April 8, 1952 V. WEBER ET AL 2,591,897

SAFETY DEVICE FOR FUEL BURNERS

Original Filed April 1, 1944 3 Sheets-Sheet 1

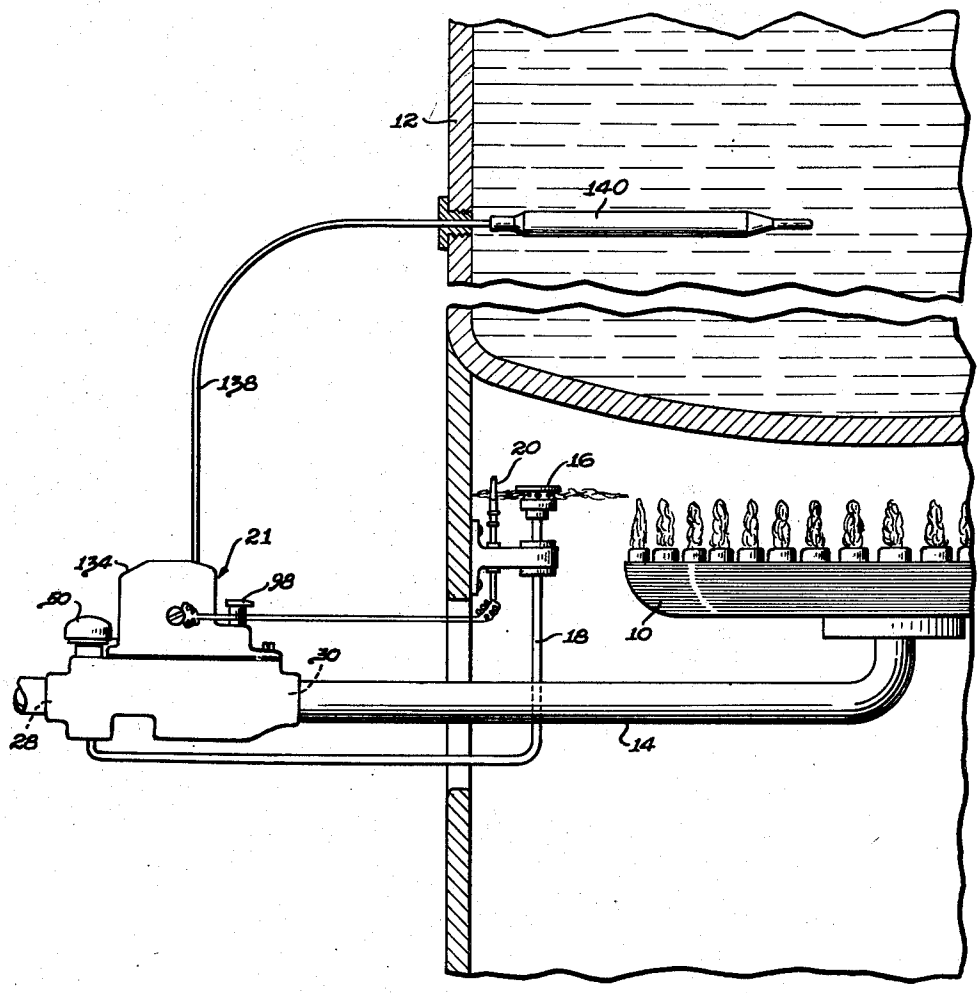


Fig. 1.

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SAFETY DEVICE FOR FUEL BURNERS

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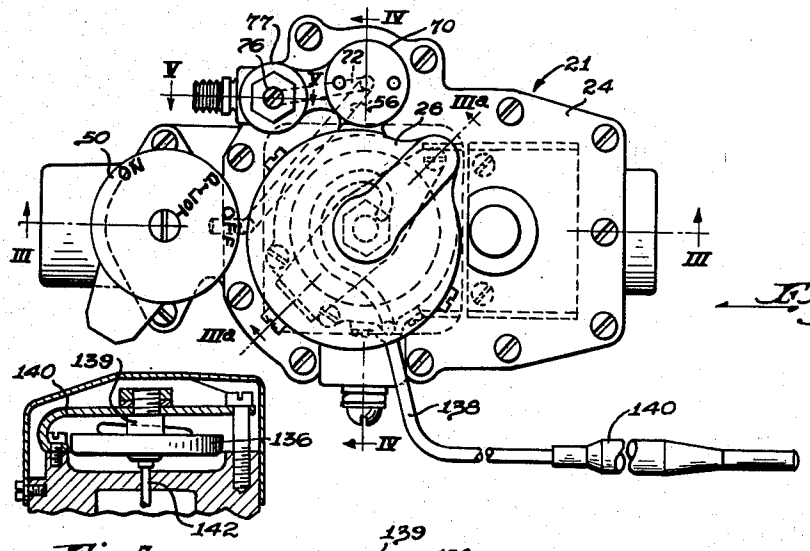


Fig. 2.

Fig. 3a

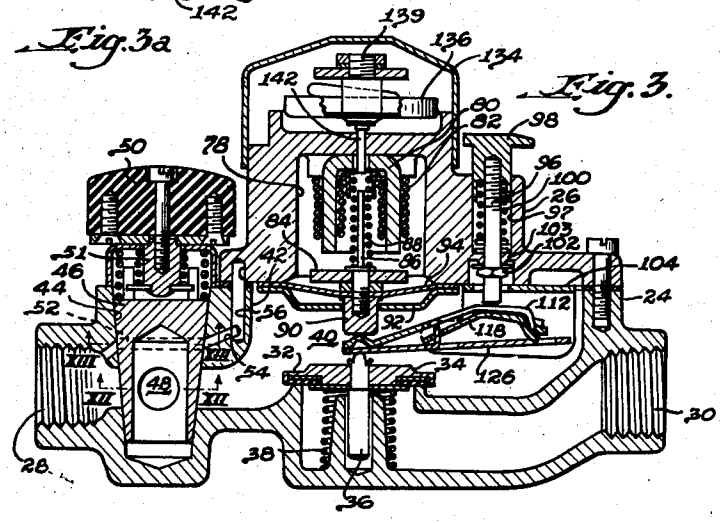
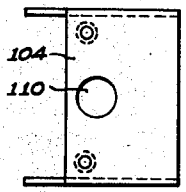


Fig. 3.

Fig. 6.



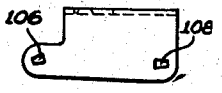


Fig. 7.

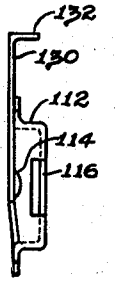


Fig. 8a

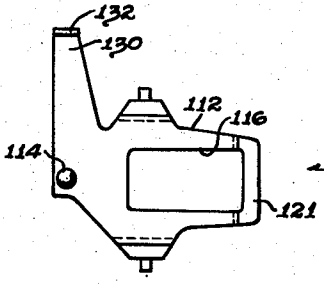


Fig. 8

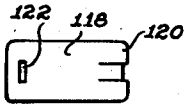


Fig. 9.

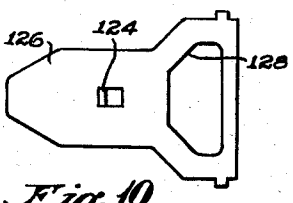


Fig. 10.

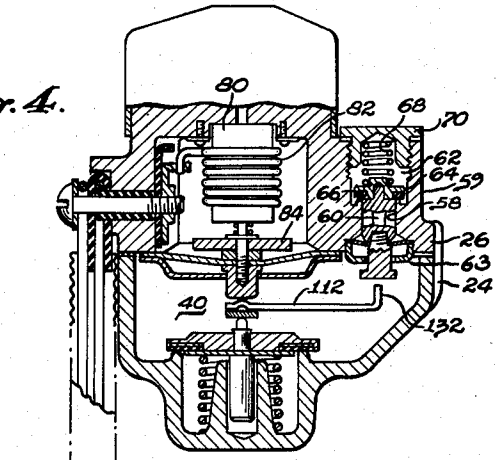
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SAFETY DEVICE FOR FUEL BURNERS

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Fig. 4.



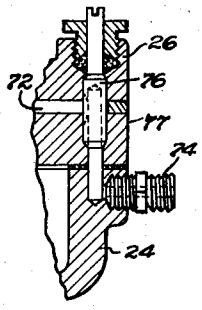


Fig. 5.

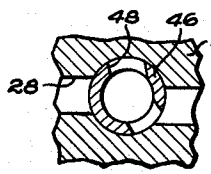


Fig. 12.

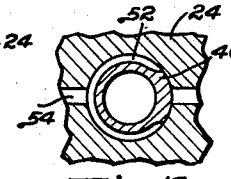


Fig. 13.

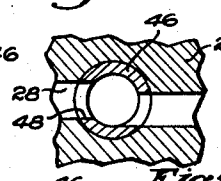


Fig. 14.

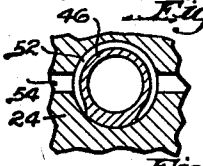


Fig. 15.

Fig. 11.

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Patented Apr. 8, 1952

2,591,897

UNITED STATES PATENT OFFICE

2,591,897

SAFETY DEVICE FOR FUEL BURNERS

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Original application April 1, 1944, Serial No. 529,201. Divided and this application April 21, 1948, Serial No. 22,406

6 Claims. (Cl. 137—139)

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This invention relates to safety controls for fuel burners and, more particularly, to thermoelectric devices for controlling flow of gaseous fuel to water heaters and like appliances.

Appliances of the type indicated have been provided with electrically operated safety valves which are energized by current generated by a thermoelectric device exposed to the flame of the pilot burner. The safety valve is thus operable for shutting off the flow of fuel to the main and pilot burners of the appliance when the pilot burner becomes extinguished. Various means have also been provided to render the thermoelectric device incapable of maintaining the safety valve open during the normal operation of the burners if a dangerous condition arises, such as excessive temperature or pressure in the water being heated by the burners.

An object of this invention is to improve such devices by providing positive acting means to shut-off the flow of fuel to the main and pilot burners whenever a predetermined water temperature is reached.

Another object of the invention is to accomplish the shut-off by operation of the thermoelectric safety valve but independent of the current generated by the thermocouple.

Another object of the invention is to insure positive actuation of the safety valve to closed position both in the event of pilot flame extinguishment or excessive water temperature.

Another object of the invention is to prevent flow of fuel to the main burner until the pilot burner produces a flame.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawings, wherein

Fig. 1 is a schematic view of a water heater having the safety control of this invention applied thereto;

Fig. 2 is a plan view of the safety control;

Fig. 3 is a section taken on the line III—III of Fig. 2;

Fig. 3*a* is a partial section taken on the line IIIa—IIIa of Fig. 2;

Fig. 4 is a section taken on the line IV—IV of Fig. 2;

Fig. 5 is a partial section taken on the line V—V of Fig. 2;

Figs. 6 to 10 inclusive are plan and elevational views of details of a lever mechanism incorporated in the control;

Fig. 11 is a longitudinal section through a modified form of control;

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Figs. 12 and 14 are partial sections taken on line XII—XII of Fig. 3 showing the different port positions of the main control valve; and

Figs. 13 and 15 are partial sections taken on line XIII—XIII of Fig. 3 showing the different by-pass passage positions of the main control valve.

Referring more particularly to Fig. 1 of the drawings, the main burner 10 of a water heater 12 is supplied with gaseous fuel through a pipe 14 and the pilot burner 16 for the main burner is supplied with gaseous fuel through a pipe 18. The fuel supplied to both the main and pilot burners is controlled by the control device 21 of this invention and which will be more fully described hereinafter. The pilot burner 16 produces a flame which serves to heat a thermocouple element 20 positioned adjacent thereto and upon extinguishment of the pilot burner flame the thermocouple 20 will cool and cause the gas supply to the main burner 10 to be cut off by operation of the control device 21 of this invention.

Referring now more particularly to Figs. 2, 3 and 4 of the drawings, the control device 21 of this invention comprises a housing formed of two main parts, namely, a valve body 24 and a magnet body 26. These parts are suitably bolted or otherwise secured together and sealed against leakage of gaseous fuel through the joints thus formed.

The valve body 24 is adapted for insertion in the pipe 14 by provision of an inlet 28 at one end thereof and an outlet 30 at the opposite end thereof to which the pipe 14 may be threadedly connected. Between the inlet 28 and the outlet 30 is a valve seat 32 with which a valve member 34 is adapted to cooperate to control flow of fuel from the inlet 28 to the outlet 30. The valve member 34 is reciprocable toward and away from the seat 32 by a stem 36 supported in the valve body 24 and is biased away from the seat 32 by a coil spring 38 extending between the body 24 and the valve member 34.

The valve stem 36 projects through the valve member 34 into a valve chamber 40 formed in the valve body 24 in communication with the inlet 28 and providing an opening 42 in the valve body which is closed by the magnet body 26.

The valve body 24 is also provided with a tapered valve seat 44 extending transversely of the inlet 28 and in which a tapered plug valve member 46 is mounted for rotation. The plug valve 46 is provided with a port 48 extending transversely therethrough and which may be moved

into alignment with the inlet 28 for passage of fuel to the valve chamber 40. A dial 50 carrying the indicia "on," "Pilot" and "off" is secured to a stem 51 projecting from the larger end of the plug valve 46 exterior of the valve body 24 and provides manual means for rotating the plug valve 46 in the valve body to selected positions.

The larger end of the plug valve 46 is provided with an arcuate groove 52 formed in its surface and serving in selected positions of the valve to connect the opposite ends of a by-pass passage 54 formed in the valve body and which the tapered valve seat 44 intersects. One end of the by-pass passage 54 communicates with the inlet 28 and the opposite end communicates with a passage 56 leading to a pilot valve stem chamber 58 (Fig. 4) extending axially in a boss 59 on the magnet body 26 and communicating at one end with the main valve chamber 40. Reciprocably mounted in the valve chamber 58 is a valve stem 60 provided with longitudinal recesses for passage of fuel from the valve stem chamber 58 into an enlarged pilot valve chamber 62 which overlies the chamber 58 and connects therewith. The valve stem 60 has an end projecting into the main valve chamber 40 and serving to support a sealing device 63 to prevent fuel flow between the main valve chamber 40 and the chamber 58. Passage of fuel between the valve stem chamber 58 and the valve chamber 62 is controlled by a pilot valve member 64 secured to the valve stem 60 and movable into and out of engagement with a valve seat 66 formed on the shoulder intermediate the chambers 60 and 62.

The pilot valve member 64 is biased into engagement with its seat 66 by a coil spring 68 extending between the valve member 64 and a cap 70 which forms a closure for the chamber 62. Communicating with the chamber 62 is a passage 72 formed in the magnet body 26 and leading to a connection 74 for the fuel supply pipe 18 of the pilot burner 16. A suitably apertured adjusting member 76 for the pilot burner fuel supply may be mounted for manual rotation in a boss 77 formed on the magnet body 26 and having an axial opening intersecting the passage 72. Adjustment of the member 76 which projects exteriorly of the magnet body serves to vary the orifice size of the passage 72.

As hereinbefore indicated, the valve mechanism of the present invention is provided with an arrangement for causing both the control valve 34 and the pilot burner valve 64 to move to closed position upon extinguishment of the pilot burner 16. This mechanism is mounted in the magnet housing 26 which is provided with an enlarged recess 78 opposite the opening 42 of the valve chamber 40. A magnet 80 is secured in the recess 78 and is of the horseshoe type having the usual coils 82 positioned on each leg thereof and connected to receive electric current generated by the thermocouple 20. The thermocouple 20 may comprise the usual pair of elements of different thermoelectric properties which are joined at one end to form a hot junction exposed to the flame of the pilot burner 16.

In the embodiment illustrated in Fig. 4 the thermocouple 20 is of the tubular type but it will be understood that any other arrangement which will provide sufficient flow of current through the coils 82 to energize the magnet 80 may be provided. An armature member 84 is provided for the magnet 80 and is carried on a stem 86 which projects on either side thereof and supports on one side a coil spring 88 extending between the armature 84 and the bottom of the magnet 80. The coil spring 88 is stronger than the spring 38 for the valve member 34 and acts in opposition thereto for seating the valve member 34 as will be apparent hereinafter.

The end of the stem 86 projecting on the opposite side of the armature 84 threadedly engages with a cap nut 90 which is located in valve chamber 40 in proximate relation to the projecting end of the valve stem 36 with which it is axially aligned. The cap nut 90 may be guided in an apertured retainer plate 92 which serves as a closure for the open end of the enlarged recess 78 and also serves to secure a sealing gasket 94 across the open end to prevent passage of fuel from the valve chamber 40 into the magnet body 26.

As the voltage generated by the thermocouple 20 is relatively small, the spring 88 will serve to maintain the armature 84 in its released position, as shown in Fig. 3, even if the magnet is in energized condition. As is customary in such devices, means are provided for resetting the armature 84 against the pole faces of the magnet 80 by a manual operation owing to the lack of sufficient magnetizing force to attract it from released position. To this end, a reset stem 96 is mounted for reciprocation in a reset stem chamber 97 formed in the magnet body 26 on one side of the magnet 80. The reset stem 96 carries a nut 98 projecting on the exterior of the magnet body 26 and is urged outwardly from the chamber 97 by a coil spring 100. The outward movement of the stem is limited by a collar 102 on the reset stem 96 which engages with a flanged portion 103 of the magnet body 26 forming a guide for the stem 96. Beyond the collar 102 the reset stem projects through an aperture into the valve chamber 40 for the purpose of effecting actuation of means for resetting the armature 84 as described and also to maintain the control valve 34 seated during the resetting operation.

The means for accomplishing this dual function includes a channel-shaped plate 104, shown in detail in Fig. 6, which has its base secured to the magnet body 26 with the opposite sides thereof projecting into the valve chamber 40. A pair of spaced slots 106, 108 are formed in each of the sides of the channel-shaped member 104 and a perforation 110 is provided in the base thereof through which the projecting end of the reset stem 96 may extend. An operating lever 112, shown in detail in Figs. 8 and 8*a*, is pivoted intermediate its ends in the slot 106 and is provided with a raised portion 114 at one end which engages with the cap nut 90 on the end of the armature stem 86. The operating lever 112 is further provided with an elongated opening 116 within which a connecting lever 118, illustrated in Fig. 9 of the drawings, is adapted to extend.

The connecting lever 118 has a forked end 120 which extends on both sides of the operating lever 112 at one end 121 thereof, this end being suitably bent from the plane of the lever to facilitate such engagement. A slot 122 is formed transversely in the end of the connecting lever 118 opposite the forked end 120 and is adapted to receive an upturned portion 124 formed intermediate the ends of a holding lever 126 illustrated in Fig. 10 of the drawings. One end of the holding lever 126 is pivoted in the slots 108 of the channel-shaped member 104 and this end is also provided with an opening 128 for the reception of the forked end 120 and the associated

end 121 of the connecting and operating levers, respectively.

When the lever mechanism described is positioned in the valve chamber 40 the end of the holding lever 126 opposite its pivot extends along the underside of the operating lever 112 and into operative engagement with the projecting end of the control valve stem 36. Extending laterally of the raised portion 114 on the operating lever 112 is an arm 130 having an upturned end 132 which is adapted to engage with the projecting end of the pilot valve stem 60 as illustrated in Fig. 4 of the drawings.

In addition to the features of the safety control so far described, the embodiment of the present invention includes an arrangement for causing closure of the control valve 34 and the pilot burner valve 64 when the temperature of the water in the water heater 12 becomes excessive. This arrangement includes means by which it is possible to move the armature 84 to its released position and cause closure of the safety control valve 34 independently of the current being generated by the thermocouple 20. To this end, the magnet body 26 is provided with a cover 134 within which an expansible and contractible element 136 of a thermally responsive device is mounted. Expansion and contraction of the element 136 may be made responsive to the temperature in the water heater 12 by the provision of a capillary tube 138 connected at one end to the element 136 and at the other end to a bulb 140 immersed in the water being heated. The bulb 140, capillary tube 138 and element 136 may be completely filled with a fluid which remains liquid at elevated temperatures such as chlorinated diphenyl.

As shown more clearly in Fig. 3*a*, the element 136 is carried on a stud 139 supported from an arm 140 mounted on the upper end of the magnet body 26. The element 136 is thus free to expand and contract as described and such movements will serve to reciprocate a pin 142 projecting from the element 136 at the side opposite the stud 139. The pin 142 projects through an aperture in the upper end of the magnet body 26 and through an axially aligned aperture in the bottom of the horseshoe magnet 80. The pin 142 is thus arranged in axial alignment with the stem 86 of the armature 84 and is adapted for engagement therewith when the armature 84 is seated against the pole faces of the magnet 80. In this condition of the armature 84 the spring 88 is compressed. When the armature 84 is in its released position the spring 88 is extended and the stem 86 is spaced from the end of the pin 142.

In the operation of the device the dial is first rotated from the "off" position to the "Pilot" position. The position of the plug valve port 48 and by-pass groove 52 in the "off" position is illustrated in Figs. 12 and 13. Until the "Pilot" position is reached no fuel can pass the plug valve 46 and both the pilot and main burner control valves are in closed position. In the "Pilot" position the fuel may flow from the inlet 28 by way of the arcuate groove 52 to the pilot passage 54 to the pilot valve stem chamber 58. The reset button 98 is then manually actuated to depress the stem 96 and cause its engagement with the connecting lever 118. Further pressure applied to the reset button 98 will cause the stem 96 to move the forked end 120 of the connecting lever 118 downwardly carrying with it the associated end 121 of the operating lever 112.

As the operating lever 112 is pivoted intermediate its ends in the slot 106 of the channel-shaped member 104, the opposite end of this operating lever will move upwardly causing the raised portion 114 engaging the cap nut 90 to move the armature 84 toward the pole faces of the magnet 80. At the same time, the extended arm 130 of the operating lever 112 will also move upwardly causing engagement between the upturned end 132 thereon with the projecting end of the pilot valve stem 60. Thus, when the armature 84 is in the attracted position in engagement with the pole faces of the magnet 80, the pilot control valve 64 is moved off its seat against the bias of the spring 68. Fuel may then flow past the pilot control valve 64 and from the chamber 62 which it controls to the passage 72 and to the pilot connection 74 and pipe 18 to the pilot burner 16 at an amount controlled by the adjustment of the pilot adjustment member 76. The pilot burner may then be lighted and the flame therefrom will impinge upon the end of the thermocouple 20 which is connected with the coils 82 of the magnet 80.

During this resetting operation, the connecting lever 118 pivots around the upturned portion 124 of the holding lever 126 as a fulcrum. The holding lever 126 is thus held stationary against the projecting portion of the control valve stem 36 while the raised portion 114 of the operating lever 112 moves away therefrom in engagement with the cap nut 90. The control valve 34 is thus held firmly against its seat 32 against the bias of its spring 38 to prevent fuel flow to the main burner should the plug valve 46 be positioned with its port 48 aligned with the inlet 28.

In a short time the thermocouple 20 generates sufficient current to energize the magnet and maintain the armature 84 in its attracted position against the pole faces of the magnet. The reset button 98 may then be released causing retraction of the stem 96 under the bias of spring 100. The consequent release of pressure on the holding lever 126 permits the control valve spring 38 to move the control valve 34 to open position carrying with it the holding lever 126 which is pivoted in the slots 108 of the channel-shaped support 104. The dial 50 may then be rotated to the "on" position shown in Figs. 14 and 15 permitting fuel to flow from the pipe 14 through the inlet 28 to the valve chamber 40 and past the valve seat 32 to the outlet 30 connected with pipe 14 to the main burner 10. In this position of the plug valve 46 it will be observed that the arcuate groove 52 permits fuel to flow to the pilot burner through the same passages as in the "Pilot" position. As the spring 38 of the main control valve 34 is stronger than the spring 68 of the pilot control valve the operating and holding levers are maintained in raised position and the pilot valve 64 is held open during normal running of the burner.

In the event that the pilot burner is extinguished, the thermocouple ceases to generate current causing deenergization of the electromagnet. Movement of the armature 84 away from the pole faces of the magnet 80 will then occur. Such movement of the armature 84 is caused by the spring 88 which being stronger than the spring 38 of the control valve 34 moves the operating and holding levers downwardly about their pivots and causes closure of the control valve 34 and the pilot valve 64. Thus, when the pilot burner is extinguished for any reason the safety mechanism operates to close both the main control valve and the pilot control valve

giving a complete shut-off of fuel to both main and pilot burners.

If the burner continues to operate without extinguishment of the pilot burner 16 and consequent operation of the safety control described, an excessive temperature may occur in the water being heated in the water heater 12. Upon occurrence of this condition, the thermal element 136 will undergo an expanding action and move the pin 142 connected thereto toward the armature stem 86. As the pin 142 is in engagement with the stem 86 in the attracted position of the armature, the magnetic force tending to hold the armature against the pole faces of the magnet is overcome and the spring 88 will move the armature 84 to its released position. This action of the thermal element 136 in overcoming the magnetic force between the magnet 80 and its armature 84 is thus entirely independent of the current generated by the thermocouple 20. It will be apparent that this positive release of the armature 84 and consequent closure of the control valve 34 and pilot valve 64 may occur under conditions of excessive temperature in the water heater even though the pilot flame has not been extinguished and thermoelectric current is still being generated.

In the embodiment shown in Fig. 11 a modified form of resetting device is disclosed. As the other elements of the construction are identical in all respects with those previously described, similar reference numerals have been applied to the corresponding parts. In this embodiment, the plug valve 46 is provided with stem 144 movable axially thereof and carrying the dial 50. The stem 144 and dial are biased from the valve body 24 by a coil spring 146 extending between the underside of the dial 50 and a cover 148 which limits axial movement of the valve stem 144.

The reset stem 150 of this embodiment is located intermediate the plug valve 46 and the magnet 80 and is mounted in a chamber 151 formed in the magnet body 26. As in the previously described embodiment, a coil spring 152 serves to urge the reset stem 150 outwardly from the magnet body but the reset button of the previous embodiment is dispensed with. In place thereof an actuating arm 154 is mounted on the reset stem 150 exterior of the magnet body 26 and projects into position to be engaged by the dial 50 upon axial movement thereof. The opposite end of the reset stem 150 projects into the valve chamber 40 and is formed with a cup-shaped end 156 which is preferably rectangular in cross-section. A pin extends transversely through the rectangular end 156 and through downturned ears formed on a rocker 158 which takes the place of the connecting lever of the previous embodiment. The rocker 158 pivots on the pin and is provided with a depending end 160 and an opposite depending end 162. A coil spring 164 extends between depending end 162 and the end 156 of the reset stem. A projection 166 on end 162 of the rocker is adapted to engage one end of the operating lever 112 which may be similar to that described in the previous embodiment. The opposite end 160 of the rocker is adapted to engage with the holding lever 126 which also may be similar to that described in the previous embodiment.

The operation of the embodiment shown in Fig. 11 differs from that previously described only in the resetting operation. In the "Pilot" position the dial 50 is pushed inwardly toward the valve body by a manual operation and serves to move the reset stem 150 downwardly as viewed in Fig. 11. The projection 166 of rocker 158 pivots the operating lever 112 in support 104 while the depending end 160 restrains movement of holding lever 126. The rocker then pivots on its pin support compressing the spring 164 until the armature 84 is seated against the pole faces of the magnet 80. The pilot burner may then be lighted and the thermocouple will generate sufficient current to retain the armature in attracted position while the dial 50 is released. Movement of the reset stem under bias of spring 152 will relieve the holding pressure of rocker end 160 on holding lever 126 and permit valve spring 38 to open the control valve 34 as in the previous embodiment. The following operations to bring the control into running condition are as previously described in connection with the preferred embodiment.

It will be understood that many changes may be made in the arrangement and combination of parts and in the details of construction herein disclosed within the scope of the appended claims without departing from the invention. This application is a division of our copending application Serial No. 529,201 filed April 1, 1944, now Patent No. 2,455,542.

We claim:

1. Resetting mechanism comprising an operating lever having a free end, a holding lever positioned on one side of said operating lever and having a free end extending substantially parallel thereto, means for mounting said levers for independent pivotal movement, a connecting lever pivotally mounted at one end on said holding lever and having motion transmitting engagement at the opposite end thereof with said operating lever, biasing means for moving the free end of said holding lever toward said operating lever, second biasing means for moving the free end of said operating lever toward said holding lever, said second biasing means having greater force than said first biasing means, and means operable on said connecting lever for overcoming both said biasing means and causing movement of said free end of said operating lever away from said free end of said holding lever, said second biasing means being effective for returning said operating lever to initial position and preventing movement of said holding lever when said last means is inoperative.

2. Resetting means as claimed in claim 1 wherein stop means limit movement of said free end of said holding lever under the force of said second biasing means, and second stop means for limiting movement of said free end of said operating lever upon operation by said last means.

3. Resetting means as claimed in claim 2 wherein said second stop means include means for overcoming said second biasing means under predetermined conditions, said first biasing means being thereby rendered effective for causing movement of said free end of said holding lever toward said free end of said operating lever.

4. Resetting mechanism comprising an operating lever pivoted intermediate its ends, a holding lever pivoted at one end and having its free end extending substantially parallel to a free end of said operating lever for independent pivotal movement, a connecting lever pivotally mounted at one end on said holding lever and having motion transmitting engagement at the opposite end thereof with said operating lever, biasing means for moving the free end of said holding lever toward said operating lever, second biasing means

for moving the free end of said operating lever toward said holding lever, said second biasing means having greater force than said first biasing means, and means operable on said connecting lever for overcoming both said biasing means and causing movement of said free end of said operating lever away from said free end of said holding lever, said second biasing means being effective for returning said operating lever to initial position and preventing movement of said holding lever when said last means is inoperative.

5. Resetting means as claimed in claim 4 wherein stop means limit movement of said free end of said holding lever under the force of said second biasing means, and second stop means for limiting movement of said free end of said operating lever upon operation by said last means.

6. Resetting means as claimed in claim 5 wherein said second stop means include means for overcoming said second biasing means under predetermined conditions, said first biasing means being thereby rendered effective for causing movement of said free end of said holding lever toward said free end of said operating lever.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 22,068	Joesting	Apr. 14, 1942
2,245,834	Sparrow	June 17, 1941
2,258,811	Ray	Oct. 14, 1941
2,309,709	Paille	Feb. 2, 1943
2,321,095	Mantz	June 8, 1943
2,361,945	Jackson	Nov. 7, 1944
2,371,351	Paille	Mar. 13, 1945