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MOISTURE-RESPONSIVE CONTROL AND METHOD FOR
OPERATING COMBINATION WASHER-DRYER
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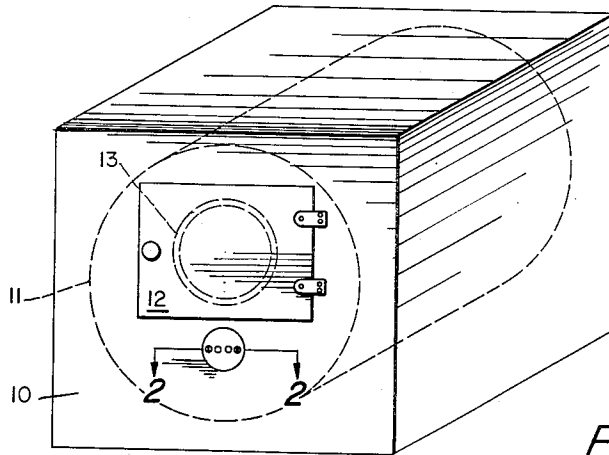


Fig. 1

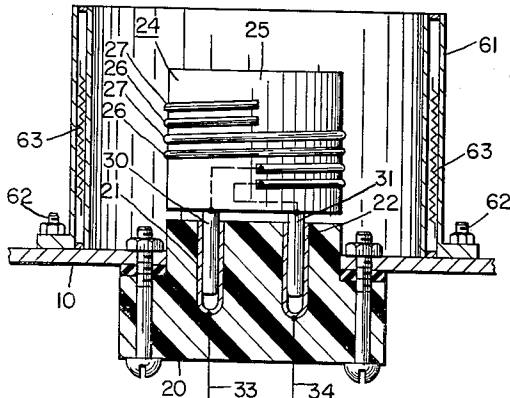


Fig. 2

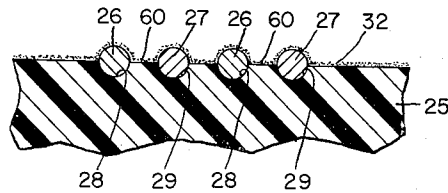


Fig. 3

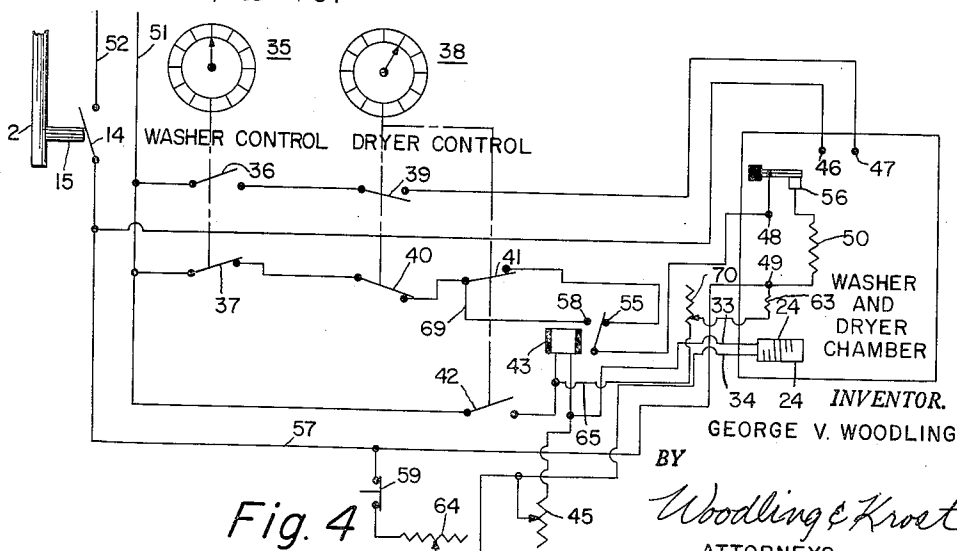


Fig. 4

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MOISTURE-RESPONSIVE CONTROL AND METHOD FOR OPERATING COMBINATION WASHER-DRYER

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2 Claims. (Cl. 68—20)

This invention relates to moisture-responsive controls and more particularly to a moisture-responsive control and method for operating combination washer-dryers.

An object of this invention is to provide a moisture-responsive control and method for operating combination washer-dryers which is free from defective operation resulting from lint, scum or other matter to which the moisture-responsive control is exposed.

Another object of the invention is the provision of a moisture-responsive control and method which utilizes the detergent used for washing to aid in conducting current between spaced insulated conductors of the moisture-responsive control.

Another object of the invention is the provision of insulating means upon which the spaced conductors of the moisture-responsive control are mounted, said insulating means cooperating with the detergent to provide for conducting current between the spaced conductors in response to moisture.

Another object of the invention is the provision of moisture-responsive circuit means which, when once exposed to a detergent such as used in washing clothes, remains operative even though the detergent has been rinsed off the moisture-responsive means.

Another object is to provide for delaying the operation of the moisture-responsive control until the drying chamber has been under operation for a predetermined period of time, so as to dry the wash water or rinse water off the moisture-responsive means before it is energized.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing, in which:

FIGURE 1 is an isometric view of a combination washer-dryer unit showing the front of the unit;

FIGURE 2 is a cross-sectional view of FIGURE 1 taken along the line 2—2 and showing principally the moisture-responsive control means;

FIGURE 3 is an enlarged cross-sectional view of the moisture-responsive means showing principally the insulation means and the spaced conductors mounted thereon; and

FIGURE 4 is a diagrammatic view of the control circuits for the combination washer-dryer unit.

With reference to the drawing, the combination washer-dryer unit is designated by the reference character 10 and has a common washing and drying chamber with a tumbler 11 mounted therein. The tumbler 11 is used both for the washing operation and the drying operation. The front of the chamber is provided with a door 12 through which the clothes are inserted into and withdrawn from the chamber. A sealing gasket 13 is employed to seal the chamber when the door is closed.

As diagrammatically shown in FIGURE 4, the door 12 operates a door switch 14 by means of a door plunger 15 so that when the door is open the electrical circuit for controlling the combination washer-dryer is de-energized for safety purposes. Upon closing the door, the plunger 15 operates the door switch 14 for energizing the circuit for both the washing cycle and the drying cycle.

Mounted below the door and extending into the chamber is a terminal receptacle or socket 20 which has two receptacles 21 and 22. The receptacles 21 and 22 are

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electrically connected by conductors 33 and 34 to the control circuit for the dryer. The reference character 24 represents moisture-responsive circuit means which has two terminal pins 30 and 31 adapted to removably fit in the receptacles 21 and 22, respectively, very much the same as an ordinary plug and socket.

The moisture-responsive circuit means 24 comprises an insulating member 25 and at least two spaced conductors 26 and 27 wrapped therearound in spaced grooves 28 and 29, respectively (see FIGURE 3). The entire moisture-responsive circuit means 24 may be removably plugged into the receptacles 21 and 22. The spaced conductor 26 is electrically connected to the terminal pin 31 and the spaced conductor 27 is electrically connected to the terminal pin 30 so that in operation an electrical potential exists between the spaced conductors 26 and 27.

In FIGURE 4, terminals 46 and 47, which are connected to the electric motor, valves, and other equipment for performing the washing operation, are controlled by a washer control 35. The terminals 48 and 49, which are connected to the electric motor and the electric heater for performing the drying operation, are controlled by a dryer control 38. The washer control 35 is adapted to operate two switches 36 and 37. The dryer control 38 is first adapted to operate two switches 39 and 40, and subsequently adapted to operate two switches 41 and 42. The switch 37 of the washer control may be characterized as an interlocking switch so that when the washer switch 36 is closed, the interlocking switch 37 is open and the dryer circuit is inoperative. Likewise the switch 39 of the dryer control may be characterized as an interlocking switch so that when the dryer switch 40 is closed, the interlocking switch 39 is open and the washer circuit is inoperative. The heater for the drying operation is designated by the reference character 50 and is connected across the dryer terminals 48 and 49. The electric motor for operating the tumbler 11 and other parts of the combination washer-dryer unit are not shown but the arrangement of the parts will be in accordance with standard practice.

The duration of the washing cycle is governed by the washer control 35 and when the cycle is finished, the switch 36 is opened by the washer control 35 for stopping the washing operation. At the same time, the switch 36 is open, the interlocking switch 37 is closed so that the drying cycle may be initiated. Upon initiation of the drying cycle, current flows from the supply line 51 through closed contacts 37, 40, 41 and 55 to the dryer terminal 48, and from there the current flows through heater 50 to the dryer terminal 49 and then through conductor 57 and the door switch 14 to the other supply line 52. After a predetermined time, preferably from five to ten minutes, after the drying cycle is initiated, the dryer control opens the switch 41 and closes the switch 42. This introduces the moisture-responsive means 24 into the dryer circuit. The conduction of current between the spaced conductors 26 and 27 energizes the relay 43 and opens the contact 55 and closes the contact 58 which establishes a circuit through conductor 69 for by-passing the contact 41. The current for energizing the heater 50, now flows through conductor 69 and relay contact 58, to the dryer terminal 48. The operation of the moisture-responsive means 24 is delayed until the drying chamber has been under operation for a predetermined period of time, so as to dry the wash water or rinse water off the moisture-responsive means before it is energized. Except as modified by the moisture-responsive means 24, the drying cycle continues in operation until the dryer control 38 reaches the end of its setting, at which time the switch 40 is opened and the switch 39 is closed, and the switch 41 is closed and the switch 42 is opened. The opening of the switch 40 interrupts the dryer circuit for

stopping the drying operation and the closing of the switch 39 re-establishes the circuit for the washer control 35.

In this invention, the duration of the drying cycle as governed by the dryer control 38, may be foreshortened by the operation of the moisture-responsive control means 24. In other words, in the event that the moisture within the drying chamber reaches a predetermined dry condition, the relay 43 becomes deenergized, which opens the contact 58 for arresting the drying operation, even though the contact 55 is re-closed, since contact 41 is now open. So long as the moisture within the drying chamber is above a predetermined value, the contact 58 of the relay 43 remains closed. The setting of the moisture value at which the relay switch 58 opens may be regulated by rheostats 45 and 64. The moisture-responsive means 24 may be removed from the circuit by the opening of a push-button switch 59.

During the washing cycle, the moisture-responsive control means 24 is located so that it is preferably immersed below the level of the washing water. In this manner, the moisture-responsive control means 24 is continually washed and rendered clean by the washing operation. As an alternative, the moisture-responsive control means 24 may be mounted above the level of the wash water so long as it is continually washed and splashed by the wash water to keep it clean. In either event, the moisture-responsive control means 24 is exposed to the washing detergent during the washing cycle to keep it clean. That is to say, the moisture-responsive control means 24 is preferably located where it is either immersed below the level of the water or where it can be splashed by the water to keep it clean. At the conclusion of the washing operation, the wash water is drained from the chamber and the drying operation is initiated. Since the moisture-responsive means 24 is not connected into the circuit until after the chamber becomes heated for about 5 to 10 minutes, the surfaces of the moisture-responsive means 24 is rendered dry from the washing or rinse water before it is energized.

The drying of the previously wet moisture-responsive control means 24 causes the unit to become coated by a detergent film, indicated in FIGURE 3 by the reference character 32, with the result that the insulated space 60 between the spaced conductors 26 and 27 becomes electrically conductive in response to moisture in the drying chamber. In the early stages of the drying operation, when the air is heavily laden with moisture, the conducting of the current between the spaced conductors 26 and 27 is sufficient to energize the relay 43 for keeping the contact 58 thereof closed. As the clothes become dryer during the drying cycle, the detergent coating on the moisture-responsive control means becomes less electrically conductive until a point is reached where the flow of the current between the spaced conductors 26 and 27 is insufficient to hold the contact 58 closed, in which case the drying operation is arrested.

Even though the detergent coating may be washed off the moisture-responsive control means during the rinsing operation, still it remains operative to conduct current between the spaced conductors 26 and 27. While this is true, the applicant does not fully understand the reason therefor. It appears that possibly the detergent during the washing operation may affect the insulating means 25 so that even though the detergent coating appears to have been completely washed off of the insulating member by the rinsing operation, the surface of the insulating member still remains electrically conductive in response to the moisture in the drying chamber. It appears when the relative humidity of the atmosphere in the drying chamber is above 35 or 40%, the conductive response is substantially uniform to hold the relay contact 58 closed, but that when the relative humidity drops below 35%, the conductive response sharply drops so that for low values of moisture, the relay 43 is readily de-energized. The

setting at which the relay 43 becomes de-energized may be adjusted by the rheostats 45 and 64. A thermostat switch 56 keeps the temperature in the chamber at a proper temperature depending upon the setting of the thermostat.

This application is copending with my application Serial No. 727,490 filed April 9, 1958, entitled "Moisture-Responsive Device" and copending with my application Serial No. 749,854 filed July 21, 1958, entitled "Temperature and Moisture Control Device," and the disclosures of these two prior applications are embodied in this application the same as though they were actually incorporated herein.

The coating 32 is very thin and is ordinarily not observable with the naked eye. I find that if a detergent comprising material consisting of ion hydrolyte agents and sulphonated fatty agents is satisfactory. The ion hydrolyte agents may be of the anion type or a cation type. The sulphonated fatty agents may be sulphonated fatty alcohols or sulphonated fatty acids. I find that a product sold under the trademark "FAB" is satisfactory as the detergent mentioned herein. Other detergents are equally effective.

The insulating member 25 may preferably be made of non-current-conducting plastic and may include cellulose butyrate and styrene. However, it is understood that many types of plastics or any other suitable material, such as glass, Pyrex, rubber and vinyl products may be used. The material used may be either thermoplastic or thermosetting.

It appears that the molecular structure of the cellulose butyrate is such that the molecules of the detergent are permitted to migrate into the plastic itself, thus even if the detergent is washed or rinsed off or removed, a thin coating of the detergent will still be ingrained in the cellulose butyrate. Thus, the longer the detergent is left on the cellulose butyrate, the more will migrate into the cellulose butyrate. Therefore, the moisture-responsive control means never loses its moisture-measuring properties.

Some of the thermoplastic plastics that may be embodied in the invention are polyvinyl chloride, polyvinyl acetate, polyvinyl butyral, polystyrene, methyl methacrylate, polyethylene, and cellulose acetate.

Some of the thermosetting plastics that may be embodied in my invention include unsaturated polyester resins. A typical example of such polyester is a product prepared by the reaction of an unsaturated dicarboxylic acid such as maleic, fumaric, itaconic, citraconic or mesaconic acid, maleic anhydride is also widely used, with a dihydric alcohol such as any polymethylene glycol in the series from ethylene glycol to decamethylene glycol, propylene glycol, any butylene glycol, any polyethylene glycol in the series from diethylene glycol to nonaethylene glycol, dipropylene glycol, any glycerol monobasic acid monester (in either the alpha or beta position), such as monoformin or monoacetin, any monether or glycerol with a monohydric alcohol, such as monomethylin or monoethylin or any dihydroxy alkane in which the hydroxy radicals are attached to the carbon atoms that are primary or secondary or both, in the series from dihydroxy butane to dihydroxy decane. It is understood that any thermosetting or thermoplastics may be used and the type of plastics mentioned above are only examples.

In this invention, the washing and rinsing operation keeps the moisture-responsive unit free from lint, scum and the like so that throughout the years it has uniform sensitivity.

The spacing between the two conductors 26 and 27 may preferably range from about .020 to .040 inches. The closer the spacing the greater the sensitivity. The spaced conductors 26 and 27 may be of any suitable length to give the required performance. The conductors 26 and 27 extend above the insulated member 25 and

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protect the detergent film on the insulated space 60 from wearing off by rubbing clothes.

The invention may be applied to those dryers which have no heaters for heating the air, but use air which is circulated through the dryer to dry the clothes. In either case air is employed as the drying medium and the air in the chamber becomes moisture laden when the clothes are being dried.

The moisture-responsive means may be used with a washer and dryer which have separate chambers. In this case the moisture-responsive means 24 may be removed from the dryer and placed in the separate washer chamber and allowed to be agitated in the detergent water along with the clothes. When the washing is finished, the moisture-responsive means is re-mounted in the dryer chamber, and it will operate for controlling the drying action in accordance with method as previously explained herein.

In some dryers, particularly those which use a cold jet of water to condense the moisture in the air in the chamber to remove the heat, the moisture-responsive means 24 may be supplied with local heat means to aid in drying the detergent film. The local heat means may be of any suitable construction and may comprise a shell heater 61 suitably fastened by screws 62 welded to the inside wall of the chamber. A resistor 63 may be mounted inside the shell 61 and electrically energized by a conductor 65 and the terminal 49. The resistor 63 becomes energized when the contact 42 is closed. The shell heater may be hermetically sealed in accordance with standard practice and may be constructed like a "Calrod" heater element but in shell form to surround the moisture-responsive means 24. In fact a "Calrod" heater, in elongated element form, may be coiled in a helix around the moisture-responsive means 24 and thus dispense with the shell form. The temperature of the heater 61 may be adjusted by a resistor 70 and may be preferably maintained at a temperature slightly about that of the temperature in the drying chamber to aid in drying the detergent film. As an alternative, the inside of the insulating member 24 may be made hollow with a "Calrod" unit mounted inside of the hollow insulating member 24 to dry the surface 60 and the detergent thereon between the conductors 26 and 27.

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Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. A moisture responsive control for a washer-dryer combination having a common washing and drying chamber used both for a washing and drying cycle, operating circuit means including heating means for heating said chamber to effect a drying action, circuit control means for controlling said operating circuit means to thereby control said drying action in said chamber during said drying cycle, moisture responsive circuit means in said chamber and exposed to a washing detergent during the washing cycle and exposed to moisture laden air during the drying cycle, circuit connection means connecting said moisture responsive circuit means to said circuit control means and thereby controlling the operation of said dryer in accordance with the moisture in said chamber, said moisture responsive circuit means comprising electrical insulation means and at least two spaced conductors thereon between which current flows, said insulation means between said conductors comprising a smooth lint-free surface and circuit means to delay the operation of the moisture responsive means until after the drying action has been in operation for a predetermined interval of time, whereby detergent deposited on said lint-free surface may become dried to the extent of being ready for operation before energization.
2. A moisture-responsive control as claimed in claim 1, whereby said moisture-responsive control includes local heater means to heat said lint-free surface independently of said heating means.

References Cited in the file of this patent

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