

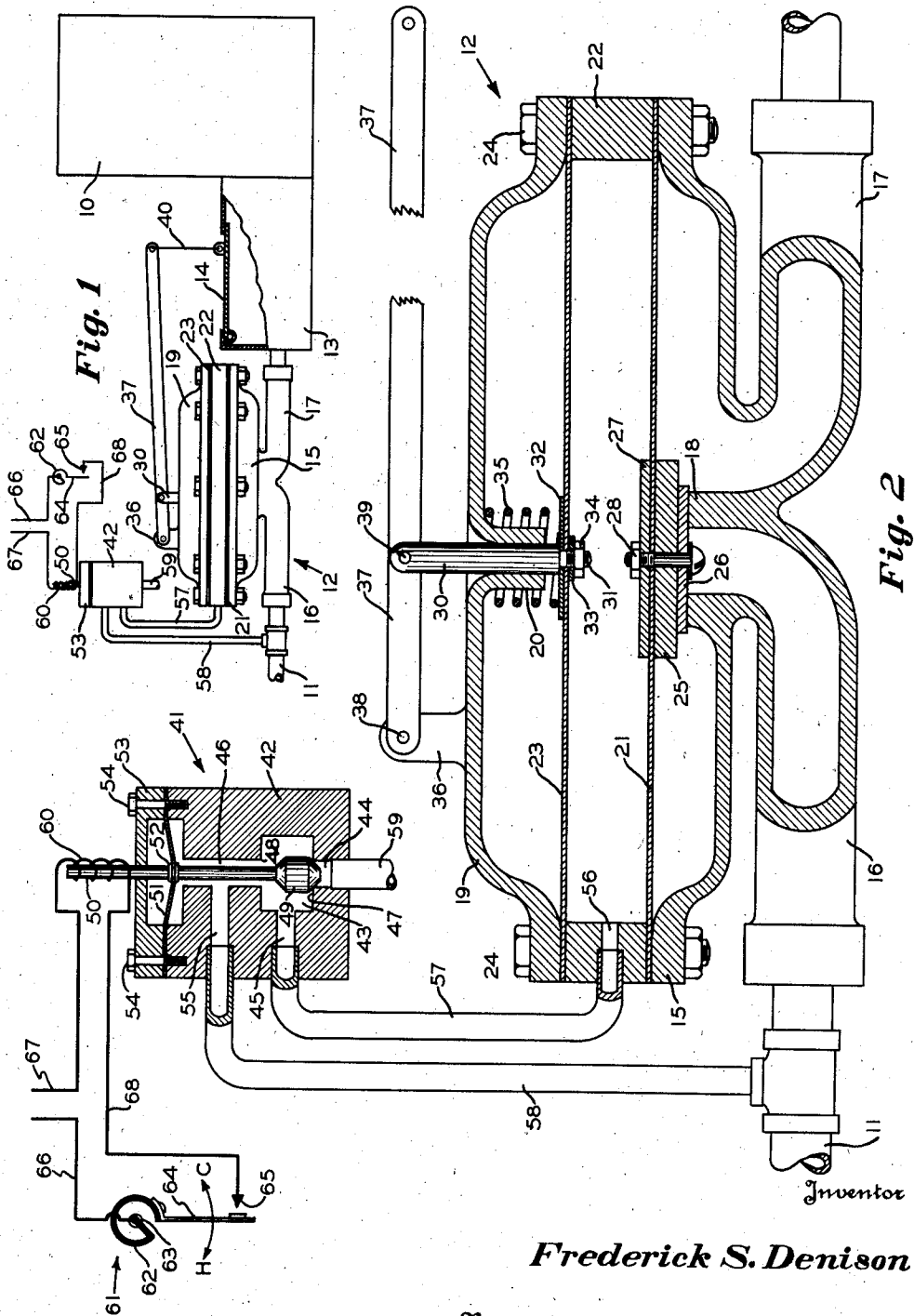
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CONTROL MECHANISM

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CONTROL MECHANISM

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The present invention relates to the control of fuel burners and particularly to those arrangements in which a single motor means controls a fuel valve and a second control device, such as a control arm for operating a secondary air damper that controls the flow of combustion supporting air.

One of the objects of the present invention is the provision of a burner control system in which a single motor means controls a fuel valve and a second control device, the arrangement being such that the fuel valve can close independently of operation of such control device whereby sticking of the control device will not cause the fuel valve to be maintained in open positions. In the specific embodiment of the invention that will be hereinafter described, the second control device takes the form of a secondary air damper.

In carrying out the present invention, the motor means is of the pressure-operated type. In order to obtain independent operation of the valve and secondary air damper, the pressure motor is provided with two movable walls which take the form of movable diaphragms. One of these diaphragms is connected to the fuel valve and the other is connected to the secondary air damper. As a result, sticking of the secondary air damper only prevents movement of its diaphragm but does not interfere with the operation of the valve controlling diaphragm whereby the fuel valve can always be closed.

A further object of the invention, therefore, is the provision of a pressure motor having a pair of movable walls each of which independently controls one of a pair of control devices.

Other objects of the invention will be found in the drawing, the detailed description and the appended claims.

For a more complete understanding of the invention, reference may be had to the following description and the accompanying drawing, in which:

Fig. 1 is an illustration of the complete system shown applied to a boiler or furnace, and

Fig. 2 is an enlarged showing of the pressure motor and devices controlled thereby and the means for controlling the pressure motor.

Referring to the drawing, the present invention is shown applied to a boiler or furnace 10, having a burner therein (not shown) to which fuel is supplied by means of a gas supply line 11. Interposed in the gas supply line 11 is a unitary structure 12 that includes a pressure motor and a main gas valve. The gas supply line 11 commu-

nicates with the burner and furnace 10 and passes through an auxiliary or secondary air housing 13 that is provided with a damper 14 which controls the flow of secondary air to the burner in a manner well known in the art.

The unitary structure 12 includes a lower casting 15 that is provided with a gas inlet conduit 16 and a gas outlet conduit 17, the casting being arranged to provide a valve seat 18. The unitary structure 12 further includes an upper casting 19 that is provided with a centrally located downwardly extending portion 20. An annular ring 22 is interposed between the upper casting 19 and lower casting 15 and serves to clamp a lower diaphragm 21 against the lower casting 15 and an upper diaphragm 23 against the upper casting 19. Suitable bolt and nut assemblies 24 are provided to securely clamp the upper and lower castings 19 and 15, the annular ring 22, and the upper and lower diaphragms 23 and 21 securely together.

The upper and lower diaphragms 23 and 21 and the annular ring 22 define a pressure motor having two movable walls constituted by the two diaphragms 21 and 23. Secured to the lower diaphragm 21 is a counter-weight 25 and a valve disc 26, the valve disc 26 cooperating with the valve seat 18 formed in the lower casting 15. A backing member 27 is preferably supplied on the upper surface of lower diaphragm 21 and a screw and nut assembly 28 securely clamps together the counter-weight 25, valve disc 26 and backing member 27.

An actuating rod 30 extends through the portion 20 of the upper casting 19 and is provided with a reduced screw threaded terminal portion 31 which extends through the upper diaphragm 23. A combined backing member and spring bearing member 32 is interposed between the actuating rod 30 and upper surface of the diaphragm 23 and a backing member or washer 33 is placed on the terminal portion 31 of the actuating rod 30 and abuts the lower surface of diaphragm 33. A nut 34 which cooperates with the screw threads of the terminal portion 31 firmly clamps these parts together. A coiled spring 35 is placed over the portion 20 of the upper casting 19 and has one of its ends abutting the spring bearing member 32 and its other end abuts the casting 19. The casting 19 is further provided with an upstanding lug 36 to which a secondary air damper arm 37 is pivoted as indicated at 38. The secondary air damper arm 37 is likewise pivotally secured to the actuating rod 30 by means of a pin 39. The extended end of

damper arm 37 is connected to the secondary air damper 14 by any suitable means such as the cable indicated at 40.

The pressure in the pressure motor defined by the diaphragms 21 and 23 and the annular ring 22 is controlled by a three-way control valve 41. This control valve 41 comprises the casting 42 that is provided with a control chamber 43. The casting 42 is further provided with passages 44, 45 and 46, all of which communicate with the control chamber 43. The passages 44 and 46 communicate with the control chamber 43 at opposite sides and form valve seats 47 and 48. A valve head 49 is located within the control chamber 43 and is adapted to selectively engage the valve seats 47 and 48 to close off the passages 44 and 46 respectively. A valve stem 50 is connected to the valve head 49 and extends upwardly through the passage 46. The passage 46 is sealed off from the atmosphere by means of a diaphragm 51 which is suitably secured to the valve stem 50, as indicated at 52, and is clamped to the casting 42 by means of a clamping ring 53 and suitable screws 54. A passage 55 is provided in the casting 42 which is substantially parallel to the passage 45 and which communicates with the passage 46.

The annular ring 22 of the pressure motor is provided with an opening 56 and a control line or pipe 57 connects the passage 45 of the casting 42 and the opening 56 of the annular ring 22. The passage 55 of the casting 42 is connected to the gas supply line 11 ahead of the main valve by a control line or pipe 58. The passage 44 is connected to the atmosphere by a bleed pipe 59 which may be utilized to lead the exhausted gas to any desired remote point such as to the main burner for consumption.

The valve stem 50 may be controlled in any desired manner and preferably is controlled in accordance with the value of some condition, changes in which indicate the desirability of permitting the flow of gas to the burner in the furnace 10. The valve stem 50 is herein shown as being electrically controlled by an electromagnetic coil 60 that is controlled by a thermostat 61. The thermostat 61 comprises a bimetallic actuating element 62 of coiled formation, one end of which is secured to a post shown at 63. The other end of the bimetallic actuating element 62 carries a switch arm 64 that is adapted to cooperate with a contact 65. A line wire 66 is connected to the fixed end of bimetallic element 62 and a second line wire 67 is connected to one end of the electromagnetic coil 60. A control wire 68 interconnects the other end of the electromagnetic coil 60 and the contact 65. The thermostat 61 may respond to any desired temperature condition and for the purposes of the present explanation will be considered as responding to variations in room temperature, the room in turn being heated by the furnace 10.

With the parts in the position shown, the room temperature is at or above the desired value so that switch arm 64 is disengaged from contact 65. The electromagnetic coil 60 is therefore de-energized and the valve stem 50 is in its lowermost position wherein the valve head 49 closes off the passage 44 and allows communication between the passages 55 and 45 by way of passage 46. Pressure from the gas line 11 is therefore transmitted to the pressure motor by way of control pipe 58, passage 55, passage 46, passage 45, control pipe 57 and opening 56. The valve disc 26 is therefore seated upon the valve

seat 18, preventing flow of gas to the burner in furnace 10 and the diaphragm 21 is raised against the counter-active force of coil spring 35 so that the secondary air damper 14 is closed. Now if the room temperature falls to the desired minimum, switch arm 64 will be brought into engagement with contact 65 by bimetallic actuating element 62 whereupon electromagnetic coil 60 is energized by the following circuit: line wire 66, bimetallic actuating element 62, switch arm 64, contact 65, wire 68, electromagnetic coil 60 and line wire 67. Valve stem 50 is therefore raised and the valve head 49 is lifted to establish communication between the passages 45 and 44 and to prevent communication between the passages 45 and 55. The pressure between diaphragms 21 and 23 therefore bleeds out through the hole 56, pipe 57, passage 45, control chamber 43, passage 44 and bleed pipe 59. The spring 35 and the weight of secondary air damper 14 thereupon cause the diaphragm 23 to move downwardly whereupon the secondary air damper 14 opens. The line pressure in the inlet conduit 16 operates on the underside of valve disc 26 to lift the same against the action of counter-weight 25, this being made possible by the draining of the pressure from above the diaphragm 21. As soon as the valve disc 26 raises slightly from the valve seat 18, gas enters the chamber formed by lower casting 15 and diaphragm 21 whereupon the whole diaphragm 21 is subjected to line pressure and quickly lifts the valve disc 26 to full open position. Gas therefore flows to the burner in the furnace 10, where it may be ignited in any of the usual manners and serves to heat the furnace 10 that in turn heats the room in which the thermostat 61 is positioned.

When the room temperature has thus been restored, the switch arm 64 will again move to the position shown wherein it is disengaged from the contact 65 so that the valve head 49 again establishes communication between passages 45 and 55 and interrupts communication between passages 45 and 44. Pressure from gas line 11 is therefore again transmitted to the pressure motor and lifts diaphragm 23 to again close the secondary air damper 14. This pressure also acts on the top of diaphragm 21 and counteracts and balances the pressure on the underside of the diaphragm 21. The counter-weight 25 is thereby rendered effective to move the diaphragm 21 downwardly and bring the valve disc 26 into engagement with the valve seat 18. As soon as this occurs, further flow of gas to the chamber formed by lower casting 15 and diaphragm 21 is prevented and the gas already therein drains off to the burner in the furnace 10 and is consumed. The valve 26 is thereafter held forcibly closed by the pressure in the pressure motor acting upon the complete upper surface of the diaphragm 21.

In the event the secondary air damper 14 should fail to open or close by reason of sticking of the parts or for any other reason, it will be apparent that the valve disc 26 is nevertheless freely controlled by the diaphragm 21, since the secondary air damper 14 is controlled by the entirely separate diaphragm 23. This insures that the valve disc 26 may move to valve closed position independently of the operation of the secondary air damper 14.

It will be apparent that while a single specific embodiment of the invention has been herein disclosed that the independent control of the gas valve and the secondary air damper could be ac-

complied in many other manners and that many changes could be made in the manner in which the pressure in the pressure motor is varied without departing from the spirit of the present invention and I therefore intend to be limited only by the scope of the appended claims.

I claim:

1. The combination with a burner, a valve in control of the flow of air to the burner; of a pressure motor having a housing and first and second movable walls in said housing, mechanical connections between one of said movable walls and said valve, mechanical connections between the other of said movable walls and said air damper, a three-way control valve, and connections between said control valve and the space between said walls of said pressure motor to admit fluid to or permit the escape of fluid from said motor.

2. In combination with a burner, a fuel valve in control of the flow of fuel to the burner and a damper in control of the flow of air thereto; of a pressure motor including a pair of diaphragms forming two walls of said pressure motor, means operatively connecting one of said diaphragms to said valve and means operatively connecting the other of said diaphragms to said damper, said connecting means being independent of each other so as to permit movement of said valve even though said damper sticks in one position, and further means controlling the pressure in said motor between said diaphragms.

3. The combination with a burner, a valve in control of the flow of fuel to the burner, and an air damper in control of the flow of air thereto, said damper being biased to an open position, of a pressure motor, a connection between said pressure motor and the fuel valve to cause actuation of the latter by the former, a lever having one portion thereof connected to said damper, connecting means between said lever and said pressure motor effective to cause said lever to close said damper upon movement of said pressure motor in a direction to close said valve, said connecting means between said lever and said motor permitting closing of said valve in the event that the lever is held in a position corresponding to damper open position due to said air damper sticking open.

4. In combination, a burner, a fuel valve in control of the flow of fuel to the burner, a secondary air damper in control of the flow of secondary air to the burner, pressure motor means, a connection between said motor means and the fuel valve to cause actuation of the latter by the former, a motor casing, a lever pivotally supported on said motor casing and having one portion thereof connected to said damper, means connecting said motor means to said lever to cause said lever upon suitable actuation of said pressure motor to open and close said damper concurrently with the opening and closing of said valve, said means connecting said motor means to said lever permitting closing of said valve in the event that the lever is held in a position corresponding to damper open position due to said air damper sticking open.

5. The combination with a burner, a valve in control of the flow of fuel to the burner, and a control device the operation of which from a first to a second position and back should desirably take place concurrently with the opening and closing of the valve, of a pressure motor, a housing therefor, a mechanical connection between said pressure motor and the fuel valve to

cause actuation of the latter by the former, said connection extending at least partly into said housing, a lever having one portion thereof connected to said control device, mechanical connecting means between said lever and said pressure motor located at least partially in said housing and effective to cause said lever to move said control device from said second to said first position upon movement of said pressure motor in a direction to close said valve, said connecting means between said lever and said motor permitting closing of said valve in the event that the lever is held in a position corresponding to the position assumed when said control device is in said second position, due to said device being stuck in said position.

6. In combination, a main burner, a valve in control of the flow of fuel to the burner, an air damper in control of the flow of air thereto and biased to an open position, a pressure motor, a housing for said pressure motor, connecting means between said pressure motor and said fuel valve to cause actuation of the latter by the former, a movable member within said housing, a non-yieldable connection between said member and said damper, connecting means between said motor and said movable member effective to cause said member to close said damper upon movement of said pressure motor in a direction to close said valve, said connecting means between said member and said motor permitting closing of said valve in the event that said member is held in a position corresponding to damper open position due to said air damper sticking open.

7. The combination with a burner, a valve in control of the flow of fuel to the burner, and an air damper in control of the flow of air thereto, of a motor, a housing therefor, members associated therewith in said housing and actuated directly thereby, said members normally moving simultaneously but being capable of independent movement, mechanical connecting means between one of said members and said valve, and further mechanical connecting means between the other of said members and said damper.

8. The combination with a burner, a valve in control of the flow of fuel to the burner, and a damper, the operation of which should desirably take place simultaneously with the valve, of a motor, a housing therefor, a plurality of members associated therewith in said housing and actuated directly thereby, said members normally moving simultaneously but being capable of independent movement, mechanical connecting means between one of said members and said valve, and further mechanical connecting means between the other of said members and said damper.

9. The combination with a burner, a fuel valve in control of the flow of fuel to the burner and a damper in control of the flow of air thereto, of a pressure motor having a housing and a pair of diaphragms in said housing forming two walls of said pressure motor, mechanical connections between one of said diaphragms and said valve, mechanical connections between the other of said diaphragms and said damper, and means in control of the pressure in said motor between said diaphragms.

10. In a fluid fuel burner control system, a valve controlling the flow of fuel to the burner, said valve comprising an inlet passage and a valve disc covering said inlet passage and subjected to the pressure of the fluid fuel, which

tends to urge said valve disc away from its seat, a diaphragm connected to said valve disc and adapted when pressure is applied to a pressure chamber face of said diaphragm to urge said valve against its seat, a secondary air damper controlling the flow of secondary air to said burner, said damper being biased to open position, a diaphragm operatively connected to said damper and adapted when pressure is applied to a pressure chamber face of said diaphragm to move said damper to closed position, and thermostatically controlled valve means for applying fuel pressure from a fuel supply line simultaneously to the pressure chamber faces of both of said diaphragms.

11. In a fluid fuel burner control system, a valve controlling the flow of fuel to the burner, said valve comprising a valve body having inlet and outlet passages with an opening therebetween forming a valve seat, a diaphragm assembly forming a movable wall extending over and seating on said valve seat, at least a portion of said diaphragm assembly being exposed on one face thereof to the inlet pressure of the fluid fuel, which tends to urge said diaphragm assembly away from the seat, said diaphragm assembly being adapted when pressure is applied to its opposite face constituting the pressure chamber face thereof to seat firmly on said valve seat, a secondary air damper controlling the flow of secondary air to said burner, said damper being biased to open position, a diaphragm assembly operatively connected to said damper and adapted when pressure is applied to a pressure chamber face of said diaphragm assembly to move said damper to closed position, and valve means controlled by means responsive to a condition indicative of the demand for burner operation for applying fuel pressure from a fuel supply line simultaneously to the pressure chamber faces of both of said diaphragm assemblies.

12. In a fluid fuel burner control system, a valve controlling the flow of fuel to the burner, said valve comprising a valve body having inlet and outlet passages with an opening therebetween forming a valve seat, a diaphragm assembly forming a movable wall extending over and seating on said valve seat, at least a portion of said diaphragm assembly being exposed on one face thereof to the inlet pressure of the fluid fuel, which tends to urge said diaphragm assembly away from the seat, said diaphragm as-

sembly being adapted when pressure is applied to its opposite face constituting the pressure chamber face thereof to seat firmly on said valve seat, a secondary air damper controlling the flow of secondary air to said burner, said damper being biased to open position, a diaphragm assembly operatively connected to said damper and adapted when pressure is applied to a pressure chamber face of said diaphragm assembly to move said damper to closed position, means including a two position valve operative in one position of said valve to apply fuel pressure from a fuel supply line simultaneously to the pressure chamber faces of both of said diaphragm assemblies and in its other position to expose said pressure chamber faces to substantially atmospheric pressure, and means responsive to a condition indicative of the demand for burner operation for controlling the position of said valve.

13. In a fluid fuel burner control system, a valve controlling the flow of fuel to the burner, said valve comprising a valve body having inlet and outlet passages with an opening therebetween forming a valve seat, a diaphragm assembly forming a movable wall extending over and seating on said valve seat, at least a portion of said diaphragm assembly being exposed on one face thereof to the inlet pressure of the fluid fuel, which tends to urge said diaphragm assembly away from the seat, said diaphragm assembly being adapted when pressure is applied to its opposite face constituting the pressure chamber face thereof to seat firmly on said valve seat, a secondary air damper controlling the flow of secondary air to said burner, said damper being biased to open position, a diaphragm assembly operatively connected to said damper and adapted when pressure is applied to a pressure chamber face of said diaphragm assembly to move said damper to closed position, means including a solenoid operated two position valve operative in one position of said valve to apply fuel pressure from a fuel supply line simultaneously to the pressure chamber faces of both of said diaphragm assemblies and in its other position to expose said pressure chamber faces to substantially atmospheric pressure, and means responsive to a condition indicative of the demand for burner operation for controlling the energization of said solenoid.

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