C. E. MOLESWORTH.

REFRIGERATING APPARATUS.

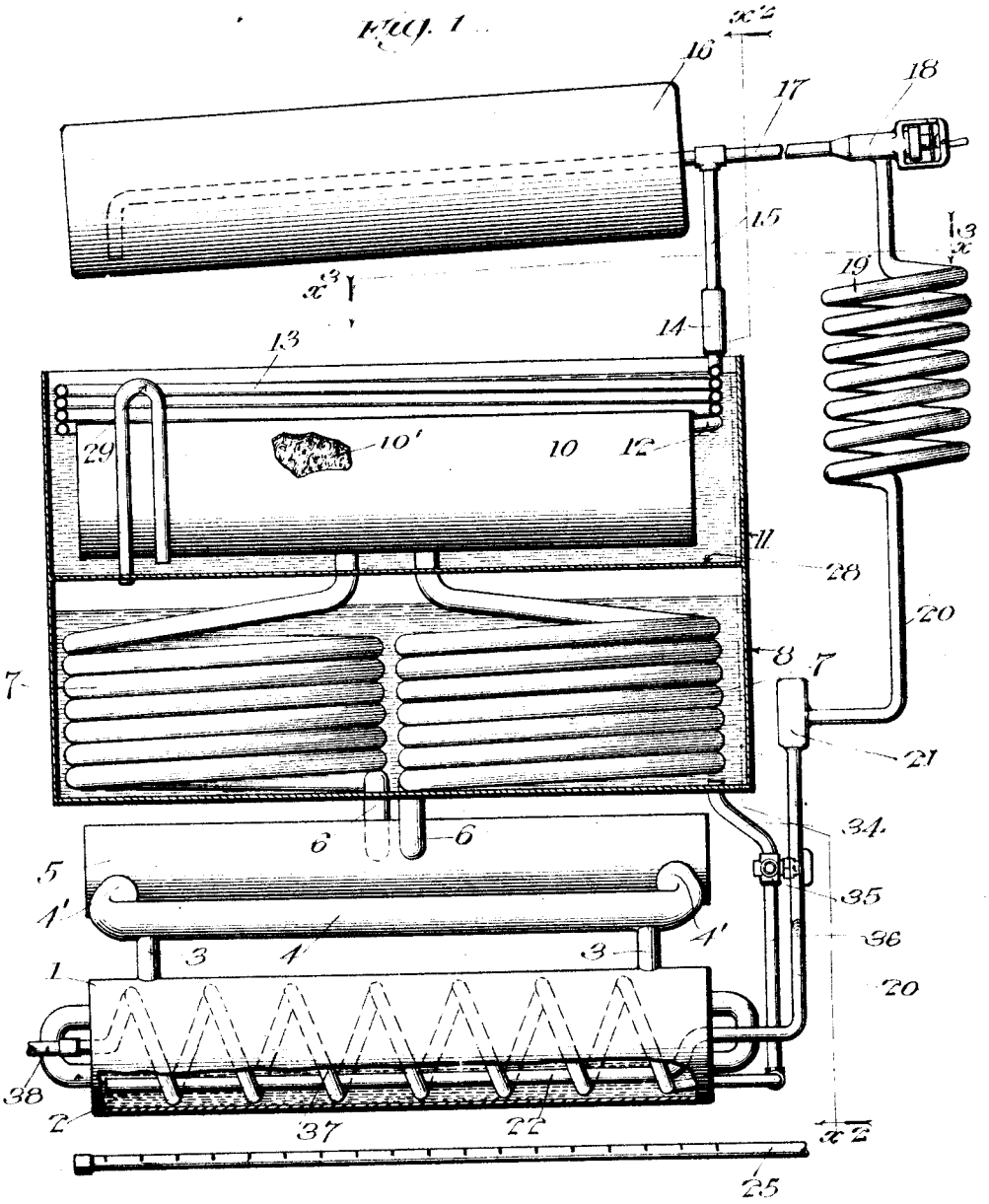
APPLICATION FILED SEPT. 9, 1913.

1,128,482.

Patented Feb. 16, 1915.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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by Lyon & Lyon

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2 SHEETS—SHEET 2.

Fig. 1.

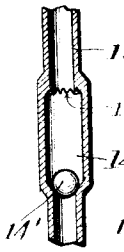


Fig. 2.

Fig. 3.

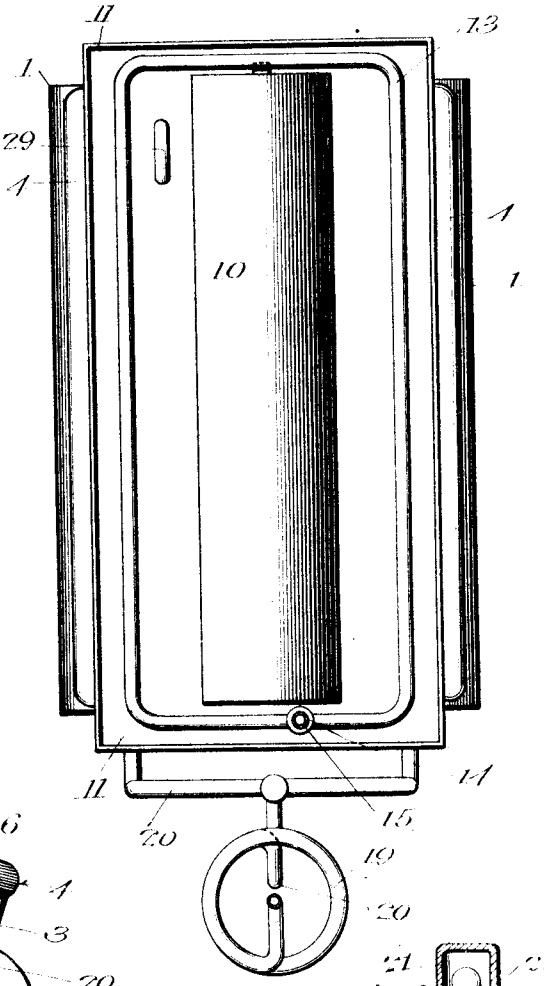


Fig. 5.

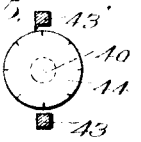


Fig. 6.

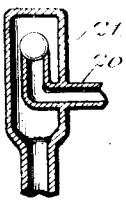


Fig. 4.

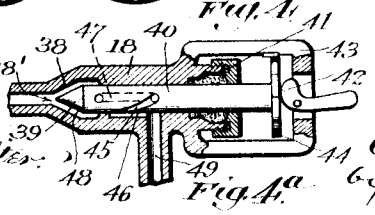
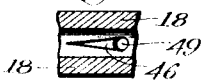


Fig. 4a.



Witnesses:

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UNITED STATES PATENT OFFICE.

CLYDE E. MOLESWORTH, OF LOS ANGELES, CALIFORNIA.

REFRIGERATING APPARATUS.

1,128,482. Specification of Letters Patent. Patented Feb. 16, 1915.

Application filed September 9, 1913. Serial No. 788,790.

To all whom it may concern:

Be it known that I, CLYDE E. MOLESWORTH, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Refrigerating Apparatus, of which the following is a specification.

This invention relates to a refrigerating apparatus which is especially designed and intended for small refrigerating plants such as in hotels, steamboats, private houses, etc., where it is desired to provide for refrigeration with an inexpensive, compact, apparatus.

The main object of the present invention is to provide an apparatus for refrigeration in which the amount of oversight and care is reduced to a minimum, so that the apparatus is not liable to get out of order by reason of inattention or abuse.

Another object of the invention is to provide a self-contained refrigerating apparatus which does not require connection with water supply means and may be moved bodily from place to place without having to make or break such connections.

The apparatus constituting the present invention operates upon the ammonia absorption principle and in this connection another object of the invention is to provide means for effectively cooling the evaporated gas.

A further object of the invention is to provide means for quickly cooling the absorbent liquid when desired, so as to enable the refrigerating cycle to be repeated more quickly than usual.

Other objects of the invention will appear hereinafter.

The accompanying drawings illustrate an embodiment of the invention, and referring thereto: Figure 1 is a vertical section of the apparatus partly in elevation. Fig. 2 is a transverse section on line x^2—x^2 in Fig. 1. Fig. 3 is a horizontal section on line x^3—x^3 in Fig. 1. Fig. 4 is a vertical section of the expansion valve. Fig. 4^a is a section of part of the casing of said valve. Fig. 5 is a section on line x^5—x^5 in Fig. 4. Figs. 6 and 7 are sectional views of the check valves.

The apparatus comprises a generator for containing the absorbent liquid, for example, water, means for heating the generator to evaporate the gas, for example, ammonia, absorbed in the water, means for receiving and cooling the evaporated gas and for removing from the gas the moisture contained therein, means for receiving the condensed gas, means for expanding the condensed gas to produce refrigeration, and means for delivering the expanded gas back to the generator.

The generator comprises any desired number of tanks or casings 1, three of such tanks being shown in the drawing, and the tanks being formed as cylinders closed at each end and adapted to contain a body of water indicated at 2 for absorbing ammonia. From the upper part of the respective cylinders or tanks 1, outlet pipes 3 lead to drums 4 having portions 4′ extending obliquely upward into a settling drum or tank 5 located above the generator tanks. From said drum or tank 5, outlet pipes 6 extend upwardly and are formed into coils 7 extending within a cooling tank 8, the upper ends of said coils communicating with a rectifier tank or drum 10 located in a tank 11 above the tank 8. This tank contains mineral wool indicated at 10′ for retaining any water that may tend to pass over with the ammonia. An outlet pipe 12 leads from the upper part of said rectifier tank and is bent to form a coil 13 also located in the tank 11, the upper end of the said coil 13 being connected through a check valve 14 and pipe 15 to tank 16 for condensed anhydrous ammonia. An outlet pipe 17 extending into said tank 16 communicates with an expansion valve 18 whose outlet or low pressure side is connected to an ammonia expanding means such as a coil 19 for receiving the expanded gas and utilizing same in cooling brine or in direct cooling of the air, or other object to be cooled, said coil 19 being located in a refrigerator or in any place where it is desired to produce the cooling effect. From the coil 19 the pipe 20 leads through the check valve 21 to the pipes 22 extending within the generator tanks 1 to deliver the ammonia gas to the said tanks 1 during the absorption period of the cycle. The check valve 14 is preferably of the construction shown in Fig. 7, the upper end of pipe 13 being slipped into a tubular metal valve body 14, and welded thereto, and the ball 14′ being then put in place and the upper pipe 15 corrugated as at 15′, inserted and welded in position giving a hermetically sealed check valve. The valve 21, shown in Fig. 6 is similarly constructed except that the inlet is from the side. A suitable construction of

expansion valve is shown in Fig. 4, the valve casing 18 having a taper seat 38 at its inlet port 38′, adapted to be engaged by a taper valve portion 39 on the cylindrical valve member 40. Valve member 40 is mounted to slide as well as turn in casing 18, a stuffing box 41 being provided therefor. A cam device 42 pivotally mounted on a bracket 43 on casing 18 serves to press the valve longitudinally into contact with its seat when it is desired to close the valve, or to allow it to move to open position under the pressure of the ammonia. In the latter case, the degree of opening of the valve may be adjusted by turning the valve member 40 by means of a graduated hand wheel 44, so as to bring a spiral tapered groove 45 in member 40 into more or less full coöperation with a tapered groove 46 in the valve casing, said groove 45 communicating through bore 47 with the inlet chamber 48 of the valve and said groove 46 communicating with the outlet 49 of the valve. Each of the said tanks and drums 1, 4, 5, 10 and 16 is formed of suitable metal such as wrought iron, capable of withstanding permanently a pressure of 125 to 150 pounds or more, and not subject to corrosion by the liquids used for refrigeration. The various coils and pipes are also of similar material and the tanks, drums, coils and pipes are connected together by welded or fused connections in such manner that the entire structure forms an integral unitary metallic body without joints or seams and is, therefore, adapted to retain the ammonia which is originally charged thereinto without loss or waste. The only place where there is any possibility of communication with the outer air is through the packed joint 41′ of the expansion valve 18, where the spindle or stem of the valve passes through the stuffing box of the valve.

Suitable means such as burners, indicated at 25 are provided for heating the generator tanks 1 to evaporate the ammonia.

The tanks 8 and 11 are adapted to contain water and are preferably located one above the other to form a single structure consisting, for example, of sheet metal formed as a box with a horizontal plate 28 forming a partition between the upper and lower tanks 8 and 11. An overflow pipe 29 extends through said plate 28 and upwardly into the upper tank 11 and is bent over to form a siphon outlet, the said overflow pipe communicating at its lower end with the tank 8 so as to enable charging of said tank 8 by overflow from the upper tank. From the bottom of the tank 8 a discharge pipe 34 leads to a valve 35, the outlet of which is connected to a pipe 36 which communicates with coils 37 extending through within the respective generator tanks 1 and having a discharge outlet connection at 38.

The generator tanks 1 are charged with a binary liquid, for example, ammonia absorbed in water, this charging taking place once for all in the manufacture of the apparatus and care being taken that all of the air is expelled from the water so that the medium contained within the circulatory system of the apparatus consists wholly of ammonia and water. As neither of these substances in the pure condition has any effect on wrought iron the apparatus will last substantially indefinitely without rusting and as there are no joints in any part of the wall of the apparatus, the ammonia contained within the apparatus is hermetically sealed from communication with the outside atmosphere, except as above stated, at the expansion valve, so that there is no deterioration of the ammonia due to such communication. In case, however, there is any slight decomposition of the ammonia due to overheating thereof in the generator, the resultant gases may find vent through this joint at the expansion valve, at any time when the condensed ammonia tank 16 is nearly or quite empty.

The upper tank 11 is charged with water so as to submerge the rectifier in said tank and an excess of water is supplied to the tank 11, such excess overflowing through the siphon outlet 29 to the lower tank 8, the tanks being filled, for example, to the levels indicated in Fig. 1. The valve 35 is normally closed, being only open when an extra rapid cooling of the generator is desired.

The operation is as follows: In starting the cycle of operations, the expansion valve 18 may be closed and the burner 25 is operated to heat the generator 1, causing the ammonia gas to boil off or evaporate from the body of water in said generator, the resultant gas or vapor passing through the outlets 3 to the drums 4 and 5. In these drums any water that is boiled off or entrained with the evaporating ammonia is allowed to settle and runs back into the generator. The gas or vapor passes from the drum 5 through the outlet pipes 6 to the coils 7 wherein it is cooled by the action of the water in the tank 8 and any water condensed by such cooling, drains back to the drum 5. The cool and relatively dry gas then passes to the rectifier 10 wherein it is subjected to a final dehydrating action and is cooled to nearly the point of condensation of the ammonia water under the pressure resulting from the evaporation in the generator, such pressure being, for example, about 125 pounds per square inch and existing at this time throughout all of the parts connected to the generator and between the generator and expansion valve. Any water vapor or moisture contained in the ammonia vapor which is condensed in this rectifier is held by the rectifier from passing along

with the ammonia vapor, so that the ammonia gas or vapor which passes through the outlet 12 of the rectifier is substantially anhydrous and is about the temperature of condensation. In passing through the cooling coil 13, the ammonia is condensed and the liquid anhydrous ammonia accumulates in the tank 16. When the evaporating operation has been completed, the burner 25 is turned off and the generator is allowed to cool to normal temperature. The liquid ammonia contained in the tank 16 cannot pass back to the generator through the pipe 15 and the cooling drums and coils for the reason that the check valve 14 prevents such passage. The body of liquid ammonia in tank 16 is therefore retained under full pressure as long as may be desired. During the heating operation above described, the check valve 21 prevents passage of ammonia gas backwardly from the generator to the pipe 20 and refrigerating coil 19, the aforesaid check valves 14 and 21 insuring movement of the fluid in one direction only. When the generator cools, the check valve 21 allows passage of ammonia from the coil 19 through the pipes 22 and tank 1, so that by reason of the absorptive action of the water on the ammonia gas or vapor, a condition of partial vacuum is produced in the coil 19. When, therefore, the expansion valve 18 is opened, the ammonia gas expands from a condition of liquid at about 125 pounds pressure to a gas or vapor at a pressure somewhat less than that of the atmosphere, and the expanded gas passes through the coil 19 and cools the said coil and the brine, air or other objects in proximity thereto by reason of the drop of temperature of gas or vapor in its expansion from a condition of liquid. The ammonia gas or vapor which enters the coil 19 in this manner is continually drawn therefrom by the absorptive action of the body of water in the generator 1, so that a low pressure is continually maintained in the refrigerating coil 9. When it is desired to cool the generator quickly so as to enable the refrigerating cycle to be performed more rapidly the valve 35 may be opened, allowing water to flow from the tank 8 through the pipe 34, valve 35, pipe 36 and coils 37 to the outlet 38, the cool water thus drawn from the tank 8 serving to cool the heated water in the generator tanks 1. Under these circumstances it is necessary to pour additional water into the upper tank 11, sufficient to make up for the water drained from said tank 8 in this operation. It will be understood that when tank 11 is filled above the bend of siphon 29, the water in said tank siphons off into tank 8 until the water level falls below the inlet of the siphon, but by filling the tank 11 to just below the overflow level, the tank may be kept full.

What I claim is:

1. In a refrigerating apparatus comprising a generator, means for heating said generator, a settling drum located above the generator and communicating therewith, cooling coils located above said settling drum and communicating therewith, a water receiving tank surrounding said cooling coils, a rectifier located above said cooling coils and communicating therewith, a water receiving tank surrounding said rectifier, an overflow outlet from said second tank to said first tank, and a valved outlet from said first named tank.

2. In a refrigerating apparatus comprising a generator, means for heating said generator, a settling drum located above the generator and communicating therewith, cooling coils located above said settling drum and communicating therewith, a water receiving tank surrounding said cooling coils, a rectifier located above said cooling coils and communicating therewith, a water receiving tank surrounding said rectifier, an overflow outlet from said second tank to said first tank, and a valve outlet from the said first named tank, and a pipe communicating with said valve outlet from said first named tank extending through said generator to cool the generator by water from said first named tank.

In testimony whereof, I have hereunto set my hand at Los Angeles, California this 2nd day of September 1913.

CLYDE E. MOLESWORTH.

In presence of—
A. P. KNIGHT,
LORA M. BOWERS.