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(54) **Control assembly for a combined laundry washing and drying machine.**

(57) A control assembly for a combined laundry washing and drying machine in which a washing liquid heated by a respective electric heater element (10) is recirculated by means of a pump (9) from the lower part to the upper part of a laundering tub (5), and the laundry drying operation is carried out by means of an air flow produced by a blower (14) and heated by an associated electric heater element (15).

The control assembly comprises a pressure switch (16) controlling the washing liquid charging level in the tub (5) and a safety pressure switch (17), operable to individually energize one or the other of the electric heater elements (10, 15) when the washing liquid is at its maximum level, or when said tub (5) is empty, respectively, in the course of respective laundry washing and drying cycles, respectively.

The thus composed control assembly is of simple construction and reliable in operation.

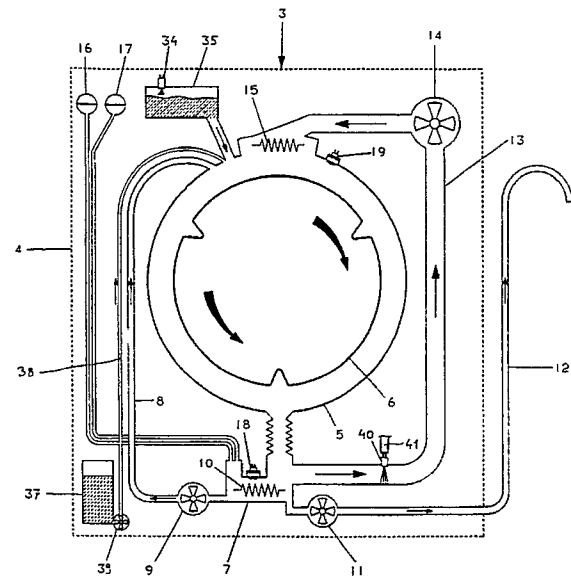


FIG. 1

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The invention relates to a control assembly for a combined laundry washing and drying machine adapted to permit the completely automatic execution by the machine of selected laundering and drying cycles.

In known types of combined machines for laundry washing and drying operations, in which a drum charged with the laundry is rotatably mounted in a tub, and the laundry is washed in successive phases by the repeated recirculation of a laundering liquid from a collector receptacle connected to a bottom portion of the tub to the upper portion of the tub, whereat the laundering liquid is sprinkled onto the laundry, the laundry is subsequently subjected to a succession of drying cycles, after the laundering liquid has been discharged from the tub at the end of the washing phases, by the circulation of a drying air flow through the laundry at temperatures selected in accordance with the type of the laundry to be dried, this air flow being produced by an associated blower and heated by at least one conventional electric heater element, and circulating through a separate conduit communicating with the bottom and top portions of the tub to thereby progressively dry the moist laundry contained in the drum.

Combined machines of this type are provided with an electric heater element for heating the laundering liquid, associated to conventional thermostat switches operable to repeatedly energize and deenergize the heater element in the course of each operating cycle, and optionally controlled by a heater protection device comprising a conventional safety thermostat switch operable to deenergize the heater element when the tub or collector receptacle containing the heater element is empty.

Machines of this type are in addition provided with a drying air heater element adapted to be repeatedly energized and deenergized in the course of each drying cycle to thereby establish different drying air temperatures in accordance with the type of laundry to be dried, in particular, lower temperatures for drying delicate fabrics (synthetics and the like) and higher temperatures for drying more resistant fabrics (cotton, linnen and the like).

Although the known machines of this type function in a satisfactory manner, they require the incorporation of specific per se known control devices for energizing and deenergizing the electric liquid heater element and the washing liquid recirculation pump in the course of the various laundering cycles, and the drying air heater element and the blower in the course of the selected drying cycles, these control devices including a number of electromechanical or electronic components resulting in a rather complicated construction and reduced reliability of the machine as a whole.

It is an object of the present invention to elimi-

nate the above discussed shortcomings by the provision of a control assembly for a combined laundry washing and drying machine, the control assembly to be of simple construction, reliable in operation, and capable of controlling the execution of the laundering and drying operations by the respective machine.

The control assembly according to the invention is realized with the characteristics as substantially described with particular reference to the drawings attached to the present description. The construction of the control assembly according to the invention will become more clearly evident from the following description, given by way of example with reference to the accompanying drawings, wherein:

fig. 1 shows a diagrammatic illustration of a combined laundry washing and drying machine provided with a control assembly according to the invention, and

fig. 2 shows an electric circuit diagram of the control assembly according to the invention.

Diagrammatically shown in fig. 1 is a combined laundry washing and drying machine 3 comprising a sheet metal housing 4 enclosing a laundering tub 5 with a rotatable drum 6 mounted therein for containing the laundry to be laundered and dried. The machine further comprises a washing liquid collector receptacle 7 connected to a bottom portion of tub 5 and to a recirculation conduit 8 having a recirculation pump 9 inserted therein. The free end of conduit 8 terminates at a top portion of tub 5, so that the laundry washing operation is carried out by the repeated recirculation of the washing liquid from the bottom portion of tub 5 to its top portion, whereat the washing liquid is sprinkled onto the laundry. In addition, the present combined machine comprises at least one electric heater element 10 of a given capacity located in collector receptacle 7 or in the bottom portion of tub 5 for heating the washing liquid supplied to the tub and to the receptacle to the temperature required for the various laundering cycles. Collector receptacle 7 is additionally in communication with a discharge pump 11 provided with a (not shown) fluff filter and connected to a flexible discharge hose 12 for the discharge of the washing and rinsing liquids at the end of each phase of the selected laundering cycle. For the execution of selected laundry drying cycles, the present combined machine further comprises a hot-air circulation conduit 13 including a blower 14 and at least one electric heater element 15 of a given rated capacity preferably located in the top portion of tub 5 which is of a suitable shape for the accommodation of the heater element. Circulation circuit 13 has its respective ends connected to discharge pump 11 upstream of the

associated fluff filter in the direction of discharge of the liquids from tub 5, and to the top portion of tub 5 adjacent the location of the heater element.

The combined machine further includes at least one liquid level control pressure switch 16 or the like for controlling the admission of a washing liquid to tub 5 up to a predetermined level so as to maintain the laundry in a soaked state during the washing liquid recirculation phases in the course of a selected laundering cycle, and preferably an additional protection device for guarding against the lack of liquid in tub 5 and/or collector receptacle 7, comprising at least one conventional safety pressure switch 17 adapted to function in response to a liquid level lower than that defined above so as to keep heater element 10 always covered by the laundering liquid.

The combined machine finally includes safety thermostat switches 18 and 19 operable to control the energization and deenergization of the associated laundering and drying heater elements and to thereby control the temperature of the washing liquid and that of the hot air flow within predetermined limits during the execution of respective laundry washing and drying cycles.

With reference now to fig. 2, there is shown the electric circuit diagram of the control assembly according to the invention incorporated in the present combined laundry washing and drying machine. As shown in this figure, safety pressure switch 17 includes two fixed contacts 20 and 21, and a movable contact 22 connected to a main conductor 23 of the electric circuit of the machine and adapted to be switched onto one or the other of fixed contacts 20 or 21, respectively, when tub 5 is empty or contains a washing liquid at a level below that to which the pressure switch is set to respond, i.e. when heater element 10 is not covered by the liquid, and when the tub is filled up to the predetermined response level and heater element 10 is covered with the washing liquid. Pressure switch 16 on its part comprises two fixed contacts 24 and 25 and a movable contact 26 adapted to be connected to the neutral conductor 27 of the electric circuit of the machine by an electric switch 28 operable by a corresponding cam of the program control unit (not shown) of the machine, movable contact 26 being adapted to be switched onto one or the other of fixed contacts 24 and 25, respectively, when tub 5 is empty or filled with washing liquid to a level below the predetermined maximum level, and when the tub is filled up to the predetermined maximum level. In particular, fixed contacts 21 and 25 of pressure switches 17 and 16, respectively are connected to one another through safety thermostat switch 18 and washing liquid heater element 10, while recirculation pump 9 is connected between fixed contact 21

of pressure switch 21 and neutral conductor 27 through an electric switch 29 operable by another cam of the program control unit of the machine. Fixed contacts 20 and 24, respectively, of pressure switches 17 and 16 are on their part connected to one another through safety thermostat switch 19 and drying air heater element 15, while blower 14 is connected between fixed contact 20 of pressure switch 17 and the connection point 30 between recirculation pump 9 and electric switch 29. Discharge pump 11 on its part is directly connected between conductors 23 and 27 through a further electric switch 31 operable by a corresponding cam of the program control unit. While heater element 15 has another electric heater element 33 connected in parallel thereto and adapted to be energized by a manually operable electric switch 32. The maximum temperature developed by heater element 33 for heating the drying air is lower than that developed by heater element 15.

From the above description, the functions of the control assembly according to the invention will become readily evident. When the machine is set to execute any selected laundering program, tub 5 and collector receptacle 7 are initially empty, so that movable contacts 22 and 26, respectively, of pressure switches 17 and 16 are in engagement with the respective fixed contacts 20 and 24, while electric switches 28 and 29 are held in the closed and opened state, respectively, by the program control unit of the machine.

Under these conditions, a washing liquid is progressively admitted to the tub 5 and collector receptacle 7, in the per se known manner, until the maximum level as determined by pressure switch 16 is attained, at which time movable contacts 22 and 26, respectively, of pressure switches 17 and 16 are switched onto the other fixed contacts 21 and 25 of the pressure switches, so that heater element 10 is energized to progressively heat the washing liquid. At the same time the program control unit acts to close switch 29, so that recirculation pump 9 is energized to initiate the recirculation of the washing liquid via conduit 8, whereby the laundry is sprinkled with the washing liquid. At the end of the selected washing cycle, the program control unit acts to open electric switches 28 and 29 and to close electric switch 31, so as to deenergize heater element 10 and recirculation pump 9 while energizing discharge pump 11, as a result of which all of the washing liquid is discharged from tub 5 and collector receptacle 7. This results in movable contacts 22 and 26, respectively, of pressure switches 17 and 16 being switched onto the respective fixed contacts 20 and 24 of the pressure switches, whereby the machine is pre-set to the subsequent laundry drying cycle. In particular, at the beginning of any selected drying cycle, the

program control unit of the machine acts to close both electric switches 28 and 29. As a result, drying-air heater element 15 and blower 14 are energized via movable contacts 22 and 26, respectively, of pressure switches 17 and 16, and on the other hand solely via movable contact 22 of pressure switch 17. In this manner the energization of heater element 15 permits more resistant fabrics such as cotton, linnen and the like to be dried, while in the presence of more delicate fabrics such as synthetics and the like, electric switch 32 is manually operated to energize heater element 33 instead of heater element 15, so that the drying operation is carried out at a lower temperature.

It is thus evident that the described control assembly permits the selective execution of laundry washing and/or drying cycles by the combined machine to be automatically controlled by the use of the two pressure switches 16 and 17 which are adapted to automatically energize one or the other of the respective washing liquid and drying air heater elements, resulting in a simplified construction of the electric circuit of the machine, and eliminating the formerly existing need for using specific control elements for the energization of the heater elements, with the beneficial result of rendering the control assembly as a whole highly reliable in operation.

Finally, and as shown in figs. 1 and 2, the control assembly additionally includes a suitable solenoid valve 34 for admitting mains water to the tub 5 of the machine, the water being directed through a detergent container 35 filled with a granular detergent and connected to the top portion of the tub. Solenoid valve 34 is connected between conductors 23 and 27 of the electric circuit of the machine in series with an electric switch 36 operable by an associated cam of the program control unit of the machine. In the present case it is also possible to supply a liquid detergent contained in a separate container 37 located in the lower part of the housing 4 of the combined machine 3 and connected to the top portion of tub 5 through a detergent conduit 38 including a pump 39 which is electrically connected between fixed contact 21 of safety pressure switch 17 and fixed contact 24 of pressure switch 16. In this manner the present control assembly selectively operates to control the supply to tub 5 of granular detergent contained in container 35 together with the admission of water to the tub, by closing electric switch 36 for the energization of solenoid valve 34, or of a liquid detergent from container 37 by the energization of pump 39 alone. In the latter case, that is, when container 35 is not filled with a granular detergent, switch 36 is closed in the first place to energize solenoid valve 34 for the admission of water to the tub until the maximum level as determined by

safety pressure switch 17 is attained, at which time movable contact 22 of this pressure switch is switched from fixed contact 20 onto fixed contact 21. Subsequently the program control unit of the machine acts to open electric switch 36 to thereby deenergize solenoid valve 34 for terminating the admission of water to tub 5, and to close electric switch 28 to thereby energize pump 39 through movable contact 26 of pressure switch 16 which under the prevailing operative condition is closed on fixed contact 24 of this pressure switch, in view of the fact that the water admitted to the tub has not yet attained its maximum charge level as determined by the setting of pressure switch 16.

Pump 39 is maintained in the energized state for a period of time determined in accordance with the type and amount of laundry to be washed, so that the amount of liquid detergent supplied to tub 5 is in proper proportion to the total amount of water already admitted and to be admitted to the tub. Subsequently the program control unit again acts to close electric switch 36 for the energization of solenoid valve 34, so that an additional amount of water is admitted to the tub together with the liquid detergent - pump 39 being meanwhile maintained in operation - until the maximum level as determined by pressure switch 16 is attained. At this time, movable contact 26 of pressure switch 16 is automatically switched over onto fixed contact 25, while the program control unit acts to open electric switch 36 to thereby terminate the supply of the liquid detergent as well as the admission of water to the tub and permit the selected laundry washing cycle to be effectively executed.

The control assembly according to the invention finally includes a further solenoid valve 40 disposed in a conduit 41 connected to the water supply circuit of the machine and opening into the hot-air circulation conduit 13, solenoid valve 40 being connected between conductors 23 and 27 of the electric circuit of the machine in series with an electric switch 42 operable by an associated cam of the program control unit of the machine. In particular, the program control unit acts to close electric switch 42 in the course of a drying operation of the present combined machine to thereby energize solenoid valve 40 for spraying cold water into air circulation conduit 13 to the purpose of condensing the water vapour released by the laundry being dried and entrained in the hot air flow. The resulting condensate collects in receptacle 7 of the machine and is successively discharged therefrom by the operation of discharge pump 11, permitting in this manner to obtain a substantially dry hot-air flow through conduit 13 for rapidly and efficiently drying the laundry.

Claims

1. A control assembly for a combined laundry washing and drying machine comprising a laundering tub, a rotatable drum for containing the laundry to be washed and dried, a washing liquid receptacle connected to a bottom portion of said tub and, through a recirculation conduit including a recirculation pump, to a top portion of said tub for sprinkling said washing liquid onto the laundry, a first and a second electric heater element each having a respective rated capacity for heating said washing liquid and drying air caused to circulate by the action of blower means through another conduit connected to top and bottom portions of said tub, at least a first and a second pressure switch or similar level control element provided respectively for controlling the liquid charge level in said tub and for protecting said first heater element from damage caused by lack of washing liquid, and a discharge pump connected to a first and a second conductor of the electric circuit of the machine, said control assembly being characterized by comprising selector means (16,17) operable respectively to individually energize said first or second heater element (10, 15) when said tub (5) is filled with said washing liquid up to the maximum charging level, or when said tub (5) is completely empty.
2. A control assembly according to claim 1, characterized in that said selector means comprise respective movable contacts (26, 22) of said first and second pressure switches (16,17), one said movable contact (26) being connected to said second conductor (27) through at least one electric switch (28) operable by the program control unit of the machine, the other said movable contact (22) being connected to said first conductor (23) and operable to energize either said recirculation pump (9) or said blower means (14) through a further electric switch (29) operable by said program control unit in the case, respectively, of said tub (5) being filled with said washing liquid to its maximum level, or of said tub being empty.
3. A control assembly according to claim 2, characterized by comprising at least one additional heater element (33) of reduced capacity adapted to be connected in parallel with said second heater element (15) through at least one electric switch (32).
4. A control assembly according to claim 2, comprising in addition at least one pump for supplying liquid detergents to said laundering tub,

characterized in that said pump (39) is adapted to be energized through said movable contacts (26, 22) of said first and second pressure switches (16, 17), respectively, until the maximum charge level as determined by said first pressure switch (16) is attained.

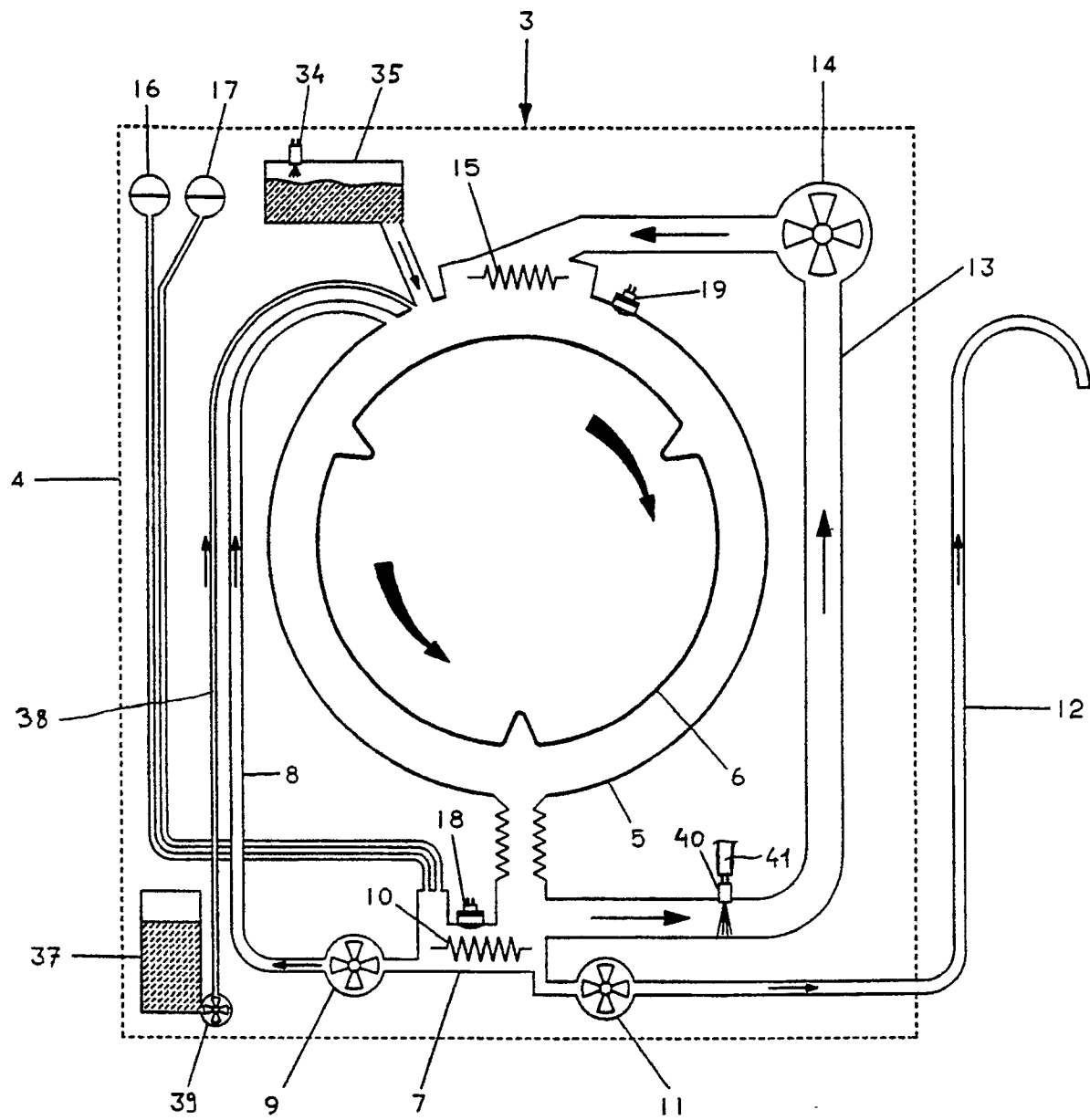


FIG. 1

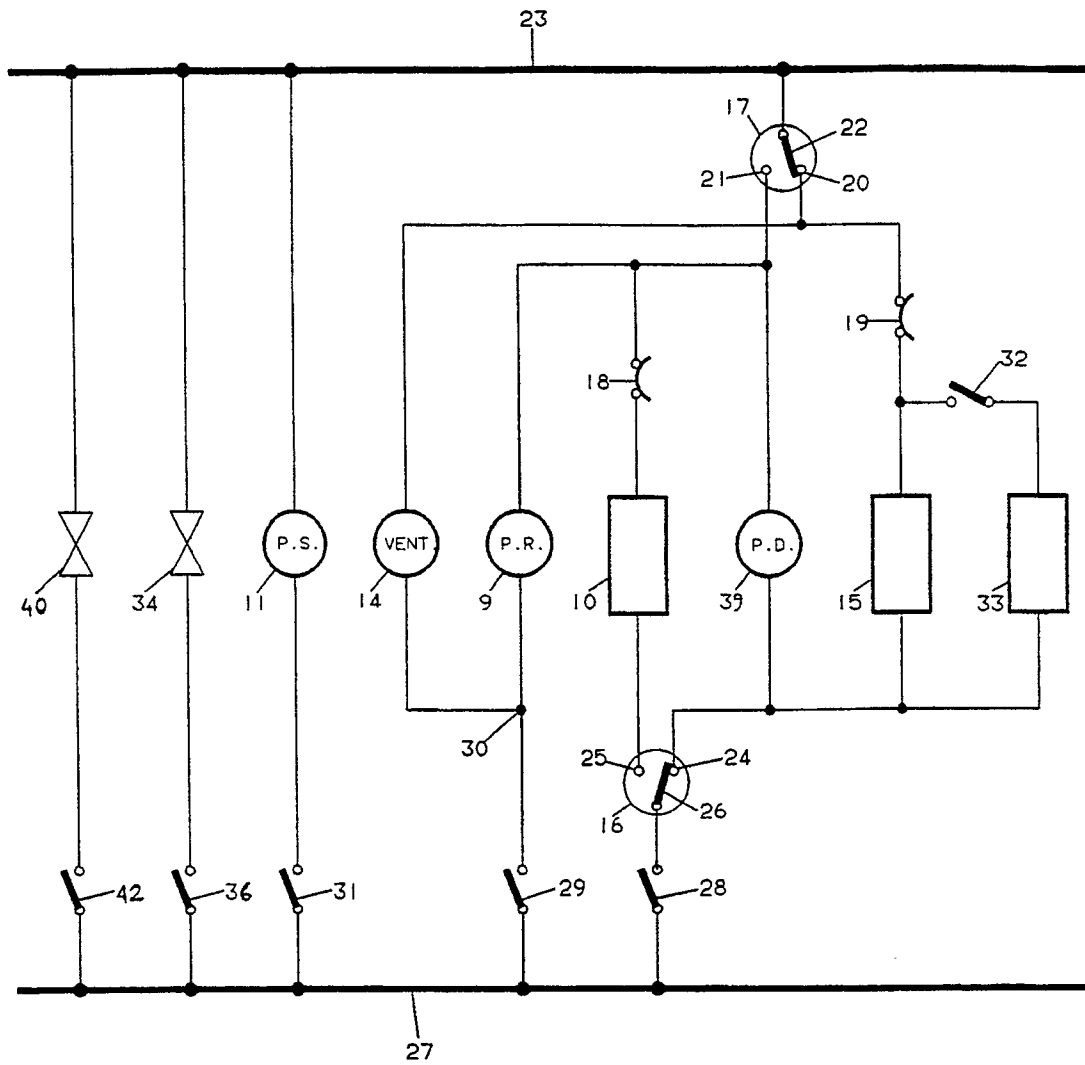


FIG.2