This invention relates to devices employed in a control system for directly determining the condition of fabrics in a machine for drying fabrics, and more particularly, to electrodes for contacting and completing an electrical circuit through the fabrics.

Many attempts have been made to relate and control the terminal point of drying operations to the condition of the fabrics. One system relies upon the change in conductivity of the fabrics as the moisture is removed to discontinue operation of a drying machine at the moment electrical conductivity of the fabrics, as sensed directly between conductors mounted on and movable with the revolving drum, attains a predetermined value.

Another system is disclosed in the pending application of Thomas R. Smith, Serial No. 329,135, filed December 9, 1963, and assigned to the assignee of the instant invention. Said application concerns a dry control system in which the electrical conductivity of the random tumbled fabrics, integrated over a period of time, attains a predetermined value before initiating termination. Electrical conductivity is sensed directly between conductors mounted on the inner periphery of the revolving drum.

In both of these systems, it is noted that the conductors are mounted on the revolving drum and movable therewith. Thus of necessity, means must be provided for carrying current from the revolving drum to a stationary member. One such current carrying system is a slip ring and brush arrangement, for example. It is known that the use of moving parts for carrying current may result in increased manufacturing and operating problems. It is also known, of course, that as additional parts are included in the control system as required with a slip ring and brush arrangement, additional cost is correspondingly added.

Additional problems are encountered when a combination washer-drier is provided with an automatic control system requiring that electrodes be positioned within the washing and drying chamber. The problem of having electrodes in the revolving drum and of connecting them to the control outside of a casing or tub is made more critical because of the presence of lint-laden wash water. First, the use of connecting wires create mounting and sealing problems. Second, the collection of lint from the wash water on the electrodes and on the connecting wires is troublesome and may result in erratic operation of the control system.

It is therefore an object of this invention to provide for a dry control system improved electrodes positioned for contact by the fabrics being tumbled.

It is a further object of this invention to provide improved means for mounting the electrodes for contact by the fabrics being tumbled.

It is a further object of this invention to provide electrodes means positioned for contact by the tumbled fabrics and mounted on a non-revolvable member thereby eliminating the need for relatively movable current carrying members.

It is still a further object of this invention to provide electrode means which are more suitable for use in a washer-drier unit by reason of the elimination of any lint collection during the washing operation.

These objects are realized in the present invention by the provision of electrodes positioned on a non-revolvable member juxtaposed to the revolving drum and openly facing the interior thereof. Specifically, in the preferred embodiment, the electrodes are positioned in a washer-drier on a non-revolvable member which openly faces the drum interior between the inner periphery of an opening provided in the front wall member of the revolving drum and the access opening provided in the machine enclosure.

Complete details of this invention and further objects and advantages will become evident as the description proceeds and from an examination of the accompanying drawings which illustrate a preferred embodiment of the invention and in which similar numerals refer to similar parts throughout the several views.

In the drawings:

FIGURE 1 is a side view of a washer-drier shown partially in section and including the subject matter of the instant invention;

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1 showing the interior of the tub front and more particularly showing the subject matter of the instant invention;

FIGURE 3 is shown below FIGURE 1 and is a schematic electrical circuit showing a control system cooperating with the present invention; and

FIGURE 4 is a fragmentary sectional view of a drier showing an additional embodiment of the present invention.

Referring now to the accompanying drawings in detail, it will be seen that a combination washer-drier unit, shown in FIGURES 1 and 2, and adapted to include a preferred embodiment of the present invention, is described hereinafter. For a complete explanation of the structural details of a washer-drier of this type, however, attention is directed to U.S. Patent 2,985,966, issued May 30, 1961, to Paul A. Martin and assigned to the same assignee as the instant invention. It is to be noted also that the instant invention is applicable for use with a fabric treating apparatus intended solely for drying fabrics, as will be discussed more fully in explaining the embodiments shown in FIGURE 4.

The washer-drier shown in FIGURES 1 and 2 includes a substantially flat surfaced base frame 10 supported on legs 11. Mounted upon base frame 10 are channel members 13 and 14 which are welded or otherwise securely affixed in some suitable manner to base frame 10 to form the two major supports for the washer-drier unit of FIGURE 1.

As seen in FIGURE 1, channel members 13 and 14 receive pivot pins 16 and 17 to form a two-point support for tub 20 on tub brackets 23 and 24 respectively. This allows tub or casing 20, which is fastened to tub brackets 23 and 24, to oscillate or pivot back and forth in a primary degree of freedom on pins 16 and 17 in response to various forces generated within tub 20.

Tub 20 is maintained in an upright position on pins 16 and 17 by two centering springs such as spring 25 connected between tub 20 and base 10. FIGURE 1 also shows tub 20 as being provided with a damper arrangement including damper leaf spring 30 fixed to tub 20 and carrying the damper pad 33 engageable with upset damping plate 34 for absorbing and dissipating the energy imparted to tub 20 by centrifugal forces generated during extraction operations involving unbalanced loads. An unbalanced control system, such as may include an actuating plunger 32, may be employed to prevent excessive vibrations.

It is seen that this assembly supported on pins 16 and 17, including tub or casing 20, is enclosed within a cabinet 35. Cabinet 35 is provided with an access door 36 hinged to cabinet 35. Door 36 may be manually opened for allowing fabrics to be inserted through opening 37 into
clothes receptacle or drum 38 positioned within tub or casing 20.

Tub 20 includes a generally cylindrical side wall 71, a pair of spaced rear walls 72 and 73 and a front wall 74. Front wall 74 terminates in an inner flange portion 77 encircling loading opening 78. Flange portion 77 may be substantially vertical as shown in FIGURE 1 or be slanted to face inwardly and upwardly for contact by the fabrics. The rear and outer walls 72 and 74, respectively, are connected to cylindrical side wall 71 by means of the encompassing flanged hoop-like members 76 while the partition wall 73 positioned between walls 72 and 74 is welded to side wall 71.

It will be seen from an inspection of FIGURE 1 that the spaced rear walls 72 and 73 support the tub bearing assembly generally indicated by the reference number 80. The tub bearing assembly 80 includes a spacer hub 81 which is located between and which abuts the rear walls 72 and 73, and a tubular clamp member (not shown) located concentrically within hub 81. The clamp member is formed with a shoulder 85 and a threaded portion 84 for receiving spanner clamp nut 83 which, when tightened on the tubular clamp member, produces a rigid support with respect to tub 20 for two bearing (not shown), one of which is located adjacent each of walls 72 and 73 for supporting drum drive shaft 89.

The rear end of drum drive shaft 89 is rigidly connected to the large drive pulley 91 whereas its front end is threaded into hub 94 of drum 38. Drum 38 includes a perforate rear wall 96 which is rigidly affixed to and cooperates with the spider-like brace member 97 to form a double cone support connected to hub 94 for providing rigid support for the drum 38 on drum drive shaft 89. The inwardly extending conical rear wall assists in moving the fabrics about in drum 38 and especially aids in moving the fabrics away from the rear of drum 38. Drum 38 also includes a perforate cylindrical side wall 104 which merges into a short front wall 106 and which carries elevating means 105.

The circular loading opening 78 is encircled by one end of bellows seal 118. The opposite end of seal 118 is fastened to access opening 37 formed in cabinet 35 enclosing the combination washer-drier unit. Rectangular door 36 carries a transparent glass window 122 having a cylindrical portion 123 extending rearwardly through the bellows seal 118 which is provided with a flexible annular sealing lip 124 engageable with the periphery of the cylindrical portion 123. The unit is then sealed while still enabling the operator of the machine to observe operation taking place within tub 20 during the washing and drying process. A lamp 126 is fastened to the exterior of tub 20 and shines through a transparent member 127 carried in front wall 74 of tub 20 for illuminating the interior of the machine.

Tub 20 also includes a heater housing 131 which may be formed separately or as a part of the casing side wall and which supports a heating element (not shown) capable of radiating heat energy through an opening located in the cylindrical side wall 71 and covered by the heater housing 131. Heater housing 131 also mounts the high limit thermostat 133 which is connected in series with the heater. Additional thermostats, such as 135 and 136, may be placed within or juxtaposed to drum 38 for contact by the tumbled fabrics to prevent excessive temperature rise in the fabrics.

Drum 38 positioned within tub 20 is connected to drive pulley 91 through shaft member 89. Pulley 91 is driven by a drive system which includes an electric motor 137 and variable speed means such as transmission 138 and which is operable for delivering a plurality of operating speeds. These speeds may include a relatively low speed for tumbling the fabrics within drum 38 during the washing and drying operations, an intermediate speed for distributing the materials contained within drum 38 in a substantially even loading about the inner periphery thereof prior to extraction, and a relatively high speed for extracting fluids from the materials contained within the drum 38.

A combination blower-condenser unit as described in U.S. Patent 3,040,440 issued June 26, 1962, to Mullinger et al., entitled "Washer-Drier Condenser System" and assigned to the assignee of the instant invention is positioned in the compartment formed by and between portions of spaced rear walls 72 and 73. This blower-condenser unit is capable of moving air through tub 20 and drum 38 for drying the fabrics, scrubbing lint from this air, and condensing out moisture from hot vapors produced within tub 20 during the drying operation.

This washer-drier includes a conventional program control timing device (not shown) for sequencing the machine and the various electrically operated components thereof through a predetermined series of operations comprising a washing and/or drying operation. The timing device may be located in control housing 140 and be manually advanced by rotating knob 142 to initiate operation of the washer-drier.

This washer-drier is also equipped with a dry control device such as disclosed in the aforementioned Smith application, Serial No. 329,155, for controlling termination of the drying operation and which includes a control circuit as shown in FIGURE 3. When the control device is mounted into cabinet 35, it may be mounted elsewhere within cabinet 35.

As seen in FIGURES 1 and 2, conductors 144 and 145, which cooperate with the dry control for sensing the dryness of the tumbled fabrics, are positioned on flange 77 of non-revolving front wall 74. These conductive members are preferably disposed in the form of thin flat elongated strips applied to a portion of the surface of flange 77, preferably facing the interior of revolving clothes drum 38. The conductors may also be in the form of wires or other shapes of conductive material. The electrodes may be fixed to the surface with rivets, screws or by bonding with adhesives. The spaced-apart conductors are insulated from each other and from the flange 77 in the preferred embodiment by a non-conductive porcelain enamel finish applied to the surface of the flange and any mounting holes therein. The conductors may also, of course, be insulated from the flanges by positioning an insulative member (not shown) between the flange and the conductor. The insulation means may also include a normally insulating material to which at least partially conductive responsive to the pickup of moisture from the fabrics. An additional embodiment of the electrodes for use with a washer-drier combination in which front wall 74 of casing 20 is finished with a porcelain enamel surface is a fired-on strip of conductive material. These fired-on conductors become an integral part of the surface and are substantially flush thereto, but are fully insulated from each other and the supporting flange by the porcelain enamel.

Electrodes 144 and 145 are formed and attached to the surface of flange 77 in a manner that the surfaces are substantially free of line-catching protrusions. They may be arranged as arcuate strips as shown in FIGURE 2 and be connected to the control circuit at terminals 149 and 150 which are also insulated from flange 77. Additional electrodes, such as conductors 154 and 155, may be connected electrically parallel to electrodes 144 and 145 through terminals 149 and 150 and jumper wire (not shown) extending from terminals 160 and 161, respectively.

It is noted that these electrodes comprise a pair of conductors or a plurality of pairs of conductors for contacting the tumbled fabrics; however, it is within the scope of this invention to provide one or more conductive surfaces, a conductive surface, or other means for adapting flange 77 as the second electrode.

It is further noted in FIGURE 2 that electrodes 144 and 145 are positioned in substantially the lower right
quadrant of circular flange 77 for contact by the tumbled fabrics. Rotation of drum 38 in a clockwise direction, as shown by the arrow in FIGURE 2, and the weight and momentum of the fabrics being tumbled tend to cause the fabrics to fall from the upper area of the basket toward this lower right quadrant and thus contact the electrodes.

The automatic dry control relies on measuring the electrical conductivity or resistance of the materials being tumbled for determining the condition of dryness thereof. Electrodes 144 and 145 are therefore positioned for contact by the fabrics or materials being tumbled so that the fabrics may short between the electrodes. The control system for measuring this change in electrical conduc-
tivity includes the sensing circuit of FIGURE 3 and is supplied with conventional 110 volt 60 cycle alternating current between power lines L1 and L2. Electrodes 144 and 145 are connected electrically to the sensing circuit by lines 164 and 165 respectively. It is noted that the mounting of the conducting electrodes upon flange 77 of the non-rerovulable front wall 74 eliminates the need for relatively movable current-carrying members, such as arrangements which include slip rings and brushes.

It is understood, of course, that the program control timing device for sequencing this washer-drier through the various operations comprising a washing and/or drying operation is operative for controlling operation of the shredding circuit to a particular portion of the cycle of operations and specifically to the drying operation for determining the termination point.

The sensing circuit of FIGURE 3 includes a half-wave recifier 166 connected on one side to power line L1 and on the other side to resistor 169. Resistor 169 is in turn connected to one side of a capacitor 170 which is in turn connected to power line L4 through resistor 171. It will be noted that the electrodes 144 and 145 positioned within the drum 38 are connected across the capacitor 170 by lines 164 and 165.

A gaseous discharge tube, such as a neon lamp 174, is also connected across capacitor 170. Neon lamp 174 normally has an infinite resistance; however, when the charge on the capacitor 170 reaches a predetermined value, the gas is ionized and the circuit is conducted there-through to produce a visible discharge.

A light sensitive cell 175 is positioned to detect the discharge of neon lamp 174. One side of the light sensitive cell 175 is connected by line 176 to power line L4 and the other side of the light sensitive cell is connected to relay coil 179. The other side of relay coil 179 is connected to power line L4 through line 180. Normally, when dark, the light sensitive cell 175 has a very high resistance. However, when it detects light, its resistance is greatly reduced and completes the circuit to energize relay coil 179.

Relay coil 179 operates switches 181 and 184. Switch 181 completes a holding circuit in order to maintain relay coil 179 energized after visible discharge of neon lamp 174 terminates. Switch 184 energizes timer motor 185 to initiate operation of the program control device for terminating the drying operation.

During operation of the dry control device, the capa-
ctor 170 is slowly charged through resistors 169 and 171, but it is also discharged through electrodes 164 and 165 when the clothes are wet. However, when the clothes are dried, the average rate of discharge through the fabrics diminishes to the point at which the charge on the capacitor reaches an amount which will fire the neon tube 174. This operates the relay coil 179 through the photoelectric cell 175. Upon energization of relay coil 179, the program control device is initiated for terminating the operation or for proceeding into an auxiliary operation.

In order to prevent shorting between electrodes 144 and 145 upon contact by metallic objects, such as buttons, clips, and the like, means such as ridges 187 or barriers may be placed between the electrodes and protruding above the surface thereof to prevent simultaneous con-
tact of the electrodes by a metallic object. Ridges 187 are non-conductive by reason of a porcelain enamel finish, for example, and prevent shorting between the con-
ductors. These improved electrode structures offer distinct ad-
"vantagess when used with a combination washer-drier.

These stationary structures, in addition to having ad-
"vantagess as a result of the stationary feature, avoid or prevent the accumulation of lint and other foreign particles between the electrodes which would result in undesirable and inconsistent operation of the dry control sensing system during the drying operation. In addition, the substantially flush configuration of the electrodes upon the flange member insures the maintenance of clean electrodes because of the constant wiping action of the tumbling fabrics.

The improved electrodes and the improved means for mounting thereof may, of course, be used with a conven-
tional drying apparatus in which a single drum or clothes-containing member is used. In FIGURE 4 is shown a fragmentary sectional view of a drier adapted to utilize the electrodes of the instant invention. This view is sufficient to show the positioning of the electrodes on a non-reovable member and positioned for contact by the materials being tumbled; however, a complete disclosure and description of the drying apparatus em-
bodying this general construction is shown in U.S. Patent 2,958,136 entitled "Clothes Drier With Stationary Cowling" issued November 1, 1960, to Alfred T. Ashby and assigned to the assignee of the instant invention. This drier includes a drum 189 for tumbling the fabrics therein and further includes a short perforate front wall member 190. Juxtaposed to front wall member 190 and having a flange member 192 openly facing the interior of drum 189 is the stationary cowling member or shroud 191. Shroud 191 is attached to cabinet member 194 and defines an ac-
"cess opening 195 aligned with an access opening 196 in cabinet member 194 and covered by an access door 198. A heating element 199 is housed within shroud member 191 and is positioned for heating air entering the interior of drum 189.

Positioned on the shroud 191 is at least one pair of electrodes positioned for contact by the tumbling fabrics. These electrodes 200 and 201 may be connected to the sensing circuit by wires 202 for cooperating with the control circuit such as described hereinabove in determining the electrical condition of the materials being tumbled. These electrodes will of course be electrically insulated from cowling 191 by insulating members 204 placed between the cowling surface and the electrodes. In the drawings and specification there has been set forth a preferred embodiment of the invention and, al-
though specific terms are employed, these are used in a generic and descriptive sense only, and not for purposes of limitation. Changes in form and the proportion of parts, as well as the substitution of equivalents are con-
templated, as circumstances may suggest or render ex-
pedient, without departing from the spirit or scope of this invention as further defined in the following claims.

We claim:

1. In an apparatus for drying fabrics, the combination comprising: non-reolvable enclosure means; a revolving drum at least partially enclosed by said enclosure means and including first and second end wall members, said first end wall member defining an opening into said revolving drum; a non-reovable panel member attached to said en-
closure means and positioned in said opening opened facing the interior of said drum and positioned for effectively forming a non-reovable extension of said first revolving end wall member; access means for allowing in-
sertion of fabrics into the interior of said revolving drum; means for rotating said revolving drum to tumble said fabrics therein; means for drying said tumbled fabrics in said revolving drum; at least one pair of conductors associated with said non-reovable panel member elec-

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2. In an apparatus for drying fabrics, the combination comprising: a revoluble drum including an inwardly extending conical shaped first end wall member at one end thereof; a pivotally mounted non-revoluble casing at least partially enclosing said drum and having a panel member juxtaposed to the other end of said revoluble drum, said panel member having a generally annular portion positioned for effectivity forming at least a portion of a second end wall for said revoluble drum openly facing the interior thereof; access means for inserting fabrics into the interior of said revoluble drum; means for rotating said revoluble drum to tumble said fabrics therein, said rotating means and said inwardly extending conical shaped first end wall member being cooperative for tumbling said fabrics against said non-revoluble panel member; means for drying said tumbled fabrics in said revoluble drum; at least one pair of conductors associated with said non-revoluble panel member electrically insulated from each other and in a position for contact by said tumbled fabrics; and control means connected electrically to said conductors for terminating a drying operation responsive to a predetermined electrical condition of said fabrics effecting completion of a circuit between said conductors.

3. In an apparatus for drying fabrics, the combination comprising: a revoluble drum; a pivotally mounted non-revoluble casing at least partially enclosing said drum and having a panel member juxtaposed to one end of said revoluble drum openly facing the interior thereof, said panel member being positioned for effectivity forming at least a portion of an end wall for said revoluble drum; access means for inserting fabrics into the interior of said revoluble drum; means for rotating said revoluble drum in a predetermined direction; means for drying said fabrics in said revoluble drum; elevating means in said revoluble drum, said rotating means and said elevating means being cooperateable for moving said fabrics from a lower region in said drum to an upper region therein from which said fabrics fall toward a predetermined lower quadrant of said casing; at least one pair of conductors associated with said panel member, said conductors being positioned within said predetermined lower quadrant openly facing the interior of said drum for contact by said tumbled fabrics; and control means connected electrically to said conductors for terminating a drying operation responsive to a predetermined electrical condition between said conductors.

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WILLIAM F. O’DEA, Examiner.
D. A. TAMBURRO, Assistant Examiner.