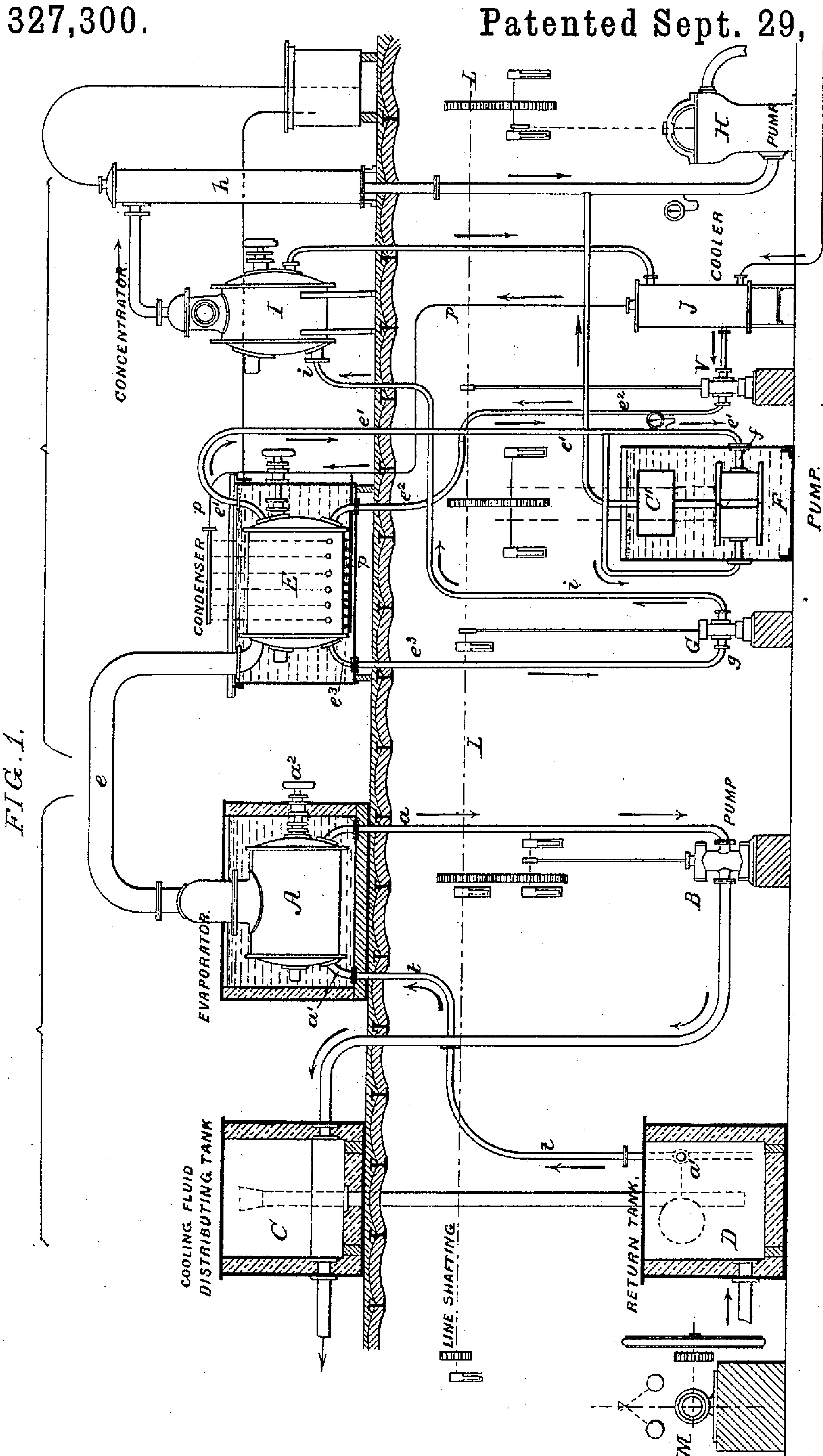
(No Model.)

4 Sheets—Sheet 1.

A. NATANSON.

REFRIGERATING APPARATUS.

No. 327,300. Patented Sept. 29, 1885.



Witnesses:
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Harry Drury

Inventor:
Adam Natanson
by his Attys.
Howson & Sons

(No Model.) 4 Sheets—Sheet 2.

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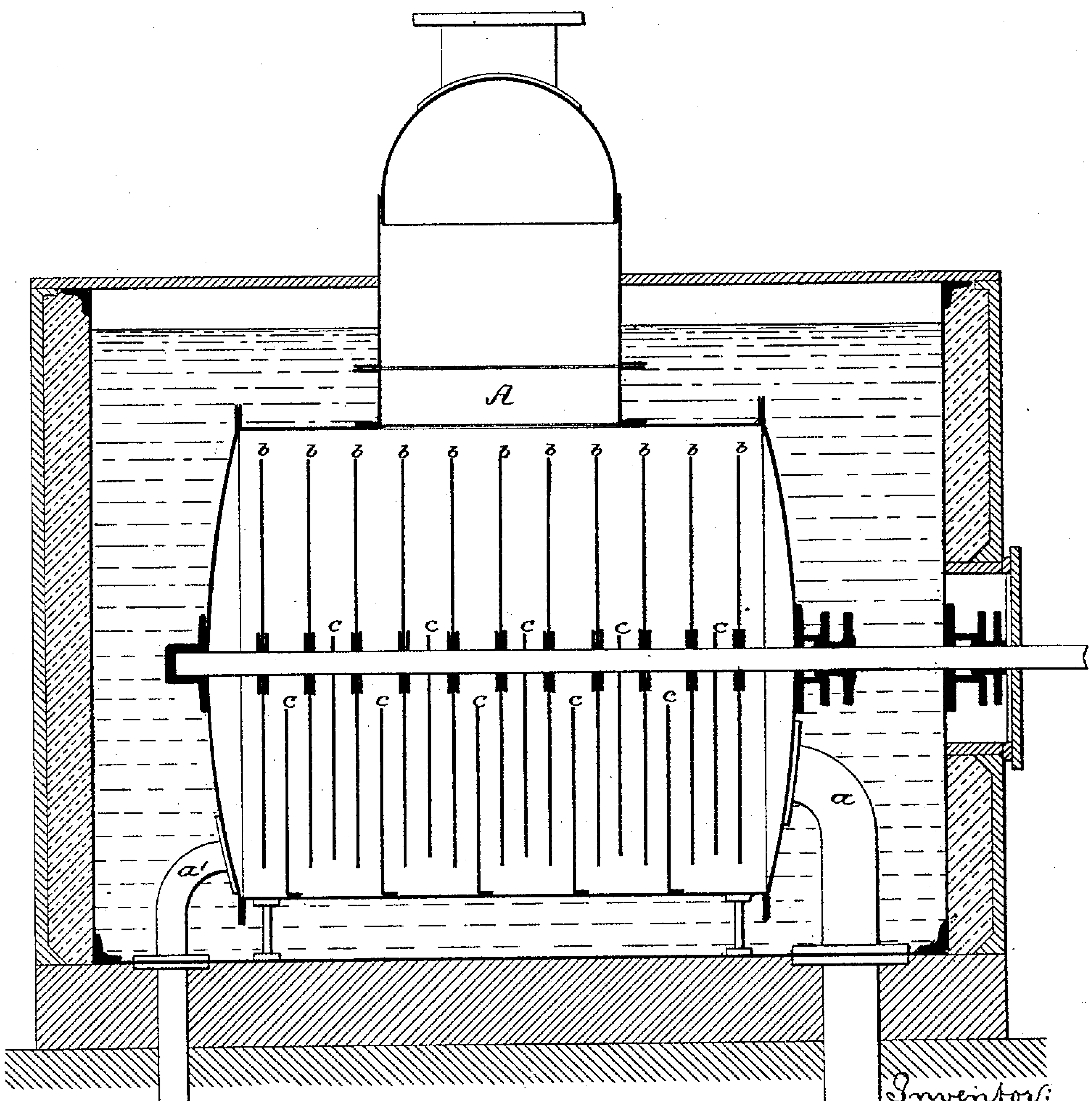
FIG. 2.



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(No Model.)

4 Sheets—Sheet 3.

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FIG. 4.

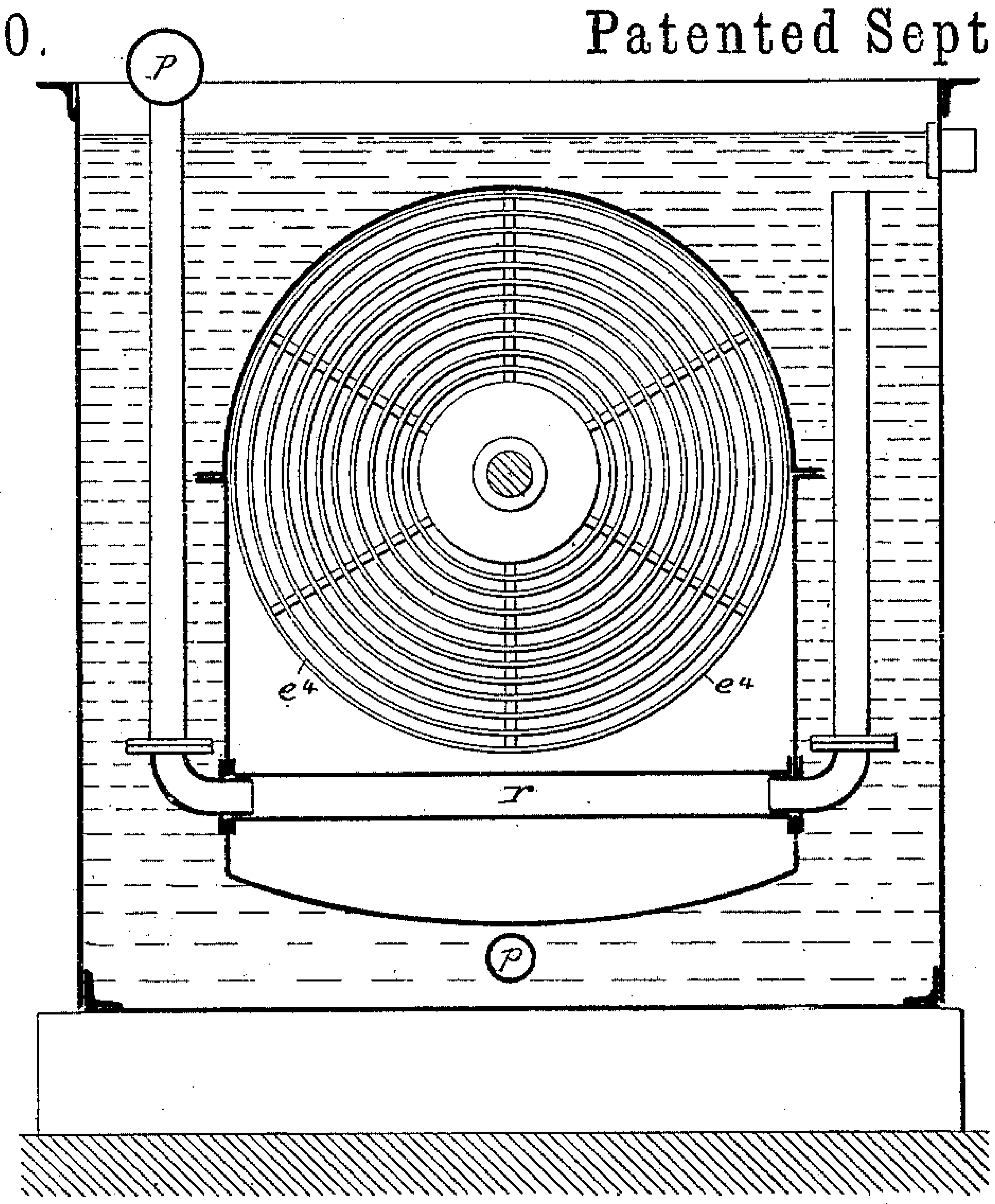
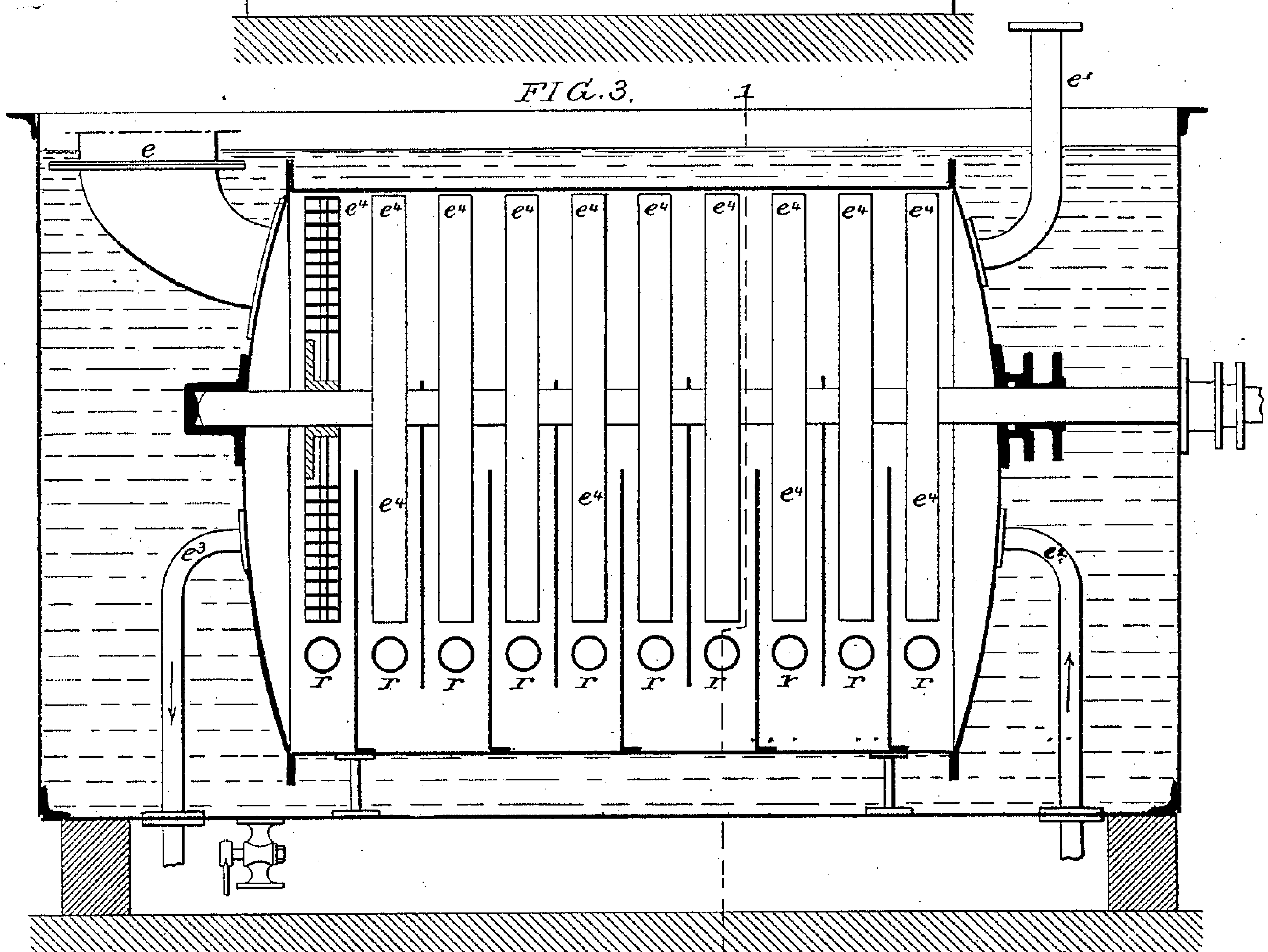


FIG. 3.



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(No Model.) 4 Sheets—Sheet 4.

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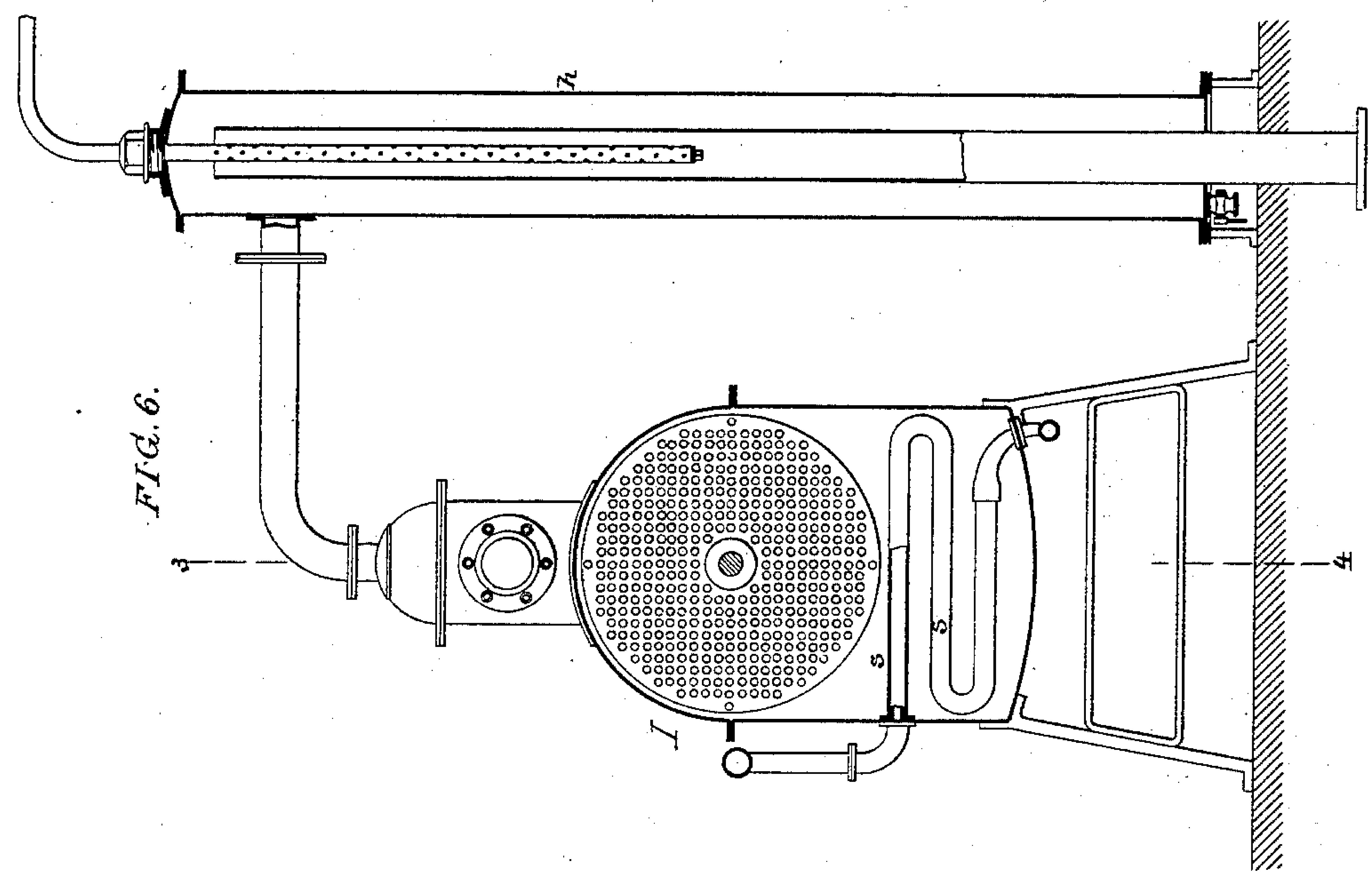

FIG. 6.

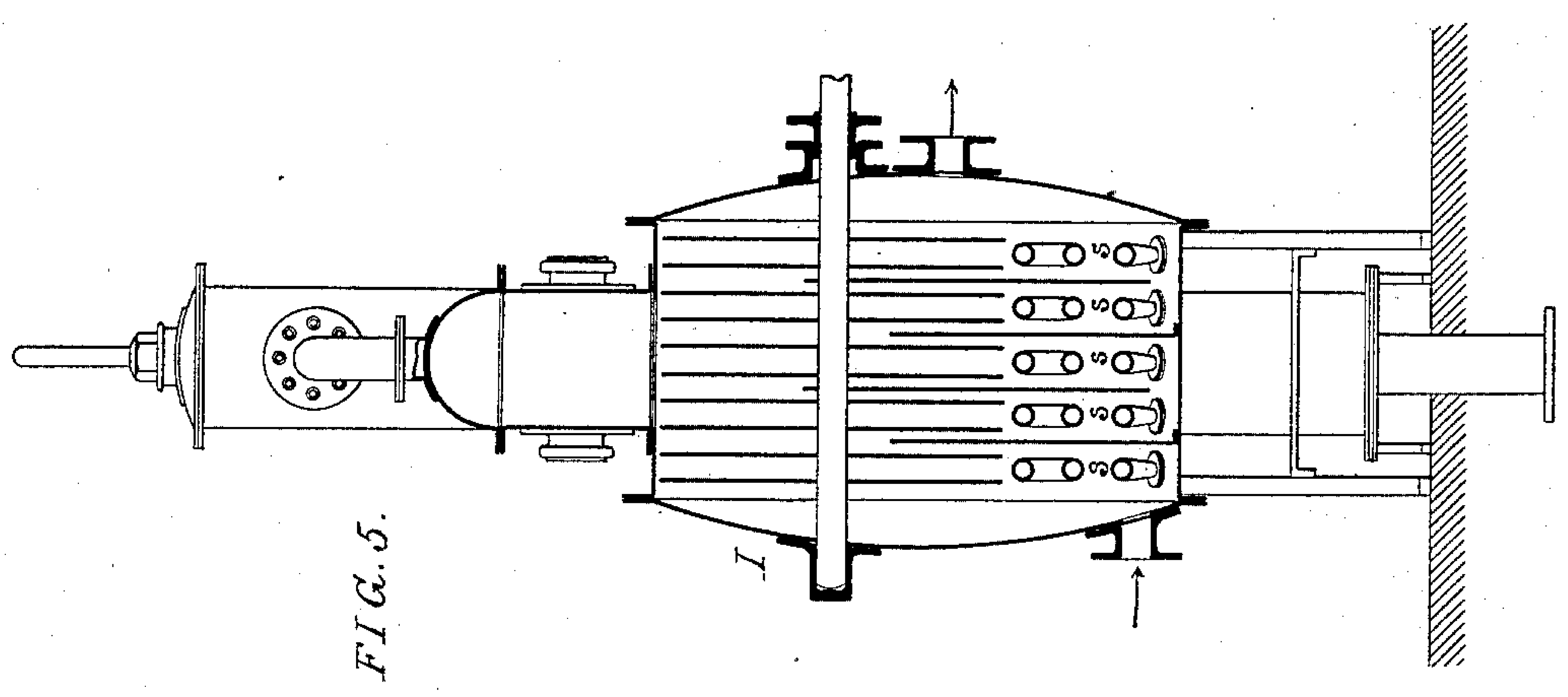

FIG. 5.

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UNITED STATES PATENT OFFICE.

ADAM NATANSON, OF PARIS, FRANCE, ASSIGNOR TO CHRISTIAN WAHL, OF CHICAGO, ILLINOIS.

REFRIGERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 327,300, dated September 29, 1885.

Application filed September 1, 1884. (No model.) Patented in France July 16, 1884, No. 163,329, and in England July 19, 1884, No. 10,357.

To all whom it may concern:

Be it known that I, ADAM NATANSON, a citizen of the United States, and a resident of Paris, France, have invented certain Improvements in Refrigerating Apparatus, (for which I have obtained French Patent No. 163,329, July 16, 1884,) of which the following is a specification.

My invention relates to refrigerating apparatus in which cold is produced by the evaporation of a liquid in a vacuum in the presence of a hygroscopic liquid.

Various means have been devised for refrigerating by the application of this principle; but the apparatus constructed and operating according to my invention, as hereinafter described, differs from those heretofore employed in the improved arrangement and construction of its parts, whereby it is enabled to be constructed at less cost, and an absolutely regular and continuous action is obtained, together with perfect freedom from all liability to get out of order.

The hygroscopic liquid which I employ is preferably an aqueous solution of basic chloride of zinc; but any other hygroscopic liquid may be employed in the apparatus without any modification in the construction.

And in order that the said invention may be fully understood, I shall now proceed more particularly to describe the same, and for that purpose shall refer to the several figures on the annexed sheets of drawings, the same letters of reference indicating corresponding parts in all the figures.

Figure 1 is a vertical section showing the general arrangement of an improved apparatus constructed, arranged, and operating according to my invention. Figs. 2 to 6 are sectional views representing details of the said apparatus, as hereinafter more fully described.

This improved apparatus is provided with an evaporating-vessel, A, (shown in the general view, Fig. 1, and in detail drawn to a larger scale in Fig. 2,) containing a solution of chloride of magnesium or other salt, being of such density as to be incongealable at temperatures considerably below zero centigrade, the said temperatures being obtained by the evaporation of the said solution in a vacuum in the presence of a hygroscopic liquid.

The incongealable liquid, after traversing the vessels or places to be cooled or refrigerated, is received in a tank, D, Fig. 1, whence it is drawn through a pipe, *t*, into the evaporator A, the supply being controlled by a float or ball-cock arrangement, *d'*. The flow of the incongealable liquid through the evaporator A is regulated by means of partitions *c*, Fig. 2, and a pipe, *a*, provides a passage for the escape of the liquid when cooled to the required extent. The temperature is lowered by the evaporation of a portion of the water of the saline solution. This evaporation is promoted by means of disks or wheels *b*, having a continuous rotary motion and serving both to obtain an extended surface for evaporation and also to retain the froth and vapors calculated to produce bubbles. These disks are fixed upon a horizontal shaft, to which rotary motion is imparted by means of a pulley, a^2, and are made of sheet-iron or other metal, perforated with holes forming cells, which take up at each revolution a small quantity of the liquid, which becomes cooled when the thin layers or films are converted into vapor.

The loss of water evaporated from the incongealable liquid is made good, when necessary, by an equivalent quantity of distilled water supplied from a concentrating-vessel, *l*, and delivered into the receiver or return-tank D.

The entire apparatus may be immersed in an incongealable liquid in order to prevent the accidental admission of air; but this precaution is unnecessary when the joints are made tight enough to prevent leakage.

The cold liquid is drawn from the evaporating-vessel A through a pipe, *a*, by means of a pump, B, which delivers the liquid into a distributing tank or vessel, *c*, Fig. 1, whence it is distributed in any suitable manner to the places or apparatus which are to be cooled. This pump works with a sufficient head of liquid to compensate for the effect of the vacuum.

The pump, as well as the evaporating-vessel A, may be immersed in the incongealable liquid in order to prevent air from entering through the joints.

The distributing-tank C, Fig. 1, which receives the cold liquid delivered by the pump B, is of any suitable capacity, and is preferably made of metal lined with heat-excluding materials. Any excess of liquid accumulating in this tank escapes through an overflow-pipe communicating with the tank D.

The cold liquid in the tank C is distributed to the places or apparatus which are to be cooled; or when ice is to be made the molds containing the liquid to be frozen may be placed in this tank, which in this case is divided by partitions into suitable compartments for the reception of the molds. These partitions are so arranged that the cooling-liquid entering at one end of the tank, circulates in a continuous stream between its molds without mixture of the liquids, and issues at the farther end after effecting the requisite interchange of temperature. The molds are hoisted out of the tank and transferred successively at suitable intervals from one compartment to another, so as to advance in the opposite direction to the cooling-liquid by means of an overhead winch.

The return-tank D, Fig. 1, is arranged underneath the evaporating-vessel A and distributing-tank C, so that, owing to the high vacuum present in the vessel A, the liquid is continuously drawn into the latter at a'. This tank is likewise enveloped in heat-excluding materials, and the passage of the liquid is regulated by a float or ball-cock.

The basic chloride of zinc or other suitable hygroscopic liquid brought to the required density is contained in a large condensing-vessel, E, Fig. 1, and in detail in Figs. 2, 3, and 4. The vacuum is produced in this vessel, and consequently in the evaporating-vessel A, by means of a special air-pump, F, to which it is connected by a pipe, e'. A pipe, e, connects the evaporator A with the larger condenser, which is constructed of a metal capable of resisting the action of the hygroscopic liquid, and which is divided, like the evaporator A, by partitions forming compartments communicating alternately at the upper and lower part. The concentrated hygroscopic liquid enters the vessel through a pipe, e^2, and escapes, saturated with evaporated water, through a pipe, e^3, after flowing through the vessel in a continuous stream.

A horizontal shaft is passed through this apparatus and carries wheels e^4, Figs. 3 and 4, which revolve continuously in each compartment. These wheels are composed of concentric hoops of suitable metal, the said hoops being of such width and arranged at such distance apart as to present a large surface of absorption to the current of aqueous vapor in a relatively-contracted space, and resemble those employed in distilling apparatus. The aqueous vapor from the vessel A becomes completely condensed upon these surfaces and never proceeds as far as the pipe e', leading to the special air-pump F.

In order to absorb the heat generated by the condensation of the aqueous vapors in the hygroscopic liquids, the vessel E is entirely inclosed in a casing in which circulates water delivered by a perforated pipe, p, Figs. 3 and 4, and in order to better maintain the hygroscopic liquid at the required temperature each compartment is traversed underneath the wheels by one or more pipes, r, through which cold water is caused to circulate.

A powerful double-acting pump, F, of special construction communicates with the vessel E through a pipe, f. This pump expels the air drawn into the tank C, in which a vacuum equal to about twenty-eight inches of mercury is produced by means of the air-pump H, of ordinary construction. In certain cases this pump F works into a suitable liquid, varying according to circumstances; but for the purposes of the present invention it is preferred to employ a hygroscopic liquid, preferably the same as is used for the absorption in the condensing-vessel E.

A pump, G, draws through a pipe, g, the chloride saturated with water and delivers it into an evaporating or concentrating vessel, I, through a pipe, i, causing the liquid to pass through a cooler or apparatus, J, for effecting an interchange of temperature where it becomes heated. (This interchange is not shown in the drawings.) This evaporating or concentrating vessel I serves to restore the weakened hygroscopic liquid to the proper degree of density, and is constructed, as shown more clearly in the detail Figs. 5 and 6, of a metal selected in accordance with the liquid which it contains. This boiler is worked in a similar manner to the vacuum-pans used in sugar-works, being connected with an air-pump, H, which produces a vacuum corresponding to about twenty-eight inches of mercury and maintained by means of a water-condenser, h. The vacuum in this boiler also acts before the air-pump F, and assists the latter.

The boiler I is arranged in a similar manner to the vessels A and E, so as to be able to work regularly and continuously.

The liquids of low density enter at one end and issue at the opposite end after being brought to the proper degree of density by concentrating in a regular and continuous stream between the partitions without mixing and being acted on by the rotating disks or wheels, which are perforated with holes, forming cells, so as to promote evaporation by presenting an extended surface of liquid and preventing the formation of froth and bubbles.

The liquids are regularly heated and evaporated by the direct action of steam circulating in a coiled pipe or pipes, s, arranged in the lower part of each compartment.

A revolving helix or endless screw of perforated or unperforated sheet metal may be substituted for the disks and partitions arranged, as hereinbefore described, with reference to the vessels A, E, and I.

An air-pump, H, is employed to evaporate the hygroscopic liquid at the temperature of ebullition, which corresponds to a vacuum of about twenty-eight inches. Between this pump and the boiler I there is a condenser, *h*, worked with a jet of water such as is employed in sugar-works.

An extraction-pump, V, working under pressure, draws the concentrated liquid from the boiler I through the cooler J, wherein it is cooled, and forces this cooled liquid into the large condenser E. The water which has been employed for cooling in the cooler is supplied to the large condenser E and thence proceeds to the condenser of the evaporating apparatus I, which discharges it at a temperature of about 40° centigrade.

A driving-shaft, L, imparts motion to the pumps B, F, G, V, and H, and also to the agitators or disks in the vessels A, E, and I.

A special motor or engine, M, or other source of motive power, is employed to give motion to the various moving parts of the apparatus.

I claim as my invention—

1. The herein-described refrigerating apparatus, consisting of an evaporator through which the liquid to be cooled is passed, a condensing-vessel in which the refrigerating-fluid is condensed, a pump to circulate the refrigerating-fluid, and a vacuum-chamber connected therewith, substantially as set forth.

2. The refrigerating apparatus consisting of an evaporator for the fluid to be cooled and circulating-pipes therefor, a condenser for the refrigerating-fluid, vacuum-pump, concentrating-vessel I, wet condenser *h*, and air-pump, all substantially as set forth.

3. The combination of the evaporator, the condenser E, and circulating-pipes with a vacuum-pump, F, inclosed in a water-jacket of hygroscopic liquid, substantially as specified.

4. The condensing, evaporating, or concentrating vessel containing a series of partitions forming compartments communicating alternately above and below with a rotary shaft carrying disks or wheels having openings through them, substantially as set forth.

5. The condensing or concentrating vessel having a rotary shaft with a series of wheels or disks and coils of pipes passing through the vessel below the disks, as and for the purpose described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ADAM NATANSON.

Witnesses:
NICOLAS GALLAUD,
ALFRED COINY.