This invention relates to improvements in safety shut-off devices for fuel burners and the like.

One of the main objects of the present invention is to provide an improved safety shut-off device comprising a valve generally of the balanced type.

Another object of the invention is to provide an improved safety shut-off device comprising a valve generally of the balanced type of means for the admission of fuel to opposite sides of the valve for actuation of the valve to closed position, with means for relieving the pressure on one side of the valve for actuation of the valve to open position and maintenance of same in open position by the pressure of the fuel on the other side of the valve, and condition responsive means controlling the pressure relief means.

Further objects of the invention and the features and advantages of the illustrated embodiment of the invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings, in which the single figure is a more or less diagrammatic view showing a thermoelectric safety shut-off system embodying the present invention.

The invention can be embodied in a wide variety of forms for use with a wide variety of devices, but for purposes of illustration the invention has been shown more or less schematically as embodied in a manner automatically to close a valve in a fuel supply pipe leading to a burner when the pilot light for the burner goes out.

In the drawing, the burner 10 is any suitable or preferred main burner, such as the burner of a room or space heater, water heater, floor furnace, or any other burner. A fuel supply pipe 11 leads to the burner 10 for the delivery of gaseous or other fuel thereto, for example, through the mixing chamber 12, to which air is admitted in the usual way, as well understood in the art. The valve, designated in its entirety at 15, is connected into the fuel supply pipe 11.

The valve 15 has an inlet 16 for the admission of fuel from the supply pipe 11 ahead of the valve into the outlet chamber 17, and an outlet 18 for the delivery of the fuel to the burner 10 through the pipe 11 posterior to the valve. The admission of fuel into the valve chamber 17 from the inlet 16 is controlled by a valve disk 20 which is adapted to seat upon the valve seat 21 in opposition to the direction of entry of the fuel to shut off the supply of fuel to the burner 10.

The valve also has associated therewith a cylindrical extension 24 shown for purposes of the more or less diagrammatic illustration as connected to the valve disk member 20 upon a valve stem 25 which is mounted for reciprocatory movement, for example, in the body of the valve, or otherwise as desired. The cylindrical extension 24 is slidable through bore 26 in the wall separating the pressure chamber 28 and the outlet chamber 17.

The cylindrical extension member 24 is shown as operating in a pressure chamber 28, the pressure in which chamber 28 acts on the extension member 24 in opposition to the action of the pressure in the inlet chamber on the valve disc 20. Duct means, 30, 32 leads from the inlet chamber 16 to the pressure chamber 28, through a pilot valve chamber conveniently formed in the body of valve 15, which latter chamber has an opening 31 for venting pressure from the pressure chamber 28 into the outlet chamber 17. Valve means 45, 45', in the form of a pilot valve operating in the pilot valve chamber, as shown, has a first position placing the inlet chamber 16 in communication with the pressure chamber 28 through the duct means 30, 32 and simultaneously closing the venting of pressure from the pressure chamber 28 to the outlet chamber 17 through the opening 31. The valve means 45, 45' also has a second position closing communication between the inlet chamber and the pressure chamber and opening the vent from the pressure chamber to the outlet chamber. A check valve 33 checks back-flow from the outlet chamber to the pressure chamber.

Disposed in juxtaposition to the main burner 10 is a pilot burner 36 which maintains a pilot flame 37 for igniting the main burner. The pilot burner 36 is supplied with fuel by a tube 38 which may be connected to the fuel supply pipe 11 in any suitable or preferred manner. For example, by connecting the pilot supply tube 36 to the pipe 11 posterior to the valve 15, this valve will operate to shut off the supply of fuel not only to the main burner, but also to the pilot burner. If it is not objectionable for the relatively small amount of fuel supplied to the pilot burner to escape unburned when the pilot burner is extinguished, the pilot supply tube 38 may be connected to the fuel supply pipe 11 anterior to the valve 15. The electromagnetic valve 34 comprises a magnet frame 42 having an energizing coil 43, and an armature is provided as shown more or less diagrammatically at 44. The armature 44 carries or is connected to the valve means 45, 45'. When the armature 44 is attracted, the valve member 45' is held in open position and valve 45 in closed position for the flow of fuel from
the pressure chamber 28 through the tube or passage 32 into the valve or outlet chamber 17, thus relieving the pressure on the other side of the extension member 24 for actuation of the valve disk member 20 to open position and for maintenance of the same in open position by the pressure of the fuel on the opposite or inlet side of the valve disk member 20.

When the armature is retracted, for example, by a spring 48 interposed between the armature and a fixed abutment 47 upon deenergization of the electromagnet, the valve member 45 is actuated to open position and valve 45' to closed position. This shuts off the flow of fuel from the pressure chamber 28 to the valve or outlet chamber 17 through the tube or passage 32. Pressure thereupon builds up in the pressure chamber 28, and the valve disk member 20 is moved to closed position against its seat 21, for example, by a spring 50 to shut off the supply of fuel to the burner 10. The spring 50 need be only strong enough to overcome in the direction of the valve seat 21 the equalized pressure on the inlet side of the valve disk 20 and on the opposite side of the extension member 24.

A thermocouple or pilot flame 37 is placed in position so that the base junction 56 thereof will be heated by the pilot flame 37 as long as the pilot flame is burning. The construction of the thermocouple may be similar to that more fully disclosed in Oscar J. Leins Patent No. 2,126,504, granted August 9, 1938, or it may be of any other suitable or preferred form. One terminal of the coil 43 is connected through a conductor 51 to the internal thermocouple element of the thermocouple, and the other terminal of the coil 43 is connected by a conductor 62 to the external thermocouple element.

For the purpose of resetting the armature to attracted position and the valve 45' to open position, I provide the armature with a reset stem 56 having a reset button or finger piece 62 at its outer end. By grasping the button or finger piece 62 and drawing or pulling the same outwardly, the armature 44 is reset to attracted position and the valve 45' is moved to open position.

It will be understood that if desired the electromagnetic valve 34 may be of a nature in which the armature is adapted to be attracted solely by the electromagnetic flux induced in the electromagnet so that a thermostat, timer, or other condition responsive device may be incorporated in circuit with the electromagnetic valve to control opening and closing of the valve. When the pilot burner is lighted, the heat of the pilot flame 37 on the thermocouple 56 of the thermocouple 55 sets up a thermelectric current in the coil 43 of the electromagnet. As soon as the electromagnet is sufficiently energized, the magnetic field holds the armature 44 in attracted position and the valve 45' in open position upon release of the reset button or finger piece 62. The relief passage or duct 32 relieves the pressure in the pressure chamber 28, and the valve disk member 20 is actuated to open position by the pressure of the fuel in the fuel supply pipe 13 on the inlet side of the valve 15, thereby setting up the desired supply of fuel to the burner 10. The valve disk member 20 is made of suitable control valve may be provided for turning the burner 10 on and off, and when it is turned on, the burner is ignited by the pilot flame 37.

Upon extinguishment of the pilot flame 37, or where the condition responsive device is some other form of condition responsive device, then upon some other abnormal, defective, or insufficient functioning of the apparatus the electromagnetic valve 43 is deenergized and the armature 44 is actuated to retracted position and the valve 45' to closed position, pressure thereupon building up in the pressure chamber 28 for actuation of the valve disk member 20 to closed position to shut off the supply of fuel to the burner 10.

The present application is a continuation-in-part of my prior application Serial No. 327,893, filed March 30, 1940.

I claim:
1. In safety shutoff means for controlling flow of fuel to a main burner, a valve body having an inlet chamber, means including a wall in said body forming an outlet chamber adjacent to and in communication with said inlet chamber and a pressure chamber adjacent said outlet chamber, a valve member controlling communication between said inlet and outlet chambers and having a cylindrical extension slidable through said wall, the area of the end of said extension exposed to pressure within said pressure chamber being substantially equal to the area of said valve member exposed to pressure in the inlet chamber whereby the opposed pressures acting on said valve member when it is closed and said inlet and pressure chambers are in communication with each other are substantially equalized means yielding urging said valve member closed, said valve body having a first passage opening into said inlet chamber and a second passage opening into said outlet chamber and a third passage opening into said pressure chamber, a pilot valve controlling communication between said passages having a first position and a second position and yielding urging toward its said first position, said pilot valve when in its said first position shutting off communication between said second passage and said first and third passages while permitting communication between the two latter passages, said pilot valve when in its said second position shutting off communication between said first passage and said second and third passages while permitting communication between the two latter passages, and electromagnetic means capable when energized of holding said pilot valve in its said second position but incapable of moving it thereto from its said first position.
2. In safety shutoff means for controlling flow of fuel to a main burner, a valve body having an inlet chamber, means including a wall in said body forming an outlet chamber adjacent to and in communication with said inlet chamber and a pressure chamber adjacent said outlet chamber, a valve member yielding urged closed and controlling communication between said inlet and outlet chambers and having a cylindrical extension slidable through said wall, the area of the end of said extension exposed to pressure within said pressure chamber being substantially equal to the same as the area of said valve member exposed to pressure in said inlet chamber whereby the opposed pressures acting on said valve member when it is closed and said inlet and pressure chambers are in communication with each other are substantially equalized, said valve body having a pilot valve chamber with three passages extending therefrom respectively opening into said inlet chamber and outlet chamber and pressure chamber, a pilot valve in said pilot valve chamber having a first position and a second po
sition and yieldingly urged toward its said first position, said pilot valve when in its said first position shutting off communication between said pilot valve chamber and said outlet chamber while permitting communication between said inlet and pressure chambers through said pilot valve chamber, said pilot valve when in its said second position shutting off communication between said inlet and pressure chambers while permitting communication between said pressure chamber and said outlet chamber through said pilot valve chamber, and electromagnetic means capable when energized of holding said pilot valve in its said second position but incapable of moving it thereto from its said first position.

3. In a safety shutoff means for controlling flow of fuel to a main burner, a valve body having an inlet chamber, means including a wall in said body forming an outlet chamber adjacent to and in communication with said inlet chamber and a pressure chamber adjacent said outlet chamber, a valve member yieldingly urged closed and controlling communication between said inlet and outlet chambers and having a cylindrical extension slidable through said wall, the area of the end of said extension exposed to pressure within said pressure chamber being substantially the same as the area of said valve member exposed to pressure in said inlet chamber whereby the opposed pressures acting on said valve member when it is closed and said inlet and pressure chambers are in communication with each other are substantially equalized, means comprising a pilot valve having a first position and a second position and passages controlled by said pilot valve whereby said inlet and pressure chambers are in communication through said passages exclusively of said outlet chamber when said pilot valve is in its said first position and said outlet and pressure chambers are in communication through said passages exclusively of said inlet chamber when said pilot valve is in its said second position, means yieldingly urging said pilot valve toward its first position, and electromagnetic means capable when energized of holding said pilot valve in its said second position but incapable of moving it thereto from its said first position.

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