

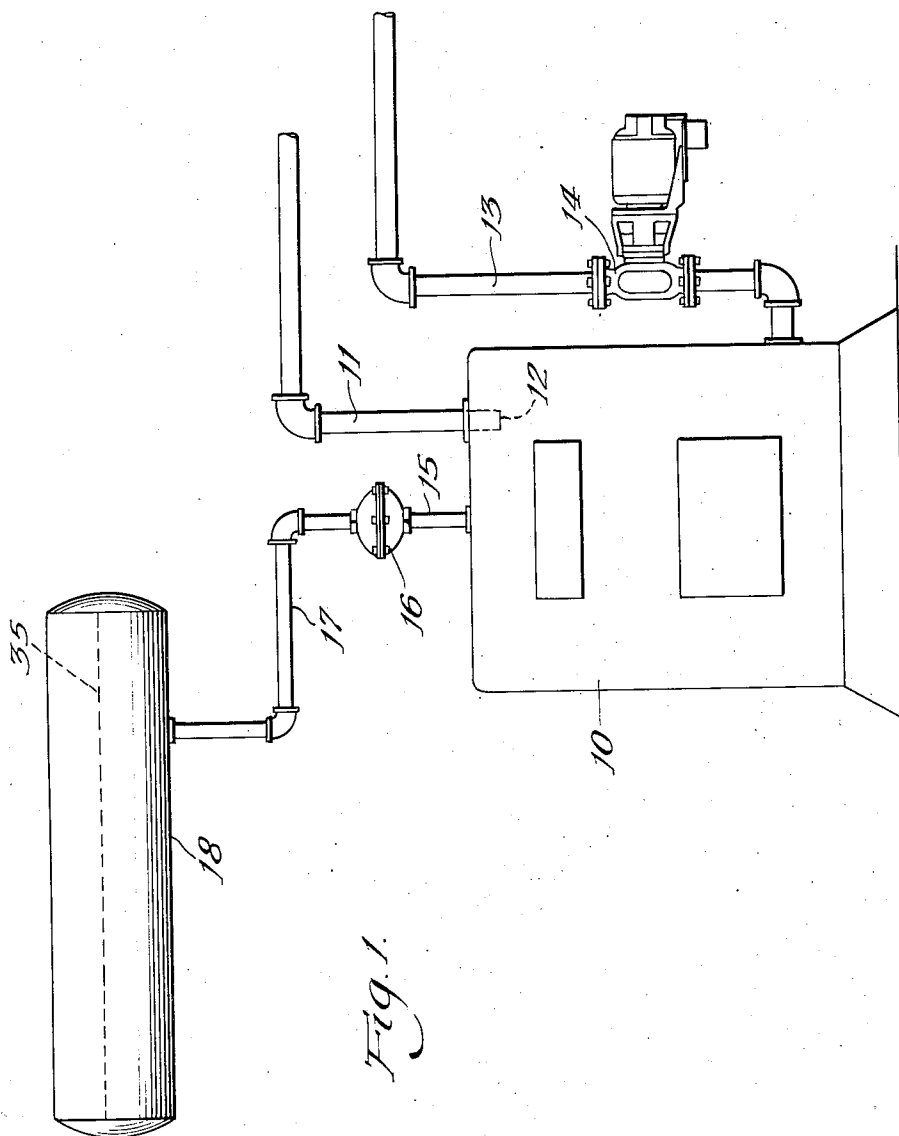
May 10, 1949.

E. B. TIDD
AIR ELIMINATOR

2,469,616

Filed June 28, 1945

2 Sheets-Sheet 1



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Fig. 3.

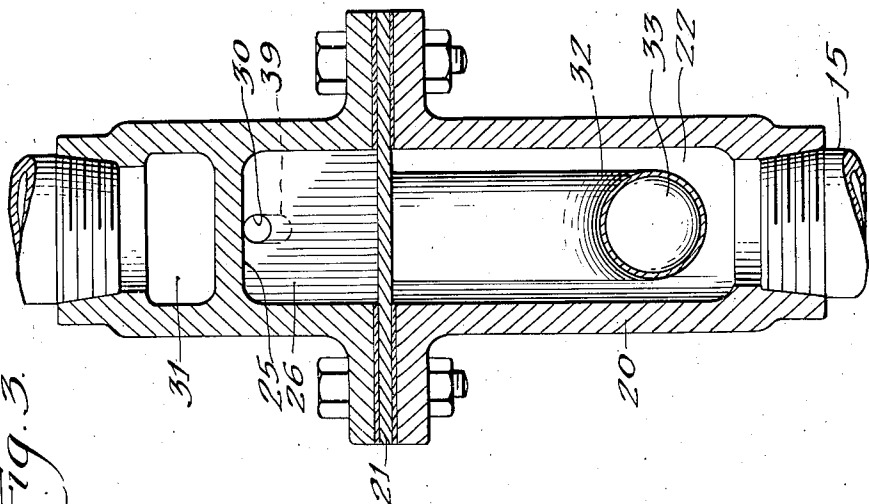
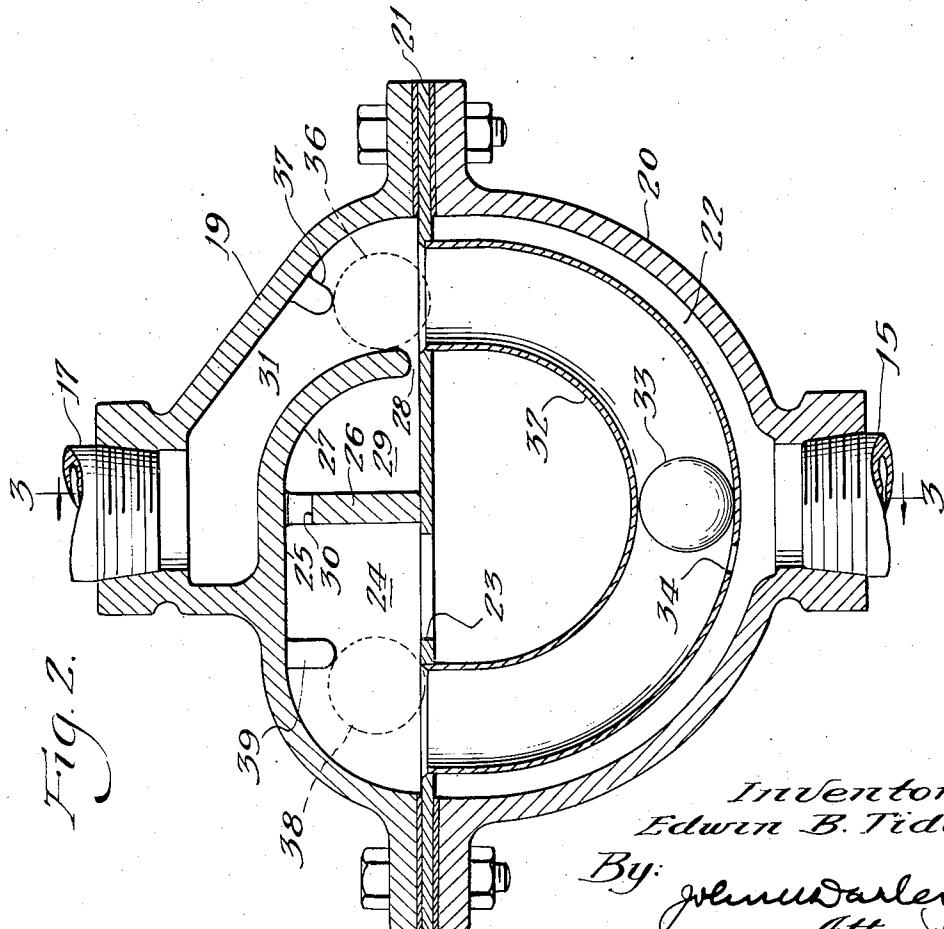


Fig. 2.



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AIR ELIMINATOR

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12 Claims. (Cl. 237—56)

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My invention relates to heating systems and more particularly to those of the closed, hot water type in which provision is made for trapping the air in the system at the boiler and for facilitating the separation of air from the water for collection in an expansion tank, while maintaining the tank relatively cool.

In the 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 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. However, with the advent of the closed system where the water space of the tank is ordinarily connected to the boiler by a single pipe and which enabled the use of higher water temperatures, and the development of an efficient, silent circulating pump that 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. I have determined that, when the pump is operating and where the pipe connecting the expansion tank to the boiler is of a size that permits two-way circulation in the same pipe, i. e., generally in excess of one-half inch, which size is desirable for adequate capacity in large installations, this circulation is not only sufficient to carry air bubbles from the tank to the radiators and piping, but unduly raises the temperature of the water and therefore of the air in the tank. This temperature increase may cause a system pressure high enough to open the relief valve with consequent loss of water. Moreover, when the system cools, the air in the tank cools and contracts and the system pressure may then be insufficient to maintain the filling of the topmost radiators. In either of these events, a compensating supply of fresh water then not only introduces more air into the system, but also additional sediment and causes more scale deposits.

It is therefore one object of my invention to provide a hot water heating system which is constructed and arranged to insure an easy and certain separation of the air from the water and its entrapment in the expansion tank.

A further object is to devise apparatus means

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for inclusion between the expansion tank and boiler of a heating system which is arranged to facilitate the entrance of air into the tank by simultaneously providing for a displacement of an equal volume of water from the tank to the system.

A further object is to provide an apparatus of the character indicated embodying novel means for preventing simultaneous two-way circulation of the water in a single pipe connection between the tank and boiler, thus maintaining the tank in a relatively cool condition and avoiding the creation of excessive pressures.

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 effectuated will be definitely pointed out in the claims.

In the drawings:

Fig. 1 is an elevation of a hot water heating system embodying the invention.

Fig. 2 is a sectional elevation of the apparatus for facilitating separation of air from the water and its entrapment in the expansion tank while preventing any substantial flow and counterflow of water between the tank and boiler.

Fig. 3 is a section along the line 3—3 in Fig. 2.

Referring to Fig. 1, the numeral 10 designates a hot water boiler that may be fired in any desired manner and from the upper portion of which extends a supply pipe 11 whose inlet end 12 is preferably disposed well below the top wall of the boiler for submergence in the boiler water for a purpose presently explained. The pipe 11 is connected to radiators (not shown) in any desired manner and the water is returned to the boiler by a pipe 13 which may include a circulating pump 14 appropriately driven and controlled by any of the well known arrangements. The pipes 11 and 13 may also include the usual flow control valves, whether pump or motor operated, for preventing the circulation of water to the radiators when not desired and the boiler may be equipped with the customary pressure relief valve (not shown). However, the invention is also applicable to thermogravitational systems, both with and without flow control valves.

To provide for expansion and to facilitate the separation of air from the water and the collection of the air in an expansion tank which more particularly forms the subject matter of my invention, a pipe 15 has its lower end connected to the upper portion of the boiler and its upper end connected to the bottom of an apparatus general-

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ly indicated by the numeral 16. A pipe 17 provides a connection between the top of the apparatus 16 and the bottom of an expansion tank 18.

The apparatus 16 is more particularly illustrated in Figs. 2 and 3 to which reference will now be made. It comprises a housing composed of hollow, upper and lower parts 19 and 20, respectively, which are bolted together and clamp therebetween a plate 21. This plate defines with the lower part 20 a chamber 22 which always communicates with the pipe 15 leading from the boiler, and also through an opening 23 in the plate 21 with a chamber 24 defined by the plate, the external wall of the part 19, a horizontal dividing wall 25 which extends interiorly of and constitutes a portion of the upper part 19, and a vertical wall 26 extending between the plate and wall 25. Beyond, or to the right of the wall 26 as viewed in Fig. 2, the wall 25 curves downwardly towards the plate 21 to form an extension 27 which terminates short of and close to the plate to thereby form a small gap 28. The plate 21, wall 26 and extension 27 create a chamber 29 which communicates with the chamber 24 through an opening 30 in the top of the wall 26, and through the gap 28 with a chamber 31 that is formed by the wall 25, extension 27 and the lateral wall of the part 19. The chamber 31 is in communication with the pipe 17 leading to the expansion tank.

A substantially vertically positioned, U-tube 32 depends from and has its ends secured to the plate 21 within the chamber 22, the left end of the tube communicating with the chamber 24 and the right end facing and communicating with the bottom end of the chamber 31. The ends of the tube 32 may be welded to the plate 21, or swaged in position, or otherwise attached so that leak proof connections are formed. The sectional diameter of the tube is less than the internal width of the chamber 22, as indicated in Fig. 3, so that water may flow freely around the tube and the flow area of the tube is about equal to that of the opening 23. A non-buoyant ball 33 constituting a valve element is positioned within the tube 32 and when not impelled by a force in either direction, as hereinafter described, occupies the lowermost position in the tube as shown. A drain opening 34 is formed in the outer, peripheral wall of the tube slightly displaced from the position of the ball shown in Fig. 2 so that the opening cannot be covered by the ball in its central position. The clearance of the ball within the tube is only that required to insure free rolling action and so that the ball provides a substantial obstruction to the free flow of water through the tube in either direction.

When the system shown in Fig. 1 is initially filled, the water rises upwardly through the pipe 15, fills the chamber 22, flows through the opening 23 into the chamber 24, thence through the tube 32 past the ball 33 which may, depending upon the volume of water entering the tube 32, be shifted from the position shown in Fig. 2. The water then flows upwardly through the chamber 31 and pipe 17 into the tank 18 to establish a water line therein indicated generally by the numeral 35 in Fig. 1 and thus trapping air in the tank for accommodating expansion in the system. Air is also trapped in the chambers 24 and 29 due to the partial enclosure provided by the wall extension 27.

When the boiler is heated with the pump not operating, air bubbles which accumulate at the

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top of the boiler move upwardly through the water in the chamber 22 into the air trap formed by the chambers 24 and 29. If sufficient air collects in this trap, the water level therein may be depressed to at least partially uncover the gap 28, whereupon the excess air flows upwardly through the chamber 31 and pipe 17 to the air space of the tank and an equivalent volume of water flows downwardly into the tube 32, since the air trap in the part 29 above the plate 21 prevents flow therethrough. The water thus forced out of the tank may return to the boiler through the drain opening 34.

From the foregoing, it will be understood that while the boiler 10 is substantially connected to the tank 18 by a single conduit composed of the pipe 15, apparatus 16 and pipe 17, this conduit comprises within the apparatus 16 a pair of passages which are in parallel communication with the boiler and tank. One passage is constituted by the air trapping chambers 24 and 29 forming an air seal which effectively prevents the flow of water therethrough in either direction since the water level in these chambers will ordinarily lie below the opening 30 in the wall 26 so that water cannot flow directly from the opening 23 to the gap 28. The other passage, which is wholly filled with water, is formed by the tube 32. Under the conditions noted above, pump not operating, the ball 33 in its lowermost position closes the tube 32 sufficiently to prevent two-way, thermo-gravitational flow between the tank and boiler so that the temperature of the water in the former will not rise appreciably.

If it is assumed that at this time the system pressure is twenty pounds gage and that the pump is capable of developing a pressure head of five pounds, then when the pump is started, a pressure wave of about twenty-five pounds is set up in the pipe 11 leading to the radiators and also in the pipe 15, apparatus 16 and pipe 17. Since the pressure in the tank 18 is then only twenty pounds, the differential pressure of five pounds effects a surge of water through the tube 32 which lifts the ball 33 from the full line position shown in Fig. 2 to the dotted position indicated by the numeral 36 where it is stopped by the lug 37. In the latter position, the major portion of the ball is above the adjacent end of the tube 32 to thereby enable the water to flow freely into and compress the air in the tank to about twenty-five pounds, and the lug 37 prevents the ball being forced into a position such that it could not return to the tube 32.

As the pressure wave set up by the pump is absorbed by the system through establishing a circulation therein, the force holding the ball in position 36 is no longer available and the ball then drops to its lowermost position. This return of the ball occurs very quickly after the starting of the pump. Also with the establishment of circulation, the pressure in the tank may fall to about twenty-one pounds and since the water level in the tank is then higher than that corresponding to the now reduced pressure, the water which was driven into the tank is forced back into the system, causing the ball to shift to dotted position 38 where it is stopped by a lug 39 which serves a purpose in relation to the ball similar to that of the lug 37. In this position, the major portion of the ball is above the adjacent end of the tube and thus permits free return of the water from the tank. A surge of sufficient intensity, if rising from the boiler at this time, would be additive to

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the gravity pull on the ball to thereby overcome the pressure driving the water from the tank so that the ball would be returned to the tube to substantially prevent simultaneous counterflow through the tube from the boiler. When the pressure becomes uniform, the ball returns to the position shown in Fig. 2.

While the pump is circulating water through the system, air bubbles are released in the boiler, including those picked up by the circulating water in other parts of the system. In this connection, the boiler provides a low velocity space relative to the system piping which enables the bubbles to be freely and easily separated from the water for collection in the upper portion of the boiler and flow into the pipe 15. The submergence of the supply pipe end 12 prevents the bubbles from flowing back into the system.

It will be obvious that the ball 33 accommodates pressure waves or surges in the system by shifts in position which enables the expansion tank to absorb the surge and that this feature is associated with the air trapping chambers 24 and 29 which provide an initial collecting trap for the air which is thus bypassed around the tube 32, unhindered by the ball 33, and eventually moves to the tank and remains there. The ball 33 prevents simultaneous flow and counterflow of water through the tube 32, thus maintaining the tank relatively cool and preventing any withdrawal of air bubbles from the tank for circulation through the system by the pump.

The apparatus 16 is not restricted to use with a pump circulated system, but may also be embodied in a thermo-gravitational arrangement. Shifts of the ball 33 may be effected by expansion and contraction of the water in the system in accordance with temperature changes. Under these conditions, the ball may move more slowly than when impelled by pump pressure, but its operation, as well as that of the other parts of the apparatus 16, remains the same.

I claim:

1. In a closed hot water heating system, the combination of a boiler, an expansion tank, and one-pipe means connecting the boiler and tank comprising an air trap and a water conduit each communicating with the boiler and tank and arranged in parallel, and valve means in the conduit biased to a position preventing simultaneous flow and counterflow therethrough and opening in response to pressure moving from the boiler or tank to provide flow in one direction only through the conduit.

2. In a closed hot water heating system, the combination of a boiler, an expansion tank, and one-pipe means connecting the boiler and tank comprising an air trap and a vertically positioned, U-tube for water each communicating with the boiler and tank and arranged in parallel, and a non-buoyant ball normally obstructing the tube to prevent simultaneous water flow and counterflow therethrough and shiftable to a non-obstructing position in response to pressure moving from the boiler or tank to provide flow in one direction only through the tube.

3. In a closed hot water heating system, the combination of a boiler, an expansion tank, and one-pipe means connecting the boiler and tank comprising an air trap and a vertically positioned, U-tube for water each communicating with the boiler and tank and arranged in parallel, a non-buoyant ball normally obstructing the tube to prevent simultaneous water flow and counterflow therethrough and shiftable to substantially open

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an end of the tube in response to pressure moving from the boiler or tank to provide flow in one direction only through the tube, and means adjacent each end of the tube providing a limit on the opening movement of the ball.

4. In a closed hot water heating system, the combination of a boiler, an expansion tank, a one pipe connection between the boiler and tank sized to normally permit two-way circulation, and means interposed in the pipe comprising an air trap having dual connections therewith, a water conduit bridged between the dual connections, and valve means in the conduit biased to a position preventing simultaneous flow and counterflow therethrough and opening in response to pressure moving from the boiler or tank to provide flow in one direction only through the conduit.

5. In a closed hot water heating system, the combination of a boiler, an expansion tank, a one pipe connection between the boiler and tank sized to normally permit two-way circulation, and means interposed in the pipe comprising an air trap having dual connections therewith, a vertically positioned, U-tube for water bridged between the dual connections, and a non-buoyant ball normally obstructing the tube to prevent simultaneous water flow and counterflow therethrough and shiftable to a non-obstructing position in response to pressure moving from the boiler or tank to provide flow in one direction only through the tube.

6. Apparatus for facilitating separation of air from the water in a closed, boiler and expansion tank equipped, hot water heating system and for preventing flow and counterflow of water between the boiler and tank comprising a housing having an air trapping chamber and a water conduit each adapted to communicate with the boiler and tank and arranged in parallel, and valve means in the conduit biased to a position preventing simultaneous flow and counterflow therethrough and adapted to be opened in response to pressure moving from the boiler or tank to provide flow in one direction only through the conduit.

7. Apparatus for facilitating separation of air from the water in a closed, boiler and expansion tank equipped, hot water heating system and for preventing flow and counterflow of water between the boiler and tank comprising a housing having an air trapping chamber and a vertically positioned, U-tube for water each adapted to communicate with the boiler and tank and arranged in parallel, and a non-buoyant ball normally obstructing the tube to prevent simultaneous water flow and counterflow therethrough and adapted to be shifted to a non-obstructing position in response to pressure moving from the boiler or tank to provide flow in one direction only through the tube.

8. In a closed hot water heating system, the combination of a boiler, supply and return lines connected to the boiler, the inlet end of the supply line extending within the upper portion of the boiler for submergence in the boiler water whereby air bubbles are prevented from flowing into the supply line, and one-pipe means connecting the boiler and tank comprising an air trap and a water conduit each communicating with the boiler and tank and arranged in parallel, and valve means in the conduit biased to a position preventing simultaneous flow and counterflow therethrough and opening in response to pressure moving from the boiler or tank to provide flow in one direction only through the conduit.

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9. In a closed hot water heating system, the combination of a boiler, an expansion tank, and one-pipe means connecting the boiler and tank comprising an air trap and a water conduit each communicating with the boiler and tank and arranged in parallel, the trap being located at a higher elevation than the conduit, and valve means in the conduit biased to a position preventing simultaneous flow and counterflow therethrough and opening in response to pressure moving from the boiler or tank to provide flow in one direction only through the conduit.

10. In a closed hot water heating system, the combination of a boiler, an expansion tank, and one-pipe means connecting the boiler and tank comprising an air trap and a vertically positioned, U-tube for water each communicating with the boiler and tank and arranged in parallel, the trap being disposed at a higher elevation than the ends of the tube, and a non-buoyant ball normally obstructing the tube to prevent simultaneous water flow and counterflow therethrough and shiftable to a non-obstructing position in response to pressure moving from the boiler or tank to provide flow in one direction only through the tube.

11. Apparatus for facilitating separation of air from the water in a closed, boiler and expansion tank equipped, hot water heating system and for preventing flow and counterflow of water between the boiler and tank comprising a housing having an air trapping chamber and a water conduit each adapted to communicate with the boiler and tank and arranged in parallel, the chamber being disposed at a higher elevation than the conduit, and

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valve means in the conduit biased to a position preventing simultaneous flow and counterflow therethrough and adapted to be opened in response to pressure moving from the boiler or tank to provide flow in one direction only through the conduit.

12. Apparatus for facilitating separation of air from the water in a closed, boiler and expansion tank equipped, hot water heating system and for preventing flow and counterflow of water between the boiler and tank comprising a housing having an air trapping chamber and a vertically positioned, U-tube for water each adapted to communicate with the boiler and tank and arranged in parallel, the chamber being disposed at a higher elevation than the ends of the tube, and a non-buoyant ball normally obstructing the tube to prevent simultaneous water flow and counterflow therethrough and adapted to be shifted to a non-obstructing position in response to pressure moving from the boiler or tank to provide flow in one direction only through the tube.

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