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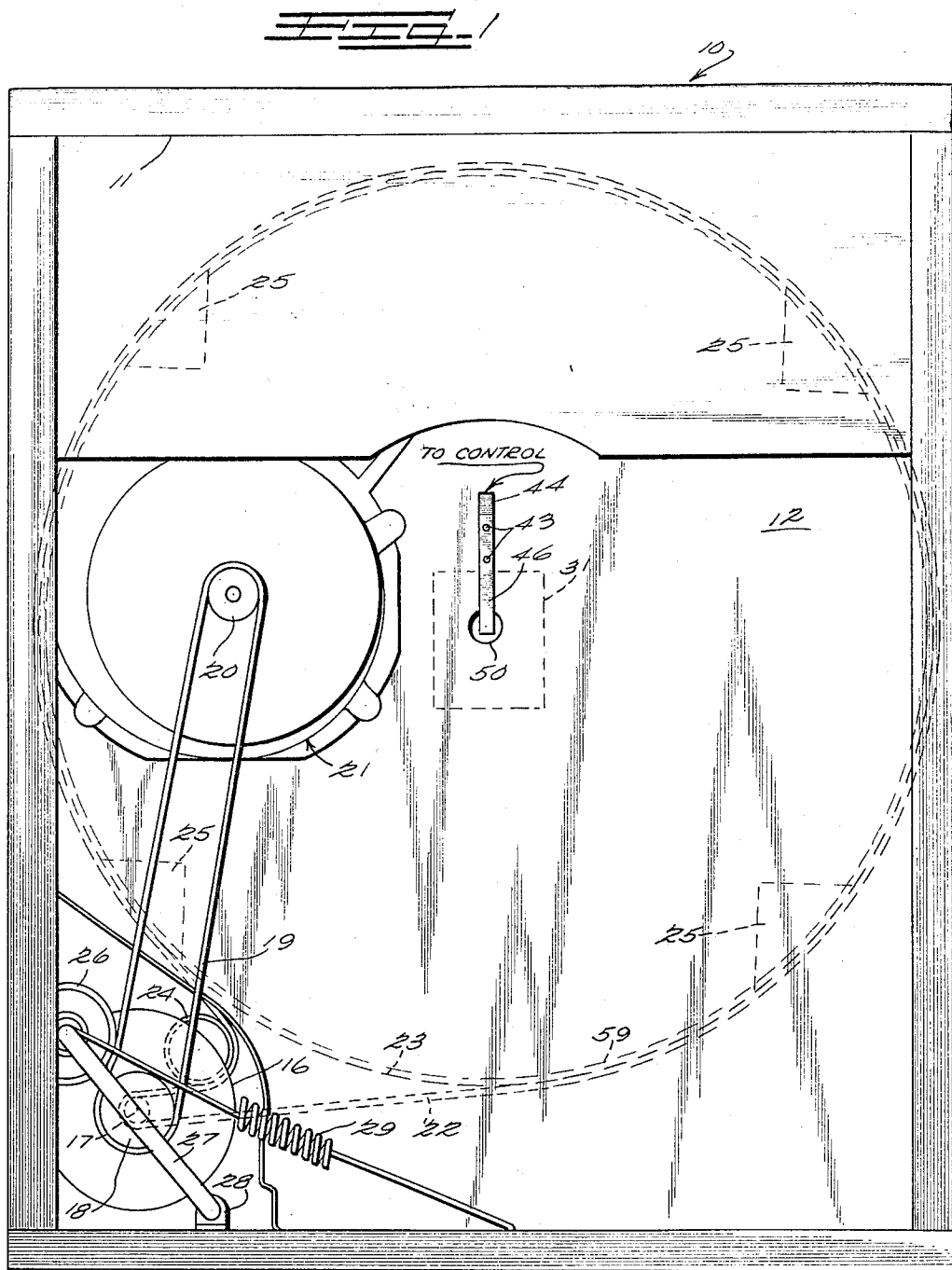
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SENSING BANDS AND COMMUTATOR SYSTEM FOR DRYERS

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3 Sheets-Sheet 1



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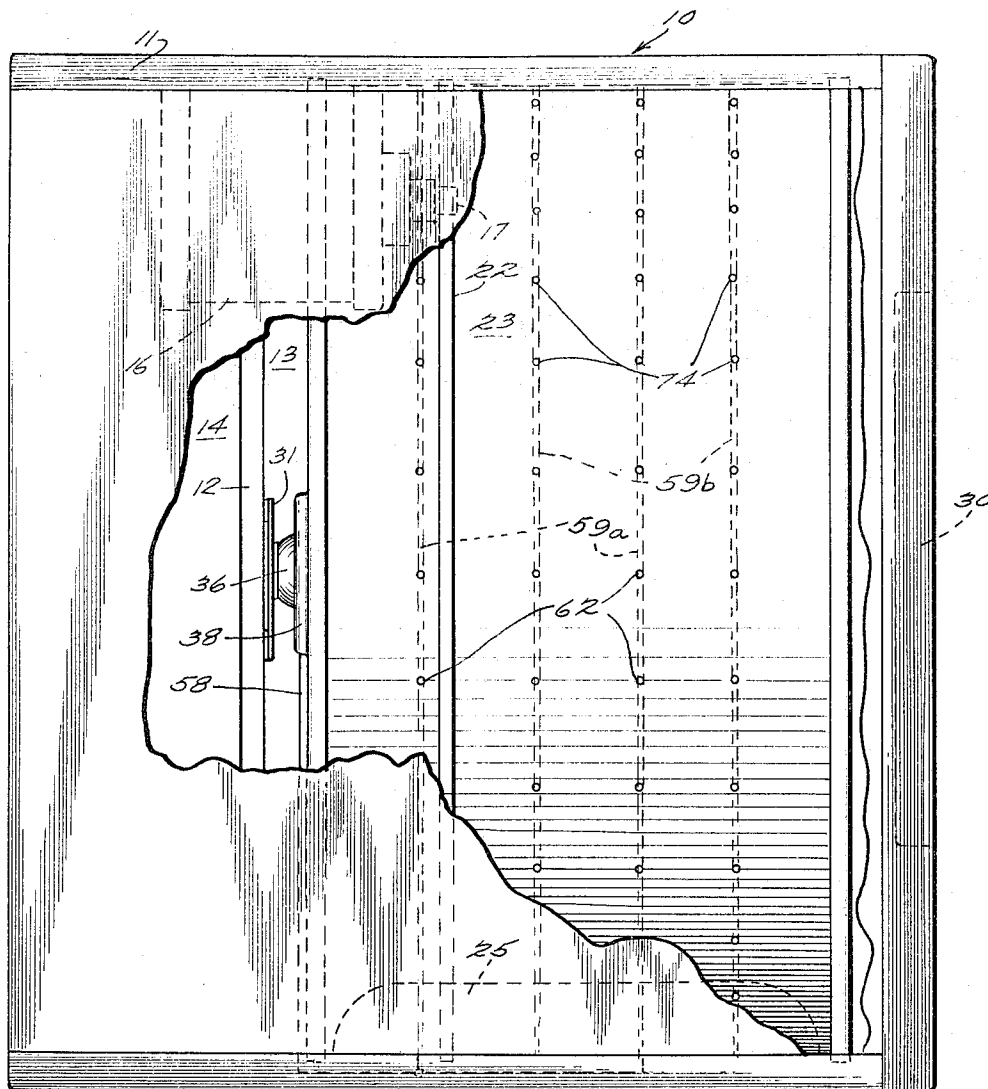
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SENSING BANDS AND COMMUTATOR SYSTEM FOR DRYERS

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3 Sheets-Sheet 2

FIG. 2



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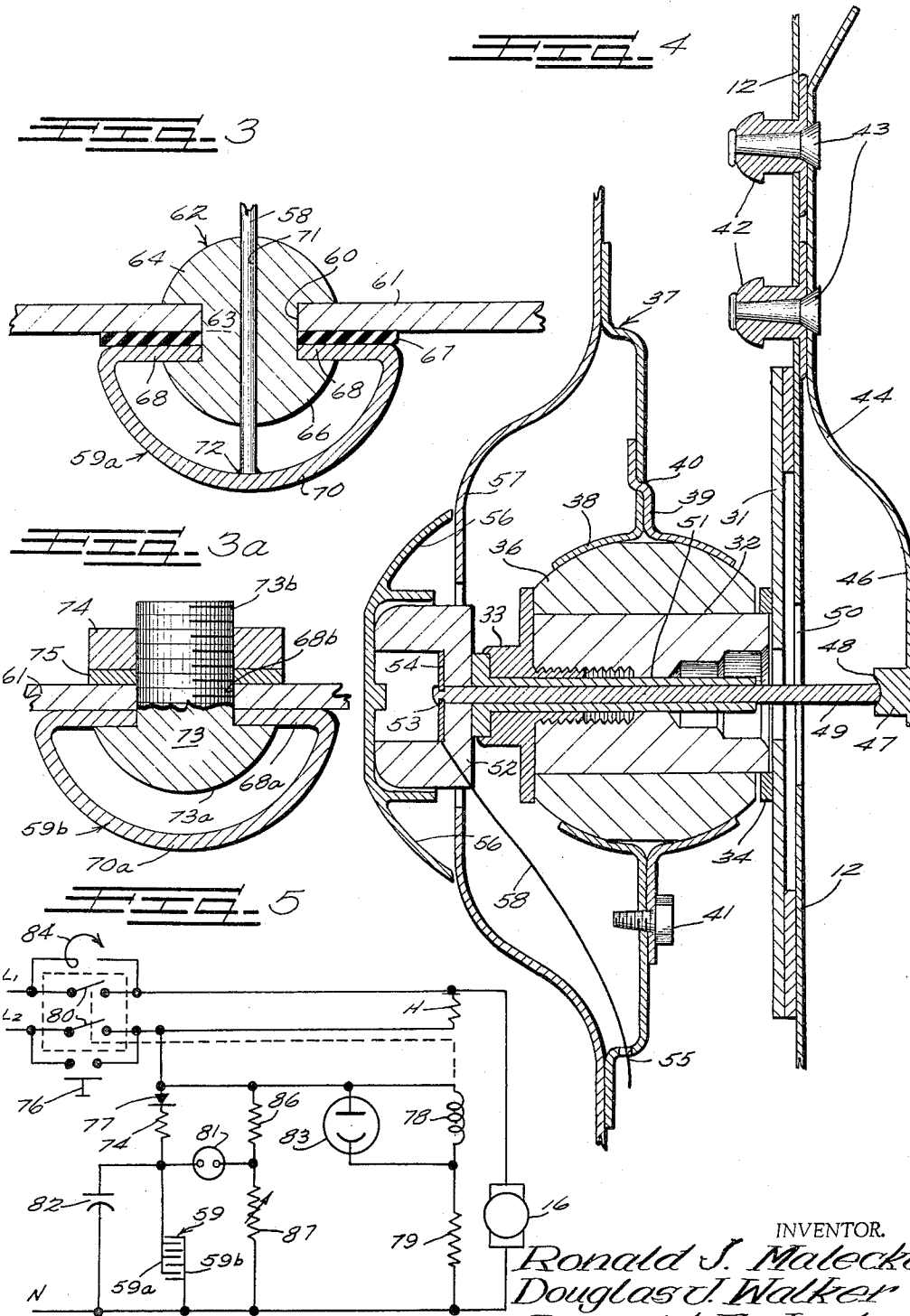
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SENSING BANDS AND COMMUTATOR SYSTEM FOR DRYERS

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3 Sheets-Sheet 3



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1

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SENSING BANDS AND COMMUTATOR SYSTEM FOR DRYERS

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3 Claims. (Cl. 34-45)

This invention relates generally to drying apparatus and more particularly relates to a dryer which is characterized by an electronic dry sensing bands arrangement and commutator system including contact means located in the wall of a drying drum and adapted to be bridged by the materials to be dried therein so that a circuit control means associated with the dryer can be regulated as a function of the conductivity and hence of the relative dryness of the materials contained within the drum and which act to bridge the contact members in the wall of the drum during the operation of the dryer.

In accordance with the principles of the present invention, it is contemplated to exploit the conductivity of the materials being dried in the regulation of an electronic control means. Thus, there is provided in the peripheral wall of a drying drum, contact members which may take the form of circumferentially continuous conductive sensing bands spaced from one another in such a manner as to be bridged by the materials to be dried within the interior of the drum. One of the contact bands is connected to ground, while the other is connected by means of a commutator system at the hub of the drum to appropriate electrical control circuitry.

In one form of electronic control, the sensing bands operate as a sensor so that the sensor, in conjunction with a resistance, operates as a voltage divider for an electric circuit including a neon lamp. As the materials within the drum dry and become less conductive, the voltage applied to the neon lamp increases until a firing voltage is reached. The light from the fired lamp excites a photo-sensitive cell which actuates relay-operated switches, thereby terminating the operation of heating means associated with the dryer. The drive motor will continue in operation through a thermostat to cool off the contents of the drum until a terminal temperature is reached, whereupon the entire drying cycle will be terminated.

It is an object of the present invention, therefore, to provide a drying method characterized by the step of conducting a control voltage through the materials being dried, such materials exhibiting conductivity as a function of the relative dryness thereof.

Another object of the present invention is to provide in a drying apparatus means for conducting a control voltage through the materials within the dryer so that the conductivity of the materials may be exhibited and exploited as a control variable in connection with the operation of the apparatus.

Yet another object of the present invention is to provide a drying apparatus utilizing a tumbling drum wherein the wall of the drum is characterized by the provision of spaced sensing bands operable as a sensor for an electronic dry control system.

Yet another object of the present invention is to provide a dryer drum having sensor bands therein and also utilizing a commutator arrangement for conducting signal voltages away from the drum.

Still another object of the present invention is to provide an electronic dry control system wherein the relative dryness of the clothes is measured directly in terms of the conductivity thereof and wherein such conductivity is utilized in connection with the operation of an electronic dry control system.

2

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a preferred structural embodiment of a dryer with electronic dry sensing bands and a commutator system is shown by way of illustrative example.

On the drawings:

FIGURE 1 is a rear view of a dryer provided in accordance with the principles of the present invention;

FIGURE 2 is a top plan view with parts broken away showing additional details of construction of the dryer of FIGURE 1;

FIGURES 3 and 3A are fragmentary cross-sectional views showing details of the construction and assembly of sensing bands respectively insulated from and connected to the dryer drums;

FIGURE 4 is a fragmentary cross-sectional view illustrating the commutator arrangement; and

FIGURE 5 is a simplified wiring diagram illustrating the electronic dry control system provided in accordance with the principles of the present invention.

As shown on the drawings:

As shown in drawings 1 and 2 there is provided a drying apparatus 10 comprising a casing 11 which is partitioned by a rear bulkhead 12 into a front compartment 13 forming a treatment zone and a rear compartment 14 adapted to contain the various power-operated components of the drying apparatus.

Thus, as illustrated in the rear view of FIGURE 1, a motor 16 has a drive shaft 17 to which is attached a pulley 18. Trained over the pulley 18 is a pulley belt 19 used to engage a pulley drive wheel 20 connected to a blower shown generally at 21 and utilized for the purpose of circulating a stream of air through the treatment zone.

A pulley belt 22 is also driven by the drive shaft 17 to rotatably drive a drum indicated generally at 23 about a substantially horizontal axis, the drum 23 with tumbling baffles 25 in this instance functioning as an agitating means for agitating or tumbling materials to be dried within the treatment zone 13.

In the exemplary embodiment, the pulley belt 22 extends around the entire circumference of the drum 23 and an idler pulley 24 is provided to insure a good frictional engagement between the pulley belt 22 and the peripheral surface of the drum 23 adjoining the same.

An idler pulley 26 also engages the pulley belt 19 and is carried on the end of a lever arm 27 pivoted to a bracket 28 and continuously biased by a spring 29.

It will be understood that the casing 11 is of the front loading type and has a front door or opening indicated generally at 30. The drum 23 has a correspondingly located opening so that a batch of materials to be dried such as clothes or the like may be inserted into the interior of the drum.

In FIGURE 4, the rear bulkhead 12 is shown as having connected thereto a reinforcing plate 31 which, in turn, carries a hub 32. A flanged hub bolt 33 is screw-threaded into assembly with the hub 32 at one end thereof and a washer 34 forms a flange at the other end thereof, thereby to confine around the periphery of the hub 32 a basket or drum bearing 36 which may be made of a suitable electrically conductive bearing material.

The rear wall of the drum 23 is identified at 37 and includes a radial wall portion flanged as at 38 to overlie and embrace the bearing 36, a supplemental flanged support member 39 being provided which may be integrated with the wall 37 at a lanced portion 40 and by a self-threading fastener member 41 to place the bearing 36 in firm assembly with the wall 37 of the drum 23.

3

A pair of insulator buttons 42, 42 are attached by rivet fasteners 43, 43 to the rear bulkhead 2, thereby to provide an insulated mounting for a spring contact arm 44. The arm 44 has a curved resilient finger portion 46 which terminates in a socket contact 47 presenting a recessed face 48 which forms a bearing socket for the correspondingly shaped end of a conductive rod 49. The conductive rod 49 extends through an opening 50 provided in the rear bulkhead 12 and the rod 49 turns in an insulator 51 which may be made of a suitable plastic material such as Teflon, the insulator 51 serving to insulate the rod 49 from the bolt 33 and also functioning as a bearing.

The end of the rod 49 is received in an insulation block 52 and the end thereof is grooved as at 53 to facilitate a good mechanical and electrical connection to a conductive disk 54. The insulation block 52 is secured by a cap member 56 to an inwardly extending portion 57 of the rear wall 37.

Permanently secured to the conductive disk 54 is insulated conductive wire means 58 leading through an opening 55 of rear drum wall portion 37 to a sensor 59a FIGURE 3 provided in accordance with the principles of the present invention.

The illustrated sensor comprises contact means within the drum in the form of a first pair of sensing bands 59a and a second pair of sensing bands 59b with one band of each pair being positioned midway between the bands of the other pair as shown in FIGURE 2.

Bands 59a are electrically connected by means of the conductor means 58 and the rod 49 to the commutator arrangement while bands 59b are electrically grounded, i.e. connected directly to the drum to be electrically connected through the bearing 36, reinforcing plate 31 and bulkhead 12 which in turn is connected to ground or to a neutral line N as shown in FIGURE 5. Each of the bands 59a and 59b is preferably of a metal such as stainless steel which is bare and not coated with paint or other insulation to insure good electrical contact with materials in the drum, while the drum is preferably painted or otherwise coated with insulating material.

The material in the drum bridges the bands 59a and the bands 59b to affect the electrical resistance therebetween, the electrical resistance being comparatively low when the material is wet and being relatively high when the material is dry. Each band forms a substantially complete circle so as to be circumferentially continuous, whereby the operation is not affected by the rotative position of the drum.

FIGURE 3 shows the construction of one of the bands 59a and the assembly thereof within the drum.

The drum is provided with a plurality of openings 60 in circumferentially spaced relation in the drum wall 61 and in each respective opening 60, there is located a button of insulating material shown generally at 62. Each button 62 has a generally cylindrical shank portion 63 which extends through the opening 60 and at opposite ends of the shank portion there is formed an enlarged semi-spherical button 64 which overlies the outside surface of the drum wall 61 and a semi-spherical button 66 which overlies the inside edges of the openings 60 in the wall 61. The axial length of the shank 63 is longer than the thickness of the drum wall 61, thereby permitting to be clamped and retained between the buttons 64 and 66 a continuous insulating strip 67 and inwardly extending legs 68 of the circumferentially continuous sensing band 59a. More specifically, the continuous sensing band 59a has the two inwardly directed legs 68 and a curved body portion 70, thereby forming in cross-section a somewhat semicircular configuration. Accordingly, the curved portion 70 presents a wide contact area which is free of sharp corners and which will not damage the materials contained within the drum, but which will, at the same time, present a large contact surface readily engaged by the materials being agitated within the interior of the drum.

4

The contact wire 58 passes through a centrally disposed opening 71 formed in the insulator button 62 and is electrically and mechanically connected to the sensing band 59a as at 72.

FIGURE 3A shows the construction of the other band 59b and the assembly thereof within the drum. As shown, the band 59b is substantially identical to the band 59a, with a curved body portion 70a and inwardly directed legs 68a. However, the insulating strip 67 is eliminated and in place of the buttons 62 of insulating material, screws 73 of conductive material are provided, having head portions 73a within the band 59b overlying the legs 68a, and having threaded shank portions 73b extending through openings 68b in the wall 61 of the drum 23. A nut 74 of conductive material is threaded on the shank portion 73b of each screw 73 and a lock washer 75 of conductive material is disposed between each nut 74 and the outer surface of the wall 61. Each washer 75 is of conventional form with a sharp edge which cuts through any paint or coating on the drum to insure good electrical contact, while also preventing loosening of the threaded connection which might otherwise be caused by vibrations.

Since the content of the drum 23 will exhibit conductivity as a function of relative dryness, it will be appreciated that the bridging contact of the sensing bands 59a and 59b by the clothes or other materials contained within the drum 23 can be exploited as a controlling variable in the regulation of the dryer 10.

In one form of exemplary control system, a circuit arrangement exemplified by the circuit diagram of FIGURE 5 may be employed. Thus, there is a first circuit which is utilized to energize the power-operated components of the dryer such as the drive motor 16 and the heating means H. (It will be understood the heating means H can taken the form of either electrical heating elements or fuel-fired electrically controlled elements.) A push-to-start switch 76 completes a circuit through a rectifier 77, a relay coil 78 and a resistance 79. A pair of relay contacts 80 then close to hold in the relay coil 78 and start the drive motor 16 and the heater means H.

In a second circuit which includes the sensor 59 represented by the sensing bands 59a and 59b and a resistance 74, as well as a neon lamp 81 and a capacitor 82 in parallel with the sensor 59, the resistance 74 and the sensor 59 act as a voltage divider so that as the clothes dry and become less conductive, the voltage across the capacitor builds up until the firing voltage of the neon lamp 81 is reached.

The light from the fired neon lamp 81 excites a photosensitive cell 83 which shunts the relay 78, and, in turn, opens the relay contacts 80, thereby shutting off the heater means H.

A fourth circuit, however, including a thermostat 84 which is of the close on rise type, operates to energize the drive motor 16, thereby permitting the dryer to continue operation to cool off the contents of the drum until a terminal temperature of the thermostat 84 is attained whereupon the entire system de-energized.

In order to adjustably select the desired amount of dryness, a control may be effected by controlling the firing point of the neon lamp 81 with a variable voltage divider network including a resistance 86 and an adjustable resistance 87 located in circuit with the neon lamp 81. By adjusting resistance 87, the base potential on neon bulb 81 is changed to vary the voltage required to be built up in capacitor 82 in order to fire neon lamp 81, thereby providing an adjustment for the dryness control.

In summary, wet materials are placed in the drum 23 through front access door 30 for the purpose of removing the moisture therefrom. The push-to-start switch 76 is closed to thereby complete the electrical circuit to relay 78 which in turn closes relay contacts 80. Relay con-

5

tacts 80 complete the electrical circuit to drive motor 16 and heating means H. Drive motor 16 serves a dual purpose of rotating drum 23 to tumble and agitate the clothes therein and driving blower 21 to force heated drying air through the materials to be dried in the drum 23. As long as the relay coil 78 remains energized, relay contacts 80 remain closed maintaining the drying apparatus in operation. Rectifier 77 supplied half wave direct current voltage across the parallel connected capacitor 82 and sensor 59 through a voltage dropping resistor 74. While moisture remains in the material to be dried, the materials bridge across the sensing bands 59a and 59b providing a path for the current to ground or to line N of FIGURE 5. As the materials reach the state of dryness, they become less conductive; therefore no longer bridging the sensing bands 59a and 59b. When the path to ground is removed, capacitor 82 is charged until the firing voltage of the neon lamp 81 is reached. The firing of neon lamp 81 excites photosensitive cell 83 into conduction thereby shutting relay coil 78 causing coil 78 to become de-energized and opening contacts 80. Thermostat 84 being normally closed at the drying temperatures will provide an energization path to drive motor 16 until the air circulating through the materials reaches the lower opening temperature of thermostat 84. Once the opening temperature of thermostat 84 is reached, the thermostat opens, de-energizing motor 16 and completing the drying cycle.

There is thus provided in accordance with the principles of the present invention a novel drying arrangement with a control system utilizing the provision of a sensing means which directly exploits the conductivity of the clothes or other materials contained within the drum as a controlling variable.

Although minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A dryer comprising, a casing having a rear bulkhead, a hub connected to said bulkhead, said hub having an insulated interior surface defining an aperture through said hub, a drum journaled for rotation on said hub, said drum having a peripheral wall for confining materials to be dried in the drum, insulator means in the wall of the drum, at least two circumferentially continuous sensing bands carried on said insulator means in said drum in spaced relationship to one another, conductor means connecting one of said bands to ground, said conductor means comprising a rod connected to the other of said sensing bands and said rod being disposed at the axis of said drum and extending through said aperture of said hub and through said bulkhead, a spring arm having a contact member engaging said rod, thereby to form a commutator, insulator means for mounting said spring arm on said bulkhead, and circuit control means including a first circuit for energizing the heaters and the drive motor of the dryer, a second circuit including said sensing bands, a resistor, a capacitor, and a neon light, a third circuit including relay-operated switch means for controlling said first circuit, and a fourth circuit including a thermostat and said drive motor and control means responsive to said neon light for controlling the energization of said relay-operated switch, said sensing bands and the resistor operating as a voltage divider so that the voltage stored in said capacitor that is applied to the neon light increases as the clothes dry and become less conductive, said control means operating said relay-operated switch means in response to firing of said neon light for opening said first circuit, whereupon said drive motor will continue to operate through said thermostat until a predetermined cool-down temperature is obtained.

6

2. A dryer of the type having heating means and a drive motor comprising:

a casing having a rear bulkhead,
said bulkhead having an aperture formed therein;
a cylindrical hub having an aperture extending axially therethrough,

said cylindrical hub extending inwardly of said casing through said rear bulkhead with said apertures disposed in axial alignment;

a drum;

bearing means secured to said drum and journaled for rotation on said hub;

an insulator sleeve positioned in said aperture through said hub;

at least two electrode means positioned within said drum in spaced relation to one another and adapted to be bridged by the materials to be dried;

control means for controlling the operation of said heating means and said drive motor responsive to control voltages conducted through the materials as a function of the relative dryness thereof;

means electrically connecting said electrode means and said control means including

first conductor means connecting one of said electrode means to ground potential,

second conductor means connected to the other of said electrode means,

a rod, having first and second ends, made of conductive material carried at said first end by said drum for rotation therewith,

said rod connected to said second conductor means and extending through the center of said sleeve,

a stationary contact member engaging the second end of said rod thereby forming a commutator for conducting control voltages between said electrode means and said control means.

3. A dryer of the type having heating means and a drive motor comprising:

a casing having a rear bulkhead,

said bulkhead having an aperture formed therein;

a cylindrical hub having an aperture extending axially therethrough,

said cylindrical hub secured to said bulkhead with said apertures disposed in coaxial alignment;

a drum disposed within said casing,

said drum having a rear wall substantially parallel to said bulkhead;

a radial flange formed by a portion of said rear wall of said drum and extending along the axis of said drum;

a supplemental flange means secured to said rear wall of said drum and extending along the axis of said drum in a direction opposite of said radial flange;

bearing means fixedly secured to said rear wall of said drum by said radial flange and said supplemental flange for rotation with said drum,

said bearing means positioned on said hub for rotation;

an insulator sleeve positioned in said aperture through said hub;

at least two electrode means positioned within said drum in spaced relation to one another and adapted to be bridged by the materials to be dried;

control means for controlling the operation of said heating means and said drive motor responsive to control voltages conducted through the materials as a function of the relative dryness thereof;

means electrically connecting said electrode means and said control means including

first conductor means connecting one of said electrode means to ground potential,

second conductor means connected to the other of said electrode means,

a rod, having first and second ends, made of conductive material carried at said first end by said drum for rotation therewith,

7

said rod connected to said second conductor
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for conducting control voltages between said
electrode means and said control means.

References Cited by the Examiner

UNITED STATES PATENTS

3,059,203 10/1962 Hetrick ----- 34—45 X
3,122,426 2/1964 Horecky ----- 34—48 X

8

3,180,038 4/1965 Chafee ----- 34—48 X
3,210,863 10/1965 Nye et al. ----- 34—48 X

FOREIGN PATENTS

877,553 9/1961 Great Britain.

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