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

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Description

The invention relates to a combined laundry washing and drying machine according to the preamble of claim 1.

Such a type of machine is known from EP-A-252 323. 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.

The object of the present invention is to provide a combined laundry washing and drying machine having a control assembly which is simple in construction and reliable in operation.

5 This object is solved by a machine having the features of claim 1.

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:

10 fig. 1 shows a diagrammatic illustration of a combined laundry washing and drying machine provided with a control assembly according to the invention, and
20 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 17 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 combined laundry washing and drying machine comprising a control assembly, a laundry tub (5), a rotatable drum (6) for containing the laundry to be washed and dried, a washing liquid receptacle (7) connected to a bottom portion of said tub, a recirculation pump (9), for conveying the washing liquid through a recirculation conduit (8) to a top portion of said tub for sprinkling said washing liquid onto the laundry, a first (10) and a second (15) electric heater element each having a first and second end for connecting the element between a pair of voltage supplying conductors (23,27), each heating element having a rated capacity for heating said washing liquid and drying air respectively, the drying air being caused to circulate by the action of blower means (14) through another conduit (13) connected to top and bottom portions of said tub, a liquid level control circuit provided 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 (11) for the discharge of the washing and rinsing liquids, **characterized in that** said liquid level control circuit comprises two pressure switches (16,17) operating in response to a first and second predetermined liquid charge level respectively, whereby the first level is higher than the second level and each pressure switch has a movable contact member (22,26) and a pair of fixed contacts (20,21,24,25), said movable contact member can be brought alternately into contact with one of the fixed contacts in dependency from the liquid charge level in the tub; the first ends of the heater elements (10,15) are connected to the fixed contacts (20,21) of one pressure switch (17) and the second ends of the heater elements are connected to the fixed contacts (24,25) of the other pressure switch (16) whereby each end is connected to only one fixed contact, and one of said movable contact members (22) is connected to one of the conductors (23) and the other movable contact member (26) is connected to the other conductor (27) whereby the first heater element (10) is electrically connectable by means of an electric switch (28) operable by a corresponding cam of the program control unit between the conductors (23,27) if the liquid level in the tub is above the first predetermined level, and the second heater element (15) is connectable by said electric switch (28) between the conductors (23,27) if the liquid level in the tub is below the second predeter-

mined level.

2. The machine according to claim 1, 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).
3. The machine according to one of claims 1 or 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 contact member (26,22) of said first and second pressure switches (16,17), respectively, until the first predetermined liquid charge level as determined by said first pressure switch (16) is attained.

Patentansprüche

1. Kombinierte Wasch- und Trockenmaschine umfassend eine Steuereinheit, einen Waschbehälter (5), eine drehbare Trommel (6), in der die zu waschende und trocknende Wäsche enthalten ist, einen Waschflüssigkeitsbehälter (7), der an einem Bodenteil des Behälters befestigt ist, eine Umwälzpumpe (9) zum Fördern der Waschflüssigkeit durch ein Zirkulationsrohr (8) zu einem oberen Teil des Behälters, um Waschflüssigkeit auf die Wäsche zu spritzen, ein erstes (10) und ein zweites (15) elektrisches Heizelement, von denen jedes einen ersten und zweiten Anschluß aufweist zum Verbinden des Elements zwischen einem Paar von Spannungsversorgungsleitern (23, 27), wobei jedes Heizelement eine Nennkapazität zum Erhitzen der Waschflüssigkeit und entsprechend der Trockenluft besitzt, und die Trockenluft mittels eines Gebläses (14) durch ein weiteres Rohr (13) zirkuliert, welches mit einem oberen Teil und dem Bodenteil des Waschbehälters verbunden ist, eine Flüssigkeitspegelsteuerschaltung zum Regeln des Flüssigkeitspegels in dem Waschbehälter und zum Verhindern einer Beschädigung des ersten Heizelements aufgrund von zu wenig Waschflüssigkeit und eine Auslaßpumpe (11) zum Abpumpen der Wasch- und Spülflüssigkeiten, **dadurch gekennzeichnet**, daß die Flüssigkeitspegelsteuerschaltung zwei Druckschalter (16, 17) umfaßt, die im Ansprechen auf einen ersten und zweiten vorbestimmten Flüssigkeitspegel entsprechend arbeiten, wobei der erste Pegel höher als der zweite Pegel ist und jeder Druckschalter einen beweglichen Kontakt (22, 26) und ein Paar von festen Kon-

takten (20, 21, 24, 25) aufweist, wobei der bewegliche Kontakt abwechselnd mit einem der festen Kontakte in Abhängigkeit vom Flüssigkeitspegel in dem Waschbehälter bringbar ist,

die ersten Anschlüsse der Heizelemente (10, 15) mit den festen Kontakten (20, 21) eines Druckschalters (17) verbunden sind und die zweiten Anschlüsse der Heizelemente mit den festen Kontakten (24, 25) des anderen Druckschalters (16) verbunden sind, wobei jeder Anschluß nur mit einem festen Kontakt verbunden ist und einer der beweglichen Kontakte (22) mit einem der Leiter (23) verbunden ist und der andere bewegliche Kontakt (26) mit dem anderen Leiter (27) verbunden ist, wobei das erste Heizelement (10) mittels eines elektrischen Schalters (28), der von einem entsprechenden Nocken einer Programmsteuereinheit betrieben wird, zwischen den Leitern (23, 27) elektrisch verbindbar ist, wenn der Flüssigkeitspegel in dem Waschbehälter sich über einem ersten vorbestimmten Pegel befindet und das zweite Heizelement (15) mittels des elektrischen Schalters (28) zwischen den Leitern (23, 27) verbindbar ist, wenn der Flüssigkeitspegel in dem Behälter niedriger als der zweite vorbestimmte Pegel ist.

2. Maschine nach Anspruch 1, **gekennzeichnet durch** wenigstens ein zusätzliches Heizelement (33) mit reduzierter Kapazität, welches parallel zu dem zweiten Heizelement (15) mit wenigstens einem elektrischen Schalter (32) verbindbar ist.
3. Maschine nach einem der Ansprüche 1 oder 2, weiterhin umfassend wenigstens eine Pumpe zum zuführen von Waschmittel zum Waschbehälter, **dadurch gekennzeichnet**, daß die Pumpe (39) über den entsprechenden beweglichen Kontakt (26, 22) der ersten und zweiten Druckschalter (16, 17) aktivierbar ist, bis der erste vorbestimmte Flüssigkeitspegel erreicht wird, was von dem ersten Druckschalter (16) festgestellt wird.

Revendications

1. Machine combinée à laver et sécher le linge, comprenant un dispositif de commande, une cuve de lavage (5), un tambour rotatif (6) pour contenir le linge à laver et à sécher, un réceptacle de liquide de lavage (7) raccordé à une portion inférieure de ladite cuve, une pompe de recyclage (9) pour transporter le liquide de lavage à travers le conduit de recyclage (8) jusqu'à une portion supérieure de ladite cuve

pour pulvériser ledit liquide de lavage sur le linge, un premier élément chauffant électrique (10) et un deuxième élément chauffant électrique (15) ayant chacun une première et une deuxième extrémité pour monter l'élément entre une paire de conducteurs de fourniture de tension (23, 27), chaque élément chauffant ayant une capacité nominale pour chauffer ledit liquide de lavage et ledit air de séchage respectivement, l'air de séchage étant amené à circuler sous l'action de moyens de ventilateur (14) à travers un autre conduit (13) raccordé aux portions supérieure et inférieure de ladite cuve, un circuit de commande du niveau de liquide prévu pour régler le niveau de charge de liquide dans ladite cuve et pour empêcher ledit premier élément chauffant d'être endommagé par l'absence de liquide de lavage, et une pompe de vidange (11) pour vidanger les liquides de lavage et de rinçage, caractérisée en ce que ledit circuit de commande d'un niveau de liquide comprend deux commutateurs à pression (16, 17) fonctionnant en réponse à un premier et à un deuxième niveau de charge de liquide prédéterminé respectivement, d'où il résulte que le premier niveau est supérieur au deuxième niveau et que chaque commutateur à pression a un élément de contact mobile (22, 26) et une paire de contacts fixes (20, 21, 24, 25), ledit élément de contact mobile peut être amené alternativement en contact avec l'un des contacts fixes en fonction du niveau de charge du liquide dans la cuve;

les premières extrémités des éléments chauffants (10, 15) sont raccordées aux contacts fixes (20, 21) d'un commutateur à pression (17) et les deuxièmes extrémités des éléments chauffants sont raccordées aux contacts fixes (24, 25) de l'autre commutateur à pression (16), d'où il résulte que chaque extrémité n'est raccordée qu'à un seul contact fixe, et l'un desdits éléments de contact mobiles (22) est raccordé à l'un des conducteurs (23) et l'autre élément de contact mobile (26) est raccordé à l'autre conducteur (27), d'où il résulte que le premier élément chauffant (10) peut être électriquement raccordé au moyen d'un interrupteur électrique (28) actionné par une came correspondante du programmeur entre les conducteurs (23, 27) si le niveau du liquide dans la cuve se trouve au-dessus du premier niveau prédéterminé, et le deuxième élément chauffant (15) peut être raccordé par ledit interrupteur électrique (28) entre les conducteurs (23, 27), si le niveau du liquide dans la cuve est inférieur au deuxième niveau prédéterminé.

2. Machine selon la revendication 1, caractérisée en ce qu'elle comprend au moins un élément chauffant additionnel (33) de capacité réduite adapté pour être monté en parallèle avec ledit deuxième élément chauffant (15) par l'intermédiaire d' au moins un interrupteur électrique (32). 5
3. Machine selon l'une des revendications 1 ou 2, comprenant en outre au moins une pompe pour alimenter ladite cuve de lavage en détergents liquides, caractérisée en ce que ladite pompe (39) est adaptée pour être mise en marche par l'intermédiaire dudit élément de contact mobile (26, 22) desdits premier et deuxième commutateurs à pression (16, 17) respectivement, jusqu'à ce que soit atteint le premier niveau de charge de liquide prédéterminé comme déterminé par ledit premier commutateur à pression (16). 10 15 20

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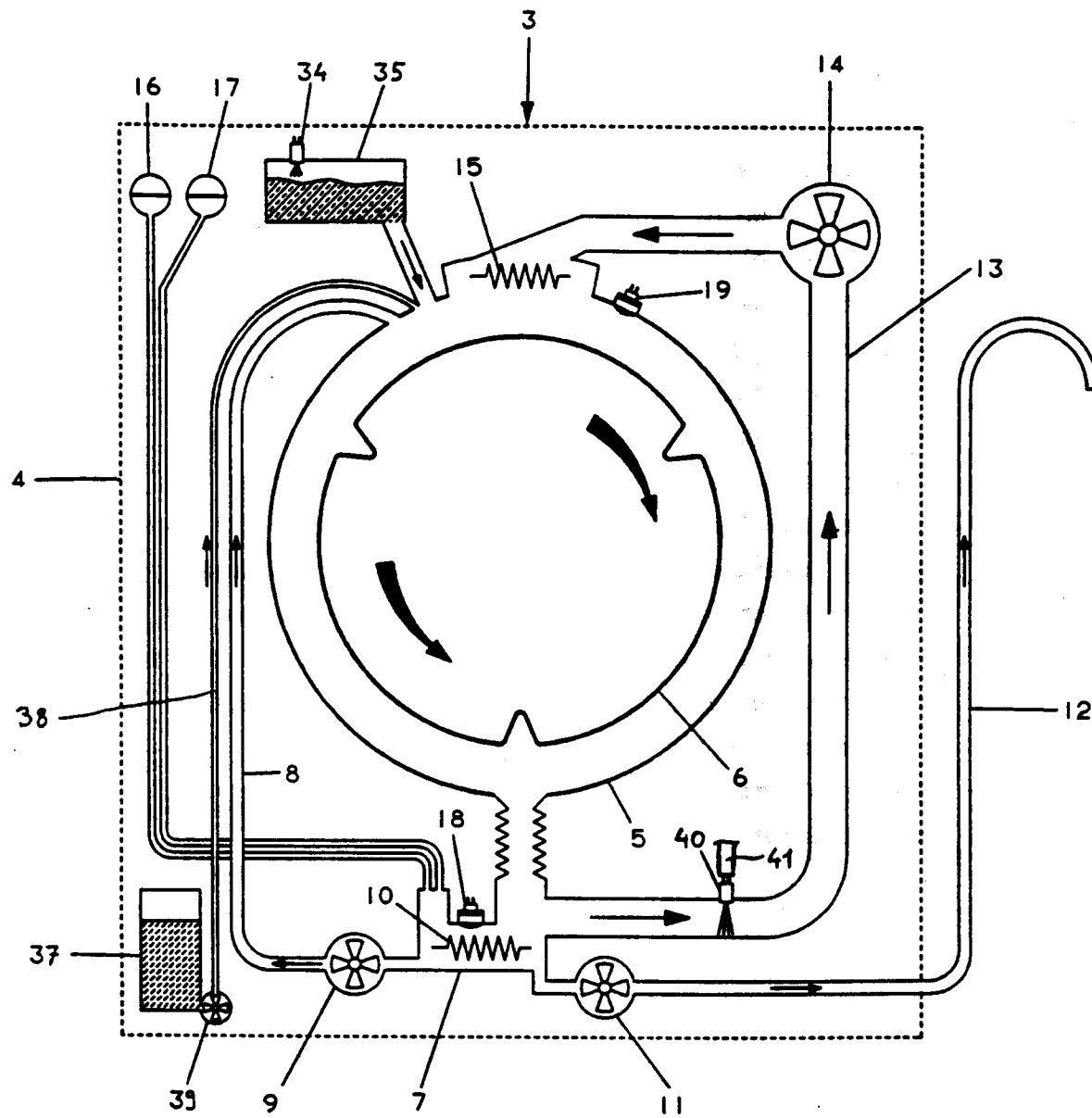


FIG. 1

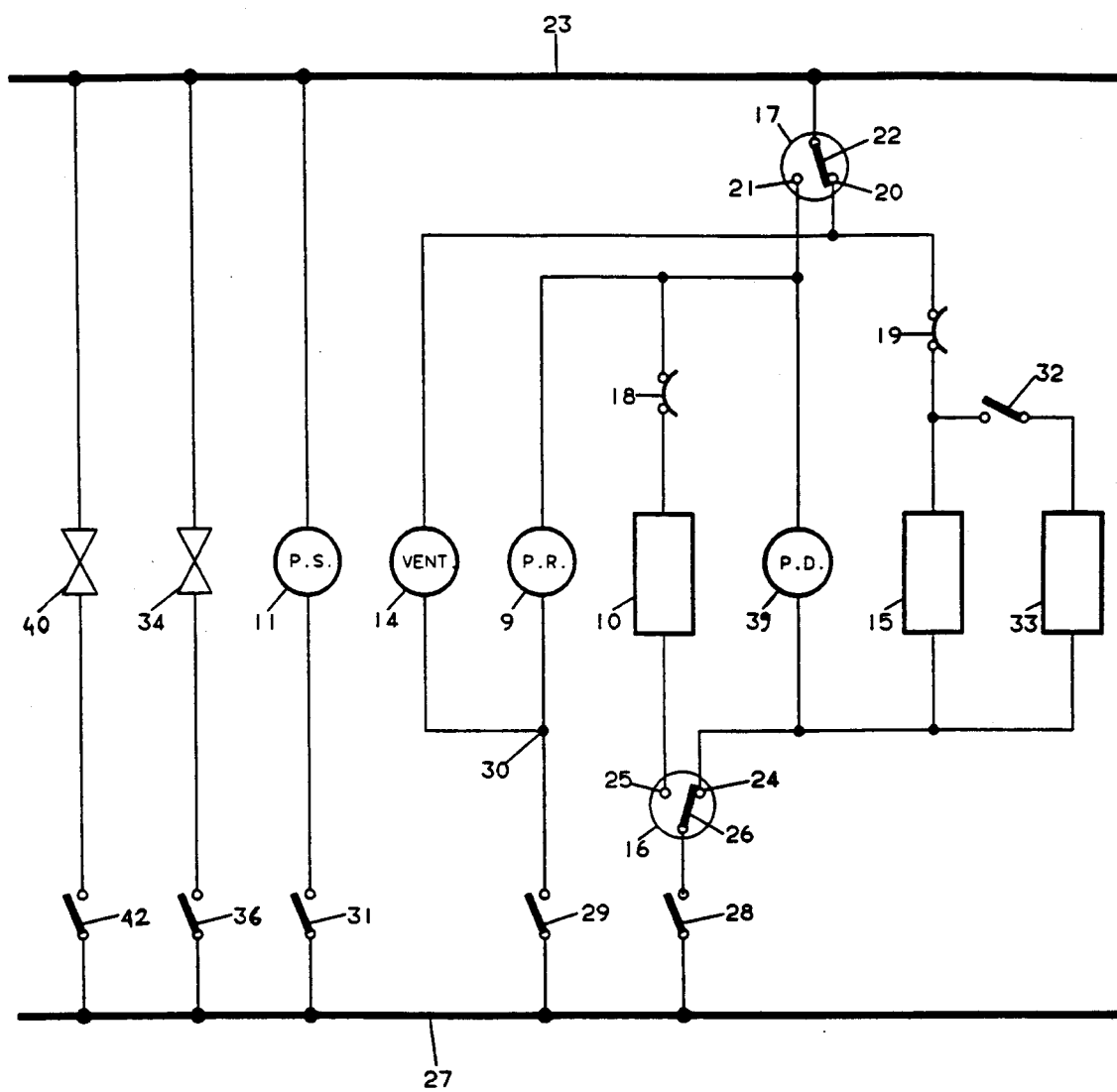


FIG.2