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METHOD OF AND MEANS FOR CONDITIONING BOILER FEED WATER

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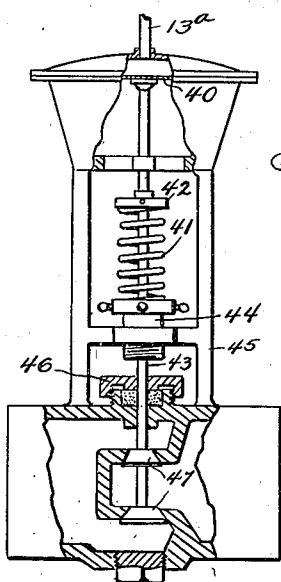
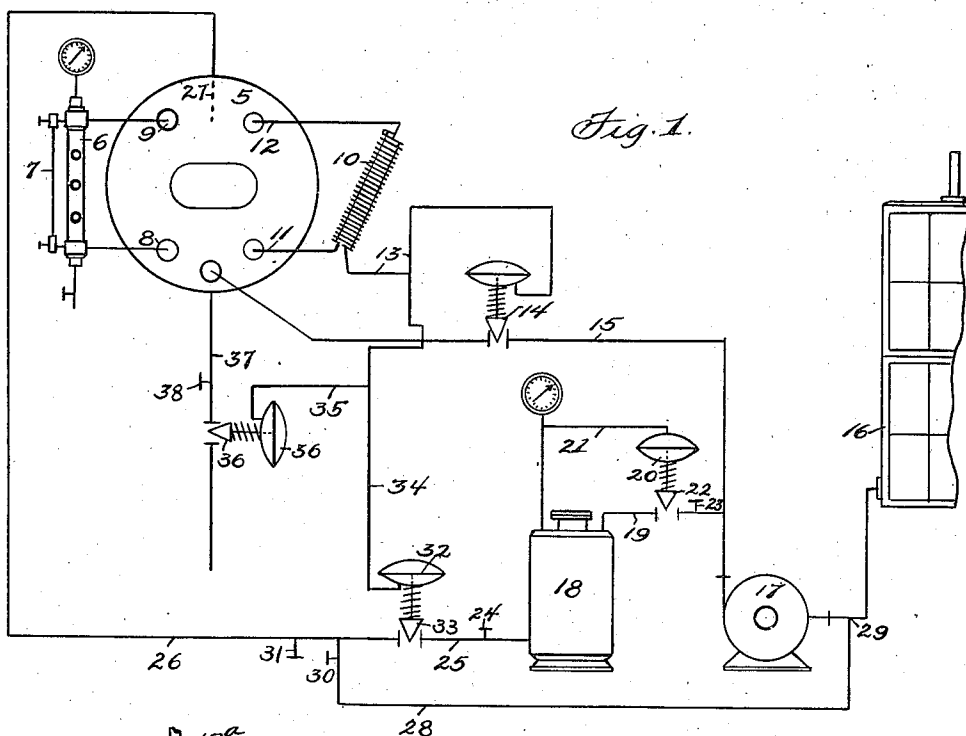


Fig. 2.

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METHOD OF AND MEANS FOR CONDITION-
ING BOILER-FEED WATER

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9 Claims. (Cl. 122-382)

The object of the invention is to provide a method of and means for introducing chemicals automatically and proportionately to boiler feed water and in conjunction therewith, or as a separate operation, to effect control of the mineral concentration of the boiler water by automatic and proportional blow-down of the boiler in continuing operations. The introduction of the chemicals may be either directly to the water in the boiler or to the feed water prior to the introduction of the feed water to the boiler. By the term "chemical" I mean to include any chemical treatment or compound of any nature whatsoever adapted to in any way modify or condition the boiling water. Compounds which may be used for this purpose include calcium carbonate, calcium hydroxide, sodium carbonate, sodium hydroxide, tannic acid, all phosphates including hexametaphosphate, sodium aluminate, sodium sulphate, aluminum sulphate, iron sulphate, starch, patented boiler compounds, treatment compounds and other chemical formulas.

The present invention aims to accomplish the foregoing objects in a particularly efficient, economical and reliable way, and to this end I provide an assembly of parts connected to and operating under control of a conventional but very efficient and reliable boiler feed water control device. This device is known as the S-C feed water regulator-generator, and in its operation, lowering of the water level in the boiler, exposes a generator heating tube to the steam above the water line, increase of temperature of said tube, generating pressure that is transmitted to a diaphragm operated feed water valve, which thereupon opens to supply additional feed water to bring the water level in the boiler back to the proper point or level. As before stated, devices of this sort are in common use. Since they avoid the use of unreliable and troublesome floats and since they contain no working parts subject to derangement they have been found to be highly reliable, economical and efficient. As this description proceeds it will be seen that by the use of relatively simple and inexpensive mechanism, I have provided an assembly adapted to operate under control of, and in synchronism with, the aforesaid boiler feed water regulator, to achieve the objects of the invention, as above outlined. A structure embodying the principles of the S-C feed water regulator-generator, above referred to, is disclosed in the patent to Copley 1,193,125 assigned to the S-C Regulator Co. of Fostoria, Ohio.

tion of the elements of my invention to a conventional steam boiler, and Fig. 2 illustrates one type of valve which may be employed.

In the drawing, 5 designates the boiler, 6 the water column and 7 the water glass. This water column is connected in the usual way, i. e., at 8 to the lower part of the water space of the boiler and at 9 to the steam space within the boiler.

A conventional S-C regulator-generator, or equivalent unit, generating increased pressure by drop of the boiler water level is indicated at 10. This unit is connected at 11 and 12 with the water and steam spaces of the boiler, as in the case of the water column connections. The pressure generated in the unit 10 is delivered through a pipe 13 to a diaphragm operated feed water control valve 14. This valve comprising diaphragm 14^a in casing 14^b is disposed in the feed water line 15 which receives its supply from the feed water supply source 16, such as a heater or hot well or otherwise, said feed water line including a feed water pump 17.

When the lowering of the water level in the boiler generates increased pressure in the unit 10 such pressure acts upon valve 14 to open the same and to feed additional water into the boiler. When the rise of the water level in the boiler protects and cools the pressure generating tube of the unit 10, a reduction of pressure in the pipe 13 permits valve 14 to close. The parts so far described are those already in use and the parts hereafter described are those that I have added to effect the objects sought. The pipe 13 and pipes 34 and 35 connected to said pipe 13 constitute a closed circuit in the sense that the fluctuations of pressure fluid therein arise from no other source than the variations of pressure in the pressure generating tube of unit 10, which pressure generating tube is in turn exposed to variations in temperature arising from the rise and fall of the boiler water level, such pressure in the generating tube increasing as the boiler water level falls and less of the generating tube is covered by water and more of it is exposed to the boiler steam and decreasing as the boiler water level rises and covers more of the generating tube and exposing less of said tube to the boiler steam. Thus the fluctuations of pressure in said closed conduit vary as the water level varies and they are largely independent of the variations of steam pressure in the boiler because it is possible to have a high water level and a low steam pressure and vice versa. A tank 18 receives the chemical which is to be fed in metered quantities into the boiler feed water.

Fig. 1 of the drawing illustrates the applica-

This tank is connected by a pipe 19 with the main feed water line 15. A conventional diaphragm operated pressure regulating valve 20 comprising diaphragm 20^a and casing 20^b is connected by pipe 21 with the tank 18 and controls valve 22 in the line 19. This pressure regulating valve is so set as to maintain a pressure in the tank 18 that is higher than the boiler pressure. In filling the tank 18 with chemicals, hand operated valves 23 and 24 are closed. When the valve 23 is opened water flows from feed line 15 through line 19 into tank 18 until the pressure in said tank exceeds the boiler pressure by an amount determined by the setting of the regulating valve 20—22. Thereupon the pressure upon the conventional diaphragm of said valve, acting through pipe 21, closes the valve proper 22 upon its seat. The valve 24 is in a pipe comprising a branch 26 which is connected to the steam space of a boiler, at 27 or any other suitable location on the boiler. A second branch 28 establishes connection between pipe 25 and the main feed water line, at 29. Valves 30 and 31 make it possible for the chemical passing through pipe 25 to be fed either directly into the boiler through the branch 26 or into the feed water line at 29 through branch 28. A diaphragm operated regulating valve, comprising diaphragm 32 in casing 32^a and valve 33 controls the passage of the chemical through pipe or line 25. Pressure for actuating diaphragm 32 is delivered through pipe line 34. Thus, whenever increase of pressure in line 13 opens the feed water valve 14, this same increase of pressure, acting through line 34, opens valve 33, this regulating valve being so set as to deliver a determined and metered quantity of chemical into the boiler either through branch 26 or branch 28, as the case may be. This proportional feeding of the chemical into the boiler will be thereafter maintained until changed by change of setting of the valve 32—33, as requirements may call for. That is to say, if 1 quart of a known strength chemical is to be introduced with 1,000 gallons of a known analysis water, the adjustment of the valve 33 would be made accordingly and thereafter it would feed at this rate regardless of the rate of flow per minute, or second, or part thereof, of the feed water. In like manner if it be desired to maintain the boiler water at 100 grains per gallon of impurities when using a feed water containing 10 grains per gallon impurities, the valve 36 would be so adjusted as to operate in step with incoming feed water at a ratio of about 1 to 10 or, in other words, to effect blow-down at the rate of about 10 per cent of the incoming feed water, as hereinafter described.

An additional line 35 leads from line 34 to the diaphragm actuated regulating and control valve 36 comprising diaphragm 36^a in casing 36^b that is disposed in the blow-down pipe 37 which leads from the boiler. A hand operated shut-off valve 38 is also located in this blow-down pipe. By proper adjustment of valve 36 a determined quantity of water may be discharged from the boiler along with mud, chemical concentrates, precipitates, flocs and other impurities, every time that a fresh charge of water is fed into the boiler. From the foregoing description it will be seen that I accomplish this highly desirable feeding of metered quantities of water softening or other chemicals and the withdrawal of a proportionate amount of impurity laden water, periodically and continuously, through the employment of a group of elements as simple as mere pipe

and regulating valves. I am able to do this because I take advantage of the existing and variable pressure field created by the rise and fall of the boiler water itself. Since the boiler feed water itself is the element to be treated, this variable pressure which fluctuates in direct accord with the call for or satisfaction of boiler feed water and wholly independently of the existing steam pressure in the boiler, admirably lends itself to the utilization of the simple, inexpensive and reliable parts, such as the simple pipe and regulating valves described, in the achievement of the important functional advantages which I have recited.

I contemplate using any of the well known, balanced diaphragm operated regulating valves already on the market and familiar to every engineer. In these valves the movement of the diaphragm under pressure is against the tension of a settable regulating spring. In some of these valves the movement of the diaphragm under pressure opens the valve and the spring tends to close it. In other cases the spring tends to open the valve and the movement of the diaphragm tends to close it. My invention is not limited to the use of any particular type of valve, but includes any valve constructed to serve the purposes sought. However, for the purpose of clarity, I have shown one type of valve in Fig. 2. Here the pressure from a pipe 13^a (corresponding to pipe 13 in Fig. 1) thrusts diaphragm 40 downwardly against the tension of spring 41 which bears between a collar 42 on the valve stem 43 and an adjusting nut 44 that is carried by valve casing 45. The valve stem passes through a conventional packing gland 46 and carries conventional balanced valve discs 47 on its lower end. It is clear that the time and degree of opening of the valve under a pressure upon the diaphragm may be set and varied by adjustment of the tension of the spring 41, by manipulation of nut 44.

As far as I am aware, I am the first to accomplish the objects recited, under control of pressure generated by fall of the boiler water level and, since many ways may suggest themselves to those skilled in the art to utilize this principle through the medium of modifications of my mechanism, I wish it to be understood that the invention is not limited to the particular arrangement shown, but that it includes within its purview whatever changes fairly come within either the terms or the spirit of the appended claims.

Having described my invention, what I claim is:

1. The combination with a boiler having as a part of its conventional assembly a feed water line, a pressure operated control valve in said feed water line, a pressure generating unit exposed to fluctuations of water level within the boiler and comprising means for generating increased pressure within said unit upon fall of boiler water level and a pipe line for conducting such increased pressure to the pressure operated control valve of the feed water line, a pressure actuated member connected to the feed water valve for opening the same to a degree determined by an increase of the pressure imposed thereon, a second pipe line leading from said source of chemical supply to the boiler, a metering valve disposed to control the flow of chemical through said second pipe line, a pressure actuated member connected to the metering valve for opening the same to a degree determined by the increase of the pressure imposed upon said pressure actu-

ated member and a pressure line disposed to conduct pressure from the pressure generating unit to said pressure actuated member of the metering valve.

2. The combination with a steam boiler having a conventional regulator-generator of the type wherein a pressure generating tube is exposed to the rise and fall of the boiler water level to thereby generate fluctuations of pressure in proportion to the coverage of said tube by more or less of the boiler water, the remainder of said tube being exposed to boiler steam so that a predetermined drop of the water level in the steam boiler causes an increase of pressure in said tube, of a closed conduit into which said fluctuations of pressure are delivered, three pressure actuated valves each comprising a valve proper for controlling a fluid flow and a pressure operated member connected to said valve for opening the same in response to increase of pressure upon the pressure operated member, casings in which said pressure operated members of the said three valves are located, said closed conduit being connected to all of said casings on the pressure responsive side of said members, a feed water supply line for the boiler in which one of said valves proper is located and the flow through which is controlled by said valve, a boiler blow down line leading from the boiler, a second of the valves proper being located in and controlling the blow down line and a chemical supply line in which the third of said valves proper is located and which is controlled by said valve.

3. The herein described method which consists of feeding water conditioning chemical and feed water into a boiler with the chemical in metered relation to the feed water and with the feed of both feed water and chemical under control of and through the medium of a pressure rise created by fall of boiler water level in the boiler and independently of the existing steam pressure in the boiler.

4. The combination with a steam boiler assembly including a feed water line, a pressure generator exposed to fluctuations of water level in the boiler and comprising means for generating a pressure that is independent of the boiler steam pressure, upon fall of boiler water level, a pressure operated feed water control valve comprising parts acted upon by such independently generated pressure for moving said valve toward open position to provide for the flow of feed water to the boiler, of means for feeding proportional quantities of chemicals to the boiler, comprising a source of chemical supply, a pipe line leading from the source of chemical supply to the boiler, a metering valve in said pipe line, an actuating member for said metering valve constructed to be actuated by pressure to open said valve, means for connecting said actuating member to the source of such independent pressure, said pressure acting to move said metering valve toward open position, a boiler blow down, a pipe connection between the feed water line and the source of chemical supply, a feed water pump for supplying feed water to said feed water line, at a pressure in excess of boiler pressure, a pressure operated regulating valve for controlling said pipe connection, and means for connecting said regulating valve to the source of chemical supply, said regulating valve comprising parts set to maintain a pressure higher than boiler pressure upon the source of chemical supply.

5. The combination with a steam boiler having as a part of its conventional assembly a feed water line, a pressure operated control valve in

said feed water line and a pressure generating unit exposed to fluctuations of water level within the boiler and comprising means for generating increased pressure in response to a fall in the boiler water level, of a tank constituting a source of chemical supply, a connection between said tank and the feed water line, and pressure responsive means comprising elements for feeding metered and proportional quantities of chemicals into the boiler feed water in response to such increased pressure in the generating unit, a boiler blow down element comprising a boiler blow down line, a valve disposed in said line and controlling the flow therethrough, a pressure responsive member connected to and moving said valve toward open position, and means for conducting pressure from said pressure generating unit, to said member, to open said valve under said increase of pressure in the generating unit to blow down an amount of boiler water proportional to the amount of water fed into the boiler.

6. A structure as recited in claim 1 in combination with a pump for creating pressure in excess of boiler pressure, in the feed water line, and means for establishing connection between the source of chemical supply and the feed water line at a point between the feed water valve and the said pump to thereby maintain a pressure in excess of boiler pressure upon the source of chemical supply.

7. The combination with a steam boiler and its feed water supply line, a feed water source from which said line leads to the boiler, a pump in said feed water line, a chemical receiving tank, a connection between the feed water line and said tank connected to the feed water line at a point between the pump and the boiler, a valve in said connection, pressure responsive means for closing said valve in response to a predetermined increase in pressure, a pipe for conducting pressure from the tank to said pressure responsive means, a feed water regulator exposed to fluctuations of water level in the boiler and generating pressure that is independent of the steam pressure that is in the boiler, upon drop of water level in the boiler, a feed water control valve disposed in the feed water line, means biasing said feed water valve to closed position, pressure responsive means for opening said valve in response to an increase in pressure, a pressure line leading from the feed water regulator to the last said pressure responsive means, a chemical supply line leading from the chemical containing tank to the boiler, a chemical controlling metering valve in said line, means biasing said chemical controlling valve to closed position, a pressure responsive means for opening said valve in response to an increase of pressure, a pressure line leading from the feed water regulator and conducting the said generated independent pressure to the last named pressure responsive means to open said chemical controlling valve, a blow down line, a metering blow down valve controlling said line, means biasing the blow down valve to closed position, pressure responsive means for opening the blow down valve in response to an increase in pressure, a pressure line leading from the feed water regulator to the pressure responsive means of the blow down valve for imposing such generated independent pressure upon the pressure responsive means of the blow down valve to open the same, and a connection leading from a point in the feed water line, in advance of the pump, to the chemical supply line at a point between the boiler and

the controlling metering valve of the chemical supply line.

8. A structure as recited in claim 1 in combination with a blow down pipe line leading from the boiler, a blow down metering valve disposed in said blow down line comprising a valve proper controlling the blow-down line and a pressure actuated means connected to and opening said valve upon an increase of pressure and a pressure line disposed to conduct pressure from the generating unit to the said means to thereby actuate the valve proper in accordance with the variations in pressure in the generating unit to thereby blow-down an amount of the boiler content that is directly proportional to the pressure variation in the pressure generating unit.

9. The combination with a steam boiler having a conventional regulator-generator of the type wherein a pressure generating tube is exposed to the rise and fall of the boiler water level to thereby generate an increase of pressure in said tube

in proportion to the uncovering of said tube by fall of the boiler water level, the uncovered portion of said tube being exposed to boiler steam, of a closed conduit in communication with said tube, three pressure actuated valves each comprising a valve proper for controlling a fluid flow, and a pressure responsive means connected to said valve for opening the same in response to an increase of pressure upon the pressure responsive means, said closed conduit being connected to all of said pressure responsive means, a feed water line for the boiler, a chemical supply line, and a blow down line one of said valves being in each of said lines, the pressure responsive means being so related to each of the valves, that increase of pressure in said conduit which responds to a demand for feed water imposes pressure upon each pressure responsive means in a direction to open the valve connected thereto.

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