ANTI-WRINKLE CYCLE FOR DRYERS WITH INTERMITTENT SIGNALING MEANS
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ABSTRACT OF THE DISCLOSURE
A control circuit for controlling the operation of a drying apparatus and for producing audible signals at periodic time intervals after the completion of the drying cycle. The apparatus includes a rotatable drum for receiving the fiber to be dried and means connected to the drum for rotating the drum. The control circuit includes means for energizing a drive motor connected to the drum and means for intermittently energizing the drive motor for short periods of time after completion of the initial drying cycle. Additionally, the control system includes signaling means which is energized for short periods of time each time the drive motor is deenergized after the drying cycle.

This invention relates generally to clothes dryers, and more particularly to a new and improved control circuit for controlling the operation of a dryer. Specifically, the present invention is directed to a control circuit for a clothes dryer which includes an anti-wrinkle sequencing control which has an alarm associated therewith.

Therefore, at the termination of operation of a clothes dryer the control system of the dryer would deenergize completely the heating apparatus as well as the drive mechanism used to rotate the clothes receiving drum. This action would terminate the application of heat to the clothes receiving chamber, and shortly thereafter terminate the agitation of the clothes therein. Therefore, should the clothes remain in the drum for a considerable length of time, the clothes would receive deep-set wrinkles.

In other applications assigned to the same assignee as the present application, there have been described various means for incorporating an "anti-wrinkle" cycle in the dryer after termination of the normal drying cycle. Generally, these means serve to periodically rotate the drum for short periods (a few seconds or so) at intervals a few minutes apart. Such periodic tumbling has been found to substantially reduce the possibility of forming deep-set wrinkles in fabrics which are left in the drum after the normal drying cycle is over.

It is important, however, to notify the operator that the dryer has completed its normal operational cycle and has proceeded to the "anti-wrinkle" phase of operation since it is not desirable to keep the anti-wrinkle operation going indefinitely. The control circuit of the present invention accomplishes this objective by giving periodic signals each time the drive motor is deenergized during the anti-wrinkle cycle.

Therefore, one of the primary objects of the present invention is to provide a control system for a clothes dryer which includes an alarm system associated therewith to indicate to the operator that the drying cycle is completed.

A feature of the present invention is the provision of a control system for a clothes dryer which includes a sequencing circuit to periodically energize a drive motor after the end of the normal drying cycle which, in turn, will rotate the driving drum to agitate the clothes therein to prevent deep-set wrinkles.

Briefly, the control system of the present invention includes a dryness sensor which is positioned within the interior of a drying drum to develop control signals indicative of the dryness of the clothes therein. The dryness sensor controls the operation of a relay energizing circuit which, in turn, controls a timer motor and a drive motor for operation of the clothes dryer during the normal drying cycle. Also associated with the control circuit is a pulser timer motor which periodically energizes the drive motor after the normal drying cycle so as to tumble the clothes within the dryer thereby changing their position to prevent deep-set wrinkles from forming in the clothes. Furthermore, the control circuit is provided with an alarm system which is energized for a short period of time each time the drive motor is deenergized.

The invention, however, will be more fully realized and understood from the following detailed description when taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a schematic circuit diagram of a control system for a clothes dryer which is constructed in accordance with the principles of this invention; and

FIGURE 2 is a diagrammatic chart showing the disposition of the timer of FIGURE 1 during various modes of operation.

The control circuit 10 comprises a silicon controlled rectifier 14 which has the anode thereof connected to one side of the relay 12 through a terminal 16. The other side of the relay 12 is connected to a pair of diodes 17 and 18 through a terminal 19. The cathode of the diode 17 is connected to the anode of the diode 18 thereby providing a unidirectional current path for the sensing elements within the driving drum 13. Half wave pulses from an alternating current power source are applied to the electronic control 11 through the diode 17 as will be described in greater detail hereibelow.

A resistor 20 has one end thereof connected to the anode electrode and the other end thereof connected to the gate electrode of the silicon controlled rectifier 14. Also connected to the gate electrode and resistor 20 is the collector electrode of a transistor 21. The emitter of transistor 21 is connected to a line 22 together with the cathode of the silicon controlled rectifier 14. Therefore, the resistor 20 and transistor 21 provide a variable voltage divider network which serves to control the operation of the silicon controlled rectifier 14.

Connected to the base electrode of transistor 21 is a gaseous discharge device 23 which is also connected to
a resistor 24. One end of the resistor 24 is connected to a moisture sensing element 26 through a resistor 27. A second moisture sensing element 28 is electrically insulated from the element 26 and connected to ground potential. The moisture sensing elements 26 and 28 are positioned within the interior of the drying drum 13 in such a manner as to be bridged, or electrically connected together, by wet clothes which are positioned within the drum 13.

A resistor 29 has one end thereof connected to a capacitor 30 and the other end thereof connected to a circuit point 31. The other end of capacitor 30 is connected to the line 22 which, in turn, is connected to a line 32 through a line 33. In the preferred embodiment of the present invention the line 32 is the common line between a pair of high voltage lines L1 and L2 which are adapted to be connected to a 240 volt AC source. Therefore, the potential between line 32 and either one of the lines L1 or L2 is 120 volts.

When power is applied to the electronic control circuit 11 the capacitor 30 will charge in response to the condition of dryness of the clothes within the drying drum as sensed by the moisture sensing elements 26 and 28. When the charge on capacitor 30 has reached the predetermined ionization potential of the gaseous discharge device 23, the discharge device 23 will be rendered conductive which, in turn, will render the transistor 21 conductive for a short period of time. This action will cause the silicon controlled rectifier 14 which previously had been conductive, to be rendered non-conductive, thereby deenergizing the relay 12.

A variable resistor 34 has one end thereof connected to the circuit point 31 and the other end thereof connected to a resistor 36. The variable resistor 34 provides a pre-selectable dryness control by varying the potential applied between the moisture sensing elements 26 and 28 thereby varying the charging rate of the capacitor 30. At the end of the moisture sensing portion of the drying cycle, capacitor 30 is completely discharged. This is accomplished by a resistor 37 and a contactor 38 which are connected in parallel with the resistor 29 and capacitor 30. Therefore, at the end of the moisture sensing portion of the drying cycle the relay 12 will be deenergized thereby closing the contactor 38 to completely discharge the capacitor 30 through resistors 29 and 37.

A relay 12 is a contactor 39 which is alternately connected to either one of a pair of contacts 40 or 41. The contact 41 is connected to a time sequencing control motor 42 and to one side of a time sequencing switch TS2. The contact 40 is connected to the line L1 through a timer sequencing switch TS3 and a contactor 43 of a push-to-start button 44. Also associated with the push-to-start button 44 is a contactor 46 which is connected to a terminal 47 which, in turn, applies power to a running winding 48 of a drive motor 49.

Associated with the drive motor 49 is a centrifugal switch 50 which is alternately engageable with either a contact 51 or a contact 52, depending upon the speed of the motor 49. Connected to the normally closed contact 51 is a starting winding 53 which is energized for a short period of time during the initial energization of the drive motor 49. That is, with the drive motor 49 deenergized and the power applied to terminal 47, the current will flow through both the starting winding 53 and the running winding 48 until the angular momentum of the drive motor 49 has reached a predetermined value at which time the switch 50 will transfer its position and be connected to the contact 52. After the centrifugal switch 50 has transferred to the run position current will continue to be applied to the running winding 48 of the motor 49 through a time sequencing switch TS4 and the centrifugal switch 50.

The line L1 is connected to one side of a heater 54 through a timer sequencing switch TS1 and through a thermostatically operated control switch 56 which is positionined in heat sensing relation with the heated air applied to the interior of the drying drum 13. Therefore, should the heated air applied to the clothes by 49, the heat thereof, the thermostat switch 56 will be opened to deenergize the heater 54 thereby eliminating the possibility of scorcheing the clothes within the drying drum 13. The other side of the heater 54 is connected to the line L2 through a centrifugal switch 57. The centrifugal switch 57 may be actuated by rotation of the clothes within the drum 13. Therefore, the timer sequencing switch 56 will thus not be energized until such time as the drive motor is rotated.

To periodically energize the drive motor 49 for short periods of time after the end of the normal drying cycle, a pulser timer motor 58 is connected between the line 32 and a timer sequencing switch TS5. The timer sequencing switch TS5 has one end thereof connected to the line L1 and the other end thereof connected to the timer pulser motor 58 through a line 59 and to a pulser switch 60 for applying power to the pulser motor 58 through a line 61.

An important feature of the present invention is the provision of an indicator such as a buzzer 62 which is connected between the line L1 and the terminal 52. The electrical resistance value of the buzzer 62 is sufficiently high so as to prevent an appreciable amount of current from flowing through the motor 49 after the motor has been deenergized. Therefore, when the centrifugal switch 59 is in the normally open position, that is, connected to the contactor 62 will be energized until the rotational speed of the motor 49 has reduced sufficiently to deactivate the switch 50.

The timer sequencing switches TS1-TS5 are mechanically connected to the timer sequencing motor 42 for operation thereby. Upon selecting the desired mode of operation of the clothes dryer certain ones of the timer sequencing switches TS1-TS5 will be closed to initiate operation of the dryer.

Reference is now had to the chart shown in FIGURE 2. Upon selecting the "regular" mode of operation of the dryer, timer sequencing switches TS1-TS4 are closed and timer sequencing switch TS5 remains open. Therefore, when the push-to-start button 44 is actuated thereby closing the contactors 43 and 46, power is applied to the drive motor 49 and to the electronic control circuit 11 through the diode 17. This action will cause the relay 12 to be energized and shift the contactor 39 into engagement with the contact 40 and to open the normally closed contactor 38. After the drive motor 49 has reached sufficient speed, the centrifugal switch 50 is disconnected from the contact 51 and connected to the contact 52 thereby deenergizing the starting winding. Also, after the drive motor 49 has reached sufficient speed, the centrifugal switch 57 will close to energize the heater 54. After the centrifugal switch 50 has transferred to the normally opened position, the push-to-start button 44 is released and the drive motor 49 will continue to be energized through the timer sequencing switch TS4 and the centrifugal switch 57. Furthermore, the relay 12 will remain energized through the switch TS4 and its own contactor 39 which applies power to the relay 12 through the diode 17. The silicon controlled rectifier 14 is rendered conductive since the transistor 21 is maintained in the non-conductive state.

Therefore, the timer control motor 42 is maintained energized through its own contact TS6 during the initial portion of the drying cycle. However, the sequencig control timer motor 42 will not advance the position of the sequencing switches TS1-TSS until the electronic control circuit 11 is energized by a control signal indicating that the desired dryness of the clothes has been reached.

The control signal developed by the moisture sensing electrodes 26 and 28 and the capacitor 30 will then be sufficient to ionize the gas in the discharge device 23 thereby rendering the transistor 21 conductive. This action will turn off the silicon controlled rectifier 14 and
deenergize the relay 12 to place the contactor 39 in engagement with the contact 41. The timer motor 42 will now be energized through the sequencing switch TS4 and the contactor 39 thereby advancing the sequencing switches TS1-TS3 until the switch TS1 is open. Thereby deenergizing the heater 54. The motor 49 and a blower, not shown, will continue to operate through the sequencing switch TS4 to provide a cool down period. In the regular mode of operation, the cool down period may be, for example, five minutes. The control timer motor 42 continuously energizes the sequencing switch TS2 when the TS2 opens to deenergize the drive motor 49 and the blower, not shown, at the end of the drying cycle. Upon deenergization of the drive motor 49, the centrifugal switch 50 will remain engaged with the contact 52 for a short period of time. Also, the switch TS4, which is in shunt relation with the buzzer 62, no longer by-passes the current path of the buzzer. Therefore, the buzzer 62 will be energized through the centrifugal switch 50 and the running winding 48 of the motor 49.

The "Wash and Wear" mode of operation of the clothes dryer is substantially the same as that of the regular mode of operation, the only difference being in the time duration of the cool down period. During the "Wash and Wear" mode of operation the cool down period is increased to insure that the clothes are thoroughly cooled so as to prevent heat setting of wrinkles in the clothes after the drum 13 has stopped rotating.

During the anti-wrinkle mode of operation, the sequencing switch TS5 will close shortly before the sequencing switch TS4 opens at the end of the normal drying cycle. The anti-wrinkle mode of operation is similar to the "Wash and Wear" mode of operation in that the cool down period is approximately the same. However, when the sequencing switch TS5 closes, the pulser timer motor 55 is energized, and after the sequencing switch TS4 opens the drive motor 49 will be periodically energized through the pulser switch 60. By way of example, the drive motor 49 will be energized for a short period of time, for example, five to ten seconds, and will be deenergized for a longer period, for example, five to ten minutes. By periodically energizing the drive motor 49, the clothes within the drying drum 13 are periodically fluffed until they are removed from the drum. During this period of the anti-wrinkle mode of operation, the timer motor 42 is energized through the contactor 39 of the relay 12 and through the centrifugal switch 50. Therefore, each time the drive motor 49 is energized the control timer motor 42 is also energized, thereby advancing the position thereof. When the sum total of the time pulses from the pulser timer motor 55 has reached a predetermined time interval as selected by the operation of sequencing switches TS5, the sequencing switch TS5 will open thereby completely deenergizing the control circuit 10.

According to the present invention, the buzzer 62 is energized for a short period of time after the pulser switch 60 has opened and while the centrifugal switch 50 remains in contact with the normally open contact 52. That is, the pulser switch 60 shunts the buzzer 62 during the initial energization period of the drive motor 49 thereby preventing a current from flowing through the buzzer 62. However, when the pulser switch 60 opens current will flow through the buzzer 62, the centrifugal switch 50 and the running winding 48 of the drive motor 49 until the drive motor has decreased in speed sufficiently to allow the centrifugal switch 50 to return to its normally closed position.

During the "Perma-Press" finishing mode of operation, only sequencing switches TS1 and TS4 are closed by the timer motor 42. This mode of operation is intended for removing wrinkles from permanently pressed garments. Therefore, the heater 54 is energized through the sequencing switch TS1 for a time interval sufficiently long to remove such wrinkles and the drive motor 49 is ener-
eriation thereof in response to said pulse signal information;
a signalling means connected in circuit with said drive motor;
ergizing means for energizing said signalling means when said drive motor is de-energized;
a pulser operated switch connected in series relation with said drive motor after one of said sequentially operated switches is opened to periodically cause energization of said drive motor, said pulser operated switch energizing said signalling means following each periodic energization of said drive motor.

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