No. 607,849. Patented July 26, 1898.

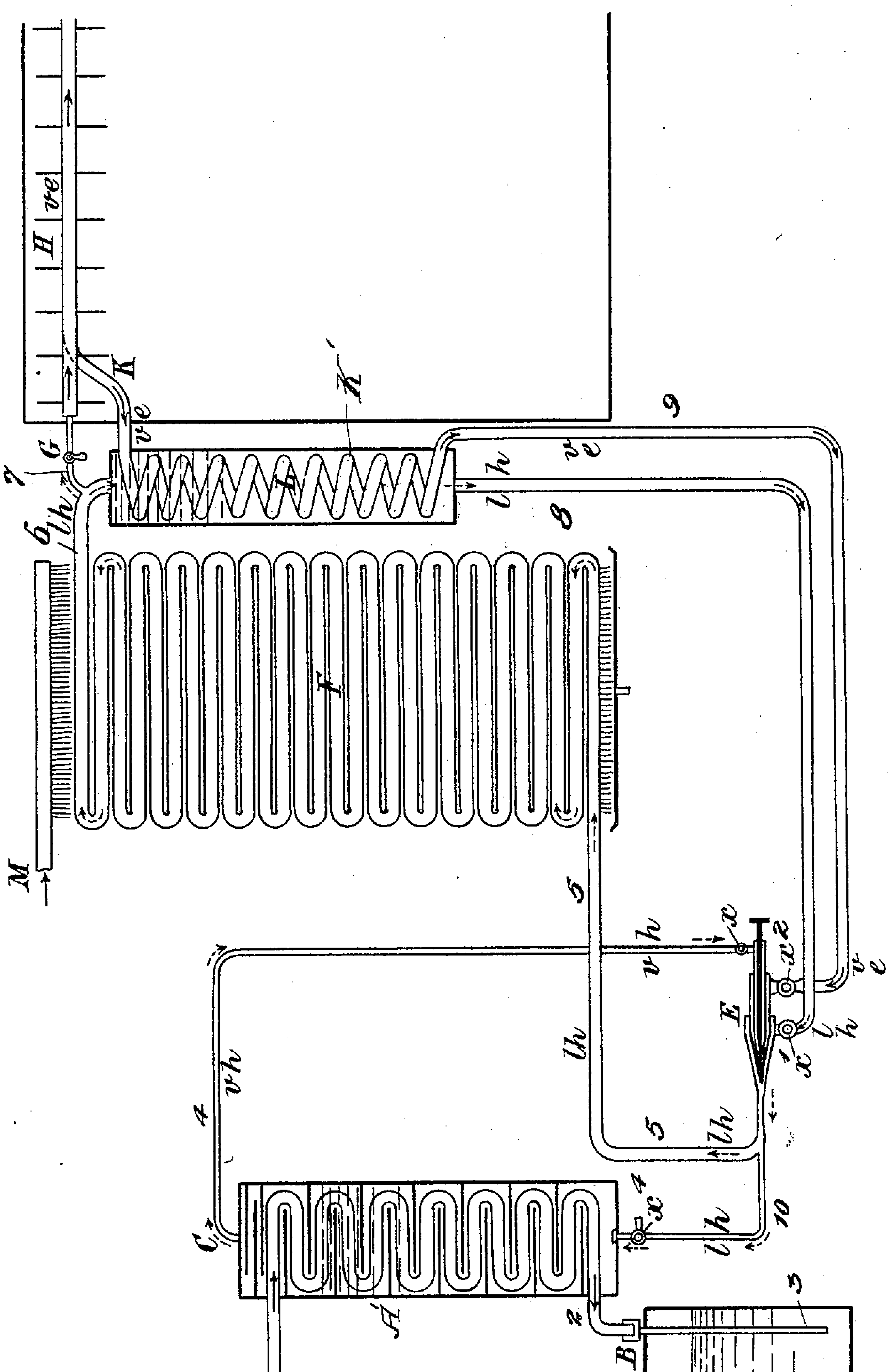
W. HAMPSON.

REFRIGERATING APPARATUS.

(Application filed Oct. 10, 1896.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



Witnesses

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E. A. Balloch.

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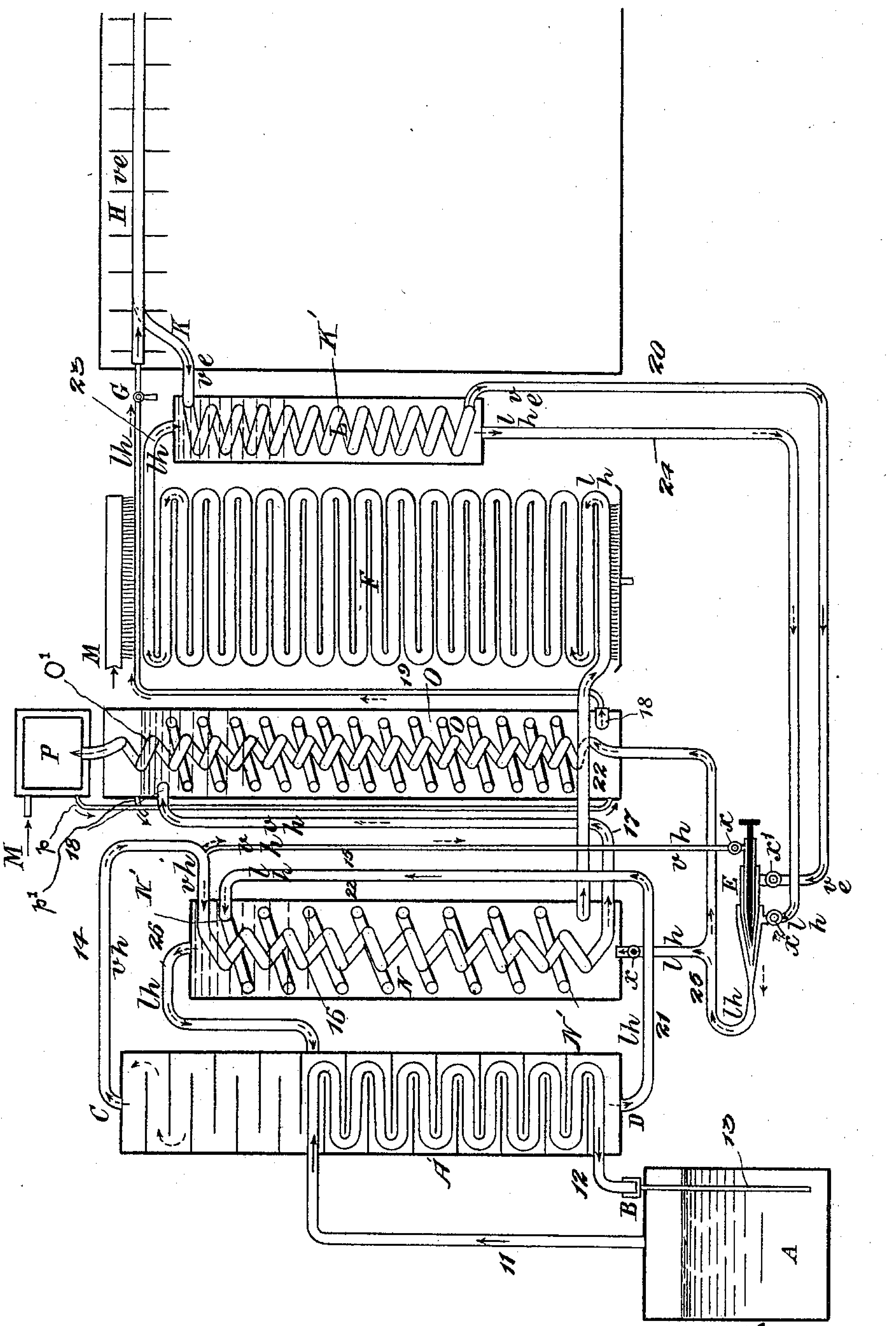
Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIAM HAMPSON, OF LONDON, ENGLAND.

REFRIGERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 607,849, dated July 26, 1898.

Application filed October 10, 1896. Serial No. 608,499. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HAMPSON, M. A., Oxford, a subject of the Queen of Great Britain, residing at No. 140 Minories, London, England, have invented certain new and useful Improvements in Refrigerating Apparatus, of which the following is a specification.

The object of this invention is to diminish the original cost, the attendance required, and the wear and tear and to increase the efficiency of refrigerating apparatus of the kinds which work by causing substances to undergo changes of physical state, as from liquid to vapor, and vice versa. Devices such as injectors or ejectors are substituted for pumps or compressors driven by motor-engines and for absorbers, in order to exhaust, compress, and liquefy vapors, and the efficiency of these injectors or ejectors is insured by causing them to receive cold liquid at the same pressure as that against which they have to deliver; also, where the liquefaction of the vapor is brought about by solution in water the solution is made to occur in the injector and the separate absorber is dispensed with.

In the accompanying drawings, Figure 1 shows ammonia-compression apparatus, and Fig. 2 an ammonia-absorption machine, constructed in accordance with my invention.

Referring to Fig. 1, A indicates a boiler, from which steam passes by a pipe 1 to heat the liquid ammonia in the hot vaporizer A'. The pipe 1 is bent back and forth within the vaporizer A' and leaves it at 2. A pipe 3 extends down into the boiler and has an enlarged funnel-shaped upper end B, into which the return portion of the pipe 1 extends, there being a break at this point, so that the temperature of the steam, and therefore that of the ammonia, can never rise above 100° centigrade.

As a further safeguard against excessive pressure in the hot vaporizer A', the parts of the apparatus are of such relative capacity that if the hot vaporizer be boiled empty the rest of the system hereinafter described can contain the whole of the liquid condensed within it.

Live ammonia-vapor under high pressure issues from the vaporizer at C and passes by a pipe 4, as indicated by the arrows, to an injector E, which is constructed to suit the nature and quantity of the work it has to do.

A non-return valve x is interposed in the pipe 4 between the injector and the hot vaporizer.

F indicates a cooler, shown as a coil cooled by dripping water from a water-supply M. The coil F is connected with the injector E by a pipe 5, the refrigerant passing through this pipe, as indicated by the arrows. A pipe 6 connects the temperature-equalizer L with the upper end of the coil F, and a pipe 7 connects with the pipe 6 and leads to the expansion-coils H.

At G is a valve or regulated aperture which controls the expansion of the liquid ammonia, and K is a pipe by which the exhaust ammonia-vapor passes from the expansion-coils.

L is a temperature-equalizer for the cold liquid and the still colder exhaust ammonia-vapor which are on their way to the injector.

In each instance where the letter l is used it indicates that the pipe contains liquid, while those where the letter v is used contain vapor. Pipes marked h are at high pressure and those marked e at exhaust-pressure.

The liquid ammonia passes from the pipe 6 into the temperature-equalizer L, and thence passes by the pipe 8 to the injector E. The expanded vapor passes through the pipe K and the coil K' to a pipe 9, and thence to the injector. Non-return valves x' x^2 are arranged in the pipes 8 and 9 near the injector.

The circulation in Fig. 1 may be traced as follows: As vapor the ammonia leaves the upper part of the vaporizer A', passes through the pipe 4, and enters the injector E. Here it meets more anhydrous ammonia, both vapor and liquid, and these are all delivered by the injector as liquid under pressure. Part of this liquid returns to the vaporizer A' through the pipe 10, (furnished with a valve X^4,) and the rest passes into the pipe 5, thence to the cooler or coil F, and then to the expansion-coils. Only some of the liquid leaving the cooling-coils F is allowed to escape past the regulating-valve G into the expansion-coil H, where it vaporizes, producing the refrigeration required. This vapor is drawn off by the injector E as fast as it is generated. It passes through the coil K' in the temperature-equalizer L back to the injector E. The remainder of the liquid anhydrous ammonia from the outer part of the cooling-coil descends through the equalizer L, and this very cold liquid also enters the injector through the pipe 8. It will thus be seen that the injector receives cold liquid at the same pressure as the liquid against which it has to deliver, and the injecting vapor from the vaporizer is at high pressure and the vapor is condensed in the injector before it is forced back into the vaporizer.

In Fig. 2, A indicates the boiler; 11, a pipe leading from the boiler to the vaporizer A′, within which it is coiled; 12, the point where the pipe 11 leaves the vaporizer, and B the upper funnel-shaped end of a pipe 13, which extends down into the boiler. The return portion of the pipe 11 extends down into the funnel-shaped upper end of the pipe 13, and there is a break at this point, so that the temperature of the steam, and therefore that of the ammonia, can never rise above 100° centigrade.

N indicates a temperature-exchanger in which the warm solution of ammonia on its way from the injector to the hot vaporizer is heated by the separated hot vapors from the hot vaporizer delivered from the vaporizer to the coil 16 by pipe 14 and which to some extent are cooled. O is a cold-water tank containing a coil in which the warm vapor from the temperature-exchanger is cooled. This vapor is still further cooled and condensed before passing to the expansion-valve. In this absorption-machine there is no direct access from the injector-outlet to the liquid-circuit of the system, and a substitute is provided in the chamber P, in which the high-pressure vapor passing through the injector may be condensed. To promote this condensation, the chamber P and the pipe leading to it are inclosed in cold water.

M indicates the pipe supplying the cold water to the water-jacket of the chamber P.

p indicates a pipe connecting the water-jacket of the chamber P with the interior of the water-tank O. This connection is made at the bottom of the tank O, and at the top thereof there is a water-overflow *p*′. The chamber P is placed high, so that when the apparatus is out of use and becomes cold the condensed liquid can pass out of it through the temperature-exchanger into the hot vaporizer, leaving the chamber P empty and ready to start the injector again. The injector is connected with the chamber P by means of a pipe 25 and a coil O′, as indicated.

A portion of the approximately anhydrous ammonia-vapor leaving the hot vaporizer A′ at C passes through the pipe 14 to the injector E by means of a pipe 15, past a non-return valve x near the injector. The remainder passes down through a coil 16 in the temperature-exchanger N and is partially cooled. It then passes out and through the pipe 17 to a coil 18 in the water-tank O, by which it is further cooled, and it assumes the liquid form.

The liquid passes from the coil 18, by means of a pipe 19, past the regulating-valve G, to the coils H, where it expands or vaporizes, producing the refrigeration required. The vapor passes from the coil H through a pipe K, and thence through a coil K′ in the temperature-equalizer L. Thence it passes by a pipe 20 past a non-return valve x' to the injector E. The hot weak water leaving the lower part of the vaporizer A′ passes through a pipe 21 to the upper part of a coil N′ in the temperature-exchanger N. It is partially cooled by passing down through the temperature-exchanger, and thence it passes through a pipe 22 to the coils F, where it is cooled. It then passes through the pipes F, cooled by the spray M, and through the pipe 23 to the equalizer L, and from the equalizer it passes by a pipe 24, past a non-return valve x^2, to the injector. In the equalizer heat is taken from the liquid by the exhaust ammonia-vapor. The injector delivers the whole as liquor ammoniæ, or if any vapor should pass the injector it is, as already explained, condensed in a closed coil in the water-tank O. The liquor ammoniæ is heated by passing upward through the temperature-exchanger N, which it reaches by means of the pipe 25, connecting the temperature-exchanger and the injector. It passes from the temperature-exchanger N through a pipe 26 to the vaporizer.

When once the expansion-valve and the injectors of these refrigerating-machines have been properly set, the whole work of refrigeration can be done automatically by merely heating the steam-boiler. They are without any moving parts to wear out or any valves to attend to, except those in the cold-water supply.

I claim as my invention—

1. In a refrigerating apparatus the combination of the vaporizer, the cooler, the expansion-coils, an injector, a connection between the vaporizer and the injector whereby the latter is operated by hot high-pressure vapor, a return connection from the injector to the vaporizer, a temperature-equalizer, a liquid-circuit including the injector, cooler and equalizer, means for delivering condensed refrigerant to the expansion-coil, and a connection including the equalizer between the expansion-coils and injector, the organization being such that the injector is operated by vapor at the high pressure of the generator and returns condensed liquid thereto and a circulation is maintained in the refrigerant-circuit, the expanded gas and liquid at high pressure being returned to the injector and then forced back into the circuit.

2. A refrigerating apparatus comprising a vaporizer, an injector and expansion-coils, a connection between the vaporizer and the injector whereby the latter is operated by hot

high-pressure vapor, a return connection between the injector and the vaporizer to return condensed liquid to the vaporizer, a cooling-circuit in which the injector maintains an endless circulation of liquid under pressure as high as that in the generator and provided with an aperture through which the portion of liquid required to be vaporized is drawn off from the liquid-circuit to the expansion-coils, and a connection from the expansion-coils to the injector through which vapor or gas is passed to and through the injector and combined with the liquid circulating in the cooling-circuit.

3. A refrigerating apparatus comprising a vaporizer, an injector having its inlet end connected with the upper part of the vaporizer and its outlet end connected with the lower part of the vaporizer, a liquid-circuit extending from the outlet end of said injector to an inlet thereof, a cooler included in said circuit, an expansion-coil, a connection between the expansion-coil and the liquid-circuit, and a connection from the expansion-coil to an inlet of the injector, substantially as set forth.

4. A refrigerating apparatus comprising a hot vaporizer, a cooler, expansion-coils, a connection from the vaporizer to the cooler and from the cooler to the expansion-coil, an injector connected with the vaporizer and supplied with high-pressure gas therefrom, a connection between the injector and the vaporizer for returning liquid thereto, a connection between the cooler and injector through which liquid from the cooler passes to the injector, and a connection between the injector and the expansion-coils by means of which the expanded vapors are exhausted from the expansion-coils; whereby the refrigerating operation is maintained continuously and fluid taken from the vaporizer returned thereto by the injector.

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Witnesses:

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