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C. V. HILDEBRECHT

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SAFETY APPARATUS FOR HEATING AND OTHER DEVICES

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Fig. 1.

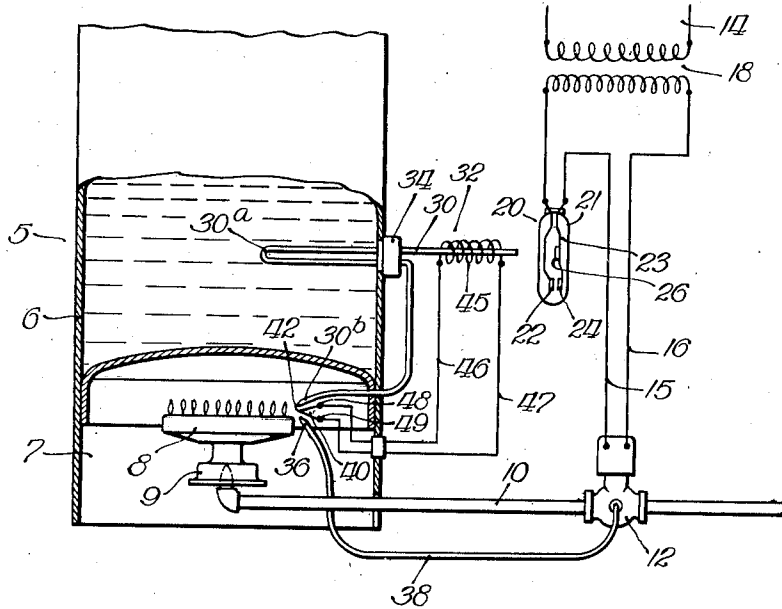


Fig. 2.

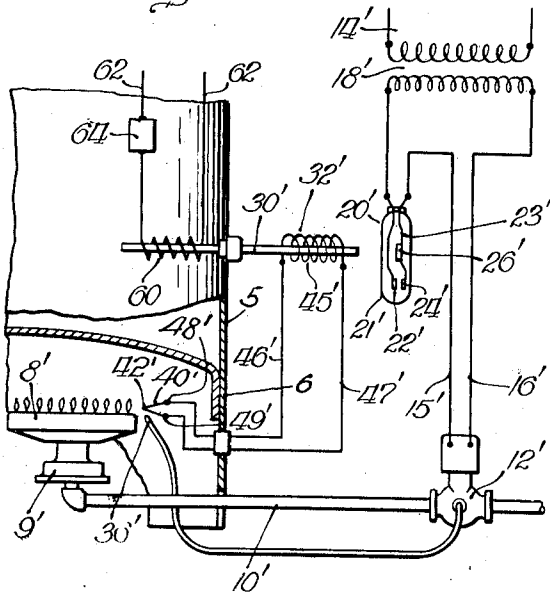
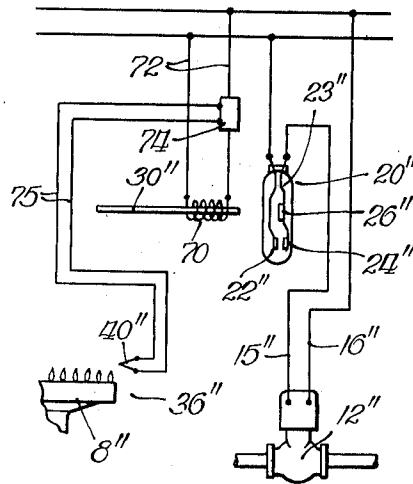


Fig. 3.



INVENTOR.
Charles V. Hildebrecht
BY
Brown, Jackson, Butcher & Vienna
ATTORNEYS. 7

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SAFETY APPARATUS FOR HEATING AND
OTHER DEVICES

Charles V. Hildebrecht, Chicago, Ill., assignor to
Milwaukee Gas Specialty Company, Milwaukee,
Wis., a corporation of Wisconsin

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8 Claims. (Cl. 122—504)

This invention relates to safety apparatus for heating and other devices.

It is known in the art that certain metallic alloys which are ordinarily magnetic become substantially non-magnetic when heated to a sufficiently high temperature. In other words, the permeability of the alloy is, to a certain extent, dependent on the temperature. The critical temperature at which the alloy becomes non-magnetic varies with alloys of different composition. All magnetic metals become non-magnetic at certain transformation points (Curie points), and recent research has developed temperature sensitive magnetic alloys which become non-magnetic at relatively low temperatures and are changed from magnetic to non-magnetic, and vice versa, by relatively slight variations in temperature.

One of the main objects of the present invention is to provide for utilizing a thermocouple having an electromagnet connected in circuit therewith and the variation in magnetic permeability according to temperature change for securing the desired safety control.

Another and more specific object is to provide for utilizing an electromagnetic having a thermocouple connected in circuit therewith as the means responsive to the heat of a pilot flame for shutting off the main fuel supply line upon extinguishment of the pilot flame, in combination with utilization of the variation of magnetic permeability of the core of such electromagnet according to temperature change, as a means for shutting off the main fuel supply line upon other abnormal, defective, or insufficient or non-functioning of the apparatus.

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

Figure 1 is a fragmentary diagrammatic view, partly in section, of one illustrative embodiment of the invention;

Figure 2 is a similar view showing another embodiment of the invention; and

Figure 3 is a view similar to Figures 1 and 2 showing a further embodiment of the invention.

Referring first to Figure 1, a hot water heater is indicated generally at 5 and comprises a tank 6 adapted to contain the water to be heated and a burner compartment 7 in which is disposed a main burner 8 which is adapted, when ignited, to heat the water in the tank 6.

Where the burner 8 is a gas burner, it is connected through a suitable air and gas admixture

chamber, indicated at 9, with a fuel supply line 10 for delivering fuel to the burner. While the burner 8 is referred to as a gas burner, any other suitable or preferred fuel may be employed within the scope of the present invention.

The fuel supply line 10 is provided with a solenoid operated safety shut-off valve 12 for shutting off the supply of fuel to the burner 8 as will hereinafter appear. Electric current for opening the solenoid valve 12 is supplied thereto from an energized circuit 14 through conductors 15 and 16. The circuit 14 may be an alternating current lighting circuit or any other circuit supplied by a suitable source of current (not shown). In the illustrated embodiment of the invention, the circuit comprising the conductors 15 and 16 is connected to the energized circuit 14 through a transformer 18.

The conductor 15 contains, in series circuit relation, a magnetic switch 20. This switch 20 may be of the general type shown and described in Oscar J. Leins Patent No. 1,958,482, issued May 15, 1934, or of the type shown and described in the present applicant's copending application Serial No. 224,248, filed August 11, 1938, or of any other suitable or preferred type.

Suffice it, for purposes of the present description, to state that the magnetic switch 20 comprises a non-magnetic evacuated tube or casing 21, or the casing 21 may be filled with an inert gas. The tube or casing 21 may be formed of glass, quartz, or other suitable material, "Pyrex" glass being contemplated for high temperature conditions. Terminal leads or extensions connected in circuit with the conductor 15 extend into the switch tube or casing 21, and one of the leads or terminal extensions carries a relatively fixed contact 22. The other lead or terminal extension carries a leaf spring member 23 at the inner end of which is a movable contact 24 which is yieldingly carried by the spring 23 and adapted to engage the contact 22 for closing the circuit 15, 16 through the solenoid valve 12, and thereby actuating the valve to open position to allow fuel to flow to the burner 8.

The spring 23 is tensioned normally to maintain the contact 24 in open circuit position spaced from the contact 22, at which time the solenoid valve 12 is deenergized and actuated by spring means (not shown) or other suitable means to closed or safety position, shutting off the supply of fuel to the burner 8. The spring 23 also carries an armature 26 suitably secured thereto and formed of magnetic material, such as soft iron or the like,

Disposed with its outer end in juxtaposition and aligned with the armature 26 is a bar or other member 30 which is made of a temperature sensitive magnetic alloy or Curie point material. The terminal extension carrying the fixed contact 22 is preferably disposed laterally of the armature 26 so that the armature 26 will be exposed directly to the end of the bar 30 without the lead for the contact 22 being in position therebetween.

The member 30 is provided with a bight or looped portion 30a which extends into the tank 6 at the lowest safe operating level of the water therein, so as to be submerged in the water in the tank 6 when the water level is above the lowest safe level. When the level of the water drops below the lowest safe level, the looped portion 30a of the temperature sensitive magnetic bar 30 is disposed above the level of the water and out of contact therewith. The opposite end of the bar 30 extends into position indicated at 30b to be heated by the pilot light. The opening in the side of the tank through which the member 30 extends is preferably provided with suitable fluid sealing means as indicated at 34.

The pilot light or pilot burner, indicated at 36, is disposed in juxtaposition to the main burner 8 for lighting the same, as well understood in the art. The pilot light is supplied with fuel by a pilot burner fuel supply pipe 38. The fuel supply pipe 38 is connected to the main fuel supply pipe 10 through the casing of the valve 12, and preferably by a by-pass around the movable valve therein (not shown) so that a supply of fuel may be maintained or set up to the pilot burner when the fuel supply to the main burner is shut off. Alternatively, the pilot burner fuel supply pipe 38 may be connected to the main fuel supply pipe 10 anterior of the valve 12 to provide a constantly burning pilot, or it may be connected to the fuel supply line 10 posterior of the valve 12 so that the fuel supply to the pilot burner, as well as the fuel supply to the main burner, will be shut off when the safety shut-off valve 12 is closed. These aspects may vary widely within the scope of the appended claims.

A thermocouple 40 is placed in position so that the thermal junction 42 between the thermocouple elements will be heated by the pilot flame. The thermocouple elements are connected in series circuit relation to the opposite ends of the winding 45 of the electromagnet 32 by conductors 46 and 47. The junctions between the outer ends of the thermocouple elements and the conductors 46 and 47 are indicated at 48 and 49, respectively. The winding 45 surrounds the outer end of the bar or member 30, which thereby constitutes the core of the electromagnet 32.

In normal operation, the level of the water in the tank 6 is above the looped part 30a of the temperature sensitive bar 30, and the looped part of this bar is submerged in the water. So long as the pilot burner 36 is ignited the heat thereof on the thermocouple produces a thermo-electric current in the coil or winding 45 of the electromagnet. At the same time the heat of the pilot flame on the adjacent end 30b of the bar 30 heats this bar and the heat is conducted through the bar toward the outer end which forms the core of the electromagnet 32.

So long as the looped portion 30a of the bar 30 is surrounded by water, a sufficient amount of the heat imparted to the bar 30 by the pilot flame will be dissipated from the bar so that the core-forming outer end of the bar will remain

below its Curie point or below the point at which this core-forming outer end of the bar becomes non-magnetic or substantially non-magnetic. The core of the electromagnet will thus be ferromagnetic. Instead of making the inner end of the bar 30 as an integral part of the core-forming part of the bar, this inner end may be in the form of a separate member adapted for transmitting heat to the core of the electromagnetic under conditions, as will be apparent from the present description.

When the core of the electromagnet is below its Curie point or below the point at which it becomes non-magnetic, or substantially non-magnetic, and the thermocouple is heated by the pilot flame to energize the coil 45, the electromagnet will be magnetized sufficiently to attract the armature 26 to the left, as viewed in Figure 1, against the tension of the spring 23, to engage the contact 24 with the contact 22. This closes the circuit 15, 16 and, as a result, the valve 12 is opened and held open so long as the conditions above stated continue.

If the pilot flame is extinguished, the holding action of the electromagnet 32 ceases to be sufficient to hold the armature 26 in attracted position, and the spring 23 snaps the contact 24 yielding to open position out of engagement with the contact 22. This opens the circuit 15, 16 for the solenoid valve 12, and, as a result, the valve 12 is actuated to closed position, shutting off the supply of fuel to the burner 8.

On the other hand, with the pilot burner 36 ignited and the coil 45 of the electromagnet 32 energized thereby, if the water in the tank 6 falls below the looped portion 30a of the bar 30 the heat will not be dissipated from the bar sufficiently and the heat imparted to the bar by the pilot flame will be conducted to the outer core forming end of the bar, raising the temperature thereof above its Curie point, or above the point at which the core of the electromagnet becomes non-magnetic or substantially non-magnetic. The core of the electromagnet 32 thus becoming non-magnetic, or substantially non-magnetic, the energization of the coil 45 by the heat of the pilot flame on the thermocouple will not magnetize the electromagnet 32 sufficiently to hold the armature 23 in attracted position. As a result, the spring 23 will snap the contact 24 to retracted position out of contact with the contact 22. As where the pilot flame is extinguished, this opens the circuit 15, 16, and the valve 12 is actuated to closed position, shutting off the supply of fuel to the burner 8.

From the foregoing description it will now be apparent that the solenoid valve 12 is held open not only so long as the pilot flame is burning, but so long as the water in the tank 6 is above the low safety level. If the level of the water drops to or below the low safety level, the apparatus operates to close the safety shut-off valve to shut off the supply of fuel to the burner 8, and, at the same time, if the pilot flame is extinguished, the apparatus operates to close the valve 12 and shut off the supply of fuel to the burner 8.

It will be understood that the water in the tank 6 may be heated by oil or coal, and the liquid level responsive apparatus may be adapted to close the oil supply valve or stop a stoker if a low water level should occur.

It will be further understood that where the magnetic attraction between the electromagnet 32 and the armature 26 is not as great as the

tension of the spring 23, the contact 24 will snap to open position away from the contact 22. When the magnetic attraction is greater than the tension of the spring 23, the contact 24 is snapped to closed position.

The embodiment of the invention illustrated in Figure 2 is similar to the embodiment illustrated in Figure 1 except that the inner end of the temperature sensitive and core-forming bar 30', instead of extending into a water tank to constitute liquid level responsive means, is provided with an electric resistance coil 60 adapted for heating the bar 30'. The coil 60 may be supplied with electric energy, for example, from the energized circuit 14', or from any other suitable or preferred source of electric current. The circuit 62 for supplying electric energy to the coil 60 is provided with a switch 64 which may be closed by any abnormal, defective, or insufficient or non-functioning of any part of the apparatus, or otherwise as desired.

In operation, so long as the pilot light or other burner is lighted and the other parts of the apparatus are functioning, the thermo-electric current set up in the winding 45' of the electromagnet 32' by the heat of the pilot or other burner on the thermocouple 40' will magnetize the electromagnet 32' sufficiently to attract the armature 26', thereby closing the switch 20'. The closing of the solenoid valve circuit 15', 16' by the switch 20' opens the solenoid valve 12' and maintains the same open so that the desired supply of fuel is set up and maintained to the burner 8'.

If the pilot light is extinguished, the electromagnet ceases to hold the armature 26' in attracted position. As a result, the switch 20' opens, opening the circuit for the solenoid valve 12', which is thereupon actuated to closed position shutting off the supply of fuel to the burner 8'. Upon occurrence of any other abnormal, defective, or insufficient or non-functioning of the apparatus, the switch 64 is closed thereby, or it may be otherwise closed. The heat imparted to the temperature sensitive or Curie point member 30' by the heating coil 60 when the switch 64 is closed, is conducted to the core-forming part of the member 30'. As this member is heated above its transformation point, or above its Curie point, the core of the electromagnet 32' is caused to become non-magnetic, or substantially non-magnetic, or at least to have its magnetization reduced to a point where the armature is released. This results in opening the switch 20' and closing of the valve 12' even when the pilot flame is burning.

Other parts of the apparatus shown in Figure 2, which correspond with parts shown in Figure 1, are designated by primed reference characters like the reference characters employed in Figure 1.

In the embodiment of the invention shown in Figure 3, the temperature sensitive or Curie point member 30'', instead of constituting the core of an electromagnet, is ordinarily magnetic to attract the armature 26'' and thereby hold the switch 20'' closed and the valve 12'' open to supply fuel to the burner 8''. In this case the electric resistance coil 70 for heating the member 30'' is supplied with electric energy by conductors 72. The circuit comprising the conductors 72 is provided with a relay 74, the winding of which is connected in series circuit relation with the thermocouple 40'' by conductors 75.

So long as the pilot flame is burning, the

thermo-electric current generated by the heat of the pilot flame on the thermocouple magnetizes the relay 74 sufficiently to hold the same open. As a result, the magnetization of the ferro-magnetic member 30'' attracts the armature 26'' closing the switch 20''. This opens and maintains the valve 12'' open for supply of fuel to the burner 8''.

If the pilot flame is extinguished, the relay 74 closes, energizing the heating coil 70 which heats the member 30'' above its transformation point, or above its Curie point. As a result, the member 30'' becomes non-magnetic, or substantially non-magnetic, or at least has its magnetization reduced to a point where the armature 26'' is released. This results in opening of the switch 20'' and closing of the valve 12'' to shut off the supply of fuel to the burner 8''.

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

I claim:

1. Apparatus of the class described comprising an electromagnet having a winding provided with a core of temperature sensitive material the permeability of which is reduced at the transformation or Curie point temperature, means for heating the core of said electromagnet, a thermocouple adapted to be heated and connected in circuit with the winding of said electromagnet, said thermocouple being subject to heat at one part of the apparatus, and means for controlling the temperature of the heat sensitive core of the electromagnet by the condition of another part of the apparatus.

2. In combination, a tank for water, a burner therefor, a fuel supply pipe leading to said burner, a valve in said pipe, a fuel supply pipe for a pilot light in juxtaposition to said burner, an electromagnet adapted to control said valve and having a winding provided with a core of temperature sensitive material the permeability of which is reduced at the transformation or Curie point temperature, the core of said electromagnet having a heat conducting extension extending into said tank at substantially the lowest operating level of the water in said tank, and a thermocouple placed in position to be heated by the pilot light and connected in circuit with the winding of said electromagnet.

3. In combination, a tank for water, a burner therefor, a fuel supply pipe leading to said burner, a valve in said pipe, a fuel supply pipe for a pilot burner in juxtaposition to said burner, an electromagnet adapted to control said valve and having a winding provided with a core of temperature sensitive material the permeability of which is reduced at the transformation or Curie point temperature, the core of said electromagnet having a heat conducting extension placed in position to be heated by one of said burners and extending into said tank at substantially the lowest operating level of the water in the tank, and a thermocouple placed in position to be heated by the pilot burner and connected in circuit with the winding of said electromagnet.

4. In a system of the class described, a tank for water, a pilot light an, electromagnet having a winding provided with a core of temperature sensitive material adapted to be rendered less magnetic at the transformation or Curie point temperature, said core having a heat conducting extension extending into said tank at substantially the lowest operating level of the water therein, and a thermocouple placed in

position to be heated by the pilot light and connected in circuit with the winding of the electromagnet.

5. In combination, a tank for water, a burner therefor, a fuel supply pipe leading to said burner, a solenoid valve in said pipe, a magnetic switch connected in circuit with said valve, a fuel supply pipe for a pilot burner in juxtaposition to said burner, an electromagnet for controlling said magnetic switch, said electromagnet having a winding provided with a core of temperature sensitive material the permeability of which is reduced at the transformation or Curie point temperature, said core being placed in position to be heated by one of said burners and extending into the tank at substantially the lowest operating level of the water in the tank, and a thermocouple placed in position to be heated by the pilot burner and connected in circuit with the winding of said electromagnet.

6. Apparatus of the class described comprising a burner, a fuel supply pipe leading to said burner, a valve in said pipe, a fuel supply pipe for a pilot light in juxtaposition to said burner, an electromagnet adapted to control said valve and having a winding provided with a core of temperature sensitive material the permeability of which is reduced at the transformation or Curie point temperature, a thermocouple placed in position to be heated by the pilot light and connected in circuit with the winding of said electromagnet, an electric heating element for heating the core of the electromagnet, and means subject to some condition of the apparatus and connected in circuit with said heating element to control same.

7. In apparatus of the class described, the combination of an electromagnet having a winding provided with a core of temperature sensitive material, the permeability of which is reduced at the transformed or Curie point temperature, means for heating the core of said electromagnet to the transformation temperature, means subject to an abnormal condition of

the apparatus for controlling the heating of said core, a pilot burner, and a thermocouple subject to the heat of said pilot burner and connected in circuit with the winding of said electromagnet for energizing said electromagnet as long as said thermocouple is heated by said pilot burner and the condition to which said controlling means is subject is normal, said electromagnet being deenergized upon extinguishment of said pilot burner regardless of whether the condition to which said controlling means is subjected is normal or abnormal and said electromagnet being also deenergized when the condition to which said controlling means is subject becomes abnormal regardless of said pilot burner.

8. In apparatus of the class described, the combination of a main burner, a fuel supply pipe leading to said burner, a pilot burner in juxtaposition to said main burner, a control device having an operating position permitting the supply of fuel to said main burner and a safety position shutting off the supply of fuel to said burner, a thermocouple subject to the heat of said pilot burner, an electromagnet having a coil connected in circuit with said thermocouple and adapted by the thermoelectric current set up in said coil by the heat of said pilot burner on said thermocouple to maintain said control device in operating position as long as the thermocouple is heated by said pilot burner, said electromagnet having a core of temperature sensitive material the permeability of which is reduced at the transformation or Curie point temperature, said core being subject to the heat produced by the main burner, and means subject to an abnormal condition of the apparatus for controlling the heating of said core and operable upon the occurrence of an abnormal condition to permit heating of said core to its transformation or Curie point temperature so as to release said first mentioned control device for actuation to position to shut off the supply of fuel regardless of said pilot burner.

CHARLES V. HILDEBRECHT.