

Feb. 13, 1940.

R. E. MOORE

2,190,382

HEATING SYSTEM

Filed July 9, 1937

3 Sheets-Sheet 1

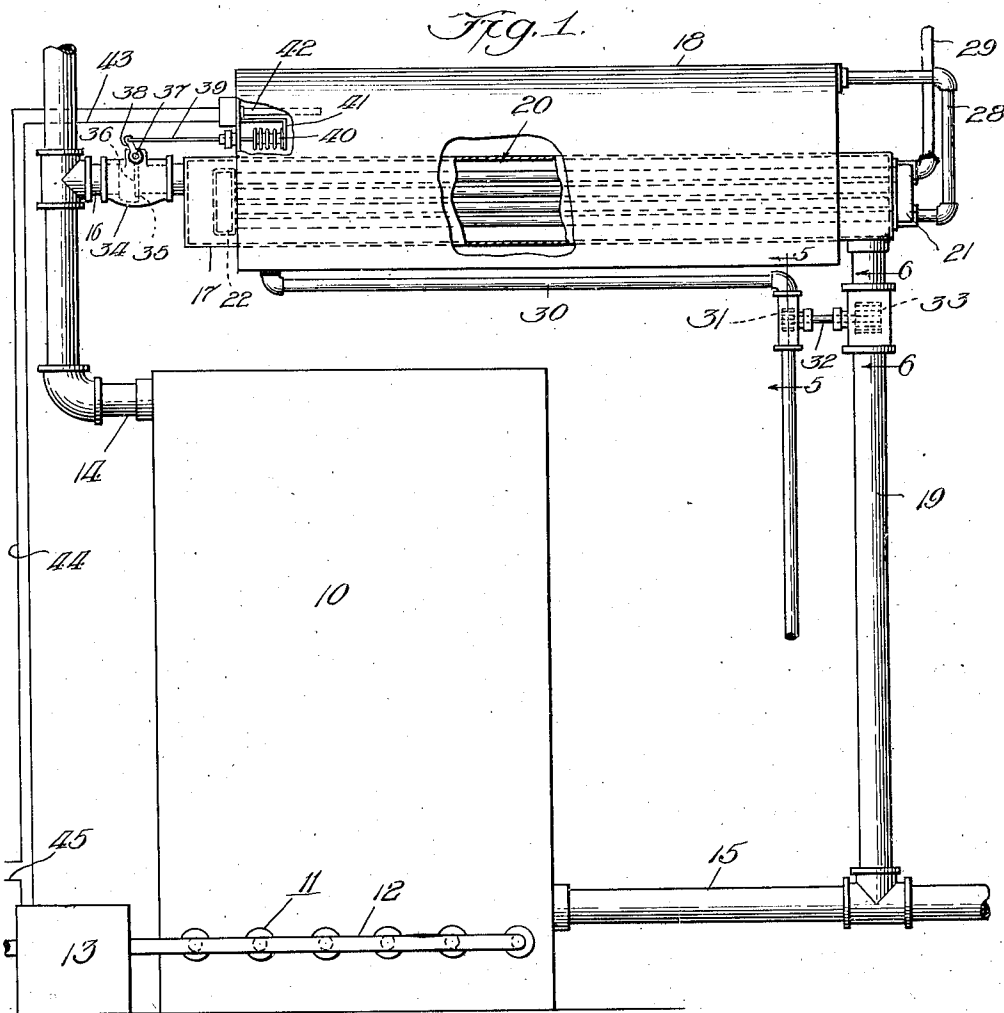
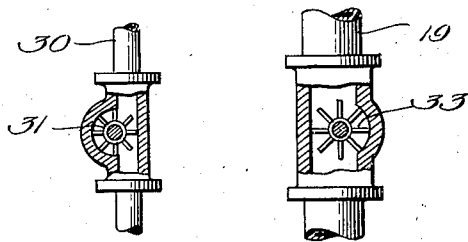


Fig. 5 Fig. 6.



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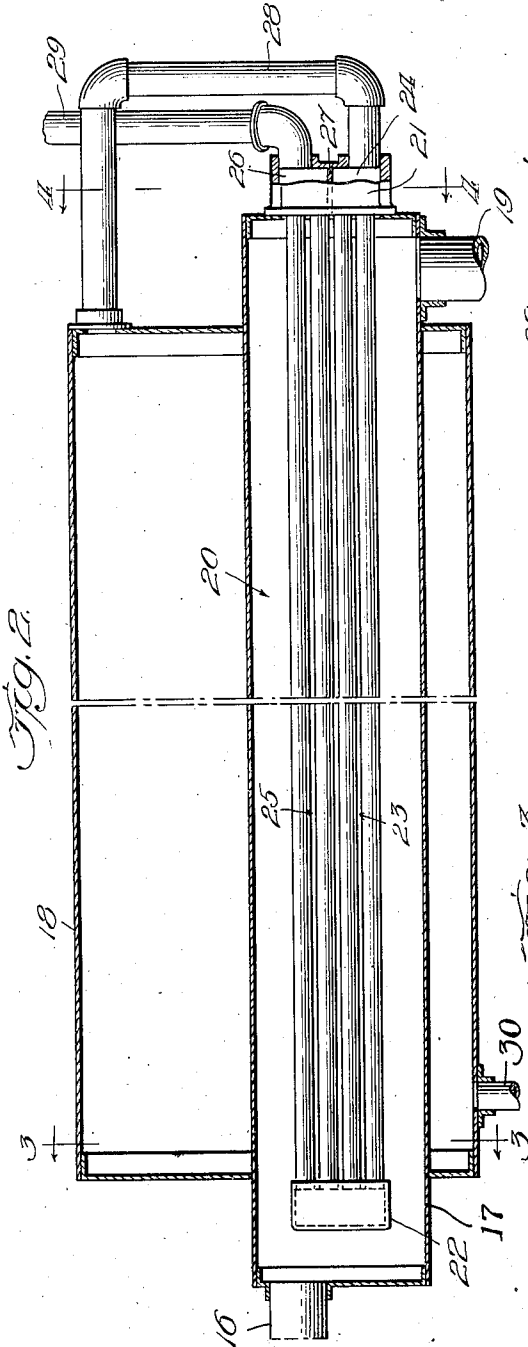
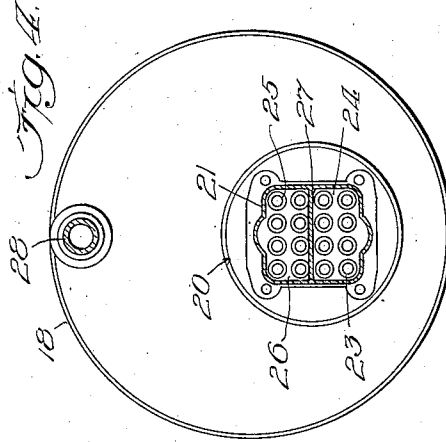
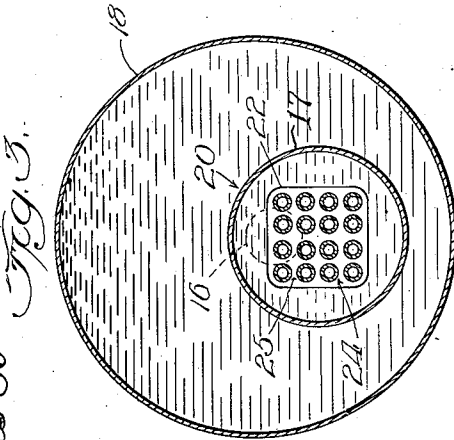
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3 Sheets-Sheet 2.



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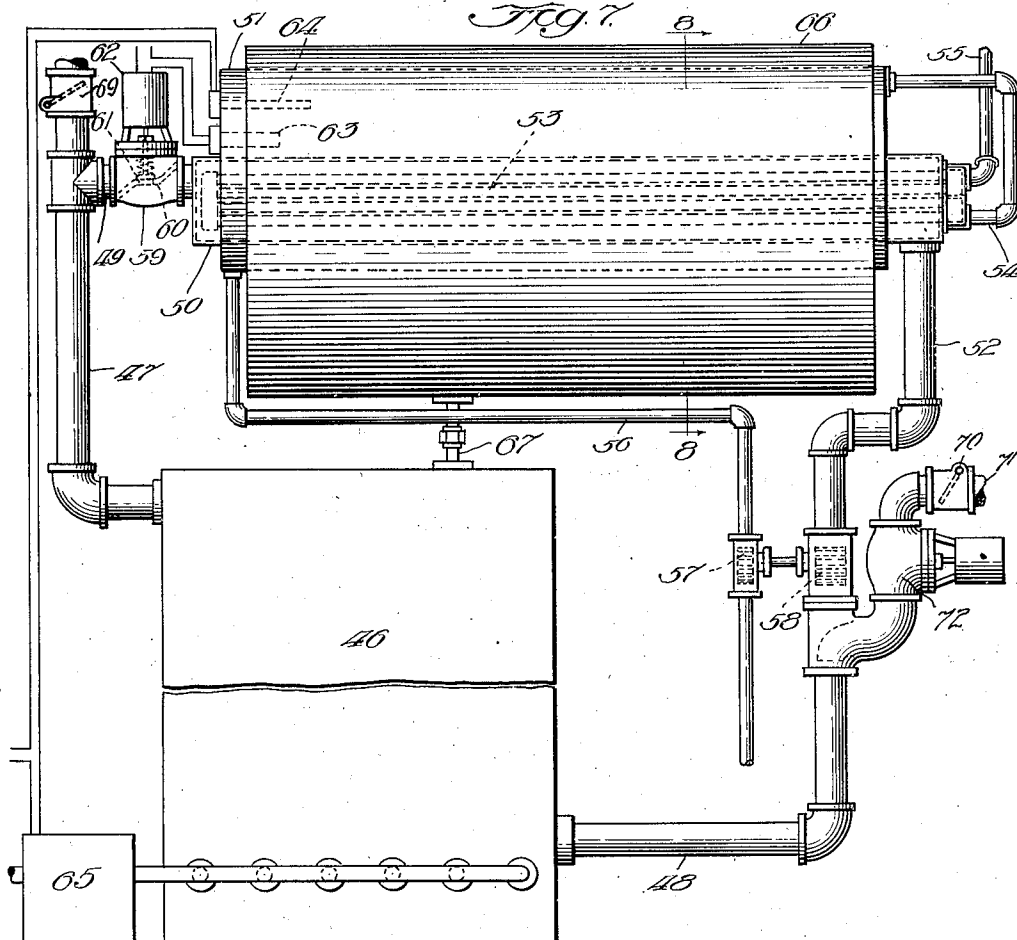
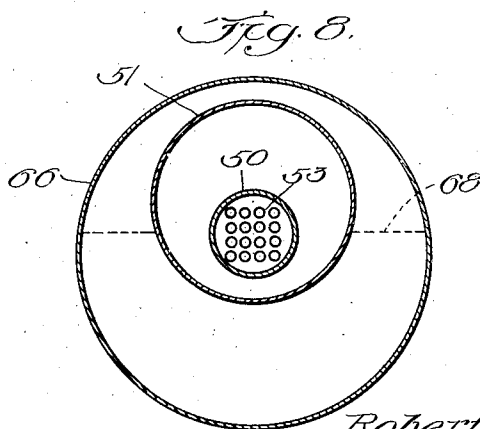
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HEATING SYSTEM

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,190,382

HEATING SYSTEM

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Application July 9, 1937, Serial No. 152,696

18 Claims. (Cl. 237—19)

My invention relates to heating systems and more particularly to a system provided with a so-called instantaneous heater for heating service water.

Instantaneous heaters are frequently submerged directly in the boiler water and, where the boiler is automatically and periodically fired with gas or oil, the reduction in temperature of the boiler water during the time that the burner is out of operation not only reduces the temperature of the water at the service fixtures below a desirable point, but also produces a lag in the system in that the temperature of the service water is not raised until the boiler water is again heated by the burner resuming operation.

This condition is especially true with boilers that are built for gas firing, since such boilers are designed with large heating surfaces and relatively small water capacity. Accordingly, such boilers cool rapidly when the burner stops due to the sweep of cold air across the heating surfaces in its passage to the chimney and the temperature of the service water likewise falls.

It is, therefore, one object of my invention to provide a heating system in which the instantaneous heater is separate from and elevated relative to the boiler so that it is unaffected by a reduction in temperature of the boiler water.

A further object is to provide elasticity in such a system by associating with the heater a storage reservoir which is available during inactive periods of the burner and until the boiler has reached operating temperature to furnish hot water for the service fixtures, and which is arranged to preheat the service water before entering the heater.

A further object is to prevent overheating and possible liming of the heater tubes by interrupting the flow of boiler water across the tubes when the water in the preheating tank attains a predetermined temperature.

A further object is to provide an instantaneous heater in which a forced circulation of the boiler water is established across the tubes of the heater whenever a service fixture is opened.

A further object is to provide a heating unit for a heating system having a capacity for storing and instantaneously heating service water and associated therewith an air cushion tank which allows for expansion of water in the system and reduces radiation losses from the unit.

These and further objects of my invention will be set forth in the following specification, reference being had to the accompanying drawings, and the novel means by which said objects are

effected will be definitely pointed out in the claims.

In the drawings:

Figure 1 is an elevation, partly in section, of a hot water heating system provided with my improved, instantaneous water heater.

Fig. 2 is an enlarged, sectional elevation of the heater, as viewed in Fig. 1.

Figs. 3 and 4 are sections along the lines 3—3 and 4—4 in Fig. 2, looking in the direction of the arrows, and showing certain details of the heater construction.

Figs. 5 and 6 are sections along the lines 5—5 and 6—6 in Fig. 1, looking in the direction of the arrows, and showing the impellers which set up a forced circulation of the boiler water across the heater tubes.

Fig. 7 is a view similar to Fig. 1, but showing the storage and preheating tank surrounded by an air tank which accommodates the expansion of water in the system.

Fig. 8 is a section along the line 8—8 in Fig. 7, looking in the direction of the arrows.

By way of example, my improved heater is illustrated in connection with a hot water heating system employing a gas fired boiler, but it will be understood that the system is not restricted to this particular type of boiler which may be of the oil or coal fired type and the latter may be either hand or stoker fired.

Referring more particularly to Figs. 1 and 4, inclusive, the numeral 10 designates a gas fired boiler having the usual burners 11 which are supplied with gas through a pipe 12 that is connected to a control device designated generally by the numeral 13. This control device is intended to diagrammatically indicate the ordinary structure employed in connection with gas fired boilers for regulating the pressure and flow of gas to the burners, as well as to stop and start such burners in response to the activity of remote thermostatic elements in the customary manner.

The boiler 10 is connected by a supply pipe 14 and a return pipe 15 to any desired heating system (not shown) which may be composed of the usual radiators or similar devices. A pipe 16 is connected at one end to the supply pipe 14 and at its opposite end to one end of a conduit 17 which is supported by and extends through the opposite ends of a combination preheating and storage tank 18. The opposite end of the conduit 17 is connected by a pipe 19 to the return pipe 15, thereby providing for a local circulation of water at substantially boiler temperature suc-

cessively through the supply pipe 14, pipe 16, conduit 17, pipe 19 and return pipe 15.

A water heater 20 is positioned within the conduit 17 and extends for substantially the full length thereof. This heater is supported in the right end of the conduit 17, as viewed in Figs. 1 and 2, and it comprises a plurality of tubes whose ends are supported in headers 21 and 22. The heater tubes are arranged in a lower tube bank 23 and the inlet ends of the tubes comprising this bank are in communication with a lower chamber 24 provided in the header 21, while the opposite ends of the indicated tubes terminate in the header 22 which is common to all tubes of the heater, including the inlet ends of an upper bank of tubes 25 whose outlets terminate in an upper chamber 26 also provided in the header 21 and separated from the lower chamber 24 by a dividing wall 27. The chamber 24 communicates by a pipe 28 with the upper portion of the tank 18, while the chamber 26 is connected by a delivery pipe 29 to any desired number of service fixtures. Cold water is introduced into the tank 18 through a pipe 30 which is properly connected to the under side of the tank 18 and adjacent the end thereof opposite to that end to which the pipe 28 is connected so as to insure a movement of the entering cold water along the full length of the tank 18 and hence into contact with the hotter surfaces of the conduit 17 before the water passes through the pipe 28 to the heater 20.

The cold water supply pipe 30 is connected to any desired source of supply, such as city mains and the like, it being understood that this cold water source is always subjected to an adequate pressure head. Included in the pipe 30 is an impeller 31 which is connected by a shaft 32 to a similar impeller 33 mounted in the pipe 19 for a purpose presently explained.

A valve body 34 is located in the pipe 16 and it includes a valve seat 35 which is engaged by a flap valve 36 for the purpose of interrupting flow of boiler water through the conduit 17 under conditions hereinafter described. The valve 36 is pivotally mounted on a pin 37 which extends without the valve body 34 and has attached thereto a rock arm 38. The free end of this arm is connected by a link 39 which is slidably mounted in and extends through the adjacent end of the tank 18 for attachment to a thermostatic device generally which is responsive to the temperature of the water in the tank 18. In the present instance, this device is indicated as taking the form of a Siphon bellows 40 which abuts against a bracket 41 that is secured to the interior of the tank 18. This bellows is filled with a suitable liquid which expands under the influence of heat and so effects a lengthwise extension of the bellows 40 for moving the valve 36 to the closed position illustrated in Fig. 1. When the temperature of the water in the tank 18 falls below a predetermined point, the bellows 40 retracts in the well-known manner to open the valve 36. As a substitute for this arrangement, the valve 36 may be electrically operated under the control of an aquastat that is submerged in the tank 18, as generally indicated in Fig. 7.

An aquastat 42 is also submerged in the tank 18 and, externally of the tank, it is electrically connected by a wire 43 to the control device 13 and also by a wire 44 to a source of electrical energy. A wire 45 also connects the control device 13 to the same source.

The operation of my improved system will now

be described. If it be considered that the system is started from a cold condition, then the aquastat 42 will be closed, thus placing the burners 11 in operation. The water in the boiler 10 is gradually heated and establishes a flow of hot water through the supply and return pipes 14 and 15 to the principal heating system of the building and there is also established a flow of water substantially at boiler temperature through the conduit 17. This water flow through the conduit not only heats the water in the tubes of the water heater 20 but also serves to preheat the water in the tank 18 due to the submerged relation of that portion of the conduit which extends through the tank to the water therein. It will be understood that, under the conditions indicated, the bellows 40 will be slightly collapsed from the position noted in Fig. 1, so that the valve 36 occupies an open position.

Each time that a service fixture is opened, a flow of water takes place through the supply pipe 30, tank 18, pipe 28, water heater 20 and delivery pipe 29 to the service fixture in question. During this water flow, the pressure on the supply pipe 30 rotates the impeller 31 which in turn rotates the impeller 33 and so establishes a gentle, forced circulation of boiler water through the conduit 17 and thence downwardly through the pipe 19 for return to the boiler. It will be understood that the relation of the impeller 33 to the pipe 19 is such that it does not prevent thermogravitational flow of water there-through when the impeller 31 is not operating.

It is important in many localities to prevent overheating of the water in the heater 20, because otherwise deposits of lime are formed in the tubes of the heater and in the pipes leading from the heater to the service fixtures. These deposits not only reduce the extent of the water flow, but, in the case of the heater, also seriously interfere with the desired exchange of heat. Accordingly, one of the principal features of my invention resides in associating with the heater devices for preventing such overheating and these devices are represented by the bellows 40 and also by the aquastat 42.

The bellows 40 may be adjusted to move the valve to the closed position shown at any desired temperature of the water in the tank 18 and the aquastat 42 may be similarly adjusted to provide for stopping the burners at any desired temperature of the water in the tank. In the present instance, it will be assumed that both of the indicated thermostatic devices are adjusted for a temperature of 140° Fahrenheit. When the temperature of the water in the tank 18 attains this point, the valve 36 will be moved to the closed position, thus interrupting all flow through the conduit 17, and, at the same temperature of the water in the tank, the burners will be cut out of operation.

During the time that the burners 11 are not operating, it is immaterial that the water in the boiler cools rapidly, because this reduction in temperature does not affect the temperature of the water in the conduit 17. The tank 18 is located at a higher elevation than the boiler 10, and, since under the conditions assumed, the water in the boiler 10 will be colder than the water in the conduit 17, no thermogravitational, one-pipe flow of the water can take place through the pipe 19. Hence, there is always available for use at the service fixtures an adequate supply of hot water, particularly during the time directly after the burners 11 resume operation. During

the indicated interval, it is unnecessary to await the rise in temperature of the water in the boiler 10, since the water in the conduit and the preheated water in the tank 18 definitely avoid the so-called lag which has heretofore been present in systems of a comparable nature. In other words, the reserve capacity of the tank 18 provides elasticity in the system, as far as a supply of hot water for service purposes is concerned. Moreover, the provision of submerging the conduit 17 within the tank 18 not only insures an economical use of the available heat by a preheating of the cold water before it reaches the tubes of the heater 20, but, due to the fact that the preheated water in the tank 18 surrounds the conduit 17, the water in the conduit is to some extent insulated, so that loss of heat from the water therein is materially decreased. Preferably, the conduit 17 is located closer to the bottom than to the top of the tank 18, as indicated in Fig. 3, to insure a thermogravitational circulation in the tank and consequently a thorough preheating of the water when a service fixture is not demanding water.

When the temperature of the water in the tank 18 falls below 140° Fahrenheit, the valve 36 will be opened to permit a resumption of boiler water flow through the conduit 17 and the burners 11 will again be placed in operation.

It will be understood that other temperature settings for the bellows 40 and aquastat 42 than that indicated may be made and also that other types of heater constructions than the particular tubular arrangement shown in Fig. 2 may be adopted for the water heater 20.

Referring to Figs. 7 and 8, there is illustrated a modification of my improved system which is identical in all important respects with that heretofore described, except that there is associated with the preheating and storage tank an air cushion tank for accommodating the expansion of water in the system.

As with the system above described, the present system comprises a boiler 46 which, for purpose of example, is of the gas fired type, and to which are connected supply and return lines 47 and 48, which lead to and from the usual radiators (not shown). An intermediate pipe 49 connects the supply line 47 with one end of a conduit 50 which, as before, is supported by and extends through the opposite ends of a combination preheating and storage tank 51. The opposite end of the conduit 50 is connected by a pipe 52 to the return line 48.

The water heater 53, which may possess the same construction as the water heater 20, is located within the conduit 50 in the same relation thereto as the heater 20 is to the conduit 17. The inlet end of the heater 53 is connected by a pipe 54 with the upper portion of the tank 51, while the delivery end of the heater is connected by a pipe 55 to any desired number of service fixtures. Cold water is introduced into the tank 51 by means of a pipe 56 and, as in the system heretofore described, the connection of the pipe 53 to the tank 51 is at a point adjacent the inlet end of the conduit 50. The cold water supply pipe 56 may be connected to any desired source of supply under an adequate pressure and there is mounted in this pipe an impeller 57 which is interconnected with a similar impeller 58 located in the pipe 52 for the same purpose as heretofore described.

A valve body 59 is located in the pipe 49 and it includes a valve seat 60 that is engaged by a valve 61 having a stem which extends outwardly

of the valve body for suitable connection to an actuating motor 62. The motor forms a part of an electrical circuit which includes a source of electrical energy (not shown) and an aquastat 63 of any approved construction which is submerged in the water in the storage tank 51. The arrangement of this electrical circuit and the component parts thereof is such that, when the temperature of the water in the tank 51 reaches a predetermined figure, the aquastat 63 will complete the circuit and cause the motor 62 to raise the valve 61 to the closed position shown in Fig. 7. Below this temperature, the circuit is broken through the motor and the valve will be moved downwardly to an open position by the spring, as shown; or any other suitable device. Motor actuated valve of this general character are common in the art so that a detailed description of the mechanism thereof is believed to be unnecessary.

A second aquastat 64 is also submerged in the water in the tank 51 and it is electrically connected to a control device 65 for the purpose of regulating the operation of the gas burners and the pressure of the fuel in accordance with standard practice.

Except for the electrically operated valve provided in the pipe 49, the heating system just described is identical with that illustrated in Fig. 1.

The particular new features of the present system consist in the incorporation of the usual air cushion tank 66 which is located above the boiler 46 and is connected thereto by a pipe 67. The tank 66 encloses the storage tank 51 with the ends of the latter tank extending through the ends of the air cushion tank. Preferably, the storage tank 51 is located eccentric to the air cushion tank 66 and with its longitudinal axis lying above the corresponding axis of the tank 66. Accordingly, a large portion of the storage tank 51 will ordinarily extend above the water line 68 in the tank 66, so that the external surface of the indicated portion of the storage tank 51 is exposed within the dead air space above the water line of the air cushion tank.

This disposition of the several tanks and conduits in the system not only provides a very convenient mechanical arrangement, but it is also characterized by the very important operating advantage of insulating to a very high degree the water in the storage tank 51. This result, of course, is obtained by the jacket of dead air which partially surrounds that portion of the storage tank 51 which lies between the ends of the air cushion tank 66. This construction further insures an adequate supply of hot water at the service fixtures, notwithstanding that the boiler 46 may have been out of operation for a relatively long period.

As with the system illustrated in Fig. 1, the aquastats 63 and 64 may be adjusted for any desired temperature and, specifically, a temperature of 140° Fahrenheit. When the temperature of the water in the storage tank 51 reaches this point, the valve 61 will be moved to the closed position shown in Fig. 7, thus interrupting all flow to the conduit 50, and, at the same temperature of the water in the tank 51, the burners will be cut out of operation.

If desired, there may be incorporated in the system a flow control valve 69 in the supply line beyond its connection with the pipe 49 in the direction of flow and a similar valve 70 in the return line 71 from the radiators which may be connected to the pipe 52 below the impeller 58.

The return line 71 may also include a motor operated pump 72 that is electrically controlled by a room thermostat (not shown). These valves provide a convenient arrangement for preventing passage of hot water to the radiators during the summer months without interfering with the local circulation through the conduit 50, since they open only when the pump is operating and the thermostat can be set to prevent pump operation during this period. A similar arrangement may be provided for the system shown in Fig. 1.

I claim:

1. A heating system comprising in combination, a boiler, a conduit connected to the boiler to contain water substantially at boiler temperature, a tank in which the conduit is submerged, a water heater submerged in the conduit having its inlet connected to the tank and its outlet connected to a service fixture, a cold water supply pipe connected to the tank, and interconnected circulating means in the supply pipe and conduit responsive to the water pressure in the supply pipe when a service fixture is opened.
2. A heating system comprising in combination, a boiler, a preheating tank adapted for connection to a cold water supply, a conduit connected to the boiler to contain water substantially at boiler temperature and submerged in the tank to thermogravitationally preheat the water therein, a water heater submerged in the conduit having its inlet connected to the tank and its outlet connected to a service fixture, and an air cushion tank connected to the boiler and surrounding the preheating tank.
3. A heating system comprising in combination, a boiler, a preheating tank adapted for connection to a cold water supply, a conduit connected to the boiler to contain water substantially at boiler temperature and submerged in the tank to thermogravitationally preheat the water therein, a water heater submerged in the conduit having its inlet connected to the tank and its outlet connected to a service fixture, and an air cushion tank connected to the boiler and surrounding the preheating tank, the preheating tank being located adjacent the top of the air tank and at least partially within the dead air space above the water in the air tank.
4. A heating system comprising in combination, a boiler, a storage tank, a cold water supply pipe connected to the tank, a conduit connected to the boiler to contain water substantially at boiler temperature and submerged in heat exchanging relation to the water of the tank, a heated water delivery pipe connected to the tank and adapted for connection to a service fixture, means responsive to the flow of water through the supply pipe, and impelling means positioned to circulate water through the conduit in response to the operation of said first named means.
5. A heating system comprising in combination, a boiler, a preheating storage tank adapted for connection to a cold water supply and to a service fixture, respectively, a conduit connected to the boiler to contain water substantially at boiler temperature and submerged in the tank to thermogravitationally preheat the water therein, and an air cushion tank connected to the boiler and surrounding the preheating tank.
6. A heating system comprising in combination, a boiler, a preheating storage tank adapted for connection to a cold water supply and to a service fixture, respectively, a conduit connected to the boiler to contain water substantially at boiler temperature and submerged in the tank to thermogravitationally preheat the water therein, and an air cushion tank connected to the boiler and surrounding the preheating tank, the preheating tank being located adjacent the top of the air tank and at least partially within the dead air space above the water in the air tank.
7. A water heater comprising a tank having a water inlet, a conduit disposed in the lower part of the tank for receiving a heating medium and having a heat transferring surface in contact with the water in the tank, and a hollow member located in heat exchanging relation with the heating medium and having a discharge outlet and an inlet positioned to draw water from an upper part of the tank.
8. A water heater comprising a tank having a water inlet, a conduit for receiving a heating medium and having a heat transferring surface located to thermogravitationally heat the water in the tank, and a hollow member located in heat exchanging relation with the heating medium and having a discharge outlet and an inlet positioned to draw water from an upper part of the tank.
9. A water heater comprising a tank having a water inlet, a conduit disposed in the lower part of the tank for receiving a heating medium and having a heat transferring surface in contact with the water in the tank, and a hollow member located in heat exchanging relation with the heating medium and having a discharge outlet and an inlet positioned to draw water from an upper part of the tank, the tank inlet being disposed below the member inlet and the heat transferring surface of the conduit being contacted by water flowing from the tank inlet to the member inlet.
10. A water heater comprising a tank having a water inlet, a conduit disposed in the lower part of the tank for receiving a heating medium and having a heat transferring surface in contact with the water in the tank, and a hollow member located in heat exchanging relation with the heating medium and having a discharge outlet and an inlet positioned to draw water from an upper part of the tank, the tank and member inlets being adjacent opposite ends of the tank, respectively, with the heat transferring surface of the conduit bathed by water flowing from the tank inlet to the member inlet.
11. A water heater comprising a horizontal tank having a water inlet in its lower portion adjacent one end, a conduit extending lengthwise in the tank for receiving a heating medium and having a heat transferring surface in contact with the water in the tank, the surface being located to thermogravitationally heat the water in the tank when the water is not flowing through the tank inlet; a tubular member within the conduit in heat exchanging relation with the heating medium and having a discharge outlet, and a pipe extending from the member inlet and terminating in the preheated water zone in the upper portion of and adjacent the opposite tank end.
12. An apparatus for heating service water and accommodating the expansion of water in a hot water heating system comprising a storage tank adapted for connection to a water supply and a service outlet, a conduit adapted for connection to the boiler of the system to contain water substantially at boiler temperature and having a heat transferring surface in contact with the water in the tank, and an expansion tank adapted for connection to the system and surrounding the storage tank.

13. An apparatus for heating service water and accommodating the expansion of water in a hot water heating system comprising a storage tank adapted for connection to a water supply and a service outlet, a conduit adapted for connection to the boiler of the system to contain water substantially at boiler temperature and having a heat transferring surface in contact with the water in the tank, and an expansion tank adapted for connection to the system and surrounding the storage tank, the storage tank being located adjacent the top of the expansion tank and at least partially within the dead air space above the water in the expansion tank.

14. An apparatus for heating service water and accommodating the expansion of water in a hot water heating system comprising a storage tank having a water inlet, a conduit disposed in the lower part of the tank for receiving a heating medium and having a heat transferring surface in contact with the water in the tank, a hollow member in the conduit in heat exchanging relation with the heating medium and having a discharge outlet and an inlet positioned to draw water from an upper part of the tank, and an expansion tank adapted for connection to the system and surrounding the storage tank to thereby partially insulate the same.

15. A water heater comprising a storage tank, a cold water supply pipe connected to the tank, a conduit for receiving a heating medium and having a heat transferring surface in contact with the water in the tank, a heated water pipe connected to the tank for delivering water to a service fixture, means in the supply pipe responsive to the flow of water therethrough, and impelling means positioned to circulate water through the

conduit in response to the operation of said first-named means.

16. A water heater comprising a storage tank, a cold water supply pipe connected to the tank, a conduit for receiving a heating medium and having a heat transferring surface in contact with the water in the tank, a heated water pipe connected to the tank for delivering water to a service fixture, a shaft having its ends projecting into the supply pipe and conduit, respectively, and an impeller secured to each shaft end whereby a flow of water through the supply pipe actuates the impeller therein to effect a flow of the heated medium through the conduit by actuating the associated impeller.

17. A water heater comprising a storage tank, a cold water supply pipe connected to the tank, a conduit for receiving a heating medium and having a heat transferring surface in contact with the water in the tank, a hollow member in the conduit in heat exchanging relation with the heating medium and having a discharge outlet and an inlet positioned to draw water from an upper part of the tank, means in the supply pipe responsive to the flow of water therethrough, and impelling means positioned to circulate water through the conduit in response to the operation of said first-named means.

18. A water heater comprising a tank having a water inlet in the bottom thereof, a conduit for receiving a heating medium and having a heat transferring surface in contact with the water in the tank, and a hollow member located in heat exchanging relation with the heating medium and having a discharge outlet and an inlet positioned to draw water from an upper part of the tank.

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