Jan. 18, 1955 E. B. TIDD 2,699,760

HOT-WATER HEATING SYSTEM

Filed Aug. 8, 1950 2 Sheets-Sheet 1

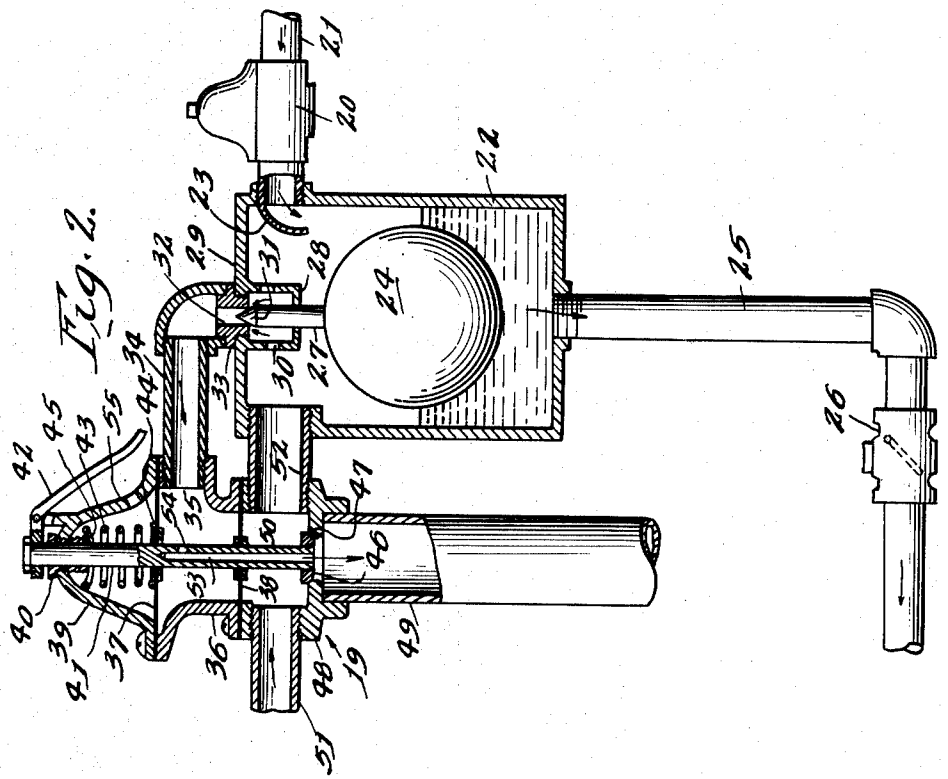


Fig. 2.

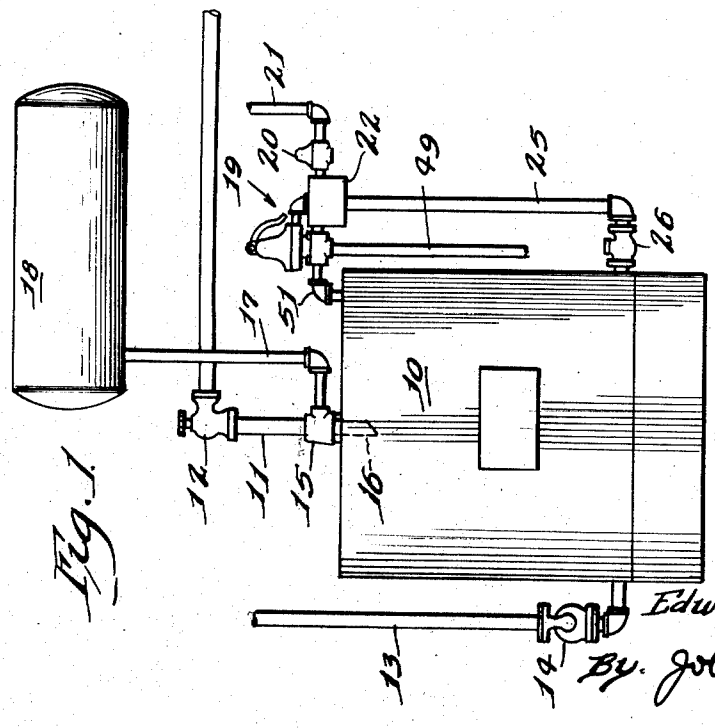


Fig. 1.

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Fig. 4.

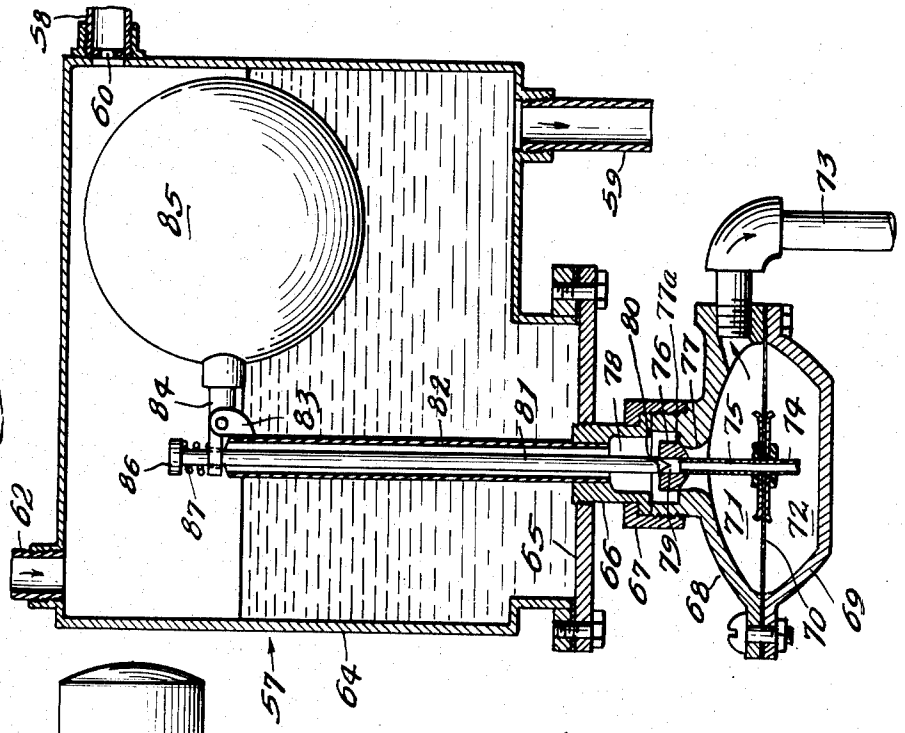
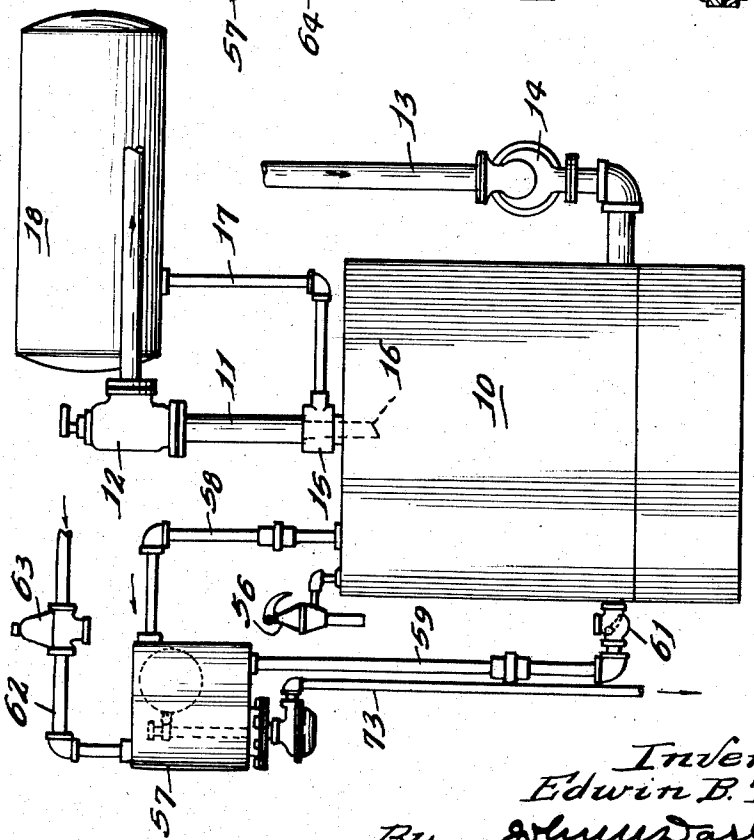


Fig. 3.



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HOT-WATER HEATING SYSTEM

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Application August 8, 1950, Serial No. 178,273

20 Claims. (Cl. 122—451.2)

My invention relates to hot water heating systems and is concerned primarily with an arrangement for automatically preventing overheating of the boiler.

In hot water heating systems, overheating of the boiler may result from the failure of the electrically operated controls to shut down the gas or oil burner when the boiler water attains its maximum, safe working temperature, or in the case of a stoker or hand fired boiler, overheating may be caused by the fact that sufficient fuel has been fed to the firebox to sustain continued heating of the boiler after the hot water circulating pump has stopped. Under either of the above conditions, heating of the boiler continues and if the system is equipped with a flow control valve which closes when the circulating pump stops, or if the system is designed so that circulation occurs only when the pump is operating, the situation soon becomes critical because the valve confines the boiler water and prevents its flow through the system where the heat could be dissipated.

As the temperature of the boiler water rises, the boiler pressure increases and where, as is usual in systems of this character, a pressure relief valve is associated with the boiler, this valve relieves the boiler pressure at the setting of the valve, ordinarily thirty pounds gage, although, as a matter of fact, such valves begin to open at about twenty-eight pounds which is evidenced by a slight drip at the valve. The valve eases the boiler pressure temporarily, but at the expense of the water content of the boiler. This intermittent water loss, so long as the heating continues, produces a water line in the boiler, and the relief valve thereafter discharges steam. A lowering of the water line is objectionable, particularly if the water loss persists until the crown sheet of the boiler is exposed accompanied by continued input of heat, because if at that time relatively cold water surges over the crown sheet, the boiler may either explode or at the very least will be subjected to racking strains occasioned by the flashing of the cold water as it flows over the crown sheet. This cold water may reach the boiler either through a manually or automatically operated valve connected to a cold water supply main, or the weight of the relatively cold water in the heating system may overbalance the weight of the steam in the boiler, thus permitting large quantities of this water to flow through the return line and enter the boiler.

It is therefore one object of my invention to devise a heating system which incorporates means for preventing overheating of the boiler by automatically introducing cold water into the boiler when steam forms at the top of the boiler and which slightly preheats such cold water before introduction.

A further object is to provide a heating system of the character indicated in which the overheating prevention means is conditioned to introduce cold water at pressures below the setting of the relief valve, and to relieve the boiler pressure in the event of failure of the cold water supply or of the safety or relief valve.

A further object is to provide an apparatus for accomplishing the foregoing results which is capable of separate assembly and installment as a unit in a hot water heating system and which incorporates a relief valve means corresponding to the standard relief valve.

These and further objects of the 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 a fragmentary elevation of a hot water heating system showing the application of one form of the apparatus thereto.

Fig. 2 is an enlarged, sectional elevation of the apparatus shown in Fig. 1, the several parts occupying positions assumed during normal or non-relieving operation of the connected system.

Fig. 3 is a view of a heating system similar to that illustrated in Fig. 1, but showing a modified apparatus connected thereto.

Fig. 4 is an enlarged, sectional elevation of the apparatus shown in Fig. 3, the several parts being illustrated in non-relieving positions.

Referring to Fig. 1 of the drawings, the numeral **10** designates a hot water heating boiler of any convenient type which may be fired in any suitable manner, automatically or manually, and which may or may not be equipped with the customary controls. A supply pipe **11** which may incorporate a flow control valve **12** leads from the top of the boiler to radiators (not shown) and a return pipe **13** which may include a motor driven, circulating pump **14** connects the radiators with the lower part of the boiler. Preferably, the supply pipe **11** is connected to the top of the boiler by means of a fitting **15** which includes a dip tube **16** that communicates with the pipe **11** and extends a distance into the boiler such that air bubbles released in the boiler above the lower end of the tube will pass to a pipe **17**, one end of which connects with the fitting and is in communication with the boiler, while the opposite end connects with an expansion tank **18**. A fitting of this type is disclosed in U. S. Letters Patent No. 2,500,621, dated March 14, 1950.

The control apparatus in Fig. 1, indicated generally by the numeral **19**, is preferably installed as a unit above the boiler and is more particularly illustrated in Fig. 2 to which reference will now be made. It includes a pressure reducing valve **20** of the usual type which provides a connection between a cold water supply pipe **21** and the upper end of a float or water chamber **22**, the valve being preferably adjusted to feed water to the chamber at a pressure of from 10 to 12 p. s. i. A downwardly extending baffle **23** is positioned at the cold water inlet to the chamber to prevent impact of the entering cold water against a float ball **24** that is freely buoyed in the chamber by water therein as presently described. The lower end of the chamber **22** connects to the lower end of the boiler by a pipe **25** which includes a swing check valve **26** that is gravity actuated to closure in a direction to prevent boiler pressure acting back through the pipe **25** to the chamber **22**, but opens in response to a differential pressure established by a mass of water in the chamber as presently described.

A stem **27** extends upwardly from the float **24** through and in guidable relation to a cage **28** that depends from the cover **29** of the chamber **22**, the interiors of the cage and chamber communicating through openings **30** in the side walls of the cage. The upper end of the stem **27** is pointed to form a valve **31** which closes the lower end of a passage **32** provided in a plug **33** threaded in the cover **29**.

The opposite end of the passage **32** communicates by means of a pipe **34** with a control chamber **35** which is bounded by an open ended casing **36** whose top and bottom are constituted by upper and lower diaphragms **37** and **38**, all respectively, the former being larger for a purpose presently explained. The periphery of the diaphragm **37** is clamped against the upper end of the casing **36** by a conical cover **39** through whose upper end is threaded an adjusting nut **40**. The upper end of a stem **41** is slidable through the nut **40** and externally of the cover **39** is connected to a pivotal handle **42** for manually raising the stem in the customary manner. The lower part of the stem extends downwardly through and is secured to the diaphragms **37** and **38**, and the former diaphragm is loaded by the lower end of a spring **43** which presses against a plate **44** secured to the diaphragm **37** while the upper end of the spring is capped by a plate **45**

which abuts the inner end of the nut 40. The lower end of the stem 41 carries a primary valve 46 whose area is smaller than that of the diaphragm 38 and which normally closes a discharge port 47 in the lower part of a second open ended casing 48, the upper end of this casing being closed by the diaphragm 38 which is clamped between the casings 36 and 48.

An exhaust pipe 49 depends from the casing 48 and when the valve 46 is raised, as presently described, communication is established through the discharge port 47 between the pipe 49 and a chamber 50 within the casing 48, the upper wall of this chamber being defined by the diaphragm 38. The chamber 50 connects with the upper part of the boiler 10 by a pipe 51 and with the upper part of the chamber 22 by a pipe 52. Beneath the diaphragm 37, the stem 41 is provided with an axial passage 53 whose lower end communicates at all times with the drain pipe 49 and whose upper end connects through an orifice 54 in the stem with the chamber 35. A venting orifice 55 in the cover 39 connects the interior of the cover with the atmosphere to eliminate air compression in the cover.

In describing the operation of the system shown in Figs. 1 and 2, it will be assumed that the same is filled with water and that the spring 43 is adjusted so as to require a system pressure in excess of 30 p. s. i. to flex the diaphragm 38 upwardly and open the valve 46. Therefore, this valve is closed, as is also the valve 31 by the buoyed position of the float 24 as shown, it being understood that the valve 31 functions as a pilot for the primary valve 46. During the filling of the system, the float rests on the bottom of the chamber 22, thus opening the valve 31 and permitting the air in the system, i. e., that which collects in the apparatus 19, to be forced through the passage 32, pipe 34, chamber 35, orifice 54 and passage 53 to the drain or exhaust pipe 49. If the air pressure is sufficiently high, the diaphragm 37 may flex upwardly and open the primary valve 46.

During normal operation, the system functions in the usual way, with the diaphragm 38 and valve 46 coacting to serve as a substitute for the customary, separate relief valve. Hence, whenever the system pressure exceeds 30 p. s. i., the valve 46 opens to relieve the excess pressure and this relief is ordinarily accompanied by a loss of some water.

Repeated loss of water, whether due to overheating by failure of the automatic controls or whatever cause, will eventually create a water line in the boiler and when this condition arises, the remainder of the apparatus begins operating to replace the water loss. Specifically, the creation of a water line in the boiler results in a lowering of the water line in the chamber 22, the water in this chamber flowing to the boiler through the pipe 25 so that the float 24 drops to thereby uncover the passage 32. With the establishment of a water line in the boiler, steam is formed whose pressure is equal to that of the system. This steam pressure becomes effective under the diaphragm 37 which accordingly flexes upwardly and opens the valve 46 to thereby rapidly dissipate the pressure in the chambers 22 and 50. Since the pressure in the chamber 22 is then below the feeding pressure of the reducing valve 20 and may be of the order of atmospheric pressure or slightly thereabove, cold water flows into the chamber 22 and, mixing with water in this chamber and the pipe 25, is slightly preheated before flowing into the lower part of the boiler. As the water rises in the chamber 22, the float 24 is raised to a position where the valve 31 closes the passage 32, thus shutting off pressure to the chamber 35 and any residual pressure in this chamber is discharged through the orifice 54 to the atmosphere.

The closing of the valve 46 by the spring 43 due to the release of the boiler pressure may occur before or after the float 24 has been returned to the position shown in Fig. 2, depending upon the rapidity with which the pressure is released and with which cold water is supplied to the chamber 22. If the first dropping of the float does not result in sufficient water being supplied to fill the boiler, the foregoing operation is automatically repeated as many times as may be necessary for the purpose. The orifice 54 has throttling characteristics so that its discharge is small and ineffective to prevent the upward flexing of the diaphragm 37. Further, by employing this diaphragm which has a greater area than the diaphragm 38, it is possible, whenever a water line exists in the boiler, to open the valve 46 at pressure below that which would flex the diaphragm 38 in an opening direction. The pipe 51 is sized smaller than the valve opening 47 and also smaller than the pipe 52. Hence, when the valve 46 opens, it adequately accommodates flow through the pipe 51 as well as relieving pressure in the chamber 22.

In Figs. 3 and 4 is illustrated a variant arrangement which differs from that shown in Figs. 1 and 2 in that it functions only to release air trapped during filling of the system and to supply water to the boiler in the event that a water line is established therein as above described. Hence, it is necessary to employ a separate, pressure relief valve with this modification.

The boiler and associated parts, such as the supply and return pipes, flow control valve, pump, expansion tank and the fitting which has dual connections to the supply pipe and expansion tank are identical with those shown in Fig. 1 and are designated by the same numerals. The pressure relief valve, indicated by the numeral 56, is of the customary type and is connected to the top of the boiler and adjusted to open in response to system pressures in excess of 30 p. s. i.

The control apparatus, generally indicated by the numeral 57 in Fig. 3, is located above the boiler 10 and its upper and lower portions are respectively connected to the corresponding parts of the boiler by pipes 58 and 59, the former pipe including a throttling orifice 60 and the latter pipe including a swing check valve 61 which functions in the same manner as the valve 26. A cold water supply pipe 62 connects with the upper part of the apparatus 57 and a pressure reducing valve 63 adjusted to admit water at a pressure of 10 to 12 p. s. i. is included in the pipe 62.

The apparatus 57 is more particularly illustrated in Fig. 4 to which reference will now be made. It comprises a float or water chamber 64 which is closed at the top and which includes an opening in its bottom wall that is closed by a cover 65. The discharge ends of the pipes 58 and 62 are connected to the side and top walls, respectively, and the inlet end of the pipe 59 connects with the bottom wall of the chamber 64, the connection of the pipe 58 being adjacent the top of the chamber.

A shouldered fitting 66 is threaded in the wall 65 and clamped against the shoulder of this fitting by a nut 67 is a top wall 68 of a split casing having a bottom wall 69. A diaphragm 70, clamped between the walls 68 and 69, defines therewith, respectively, discharge and control chambers 71 and 72, the former chamber communicating with an exhaust pipe 73. A tube 74 extends through and is secured to the diaphragm 70, the lower end of the tube terminating within the chamber 72 in spaced relation to the wall 69. Above the diaphragm 70, the wall of the tube 74 includes a throttling orifice 75 which provides communication between the interior of the tube and the chamber 71. The upper end of the tube 74 carries a primary valve 76 which normally closes a discharge port 77a at the upper end of a passage 77 provided in the wall 68 which, when the valve 76 is raised, connects the chamber 71 with a chamber 78 included within the fitting 66 and an extension of the wall 68. The normal seating of the valve 76 is due to its weight and the biasing of the diaphragm 70 to lie in a horizontal plane, and the area of this diaphragm is several times that of the valve 76 as shown in Fig. 4.

Extending through the valve 76 is a passage 79 which is in effect a continuation of the interior of the tube 74. The upper end of the passage 79 is shaped as a valve seat that is normally engaged, as shown in Fig. 4, by a pilot valve 80 provided on the lower end of a stem 81 which extends upwardly through and in spaced relation to a tube 82. The lower end of this tube is mounted in the fitting 66 and the upper end carries a pair of arms 83 between which a lever 84 is intermediately pivoted, one end of the lever having attached thereto a float ball 85 and the other end being apertured to loosely receive the upper end of the stem 81 which extends therethrough. Above the apertured end of the lever, the stem 81 is headed at 86 and a helical spring 87 encircles the stem between the head and lever for a purpose presently explained. The lever 84 is pivoted so that it may freely rock to the normal position shown without interference with the top of the tube 82 and so that the valve 80 may freely seat of its own weight, plus the effect of any boiler pressure present.

Before the system is first filled with water, the float 85,

being unbuoyed, is rocked clockwise from the position shown in Fig. 4 to thereby raise the stem **81** through the spring **87** and open the pilot valve **80**, the primary valve **76** remaining closed. At this time, the chamber **64** communicates through the tube **82**, chamber **78**, passage **79** and tube **74** with the control chamber **72** and also through the throttling orifice **75** with the discharge chamber **71**. The chamber **72** constantly communicates through the tube **74** and orifice **75** with the chamber **71** and hence with the exhaust pipe **73**.

As water rises in the system, air flows through the pipe **58** into chamber **64** and thence through the tubes and chambers referred to above into the control chamber **72**. As the pressure increases in the latter chamber, the diaphragm **70** is flexed upwardly to raise the primary valve **76** to thereby relieve the accumulated air in the chamber **64** to the exhaust pipe **73**. When sufficient water has been supplied to the system, the float **85** is buoyed to the position shown in Fig. 4, the primary valve **76** is seated due to the exhausting of any residual air pressure in the chamber **72** through the throttling orifice **75**, and the valve **80** is seated against the valve **76**.

The parts remain in the positions shown in Fig. 4 until the creation of steam in the system by reason of the failure of the safety controls on the heat source effects a lowering of the water line in the chamber **64** because of loss of water from the boiler through the relief valve **56**.

The float **85** then drops, opening the pilot valve **80** to thereby admit steam pressure under the diaphragm **70** which opens the primary valve **76**. Since the steam is discharged to the pipe **73** faster than it can be replenished through the throttling orifice **60**, the pressure in chamber **64** drops and when its value is below the setting of the reducing valve **63**, which includes a possible drop in water chamber pressure to that of the atmosphere or slightly thereabove since the chamber **64** then communicates with the exhaust pipe **73**, cold water flows into the chamber and buoys the float **85** to thereby permit closing of the valves **76** and **80**. The entering steam is condensed by and preheats to some extent the cold water and since the apparatus **57** is positioned above the boiler, this water flows slowly to the boiler through the pipe **59**. Eventually, the water rises in the chamber **64**, buoys the float **85** to a position permitting closing of the valves **76** and **80**, and boiler pressure is reestablished in the chamber **64**. This cycling is repeated at intervals until the condition which caused the lowering of the water in the chamber **64** is remedied.

Under overheating conditions, the boiler pressure in the chamber **64** tends to hold the pilot valve **80** closed, but as the float **85** drops when the water level in the chamber falls, the spring **87** is compressed. When this compression has proceeded sufficiently, the valve **80** is forced rapidly from its seat, thereby avoiding any hesitant action in its opening movement.

I claim:

1. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a chamber normally partially containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the chamber, a discharge port arranged for communication with the inlet port and chamber, a normally closed, primary valve for controlling said communication, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet port, pressure responsive means for opening the primary valve, float controlled means for admitting pressure from the chamber to the responsive means when the depth of water in the chamber drops below a predetermined minimum, and means responsive to the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

2. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a chamber normally partially containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the chamber, a discharge port arranged for communication with the inlet port and chamber, a normally closed, primary valve for controlling said communication, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet port, pressure responsive means for opening the primary valve, a pilot valve for admitting pressure from the chamber to the responsive means, a float in the chamber connected to and operable to open the pilot valve when the depth of water in the chamber drops below a predetermined minimum, and means responsive to the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

3. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a first chamber normally containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the chamber, an exhaust port arranged for communication with the inlet port, a normally closed, primary valve for controlling said communication, a spring actuated diaphragm connected to the primary valve and forming part of a second chamber arranged for communication with the first chamber, means for admitting pressure from the first to the second chamber when the depth of water in the first chamber drops below a predetermined minimum to thereby actuate the diaphragm and open the primary valve, and means operable by the drop in first chamber pressure when the primary valve opens, for feeding cold water to the first chamber to at least restore said minimum depth.

4. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a first chamber normally containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the first chamber, an exhaust port arranged for communication with the inlet port, a normally closed, primary valve for controlling said communication, a spring actuated diaphragm connected to the primary valve and forming part of a second chamber arranged for communication with the first chamber, a float actuated, pilot valve in the first chamber for admitting pressure from the first to the second chamber when the depth of water in the first chamber drops below a predetermined minimum to thereby actuate the diaphragm and open the primary valve, and means operable by the drop in first chamber pressure when the primary valve opens for feeding cold water to the first chamber to at least restore said minimum depth.

5. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a first chamber normally containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the first chamber, an exhaust port arranged for communication with the inlet port, a normally closed, primary valve for controlling said communication, a spring actuated diaphragm forming part of a second chamber arranged for communication with the first chamber, a stem connecting the diaphragm and primary valve and including an axial passage constantly communicating at one end with the exhaust port and having at the opposite end a throttling orifice providing communication with the second chamber, means for admitting pressure from the first to the second chamber when the depth of water in the first chamber drops below a predetermined minimum to thereby actuate the diaphragm and open the primary valve, and means operable by the drop in first chamber pressure when the primary valve opens for feeding cold water to the first chamber to at least restore said minimum depth.

6. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a chamber normally containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the chamber, an exhaust port arranged for communication with the inlet port, a primary valve normally closing the exhaust port, first and second means independently operable to open the primary valve, the first means being responsive to a predetermined pressure in the inlet port and the second means being responsive to pressure communicated from the chamber, means for admitting pressure from the chamber to the second means when the depth of water in the chamber drops below a predetermined minimum, and means operable by the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

7. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a chamber normally containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the chamber, an exhaust port arranged for communication with the inlet port, a primary valve normally closing the exhaust port, first and second means independently operable to open the primary valve, the first means being responsive to a predetermined pressure in the inlet port and the second means being responsive to pressure communicated from the chamber, a float actuated, pilot valve in the chamber for admitting pressure from the chamber to the second means when the depth of water in the chamber drops below a predetermined minimum, and means operable by the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

8. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a first chamber normally containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the first chamber, an exhaust port arranged for communication with the inlet port, a primary valve normally closing the exhaust port, first and second, spring actuated diaphragms independently operable to open the primary valve, the first diaphragm being responsive to a predetermined pressure in the inlet port and the second diaphragm being larger than the first diaphragm and forming part of a second chamber arranged for communication with the first chamber, a float actuated, pilot valve in the first chamber for admitting pressure from the first to the second chamber when the depth of water in the first chamber drops below a predetermined minimum, and means operable by the drop in first chamber pressure when the primary valve opens for feeding cold water to the first chamber to at least restore said minimum depth.

9. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a first chamber normally containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the chamber, an exhaust port arranged for communication with the inlet port, a primary valve normally closing the exhaust port, first and second, spring actuated diaphragms, the first diaphragm being connected to the primary valve and being responsive in an opening direction to a predetermined pressure in the inlet port and the second diaphragm being larger than the first diaphragm and connected to the primary valve and forming part of a second chamber arranged for communication with the first chamber, the connection of both diaphragms to the primary valve comprising a common stem including an axial passage constantly communicating at one end with the exhaust port and having at the opposite end a throttling orifice providing communication with the second chamber, a float actuated, pilot valve in the first chamber for admitting pressure from the first to the second chamber when the depth of water in the first chamber drops below a predetermined minimum, and means operable by the drop in first chamber pressure when the primary valve opens for feeding cold water to the first chamber to at least restore said minimum depth.

10. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a chamber normally partially containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and an outlet port adapted for connection to the boiler and having means for preventing return flow to the water chamber, a casing depending from the water chamber, a diaphragm dividing the interior of the casing into discharge and control chambers, a first tube extending within the water chamber for providing communication between the discharge chamber and the upper part of the water chamber, a normally closed, primary valve for controlling said communication and having a passage therethrough, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet port, a second tube dependently carried by the primary valve and extending through and being secured to the diaphragm, the second tube including a throttling orifice providing communication with the discharge chamber and its lower end communicating with the control chamber, a float pivoted on the upper end of the first tube, a pilot valve normally closing the primary valve passage and having a stem extending upwardly through the first tube for operable connection with the float whereby when the depth of water in the water chamber drops below a predetermined minimum the pilot valve opens to admit pressure from the water chamber to the control chamber to thereby flex the diaphragm upwardly and open the primary valve, and means responsive to the drop in water chamber pressure when the primary valve opens for feeding cold water to the water chamber to at least restore said minimum depth.

11. In a hot water heating system, the combination of a boiler having supply and return lines for connection to radiating elements, a chamber normally partially containing a mass of water disposed above the boiler, an inlet pipe leading from the top of the boiler to the upper part of the chamber, an outlet pipe connecting the lower part of the chamber to the boiler and having means for preventing return flow from the boiler, a discharge port arranged for communication with the inlet pipe and chamber, a normally closed, primary valve for controlling said communication, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet pipe, pressure responsive means for opening the primary valve, float controlled means for admitting pressure from the chamber to the responsive means when the depth of water in the chamber drops below a predetermined minimum, and means responsive to the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

12. In a hot water heating system, the combination of a boiler having supply and return lines for connection to radiating elements, a chamber normally partially containing a mass of water disposed above the boiler, an inlet pipe leading from the top of the boiler to the upper part of the chamber, an outlet pipe connecting the lower part of the chamber to the boiler and having means for preventing return flow from the boiler, a discharge port arranged for communication with the inlet pipe and chamber, a normally closed, primary valve for controlling said communication, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet pipe, pressure responsive means for opening the primary valve, a pilot valve for admitting pressure from the chamber to the responsive means, a float in the chamber connected to and operable to open the pilot valve when the depth of water in the

chamber drops below a predetermined minimum, and means responsive to the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

13. In a hot water heating system, the combination of a boiler having supply and return lines for connection to radiating elements, a first chamber normally containing a mass of water disposed above the boiler, an inlet pipe leading from the top of the boiler to the upper part of the first chamber, an outlet pipe connecting the lower part of the first chamber to the boiler and having means for preventing return flow from the boiler, an exhaust pipe arranged for communication with the inlet pipe, a normally closed, primary valve for controlling said communication, a spring actuated diaphragm connected to the primary valve and forming part of a second chamber arranged for communication with the first chamber, means for admitting pressure from the first to the second chamber when the depth of water in the first chamber drops below a predetermined minimum to thereby actuate the diaphragm and open the primary valve, and means operable by the drop in first chamber pressure when the primary valve opens for feeding cold water to the first chamber to at least restore said minimum depth.

14. In a hot water heating system, the combination of a boiler having supply and return lines for connection to radiating elements, a chamber normally containing a mass of water disposed above the boiler, an inlet pipe leading from the top of the boiler to the upper part of the chamber, an outlet pipe connecting the lower part of the chamber to the boiler and having means for preventing return flow from the boiler, an exhaust pipe arranged for communication with the inlet pipe, a primary valve normally closing the exhaust pipe, first and second means independently operable to open the primary valve, the first means being responsive to a predetermined pressure in the inlet pipe and the second means being responsive to pressure communicated from the chamber, means for admitting pressure from the chamber to the second means when the depth of water in the chamber drops below a predetermined minimum, and means operable by the drop in the chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

15. In a hot water heating system, the combination of a boiler having supply and return lines for connection to radiating elements, a first chamber normally containing a mass of water disposed above the boiler, an inlet pipe leading from the top of the boiler to the upper part of the first chamber, an outlet pipe connecting the lower part of the first chamber to the boiler and having means for preventing return flow from the boiler, an exhaust pipe arranged for communication with the inlet pipe, a primary valve normally closing the exhaust pipe, first and second, spring actuated diaphragms independently operable to open the primary valve, the first diaphragm being responsive to a predetermined pressure in the inlet pipe and the second diaphragm being larger than the first diaphragm and forming part of a second chamber arranged for communication with the first chamber, a float actuated, pilot valve in the first chamber for admitting pressure from the first to the second chamber when the depth of water in the first chamber drops below a predetermined minimum, and means operable by the drop in first chamber pressure when the primary valve opens for feeding cold water to the first chamber to at least restore said minimum depth.

16. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a chamber normally partially containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and communicating with the chamber and an outlet port adapted for connection to the boiler and having means for preventing return flow to the chamber, a discharge port arranged for communication with the chamber, a normally closed, primary valve for controlling said communication, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet port, pressure responsive means for opening the primary valve, float controlled means for admitting pressure from the chamber to the responsive means when the depth of water in the chamber drops below a predetermined minimum and including a passage through the primary valve for connecting the chamber to the responsive means, and means responsive to the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

17. Apparatus for facilitating the evacuation to the atmosphere of gases and steam liberated from the water in a hot water heating boiler and for cooling the boiler by admitting cold water thereto comprising a chamber normally partially containing a mass of water and having adjacent the top and bottom thereof, respectively, an inlet port adapted for connection to the upper part of the boiler and communicating with the chamber and an outlet port adapted for connection to the boiler and having means for preventing return flow to the chamber, a discharge port arranged for communication with the chamber, a normally closed, primary valve for controlling said communication, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet port, pressure responsive means for opening the primary valve, a passage through the primary valve for connecting the chamber to the responsive means, a pilot valve normally closing the primary valve passage, a float in the chamber connected to and operable to open the pilot valve when the depth of water in the chamber drops below a predetermined minimum, and means responsive to the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

18. In a hot water heating system, the combination of a boiler having supply and return lines for connection to radiating elements, a chamber normally partially containing a mass of water disposed above the boiler, an inlet pipe leading from the top of the boiler to the upper part of the chamber, an outlet pipe connecting the lower part of the chamber to the boiler and having means for preventing return flow from the boiler, a discharge port arranged for communication with the chamber, a normally closed, primary valve for controlling said communication, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet pipe, pressure responsive means for opening the primary valve, float controlled means for admitting pressure from the chamber to the responsive means when the depth of water in the chamber drops below a predetermined minimum and including a passage through the primary valve for connecting the chamber to the responsive means, and means responsive to the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

19. In a hot water heating system, the combination of a boiler having supply and return lines for connection to radiating elements, a chamber normally partially containing a mass of water disposed above the boiler, an inlet pipe leading from the top of the boiler to the upper part of the chamber, an outlet pipe connecting the lower part of the chamber to the boiler and having means for preventing return flow from the boiler, a discharge port arranged for communication with the chamber, a normally closed, primary valve for controlling said communication, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet pipe, pressure responsive means for opening the primary valve, a passage through the primary valve for connecting the chamber to the responsive means, a pilot valve normally closing the primary valve passage, a float in the chamber connected to and operable to open the pilot valve when the depth of water in the chamber drops below a predetermined minimum, and means responsive to the drop in chamber pressure when the primary valve opens for feeding cold water to the chamber to at least restore said minimum depth.

20. In a hot water heating system, the combination of a boiler having supply and return lines for connection to radiating elements, a chamber normally partially containing a mass of water disposed above the boiler, an inlet pipe leading from the top of the boiler to the upper part of the water chamber, an outlet pipe connecting the lower part of the water chamber to the boiler and having means for preventing return flow from the boiler, a casing depending from the water chamber, a diaphragm dividing the interior of the casing into discharge and control chambers,

a first tube extending within the water chamber for providing communication between the discharge chamber and the upper part of the water chamber, a normally closed, primary valve for controlling said communication and having a passage therethrough, the discharge capacity of the primary valve when open being greater than the supply capacity of the inlet pipe, a second tube dependently carried by the primary valve in communication with the primary valve passage and extending through and being secured to the diaphragm, the second tube including a throttling orifice providing communication with the discharge chamber and its lower end communicating with the control chamber, a float pivoted on the upper end of the first tube, a pilot valve normally closing the primary valve passage and having a stem extending upwardly through the first tube for operable connection with the float whereby when the depth of water in the water chamber drops below a predetermined minimum the pilot valve

opens to admit pressure from the water chamber to the control chamber to thereby flex the diaphragm upwardly and open the primary valve, and means responsive to the drop in water chamber pressure when the primary valve opens for feeding cold water to the water chamber to at least restore said minimum depth.

References Cited in the file of this patent

UNITED STATES PATENTS

1,839,144	Flagg	Dec. 29, 1931
1,856,105	Marden	May 3, 1932
1,961,550	Carson	June 5, 1934
2,335,785	Moore	Nov. 30, 1943
2,487,418	Berkemeier	Nov. 8, 1949

FOREIGN PATENTS

655,966	France	Apr. 25, 1929