

April 19, 1966

J. F. OLES

3,246,493

DRY CLEANING APPARATUS

Filed Dec. 24, 1963

6 Sheets-Sheet 1

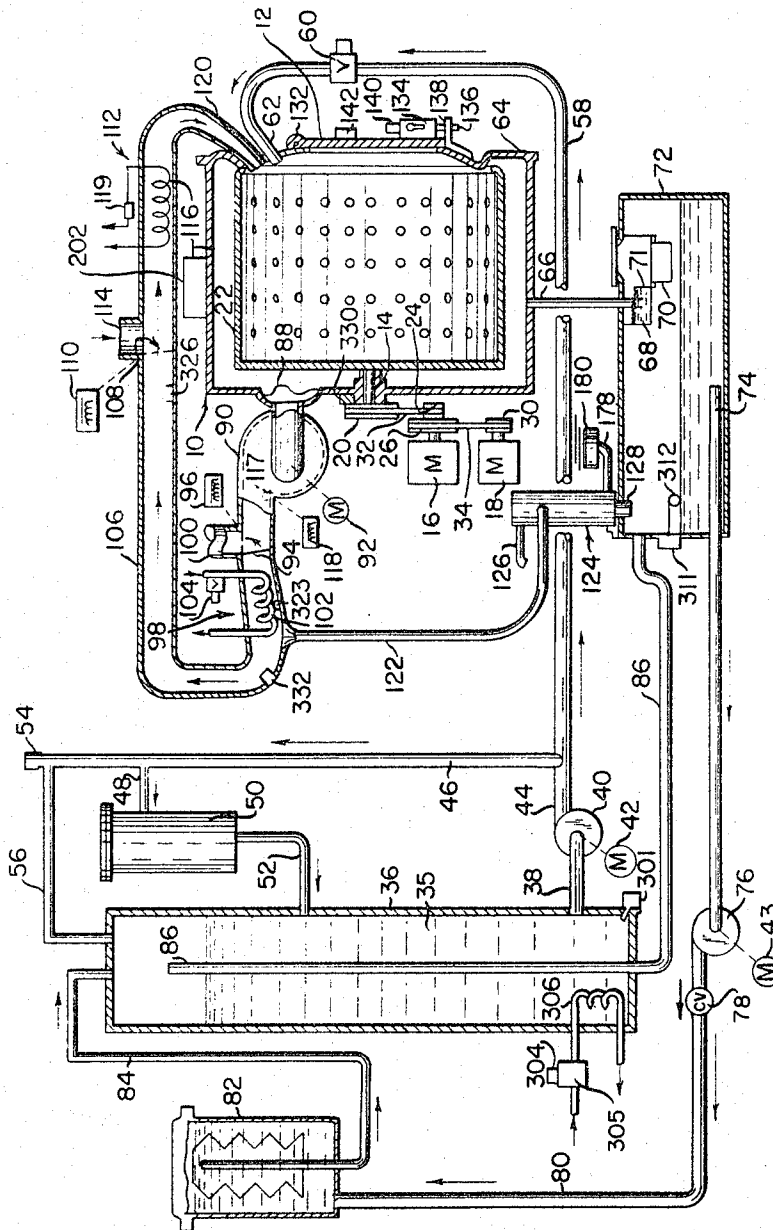


FIG. 1

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April 19, 1966

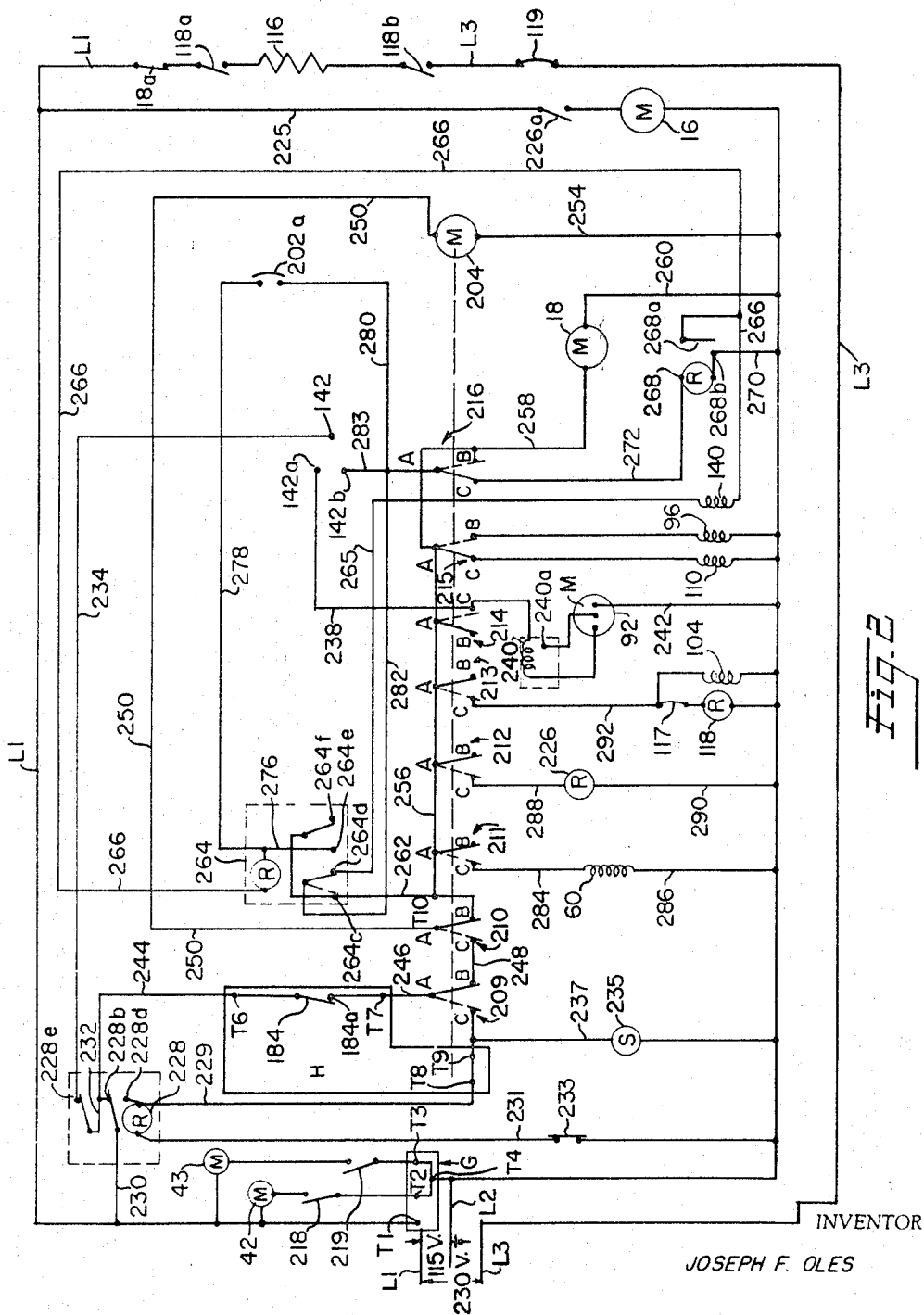
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6 Sheets-Sheet 2



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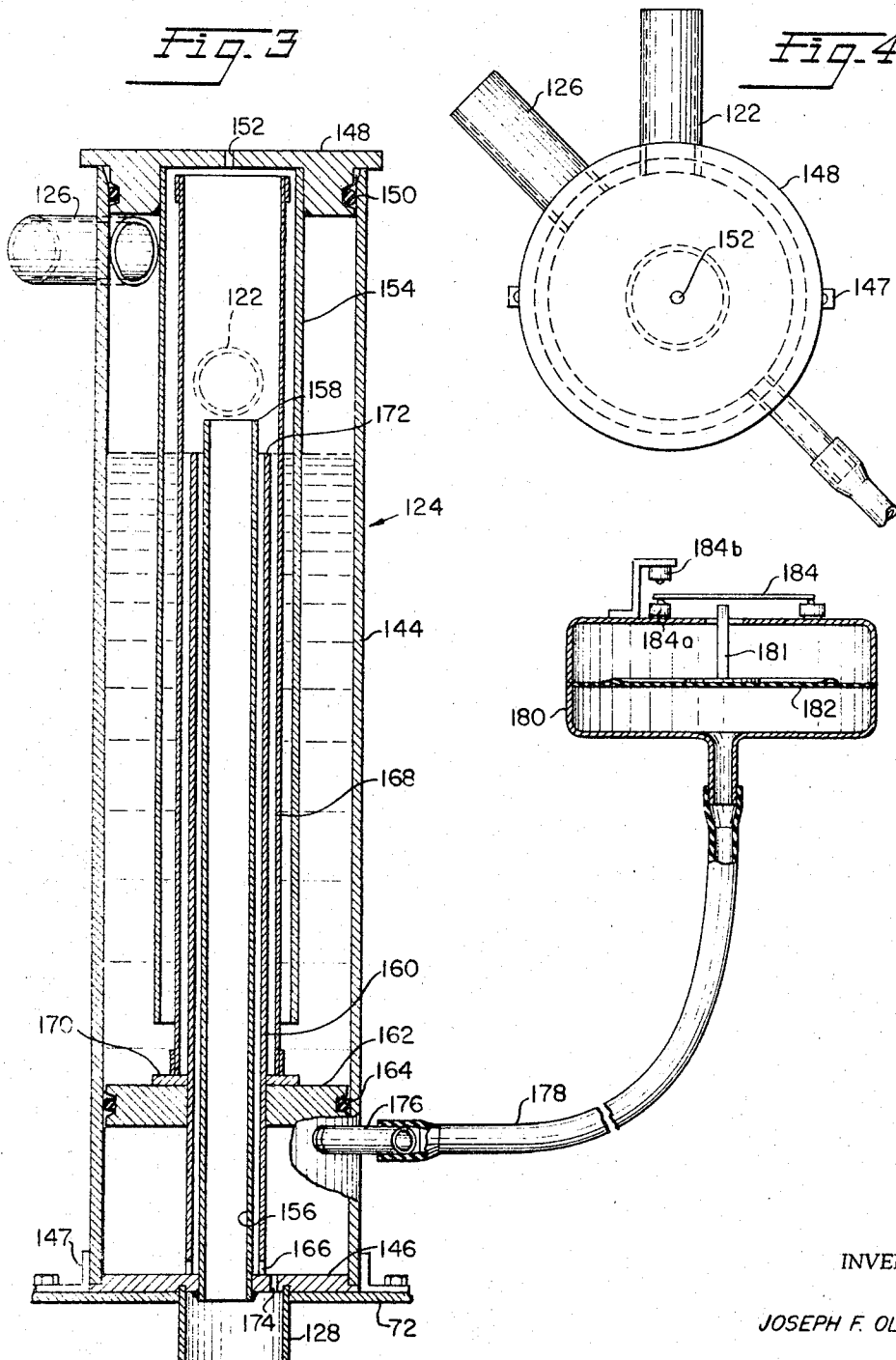
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6 Sheets-Sheet 3



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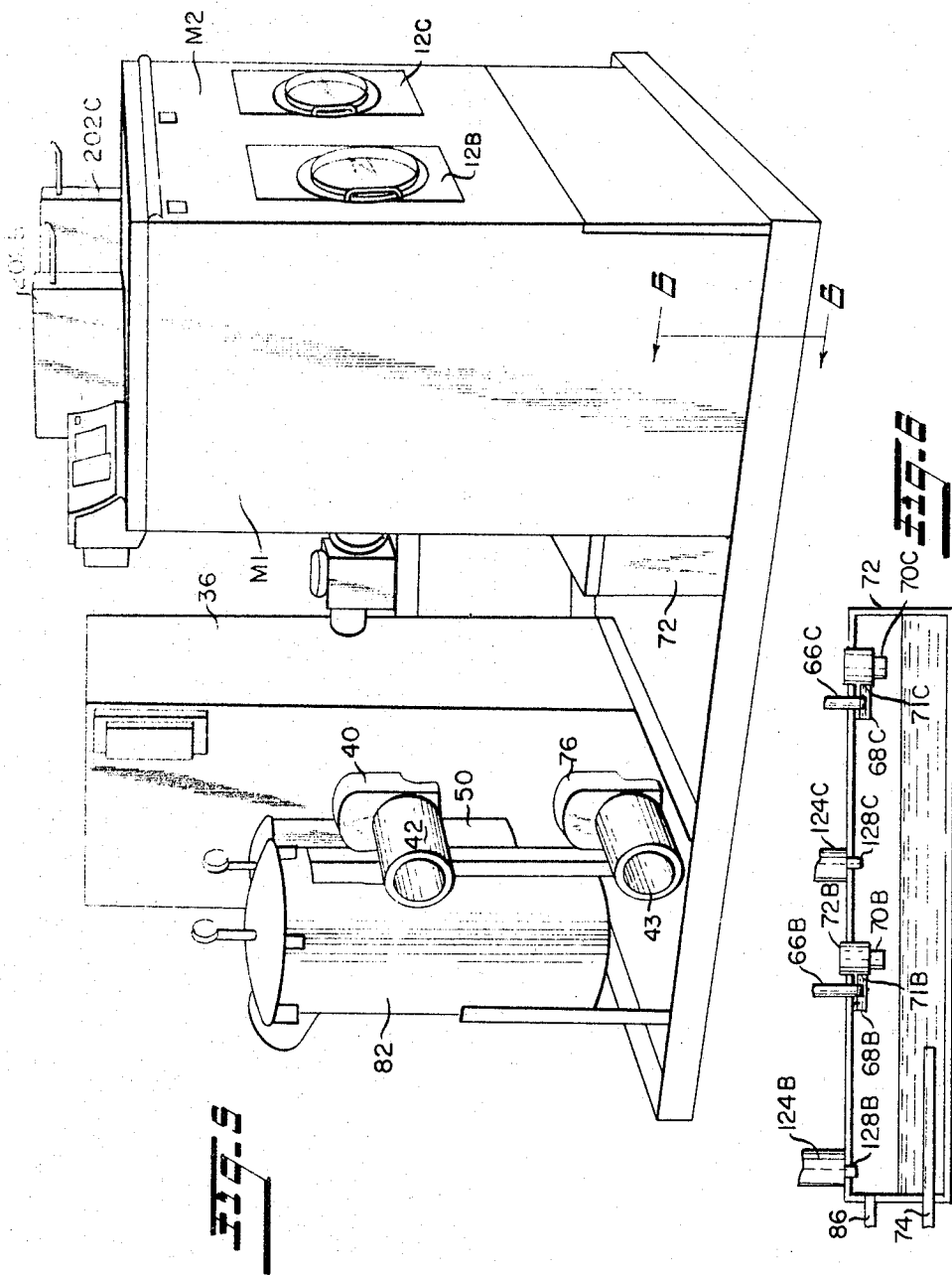
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6 Sheets-Sheet 4



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6 Sheets-Sheet 5

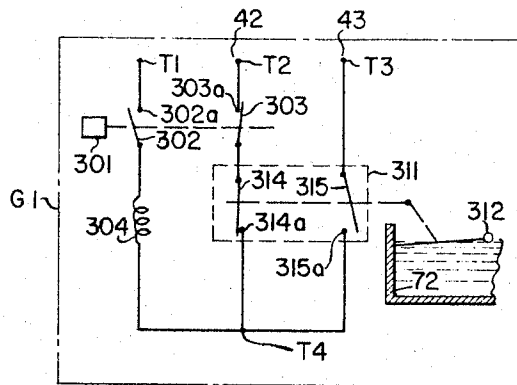


Fig. 7

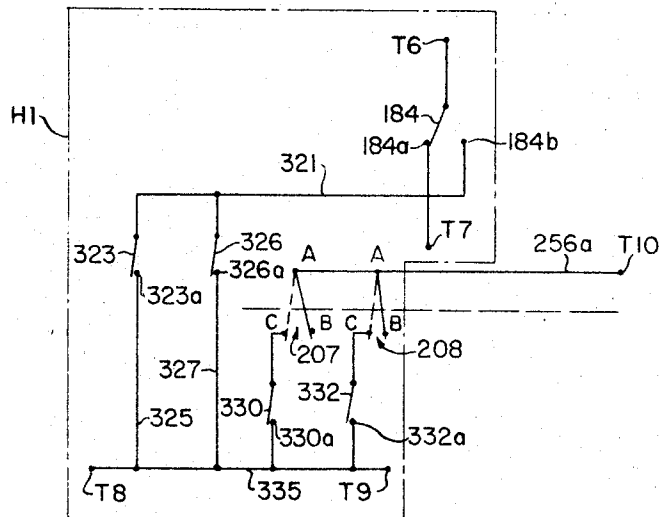


Fig. 6

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6 Sheets-Sheet 6

SWITCH UNIT CONTACT	LOAD	TIMER - MINUTES										VARIABLE	TIMER	UNLOAD
		1	2	3	4	5	6	7	8	9	10	TIME	1 2 3	
220	PUMPS	SOLVENT CIRCULATION												
202a	COIN SWITCH	MOMENTARY CONTACT												
142a	DOOR SWITCH	DOOR CLOSED												OPEN
209	B TEST CONTACT	OFF										OFF		
210	B TIMER MOTOR 204	ON											ON	
211	B C SPRAY SOLENOID 60	TUMBLE & DRAIN												
212	B C SPIN MOTOR 16	SPIN												
213	B C HEAT 116 WATER 102	DRYING & SOLVENT RECOVERY												
214	B C BLOWER 90	ON										ON		ON
215	B VENT SOLENOID 96 C AIR DAMPER 110	100 CLOSED												DEODORIZING PERIOD - 114 OPEN
216	B TUMBLE MOTOR 18 C DOOR LOCK 140	ON												
184	A CONDENSATE FLOW B CONTACTS	CLOSED										CLOSED		
208	AIR FLOW SWITCH 332											ON		
207	TUMBLE SWITCH 330	ON												

Fig. 6

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DRY CLEANING APPARATUS

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7 Claims. (Cl. 68—18)

This invention relates to dry cleaning machines and more particularly to control apparatus for such machines and apparatus for handling the cleaning fluid, commonly called solvent, at the completion of a dry cleaning operation.

In general, automatic dry cleaning machines include tumblers, blowers, solvent condensers, heaters and the like, controlled by a sequence timer the operation of which may be initiated manually or, in commercial machines, by the deposit of a coin.

The sequence timer then operates the apparatus automatically through the complete cycle, a portion of which includes the extraction and recovery of the solvent from the load. As is well known in the art, the solvent recovered from the load contains excessive amounts of water as well as solid impurities.

Thus, to assure efficient operation of the apparatus it is necessary to recover the optimum amount of solvent from the load and to purify the solvent by the removal of water and solid impurities before the solvent is returned to a reservoir for use in a subsequent cleaning cycle.

The optimum time required to recover the solvent varies considerably as a function of a number of variables including the weight of the load, the absorbency of the exposed area of the load, the temperature of the work chamber and other factors. If the cycle is too long the load may be overdried and damaged. Accordingly, the length of the extraction and recovery cycle must be automatically varied to avoid either of these two undesirable results.

One proposal for effecting automatic variation of the extraction and recovery cycle is disclosed in co-pending application Serial No. 186,440, filed April 10, 1962, for Coin Operated Dry Cleaning System, now abandoned. The apparatus disclosed in that application includes a device responsive to the flow of solvent during the recovery cycle which is effective to disable the automatic timer until the solvent flow diminishes to a point which indicates that the drying and solvent recovery process has been completed at which time the fixed timing operation is continued. While experience has shown that the operation of this prior apparatus is satisfactory in principle, nevertheless, it is difficult and expensive to manufacture, is relatively bulky and requires excessive maintenance.

It is accordingly an important object of the present invention to provide improved solvent recovery apparatus for dry cleaning machines which overcomes the above stated problems encountered with prior devices and which is of simplified, compact construction which may be manufactured and assembled at substantially reduced cost.

It is also an object of the present invention to provide improved solvent recovery apparatus which affords an extended maintenance-free service life.

It is a further object of the present invention to provide improved solvent recovery apparatus which may be disassembled and reassembled easily for cleaning, inspection or repair.

It is an additional object of the present invention to provide improved solvent recovery apparatus in which water and particles of varying specific gravity, including those which are lighter than water and heavier than solvent, are removed and either carried to a convenient point of disposal or collected in a convenient accessible position within the apparatus.

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It is also an object of the present invention to provide improved solvent recovery apparatus for dry cleaning machines including a control for determining the length of the recovery cycle, the control having a considerably greater sensitivity than units heretofore available.

The dry cleaning fluid or solvent, usually perchlorethylene, is, in some instances, toxic or irritating and it accordingly necessary that precautions be taken to prevent the escape of the fluids or fumes from the apparatus either during normal operation or abnormal operation.

In accordance with the present invention the solvent storage tank is separated from the dry cleaning apparatus by one or more novel traps which prevent the escape of fumes into the machine itself. The novel arrangement of the storage tank system and the trap system is such that in multiple dry cleaning machines served by a common storage and filtration system the solvent fumes cannot pass from one machine to the other.

Additional objects and advantages will become apparent as the description proceeds in connection with the accompanying drawings in which:

FIGURE 1 is a diagrammatic illustration of a dry cleaning apparatus incorporating the present invention;

FIGURE 2 is an electrical diagram of the control circuit for the apparatus of FIGURE 1;

FIGURE 3 is an enlarged vertical central section of the solvent recovery apparatus shown removed from the remainder of the apparatus;

FIGURE 4 is a top plan view of the apparatus of FIGURE 3;

FIGURE 5 is a perspective view of a two-machine unit

FIGURE 6 is a fragmentary vertical section taken along line 6—6 of FIGURE 5;

FIGURE 7 illustrates a terminal block adapted to be substituted for terminal block G in FIGURE 2;

FIGURE 8 illustrates a terminal block adapted to be substituted for terminal block H in FIGURE 2; and

FIGURE 9 is a time-operation chart graphically depicting the operational sequences of this dry cleaning apparatus.

As shown in FIGURE 1, the main housing of the dry cleaning machine, indicated generally at 10, encloses perforated tumbling and spinning drum 22 accessible through a door 12. Drum 22 is supported on a shaft 24 which may be driven at either high speed by motor 16 or at low speed by motor 18.

Attached to shaft 14 is a large diameter driven pulley 20. Motor 16 drives a small pulley 24 and a larger pulley 26 while motor 18 drives a single small pulley 30. The sizes of the pulleys are relative, depending on motor speed and the speeds at which drum 22 is to be driven.

Pulleys 24 and 20 are connected by belt 32, while pulleys 28 and 26 are connected by belt 34. Pulley 28 incorporates an overrunning clutch (not shown) arranged to transmit power from motor 18 to shaft 14 and to prevent power transmission in the reverse direction.

When only motor 18 is energized, drum 22 will rotate at a low speed. When motor 16 is energized drum 22 will be rotated at high speed whether motor 16 is running, or not. The door 12, hinged at 132, is closed by lock 134 having bolt 136 spring biased into engagement with hasp 138. Lock 134 is unlocked only either by energization of solenoid 140 at the end of the cycle or in an emergency by a key retained by an attendant. Solenoid 140, when energized, withdraws bolt 136 from hasp 138 and permits door 12 to be opened. The circuit is arranged so that solenoid 140 is energized only after the cycle is completed and door 12 is kept locked throughout the complete machine cycle. Door switch 142 allows the machine to be started only when door 12 is closed.

Air and solvent circulation

Dry cleaning solvent 35 is contained in tank 36 which may hold 65 gallons and is pumped from tank 36 through conduit 38 by pump 40 driven by motor 42 which generally runs continuously while the machine is activated for use.

Solvent is continuously circulated through conduits 44, 46 and 48, carbon filter unit 50 and conduit 52 back to tank 36, the carbon filter clarifying the solvent. Conduit 46 is also connected via pressure relief valve 54 and conduit 56 to the top of tank 36. Valve 54 is normally closed, but opens if pressure in line 46 becomes excessive and allows solvent to flow through line 56 to return to tank 36.

A conduit 58, forming an extension of conduit 44 is connected to a nozzle 62 extending through the front panel 64 of housing 10. When normally closed solenoid valve 90 in conduit 58 is energized, solvent will be sprayed out of nozzle 62 on to the clothes in drum 22 and will drain into the bottom of housing 10, then through conduit 66 to vapor trap 68, overflowing through lint screen 70 into base tank 72. Solvent liquid level in trap 68 is maintained above the bottom outlet of conduit 66 by wall 71. This vapor trap prevents travel of solvent fumes upward from tank 72 into housing 10 and out door 12. As liquid flows over wall 71, it drops down into screen type lint trap 70 before flowing down into tank 72. Trap 70 is removably mounted inside tank 72 so accumulated lint can be cleaned therefrom.

From the bottom of tank 72, solvent is pumped through return conduit 74 by pump 76 driven by motor 43 through check valve 78 and line 80 to filter 82, from which solvent flows through conduit 84 to the top of tank 36. Overflow conduit 86 connects the upper part of tank 36 with the interior of tank 72.

The upper interior of housing 10 is connected through screen 88 to the inlet of blower 90 driven by motor 92. The blower outlet is connected to a two-way damper 94 controlled by solenoid 96. When the solenoid 96 is de-energized, the output of the blower is vented to the outside atmosphere. When the solenoid is energized, damper 94 is moved from the position shown in full lines to the dotted line position where it blocks outlet 100 and permits the blower to blow air and vapor from housing 10 through condenser 98.

Condenser 98 is cooled by water flowing through coil 102, the flow being controlled by solenoid valve 104 which opens when energized. Air and uncondensed vapor leaving condenser 98 are blown through duct 106, past a two way damper 108 and through a heater 112. Damper 108 is normally in the position shown in full lines, in which position it closes fresh air inlet 114. When solenoid 110 is energized, damper 108 assumes the dotted line position, where it blocks flow through duct 106 but opens inlet 114 to admit fresh air to heater 112.

Air and/or vapor from the heater 112 passes through duct 120 connected through front 64 of housing 10, through the interior of drum 22 and housing 10 to blower 90.

When condenser 98 is in operation, condensate flows into the lower portion of the condenser and drains through conduit 122 into separator 124 where water is separated and carried off through outlet 126. The condensed solvent flows through drain 128 to tank 72.

Water separator

One of the features of the present invention is the apparatus for separating water from the returning condensed solvent and the means for continuing the solvent extraction and condensation until the clothes are entirely dry, the time required varying with the type of clothes being cleaned.

As shown in FIGURES 3 and 4, separator 124 comprises an elongated cylindrical housing member 144 welded at its bottom end to angles 147 and bottom cover

plate 146 which is bolted by angles 147 to the top wall of storage tank 72 so that separator 124 can be removed from tank 72 for servicing. At its upper end, the housing member 144 is closed by a removable cover plate 148, normally held in place by the friction of an O-ring 150. The cover plate 148, which is provided with a small vent 152 to prevent any possible siphoning action, has soldered thereto cylindrical barrier tube 154 which projects downwardly into the interior of the housing member 144 in concentric relation therewith. A solvent recovery tube 156 extends through a central opening in the base plate 146 to which it is welded and is in direct communication with stub pipe 128 welded to base plate 146 and leading into the interior of the solvent storage tank 72. At its upper end, the tube 156 provides an overflow rim 158.

A tube 160 is positioned concentrically around the recovery tube 156 by a divider plate 162, the outer periphery of which is sealed against the housing member 144 by an O-ring 164. The plate 162 is welded to the tube 160 to maintain the parts in proper position. The lower end of the tube 160, which rests on the upper surface of the bottom closure plate 146, is provided with a plurality of ports 166 for a purpose to appear. The assembly is completed by a cylindrical fine mesh screen 168, the lower end of which rests by its own weight on a sealing felt washer 170. The unit is initially primed by filling the space formed above the divider plate 162 to the level of the overflow rim 172 provided by the top of the tube 160.

The condensed solvent collected from the bottom of the condenser 98 passes by gravity through conduit 122 into the annular space between the housing 144 and the barrier tube 154, thence around the bottom of the barrier tube and through the screen 168, displacing solvent over the overflow rim 172 for passage through the ports 166 into the annular air bell formed in the space between the plates 146 and 162 and tubes 144 and 160.

Since the specific gravity of water is considerably less than that of a solvent, any water (which is extracted from the load and from the atmosphere) collects at the top of the solvent outwardly of the barrier tube 154. When sufficient water has been collected in this area, it passes outwardly from the apparatus through the water outlet tube 126 to any convenient point of disposal. Solvent entering the air bell through the ports 166 will be delivered to the solvent storage tank 72 at a controlled rate through an orifice 174 in the bottom closure plate 146, the rate of delivery being a function of the orifice diameter and the pressure head at the upstream side of the orifice. As solvent continues to flow into the air bell, the pressure therein increases. This pressure is communicated through a pipe 176 and a flexible hose 178, to a switch operator 180 having an actuator plunger 181 moved by a diaphragm 182. When the pressure in the air bell reaches a predetermined level, the diaphragm 182 and the plunger 181 will be displaced upwardly to open contact 184a of switch 184 and to close contact 184b of switch 184 which, as described below, modifies the operating cycle of the dry cleaning apparatus.

As the condensate flow rate diminishes, indicating completion of the drying and solvent recovery cycle, the pressure developed in the air bell will diminish to a level which will permit the diaphragm 182 to return to its normal position to reclose contact 184a of the switch 184 to permit continuation of the programmed cycle and to re-open contact 184b.

In normal operation, the condensate flow rate, particularly during the initial portions of the recovery cycle, will be great enough to require an additional flow passage. This is provided by the solvent recovery tube 156 which has an overflow rim 158 higher than the primary overflow rim 172 and directs the excess solvent into the storage tank 72. It is to be noted that any dirt or other impurities which are lighter than water will be carried off through the water disposal pipe 126. Impurities which are heavier than the solvent will be prevented from pass-

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ing to the orifice 174, or to the storage tank 72, by the fine mesh screen 168 and will gradually collect on the upper surface of the divider plate 162.

The construction of the separator apparatus is such that it may be easily cleaned at desired intervals. When the top cover plate 148 is axially removed from housing member 144, it carries the barrier tube 154 with it, exposing the screen 168 which may be removed for cleaning. Removal of the screen permits access to the upper end of the tube 160 which may be lifted out of the apparatus carrying the divider plate 162 and washer 170 with it to permit removal of any impurities collected on its upper surface. After cleaning, the parts may be quickly and easily reassembled.

General operation

The overall operation of the machine is depicted graphically in FIGURE 9.

The operation of the machine is controlled primarily by a series of single pole double throw micro switches 209-216 operated by a series of cams mounted on a shaft driven by a timer motor 204. Since the cams and shaft are conventional they have been omitted. Each micro-switch has a terminal A and contacts B and C to which terminal A is alternately connected as required to energize the elements of the mechanism in proper sequence to perform the required cycle of operations. Terminal block H1 (FIGURE 8) adds two additional timer controlled switches 207 and 208.

The machine is loaded with clothes through door 12, the door is closed and the machine put into operation by inserting coins in coin box 202 to start timer motor 204. Tumbling by motor 18 starts immediately, followed a few seconds later by a four minute spray of solvent through nozzle 62 at approximately seven gallons per minute. A short tumble and drain period is followed by a two minute spin by motor 16 at approximately 265 r.p.m. At the end of the spin period, blower 90, condenser water in coil 102, the heater 116 are turned on; blower 90 circulates about 175 c.f.m. through the load; and 2.6 g.p.m. of water flows through condenser 98.

This starts drying of the clothes and condensation of the solvent which causes switch contact 184a to open as previously explained. At the end of 3½ minutes timer motor 204 stops until drying is completed, the reduced rate of condensation causing switch contact 184a to re-close which restarts the timer motor. Drying then continues for an additional two minutes. Following is a two minute deodorizing period during which fresh air is blown through the clothes and out of the vent. Tumbling is continued throughout the drying and deodorizing periods.

Electrical circuits and operation of controls

A three-wire supply circuit has a potential of 230 volts across outside line L1 and L3 and 115 volts from center line L2 to either outside line L1 or L3.

When the apparatus is completely shut down, it is in the condition shown in FIGURE 2.

Terminal block G (FIGURE 2) may also take the form of block G1 (FIGURE 7). Terminal block H (FIGURE 2) may also be of the form of block H1 (FIGURE 8).

When block G is used, manually closing switches 218 and 219 drives circulating pumps 40 and 76 by energizing motors 42 and 43 since terminals T2 and T3 are internally connected to T4. It is often desirable to keep pump 76 in operation to filter the solvent even when the dry cleaning machine is not running.

Block G1 may be used in place of block G to provide more sensitive control of the machine after switches 218 and 219 are manually closed and to control the level of solvent in tank 72.

If the solvent is too high, rising float 312 (pivoted to the wall of 72) opens contact 314a (FIGURE 7) in float

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switch 311 to stop pump 40 by de-energizing motor by breaking the circuit between terminals T2 and T4.

If the solvent level is too low, falling float 312 opens contact 315a to stop pump 76 by de-energizing motor by breaking the circuit between terminals T3 and T4. This prevents air from being drawn into filter pump and may also serve as a warning of either a low solvent level in the machine or clogging of filter 82.

Switches 314 and 315 may be operated by separate cams to control each switch individually or by a motion linkage so a wide variation in level is permitted before switch contact 314a or 315a is opened so that both pumps will usually be in operation. When solvent level within proper limits, both switch contacts 314a and 315a are closed.

If tank 36 is filled with solvent 35 to the top of overflow pipe 86 during continuous operation to return the solvent to tank 72, pump 76 will remain in operation to filter the solvent to provide clean filtered solvent for the next cleaning operation even when the dry cleaning machine is not running through a timed cleaning cycle.

Mechanism associated with block G1 also maintains the solvent at a given temperature. The temperature of the solvent in tank 36 is preferably kept within the 70°-78° F. range. When 78° F. is reached, a temperature sensitive element 301 closes contact 302a of switch 302 to energize solenoid 304 opening a valve 305 to permit cooling water to circulate through coil 306 in tank 36. After the solvent has been cooled sufficiently, contact 302a opens, and cooling water circulation stops. If the solvent temperature exceeds 80° F., element 301 opens a normally closed contact 303a of switch 303 to prevent damage to clothes in drum 22 by de-energizing motor 42 so that pump 40 cannot deliver any more solvent through nozzle 62 to the clothes until this condition is corrected.

When door 12 is opened to load drum 22 with clothes, blower 90 draws fresh air through open door 12 and blows it out exhaust outlet 100. More specifically opening door 12 energizes blower 90 by closing door switch contact 142a to complete a circuit from line L1 through line 230, closed contacts 228b and 228e of fail-safe relay 228, line 234, door switch contact 142a, line 238, blower motor relay coil 240 to close its normally open contact 240a, blower motor 92, and line 242 to line L2. De-energized solenoid 96 positions damper 94 in its solenoid position.

When the door is closed after the machine has been loaded, contact 142a is opened and contact 142b is closed to energize relay 268 by forming a circuit from line L1 to line 234, contact 142b, line 283, closed contact 21 of switch 216, line 272, relay coil 268 and line 270 to line L2.

Energizing relay coil 268 closes its normally open contact 268b to energize door latch solenoid coil 140 by closing a circuit from line L1 to contact 142b and then through line 283, line 282, normally closed contact 26 of relay 264, line 265, door solenoid coil 140, line 266, normally open contact 268b, now closed by its energizing relay coil 268, and line 270 to line L2. Energized door latch solenoid coil 140 holds bolt 136 out of engagement with hasp 138 so that the door can be opened by the operator at any time until the machine is started.

After the operator finishes loading the clothes in drum 22 and closes door 12, the operator inserts the required coins in coin switch box 202. This action energizes start relay coil 264, energizes timer motor 204 to provide the timing action for the cleaning cycle, forms a holding circuit to maintain start relay coil 264 energized after the coin-actuated switch opens, and starts drum 22 to rotate to tumble the clothes therein.

More specifically, closing contact 202a of coin box 202 energizes start relay coil 264 by forming a circuit from line L1 to door switch contact 142b, and then through line 283, line 280, closed contact 202a, line 278, rel-

oil 264, line 266, closed contact 268b and line 270 to line L2.

Energizing start relay coil 264 closes relay contacts 64c and 264e to energize timer motor 204 and a holding circuit for relay 264.

Timer motor circuit is formed from line L1 through relay 228, contact 142b, and then through line 276, normally open relay contact 264e closed by its energized relay coil 264, line 262, normally closed timer contact 10b, line 250, timer motor 204 and line 254 to line L2.

The holding circuit is formed to keep start relay coil 64 energized before coin-actuated switch contact 202a opens. Closing relay contacts 264c and 264e forms the holding circuit from line L1 to door switch contact 42b and then through line 283, line 282, normally open relay contact 264c closed by its energized relay coil 264, closed relay contact 264e, line 276, relay coil 264, line 66, closed relay contact 268b, and line 270 to line L2.

Tumble motor 18 is energized by either of the circuits from line L1 to closed contact 264c of relay 264 and then through line 262, line 256, line 258, motor 18 and line 260 to line L2. Energization of motor 18 rotates drum 22 to tumble the clothes therein.

The timer now moves switch 215 from contact C to contact B to energize damper solenoid 96 to close exhaust 100 and to de-energize damper solenoid 110 to close exhaust 114 by damper 109.

A few seconds later, timer motor 204 moves switch 16 from contact 216C to contact 216B and switch 211 from contact 211B to contact 211C.

Opening contact 216C de-energizes relay coil 268 to open normally open relay contact 268b to de-energize door latch solenoid 140 to lock door 12 and to break the holding circuit de-energize relay coil 264 to open contacts 264C and 264e and close normally closed contacts 264d and 264f. Relay contact 264e is also opened but motors 204 and 18 remain energized by a circuit described below.

Timing motor 204 is kept energized by closed contact 216B forming a holding circuit from line L1 through contact 228b and 228e of relay 228 to line 283 and then through closed contact 216B, line 256, closed contact 10B, line 250, timer motor 204 and line 254 to line L2.

Tumble motor 18 is kept in operation by closed contact 216B forming a holding circuit from line L1 to closed contact 216B and then through line 258, motor 18 and line 260 to line L2.

Solenoid valve 60 is opened to spray solvent on the clothes through nozzle 62 when timer motor 204 closes contact 211C to form a circuit from line L1 to line 256 and then through closed contact 211C, line 284, solenoid valve 60 and line 286 to line L2 to energize and open solenoid valve 60.

Now a solvent drain period occurs. After four minutes of spray by nozzle 62, timer motor 204 causes switch 211 to open contact 211C to stop solvent spray through nozzle 62. Then, solvent drains from the clothes as they are tumbled by motor 18 for about one-half minute following cutoff of spray through nozzle 62.

Following the drain period, solvent extraction begins. Now, timer motor 204 energizes spin relay 226 to energize spin motor 16 to spin drum 22 at 265 r.p.m. to extract solvent from the clothes by centrifugal force.

Spin relay 226 is energized by timer motor 204 opening contact 212B and closing contact 212C. Closing contact 212C forms a circuit from line L1 to line 256, closed contact 212C, line 288, spin motor relay coil 226 and line 290 to line L2. This energizes spin motor relay 226 and closes its relay contact 226a. Closing relay contact 226a energizes spin motor 16 by forming a circuit from line L1 through line 225, contact 226a and motor 16 to line L2.

After two minutes of spinning, spinning stops and solvent recovery begins. At this time timer motor 204 closes contacts 212B, 213C and 314C and opens contacts

212C, 213B and 214B to de-energize spin motor 16 to discontinue spinning; to energize solenoid 104 to cause water to flow through condenser coil 102; to energize relay coil 118 to energize heating coil 116; and to energize blower motor 92 to circulate air and solvent vapor by blower 90 for drying the clothes in drum 22 and recovering the solvent vapor. However, tumbling continues because tumble motor 18 has remained energized throughout the spin period.

Closing contact 213C forms a circuit from line L1 to line 256, contact 213C, line 292, and parallel circuits to line L2 through normally closed thermostat 117 and heater relay 118 and through condenser water solenoid 104. Energizing relay coil 118 closes contacts 118a and 118b to energize by 230 volts heating coil 116 from line L1 through normally open contact 18a (back contact of the starter for motor 18) closed when motor 18 is energized, normally open relay contact 118a now closed by its energized relay coil 118, heating coil 116, normally open relay contact 118b now closed by its energized relay coil 118, and normally closed thermal overheat switch 119 to line L3. Heater 112 incorporates heating coil 116 controlled by thermostat 117 to maintain air leaving blower 90 at 150° F. when heater 112 is on. Overheat switch 119 disconnects coil 116 when heater 112 exceeds 255° F. Back contact 18a of motor 18 assures that heating coil 116 will not be on to heat damage the clothes if tumble motor 18 is not running.

Closing contact 214C forms a circuit from line L1 to line 256, contact 214C, blower motor relay coil 240 to close its normally open contact 240a, blower motor 92 and line 242 to line L2. Now, blower 90 circulates air and solvent vapor from housing 10 through condenser 98, where most of the solvent is condensed; and circulates air and uncondensed vapor through duct 106 and heating coil 116 so that heated gases are returned to the inside of drum 22 through nozzle 120 for recirculation through the clothes in drum 22 to absorb more vapor therefrom before re-entry into blower 90.

Solvent recovery now takes place. Solvent condensate flows from condenser 98 through conduit 122 and separator 124 to tank 72, as previously explained. Solvent recovery takes place in two different periods: (1) a timed solvent recovery period controlled by timer motor 204 and (2) a variable time solvent recovery period controlled, independently of timer motor 204, by the solvent recovery rate acting on pressure sensitive switch 184.

During variable solvent recovery, the machine is controlled by switch 184 with either the terminal block H in FIGURE 2 or the block H1 in FIGURE 8. Block H will be used for the remainder of this description, and the use of block H1 will be described hereafter under the heading "Safety Features."

During the timed recovery period, solvent recovery test contact 209C is momentarily closed by timer motor 204 to determine whether or not solvent recovery is taking place properly to guard against failure of the apparatus by such causes as lack of circulation of cooling water through condenser 98 or failure of blower 90 to operate. The electrical controls and timer circuits are so arranged that normally closed flow switch contact 184a must be opened or tripped within a predetermined time after drying and solvent recovery starts to indicate proper operation of the solvent recovery and drying systems. If solvent recovery is not taking place properly, the flow switch contact 184a is not opened or tripped within this time period, an electrical pulse energizes fail-safe relay 228, the machine is shut down, and alarm signal 235 is actuated.

If the solvent recovery is taking place properly, the machine proceeds into the variable time solvent recovery period. Then, when switch 184a closes, it indicates that solvent recovery is complete so that control of the machine cycle is then again returned to timer motor 204 to start the next operation.

The operation of test contact 209C will now be considered in more detail. If solvent condensation and recovery is proceeding normally, switch 184 will open contact 184a. After three minutes of this timed solvent recovery period, timer motor 204 momentarily closes solvent recovery test contact 209C. Then, either of the following two modes of operation will occur.

First, if contact 184a has not opened, this action would indicate that alarm signal 235 should be sounded and the machine shut down because solvent recovery was not taking place properly. This would occur if there were no water flowing through condenser coil 102 or if blower 90 failed to operate. Then, when switch 209 closes contact 209C, fail-safe relay 228 is energized by forming a circuit from line L1 through line 230, normally closed contact 228b, line 244, terminal T6, closed contact 184a, terminal T7, line 246, contact 209C, line 229, fail-safe relay coil 228, line 231, and normally closed push button switch 233 to line L2.

Now, the machine - shut - down - and - alarm - circuit - sequence starts. Energizing relay coil 228 opens contacts 228b and 228e of relay 228 to break circuits through line 234 to de-energize damper solenoid 96, timing motor 204, tumble motor 18, water solenoid 104, heater relay 118 and blower motor 92. De-energizing heater relay 118 de-energizes heating coil 116 and the machine is shut down.

Energizing relay coil 228 also closes contact 228d of relay 228. Closing contact 228d holds relay coil 228 energized and energizes alarm signal 235 by forming a holding circuit from line L1 through line 230, closed contact 228d, relay coil 228, line 231 and switch 233 to line L2 to keep relay coil 228 energized after contact 228b is opened. A circuit is also completed from line L1 through line 230, contact 228d, line 229, terminals T8 and T9, line 237 and alarm signal light 235 to line L2 to cause signal 235 to be energized.

To restore operation, the operator must: open contact 209C by rotating timer motor out of test fire position and manually open push button switch 233 momentarily to de-energize fail-safe relay coil 228 and to de-energize alarm signal 235 by opening contact 228d. Then, contacts 228b and 228e return to their normal closed position to remake any necessary circuits to continue the operation of the machine from the new timer setting. This is the end of the machine-shut-down-and-alarm-circuit-sequence.

If condensate recovery is proceeding normally, the rate of flow of the condensed solvent will open switch contact 184a. Then, closing of test contact 209C momentarily will not affect the operation of the machine.

At the end of the timed solvent recovery period, drying is usually not complete and the solvent flow will normally maintain contact 184a open. Now, the machine enters the variable time solvent recovery period. At this time, timer motor 204 opens contact 210B and closes contact 210C. Opening contact 210B de-energizes and stops timer motor 204. Switch 184 controls the machine's cycle during the variable time solvent recovery period. Hence, timer motor 204 is stopped until drying is complete and contact 184a closes in response to the decrease in solvent recovery flow to indicate that the clothes are substantially dry and that solvent recovery is substantially complete.

Closing contact 184a energizes timer motor 204 by forming a circuit from line L1 through line 230, contact 228b, line 244, terminal T6, contact 184a, terminal T7, line 246, contact 209B, line 248, contact 210C, line 250, timer motor 204 and line 254 to line L2. As timer motor 204 rotates, it opens contact 210C to break the circuit just described and to close contact 210B. Closing contact 210B maintains timer motor 204 energized by forming a circuit from line L1 through line 230, contact 228b, line 232, contact 228e, line 234, contact 142b, line 283, contact 216B, line 256, contact 210B, line 250, timer motor 204 and line 254 to line L2.

Now solvent recovery stops and the clothes are deodorized. Two minutes after rotation of timer motor 204

resumes, heating coil 116 is de-energized and water through condenser coil 102 is shut off since solvent recovery complete. The clothes are deodorized by energizing solenoid 110 and de-energizing solenoid 96 to allow damper 108 and 94, respectively, to open ports 114 and 100 exhausting air and vapor from housing 10 and drum 22 the clothes continue to be tumbled by energized tumble motor 18.

To accomplish this, timer motor 204 opens contact 213C and 215B and closes contacts 215C and 213B. Opening contact 213C de-energizes and closes solenoid valve 104 and de-energizes relay coil 118 to open normally open contacts 118a and 118b to de-energize heating coil 116. Opening contact 215B de-energizes damper solenoid 96, and closing contact 215C energizes damper solenoid 110.

After two minutes of the deodorizing operation, cycle is completed and the machine is stopped. No timer motor 204 and tumbling motor 18 are de-energized and stopped, door latch solenoid 140 is energized so that door 12 can be opened, and blower motor 92 is restarted to exhaust any fumes from drum 22 during the unload and loading operations.

This is accomplished when timer motor 204 opens contact 216B, closes contact 216C, opens contact 214C and closes contact 214B. Opening contact 216B de-energizes and stops timer motor 204, de-energizes motor 18 and stops the tumbling operation, and de-energizes damper solenoid 110 to close port 114 with damper 109 in full line position. Opening contact 214C de-energizes blower motor 92.

Closing timer switch contact 216C re-energizes relay 268 to close contact 268b to re-energize door latch solenoid 140, as described at the beginning of the cycle, retract bolt 136 from hasp 138 so that door 12 can be opened. When door 12 is opened, switch 142 opens contact 142b and closes contact 142a to re-energize blower motor 92 so that blower 90 will suck air through door opening and exhaust through open port 100 a solvent fumes from within machine housing 10 during clothes loading and unloading operation because solenoid 96 is de-energized at open contact 216B.

The machine has now completed a cycle, and is ready for reloading and restarting by insertion of coins in coin box 202.

Safety features

When block H1 (FIGURE 8) is substituted for block H, the aforementioned mode of operation is still obtainable because the connections between terminals T6 and T7 and between terminals T8 and T9 are the same in both blocks. However, the additional structure in block H1 gives it additional and desirable safety features.

These safety features, including use of test contact 209 operate on the assumption that at the conclusion of a dry cleaning cycle, the load should be dry and free of solvent. This eliminates any health hazard to users of the machine by inhaling solvent fumes either from escape of solvent from the open door or from solvent still on clothes after removal from the machine if the solvent was not completely removed because of an operating failure of some component essential to complete solvent recovery. These safety features also operate on the assumption that a reliable indication that the operation is progressing satisfactorily to this end may be ascertained from the rate of solvent recovery condensate flow, the speed and temperature of the air flow in duct 106, the temperature of the water in condenser coil 102, and the speed of rotation of drum 22. If the rate of condensate flow is insufficient to open pressure switch contact 184a when test contact 209C closes or if one of the last-mentioned speed or temperature indications occur, this serves as a warning that, at the close of the cycle, the load would be fouled with solvent. The fail-safe relay coil 228 is energized in any of the manners mentioned hereafter a door 12 remains locked except by an attendant using

ey, after he sees signal alarm 235. Even if the electricity fails, de-energized door latch solenoid 140 will keep door 12 locked.

Since test contact 209C described heretofore checks the operation of the machine only momentarily and in only one portion of the machine cycle, it is desirable to check the operation of the machine more frequently so as to get safer operation. This is done by the circuits provided by block H1.

Each safety feature will be first described as to how it energizes fail-safe relay coil 228 and then all of the safety features will be described as they go into the machine-shut-down-and-alarm-circuit-sequence earlier described. If test contact 209C does not energize fail-safe relay 228, solvent recovery must be proceeding at a normal rate, switch contact 184a must be open, and switch contact 184b must be closed. If at any time during solvent recovery the temperature of the water in condenser coil 102 rises to an unsafe level or the temperature of the air in conduit 106 rises to an unsafe level, it indicates that the condensing action is not occurring properly. These temperatures will respectively close contact 123a of switch 323 or contact 326a of switch 326.

Switch contact 323a closes in response to rise in water temperature in condenser coil 102 if water fails to flow through the condenser coil or if the temperature of the cooling water is too high. Closing switch 323 energizes fail-safe relay coil 228 by forming a circuit from line L1 through line 230, normally closed contact 228b, line 244, terminal T6, contact 184b, line 321, closed contact 123a, line 325, terminal T8, line 229, fail-safe relay coil 228, line 231 and switch 233 to line L2.

Switch contact 326a may close in response to rise in air temperature for any of many reasons, including a blocked screen in the air flow path, excessive air leakage from conduit 106, etc. Switch contact 326a is set to close when a suitable upper air temperature limit, such as 110° F., is reached. Closing switch 326a forms a circuit from line L1 along the circuit just described except through closed contact 326a and line 327 instead of through closed contact 323a and line 325.

If drum 22 fails to be rotated properly during the machine cycle, the clothes may remain in a wad so as to be neither properly cleaned nor properly dried but may be laden with solvent when door 12 is opened. To guard against this type of failure, the machine has a tumble speed sensing switch 330 such as a centrifugally actuated switch, designed to close contact 330a if shaft 14 is either stationary or rotating at a too low speed. Timer switch 207 operated by motor 204 has its contact 207C closed shortly after switch contact 216B is closed and is opened shortly before contact 216B is opened to monitor operation of tumble motor 18 by switch contact 216B. If switch contact 330a closes while switch contact 207C is closed, the fail-safe relay coil 228 is energized by a circuit from line L1 to line 256 and then through terminal T10, line 256a, contact 207C, contact 330a, line 335, terminal T8, line 229, fail-safe relay coil 228, line 231, and closed switch 233 to line L2.

If blower 90 does not operate properly during solvent recovery, the clothes will be inadequately dried and laden with solvent to cause an unsafe condition when door 12 is opened. To guard against this problem, air flow sensing switch 332 is provided. This switch is in series with contact 208C which is closed by motor 204 shortly after contact 214C is closed and opened shortly before contact 214C is opened. If air flow does not exist or is below a predetermined minimum while switch contact 208C is closed, switch contact 332a will close to form a circuit along the same path as that for switch 330 except through closed switch contacts 208C and 332a instead of closed contacts 207C and 330a.

After fail-safe relay coil 228 is energized as above described, the earlier described machine-shut-down-and-alarm-circuit-sequence occurs to shut down the machine.

After repair of the defect has been made, operation

may be restored by following the steps earlier described in this aforementioned sequence to restore operation.

Multiple units

Coin operated machines are preferably installed in multiples as shown in FIGURE 5. A single solvent storage and filtration system, including only one base tank 72, storage tank 36, filters 50 and 82, and pumps 44 and 76 is provided for a pair of cleaning machines M1 and M2, each machine having its own coin switch box 202 and controls as previously described.

As shown in FIGURE 6, a single base tank 72 is located beneath machines M1 and M2. Machine M1 incorporates separator 124B, which discharges into tank 72 through drain 128B, and conduit 66B which discharges into tank 72 through air trap 68B and lint trap 70B. Machine M2 incorporates separator 124C, which discharges into tank 72 through drain 128C and conduit 66C, which discharges into tank 72 through air trap 68C and lint trap 70C.

Since the two machines may be started at different times and may be at different parts of their respective cycles at any given time, it is important that solvent vapor not be transferred from one machine to the other. The provision of liquid traps 68B and 68C prevents such transfer without need for valves. The traps 68B and 68C, lint traps 70B and 70C, etc. correspond in structure and mode of operation to corresponding parts shown and described in FIGURE 1.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. For use in dry cleaning apparatus including a receptacle for clothes and a circuit for recirculating dry cleaning solvent through said receptacle, solvent recovery and control apparatus in said circuit comprising: a vertically extending container with an inlet adjacent its upper end for receiving solvent from said receptacle and a bottom outlet for returning solvent to said receptacle, means in said container forming a trap for retaining liquid at a level between said outlet and said inlet, means forming a control chamber below said trap, means for conducting excess liquid from said trap into said control chamber, means forming a restricted passage connecting the bottom of said control chamber to said outlet whereby said liquid entering the control chamber from said trap passes to said outlet through said restricted passage thus providing a variable liquid level in said control chamber, the liquid in said control chamber exerting pressure on the gas above said liquid, said pressure being dependent on the relative rate of flow of liquid into and out of said chamber, and means responsive to the pressure in said control chamber for generating a signal to modify the operation of said dry cleaning apparatus.

2. The combination according to claim 1 together with a wall depending from the top of said container and extending downwardly below the level of the top of said trap to form with said container a water chamber, and means providing a water outlet from said trap.

3. For use in dry cleaning apparatus including a receptacle for clothes and a circuit for re-circulating a dry cleaning solvent through said receptacle; solvent recovery apparatus in said circuit comprising a cylindrical container having an inlet adjacent its upper end for receiving solvent from said receptacle and an outlet positioned centrally of its lower end for returning solvent to said receptacle, a top cover plate removably closing the upper end of said container, a first tube rigid with said

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top cover plate and extending downwardly therefrom toward the bottom of said container, a second tube positioned within said first tube and extending from the bottom of said container upwardly within said first tube toward the top of said container, a plate carried by said second tube and dividing said container into an upper separating section and a lower control section, said second tube being in communication with said control chamber, a third tube positioned within said second tube and having its lower end in communication with said outlet and its upper end in communication with said separating chamber, an orifice connecting said control chamber to said outlet whereby solvent delivered to said container through said inlet will flow around the bottom of said first tube and over the top of said second tube into said control chamber to generate a variable pressure control signal in said control chamber and additional solvent will flow over the top of said third tube for passage to said outlet, and means responsive to said control signal to modify the operation of said dry cleaning apparatus.

4. For use in dry cleaning apparatus including a receptacle for clothes and a circuit for re-circulating a dry cleaning solvent through said receptacle; solvent recovery apparatus in said circuit comprising a vertically extending cylindrical container having a side inlet adjacent its upper end for receiving solvent from said receptacle, a bottom end plate for said container having a central outlet for returning solvent to said receptacle, a top cover plate removably closing the upper end of said container, a first tube rigid with said top cover plate and extending downwardly therefrom toward said bottom end plate, a second tube positioned within said first tube and having its lower end resting on said bottom end plate, a plate carried by said second tube and dividing said container into an upper separating section and a lower control section, the lower end of said second tube being in communication with said control chamber, a third tube positioned within said first and second tubes and having its lower end connected to said outlet and sealed from said control chamber and its upper end in communication with said separating chamber, and an orifice connecting said control chamber to said outlet whereby solvent delivered to said container through said inlet will flow around the bottom of said first tube and over the top of said second tube into said control chamber to generate a variable pressure control signal in said control chamber, and means responsive to said control signal to modify the operation of said dry cleaning apparatus.

5. In a dry cleaning apparatus including a housing containing a receptacle for clothes and a circuit for re-circulating cleaning solvent through said receptacle, said

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circuit including a storage tank: a conduit in said circuit through which solvent flows from said housing into said storage tank by gravity, the lower end of said conduit being disposed above the normal liquid solvent level in said storage tank, and a small receptacle in said storage tank surrounding the lower end of said conduit, whereby liquid solvent from said conduit fills said receptacle and overflows into said tank, the body of fluid within said receptacle forming a trap to prevent the escape of fumes into said housing.

6. The combination according to claim 5 together with a filter removably mounted in said storage tank and interposed in the path of said solvent overflowing from said receptacle into said storage tank.

7. In a dry cleaning apparatus including at least two dry cleaning machines, each having a housing containing a receptacle for clothes and a circuit for re-circulating solvent through said receptacle, said circuits including common storage tank positioned below said housings, a conduit in one of said circuits through which solvent flows from one of said housings into said tank by gravity, a second conduit in the other circuit through which solvent flows from the other housing into said tank by gravity, the lower ends of said conduits being disposed above the normal level of the solvent in said tank, and small receptacles in said tank surrounding the respective lower ends of said conduits whereby solvent from said conduits fills said receptacles and overflows into said tank, the body of fluid in said receptacles forming a trap to prevent the escape of fumes from said storage tank into either of said housings.

References Cited by the Examiner

UNITED STATES PATENTS

35	612,791	10/1898	Winkel	210—30
	681,477	7/1901	Franke	210—30
	1,290,820	1/1919	Winkel	210—300
	2,310,680	2/1943	Dinley	34—7
	2,539,407	1/1951	Dinley	34—7
40	2,729,961	1/1956	Shields	68—1
	2,844,213	7/1958	Wilson	137—17
	3,085,415	4/1963	Gosnell	68—1
	3,103,112	9/1963	Behrens et al.	68—1
	3,110,544	11/1963	Moulthrop.	
45	3,122,908	3/1964	Stanulis et al.	68—1
	3,172,276	3/1965	Moore	68—18.2

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