Dec. 18, 1962 F. H. RICHTERKESSING ET AL 3,068,588

CLOTHES DRYER HAVING IMPROVED SAFETY CONTROLS

Filed Oct. 12, 1959 4 Sheets-Sheet 1

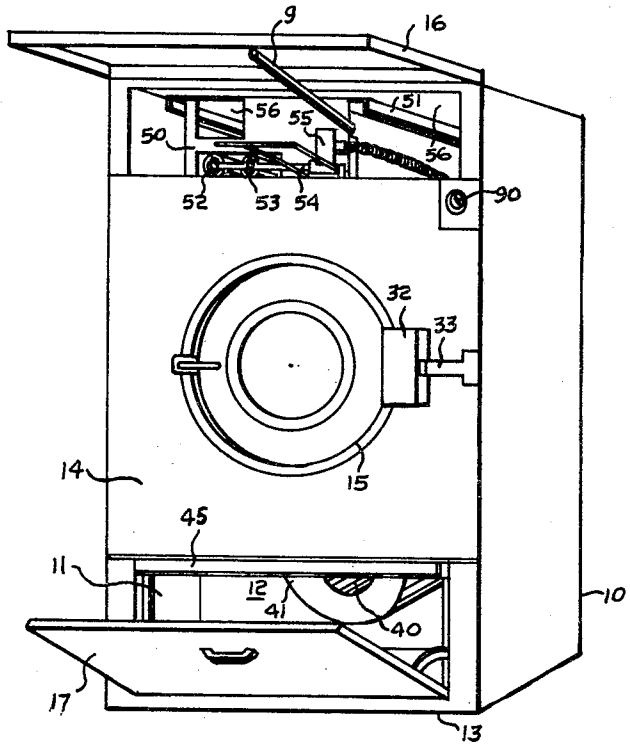


FIG. 1

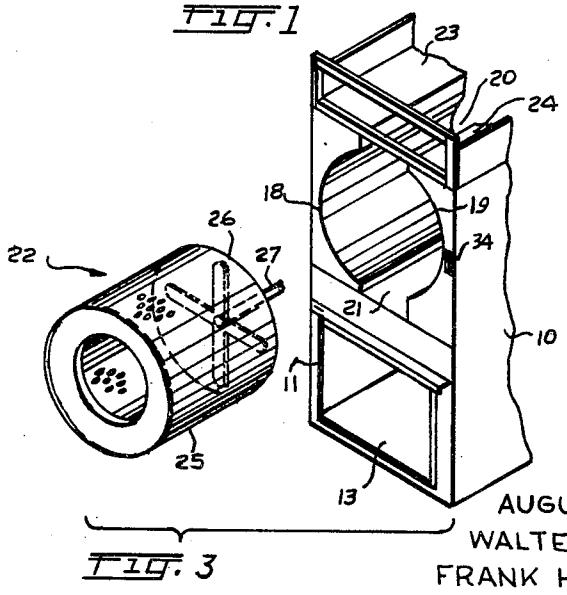


FIG. 3

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CLOTHES DRYER HAVING IMPROVED SAFETY CONTROLS

Filed Oct. 12, 1959 4 Sheets-Sheet 2

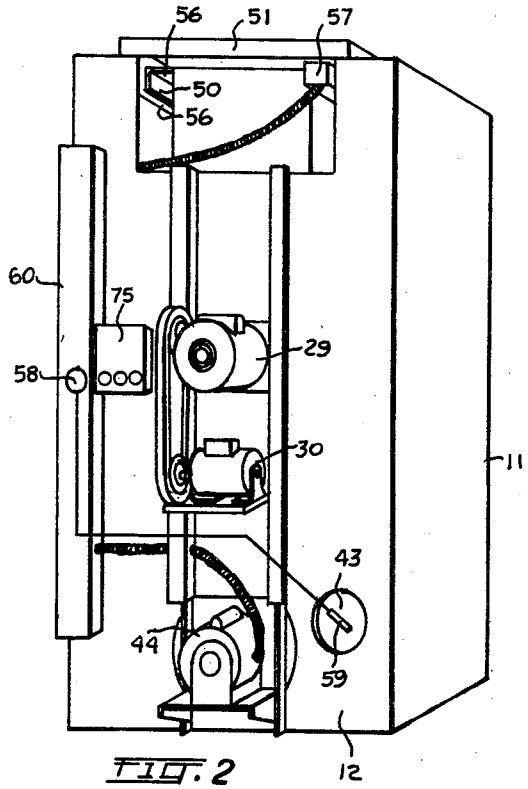


FIG. 2

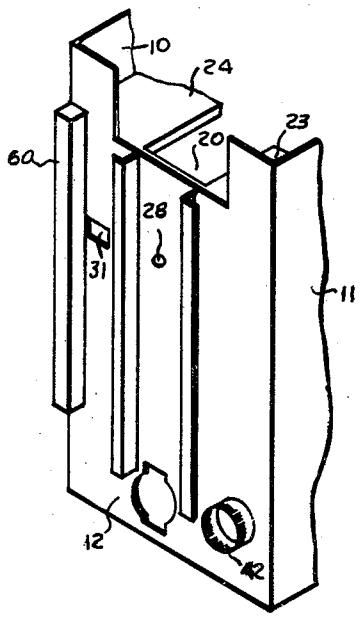


FIG. 4

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CLOTHES DRYER HAVING IMPROVED SAFETY CONTROLS

Filed Oct. 12, 1959 4 Sheets-Sheet 3

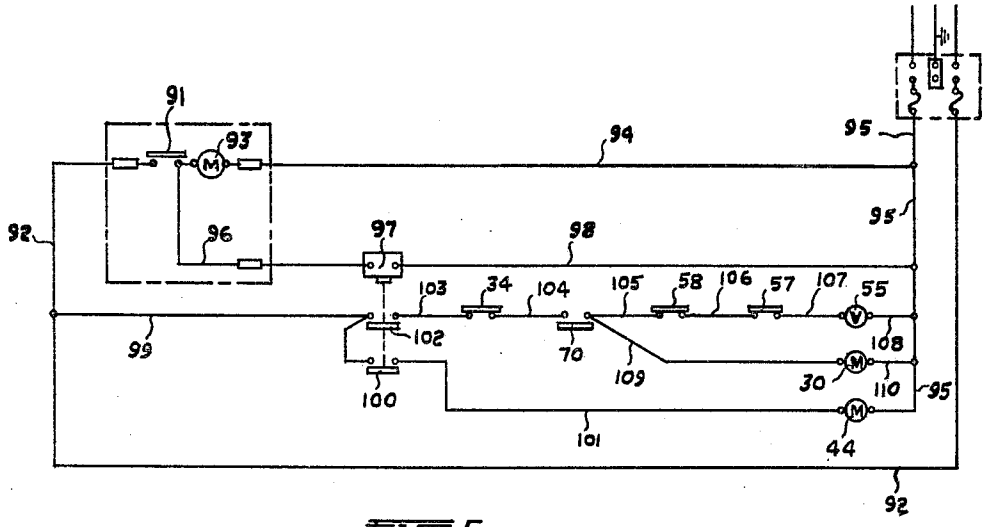


FIG. 5

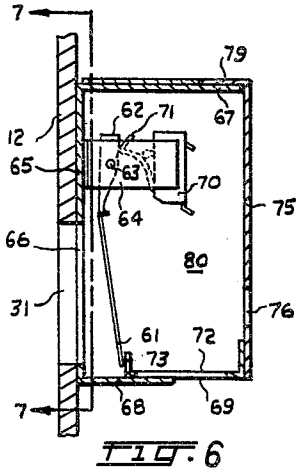


FIG. 6

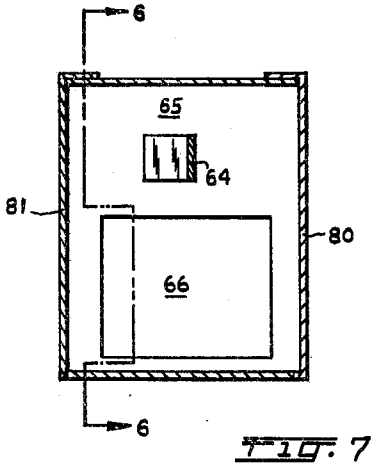


FIG. 7

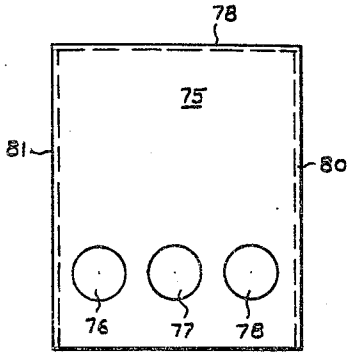


FIG. 8

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Dec. 18, 1962 F. H. RICHTERKESSING ET AL 3,068,588

CLOTHES DRYER HAVING IMPROVED SAFETY CONTROLS

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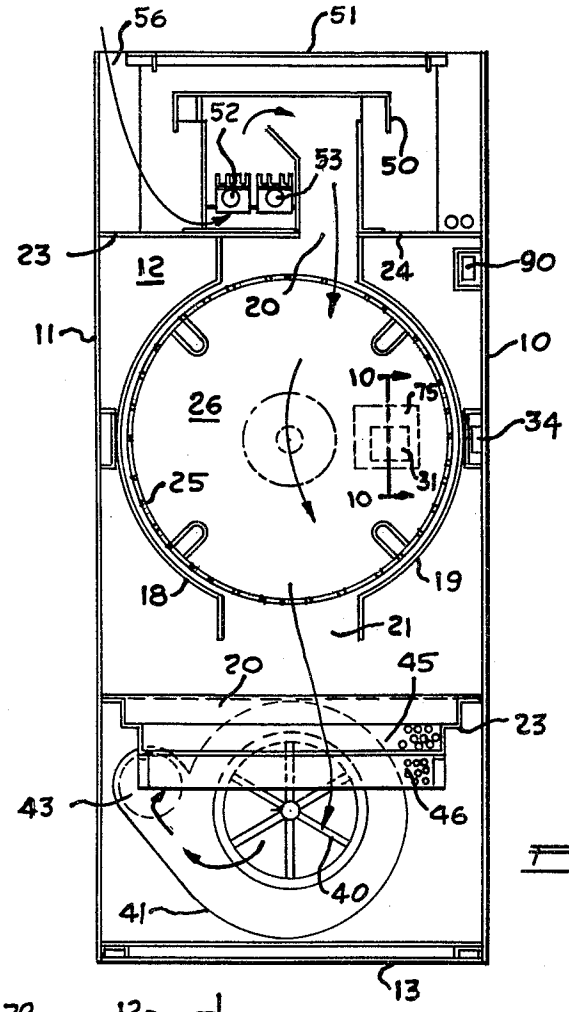


FIG. 9

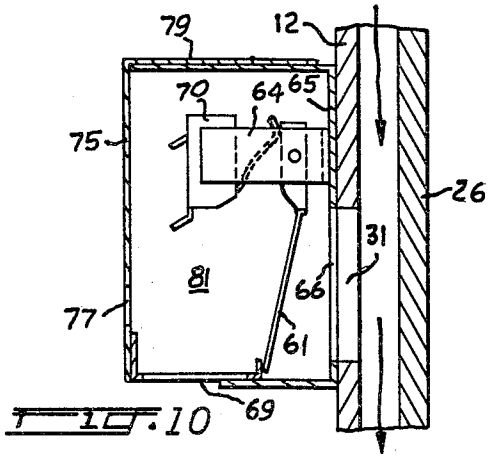


FIG. 10

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CLOTHES DRYER HAVING IMPROVED SAFETY CONTROLS

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Filed Oct. 12, 1959, Ser. No. 845,749
4 Claims. (Cl. 34—48)

This invention relates to an automatically controlled clothes dryer and more particularly to a dryer equipped for coin-meter control operation, as in unattended washer and dryer establishments, and in which automatically operable safeguards are incorporated in the dryer construction.

Although the conventional automatic clothes dryer of the domestic type, used singly in the home, is usually provided with a control circuit having means for interrupting the supply of heat thereto when the door of the dryer is opened, or when the thermostat setting controlling the temperature of the drying medium is exceeded, these simple controls are generally not adequate for such dryers when used in batteries in a commercial establishment. In such establishments, which are frequently of the coin-meter control, unattended type, the equipment may be subjected to almost continuous usage; may be arranged in such manner with respect to other dryers that pressure blow-back can occur; and may be operated by individuals who are relatively unskilled in using the equipment; as, for example, permitting the lint collector to become clogged, or opening the lint collector space, or the basket door, during a normal cycle of operation. Under such conditions, an abnormal situation may develop in which dry lint is carried back to the burners supplying heat to the dryer, and which could conceivably result in a fire within the dryer. As the description proceeds, it will be apparent that the present invention, while useful with a coin-meter control dryer cycle, is in no way limited thereto and on the contrary may be used with other types of dryers operating on a manual time control cycle.

It is an object of our invention to provide an automatically controlled clothes dryer having improved safety controls.

Another object is to provide an automatically controlled clothes dryer in which the exhaust blower runs continuously throughout the cycle, but in which the heat supplied to the drying medium is reduced whenever that blower is unable to maintain a predetermined value of sub-atmospheric pressure within the dryer casing.

Other objects and advantages of the invention will become more apparent as the description proceeds and when considered in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a dryer embodying the invention, as seen from the front and with the lint tray door and the access door to the heater shown in outward position.

FIG. 2 is a perspective view of the dryer of FIG. 1 as seen from the rear.

FIG. 3 is a perspective view to a smaller scale of a portion of the interior of the dryer casing seen from the front and showing the relation of the several interior compartments, and with the basket removed therefrom.

FIG. 4 is a perspective view of a portion of the interior of the dryer casing of FIG. 3 as seen from the rear.

FIG. 5 is a wiring diagram of the circuit for the dryer and suitable for coin-meter control operation.

FIG. 6 is a vertical sectional view of an air switch assembly suitable for use in the circuit shown on FIG. 5 and taken on line 6—6 of FIG. 7.

FIG. 7 is a sectional view taken on line 7—7 of FIG. 6.

FIG. 8 is a face view of the rear of a shield used in combination with the air switch assembly.

FIG. 9 is a front elevation view of the dryer with the front of the casing and all access doors removed and with arrows indicating the general path of air flow through the dryer, and

FIG. 10 is a detail sectional view taken on line 10—10 of FIG. 9 to an enlarged scale and showing the air flow path past the air switch assembly.

In accordance with the invention there is provided a dryer casing having a basket compartment with an access door therefor, and an air intake compartment and an air collecting compartment in communication with the basket compartment for permitting air circulation through the casing. A second motor drives a blower for exhausting air from the collecting compartment and located in this same compartment is a lint collector through which air leaving the basket compartment is compelled to pass. A separate access door is mounted in the air collecting compartment in order to provide for insertion and removal of the lint collector, and a separate first motor drives the basket. The sub-atmospheric pressure induced in the casing by the blower during normal operation acts upon a pressure-sensitive device also responsive to pressure of the ambient air outside the casing and causes the device to control a switch in the electrical circuit, and to exert a safety control on the cycle of operation of the entire dryer. This pressure-sensitive device is so constructed and shielded as to be movable alternately between two distinct positions and to avoid stopping intermediate those positions.

Referring first to FIG. 1, a casing of generally parallelepiped shape is provided with side walls **10** and **11**, a rear wall **12** and a bottom **13**, but is open at the top. A front panel **14** having an aperture therein adapted to be closed by the basket access door **15** is mounted at the central portion of the front of the casing. Openings above and below the front panel are selectively closed by the air intake compartment access door **16** equipped with an adjustable latch **9** and by the air collecting compartment access door **17**, respectively.

As best seen in the interior view of FIG. 3, a pair of arcuate sweep sheets **18** and **19** extending inwardly from the side walls and separated at their tops by a space **20** and at their bottoms by a space **21**, serve to define a central compartment for containing the dryer basket **22**. It will be understood that these sweep sheets are affixed to the rear wall **12** and have upper shelves **23** and **24**, which when the front panel **14** is in place, causes all air moving from the air intake compartment to the air collecting compartment to move through the basket compartment as indicated generally by the arrows in FIG. 9. Although various forms of baskets may be employed, we prefer to use a dryer basket such as shown in Richterkessing and Ingold Patent 2,816,742 and having a reinforced perforated cylindrical wall **25**, an imperforate rear wall **26** and a drive shaft **27** extending from that basket rear wall. This drive shaft extends through an aperture **28** in the rear wall of the casing and is driven by a first or basket motor **30** through a gear reducer **29**, as seen in FIGS. 2 and 4. In addition, the basket rear wall **26** is spaced a suitable distance from the inner surface of the rear wall **12** of the casing to permit some air passing through the basket compartment to sweep along the rear wall of the casing and across an aperture **31** in that rear wall of the casing located in the basket compartment, as best shown in FIG. 9.

The basket access door is suitably hinged at **32** and may have an arm **33** adapted to open a switch **34** (FIG.

3) mounted in the casing adjacent side wall 10 whenever the door is opened. Mounted within the rear and lower portions of the air collecting compartment is a blower 40 having a central intake and a peripheral discharge pipe 41 extending through an aperture 43 in the rear wall of the casing and into a conventional vent conduit 42. This blower is driven by a second motor 44 and, as a feature of the invention, runs continuously throughout the dryer cycle after that cycle is once begun. The air-moving capacity of this blower, as driven by motor 44, is so chosen, however, that when either or both of the access doors 15 and 17 are open, the blower will be unable to maintain a sufficiently low pressure within the basket compartment to prevent the air switch, later to be described, from opening certain circuits.

By means of rigid supports interiorly of the casing and extending from the front to rear of that casing, a removable lint tray or collector 45 is mounted in the air collecting compartment beneath space 21. This lint collector, as fully shown and described in the co-pending application of Frank H. Richterkessing, Serial No. 841,311, filed September 21, 1959, is adapted for partial or complete withdrawal from the casing whenever desired, as, for cleaning purposes.

The access door 17, pivotally mounted on the front of the casing beneath front panel 14, serves to define a portion of the air collecting compartment when in normal closed position and thereby to limit the volume of air handled by the blower substantially to that amount which has passed through the basket compartment. As will later appear, if this access door 17 is inadvertently or purposely opened during the operation of the dryer, an abnormal operating condition will occur and for which the present invention provides suitable safety precautions.

Within the confines of the casing above the shelves 23 and 24, an appreciable space, defining an air intake compartment, is formed and centrally mounted within this space is a framework 50 above which a heat insulating plate 51 may be disposed. Carried by the framework is a pair of gas burners 52 and 53 having a gas supply line 54 leading thereto and with a solenoid-operated valve 55 in that line for controlling the supply of fuel to the burners. Air pulled into the air intake compartment through the open top of the casing, serving as an air inlet 56, moves into one end of the gas burners and upon being heated, is then pulled through space 20 into the top of the basket compartment. A suitable temperature limiting thermostat 57 subject to the heat from the drying air is set to actuate a switch and to cut off the fuel supply when a prescribed temperature of the heated air, for example, 300° F., is exceeded. In addition, a temperature regulating thermostat 58, mounted in a wiring duct 60 at the rear of the casing and having a temperature sensitive bulb 59 acted upon by the temperature of the exhaust air, serves to actuate a switch and to open the heating circuit in case the temperature of that exhaust air is too high, as caused, for example, by an excess of heat for a small load of clothes.

Referring now to FIGS. 6 to 8 and 10, a pressure-responsive means, including a shield therefor and which is adapted for use with the above-described structure, is shown. One convenient form of this pressure-responsive means comprises a pivoted damper having a lower planar portion 61 adapted when in a first position to substantially close the aperture 31 in the rear wall of the casing and in a second and normal position to open that aperture. Offset from the plane of portion 61 is a switch-actuating arm 62, and with the damper being pivotally mounted upon a pin 63 intermediate the planar portion and the arm and supported upon a bracket 64. This bracket in turn is supported upon a back plate assembly having a plate 65 adapted for mounting flush against the back wall 12 of the dryer casing. The outer surface of the back plate contains an aperture 66 coinciding with the aperture 31 of the casing and also has an upper shelf 67 and a lower shelf 68 extending normally from the plane of the back plate. The upper and lower shelves are of equal width, but the lower shelf is shorter in length than the upper shelf, thus to provide an opening 69 (FIG. 6). Carried by bracket 64 is a micro-switch assembly 70 having a resilient arm 71 held at all times in engagement with the switch-actuating arm 62 of the damper and arranged to close that switch when arm 62 moves to the position at which the damper closes the apertures 66 and 31. For convenience, switch 70 is herein termed an air switch.

Due to the combined effects of the offset portions of the damper, the location of the greater mass of the damper below pivot pin 63 and the action of resilient arm 71; the normal position of the damper is generally as seen in FIG. 6. To limit the outward swing of the same and at the same time to assist in calibrating the entire pressure-responsive means, a suitable bracket 72 having an abutment 73 against which the damper rests in normal position, is rigidly affixed to the shelf 68 of the back plate assembly.

Since operation of the air switch forms an essential part of the present invention, it is necessary that its action be reliable in all respects and, as a significant feature, a shield is provided to assure that reliability in operation. One convenient form of shield may comprise a partial box-like member having a front plate 75 with a plurality of apertures 76, 77 and 78 therein in confronting relation to the planar portion 61 of the damper. At its lower edge the front plate may be secured to the end of bracket 72 and at its upper edge the front plate may overlie the edge of the upper shelf 67 as seen at 79. The box-like shield member also includes sides 80 and 81 extending to the surface of the back plate 65. With the pressure-sensitive air switch thus assembled, ambient air whose pressure is a factor in the operation of the switch can contact the damper surface only by moving into the box-like structure through the lower opening 69 and through the confronting apertures 76, 77 and 78. As will further be evident, the described shield also serves as a mechanical shield against inadvertent striking of the damper.

In general, the size and speed of blower 40 is such that during normal operation of the dryer a vacuum reading of about 0.15 to 0.30 inch of water column, read against the pressure of the outside ambient air, is maintained within the dryer basket compartment due to the rate of removal of air from that compartment by that blower. Under these conditions, the damper portion 61 seats positively in its first or closed position covering the apertures 66 and 31, and most importantly, does not teeter or adopt an intermediate position as it moves from its open to closed position at the start of dryer operation. The presence of the apertures in the front plate of the shield are found to contribute to this positive closing movement of the damper. Moreover, whenever the difference in pressure between the air in the basket compartment and the ambient air drops to a prescribed value, for example, 0.09 inch of water column, the damper being biased toward its open or second position, as above described, moves positively to that position and comes to rest against abutment 73.

The reduction of the pressure difference to such a prescribed value may be caused by any of, or a combination of, several factors encountered in dryers operating in unattended installations, and the switch 70 controlled by the damper and in turn controlling the circuit through the solenoid valve, thus serves to reduce the heat supplied to the dryer when such factors come into play. Among such factors which the present safety controls guard against, are, stoppage of the blower, opening of the lint drawer, opening of the basket door, clogging of the lint drawer with an excess of lint deposit, obstruction in the dryer vent system, or pressure blow-back into the

dryer from a vent system having other dryers connected thereto.

With the foregoing in mind, reference now is made to FIG. 5 showing an across-the-line electrical circuit for the dryer and to the following description of the operation of the dryer in accordance with the invention.

When a coin is deposited in slot 90 (FIG. 1), or when an alternative manual starting means is used, a starting switch 91 is first closed whereupon a timing circuit is made from conductor 92 through the closed starting switch, timer motor 93, and conductor 94 to return conductor 95. If desired, a different time switch arrangement may be employed with the starting switch and which may be of a conventional type having the ability to permit untimed operation as when the dryness of the load of clothes in the basket is judged by inspection or by operation of a temperature signal light. Since this type of control is well known and forms no part of the present invention, it has been omitted from the drawings in the interests of simplicity. In general then, the above-described timing circuit is maintained until the end of a prescribed drying cycle or until the operator wishes to terminate the drying cycle.

Closing of the timing circuit also establishes a relay circuit through starting switch 91, conductor 96, relay 97, conductor 98, and return conductor 95. As relay 97 closes, it in turn establishes a blower circuit through conductor 92, conductor 99, relay contacts 100, conductor 101, motor 44, and return conductor 95, and this blower circuit remains closed so long as the timing circuit is closed. It will be apparent that when the blower circuit is closed, motor 44 begins to drive blower 40 which then effects a sub-atmospheric pressure within the basket compartment tending to move the pressure-sensitive air switch to closed position. The continuous driving of the blower throughout the drying cycle is especially important in that if the basket door 15 is opened during operation, no hot air blast can emerge therefrom and which otherwise might blow lint into the room or frighten the operator. Moreover, since the blower is constantly pulling air from the basket compartment, the dryer area will be kept cooler for the operator in the event he wishes to handle the clothes while the timer is still operating.

Simultaneously with the closing of the blower circuit, relay contacts 102 also close. If at this time the basket door 15 is closed, and if the lint tray is sufficiently clean, and if the lint tray access door 17 is closed, the rate of removal of air from the basket compartment by the blower will be sufficient to create the above-mentioned pressure difference acting upon the air switch and thus the switch 70 also closes. At the beginning of operation, the thermostatically controlled switches 58 and 57 will, of course, be closed, since the burners have not yet attained their full heating effect. Accordingly, under these normal conditions, closing of relay contacts 102 establishes a heating circuit through conductor 103, door switch 34, conductor 104, air switch 70, conductor 105, temperature regulating thermostat switch 58, conductor 106, temperature limiting thermostat switch 57, conductor 107, solenoid valve 55, conductor 108 and return conductor 95. As this circuit is completed, the valve 55 opens and fuel is supplied to the burners whereupon heated air is pulled through the dryer by the blower and this continues normally until the timing circuit is opened.

Simultaneously with the closing of air switch 70, a shunt circuit is made through conductor 109, motor 30 driving basket 22, conductor 110, and return conductor 95. As this circuit is closed, the clothes in the basket are tumbled in the presence of the heated air being drawn through the basket compartment. However, in the event that the basket access door 15 is opened or if the air switch is opened due to sufficient fall of the pressure differential caused by any reason, the basket thereupon comes to rest.

Various modifications of the dryer structure and of its control circuit may be employed without departing from the spirit of the invention. For example, the door switch 34 may be omitted since opening of the door even a slight amount immediately affects the volume of air being handled by blower 40 and thus causes a change in the normal pressure differential for which the pressure-sensitive damper is calibrated.

Having thus described the invention, it will be apparent that modifications may be made therein and by the appended claims it is intended to cover all such modifications or variations as fall within the true spirit and scope of the invention.

What is claimed is:

1. An automatically controlled clothes dryer comprising in combination, a casing having a basket compartment, a basket, a basket access door opening into said basket compartment, a first motor for driving said basket, an air intake compartment having an air inlet, a burner in said air intake compartment, a fuel supply line leading to said burner, a solenoid controlled valve in said supply line, an air collecting compartment having an exhaust line, a blower for removing air from said casing through said exhaust line, a second motor for driving said blower, a lint collector in said air collecting compartment, an access door opening into said air collecting compartment, said air intake and air collecting compartments being in communication respectively with said basket compartment and permitting air circulation through said casing, an aperture in the wall of said casing intermediate said air intake compartment and said air collecting compartment and communicating said basket compartment with the ambient air external of said casing, means responsive to the difference in air pressure between the inner and outer sides of said aperture and movable under the influence of said pressure difference from a second position opening said aperture to a first position substantially closing said aperture, said pressure-responsive means being biased to occupy normally said second position, means shielding said pressure-responsive means to insure positive movement thereof from said second to said first position, electrical circuit means including a starting switch, a relay actuated by said starting switch and adapted in closed position to establish a blower circuit through said second motor, a heating circuit through said solenoid-operated valve and a shunt circuit through said first motor; and an air switch in said heating circuit operable by said pressure-responsive means and adapted to interrupt said heating circuit while said pressure-responsive means is in its second position thereby to operate said solenoid-operated valve and to reduce the supply of heat to said dryer.

2. Apparatus as defined in claim 1 wherein said blower has an air-moving capacity insufficient to maintain said pressure difference at a value commensurate with holding said pressure-responsive means in said first position while said basket access door is open.

3. Apparatus as defined in claim 1 wherein said blower has an air-moving capacity insufficient to maintain said pressure difference at a value commensurate with holding said pressure-responsive means in said first position while said access door to said air collecting compartment is open.

4. An automatically controlled clothes dryer comprising in combination, a casing having a basket compartment, a basket, a first motor for driving said basket, an air intake compartment having an air inlet, a burner in said air intake compartment, a fuel supply line leading to said burner, a solenoid controlled valve in said supply line, an air collecting compartment having an exhaust line, a blower for removing air through said exhaust line, a second motor for driving said blower, said air intake and air collecting compartments being in communication respectively with said basket compartment and permitting air circulation through said casing, an aperture in the wall of said casing intermediate said air

intake compartment and said air collecting compartment and communicating said basket compartment with the ambient air external of said casing, means responsive to the difference in air pressure between the inner and outer sides of said aperture and movable under the influence of said pressure difference from a second position opening said aperture to a first position substantially closing said aperture, said pressure-responsive means being biased to occupy normally said second position, means shielding said pressure-responsive means to insure positive movement thereof from said second to said first position, electrical circuit means including a starting switch, a relay actuated by said starting switch and adapted in closed position to establish a blower circuit through said second motor, a heating circuit through said solenoid operated valve and a shunt circuit through said first motor; and an air switch in said heating circuit operable by said pressure-responsive means and adapted to interrupt said

heating circuit while said pressure-responsive means is in its second position thereby to operate said solenoid operated valve and to reduce the supply of heat to said dryer, said shunt circuit being connected to said heating circuit intermediate said air switch and said valve thereby to bring said basket to rest by stoppage of said first motor during interruption of said heating circuit by said air switch.

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