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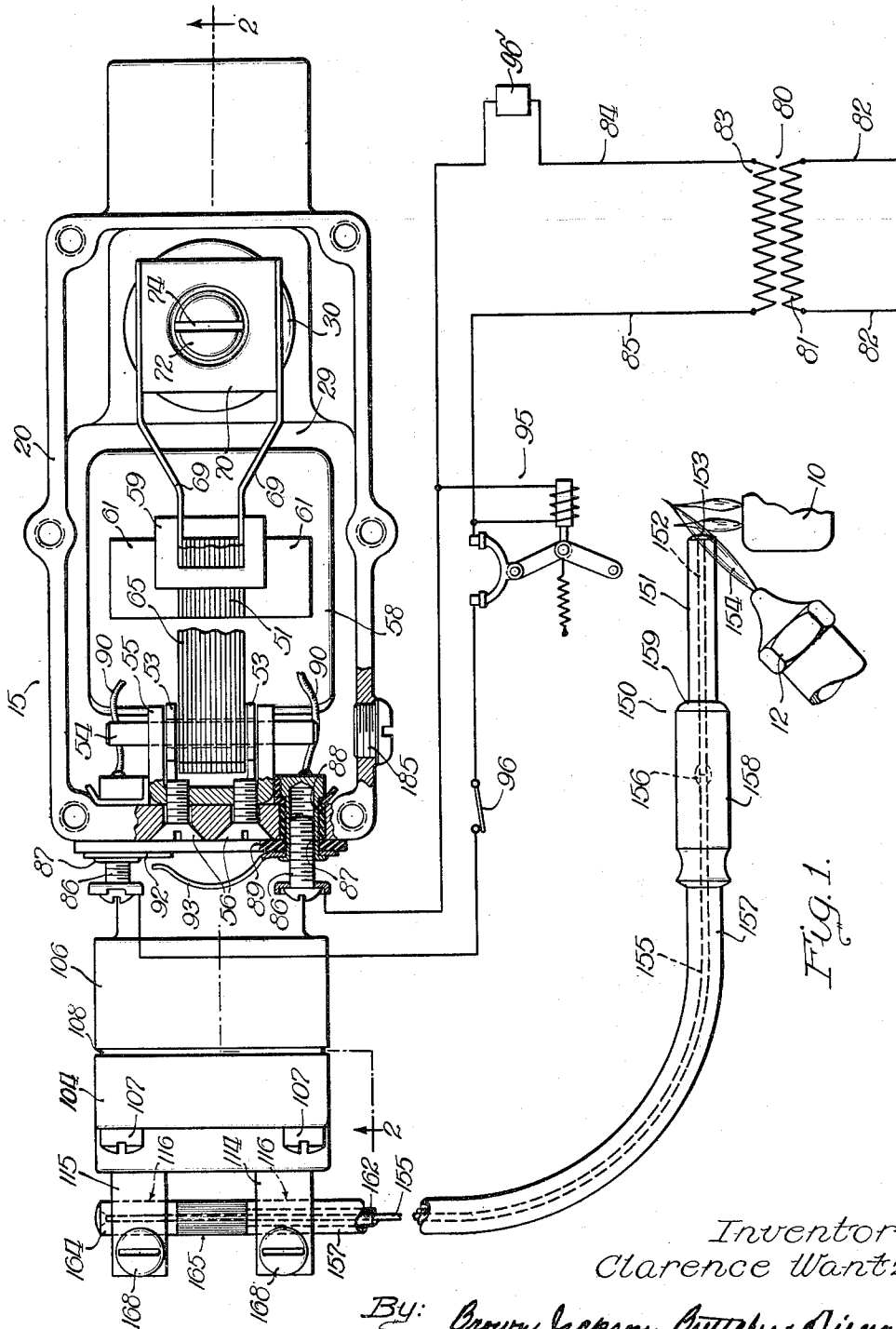
C. WANTZ

2,299,286

MAGNETIC SAFETY VALVE

Filed Aug. 17, 1939

2 Sheets-Sheet 1



Inventor:
Clarence Wantz

By: *Brown, Jackson, Butler & Sinner*
Attys.

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2 Sheets-Sheet 2

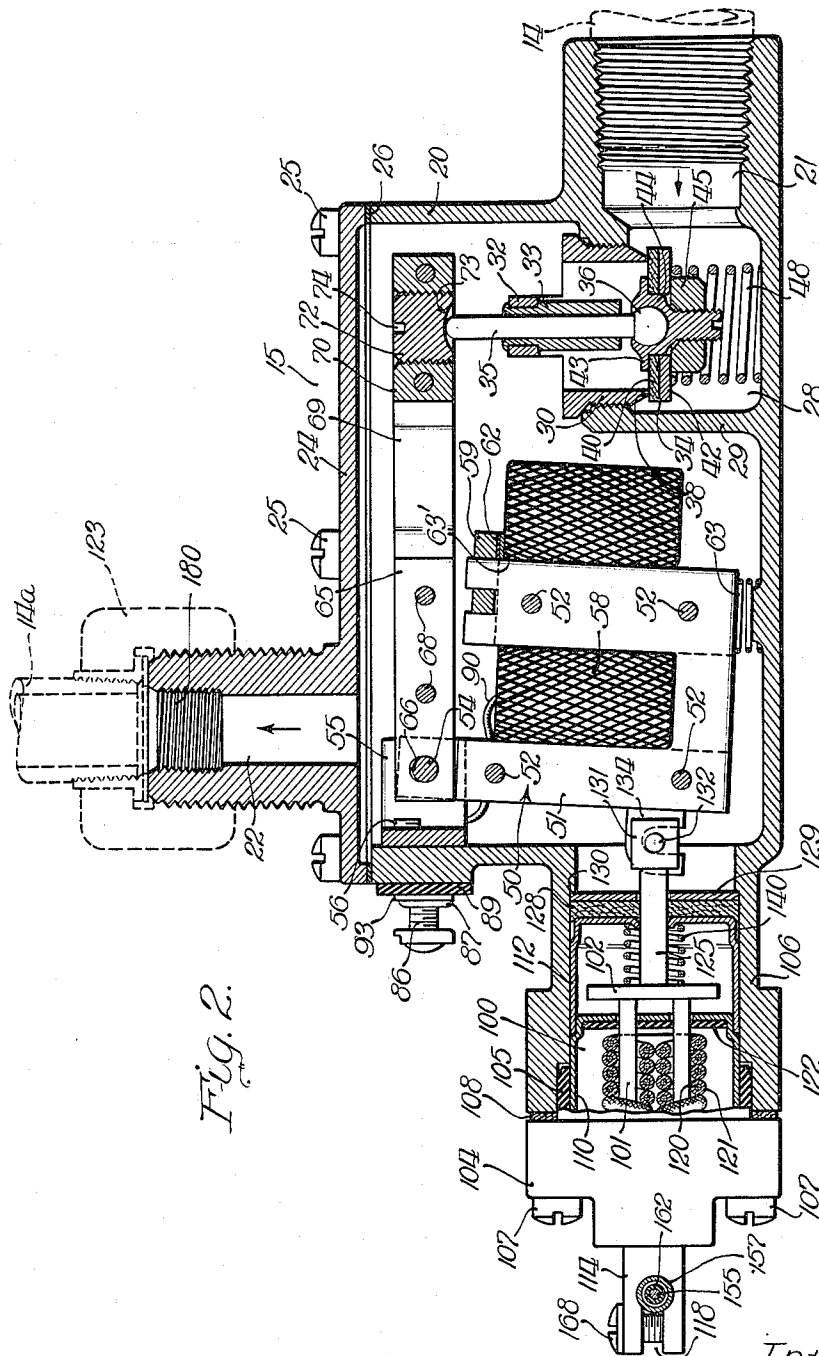


Fig. 2.

Inventor:
Clarence Wantz

By: *Brown, Jackson, Butcher & Vianna*
Attys.

UNITED STATES PATENT OFFICE

2,299,286

MAGNETIC SAFETY VALVE

Clarence Wantz, Milwaukee, Wis., assignor to Milwaukee Gas Specialty Company, Milwaukee, Wis., a corporation of Wisconsin

Application August 17, 1939, Serial No. 290,680

18 Claims. (Cl. 137—139)

This invention relates to safety devices for heating and other apparatus and has particular reference to an improved magnetic safety valve.

It is common to employ for various safety shut-off purposes a valve or an electric switch which will remain in operative position only when some controlling condition is functioning as desired or has a desired value. A particularly useful purpose for such a valve or switch is in a "safety pilot" or "safety shut-off" in a control system for heating apparatus and the like wherein the valve or switch will remain in operative position to maintain, for instance, the desired supply of fuel to the burner as long as, for example, the flame to which the safety device is subjected—such as a pilot flame—is ignited; the valve or switch operating to safety position to shut off the fuel supply to the burner if the flame fails or is extinguished.

It has previously been proposed to provide a control system generally of the class described with a valve in the fuel supply line leading to the burner, there being an electromagnet and an armature for the electromagnet which, when attracted, holds the valve in open position, and when retracted releases the valve for movement to closed position, and a thermocouple placed in position to be heated by the pilot burner, or other flame, and connected with the electromagnet so that the electromagnet will be energized to hold the armature in attracted position and thereby the valve open as long as the thermocouple is heated by the flame, the electromagnet being deenergized, or at least becoming insufficiently energized, to hold the valve open upon extinguishment of the flame.

It has also previously been proposed to provide a control system generally of the class described with an electroresponsive valve in the fuel supply line leading to the burner, there being an electric circuit for this valve, a switch in said circuit, an electromagnet and an armature for the electromagnet which, when attracted, holds the switch closed, thereby maintaining the electroresponsive valve in open position, and a thermocouple placed in position to be heated by the pilot burner, or other flame, and connected with the electromagnet so that the armature will be held in attracted position and thereby the switch in closed position to maintain the valve open as long as the thermocouple is heated by the flame, the electromagnet being deenergized or at least becoming insufficiently energized to hold the switch closed upon extinguishment of the flame and the

valve thereupon operating to closed position to shut off the fuel supply to the burner.

According to the first of the previously proposed schemes as above set forth, the relatively weak thermoelectric current produced by the heat of the flame on the thermocouple has been incapable of energizing the electromagnet sufficiently to actuate the valve to open position and, as a result, reset means has been required for resetting the armature to attracted position and the valve to open position.

According to the second of the previously proposed schemes as above set forth, it has been necessary to provide a switch in the circuit for the electroresponsive valve, to maintain this switch closed by the electromagnet connected in circuit with the thermocouple as long as the flame is ignited and to release said switch for movement to open position to open the circuit for the electroresponsive valve in the fuel supply line upon extinguishment of the flame.

One of the main objects of the present invention is to make it unnecessary to provide reset means for the purpose described and to eliminate the manual resetting operation heretofore required to reset the armature to attracted position and the valve to open position.

Another object of the invention is to make it unnecessary to provide in the circuit for the electroresponsive valve in the fuel supply line a switch under the control of the electromagnet connected in circuit with the thermocouple and to eliminate the matter of closing and maintaining said switch closed as long as the flame is burning and releasing same for movement to open position upon extinguishment of the flame.

Another object is to provide a safety system for fuel burners whereby the valve in the fuel line leading to the burner will not only be closed automatically whenever the burner to which the safety system is subjected, as for instance the pilot burner, is extinguished, but which will also be opened automatically and without manual resetting to open position whenever the burner to which the safety system is subjected is ignited, and will be maintained open as long, for instance, as the pilot burner is burning.

Another and more specific object is to provide in a system of the class described a fuel supply line leading to the burner, a magnetic valve in said line, a first electromagnet, an armature therefor, and means comprising a second electromagnet connected in circuit with the thermocouple for holding the first electromagnet in position wherein the armature therefor is actuated

to attracted position to open the valve and hold the valve open as long as the flame is burning, the second electromagnet becoming deenergized or at least not sufficiently energized to hold the first electromagnet in operative position upon extinguishment of the flame, whereupon the first electromagnet is released for movement with the armature therefor in its movement to retracted position to close the valve and shut off the supply of fuel to the burner.

It is also a more specific object of the present invention to provide the electromagnet, which is connected in circuit with the thermocouple, with an armature which is normally held in attracted position and returned to attracted position regardless of whether or not the electromagnet is energized by the heat of the flame on the thermocouple, the force for holding this armature in attracted position being insufficient to hold the other electromagnet in operative position unless the holding electromagnet is energized by the heat of the flame on the thermocouple.

Another object is to provide an improved short circuiting arrangement for deenergizing the main valve controlling electromagnet, or at least reducing the energization thereof sufficiently to release said electromagnet for movement to its operative position in which it is adapted to be held by the holding electromagnet, thereby freeing the holding electromagnet and the means for moving the armature thereof to attracted position, of the armature for the main electromagnet and also of the shut-off valve and of the spring or other means for actuating the shut-off valve to closed position.

Another object of the present invention is to provide a magnetic valve of the class described which is of simple character and relatively low cost, and which will operate positively and effectively for the purposes described.

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

Figure 1 is a top plan view of a magnetic valve embodying the present invention, with the cover for the valve housing removed and showing more or less diagrammatically the valve embodied in one form of safety control system; and

Figure 2 is a longitudinal section taken on the line 2-2 of Figure 1.

Referring now to the drawings, which are for purposes of illustrating one embodiment of the invention and one particular manner of using the same and are not to be construed as limiting the scope of the invention, either as to the form of the magnetic valve or as to the illustrated use of the same, the burner 10 is any suitable or preferred burner, such as the main burner of a hot water heater, gas furnace, oil heater, automatic space heater, gas range, or it may be a conversion burner or any other burner.

Associated with the main burner 10 is the usual or any suitable or preferred pilot burner indicated more or less diagrammatically at 12, which pilot burner is intended to remain lighted for the purpose of relighting the main burner upon extinguishment thereof. The pilot burner 12 is supplied with gaseous or any other suitable fuel, for example by a tube connected to the fuel supply conduit 14 which supplies fuel to the main burner. The magnetic safety device of the present invention is shown in the form of a magnetic valve designated in its entirety at 15 and positioned in the fuel supply line leading to the main

burner. The connection between the pilot tube and the fuel supply conduit 14 is preferably disposed anterior to the valve 15, or is otherwise arranged to supply fuel to the pilot burner 12 when the valve 15 is in closed position, shutting off the supply of fuel to the main burner 10, as well as when the valve 15 is open.

The magnetic valve 15 comprises a valve housing 20 having a fuel inlet 21 and a fuel outlet 22. The inlet 21 is tapped internally to receive the inlet pipe section 14 of the fuel supply pipe, and the outlet 22 is threaded externally for connection at 23 to the outlet pipe section 14a leading to the main burner 10. In the illustrated embodiment of the invention, the outlet 22 is formed on a cover 24 which closes the open top of the housing 20 as the device is viewed in Figure 2, and is secured in place by cap screws 25, preferably with a gasket 26 between the valve housing and the cover as shown. Within one end of the housing 20 is an inlet chamber 28 closed off from the interior of the housing 20 by a wall 29 and adapted to have communication with the interior of the housing 20 and thereby with the outlet 22 through a tubular valve seat member 30 which has threaded engagement in an internally threaded opening in the top of the enclosure for the inlet chamber 28.

The valve seat member 30 has an integral guide support 32, and fixed therein is a guide sleeve 33. The valve member 34 is of disc-like form and is secured at one end of a reciprocatory valve stem 35. The valve stem 35 has reciprocatory movement in the sleeve 33. The attachment of the valve member 34 to the stem 35 is preferably of generally universal character as shown at 36, or otherwise formed to permit self-accommodation of the valve member to the valve seat 38 at the adjacent end of the valve seat member 30.

The particular valve member shown in the drawings preferably has a valve disc gasket or yielding seating material 40 secured thereto for yielding seating engagement with the valve seat 38. The gasket or yielding seating material 40 is shown clamped between a washer 42 and a flange 43 on the member 44 by a nut 45 which has threaded engagement with a threaded stem integral with the member 44. These details may, of course, vary widely within the scope of the present invention. A coiled spring 48, interposed between the base of the housing 20 as the device is viewed in Figure 2, or between any other relatively fixed abutment and the valve member 34, serves to actuate the valve member to closed position engaging the seat 38 to shut off the supply of fuel to the main burner when, for example, the flame at the pilot burner is extinguished, as will hereinafter appear.

Also disposed within the valve housing 20 is an electromagnet 50 comprising a magnet frame 51 shown as made up of U-shaped laminations, although this may vary within the broader aspects of the invention. The laminations are secured together at 52 and secured to the outer sides of one leg of the magnet frame are a pair of bracket members 53 which extend upwardly and are pivoted upon a pin 54, thereby supporting the electromagnet 50 for pivotal or rocking movement. The pin or pivot 54 is carried by the outstanding arms of a U-shaped bracket 55, the base of which is secured, for instance, by screws 56 to the adjacent end wall of the valve housing 20.

The coil or winding 58 for the electromagnet

50 is shown as coiled about one of the legs of the magnet frame 51, although this, too, may vary, and shading pole means is preferably provided, as indicated at 59, for a purpose well understood in the art. Strips 61 of insulating material extend down between the coil 58 and the opposite sides of the leg of the magnet frame about which the coil is wound. The opposite ends of these strips 61 are turned out along the opposite ends of the coil 58, and the upper out-turned end is extended between the coil 58 and the shading pole means 59 as indicated at 62. A relatively light coiled spring 63 is interposed between the bottom of the magnet frame 51 and the bottom of the valve housing 20, preferably in position generally diagonally opposite the pivot 54 for maintaining the electromagnet in the desired position and cushioning its movement, as will hereinafter appear. The insulating strips 62 serve to insulate from the magnet frame and the shading pole means 59 the metal members 63' which extend through the opening in the coil and between the out-turned ends of which the coil is secured.

The electromagnet 50 is provided with an armature 65 shown as of laminated construction and pivoted at one end upon the pivot 54 between the bracket members 53 of the magnet frame. Looseness is preferably provided at the pivotal support, as indicated at 66, to permit the armature properly to seat against the pole ends of the magnet frame when in attracted position. The laminations forming the armature 65 are secured together at 68, and the outer laminations form extending arms 69 at the outer end of the armature. A block 70 is secured between the outer ends of the arms 69, and threaded for adjustment in the block 70 is a screw 72, the inner end of which is of concave form at 73 for engagement with the adjacent end of the valve stem 35, which is preferably rounded for proper cooperation with the screw. The outer end of the screw 72 is provided with a kerf 74 which is adapted to be engaged by a screw driver or other suitable tool for the purpose of adjusting the screw in the block 70 to adjust the operation of the valve 34 by the movement of the armature 65.

A step-down transformer 80 supplies current for energizing the electromagnet 50. This transformer has a primary winding 81 connected to line wires 82, which may be the line wires of a 110-volt circuit or any other suitable circuit. The secondary winding 83 is connected through conductors 84 and 85 with terminals on the valve housing 20. These latter terminals comprise terminal screws 86 connected as shown diagrammatically in Figure 1, in circuit with the respective conductors 84 and 85. Each screw 86 is threaded into a terminal bushing or sleeve 87 secured in the wall of the valve housing 20, for example as shown, or in any other suitable manner.

The terminal bushings 87 are insulated from the wall of the valve housing by insulation at 88 and 89. The terminals of the coil 58 are connected in circuit with the conductors 84 and 85 by terminal leads 90 connected, for instance, to the inner ends of the terminal members 87. Fixed to one terminal bushing 87 and connected in circuit therewith is a contact member 92. A spring contact arm 93 is fixed to the other terminal bushing 87 and connected in circuit therewith, the contact arm 93 and contact member 92 being insulated from the wall of the valve housing 20 by the insulation at 89. The contact

arm 93 is bowed outwardly with its free end normally retained out of contact with the contact 92 by the inherent resiliency in the arm.

The contact arm 93 and contact 92 form a short circuiting switch which is closed, for instance, by engaging the arm 93 with the finger and pressing the free end of the arm into engagement with the contact 92. Any other suitable or preferred form of switch may be employed. The closing of this switch short circuits the coil of the electromagnet 50, closing the circuit 84, 85 through the contact arm 93 and its cooperating contact 92 to deenergize the coil 58, or at least reduce the energization thereof sufficiently to release the electromagnet 50 from the armature 65 for movement to the position shown in Figure 2, as will hereinafter appear.

The circuit comprising the conductors 84 and 85 is preferably provided with an overload circuit breaker shown diagrammatically at 95 which acts to open this circuit to protect the same, and particularly the transformer 80, in case the contact arm 93 is held in engagement with the contact 92 too long. The circuit 84, 85 is also provided with a manually operable switch 96, although a room thermostat, pressure switch, or other controls may be used in lieu of or with the switch 96 as indicated, for instance, at 96'.

For the purpose of holding the electromagnet 50 in the position shown in Figure 2 and against rocking or swinging movement about its pivot 54, I provide holding means comprising a second electromagnet 100. This second or holding electromagnet comprises a magnet frame 101 shown of generally U-shaped form and provided with an armature 102.

The housing and lead connection cap for the electromagnet 100 are of the general character disclosed and claimed in the copending application of Clarence Wantz, Serial No. 239,790, filed November 10, 1938. The cap 104, which is preferably formed of "Bakelite" or any other suitable or preferred insulating material, has an integral cylindrical extension 105 which fits in a counter-bore at the outer end of the bore in the hollow boss or tubular extension 106 on the valve housing 20. The cap 104 is fastened in place by cap screws 107 preferably with a sealing gasket or washer 108 between the cap and the end of the boss 106.

The electromagnet housing 110 is in the form of a generally cup-shaped metal shell secured, for instance, to the cap 104 by pressed fit engagement of its open end in the cap. The housing or shell 110 is reduced at its inner end, and the armature housing 112, which is also in the form of a generally cup-shaped metal shell, is mounted on the shell 110, for instance by secure pressed fit engagement of its open end telescopically over the reduced inner end of the shell 110. The inner end of the shell 112 is preferably reduced as shown.

The magnet frame 101 is positioned within the shell 110 with its legs extending through openings in the inner end of the shell and presenting pole ends within the armature housing 112. Fixed rigidly in the cap 104, as, for example, by molding the insulating material of the cap thereto and extending endwise from the cap, are a pair of spaced metallic terminal connectors 114 and 115 having aligned openings 116 and split outwardly of these openings at 118. The electromagnet coil 120 surrounds the legs of the magnet frame 101, and the leads or ends of this coil extend out and are connected to the terminal con-

nectors 114 and 115 preferably externally of the cap 104 and in a manner to provide good conducting contact. The coil 120 is preferably covered with insulation between its bared ends at 121. Suitable insulation is provided at 122 between the inner end of the coil and the inner end of the shell 110, and, if desired, additional insulation may be provided between the turns of the coil and the legs of the magnet frame 101.

The armature 102 is disposed in the armature housing 112 and is adapted to be held in attracted position against the pole ends of the magnet frame 101 upon energization of the electromagnet 100. The armature 102 is of disc-like form and is secured to the outer end of a reciprocatory stem 125. The attachment of the armature to the stem 125 may, if desired, be sufficiently loose to permit self-accommodation of the armature to the pole ends of the magnet frame, although this is not necessary because the connection between the inner end of the stem 125 and the electromagnet 50 is of a character to permit this self-accommodation of the armature to the magnet frame 101.

The stem or shaft 125 extends inwardly for reciprocating movement through an opening in the inner end of the housing 112. Packing 128 of felt or other suitable or preferred material is interposed between the inner end of the shell 112 and a disc 129, which disc seats inwardly upon the shoulder 130. The inner end of the pin or shaft 125 carries a block 131 which has a pin 132 extending laterally from the opposite sides thereof. The bracket members or side pieces 53 on opposite sides of the adjacent leg of the magnet frame 51 have integral notched lugs forming hooks 134 which engage over the pin 132 on opposite sides of the block 130 as shown in Figure 2. The engagement of the hooks 134 with the pin 132 connects the electromagnet 50 to the armature stem or shaft 125, so that when the electromagnet 100 is energized to hold the armature 102 in attracted position, the electromagnet 50 will be held fixedly in the position shown in Figure 2. The armature 102 is normally maintained in attracted position and returned to attracted position by a spring 140 coiled about the stem or shaft 125 and interposed between the armature 102 and the inner end of the armature housing 112.

The thermocouple illustrated in the drawings is of the general character disclosed and claimed in Oscar J. Leins Patent No. 2,126,564, granted August 9, 1938, and the lead connection therefor is of the character disclosed in the copending application of Clarence Wantz, Serial No. 239,790, filed November 10, 1938. It is to be understood that the form of the thermocouple and lead connection therefor may vary widely within the scope of the present invention.

The thermocouple 150 comprises an outer tubular metallic thermocouple member 151 and an inner metallic thermocouple member 152 disposed within the outer thermocouple member and joined at one end to the outer thermocouple member to form the thermal junction 153 which is placed in position to be heated by the flame—for instance, the pilot flame 154. An inner lead conductor 155 is joined to the inner thermocouple member to form an internal thermal junction 156, and an outer tubular lead conductor 157 is connected to the outer thermocouple member through a sleeve 158 to form a third thermal junction 159. The outer lead conductor 157 encloses the inner lead conductor and, with the

outer thermocouple member, constitutes an enclosure about the inner thermocouple member and the inner lead conductor and the inner thermocouple junction 156. The inner lead conductor 155 is insulated from the outer lead conductor 157 by a wrapping of insulation on the inner lead conductor as indicated at 162.

The inner and outer lead conductors 155 and 157 are preferably of a character that will permit bending, as desired, to permit disposing the thermocouple in any desired position. At the same time 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 supporting the thermocouple and lead connection. At the end opposite the end at which the thermocouple is positioned the inner lead conductor 155 extends from the outer lead conductor 157 and has a metallic terminal sleeve 164 fixed thereon in good conductive contact therewith and spaced from the end of the outer lead conductor. An insulating sleeve 165 is interposed between the terminal sleeve 166 and the outer lead conductor 157.

A quick detachable connection is thus provided between the thermocouple leads and the terminals 114 and 115 for the electromagnet coil 120. The thermocouple is connected to the terminals 114 and 115 by slipping the terminal end of the thermocouple lead means through the opening 116 in one terminal 114 and into the opening 116 in the other terminal, with the terminal sleeve 164 in the opening 116 in one terminal 115 and the end of the tubular thermocouple lead 157 in the opening 116 in the other terminal 114. Screws 168 are then tightened to clamp the split portions 118 of the terminals 114 and 115 into good conductive contact and gripping engagement with the terminal sleeve 164 and tubular lead 157, respectively. The thermocouple is disconnected from the device by loosening the screws 168 and withdrawing the terminal end of the thermocouple leads from the terminals 114 and 115.

Assuming that the parts of the magnetic switch are positioned as shown in Figure 2, the operation of the device is as follows:

When the pilot flame 154 or other flame, to the heat of which the thermocouple is subjected, is burning, the heat of this flame upon the thermal junction 153 produces a thermoelectric current in the coil 120 of the holding electromagnet 100. The magnet frame 101 and armature 102 are preferably formed of an alloy of low magnetic reluctance and, as a result, the thermoelectric current produces a magnetic field of sufficient strength to hold the armature 102 in attracted position against the pole ends of the magnet frame. The spring 140, which normally holds the armature 102 in attracted position, assists the magnetic action in holding this armature against the magnet frame when the electromagnet 100 is energized and, as a result, the electromagnet 50 is held fixedly in the position shown through the pin and hook connection 132, 134.

Closing of the manual switch 96 with the short circuiting switch arm 93 open completes the circuit 84, 85 through the coil 58 of the electromagnet 50. This produces a relatively strong magnetic field in the electromagnet 50, and, as a result, with the electromagnet 50 held in the position shown in Figure 2, the armature 65 is swung by the magnetic action about its pivot 54 to attracted position against the pole ends of the magnet frame 51. This movement of the

armature 65 to attracted position moves the valve 34 to open position against the tension of the spring 48 through the engagement of the adjusting screw 72 with the adjacent end of the valve stem 35.

The valve 34 is held in open position, permitting fuel to flow into the interior of the valve housing 20 through the inlet pipe section 14 and out through the outlet pipe section 14a to the burner 10 as long as the circuit 84, 85 is closed and the thermocouple is heated to hold the electromagnet 50 positioned as shown. Manual or other control valves may, of course, be provided in the fuel supply line leading to the burner 10.

With the valve 34 thus held in open position, the magnetic attraction of the armature 102 to the electromagnet 100, aided by the spring 140, is sufficient to hold the electromagnet 50 positioned as shown against the action of the spring 48. The magnetic attraction of the armature 65 to the electromagnet 50 is also sufficient to hold the armature 65 from moving away from the electromagnet 50 to retracted position under the action of the spring 48.

If the flame, to the heat of which the thermocouple 150 is subjected, is extinguished, the holding action of the electromagnet 100 ceases to be sufficient to hold the armature 102 in attracted position, and the hold on the electromagnet 50 is thus released. The electromagnet 50 is thereby freed for movement with the armature 65, and the spring 48 moves the valve 34 to closed position, shutting off the supply of fuel to the burner 10 at the same time, through the valve stem 35, swinging the armature 65 to its retracted position about the pivot 54 with the electromagnet 50 following the movement of the armature.

The device is reset merely by relighting the pilot burner 12 and closing the short circuiting switch 93 for an instant. The switch 93 does not have to be held closed until the heat of a flame on the thermocouple has set up the thermoelectric current required to maintain an armature in attracted position, but is held closed only for an instant. This closing of the switch 93 short circuits the coil of the electromagnet 50 and, as a result, the holding action of the electromagnet 50 ceases to be sufficient to hold the same to the armature 65, and the electromagnet 50 drops by gravity or is otherwise actuated to the position shown in Figure 2, the armature 65 remaining in retracted position as shown.

If the pilot burner 12 is lighted and sets up a thermoelectric current to hold the armature 102 in attracted position and thereby the electromagnet 50 positioned as shown, the magnetic field set up in the electromagnet 50 by the flow of current through the coil thereof draws the armature 65 to attracted position against the pole ends of the magnet frame 51. This actuation of the armature 65 to attracted position moves the valve 34 to open position through the stem 35, and the valve is held open as long as the flame 154 is burning and the circuit 84, 85 is completed.

If the burner is not lighted to produce the thermoelectric current for holding the armature 102 in attracted position and thereby the electromagnet 50 in operative position, the valve 34 will be closed and the armature 65 and electromagnet 50 swung to the retracted position of the armature 65 under the action of the spring 48, as already described. The circuit 84, 85 is opened and closed as desired by means of the switch 96.

For the purpose of sealing the interior of the valve housing 20 against the entry of dust, mois-

ture, or other foreign matter—for instance, during shipment and until the device is installed for use—the outlet 22 is tapped internally at 180 to receive a suitable closure plug (not shown) which may be removed when the device is ready for use. The inlet 21 may also be closed during shipment and until the device is ready for use by a suitable seal fastened over the outer end of the tubular boss or extension through which the inlet 21 enters the housing 20, or arranged otherwise as desired.

The plug 185 (Figure 1) closes an opening in the side wall of the valve housing 20. This opening is aligned axially with the pivot pin 54 and permits insertion and withdrawal of the pin therethrough.

The spring 63, which is preferably a weak and low rate spring, takes out any lost motion in the connection 131, 134 between the armature stem 125 and the magnet frame 51. The valve 34 is always preferably in a vertical position. The spring 140 is preferably just strong enough to hold the armature against the magnet frame 101 and to hold the magnet frame 51 against the spring 63. The spring 48 is strong enough to raise the armature 65 and to hold the valve 34 closed against the seat 38. The spring 140 is weaker than the spring 48 but spring 140 plus the pull of the armature 102 to the magnet frame 101 when the electromagnet comprising the magnet frame 101 is energized is stronger than the spring 48.

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

I claim:

1. In combination, an electromagnet comprising a pivoted magnet frame having a magnet coil thereon, a pivoted armature for said electromagnet, a second electromagnet, and an armature for said second electromagnet which, when held attracted by energization of said second electromagnet, is adapted to hold said first electromagnet against pivotal movement.

2. In combination, an electromagnet comprising a pivoted magnet frame having a magnet coil thereon, a pivoted armature for said electromagnet, a second electromagnet, and an armature for said second electromagnet which, when held attracted by energization of said second electromagnet, is adapted to hold said first electromagnet against pivotal movement, said first electromagnet being freed for pivotal movement with said armature upon deenergization of said second electromagnet.

3. In combination, an electromagnet comprising a pivoted magnet frame having pole means and provided with a magnet coil, a pivoted armature for said electromagnet, a second electromagnet, an armature for said second electromagnet, and means connecting the magnet frame of said first electromagnet with the armature of said second electromagnet.

4. In combination, an electromagnet comprising a pivoted magnet frame having pole means and provided with a magnet coil, a pivoted armature for said electromagnet, a second electromagnet, an armature for said second electromagnet, and means connecting the magnet frame of said first electromagnet with the armature of said second electromagnet, said connection being of a character to allow pivotal movement of said first electromagnet and there being looseness in the pivot for said armature to permit accommodation of said armature to the pole means of said first electromagnet.

5. In combination, an electromagnet comprising a pivoted magnet frame having a magnet coil, a pivoted armature for said electromagnet, a second electromagnet, an armature for said second electromagnet, means connecting the magnet frame of said first electromagnet with the armature for said second electromagnet, and shading pole means for said first electromagnet.
6. In combination, valve means comprising a pair of electromagnets, a condition responsive electromagnetic connection between said electromagnets, valve opening and closing means associated with one of said electromagnets, a thermally responsive means connected in circuit with the other of said electromagnets for energizing the same, said other electromagnet upon being energized rendering said one electromagnet operative, and deenergization of said other electromagnet rendering said one electromagnet inoperative.
7. In combination, a thermocouple subject to the heat of a flame, an electromagnet connected in circuit with said thermocouple, an armature for said electromagnet, means normally holding said armature in attracted position and returning said armature to attracted position regardless of whether or not the electromagnet is energized by the heat of the flame on the thermocouple, and a second electromagnet adapted to be held in operative position by said first electromagnet as long as said flame is burning, the force of the means for holding said armature in attracted position being insufficient to hold said second electromagnet in operative position unless the holding electromagnet is energized by the heat of the flame on the thermocouple.
8. In combination, a fuel supply line, a valve in said line, a movable electromagnet having an operative position and adapted when in said position and when energized to move said valve to open position, and a second electromagnet which, when energized, is electromagnetically connected to said first electromagnet to hold same in operative position and, when deenergized, releases the electromagnetic connection with said first electromagnet for movement of said electromagnet to inoperative position and said valve to closed position.
9. In combination, a fuel supply line, a valve in said line, a movable electromagnet having an operative position and adapted when in said position and when energized to move said valve to open position, a second electromagnet which, when energized, is electromagnetically connected to said first electromagnet to hold same in operative position and, when deenergized, releases the electromagnetic connection with said first electromagnet for movement of said first electromagnet to inoperative position and movement of said valve to closed position, and means for deenergizing said first electromagnet to free same for movement to operative position.
10. In combination, a fuel supply line, a valve in said line, an electromagnet having an operative position and adapted, when in said position and when energized, to move said valve to open position, a second electromagnet which, when energized, is electromagnetically connected to said first electromagnet to hold same in operative position and, when deenergized, releases the electromagnetic connection with said first electromagnet for movement of said valve to closed position, a thermocouple placed in position to be heated by a flame and connected in circuit with said second electromagnet, and a circuit provided with a source of current and connected to said first electromagnet.
11. In combination, a controlling member having an operating position and a safety position, an electromagnet, an armature associated with said controlling member and adapted to be attracted by said electromagnet, and means for holding said electromagnet in a position wherein it is operative to move said armature to actuate said controlling member to operating position and to hold same in operating position, said holding means being releasable to release said electromagnet for movement with said armature attracted thereto whereupon said armature is adapted to release said controlling member for movement to safety position.
12. In combination, a controlling member having an operating position and a safety position, a first electromagnet, means comprising a second electromagnet which, when energized, is adapted to hold said first electromagnet in a position wherein it is operative to move said controlling member to one of said positions, said second electromagnet being adapted, when deenergized, to release said first electromagnet for movement to inoperative position for movement of said controlling member to the other position, a thermocouple placed in position to be heated by a flame and connected in circuit with said second electromagnet, and a circuit provided with a source of current and connected to said first electromagnet.
13. In combination, a controlling member having an operating position and a safety position, a first electromagnet, an armature for said first electromagnet which, when attracted to said electromagnet, is adapted to actuate said controlling member to operating position and to hold same in said position, means comprising a second electromagnet which, when energized, is adapted to hold said first electromagnet in a position wherein it is operative to move said armature to attracted position and to hold same in attracted position, said second electromagnet being adapted, when deenergized, to release said first electromagnet for movement to inoperative position to release said controlling member for movement to the other position, a thermocouple placed in position to be heated by a flame and connected in circuit with said second electromagnet, and a circuit provided with a source of current and connected to said first electromagnet.
14. In combination, a controlling member having an operating position and a safety position, a first electromagnet, an armature for said first electromagnet which, when attracted to said electromagnet, is adapted to actuate said controlling member to operating position and to hold same in said position, means comprising a second electromagnet which, when energized, is adapted to hold said first electromagnet in a position wherein it is operative to move said armature to attracted position and to hold same in attracted position, said second electromagnet being adapted, when deenergized, to release said first electromagnet for movement to inoperative position to release said controlling member for movement to the other position, a thermocouple placed in position to be heated by a flame and connected in circuit with said second electromagnet, a circuit provided with a source of current and connected to said first electromagnet, and means for deenergizing said first

electromagnet to free same from said armature for movement to the position in which it is held by said second electromagnet.

15. In combination, a controlling member having an operating position and a safety position, a first electromagnet, an armature for said first electromagnet which, when attracted to said electromagnet, is adapted to actuate said controlling member to operating position and to hold same in said position, means comprising a second electromagnet which, when energized, is adapted to hold said first electromagnet in a position wherein it is operative to move said armature to attracted position and to hold same in attracted position, said second electromagnet being adapted, when deenergized, to release said first electromagnet for movement to inoperative position to release said controlling member for movement to the other position, a thermocouple placed in position to be heated by a flame and connected in circuit with said second electromagnet, a circuit provided with a source of current and connected to said first electromagnet, and means for deenergizing said first electromagnet to free same from said armature for movement to the position in which it is held by said second electromagnet, said last means comprising a short circuiting switch in the circuit connected to said first electromagnet.

16. In combination, a controlling member having an operating position and a safety position, a first electromagnet, an armature for said first electromagnet which, when attracted to said electromagnet, is adapted to actuate said controlling member to operating position and to hold same in said position, means comprising a second electromagnet which, when energized, is adapted to hold said first electromagnet in a position wherein it is operative to move said armature to attracted position and to hold same in attracted position, said second electromagnet being adapted, when deenergized, to release said first electromagnet for movement to inoperative position to release said controlling member for movement to the other position, a thermocouple placed in position to be heated by a flame and connected in circuit with said second electromagnet, a circuit provided with a source of current and connected

to said first electromagnet, means for deenergizing said first electromagnet to free same from said armature for movement to the position in which it is held by said second electromagnet, said last means comprising a short circuiting switch in the circuit connected to said first electromagnet, and an overload circuit breaker in said last mentioned circuit.

17. In combination, a valve housing having an inlet chamber adapted for communication with the interior of said housing, said housing having an outlet leading therefrom, an electromagnet pivoted in said housing, a circuit provided with a source of current and connected to said electromagnet, an armature pivoted in said housing, a second electromagnet adapted for holding said first electromagnet in operative position wherein it is operative to move said armature to attracted position, said valve being actuated to open position by movement of said armature to attracted position and held in open position as long as said armature is held in attracted position and said first electromagnet is held in operative position, said second electromagnet being adapted, when deenergized, to release said first electromagnet for movement to inoperative position to release said valve for movement to closed position, means in the circuit for said first electromagnet for deenergizing said first electromagnet to free same from said armature for movement to the position in which it is held by said second electromagnet, and a thermocouple placed in position to be heated by a flame and connected in circuit with said second electromagnet.

18. In combination, an electromagnet comprising a movable magnet frame having pole means and provided with a magnet coil, an armature for said electromagnet, a second electromagnet, an armature for said second electromagnet, and means for connecting the magnet frame of said first electromagnet with the armature of said second electromagnet, said connecting means being operable when the armature for said second electromagnet is held in attracted position to hold the magnet frame of said first electromagnet against movement.

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