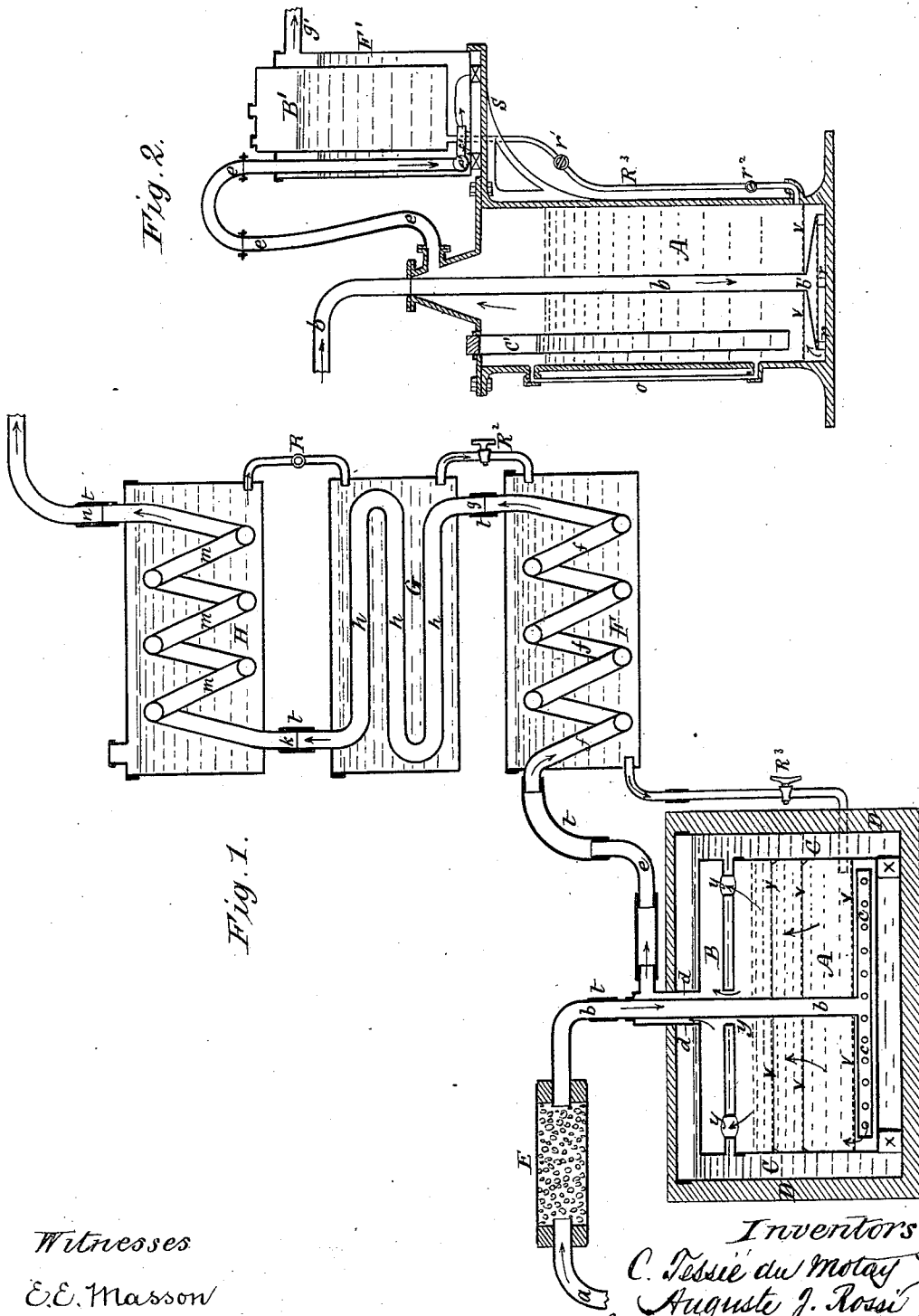


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Refrigerating Process and Apparatus.

No. 228,487.

Patented June 8, 1880.



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REFRIGERATING PROCESS AND APPARATUS.

SPECIFICATION forming part of Letters Patent No. 228,487, dated June 8, 1880.

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To all whom it may concern:

Be it known that we, CYPRIEN TESSIÉ DU MOTAY, of Paris, France, temporarily residing in New York, United States of America, and AUGUSTE J. ROSSI, of New York, United States of America, have invented a new and useful Recuperating Ice-Machine, which invention is fully set forth in the following specification.

It is well known that gases in motion, in coming into contact with extended surfaces of volatile liquids, such as hydrocarbons, essential oils, alcohols, ether, water, &c., possess the quality, particularly when dry, of volatilizing and retaining in a vesicular shape the particles or vapors of liquids such as above designated. Thus they refrigerate the liquids which they volatilize, becoming cold themselves at the same time, the temperature descending to the freezing-point of water, and even lower. These facts, known to all physicists, have served as a starting-point for the construction of a refrigerating apparatus or ice-machine.

We have invented a machine for the production of cold based upon the putting into action of these phenomena and realizing the conditions of an economical maximum of fall of temperature.

Our invention also comprises certain methods or processes for the recovery or recuperation of the cold, which would otherwise be lost, and also of the volatilized substance.

Generally speaking, this machine consists of—

First, a ventilator, blower, or gasometer, furnishing the gases supplying the refrigerating vessel or chamber.

Second, a first receptacle, vase, or refrigerating-chamber provided with a double bottom perforated with very fine holes or furnished with any other suitable device for finely subdividing the gases introduced and containing the liquid to be vaporized.

Third, a second vase or regenerator containing a coil or other circulating apparatus, which vase is closed and is filled with the same liquid as the first. The gas charged with the liquid volatilized by it in the first vase circulates through the coil, and, being cooled by

the fact of the volatilization of the said liquid in the first vase, cools in turn the liquid in which is submerged the coil or circulating apparatus.

Fourth, tubes putting in communication the regenerator or second vase with the first vase or refrigerator, provided with valves, cocks, or supply-pumps, which devices serve to supply to the first vase, in place of the liquid volatilized, fresh liquid cooled by the passage through it of the cold gases carrying in suspension the volatilized particles.

With this apparatus may be connected one or more additional regenerators, all acting in succession to return the liquid least cooled back into the next vessel which has been more cooled until the refrigerating-vase is reached, and this is thus fed by the coldest liquid.

The following description will enable those skilled in the art to which it appertains to make and use our invention, reference being had to the accompanying drawings, which form a part of this specification, and which represent apparatus constructed in accordance with this invention.

Both figures are sectional views, and the same letters indicate like parts where they occur.

A is the first or refrigerating vessel, which can be of tin, galvanized iron, copper, or any other suitable material. Referring to Figure 1, this vessel A is divided into compartments by diaphragms of copper-wire gauze of a proper fineness. At its upper part is provided a dome, B, of the same material as that of the vessel A, communicating with which dome B is the vertical dome *d*.

The vessel A is, as shown, of a rectangular form, as well as the dome B, with which it communicates by the openings or legs *y*. The dome *d* is circular. Any other forms could, however, be adopted for the vessel A and the domes B and *d*.

The vessel A, supported on the bottom by legs *x*, is inclosed in the vessel C, and is immersed in a suitable medium in water, in case ice or cold water is desired, or in an uncongealable mixture, glycerine solutions in water, or chloride of sodium or magnesium solutions of proper strength, or any other liquid which

might be found suitable, when it is intended to circulate such liquid through pipes or otherwise for the purpose of cooling air or for other purpose.

5 The vessel C, which can be made of any suitable material, is isolated all around by felting, (shown at D,) charcoal-powder, asbestos, or any other appropriate non-conducting substance.

10 In the vessel A plunges a tin, copper, or iron pipe or tubing, *b*, terminating at its lower end in a perforated tube, *c*, located at or very near the bottom of the vessel A, and reaching under the lowest of the diaphragms, *v*. The tube *b* 15 is put in communication with a drying chamber or vessel, E, containing chloride of calcium, unslaked lime, or any other desiccating material. The opposite end of the vessel E is connected by a pipe, *a*, with a fan, ventilator, 20 gasometer, or other forcing apparatus. (Not shown in the drawings.)

The dome *d* is connected by the pipe *e* with the coil *f* in the vessel F, and this, by the pipe *g*, with the system *h* in the vessel G, and this 25 system with the coil *m* in the vessel H by the pipe *k*. With the coil *m* the pipe *n* is connected.

The vessels H, G, F, and A are connected with each other to form a series by the pipes 30 R R² R³, each provided with a suitable cock.

The operation of this apparatus will be readily understood.

The vessel A, being immersed in the liquid contained in the vessel C, is filled about three-fourths full with the volatile liquid refrigerant. 35 The vessels H G F are filled also with this liquid. The gas—say air—employed enters, by the pipe *a*, the vessel, in which it is dried, and it then passes into the pipe *b*, reaches *c*, and discharges through the openings therein. It ascends through the diaphragms *v*, through the liquid contained in the vessel A, and escapes, through the openings *y* and domes B and *d*, into the pipe *e*. Its rapid passage volatilizes the volatile liquid in A, and it carries off a part of it in a state of vapor, thereby producing cold and lowering the temperature of the remaining liquid by the absorption of heat which becomes latent. 45 The air, which is cooled also and carries with it a portion of the cold thus generated, enters the coil *f*, contained in the vessel F, and immersed in the same liquid as that contained in the vessel A. The vessel F should, of course, be properly protected by non-conducting material. In this passage the air charged with 50 the vapor abandons a part of the cold it has carried with it to the liquid in F. It then passes through the coil *h*, immersed in a bath of the same liquid contained in a vessel, G, also properly isolated or protected. It abandons there another portion of the cold carried away from A, and passes thence, through *k*, into the coil *m*, immersed in the same liquid as in A, contained in a vessel, H. It abandons there another portion of the cold carried 65 away from A, and it is easy to see that this

operation of recuperating or regenerating the cold otherwise lost can be repeated as often as found necessary by increasing the number of such recuperating vessels or regenerators, 70 as F G H. Finally the air or gas escapes at *n*, carrying with it the vaporized liquid of A, but at a temperature sensibly equal to the initial temperature. This air, in case light petroleum, naphtha, or gasoline has been used as the liquid refrigerant in A, can be directed 75 either under an appropriate boiler, to furnish, by the combustion of it with the hydrocarbon vapors wherewith it is charged, the power necessary to drive the fan, or other forcing apparatus connected with the pipe *a*. It can, if 80 desired, be collected in a gasometer to be used for illuminating purposes, or it can be burned in a chimney, with proper admission of fresh air and special contrivances of turbine, helix, 85 ejector, or other suitable apparatus, so as to produce an aspiration sufficient to make the apparatus automatic. In this case we may dispense with the fan or other apparatus for forcing the air. 90

In case solutions of ammonia in glycerine or in chloride of sodium or magnesium solutions are used in A, the ammonia gas carried away by the air can be recuperated by passing the air thus charged through a properly- 95 constructed condenser containing simple solutions of either chloride of sodium, magnesium, or glycerine, which solutions deprive the air of its ammonia, with which gas they can be saturated and then be recharged in the vessel A for 100 another operation.

To render the operation continuous the vessel A is fed with the liquid by the return-pipes R³ R² R, which discharge the liquid from the upper recuperator, H, to G, G to F, and finally, 105 becoming cooler and cooler, into the vessel A in a proper stream, so as to maintain the level of said liquid constant in A. An indicator of level (not shown in Fig. 1) permits the proper regulation of the cocks in the pipes R R² R³. The liquid contained in the vessel C is of course kept at the same temperature as the liquid in A. It may be drawn off for use as required. If air is to be cooled thereby, it may be circulated through coils in any ordinary or suitable 115 way. If ice is to be made, or milk, beer, or other liquids are to be cooled, the liquid in the vessel C can be circulated among the cans or vessels containing the water to be frozen, or through any ordinary or suitable cooler, or 120 the cans or vessels may be placed in the vessel C.

The apparatus shown in Fig. 2 is specially intended to make ice. The petroleum, naphtha, gasoline, ammonia, or other suitable liquid is 125 charged into the cast-iron vessel A, preferably cylindrical, which has a cast-iron cover properly bolted on it. This cover has a dome with proper connections. Through this iron cover, and secured on it by means of a cast-iron ring, 130 passes a certain number of copper cans, C', in which is put the water to be frozen.

On the side of the cylinder A is cast a flange with a bracket, S, to support the recuperator F' and feeder B'. This feeder is simply a tin vessel containing the same liquid as contained in A. It is provided with proper openings to introduce the liquid. The vase B' is immersed in water contained in vessel F' (properly insulated) or in water containing in solution some salts to prevent its freezing. The admitting-pipe *b* for air crosses a diaphragm, *v*, and ends in a funnel, *b'*, closed at its mouth by a perforated plate like a sieve. It is supported by legs *p*.

A pipe, R³, provided with two cocks, *r'* *r*², conveys the liquid from B' to A to replace the portion volatilized by the passage of air through the liquid in A. An indicator of level, *o*, allows the cocks to be properly regulated to maintain a constant level in A.

The discharging-pipe *e*, for air, plunges to the bottom of the vase F', and there branches off at right angles into a pipe, *e'*, provided with cylindrical appendices *f'*.

The operation is conducted substantially as before described.

A ventilator, fan, bellows, or gasometer discharges the air properly desiccated, by its passage through appropriate substances, into the pipe *b* and *t*. Through the funnel *b'* it discharges in a very minutely divided state, traverses the diaphragm *v*, and ascends through the liquid in A. By its rapid passage and division it volatilizes the liquid in A, thereby lowering its temperature, and also that of the water in the cans C'. The air then escapes through *e* charged with the volatile substance, and carrying with it a part of the cold thus produced by evaporation. It is divided at *e'* and discharges through the water in F', which water it cools, thereby cooling also the feeder B' and the liquid therein by abandoning all or part of the cold carried away from A. The air finally escapes at *g'*, to be used, as before described, in case a hydrocarbon has been filled in A—that is, to burn under a boiler or for illuminating purposes, or to make the apparatus automatic and dispense with the fan. The temperature in A soon reaches a low degree, 16° Fahrenheit having been obtained with gasoline and by a continuous blowing of one hour. Five pounds of solid ice have been formed in cans with an apparatus of about eight times the size of the one shown in the original drawings, Fig. 2.

Many modifications may be made in the apparatus described. The materials of which the various parts are constructed are not essential, but they should be such as not to be affected or corroded in use.

It is obvious that the recuperator or regenerator shown in Fig. 2 might be used with the apparatus shown in Fig. 1, and vice versa. The special construction of both may be varied within wide limits. In both figures it will be seen that there are two chambers or passages, one for the liquid and the other for

the gas. If deemed best, however, the air may be brought in some cases into direct contact with the volatile liquid, which, as the air or gas is already saturated, or nearly so, will lose but little of its volume.

It is, of course, desirable that all the vessels should be insulated or packed to prevent absorption of outside heat. In order thoroughly and economically to dry the air, and at the same time prepare it better for admission to the refrigerating-vessel, it may be cooled before it is admitted to the desiccator or vessel containing calcinum, chloride, or quicklime. This cooling may be effected by the cool air escaping from the refrigerating-vessel before, after, or at the same time that it is passed through the recuperator in which the liquid refrigerant is cooled.

The vessel A may both contain cans C', immersed in the volatile liquid therein, and also be itself immersed in a liquid. When it is desired to cool air or gas the same may be passed through pipes surrounded by the liquid refrigerant, or a cooling apparatus of any ordinary or suitable construction may be immersed in said liquid.

I do not intend to confine myself to the liquids specified, as others may be used, nor to the use of air as the volatilizing agent, as other gases may be employed.

Having thus fully described my said invention, and the manner in which the same is or may be carried into effect, what I claim, and desire to secure by Letters Patent, is—

1. A refrigerating apparatus or ice-machine comprising the following elements in combination: a refrigerating-vessel for containing a volatile liquid, an inlet-pipe and distributor for introducing a gaseous medium into said vessel and bringing it into contact with the volatile liquid therein contained, and one or more recuperators or regenerators for cooling the supply of volatile liquid, said recuperators being each composed of a receptacle for the volatile liquid, connected by an inlet-pipe with the refrigerating-vessel, and a coil or chamber for the passage of the cold gaseous medium, connected with the said refrigerating-vessel by a suitable pipe through which the cold gaseous medium escapes, substantially as described.

2. The combination of the refrigerating-vessel for containing a volatile liquid, a desiccator for drying air or other gaseous medium, an inlet-pipe and a distributor for introducing the dried gaseous medium into said refrigerating-vessel and bringing it into contact with the volatile liquid therein contained, and one or more recuperators composed of a vessel for containing the volatile liquid to be supplied to said refrigerating-vessel and connected with the latter, and a coil or chamber for the passage of the gaseous medium charged with the vapors, connected with the pipe for the escape of said gaseous medium from the refrigerating-vessel, substantially as described.

3. In an apparatus for the production of cold,

the combination, with a vessel for containing a liquid, the said vessel having one or more wire diaphragms extending across it, of an air or gas inlet pipe extending to near the bottom of said vessel and provided at its end with a distributing device below the wire diaphragm or diaphragms, substantially as described.

4. In the production of cold by means of the volatilization of a liquid by the passage in contact therewith of a gas, the method of cooling the liquid to be supplied for volatilization by exposing it to the action of the cold current of gas charged with the vaporized liquid, substantially as described.

5. The method of cooling the supply of volatile liquid by means of the gas charged with vapors of said liquid, in the production of cold in the manner described, by passing the

gas successively through a series of receivers or recuperators containing the same liquid as that which is vaporized, and conveying said liquid from one receiver or recuperator to another as it is gradually reduced in temperature, and finally delivering it into the vessel or chamber in which the vaporization by the current of gas is effected, substantially as described.

In testimony whereof we have signed this specification in the presence of two subscribing witnesses.

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AUGUSTE J. ROSSI.

Witnesses:

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LEONARD F. BECKWITH.