June 7, 1938. H. E. FELLOWS ET AL 2,119,740

FUEL REGULATOR VALVE FOR OIL BURNERS

Filed March 27, 1936 2 Sheets-Sheet 1

Fig. 2.

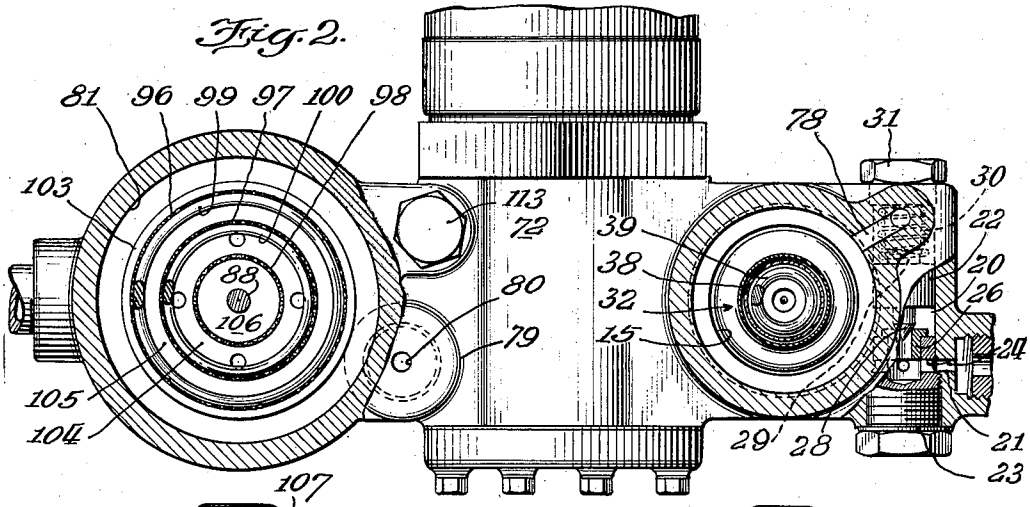
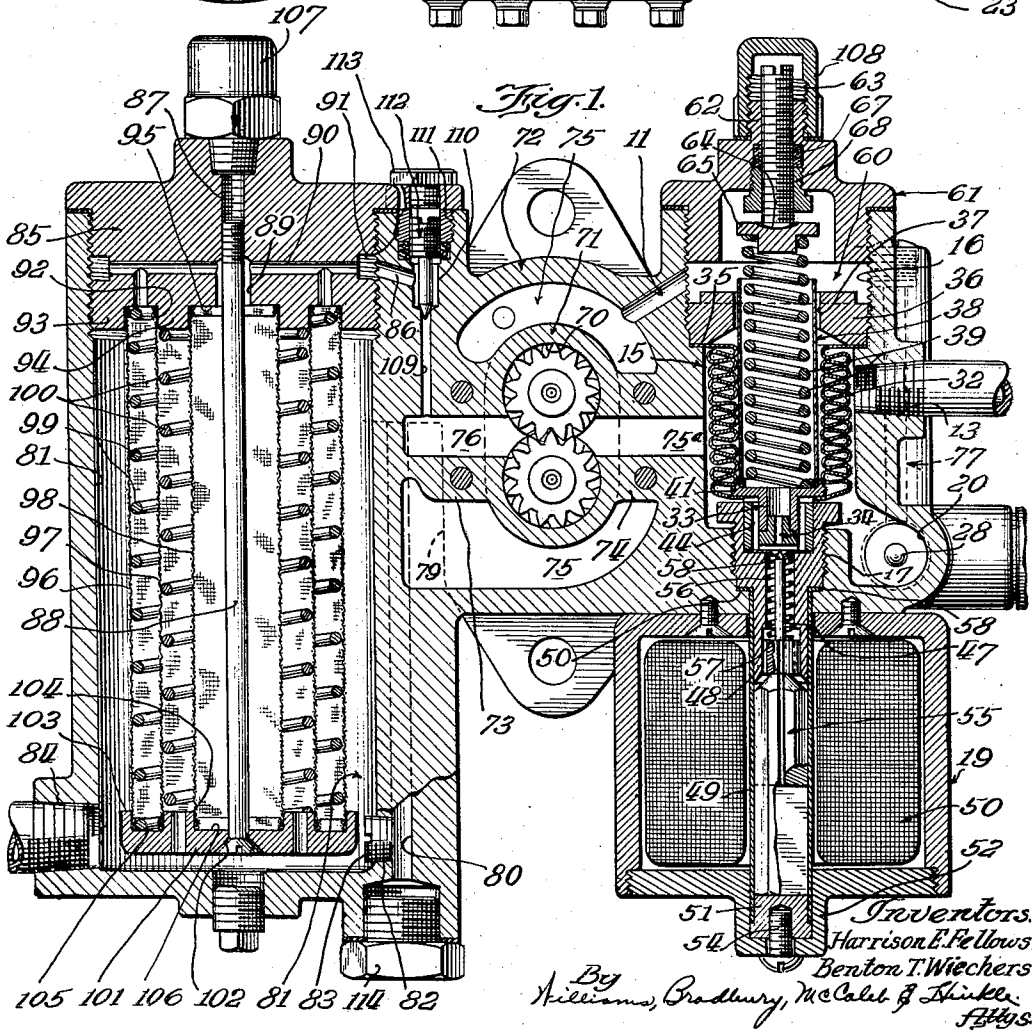


Fig. 1.



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Fig. 3.

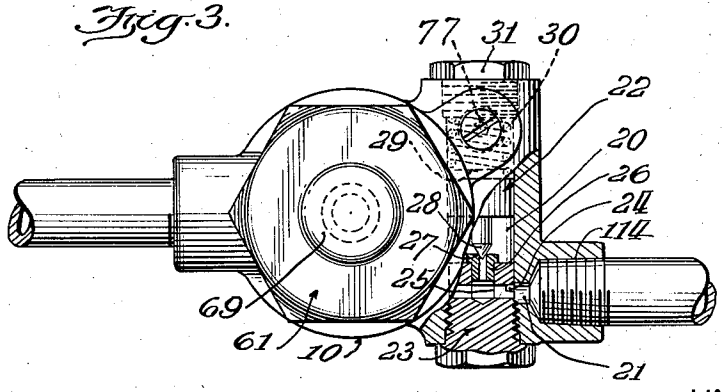


Fig. 4.

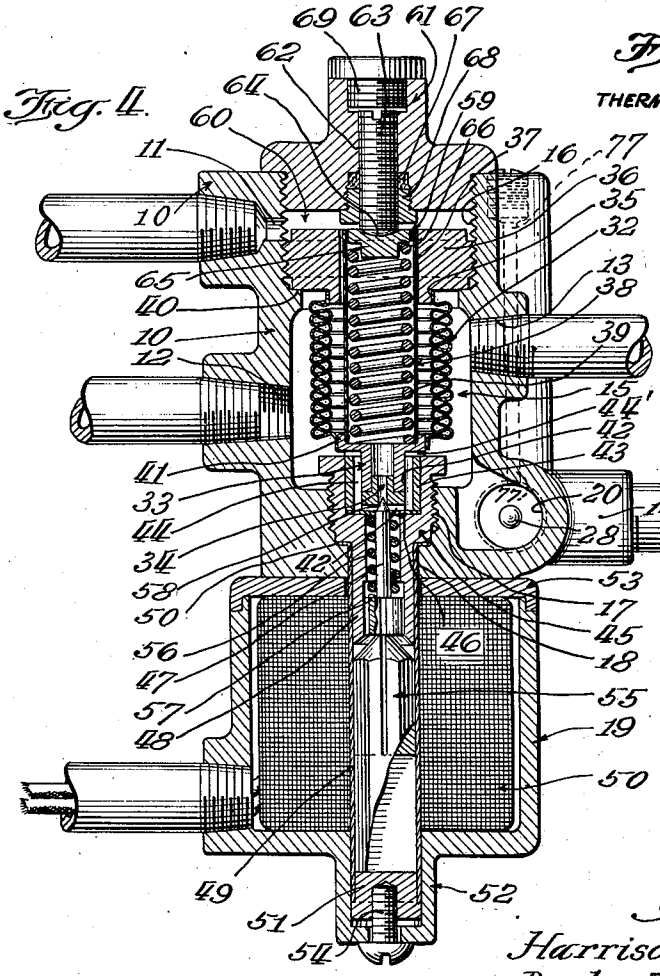
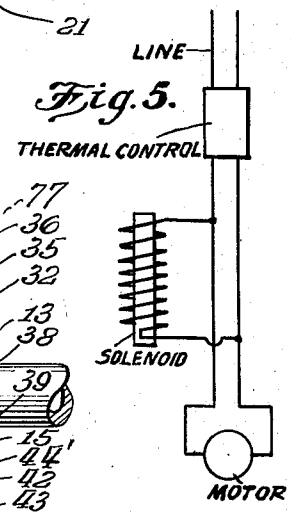


Fig. 5.



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UNITED STATES PATENT OFFICE

2,119,740

FUEL REGULATOR VALVE FOR OIL BURNERS

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Application March 27, 1936, Serial No. 71,130

13 Claims. (Cl. 158—42.1)

The present invention relates to fuel regulator devices for oil burners, and is particularly concerned with an improved regulator valve of the type adapted to supply the nozzle of an oil burner with fuel at a predetermined pressure and to by-pass the excess of fuel back to the source of supply.

One of the disadvantages of the prior art devices is that when the burner is shut off in such devices, pressure in the regulator valve decreases slowly and not in proportion to the decrease of air being supplied to the combustion chamber. The result is that inefficient combustion occurs, causing excessive combustion gases, which cause pulsating back pressures in the flues and rattle any loose parts of the furnace. This puffing action of some of the devices of the prior art is very annoying, and one of the objects of the present invention is the provision of an improved regulator valve which is adapted to shut off the fuel to the burner so quickly as to avoid any such disproportionate feeding of air and liquid fuel.

Another object of the invention is the provision of an improved regulator valve which is adapted to accomplish a quick cut-off at the burner nozzle, after the motor current is shut off, and thereby eliminate any possibility of dribbling of oil or smoking of the burner due to leakage after the air supply has been decreased.

Another object of the invention is the provision of an improved regulator valve having a special pressure release device which is controlled by the energization of the motor so that pressure in the valve chamber may be released very quickly after the motor has been shut down, and thus accomplish a quick cut-off at the burner nozzle.

Another object is the provision of an improved fuel supply unit of the class described, including a fuel pump and regulator valve with or without a strainer unit, which is adapted to be used with either a single pipe or a two-pipe system, by merely effecting a change in the connections of the pipe or pipes.

Another object is the provision of an improved fuel unit having an improved strainer construction which is simpler and therefore more economical to manufacture than the devices of the prior art.

Other objects and advantages will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the two sheets of drawings accompanying the specification,

Fig. 1 is a vertical sectional view, taken on a plane passing through the axis of the strainer unit, the valve unit, and through the pump unit, at a point in front of the gears;

Fig. 2 is a top plan view, in partial section, showing the details of construction of the strainer unit and a cut-off valve for the burner nozzle;

Fig. 3 is a top plan view of a modification in which the oil regulator valve is embodied in a separate housing so as to provide a valve unit separate from the pump and strainer, the housing being broken away to show the construction of the cut-off valve;

Fig. 4 is a view similar to Fig. 1, showing the invention embodied in a separate regulator valve of the type disclosed in Fig. 3.

Fig. 5 is a wiring diagram of the electrical circuit used, with suitable indicia to indicate the elements of the circuit.

Referring to Figs. 3 and 4, the regulator valve shown in these figures preferably includes a cast metal housing 10, which may be provided with various threaded outlet or inlet ports adapted to receive suitable pipes.

The port 11 at the top is a by-pass outlet port leading to a pipe which may conduct excess fuel back to the tank or to the pump inlet, if desired.

The port 12 is a pressure inlet port which receives fuel from the outlet of the pump, usually employed in an oil burner system, to which it is connected by the pipe shown.

The port 13 may be used for attachment of a pressure gauge. The port 14 is adapted to be connected to a burner nozzle, and is the burner outlet port of the valve.

The housing 10 may be substantially cylindrical in form, and is formed with a substantially cylindrical pressure chamber 15, which communicates with a threaded counterbore 16 at the open upper end of the housing. At its lower end the chamber 15 communicates with a threaded bore 17 which leads to a smaller bore 18 that is adapted to receive means for securing a solenoid housing 19 to the valve housing 10.

The chamber 15 also communicates at one side with a cylindrical cut-off valve chamber 20, which has its axis disposed transversely to the axis of the cylindrical chamber 15, as shown in Fig. 3. Cut-off valve chamber 20 leads to the burner outlet port through an aperture 21, and is a substantially cylindrical bore adapted to slidably receive a cut-off piston 22.

The lower end of the chamber or bore 20 in Fig. 3 may be threaded to receive the threaded valve-supporting plug 23 which comprises a metal

member having a non-circular head and having a pair of bores 24, 25 arranged at right angles to provide communication from the interior of chamber 20 to the port 21.

A plurality of transverse bores 24 may be provided, or the plug may have an annular groove communicating with the bore 24, in order to assure communication with the aperture 21. The axial bore 25 is adapted to receive the valve seat plug 26, which has a close frictional fit in the bore 25, and is provided with a frusto-conical seat 27 for receiving the conical end of the needle valve 28 carried by piston 22.

Piston 22 may have a centrally located cylindrical lug 29 projecting from its upper end to maintain the alignment of a spring 30, which seats against the piston and is pressed in the bore 20 by screw plug 31, which also closes the other end of the bore 20. The pressure of the spring 30 is such that when the liquid fuel pressure has built up to a predetermined degree in the valve chamber 15 and cut-off chamber 20, the piston 22 is forced back against the pressure of spring 30 sufficiently to open the valve 28.

Valve 28 may open at any predetermined value which is determined by the area of the piston and the strength of the spring. It closes after the burner has been shut down, only after the pressure in the valve chamber has decreased to such an amount that the spring 30 is enabled to close the valve 28.

The pressure regulator valve is preferably provided with a by-pass valve which is controlled by a pressure responsive metal bellows 32, which is adapted to control the movement of a valve seat member 33, which is provided with a by-pass port 34.

The bellows 32 may be supported at one end by being soldered, brazed, or otherwise secured to a reduced cylindrical portion 35 of a screw plug 36, which fits in the threaded bore 16. Plug 36 is provided with a centrally located bore 37 for passing a spring housing and stop member 38, as well as the helical spring 39.

The chamber 15 is preferably formed with an annular shoulder 40, which determines the final position of the screw plug 36 when it is screwed into place, and this plug may be provided with any form of wrench-engaging depression or slot.

The opposite end of the bellows 32 engages the cylindrical outer surface of the member 33, to which it is soldered, brazed or otherwise secured. The member 33 comprises a metal plug having the axially extending flange 41 for receiving the metal tube 38, which is soldered or otherwise secured in the cup formed by flange 41.

Spring 39 has one end seated in this cup and urges the valve seat member 33 downward, in Fig. 4. The member 33 is substantially cylindrical in form and is slidably mounted in a cylindrical bore 42 of a sleeve 43. Sleeve 43 has axially extending slots 44, and there is a slot 44' across the top of sleeve 43 so as to permit access of fluid from the chamber 15 through slots 44' and 44 to the interior of bore 42 below the valve seat plug 33.

Sleeve 43 may be secured by a tight frictional fit in a threaded supporting member 45 which carries the housing 19 of the solenoid. The sleeve 43 may secure an apertured gasket 46 below it in the supporting member 45 for passing the valve stem 47 without leakage of oil into the interior of the solenoid housing 19. Supporting member 45 comprises a cylindrical metal member which is threaded to be received in the bore 17. It has an extension 48 of reduced size, which supports a non-magnetic metal sleeve 49 of brass or similar material.

The sleeve or tube 49 has a radially outwardly extending flange 50 at the top, which is secured in bore 18 by the clamping action of threaded member 45. Tube 49 also serves as a support for the solenoid coils 50, which are enclosed in the housing 19. The lower end of the tube 49 is closed by a plug 51, which may be soldered, brazed, or otherwise permanently secured therein, and the housing 19 is of substantially cup shape, with a tubular extension 52 for receiving the end of tube 49.

Housing 19 has a cover 53, closing its upper end and mounted on tube 49, and a screw bolt 54 clamps the lower portion of housing 19 and cover 53 against the base of the valve housing 10 by being threaded into the plug 51. The housing parts 19 and 53 are preferably made of magnetic material adapted to complete the magnetic circuit which runs through the core of the coil 50 and about the exterior of the housing. Inside the tube 49 there is a solenoid plunger 55 of magnetic material which is slidably mounted in the tube and adapted to be drawn upward by the coil 50 when the coil is energized.

The solenoid 55 carries the valve stem 47, which is surrounded by the helical spring 56 that engages gasket 46 and annular seat 57 on the solenoid. Spring 56 urges the solenoid and valve stem 47 downward against the pull of the magnet so that the spring urges the valve to open position. The valve stem 47 carries a conical point or valve surface 58 which is adapted to engage a complementary frusto-conical seat on the lower end of the bore 34 in the plug 33.

The port 34 communicates with the interior of the bellows 32 and tube 38 and through the space or crack 59 with the space 60 above the plug 36. Space 60 is in communication with the by-pass port 11 so that the valve 58 is adapted to by-pass excess liquid fuel back through the bellows to the by-pass port, which may have a conduit leading to the tank or to the intake side of the pump.

The circuit of the solenoid 50 is connected in parallel with the burner motor so that it is controlled by the same switch that controls the starting or stopping of the burner motor, or by a separate control circuit, if so desired, for delaying the oil delivery until after the starting of the motor.

The upper end of threaded bore 16 is closed by a threaded cap plug 61 which is provided with threaded bore 62 for receiving the spring adjusting screw 63. The spring adjusting screw may have a partially spherical end 64 engaging in a complementary aperture in a spring seating member 65.

Spring seating member 65 is a circular metal member having a reduced cylindrical extension engaging inside the spring 39 and an annular seat 66 engaging the end of the spring. A liquid-tight packing 67 may be placed in a counterbore surrounding the adjustment screw 63, and it may be compressed by a gland 68. Another screw cap 69 may close the upper end of a counterbore which communicates with the upper end of bore 62 above the adjustment screw 63, giving the valve a finished appearance and concealing the mode of adjustment so that the householders will not have the tendency to tamper with the adjustment.

The bore 20, which houses the cut-off valve 22, has a cored conduit 77 leading from the space

behind the piston 22 upward to a laterally extending conduit 78, which communicates with the space 60. Thus any leakage past the piston 22 is carried to the by-pass outlet port 11.

Referring to Figs. 1 and 2, these modifications show a similar regulator valve, which is an integral part of a complete fuel unit, also having a two-stage pump and an oil strainer. The two-stage pump may be substantially similar in construction to that shown in the prior Patent No. 2,009,137 of A. C. Kleckner, issued July 23, 1935, on Multi-stage pump and pumping systems, and therefore need not be described in all its details.

The pump has two sets of gears, one for the low pressure stage, and the other for the high pressure stage, the two sets being separated by partitions in the bores 70. The pump gears are housed in a separate pump housing 71, which is supported and connected to the outer pump housing 72 by means of connecting lugs 73, 74. An oil reservoir 75 surrounds the pump housing 71 and tends to reduce the noise incident to the action of the gears.

The conduit 75A at the right hand of the gears is the high pressure outlet leading from the high pressure gear stage to the valve chamber 15, while the cored conduit 76, shown at the left of the gears, is in communication with the reservoir parts 75, and it receives the low pressure output from the low pressure stage of the pump.

The conduit 11, shown in Fig. 1, is the by-pass outlet port from the valve which leads, in this case, back to the reservoir 75. The low pressure stage of the pump has gears which are adapted to pump up an excess of liquid fuel over that necessary for the operation of the burner and beyond that pumped by the high pressure gears. Thus the reservoir 75 is always filled with an excess of liquid fuel from the low pressure stage, and the high pressure stage has available a constant supply of liquid fuel for supply to the valve.

The reservoir 75 may be provided with an upwardly projecting wall 79, which brings the conduit 80 up to the middle of the reservoir and keeps a supply of liquid fuel in the reservoir at all times to aid in priming the high pressure stage.

Conduit 80 communicates with the strainer chamber 81 through a selective conduit 82, which is closed by a screw plug 83, preferably located directly opposite the strainer intake port 84, so that a screw driver may be inserted in this port to engage plug 83.

The present strainer represents an improvement over that shown in the prior patent mentioned, in that the strainer chamber 81 has its threaded upper end closed by one closure plug 85, which is provided with conduits for conducting liquid from the spaces between the strainers to the intake conduit 86 of the pump.

The plug 85 has a centrally located threaded bore 87, which supports the threaded screw bolt 88. A counterbore 89 surrounds the screw bolt at the top and communicates with the transverse bore 90, which leads to an annular groove 91. The annular groove 91 is so located as to register with intake port 86 of the pump when the plug is threaded home, and it provides connection between this intake port and the transverse bore 90, irrespective of the rotative position of the plug.

The plug 85 is provided with a plurality of annular grooves 92, separated by depending annular ribs 93, 94 and with a centrally located depression 95. A plurality of screens 96, 97, 98 of cylindrical form are provided, each screen being adapted to fit against the cylindrical side wall of one of the lugs 93, 94. The coil springs 99 and 100 are located between the screens to maintain them in spaced relation and prevent their collapse.

The screens may comprise cylindrical pieces of screen formed by soldering together the opposite edges of a rectangle of screen, and the ends of the cylinders may be turned over and soldered or may be dipped in solder to provide a stronger stiffening edge. A screen plate 101 is provided at the bottom with a countersunk bore 102 for receiving the screw bolt 88. It has upwardly projecting annular ribs 103, 104 and the grooves 105, and cup shaped depression 106, similar in shape to the lower end of plug 85, and adapted to receive the lower end of the respective screens.

The screens are clamped in place by means of the bolt 88 which draws the screen plate against the ends of the screens and clamps them against the lower surfaces of plug 85. The cap plug 107 is provided at the top of the screen unit to finish it symmetrically with the top of the valve housing, which, in Fig. 1, also has a screw cap 108 covering the adjustment screw.

The conduit 109 (Fig. 1) leads to the intake side of the low pressure stage of the pump and communicates with a counterbore 110 that leads to the intake port 86. Another threaded bore 111 supports a screw plug, which in turn is threaded to receive the threaded end 112 of a needle valve.

The needle valve projects down into the conduit 109, where it engages a frusto-conical seat or is located in spaced relation to the seat if the needle valve is open, as is normally the case. The bore which supports the needle valve 112 is closed by a cap screw 113. Needle valve 112 is adapted to place a restriction in the intake side of the low pressure stage for the purpose of causing a reduced pressure and therefore a gasification of the volatile elements of the fuel, which causes a cushioning action between the teeth and reduces the noise.

The operation of the fuel unit and regulator valve is as follows: It should be understood that the present regulator valve and strainer features may also be embodied in a single stage unit, the double stage pump unit having been selected for an example. When the pump motor is started, oil is sucked in through the strainer chamber, the oil coming in at the intake port 84 of the strainer chamber, passing through the strainer elements and out through the conduit 90, to the intake conduit 86 of the pump. It passes down through the conduit 109 to the intake side of the low pressure stage, which pumps up a supply of liquid fuel into the reservoir 75. The low pressure stage preferably pumps an excess of fuel over that required for the high pressure stage.

The high pressure stage takes its fuel from the reservoir 75 and pumps liquid fuel under pressure through the conduit 75A into the valve chamber 15. When the pressure in the valve chamber has reached a predetermined amount, suitable for operation of the burner, this pressure acts on the piston 22 of the cut-off valve 28 to force the piston upward in Fig. 3 and open the cut-off port 27 to the burner. Any leakage that might pass the piston is immediately conducted back to the by-pass conduits, through the conduits 77 and 78 leading to space 60.

When the motor is turned on, the solenoid coil 50 is energized and the core 55 is pulled upward to close the by-pass port 34. This by-pass port

being closed, all of the supply of fuel from the pump is devoted to building up pressure in the valve chamber until the burner cut-off valve is opened. Thereafter any further build-up of pressure causes the bellows 32 to retract, drawing with it the plug 33, which carries the seat of the valve 58 and opens the by-pass port 34.

The by-pass port 34 is opened by such an amount as is necessary to by-pass the excess fuel not required for the burner and this fuel passes up through the bellows inside the tube 36 around the metal plug 65 into space 60, and out of the by-pass port 11.

In a two-pipe system, the pipe from the by-pass port 11 may lead back to the tank or to the intake side of the pump. In the embodiment of Fig. 1, the by-pass port 11 leads back to the reservoir 75. Any excess in the reservoir 75 may be conducted back to the tank by a pipe connected to the lower end of conduit 60, which is now closed by a plug 114.

In a single pipe system the plug 14 may be used as shown, and the plug 33 may be removed so that any excess fuel in the reservoir is led back to the intake side of the low pressure stage by being conducted into the strainer chamber.

The present device is adapted to effect a very quick cut-off of the burner valve as follows: When the motor is shut down, the solenoid 50 is de-energized at the same time as the motor, being controlled by the same switch. This causes the valve 58 to recede from the by-pass port 34, opening this by-pass port wide, as shown in Fig. 1.

The liquid fuel under pressure in the valve chamber 15 is immediately discharged out through the by-pass port 34, the pressure reducing very quickly, and this reduced pressure results in immediate closing of the needle valve 28 by piston 22, which is actuated by spring 30.

Thus the present device is adapted to build up pressure quickly upon starting of the motor, so that the burner will be started quickly, and it is also adapted to release the pressure very quickly so as to stop the flow of oil almost simultaneously with the stopping of the motor. This eliminates the inefficient combustion which resulted in the devices of the prior art, where the regulator valve continued to supply liquid fuel to the burner for a few moments after the motor had been cut off.

Such inefficient combustion resulted in a puffing action and in the production of a large volume of smoke, which would rattle the loose parts of the furnace, an undesirable feature of the prior devices, which is eliminated by the present invention.

It will thus be observed that we have invented an improved regulator valve and fuel unit which accomplishes a quicker cut-off than the devices of the prior art. The present regulator valve also discharges the by-passed liquid fuel through the bellows so that if there is any leakage in the bellows it only serves to reduce the amount of fuel that goes through the by-pass port. There is no possibility of a high pressure building up in this valve chamber because any increase of pressure tends to open the by-pass farther.

In some of the devices of the prior art, where the inside of the bellows was not open to the by-pass ports, a leak of liquid fuel through the bellows would cause a pressure to be built up inside the bellows which could not be released upon closing down of the motor, and which might result in complete closing of the by-pass port and excessive pressure in the valve chamber. Such action is completely eliminated by the present device, where the by-pass ports are connected with the inside of the bellows.

While we have illustrated a preferred embodiment of our invention, many modifications may be made without departing from the spirit of the invention, and we do not wish to be limited to the precise details of construction set forth, but desire to avail ourselves of all changes within the scope of the appended claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States, is:

1. In an oil burner fuel system, the combination of an electric motor with a pump for supplying liquid fuel under pressure, a regulator valve comprising a chamber for receiving the fuel under pressure, a cut-off valve for the burner port including pressure responsive means for opening said cut-off valve upon a predetermined pressure in said chamber, a by-pass port leading from said chamber, a by-pass valve controlled by pressure responsive means, for by-passing any excess of fuel over that required for the burner, and electro-magnetic means for relieving the pressure in said chamber immediately upon the shutting down of the motor, said electro-magnetic means comprising an electrically operated valve cooperating with the by-pass port, and said valve being controlled with the motor circuit.

2. In a regulator valve, the combination of a housing having a valve chamber, said housing also having a by-pass outlet port and a burner outlet port, said burner outlet port being controlled by a burner valve and said by-pass outlet port being controlled by a by-pass valve, pressure responsive means for controlling said burner valve and said by-pass valve, and electro-magnetic means for further controlling said by-pass valve to relieve pressure in said chamber when the burner motor is de-energized.

3. In a regulator valve, the combination of a housing having a valve chamber, said housing also having a by-pass outlet port and a burner outlet port, said burner outlet port being controlled by a burner valve and said by-pass outlet port being controlled by a by-pass valve, pressure responsive means for controlling said burner valve and said by-pass valve, and electro-magnetic means for further controlling said by-pass valve to relieve pressure in said chamber when the burner motor is de-energized, and to close said by-pass valve when the burner is started up, in order to build up pressure in the valve chamber quickly.

4. In a regulator valve for oil burners, the combination of a valve housing having a chamber therein with a pressure responsive bellows located in said chamber, valve means comprising a first member movably carried by one end of said bellows and having a by-pass port extending through said first member, a second member adapted to close said by-pass port, and electro-magnetic means carried by said housing for controlling the actuation of said valve means.

5. In a regulator valve for oil burners, the combination of a valve housing having a chamber therein with a pressure responsive bellows located in said chamber, valve means comprising a first member movably carried by one end of said bellows and having a by-pass port extending through said first member, a second member adapted to close said by-pass port, and electro-magnetic means carried by said housing for con-

trolling the actuation of said valve means, said second member comprising a needle valve, and said electric means comprising a solenoid for actuating said needle valve when the motor circuit is closed.

6. In a regulator valve for oil burners, the combination of a valve housing having a chamber therein with a pressure responsive bellows located in said chamber, valve means comprising a first member movably carried by one end of said bellows and having a by-pass port extending through said first member, a second member adapted to close said by-pass port, electric means carried by said housing for controlling the actuation of said valve means, said second valve means comprising a needle valve, and said electromagnetic means comprising a solenoid for actuating said needle valve when the motor circuit is closed, and spring means for urging said second member away from said first member to effect an opening of said by-pass port when said solenoid is not energized.

7. In a regulator valve for oil burners, the combination of a housing formed with a valve chamber, a pressure responsive bellows in said housing, valve means comprising a first member slidably mounted in said housing and having a by-pass port extending through said first member into said bellows, a second member adapted to cooperate with said port to effect a closure thereof and a solenoid for controlling the actuation of said means whereby said by-pass port is opened promptly on de-energization of said solenoid.

8. In a fuel regulator valve for oil burners, the combination of a housing having an inlet for fuel under pressure, said housing having pressure responsive means therein subjected to the pressure in said housing and having a by-pass outlet and a burner outlet, said by-pass outlet being controlled by said pressure responsive means, said by-pass outlet also being under the control of a pressure relief valve, and electromagnetic means for controlling the actuation of said pressure relief valve.

9. In a fuel regulator valve for oil burners, the combination of a housing having an inlet for fuel under pressure, said housing having pressure responsive means therein subjected to the pressure in said housing and having a by-pass outlet and a burner outlet, said by-pass outlet being controlled by said pressure responsive means, said by-pass outlet also being under the control of a pressure relief valve, and electromagnetic means for controlling the actuation of said pressure relief valve, said electromagnetic means comprising a solenoid and core armature connected to said pressure relief valve.

10. In a fuel regulator valve for oil burners, the combination of a housing having an inlet for fuel under pressure, said housing having pressure responsive means therein subjected to the pressure in said housing and having a by-pass outlet and a burner outlet, said by-pass outlet being controlled by said pressure responsive means, said by-pass outlet also being under the control of a pressure relief valve, electromagnetic means for controlling the actuation of said pressure relief valve, said electromagnetic means comprising a solenoid and core armature connected to said pressure relief valve, and resilient means for urging said pressure relief valve toward open position.

11. In a fuel regulator valve for oil burners, the combination of a housing having an inlet for fuel under pressure, said housing having pressure responsive means therein subjected to the pressure in said housing and having a by-pass outlet and a burner outlet, said by-pass outlet being controlled by said pressure responsive means, said by-pass outlet also being under the control of a pressure relief valve, and electromagnetic means for controlling the actuation of said pressure relief valve, said by-pass port being located in a movable member carried by said pressure responsive means, and said pressure relief valve cooperating with said port, said port having a seat for said latter valve.

12. In a fuel supply system for oil burners, the combination of an electric motor driven oil burner with a pressure regulator valve having a pressure responsive burner cut-off valve and port and having pressure responsive means for by-passing an excess of oil, said pressure responsive means controlling a by-pass valve, and an electrically actuated valve means also controlling said by-pass valve whereby the oil burner motor and electrically actuated means may be simultaneously deenergized to by-pass the fuel in the regulator valve and effect a quick closure of said pressure responsive burner outlet valve.

13. In a liquid pressure regulator device, the combination of a housing provided with inlet and outlet ports, said housing having a pressure chamber and a pressure responsive diaphragm mounted in said chamber and adapted to be subjected to pressure of liquid fuel therein, electrically actuated means carried by said housing, and valve means comprising a movable member having a valve aperture and a movable closure member adapted to close said valve aperture, said movable members being controlled by said pressure responsive diaphragm and by said electric means, whereby predetermined pressure and electrical conditions control the closure of said valve means.

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