March 9, 1965 S. F. MULFORD 3,172,824

EVAPORATOR CONSTRUCTION

Filed April 25, 1961 3 Sheets-Sheet 1

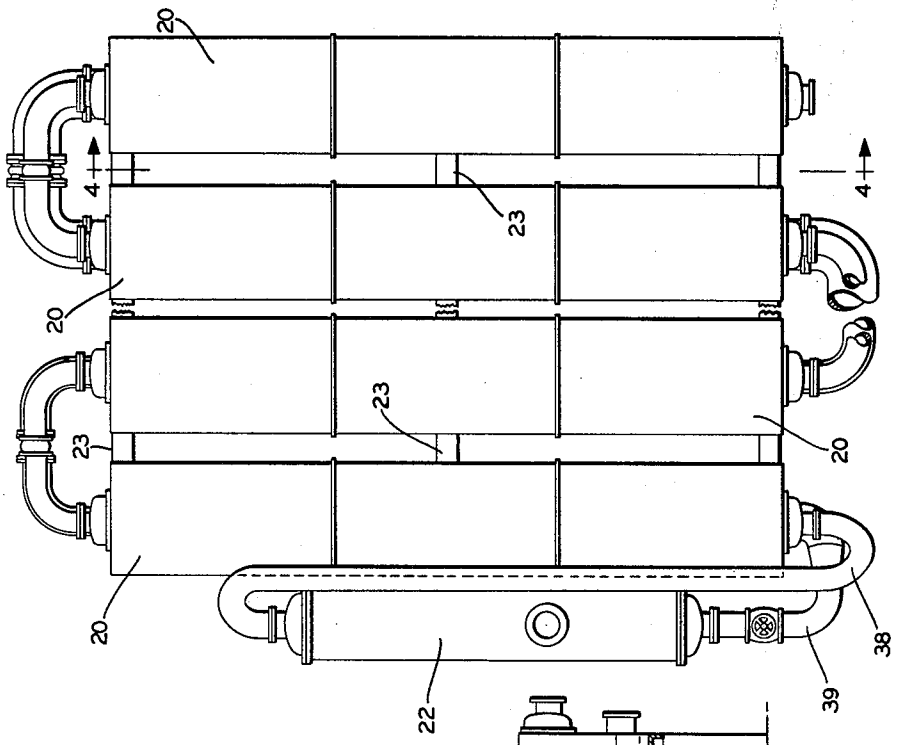

Fig. 1

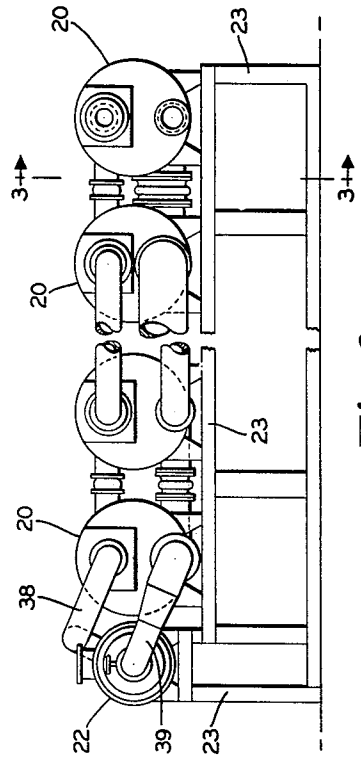

Fig. 2

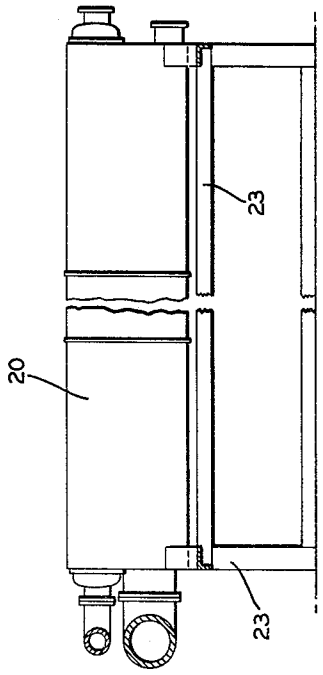

Fig. 3

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March 9, 1965 S. F. MULFORD 3,172,824

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Filed April 25, 1961 3 Sheets-Sheet 2

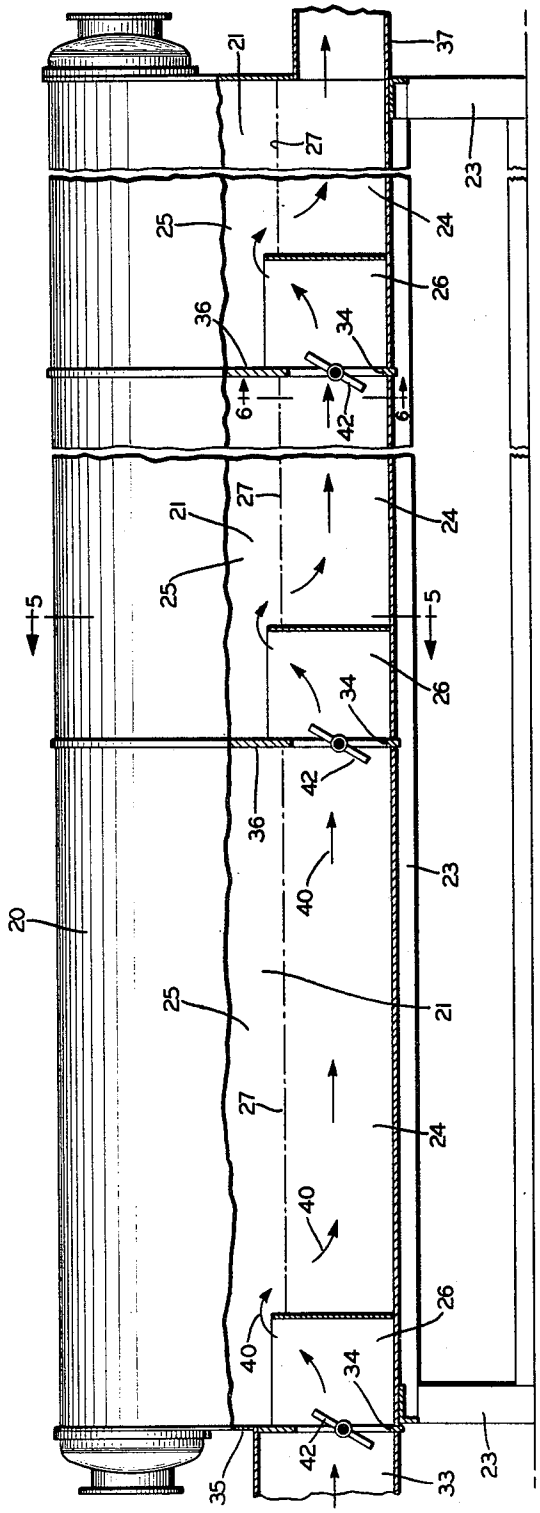

Fig. 4

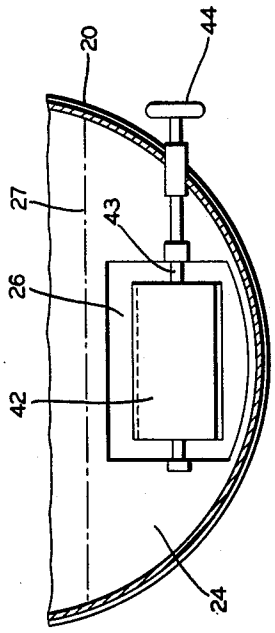

Fig. 6

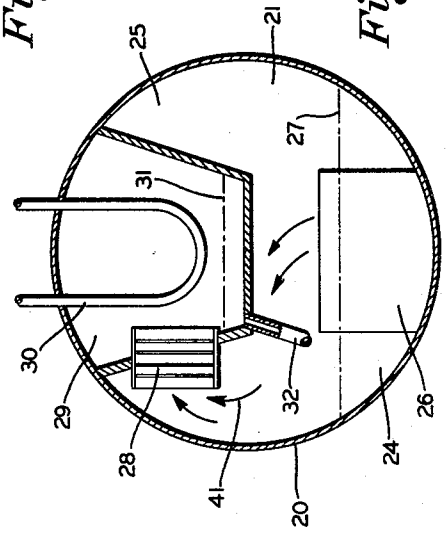

Fig. 5

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March 9, 1965 S. F. MULFORD 3,172,824

EVAPORATOR CONSTRUCTION

Filed April 25, 1961 3 Sheets-Sheet 3

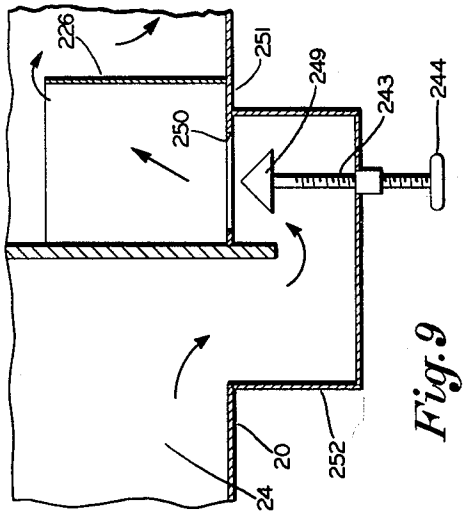

Fig. 9

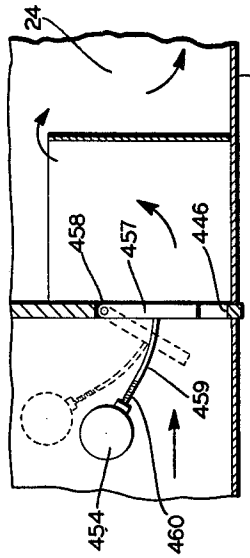

Fig. 11

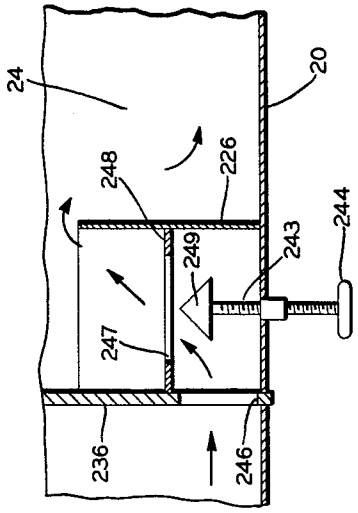

Fig. 8

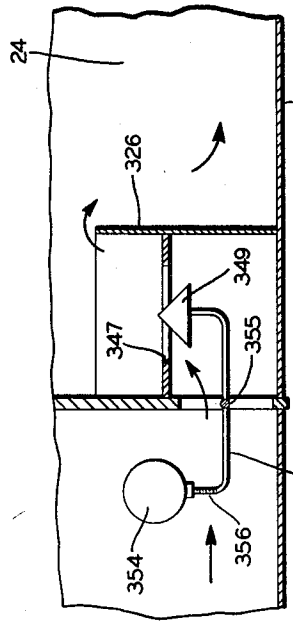

Fig. 10

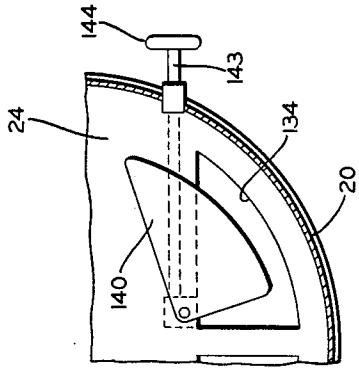

Fig. 7

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3,172,824

EVAPORATOR CONSTRUCTION

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Filed Apr. 25, 1961, Ser. No. 105,358
5 Claims. (Cl. 202—173)

My invention relates to improvements in evaporator construction for use in distilling sea water and the like, and more specifically to evaporators of the multi-stage type. Even more specifically, my invention relates to improvements in flash evaporators having two or more stages, with the sea water being evaporated or distilled flowing continuously from one stage to the next.

In prior constructions of multi-stage flash evaporators, certain problems have been encountered in attempting to design and construct a particular evaporator construction for maintaining the proper flow of sea water to be evaporated or distilled therethrough, while still maintaining properly balanced and efficient operating conditions. This problem is due principally to the fact that in multi-stage flash evaporators, each subsequent evaporator chamber or stage into which the sea water being evaporated flows, operates under a slightly lower temperature and pressure condition from the evaporator chamber directly prior thereto.

It is, therefore, necessary in the design and construction of multi-stage flash evaporators that a seal of some form must be provided between adjacent chambers while still maintaining a constant flow of sea water to be evaporated between such chambers, in order to prevent the blow-through of vapors between chambers in view of the fact that the different pressure conditions are present. This problem is even more greatly complicated by the fact that this seal must be maintained despite varying pressure conditions between the various chambers resulting from varying temperature conditions of the particular chambers.

If the operating conditions of an evaporator could be exactly predetermined during the design and construction period thereof and if these operating conditions, such as for instance, the temperature of the raw sea water taken into the evaporator construction, would remain perfectly constant this problem would be greatly simplified. Unfortunately, however, the operating conditions of a particular evaporator construction cannot always be exactly predetermined and calculated and it is impossible in many, if not most cases, to determine beforehand exactly how a particular evaporator construction will function, even if absolutely constant operating conditions would prevail. In these cases, this can only be determined after the evaporator is installed and pilot runs have been made. Thus, in prior construction it has been necessary after pilot runs of particular evaporator plants to make many alterations in an attempt to adapt the constructions to the particular conditions present.

This still does not solve the problem, however, in view of the fact that seasonal changes can regularly change the operating conditions. For instance, as seasonal changes take place, the temperature of the raw sea water being taken into the evaporator plant will change, thereby, in many cases, causing the temperature and pressure of each evaporator chamber or stage to change and requiring a different rate of flow through the plant and between the various chambers. Thus, it is desirable to provide some means in the evaporator construction and preferably between each of the various chambers thereof for regulating the flow of the sea water being evaporated between and into these chambers. By selective adjustment of such means, therefore, not only can optimum operating conditions be provided after original installation of a particular evaporator plant, but also further adjustments can be made from time to time in order to adjust for the seasonal changes encountered.

Various attempts have been made to satisfy this want and need, for instance, by the use of the non-adjustable so-called loop seals between the various evaporator chambers, which seals merely consist of a generally U-shaped conduit for providing the flow of sea water between adjacent chambers with this conduit extending downwardly between the particular chambers. Thus, by maintaining these U-shaped conduits or loop seals at all times at least partially filled with sea water, it is hoped that a seal between chambers will be maintained for preventing the blow-through of vapors discussed above.

The solution of the problem in this manner, however, has not been satisfactory in view of the fact that the temperature and pressure conditions can vary as discussed above. Also, since there is no adjustability provided, under many operating conditions such seals will be completely inoperable. Furthermore, even though these loop seals might function under certain varying operating conditions, the particular flow of sea water between the chambers cannot be maintained at its optimum condition.

It is, therefore, a general object of the present invention to provide a multi-stage flash evaporator construction which eliminates the difficulties and solves the problems of the prior constructions as discussed above.

It is a primary object of the present invention to provide a multi-flash evaporator construction in which selectively adjustable means is provided preferably for each of the individual evaporator chambers for selectively adjusting the flow of sea water into and through the particular evaporator chamber in order to provide the optimum and balanced flow conditions for maximum efficiency and operability.

It is a further object of the present invention to provide a multi-stage flash evaporator construction in which selectively adjustable variable orifice means are provided between the various evaporator chambers thereof for regulating the flow of sea water through these chambers and preventing the sea water level in any chamber from dropping below a predetermined minimum level.

It is still a further object of the present invention to provide a multi-stage flash evaporator construction in which selectively adjustable orifice means is provided for each of the evaporator chambers thereof in order that, by selective adjustment, a sea water level in a particular chamber may be provided for preventing blow-through between adjacent chambers, yet such sea water level may be maintained at a minimum providing the optimum operating conditions.

It is an additional object of the present invention to provide a multi-stage flash evaporator construction in which selectively adjustable means is provided between the various adjacent evaporator chambers for maintaining a relatively constant level of sea water within a particular chamber despite the variation from time to time of the pressure therein.

Finally, it is an object of the present invention to provide a multi-stage flash evaporator construction satisfying the foregoing objects in a simple and efficient manner and at a minimum of expense.

These and other objects are accomplished by the parts, constructions, arrangements, combinations and subcombinations comprising the present invention, the nature of which is set forth in the following general statement, preferred embodiments of which—illustrative of the best modes in which applicant has contemplated applying the principles—are set forth in the following description and illustrated in the accompanying drawings, and which are

particularly and distinctly pointed out and set forth in the appended claims forming a part hereof.

In general terms the evaporator construction for distilling sea water and the like comprising the present invention may be stated as including shell means in the form of one or more shell members enclosing at least two operably connected flash evaporator chambers which chambers operate under different temperature and pressure conditions but through which the feed water or salt water being evaporated flows in a continuous flow path. Each of said chambers preferably has a feed water portion for receiving the sea water therein to be evaporated or flashed into vapor and a condensing portion for condensing the vapors flashed, thereby providing the desired distillate.

Furthermore, the construction includes selectively adjustable orifice means communicating between the feed water portions of the two chambers for directing the flow of sea water between the chamber sea water portions and being selectively adjustable for maintaining the sea water level in the first chamber at least at a minimum level sufficient to prevent the blow-through of vapors between these chambers through said orifice means while still maintaining flow at all times therethrough. In the case of a plurality of operably connected shells, each having one or more operably connected flash chambers therein, the adjustable orifice means would also be provided between the last chamber or stage of each shell and the first chamber of the next operably connected shell for the same purpose.

Further, this variable orifice means may be in many forms such as, for instance, a selectively adjustable butterfly plate located within the orifice or a hinged plate selectively movable to obstruct the orifice or a conical member selectively movable axially at least partially into the orifice, all of which may be adjusted to partially obstruct the orifice and thereby regulate the flow of sea water therethrough. Furthermore, any one of these forms may be provided with a selectively adjustable float control, wherein the float will automatically adjust the variable orifice under limited varying operating conditions to maintain relatively constant sea water level control, yet may be selectively adjusted to operate under particular limits for larger changes of operating conditions.

By way of example, embodiments of the improved evaporator construction of the present invention are illustrated in the accompanying drawings forming a part hereof, wherein like numerals indicate similar parts throughout the several views and in which:

FIG. 1 is a fragmentary top plan view of a multi-stage flash evaporator construction incorporating the principles of the present invention;

FIG. 2, a fragmentary side elevation of the multi-stage flash evaporator construction of FIG. 1;

FIG. 3, a fragmentary end elevation of the multi-stage evaporator construction of FIG. 1;

FIG. 4, an enlarged fragmentary view, part in elevation and part in section, showing a portion of the interior of the lowest temperature shell looking in the direction of the arrows 4—4 in FIG. 1;

FIG. 5, a partially diagrammatical sectional view looking in the direction of the arrows 5—5 in FIG. 4;

FIG. 6, an enlarged fragmentary sectional view, part in elevation, looking in the direction of the arrows 6—6 in FIG. 4;

FIG. 7, a view similar to FIG. 6 showing a second embodiment of the present invention;

FIG. 8, an enlarged fragmentary sectional view, part in elevation, taken parallel to the longitudinal length of one of the shells and illustrating a third embodiment of the present invention;

FIG. 9, a view similar to FIG. 8 illustrating another form of the third embodiment of the present invention;

FIG. 10, a view similar to FIG. 8 illustrating a fourth embodiment of the present invention; and

FIG. 11, a view similar to FIG. 8 illustrating a fifth embodiment of the present invention.

As shown in the drawings, the principles of the present invention are illustrated in a multi-stage flash evaporator construction made up of a series of generally horizontal longitudinally extending and laterally adjacent tubular shells **20**, each containing three longitudinally adjacent and operably connected evaporator chambers or stages **21**. Furthermore, operably connected within the evaporator construction is an auxiliary salt water heater **22**, the operable connection and function thereof to be hereinafter explained. Also, the entire evaporator construction including the shells **20** and salt water heater **22** are mounted supported on a plane surface by the usual structural supporting members **23**.

As shown in FIG. 4 and stated above, each of the generally horizontal shells **20** contains or encloses three tandem-arranged or longitudinally adjacent evaporator chambers **21** with each chamber being formed of a feed water portion **24** and a condensing portion **25**. Each of the feed water portions **24** may be made up of a distribution box **26** into which the incoming sea water, a portion of which is to be evaporated or flashed, enters and overflows into the remainder of the feed water portion **24** forming the sea water level within the feed water portion, as indicated by the broken lines **27**.

Each of the condensing portions **25** of each of the evaporator chambers **21**, as illustrated diagrammatically in FIG. 5, includes a vapor separator **28**, through which the vapors flashed from the sea water enter the condensing chamber **29** to contact the condensing tubes **30** extending within this condensing chamber. The distillate thereby formed from this condensing of vapors collects at the lower portion of the condensing chamber **29** forming the distillate level, as indicated by the broken lines **31**, which distillate may be drained from the condensing chamber **29** through the usual distillate drain **32**.

The sea water entering the feed water portions **24** of the evaporator chambers **21** enters the particular shell **20** through a conduit **33** and passes into the distribution box **26** of the first evaporator chamber of that particular shell through the feedwater passageway formed by the orifice **34**, which, for this particular evaporator chamber, would be formed at the end wall **35** of the particular shell. Furthermore, this sea water passes directly between longitudinally adjacent evaporator chambers **21** through similar orifices **34** formed in the partition or division plates **36** between the adjacent evaporator chambers, in each case entering from the orifice **34** into the particular distribution box **26** and overflowing into and forming a continuously moving lengthwise body of feedwater in the remainder of the feed water portion **24** of that particular evaporator chamber.

Finally, the sea water leaves the third evaporator chamber **21** of the particular shell **20** through a conduit **37** and if this particular shell **20** were intermediate the evaporator plant the sea water could flow through conduit **37** into the next shell. In this particular case, however, the particular shell **20** shown is the last or lowest temperature and lowest pressure shell so that the sea water would flow from this shell either to waste, or a portion might be used for recirculation within the evaporator plant in the usual manner.

As will be hereinafter fully explained in a description of the general operation of the evaporator construction, all of the shells **20** are operably connected for a continuous flow of sea water from the salt water heater **22** longitudinally through each of the shells **20**, and this flow is longitudinal through each shell but in opposite longitudinal directions through laterally adjacent shells. Referring to FIGS. 1 and 2, the shell **20** at the lefthand side of the evaporator plant would constitute the highest temperature and highest pressure shell, with the temperature and pressure within the evaporator chambers **21** of the shells decreasing progressively through this particular shell **20** and progressively through and between the re-

mainder of the shells to the last or lowest temperature and pressure shell 20 at the righthand side of the plant.

The condensing medium or cooling medium flowing through the condensing tubes 30 of the condensing chamber 29 of each evaporator chamber 21 is raw sea water being preheated preparatory to having a portion thereof evaporated or flashed within the evaporator chambers 21. Further the condensing tubes 30 of each particular evaporator chamber 21 are operably connected with the condensing tubes of longitudinally adjacent evaporator chambers and laterally adjacent shells in the usual manner for continuous flow through all the condensing tubes.

Thus, the raw sea water first enters the evaporator plant into the condensing tubes 30 of the lowest temperature and lowest pressure evaporator chamber 21 of the lowest temperature and lowest pressure shell 20, or the lower righthand end of the plant, as viewed in FIG. 1. This sea water being preheated then flows continuously through longitudinally adjacent evaporator chambers and between laterally adjacent shells to finally exit from the highest temperature and highest pressure evaporator chamber 21 of the highest temperature and highest pressure shell 20 through the conduit 38, or from the lower lefthand corner of the plant as viewed in FIG. 1.

The flow of the raw sea water through the condensing tubes 30 of the evaporator chambers 21, through the shells 20 and between these shells, is therefore exactly longitudinally opposite from the flow of the sea water being evaporated through the shells and chambers, so that the sea water first entering the plant is preheated by passing through the various condensing tubes 30 and at the same time constitutes the condensing medium within these tubes. Furthermore, after passing through each of the evaporator chambers 21, this preheated sea water then flows through the conduit 38 into the salt water heater 22 and from the salt water heater through the conduit 39 into the conduit 33 of the first or highest temperature and pressure shell 20.

Generally the operation of the evaporator plant is therefore as follows. The raw sea water enters the condensing tubes 30 of the lowest pressure and temperatrue evaporator chamber 21 or at the lower righthand corner of the plant, as viewed in FIG. 1, and this sea water is preheated by forming the condensing or cooling medium within the condensing tubes 30, passing progressively through each of the evaporator chambers 21 to finally exit through the conduit 38 of the highest temperature and pressure chamber. The salt water then passes through conduit 38 into the salt water heater 22 where it is heated to the desired temperature preparatory to entering the feed water portion 24 of the highest temperature and pressure evaporator chamber 21 to begin the distillation process thereof. The heat added in the salt water heater 22 may be derived from any usual source.

The fully preheated sea water flows from the salt water heater 22 through conduit 39 into the conduit 33 of the first shell 20 and from conduit 33 into the distribution box 26 of the highest temperature and pressure evaporator chamber 21. The sea water overflows the distribution box 26 into the remainder of the feed water portion 24 of this particular evaporator chamber 21, such flow being illustrated by the arrows 40 in FIG. 4.

Within the particular evaporator chamber 21, a certain portion of the sea water is flashed into vapor and rises passing through the vapor separator 28 into the particular condensing chamber 29, as indicated by the arrows 41 in FIG. 5. As this vapor contacts the condensing tubes 30 within the condensing chamber 29, it gives up a certain portion of its heat to the sea water being preheated within these condensing tubes and this vapor therefore condenses at the lower portion of the chamber 29 as distillate, draining therefrom through the distillate drain 32.

The remainder of the sea water not vaporized within this first chamber, continuously flows through the orifice 34 between this chamber and the next longitudinally adjacent chamber of this particular shell 20, and the same process takes place. The sea water as it enters this next chamber, however, is at a slightly lower temperature and the contained pressure of this next chamber is slightly lower. Thus, in this manner the sea water flows continuously through the progressively lower temperature and lower pressure evaporator chambers 21, longitudinally through each of the shells 20 and finally exits from the lowest temperature and lowest pressure evaporator chamber 21 through the conduit 37 thereof.

In view of the fact that the evaporator chambers 21 operate at different pressures, with the pressure in each chamber being slightly less than the pressure in the preceding longitudinally adjacent chamber, in order to prevent blow-through of vapors between longitudinally connected chambers as well as longitudinally connected shells 20, a seal or barrier must be maintained by the sea water between the longitudinally adjacent chambers and shells despite the fact that there must be continuous flow between these chambers and shells. Referring to FIG. 4, the sea water surface elevation level 27 therefore must be maintained above the upper edge of the orifices 34 connecting the chambers with adjacent chambers.

Furthermore, the ideal operating conditions are to maintain the sea water levels 27 in the evaporator chambers 21 at a minimum level at which this seal may still be maintained. Obviously if the sea water level in a particular chamber becomes too high there is a possibility of malfunctioning of the entire evaporator plant.

The sea water level in any given evaporator chamber 21 is dependent on a balancing of the temperature and resultant pressure therein against the flow of sea water to be evaporated therethrough, and as previously discussed, it is extremely difficult if not impossible to exactly predetermine during the original design and construction of a given evaporator plant exactly what these conditions will be under operation thereof. Furthermore, seasonal changes resulting in a variation in the temperature of the raw sea water originally taken into the plant for distillation can cause the particular operating conditions and therefore the operating balance of the plant to change, thereby requiring an adjustment in the flow of sea water therethrough.

According to the principles of the present invention, therefore, means is provided at the entrance to and/or exit from each of the evaporator chambers 21 of the multi-stage evaporator for regulating this flow of sea water through the passageway into or from that particular chamber. This means is located within the orifice or orifices 34 of the particular evaporator chamber 21 to be controlled and thereby provides selectively adjustable variable orifice means for preferably each of the evaporator chambers to maintain a sea water level in that particular chamber which is preferably the minimum level required to form a sea water barrier and prevent blow-through of vapors between adjacent chambers.

As shown in FIGS. 4 and 6, this variable orifice means is formed by a rectangular plate 42 mounted pivotal about the horizontal center line thereof on a control rod 43. Further, the angle of pivoting of plate 42 for increasing or decreasing the obstruction with the orifice 34 is controlled from outside the particular shell 20 by the control wheel 44.

As is clear from FIGS. 4 and 6, plate 42 is preferably of smaller size than the orifice 34, since it would be unnecessary to ever completely close orifice 34 and, as a matter of fact, it is preferable that this orifice can never be completely closed since this would prevent operation of the entire evaporator plant. It is sufficient that this plate 42, or whatever variable obstruction is used within the orifice 34, be only of sufficient size so that when this plate or other obstruction is in its maximum limiting or flow obstructing position, it will permit only the minmum flow desired under any conditions and

when in its minimum flow obstructing position it permits the maximum flow ever to be desired under any conditions.

This variable orifice means is therefore to be distinguished from, for instance, a float valve which would completely shut off flow when a particular water level is reached and would open for flow as the water level decreased. Here, rather, a selectively adjustable variable orifice is used which will preferably always permit continuous flow therethrough but may be selectively regulated to determine the continuous flow between certain maximum and minimum limits.

The particular construction of plate 42 pivotal about a central horizontal axis and mounted preferably substantially horizontally centrally within the orifice 34 constitutes such a desired variable orifice construction. Furthermore, it is preferable to provide such a variable orifice construction ahead of or at the inlet to each of the connected evaporator chambers 21 so that the head of sea water in the preceding chamber and in subsequent chambers may be individually regulated as conditions require.

Thus, a particular multi-stage evaporator may be constructed at the site of operation and pilot operation thereof begun to determine the exact conditions for such operation. As these conditions are determined, the various variable orifices can be individually regulated to provide the proper flow into and from each evaporator chamber 21, to thereby provide the most efficient operating conditions. Furthermore, as seasonal changes take place, these variable orifices can be adjusted from time to time in order to maintain the most efficient operating conditions.

In FIG. 7, a second construction of variable orifice which likewise cannot be fully closed is shown and in this case a plate 140 of somewhat triangular shape is pivoted at the right angle corner thereof movable to cover a greater or lesser area of the passageway formed by the orifice 134. Furthermore, the pivoting of plate 140 may be controlled by usual gear means through the control rod 143 extending outwardly of the shell 20 manipulated by the control wheel 144.

The particular form of variable orifice shown in FIG. 7 could be used, one at either side for providing double control of flow into and from a particular evaporator chamber 21. Also, this particular construction could be used in the case of shells 20 having a central division plate segregating the shell into two laterally adjacent sets or lines of longitudinally connected evaporator chambers, such general construction and form of multi-stage evaporator being well known in the art.

In FIG. 8, a third form of non-closing variable orifice means is shown in which case a first orifice 246 is provided in the partition or division plate 236 and a second vertical flow orifice 247 is provided in a partition or division plate 248. Division plate 248 is mounted substantially vertically midway and horizontally extending within the distribution box 226 and above the upper edge of the orifice 246. Thus, the passageway between chambers is formed by the partition plates 236 and 248, and by the orifices 246 and 247 therethrough, and this passageway is connected to the feedwater distribution means formed by the upper part of the distribution box 226.

In this case, the selectively adjustable means for varying the size of the orifice 247 and the flow therethrough is a conical member 249, regulated by the control rod 243 extending outwardly of the shell with the control wheel 244. Thus, by vertically raising and lowering the conical member 249 axially toward and away from the orifice 247, the flow of sea water through this orifice is selectively diminished and increased. In this manner, the same previously discussed regulation of the flow of sea water into and/or from a particular evaporator chamber is provided.

The particular construction illustrated in FIG. 9 is merely a variation of the form shown in FIG. 8, providing a combination of the loop seal hereinbefore discussed with the variable orifice of the present invention. As shown, the orifice 250 is provided in the bottom wall 251 of the distribution box 226 and is regulated by the conical member 249, control rod 243 and control wheel 244. The loop seal portion is provided with the downwardly extending U-shaped cross section partition wall 252 which directs the flow from the first chamber downwardly below the bottom wall 251 of the distribution box 226 and then upwardly through the variable orifice 250 and forming the passageway between chambers. The advantage here is the provision of a more positive seal between adjacent evaporator chambers which still may be selectively adjusted through the variable orifice means.

The form of variable orifice means shown in FIG. 10 is a selectively adjustable float control non-closing variable orifice means. The construction is generally similar to that shown in FIG. 8 and previously described, having the same construction of distribution box 326, orifice 347, and conical member 349 for obstructing the flow of sea water a predetermined amount through the orifice 347. In this case, however, the conical member 349 is connected through a generally U-shaped control rod 353 to a generally spherical float 354.

Control rod 353 is pivoted generally midway of its length for pivotal movement in a vertical plane through the pivot pin 355. Further and very important to the principles of the present invention is the fact that float 354 is operably connected to the control rod 353 through adjustment means, such as the threads 356, so that the level of float 354 may be adjusted with reference to the control rod 353.

Thus, with this third form of variable orifice means, the float 354 will automatically regulate the movement of the conical member 349 toward and away or into and out of the orifice 347, thereby regulating the flow of sea water through orifice 347 automatically for minor changes in water level of the preceding evaporator chamber. For originally adjusting the sea water flow during the pilot run of the evaporator plant, however, or for making seasonal adjustments which would be major in character, the adjustment of the float 354 with reference to the control rod 353 would be used, in this case by virtue of the threads 356. Thus, in this third form, an automatic variable orifice is shown providing automatic minor adjustments while still permitting selective major adjustments for major changes of operating conditions.

Finally a fourth form of variable orifice means is shown in FIG. 11 provided by the plate 457 pivoted along its upper edge and along the upper edge of the orifice 446 by the pivot rod 458. Furthermore, this fourth form may be controlled automatically for minor changes in flow of sea water similar to the third form previously described, that is, through the control rod 459 and generally spherical float 454. Again float 454 is selectively adjustably connected to control rod 459 through adjustment means, such as the threads 460.

In this fourth form, similar to the previous forms, the plate 457, even when in its maximum obstructing position as shown, does not fully close the orifice 446. So in this fourth form, as in the third form, the float 454 will automatically adjust the plate 457 and thereby the flow of sea water therethrough between the evaporator chambers for minor changes in operating conditions, while major changes in operating conditions are still regulated through the selective adjustment of float 454 with reference to the control rod 460.

Thus, in every form herein described, variable orifice means is provided in the passageway formed in the partition means between the evaporator chambers to maintain the optimum condition of flow of the sea water through the evaporator plant. Through selective adjustment of this variable orifice means, the sea water level of the body of sea water in the feed water portions of each of

the chambers can be maintained sufficiently high to form a barrier and prevent blow-through of vapors between chambers, while still maintaining this sea water level at a minimum. Further, in certain of the forms illustrated and described, the variable orifice means is automatically regulated for minor changes in operating conditions to thereby provide minor changes in sea water flow, while still being provided with selectively adjustable means for making major regulations for major changes in operating conditions.

Still further, it is preferred in every form of the variable orifice construction that it be impossible to completely shut off the flow between any of the evaporator chambers, but rather only that the variable orifice means be capable of providing the maximum necesary flow and the minimum necessary flow. Finally, in certain of the forms shown, the selective adjustment of this variable orifice means can be accomplished from outside of the particular evaporator chambers and evaporator shell, eliminating the necessity of disassembling portions of the evaporator construction for making such adjustments and furthermore permitting such adjustments while the plant is in actual operation.

Although the term "sea water" has been used in illustrating and describing the present multi-stage flash evaporator construction, it should be understood that the principles of the present invention are equally applicable to other forms of salt water or brackish solutions which it might be desirable to evaporate or distill.

In the foregoing description, certain terms have been used for brevity, clearness and understanding but no unnecessary limitations are to be implied therefrom, because such words are used for descriptive purposes herein and are intended to be broadly construed.

Moreover, the embodiments of the improved construction illustrated and described herein are by way of example and the scope of the present invention is not limited to the exact details of construction shown.

Having now described the invention, the construction, operation and use of preferred embodiments thereof, and the advantageous new and useful results obtained thereby, the new and useful construction and reasonable mechanical equivalents thereof obvious to those skilled in the art are set forth in the appended claims.

I claim:

1. In a flash evaporator construction for distilling sea water and the like in multi-stage, generally horizontally disposed, tandem-arranged evaporator chambers of a type in which feedwater flows continuously between successive stages, in which successively lower internal pressures exist in adjacent stages, and in which the flow of feedwater between adjacent stages must form a feedwater barrier to prevent the blow-through of flashed vapors between said adjacent stages; an elongated generally horizontally disposed tubular shell; partition means intermediate the ends of the tubular shell dividing the shell longitudinally into tandem-arranged adjacent evaporator chambers; means dividing each chamber into a feedwater receiving portion and a communicating condensing portion for condensing vapors produced by vaporization of part of the feedwater in the chamber receiving portion; the evaporator chamber feedwater receiving portions being provided with inlet and outlet means including a passageway formed in the partition means serving as the feedwater outlet means for one chamber and the feedwater inlet means for the next lower pressure stage chamber; feedwater distribution means in each chamber receiving portion communicating with the inlet means for such chamber; orifice means forming at least a part of said passageway serving as the feedwater outlet means for one chamber and the feedwater inlet means for the next lower pressure stage chamber including feedwater flow regulating means at said orifice means adjustable to various orifice means closing positions regulating the flow of feedwater through the orifice means and to the feedwater distribution means of said next lower pressure stage chamber, said flow regulating means in maximum orifice means closing position being incapable of completely closing off the flow of feedwater through said orifice means for maintaining a continuous flow of feedwater through said orifice means at all times; and the feedwater distribution means in any chamber cooperating with said orifice means and flow regulating means between said chmaber and the next lower pressure stage chamber so as to distribute a body of continuously moving feedwater lengthwise of the shell in said chamber with a surface elevation level above the outlet means for such chamber, thereby separating the internal pressures in the successive chamber stages above the levels of the feedwater bodies therein and maintaining pressure differentials between adjacent chambers; whereby, the surface elevation levels in each chamber of the feedwater flowing continuously through said chamber may be maintained at a proper operating level and at least at a minimum sufficient to form a feedwater barrier between adjacent stages for preventing the blow-through of flashed vapors between said adjacent stages by the adjustment of said flow regulating means at said orifice means and despite unforeseen operating conditions of the flash evaporator construction at the time of initial installation and despite seasonal variations in said operating conditions.

2. Flash evaporator construction as defined in claim 1 in which the flow regulating means for said orifice means includes a plate pivotally mounted at said orifice means pivotally adjustable in the direction of flow of feedwater through said orifice means.

3. Flash evaporator construction as defined in claim 1 in which the flow regulating means for said orifice means includes a plate mounted at said orifice means slidably adjustable in a direction perpendicular to the direction of flow of feedwater through said orifice means.

4. Flash evaporator construction as defined in claim 1 in which the flow regulating means for said orifice means includes a generally conical member positioned with the axis thereof generally parallel to the direction of flow of feedwater through said orifice means and being movable axially into lesser and greater orifice means closing positions.

5. Flash evaporator construction as defined in claim 1 in which the flow regulating means for at least certain of the orifice means are float controlled between lesser and greater orifice closing positions by floats subject to the feedwater level in the chambers next preceding said certain orifice means.

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