Aug. 19, 1941. P. S. ARNOLD 2,253,160

APPARATUS FOR AUTOMATICALLY CONTROLLING FEED OF FUEL TO BURNERS OR FURNACES

Original Filed April 16, 1934 2 Sheets-Sheet 1

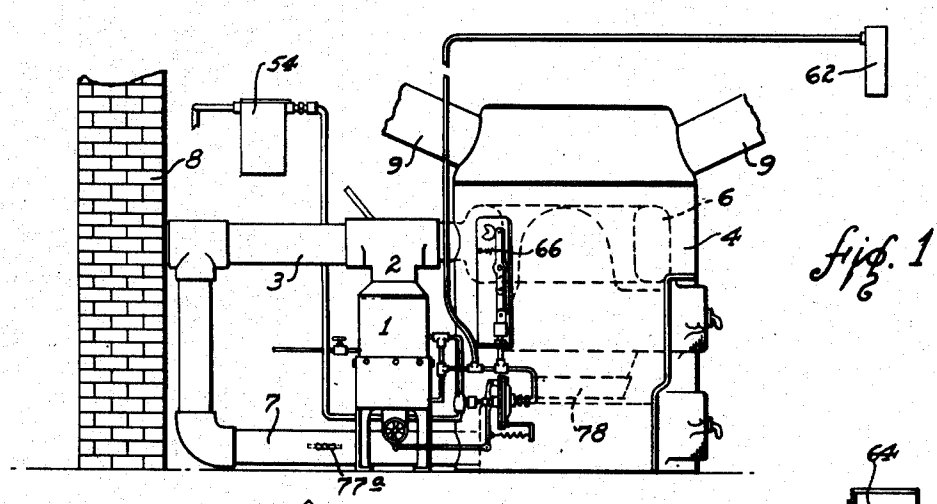


Fig. 1

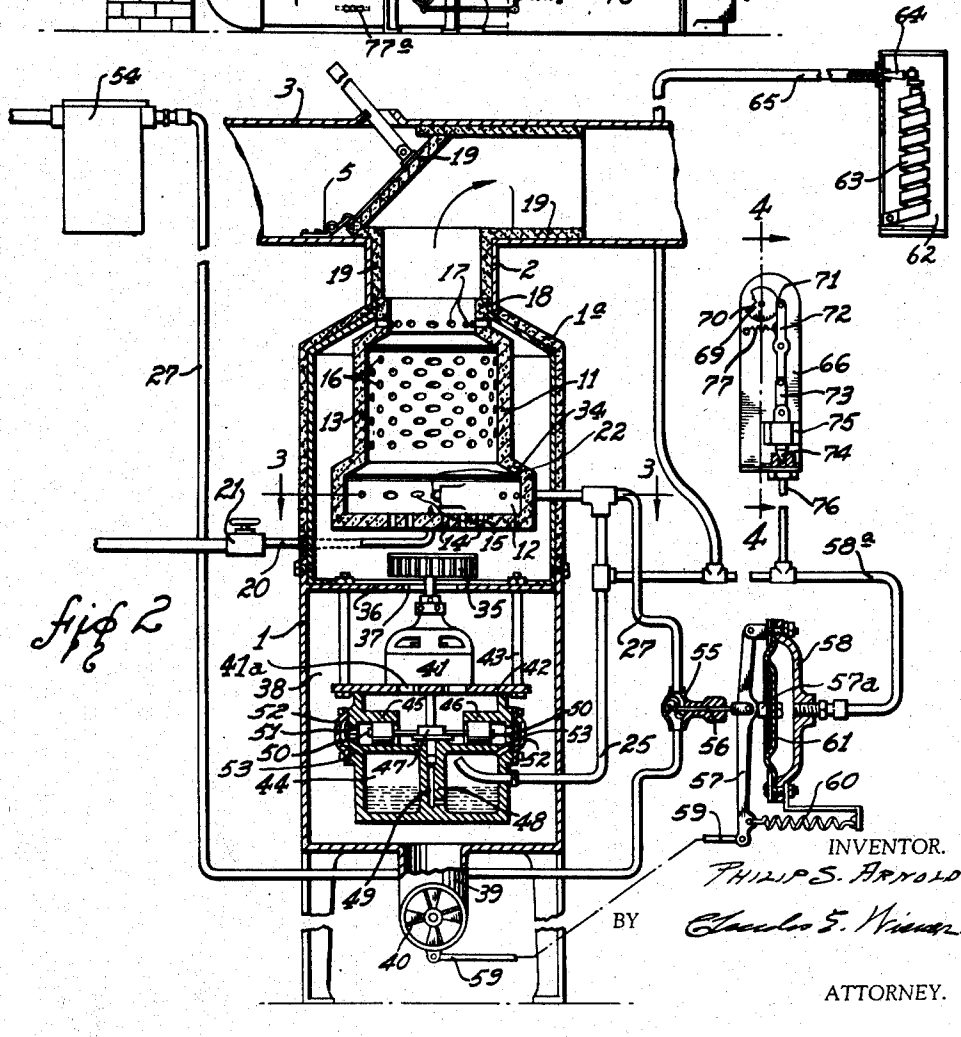


Fig. 2

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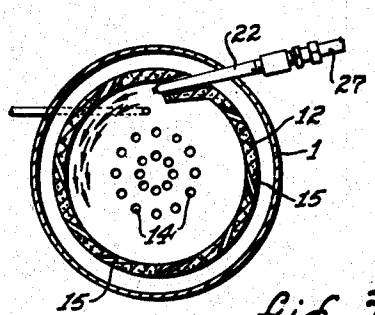


Fig. 3

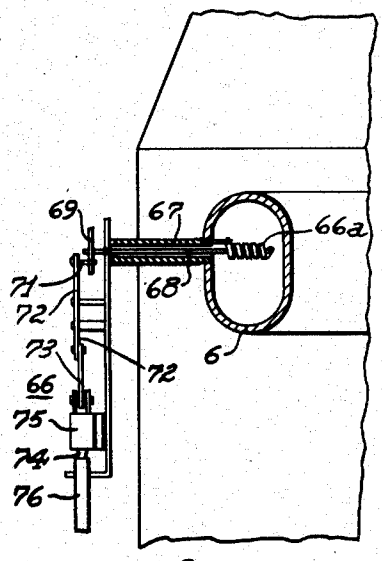


Fig. 4

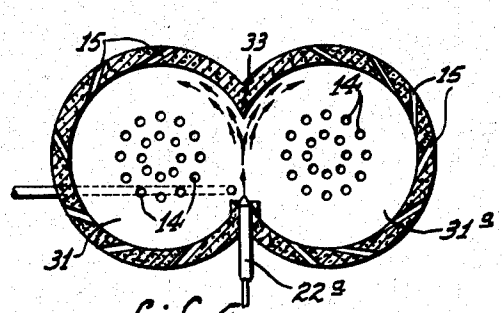


Fig. 5

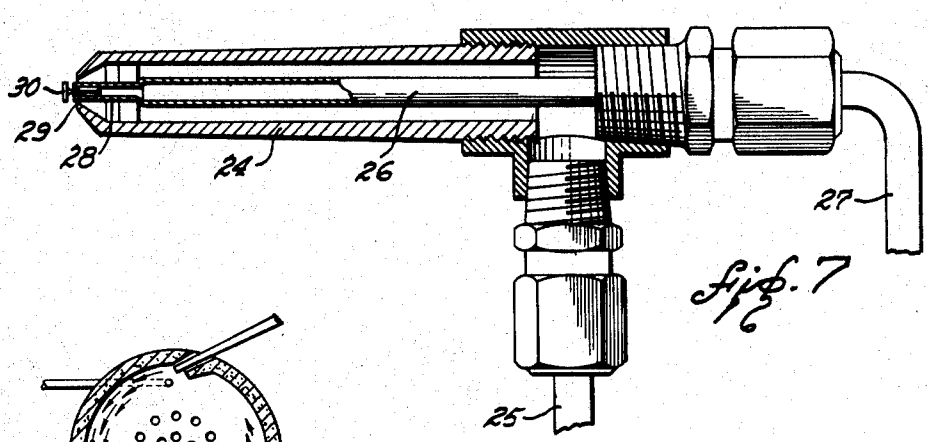


Fig. 7

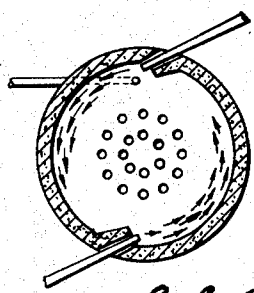


Fig. 6

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2,253,160

APPARATUS FOR AUTOMATICALLY CONTROLLING FEED OF FUEL TO BURNERS OR FURNACES

Philip S. Arnold, Flint, Mich.

Original application April 16, 1934, Serial No. 720,826. Divided and this application September 9, 1939, Serial No. 294,170

3 Claims. (Cl. 158—28)

This invention relates to apparatus for automatically supplying and for controlling the volume of flow of fuel per unit of time to a burner or furnace and is a division of my U. S. application for patent, Serial No. 720,826, for Fuel burner, filed April 16, 1934.

The object of the invention is to provide a nozzle for the discharge of hydro-carbon fuel into a combustion chamber in association with means for providing air under pressure to the nozzle to cause the liquid fuel to discharge into the combustion chamber in atomized form, and a pressure actuatable device connected with the air line for maintaining flow of fuel under pressure and a temperature controlled apparatus to vary pressure in the air line to correspondingly vary the volume of fuel discharged per unit of time in correspondence with variation in atmospheric temperature.

These and other objects and novel features of the invention are hereinafter more fully described and claimed and a burner or furnace embodying my invention is shown in preferred form in the accompanying drawings in which—

Fig. 1 is an elevation showing my improved burner as applied to a domestic heating furnace.

Fig. 2 is an enlarged vertical section of the burner proper and the associated control devices.

Fig. 3 is a section of the combustion chamber taken on line 3—3 of Fig. 2.

Fig. 4 is a section taken on line 4—4 of Fig. 2 showing the safety control.

Fig. 5 is a section similar to that shown in Fig. 3 showing an alternative form of construction of the combustion chamber at the point of introduction of the fuel.

Fig. 6 is a similar view of another form of construction of the combustion chamber.

Fig. 7 is a longitudinal section of a convenient form of atomizing nozzle.

In Figs. 1 and 2 is shown a preferred form of the construction and arrangement of the burner and the means for supplying air and oil under pressure thereto, the burner being housed in the casing indicated at 1 and to this casing is connected a conduit 2 opening to the exhaust flue 3 of the furnace indicated generally at 4. A valve 5 is provided in the flue 3 which, when in the open position as shown in Fig. 2, directs the gases of combustion into the flue and into the radiator ring 6 or chamber of the furnace through which the gases of combustion usually pass when used in the ordinary way in the burning of fuel and in my arrangement, these gases pass downward through the radiator, firepot, grate, ashpit, and thence out through an auxiliary flue 7 which is here shown as discharging into the exhaust flue 3 adjacent the stack (not shown) in the wall 8. The heating of these usual channels for heated gases in a hot air furnace heats the air in the exterior shell of the furnace and this heated air passes through the usual flues 9, 9 to the rooms of a building to be heated. The casing 1 having my improved burner may be formed of any approved material, preferably metal, and the exterior thereof may have an insulating covering 1a particularly about that portion thereof immediately surrounding the combustion chamber 11 to prevent material loss of heat to atmosphere.

The combustion chamber 11 is preferably formed of a refractory material and the bottom section thereof, indicated at 12, is greater in diameter than the body 13. The bottom wall of the chamber is provided with a series of apertures 14 for inflow of air and the side walls of the bottom portion 12 are provided with the tangential apertures 15. The body of the chamber above the bottom wall has apertures 16, preferably tangential, opening therethrough. There are also a series of air inlet holes 17 at the open upper end 18 of the combustion chamber 11. This end 18 closes the interior of the casing 1 to the conduit 2 so that air in the casing must pass into the combustion chamber to complete combustion. The flue 2, valve 5, and the walls of the tube 3 to the point of entrance into the combustion chamber and channel 6 of the furnace are lined with a fire resistant material indicated at 19. To the bottom wall of the combustion chamber 11 and adjacent the nozzle 22 is connected a fuel pipe 20 having a valve 21 for control thereof to provide a pilot light. Liquid or other form of fuel in atomized condition is discharged through the nozzle 22 into the bottom section 12 of the combustion chamber as shown in Fig. 3 from which it will be observed that the atomizing nozzle by discharging the fuel stream tangentially into the chamber causes the supplied fuel to pass circumferentially thereabout in order that burned and/or unburned gases will partially or wholly envelop the fuel jet. This condition is enhanced by extending the wall of the chamber at the nozzle aperture inwardly of the circumference to provide a shield for the nozzle as indicated in Fig. 3 and preventing contact of free air with the jet.

The atomizing nozzle is shown generally in

Fig. 7 and is a common form of structure having an exterior shell 24 through which air under high pressure is fed from the pipe 25 and within this member 24 is the terminal portion 26 of the oil supply pipe 27. The discharge end 28 of the pipe 26 is of a smaller diameter and terminates at the opening 29 of the shell 24 through which air flows parallel to the end of this tube and past the button 30 to produce spray. This is a common form of atomizing nozzle and other forms of nozzles adapted for the purpose may be utilized if desired without departing from the spirit of this invention.

In the form of construction of the bottom section of the combustion chamber shown in Fig. 5, a single nozzle 22*a* may be employed discharging centrally between two circular portions providing chambers 31 and 31*a*. In either of these chambers shown and in any form of the combustion chamber the apertures 15 for inflow of air into the fuel stream should extend practically tangentially through the wall or at least at a material angle to a radial line of the circular chamber and in a direction to permit air to pass into the chamber in approximately the direction of flow of fuel discharged by the nozzle.

Thus the inflow of air tends to accentuate the rotation of the gaseous body in combustion and preferably in any of the constructions of the combustion chamber shown, the wall, as the wall 34 shown in Fig. 2, between the body and the bottom section or chamber 12, is inclined or so constructed as to tend to delay movement of the gases in combustion axially through the body of the burner.

Ignition of the fuel takes place in this bottom section and the inflowing fuel body is raised in temperature to above the combustion temperature. To continue the combustion, the openings 16 are provided in the body in order to discharge air into the gases in passing upwardly toward the exhaust flue 3 of the furnace. Air passing through these apertures 14, 15, 16 and 17 in the form of combustion chamber shown in Fig. 2 is provided by a fan 35 which is positioned above a dividing wall 36 in the casing 1 and takes its supply through an aperture 37 opening to the lower chamber 38 of the member 1. The chamber 38 is open at its bottom to atmosphere through a conduit 39 having a valve 40 for varying the area of the opening, the control of which is hereinafter described. The fan 35 is driven by a motor 41 supported on a base 42 suspended from the dividing wall 36 by the studs 43.

For supplying air under pressure to the nozzle, I provide a two-cylinder compressor supported from the base 42 on which the motor is mounted and this apparatus consists of a casing providing a chamber 44 containing oil for lubrication purposes and the compressor consists of the two outwardly disposed cylinders 45 and 46 and companion pistons operated alternately by any approved means as an eccentric 47 on the motor shaft.

The said shaft has a bearing in a central column 48 in the chamber 44 and the column has an aperture 49 opening into the chamber below the oil surface and leading upwards to the bearing for the motor shaft. The pistons have the usual spring valve 50 in the outer end which opens on the instroke of the piston and closes on the outgoing stroke and the head of the cylinders is formed with an aperture 51 covered by a recessed plate 52. An aperture 53 is provided from the recess of this plate to the interior of the chamber 44. Thus the air is taken from the interior 38 of the casing 1 in which the compressor is mounted through the motor 41 and through apertures 41*a* in the base 42 and is discharged into the chamber 44 and thus the oil in the said chamber is under pressure and is caused to lubricate the bearing for the motor and compressor. This oil under pressure may, by a conduit (not shown), lead to any part of the apparatus which requires to be oiled.

The chamber 44 acts as a storage tank for air under pressure and the air line 25 has its intake end in this chamber above the oil surface and upturned as shown to prevent any material amount of oil entering the same. As before described, the air line 25 opens to the nozzle as shown in Fig. 7. The oil line 27 has a constant level chamber 54 and leads to the atomizer or nozzle as indicated in Fig. 7. The compressor may be of any type providing for substantially constant air pressure.

The control of the burner in operation is accomplished by the following described mechanism:

Connected into the fuel supply pipe 27 is a control valve 55 and this valve has a stem 56 connected to a lever 57 hinged at one end to a diaphragm casing 58 and the opposite end of the lever 57 is connected by means of a lever 59 with the valve 40 controlling the air inlet to the casing through which the fan 35 is supplied. The lever 57 has a spring 60 tending to close the fuel valve 55 and also to restrict the air opening through the turning of the air valve 40. The lever also has a bearing 57*a* opposite the pivotal connection with the oil valve stem 56 engaging the flexible diaphragm 61 forming one wall of the casing 58. The chamber of the casing 58 is connected to the ail line 25 by a pipe 58*a* through which air under pressure is supplied to automatically open the valve and permit flow of oil. Thus it will be observed that the oil valve 55 and the valve or shutter 40 may both be operated or adjusted in unison and the proper proportion of the air and oil are admitted to the combustion chamber 11 for accomplishing complete combustion. The construction shown in Fig. 2 is an arrangement adapted for use with oil or gas as a fuel. With a powdered fuel some change in construction of the valve would be required but the relationship of the parts would be substantially the same.

The compressor preferably has a constant output greater than is required by the atomizing nozzle or nozzles and to control the operation of the burner, I provide a thermostat, indicated generally at 62, which may be located at any convenient point of the building or space to be heated. The thermostat consists of a bimetal helix 63 for operating a needle valve 64 normally closing the opening to a conduit 65 connected with the air line 25 here shown as being connected to the line 25 through the conduit 58*a* for the diaphragm chamber. Due to an excess temperature in the heated space the thermostat opens the conduit 65 permitting escape of air, thereby reducing the pressure in the diaphragm chamber 58 permitting the lever to act under tension of the spring 60 to partially close the valve 55. Under the opposite condition, that is, a reduction in temperature of the heated space, the helix operates to close the needle valve 64

which tends to build up the pressure in the diaphragm chamber thereby opening the fuel valve 55 to a greater extent and also opening the valve or shutter at 40 to increase the air flow to the fan 35 and thus increasing the heat output of the burner.

There is an additional safety control shown generally at 66. This, as shown in Figs. 2 and 4, consists of a bimetal helix 66a mounted rigidly at one end on the end of a tube 67 which is screwed into an aperture provided in the radiator ring or channel 6 of the furnace and attached to the inner end of the helix and extending out through the tube 67 is a shaft 68 on the outer end of which is mounted a disc 69 having a notch 70 in its periphery.

If at any time the fire in the combustion chamber goes out, the helix in the radiator ring is allowed to cool and thus rotate the disc 69 to bring the notch 70 opposite the pin permitting the lever to be moved by a spring 77 to open the valve 74 releasing the air pressure and closing the fuel valve. Flow of raw oil into the combustion chamber is thus prevented.

When the temperature of the helix is not increased by combustion gases passing through the radiator ring from the combustion chamber 11 the disc rests in such a position that a pin 71 mounted on the end of a pivoted lever 72 is held in the notch by tension of the spring 77. The lower end of the lever 72 is connected by a link 73 with a needle valve 74 having a stem riding in a guide 75. The valve may seat in the end of the tube 76 connected with the air supply pipe 58a and thence with the main air supply pipe 25. The toggle structure consisting of the lever 72 and link 73, is so arranged that when the pin 71 rests in the notch in the disc 69, the needle valve 74 is open.

To start the burner, the lever 72 may be manually held in the position shown in Fig. 2 with the valve 74 closed. This causes a rise of pressure within the air supply pipe through operation of the motor and compressor which is understood to be in operation at the time and the consequent deflection of the diaphragm 61 to the position shown in Fig. 2 opens the fuel valve. After the fire has been burning a short time the helix in the furnace radiator ring 6, which has become heated, rotates the disc so that the lever upon release by the operator has the pin 71 resting upon the periphery of the disc thereby holding the needle valve 74 closed and the fuel valve 55 open permitting the burner to continue in operation.

It is to be seen from the foregoing that there are preferably two instrumentalities for controlling the oil burner, one consisting of the thermostat structure 62 for varying the rate of consumption of oil to correspond with the temperature changes in the room being heated, and the other consisting of the safety control 66 both of which operate through a release of air pressure in the air supply connected to the nozzle or nozzles. The room thermostat structure 62 and capacity of the port controlled by the needle valve 64 is such as to reduce the pressure but not to such extent as to quickly or fully close the fuel valve and its operation is therefore to control the burner in the amount of fuel consumption while the structure indicated generally at 66 is adapted to cause complete cessation of the fuel flow.

It will be observed that in the event of breakdown of the oil burner structure and necessity for continued use of the furnace through consumption of fuel within the furnace itself, the valve 5 in the exhaust flue 3 is closed and a valve 77a in the flue 7 is closed. This permits the furnace to be operated in the usual way with the fire in the grate indicated by the dotted line 78 and the products of combustion will pass out through the usual exhaust conduit 3. Under this condition, the valve plate 5 prevents soot or dust from entering the oil burner chamber. When used with the oil burner the valve 5 is open and the valve 77a is also open so that the products of combustion pass through the radiator ring 6 downward through the furnace and out through the flue 7.

The combustion chamber is formed of fire resistant material into which oil is discharged tangentially and to which air is progressively provided through apertures therein as the combustible products pass linearly through the chamber to finally discharge into the furnace. The invention is not confined to the use of a combustion chamber as shown in Figs. 1 and 2.

With a rotating body of the gases and air entering only from the exterior of the gaseous body, the central portion does not in some cases receive sufficient air for combustion or at least for complete combustion by the time the gases pass from the chamber and this, of course, varies with the diameter of the body of the rotating gases. By the arrangement shown, the gaseous body is provided with air in the interior as well as the exterior thereof.

By the construction of the combustion chamber hereinbefore described and particularly by the constructions shown more fully in Figs. 1 and 2, a complete burner outfit may be installed in conjunction with an ordinary wood or coal burning heating furnace without removal of any of the usual furnace parts leaving it all in normal state. The installation may be made at very little cost, it being only necessary to provide the flue 7 open to the ash pit of the furnace and to the exhaust flue 3 of the furnace to which the discharge flue 2 of the combustion chamber is connected and also to provide a threaded opening in the radiator ring or correspondingly similar structure of the furnace for introduction of the safety trip 66.

The burner may thus be completely set up in all its relationship of parts even including the trip 66 at the factory and practically adjusted prior to installation and thus upon installation and connection of the thermostat 62 and air supply pipe therefor and the oil supply pipe the installation is completed and ready for operation.

The combustion chamber may be used in any way that may be found desirable where a complete combustion of gases is desired. The burner may be used in the production of heat for any purpose and, as before stated, the invention is not only in the construction of the combustion chamber and the associated fuel supply pipe etc., but exists fundamentally in the method by which the fuel is progressively burned in passing through the chamber. In so far as this feature is concerned, the fuel may be of various forms in which it is first brought to a temperature above combustion temperature and given a rotary motion and passes linearly or outwardly through the chamber during which air for combustion is added as the gases pass progressively through the chamber. The air may be introduced to the exterior of the rotating body only or to both the exterior and interior thereof and in the same direction

as the body of gases is rotating to increase the rapidity of rotation.

By this method of burning a very quiet combustion is attained. This quietness is due firstly to the excess of fuel over air and next to the fact that the fuel jet is surrounded by combustion gases and gasified fuel which prevents contact of the free air with the jet and thirdly to the fact that the air is admitted in small streams to the gasified and heated fuel that are distributed over a comparatively large area and therefore I do not secure a successive ignition within the mixture or a periodic portional heating of the mixture and thus avoid flame noises which are produced in other types of burners through the individual combustion of portions of the combustible mixture which reach ignition temperature at different time periods.

Thus while I have herein described a specific use of my improved combustion chamber, the invention is not confined to such use as the combustion chamber need not of necessity be positioned with its longitudinal axis in vertical position as is the desired arrangement in the use of the burner illustrated.

From the foregoing description it is believed evident that the various objects of the invention are attained by the structures described, and that a comparatively simple and economic construction is secured.

Having thus described my invention, its utility and mode of operation, what I claim and desire to secure by Letters Patent of the United States is:

1. In an oil burner for use with a furnace having a combustion chamber, a nozzle for discharge of hydrocarbon fuel into the combustion chamber, a fuel line connected with the nozzle, a fuel valve for controlling the flow of liquid hydrocarbon through the fuel line, a compressor for providing air under pressure to the nozzle to cause the liquid fuel to discharge into the combustion chamber in atomized form, and a means for ignition of the fuel, means actuatable by temperature change to vary the position of the fuel valve from an open to a closed position comprising a thermostatic element, a conduit connected with the air line and having an opening to atmosphere, a valve actuatable by the thermostatic element to open or close the said conduit to thereby permit or prevent escape of air from the air line, a spring restrained pressure actuatable means open to the air line and through the air pressure openings the said valve in the fuel line, the opening or closing of the said valve in the conduit through operation of the thermostat providing a means for varying the air pressure applied to said pressure actuatable means to thereby vary the position of the fuel valve and means actuable by certain high furnace temperature to relieve the air pressure applied to said pressure actuatable means to thereby close the fuel valve.

2. In an oil burner for a furnace having a combustion chamber, a nozzle for discharge of hydrocarbon fuel thereto, a fuel line and an air line connected with the nozzle, means for causing a flow of fuel through the fuel line and nozzle, means for providing air under pressure in the said air line to cause discharge of fuel in atomized form into the combustion chamber, and a valve in the fuel line for varying the volume of fuel discharged to the nozzle per unit of time, a control means for the said valve, comprising a chamber, a diaphragm forming a wall thereof, said air line having a connection with the said chamber whereby the pressure of the air may move the diaphragm in one direction to open the valve, spring means associated with the valve and diaphragm for moving the valve in the opposite direction on reduction in pressure in the diaphragm chamber, a valve controlled discharge aperture through which air may pass from the air line, a valve for closing the aperture, and a temperature sensitive means for varying the position of the said last named valve to thereby vary the pressure in the air line and diaphragm chamber in accordance with temperature change, a second temperature sensitive means subject to the furnace temperature including a valve for opening the air line to atmosphere to thereby close the fuel valve on certain high furnace temperature.

3. In an oil burner having a combustion chamber, a nozzle for the discharge of liquid hydrocarbon fuel thereinto, a fuel line connected with the nozzle, a fuel valve for controlling the flow of liquid hydrocarbon through the fuel line, a compressor for providing air under pressure to the nozzle to cause the liquid fuel to discharge into the combustion chamber in atomized form, and a pilot light for ignition of the fuel, a control means for varying the volume of flow of fuel and of the air to the combustion chamber comprising a thermostatically controlled valve, a conduit connected with the air line and having an opening to atmosphere, a valve for controlling the said opening, an expandable element, the said air line being connected therewith whereby certain pressure of the air may expand the said element, said fuel valve being associated with the said expandable element and held in open position by the expansion thereof, a spring tending to close the valve, the thermostatically controlled valve upon opening of the air conduit releasing the pressure in the air line and the expandable member whereby the position of the fuel valve may be varied from the full open to the closed position in response to temperature changes affecting the thermostat, a safety device including a thermostatic element and a safety valve arranged to open or close the air line to atmosphere, the thermostatic element of the said control means being so arranged that, under the heat of combustion, the safety valve is held closed and upon practical cessation of combustion the safety valve is opened to thereby release the pressure in the air line and expandable member and close the fuel valve.

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