

Oct. 15, 1963

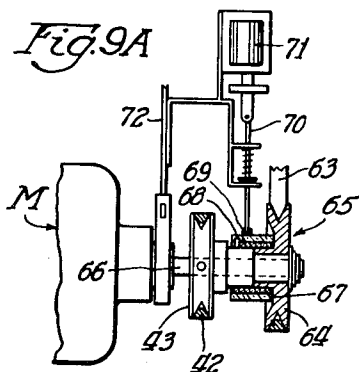
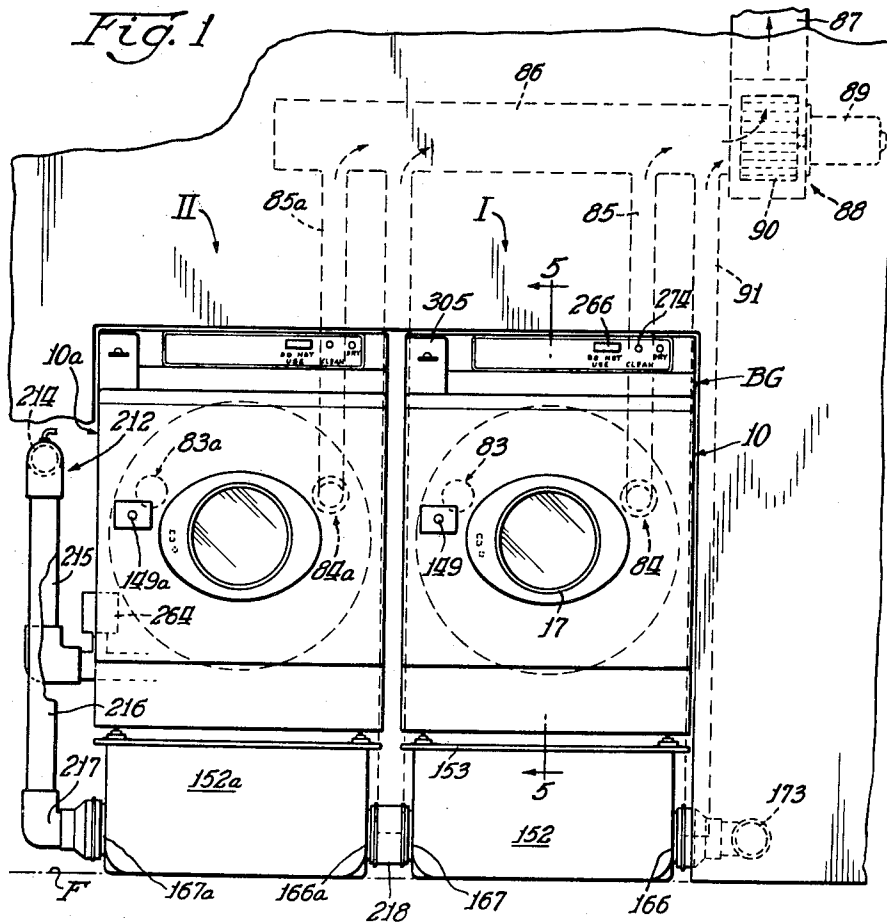
C. E. BEHRENS

3,106,831

DRY CLEANING MACHINE

Filed Oct. 3, 1961

17 Sheets-Sheet 1



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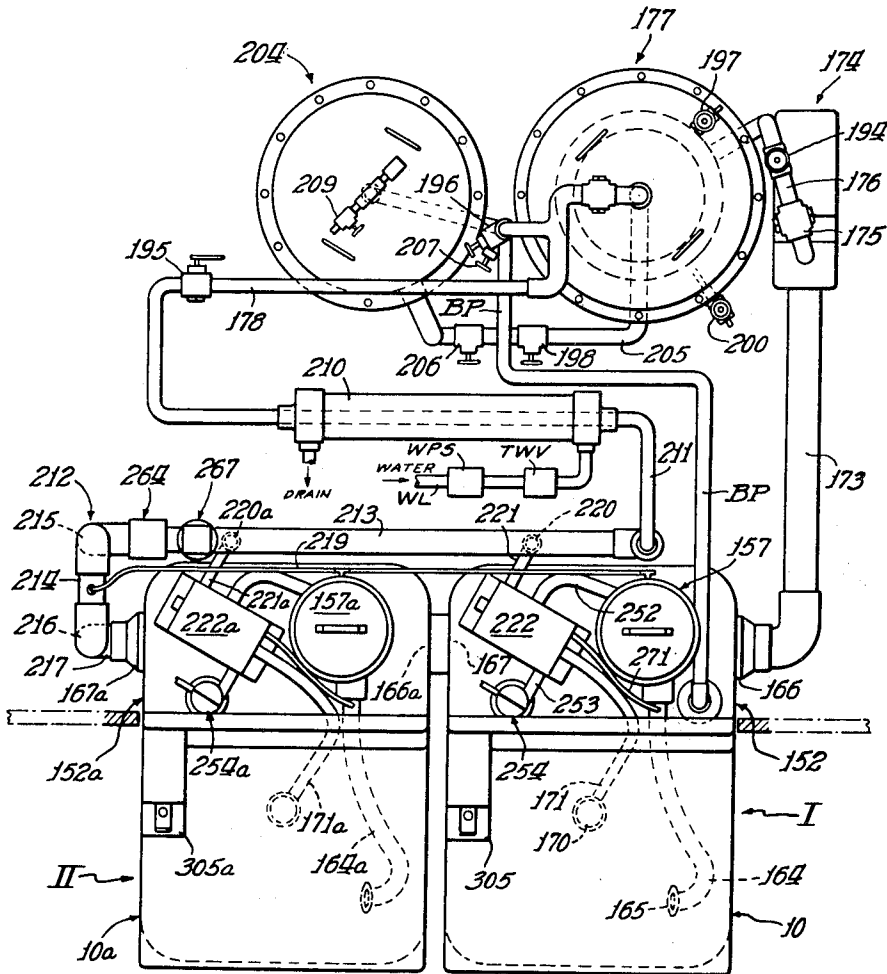
C. E. BEHRENS
DRY CLEANING MACHINE

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17 Sheets-Sheet 2

Fig. 2



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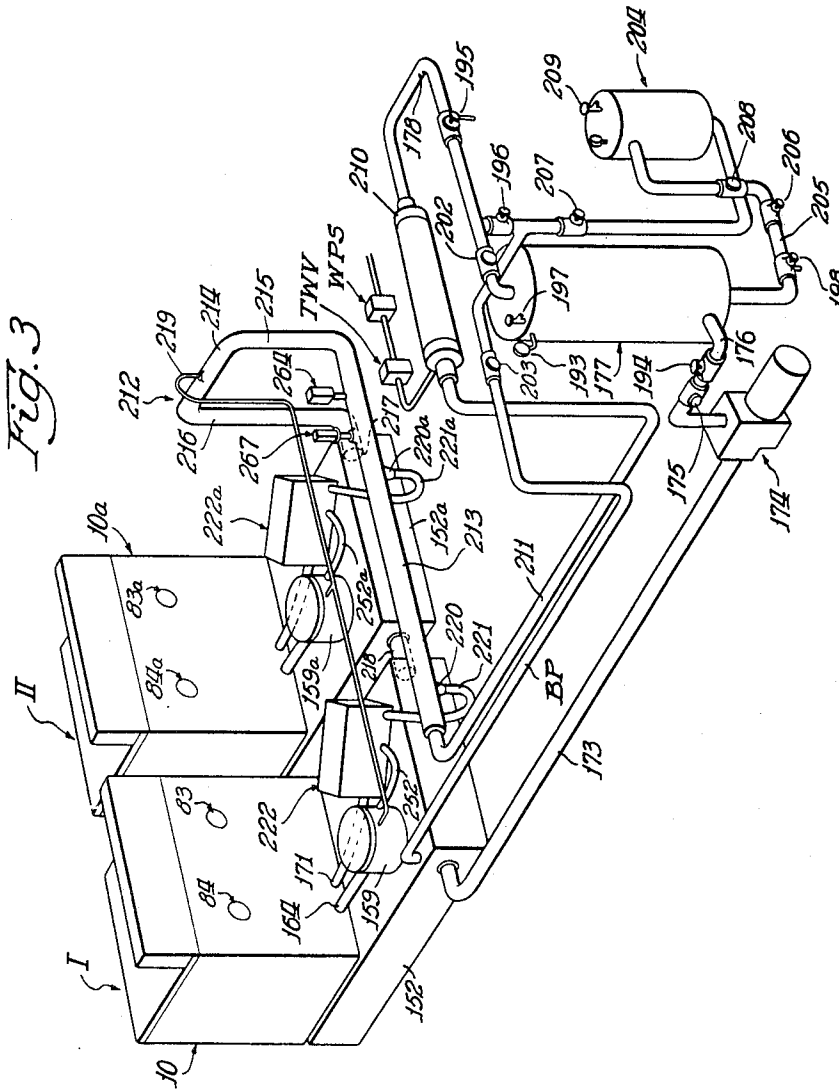
Oct. 15, 1963

C. E. BEHRENS
DRY CLEANING MACHINE

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17 Sheets-Sheet 3



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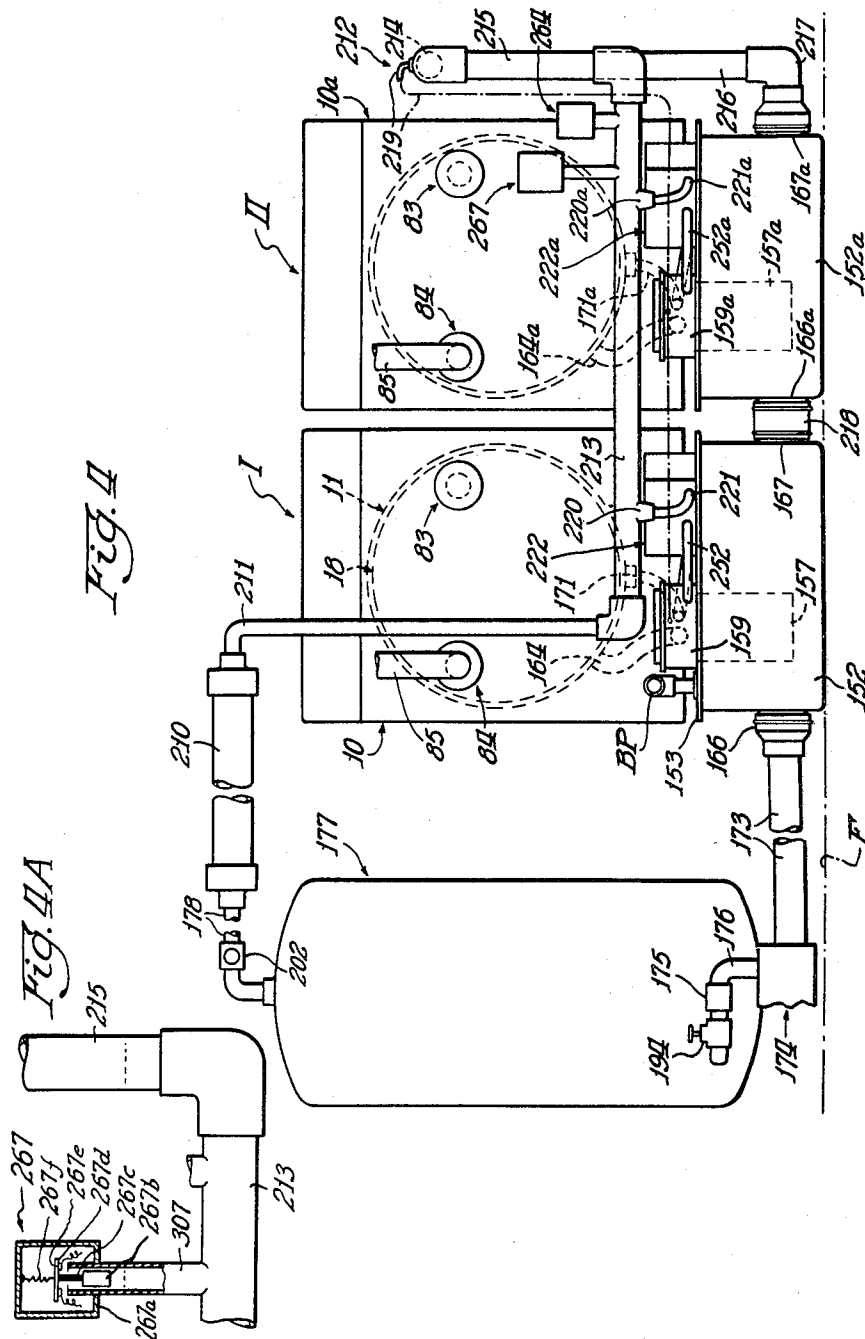
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C. E. BEHRENS
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17 Sheets-Sheet 4



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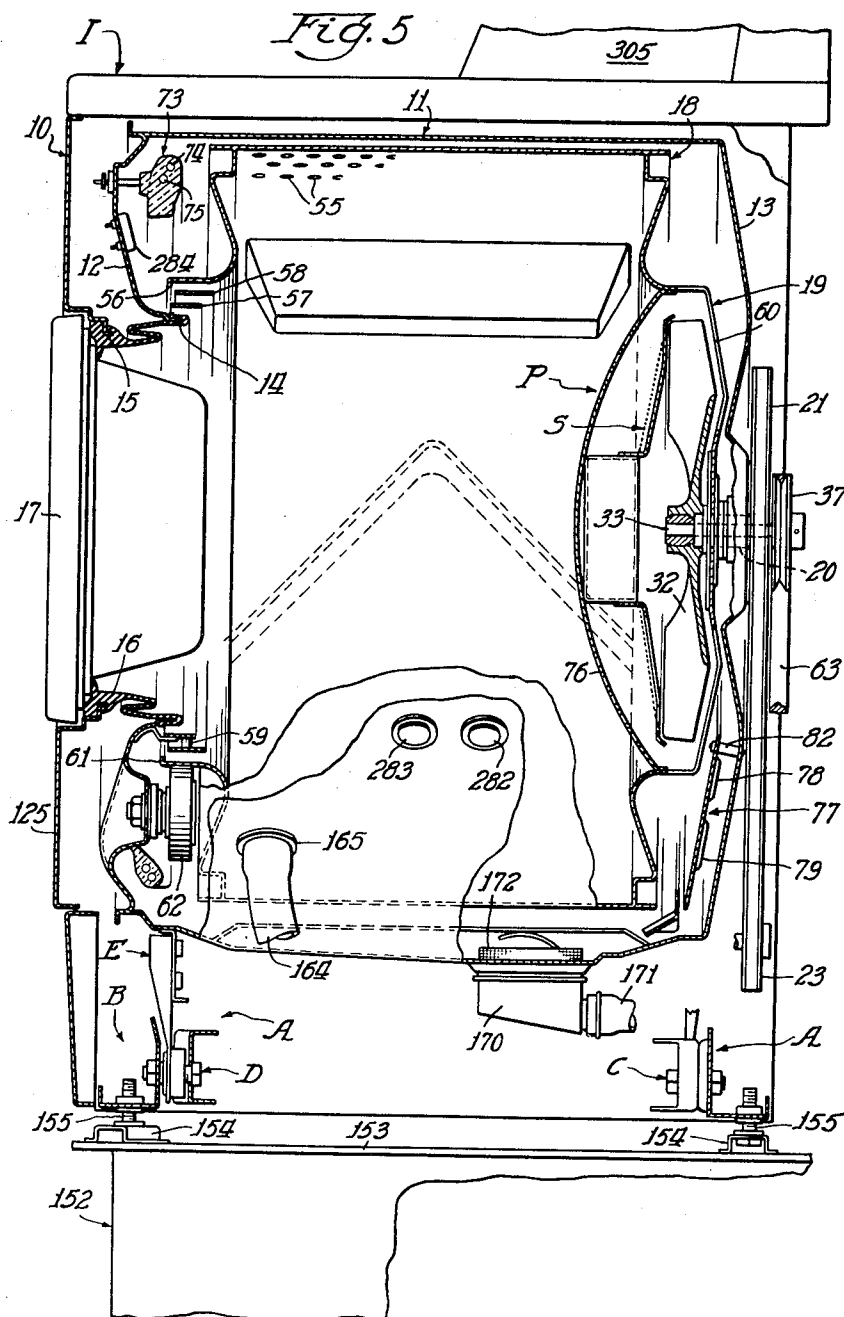
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Filed Oct. 3, 1961

DRY CLEANING MACHINE

17 Sheets-Sheet 5



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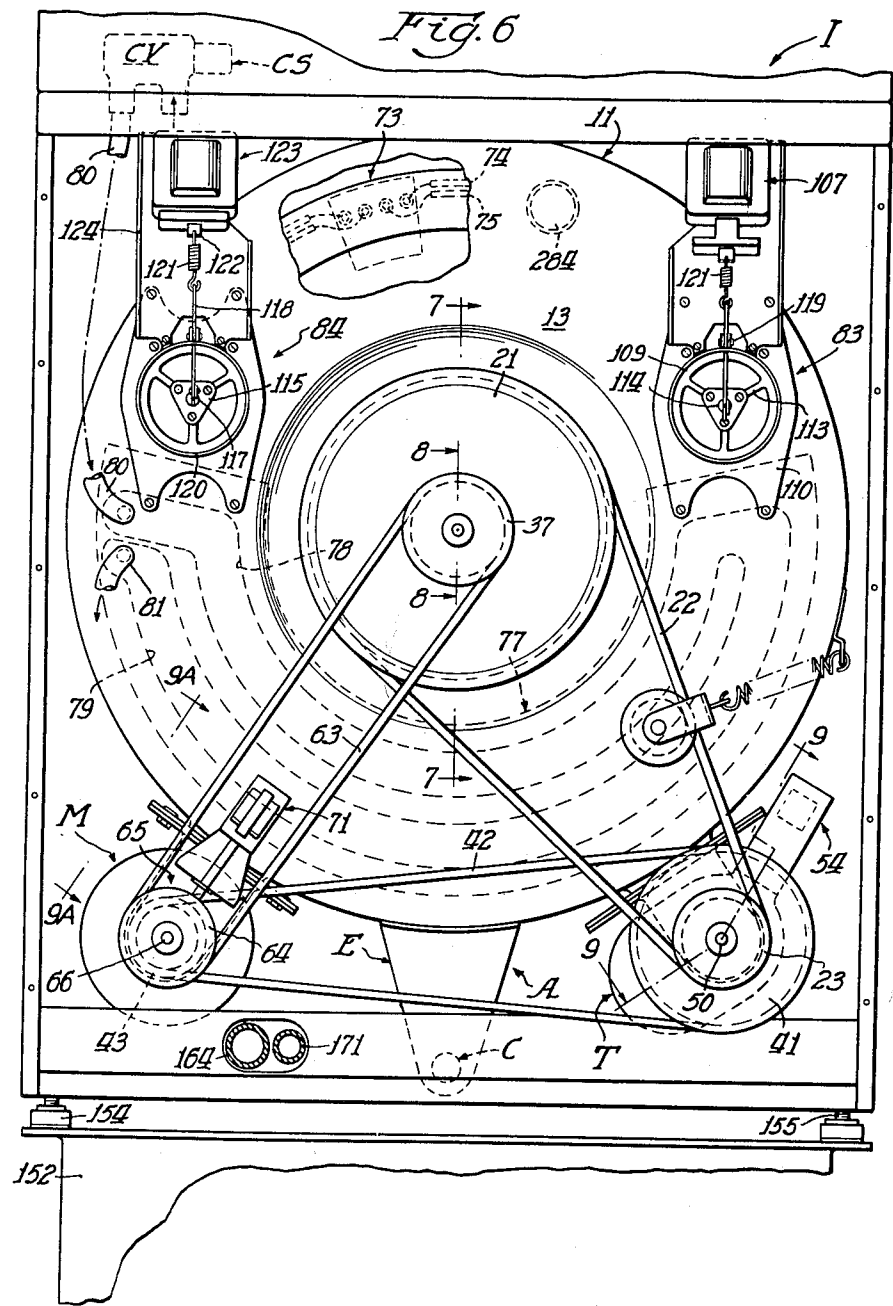
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C. E. BEHRENS
DRY CLEANING MACHINE

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17 Sheets-Sheet 6



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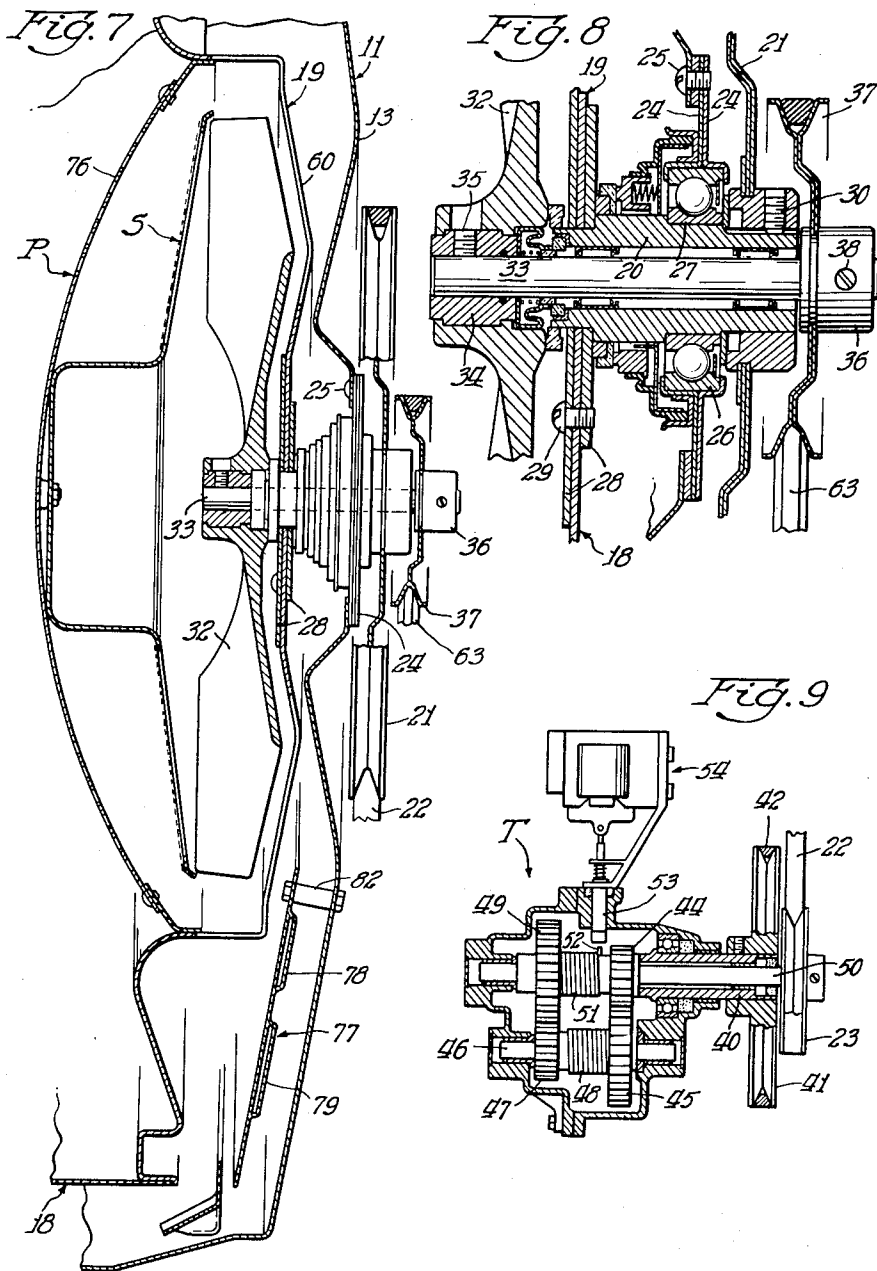
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C. E. BEHRENS
DRY CLEANING MACHINE

3,106,831

Filed Oct. 3, 1961

17 Sheets-Sheet 7



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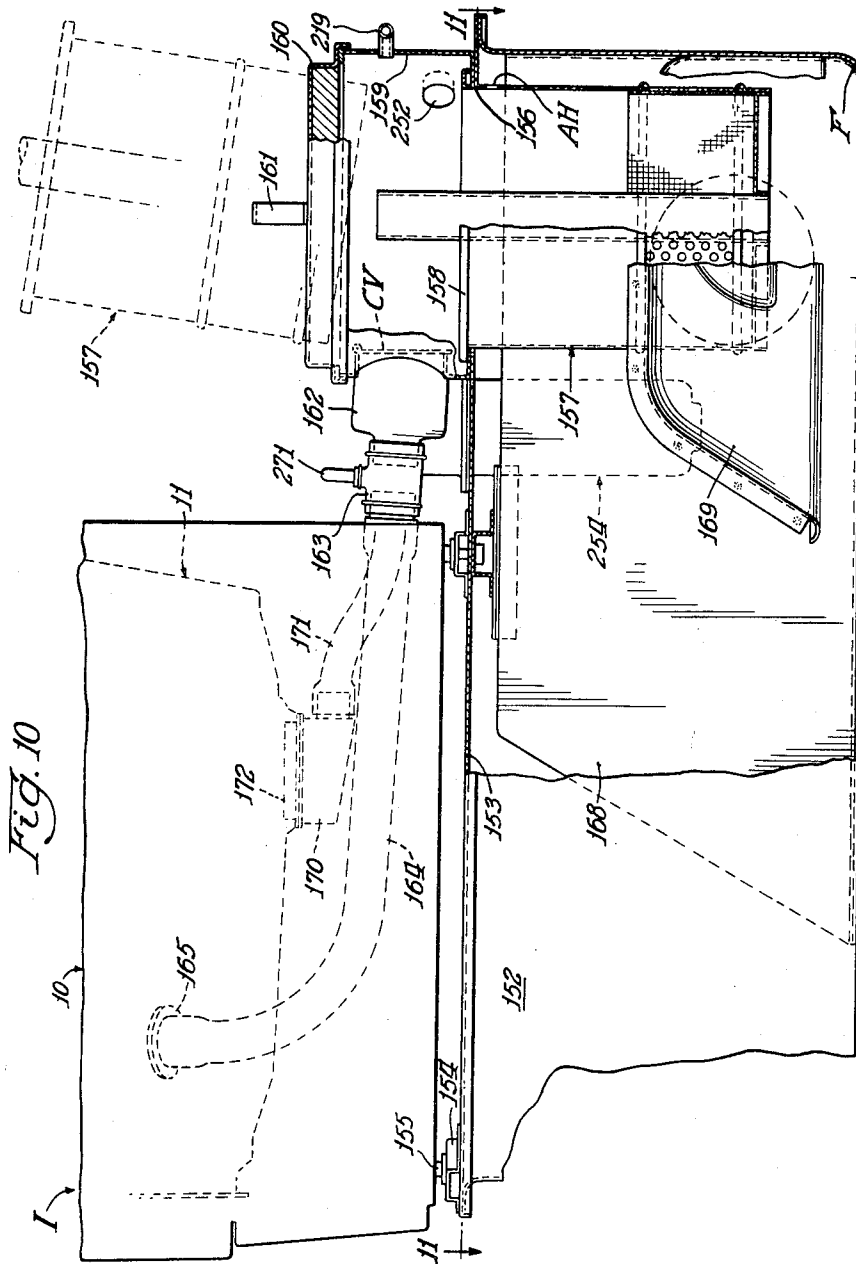
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DRY CLEANING MACHINE

Filed Oct. 3, 1961

17 Sheets-Sheet 8



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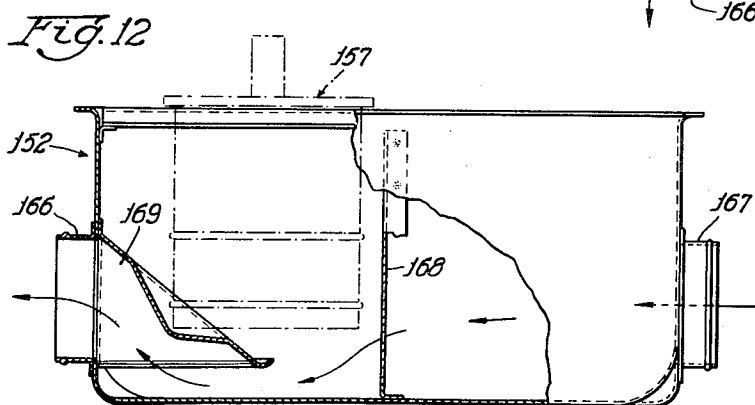
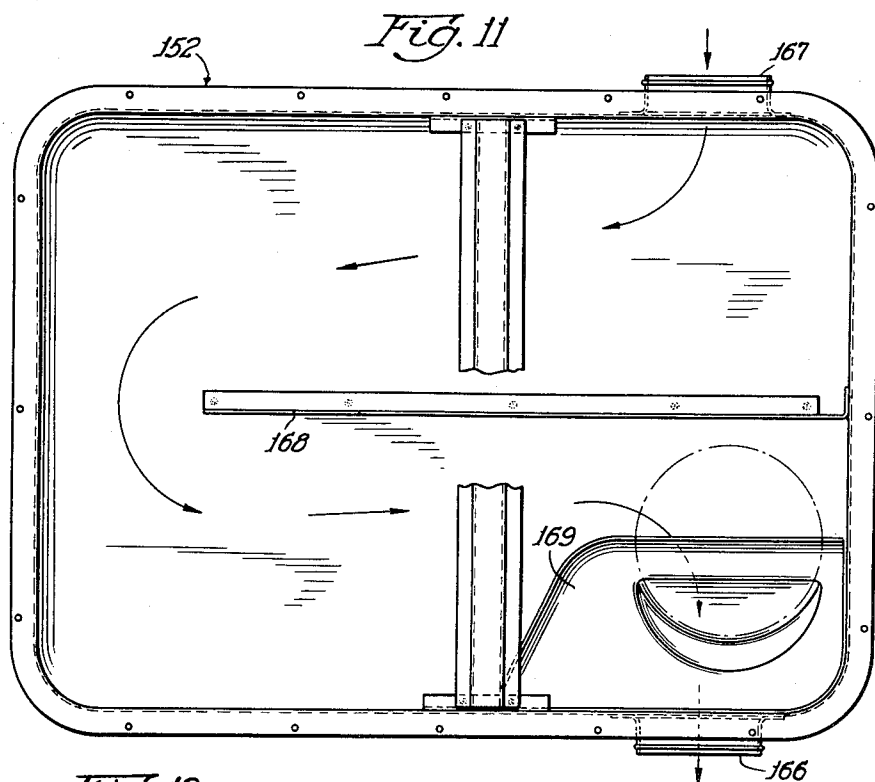
Oct. 15, 1963

C. E. BEHRENS
DRY CLEANING MACHINE

3,106,831

Filed Oct. 3, 1961

17 Sheets-Sheet 9



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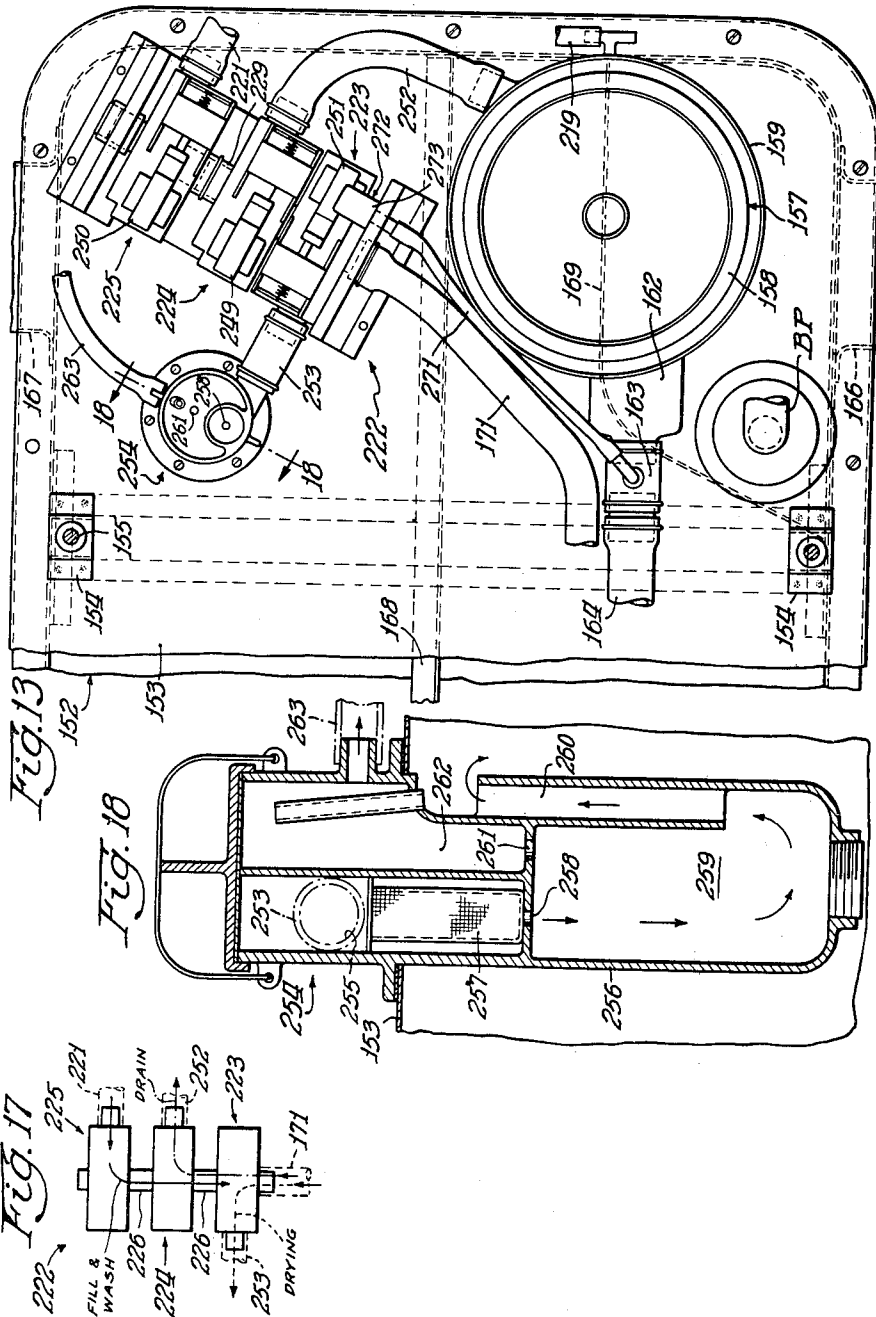
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C. E. BEHRENS
DRY CLEANING MACHINE

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Filed Oct. 3, 1961

17 Sheets-Sheet 10



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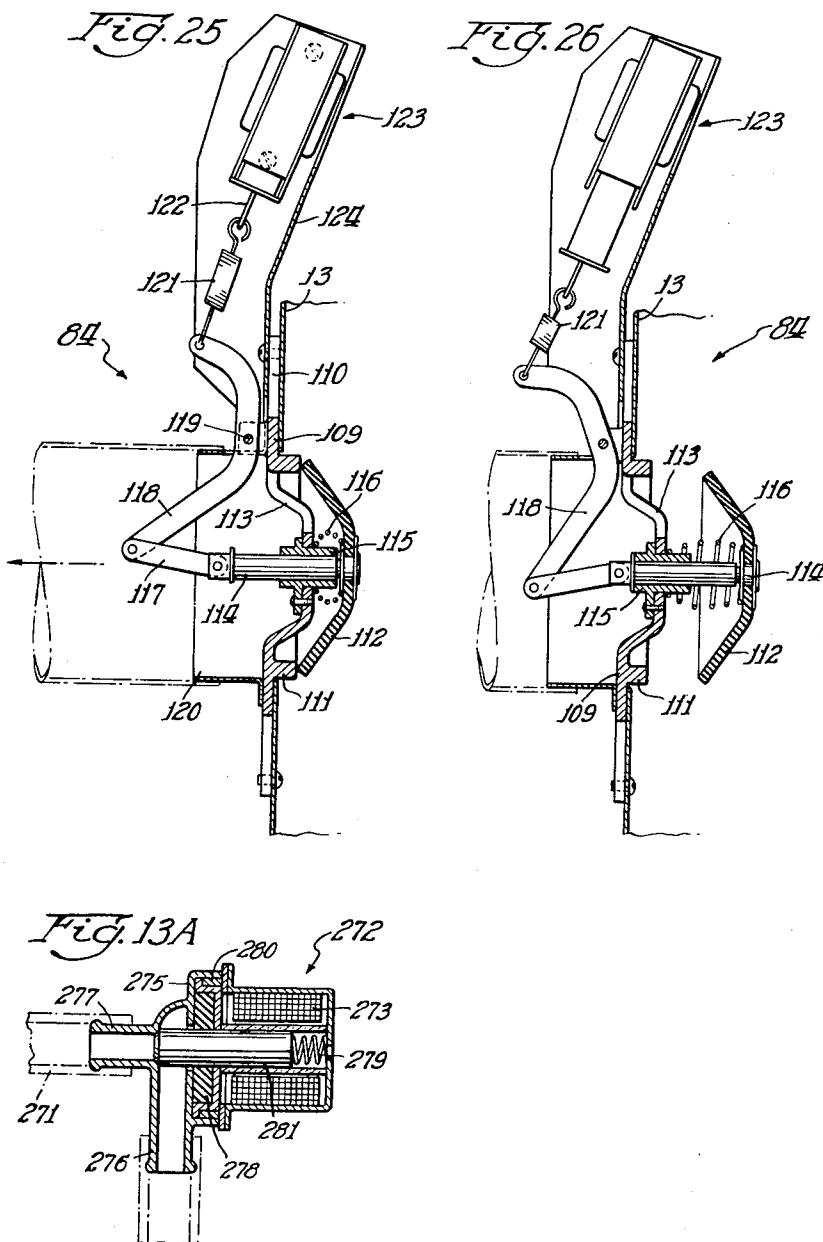
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DRY CLEANING MACHINE

Filed Oct. 3, 1961

17 Sheets-Sheet 11



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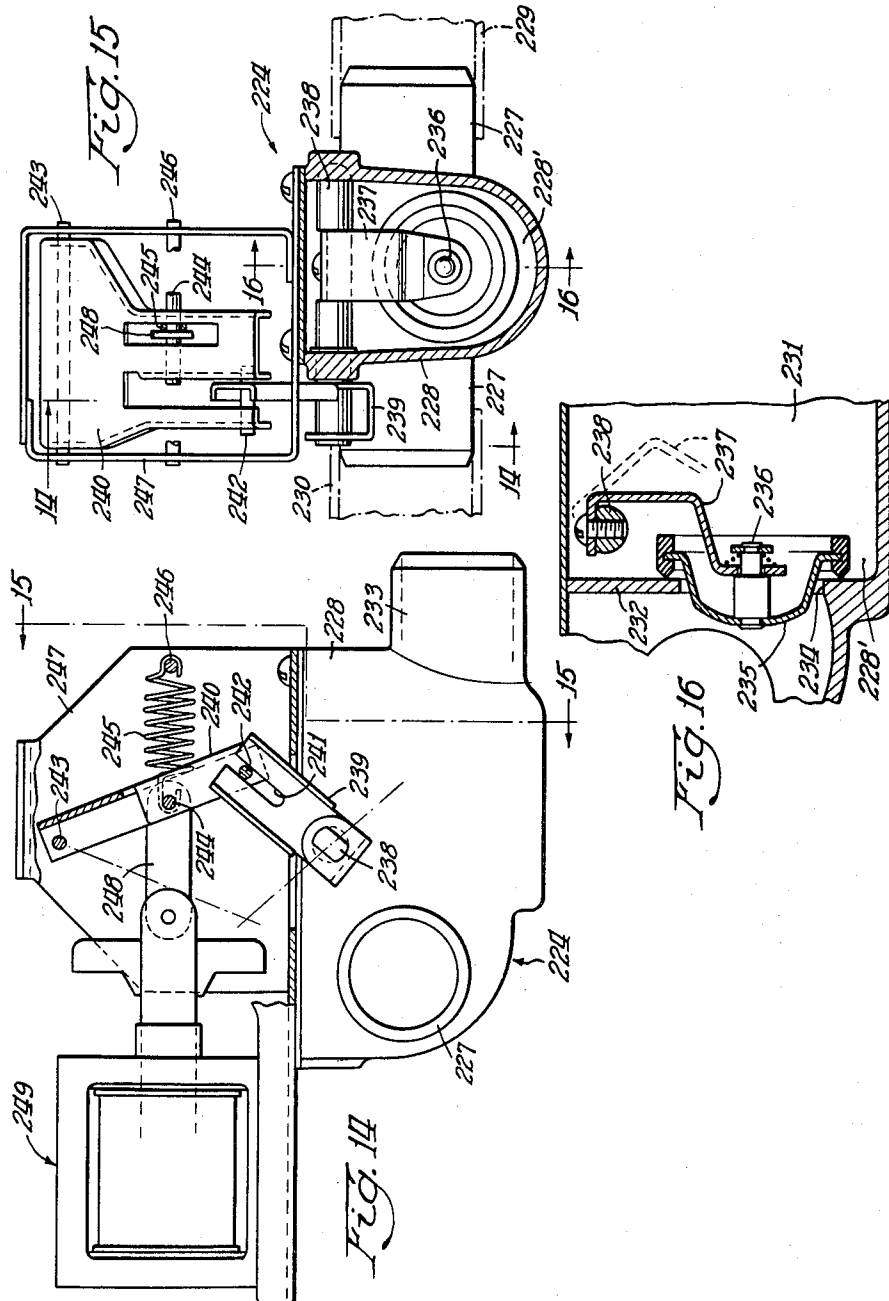
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C. E. BEHRENS
DRY CLEANING MACHINE

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17 Sheets-Sheet 12



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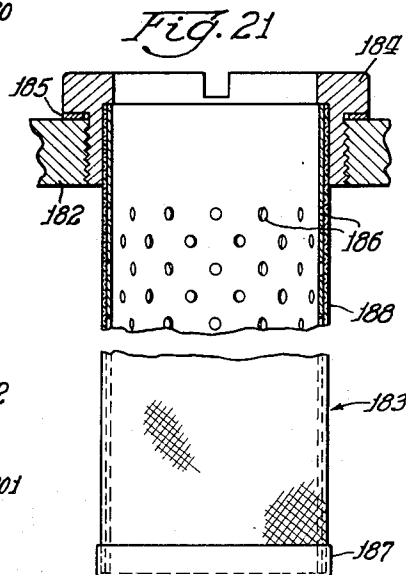
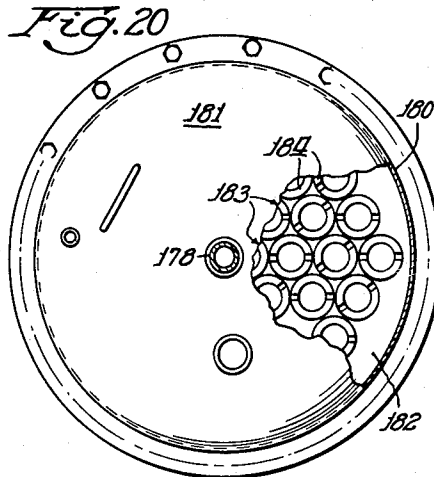
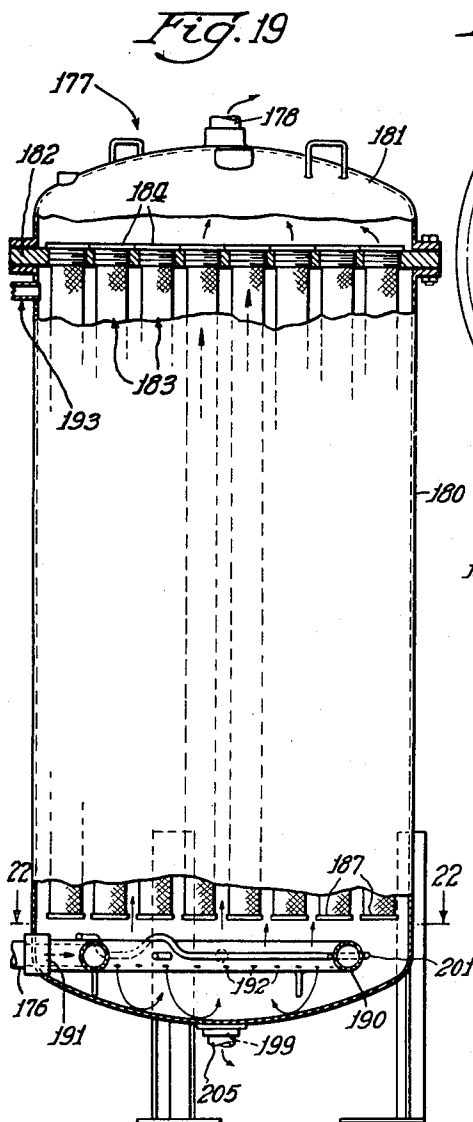
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C. E. BEHRENS
DRY CLEANING MACHINE

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17 Sheets-Sheet 13



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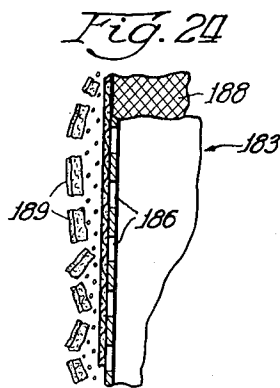
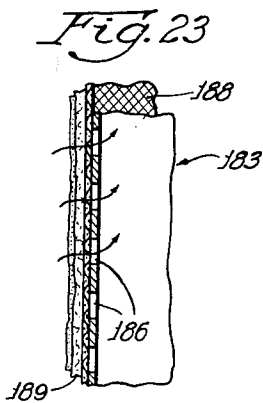
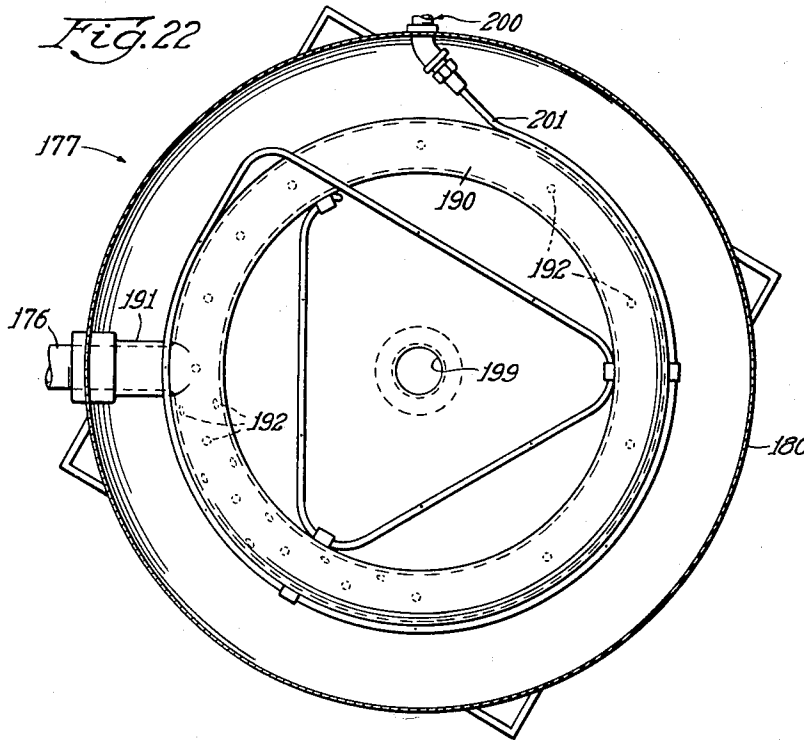
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C. E. BEHRENS
DRY CLEANING MACHINE

3,106,831

Filed Oct. 3, 1961

17 Sheets-Sheet 14



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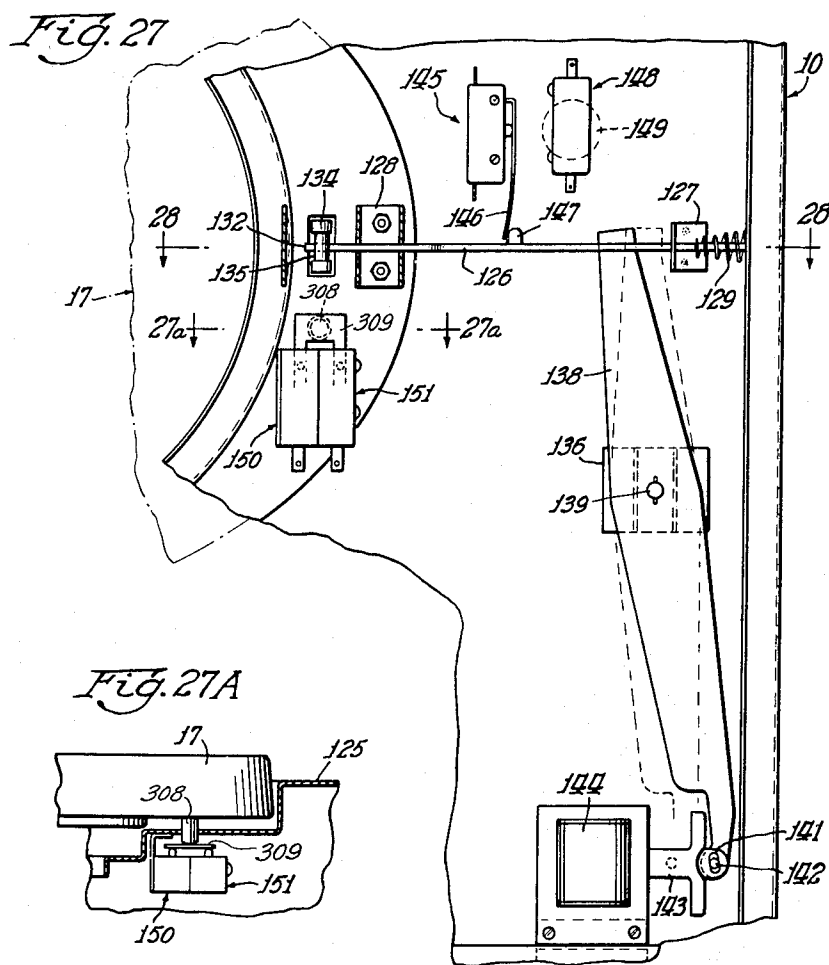
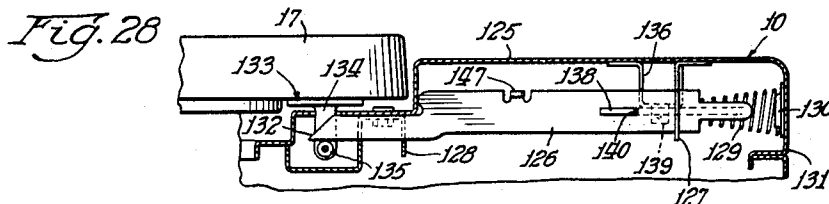
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C. E. BEHRENS
DRY CLEANING MACHINE

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17 Sheets-Sheet 15



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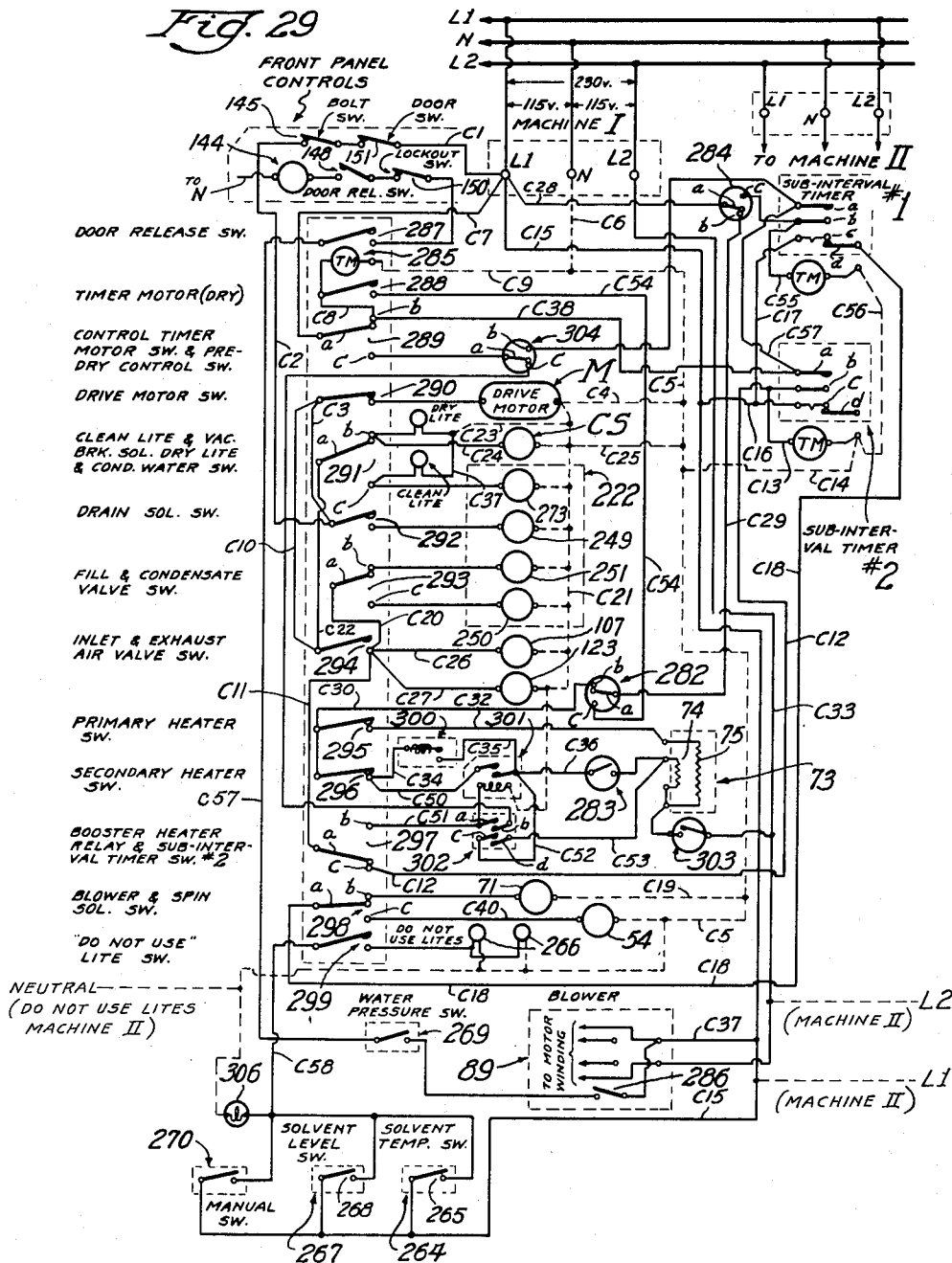
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DRY CLEANING MACHINE

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17 Sheets-Sheet 16



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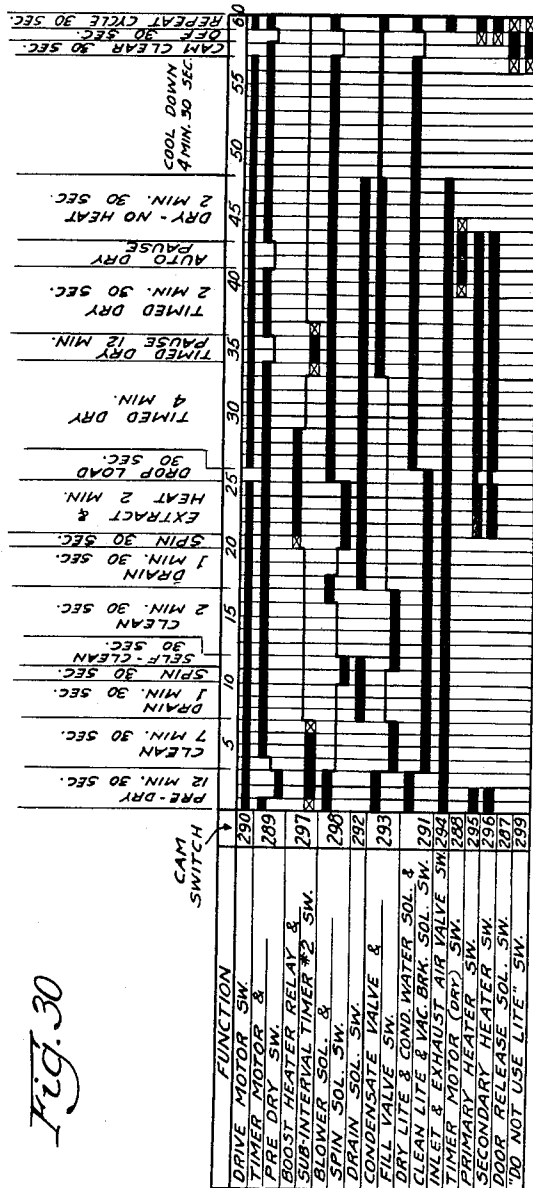
Oct. 15, 1963

C. E. BEHRENS
DRY CLEANING MACHINE

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LEGEND:
■ TIMER CONTACTS CLOSED AND COMPONENT ENERGIZED.
□ TIMER CONTACTS CLOSED BUT COMPONENT NOT ENERGIZED.
⊗ TIMER CONTACTS MAY BE OPEN OR CLOSED.

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3,106,831

DRY CLEANING MACHINE

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Filed Oct. 3, 1961, Ser. No. 142,632
28 Claims. (Cl. 68-12)

This invention relates to a dry cleaning system having one or more dry cleaning machines and a cleaning fluid control arrangement therefor.

In conventional dry cleaning of fabrics, it is well known that the fluid supplied to the dry cleaning machine or machines having a closed fluid circuit arrangement, must be not only maintained in a temperature range between certain limits but must also be provided at a flow rate effective to properly clean the fabrics. In the event the temperature of the fluid is too high, the solvent dissolves dyes in the fabrics and causes wrinkling and shrinkage of the fabrics, and graying in white fabrics. In the event the fluid is not supplied to the machine, or at a proper flow rate to and through the machine, it is obvious that inadequate cleaning of the fabrics will occur.

An object of the invention is to provide an improved control arrangement having means operative to sense and indicate undesirable conditions of the cleaning fluid supply for proper cleaning of fabrics.

Another object of the invention is to provide an improved control arrangement having means operative to sense and indicate failure of sufficient fluid supply to the machine for satisfactory cleaning of fabrics.

Another object of the invention is to provide an improved control arrangement having means operative to sense and indicate an undesirable temperature of the cleaning fluid adversely affecting proper cleaning of fabrics.

Another object of the invention is to provide an improved control arrangement in which the cleaning fluid is continuously circulated to one or more machines by conduit means and wherein a temperature-responsive device and a fluid supply detecting device are inserted to respectively sense the temperature and supply of the fluid, the devices having switches arranged in parallel in an electric circuit, indicating means being provided having a switch arranged in series relation to each of the switches of the devices so that closure of either of the switches of the devices and the switch of the indicating means will be effective to energize the indicating means to notify the operator of the machine or machines that the fluid supply is inadequate, or the temperature of the fluid is too high, for efficient cleaning of the fabrics.

Another object of the invention is to provide an improved control arrangement as described wherein the dry cleaning operation of the machine or machines is controlled by a sequential controller having a switch in the electric circuit operative, upon completion of the dry cleaning operation, to complete the circuit to energize the indicating means.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIG. 1 is a front elevation of the dry cleaning system embodying the invention, including two combination cleaning and drying machines;

FIG. 2 is a top plan view of the system illustrating the fluid supply arrangement and including a filter;

FIG. 3 is a diagrammatic perspective view of the system shown in FIG. 2;

FIG. 4 is a diagrammatic rear view of the system, certain parts of the system being shown in changed posi-

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tion from that of FIGS. 1-3 to more clearly illustrate a feature thereof;

FIG. 4A is a sectional view of a portion of the fluid supply system and also showing details of a fluid level device;

FIG. 5 is a vertical sectional view of one of the machines shown in FIG. 1, said section being taken on line 5-5 of FIG. 1, and illustrating interior parts of the machine including a fluid-containing receptacle, a fabric-receiving basket, and an air-circulating fan, and means for rotatably mounting the basket and fan on the receptacle;

FIG. 6 is a rear elevational view of the machine shown in FIG. 5, illustrating the drive mechanism for basket and fan rotation and including a transmission providing different speeds of rotation of the basket;

FIG. 7 is an enlarged sectional view of the receptacle, basket and fan and mounting means therefor of FIG. 5, said section being taken on line 7-7 of FIG. 6, looking in the direction of the arrows;

FIG. 8 is a greatly enlarged sectional view of the basket and fan mounting means shown in FIGS. 5 and 7, said section being taken on line 8-8 of FIG. 6, looking in the direction of the arrows;

FIG. 9 is a sectional view of the transmission shown in FIG. 6, said section being taken on line 9-9 of FIG. 6;

FIG. 9A is a front elevation of the electric drive motor unit including drive pulleys and clutch, said view being taken on line 9A-9A of FIG. 6 and being partly in section to more clearly illustrate the structure thereof;

FIG. 10 is a side elevational view of the lower half of the machine including a cleaning fluid storage tank, said view partly being in section to more clearly illustrate the structure thereof;

FIG. 11 is a top plan view of the fluid storage tank, taken on line 11-11 of FIG. 10;

FIG. 12 is an end view, partly in section, of the fluid storage tank;

FIG. 13 is a fragmentary top plan view of the control valve arrangement mounted on the top of the fluid storage tank;

FIG. 13A is a view illustrating an air-venting vacuum-breaker valve shown in FIG. 13;

FIG. 14 is a side elevation of one of the control valves, taken on line 14-14 of FIG. 15;

FIG. 15 is an end view partly in section, of the valve of FIG. 14, said view being taken on line 15-15 of FIG. 14;

FIG. 16 is a fragmentary sectional view of the valve of FIGS. 14 and 15, said section being taken on line 16-16 of FIG. 15;

FIG. 17 is a diagrammatic view of the control valve arrangement shown in FIG. 13;

FIG. 18 is a sectional view of a separating device for different fluids, said section being taken on line 18-18 of FIG. 13;

FIG. 19 is a side elevational view of the filter shown in FIG. 2, said view being partly in section to illustrate the filter tube and screen assemblies;

FIG. 20 is a top view of the filter shown in FIG. 19, said view being partly in section to illustrate the tube and screen assemblies;

FIG. 21 is a greatly enlarged vertical sectional view of one of the filter tube and screen assemblies shown in FIGS. 19 and 20;

FIG. 22 is a horizontal sectional view of the filter, said section being taken on line 22-22 of FIG. 19, looking in the direction of the arrows;

FIG. 23 is a greatly enlarged vertical sectional view of one of the tube and screen assemblies of the filter, and illustrating a fluid-filtering agent coating and accumula-

tion of soil and lint particles, forming a film on the coating, during filtering of the cleaning fluid;

FIG. 24 is a view of the tube and screen assembly of the filter, similar to FIG. 23 but illustrating the coating and film breaking away from the screen during a backwash operation.

FIGS. 25 and 26 are vertical sectional views of one of the two identical air shutters, in the form of poppet valves, shown in FIG. 6 and provided for removal of cleaning fluid fumes from and about the machine at the conclusion of the drying cycle of the dry cleaning machine, FIG. 25 illustrating the closed position of the valve and FIG. 26 illustrating the open position of the valve;

FIG. 27 is a rear view of a portion of the door and the door-mounting front panel of the machine shown in FIG. 6 and illustrating the door-locking mechanism and control means therefor;

FIG. 27A is a horizontal section view of a switch-actuating arrangement associated with the door lock mechanism controls, said section being taken on line 27A—27A of FIG. 27;

FIG. 28 is a horizontal sectional view of the door-locking mechanism of FIG. 27, said section being taken on line 28—28 of FIG. 27;

FIG. 29 is a diagrammatic view of the electrical control arrangement of the dry cleaning machine of FIGS. 5-28, inclusive, and including sequentially-controlled cam-operated switches;

FIG. 30 is a cam sequence chart illustrating the cleaning and drying cycles of the dry cleaning machine of FIGS. 5-28, inclusive.

Referring now to the drawings, FIGS. 1, 2, 3, and 4 illustrate an improved dry cleaning arrangement particularly, but not necessarily, adapted for a plurality of combination fabric-cleaning and drying machines, two of which are shown and generally identified as I and II.

The cleaning fluid supply system utilized with the machines has been designed to provide a constant flow of clean, filtered cleaning fluid or solvent, such as perchlorethylene, to each machine during the fabric-cleaning cycle, each machine having an overflow arrangement to expel the soiled solvent from the machine to a solvent storage base tank of the machine for flow of the solvent to a pump and then to a filter for removing soil and other impurities from the solvent and for recirculation of the cleaned solvent. The filtered solvent is supplied to each machine by a manifold providing a metered quantity of cleaning solvent to each machine with a proper solvent level or height being constantly maintained in the machines by the location of the solvent overflow pipe in the machine. This feature is important as each machine includes a fabric-containing basket rotatable about a horizontal axis and designed to permit the fabric to be picked up from the solvent, lifted above the solvent and dropped back a maximum distance into the solvent to provide the best flushing action of the solvent through the fabric and greater dispersion and elimination of the soil from the fabric.

Prior to describing the fluid supply system, reference is made to FIGS. 1 to 4, inclusive, illustrating machines I and II. As each of these machines are identical in construction and operation, it is believed the description of one of the machines (machine I) will be adequate to an understanding of each machine structure and operation. Identical structural parts of machine II are designated with the same numeral as machine I but with the suffix *a*. The structure of machine I is illustrated in FIGS. 5-17, and 25-28, inclusive, and referring first to FIGS. 5 and 6, the machine comprises a cabinet 10 receiving a cleaning fluid-containing receptacle in the form of an imperforate cylindrical casing or tub 11 having a front wall 12 and a rear wall 13. The tub 11 is supported by a suspension system of the inverted pendulum type generally indicated at A mounted on a base structure B, the suspension system A comprising pivots C and D attach-

ing the tub to the base structure B for operating movement of the tub, the pivots C and D being directly below the center line of the tub and being connected to the bottom of the tub by a pair of front and rear brackets, one of which is shown at E. Control springs (not shown) can be located on opposite sides of the tub, and these springs, in conjunction with an hydraulic damper assembly are effective to control the tub movement during rotation of a cylindrical fabric-containing basket or drum 18 at high speed with an unbalanced load of fabric, such as clothes, in the basket. The suspension system arrangement of the tub is more particularly shown and described in U.S. Patent 2,978,892, issued April 11, 1961. The front wall 12 of the tub 11 is provided with an access opening 14 and a corresponding opening 15 is in the cabinet 10. A flexible corrugated gasket 16 extends between and connects the annular portions of the front walls of the tub and cabinet defining two openings, and the cabinet is provided with a door 17 to close the opening in the tub.

The basket or drum 18 is disposed in the tub 11 for the reception of fabric to be cleaned and dried and the basket is supported by means of a spider 19, forming a portion of the rear wall of the drum, on a sleeve shaft 20 rotatably mounted on the rear wall 13 of the tube 11 for rotation of the drum 18. A pulley 21, fixedly secured to the shaft 20, is adapted to be rotated by a belt 22 in driven relation to a driving pulley 23 connected to the driven shaft of a two-speed transmission T driven by an electric motor M. Briefly described, the two-speed transmission is controlled by clutches, one of which is self-energizing and the other clutch is solenoid-controlled to provide low speed for slow rotation of the basket or high speed for rapidly rotating or spinning the basket. When the solenoid is deenergized, its clutch is ineffective and power flow is through the self-energizing clutch to provide low speed to tumble the basket during a portion of a cleaning operation and during the drying operation, and when the solenoid is energized, its clutch is operative and the self-energizing clutch becomes inoperative, so that the transmission is conditioned to provide a relatively high speed to rotate the basket, for example, during the extraction of the cleaning fluid from the fabric.

More particularly, and referring to FIGS. 7 and 8, the tub 11 has the radially inner edge of its rear wall 13 connected to two annular support housings 24, 24 by screws 25, the housings 24, 24 having radially inner ends overlapping and confining therebetween an outer race 26 of a ball bearing assembly, with the inner race 27 fixed to the sleeve shaft 20 for rotatably supporting the shaft 20. The front end of the shaft 20 is connected to a hub of the basket provided by the radially inner edge of the rear wall of the basket and two retaining rings 28, 28 connected by screws 29 so that rotation of the shaft 20, by pulley 21 keyed as at 30 to the rear end of the shaft, will rotate the basket.

A blower fan 32 is supported for rotation by the sleeve shaft 20 including a shaft 33 extending through and mounted on needle bearings between the shafts, the front end of the shaft 33 being connected to the hub 34 of the fan 32 by a bolt 35 threaded into the hub and engaging the shaft 33. The rearward end of the shaft 33 extends outwardly of the shaft 20 and receives the hub 36 of a pulley 37 for rotating the fan independently of the basket, the pulley hub 36 being connected to the shaft 33 by a bolt 38 threaded into the hub and engaging the shaft 33.

The basket and fan shaft mounting assemblies also comprise grease seals and thrust washers as clearly evident from an inspection of FIG. 8.

Referring now specifically to FIGS. 6 and 9 for the structure and operation of the drive mechanism including the transmission T, the transmission comprises an input sleeve shaft 40 having a pulley 41 connected by a belt 42 to a pulley 43 driven by the electric motor M. The shaft 40 has an input pinion 44 meshing with a gear 45 fixed

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to a countershaft 46. A gear 47 is rotatably supported on the countershaft 46 and may be coupled to the countershaft for rotation therewith by a self-energizing clutch spring 48 of well known type, surrounding the countershaft between gears 45 and 47. The countershaft gear 47 meshes with a gear 49 fixed to the output shaft 50. A clutch spring 51 surrounds the input shaft 40 and is positioned between the gear 49 and pinion 44, the clutch spring having a tab 52 at one end of its helically wound coil engageable with a plunger 53 actuated by a solenoid 54.

In operation, the basket may be slowly rotated to tumble the fabric in the cleaning fluid in the tub. As the solenoid is deenergized, its plunger 53 engages the tab 52 of the clutch spring 51 to prevent operation of the clutch spring 51 to couple the gear 49 and spring 51, and the hub of the gear 49 turns freely within the clutch spring 51. Power flow from the motor is transmitted to the pulley 41 and thereby input shaft 40 and input pinion 44. Pinion 44 rotates gear 45 on the countershaft and gear 49, keyed to the output shaft 50, to drive pulley 23 to rotate the basket at slow speed.

During the fluid-extraction period of the cleaning cycle, the basket rotates rapidly to centrifuge the fluid from the fabric. For this purpose, the solenoid 54 is energized to remove its plunger 53 from the tab 52 of the clutch spring 51 so that power flow will be from the input shaft 40, input pinion 44, and, as the clutch spring 51 is effective at this time to couple the input pinion 44 and gear 49, gear 49 will be rotated to drive the output shaft 50 to rotate the basket at high speed. It will be apparent, due to the sizes of the input pinion 44 and gears 45, 47, and 49, that the gear 49 will drive the gear 47 at such high speed that the clutch spring 48 will overrun to prevent power flow through the countershaft and gear 45 to the gear 44.

Referring to FIG. 5, the cylindrical wall of the basket 13 is perforated having a plurality of openings 55 therein. The basket front wall is provided with an opening 56 spaced from the access opening in the front wall 12 of the tub 11. An annular ring 57 is suitably attached to the front wall 12 of the tub 11, a second annular ring 58 is attached to the ring 57 and spaced therefrom by pins or rivets 59. The rear wall of the basket 13 is provided with a pocket P formed by the legs of the spider 19 merging with the cylindrical portion of the basket extending about the rotational axis of the basket, the pocket P having a plurality of openings 60 defined by the legs of the spider 19. The front of the basket 13 has a cylindrical flange 61 defining the opening 56, and the front wall 12 of the casing 11 has a pair of bearing rollers 62 secured thereto to support the front of the basket.

Air circulating means, in the form of the suction type blower fan 32, is rotatably mounted in a pocket P in the rear wall of the basket 13. The fan 32 has a plurality of curved blades and, as previously described, is driven by a belt and pulley arrangement, the pulley being indicated at 37 and the belt being indicated at 63 to be driven by the pulley 64 of the electric motor M. Referring to FIGS. 6 and 9A, operation of the fan is controlled by a clutch generally indicated at 65 and including a clutch spring, surrounding the motor drive shaft 66 and located within a housing 67, the spring having an end tab 68 seated within a recess in the housing, and the housing having an outwardly projecting finger 69 engageable with the end of a plunger 70 of a solenoid 71 so that, when the solenoid is energized to move its plunger from the spring tab 68, the clutch spring is effective to couple the pulley 64 to the drive shaft 66 to effect drive of the pulley, and thereby the fan, by the motor. The solenoid 71 is mounted on a bracket 72 fixed to the motor casing which is mounted on a plate secured to the tub,

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as shown in FIG. 6. The solenoid is energized to effect rotation of the fan during the drying operation.

In FIGS. 5 and 6, an annular heater assembly 73 is fixedly secured to the front wall 12 of the tub 11 and includes an aluminum body having embedded annular Calrod type heating coils 74 and 75 suitably connected to a supply of electric current controllable to energize one or the other, or both, heating coils of the heater assembly during the drying operation of the machine. During this drying operation, the basket is rotated slowly to tumble the fabric and the fan is effective to cause the heated air to circulate and flow between the tub and basket and around the basket and through the perforations in the basket to dry the clothes in the basket. The heated air is then drawn through a perforated plate 76 and lint screen S by the fan and through the pocket P of the basket and through the openings 60 defined by the spokes of the basket rear wall spider 19 and into the space between the basket and the rear wall 13 of the tub to be recirculated in the machine. As it is contemplated the machine will be used with a dry cleaning solvent, such as perchlorethylene, vaporizable during the drying operation, a condenser, generally indicated at 77, is positioned adjacent the lower portion of the wall 13 of the tub 11 for condensation of the solvent vapors produced by the drying operation. More particularly, the condenser 77 comprises a plate of arcuate configuration and having upper and lower connected passages 78 and 79 with the upper passage 78 being connected to a water inlet hose 80, the passages 78 and 79 of the condenser conducting the water to a hose 81 leading to a drain exteriorly of the machine. As seen in FIG. 5, the condenser is mounted on the inside of the rear wall 13 of the casing 11 by securing means 82. The hose 80 extends to a valve CV controlled by a solenoid CS which, when energized, opens the valve to permit cold water to enter and flow through the hose 80 into and through the condenser into the hose 81.

Referring now to FIGS. 1 and 6, the drum 11 has the upper portion of its rear wall provided with air shutters in the form of air inlet and exhaust poppet valves, generally indicated at 83 and 84, operative to permit air to enter the tub 11 through valve 83 so that all solvent vapors may be flushed and discharged from the machine through the valve 84 at the end of the drying cycle of the machine to be carried away by a ventilating system. The ventilating system includes an air intake opening in wall 13 of the tub 11, through which flow of air into the machine is controlled by valve 83, the air entering and mixing with the solvent vapors and the mixture then being discharged through the valve 84 into an air duct 85 and a plenum duct 86 and through an exhaust duct 87 into the atmosphere exterior of the building. The duct 86 has a blower 88, including an electric motor 89 and a fan 90, for causing air flow into and through the machine and into the ventilating system ducts. During operation of the blower fan, any vapor-laden air about the machine is also drawn through a scavenger duct 91 extending upwardly into the duct 86 for exhaust by the blower fan.

The poppet valves 83 and 84 are identical and, for this reason, a description of the structure and operation of only one of these valves (valve 84) will be made. The valve 84 is shown in detail in FIGS. 6, 25 and 26. This valve comprises valve body 109 having a plate portion 110 with an annular flange 111 fitting within an opening in the tub rear wall 13 and providing a seat for a flexible seal 112 to prevent air flow between the three spaced legs 113 of the valve body from the machine. The seal is normally held engaged with the flange 111 by an activating rod 114 slidably mounted within a sleeve 115 secured to the radially inner ends of the legs 113, the sleeve 115 having a surrounding spring 116 compressed between the seal 112 and the valve body. The rod 114 is connected to a link 117 which is connected to one end of a U-shaped lever 118 centrally pivoted at 119 at upstand-

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ing ears on a tubular extension collar 120, the other end of the lever 118 being connected to a spring 121 coupled to the plunger 122 of a solenoid 123 mounted on a bracket 124 fixed to the tub rear wall 13. The valve is shown in closed position in FIG. 25, the solenoid being energized at this time. Upon deenergization of solenoid 123 as shown in FIG. 26, the plunger 122 will move downwardly to cause spring 116 to expand to move seal 112 from the flange 111 to thereby permit air to flow from the tub 11 through the valve 84 and into the duct 85. When the solenoid is energized, the valve 84 will close, as shown in FIG. 25, as the link and lever arrangement will cause seal 112 to again seat against the flange 111, the spring 116 being compressed at this time.

Referring to FIGS. 1, 27 and 28, each of the machines I and II is also provided with a door lock mechanism having electrically-operated and controlled components effective to prevent the machine operator opening the door during operation of the machine. This safety factor is important to prevent solvent vapors entering the room, containing the machines, with possible injury to the operator during the cleaning and drying cycles of the machine operation, or in the event, the machines become inoperative due to a mechanical or electrical failure. More particularly, the door lock mechanical and electrical components are mounted on the rear of the front panel 125 of the cabinet 10 of the machine and comprise a door lock pin or latch 126 extending through and being slidably supported in a fixed guide plate 127 and a removable guide plate 128, the pin 126 being moved to the left in FIGS. 27 and 28 by a spring 129, surrounding the reduced end of the pin, the spring having one end engaged with a boss 130 on a flange 131 of the panel 125, and the other end of the spring engaging the pin to move the angular nose 132 of the pin 126 into the keeper 133 secured to the door 17. The keeper 133 comprises a U-shaped bracket 134 having a roller pin 135 rotatably supported by the ends of the arms of the bracket and engageably by the pin 126 to positively lock the door. The pin 126 is movable to the right, as viewed in FIGS. 27 and 28, by an activating bolt arm or lever 138 rotatably supported intermediate its ends by a pivot pin 139 positioned in a bracket 136, the arm 138 having its upper end received within a slot 140 in the latch and having its lower end provided with a slot 141 receiving a roll pin 142 secured to a plunger 143 of a solenoid 144. Energization of solenoid 144 is effective to rotate the lever 138 in a clockwise direction about pin 139 to cause the upper end of the lever to move the latch 126 from the keeper 133 and thereby to its door-unlocking position to permit opening of the door 17. Safety features are provided for insuring the inability of the operator unlocking and opening the door during machine operation or, in the event of failure of mechanical or electrical components of the machine during machine operation. More particularly, a bolt switch 145 having an actuating arm 146 engaging a laterally-extending tab 147 on the latch; a door release switch 148 actuated by a pushbutton 149 on the front of the machine by the operator; a lockout switch 150; and a door switch 151, all of these switches being arranged in electrical circuits to be later explained during the description of the operation of the electric circuit diagram of FIG. 29.

Referring now more particularly to the closed fluid supply system, machine I has its base structure B supported above and on a rectangular solvent storage tank indicated at 152, the tank including a top plate 153 enclosing the top of the tank and on which the machine is mounted by means of brackets 154, and bolt and nut securing and leveling devices, such as illustrated at 155. The flat bottoms of the tanks of machines I and II are positioned on a floor F that is smooth, flat, and level with no rise or drop in elevation from one end of the row of tanks to the opposite end for insuring the proper flow and correct distribution of the solvent to the tank assemblies

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as will be later described. Each tank extends rearwardly of its machine, as will be obvious from the drawings, and the top plate 153 of the tank is provided with a circular opening 156 for receiving a basket-type filter 157 formed of mesh wire screen and extending downwardly into the tank, the filter having its upper rim 158, defining the open top thereof, extending over and engaging the edge of the opening 156 of the top plate 153 of the tank to removably position the filter within the tank. A cylindrical header 159 (FIG. 10) is positioned on and may be welded to the top plate 153, the header having its bottom edge inwardly turned and extending beneath the rim 158 of the filter 157, the header also extending upwardly and having its upper end closed by a removable cover 160 having sufficient weight to insure tight sealing engagement with the upper end of the header to prevent the escape of solvent vapors from the tank and filter. The cover 160 is provided with a handle 161 for removal of the cover to permit access to the filter 157 which may be raised from its position within the tank and through the header for cleaning lint from the filter, as shown in dotted lines in FIG. 10. The header 159 is formed with a tubular portion 162 extending laterally thereof and provided with a reduced end portion for attachment to a tubular connector 163 having one end receiving a hose 164. As seen in FIGS. 5 and 10, the hose 164 extends along the top of the tank and upwardly for connection to a tubular extension 165 secured to the tub 11 and defining an opening within the cylindrical wall of the tub located a predetermined distance above the bottom of the tub for a purpose to be described more fully hereinafter.

As seen more particularly in FIGS. 11 and 12, the opposite sides of the tank have substantially large, tubular extensions 166 and 167, the tubular extension 167 providing a fluid inlet passage for solvent entering the tank and the tubular extension 166 providing a fluid outlet for the solvent from the tank. The tank has a central baffle 168 around which the solvent flows, as indicated by the arrows in FIGS. 11 and 12, and also a baffle 169 connected to the side wall of the tank adjacent the outlet tubular extension 166, the baffles being effective to prevent settling of impurities in the tank.

Referring to FIG. 5, there is a sump elbow 170 located in and connected to the bottom of the tub of the machine, the elbow 170 having a laterally extending tube receiving one end of a hose 171. The opening in the elbow 170 is covered by a screen 172 providing a pin and button trap.

Solvent is supplied to the tub of the machine through the hose 171 and, as the solvent enters the tub, the solvent rises to a predetermined level defined by the opening 165 in the side wall of the tub and through which the solvent overflows from the tub into the hose 164 and through the connector 163 and tubular extension 162 of the header 159 into the lint filter basket 157, lint being filtered from the solvent and the solvent then being added to and mixed with solvent circulating through the tank from the inlet opening of the tank, provided by the tubular extension 167 of the tank, to the outlet opening of the tank, provided by the tubular extension 166 of the tank.

Referring now more particularly to FIGS. 2, 3, and 4, the tubular fluid outlet extension 166 of the base tank of machine I is connected to a pipe 173 effective to direct the soiled solvent to a circulating pump 174, the pump causing the solvent to be forced under pressure through an open check valve 175 and a pipe 176 into the bottom of the filter 177. The filter 177 may employ screens covered with a filtering compound for filtering impurities from the solvent. The soiled solvent enters the filter 177, adjacent the bottom thereof, through the pipe 176, and filtered clean solvent flows from an outlet at the top of the filter into a pipe 178 which, as shown in FIGS. 3 and 4, is elevated above the top of the filter.

Referring now specifically to the filter construction and

operation as shown in FIGS. 19-24, inclusive, the filter 177 comprises a tank 180 of cylindrical construction having a head 181 closing the top of the tank and securely fastened to the tank by a plurality of bolts extending through annular flanges on the tank and head as shown in FIGS. 19 and 20. Between the flanges on the top edge of the tank and on the head, there is positioned a plate 182 supporting a plurality of spaced cylindrical tubes 183 connected thereto and suspended therefrom by having their upper ends provided with annular support members 184 (FIG. 21) threaded into openings in the plate 182, each tube having a gasket 185 positioned between and engaging the plate 182 and support member 184. Each tube 183 extends for substantially the height of the tank and is provided with perforations 186 throughout its entire length with the lower end of the tube being closed by a cap 187, each tube also being covered by a wire mesh screen 188.

A filtering agent, such as diatomaceous earth and activated charcoal, may be added to the solvent in the tanks of the machines and forms a coating 189 over the screen 188 to filter dirt and lint from the solvent. The tank is also provided with a ring-shaped manifold 190 disposed in the bottom thereof and having a tubular inlet 191 connected to the pipe 176 and through which soiled solvent is pumped into the manifold 190. The manifold 190 has a plurality of small openings 192 in the bottom thereof and facing toward the bottom of the tank so that the soiled solvent flows through the small openings in the manifold at high velocity to provide a scrubbing action of the bottom of the tank to insure the upward flow of the impurities in the solvent and tank and to prevent impurities settling on the bottom of the tank. However, the high velocity of the solvent is reduced substantially during upward flow in the tank and before entering the filter tubes so that the coatings on the tubes are not disturbed in their solvent filtering function assuring uniform and even distribution of the filtering agent on the filter tube screens. Due to this method of filtration it will be observed that the filtered solvent flowing from the filter tank, is only under slight pressure.

Due to the continuous filtering action of the system as will be described, the coating of the diatomaceous earth, activated charcoal, lint and dirt particles accumulates and can build up to a point at which restriction occurs to the flow of solvent through the coating and screen. This restriction can be determined by the increased operating pressure indicated on the pressure gauge 193 (FIG. 3). The normal operating pressures with filtered or clean solvent is slightly higher than the base pressure after it is charged with filtering agents. When the operating pressure increases to 10 p.s.i. above the base pressure, it is necessary to "drop" or "agitate" the accumulation of soil and lint built up on the filter screens to restore maximum filtration. For this purpose, the pump motor is deenergized, and referring to FIGS. 2 and 3, inlet valve 194 and outlet 3-way valve 195 are closed, bypass valve 196 is opened, and an air vent valve 197 is opened. The bypass valve controls flow of solvent from the filter to a bypass pipe BP extending into the tank 152 of machine I. Air under pressure is injected into the filter through the valve 198 (when the filter pressure gauge 193 is zero) and into the bottom opening 199 (FIG. 19) in the filter tank for 1/2 to 1 minute. Thereafter, air under pressure is injected, for about 1 minute, through valve 200 into a perforated tube 201 in the tank (FIG. 22), the tube substantially surrounding the manifold 190 and also having a triangularly shaped section within the manifold, the admitted air under pressure being effective to agitate or bubble the filter cake and soil loose from the filter screens of the tubes, as shown in FIG. 24. Thereafter, valve 194 is opened and the pump motor is energized. To determine when this cake-loosening action has occurred, the solvent may be viewed in sight glasses 202 and 203 (FIG. 3) to determine when the solvent is cleared. At this time,

valve 197 is closed, and valve 195 is opened and valve 196 is closed, quickly, to resume filter operation. When the dropping and agitating procedures are complete, a prescribed amount of activated carbon and diatomaceous earth is added to the system.

A sludge tank 204 is provided for backwashing the filter 177 to remove sludge, in the form of broken pieces of the cake of filtering agents and soil, from the filter. For this purpose, the sludge tank 204 is connected to the filter by a pipe 205 and valves 206 and 208 are opened to withdraw the sludge from the filter and, also, valve 207 is opened so that solvent is pumped through the filter to remove the accumulated sludge for flow of the sludge through pipe 205 into the sludge tank, valve 195 being closed at this time so solvent under full pump pressure is introduced into the sludge tank. The pump motor is then deenergized, valve 194 and valve 206 are closed, and bypass valve 196 and valve 197 are opened. Air is forced under pressure for about 1 minute through air valve 198. At this time, the filter pressure gauge should remain at zero, and a surge of black solvent should be seen in sight glass 202. The valve 200 is opened to inject air under pressure into the filter 177 for about 1 minute, when the bypass valve 196 is closed.

During the next backwashing step, the sludge tank inlet valve 206 and valve 207 are opened and valve 197 is closed. The valve 194 is then opened and the pump motor energized, the valve being throttled to obtain 10 p.s.i. on the gauge 193. The sight glass 203 is observed until clean solvent is indicated in about 1 minute and the backwashing operation is then continued for 5 minutes. Thereafter, the inlet valve 194 is gradually opened fully until sight glass 203 is reasonably clear.

The final backwashing step is performed by closing valve 206, deenergizing the pump motor, and closing valve 194. Air under pressure is then forced through air valve 209 for blowdown of the sludge tank until sight glass 203 no longer indicates significant solvent flow, when the air under pressure is removed from valve 209. The sludge tank outlet valve 207 is then closed.

At this time, it is necessary to precoat the screens of the filter tubes 183 with filtering agents. Accordingly, filter inlet valve 194, air valve 197, and bypass valve 196 are opened, and the pump motor is energized. Diatomaceous earth is then poured into the filter basket 159 of machine I. Air valve 197 is then opened to purge all air from the filter tank, and the valve 197 is then closed, to insure even distribution of the filtering agents over the entire area of the filter screens. When the sight glasses 202 and 203 are clear, the filter screens are precoated with the filtering agents. At this time, a mixture of activated carbon and diatomaceous earth and solvent is poured into the basket 159. The pump continues to operate for a predetermined time to allow the filtering agents to deposit on the filter screens. When the sight glass 202 is clear, valve 195 is opened and valve 196 is closed to complete the backwash and recharging operation.

Proceeding further with the description of the fluid supply system, it will be seen from FIGS. 2, 3, and 4, solvent flows from the filter 177 into the pipe 178 which extends downwardly through a water-cooled heat exchanger 210 and thereafter turns at a right angle in a horizontal plane for delivery of solvent to the horizontal pipe 211 connected to a horizontal manifold pipe 213. An inverted U-shaped assembly 212 includes a horizontal pipe 214 and two vertical pipes 215 and 216, the pipe 213 being connected to pipe 211. The pipe 215 functions as a standpipe and is connected to pipe 213 and the solvent is forced upwardly through pipe 215 and flows into pipe 214 and then downwardly into the overflow pipe 216, pipe 216 terminating in a pipe 217 positioned in a horizontal plane below that of pipe 213. The pipe 217 has its outlet end connected to the inlet tubular extension 167a of the side wall of the solvent storage base tank 152a of machine II so that the filtered solvent flows into and

through the base tank of machine II, as shown in FIGS. 2, 3, and 4, for mixture with the soiled solvent entering the tank from the overflow hose and the lint filter basket of machine II when machine II is in operation, the solvent then flowing through a pipe 218 connecting outlet tubular extension 166a with the inlet tubular extension 167 of base tank 152 of machine I for mixture with the soiled solvent overflowing the tub of machine I and for flow therethrough and the outlet tubular extension of tank 152 into the pipe 173 to the pump for recirculation through the filter, the assembly 212, and the storage base tanks of machines I and II. A vacuum breaker hose 219 is connected to the top of pipe 214 and also to the headers 159 and 159a of the storage tanks 152 and 152a as shown in FIGS. 2 and 3.

It will be apparent from this description that a substantially large volume of filtered clean solvent flows from the filter and heat exchanger through the manifold pipe 213 and pipes of the U-shaped assembly 212 to effectively mix with the relatively small volume of soiled solvent in the base tanks 152 and 152a of machines I and II during the cleaning operation. The mixture of soiled and clean solvent then flows through the pipe 173 into the suction side of the circulating pump 174 for movement under pressure by the pump into the filter, the clean solvent then being again returned to the base tanks, to thereby insure a continuous circulation of the solvent in a manner providing a constant supply of clean filtered solvent to the machines.

A feature of the fluid supply system is that, after the clean solvent flows out of the upper end of the filter 177 and the heat exchanger 210, the solvent flows, by gravity, through the pipe 211 and through pipes 213, 215, 214, 216, and 217 into the base tank of machine II. More particularly, this advantageous feature contemplates that the pump 174 forces the soiled solvent into the filter 177 under pressure to filter the solvent, the cleaned solvent being raised to an elevated position for flow out of the top of the filter. As the solvent in the filter is only under pressure, the solvent thereafter flows from the filter and into the manifold pipe 213 and pipes of the assembly 212 by gravity and into the base tank of machine II and thence into the base tank of machine I, the solvent continuing to flow by gravity into the machines and flowing out of the machines and back to the pump. It is emphasized that this improved fluid supply system contemplates that none of the fluid lines leading to or from the machines are under pressure from the pump. It is not necessary to mount the machines on a slope or to incline the pipes. The "slope" is in the solvent that causes it to flow by gravity. Due to the employment of the gravity flow of solvent through pipe 211 and the manifold pipe 213, standpipe 215, pipe 214, and overflow pipe 216, this gravity flow system not only allows metered solvent supply feed selectively to each machine, but provides a balanced feed to one or more machines so that they receive equal amounts of solvent. In effect, the gravity flow of the solvent (the "slope" of the solvent causing the flow) through the machines is based on the concept that any fluid will seek to find its own level and once that level has been established, the fluid flowing, for example, into machine II has a level deeper than that of the level of the fluid in machine I causing the flow of the fluid by gravity through the machines and back to the circulating pump. The function of the standpipe 215 is to provide a pressure, caused by an active head of solvent, for feeding solvent by gravity into the tanks and tubs of the dry cleaning machines I and II.

Solvent is fed into the tub of each machine by the manifold pipe 213 which, as shown in FIGS. 2, 3, and 4, is provided with downwardly extending tubular portions 220 and 220a connected respectively to hoses 221 and 221a which are connected to identical diverter valve assemblies 222 and 222a. Each diverter valve assembly comprises three valves, respectively identified at 223, 224,

and 225 in FIG. 13 of similar construction but having different control functions during cleaning and drying cycles of its machine. To describe the structure of each valve assembly, reference is made to valve assembly 222, and its valves 223, 224, and 225, shown in FIGS. 13 and 17. For a description of one of the valves 223, 224, and 225, reference is made to FIGS. 14, 15, and 16. More particularly, the valve 225 functions to direct solvent from the hose 221 into and through the valve assembly 222 and into the hose 171 and the tubular extension 170 of machine I, the solvent flowing into the machine until it reaches a level equal to the height of the overflow opening 165 in the tub of the machine for flow therefrom into the hose 164 and into the filter basket and storage base tank.

The introduction of air, at substantially atmospheric pressure, into the stand pipe 215 through the hose 219 causes a liquid-air interface in the overflow pipes 214 and 216 that establishes the level of the solvent at the overflow point. The head of solvent feeding the machines is the distance from the liquid-air interface to the fluid inlet valves 225 of the valve assembly 222 and/or the valve assembly 222a. The head is substantially the same throughout the manifold pipe 213; however, the head is slightly higher at the filter end of the manifold pipe. This slight variation in head represents the amount of pressure drop through the manifold pipe due to its inherent internal restriction. The head in the solvent manifold pipe 213 can be referred to as the apparent depth of the solvent in the pipe, the variation in the head at different points in the manifold pipe represents the "slope" of the fluid that causes the flow through the pipe.

All of the fluid in the system is under continuous flow at all times due to the pumping capacity of the filter pump 174. The base tanks 152 and 152a, interconnected by the connecting conduit 218, represent an extension of the flow paths or pipes of the manifold and overflow arrangement. Removal of a quantity of fluid from the manifold pipe 213 represents removal of fluid from the base tanks 152 and 152a since both the pipe 213 and the base tanks are in the same flow path. When a quantity of solvent is removed from the manifold base tank portion of the fluid circuit and introduced into the tub of the machine, an equal quantity of air must be moved from the tub of the machine through the overflow pipe 164 past the check valve CV into the base tank 152 to maintain substantially atmospheric pressure throughout the system.

The gravity flow standpipe and fixed head feed arrangement has three primary advantages. First, since all portions of the manifold pipe 213 are under approximately the same head when the fill valves 225 of the valve assembly 222 and/or the valve assembly 222a open allowing fluid to flow from the manifold pipe into either or both of the machines I and II, the fixed head in the manifold pipe combined with the inherent internal restrictions of the fill hose, fill valve and flow path into either or both of the machines gives a metered flow of fluid for cleaning. This condition is maintained as long as solvent supply exceeds solvent demand and the surplus fluid of supply, exceeding demand, flows over the overflow pipe 216. At any time the supply exceeds the demand, there is no surplus fluid flowing over the stand pipe 215 into the overflow pipe 216 and the amount of fluid available is proportioned equally among the machines calling for fluid. An additional feature is that the rate of flow of the fluid supply may be less than that required for the number of machines connected to the fluid supply, allowing more economical use of cleaning machines in relation to the size of the filtration apparatus. For instance, the filter may be partially clogged with soil and only 30 gallons of fluid are available and flowing through the manifold pipe. Assuming eight machines are employed in the dry cleaning system and three machines are energized and call for fluid, each machine receives approximately 9 gallons per min-

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ute of fluid for cleaning the garments. The surplus fluid flows over the stand pipe into the overflow pipe to the base tanks of the machines. When the fourth machine is energized, no surplus fluid may flow over the stand pipe into the overflow pipe, the head in the standpipe falls and the contacts of a solvent level switch 267 close to energize "Do Not Use" lamps 266 on the backguards of any machines not in use. The 30 gallons per minute of available fluid or solvent supply is equally proportioned among the four machines energized resulting in 7½ gallons per minute to each machine. As soon as one of the four machines stops calling for fluid, a surplus of fluid supply exceeding demand will exist and fluid will flow over the stand pipe into the overflow pipe thereby opening the contacts of the solvent level switch and deenergizing the "Do Not Use" lamps on the machines, alerting the customer that the condition of fluid supply exceeds fluid demand and allowing another machine to be energized.

The solvent level switch device is shown in FIG. 4A and comprises a pipe 307 extending upwardly of pipe 213 and in fluid communication therewith and having its upper end projecting into and positioned within a casing 267a. It will be noted that the fluid level in the pipe 307 reflects any variations in the fluid level in the standpipe 215 continuously and proportionately. During static or changing levels of fluid in the pipe 307, contacts 267d and 267e of switch 267 may or may not be closed depending on the level of the fluid in pipe 307. In the event the level of the fluid in the pipe 307 is as shown in FIG. 4A, it will be seen that the switch contacts 267d and 267e are closed. The contacts 267e are fixed to the casing and have conductors C15 and C58 connected thereto, as shown in FIG. 29. The contacts 267d are fixed to a rod 267c which is connected to a cylindrical block 267b of aluminum guidingly movable vertically within the pipe 307 in response to the level of the fluid in this pipe and as also controlled by a tension spring 267f extending between and connected to the top wall of the casing 267a and contact 267d. More particularly, when the block 267b is above the low level of the fluid in pipe 307 and suspended by spring 267f, contacts 267d and 267e are closed. As the fluid level rises in pipe 307 and the block is immersed in the fluid, the block will be moved upwardly by the tension spring 267f to open contacts 267d and 267e. It will be apparent that this occurs due to the physical phenomena of the change in density of the fluid and air mediums causing the fluid to exert an upward force or buoyancy on a body immersed or submerged in the fluid to thereby permit upward movement of the block by the spring to open the contacts of switch.

It will be apparent that the dynamic condition of solvent fluid flow through the manifold standpipe and overflow pipe, the injection of air through the vent hose 219, and the establishment of the liquid-air interface, determine the level of the solvent fluid in the manifold pipe can be compared to an elevated storage tank open to atmospheric pressure which always has a liquid interface that would establish the level of the solvent. The injection of air at substantially atmospheric pressure through the hose 219 into the stand pipe 215 and overflow pipe 214 results in a liquid-air interface under dynamic conditions that forms a static head the same height in the manifold. If a manometer were connected to the solvent manifold pipe 213, it would indicate a head or effective solvent fluid depth approximately equal to the center line of the pipe 214, and depending upon the solvent manifold pipe length, this head or effective depth would increase at points in the manifold pipe farther from the standpipe 215 to the filter end of the manifold pipe. For example; using a three inch diameter manifold pipe, which provides inherently low internal resistance to the flow of 55 gallons per minute, the head was found to be two inches more 20 feet away from the

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manifold pipe than adjacent to the standpipe. This slight variation in head at different positions in the manifold pipe does not significantly affect the metering and flow rate into the machines.

An additional feature of the solvent manifold and solvent fluid flow system is the venting system. In general, each component is vented to the next component but at no place in the closed re-circulating system is the unit intentionally vented to atmosphere. The solvent fluid standpipe 215 is vented by the hose 219 to the lint basket header 159a of the adjacent machine. In addition, this lint basket header is vented to the next adjacent lint basket header 159. Each lint basket header is vented to its base tank through a hole AH (FIG. 10) in the lint basket. When a volume of solvent fluid is withdrawn from the manifold 213 and introduced into the tub of the machine, it results in a drop in the solvent fluid level in a base tank and, since both are part of the same flow circuit, an equal volume of air is moved from the tub of the machine through the overflow pipe 164 past the check valve CV into the base tank 152. Accordingly, this air, carried into the base tank, replaces the volume of solvent fluid withdrawn from the base tank. For each volume of liquid moved out of the flow path from one place in the system to another, an equal volume of air is moved in the opposite direction. As a result, this system remains vapor-tight and no outside air is intentionally introduced into the system and no vapor-laden air is intentionally expelled from the system during operation of the machines. In preventing the expulsion of vapor-laden air from the machines, economical solvent fluid usage results. When a volume of fluid is introduced into the cleaning machine, an equal volume of air is expelled from the cleaning machine through the overflow pipe 164 and past the check valve CV into the lint trap header 159 through the hose 219 into the stand pipe 215 and into the base tank 152 to replace the volume of liquid removed from the base tank. When a volume of liquid is drained from the cleaning machine through the drain line 171, an equal volume of air is introduced around the check valve CV through the vent hose 271. This air is removed from the base tank 152 through the hole AH and into the lint trap 159, through the vent valve 272, through the vent hose 271, into the overflow hose 164 and into the tub of the machine.

Additional advantages inherent in this system are:

The pressures in the fill system are very low, as they are caused only by the "head" of the fluid in the standpipe. Typical is a little over 1 p.s.i. (17" head=1 p.s.i.).

The system allows metered feed due to the fixed head and fixed restriction.

The pressures are low enough to allow the use of thin wall non-reinforced rubber tubing for solvent lines.

The pressures are low enough so that recognizing agencies controlling hazards, pressure vessels, etc. do not recognize this "head" as a pressure of significance.

Leaks are at a minimum in the fill system.

The system will equally divide available solvent between machines demanding when demand exceeds supply.

The connections allow any surplus of supply over demand, particularly when there is no demand, to sweep all of the base tanks of insoluble soil particles.

There is no valve functioning in the fill system during filtration that could become clogged and fail that could cause a pressure in the fill system.

If the overflow line carrying solvent from the machine during fill should become clogged, the gravity feed will not pressurize the cleaning machine nor cause it to fill beyond the head feeding the machine.

Referring to the valve assembly 222 in detail, the flow of the solvent through the valve assembly 222 is diagrammatically shown in FIG. 17 in which, briefly described, the fluid enters the assembly through the hose 221 and flows through the valve 225 into a common passage 226 through the valve assembly for all of the valves of the

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assembly, valves 224 and 223, at this time, being ineffective to divert the solvent from the passage. Accordingly, as the valve 224 is open, the solvent passes therethrough and into and through the passage 226 to flow outwardly of the valve assembly and into and through the hose 171 into the tub of the machine during the fill and cleaning cycle of the machine. This flow of the solvent is diagrammatically illustrated in FIG. 17. During the drain and extraction periods of the cleaning cycle of the machine, the valves 225 and 223 are closed and the valve 224 is open so that the solvent flows from the tub sump and through hose 171 into the passage 226 of the valve assembly and through valve 224 into the hose 252, connected to the header 159, for flow of the solvent into the storage base tank. During the drying cycle, the valve 223 is open and the valves 224 and 225 are closed. The solvent vapors are condensed by the condenser 77 into liquid solvent which drains from the hose 171 into the passage 226 to flow through open valve 223 into hose 253 connected to a solvent and water separator 254. A more complete description will be later given.

As each of the valves are identical in structure, it is believed that an explanation of one of these valves will be sufficient and, for this purpose, referring to FIGS. 14, 15, and 16, it will be seen that, for example, the valve 224 is provided with a passage therethrough, forming a portion of the common passage 226 of the valve assembly, and including tube-like extensions 227, 227 extending laterally from the valve body 228 and providing passages through hoses 229 and 230 for solvent between the valve 224 and the valves 225 and 223. The tubular extensions 227, 227, of the valve 224 provide fluid connections to an interior valve chamber 231 of the valve body 228 through which the solvent flows, the chamber having a wall 232 providing a partition between the chamber and a tubular extension 233 disposed at a right angle to the passage through the valve. The wall 232 is provided with an opening 234 adapted to permit solvent to be diverted and flow from the main chamber 231 into the tubular extension 233 and from the valve, upon pivotal movement of a flexible seal or closure member 235 adapted to engage the peripheral edge of the opening 234 to prevent passage of solvent from the chamber into the tubular extension 233 of the valve body. More particularly, the valve closure member 235 is connected by a pin 236 to a lever arm 237 connected to a pivot pin 238 mounted in opposite facing walls of the valve body, the pivot pin having one end projecting outwardly of the valve body and being rotatable by a lever arm 239 projecting upwardly therefrom and having a lost motion connection to lever arm 240 by virtue of a slot 241 in arm 239 receiving a pin 242 fixed to a lever arm 240 pivotally connected to the valve body by a fixed pin 243 between the opposite ends of the lever 240. A pin 244 is secured to the lever arm 240 and one end of a coil spring 245 is connected to the pin 244 with its other end positioned on a pin 246 fixed to a U-shaped frame 247 secured to the top of the valve body and to the tank top 153. The spring 245 normally causes the lever arms 240 and 239 to urge the pivot pin 238 and thereby the lever arm 237 to the position shown in FIGS. 15 and 16 so that the valve closure member 235 is normally effective to prevent the passage of solvent through the opening 234 from the chamber 231 into the tubular extension 233 of the valve body. To open the valve 224, pin 244 of the lever 240 is connected to the plunger 248 forming a portion of the core of a solenoid 249 mounted on the frame 247 and having a winding adapted to be energized to cause the plunger to move to the left, as viewed in FIG. 14, for rotating lever arm 240 in a clockwise direction, and through the lost motion connection 241—242, rotating pivot pin 238 in a counter-clockwise direction, as seen in FIG. 16, to disengage the closure member 235 from the peripheral edge of the opening 234 in the wall 232 of the valve body to permit fluid to flow into and out of the tubular extension 233 of the

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valve body. The comparable solenoids of the valves 223 and 225 are identified at 250 and 251 in FIG. 13.

Referring now to FIGS. 13 and 17, it will be assumed that the tub of machine I is empty of solvent and that solvent is continuously flowing through the manifold pipe 213, the standpipe 215, and overflow pipes 214 and 216 into and through the storage tanks of the machines. As the solenoid 250 of the valve 225 is deenergized, the solvent will not flow from the hose 221 into machine I. To permit the solvent from the manifold pipe to enter the hose and the machine, the solenoid 250 of valve 225 is energized to open the valve. At this time, it may be noted that the valve 225 has one of its two oppositely disposed tubular extensions plugged, and also its closure member is open so that solvent entering the hose 221 flows through the valve body and the other open tubular extension toward and into the valve 224. As the solenoids 248 and 250 of valves 224 and 223 are deenergized, the solvent flows through the aligned tube-like extensions of the valves and chambers of the valves and through hose 171 into the tub of the machine.

Accordingly, from the description of the operation of the diverter valve assembly, it will be apparent that the solvent may flow from the manifold pipe to either or both of the machines, depending upon the selective opening or closure operation of the valves 225 and 225a of their valve assemblies 222 and 222a as desired by the operator of the dry cleaning system. After the clothes are cleaned by the solvent for a predetermined time period, and assuming machine I is only in use, the tub of machine I may be drained by closing the valve 225 and opening the valve 224 while maintaining the valve 223 closed, the solvent then drains from the tub of the machine through the hose 171, chamber of valve 223 and, as the closure member of valve 224 is now open, the solvent is diverted into and passes through its lateral tubular extension 233 into a hose 252 extending through one side of the header 159 and into the filter basket and the storage base tank, as shown in FIGS. 10 and 13, for circulation by the pump to the filter 177.

The present dry cleaning system is adapted also to dry the clothes and, for this purpose is provided with the heater assembly 73 and fan 32, shown in FIG. 5, to cause the heated air to be circulated throughout the dryer for drying the cleaned clothes. During this time, cooling water may be circulated through condenser 77 to condense the vaporized solvent, the solvent flowing down the walls of the tub and into the hose 171. At this time, the valve 225 and the valve 224 are closed and the solenoid 251 of valve 223 is energized to open its closure member, so that the condensed solvent flows through the hose 171 into the valve 223 and flows through its lateral tubular extension into a hose 253 connected to a solvent-water separator 254 shown in FIG. 18. As the condensed vapor solvent may also contain a small portion of water, it is desirable that the water be extracted from the solvent prior to return of the solvent to the fluid supply system. For this purpose, the water and solvent mixture enters the hose 253 and passes into the water separator through an opening 255 in the cylindrical body 256 of the separator, the mixture flowing through a tubular screen strainer 257 and through an opening 258 in an interior wall of the tubular body 256 of the water separator, the water and solvent stratifying in the chamber 259 with the water rising upwardly through an opening 261 in the wall and into a chamber 262 and through an opening in the tubular body for disposal to a drain while the solvent rises upwardly through a passage 260 and into a hose 263 (FIGS. 2, 10, and 13) connected to the header 159 of the tank 152 for passage of the solvent into the lint basket and thence into the storage tank 152 of the machine.

It will be apparent that the solvent manifold pipe and standpipe function to evenly distribute clean filtered solvent through the supply lines connected to the respective

machines, the manifold pipe supplying a metered quantity of cleaning solvent to each machine. In a typical installation, the solvent circulating self-priming pump is capable of circulating approximately 55 gallons per minute, the check valve 175 installed in the pump discharge line preventing drainage back to the storage space tanks of the machines and possible overflow in cases where pump or power failure occurs. Accordingly, it will be seen that during the cleaning or washing cycle of the machine, the fabric-containing basket will rotate to cause immersion and tumbling of the fabric in the predetermined quantity of solvent in the basket as controlled by the overflow hose of its machine, the basket rotation causing the fabric, such as clothes, to be lifted up and then dropped back into the solvent to insure proper cleaning of the clothes. During this time, the suction side of the pump is connected to the pipe 173 to draw the solvent at a rate of 55 gallons per minute, from the storage base tank of machine I, the pump then causing the solvent to flow under pressure into the filter 177. The solvent flows through the filter for removal of the soil and lint, the clean solvent flowing from the top of the filter and through the pipe 178 to the water-cooled heat exchanger 210. The solvent flows downwardly through the heat exchanger, and, as it has little or no pressure supplied by the pump, the solvent continues to flow at a rate of 55 gallons per minute by gravity to the fill hose 221 of the machine I and also to the fill hose 221a of machine II, assuming both of the diverter valve assemblies of these machines are controlled to permit this solvent flow from the manifold pipe 213 into the machines. The fill hoses may contain fixed orifices so that the solvent is supplied at a metered rate of 9 gallons per minute to each of the machines. As the solvent continues to flow through the pipe 213, the solvent flow drops to 46 gallons per minute prior to its entering the pipe 215 for flow through the pipes 214 and 216 into the storage base tank of machine II for circulation through the base tank and mixture with the soiled solvent entering the base tank from the overflow pipe of machine II. The mixture of clean and soiled solvent then passes into the storage base tank of the machine I and mixes with the soiled solvent entering the base tank of machine I from its overflow pipe and thence through the discharge pipe 173 to the pump. As the solvent entering into each machine flows at the rate of 9 gallons per minute, this rate will be maintained during the flow of the solvent through the diverter valve assemblies, the fill hoses, and into the machines and through the overflow pipes or hoses into the base tanks of the machines.

It will be apparent that, after the solvent flows from the filter, the solvent flows by gravity throughout the entire dry cleaning system with a head being maintained by the fluid in the standpipe 215 which controls the level or head of the solvent for feeding the solvent under pressure into the tubs of the dry cleaning machines and also through the base tanks of the machines. After leaving the tubs of the dry cleaning machines, the solvent flows, by gravity, into the lint baskets and then into the storage base tanks, the base tank 152 of machine I being connected to the intake suction line of the pump. This important feature is made possible by the filter assembly being only under pressure, the solvent flow thereafter being entirely by gravity. This feature not only allows a metered supply of clean solvent to a machine or machines but also provides a balanced feed to a number of machines so that they receive equal quantities of solvent. The standpipe 215 further functions to provide a head or effective depth of solvent throughout the machines so that the solvent leaving the manifold pipe 213 and flowing through the pipes 215, 214, and 216 will provide an effective pressure to cause the flow of the solvent through the tanks by gravity, the solvent depth in the base tank of machine II being greater than the depth of the solvent in machine I

for continually effecting the flow of the fluid through machines II and I. It will be apparent that, in addition to the fluid supply system providing cleaning solvent to each machine, it is also effective to provide a continual large supply of clean solvent flow through the machines for mixture with the relatively small amount of soiled solvent so that this continual flow of the solvent insures a solvent filtering system, consisting of the storage base tanks, circulating pump, filter, heat exchanger, and connecting piping providing a constant flow of clean, filtered solvent at the proper temperature to the dry cleaning machines at all times during operation. During the wash cycle, the garments are constantly washed in filtered solvent at a rate of nine gallons per minute for the machine. As the filter employs certain filter means, such as diatomaceous earth and activated carbon, to perform its function of removing dirt, lint, and foreign matter from the solvent, the soiled solvent is continuously filtered. In operation of the filtering system, the circulating pump draws dirty solvent from the storage base tank of machine I and forces it into the inlet of the filter. The solvent is forced upwardly in the filter passing through the filter which collects the soil and the filtered solvent returns to the manifold pipe.

In view of the foregoing, it will be apparent that the new and improved dry cleaning system is characterized by the constant flow of clean solvent from the filter to and through piping arranged for providing a continual circulation of clean solvent through one or more storage base tanks of dry cleaning machines by gravitational flow of the fluid while insuring a metered quantity of the solvent is supplied to each machine for its proper cleaning function and in such quantities that a constant flow of the solvent and removal of the soiled solvent from the machine or machines for proper cleaning of the clothing is obtained. This feature is of considerable importance in avoiding the necessity of providing a pump for supplying fluid under pressure to the dry cleaning machine or machines, which pressure is difficult to control due to variations in pump pressures because of restrictions occurring in the pipes to and from the machine or machines induced by the soiled solvent, and other factors, preventing proper cleaning of the clothes. In the system of the present invention, the solvent flow is maintained at a constant rate due to the natural gravitational effect on the flow provided by the piping arrangement functioning in a manner insuring a proper and desired predetermined solvent flow under the same head or pressure in one or more machines throughout the cleaning operation, thus providing for the correct operation of the dry cleaning machine or machines in performing their clothes-cleaning function. As the soiled solvent is continually added to and mixed with the cleaning solvent flowing through the storage base tank or tanks in a substantially lesser quantity than the clean solvent flowing through the tank or tanks, the soil may be readily removed from the solvent flow by the filter and without any possibility of clogging or other malfunctioning of the dry cleaning system. In practice, as many as eight machines may be serially connected with the fluid supply system and have functioned properly in dry cleaning fabrics.

The heat exchanger on the filter discharge line provides cooling of the solvent and maintains the solvent at temperatures between 75° F. to 85° F. for best cleaning results. It is, of course, necessary that the water-cooled heat exchanger does not exceed 70° F.

Warning indicators are embodied in the fluid supply system to inform the operator in case of an undesirable temperature of the solvent or an inadequate supply of the solvent and, for this purpose, the pipe 213, adjacent to its connection to the pipe 215, is supplied with a temperature control alarm 264 (FIGS. 2 and 3) having a thermostatic switch 265 (FIG. 29) that closes, in the event the temperature should rise, for example, above 90° F. and opens if the temperature falls below 85° F., during solvent circulation in the described closed fluid circuit,

to close an electrical circuit for lighting the indicator lamps 266 in the backguard of the machine (see FIG. 1) to inform the operator of this undesirable temperature condition of the solvent, upon completion of the cleaning and drying operations. In addition, the pipe 213 is provided with the previously described solvent low level alarm 267 having a switch 268 (FIG. 29) actuable by a pressure sensing device effective to open single pole, single throw contacts of the switch when the solvent head is maintained at fifteen inches but, when the solvent head becomes 12 inches, causes the contacts to close to supply electrical current to the lamps 266 at the completion of the cleaning and drying operations. The solvent level alarm switch and temperature control alarm switch are placed in parallel in an electrical circuit having a cam-controlled switch closable at the end of the cleaning and drying operations, so that when either warning indicator switch is closed, a circuit is established to the indicator lamps notifying the operator of the machine or machines that the solvent temperature is incorrect, or the solvent level head is so low, that a proper cleaning of the clothing in the machines may not occur. The indicator lamps 266 are disposed in the backguard BG of the machine (FIG. 1) behind red glass, above the legend "Do Not Use" on the face of the backguard of the machine to clearly indicate this undesirable condition or conditions of the solvent.

Referring to FIGS. 2 and 3, another safety feature is the condenser water control arrangement for the heat exchanger 210 provided by a water pressure switch WPS (FIG. 2) which is installed in the water line or pipe WL and ahead of a thermostatically-controlled water regulating valve TWV in the pipe, the pipe conducting cooling water to the heat exchanger. The switch 269 is provided with contacts in an electrical control circuit for the clothes-loading door lock arrangement shown in FIGS. 27 and 28 and functions to prevent opening of the door in the event water pressure is inadequate. The pressure switch operates between 0-125 p.s.i. and its contacts will open the electrical door lock circuit to prevent energization of the solenoid 144 to open the door when the water pressure falls below 5 p.s.i. In cases where this water pressure drop occurs, a manual reset button (not shown) will trip to open the circuit. To re-close the switch contacts, after the water pressure drop has been corrected, the switch is manually re-set by pressing a re-set lever (not shown).

With reference to the thermostatic water valve TWV, this valve functions to supply proper water temperatures to the heat exchanger. The valve TWV operates from a thermostatic sensing bulb immersed in the discharge line carrying the cleaning solvent. The valve is designed to close at 75° F. and to be fully open at 85° F. It is important that solvent temperatures are maintained between 75° and 85° F. as temperatures have a direct effect upon the efficiency and dry cleaning properties of the cleaning solvent. The solvent has its own independent effect in wrinkling, shrinking, color loss, etc. Also, it is a critical factor in the amount of moisture the solvent will hold safely. Maintenance of the solvent temperature below 90° F. is important to prevent wrinkling clothes and extracting dyes from clothes; also solvent below 70° F. will fail to penetrate deeply or thoroughly into the fabric and results in poor cleaning qualities and wrinkling. A more complete and specific description of these controls will be later provided in an explanation of the electric circuit diagram of FIG. 29.

As previously described, the sludge tank 204 receives a mixture of solvent and soil, and other foreign material, when the filter 177 is backwashed, during the above described separate operation, and is effective to eliminate the broken cake of filtering agents, soil, lint and foreign matter from the filter, the mixture flowing from the bottom of the filter into the sludge tank by closing and opening certain previously described valves. The

pump is hereby effective to cause the mixture to flow into the sludge tank for backwashing the filter tank. The pipe BP provides a by-pass line permitting circulation of the solvent by the pump to backwash the filter to remove soil and other foreign matter from the mixture entering the sludge tank and the clean solvent flows to the storage base tank of machine I and into the pump. It may be noted from an inspection of FIG. 4 that the bypass pipe BP is the only pipe of the fluid supply system that is inclined with respect to a horizontal or vertical plane, all of the other pipes being disposed in truly horizontal or vertical planes.

In this dry cleaning system, each machine may be operated independently of the other machine and, for this purpose, each machine is provided with an electrical control system shown in FIG. 29, and including a sequential controller or timer arrangement, for operation of the machine through a cleaning cycle, a drain cycle, and a drying and reclaiming cycle. Briefly described, in the initiation of the cleaning cycle, and after the clothes have been deposited in the basket of machine I, for example, the solenoid 250 of valve 225 is energized to open the valve to allow solvent flow through the valve assembly into the hose 171 for entry into the tub of the machine and for overflow through the pipe 164 into the filter basket and the storage base tank for mixture with the solvent flowing through the tank and circulation to the filter and to the machine. During this time, the basket is slowly rotated to tumble the clothes in the basket for cleaning the clothes in the solvent in the tub. After a specific time has elapsed, the solenoid 250 of the valve 225 is deenergized and the solenoid 249 of valve 224 is energized to open the valve to divert solvent flowing from the machine through the hose 171 into the drain hose 252 and into the lint filter basket and the storage base tank of the machine. After a predetermined time, the basket is rotated rapidly to extract the solvent from the clothing in the basket and to drain the solvent from the machine through open valve 224 into the base tank of the machine. After the drain cycle of the machine, the heater assembly 73 is energized to provide heated air which is circulated by the fan 32 through the basket to dry the clothes. Due to the circulated heated air, any solvent or water, remaining in the clothes and in the machine, vaporizes and is condensed by the condenser 77 into liquid form. At this time, the solenoid 251 of the valve 223 is energized so that the drops of the condensed water and solvent mixture drips from the machine through the hose 171 into the valve 223 and then into hose 253 and separator 254. It will be noted from an inspection of FIGS. 14, 15, and 16 that the body of each valve is provided with a well 228' and that the tubular extension 233 is at a lower level than the tubular extensions 227 of the valve. Accordingly, drops of solvent and water entering the well of the valve 223, through the hose 171 and one of the extensions 227, will flow from the well into the tubular extension 233 and hose 253 into the separator 254. This feature prevents drops of the solvent and water mixture entering one of the tubular extensions 227, from flowing through the valve chamber and the other tubular extension 227 of valve 224 into the valve 224 and into the drain hose 252. The separator is effective to stratify the solvent and water mixture, as shown in FIG. 18, so that the solvent flows from the separator to the hose 263 into the lint filter basket and the storage base tank of the machine.

After the drying operation, the solvent-vapor laden air is exhausted from the machine through duct 85 to the atmosphere exteriorly of the building housing the dry cleaning system, as shown in FIG. 1, the flow of air into the machine being controlled by the solenoid-operated poppet valves 83 and 84, valve 83 being effective to admit air surrounding the machines into the machines and valve 84 operating to permit the flow of the solvent vapor-laden air in the machine into the duct 85. After

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a sufficient time has elapsed, the machine operation will stop when the timer moves to its "Off" position.

Referring to FIG. 10, it will be noted that the end of the overflow hose 164 is provided with a check valve CV having the function of preventing loss of the solvent vapors from the storage base tank traveling back into the overflow hose during the drying cycle or when the dry cleaning machine is inoperative and exhausting to the atmosphere through the ventilating system.

Referring to FIG. 13, a hose 271 is connected to the sleeve 163 and has one end entering the sleeve 163, the other end of the hose 271 being connected to a valve, generally indicated at 272, on the valve assembly 222. The valve 272 functions as an air vent valve and is operated by a solenoid 273 which is electrically connected to a circuit for a lamp 274 on the backguard BG of the machine over the designation "Clean" (FIG. 1). In operation, when the machine drains liquid solvent, the solenoid 273 is energized to permit air to enter the air vent hose 271 and prevents the possibility of a vacuum being developed in the machine. Details of the solenoid-operated valve 272 are shown in FIG. 13A wherein the valve comprises a valve body 275 having angular conduits 276 and 277 extending therefrom, the conduit 276 extending downwardly into a solvent flow passage of the valve assembly and the conduit 277 extending into one end of the hose 271. Air flow into the hose 271 is controlled by a flexible seal 278 normally preventing air flow between the conduits by a spring 279 acting to engage the seal with an annular seal 280 on the valve body and positioned in the valve body at the inner end of the passage of the conduit 277. The seal 278 is connected to the armature 281 of the solenoid 273 which, when energized, moves the seal 278 to a position permitting air to enter the hose 271.

To control the temperature of the circulating air heated by the heater assembly coils 74 and 75 during the drying cycle and referring to FIG. 5, the machine is provided with a control thermostat 282, a low temperature thermostat 283 and a safety thermostat 284. The thermostats 282 and 283 are located adjacent each other on the lower inner portion of the cylindrical tub 11 and the thermostat 284 is mounted on the front wall 12 of the tub adjacent the heater assembly 73 and above the clothes-receiving opening in the tub wall. In addition, other controls used are included in electrical circuits, shown in FIG. 29, having a control timer 285 including control cams operative to open and close a plurality of switches identified at 287 to 299, inclusive, in FIG. 29 to control the sequence of machine operation shown in FIG. 30. Switches 289, 291, 293, 297, 298 are single-pole, double-throw switches and switches 290, 292, 294, 295, 296, and 299 are single-pole, single-throw switches.

Other controls identified in FIG. 29 are a cycling switch 300, heater relay 301, "Hi-Lo" volt switch 302, a centrifugal switch 303 in the drive motor M, and a pre-dry switch 304. The operation and cooperation of these electrical control components of the machine will be more fully explained in the description of the schematic electrical control circuit diagram of FIG. 29 and control timer cam sequence chart of FIG. 30.

Referring now particularly to FIGS. 29 and 30, the electrical control circuit diagram and control timer cam sequence chart illustrate the performance and operation of one of the machines, for example machine I, during the cleaning and drying cycles of the machine. Each of the several machines, used with the fluid supply system including the solvent filter 177, manifold 212, pump 174 and their associated solvent-carrying pipes, and heat exchanger 210, is controlled by the electric circuits and electrically-operated components shown in FIG. 29. However, the solvent level alarm switch 267, solvent temperature alarm switch 265, water pressure switch 269, ventilating blower 89 and manual switch 270, are controls

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particularly directed to the fluid supply and ventilating air systems for all of the machines, which may be from two to eight machines, and to which the machines may be connected by circuits effective to indicate operation of these latter electrical components common to all of the machines.

ELECTRICAL CONTROL ARRANGEMENT

In the electric circuit diagram of FIG. 29, there are two basic electrical circuits respectively using 115 and 230 volts, the 115 volt circuit provides current to the various solenoids, and to the controls, drive motor, etc., and the 230 volt circuits provide current to the heating elements 74 and 75 and the solvent circulating pump 174. Each dry cleaning machine and the closed circuit solvent supply and filtering system operate on independent electrical circuits. However, the temperature alarm and solvent level alarm switches, located in the filtering system, are electrically connected to the "Do Not Use" indicator lights on the backguard of the dry cleaning machines. Also, the ventilating blower fan and the water pressure switch on the filter is wired in conjunction with the door lock release assembly to prevent the operator from removing garments from the machine in cases where power failures occur in the ventilating system, or water pressure failure occurs.

The cleaning and drying cycles of machine I are controlled in accordance with the timer cam sequence chart of FIG. 30. The control timer 285 is of the rotary type shown and described in U.S. Patent No. 2,703,347, issued March 1, 1955. The timer is of the form of a sequential controller for automatically controlling machines and embodies a device operated by a suitable electric motor and capable of delivering an intermittent step-by-step motion from a source of constant rotary motion for the purpose of opening and closing a multiple of electric circuits in a predetermined timed relation. More particularly, the timer is constructed of a rotary cam board, contact switches, terminal blocks, motor and an escapement assembly. The motor is a constant speed motor which drives a gear train and ratchet assembly inside the escapement housing. The escapement assembly, in turn, drives the rotary cam board and shaft assembly and rotates the cam board 6° every 30 seconds. This advance motion is called a "timer impulse," and there are a total of 60 impulses in a complete revolution of the cam board assembly.

An important feature of the present electrical control arrangement is the provision of two timers identified as sub-interval timer #1 and sub-interval timer #2 in the electrical circuit diagram of FIG. 29. Each of these timers have a motor (T.M.) energizable to rotate a cam, in timed step-by-step sequence, to actuate switches having contacts *a*, *b*, *c*, and *d* to complete electric circuits.

The sub-interval timer #1 functions to provide drying time delay in cases where there may be an interruption of air flow during the dry cycle. The loss of air flow may be due to the basket blower fan belt 63 becoming loose or broken; excessive clothes loading of the basket 11; clothes blockage of the basket blower fan screen S (FIG. 7); or failure of the control thermostat 282. The motor of the sub-interval timer, when activated by the safety thermostat 284, will cause the timer to attempt to correct the air-flow interruption by deenergizing the fan clutch solenoid 71. The timer is also effective to energize the control timer so that it may advance beyond the dry pause period to complete the cleaning cycle, as will be explained.

In operation, if and when sub-interval timer #1 is activated by the safety thermostat (285° F.), the timer motor and its cam rotates one revolution and activates the internal stack switch (contacts *a*, *b*, *c*, and *d*) 5 to 6 seconds resulting in an interruption in the energization of the fan clutch solenoid 71 and at the same instance, the motor of the control timer 285 is energized so that it will

advance during this 5 to 6 second period. The sub-interval timer will continue to do these functions until the air flow is restored or the control timer begins to operate under its own power in which case it would require 12 minutes' operation of the subinterval timer to advance the control timer 2 impulses.

Referring now to sub-interval timer #2, the structure and operation of this timer is identical to that of sub-interval timer #1, except that it functions differently by providing means of delaying the advancement of the control timer during a "Pre-Dry" period and during a 12 minute "Timed Dry Pause" period. During these periods, the subinterval timer #2 is energized through the contacts *a* and *c* of the switch 297 of the control timer 285. In case of the "Pre-Dry" period, current is supplied through the contacts *a* and *c* of "Pre-Dry" selector switch 304 and contacts *a* and *b* of the control timer.

The cam of the sub-interval timer #2 rotates one revolution per minute at which time it will advance the cams of the control timer for 5 seconds. Accordingly, it requires approximately 12 minutes to advance the cams of the control timer through each of the above two phases of the period. The subinterval timer #2 will also control the advancement of the control timer cams one impulse in the initial clean period.

The above-identified operations and functions of the sub-interval timers #1 and #2 will become apparent hereinafter in the description of the pre-dry, clean and automatic-dry cycles of the machine with reference to the electrical circuit diagram of FIG. 29.

The timer sequence chart of FIG. 30 illustrates the contacts of switches which are opened and closed at any given position of timer operation. The chart is divided into 60 segments, each segment representing one impulse of the timer. To establish exactly the electrical components functioning at any given time in the cycles of machine operation, it is only necessary to establish which sequences is of interest and then to identify the switches that are closed as represented by the dark squares on the timer sequence chart. Each individual energizing circuit, during a given period, may thus be identified by using the timer sequence chart and electrical circuit diagram.

The timer 285 is installed in the backguard of the machine and is activated by a coin-operated slide assembly 305 on the top of the machine, the slide assembly being of a well-known type which, upon receiving the required coins and movement of the slide, will activate the timer to begin its controlling functions to effect the cleaning and drying cycles represented by the timer sequence chart. It may be observed that the circulating pump 174 is energized through a separate 230 volt circuit (not shown) to continually withdraw solvent from the base tank of machine I and to direct the solvent at 55 gallons per minute to the filter 173 for flow by gravity therefrom into the manifold assembly 212 and into the base tank of machine II to the base tank of machine I.

Referring now to the timer sequence chart and electrical circuit diagram of FIGS. 30 and 29, assuming the operator has placed clothing or other fabrics within the basket of the machines, closed the door, placed coins in the slide assembly and actuated the slide to start the sequential timer operations and thereby the automatic cleaning and drying operations of the machine.

When the operator closes the door, the door lock pin 126 is engaged with the keeper 133 by the spring 129 to prevent opening of the door until the completion of the pre-drying, cleaning and automatic-dry cycles of the machine when the machine operation stops, at which time the door button 149 will be pushed in to close switch 143 to energize solenoid 144 to release the lock pin from the keeper to permit the operator to open the door.

PRE-DRY OPERATION

Prior to the cleaning and drying cycles of the machine,

it may be desirable to use an optional operation to pre-dry the clothing to remove excessive moisture from the clothing where the relative humidity at times will exceed 75%. For this purpose, the pre-dry switch 304 has previously been manually adjusted to engage its contact *a* with the fixed contact *b*. Referring to the cam sequence chart, it will be observed that the pre-dry period is for 12 minutes, and it will be noted current also flows through the movable arm contact *a* and fixed contact *b* of the heater safety thermostat 284 to the movable arm contact *a* and fixed contact *b* of control thermostat 282 and to the control timer 285, and also that the contacts of the drive motor switch 290 are closed during this period to energize the drive motor M to rotate the basket to tumble the clothes; the contacts of control timer switch 289 are closed to energize the control timer motor for first 6½ minutes; the heater assembly circuit is established by the control timer closing contacts of its switch 295 and its switch 296 to directly energize one heater and to energize the other heater through the closed contacts of cycling switch 300 and the closed contacts of the low temperature thermostat switch 283. As the current flows through the cycling thermostat during this period, the cycling switch 300 will interrupt the current at a fixed interval and, accordingly, one heater will cycle on and off while the other heater is continuously energized. During the heating period, low temperature thermostat 283 may or may not open which is of no consequence. The control thermostat 282 does not cycle during this period of approximately 6 minutes. The circuit to the heater assembly is completed through the centrifugal switch 303 in the drive motor M back to power line L2.

It may be noted that the cycling switch 300 is of the well-known bi-metal type and which contains a resistance coil. When the resistance coil becomes heated due to current flow, it causes the bi-metal contact arm to warp and break an electrical contact in the switch. The switch cycles at a fixed rate allowing current to be supplied intermittently to one of the 2375 watt heater coils during the drying cycle.

Considering now in detail the circuits established by the switch-operating cams of the control timer 285 and also the various thermostatic and other control switches, and referring first to the condition of the switches of the control timer to establish the circuits and the operation of the switches by the cams, the contacts of the drive motor switch 290 are closed to rotate the basket at low speed to tumble the clothes during the entire 12 minute period; the movable contact *a* engages fixed contact *b* of the control timer switch 289 for the first 30 seconds and then engages fixed contact *c* to interrupt timing by the control timer; contacts *a* and *c* of the switch 297 for the sub-interval timer #2 are closed so that the sub-interval timer #2 becomes effective to advance the timer motor 5-6 seconds at 1 minute intervals during the pre-dry period; the contacts *a* and *b* of the switch 298 are closed to energize the basket fan clutch solenoid 71; the contacts *a* and *b* of the condensate switch 293 are closed to energize the solenoid 251 of the condensate diverter valve 223 to direct condensate to the water and solvent separator 254; the contacts *a* and *b* of the "Dry" light and condenser water solenoid switch 291 are closed to energize the "Dry" lamp and to energize solenoid CS to actuate valve CV to provide cool water to the condenser 77; the contacts of the switch 294 are closed to energize the solenoids 107 and 123 of the inlet and exhaust poppet valves 83 and 84 to close the valves, and the contacts of switches 295 and 296 are closed for the first 6½ minutes to energize the heaters to evaporate the moisture from the clothes.

More particularly, the circuit for energizing the drive motor M includes the power line L1; conductor C1; door and bolt switches 151 and 145; conductors C2 and C3; contacts of drive motor switch 290, windings of drive motor M; conductors C4, C5, and C6 to line N. The motor of the control timer 285 is energized by a circuit

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including line L1; conductor C7; closed contacts *a* and *b* of switch 289; conductor C8; winding of the motor of control timer 285; conductors C9 and C6 to line N. This circuit is provided for 30 seconds when the control timer cam moves contact *a* of switch 289 to engage contact *c* to interrupt the circuit and thereby to interrupt timing by the control timer, and to establish a circuit to energize the sub-interval timer #2, through the closed contacts *a* and *c* of switch 297, to advance the control timer motor at 5-6 seconds at 1 minute intervals during the first six minutes of the pre-dry period, the contacts *a* and *b* of switch 289 being open during this time. The circuit energizing sub-interval timer #2 includes the line L1; conductor C1; switches 151 and 145; C2; C3; C10; closed contacts of switch 294; C11; closed contacts *a* and *c* of switch 297; C12; C13; winding of the motor of the sub-interval timer #2; C14; C5; C6 to line N. The circuit for energizing the basket fan clutch solenoid 71 includes line L1; C15; C16; C17; contacts *c* and *d* of the switch of sub-interval timer #1; C18; closed contacts *a* and *b* of switch 298; the winding of solenoid 71 to engage the clutch to drivingly couple the fan 32 to the drive motor M; C19; C5; C6 to line N. The circuit for energizing the condensate diverter valve solenoid 251 is established by closing contacts *a* and *b* of the switch 293, this circuit including line L1; C1; switches 151 and 145; C2; C3; C10; C22; contacts *a* and *b* of switch 291; filament of "Dry" lamp; C23, C21; C4; C5; C6 to line N; the circuit for the condenser motor solenoid CS including contacts *a* and *b* of switch 291; C24; winding of solenoid CS; C25; C15; C6 to line N. The circuit to energize solenoids 107 and 123 of the inlet and exhaust poppet valves 82 and 83 include C2; switch 294 to parallel conductors C26 and C27 and windings of solenoids 107 and 123 to C21, the dotted lines in the diagram indicating conductors connected to the line N.

The heaters 74 and 75 of the heater assembly 73 are energized by closing switches 295 and 296 for the first 6½ minutes to evaporate moisture from the clothes, the heaters being deenergized at the end of the 6½ minutes of the 12 minute pre-dry period to permit "cool down" of the clothes prior to the machine beginning its clean and automatic dry cycles. The circuits for energizing heaters 74 and 75 include the drive motor-operated centrifugal switch 303 which closes when the drive motor attains a predetermined speed from a stopped position. More particularly, the circuits energizing heater coil 75 includes line L1; C28; closed contacts *a* and *b* of the safety thermostat switch 284; C29; contacts *a* and *b* of the high temperature control thermostat 282; C30; switch 295; C32; heater coil 75; centrifugal switch 303; C33 to line L2. The circuit energizing heater coil 74 includes C30; switch 296; C34; cycling switch 300; C35; C36; low temperature thermostatic switch 283; heater coil 74; centrifugal switch 303; C33 to line L2. The "cool-down" phase of the pre-dry operation, is initiated by the control timer opening the contacts of its switches 295 and 296 after the first 6½ minutes of operation of the heater assembly 73 and which is effective to stop all current flow through the heaters for the remaining approximate 6 minutes of the pre-dry period, the basket fan continuing to operate. It may be noted that all of the contacts of the Hi-Lo volt switch 288 are open during the pre-dry period.

Throughout the pre-dry operation, a circuit is established to the motor winding of the ventilating blower 88 to energize its motor 89, the circuit including line L2; C33; winding of motor 89; C37; C15; to line L1.

As previously explained, the pre-dry operation is used prior to the normal cleaning and drying cycles of the machine to remove excessive moisture from clothes in

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areas where the relative humidity at times will exceed 75% and is to be used only under this condition, and not under normal humidity conditions, or where the relative humidity is below 75%. This pre-dry operation is important as excess moisture in the clothes will cause the loss of desired pleats and creases in the clothes and/or wrinkling of coat linings, and also may cause shrinkage of soft or loosely woven woolen clothes.

In the event the clothes do not have excessive moisture, the pre-dry switch 304 may be manually adjusted to move and engage its contact *a* with contact *c* to bypass the pre-dry operation and to proceed with the normal clean and automatic dry cycles.

CLEAN CYCLE

First Clean Period

After the pre-dry operation, the clean cycle of the machine is automatically initiated. In the event the pre-dry operation is not necessary, the clean cycle begins upon movement of the coin slide 305 to close a switch (not shown) and by closure of the door of the machine to close switch 151, thereby effecting operation of the machine to begin a 7½ minute clean period of the clean cycle. Referring again to the circuit diagram of FIG. 29 and the cam sequence chart of FIG. 30, at this time, the control timer cams are positioned to close certain of the control timer switches including the contacts of the drive motor switch 290; the contacts of the sub-interval timer #2 switch 297; contacts *a* and *c* of fill valve switch 293; contacts *a* and *c* of switch 291; inlet and exhaust air valve switch 294. At this time, the contacts *a* and *b* of the control timer motor switch 289 are open. While the contacts *a* and *b* of the switch 289, energizing the motor of the control timer 285, are open, the motor will not be energized; however, these switch contacts will close after the first 6 minutes of the 7½ minute of the clean cycle has elapsed. Energization of the motor of the sub-interval timer #2 advances the control timer motor at 5 seconds intervals during the first 6 minutes period that contacts *a* and *b* of switch 289 are open.

During this 7½ minute clean period, an electric circuit is established to the drive motor M of the machine to rotate the basket at slow speed to tumble the clothes in the solvent in the machine, the solvent being admitted to the machine by energization of the solenoid 250 of the fill valve 225 of the diverter valve assembly 222. During this period, the "Clean" lamp lights; the vacuum breaker solenoid 249 is energized; the inlet and exhaust air poppet valve solenoids 107 and 123 are energized; the ventilating blower motor 89 is energized; all of which function in the manner previously described.

Describing the electrical circuits for energizing these electrically-operated components, the drive motor M is energized by a circuit including power line L1; C1; switches 151 and 145; C2; C3; switch 290; start and run windings of drive motor M; C4; C5; C6 to line N. The fill valve solenoid 250 is energized by a circuit including line L1; C1; switches 151 and 145; C2; C3; C10; switch 294; C20; contacts *a* and *c* of switch 293; winding of solenoid 250; C21; C25; C5; C6 to line N. The air inlet and exhaust valve solenoids 107 and 123 are energized by a circuit including switch 294; C26 and C27 in parallel with the windings of solenoids 107 and 123; C21; to line N. The vacuum breaker solenoid 273 has an energizing circuit including line L1; C1; switches 151 and 145; C2; C3; C10; C22; contacts *a* and *c* of switch 291; winding of solenoid 273; C21; C25; C5; C6 to line N. The "Clean" lamp is illuminated by a circuit including contacts *a* and *c* of switch 291; filament of the "Clean" lamp; C37; C23; C21 to line N.

The circuit for energizing the motor of the sub-interval timer #2 includes line L1; C1; switches 151 and 145; C2; C3; C10; switch 294; C11; contacts *a* and *c* of

switch 297; C12; C13; winding of motor of the timer #2; C14; C5; C6; line N. After the motor advances its cam at 5 seconds intervals during the first 6 minutes period (contacts *a* and *b* of switch 289 being closed during this time), switch contacts *a* and *b* of the timer #2 are closed by its cam to provide a circuit energizing the control timer motor, this circuit including line L1; C1; switches 151 and 145; C2; C3; C10; switch 294; C11; contacts *a* and *c* of switch 297; C12; contacts *a* and *b* of timer #2; C33; C8; motor of the control timer 285; C9; C6; to line N. The control timer motor will be energized for the remaining 1½ minutes of this 7½ minute clean period and for operation during the subsequent drain period.

First Drain Period

During this period of 1½ minutes, the control timer cams function to open switch 293 to the fill valve solenoid 250 to close diverter valve 225, and to close switch 292 to establish a circuit energizing the solenoid 249 of the drain valve 224 of the diverter valve assembly to drain the solvent from the machine. For this purpose, the control timer cams operate to close switch 292 to energize solenoid 249, while continuing to close switch 290 for energizing the drive motor M; close contacts *a* and *c* of switch 291 to energize the "Clean" lamp and vacuum breaker solenoid 273; close switch 294 to maintain the inlet and exhaust air valve solenoids 107 and 123 operative, by the previously described circuits for these components. The contacts *a* and *b* of switch 289 remain closed to establish a circuit to energize the motor of the control timer 285.

The drain solenoid 249 is energized by a circuit including line L1; C1; switches 151 and 145; C2; switch 292; winding of drain solenoid 249; C21; C25; C5; C6; to line N.

Spin Period

In the subsequent spin period of ½ minute, the control timer cams operate to maintain the previous circuits established during the previous drain period, and also to engage contact *a* with contact *c* of switch 298 to energize spin solenoid 54 to release its plunger 51 (FIG. 9) from engagement with the tab 52 of the clutch spring 51 to provide high speed drive of the transmission to rapidly rotate the basket to extract the solvent from the clothes in the basket for drainage of the solvent through the valve 224 into the storage base tank of the machine. The circuit energizing solenoid 54 includes line L1; C15; C16; C17; contacts *c* and *d* of subinterval timer #1; C18; contacts *a* and *c* of switch 298; C40; winding of solenoid 54; C5; C6; to line N.

Following the spin period of ½ minute, the machine operation continues into a self-cleaning period.

Self-Cleaning Period

This period is provided to permit flushing of lint and soil from the interior parts of the machine, namely, the basket and tub, for drainage into the storage base tank of the machine. The flushing operation is assisted by V-shaped vanes V on the outer cylindrical wall of the basket, as shown in FIG. 5, which vanes are effective, during admission of solvent into the machine tub by operation of the fill valve solenoid 250 and high speed rotation of the basket, to cause the solvent to be highly agitated to flush the lint and soil from the interior parts of the tub and exterior of the basket for flow to the base tank of the machine.

During this ½ minute self-cleaning period, the circuits established, during the above-described spin period, remain effective and, in addition, a circuit is established to energize the fill valve solenoid 250 by the closing of contacts *a* and *c* of switch 293. This circuit includes line L1; C1; switches 151 and 145; C2; C3; C10; switch 294; C20; contacts *a* and *c* of switch 293; winding of solenoid 250; C21; C25; C5; C6 to line N.

Second Clean Period

Following the self-cleaning period, a second clean period of 2½ minutes is initiated by the cams of the control timer 285 being effective to close contacts *a* and *b* of its motor switch 289; drive motor switch 290; switch 291; contacts *a* and *c* of the fill switch 293; and the air inlet and exhaust switch 294, to provide circuits energizing the control timer motor; drive motor M; "Clean" lamp; vacuum breaker solenoid 273; fill valve solenoid 250; and air inlet and exhaust valve solenoids 107 and 123. These circuits energizing these electrically-operated components are identical and have been previously described with reference to the "Spin Period."

During the last ½ minute of this second clean period, the control timer is effective to close contacts *a* and *b* of switch 298 to provide a circuit energizing the solenoid 71 to engage clutch 65 for operation of the basket fan 32 by the drive motor M to wash the lint accumulation from the condenser plate. This circuit includes line L1; C15; C16; C17; contacts *c* and *d* of sub-interval timer #1; C18; contacts *a* and *b* of switch 298; winding of solenoid 71; C19; C5; C6 to line N.

Second Drain Period

During the second drain period of 1½ minutes, the control timer has its cams operative to continue to close the drive motor switch 290; the contacts *a* and *b* of the control timer switch 289; the contacts *a* and *c* of the "Clean" lamp and vacuum breaker switch 291; and the inlet and exhaust air valve switch 294, thereby continuing to establish circuits previously described in the "First Drain Period" to energize the drive and control timer motor windings; the vacuum breaker solenoid; the inlet and exhaust air valve solenoids, and filament of the "Clean" lamp during this period.

In addition, the drain solenoid switch 292 of the control timer is closed to energize solenoid 249 to operate the diverter valve 224. Also, during the first ½ minute only of this period, the control timer switch contacts *a* and *b* of switch 298 are closed to energize solenoid 71 to engage clutch 65 for operating the basket fan 32 by the drive motor M.

Second Spin Period

During this second spin period of ½ minute, the control timer is effective to close the same switches to energize the same electrically-operated components previously described in the explanation of the "First Spin Period."

AUTOMATIC DRY CYCLE

Extract and Heat Period

The control timer 285 has operated its cams to close switches effective to energize solenoid 54 to maintain engagement of the clutch 51 to condition the transmission to rotate the basket at high speed to further extract any remaining solvent from the clothes and has energized the drain solenoid 249 to continue operation of valve 224 to drain solvent into the base storage tank of the machine, and then energized the heater coils 74 and 75 of the heater assembly 73 to heat cast heater assembly 73.

More particularly, during this extract and heat period of 2 minutes, the control timer has operated its cams to continue closure of the drive motor switch 290; contacts *a* and *b* of control timer motor switch 289; air inlet and exhaust valve switch 294; contacts *a* and *c* of the "Clean" lamp and vacuum breaker switch 291; contacts *a* and *c* of the spin solenoid switch 298; and drain valve solenoid switch 292 to establish previously described circuits energizing the winding of the drive motor 171; the control timer motor winding; air inlet and exhaust valves solenoids 107 and 123; the filament of the "Clean" lamp; the vacuum breaker solenoid 273; the spin solenoid 54 for rotation of the basket at high speed; and the drain

solenoid 249 to drain solvent into the storage base tank of the machine. As the timer has moved contact arm *a* of switch 298 to engage contact *c*, the basket fan clutch solenoid 71 is deenergized.

In addition, the control timer 285 has its cams operative to close the primary heater switch 295; the secondary heater switch 296; and the contacts *a* and *b* of the booster heater relay switch 297. As a result, the heater coils 74 and 75 will be energized to heat the air. The circuit for energizing the heater coil 75 includes line L1; C28; contacts *a* and *b* of the heater safety thermostat switch 284; C29; contacts *a* and *b* of the high temperature control thermostat 282; C30; switch 295; C32; heater coil 75; drive motor centrifugal switch 303; C33; to line L2. The circuit for energizing the heater coil 74 includes line L1; C28; contacts *a* and *b* of the heater safety thermostat switch 248; C29; contacts *a* and *b* of the high temperature control thermostat 282; C30; switch 296; C50; contacts of the booster heater relay switch 301; the low temperature thermostat switch 283; heater coil 74; drive motor centrifugal switch 303; C33; to line L2. It may be pointed out that the coil of the booster heater relay 301 has been energized to close its contacts by a circuit established by the control timer closing contacts *a* and *b* of its switch 297, the circuit including the line L1; C1; switches 151 and 145; C2; C3; C10; switch 294; C11; switch contacts *a* and *b* of switch 297; C51; coil of the booster heater relay C21; C25; C5; C6 to line N. Accordingly, both heater coils 74 and 75 are energized to heat the cast heater assembly 73 in the tub 11 of the machine during the 2 minute extract and heat period.

Drop Load Period

Following the above extract and heat period, a drop load period of ½ minute occurs, in which current is removed from the heater coils 74 and 75, and the drive motor M is deenergized to prevent its motive force being transmitted to the basket so that clothes adhering to the basket will fall to the bottom of the basket for subsequent re-distribution when the basket is again rotated by reenergizing the motor.

More particularly, the control timer has its cams continue to operate the same switches to establish the circuits noted in the "Extract and Heat Period," except the cams open the drive motor switch 290 to interrupt the energizing circuit to the drive motor M; the cams move the contact arm *a* from contact *c* and to engage contact *b* of switch 298 to interrupt the circuit to the spin clutch solenoid 54 and to establish a circuit energizing the blower fan clutch solenoid 71. The primary and heater switches 295 and 296 remain closed but no current flows through the heater coils 74 and 75 since the drive motor is not operating and, accordingly, the drive motor internal centrifugal switch 303 opens the circuits to the heater coils by interrupting current flow from the line L2.

First Timed Dry Period

During the timed dry period of 4 minutes, immediately after the drop load period, both heater coils 74 and 75 are reenergized by the control timer cams closing the drive motor switch 290 to energize the drive motor M and thereby its centrifugal switch 303 to again re-establish energizing circuits to the heater coils 74 and 75 for the first 1½ minutes of this period. The current through the contacts of the switch 296 is directed through the heater relay switch 301 and low temperature thermostat 283 to the heater coil 74. Thereafter, contacts *a* and *b* of booster heater relay switch 297 are opened to deenergize the coil of the relay 301 which cause its switch to open, so that the energizing circuit for the secondary heater coil 74 is through the cycling switch 300 during the remaining entire dry-cycle periods. (It may be noted that the contacts *a* and *b* of the High-Low volt switch 302 are open on 230-240 volt operation, but the contacts *c* and *d* are closed to provide a low voltage (120-208)

after the 1½ minute period, this low voltage circuit including C36; C52; contacts *c* and *d* of switch 302; C53; to heater coil 74.)

Describing in detail the circuits established during this timed dry period, the control timer cams are operative to close contacts *a* and *b* of switch 289 to energize the control timer motor; close switch 290 to energize the drive motor M; close contacts *a* and *b* of switch 291 to energize the filament of the "Dry" lamp and condenser water valve solenoid CS; close switch 292 to energize the drain valve solenoid 249; close switch 294 to energize the air inlet and exhaust valve solenoids 107 and 123; close switches 295 and 296 to energize the heater coils 74 and 75; close contacts *a* and *b* of the booster heater relay and subinterval timer #2 switch 297; and close contacts *a* and *b* of switch 298 to energize the basket fan clutch solenoid 71. During the last ½ minute of this period, the control timer is effective to close contacts *a* and *b* of switch 293 to energize the condensate valve solenoid 251. All of these circuits have been previously described.

After the first 1½ minute period, the control timer cams operate to open the contacts *a* and *b* of the booster relay switch 297 to deenergize the coil of the booster relay 301 to open its switch contacts so that the energizing circuit for the secondary heater coil 74 is through the cycling switch 300 for the remaining 2½ minutes of this timed dry period.

Timed Dry Pause Period

In the subsequent timed dry pause period of 12 minutes, assuming the Hi-Lo volt switch contacts *a* and *b* are closed in high voltage position for 115/230 volt operation, the control timer operates its cams to open contacts *a* and *b* of its timer motor switch 289, but the motor of the sub-interval timer #2 is energized to advance the control timer motor at 5 second intervals during the 12 minute period.

The control timer cams are operative, at this time, to close the same switches to establish the same circuits as previously described in the Timed Dry Period (with the exception of the contacts *a* and *b* of the timer switch 289), namely, drive motor switch 290; air inlet and exhaust valve switch 294; contacts *a* and *b* of the switch 291 to energize the "Dry" lamp and condenser valve solenoid CS; drain valve switch 292; contacts *a* and *b* of switch 293 for energizing the condensate valve solenoid 251; heater switches 295 and 296; contacts *a* and *c* of the switch 297 for subinterval timer #2; and contacts *a* and *b* of switch 298 for energizing the basket fan clutch solenoid 71. The contacts *a* and *b* of the booster heater relay switch 297 are open to deenergize the booster relay 301 so that the energizing circuit for the secondary heater coil 74 is still through the cycling switch 301 until the thermostat 283 operates at 115° F. to make the cycling switch 301 inoperable by breaking the circuit to the heater 74.

Referring now to the subinterval timer #2 operation, its motor is energized by a circuit including line L1; C1; switches 151 and 145; C2; C3; C10; switch 294; C11; contacts *a* and *c* of switch 297; C12; C13; the winding of the subinterval timer #2 motor; C14; C5; C6 to line N. The subinterval timer motor operates its cam to close the contacts *a* and *b* of its switch to establish a circuit energizing the motor of the control timer and which circuit includes C12; contacts *a* and *b* of the subinterval timer #2 switch; C38; C8; the winding of the timer motor of the control timer 285; C9; C6 to line N.

It will be apparent that, during this period, the clothes will be tumbled in the basket which slowly rotates while the basket fan is effective to circulate heated air through the clothes to dry the clothes.

Second Timed Dry Period

During the second timed dry period of 2½ minutes,

identically the same circuits are established as previously pointed out with reference to the preceding timed dry pause period, with the exception that the control timer 285 has its motor energized to actuate cams to close the contacts *a* and *b* of switch 289 to establish a circuit energizing the control timer motor, the contacts *a* and *b* of the subinterval timer #2 switch having been opened by its timer motor to interrupt its control of the circuit to the control timer motor, and the control timer opening contacts *a* and *c* of the switch 297 to open the circuit energizing the motor of the subinterval timer #2.

Automatic Dry Pause Period

In the subsequent automatic dry pause period of a 1 minute minimum period, the basket is rotated slowly to tumble the clothes while heated air is circulated through the clothes by the basket fan.

At the beginning of this period, the control timer motor has advanced the cams to open the contacts *a* and *b* of the control timer switch 289 to interrupt the flow of current to the motor of the control timer. However, the control timer motor cams have closed (dry) switch 288 at this time but no current flows to the control timer motor until the control thermostat 282 opens contacts *a* and *b* of its switch at 145° F. to open the heater circuits and to close contacts *b* and *c* of the control thermostat switch to establish a circuit to energize the control timer motor into the succeeding Dry-No Heat Period.

During this automatic dry pause period, the control timer motor is not operative, but the control timer cams have operated to close switch 290 to continue operation of the drive motor M; close contacts *a* and *b* of switch 298 to continue energization of the basket fan clutch solenoid 71; close switch 292 to energize the drain valve solenoid 249; close contacts *a* and *b* of the condensate valve switch 293; close contacts *a* and *c* of switch 291 to energize the "Dry" lamp and condenser water valve solenoid CS; close switch 294 to energize the inlet and exhaust valve solenoids 107 and 123; close switches 295 and 296 to energize the heater coils 74 and 75, and, also, as previously described, close the control timer (dry) switch 288.

The time lapse for the automatic dry pause period relies solely on the control thermostat operating when the circulated air temperature reaches 145° F., at which time, the contacts *a* and *b* of the control thermostat switch 282 will open to deenergize the heater coils 74 and 75 and the contacts *a* and *c* of this switch will close to again establish a circuit to energize the control timer motor to continue timed dry operation until the control timer will advance into the next Dry-No Heat Period.

When the contacts *a* and *c* of the switch 282 close, the control timer motor-energizing circuit includes line L1; C28; contacts *a* and *b* of heater safety thermostat switch 284; C29; contacts *a* and *c* of control thermostat switch 282; C54; switch 288; C8; winding of the motor of the control timer; C9; C6; to line N.

Sub-Interval Timer #1 Operation

Should there be a loss of air flow during the preceding Automatic Dry Pause Period due to a broken basket fan belt, excessive clothes or fabric loading, fan screen blockage by the clothes or fabric, the contacts *a* and *b* of the safety thermostat switch 284 will open and the contacts *a* and *c* of this switch will close, due to the temperature of the heated air rising, to provide a circuit energizing the motor of sub-interval timer #1. This action will cause this energized motor to rotate its cam to close the contacts *c* and *d* of timer #1, resulting in the interruption of the circuit energizing the fan clutch solenoid 71 to disengage drive from the drive motor to the fan. In the event the temperature rise is caused by failure of air circulation due to the air causing clothes to adhere to the fan screen and thereby block passage of air through

the screen, the interruption of the circuit energizing solenoid 71 will permit the clothes to drop away from the screen so that air circulation is again restored if it is caused by garments blocking the fan plate 76. At the same time, the solenoid 71 is deenergized, current will flow through engaged contacts *a*, *b*, *c* of the switch of the sub-interval timer #1 and to the motor of the control timer to advance this timer for 5 seconds at every 1 minute interval of operation of the sub-interval timer #1. The sub-interval timer #1 will continue to activate both components until the air flow condition is corrected. If not correctible, such as a broken fan belt, it will require 12 minutes operation of the sub-interval timer #1 to continue energization of the motor of the control timer 285 through the above phase of the dry cycle. If desired, the subinterval timer #1 circuit may be altered to prevent energization of the motor of the control timer 285 so that the above phase of the drying cycle is not completed and the control timer will continue to be inoperable until the control thermostat 282 operates at 145° F. to reenergize the control timer motor. This can be done by eliminating conductor C57 and connecting the conductor from contact *b* of switch 394 directly to terminal *a* of subinterval timer #2, instead of to terminal *a* of subinterval timer switch #1.

Referring now to the circuit established by the closing of contacts *a* and *c* of thermostat 284 to energize the motor of the sub-interval timer #1, this circuit includes line L1; C28; contacts *a* and *c* of thermostat 284; C55; winding of motor of the timer #1; C56; C14; C5; C6; to line N. Operation of the motor of timer #1 closes contacts *a*, *b*, and *c* of the switch of timer #1 to provide a circuit energizing the winding of the motor of the control timer 285, the circuit including line L1; C15; C16; C17; contacts *a*, *b*, *c* of timer motor #1 switch; C57; C38; C8; winding of the control timer motor; C9; C6; to line N.

Dry-No Heat Period

During the Dry-No Heat Period of 2½ minutes normally following the Automatic Dry Pause Period, the control timer has its cams operative to close the drive motor switch 290 to continue energization of the drive motor M; to close contacts *a* and *b* of switch 298 to energize the basket fan clutch solenoid 71 to circulate air through the clothes by the basket fan; to close the switch 292 to energize the drain valve solenoid 249; to close contacts *a* and *b* of switch 293 to energize the condensate valve solenoid 251; to close contacts *a* and *c* of switch 291 to energize the "Dry" lamp and also the condenser water valve solenoid CS; to close switch 294 to energize the air inlet and exhaust valve solenoids 107 and 123; to close the timer motor (dry) switch 288; and also to close the contacts *a* and *b* of switch 289 of the control timer motor 285. While the switches 295 and 296 are closed to presumably energize the heater coils 74 and 75, the switches are opened by the control timer after the first 30 seconds of the 2½ minute period. There will be no current flow to the heater coils during these 30 seconds as the contacts *a* and *b* of control thermostat switch 282 open due to the rise in temperature to interrupt current flow to the heater coils, the contacts *a* and *c* now being engaged by operation of the control thermostat.

During this period the basket is slowly rotated to tumble the clothes in the circulating heated air, the clothing continuing to dry on heat retained in the heater assembly and the tub and basket of the machine.

Cool-Down Period

Following the Dry-No Heat Period, the cool-down period of 4½ minutes occurs. During this latter period, the control timer has its cams operative to close the drive motor switch 290 to continue energization of the drive motor M to slowly rotate the basket; to close contacts

a and *b* of switch 298 to energize the basket fan clutch solenoid 71 to rotate the fan; to close the contacts *a* and *b* of switch 291 to energize the "Dry" lamp and the condenser valve solenoid CS; to close contacts *a* and *b* of switch 289 to energize the motor of the control timer. Also, while the contacts *a* and *b* of the condensate valve switch 293 are closed, no circuit is established to the condensate valve solenoid 251 as, at this time, switch 294 is open to interrupt this circuit and also to interrupt the circuits energizing the air inlet and exhaust valve solenoids 107 and 123. Upon deenergization of the solenoids 107 and 123, the poppet valves 83 and 84 open to provide aeration of the garments, to remove non-condensable solvent vapors, and to cool down the machine.

Completion of the Drying Cycle

After the Cool-Down Period, the control timer operates for ½ minute to close contacts *a* and *b* of switch 289 and the contacts of switch 287 to continue energization of the control timer motor to condition a circuit for energizing the door release solenoid 144 when the door release switch 148 is closed by the operator pushing button 149 to establish the circuit. Also, the timer closes switch 299 which will energize the "Do Not Use" lamps under certain conditions. Closing of switch 289 and switch 287 by the control timer 285 energizes its motor by a circuit including line L1; C7; contacts *a* and *b* of switch 289; winding of the control timer motor; C9; C6 to line N.

Closing of switch 287 by pushbutton 149 by the machine operator provides a circuit for energizing the solenoid 144 (FIG. 27) to rotate the activating bolt arm 138 to move the door lock pin 126 from the keeper 133 of the door to thereby permit the door to be opened by the operator. This circuit includes line L1; C15; C37; closed contacts of the ventilating blower motor-operated centrifugal switch 286; water pressure switch 269; C57; control timer switch 287; lockout switch 150; manually-operated door release switch 148; door release solenoid 144; to line N. When solenoid 144 is energized, the activating door lock pin 126 is released to permit the door to be opened. When the door is opened, a pin 308 (FIG. 27A) on and projecting inwardly of the door is released from its engagement with a U-shaped leaf spring actuator 309 having its arms release their actuating engagement with the switch buttons of the door switch 151 and the lockout switch 150 to open these switches to prevent any possibility of any circuits including these switches to become established. Furthermore, the door-opening movements of the door lock pin 126 cause its boss 147 to release its engagement with the arm 146 to cause bolt switch 145 to open. It will be apparent that, should the door release button 149 be pushed during the operation of the machine, the door release solenoid 144 will not be energized since the control timer switch 287 is open during the entire machine operation.

When the door release solenoid-energizing circuit is established by closure of switch 287, the switch 299 is also closed by the control timer operation to provide a circuit to energize the "Do Not Use" lamps only in the event the solvent level in the manifold is too low, or the solvent temperature is too high as will be later explained.

A further feature of the control system is the provision of the electric circuit and switch arrangement to prevent the door being opened at the end of the operation of the machine in the event of power failure to the ventilating blower motor 89, or in the event the water pressure is inadequate, there will be a lack of a proper supply of cooling water to the condenser 77 will result in improper drying of the clothes. More particularly, the door release and water pressure circuit receives current from L1; C15; C37; and to a branch circuit of conductor C37 directing current to the ventilating blower motor 89 and to centrifugal switch 286 and thence to switch 269 so that, should there be power failure to the blower motor 89, the switch 286 will not close, and, if adequate water pressure

fails (drops 5 p.s.i.), the switch 269 will not be closed. Accordingly, in either of these conditions occurring, as these switches are in series with the door release switch 148, the door release solenoid-energizing circuit will be broken and the door cannot be opened by the operator closing the door release switch 148.

An additional safety feature is that the solvent temperature switch 264 and solvent level switch 267 are arranged in parallel circuits between the conductor C15 and a conductor C58 and in a series circuit of the "Do Not Use" lamps 266 of machines I and II and function to indicate certain undesirable operating conditions of the dry cleaning solvent.

Prior to a description of the operation of the solvent level switch 267, it may be noted that the solvent level switch is effective to subtract solvent demand by the machines from solvent supply from the filter independent of the quantity of flow. As long as supply exceeds demand, even by a small amount, the level switch contacts remain open, as the surplus of supply over demand passes over the standpipe 215 and into and through the overflow pipes 214 and 216. When the demand exceeds supply, the level drops down and the switch closes.

As previously described and referring first to the solvent manifold level switch 267, this switch detects a condition where the machines call for solvent where the solvent demand exceeds the supply. If, for some reason, the circulating pump 174 is inoperative, or the filter tank becomes restricted, due to excessive dirt accumulation, these factors will not actuate the solvent level switch until the above condition occurs, in which case, the contacts of the solvent level switch 267 will close and light the "Do Not Use" lamps mounted on the backguards of the machines not in use, and the contacts will open when the solvent level is re-established by having the supply of solvent exceed the demand. The "Do Not Use" lamps will only be energized when the machine or machines are in the "Off" position when the above undesirable condition occurs. If the machine or machines are operating and the above undesirable condition occurs, the "Do Not Use" lamps will not be energized.

The switch 270 is a manually-controlled switch which is normally open during normal operation but may be closed to energize a master "Do Not Use" lamp 306 in a service location to immediately inform the machine operator mechanic that there is a failure of fluid detected by a low solvent level in the standpipe or high temperature solvent condition exists. This lamp 306 functions independently from the "Do Not Use" lamps on the backguards of the machines. If desired, the master lamp 306 can be energized by the service mechanic to energize all of the "Do Not Use" lamps on the machines not in use in the event he wishes to perform service on the machines. It will be observed that closing switch 270 provides a circuit bypassing the contacts 265 of the switch of the temperature control alarm 264 and contacts 268 of the switch of the solvent low level alarm 267. This circuit includes C15; switch 270; C58; lamp 306 to line N, and also another circuit including C58; closed switch 299; and the "Do Not Use" lamps 266, to line N.

The switch 270 is a manually-controlled switch which is normally open during normal operation but may be closed to energize a master "Do Not Use" lamp 306 in a service location to immediately inform a service mechanic to alert the cleaning machine operator that there is a failure of fluid supply or a low solvent level, or high temperature solvent condition exists. This lamp 306 functions independently from the "Do Not Use" lamps in the backguards of the machines. If desired, the master lamp 306 can be energized by the service mechanic to energize all of the "Do Not Use" lamps on the machines not in use in the event he wishes to perform service on the machines. It will be observed that closing switch 270 provides a circuit bypassing the switches 265 and 268 and including C15; switch 270; C58; lamp 306 to line N,

and also another circuit including C58; closed switch 299; the "Do Not Use" lamps 266, to line N.

It is to be understood, and it is believed apparent, that the control arrangements embodying the solvent level and solvent temperature control warning of safety devices in combination with the lamp indicating means may be utilized also with a conventional dry cleaning machine having means for supplying solvent under pressure to the machine by a pump instead of by gravity flow of the solvent to the machine as provided by the fluid supply system as described. Accordingly, having described the invention, it should become obvious that although there has been shown and described a preferred embodiment of it in detail, various modifications and alternations could be made without departing from the scope of the invention. Accordingly, the protection afforded this invention should be limited only as set forth by the appended claims.

What is claimed is:

1. In a fabric dry cleaning machine, a cleaning fluid container having a fluid inlet and a fluid outlet; a closed fluid circuit including said container, fluid supply means, and means connecting said fluid supply means to said inlet of said container and providing for gravitational flow of fluid to said container; thermostatically-operable means positioned in the path of the fluid flowing in said circuit and responsive to the temperature of the fluid; first normally-open switch means closable by said thermostatically-operable means in response to a predetermined temperature of the fluid; fluid-operable means in said circuit and responsive to the fluid supplied by said fluid supply means to said container; second normally-open switch means closable by said fluid-operable means upon movement thereof in response to failure of the fluid supply means to provide a predetermined quantity of fluid to said container; electrically-energizable indicating means; normally-open third switch means; means for closing said third switch means; and an electric circuit for energizing said indicating means including said first and second switch means in parallel relation and respectively in series relation with said third switch means, closure of either or both of said first and second switch means, and closure of said third switch means, energizing said indicating means.

2. In a fabric dry cleaning machine as defined in claim 1 wherein the means for closing the third switch means is operative at the completion of operation of the machine.

3. In a fabric dry cleaning machine as defined in claim 1 wherein the means for closing said third switch means includes means for controlling the operation of the machine.

4. In a fabric dry cleaning machine as defined in claim 1 wherein the means for closing said third switch means includes means for controlling operation of the machine and operative to close the third switch means at the completion of operation of the machine.

5. In a fabric dry cleaning machine, a cleaning fluid container having a fluid inlet and a fluid outlet; a closed fluid circuit including said container, fluid supply means, and means connecting said fluid supply means to said inlet of said container and providing for gravitational flow of fluid from said fluid supply means to said container; a thermostatically-operable element positioned in the path of the fluid in said circuit and responsive to the temperature of the fluid therein; means operable by said element in response to a predetermined temperature of the fluid; a fluid-operable member in said circuit and responsive to the fluid supplied by said fluid supply means to said container; means operable by said element in response to failure of the fluid supply means to provide a predetermined quantity of fluid to said container; indicating means; and means activating said indicating means on completion of the operation of the machine and upon operation of either said element-operable means or said member-responsive means.

6. In a fabric dry cleaning machine as defined in claim 5 wherein said activating means includes means controlling the operation of the machine.

7. In a dry cleaning machine, a cleaning fluid container having a fluid inlet and a fluid outlet; a closed fluid circuit including said container, fluid supply means, and a conduit connecting said fluid supply means to said inlet of said container; a thermostatically-operable element positioned in the path of the fluid in said conduit and responsive to the temperature of the fluid therein; means operable by said element in response to a predetermined temperature of the fluid; a fluid-operable member in said conduit and responsive to the fluid supplied by said fluid supply means to said container; means operable by said member in response to failure of the fluid supply means to provide a predetermined quantity of fluid to said container; indicating means; and means activating said indicating means on completion of the operation of the machine and upon operation of either said element-operable means or said member-responsive means.

8. In a dry cleaning machine as defined in claim 7 wherein said activating means includes means controlling the operation of the machine.

9. In a dry cleaning machine, a cleaning fluid container having a fluid inlet and a fluid outlet; a closed fluid circuit including said container, fluid supply means, and means connecting said fluid supply means to said inlet of said container and providing for gravitational flow of fluid to said container; a fluid-operable element in said circuit and responsive to the fluid supplied by said fluid supply means to said container; first normally-open switch means closable by said fluid-operable element upon movement thereof in response to failure of the fluid supply means to provide a predetermined quantity of fluid to said container; electrically-energizable indicating means; normally-open second switch means; and means for closing said second switch means on completion of operation of the machine; and an electric circuit for energizing said indicating means including said first and second switch means energizing said indicating means.

10. In a fabric dry cleaning machine as defined in claim 9 wherein the means for closing said second switch means includes means controlling the operation of the machine.

11. In a fabric dry cleaning machine, a cleaning fluid container having a fluid inlet and a fluid outlet; a closed fluid circuit including said container, fluid supply means, and means connecting fluid supply means to said inlet of said container and providing for gravitational flow of fluid to said container; a fluid-operable element in said circuit and responsive to the fluid supplied by said fluid supply means to said container; means operable by said element in response to failure of said supply means to provide a predetermined quantity of fluid to said container; indicating means; and means actuating said indicating means on completion of the operation of the machine and upon operation of said element-operable means.

12. In a dry cleaning machine as defined in claim 11 wherein said activating means includes means controlling the operation of the machine.

13. In a dry cleaning machine, a cleaning fluid container having a fluid inlet and a fluid outlet; a closed fluid circuit including said container, fluid supply means, and means connecting said fluid supply means to said inlet of said container and providing for gravitational flow of fluid to said container; a fluid-operable element in said circuit; means operable by said element in response to failure of said fluid supply means to provide a predetermined quantity of fluid to said container; indicating means; and means controlling the operation of the machine and operable to activate said indicating means upon operation of said element-operable means.

14. In a dry cleaning machine, a cleaning fluid con-

tainer having a fluid inlet and a fluid outlet; a closed fluid circuit including said container, a fluid supply means, and means connecting said fluid supply means to said inlet of said container; a fluid-operable element in said circuit and responsive to the fluid supplied by said fluid supply means to said container; first normally-open switch means closable by said fluid-operable element upon movement thereof in response to failure of the fluid supply means to provide a predetermined quantity of fluid to said container; electrically-energizable indicating means; normally-open second switch means; and means for closing said second switch means on completion of the operation of the machine; and an electric circuit for energizing said indicating means including said first and second switch means, closure of said first and second switch means energizing said indicating means.

15. In a dry cleaner as defined in claim 14 wherein the means for closing said second switch means includes means controlling the operation of the machine.

16. In a dry cleaning machine, a cleaning fluid container having a fluid inlet and a fluid outlet; a closed fluid circuit including said container, fluid supply means, and means connecting said fluid supply means to said inlet of said container; a fluid-operable element in said circuit and responsive to the fluid supplied by said fluid supply means to said container; means operable by said element in response to a failure of said fluid supply means to provide a predetermined quantity of fluid to said container; indicating means; and means actuating said indicating means on completion of the operation of the machine and upon operation of said element-operable means.

17. In a fabric dry cleaning machine, a cleaning fluid container having a fluid inlet and a fluid outlet; a closed fluid circuit including said container, fluid supply means, and means connecting said fluid supply means to said inlet of said container; a thermostatically-operable element positioned in the path of the fluid flowing in said circuit and responsive to the temperature of the fluid; first normally-open switch means closable by said element in response to a predetermined temperature of the fluid; electrically-energizable indicating means; normally-open second switch means; and means operable to close said second switch on completion of operation of the machine; and an electric circuit for energizing said indicating means including said first and second switch means, closure of said first and second switch means energizing said indicating means.

18. In a dry cleaning machine as defined in claim 17 wherein said second switch-closing means includes means controlling the operation of the machine.

19. In a fabric dry cleaning machine, a cleaning fluid container having a fluid inlet and a fluid outlet; a closed circuit including said container, fluid supply means, and means connecting said fluid supply means to said inlet of said container; thermostatically-operable means positioned in the path of the fluid flowing in said circuit and responsive to the temperature of the fluid; means energizable by said thermostatically-operable means in response to a predetermined temperature of the fluid; indicating means; and means operable to activate said indicating means on completion of operation of the machine and when said thermostatically-operable means is operative to energize said energizable means.

20. In a dry cleaning system, a plurality of dry cleaning machines each including a cleaning fluid container having a fluid inlet and an overflow fluid outlet for providing a predetermined operating level of fluid in said container, and a fluid storage tank connected to and receiving fluid from the overflow fluid outlet of said container; a filter; closed fluid circuit including said filter and said machines, said circuit including means connecting said filter to said containers and said tanks and providing flow of fluid by gravity therebetween, and providing a manifold having one end connected to said filter; conduits arranged in parallel between said manifold and said

containers and connecting said manifold and the fluid inlets of said containers for flow of fluid into said containers and through the overflow fluid outlets of said containers into said tanks, a standpipe connected to the other end of said manifold to provide a head of fluid effecting a metered flow rate of fluid through said conduits and into said containers, and an overflow pipe connected to the upper end of said standpipe, the tanks of said machines being arranged in series in said circuit with the tank of said serially first machine being connected to the overflow pipe for flow of fluid from the filter to the tank of the serially last machine to said filter; means for selectively controlling the flow of fluid through said conduits into said containers; a thermostatically-operable element positioned in the path of the fluid flowing in said manifold and responsive to the temperature of the fluid therein; first normally-open switch means closable by said element in response to a predetermined temperature of the fluid; a fluid-operable element in said manifold and responsive to fluctuations of the head, and thereby the level of the fluid in said standpipe; second normally-open switch means closable by said fluid-operable element upon movement thereof in response to a predetermined level of the fluid in said standpipe; and an electrical circuit including electrically-energizable indicating means, normally-open third switch means, and means for closing said third switch means, associated with each machine, said first and second switch means being in parallel relation and said third switch means in series relation respectively to said first and second switch means, closure of either or both of said first and second switch means, and closure of said third switch means, energizing said indicating means of the respective machines.

21. In a fabric dry cleaning system as defined in claim 20 wherein the means for closing the third switch means provided in each machine includes means controlling the operation of the machine.

22. In a fabric dry cleaning system as defined in claim 20 wherein the means for closing the third switch means provided in each machine is a sequential controller controlling the operation of the machine, the controller being operative to close the third switch means at the completion of the operation of the machine.

23. In a fabric dry cleaning system, a plurality of dry-cleaning machines each including a cleaning fluid container having a fluid inlet and an overflow fluid outlet for providing a predetermined operating level of fluid in said container, and a fluid storage tank connected to and receiving fluid from the overflow fluid outlet of said container; a closed fluid circuit including fluid supply means, a manifold having one end connected to said fluid supply means, conduits arranged in parallel between said manifold and said containers and connecting said manifold with the fluid inlets of said containers for flow of fluid into said containers and through the overflow fluid outlets of said containers into said tanks, a standpipe connected to the other end of said manifold to provide a head of fluid effecting a metered flow rate of fluid into said conduits and said containers, and an overflow pipe connected to the upper end of said standpipe, the tanks of said machines being arranged in series in said circuit with the tank of the serially first machine being connected to the overflow pipe so as to allow the continuous flow of fluid from the tank of the serially first machine to and through the tank of the serially last machine when the supply of fluid from the fluid supply means exceeds the demand for fluid through the conduits into said containers; means for selectively controlling the flow of fluid through said conduits into said containers; a fluid-operable element in said manifold and responsive to the head of fluid in said standpipe; first normally-open switch means closable by said fluid-operable element upon movement thereof in response to the fluid supply to said machines being inadequate to provide a predetermined

head of fluid in said standpipe; an electric circuit and including electrically-energizable indicating means, and normally-open second switch means, and means for closing said second switch means associated with each machine, said first and second switch means being in series relation, closure of said first and second switch means energizing said indicating means.

24. In a fabric dry cleaning system as defined in claim 23 wherein the means for closing the second switch means provided in each machine includes means for controlling the operation of the machine.

25. In a fabric dry cleaning system as defined in claim 23 wherein the means for closing the second switch means provided in each machine includes means for controlling the operation of the machine and operative to close the second switch means at the completion of the operation of the machine.

26. In a fabric-dry cleaning system, a plurality of dry-cleaning machines each including a cleaning fluid container having a fluid inlet and an overflow fluid outlet for providing a predetermined operating level of fluid in said container, and a fluid storage tank connected to and receiving fluid from the overflow fluid outlet of said container; a closed fluid circuit including fluid supply means, a manifold having one end connected to said fluid supply means, conduits arranged in parallel between said manifold and said containers and connecting said manifold with the fluid inlets of said containers for flow of fluid into said containers and through the overflow fluid outlets of said containers into said tanks, a standpipe connected to the other end of said manifold to provide a head of fluid effecting a metered flow rate of fluid into said conduits and said containers, and an overflow pipe connected to the upper end of said standpipe, the tanks of said machines being arranged in series in said circuit with the tank of the serially first machine being connected to the overflow pipe so as to allow the flow of fluid from the tank of the serially first machine to and through the tank of the serially last machine; means for selectively controlling the flow of fluid through said conduits into said containers; means for sensing the level of the fluid in said standpipe and including a pipe extending upwardly and receiving fluid from said manifold to establish a level of fluid varying with the level of fluid in the standpipe, and a sensing element in said pipe responsive to the level of fluid in said pipe; first normally open switch means closable by said sensing element in response to movement thereof by a low level of fluid in said pipe or failure of fluid supply to said pipe; an electrical circuit and including electrically-energizable indicating means,

and normally-open second switch means, and means for closing said second switch means associated with each machine, said first and second switch means being in series relation, closure of said first and second switch means energizing said indicating means.

27. In a fabric-dry cleaning system, a plurality of dry-cleaning machines each including a cleaning fluid container having a fluid inlet and an overflow fluid outlet for providing a predetermined operating level of fluid in said container, and a fluid storage tank connected to and receiving fluid from the overflow fluid outlet of said container; a closed fluid circuit including fluid supply means, a manifold having one end connected to said fluid supply means, conduits arranged in parallel between said manifold and said containers and connecting said manifold with the fluid inlets of said containers for flow of fluid into said containers and through the overflow fluid outlets of said containers into said tanks, a standpipe connected to the other end of said manifold to provide a head of fluid effecting a metered flow rate of fluid into said conduits and said containers and establishing a variable level of fluid in said standpipe, and an overflow pipe connected to the upper end of said standpipe, the tanks of said machines being arranged in series in said circuit with the tank of the serially first machine being connected to the overflow pipe so as to allow the flow of fluid from the tank of the serially first machine to and through the tank of the serially last machine; means for selectively controlling the flow of fluid through said conduits into said containers; means for sensing the level of the fluid in said standpipe and including a pipe extending upwardly and receiving fluid from said manifold to establish a level of fluid varying with the level of fluid in the standpipe, and a sensing element in said pipe responsive to the level of fluid in said pipe; indicating means; and means controlled by said sensing element and operative, in response to movement thereof by a low level of fluid in said pipe or failure of fluid supply to said pipe, to actuate said indicating means.

28. In a fabric dry cleaning machine as defined in claim 27 wherein said actuating means includes means controlling operation of the machine.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,106,831

October 15, 1963

Curtis E. Behrens

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 60, for "to", first occurrence, read -- is --; column 4, line 25, for "tube" read -- tub --; column 17, line 22, for "lint." read -- lint, --; column 20, line 35, for "linter" read -- lint --; column 24, line 70, for "energinzinz" read -- energizing --; column 34, line 1, after "drops" insert -- below --; column 35, line 14, for "alternation" read -- alterations --; column 36, line 38, for "eelctric" read -- electric --; column 38, line 73, for "closably" read -- closable --.

Signed and sealed this 14th day of April 1964.

(SEAL)

Attest:

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