

Sept. 17, 1957

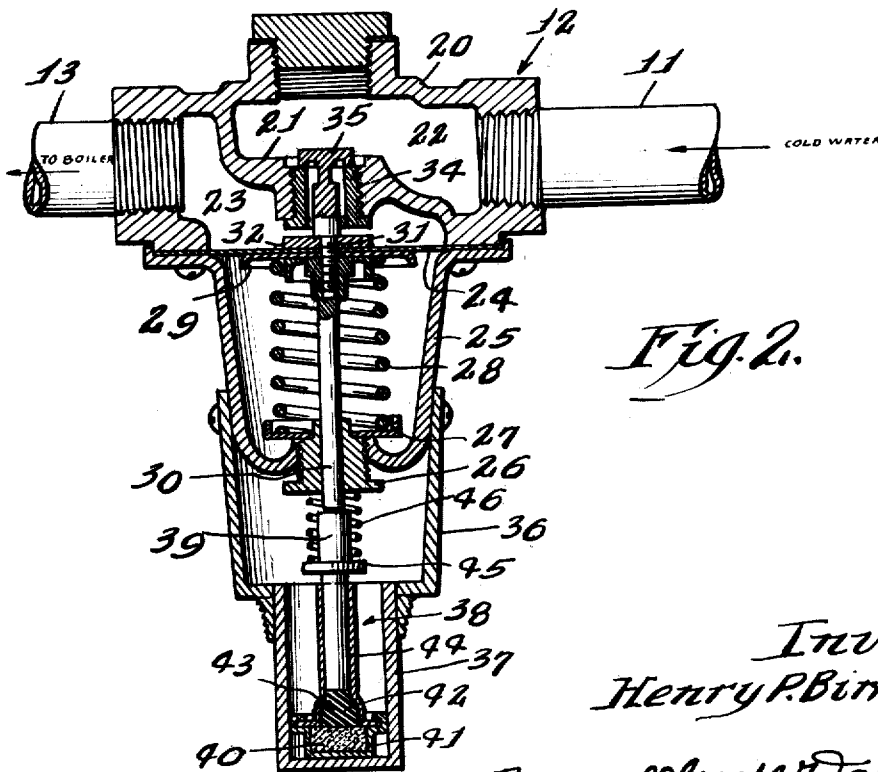
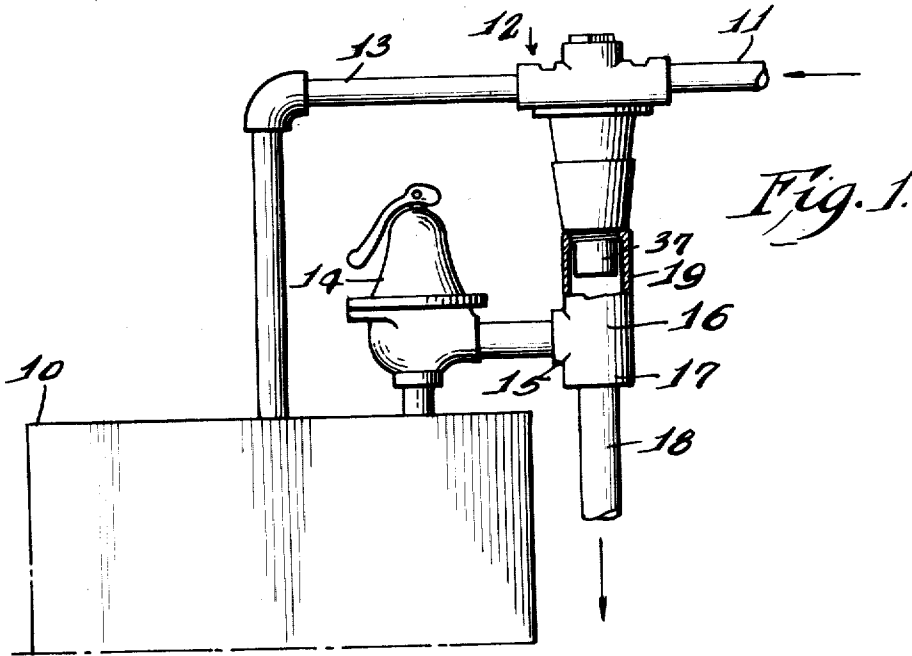
H. P. BIRKEMEIER

2,806,455

APPARATUS FOR PREVENTING OVERHEATING OF A HOT WATER BOILER

Filed Feb. 12, 1953

3 Sheets-Sheet 1



Inventor:
Henry P. Birkemeier

By. John W. Darley
Attorney.

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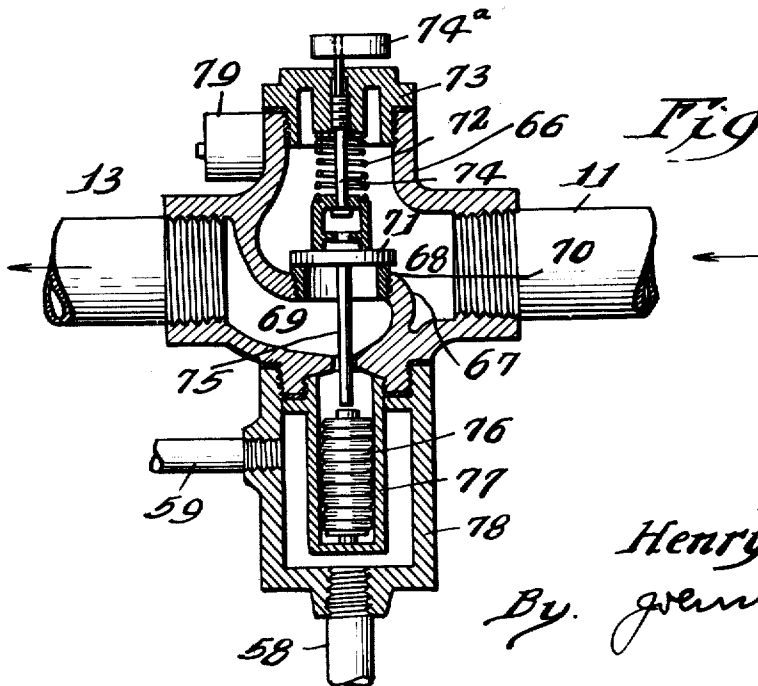
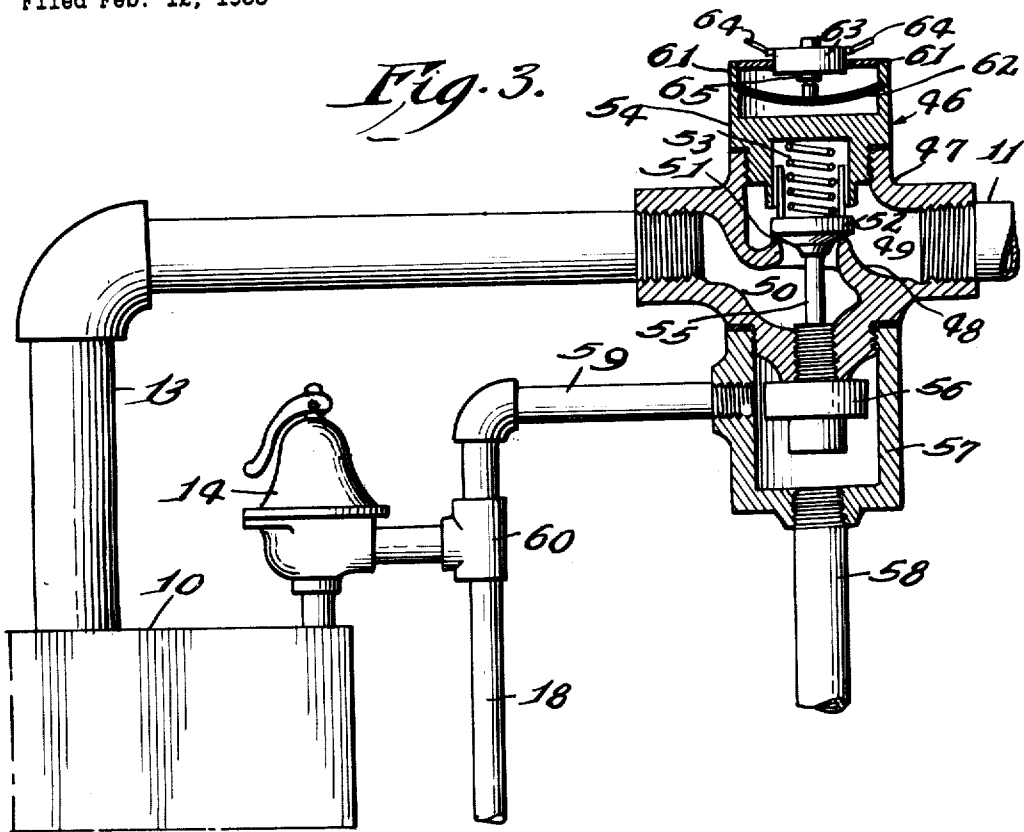
H. P. BIRKEMEIER

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APPARATUS FOR PREVENTING OVERHEATING OF A HOT WATER BOILER

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3 Sheets-Sheet 2



Inventor.
Henry P. Birkemeier.
By. *James W. Darley*
Attorney.

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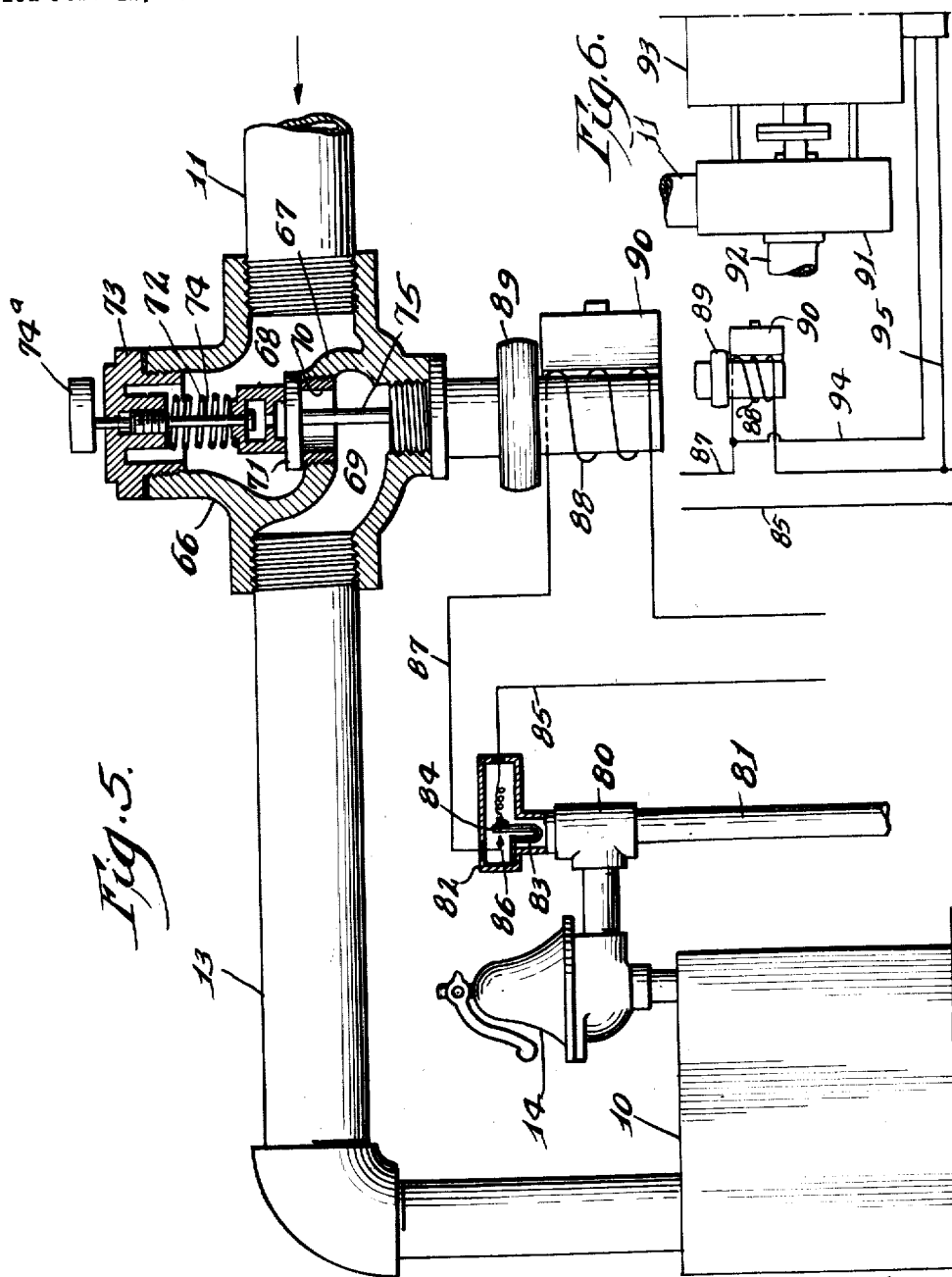
H. P. BIRKEMEIER

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APPARATUS FOR PREVENTING OVERHEATING OF A HOT WATER BOILER

Filed Feb. 12, 1953

3 Sheets-Sheet 3



Inventor.
Henry P. Birkemeier.

By. *John W. Farley*
Attorney.

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2,806,455

APPARATUS FOR PREVENTING OVERHEATING OF A HOT WATER BOILER

Henry P. Birkemeier, Chicago, Ill., assignor to Bell & Gossett Company, Morton Grove, Ill., a corporation of Illinois

Application February 12, 1953, Serial No. 336,571

15 Claims. (Cl. 122—504)

My invention relates to an apparatus for preventing overheating of a hot water boiler by insuring a supply of cold water thereto under controlled conditions.

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 provide an apparatus for preventing overheating of a hot water boiler by automatically introducing cold water into the boiler when either steam or water at a temperature sufficiently high to flash into steam is discharged through the usual pressure relief valve that is commonly associated with such a boiler.

A further object is to provide an apparatus as indicated above which includes in the cold water supply pipe a pressure reducing valve of characteristic construction for automatically feeding cold water to the boiler whenever the pressure therein is less than the cold water pressure, but is additionally modified to insure a thermally controlled opening of the reducing valve when steam exists on the discharge side of the relief valve.

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A further object is to provide an apparatus for preventing overheating whose control on the supply of cold water to the boiler is independent of boiler pressure and occurs when the relief valve discharges boiler fluid at a selected temperature.

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 boiler showing one form of the improved apparatus applied thereto.

Fig. 2 is an enlarged, sectional elevation of the thermally responsive, pressure reducing valve shown in Fig. 1.

Fig. 3 is an elevation, partly in section and similar to Fig. 1, but showing a different type of cold water supply valve.

Fig. 4 is a sectional elevation of a further modified cold water supply valve.

Fig. 5 is an elevation, partly in section and partly diagrammatic, showing a further modification.

Fig. 6 schematically shows an arrangement which may be embodied in the apparatus shown in Fig. 5 as a means of boosting the pressure of the cold water supply where such pressure is lower than that of the boiler.

Referring to Figs. 1 and 2 of the drawings, the numeral 10 designates a hot water boiler of conventional type which, if forming part of a heating system, would be connected thereto by the usual supply and return pipes (not shown). A cold water supply pipe 11, connected to a source of water under pressure such as a city main, has its delivery end in communication with the inlet of a specially arranged pressure reducing valve, generally indicated by the numeral 12, and the outlet of this valve connects by a pipe 13 with the upper part of the boiler 10.

A pressure relief valve 14 of usual construction has its inlet connected to the upper part of the boiler 10 and its outlet connected to the lateral branch 15 of a T fitting 16. The pressure relief valve is spring-biased to closed position and may, for example, be of the type shown at 77 in Moore Patent No. 2,335,785, granted November 30, 1943. One axial branch 17 of this fitting is connected to a drain pipe 18 while the other axial branch 19 is threaded to receive an extension carried by the reducing valve 12 as presently described.

Referring to Fig. 2, the reducing valve 12 includes a housing 20 which is interiorly divided by a wall 21 to form a chamber 22 communicating with the cold water pipe 11 and a chamber 23 communicating with the pipe 13. The chamber 23 is partially defined by a diaphragm 24 that bridges an opening on the lower side of the housing 20 and whose periphery is clamped to the housing by the upper and outwardly flanged end of a casing 25 that depends from the housing. Accordingly, the diaphragm is responsive on its upper side, as viewed in Fig. 2, to boiler pressure in the chamber 23.

The lower end of the casing 25 is apertured to threadingly receive a plug 26 whose upper end within the casing 25 is abutted by a spring washer 27 on which seats one end of a helical spring 28 whose opposite end bears against a washer 29 clamped to the under side of the diaphragm 24. The lower end of a rod 30 is slidable through the plug 26 and its upper end is enlarged to threadingly receive the lower end of a valve stem 31, the enlarged end of the rod 30 acting as a nut to clamp the diaphragm 24 between the washer 29 and a disk 32 on the upper side of the diaphragm.

The stem 31 extends upwardly through the disk 32 and freely through a bushing 34 that is threaded through the wall 21 in coaxial relation to the diaphragm 24 and

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rod 30. The upper end of the bushing 34 serves as a valve seat for the upper end of the stem 31 which is headed to act as a valve element 35. It will be understood that there is sufficient clearance between the stem 31 and the bore of the bushing 34 to permit flow from the chamber 22 to the chamber 23 when the valve element 35 is raised.

So far as described, the pressure reducing valve 12 is substantially of conventional construction in that the spring 28 will raise the valve element 35 to open position and permit cold water to flow to the boiler whenever the pressure therein is sufficiently low and the boiler can receive water, but when the boiler pressure is sufficiently high, it acts against the diaphragm 24 to move the valve element to closed position. The latter is the position shown in Fig. 2.

The essence of the invention resides in the provision of a thermally responsive member for opening the valve element 35 under a condition where the boiler may require water to prevent overheating but its pressure may be so high that the spring 28 is unable to open the valve element. This condition may arise where a water line has developed in the boiler due to loss through the relief valve 14 and the continued input of heat to the boiler has caused steam to be discharged through this valve, or where, although the boiler is full, the heat input has raised the temperature of the boiler water to a point that, when discharged through the relief valve, it flashes into steam at atmospheric pressure.

Still referring to Fig. 2, an extension casing 36 depends from the lower end of the casing 25 and the lower extremity of the former casing carries a heat conducting, well portion 37 that extends within and is threaded to the T branch 19 (see Fig. 1), the portion 37 being spaced from the wall of the branch 19. Positioned within the well portion 37 is a thermally responsive member 38 having a push rod 39 aligned with the rod 30 and having one end slightly spaced from the adjacent end of the latter rod, the construction being such that when the member 38 is subjected to a predetermined temperature, the push rod 39 is moved upwardly a distance sufficient to engage the rod 30 and shift the valve element 35 to an open position. The clearance between the ends of the rods 30 and 39 is only that necessary to insure a full closure seating of the valve element when the member 38 is inactive.

There are many devices commercially available that will satisfy the functional requirements outlined above for the member 38 but, by way of example, the latter is illustrated as constructed according to U. S. Letters Patent No. 2,368,181, dated January 30, 1945. Briefly, the member 38 includes a temperature responsive body 40, as disclosed in U. S. Letters Patent No. 2,259,846, dated October 21, 1941, that is contained in a casing 41 formed of metal having a high heat conductivity. The body 40 is sealed in the casing 41 by a rubber plug 42 that is mounted in a restricted throat 43 provided in the lower end of a tube 44 that is secured to the casing 41. The push rod 39 is slidable in the tube 44 and its lower end rests on the upper end of the plug 42. Above the upper end of the tube 44, the push rod 39 is shouldered at 45 and encircling the rod 39 between the shoulder 45 and plug 26 is a helical spring 46 which places the rubber body 42 under substantial compression, all as described in the first noted patent above.

During normal operation, the pressure relief valve 14 and the valve element 35 may open and close from time to time as the boiler pressure varies to respectively relieve the boiler and admit cold water thereto, all in the usual and characteristic manner. The remainder of the apparatus functions to insure the admission of cold water to the boiler under a critical condition of overheating that may be created as discussed above. The continued input of heat to the boiler raises the pressure therein above that which may be overbalanced by the spring 28

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since this pressure acts against the enlarged area presented by the diaphragm 24. Hence, without the additional force provided by the thermally responsive member 38, as presently described, the valve element 35 could not open to admit cold water when most needed. During this period, the relief valve 14 is constantly or at short intermittent intervals discharging water which, if the boiler is not under regular observation, may quickly lead to an explosive situation.

In any case, the boiler water temperature continues to rise and if below 212° F. at the commencement of the period of sustained heat input, this temperature will soon be exceeded. Therefore, assuming a setting of the relief valve 14 of 30 p. s. i., when this valve opens to discharge boiler water having a temperature in excess of 212° F., this water flashes into steam which becomes incident upon the well portion 37 to thereby activate the thermally responsive member 38. The push rod 39 is then shifted upward to engage the rod 30 and open the valve element 35 to admit cold water to the boiler for cooling, it being assumed that the cold water supply pressure is then higher than the boiler pressure. It will be understood that the thermally responsive member 38 is so conditioned that it does not react to relief valve discharges having a temperature below 212° F. and that it therefore acts only under a critical condition of overheating.

In Fig. 3 is illustrated a variant form of the apparatus which embodies a modified type of globe valve in the cold water supply pipe that is characterized by a larger flow capacity than the valve 12 in Figs. 1 and 2, but lacks the pressure reducing feature of the latter valve. Parts common to Figs. 1 and 3 are designated by like numerals.

Referring to Fig. 3, the numeral 46 designates a modified form of globe valve which includes a housing 47 that is interiorly divided by a wall 48 to provide a chamber 49 that communicates with the delivery end of the cold water pipe 11 and a chamber 50 that communicates through the pipe 13 with the upper part of the boiler 10. The wall 48 is apertured to provide a valve seat 51 that is normally engaged by a valve 52 under the bias of a spring 53 interposed between the top of the valve and a cover 54 threaded in the upper part of the housing 47. The valve 52 is provided with a stem 55 that extends downwardly through the chamber 50 into operable relation to a thermally responsive member 56, similar to the member 38 in Fig. 2, whose upper portion is mounted in the lower wall of the housing 47. The responsive part of the member 56 is exposed within a casing 57 whose upper end is threaded to the housing 47 in sealable relation thereto and whose lower end has fastened thereto a drain pipe 58. Also communicating with the interior of the casing 57 is one end of a pipe 59 whose opposite end connects with a T fitting 60 that also carries the drain pipe 18 and is in communication with the discharge side of the relief valve 14.

Under normal operating conditions, the relief valve 14 may discharge boiler water to the drain pipe 18, but during a period of overheating, if the water discharged by the valve 14 flashes into steam, the latter will flow through the pipe 59 into contact with the thermally responsive member 56. Accordingly, the valve 52 will be opened to permit cold water to flow to the boiler and thereby replenish the water content and lower the temperature thereof. Steam discharged into the casing 57 is evacuated through the drain pipe 58.

As an auxiliary safety feature, the apparatus shown in Fig. 3 also includes a provision for insuring an interruption of the automatic firing means for the boiler in the event that there is a failure of or an inadequate pressure in the cold water supply. Specifically, opposed, spaced walls 61—61 extend upwardly from the cover 54 and bridged between these walls for an up and down flexing movement is a bimetal strip member 62. A switch 63 of any convenient type is carried by the walls 61 above the strip member 62 and it will be understood that the

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switch forms part of a power circuit including the wires 64—64 and the automatic firing means (not shown) for the boiler.

Since the housing 47 and cover 54 and casing 57 are made of metal, it will be apparent that when steam is discharged into the casing 57, not only will the valve 52 open but the indicated metal parts will become heated sufficiently to cause an upward flexing of the strip member 62 which engages a switch button 65 to open the burner circuit. This action will occur only if the cold water pressure is inadequate to feed water to the boiler because if this pressure is sufficient, the cover 54 will be cooled enough to prevent upward flexing of the strip member 62. In the position of the switch 63 as shown, it provides for a delayed interruption of the burner circuit; an earlier response can be obtained by mounting the interrupting means, including the strip member 62 and switch 63 on the side of the casing 57.

After the cause of the overheating has been remedied, the burner circuit is completed by a manual resetting of the switch 63 by moving the button 65 downwardly to thus return the strip member 62 to the position shown.

A variation of the apparatus illustrated in Figure 3 is shown in Fig. 4, the principal difference consisting in the use of a filled bellows as the thermal power element for opening the cold water valve. The Fig. 4 modification is connected to the boiler 10 in the manner shown in Fig. 3 so like parts are indicated by like numerals in these two figures.

Referring to Fig. 4, the valve housing 66 is interiorly divided by a wall 67 to form a chamber 68 that communicates with the delivery end of the cold water pipe 11 and a chamber 69 that connects through the pipe 13 with the boiler 10. The wall 67 is apertured to receive a bushing 70 having a valve seat that is normally engaged by a valve 71 biased to the closed position shown by a spring 72 interposed between the valve 71 and a cover plug 73 threaded in the upper part of the housing 66. If desired and as a means for manually lifting the valve 71 from its seat to admit cold water to the boiler, an intermediate part of a stem 74 may be threaded in the plug 73, with its upper end connected to a convenient handle 74^a and its lower end arranged to lift the valve 71 while permitting an independent upward movement thereof. This type of connection is well known in the art of pump actuated, flow control valves.

For opening the valve 71 in response to a steaming condition, a stem 75 depends therefrom and freely through an opening in the lower wall of the housing 66, the lower end of the stem being slightly spaced from the upper end of a bellows 76 that is filled with any of the suitable fluids commonly used in the bellows when employed as thermal power elements. The bellows 76 is carried in a well 77 whose upper end is threaded and sealed to the housing 66 and surrounding the well 77 in spaced relation thereto is a casing 78 whose upper end is also threaded and sealed to the housing 66. The delivery end of the pipe 59 communicates with the interior of the casing 78 and the drain pipe 58 connects with the lower portion of this casing.

During a period of overheating as above described, the extension of the bellows 76 will open the valve 71 and when the boiler has sufficiently cooled with accompanying cessation of steam flow through the pipe 59, the contraction of the bellows 76 will permit the valve 71 to close.

An automatic interruption of the burner circuit for the boiler may also be employed with the apparatus shown in Fig. 4. The device for this purpose is generally indicated by the numeral 79, it being attached to a convenient portion of the housing and including parts comparable to the strip member 62 and switch 63 as shown in Fig. 3.

A further variant arrangement is shown in Fig. 5 whose essential features may be applied to any of the previously described forms, but for convenience is shown in connection

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with the cold water valve illustrated in Fig. 4. Parts in Fig. 5 which are identical with those shown in Figs. 1, 3 and 4 are denoted by like numerals.

Referring to Fig. 5, the relief valve 14 discharges to a T fitting 80 having one axial branch connected to a drain pipe 81. The other axial branch communicates with the interior of a casing 82 which has suitably mounted therein an electric thermostat in the form of a bimetal member 83 having a freely movable arm 84 that connects by a wire 85 with a source of electricity. When a suitable temperature condition is established in the casing 82, the arm 84 bows and engages a contact 86 which connects by a wire 87 that includes a heating coil 88 with the electric power source. The bimetal member 83 and wires 85 and 87 are appropriately insulated from the casing 82.

The heating coil 88 surrounds and is in heat exchange relation with the lower portion of a thermally responsive member 89 which is similar to the members 38 and 56 and is operably related to the stem 75 which depends from the valve 71.

When water discharged by the relief valve 14 flashes into steam, as during a period of overheating, the rise in temperature in the casing 82 effects a closing of the circuit including the heating coil 88 and the valve 71 is opened in the manner previously described to admit cold water to the boiler. After the temperature in the casing 82 drops, the bimetal member 83 automatically opens the circuit and interrupts the application of heat to the thermally responsive member.

This modification may also include a safety switch member 90, similar to the member 79 and which is mounted in heat exchange relation to the heating coil 88. The member 90 would be included in the circuit of the automatic firing means for the boiler for reasons already noted.

In Fig. 6 is schematically illustrated a booster pump and the control therefor which may be embodied in the apparatus shown in Fig. 5 where the cold water supply pressure is lower than that of the boiler during a steaming condition. Parts in Fig. 6 which are identical with those in Fig. 5 are denoted by the same numerals.

A booster pump 91 has its intake connected to a water main 92 while its discharge connects with the cold water supply pipe 11. The pump 91 is driven by a motor 93 which is connected in parallel with the heating coil 88 through wires 94 and 95 that appropriately join with the wire 87.

When the bimetal arm 84 closes on the contact 86 to thereby heat the coil 88 as described in connection with Fig. 5, the pump 91 is also placed in operation so that the pressure of the cold water supply is raised sufficiently to insure delivery of cold water to the boiler where the pressure of the latter is higher than that of the available cold water supply.

I claim:

1. Apparatus for preventing overheating of a hot water boiler by admitting cold water thereto comprising a valve adapted to control flow through a cold water supply pipe leading to the boiler, a diaphragm connected to the valve and responsive to boiler pressure on the discharge side of the valve in a direction closing the same, spring means for opening the valve when the boiler pressure falls below a predetermined value, means independent of boiler pressure for opening the valve including thermal means responsive to the discharge from the boiler of boiler fluid having a temperature in excess of a predetermined temperature and characterized by an expansion movement at said temperature, and means mechanically actuated by the movement of the thermal means for opening the cold water valve.

2. Apparatus for preventing overheating of a hot water boiler by admitting cold water thereto comprising a pressure relief valve arranged for connection to the boiler and adjusted to open at a selected boiler pressure, a cold water

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supply pipe adapted to lead to the boiler, a valve in the cold water supply pipe, thermal means adapted to be responsive to a discharge by the relief valve of boiler water having a temperature in excess of a predetermined temperature, and means actuated by the thermal means at said temperature for opening the cold water valve.

3. Apparatus for preventing overheating of a hot water boiler by admitting cold water thereto comprising a pressure relief valve arranged for connection to the boiler and adjusted to open at a selected boiler pressure, a cold water supply pipe adapted to lead to the boiler, a valve in the cold water supply pipe, thermal means adapted to be responsive to a discharge by the relief valve of boiler water having a temperature in excess of a predetermined temperature and characterized by an expansion movement at said temperature, and means mechanically actuated by the movement of the thermal means for opening the cold water valve.

4. The combination of a hot water boiler, a cold water supply pipe leading to the boiler, a pressure relief valve connected to the boiler and adjusted to open at a selected boiler pressure, and apparatus for preventing overheating of the boiler by admitting cold water thereto comprising a valve in the cold water supply pipe, a diaphragm connected to the cold water valve and responsive to boiler pressure on the discharge side of the cold water valve in a direction closing the same, spring means for opening the cold water valve when the boiler pressure falls below a predetermined value, means independent of boiler pressure for opening the cold water valve including thermal means responsive to the discharge by the relief valve of boiler fluid having a temperature in excess of a predetermined temperature, and means connected to the cold water valve and actuated by the thermal means at said temperature for opening the cold water valve.

5. Apparatus for preventing overheating of a hot water boiler by admitting cold water thereto comprising a pressure relief valve arranged for connection to the boiler and adjusted to open at a selected boiler pressure, a cold water supply pipe leading to the boiler including a valve for controlling flow therethrough, thermal means responsive to a discharge by the relief valve of boiler water having a temperature in excess of a predetermined temperature, means actuated by the thermal means at said temperature for opening the cold water valve, metallic casing means enclosing the cold water valve, thermal means and the means actuated thereby and having a portion surrounding the thermal means into which the discharge from the boiler flows, and safety means for interrupting the heat input to the boiler when the cold water supply is inadequate including a switch adapted to form part of an electrical circuit controlling the heat input, and a bimetallic member positioned in heat exchange relation to the casing and arranged to flex at a predetermined temperature to a position opening the switch.

6. Apparatus for preventing overheating of a hot water boiler by admitting cold water thereto comprising a pressure relief valve arranged for connection to the boiler and adjusted to open at a selected boiler pressure, a cold water valve adapted to control flow through a cold water supply pipe leading to the boiler, an electric circuit including a heating coil and thermal switch means exposed to fluid discharged by the relief valve and arranged to close the circuit when the fluid has a temperature in excess of a predetermined temperature, and a member thermally responsive to the heat emitted by the heating coil and actuatingly related in an opening direction to the cold water valve.

7. Apparatus for preventing overheating of a hot water boiler by admitting cold water thereto comprising a pressure relief valve arranged for connection to the boiler and adjusted to open at a selected boiler pressure, a cold water valve adapted to control flow through a cold water supply pipe leading to the boiler, an electric circuit including a heating coil and thermal switch means exposed to fluid discharged by the relief valve and arranged to

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close the circuit when the fluid has a temperature in excess of a predetermined temperature, a member thermally responsive to the heat emitted by the heating coil and actuatingly related in an opening direction to the cold water valve, and a booster pump located on the inlet side of the cold water valve and responsive to the closing of the switch means for raising the pressure of the available cold water supply.

8. Apparatus for preventing overheating of a hot water boiler by admitting cold water thereto under prescribed conditions, comprising a control device having a valve adapted to control flow of cold water from a supply pipe to the boiler, a diaphragm connected to the valve and responsive to boiler pressure on the discharge side of the valve for moving the valve toward its closed position, spring means opposing movement of the valve toward said closed position, and means for opening the valve independently of boiler pressure, including thermal means responsive to the discharge from the boiler of boiler fluid having a temperature in excess of a predetermined value, and means actuated by the movement of the thermal means for opening the valve.

9. A control device adapted to be interposed in the cold water supply pipe to a boiler, which boiler is also provided with a pressure relief valve, said control device comprising a valve normally biased to closed position, whereby the valve prevents the flow of cold water therethrough, said control device having thermal means adapted to be responsive to fluid passing through said pressure relief valve at a temperature in excess of a predetermined value for opening said valve, whereby cold water is adapted to be admitted to the boiler through said control device.

10. In combination, a hot water boiler, a heat source for the boiler including a control circuit therefor, a pressure relief valve for the boiler, a control device adapted to admit cold water from a supply line to the boiler under prescribed conditions, said control device comprising a casing that houses a control valve normally biased to closed position, and thermal means responsive to the discharge of fluid through said pressure relief valve in excess of a predetermined temperature for opening said control valve to admit cold water to said boiler.

11. The combination as set forth in claim 10 in which said thermal means also acts to close said control valve when the temperature of said discharged fluid falls to said predetermined temperature.

12. The combination as set forth in claim 10 in which a thermostatically operated limit switch is associated with the casing and responsive to its temperature, said limit switch being adapted to be connected in said control circuit for shutting off said heat source when the casing exceeds a predetermined temperature.

13. The combination as set forth in claim 10 in which said control valve has a diaphragm connected thereto and is normally biased to closed position by boiler pressure acting in one direction on said diaphragm, spring means acting on the diaphragm in the other direction for opening said valve in response to a predetermined drop in boiler pressure, said thermal means when actuated being of sufficient capacity to override the boiler pressure acting on said diaphragm tending to keep said control valve closed.

14. The combination as set forth in claim 13 in which the thermal means is responsive to fluids passing through the pressure relief valve at temperatures in excess of 212° F.

15. The combination as set forth in claim 10 in which a cold water supply means is connected to said boiler, a booster pump is connected with said supply means, and in which means are also provided to actuate said booster pump in response to actuation of said thermal means to force water from the supply line through said control valve and into said boiler.

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