APPARATUS FOR WASHING AND DRYING CLOTHES

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The present invention relates to a machine for washing and drying the clothes efficiently.

In particular, this invention relates to a machine for agitating the clothes in a mixture of a cleansing agent and water, preferably rinsing said clothes at least once with fresh water, removing the free water or drainable water from the clothes and thereafter alternatively subjecting said clothes to intermittent blasts of heated air and a vacuum or reduced pressure until said clothes are dry.

It has been proposed to dry clothes by tumbling them in a heated chamber at reduced pressure or vacuum. While such a process removes water more efficiently, the clothes are not as fluffy and desirable as those dried in a hot air blast; hence, vacuum drying has not come into appreciable, if any, use.

An object of this invention is to provide a machine for drying clothes whereby the water may be efficiently removed and the clothes obtained in a fluffy and fresh condition.

Another object of the invention is to provide a machine capable of drying the clothes with the efficiency of vacuum drying and the fluffing action of an air stream.

A further object is to provide a single machine which will automatically wash and dry the clothes with the high efficiency had with reduced pressure and with the fluffiness had when they are dried in an air stream.

Clothes have frequently been dried by tumbling them in a blast of heated air, but much difficulty is experienced in maintaining a saturation of moisture in the exhaust gases and in obtaining full utilization of the hot air. Generally the amount of heat required to remove the water is high and the process is too expensive. Furthermore, there is considerable lint scattered about the drying room by the exhaust gases.

Another object of the present invention is to provide a clothes washer and dryer which efficiently dries the clothes by blasts of hot air without their being removed from the machine.

Other objects and advantages will be apparent from the following description and drawings, in which

Fig. 1 is a side elevation, partly in cross-section and with a portion broken away, of a washer embodying the present invention;

Fig. 2 is an end elevation of a portion of the washer;

Fig. 3 is a cross-section taken along the line 3—3 of Fig. 2 showing the rotating tub rests on the washer frame;

Fig. 4 is a cross-sectional view of one end of the washer taken along line 4—4 of Figure 1;

Fig. 5 is a cross-sectional view taken on the line 5—5 of Figure 1;

Fig. 6 is a schematic diagram of the wiring and control mechanisms for the machine showing the air heater compressor vacuum pump as well as the controller and the various solenoid operated valves;

Fig. 7 is an elevation, in cross-section of an alternative form of blowing means for supplying air to the washer;

Fig. 8 is a side elevation, in cross-section, of a modified form of rotating drum in which the air blast enters the drum from the center portion;

Fig. 9 is an end view of a portion of the drum of Fig. 8 as seen from line 9—9 and showing the ports or nozzles through which heated air is intermittently passed into the drum.

The process of the present invention comprises washing the clothes by agitating them in a suitable container containing washing fluid, removing the drainable washing fluid from the clothes and from the container by suitable means and alternately subjecting the clothes to a vacuum and blasts of heated air. The air blast functions to heat the clothes and surroundings so that a substantial amount of water may be removed when they are subjected to a vacuum and the water is evaporated. The air blast also serves to fluff-up and freshen the clothes. Then the reduced pressure is applied to the warm clothes, the water is removed at a much lower pressure and with less energy than otherwise, but the temperature of the clothes and of the machine is rapidly reduced.

In accordance with the preferred process of the invention, the vacuum is suddenly relieved so that there is a strong in-rush of heated air through the clothes whereupon they are separated, then fluffed.

Referring to the drawings, it is seen that the washer of this invention comprises a rotating drum enclosed in a sealed casing and provided with means to supply water and hot air to said drum to evacuate said drum.

The clothes receiving drum 1 is a relatively large perforated cylinder which is rotatable within the housing 13. The drum 1 has a relatively large opening 6 to receive the clothes and is supported by suitable bearings such as at bearing 2 in the journal 3 which is in turn carried by the end portion or panel 63 of the housing or frame 13.

An air-tight casing 13 surrounds the drum and completely encloses it. The casing comprises a cylinder with panels 63 and 64 sealing off both ends. In the top of the casing is a pressure relief valve 38 which relieves pressure in the casing when it is aspirated by atmospheric pressure. The other end of the drum is supported by wheels or runners 4 (Fig. 3) bolted to the panel 64. The drum ends have heads 5 resting on wheels 4 and rotated therewith.

Mounted in one end of the casing is a circular frame 15 with a lip or projection 17 extending into the drum. Hinged to the frame at the side hinges 20 and 22 is a cover or lid 18 and lock 19. The cover has a circumferential ridge 23 (Fig. 3) which fits into a circular channel in the frame edge to provide an air-tight seal therewith. The clothes or objects to be laundered are placed in the drum through this frame opening at the input end of the drum.

The drum is rotated by pulley wheel 24 on drum shaft 14 which connects to the drive wheel 25 of motor 27 by belt 28. The motor preferably has two speeds so that the drum can be rotated rapidly and slowly as desired.

A blower 29 blows air through pipe 30 and into the journal chamber 16. Pipe 30 has suitable means, such as the heating elements 32 disposed throughout its length, for heating the air as it passes through. These elements are preferably high resistance wire as shown in Fig. 4. This heating can also be accomplished by gas burners or jets (not shown). In the pipe between the heating elements and blower is a butterfly-check valve 33 (Fig. 6) which seals off the pipe when a vacuum is drawn.

An alternative means for forcing air into the drum chamber is disclosed in Fig. 7. Here a compressor 75 powered by motor 76 forces air through pipe 77 into surge tank 78. When valve 33 is opened, the air rushes through pipe 30 and past heating elements 32 into the drum chamber. This provides powerful bursts of hot air to fluff and
dry the clothes. When the air is compressed in the tank, water may be condensed out and the air tends to be dehumidified and dried. A float valve 79 on the bottom of the tank 78 drains off condensed water when it accumulates. The tank 78 is surrounded by insulation 80 which increases the air relatively warm. If desired, means such as the heating element 90 which is controlled by the thermostatic operated switch 92 having a bulb 91 in the tank, may be provided to maintain the air in the tank at an elevated temperature (preferably above 250° F.). The heating element is connected across the line through the switch 92 by means of the wires 93 and 94. When a surge tank is used the compressor 75 may be controlled by the pressure switch 87 to maintain pressure in the tank at all times. Wires 83 and 88 are suitably connected to opposite sides of the line.

Spaced about the inner circumference of the drum are vent pipes 7 which connect into central manifold 8 on the drum shaft. The manifold is sectioned off with sections or partitions to provide separate passageways for each vent and is provided with vent slots 11 corresponding to each vent or vent passageway in the circumference of the manifold bearing 9. The journal chamber casing 21 also causes the manifold 8 also has a slot or opening 26 so that when slot 11 of the manifold bearing coincides with slot 26 of the journal casing, the air from blower 29 rushes into the particular vent uncovered. An added feature of this arrangement is the fact that the vent pipes are uncovered only when they are in the bottom or down position. Thus, the hot air will always blow up through the clothes where it heats them to permit rapid drying during the next stage when reduced pressure or vacuum is applied. It also fluffs up the clothes.

A modified form of drum is shown in Figs. 8 and 9 in which the air blows out through central hub 81 and not from a vent underneath the clothes, as in Figs. 1 and 2. In this modification, the air enters from conduit or pipe 36 into the journal chamber 16 and goes out through hub 81 into the chamber containing clothes. The manifold 82 on the drum shaft is provided with slots or ports 84 through which the air enters in bursts as the drum rotates. The clothes fall through the air stream as the drum rotates. In other respects, this drum is similar to the one of Figs. 1 and 2.

The interior of the casing 13 is evacuated by pump 34 which pumps both water and air. This pump has resilient valve 35 which consists of a rubber bladder which seal wash the pump casing. Insamuch as the volume of water vapor at reduced pressure and elevated temperatures becomes too great to economically expel by pump alone, condensing means such as a suitable jet condenser having nozzles 35 for spraying cold water are located in the chamber 37 which connects the pump with the interior of the casing. There is a check valve for condensing the water vapor prior to its passage through the pump. Cold water is supplied to the nozzles 35 of the jet condenser from a suitable source (not shown) connected to the connection 31 of the solenoid valve 58 which is controlled to cam 55 of the controller to supply water to the jet at those periods and only at those periods when the pump 34 is operating during the drying cycle. There is a check valve 56 in the drain or passageway 66 opening into the bottom of the housing or casing as shown and connecting the interior of the casing. At the time of the casing or housing 13 is relief valve 38 to relieve pressure in the casing when it is substantially above atmospheric as aforementioned. The casing is supplied with hot or warm water through solenoid valve 39 (Fig. 5) controlled by cam 40 of the controller 56. The cam 40 operates the appropriate microswitch 67 to energize the solenoid 39 when water is required during the washing or rinsing steps.

A suitable control 56 for this machine is shown in the schematic diagram of Fig. 6. The controller may comprise a series of cams driven by the motor 59 and suitably arranged to control the sequence of operation of the various parts. As before mentioned cam 40 activates solenoid 42 which, in turn, opens valve 39 and lets hot water into the drum. Cam 42 energizes solenoid 43, which in turn energizes the heating wires 52 in the blower pipe 30. Cam 43 controls the blower motor 46 running blower 29. Cam 47 controls the energizing of the solenoid 48, which when energized opens the check valve 36 in the casing bottom, and cam 49 controls motor 51 for the water and air pump 34 to evacuate the casing. Cam 50 activates solenoid 52 which opens butterfly valve 33 in blower pipe 30. Cam 53 controls the motor 27 which rotates pulley 25 through driving means and rotate drum pulley 24. Cam 55 activates solenoid 57 which opens valve 58, supplying water to condenser nozzles 35. Motor 59 drives cam shaft 60 through means 62 to operate the cams as described. The cams are positioned with respect to each other and shaped as known to the art to provide for the desired cycle of operation.

The preferred cycle of operation is as follows: The clothes are placed in the drum with some detergent or soap and the drum is closed by the cover or lid 18. Drain valve 36 is closed. The controller is started and pump 34 is in operation. The drum is partially filled with hot water. The depth of the water may be controlled if desired by a suitable float 73 in the stand pipe 72 which operates the switch 74 through a suitable stuffing box to break the circuit to valve 39 when the water level reaches the desired maximum. At the same time the drum is rotated and agitated for a suitable time, such as ten to twenty minutes to constitute the washing step. The micro switch 67 may be maintained closed during the entire washing step and during each rinsing step. The rotation of the drum is continued but at the end of the washing step the contacts of switch 67 are opened to insure that valve 39 remains closed and valve 36 is then opened and the dirty, soapy water is drained from the drum by the operation of pump 34. Valve 36 is thereupon closed and valve 39 again opened to permit clear, rinse water to fill the drum to the desired level. Valve 39 is closed and valve 36 opened and pump 34 operated to again drain the housing. The rinse may be repeated two or more times so that the clothes are thoroughly rinsed by simply changing the cam design as well known in the art. The pump is operated for a substantial period to remove all drainable water from the clothes and if desired may be operated continuously during the washing, drying, and rinsing steps. Next, while the drum is continually rotated, heating coils 32 in the blower pipe 30 are energized by operation of the solenoid switch 43 which causes the contacts 68 and 69 to be connected respectively to contacts 70 and 71 and the blower turned on so that hot air is blown into the drum. The coils may if desired be energized a short time before the blower so that they are heated up before the blower starts. This heated air is preferably forced through the wet clothes until they are quite hot. Next the solenoid 52 is energized and the blower is stopped, the butterfly valve 53 in the blower pipe is shut, the valve 36 opened and pump 34 commences to draw a vacuum on the drum. Water is forced through condenser nozzles 35 to condense warm vapor. The vacuum which is preferably at least 15 inches of mercury tends to evaporate the moisture from the clothes, the moisture being removed rapidly until the clothes drops to the temperature of the condenser water. After a suitable vacuum interval the rapid acting valve 33 is suddenly opened and hot air heated by suitable means is again forced into the clothes. Another vacuum is then drawn on the drum, and the process is repeated several times until the clothes are dry. The drum is then rotated continuously throughout this operation so that the air enters the drum in puffs or blasts through the clothes.

This method of washing and drying clothes is par-
particularly advantageous because it leaves the clothes very fresh, fluffy, and clean smelling. The rinsing steps may be omitted if desired. Alternate use of air pressure and vacuum achieves this effect very efficiently.

While it is preferable to have the washing and drying operation as above described in a single machine, the various options may be eliminated if the machine is to be used mainly for washing and the machine operated solely as a dryer, the clothes being placed in the clothes receiving container or drum and being heated alternately by forcing heated air into said chamber through said clothes and subjected to reduced pressure or vacuum. Even without the apparatus for creating a source of air under pressure which is operable, the subjection of the clothes to intermittent puffs of hot air, which is directed to selected portions of the drum, i.e. the lower portions of said drum between separate passageways connecting with the housing, is advantageous in facilitating drying and in utilizing the heat and moisture carrying capacity of the heated air.

It is understood that various modifications of my invention may be employed by those skilled in the art without departing from the scope of the claims and spirit thereof.

What I claim is:
1. A clothes dryer, means forming an air-tight receptacle, including a clothes-receiving drum, means for rotatorily supporting said drum, closure means providing access to the interior of said drum for insertion and removal of clothes from said drum, means including a blower for supplying heated air to said drum, means including a vacuum pump for exhausting said drum and for creating a vacuum in said drum, valve means for starting and stopping the supply of air from said blower to said drum, means for controlling said exhausting means to start and stop evacuation of said drum, and means for regulating the operation of said valve means and said controlling means to subject the interior of said drum and the clothes therein periodically to a vacuum, said regulating means causing the supply of air to said drum from said blower to be discontinued during the pulling of a vacuum in the drum and stopping evacuation of said drum while air is being supplied to the drum so that the interior of said drum and the clothes therein are intermittently subjected to vacuum and rapidly returned to about atmospheric pressure, whereby drying is accomplished at relatively low temperatures and heat to compensate for heat lost by latent heat is supplied intermittently to clothes in the interior of said drum.

2. A washing machine comprising a housing having an opening therein, closure means for closing said opening in a substantially air-tight manner, a perforated drum mounted for rotation in said housing and having an opening therein adapted to register with the housing opening to provide access into the interior of said drum, means for supplying heated air to said drum including a source of air under pressure, means including a valve for intermittently stopping and starting the flow of air to said drum from said source, means including a valve for supplying water into said housing and for controlling the flow of water from said drum, means for removing said water and said air from said drum including an air-liquid suction pump and a drain conduit connected at its upper end to the bottom portion of said housing below said drum and at its lower end to said pump, a drain valve for controlling the flow of fluid through said conduit, means for stopping and starting the evacuation of said drum by said pump.

3. A washing machine comprising a housing having an opening therein, closure means for closing said opening in a substantially air-tight manner, a perforated drum mounted for rotation in said housing and having an opening therein adapted to register with the housing opening to provide access into the interior of said drum, means for supplying heated air to said drum including a source of air under pressure and means for heating said air, means including a valve for intermittently stopping and starting the flow of air to said drum from said source, means including a valve for supplying water into said housing and for controlling the flow of water from said drum, means for removing said water and said air from said drum including an air-liquid suction pump and a drain conduit connected at its upper end to the bottom portion of said housing below said drum and at its lower end to said pump, a drain valve for controlling the flow of fluid through said conduit, means for stopping and starting the evacuation of said drum by said pump, and control means operably connected to said valves for automatically opening and closing said valves periodically in a predetermined sequence to regulate the supply of air and water to said housing and for the removal of said air and water by said air-liquid pump.

4. A clothes dryer comprising a housing, closure means providing an opening into said housing and closing said housing to form an air-tight receptacle, a perforated drum mounted for rotation in said housing, closure means in said drum providing access through said housing into the interior of said drum to insert and withdraw clothes therefrom, means for supplying heated air under pressure to said drum including a blower and a conduit from said blower to said housing, exhausting means including a vacuum pump for evacuating said drum and said housing to create a vacuum therein, valve means for admitting and exhausting said air from said drum and for periodically subjecting the interior of said drum to a vacuum, control means causing the valve means to discontinue the supply of air to said drum during the period while said vacuum is pulled on said drum and stopping the evacuation of said drum while air is being supplied to the drum.

5. A clothes dryer comprising means providing an air-tight receptacle including a rotatable drum, closure means providing access to the interior of said drum for insertion and removal of clothes, means defining a plurality of circumferentially spaced longitudinal passages adjacent the radially outer periphery of said drum and rotatable with said drum, means for directing gases radially inwardly from said passages to the interior of said drum, means for supplying heated gases under pressure to said passages including distributing valve means at one end of said drum adjacent the axis thereof, passage means leading radially outwardly from said distributing means to each of said passages, a source of heated gases for supplying said gases through said supply conduit to said distributing means, said distributing valve means establishing communication between said source and one of said passages when that passage arrives at the lower portion of said drum and simultaneously cutting off communication with the remaining passages so that gases are supplied intermittently during rotation of said drum directly to the low region of said drum to fluff up and freshen the clothes, vacuum producing means including a pump for pulling a vacuum on the interior of the drum, and means for automatically controlling the supply of said heated gases and said vacuum-producing means to periodically stop and start the flow of said gases to said distributing means and to said drum whereby the interior of said drum and the clothes therein are intermittently subjected to partial vacuum and rapidly returned to about atmospheric pressure.

6. In a clothes dryer, a housing having an opening therein, closure means for closing said opening in a substantially air-tight manner, a perforated drum mounted for rotation in said housing and having an opening therein adapted to register with the housing opening to provide access into the interior of said drum, means for supplying heated air to said drum including a source of air under pressure and means for heating said air, means including a valve for intermittently stopping and starting the flow of air to said drum from said source, means including a valve for supplying water into said housing and for controlling the flow of water from said drum, means for removing said water and said air from said drum including an air-liquid suction pump and a drain conduit connected at its upper end to the bottom portion of said housing below said drum and at its lower end to said pump, a drain valve for controlling the flow of fluid through said conduit, means for stopping and starting the evacuation of said drum by said pump, and control means operably connected to said valves for automatically opening and closing said valves periodically in a predetermined sequence to regulate the supply of air and water to said housing and for the removal of said air and water by said air-liquid pump.
heated air to the interior of said drum, a conduit extending from said source to one end of said drum, means for conveying heated air under pressure from said conduit to the interior of said drum including distributing means at one end of said conduit adjacent to the axis of said drum and including passage means for intermittently introducing air from said distributing means directly to the low interior region of said drum to fluff up and freshen the clothes, vacuum-producing means including a pump for pulling a vacuum on the interior of the drum, control means for automatically regulating the operation of the vacuum producing means and means for periodically starting and stopping the flow of said air from said air supply means to said drum so that the interior of the drum is intermittently subjected to partial vacuum and rapidly returned to about atmospheric pressure.

7. In a clothes dryer, means forming a substantially air-tight receptacle including a clothes-receiving drum, closure means providing access to the interior of said drum for insertion and removal of clothes from said drum, means for rotatably supporting said drum,空气输送 means including air supply means for intermittently introducing air from said drum including distributing means at one end of said conduit adjacent to the axis of said drum and including passage means for intermittently introducing air from said drum to fluff up the clothes, vacuum producing means including an air-liquid pump for pulling a vacuum on the interior of said drum, said vacuum producing means including an exhaust conduit to conduct air from said drum to said pump and a jet condenser in said exhaust conduit between said drum and said pump, said condenser comprising a chamber and a series of nozzles for spraying water into the interior of said chamber, control means for regulating said vacuum-producing means and the supply of air from said source to said distributing means to subject the interior of said drum and the clothes therein periodically to a vacuum, said control means causing the supply of air to said drum from said source to be discontinued during the pulling of a vacuum in the drum and stopping the evacuation of said drum by said air-liquid pump while air is being supplied to the drum from said source.

8. In a machine for washing and drying clothes having a rotatable clothes-receiving drum, a housing enclosing said drum, means for rotating said drum, valve-controlled means for supplying water to the interior of said housing during the washing operation and for draining water therefrom, cover means for opening said housing to permit access to said drum and for closing said housing to form a substantially air-tight chamber, means for permitting access to the interior of said drum for insertion or removal of clothes when access to said drum is provided through said housing opening means, and vent means spaced about the circumference of said drum for escape of liquid or gaseous fluid from said drum, the improvement which comprises: a source of air under pressure, means for heating said air, air supply means for conveying the hot air in blasts to the interior of said drum, control means for automatically regulating the operation of the air supply means and for periodically increasing and decreasing the flow of hot air from said source to said drum to subject the clothes in said drum intermittently to hot air blasts, and vacuum-producing means for pulling a vacuum on the interior of the drum during intervals between said blasts.

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