

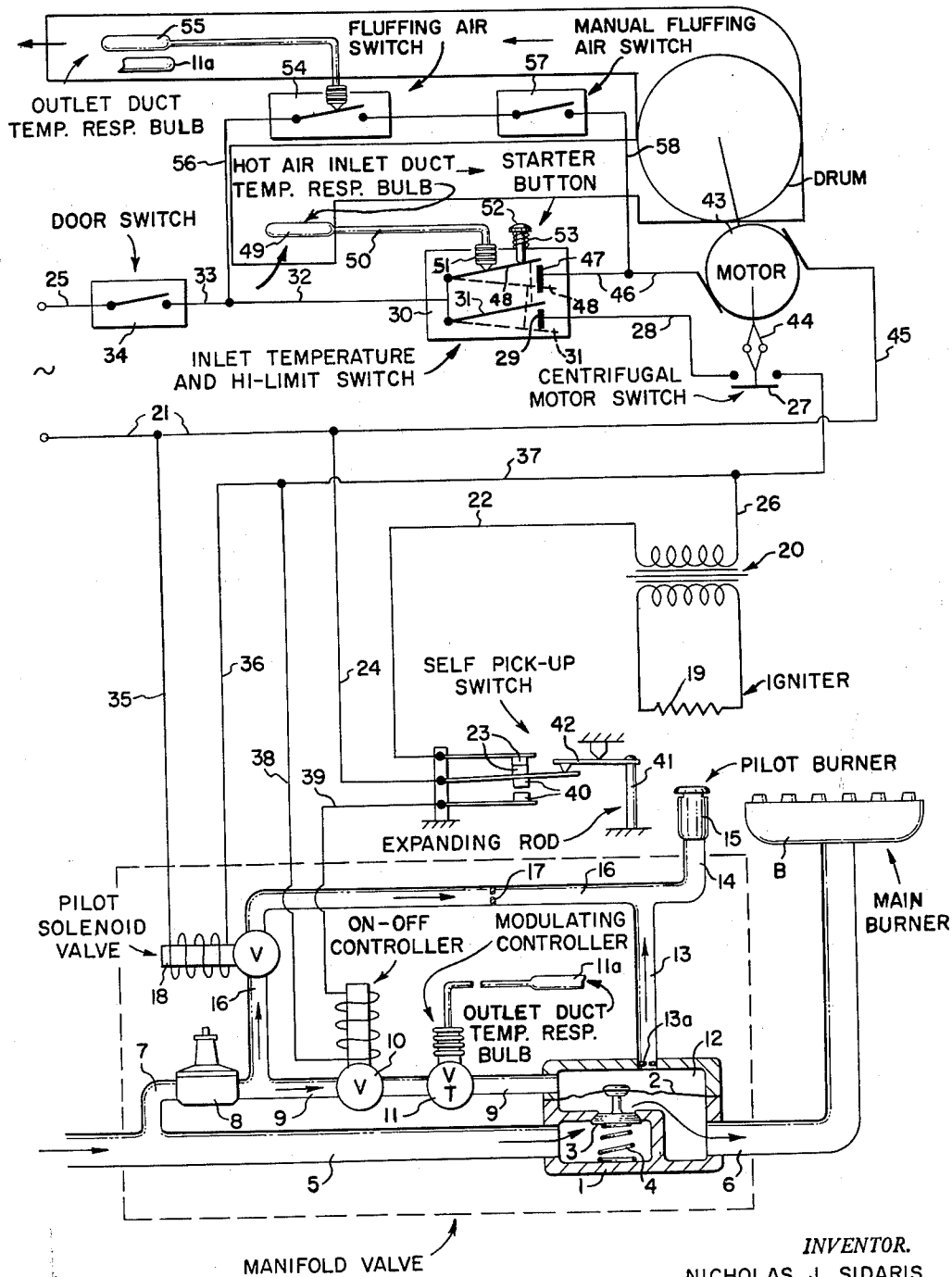
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DRYER APPARATUS

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DRYER APPARATUS

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This invention relates to dryer control systems and apparatus and, more particularly, to control systems and apparatus for dryers having means for modulating the energy supplied to the dryer for heating the air that passes through the dryer.

In the prior art, dryers generally and clothes dryers in particular are normally operated on a time cycle which may be adjusted to provide the necessary length of drying time for a particular type of clothing. It has also been suggested in the prior art that the time of operation of the clothes dryer be governed by a humidity sensing element positioned in the outlet of the clothes dryer. These different systems for drying clothes are generally unsatisfactory in that it is often necessary to operate the dryer for a much longer time than is necessary to assure the proper dryness of the clothes which, obviously, is wasteful of the energy necessary to supply the heat for drying the clothes as well as the mechanical operation of the dryer.

One of the objects of this invention is to use a modulating type of energy supplying means to the dryer for regulating the energy so as to maintain a uniform temperature at the outlet of the dryer.

Another object of the invention is to provide a control system for a dryer which will regulate the energy supply to the dryer in response to outlet temperature of the dryer and also provide means for cutting off the dryer in response to the inlet temperature, with the means including a switch that will close at one predetermined temperature and will open at another higher predetermined temperature.

Still another object of the invention is to provide a modulating diaphragm valve for controlling the flow of gas to a main burner of a material or article dryer in combination with an atmospheric type of pilot burner and a bleed passage or passageway leading from the pressure chamber of the diaphragm valve and through a conduit to the pilot burner and with a pilot gas passage leading from the gas supply upstream of the diaphragm valve to the bleed passage, with a flow restrictor in the pilot gas passage.

A still further object of the invention is to provide an ambient temperature compensated condition responsive switch, which is adapted to cut off a dryer when a predetermined temperature condition is reached and to also cut off the energy supply if a predetermined different condition is reached, and a manually operable means for initially closing the switch.

Still further objects of the invention will become apparent upon reading the following detailed description of the invention in conjunction with the accompanying drawing wherein:

The only figure of the drawing is a schematic showing of the control system and the components thereof.

A manifold valve is shown outlined by a broken line and comprises a modulating pressure operated valve 1 having a diaphragm 2 therein carrying a valve 3 which is biased toward its closed position by means of a compression spring 4. The valve 1 has an inlet passageway or passage 5 and an outlet passage 6 which is connected to a main burner B of a clothes dryer. A passage 7 leads from the inlet passage 5 to a conventional pressure regulator valve 8 and from the valve 8 there is a passage 9 that leads to a conventional solenoid operated control valve

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10. From the valve 10, the passage 9 continues on to a conventional temperature responsive modulating valve 11, having a temperature sensing bulb 11a. The passage 9 then continues on to a pressure chamber 12 above the diaphragm 2. A passage 13 leads from the chamber 12 to another passage 14, which, in turn, leads to a pilot burner 15 which is of the atmospheric type. An atmospheric type of burner is one that does not have a flow restriction therein but has sufficient outlet openings therein as to cause the pressure within the pilot burner to be substantially atmospheric.

A second passage 16 extends from the passage 9 between the valves 8 and 10 to the junction of the passages 13 and 14. A flow restrictor in the form of an orifice plate 17 is positioned somewhere in this passage 16 while a pilot valve 18 is positioned also in the passage 16 in any suitable location. This pilot valve is normally closed and is adapted to be moved to an open position upon energization of the power means for the valve, in this instance a solenoid coil.

The pilot burner is adapted to be ignited by an electrical igniter 19 through a transformer 20. The transformer is connected to one wire 21 of an electrical power supply through line 22, normally closed contacts 23 of a self pick-up switch and line 24. The other side of the transformer is connected to the other wire 25 of the power line through line 26, centrifugal switch 27, line 28, bar contact 29 of an inlet temperature and high limit switch 30, contact arm 31, line 32, line 33 and a clothes dryer door operated switch 34. One terminal of the pilot burner valve is directly connected to line 21 through lead wire 35 while the other terminal of the pilot burner valve is connected through lead 36 and lead 37 to lead wire 26 so that the pilot valve will be energized simultaneously with the energization of the transformer.

One terminal of the control valve 10 is electrically connected by lead wire 38 to the lead wire 37 while the other terminal of the diaphragm control valve is connected through a lead 39 through out contacts 40 of the self pick-up switch to lead wire 24 so that when the pilot burner has become ignited and a rod 41 of the self pick-up switch is expanded, a lever 42 will break the contacts 23 and make the contacts 40.

The motor 43 for rotating the drum of the clothes dryer operates the centrifugal switch 27 by means of a fly-ball actuator 44. This motor has one of its terminals connected to the line 21 through a lead wire 45. The other terminal of the motor is connected to the other wire of the power source by means of a lead wire 46 to a bar type of contact 47 of the inlet temperature and high limit switch, contact arm 48 and lead 32 to the lead 33 connected to the door switch in line 25. A temperature-responsive liquid-filled bulb 49 is connected through tube 50 to an ambient temperature compensating liquid-filled bellows 51 which is adapted to operate the two contact arms 48 and 31. The bulb 49 is adapted to be positioned in any suitable location in the hot air inlet duct of the clothes dryer and the associated switch is so calibrated as to cause closing of the contacts 48—47 and 31—29 around a predetermined temperature (for example, 250° F. at an ambient temperature of 70° F.) and is adapted to break the contacts around a higher predetermined temperature (for example 450° F. at the same ambient temperature). The contact bar 47 is substantially longer than the contact bar 29 so as to continue the motor operation for a period of time longer than the energization of the diaphragm control valve. In other words, the contact between the bar 29 and arm 31 breaks before the contact between the bar 47 and arm 48 at the high temperature end. If desired, the contact between the arm 48 and contact bar 47 may remain closed to a lower temperature than the contact between the bar 29 and 31 upon

the bulb 49 reaching its lower control temperature. The bulb 51 is so proportioned with respect to the bulb 49 and is so located with respect to the atmosphere surrounding the dryer that it compensates for changes in ambient temperature so as to adjust the cut-out or shut-off temperature of the dryer. Obviously, various arrangements of the switch contacts and actuating mechanism may be provided that would provide the functions of this switch without using the specific details disclosed herein, which are more or less schematic in nature.

The contacts of the switch are initially closed by pressing inwardly on a starter button 52 against the bias of a spring 53. This closing of the contacts of the switch 30 causes energization of the motor 43, provided the door switch is closed, and energization of the pilot burner valve and the igniter 19. Upon ignition of the pilot burner and heating of the self pick-up switch, the circuit to the igniter is broken as mentioned above and the circuit to the diaphragm control valve 10 is closed by the centrifugal switch 27 closing in response to operation of the clothes dryer motor. Once the valve 10 has been opened, gas under pressure will flow through the valve 10 and pass the valve 11 to the pressure chamber of the main diaphragm valve, causing it to move to its open position. The diaphragm valve will then be modulated between its open and closed position by means of the thermostatic valve 11 which has its temperature responsive bulb 11a positioned in the outlet duct of the clothes dryer maintaining a relatively constant predetermined outlet temperature. As the temperature of the outlet duct air rises, indicating that the clothes are becoming dryer, the control valve 11 will gradually close to reduce the pressure in the chamber 12 and thus cause partial closing of the valve 3. After the valve 3 has throttled the gas down to the point where the input rate is just above that required to maintain tinder dry clothes at the controlled outlet temperature, slight further throttling causes a slight additional lowering of the inlet temperature to break the contacts of the switch 30 and thus cause shut down of the dryer, the clothes being dry. At lower ambient temperatures the inlet temperature control points are higher, and vice versa.

To provide for a fluffing period for the clothes following shut down of the fuel supply to the burner, a fluffing air switch 54 having a temperature sensing bulb 55 positioned in the outlet duct of the clothes dryer is connected to a lead wire 56 to the wire 33 and is also connected through a manually operable switch 57 and a lead wire 58 to the lead wire 46 between the contact 47 and the motor. The switch 54 normally closes at approximately 130° F. and normally opens at approximately 100° F. It is thus seen that due to the fact that the switch 54 and switch 57 are in shunt relationship with respect to the contacts 47 and 48 the motor will remain energized for a period of time after these contacts and contacts 29 and 31 have been broken.

While the invention has been described and illustrated as control apparatus and a control system for a gas type of clothes dryer, it is to be understood that the control apparatus could be used for drying other material or articles and could be readily adapted to the control of an electric gas dryer just as well.

It is to be noted that the modulating gas valve of this system is particularly superior to the prior art modulating gas valves due to the fact that an atmospheric type of pilot burner is used in conjunction with the constant bleed type of diaphragm valve, controlled by a modulating controller valve.

It is to be further noted that with a constant bleed type of diaphragm valve, controlled with a modulating controller valve, the valve is automatically sized to any burner within the valve's capacity range, without individual minimum rate adjustments. The valve is capable of operating at much lower differentials between on and off than those of the prior art.

Since various modifications of components of the control apparatus described above may be made without departing from the spirit of the invention, it is to be understood that the scope of the invention is to be determined from the appended claims.

I claim as my invention:

1. A dryer comprising a drum, a motor for driving said drum, control means for controlling a heat supply to said drum, first means responsive to a condition indicative of drying in said drum for operating said control means to variably supply heat to said drum to maintain a uniform drying condition therein, and second means responsive to the heat supplied to the dryer also adapted to control said control means for starting and stopping the supply of heat to said drum and for controlling the operation of said motor, said second means having a manual operator for initially actuating said second means to start the supplying of heat to said drum and to start said motor, said second means being operable to keep said motor operating so long as the heat supplied to the drum does not cause the temperature within the drum to exceed a preselected amount or the temperature of the heat supplied to said drum does not drop below a preselected lower amount and to stop the supply of heat and said motor when the temperature of the heat supplied to the drum has dropped to a preselected level.

2. A clothes dryer comprising a drum, a motor for turning said drum, said drum having an air inlet and an air outlet, a diaphragm valve having an inlet passageway, an outlet passageway, a diaphragm actuated valve between said passageways, and a pressure chamber on the opposite side of said diaphragm from the actuated valve; a first passage extending from said inlet passageway to said pressure chamber; a pressure regulator valve in said first passageway and regulating gas flow through said first passage; an atmospheric type pilot burner; a second passageway extending from the outlet side of said pressure regulator to said pilot burner; a first flow restrictor in said second passageway; a condition responsive modulating valve in said first passageway between said second passageway and said diaphragm valve and responsive to a drying condition in said dryer; an electrically operated valve in said first passageway between said second passageway and said pressure chamber of said diaphragm valve; means responsive to heat at said air inlet to said drum for completing a circuit to said electrically operated valve to open said valve when the heat is sufficient to keep the inlet temperature above a predetermined amount and below a predetermined higher amount; a third passageway communicating with said pressure chamber and with said second passageway between said first flow restrictor and pilot burner; and a second flow restrictor in said third passageway for cooperation with said modulating valve to control the pressure in said pressure chamber and thereby control the position of the diaphragm actuated valve.

3. A clothes dryer comprising an electric motor driven drum, said drum having an air inlet and an air outlet; a diaphragm valve having an inlet passageway, an outlet passageway, a diaphragm actuated valve between said passageways and a pressure chamber on one side of the diaphragm of the actuated valve; a first passageway extending from said inlet passageway to said pressure chamber; a pressure regulator valve in said first passageway and regulating gas flow through said first passageway and pilot burner; a second passageway extending from the outlet side of said pressure regulator to said pilot burner; a first flow restrictor in said second passageway; a control valve located in said first passageway between said second passageway and said pressure chamber and having valve operating means responsive to a drying condition in said dryer; an electrically operated valve in said first passageway between said second passageway and said pressure chamber; means responsive to the air temperature at the inlet of said drum for maintaining a circuit to said electrically operated valve and motor to energize said valve

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and motor when the temperature is above a predetermined temperature and below a predetermined higher temperature, said means having a manual operator for initially completing said circuit; a third passageway communicating with said pressure chamber and with said second passageway between said first flow restrictor and pilot burner; and a second flow restrictor in said third passageway for cooperation with said control valve to control the pressure in said pressure chamber and the position of the diaphragm actuated valve.

4. A clothes dryer comprising a dryer drum having an inlet and an outlet; a diaphragm valve having an inlet passageway, an outlet passageway, a diaphragm actuated valve between said passageways and a pressure chamber on the opposite side of the diaphragm from the actuated valve; a first passageway extending from said inlet passageway to said pressure chamber; a pressure regulator valve in said first passageway and regulating gas flow through said first passageway; a pilot burner; a second passageway extending from the outlet side of said pressure regulator to said pilot burner; a first flow restrictor in said second passageway; a control valve responsive to the temperature of air leaving the dryer drum and located in said first passageway between said second passageway and said diaphragm valve; an electrically operated valve in said first passageway between said second passageway and said diaphragm valve; a control circuit having a thermostat positioned to be responsive to the temperature of air entering the dryer drum for completing a portion of said control circuit to said electrically operated valve to open said valve when the temperature is above a predetermined level and below a predetermined higher temperature; a third passageway communicating with said pressure chamber and with said second passageway between said first flow restrictor and pilot burner; and a second flow restrictor in said third passageway for cooperation with said control valve to control the pressure in said pressure chamber and the position of the diaphragm actuated valve.

5. A clothes dryer comprising a dryer drum having an inlet and an outlet; a diaphragm valve having an inlet passageway, an outlet passageway, a diaphragm actuated valve and a pressure chamber on the opposite side of the diaphragm from said diaphragm actuated valve; a first passageway extending from said inlet passageway to said pressure chamber; a pressure regulator valve in said first passageway and regulating a gas flow through said

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passageway; an atmospheric type pilot burner; a second passage extending from the outlet side of said pressure regulator to said pilot burner; a first flow restrictor in said second passageway; a control valve positioned in said first passageway between said second passageway and said diaphragm valve and having valve operating means responsive to a drying condition in said dryer drum; a third passageway communicating with said pressure chamber and with said second passageway between said first flow restrictor and said pilot burner; and a second flow restrictor in said third passageway for cooperation with said control valve to control the pressure in said pressure chamber and thereby control the position of the diaphragm actuated valve to regulate the rate of flow of gas.

6. A dryer comprising a motor, a drum driven by said motor, a control circuit for controlling the supply of heat to said drum, said drum having an outlet duct for discharging moist air, first means adapted to be responsive to a first condition indicative of the degree of drying of a load contained in the drum, said first means being adapted to modulate the supply of heat to the dryer, and second means adapted to be responsive to a second condition indicative of the amount of heat being supplied to the drum, said second means also being adapted to control the energization of said motor and the supply of heat and to shut down the heat supply whenever said second condition reaches a predetermined low degree without stopping said motor and to stop said motor when a lower predetermined degree is reached, said second means also being adapted to shut off the heat supply when a predetermined high degree is reached.

7. The dryer defined in claim 6 wherein the second means has means to compensate for changes in ambient temperature and has means for manually starting the supply of heat to the drum.

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