

March 1, 1927.

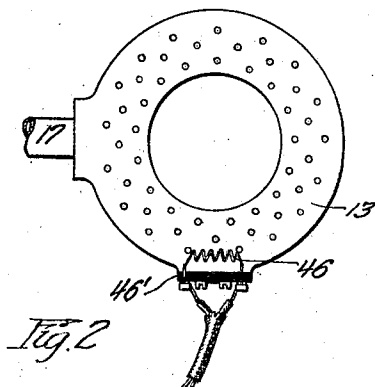
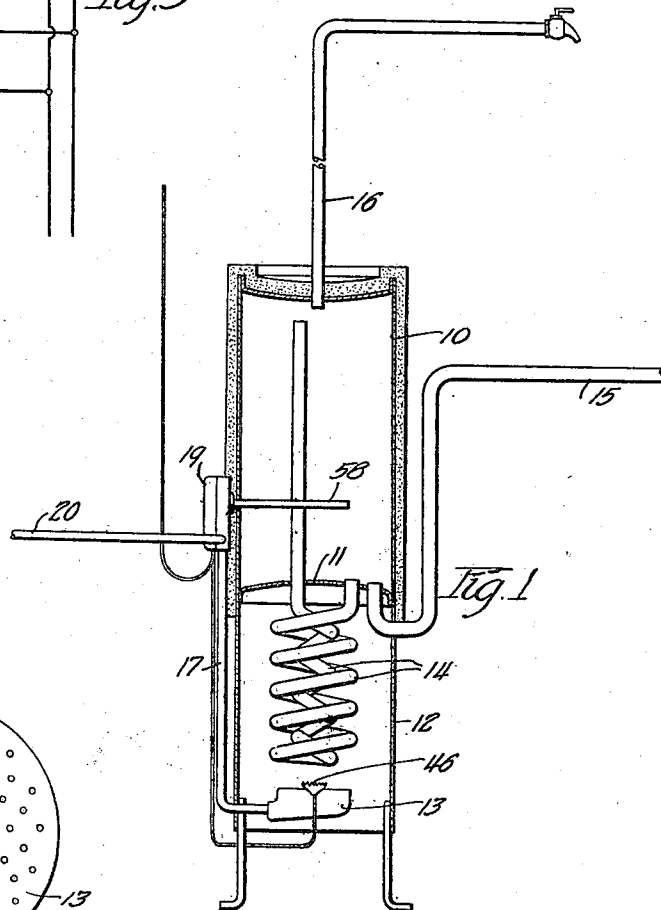
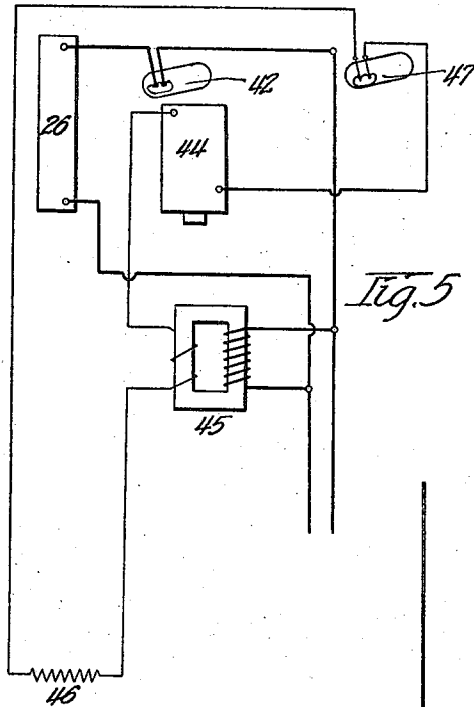
H. J. SAUVAGE

1,619,636

THERMOSTATIC CONTROL

Filed May 4, 1923

2 Sheets-Sheet 1



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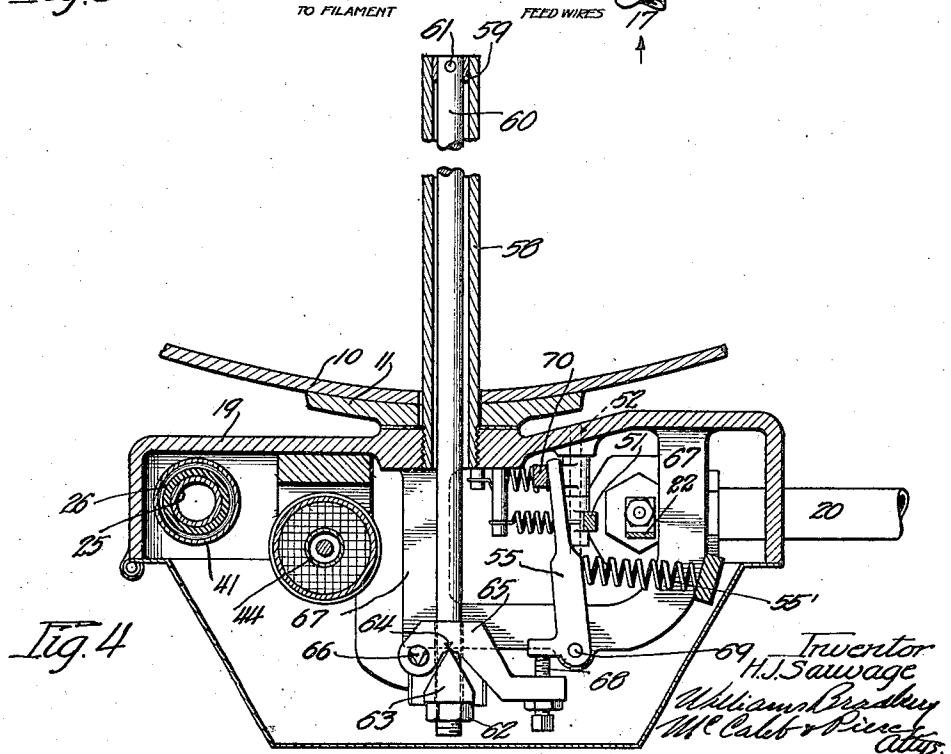
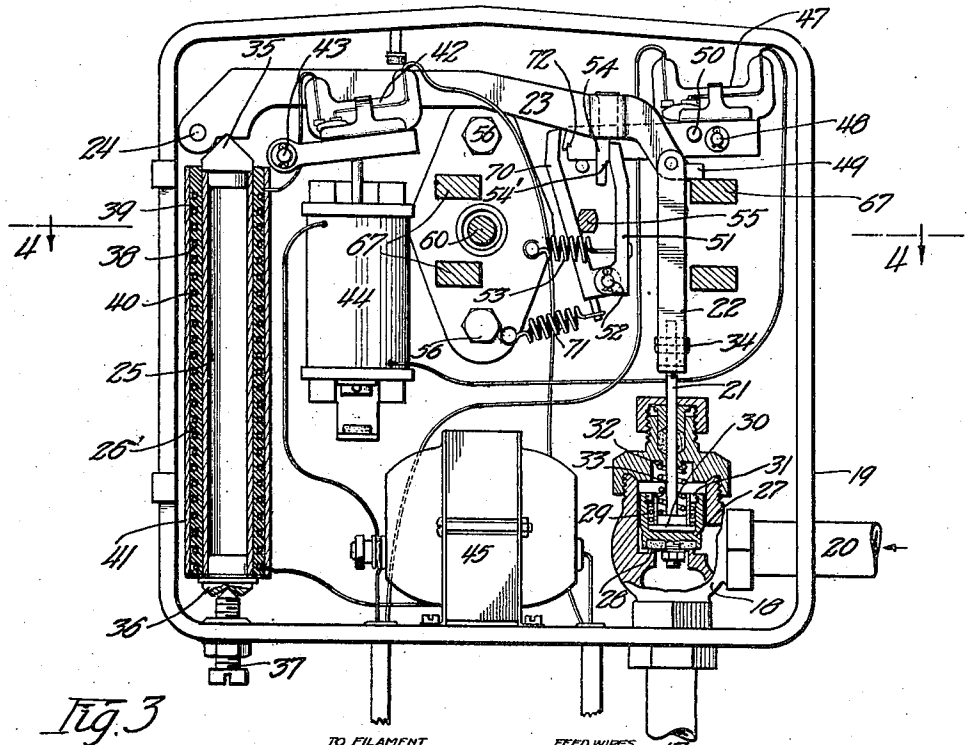
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H. J. SAUVAGE

THERMOSTATIC CONTROL

Filed May 4, 1923

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE.

HERBERT J. SAUVAGE, OF CHICAGO, ILLINOIS, ASSIGNOR TO TRUSTEES OF THE ELECTRO THERMOSTATIC CONTROL COMPANY, A TRUST ESTATE, OF CHICAGO, ILLINOIS.

THERMOSTATIC CONTROL.

Application filed May 4, 1923. Serial No. 636,666.

My invention relates to thermostatic controls and more especially to thermostatic controls for the fuel valves and igniting means for the burners of hot water heaters, and still more particularly to that type of hot water heater wherein a reservoir of hot water is continually maintained at substantially constant temperature. Among other features, my invention precludes the possibility of the gas being admitted to the burner until the igniting means will properly ignite the fuel gas. Another purpose of my invention is to provide such a thermostatic control which is simple yet positive in its operation, which will not easily get out of adjustment, and which is not materially affected by external conditions.

The other several features and advantages of my invention can best be understood as they are pointed out and discussed in the following specification of a preferred embodiment of my invention, as illustrated by the accompanying drawings, wherein—

Figure 1 is a diagrammatic vertical section of the heater unit embodying my invention;

Figure 2 is a plan view of the gas burner therefor;

Figure 3 is a side elevation of the control apparatus, the cover of the housing being removed and certain of the parts therein being shown in section;

Figure 4 is a plan section taken on the line 4—4 of Figure 3;

Figure 5 is a circuit diagram.

The heater unit shown in Figure 1 comprises an insulated tank 10, the shell of which extends below the bottom wall 11 of the tank to form a jacket 12 about the gas burner 13 and the spiral heating coils 14, upon which the flame of the gas burner is directed.

The tank is fed through a cold water pipe 15 entering at the bottom thereof, while hot water is withdrawn from the tank by means of a discharge pipe 16 communicating with the upper end of the tank. The heater coil 14 is adapted to take water from adjacent the bottom of the tank and discharge it from the other end of the coil adjacent the top of the tank by the well-known thermogravity action. The burner 13 is supplied with gas through a gas feed pipe 17 controlled by the valve 18 within the control housing 19. The

inlet port of the valve 18 is connected by the pipe 20 to the city gas main or other suitable gas supply.

The means for opening the valve 18 to admit gas to the burner and thus heat the water in the tank to its predetermined temperature comprises in general a stem 21, which is lifted through a lost motion link 22 by the free end of a lifting lever 23 which extends horizontally near the top of the housing 19 from a stationary pivot 24 on the housing. The lever 23 is raised by the expansion of a metallic tube 25 within the heat motor 26 when an electric current is allowed to pass through the filament winding of the heat motor.

It is desirable that, although the lifting lever 23 moves very gradually, the valve 18 be either fully opened or closed in order that the flame of the burner may always be at its maximum while the water is being heated. To accomplish this, I provide means whereby the stem 21 of the valve does not directly lift the valve closure 27 from the seat 28, but acts through a relatively weak spring 29 interposed between a head 30 at the lower end of the valve stem and an internal shoulder 31 in a vertical boss of the closure 27. I prefer annularly to space the spring 29 from the valve closing spring 32, which is concentric therewith, by means of a sleeve 33. The strength of the spring 29 is such that until it is considerably compressed, the positive pressure of the gas in the pipe 20 exerted on the area of the closure 27 is sufficient to hold the closure against the valve seat 28. However, after the head 30 has been moved upwardly a considerable distance by the lifting lever 23, the pressure of the spring 29 will overcome the pressure of the gas on the closure and allow the pressure to build up on the low pressure side of the valve adjacent the feed pipe 17, whereupon the pressure of the gas on the closure 27 is substantially equalized on both sides and the spring 29 will then cause the valve to become fully opened with a snap. The distance through which the valve opens is controllable by means of the nut 34 on the upper end of the stem 21 to vary the point at which the nut 34 will be caught by the offset end of the lost motion link 22.

As previously stated, the heat motor 26 comprises an expansion tube 25 for operat-

ing the lifting lever 23. The upper end of this tube is provided with a knife-edged cap 35 which co-operates with a groove very near the pivot 24 of the lifting lever, whereby the free end of the latter at its connection with the link 22 is given a very big swing by a small expansion of the heat motor. The lower end of the expansion tube 25 is similarly provided with a cap 36 for the reception of an adjusting screw 37 threaded in the housing 19. The expansion tube 25 is surrounded by a sleeve 38 provided with peripheral spiral grooves 39 for the reception of the heating resistance 40. The material of this sleeve is preferably one having the property of electrical insulation without heat insulation, such as the kilned steatite now in commercial use. An asbestos or other heat insulating wrapping 41 is preferably placed around the heat motor to protect the nearby parts of the apparatus as well as to increase the efficiency of the heating resistance.

As also shown in Figure 5, electric current is supplied to the resistance 40 of the heat motor from the usual 110 or 220 volt feed lines, and is controlled by a relay switch 42. This switch is pivoted to the housing at 43 and is swung to its alternate positions by a controlling solenoid 44 bracketed therebeneath. The solenoid 44 is in series with the controlling circuit for the relay switch 42, which controlling circuit derives its current from the low voltage windings of a transformer 45 and includes a filament 46 mounted on the burner 13 (Fig. 1) as well as a second mercury contact switch 47 for making and breaking the control circuit. The frame of the switch 47 is pivoted to the housing at 48, and is raised to its open circuit position by the contacting of a projection 49 at the free end of the lifting lever 23 with a contact pin 50 on the frame of the switch.

In the position shown in the drawings, the controlling circuit is closed and the solenoid drawn up to close the heat motor switch 42. As the heat motor raises the lifting lever 23 to open the valve, the projection 49 approaches the contact pin 50 in such a relation that shortly after the valve has been opened, the mercury contact switch 47 of the control circuit will have been tilted to its open position, allowing the solenoid 44 to drop and in turn open the relay switch 42, whereupon the heat motor gradually cools off. Because the heat motor imparts a timed movement to the lifting lever 23, there is a substantial time interval between the opening of the valve and the opening of the switch 47 which insures that the filament will be held at its igniting temperature long enough for a proper igniting of the gas even under rather adverse conditions.

It is to be observed that, in order for the solenoid 44 to be actuated, a current must pass through the low voltage circuit, and

that inasmuch as the igniter filament 46 is in series with that circuit, the solenoid cannot be actuated unless the filament is heated. The igniting of the gas at the burner is made certain by so proportioning the solenoid and its windings and the filament 46 that the armature of the solenoid will not be drawn up until current of sufficient amperage and voltage is passed through the filament to bring it to an igniting temperature. Shortly after the heat motor has opened the valve, however, the low voltage circuit is opened with the result that not only the heat motor is allowed to cool off and return the lifting lever to its normal position, but the filament is allowed to cool off to save it from undue deterioration and also to save current.

I have found it desirable to employ a low voltage for the filament 46, inasmuch as the filament is subjected to great heat and other deteriorating conditions which would make the comparatively fragile filament for a high voltage short lived. It is advantageous, however, to retain the high voltage for the heat motor because of the increased rapidity with which the metal tube 25 will be expanded. I contemplate that in the circuit shown, there will be but a negligible current consumption on the high voltage side of the transformer while the low voltage circuit is opened.

Since the heat motor circuit is opened, once the valve is fully opened, it is necessary to hold the valve open until such time as the water in the tank rises to the desired temperature. This is accomplished by means of a catch or pawl 51 pivoted at its lower end about a stationary pin 52, while the upper end under the influence of a tension spring 53 is caught beneath the shoulder 54' on a catch pin 54 depending from the free end of the valve lifting lever 23. By means of the catch pawl 51, the valve 18 is thus held open until such time as the thermostat arm 55 can contact the pawl to disengage the latter when the water in the tank has attained its maximum temperature, as will now be described.

The back wall of the controller housing 19 is secured to the cylindrical wall of the supply tank 10 by means of an adapter 11 to which the housing is secured by a plurality of cap screws 56. Threaded into this back portion of the housing 19 is a pipe or tube 58 of brass or other metal having a comparatively high co-efficient of expansion. As shown in Figure 1, this thermostat tube 58 extends radially past the center of the tank and somewhat adjacent its lower end. The inner end of the tube 58, by means of a suitable closure 59 or any other suitable manner, is made fast to the inner end of a thermostat rod 60, which is formed of a metal having a co-efficient of expansion less than that of the metal in the tube 58—pref-

erably a non-expanding metal, such as that commercially known as Invar. If desired, a pin 61 may be used to lock the ends of the two elements securely together. The Invar bar 60 extends into the housing beyond the end of the tube 58, and is threaded at its extremity to receive a nut 62 to determine the position of a knife-edged washer 63.

This knife edge bears against a co-operating groove 64 and a thermostat lever 65 pivoted close to the washer 63 by means of a knife-edged pivot pin 66, held between vertically spaced U-brackets 67, which are cast integrally with the back wall of the housing 19. The free end of the thermostat lever 65 carries an adjustable contact screw 68 which bears against the short leg of the L-shaped thermostat arm 55, this arm being pivoted at 69 to the brackets 67, and normally urged counter-clockwise (Fig. 4) by a compression spring 55' to keep the several parts of the thermostat mechanism rigid.

When the gas valve 18 is opened, the burner 13 with the help of the heater coil 14 will bring the water in the tank 10 up to a predetermined temperature. As the water in the tank into which the thermostat is inserted becomes heated, the thermostat tube 58 will expand while the Invar rod 60 remains substantially the same length, thereby causing the knife-edged washer 63 to force the arm 65 toward the tank, swinging the thermostat arm 55 to the right (Figs. 4 and 3). When the water in the tank reaches its predetermined maximum temperature, the thermostat arm 55 will disengage the pawl 51 from the catch pin 54 on the valve lifting lever 23, allowing the valve to close under gravity and the force of the return spring 32.

The lowering of the valve lifting lever 23 by the disengagement of the pawl 51 therewith would normally result in the falling of the mercury contact switch 47 to its lower position, where the low voltage circuit would be closed and the heat motor relay switch closed to start opening the valve again. However, it is very desirable under most conditions to allow the temperature of the water in the tank to have a range of several degrees, so that the gas burner will be operated only occasionally rather than for frequent short periods. For this reason, a second catch pawl 70 is likewise pivoted on the stationary pin 52 and the tension of a spring 71 tends to throw the free end of the pawl under a notch 72 provided at the left end of the frame of the low voltage switch 47. Thus, as soon as the valve lifting lever 23 has lifted the mercury contact switch 47, by means of the contact pin 50, the pawl 70 catches beneath the frame of the switch and holds the low voltage circuit open even after the pawl 51 has been disengaged by the thermostat arm 55 to again close the gas valve. It is not un-

til the water in the tank has cooled sufficiently to swing the thermostat arm 55 to the left to the predetermined position where it disengages the pawl 70, that the switch 47 is permitted to drop to its lower position to close the low voltage circuit and actuate the relay 42 to again start the opening of the gas valve.

While I have shown this particular embodiment of my invention, it is to be understood that I do not wish to limit myself thereby, as many modifications in the apparatus and operation herein disclosed might be made without departing from the spirit and scope of my invention.

What I claim is:

1. In combination in a water heater having a gas burner with a valve, electrical means normally electrically disconnected, for opening the valve, an electrical igniter, a solenoid in series with said igniter adapted to electrically connect said means for opening the valve when the igniter is excited, and a thermostat in the heater for energizing and de-energizing the solenoid.
2. In combination with a hot water tank, a thermostatically controlled heating element therefor, a valve for said element, a support adjacent said tank, a tube secured at one end to said support, the opposite end extending into said tank, a rod having a coefficient of expansion less than said tube extending within said tube, the inner ends of said tube and said rod being secured together, an arm actuated by movement of the outer end of said bar, electric means put in operation by said arm to open said valve, means to hold said valve open independently of the position of said electric means, said arm moving to release said holding means, and means controlled by said arm to return said electric means to a normal position from which said electric means may again be put in operation by said arm to open said valve.
3. A water heater comprising a water tank, a gas burner for heating the water therein, an electric igniting coil for said burner, control apparatus for said burner, a housing for said apparatus mounted on the side of said tank, a bi-member thermostat extending into said tank from said housing, one of said members being secured to said housing and the other operating a control arm in said housing, a valve for controlling the gas supply to said burner, electric means in said housing for operating said valve, a circuit for said electric means closed by said arm at a predetermined temperature of said tank to open said valve, and means for holding the valve open after said electric means returns to a normal position from which said electric means may again be put in operation by said arm, said arm releasing said holding means at a predetermined tempera-

ture in said tank, and said electric means opening the circuit of said coil when the valve has been opened.

4. A water heater including a water tank,
 5 a gas burner for heating the water therein,
 a gas valve for said burner, and a control
 apparatus therefor mounted on a wall of the
 tank and comprising a control arm, a bi-
 member thermostat extending into the tank,
 10 one of the members being fixed to the tank
 and the other operating said arm, electric
 means for actuating the valve, said arm clos-
 ing the circuit of said electric means at a
 predetermined temperature in the tank to
 15 open the valve, and means controlled by the
 thermostat for holding the valve open after
 said electric means has opened it.

5. A water heater comprising a reservoir,
 a gas burner for heating water therefor, an
 20 electric igniting coil for said burner, a ther-
 mostat responsive to the temperature of
 water in said reservoir, an arm controlled by
 said thermostat, a valve for controlling said
 burner, an electric heat expansion motor, a
 25 lifting lever moved by said motor, the free
 end of said lever connecting with said valve,
 a circuit including said motor and said coil,
 a switch in said circuit opened by said mo-
 tor after the latter has opened said valve,
 30 catch means for holding said valve open
 after said circuit is opened, said catch means
 being released and said switch closed by said
 arm at different predetermined temperatures
 respectively of said water.

- 35 6. A hot water heater comprising a reser-

voir, a gas burner for heating water there-
 in, a thermostat responsive to the tempera-
 ture of the water in the reservoir, a gas
 valve for said burner, an electric heat ex-
 pansion motor, a pivotally mounted lifting
 40 lever engaged adjacent its pivot by said mo-
 tor and adapted to be swung thereby, the
 free end of the lever being connected with
 the stem of said valve, a circuit for said
 motor, a switch in said circuit, means con-
 45 trolled by said thermostat for closing said
 switch, said switch being opened by said
 lever after it opens said valve, and catch
 means for holding the valve open after the
 opening of said circuit, said catch means be-
 50 ing subsequently released by said thermostat.

7. A water heater comprising a fluid res-
 ervoir, a burner for heating the water in the
 reservoir, a fuel valve for the burner, an
 electric expansion motor for opening said
 55 valve, a circuit for said motor including a
 switch, means on said actuating mechanism
 for opening said circuit when the valve is
 opened, means for controlling said mecha-
 nism after the opening of said circuit, means
 60 for holding said switch open after the re-
 lease of said first mentioned holding means,
 and thermostatically controlled means for
 releasing said mechanism holding means at
 a predetermined temperature and for releas-
 65 ing said switch holding means.

In witness whereof, I hereunto subscribe
 my name this 30th day of April, 1923.

HERBERT J. SAUVAGE.