

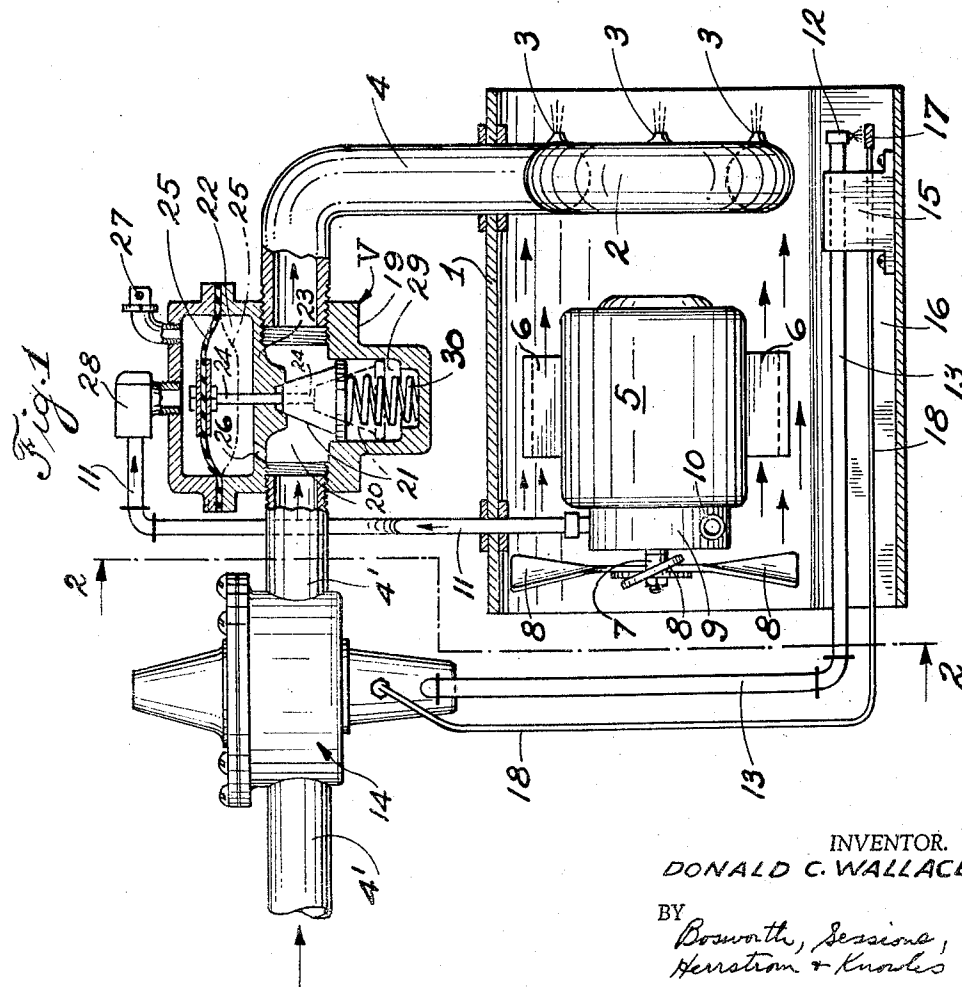
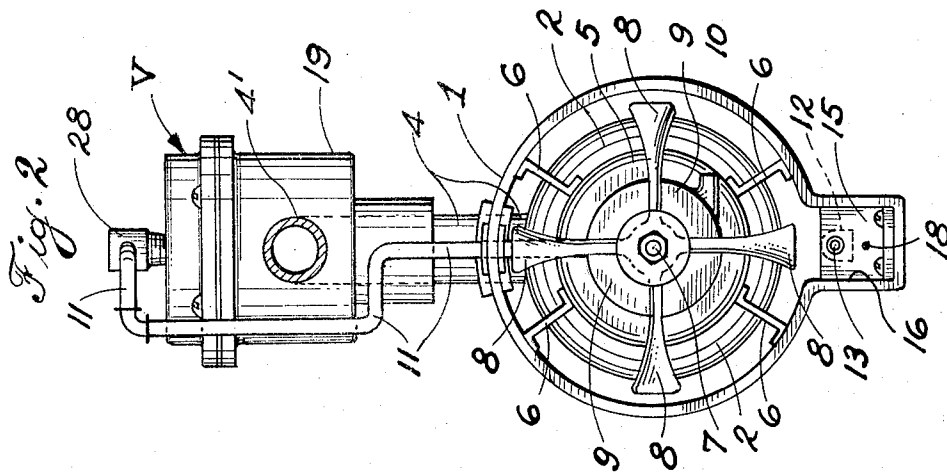
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AUTOMATIC SHUT-OFF VALVE CONTROL FOR FUEL BURNERS

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AUTOMATIC SHUT-OFF VALVE CONTROL FOR FUEL BURNERS

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This invention relates to fuel burner apparatus and more particularly to improved control apparatus for a main shut-off valve of a fluid fuel burner having blower means for providing combustion air thereto.

In various types of furnaces and heating apparatus fluid fuel burners are employed wherein combustion air is supplied by a power driven blower. Such burners may be designed for either gaseous or liquid fuel. In this specification a gas burner is particularly referred to, but it will be understood that my invention is also applicable to liquid fuel burners.

When combustion air is supplied to a fluid fuel burner by a power blower (which may be of the centrifugal, propeller, gear, piston or other type), it has been proposed to control the main fuel valve by means actuated by the air under pressure delivered from the blower. The object of such devices is to provide an automatic safety shut-off means whereby, if the combustion air supply fails due to stoppage of the blower, the fuel supply will be shut off, thus preventing the continued and dangerous flow of fuel to the burner without the regular and proper supply of combustion air.

It is among the objects of the present invention to provide an improved type of automatic control means for fluid fuel burners having a supply of combustion air delivered from a power actuated blower whereby positive shut-off action is obtained and whereby, when the burner is started in operation, the main fuel valve will not be opened until a predetermined time after the combustion air blower has started, thus permitting proper combustion conditions to be obtained in the burner and to purge the burner of any undesirable gas accumulations before ignition of the fuel.

A further object of my invention is the provision of a rugged, simple and completely automatic fuel control valve for gas burners or the like whereby the fuel valve is positively closed when the combustion air blower is not operating, the lag or delay in opening the main valve after starting the blower may be readily adjusted, and which, in the event of failure of the valve operating diaphragm, will "fail safe" and immediately close the main fuel valve, thus shutting off the burner.

The above and other objects of my invention will appear from the following description of one embodiment thereof, reference being had to the accompanying drawings in which:

Figure 1 is a more or less schematic illustration, in partial vertical cross-section, of a burner incorporating my improved automatic fuel control means; and

Figure 2 is a vertical cross-sectional view taken substantially on line 2—2 of Figure 1.

It has been previously pointed out that the present invention is adapted for use with various types of fuel burners. In the drawings, I have illustrated a simple form of gas burner comprising a generally cylindrical shell or housing 1, open at both ends and having adjacent its outlet end a generally circular gas manifold 2 having jets or nozzles 3 spaced circumferentially there-

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about and adapted to direct gas toward the outlet (right-hand) end of the shell 1. Gas is supplied to the manifold 2 through the main gas line 4 which passes through and is suitably supported in the shell 1.

Upstream of the gas manifold 2 and within the shell 1 is the blower drive motor 5. This motor is, of course, provided with suitable electrical connections (not shown) and is supported in a central location within the tubular shell 1 by a plurality of radial webs 6 which are secured to the outside of the motor housing and to the inside of the shell 1. The shaft 7 of motor 5 carries at its outer end a propeller type fan or blower 8. Motor 5, when operating, rotates shaft 7 in a direction to cause the fan 8 to pull air into the lefthand end of shell 5 and force same around motor 5 and past the gas manifold 2. This combustion air mixes with the gas delivered from the nozzles 3 and thus a proper combustion mixture is provided. It will be understood that the burner arrangement that has been described may be enclosed in a furnace or other structure and further that any suitable type of air pump or blower mechanism may be employed for delivering combustion air to the burner housing.

Also mounted on and driven by the shaft 7 of blower motor 5 is an independent air pump 9. As illustrated this unit is a vane-type pump having an air inlet at 10 and having its outlet directed into the pipe 11. Again, although I have illustrated a vane-type rotary pump 9, other independent air pump means may be employed such as centrifugal pumps, piston pumps, etc.

As the independent air pump 9 is driven by the same motor 5 that drives the combustion air blower 8, the two units will operate concurrently. Thus, whenever the motor 5 is started to deliver combustion air through the burner, the air pump 9 will be started and will independently deliver air under pressure to the outlet pipe 11. In apparatus of this type the output of the blower 8 is at relatively low pressure whereas the output air pump 9 is preferably designed to deliver atmosphere at a considerably higher pressure. The separate supply of air under relatively high pressure provided by the air pump 9 is utilized to actuate and control a shut-off valve V in the main fuel line, as will be described later. By providing a higher outlet pressure for the pump 9 than that provided by the blower 8, and utilizing the output of the pump 9 solely for operation of the fuel shut-off valve, the shut-off valve structure may be made most compact and efficient.

Before describing the automatic fuel shut-off valve and operation thereof, it is pointed out that the burner illustrated in the drawings includes a pilot light 12 which is supplied with gas through a pipe 13 which leads to the combined pressure regulator and safety pilot unit 14. The pilot 12 is supported in a bracket 15 disposed in a depending trough 16 at the bottom of the cylindrical shell 1. Also supported in bracket 15 and disposed adjacent the flame from the pilot light 12 is a thermocouple 17, the leads from which are indicated at 18 and extend through trough 16 with the pipe 13 and up to the pressure regulator and safety pilot unit 14. The gas supplied to the burner enters through the upstream end 4' of the main gas line, and the pressure regulator and safety pilot unit 14 are disposed in this pipe 4'. The pressure regulator portion of unit 14 maintains a constant pressure of the gas that flows from its delivery side to the burner. The safety pilot mechanism is such that if the pilot light 12 goes out, with resultant cooling of the thermocouple 17, the main gas line 4' will be closed, shutting off the main burner and the flow of gas to pilot 12 through pipe 13. The pressure regulator and safety pilot mechanism per se forms no part of the present invention but the pressure regulator function of

unit 14 is of assistance in the operation of our safety control apparatus by furnishing gas to the burner under substantially constant pressure regardless of fluctuations in the main gas supply.

My improved automatic shut-off valve is generally indicated at V and, as clearly seen in Figure 1, includes a housing 19 having a gas passage 20 extending therethrough. The pipe 4' is connected on the upstream side and the pipe 4 on the downstream or outlet side of passage 20. The plug type closure member 21 is seen in closed position in full lines in Figure 1 and in opened position in phantom lines. When in closed position the closure member 21 completely shuts off the flow of gas through the valve V and thus shuts off the supply of gas to the burner. A diaphragm chamber 22 is separated from the main gas passage 20 by a wall 23, and the valve stem 24 carries the closure member 21 at its lower end and extends through wall 23 with a substantially gas-tight sliding fit therein.

The upper end of the valve stem 24 is secured to a flexible diaphragm 25 which extends across the diaphragm chamber 22 and is movable therein. Although I have illustrated a flexible diaphragm as the means for moving the closure member 21, it will be understood that any equivalent mechanism, such as a piston operable in a cylinder, may be substituted for the flexible diaphragm shown. Accordingly, where the term diaphragm is used herein, it is intended to include and cover all types of movable pressure-responsive devices.

The diaphragm chamber 22, on the underside of diaphragm 25, is connected to the gas passage 20 by a hole 26, and on the opposite or outer side of diaphragm 25, is connected to atmosphere by a vent opening or orifice 27. The outlet pipe 11 from the independent air pump 9 is connected to the upper side of diaphragm chamber 22 through a suitable fitting 28 so that, whenever the pump 9 is operating, air under pressure will be applied against the topside of diaphragm 25. The bottom of closure member 21 has a sliding fit in a well 29 formed in the lower part of housing 19, and a compression spring 30 engages the underside of closure member 21 at its upper end and the bottom wall of well 29 at its lower end. This spring 30 at all times exerts a force urging the closure member 21 upwardly to its closed position seen in full lines in Figure 1.

The operation of the above described apparatus will now be explained.

When the motor 5 is turned off, the blower fan 8 will be stationary and the independent air pump 9 will also be inoperative. Accordingly there will be no flow of combustion air through the shell 1, and there will be no super-atmospheric air pressure from pump 9 impressed against the upper side of diaphragm 25. As the upper side of diaphragm 25 is connected to atmosphere through the vent hole 27, the spring 30, acting on the underside of closure member 21, together with the pressure of the gas in the passage 20 on the upstream side of closure member 21 will combine to hold the closure member 21 in closed position, thus shutting off completely the flow of gas through the pipe 4 to the burner manifold 2 and gas jets 3. The pressure of the gas on the upstream side of closure member 21 is effective against the underside of diaphragm 25 because of the connection between the bottom half of the diaphragm chamber 22 and the gas passage 20 provided by the hole 26 in wall 23.

Assuming that the pilot light 12 is burning so that the pressure regulator unit 14 will be open to permit the flow of gas therethrough, if the motor 5 is now started, the propeller fan 8 will immediately start to move combustion air through the burner shell 1 past the gas manifold 2 and nozzles 3, and the independent air pump 9 will immediately start to pump air through the pipe 11 to the upper half of the diaphragm chamber 22 and build up air pressure therein.

The pressure output of the pump 9, the area of the

diaphragm 25, and the size of the vent opening or orifice 27 are so designed and correlated that, after the motor 5 has been running at full speed for a short time, the air pressure generated by pump 9 will be sufficient to overcome the force exerted on the diaphragm 25 by the spring 30 and the gas pressure through the hole 26 and to move the diaphragm 25 down into its opened position shown in phantom lines in Figure 1. Corresponding downward movement of the closure member 21 fully opens the gas passage 20 through the valve V and gas will be supplied to the burner and ignited at the nozzles 3 by the pilot light 12.

The vent opening 27 permits the continuous escape of a limited quantity of air from the upper half of the diaphragm chamber 22. The effect of this escape orifice, when starting up the apparatus, is to delay the time at which the pressure on the upper side of diaphragm 25 will be built up to a value sufficient to overcome the combined action of spring 30 and the gas pressure on the underside and move the closure member 21 to opened position. The larger the vent opening 27, the longer will be the lag between the time when the motor 5 is started and the time when the valve V will open, and by regulating the size of the opening 27, the proper lag may be established to provide for complete purging of the burner and/or adjacent structures before the gas is turned on.

The vent 27 also facilitates prompt closing of the valve V under the action of spring 30 when the motor 5 stops or if for any reason the diaphragm 25 should rupture or otherwise fail. When the motor 5 stops, pressure on top of diaphragm 25 is eliminated and spring 30 can move the diaphragm immediately to its upper position and close the valve because the air in the upper half of the diaphragm chamber may escape to atmosphere through vent 27. In the event of rupture of the diaphragm 25, pressure on both its sides would immediately be equalized and the spring 30 would move the closure member 31 and diaphragm 25 into closed position. Prompt upward closing movement of these elements is permitted because the chamber 22 on top of the diaphragm 25 would be vented to atmosphere through opening 27. Furthermore any gas which, after such failure of the diaphragm 25, might escape into the top half of the diaphragm chamber 22, would also be vented to atmosphere through the orifice 27.

Another feature of my improved automatic shut-off apparatus is the provision of a proportional control for the fuel supplied to the burner. Thus if the motor 5 should slow down for any reason, the flow of combustion air from the fan 8 through shell 1 would be reduced. At the same time the pressure output of the air pump 9 would also be reduced and the pressure on the diaphragm 25 which, when the motor 5 is operating at full speed, holds the closure member 21 in full opened position, would be reduced permitting the partial closure of the closure member 21. Thus the flow of gas to the burner would be throttled in accordance with the reduction in the flow of air to the burner and proper and efficient combustion would be maintained but at a reduced rate.

Although I have described the illustrated embodiment of my invention in considerable detail, it will be understood that variations and modifications may be made in the form and arrangement of the various elements of my improved burner apparatus. I do not, therefore, wish to be limited to the exact structures and devices herein shown and described but claim as my invention all embodiments thereof coming within the scope of the appended claims.

I claim:

1. In combination with a fuel burner, a conduit for conducting fuel to the burner, a single blower means for supplying all of the combustion air to the burner, an independent air pump, common driving means for said blower means and said air pump, a fuel shut-off

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valve in said conduit, valve closing means effective at all times to urge said shut-off valve to closed position, diaphragm means for opening said shut-off valve in opposition to said valve closing means, and a conduit from said independent air pump to said diaphragm means whereby the entire output of air under pressure from said air pump is effective on said diaphragm means to open said shut-off valve when said blower means is operating, said diaphragm means including a vent connected at all times to atmosphere from the side of said diaphragm means against which said air under pressure from said air pump is effective.

2. In gas burner apparatus, a gas outlet nozzle, a pipe for conducting gas thereto, a single blower means for moving all of the combustion air past said nozzle, a gas shut-off valve in said pipe upstream of said gas nozzle, said shut-off valve including a movable closure member, a diaphragm chamber, a movable diaphragm in said chamber, operating connection between said diaphragm and said closure member, spring means for urging said closure member to closed position to shut off gas flow through said pipe, said diaphragm chamber having a gas passage connecting said pipe to said chamber on one side of said diaphragm and upstream of said closure member whereby the pressure of gas on said one side of said diaphragm will urge said closure member to closed position at all times, independent air pump means connected to and driven by said blower means, and conduit means for conducting the entire output of said air pump to said diaphragm chamber on said other side of said diaphragm.

3. In gas burner apparatus, a gas outlet nozzle, a pipe for conducting gas thereto, a single blower means for moving all of the combustion air past said nozzle, a gas shut-off valve in said pipe upstream of said gas nozzle, said shut-off valve including a movable closure member, a diaphragm chamber, a movable diaphragm in said chamber, operating connections between said diaphragm and said closure member, spring means for urging said closure member to closed position to shut off gas flow through said pipe, said diaphragm chamber having a gas passage connecting said pipe to said chamber on one side of said diaphragm and upstream of said closure member whereby the pressure of gas on said one side of said diaphragm will urge said closure member to closed position at all times, said diaphragm

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chamber on the other side of said diaphragm having a vent opening connected at all times to atmosphere, independent air pump means connected to and driven by said blower means, and conduit means for conducting the entire output of said air pump to said diaphragm chamber on said other side of said diaphragm.

4. In gas burner apparatus, a gas outlet nozzle, a pipe for conducting gas thereto, a single blower means for moving all of the combustion air past said nozzle, a pressure regulator in said pipe adapted to maintain a predetermined gas pressure in said pipe between said regulator and said nozzle, a gas shut-off valve in said pipe between said pressure regulator and said gas nozzle, said shut-off valve including a movable closure member, a diaphragm chamber, a movable diaphragm in said chamber, operating connections between said diaphragm and said closure member, spring means for urging said closure member to closed position to shut off gas flow through said pipe between said regulator valve and said nozzle, said diaphragm chamber having a gas passage connecting said pipe to said chamber on one side of said diaphragm and upstream of said closure member whereby the pressure of gas on said one side of said diaphragm will urge said closure member to closed position at all times, and said diaphragm chamber on the other side of said diaphragm having a vent opening connected at all times to atmosphere, independent air pump means connected to and driven by said blower means, and conduit means for conducting the entire output of said air pump to said diaphragm chamber on said other side of said diaphragm, said independent air pump being adapted, when said blower means is operating, to supply air only to said other side of said diaphragm under sufficient pressure to overcome the combined closing force exerted on said closure member by said spring and the gas pressure and move said closure member to opened position, said air vent permitting a limited quantity of air to escape to atmosphere from said other side of said diaphragm and creating a lag between the starting of said blower means and the opening of said shut-off valve.

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