July 9, 1968 D. R. WILLIAMS 3,391,550

DRYCLEANING MACHINE

Filed May 28, 1962 5 Sheets-Sheet 1

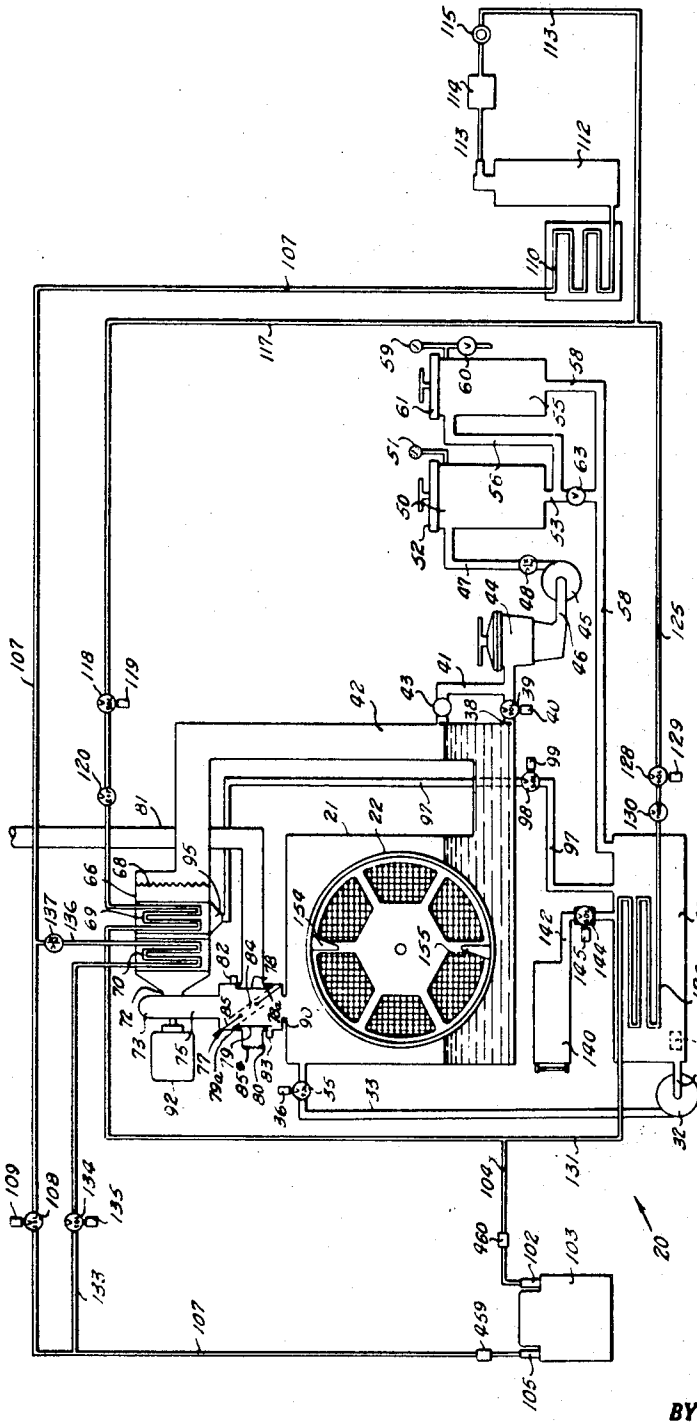


Fig. 1

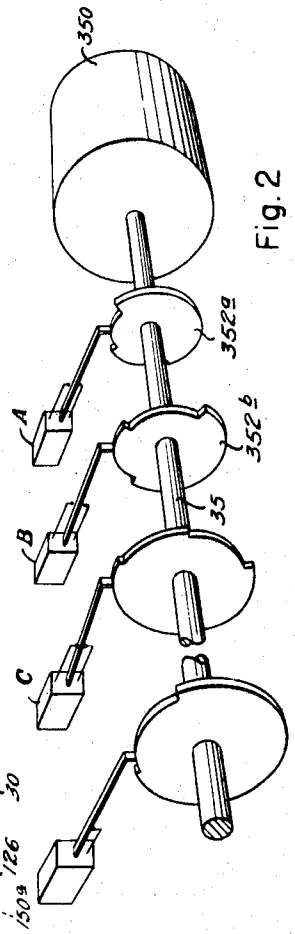


Fig. 2

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DRYCLEANING MACHINE

Filed May 28, 1962 5 Sheets-Sheet 2

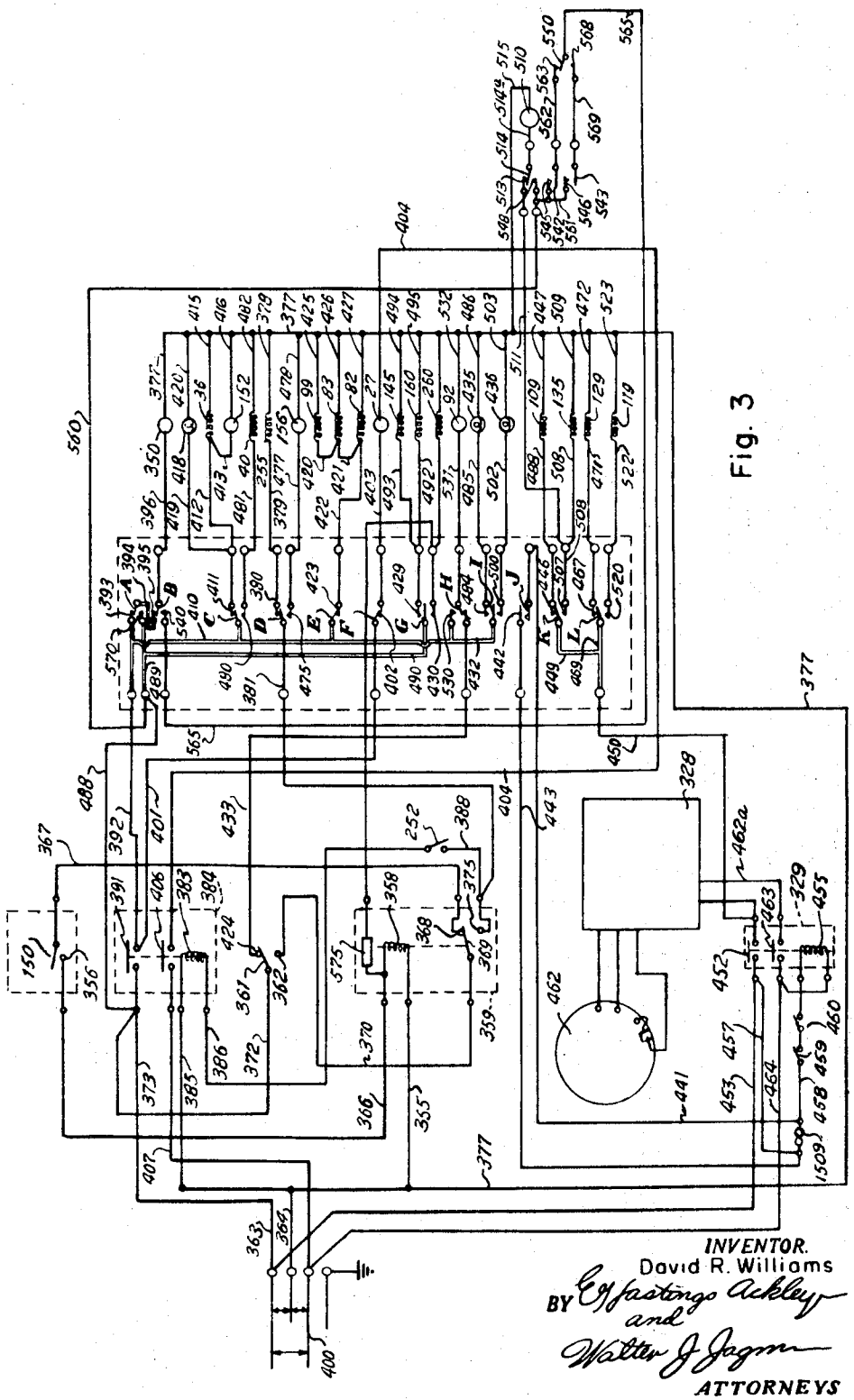


Fig. 3

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DRYCLEANING MACHINE

Filed May 28, 1962 5 Sheets-Sheet 3

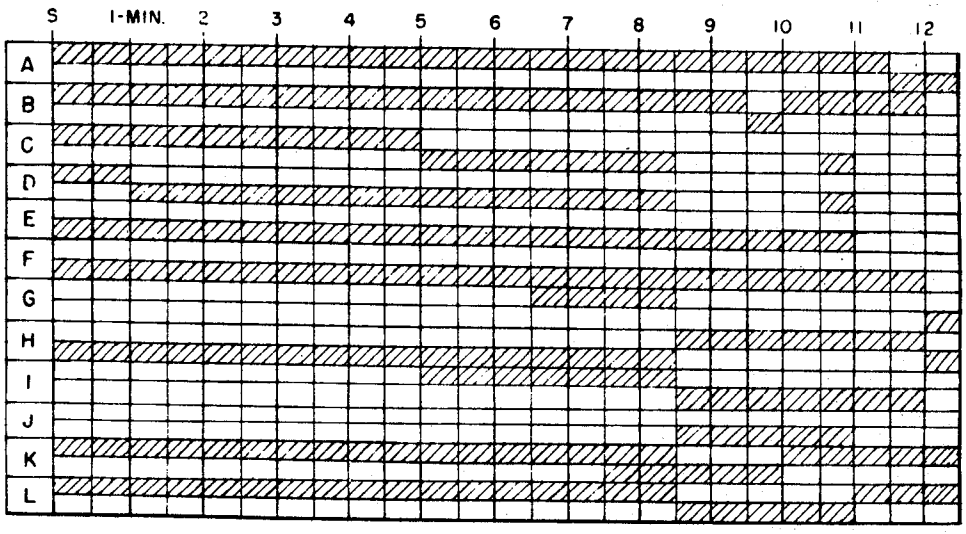
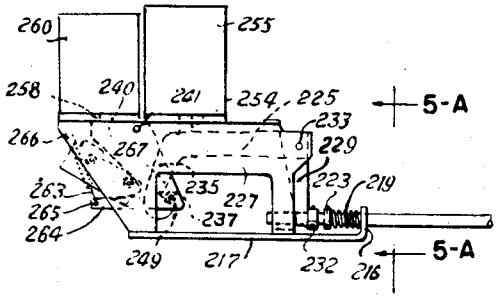


Fig. 4



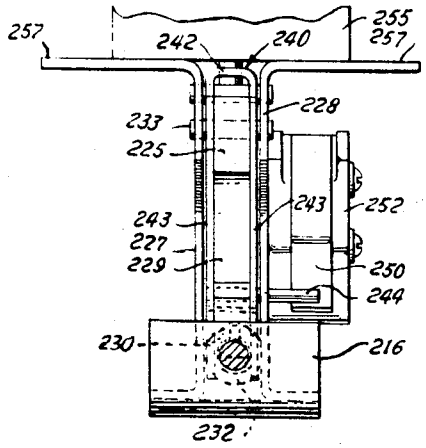


Fig. 5-A

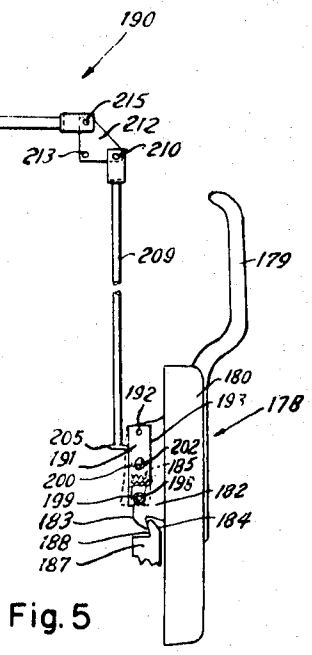


Fig. 5

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DRYCLEANING MACHINE

Filed May 28, 1962 5 Sheets-Sheet 4

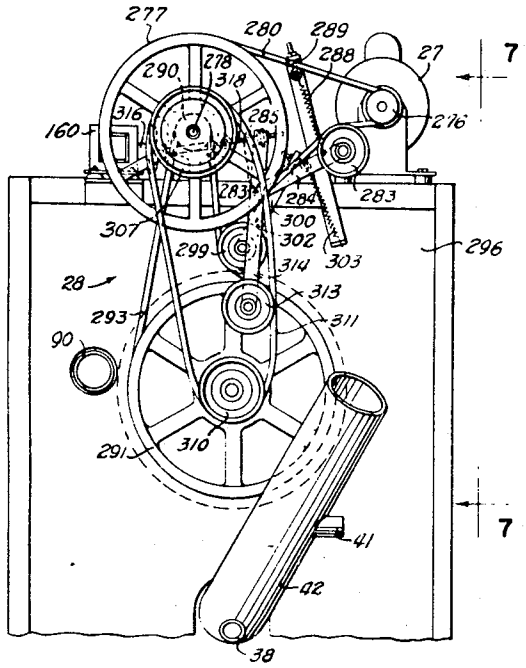


Fig. 6

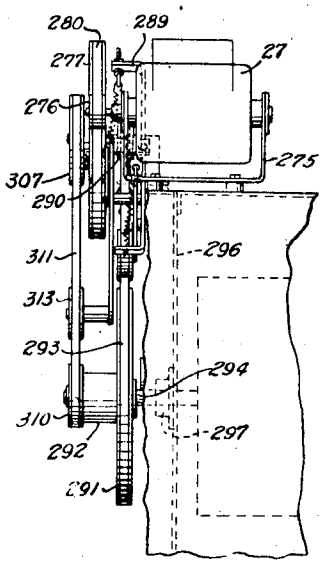


Fig. 7

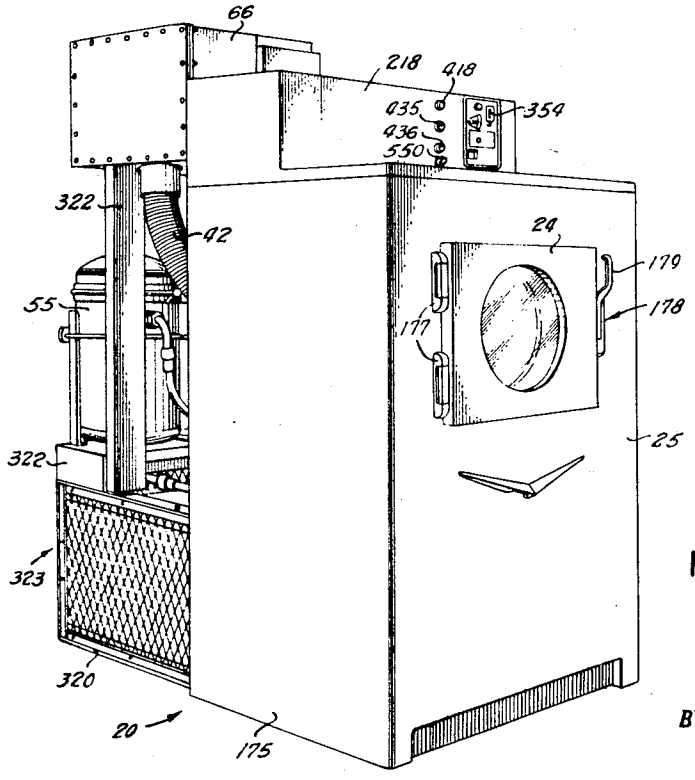


Fig. 8

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July 9, 1968 D. R. WILLIAMS 3,391,550

DRYCLEANING MACHINE

Filed May 28, 1962 5 Sheets-Sheet 5

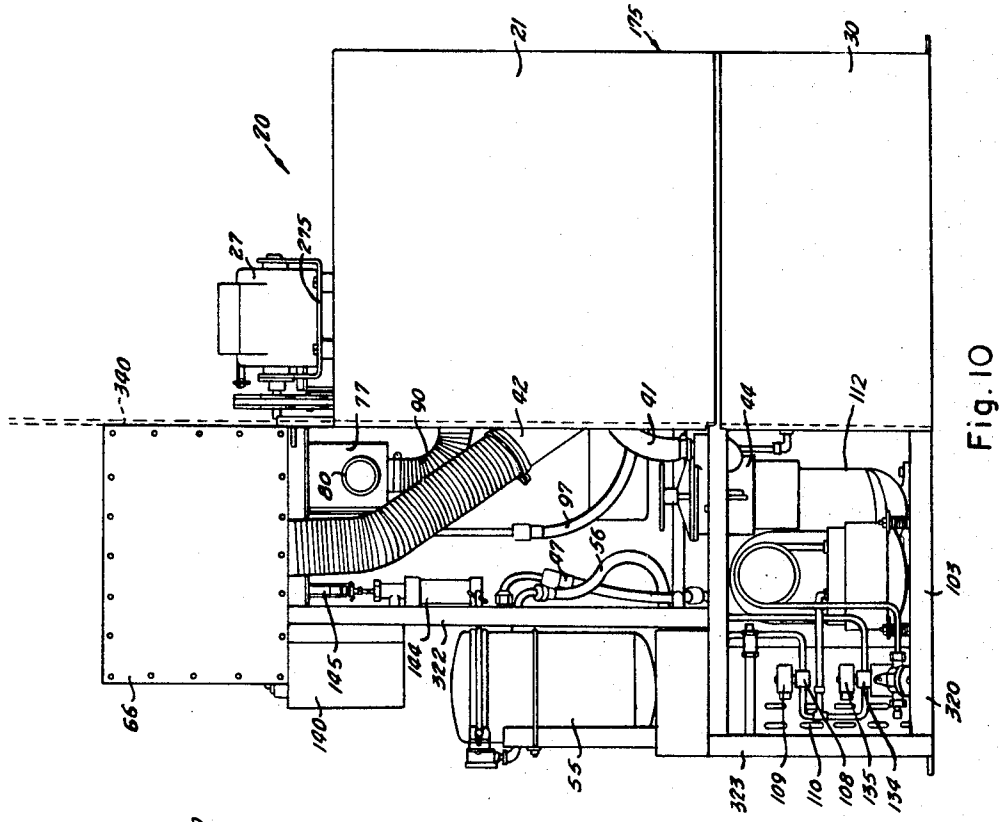


Fig. 10

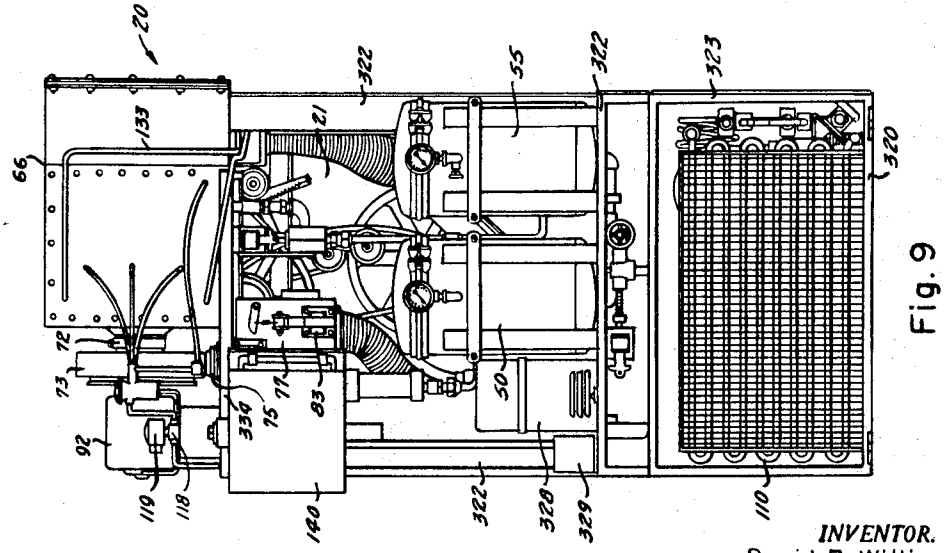


Fig. 9

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United States Patent Office 3,391,550 Patented July 9, 1968

3,391,550

DRYCLEANING MACHINE

David R. Williams, Dallas, Tex., assignor, by mesne assignments, to L. T. Industries, Inc., Dallas, Tex., a corporation of Delaware

Filed May 28, 1962, Ser. No. 198,200
13 Claims. (Cl. 68—12)

This invention relates to a cleaning apparatus and more particularly to a drycleaning appartus employing a solvent which must be recovered upon the completion of each cycle of operation of the drycleaning apparatus.

An object of this invention is to provide a new and improved dry cleaning apparatus for cleaning garments and the like having means for recovering a maximum amount of the solvent from the cleaned garments upon the completion of the cleaning operation.

Another object is to provide a drycleaning apparatus wherein the garments to be cleaned are placed in a rotatable tumbler or drum in a closed tub through which the solvent is continuously circulated to dissolve and extract the foreign substances, such as dirt, grease and the like from the garments and having means for extracting the foreign substances from the solvent prior to its recirculation through the tub.

Still another object is to provide a drycleaning apparatus of the type described wherein the solvent is drained from the tub upon the completion of the cleaning operation and heated air is circulated through the tub and the garments contained therein and past a condensing means for condensing the solvent vapors carried by the air.

A further object is to provide a drycleaning apparatus of the type described having means for establishing, upon the completion of the cleaning operation, a closed airflow path through the tub and past a cooling means for condensing the solvent vapors from the air moving from the tub and a heating means for heating the air cooled due to the condensation of the solvent vapors therefrom prior to its movement back to the tub.

A still further object is to provide a drycleaning apparatus having a solvent reservoir disposed below a tub and a refrigerant system wherein the refrigerant system has cooling coils disposed in the reservoir and also cooling coils disposed in the closed air path and control means for selectively directing the refrigerant gases to either set of the coils, whereby the full capacity of the refrigerant system is utilized to condense the solvent vapors circulated in the closed air path.

A still further object is to provide a drycleaning apparatus which sequentially causes washing or immersion of the garments to be cleaned in the solvent as the solvent is circulated continuously through the tub and through dirt and grease extraction or filtering apparatus and the reclamation of the solvent absorbed by the garments after the completion of the washing or cleaning operation.

Another object is to provide a control system for the drycleaning apparatus which cannot be accidentally interrupted by a premature or inadvertent opening of the door of the tub.

Still another object is to provide a drycleaning apparatus having means for preventing any escape of solvent vapors or fumes through the door opening of the tub.

Additional objects and advantages of the invention will be readily apparent from the reading of the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

FIGURE 1 is a schematic view of the drycleaning apparatus embodying the invention;

FIGURE 2 is a schematic perspective view of a timer motor and cam control means for the switches of the electric control system of the drycleaning apparatus;

FIGURE 3 is a schematic illustration of the electric control circuit of the drycleaning apparatus;

FIGURE 4 is a time chart showing the sequence of operation of the various switches of the electric control system of the drycleaning apparatus;

FIGURE 5 is a view of the door lock control mechanism of the drycleaning apparatus;

FIGURE 5A is a view taken on line 5A—5A of FIGURE 5;

FIGURE 6 is a fragmentary view of the apparatus showing the drive means for the tumbler or the rotatable drum of the drycleaning apparatus;

FIGURE 7 is a fragmentary side view taken on line 7—7 of FIGURE 6;

FIGURE 8 is a perspective view of the drycleaning apparatus;

FIGURE 9 is a view of the back of the apparatus with some parts removed; and,

FIGURE 10 is a side view of the apparatus with some parts removed.

Referring now particularly to the drawings, the drycleaning apparatus **20** includes a tub **21** in which a rotatable tumbler or drum **22** is disposed into which the garments to be cleaned may be inserted through the door **24** on the front side of the cabinet **25** in which the tub is mounted. The tumbler is rotated by a suitable motor **27** by means of the two speed transmission **28**.

A solvent reservoir **30** is disposed below the tub and has an outlet **31** connected to the inlet of a pump **32** whose outlet is connected to the conduit **33** which opens into the tub **21** adjacent the upper end thereof. A valve **35** operated by a solenoid **36** is provided for closing the conduit.

The tub has a drain or outlet conduit **38** provided with the valve **39** which is operated by the solenoid **40**. An overflow duct or conduit **41** connects the drain conduit **38** downstream of the valve **39** with the duct **42** which communicates with the interior of the tub. The overflow duct is provided with a check valve **43**. It will be apparent that whenever the level of the solvent within the tub tends to rise above a predetermined level, the fluid flows out through the overflow duct **41** and to the drain conduit **38**, the check valve preventing reverse flow of fluid into the tub through the overflow conduit. The drain conduit opens into a trap **44** which prevents movement of the large objects, such as buttons and the like, to the drain pump **45** whose inlet is connected to the outlet of the trap by the conduit **46** and whose outlet, in turn, is connected by conduit **47** to the inlet of a mechanical filter **50**, provided with a suitable cartridge having a porous material which filters out all particles of dirt and debris from the solvent passing through the filter. A check valve **48** is provided in the conduit **47** to prevent reverse flow of fluids therethrough.

A suitable pressure gauge **51** is connected to the filter **50** to indicate the pressure therein. The filter **50** is provided with a cover **52** which may be removed to remove or replace the mechanical porous filtering cartridge disposed therein. The outlet duct **53** of the filter **50** is connected to the inlet of the absorbent filter **55** by a conduit **56**. A cartridge of activated charcoal or similar absorbent substance is disposed within the filter **55**. The activated carbon of the filter **55** absorbs the fatty acids or other compounds into which the solvent converts the greases, fats and other substances removed from the garments so that clean solvent flows from the outlet of the filter **55** into the inlet conduit **58** which opens into the upper portion of the reservoir **30**. The filter **55** may also be provided with a gauge **59** to show the upstream fluid pressure therein and a blowoff or bleed valve **60** for obtaining fluid samples and for relieving the pressure therein before the cover **61** of the filter **55** is removed for re-

moval or replacement of the adsorbent substance or cartridge of the filter. The outlet conduit **53** of the mechanical filter **50** is also connected to the inlet conduit **58** of the reservoir **30**. A valve **63** downstream of the point at which the duct **56** communicates with the outlet duct **53** controls flow of solvent through the outlet conduit **53** into the inlet conduit **58**. The valve **63** may be opened when it is desired to drain the mechanical filter of the solvent preparatory to removal or replacement of the mechanical filter cartridge therein.

The duct **42** extends upwardly at one side of the tub and opens into a housing **66** in which is disposed a lint trap or screen **68**, the cooling coils **69**, and the heating coils **70**. The housing has an outlet **72** connected to the inlet of a blower **73** whose outlet **75** opens into an air valve housing **77** having a pair of valves **78** and **79**. The valves **78** and **79** are moved to the full line positions illustrated in FIGURE 1 wherein they close the inlet and outlet ducts **80** and **81** of the valve housing when the solenoids **82** and **83** which operate the valves are energized. The inlet duct **80** may be provided with a screen **85***a* while the outlet duct **81** may open to the atmosphere exteriorly of the building in which the dry cleaning apparatus is located. The valves, when solenoids **82** and **83** are de-energized, are moved by suitable springs (not shown) such as the usual wellknown hinge springs associated with the hinges or pivots **78***a* and **79***a* by means of which the valves are hingedly or pivotally secured to the air valve housing, to the broken line positions illustrated in FIGURE 1 wherein they close the aperture or passage **84** in the diagonally extending partition **85** of the housing and open the inlet and outlet ducts **80** and **81**. When the valves **78** and **79** are in the full line positions illustrated in FIGURE 1, and the blower is operating, air may be circulated by the blower through the closed flow path or passage which includes the tub, the duct **42**, the housing **66**, the blower **73**, the air valve housing **77** and back to the tub. When the valves are in their broken line positions illustrated in FIGURE 1, closing the passage **84** of the partition **85**, and the blower is operating, air is drawn into the tub through the inlet duct **80**, or through the door opening of the tub if the door is open, and expelled from the tub through the duct **42**, the housing **66**, the blower **73**, the air valve housing **77** and the outlet or exhaust duct **81**. The blower **73** is driven by any suitable motor **92**.

The housing **66** is provided with a sump **95** below the cooling coils **69** into which flows the solvent condensed by the cooling coils **69**. The drain conduit **97** connects the sump **95** to the reservoir **30** and is provided with a valve **98** operated by the solenoid **99**.

The valves **35** and **98** are normally closed so that no vapors or evaporated solvent from the reservoir may flow into the tub. These valves are provided both to prevent loss of the solvent and also to prevent accumulation of vapors within the tub. In addition, the blower **73** is energized and the solenoids **82** and **83** are de-energized and the valves **78** and **79** moved to the broken line positions indicated in FIGURE 2 whenever the door **24** is opened so that air is drawn into the tub through the door opening and expelled from the tub whenever the door is open. The door, however, as will be explained below, can be opened only after the drycleaning cycle of operation of the apparatus is completed. This prevents any of the fumes or vapors of the solvent which may be present in the tub from being breathed by the operator of the machine when he opens the door or released into the room in which the apparatus is located. This safeguard is desirable since the solvent vapor or fumes may be irritating or noxious.

The cooling coils **69** are connected to the inlet of a suitable compressor **103** by the conduit **104** and connected to the outlet **105** of the compressor through a conduit **107** having a valve **108** which is controlled by the solenoid **109**, the heat dissipating coils **110**, a receiver **112** into which the compressed and cooled refrigerant passes, the conduit **113**, to which are connected a dryer **114** for the refrigerant and a sight glass **115**, the conduit **117** having the valve **118** controlled by the solenoid **119** and the usual expansion valve **120**.

It will be apparent that the compressor **103**, the heat dissipating coils **110**, the receiver **112**, the dryer **114**, the sight glass **115** and the expansion valve **120** constitute a conventional refrigeration system employing a gas which is first compressed and cooled and then allowed to expand in the cooling coils to absorb heat.

A conduit **125** is also connected to the conduit **113** and supplies compressed refrigerant to the cooling coils **126** disposed in the reservoir **30**. The conduit **125** has a valve **128** controlled by the solenoid **129** and an expansion valve **130**. The outlet of the cooling coils **126** is connected by the conduits **131** and **104** to the inlet **102** of the compressor.

It will now be apparent that when the solenoid **119** is energized, refrigerant gas which has been compressed by the compressor **103** and cooled by the passage through the heat dissipating coils **110**, flows through the cooling coils **69** to expand therein and to absorb heat from the air and solvent vapors which may be circulating through the housing **66**.

One end of the heating coils **70** is connected to the outlet **105** of the compressor **103** by the conduit **107** and the conduit **133** which has a valve **134** controlled by the solenoid **135**. The other end of the heating coils **70** is connected by the conduit **136** to the conduit **107** downstream of the valve **108**. A check valve **137** in the conduit **136** prevents reverse flow through the conduit. It will be apparent that when the valve **108** is closed and the valve **134** is open the hot refrigerant gas from the compressor first flows through the heating coils **70** to heat the air passing through the housing **66** which has been cooled by passing past the cooling coils and by the condensation of the solvent vapors therefrom.

An additive tank **140**, in which a reserve supply of the solvent is stored, is disposed above the reservoir **30**. The tank has an outlet conduit **142** which opens into the reservoir **30** and has a valve **144** connected therein which is controlled by the solenoid **145** so that an additional amount of solvent may be added to the reservoir upon the completion of each cycle of operation of the apparatus to make up for any loss of the solvent during such cycle. The solvent used may be of the type commercially available under the name Valclene and may include some detergent in solution in the solvent.

At the initiation of a cycle of operation of the apparatus, the tub is empty of the solvent and the valves **98** and **35** are closed. The solenoids **82** and **83** are now de-energized so that the valves **78** and **79** are in the broken line positions indicated in FIGURE 1 wherein they close the passage **84** of the partition **85**. The valves **118** and **134** are now closed so the refrigerant is not flowing through either the cooling coil **69** or the heating coil **70** of the reclaimer housing **66**. The valves **128** and **108**, however, are open so that the refrigerant is circulating through the heat dissipating coils **110** and the cooling coils **126** in the reservoir and is maintaining the temperature of the solvent within the tank at a desired low temperature which is set by the usual thermostats **150***a* which control the operation of the compressor **103**.

When the door of the tub is opened to permit placement of any load of soiled garments, or the like, into the drum, the motor **92** is immediately energized to operate the blower **73** so that air is now drawn in through the open door of the tub as well as through the inlet duct **80** and is moved through the duct **42**, the reclaimer housing **66**, the blower **73**, the outlet **75**, the air valve housing **77**, and the vent duct **81** to the atmosphere. When the door is closed and the control circuit, which will be described in greater detail below, is energized by a coin operated switch **150**, the drive motor **27** of the drum

22 is immediately energized and causes rotation of the drum at a low speed. Simultaneously, the solenoids 36 and 99 are energized to open the fill valve 35 and the condensate return valve 98. The solenoids 82 and 83 are also energized at this time to move the valves 78 and 79 to the positions where they close off the conduits 80 and 81 and open the aperture or passage 84 in the partition 85 of the air valve 77. The electric motor 152 which drives the fill pump 32 is also energized and pumps the solvent from the reservoir 30 into the tub 21. Since the valve 98 of the condensate return conduit 97 is open, the air displaced from the tub by the solvent being pumped into the tub may flow into the reservoir 30 and replace the solvent being pumped from the reservoir. After the fill pump has operated for a predetermined period of time sufficient to fill the tub to a level above the overflow conduit 41 so that the solvent passes through the check valve and fills the trap 44, the electric motor 156 which drives the drain pump 45 is energized and causes the drain pump to pump liquid from the trap 44 and back to the reservoir through the mechanical and adsorbent filters 50 and 55, respectively.

The motors of the fill and drain pumps 32 and 45 continue to operate for a predetermined period of time to cause circulation of the solvent through the tub and through the filters. During this circulation of the solvent, the dirt, oil, greases and other foreign matter are removed from the garments by the solvent, since the lower portion of the drum is now immersed in the solvent and the garments therein are tumbled and periodically immersed in the solvent as the drum rotates due to the vanes 154 and 155 of the drum. The oils and greases are dissolved by the solvent and changed into fatty acids. The dirt and the fatty acids are removed by the mechanical and adsorbent filters so that clean solvent is circulated back into the tub and the solvent carrying any foreign matter is moved from the tub during the operation of the fill and drain pumps.

This circulation of the cleaning fluid through the tub, the filters and the reservoir continues for a predetermined period of time sufficiently long to extract all foreign matter from the soiled garments.

When this predetermined period of time elapses, the solenoid 36 of the valve 35 and the motor 152 which drives the fill pump are de-energized. As a result, no solvent may now flow into the tub. Simultaneously, the solenoid 40 of the drain valve 39 is energized to open the drain valve so that all solvent in the tub now drains into the trap 44 and, since the motor of the drain pump is still energized, will be pumped back into the reservoir 30. The drain pump and the drain valve remain energized for a predetermined period of time sufficiently long to drain all the solvent from the tub.

Toward the end of this period of energization of the drain pump and the drain valve, the solenoid 160 which controls the operation of the two speed transmission 28 is energized to increase the speed of rotation of the drum. The increased speed of rotation or spinning of the drum causes most of the liquid solvent to be thrown out by centrifugal force from the garments. The drum is spun or rotated at this increased speed of rotation for a predetermined period and then its rotation is stopped. The solenoid 160 is de-energized and the two speed transmission 28 reverts to its former condition causing the tumbler to rotate at the initial slow speed.

During the period of time that the transmission control solenoid is energized, the solenoid 145 of the valve 144 may also be energized to open the valve 144 so that a predetermined amount of solvent flows from the storage tank 140 into the reservoir 30. This amount of solvent is added to make up for any loss of the solvent during each cycle of operation of the apparatus.

At the end of the period of spinning or increased speed of rotation of the drum, the drain valve solenoid 40 and the drain pump motor 156 are de-energized, the motor 92 of the blower 73 is energized and the solenoid 109 is de-enerized so that the valve 108 closes while the solenoid 135 is energized to open the valve 134 so that the hot compressed refrigerant gas is now caused to flow through the heating coil 70 of the housing 66 prior to its passage to the heat dissipating coils 110. At the same time, the solenoid 129 is de-energized so that the valve 128 is closed while the solenoid 119 is energized to open the valve 118. As a result, all of the compressed and cooled refrigerant gas now passes through the expansion valve 120 and into the cooling coils 69 to cool them and cause condensation of the solvent in gaseous state which is now moved past the cooling coils by the blower 73. The condensed solvent is of course received in the sump 95 and returned back to the reservoir 30 through the drain duct 97.

The air which has been cooled due to the evaporation of the liquid solvent from the garments, the condensation of the solvent from its gaseous state, and also by its passage over the cooling coils 69, is heated by the heat dissipated by the coils 70 so that the blower moves air back into the tub which is hot enough to cause further evaporation of the liquid solvent still in the garments, the air is now continuously circulated through the closed path which includes the cooling and heating coils for a predetermined period of time necessary to cause evaporation of all the liquid from the garments. At the end of this period of time, the solenoid 135 is de-energized and the solenoid 109 is energized to close the valve 134 and open the valve 108. The heating coils 70 are then no longer supplied with hot compressed refrigerant gas. The air in the closed path is now only cooled so that all the air throughout the closed path is cooled to cool all wall surfaces thereof so that any additional remaining solvent in the gaseous state will condense on the walls of the tub and of the closed path and flow downwardly to the bottom of the tub. During a short interval of time toward the end of the period of time during which the refrigerant gas is passing through the cooling coils 69, the drain valve and the drain pump are again energized for a short period of time to cause pumping of such condensed solvent from the tub through the filters and back to the reservoir 30. The drain pump and the solenoid controlling the drain valve are now de-energized and simultaneously the valve solenoid 119 is de-energized and the valve solenoid 129 is energized to close the valve 118 and open the valve 128 so that the refrigerant gas will now circulate only through the cooling coils 126 in the reservoir 30 and the heat dissipating coils 110. The refrigerant system, therefore, is no longer operative to cool any air which might be moved past the cooling coils. The solenoids 82 and 83 are then de-energized so that the valves 78 and 79 take the broken line positions indicated in FIGURE 1 wherein they close the passage 84 in the partition 85 of the air valve 77, and the solenoid 99 is de-energized so that the condensate return valve is closed. The blower now operates for a predetermined period of time to circulate fresh air from the duct 80 through the tub and out to the atmosphere after which the motor 27 is de-energized to stop rotation of the tub.

The door may now be opened to permit removal of the now clean and dried garments from the tub. The blower of course will commence operation when the door is opened. The apparatus is now in condition for another cycle of operation.

It will now be apparent that a new and improved dry cleaning apparatus has been illustrated and described which includes a tumbler or drum 22 disposed in a closed tub through which solvent is continuously circulated during a dirt extraction stage of the cycle of operation of the apparatus to extract foreign matter, such as dirt, grease or the like, from the soiled garments and through filters which remove such foreign matter carried by the solvent from the tub prior to recirculation of the solvent back to the tub.

It will further be seen that the drycleaning apparatus also includes a reservoir into which the filtered clean solvent is pumped and from which reservoir the solvent is pumped into the tub during the cleaning or foreign matter extracting stage of the cycle of operation of the drycleaning apparatus.

It will further be seen that the apparatus includes means such as the tub **22**, the air valve housing **77**, the duct **42**, the housing **66** and the blower **73** for establishing a closed air path or passage through which air may be moved, and that the cooling coils **69** and the heating coils **70** are disposed in such air path so that the air laden with the solvent in a gaseous state first passes the cooling coils **69** which cause condensation of the solvent, the condensate being returned by a suitable condensate return conduit to the reservoir **30**, and then through the heating coils **70** to be reheated prior to its circulation back into the tub so that the warm or hot air will cause evaporation of any liquid solvent absorbed in the clothing or still in the tub prior to the movement of the air again past the cooling coils.

It will further be seen that the air is heated prior to its recirculation back into the tub for a period of time long enough to insure that all of the solvent in liquid state has evaporated and that thereafter the heating coils **70** are rendered ineffective in order that the air and all surfaces of the closed air path, which may be formed of suitable substances, such as metal, having a high coefficient of conductivity, are cooled to cause condensation of such solvent remaining in a gaseous state from the air circulating in such closed air path and its return in a liquid state back to the reservoir. Since the closed air path is formed of metallic structures having a relatively high coefficient of conductivity of heat and since the garments have a relatively low coefficient of conductivity of heat, the various surfaces forming the closed air path are of course cooled more quickly than the garments so that solvent in the gaseous state will condense on the various walls which of course offer a large area for condensation as well as on the cooling coils **69**.

It will further be seen that the apparatus includes means for closing or shutting off the reservoir **30** from the tub so that once the cycle of operation of the apparatus has been completed the solvent may not evaporate into the tub.

It will further be seen that the apparatus is provided with a refrigerant system having means for selectively passing hot compressed refrigerant gas to the heating coils and for permitting expansion and passage of the cooled compressed refrigerant selectively through the cooling coils **126** disposed in the reservoir tank and the cooling coils **69** disposed in the closed air path so that the full heating and cooling capacity of the refrigerant system may be used to selectively cool the air in the closed air path and then heat it, to cool only the air in the closed air path or to cool only the solvent in the reservoir.

It will further be seen that a new and improved method for drycleaning garments and the like by the use of a solvent has been illustrated and described which includes the sequential steps of circulating the solvent in liquid form through a closed tub or chamber in which the soiled garments and the like are placed to extract foreign matter from the soiled garments, filtering the solvent to remove such foreign matter from the solvent, cooling the solvent while it passes through a reservoir and then recirculating it through the tub; draining the liquid solvent from the closed chamber; establishing a closed path which includes the chamber and an air moving means, cooling the air moving from the chamber to condense the solvent in a gaseous state from the air being moved through the closed path and return the condensate to the reservoir and reheating the cooled air prior to its return to the chamber in order that it may be hot enough to cause evaporation of any liquid solvent remaining absorbed in the garments in the chamber for a predetermined period of time sufficiently long to insure that all of the liquid solvent has been evaporated into the air being moved through the closed air path; then cooling the air being circulated through the closed air path to cause condensation of all of the solvent in the gaseous state; and draining the condensed solvent from the closed air path.

The door latch **178** may be of the usual construction having a handle **179** pivotally mounted on a housing **180** which, when pivoted in a clockwise manner, as shown in FIGURE 5, pivots cam hook **182** in a clockwise manner by means of a suitable linkage therebetween. The cam hook is also pivotally mounted in the latch housing **180** by a suitable linking mechanism, not shown. The cam hook **182** is movable independently of the handle **179** so that as the door closes its cam edge **183** will engage the beveled or upper edge **184** of the striker hook **187** which is secured in the usual manner to the cabinet, so as the door moves toward closed position the cam hook **182** will move upwardly and downwardly to engage the hook surface **188** of the striker to thus hold it in closed position until the handle **179** is pivoted in a clockwise manner to cause clockwise pivotal movement of the cam hook **182**.

In order to prevent accidental opening of the door during the operation of the apparatus, the latch is provided with a lock mechanism **190** which includes a substantially channel shaped bracket **191** pivoted as at **192** to a vertical plate **193** of the housing **180** which extends between the flanges of the channel bracket. A spring **185** biases the bracket in a clockwise direction about the pivot **192**. The bracket has a roller **198** between its flanges which is adapted to engage the upper surface **199** of the cam hook when the bracket **191** is in the full line position illustrated in FIGURE 5. The vertical plate **193** has a pin **200** which extends into the aligned apertures **202** of the flanges of the channel bracket **191** to limit the pivotal movement of the bracket **191**, the apertures **202** being of larger diameter than the pin **200**.

The channel bracket has an outwardly extending lug **205** which is engageable by the lower end of the vertical link rod **209** slidably mounted in the cabinet with its upper end pivotally secured, as at **210**, to a crank lever **212** pivotally mounted within and to the cabinet, as at **213**. A horizontal link rod **214** has its end connected to the crank lever **212** as at **215**, and extends through a suitable aperture in the flange **216** of a mounting bracket **217** secured to the cabinet in any suitable manner and housed within the control housing **218** mounted on top of the cabinet. The horizontal link rod is biased to the left as seen in FIGURE 5, by a spring **219** whose opposite ends engage the upwardly extending flange **216** of the support bracket **217** and the stop ring **223** rigidly secured to the horizontal link rod. The horizontal link rod is movable to the right by an operator lever **225** pivotally disposed between the side plates **227** and **228** which are mounted on the support bracket **217** and which are secured thereto in any suitable manner, as by welding. The lever **225** has a front arm **229** provided with a downwardly opening slot **230** in which is received the horizontal link rod **214**. The front arm engages the collar **232** rigidly secured to the horizontal link rod.

The operator lever is pivotally mounted adjacent its forward end to the side plates by the shaft **233** which extends through suitable apertures in the side plates. The operator lever is also provided with a rear arm **235** whose lower end is hook shaped to receive the lock roller **237** carried by a lever **240** which is pivotally mounted at its upper forward portion on a shaft **241** which extends through suitable aligned apertures in the side plates **227** and **228**. The lock lever has an upper horizontal web **242** and a pair of spaced sides **243** which extend on opposite sides of the operator lever. The lock roller **237** is rotatably mounted between the two sides **243** of the lock lever on a shaft **244** and is adapted to engage the hook **249** of the operator lever to lock the lever in the position illustrated in FIGURE 5 wherein the operator lever holds the channel bracket in the position illustrated in

FIGURE 5 with the roller **198** thereof engaging the cam hook and thus preventing unlocking of the door. The shaft **244** on which the roller **237** is mounted extends outwardly of the side plate and is adapted to engage the operator arm **250** of the switch **252** mounted on one of the side plates.

The operator lever **225** is movable to its locking position by the armature **254** of the solenoid **255** mounted on the upper lateral extensions **257** of the side plates while the lock lever **240** is rotatable in a counter-clockwise direction by the armature **258** of the solenoid **260** also mounted on the lateral extensions **257** of the side plates. The lock lever is yieldingly biased to the position illustrated in FIGURE 5 by the spring **263**, one of whose ends is secured to the rear extensions **264** of the sides **243** of the lock lever by means of the pin **265** and whose other end is secured to the pin **266** carried by the side plates.

It will be apparent that when the solenoid **260** is energized to move the armature **258** downwardly, the lock lever is pivoted in a counter-clockwise direction about the pivot shaft **241** to move the roller **237** out of engagement with the hook **249** of the operator lever thus freeing the operator lever **225** for clockwise pivotal movement about its shaft **233**. The operator lever of course is biased in this direction by the spring **219**. As a result, when the solenoid **260** is energized, the horizontal link rod **214** moves to the left as seen in FIGURE 5, thus causing upward movement of the vertical link rod **209**, thus permitting the channel bracket **191** to pivot in a clockwise direction to the broken line position wherein the roller **198** moves out of engagement with the upper surface **199** of the cam hook, thus unlocking the cam hook of the door latch for pivotal movement out of engagement with the hook of the striker when the handle **179** is pivoted downwardly in the usual manner.

When it is desired to lock the door, the solenoid **255** is energized whereupon its armature **254** pivots the operator lever **225** downwardly in a counter-clockwise direction moving the horizontal link rod **214** to the right and thus causing the vertical link rod **209** to move downwardly whereby the channel bracket causes the roller **198** to engage the upper surface **199** of the cam hook and thus prevent unlocking of the door. During such counter-clockwise pivotal movement of the operator lever **225** the lower cam surface of hook **249** engages the roller **237** of the lock lever **240** and moves the lock lever in a counter-clockwise manner about its pivot shaft **244** until the hook **249** moves downwardly beneath the roller whereupon the roller is moved into engagement with the hook and against the inner hook surface **267** thereof by the force of the spring **263** and thus locks the operator lever in its door locking position. The solenoid **255** may then be de-energized leaving the operator lever locked in the position illustrated in the drawing by the lock lever.

The motor **27** for rotating the drum **22** is mounted on top of the cabinet within the housing **218** by means of a mounting bracket or plate **275** and its drive pulley **276** is connected by the belt **280** to a large pulley **277** rigidly mounted on a shaft **278**. The shaft **278** is rotatably mounted in a suitable bearing block **282** secured to the top of the cabinet. The belt **280** is maintained under proper tension by a tension pulley **283** rotatably mounted on one end of the arm **284** whose opposite end is pivotally secured, as at **285**, to the cabinet. The arm **284** is biased in a counter-clockwise direction as seen in FIGURE 6 by a spring **288** whose opposite ends are secured to the arm **284** and to the upper end of the support bracket **289** rigidly secured to the cabinet, in a suitable manner, as by welding. The shaft **278** has a small pulley **290** rigidly mounted thereon which is connected to the large pulley **291** of the clutch **292** by a belt **293**. The clutch connects the large pulley to the shaft **294** which extends into the tub **21** and on which the drum **22** is mounted. The drum shaft extends through the wall **296** of the tub and is mounted thereon by a suitable bearing block **297**. The low speed belt **293** is maintained under a predetermined tension by a tension pulley **299** mounted on one end of the arm **300** which is pivotally secured to the cabinet intermediate its ends as at **302**. A spring **303**, one of whose ends is secured to the lower end of the support bracket **289** and whose other end is secured to the end of the arm **300**, biases the arm **300** in a clockwise direction as seen in FIGURE 6 so that the low speed belt **293** is maintained under a predetermined tension. A large pulley **307** also rigidly secured to the shaft **278** is connected to the smaller pulley **310** of the clutch by a high speed belt **311**. The high speed belt is normally not under tension but may be placed under tension by the tension pulley **313** rotatably mounted on the lower end of the arm **314** pivotally secured to the cabinet on the same pivot **285** as the arm **284** and its upper end is secured to the armature **316** of the solenoid **160** by a suitable rod **318** pivotally secured at its opposite ends to the arm **314** and to the armature.

When the solenoid **160** is energized and the armature **316** is moved to the left, as seen in FIGURE 6, the arm **314** is pivoted in a counter-clockwise manner about its pivot **283** and thus places the belt **311** under tension. The clutch **292** is of a conventional type and will not therefore be described in detail. The clutch, when the belt **311** is under tension, operatively connects the pulley **310** to the drum shaft **294**. As a result, since the pulley **307** is larger than the pulley **310**, the drum will be rotated at a greater speed when the solenoid is energized than when it is de-energized because the pulley **290** of the shaft **278** is of course much smaller than the large pulley **291**. When the solenoid **160** is not energized, therefore, the drum shaft is rotated at a low speed. The clutch **292** permits over-riding of the large pulley **291** by the pulley **310** when the pulley **310** is rotated at a greater speed than the large pulley.

The base **320** of the cabinet extends rearwardly thereof on which the compressor **103**, the heat dissipating coils **110**, the trap **44** and the receiver **112** may be mounted. A horizontal platform **322** is supported on the rearward extension of the base **320** by the substantially rectangular frame **323** which may be formed of angle members. The filters **50** and **55**, the starter or contactor **328** for the compressor motor, and the compressor relay **329** are mounted on the platform. A plurality of vertical standards **332** extend upwardly from the frame **323** and supports the housing **66** and the upper platform **334**. A portion of the housing **66** is also disposed on the upper platform **334**. The blower **73** and its motor **92** are also mounted on the upper platform **334**. The reservoir or additive tank **140** may be secured to and below the upper platform **334**, as may be the air valve housing **77**.

The various ducts and the various conduits may be provided with flexible sections, as shown in the drawings for ease of manufacture and assembly. The other operative elements of the apparatus may be secured to the upper and lower platforms in any suitable manner.

In use, the cabinet of the drycleaning apparatus is disposed in one room on one side of a partition **340** while all the components of the apparatus mounted on and above the rearward extension of the base **320** are disposed on the other side of the partition **340** in a second room where they are easily accessible for maintenance. It will be noted that the inlet duct **80** of the air valve housing **77** opens into the second room and not into the room in which the cabinet is disposed.

The control circuit for sequentially and properly energizing and de-energizing the various solenoids and motors includes a main timer motor **350** (FIGURE 2) on whose shaft **351** are mounted a plurality of switch cams **352A–352L** of the respective switches A–L. The switch cams may move their respective switches between two positions, in one of which the switch is moved to an upper open position, or an upper position engaging an upper

stationary contact and a lower position wherein the switch engages a lower stationary contact or may move the associated switch between an upper position wherein the switch engages the upper stationary contact, an intermediate position wherein the switch does not engage any stationary contact and a lower position wherein the switch engages a lower contact. It will be apparent that in the latter case, the cam is provided with three peripheral segments, each of different radius than the other, and in the former case is provided with only two peripheral segments of different radii. At the initiation of operation of the apparatus the switches A–L are in the positions illustrated in FIGURE 3.

The time chart of FIGURE 4 indicates by the upper and lower shaded areas the upper and lower positions of the various switches A–L. If a particular switch, such as for example the switch G, during the first six and one-half minutes of operation of the timer motor is neither in its upper or lower position but in an intermediate position, neither the upper nor the lower areas of the chart indicating the position of the switch are shaded.

The timer motor **350** is initially energized at the initiation of a cycle of operation of the machine when a suitable number of coins are deposited in the coin slot **354** of a suitable coin rejecter mechanism which has a switch **150** which is moved from the upper position illustrated in FIGURE 3 to the lower position where it engages the stationary contact **356** each time a coin of proper denomination is inserted in the coin chute. When the switch **150** is momentarily moved to its lower position, the coil **358** of a conventional switch mechanism or "stepper" **359** is momentarily energized provided that the door switch **361** is in a lower position wherein it engages the lower stationary contact **362**. The stepper may be of any suitable commercially available type, such as the type presently manufactured by H. Greenwald Company, Inc., Model 58–210. The door switch **361** is mounted on the cabinet and is moved to the position wherein it engages a stationary contact **362** whenever the door **24** to the tub is closed.

The coil **358** is then supplied with 110 volt current by being connected across the lines **363** and **364** by the conductors **365** and **366**, the stationary contact **356**, the switch **150**, which is now momentarily in the lower position, the conductor **367**, the upper stationary contact **368**, the movable switch **369** of the stepper **359**, the conductor **370**, the stationary contact **362** of the door switch, the movable switch contact **361** and the conductors **372** and **373**.

When the proper number of impulses have been transmitted to the coil **358** of the stepper, the mechanical linkage of the stepper actuated by the energization of the winding **358** moves the movable switch contact **369** of the stepper to its lower position wherein it engages its lower stationary contact **375**. When this occurs, the door lock solenoid **255** is energized to lock the door **24** since it is now connected across the conductors **364** and **363** through the conduits **377**, **378** and **379**, the stationary contact **380**, the switch D which is now in its upper position, the conductor **381**, stationary contact **375**, the movable switch **369**, the conductor **370**, the stationary contact **362**, the movable switch contact **361** of the door lock and the conductors **372** and **373**. The solenoid **255** when energized of course pivots the operator lever to cause the door latch to be locked against opening movement and at the same time the switch **252** is closed due to the movement of the shaft **244** carried by the lock lever **240**.

Once the door lock mechanism switch **252** is moved to its closed position, the coil **383** of the main relay **384** is connected across the lines **364** and **363** by the conductors **377**, **385** and **386**, the switch **252**, the conductor **388**, the stationary contact **375**, the switch **369**, the conductor **370**, the stationary contact **362**, the switch **361** of the door lock and the conductors **372** and **373**.

When the relay winding **383** is energized, the timer motor **350** is connected across the lines **363** and **364** by the conductor **373**, the contact **391** of the main relay **384**, the conductor **392**, the upper stationary contact **393** of the switch A, the conductor **394**, the upper stationary contact **395** of the switch B, and the conductors **396** and **377**. At the same time, the drum motor **27** is supplied with 220 volt current by being connected across the lines **363** and **400** by the conductor **373**, the movable contact **391**, the conductor **401**, the switch F which now engages its stationary contact **402**, the conductors **403** and **404**, the contact **405**, and the conductor **407**. The drum is therefore rotated at the beginning of the operation of the timer motor **350**.

The solenoid **36** is now energized as is the electric motor **152** of the fill pump **32** so that the solvent from the reservoir **30** will now be pumped into the tub **21**. One side of the motor **152** and one side of the solenoid **36** are connected to the line **363** through the conduit **373**, the contact **391**, the conductors **392** and **410**, the upper contact **411**, the switch C, the conductor **412** which is directly connected to one side of the solenoid **36** and to the conductor **413** which connects the motor **152** to the conductor **412**. The other sides of the solenoid **36** and the fill pump motor **152** are connected to the line **364** by the conductors **415** and **416**, respectively, and the conductor **377**. An indicator light **418** mounted on the control housing **218** which is connected across the solenoid **36** by means of the conductors **419** and **420** will now be lighted to indicate that the cleaning or dirt extracting stage of the cycle of operation of the dry cleaning is in progress.

The solenoids **82** and **83** of the air valves **78** and **79** and the solenoid **99** of the condensate drain valve **98** are energized simultaneously with the movement of the contact **391** to its closed position since one side of these solenoids are connected to one another by the conductors **420** and **421** and to the line **363** by the conductor **422**, the sationary contact **423** of the switch E, the conductor **410**, the conductor **392**, the movable contact **391** and the conductor **373**. The other sides of the solenoids **99**, **83** and **82** are connected by the conductors **425**, **426** and **427**, respectively, to the conductor **377** and thence to the line **364**. As a result, the valve **98** is opened to permit air to move into the reservoir **30** to replace the solvent being pumped into the tub and the air valves **78** and **79** moved to the full line positions indicated in FIGURE 1.

The switch G which controls the operation of the solenoids **145**, **160** and **260** which control the solvent make up valve **144**, the two speed transmission **28** and the door lock mechanism **190**, respectively, are now therefore de-energized.

The switch H which controls the operation of the blower motor **92** is now in its lower position engaging its lower stationary contact **432** but the blower is not energized since the conductor **433** connected to the lower stationary contact **432** is not connected to the line **363** since the door switch **361** is now in its lower position and does not engage its upper stationary contact **434**.

The switch I is now in its intermediate position where it connects neither the light **435** nor the light **436** across the lines **363** and **364**.

The switch J which is employed to render ineffective the usual thermostat switch **150***a* which controls operation of the compressor of the refrigeration system to maintain the temperature of the solution in the reservoir **30** below a predetermined value is now in its open position. When in its closed position, the switch J short circuits the thermostat switch by means of the conductor **441**, the stationary contact **442** and the conductor **443**.

The switch K is now in its upper position wherein it contacts the stationary contact **446** and connects the solenoid **109** across the lines **363** and **364** by means of the conductors **377**, **447**, and **488**, the upper stationary contact **446**, and conductors **449** and **450**, the contact

452 of the compressor relay 329 and the conductor 453. The controls of the compressor relay 329 are normally in closed positions since its coil 455 is normally connected across 220 volt lines 363 and 400 by means of the conductors 453 and 457, the thermostat switch 150*a* when it is closed, the conductor 458, the high and low pressure switches 459 and 460, which sense the pressure in the inlet and outlet conduits 104 and 107 of the compressor 103 and stop the operation of the compressor motor 462 whenever the pressure in the outlet conduit 107 exceeds a predetermined value or whenever the pressure within the return or inlet conduit 104 drops below a predetermined value and the conductor 464.

The compressor motor 462, which may be of the single phase capacitor start type, is energized by the usual contacter or starter 328 whenever the relay winding 455 of the compressor relay 329 is energized being then connected across the 220 volt lines 363 and 400 through the conductor 453, the movable contact 452, the conductor 462*a*, the movable contact 463 and the conductor 464. It will thus be apparent that the compressor motor of the refrigerant system will operate in the usual manner as dictated by the settings of the thermostat switch 150*a* and the high and low pressure switches 459 and 460, respectively, unless the switch J is moved to its closed position.

At the initiation of the commencement of the operation, the switch L is in its upper raised position engaging its upper stationary contact 467 to energize the solenoid 129 to open the valve 128, the solenoid 129 then being connected across the lines 363 and 364 by the conductor 453, the movable contact 452, the conductors 450 and 469, the switch L, the stationary contact 467 and the conductors 471, 472 and 377.

Thus at the time that the timer motor 350 is energized, the solenoids 36 and 99 are energized to permit flow of solvent from the reservoir tank into the tub and to permit flow of air into the reservoir from the tub through the condensate return conduit 97 and the fill pump motor 152 is energized to pump solvent from the reservoir into the tub.

Upon the completion of one minute of operation of the main timer motor 350, the cam controlling the operation of the switch D moves the switch D down to engage its lower stationary contact 475. The door lock solenoid is thus disconnected from the source of electric current but the door lock mechanism remains locked due to the engagement of the lock roller 235 with the hook of the operator lever 225. Simultaneously the motor 156 of the drainpump 45 is energized, now being connected across the lines 363 and 364 by means of the conductors 373 and 372, the door switch 361 which is now in its lower position, the stationary contact 362 thereof, the conductor 370, the switch 369 which is now in its lower position, the stationary contact 375, the conductors 388 and 381, the switch D, the stationary contact 475, and the conductors 477, 478 and 377. During this initial minute of operation of the fill pump, the tub has been filled with solvent to the level predetermined by the level of the overflow duct 41 and any excess of the solvent has flown into the trap 44. The motor of the drain pump now circulates the solvent through the filters 50 and 55 back to the reservoir 30 from where it is pumped by the pump 32 back into the tub.

All of the switches A through L now remain in the same positions until the end of the fifth minute of operation of the main timer motor 350. At the end of the fifth minute, the cam associated with the switch C moves the switch C downwardly out of engagement with its upper stationary contact 411 and into engagement with its lower stationary contact 480 so that the solenoid 36 of the fill valve 35 is deenergized. At the end of the fifth minute of operation of the timing motor the fill valve 35 is closed and the operation of the fill pump 32 is stopped. Simultaneously the solenoid 40 which controls the operation of the drain valve 39 is energized to open the drain valve 39 so that the solvent will drain from the bottom of the tub through the conduit 38 into the trap 44 and be pumped therefrom by the drain pump 45 back into the reservoir. The switch C when it moves to its lower position connects the solenoid 40 across the lines 363 and 364 by means of the conductor 373, the movable contact 391, the conductors 392 and 410, the switch C, the lower stationary contact 480 thereof and the conductors 481, 482 and 377.

Also at the end of the fifth minute of operation of the main timer motor the switch I is moved to its upper position to energize the lamp 435, the lamp then being connected across the lines 363 and 364 by means of the conductor 373, the contact 391, the conductors 392 and and 410, the switch I, the upper stationary contact 484 thereof, and the conductors 485, 486 and 377. The lamp 435 will now indicate that the apparatus is in the stage of extraction of the solvent from the garments in the drum and the lamp 418 is de-energized.

At the end of six and a half minutes of operation of the main timer motor, the switch G is moved by its associated cam to its upper position wherein it engages its upper stationary contact 429 and connects the solenoids 145 and 160 across the lines 363 and 364 by means of the conductors 373, 488, 489, 490, switch G, the upper stationary contact 429 thereof, the conductor 492 which is connected to one side of the solenoid 160 and the conductor 493 which is connected to the conductor 492 and to one side of the solenoid 145, the other sides of the solenoids 145 and 160 being connected by means of the conductors 494 and 495 and 377. The valve 144 will be opened for a period of two minutes and during this time a predetermined quantity of solvent will flow from the tank 140 into the reservoir 30 to make up for any solvent which may be lost during this particular cycle of operation of the dry cleaning apparatus.

Simultaneously the energization of the solenoid 160 which controls the operation of the two speed transmission 28 causes the drum to be rotated or spun at a very high speed so that liquid solvent is thrown off by centrifugal force during this period of two minutes.

At the end of eight and a half minutes of operation of the main timer motor the switch C is moved out of engagement with its lower stationary contact 480 to an intermediate open position between its upper and lower stationary contacts 411 and 480. As a result the solenoid 40 is de-energized and the drain valve 39 is closed. Also at the end of eight and a half minutes of operation of the main timer motor the switch D moves to an intermediate open position between its upper and lower contacts thus de-energizing the motor 156 of the drain pump 45.

The switch G is now moved by its associated cam back from its upper position to its intermediate open position thus de-energizing the solenoid 145 and the solenoid 160 so that the makeup valve 144 now closes and the two way speed transmission 28 now returns to its original condition, the speed of rotation of the drum now being slowed to its original value. Also at the end of eight and a half minutes of operation of the main timer motor the switch I moves to its lower position wherein it engages its lower stationary contact 500 to connect the lamp 436 across the lines 363 and 364 to indicate that the apparatus is now in the drying stage of its operation by means of the conductor 373, contact 391, the conductors 392 and 410, switch I, the lower stationary contact 500 and the conductors 502, 503 and 377.

Also at the end of the period of eight and a half minutes of operation of the main timer motor the switch J is moved to its lower position to short circuit the thermostat 150*a* so that the compressor motor 462 may now operate regardless of the temperature of the solvent within the reservoir 30. This assures that the compressor will operate at all times, except as controlled by its high and low pressure switches 459 and 460, during the drying stage of the operation of the apparatus. Switch K

at the end of seven and a half minutes of operation of the main timer motor is now moved from its upper position thus de-energizing the solenoid **109** so that the valve **108** now closes and into engagement with its lower stationary contact **507** to connect the solenoid **135** of the valve **134** across the lines **363** and **364** by means of the conduit **453**, the movable contact **452** of the compressor relay **329**, the conductors **450** and **449**, the switch K, the stationary contact **507** and the conductors **508**, **509** and **377**. As a result, all of the hot compressed refrigerant gas will now flow through the heating coils **70** prior to its movement to the heat dissipating coils **110**. The switch K now also connects an auxiliary timer motor **510** across the lines **363** and **364** by means of the conductor **453**, contact **452**, the conductors **450** and **449**, the switch K, the lower stationary contact **507**, the conductors **508** and **511**, the upper stationary contact **513**, the movable switch **514** and the conductors **514***a*, **515** and **377**. The function of the auxiliary timer motor **510** will be set forth below.

The switch L at the end of eight and a half minutes of operation of the main timer motor is moved out of engagement with its upper stationary contact, thus de-energizing the solenoid **129** so that the valve **128** closes and the cooled compressed refrigerant no longer can flow into the cooling coils **126** in the reservoir **30**, and to its lower position wherein it engages its lower stationary contact **520** to energize the solenoid **119** which opens the valve **118** so that all of the cooled compressed and expanding refrigerant now flows through the cooling coils **69** in the housing **66**. The solenoid **119**, when the switch L is in its lower position, is connected across the lines **363** and **364** by the conductor **453**, contact **452**, the conductors **450** and **469**, the switch L, the stationary contact **520** and the conductors **522**, **523** and **377**.

At the end of eight and a half minutes of operation of the timing motor, the switch H is moved to its upper position wherein it engages its stationary contact **530** to connect the blower motor **92** across the lines **363** and **364** by means of the conductor **373**, the movable contact **391** of the main relay **384**, the conductors **392** and **410**, stationary contact **530**, the switch H and the conductors **531**, **532** and **377**.

All of the hot compressed refrigerant gas now passes through the heating coils **70** and all of the compressed cooled and expanding refrigerant gas passes through the cooling coils **69**. The entire capacity of the refrigeration system is now employed first to cool the vapor laden air and cause condensation of the solvent and then to heat the air. The blower **72** now moves the air in the closed flow path or passage which includes both the tub and the housing **66** so that the air warmed by the heating coils **70** and flowing into the tub will cause evaporation of the liquid solvent still present in the tub or absorbed by the garments. The air cooled by this evaporation and carrying the solvent in gaseous state thus moves to the cooling coils where the solvent is condensed and allowed to drain back to the reservoir **30**.

At the end of nine and a half minutes of operation of the timing motor the switch B is moved to its lower position wherein it engages its lower stationary contact **540**. The main timer motor is now disconnected from the lines **363** and **364** and its drive shaft now stops rotating and the switches A through L remain in the positions described until the operation of the auxiliary timer motor **510** again causes energization of the main timer motor.

The auxiliary timer motor may be similar to the main timer motor **350** and be provided with the switches **514**, **542** and **543** which are moved between their upper and lower positions by three cams similar to the cams **352**. The cam which actuates the switch **542** may be of such configuration that it will cause movement of the switch **542** to its upper position wherein it engages its contact **545** at the end of a short period of energization of the auxiliary timer motor, for example, six minutes. The cam which actuates switch **543** may be of such configuration that it will move the switch **543** to its upper position wherein it engages its stationary contact **546** at the end of a still longer period of time after the commencement of the operation of the auxiliary timer motor **510**, for example, twelve minutes, and the cam which moves the switch **514** out of engagement with the upper stationary contact **513** and into engagement with its lower stationary contact **548** may be of such configuration as to cause the switch **514** to move downwardly a still longer period of time, say twelve and a half minutes after the commencement of the operation of the auxiliary timer motor **510**. As a result when, after nine and a half minutes of operation of the main time motor, the switch B is moved to its lower position, and for example the manual switch **550** is in the upper position illustrated in FIGURE 3, the main timer motor remains inoperative and the drying stage of the cycle of operation of the apparatus during which the liquid solvent is being vaporized continues for an additional period of six minutes until the switch **542** is moved to its upper position where it engages the stationary contact **545**. At this time the main timer motor **350** is again energized being then connected across the lines **363** and **364** by means of the conductors **373**, **488**, **560** and **561**, the stationary contact **545**, the switch **542**, the conductor **562**, the upper stationary contact **563** of the switch **550**, the switch **550**, the conductor **565**, the stationary contact **540**, the switch B and the conductors **396** and **377**. If it were desired to operate the motor to continue the drying cycle for an additional period of twelve minutes, the switch **550** would have been moved to its lower position where it engaged its stationary contact **568** so that the connection between the conductor **561** and the conductor **565** would have been made twelve minutes after the commencement of operation of the auxiliary timer motor when the switch **543** is moved to its upper position to connect the conductors **561** and **565** through its stationary contact **546** and the conductor **569** which connects the switch **543** to the stationary contact **568**.

At the end of one of these two preselected periods of time of operation of the auxiliary timer motor and after the main timer motor **350** has operated for another half minute, that is, when the main timer motor has operated for a full ten minutes, the switch B is again moved upwardly to its upper position where it engages its upper stationary contact **395** so that further operation of the main timer motor **350** for the remainder of the cycle of operation of the apparatus is independent of the operation of the auxiliary timer motor **510**. Once the auxiliary motor **510** has commenced operation the cam which controls the movement of its switch **514** moves the switch to its lower position so that continued operation of the auxiliary timer motor **510** once it has been initiated by the movement of the switch K to its lower position is independent of the operation of the switch K. The auxiliary timer motor **510** is then connected across the lines **363** and **364** through the conductors **373**, **488** and **560**, the stationary contact **548**, the switch **514**, the conductor **514***a* and the conductors **515** and **377**. The auxiliary timer motor then continues to operate for a period of time longer than twelve minutes and until the cams which control its switches **514**, **542** and **543** again move these switches to the positions illustrated in FIGURE 3 and in condition for another cycle of operation of the cleaning apparatus. It will be noted that more than thirteen minutes must elapse after the energization of the auxiliary timer motor before another cycle of operation of the cleaning apparatus progresses to the point that switch K is again moved to its lower position.

After the tenth minute of operation of the main timer motor the switch B moves back to its upper position and the switch K moves back to its upper position to de-energize the solenoid **135** in the manner previously described and thus close the valve **134** so that hot compressed refrigerant gas no longer is permitted to flow

through the heating coils **70** and at the same time to energize the solenoid **109** to open the valve **108** to permit the hot refrigerant gases from the compressor **103** to flow directly to the heat dissipating coils **110**. As a result, the air moving through the closed flow path which includes the tub and the housing **66** is now only cooled and is not reheated since at this time all of the solvent is in its gaseous state. The temperature within the closed flow path as it is lowered causes condensation of the gaseous solvent not only in the housing **66** as it passes over the cooling coils **69**, but also on the various wall surfaces of the closed flow path since these tend to cool off more rapidly than the garments.

At the end of the ten and a half minutes of operation of the main timer motor, the switch C is moved to its lower position to energize the solenoid **40** and to open the drain valve **39** and simultaneously the switch D is moved to its lower position to energize the motor **156** of the drain pump **45** so that any condensed solvent in the tub which drains into the trap **44** off the walls of the closed flow path is moved into the reservoir **30**.

At the end of the eleventh minute of operation of the main timer motor, the switches C and D are again moved to their intermediate inoperative positions to cause the drain valve **39** to close and the motor of the drain pump **45** to stop operation. At the same time the switch J moves to its off position so that the thermostat switch **150***a* is no longer short circuited and the operation of the compressor motor will then be independent of the temperature conditions within the reservoir **30**.

The switch E at the end of eleven minutes of operation of the main timer motor is moved to its off position, de-energizing the solenoid **99** to cause the condensate drain valve **98** to close and de-energizing the solenoids **82** and **83** to cause the air valves **78** and **79** to close the passage **84** in the partition of the air valve housing and thus permit ventilation of the tub.

Also, at the end of the eleventh minute of the operation of the main timer motor, the switch L moves to its upper position to open the valve **128** so that the compressed and cooled refrigerant gas now will flow through the cooling coils **126** and the reservoir **30**.

At the end of the eleven and a half minutes of operation of the main timer motor the switch A moves down to its lower position so that the timer motor **350** will now continue to operate independent of the position of the contact **391** of the main relay **384** since it is then connected across the lines **363** and **364** through the conductors **373** and **488** and **489**, the lower stationary contact **570** of the switch A, the switch A, the conductor **394**, the upper stationary contact **395** of the switch B, the switch B and the conductors **396** and **377**.

At the end of the twelfth minute of operation of the main timer motor, the switch B moves to its off position wherein it engages neither its upper nor its lower stationary contact. At the end of the twelfth minute of operation of the main timer motor the switch F is moved to its upper open position thus de-energizing the drum motor **27** and the drum stops rotating. Simultaneously, at the end of the twelfth minute of operation of the main timer motor, the switch G moves to its lower position wherein it energizes the solenoid **260** which causes the door lock mechanism to become unlocked in the manner described previously, and also the switch G, when it moves to this lower position, actuates the reset mechanism **575** of the stepper **359** which causes its switch **369** to be moved to the upper position illustrated in FIGURE 3.

The switch H at the end of the twelfth minute of the cycle of operation of the main timer motor moves downwardly to engage its stationary contact **432** so that the blower motor is placed in condition to operate and blow any remaining solvent in gaseous state to the atmosphere through the exhaust duct **81**. Also at the end of the twelfth minute of operation the switch I is moved to its intermediate off position so that the lamp **436** is extinguished and thus indicates that the drying stage of the cycle of operation of the apparatus has been completed. When the switch G moves to its lower position at the end of the twelfth minute it causes the reset mechanism **575** of the stepper **359** to reset the switch **369** to the upper position illustrated in FIGURE 3 and out of contact with the stationary contact **375**. The relay winding **383** of the main relay **384** is thus de-energized and the movable contacts **391** and **406** move to the upper open positions illustrated in FIGURE 3.

At the end of the twelfth minute of operation therefore the door may be opened and the blower will continue to operate. The timer motor **350**, however, will continue to operate for another half minute, at the end of which time the switches A, B, C and D are moved to their upper positions, the switch E is moved to its lower position, the switch F is moved to its lower position, the switch G is moved to its intermediate open position, switch H is left in its lower position, switches I and J are left in their intermediate open positions and the switches K and L are left in their upper positions. At this time the apparatus is returned to its initial starting position with the exception of the auxiliary timer motor which, as was pointed out before, will continue to operate for a period of time until it resets the switch contacts **542** and **543** to their open positions and the switch contact **514** to its upper position at which time the motor **510** itself will cease operation since the switch K is now in its upper position. The above cycle of operation can then again commence to clean a new load of soiled garments.

It will be noted that the switches K and L are connected across the lines **363** and **364** through the movable contact **452** of the compressor motor relay **329** so that the solenoids **109**, **135**, **129** and **119** will all be de-energized so the valves **108**, **134**, **128** and **118**, which control the flow of refrigerant gas to and from the compressor, will be closed whenever the compressor motor stops operating either when the temperature within the reservoir **30** falls below the predetermined value or when either of the high and low pressure switches is opened.

The auxiliary timer motor **510** and the manual switch **550** which is mounted on the control housing **218** provide the customer with a means for varying the length of the time during which the liquid solvent is evaporated from the garments, since some fabrics may absorb greater quantities of the solvent than others and since the load itself of the garments which is placed in the drum may also vary, it being obvious that a shorter time will be needed to evaporate all liquid solvent from a light load of garments than from a heavy load of garments.

If desired, the length of the drying cycle of the apparatus may be controlled in other ways; for example, by a temperature sensing means responsive to the temperature differential in the closed air path between the inlet and the outlet of the tub which will close to restart operation of the motor **350** when such temperature differential drops when all liquid solvent has evaporated, since the cooling of the air flowing through the air path due to the evaporation of the liquid solvent will of course cease once all the liquid solvent has evaporated.

It will now be seen that the control circuit illustrated in FIGURE 3 will cause the cleaning apparatus to operate automatically in the manner described to clean the soiled garments by circulating a solvent, such as is commercially available under the name "Valclene," through the soiled garments and through a filtering means for removing from the solvent the foreign matter extracted from the soiled garments, draining the tub of the apparatus of liquid solvent when the cleaning operation has been completed, evaporating the liquid solvent from the garments and condensing the solvent in gaseous form from the air being circulated through the closed air path.

It will further be seen that the control circuit causes automatic ventilation of the tub prior to the opening thereof to exhaust all unreclaimed solvent to the atmosphere

in order that if the solvent has irritating or noxious qualities, the person opening the tub will not be exposed to the danger of inhalation thereof, that the circuit provides for the locking of the door to prevent its opening during the cycle of operation of the apparatus and that the circuit also provides for the automatic circulation of the air through the door opening and out to the atmosphere whenever the door is opened for the same purpose.

If desired, an additional solenoid controlled valve (not shown) may be connected in the outlet conduit **142** of the additive tank **140** above the valve **144**. The additional valve would be opened when the valve **144** is closed and would be closed by a suitable control before the valve **144** is opened. By this arrangement of the valves only a predetermined amount of solvent would flow into the reservoir **30** each time the valve **144** opens regardless of the length of time the valve **144** remains open.

It will now be seen that a new and improved dry cleaning apparatus having automatic controls has been illustrated and described which provides for a maximum recovery of the solvent and for the efficient automatic dry cleaning of soiled garments.

The foregoing description of the invention is explanatory only, and changes in the details of the construction may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

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

1. An apparatus for cleaning soiled garments and the like by use of a solvent including: means providing a closed chamber having an opening and a door for closing said opening; a drum rotatably mounted in said chamber whereby soiled garments and the like may be introduced into the drum through said opening when said door is open; a reservoir for solvent disposed below said chamber; conduit means connecting said reservoir to said chamber, said conduit means having first pump means and valve means connected therein whereby fluid may be moved from the reservoir into said chamber when said valve means is in open position and said pump means is energized; overflow conduit means connecting said chamber at a level intermediate its top and bottom to said reservoir; filter means and second pump means connected between said overflow conduit means and said reservoir whereby fluid flowing into said overflow conduit means is moved by said second pump means when said second pump means is energized through said filter means and back to said reservoir; and drain conduit means connecting the bottom of said chamber to said filter means and said second pump means and having drain valve means connected therein whereby all liquid in said chamber may flow to said second pump means when said drain valve is open; air duct means connecting the lower portion of said chamber with the upper portion of said chamber including a heat exchanger housing, an air moving means and an air valve means connected in said air duct means; a vent duct, said vent duct being connected to said air duct and opening into the atmosphere at two spaced points, said air valve means when in one position and when said air moving means is operating causing the air to be drawing in through said vent duct at one of said points and moved into said chamber and carrying air to be exhausted from said chamber through said air duct means and said vent means to the atmosphere at the other of said points, said air valve means when in a second position establishing a closed air flow path which includes said chamber whereby said air moving means circulates air through said chamber and through said air duct and back to said chamber when said air valve means is in said second position; cooling and heating means disposed in said heat exchanger housing to first cool the air moving through said air duct from said chamber and then to heat the cooled air prior to its return to said chamber, and condensate return conduit means connecting said heat exchanger housing and said reservoir for returning solvent condensed by said cooling means back to said reservoir, said condensate return conduit means having valve means connected therein for closing said condensate return conduit.

2. The apparatus of claim **1**, and means operatively associated with said door for energizing said air moving means each time said door is open to cause movement of the air into said chamber through said opening and out of said chamber through said vent duct.

3. The apparatus of claim **1**, and means for causing simultaneous operation of said heating and cooling means for a period of time sufficiently long to cause evaporation of any liquid solvent in said closed air flow path when said air valve means is in said second position and then causing operation only of said cooling means to cause condensation of solvent is gaseous state present in the closed air flow path.

4. The apparatus of claim **3**, and means operatively associated with said door for energizing said air moving means each time said door is open to cause movement of the air into said chamber through said opening and out of said chamber through said vent duct.

5. The apparatus of claim **1**, and a refrigerant gas system including a compressor and said cooling means and said heating means; and means for selectively permitting circulation of compressed hot refrigerant gas from said compressor through said heating means and of cooled and expanded refrigerant gas through said cooling means and back to said compressor to be compressed thereby; and means operatively associated with said refrigerant gas system for causing simultaneous circulation of gas through said heating means and said cooling means for a period of time sufficiently long to cause evaporation of liquid solvent in said closed air flow path when said air valve means is in said second position and then causing circulation of refrigerant gas only through said cooling means to cause condensation of solvent existing in gaseous state in said closed air path.

6. The apparatus of claim **5**, wherein said refrigerant gas system includes a second cooling means disposed in said reservoir and a heat dissipating means; and means for selectively permitting circulation of compressed hot refrigerant gas from said compressor through said heat dissipating means and of cooled and expanded refrigerant gas through said second cooling means and back to said compressor to be compressed thereby, said means operatively associated with said refrigerant gas system preventing circulation of refrigerant gas through said second cooling means when the refrigerant gas is being circulated through said cooling means in said heat exchanger housing.

7. An apparatus for reclaiming solvent absorbed in garments and the like, including: means providing a closed chamber having a closable opening through which garments and the like may be introduced into said chamber; means providing a closed air flow path including said chamber; vent means operatively associated with said last mentioned means; valve means for selectively connecting said chamber to said vent means and to said closed air flow path to cause said chamber to constitute a section of said closed flow path; means for moving air through said chamber; a first cooling means disposed in said means providing said closed air flow path for cooling air flowing from the chamber through said closed air flow path; heating means for heating the air previously cooled by said cooling means and moving through said closed air flow path back into said chamber; means for removing solvent condensed by said cooling means from said closed air flow path; and means for causing simultaneous operation of said heating means and cooling means for a period of time sufficiently long to cause evaporation of any liquid solvent in said closed air flow path and its condensation for removal by said means for removing solvent and then causing operation only of said cooling means to cause

condensation of any remaining solvent present in a gaseous state in the closed air flow path for removal by said means for removing solvent.

8. The apparatus of claim 7; and a refrigerant gas system, said refrigerant gas system including a compressor and said cooling means and said heating means; and means for selectively permitting circulation of compressed hot refrigerant gas from said compressor through said heating means and of cooled and expanded refrigerant gas through said cooling means and back through said compressor to be compressed thereby.

9. An apparatus for reclaiming liquid solvent from garments and the like including: means providing a closed chamber having an opening and a door for closing said opening; air duct means connecting the lower portion of said chamber with the upper portion of said chamber including a heat exchanger housing, an air moving means and an air valve means connected in said air duct means; a vent duct, said vent duct being connected to said air duct means and opening into the atmosphere at two spaced points, said air valve means when in one position and when said air moving means is operating causing the air to be drawn in through said vent duct at one of said points and moved into said chamber and carrying air to be exhausted from said chamber through said air duct means and said vent duct to the atmosphere at the other of said points, said air valve means when in a second position establishing a closed air flow path which includes said chamber whereby said air moving means circulates air through said chamber and said air duct means and back to said chamber when said air valve means is in said second position; cooling and heating means disposed in said heat exchanger housing to first cool the air moving through said air duct means from said chamber and then to heat the cooled air prior to its return to said chamber; and means connected to said heat exchanger housing for removing solvent condensed by said cooling means from said closed air flow path.

10. The apparatus of claim 9, and means operatively associated with said door for energizing said air moving means each time said door is opened to cause movement of air into said chamber through said opening and out of said chamber through said vent duct.

11. The apparatus of claim 9, and means for causing simultaneous operation of said heating means and cooling means for a period of time sufficiently long to cause evaporation and then condensation of any liquid solvent in said closed air flow path for removal by said means

for removing said solvent when said air valve means is in said second position and then causing operation only of said cooling means to cause condensation of any solvent present in gaseous state in the closed air flow path for removal by said means for removing said solvent.

12. The apparatus of claim 11, and means operatively assocated with said door for energizing said air moving means each time said door is opened to cause movement of the air into said chamber through said opening and out of said chamber through said vent duct.

13. The apparatus of claim 9, and a refrigerant gas system including a compressor and said cooling means and said heating means; means for selectively permitting circulation of compressed hot refrigerant gas from said compressor through said heating means and of cooled and expanded refrigerant gas through said cooling means and back through said compressor to be compressed thereby; and means operatively associated with said refrigerant gas system for causing simultaneous circulation of gas through said heating means and said cooling means for a period of time sufficiently long to cause evaporation of liquid solvent in said closed air flow path when said air valve means is in said second position and then causing circulation of refrigerant gas only through said cooling means to cause condensation of solvent existing in gaseous state in said closed air flow path.

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