July 14, 1942. H. A. MANTZ 2,290,108

THERMOELECTRIC VALVE

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Fig. 2.

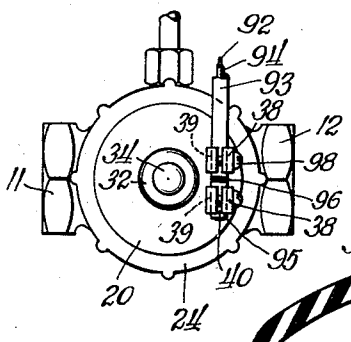


Fig. 1.

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Fig. 3.

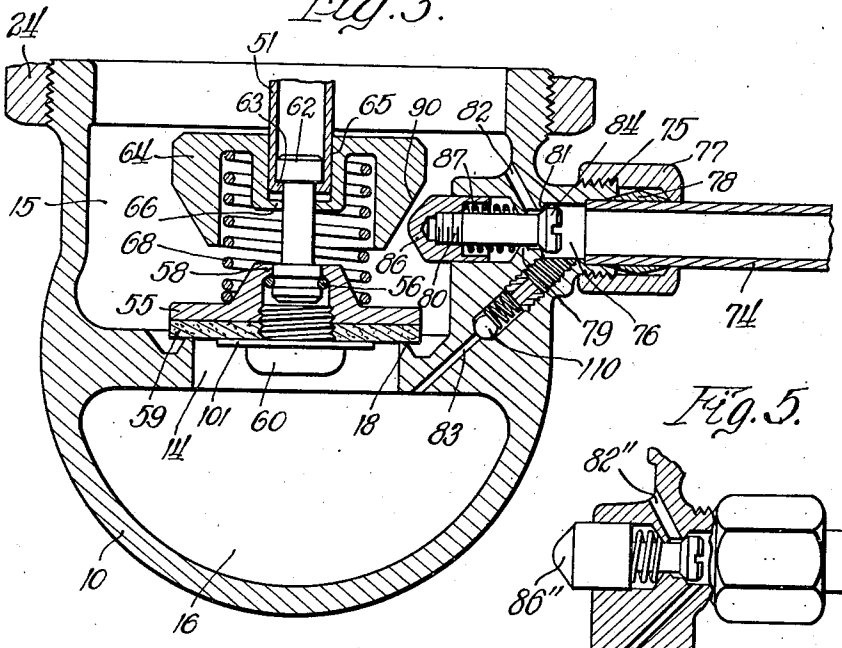


Fig. 5.

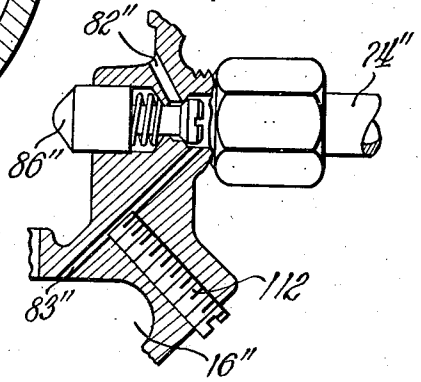
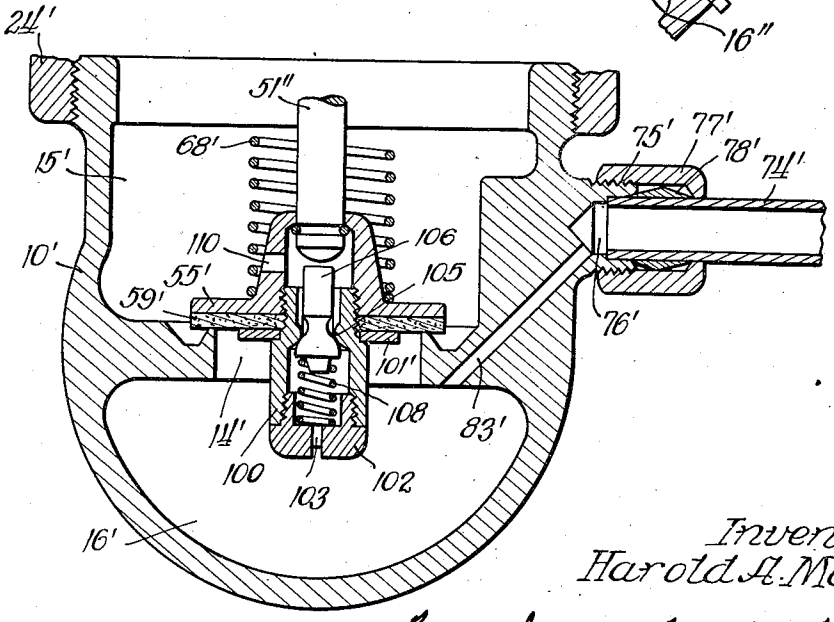


Fig. 4.



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Patented July 14, 1942 2,290,108

UNITED STATES PATENT OFFICE

2,290,108

THERMOELECTRIC VALVE

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Application June 29, 1939, Serial No. 281,762

17 Claims. (Cl. 137—144)

This invention relates to safety devices for heating and other apparatus, and has particular relation to an improved thermoelectric valve for automatically shutting off the fuel supply for a burner upon extinguishment of a pilot light in juxtaposition to the burner.

In its illustrated embodiments, the thermoelectric valve of the present invention is disposed in the fuel supply pipe leading to the burner and has an electromagnet and an armature which, when attracted, is adapted to hold the valve open to permit the desired supply of fuel to the burner, and when the armature is retracted the valve moves to closed position to shut off the supply of fuel to the burner. The electromagnet is adapted to be energized to hold the valve open as long as the pilot burner is ignited by heating of a thermocouple which is placed in position to be heated by the pilot burner and is connected in circuit with the electromagnet.

The burner may be the main burner for a space or room heater, or for a water heater, or it may be an oven burner or one or more top burners of a gas range or any other burner.

One of the main objects of the invention is to provide an improved form of thermoelectric valve of the general character above set forth and which is adapted to be reset without opening the valve to set up the supply of fuel to the main burner until the pilot burner has been lighted and, by the heat thereof on the thermocouple, has energized the electromagnet sufficiently to hold the armature in attracted position.

Another object of the invention is to provide improved means for by-passing fuel for the pilot burner through or around the main shut-off valve while it is in closed position to supply fuel to the pilot burner during the resetting operation and until the main shut-off valve is actuated to open position, and for continuing the supply of fuel to the pilot burner after the main burner is open.

It is also an object of the invention to provide an improved form of thermoelectric valve of relatively simple and inexpensive construction and which is effective and reliable in operation; also a device which may be easily and quickly installed in the fuel supply pipe and connected in circuit with the thermo-couple.

Further objects and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a vertical section through a thermoelectric valve embodying the present invention;

Figure 2 is a fragmentary top plan view of the device as viewed in Figure 1;

Figure 3 is a fragmentary vertical section taken on the line 3—3 of Figure 1;

Figure 4 is a fragmentary vertical section similar to Figure 3 and showing modified means for by-passing fuel for the pilot burner to supply the same with fuel during the resetting operation; and

Figure 5 is a fragmentary sectional view showing metering means for the pilot supply of fuel from the outlet chamber to the pilot burner.

Referring to the drawings, the device shown in Figures 1 to 3, inclusive, comprises a valve body 10 having a fuel inlet 11 and a fuel outlet 12 which are tapped internally to receive the inlet and outlet pipe sections of the fuel supply pipe leading to the main burner. The valve body 10 has an internal wall or partition 13 which has a valve opening 14 through which communication is adapted to be effected between the inlet chamber 15, which is in communication with the inlet 11, and the outlet chamber 16, which is in communication with the outlet 12. The valve opening 14 is surrounded by a valve seat 18.

The lead connection hood and electromagnet, armature, and valve assembly is mounted upon the top of the valve body 10 as the same is viewed in Figure 1, and when in place, closes the open upper end of the valve body. The hood 20, which is preferably formed of "Bakelite," or any other suitable or preferred insulating material, in the illustrated embodiment of the invention is of generally cylindrical cup-shaped form provided at its open lower end with an external flange 21. A metal shell 22 has an external annular flange 23 which abuts against the flange 21, and the shell 22 closes and seals the interior of the hood 20 from the deleterious action of the gases or other fuel which passes through the valve body. The hood 20 and shell 22 are clamped to the top of the valve body by a union nut 24 having threaded engagement with the valve body and with the shell 22 fitting into the open upper end of the valve body. A gasket may be provided at 25.

The electromagnet, which is sealed within the hood 20, comprises a magnet frame 28. The particular magnet frame shown in the drawings is of U-shaped form, but this may vary widely within the scope of the present invention. The magnet frame 28 has a reset stem 29 formed integral therewith or suitably secured thereto. The reset stem 29 extends outwardly through an opening 30 centrally through the top of the hood 20 and through the interior of a hollow boss 32 integral

with the hood 20. The opening 30 is sealed by packing 33. A reset button 34 is threaded or otherwise suitably secured at 35 upon the outer end of the stem 29 and operates or is guided slidingly within the boss 32.

A coiled spring 36 is coiled about the stem 29 and interposed between the button 34 and a washer 37 which engages against the packing 33. The spring 36 normally holds the button 34, stem 29, and the electromagnet connected thereto, in outwardly projected position as shown in Figure 1, and serves to move these parts to the positions shown, as will presently appear. The spring 36 also serves to compress and hold the packing 33 in tight sealing relation about the opening 30.

Fixed rigidly in the hood 20 as, for example, by molding the insulating material of the hood thereto and extending lengthwise from the hood are a pair of spaced metallic terminal posts 38. These terminal posts 38 have aligned openings 39 and are split outwardly of these openings as shown at 40. A coil clamp 41 is positioned upon the magnet frame 28, and is flanged outwardly at its inner end, and the electromagnet coil 42 surrounds the legs of the magnet frame and the legs of the coil clamp 41, as shown. The opposite terminals of the coil 42 are connected to the inner ends of the respective terminals posts 38 by flexible conducting connectors 45. The posts 38 may have reduced portions at 46 to assure firm anchorage in the hood 20. The coil 42 may be covered with insulation as shown, and the flexible connectors 45 may be extensions of the opposite ends of the coil, the ends of the connectors being bared for good contact with the posts 38 where they are connected thereto.

The armature 50 is disposed within the hood 20 and is also sealed from the gaseous or other fuel by the shell 22. The armature 50, which is shown as of disc-like form and as secured to the upper end of a reciprocatory armature stem 51 is adapted to be held in attracted position against the pole ends of the magnet frame 28 upon energization of the electromagnet. The attachment of the armature 50 to the stem 51 may, if desired, be sufficiently loose to permit self-accommodation of the armature to the pole ends of the magnet frame, although this may vary. The stem 51 is disposed generally concentrically of the hood 20 and valve 10, and extends inwardly for reciprocating movement through an opening 52 in the outwardly raised central part of the shell 22. The opening 52 is sealed against leakage of the gas or other fuel or other deleterious substances into the hood 20 from the valve body by packing 53.

The valve disc 55 is held upon the lower end of a valve stem 51' by a snap ring 56 which is engaged in an annular groove in the headed lower end of the stem 51'. The ring 56, by engagement with an annular flange 58 on the valve disc 55 compels movement of the valve disc outwardly to open position with outward movement of the armature 50 and stem 51 as will hereinafter appear. The particular valve disc shown in the drawings has a valve disc gasket or yielding seating material 59 secured thereto by a valve disc screw 60, but this may, of course, vary. With the valve disc 55 positioned as shown, the valve disc gasket or yielding seating material 59 seats against the valve seat 18 and closes communication between the inlet chamber 15 and the outlet chamber 16 through the valve opening 14.

The valve stem 51' is headed at its outer end at 62, and this headed end 62 operates slidingly within the interior of the hollow armature stem 51, the inner end of which is turned or flanged inwardly at 63 for cooperation with the head 62 on the stem 51'. A cam disc 64 is loosely mounted at 65 on the stem 51 and is flanged or turned inwardly at 66 for cooperation with the inner end of the stem 51. A coiled spring 68 is interposed between the cam disc 64 and the valve disc 55 and serves to close the valve when the electromagnet ceases to hold the armature 50 in attracted position. The spring 68 also, through the cam disc 64 and by cooperation of this cam disc with a bearing washer 70, serves to compress and hold the packing 53 in tight sealing relation about the opening 52.

The tube 74 for supplying fuel to the pilot burner is connected to a hollow boss 75 extending laterally from the valve body 10 outwardly of the valve seat 18. The boss 75 has a passageway 76 extending therethrough for supplying fuel to the pilot burner supply tube 74. The tube 74 is joined at its inner end to the hollow boss 75 by a union nut 77 having threaded engagement with the boss 75, and the union is sealed by a union sleeve 78. The outer end of the tube 74 is connected to a suitable pilot burner (not shown), which pilot burner is disposed in juxtaposition to the main burner for the purpose of lighting the same, as well understood in the art. The pilot burner may be of any suitable or preferred form.

The passageway 76 is provided within its length with an inwardly extending annular flange 79 which slidingly supports a pilot valve plunger 80. Outwardly of the flange 79 the passageway 76 has a valve seat 81. The valve body 10 is provided with a by-pass opening 82 which is adapted to place the inlet chamber 15 in communication with the passageway 76 inwardly of the valve seat 81. A second by-pass opening 83 formed in the valve body 10, and preferably smaller in diameter than the passageway 82, is adapted to place the outlet chamber 16 in communication with the passageway 76 outwardly of the seat 81.

The pilot valve plunger 80 is provided at its outer end with a valve head 84 which is adapted to seat upon the valve seat 81 to shut off communication between the inlet chamber 15 and the passageway 76 through the opening 82. A valve button 86 is fixed as, for example, by threaded engagement upon the inner end of the stem or plunger 80 and operates slidingly in the inner end of the passageway 76. A spring 87 is coiled about the plunger 80 and interposed between the button 86 and the flange 79. The spring 87 normally holds the plunger 80 and button 86 yieldingly in inwardly projected position, and the valve head 84 of the plunger 80 seated upon the valve seat 81. The inner end of the button 86 is rounded or otherwise suitably formed for cooperation with the tapered cam surface 90 of the cam disc 64.

The passageway 83 is provided with a check valve or other suitable valve as indicated at 110 which, when the part 51 is cocked and the pilot fuel flows through the passageway 82 to the pilot burner, prevents the pilot fuel from entering the outlet chamber 16 through the passageway 83 before the main valve is opened.

The thermocouple (not shown) and lead connection therefor may be of the general character disclosed and claimed in Oscar J. Leins Patent No. 2,126,564, granted August 9, 1938, or of any

other suitable or preferred form. The terminal end of the thermocouple lead connection, except for the differences shown, is, in general, of the type disclosed and claimed in the copending application of Clarence Wantz, Serial No. 239,790, filed November 10, 1938. The thermocouple is placed in position to be heated by the pilot light and is connected in circuit with the electromagnet, and particularly with the coil 42 thereof, through the terminal posts 38.

The particular thermocouple lead connection shown in the drawings comprises an inner lead conductor 92 which is joined to the inner thermocouple member to form an internal thermal junction, and an outer lead conductor 93 which is connected to the outer thermocouple member to form another thermal junction. The two thermocouple elements are joined to form a third thermal junction which is adapted to be heated by the pilot light, as well understood in the art. The outer lead conductor 93 encloses the inner lead conductor 92, and the inner lead conductor 92 is insulated from the outer lead conductor by a wrapping of insulation on the inner lead conductor, as indicated at 94.

The thermocouple lead connection is preferably of a character that will permit bending, as desired, to permit disposing the thermocouple in any desired position. The lead connection may be of a character to support the thermocouple in any desired position, although supporting brackets or other means may be employed for this purpose. The end of the inner lead conductor opposite the end connected to one of the thermocouple elements extends from the outer lead conductor 93 and has a metallic terminal sleeve 95 fixed thereon in good conductive contact therewith and spaced from the end of the outer lead conductor 93. An insulating sleeve 96 is interposed between the terminal sleeve 95 and the adjacent end of the outer lead conductor.

A quick detachable connection is thus provided between the thermocouple leads and the terminal posts 38 for the electromagnet coil 42. The thermocouple is connected to the posts 38 by slipping the terminal end of the thermocouple lead means through the opening 39 in one terminal post 38 and into the opening 39 in the other terminal post, with the terminal sleeve in the opening in one post and the end of the tubular thermocouple lead 93 in the opening in the other terminal post. Screws 98 are then tightened to clamp the split portions of the terminal posts into good conductive contact and gripping engagement with the terminal sleeve 95 and tubular lead 93, respectively. The thermocouple is disconnected from the device by loosening the screws 98 and withdrawing the terminal end of the thermocouple lead from the posts 38.

The operation of the device is as follows:

When the pilot burner or the other flame to the heat of which the thermocouple is subject is extinguished, the electromagnet is deenergized, or at least the holding action thereof ceases to be sufficient to hold the armature 50 attracted to the poles of the magnet frame 28, and the spring 68 compels the valve 55 to closed position as shown in Figure 1, thereby shutting off the supply of fuel to the main burner through the outlet 12. In the movement of the valve member 55 to closed position, the headed outer end 62 of the valve stem 51', by engagement with the inturned or inwardly flanged inner end of the hollow armature stem 51, moves the armature 50 to retracted position as shown.

When it is desired to reset the device the reset button 34 is pressed inwardly. This results in moving the magnet frame 28 inwardly to engage its poles with the armature 50. Continued inward movement of the reset button 34 thereupon moves the armature 50 and its stem 51 inwardly with respect to the valve stem 51'. The armature stem 51, upon inward movement, engages the inturned or inwardly flanged inner end 66 of the hub part of the cam disc 64 and forces this cam disc inwardly. The cam disc 64, in its inward movement, engages the pilot valve button 86 and forces same outwardly against the tension of the spring 87, unseating the valve head 84 to permit a pilot supply of fuel which is under pressure in the inlet chamber 15 to flow through the passageways 82 and 76 and tube 74 to the pilot burner where it can be ignited as it issues from the pilot burner.

The pilot burner is then lighted and the heat of the pilot flame upon the "hot" junction of the thermocouple creates a thermoelectric current in the coil 42 of the electromagnet which energizes the electromagnet and causes the armature 50 to be held positively against the inner end of the magnet frame 28 by magnetic attraction. As a result, when the reset button 34 is released the spring 36 moves or returns the button 34 to its outwardly projected position. The outward movement of the button 34 moves the electromagnet outwardly therewith, and the valve member 50, being held attracted by magnetic attraction to the magnet frame 28, is moved outwardly to open position. Upon the outward movement of the armature, the cam disc 64 is released and actuated outwardly by the spring 68, thus releasing the pilot valve button 86, and the pilot valve 84 is returned to its seat and closes off the pilot supply of fuel to the tube 74 through the passageway 82.

Before closing off the by-pass passageway 82 the valve 55 is in open position and the desired supply of fuel for the pilot burner is set up from the outlet chamber 16 through the by-pass passageway 83. It is to be understood that the showing of the by-pass passageway 83 is illustrative and more or less diagrammatic. If, because of the greater amount of fuel outlet opening at the main burner, the by-pass passageway 83 does not supply the desired pilot supply of fuel to the pilot burner from the outlet chamber 16 when the valve 55 is open, the passageway 83 may be disposed in any other suitable or preferred manner to secure the desired pilot supply of fuel to the pilot burner when the valve 55 is open.

In other words, the electromagnet is now in its outwardly projected position and the armature is held in attracted position to the magnet frame 28, thereby holding the valve 55 open. The fuel flows from the inlet chamber 15 through the valve opening 14 and outlet chamber 16 to the main burner or burners. At the same time sufficient fuel is supplied to maintain the pilot burner. Upon extinguishment of the pilot burner the electromagnet is immediately deenergized, or at least immediately ceases to hold the armature 50 in attracted position. The spring 68 thereupon forces the valve 55 to closed position to shut off the supply of fuel to the main burner and the pilot supply valve 84 is closed to shut off the supply of fuel to the pilot burner through the by-pass passageway 82 and until the reset button is actuated to reset the device, as already described.

The mounting of the electromagnet with the flexible connectors at 45 permits the inward and outward movement of the electromagnet with the resetting button, and the manner in which the armature 50 and valve 55 are connected provides a simple, effective, and inexpensive construction. Moreover, the cam disc 64, with its manner of operation by the resetting means for the electromagnetic valve, provides a simple, effective and inexpensive arrangement for opening the by-pass passageway 82 to set up the desired supply of fuel to the pilot burner in the resetting operation.

In Figure 5, the passageway 83'', which corresponds with the passageway 83 in Figure 3, is shown provided with a metering screw 112 for metering the pilot fuel supply from the outlet chamber 16'' to the pilot burner. Of course the pilot fuel supply may be metered or regulated in any other suitable or preferred manner.

In the modified form of control for the fuel supply to the pilot burner as shown in Figure 4, a tubular valve housing 100 is threaded axially into the main valve member 55', there being a valve washer provided at 101' and corresponding with the valve washer 101 in the preceding embodiment of the invention. Threaded into the valve housing 100 is a valve cap 102 having an orifice 103 opening into the outlet chamber 16' of the valve body 10'. The passageway 83' is adapted for supplying fuel for the pilot burner from the outlet chamber 16' to the pilot supply tube 74'.

The interior of the valve housing 100 has a valve seat 105, and mounted in the valve housing 100 is a pilot valve plunger 106. This valve plunger 106 is normally seated against the seat 105 by a spring 108 to shut off the pilot supply of fuel into the outlet chamber 16' through the orifice 103. A port or opening 110 places the interior of the hollow hub part of the valve disc 55' in communication with the inlet chamber 15'.

In the resetting operation of the device the armature stem 51'' is projected inwardly as in the preceding embodiment, and in its inward movement engages and unseats the pilot control valve 106 from its seat 105. A pilot supply of fuel thereupon passes from the inlet chamber 15' through the port 110 and the interior of the hub part of the valve disc 50' and out past the seat 105 and through the orifice 103 into the outlet chamber 16'. This pilot supply of fuel passes from the outlet chamber 16' through the passageway 83' and pilot tube 74' to the pilot burner. When the valve disc 55' is closed with the armature stem 51'' released for movement to its outwardly projected position, the valve 106 closes and shuts off the supply of fuel to the pilot burner, and when the valve 55' is open the fuel passes from the inlet chamber through the valve opening 14' into the outlet chamber, and from the outlet chamber to the main burner and also through the duct 83' to the pilot burner. As in the preceding embodiment of the invention, the duct arrangement shown at 83' is more or less diagrammatic, and it is to be understood that if the desired pilot supply of fuel is not set up to the pilot burner when the valve 55' is open because of the greater amount of burner openings at the main burner, the passageway 83' may be otherwise arranged to provide the desired pilot supply of fuel at such time.

I do not intend to be limited to the precise details shown or described.

I claim:

1. In a device of the class described, in combination, a body, an insulating hood on said body, terminal means on said hood, a stem extending slidingly through an opening in said hood, an electromagnet carried by said stem and movable to outwardly and inwardly projected positions therewith, and flexible connectors connecting said electromagnet in circuit with the terminal means on said hood.

2. In a device of the class described, in combination, a body having an interior portion opening therefrom, a hood on said body, said hood having an interior portion opening from the hood adjacent the opening of the interior portion of the body from said body, terminal means on said hood, a stem extending slidingly through an opening in said hood, an electromagnet carried by said stem and movable to outwardly and inwardly projected positions therewith, means connecting said electromagnet in circuit with the terminal means on said hood, means secured to said body with said hood for sealing the interior of the hood from the interior of said body, an armature disposed within said hood and having attracted and retracted positions, an armature stem connected to said armature and operating slidingly through said sealing means with its inner end disposed in the body, a member having a stem connected to said armature stem for sliding movement relative thereto, a cam actuated by inward movement of said armature stem, and a pilot valve actuated by said cam.

3. In a device of the class described, in combination, a valve body, a hood on said body, terminal means on said hood, a stem extending slidingly through an opening in said hood, an electromagnet carried by said stem and movable to outwardly and inwardly projected positions therewith, means connecting said electromagnet in circuit with the terminal means on said hood, means secured to said valve body with said hood for sealing the interior of the hood from the interior of the valve body, an armature disposed within said hood and having attracted and retracted positions, an armature stem connected to said armature and operating slidingly through said sealing means with its inner end disposed in the valve body, a valve member having a stem connected to said armature stem for sliding movement relative thereto, a cam actuated by inward movement of said armature stem, a pilot valve actuated by said cam, and a spring interposed between said first valve and said cam for moving said first valve to closed position and said armature to retracted position.

4. In a device of the class described, in combination, a valve body having an inlet chamber and an outlet chamber, a hood on said body, terminal means on said hood, a stem extending slidingly through an opening in said hood, an electromagnet carried by said stem and movable to outwardly and inwardly projected positions therewith, means connecting said electromagnet in circuit with the terminal means on said hood, means secured to said valve body with said hood for sealing the interior of the hood from the interior of said valve body, an armature disposed within said hood and having attracted and retracted positions, an armature stem connected to said armature and operating slidingly through said sealing means with its inner end disposed in the valve body, a valve member having a stem connected to said armature stem for sliding movement relative thereto, a cam actuated by in-

ward movement of said armature stem, a pilot valve actuated by said cam, a spring interposed between said first valve and said cam for moving said first valve to closed position and said armature to retracted position, a fuel supply tube for a pilot burner connected to said valve body, a passageway adapted for supplying fuel from said inlet chamber to said pilot supply tube, and a valve actuated laterally to open position by said cam upon the resetting operation for establishing a supply of fuel for a pilot burner and shutting off the fuel supply for the pilot burner when said first valve is closed.

5. In a device of the class described, in combination, a valve body having an inlet chamber and an outlet chamber, a hood on said body, terminal means on said hood, a stem extending slidingly through an opening in said hood, an electromagnet carried by said stem and movable to outwardly and inwardly projected positions therewith, means connecting said electromagnet in circuit with the terminal means on said hood, means secured to said valve body with said hood for sealing the interior of the hood from the interior of said valve body, an armature disposed within said hood and having attracted and retracted positions, an armature stem connected to said armature and operating slidingly through said sealing means with its inner end disposed in the valve body, a valve member having a stem connected to said armature stem for sliding movement relative thereto, a cam actuated by inward movement of said armature stem, a pilot valve actuated by said cam, a spring interposed between said first valve and said cam for moving said first valve to closed position and said armature to retracted position, a fuel supply tube for a pilot burner connected to said valve body, a passageway adapted for supplying fuel from said inlet chamber to said pilot supply tube, a valve actuated laterally to open position by said cam upon the resetting operation for establishing a supply of fuel for a pilot burner and shutting off the fuel supply for the pilot burner when said first valve is closed, and means for establishing a supply of fuel for the pilot burner when said first valve is open.

6. In a device of the class described, in combination, a valve body, a hood on said body, a reset stem extending slidingly through an opening in said hood, an electromagnet carried by said reset stem, an armature within said hood and having attracted and retracted positions, an armature stem connected to said armature and extending into said valve body, a cam on said stem and actuated thereby, a pilot control valve actuated laterally to open position by said cam in the resetting operation of said stem, a valve member having a stem connected to said armature stem for sliding movement relative thereto, and a spring interposed between said cam and said last valve member for actuating said valve member to closed position and said armature to retracted position.

7. In a device of the class described, in combination, a valve, an electromagnet, an armature connected for relative movement to said valve and, when attracted, adapted to hold said valve open and, when retracted, compelling closing of said valve, a second valve, and cam means operated by movement of said armature relative to said first valve for opening said second valve.

8. In a device of the class described, in combination, a valve, an electromagnet, an armature connected for relative movement to said valve and, when attracted, adapted to hold said valve open and, when retracted, compelling closing of said valve, a second valve, cam means operated by movement of said armature relative to said first valve for opening said second valve, and a spring interposed between said first valve and said cam means for closing said first valve and moving said armature to retracted position.

9. In a device of the class described, in combination, a valve, an electromagnet, an armature connected for relative movement to said valve and, when attracted, adapted to hold said valve open and, when retracted, compelling closing of said valve, a second valve, cam means operated by movement of said armature relative to said first valve for opening said second valve, and a spring interposed between said first valve and said cam means for closing said first valve and moving said armature to retracted position, said spring also adapted to move said cam means from the position in which it actuates said second valve.

10. In a device of the class described, in combination, an armature, a valve connected for relative movement to said armature, an electromagnet movable into engagement with said armature to attract and hold said armature in attracted position and also movable in a direction to actuate said valve to open position, a second valve, and means for opening said second valve by continued movement of said electromagnet in the direction in which it is moved to attract and hold said armature and after said electromagnet is engaged with said armature.

11. In a device of the class described, in combination, an armature, a valve connected for relative movement to said armature, an electromagnet movable into engagement with said armature to attract and hold said armature in attracted position and also movable in a direction to actuate said valve to open position, a second valve, means for opening said second valve by continued movement of said electromagnet in the direction in which it is moved to attract and hold said armature and after said electromagnet is engaged with said armature, and means for releasing said last means and for closing said first valve and moving said armature to retracted position.

12. In a device of the class described, in combination, a body, a hood having the interior thereof sealed from the interior of said body, a stem extending from said hood, an electromagnet disposed within said hood and carried by said stem for movement to outwardly and inwardly projected positions therewith, an armature also disposed within said hood and having attracted and retracted positions, an armature stem connected to said armature with its inner end extending into the body, a main valve connected to said armature stem for sliding movement relative thereto, and a pilot valve actuated by inward movement of said armature stem relative to said main valve.

13. In a device of the class described, in combination, a body, a hood having the interior thereof sealed from the interior of said body, a stem extending from said hood, an electromagnet disposed within said hood and carried by said stem for movement to outwardly and inwardly projected positions therewith, an armature also disposed within said hood and having attracted and retracted positions, an armature stem connected to said armature, a first member connected to said armature stem for sliding move-

ment relative thereto, and a second member actuated by movement of said armature stem relative to said first member.

14. In a device of the class described, in combination, a first valve member, an electromagnet, an armature connected for movement relative to said first valve member and, when attracted, adapted to hold said first valve member in open position and, when retracted, releasing said first valve member for movement to closed position, and a second valve member adapted for operation to open position by movement of said armature relative to said first valve member.

15. In a device of the class described, in combination, electromagnet means, armature means for said electromagnet means, a first valve member adapted to be held in operating position by one of said first means when same is attracted and having movement relative to said means, and operable to closed position upon retraction of said means, and a second valve member adapted for operation to open position by movement of the one of said first means which is adapted to hold said first valve member in open position.

16. In combination, a valve seat, a valve member cooperable with said valve seat, an armature having lost motion connection with said valve member, and an electromagnet normally sufficiently removed from the armature as to prevent the armature being attracted when the electromagnet is energized and mounted for movement relative to said armature and movable into cooperation with the armature to pick up the armature and in a direction away from the valve seat to move said armature with said electromagnet, said lost motion connection comprising means carried by the armature and engageable with means carried by said valve member for moving said valve member to open position by the movement of said armature away from the valve seat.

17. In combination, a valve seat, a valve member cooperable with said valve seat, an armature having lost motion connection with said valve member, an electromagnet normally sufficiently removed from the armature as to prevent the armature being attracted when the electromagnet is energized and mounted for movement relative to said armature and movable into cooperation with the armature to pick up the armature and in a direction away from the valve seat to move said armature with said electromagnet, said lost motion connection comprising means carried by the armature and engageable with means carried by said valve member for moving said valve member to open position by the movement of said armature away from the valve seat, and means operable by relative movement of the lost motion connection between said armature and said valve member.

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