

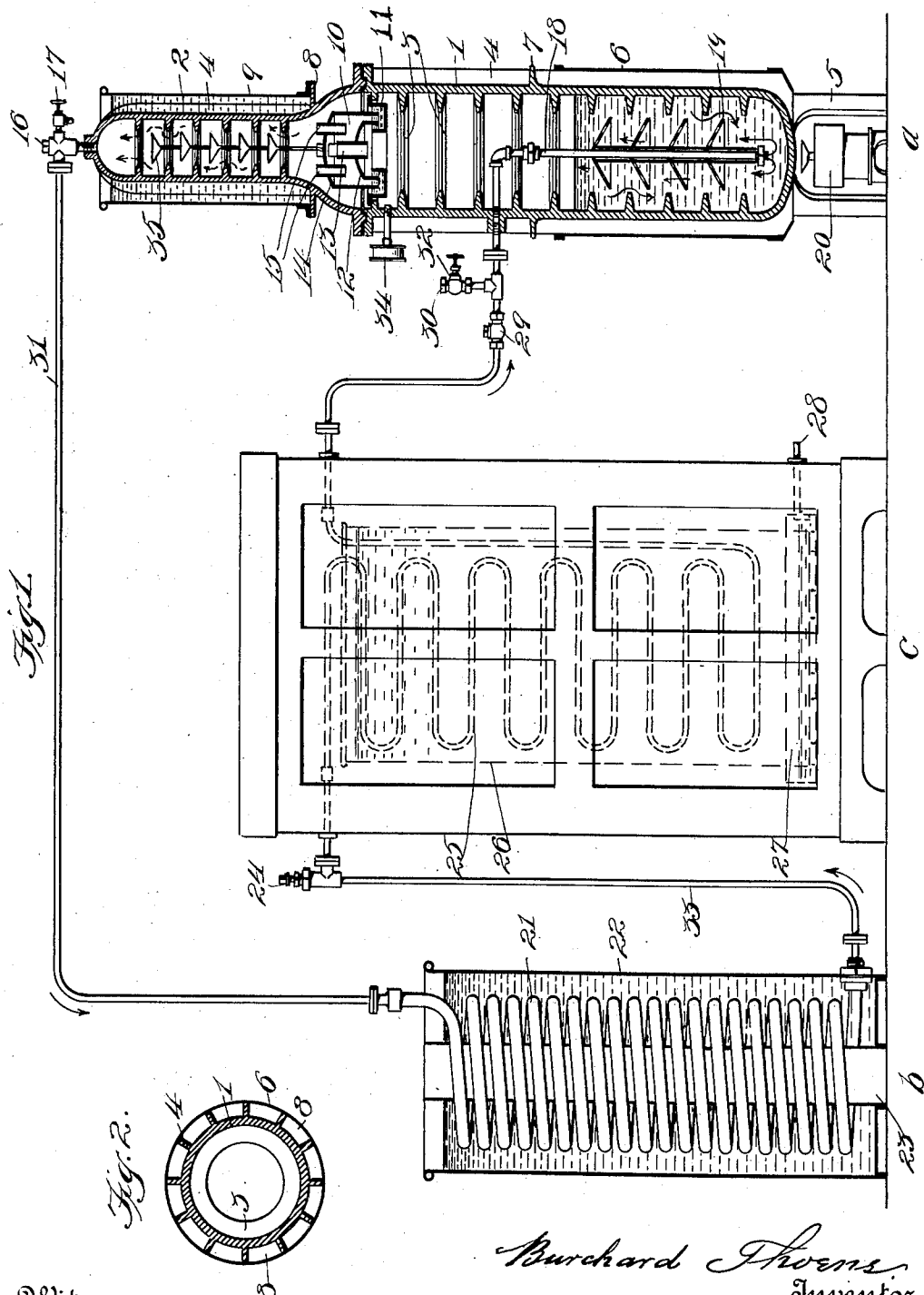
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ICE AND REFRIGERATION MACHINE.

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ICE AND REFRIGERATION MACHINE.

No. 830,466.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, BURCHARD THOENS, a subject of the German Emperor, and a resident of New York, State of New York, have
5 invented certain new and useful Improvements in Ice and Refrigeration Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in
10 the art to which it appertains to make and use the same.

My invention relates to an improvement in ice and refrigeration machines.

The objects of my invention are to provide
15 an ice or refrigeration machine of limited capacity suitable for use in houses, groceries, butcher-shops, markets, &c., especially for localities where ice cannot be obtained regularly or in small villages which cannot support an ice plant. With these objects in
20 view my apparatus is so constructed that it may be safely placed in charge of inexperienced persons, requiring no skill or judgment for its operation. Its operation requires no opening or closing of valves at certain times, as is required in many similar devices. It needs no continuous water-supply for cooling purposes. It will not get out of
25 order, inasmuch as all complicated mechanism has been eliminated. It occupies but little space, and the parts can be placed in any position relatively to each other. It may, for instance, be mounted on wheels to be used in war time in connection with field
30 hospitals.

My device is of the intermittent-working ammonia-absorption type, in which the following steps occur in succession: separating the ammonia-gas from a solution containing it by means of heat in a generator; liquefying the separated ammonia-gas by pressure and cold in a condenser; vaporizing or expanding the liquefied ammonia by reducing its pressure in a refrigerator, thereby producing refrigeration; reabsorbing the vaporized or expanded ammonia-gas again in the same water from which it was expelled by heat in the generator, which then acts as
45 an absorber.

50 With these objects in view my invention consists in the construction and combinations of parts as hereinafter described and claimed.

In the accompanying drawings, Figure 1
55 is a longitudinal section of my improved device; and Fig. 2 is a cross-section of the gen-

erator-absorber through the lower part thereof, although a cross-section of the upper part would be exactly the same in shape, only smaller.

60 *a* represents the generator, which consists of a lower shell 1 and an upper smaller shell 2. Both shells are provided on the inside with annular ribs 3 and on the outside with longitudinal ribs 4, four of which ribs
65 are elongated, forming legs 5. These ribs, both inside and outside, are for the purpose of rapidly conducting heat into and out of the generator, which is made of metal. While I have shown longitudinal ribs on the outside
70 and annular ribs on the inside, I do not restrict myself to this particular form, as both annular and longitudinal ribs might be used both on the inside and outside of the generator, or the arrangement shown might be
75 reversed.

The generator instead of being provided with ribs may of course be provided with corrugations, which effect the same purpose.

A casing 6 surrounds the lower shell 1 and
80 reaches up nearly to a horizontal ring 7, which is a part of the shell 1, leaving a discharge-space between the ring 7 and the upper edge of the casing 6. This casing 6 forms with the longitudinal ribs 4 vertical
85 air-flues around the shell 1.

The upper shell 2 is surrounded by a water-jacket 9 and is similar in shape to the lower shell, except that it is smaller. The shells are secured together in any suitable
90 way, and a packing, if desired, may be used between them. The water-jacket 9 is supported on a ledge 8, which forms a part of the upper shell 2. The shells 1 and 2 are separated from each other by the separator 10, 95 which consists of a circular annular trough 11, which supports a bell 12, having a central discharge-pipe 13. A bell 14 larger than the bell 12 is also supported on the trough 11 and is provided with a number of discharge-pipes
100 15. The upper end of the pipe 13 is below the lower ends of the pipes 15, compelling the gas to make a turn and flow downward and then upward as it passes from the shell 1 into the shell 2. The bells 12 and 14 rest on ribs
105 on the bottom of the trough 11, leaving a space between the bottom of said trough and the lower rims of said bells.

From the top of the shell 2 leads a discharge-pipe 31 for the ammonia-gas which is
110 provided with a check-valve 16 and an air-escape valve 17. A pipe 18 enters the lower

shell 1 near the central portion thereof and reaches down to a point near the bottom thereof. Surrounding this pipe are a number of perforated conical plates 19.

Below the generator *a* is provided a suitable heater or lamp 20, containing just enough fuel for one operation—that is to say, it is arranged to heat the generator for a certain time only until the supply of fuel is exhausted—and the refrigeration then goes on for a considerable time, after which the receptacle 20 is again filled with fuel which is ignited and the operation is then repeated. After the generator has once been filled, which is done by forcing a solution containing ammonia into the pipe 18 through the connecting-pipe 30, provided with a valve 32, which is then closed, and the air has been allowed to escape through the pipe 17 all that needs to be done to operate my device is to fill the lamp 20 at intervals with fuel and light it. The apparatus then works automatically. The pipe 31 leads from the shell 2 to the condenser *b*, which consists of a coil of pipe 21, submerged in water in a tank 22, which tank is provided with a vertical air-flue 23 in its center. The lower part of the large coil 21 is connected by a pipe 33 with the expansion-valve 24, which is of a suitable type and which connects with a coil-pipe 25, which is located inside of a suitable refrigerator-chamber *c*. In the apparatus as shown the coil-pipe 25 is arranged in a tank 26, filled with a non-congealable liquid—such as brine, for example—but the use of such a tank is not strictly necessary. In either case I prefer to provide a drip-pan 27, provided with a water-sealed outlet-pipe 28.

The outlet end of the coil 25 is connected to the pipe 18, which runs into the generator and is provided with a check-valve 29.

My apparatus is so arranged that it will liquefy in one hour sufficient ammonia to cool the refrigerator for twenty-one hours, requiring but one operation each day. The lower part of the condenser-coil 21 acts as a receiver for the liquid ammonia. The amount of cooling water in the tank 22 should be large enough so that it should only be raised about 10° Fahrenheit at one heating operation, and it will then have twenty-three hours to cool off again. As the tank 22 is of considerable height, the lower part of the water therein will be of a practically uniform temperature, as the heated water will naturally rise to the upper surface, where it has ample time to cool off again before the next operation. The cooling of the condensing water is assisted by the central air-flue 23 in the tank and may be further assisted by making the tank 22 and also jacket 9 of corrugated iron, thereby increasing the cooling-surface.

The perforated conical plates 19 serve for retarding the ascent of the ascending gas-

bubbles and confine to some degree the liquid heated during absorption to the center of the apparatus. This heated liquor will naturally rise and a downward current will be established near the outer edge of said shell, and as this is continually cooled by the air-currents flowing upwardly between the casing 6 and the shell after the lamp 20 ceases to burn the heat of absorption will be rapidly carried away and the back pressure reduced.

If the liquor in the generator should start to boil over, especially when nearly all of the ammonia has been driven off therefrom, the vapor and moisture have to pass up through the tube 13, where it is deflected and passes downwardly in the separator 10, where the moisture is precipitated and drips back over the edge of the circular trough 11 into the shell 1. Any steam condensed in the shell 2 on account of the water-jacket 9 will drip back and return into the generator over the edge of the trough 11. If desired, I may use a deflector 35, though this is not indispensable, to cause the vapor and gas to come in contact with the cool walls of the shell 2. This deflector consists of a number of disks mounted upon a rod supported on the top of the shell 14.

I prefer to make the expansion-valve as an ordinary check-valve with a spring on its top with a set-screw to adjust the pressure, as desired. The temperature in the expansion or refrigerator coil 25 is in proportion to the back pressure. If the condensing pressure is two hundred pounds, for example, I adjust the expansion-valve to, say, one hundred and seventy pounds. Under these conditions the generator will also have two-hundred-pounds pressure during the distillation of the ammonia, but as soon as the lamp is extinguished the generator cools off, reducing its pressure and becoming an absorber. When the pressure in the generator, acting as an absorber, falls to thirty pounds, the expansion-valve 24 balances the condenser-pressure and any further reduction will admit liquid ammonia into the coil 25. If this should happen to cause the back pressure to rise in the absorber, the expansion-valve will close and cut off the flow of the liquid ammonia, which flow will not again commence until the pressure in the generator is reduced again to below thirty pounds by cooling. Ammonia expanding against thirty-pounds pressure has a temperature of about 17° Fahrenheit, which is usually sufficient for this kind of apparatus. Should a lower temperature be required, the screw in the expansion-valve is turned, reducing the tension of the spring.

The operation of my device is as follows: A solution of ammonia of about twenty-six per cent. is pumped into the generator through the valve 32. The water-jacket 9 and condenser-tank 22 are filled with water. The lamp 20,

filled with a predetermined quantity of fuel, is placed under the generator and lighted. The air-valve 17 is opened for a minute or so and then closed. For the first operation only the expansion-valve 24 is screwed down tightly. The heat of the lamp is rapidly conducted by means of the ribs 3 and 4 to the ammonia solution, expelling the gas and driving it into the condenser-coil 21, where it is liquefied by its own pressure and by the water in the tank 22. The gas rising from the liquid in the shell 1 passes through the pipe 13 of the separator 10, then changing its direction passes downward and again upward, going through the pipes 15. By this change of direction it deposits any moisture bodily carried along by the gas, which moisture drips back into the lower part of the generator over the edge of the trough 11 without allowing any gas to pass back. The gas passes now into the shell 2 of the generator, where it is partly cooled by the water-jacket, and any steam carried along with the gas will be there condensed and will drip back into the trough 11. After the fuel in the lamp has burned out cold air passes upward through the flues between the shells 1 and 6 and rapidly cools the generator, thereby reducing its pressure. A gage 34 is connected to the shell 1 and when this gage indicates a pressure of thirty pounds the spring in the expansion-valve is gradually released by means of the set-screw until frost commences to form on the expansion-valve. The valve is thereby adjusted for any further operation. The temperature of the brine in the tank 26 is reduced, thereby cooling the interior of the refrigerator *c*. The expanding gas enters the absorber through the lower end of the pipe 18 and is absorbed as it issues therefrom, or if it is only partly absorbed at the bottom it bubbles up and its course is determined by the concave perforated plates 19 and it is caused to pass toward the center of the generator in its upward movement. As it ascends it is gradually absorbed and the heat generated by the absorption is conducted off by means of the ribs 3 and 4 to the air-currents, passing around the shell 1 and between it and the shell 6. After the liquid ammonia has all evaporated, which will be shown by the melting of the frost on the expansion-valve 24, the operation can be repeated as often as desired.

I am aware that similar machines have been constructed and patented, but so far as I am aware they have all proved to be unsuccessful, being either too complicated, too expensive, or dangerous, or requiring constant care and watchfulness, or requiring a high degree of skill for their operation. The

boiling over and the passage of steam into the condenser has made many of them unreliable. Others could not be placed conveniently in an available space, as some parts had to be elevated. These objections are entirely absent in my machine. In addition to the cooling effect produced by the ribs 3 and 4 these ribs also serve to strengthen the generator, which therefore can be made with a thin shell.

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

1. In a refrigeration-machine, a generator formed in two compartments, a separator separating said compartments and composed of bells with pipes running therethrough, the ends of said pipes overlapping each other, and a trough surrounding the bottoms of said bells forming a water seal, substantially as described.

2. In a refrigeration-machine, a generator provided with longitudinal ribs on the outside and annular ribs on the inside, a casing surrounding the lower part of said generator forming flues, a water-jacket surrounding the upper part of said generator, diverting-plates arranged between the annular ribs in the upper part of said generator, and a separator located between the upper and lower part of said generator, substantially as described.

3. In a refrigeration-machine, the combination of a generator formed in two compartments, a separator separating said compartments and composed of bells with pipes running therethrough, the ends of said pipes overlapping each other, a trough surrounding the bottoms of said bells forming a water seal, a refrigerator, and means for cooling and liquefying the ammonia, substantially as described.

4. In a refrigeration-machine, the combination of a generator provided with longitudinal ribs on the outside and annular ribs on the inside, a casing surrounding the lower part of said generator forming flues, a water-jacket surrounding the upper part of said generator, diverting-plates arranged between the annular ribs in the upper part of said generator, a separator located between the upper and lower part of said generator, a refrigerator, and means for cooling and liquefying the ammonia, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

BURCHARD THOENS.

Witnesses:

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C. M. HERO.