFRIGERATION MEANS

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Filed Mar. 23, 1961, Ser. No. 113,571
2 Claims. (Cl. 68—12)

This invention relates generally to cleaning apparatus and more particularly relates to a control system for a dry cleaner of the type wherein refrigeration is alternatively available to assist in reclaiming solvent in the air circuit of the apparatus or for temperature-conditioning the liquid cleaning solvent in the hydraulic circuit of the apparatus.

The dry cleaning solvent used in the fluid system of contemporary dry cleaning machines and contemplated for use in accordance with the principles of the present invention may be a suitable noninflammable chlorinated hydrocarbon such as perchlorethylene, thus eliminating fire hazards.

It has been found that for optimum overall dry cleaning conditions, it is best to maintain the perchlorethylene in a temperature range of approximately 70 to 80° F. For example, it has been found that when perchloroethylene exceeds 80° F., excessive dye bleed from the materials being dry-cleaned and excessive wrinkling of the same materials occurs.

Installations of dry cleaners intended for both commercial and coin-operated usage are subjected to great variations in temperature. In this connection installations may be operated through a 24 hour period, which will subject the apparatus and the fluids contained therein to temperatures which vary during the daytime and during the nighttime hours. Also, the apparatus and the fluids contained therein will be subject to temperature variations which occur during different parts of the year. Accordingly, it is possible the temperature of the perchlorethylene may be subjected to ambient temperatures tending to raise the solvent liquid above the 80° F. maximum allowable temperature. It is contemplated in accordance with the principles of the present invention to provide control means for preventing any increase in temperature of the cleaning solvent above the maximum allowable temperature.

Although perchlorethylene is a particularly efficient cleaning solvent, the cost thereof is sufficiently high to warrant reclamation of the solvent from the drying system of the cleaner apparatus. Thus, it would be prohibitive to use a drying system for a dry cleaner wherein the air stream carrying the perchlorethylene vapors is directed or vented to the atmosphere. Accordingly, many dry cleaner constructions contemplate apparatus for reclaiming the perchlorethylene vapor from the air stream so it can be used again in subsequent cycles.

It is contemplated by the present invention to provide an air circuit for the dry cleaner apparatus wherein temperature-conditioned air is circulated through a treatment zone to vaporize perchlorethylene from the materials being dry-cleaned. The air stream is circulated through the air circuit and a vapor condensing means is provided in the air circuit to condense the perchlorethylene vapors, whereupon the reclaimed liquid is returned to the hydraulic circuit of the dry cleaning apparatus.

In accordance with the principles of the present invention, a single refrigerating system is provided for the dry cleaning apparatus with two separate evaporator units, one being located in the air circuit of the dry cleaner and the other being located in the hydraulic circuit of the dry cleaner. Electrically operated valve control means are utilized in connection with the refrigeration apparatus, thereby to selectively direct refrigerant to only one of the evaporator units at a time. The electrically operated valve control means may conveniently be integrated operatively into the electrical circuitry associated with the sequential control means of the dry cleaning apparatus, thereby to correlate the direction of refrigerant to the evaporator unit in the air circuit during the drying periods of the operating cycle and at all other times directing the refrigerant to the evaporator coil in the hydraulic circuit.

It is an object of the present invention, therefore, to provide an improved dry cleaning apparatus.

Yet another object of the present invention is to provide a method and means for alternatively refrigerating a vapor condenser in a dry cleaner air circuit and a supply of solvent in the hydraulic solvent circuit.

A further object of the present invention is to provide a sensing system and circuitry to ascertain the proper operation of the refrigeration system during a complete dry cleaner cycle.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a preferred structural embodiment of a dry cleaner apparatus incorporating the principles of the present invention is shown by way of illustrative example.

On the drawings:

FIGURE 1 is a plumbing diagram of a fluid flow system for a dry cleaning apparatus provided in accordance with the principles of the present invention.

FIGURE 2 is a somewhat schematic view showing a dry cleaner apparatus in accordance with the principles of the present invention and illustrating in parts which are broken away and which are partly shown in cross-section, additional details of the air circuit and some details of the hydraulic circuit incorporated in the dry cleaning apparatus as illustrated in FIGURE 1.

FIGURE 3 is a wiring diagram showing only such portion of the complete dry cleaner controls as is necessary to emphasize the novel developments disclosed herein.

FIGURE 4 is a timer schedule showing the various time relationships existing in a sequenced program of selected periods constituting a dry cleaning cycle effected in accordance with the principles of the present invention.

As shown on the drawings:

It is contemplated according to the present invention to provide a dry cleaning apparatus for washing, extracting and drying in one continuous operation flexible textile materials such as clothes. Moreover, all such functions are combined in a single machine, preferably of the so-called horizontal drum-type shown generally at **5**. A generally imperforate tank or casing **6** has a drain outlet **7** and a solvent circulation injection nozzle **8** which is located on the exterior of the tank **6** and which is directed in an inwardly direction so as to project cleaning solvent circulated through that nozzle **8** into an access opening **9** located in the front wall of a rotatable perforate drum **10** which, in turn, is selectively driven at tumbling and extraction speeds by a motor **11** through a conventional power transmission path diagrammatically indicated by a dotted line **12** interconnecting the drum **10** and the motor **11**. Solvent emanating from the nozzle **8** passes through the access or loading opening **9**, preferably in a fan-shaped stream or spray through which the elevated fabrics fall prior to their forcefully impacting in a flexing action against the solvent-free lower surface of the drum **10**.

The casing or tank **6** is provided with a sump **13** which is located below the drum **10** so that all solvent draining

from the fabrics placed within the drum 10 will not recontaminate either the drum 10 or the fabrics themselves.

In order to supply the machine 5 with a stream of dry cleaning solvent, there is provided a pump 14 driven through mechanical connections 16 by a pump motor 17. The pump pressurizes a supply of dry cleaning solvent and drives the same in the form of a stream through a conduit 18 containing a check valve 18*a* and connected to a filter apparatus shown generally at 19.

The filter apparatus 19 is preferably of the type wherein a plurality of foraminous or porous tubes 19*a* are positioned within a filter housing 19*b* and are supported by a divider or separator plate 19*c* so that all solvent passing through the filter apparatus passes through the tubes 19*a*. The tubes are of a type adapted to receive a coating of filter aid material such as diatomaceous earth to restrict their perforations and thus render the filter more effective in filtering out soil particles of, for example, one micron size or below.

The filter apparatus has a filter inlet 20 to which the conduit 18 is connected and a filter outlet 21 to which a conduit 22 is connected. The conduit 22 leads to two separate branches, one being shown at 23 and containing a control valve 24 for directing filtered solvent to the nozzle 8. The valve 24 may include electrically actuated controller means for regulation by a presettable timing apparatus or sequential control means 60. The second branch connected to the conduit 22 is shown at 26 and contains a pressure relief valve 27 of the type which automatically opens as soon as an upstream pressure in the conduit 22 reaches a predetermined quantitative value. Thus, whenever the valve 24 is open, the cleaning solvent discharged through the conduit 22 will be directed through the conduit 23 to the machine 5. However, if the valve 24 is closed, cleaning solvent will be discharged through the pressure relief valve 27 and into the branch 26 leading to a tank means having a tank compartment 28*a* sometimes referred to herein as a "filtered solvent tank," and further including a separate tank compartment 28*b*, sometimes referred to herein as an "unfiltered solvent tank." The tank compartments 28*a* and 28*b* are separated from each other by a common weir 29 extending between them so that solvent from the filtered solvent tank 28*a* may overflow into the unfiltered solvent tank 28*b* when a level is reached determined by the weir 29.

A bottom outlet is provided at 32 for the filtered solvent tank 28*a* and at 33 for the unfiltered solvent tank 28*b*, which bottom outlets are connected by means of a two-way valve 34 to the pump 14 whereby the pump 14 may draw a supply of solvent for pressurization to drive the solvent in the form of a stream in the conduit 18 from either tank. The bottom outlet 32 is connected to the two-way valve 34 by a conduit 36, while the bottom outlet 33 is connected by means of a conduit 37 and the valve 34 is connected to the pump 14 by a conduit 38.

Solvent admixed with impurities removed from the materials being dry cleaned is collected in the sump 13 and drains through the outlet 7 via a conduit 42 into the unfiltered solvent tank 28*b*.

The filter apparatus 19 has a dump valve 43 connected to a sediment trap 44 shown generally in diagrammatic form and including a removable filter basket or container 44*a* and a closure shown generally at 46, whereby the sediment contained within the trap 44 may be periodically removed. The sediment trapped within the basket 44*a* includes, as will hereinafter be more apparent, a precoating material used on the filter tubes 19*a*, the soil filtered thereon and the adsorbent additive used in the apparatus. In practice with an apparatus of the type herein disclosed, the basket is normally removed and emptied for residual solvent recovery after every twelve complete cycles.

Two separate dispensing units are provided, a first unit being shown at 50 and including an electrically operated dispenser actuator 51 for regulating the admission of an additive such as a supply of filter aid material. The material can conveniently comprise diatomaceous earth, which advantageously precoats the filter tubes 19*a* to improve the filtering efficiency thereof insofar as removal of solvent-immiscible components from the solvent stream is concerned.

A second dispenser unit 53 is regulated by a suitable electrically controlled actuator 54. The dispenser 53 may be charged with an additive material such as activated carbon, or adsorptive magnesia, or both, which additives have the effect of adsorbing dyes which go into the solution in the solvent stream and which also remove fatty acids from the solvent stream to maintain the solvent in a "sweetened" condition.

The dispenser 50 discharges through a conduit 52 into a dispenser well 50*a*, while the dispenser 53 discharges through a conduit 56 into a dispenser well 53*a*, the dispenser wells 50*a* and 53*a* being provided immediately below their respective dispensers within the tank compartment 28*a* and 28*b*, respectively.

To assist in the dumping action of the filter apparatus, the filter apparatus 19 is provided with a dump aid atmospheric check valve 47. Thus, all soils, precoat additives and adsorbents carried on the exterior surfaces of the filter tubes 19*a* will be trapped within the trap 44 and the solvent will be returned into the hydraulic system via the unfiltered solvent tank 28*b*.

The cleaning solvent used in the machine of the present invention may conveniently comprise a chlorinated hydrocarbon such as perchlorethylene. Accordingly, in order to reclaim the perchloroethylene vapor removed from the fabrics during a drying operation, a closed air circuit is supplied for the machine 5. Referring to FIGURE 2, it will be noted there is provided an air discharge conduit 100 connected to a vapor condenser 101, the vapor condenser 101 having an air inlet 102 near an upper portion thereof. The vapor condenser may comprise a vertically extending casing having a top wall 103 formed with an opening 104 through which extends a centrally disposed conduit 106 which opens at a lower end 107 in spaced relationship to the inlet 102, thereby providing an outlet 107 for the vapor condenser 101.

Closely surrounding the conduit 106 is a helically wound coil forming a refrigerator-evaporator 108.

The conduit 106 returns to the casing 6 of the machine 5 and extends through one wall of the casing 6 into a heater box 109 provided with suitable heat exchange means shown generally at 110.

The machine 5 is provided with a blower 111 driven by the motor 11 through mechanical connections shown at 112 (FIGURE 1), thereby to drive the stream of air for recirculation through the treatment zone of the machine 5 into the conduit 100 and for return through the heater box 109 via the conduit 106.

The refrigeration system incorporated in the apparatus further includes a compressor 113 driven by an internally mounted motor 114 (FIGURE 3). There is also provided a condenser for the refrigerating system, which condenser is shown at 117 and includes condenser coils shown diagrammatically at 118. A blower 119 is connected by a shaft 120 to a blower motor 116. The condenser 117 and the compressor 113 are interconnected by a conduit 121. Refrigerant leaving the condenser 117 is directed through a conduit 122 having two separate branches including a first branch 123 and a second branch 124. The first branch 123 has a refrigerant control valve 126 regulating the supply of refrigerant to an expansion valve 127 connected to one end of the evaporator 108, thereby to expand the refrigerant for absorbing thermal energy within the vapor condenser 101. The other end of the evaporator 108 is connected to a return conduit 128 leading to the compressor 113.

The second branch 124 has a refrigeration control valve 129 therein controlling the admission of refrigerant to an expansion valve 130 connected to an evapo-

rator 131 located in the solvent tank 28*a*, 28*b*, which also is connected to the return line 128 for returning refrigerant to the compressor 113.

A solvent condenser thermostat 132 has a sensing element 133 positioned inside of the solvent condenser 101. A solvent cooler thermostat 134 has a sensing element 136 positioned inside of the solvent tank 28*a*, 28*b*. The thermostats 132 and 134 provide control mechanism for regulation of the operation of the system as will be hereinafter amplified. In this connection, it may be noted that both of the valves 126 and 129 may be motor-operated and in this connection there is shown in FIGURE 2 a motor 126*m* for the valve 126 and a motor 129*m* for the valve 129. Thus, all of the mechanical components already described may now be compared to the controls provided in accordance with the principles of the present invention and illustrated in greater detail in connection with an additional reference to FIGURES 3 and 4 of the drawings.

The sequential controller 60 provided for the dry cleaner apparatus is of the type incorporating a timer motor 61 which may be of the stepping type and which operates to advance, in accordance with predetermined time increments, a series of switch cams each having an appropriate action surface engaging and controlling a corresponding switch blade establishing appropriate electrical connections to operate the machine through a complete cycle having at least five distinct cycle parts or periods including (1) predry, (2) wash, (3) extract, (4) dry and (5) deodorizing.

Predrying is for the purpose of drying out excessive moisture in woolen articles, thereby eliminating intolerable shrinkage and wrinkling. Predrying is achieved by placing articles in the cylinder 10 of the machine 5 and tumbling the same while operating the air circulating system and temperature-conditioning the stream of air circulated through the treatment zone.

During predrying, the pump 14 begins to take solvent from the tank means and the dispensing actuator 51 is energized so a quantity of filter aid such as diatomaceous earth is injected into the filtered solvent tank 28*a* from where it is pumped to the filter elements 19*a*, thereby to form a filter aid coating on the exterior of the filter tubes to improve the filtering efficiency thereof.

During a wash cycle, the air heater 110 is turned off and the valve 24 opened to direct solvent into the machine 5 for conditioning contact with a load of tumbling materials in the drum 10. The two-way valve 34 is also operated to draw dry cleaning solvent out of the unfiltered solvent tank compartment 28*b*. The actuator 54 of the dispenser 53 is energized so additional additive is injected into the fluid flow system such as activated carbon and adsorptive magnesia, thereby to remove dyes and fatty acids from the solvent.

In the extraction portion of the cycle, the drum 10 is elevated to centrifuging speed and the valve 24 closed, however, the pump 14 continues to operate, thereby recirculating the solvent through the filter 19 and conditioning the solvent for the next subsequent cleaning operation.

During drying, the timer motor 61 will energize and actuate the necessary components to energize the heating elements 110 and condition the air flow system by suitable actuation of valves to provide an air flow path through the solvent condenser 101. Thus, perchlorethylene vapor is condensed when the vapor-laden air contacts the evaporator 108 and reclaimed solvent is restored to the hydraulic circuit via a solvent drain conduit 140 connected to the bottom of the solvent condenser 101 and leading to the tank means 28*a*, 28*b*.

After the dry cycle has progressed for a long enough period of time so all of the solvent has been filtered and treated, the solvent circulation pump 14 is stopped by deenergization of the pump motor 17. Backflow of solvent filter additives from the filter apparatus 19 through the conduit 18 is prevented by check valve 18*a* in the conduit 18 and circulation of dry cleaning solvent through the hydraulic circuit is stopped.

At this point, the dump valve 43 at the bottom of the filter apparatus 19 is actuated so the solvent contained therein, together with the soil and filter coatings accumulated will be discharged into the sediment trap 44. The soil and filter coatings will be trapped within the sediment container 44*a*, while the solvent will be returned into the unfiltered solvent tank 28*b*.

At the end of the dry cycle, the timer motor 61 advances an appropriate cam for effecting a deodorizing part of the complete cycle. When this happens the heating elements 110 are deenergized and operation of the condenser 101 is stopped, whereupon air from the atmosphere is circulated through the machine and vented to assist in removing undesirable odors from the materials being cleaned.

In accordance with the principles of the present invention, the electrical circuitry of the machine is augmented by the provisions shown in FIGURE 3. Therein, the timer motor is shown at 61 and drives through suitable mechanical connections shown at 200, a plurality of cams herein identified as A, B, C and D. Each of the cams operates a corresponding switch herein identified as S_a, S_b, S_c, and S_d.

Elements corresponding to the components already described such as the thermostats 132 and 134 and the valve motors 126*m* and 129*m* are identified in FIGURE 3 with like reference numerals. There is also provided a service signal herein shown as comprising a visible signal 201, but it will be understood that an audible signal could also be used, or both visual and audible signals could be used to attract the attention of an attendant or an operator whenever the signal 201 is energized. The power lines from the usual power source are indicated at L_1, L_2 and a neutral line is indicated at N.

The program schedule effected under the regulation of the sequential control means 60, by way of illustrative example, is depicted in chart form in FIGURE 4. It will be understood, of course, that any suitable program can be preselected for the operation of the machine, however, a typical program is herein illustrated. The program is divided into 50 separate intervals of one minute each. The first three one minute intervals are assigned to the precoating period of the cycle, while intervals 4–12 are assigned to the washing period of the cycle and intervals 13–17 are assigned to the extracting portion of the cycle.

Since the control adaptations herein disclosed in detail affect the drying and deodorizing periods, such portions of the cycle are shown on the chart of FIGURE 4. Thus, the dry portion of the cycle extends from intervals 18 through 46, while the deodorizing part of the cycle extends from intervals 47 through 50.

At the end of the high speed extraction portion of the total dry cleaner cycle, the timer motor 61 advances the machine into the dry cycle. At this time, the drum 10 of the machine 5 is tumbling and the drying air heater 110 is energized since the cam D has operated the switch S_d to a closed position, thereby closing contacts 202 and 203 to complete an energization circuit including conductor wire 204 and 205 extending between the power lines L_1 and N.

When the air heater 110 is energized, the condenser control valve 126 will be opened by virtue of energization of the condenser control valve motor 126*m* through the switch S_c operated by the cam C. In this connection, the switch S_c closes contacts shown at 207 and 208, the switch S_c being connected to a conductor wire 209 leading to the power line L_1 and the contact 208 being connected to a conductor wire 210 leading through the motor 126*m* to the neutral line N. There is also connected in this same energization circuit a relay 211 which is energized through the switch S_c, which relay 211 is connected at one terminal to the conductor wire 210 and to

a conductor wire 212 at its other terminal leading to the neutral line N. The relay 211 operates a ganged switch and there is shown diagrammatically a mechanical actuating means 213 connected to a first blade 214 and a second blade 216 of the ganged switch. The stationary contacts of the switch are shown at 217 and 218. The blade 214 has a contact 219 and the contacts 217, 219 are normally open. The blade 216 has a contact engageable with the contact 218 and is normally closed.

The energization of the relay 211 operates to close the normally open contacts 217, 219, thereby energizing the motor 116 which is illustrated as driving the blower 119 and the motor 114 which drives the compressor 113 of the refrigerating apparatus. Accordingly, when the switches S_c and S_d are closed, liquid refrigerant will be directed through the expansion valve 127 and through the evaporator 108 within the vapor-condenser 101, thereby to assist in condensing solvent vapors out of the air stream.

Upon opening the normally closed contact between the blade 216 and the contact 218, the energization of the motor 129*m* is precluded, thereby insuring that the valve 129 remains closed and preventing the possibility of the refrigeration system supplying refrigerant to both evaporators 108 and 131 simultaneously.

The solvent cooler thermostat 134, having its sensing element 136 positioned within the solvent tank 28*a*, 28*b*, continuously monitors the temperature of the perchlorethylene dry cleaning solvent within the tank means. As shown in FIGURE 3, the solvent cooler thermostat 134 is electrically connected across the line in series relationship with the solvent refrigeration control valve motor 129*m*, as well as the compressor and refrigeration blower motors 114 and 116.

If the thermostat 134 is set to close at a temperature of 75° F., for example, then any time during the day or night and regardless of whether or not the machine 5 is being operated, when the set temperature is attained in the tank means, the solvent refrigeration control valve 129 will be open because the motor 129*m* will be energized through the normally closed contacts 216, 218 of the energization circuit, thereby energizing also the blower motor 116 and compressor motor 114 to operate the compressor 113. Accordingly, refrigerant will be directed through the expansion valve 130 and into the coils of the evaporator 131 for cooling the perchlorethylene dry cleaner solvent within the tank means 28*a*, 28*b*.

When the perchlorethylene is cooled to 70° F., for example, the solvent cooler thermostat 134 will reopen to deenergize the refrigeration system. In this connection, the thermostat 134 is shown as including a switch blade 221 having a contact 222 engageable with a contact 223 and being connected to a conductor wire 224 leading to the power line L_1. The contact 223 is connected to a conductor wire 226 leading to the stationary contacts 217 and 218 of the ganged switch and operating also to be connected to the blower motor 116 and compressor motor 114.

The dry cleaner circuitry as thus provided effects full time protection to prevent the perchlorethylene from obtaining a temperature wherein excessive dye bleed and wrinkling will occur in materials being dry cleaned.

The only exception as to the availability of the refrigeration system for cooling the perchlorethylene in the solvent tank means, is during the twenty-nine intervals of the drying portion of the cycle, at which time the refrigerant is being directed through the valve 126, the expansion valve 127 and into the evaporator 108 of the vapor condenser 101.

In addition to the controls for determining what evaporator coil 108 or 131 will be receiving the refrigerant, the circuit also provides a sensing system that operates once each cycle to assure that the refrigeration system is operating properly. If it is not, the signal 201 is energized to immediately notify the attendant or maintenance man that a malfunction exists.

Note that the timer motor 61, with the exception of cycle intervals 33 through 47 is solely energized for the complete dry cleaner cycle through the switch S_a, as operated by cam A. As shown on the timer schedule of FIGURE 4, when the condenser valve relay 211 and the condenser refrigeration control valve motor 126*m* are energized, power is also supplied to the solvent condenser thermostat 132, which, at this time, will be open.

At the beginning of interval 33, however, the cam B closes the switch S_b, thereby closing contacts 227 and 228, respectively. At the end of the thirty-third interval, the cam A opens the switch S_a, thereby opening contacts 229 and 230, respectively. The time period from the eighteenth interval through the thirty-third interval allows for the refrigerant passing through the coils of the solvent condenser-evaporator 108 to cool the air temperature within the solvent vapor condenser 101 to a low enough temperature wherein a preselected temperature will close a switch blade 231 embodied in the solvent condenser thermostat 132, thereby closing contacts 232 and 233, respectively. During normal operation, the solvent condenser thermostat 132 will close well within this period of time and the timer motor 61 will then be energized through the switch S_b at the end of the thirty-third interval when the switch S_a is opened by the cam A.

If there is a malfunction in the refrigeration system, however, the solvent condenser thermostat 132 will not have closed in this time period and thus the timer motor 61 and a service signal relay 234 will stall out. When the service signal relay 234 is not energized, its contacts, shown at 236 and 237, will reclose to their normally closed position, whereupon the service signal 201 will be energized, thereby indicating the existence of the malfunction to the maintenance man. During the complete dry cleaner cycle, of course, the service signal relay 234 is energized whenever the timer motor 61 is energized so the service signal 201 will normally not be energized unless a concurrence of the conditions herein described occurs, thereby evidencing a malfunction in the refrigeration system.

For better identification, the parts of the energization circuit for the relay 234 include a conductor wire 240 connected to the neutral line N and connected to one terminal 241 of the relay 234. The other terminal 242 of the relay 234 is connected to a conductor wire 243 leading to the contact 230.

The switch S_a is connected to the power line L_2 via a conductor wire 244. The timer motor 61 is connected to the neutral line N via a conductor wire 246 and is connected to the contact 230 via a conductor wire 247.

It will be noted that the power supply to the service signal 201 and to the solvent cooler thermostat 134 is independent of any timer-operated switches.

At the end of the forty-sixth interval, the dry cleaner machine 5 goes into its deodorizing cycle, at which time the solvent condenser valve motor 126*m* is deenergized, thereby closing the valve 126 and the air heater 110 is deenergized. Fresh outside air is then circulated through the treatment zone to deodorize the materials. When valve motor 126*m* is denergized, the relay 211 is also deenergized which allows relay contacts 217 and 219 to reopen and contacts 218 and 220 to reclose. Thus, unless the contacts 222 and 223 of the solvent thermostat 134 happen to be closed at this time, the compressor motor 114 and refrigeration condenser blower motor 116 will also be deenergized.

Although minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a dry cleaner control system, a sequential con-

troller having a timer motor for driving a plurality of cam-operated switches and automatically regulating a dry cleaner through a sequential program of washing, extracting and drying periods, air circuit means for the dry cleaner including a vapor-condenser and a solvent condenser thermostat in said vapor condenser, refrigeration means including an evaporator in said vapor condenser, first, second and third cam-operated switches in series with said thermostat, a refrigerant control valve and a motor operating said valve in series with said first cam-operated switch and energized thereby to allow refrigerant to flow through said evaporator, said timer motor being energized through said third cam-operated switch during a first interval and through said second cam-operated switch, said thermostat and said first cam operated switch during a second interval, said thermostat closing during normal operation within said first interval, a signal relay having a signal actuated thereby, said signal relay being in parallel with said timer motor, whereupon a malfunction in the refrigeration system sensed by a failure of said thermostat to close during said first interval will deenergize said relay and said timer motor during said second interval, thereby energizing the signal and indicating the malfunction to an attendant.

2. A dry cleaner comprising,

air circuit means through which a stream of air may be driven,

a solvent reclamation condenser in said air circuit means

to condense solvent vapors in the stream of air,

and hydraulic circuit means through which a stream of solvent may be driven,

a solvent storage reservoir in said hydraulic circuit means,

a thermostat in said solvent reservoir,

motor means for driving a refrigeration compressor,

motor means for driving a refrigeration condenser blower,

a solvent cooling refrigeration control valve,

a motor controlling said solvent cooling refrigeration control valve,

a relay having a normally closed switch,

and a normally opened switch,

a relay coil to operate said relay,

a first circuit including

said thermostat, said compressor motor, said blower motor, said normally closed relay switch and said solvent cooling refrigeration control valve motor,

a second circuit including

said normally opened relay switch, said compressor motor and said blower motor,

a solvent condenser refrigeration control valve,

a motor controlling said solvent condenser refrigeration control valve,

a third circuit including

said relay coil and said solvent condenser refrigeration control valve motor,

a refrigeration means including

an evaporator coil in said solvent reclamation condenser and

an evaporator coil in said solvent storage reservoir,

and conduit means in said refrigeration means regulated by said control valves to direct refrigerant into said solvent condenser evaporator coil

to condense solvent vapors when said second and third circuits are energized and to direct refrigerant into said solvent reservoir evaporator coil to cool solvent in said solvent storage reservoir whenever said second and third circuits are deenergized and said first circuit is energized,

and sequential control means in control of said circuits for automatically operating the dry cleaner through a cycle having a series of washing, extracting and drying periods.

References Cited in the file of this patent

UNITED STATES PATENTS

1,985,376	Lindenberger	Dec. 25, 1934
2,011,083	Sando	Aug. 13, 1935
2,114,776	Davis	Apr. 19, 1938
2,462,240	Van Vliet	Feb. 22, 1949
2,573,966	Hamlin	Nov. 6, 1951
2,656,696	McDonald	Oct. 27, 1953
2,681,556	Creighton et al.	June 22, 1954
2,733,587	McKendree	Feb. 7, 1956
2,736,632	Blau	Feb. 28, 1956
2,966,050	Kellerman	Dec. 27, 1960