

(No Model.)

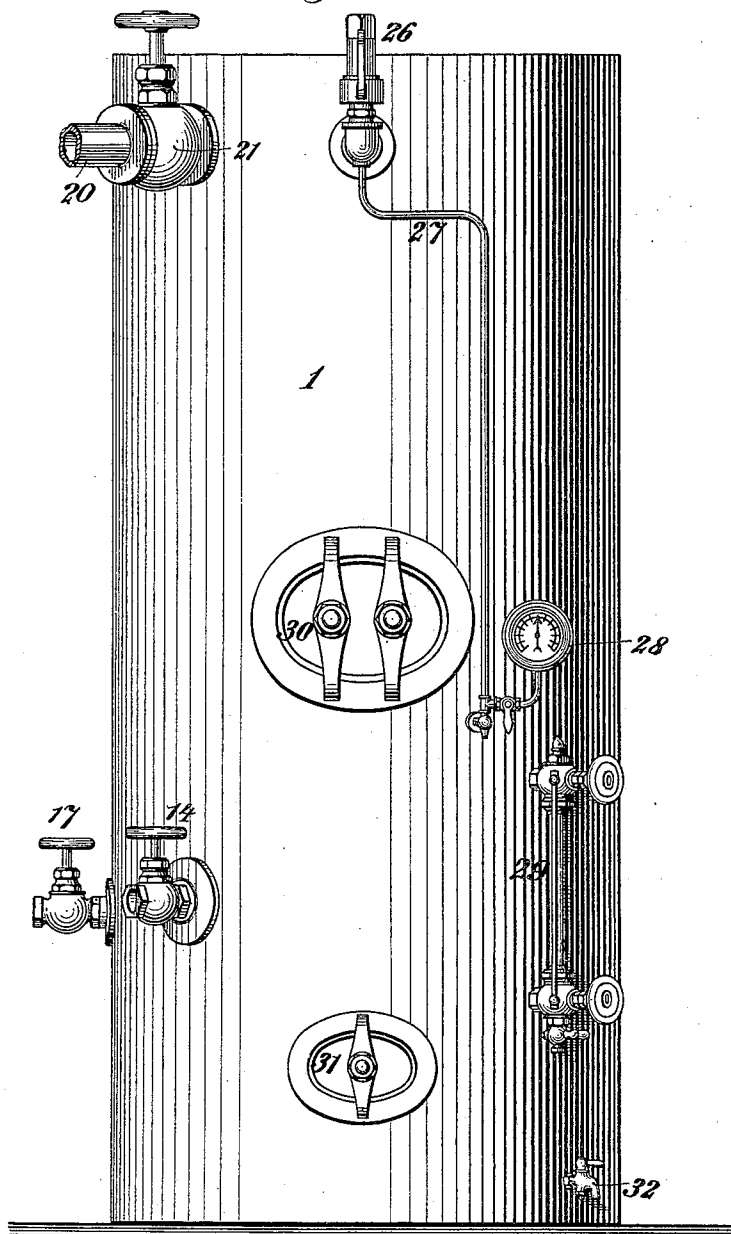
4 Sheets—Sheet 1.

H. SEE.
EVAPORATING APPARATUS.

No. 529,533.

Patented Nov. 20, 1894.

Fig. 1.



Witnesses:-
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H. R. Moller

Inventor:-
Horace See
By R. B. Benjamin
his attorney.

(No Model.)

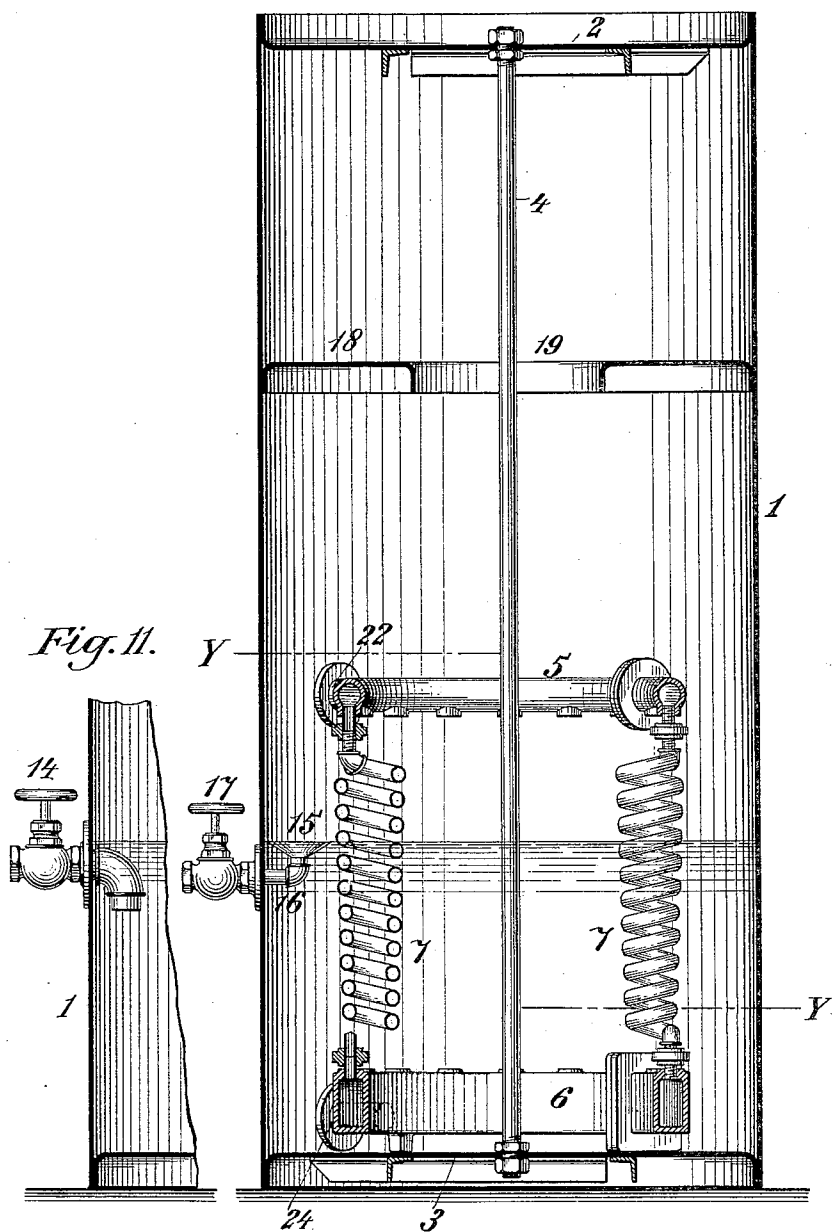
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EVAPORATING APPARATUS.

No. 529,533.

Patented Nov. 20, 1894.

Fig. 2,



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(No Model.)

4 Sheets—Sheet 3.

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EVAPORATING APPARATUS.

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Fig. 3,

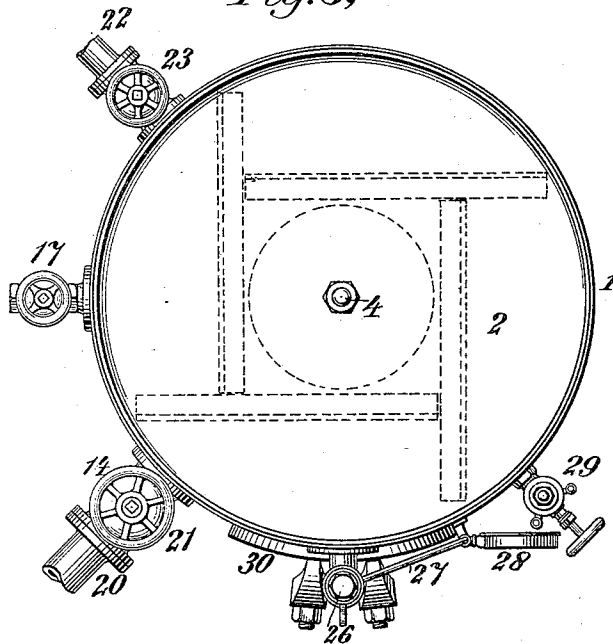
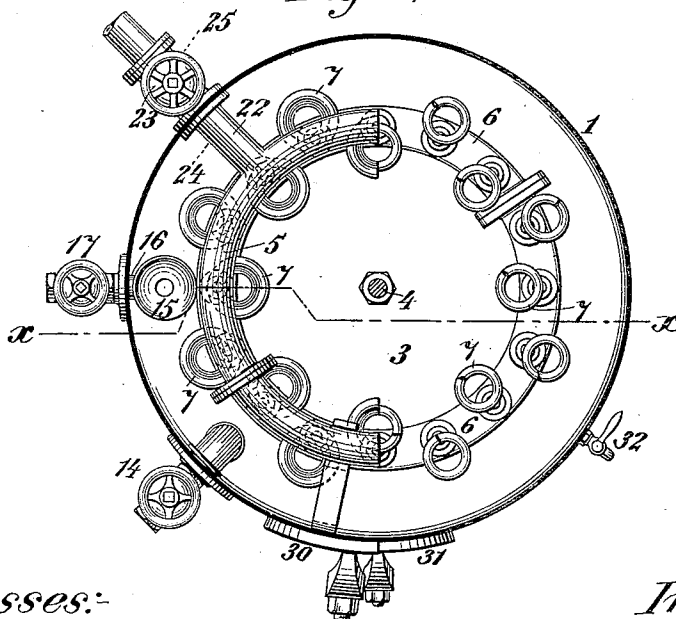


Fig. 4,



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(No Model.)

4 Sheets—Sheet 4.

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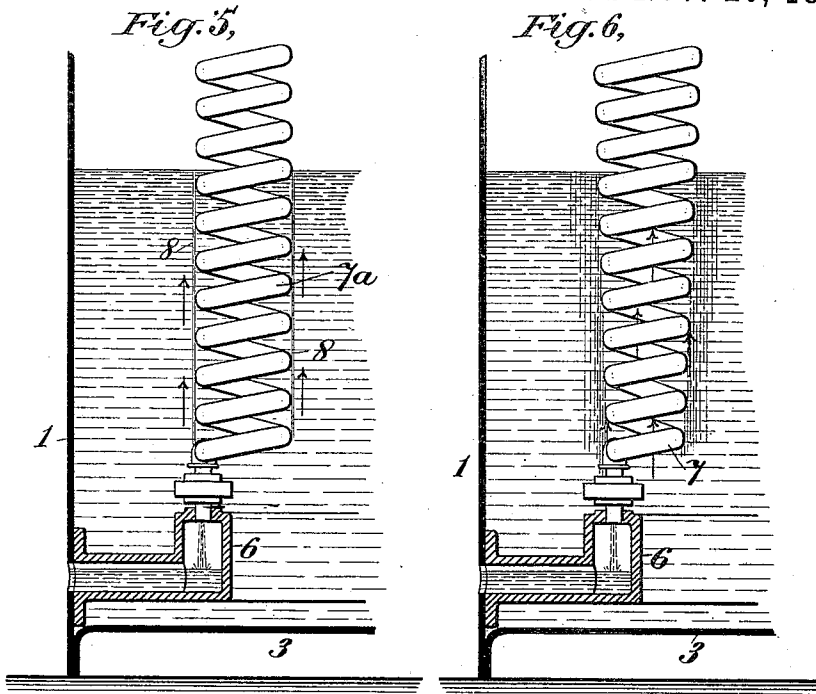


Fig. 7.

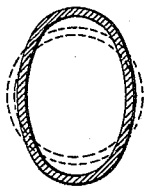


Fig. 8.

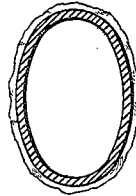


Fig. 10.

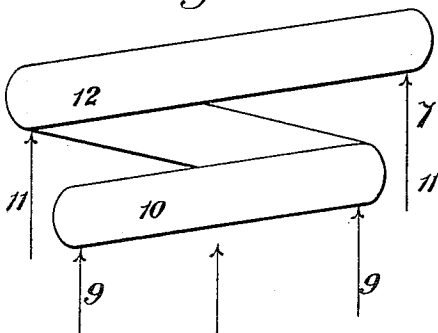
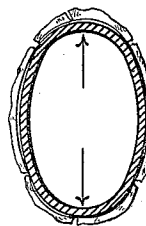


Fig. 9.



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UNITED STATES PATENT OFFICE.

HORACE SEE, OF NEW YORK, N. Y.

EVAPORATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 529,533, dated November 20, 1894.

Application filed January 10, 1894. Serial No. 496,362. (No model.)

To all whom it may concern:

Be it known that I, HORACE SEE, of the city, county, and State of New York, have invented a new and useful Improvement in
5 Evaporating Apparatus, of which the following is a specification.

The invention relates to an apparatus for changing the physical state of a substance by submitting it to the action of a high tempera-
10 ture.

In the accompanying drawings, Figure 1 is an elevation of my improved evaporator. Fig. 2 is a vertical section on the line X X of Fig. 4. Fig. 3 is a top view. Fig. 4 is a horizontal section on the line Y Y of Fig. 2. Figs. 5 and 6 are detail views showing in comparison the arrangement respectively of cylindrical and conical coils. Fig. 7 illustrates respectively a tube of circular and elliptical cross-section. Fig. 8 shows the formation of scale on an elliptical tube before expansion. Fig. 9 shows the effect of expansion upon said scale. Fig. 10 illustrates the meeting of water currents with the successive turns of a
20 conical coil. Fig. 11, is a detail view of the salt water inlet valve.

Similar numerals of reference indicate like parts.

1 is the evaporating tank of suitable plate metal, cylindrical in form and provided with heads, 2 and 3, braced by the tie-rod 4.

5 is an upper annular steam-chamber, which may be circular in cross-section.

6 is the lower steam chamber, also annular, but preferably made rectangular in cross-section, and of greater sectional area than the chamber 5, so as to afford ample space for the condensed steam readily to separate itself.

Between the chambers 5 and 6 extend the
40 evaporator coils 7. Of these coils any desired number may be provided. They are preferably arranged as shown in Fig. 4, so that while their extremities are connected to the median line of the annular chambers the coil bodies
45 protrude alternately on opposite sides of that line—or, in other words, are staggered. In this way I am enabled to pack a greater number of coils in smaller space, and at the same time to concentrate better their heating effect. Each coil is made in the form of a spiral—the diameter of the spiral gradually aug-
50 menting from the bottom of the coil to the

top. This is a feature of especial importance. I have found that where such a coil is made of uniform diameter, as at 7^a Fig. 5 so that a
55 vertical line would touch the outer surface of every turn, a cylindrical film of steam forms around the coil about as indicated at 8 in Fig. 5. This prevents the water in the tank 1 from coming in contact with the surface of
60 the coil, and therefore the evaporative effect of the heated surface of the latter is greatly retarded, for the upward water current simply runs along this steam cushion, as indicated by the arrows in Fig. 5, and the circulation
65 does not take place within the interior of the coil. On the other hand, if the coil is made with its diameter gradually increasing upward, then the water current, moving vertically, meets the turns of the coils successively,
70 as shown in Fig. 6, and in larger detail in Fig. 10. In Fig. 10, it will be noted that the current represented by arrow 9 strikes the turn 10, while the current represented by arrow 11 strikes the turn 12. In this way,
75 instead of the upwardly-circulating water merely flowing along the outer surfaces of all the turns, the under surface of every turn is met by it, and, as a consequence, there is a free circulation around every turn and through
80 the interior of the coil. The steam which forms on the coil is thus wiped off by the ascending currents which make contact with the whole of the heating surface afforded. Another important feature in these coils re-
85 sides in the fact that the tubes of which they are composed are not circular, but elliptical, in cross-section. As is well known in all apparatus of this kind, much trouble arises from the formation of scale on the evaporating sur-
90 faces, which reduces the evaporating effect, besides resulting in other well-understood disadvantages. It is exceedingly desirable therefore that the apparatus should operate automatically as much as possible, to free itself
95 from scale deposits: thus saving the need of intermittent delays for the purpose of cleaning, with the difficulties incident to that operation. I find that when a tube is truly circular in cross-section, its expansion is sub-
100 stantially uniform, so that the total enlarging effect is not concentrated at any points, but is distributed around the circle. In such event, the increase in dimension of the tube

is not sufficient, ordinarily, to cause a rupture of the envelope of scale which surrounds it, and therefore the tube may go on contracting and expanding as the temperature fluctuates within an inclosing shell of scale, without necessarily causing the latter to become detached. I propose to give to the tube such a shape as that the expansive effect will be so exerted, and will be sufficient to cause, under all ordinary conditions, the rupture of this scale envelope, so that, thereafter, the scale deposit will readily fall off or be washed off by the water currents. It will readily be understood that, considering simply an elongated bar of metal, the expansion of that bar occurs in greatest degree in a longitudinal direction; and so also in the case of a plate of elongated form, there will be the greatest amount of expansion between the edges most widely separated. If then, for example, I should take two such plates and curve over their edges and join them so as to form a cylinder of elliptical section, then obviously the expansion of these plates would be greatest in the direction of the major axis of the ellipse; or, in other words, there would be a greater degree of expansion along the major axis of the ellipse, which constitutes the cross-section of the supposed cylinder, than there would be along the transverse or minor axis. Therefore, as indicated in Fig. 7, I propose to change the form of the tube of which my coils are made from the circular shape indicated in dotted lines in said figure to substantially the elliptical shape there shown in cross-section. The deposit of scale on such an elliptical tube is shown in Fig. 8, and in Fig. 9 is shown the effect upon that scale of the expansion of such an elliptical tube along the line of its major axis, or as indicated in direction by the arrows in said figures. The extent of the expansion is thus rendered sufficient to break up the scale substantially as indicated, after which, as already stated, the scale either falls off or is washed off.

As I have designed the apparatus here shown more particularly for use in evaporating salt water on board ship in order to produce a fresh water supply, I will describe its operation with reference to that particular use, and with reference to the construction particularly suited thereto, which is exhibited in the drawings. The salt water to be evaporated is introduced through the valve 14, which is shown in the detail view. Fig. 11. The inlet pipe is here curved downward inside of the tank, so as to prevent its becoming clogged. The salt water then fills the tank about up to the level indicated in Fig. 2, and flows over the edge of the funnel 15, which is secured upon the outlet pipe 16; said pipe passing through the wall of the tank, and being provided with a suitable valve, 17. In this water the coils are immersed. I find it preferable not to completely submerge the coils, but to leave the upper portion of them, as well as the upper steam-chamber 5, uncov-

ered, so that the rising vapor may have access directly to these hot surfaces; and thus any entrained particles of water in the vapor may be the better evaporated. The vapor then passes upward, meeting on its way the deflecting disk 18, which tends to throw back any unvaporized water-particles; and, passing through the opening 19 in said disk, goes to the escape outlet 20, which communicates with the upper part of the tank, as shown in Figs. 1 and 3, and is provided with a suitable valve, 21. The live steam enters by the pipe 22, which is provided with a valve, 23. The pipe 22 communicates directly with the upper steam-chamber 5, so that the steam, circulating around the chamber 5, passes thence into the coils 7, and then to the lower chamber 6. Meanwhile, it has become cooled by radiation, and becomes, in part, condensed in the chamber 6. The spent steam and condensed water thence flow from the chamber 6 out through the pipe 24, which has a suitable valve, 25. It will be noticed that by this arrangement the vapor which is given off from the surface of the water meets the hottest part of the evaporating coils, while, on the other hand, after the steam has become expanded in the coils, it goes into the large chamber 6, which exposes a materially increased area to the heating effect of the now partly cooled steam, thus utilizing that effect to the best advantage, while at the same time, as already pointed out, affording ample space for the collection of the condensed water.

It will be apparent from the foregoing that the operation of this apparatus is continuous—that is, there may be a constant flow of salt water to be evaporated through the tank from the valves 14 to 17, constant flow of live steam through the evaporating coils and chambers between valves 21 and 25, and a constant outflow of vapor from the outlet pipe 20, controlled by valve 21, to the condenser, if desired.

In Fig. 1 I indicate at 26 a safety valve, which communicates with the lower part of the tank, and the pipe of which, by means of the tube 27, is connected to the pressure gage 28. A suitable glass water-gage, 29, is also provided on the outside of the tank. The manholes 30 and 31 afford access to the interior of the tank, and the faucet 32 serves for drawing off any material which may accumulate at the bottom.

The terms used in the claims hereof, mean, and I intend them to be construed, as follows:

"An apparatus substantially as hereinbefore set forth" includes any structure capable of producing substantially similar results in like manner, regardless of specific use or employment. Therefore the term includes devices for subjecting any substance to the action of heat or cold of any degree of temperature, whether the ultimate effect be congelation, vaporization, or superheating.

"Fluid supply" means both liquids and gases. It includes, therefore, hot air, hot

water, steam, cold air, brine or other refrigerating liquids, expanded gases, such as ammonia or sulphurous acid, and so on. It likewise includes the hot gases directly coming from a furnace, such as enter the tubes of a fire tube boiler.

"Receptacle for material to be acted upon" means any limiting boundary or boundaries whereby the substance treated is so confined as to be properly presented to the action of the apparatus.

I claim—

1. In an apparatus substantially as hereinbefore set forth, the combination of a receptacle for material to be acted upon, two chambers arranged within said receptacle, one of the chambers being of larger cross-sectional area than the other, a coiled tapering fluid conduit connecting said chambers, the part of said coil of least diameter being connected to the chamber of greater cross-sectional area, an inlet pipe connected with the smaller chamber, and an outlet leading from the larger chamber; substantially as described.

2. In an apparatus substantially as hereinbefore set forth, the combination of a vertical receptacle for material to be acted upon, two chambers disposed one above the other in said receptacle, the lower of said chambers being of larger cross-sectional area than the other, a coiled tapering tubular fluid conduit connecting said chambers, the part of said coil of greatest diameter being connected to

the upper chamber, an inlet pipe connected with the upper chamber, and an outlet leading from the lower chamber; substantially as described.

3. In an apparatus substantially as hereinbefore set forth, the combination of a vertical receptacle for material to be acted upon, two tubular chambers located in said receptacle one above the other, the lower chamber being of larger cross sectional area than the upper one, a plurality of coiled tapering fluid conduits connecting said chambers, the part of said conduits of least diameter being connected to the lower chamber, an inlet pipe connected with the upper chamber, and an outlet leading from the lower chamber; substantially as described.

4. In an apparatus substantially as hereinbefore set forth, the combination of a receptacle for material to be acted upon, two tubular chambers arranged in said receptacle one above the other, and a plurality of tubular fluid conduits connecting said chambers, the ends of said conduits being connected to the chambers on the median line of said chambers and the bodies of the conduits being staggered or protruding on opposite sides of said line; substantially as described.

HORACE SEE.

Witnesses:

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