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DRYING APPARATUS

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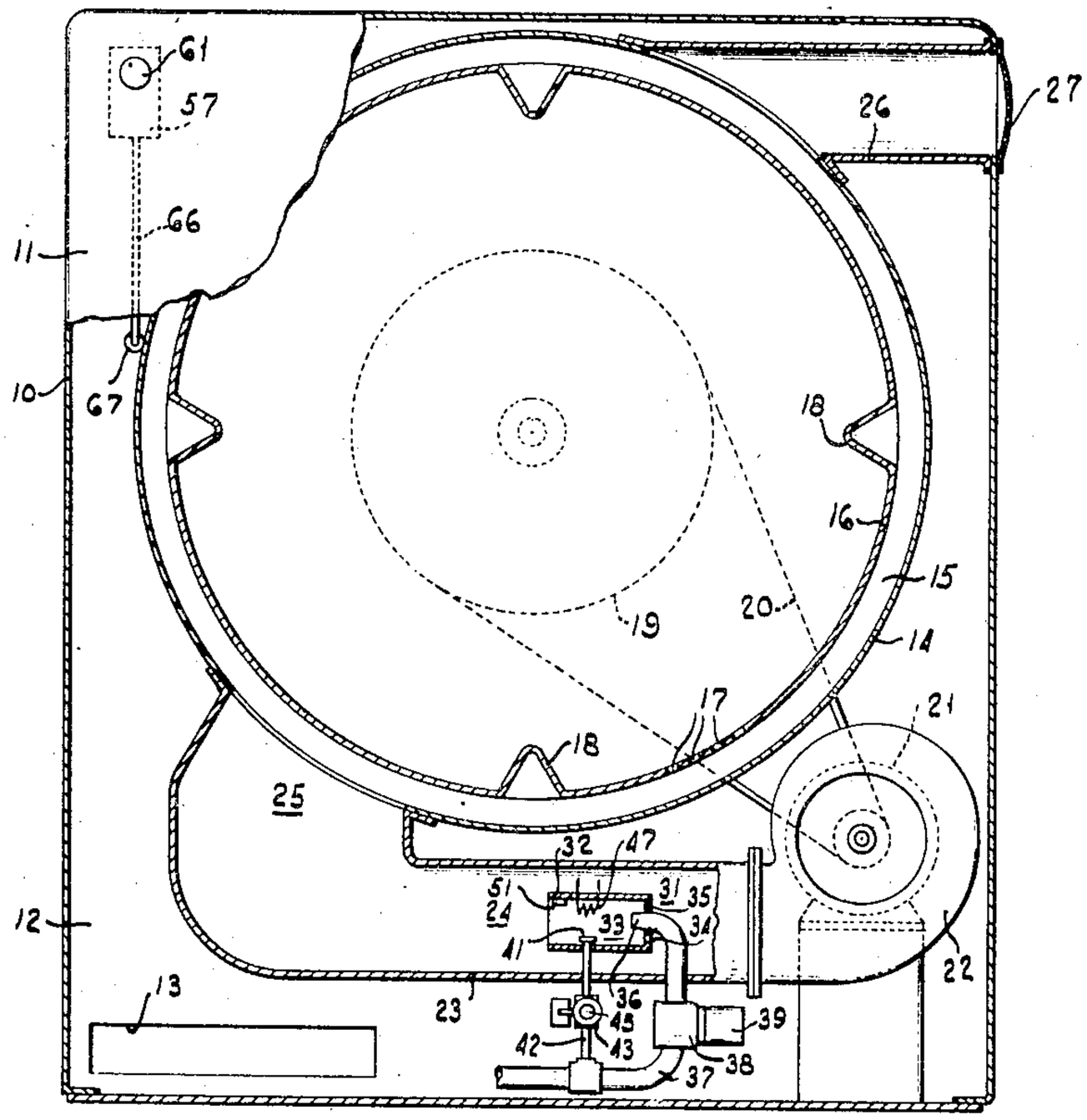

FIG. 1.

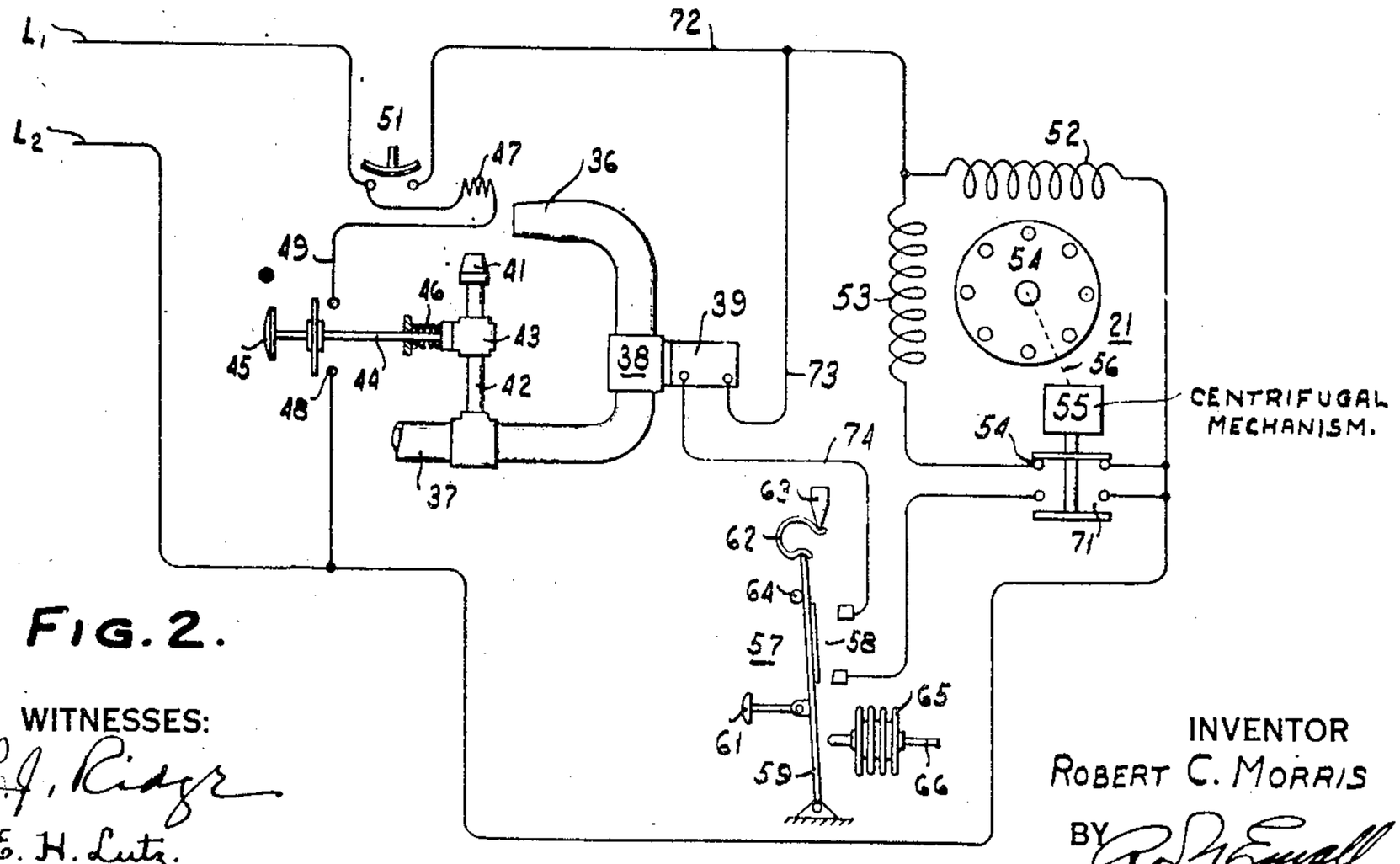

FIG. 2.

WITNESSES:

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DRYING APPARATUS

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2 Claims. (Cl. 263—40)

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My invention relates to apparatus for drying clothes anad has for an object to provide improved apparatus of this kind.

A further object of the invention is to terminate the flow of gas to a gas-heated clothes dryer having means for translating heated air to the drying chamber of the dryer in the event that the air-translating means becomes inactive.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a vertical, sectional view of a domestic clothes dryer having a portion of the outer casing shown in elevation; certain control elements for the dryer being diagrammatically shown for the sake of clearness; and

Fig. 2 is a diagram of the electrical connections for the various electrical translating and control devices employed in the dryer.

Gas-heated clothes dryers of the domestic type usually include a drying chamber within which clothes are tumbled and dried. An air heating chamber is arranged adjacent the drying chamber through which air is forced by a motor-driven blower prior to the delivery of the air to the drying chamber. A gas heater is disposed in the heating chamber over which the air is passed for direct heating. Accordingly, products of combustion and heated air are delivered to the drying chamber for abstracting moisture from the fabrics. During normal operation, the forced draft through the heating chamber provides a relatively short but very hot flame at the burner due to the copious quantities of oxygen present. If for any reason, the motor-driven blower should stop, the reduced quantity of oxygen in the air within the heating chamber retards combustion of the gas and the attenuated flame produced by the burner lengthens and may extend to within the drying chamber, whereby the fabrics being treated may become scorched or burned. Furthermore, the temperature of the air in the heating and drying chambers increases to an abnormally high value which may damage the fabrics when the flow of air delivered by the blower is reduced.

In accordance with the present invention, means is provided for terminating the flow of gas to the burner if the supply of air is reduced. I employ, preferably, a centrifugal device responsive to the speed of the blower motor for controlling gas delivery. An electrically-operated valve controls the flow of gas, which valve is

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open when energized and closed when deenergized. A centrifugal switch driven by the motor controls the solenoid valve and is actuated to its open position if the speed of the motor falls below a predetermined value. The valve is, therefore, closed and operation of the burner ceases. In domestic type dryers, the switch for the solenoid valve is preferably actuated by the centrifugal control mechanism for the starting winding of the split-phase motor usually employed to drive the blower of such dryers.

Reference will now be had to Fig. 1 of the drawing, wherein I have elected to disclose a domestic type clothes dryer constructed and arranged in accordance with my invention. The dryer includes a casing structure 10 having a front wall 11, a portion of which is shown in elevation in Fig. 1, and a rear wall 12, the latter being provided with an air opening 13 for the admission of air to the interior of the cabinet structure 10. Arranged within the cabinet 10 is a generally cylindrical baffle 14 which encloses a drying chamber 15. Within the latter, a basket structure 16 is disposed for rotation about a horizontal axis. The basket 16 includes a generally cylindrical side wall which is perforate substantially throughout its extent, a number of the perforations being indicated by the reference character 17. The basket 16 is also provided with a plurality of vanes 18 which extend radially inwardly from the basket side wall. The basket 16 may be rotated about its axis in any well-understood manner. As shown, a pulley 19 is fixed to the basket for rotation therewith and is belted, as shown at 20, to an electric motor 21.

The motor 21 also functions to drive a blower 22, the discharge end of which is connected to a duct structure 23 disposed beneath the cylindrical baffle 14. A portion of the duct structure indicated at 24 defines a heating chamber within which the air delivered by the blower 22 is heated. The duct structure 23 is also provided with a discharge passage, indicated at 25, which conveys the heated air to the drying chamber 15. As is well understood, the heated air passes through the various perforations 17 to the interior of the basket, wherein moisture is abstracted from the fabrics. The drying air and the moisture which is vaporized thereby pass from the drying chamber 15 through a discharge duct 26 to the ambient atmosphere. Preferably, a filter or lint trap 27 is associated with the duct 26 for the separation of lint from the body of translated air.

The air passing through the heating chamber

24 is heated by a gas heater of any type suitable for operation in a forced air stream. As shown, the heater, indicated generally at 31, includes a cylindrical shell 32 having a combustion chamber 33 formed therein. An end wall 34 of the shell 32 is provided with suitable openings 35 for the admission of combustion air. The end wall is also provided at its center with a main burner or nozzle 36 which is supplied with gas under pressure by a conduit 37 having an electrically-operated valve 38 connected therein. The valve 38 is preferably provided with a solenoid 39 which, when energized and deenergized, effects, respectively, the opening and closing of the valve 38. As the construction of solenoid valves of the type shown is well understood, further description of the same is deemed unnecessary.

A pilot burner, indicated at 41, is disposed adjacent the nozzle 36 for igniting the gas issuing from the nozzle 36. As shown, the pilot burner 41 is supplied with gas through a branch 42 of the gas pipe 37. A pilot valve 43 is arranged in the branch pipe 42 for controlling flow of gas to the pilot burner 41. As shown, the valve 43, is opened by manually actuating a push rod 44 having a button or handle 45 arranged in a location accessible to the operator. The valve 43 is biased closed, by a spring 46 shown in Fig. 2. It will be understood that the pilot valve 43 is closed at all times except when manually opened by the operator. The pilot is ignited in any suitable manner such as by a conventional hot wire diagrammatically shown at 47. The hot wire is controlled by a switch 48 actuated to its closed position when the operator opens the valve 43, said switch 48 being opened when the valve 43 is spring closed.

Referring now to Fig. 2, particularly, the source of power for the electrical devices referred to is represented by line conductors L_1 and L_2, which, for example, may be a conventional domestic lighting circuit. The hot wire igniter 47 and switch 48 are series connected in a conductor 49 connected across the conductors L_1 and L_2. A thermostatic switch 51 is arranged in the combustion chamber 33 and is subjected to heat provided by either the pilot burner 41 or the main burner 36. The thermostatic switch 51 is so constructed that it closes when either the pilot burner 41 or the main burner 36 are active and opens when both of these burners are inactive. As set forth hereinafter, the thermostatic switch 51 controls energization of both the solenoid 39 of the main gas valve 38 and also the motor 21 so that, for energization of either the solenoid 39 or the motor 21, a flame must be present in the combustion chamber 33 to maintain the thermostatic switch 51 closed.

As shown in Fig. 2, the motor 21 is of the split-phase type and includes a running winding 52, a starting winding 53 and a squirrel cage rotor 54. The starting winding 53 is controlled by a conventional centrifugal switch 54 which is closed when the motor is inactive and which is opened when the speed of the motor exceeds a predetermined value, for example, 75 per cent of the full load running speed. The switch is actuated by any well-known centrifugal mechanism diagrammatically shown at 55 and driven by the shaft 56 of the motor 21.

Operation of the main heater 36 is under control of a primary thermostat 57 which is manually closed and thermostatically opened. This primary thermostat 57 is carried in a convenient location on the front wall 11 of the dryer. As

shown in Fig. 2, the thermostat 57 includes a switch 58, carried by a pivoted switch arm 59 and actuated to its switch closed position by a push button 61. The arm 59 is maintained in its switch closed or switch open positions by an overcenter horseshoe spring 62 engaging a fixed knife edge support 63 and the end of arm 59. A stop 64 limits movement of the arm 59 in switch opening direction. The arm 59 is actuated automatically from its switch closed to its switch open position by a bellows 65 when expanded a predetermined amount. The bellows 65 is connected by a tube 66 to a bulb or reservoir 67 (see Fig. 1), the latter being preferably secured in heat transfer relation to a portion of the baffle 14 whose temperature closely follows the temperature of the fabrics being dried. The bulb 67, tube 66 and bellows 65 are completely filled with a fluid whose volume changes with variations in temperature at the bulb 67, all of which is well understood. The switch 58 of thermostat 57 is connected in series with the solenoid 39 as shown in Fig. 2.

In accordance with the present invention, an additional switch, indicated at 71, also controls energization of the solenoid 39 and is effective to deenergize the solenoid 39 in the event that the motor 22 is slowed down in speed or stopped for any reason, further reference to this operation appearing hereinafter. Preferably, the switch 71 is actuated by the centrifugal mechanism 55 of motor 21 so that the switch 71 is closed only when the motor operates at full speed or within 75 per cent of full speed. At lower speeds or when the motor is inactive, the switch 71 is open.

Operation

After the operator has deposited the bundle of damp fabrics in the basket 16 in the usual manner, the push buttons 45 and 61 are depressed. The push button 61 actuates the switch 58 of thermostat 57 to its closed position with a snap action when the spring 62 passes overcenter. The switch 58 is retained closed by the horseshoe spring 62, it being understood that, at this time, the temperature of the fluid in the bellows is relatively low or at room temperature and that the bellows 65 is contracted. The closing of the switch 58 is of no moment for the present as the circuit controlled thereby is open at the thermostat 51, also at room temperature. Actuation of the push button 45 closes the switch 48 and also opens the pilot valve 43 against the bias of spring 46. Accordingly, there is a flow of gas to the pilot burner 41 and energization of the hot wire is effected through a circuit extending from line conductor L_1 through the hot wire 47, conductor 49, and switch 48 to the line conductor L_2. The hot wire 47 rapidly heats and ignites the gas issuing from the pilot burner 41. The push button 45 is held in its depressed position for a few seconds during which time the thermostat 51 is heated by the pilot flame and moves to its closed position.

The closing of the thermostat 51 completes a circuit to the electric motor 21, which circuit extends from the line conductor L_1, thermostat 51, conductor 72, the running winding 52 of the motor 21 and thence to line conductor L_2. Since the starting switch 54 of the motor 21 is closed, a parallel circuit is completed which extends from the conductor 72 through the starting winding 53 of the motor 21, starting switch 54 to line conductor L_2. Accordingly, operation of the motor 21 is initiated and when the motor speed has increased to approximately 75 per cent of its

running value, the centrifugal mechanism 55 operates to open the switch 54 for deenergizing the starting winding 53 and closing the switch 71. Closing of the switch 71 during acceleration of the motor energizes the solenoid 39 by a circuit extending from the line conductor L_1, thermostat 51, conductor 72, conductor 73, solenoid 39, conductor 74, switch 58 and closed switch 71 to line conductor L_2. Accordingly, the main gas valve 38 is opened and gas issuing from the main burner 36 is ignited by the pilot. The operator may then release the button 45 for opening switch 48 and closing the pilot valve 43. It will be understood that the thermostat 51 is retained closed by the heat of the main burner after the pilot is extinguished.

During the drying period, air translated by the blower 22 passes through the heating chamber 24, a portion of the air entering the combustion chamber 33 through ports 35 for mixture with the gas to produce a hot flame within the combustion chamber 33. The flame produced is confined, substantially, within the combustion chamber 33 and the walls of the heater 31 are heated to a relatively high temperature for heating the main body of air which passes through the space intervening between the heater 31 and the walls of the duct 23. This body of heated air mixes with the products of combustion issuing from the combustion chamber 33 and this heated mixture then passes through the duct 25 to the drying chamber 15. The heated mixture passes through the numerous openings 17 of the basket and contacts the tumbling fabrics for the vaporization of water therefrom. The heated mixture with the vaporized moisture then passes through the discharge duct 26 to the ambient atmosphere.

During the early stages of the drying period, the dry bulb temperature within the drying chamber 15 rises slowly as most of the heat in the stream of air is abstracted as latent heat of vaporization. During the later stages of the drying cycle when substantially all of the water in the fabrics has been evaporated, the dry bulb temperature within the drying chamber increases more rapidly. At a predetermined temperature of, for example, 180° F., the bellows 65 will have expanded sufficiently to open the switch 58, whereupon the solenoid 39 is deenergized to close the valve 38 and terminate operation of the main burner 36. The motor continues to operate for the circulation of air until the thermostat 51 has been cooled sufficiently to move to its open position. The dry fabrics may then be removed from the dryer.

If, during the drying cycle the motor 21 stops operating for any reason, the flow of air through the heating chamber 24 would be discontinued. Accordingly, the reduced quantity of oxygen present in the combustion chamber 33 and heating chamber 24 would retard combustion at the main burner 36, and I have found that the flame produced under these circumstances becomes attenuated and lengthens to such an extent that it may pass upwardly through the discharge duct 25 to within the drying chamber 15. This operation would, of course, burn or badly scorch the fabrics within the basket 16. Furthermore, at this time, the tempartures within the heating chamber 24 may rise to an abnormally high value which would also damage the fabrics within the basket and possibly the drying apparatus itself. This undesirable operation is precluded by the opening of the switch 71 which terminates operation of the burner 36 if the motor 21 is stopped or operated at an abnormally low speed.

From the foregoing description, it will be apparent that I have provided an improved gas-fired clothes dryer wherein the flow of gas to the burner thereof is terminated if the flow of air to the burner is substantially reduced. While I have shown a switch actuated by the centrifugal control mechanism of a split-phase motor as the controlling element for the flow of gas, it will be understood that this switch may be operated in response to any condition of operation of the blower motor that is a function of the speed of the blower motor.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What I claim is:

1. In a gas-fired clothes dryer, the combination of means defining a drying chamber, a duct structure for conveying air to said chamber, a blower for translating said air, a motor for driving the said blower and having a running winding and starting winding, a switch controlling said starting winding, centrifugally-operated means driven by the motor for opening said switch when the speed of the motor is above a predetermined value and for closing the switch at lower motor speeds, a gas heater arranged in said duct structure, a conduit for conveying gas to said heater and having an electrically-operated valve connected therein, said valve being open when energized and closed when deenergized, a second switch controlling energization of the electrically-operated valve and actuated by said centrifugally-operated means, said second switch being closed when the speed of the motor exceeds said predetermined value and open at lower motor speeds.

2. In a gas fired clothes dryer, the combination of means defining a drying chamber, a duct structure for conveying air to said chamber, a blower for translating said air, a motor for driving said blower and having a running winding and a starting winding, switching means controlling said starting winding, means responsive to a condition of operation of said motor which is a function of the speed thereof for controlling said switching means, said switching means being closed when the speed of the motor is below a predetermined value and open when the speed of the motor is above said value, a gas heater arranged in said duct structure, a conduit for conveying gas to said heater and having an electrically-operated valve connected therein, said valve being open when energized and closed when deenergized, and second switching means controlling energization of the electrically-operated valve and actuated by said condition responsive means, said second switching means being closed when the speed of the motor exceeds said predetermined value and open at lower motor speeds.

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