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2,851,790

TEMPERATURE CONTROL MEANS FOR CLOTHES DRYER

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FIG. 1

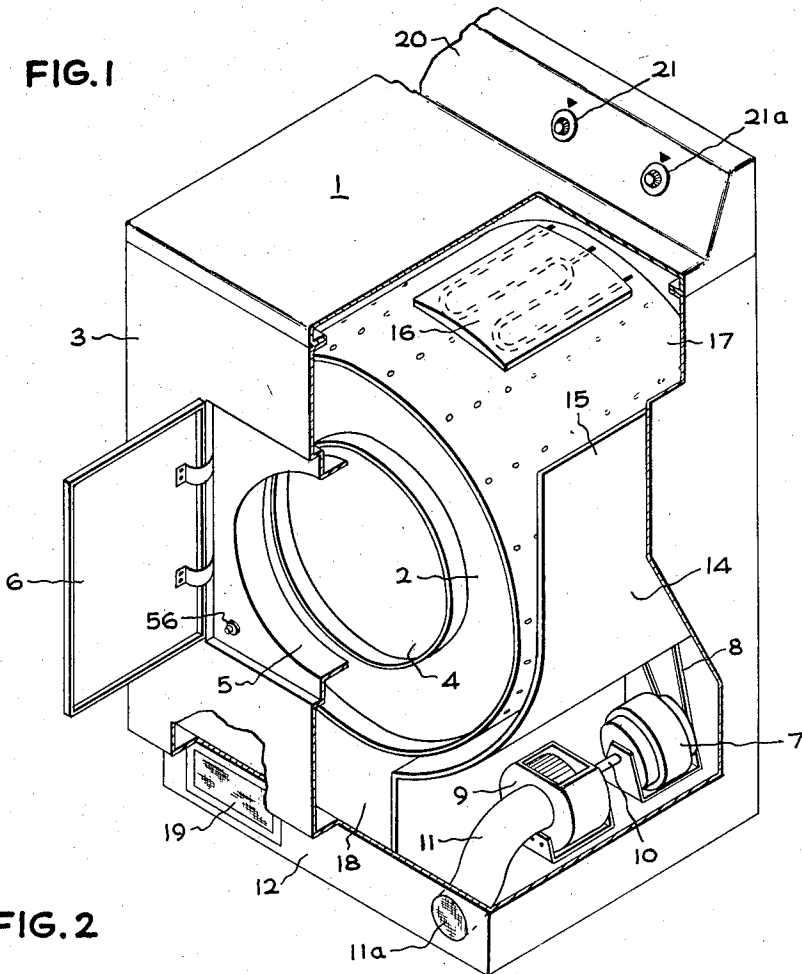
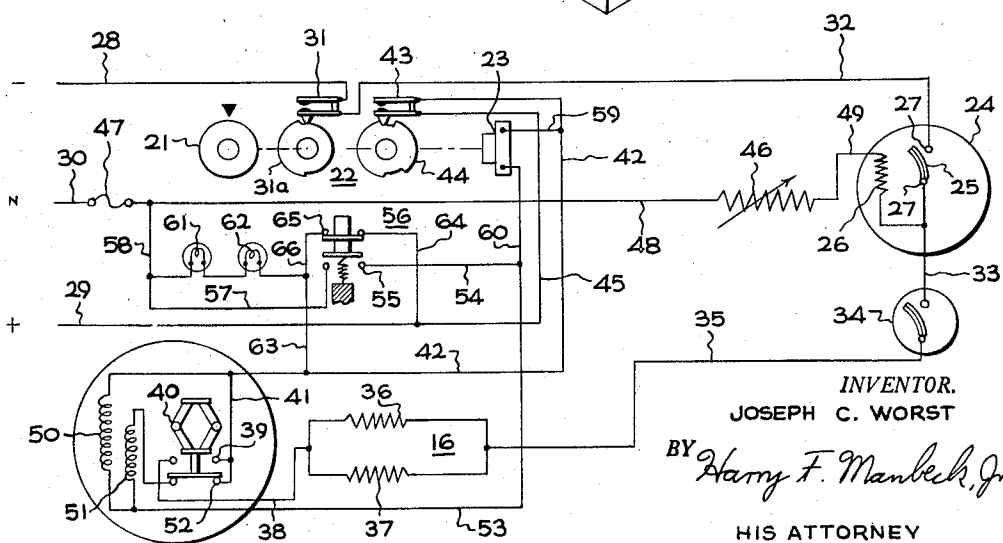


FIG. 2



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TEMPERATURE CONTROL MEANS FOR CLOTHES DRYER

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1 Claim. (Cl. 34—48)

My invention relates to clothes dryers and more particularly to adjustable temperature controls for use in clothes dryers.

It is an object of my invention to provide a new and improved adjustable temperature control arrangement for a clothes dryer, whereby the drying temperature maintained in the dryer may be selectively varied over a wide range.

It is another object of my invention to provide improved adjustable temperature control means for a clothes dryer, which effects a gradual, continuous adjustment of the drying temperature between high and low limits rather than a step by step adjustment.

A further object of my invention is to provide an adjustable temperature control for a clothes dryer which is simple and inexpensive to manufacture and assemble within the dryer.

In carrying out my invention I provide a clothes dryer having a clothes container and means including an electrical heating unit for drying the clothes in the container. Within the dryer there is mounted a thermostat for determining the temperature at which the clothes drying operation takes place. This thermostat controls the energization of the electrical heating unit, and in accordance with my invention it comprises a temperature responsive, bi-metallic actuating element and a biasing heater for the bi-metallic element. To provide for different drying temperatures the heater for the bi-metallic element is energized by circuit means which are arranged to energize it at various levels according to the selection of the operator. By varying the level of energization of the biasing heater the response of the bi-metal to the actual temperature within the dryer is varied, and thus the thermostat is adjusted to maintain different temperatures within the dryer. The biasing heater is energized and de-energized concurrently with the main electrical heating unit whereby the temperature at the bi-metal follows accurately the temperature within the dryer.

The features of my invention which I believe to be novel are pointed out with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation may be best understood by reference to the following description taken in conjunction with the accompanying drawing in which:

Fig. 1 is a perspective view of a clothes dryer incorporating a preferred embodiment of my improved temperature control means, the view being partially broken away and partially in section to illustrate details of construction; and

Fig. 2 is a schematic diagram of the electrical circuit included in the dryer of Fig. 1, the circuit including my improved temperature control means in one preferred form thereof.

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Referring now to Fig. 1, I have shown therein a clothes dryer 1 having a rotatable drum or basket 2 which is mounted for rotation about a generally horizontal axis. The basket 2 is disposed within an outer enclosing cabinet structure 3, and aligned openings 4 and 5 are provided respectively in the front walls of the basket and the cabinet structure for the loading and unloading of clothes from the basket. The openings 4 and 5 are flanged as shown to prevent clothes from dropping down between the basket and the cabinet. A door 6 hingedly mounted on the outer cabinet closes the opening 5 during operation of the machine.

For rotating the basket 2 during the operation of the dryer there is provided an electric motor 7 which is connected to the basket by a suitable belt drive 8. The pulleys (not shown) mounting the belt are so arranged that the basket 2 is driven at suitable speed for tumbling articles of clothing placed therein. Upstanding ribs (not shown) are preferably provided on the inner surface of the basket to aid in producing the tumbling action. Besides driving the basket 2 the motor 7 also serves to drive air moving means for circulating a stream of air through the basket during the drying operation. The air moving means comprises a centrifugal blower 9 which is driven from the motor 7 by means of a direct coupling 10. The blower 9 draws in air from the surrounding room through a conduit 11 which leads from a screened air inlet opening 11a in the toeboard 12 of the cabinet.

The air drawn in by the blower 9 is discharged through an opening 13 at the top thereof into a space 14 which is separated from the rotating basket by a baffle 15. As shown, the baffle 15 extends upwardly from the base of the machine to the point in the general vicinity of an electrical heating element 16 which is mounted at the top of the machine, the baffle being curved arcuately around the cylindrical side wall 17 of the basket for a portion of its length. The air discharged from the blower 9 flows upwardly through the space 14 and passes outwardly therefrom across the electrical heating unit 16. The heated air still under pressure from the blower then flows downwardly through the foraminated side wall 17 of the rotating basket. The heated air moves through the basket and the articles of clothing being tumbled therein, extracting moisture from the clothing during its passage, and passes into a collecting chamber 18 lying beneath the basket 2 on the opposite side of the baffle 15 from the space 14. From the chamber 18 the air is discharged to the outside of the cabinet through an appropriate lint trap structure (not shown) and a discharge opening 19 in the toeboard 12. The dryer construction as thus far described is a more or less conventional arrangement of a domestic clothes dryer and is intended to illustrate only one suitable dryer to which my invention may be adapted.

In the domestic appliance field a clothes dryer must be universally adaptable to small loads consisting of one or two articles to large loads of 8 to 10 pounds of dry clothes representing the capacity of a typical machine. In addition, the dryer must be capable of safely drying all types of fabrics from the delicate synthetics to the more rugged cotton and linens. To meet these requirements I have provided both a time control and a temperature control in the machine 1. By means of the time control the length of the drying operation may be varied and by means of the temperature control the temperature maintained in the machine during the drying operation may be varied. Both the time control and the

temperature control are preferably mounted on the back-splasher 20 of the cabinet 3 and each includes a manually operable, adjustment knob. Thus the time control includes an adjustment knob 21 and the temperature control an adjustment knob 21a.

The time control comprises a sequence control 22 which is operated by means of a timer motor 23 (see Fig. 2). The temperature control comprises a thermostat 24 which is arranged to control the heating unit 16 to maintain the desired drying temperature within the machine. The thermostat 24 may be positioned at any suitable place within the machine for sensing the drying temperature, but preferably it is positioned within the exhaust air collection chamber 18 so that the air flow leaving the basket 2 passes over it.

The thermostat 24 includes a bimetallic actuating element 25 and an electrical heater 26 for biasing the bimetallic element. The bimetallic element 25 and the biasing heater 26 are both mounted within the same casing as indicated schematically in Fig. 2. The bimetal 25 is arranged to open and close a pair of contacts 27 depending upon the temperature within the casing and the heater 26 serves as a means whereby the response of the bimetal may be varied. When heater 26 is energized, it supplies heat to the bimetal and thereby the bimetal opens the contacts 27 at a lower temperature within the dryer than it would if heater 26 were de-energized. By varying the energization of the heater 26 and thus the heat supplied to the bimetal 25 the response of the thermostat may be varied over wide limits.

The thermostat 24 is connected in the electrical circuit of the dryer 1 so that by varying its response different temperatures may be maintained within the machine. Specifically the thermostat is connected in series circuit relation with the heating unit 16 so that it cycles the unit 16 "on" and "off" by its operation. When the contacts 27 are opened, the heating unit is de-energized, and when the contacts 27 are closed, the heating unit is energized. As shown in Fig. 2 the electrical circuit of the dryer is energized from a 3-wire source comprising supply conductors 28 and 29 and an electrical neutral line 30. My preferred circuit for domestic use is intended for use with a voltage of approximately 220 volts between the supply conductors 28 and 29 and voltage of approximately 110 volts between each of the conductors and neutral line 30. The heating unit 16 is energized in series with the thermostat 24 across the 220 volt supply conductors 28 and 29.

Starting with line 28 the energizing circuit for the heating unit extends through a switch 31 which is controlled by a cam 31a of the sequence control 22. From switch 31 the circuit continues through a line 32 to the contacts 27 of the thermostat 24, and from contacts 27 it extends through a line 33, the safety thermostat 34, and a line 35 to the heating unit 16. As shown, the heating unit 16 preferably comprises a pair of heating elements 36 and 37 which are connected in electrical parallel. From the heating unit 16 the circuit passes through a line 38 to the contacts 39 of a motor centrifugal switch 40 and then through lines 41 and 42 to a switch 43 which is operated by a cam 44 of the sequence control 22. The heater circuit is completed from the switch 43 by a line 45 which is connected to the supply conductor 29.

With this circuit it will be seen that when the switches 31 and 43 are closed by the sequence control and the contacts 39 are closed by the motor centrifugal switch 40, the heating unit 16 is under the control of the thermostat 24. The thermostat thereby controls the heating unit during the drying cycle since, as explained herein-after, the switches 31 and 43 are closed throughout the cycle and the contacts 39 are closed whenever the drive motor 7 is operating. By varying the response of the thermostat any suitable temperature within a wide range may be maintained within the machine. The response

of the thermostat is, of course, adjusted by varying the amount of heat supplied to the bimetal 25 from the biasing heater 26.

In my preferred control the energization of the bimetal heater is controlled by means of a rheostat or variable resistor 46 which is controlled by the setting of the knob 21a. The resistor 46 is connected in series with the bimetal heater 26 between the electrical neutral line 30 and the supply conductor 28. Starting with the neutral line 30, the circuit extends through a fusible link 47 and a line 48 to the variable resistor 46, and thence through a line 49 and the heater 26 to the contacts 27 of the thermostat itself. From the contacts of the thermostat the circuit is completed through the line 32 and the switch 31 to the conductor 28. This circuit is thus energized whenever the switch 31 and the thermostat contacts 27 are closed. But if either of these is open, the bimetal heater is de-energized.

Since the variable resistor 46 and the heater 26 are connected serially, the more resistance is offered by the resistor 46 the less heat will be produced by the biasing heater 26 and the higher is the temperature level within the dryer to which the thermostat 24 responds. That is, the higher is the temperature level at which bimetal 25 opens contacts 27. When the resistance of the resistor 46 is set at its maximum value, the highest safe temperature is maintained in the machine; whereas when the resistance of the resistor 46 is set at its minimum value, the thermostat maintains the lowest suitable temperature within the machine. Any temperature between these limits may be maintained by adding the proper amount of resistance to the biasing heater circuit through the resistor 46. It is preferred that the resistor 46 be of the type which provides a continuous increase or decrease of resistance as the knob 21a is turned, rather than a step by step increase or decrease. With such a resistance any suitable temperature between the upper and lower limits may be maintained within the dryer.

It will be noted that since the heater 26 is energized through the contacts 27, the heater is de-energized concurrently with the air heating unit 16. Such a connection of the bi-metal heater is desirable in order to provide a satisfactory response of the thermostat, i. e. the bimetal, to the temperature within the dryer. With the bi-metal heater 26 and the air heating means 16 energized and deenergized concurrently, the temperature within the casing of the thermostat 24 follows the temperature within the dryer accurately whereby the bi-metal 25 opens and closes the heater circuit at the correct levels. The temperature within the thermostat casing adjacent the bi-metal rises and falls at substantially the same rate as the temperature within the machine, and thus the bi-metal is enabled to open and close the contacts 27 at the proper differentials to maintain the desired average temperature without overlarge temperature fluctuations occurring.

If, however, the bi-metal heater remained energized when the heaters were de-energized, the temperature within the thermostat casing would not follow the temperature of the dryer accurately and thus the bimetal 25 would not open and close the contacts 27 so as to maintain a relatively even temperature within the machine. The temperature within the machine would both fall and rise more rapidly than that at the bi-metal, and hence would fluctuate between relatively wide limits. The bi-metal would still cycle at the same differential but the temperature within the machine would have to fluctuate much further to produce that differential at the bi-metal. Although the desired average temperature might be maintained with the machine, the temperature would vary widely on both sides of that average and in fact would likely be too uneven for proper drying. Thus for accurate response of the thermostatic element and proper operation of the dryer the bi-metal heater 26 is

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energized and de-energized concurrently with the heating unit 16.

As mentioned above, the heating unit 16 can be energized only when the drive motor 7 is rotating the basket 2 since the contacts 39 of the motor centrifugal switch 40 are included in the heater circuit. To explain the operation of the motor 7, it is energized by a circuit connected across the conductor 29 and the electrical neutral 30. Starting with conductor 29 the circuit for motor 7 extends through line 45, switch 43, and line 42 to the windings 50 and 51 of the motor. The main running winding 50 is connected directly to line 42 and the start winding 51 is connected thereto through contacts 52 of the motor centrifugal switch 40. When the motor comes up to speed, the contacts 52 are opened at the same time as the heater contacts 39 are closed, whereby the starting winding 51 is in the circuit only until the motor comes up to speed. From the windings 50 and 51 the motor circuit extends through lines 53 and 54 to the contacts 55 of a door switch 56. The door switch 56 is actuated by the door 6 of the machine so the contacts 55 are closed whenever the door is closed and open whenever the door is open. From the contacts 55 the circuit is completed through lines 57 and 58 and the fusible link 47 to the electrical neutral 30. With the contacts 55 of the door switch in the motor circuit, it will be seen that the motor 7 is de-energized whenever the door is open. As a result, basket rotation is terminated whenever the door is opened. Also the heating element 16 is de-energized, since the stopping of the motor opens the contacts 39 of the motor centrifugal switch.

With regard to the switch 43 in both the heater and the motor circuits and the switch 31 in the heater circuit, these switches are, of course, operated by means of the sequence control 22. Unless both switches are closed, the heating unit 16 is inoperative, and unless switch 43 is closed, the motor 7 is inoperative. The cam 44 which controls the switch 43 includes two raised portions which are separated by short depressions. On the other hand the cam 31a which controls the switch 31 includes only a single raised portion corresponding to one of the raised portions of the cam 44. With this arrangement of the cams one period of operation of the dryer is provided wherein both switches are closed and a second period of operation is provided wherein only the switch 43 is closed. With both switches closed both the drive motor 7 and the heating unit 16 are energized whereby the basket 2 is rotated and heated air is passed through it for drying the clothes therein. When, however, the switch 43 is closed separately, the drive motor only is energized, whereby although the basket is rotated and air is passed through it, the air is not heated. As a result no appreciable drying effect is produced. This period of operation without the heating means provides for a clothes sprinkling operation. In order to sprinkle the clothes during this period of operation there may be provided within the basket 2 a suitable container which discharges water onto the clothes at a slow rate as the basket rotates. A suitable container for this purpose is shown and described in the copending application of Eugene G. Olthuis S. N. 430,794, filed May 19, 1954 and assigned to the same assignee as the present invention.

The mechanical connections between the cams 31a and 44, the dial 21 and the timer motor 23 are such that the sequence control may be manually rotated into either the dry range or the sprinkle range. That action places the dryer in operation with or without the heating unit depending upon the range selected. Once the cams have been moved into one of the ranges, the timer motor then rotates the cams until one of the depressions in the cams 44 is reached. At that point the switch 43 opens and de-energizes both the heating unit and the drive motor thereby terminating the operation of

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the machine. The switch 31 is, of course, open continuously during the sprinkling operation and opens slightly before the switch 43 during the drying operation to provide a machine cool-down period. Any desired period of sprinkling or drying up to a predetermined maximum may be obtained by the initial setting of the dial 21.

The timer 23 is energized by the same switch as the drive motor 7 i. e. the switch 43. Whenever the knob 21 is rotated so as to move the cam 44 into either the dry or the sprinkle range and close the switch 43, the timer 23 is energized. Specifically the timer is energized between the conductor 29 and the neutral line 30. Starting with the line 29 the circuit for the timer extends through line 45, switch 43, line 42, and a connection 59 to the timer itself. From the timer the circuit is completed through lines 60 and 54, the contacts 55 of the door switch, and lines 57 and 58 to the fusible link 47 and neutral line 30. Since the contacts 55 of the door switch are included in this circuit, the timer is also de-energized along with the drive motor and the heating unit whenever the door 6 is opened.

From the above it will be seen that I have provided a clothes dryer including not only means for controlling the duration of operation but also means for controlling the drying temperature. The thermostat provided for the temperature control is so arranged that it provides for a gradual continuous adjustment whereby any temperature within predetermined limits may be selected. Since the thermostat includes only a single bimetallic actuating member and a single biasing heater, it is very inexpensive to manufacture and assemble within the dryer. Further, since the biasing heater is de-energized whenever the air heating means are de-energized, the temperature within the thermostat housing follows accurately the temperature of the dryer whereby a very accurate control is obtained.

In addition to the elements pointed out above, my preferred control circuit also includes a light 61 for lighting the interior of the machine and an ozone lamp 62 for freshening the air within the machine. The lamps 61 and 62 are energized whenever the machine is in operation by means of a circuit connected between conductor 29 and neutral line 30. Starting with line 29 the circuit extends through line 45, switch 43, line 42 and a line 63 to the lamps. The lamps are connected in series and the circuit is completed to neutral line 30 through line 58 and the fusible link 47.

The lamps 61 and 62 are also energized whenever the door 6 is open, whether the switch 43 is closed or not. They are then energized across conductor 29 and the neutral line 30 through a circuit including a line 64 and the back contacts 65 of the door switch 56. The back contacts 65 of the door switch are closed when the door is open, and open when the door is closed. Commencing with conductor 29 this circuit for energizing the lamps when the door is open proceeds through line 64, back contacts 65 of the door switch, and a line 66 to the lamps 61 and 62. The circuit is completed through line 58 and fusible link 47 to the neutral line 30. It will be seen that this circuit is broken whenever the door is closed since the contacts 65 of the door switch are then opened.

While in accordance with the patent statutes, I have described what at present is considered to be the preferred embodiment of my invention it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claim to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

A clothes dryer comprising a clothes container, means for circulating a stream of air through said container, electrical heating means for heating the air before it

enters said container so as to dry clothes in said container, a thermostat responsive to the temperature of the air after it has passed through said container for controlling said heating means, said thermostat including a temperature responsive bimetallic actuating element, contact means controlled by said element, and a single heater for said bimetallic element, and a control circuit for selectively energizing said bimetal heater at various levels to vary the response of said element to the temperature of the air within said container and thereby selectively vary said temperature itself, said control circuit

being energized through said contact means whereby said bimetal heater is energized and de-energized concurrently with said heating means.

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