

July 9, 1968

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3,391,468

CLOTHES DRYER WITH BULKHEAD SENSOR

Filed May 9, 1966

4 Sheets-Sheet 1

Fig. 1

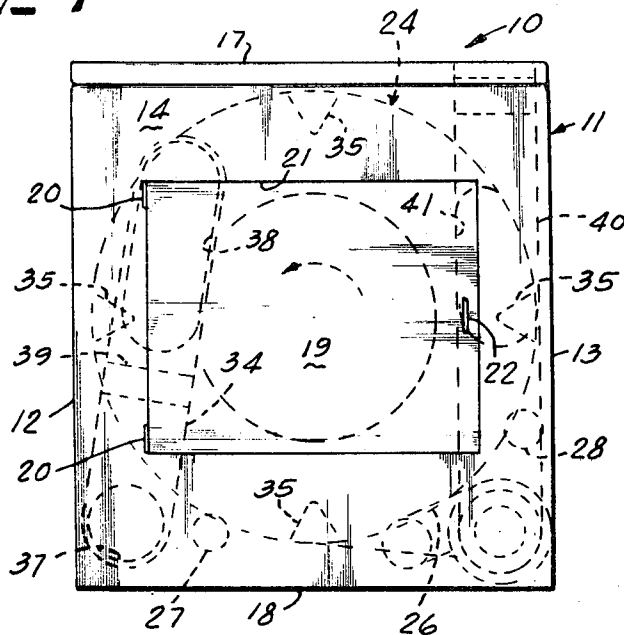
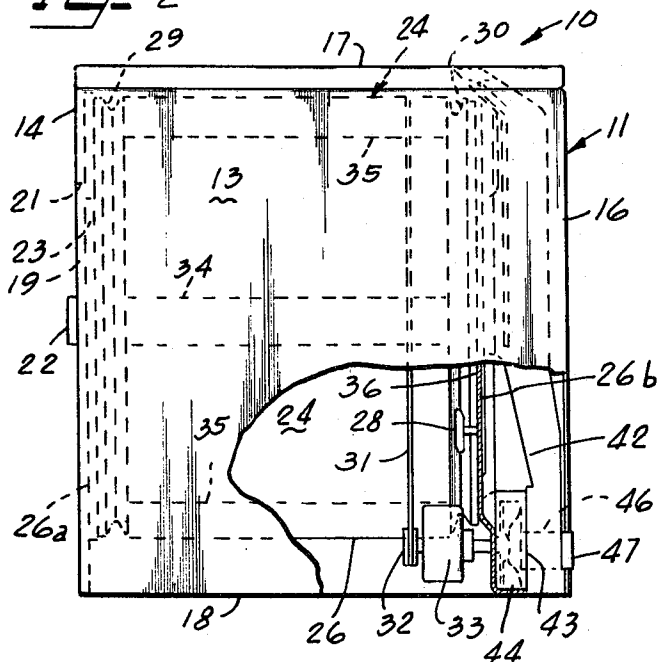


Fig. 2



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Fig-3

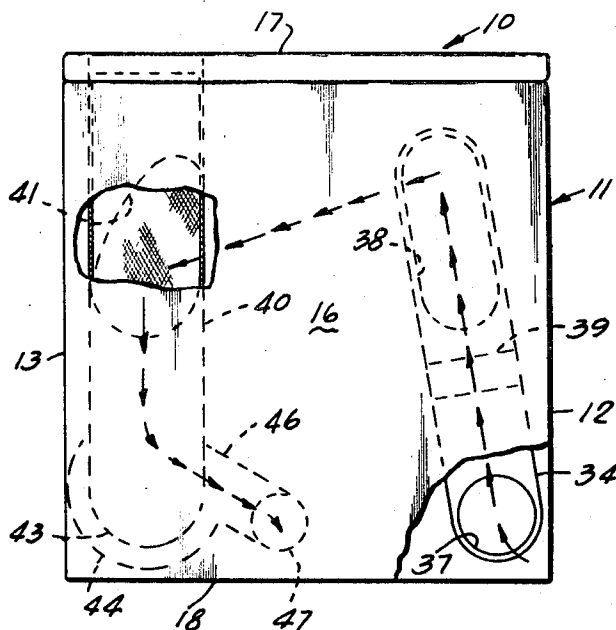


Fig-8

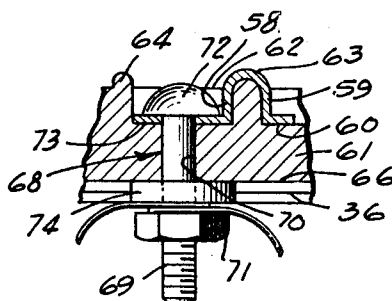
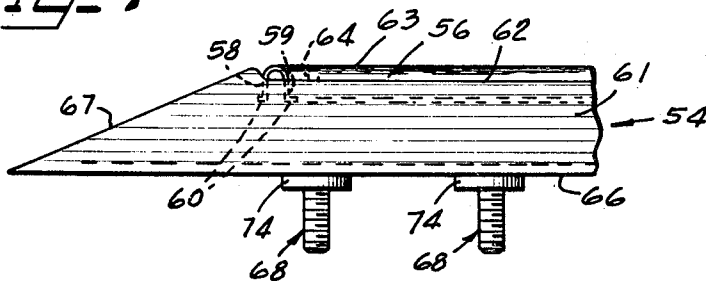


Fig-7



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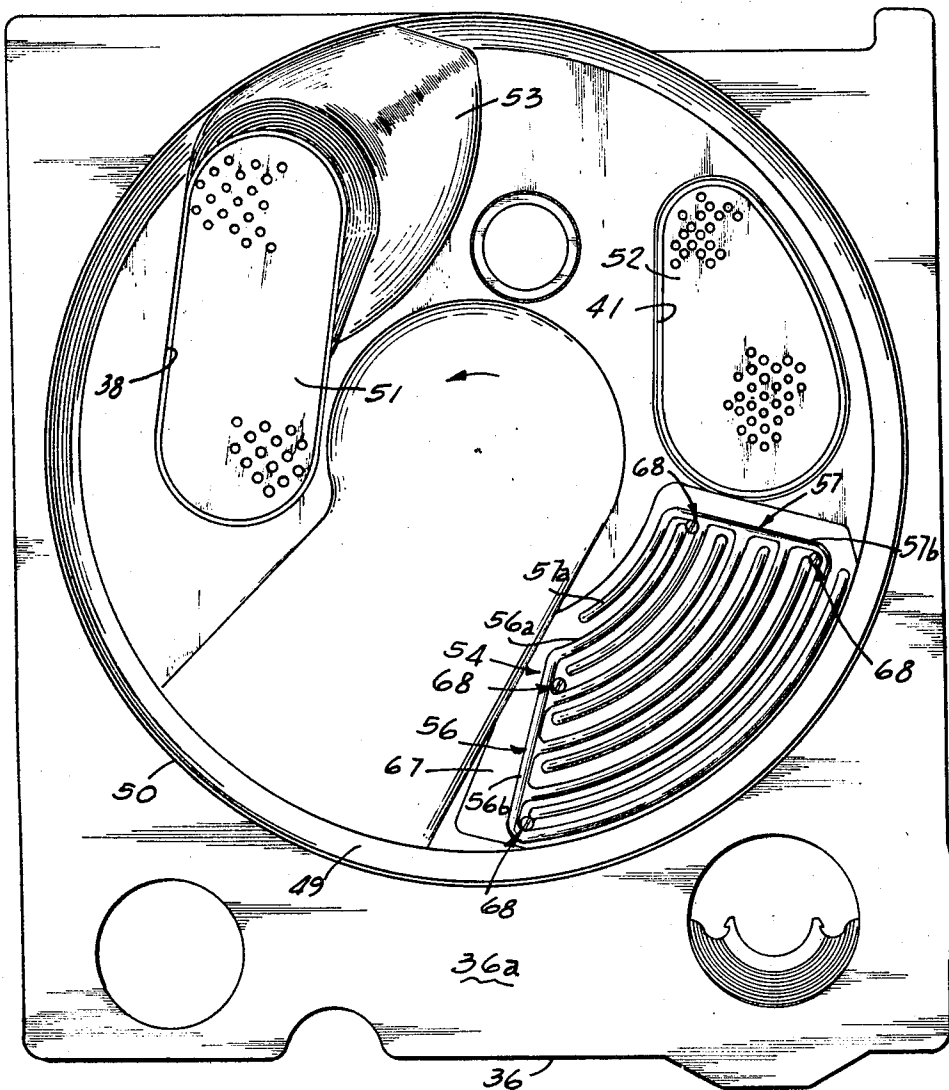
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Fig- 4



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Fig-5

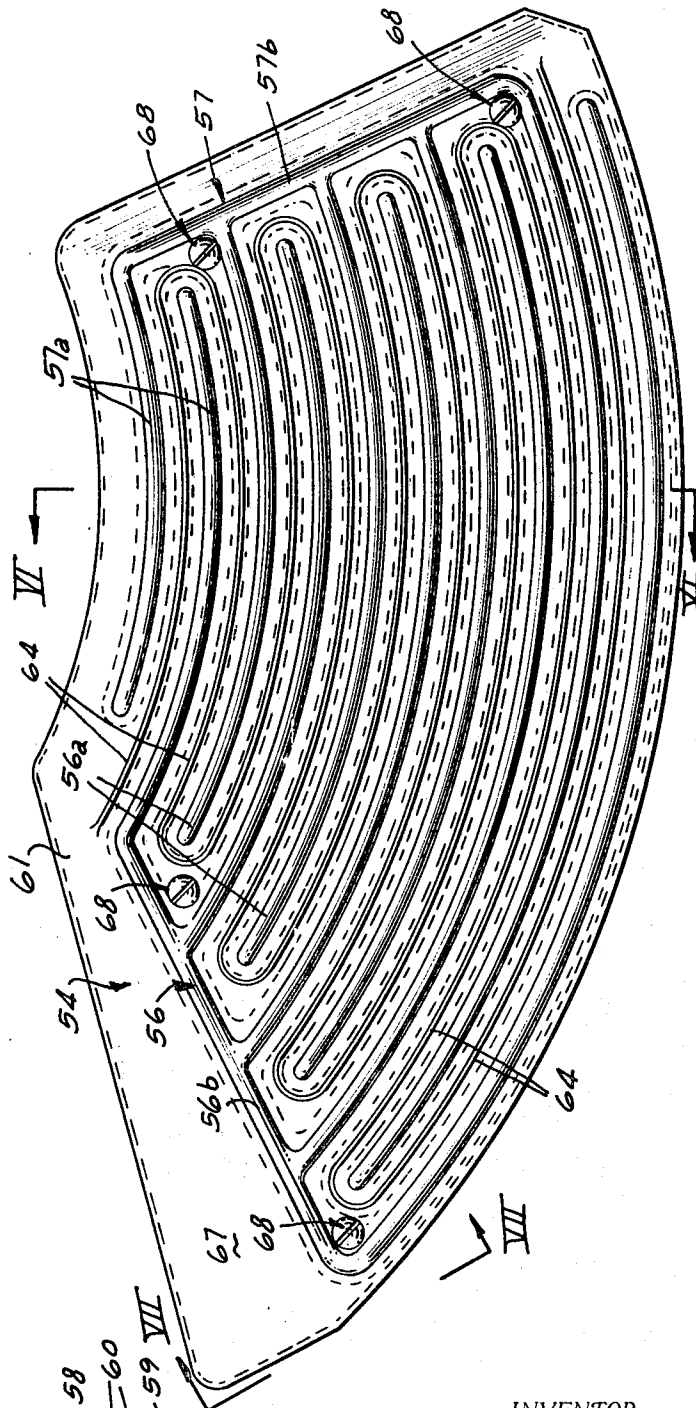
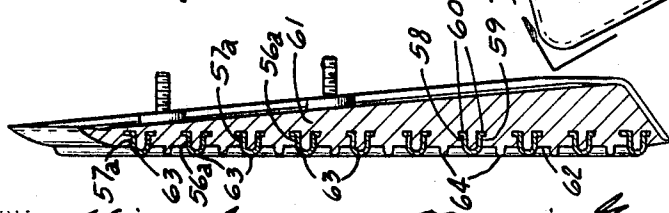


Fig-6



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CLOTHES DRYER WITH BULKHEAD SENSOR
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9 Claims. (Cl. 34—50)

ABSTRACT OF THE DISCLOSURE

A dryer including a rotating drum for receiving and tumbling the material to be dried, a stationary bulkhead closing one end of the drum and an air inlet and an air outlet formed in the bulkhead within the confines of the drum. The outlet is disposed with respect to the axis of the drum on the ascending side thereof, and below the outlet and mounted on the bulkhead is a wetness sensor for sensing the wetness of the material as it tumbles within the drum.

This invention relates generally to sensing control means for dryers and more particularly to a dryer of the type having a rotatable drum and wherein a digitated stationary electrode for sensing the wetness of the tumbling material is engaged by the tumbling materials in the drum.

It is, therefore, an object of the invention to provide improved means for sensing the wetness of material in a dryer.

Another object of the invention is to provide, in a dryer having a rotatable drum, means for sensing the wetness of material tumbling within the drum comprising a plurality of electrodes engageable with the tumbling material and spaced from one another to provide one or more gaps which can be bridged by the tumbling material, the electrodes being stationarily mounted to obviate commutation problems inherent in movable sensor arrangements.

Another object of the invention is to provide means for improving the engageability of the tumbling material with the wetness sensor.

Another object of the invention is to provide a stationary bulkhead for closing an open end of a drum and for mounting the wetness sensor on the stationary bulkhead.

Another object of the invention is to provide air moving means for moving air through the drum and an air outlet formed in the stationary bulkhead and located with respect to the wetness sensor so that the air moving through the air outlet tends to urge material tumbling in the drum into engagement with the sensor.

Still another object of the invention is to sense a condition of moving material by providing a sensor comprising a pair of electrodes each having one or more spaced fingers extending in a generally common direction and in interdigital spaced relation with the corresponding fingers of the other electrode to provide gaps between adjacent fingers of the electrodes bridgeable by the moving material, whereby the total effective sensing is increased for improved sensing of the condition of the material.

Many other features, advantages 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 preferred structural embodiments incorporating the principles of the present invention are shown by way of illustrative example only.

On the drawings:

FIGURE 1 is a front elevational view of a dryer incorporating the principles of the present invention;

FIGURE 2 is a side elevational view of the dryer of

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FIGURE 1 with a side wall partially broken away to show the relative disposition of parts;

FIGURE 3 is a rear elevational view of the dryer of FIGURE 1 with a back panel partially broken away;

FIGURE 4 is a front elevational view of a stationary bulkhead of the dryer of FIGURE 1 having a sensor assembly of the present invention mounted thereon;

FIGURE 5 is an enlarged front elevational view of the sensor assembly shown in FIGURE 4;

FIGURE 6 is a vertical sectional view of the sensor assembly taken along lines VI—VI of FIGURE 5;

FIGURE 7 is an enlarged fragmentary side elevational view of the sensor assembly taken along lines VII—VII of FIGURE 5; and

FIGURE 8 is an enlarged partial cross-sectional view of the sensor to illustrate the mounting arrangement thereof.

As shown on the drawings:

Although the principles of the present invention are of utility in any dryer construction, a particularly useful application is made to dryers for fabrics and the like and an illustrative embodiment herein shown consists of a domestic clothes dryer.

Referring to FIGURES 1—3, a dryer is indicated generally at 10 and comprises a cabinet 11 having a pair of vertical side panels 12 and 13, vertical front and rear panels 14 and 16 and horizontal top and bottom panels 17 and 18.

In order to load and unload the dryer an access or closure door 19 is swingably mounted by means of hinges 20, 20 in a complementarily shaped recessed portion 21 of the front panel 14 and a handle 22 is mounted on the door 19 to facilitate the opening and closing of the door. Also formed in the front panel 14 is a centrally located access opening 23 for loading and unloading of the dryer 10.

Housed within the cabinet 11 for receiving the fabrics to be dried is a horizontally disposed receptacle or drying drum 24 extending axially between the front and rear panels 14 and 16 in concentric relation with the access opening 23. The drum 24 comprises a cylindrical side wall 26 extending from one end 26a to an opposite end 26b and may be made of perforate or imperforate sheet-form material. The drum 24 is mounted for rotation about its longitudinal axis in order to provide a tumbling action to the material loaded therein.

In the illustrated embodiment the direction of rotation of the drum 24 is counterclockwise when viewing the drum from the front thereof as shown in FIGURE 1 and supporting the drum for rotation are a plurality of rollers as at 27 and 28 rotatably mounted within the cabinet 11 and riding in axially spaced track means or grooves 29 and 30 formed in the peripheral wall 26 of the drum 24. The drum is rotated by means of a continuous belt 31 wrapped around the cylindrical wall 26 and a sheave or pulley 32 driven by suitable means such as an electric motor 33. A plurality of circumferentially spaced baffle members 35 are formed on the inside of cylindrical wall 26 in order to enhance the tumbling action of the dryer 10.

The fabrics which tumble within the drum 24 are dried by a warm air system or air translation means housed within the cabinet 11 and including an air tempering duct 34 extending substantially vertically between the rear panel 16 and a stationary end wall or bulkhead 36 which abuts and closes the rear end 26b of the drum 24. An air supply opening 37 is formed at the lower end of duct 34 to communicate with air outside of the cabinet and the bulkhead 36 has a warm air inlet opening 38 formed therein in communication with the upper end of the duct 34 to circulate warm air from the duct 34 into the interior of the drum 24. Suitable air heat-

ing means such as an electric heater 39 is mounted in the duct 34 between the air supply opening 37 and the opening 38 in order to heat the air to the desired temperature.

Also disposed in the space between the rear panel 16 and the bulkhead 36 and comprising a part of the air translation means is a vertical air discharge duct 40 which extends in substantially the entire height of the cabinet 11. An air exhaust opening 41 is formed in the bulkhead 36 in communication with the upper end of duct 40 for discharging the air from the drum 24 and a lower portion 42 of the duct 40 is connected at 43 to the inlet of an air blower 44. A short branch duct 46 (FIGURE 3) is connected to the outlet of the blower 44 and to an opening 47 which opens to the rear panel 16 of the cabinet 11.

As shown diagrammatically by the arrows in FIGURE 3, the air blower 44 circulates air from outside the cabinet 11 into the air supply opening 37, then through the duct 34 across the heater 39, then out inlet opening 38 into the drum 24, then out of the drum 24 into the air exhaust opening 41, then through duct 40 to the air blower 44 and then through duct 46 to the air discharge outlet 47.

Referring to FIGURE 4, an inner side 36a of the bulkhead 36 which confronts the rear end 26b of the drum 24 has formed thereon a circular embossment 49 having a groove 50 for receiving the cylindrical wall 26 of the drum 24 in sealing abutting engagement. As noted, the air inlet opening 38 and the air exhaust opening 41 formed in the bulkhead 36 are within the confines of the drum 24 and are generally adjacent the periphery thereof. A pair of perforated grills 51 and 52 are formed in the bulkhead 36 to extend across openings 38 and 41, respectively.

During a drying operation the drum 24 is rotated at a tumbling speed sufficient to prevent the fabrics within the drum from merely rolling over at the bottom of the drum but not so great as to form an annulus of the fabrics along the inner periphery of the drum wall 26.

In order to increase the efficiency of the drying operation a baffle 53 is formed on the bulkhead 36 on the oncoming side of the air inlet opening 38. At tumbling speed, the baffle 53 urges the tumbling fabrics away from the opening 38 to allow the warm air to enter the drum 24 before it comes into contact with the fabrics. The baffle 53 also tends to "open up" the fabrics whereby the warm air is brought into greater contact with it, thereby increasing the efficiency of and reducing the time required for the drying operation.

In accordance with the principles of the present invention, means are provided for sensing the wetness of the tumbling fabrics, that is, the amount of moisture remaining in the fabrics. The wetness sensor of this invention comprises a pair of electrodes stationarily situated within the confines of the drum 24 and openly engageable with the fabrics tumbling therein. As the fabrics temporarily bridge the gap between the two stationary electrodes, the amount of moisture in the fabrics is sensed as a function of the electrical conductivity in a control circuit of which the electrodes and the fabrics constitute a part.

The problems in commutation normally inherent in an electrical arrangement wherein rotating contact or electrode members are connected in circuitry with stationary conductors are completely eliminated by this invention since the utilization of stationary electrodes permits the electrodes to be connected in fixed assembly with their respective electrical conductors.

An illustrative wetness sensor assembly constructed in accordance with the principles of this invention is indicated generally at 54 and is securely fastened to the inner face 36a of the stationary bulkhead 36.

It will be appreciated that until all of the fabrics in the drum 24 are completely dried the degree of wetness of the material may not be uniform throughout the entire

load. The two electrodes of the sensor assembly 54 afford a greatly increased effective sensing area which is exposed to and engageable with the fabrics in the drum 24, thereby improving the operation of the sensor.

The sensor assembly 54 is characterized as comprising a pair of electrodes 56 and 57 each of which comprises a plurality of elongated fingers 56a and 57a. Fingers 56a are spaced substantially at equal distance from one another and fingers 57a extend in a generally opposite direction and are also spaced from one another to be disposed in interdigital relation with fingers 56a.

The fingers of each of the electrodes 56 and 57 are interconnected by an electrically conductive transverse linkage or body member as at 56b and 57b. The resultant configuration of the assembly 54 including the interdigital relation of the fingers of each electrode forms an enlarged sensor area which is coextensive with the area covered by the interdigitated fingers. The electrodes 56 and 57 are conveniently connected to a pair of stationary electrical conductors extending through the stationary bulkhead 36.

The electrodes 56 and 57 may constitute similar complementary parts.

Referring to FIGURES 5-8, the fingers 56a and 57a of the illustrated embodiment extend along their longitudinal axis substantially on concentric arcs of radially spaced circles having a common center on the axis of rotation of the drum 24. In cross-section each of the fingers comprises a pair of spaced parallel side walls 58 and 59 which terminate at outturned flanges as at 60.

The electrodes 56 and 57 are embedded in a mounting bracket or insulator 61 which is made of non-conductive material to insulate the electrodes from each other and from the bulkhead 36. The side walls 58 and 59 and the outturned flanges 60 of each of the fingers 56a and 57a extend into the bracket 61 from a front face 62 thereof, and a curved end wall 63 of each of the fingers interconnects the side walls 58 and 59 and projects outwardly from the face 62. The end walls 63 provide fabric engaging and sensing surfaces which reside in a common plane as seen in FIGURE 6.

The exposed portions of adjacent fingers of the electrodes 56 and 57 are separated from each other by the formation of a plurality of raised ridges or insulator members 64 which extend in a serpentine fashion back and forth on the front face 62 of the bracket 61. In the illustrated embodiment the ridges 64 are formed integrally with the bracket 61 and it should be noted that the outermost surfaces of the ridges 64 reside in the same plane in which the outermost surfaces of the end walls 63 reside.

In order to facilitate engagement of the fabrics within the drum 24 with the exposed portions of the fingers of the electrodes 56 and 57 a rear face 66 of the bracket 61 which abuts the inner face 36a of the bulkhead 36 slopes downwardly away from the front face 62. Thus, in the assembled position of the bracket 61 on the bulkhead 36, the fingers 56a and 57a are disposed in a plane sloping downwardly away from the bulkhead and into the interior of the drum. As the fabrics tumbling in the drum are moved across the front face 62 of the bracket 61 more of the surfaces of the material will engage the exposed sensing surfaces 63 of most or all of the fingers 56a and 57a across the entire face of the bracket 61. A leading edge 67 of the bracket 61 is sloped outwardly toward the face 62 and in the direction of rotation of the drum 24 to provide a ramp for the fabrics as they approach the face 62, as shown in FIGURES 5 and 7.

The sensor assembly 54 is positioned subjacent the air outlet opening 41 on the inner face 36a of the bulkhead on the ascending side thereof with respect to the direction of rotation of the drum 24. That location is optimum in that a greater quantity of fabrics within the drum 24 engages the electrodes 56 and 57 in this position than in other locations on the bulkhead 36. This is attributable

in part to the fact that in the lower quadrant of the ascending side of the drum 24 the movement of the fabrics within the drum is essentially rotational, and also to the fact that the air directed towards the air outlet opening 41 tends to bias the tumbling fabrics in the drum in the direction of the opening and thus toward the sensor assembly 54.

The assembly 54 is securely and stationarily connected to the bulkhead 36 by means of a plurality of bolts or other suitable fastening devices 68. In the illustrated embodiment a threaded shank portion 69 of each of the bolts 68 extends through a bore 70 formed in the bracket 61 and through a registered opening in the bulkhead 36 and receives a threaded nut 71. An enlarged head 72 formed at one end of the shank 69 overlies an extension 73 of one of the electrodes 56 and 57. The bolts 68 can be suitably insulated from the bulkhead 36 by means of insulating washers 74 or the like so as to receive a similarly stationary electrical conductor to energize its respective electrode, and in this regard it will be understood that each of the bolts 68 is in electrical contact with only one of the electrodes 56 and 57.

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

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

1. In a clothes dryer, a cabinet; a rotatable drum having a cylindrical peripheral wall defining a drying cavity for receiving fabrics to be dried, said drum having at least one open end; a stationary bulkhead in said cabinet confronting the open end of said drum to form a closure for said open end; a motor for rotating said drum to tumble the fabrics; heating means for drying the fabrics in said drum; sensing means for controlling the operation of said dryer including a pair of electrodes mounted on said stationary bulkhead, openly facing said drying cavity, and positioned to make contact with the tumbling fabrics for sensing the electrical conductivity thereof; air outlet means in said bulkhead located within the confines of said peripheral wall; air inlet means directly communicating with said drying cavity; and air translation means for moving air through said air inlet means, into said drying cavity and outwardly through said air outlet means whereby the moving air urges the tumbling fabrics against said sensing means.

2. The apparatus of claim 1 wherein said sensing means is located subjacent said air outlet means.

3. The apparatus of claim 1 wherein said pair of electrodes are disposed in a plane sloping away from said stationary bulkhead to thereby project into said drum for improved contact with the tumbling fabrics.

4. A dryer comprising:

a rotatable drum for tumbling fabric therein,
a stationary bulkhead closing one end of said drum,
means for rotating said drum in one direction of rotation,

means on said bulkhead defining an air exhaust opening communicating with the interior of said drum,
air translation means for moving air out of said drum through said exhaust opening,

a pair of electrodes, and

means mounting said electrodes stationarily on said bulkhead,

said electrode mounting means being positioned on said bulkhead on the oncoming side of said exhaust opening with respect to the direction of rotation of said drum.

5. The dryer as defined in claim 4 wherein said air exhaust opening and said electrodes are situated on the ascending side of said bulkhead with respect to the direction of rotation of said drum.

6. The dryer as defined in claim 5 wherein said air outlet is situated adjacent the periphery of said drum.

7. A dryer comprising:

a rotatable drum for tumbling fabric therein,
a stationary bulkhead closing one end of said drum,
and

means for sensing the wetness of the fabric tumbling within said drum comprising:

a plurality of electrodes on said bulkhead within the confines of said drum,

said electrodes being disposed with respect to the axis of rotation of said drum on the ascending side of said drum.

8. The dryer as defined in claim 7 wherein said electrodes are disposed on said bulkhead substantially within the lower ascending quadrant of said drum.

9. The dryer as defined in claim 7 and including:

air inlet means for introducing drying air into said drum, and

air outlet means in said bulkhead adjacent said electrodes whereby the fabric is urged in the direction of said electrodes by movement of air through said drum between said air inlet means and said air outlet means.

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