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DRY CLEANING APPARATUS

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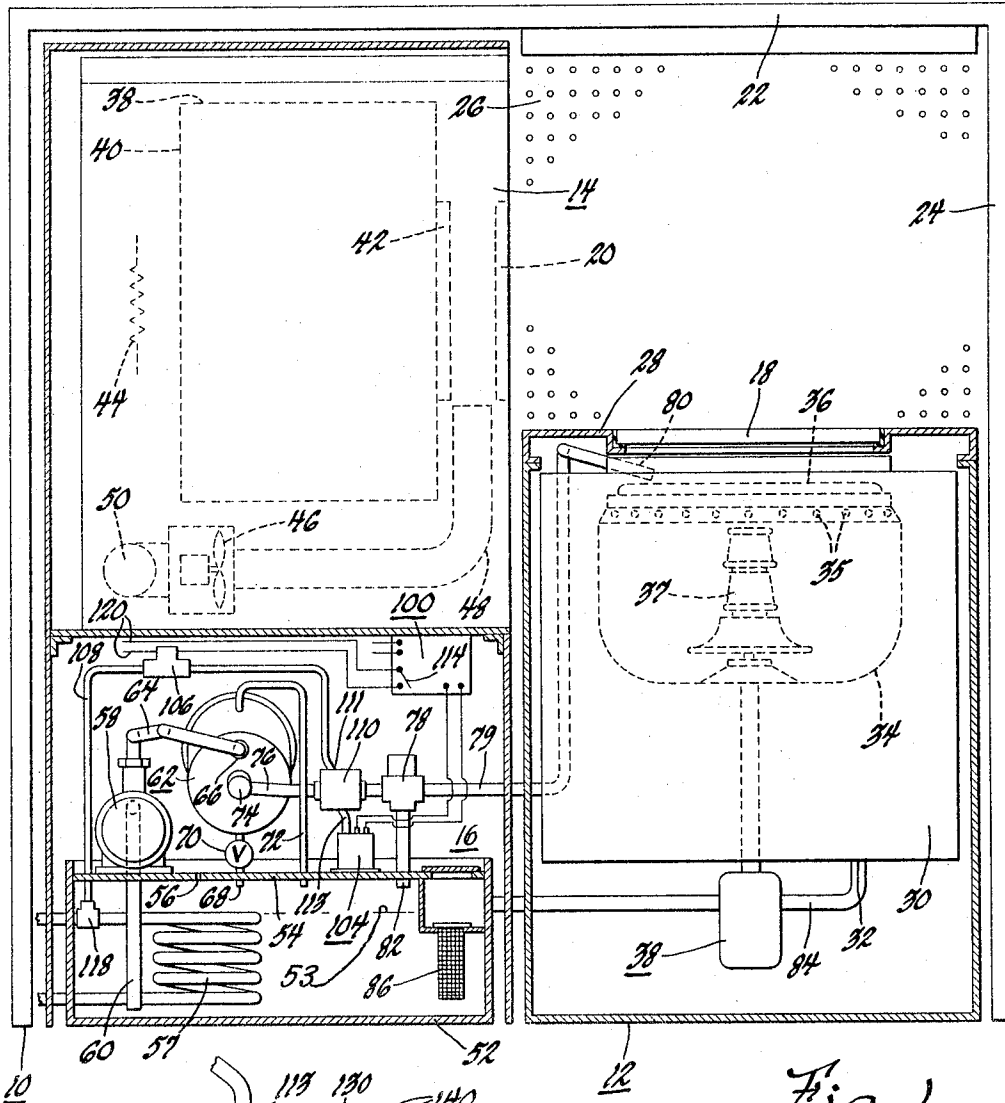


Fig. 1

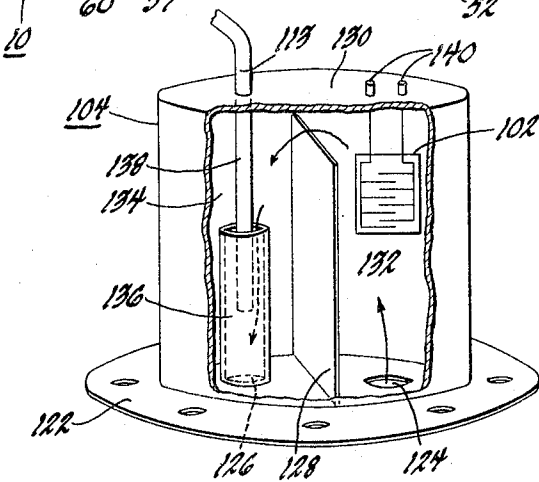


Fig. 2

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DRY CLEANING APPARATUS

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This invention relates to a dry cleaning apparatus and more particularly to a controlled water injection system for a dry cleaner having an improved electronic relative humidity sensing arrangement.

The proper operation of an effective dry cleaning system requires that all soil, both water soluble and solvent soluble, be removed from the garments being cleaned. For this reason perchlorethylene and detergent are frequently combined in a water-solvent solution to perform the cleaning task, and it is essential that the water content or relative humidity of the solution be maintained at a predetermined level in order to optimize the effectiveness of the detergent in removing water soluble spots.

Accordingly, it is an object of this invention to provide an improved system for sensing the relative humidity of a dry cleaning solvent and, in response thereto, providing a controlled supply of water to the solvent in order to maintain the solvent at a desired relative humidity.

It is a further object of this invention to provide in a dry cleaner a combination system for sensing the relative humidity of a dry cleaning solvent and supplying makeup water thereto.

A more specific object of this invention is the provision of a dry cleaner having a substantially enclosed solvent reservoir in combination with a relative humidity sensor and a solvent bleed supply nozzle—an aspirating effect created by the bleed supply nozzle serving to draw solvent vapor over the relative humidity sensor.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

FIGURE 1 is a front sectional view, partly in elevation, of a dry cleaning apparatus suitable for use with this invention; and

FIGURE 2 is an enlarged perspective view with parts broken away to show the aspiration arrangement whereby vapor flow is induced past the relative humidity sensor.

Suitable for use with this invention and turning now to FIGURE 1, a unitary dry cleaning system or apparatus of the replaceable filter cartridge type is illustrated. The system includes an outer cabinet 10 for partially enclosing a clothes cleaner or agitating apparatus 12 and a clothes dryer or drying apparatus 14. Note that the clothes dryer 14 is elevated above the floor to provide for a filter compartment 16 therebelow. The clothes cleaner 12 has a top access door 18 which is pivotally openable for inserting and removing fabrics from the cleaner.

The clothes dryer 14 has a front access door 20 which faces the washer access door 18 adjacent one side thereof. This arrangement places the access doors 18 and 20 in a confined area defined by a top wall 22 and a side wall 24 of the dry cleaning cabinet 10—a perforate grille 26 at the rear of the confined space operating to withdraw fumes from the area. The outlet or vent grille 26 is connected to the atmosphere through an exhaust blower at the rear of the cabinet.

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The cleaner or agitating apparatus 12 is shown comprised of an outer cabinet 28 in the top wall of which is located the access door 18, hinged along a rear edge thereof. Within the washer cabinet 28, a generally cylindrical, imperforate solvent container 30 is disposed which includes an access opening in axial alignment with the top access lid 18 of the washer. The lower end of the solvent container 30 includes a drain opening 32 draining the solvent container from a lowermost portion thereof. A generally cylindrical spin tub or container 34 is rotatably supported in the solvent container and includes a plurality of circumferentially arranged outflow ports 35 around an upper portion thereof and a top access opening 36 which aligns with the door 18 immediately above. Within the spin tub 34, an agitator 37 is adapted for vertical reciprocation. A motor-driven agitating and spinning mechanism is shown generally at 38 and is adapted to vertically reciprocate the agitator 37 when operated in one manner and to rotate or spin the tub 34 when rotated in another manner.

The clothes dryer 14 is a conventional, single pass, circulating air dryer substantially like that taught in the patent to Whyte 2,843,945 issued July 22, 1958. The dryer includes a horizontally rotatable tumbling drum or container 38 having a perforate rear wall 40 and a front access opening 42 in alignment with the dryer door 20. A drying heater 44 is disposed adjacent the perforate rear wall 40 of the tumbling drum and is adapted to be energized for drying clothes within the tumbling drum. During operation of the heater 44 and rotation of the tumbling drum 38, air is circulated by a fan 46 connected with the drum access opening 42 by way of a front duct 48, said front duct being exhausted to atmosphere by the fan through an exhaust duct 50.

The solvent circulating system for a dry cleaning fluid or solvent, such as perchlorethylene (a somewhat toxic dry cleaning fluid) or Valclene (a nontoxic dry cleaning fluid made by the Du Pont Corporation which is essentially Freon 113) will now be described with reference to FIGURE 1. The main components of the circulating system include a sump or solvent reservoir 52 containing a predetermined level 53 of dry cleaning solvent and having a top wall 54 with an air vent and spill-over return 56, thereby to substantially enclose the solvent and its vapor. Immersed in the solvent is a cooling coil 57 through which water courses, said water being thermostatically controlled to maintain the solvent at its best cleaning temperature. Above the sump top wall 54 is a pump 58 which has its inlet connected through a solvent suction dip tube 60 to the bottom of the sump 52. A filter 62 is adapted to receive the output of the pump through a conduit 64 which connects to the inlet 66 of the filter. The case of the filter 62 is positioned angularly in the filter compartment 16, such that a gravity drain 68 extends through the sump wall 54 and includes a valve 70 manually openable to substantially drain the filter of solvent when the dry cleaning system is shut down. A solvent by-pass line 72 is provided at the top of the filter case to bleed air from the case. Unfiltered solvent passes through the by-pass line during operation of the filtration system and returns to the solvent reservoir.

At one end of the filter, an outlet fitting 74 connects by way of a solvent supply conduit 76 through a two-way or two-position valve 78 and supply conduit 79 to the tub access opening 36—a terminal portion 80 overlying the top of the spin tub. The two-position valve 78 may be controlled such as by a solenoid into a first position connecting the filter outlet 74 to the spin tub 34 and a second position connecting the filter outlet to a sump return line 82. Completing the circulating system

is a conduit 84 which connects to the drain outlet 32 of the solvent container 30. This conduit 84 enters the sump 52 by way of a button trap 86, access to which is gained through a removable lid thereabove for cleaning.

The fluid circulation system operates as follows. The pump 58 draws dry cleaning fluid or solvent from sump 52 through the dip tube 60. This dry cleaning fluid, cleaned of large objects by the trap 86, is forced through the conduit 64 to the filter 62 which is effective to remove small solids, solubles and any loose carbon particles from the dry cleaning fluid. After an initial period in which the two-position valve 78 returns the solvent to the sump, the valve is actuated to discharge the solvent from the filter by way of the conduit 76 and its end nozzle 80 into the spin tub 34. When the level of dry cleaning fluid within the tub reaches the outflow ports 35, the dry cleaning fluid will continue to overflow into the solvent container 30 during the agitate cycle and will return by gravity through the conduit 84 to the sump 52. For additional details on the replaceable cartridge type of dry cleaning system, reference may be had to the copending application Serial No. 120,420 filed June 28, 1961, now Patent No. 3,110,170, and to the other applications referred to therein and assigned to the same assignee.

In the foregoing equipment a cleaning solution of perchlorethylene and detergent will remove or dissolve most of the soil from the garments being cleaned, and water soluble spots not removable in dry cleaning solvent alone can often be removed by spotting with water prior to dry cleaning. Such prespotting requires a certain amount of skill and extra time on the part of the attendant. Thus, it appears that the presence of water in a dry cleaning solution is helpful in the removal of water soluble spots and it is known that even an increase in detergent concentration does not sufficiently increase the system's potential for spot removal unless accompanied by an increase in the relative humidity (R.H.) of the solvent, i.e., the water content of the cleaning solution. Moreover, carbon soil removal will also increase slightly with the solvent solution at a higher R.H. and linting on the clothes will be reduced.

On the other hand, an excess of water in the dry cleaning solution has some disastrous side effects, such as severe wrinkling of the garments being cleaned, shrinkage, and higher redeposition of soil which results in graying of the garments. This suggests that the proportion of water to solvent maintained in the dry cleaning system is critical and it is to improved electronic apparatus for sensing and controlling this proportion that this invention is directed.

In general, the sensing system of this invention is comprised of an electronic controller and magnetic amplifier 100, a relative humidity sensing element 102 housed in an air flow inducer chamber or sniffer box 104 to be described more fully hereinafter. The water injection system consists of a solenoid valve 106 for controlling a water supply line 108 which leads to a mixing fitting 110 in the solvent supply line 76.

The mixing fitting 110 is comprised of a water inlet 111 and a solvent outlet or bleed line 113. The fitting 110 is more of an enlarged portion in the solvent supply line 76 for intermixing the water with the solvent. In other words, water is injected through the conduit 108 into the solvent supply prior to the introduction of the mixture to the spin tub 34. As long as solvent is being circulated, a steady stream of the mixed water and solvent is bled through the conduit 113 as the means for initiating the aspiration in the sniffer box 104.

The controller 100 consists of a bridge circuit in which the humidity sensing element 102 is one leg of the bridge. With a change in the humidity of the dry cleaning solution in the sump (the amount of moisture the vapor above the dry cleaning solution is holding compared to what it could hold), the resistance of the sensing element 102 changes, thereby unbalancing the bridge. This signal is amplified and used to activate a relay whose contact

switch 114 closes to energize the solenoid valve 106 in the water supply line 108. This supply line may be tapped into the solvent cooling coil 57 as at 118 or to any other suitable source of water.

The amplifier portion of the controller 100 is energized through conductors 120 whenever the two-way valve 78 in the tub fill line is energized in its first position to condition the solvent supply conduit for continuous solvent supply during the clothes cleaning cycle.

The humidity sensing element 102 is made of two gold electrodes having intermeshed legs embossed on one side of a plastic base. A humidity sensitive film of polyvinyl alcohol and lithium chloride is applied over the gold grid.

Turning now to FIGURE 2, the air flow inducer or sniffer box 104 is shown comprised of an inverted cup having a mounting flange 122 adapted to rest on the top wall 54 of the sump. Note that the sump top wall includes an inlet port 124 and an outlet port 126, both connecting the air flow inducer or sniffer box to the sump. The sniffer box 104 is divided by a central partition 128 which terminates short of the top wall 130 of the sniffer box to form a passageway interconnecting a sniffer or relative humidity sensing chamber 132 with a vapor flow inducing chamber or aspiration chamber 134. The standpipe 136 is supported over the outlet port 126 and receives a nozzle 138 on the terminal end of a solvent bleed line 113 which is tapped into the solvent supply line, for instance, at the mixing fitting 110. The relative humidity sensing element 102 is supported within the sensing compartment 132 and is connected to terminals 140 on the top wall of the sniffer box—these terminals serving to communicate the sensed signal to the controller 100, thereby to control the valve 106 and, thus, the injection of water into the solvent supply line.

In operation, a solvent is supplied to the spin tub 34 continuously during a clothes cleaning cycle by way of the supply conduit 76. Since the supply of solvent during cleaning is continuous, a continuous supply of dry cleaning solution is bled from the system by way of the conduit 113 into the sniffer box 104. A fluid velocity aspiration is initiated by the supply of solution in the standpipe 136. This aspiration draws vapor from the sump 52 over the sensor 102 and the partition 128, returning to the sump through the standpipe 136. If the relative humidity of this recirculating vapor is low, the sensor 102 will signal the controller 100 to open the valve 106 for supplying additional water to the circulating solvent.

It should now be seen that an improved relative humidity control arrangement has been provided for a dry cleaning solvent system wherein the circulation of the solvent is used to induce a vapor circulation over the means for sensing the relative humidity.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In combination:

- (a) means forming a container adapted to contain a dry cleaning solvent such as perchlorethylene or the like for dry cleaning clothes,
- (b) means forming a substantially closed sump means containing a predetermined level of dry cleaning solvent therein and having a top wall, said top wall having first and second relative humidity sensing ports,
- (c) means including a water cooling line in said sump means below said predetermined level for cooling said dry cleaning solvent,
- (d) means including a solvent supply conduit connected in supply relationship to said container for effecting the circulation of dry cleaning solvent between said sump means and said container,
- (e) means for supplying water to the dry cleaning solvent being supplied to said container including a mixing means in said solvent supply conduit having a

water inlet and an outlet, a water supply conduit having one end connected to said water cooling line and its other end connected to the water inlet of said mixing means, and valve means in said water supply conduit openable for passing a regulated amount of water to said mixing means for entrainment into the solvent being supplied to said container,

- (f) and control means for controlling said valve means, said control means including an inverted cup-like sniffer box supported on said top wall of the sump means and having a closed top and an open bottom positioned over said first and second relative humidity sensing ports, said sniffer box having a partition therein between said first and second ports for separating said sniffer box into a sensing chamber and a vapor flow inducing chamber, said partition being spaced from said closed top to form a passageway interconnecting said chambers, a standpipe in said vapor flow inducing chamber having one end connected to said first port, a relative humidity sensing element in said sensing chamber in vapor flow intercepting relationship between said second port and said passageway, and aspiration means including nozzle means in said standpipe having an inlet end connected to the outlet of said mixing means to supply a bleed sample of solvent to said standpipe whenever solvent is being circulated to said container thereby to induce a stream of vapor through said sensing chamber from above said predetermined level of dry cleaning solvent in said sump means for sampling the relative humidity of the vapor of the dry cleaning solvent in said sump means, said relative humidity sensing element effecting a control signal in response to the relative humidity sensed to open said valve means when the relative humidity of said stream of vapor is below a predetermined value.

2. In combination:

- (a) means forming a container adapted to contain a dry cleaning solvent such as perchlorethylene or the like for dry cleaning clothes,
- (b) means forming a substantially closed sump means containing a predetermined level of dry cleaning solvent therein and having first and second relative humidity sensing port means,
- (c) means including a solvent supply conduit connected in supply relationship to said container for effecting the circulation of dry cleaning solvent between said sump means and said container,

(d) means for supplying water to the dry cleaning solvent being supplied to said container including a mixing portion of said solvent supply conduit having a water inlet and an outlet, a water supply conduit having one end connected to a source of water and its other end connected to the water inlet of said mixing portion, and valve means in said water supply conduit openable for passing a regulated amount of water to said mixing portion for entrainment into the solvent being supplied to said container,

- (e) and control means for controlling said valve means, said control means including sniffer means supported on said sump means and adapted to cover said first and second relative humidity sensing port means, said sniffer means having means for separating said sniffer means into a sensing chamber including said first sensing port means and vapor flow inducing chamber including said second sensing port means, said separating means forming a passageway interconnecting said chambers, a relative humidity sensing element in said sensing chamber in vapor flow intercepting relationship between said first port means and said passageway, and aspiration means including nozzle means in said second port means having an inlet end connected to the outlet of said mixing portion to supply a bleed sample of solvent to said second port means whenever solvent is being circulated to said container thereby to induce a stream of vapor through said sensing chamber from above said predetermined level of dry cleaning solvent in said sump means for sampling the relative humidity of the vapor of the dry cleaning solvent in said sump means, said relative humidity sensing element effecting a control signal in response to the relative humidity sensed to open said valve means when the relative humidity of said stream of vapor is below a predetermined value.

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