(No Model.)

G. W. STOCKMAN.

COOLING AND ABSORBING APPARATUS FOR AMMONIA REFRIGERATING OR ICE MACHINES.

No. 304,872. Patented Sept. 9, 1884.

Fig. 2.

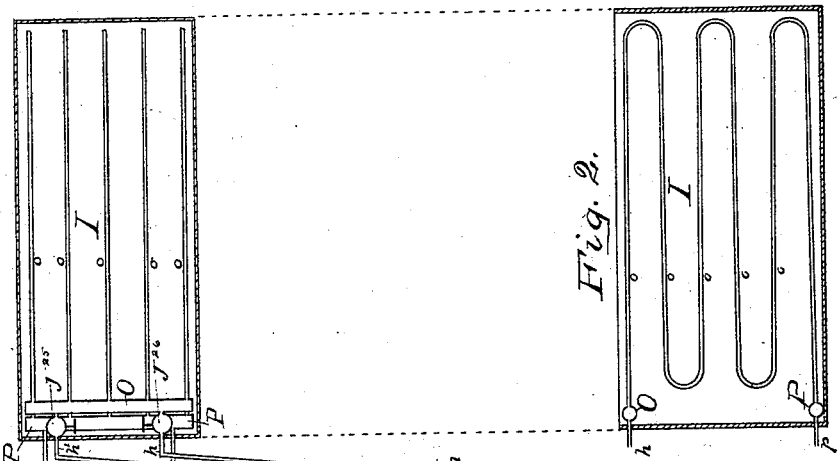
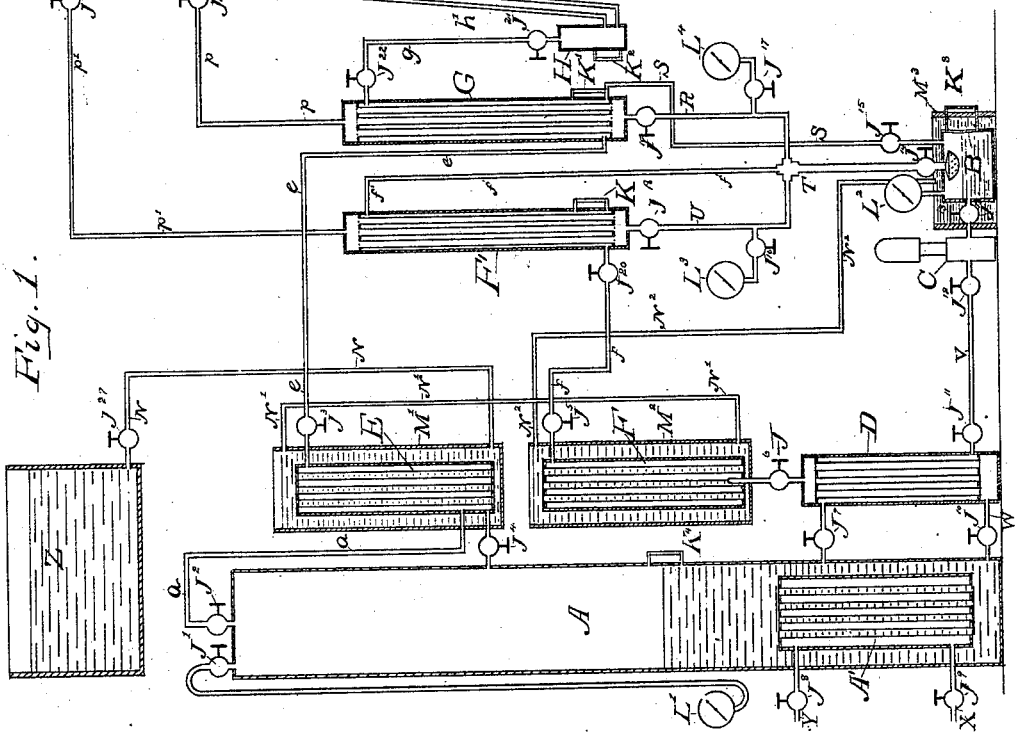


Fig. 1.



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COOLING AND ABSORBING APPARATUS FOR AMMONIA REFRIGERATING OR ICE MACHINES.

SPECIFICATION forming part of Letters Patent No. 304,872, dated September 9, 1884.

Application filed November 15, 1883. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. STOCKMAN, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented a new and useful Cooling and Absorbing Apparatus for Ammonia Refrigerating or Ice-Making Machines, of which the following is a specification.

My invention relates to improvements in ammonia refrigerators and ice-making machines in which my improved gas cooling and absorbing apparatus is used in connection with a retort, drier, exchanger, cooler, pump, and expansion-box of ordinary form; and the object of my invention is to effect a continuous circulation of the ammonia, either as a free gas or in a liquefied or absorbed form, the absorbing medium in the latter case being the weak or dilute liquor ammonia, which has been reduced in temperature by the joint action of a cold-water bath and the refrigerating-power of the partially-spent gas from the expansion-box. I attain this object by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 represents my improved cooler and absorber and their connection with a retort, a drier, a cooler, an exchanger, a pump, and an expansion-box. All the parts in this figure are shown in vertical section, with the exception of the expansion-box, which is shown in plan or top view. Fig. 2 is a vertical section of the expansion-box.

Similar letters refer to similar parts throughout the two views.

A represents a retort or evaporator, with heater A′.

B is a receiver for the weak ammonia-gas from the expansion-box.

C is a force-pump, of common form.

D is an exchanger, through which the weak liquor, with its absorbed gas, passes in going from the pump C to the retort A. It has a number of longitudinal flues emptying into collecting-chambers at each end, and through which flows a current of hot dilute liquid ammonia from the retort A to the cooler F. It is called an "exchanger" because the two currents of liquid ammonia moving to and from the retort A pass each other at this point, and, as each contains different degrees of heat, the tendency is to exchange temperatures.

E is a drier through which the freshly-evaporated ammonia-gas is forced. In construction it is a small tubular boiler of common form, and is surrounded by the water-jacket M′.

F is a cooler. It is a small tubular boiler, similar in construction to the drier E, and is surrounded by the water-jacket M^2. The dilute liquor ammonia from the retort A, after passing through the exchanger D, is here further reduced in temperature by the action of the cold water in the jacket M^2.

F′ is a second cooler for the weak ammonia-liquor. It has a number of longitudinal tubes emptying into a collecting-chamber at each end. The partially-spent ammonia-gas from the expansion-box I passes through these tubes, and by means of its remaining refrigerating-power lowers the temperature of the liquor in the body of the cooler.

G is a condenser, and is similar in construction to the cooler F′, having longitudinal tubes emptying into collecting-chambers at each end of the cooler. The partially-spent ammonia-gas from the expansion-box passes through these tubes, and by its remaining refrigerating-power lowers the temperature and tends to condense the freshly-evaporated gas in the body of the condenser.

H is the liquefier, where the ammonia-gas from the retort A, after being cooled and condensed, is collected in a liquefied form.

I is the refrigerating or expansion box, of common form.

J′ J^2 J^3, &c., are valves for regulating the flow through their respective pipes.

K K′ K^2 K^3 K^4 are water-glasses.

I/ L^2 L^3 L^4 are pressure-gages.

Z is a cold-water tank, and furnishes the water through the pipe N to the water-jacket M′.

N′ is a pipe leading from the top of the water-jacket M′ to the bottom of the water-jacket M^2, and carries the surplus water from M′ to M^2.

N^2 is a pipe leading from the top of the water-jacket M^2 to the water-jacket M^3, and

carries the surplus water from M^2 to M^3. By this arrangement the same water from Z is successively utilized in the three water-jackets.

O, Figs. 1 and 2, is the distributing-manifold, into which the condensed ammonia passes after leaving the liquefier H.

P, Figs. 1 and 2, is the collecting-manifold into which the ammonia-gas is collected after it has been allowed to expand through the coils of pipe *o o o o o*, Figs. 1 and 2, in the expansion or refrigerating box I.

o o o o o, Figs. 1 and 2, represent several independent coils of pipe, one end of each coil starting from the distributing-manifold O and discharging at the other end into the collector P.

The operation of my improved cooler and absorber, with the other apparatus, is as follows: The retort A, which is made of iron strong enough to withstand an extremely high pressure of ammonia-gas, is partially filled with aqua-ammonia, and heat is applied by means of steam introduced through the pipe Y into the heater A′. A′ may be a small boiler, as shown, or it may be a plain cylinder, or simply a coil of pipe. The exhaust-steam escapes at X.

J^8 and J^9 are valves to regulate the current of steam passing to and from the heater. The proper amount of aqua-ammonia in the retort A is indicated by the water-glass K^1. When the steam is admitted to the heater A′, the action of the heat evaporates the aqua-ammonia in the retort A, and the vapor is forced by the resulting pressure through the pipe *a*, leading from the top of the retort into the drier E.

J^2 is a valve for regulating the discharge of the vapor through the pipe *a*.

L′ is a pressure-gage conveniently attached to the retort A, to indicate the amount of pressure in the retort.

J′ is a valve in the pipe communicating with the gage. The vapor from the retort A is carried through the pipe *a* into the drier E. This drier is surrounded by the cold-water jacket M′, the water in the water-jacket completely enveloping the drier and filling the longitudinal tubes in the drier. The cold water surrounding the drier cools the vapor contained within it and condenses the steam and watery portion, which, collecting as water in the bottom of the drier, is drained back into the retort A by opening the valve J^4. The dry ammonia-gas in the drier E then passes through the pipe *e* into the gas-condenser G, (the supply being regulated by the valve J^3,) where it is reduced in temperature and condensed by the refrigerating-power of the partially-spent gas from the expansion-box I, as will hereinafter be more fully described.

The condenser G is provided with the water-glass K′ near the bottom, which will indicate the presence of any water or weak liquor that, having escaped the drier, may have been condensed and collected here, in which case it may be drained through the pipe S into the receiver B by opening the valve J^{15}. From the condenser G the gas passes through the pipe *g* into the liquefier H. The pipe *g* is provided with the stop-valves J^{21} and J^{22}, by which to control the supply of gas through the pipe. The ammonia-gas, being under pressure and sufficiently reduced in temperature, is here collected in a liquid form, the amount of liquid being indicated by the water-glass K^2. From the liquefier the ammonia-liquid passes through the two pipes *h* and *h′* to the distributing-manifold O, placed at one end and near the top of the expansion-box I. The two pipes are used instead of one, in order to give two points of delivery, thereby affording a more speedy and perfect distribution of the liquor through the manifold, and from the manifold into the coils of pipe *o o o o o*. The condensed and liquefied gas, being relieved of its pressure, volatilizes with great rapidity, and, rushing through the coiled pipes, absorbs the heat in the brine, with which the expansion-box is filled, and in which the coils are immersed. The gas, after its expansion and passage through the coils, is collected into the collecting-manifold P, Figs. 1 and 2, and from there is carried by the pipes *p* and *p′* into the condenser G and cooler F′, respectively, the pipe *p* being provided with the stop-valve J^{23}, and *p′* with the stop-valve J^{24}, for regulating the flow of gas through the pipes.

From the bottom of the retort A the pipe W passes into the bottom of the exchanger D. The exchanger D, as before described, has a number of longitudinal tubes running through it, said tubes emptying into a collecting-chamber at each end of the exchanger. The pipe W connects with the chamber in the bottom of the exchanger, and when the stop-valve J^{10} is opened the aqua-ammonia or weak liquor in the retort A is forced, by the pressure in the retort, through the tube W into the lower chamber in the exchanger D, from whence, through the longitudinal tubes, it passes to the upper chamber, and from there, when the valve J^6 is opened, it passes through the connecting-pipe into the bottom of the cooler F. The cooler F is immersed in the cold-water jacket M^2. A greater cooling-surface is secured in the cooler by passing a number of pipes longitudinally through it, as in a tubular boiler of common form, the tubes being open to the circulation of the water in the jacket M^2. From the cooler F the weak liquor passes to the cooler F′ through the pipe *f*, which connects the top of the cooler F with the bottom of the cooler F′. The pipe *f* has the stop-valves J^5 and J^{20}, for regulating the flow of liquor from F to F′.

The cooler F′ in construction is similar to the exchanger D—that is, it has a collecting-chamber partitioned off at each end and the two chambers connected by a number of parallel pipes. The body of the cooler, by means of the pipe *f*, is filled with weak liquor. The parallel pipes connecting the upper and lower collecting-chamber pass through this weak liquor, and through the parallel pipes passes

the partially-spent ammonia-gas from the collecting-manifold P in the expansion-box I. The weak ammonia-liquor flows in at the bottom of the cooler F′ through the pipe *f*, and out at the top of the cooler through the pipe *f′*. The partially-spent ammonia-gas from the expansion-box I flows into the top of the cooler F′ through the pipe *p′*, passes through the parallel tubes, and out at the bottom of the cooler through the pipe U. The refrigerating-power of the partially-spent ammonia-gas, in passing through the weak liquor, lowers the temperature of the liquor and leaves it in a condition to more rapidly absorb the free gas in the next step of the process. The cooler F′ is provided with a water-glass, K, for determining the height of the weak liquor in the cooler.

The condenser G is identical in construction with the cooler F′. It has the parallel pipes emptying into a collecting-chamber at each end of the condenser. The body of the condenser is filled by means of the pipe *e* with the freshly-evaporated ammonia-gas from the drier E. The partially-spent gas from the collecting-manifold P enters the top collecting-chamber of the condenser through the pipe *p*, and, passing down through the parallel pipes connecting the upper and lower collecting-chambers, leaves the condenser through the pipe R at its lower end. The refrigerating-power still remaining in the partially-spent gas from the expansion-box I, in passing through the condenser G, lowers the temperature of the freshly-evaporated gas with which the condenser is filled. The gas, entering at the bottom through pipe *e*, passes out at the top through the pipe *g*.

The water-glass K′ is to indicate the presence of any liquid matter that may collect in the bottom of the condenser, and the pipe S is to convey this liquid down into the receiver B by opening the valve J^{15}. The weak ammonia-liquor, entering the cooler F′ by the pipe *f*, leaves the cooler by the pipe *f′*, and descends to the receiver B. The partially-spent ammonia-gas, after leaving the expansion-box I, passes through the pipes *p* and *p′* (the amount of flow being regulated by the stop-valves J^{23} and J^{24}) into the cooler F′ and condenser G, and out of these retorts through the pipes U and R, respectively. These pipes U and R are brought together at T, and are met at this point by the pipe *f′*, and all then unite to form a single pipe leading directly to the receiver B. The pipe *f′* conveys the weak ammonia-liquor, and when the two pipes U and R meet it at T the spent gas in the pipes U and R intermixes with the liquor in *f′* and is absorbed by mutual affinity. The quantity of gas circulating through the pipe U is regulated by the stop-valve J^{18}, and through the pipe R by the valve J^{19}. The number of pounds pressure in the pipe U is indicated by the pressure-gage L^3, and in the pipe R by the pressure-gage L^4.

J^{16} and J^{17} are stop-valves regulating the supply of gas to the gages. The liquor, with its absorbed gases, is discharged through the rose-jet or sprinkler into the receiver B, the discharge being regulated by the stop-valve J^{14}. This liquor in the receiver B is then returned to the retort A by means of the force-pump C. The amount of pressure in the receiver at any time is indicated by the pressure-gage L^2, and the quantity of liquor by the water-glass K^3. The receiver is kept cool by being immersed in the water-jacket M^3. The supply of liquor from the receiver to the force-pump is regulated by the valve J^{13}. After the liquor leaves the force-pump C it passes through the pipe V, with its regulating-valves J^{11} and J^{12}, into the exchanger D. From the exchanger it passes into the retort A through the connecting-pipe at the top of the exchanger. The valve J^7 regulates the flow of liquor from the exchanger to the retort.

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

1. In an ammonia refrigerating-machine, the partially-spent gas from the expansion-box I, divided into two currents, one current passing through the cylinder G and cooling the freshly-evaporated ammonia-gas, and the other current passing through the cylinder F′ and reducing a stream of weak aqua-ammonia to a temperature most favorable for absorbing the two currents of spent gas when the two latter and the stream of aqua-ammonia are combined in the tube T, substantially as described and specified.

2. The weak-liquor pipe *f′*, in combination with the spent-gas pipe U and spent-gas pipe R, to obviate the necessity of an absorbing-vessel, as described, and for the purposes specified.

3. An ammonia refrigerating and ice-making machine in which the dilute aqua-ammonia is made to absorb the spent ammonia-gas without passing through an absorber, and without the aid of an absorber as a separate vessel, substantially as described, and for the purposes specified.

4. An ammonia refrigerating and ice-making machine in which the spent ammonia-gas and a stream of cold dilute aqua-ammonia are together forced through a single tube, T, with its sprinkler or rose-jet, into the receiver B, and from the receiver B forced by the pump C into the retort A before the retained gas can liberate itself from the dilute aqua-ammonia, substantially as described, and for the purposes mentioned and set forth.

5. An ammonia refrigerating or ice-making machine in which the absorber is discarded by passing the spent ammonia-gas and a stream of specially-cooled dilute aqua-ammonia through a single tube, T, emptying through a rose-jet or sprinkler directly into the receiver B, substantially as and for the purposes mentioned and set forth.

6. The liquefier H, water-glass K^2, pipes *h* and *h′*, valve J^{21}, pipe *g*, valve J^{22}, and con-

denser G, combined as described, and for the purposes specified.

7. The cooler F′, pipe *f*, valve J^{20}, water-glass K, pipe *p′*, pipe *f′*, pipe U, valve J^{18}, valve J^{16}, pressure-gage L^3, condenser G, pipe *e*, pipe *p*, pipe *g*, water-glass K′, drain-pipe S, pipe R, valve J^{19}, valve J^{17}, pressure-gage L^4, and pipe T, combined substantially as described, and for the purposes specified.

8. An ammonia refrigerating or ice-making machine without an absorber as a separate vessel for absorbing the spent ammonia-gas, substantially as described and specified.

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