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THERMOELECTRIC SAFETY DEVICE

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This invention relates to the thermo-electric safety devices, and more particularly is directed to such devices employed in connection with gas burner igniting apparatus for use in heating appliances such as hot water heaters, ranges, and similar apparatus.

In the copending application John H. Thornberry and myself, Serial No. 743,382, filed September 10, 1934, there is disclosed a safety device of the type in which the valve controlling the supply of fuel to the main burner can be manually held open when the pilot flame has been extinguished. In some situations this may be undesirable, since a large accumulation of gas may collect in the burner chamber before the pilot flame is ignited, with resulting hazards of explosion.

The present invention contemplates a mechanism in which the main valve member is snapped closed whenever the pilot burner is extinguished, and cannot be moved to open position until the pilot burner is again ignited. This precludes any attempt to hold the valve open while the pilot burner is extinguished.

In conjunction with this feature, the present invention includes means for by-passing a certain quantity of fuel through the valve while it is in closed position to supply the pilot burner during the manual resetting operation. The gas by-passed is directed to the pilot burner through a connection which also serves as one conductor for the thermocouple formed at and responsive to the heat of the pilot burner.

As one important advantage of the present construction I provide a thermocouple combined with a pilot burner, the connection from the thermocouple to the safety device in turn forming the supply passage from the fuel supply line to the pilot head, which is supported solely by this connection.

In addition, the combined thermocouple and pilot head are connected to the safety device through a quick detachable connection which allows rapid and easy assembly without the necessity of terminal lugs, solder connections or the like.

Still another advantage of the present invention resides in the provision of a magnetic frame which may be of round or circular type, instead of the usual horseshoe type, and which is mounted for reciprocatory movement in the housing of the safety device. The magnetic frame assembly and resetting mechanism is provided with a series of coacting spring means whereby upon resetting movement of the frame the secondary or by-pass

valve means is open while the main safety valve remains closed, and upon energization of the magnetic means the valve is attracted to the frame and the valve and frame are conjointly moved into valve opened position, the by-pass valve to the pilot burner being simultaneously closed.

Another important advantage of the present invention is that the safety device may be mounted in any position in the fuel supply line, and the valve mechanism, magnetic frame and resetting mechanism remain fully operative regardless of the position in which the device is mounted.

Still another advantage of the present invention is the use of the housing of the device itself as the ground connection for one side of the electromagnet coil, whereby the combined thermocouple and pilot burner has one side thereof directly grounded to the housing, while the other side thereof is connected through an insulated and closed conductor to the coil, this conductor at the same time forming a gas supply passage to the pilot burner from the valve seat.

Other objects and advantages of the present invention will be more apparent from the following detailed description which, taken in conjunction with the accompanying drawing, will disclose to those skilled in the art the particular construction and operation of a preferred form of the present invention.

In the drawing:

Figure 1 is a diagrammatic view showing the application of the present invention to heating apparatus;

Figure 2 is a sectional view through the device of the present invention, including the combined thermocouple and pilot head construction;

Figure 3 shows a modified manner of connecting the thermocouple to the device; and

Figure 4 shows a still further modified arrangement.

Referring now in detail to the drawing, in Figure 1 I have shown the main fuel supply line 5, having the safety device 3 mounted therein, and communicating through the conduit 7 from the outlet side of the safety device to a fuel supply manifold or the like indicated at 8, provided with the usual gas cock 9, which may be either manually or automatically operated, for delivering fuel under pressure to the main burner 10.

The burner 10 is preferably ignited by means of a lighter tube 12, which extends into the torch head 13 receiving the pilot head indicated generally at 14. In the embodiment of the invention shown in Figure 1, the device has been shown

and applied to a gas range in which a number of burners 10 may be mounted symmetrically about the torch head 13, each being supplied with a lighter tube 12 whereby gas from the main burner 10 is transmitted through an auxiliary port and the tube 12 to the pilot burner, is there ignited and flashes back to the burner to ignite the main burner ports. However, it is to be understood that the torch head 13 and lighter tubes 12 may be eliminated, and in such case the pilot burner 14 may be disposed directly adjacent the main burner 10, where only a single burner is employed, such as in hot water heaters or other types of heating apparatus.

Considering now in detail the specific construction illustrated as showing one form of the present invention, in Figure 2 I have provided a safety device comprising the main valve body 15, provided with the inlet chamber 16 and with the outlet chamber 17. Intermediate these chambers there is provided the partition 18 forming the valve seat 19 defining the opening through which communication is effected between the inlet and outlet chambers.

Mounted in any suitable manner upon the upper portion of the valve body 15 is a housing 20, which may be bolted thereto as indicated by the cap screws 22, or may be secured thereto in any other suitable or desired manner. Interposed between the housing 20, which is preferably of inverted cup-shape, and the annular shoulder 23 of the valve body 15 is a gasket member 24, which seals the surfaces that are clamped together, and is provided with an axially extending flange portion 24' at its inner periphery.

Mounted in the passage formed between the valve body 15 and the housing 20 is a magnetic frame member 25, having the electromagnetic coil 26 carried therein, the coil 26 having one terminal thereof grounded to the housing 20 as indicated at 27 through the conductor 28, and having its opposite terminal connected through conductor 29 to a terminal stud 30 which is disposed in insulated relation to the housing by being carried within the insulating bushing 32.

The magnet frame 25 is provided with a central axially extending recess 33, which is adapted to receive a spring member 34 biased at one end against the inner end of the recess 33, and at its opposite end bearing against the turned over edge 35 of the projecting stem portion 36 of valve member 37, the member 37 in turn carrying at its lower base the leather valve seating member 38 adapted to have engagement with the valve seat 19. The leather seating member is held in position by the retaining washer or disc 39, which in turn is secured to the member 37 by means of the threaded plug 40 extending into the open end of the recess 42 formed in the member.

A suitable valve stem 43 is carried within the recess 42 of the member 37, and normally is pressed into seating engagement with the valve seat 44 by means of the spring 45 encircling the valve stem and biased at its lower end against the packing carried in the upper end of the recess 42.

The member 37 is provided with a laterally extending port 46, which extends into and communicates with the passageway 42 above the valve stem head 47. The member 37 is also provided with a second axially offset laterally extending passageway 48 which, adjacent its outer end communicates through the passageway 49 directed axially of the valve member and through

the valve member 38, to the lower radial face of the valve member 38.

The valve seat 19 is provided with a passageway 50, adapted to be aligned with the passageway 49, and extending upwardly through the valve body as indicated at 52 to the gasket 24. The gasket 24 is apertured, as indicated at 53, providing communication between the passageway 52 and a corresponding passageway 54 extending through only one side wall of the housing 20 and through the insulating bushing 32 into the interior of the terminal member 30, which terminal member is provided with an axially outwardly directed recess 56 which opens outwardly through the threaded boss portion 57 extending laterally from the side of the housing 20.

The valve member 37 forms, together with the cup-shaped member 60 and the annular plate member 62, an armature-like valve member which is movable toward and away from the lower end of the magnet frame 25, having sliding movement guided by the axially extending flange portion 24' of the gasket 24. Thus, when the coil 26 is deenergized, the spring 34 urges the armature, consisting of the members 60, 62 and 37, downwardly away from the lower end of the magnet frame 25 and into engagement with the valve seat 19.

The magnetic frame 25 is normally retained in position within the safety device by means of the spindle member 65, which has the head portion 66 engaged within the recess 33 of the armature frame, and which extends upwardly and carries at its outer end the resetting button 67, which is threaded to the end of the spindle 65 and is recessed to receive one end of the spring 68, the opposite end of the spring 68 bearing against packing 69 carried within the recessed portion 70 or extending downwardly into the housing 20 and formed integral therewith. The spring 68 normally urges the button 67 outwardly of the housing 20, and thereby urges the spindle 65 upwardly, holding the magnetic frame 25 against the lower end of the wall portion 72 of the housing which defines the recess 70.

Considering now in detail the pilot burner construction, this comprises an outer tubular member 80 which is provided with relatively large open ports 82 through which pilot flames 83 are adapted to project, as indicated diagrammatically in Figure 2, and which is joined to an inner tubular member 84, there being a welded junction between these two members as indicated at 85 forming a thermocouple junction disposed in the path of the pilot flame 83. The inner tubular member 84 is provided with a plurality of ports 86, of reduced area as compared to the ports 82, and is connected, at its open end, through the bushing 87 with a hollow metallic conduit 88 which extends to the thermocouple and burner connection indicated generally at 89 whereby the burner and thermocouple are connected to the safety device 6. The lower end of the outer member 80 is supported by a spider-like member 92 which is provided with openings 93 therein for admitting air into the space between the members 80 and 84, this air merging with the gas issuing from the ports 86 to produce the burner flame 83. Suitable insulation 94 is provided between the inner metallic structure 88 and the outer metal tube 95 which terminates in the spider 92. It will thus be seen that a thermocouple junction is provided at 85, and that one terminal of this junction is connected through the outer cylin-

drical member 80 and the metal tube 95 to the thimble 96, which is threaded over the threaded extension 57 of the housing 20, and thereby completes a connection to the grounded terminal 27 from one side of the coil 26. The other side of the thermocouple circuit extends from the inner tubular member 84 and the metal conduit member 88, within the insulating sleeve 94, to the recess 56 formed in the terminal bushing 30. This makes metallic contact through the bushing 30 with the conductor 29 leading from the other side of the magnetic coil 26.

An insulating disc 98 is disposed about the projecting end of the conduit 88 within the thimble 96, and a wedge-shaped member 99, preferably of ductile metal, is disposed over the projecting end of the conduit 88, whereby upon threading of the thimble 96 upon the extension 57, the wedge member 99 is wedged, together with the projecting end of the conduit 88, into the recess 56 of the thimble 30, and consequently forms a positive and gas tight electrical connection therewith which is insulated from the metal tube 95 and from the supporting sleeve 100 disposed within the thimble 96. If desired, the metal tube 95 may be provided with a riding wipe or enlargement 102, with which the thimble 96 may engage at its reduced end in order to move the entire structure as a unit inwardly with respect to the bushing 30 when the thimble is tightened over the extension on the housing 20.

This provides a quick detachable connection not requiring the unloosening of any terminal screws, terminal lugs or the like, since by merely unthreading the thimble 96, the connection between the conduit 88 and the bushing 30 may be readily broken, and the entire pilot burner and thermocouple structure may be removed from the safety device 6.

In the operation of the device as thus far described, the device is shown in Figure 2 as being in valve opened position, with the pilot flame ignited and the magnetic coil 26 thereby energized to hold the armature including the valve member 37 thereagainst against the resistance of the spring 34. This is due to the fact that the heat of the pilot flame acting on welded junction 85 creates a current flow between the metal tube 95 and the hollow conduit 88 which, in turn, creates a flow of current through the coil 26 sufficient to magnetize the magnet frame 25 and create an attractive force on the valve member 37 sufficient to hold it against the magnet frame. Consider now that the pilot flame is accidentally extinguished. The thermocouple junction rapidly cools, and thereby deenergizes the coil 26. The spring 34 thereupon becomes active and snaps the valve member 37 downwardly into engagement with the valve seat 19. This results in relative sliding engagement of the cup-shaped member 60 with respect to the gasket portion 24' of the gasket 24, while the magnetic frame 25 and the coil 26 remain in fixed position due to the effect of the spring 68. The valve is therefore closed, closing off communication between the inlet chamber 16 and the outlet chamber 17, and also closing off the fuel supply to the pilot burner. This latter fuel supply is closed off due to the fact that the spring 45 retains the valve stem 43 in position with the head 47 thereof pressed against the valve seat 44 so that no gas may flow from the inlet chamber 16 through the passageways 46 and 48 to the passageway 50.

When it is desired to either ignite the main burner or to reignite the pilot burner, the reset-

ting button 67 is manually pushed downwardly. This results in moving the spindle 65 downwardly with respect to the magnet frame 25, and the magnet frame thereby slides downwardly within the upper end of the cup-shaped member 60, due to the fact that the shoulder 104 of the spindle 65 engages the top of the magnet frame and forces it downwardly against the pressure of spring 32. At the same time, the head end 66 of the spindle 65 engages the upper end of the valve stem 43, forcing the valve stem 43 away from its seat 44, and thereby opening communication between the passageways 46 and 48 formed in the valve member 37.

As a result, the gas which is under pressure in the inlet chamber 16 flows through the passageways 46 and 48 and thence through the axially extending passageway 49 into the passageway 50 formed in the valve seat 19. From the passageway 50, this gas flows upwardly through passageways 52 and 54 and into the recess 56 in the terminal bushing 30. From this recess, gas is passed through the hollow conductor 88 to the interior of the tubular member 84, from which it escapes through ports 86 and mixes with air introduced into the interior of the tubular member 80, and can be ignited as it issues with the air from the ports 82. The resulting pilot flames serve to energize the thermocouple, creating a current which in turn energizes the coil 26 and causes the armature formed by the members 60, 62 and 37 of the valve construction to be held positively against the lower end of the frame 25 by magnetic attraction. As a result, when the reset button 67 is released, the spring 68 moves the button 67 and spindle 65 upwardly, which in turn, through the head end 66 of the spindle 65, moves the frame 25 upwardly and consequently moves the valve member therewith, the two being held in magnetic attraction. This opens the valve, and the gas may then flow from the inlet chamber 16 through the valve seat 19 into the outlet chamber 17 and thence to the main burner or burners. At the same time, sufficient gas is still supplied through the port 50 in the valve seat to maintain the pilot burner 14 ignited, and consequently retain the valve member in raised position against the lower end of the magnet frame 25. Upon any accidental extinguishment of the pilot burner, the magnet is immediately deenergized, and the spring 34 consequently forces the valve member down into engagement with the valve seat, thereby shutting off flow of fuel to either the pilot burner or the main burner.

In Figure 3 I have shown a modified structure, in which the coil 26 of the magnet is connected to the two terminals of the thermocouple junction, and is not grounded on the housing. In this embodiment of the invention, the upper housing of the safety device is indicated at 110, and is connected to the valve body housing 112 through the threaded sleeve 113 carried by the housing 110. A suitable bushing 114 is secured in the side wall of the housing 110, and is adapted to receive, on its inner end, the terminal 115 of a conductor 116 leading to one side of the coil 26. The other side of the coil 26 is connected through conductor 117 and terminal 118 to a terminal bushing 119 which is insulated within the bushing 114 by the insulating sleeve 120. The thermocouple connection leading from the pilot burner, and consisting of the outer metallic tube 95, the thimble 96 which threads over the bushing 114 to effect electrical connection from

the tube 95 through the thimble 96 and bushing 114 with conductor 116, and the inner hollow conductor 122, extends into the terminal bushing 119 and is wedged therein in substantially the same manner as described in connection with Figure 2. At the same time, gas for the pilot burner is supplied to ports 123 and 124 in the housings 112 and 110 respectively to the interior of the terminal bushing 119, and thence through the hollow conductor 122 to the pilot burner. Suitable insulating sleeve means 125 is provided between the outer metallic tube 95 and the inner hollow metallic conductor 122. The details of the manner in which the thermocouple and burner connections can be quickly coupled and disconnected from the housing structure is believed apparent from the drawing, when considered in conjunction with the description of this particular manner of assembly as set forth in connection with Figure 2.

In Figure 4 I have shown a still further modified construction, in which the supply for the pilot burner is separated from the connection to the thermocouple junction. In this embodiment of the invention, the valve body is indicated at 130, while the housing for the magnetic frame and reset mechanism is indicated at 132, the two being secured together with the gasket 133 interposed therebetween in any desired manner. A suitable port 134 is formed in the valve body 133 and extends upwardly through the gasket and into the port 135 communicating with the interior 136 of a recess which opens outwardly through the attaching member 137 to the hollow conduit 138 leading to the pilot burner. The attaching member 137 is secured to the housing 132 by means of the cap screw 139, threaded to the side wall of the housing. The connection for the coil 26 is provided by the conductor 140, which extends into the metallic thimble 142 secured within the insulating bushing 143 and joined to the conductor 144 extending to the thermocouple junction by means of the coupling member 145. Suitable insulation 146 extends about the conductor 144, and into the attaching member 137, forming a continuation of the insulating bushing 143.

As far as the operation of the device or the energization of the coil 26 and the supply of fuel to the pilot burner is concerned, the mechanism shown in Figures 3 and 4 will operate in the same manner as described in connection with Figure 2, and no further description of the operation thereof is deemed necessary.

It is therefore believed apparent that I have provided a novel type of safety device, in which the magnet frame is reciprocally mounted in the housing for the safety device, and is moved downwardly into engagement with the valve member in order to pick up the valve member when the magnet has been energized and move it into valve open position. At the same time, whenever the pilot flame is accidentally extinguished, the supply of fuel to both the main burner and the pilot burner is automatically shut off, and when the resetting means is actuated, a limited supply of fuel to the pilot burner is provided without opening the main valve until such time as the pilot burner has been ignited and a sufficient current has been generated to allow actuation of the magnet. Further, I have provided means for rapidly attaching and disconnecting the thermocouple and pilot burner connections, which facilitates assembly of the

device, and insures easy replacement or repair in case of damage or for inspection.

I am aware that various modifications may be made in details of structure and particular design, and intend that the illustrated embodiment of the invention be considered for purposes of illustration only as showing one form of the invention. I do not intend to limit my invention to the exact details shown, but only insofar as defined by the scope and spirit of the appended claims.

I claim:

1. A thermocouple and pilot burner, comprising an inner metallic tubular thermocouple member, an outer metallic tubular thermocouple member surrounding said inner thermocouple member and joined to said inner thermocouple member to form a thermal junction adapted to be heated, said inner and outer thermocouple members having ports through which fuel is adapted to issue to maintain a flame adjacent said junction, an inner tubular lead conductor joined to said inner thermocouple member and adapted to supply fuel into said inner thermocouple member, said inner tubular lead conductor constituting a thermoelectric lead conductor for the inner thermocouple member, and an outer tubular lead conductor enclosing the inner lead conductor and joined to the outer thermocouple member and constituting a thermoelectric lead conductor for the outer tubular thermocouple member.

2. A thermocouple and pilot burner, comprising an inner metallic tubular thermocouple member, an outer metallic tubular thermocouple member surrounding said inner thermocouple member and joined to said inner thermocouple member to form a thermal junction adapted to be heated, said inner and outer thermocouple members having ports through which fuel is adapted to issue to maintain a flame adjacent said junction, an inner tubular lead conductor joined to said inner thermocouple member and adapted to supply fuel into said inner thermocouple member, and an outer lead conductor insulated from said inner lead conductor and joined to said outer tubular thermocouple member, said outer lead conductor supporting the outer tubular thermocouple member and being of tubular form and enclosing said inner lead conductor.

3. A thermocouple and pilot burner, comprising an inner metallic tubular thermocouple member open at its inner end to receive fuel and having an opening at its outer end through which the fuel is adapted to issue to maintain a flame, an outer metallic tubular thermocouple member surrounding said inner thermocouple member and having an opening at its outer end and joined to said inner thermocouple member around the edge of the opening at the outer end of the inner thermocouple member to form a thermal junction, an inner tubular lead conductor joined to said inner thermocouple member and adapted to supply fuel into said inner thermocouple member, and an outer tubular lead conductor enclosing said inner lead conductor and joined to and supporting said outer tubular thermocouple member.

4. In combination, an electromagnetic valve having an inner terminal member and an outer terminal member surrounding said inner terminal member and insulated therefrom, said valve having a fuel supply passage leading from the valve through said inner terminal member, an inner metallic tubular thermocouple member, and an outer metallic tubular thermocouple mem-

ber surrounding said inner thermocouple member and joined to said inner thermocouple member to form a thermal junction, said inner and outer thermocouple members having ports through which fuel is adapted to issue to maintain a flame adjacent said junction, an inner tubular lead conductor joined to said inner thermocouple member and adapted to supply fuel to said ports through said inner thermocouple member, an outer tubular lead conductor surrounding said inner lead conductor and insulated therefrom, said outer tubular lead conductor being joined to said outer thermocouple member, and a connector nut for connecting said outer tubular lead conductor in circuit with the outer terminal member of said valve and the inner tubular lead conductor in circuit with the inner terminal member of said valve and with the inner tubular lead conductor in communication with the fuel supply passage of said valve.

5. In combination, an electromagnetic valve having an inner terminal member and an outer terminal member surrounding said inner terminal member and insulated therefrom, said valve having a fuel supply passage leading from the valve through said inner terminal member, an inner metallic tubular thermocouple member, an outer metallic tubular thermocouple member surrounding and spaced from said inner thermocouple member and joined to said inner thermocouple member to form a thermal junction, said inner and outer thermocouple members having ports through which fuel is adapted to issue to maintain a flame adjacent said junction, an inner tubular lead conductor joined to said inner thermocouple member and adapted to supply fuel to said ports through said inner thermocouple member, an outer tubular lead conductor surrounding said inner lead conductor and insulated therefrom, said outer tubular lead conductor being joined to said outer thermocouple member, a connector nut for connecting said outer tubular lead conductor in circuit with the outer terminal member of said valve and the inner tubular lead conductor in circuit with the inner terminal member of said valve and with the inner tubular lead conductor in communication with the fuel supply passage of said valve, and means for admitting air into the space between said inner and outer thermocouple members.

6. A thermocouple and pilot burner comprising an inner metallic tubular thermocouple member, an outer metallic tubular thermocouple member surrounding the inner thermocouple member and joined to the inner thermocouple member to form a thermal junction adapted to be heated, said inner and outer thermocouple members having ports through which fuel is adapted to issue to maintain a flame adjacent said junction, an inner tubular lead conductor joined to said inner thermocouple member and adapted to supply fuel

into said inner thermocouple member, and an outer tubular lead conductor insulated from said inner lead conductor and having an enlarged end joined to said outer tubular thermocouple member, said outer lead conductor constituting a thermoelectric lead conductor for the outer tubular thermocouple member and enclosing the inner lead conductor, and the enlarged end of said outer lead conductor having opening means for admitting air into the space between the inner and outer thermocouple members.

7. In combination, an inner metallic tubular thermocouple member having a rounded outer end provided with a port for a pilot flame, an outer metallic tubular thermocouple member surrounding said inner thermocouple member and having a rounded outer end provided with a port in register with said first mentioned port, the rounded outer end of said inner thermocouple member being joined to the rounded outer end of said outer thermocouple member peripherally about the edges of said port to form a "hot" thermojunction adapted to be heated by a flame, a metallic fuel supply tube connected to the opposite end of said inner thermocouple member and constituting a thermoelectric lead conductor for said inner thermocouple member, and an outer tubular lead conductor enclosing the inner lead conductor and joined to the outer thermocouple member and constituting a thermoelectric lead conductor for said outer tubular thermocouple member, said inner and outer thermocouple members having port means opening laterally through the walls thereof in position spaced from the joined ends of said thermocouple members for discharging fuel for maintaining a flame which sweeps over the rounded outer end of the outer thermocouple member adjacent said "hot" thermojunction.

8. In combination, a control body, an electromagnet within said body, an insulating sleeve mounted in the wall of the control body, and a terminal member connected in circuit with the electromagnet and mounted in the insulating sleeve and insulated from the control body thereby, said terminal member having a fuel supply passage therein for delivering fuel from the control body.

9. In combination, a control body, an electromagnet within said body, an insulating sleeve mounted in the wall of the control body, and a terminal member connected in circuit with the electromagnet and mounted in the insulating sleeve and insulated from the control body thereby, said terminal member having a passage opening axially outwardly therefrom for delivering fuel from the control body, and said insulating sleeve and terminal member having a passage opening laterally therethrough for delivering fuel into said axially opening outlet passage.

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