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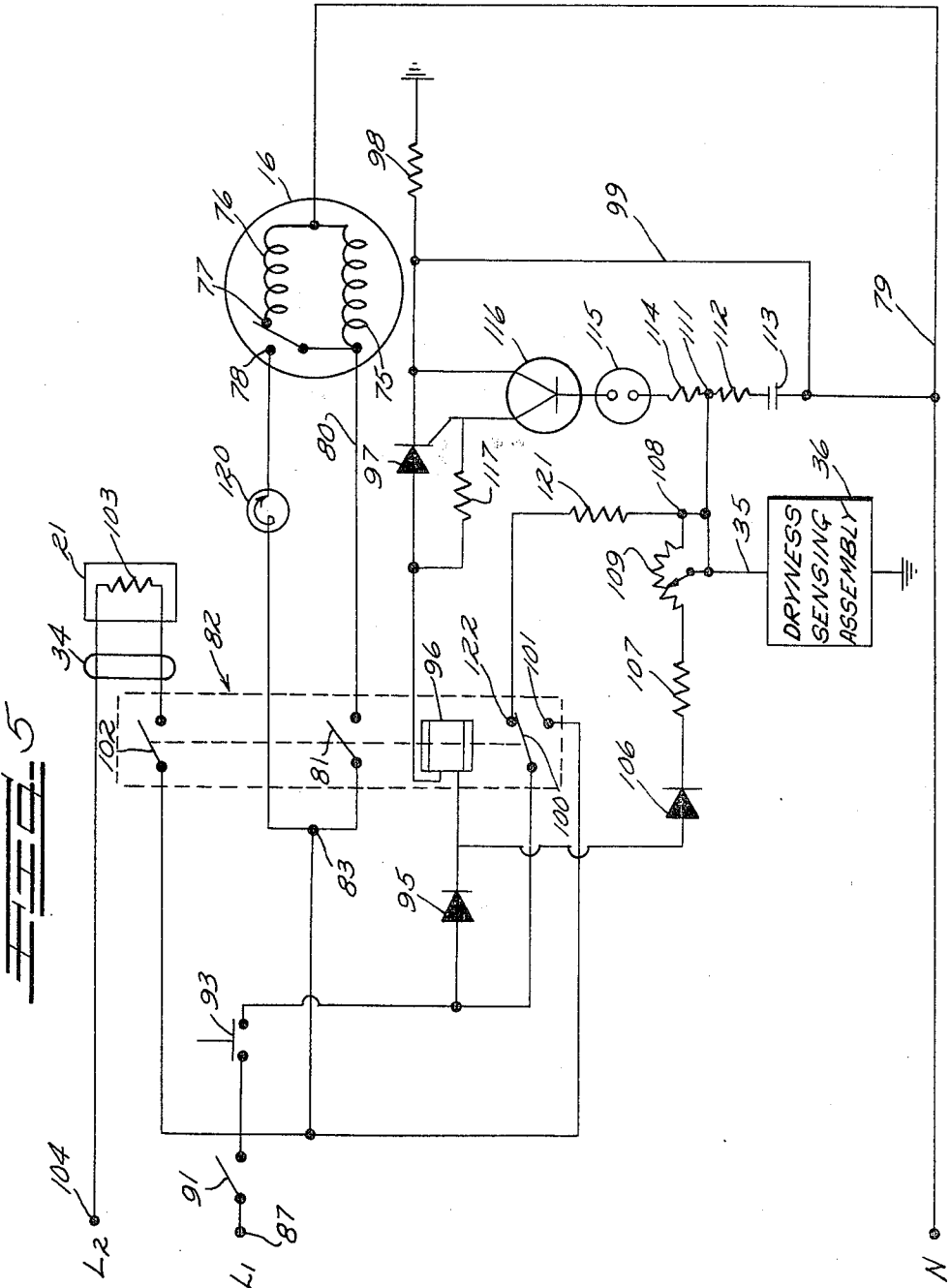
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ELECTRONIC DRYER CONTROL PICK-UP DEVICE

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ELECTRONIC DRYER CONTROL PICK-UP DEVICE

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This invention relates to a clothes dryer and more particularly to a clothes dryer dryness measuring and control system evolved with the objects of providing a system which is highly reliable, efficient and trouble-free in operation while being readily and economically constructed and assembled from a minimum number of component parts.

The illustrated embodiment of the invention is incorporated in a home type clothes dryer but it will be understood that various principles and features of the invention can be applied to other types of material handling systems, the terms "clothes" and "clothes dryer" being used herein in a generic sense to include equivalent materials and systems.

In the dryness control system of this invention, the dryness of clothes is measured electrically by measuring the electrical resistance presented between conductors engaged with spaced portions of a mass of clothes, the resistance being low when the clothes are wet and being increased as the clothes approach a dry state. The measured value of electrical resistance may be indicated or may preferably be used to automatically control the operation of drive, air circulating and heating means incorporated in the dryer.

An important feature of the invention relates to a slip ring arrangement for providing an electrical connection between a conductor within a rotating drying drum and electrical measuring means outside the drum. In particular, a brush carried from the casing of the dryer is engaged with a metal slip ring which is disposed in surrounding relation to the periphery of the drum, and a continuous strip of insulating material is disposed inside the slip ring to support the ring and maintain it in coaxial relation to the drum axis, the slip ring being electrically connected to contacting means engaged with the clothes inside the drum. With this arrangement, a reliable electrical connection is obtained with the parts being readily assembled on the outside of the drum.

A specific feature of the invention is in the arrangement whereby the strip of insulating material and the slip ring are firmly locked in position with the strip being resiliently stressed in opposition to tension in the slip ring.

Further important features of the invention relate to the mounting of one or more conductive bands within the drum to contact the clothes, using parts which are readily assembled and fixed in position, with no edges or crevices or openings exposed to catch the clothes or lint or the like therein.

This invention contemplates other and more specific objects, features and advantages which will become more fully apparent from the following detailed description taken in conjunction with the accompanying drawings which illustrate preferred embodiments, and in which:

FIGURE 1 is a diagrammatic elevational view of the rear side of a dryer incorporating a dryness control system according to this invention;

FIGURE 2 is a sectional view taken substantially along line II-II of FIGURE 1, illustrating a dryness sensing assembly constructed according to this invention;

FIGURE 3 is a sectional view taken substantially along line III-III of FIGURE 2, illustrating the mounting of a contacting brush;

FIGURE 4 is a sectional view illustrating a modified slip ring mounting arrangement; and

FIGURE 5 is an electrical circuit diagram.

Reference numeral 10 generally designates a clothes dryer incorporating the dryness control system of this invention, wherein the dryness of clothes is sensed by electrical resistance measurement to automatically control energization of drive and heating means. It will be understood that the dryness control system of this invention, and various features thereof, may be applied to dryers of types different from that illustrated.

In the illustrated dryer 10, clothes to be dried are placed within a drum 11 disposed within a casing 12 and journaled for rotation in a bearing assembly 9 about a horizontal axis. To drive the drum 11 and tumble clothes therewithin, a belt 14 is trained about the periphery of the drum and about a pulley 15 driven by an electric motor 16. For drying the clothes, air enters from the lower portion of the casing 12 and through an inlet opening 18 in a back panel 19 of the casing 12, into a duct 20 having an electric heater 21 therewithin. Heated air from the duct 20 passes through an outlet opening 22 and into the drum 11, through openings in the back wall thereof. The air, after picking up moisture from clothes within the drum, is withdrawn from the drum into the inlet 27 of a blower 24 which discharges from the blower through a vent 25 in partial back panel 26 and through a suitable pipe (not shown) to the outside atmosphere. The blower is driven by a pulley 28 driven through a belt 29 from a pulley 30 on the shaft of the motor 16.

The motor 16 and heater 21 are connected to a control unit 32 through cables 33 and 34, the control unit 32 being connected through a wire 35 to a dryness sensing assembly 36 (FIGURE 5) constructed according to the principles of this invention. This assembly is readily constructed from a minimum number of parts, is easily installed and is rugged and trouble-free in operation while providing an accurate and reliable electrical indication of the dryness of clothes.

As shown in FIGURE 2, the dryness sensing assembly 36 comprises a pair of spaced bands 37 and 38 of conductive material, preferably stainless steel, mounted within the drum 11 at positions intermediate rows of tumbling baffles 39 and 40. The ring 37 is electrically connected through a wire 41 to the drum 11 which is electrically connected through the drum-support bearings to the casing 12 of the dryer, the casing forming an electrical ground of the system. The ring 38 is connected through a wire 42 to a continuous slip ring 43 of conductive material, preferably stainless steel, on the outside of the drum 11. The ring is engaged by the contactor brush 44 which is connected through the wire 35 to the control unit 32.

As described hereinbelow in connection with the electrical circuit diagram of FIGURE 5, the control unit 32 controls the drive and heating means in response to the electrical resistance presented by the clothes between the rings 37 and 38, as measured between the wire 35 and the casing 12, the electrical resistance being relatively low when the clothes are wet and being increased as the clothes approach the dry state.

Important features of the invention reside in the support of the slip ring 43 on the drum 11 in a manner to permit the ready assembly of parts and the firm locking thereof in position when assembled. In particular, the slip ring 43 is disposed in a groove 47 in the outer surface of a strip 48 of insulating material, preferably an extruded strip of polypropylene material. The strip 48 forms a complete ring about the periphery of the drum and thereby provides uniform support of the slip ring which is thereby maintained in concentric relation to the drum axis.

The strip 48 has a groove 49 in its inner surface which

engages over a bead 50 on the drum 11, formed by the junction between the edge portion of an outer cylindrical wall 51 of the drum and the outer peripheral edge portion of a front wall 52 of the drum 11. The strip 48 additionally has a radially inwardly projecting portion 53 engaging the drum to space an internal surface portion 54 of the strip 48 from the opposed surface of the drum 11.

Thus the circumference of the inside surface of the slip ring 43 measured in the unstressed (unassembled) condition is slightly less than the circumference of strip 48 measured at surface 47 when in the position as shown in FIGURE 2 without ring 43 in position. Therefore, when slip ring 43 is assembled into position in groove 47 as shown in FIGURE 2, the ring 43 is stressed in tension and strip 48 is subjected to compressive forces thereby providing a firm assembly of the ring 43 and strip 48 on the drum 11.

This arrangement also permits ready assembly of the parts. In particular, the strip is initially disposed on the drum behind the bead 50, to the right of the illustrated position, with the slip ring 43 loosely disposed about the strip 48. The assembly is then moved forwardly and the forward portion of the strip 48 is sprung outwardly until it reaches the illustrated position, when it snaps back to engage the bead 50 in the groove 49. This assembly is facilitated by providing a rounded edge 55 on the forward portion of the strip 48.

FIGURE 4 illustrates a modification wherein a modified strip 48' is provided having groove 47' corresponding to the groove 47 of the strip 48 as illustrated in FIGURE 2. In this modification, no continuous projection such as the projection 53 of FIGURE 2 nor bead overlapping portion with groove 49 is provided but instead a plurality of tensioning clips 56 circumferentially spaced are inserted under the strip 48' to hold the parts in firm assembly and provide the tensioning that is necessary. By placing the number of tensioning clips 56 that are needed to apply adequate tension to the slip ring 43' to retain the strip, 48', a smooth continuous, conductive surface is provided for contact 44.

FIGURE 3 shows the support of the brush 44 which is preferably of a metal conductive material, such as, graphite, disposed in a holder 58 which is secured to one end of a spring wire 59 having a coiled portion and having an opposite end secured to a rod 60 of insulating material supported from the casing 12. A copper braided wire 61 extends from the brush holder 58 to a terminal 62, to which the wire 35 is attached.

Further important features of the invention relate to the support of the bands 37 and 38 on the interior of the drum. In particular, a strip 64 of insulating material, preferably extruded polypropylene, is provided forming a ring in engagement with the internal surface of the drum 11, intermediate the tumbling baffles 39 and 40. The strip 64 has a pair of radially inwardly extending annular ribs 65 and 66 with projections 67 and 68 from opposite sides of the ribs 65 and 66 spaced axially inwardly from opposed surface portions of the strip 64 to define annular grooves which receive turned-in edge portions of the bands 37 and 38 to firmly hold the bands 37 and 38 in position.

The strip 64 is additionally formed with a groove 69 projecting inwardly from the outer surface thereof and of generally T-shaped configuration, to receive the heads of a plurality of securing clips 70 which have reduced diameter shank portions projecting through openings in the cylindrical wall 51 of the casing 11, the outer ends of the clips 70 being deformed to lock the same in position after assembly.

The strip 64 has a central portion 72 which is thicker than the side portions thereof to allow for the groove 69 while minimizing the weight and amount of material in the strip. To prevent snagging of clothes, the edges of the portion 72 are rounded, and rounded reinforcing

beads 73 and 74 are also provided on the edges of the strip 64.

Referring now to the electrical circuit diagram of FIGURE 5, the motor 16 has a main winding 75 and a starting winding 76 initially connected in parallel through a contact 77 of a centrifugal switch, contact 77 being disconnected from the starting winding 76 and connected to a contact 78 when the motor reaches a certain speed. The common connection of the windings 75 and 76 are connected to a neutral line 79, while the main winding 75 is connected through a conductor 80 and through a normally open contact 81 of a relay 82 to a circuit point 83 which is connected through a door switch 91 to an L₁ line terminal 87. The door switch 91 is physically located in such relation to drum access door (not shown) so as to be actuated to the closed position upon the closing of the door and thereby completing the electrical connection to the control circuit. When the door is opened, the door switch 91 opens thereby deenergizing the electrical control circuit thus deenergizing the drive motor and heater preventing drum rotation and heat input whenever the door is open.

One terminal of an operating coil 96 of the relay 82 is connected to push-to-start switch 93 through diode 95. Push-to-start switch 93 is a normally open spring biased switch that is momentarily manually actuated to initiate a cycle of operation. The other terminal of the coil 96 is connected to the anode of a silicon controlled rectifier 97 having a cathode connected through a resistor 98 to ground and also connected through conductor 99 to the neutral line 79. The silicon controlled rectifier 97 normally has a gate voltage applied thereto through the shunting circuit which includes resistor 117 such as to render it conductive, and the relay coil 96 is thus energized to close the contact 81 and start the motor 16, to also engage a holding contact arm 100 with a fixed contact 101 and short-circuit the start switch 93, and to additionally close a contact 102 and connect the line terminal 87 to one terminal of a resistance element 103 in the heater 21, the other terminal of the element 103 being connected to an L₂ line terminal 104.

The silicon controlled rectifier 97 is controlled in response to dryness, to be rendered non-conductive when the resistance presented between the line 35 and ground reaches a certain value. In particular, the cathode terminal of the diode 95 is connected through a diode 106, a resistor 107 to a circuit point 108 which is connected and an adjustable resistor 109 to the line 35. Circuit point 108 is connected to a circuit point 111 which is connected through a resistor 112 and a capacitor 113 to the cathode of the silicon controlled rectifier 97, circuit point 111 being also connected through a resistor 114 and a neon lamp 115 to the base of a transistor 116 having its emitter connected to the cathode of the silicon controlled rectifier 97, and having its collector connected to the gate of the silicon controlled rectifier 97, a resistor 117 being connected between the gate and anode of the rectifier 97. In operation, the capacitor 113 is charged by current flow through the circuit including resistors 112, 109 and 107 and the diode 106 but initially, when the clothes are wet, the amount of charge of the capacitor 113 is limited by the low resistance of the shunt circuit from circuit point 108 to ground, through the resistor 109 and the low resistance of the clothes as presented between the line 35 and ground. However, as the clothes dry, the resistance of the shunt circuit increases and ultimately the charge across the capacitor 113 reaches a certain level such as to cause the neon lamp 115 to discharge through the base-emitter circuit of the transistor 116. The transistor 116 then conducts to reduce the voltage of the gate of the silicon controlled rectifier 97 to a value such that it will not conduct during the next half-cycle of voltage applied thereto, only positive half-cycles being applied because of the provision of the diode 95 in the circuit. The rectifier will not conduct as long as the neon lamp 115 is ionized and is con-

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ductive which is approximately $\frac{1}{2}$ second in the present illustration.

When the rectifier 97 ceases to conduct, the relay 96 is deenergized to open the contacts 81, 101 and 102. The heater 103 is then deenergized, but energization of the motor 116 may be continued through a "cool down" thermostat 120 connected between the contact 78 of the motor centrifugal switch and the timer contact 84. The thermostat 120 is mounted in the blower 24 and protrudes through a circular opening in the blower wall in order to sense the temperature of the exhaust air flowing through the blower. The thermostat 120 includes a switch which is closed when the dryer is heated to a certain temperature and does not open until the temperature drops below a certain value. Thus the tumbling and blowing operations are continued after deenergization of the heater, until the temperature drops below a certain value.

The resistors 107 and 109 should preferably have a relatively high resistance, to provide a delay action between the attainment of a certain dryness level and the deenergization of the heater. This delay action allows the clothes to become quite dry, without imposing critical adjustment requirements on the resistance measuring circuit, which might otherwise create a dangerous no shut-off condition. By way of example, the variable resistor 109 may have a selective value of between .47 and 27 megohms, the resistor 107 a value of 68,000 ohms, the resistor 112 a value of 22,000 ohms, the resistor 114 a value of 10,000 ohms and the resistor 117 a value of 8,200 ohms. The resistor 98 is provided as a safety precaution in event the terminals L_1 and N are reversed when being connected to the household power line to avoid tying the neutral line 79 directly to the cabinet or casing of the dryer, and many preferably have a value of 1 megohm. The capacitor 113 may have a value of 4 microfarads. Upon the deenergization of the relay 82, contact arm 100 moves to contact 122 and thereby provides a path through resistor 112, resistor 121, diode 95, solenoid coil 96, resistor 117, the gate of silicon controlled rectifier 97 to fully discharge capacitor 113. The complete discharge of the capacitor 113 conditions it for a subsequent drying operation and also eliminates the possibility of a shock hazard to the operator who may accidentally contact the sensing bands 38 when removing the materials from the drum 11.

It will be apparent that other resistance-measuring circuits might be employed and also that the circuit might be used to control heating means other than the electrical heating means as illustrated, such as for example gas-fired heaters where the ignition and supply of gas may be electrically controlled.

It will be understood that other modifications and variations may be made without departing from the spirit and scope of the novel concepts of this invention.

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

1. In a clothes dryer,

a casing,

a drum supported for rotation within said casing to tumble clothes therewithin,

and control means for sensing the electrical resistance of the clothes, comprising:

insulated contact means inside said drum for engaging the clothes,

a continuous metal slip ring outside said drum electrically connected to said contact means,

a strip of insulating material between said slip ring and the outside surface of said drum,

said strip being stressed in opposition to tension in said ring to provide a firm frictional locking of said slip ring and strip in position for co-rotation with said drum,

a stationary brush carried from said casing and engaging said slip ring,

and means electrically interconnecting to said brush and said control means.

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2. A clothes dryer as described in claim 1 wherein tensioning clips are spaced circumferentially between said strip and said outside of said drum to provide the firm frictional locking of said slip ring and said strip in position.

3. In a clothes dryer,

a casing,

a drum supported for rotation within said casing to tumble clothes therewithin,

and control means for sensing the electrical resistance of the clothes, comprising:

insulated contact means inside said drum for engaging the clothes,

a continuous metal slip ring outside said drum electrically connected to said contact means,

a strip of insulating material between said slip ring and the outside surface of said drum,

said strip having surface portions engaged with outer surfaces of said drum spaced axially on opposite sides of said slip ring and having an intermediate surface portion spaced from the opposing outer surface portion of said drum,

said strip being stressed in opposition to tension in said slip ring to provide a firm frictional locking of said slip ring and strip in position for co-rotation with said drum,

a stationary brush carried from said casing and engaging said slip ring,

and means electrically interconnecting said brush and said control means.

4. In a clothes dryer,

a drum supported for rotation to tumble clothes therewithin,

and control means for sensing the electrical resistance of the clothes as a function of the dryness thereof, comprising:

a contact member of conductive materials within said drum,

a strip of insulating material supporting said contact member of conductive material in engagement with the internal surface of said drum,

means securing said strip to said drum,

said strip having a radially inwardly extending annular rim with projections from opposite sides of said rim spaced axially inwardly from opposed surface portions of said strip to define annular grooves,

and said contact member being formed of sheet metal and having opposite edge portions turned inwardly to engage in said grooves and to lock said contact member in position on said strip.

5. In a clothes dryer,

a casing,

a drum supported for rotation within said casing to tumble clothes therewithin,

and means for measuring the electrical resistance presented by the clothes, comprising:

insulated contact means inside said drum for engaging the clothes,

a continuous metal slip ring outside said drum electrically connected to said contact means,

a strip of insulating material between said slip ring and the outside surface of said drum,

said strip being stressed in opposition to tension in said ring to provide a firm frictional locking of said slip ring and strip in position,

a brush carried from said casing and engaging said slip ring,

and electrical contact means connected to said brush,

said drum having an annular projection thereon, and said strip having a groove receiving said projection to prevent movement of said strip.

6. In a clothes dryer,

a casing,

a drum supported for rotation within said casing to tumble clothes therewithin, and means for measuring the electrical resistance presented by the clothes, comprising:

- insulated contact means inside said drum for engaging the clothes,
- a continuous metal slip ring outside said drum electrically connected to said contact means,
- a strip of insulating material between said slip ring and the outside surface of said drum,
- said strip being stressed in opposition to tension in said ring to provide a firm frictional locking of said slip ring and strip in position,
- a brush carried from said casing and engaging said slip ring,
- and electrical contact means connected to said brush,
- said drum having an outer wall and an end wall with a bead at the inner section of said walls forming an annular projection,
- and said strip having a groove receiving said bead.

7. In a clothes dryer, a drum supported for rotation to tumble clothes therewithin,

and means for measuring the electrical resistance presented by the clothes to measure the dryness thereof, comprising:

- a contact member of conductive material within said drum,
- a strip of insulating material supporting said contact member of conductive material in engagement with the internal surface of said drum,
- means securing said strip to said drum,
- said strip having an annular groove in its outer surface,
- and a plurality of clips engaged in said groove and extending through the drum to lock said strip in position.

8. In a clothes dryer, a drum supported for rotation to tumble clothes therewithin,

and control means for sensing the electrical resistance of the clothes as a function of the dryness thereof, comprising:

- a pair of contact members of conductive material in axially spaced parallel relation within said drum,
- an extruded strip of insulating material supporting said contact members of conductive material in engagement with the internal surface of said drum,
- said strip being biased by inherent resiliency thereof into engagement with the internal surface of said drum,
- means electrically connecting one of said contact members to the drum,
- and slip ring means for establishing an electrical connection to the other of said contact members.

9. In a clothes dryer of the type having a casing and a drum supported for rotation within said casing to tumble clothes therewithin, the improvement of

control means for sensing the electrical resistance of the clothes, comprising

- insulated contact means inside said drum for engaging the clothes,
- a continuous metal slip ring outside said drum for co-rotation therewith and electrically connected to said contact means,
- a strip of insulating material between said slip ring and the outside surface of said drum,
- and tensioning means interposed between said strip and said outside surface of said drum to tension said strip for providing a firm frictionally-locked assembly of said strip,

said slip ring, said tensioning means and said outside surface of said drum.

10. A clothes dryer as described in claim 9 in which said tensioning means comprises a plurality of tensioning clips spaced circumferentially about said outside surface of said drum and adapted to be moved axially on said outside surface for snug insertion between said surface and said strip of insulating material.

11. In a clothes dryer of the type having a casing and a drum supported for rotation within said casing to tumble clothes therewithin, the improvement of

means for sensing the electrical resistance of the clothes which comprises insulated contact means inside said drum for engaging the clothes,

a continuous metal slip ring outside said drum electrically connected to said contact means,

a strip of insulating material between said slip ring and the outside surface of said drum,

said strip being generally U-shaped in cross-section and including an axially extending flat portion and a pair of axially spaced radially outwardly extending leg members for forming a groove on the outside surface of said flat portion between said leg members for receiving said slip ring, and

a plurality of tensioning clips spaced circumferentially about said outside surface of said drum to tension said strip for providing a firm frictionally locked assembly of said strip, said slip ring, said tensioning clips and said drum, said clips having a generally axially extending body portion adapted to be moved axially and to be forcibly inserted between said outside surface of said drum and said strip and having a radially outturned flange portion to accommodate and to facilitate insertion of said body member.

12. In a clothes dryer,

a casing,

a drum supported for rotation within said casing to tumble clothes therewithin, and

means for sensing the electrical resistance of the clothes comprising

insulated contact means inside said drum for engaging the clothes,

a continuous metal slip ring outside said drum electrically connected to said contact means,

a strip of insulating material between said slip ring and the outside surface of said drum,

said strip being generally U-shaped in cross-section and comprising a substantially flat axially extending portion and a pair of axially spaced radially outwardly extending leg members,

the radially outwardly facing surface of said axially extending portion forming with said leg members a groove for receiving said slip ring and the radially inwardly facing surface of said axially extending portion having a circumferentially continuous shallow arcuately-shaped groove formed therein,

a plurality of tensioning clips spaced circumferentially about said outside surface of said drum to tension said strip for providing a firm frictionally-locked assembly of said strip, said slip ring, said tensioning clips and said drum,

said clips each having a generally axially extending body portion constructed with a shallow radially outwardly projecting bow formed therein to be inserted between said outside surface of said drum and said strip to tension said strip and to be received in said complementarily shaped shallow groove of said strip and each having a radially outturned flange portion to accommodate and facilitate insertion of said body portion,

a brush carried from said casing and engaging said slip ring, and

means electrically interconnecting said brush and said sensing means.

13. In a clothes dryer having a rotatable drum for tumbling clothes therewithin and an electrical control apparatus for sensing the electrical resistance of said clothes, the improvement comprising

an electrically conductive element mounted on said drum 5
and having a portion thereof projecting into said drum for contacting the clothes tumbling therein,
first insulating means for insulating said inwardly projecting portion of said electrically conductive element from said drum,

an annular commutator ring connected to said electrically conductive element and encircling the outside of said drum for co-rotatable assembly therewith,
second insulating means for insulating said annular commutator ring from said drum,

means positioned on the periphery of said drum within the confines of said second insulating member and engaging said second insulating member in an interference, snap-fit for retaining said commutator ring in position on said second insulating member by the 20

tensile forces created in said annular commutator ring by said interference fit,
a signal pick-up brush engaging said annular commutator ring in a sliding relationship,
and means electrically interconnecting said pickup brush with said electrical control apparatus.

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