April 19, 1938. C. V. HILDEBRECHT 2,114,446

THERMOELECTRIC SAFETY DEVICE AND THE LIKE

Filed Nov. 14, 1935

Fig. 1.

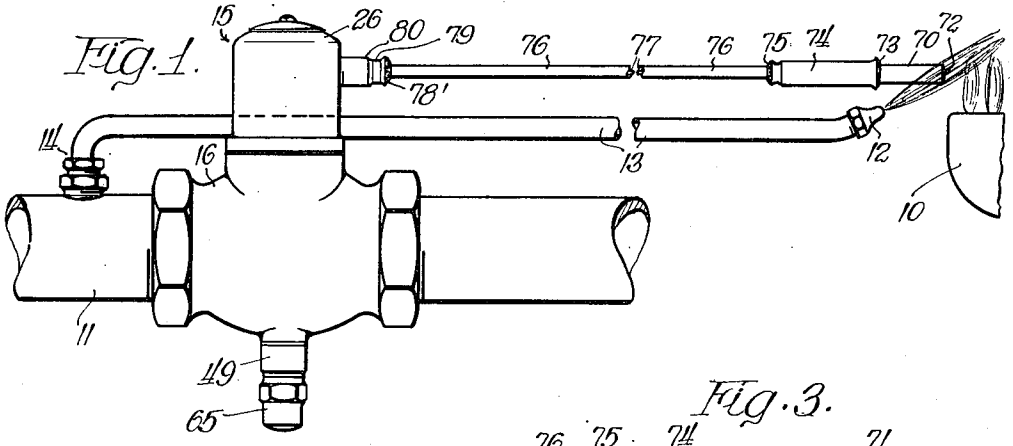


Fig. 3.

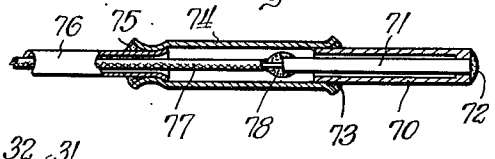
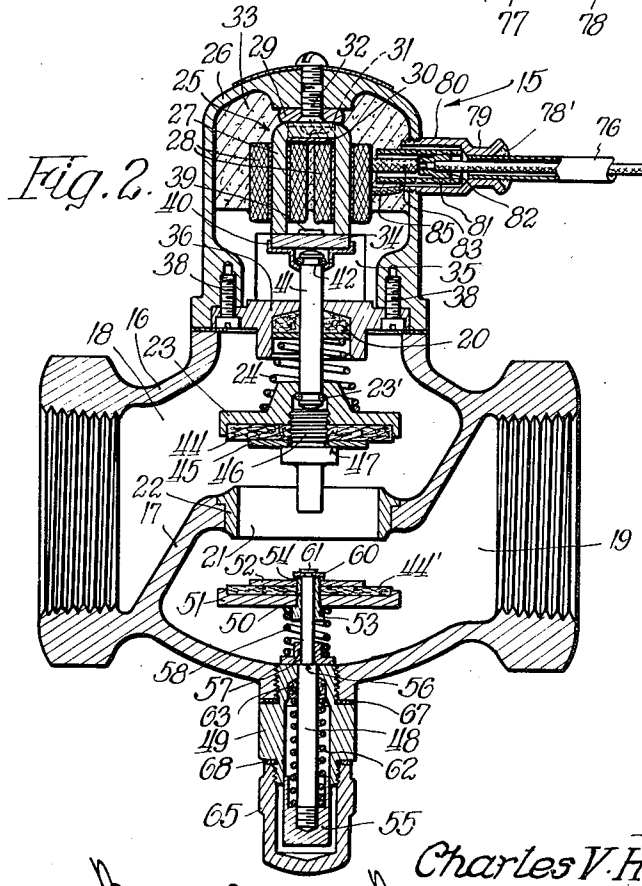


Fig. 2.



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UNITED STATES PATENT OFFICE

2,114,446

THERMOELECTRIC SAFETY DEVICE AND THE LIKE

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8 Claims. (Cl. 158—117.1)

My invention relates to an improvement in thermo-electric safety devices and the like.

While the particular device which I shall describe in connection with the drawing is a thermo-electric safety valve of the type illustrated and described in the copending application of John H. Thornbery and Harold A. Mantz, Serial No. 743,382, filed September 10, 1934, it is to be understood that the present invention is not limited to use with this particular type of device but may be employed with all similar devices and elsewhere as suitable or desired. For example, the present invention may be used with the thermo-electric safety valve and switch combination shown and described in the copending application of Thomas T. Arden, Serial No. 76,988, filed April 29, 1936, as well as with other thermo-electric safety valves and thermo-electric safety valve and switch combinations, and devices of similar character.

Thermo-electric safety devices which depend upon a weak voltage thermo-electric current for maintaining the desired flow of fuel and which operate to shut off the flow of fuel upon extinction, for example, of the pilot flame, require resetting means for resetting the device. These resetting devices usually move the armature into contact with the pole faces of the electromagnet and, simultaneously, the valve to open position for setting up the desired supply of fuel. If the valve or other control device is operated to set up the supply of fuel when the resetting device is operated and irrespective of whether the pilot burner is lighted, fuel may pass, for example, to the main burner and escape and collect unburned. This unburned gas presents the danger of asphyxiation and possible explosion when a flame is applied to light the pilot burner.

The object of the present invention is to provide means which will permit resetting and holding the armature in contact with the pole faces of the electromagnet, and the valve controlled thereby in open position, without setting up the desired supply of fuel to the burner, and, particularly, means which will permit resetting and holding the armature in contact with the pole faces of the electromagnet and the valve controlled thereby in open position without setting up the desired supply of fuel to the burner until the pilot flame has been relighted and a thermo-electric current set up to hold the armature in contact with the pole faces of the electromagnet.

In its more specific aspects, the resetting device of the present invention has a resetting button preferably provided with a closure cap, and the supply of fuel is not set up to the burner until the pilot flame has been relighted to set up a thermo-electric current to hold the armature in contact with the pole faces of the electromagnet and the resetting button has been released.

Still more specifically, the present invention provides a double acting valve arrangement which is maintained open for the passage of fuel to the burner when the pilot flame is burning and the resetting device released. This valve arrangement includes a first valve member which operates to shut off the flow of fuel upon extinction of the pilot flame and a second valve member which operates to shut off the flow of fuel during the resetting operation and until the pilot flame is relighted and sets up a thermo-electric current to hold the first valve member in open position. The second valve member moves to open position when the resetting device is released.

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

Figure 1 is a fragmentary and more or less diagrammatic view showing an embodiment of the present invention in a pilot burner and main burner gas supply system;

Figure 2 is a vertical section through the thermo-electric safety valve shown in Figure 1; and

Figure 3 is a fragmentary detail section of the thermo-couple.

Referring to the drawing, the burner 10 is any suitable or preferred main burner, and the conduit 11 is the fuel supply conduit therefor.

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 extinction thereof. This pilot burner 12 is supplied with gaseous fuel by a tube 13 connected at 14 to the conduit 11.

The thermo-electric safety valve, designated in its entirety at 15, comprises a valve casing 16 connected into the conduit 11, preferably posterior to the pilot burner connection 14 and provided with a partition wall 17 dividing the interior of the casing 16 into an inlet chamber 18 and an outlet chamber 19. Formed in the partition wall 20 is a valve opening 21 formed by an annular pressed valve seat member 22 suitably secured in the opening in the partition wall 20. The valve member 23 is resiliently pressed against

the upper end of the valve seat member 22 by compression spring 24 when the electromagnet, indicated in its entirety at 25, is deenergized.

The electromagnet 25 is disposed within the hood 26 which may be secured, as by means of screws (not shown), to the top of the valve casing 16. The electromagnet 25 comprises a U-shaped magnet frame 27 provided about each of its legs with a coil 28. The magnet frame 27 is held rigidly to a magnet mounting plate 29 by means of a bracket 30 which is secured to the plate 29 by screws 31. The plate 29 is, in turn, secured to the hood 26 by a screw 32.

The magnet armature 34 is adapted to have engagement with the end portions of the U-shaped magnet 27. This armature is guided for reciprocatory movement within upright guide lugs 35 on an armature guide 36 which is secured to the hood 26 by screws 38. The armature 34 has attached thereto by upwardly extending bent-over portions 39 a cradle 40 which, in turn, is connected to the upper end of the valve stem 41 by means of a U-shaped retainer 42 engaging in a groove in the upper end of the stem 41 and cooperating with the inturned lower end of the cradle 40. A limited universal connection is thus provided between the armature 34 and the upper end of the stem 41.

The under surface of the valve disc member 23 has a gasket 44 clamped in a recess in the valve disc, and between the disc and a washer 45 by a valve disc stud 46, the upper threaded end of which is threaded into the valve disc 23 as shown. The stud 46 preferably has a depending stem part below the clamping shoulder 47 for a purpose which will hereinafter appear. The valve disc member 23 is connected to the lower end of the valve stem 41 by means of a U-shaped retainer 23' engaging in a groove in the lower end of the stem which has a conical extension seating in the upper end of the stud 46. A limited universal connection is thus provided between the valve disc member 23 and the lower end of the stem 41.

The resetting stem 48 extends downwardly through a resetting housing 49 threaded into an opening in the bottom of the valve casing 16. Slidably mounted upon the upper end of the resetting stem 48 is a bushing 50 which carries a resetting valve 51. This valve 51 is adapted to seat against the lower end of the valve seat member 22 to close off the supply of fuel to the burner 10 during the resetting operation and until the pilot burner is lighted and a thermo-electric current set up to hold the armature 34 in contact with the pole faces of the magnet 27 and the valve 23 in open position. The upper surface of the valve disc member 51 has a gasket 44' held in a recess in the valve disc and between the valve disc and a washer 52 by providing a shoulder 53 on the bushing 50 and riveting or heading over the upper end of the bushing 50 at 54.

The stem 48, which is slidable at its upper end in the bushing 50 and thereby with respect to the resetting valve 51, has fixed upon its lower end a resetting button 55 secured to the stem 48, for example, by threading it upon the lower end of the stem. The stem 48 has a shoulder 56, and cooperating with this shoulder is a collar 57. A coiled spring 58 is interposed between the flange at the lower end of the collar 57 and the bottom of the valve disc 48. Downward movement of the stem 48 with respect to the bushing 50 and valve 51 is limited by a washer or other abutment 60 secured, for example, upon the reduced upper end of the stem 48 by riveting or heading the same over at 61. A coiled spring 62 extends into the hollow upper end of the button 55 and is confined endwise between the button 55 and packing 63 for sealing the upper end of the resetting housing 49 against the escape of gas from the valve casing 16.

In order to prevent unwarranted actuation of the button 55 a closure cap 65 is threaded upon the lower end of resetting housing 49 and, when in place, completely encloses the button 55. This cap 65 is removed to reset the device. Gaskets are preferably provided at 67 and 68.

The thermo-couple comprises an outer tubular element 70 which, at one end, is welded to the inner element 71 as shown at 72 for the purpose of providing a hot-welded junction between the two members. This thermo-couple is disposed with the hot-welded junction in proximity to the pilot flame, as shown more or less diagrammatically in Figure 1, so as to be responsive to the heat of the pilot flame. The external element 70 is joined at its opposite end, as by means of welding or the like, at 73 to a tubular couple connector 74. The opposite end of the tubular connector, which may be formed of copper or other suitable metal, is joined as by welding or the like at 75 to the adjacent end of the lead tube 76. Extending through the tube 76 is the lead wire 77 which may be an insulated wire and which, within the connector 74, is joined at 78 to the internal element 71 of the thermo-couple. The thermo-couple elements 70 and 71 are formed of dissimilar metals, such as "constantan" and "chromel", "chromel" and "copel", or any other dissimilar metals which, when heated at the junction therebetween, are adapted to produce a thermo-electric current.

The lead tube 76, which may be formed of copper, extends to the thermo-electric valve and is secured as by means of a welded joint at 78' within a reduced portion 79 of a connector 80 which is threaded into and electrically contacts the hood 26. Within the connector 80 is provided an insulating sleeve 81 disposed about the adjacent end of the conductor 77 and enclosing the connector 82 between the conductor 77 and the terminal conductor 83 of one of the coils 28. The other coil terminal is connected to the connector 80 as shown at 85. Thus a circuit is completed through the coils 28 about the legs of the magnet 27 and the conductors 76 and 77 leading to the hot thermo-couple junction.

After the connections are made between the electromagnet and the tube 76 and conductor 77 and between the electromagnet and the connector 80, the space between the electromagnet and the upper portion of the hood 26 is filled with sealing compound 33 for holding the parts in position and sealing the same in place. This compound also seals the hood against the leakage of any gas which may leak up into the hood past the packing at 20 or around the armature guide 36.

The operation of the device is as follows:

When the pilot flame is burning, the heat of the pilot flame upon the junction 72 of the thermo-couple produces a thermo-electric current in the coils 28 of the electromagnet 25. The magnet frame 27 and armature 34 are preferably formed of "permaloy", "hypernic", or a similar alloy of relatively low magnetic reluctance, and, as a result, the relatively weak thermo-electric current produces a magnetic field in the magnet frame and armature of sufficient strength so

that when the magnet armature is placed in contact with the ends of the magnet frame by pushing the resetting button 55 the magnetic attraction between the magnet frame and the armature holds the armature in raised position against the frame with a force greater than the force exerted by the spring 24, thereby holding the valve 23 in open position so long as the pilot flame is burning.

If the pilot flame goes out, the thermo-electric current through the electromagnet 25 ceases and the spring 24 moves the valve member 23 to closed position. The operation of the spring in closing the valve is aided by gravity if the device is installed vertically as shown, but the spring is preferably of sufficient tension to close the valve without the aid of gravity, whereby the device may be installed in any desired position. The spring 24 also assures detachment of the armature from the electromagnet upon deenergization of same and notwithstanding any residual magnetization therein. The closing of the valve 23 shuts off the supply of gas to the main burner.

The current produced by the thermo-couple at the pilot tip is not sufficient to energize the magnet sufficiently to draw the armature upwardly from its lowermost position, and therefore the valve is reset by removing the cap 65 and pushing the resetting button 55 sufficiently to raise the armature into contact with the magnet frame 27. As the resetting stem is pushed upwardly, its upper end strikes the depending stem part of the stud 46 and moves the stud 46, valve 23, stem 41, and armature 34 upwardly as a unit until the armature comes into contact with the magnet 27 and the valve 23 is positioned in open position as shown.

Simultaneously, the upward movement of the resetting stem 48 through the engagement of the shoulder 56 with the bushing 57 and the coiled spring 58 moves the valve 51 yieldingly into engagement with the lower end of the valve seat member 22, thereby closing off the opening 21 against the supply of fuel therethrough during the resetting operation and until the pilot flame is lighted to set up a thermo-electric current to hold the armature in contact with the pole faces of the electromagnet and the resetting button has been released. The sliding movement of the stem 48 in the bushing 50 permits the stem to move on upwardly to bring the armature into contact with the magnet after the valve 51 is yieldingly seated against the lower end of the valve seat member 22.

If the pilot burner is lighted and sets up a thermo-electric current to hold the armature in contact with the pole faces of the electromagnet the valve 23 will remain in open position, and when the resetting button 55 is released the downward movement of the resetting stem and button to the position shown, by means of the spring 62, will cause the abutment 60 at the upper end of the resetting stem to move the valve 51 downwardly to open position. If, on the other hand, the pilot burner is not lighted to produce the thermo-electric current for holding the valve 23 open, this valve will move to closed position upon release of the button 55, and in this manner a double-acting valve arrangement is provided which prevents the passage of fuel through the valve opening 21 until the pilot burner is lighted and a thermo-electric current set up to hold the armature in contact with the pole faces of the electromagnet. After resetting the device and releasing the resetting button, the cap 65 may be replaced.

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

I claim:

1. In combination, a fuel supply conduit, a valve in said conduit, an armature connected to said valve, a main burner connected to said conduit, a pilot burner connected to the conduit ahead of said valve, a thermo-couple subject to the heat of the pilot burner, an electromagnet connected to said thermo-couple and adapted to be energized by said thermo-couple to hold said armature in contact therewith and said valve open as long as the thermo-couple is heated by the pilot burner, means for closing said valve upon extinction of the pilot flame, a resetting device for resetting said valve to open position and said armature in contact with said electromagnet, and a second valve actuated by said resetting device to shut off the flow of fuel through said conduit during the resetting operation and until the pilot flame is relighted and sets up a thermo-electric current to hold the first valve open, said second valve being movable to open position independently of said armature and said first valve when said resetting device is released.

2. In combination, a fuel supply conduit, a first valve member controlling the supply of fuel through said conduit, a thermo-electric device comprising an electromagnet having coil means and a core, an armature, a thermo-couple connected to said coil means for producing a thermo-electric current to hold said armature against said core, said armature being connected to said first valve member to hold said first valve member open when said armature is in position against said core, means for resetting the armature into cooperation with said core and said first valve member into open position, and a second valve member actuated to closed position by the resetting operation of said resetting means, said second valve member being movable to open position independently of said first valve member and said armature when said resetting means is released whereby said armature may remain against said core during the movement of said second valve member to open position.

3. In combination, a fuel supply conduit, a first valve member controlling the supply of fuel through said conduit, a thermo-electric device comprising an electromagnet having coil means and a core, an armature, a thermo-couple connected to said coil means for producing a thermo-electric current to hold said armature against said core, said armature being connected to said first valve member to hold said first valve member open when said armature is in position against said core, means for resetting the armature into cooperation with said core and said first valve member into open position, and a second valve member actuated to closed position by the resetting operation of said resetting means, said second valve member being movable to open position independently of said first valve member and said armature when said resetting means is released whereby said armature may remain against said core during the movement of said second valve member to open position, said second valve being movable with respect to said resetting means whereby to permit continued resetting operation of said resetting means after said second valve is seated.

4. In combination, a fuel supply conduit, a first valve controlling the supply of fuel through said conduit, a thermo-electric device comprising an electromagnet having coil means and a core, an armature, a thermo-couple connected to said coil means for producing a thermo-electric cur-

rent to hold said armature against said core, said armature being connected to said first valve member to hold same open when said armature is in position against said core, a resetting stem for resetting said armature into cooperation with said core and said first valve member into open position, and a second valve member on said resetting stem and actuated to closed position by the resetting operation of said stem, said second valve member being movable to open position independently of said first valve member and said armature when said resetting stem is released whereby said armature may remain against said core during the movement of said second valve to open position, said stem being movable slidingly through said second valve member whereby to permit continued operation of said resetting stem to assure resetting of said armature into position against said core after said second valve member is seated.

5. In combination, a fuel supply conduit, a first valve controlling the supply of fuel through said conduit, a thermo-electric device comprising an electromagnet having coil means and a core, an armature, a thermo-couple connected to said coil means for producing a thermo-electric current to hold said armature against said core, said armature being connected to said first valve member to hold same open when said armature is in position against said core, a resetting stem for resetting said armature into cooperation with said core and said first valve member into open position, a second valve member on said resetting stem and actuated to closed position by the resetting operation of said stem, said second valve member being movable to open position independently of said first valve member and said armature when said resetting stem is released whereby said armature may remain against said core during the movement of said second valve to open position, said stem being movable slidingly through said second valve member whereby to permit continued operation of said resetting stem to assure resetting of said armature into position against said core after said second valve member is seated, an abutment on said stem, and a spring confined between said abutment and said second valve member for yieldingly pressing said second valve member to closed position upon resetting operation of said stem.

6. In combination, a fluid supply conduit, a valve member for controlling the supply of fluid through said conduit, an armature connected to said valve member, an electromagnet operable to hold said armature with said valve in open position, said armature separating from said electromagnet and said valve member moving to closed position upon deenergization of said electromagnet, means for resetting the armature with respect to said electromagnet and said valve member to open position, a second valve member operable by said resetting means to shut off the supply of fuel through said conduit during the resetting operation, and means for moving said second valve member to open position independently of said armature and said first valve member upon completion of the resetting operation.

7. In combination, a fluid supply conduit, a valve member for controlling the supply of fluid through said conduit, an armature, an electromagnet cooperable with said armature to hold said valve member in open position, means for resetting the armature into cooperation with the electromagnet and said valve member into open position, and a second valve member actuated to closed position by the resetting operation of said resetting means to shut off the supply of fluid through said conduit during the resetting operation.

8. In combination, a fluid supply conduit, a valve member for controlling the supply of fluid through said conduit, an armature, an electromagnet cooperable with said armature to hold said valve member in open position, means for resetting the armature into cooperation with the electromagnet and said valve member into open position, and a second valve member actuated to closed position by the resetting operation of said resetting means to shut off the supply of fluid through said conduit during the resetting operation, said second valve member being movable to open position independently of said first valve member and said armature upon completion of the resetting operation.

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