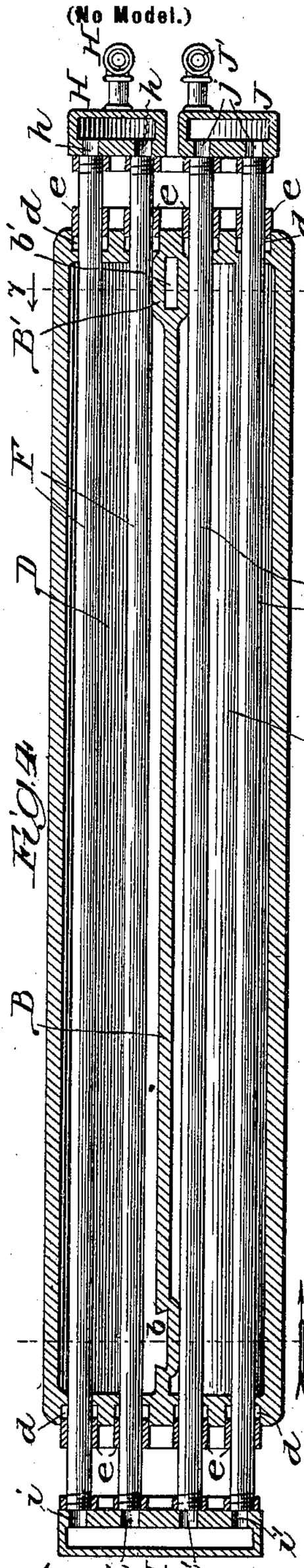
No. 671,811. Patented Apr. 9, 1901.

S. THURSTENSEN.

AMMONIA STILL.

(Application filed Aug. 2, 1900.)

(No Model.) 2 Sheets—Sheet 1.



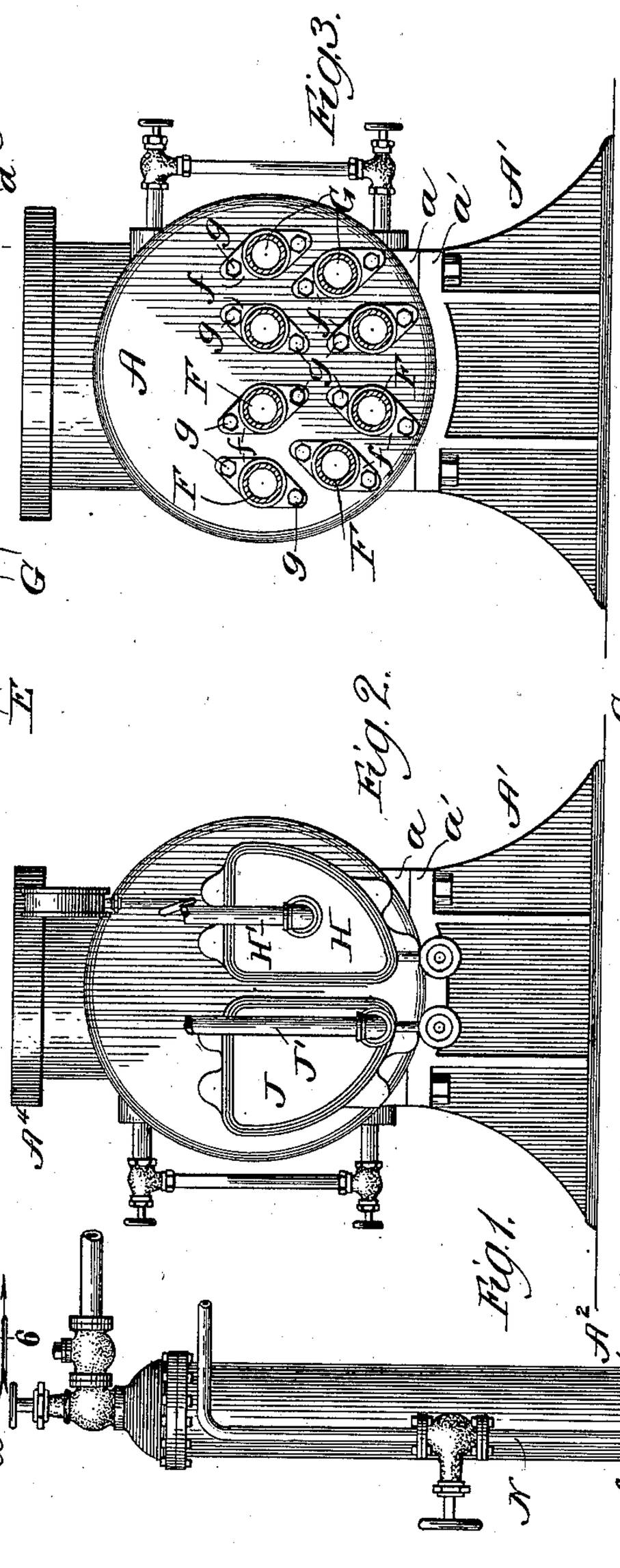


Fig. 3.

Fig. 2.

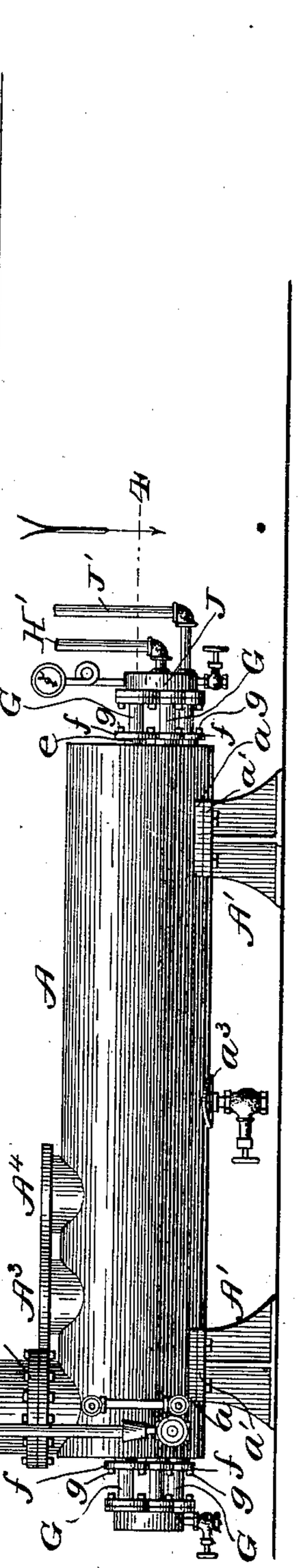


Fig. 4.

Fig. 1.

Witnesses:
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Fig. 8,

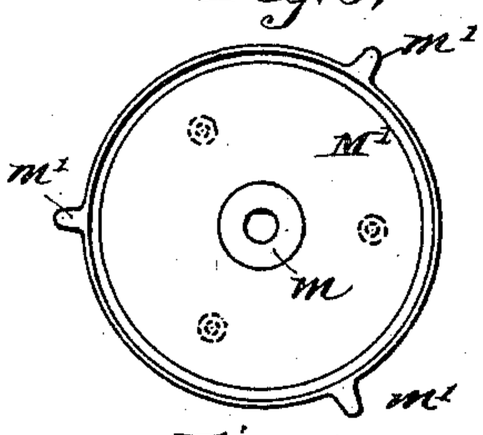


Fig. 9,

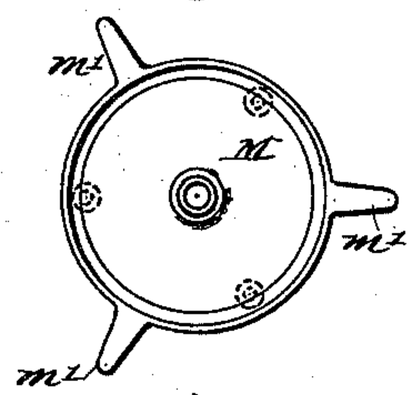


Fig. 6,

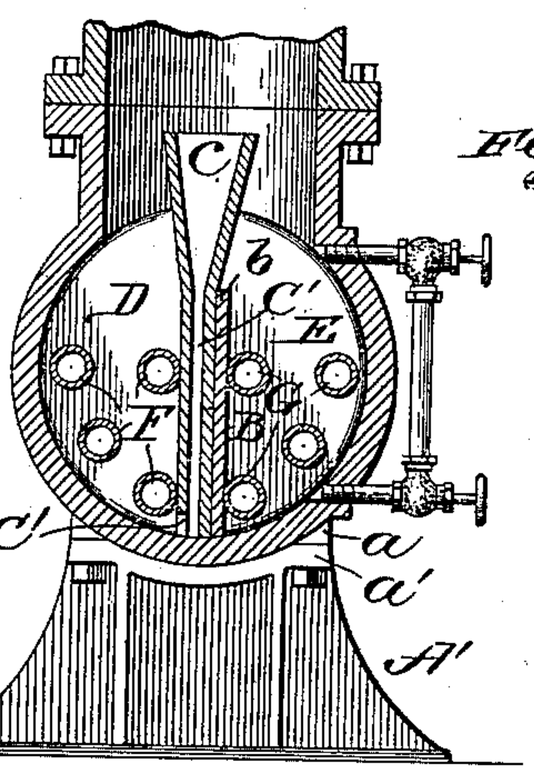


Fig. 10,

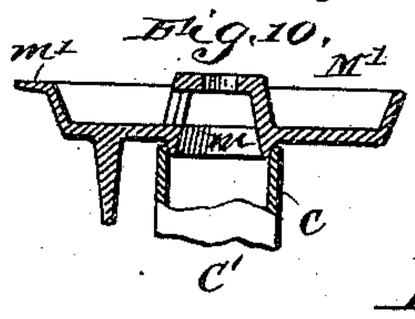


Fig. 11,

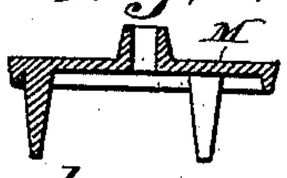
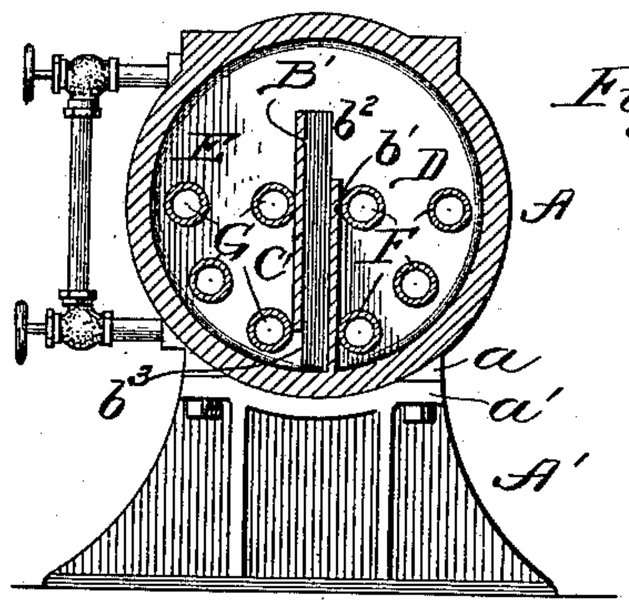


Fig. 5.

Fig. 7.



Witnesses:
John Enders Jr.
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UNITED STATES PATENT OFFICE.

SOREN THURSTENSEN, OF LOUISVILLE, KENTUCKY, ASSIGNOR TO HENRY VOGT MACHINE COMPANY, OF SAME PLACE.

AMMONIA-STILL.

SPECIFICATION forming part of Letters Patent No. 671,811, dated April 9, 1901.

Original application filed February 19, 1900, Serial No. 5,827. Divided and this application filed August 2, 1900. Serial No. 25,610. (No model.)

To all whom it may concern:

Be it known that I, SOREN THURSTENSEN, a citizen of the United States, residing at Louisville, in the county of Jefferson and State of Kentucky, have invented certain new and useful Improvements in Ammonia-Stills, of which the following is a specification, the same being a division of my application, Serial No. 5,827, filed February 19, 1900.

This invention relates to what are known or termed "absorbing ice-machines," in which the operation is carried on in three principal stages, comprising the generation of gas by heat, the liquefaction of the gas by the withdrawal of heat, and the expansion of the liquid to a gaseous state absorbing heat from the surrounding objects and the reabsorption of the gas by the weak liquid, such machines employing usually in the operation aqua-ammonia as the refrigerating agent. The production of the gas in this class of ice-machines is had by pumping the ammonia or refrigerating agent into a generator or still and there subjecting it to heat until the ammonia is driven off in the form of gas under varying pressure of pounds per square inch, according to the temperature of the cooling-water in the condenser.

The invention relates particularly to the construction and operation of the generator or still for ice-machines and the connection and operation thereof with the analyzer from which the liquid ammonia or refrigerating agent is discharged into the generator or still and through which the ammonia-gas as it is generated passes for application and use.

The objects of the invention are to improve the construction of the generator or still so as to produce a better result and a more perfect circulation for the action of the heat-transmitting pipe on the aqua or liquid ammonia, thereby insuring an increased production and a better quality of gas; to furnish a longer travel and consequent contact of the ammonia liquid over the gas-generating pipes in the generator or still; to dispense as far as practicable with all joints in the construction of the generator or still; to dispense with coils having joints inside of the generator or still by employing straight-line pipes extending through the generator or still and having the joints on the outside with the pipes submerged in the ammonia liquid within the body of the generator or still for the passage of steam to produce heat and generate the gas, and to improve the construction, arrangement, and operation of the generator or still generally and its coacting relation and operation with the analyzer.

The invention consists in the features of construction and the combination and arrangement of parts hereinafter described and claimed.

In the drawings illustrating my invention, Figure 1 is a side elevation of the generator or still with the analyzer mounted thereon; Fig. 2, an elevation of one end of the generator or still; Fig. 3, an elevation of the opposite end of the generator or still to that shown in Fig. 2, with the steam-pipes in section; Fig. 4, a central horizontal section of the generator or still; Fig. 5, a central vertical section of one end of the generator or still, with the steam-heating pipes in elevation and with the analyzer in section and broken in two; Fig. 6, a cross-section of the generator or still, taken at the receiving end for the ammonia liquid; Fig. 7, a cross-section of the generator or still, taken at the opposite end to Fig. 6; Fig. 8, a plan view of one of the large pans employed in the analyzer; Fig. 9, a plan view of one of the small pans employed in the analyzer; Fig. 10, a sectional elevation of the lower large pan of the analyzer, showing the manner of connecting the pan with the upper end or hopper portion of the discharge-pipe for the liquid to pass from the pan into the supply-pipe and enter the generator; and Fig. 11 a sectional elevation of a modified form of small pan having the peripheral rim removed.

In carrying out my invention I construct a generator or still in the form of a cylinder having its body and ends in one piece. The generator or still, as shown, is supported upon feet or standards A′, for which purpose the cylinder of the generator or still A is provided on each side, at the ends, with ears or flanges *a*, Fig. 1, which coact with ears or flanges *a*′ on the feet or standards, so that by the use of

suitable bolts the cylinder of the generator or still *a* is mounted on and connected with its base or support. The upper side of the generator or still cylinder, at one end thereof, has a series of rests or supports A^2, A^3, and A^4 on which to mount the exchanger, rectifier, and analyzer, none of which are shown except the analyzer, as they form no part of the present invention, being embodied in my said application Serial No. 5,827. The body of the generator or still cylinder in the construction shown has therein an armhole or opening a^2, closed by a plate or cover a^3, Fig. 5, for admission to the interior of the generator or still for cleaning or other purposes.

The interior of the generator or still is divided by a central longitudinal vertical wall or partition B into two chambers or compartments D and E, Fig. 7. The wall or partition is not the full depth of the interior of the generator or still, but extends from the bottom upward, leaving an open space between the top of the wall or partition and the top of the interior of the generator or still, as shown in Figs. 5, 6, and 7. The receiving end of the generator or still has a funnel or hopper C, Fig. 5, into which the ammonia liquid is delivered from the analyzer. The funnel or hopper has a discharge tube or spout C′, which is entered into a dovetail slot *b* in the wall or partition, so as to hold the funnel or hopper in a fixed relation to the analyzer. The lower end of the discharge tube or spout C′ has in its outer wall an opening or mouth *c*, which leads directly into one chamber or compartment D of the generator or still, in which compartment is located a series of steam-pipes F, extending in a straight line through the chamber or compartment, from end to end thereof. The opposite end of the wall or division plate B to that having the funnel and discharge-spout attached thereto is enlarged so as to form a casing or wall B′, having a vertical passage *b*′, terminating at its upper end with a mouth or opening b^2 in communication with the chamber or compartment D, and at the lower end of the vertical passage *b*′, on the opposite side to the mouth or opening b^2 in the wall or shell B′, is a mouth or opening b^3, leading directly into the other chamber or compartment E of the generator or still, in which chamber or compartment is located a series of steam-pipes G, extending in straight lines through the chamber, from end to end thereof. The ammonia discharged into the funnel or hopper is discharged through the tube or spout C′ and the mouth or opening *c* into the chamber or compartment D and rises in such chamber or compartment until it flows into the mouth or opening b^2 and through the passage *b*′, passing out through the mouth or opening b^3 into the chamber or compartment E. It will thus be seen that the ammonia liquid enters the compartment D at one end and flows and rises in such compartment to the opposite end for discharge into the chamber or compartment E at the opposite end to its point of reception in the chamber or compartment D.

Both series of steam-pipes F and G pass at each end through the solid end walls of the generator or still cylinder, and at the point of passage of each steam-pipe F in each cylinder-head is an opening *d*, receiving a stuffing-box *e*, and a similar construction and arrangement of opening and stuffing-box is provided for each steam-pipe G, where such pipe passes through the heads of the generator or still cylinder, thus forming a tight joint around each steam-pipe against the escape of ammonia or ammonia-gas. As shown, each stuffing-box *e* is carried by a plate *f*, through which bolts *g* pass for attaching the stuffing-box in place on the end of the generator or still cylinder, so as to insure the proper packing of the stuffing around the pipe.

The steam-pipes F all open into a steam-induction chamber H, to which steam is supplied by a pipe H′, and from which chamber the steam passes into the pipes F, through ports or openings *h*, as shown in Fig. 4, one for each pipe. The steam flows through the set of pipes F into a return steam-chamber I through ports or openings *i*, and from the chamber I the steam enters the pipes G through ports or openings *i*′, one for each pipe, as shown in Fig. 4. The steam flows through the set of pipes G and after traveling through the pipes enters an eduction-chamber J through ports or openings *j*, one port for each pipe, as shown in Fig. 4, and from the eduction-chamber the exhaust-steam passes out through an eduction-pipe J′ to the point of discharge.

The steam-pipes traverse the entire length of their respective chambers or compartments D and E, and the aqua-amuionia or ammonia liquid as it enters the chamber D and rises therein comes in contact with the hot pipes F of that chamber, causing ammonia-gas to be thrown off, and from the chamber or compartment D the liquid, after being subjected to the heat of the pipes of that chamber or compartment, flows into the passage *b*′, Fig. 4, from the mouth or opening b^2 and out from the passage through the mouth or opening b^3 and enters the chamber or compartment E at the bottom and rises in such chamber or compartment, subject to the action of the heat of the pipes G, causing ammonia-gas to be thrown off from the action of the heat. It will be seen that the aqua-ammonia liquid travels the full length of both chambers or compartments, as well as rising in each, and in this way is subjected to the action of a large heating-surface, furnished by the series of steam-pipes in the two sections or compartments, by which an increase in the amount of gas produced is secured and the liquid is more efficiently and thoroughly evaporated. The induction of steam into the pipes F is at the opposite end to the induction of the rich liquid into the chamber D, and the

induction of steam from the chamber I into the pipes G is at the opposite end to the induction of the liquid from the chamber or compartment D into the chamber or compartment E. This arrangement gives a circulation for the rich liquid and steam through the generator or still in opposite directions, producing an increased effect in the absorbing of heat by the liquid for the generating of gas.

The aqua-ammonia or ammonia liquid in the construction and arrangement shown is discharged into the generator or still from an analyzer K, and the generated ammonia-gas passes from the generator or still up through the analyzer. The analyzer K is in the form of a cylinder having a cap or cover *k* and having a base or rim at its lower end for mounting the analyzer on the rest or support A^2 for the interior of the analyzer to be in free communication with the interior of the generator or still through an opening K', into which the funnel or hopper C projects, as shown in Fig. 5. The cap or cover *k* has entered thereinto a delivery pipe or tube L, having a controlling-valve L' in communication with a supply-pipe L^2 for the aqua-ammonia or ammonia liquid, and, as shown, between the valve L' and the supply-pipe L^2 is a check-valve *l* to admit or stop the supply of liquid to the analyzer.

The tube or cylinder of the analyzer K has located in its interior a series of pans M and M', of which M is of a less diameter than M', and the pans or receptacles M' are provided with a central hole or opening *m*, so that the liquid deposited in the initial pan or receptacle overflows its top and enters the adjoining larger pan to pass therefrom through the hole or opening *m* in the bottom of such pan into the adjoining smaller pan to overflow the top of that pan or receptacle into the next adjoining pan or receptacle, and so on until the bottom pan or receptacle is reached, from the opening *m* in the bottom of which pan or receptacle the liquid discharges into the funnel or hopper C to enter the generator or still, as already described. Each pan, as shown, has three outwardly-projecting lugs or prongs *m'*, which contact with the wall of the cylinder or tube of the analyzer and hold the pan central in place. The space above the initial or first analyzer pan or receptacle proper is provided with two large pans or receptacles M^2 in the arrangement shown for receiving the drip and causing it to flow into the first acting pan or receptacle. The acting pans or receptacles proper are united one to the other and held in position by a tie-rod m^2, and, as shown, the bottom pan or receptacle is supported on the top of the funnel or hopper, so as to insure the discharge of the ammonia liquid from the pan into the funnel or hopper.

The generated ammonia-gas passes up through the opening in the generator or still cylinder, around the funnel or hopper C, and enters the analyzer K and passes up therein through the openings or passages around the several pans or receptacles for final discharge from the top of the analyzer at the outlet *n*, (shown by dotted lines in Fig. 5,) and the aqua-ammonia or ammonia liquid descends in the analyzer from pan to pan, so that the upwardly-ascending gas and the downwardly-descending liquid come in contact, thereby removing a large proportion of the moisture of the gas.

The operation of the generator or still will be understood from the foregoing description, but is, briefly, as follows: The rich or full-charged aqua-ammonia or ammonia liquid is delivered into the upper end of the analyzer by the delivery-pipe L to descend therein, passing from pan or receptacle to pan or receptacle, and finally entering the funnel or hopper to pass through the tube or spout thereof into the first generating compartment or chamber at one side of the vertical longitudinal wall or partition of the generator or still. The rich liquid thus delivered into the first or initial receiving compartment or chamber of the generator or still is subjected to the heat of the steam flowing through the pipes in such chamber in the opposite direction to the flow of the liquid in the chamber for the heat to evolve ammonia-gas from the liquid, and after such subjection to the heat of the first receiving compartment or chamber the liquid flows into the second or final receiving compartment or chamber and is subjected to the heat of the steam flowing through the pipes in such compartment or chamber in the opposite direction to the flow of the liquid in the chamber for the heat to complete the evolving of ammonia-gas therefrom, leaving only a weak liquid. The evolved gas passes upward in the analyzer and out therefrom through a discharging pipe or tube (not shown) connected with the outlet *n* to the rectifier, and thence to the condenser-coil. (Also not shown.) The weak liquid passes from the second or final receiving compartment or chamber of the generator or still through a discharge-pipe N, to be again recharged and made rich for the next operation of evolving gas.

The division of the generator or still into two sets of independent chambers or compartments and passing the rich liquid into each compartment at the bottom to rise upward and flow lengthwise therein to have the flow against the opposite flow of steam in the heating-pipes insures a complete and perfect subjecting of the rich liquid to the action of the heating-pipes under the best possible conditions for the production or evolving of ammonia-gas, and by subjecting the rich liquid, in effect, to a double heating action the generating or evolving of practically all the gas contained in the liquid is assured, leaving only a very weak liquid. The extending of the heating-pipes lengthwise of the generator or still and from end to end of the chambers or compartments to have the pipes pass

through the solid ends of the generator or still cylinder gives a better surface for contact with the rich liquid and a closer fit and a tighter joint against the escape of ammonia around the pipes where they pass through the ends or heads of the cylinders. This construction and arrangement of the heating-pipes dispenses with joints and coils and simplifies the construction and improves the operation of the generator or still. The delivering of the liquid into the bottom of each chamber or compartment of the generator or still insures a perfect circulation of the liquid on and over the heating-pipes and prevents deterioration of the heating-pipes, as would be the case if the liquid were allowed to flow thereon instead of rising upward against the pipe.

I claim—

1. In an ammonia-still, the combination of a generator or still having two chambers or compartments for the circulation of liquid from one chamber or compartment to the other, and longitudinal heating-pipes in each chamber or compartment for a circulating heating medium through each chamber or compartment in an opposite direction to the flow of the liquid, substantially as described.

2. In an ammonia-still, the combination of a generator or still having a longitudinal partition dividing the chamber of the generator or still into two chambers or compartments, an opening on one side of the partition discharging into one compartment, an opening on the opposite side and at the opposite end of the partition discharging into the other compartment, and a series of heating-pipes in each compartment for acting on ammonia liquid and evolving ammonia-gas, substantially as described.

3. In an ammonia-still, the combination of a generator or still having a longitudinal partition dividing its interior into two chambers or compartments, an opening at one side of the partition leading into one compartment, an opening on the opposite side of the partition and at the opposite end thereof leading into the other compartment, a series of steam-pipes longitudinal of each compartment, a steam-induction chamber for one series of pipes, a return steam-chamber into which both series of pipes lead and a steam-eduction chamber for the other series of pipes, substantially as described.

4. In an ammonia-still, the combination of a generator or still formed of a cylinder having a continuous body and ends, and longitudinal steam-pipes passing through the solid ends or heads of the cylinder and exterior stuffing-boxes in the solid ends around the pipes for insuring a tight joint for the cylinder ends or heads and the steam-pipes, substantially as described.

5. In an ammonia-still, the combination of a generator or still having a longitudinal partition dividing the interior into two chambers or compartments, a funnel or hopper discharging into one chamber or compartment, and an analyzer mounted on the generator or still and communicating at the bottom with the funnel or hopper for discharging liquid into the initial receiving compartment or chamber of the generator or still, substantially as described.

6. In an ammonia-still, the combination of a generator or still having a longitudinal partition dividing the interior into two chambers or compartments, and an analyzer mounted on the generator or still and communicating at the bottom with one chamber or compartment of the generator or still for discharging liquid thereinto, substantially as described.

7. In an ammonia-still, the combination of a generator or still having a longitudinal partition dividing the interior into two chambers or compartments, and an analyzer communicating at the bottom with the two chambers or compartments of the generator or still for discharging liquid into one chamber or compartment and receiving the supply of gas generated from both chambers or compartments to pass up through the analyzer, substantially as described.

8. In an ammonia-still, the combination of a generator or still having a longitudinal partition dividing its interior into two chambers or compartments, an outer tube or cylinder having free communication at its lower end with the generator or still, and a series of alternating large and small pans or receptacles in the tube or cylinder delivering liquid downward from one pan to the other for final discharge into one chamber or compartment of the generator or still and admitting generated gas from both chambers or compartments of the generator or still to pass upward around and between the pans or receptacles in the tube or cylinder, substantially as described.

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