

Aug. 16, 1949.

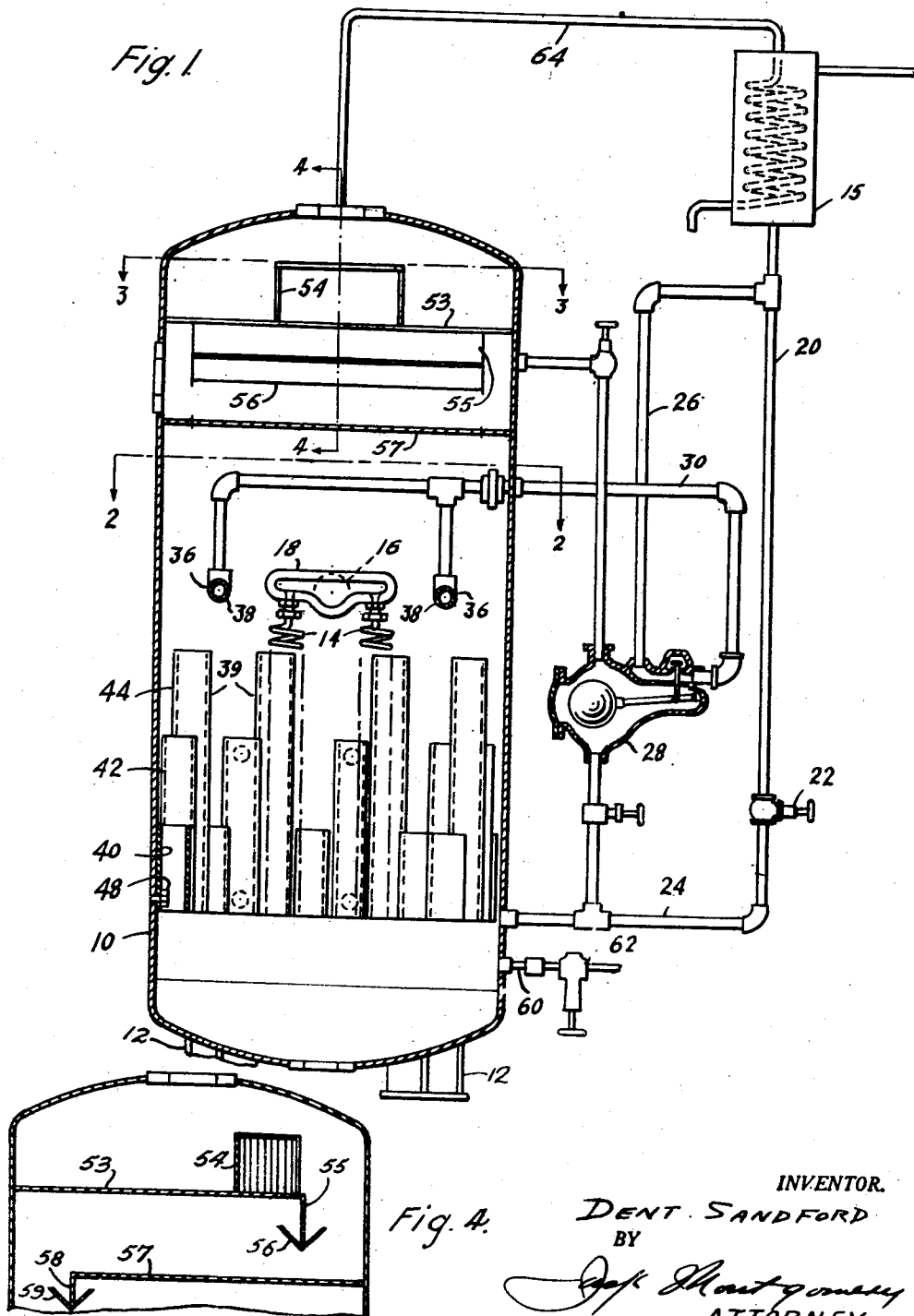
D. SANDFORD

2,479,267

APPARATUS FOR PROMOTING RECIRCULATION AND REDUCING
EBULLITION AND PRIMING IN EVAPORATORS

Filed Sept. 11, 1945

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 2

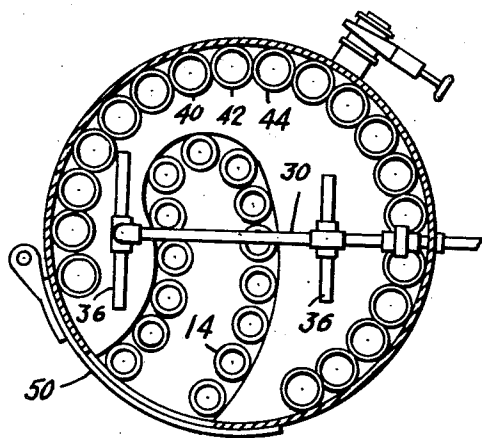


Fig. 5.

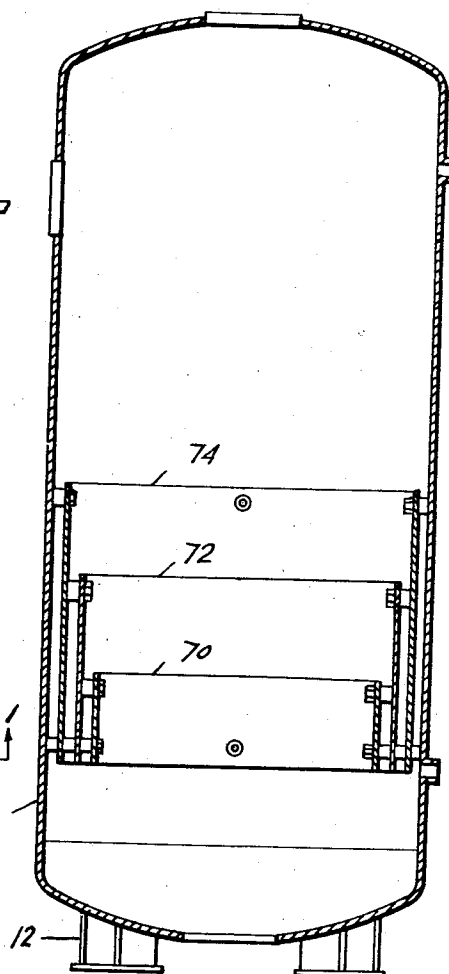
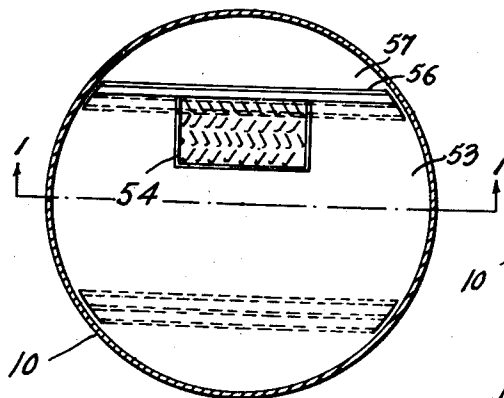


Fig. 3.



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APPARATUS FOR PROMOTING RECIRCULATION AND REDUCING EBULLITION AND PRIMING IN EVAPORATORS

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3 Claims. (Cl. 202—180)

1

This invention relates to improvements in apparatus for promoting recirculation and reducing ebullition and priming evaporators.

On board ship, especially on long voyages it is necessary that fresh water for drinking and other purposes be carried in large quantities or that the ship be provided with evaporators for converting sea water to fresh water for the purposes mentioned.

It has been found in carrying a large number of passengers and cargo, such as troops and equipment, insufficient space is available for tanks of fresh water. It has also been found that the capacity of the evaporators for supplying fresh water is inadequate, necessitating the rationing of fresh water.

The present invention in actual practice on board ship has resulted in the provision of adequate fresh water to supply all the needs and to eliminate the necessity of troops or other passengers waiting in line for the water to be rationed.

One of the objects of the present invention is to provide an evaporator which will convert sea water to fresh water in such capacity as to adequately supply all the need for fresh water for drinking and other purposes on board ship.

Another object of the invention resides in the provision of an evaporator of the character indicated wherein the conversion of the sea water to fresh water is entirely automatic.

Another object of the present invention is the provision of means for stepping up the rate of conversion without increasing the size of the evaporator.

A still further object resides in the provision of means for calming the ebullition zone and increasing the overall effectiveness of the steam coils in the evaporator shell.

Further objects of the invention will be manifest from the following description and the accompanying drawing, in which drawing:

Fig. 1 is a vertical sectional view of my improved evaporator taken on line 1—1 of Fig. 3; Fig. 2 is a sectional view on line 2—2 of Fig. 1; Fig. 3 is a sectional view on line 3—3 of Fig. 1; Fig. 4 is a sectional view taken on line 4—4 of Fig. 1; and

Fig. 5 is a vertical sectional view of a modified form of my invention.

A complete system in which the evaporator of the present invention may be employed is shown in Delahanty Patent 2,320,853.

Referring to the drawing in detail, 10 designates a conventional evaporator shell mounted on supports 12. Within the shell are evaporator coils 14 through which steam is passed in the conventional and well known manner from steam inlet 16 and header 18, a condensate drain

2

(not shown) being provided for the return of condensate from the coils 14.

The steam coils 14 when contacted by water generate vapor. Before sea water is fed into the evaporator shell it passes through a distiller 15, in the manner disclosed in the abovementioned patent.

Water from the distiller 15 enters the conduit 20, controlled by a hand operated valve 22, and is fed into the bottom of the shell 10 through conduit 24.

A branch conduit 26 leads from the conduit 20 to a liquid level regulator 28, which may be of any conventional type insofar as the present invention is concerned. From the regulator 28 the water passes by way of conduit 30 to the interior of the shell 10 above the coils 14, where the conduit is provided with a pair of spray heads 36 having orifices 38 directed toward the coils, whereby the distilled sea water is sprayed directly on the coils.

Within the shell 10 I provide a series of vertically extending baffles comprising tube elements 39. Each element 39 is made up of three tubes 40, 42 and 44 each of the same diameter but differing in length relatively to each other. The tube 44 is the longest and extends from a point substantially in alignment with the bottom of the coils 14 to a point substantially in alignment with the top of the coils 14. Tube 40 is the shortest. This tube has its lower end on the same horizontal plane as the lower end of the tube 44 and extends about one third the height of tube 44. The tube 42 likewise has its lower end in the same horizontal plane as the other tubes and extends substantially two thirds the height of tube 44.

The three tubes of each element are welded or otherwise secured to each other and are secured to the shell 10 and supported thereon by means of studs 48 screwed into the shell from the inside of one of the tubes and fixed with round head nuts. Two of these studs are provided and preferably are in the intermediate tube 42.

A plurality of the elements 39 are positioned close to the inner wall of the shell and extend substantially entirely around the inner circumference thereof as shown in Fig. 2. Preferably no elements are positioned adjacent the opening of the shell which is closed by a door 50.

It is to be understood that while I have illustrated and described three tubes as comprising each element, any desired number may be employed and any desired variation in the sizes of the tubes may be employed, as well as providing tubes of equal sizes, all within the purview of my invention.

It is the provision of these tube elements in the evaporator shell that contributes to, or resulted in, the increased production of fresh

3

water and the increased efficiency of the evaporator, in that, they serve as positive downcomers for directing the boiling fluids downwardly from the ebullition zone to the lower portion of the shell 10 adjacent the bottom of the coils 14 for recirculation. The spaces between the tubes and the inner wall of the shell also serves as positive downcomers for the boiling fluids.

The efficiency of the evaporator is also increase by the provision of the spray heads 36. These serve effectively to spray cold water against the upper portion of the coils 14 in the ebullition zone, the coils subsequently breaking up the water spray and themselves becoming additional means for distributing the water over the lower sections of the coils, thereby increasing the overall effectiveness of the coils.

A vapor separator 54 is provided adjacent the upper portion of the shell. This separator is designed to comb out particles of salt water through a wiping action, all for the refinement of the quality of the vapors produced. This separator is supported on a horizontal baffle 53 (Figs. 1, 3 and 4), which terminates short of the inner wall of the shell 10. A plate 55 depends from the edge of the baffle 53 and supports a catch hook 56, which is in the form of a V-shaped trough. Another baffle 57 is provided below the baffle 53 and extending in the opposite direction therefrom. A plate 58 depends from the edge of the baffle 57 and supports another catch hook 59 similar to the catch hook 56. A plurality of these catch hooks means are provided spaced from each other, the number thereof being predetermined so as to maintain the resistance of flow through the vapor separator within reasonable limitations of not more than substantially one quarter pound pressure or one half inch of vacuum, the vapors rising in the shell strike the under face of the lower baffle 57 then pass through the space provided between the edge of that baffle and the wall of the shell, thence over that baffle to the space provided between the edge of the upper baffle 53 over the latter baffle, and thence through the separator 54 and the line 64. As the vapor passes over the baffles, as just described, the condensate falls into the catch hooks and flows out of the open ends thereof back into the shell.

An outlet 60 is provided in the lower end of the shell 10 for continuous "blowdown" of the brine. This outlet is fixed to maintain the density or concentration of the brine at substantially 1.3%. A gate valve 62 provides access means for periodically cleaning the salt accumulation from the outlet 60.

In operation, sea water at a temperature of about 100° F. from distiller 15 passes into evaporator shell, by way of conduits 20 and 24 which are manually controlled by valve 22. Preferably, however, the water is fed to the shell at a high velocity by way of the regulator 28, conduit 30 and spray heads 36 in a continuous flow. This high cool feed into the ebullition zone further decreases ebullition and priming at or near the top of the ebullition zone. It has been found in actual practice that feeding water at high velocities into the zone effectively reduces priming, contrary to the generally accepted theory in the evaporating field that feed water must be supplied near the bottom of the body of boiling fluids.

When operating the evaporator beyond its desired capacity the manual feed valve 22 is opened permitting the water level to rise in the shell

4

whereby to take advantage of the full length of the steam coils, or so much thereof as is desired.

The water from the sprays 36 directly contacts the steam coils 14 and the resultant vapor rises, in the manner previously described, to the vapor separator 54 from which it passes through the line 64 to the distiller 15 and then to a distillate tank (not shown).

The boiling fluids at various levels in the ebullition zone are positively directed downwardly through the downcomers and through the space between the tubes of the elements 39 and the wall of the shell to the lower end of the shell adjacent the lower zone of the coils, whereby continuous circulation is provided.

The modification shown in Fig. 4 is similar in all respects to that of Fig. 1, except that the baffles or downcomers are in the form of partitions 70, 72 and 74 corresponding to the tube elements 40, 42 and 44 of Fig. 1. The operation of this form of evaporator will readily be understood from the description of the operation of the form illustrated in Fig. 1.

While I have illustrated and described two embodiments of my invention it is to be understood that I do not wish to be limited thereto, as obviously, various changes and modifications may be made therein without departing from the spirit and scope of my invention.

What I claim is:

1. In an evaporator of the class described the combination of an evaporator shell, steam coils in said shell, means for spraying water on said coils, and water directing means at various levels within and adjacent the wall of said shell for directing various strata of boiling fluids to adjacent the lower zone of the steam coils.

2. In an evaporator of the class described the combination of an evaporator shell, steam coils therein, spray means adjacent the upper ends of said coils, a distiller whose cooling medium is sea water, conduit means for passing vapor from said shell to said distiller, a fluid flow connection for delivering cooling medium from the distiller to the shell, and a plurality of spaced baffles of different heights within said shell disposed adjacent the inner periphery thereof for directing boiling fluids downwardly to adjacent the lower ends of the coils.

3. In an evaporator of the class described the combination of an evaporator shell, steam coils therein, spray means adjacent the upper ends of said coils, a distiller whose cooling medium is sea water, conduit means for passing vapor from said shell to said distiller, a fluid flow connection for delivering cooling medium from the distiller to the spray means, and a plurality of downcomers within said shell disposed adjacent the inner periphery thereof intermediate the upper and lower extremities of said coils for directing boiling fluids from the ebullition zone downwardly to adjacent the lower ends of the coils.

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