Nov. 30, 1943. R. E. MOORE 2,335,785

HEATING SYSTEM

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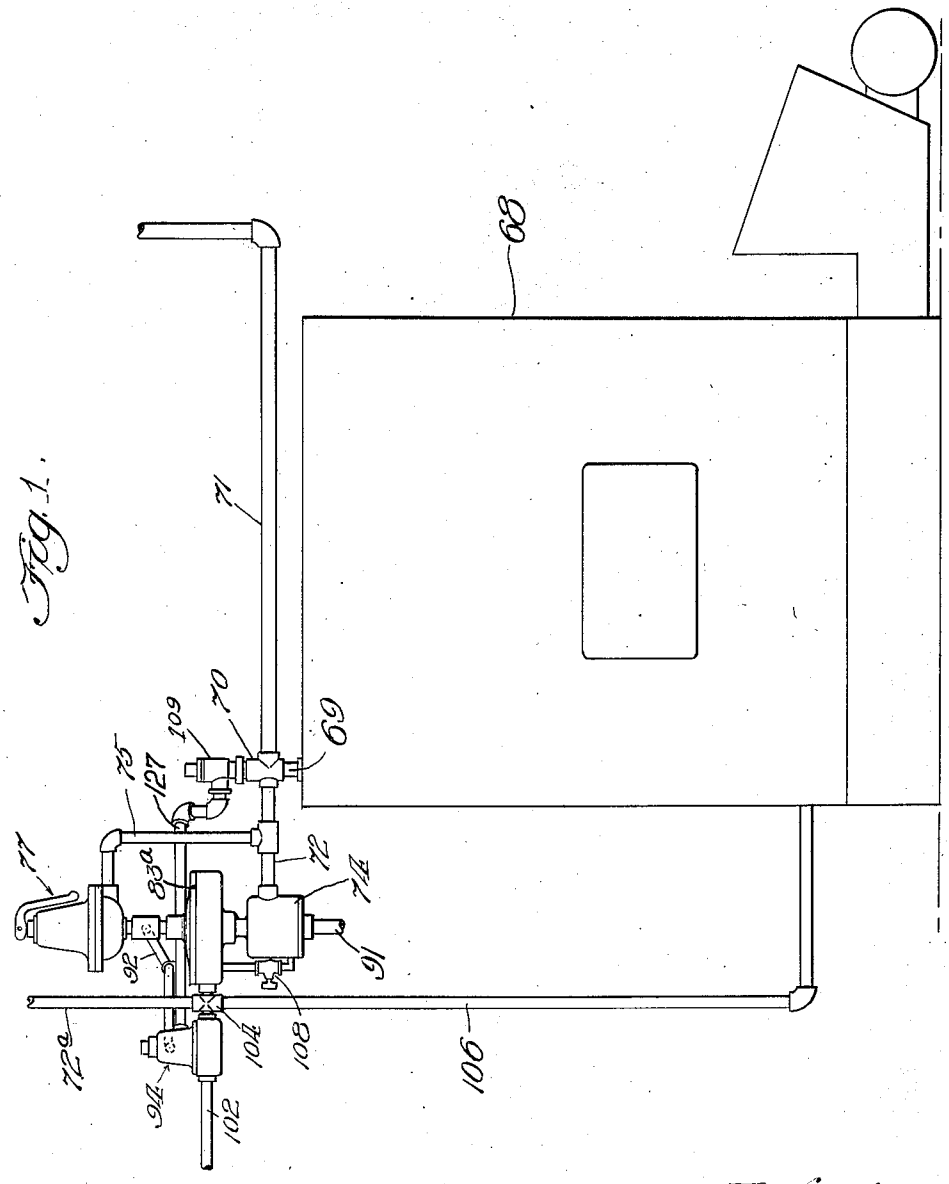


Fig. 1.

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Fig. 3.

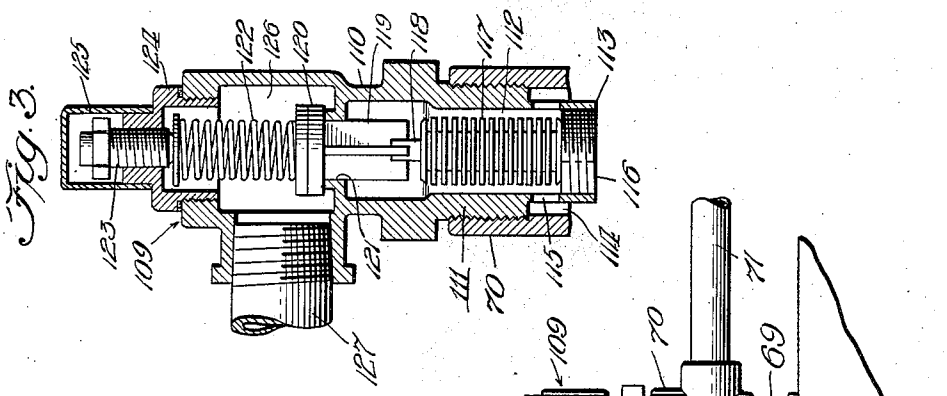


Fig. 2.

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UNITED STATES PATENT OFFICE

2,335,785

HEATING SYSTEM

Robert Edwin Moore, Park Ridge, Ill.

Application July 3, 1941, Serial No. 400,999

26 Claims. (Cl. 122—451)

My invention relates to continuously heated, hot water heating systems of the closed type, such as those which are hand or stoker fired, and is concerned primarily with an arrangement for preventing the boiler water from reaching an excessive temperature to thereby protect the boiler and auxiliary devices and controls.

In heating systems of the type indicated, the boiler water is subjected to continuous heat, as distinguished from the intermittent firing of gas or oil fired boilers in which the burner is readily controlled by a boiler aquastat. It has been ascertained that, notwithstanding that a continuously heated system may be provided with a relief valve that relieves water to a drain when the gage pressure in the system attains or exceeds thirty pounds per square inch, a condition may be created in which the temperature of the water is considerably in excess of that to which auxiliary controls such as aquastats, thermometers, and like devices may be safely subjected. To prevent destruction of these controls, the temperature of the boiler water should not exceed 235° F.

For example, with a relief valve setting of thirty pounds gage, it is possible to raise the water temperature to approximately 275° F. which is objectionable. In other words, under ordinary operating conditions, the boiler water may attain an excessive temperature at a pressure less than that at which the relief valve will open. The relief valve is, therefore, wholly ineffective to protect the system against a high water temperature.

As an illustrative condition, the pressure in the system may be of the order of twenty pounds gage, but the temperature of the boiler water may be 260° F. or more. Even though the system may be provided with the usual reducing valve for automatically introducing cold water into the system, such an arrangement would not operate to correct this situation, since these valves are normally set to operate at a pressure of about twelve pounds per square inch.

Overheating presents a serious operating and economic problem in numerous localities because where the service water is indirectly heated by the boiler water to a temperature in excess of 140° F., deposits of lime and sediment are formed rapidly in the coils or tubes of the heater, 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. Moreover, in those systems which include a valve in the supply line leading to the radiators, which valve may be motor operated or opened in response to pump pressure under the control of a room thermostat, the temperature rise in the boiler may be accelerated, during periods when the valve is closed, by the fact that the valve confines the boiler water to a relatively small space.

It is, therefore, one object of my invention to provide means for automatically preventing overheating of the water in a hot water boiler by utilizing the cold water supply as a cooling agent and providing for a controlled introduction of the cold water into the boiler and an evacuation of a portion of the hot water.

A further object is to prevent overheating by an arrangement of the character indicated which is thermally responsive to the temperature of the boiler water.

A further object is to prevent overheating by introducing cold water into the system when the temperature of the boiler exceeds a predetermined amount and to discharge a portion of the hot water through a relief valve at the set pressure of this valve.

A further object is to devise an apparatus for preventing overheating in which separate valves for respectively introducing cold water into the system and evacuating hot water therefrom are operably responsive to the functioning of a temperature relief valve that is responsive to the temperature of the boiler water.

A further object is to relieve hot water and pressure from a heating system by an arrangement including two, series related, pressure relief valves in which one of the valves is not restrained by a spring and is adapted to open quickly in response to pressure freed by the other valve.

A further object is to provide an apparatus which may be readily attached to any hot water boiler and which includes controls responsive to the temperature and pressure of the boiler water.

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 a front elevation of a typical hot water heating boiler equipped with my improved apparatus.

Fig. 2 is an enlarged, sectional elevation of the apparatus shown in Fig. 1.

Fig. 3 is a sectional elevation of a temperature relief valve employed with my apparatus.

Referring to the drawings, the numeral 68 indicates a hot water heating boiler of the continuously fired type, stoker firing being illustrated in this instance, although hand firing may be employed. From the upper portion of the boiler extends a riser pipe 69 which is connected to one branch of a four-way fitting 70. A second branch of this fitting has connected thereto one end of a supply pipe 71 which delivers hot water to any number of radiators (not shown). The system may also include the usual circulating pump and operating controls, but as these details form no part of the invention, they have not been illustrated.

A third branch of the fitting 70 has one end of a pipe 72 connected thereto, the opposite end of this pipe being connected to a chamber 73 (see Fig. 2) formed in the lower casing part of a primary relief valve 74. From an intermediate part of the pipe 72 extends a pipe 75 that communicates with a chamber 76 provided in the lower portion of a standard pressure relief valve 77, this chamber being located below the usual diaphragm 78. As hereinafter described, the valve 77 has a piloting relation to the valve 74. Secured to the under side of the diaphragm 78 is a valve 79 which controls flow of water through a port 80 formed in the lower portion of the valve 77 and which communicates with the upper end of a pipe 81. The valve 79 normally closes the port 80 under the impulse of a helical spring 82, the lower end of which bears against the upper side of the diaphragm 78, while the opposite end of the spring abuts the inside of the cover 83. If desired, the valve 79 may be arranged for manual opening by means of the usual handle 84 and linkage connected to the diaphragm 78. The spring 82 is normally set to load the diaphragm at a pressure of thirty pounds per square inch, so that when the boiler pressure exceeds this setting, it will actuate the diaphragm 78 to open the valve 79 and relieve hot water into the pipe 81. In this connection, it will be understood that boiler pressure is at all times effective in the riser 69, fitting 70, pipes 72 and 75, and the chambers 73 and 76.

Water at boiler pressure which is relieved into the pipe 81 passes downwardly into a chamber 82^a included between a cover 83^a attached to the casing of the valve 74 and a diaphragm 84^a that is secured between the casing and cover. The upper end of a valve stem 85 is secured to the diaphragm 84^a while the opposite end carries a valve 86 which normally closes a port 87 formed in the lower wall of the chamber 73. Beneath the diaphragm 84^a, a second diaphragm 88 having a smaller area than the diaphragm 84^a is secured to the stem 85, the periphery of the diaphragm 88 resting on and being clamped against an annular wall 89 by means of a ring 90, the wall 89 forming a part of the casing for the valve 74.

At pressures below the relieving pressure of the valve 77, the valve 86 is held in the closed position illustrated in Fig. 2 by means of boiler pressure operating on the under side of the diaphragm 84^a, and when valve 86 is opened as hereinafter described, a portion of the hot boiler water is discharged to a drain pipe 91 that is secured to the lower portion of the casing of the valve 74.

One end of a pipe 92 is connected to an intermediate portion of the pipe 81, while the opposite end thereof communicates with the interior of a cover 93 forming part of a standard pressure reducing valve 94. The cover 93 is secured to a casing 95 and clamped between these parts is a diaphragm 96. From the foregoing, it will be understood that pressure acting in the pipe 92 is also effective against the upper side of the diaphragm 96.

Depending from the under side of the diaphragm 96 is a valve 97 that normally closes a valve port 98 provided in a wall 99 which divides the interior of the casing 95 into an inlet chamber 100 and a discharge chamber 101, the former of which is in communication with a cold water supply pipe 102 in which the pressure may be that of an ordinary city main, i. e., generally of the order of about twenty-two pounds per square inch. The chamber 101 is so located with reference to the diaphragm 96 that at a predetermined pressure therein, the diaphragm 96 will be deflected to close the valve 97. The diaphragm 96 is loaded by one end of a helical spring 103 with the opposite end abutting the interior of the cover 93. In accordance with standard practice, it is contemplated that this spring will be set to open the valve 97 when the pressure in the chamber 101 reaches or falls below about twelve pounds per square inch, but this adjustment may be varied as desired.

One branch of a four-way fitting 104 communicates with the chamber 101 and the opposite branch of the same fitting communicates with a chamber 105 which is formed in the casing of the valve 74 between the diaphragms 84^a and 88. The other opposite branches of the same fitting are connected, respectively, to the return line 72^a from the radiators and to a pipe 106 which delivers the radiator return water, or a mixture thereof with cold water, as hereinafter described, to the lower portion of the boiler.

One end of a dribble pipe 107 is connected to an intermediate part of the pipe 92 while the other end of the pipe 107 may be connected to the drain pipe 91. The pipe 107 incorporates a valve 108 which is so adjusted that when water at boiler pressure is delivered into the pipe 81, the valve 108 will exercise such a throttling effect on the water tending to flow through the pipe 107 that substantially all of the pressure released by the valve 77 will be effective against the diaphragms 84^a and 96. When the valve 77 closes, the pipe 107 slowly relieves the pressure in the chamber 82^a and the interior of the cover 93.

The system also provides for relieving the boiler at pressures either above or below the setting of the relief valve 77; this result is accomplished by a device that is responsive to the temperature of the boiler water. Such a device is indicated by the numeral 109 which is a temperature relief valve and is more clearly illustrated in Fig. 3.

This valve comprises a casing 110 whose lower end is formed as a sleeve 111 that is threaded in one of the branches of the fitting 70. The sleeve 111 is provided with a central passage 112 and the lower end of the sleeve 110 has its outer diameter reduced to form a shell 113. Because of the reduced diameter of this shell, an annular passage 114 is formed between the shell and the fitting branch. Communication between the passages 112 and 114 is provided by means of a plurality of ports 115 formed in the shell 113. The lower end of the shell 113 is closed by a plug 116 and secured thereto is the lower end of a thermostatic element 117 of the bellows type whose diameter is less than the diameter of the passage 112. Accordingly, hot water flowing through the ports 115 completely bathes the external sur-

face of the bellows. The bellows is filled with alcohol or any of the liquids commonly used in thermostats of this type, the arrangement being such that at the adjusted temperature, the bellows will elongate and actuate a valve presently described.

The other end of the bellows 117 is provided with a stem 118 which fits within and abuts the lower end of a multi-winged guide 119 that depends from a valve 120. This valve controls the water flow through a port 121 within which the guide 119 moves. The valve 120 is normally seated by a helical spring 122 whose lower end abuts the valve 120 while the opposite end is loaded by a set screw 123 that is threaded in a plug 124 carried by the upper end of the casing 110. Leakage around the screw 123 is prevented by a cover 125.

The temperature relief valve discussed above in and of itself forms no part of the invention and is generally of the standard type now commonly employed in the industry. This valve may be adjusted to relieve the boiler at any desired temperature, and for purpose of present discussion, it will be assumed that the valve 120 will be opened by the bellows 117 at a boiler temperature of about 235° F., regardless of the pressure then existing in the boiler, i. e., higher or lower than the setting of the relief valve 77.

Hot water flowing through the port 121 is delivered into a chamber 126 and thence through a pipe 127 to the interior of the cover 93 where the boiler pressure becomes effective against the upper surface of the diaphragm 96, or in other words, is additive to the pressure exerted on this diaphragm by the spring 103. The result is that the valve 97 is opened by the spring 103 and the boiler pressure acting directly against the valve 97 since the boiler pressure is then equalized on both sides of the diaphragm 96 and, if the water pressure in the pipe 102 is higher than the boiler pressure, cold water will flow through the port 98 into the chamber 101 and thence to the pipe 106 where it is preheated by mixing with warm water returning from the radiators preliminary to being introduced into the boiler. By this expedient, it is possible to avoid an excessive temperature differential between the hot water in the upper part and the relatively cold water then entering the lower part of the boiler. The boiler is therefore not subjected to excessive racking strains.

Water which is delivered to the interior of the cover 93 by means of the pipe 127 also flows through the pipe 92 into the chamber 82^a so that even though the relief valve 77 is closed, boiler pressure acts against the upper surface of the diaphragm 84^a. Cold water flowing through the fitting 104 also passes into the chamber 105 and since as soon as this water flows through the valve 94, it becomes subject to boiler pressure, the latter is also effective against the under surface of the diaphragm 84^a and the top surface of the diaphragm 88. Boiler pressure also acts through the chamber 73 against the under side of the diaphragm 88 and hence, under the stated conditions, the forces acting on the respective diaphragms are substantially balanced. However, boiler pressure acts directly on the valve 86 and unbalances the system of forces operative on the diaphragms sufficiently to open the valve 86 and discharge a portion of the high temperature water from the boiler. In this connection, it will be noted that while the unit pressure is the same on opposite sides of the diaphragm 84^a, the total force acting on the upper side of the diaphragm is slightly greater than that on the lower side because of the stem 85. However, since the top area of the diaphragm is large in relation to the cross-sectional area of the stem, it may be considered that the total pressures on opposite sides of the diaphragm are substantially balanced. In any case, the small differential pressure acts in a direction to open the valve 86.

Due to the fact that when the system is operating the valve 86 can only be closed by boiler pressure operating against the under side of the diaphragm 84^a, provision must be made for insuring the closing of this valve when the system is first filled since at this time there is no pressure in the boiler. Under these conditions, the valve 97 is opened by the spring 103 and cold water flows through the port 98 and pipe 106 into the boiler and also into the chamber 105 where its pressure acts upwardly on the diaphragm 84^a and downwardly on the diaphragm 88. However, since the diaphragm 84^a is larger than the diaphragm 88, the total upward force acting on the stem 85 is greater than the total downward force thereon, so that this force differential maintains the valve 86 closed during the filling operation. When the system has been filled, the valve 97 is closed by the system pressure acting on the underside of the diaphragm 96 and thereafter until either the valve 77, or the valve 109, opens, or both, the valve 86 is held closed by the system pressure operative against the underside of the diaphragm 84^a.

The operation of the system is as follows. At a boiler pressure substantially equal to or in excess of the setting of the valve 77, the boiler will be relieved by opening of the valve 79 to thereby cause a sudden discharge of boiler water at boiler pressure into the chamber 82^a, and against the diaphragm 84^a. This diaphragm is substantially balanced and the diaphragm 88 is then balanced by oppositely acting forces for reasons already noted and since boiler pressure is effective in the pipe 106 and chamber 105. The valve 86 will therefore be opened by the boiler pressure acting directly. In this action, the relief valve 77 has a piloting relation to the primary relief valve 74 and, due to the fact that the operation of the latter is unrestrained by a spring, a larger quantity of water can be evacuated from the boiler in a given period of time and at a stated pressure than is possible with the standard type of relief valve indicated by the numeral 77. When the pressure in the boiler after such an evacuation has fallen below the setting of the valve 77, the latter valve will be closed by the spring 82 and the pressure in the chamber 82^a will be relieved through the pipe 107. The valve 86 will then be returned to the closed position illustrated in Fig. 2 by boiler pressure operating against the under surface of the diaphragm 84^a.

Under the assumed condition of a cold water pressure of about twenty-two pounds per square inch in the pipe 102, no cold water could be admitted to the system even though the valve 97 may be opened by the spring 103 and the boiler pressure acting against the valve 97. This result is due to the fact that at this time the boiler pressure is of the order of thirty pounds or more per square inch. However, it is deemed to be within the scope of this invention to have a pressure available in the pipe 102 higher than the maximum pressure obtainable in the boiler having due regard to the setting of the valve 77. This increased cold water pressure may be ob-

tained by the use of a pump (not shown) and would necessitate a heavier loading on the spring 103.

When the boiler water reaches a temperature equal to or in excess of 235° F. regardless of the pressure in the boiler, the valve 109 will open to thereby apply boiler pressure to the upper side of the diaphragm 96 and thus enable the spring 103 and boiler pressure in the chamber 101 to open the valve 97 and permit the entrance of cold water if the latter's pressure is higher than the boiler pressure and to also open the valve 86 and permit the discharge of a portion of the hot water from the boiler. It will be understood that under conditions of temperature relief of the boiler, the valve 108 exercises the same throttling action on the water flowing from within the cover 93 to the pipe 81 and which tends to escape through the pipe 107 as obtains when the valve 77 opens. When the valve 109 closes, the pressure within the cover 93 and in the chamber 82 is slowly relieved by the valve 108 and the valve 86 then closes. The pipe 107 may also be effective to discharge small quantities of water in relation to the discharge capacity of the valve 86 for small openings of the valves 77 or 109.

The pressure and temperature relief controls above described may operate separately or simultaneously depending upon the operative conditions in the system and may be adjusted for other pressures and temperatures, respectively, than those indicated.

While the invention has been discussed in connection with hand or stoker fired boilers, it will be understood that it is not restricted to arrangements of this character, and that these terms are intended to be generally representative of any boiler forming part of a hot water heating system which is subjected to continuous firing.

It should be noted that the diaphragm 88 is merely a convenient arrangement for separating the chambers 73 and 105 so that sufficient pressure can be built up in the chamber 105 during filling of the boiler to close the valve 86 by this pressure acting against the diaphragm 84a and so that when either or both of the valves 77 and 109 opens, the forces acting on opposite sides of the diaphragm 84a will be substantially equal. It is considered to be within the scope of the invention and the full equivalent of the diaphragm 88 to use a simple dividing wall between the chambers 73 and 105 in conjunction with suitable packing around the stem 85.

I claim:

1. In a hot water heating system, the combination of a boiler, and means for preventing overheating of the boiler comprising first and second valves pressure operated in an opening direction for respectively controlling a cold water supply to the boiler and the discharge of hot water from the boiler, and thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening both valves by applying boiler pressure thereto.

2. In a hot water heating system, the combination of a boiler, and means for preventing overheating of the boiler comprising first and second valves pressure operated in an opening direction for respectively controlling a cold water supply to the boiler and the discharge of hot water from the boiler, thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening both valves by applying boiler pressure thereto, and means responsive to boiler pressure for returning the second valve to closed position.

3. In a hot water heating system, the combination of a boiler, and means for preventing overheating of the boiler comprising a diaphragm, a valve secured to one side thereof for controlling a cold water supply to the boiler, a casing having an intermediate chamber communicating with the boiler and the valve side of the diaphragm and including two movable wall portions, a second chamber communicating with the opposite side of the diaphragm and including one of the wall portions, a third chamber communicating with the boiler and including the other wall portion and a valve port communicating with a drain, a relief valve having a stem connected to both wall portions for controlling flow through the port, boiler pressure acting against said one wall portion to normally close the relief valve, and thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening the diaphragm and relief valves by applying boiler pressure thereto, the pressure on opposite sides of the wall portions being substantially balanced.

4. In a hot water heating system, the combination of a boiler, and means for preventing overheating of the boiler comprising a diaphragm, a valve secured to one side thereof for controlling a cold water supply to the boiler, a casing having an intermediate chamber communicating with the boiler and the valve side of the diaphragm and provided with a large and a small diaphragm located in opposed relation, a second chamber communicating with the opposite side of the first named diaphragm and including the large diaphragm, a third chamber communicating with the boiler and including the small diaphragm and a valve port communicating with a drain, a relief valve having a stem connected to the large and small diaphragms for controlling flow through the port, boiler pressure acting against the large diaphragm to normally close the relief valve, and thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening the diaphragm and relief valves by applying boiler pressure thereto, the boiler pressure on opposite sides of the large and small diaphragms, respectively, being substantially balanced when the relief valve is opened and cold water discharged by the diaphragm valve during filling of the boiler acting on the intermediate chamber side of the large diaphragm to close the relief valve.

5. In a hot water heating system, the combination of a boiler, and means for preventing overheating of the boiler comprising separate boiler pressure operated means for respectively controlling a coldwater supply to the boiler and the discharge of hot water from the boiler, and valve means responsive to and opening at a predetermined temperature of the boiler water for opening said separate means by applying boiler pressure thereto.

6. In a hot water heating system, the combination of a boiler, and means for preventing overheating of the boiler comprising a valve controlling a cold water supply to the boiler, a relief valve for discharging hot water to a drain, and thermostatic means responsive to a predetermined temperature of the boiler water, both valves opening in response to the actuation of the thermostatic means.

7. Apparatus for preventing overheating of the boiler of a heating system comprising a casing

having a pair of communicating chambers, one chamber constituting a cold water supply and the other being arranged for connection to a boiler, a valve controlling communication between the chambers, a relief valve opening to a drain for evacuating a portion of the hot water in the boiler, and means responsive to a predetermined temperature of the boiler water, both valves opening in response to the actuation of the means.

8. In a hot water heating system, the combination of a boiler, and means for preventing overheating of the boiler comprising a diaphragm, a valve secured to one side thereof for controlling a cold water supply to the boiler, a casing having an intermediate chamber communicating with the boiler and the valve side of the diaphragm and including two movable wall portions, a second chamber communicating with the opposite side of the diaphragm and including one of the wall portions, a third chamber communicating with the boiler and including the other wall and a valve port opening to a drain, a relief valve having a stem connected to both wall portions for controlling flow through the port, boiler pressure acting against said one wall portion to normally close the relief valve, thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening the diaphragm and relief valves by applying boiler pressure thereto, the pressure on opposite sides of the wall portions being substantially balanced when the thermostatic means opens, and a bleeding port for slowly reducing the pressure in the second chamber when the thermostatic means closes.

9. Apparatus for preventing overheating of the boiler of a heating system comprising a diaphragm, a valve secured to one side thereof for controlling a cold water supply to the boiler, a casing having an intermediate chamber communicating with the boiler and the valve side of the diaphragm and including two movable wall portions, a second chamber communicating with the opposite side of the diaphragm and including one of the wall portions, a third chamber communicating with the boiler and including the other wall portion and a valve port opening to a drain, a relief valve having a stem connected to both wall portions for controlling flow through the port, boiler pressure acting against said one wall portion to normally close the valve, and thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening the diaphragm and relief valves by applying boiler pressure thereto, the pressure on opposite sides of the respective wall portions being substantially balanced when the thermostatic means opens.

10. Apparatus for preventing overheating of the boiler of a heating system comprising a diaphragm, a valve secured to one side thereof for controlling a cold water supply to the boiler, a casing having an intermediate chamber communicating with the boiler and the valve side of the diaphragm and provided with a large and a small diaphragm located in opposed relation, a second chamber communicating with the opposite side of the fire named diaphragm and including the large diaphragm, a third chamber communicating with the boiler and including the small diaphragm and a valve port opening to a drain, a relief valve having a stem connected to the large and small diaphragms for controlling flow through the port, boiler pressure acting against the large diaphragm to normally close the relief valve, and thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening the diaphragm and relief valves by applying boiler pressure thereto, the pressure on opposite sides of the large and small diaphragms being substantially balanced when the thermostatic means opens and the cold water discharged by the diaphragm valve acting on the intermediate chamber side of the large diaphragm to close the relief valve during filling of the boiler.

11. In a hot water heating system, the combination of a boiler, and means for relieving the boiler at a predetermined pressure comprising a pilot relief valve boiler pressure operated in an opening direction at said predetermined pressure and spring actuated to closure, a primary relief valve having an intermediate chamber communicating with the boiler and provided with two movable wall portions, a second chamber communicating with the discharge side of the pilot valve and including one of the wall portions, a third chamber communicating with the boiler and including the other wall portion and a valve port opening to a drain, and a valve element having a stem connected to both wall portions for controlling the flow through the port, boiler pressure acting against the intermediate chamber side of said one wall portion to normally move the valve element to a closed position, the boiler pressure on opposite sides of the respective wall portions being substantially balanced when the pilot valve opens and the valve element being opened by boiler pressure acting directly thereagainst.

12. In a hot water heating system, the combination of a boiler, and means for relieving the boiler at a predetermined pressure comprising a pilot relief valve boiler pressure operated in an opening direction at said predetermined pressure and spring actuated to closure, and a primary relief valve having an intermediate chamber communicating with the boiler and provided with a large and a small diaphragm located in opposed relation, a second chamber communicating with the discharge side of the pilot valve and including the large diaphragm, a third chamber communicating with the boiler and including the small diaphragm and a valve port opening to a drain, and a valve element having a stem connected to both diaphragms for controlling flow through the port, boiler pressure acting against the intermediate chamber side of the large diaphragm to normally hold the valve element in closed position and the pressure on opposite sides of the respective diaphragms being substantially balanced when the pilot valve opens to thereby open the valve element by boiler pressure acting directly thereagainst, the element being closed during filling of the boiler by pressure against the intermediate chamber side of the large diaphragm.

13. In a hot water heating system, the combination of a boiler, and means for relieving the boiler at a predetermined pressure comprising a pair of series related valves, one valve being spring actuated to closure and opening at said predetermined pressure and the other valve comprising an intermediate chamber communicating with the boiler and including a pair of oppositely disposed diaphragms, a second chamber communicating with the discharge side of the first named valve and including one of the diaphragms, and a third chamber communicating

with the boiler and including the other diaphragm and a valve port opening to a drain, and a valve element having a stem connected to both diaphragms for controlling flow through the port, boiler pressure acting against the intermediate side of said first named diaphragm to normally hold the valve element in closed position and pressure on opposite sides of the respective diaphragms being substantially balanced when the first named valve is opened to thereby open the valve element by boiler pressure acting directly thereagainst.

14. Apparatus for relieving a hot water heating boiler at a predetermined pressure comprising a pilot relief valve operable in an opening direction at and by said predetermined pressure and spring actuated to closure, and a primary relief valve having an intermediate chamber communicating with the boiler and provided with a pair of movable wall portions, a second chamber communicating with the discharge side of the pilot valve and including one of the wall portions, a third chamber communicating with the boiler and including the other wall portion and a valve port opening to a drain, and a valve element having a stem connected to both wall portions for controlling flow through the port, boiler pressure acting against the intermediate chamber side of the first named wall portion to normally hold the element in closed position and the pressure on opposite sides of the respective wall portions being substantially balanced when the pilot valve opens to thereby open the valve element by boiler pressure acting directly thereagainst.

15. Apparatus for relieving a hot water heating boiler at a predetermined pressure comprising a pilot relief valve operable in an opening direction at and by said predetermined pressure and spring actuated to closure, and a primary relief valve having an intermediate chamber communicating with the boiler and including a large and a small diaphragm located in opposed relation, a second chamber communicating with the discharge side of the pilot valve and including the large diaphragm, a third chamber communicating with the boiler and including the small diaphragm and a valve port opening to a drain, and a valve element having a stem connected to both diaphragms for controlling flow through the port, boiler pressure acting against the intermediate chamber side of the large diaphragm to normally hold the element in closed position and pressure on opposite sides of the respective diaphragms being substantially balanced when the pilot valve opens to thereby open the valve element by boiler pressure acting directly thereagainst, the element being closed during filling of the boiler by pressure against the intermediate chamber side of the large diaphragm.

16. In a hot water heating system, the combination of a boiler, and means for preventing overheating of the boiler by introducing cold water into and discharging a portion of the hot water from the boiler at a predetermined pressure comprising a valve controlling a cold water supply to the boiler and boiler pressure operated in an opening direction, a pilot relief valve operable in an opening direction at and by said predetermined pressure and spring actuated to closure, and a primary relief valve having an intermediate chamber communicating with the boiler and including two movable wall portions, a second chamber communicating with the discharge side of the pilot valve and including one of the wall portions, a third chamber communicating with the boiler and including the other wall portion and a valve port opening to a drain, a valve element having a stem connected to both wall portions for controlling flow through the port, boiler pressure acting against the intermediate chamber side of the said one wall portion to normally hold the element in closed position and the pressure on opposite sides of the respective wall portions being substantially balanced when the pilot valve opens to thereby open the element by boiler pressure acting directly thereagainst.

17. Apparatus for relieving a hot water heating boiler at a predetermined pressure comprising a pilot relief valve operable in an opening direction at and by said predetermined pressure and spring actuated to closure, and a primary relief valve having an intermediate chamber communicating with the boiler and provided with a pair of movable wall portions, a second chamber communicating with the discharge side of the pilot valve and including one of the wall portions, a third chamber communicating with the boiler and including the other wall portion and a valve port opening to a drain, and a valve element having a stem connected to both wall portions for controlling flow through the port, boiler pressure acting against the intermediate chamber side of the first named wall portion to normally hold the element in closed position and the pressure on opposite sides of the respective wall portions being substantially balanced when the pilot valve opens to thereby open the valve element by boiler pressure acting directly thereagainst, the second chamber including a bleeding port for slowly relieving the pressure therein after the pilot valve closes.

18. Apparatus for preventing overheating of a hot water heating boiler comprising a pilot relief valve operable at a predetermined boiler pressure, a temperature relief valve opening at a predetermined temperature of the boiler water, and a primary relief valve operably related to the discharge sides of the pilot and temperature relief valves and opening to relieve a portion of the boiler water to a drain when either or both of the last two named valves operate.

19. Apparatus for preventing overheating of a hot water heating boiler comprising a pilot relief valve opening at a predetermined boiler pressure, a temperature relief valve opening at a predetermined temperature of the boiler water, and a primary relief valve operable related to the discharge sides of the pilot and temperature relief valves and having a part pressure operated in an opening direction to relieve a portion of the boiler water to a drain when either or both of the two last named valves operate.

20. Apparatus for preventing overheating of a hot water heating boiler comprising a pilot relief valve opening at a predetermined boiler pressure, a temperature relief valve opening at a predetermined temperature of the boiler water, and a primary relief valve operably related to the discharge sides of the pilot and temperature relief valves and pressure operated in an opening direction to relieve a portion of the boiler water to a drain when either or both of the two last named valves operate, and means carried by the primary valve responsive to boiler pressure for closing the same.

21. Apparatus for relieving a hot water heating boiler at a predetermined pressure comprising a pilot relief valve operable in an opening

direction at and by said predetermined pressure and spring actuated to closure, and a primary relief valve having an intermediate chamber communicating with the boiler and provided with a movable wall portion, a second chamber communicating with the discharge side of the pilot valve and including the wall portion, a third chamber communicating with the boiler and including a valve port opening to a drain and separated from the intermediate chamber by a dividing wall, and a valve element having a stem extending through the dividing wall for connection to the wall portion for controlling flow through the port, boiler pressure acting against the intermediate chamber side of the wall portion to normally hold the element in closed position and the pressure on opposite sides of the wall portion being substantially balanced when the pilot valve opens to thereby open the valve element by boiler pressure acting directly thereagainst.

22. Apparatus for preventing overheating of the boiler of a heating system comprising a diaphragm, a valve secured to one side thereof for controlling a cold water supply to the boiler, a casing having an intermediate chamber communicating with the boiler and the valve side of the diaphragm and provided with a movable wall portion, a second chamber communicating with the opposite side of the diaphragm and including the wall portion, a third chamber communicating with the boiler and including a valve port opening to a drain and separated from the intermediate chamber by a dividing wall, a valve element having a stem extending through the dividing wall for connection to the wall portion for controlling flow through the port, boiler pressure acting against the wall portion to normally close the valve, and thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening the diaphragm actuated valve and valve element by applying pressure thereto, the pressure on opposite sides of the wall portion being substantially balanced when the thermostatic means opens.

23. Apparatus for preventing overheating of a hot water heating boiler comprising first and second valves pressure operated in an opening direction for respectively controlling a cold water supply to the boiler and the discharge of hot water from the boiler, and thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening both valves by applying boiler pressure thereto.

24. Apparatus for preventing overheating of a hot water heating boiler comprising first and second valves pressure operated in an opening direction for respectively controlling a cold water supply to the boiler and the discharge of hot water from the boiler, thermostatic valve means responsive to and opening at a predetermined temperature of the boiler water for opening both valves by applying boiler pressure thereto, and means responsive to boiler pressure for returning the second valve to closed position.

25. Apparatus for preventing overheating of a hot water heating boiler comprising separate boiler pressure operated means for respectively controlling a cold water supply to the boiler and the discharge of hot water from the boiler, and valve means responsive to and opening at a predetermined temperature of the boiler water for opening said separate means by applying boiler pressure thereto.

26. In a hot water heating system having a boiler, apparatus for preventing overheating of the boiler comprising a valve controlling a cold water supply to the boiler, a relief valve for discharging hot water to a drain, and thermostatic means immersed in and responsive to a predetermined temperature of the boiler water, both valves opening in response to the actuation of the thermostatic means.

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