(No Model.) 2 Sheets—Sheet 1.

D. L. HOLDEN.

REFRIGERATING APPARATUS.

No. 493,721. Patented Mar. 21, 1893.

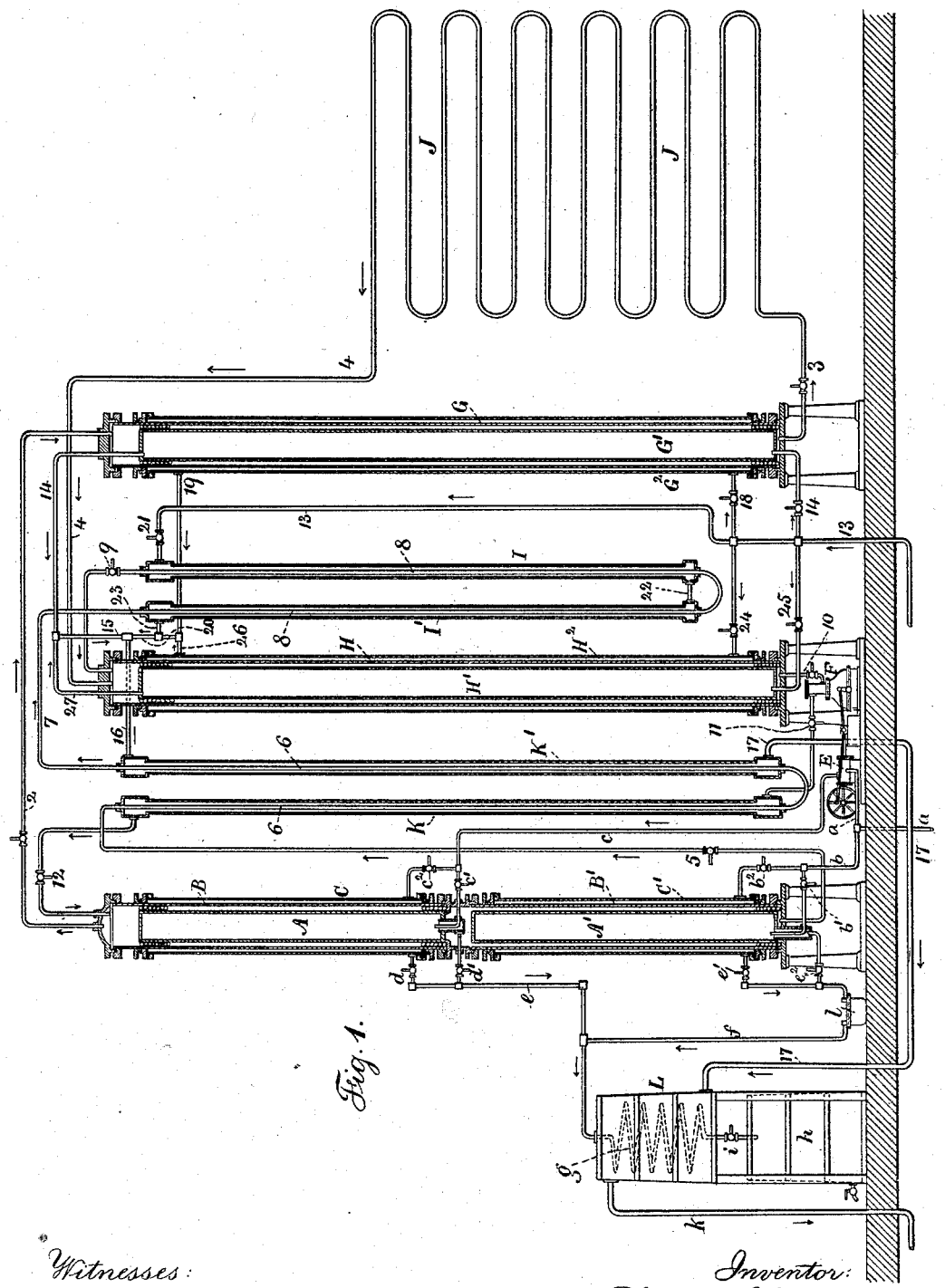

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

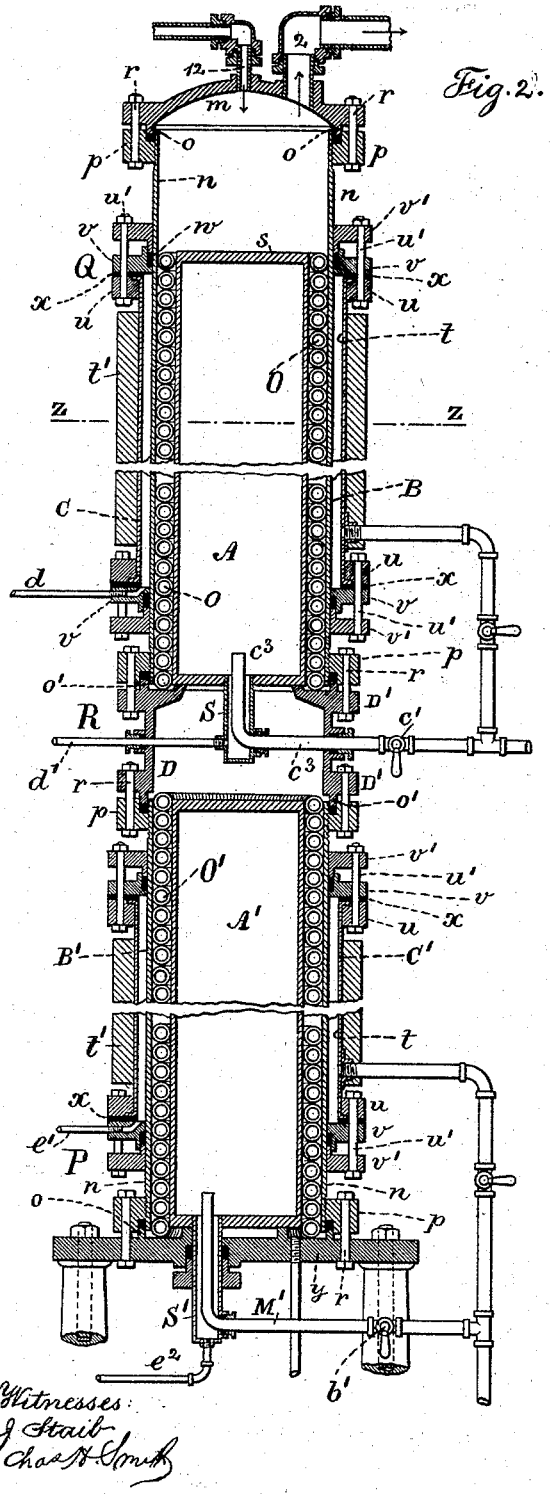
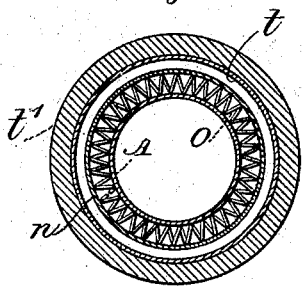


Fig. 3.



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UNITED STATES PATENT OFFICE.

DANIEL L. HOLDEN, OF NEW YORK, N. Y.

REFRIGERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 493,721, dated March 21, 1893.

Application filed March 28, 1892. Serial No. 426,660. (No model.)

To all whom it may concern:

Be it known that I, DANIEL L. HOLDEN, a citizen of the United States, residing in the city and State of New York, have invented an Improvement in Refrigerating Apparatus, of which the following is a specification.

In the distillation of gaseous ammonia a large portion thereof will pass off from the liquid at a comparatively low temperature, but a higher temperature is required for more fully driving off such gaseous ammonia. Exhaust steam from an engine can be used in refrigerating apparatus, but ordinarily it is not of a sufficiently high temperature to properly vaporize the ammonia.

In my present invention the rich liquor is first subjected to heat from exhaust steam and then it is subjected to a higher temperature by steam directly from the boiler or generator, and I construct the still, the absorber and the condenser in a peculiar manner so that a coil or helix of wire is either heated or cooled and the liquid material trickles down upon the wire of the spirals or helices, so that a very large surface is exposed to the heating or cooling action, as hereinafter described.

In the drawings Figure 1 is a diagrammatic sectional elevation illustrating the present improvement, and Fig. 2 is a section in larger size representing the construction of the still, or generator, and also of the absorber and condenser, and Fig. 3 is a horizontal section at the line *z*, *z* of Fig. 2.

The still or generator is represented in two parts B B′, and the vapors from the still pass by the pipe 2 to the condenser G, and the liquid ammonia is allowed to flow from the bottom of the condenser by the pipe and cock 3 to the coil J which is in the chamber or space to be refrigerated, and the spent gas passes by the pipe 4 back to the absorber H, and the weak ammonia liquor from the bottom of the still or generator B B′ passes by the pipe and cock 5 and pipe 6 of the interchanger K and auxiliary cooler K′ and by the pipe 7 to the pipes 8 of the cooler I I′, and thence the weak liquor is admitted in the proper quantity by the cock 9 to the upper end of the absorber H, and the rich liquor from the bottom of the absorber H is conveyed by the pipe and cock 10 to the pump F and from that it is forced by the pipe and cock 11 to the interchanger K containing the pipe 6 that leads the weak liquor away from the still, and from the top of the interchanger K the rich liquor is carried by the pipe and cock 12 to the top of the generator. The condensing and cooling water is admitted by a pipe 13 from a hydrant or suitable supply and by the cock 14 is allowed to flow into the bottom of the inner water tube G′ of the condenser, and from the top of such condenser tube G′ the partially warmed water passes by the pipes 14, 15, 16 to the top of the auxiliary cooler K′ and by the pipe 17 to the water cooler and condenser L; water from the pipe 13 is also allowed to flow by the cock 18 into the jacket G^2 of the condenser, and from the upper part of the jacket by the pipes 19 and 20 to the pipe 16 before mentioned. Water also can pass from the pipe 13 by the cock 21 into the top of the cooler I, and by the branch pipe 22 to the cooler I′, and from the top of I′ by the branch 23 and pipe 20 to the pipe 16 aforesaid. The supply water can also pass by the cock 24 into the jacket H^2 of the absorber H, and by the pipe and cock 25 into the inner tube H′ of the absorber H, and the water can escape from the upper end of the absorber jacket H′ by the branch pipe 26 and pipe 20 to the pipe 16 before named, and the water can pass off from the inner tube H′ of the absorber by the pipe 27 to the pipes 15 and 16 before named.

From the foregoing general description it will be observed that the water that is used for cooling purposes is supplied by the pipe 13 and led through the various portions of the apparatus, and that in a partially warm condition it passes through the interchanger, that is to say, by the auxiliary cooler K′ around the pipe 6 and thence to the water cooler and condenser L hereinafter named, and that the weak liquor in its heated condition as it passes from the generator B B′ by the cock and pipes 5 and 6 through the interchanger K and auxiliary cooler K′ such weak liquor serves to warm up the rich liquor that is passing from the pump F and cock 11 through the interchanger K and pipe and cock 12 into the still, and the weak liquor passing through the auxiliary cooler K′ is cooled by the liquid in such auxiliary cooler K′ around the pipe 6, and when the weak liquor passes by the pipes 7 and 8 through the cooler I I′,

such weak liquor is still further cooled by the water from the pipe 13 and cock 21, so that when the weak liquor reaches the absorber H it is in a cold condition and better adapted to the absorption of the spent gas passing into the absorber by the pipe 4, and this absorber is kept in a cool condition by water passing through the inner tube H′ of the absorber and within the jacket H^2 of the absorber, and the water which becomes partially warmed in the absorber goes away by the pipes 26 and 27 to the pipes 15, 20 and 16 before mentioned, hence by this arrangement the cooling and condensing water is used as economically as possible, and it will be observed that the water flowing from the pipe 13 by the cocks 14 and 18 to the condenser also passes by the pipes 14 and 19 to the pipes 15, 20 and 16, so that the pipe 16 and auxiliary cooler K′ become the common outlet for the water that has been used for cooling purposes.

The steam pipe *a* supplies steam to the engine E, and by the pipe *b* and cocks *b′* b^2 the live steam is admitted to the jacket C′ and to the inner cylinder A′ of the still or lower generator B′, and the exhaust steam from the engine passes by the pipe *c* and cocks *c′* c^2 to the inner cylinder A and to the jacket C of the upper still or generator, and the water of condensation passes by the cocks *d d′* and pipe *e* to the worm *g* and the water of condensation from the live steam goes by the cocks *e′* e^2 and pipe to the steam trap *l* and thence by the pipe *f* to the worm *g* in the water cooler and condenser L, and the water of condensation in a cool condition passes by the cock *i* into a vessel or holder *h*, so that this pure water of condensation may be availed of and frozen into ice or otherwise used, and the overflow pipe *k* leads to a sewer or other discharge from the water cooler and condenser L. By passing the water of condensation through a steam trap *l* before passing by the pipe *f* to the worm *g* the pressure of steam may be maintained in the still, and such steam trap being of ordinary construction does not require further description.

Having now given a general description of the apparatus and set forth the manner in which the ammonia is caused to circulate through the apparatus, and also the manner in which the cooling water is made to pass through the apparatus I will now proceed to describe the features of construction of the respective parts.

The interchanger K, auxiliary cooler K′ and the cooler H′ are made of pipes one within the other with suitable enlargements at the end for the respective branch pipes and with packings at the heads of the enlargements around the respective inner pipes, so that leakage may be prevented.

The lower parts of the still, the absorber and the condenser are made substantially in the manner represented in the lower portion P of Fig. 2. The upper part of the still, the absorber and the condenser are made substantially as represented at the portion Q of Fig. 2, with the exception of the connecting pipes which are illustrated in Fig. 1; the center portion R, however of this Fig. 2, shows the center portion of the still or generator and the description of the upper and lower portions of Fig. 2 is made general as follows, so as to apply to either still, absorber or condenser, and the center portion of Fig. 2 will be described with special reference to that portion which is found in the still or generator only.

The head *m* is either flat or convex and it is provided with a rib *o*, and the tube *n* has a screw thread cut around the exterior surface thereof upon which the ring *p* is screwed, and this ring *p* has an annular cavity or recess adjacent to the screw thread portion of the tube *n*, so that a packing of lead or other suitable material introduced into this annular recess when pressed upon by the rib *o* as the screws or bolts *r* are screwed up, is firmly pressed into the screw thread so that a perfectly tight joint is made between the head *m* and the tube *n*. The inner tube has a closed head *s* and the coils or helices of wire are laid in between the inner tube and the tube *n*, hence it will be observed that any liquid material supplied into the upper part of the tube *n* will run down over the coils O and be subjected to either heat or cold according to whether steam is within the inner tube, or cooling water, and the liquid will trickle over or down such coils from the top toward the bottom, and the vapors driven off from such liquid or absorbed by such liquid or condensed upon such coils, will be subjected to an extended cooling or heating action because of the extended surface of such coils or helices, and these are in contact with both the inner tube and the outer tube, and for this reason a very efficient still, absorber or condenser can be made in a very compact space.

In addition to the cooling or heating action from the inner tube, the outer tube is exposed also to a corresponding cooling or heating action in consequence of the jacket surrounding the same, and such jacket is either to receive within it water for cooling or steam for heating, but in order to connect the jacket or case steam or water tight with the outer tube has involved considerable difficulty, because the parts are sometimes exposed alternately to expansion and contraction; to overcome this difficulty the top and bottom ends of the jacket are similarly fitted, that is to say, the jacket *t* is preferably covered with non-conducting material *t′* and the ends of the jacket are flanged outwardly and each surrounded by a ring *u* through which bolts *u′* pass, and these bolts also go through the rings *v v′*, and one ring has an annular rib upon it projecting into an annular recess in the other ring, so that a packing *w* received into such annular recess is forced by the pressure of the screws or bolts against the ex-

terior of the tube n, and there is a washer or packing x between the ring u and the ring v. By this means a tight joint is made between the respective parts, and expansion and contraction are allowed for.

I remark that the same character of joint is made at the top and bottom of the respective jackets, and the same letters of reference are applied at the top and bottom ends of the two jackets, as represented in Fig. 2, and the connections between the tube n and the base plate y are the same as between the tube n and the head m and the same letters of reference are applied thereto.

The inner tube, the outer tube and the jacket in the absorber and also in the condenser are uninterrupted from end to end, hence further description of the details of construction is unnecessary, but the still is made with an upper and lower section, the intermediate portion being represented at R, Fig. 2, and by bearing in mind the features of construction before mentioned as applicable to the upper and lower ends of the still as a whole, the middle portion of the still which divides it into sections alone requires to be described. It is constructed as follows: The inside cylinders A and A′ of the still are tightly closed at the adjacent ends, as represented in Figs. 1 and 2. The cylinders B and B′ of the still terminate at the head m and base y respectively, at the top and bottom ends, and at the intermediate connecting cylinder D, and the rib o' and rings p and the screws r are employed for connecting the flanges D′ of the connecting cylinder D to the respective cylinders B and B′ of the still, and the connections at the bottom of the jacket C and top of the jacket C′ are made the same as before described for the upper and lower ends of such jackets. The upper still tube B is supported by the connecting cylinder D, and the inner tube A and the helices or coils O are preferably sustained by inwardly projecting brackets upon the connecting cylinder D, and the steam pipe for the exhaust steam is allowed to pass through the cock c' and branch pipe c^3 into the interior tube A of the still, such tube c^3 passing through a suitable gland or packing upon the connecting cylinder D, and in order to allow the water of condensation from the inner cylinder A to pass away to the pipe and cock d', I provide a tubular pocket S below the bottom of the inner cylinder A and into which the pipe from the cock d' passes, and this tubular pocket receives within it the upwardly projecting end of the branch pipe c^3, and the drip pipe or escape for the water of condensation within the jacket C passes to the cock d by the branch pipe which may be screwed into the ring v, as shown in Fig. 2, and the drip pipe for the water of condensation from within the jacket C′ to the cock e' may also be screwed into the similar ring v of such jacket C′.

At the bottom of the inner cylinder A′ the live steam through the pipe M′ is admitted by the cock b', and the tubular pocket S′ is represented as passing through a gland or stuffing box in the base y, such tubular pocket S′ being screwed into the bottom end of the cylinder A′ and the waste pipe for water of condensation passes from the bottom of this tubular pocket and by the pipe e^2 to the trap l as aforesaid.

In operating this still it will be understood that the ammonia gases pass off by the pipe 2 to the condenser, and the rich liquor is allowed to run into the upper part of the still by the pipe and cock 12, and this liquor is in a warm condition in consequence of passing through the interchanger K and the rich liquor runs upon the exterior of the inner cylinder A and it also flows over the coils or helices O, and as the liquid descends it is exposed to the heat from the exhaust steam, and the more volatile ammonia is driven off and the liquid runs from the bottom of the cylinder A and of the coils O, through the connecting chamber D upon the top of the lower cylinder A′ and upon the coils O′ and it passes down and is subjected to a higher temperature, so that the ammonia vapors are driven off and pass uppwardly between the coils and in the space between the still B B′ and the inner cylinders A A′ and pass to the condenser as aforesaid, and such vapors are condensed in the condenser by contact with the inner and outer cylinders thereof and with the coils or helices that intervene between such cylinders, and the liquid ammonia accumulates in the lower part of the condenser between G and G′ and is allowed to pass to the refrigerating coil as aforesaid.

By the aforesaid arrangement of apparatus, the operations can be carried on continuously, the weak liquor being returned to the absorber through the interchanger K and auxiliary cooler K′, and coolers I I′ and to which absorber the spent gas from the refrigerating coil is admitted and the rich liquor is fed continuously by the pump through the interchanger K to the upper part of the still.

I claim as my invention—

1. The combination in an ice machine of a still in two parts each part having an inner heating tube and an outer jacket and a metallic coil or helix in the intermediate generating chamber, a pipe for supplying the rich liquor at the top of the upper still, a chamber connecting the upper and lower generating chambers and a pipe for weak liquor from the lower part of the still, pipes and cocks for supplying exhaust steam to the inner tube and jacket of the upper still and pipes and cocks for supplying steam at a high temperature to the inner tube and jacket of the lower still substantially as specified.

2. The combination in a refrigerating apparatus, of an inner cylinder and an outer cylinder for heating or cooling and intervening wire helices of metal in contact with the respective cylinders to act as conductors for varying the temperature of the liquid material

allowed to run over the helices and between the cylinders, substantially as set forth.

3. The combination in a still or generator of an inner tube, an outer tube, a metal coil or helix in the generator space between the respective tubes, heads for closing the outer and inner tubes, a jacket for fluid such as steam or water surrounding the outer tube, rings secured upon the outer tube and to the ends of the jacket and packings confined between the respective rings and tube for rendering the joints tight but for allowing for expansion and contraction substantially as specified.

4. The combination in a two-part still or generator for ice machinery of two inner tubes closed at their ends and one above the other, outer tubes closed at their top and bottom ends, an intermediate cylinder connecting the outer tubes and forming a chamber that opens into the generator spaces between the outer and inner tubes of the respective parts of the still, jackets around the upper and lower parts of the still and separate pipes for supplying steam to the respective parts of the still, so that the lower part of the still can be the hottest and pipes for supplying the rich liquor at the top of the still and for taking off the weak liquor from the bottom of the still substantially as specified.

Signed by me this 8th day of December, 1891.

DANIEL L. HOLDEN.

Witnesses:
GEO. T. PINCKNEY,
WILLIAM G. MOTT.