

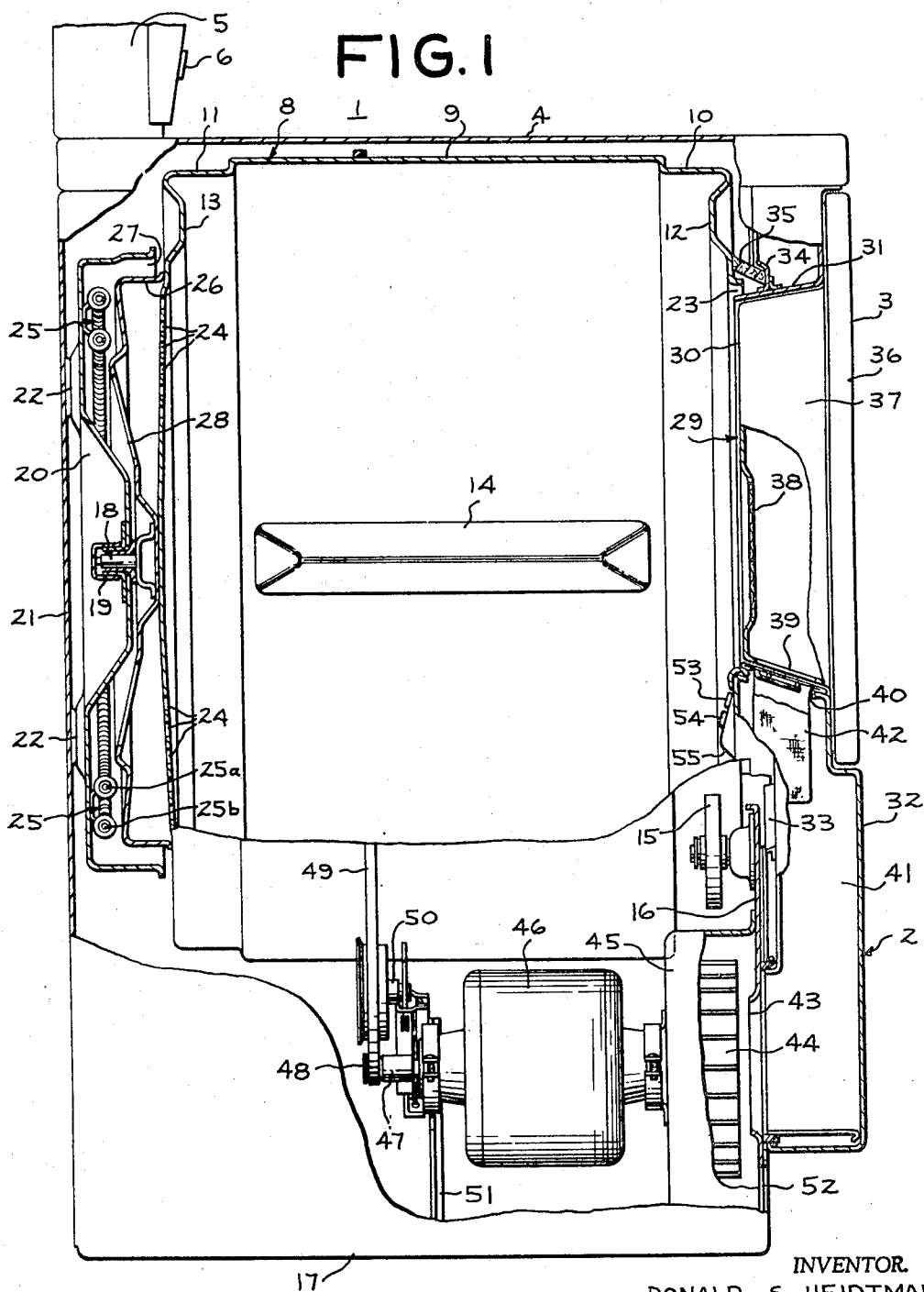
July 30, 1968

D. S. HEIDTMANN
ELECTRONIC DRYNESS CONTROL

3,394,466

Filed June 30, 1967

2 Sheets-Sheet 1



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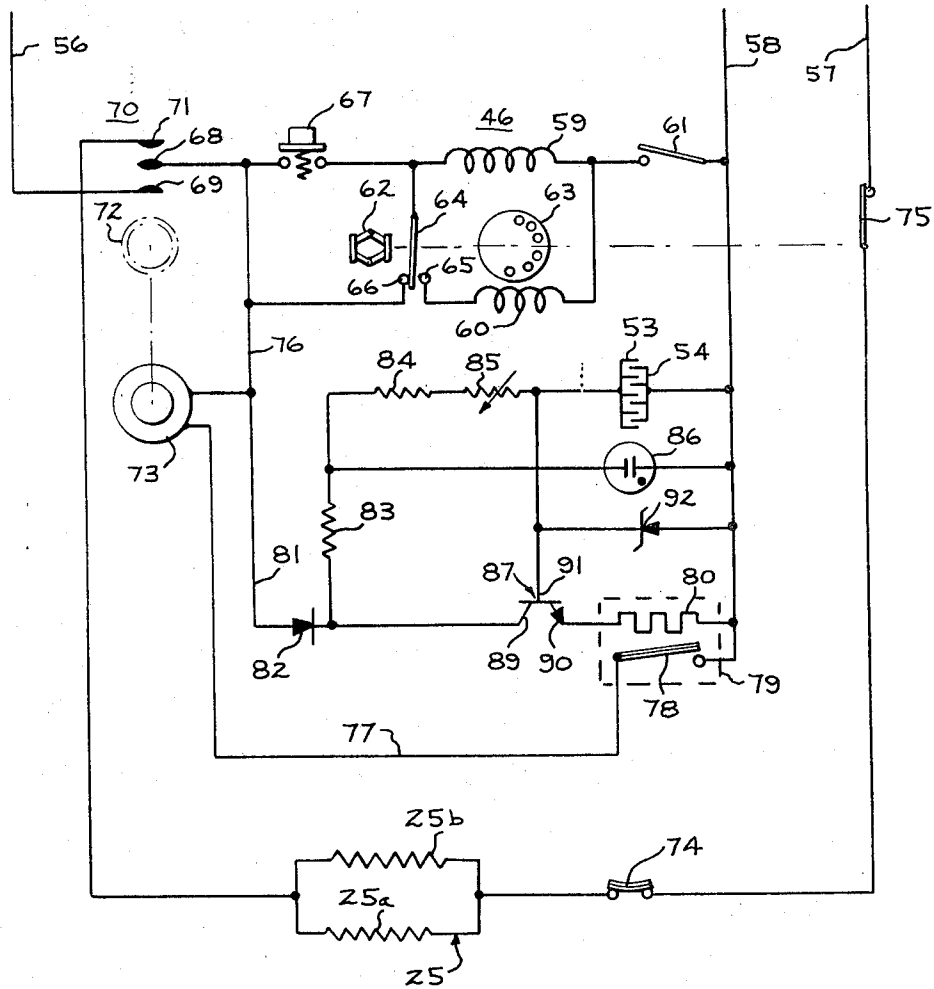
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ELECTRONIC DRYNESS CONTROL

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ABSTRACT OF THE DISCLOSURE

In a dryer of the type having spaced sensors to provide a resistance responsive to the amount of moisture in the articles being dried, the shut-off control timer motor is connected in the electrical supply circuit in series with the switch of a thermal relay. The resistance of the thermal relay is connected to the sensors by means of a transistor, which matches the impedance of the relay resistance to the impedance of the articles across the sensors. The relay resistance averages the instantaneous voltages appearing across this connection to give a voltage proportional to the average resistance across the sensors. The relay switch closes when the average resistance exceeds a preset value.

Background of the invention

During the past several years clothes dryer controls which use a measurement of the resistance of the fabrics being dried as the control basis have come into vogue. In one of the more usual prior art approaches for this type of control sensors for the dryer drum are connected across a storage capacitor and control the voltage toward which the charge on the capacitor builds. When the charge reaches a predetermined amount, some means is initiated to terminate the dryer operation. In this type of control the capacitor serves as an integrator; that is, it averages the instantaneous voltages across the sensors to prevent incorrect momentary "dry" voltages from terminating the dryer operation.

Obtaining appropriate time delays with controls of this type has proven rather difficult and involves the use of fairly expensive components. Other controls, designed to eliminate the capacitor storage feature, have not been completely satisfactory and, quite often have proven to be rather complicated themselves.

An object of this invention is to provide an improved dryer control of the resistance sensing type.

Another object of this invention is to provide such an improved control which provides for suitable time delays without the necessity of utilizing storage capacitor devices.

A further object of this invention is to provide such an improved control which is effective to compensate for variations in the amount of fabrics being dried.

Summary of the invention

In a fabric drying machine having a chamber to receive fabrics to be dried, heating means arranged to heat fabrics in the chamber, and cyclically moving means for tumbling fabrics in the chamber; a control is provided having a pair of conductors for connection to a source of electrical energy. The control also includes shut-off control means, effective after energization to interrupt operation of the dryer. The control also includes a thermal relay having a switch and a first resistance, the switch being normally open and closing in response to a predetermined average voltage being impressed across the first resistance. The shut-off control means and the switch are connected in series between the conductors. A pair of spaced sensors are positioned in the chamber so as to be bridged by the tumbling fabrics. A voltage divider is established, including a second resistance and the sensors. The second resistance is connected between one of the conductors and one of the sensors, while the other of the sensors is con-

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nected to the other conductor. A transistor having a collector, an emitter, and a base is provided with the collector connected to the one conductor and the emitter connected to the other conductor through the first resistance. The base of the transistor is connected to the voltage divider between the second resistance and the first sensor.

Brief description of the drawings

FIGURE 1 is a side elevational view of a clothes dryer suitable for incorporation of the improved electronic dryer control of this invention, the view being partly broken away and partly sectionalized to illustrate details; and

FIGURE 2 is a schematical electric circuit diagram showing one embodiment for the invention.

Description of the preferred embodiments

Referring now to FIGURE 1, the machine illustrated is a domestic clothes dryer generally indicated by the numeral 1. Dryer 1 is provided, in the usual way, with a cabinet 2 having a front door 3 to provide access to the interior of the cabinet. Provided on the top wall 4 of the cabinet 2 is a control panel 5 which may include a suitable manual control 6. By manual manipulation of control 6, the machine can be caused to start and automatically proceed through a cycle of operation.

Within cabinet 2 there is provided a fabric tumbling chamber, or drum 8, mounted for rotation on a substantially horizontal axis. Drum 8 is generally cylindrical in shape having a first, outer cylindrical wall portion 9, second and third, outer, cylindrical wall portions 10 and 11, located adjacent the front and back of the drum respectively, a front wall 12 and a back wall 13. Outer wall portions 9, 10 and 11 are imperforate so that the outer shell of the basket is imperforate. A plurality of clothes tumbling ribs 14 are provided on the interior of wall portion 9 to lift fabrics as the drum rotates, and then allow them to tumble back down to the bottom of the drum.

The front of the drum 8 is rotatably supported within the outer casing 2 by suitable idler wheels, one of which is shown at 15. These wheels are mounted near to the top of a member 16, which extends up from the base 17 of the machine. The wheels 15 are disposed beneath the drum and contact the portion 10 so as to provide a support on each side of the drum. The rear end of drum 8 receives support by means of a stub shaft 18 extending from the center of wall 13. Shaft 18 is secured within a bearing 19 supported by a baffle 20 which, in turn, is rigidly secured to the back wall 21 of cabinet 2 by any suitable means such as welding at a number of points 22. With this arrangement, the drum rotates about a horizontal axis with rollers 15 providing the front support and stub shaft 18 within bearing 19 providing the rear support.

In order to provide for the flow of a stream of drying air through the drums, the drum is provided with a central aperture 23 in its front wall 12 and with an opening in the form of a plurality of perforations 24 in its rear wall 13. Baffle member 20 also supports heating means 25 which includes two electrical resistance heating elements 25a and 25b, appropriately insulated from the baffle. A second baffle member 26 is secured to the back wall 13 of the drum outside the ring of perforations 24 and within the stationary baffle 20, so that an annular air inlet 27 is, in effect, formed by baffles 20 and 26. In this manner a passage is formed for air to enter the annular inlet opening 27 between the baffles, pass over the heating means 25, pass through an opening 28 formed in baffle 26, and then through the perforations 24 to the interior of the drum 8.

The front opening 23 of the drum is substantially closed by means of a stationary bulkhead generally indicated by the numeral 29. Bulkhead 29 is made up of a number of

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adjacent members which include the inner surface 30 of the access door 3, stationary frame 31 for the door, formed as a flange of the front wall 32 of the cabinet, the inner surface member 33 of an exhaust duct which is formed by cooperation of member 33 with the front wall 32 of the cabinet, and an annular flange 34 mounted on frame 31 and on the duct wall. A suitable clearance is provided between the inner edge of the drum opening 23 and the edge of the bulkhead 29 so that there will be no rubbing between the drum and bulkhead during rotation of the drum. To prevent any substantial air leakage through opening 23 between the interior and exterior of the drum, a suitable ring seal 35 is secured to flange 34 in sealing relationship to the exterior surface of the drum wall 12.

Front opening 23 also serves as a means whereby clothes may be loaded into and unloaded from the drum. Door 3, whose inner surface 30 forms part of the bulkhead closing the opening, is mounted on cabinet 2 so that, when the door is opened, clothes may be inserted into or removed from the drum through the door frame 31. The door includes an outer, flat, imperforate section 36 and an inwardly extending hollow section 37 mounted on the outer section. Hollow section 37 extends into the door frame 31 when the door is closed and the door surface 30 is the inner wall of the hollow section.

The air outlet from the drum is provided by a perforated opening 38 formed in the inner wall 30 of the hollow door section 37. The bottom wall section of door 3 and the adjacent wall of door frame 31 are provided with aligned openings 39 and 40. Opening 40 provides the entrance to the duct 41 formed by the cooperation of members 32 and 33. A lint trap 42 is positioned in the exhaust duct 41 at the opening 40, the trap being supported by the door frame 31.

Duct 41 leads downwardly to an opening 43 formed in the member 16. Opening 43 constitutes the inlet to a blower member 44, contained within a housing 45 and directly driven by an electric motor 46. An inlet such as the opening 52 is provided in the cabinet so that the blower brings ambient air in through the opening 52, over the heater means 25, through the basket, through the door 3 and duct 41, and then into the blower. From the blower the air passes through an appropriate duct (not shown) out of cabinet 2 so as to be exhausted from the machine.

In addition to driving blower 44, motor 46 constitutes a cyclically moving means for rotating the drum to tumble fabrics. To effect this rotation, motor 46 is provided with a shaft 47 having a small pulley 48 formed at the end thereof. A belt 49 extends around the pulley and completely around the cylindrical wall 9 of the drum 8. The relative circumferences of pulley 48 and wall section 9 cause the drum to be driven at a speed suitable to effect tumbling of the fabrics. A suitable idler assembly 50 is secured to the same support 51 which supports the pulley end of the motor and provides proper tensioning of the belt 49. Thus, operation of the motor both causes the fabrics to be tumbled within the drum and air to be forced through the drum. When the air is heated by heating elements 25a and 25b, the heated air passing through the drum causes vaporization of the moisture from the fabrics and the vapor is carried off with the air as it passes out of the machine.

In order to sense the amount of moisture in the fabrics being dried in the drum 8, and thus obtain a suitable signal for controlling operation of the dryer 1, sensing means are provided to contact the items being dried. In the machine of FIGURE 1, the sensing means is in the form of a pair of spaced sensors 53 and 54 which are mounted on an inwardly extending portion 55 on the member 33. The extension 55 is formed so that the conductors 53 and 54 are exposed to the interior of the drum and positioned to be contacted readily by the fabrics as they tumble within the drum.

Operation of the dryer of FIGURE 1 is controlled by

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the new and improved electronic control schematically illustrated in the circuit diagram of FIGURE 2. As shown therein the entire control of the machine may be energized to cross a three-wire power supply system which includes supply conductors 56 and 57 and a neutral conductor 58. For domestic use, the conductors 56 and 57 normally will be connected across a 220 volt alternating current power supply, with 110 volts appearing between neutral conductor 58 and each of the supply conductors, and with neutral conductor being at ground voltage.

Motor 46 is connected between the conductors 56 and 58 and is a single phase, induction type motor having a main winding 59 and a start winding 60, both connected at a common end to conductor 58 through a conventional door switch 61, which is closed when the door 3 is closed and is opened when the door 3 is opened. Start winding 60 is connected in parallel with main winding 59 under the control of a speed responsive device such as that shown at 62, which is schematically shown as connected to the rotor 63 of the motor. The speed responsive device 62 controls a switch 64 which is engageable either with a contact 65 or a contact 66. Switch 64 engages contact 65 when the machine is at rest, and moves into engagement with contact 66 as the motor comes up to speed. It readily can be seen that engagement of switch 64 with contact 65 connects the start winding 60 in parallel with the main winding 59, while movement of the switch 64 away from this position opens the start winding. Thus, as rotor 63 comes up to speed the start winding becomes de-energized and the motor then continues to run on the main winding 59 alone.

The starting of the motor is provided by a manually operable switch 67 which may, for instance, in the structure of FIGURE 1 be moved to its closed position by depressing control member 6. Switch 67 connects the motor to supply conductor 56 through contacts 68 and 69 of a switch 70, also having a contact 71. The switch 67 is normally biased to the open position as shown in FIGURE 2. When member 6 is depressed, assuming that contacts 68 and 69 are closed, energization of the motor is provided and, within less than a second under normal circumstances, the motor comes up to speed so that switch 64 moves from contact 65 to contact 66. As a result of this movement of the centrifugally operated switch 64, the main winding 59 of motor 46 continues to be energized by a bypass around switch 67 when member 6 is released and the switch 67 opens.

The switch 70 is controlled by a cam 72 which, in turn, is controlled by a timer motor 73 of the shut-off control means. The cam 72 and timer motor 73 also are connected to manual control 6 so that rotation of the manual control causes the cam to rotate and close the contacts 68, 69 and 71 of switch 70. Thereafter, the cam 72 is controlled by the motor 73 and, after predetermined periods of operation of the timer motor, the cam is effective to cause the various contacts of switch 70 to be opened for terminating the cycle of operation of the machine.

An energizing circuit for the heating means 25 is completed through the following circuit. Starting at conductor 56, the circuit proceeds through switch 70 to the heating means 25, then through a conventional temperature control thermostat 74 and a centrifugally responsive switch 75 to supply conductor 57. Switch 75 is controlled by centrifugal member 62, being closed only when the motor has come up to speed so that there can be no energization of the heating means 25 except when motor 46 is operating properly.

The timer motor 73 is connected on one side through a conductor 76 to contact 68 and then through contact 69 to supply conductor 56. The other side of the motor is connected through a conductor 77 to a switch 78 of a thermal relay 79, which also has a resistance or heater 80. The other side of switch 78 is connected to neutral conductor 58. The thermal relay is constructed such that the switch 78 is normally open and closes in response to a pre-

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determined average voltage being impressed across the resistance 80. Thus, assuming contacts 68 and 69 are closed, the timer motor 73 will be energized only when the switch 78 is closed.

A conductor 81 connects conductor 76 to one side of a rectifier 82. The other side of the rectifier is connected to a series arrangement of a current limiting resistance 83, a fixed resistance 84, a variable resistance 85 and the sensor 53. The other sensor 54 is connected to the neutral conductor 58. This establishes a circuit from conductor 56 to conductor 58, assuming contacts 68 and 69 of switch 70 are closed. The fixed resistance 84 and variable resistance 85, together with the sensors 53 and 54, provide a voltage divider. It will be understood that the fixed resistance 84 and variable resistance 85 may be combined into a single, variable resistance. They are shown as separate resistors because, as a matter of economics, this is the best arrangement. With a control of the type herein described, it is desirable to vary the total resistance of 84 and 85 between two fixed amounts. A fixed resistance equal to the lower of these two amounts and a resistance variable between 0 and the difference between the higher of the fixed amounts and the lower amount is less expensive than a single resistance variable between the lesser amount and the greater amount.

A voltage regulation device, such as the neon lamp 86, is connected, on one side, between the current limiting resistance 83 and the fixed resistance 84 and, on the other side, to neutral conductor 58. A transistor 87 is provided and includes a collector 89, an emitter 90, and a base 91. The collector 89 is connected to the rectifier 82 and the emitter 90 is connected to resistance 80 of the thermal relay, the other side of the resistance 80 being connected to the neutral conductor 58. This provides a circuit from the rectifier 82 to the neutral conductor 58 through the collector to emitter path of the transistor. The base of the transistor is connected to the voltage divider between the variable resistance 85 and the sensor 53. A second voltage regulation device, such as the Zener diode 92, is connected between the base 91 of the transistor and the neutral conductor 58; which, in effect, connects the voltage regulation device 92 in parallel with the sensors 53 and 54.

Since, the voltage regulation devices 86 and 92 and the current limiting resistor 83 may be omitted from the control for many applications the basic manner of operation of this control will be explained with these elements omitted. The rectifier or diode 82 allows current to pass when supply conductor 56 is positive with respect to neutral conductor 58 and blocks passage of current when supply conductor 56 is negative with respect to neutral conductor 58. During those half cycles of proper polarity, resistances 84 and 85, together with the effective resistance across the sensors 53 and 54, provide a voltage divider. The effective voltage across the sensors 53 and 54 is a portion of the applied voltage, dependent upon the relationship of the fabric resistance compared to the total resistance of 84 and 85.

The resistance 80 of the thermal relay 79 is connected to the transistor in a circuit arrangement, commonly known as an emitter follower connection. With this connection, for all practical purposes, the voltage appearing across the sensors 53 and 54 also appears across the resistance 80. This arrangement has two distinct advantages. First the thermal delay of the resistance averages the effect of the applied voltage so that the switch 78 is closed as a result of an average voltage which is responsive to the resistance of the fabrics bridging the sensors 53 and 54. Secondly, the relatively low value of the resistance 80 is, in effect, multiplied by the gain of the transistor so that the apparent resistance looking into the base of the transistor is matched with the rather high impedance the fabrics will present across the sensors 53 and 54. This enables the resistance 80 to be connected in parallel with the sensors.

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When the average voltage impressed on the resistance 80 has reached a predetermined value, corresponding to a predetermined resistance across the sensors 53 and 54, the heat generated by the resistance 80 will be sufficient to cause the switch 78 to close. This completes a circuit for the timer motor 73 from conductor 56 through contacts 68 and 69, the conductor 76, motor 73, the switch 78 to neutral conductor 58. The motor then will begin to run. If, as quite often happens, only part of the load of fabrics in the machine is dry, a wet item quite likely will later bridge the sensors 53 and 54 and, because of the voltage divider, will reduce the voltage applied to the resistance 80. The heating effect of the resistance 80 then becomes less and the switch 78 will open to interrupt the operation of the timer motor 73. Because of the time delay provided by the heating effect of the resistance 80 and switch 78 the timer motor is caused to run or not run in response to the average dryness of a load of clothes.

For a complete cycle of operation, with the circuit as thus far described, the user would place the fabrics within the drum 8, close the door, which closes the switch 61. The user would then rotate the member 6, causing the cam 72 to close contacts 68, 69 and 71 of switch 70, and then depress member 6, closing switch 67. The motor 46 would quickly come up to speed, moving the switch 64 from contact 65 to contact 66, and, thereafter, the motor would continue to operate on its main winding 59 alone after the member 6 has been released, allowing switch 67 to open. With this setting the motor is operating to cause the drum to be rotated to tumble the fabrics and to draw air through the drum. Also, the heating means 25 is energized, under the additional control of thermostat 74, to heat the air so that the moisture will be evaporated from the fabrics and carried out of the machine.

Since, at the beginning of the sequence of operation the fabrics in the machine are quite wet, the resistance across the sensors 53 and 54 will be low and most of the applied voltage drop in the sensing circuit will appear across the resistances 84 and 85. This means that too little voltage is impressed on the resistance 80 to cause switch 78 to close. As the fabrics in the machine become drier their resistance increases. This changes the relative values of the voltage divider so that more and more of the applied voltage appears across the sensors and the heating effect of the resistance 80 becomes greater and greater. Eventually, when the resistance across the sensors rises to a predetermined value, the voltage associated therewith will be sufficient; and, after a suitable time delay caused by the thermal delay of the resistance 80, the switch 78 will close. This energizes the timer motor 73 which rotates the cam 72. After a first predetermined amount of timer motor operation the cam 72 will cause contacts 71 and 68 to open to de-energize the heating means 25. After a second, relatively short period of operation of the motor 46 alone to continue tumbling the clothes with cool air being drawn through the drum to reduce the clothes to a comfortable handling temperature, the timer motor will cause contacts 68 and 69 to open. The opening of these contacts causes the complete circuit to be de-energized.

It will be understood that, after timer motor 73 has begun to operate, if wet fabrics again bridge the sensors 53 and 54 they will cause, after a suitable time delay, the switch 78 to open and interrupt the operation of the timer motor. In this case the timer motor would begin operating again after these wet fabrics have reached the degree of dryness corresponding to the predetermined resistance. The resistance 85 is made variable for two purposes. First it may be used by the manufacturer to calibrate the control. Secondly, since variation of this resistance will vary the value of resistance across the sensors 53 and 54 corresponding to the voltage necessary to close switch 78, resistance 85 may be varied by the user to provide different degrees of dryness.

The circuit as thus far described normally will provide excellent results. However, two separate situations may cause something other than optimum operation. Obviously, the circuit is designed to operate from a source of predetermined voltage. For the normal domestic use it would be for a value of 110 volts A.C. between conductors 56 and 58. Some utilities are not able to hold their supply voltage within fairly close tolerances of this value and the supply voltage for some users may vary substantially both above and below the desired level. To prevent the switch 78 from being closed either too soon or too late, the voltage regulator or neon lamp 86 and the limiting resistor 83 may be included in the circuit. The neon lamp 86 will block current until a predetermined breakdown voltage is impressed across the lamp, at which time it begins to conduct sufficient current to maintain a slightly lower voltage across the circuit in which it is connected. When a voltage regulator, having a breakdown voltage of less than the expected supply voltage, is connected as the lamp 86 is shown, it will begin to conduct at its breakdown voltage and maintain a predetermined voltage across the voltage divider, regardless of variations in the supply voltage above this predetermined voltage. The resistance 83 is used when the neon lamp 86 is used because the neon lamp 86 is a low resistance device, in its conducting state, and some means is needed to insure that excess current does not flow through it and burn it out.

With relatively large loads of fabrics there will almost always be fabrics bridging the sensors 53 and 54 and thus the voltage impressed on that portion of the voltage divider will correspond to the degree of dampness of the fabrics. With very small loads in the machine there may be a substantial period of time when no fabrics whatsoever bridge the sensors 53 and 54. If no fabrics are bridging the sensors they provide an open circuit and a very high voltage is applied to the resistance 80. This will cause the switch 78 to close sooner and may result in the dryer operation being terminated before the fabrics are actually dry. By connecting the second voltage regulator, such as the Zener diode 92, in parallel with the sensors 53 and 54 it is possible to compensate for this condition of non-bridging of the sensors by fabrics. The Zener diode operates in a manner somewhat similar to the neon lamp. That is, it blocks current flow until its breakdown voltage is reached and, thereafter, it will carry sufficient current to maintain that voltage. Thus, with the second voltage regulator 92 in the circuit, some predetermined voltage, less than the supply voltage but greater than the voltage corresponding to dry fabrics, fabrics bridging sensors 53 and 54, will be applied to the resistance 80. This lengthens the time before the switch 78 closes when no fabrics bridge the conductors.

Those skilled in the art will realize that a Zener diode may be used instead of the neon lamp 86 and, if the first voltage regulator or neon lamp 86 is not used or a Zener diode is used in its place, a neon lamp may be used where the Zener diode is shown. In this regard the only thing that presently cannot be done is to make both the first and the second voltage regulators neon lamps. This is because the breakdown or operating voltage of a neon lamp (that is the voltage at which it begins to conduct) is higher than its regulating voltage (that is the voltage which it tends to maintain). Thus, if two neon lamps are used the one connected as lamp 86 will tend to maintain a supply voltage which is too low for the neon lamp connected in the place of Zener diode 92 to operate. Where two Zener diodes are used, the one used for the first voltage regulator will be selected to have a higher value than the one used as the second voltage regulator.

It will be obvious to those skilled in the art that the values of the particular components are interrelated and the value of any one component may be altered by altering the value of one or more of the other components. However, as an example, it has been found that a control

suitable for use in a clothes dryer currently produced by the General Electric Company, assignee of the present invention, may have the following values:

- Rectifier 82—1N5050.
- Resistance 83—33 kilohms.
- Resistance 84—1 megohm.
- Resistance 85—Variable between 0 and 2.5 megohms.
- Neon lamp 86—5AH.
- Transistor 87—2N4056.
- Thermal relay 79—Bimetal relay (G.E. BA6C331 Automatic Blanket Control Relay).
- Zener diode 92—1N4754.

The term "thermal relay" has been used herein in a broad sense. It may be a bimetal switch and heater illustrated, a "hot wire" relay or any other of many known devices in which a switch element opens in response to an average voltage being impressed across an associated resistance.

The foregoing is a description of illustrative embodiments of the invention and it is applicant's intention in the appended claims to cover all forms which fall within the scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a fabric drying machine having a chamber to receive fabrics to be dried, heating means arranged to heat fabrics in the chamber, and cyclically moving means for tumbling fabrics within the chamber; a control including:
 - (a) shut-off control means effective, after energization, to interrupt the fabric drying machine;
 - (b) a thermal relay including a switch and a first resistance, said switch being normally open and closing in response to a predetermined average voltage being impressed across said first resistance;
 - (c) circuit means for energizing said shut-off means upon the closure of said switch;
 - (d) spaced sensors positioned in the chamber so as to be bridged by tumbling fabrics to provide a resistance across said sensors which is a function of the degree of dryness of fabrics bridging said sensors;
 - (e) a voltage divider including said sensors and a second resistance connected in series circuit relationship to said sensors;
 - (f) a transistor having a collector, an emitter, and a base;
 - (g) means connecting said first resistance in series with said emitter for energization through the collector to emitter path of said transistor;
 - (h) and means connecting said base to said voltage divider at the common point between said second resistance and one of said sensors, thereby to impress across said first resistance an average voltage which is a function of the resistance of fabrics bridging said sensors to cause said switch to close and energize said shut-off means in response to a predetermined degree of dryness of fabrics bridging said sensors.
2. In a fabric drying machine having a chamber to receive fabrics to be dried, heating means arranged to heat fabrics in the chamber, and cyclically moving means for tumbling fabrics within the chamber; a control, including:
 - (a) a pair of conductors for connection to a source of electrical energy;
 - (b) shut-off control means, effective after energization to interrupt operation of the dryer;
 - (c) a thermal relay including a switch and a first resistance, said switch being normally open and closing in response to a predetermined average voltage being impressed across said first resistance;
 - (d) said control means and said switch being connected in series between said conductors;
 - (e) a pair of spaced sensors positioned in said chamber so as to be bridged by tumbling fabrics to provide a resistance across said sensors which is a function of

- the degree of dryness of fabrics bridging said sensor;
- (f) a voltage divider including a second resistance and said sensors, said second resistance being connected between one of said conductors and one of said sensors, the other of said sensors being connected to the other of said conductors;
- (g) and a transistor having a collector, an emitter and a base, said collector being connected to said one conductor, said emitter being connected to said other conductor through said first resistance to control the average voltage impressed across said first resistance;
- (h) said base of said transistor being connected to said voltage divider between said second resistance and said one sensor so that the average voltage impressed across said first resistance is a function of the resistance of fabrics bridging said sensors, thereby to cause said switch to close and energize said controls means in response to a predetermined degree of dryness of fabrics bridging said sensors.
3. The invention as set forth in claim 2, further including voltage regulation means connected in parallel with said voltage divider.
4. The invention as set forth in claim 2, further including voltage regulation means connected in parallel with said sensors.
5. The invention as set forth in claim 2, further including first voltage regulation means connected in parallel with said voltage divider and second voltage regulation means connected in parallel with said sensors; the regulating voltage of said first voltage regulation means being higher than the operating voltage of said second voltage regulation means.
6. In a fabric drying machine having a chamber to receive fabrics to be dried, heating means arranged to heat fabrics in the chamber, and cyclically moving means for tumbling fabrics within the chamber; a control, including:
- (a) a pair of conductors for connection to a source of alternating current electrical energy;
- (b) shut-off control means including a timer motor, effective after a period of timer motor energization to interrupt operation of the dryer;
- (c) a thermal relay including a switch and a first resistance, said switch being normally open and closing in response to a predetermined average voltage being impressed across said first resistance;
- (d) said timer motor and said switch being connected in series between said conductors;
- (e) a pair of spaced sensors positioned in said chamber so as to be bridged by tumbling fabrics to provide

- a resistance across said sensors which is a function of the degree of dryness of fabrics bridging said sensors;
- (f) a rectifier connected on one side thereof to one of said conductors;
- (g) a voltage divider including a second resistance and said sensors, said second resistance being connected between the other side of said rectifier and one of said sensors, the other of said sensors being connected to the other of said conductors;
- (h) and a transistor having a collector, an emitter and a base, said collector being connected to said other side of said rectifier, said emitter being connected to said other conductor through said first resistance to control the average voltage impressed across said first resistance;
- (i) said base being connected to said voltage divider between said second resistance and said one sensor so that the average voltage impressed across said first resistance is a function of the resistance of fabrics bridging said sensors, thereby to cause said switch to close and energize said timer motor in response to a predetermined degree of dryness of fabrics bridging said sensors.
7. The invention as set forth in claim 6, further including voltage regulation means connected in parallel with said voltage divider and a current limiting resistance connected between said voltage regulation means and said other side of said rectifier.
8. The invention as set forth in claim 6, further including voltage regulation means connected in parallel with said sensors.
9. The invention as set forth in claim 6, further including first voltage regulation means connected in parallel with said voltage divider; a current limiting resistance connected between said first voltage regulation means and said other side of said rectifier; and second voltage regulation means connected in parallel with said sensors; the regulating voltage of said first voltage regulation means being higher than the operating voltage of said second voltage regulating means.

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