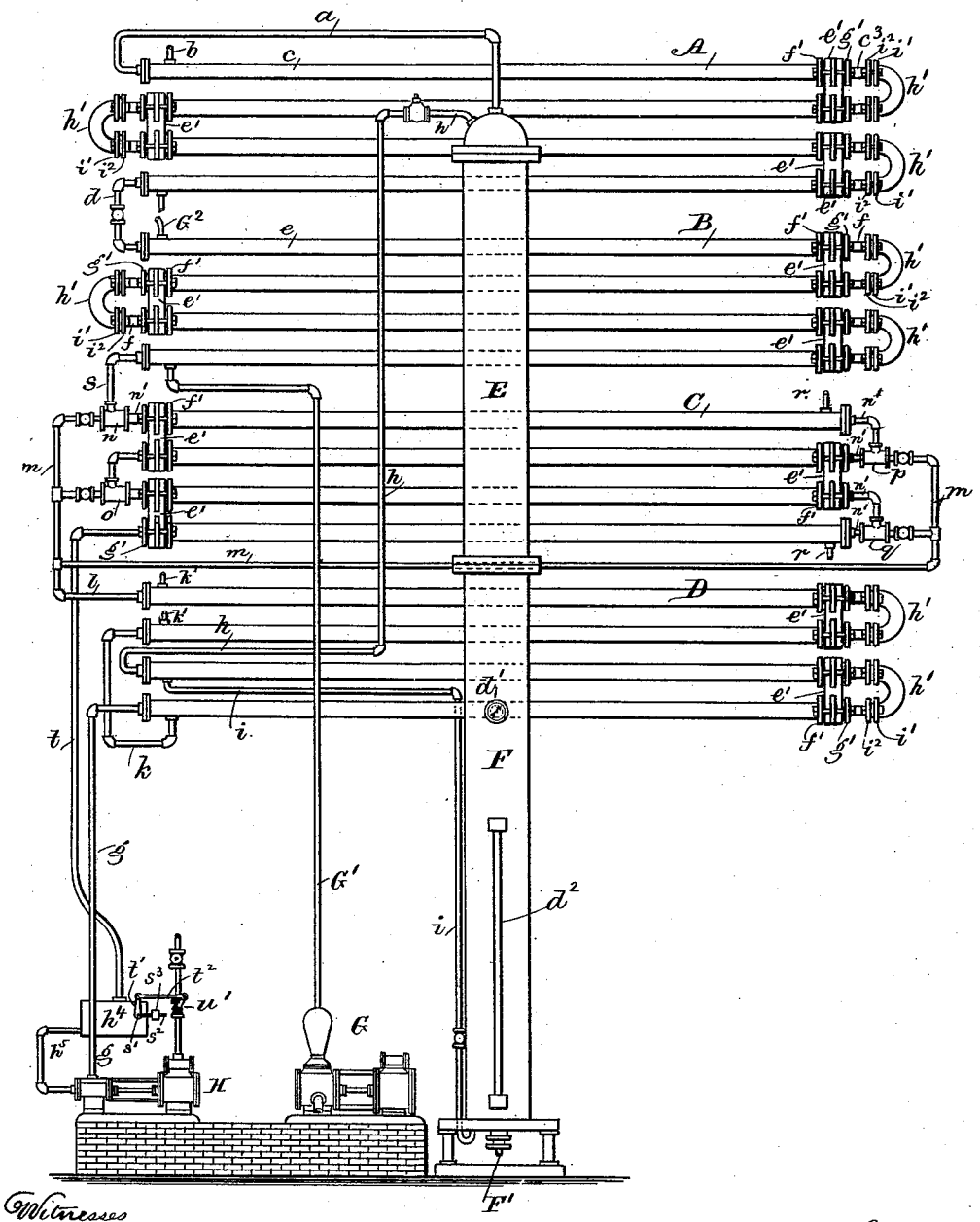
(No Model.) 2 Sheets—Sheet 1.

# D. L. HOLDEN.

## ICE AND REFRIGERATING MACHINE.

No. 444,532. Patented Jan. 13, 1891.

Fig. 1.




Witnesses

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## ICE AND REFRIGERATING MACHINE.

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Fig. 6.

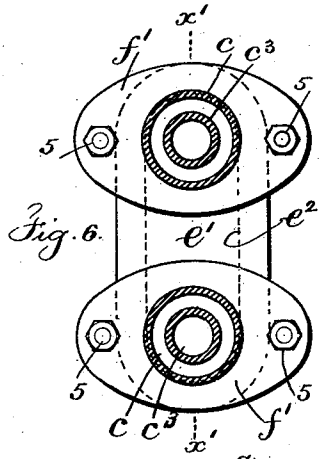



Fig. 5.

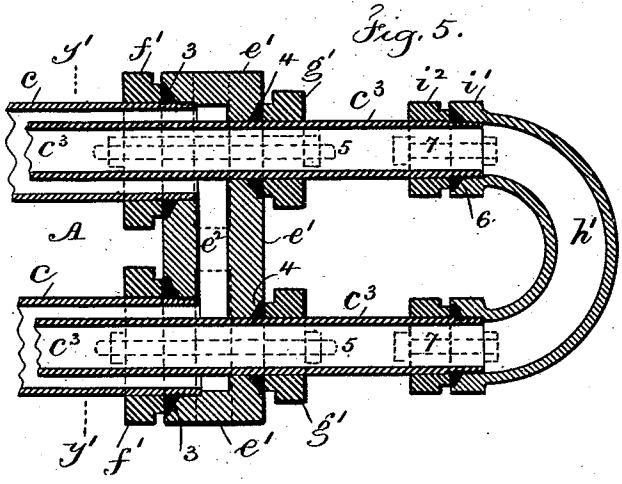



Fig. 2.

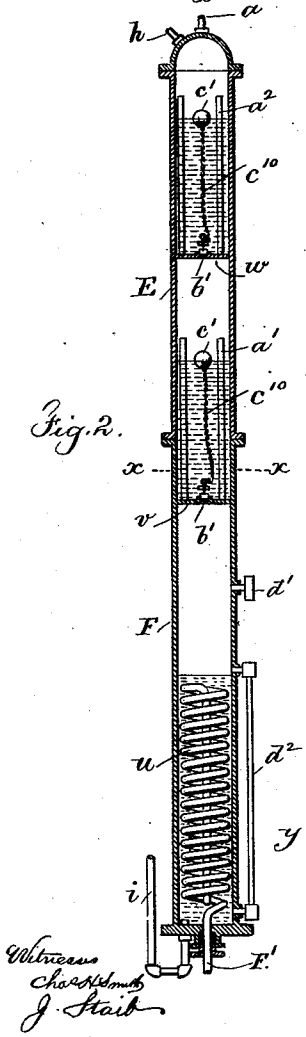



Fig. 7.

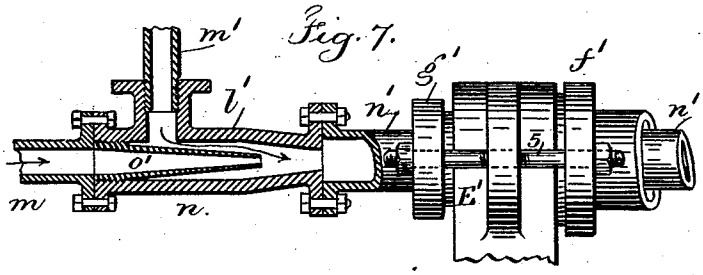



Fig. 8.

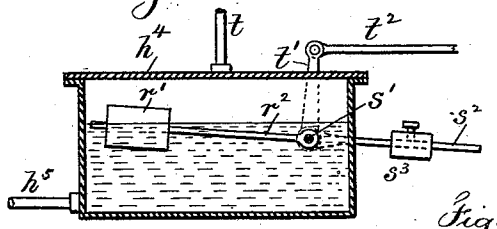



Fig. 3.

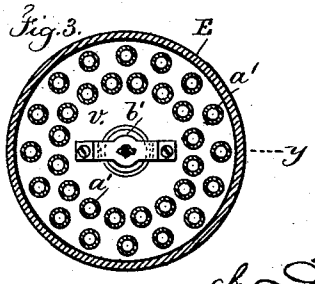
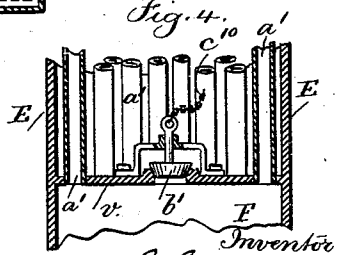



Fig. 4.




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# UNITED STATES PATENT OFFICE.

DANIEL L. HOLDEN, OF NEW YORK, ASSIGNOR TO THE NEW PROCESS ICE AND REFRIGERATING MACHINE COMPANY, OF BROOKLYN, NEW YORK.

## ICE AND REFRIGERATING MACHINE.

SPECIFICATION forming part of Letters Patent No. 444,532, dated January 13, 1891.

Application filed October 14, 1889. Serial No. 326,946. (No model.)

*To all whom it may concern:*

Be it known that I, DANIEL L. HOLDEN, a citizen of the United States, residing at the city, county, and State of New York, have invented a new and useful Improvement in Ice and Refrigerating Machines; and the following is declared to be a full, clear, and exact description thereof.

Ice and refrigerating machines of various forms employing various processes have heretofore been in successful operation.

My invention relates to the absorption class of ice and refrigerating machines—that is, where ammonia-gas is distilled or volatilized by heat and condensed under the cooling action of water and then expanded to create cold for the purpose of making ice or cooling apartments, the ammonia-gas being afterward absorbed into the spent liquid from which it was distilled or volatilized to be again redistilled and repeatedly used again. In such apparatus a non-congealable liquid—such as salt-water—is employed as a vehicle for receiving and conveying cold to the ice-making machine or to pipes in an apartment or building where the temperature of the atmosphere is to be reduced or the expanded ammonia-gas conveyed and employed directly.

My invention relates to details in the construction of such apparatus whereby I am enabled to simplify the mechanism, to render the same more absolutely gas-tight as well as more efficient in the operations required of it. These details relate to improvements in the form of generators, to the connections between the series of pipes, and to other details more particularly hereinafter described.

In the drawings, Figure 1 represents by elevation my improved apparatus. Fig. 2 is a vertical section of the generators. Fig. 3 is a cross-section at $x\ x$ of Fig. 2 in larger size, and Fig. 4 is a sectional elevation at $y\ y$ of Fig. 3. Fig. 5 is a vertical section at $x'\ x'$ of Fig. 6, and Fig. 6 is a cross-section at $y'\ y'$ of Fig. 5. These figures (5 and 6) represent the end connections of the pipes in series. Fig. 7 is a vertical section of the ejector hereinafter described, together with a partial elevation at one end of the pipes; and Fig. 8 is a vertical section of the device for controlling the ammonia-liquid pump.

A represents by a series of four pipes the condenser, B by a like series of four pipes the refrigerator, C by a like series represents the absorber, and D the cooler.

E F represent the vertically-placed generators, one above the other.

G represents the salt-water pump, and H the ammonia-pump.

The operation of the device, Fig. 1, is briefly as follows, this device generally being the same as has heretofore been employed and to which my improvements relate: Liquid ammonia is heated in the generators E F by steam that enters by the pipe F′, and the ammonia-gas generated passes away from said generator by a pipe $a$, and then passes through the central pipe of the condenser series A simultaneously with cold water, which is passed by the pipe $b$ through the larger pipes $c$ of the condenser series, and said ammonia-gas is cooled and condensed and liquefied in said condenser and passes from the same by the pipe $d$ and through the stop-cock thereof into the refrigerating series B. The non-congealable liquid—such as salt-water—is forced by the pump G through the pipe G′ into the outer pipes $e$ of the series B, and finally away by the pipe $G^2$. The condensed ammonia-gas entering by the pipe $d$ into the inner tubes $f$ of the series B is expanded, and with the expansion a refrigerating-temperature is produced, which makes cold the salt-water passing through the outer pipes around the pipes $f$, so that when said salt-water passes away by the pipe $G^2$ to a machine in which blocks of ice are to be formed or to a system of pipes for cooling a building said salt-water is at a low temperature. The expanded ammonia-gas may, if desired, be conveyed away in pipes for direct use as a refrigerating agent. Liquid ammonia is forced by the pump H through the pipe $g$ into and through the central pipes of the two lower pipes in the series D, and thence by the pipe $h$ upward and into the top of the generators E F. The spent liquid or water passes from the bottom of said generator by the pipe $i$ into the outer of the two pipes of the series D, and thence by the pipe $k$ into the center pipes of the two upper pipes of the series D, through the outer pipes of which water or other liquid is caused to pass by the pipes $k'$. The spent liquid then passes by

the pipe *l* and pipes *m* through the ejectors *n o p q* into and through the central pipes of the series C, water or other liquid being caused to flow through the outer pipes of the series C by the pipe *r* to reduce the temperature of the central pipes and their contents. The ammonia-gas, after being employed for refrigerating purposes in the refrigerator series B, passes by the pipe *s* through the ejector *n*, meeting the spent liquor, and is absorbed by it. The liquid and gas not absorbed then passes alternately through the ejectors *p*, o, and *q*, at each of which more of the spent liquid is met, so as to insure the reabsorbing of all the ammonia-gas. The liquid ammonia or reconstructed ammonia then passes by the pipe *t* into the ammonia-pump H to be forced upwardly, as heretofore described, through the pipe *g* into the generators E F, and the operations are then continuously repeated.

I will now describe the features of my invention. I construct the generators E F, by preference, in two parts and in the lower portion of F, I place a steam-coil *u*, and liquid ammonia is received into the lower part of this generator F around this coil *u*. There are cross-heads *v w* (see Fig. 2) or separately-introduced cylinders closed at one end dividing the generators into compartments, and there are vertical pipes $a'$ $a^2$ connected to, opening through, and rising above the cross-heads *v w*, and in the center of said cross-heads there are valves $b'$, connected by chains $c^{10}$ to floats $c'$. As the liquid ammonia passes into the generators by the pipe *h* the same fills the upper part of the generator above the head *w* around and between the pipes $a^2$, and after a certain height is reached the float $c'$ raises the valve $b'$ and allows liquid to descend. When the next compartment is filled, the float $c'$ raises the valve $b'$ and allows the liquid to fall around and cover the steam-coil. As the liquid is heated by the steam-coil and the ammonia-gas liberated, said gas passes upwardly through the open pipes $a'$ and $a^2$ and away by the pipe *a* into the condenser series of pipes A, heretofore described, when the heated gas is cooled, condensed, and liquefied. As the ascending heated gas passes through the pipes $a'$ $a^2$, the ammonia surrounding said pipes is heated sufficiently to give off gas also. The supply of ammonia by the pipe *h* and the discharge of spent liquid by the pipe *i* are continued, and I provide at $d'$ a pressure-gage and at $d^2$ a water-gage, so as to indicate, respectively, the pressure and the height of the ammonia-water in the lower part of the generators. During the operation of heating the ammonia around the pipes $a'$ $a^2$ the poor liquor goes to the bottom, the ammonia remains on top, and when the valve $b'$ is raised by the float $c'$ it is the poor liquor that descends to the apartment below.

The feature of improvement illustrated in Figs. 5 and 6 is adapted to connect the respective ends of the inner and outer pipes of the series A, and also of any and all the other series where there is direct connection between the ends of the pipes, and this improvement does away with the old method of connecting by short vertical pieces of pipe, wherein it is difficult to make tight joints either for gas or liquid.

In ammonia apparatus, when the iron pipes are screwed into the iron bends or into the iron connections, difficulty arises in unscrewing the same for repairs or the insertion of new pipes, because the screw-threads are rusted together. I bring lead rings into contact with the screw-threaded portions to prevent the pipes slipping endwise and make the joints tight by pressure applied to force the lead rings into conical cavities. These improvements consist of a casting or box $e'$, having a passage-way at $e^2$ vertically placed, and there are upper and lower openings made through the box at opposite sides, and the edges of the box bounding these openings are reamed out at an inclination, so that the openings are conical. The outer pipes *c* have screw-threaded ends that are received freely into the larger openings in the box $e'$, and around these pipes there are loose collars $f'$ and soft-metal packing-rings 3, internally threaded and having inclined faces, which are adapted to fit into the conical openings or recesses in the box. The inner pipes $c^2$ pass through the outer pipes *c* and through the box $e'$ and out of its smaller openings, and around said pipes are collars $g'$ and soft-metal packing-rings 4, which are adapted to fit into the conical recesses around these smaller openings. The collars $f'$ $g'$ are drawn together by the bolts 5 at their sides, and the packings 3 4 are consolidated around the pipes and compressed into the recessed or reamed-out portions of the box $e'$, the packings 3 being pressed into the screw-threads at the ends of the pipes *c*, and thus forming liquid and gas tight joints, which are easily made and kept tight, and also readily taken apart, if necessary, by simply removing the bolts 5. The ends of the pipes $c^3$ are connected by half-round elbows $h'$, having collars $i'$ and conical recesses, into the smooth open ends of which elbows the screw-threaded ends of the pipes $c^3$ are received, and there are separate collars $i^2$ around the pipes $c^3$ and lead packings 6 between them, and I draw said collars together by the bolts 7 (shown by dotted lines) to force the lead of the packings 6 into the screw-threads of the pipes $c^3$ and into the conical recesses in a similar manner to that described for the box or casting $e'$.

The ejectors *n o p q*, which form a feature of my improvement, are each made alike. One of them, *n*, is illustrated in Fig. 7, wherein the same is shown as an outer case at $l'$, connecting, respectively, to the vertical inlet-pipe $m'$ and one central pipe $n'$ of the series C. The inlet-pipe *m* is connected with a tapering nozzle $o'$, which is smaller than the internal diameter of the case $l'$, and as the liquid enters in the direction of the arrow through

$m$ and $o'$ the gas enters in the direction of the arrow through $m'$ into $l'$, where they commingle, and the gas is absorbed in whole or in part, the liquid and unabsorbed gas passing into the inner pipe $n'$, the further operations being heretofore described.

A feature of my improvement is shown in Fig. 8, which illustrates a trap or cylinder $h^4$ and float, and into this trap reconstructed ammonia-liquid passes from the series of pipes C and from this trap by the pipe $h^5$ to the pump H. Within this trap is a float $r'$, connected by an arm $r^2$ to the cross or rock shaft $s'$, and upon said cross-shaft $s'$ is a crank $t'$ and arm $t^2$ to the valve $u'$ of the steam-pipe, and upon the cross-shaft $s'$, outside of the case of the cylinder or trap, there is an arm $s^2$ and an adjustable weight $s^3$, which weight about balances the weight of the float $r'$. When the reconstructed ammonia in the trap $h^4$ rises, the steam-valve $u'$ is entirely or almost entirely opened and the pump operates, pumping the ammonia upward by the pipe $g$; but when the ammonia in the trap falls the movements of the parts are reversed, so that the steam-valve $u'$ is entirely or almost entirely closed, so that little or no ammonia is pumped upwardly through the pipe $g$. The object of this improvement is to prevent the action of the ammonia-pump when there is a scarcity of liquid ammonia and to accelerate the movement of the pump by more fully opening the steam-valve when there is an abundance of liquid ammonia, because in apparatus heretofore employed it sometimes happens that the ammonia-pump operates when there is little or no ammonia-liquid at hand to be pumped, and under these circumstances much damage is frequently done to the ammonia-pump, because the ammonia-cylinder of the pump is more or less empty, and the pump is liable to pound and increase its momentum to a dangerous degree.

My features of improvement all relate to one special form of ice and refrigerating machine, and the same coact together to form a more perfectly operative apparatus than any heretofore employed.

I claim as my invention—

1. The combination, in an ice and refrigerating machine having the series of pipes employed to carry out the various operations, of the two-part generator E F, the steam-coil $u$ in the lower part thereof, partitions or heads dividing such generator into compartments, and vertical pipes connected to, opening through, and rising above said heads, there being openings in said heads for the descent of the liquid, substantially as set forth.

2. The combination, in an ice and refrigerating machine having the series of pipes employed to carry out the various operations, of the two-part generator E F, the steam-coil $u$ in the lower part thereof, partitions or heads dividing such generator into compartments, vertical pipes connected to, opening through, and rising above said heads, there being openings in the heads $v$ $w$ and valves, chains, and floats, a pipe $i$ for the spent liquid, and inlet-pipes $h$ and $a$, substantially as set forth.

3. The combination, in an ice and refrigerating machine having the series of pipes employed to carry out the various operations, of boxes or castings $e'$, having each a vertically-placed passage-way $e^2$ and smooth upper and lower openings at opposite sides thereof, the outer pipes $c$, having screw-threaded ends adapted to be loosely inserted into the larger openings in the boxes $e'$ without being screwed, the internal pipes $c^3$, passing freely through the said boxes $e'$ and smaller openings, the loose collars $f'$ $g'$ upon the pipes $c$ and $c^3$, the packing-rings 3, internally threaded and screwed upon the ends of the pipes $c$, the packing-rings 4 upon the pipes $c^3$, and the bolts 5, by which the collars are drawn together and held, whereby when the bolts 5 are removed the parts will freely separate, substantially as set forth.

4. The combination, in an ice and refrigerating machine having the series of pipes employed to carry out the various operations, of boxes or castings $e'$, having each a vertically-placed passage-way $e^2$ and smooth upper and lower openings at opposite sides thereof, the outer pipes $c$, having screw-threaded ends adapted to be loosely inserted into the larger openings in the boxes $e'$ without being screwed, the internal pipes $c^3$, passing freely through the said boxes $e'$ and smaller openings, the loose collars $f'$ $g'$ upon the pipes $c$ and $c^3$, the soft-metal packing-rings 3, internally threaded and screwed upon the ends of the pipes $c$, the packing-rings 4 upon the pipes $c^3$, the bolts 5, by which the collars are drawn together, the half-round elbows $h'$ and their collars $i'$, into which the screw-threaded ends of the pipes $c^3$ are loosely inserted, the loose collars $i^2$ around the pipes $c^3$, the packings 6, internally threaded and screwed upon the ends of the pipes $c^3$, and the bolts 7, the parts being constructed in the manner and for the purposes substantially as set forth.

5. The combination, with the box or bend connecting the ends of pairs of pipes and having a vertically-placed passage-way and smooth upper and lower openings having conical recesses, of pipes whose ends are received loosely into said openings, collars upon the pipes, conical packing-rings of soft metal internally threaded to screw upon the ends of said pipes and fitting into the conical recesses, and bolts for drawing up the collars and pressing the packing-rings against the screw-threads of the pipes and into the recesses to form tight joints, substantially as specified.

Signed by me this 3d day of October, 1889.

D. L. HOLDEN.

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