

Jan. 6, 1970

LE ROY A. BROMLEY ET AL

3,487,873

MULTIPLE EFFECT FLASH EVAPORATOR

Filed Feb. 15, 1967

4 Sheets-Sheet 1

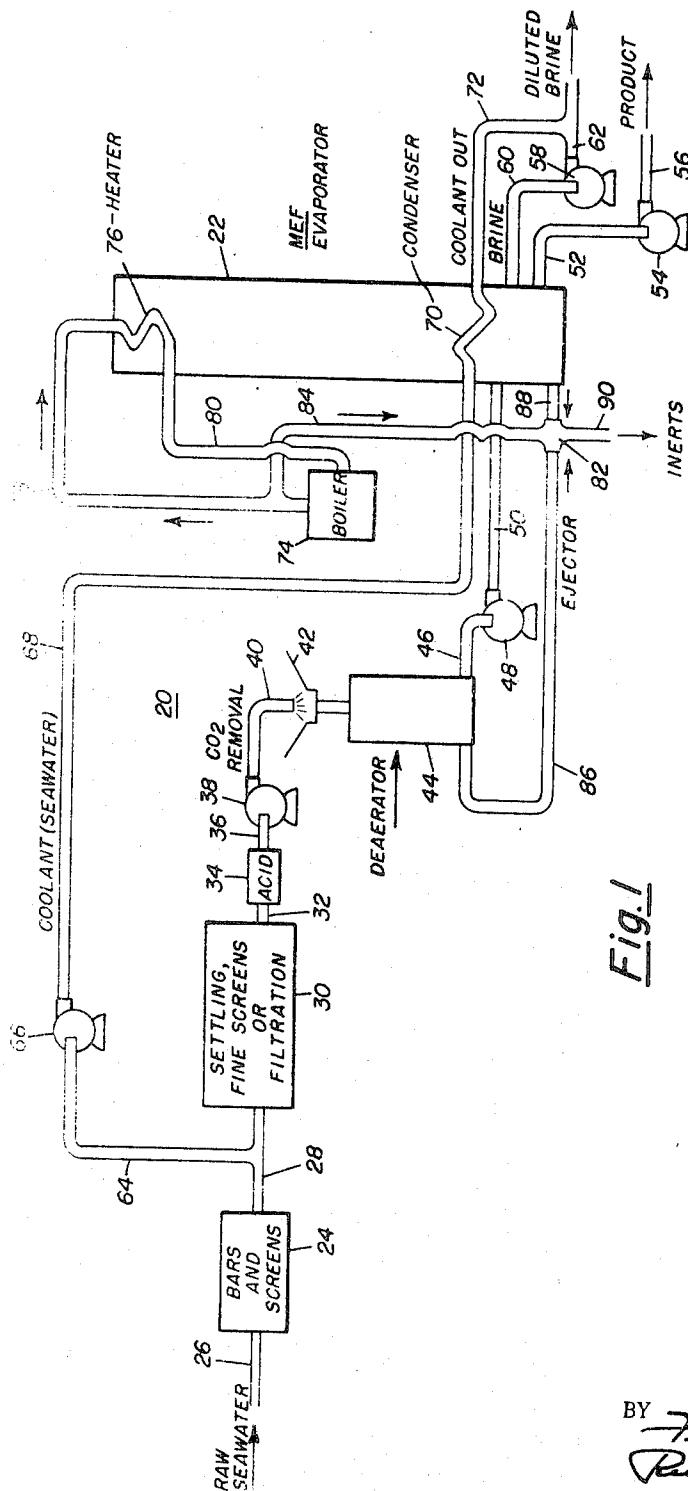


Fig. 1

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4 Sheets-Sheet 2

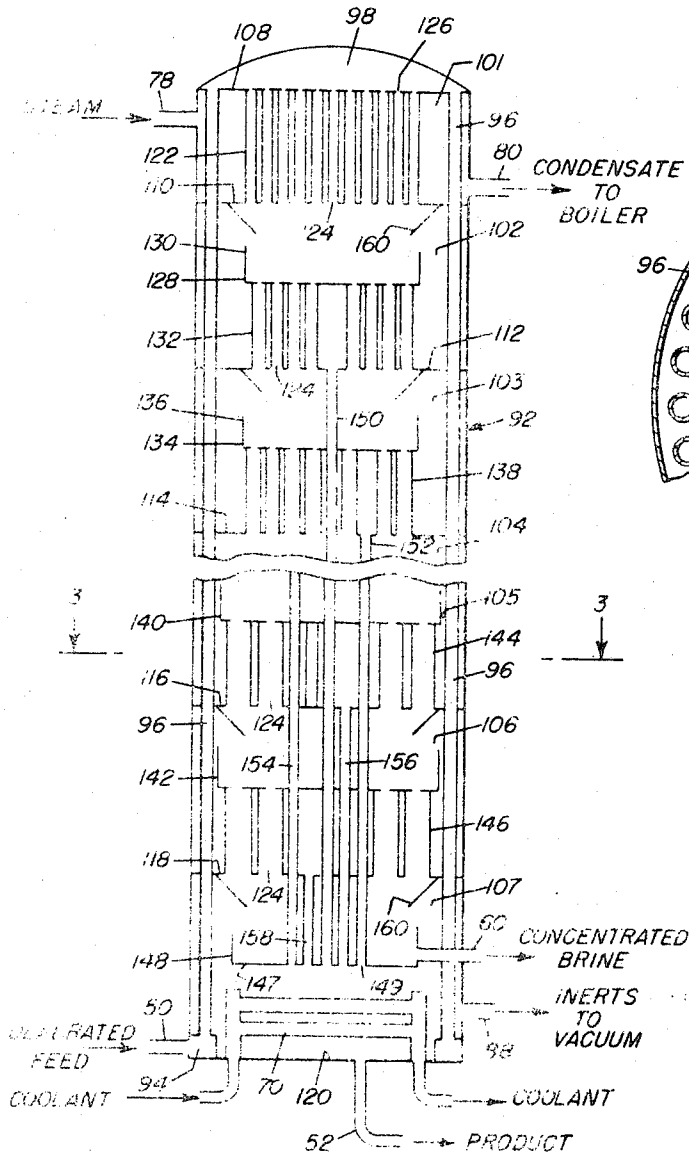


Fig. 2

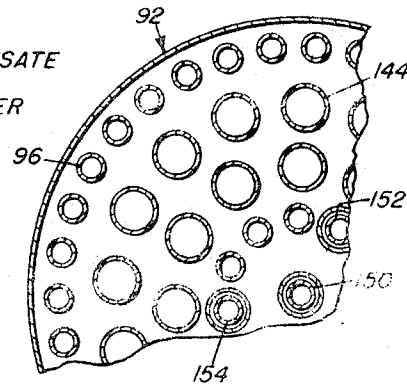


Fig. 3

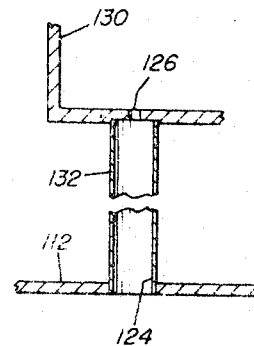


Fig. 4

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4 Sheets-Sheet 3

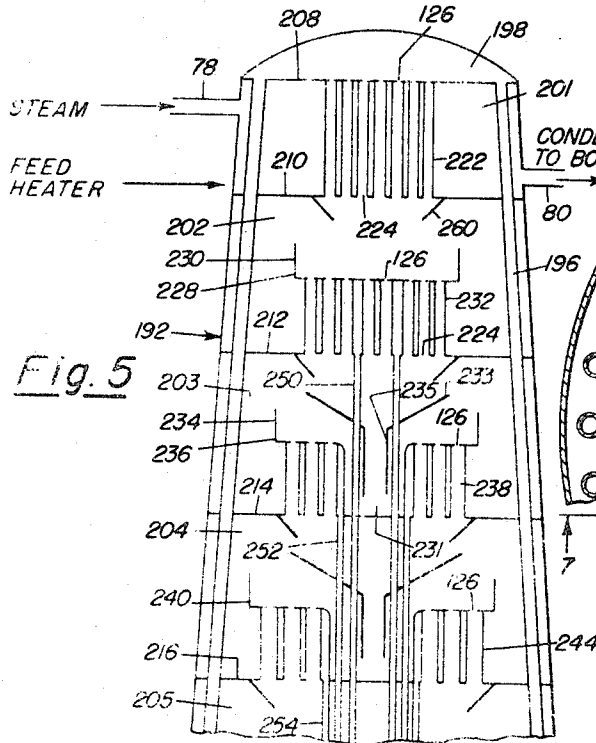


Fig. 5

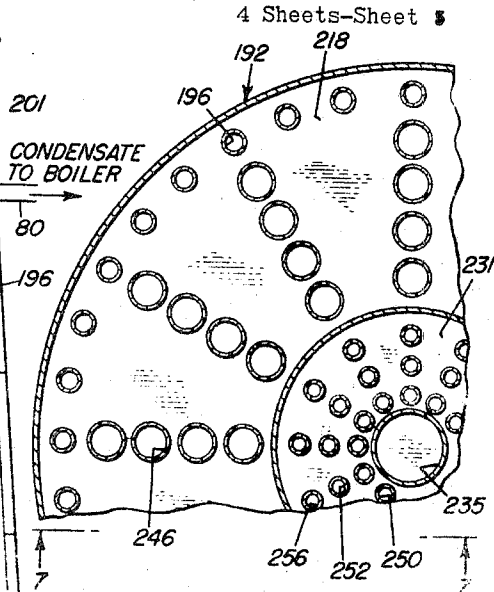


Fig. 6

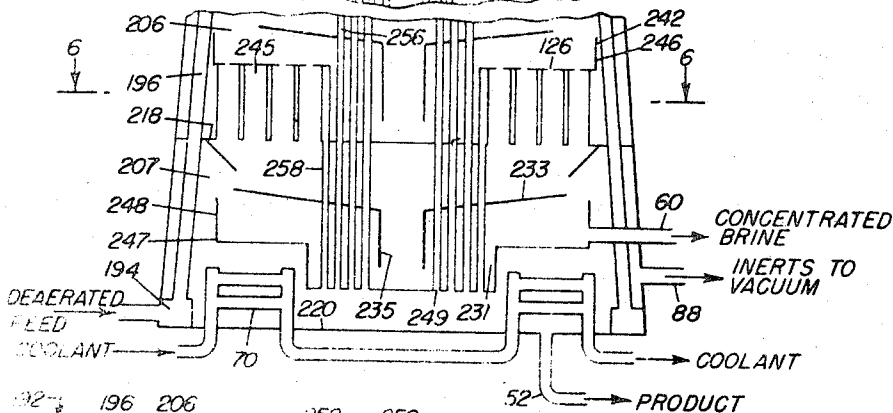


Fig. 7

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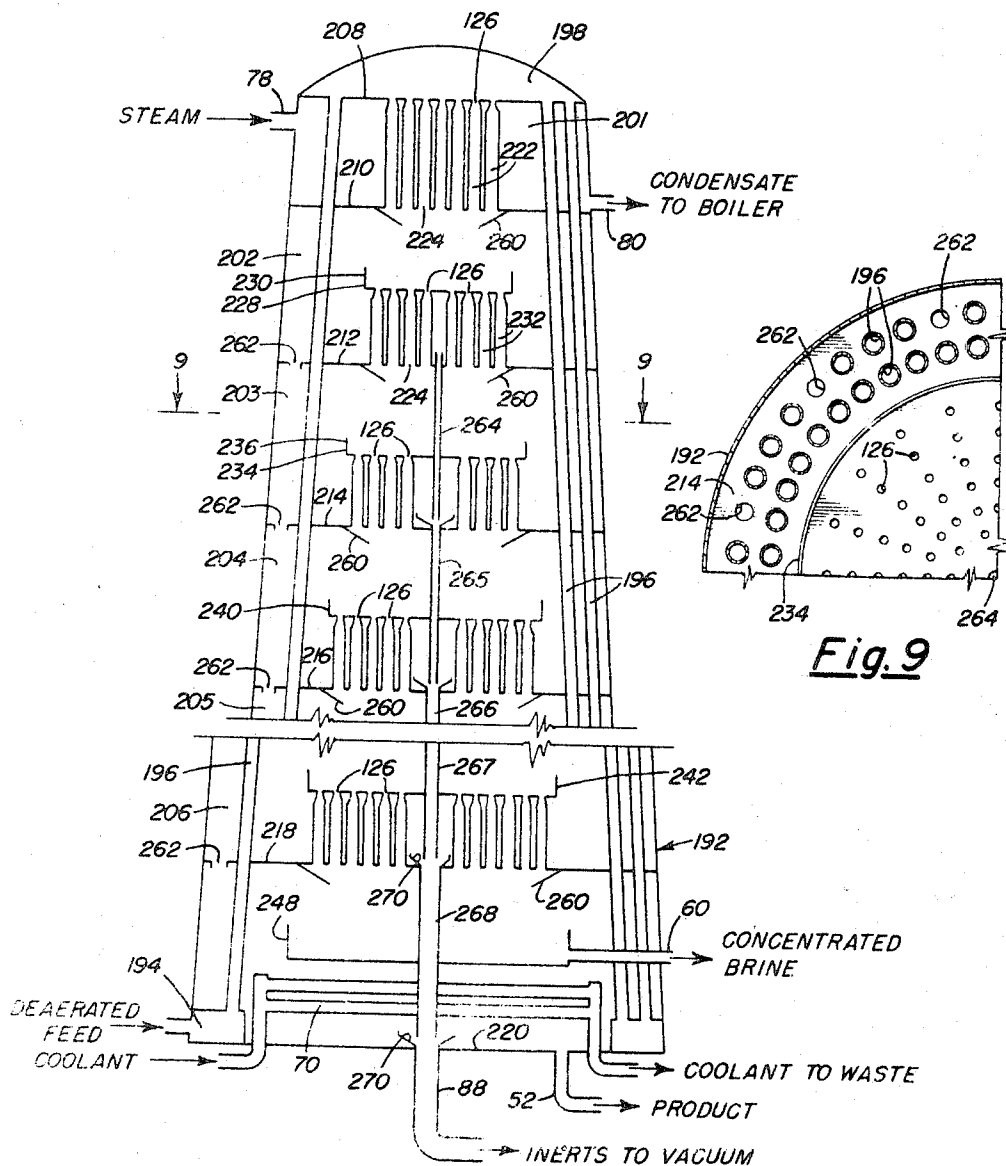


Fig. 8

Fig. 9

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3,487,873

MULTIPLE EFFECT FLASH EVAPORATOR

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Continuation-in-part of application Ser. No. 348,550, Mar. 2, 1964. This application Feb. 15, 1967, Ser. No. 629,843

Int. Cl. B01d 1/22

U.S. Cl. 159—13

10 Claims

ABSTRACT OF THE DISCLOSURE

Method of and apparatus for distilling liquid, which comprises apparatus for conducting liquid from a container in which the liquid is being heated to a second container through a plurality of tubes, the inlets of the tubes being restricted for causing a pressure drop and consequent vaporization of a portion of the liquid. The liquid entering the second container is conducted therefrom to a third container through its tubes and restrictors as aforementioned for causing a further pressure drop and vaporization. The vapor emanating from the tubes of the first mentioned container is subjected to the environment of the tubes in the second mentioned container whereby that vapor is condensed to a distillate.

While not necessarily limited to a plurality of super-imposed stages of flash vaporization, the multiple effect flash evaporator of the present invention is illustrated as including a plurality of super-imposed containers or compartments. The liquid to be distilled is passed upwardly in intimate heat exchange relationship with the containers to preheat the liquid. It is then conducted to the upper container where it is heated. This upper container is provided with a series of tubes which are disposed above the receiver of the lower container. Restrictors at the inlet ends of the tubes provide for most of the pressure drop between the two containers. Separate conduits drain the distillate from the lower container. The lower container is also provided with tubes and restrictors connected with the receiver and those tubes lead to a third container. Pressure drop and vaporization occurs in the tubes. The vapor emanating from the tubes of the first mentioned container are subjected to the chilling effect of the tubes in the second mentioned chamber causing the vapor to condense into a distillate.

The present invention is a continuation-in-part application of our copending application, Ser. No. 348,550, filed Mar. 2, 1964 and now abandoned.

The prior art, such as the Hickman Patent No. 2,894,879, requires a complicated mechanism for producing centrifugal force to propel liquids across the evaporating and condensing surfaces. The prior art, such as the Holtslag Patent No. 3,175,962, provides downwardly increasing diameter tubes between the upper and lower compartments, not for developing a high velocity flow, but for the contrary purpose of maintaining a film of

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distillant through the lengths of the tubes to overcome the detrimental factor of the constant diameter tubes in such systems as is disclosed in the Lustenader et al. Patent No. 3,099,607.

Suitable means is provided for withdrawing inert gases from the containers, and means is provided for further cooling the distillate after it is subjected to the last stage of distilling.

In one embodiment, each of the conduits for draining distillate from the floors of the containers is in intimate heat exchange relationship with the depending tubes, and, in that embodiment, those conduits extend through depending tubes.

In a second embodiment, at least some of the receivers include wells which extend below the upper or receiving ends of the respective tubes connected with the receiver; the receiver also includes a basin for receiving the liquor from the tubes of receivers thereabove; a tube is connected with the basin for delivering liquor to the well. The conduits for conducting distillates from containers are in heat exchange relationship with the liquid below the floors of the containers from which the conduits receive the distillate.

In a third embodiment, the distillate is drained from upper containers to lower containers through conduits in the floors of the upper containers.

Also, in each of the embodiments, the lower portion of the evaporator is provided with an inlet manifold which is connected with the upper manifold by a series of tubes, and these tubes are subjected to heat within the compartments aforementioned.

Also, the inside diameter of at least some of the lower tubes, leading from the receivers, are larger than some of the tubes thereabove.

Other features and the advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the invention are illustrated.

In the drawings:

FIG. 1 is a diagrammatic view showing the present invention in a system for converting sea water to fresh water;

FIG. 2 is a longitudinal sectional view of the multiple effect flash evaporator, shown diagrammatically in certain aspects, and some of the compartments or stations for conversion have been omitted;

FIG. 3 is a fragmentary view in cross-section, the section being taken along line 3—3 of FIG. 2, but on a larger scale;

FIG. 4 is a fragmentary view in section of part of the evaporator shown in FIG. 2, but on a larger scale;

FIG. 5 is a view similar to FIG. 2, but showing another aspect of the invention;

FIG. 6 is a fragmentary sectional view taken along line 6—6 of FIG. 5, but on a larger scale;

FIG. 7 is a fragmentary sectional view taken along line 7—7 of FIG. 6;

FIG. 8 is a view similar to FIG. 5, but showing another aspect of the invention; and

FIG. 9 is a fragmentary sectional view taken along line 9—9 of FIG. 8, but on a larger scale.

Referring first to FIG. 1, the system is shown at 20 and the evaporator is shown at 22. Sea water is delivered to a compartment 24 by a pipe 26. This compartment contains bars and screens (not shown) for removing extraneous matter, such as weeds and other matter contained in the water. Water then flows by pipe 28 to a tank 30 containing fine screens or filtration articles (not shown). Water then flows by pipe 32 through an element 34, where acid is applied to the water, and then water flows by pipe 36 to a water pump 38. Water emanating from the pump is carried by a pipe 40, the end of which is open for the escape of CO₂. The water emanating from the end of the pipe 40 is caught by a funnel 42 and delivered to a tank 44 containing de-aerator mechanisms (not shown). The water flows from tank 44 by a pipe 46 to a pump 48 and delivered to the lower end of the evaporator 22 by a pipe 50. After treatment in the evaporator, the product, namely fresh water, is withdrawn from the evaporator through a pipe 52 to a pump 54 and delivered from the pump by a pipe 56.

Brine is withdrawn from the lower portion of the evaporator by a pump 58 through a pipe 60, and is connected from the pump 58 by a pipe 62.

A pipe 64 is connected to pipe 28 for delivering water to a pump 66. This pump discharges into a pipe 68 connected with a cooling element 70, contained in the lower portion of the evaporator. This water functions as a coolant within the evaporator. Water is conducted from the cooling element 70 by a pipe 72 which is joined with pipe 62.

An extraneous source of heat is used to heat the upper part of the evaporator. This extraneous source includes a boiler 74 which is connected to a heating element, shown diagrammatically as a coil 76. Steam is delivered to the heating element 76 by a pipe 78, and hot water is returned to the boiler by a pipe 80.

Gases are withdrawn from the tank 44 and the evaporator 22 by an ejector, shown diagrammatically at 82. This ejector is actuated by steam delivered thereto from the boiler by a pipe 84. Gases are delivered to the ejector 82 from the tank 44 by a pipe 86 and are delivered to the ejector from the bottom of the evaporator by a pipe 88. These gases and steam flow through an outlet pipe 90.

The system generally shown in FIG. 1 is more or less standard for sea water conversion.

Referring now to the evaporator 22 shown in detail in FIGS. 2 and 3, it includes an elongated vertically extending tank or tower 92 which encloses a manifold 94 in the extreme bottom thereof. This manifold receives liquid (sea water) from pipe 50. This lower manifold 94 is connected by a series of tubes 96 to an upper manifold or top container 98, disposed in the top portion of the tower 92. The tower, in addition to manifold or container 98, includes a plurality of superimposed containers. While only four containers are shown fully, it is to be understood that an additional number of compartments are usually desired.

These four containers are shown, and parts of two other containers are shown at 101, 102, 103, 104, 105, 106 and 107. Manifold 98 is provided with a floor 108; containers 101, 102 and 103 are provided with floors 110, 112 and 114, respectively, and containers 105, 106 and 107 are provided with floors 116, 118 and 120, respectively.

A series of tubes 122 depends from the floor 108 of manifold 98. These tubes extend through openings 124 in the floor 110 of container 101. The container 101 forms the heating element, diagrammatically shown at 76 in FIG. 1. It receives steam from pipe 78; the condensate is removed through pipe 80. The steam surrounds and heats tubes 122 and tubes 96 in container 101. Liquid from the manifold 98 flows through tubes 122 and into container 102. A restrictor 126 is provided at the inlet

to each of the tubes 122 in the form of an orifice of approximately one-tenth inch in diameter. In this manner, pressure drop, expansion and vaporization takes place in the tubes 122. The vapor in the form of distilled steam in container 102, upon condensing, falls to the floor 112 of that container, which floor functions as a receiver for the condensate.

The liquid emanating from tubes 122 in container 101 falls into a receiver 128 in container 102. This receiver includes an open top pan 130, and a series of tubes 132, similar to tubes 122, which depend from the bottom of the pan. These tubes 132 extend through openings 124 in the floor 112 of container 102. Expansion takes place in tubes 132, as previously explained with respect to tubes 122. The vapor emanating from the bottom of the tubes 132 in container 102, upon condensing, falls to the floor 114 of container 103, while the liquor falling into container 103 is received by a receiver 134 in container 103. This receiver is similar to receiver 128 in that it includes a pan 136 and depending tubes 138.

Similar receivers 140 and 142 are disposed in containers 105 and 106, respectively, and in all containers between containers 103 and 105. The tubes for these receivers are shown at 144 and 146, respectively. All depending tubes of all receivers are provided with restrictors 126. It is to be observed that the diameter of tubes 138 of container 103 may be slightly larger than the diameter of tubes 132 in container 102. The same variation in diameter is present with respect to tubes 146 in container 106, and tubes 144 in container 105, while the diameters of tubes 144 and 146 are considerably larger than tubes 132 and 138.

Each of the containers form a stage in which expansion and condensation of distillate takes place, and, in a system employing, for example, fifteen stages (fifteen containers), the depending tubes of at least some of the receivers in certain lower containers are increased in diameter progressively downwardly. Those tubes in container 101 will have an inside diameter of approximately one-half inch, and the tubes 146 in container 106 will have an inside diameter of approximately one and one-half inches. This increase in diameter of depending tubes is desirable because the specific volume of the vapor increases and the pressure drop between stages decreases.

Container 107 is also provided with a receiver 147 in the form of a pan 148 for concentrated brine. This receiver is connected with the brine outlet pipe 60.

Each of the floors of the containers 102, 103, 104, 105 and 106 is provided with at least one drain tube 150, 152, 154, 156 and 158, respectively. Similar drain tubes are provided for each container, intermediate containers 104 and 105. These tubes have an inside diameter of approximately one-quarter inch, and each extends through fluid present below the floor being drained thereby, and in the embodiment shown in FIGS. 2 and 3, the conduits extend through depending tubes therebelow of each receiver, having a depending tube. For example, tube 150 extends, as shown, through depending tubes 138, 144 and 146, and also through depending tubes of each receiver which is interposed between receivers 134 and 140. Thus, the drain tubes for the distillate are in intimate heat exchange relationship with the sea water in the depending tubes of receivers. These drain tubes extend through holes 149 in the bottom of receiver 148 in container 107, and the distillate falls to the bottom 120 of that container and is conveyed therefrom by pipe 52. The cooling element 70 effects condensation of all vapor being generated in container 107. While only five drain tubes are shown, it is to be understood that there will be at least as many drain tubes as there are containers in which distillation takes place, for example, fifteen.

The number of containers or stations elected could depend on economic consideration of the various factors encountered, such as the cost of heating, equipment necessary, maintenance problems. For example, fifteen superimposed containers may be desirable. In the embodiment, only four containers are being fully shown together with the upper part of one container and the lower part of another.

Deflectors 160 depend from the bottoms of the floors for guiding liquor to the pans of the receivers.

Referring now to the embodiment shown in FIGS. 5, 6 and 7, there the evaporator tank or tower is shown at 192. In this embodiment, the tower is in the form of a frustum of a cone. Like in FIGS. 2, 3 and 4, the tower encloses lower manifold 194 which is connected by a series of tubes 196 with an upper manifold 198.

Containers are shown at 201, 202, 203, 204, 205, 206 and 207, the fourteenth container being shown at 206 and the fifteenth at 207. Manifold 198 is provided with a floor 208 and containers 201, 202, 203, 204, 206 and 207 are provided, respectively, with floors 210, 212, 214, 216, 218 and 220.

A series of tubes 222 depends from floor 208 of manifold 198. These tubes extend through openings 224 in the floor 210 of container 201. The container 201 forms the major heating element, diagrammatically shown at 76 in FIG. 1. It receives steam from pipe 78 and the condensate is removed through pipe 30. The steam surrounds and heats tubes 222 and 196 in container 201. Liquid from manifold 198 flows through tubes 222 into container 202. A restrictor, like 126 in FIGS. 2 and 3, is provided at the inlet of each tube 222. Expansion and vaporization takes place in the tubes 222.

The vapor, upon condensing, falls to floor 212 of container 202. Liquid falling from tubes 222 is directed by deflector 260 and enters a receiver 228 in the same manner as in FIG. 2. The receiver includes an open top pan 230 and a series of tubes 232, similar to tubes 222, depends from the bottom of the pan. These tubes extend through openings 224 in floor 212 of container 202. The inlets of the tubes are provided with restrictors 126. Expansion takes place in tubes 232, as previously explained with respect to tubes 222, and vapor, upon condensing, falls to the floor 214 of container 203, and the liquid, falling from the tubes 232, is caught in a receiver 234 in container 203.

Receiver 234 includes a pan 236 having a centrally disposed well 231 which extends to the floor 214. Receiver 234 also includes a catch basin 233, the bottom of which is connected to a downwardly extending tube 235 which extends into the well 231 and terminates near the bottom of the well. Liquid emanating from the tubes 232 is directed by deflector 260 into the catch basin 233, flows downwardly through the tube 235 into the well and then upwardly into the pan 236 of the receiver. A series of tubes, similar to tubes 222 and 232, depends from pan 236 and extends through opening 224 in the floor 214. The inlet ends of tubes 38 are provided with restrictors 126.

Similar receivers 240 and 242 are disposed in containers 204 and 206, respectively, and in all containers interposed between containers 204 and 206. The depending tubes for receivers 240 and 242 are shown at 244 and 245, respectively. Each tube is provided with a restrictor 126 at the inlet end thereof. It will be observed that tubes 232 may be slightly larger in inside diameter than tubes 222, and that tubes 240 may be considerably larger in diameter than tubes 245. In an evaporator having, for example, fifteen stages (fifteen superimposed stages) some of the expansion tubes in at least certain of the lower containers are increased in diameter progressively downwardly. Those tubes in container 201 will have an inside diameter of approximately one-half inch, and the tubes 245 in container 206 will have an inside diameter of approximately one and one-half inches.

Container 207 is also provided with a receiver 247 including a pan 248. It is also provided with a well 231, a catch basin 233 and a depending tube 235, for receiving liquid emanating from tubes 245. The concentrated brine is drained from the pan 248 by pipe 60.

Each floor of containers 202 to 206 is provided with at least one drain tube, each being shown as having two drain tubes 250, 252, 254, 256 and 258, respectively. The drain pipe 254 for the compartment 204 is not shown in compartment 6 in FIGS. 5 and 7, since it is apparent from FIG. 6 that some pipes are behind others and cannot be seen. Similar drain tubes are provided for the containers (not shown) which are disposed between containers 204 and 206. These drain tubes are in intimate heat exchange relative with the liquid for the dual purpose of cooling the distillate and for heating the liquid. These tubes are shown as extending through the wells of the receiver; they surround the tubes which extend downwardly from the catch basins. The drain tubes extend through openings 249 in the bottom of pan 248. The distillate falls to the floor 220 of container 207 and is drained from that container by pipe 52. The cooling element 70 effects condensation of all vapor generated in container 207.

Since liquid, upon entering the basins, must first pass downwardly through the tubes 235 and then upwardly through wells 231 before entering the receiver pan, and since the drain tubes surround the tubes 235, desirable heat exchange relationship is provided between the liquid and the distillate.

Since it is desirable to progressively increase the diameters of the expansion tubes, it is also desirable to maintain a large number of these expansion tubes, and since it is desirable to have the drain tubes for the distillate in heat exchange relationship with the liquid in the wells of the receivers, the widths of the receiver pans, the wells and the basins have been increased.

Vapor surrounding these depending tubes gives up its heat to the liquid falling through these tubes, resulting in condensation of vapor about the tubes and the heat, being transferred to the liquid, assists in evaporation within the tubes.

Referring now to the embodiment shown in FIGS. 8 and 9, the drain tubes 250, 252, 254, 256 and 258, and similar drain tubes for the containers (not shown), have been eliminated, and in their stead, a series of conduits 262 is provided in each of the floors 212, 214, 216 and 218, and in the floors of the containers (not shown), for draining the distillate to the next below container. These conduits 262 are disposed radially outwardly beyond the peripheries of the pans of the containers next below the container being drained.

Inert gases are withdrawn from each of the containers 202, 203, 204, 205, 206 and the containers (not shown) through tubes. The tubes for containers 202 to 206 are shown at 264, 265, 266, 267 and 268, respectively. The inlets for tubes 265 to 268 are in the shape of funnels 270 for receiving not only the inert gases from the gas tubes thereabove, but also from the container which it drains. The inert gas tube 88 is also provided with a funnel-shaped inlet for receiving gas from container 206 and all gas flowing downwardly from gas tube 267.

The elimination of tubes 259, 252, 254, 256, 258 and like tubes for the containers (not shown), materially simplifies the construction related to the embodiments shown in FIGS. 2 to 7 using such tubes.

The advantage of the present invention will be readily apparent to those skilled in the art from the table following, wherein comparisons are made between the present "multiple effect flash evaporator" (referred to as "MEF") and a typical "multi-stage flash evaporator" (referred to as "F"), and a typical "multiple effect evaporator" (referred to as "E").

COMPARISON OF PROPOSED MULTIPLE EFFECT FLASH EVAPORATOR SYSTEM (MEF) WITH A TYPICAL MULTI-STAGE FLASH EVAPORATOR (F), AND A TYPICAL MULTIPLE EFFECT EVAPORATOR (E)

Item	Fair or poor	Good	Better	Best	Comments (Refer to MEF system unless otherwise stated)
Number of stages (thermodynamic efficiency).....		F	E	MEF	A smaller number of stages for the same product to steam ratio is a measure of thermodynamic efficiency.
Volume of equipment.....		F	E	MEF	This is a crude measure of the capital investment required.
Simplicity of flow scheme:					Arrangement is very similar to multi-stage flash system. Internal stage structure of MEF is more complex than F, but external arrangement involves simplified relation to deaerator and no recirculation.
Internal.....	E		MEF	F	
External.....	E		F	MEF	
Brine concentration in hot stage.....		F		E, MEF	Feed to hot stage should be of as low a concentration as possible. In this system it is unevaporated sea water. No brine recirculation. Consequently less scale formation.
Brine discharge concentration.....		F		E, MEF	Maximum limited only by possible scale on low temperature stage.
Vapor piping.....	E			F, MEF	External vapor piping is undesirable and is not used in MEF system except for steam feed.
Heat transfer coefficients.....		E	F	MEF	Overall coefficients will be above 1,000 B.t.u./hr. ft. ² F.
Utilization of pressure drop between stages to improve heat transfer.....	F			E, MEF	Flow through brine tubes is caused by this and gravity. No advantage is taken of this in the multi-stage flash system.
Number of pumps.....	E		F	MEF	The fewer the better.
Pumping power required.....		F, E		MEF	No recirculation, interstage pumping or pumping to exchangers.
External heat exchangers.....	E			F, MEF	None required.
Allowable steam temperature.....			F, E	MEF	The high desirable temperature is possible because of lower brine concentration than F in hot stage and improved distribution over E in brine evaporation tubes.
Piping, liquid.....	E			F, MEF	This external piping is kept to a minimum.
Feed pretreatment.....			E, MEF	F	A finer screening or settling of the feed is required because the particle size must be smaller to pass through this system than in flash system. Otherwise treatment is about the same.
Feed heating.....	E			F, MEF	Preheating of liquor in evaporator. Same as multi-stage flash system.
Evaporation in contact with metal surface with condensation on other side.....	E		MEF		This is somewhat desirable from a thermodynamic point of view but undesirable from heat transfer considerations. This is not used in the multi-stage flash system.
Flash evaporation efficiency.....			F	E, MEF	Intimate contact between liquid and vapor during flashing assured by turbulent two phase flow through brine tubes. This does involve some entrainment of brine into product (but less than 200 p.p.m.). Product is sterilized by high temperature.
Product salinity.....					The MEF system should be located on a slope or be verticle. It could be operated on a horizontal surface if brine pumps were added between stages as in the multiple effect system.
Orientation of stages.....	E, MEF			F	
Land area required.....	F		E	MEF	
Estimated cost of product water from large plant.....	E		F	MEF	The cost should be below that for water from a large multi-stage flash plant which has been estimated to be about \$.50/1,000 gallons.*

* U.S. Department of Interior, Office of Saline Water R & D Report No. 72, March 1963.

While the forms of embodiment herein shown and described, constitute preferred forms, it is to be understood that other forms may be adopted falling within the scope of the claims that follow.

We claim:

1. Those steps in a method of distilling liquid, which 50 steps comprise:

- (A) conducting liquid to a container in a closed tank;
 - (B) conducting the liquid from the container to a second container in the tank through a plurality of tubes in the tank;
 - (C) heating the liquid in the tubes;
 - (D) causing a pressure drop and consequent vaporization of a portion of the liquid in the tubes by restricting the flow of liquid at the inlets of the tubes;
 - (E) condensing the vapor in the second container by causing the liquid which was conducted thereto, through a plurality of tubes in the second container and causing a pressure drop and consequent vaporization of a portion of the liquid in the second mentioned tubes by restricting the flow of liquid at the inlets of the second mentioned tubes, and impinging the vapor, emanating from the first mentioned tubes, on the exterior of the second mentioned tubes;
 - (F) conducting the liquid and vapor from the outlets of the second mentioned tubes to a third container 70 in the tank;
 - (G) collecting and removing the condensate from the second container through an outlet which is independent of the outlets of the second mentioned tubes.
2. Those steps in the method as defined in claim 1, 75

45 characterized in that the liquid flows at least partly by gravity from the first mentioned container to the second mentioned container.

3. Those steps in the method as defined in claim 1, characterized to include the step of:

(E) conducting the liquid to the first mentioned container in intimate heat exchange relation with at least one of the other containers.

4. A multiple effect flash evaporator, comprising in combination:

- (A) a tank;
- (B) a second container in the tank including:
 - (1) a series of tubes extending therethrough and connected with the first mentioned container;
 - (2) flow restrictor means at the inlet ends of the tubes;
 - (3) means for heating the liquid in the second containers;
- (D) a third container connected with the outlet of said tubes and having a vapor area and including:
 - (1) a liquid receiver for receiving liquid from the tubes of the second mentioned container;
 - (2) a series of tubes connected with the receiver below the liquid level in the latter;
 - (3) flow restrictor means at the inlet ends of the second mentioned tubes;

the vapor emanating from said tubes of the second mentioned container being directly impinged by the exterior of the tubes in the third mentioned container for causing condensation of the vapor;

(4) a receiver, independent of the liquid receiver and the second mentioned series of tubes, for receiving the vapor which is condensed in the third mentioned container, said condensate receiver having an outlet independent of the outlets in the second mentioned tubes.

5 5. A multiple effect flash evaporator as defined in claim 4, characterized in that the receiver of the third mentioned container is disposed to receive liquid from the tubes of the second mentioned container at least partly by gravity.

10 6. A multiple effect flash evaporator as defined in claim 4, characterized in that the receiver of the third mentioned container is disposed below the tubes of the second mentioned container.

15 7. A multiple effect flash evaporator as defined in claim 4, characterized to include:

(E) means in intimate heat exchange relation with the third mentioned container for delivering liquid to the first mentioned container.

8. A multiple effect flash evaporator as defined in claim 4, characterized in that the receiver (C)(1) includes:

(a) a well extending below the first mentioned restrictor means.

25 9. A multiple effect flash evaporator as defined in claim 8, characterized in that means (D) for conducting the condensate from the third mentioned container is in intimate heat exchange relation with the well.

10. A multiple effect flash evaporator as defined in claim 8, characterized in the means (D) for conducting the condensate from the third mentioned container is a tube extending through the well.

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NORMAN YUDKOFF, Primary Examiner

J. SOFER, Assistant Examiner

U.S. Cl. X.R.

159—18, 49; 202—174; 203—89

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,487,873 Dated January 6, 1970

Inventor(s) LeRoy A. Bromley, Stanley M. Read & Anthony J. Diamond

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 58 cancel "38" and substitute --238--.
Column 6, line 41 cancel "assets" and substitute --assists--;
line 64 cancel "259" and substitute --250--.

Cancel Claim 4, and substitute the following claim:

4. A multiple effect flash evaporator, comprising in combination:

- (A) a tank;
 - (B) a container for liquid in the tank;
 - (C) a second container in the tank including:
 - (1) a series of tubes extending therethrough and connected with the first mentioned container;
 - (2) flow restrictor means at the inlet ends of the tubes;
 - (3) means for heating the liquid in the second container;
 - (D) a third container connected with the outlet of said tubes and having a vapor area and including:
 - (1) a liquid receiver for receiving liquid from the tubes of the second mentioned container;
 - (2) a series of tubes connected with the receiver below the liquid level in the latter;
 - (3) flow restrictor means at the inlet ends of the second mentioned tubes;
- the vapor emanating from said tubes of the second mentioned container being directly impinged by the exterior of the tubes in the third mentioned container for causing condensation of the vapor;
- (4) a receiver, independent of the liquid receiver and the second mentioned series of tubes, for receiving the vapor which is condensed in the third mentioned container, said condensate receiver having an outlet independent of the outlets in the second mentioned tubes.

SIGNED AND
SEALED
JUL 21 1970

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents