Dec. 1, 1942. R. C. NEWHOUSE 2,303,382

HEATER CONTROL

Filed Feb. 28, 1940

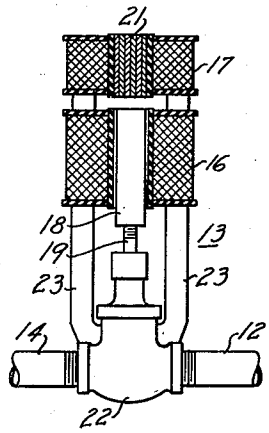


Fig. 2

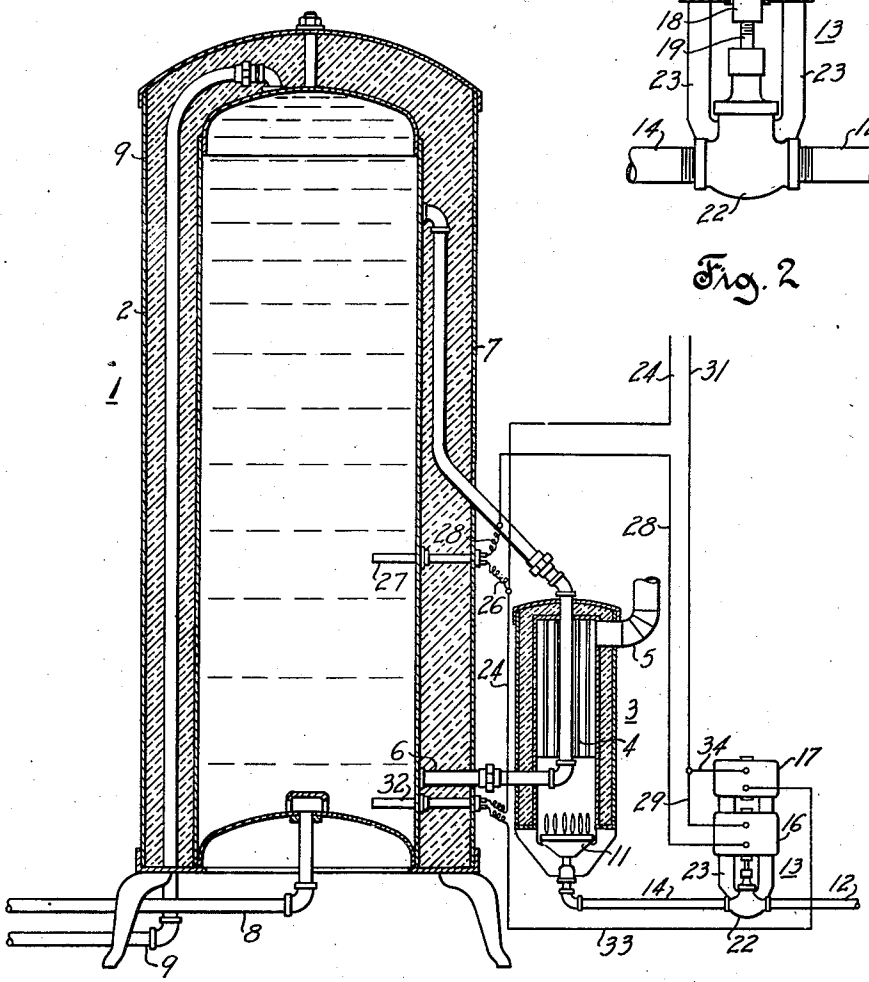


Fig. 1

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Patented Dec. 1, 1942 2,303,382

UNITED STATES PATENT OFFICE

2,303,382

HEATER CONTROL

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Application February 28, 1940, Serial No. 321,233

7 Claims. (Cl. 236—20)

This invention relates to the control of heat generating devices and more particularly to the manner of and means for controlling the fuel burning heat generating devices of hot water storage systems.

Hot water storage systems embodying a fuel burning heater generally include an automatic temperature responsive control means operable to increase the rate of heat generation whenever the temperature of the stored hot water decreases a predetermined amount. The known arrangements comprise a motor actuated fuel valve, a thermostatic device positioned to be responsive to the water temperature at a point near the bottom of the storage tank and connections rendering said device operative to effect an opening and closing movement of the valve whenever the temperature of the water at such point reaches predetermined minimum and maximum values respectively. In the usual hot water storage system the hot water withdrawn from the top portion of the storage tank is replaced by a commensurate quantity of cold water which enters the tank near the bottom thereof and contacts the said thermostatic device. Consequently, whenever a relatively small quantity of hot water is withdrawn from the tank, the thermostatic device opens the fuel valve and the rate of heat generation is increased for the short time interval necessary to heat the cold water which entered the tank to the desired temperature.

The efficiency of intermittently operated fuel burning water heaters decreases as the frequency of operation increases and as the duration of operation decreases since an increasing amount of fuel is used in reheating the burner and the other associated heater parts which dissipate heat and become cool during the non-operating intervals. Moreover, the gas or oil burners generally used in water heaters, which consist of a main burner to which the fuel supply is entirely cut off by the thermostatic device and a constantly burning pilot or an electric ignition device to ignite the fuel issuing from the main burner when the said valve is opened, invariably waste an appreciable amount of fuel during the ignition period. Furthermore, these burners seldom operate efficiently until after the walls of the mixing and combustion chambers have become thoroughly heated.

It is, therefore, an object of this invention to provide an improved method of operating fuel burning heaters.

Another object of this invention is to provide an improved heater control means.

Still another object of this invention is to provide an improved control means operable to increase the thermal efficiency of intermittently operated fuel burning heaters.

Another object of this invention is to provide an improved control means operable to decrease the frequency and to increase the duration of the intervals of operation of intermittently operated fuel burning heaters.

A further object of this invention is to provide an improved control means for hot water storage systems embodying a fuel burning heater which is operable to heat the entire contents of the storage tank, and to prevent the operation of the heater until a predetermined quantity of water has been withdrawn from the said tank.

The invention accordingly consists of the method of operation and of the various features of construction, combinations of elements and arrangements of parts as more particularly set forth in the appended claims, and in the detailed description, in which:

Fig. 1 is a schematic illustration of a hot water storage tank and fuel burning heater arrangement embodying the invention; and

Fig. 2 is an enlarged view, partly in section, of the fuel valve operator shown in Fig. 1.

Referring to Fig. 1 it is seen that the hot water storage tank 1, which includes the usual jacket 2 filled with a fabric or other suitable material, is provided with a water heater arrangement comprising the fuel burning heater 3, a heat exchanger 4 disposed within the heater 3, a flue connection 5 adapted to be connected to a chimney for withdrawing the products of combustion, and the pipes 6 and 7 which connect the interior of the tank in gravity circulatory relation with the heat exchanger 4. The tank 1, is provided with the usual cold water inlet and hot water outlet connections 8 and 9 respectively. The heater 3 is provided with a main burner 11, to which fuel is supplied through the pipe 12, the motor actuated valve 13, and the pipe 14. The usual pilot or ignition device which operates to ignite the main burner whenever the valve 13 is opened has been omitted in the interests of simplicity.

Referring to Fig. 2, it is seen that the actuating means for the valve 13 comprises a pair of axially spaced solenoids 16 and 17, and the axially movable core 18 to which is secured the stem 19 of the valve 13. The arrangement is such that when the solenoid 16 is energized, the core 18 is moved upward and into engagement with the stationary core 21 of the solenoid 17, which

movement opens the valve 13, that when the movable core 18 is contacting the stationary core 21, and the solenoid 17 energized, the core 18 will be retained in the raised position and the valve 13 held open solely by the action of the solenoid 17, and that when the solenoid 16 is de-energized and the valve 13 is in its closed position, energization of the solenoid 17 will not raise the core 18 and open the valve 13. The solenoids may be mounted on the valve casing 22 by any suitable means, such as the bracket 23.

The circuit for energizing the solenoid 16 comprises the wire 24, wire 26, the thermostatic switch 27, wire 28, wire 29 and wire 31. The wires 24 and 31 connect with a suitable source of electric power not shown. The circuit for energizing the solenoid 17 comprises wire 24, thermostatic switch 32, wire 33, wire 34 and wire 31. The thermostatic switches 27 and 32 operate to close and open the circuits in which they are included whenever the temperature of the heater water in the immediate vicinity of the temperature responsive elements of the said switches reaches predetermined minimum and maximum values respectively. The thermostatic switch 32 is positioned so as to be responsive to the temperature of the water at a point closely adjacent the bottom of the tank, and the thermostatic switch 27 is positioned so as to be responsive to the temperature of the water at a predetermined point an appreciable distance above the thermostatic switch 32. In this connection it is preferable that the thermostatic switch 27 be so positioned that a predetermined and substantial portion of the contents of the storage tank must be at a temperature less than a predetermined value before the switch 27 closes. The shown position of the thermostatic switch 27 which permits the withdrawal of approximately one-third of the contents of the storage tank before the burner is operated to increase the rate of heat generation, will be found satisfactory for most installations.

The operation of the previously described system, assuming that the storage tank is completely filled with heated liquid at the desired temperature, is as follows: Under the assumed conditions, the thermostatic switches 27 and 32 are both open, and the fuel valve 13 is either closed or partially closed, but, as soon as a relatively small quantity of heated liquid is withdrawn from the tank, the incoming unheated liquid will cause the thermostatic switch 32 to close, which energizes solenoid 17. However, energization of solenoid 17 does not move the valve 13 toward its fully open position for the reasons previously described, and small quantities of heated liquid can thereafter be withdrawn from time to time and without effecting an opening movement of the valve 13 and a corresponding high rate of heat generation until sufficient unheated liquid has entered the tank to reach the immediate vicinity of the thermostatic switch 27. When this occurs the switch 27 closes and energizes the solenoid 16, whereupon the valve 13 is moved toward its fully open position and the burner 11 operated to increase or initiate the rate of heat generation which operation continues until the liquid adjacent the bottom of the tank reaches a value operative to again open the switch 32. The operation of the burner 11 for a relatively short period is sufficient, unless heated liquid has been withdrawn in the meantime, to open the switch 27, but the opening of this switch will not decrease or terminate the rate of heat generation since the valve 13 is held open by solenoid 17 which remains energized until the switch 32 opens. Opening of the switch 32 decreases or terminates the generation of heat by the burner 11 which again remains in this inoperative condition until the unheated liquid in the tank reaches the immediate vicinity of the thermostatic switch 27.

Consequently, it is seen that unless relatively large quantities of heated liquid are withdrawn at any one time, the heater only operates at infrequent intervals, and that the duration of heater operation is materially increased with respect to the prior art arrangements, which has resulted in an appreciable increase in the thermal efficiency of heated liquid storage systems embodying a fuel burning heater arrangement. The terms "heated" and "unheated" as herein used are intended to mean that the temperature of the medium or substance to which the terms are applied is above and below a predetermined value respectively. The invention is applicable to the control of fuel burning heaters generally and although the invention has been disclosed as applied to a hot water storage system, and as embodying an electrical control system, it should be understood that the disclosed heating and control systems are merely illustrative, and that it is not desired to limit the invention to the exact construction and operation herein shown and described as various modifications within the scope of the appended claims may occur to persons skilled in the art.

It is desired to claim and secure by Letters Patent:

1. A liquid heating arrangement comprising a heated liquid storage tank having connections for withdrawing heated liquid and for admitting liquid to be heated, a fuel burning liquid heater, a first temperature responsive device operatively associated with said tank at a point near the bottom thereof, a second temperature responsive device operatively associated with said tank at a point a substantial distance above said first device, a regulative device controlling the fuel supply to said heater and including a first means operative when actuated to move said regulative device toward its maximum fuel supplying position and a second means operative when actuated to retain said regulative device in the position to which it is moved by said first means, means connecting said first device and said second means so that the said second means is actuated only when the temperature of the liquid in proximity to said first device is at less than a predetermined value, and means connecting said second device and said first means so that the said first means is actuated only when the temperature of the liquid in proximity to said second device is at less than a predetermined value.

2. A liquid heating arrangement comprising a heated liquid storage tank having connections for withdrawing heated liquid and for admitting liquid to be heated, a fuel burning liquid heater, a first temperature responsive device operatively associated with said tank at a point near the bottom thereof, a second temperature responsive device operatively associated with said tank at a point a substantial distance above said first device, a regulator controlling the supply of fuel to said heater, and means for rendering said second device operative whenever the liquid in proximity thereto is at less than a predetermined temperature and independently of said first device to cause said regulator to be moved toward its maximum fuel supplying position, said first

device being operative whenever the liquid in proximity thereto is at less than a predetermined temperature to cause said regulator to be retained in the fuel supplying position to which it has been moved by the operation of said second device.

3. A liquid heating arrangement comprising a heated liquid storage tank having connections for withdrawing heated liquid and for admitting liquid to be heated, a fuel burning liquid heater, a first temperature responsive device operatively associated with said tank at a point near the bottom thereof, a second temperature responsive device operatively associated with said tank at a point which is a substantial distance below the top thereof and which is a substantial distance above said first device, a regulator controlling the supply of fuel to said heater, and connections rendering said second device operative whenever the liquid in proximity thereto is at less than a predetermined temperature and independently of said first device to cause said regulator to be moved toward its maximum fuel supplying position, and said first device being operative whenever the liquid in proximity thereto is at less than a predetermined temperature to cause said regulator to be retained in the fuel supplying position to which it has been moved by the operation of said second device.

4. A liquid heating arrangement comprising a heated liquid storage tank having connections for withdrawing heated liquid and for admitting liquid to be heated, a fuel burning liquid heater, a first temperature responsive device operatively associated with said tank at a point near the bottom thereof, a second temperature responsive device operatively associated with said tank at a point a substantial distance above said first device, a regulator controlling the supply of fuel to said heater, and connections rendering said second device operative whenever the liquid in proximity thereto is at less than a predetermined temperature and independently of said first device to cause said regulator to be moved toward its maximum fuel supplying position, said first device being operative whenever the liqiud in proximity thereto is at less than a predetermined temperature to cause said regulator to be retained in the fuel supplying position to which it has been moved by the operation of said second device.

5. A liquid heating arrangement comprising a heated liquid storage tank having connections for withdrawing heated liquid and for admitting liquid to be heated, a fuel burning liquid heater, a first temperature responsive switch actuating device operatively associated with said tank at a point near the bottom thereof, a second temperature responsive switch actuating device operatively associated with said tank at a point a substantial distance above said first device, a regulator controlling the supply of fuel to said heater, and electrical connections rendering said second device operative whenever the liquid in proximity thereto is at less than a predetermined temperature and independently of said first device to cause said regulator to be moved toward its maximum fuel supplying position, and said first device being operative whenever the liquid in proximity thereto is at less than a predetermined temperature to cause said regulator to be retained in the fuel supplying position to which it has been moved by the operation of said second device.

6. A liquid heating arrangement comprising a heated liquid storage tank having connections for withdrawing heated liquid and for admitting liquid to be heated, a fuel burning liquid heater, a first temperature responsive switch actuating device operatively associated with said tank at a point near the bottom thereof, a second temperature responsive switch actuating device operatively associated with said tank at a point which is a substantial distance below the top thereof and which is a substantial distance above said first device, a regulator controlling the supply of fuel to said heater, and electrical connections rendering said second device operative whenever the liquid in proximity thereto is at less than a predetermined temperature and independently of said first device to cause said regulator to be moved toward its maximum fuel supplying position, and said first device being operative whenever the liquid in proximity thereto is at less than a predetermined temperature to cause said regulator to be retained in the fuel supplying position to which it has been moved by the operation of said second device.

7. A liquid heating arrangement comprising a heated liquid storage tank having connections for withdrawing heated liquid and for admitting liquid to be heated, a fuel burning liquid heater, a, first temperature responsive device operatively associated with said tank at a point near the bottom thereof, a second temperature responsive device operatively associated with said tank at a point a substantial distance above said first device, a regulator controlling the supply of fuel to said heater, a first means operative to move said regulator toward its maximum fuel supplying position, a second means operative to retain said regulator in the position to which it is moved by said first means, means connecting said first device and said second means so as to render said second means operative only when the liquid is proximity to said first device is at less than a predetermined temperature, and means connecting said second device and said first means so as to render said first means operative only when the liquid in proximity to said second device is at less than a predetermined temperature.

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