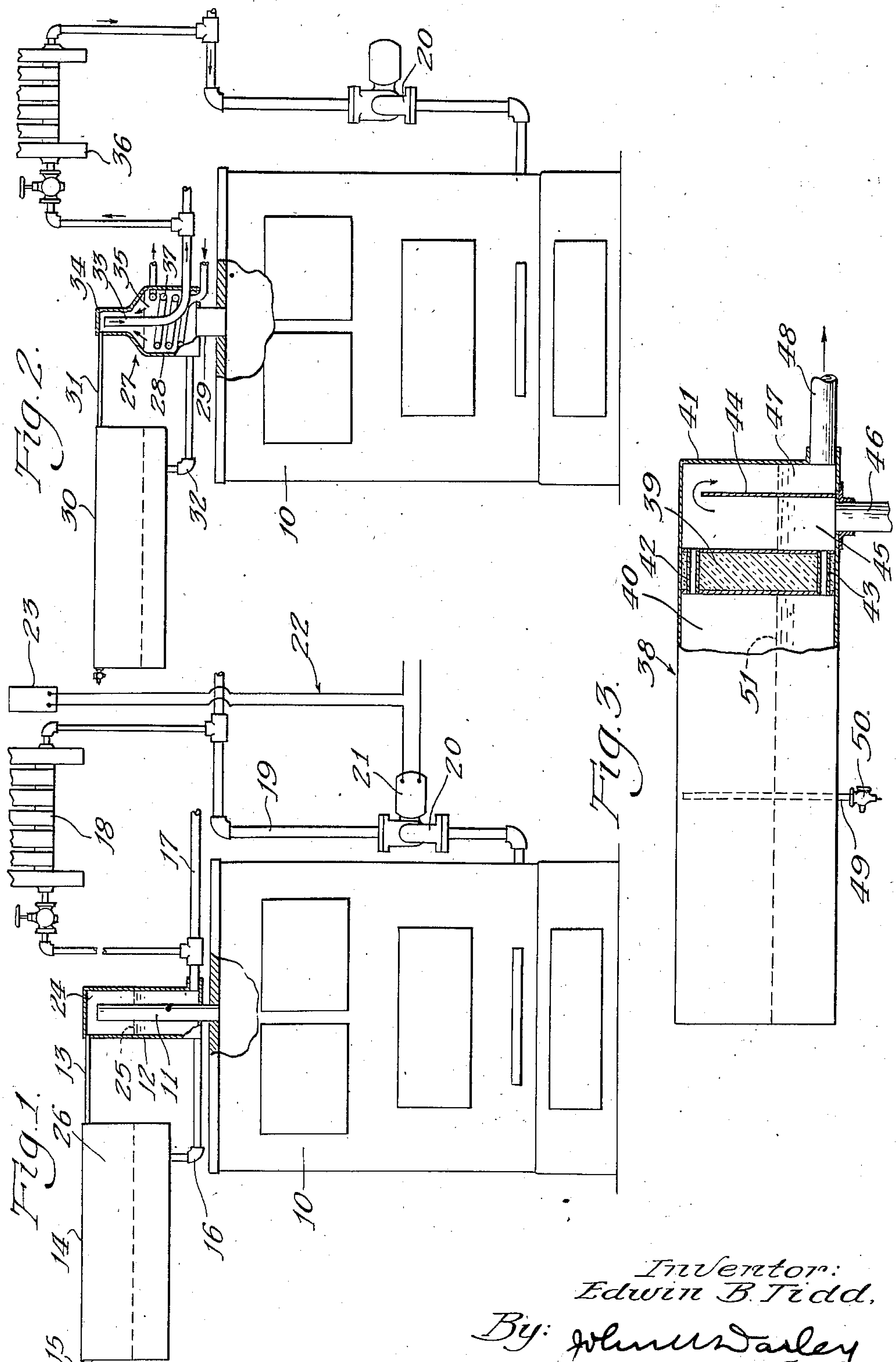
March 7, 1944. E. B. TIDD 2,343,856

HOT WATER HEATING SYSTEM

Filed May 21, 1942



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Patented Mar. 7, 1944

2,343,856

UNITED STATES PATENT OFFICE

2,343,856

HOT WATER HEATING SYSTEM

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Application May 21, 1942, Serial No. 443,902

18 Claims. (Cl. 237—19)

My invention relates to closed hot water heating systems and more particularly to those of the gravity and forced circulation type in which a valveless device is employed to control the flow of hot water to the radiators, or other heat emitting devices, and in which special provision is made for handling the air and gas in the system.

As now commonly arranged, a closed hot water heating system incorporates a circulating pump, a weighted valve for controlling flow to the radiators and an expansion tank which is connected directly to the top of the boiler or to the radiator supply line by a relatively small pipe, usually having a diameter of the order of one-half inch. The valve prevents thermo-gravitational flow to the radiators during the summer season, or at other times when heat is not wanted in the radiators, and is opened by pump pressure in response to heat demands.

In systems of the above character which are hand or stoker fired and in which the boiler water is accordingly subjected to continuous heat, the operation of the pump is controlled by a room thermostat which is responsive to the demand of the associated space for heat, or by a boiler aquastat which serves as a high limit and safety switch and closes the circuit to the pump when the temperature of the boiler water reaches a predetermined maximum. For a space heating demand, the pump produces a beneficial heating effect in the radiators, but when the pump is placed in operation by the aquastat, the excess heat of the boiler water is dissipated through the radiators so that abnormal heating of the boiler water is prevented.

An important operating objection to such a system is that in the event of pump or electric power failure, the flow control valve will not be opened and the temperature of the boiler water will begin to rise. This rise may be accelerated by the fact that the valve in the supply line confines the boiler water to a relatively small space. Moreover, the failure of the electric power may continue unnoticed for such a time that the boiler water reaches a dangerous temperature, or may begin to steam. In any event, overheating of the boiler water presents a serious operating and economic problem because where the service water is indirectly heated to a temperature in excess of 140° Fahrenheit, deposits of lime and sediment are formed rapidly in the coils or tubes of the heater in numerous localities, thus reducing the rate of heat exchange and lowering the temperature of the water available at the service outlets. This liming condition is continuously aggravated by recurrent periods of overheating.

Further, modern closed systems, whether or not equipped with flow control valves and a circulating pump and regardless of how fired, are occasionally in difficulty because of haphazard methods of handling air and gas, including that trapped when the system is first filled and that liberated from the water when heated, and the consequent air binding of some of the radiators or pipe lines. It has been customary, and largely because of this air problem, to use expansion tanks which are larger than demanded by operating requirements.

In older types of hot water heating systems with their large radiators and piping and an open expansion tank at the highest point in the system, the handling of the air did not present a problem. The pipes and radiators were vented during filling and if some portion of one or more of the radiators afterwards developed air pockets, the operation of the system was disturbed very slightly. With the advent of the closed system, however, which enabled the use of higher water temperatures and the development of an efficient, silent circulating pump which permitted the employment of smaller diameter piping, smaller radiators and the so-called convector heaters, the formation of air bubbles at different points in the system caused trouble. These bubbles may form at the top of a convector or radiator, for example, and may partially or wholly prevent these units from acting as heat emitting agents and so reduce the efficiency of the system. This blocking can occur even though the pump is operating and, in fact, I have determined that, under these conditions, the weak circulation between the boiler and tank is sufficient to carry air bubbles from the tank to the radiators.

Air blocking is primarily due to a failure to correctly evaluate certain factors now inherent in a closed system, such as the trapping of a large amount of air in the expansion tank when the system is first filled, the retention of this air in the system, and the lack of provision for the 10% or more of air and other gases by volume which are released from the water during heating. I have ascertained that this liberated air will not move upwardly through the water in the expansion tank, even when the pump is running, but, on the contrary, will pass to the radiators, particularly those closest to the boiler, where it must be vented.

In view of the foregoing, it is one object of my invention to devise a valveless flow control for a hot water heating system having a circulating pump which prevents flow to the radiators over an operating range of boiler water temperature when the pump is not working, but provides for flow when the pump is operating.

A further object is to provide a flow control of the character indicated which is constructed and arranged to automatically prevent overheating of the boiler water by permitting flow to the radiators when the pump is not operating, thereby avoiding any necessity for a high limit, boiler aquastat and its connection to the pump.

A further object is to devise a flow control as above in which provision is made for an easy and certain separation of the liberated air from the water and its collection in a closed tank to establish the desired expansion factor.

A further object is the incorporation in a valveless flow control having a water space always filled with water substantially at boiler temperature of means located in the water space for indirectly heating service water.

A further object is to provide a closed hot water heating system of the forced circulation type having a valveless flow control in which the parts are arranged to insure that, after the system is conditioned for operation, all air in the system will be collected in the expansion tank.

A further object is to devise an apparatus unit for a closed hot water heating system having a circulating pump which embodies an expansion tank and a valveless flow control so related that all air liberated from the water in passing through the boiler is trapped in the control and collected in the tank.

These and further objects of my invention will be set forth in the following specification, reference being had to the accompanying drawing, and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

In the drawing:

Fig. 1 is a diagrammatic elevation, partly in section, of a hot water heating system equipped with my improved valveless control and air trapping arrangement.

Fig. 2 shows a similar system, but equipped with a modified flow control which is arranged for heating service water.

Fig. 3 is an elevation of an expansion tank, partly in section, in which is embodied a valveless flow control and air trapping structure.

Referring to Fig. 1, the numeral 10 diagrammatically represents a hot water heating boiler which may be hand or stoker fired and from the top of which extends a pipe 11 into a casing 12, the pipe terminating short of the upper end of the casing so that, under certain conditions, water may flow from the pipe into the casing. As presently described, the pipe and casing constitute the valveless flow control for the system.

The upper end of the casing 12 is connected by a pipe 13 with the upper portion of an expansion tank 14 having a manual vent 15 for relieving air from the system under certain conditions. The lower portion of the tank is connected by a pipe 16 with the lower end of the casing 12. Also connected to the lower part of the casing is one end of a pipe 17 for supplying hot water to one or more radiators 18, from which the water is recirculated to the boiler by a return pipe 19 which may include a circulating pump 20. The pump is driven by a motor 21 forming part of an electric circuit 22 that includes a thermostat 23 positioned to be affected by the radiator 18.

Instead of bridging the radiator between the supply and return pipes, the so-called one pipe system may be used without departing from the invention. In such a case, each radiator would be connected to the pipe 17 by the fitting disclosed in United States Letters Patent No. 1,663,271.

Since one phase of my invention is concerned with the elimination of unnecessary air from the system to prevent air binding and to permit the use of a smaller expansion tank, reference will first be made to the method of conditioning the system in this respect for normal operation.

The system is filled with water in the usual way and the air thus initially trapped in the radiators and any high points of the piping is vented. More importantly, the air trapped in the tank 14, as well as in the upper part of the casing 12, is vented through the valve 15, thus removing a primary cause of air pockets, so that before the boiler is fired, the system is completely filled with water and the only air in the system is that contained in the water. The boiler is then fired, preferably with the pump out of operation, for a time sufficient to insure the expulsion of air from the water in the boiler. This air will freely separate from the water and will collect in the upper parts of the casing 12 and tank 14 and is then vented through the valve 15, thus again filling the casing and tank with water.

Firing of the boiler is continued, but with the pump 20 in operation, so that as the water in the remainder of the system passes through the boiler, its contained air is expelled and trapped in the upper portion of the casing 12 to thereby form an air zone 24 above the surface of the water therein which is located below the upper end of the pipe 11 or generally as indicated by the numeral 25, and also an air zone 26 in the upper part of the tank 14 to accommodate expansion in the system. The system is now fully conditioned for operation. The air zone 24 constitutes a seal to prevent, as hereinafter described, thermogravitational flow through the system since water in the casing 12 and pipe 11, when the pump is not operatin, stands at the same level. It will be understood, however, that the operation of the flow control presently described is not dependent upon the foregoing conditioning method, but requires only a trapping of air in the casing 12, regardless of how obtained.

The elimination from the system of the initially trapped air and, preferably, of at least a portion of the air and the water permits the use of a considerably smaller expansion tank for any given system than is now common practice. Moreover, the air expulsion renders the water air absorptive and therefore conditioned, to pick up small air bubbles that may cling to the surfaces in different portions of the system. This air is freed when the water passes through the boiler and is trapped in the tank 14 and casing 12. Separation of air from the water in the pipe 11 at all times is facilitated by the connection between the water spaces of the casing 12 and tank 14 provided by the pipe 16 which is a feature of the invention. The pipe 16 permits displacement of water therethrough as air is freed in the pipe 11 and so permits the separation of air from the water with a minimum of resistance, compared to the normal arrangement in which the expansion tank is connected to the boiler or radiator supply line by a single pipe.

As indicated above, the pipe 11 and casing 12 constitute the valveless flow control for the system. During periods when the thermostat 23 is open and the pump 20 therefore not running, thermogravitational flow of hot water to the radiators is prevented by the air zone 24 unless the boiler is inadvertently overheated. With a pressure of say ten pounds in the system, the boiler water may be heated to a temperature of approximately 225° F. without setting up a gravity flow through the system. Above this temperature, however, the boiler water will surge intermittently through the pipe 11 into the casing 12 and will relieve the excess heat to the radiators. The control therefore provides an automatic means of preventing overheating of the boiler and one that does not require a high limit boiler aquastat that is connected to the pump.

When the thermostat 23 demands heat, the pressure established by the pump 20 is sufficient to force the water through the pipe 11 into the casing 12, thereby providing a forced circulation through the system. In this connection, it will be understood that the height of the pipe 11 above the water level therein is always capable of being overcome by the head of the pump.

The modification shown in Fig. 2 differs from that illustrated in Fig. 1 in that the valveless flow control 27 is arranged to heat service water. This control comprises a casing 28, corresponding to the casing 12, but directly connected to the boiler 10 by a pipe 29. As in Fig. 1, the upper and lower portions of the casing 28 are connected to the corresponding portions of an expansion tank 30 by pipes 31 and 32, respectively. The inlet end of a radiator supply pipe 33 is located within and close to the upper end of the casing 28, i. e., in the air zone 34, and passes downwardly through the water zone 35 and thence outwardly for connection to a radiator 36.

As so far described, the operation of the system is the same as that shown in Fig. 1, both as to air elimination and flow control. The distinction resides in the fact that the casing 28 is sufficiently large to include a service water heating coil 37 immersed in the water zone 35 and externally connected to a cold water supply and storage tank (not shown). The diameter of the pipe 29 is large enough to insure a local circulation between the casing 28 and boiler when the pump 20 is not working, so that the casing is always filled with water substantially at boiler water temperature. Otherwise, this system is arranged and operates in the same manner as that shown in Fig. 1.

In the systems described above, the flow control and expansion tank are separate elements, but in Fig. 3, these features have been combined in a single unit which offers certain installation and manufacturing advantages. The numeral 38 designates a container which is closed, except for certain connections presently noted. The container is internally divided by a wall 39 which may be insulated into an expansion tank 40 and a flow control 41. The upper or air zones of the tank and flow control are connected by a passage 42, while the lower or water zones are connected by a passage 43.

The flow control portion of the container is partially divided by a baffle 44 which extends upward from the bottom of the container and terminates short of the top thereof to form a chamber 45 which communicates with the upper portion of a boiler (not shown) by means of a pipe 46 and a chamber 47 whose lower portion is connected to radiators (not shown) by a supply pipe 48. The chambers 45 and 47 communicate with each other over the upper edge of the baffle 44.

For purposes already noted, elimination of air from the associated system and the unit shown in Fig. 3 is accomplished by a pipe 49 which extends upward through the bottom of the expansion tank 40 to a point close to the top thereof, i. e., in the air zone of the tank, and beneath the tank, the pipe 49 is provided with a vent valve 50.

During non-pumping periods, the water level in the tank 40 and control 41 may be generally indicated by the numeral 51. Surging due to overheating of the boiler may take place over the baffle 44, which is also surmounted during pump operation. The passages 42 and 43 insure free separation of air from the water in the chamber 45 for reasons set forth above.

It is also contemplated that my improved flow control device may be employed in a gravity flow system which may be identical with that shown in Fig. 1, except that the pump 20 is eliminated. In this case, when the boiler is fired sufficiently to raise the temperature of the boiler water above 225° F., for example, the surge of hot water through the pipe 11 will carry heat to the radiators and at lower temperatures, no hot water will flow through the pipe 11. In stoker or oil fired boilers, control may be exercised in the usual way by a room thermostat connected to the stoker or burner. The unit shown in Fig. 3 may also be used in a gravity system.

I claim:

1. In a hot water heating system having one or more radiators, the combination of a boiler, a flow control device comprising an air trap and barrier means extending into the trap for preventing thermogravitational flow through the system, and a pump for forcing the water over the barrier means and through the trap to establish a circulation through the system.

2. In a hot water heating system having a radiator and a thermostat positioned to be affected thereby, the combination of a boiler, a flow control device comprising an air trap and a wall interposed in the piping to the radiator, the wall extending into the trap for preventing thermogravitational flow through the system, and a pump responsive to the demand of the thermostat for heat for forcing the water over the wall and through the trap to establish a circulation through the system.

3. In a hot water heating system having one or more radiators, the combination of a boiler, a flow control device having air entrapping means forming a seal for preventing thermogravitational flow through the system, and a pump for forcing water through the seal to establish a circulation through the system.

4. In a hot water heating system having one or more radiators, the combination of a boiler, a flow control device comprising two separate water chambers, one communicating directly with the boiler and the other with the radiators, and air entrapping means forming a seal common to both chambers for preventing thermogravitational flow through the system, and a pump for forcing water through the seal to establish a circulation through the system.

5. In a hot water heating system having one or more radiators, the combination of a boiler, a flow control device comprising a pipe extending from the upper portion of the boiler, a casing surrounding the pipe and flow connected to the radiators, and air entrapping means forming a seal common to the pipe and casing for prevent-

ing thermogravitational flow through the system, and a pump for forcing water through the seal to establish a circulation through the system.

6. In a hot water heating system having one or more radiators, the combination of a boiler, a flow control device comprising first and second chambers, the first communicating directly with the boiler and always containing water substantially at boiler water temperature and the second with the radiators, air entrapping means forming a seal common to both chambers for preventing thermogravitational flow through the system, a pump for forcing water through the seal to establish a circulation through the system, and a heat exchanging device immersed in the first chamber for heating service water.

7. In a hot water heating system having one or more radiators, the combination of a boiler, a flow control device having air entrapping means forming a seal for preventing thermogravitational flow through the system, a pump for forcing water through the seal to establish a circulation through the system, and an expansion tank having a pipe connecting the air space thereof with the seal and a second pipe connecting the water space in the tank with the water in the system.

8. In a hot water heating system having one or more radiators, the combination of a boiler, a flow control device comprising two separate water chambers, one communicating directly with the boiler and the other with the radiators, air entrapping means forming a seal common to both chambers for preventing thermogravitational flow through the system, a pump for forcing water through the seal to establish a circulation through the system, and an expansion tank having a pipe connecting the air space thereof with the seal and a second pipe connecting the water space in the tank with the water in the system.

9. In a hot water heating system having one or more radiators, the combination of a boiler, a flow control device comprising a pipe extending from the upper portion of the boiler, a casing surrounding the pipe and flow connected to the radiators, and air entrapping means forming a seal common to the pipe and casing for preventing thermogravitational flow through the system, a pump for forcing water through the seal to establish a circulation through the system, and an expansion tank having a pipe connecting the air space thereof with the seal and a second pipe connecting the water space in the tank with the water in the system.

10. In a closed hot water heating system having a boiler, one or more radiators, and a pump for circulating water through the system, the combination of a device forming part of the supply line leading to the radiators having air entrapping means forming a seal for preventing thermogravitational flow through the system, and an expansion tank having a pipe connecting the air space thereof with the seal and a second pipe connecting the water space in the tank with the water in the system.

11. In a closed hot water heating system having a boiler, one or more radiators, and a pump for circulating water through the system, the combination of a device forming part of the supply line leading to the radiators having two separate water chambers, one communicating directly with the boiler and the other with the radiators, air entrapping means forming a seal common to both chambers for preventing thermogravitational flow through the system, and an expansion tank having a pipe connecting the air space thereof with the seal and a second pipe connecting the water space in the tank with the water in the system.

12. In a closed hot water heating system having a boiler, one or more radiators, and a pump for circulating water through the system, the combination of a device forming part of the supply line leading to the radiators having first and second chambers, the first communicating directly with the boiler and always containing water substantially at boiler water temperature and the second with the radiators, air entrapping means forming a seal common to both chambers for preventing thermogravitational flow through the system, a heat exchanging device immersed in the first chamber for heating service water, and an expansion tank having a pipe connecting the air space thereof with the seal and a second pipe connecting the water space in the tank with the water in the system.

13. In a closed hot water heating system having a boiler, one or more radiators, and a pump for circulating water through the system, a unit casing comprising an expansion chamber, a first water chamber communicating with the boiler, a second water chamber communicating with the radiators, the water chambers constituting parts of the flow path to the radiators, air entrapping means forming a seal common to both water chambers for preventing thermogravitational flow through the system but yielding to pump pressure for forced circulation, and pipes respectively connecting the air space of the expansion chamber with the seal and the water space of the expansion chamber with the first chamber.

14. In a closed hot water heating system having one or more radiators, the combination of a boiler, a unit casing comprising an expansion chamber, a first water chamber communicating with the boiler, a second water chamber communicating with the radiators, the water chambers constituting parts of the flow path to the radiators, air entrapping means forming a seal common to the water chambers for preventing thermogravitational flow through the system, pipes respectively connecting the air space of the expansion chamber with the seal and the water space of the expansion chamber with the first chamber, and a pump for forcing the water through the seal to establish a circulation through the system.

15. In a closed hot water heating system having a boiler, one or more radiators, and a pump for circulating water through the system, the combination of a device forming part of the supply line leading to the radiators having first and second chambers, the first communicating directly with the boiler and always containing water substantially at boiler water temperature and the second with the radiators, air entrapping means forming a seal common to both chambers for preventing thermogravitational flow through the system but yielding to pump pressure for forced circulation, and a heat exchanging device immersed in the first chamber for heating service water.

16. A valveless flow control device for a closed hot water heating system having one or more radiators and a circulating pump comprising air entrapping means adapted to form a seal for preventing thermogravitational flow through the system but yielding to pump pressure for forced circulation.

17. A valveless flow control device for a closed hot water heating system having a boiler, one-

or more radiators, and a circulating pump comprising two separate water chambers, one chamber communicating directly with the boiler and the other with the radiators, and air entrapping means forming a seal common to both chambers for preventing thermogravitational flow through the system but yielding to pump pressure for forced circulation.

18. A valveless flow control device for a closed hot water heating system having a boiler, one or more radiators, and a circulating pump comprising a pipe adapted for connection to the upper portion of the boiler, a casing surrounding the pipe and flow connected to the radiators, and air entrapping means forming a seal common to the pipe and casing for preventing thermogravitational flow through the system but yielding to pump pressure for forced circulation.

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