March 4, 1958 J. F. KOSTELICH 2,825,146

CLOTHES DRYING APPARATUS

Filed March 22, 1955

FIG. 1.

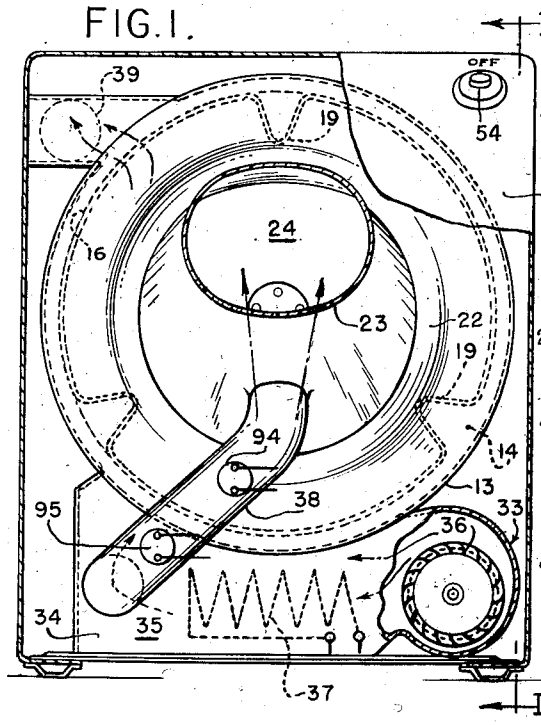


FIG. 2.

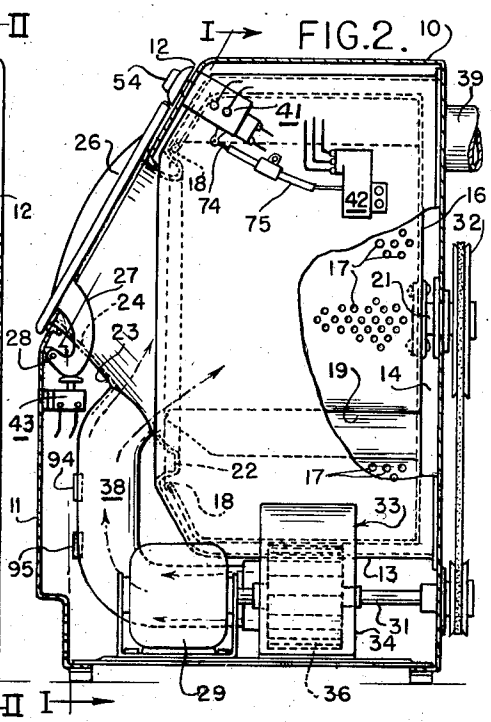
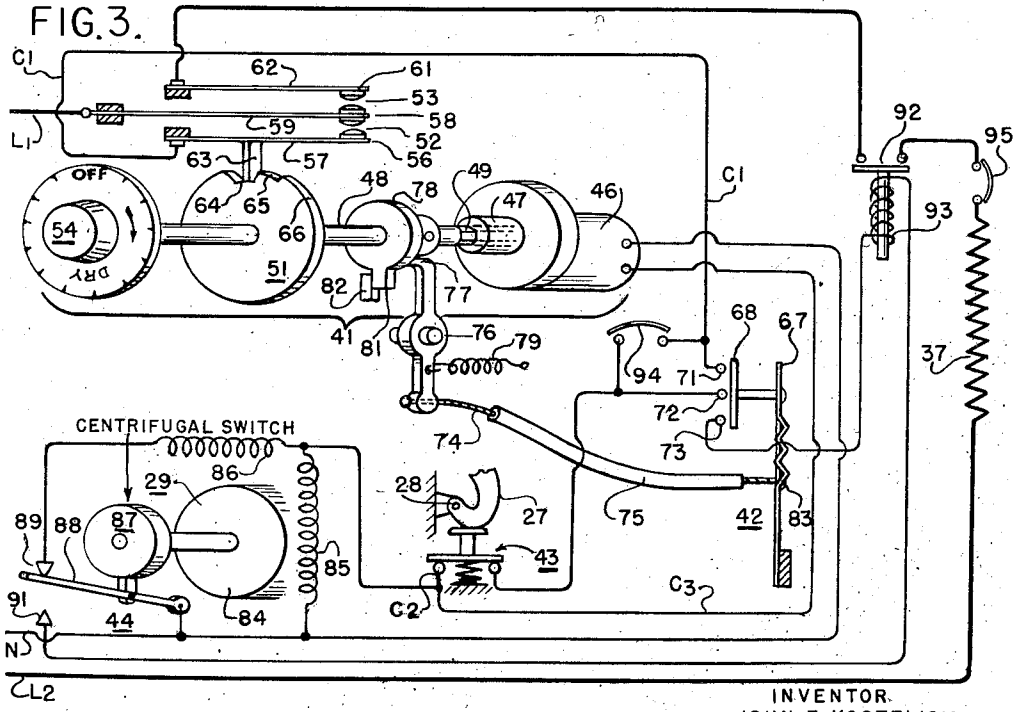


FIG. 3.



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CLOTHES DRYING APPARATUS

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7 Claims. (Cl. 34—45)

This invention relates to a control system for a clothes dryer and has for an object to provide an improved system of this kind.

In practicing the invention, the motor driven air translating mechanism and the heater of a conventional clothes dryer are controlled primarily by a time controlled sequence switch to provide a series of steps in a drying program of selected duration. A manually closed, thermostatically opened switch is provided to terminate a drying program in response to a predetermined high temperature of the clothes indicative of completed dryness thereof in the event that drying of the fabrics is completed before the end of the period provided by the sequence switch. In order to insure that the thermostatic switch is closed at the beginning of a drying cycle, it is interconnected, mechanically, with the sequence switch so that, when the latter is actuated from its off to one of its active stations, the thermostatic switch is closed by the mechanical interconnection. The arrangement is such that the thermostatic switch is opened only in response to said predetermined high temperature of the clothes. The control also includes a door operated switch for terminating operation of the dryer upon opening of the door and for starting operation of the dryer when the door is closed; no other manipulations of the control system being necessary in restarting the dryer.

Accordingly, it is an object of the invention to provide an improved control system, as set forth, wherein the sequence switch and the thermostatic switch are interconnected to insure closing of the latter when the former is actuated from its inactive to an active station.

A further object of the invention is to provide an improved control system, as set forth, for a dryer having a closure for the access passage thereof wherein operation of the dryer may be terminated and initiated by the actuation of the closure to its open and closed positions, respectively.

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

Fig. 1 is a sectional view of a dryer controlled in accordance with the invention, as viewed from the plane I—I of Fig. 2 and with parts broken away for the sake of clearness;

Fig. 2 is a section taken along the line II—II of Fig. 1, also with parts broken away for the sake of clearness; and,

Fig. 3 is a diagram of the electrical connections of the control system for the dryer shown in Figs. 1 and 2.

Reference will now be had to the drawing wherein the invention is disclosed applied to a domestic type clothes dryer of the type including an outer casing structure 10 having a front wall 11, the upper portion 12 of which is inclined upwardly and rearwardly as shown in Fig. 2. Arranged within the casing 10 is a generally cylindrical baffle structure 13 secured in any suitable manner to the casing 10 and enclosing a drying chamber 14. A generally cylindrical basket structure 16 is disposed within the drying chamber 14 for rotation about a substantially horizontal axis. The basket 16 is perforate throughout a major portion of its extent, some of the perforations being indicated at 17, and is also provided with a relatively large opening 18 at the front side thereof through which access may be had to the interior of the basket. The basket is also provided with a number of inwardly extending vanes 19 for tumbling the fabric contained within the basket during the drying operation all of which is well understood. Rotation of the basket is effected by a shaft 21 journalled in any suitable manner in the rear wall of the casing 10, the shaft 21 defining the sole support for the basket.

The front side of the baffle 13 is reentrant as shown at 22 and connects with the inner end of an inclined chute 23, the outer end of the latter being secured to the portion 12 of the front wall 11. The chute 23 is hollow and defines a relatively large access passage 24 communicating at its inner end with the interior of the basket 16. The access passage 24 is closed by a closure 26 carried by arms, one which is shown at 27, and hinged in any suitable manner to the front wall 11, as indicated at 28.

Rotation of the basket 16 is effected by a motor 29 having a shaft 31 extending through the rear of the casing 10 and driving the shaft 21 of the basket by means of a suitable transmission shown, by way of example, as a transmission of the belt and pulley type 32. The motor 29 also serves to drive a blower 33 arranged at one end of a transverse duct 34, the latter enclosing a heating chamber 35 for air. The blower 33 has a runner 36 which withdraws air from the interior of the casing 10 and forces it through the heating chamber 35. The air is heated by a suitable electric heater 37 and then passes through a conduit 38 which is connected to the bottom side of the chute 23 and so arranged that it discharges the heated air inwardly and upwardly within the basket 16. The heated air having a high capacity for absorbing moisture contacts the tumbling fabrics within the basket 16. The water in the fabrics is vaporized and carried with the air through a discharge conduit indicated at 39 to a suitable point of discharge. A clothes dryer of the type described up to the present is disclosed in the patent of R. T. Wakefield No. 2,682,711 granted July 6, 1954.

The apparatus for controlling operation of the motor 29 and heater 37 will now be described. In the control of these members, a timer or motor driven sequence switch, generally indicated at 41, is employed. The switch 41 is carried by the front wall 12 where it is convenient to the operator. It will be understood that the timer 41 is adjustable to provide periods of operation of various durations depending upon the size of the load being dried and/or the degree of dampness to be retained in the clothes at the conclusion of the drying cycle. The control also includes a thermostatically operated switch structure, generally indicated at 42 and disposed to reflect the temperature of the air within the drying chamber. The thermostatic switch 42 is preferably disposed to reflect an air temperature which closely follows or which is a function of the temperature of the fabrics being treated and, therefore, indicative of the degree of dryness of the fabrics. The control mechanism further includes a door switch, indicated generally at 43, preferably actuated by one of the arms 27 of the door 26. The arrangement is such that the door switch 43 is closed when the door 26 is closed and is actuated to an open position when the door 26 is moved to an open position. The control further includes a modified centrifugally operated switch 44 for the motor 29 to be referred to hereinafter.

Referring now to the timer 41, this device includes a driving motor of the type commonly employed for use in clocks and indicated at 46. This motor 46 drives a

slow speed shaft, indicated at 47, through suitable reduction gearing, not shown. It will be understood that the shaft 47 operates at a relatively low speed of for example one revolution in one or two hours depending upon the dryer design and the capacity of the heating element employed therewith. The timer 41 also includes a cam shaft 48 which is splined, as shown at 49, to the drive shaft 47, the arrangement being such that the cam shaft 48 rotates at all times with the shaft 47 but may be moved axially with respect thereto for a purpose to be described. The cam shaft 48 carries a cam 51 which operates switches 52 and 53 in a predetermined sequence. The cam shaft 48 is also provided with a knob or handle 54 disposed on the ouside of the dryer casing for actuation by the operator. The knob is provided with indicia, one of which is marked "off" and indicates an inactive station of the timer, while the remaining indicia will represent minutes of operation to be provided.

The cam shaft and knob 54 are rotated in the direction of the arrow by the motor 46 and it will be understood that the cam shaft 48 may be advanced manually in this same direction by the turning of the knob 54. In this connection, a slip or one way clutch (not shown) is usually provided in this type apparatus to permit such manual advancement of the cam shaft relative to the motor 46.

The switch 52 includes a movable contact 56 carried by a spring 57 and engageable with a contact 58 carried by a spring 59. The switch 53 includes contact 58 and a contact 61 carried by a spring arm 62. An insulating cam follower 63 is fixed to the spring arm 57 and rides on the surface of the cam 51 at all times. The bias of the springs 57, 59 and 62 is such as to maintain the contacts in the position shown in Fig. 3. It will be noted that the cam 51 is provided with a relatively low cam surface 64, an intermediate cam surface 65 and a relatively high cam surface 66.

With the follower 63 engaging the surface 64, the switches 52 and 53 are open as shown. When the follower 63 rests upon the cam surface 65, the spring 57 is bent upwardly to an extent sufficient to close the switch 52. When the cam follower 63 rides on the upper cam surface 66 both the springs 57 and 59 are bent upwardly to an extent sufficient to close both switches 52 and 53.

The thermostatically operated switch 42 includes a snap acting bimetal element 67 of any suitable construction and effective to move with snap action from one stable position to another. The movable end of the bimetal 67 carries a bridging member 68 of the switch 42, which member in the closed position bridges the contacts 71, 72 and 73. The thermostatically operated switch structure 42 is so constructed that it is closed only by manual movement of the bimetal 67 in switch closing direction. Opening of the thermostatically operated switch structure 42 is effected, of course, by a relatively high air temperature within the drying chamber. This temperature is usually of the order of 190° F., a temperature assumed when the fabrics are substantially bone dry. In connection with this switch, it will be understood that the bimetal 67 cannot move in switch closing direction when subjected to ordinary room temperatures.

In accordance with this invention, a mechanical interlock is provided between the timer 41 and the thermostatically operated switch 42, the arrangement being such that the thermostatically operated switch 42 must be closed at any time that the timer 41 is moved from its "off" or inactive station to any active station. Any suitable form of mechanical interlock may be employed for this operation. As shown, a flexible wire commonly referred to as a "choke wire" 74 is slidably arranged within a casing 75 supported in any suitable manner on the baffle 13. One end of the wire 74 is brazed or otherwise fixed in an opening in a pivoted lever 76 associated with the timer 41. The lever 76 has an upper finger portion 77 engaging the side surface of a disc 78 fixed to and rotatable with the cam shaft 48. A spring 79 biases the lever 76 at all times into engagement with the disc 78. The disc 78 is also provided with a radially extending finger 81 which, in the off position of the timer, engages a fixed stop 82 as shown in Fig. 3. It will be noted that, in order to manually advance the timer from its inactive or off position, the cam shaft 48 must be moved axially until the finger 81 clears the stop 82 whereupon the cam shaft 48 may be rotated. This axial movement of the shaft 48 and the disc 78 carried thereby will swing the lever 76 about its pivot in opposition to the bias of the spring 79. This movement, of course, moves the wire 74 in its casing 75 to the left and, since the end of the wire 74 bears against the bimetal arm 67, the latter will be mechanically moved to close the thermostatically operated switch 42. It will be understood that the wire 74 is slidable through a suitable opening in the bimetal 67 and is provided with a beaded head 83 engaging the bimetal 67 for moving the latter as described.

Referring now to the diagrammatic representation of the motor 29 in Fig. 3, this is a split phase type of motor having a rotor 84 and running and starting windings 85 and 86, respectively. A centrifugally operated mechanism, generally indicated at 87 and of the type commonly used with motors of this kind, actuates a switch arm 88 of the switch 44. When the motor is idle or operating at a speed below a predetermined value, the movable switch arm 88 engages a contact 89 but when the motor is operating at its full normal speed the movable contact 88 engages a contact 91. It will be noted that, except for the contact 91, all elements of the motor 29 are of conventional construction and need not be further described.

The source of power for the apparatus is represented by a three wire circuit having main conductors L_1 and L_2 and a neutral conductor N. The circuit may be a conventional Edison three wire circuit wherein the voltage across the main conductors L_1 and L_2 is approximately double the voltage obtaining between either conductor L_1 and L_2 and the neutral conductor N.

Preferably the heater 37 is under control of a relay, the main contacts of which are indicated at 92 and the operating coil being indicated at 93. The arrangement is such that the relay contacts 92 are closed when the coil 93 is energized and conversely are open when the coil 93 is deenergized. The control system further includes, preferably, a thermostatically operated switch indicated at 94 and arranged in conduit 38 where it is subject to hot air being discharged from the heater 37. This thermostatic switch 94 is arranged to close at temperatures above, for example, 130° F. and to open at temperatures below that value. This is a so-called motor over-run thermostat and provides for a period of continued operation of the motor 29 and the circulation of cool air after the heater 37 has been deenergized by the thermostatic switch 42 as set forth hereinafter. In order to maintain the temperature of the heated air passing through the conduit 38 at a substantially constant mean value a thermostat 95 responding to the temperature of the air in the conduit 38 is connected in series with the heater 37 as shown in Fig. 3. It will be understood that the thermostat 95 opens the circuit to the heater 37 in response to a predetermined high temperature and closes the circuit at a predetermined lower temperature.

A description of the operation of the dryer and its control mechanism will now be given. It will be assumed that a full or regular load of fabrics is to be completely dried for immediate storage. The fabrics are deposited in the basket 16 after which the door 26 is latched closed. The timer knob 54 is then moved axially to the right as seen in Fig. 3 sufficiently for the finger 81 to clear the stop 82, after which the knob is turned to its first active position which provides a drying period of maximum duration. The axial movement first imparted to the timer

knob 54 actuates the pivoted lever 76 and the wire 74 to close the thermostatically operated switch 42 as described heretofore.

The rotative movement imparted to the timer shaft 48 closes the cam operated switches 52 and 53, as the cam follower 63 rides upwardly upon the cam surface 66. The closing of the switch 52 completes a circuit for the main motor extending from line conductor L_1 and including the spring 59, the contacts of the switch 52, spring 57, a conductor C_1, contact 71, bridging member 68 and contact 72 of the switch 42, door operated switch 43, a conductor C_2, running winding 85 of the motor 29 and the neutral conductor N. The starting winding 86 of the motor is, of course, also energized in parallel with the running winding 85 through a circuit including the fixed contact 89 and the movable switch blade 88 of the centrifugal switch. Accordingly, the motor 29 is now operated to drive the blower 33 and the basket 16 as described.

During acceleration of the motor 29, the centrifugal mechanism 87 moves the switch blade 88 out of engagement with the contact 89 for deenergizing the starting winding 86 and into engagement with the contact 91. The latter operation completes a circuit from the conductor C_1, which, as set forth, is now at the potential of the line conductor L_1 through contact 71, bridge 68 and contact 73 of the switch 72, the coil 93 of the heater relay, contact 91, and switch blade 88 to the neutral conductor N. The relay contacts 92 are closed by the last described operation completing a circuit from the line conductor L_1 through the cam operated switch 53, the spring support 62, relay contacts 92, thermostat 95, main heater 37 to the line conductor L_2. Accordingly, heated air is now delivered to the tumbling fabrics in the basket as described, the mean temperature of the heated air being determined by the cycling thermostat 95.

A circuit for the timer motor 46 may be traced from the conductor C_2 which is also at the potential of the line conductor L_1 at this time, through a conductor C_3 to the timer motor 46 and thence directly to the neutral conductor N. Accordingly, the timer motor operates to slowly rotate the cam 51 during the drying of the fabrics. At this time, the thermostat 94 is actuated to its closed position by the heated air passing through conduit 38. This operation is of no moment at the present as the thermostat contacts 94 are shunted at this time by the bridging member 68 which engages the contacts 71 and 72 of the thermostatic switch 42.

The heated air now being translated through the drying chamber vaporizes water in the fabrics and the water vapor is discharged with the air through the discharge conduit 39. During the early stages of the drying period, the temperature of the air in the drying chamber is relatively low because of the refrigerating effect provided by the vaporizing water in the fabrics. In other words, at this time, a substantial portion of the energy dissipated by the heater is converted to latent heat of vaporization and the dry bulb temperature of the air is, therefore, relatively low. As the drying progresses, less water is present to be vaporized and, therefore, less energy is converted to latent heat and more to sensible heat so that the dry bulb temperature progressively increases.

Under ordinary circumstances the drying cycle is completed by the operation of the timer 41. A short time, for example, five minutes, before the end of the cycle the follower 63 rides downwardly from the cam surface 66 onto the surface 65 whereupon the cam switch 53 is opened. This, of course, is the main switch for the heater 37 and, therefore, the latter is deenergized. The timer then provides about five minutes of operation during which time the motor continues to operate to circulate unheated or relatively cool air through the heating chamber. This has a double effect of completing the drying and cooling the fabrics to a temperature where they may be comfortably handled. At the end of this period the cam follower 63 rides downwardly from the surface 65 onto the surface 64 as shown in Fig. 3 in which position both cam switches 52 and 53 are open and, therefore, all of the electrical translating devices of the dryer are deenergized and operation is terminated. This completes a drying cycle.

If it is desired to retain some moisture in the fabrics so that the may be immediately ironed, the timer knob 54 will be advanced to a position which the operator knows from experience will provide a certain degree of dampness. The operation will be the same as that described except that the drying operation is terminated prior to complete drying of the clothes. Where a light load is to be dried, the timer will also be actuated to an advanced position in order to reduce the drying period. If, for any reason, during a drying period, the clothes are completely dried prior to the end of the period provided by the timer, the temperature within the drying chamber will increase to the value at which the thermostatically operated switch 42 is set. Accordingly, the latter will snap to its open position disconnecting the bridge 68 from its associated contacts 71, 72 and 73. Accordingly, both circuits leading to the main motor 29 and to the relay coil 93 will be broken. The heater 37 will, therefore, be deenergized but the main motor will continue to operate for a short period of time to circulate cool air as described because of the shunt circuit provided by the thermostat 94, now closed, and the conductor C_1 to the door switch 43. When the thermostat 94 is cooled, it opens for deenergizing the motor 29 as well as the timer motor 46. Accordingly, the thermostatically operated switch 42 is effective to completely deenergize the system and stop operation even though the timer may be in an active position with both of its cam switches 52 and 53 closed. However, in order to restart the dryer for a succeeding operation, it will be necessary for the operator to first push the dial 54 inwardly in order to close the thermostatic switch 42 before adjusting the timer to the desired position.

It is believed apparent from the foregoing description that an improved control system for a clothes dryer is provided wherein the period of drying is determined, primarily, by an adjustable timer or sequence switch but wherein thermostatic means responsive to a temperature indicative of complete drying of the fabrics terminates a cycle independent of the timer if drying is completed prior to the end of the cycle provided by the timer. The arrangement is such that the thermostatic means is conditioned for operation in response to actuation of the timer from its inactive station to an active station thereof.

While the invention has been shown 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:

1. In a control for a clothes dryer having a drying chamber, motor driven means for tumbling clothes in the drying chamber and for translating air thereover and a heater for heating the air, the combination of a timer manually movable from an inactive position to selective active positions and controlling energization of the heater and said motor driven means, a thermostatically operated switch also controlling energization of the heater and the motor driven means when said timer is adjusted to an active position thereof, said thermostatically operated switch being opened in response to a predetermined high temperature within the drying chamber, and means actuated by the timer in moving from its inactive position to an active position thereof for closing the thermostatically operated switch.

2. In a control for a clothes drier structure having a drying chamber and an access opening thereto, a door closing said access opening and movable to an open position, means for tumbling the clothes in said chamber, motor driven means for translating air through the chamber, and a heater for heating the air, the combination of

a timer manually movable from an inactive position to selective active positions and controlling energization of the heater and said motor driven means, a thermostatically operated switch also controlling energization of the heater and the motor driven means when said timer is adjusted to an active position thereof, said thermostatically operated switch being opened in response to a predetermined high temperature within the drying chamber, switching means actuated by said door and controlling energization of the motor driven means when the timer is disposed in an active position, and means actuated by the timer in the moving from its inactive position to an active position thereof for closing the thermostatically operated switch.

3. In a control system for a clothes drier having a drying chamber, means for tumbling fabrics within the drying chamber, means including a motor for translating air through the drying chamber and a heater for heating said air, the combination of first and second electric circuits for the motor and heater, respectively, a sequence switch controlling said circuits, a timing motor for driving the sequence switch, said sequence switch being manually movable from an inactive station to selective active stations for the energization of said electric circuits and the timing motor, said timing motor actuating the sequence switch to its inactive station to deenergize the circuits and conclude a drying program, thermostatically operated switching means controlling said circuits and effective to open the circuits in response to a predetermined high temperature within the drying chamber, and means actuated by the sequence switch in moving from its inactive station to an active station for closing the thermostatically operated switching means.

4. In a control system for a clothes drier structure having a drying chamber and an access opening thereto, a door for closing the opening, means for tumbling the fabrics within said chamber, means including a motor for translating air through the chamber and a heater for heating the air, the combination of first and second electric circuits for the motor and heater, respectively, a sequence switch controlling said circuits, a timing motor for driving the sequence switch, said sequence switch being manually movable from an inactive station to selective active stations for the energization of said electric circuits and the timing motor, said timing motor actuating the sequence switch to its inactive station to deenergize the circuits and conclude a drying program, thermostatically operated switching means controlling said circuits and effective to open the circuits in response to a predetermined high temperature within the drying chamber, a switch actuated by said door and movable to open and closed stations as the door is actuated to respective open and closed positions, said door operated switch controlling energization of the motor circuit, and means actuated by the sequence switch in moving from its inactive station to an active station for closing the thermostatically operated switching means.

5. The combination as claimed in claim 2 including a speed responsive switch actuated by the motor driven means and effective when the speed thereof is depressed to a predetermined value for the deenergization of the heater.

6. In a control for a clothes dryer having a drying chamber for containing the clothes, motor driven means for translating air through the chamber and in contact with the clothes and a heater for heating the air, the combination of a timer controlled sequence switch for controlling energization of the heater and said motor driven means, manually actuated means for moving the sequence switch from an inactive station to selective active stations, a thermostatically operated switch also controlling energization of the heater and the motor driven means when said sequence switch is adjusted to an active station thereof, said thermostatically operated switch being opened in response to a predetermined high temperature within the drying chamber, and means operated by said manually actuated means in moving the sequence switch from its inactive station to an active station thereof, for closing the thermostatically operated switch.

7. In a control for a clothes dryer including a drying chamber for containing clothes to be dried, motor driven means for translating air through the drying chamber, and heating means for heating the air, the combination of a timer controlled mechanism manually movable from an inactive station to selective active stations and controlling energization of the heating means and the motor driven means, thermostatically operated switching means also controlling energization of the heating means when the timer controlled mechanism is adjusted to an active station thereof, said thermostatically operated switching means being moved to one controlling position wherein the heating means is deenergized, in response to a predetermined high temperature within the drying chamber and means actuated by the timer controlled mechanism in moving from its inactive station to an active station thereof for moving the thermostatically operated switching means to a second controlling position wherein the heating means is energized.

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