Aug. 20, 1935. V. V. VEENSCHOTEN 2,011,600

FEEDING WATER TO BOILERS

Filed Oct. 30, 1933 5 Sheets-Sheet 1

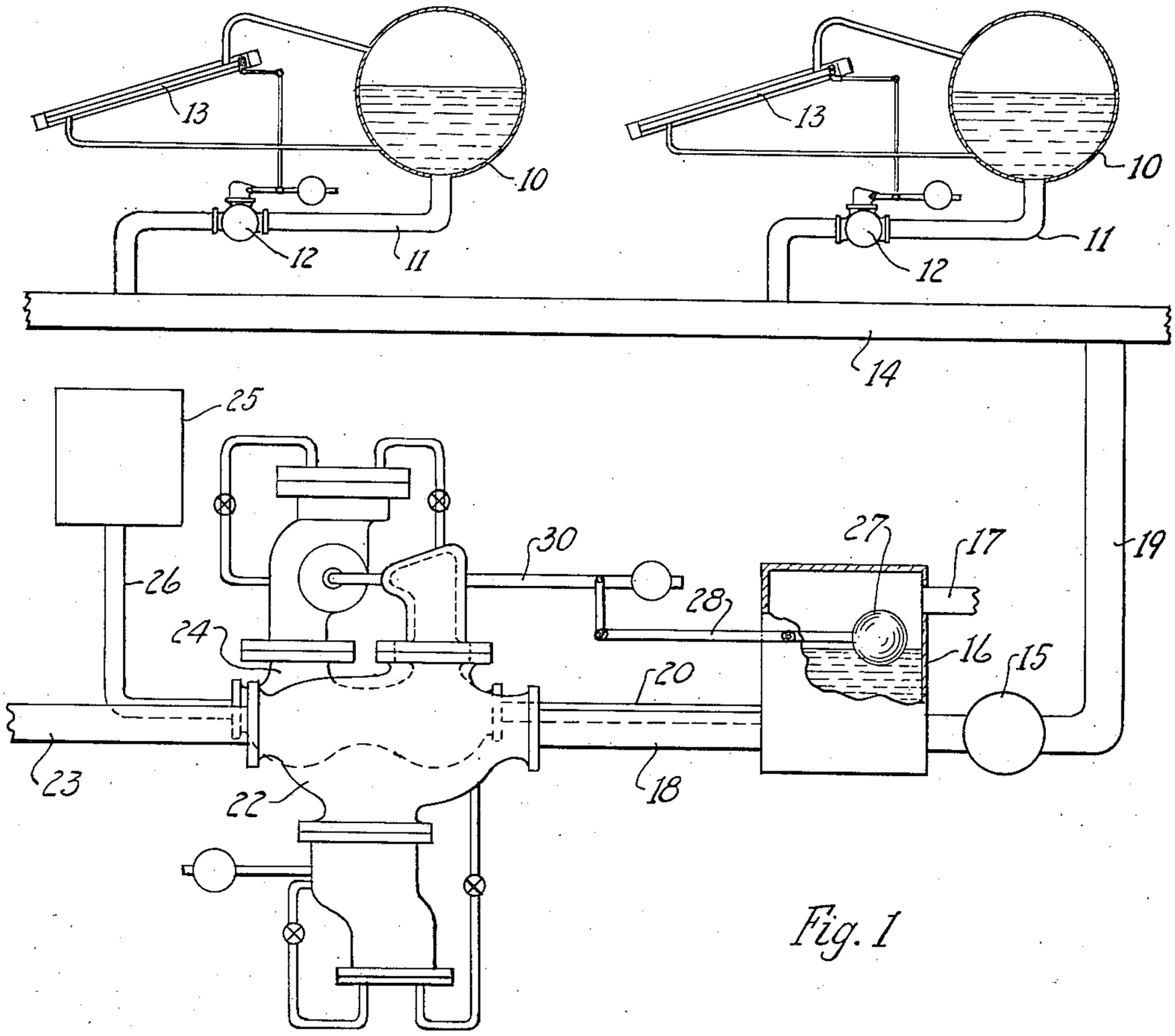

Fig. 1

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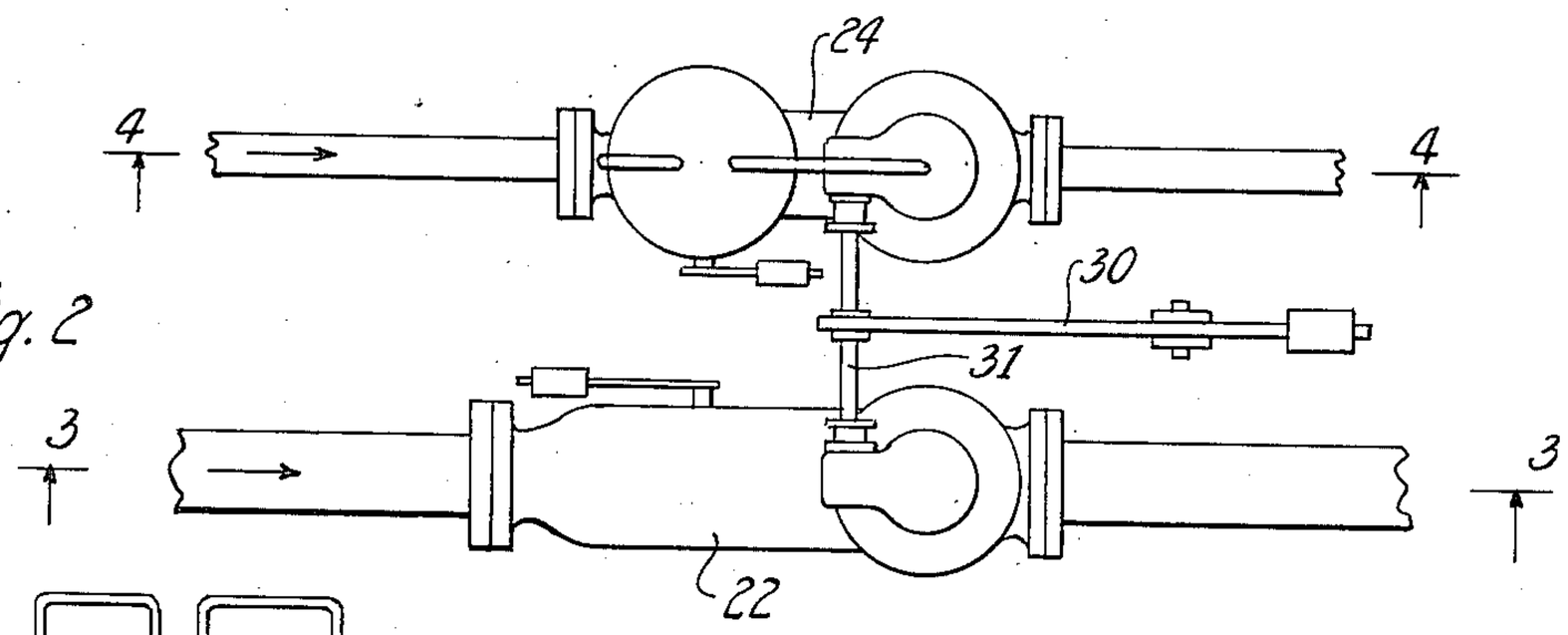

Fig. 2

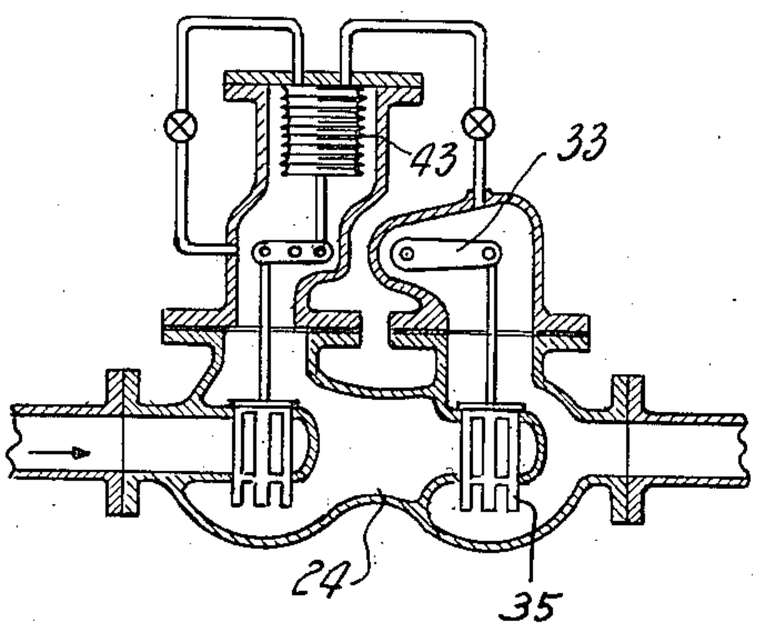

Fig. 4

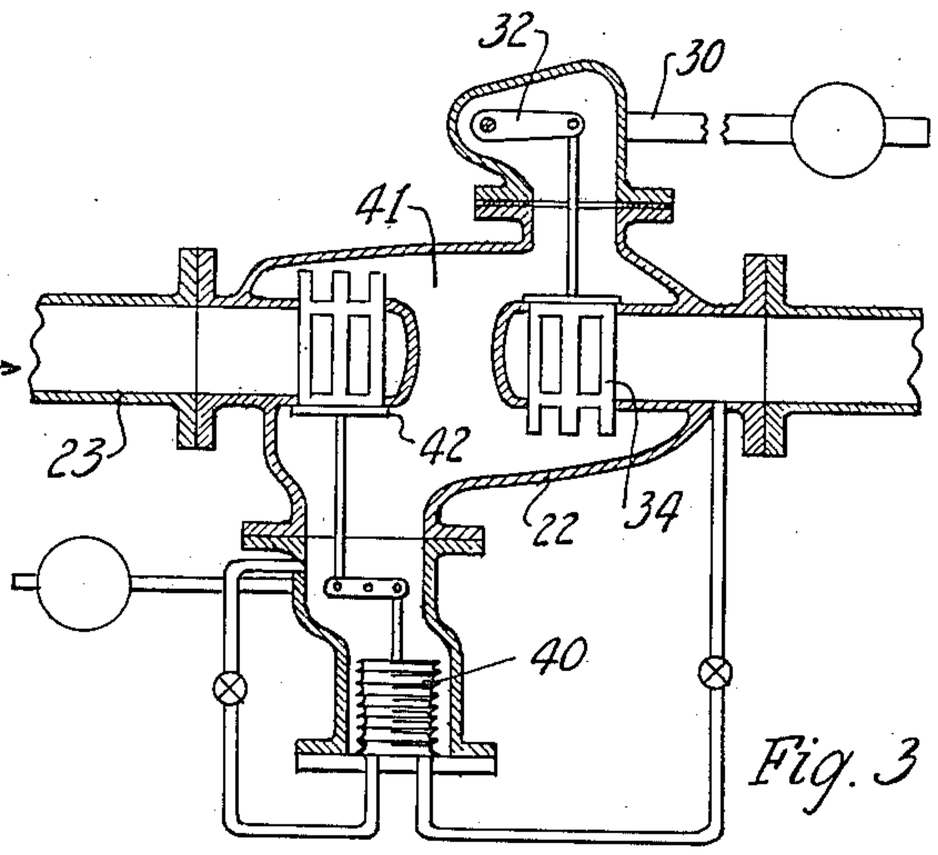

Fig. 3

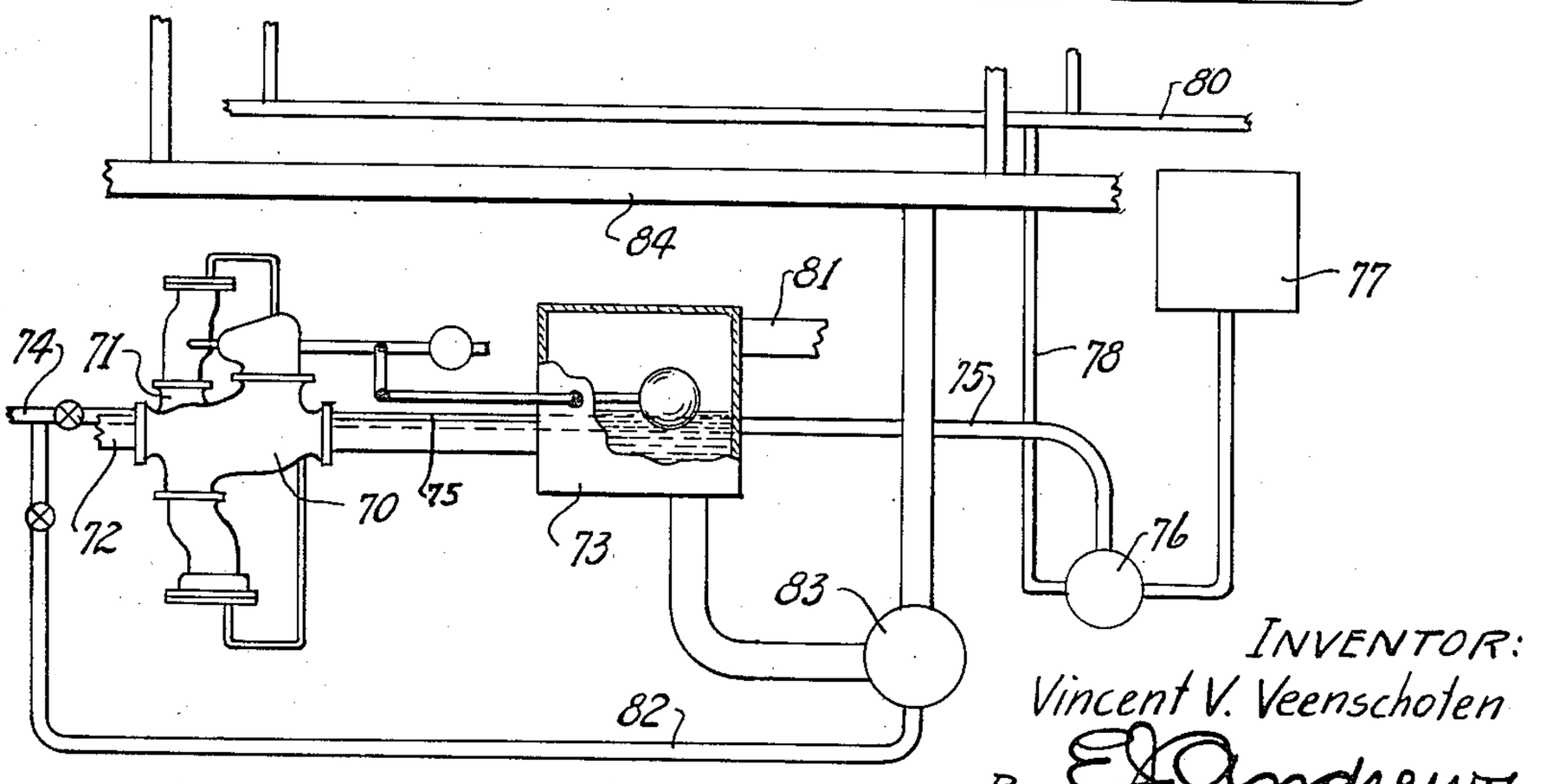

Fig. 6

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FEEDING WATER TO BOILERS

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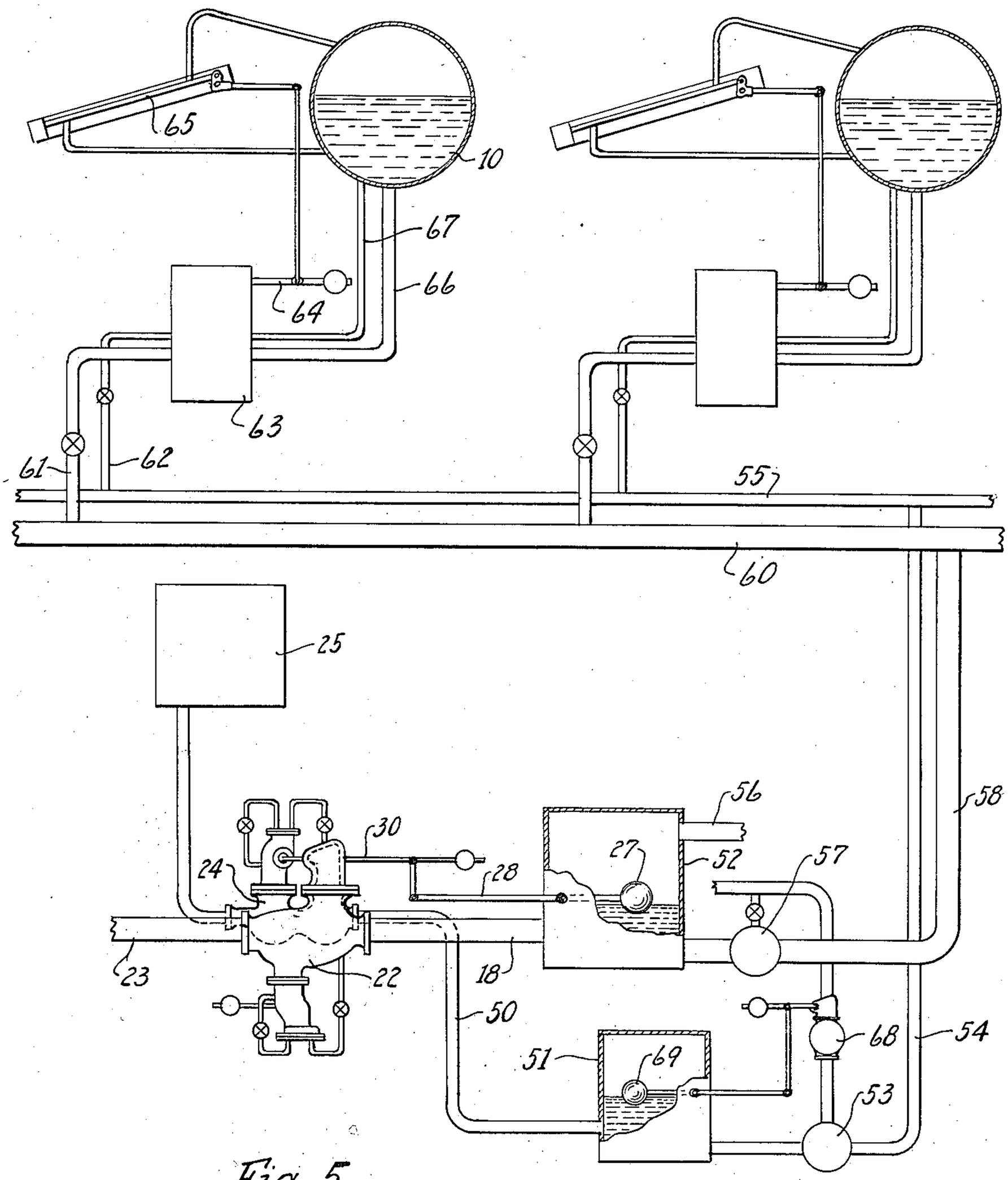

Fig. 5

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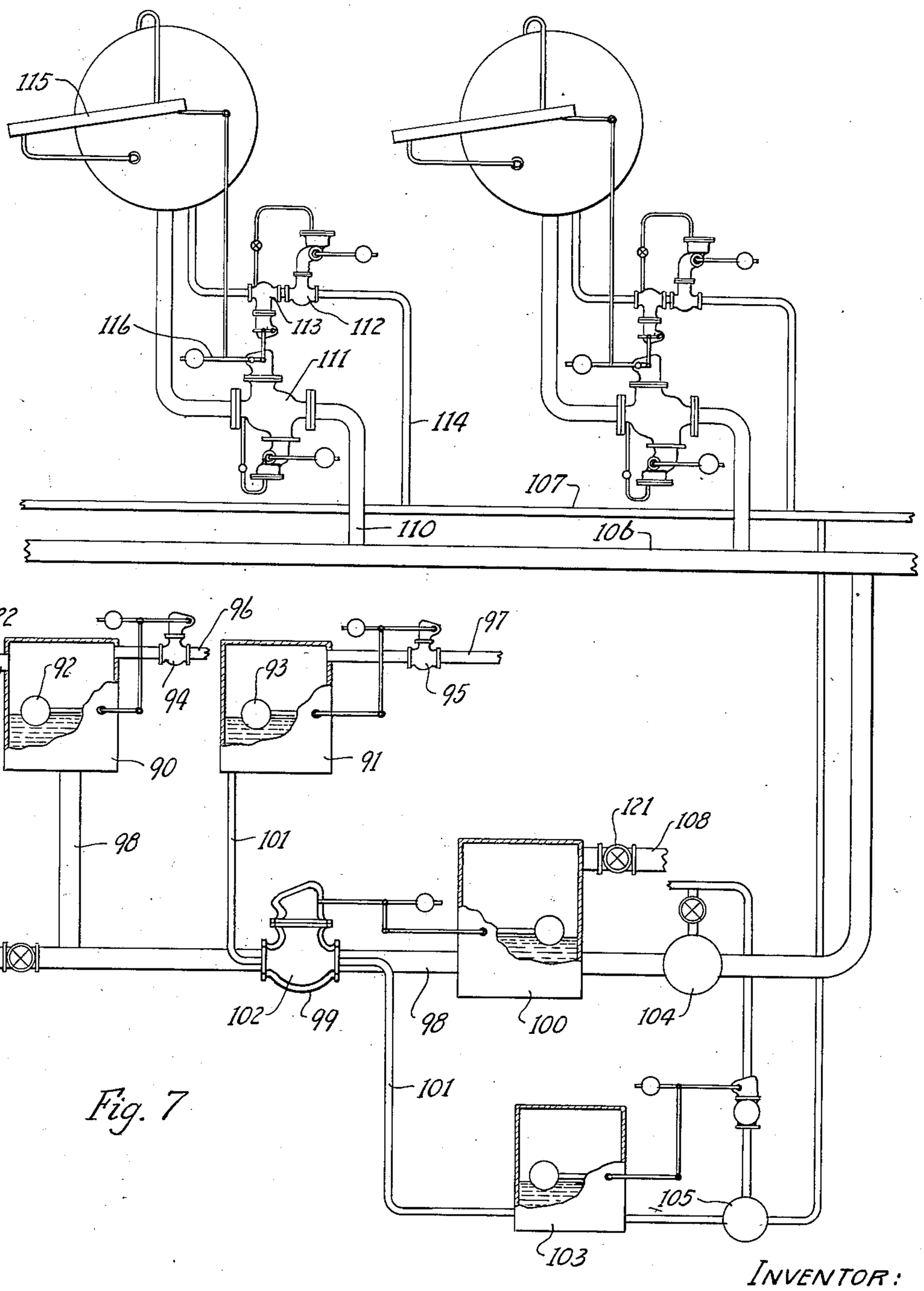

Fig. 7

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FEEDING WATER TO BOILERS

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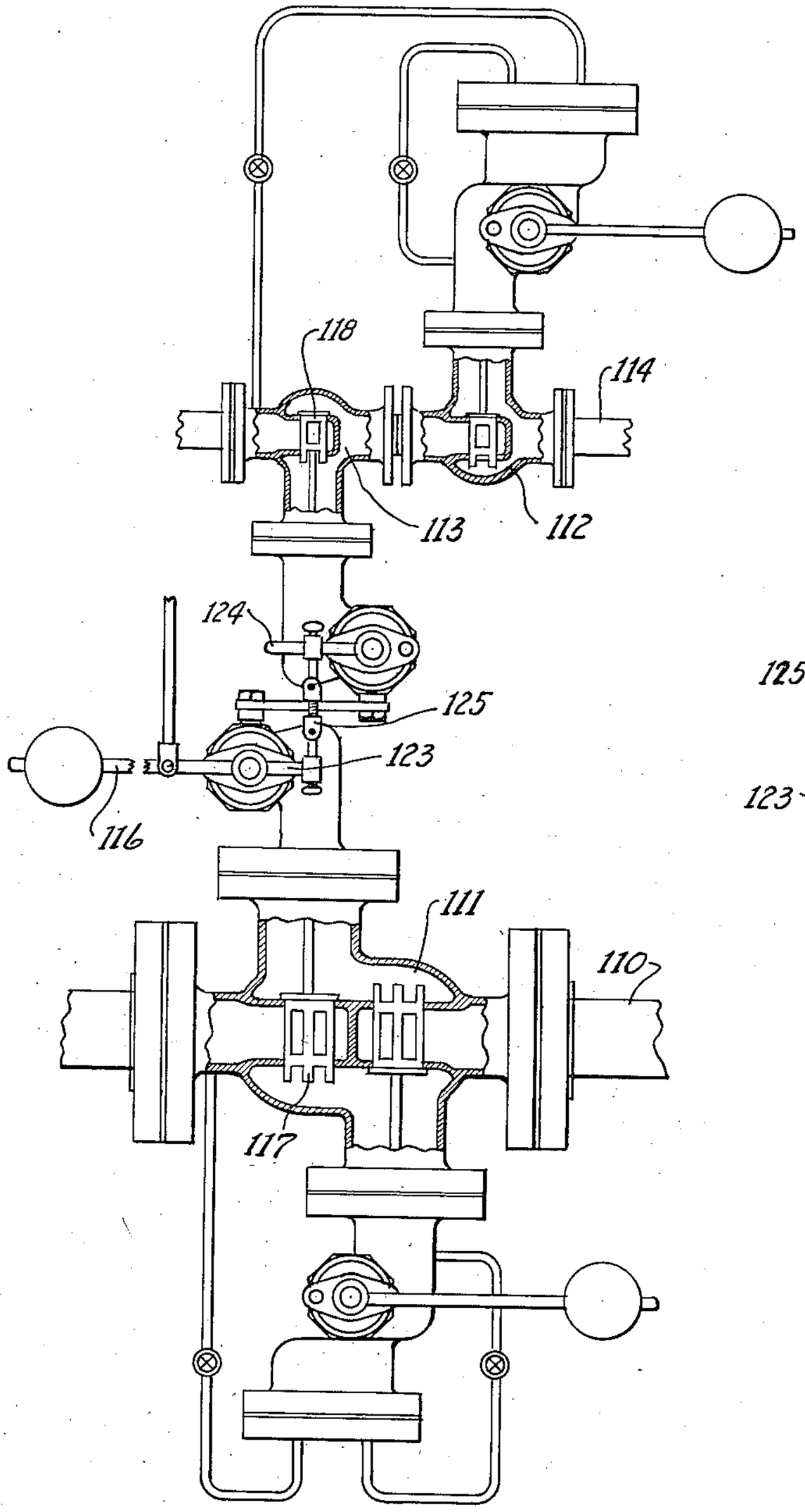

Fig. 8

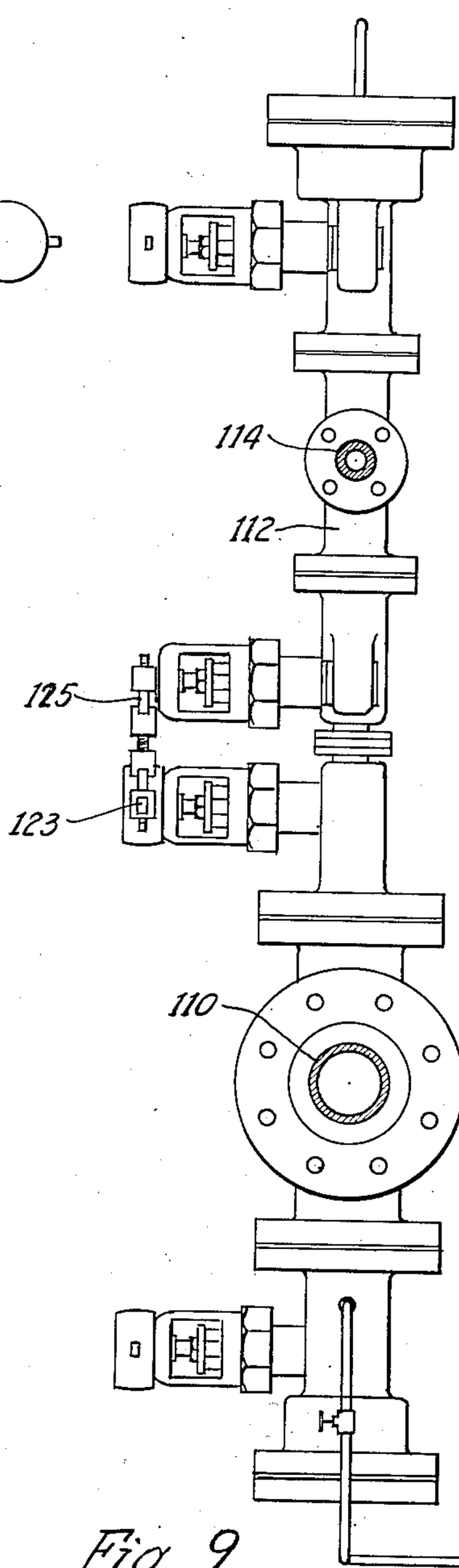

Fig. 9

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FEEDING WATER TO BOILERS

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Application October 30, 1933, Serial No. 695,726

21 Claims. (Cl. 122—451)

This invention relates to the feeding of water to boilers and has for its object providing a suitable method of feeding water to the boilers when it is desired to mix therewith a chemical for precipitating or other purposes, and also for providing suitable apparatus for carrying out the method.

In boiler operation, as is well understood, the continual evaporation of water in the boiler increases the concentration of soluble and insoluble matter in the water which produces deposits of scale, foaming and priming and caustic embrittlement, and not only necessitates frequent blowing down of the water but is otherwise objectionable. It has been the practice to introduce with the feed water certain chemicals, such as sodium phosphate, usually in solution, to assist in keeping the boiler surface clean. It is also common to pass into the boiler the condensate provided by the condensation of the steam used for various purposes, or to introduce water without objectionable chemicals therein, in addition to raw water which is provided to make up the deficiency.

In any case, it is usually desirable, when introducing the sodium phosphate, to proportion it to the amount of impurities that go in with the feed water rather than in proportion to the total amount of water. Herein, for convenience, I shall refer to the pure water that is introduced as the "condensate", and to the impure water as the "make-up", and to the liquid which contains the chemical, such as sodium phosphate, as the "treatment".

One object of my invention is to provide for supplying to the boiler the treatment in proportion to the make-up, without any reference to the proportion of the make-up to the condensate, it being understood that, in practice, the proportion of the make-up to the condensate varies greatly from time to time, even with the same boiler load.

Of the accompanying drawings, Fig. 1 is a more or less diagrammatic elevation of a boiler system and the means therefor which supply liquids thereto, according to my invention; Fig. 2 is an enlarged plan view of the proportioning valves of Fig. 1; Fig. 3 is a sectional view along the line 3—3 of Fig. 2; Fig. 4 is a sectional view along the line 4—4 of Fig. 2; Fig. 5 is a diagrammatic elevation of a modified form of apparatus; Fig. 6 shows a modification of the system illustrated by Fig. 5; Fig. 7 illustrates a further modification; and Figs. 8 and 9 illustrate by enlarged drawings the proportioning valves of Fig. 7.

Referring to Fig. 1, the upper portion of the figure represents a battery of boilers 10, which are being supplied with treated water through the pipes 11, by means of the feed water valves 12, the opening of the valves being controlled by any of the ordinary feed water regulators, such as the thermostats 13. The water is supplied to each boiler through a main 14, by means of a pump 15, which draws the treated water from a storage tank 16.

In this instance, the water consists of the condensate, the make-up water, and the treatment. The latter we may consider as a suitable chemical for suitably treating the water in the boilers. The condensate is passed directly into the storage tank 16, in any suitable manner, such as by means of a pipe 17. The make-up water is passed into the tank through a pipe 18, and the treatment is passed into the tank through a pipe 20. The valve 22 is adapted to control the flow of make-up water into the pipe 18 from any suitable source of supply under pressure through a pipe 23. The valve 24 controls the flow of the treatment from a suitable tank 25 through a pipe 26.

In order to maintain constantly the predetermined relation between the mass of make-up water and treatment, the valves 22 and 24 are operated synchronously and proportionately by common operating means. These means comprise a float 27 mounted in the storage tank 16 and adapted to operate an external arm 28 in an ordinary manner. This arm controls an arm 30, which is arranged to operate simultaneously the plungers 34 and 35 of the valves 22 and 24.

Referring to Figs. 2, 3 and 4, it will be seen that the valves 22 and 24 are associated by means of a spindle 31. Each end of the spindle is arranged to pass into one of the valve casings and is operatively fixed to an arm 32 or 33 therein, and these arms are arranged respectively to operate the plungers 34 and 35 of the respective valves. Fixed to the spindle 31 is the arm 30, which is operated by the arm 28 of the float 27.

From this, it will be seen that, as the water in the storage tank rises, carrying with it the float, the arm 30 will be lowered, lowering also the arms 32 and 33 of the valves and the respective plungers 34 and 35. Thus the flow of liquids to the tank will be decreased proportionately, if properly arranged, as the two valves will be closed proportionately the same amount.

As a consequence of this arrangement, the proportionate amounts of treatment and make-up liquids will remain constant, without refer-

ence to the flow of condensate into the tank 16. If the amount of condensate is sufficient at any time to supply the needs of the battery of boilers, the water in the tank 16 will rise sufficiently to entirely close the valves 22 and 24, but if, at any time, the condensate is not sufficient for the needs, these valves will be opened more or less to meet the needs of the boiler. But in any such case, the proportionate amount of liquid passed through the valves will remain unchanged.

However, the amount of liquid passing through either valve is not necessarily proportional to the opening of the valve, as the amount flowing will depend also upon the pressures in the valve inlet and outlet. Obviously, as the amount of treatment in the tank 25 varies, the head thereof will vary, changing the pressure in the inlet of the valve accordingly. Or, as is well understood, the pressure of the make-up liquid in the pipe 23 may be varied, or the pressure in the tank 16 may be varied, depending upon various circumstances.

Hence, to insure a proportionate amount of flow through these valves, irrespective of variations in the inlet or outlet pressures, I provide means for maintaining a constant drop in pressure through the valves. Any suitable means may be used for this purpose, and such means in itself is not a feature of my invention, as such means is old. But I prefer for the purpose the use of a sylphon bellows 40 mounted in the casing of the valve 22 and operatively connected with the outlet of the valve and with the inner chamber 41, and also operatively connected with the plunger 42, which controls the flow of liquid from the pipe 23 into the chamber 41. As is well understood, this arrangement is such that a constant drop in pressure through the plunger 34 will be maintained and, hence, the flow of water therethrough will be proportional to the magnitude of the opening of the valve. Similarly with valve 24. The sylphon bellows 43 maintains a constant drop in pressure through the plunger 35, so that the flow of treatment is always proportional to the opening of the ports therethrough.

While my invention has no particular relation to the chemical that may be used for properly affecting the chemicals in the make-up water, yet it is customary for such purposes to use sodium phosphate, and the introduction of this substance into the make-up water as herein described tends to form a coat on the inner surface of the pipes 19 and 14, through which the liquid passes on its way to the boiler. This tendency to lime up the pipes is to be avoided, if possible, and to accomplish this, when sodium phosphate or similar chemicals are used in the treatment, I provide a somewhat modified system, which is illustrated in Fig. 5. This system is adapted to pass the treatment which may be necessary directly into each of the boilers of the battery substantially in proportion to the amount of make-up liquid that is passed in that particular boiler, but to entirely prevent any mixing of the two liquids before the boiler is reached.

The system which I provide for this purpose is similar to that of Fig. 1, except that the pipe 20 is replaced by a pipe 50 which passes the treatment from the proportioning valves into a tank 51, instead of into the storage tank 52 which corresponds to the tank 16 of the other system. This treatment is then forced, by means of a pump 53, through a pipe 54 to a main treatment pipe 55. The make-up liquid passes into the tank 52 through the pipe 18, and this tank also receives the condensate through any suitable pipe 56. From the tank 52, the mixed waters are forced, by means of a pump 57, through a pipe 58 into the main pipe 60. The pumps 53 and 57 may be operated by any suitable means. As shown, they are operated by steam, but the pump 53, for instance, may be operated by an electric motor, the controller of which is responsive to the liquid level in the tank 51.

In this manner, the make-up and the treatment are properly proportioned as before, by means of the valves 22 and 24 operated in the manner already described, by the float 27 in the tank 52. So that the amount of the two liquids which are delivered to the respective tanks 51 and 52 are always substantially proportional as before, irrespective of the condensate that is passed into the tank 52. It will be understood that the proportioning of the treatment to the boilers or to the tanks may be regulated in various manners, such as by adjusting the pressure maintained by the pressure regulating valves on the treatment lines.

In the branches 61 and 62 are valves 63, which may be similar to the valves 22 and 24, except that the spindles 31 of these valves have fixed thereto arms 64 corresponding to the arms 30 of the valves 22 and 24, and these arms 64 are operated by the thermostats 65, so as to supply to the boilers 10 liquid in proportion to the needs, in an ordinary manner. The only difference is that there are two pipes 66 and 67 feeding the boiler instead of one, and in each of the pipes is a valve corresponding to the valves 22 and 24. These valves, however, may be any suitable constant pressure drop valves, such as the valves of Figs. 8 and 9.

It will thus be seen that, my means of the valves 22 and 24, in this system the treatment is supplied to the tank 51 in proportion to the supply of the make-up liquid to the taank 52, entirely irrespective of the condensate which is supplied through the pipe 56 in any ordinary manner. At the same time, the two liquids are properly distributed to the individual boilers of the battery as the valves open always proportional. This, however, does not mean that these two valves will pass proportional amounts of liquid. If such were the case, the amount of treatment would be proportional to the combined amounts of make-up and condensate. The pump 53 being controlled by the elevation of the liquid level in the tank 51, the pressure in the pipe 62 is varied accordingly. For instance, if the system is being fully supplied by the condensate, although the valve in pipe 62 will be open in the same proportion as the valve in pipe 61, yet there will be no flow therethrough, as the valves 68 supplying steam to the pump 53 will be closed by the float 69. Or, in any event, the flow of treatment through the pipe 62 will be proportional to the pressure delivered by the pump 53, and this in turn will be proportional to the make-up liquid supplied to the tank 52.

I have found that it is unnecessary to provide, at least in some cases, the treatment tank 51. This may be eliminated by passing the steam for operating the treatment pump through the valve 24 instead of the treatment itself. In this manner, the pressure of the pump is controlled by the valve 24, and the treatment is pumped directly from the tank 25 to the pipe 62 and hence, is delivered to that pipe always in proportion to

the amount of make-up liquid. This system is illustrated in Fig. 6.

This system comprises the valves 70 and 71, which may be in all respects similar to the valves 22 and 24 hereinabove described. The make-up water is passed through the pipe 72 and the valve 70 into the tank 73, and steam is passed through the pipe 74 through the valve 71 and pipe 75 to the pump 76. This pump 76 pumps the treatment from the tank 77 into the pipe 78 and the main pipe 80. The condensate passes into the tank 73 through the pipe 81. Steam is also passed through the pipe 82 to the pump 83, and this pump pumps the mixed water from the tank 73 into the main pipe 84.

The remainder of the system has not been illustrated, as it may be in all respects similar to the system illustrated in Fig. 5. The treatment and the mixed liquids pass from the main pipes through suitable valves, such as the valves 22 and 24, into the respective boilers, these valves being controlled by the feed water regulator as hereinabove described.

With this arrangement, the supply of treatment will always be proportional to the supply of make-up, just as with the other systems, irrespective of the amount of condensate supplied. If the condensate alone is sufficient to supply the needs of the boilers, the valves 70 and 71 will close and no treatment will be supplied by the pump 76. As the valves 70 and 71 open, in case of insufficient condensate, the amount of treatment passed by the pump 76 will always be proportional to the make-up passed into the tank 73.

Figs. 7 to 9 illustrate a system somewhat similar to that shown in Fig. 5. In this case, however, the method of providing constant pressure drop through the valves corresponding to valves 22 and 24 is materially different. To accomplish this, I provide constant liquid heads above the valves. For this purpose, I provide tanks 90 and 91 which, by means of floats 92 and 93, maintain at a constant elevation the level of the liquid therein. These floats control valves 94 and 95, which control the flow of make-up liquid through the pipe 96 and treatment through the pipe 97. From these tanks, the make-up flows through the pipe 98 and valve 99 to the storage tank 100, and the treatment flows through the pipe 101 and valve 102 to the tank 103. The valves 99 and 102 are operated by the float substantially as described with reference to the valves 22 and 24, so that these valves open simultaneously and proportionally at all times and, hence, pass proportional amounts of liquids therethrough. The pumps 104 and 105 pass the liquids to the mains 106 and 107, as hereinabove described. The condensate may be passed to the storage tank through the pipe 108 as with the system of Figs. 5 and 6.

The valve system for passing the liquids from the mains to the boilers is in general the same as has been described with reference to Fig. 5. But in this case I prefer to position the valves and to connect them up somewhat differently. The pipe 110 conveys the make-up liquid to the boiler through the valve 111 which is substantially the same as the valve 22 illustrated in Fig. 3. The valves 112 and 113 convey the treatment to the boiler through the pipe 114, and these valves are substantially the same as the valves 24 illustrated in Fig. 4. In each case, the valve system provides a constant pressure drop therethrough.

Each feed water regulator 115 operates the valve lever 116 in a well known manner, and this lever operates simultaneously and proportionally the plungers 117 and 118 of the valves 111 and 113. This is accomplished by means of the arms 123 and 124 and the adjustable connecting link 125. The valve plungers 117 and 118 both open by moving upwardly.

Hence, in this system, the amount of treatment is always substantially proportional to the amount of make-up liquid, irrespective of any variations in the condensate, as has been explained herein with reference to Fig. 5. These systems also distribute the treatment to the boiler substantially proportional to the loads on the various boilers. With feed water regulators responsive to the elevation of the water level in the boiler, the aggregate amount of water passed to the boiler will be substantially proportional to the load on the boiler. However, any ordinary or suitable means for regulating the flow directly responsive to the load itself could be introduced in these systems, as is done in other feed water systems.

It may be desired to feed the treatment to the boilers in proportion to the total amount of water fed thereto. This may be accomplished in case of the system of Fig. 7 by passing the condensate into the tank 90, by means of the pipe 120. By closing the valve 121 and opening the valve 122, and with a suitable source of supply of condensate, the condensate would pass into the tank 90 instead of the tank 100 and, hence, the tank 90 would become a storage tank and the valves 99 and 102 would pass the treatment proportional to the total amount of water which passed to the boiler. In case of Fig. 5, this same process would be carried out by passing the condensate together with the make-up liquid through the pipe 23, instead of passing the condensate through the pipe 56.

I claim as my invention:

1. A boiler feed water system comprising three independent pipes for transmitting, respectively, a treatment, a make up, and a condensate liquid, a valve in each of the treatment and the make up pipes, a tank, means responsive to the liquid level elevation in the tank for operating simultaneously and proportionally said valves, each of the three pipes communicating with the tank, and means for forcing liquid from the tank into the boiler.

2. A boiler feed water system comprising three independent pipes for transmitting respectively, treatment, make up and condensate liquids, a valve in each of two of the pipes, means for operating simultaneously and proportionally said valves, a tank, each of the three pipes communicating with the tank, and means for forcing liquid from the tank into the boiler, the said operating means comprising a float mounted in the tank and operatively associated with each of the valves.

3. A boiler feed water system comprising a first, a second and a third pipe for transmitting respectively, treatment, make up and condensate liquids, a valve in the first and the second pipes, a tank for containing liquids, the third pipe and second pipe communicating with the tank, means responsive to the liquid level elevation in the tank for operating said valves, means for passing liquid from the tank to the boiler, and means for passing a liquid from the outlet of the first valve to the boiler.

4. A boiler feed water system as claimed in claim 3, the latter means comprising a second tank, and a pump, and means responsive to the

liquid level elevation in the second tank for passing liquid from the second tank to the boiler.

5. A boiler feed water system as claimed in claim 3, each of said passing means comprising a valve, and means responsive to the liquid level elevation in the boiler for simultaneously and proportionally operating the two valves of the passing means.

6. A boiler feed water system as claimed in claim 3, each of said passing means comprising a valve, and means responsive to the operation of the boiler for simultaneously and proportionally operating the two valves of the passing means.

7. A boiler feed water system as claimed in claim 3, each of said passing means comprising a valve, and means responsive to the load on the boiler for simultaneously and proportionally operating the two valves of the passing means.

8. In a boiler feed water system, means for passing into the boiler variable amounts of a condensate liquid, and means for passing to the boiler proportional amounts of make-up water and a liquid treatment, said latter means arranged to pass amounts of the make-up and the treatment inversely proportional to the amount of condensate passed to the boiler.

9. In a boiler system as claimed in claim 8, in which said latter means comprises two pipes, a valve in each pipe, means for operating simultaneously and proportionally said valves, one of the pipes being adapted to transmit the make-up water, and the other pipe adapted to transmit the treatment.

10. In a boiler feed water system as claimed in claim 8, said latter means comprising two valves and means for operating said valves simultaneously and proportionally, the amount of make-up water and treatment passed to the boiler being respectively responsive to the opening of the valves.

11. In a boiler feed water system a first, a second, and a third pipe for transmitting, respectively, a treatment, a make up, and a condensate liquid, a valve in the first and in the second pipe, a tank for containing liquids, the second and the third pipe adapted to pass liquids in the tank, means responsive to the liquid level in the tank for operating the two valves, means for passing liquid from the tank to the boiler, and means responsive to the opening of the valve in the first pipe for passing a third liquid into the boiler.

12. In a boiler feed water system as claimed in claim 11, said latter means comprising a pipe for transmitting the third liquid, a pump operatively connected to the latter pipe, a pipe connecting the pump with the boiler, said first pipe being connected to the pump and adapted to convey a power fluid to said pump.

13. In a boiler feed water system, means for passing into the boiler variable amounts of make-up water and means for passing into the boiler, continuously and automatically, amounts of a liquid treatment proportional to the amounts of make-up water passed thereto.

14. A boiler feed water system as claimed in claim 3, comprising two tanks mounted above the valves, the first and the second pipes communicating with the respective tanks, and means for passing a liquid into each of the latter tanks.

15. A boiler feed water system as claimed in claim 3 comprising means for producing equal liquid pressures at the inlets of the two valves.

16. A boiler feed water system as claimed in claim 1, comprising means for providing constant liquid pressure drops through each of the valves.

17. A boiler feed water system as claimed in claim 3, comprising means for providing constant fluid pressure drops through each of the valves.

18. A boiler feed water system as claimed in claim 8, comprising means for providing uniform pressure drops of the fluids passing through each of the valves.

19. A method of feeding water to boilers consisting in passing to the boiler under constant load variable amounts of condensate, in feeding to the boiler at the same time aggregate amounts of make-up water and treatment inversely equal to the amount of change of condensate, and in feeding the treatment in proportion to the amount of make-up water.

20. A method of feeding water to a battery of boilers, consisting in passing to each of the boilers a mixture of make-up and condensate water, and in simultaneously passing to the boiler an amount of treatment liquid proportional to the amount of make-up in the mixture.

21. A method of feeding water as claimed in claim 20, the treatment being passed to the boiler independently of the mixture.

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