Dec. 16, 1952 E. K. CLARK 2,621,423

LAUNDRY APPARATUS

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FIG. 1.

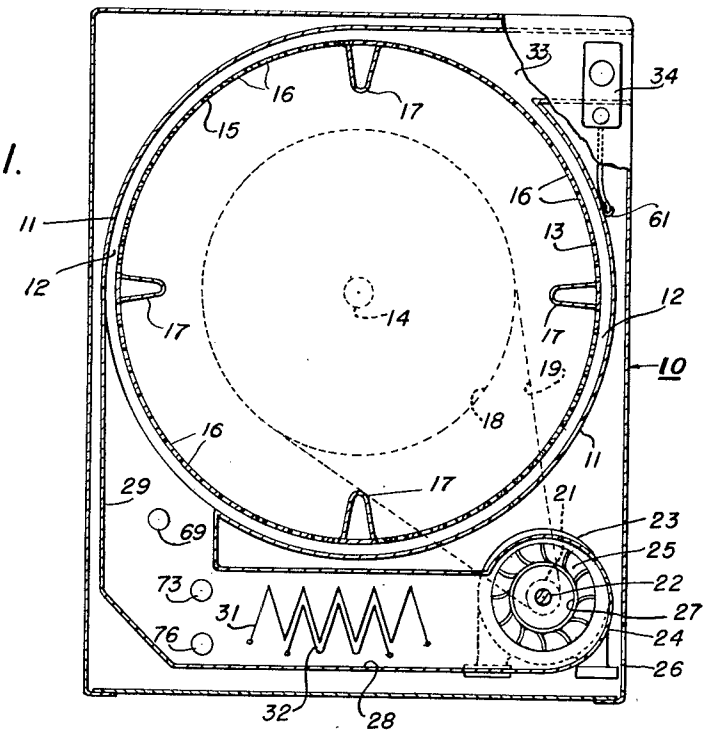
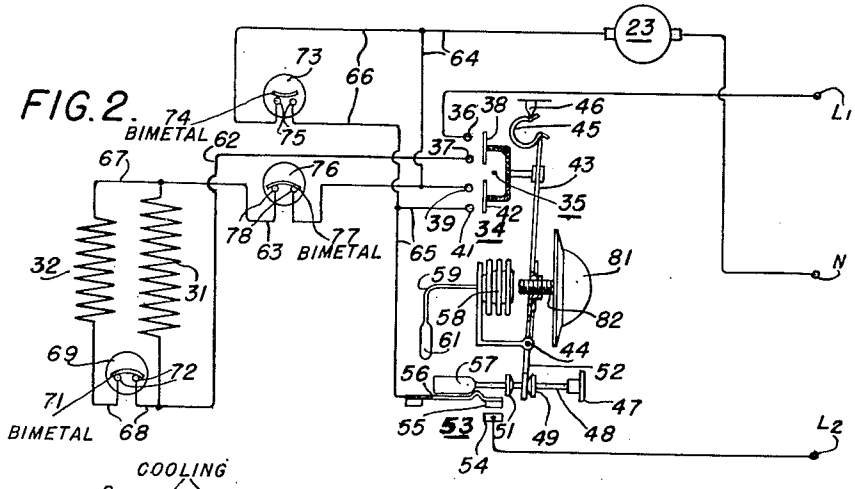


FIG. 2.



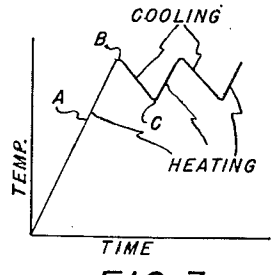


FIG. 3.

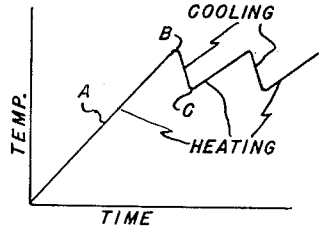


FIG. 4.

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LAUNDRY APPARATUS

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1 Claim. (Cl. 34—45)

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My invention relates to apparatus for drying clothes or the like and has for an object to provide improved apparatus of this kind.

Further objects of my invention are to expedite the heating of the air translated to the drying chamber of an electrically heated clothes dryer of the domestic type when the dryer is started from a cold condition; to maintain the temperature of the heated air supplied to said drying chamber substantially constant regardless of fluctuations of voltage impressed on the heaters of the dryer and to compensate for changes in temperature of the ambient atmosphere.

In practicing my invention, I provide a drying chamber in which clothes are preferably tumbled during the drying treatment, which chamber is supplied with air heated electrically by a pair of heaters. The heaters are energized by manually closing a master switch and deenergized when the temperature of the air in the drying chamber increases to a predetermined value prevailing when the clothes are dry. The heaters which have different capacities are preferably energized in parallel and the smaller heater is controlled by a thermostat responsive to the temperature of the heated air as it leaves the heaters and prior to its admission to the drying chamber, the arrangement being such that said heated air is maintained at a predetermined mean temperature. When started from a cold condition, both heaters are energized for rapidly raising the temperature of the air admitted to the drying chamber. The large heater is continuously energized and the smaller heater intermittently energized to maintain the temperature of the air constant. When operated at a lower than normal voltage, the smaller heater is energized for longer periods than when the voltage is normal. With normal voltage prevailing, the periods of energization of the smaller heater are relatively short. Also, the periods of energization of the smaller heater are longer when the ambient atmosphere is relatively cool and of shorter duration when the ambient atmosphere is relatively warm.

The foregoing and other objects are effected by my invention as will be apparent from the following description and claim taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a vertical sectional view of one form of domestic dryer constructed and arranged in accordance with my invention;

Fig. 2 is a diagram of the electrical connections for the dryer shown in Fig. 1; and

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Figs. 3 and 4 are curves illustrating temperature conditions within the dryer during a cycle of operation.

Reference will now be had to the drawing wherein I have elected to show my invention applied to a domestic clothes dryer of the type including an outer casing structure 10 having a general cylindrical baffle 11 secured therein and enclosing a drying chamber 12. A basket structure 13 is rotatably supported within the drying chamber 12 and includes a shaft 14 suitably journaled in the casing 10. The basket structure 13 includes a side wall 15 which is substantially perforate throughout its extent, a few of the perforations being indicated at 16, and a plurality of vanes 17 extending radially inwardly from the side wall 15. The basket 13 is driven by a pulley 18 belted, as shown at 19, to a pulley 21 driven by the shaft 22 of a conventional electric motor 23. It will be understood that, as the basket 13 is rotated, fabrics contained therein are elevated and dropped by the rotating vane 17.

Air for drying the fabrics is translated through the drying chamber 12 by a blower 24, the rotating element 25 of which is directly driven by the shaft 22. Air from the ambient atmosphere enters the casing 10 through an opening indicated at 26 and passes through an opening 27 formed in the blower housing 24 to be driven by the runner 25 through a duct structure 28 to the drying chamber 12. The downstream end of the duct structure 28 is provided with an upwardly extended portion 29 which is fixed to the baffle 11. The air translated by the blower is heated by a plurality of electric heaters 31 and 32 which, for the sake of clearness and brevity, are diagrammatically shown. It will be understood that the heaters 31 and 32 may be of any well-understood construction and supported within the duct 28 in any suitable manner. Preferably, the heaters 31 and 32 are coiled lengths of bare heater wire which are directly contacted by the air as it passes through the duct 28. As described hereinafter, the heater 31 operates throughout the drying portion of the cycle continuously and will be referred to as the primary heater while the heater 32 is intermittently operated and will be referred to as the secondary heater.

The heated air entering the drying chamber 12 passes through the numerous perforations 16 to the interior of the basket 13 where it contacts the tumbling fabrics and, due to its high capacity for vaporizing water contained in the clothes, effects the drying of the clothes. The air and

moisture entrained therein passes through an outlet duct 33 to the ambient atmosphere. Energization of the electric motor 23 and the heaters 31 and 32 is under control of a primary control element generally indicated at 34 and described hereinafter.

The primary control device 34 is manually actuated to initiate energization of the heaters 31 and 32 and operation of the electric motor 23. The device 34 is thermostatically operated to terminate energization of the heaters 31 and 32 at the conclusion of the drying cycle. The control device 34 preferably includes a main 2-pole switching element 35, one pole of which is defined by contacts 36 and 37 and a bridging member 38. The other pole of the switching element 35 is defined by stationary contacts 39 and 41 and the movable bridging member 42. The movable bridging members 38 and 42 are insulatedly carried by a movable resilient switch arm 43 pivotally supported by a fixed pivot 44. At the upper end of the switch arm 43, a conventional U-shaped snap-over compression spring 45 is provided to effect snap-acting movement of the switch arm 43 in both closing and opening directions thereof. The U-shaped spring 45 is compressed between the end of the switch arm 43 and a fixed knife-edge, indicated at 46.

The switch arm 43 is moved to a switch closed position from the position shown in the drawing by a manually actuated handle 47 when moved to the right as viewed in Fig. 2. The handle 47 is carried by a rod 48 having a pair of spaced shoulders 49 and 51 formed thereon and arranged on opposite sides of an extension 52 of the switch arm 43. The manually actuated handle 47 also operates to close a single pole switch, indicated at 53 and including a fixed contact 54 and a movable contact 55, the latter being carried by a spring support 56 which biases the movable contact 55 to a switch open position, as shown in the drawing. A cam 57 carried by the rod 48 is engageable with the spring arm 56 for closing the contacts 54 and 55. Opening of the main switch 35 at the conclusion of the drying cycle is effected by a thermostatic element including a bellows 58 and a tube 59 communicating therewith and terminating in a thermostatic bulb 61, which bellows and tube are filled with an expansible liquid. As shown in Fig. 1, the bulb 61 is fixed to the baffle 11 at a location thereof which closely follows the temperature of the air within the drying chamber 12.

In actuating the primary control device 34 to its active position, the handle 47 is moved to the right, as viewed in Fig. 2. The first stage of movement of handle 47 causes the cam 57 to force the switch 53 to its closed position and to engage the shoulder 51 with the projection 52. Continued movement of the handle 47 through a second stage swings the arm 43 counterclockwise in opposition to the bias of the over center spring 45 and closing of the main switch 35 is carried out with snap action. As the bellows expands during heating of the bulb 61, the arm 43 is deflected in clockwise direction in opposition to the bias of the spring 45. When a predetermined temperature of the bulb 61 is attained, the spring 45 moves over center with snap action and arm 43 operates to open main swtich 35. During this movement of arm 43, the projection 52, now in engagement with shoulder 51, moves cam 57 and handle 47 to the left but not sufficiently to open switch 53. Opening of the switch 53 is effected only by further movement of handle 47 and cam 57 to the left, manually, or to the position shown in the drawing. Opening of the main switch 35 and the single pole switch 53 may be effected at any time by manually moving the handle 47 to the left through its complete range of movement. Such movement of handle 47 would first disengage shoulder 51 from projection 52 and engages shoulder 49 with the projection 52. The cam would still engage the spring 56 for retaining the single pole switch 53 closed. Further movement of the handle 47 to the left, or to the position shown in Fig. 2, will open both switches 35 and 53.

The source of power for the heaters 31 and 32 and for the electric motor 23 is preferably defined by an Edison 3-wire circuit having line conductors L_1, L_2, and N, the voltage across conductors L_1 and L_2 being 230 volts and the voltage between either L_1 and L_2 and the neutral conductor N being 115 volts. As clearly shown, the conductor L_1 is directly connected to the fixed contact 36 and the conductor L_2 directly connected to the fixed contact 54. The neutral conductor N is directly connected to one side of the motor 23. The fixed contact 37 connects, by means of a conductor 62, with one terminal of the primary heating element 31, the opposite terminal of which is connected by conductor 63 with the fixed contact 39. One terminal of the motor 23 is connected by means of a conductor 64 with the fixed contact 39. As shown, the fixed contact 41 is connected by means of a conductor 65 with the movable contact 55 of switch 53. In order to provide for continued running of the motor 23 after the main switch 35 has opened, as described hereinafter, a shunting conductor 66 is provided which extends from the conductor 64 to the conductor 65 and, therefore, shunts the fixed contacts 39 and 41 of the main switch 35.

According to my invention, the secondary heater 32 is directly connected in parallel with the primary heater 31 by means of conductors 67 and 68 and is, therefore, under control of the main switch 35. The secondary heater 32 is also controlled, according to my invention, by a thermostat, indicated at 69 and including a bimetal element 71 which, when relatively cool, bridges contacts 72, the latter being connected in series in the conductor 68. When heated to a predetermined high temperature, as described hereinafter, the bimetal element 71 snaps to an open position and disengages the contacts 72.

A second thermostat, indicated at 73, includes a bimetal element 74 which when heated to a predetermined temperature bridges contacts 75 connected in series in the conductor 66, for a purpose to be described. A safety thermostat 76 including a bimetal element 77 which, when closed, bridges contacts 78 connected in series in the conductor 63. The thermostat 76 is normally closed and opens its contacts 78 only when an abnormal temperature obtains in the duct 28 for any reason. All of the thermostats 69, 73 and 76 are preferably located in the duct 28 on the downstream side of the heaters 31 and 32 where they reflect the temperature of the heated air being discharged to the drying chamber 12.

In operating the dryer described up to the present, the clothes to be dried are deposited in the basket 13 through a suitable access opening, not shown. The handle 47 is then withdrawn or moved to the right from the position shown in Fig. 2 for closing both switches 35 and 53, as described heretofore. This operation of the primary control element 34 energizes both

heaters 31 and 32 and the motor 23 is energized to initiate the circulation of air to the drying chamber 12. The circuit for the heaters 31 may be traced from the line conductor L_1 through the bridged contacts 36 and 37, the conductor 62, the main heating element 31, the conductor 63 and safety thermostat 76, bridged contacts 39 and 41, the conductor 65 and switch 53 to the line conductor L_2. As the secondary heating element 32 is directly connected in parallel through the closed thermostat 69 with the primary heating element 31, the secondary heating element 32 is also energized. The circuit for the electric motor 23 may be traced from the line conductor L_2 through switch 53, conductor 65, the bridged contacts 39 and 41, conductor 64 and motor 23 to the conductor N.

The temperature of the air passed in heat-exchange relation with the heaters 31 and 32 progressively increases during the early stage of the heating cycle. During this heating up portion of the cycle, the bimetal 74 of the thermostat 73 operates at a temperature of about 160° F. to bridge the contacts 75 and, therefore, close the shunt circuit defined by the conductor 66. At the moment, this is of no importance as the shunted contacts 39 and 41 are already bridged by the member 42. The purpose of closing this shunt circuit is to maintain operation of the motor 23 after the two pole switch 35 has opened at the end of the drying cycle, as described hereinafter. Heating of the air continues until a temperature of approximately 300° F. is attained, at which time, the thermostatic element 71 snaps to its open position for deenergizing the secondary heating element 32. Subsequent cooling of the air in the duct 28 will again close the thermostat 69, this operation occurring at a temperature of about 280° F. The thermostat 69 will then function to energize and deenergize the secondary heating element 32 to maintain a mean air temperature of approximately 290° as it enters the drying chamber 12.

Assuming the secondary heating element has a capacity of 1400 watts and the primary heating element 31 a capacity of 3400 watts, when energized at 230 volts, 4800 watts of energy is dissipated during the heating up portion of the cycle. During the early stage of the drying cycle, a substantial portion of the energy in the heated air stream is converted to latent heat of vaporization so that the temperature rise of the air in the drying chamber is relatively small. As the fabrics become dried, less energy is converted to latent heat and more to sensible heat so that the temperature of the air in the drying chamber 12 progressively increases. When the temperature of the air in the drying chamber 12 attains a value of approximately 200° F., the clothes are substantially dry. During the period of drying of the fabrics, the bellows 58 expands and deforms the resilient arm 43 and, when the temperature of the air in the chamber has attained a temperature of 200° F., the main arm 43 snaps to the position shown in the drawing for opening the two pole switch 35 and, therefore, deenergizing both heaters. During this operation of the switch element 34, the rod 48 is moved to the left by the projection 52 which now engages the shoulder 51. As set forth heretofore, this movement of the rod 48 is not sufficient to open the switch 53 as the cam 57 still engages the switch arm 56. Accordingly, operation of the motor 23 continues for the circulation of cool air as the motor 23 is energized

through the shunt circuit defined by the conductor 66 and the switch 53. Operation of the motor 23 is terminated by the opening of the shunt circuit 66 when the temperature of the bimetal 74 has been reduced to a value slightly below 160° F. The operation of the motor 23 can be terminated at any time however by manually moving the handle 47 completely to the left as viewed in the drawing.

The temperature at which the bellows 58 operates to open the two switches 35 may be varied by a temperature adjusting knob 81 and an abutment 82 which is threaded in the resilient arm 43. Accordingly, the fabrics may be completely dried or "damp" dried depending upon the adjustment of the handle 81 all of which is well understood.

From the foregoing, it will be apparent that the heaters 31 and 32 are cycled between 4800 watts and 3400 watts for heating the air, in the example cited, when energized at a normal potential of 230 volts. The two curves shown in Figs. 3 and 4 show temperatures plotted against time, Fig. 3 illustrating conditions when a relatively high potential of 245 volts is impressed on conductors L_1 and L_2 and Fig. 4 showing conditions when a low potential of 215 volts prevails. The portion A of the curves illustrates the initial heating period of the input air passing over the thermostat 69. The point B represents 300° F. in the example cited and the point C 280° F. In Fig. 3, the input air is heated by the elements 31 and 32 which consume 5440 watts and the air cools at a slow rate with 3850 watts being consumed after the thermostat 69 opens. In Fig. 4 the input air is heated at a lower rate of 4180 watts and the air cools with the primary heater dissipating 2960 watts.

In one form of dryer which I have constructed, the input air, when heated by 4000 watts of dissipated energy, is maintained substantially at its proper mean temperature of 290° F. This wattage is dissipated by the primary heater 31 when energized at 250 volts and by the combined heaters 31 and 32 when energized at 210 volts. At these two voltages, the thermostat 69 would not be called upon to operate and the temperature curve, after the initial preheating period, would be substantially flat. Accordingly, this dryer will maintain the proper temperature of input air when operated between 210 and 250 volts. Beyond these voltages compensation ceases, but abnormal voltages beyond this range are infrequently met on lines of present day utilities.

From the foregoing description it will be apparent that I have provided an improved clothes dryer of the domestic type wherein the temperature of the air admitted to the drying chamber is maintained at a substantially constant value by a pair of heaters, one of which is continuously energized during heating periods and the other of which is controlled in accordance with the temperature of the air leaving the heaters. With this arrangement, the temperature of the admitted air is maintained at a fixed value regardless of variations in voltage within a relatively wide range. Furthermore, the initial preheating of the air is expedited and compensation for changes in temperature of the ambient air is carried out. In this connection, with a relatively high ambient temperature, the periods of energization of the secondary heater are relatively short and, conversely, with a lower ambient temperature, the periods of energization of the secondary are relatively long.

While I have shown the invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What I claim is:

In a clothes dryer, the combination of means defining a drying chamber, a duct structure for conveying air to the drying chamber, means for translating air through the duct structure, primary and secondary electric heaters connected in parallel and disposed within said duct structure for heating air translated therethrough, a pair of line conductors defining a source of electric power for said heaters, a master switch controlling said heaters and manually movable to a closed position, said switch when closed connecting said heaters directly across said line conductors and subjecting said heaters to the full voltage of said source of power, means responsive to a predetermined high temperature of the air in the drying chamber for opening the master switch, and a thermostatically operated switch responsive to the temperature of the heated air

in said duct structure and connected in series with said secondary heater for controlling energization thereof, said thermostatically operated switch effecting energization and deenergization of said secondary heater in response, respectively, to predetermined low and high temperatures of the heated air.

EARL K. CLARK.

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