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FABRIC CLEANING APPARATUS WITH RECOVERY CONTROL MEANS

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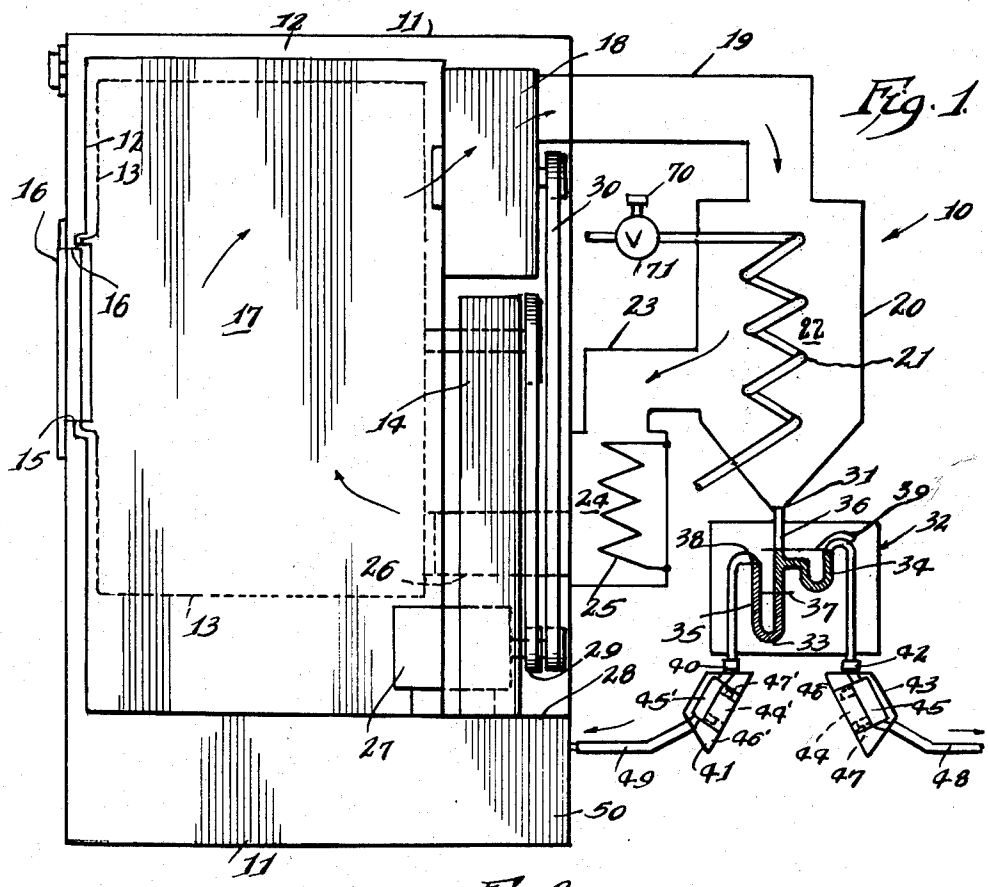

Fig. 1.

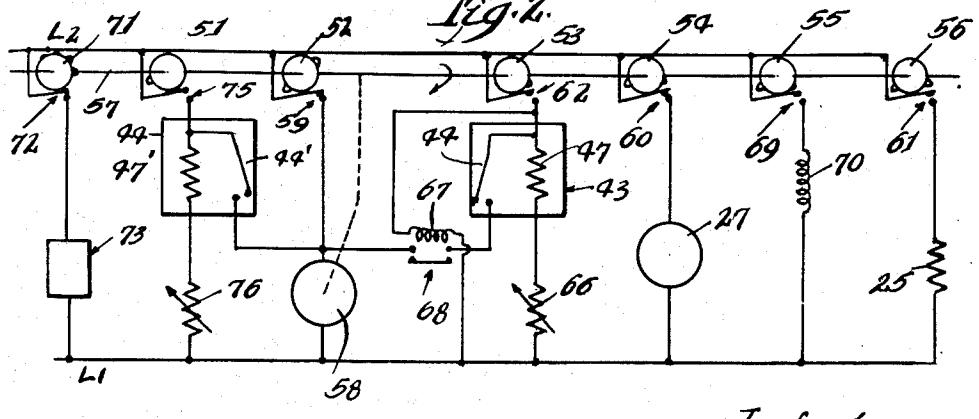

Fig. 2.

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FABRIC CLEANING APPARATUS WITH RECOVERY CONTROL MEANS

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This invention relates to cleaning apparatus and in particular to dry cleaning apparatus.

In the copending Clifton A. Cobb and James T. Williams application, Serial No. 87,160 filed February 6, 1961, an apparatus for drying fabrics and the like subsequent to a cleaning operation is disclosed and claimed wherein means are provided for automatically discontinuing the drying cycle when the amount of cleaning fluid remaining in the material being dried reaches a preselected low volume. The present invention comprehends an apparatus wherein means are provided for automatically discontinuing a plurality of drying cycles, including a pre-dry cycle, successively in the operation of such a dry cleaning apparatus. More specifically, the present invention comprehends a novel utilization of a plurality of control devices, such as disclosed in said Clifton A. Cobb and James T. Williams application, providing novel, improved functioning of such a dry cleaning apparatus.

A principal feature of the present invention, therefore, is the provision of a new and improved apparatus for cleaning materials such as fabric and the like.

Another feature of the invention is the provision of such an apparatus arranged for automatic control of a pre-dry and a final dry operation.

A further feature of the invention is the provision of such an apparatus wherein the control of each of the drying operations is made to be a function of the condition of the material being dried.

Still another feature of the invention is the provision of such an apparatus including new and improved control means for automatically regulating the drying operations.

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIGURE 1 is a diagrammatic vertical section of a dry cleaner apparatus embodying the invention; and

FIGURE 2 is a diagram illustrating the electrical circuit of the apparatus.

In the exemplary embodiment of the invention as shown in the drawing, a dry cleaner apparatus generally designated 10 is shown to comprise a cabinet 11 defining a casing 12 within which is disposed a cylinder 13 rotatably supported on a pylon 14. The cabinet 11 is provided with a front opening 15 selectively closed by a door 16 for controlled access to the interior of the cylinder 13. The material (not shown) to be cleaned, such as fabric and the like, is placed within the chamber 17 defined by the cylinder 13. During both the pre-dry and final dry portions of the complete dry cleaner cycle, air is circulated through the chamber 17 by means of a suitable air-moving device such as blower 18. From chamber 17, the vapor laden air is delivered through a duct 19 to a condenser 20 having a suitable condensing coil 21 disposed within a chamber 22. From chamber 22, the air, having the condensible vapors removed therefrom in chamber 22, passes through a duct 23 to a chamber 24 in which is disposed a suitable air heater 25. From chamber 24, the heated air passes through the duct 26 back to cylinder chamber 17 to complete the circulation thereof. An electric motor 27 carried on the base 28 of the cabinet 11 is connected by a suitable belt drive

29 to the cylinder 13, and by a suitable belt drive 30 to the blower 18 for driving the cylinder and blower respectively.

In a dry cleaning operation it is very important to limit the introduction of water into the dry cleaning system to keep the relative humidity of the system below 75% and thus keep shrinkage and wrinkling at an absolute minimum. Woolen goods in addition to being susceptable to shrinkage and wrinkling also absorb relatively large amounts of moisture from the ambient air. Thus, it is desirable to provide an initial pre-dry operation wherein this absorbed moisture is removed from the material prior to the dry cleaning operation. In the pre-dry operation, the heated air is passed through the chamber 17 to pick up this moisture and deliver it to the condenser 20. The condensate water in condenser 20 is delivered therefrom through an outlet 31 at the bottom of chamber 22 to a separator generally designated 32. Subsequent to the dry cleaning operation, it is desirable to provide a final drying operation wherein substantially all of the dry cleaning fluid, herein, perchlorethylene, is removed from the material to be used in subsequent cycles. Thus, heated air is again circulated through chamber 17 and delivered to the condenser 20 wherein the vaporized perchlorethylene is condensed and also delivered through outlet 31 to separator 32.

Separator 32 functions to deliver the water and the perchlorethylene in two different paths. As shown in FIGURE 1, separator 32 herein comprises a manometer device 33 having an upper, right, trap leg 34 and a lower, left, trap leg 35, and is connected to a conduit 36 depending from outlet 31. Perchlorethylene, having a much greater density than water, tends to flow downwardly into the lower trap leg 35 to have a lower level 37 in conduit 36 and an upper level 38 in left leg 35. The relatively light water remains above the perchlorethylene level 37 in conduit 36 and has an upper level 39 controlled by right leg 34 of the manometer. An outlet 40 of the left leg 35 is connected to a first sensor device 41 and an outlet 42 of the right leg 34 is connected to a second sensor device 43. The sensor devices are identical to the sensor devices of the above-indicated Clifton A. Cobb and James T. Williams application, to which reference may be had for a complete detailed description thereof. However, briefly each device includes a thermoresponsive switch 44, 44' exposed to the flow of fluid from the respective outlet 40 or 42 through a chamber 45, 45' defined by the housing 46, 46' of the device. Each sensor device further includes a heater 47, 47' which when energized provides heat to the normally open thermoresponsive switch 44, 44' tending to close the switch. The fluid flowing through the chambers 45, 45', however, prevents the closing of the switch by dissipating the heat delivered from the heater 47, 47' until such time as the rate of flow of the fluid through the chamber reaches a preselected reduced flow rate indicating that the material in chamber 17 has been dried to a preselected degree. Thus, in the pre-dry operation, the water flowing through the chamber 45 of sensor 43 maintains the swith 44 open until such time as the material in chamber 17 has been pre-dried to a preselected degree wherein the material is ready for the dry cleaning operation. Similarly, the perchlorethylene flowing through the chamber 45' of the sensor 41 in the final dry operation maintains the switch 44' thereof open until such time as the level of perchlorethylene remaining in the material reaches a preselected low level so that the material is ready for a final deodorizing operation. In each instance, the duration of the drying operation is controlled by the condition of the material itself, as the rate of flow of the condensed fluid being removed from the material is substantially directly related to the condition of dryness of

the material. Thus, the condition of material is automatically brought to a preselected dry condition irrespective of the original condition of the material. Where the material originally had a substantial amount of moisture therein, the pre-dry operation is maintained for a sufficient rate of time to remove this relatively large quantity of water. Alternatively, where the material is relatively dry to begin with, the pre-dry operation is terminated correspondingly after a shorter period of time, effectively precluding over-drying of the material. Thus, apparatus 10 provides a substantial improvement over conventional dry cleaning apparatuses wherein timers are provided for controlling a pre-dry operation, as such timers do not provide automatic co-ordination of the drying time with the requirements of the specific load of material to be cleaned.

In addition to the rate of fluid flow through the sensors 41 and 43, these sensors would also be effected by the temperature of the fluid passing therethrough. However, it has been found that in any particular installation, that the temperatures of the fluids entering the sensors vary only insignificantly and thus, the sensors are actually sensing only the differences in flow rates.

As shown in FIGURE 1, chamber 45 of sensor 43 may be connected to a suitable conduit 48 for delivering the removed water to a point of disposition, such as a drain (not shown). The chamber 45' of sensor 41 may be connected through a conduit 49 to a reservoir 50 within base 28 of the cabinet 11 where the perchlorethylene may be stored for re-use in a subsequent dry cleaning operation.

Referring now to FIGURE 2 of the drawing, the electrical control circuit associated with the sensors 41 and 43 for controlling the drying operations is shown to include a plurality of cams 51, 52, 53, 54, 55, 56 and 71 carried on cam shaft 57 driven by a timer motor 58. The timer motor is connected directly to one power supply lead L1 and during portions of the dry cleaner cycle through a switch 59 to the other power supply lead L2. Switch 59 is controlled by cam 52 to be closed for a short preselected period of machine heat-up time to initiate the pre-dry operation. During this period of time, cam 54 causes the closing of a switch 60 connecting the drive motor 27 between power supply leads L1 and L2 thereby effecting a rotation of cylinder 13 and operation of blower 18. Further, concurrently, cam 56 closes a switch 61 to connect air heater 25 between power supply leads L1 and L2. After a short interval, timer motor 58 rotates the shaft 57 sufficiently to cause cam 52 to permit switch 59 to open thereby de-energizing the timer motor. At this time, cam 53 closes an associated switch 62 which is connected in series from lead L2 through the heater 47 of sensor device 43 and a potentiometer 66 to the power supply lead L1. In parallel with the series connected heater 47 and potentiometer 66 from switch 62 to lead L1 is a relay coil 67. A set of normally open contacts 68 are controlled by relay coil 67 and are connected in series with switch 44 of sensor 43 between switch 62 and timer motor 58. Relay coil 67 and contacts 68 prevent continued energization of heater 47 when timer motor 58 is again energized through timer switch 59 when switch 44 is closed. Concurrently, or during the machine heat-up time, with the closing of switch 62, cam 55 closes a switch 69 connecting the solenoid 70 of a solenoid operated valve 71 between leads L1 and L2, thereby opening the valve 71 to permit the flow of condensing fluid through the condenser coil 21. The water removed from the material in chamber 17 and condensed in condenser 20 by coil 21 flows through manometer leg 34 and chamber 45 of sensor device 43 to the discharge conduit 48. As long as the rate of flow of the water through chamber 45 is sufficient to dissipate sufficient heat from heater 47, the switch 44 remains open. In this connection, it should be noted that the potentiometer 66 may be adjusted so as to vary the heating effect of heater 47 to control the degree of dryness of the material being dried, as well as to adjust the heating effect for variations in the installation supply voltage between the leads L1 and L2.

When the rate of flow of the water through chamber 45 reaches a preselected low level permitting the switch 44 to close, a circuit is established from lead L1 through timer motor 58, relay contact 68, switch 44, and switch 62 to lead L2 thereby causing the timer motor 58 to rotate the shaft 57 sufficiently to reposition cams 53, 55 and 56 to open switches 62, 69 and 61 respectively. At the same time, cam 52 is rotated sufficiently to reclose switch 59 thereby maintaining the timer motor energized for a preselected period of time during which suitable means such as cam 71 on shaft 57 operates a switch 72 controlling suitable conventional means, such as control 73, for effecting a series of wash and extraction cycles wherein cleaning fluid is successively introduced and removed from the chamber 17 by suitable conventional apparatus (not shown).

After the washing and extraction portions of the dry cleaner cycle, timer motor 58 rotates shaft 57 sufficiently to reposition cam 52 to reopen switch 59 thereby de-energizing the timer motor. At this time, cam 51 has been positioned to close a switch 75 connected from lead L2 in series with heater 47' of sensor device 41 and a potentiometer 76 to lead L1, and cams 54, 55 and 56 are arranged to reclose switches 60, 69, and 61 to effect concurrent operation of the drive motor 27, condenser solenoid valve 70, and air heater 25. Heater 25, if desired, can be energized during the extraction period. Thus, as long as sufficient perchlorethylene is being condensed by condenser 20 and passed through chamber 45' of sensor device 41, the switch 44' of sensor device 41, which is connected between switch 75 and timer motor 58, remains open. However, when the rate of flow of the perchlorethylene through chamber 45' reaches a preselected flow level, indicating that the material in chamber 17 has reached the preselected dry condition, heater 47' causes switch 44' to close, thus re-energizing timer motor 58 and causing further rotation of shaft 57 to initiate a deodorizing cycle portion to complete the cycle of operation of the apparatus 10.

As indicated briefly above, manometer 32 effectively functions as a fluid separator, automatically directing the water through the leg 34 to sensor device 43 and the perchlorethylene through the leg 35 to the sensor device 41. As the specific gravity of perchlorethylene is approximately 1.6 times the specific gravity of water, the manometer effectively precludes the delivery of any water to the sensor device 41 and the delivery of any perchlorethylene into the sensor device 43, as the relatively light water cannot force itself downwardly through the perchlorethylene and, conversely, the relatively heavy perchlorethylene passes downwardly through leg 35 rather than flowing through the relatively elevated leg 34. Thus, the manometer separator 32 effectively eliminates the need for the use of relatively complicated and costly flow directing valves, providing the desirable positive separation of the water and perchlorethylene in a simple automatic manner. However, if desired, an electrically controlled two-way valve or two individual electrically controlled valves could be used as equivalent fluid separation means to direct the water and dry cleaning solvent during the proper cycle portions to the proper sensors 41 or 43.

While we have shown and described certain embodiments of our invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

We claim:

1. In an apparatus for cleaning material such as fabric and the like, fluid control means comprising: means for removing seriatim first and second fluids from the material; means operating said removing means to remove the

first fluid from the material; means directing the first fluid removed from said material in a first path; means responsive to a decrease in the rate of flow of the first fluid in said first path to a preselected rate to discontinue operation of the removing means; means for subsequently operating said removing means to remove the second fluid from the material; means directing the second fluid removed from said material in a second path and being arranged to preclude delivery of said first fluid in said second path; and means responsive to a decrease in the rate of flow of the second fluid in said second path to a preselected rate to control the discontinuation of operation of the removing means.

2. The apparatus of claim 1 wherein said means responsive to the rate of flow of said fluids include thermoresponsive means controlled by the rate of heat dissipation effected by the flow of said fluids in said paths.

3. In an apparatus for cleaning material such as fabric and the like, fluid control means comprising: means defining a collecting chamber; means for removing first and second fluids from the material and delivering them to said collecting chamber; means operating said removing means to remove the first fluid from the material and delivering it to said collecting chamber; means directing the first fluid from said collecting chamber in a first path; means responsive to a decrease in the rate of flow of the first fluid in said first path to a preselected rate to discontinue operation of the removing means; means responsive to discontinuation of operation of the removing means to deliver the second fluid to the material; means subsequently operating said removing means to remove the second fluid from the material and delivering it to said collecting chamber; means directing the second fluid from said collecting chamber in a second path, said collecting chamber being arranged to preclude delivery of said first fluid in said second path; and means responsive to a decrease in the rate of flow of the second fluid in said second path to a preselected rate to control the discontinuation of operation of the removing means.

4. In an apparatus for cleaning material such as fabric and the like, fluid control means comprising: means defining a collecting chamber; a condenser in said chamber for liquefying fluids delivered thereto; means for removing first and second fluids in vaporized form from the material and delivering them to said collecting chamber to be liquefied therein; means operating said removing means to remove the first fluid from the material and delivering it to said collecting chamber; means directing the first fluid from said collecting chamber in a first path; means responsive to a decrease in the rate of flow of the first fluid in said first path to a preselected rate to discontinue operation of the removing means; means responsive to discontinuation of operation of the removing means to deliver the second fluid to the material; means subsequently operating said removing means to remove the second fluid from the material and delivering it to said collecting chamber; means directing the second fluid from said collecting chamber in a second path, said collecting chamber being arranged to preclude delivery of said first fluid in said second path; and means responsive to a decrease in the rate of flow of the second fluid in said second path to a preselected rate to control the discontinuation of operation of the removing means.

5. In an apparatus for cleaning material such as fabric and the like, fluid control means comprising: means for removing first and second fluids having different densities from the material; a fluid separator; means operating said removing means to remove the first fluid from the material and delivering it to said separator; means directing the first fluid from said separator in a first path; means responsive to a decrease in the rate of flow of the first fluid in said first path to a preselected rate to discontinue operation of the removing means; means operating said removing means to remove the second fluid from the material and delivering it to said separator; means directing the second fluid from said separator in a second path; and means responsive to a decrease in the rate of flow of the second fluid in said second path to a preselected rate to control the discontinuation of operation of the removing means.

6. The apparatus of claim 5 wherein said first fluid comprises water and said second fluid comprises an organic dry-cleaning fluid.

7. The apparatus of claim 5 wherein said separator comprises a manometer.

8. Apparatus for cleaning material such as fabric and the like, fluid control means comprising: means for removing first and second fluids from the material; means operating said removing means to remove the first fluid from the material; means directing the first fluid removed from said material in a first path; means for subjecting the material to the second fluid; means responsive to a decrease in the rate of flow of the first fluid in said first path to a preselected rate to discontinue operation of the removing means and cause operation of said subjecting means; means arranged to discontinue operation of said subjecting means after a preselected time; means subsequently operating said removing means to remove the second fluid from the material; means directing the second fluid removed from said material in a second path and being arranged to preclude delivery of said first fluid in said second path; and means responsive to a decrease in the rate of flow of the second fluid in said second path to a preselected rate to control the discontinuation of operation of the removing means.

9. Apparatus for cleaning material such as fabric and the like, fluid control means comprising: means for vaporizing and removing first and second fluids from the material; a condenser; means operating said vaporizing and removing means to deliver the first vaporized fluid from the material to said condenser for liquefication therein; means directing the first liquefied fluid from said condenser in a first path; means for subjecting the material to the second fluid; first control means responsive to a decrease in the rate of flow of the first liquefied fluid in said first path to a preselected rate to discontinue operation of the vaporizing and removing means and cause operation of said subjecting means; means arranged to discontinue operation of said subjecting means after a preselected time; means operating said vaporizing and removing means to deliver the second fluid from the material to said condenser for liquefication therein; means directing the second liquefied fluid from said condenser in a second path and being arranged to preclude delivery of said first fluid in said second path; and second control means responsive to a decrease in the rate of flow of the second liquefied fluid in said second path to a preselected rate to control the discontinuation of operation of the vaporizing and removing means.

10. The apparatus of claim 9 including means for precluding operation of said first control means during operation of said subjecting means.

11. A control for use in an apparatus for cleaning material such as fabric and the like, fluid control means comprising: a timer motor; first, second and third cams driven by said timer motor; a first switch controlled by said first cam to energize said timer motor for a preselected period of time and then to de-energize said timer motor; a second switch; first actuating means for closing said second switch; a third switch controlled by said second cam to close when said first switch is opened and energize said actuating means, said second and third switches being in series with said timer motor to re-energize said timer motor when both the second and third switches are closed; a fourth switch; second actuating means for closing said fourth switch; and a fifth switch controlled by said third cam to close when said first and third switches are open and energize said second actuating means, said fourth and fifth switches being in series with said timer motor to re-energize said timer motor when both the fourth and fifth switches are closed.

12. The control of claim 11 wherein said second and fourth switches are thermoresponsive and said actuating means comprise heating elements arranged to be cooled by a fluid flow in association therewith whereby the closing of said second and fourth switches is controlled by the fluid flow.

13. The control of claim 11 wherein a relay is provided having a coil connected in series with said third switch and a switch controlled by said coil connected between said timer motor and said second switch.

14. In an apparatus for cleaning material such as fabric and the like, fluid control means comprising: means for removing seriatim first and second fluids from the material; means operating said removing means to remove the first fluid from the material; means responsive to a decrease in the amount of first fluid only remaining in the material to a preselected low amount to discontinue operation of the removing means; means for subsequently operating said removing means to remove the second fluid from the material; and means responsive to a decrease in the amount of second fluid only remaining in the material to a preselected low amount to discontinue operation of the removing means.

15. In a dry-cleaning machine for subjecting fabrics or the like to a complete cycle comprised of a preliminary drying portion to remove residual moisture from said fabrics, a wash portion using a dry-cleaning solvent and a final drying portion to remove dry-cleaning solvent from said fabrics, fluid control means comprising: means defining a treatment chamber for receiving said fabrics; means for vaporizing moisture from said fabrics in said treatment chamber during said preliminary drying cycle portion and dry-cleaning solvent during said final drying cycle portion; means defining a condensing chamber; means for transferring said vaporized moisture and dry-cleaning solvent from said drying chamber to said condensing chamber; means in said condensing chamber for condensing said vaporized moisture and dry-cleaning solvent therein; an outlet from said condensing chamber; fluid separation means communicating with said condensing chamber outlet; first and second outlet conduits connected to said fluid separation means, said fluid separation means directing

vaporized moisture removed from said fabrics during said preliminary drying cycle portion through said first outlet conduit and vaporized dry-cleaning solvent removed from said fabrics during said final drying cycle portion through said second outlet conduit; means in said first outlet conduit sensitive to the rate of flow of condensed moisture therethrough to control said vaporizing means to terminate said preliminary drying cycle portion and initiate said wash cycle portion; and means in said second outlet conduit sensitive to the rate of flow of condensed dry cleaning solvent therethrough to control said vaporizing means to terminate said final drying cycle portion.

16. The dry-cleaning machine of claim 15 wherein said flow rate sensitive means in said first and second outlet conduits include thermoresponsive means controlled by the rate of heat dissipation effected by the rate of flow of condensed moisteure and dry cleaning solvent in said first and second outlet conduits.

17. The dry-cleaning machine of claim 15 wherein said moisture vaporized from said fabrics during said preliminary drying cycle portion is water and wherein said means in said first conduit is calibrated for actuations by a predetermined minimal flow rate of water.

18. The dry-cleaning machine of claim 15 wherein said dry-cleaning solvent has a specific density greater than 1 and wherein said means in said second conduit is calibrated for actuation by a predetermined minimal flow rate of dry-cleaning solvent.

19. The dry-cleaning machine of claim 15 wherein the operation of said fluid separation means is dependent upon the relative specific densities of said moisture and said dry-cleaning solvent.

20. The dry-cleaning machine of claim 19 wherein the specific density of said dry-cleaning solvent is greater than the specific density of said moisture.

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