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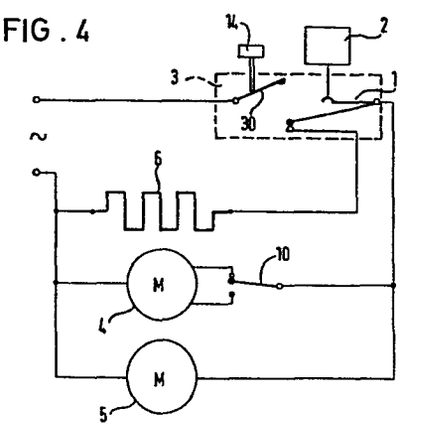
(54) Control means for a tumble dryer.

(57) In a control means for a tumble dryer, wherein the temperature of air preheated by the drum is sensed upstream the heating means (6) and the temperature of the air discharged from the tumble dryer is sensed, the heating means (6) is de-energized when a first, presettable difference of these temperatures is reached, and the drum motor (4) and fan motor (5) is de-energized when a second, presettable difference of these temperatures is reached, the means for sensing the temperature differences is a mechanical measuring and actuating means (2) operating on a change-over switch (1) the bistable switch (1) is coupled with a switching means (3) for sequentially switching the heating means (6) and the drum motor (4) and fan motor (5). The control means is mechanically simple and robust and constructed so as to be extensively free of servicing.

FIG. 4



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CONTROL MEANS FOR A TUMBLE DRYER

The invention relates to a control means for a tumble dryer, wherein the temperature of air preheated by the drum is sensed upstream to the heating means and the temperature of the air discharged from the tumble dryer is sensed, the heating means is de-energized when a first, presettable difference of these temperatures is reached, and the drum and fan motor is de-energized when a second, presettable difference of these temperatures is reached.

Such a control means, which permits on the one hand an exact de-energizing of the heating means with the least possible circuitry expenditure, and on the other hand ensures a cooling down period, dependent on the filling of the drum and the humidity with the drum and fan motor still energized after the heating means has been de-energized, until the desired humidity of the drum filling is reached, has become known for example from the German patent 30 15 428. The control means known therefrom operates electronically, which can lead to difficulties and higher costs of the control means upon adaption to known proven switching means with timer and program control.

The invention is therefore based on the object of providing a control means of the above described

species, which is simple and stable in construction, and operates reliably and as free as possible of services, and which permits the selective use of known, proven switching units or simple relay switching units.

This object is solved according to the invention in that the means for sensing the temperature differences is a mechanical measuring and actuating means operating on a change-over switch, and that the bistable switch is coupled with a switching means for sequentially the heating means and the drum and fan motor.

With this construction of the control means, a more compact assembly of both the measuring and actuating means as unit and also the switching means as unit can be achieved, and the switching means can be a simple, stable electromechanical switching unit.

The measuring and actuating means expediently contains two mechanical-thermal actuating members coupled with temperature sensors for the temperature of the preheated air and the discharged air, said actuating members operating on two lever arms of a switch actuating lever, wherein the switch actuation lever can be biased by means of at least one adjustable spring means.

This leads to a robust unit which is extensively free of servicing, with which the two temperature differences can be sensed and processed for the safe switching of the heating means and the drum motor and fan motor.

Advantageously two springs are provided which respectively apply adjustable biasing forces to the lever arms of the switch actuation lever. This permits a very exact and sure adjustement of the resulting biasing force.

The biasing by the at least one spring expediently is as a whole adjustable externally by a rotary cam plate, so that an adjustment of the switch-triggering temperature differences can be effected in a simple manner.

According to an especially advantageous further development of the invention the change-over switch is included in the switching means, the input terminal of the change-over switch is connected to the drum and fan motor and one of its output terminals is connected to the heating means, and the switching means includes a snapping contact switch being mechanically actuable by a switching knob and by the change-over switch. With this construction the desired energizing and de-energizing of the heating means and the drum and fan motor will be achieved with minimum effort.

The measuring and actuating means and the switching means are expediently placed in a common housing as a unit.

Alternatively, the switching means advantageously includes switches for the heating means and the drum and fan motor being thermally actuable via resistance heating.

Depending from the constructions of the tumble dryer the drum and fan motor can be sparate motors switched via a commom switch. In this case, in series to the drum motor, a reversing switch is expediently provided, which is thermally actuatable via resistance heating and expediently includes a stable, contactless middle position.

The invention is explained in more detail in the following with respect to embodiments thereof and on the basis of the drawings. The drawings show

Fig. 1 a schematic representation of a first embodiment of the control means according to the invention,

Fig. 2 a schematic representation of a temperature-time curves for the preheated air and for the discharged air,

Fig. 3 a schematic cross-section through a first embodiment of a mechanical measuring and actuating means for the control means according to the invention,

Fig. 4 a schematic representation of a further preferred embodiment of the control means according to the invention, and

Fig. 5 a schematic cross-section through a further preferred embodiment of the mechanical measuring and actuating means for the control means according to the invention, especially according to Fig. 4.

In the schematic representation of the control means for a tumble dryer in Fig. 1, a change-over switch 1 is shown, on which a measuring and actuating means 2, as shown for example in Fig. 3 operates, instead of the measuring and actuating means and change-over switch constructed as unit. The change-over switch 1 is coupled with a switching means 3, which in turn contains four switches, and energizes and de-energizes a drum motor 4, a fan motor 5 and a heating means 6 of a tumble dryer.

The switching means 3 contains a main switch 7, a heater switch 8, a drum and fan motor switch 9 and a drum motor reversing switch 10. All the switches are shown in their position before enrgizing the tumble dryer. The switches 8, 9 and 10 are bimetal switches with associated heat

resistances 11, 12 and 13, the energizing of which causes a switching of the switch 8, 9 or 10 respectively into the switching position shown in Fig. 1

Before switching on the drum dryer, the change-over switch 1 is in the switching position shown in Fig. 1. The main switch 7, the heater switch 8 and the drum and fan motor switch 9 are brought by means of a common switching knob 14 from the switching position shown in Fig. 1 into the switch-on position, when the tumble dryer is energized. Thus, the heating means 6 is energized via the main switch 7, the change-over switch 1 and the heater switch 6. The drum motor 4 is energized via the main switch 7 and the switch 9 and via the reversing switch 10 for running in one direction. The fan motor 5 is energized via the main switch 7 and the switch 9. At the same time, the heating resistance 13 of the reversing switch 10 is energized and after a few seconds causes the recersing switch 10 to switch over the running direction of the drum motor 4. In this way the heating resistance 13 is bridged and the reversing switch 10 returns after a few seconds into the original switching position shown in Fig. 1.

The change-over switch 1 remains in its original switching position shown in Fig. 1 until a preset temperature difference ΔT_1 (Fig. 2) is reached between preheated and discharged air of the tumble dryer. When this first temperature difference ΔT_1 is reached, the change-over switch 1 switches into its upper switching position in Fig. 1. In this manner, the heating means 6 is de-energized. At the same time, by means of the change-over switch 1 the heating resistance 11 of the heater switch 8 is energized and effects a switch-over of the heater switch 8 into the switching position shown in Fig. 1.

As soon as a second preset temperature difference ΔT_2 (Fig. 2) is reached with the heating means 6 being de-energized, but the drum motor 4 and fan motor 5 being energized, the change-over switch 1 switches back into the switching position shown in Fig. 1. Since the heater switch 8 still is in its upper switching position in Fig. 1, the heating means 6 remains de-energized but the heating resistance 12 of the drum and fan motor switch 9 is energized, and effects that the switch 9 assumes the switched-off position shown in Fig. 1. Accordingly, both the drum motor 4 and the fan motor 5 are de-energized.

In Fig. 2 the temperature-time curves $T = f(t)$ for the preheated air and the air discharged from the tumble dryer upon control by the described control means are schematically shown. The curve K1 shows the temperature course of the discharged air during a drying cycle. Both temperatures have the highest value (first temperature difference ΔT_1) at the moment when the heating means 6 de-energized, and thereafter decrease with the heating means 6 de-energized, but the drum motor 4 and fan motor 5 running, until the second temperature difference ΔT_2 is reached. The drum motor 4 and the fan motor 5 are then also de-energized. The duration of time $t_1 - 0$ represents the heating period, the duration of time $t_2 - t_1$ represents the cooling down period. The cooling down period has no fixed predetermined time duration and is not dependent alone on the temperature of the discharged air, but is also dependent on the second temperature difference ΔT_2 between the temperatures of the preheated air and the discharged air. Thus, the time duration of the cooling down period is a function of the filling degree of the drum and the water absorbing capacity of the dried laundry. Thus, upon termination of the drying cycle, laundry having a humidity within a

desired humidity range is always obtained without a direct measurement of the humidity needing to take place.

By detecting the temperature of the preheated air instead of the temperature of the ambient air, it is further ensured that the temperature differences between sensed temperatures are relatively kept as low as possible throughout drying cycle, which results in a simple construction of the control means and precise switching possibilites for de-energizing the heating means 6 at the point of time $t = t_1$ and the motors 4 and 5 at the point of time $t = t_2$.

Fig. 3 shows a first embodiment of a mechanical measuring and actuating means 2 operating on a change-over switch 1, said means 2 including a temperature sensor 16 for preheated air and a temperature sensor 17 for the air discharged from the tumble dryer which are coupled with mechanical-thermal actuating members 18, 19, respectively. The actuating members 18 and 19 operate on two lever arms 20 and 21 of a switch actuation lever 23 pivotable around a swivel point 22. By means of a spring 24, a counter force, adjustable via a screw 25, is applied to the actuation member 19. Additionally a spring 26 can be provided by which a counter force adjustable via a screw 27 is applied to the actuation member 18. The change-over switch 1 is actuated by the switch actuation lever 23. The resulting moment from the forces applied to the lever arms 20 and 21 by the spring 24 and by the spring 26, if appliable, and the forces applied via the counter forces of the change-over switch 1 to the switch actuation lever 23 determines the temperature differences $\Delta T_1, \Delta T_2$, upon which the change-over switch 1 is switched. The biasing of the spring means formed by the spring 24 or the springs 24

and 26 can be varied as a whole by a rotary cam plate 28 which is adjustable externally via a shaft 29.

Fig. 4 shows a schematic representation of a further, preferred embodiment of the control means. Instead of the heater switch 8 and the drum and fan motor switch 9 there is provided a snapping contact switch 30 which together with the change-over switch 1 preforms the function of the heater switch 8 and the drum and fan motor switch 9. All switches are shown in Fig. 4 in their position prior to energizing the drum dryer.

Before switching on the drum dryer, the change-over switch 1 is in the switching position shown in Fig. 4. The main switch 7, not shown in Fig. 4, and the snapping contact switch 30 are brought by means of the common switching knob 14 from the switching position shown in Fig. 4 into the switch-on position in which the snapping contact switch 30 contacts the change-over switch 1, when the tumble dryer is energized. Thus, the heating means 6 as well as the drum motor (via the reversing switch 10) for running in one direction and the fan motor 5 are energized.

The change-over switch 1 remains in its original switching position shown in Fig. 4 until a preset temperature difference ΔT_1 (Fig. 2) is reached between preheated and discharged air of the tumble dryer. When this first temperature difference ΔT_1 is reached, the change-over switch 1 switches into its upper switching position in Fig. 4. In this manner, the heating means 6 is de- energized and, at the same time, the snapping contact switch 30 is brought into the switch-off position. Drum motor 4 and fan motor 5, however, remain energized via the snapping contact switch 30 and the

change-over switch 1 in its upper position in Fig. 4.

As soon as a second preset temperature difference ΔT_2 (Fig. 2) is reached with the heating means 6 being de-energized, but the drum motor 4 and fan motor 5 being energized, the change-over switch 1 switches back into the switching position shown in Fig. 4, whereas the snapping contact switch 30 remains in its upper position in Fig. 4. Thus, the drum motor 4 and the fan motor 5 are de-energized, and the control means is in its switching position for another energizing cycle.

Fig. 5 shows a preferred embodiment of the mechanical measuring and actuating means 2 in connection with the whole control means according to Fig. 4. Compared with the embodiment shown in Fig. 3 the second spring 26 including the screw 27 which are not absolutely necessary are omitted. An actuation lever 31 being actuated by a switching knob 14 concentrically disposed to the shaft 29 brings the snapping contact switch 30 from its position shown in Fig. 5 with compact lines into the switch-on position shown in dotted lines. The snapping contact switch 30 can be a mechanical or magnetic snapping contact switch.

In the preferred embodiment shown in Fig. 5 the measuring and actuating means 2 and the switching means 3 are incorporated in a common housing as a unit.

As a whole, the measuring and actuating means 2 together with the change-over switch 1 is a robustly constructed mechanical unit which is practically free of servicing, and which can be used with a switching means 3 or is incorporated with the latter into a single unit.

CLAIMS:

1. A control means for a tumble dryer, wherein the temperature of air preheated by the drum is sensed upstream the heating means (6) and the temperature of the air discharged from the tumble dryer is sensed, the heating means (6) is de-energized when a first, presettable difference of these temperatures is reached, and the drum and fan motor (4, 5) is de-energized when a second, presettable difference of these temperatures is reached, characterized in that the means for sensing the temperature differences (ΔT_1, ΔT_2) is a mechanical measuring and actuating means (2) operating on a change-over switch (1), and that the change-over switch (1) is coupled with a switching means (3) for sequentially switching the heating means (6) and the drum and fan motor (4, 5).

2. A control means according to claim 1, characterized in that the measuring and actuating means (2) contains two mechanical-thermal actuating members (18, 19) coupled with temperature sensors (16, 17) for the temperature of the preheated air and the discharged air, said actuating members (18, 19) operating on two lever arms (20, 21) of a switch actuation lever (23), and that the switch actuation lever (23) can be biased by means of at least one adjustable spring (24).

3. A control means according to claim 2, characterized in that two springs (24, 26) are provided which respectively apply adjustable biasing forces to the lever arms (21, 20) of the switch actuation lever (23).

4. A control means according to claim 2 or 3, characterized in that the biasing by the at least one spring (24) is as a whole adjustable externally by a rotary cam plate (28).

5. A control means according to any one of the claims 1 to 4, characterized in that the change-over switch (1) is included in the switching means (3), that the input terminal of the change-over switch (1) is connected to the drum and fan motor (4, 5) and one of its output terminals is connected to the heating means (6), and that the switching means includes a snapping contact switch (30) being mechanically actuable by a switching knob (14) and by the change-over switch (1).

6. A control means according to any one of the claims 1 to 5, characterized in that the measuring and actuating means (2) and the switching means (3) are placed in a common housing as a unit.

7. A control means according to one of the claims 1 to 4, characterized in that the switching means (3) includes switches (8, 9) for the heating means and the drum and fan motor (4, 5) being thermally actuable via resistance heating.

8. A control means according to any one of the claims 5 to 7,
c h a r a c t e r i z e d in that the drum motor (4) and fan motor (5) are separate motors switched via a common switch (9).

9. A control means according to claim 8,
c h a r a c t e r i z e d in that series to the drum motor (4), a reversing switch (10) is provided, which is thermally actuatable via resistance heating.

10. A control means according to claim 9,
c h a r a c t e r i z e d in that the reversing switch (10) includes a stable, contactless middle position.

FIG. 1

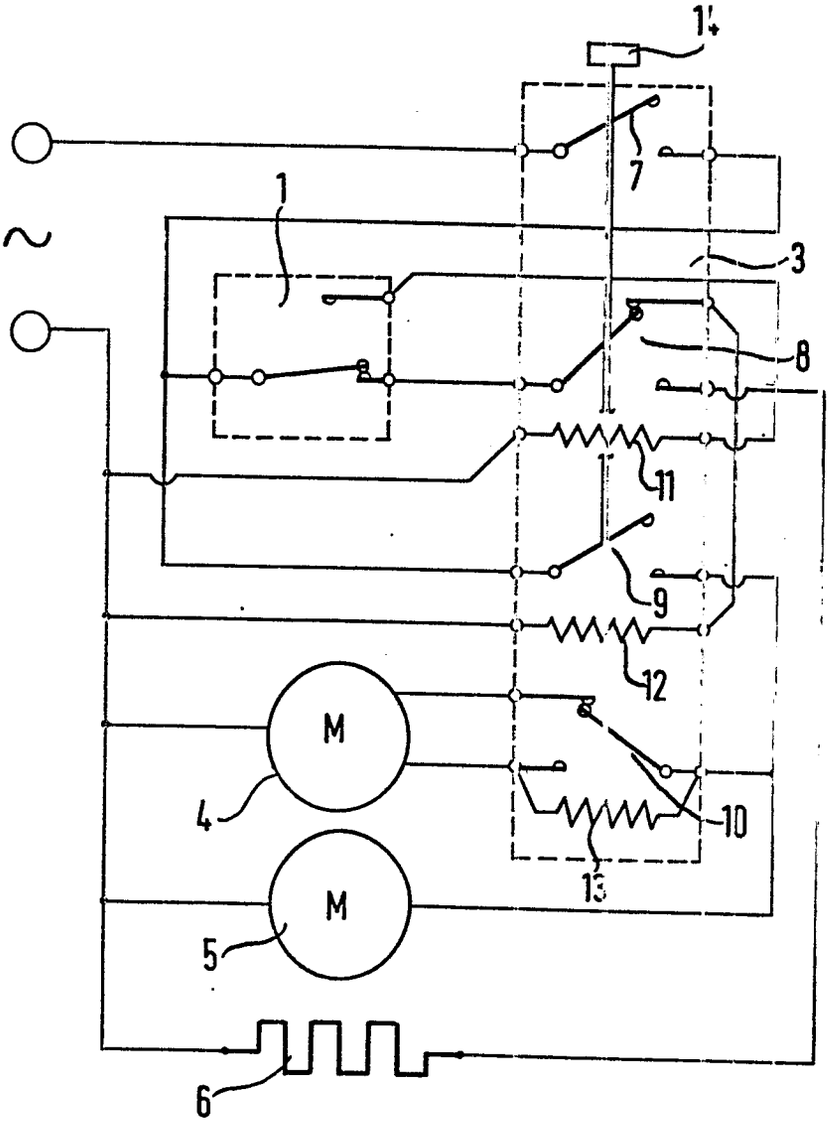

FIG. 2

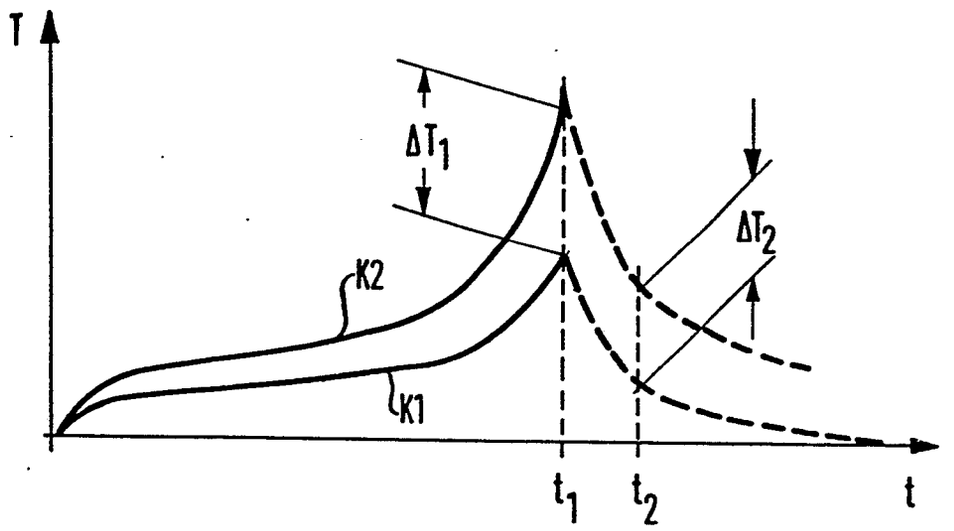

FIG. 3

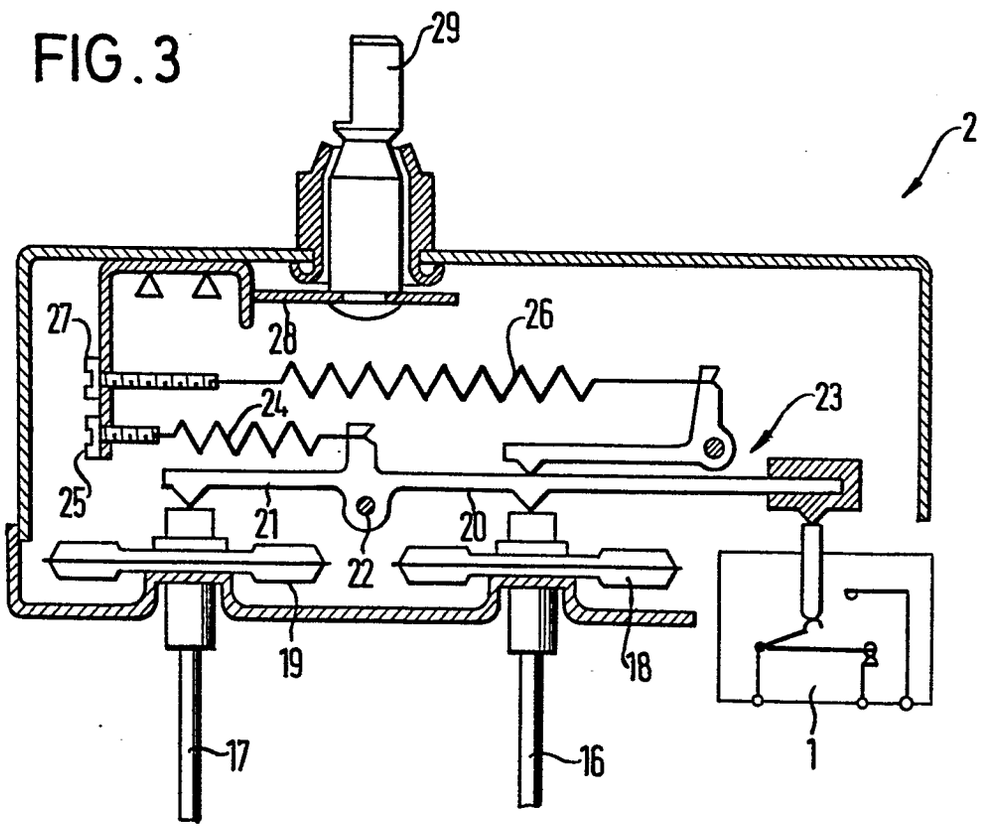

FIG . 4

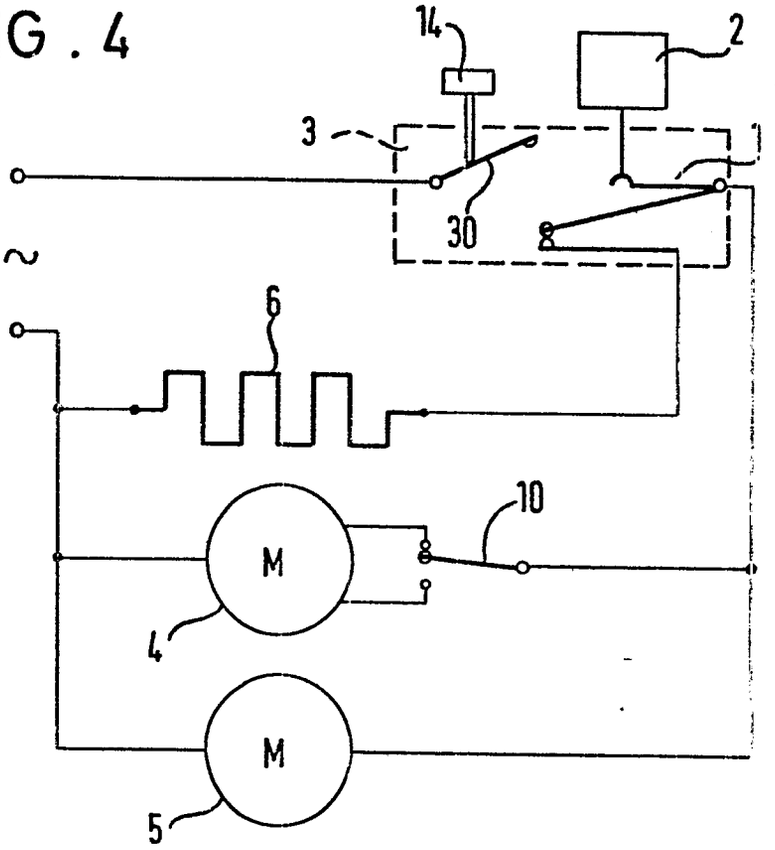

FIG . 5