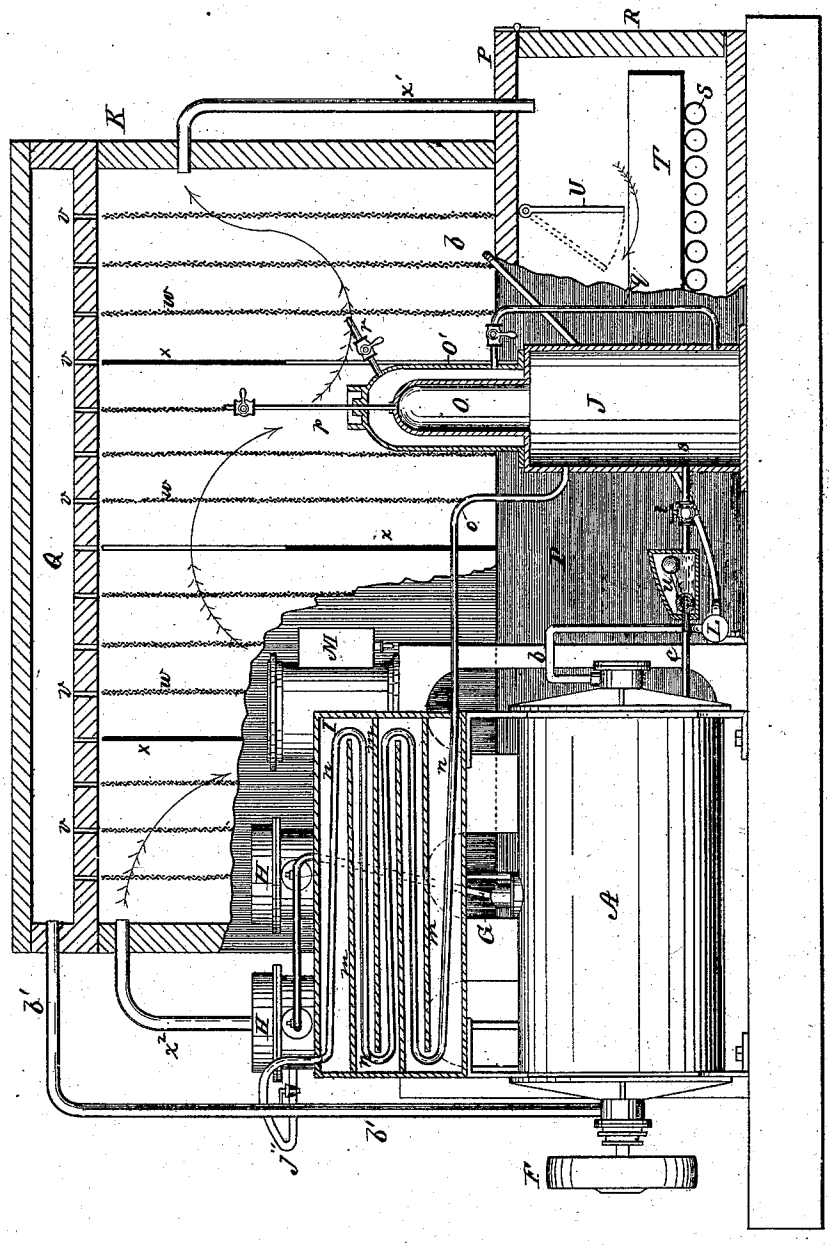
4 Sheets—Sheet I.

D. L. HOLDEN.

ICE-MACHINE.

No. 190,036. Patented April 24, 1877.

Fig. 1.



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4 Sheets—Sheet 2.

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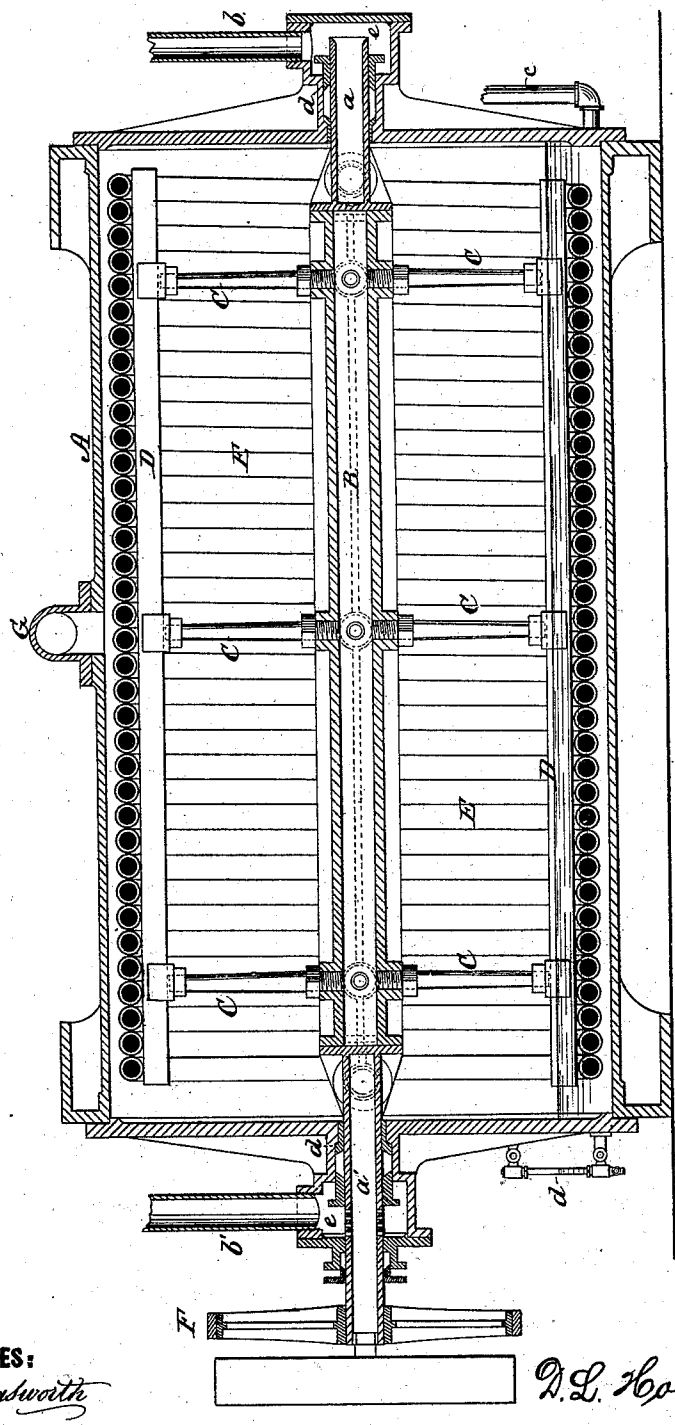

Fig. 2.

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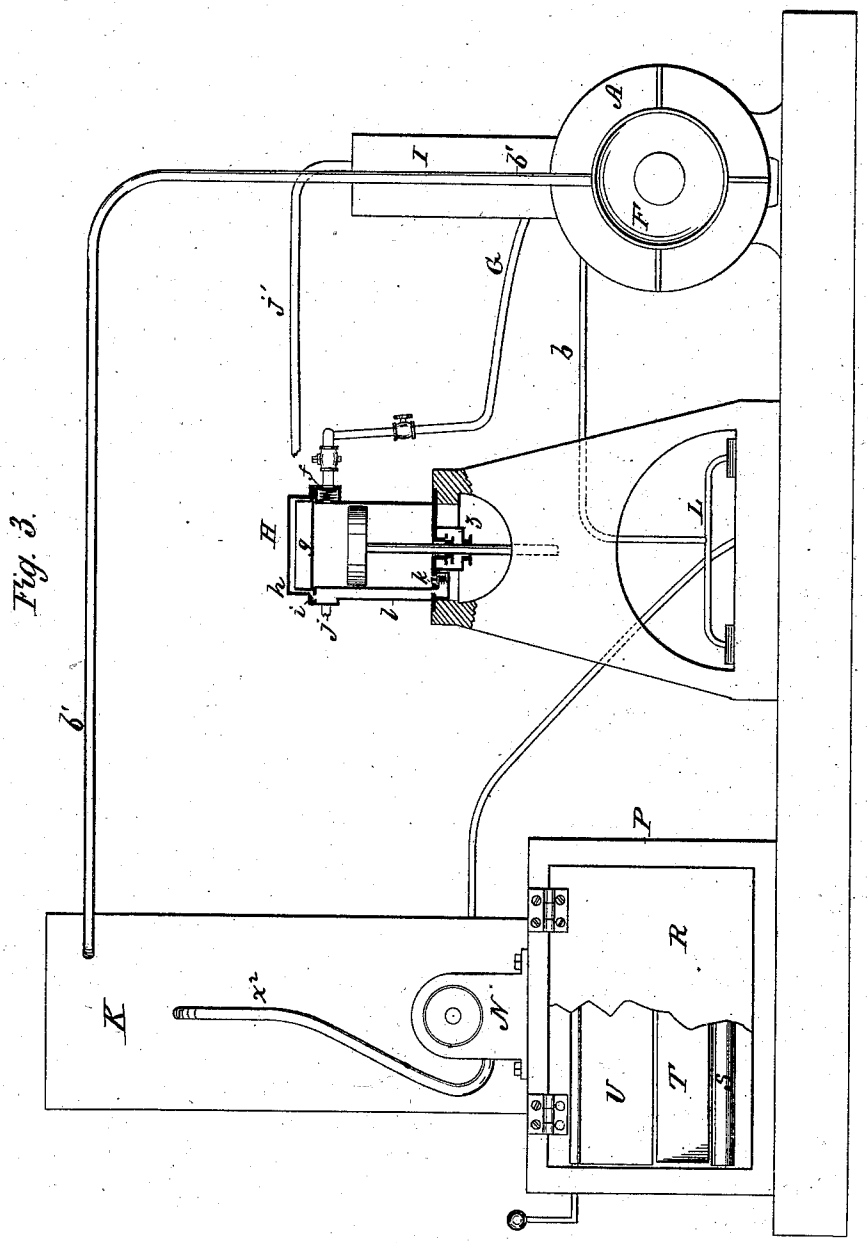
Fig. 3.



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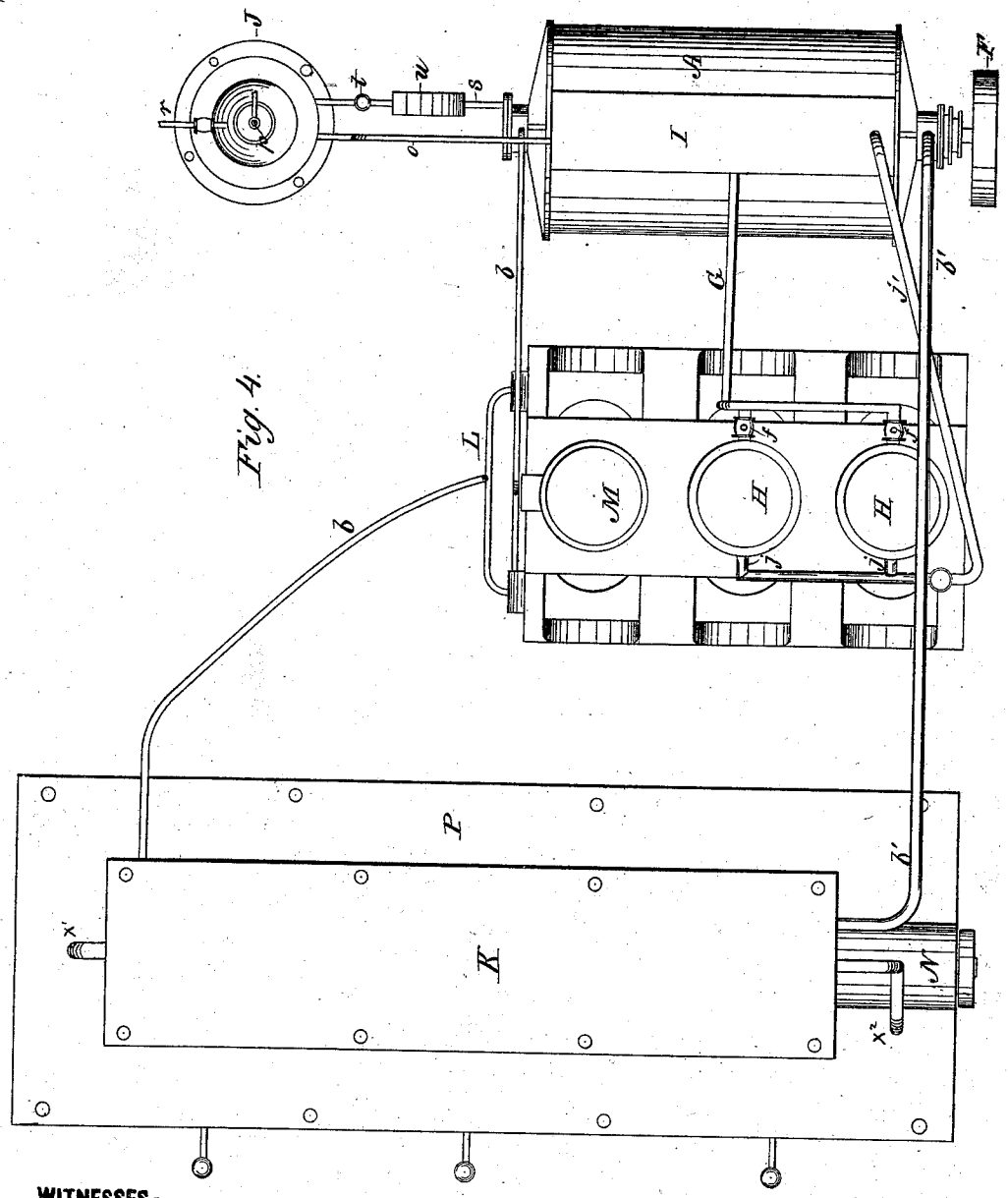

Fig. 4.

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UNITED STATES PATENT OFFICE.

DANIEL L. HOLDEN, OF COVINGTON, KENTUCKY.

IMPROVEMENT IN ICE-MACHINES.

Specification forming part of Letters Patent No. **190,036**, dated April 24, 1877; application filed January 31, 1877.

To all whom it may concern:

Be it known that I, DANIEL L. HOLDEN, of Covington, in the county of Kenton and State of Kentucky, have invented a new and Improved Apparatus for Refrigerating and Making Ice; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, forming part of this specification, in which—

Figure 1 is a side elevation partly in section. Fig. 2 is a vertical central longitudinal section of the refrigerator. Fig. 3 is a vertical end view with the pump in section, and the door of the congealing-case broken away. Fig. 4 is a plan view.

My invention relates to a novel form of ice-machine constructed upon the general principle of the employment of a non-congealable liquid as a vehicle for conveying the cold produced in a refrigerator to a case where the temperature of the cooled liquid is transmitted to atmospheric air, and the latter from thence directed into a congealing-case, where it produces the freezing effect upon the water contained in the pan. The invention consists in the construction of the refrigerator for facilitating evaporation to effect the cooling of the non-congealable liquid, the construction and arrangement of the case for imparting the temperature of the non-congealable liquid to the air circulating in the congealing-case; the construction and arrangement of the congealing-case and its adjuncts; a receiver and purger for containing the condensed volatile gas, and removing the air from the gas-circulating apparatus, and the combination, with the refrigerator and the receiver, of an automatic valve for feeding the condensed volatile liquid back to the refrigerator. In connection with which apparatus, also, I employ a pump of my own invention, which is especially adapted to the requirement of ice-making, but which, being capable of general use, I claim in a separate application.

In the drawing, Fig. 1, A represents the refrigerator, which is made of any suitable material in the form of a cylinder, the same being arranged horizontally and covered with felt or other non-conducting material. In said cylinder is journaled a longitudinal shaft, B, Fig. 2, which is provided with radial arms C that carry upon their outer ends longitudinally-arranged ribs D. Around these ribs, and near the inner periphery of the cylinder, is wound a continuous coiled pipe, E, in which circulates strongly-saturated brine, or the non-congealable liquid. This coil of pipe extends the entire length of the cylinder, and at each end communicates with the hollow ends *a a'* of the shaft B, and through said hollow ends with the supply-pipe *b* and the exhaust-pipe *b'*, so that a continuous circulation of the non-congealable liquid may be kept up in said coil. Inside the cylinder the volatile liquid is contained, which may be either ether, gasoline, ammonia, bisulphide of carbon, or other easily-evaporated liquid. This liquid is introduced through a pipe, *c*, and is maintained at such a level as to immerse the bottom portion of the coil of pipes, which level may be regulated by means of a glass gage, *d*, upon the outside. Now, as the coil of pipes is revolved by a band connecting the engine with the pulley F, the said coil passes into the upper portion of the cylinder with its surface moistened by the volatile liquid which it carries up from adhesive attraction, and as the cylinder is exhausted of its gaseous contents through pipe G by means of a pump, the evaporation of the liquid upon the surface of the coil rapidly takes place to supply the partial vacuum, and a corresponding reduction of the temperature of the pipes and its contained vehicle of non-congealable liquid takes place. It is especially desirable, in fact necessary, to the successful operation of this class of machines, that no air should leak into the cylinder or any portion of the gas-circulating apparatus, as its elasticity prevents the best action of the pumps in effecting the evaporation, and to guard against such leakage, the ends of the shaft B are provided with stuffing-boxes *d*, while the outer parts of the bearings are enlarged at *e* to form water-boxes which are filled with the non-congealable liquid, and, together with the stuffing-boxes, effectually seal said bearings against all leakage of air to the interior.

As the gas is exhausted from the cylinder,

it passes to the pumps H H, from thence to a condenser, I, through pipe *j'*, and from thence in a liquid form to a receiver and purger, J, while the cooled non-congealable liquid passes into the case K through the pipe *b'*, and from thence back to the coil in cylinder A through pipe *b*, the circulation of the liquid being effected by a force-pump, L, operated by the engine M, which latter is arranged to drive a subjacent shaft and operate also the pumps H, the refrigerator-coil, and a rotary blower, N, for the circulation of air in the congealing-case.

The pumps referred to are designed to meet special requirements of the ice-machine, and form an important part of its organization. These pumps are single-acting and two in number, and are made air-tight by water-boxes *z*. They communicate with pipe G from the cylinder A through inwardly-opening check-valves *f f*, located in the branches of said pipe, and are provided also with a gravity cup-shaped valve, *g*, which is of a greater diameter than the piston-cylinder, and plays between the cylinder-head *h* and the flange of the body of the cylinder, upon which latter it is seated, being guided in its movement by ribs in the enlarged cavity of the cylinder-head. Now, upon the descent of the piston the gas is drawn through pipe G, check-valves *f* opened, and the pump-cylinder filled; but when the piston rises check-valves *f* are closed, and the compressed gases above the piston lift the valve *g*, and allow the gas to pass out orifice *i* into the pipe *j*, and from thence to the condenser through *j'*. As, however, the gases contained in the portion of the pipe between the pump-cylinder and the check-valve are compressed, but not forced out, if the piston should descend with this pressure of gas retained here, it is obvious that the gas would expand, and, by partially filling the chamber, prevent the perfect and positive exhaustion from the gas-cylinder A. To provide for this objection I have arranged the piston to pass in its upward stroke the orifices of branch pipes from G, so that the compressed charge of gas held in the confined space is liberated beneath the piston, and upon the descent of the latter is driven out through a check-valve, *k*, at the bottom into a pipe, *l*, that communcates with the pipe *j*. It will be seen also that the plain face of the piston in rising strikes against the plain bottom of the cup-valve and lifts it, and upon the reverse stroke the cup-valve seats itself upon the flange of the cylinder, while the plain ground face of the piston departs from the plain ground bottom of the valve to produce as nearly a perfect vacuum as is possible to attain in a pump, there being practically no cushion of gas left between the said valve and piston. This form of pump, which I do not claim in this application, I have found to be a valuable and important adjunct to an ice-machine, as it permits the most perfect and positive exhaustion, upon which the success of the machine depends, and is liable to but little leakage or derangement.

As the gas is delivered to the condenser I from pipe *j'* it is there made to traverse the coil *n*, arranged between alternating shelves or baffle-plates *m*, and is cooled by the circulation of water of the normal temperature, which passes through the case I. As the gas becomes cooled and liquefied it passes through pipe *o'* to a combined receiver and purger, J. The lower part of this device constitutes a receiver for the volatile liquid, and holds the same until it is to be fed back to the cylinder A for a repetition of the former action, while the upper portion constitutes the purger. As before stated, the presence of air, in the gas-circulating apparatus is highly objectionable; but as, in spite of precautions, it is sometimes liable to occur, I have constructed a device which I denominate a "purger," for removing the air from its admixture with the gas.

The said purger consists of two vases or domes, O O', located one within the other, and immediately above the receiver. The inner dome O opens at the bottom directly into the upper portion of the receiver, and is provided with a blow-off pipe, *p*, provided with a cock, while the outer dome O' forms a closed annular chamber about the inner dome; but has a communication with the receiver through a separate pipe, *q*, provided with a stop-cock. The said dome O' is also provided with a separate pipe, *r*, having stop-cock, which is designed to communicate with the pumps. Now, when air is to be expelled from the receiver a portion of the volatile liquid in the receiver is allowed (through the pressure in the latter) to pass through pipe *q* to the annular space between the two domes, and the pumps made to exhaust from said annular space through pipe *r*. This has the effect to evaporate the volatile liquid in said annular chamber, and to produce upon the dome O, and its contained air and gas, a reduction of temperature, which reduction has the effect to throw down or separate the gas in the receiver from the air, which latter may be then allowed to escape through the blow-off pipe *p*. This air is driven off by the pressure maintained in the receiver, and its complete removal may be ascertained by the odor of the gas from the volatile liquid, which will, in turn, commence to volatilize and pass off.

As the volatile liquid accumulates in the receiver it is fed from time to time back into the refrigerator-cylinder A through a pipe, *s*, provided with valve *t*, and as such feeding is required to be uniform I have arranged in said pipe a float-valve, *u*, which is automatic in its action, the float of said valve being regulated by the level of the liquid in the receiver J, either to open or close communication in the pipe *s*, while the valve *t* is employed to cut off the supply when necessary.

As the non-congealable liquid in the coil of the refrigerator circulates, it passes out pipe b' to the case K, where its temperature is to be transferred to the air circulating in the subjacent congealing-case P. Both these cases K and P are to be made with double walls, with sawdust packed between, and may have also external layers of felt. The upper case is provided at the top with a distributing-pan, Q, into which the cooled liquid is admitted from pipe b'. Said pan is provided with bottom perforations v, which are arranged in rows immediately above a series of vertical partitions of gauze-wire or fibrous netting, w, between which, at suitable distance apart, are arranged vertical baffle-plates x.

Now, as the cooled liquid drops through the rows of perforations in the distributing-pan, it falls edgewise upon the gauze-wire partitions, and, being retarded thereby in its descent, trickles slowly down, while the current of air driven through said case by the blower N is made to pass through and penetrate all parts of the case by reason of the baffle-plates, and in so doing takes on the temperature of the non-congealable liquid, which is below the freezing-point of water, and passes into the congealing-case at one end through pipe x^1, then traverses the pans in the congealing-case to freeze the water contained therein, and after having done its duty passes up through the blower and pipe x^2 to be reduced in temperature again.

The congealing-case has doors R at each end, and is provided with supporting-rollers S, upon which the pans T are fed at one end and removed at the other. In said case are arranged deflecting blades U for the cold current, which divert the cold blast directly upon the surface of the water in the pans. To make the ice clear, these pans are partially filled when first inserted, and are afterward filled from time to time from pipes leading into the case, and to provide for the passage of the air as the level of the water rises the de-deflector-blades are provided upon the outside of the case with counter-balances, which permit the current of cold air to automatically deflect the blades when the pans are nearly full, in order to give free passage to the cold blast.

As shown, the congealing-case is arranged for but a single row of pans; but, in practice, the case may be sufficiently enlarged to have a series of ways for the pans arranged in stories or otherwise.

Having thus described my invention, I would have it understood that I do not limit myself to the particular details of construction shown, as they may be varied without departing from my invention. Thus, for instance, in the combination constituting the refrigerator, I do not limit myself to a single coil in the refrigerator, but may employ a series of coils, a series of hollow disks or compartments, an annular chamber, an Archimedes screw, or any other equivalent for the coil, which is capable of containing the non-congealable liquid without opening into the gas-cylinder, and also capable of presenting a constantly-changing surface moistened with the volatile liquid to facilitate evaporation.

The apparatus as thus described I may employ generally for purposes of refrigeration as well as for ice-making.

With respect to the employment of the automatic float-valve, I do not claim the same broadly, but only in combination with the refrigerator and receiver, with which it co-operates.

I am also aware that it is not new in vinegar-making, carbureting, and other similar operation to use a distributing trough or tray for a liquid with subjacent septums or partitions for producing a large superficial area of contact between the liquid and the gas, and I therefore limit myself to the particular construction of case K, as modified to my particular purpose of refrigeration.

Having thus described my invention, what I claim as new is—

1. The refrigerator, consisting of an outer case, a rotary shaft, having hollow ends communicating with a supply and exhaust pipe, and a set of pipes, chambers, or passage-ways for the fluid to be refrigerated communicating with the hollow ends of the rotary shaft, and arranged to revolve with the latter, substantially as and for the purpose described.

2. The combination, with the case A for a volatile liquid and gas, and the rotary shaft journaled in the same, of the stuffing-boxes d, and the water-sealing boxes e, as and for the purpose described.

3. The purger, consisting of the dome O, having a direct communication with the receiver, and a blow-off pipe and cock, and the outer dome O′, forming a closed annular chamber about O, and having a communication, q, with the receiver, and a connection, r, for an exhausting apparatus, substantially as and for the purpose described.

4. The combination, with the refrigerator-case A, and the receiver J, of a communicating-pipe, s, provided with an automatic float-valve, t, as and for the purpose described.

5. The air-refrigerating case K, consisting of the distributing-pan Q for the non-congealable liquid, having its bottom perforated in rows, and combined with subjacent vertical partitions of gauze-wire or fibrous netting, arranged edgewise beneath the rows of perforations, and separated by baffle-plates, as and for the purpose described.

6. The congealing-case P, having doors at both ends, and supporting rollers or ways for the pans, in combination with the counter-balanced deflector-blades U, substantially as and for the purpose described.

7. The combination of the refrigerator A,

pumps H, condenser I, and receiver and purger J, substantially in the manner and for the purpose set forth.

8. The combination, with refrigerator A, pumps H, condenser I, and receiver and purger J, of the air-refrigerating case K, the circulating-pump L, the congealing-case P, and the blower N, as and for the purposes specified.

The above specification of my invention signed by me this 24th day of January, 1877.

D. L. HOLDEN.

Witnesses:
EDWD. W. BYRN,
CHAS A. PETTIT.