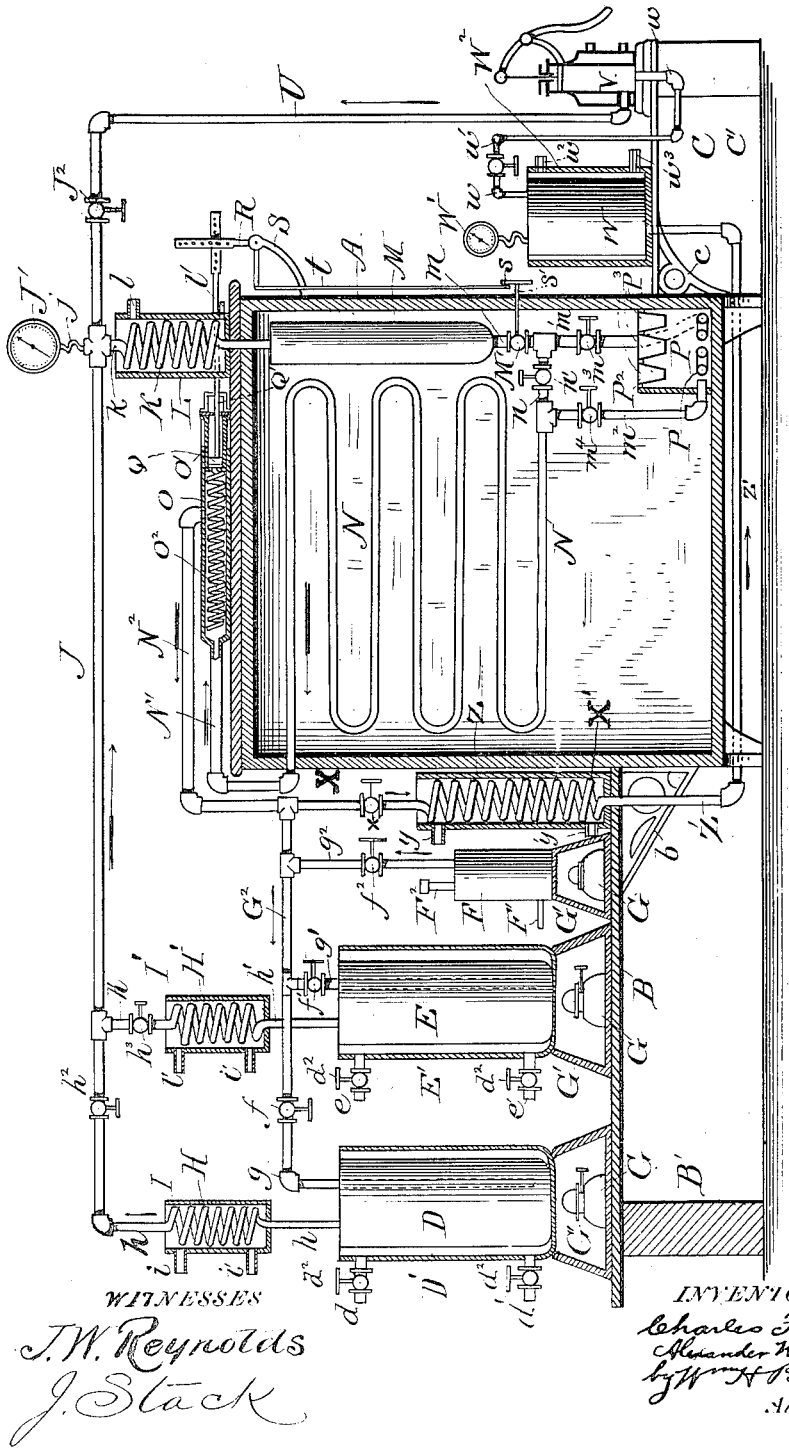
(No Model.)

C. F. MILLER & A. W. CARLILE.

REFRIGERATOR.

No. 453,651. Patented June 9, 1891.



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REFRIGERATOR.

SPECIFICATION forming part of Letters Patent No. 453,651, dated June 9, 1891.

Application filed November 29, 1890. Serial No. 373,031. (No model.)

To all whom it may concern:

Be it known that we, CHARLES FREDERICK MILLER and ALEXANDER WHITESIDE CARLILE, citizens of the United States, residing at Lancaster, in the county of Lancaster and State of Pennsylvania, have invented certain new and useful Improvements in Refrigerators; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The object of this invention is to increase the efficiency of refrigerating devices operating by the alternate vaporization and liquefaction of volatile liquids, the same being conducted while in the gaseous form in a closed pipe through a refrigerating-chest for the purpose of cooling the contents of the latter. To this end we adapt the said devices, whether within or without the chest, to be used either in the compressing or the absorbing system of refrigeration, and combine them with compressing and absorbing devices and the necessary tubular connections and cut-off valves, as hereinafter stated.

The said invention also consists in certain mechanism whereby an insufficient supply of refrigerating-vapor is made to automatically cure itself by the action of the overheated vapor on devices expansible by heat, this device being connected to an outlet-valve of a receptacle of volatile liquids, and in the construction and combination of parts hereinafter particularly set forth and claimed.

In the accompanying drawing, the figure represents a side elevation, partly in section, of the refrigerating apparatus embodying our invention.

A designates the refrigerating-chest; B, a horizontal platform extending out from one side it, and C a smaller horizontal platform extending out from the other side, each platform resting on a bracket *b* or *c*, attached to said chest and on a leg or supporting-block B′ C′ under the outer end of said platform.

On the platform B three generating-cylinders D E F are supported, each being heated by a lamp G or other calorific device in a chamber G′ under said cylinder or generator. Generators D and E are surrounded by water-jackets D′ E′, provided with inlet-pipes *d e* and outlet-pipes *d′ e′* for allowing the supply of water to said jackets and its escape therefrom. Each of these pipes is provided with a cut-off valve d^2 for controlling or stopping such flow. A horizontal pipe G^2 receives branch pipes *g g′* g^2 from said generators, the pipes *g g′* extending down within the generators D E, respectively, and nearly to the bottoms thereof. The pipe g^2 extends down to and within the generator F.

A cut-off valve *f* is arranged in pipe G^2 between pipes *g* and *g′*, a similar valve *f′* being in pipe *g′* and another f^2 in pipe g^2. Each of these valves thus serves to cut off one of these generators from communicating with the others. The cylinder F is used only as a re-enforcing generator to supply gaseous ammonia to either one or both of the other generators when the ammoniacal solution therein becomes weak. When the valve f^2 is closed, both of the generators D and E are cut off from cylinder or generator F. When this valve is open and either one of the other valves *f* or *f′* is open also, the generator to which the valve *f* or *f′* belongs will be supplied by re-enforcing generator F. When all the valves *f f′* f^2 are open, both of the generators D and E are thus supplied.

From generator D a pipe *h* extends upward, forming a coil H within a steam-condensing cylinder I; and from generator E a similar pipe *h′* extends upward, forming likewise a coil H′ within a steam-condensing cylinder I′. The pipes *h h′* join after passing through said condensing-cylinders, the former being bent into a horizontal position for convenience and provided with a cut-off valve h^2 before reaching the point of junction. The pipe *h′* is also provided with a similar valve h^3 above the cylinder I′. Each steam-condensing cylinder I or I′ is provided with a water-inlet *i* and a water-outlet *i′*. The current of cold water passing through each cylinder from the inlet to the outlet condenses the steam in the gas ascending from the generator through the coil, and this steam in the form of water runs back into the generator, leaving the ammoniacal gas in said coil comparatively free.

From the junction of the pipes *h h′* a long horizontal pipe J extends to and beyond a

point where a pipe *j* is attached thereto, leading to a pressure-gage J′. A valve J² in said pipe J beyond this point cuts off at will all further passage of the gas in that direction and directs it into a pipe *k*, opposite to pressure-gage pipe *j*. This pipe *k* is formed into a coil K within a condensing-cylinder L, which is provided with an inlet *l* and an outlet *l′* and operates like those condensing-cylinders before described. Its office is to convert into liquid the vapor passing through said coil, and the degree of cold in the condenser is adapted thereto. From this coil and condenser the pipe *k* extends down to a storage-tank M for the liquefied gas located within said refrigerating-chest. From the lower end of this tank the ammoniacal liquid descends through a pipe *m* to a cooling-pipe *n*, which is formed into a large cooling-coil N within said refrigerator-chest. From this coil the liquid passes through a pipe N′ to a cylinder O, for a purpose hereinafter explained, and thence through a pipe N² to the pipe G², leading to the generators. During the passage of the liquid through the coil N it expands into gas again, abstracting heat in so doing from the interior of the refrigerating-chest and whatever the latter may contain. The gas thus produced is received by one of the generators D or E, the other generator of this pair being cut off by the valve *f* or *f′*, before described. These generators are used alternately—that is to say, one is used for generating during a considerable period and then the other, the receiving one being cooled by the cold water applied to its jacket or surrounding water-space, as before described, while the other is heated by its lamp to generate gas.

Instead of allowing the refrigerant to pass directly from pipe *m* to pipe *n* and coil N, as before described, we may use it in the transit to cool or freeze liquid. Thus the pipe *m* is provided with a downward extension *m′*, which enters a small brine-tank P and forms a coil P′ on the bottom thereof, thence passing out and connecting with an upward-extending pipe *m*², which leads to pipe *n* aforesaid. Pipe *n* is provided with a valve *n′* between pipes *m* and *m*² for cutting off at will the passage from the former directly to the latter, and thus bringing said brine-chest into the circuit. Pipes *m′* and *m*² are provided with valves *m*³ and *m*⁴ for controlling the current through said brine-chest. Ice-cans P² are set into the top of the latter and supplied with water to be frozen. Bottles of wine may be set into the brine within said chest, the top, to which said cans are attached, being removable.

A valve M′ in pipe *m* serves to regulate the flow of liquid from the tank M to the coil N, whether the said brine-chest be in circuit or not. It is very desirable to make the action of this valve automatic, so that the weakening and consequent overheating of the refrigerant may compensate for itself by partly or wholly opening the said valve beyond the position previously occupied thereby. To this end, we provide an alcohol-tube O² in the form of a worm or spiral, within cylinder O aforesaid, where the ammoniacal gas after leaving coil N has access to it. One end of said alcohol-tube is closed; but the other end opens into a cylinder O′, where it acts on a piston Q, the rod Q′ of which is adjustably attached to an angle-lever R, pivoted to a bracket S on the outside of the machine. A connecting-rod *t* extends from the other end of this angle-lever to a disk *s* on the rotary valve rod or stem *s′* of the said valve M′. The overheating of the gas and consequent expansion of the alcohol in the said tube will through these connections open the said valve and allow a larger supply of fluid to pass down from the tank.

From the pipe J beyond the valve J² a long pipe U extends down to a pump V, mounted on platform C. This pump is supplied through pipe *w*, having valve *w′* from an external storage-tank W, provided with pressure-gage W′ and water-jacket W², the latter having inlet *w*² and outlet *w*³. The gas passes to this storage-tank from the coil N through the pipe N′, cylinder O, and pipe N² aforesaid, and a pipe X, leading from the latter, a coil X′ in a condenser Z, and a pipe Z′, leading from said coil to said tank W. The pipe X is provided with a valve *x*, and the condenser Z is provided with a water-inlet *y* and a water-outlet *y′*. When this pump and external tank are used, neither of the generators is employed as a means of supplying the inner storage-tank M or as a receptacle for the gas given off by the coil N. This gas is cooled in the condenser Z, and again in the external tank W, but does not become liquefied until it reaches the inner storage-tank M. This liquefaction is chiefly due to the pressure caused by the continuing action of said pump. The valve M then is opened slightly or opens automatically by the means hereinbefore described, and the refrigerating action proceeds within the chest A. This pump circuit or system is used when both the generators are undergoing repairs or cleansing or when for any reason it is deemed best not to use them for a time. Thus our tank and coil are adapted to be used with either the compression system or the absorption system of refrigeration, the pump being the compressing agent in the one case, and the generator in use being a receptacle for liquid material adapted to absorb the vapors given off by the coil.

Either generator alone or the pump alone, with, of course, in each instance the necessary connections, will suffice as a means of charging the storage-tank M, which is always the means of supplying the cooling-coil N, these two latter devices with the automatic controlling mechanism being the only ones necessarily actively employed during long intervals.

Each generator D or E, when used for

charging, is heated by the lamp as aforesaid, and when used for absorption is cooled by a current of cold water through its jacket, the heated water being of course first withdrawn.

The chief use of the third generator F is to compensate for weakness of the gas due to leakage. When its own charge becomes weak after one or more heatings, or when for any reason withdrawal of it becomes necessary, the contents of said cylinder or generator may be entirely withdrawn through an outlet-cock F′ near the bottom thereof, a fresh supply of ammonia being introduced at the top of said generator through supply-tube F^2.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is—

1. In combination with the pipes and other passages of a refrigerating-circuit, a valve arranged in one part thereof, a device expansible by heat arranged in another part thereof, and connections between said device and said valve, in order that the expansion of the former caused by the insufficient supply and consequent overheating of the gas or vapor may open the latter to increase the flow of volatile liquid beyond said valve, and thus compensate for overheating, substantially as set forth.

2. A storage-tank for volatile liquid, in combination with a valve controlling the outflow of said liquid therefrom, a tubular coil supplied thereby, an alcohol-tube closed at one end, open at the other end, and arranged in the passage or tubular communication between said coil and said tank and before the latter in the circuit, a piston arranged to be acted on by the expansion of the alcohol through the open end of the tube, and a connecting-rod and lever making connection between the piston-rod and the valve-rod, substantially as and for the purpose set forth.

3. A storage-tank for liquefied volatile refrigerant, in combination with a coil supplied thereby, a condensing-pump, a receptacle adapted to contain absorbent material, a tube extending from the outlet of said coil, tubular connections from this tube to the said pump and receptacle, respectively, an inlet-tube for said tank, tubular connections to the said inlet from said pump and said receptacle, and valves for cutting out of circuit at will either the receptacle or the pump, substantially as set forth.

4. In combination with a refrigerator-chest, a brine-chest formed in a corner thereof and adapted to receive and support water-cans in its cover, a coil in said brine-chest, a storage-tank for vaporizable liquid, a tube connecting said tank with said coil, the main cooling-coil for said chest, tubular connections from one of these coils to the other and from the tank directly to the main coil, valves allowing the coil in the brine-chamber to be cut off or admitted into the circuit at will, and tubular connections from the main coil to the receiving end of the said tank, substantially as set forth.

5. A tank for volatile liquid, in combination with a condenser through which it is supplied, a compressing device, and an absorbing and generating device, each having tubular connection with the inlet end of said condenser and tubular connections between the outlet of said tank and the aforesaid compressing and absorbing and generating devices, the said devices being used alternatively, substantially as set forth.

6. A tank for volatile liquid, in combination with a compressing-pump and a generator, each connected by tubular devices in circuit therewith, and a common condenser for said pump and said generator, which receives the gas discharged from them on its way to the said tank, the said pump and generator being used alternatively, substantially as set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

CHARLES FREDERICK MILLER.
ALEXANDER WHITESIDE CARLILE.

Witnesses:
JACOB HALBACH,
WILLIAM PRICE.