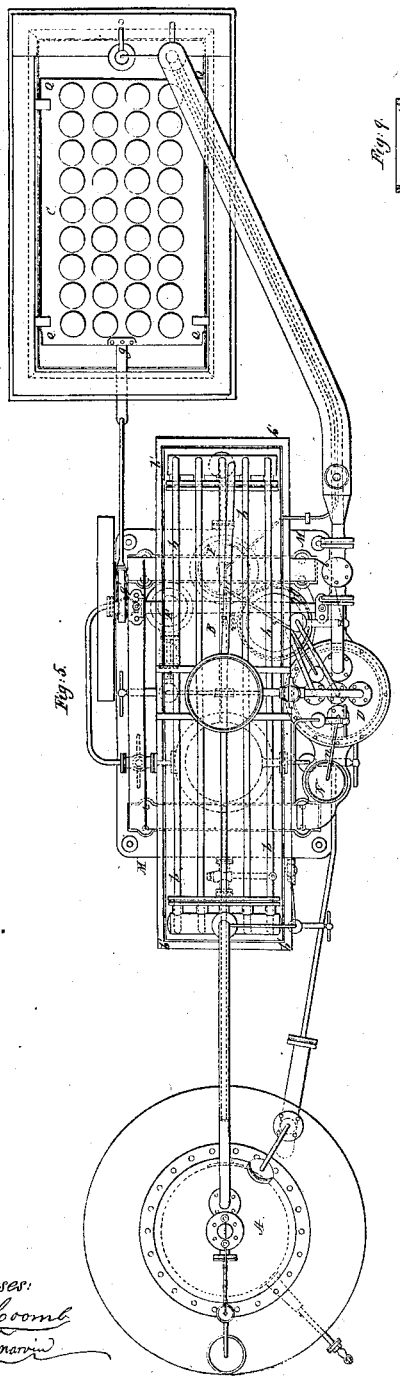
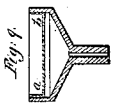
2 Sheets—Sheet 1.

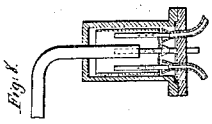
J. B. J. MIGNON & S. H. ROUART.

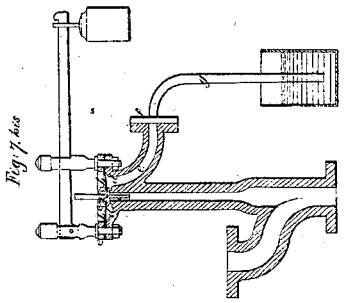
APPARATUS FOR FREEZING LIQUIDS.

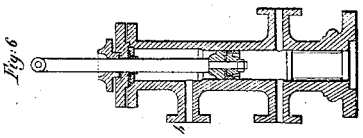
No. 50,212. Patented Sept. 26, 1865.

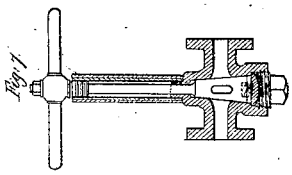


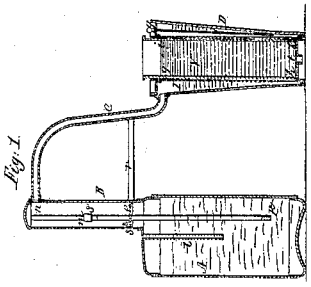












Witnesses:
Jos. L. Coombs
Wall. Kinnavin

Inventor
Mignon & Rouart
Atty

2 Sheets—Sheet 2.

B. J. MIGNON & S. H. ROUART.

APPARATUS FOR FREEZING LIQUIDS.

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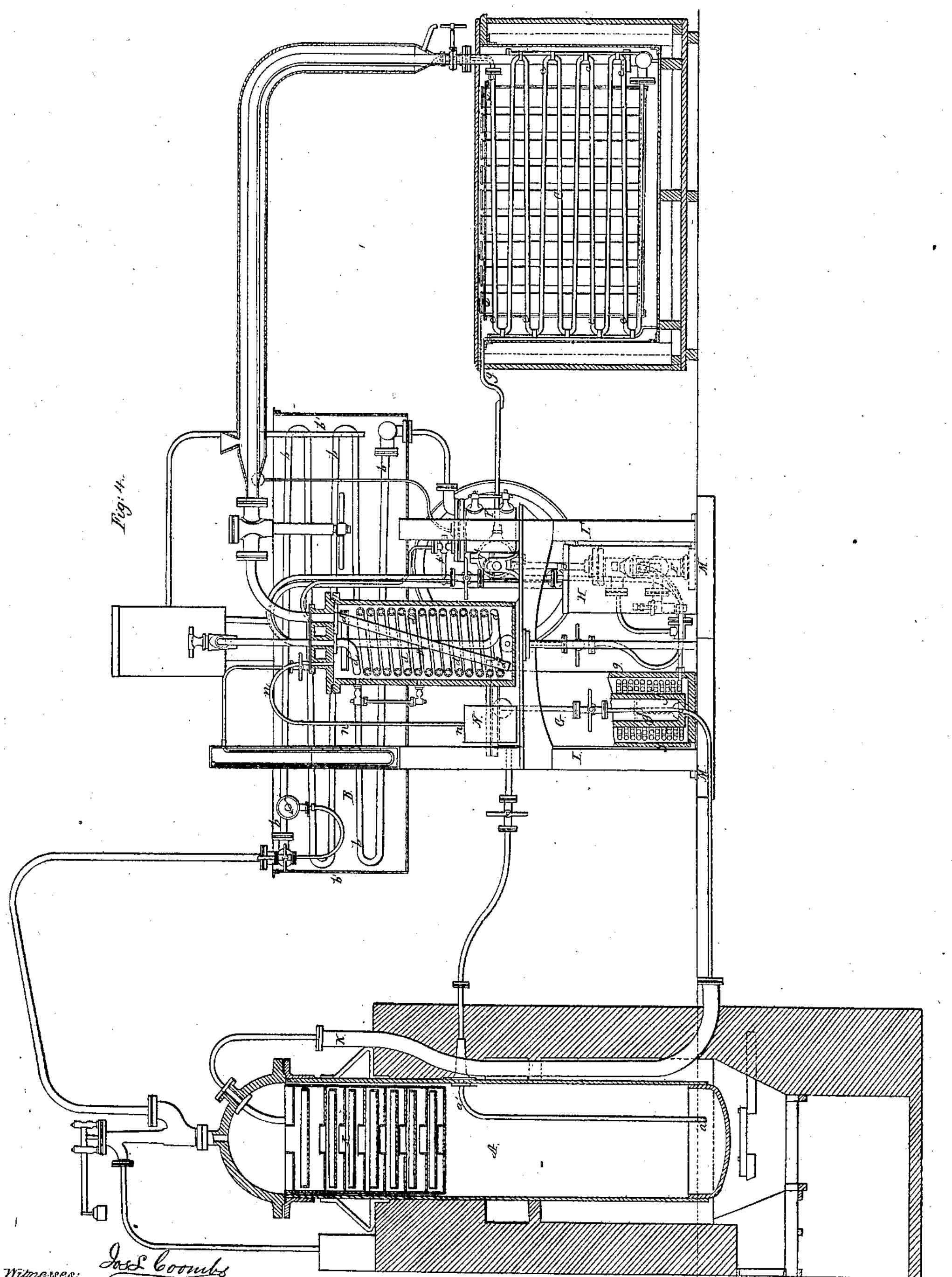

Fig. 4.

Witnesses: Jos. L. Coombs

Inventors: Mignon & Rouart

UNITED STATES PATENT OFFICE.

JEAN BAPTISTE JAVA MIGNON AND STANISLAS HENRI ROUART, OF PARIS, FRANCE.

IMPROVED APPARATUS FOR FREEZING LIQUIDS.

Specification forming part of Letters Patent No. **50,212**, dated September 26. 1865.

To all whom it may concern:

Be it known that we, JEAN BAPTISTE JAVA MIGNON and STANISLAS HENRI ROUART, both of Paris, in the Empire of France, have invented certain new and useful Improvements in Apparatus for Freezing Liquids; and we do hereby declare that the following is a full, clear, and exact description of the same.

The invention subject of this patent relates to a particular arrangement which we have adopted for machinery or apparatus of continuous action; also, to certain improvements in the construction and arrangement of apparatus of intermittent action, or for domestic purposes, rendering the same particularly more efficient. The former is an improvement upon the apparatus for which Letters Patent of the United States were issued to F. P. E. Carré on the 23d day of October, 1860, while the latter relates more particularly to constructive details, whereby greater simplicity of construction and perfection of operation is attained. Either apparatus, however, is specially designed with a view of utilizing the action of ammonia in solution in water.

The annexed drawings represent several views in plan and sectional elevation.

Figures 1 and 2, Plate 1, are, respectively, a vertical section and plan view of the intermittent apparatus, which is composed of a boiler, A, surmounted by a cylindrical chamber, B, which is united by means of the tube of communication C with the congealing apparatus. In this cylindrical chamber there is a plate, *e*, carrying two valves, one, *s*, located at the extremity of an upright tube, and another, *s'*, placed on the end of the tube, which constitutes a siphon, *m n p*, as shown in detail in Fig. 3. Centrally and from the top of the boiler descends a tube, *l*, closed at the lower extremity and designed to hold oil, in which a thermometer is placed.

The congealing apparatus is annular and conical, the interior cavity, *g h i k*, receiving a movable vessel, V, in which the congelation takes place. It is closed at the under side by means of a metallic disk provided with a hole which may be closed by a stopper.

r is a brace, applied only for convenience of construction, and *q* is a tube, the upper part of which is enlarged and closed by means of a screw compressing a tin washer, and is designed to expel the air which the apparatus may contain at the commencement of the operation. In order to make ice or produce cold by means of this apparatus, the boiler is placed over a fire or furnace, while the congealing apparatus is put in water which is as cold as possible. The temperature in the boiler is raised until the thermometer in the tube *b* indicates a temperature of from 130° to 160° centigrade, according to the climate. The gas thus generated in the boiler escapes through the valve *s*, and condenses in the annular space L under the influence of pressure and cold. The boiler is then removed from off the fire and placed in water, which operation causes a diminution of the pressure in the boiler and the volatilization of the liquefied gases, whereby the valve *s'* is actuated, and the gas becomes absorbed or dissolved in the water of the boiler. This volatilization of the liquefied ammoniacal gas produces intense cold, which may be utilized in any manner desirable. If ice be wanted, the hole at *t* is closed by means of a cork, and the vessel V, filled with water, is placed within the chamber *g h i k*, leaving a small annular space between it and the chamber, which is filled with a non-congealable liquid. This will aid the transmission of the cold produced, and after a short lapse of time the said vessel may be removed, containing a lump of ice of the form of the interior of the vessel. The apparatus may then be used again for a new operation. The functions of this machine are necessarily intermittent. During the first part of the operation the boiler distills the ammoniacal gases and the congealing apparatus liquefies the same, while during the second part of the operation the boiler absorbs the gases and the congealing apparatus vaporizes the same. Thus it will be seen that each organ performs functions radically opposite, and if it be desired to give this apparatus a continuous action it will be necessary to compose the same of four principal organs, such as will be seen in Fig. 4 of Plate 2, which represents an elevation, partly in section, of an apparatus of continuous action, and in Fig. 5, Plate 1, which is a plan view of the same.

The apparatus shown in the said figures is composed, first, of a boiler, A, permanently placed in a furnace, and in which the ammoniacal vapors or gases are continuously generated; second, of a liquefier, B, which is composed of a serpentine or coiled pipe, *b*, placed in a tank, *b'*, in which is circulated a constant current or stream of cold water; third, of a congealing apparatus, C, which is composed of a series of vertical serpentine pipes, *c*, submerged in a non-congealable liquid, in this apparatus the volatization of the gases being effected; fourth, of an absorber, D, in which the exhausted liquids of the boiler or those poor in ammonia are charged with ammoniacal vapors and are returned to the boilers rich in ammonia. A serpentine pipe, *d*, placed in this vessel will constantly absorb the heat generated by the combination of the ammonia with the water. The exhausted ammoniacal solution, which sinks to the bottom of the boiler, because of its greater density, is directly brought into the absorbing vessel by the pressure in the boiler, and a cock in the pipe communicating the boiler with the absorbing-vessel regulates the flow of the liquid from the boiler to the absorber. On the other hand the gas, which is entered in suitable proportions into the congealing apparatus, will be carried to the absorber; but in order that the volatilization may be effected in a proper manner, it is necessary that the pressure in the congealing apparatus, and consequently in the absorption-vessel, with which it is in direct communication, shall be constantly maintained according to the temperature which it is desired to be produced. It is therefore necessary to employ a pump, E, or a device to restitute or return from the absorption-vessel to the boiler the liquid, which shall have been charged again with ammoniacal vapor.

The apparatus further contains several accessory devices of relative utility, which, rendering the operation both easy and economical, deserve special mention. Between the liquefier and the congealing apparatus or refrigerator there is a recipient, F, for the liquefied gas. It is provided with a tube to indicate the level, and consequently the quantity of available liquefied gas it contains, and it also serves the purpose of regulating the flow of the liquid into the refrigerator, where it is to be received in a quantity varying with the extent of the serpentine pipe contained.

Between the boiler and the absorption-vessel there is a cylindrical vessel, G, which is composed of an outer cylinder, *g*, and a plunger, *g'*, between which there is an annular space, within which a serpentine pipe composed of several branches is located. The exhausted but warm liquid coming from the boiler circulates through the serpentine and parts with the greater part of its heat, heating the rich but cold liquid which fills the annular space and surrounds the serpentine pipe.

It is hardly necessary to add that the exhausted liquid and the rich liquid circulate in opposite directions, the rich liquid ascending and the exhausted liquid descending. This contrivance has the double advantage of preparing the exhausted ammoniacal solution for a new absorption by cooling it and of producing an economy by utilizing the heat which is abandoned by the reheating of the rich liquid that is to undergo a new distillation. Complementary to this we use a cylindrical tank, H, containing a serpentine pipe, in which the exhausted liquid coming from the vessel G circulates. The tank, being constantly supplied with a fresh stream of water, will effect the cooling of the liquid circulated through the serpentine.

K is a heater located in the flue of the furnace, and has for its object to complete upon the rich liquid the effect produced in the vessel G. We also use a device for expelling from the apparatus the air and the non-condensable gases which it may contain. It consists of a vessel, *m*, filled with water, in which plunges a tube, *n*, having a cock on its extremity. By means of the cock *p*, placed on the recipient of the liquefied gas, a similar expulsion of the air and non-condensable gases is made from the boiler and the liquifier. The boiler is placed in a furnace built of brick, and the liquefier, the absorption-vessels, pump, and the other contrivances described are arranged on a suitable frame-work, of which M is the foundation-plate and L L' the standards.

In order to use this apparatus for the purpose of making ice, a series of molds of any form that may be deemed proper are placed in the bath of non-congealable liquids. It is well then to agitate them, which may be effected by placing them in a movable frame, Q, the tail-piece *q* of which is connected by means of an eccentric, *q'*, with the shaft operating the pump, and which is moved simultaneously therewith.

If the apparatus be used only to produce cold, the serpentine pipes of the refrigerator may be caused to act directly upon the liquid.

In the boiler are arranged a series of disks, one above the other, the object of which is to rectify the gas—that is to say, to deprive it as much as possible of water. These plates constitute the rectifier R.

The operation of the machine above described is as follows: The ammonia distilled in the boiler A is rectified by its passage through the rectifier R, is then conveyed to the liquefier B, under the influence of pressure and cold becomes liquefied, accumulates in the recipient T of the liquefied gases, and finally arrives in the absorption-vessel D through the plunging tube *d'*. The exhausted ammoniacal solution, on the other hand, sinks to the bottom of the boiler, whence, by means of the tube *a'*, it is conveyed into the serpentine of the cylindrical vessel G and its complemen-

tary vessel, and finally arrives cooled in the absorption-vessel, whence it drops upon a perforated plate, which returns it to the cooling-serpentine in the form of spray or shower.

The gas and the exhausted ammoniacal solution arrive simultaneously in the absorption-vessel and combine with each other, thus generating a rich ammoniacal liquor, which is taken and forced by the pump through the vessel G and a reheating apparatus into the upper plates of the rectifier. This ammoniacal solution undergoes a new distillation, and will again pass through the several stages of the operation, as just described. Cold is produced in the serpentine pipe of the refrigerator, and is transmitted to the non-congealable liquid in which the ice-molds are placed. The ice is removed from the molds by bathing the latter in water of ordinary temperature.

To save all the cold that may be produced, we use a sleeve around the tube through which the ammoniacal vapors of the refrigerator escape, which sleeve constitutes a reservoir for water which is ultimately to be congealed. In this way it is caused preliminarily to lose several degrees of temperature. A small tank placed upon the liquefier B, on top of the apparatus, has no other object than to effect an easy distribution of the water of condensation between the liquefier and the absorption-vessel.

Having thus described the general arrangements and functions of this apparatus, we shall now refer to some details which deserve special mention. The pump, for instance, is composed of a disk of leather bent into a cup shape and clamped between two metallic disks, as shown in Fig. 6 of Plate 1. Movement is imparted to the piston by means of a connecting-rod attached to a crank-shaft of which the bearings are in brackets which are fast to or part of the frame. The piston-rod, it will be seen, traverses a double stuffing-box, made of india-rubber or leather. By a very simple arrangement the pressure exerted by the stuffing-box on the piston-rod is greatly reduced. The arrangement consists in placing in communication, by means of tubes, the absorption-vessel with the pump-cylinder. The tube is connected with a branch, *b*, as shown in Fig. 6, Plate 1, establishing communication between the absorption-vessel and the portion of the cylinder which is between the upper end of the stroke of the piston and the stuffing-box.

The valves or cocks used in this apparatus are made to be perfectly tight at whatever pressure. To this effect the conical plug or stopper is provided with a stem, *a*, Fig. 7, which is soldered or otherwise secured to the upper or contracted portion of the plug, which is placed in the cock-chamber in such a manner as that the stem *a* will protrude at the upper part thereof, while the chamber itself forms a projection at the under side. From this it will be seen that leakage can only take place either above or below the conical plug. Below the escape is prevented by means of a stopper, *c*, which is screwed onto a metallic washer, *d*, which compresses another washer made of rubber, *e*. Above, a rubber tube is connected with the cock-chamber on the one side and the upper portion of the stem *a* on the other, in which tube the leaks, if there be any, are collected. The elasticity of the rubber tube will allow of the working or rotation of the plug without allowing any of the ammoniacal gases to escape. The plug is maintained in position in the cock-chamber by means of a small spring, which renders the working of the cock comparatively easy. A safety-valve (shown in Fig. 7bis) is arranged in such a manner as to allow of no loss of gas, even if the pressure should exceed that of safety. The clappet-valve *a* is suspended in the center of a flexible rubber valve, *b*, held in place by means of a ring, *c*, over the cavity *d*. A lever provided with a weight rests, according to the ordinary arrangement, on the central pin of the clappet-valve. In the cavity *d* a side opening, *e*, is made, from which starts a branch, *f*, in which is fastened the tube *g*, the lower extremity of which plunges in a bath, *h*.

It is evident that if by excess of pressure the clappet-valve *a* be raised, the gas, instead of escaping into the open air, will pass through the opening *e* into and become absorbed by the water.

The distributer shown in Fig. 8 of the accompanying drawings is a device by which the liquefied gas is distributed in equal quantities through the several serpentine pipes which compose the refrigerator.

In the construction of this apparatus no materials other than metal—*i. e.*, materials not attackable by ammonia—should be employed. Care should be taken to avoid the employment of alloys of copper and zinc. Copper may, however, be employed by tinning or silvering it. The solder employed should be either silver or tin, and the joints are packed by means of a cement composed of the white of eggs mixed with quick-lime, or by means of rubber or tin washers.

Pressure-gages should always be used on the boiler of the apparatus of continuous action and upon the absorption-vessels. On small machines a safety-valve may be used which is composed of a disk inclosed in a suitable chamber. This disk should be of a resistance such as to tear or break when submitted to a pressure which is less than that necessary to burst the boiler.

With this apparatus may be used the various forms of refrigerators described in the patent before referred to of F. P. E. Carré, and other modifications in the construction and operation may be adopted without departure from our invention.

Having thus described the improvements subject of this patent and the manner in which the same are or may be carried into effect, we claim—

1. The general construction and arrangement

or combination of apparatus having continuous action.

2. The general construction and arrangement or combination of apparatus having intermittent action.

3. The particular construction and arrangement of the pumps, stop-cocks, distributer, and safety-valve, all as herein shown and described.

In testimony whereof we have signed our names to this specification before two subscribing witnesses.

J. MIGNON.
H. ROUART.

Witnesses:
EDWARD TUCK,
U. S. Vice-Consul.
S. KINNARD.