

DRYING AND STEAM CLEANING SYSTEM AND METHOD

FIELD

The present invention relates to a drying and cleaning system, and in particular, a heat air and steam for drying and cleaning laundries and/or other fabric items such as bags, shoes etc.

BACKGROUND

This highly populated society requires a high degree of personal cleanliness and hygiene for maintaining one in a healthy lifestyle. Unfortunately, unavoidable foreign substances, such as dust, odour or even germs, etc, are surrounding our daily life.

Washing machines which can almost be found in every household are used for cleaning laundries. Such cleaning method may clean up dirt and dust, but in most cases, germs stay. Further, as most of the common available washing machines which are operated in a high rotating speed, they may damage the laundries.

Laundries cleaned by the washing machines are required to be dried up manually. Today's urbanised societies require an uncluttered live-in space, such daily laundries chore is space consuming and dislike by most. Yards are often introduced to contain the management of laundries. However, laundries hanged within the yards take several hours to dry up. Further, yards measuring about 3 m², for example, take up valuable space which may be used for other activities. Furthermore, most, if not all, apartments are built without such yards.

Drum dryer which operates in a high rotational speed are often use for drying up laundries. However, laundries dried by the dryer often have the tendency to become crumbly and in some occasions, it damages the laundries' fabrics.

Further more such drum dryer need ducting to exhaust heat, moisture and lint that is fire hazard, difficult and costly to install in high rise apartment. More heating energy is required due to the exhausted heat.

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Dry cleaning which uses solvent, are commonly used for the cleaning laundries that are not suitable for washing machine cleaning. Such cleaning fluids stay in the laundry for which, in long run may effects the health of human bodies.

Steam cleaning without chemical is a great way to care for your wardrobe. It is the cleaning treatment of choice for multiple chemical sensitivity sufferers. It is the only cleaning system that is really effective without the use of chemicals. Vapor steam is naturally sanitizing while cleaning and removes odors. It does smooth away wrinkles and clean odors greatly reducing time-consuming and costly chores like ironing and making trips to the dry cleaners. This is because the steam straightens the fibers and removes static charge from fabrics.

At least preferred embodiments of the present invention seek to provide a drying and cleaning system that is economical to manufacture, while providing a drying and cleaning system which is easy to operate, and preferably drying and cleaning fabric materials without causing damage while removing all dust and germs.

At least other preferred embodiments seek to provide a drying and steam cleaning system, which preferably overcomes or at least partially alleviates drawbacks with existing systems.

SUMMARY

According to one aspect of the present invention, there is provided a drying and cleaning system comprising: a loading compartment for loading articles for cleaning, a heater for supplying dry air to said loading compartment; a steamer comprising a water inlet for connecting to a water source and a steam outlet for supplying steam to said loading compartment; a plurality of sensors for detecting operating conditions of said drying and cleaning system; a control panel; and a controller for controlling said drying and cleaning system, based on input from said control panel and input from said plurality of sensors to control said steamer and said heater.

The drying and cleaning system may further comprise an exhaust opening and means for circulating said dry air and said steam in a manner such that at least a portion of the said dry air and said steam is exhausted through said exhaust opening

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and a remaining portion of said circulating dry air and steam is recirculated into said loading compartment.

The drying and cleaning system may further comprise an openable lid for covering said loading compartment, said lid configured to define an air path for recirculating said dry air and steam into said loading compartment.

The steamer may comprise a pressure container for receiving water through said water inlet and for supplying steam to said steam outlet.

The pressure container may comprise a steam pipe for superheated steam, said steam pipe being coiled around the pressure container.

The steamer may be heated by burning gas.

The controller may be operable to control gas supplied to said steamer via a valve.

The valve may be a solenoid valve.

The heater may be a gas burner.

The controller may be operable to control gas supplied to said heater via a valve.

The valve may be a solenoid valve.

The loading compartment may comprise at least one rack for hanging clothing.

The drying and cleaning system may be configurable for installation in an existing cabinet or configurable for wall mounting.

The drying and cleaning system may be configurable for installation in an outdoor use cabinet.

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The drying and cleaning system may be housed in an encasement, said encasement comprising double insulated sandwich construction fabricated from metal coated with rust preventing enamel paint.

The drying and cleaning system may be housed in an encasement arranged for providing hot water and steam to a desired washing point for cleaning purposes.

According to another aspect of the present invention, there is provided a method of drying and cleaning, said method comprising the steps of: loading articles for drying and cleaning into a loading compartment; supplying dry air from a heater to said loading compartment; supplying steam from a steamer to said loading compartment; sensing drying and cleaning operating conditions; sensing input from a control panel; and controlling said drying and cleaning using a controller responding to sensed drying and cleaning operating conditions and input from said control panel.

The dry air and said steam may be circulating in a manner such that at least a portion of the said dry air and said steam is exhausted through an exhaust opening and a remaining portion of said circulating dry air and steam is recirculated into said loading compartment.

The dry air and said steam may be recirculated into said loading compartment via an air path defined within an openable lid for covering said loading compartment.

Embodiments of the present invention provide the advantage of minimising exhausted dry air as most of the dry air is circulated within the drying and cleaning system, therefore significantly reducing the need for ducting that is present in conventional household dryers. Such ducting can be a fire hazard.

The circulation of dry air and steam to facilitate the drying and cleaning of articles may reduce the energy consumption of said drying and cleaning system.

BRIEF DESCRIPTION OF DRAWINGS

Further features of the present invention will readily be apparent from the following detailed description of a non-limitative example, with reference to the accompanying drawings, in which:-

FIG. 1 is a perspective cross sectional view of a drying and steam cleaning system according one embodiment of the present invention;

FIG. 2 is a schematic diagram of a multi-gas system;

FIG. 3a-c are cross sectional views from different directions of the drying and steam cleaning system of FIG. 1 showing air flows with in the system when operating;

FIG. 4a is a block diagram of a controller of the drying and steam cleaning system of FIG. 1;

FIG. 4b is a control panel for coupling with the controller of FIG. 4a;

FIG. 5 is a flow diagram of an operating process of the drying and steam cleaning system;

FIG. 6a is a graphical representation of the performance over time of the dryer of FIG. 1; and

FIG. 6b is a graphical representation of the performance over time of the steamer of FIG. 1.

DETAILED DESCRIPTION

Where the same reference numeral appears in more than one of the accompanying drawings, it is used to denote the same element.

FIG. 1 illustrates a perspective cross sectional view of a drying and steam cleaning system 100 according to one embodiment of the present invention. The drying and steam cleaning system 100 includes a chamber 102 having a heater compartment 104 and a loading compartment 106, adjacent one another, where the loading compartment 106 occupies a major portion of the chamber 102. The top of the loading compartment 106 is an upper lid 105 which is hinged to an edge of the chamber 102 on one side and may be lifted up from an opposing side. The upper lid

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105 includes a flat plate 108 attached to a perforated plate 107 above an air plenum frame 111. Along the bottom edge of the upper lid 102, a door gasket 109 may be attached thereto for sealing the top opening when the upper lid 105 is closed down on the chamber 102.

In another configuration, the upper lid 105 may be mounted on the chamber 102 such that the upper lid 105 is slidable over the top of the chamber 102 for covering the loading compartments 106.

One side wall of the chamber 102, at the heater compartment 104 side, is provided with doors 110 for covering the heater compartment 104. The doors 110 define a plurality of horizontal perforated lines 112 for air ventilation. An air outlet 114 is formed on other side wall at the other end of the chamber 102, near the top, for dissipating hot air.

The heater compartment 104 is further partitioned into two portions 120, 124. A first portion 120 is provided for mounting a steamer 122 and a second portion 124, located below the first portion 120, is provided for mounting a heater 126. The first portion 120 is configured to isolate from the loading compartment 106. The steamer 122 mounted therein may supply steam to the loading compartment 106 through a perforated pipe which extended from the steamer 122 into the loading compartment 106. The perforated pipe is mounted along the edge of the chamber 102 where the upper lid 105 is hinged.

The second portion 124 is channelled into a vertical ditch 129, of which the upper end of the vertical ditch 129 defines a vent, which would allow air flowing into the loading compartment 106. In accordance with the present embodiment, the heater 126 is a gas burner to provide heated dry air. The heated dry air is guided by the vertical ditch 129 and entered into the loading compartment 106 through the vent.

The loading compartment 106 defines a cavity for loading articles. In this particular embodiment, the drying and steam cleaning system 100 may be used for drying and steam cleaning laundries. At least one height adjustable hanger 128 is mounted within the cavity of the loading compartment 106, of which laundries such as shirts, pants, etc. may be hanged thereon. At a bottom corner of the loading compartment 106, away from the heater compartment 104, is partitioned into a

separated space 130, where part of the partitioning panel 131 is perforated for making the loading compartment 106 and the separated space 130 connected. An air path 132 is extended vertically from the separated space 130 to the top. An electric blower may be installed within the separated space 130 for guiding air flows into the air path 132. The exhaust opening 114 is defined at the top end of the air path 132, through the chamber 102. Further, the end of the air path 132 is adapted to connect with the upper lid 105 when the upper lid 105 is closed. Such configuration allows air to flow into the inner space of the upper lid 105, and returns to the loading compartment 106 through the perforations of the perforation plate 107.

FIG. 2 illustrates a schematic diagram of the multi-gas system 200 for installation to the heating compartment 104 of the drying and steam cleaning system 100. The multi-gas system 200 includes a gas piping 210 connecting the gas burners 202 to a gas source (not shown). A cock valve 206 is installed on the gas piping 210 to prevent reverse flow of the gas into the gas source. The multi-gas system 200 has an automatic ignition starter for igniting the gas burner 202 on control by a controller of the drying and steam cleaning system 100. A solenoid valve 205 is installed before each of the gas burners 202, in response to the controller, for controlling the gas flow.

The steamer 122 is a gas-heating steamer which includes a pressure container 220 for containing fluid. The pressure container 220 is supplied with water from a water source (not shown) via a water pipe 222. Along the water pipe 222, a solenoid valve 224 is installed for controlling water flow to the pressure container 220. A cock valve 226 is also installed to prevent water from reverse flow.

The pressure container 220 has a steam pipe 228 for delivering steam to the loading compartment 106. The steam pipe 228 is configured to coil around the pressure container 220 in replacement of solenoid valve 224, which provides superheated steam at about 121°C. The steam pipe 228 is further extended into the cavity of the loading compartment 106 and connected to a steam outlet bar 232 for supplying steam into the loading compartment 106. The steam outlet bar 232 is installed horizontally along the edge of the chamber 102 where the upper lid 105 is hinged.

A water level sensor 230 installed within the pressure container 220, for

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monitoring the water level. The water level sensor 230 communicates with a controller 400 (shown in Fig. 4a), to control the solenoid valve to maintain the water at a desired level. According to an alternative embodiment, a ball valve may be installed within the pressure container 220, thereby, when the water level is below a certain level, the ball valve is opened and the ball valve is closed automatically when the pressure container 220 has enough water.

In accordance with the preferred embodiment of the present invention, the valves used were found to work well. However, it is understood that other valves suitable for the present invention may be desired.

FIGs. 3a-c illustrate cross sectional views from top, front and side respectively, the dry hot air and/or steam flow is being shown with arrows. FIG. 3b is the top view of the drying and steam system 100 where the top of the system 100 is removed. FIG. 3a is a cross sectional view of the drying and steam system 100 cutting along line A-A. FIG. 3c is a cross sectional view of the wet and dry system 100 cutting along line C-C.

During operation, when the gas burner 126 is ignited, hot air within the second portion 124 flows along the vertical ditch 129 and is guided into a perforated channel 150 which is mounted on the upper edge of the chamber 102. This perforated channel 150 is provided for distributing dry air into the loading compartment 106.

Similarly, when the gas burner 122 ignites the gas burner 122 boils water within the pressure container 220. The water vapor flows into the steam pipe 228, travel along the coiled pipe and emitted through the steam outlet bar 232 which is enclosed within the perforated channel 150. Steam will also be distributed along the perforated channel 150 into the loading compartment 106.

The heated air or the steam both flow along a same path within the loading compartment 106 after emission from the perforated channel 150. For simplicity, the heated air and the steam are hereinafter referred to as "the air".

After the air is emitted from the perforated channel 150, the air flows down into the loading compartment 106 as shown in the direction of arrows 30. Once the

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air reaches the bottom of the loading compartment 106, the air flows into the separated space 130, through the perforations of the partitioning panel 129 as shown in the direction of the arrows 32. The electric blower mounted in the separated space 130 may blow the air, along the air path 132, to the top of the chamber 102 as shown by the direction of the arrows 34. Some of the air flow out of the chamber 102 from the hot air outlet to the ambient (as arrows 38) and some channels into the space defined in the upper lid 105 as shown by arrows 36. The air is distributed among the space and flows back into the loading compartment 106.

FIG. 4a is a block diagram of the controller 400 of the drying and steam cleaning system 100. The controller 400 is electrically coupled to a control panel 450, a plurality of sensors 410 and multi-gas system 200. The controller 400 may be a microprocessor for controlling the operation of the drying and steam cleaning system 100.

The sensors 410 may include temperature sensors, pressure sensors, humidity sensors, gas sensors, water level sensors and the like, depending on application requirements. All such sensors 410 may be used for system monitoring to ensure the system is functioning under a preferred condition and providing a optimal performance for drying and cleaning.

In response to parameters detecting by the sensors 410, the controller 400 controlling the multi-gas system 200 in a preferred manner. For example, the solenoid valve 224 is controlled by the controller 400 in response to the water level sensor installed for the pressure container 220 for controlling the water supplies.

The controller 400 may be programmed to run the drying and steam cleaning system 100 in a plurality of prescribed cycles to provide drying and cleaning for different kind of laundry materials. The controller 400 may be incorporated with artificial intelligence control, such as fuzzy logic, for controlling the overall operation.

The control panel 450 as shown in FIG. 4b is provided for user selection. The control panel 450 include a plurality of buttons 451, 452, 453, 454 and 455, and a plurality of display LEDs 456. The buttons 451, 452, 453 and 454 are arranged in a column at the left of the control panel 450, where each of the buttons are labelled to denote their function. Above the top most button 451, there is further labelled with

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"Dryer" to denote that the buttons located below are for controlling the heater 126. The top most button 451 labelled "On/Off" is used for turning on the heater 126 manually by users. The subsequence buttons 452, 453 and 454 labelled "Low", "Medium" and "High" respectively are used controlling the level of the heater 126. When the buttons 452, 453 or 454 is pressed, the controller 400, in respond to the selected button, for controlling the gas supplies by adjusting the solenoid valve 205.

A button 455 is located, by the left of the button 451, for controlling the steamer 122. A label "Steamer" is provided for denoting that the button 455 may be used for controlling the steamer 122. In this embodiment, the steamer 122 is controllable in either on or off only. However, it necessary, the steamer 122 may be controlled in different temperature levels, and more buttons may be required accordingly.

The plurality of LEDs 456, arranged in a column, located below the button 455 for displaying operating status. The control panel 400 may further provide with a more precise display panel, for example liquid crystal display, for displaying the operating condition that could include controls and diagnostic status of the drying and steam cleaning system 100.

FIG. 5 is a flow diagram illustrating operations of the controller according to one embodiment of the present invention. When the drying and steam cleaning system 100 is energised, the controller 400 self initialises the drying and steam cleaning system 100 (step S510). During the self initialising step S510, the controller 400 first performs a checking on itself to ensure all components of the system 100 is functioning properly. The controller 400 may further perform few, such as gas leakage checking, oxygen depletion checking and the like for safety measures. After the controller 400 initialises itself, the controller 400 checks which button is pressed.

The controller 400 checks if the dryer high button 454 is pressed at step S512. If the dryer high button 454 is pressed, a counter of the controller 400 starts its counting (step S520). On of the LEDs 456 corresponding to the dryer high button 454 lights up (step S522). The controller 400 performs a shot delay, for example 500ms (step S524). The controller 400 activates the heater 126 and controls the loading compartment 106 within a first temperature limit (step S526). Once the temperature reaches the first temperature limit, the LED corresponding to the dryer

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high button will be turned off (step S528). Once the dryer high cycle is completed, the controller 400 proceed to END (step S580).

If the dryer medium button 453 is pressed (step S514), the counter of the controller 400 starts its counting (step S530). One of the LEDs 456 corresponding to the dryer medium button 453 lights up (step S532). The controller 400 performs a shot delay, for example 500ms (step S534). The controller 400 activates the heater 126 and controls the loading compartment 106 within a second temperature limit (step S536). Once the temperature reaches the second temperature limit, the LED 456 corresponding to the dryer medium button 453 will be turned off (step S538). Once the dryer medium cycle is completed, the controller 400 proceed to END (step S580).

If the dryer low button 452 is pressed (step S516), the counter of the controller 400 starts its counting (step S540). One of the LEDs 456 corresponding to the dryer low button 454 lights up (step S542). The controller 400 performs a shot delay, for example 500ms (step S544). The controller 400 activates the heater 126 and controls the loading compartment 106 within a third temperature limit (step S546). Once the temperature reaches the third temperature limit, the LED corresponding to the dryer low button will be turned off (step S548). Once the dryer low cycle is completed, the controller 400 proceed to END (step S580).

If the steamer switch button 455 is pressed, the counter of the controller 400 starts its counting (step S550). One of the LEDs 456 corresponding to the steamer button 455 lights up (step S552). The controller 400 performs a shot delay, for example 500ms (step S554). The controller 400 activates the steamer 122 and top up water in the pressure container 220 if water level is low (step S556). The controller 400 runs the steamer 122 limits (step S558) the coiling around container 220 produce the superheated steam at 122°C. Once the counter finishes its counting, the LED corresponding to the steamer button 455 is turn off (step S560) and the controller 400 proceed to END(step S580).

In accordance with other alternative embodiment of the present invention, it is also possible to combine the operation of both drying and steamer depending on user's needs.

FIG. 6a exemplifies a graphical representation of heating performances over time of the heater 126 for one operating cycle. The vertical axis represents temperatures in °C and humidity in %, and the horizontal axis represents time in minutes. Three temperature measurements were taken over a period of about sixty minutes, of which, a line formed on the square dots represent humidity of the loading compartment 106, a line formed on the rhombus dots represent temperatures of the loading compartment 106, and a line formed on the triangle dots represent the supplied hot dry air temperature. Before the heater 126 was started, the humidity was at 90%. When the heater 126 starts burning, for example, when the button 454 is pressed at step S520, it supplied dry heat air to the loading compartment 106 and the temperature of the supplied dry heat air increased in rapidly from 30°C to 100°C within ten minutes. The temperature of the compartment 106 increase constantly, whilst the humidity of the loading compartment 106 maintained at 90 %.

After ten minutes of heating, and drying, when the temperature of the supplied dry heat air over 110°C, the humidity level of the loading compartment 106 started to drop. In about another 25 minutes later, the supplied heat dry air reached its highest temperature of around 120°C, which may be the first temperature limit, and the humid temperature of the loading compartment 106 drop to 28%. At this stage, it is determined that most of the cotton material laundries were dried. At around 50 minutes later from the start, the heater 126 was switched off by the controller automatically at step S528. Such cycle may be controlled by the fuzzy control. At around 60 minutes from the start, all of the laundries dried except for those thick jeans or carpets.

A similar results may be expected when other button (i.e. button 452, or 453) is pressed, but the cycle may take place in a longer period depending on the configuration of the controller.

FIG. 6b is a graphical representation of performances over time of the steamer 122 among one of the operating cycles. The temperature measurements are taken within the loading compartment 106 but away from the steam outlet. In the graph, it shows that the temperature is raised from around 35°C to 75°C within a period of around 55 minutes. According to an experimental results, after the burner of the steamer is started, the water in the container boils in about 10 minutes. It is not that the steam that supplies to the loading compartment 106 is around 120°C. As

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there is energy loss during the air cycling process, and some of the hot air/vapour is exhausted from the loading compartment 106, the steam temperature is maintained at around 60°C to 75°C.

It is understood by those skilled in the art that even though numerous characteristics and advantages of various preferred embodiments of the present invention have been set forth in the foregoing description, this disclosure is illustrative only. Other modifications may be made, especially in matters of structure, arrangement of parts and/or steps within the principles of the invention to the full extent indicated by the broad general meaning of the appended claims without departing from the scope of the invention.

CLAIMS

1. A drying and cleaning system comprising:
 - a loading compartment for loading articles for drying and cleaning;
 - a heater for supplying dry air to said loading compartment;
 - a steamer comprising a water inlet for connecting to a water source and a steam outlet for supplying steam to said loading compartment;
 - a plurality of sensors for detecting operating conditions of said drying and cleaning system;
 - a control panel; and
 - a controller for controlling said drying and cleaning system, based on input from said control panel and input from said plurality of sensors to control said steamer and said heater.
2. The drying and cleaning system according to claim 1, further comprising an exhaust opening and means for circulating said dry air and said steam in a manner such that at least a portion of the said dry air and said steam is exhausted through said exhaust opening and a remaining portion of said circulating dry air and steam is recirculated into said loading compartment.
3. The drying and cleaning system according to claims 1 or 2, further comprising an openable lid for covering said loading compartment, said lid configured to define an air path for recirculating said dry air and steam into said loading compartment.
4. The drying and cleaning system according to claims 1, 2 or 3, wherein said steamer comprises a pressure container for receiving water through said water inlet and for supplying steam to said steam outlet.
5. The drying and cleaning system according to claim 4, wherein said pressure container comprises a steam pipe for superheated steam, said steam pipe being coiled around the pressure container.
6. The drying and cleaning system according to any one of the preceding claims, wherein said steamer is heated by burning gas.

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7. The drying and cleaning system according to claim 6, wherein said controller is operable to control gas supplied to said steamer via a valve.
8. The drying and cleaning system according to claim 7, wherein said valve is a solenoid valve.
9. The drying and cleaning system according to any one of the preceding claims, wherein said heater is a gas burner.
10. The drying and cleaning system according to claim 9, wherein said controller is operable to control gas supplied to said heater via a valve.
11. The drying and cleaning system according to claim 10, wherein said valve is a solenoid valve.
12. The drying and cleaning system according to any one of the preceding claims, wherein said loading compartment comprises at least one rack for hanging clothing.
13. The drying and cleaning system according to any one of the preceding claims, wherein said drying and cleaning system is configurable for installation in an existing cabinet or configurable for wall mounting.
14. The drying and cleaning system according to any one of claims 1 to 12, wherein said drying and cleaning system is configurable for installation in an outdoor use cabinet.
15. The drying and cleaning system according to any one of the preceding claims, wherein said drying and cleaning system is housed in an encasement, said encasement comprising double insulated sandwich construction fabricated from metal coated with rust preventing enamel paint.
16. The drying and cleaning system according to any one of the preceding claims, wherein said drying and cleaning system is housed in an encasement arranged for providing hot water and steam to a desired washing point for cleaning purposes.

17. A method of drying and cleaning, said method comprising the steps of:
loading articles for drying and cleaning into a loading compartment;
supplying dry air from a heater to said loading compartment;
supplying steam from a steamer to said loading compartment;
sensing drying and cleaning operating conditions;
sensing input from a control panel; and
controlling said drying and cleaning using a controller responding to sensed drying and cleaning operating conditions and input from said control panel.
18. The method according to claim 17, further comprising the step of circulating said dry air and said steam in a manner such that at least a portion of the said dry air and said steam is exhausted through an exhaust opening and a remaining portion of said circulating dry air and steam is recirculated into said loading compartment.
19. The method according to claim 18, wherein said dry air and said steam is recirculated into said loading compartment via an air path defined within an openable lid for covering said loading compartment.