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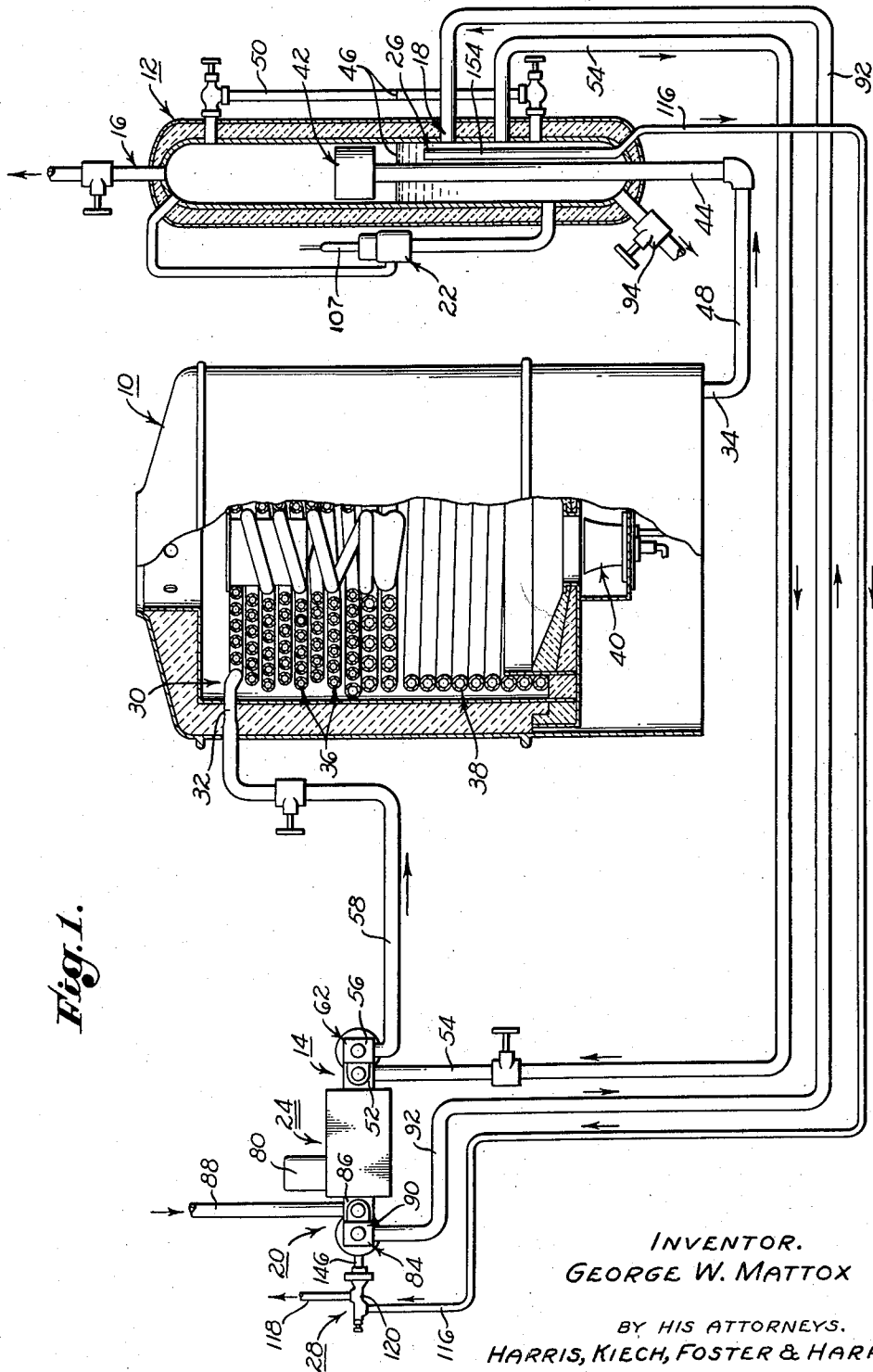
G. W. MATTOX

2,921,564

AUTOMATIC BLOWDOWN FOR STEAM GENERATOR

Filed Nov. 10, 1955

2 Sheets-Sheet 1



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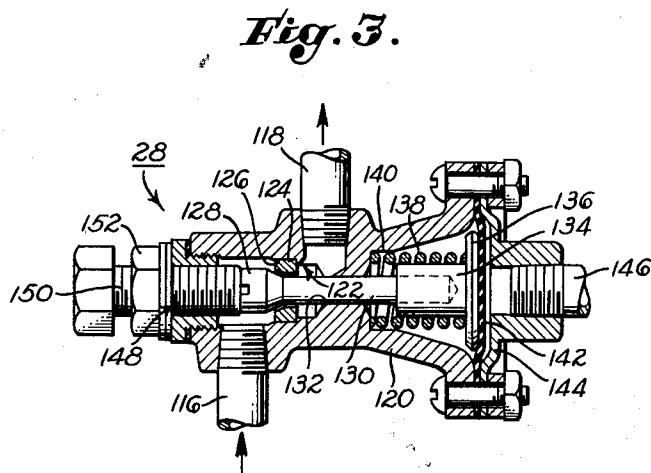
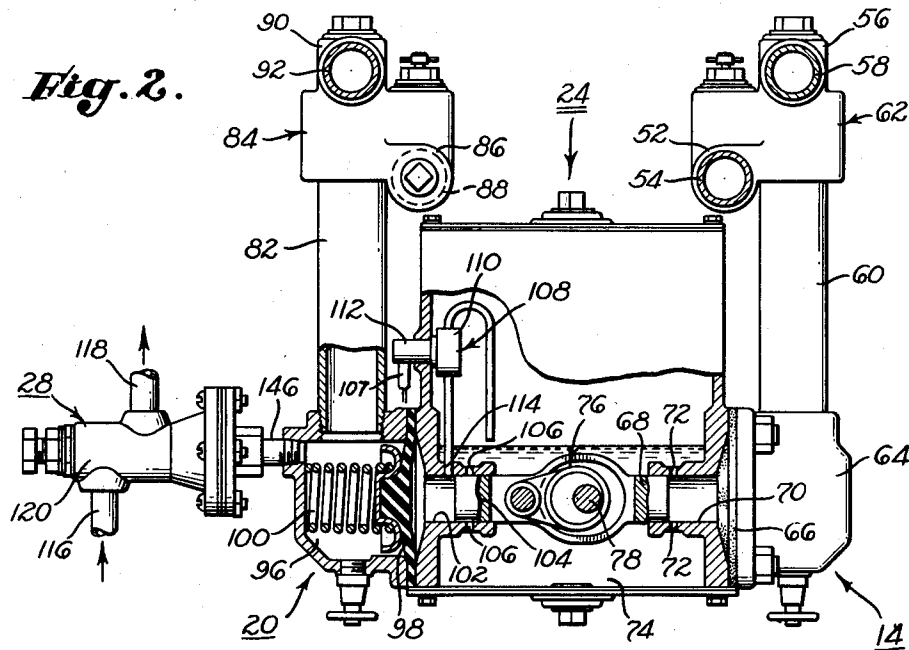
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2 Sheets-Sheet 2



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AUTOMATIC BLOWDOWN FOR
STEAM GENERATOR

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Application November 10, 1955, Serial No. 546,175

7 Claims. (Cl. 122—382)

The present invention relates in general to steam generating equipment and, more particularly, to a blowdown system for a steam generator or boiler. While applicable to various steam generators or boilers, and particularly to those which have a pulsating unit which can be used to control the blowdown function, the invention will be particularly exemplified as applied to a closed steam generating system wherein the feed or make-up water introduced into the system is always maintained in balance with the amount of water withdrawn from the system in the form of steam so that a substantially constant volume of excess water is always present in the system, the excess water being constantly circulated throughout the system. Such a steam generating system is exemplified in the copending application of Perry Arant, Serial No. 432,631, entitled "Balanced Feed Water System for Steam Generators," and assigned to the same assignee as the present application. It should be clear, however, that a closed steam generating system preferably includes a boiler, an accumulator and a circulating pump connected in series in such a manner that the fluid in the system flows from the accumulator through the circulating pump, through the boiler, and into the accumulator again, steam being drawn off from the accumulator as required to meet the demand. The steam generator includes a feed pump for introducing make-up water into the system whenever the amount of liquid in the system falls below a predetermined value, the feed pump preferably being rendered operative to introduce make-up water into the system by a control means which responds to the water level in the accumulator. The control means may render the feed pump inoperative to introduce make-up water into the system, when the amount of water in the system is up to the desired value, in various ways, as by by-passing the make-up water discharged by the feed pump back to the inlet of the feed pump, by rendering a pumping element of the feed pump inoperative, or by stopping the feed pump entirely.

In such a steam generator, impurities concentrate in the excess water in the steam generating system with the passage of time, even with proper conditioning of the make-up water introduced into the steam generating system to balance the water withdrawn in the form of steam concentration of impurities occurring primarily in the accumulator due to steam-water separation in the accumulator and to discharging the make-up water in a zone below the water level in the accumulator where the water temperature is such as to precipitate out many of the impurities which may be present in the make-up water. Conventionally, the impurity concentration is reduced from time to time by periodically blowing down the steam generating system manually so as to bleed off the impurity-laden water in the system. Such manual blowing down of the system is preferably accomplished by means of a manual blowdown valve communicating with the lower end of the accumulator.

With the foregoing manual blowdown procedure, whenever the impurity concentration in the excess water in

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the system reaches a level such as to tend to produce scale formation, corrosion, embrittlement, or carryover of contaminants into the steam discharged by the system, it is necessary to shut the steam generator down while the manual blowdown of the system is accomplished, which is obviously undesirable.

In view of all of the foregoing, a primary object of the present invention is to provide means for blowing down a steam generating system automatically while the steam generator is in operation. With such a means, the impurity concentration is kept within acceptable limits for prolonged periods of time to eliminate frequent shutdowns, which is an important feature.

More particularly, an object of the invention is to provide means for bleeding off water from a steam generating system in proportion to the introduction of make-up water into the system so that impurities are removed at a rate proportional to the rate at which they are introduced.

Another object is to provide a steam generator blowdown valve means for bleeding off impurity-laden water, this valve means being operated whenever feed water is being introduced into the system, thereby attaining a concentration removal rate proportional to the concentration introduction rate.

Another object of the invention is to provide an oscillatory blowdown valve means which cyclically opens and closes a blowdown outlet communicating with the steam generating system, and to provide means for oscillating the blowdown valve means to alternately open and close the blowdown outlet whenever make-up water is being introduced into the system by the feed pump. This oscillating or pulsating action of the blowdown valve means results in self-cleaning thereof to assure a uniform blowdown rate, which is an important feature.

Another object is to provide a feed pump which includes means for producing pressure pulsations concurrently with the introduction of make-up water into the steam generating system, and to apply these pressure pulsations to the oscillatory blowdown valve means to oscillate same between its open and closed positions. With this construction, whenever the feed pump is rendered operative to introduce make-up water into the system, the blowdown valve means is automatically actuated to bleed impurity-laden water off from the system, thereby attaining a blowdown rate proportional to the make-up rate, which is an important feature.

Still another object of the invention is to provide a feed pump having a pulsation chamber and having means for producing pressure pulsations in such chamber whenever the feed pump is operative to introduce make-up water into the steam generating system, a related object being to provide an oscillatory blowdown valve means which includes a valve member movable toward and away from a valve seat and having connected thereto diaphragm means, or the equivalent, exposed to the pressure pulsations in the pulsation chamber.

The feed pump may be caused to produce these pressure pulsations in the pulsation chamber only during introduction of make-up water in various ways. Preferably, the feed pump includes a diaphragm or piston which is oscillated to introduce make-up water into the system and to produce pressure pulsations in the pulsation chamber, the feed pump being rendered inoperative to introduce make-up water and to produce pressure pulsations either by rendering the diaphragm or piston non-oscillatory, or by by-passing the make-up water discharged back to the inlet of the feed pump. Another alternative would be to stop the feed pump completely whenever the amount of excess water in the steam generating water is at the desired value.

In order to bleed off water of maximum impurity

concentration, an important object is to connect the blowdown valve means to the accumulator in communication with a zone in the accumulator wherein the impurity concentration is at a maximum. This zone is just below the water level in the accumulator, the impurity concentration being a maximum in this zone due to the release or precipitation of impurities in the accumulator at the water level therein upon steam-water separation in the accumulator.

More particularly, an object is to provide a skimmer duct which communicates at one end with the accumulator in a zone just below the water level therein, and which communicates at its other end with the blowdown valve means.

An important object of the invention is to so locate the skimmer duct in the accumulator that it extends downwardly therein from the blowdown intake zone in heat-transferring relation with the water in the lower regions of the accumulator, the lower end of the skimmer duct being connected to the blowdown valve means. Since a substantial vertical temperature gradient or stratification exists in the water zone of the accumulator, due primarily to the introduction of make-up water into this zone thereof, the impurity-laden water flowing downwardly through the skimmer duct during blowdown is cooled materially so that it can be safely discharged at any suitable point of disposal, such as a sewer, which is an important feature of the invention.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be quite evident to those skilled in this art in the light of this specification, may be attained with the exemplary embodiment of the invention which is illustrated in the accompanying drawings and which is described in detail hereinafter. Referring to the drawings:

Fig. 1 is a diagrammatic view of a steam generator which embodies means of the present invention for automatic blowdown at a rate proportional to the make-up rate;

Fig. 2 is a view, partially in section and partially in elevation, of a feed pump embodying one means of oscillating a blowdown valve means of the invention during feed-water introduction; and

Fig. 3 is a sectional view of a blowdown valve means of the invention.

Referring particularly to Fig. 1 of the drawings, the illustrated steam generator includes a closed system comprising a steam generating unit or boiler 10, an accumulator or steam separator 12 and a circulating pump 14, all connected in series, with the circulating pump downstream from the accumulator and upstream from the boiler. The steam generating system is provided with a steam outlet 16 connectible to a load, and includes a feed water inlet 18 through which make-up water is introduced by a feed pump 20 the operation of which is regulated by a control means 22 responsive to the water level in the accumulator 12, the circulating pump 14 and the feed pump 20 being combined in a single pumping unit 24 in the particular construction illustrated. The steam generating system also includes a blowdown outlet 26 controlled by a blowdown valve means 28 responsive to the introduction of make-up water into the system by the feed pump 20, as hereinafter described.

Considering the steam generating system in more detail, the boiler 10 includes a continuous heating coil 30 having an inlet end 32 and an outlet end 34, this coil including a number of spiral pancake sections 36 surmounting a helical water-wall section 38. A thermostatically controlled burner 40 evaporates water in the heating coil 30 as it flows from the inlet end 32 of the coil toward the outlet end 34 thereof.

The steam generated within the heating coil 30 is discharged into the accumulator 12 through a discharge

means 42, the latter being mounted on the upper end of a discharge pipe 44 which extends upwardly within the accumulator 12 to a point above the desired water level 46, and which is connected to the outlet end 34 of the heating coil by a pipe 48. The discharge means 42, which may be of any suitable type, separates the steam generated in the heating coil 30 from the water passing therethrough, whereby the steam zone in the accumulator, above the water level 46, contains substantially dry steam, the water discharged by the discharge means 42 descending to the water zone below the water level 46. The steam outlet 16 communicates with the interior of the accumulator 12 at the upper end of the steam zone therein to minimize water carry-over into the steam outlet. The water level 46 within the accumulator 12 may be determined visually through a sight tube 50 communicating with the interior of the accumulator above and below the water level.

The circulating pump 14 continuously draws water from the water zone of the accumulator 12 and delivers it to the inlet end 32 of the heating coil 30 while the steam generator is in operation, the inlet 52 of the circulating pump being connected to the water zone of the accumulator 12 by a pipe 54. The pipe 54 communicates with the water zone of the accumulator at a level intermediate the upper and lower ends of the water zone so as to circulate water having a minimum impurity concentration, the impurity concentration being higher adjacent the water level 46 due to the discharge of impurities by the discharge means 42 and due to precipitation of impurities at the feed-water inlet 18, and being higher near the bottom of the accumulator, where sludge tends to collect. The outlet 56 of the circulating pump 14 is connected to the inlet end 32 of the heating coil 30 by a pipe 58, thereby completing the closed steam generating system or loop.

Considering the circulating pump 14 in a little more detail, various types may be utilized, the one illustrated being exemplary only. In the particular construction illustrated, a standpipe 60 is provided, this standpipe having at its upper end an inlet-outlet check valve assembly 62 which causes incremental flow from the inlet 52 to the outlet 56 in response to pressure pulsations in the standpipe. Such pressure pulsations in the standpipe are created in a pulsation chamber 64, which communicates with the lower end of the standpipe, by a diaphragm 66 which may be oscillated in any suitable manner. In the particular construction shown, the diaphragm 66 is oscillated by a piston 68 through a body of oil trapped in a cylinder 70 when the piston 68 is moved toward the diaphragm 66 to cover ports 72 leading to a sump 74 in the pumping unit 24. The piston 68 is reciprocated to oscillate the diaphragm 66 in this manner by an eccentric means 76 driven by a shaft 78, the latter, in turn, being driven continuously in any suitable manner, as by an electric motor 80, Fig. 1, while the steam generator is in operation.

Considering the feed pump 20, it is also shown as including a standpipe, identified by the numeral 82, surmounted by an inlet-outlet check valve assembly, designated by the numeral 84. This assembly provides an inlet 86 which communicates with a hot well, not shown, through a pipe 88, and provides an outlet 90 which is connected to the feed-water inlet 18 into the accumulator 12 by a pipe 92, the inlet 18 being located in a zone where the water temperature in the accumulator is such as to precipitate various impurities. These impurities settle to the bottom of the accumulator, from which they may be removed periodically by means of a manual blow-off or blowdown valve 94. Adverting to the feed pump 20, the standpipe 82 communicates at its lower end with a pulsation chamber 96 one wall of which is formed by a diaphragm 98. This diaphragm is biased in one direction by a compression spring 100 and is biased in the opposite direction by oil pressure produced in a cylinder 102 by

a piston 104 when it covers ports 106 communicating with the sump 74. The piston 104 is reciprocated by the eccentric means 76, the two pistons 68 and 104 preferably being interconnected for simultaneous reciprocation by the eccentric means. The feed pump 20 operates in the same way as the circulating pump 14. More particularly, as the piston 104 reciprocates, the oil trapped in the cylinder 102 between the piston and the diaphragm 98 each time the piston covers the ports 106 moves the diaphragm in one direction, the diaphragm being moved in the opposite direction, upon movement of the piston in the opposite direction, by the spring 100. Thus, pressure pulsations are produced in the water-filled pulsation chamber 96, these pressure pulsations being transmitted through the standpipe 82 to the check valve assembly 84. The latter regulates communication between the inlet 86 and the outlet 90 of the feed pump 20 in such a way as to produce incremental make-up water flow toward the inlet 18 in response to the pressure pulsations.

Since, as hereinbefore suggested, it is desired to maintain the amount of water in the steam generating system substantially constant by adding make-up water at a rate sufficient to balance the steam demand, the feed pump 20 is rendered operative to produce pressure pulsations in the pulsation chamber 96 whenever the water in the accumulator 12 tends to drop below the desired water level 46, the water level being sensed by the control means 22, which governs the operation of the feed pump 20 in a manner about to be described. The control means may be of any suitable type, and preferably includes a switch, not shown, which is actuated whenever the water level varies from the desired level 46. The control means 22 is electrically connected, by an electrical conductor means 107, to a means 108, Fig. 2, for preventing pressure pulsations in the pulsation chamber 96 whenever the water level in the accumulator is at or above the desired level 46. The means 108 may comprise a valve 110 controlled by a solenoid 112 to which the switch of the control means 22 is electrically connected by the conductor means 107, the valve 110 controlling communication between the sump 74 and a port 114 communicating with the cylinder 102 between the ports 106 and the diaphragm 98. With this construction, whenever the water level attains or exceeds the desired level 46, the control means 22 is actuated and operates the solenoid 112 to produce opening of the valve 110 so as to permit the discharge of oil from the cylinder 102 into the sump, thereby preventing displacement of the diaphragm 98 by the piston 104 and preventing pressure pulsations in the pulsation chamber 96. Thus, make-up water is introduced into the steam generating system by the feed pump 20 only when necessary to maintain the desired water level in the accumulator 12, no make-up water being introduced at other times even though the shaft 78 and eccentric means 76 operate continuously.

The foregoing merely represents one way of producing pressure pulsations during the introduction of make-up water. Pressure pulsations may be prevented in other ways when no make-up water is being introduced into the steam generating system. For example, instead of an oil by-pass as shown, a make-up water by-pass governed by the control means 22 may be utilized. Alternatively, the feed pump 20 may be driven independently of the circulating pump 14 and stopped whenever no introduction of make-up water is necessary.

The steam generator thus far described in detail, is, except for the automatic blowdown means to be described hereinafter, generally similar to the steam generator disclosed in specific detail and claimed in copending application Serial No. 432,631, supra. Reference is hereby made to said copending application for a more specific disclosure of the steam generator, minus the automatic blowdown means of the present invention.

As suggested earlier herein, the automatic blowdown means, which includes the blowdown outlet 26 controlled

by the oscillatory blowdown valve means 28, bleeds off impurity-laden water from the accumulator 12 whenever the feed pump 20 is operative to introduce make-up water into the system along the avenue hereinbefore described.

Thus, the blowdown rate is always proportional to the make-up rate so that the rate of impurity removal is proportional to the rate of impurity introduction into the system. Consequently, the impurity concentration level is maintained within acceptable limits for prolonged periods of time with only infrequent necessity for manual blowdown, by means of the manual blowdown valve 94, to completely clear the system of impurity-laden water.

Considering the automatic blowdown means in more detail, the blowdown outlet 26 is connected to a pipe 116 which, in turn, is connected at its other end to the blowdown valve means 28, the latter controlling flow from the pipe 116 to a waste pipe 118 leading to a suitable point of disposal for the impurity-laden water, such as a sewer.

The valve means 28 includes a valve body 120 having ports into which the pipes 116 and 118 are threaded, there being a connecting passage, indicated generally by the numeral 122, which extends through the valve body 120 from the pipe 116 to the pipe 118. Disposed within the valve body 120 and forming part of the passage 122 is a valve seat 124, shown as a separate member pressed into a counterbore 126 in the valve body. This valve seat is engageable by an oscillatory valve member 128 having a stem 130 which is of smaller diameter than and extends through the valve seat and through a guide bore 132. The stem 130 of the valve member 128 is connected to a member 134 having an annular flange 136 which serves as a seat for a compression spring 138, the other end of the spring being seated in a counterbore 140 in the valve body 120. As will be apparent, the spring 138 biases the valve member 128 toward the seat 124, and thus tends to close the passage 122 through the valve body 120.

Considering the manner in which the valve member 128 is moved off its seat 124, the member 134 is seated against one side of a diaphragm 142 clamped between one end of the valve body 120 and a closure 144. The opposite side of the diaphragm 142 is exposed to the pressure in the pulsation chamber 96, as by means of a pipe 146 threaded into the wall of the pulsation chamber and threaded into the closure 144. Thus, pressure in the chamber 96 tends to unseat the valve member 128, this unseating tendency being opposed by the spring 138 and by the pressure in the steam generating system applied to the outer end of the valve member 128. The area of the diaphragm 142 is sufficiently large that, whenever pressure pulsations occur in the pulsation chamber 96 in response to the introduction of make-up water into the system, the valve member 128 is moved off its seat. The distance that the valve member 128 may move off its seat 124, which determines the rate at which impurity-laden water is bled off from the system, is determined by an adjustable stop means 148 engageable by the outer end of the valve member 128 to limit its movement off its seat. The adjustable stop means 148 is shown as including a threaded stop 150 adapted to be locked in any given position by a lock nut 152.

Considering the operation of the oscillating blowdown valve means 28, it will be remembered that pressure pulsations occur in the pulsation chamber 96 when, and only when, make-up water is being introduced into the steam generating system, pressure pulsations in the chamber 96 when, and only

when 96 being prevented at other times by the means 108. The pressure pulsations produced in the chamber 96 during the interval of introduction of make-up water cause the valve member 128 to rapidly and repeatedly oscillate between its closed position in engagement with seat 124 and its open position in engagement with stop

150, the position of which determines the rate at which stop impurity-laden water is bled off. Preferably, the stop 150 is adjusted to provide a blowdown rate of $3\frac{1}{2}\%$ to 4% of the evaporation rate. This oscillating action of the valve member 128 results in self-cleaning of the valve member and its seat 124, whereby operation of the valve means 28 is not adversely affected by the impurity-laden water passing therethrough into the waste pipe 118. In other words, this self-cleaning action permits the valve means 28 to maintain a uniform blowdown rate for each intermittent period of time, which is an important feature of the invention.

Another important feature of the invention resides in the location of the blowdown outlet 26, which is shown as including the open upper end of a skimmer duct or tube 154 positioned in the water zone of the accumulator 12. The upper end of this skimmer duct communicates with the water zone in the accumulator below the water level 46, in a zone where the impurity concentration is relatively high, due to the discharge of impurities above the water level by the discharge means 42, and due to precipitation of impurities from the feed water introduced by the feed water inlet 18. By locating the inlet end of the skimmer duct 154 in a zone of high impurity concentration in this manner, maximum impurity removal with a minimum of water removal is attained. The skimmer duct 154 extends downwardly in the water zone of the accumulator 12 to, or substantially to, the lower end of the accumulator in heat-transferring relation with the water in the water zone, the lower end of the skimmer duct being connected to the pipe 116 leading to the blowdown valve means 28. The water in the water zone is subject to considerable vertical temperature stratification due to the introduction of the feed water into the system by way of the accumulator 12. For example, the temperature at the lower end of the water zone in the accumulator may be in the neighborhood of 100° F. when the temperature in the upper end of the water zone is of the order of 300° to 400° F. Consequently, as the water which is bled off passes downwardly through the skimmer duct 154, it is cooled very appreciably due to the temperature stratification in the water zone of the accumulator, and the temperature of the impurity-laden water discharged into the waste pipe 118 is therefore sufficiently low to permit disposing of it in a sewer, or the like, which is an important feature.

Thus, the present invention provides an automatic blowdown means which discharges impurity-laden water in response to the introduction of make-up water into the system so that the blowdown rate is proportional to the make-up rate to obtain a rate of impurity discharge proportional to the rate of impurity introduction into the system. By using an oscillating blowdown valve means 28, such valve means is self-cleaning so that its operation is not adversely affected by the impurity-laden water passing therethrough, whereby the blowdown valve means will operate without attention for prolonged periods of time. Also, by utilizing the temperature stratification in the accumulator 12 to cool the water which is bled off, it may safely be discharged into any convenient means of disposal.

Although I have disclosed an exemplary embodiment of my invention herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiment without departing from the spirit of the invention as defined by the claims hereinafter appearing.

I claim as my invention:

1. In combination: a closed steam generating system including a boiler, an accumulator and a circulating pump in series; a feed pump communicating with said system for intermittently introducing make-up water therinto, said feed pump including means for producing pressure pulsations in the make-up water as it is introduced into said system; means controlling the introduction of make-

up water into said system by said feed pump for maintaining the amount of water in said accumulator substantially constant; and oscillatory blowdown valve means communicating with said accumulator for bleeding water therefrom, said blowdown valve means including an oscillatory element for controlling flow from said accumulator, said element normally occupying a closed position and being operable by means responsive to said pressure pulsations to rapidly and repeatedly move from closed to open position in response to the introduction of make-up water into said system.

2. In combination with a steam generating system: a feed pump communicating with said system for introducing make-up water therinto, said feed pump including means for producing pressure pulsations concurrently with said introduction of make-up water into said system; means for controlling the introduction of make-up water into said system by said feed pump; and normally closed oscillatory blowdown valve means exposed to said means for producing pressure pulsations, and operable rapidly and repeatedly by said pressure pulsations from closed to open position and communicating with a portion of said steam generating system for bleeding off water from said portion in response to the introduction of make-up water into said system by said pump.

3. In combination with a multi-component steam generating system: a feed pump communicating with said system for introducing feed water therinto, said feed pump including a pulsation chamber and including means for producing pressure pulsations in said pulsation chamber concurrently with said introduction of feed water into said system; means responsive to the amount of water in a component of said system for controlling such introduction of feed water into said system by said feed pump; and normally closed oscillatory blowdown valve means connected with said system and exposed to said pulsation chamber and rapidly and repeatedly operable from closed to open position by said pressure pulsations therein for bleeding off water from said system in response to the introduction of said feed water into said system by said feed pump.

4. A blowdown for a closed steam generating system including a boiler, an accumulator and a circulating pump in series, said steam generating system also including feed pump means for introducing make-up water therinto, and further including control means for rendering said feed pump means operative to introduce make-up water into said system whenever the water level in said accumulator is below a predetermined value and for rendering said feed pump means inoperative to introduce make-up water into said system whenever the water level in said accumulator is not below said predetermined value, said accumulator having an outlet, and said blowdown including: normally closed oscillatory blowdown valve means communicating with said outlet; and means responsive to operation of said feed pump means to introduce make-up water into said system for rapidly and repeatedly oscillating said blowdown valve means between its closed position and its open position each time said feed pump means is in operation.

5. In a steam generator, the combination of: a closed steam generating system including a boiler, an accumulator and a circulating pump in series, said steam generating system also including normally inoperative feed pump means capable of being rendered operative to introduce make-up water into said system, and said system further including control means for rendering said feed pump means operative to introduce make-up water into said system whenever the water level in said accumulator is below a predetermined value and for rendering said pump means inoperative to introduce make-up water into said system whenever the water level in said accumulator is not below said predetermined value, said accumulator having an outlet; normally closed oscillatory blowdown valve means communicating with said outlet; and means

responsive to operation of said feed pump means to introduce make-up water into said system for rapidly and repeatedly oscillating said blowdown valve means between its closed position and its open position each time said feed pump means is in operation.

6. In combination with a multi-component steam generating system having a steam outlet, a feed water inlet and a blowdown outlet: normally inoperative feed-water-introducing means operative in response to a reduction in the amount of liquid in a component of said system below a predetermined value for introducing feed water into said system through said feed water inlet as required to maintain the amount of liquid in said component substantially constant; and oscillatory means connected with said blowdown outlet and being automatically responsive to operation of said feed-water-introducing means for rapidly and repeatedly effecting opening and closing of said blowdown outlet while said feed-water-introducing means is in operation.

7. In an automatic blowdown for a steam generating system having a water zone, a steam outlet, a feed water inlet and a blowdown outlet, the combination of: normally inactive feed-water-introducing means operative in response to a reduction in the amount of water in said water zone below a predetermined value for introducing feed water into said system through said feed water inlet

as required to maintain the amount of water in said water zone substantially constant; normally closed oscillatory blowdown valve means operable to open and close said blowdown outlet; and means automatically responsive to operation of said feed-water-introducing means for continually oscillating said blowdown valve means rapidly and repeatedly between its closed position and its open position while said feed-water-introducing means is in operation.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,921,564

January 19, 1960

George W. Mattox

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 26, for "velve" read -- valve --; line 69, str out "ber 96 when, and only"; line 75, before "stop" insert -- the column 7, line 1, after "which" insert -- stop --; line 2, strike "stop"; line 19, for "lever 46" read -- level 46 --.

Signed and sealed this 12th day of July 1960.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents