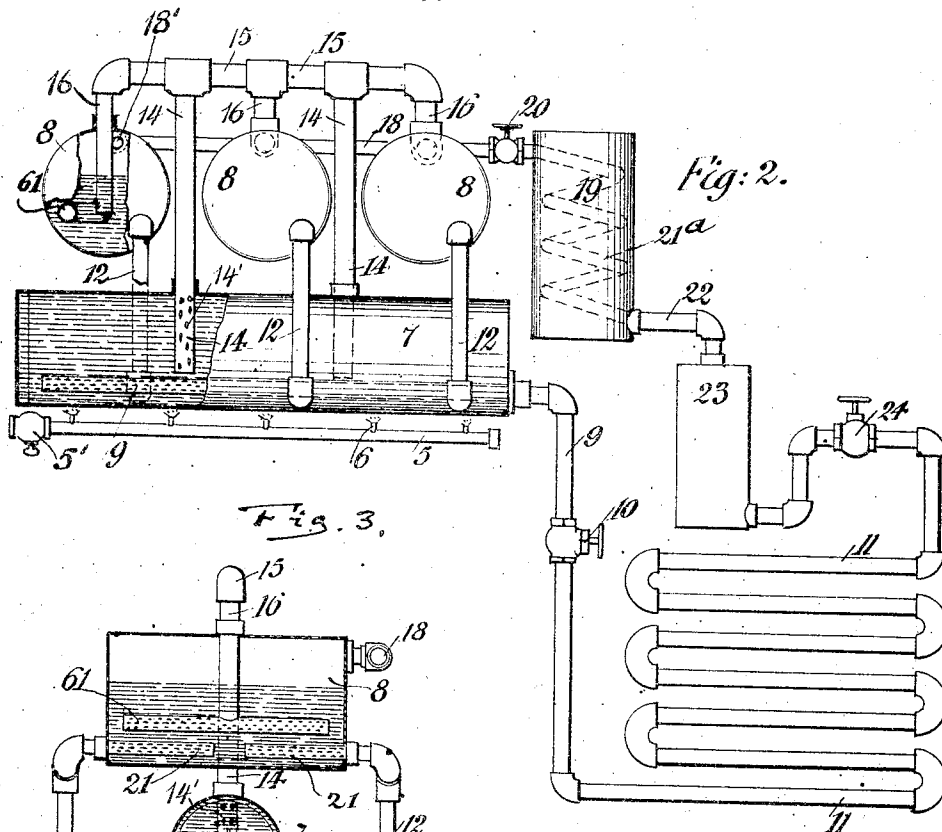
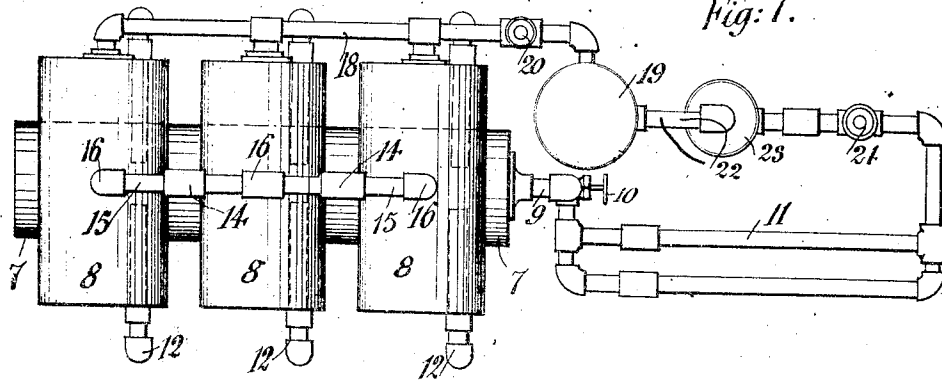


D. C. SMITH.
REFRIGERATING MACHINE.
APPLICATION FILED JUNE 29, 1911.

1,038,221.

Patented Sept. 10, 1912.



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UNITED STATES PATENT OFFICE.

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REFRIGERATING-MACHINE.

1,038,221.

Specification of Letters Patent.

Patented Sept. 10, 1912.

Application filed June 29, 1911. Serial No. 635,996.

To all whom it may concern:

Be it known that I, DANIEL C. SMITH, a citizen of the United States of America, formerly a resident of Brooklyn, New York, and now a resident of Milford, Connecticut, have invented certain new and useful Improvements in Refrigerating-Machines, of which the following is a specification.

My invention relates to improvements in refrigerating machines and apparatus. The refrigerant which I employ is preferably ammonia, and my invention has special reference to apparatus for employment in those processes of refrigeration which are characterized by the distillation of ammonia from ammonia water, the condensing and storing of the ammonia under pressure, the expansion of the ammonia in a refrigerating element such as an expansion coil, and, cyclically, the re-absorption of the ammonia by the water residue of the distillation. It has been proposed to conduct such processes without resort to mechanical power-actuated accelerating or relaying devices, such as circulating and compression pumps; but up to this time, as I am informed, no project of the kind has ultimated in any process of apparatus of a practical or commercial nature. The common purpose of inventors in this branch of the art has been to avoid the employment of moving parts, pumps and the like, and, generally, to avoid the use of machinery and apparatus which would require expert knowledge or skill for its operation, and to provide apparatus which would be reliable, safe, efficient, economical, and yet be simple and cheap to manufacture. These have also been my objects, yet up to the time of making the invention and discoveries herein disclosed, my experiments, like those of my predecessors, were productive only of processes and apparatus which were uncertain and unreliable, and which, if approximately safe, were not efficient; and, if approximately efficient, were most dangerous and unsafe, even in the hands of persons thoroughly familiar with the art.

The apparatus or machine constituting the subject-matter of this application comprises a number of constantly closed receptacles joined by a simple system of pipes and which, except for a few valves in said pipes, is free from moving parts. This apparatus is reliable as to results to be secured from time to time; is efficient and economi-

cal; and is entirely safe, even when operated by persons having little skill in the art. The apparatus is such that it may be made in the small sizes desirable for household usage, and also in the larger sizes required by factories and plants calling for more extensive refrigeration.

I attain reliability in operation by securing a substantially anhydrous distillate at each distillation of the ammonia water, and by maintaining the ammonia water in maximum absorptive condition during refrigeration. The efficiency of my invention arises from this obtainance and use of anhydrous ammonia, coupled with the advantages attained by securing a maximum quantity of distillate from a minimum of heat expended, and which also result in the re-absorption thereof during refrigeration.

Economy is assured by the small consumption of heat, by the simplicity of the apparatus, and by the general avoidance of parts which would require more attention or a higher degree of skill on the part of the user.

I attain safety by employing a completely closed system and, more particularly, by constructing the apparatus in such manner as to avoid and prevent the formation or accumulation of bodies of either steam or ammonia gas in that part of the system in which the distillation of the ammonia is initiated and to which heat at high temperature is necessarily applied.

As more fully explained hereinafter, I attain these desirable and necessary effects and advantages chiefly by the manner in which I treat and manipulate the ammonia water at times of distillation and at times of absorption; that is, at times of distillation I treat and manipulate the ammonia water in such manner as to substantially preclude the escape of steam from the ammonia water; and, during the absorption period, and in the same manner, I preclude the escape of ammonia gas from the ammonia water. By insuring the complete absorption of the returned ammonia, I make it possible to maintain an efficient vacuum above the ammonia water, and hence permit greater expansion of the ammonia gas. As will appear hereinafter, a partial vacuum is created by the cooling of the ammonia water in the interval between distillation and absorption, and by preventing the escape of ammonia

gas during absorption the effect of this partial vacuum is preserved until the water becomes saturated. I divide the requisite quantity of ammonia water primarily into upper and lower bodies, in closed containers or tanks at different elevations, and place them in siphonic circulatory connection by means of suitable pipes or conduits. Whenever the temperature of the liquid in the lower tank exceeds that of the liquid in the upper tank or when the states of saturation are different, the liquid, through differences in specific gravity, will rise from the lower tank into the upper tank, and the cooler or heavier liquid in the upper tank will fall or flow downward into the lower tank to replace the lighter liquid rising therefrom. Thus the lower tank is always kept full of liquid. This circulation takes place in both the distilling and the absorbing steps or periods, differences of temperature existing at both times; for, as herein-after explained, I apply heat to the lower tank, to distil the ammonia; and in the absorbing period I admit the ammonia gas to the lower tank and hence the lower body of liquid is the first to receive the heat liberated therefrom. The rapidity of the circulation is primarily induced and determined by the differences of temperature in the two tanks, and in the several parts thereof, but is augmented or accelerated by two forces which operate during the distilling and absorbing periods, respectively, said forces being local differences of pressure in the two tanks. The first of these differences of pressure is occasioned by the vapors and gases that are rapidly evolved when the lower tank is externally heated, and the second difference of pressure is induced by the heat given off in the lower tank when the ammonia gas recombines with or is absorbed by the water; aided by the partial vacuum which I am careful to create and maintain above the liquid in the upper tank prior to and substantially throughout the absorbing period.

The described circulation of the liquid hastens the liberation of the ammonia gas from the ammonia water when the lower tank is heated, and at the same time prevents the attainment of dangerous temperatures or pressures. When the hot liquid rises from the lower tank, its temperature is often sufficient to admit of the presence of steam bubbles, but in circulating through the pipes and in being diffused in the cooler water in the upper tank, much of this heat is lost by heat radiation and absorption, and the steam is immediately condensed and not permitted to pass off with the ammonia gas. This goes far to explain the reliability and efficiency of my apparatus, for it follows that the gas which is evolved or distilled is substantially anhydrous. While main-

taining in the upper tank a temperature which causes the condensation of the steam, I at the same time hold that temperature at such a point that there is substantially no re-absorption of ammonia gas in the upper tank after the first few minutes of distillation; this adds much to the efficiency of the apparatus inasmuch as waste of heat is thereby avoided. Similarly, the described circulation of the liquid, during the absorption period, insures the rapid dissipation or radiation of the heat caused by the absorption or re-combination of the ammonia gas with the water, and also insures the retention of the free gas in water until combination or absorption is complete. I place little if any reliance upon the surface absorption of gas by the water in the upper tank, and on the contrary am careful to keep the gas immersed in the water until it is absorbed, to the end that the vacuum before referred to may be maintained substantially throughout the absorbing period, and efficiently, until the water has reached a state of substantially complete saturation with ammonia. These conditions being preserved, it follows that the re-absorption of the ammonia may be protracted over a very considerable period, and it also follows that the expansion of the gas in the refrigerating element will not be opposed by back pressure in the tanks and will be highly efficient.

To insure the described condensation of steam during the distilling operation, and to create and maintain the partial vacuum in the upper tank after distilling and during the absorption period, I am careful to prevent the free discharge of either ammonia water, steam or gas into the upper part of the upper tank, that is, above the surface of the liquid therein. In other words, I confine the circulation to and within the bodies of the liquid. I accomplish this by means of one of the pipes before referred to, which pipe rises from the lower tank, enters the upper tank, and opens below the surface of the liquid therein. That is, I insure such condensation, and insure and maintain the described vacuum by extending this pipe downward in the upper tank, to a point considerably below the surface of the liquid therein. The pipe which conducts the liquid from the upper tank to the lower tank extends from the lower part of the upper tank to the lower part of the lower tank. In this manner I effectually seal the upper tank against the entrance of steam or gas except through the medium of the liquid contained therein. This results in the elimination of steam from the distillate during the distilling operation, and further results in preventing the rise of vapors or gas into the vacuum space in the upper tank during the absorption period, the gases as before stated being held in a

state of submersion and admixture with the water until absorbed thereby, so that the partial vacuum is not destroyed until, under normal conditions, the water has reached a state of substantial saturation. And by maintaining such partial vacuum I avoid the back pressure which has been one of the most objectionable features of previously proposed processes and apparatus. It will now be clear that the steps and the means which I employ to insure the condensation of water vapor and consequent dehydration of the distilled gas are identical with the steps and means which I perform and employ to insure and preserve the described vacuum during the absorption period.

I employ a condenser to receive the gas from the upper tank, and this condenser delivers the liquid ammonia into a reservoir. The reservoir is in turn connected to a refrigerating element, such as a refrigerating coil, and a return pipe joins the latter to the lower tank. A valve is interposed between the upper tank and the condenser. Another valve is interposed between the reservoir and the refrigerating coil, and a third valve is interposed between the refrigerating coil and the lower tank. Before beginning the distilling operation, I close all these valves. When the pressure in the tanks rises to a point where it exceeds approximately ninety pounds, and exceeds the pressure in the reservoir, without which the gas would not flow toward the reservoir, I open the valve between the upper tank and the condenser, and put the condenser in operation. The condenser remains in operation until distillation has been completed, whereupon said valve is closed and the heat is withdrawn from the tanks. At this stage I allow the tanks to cool until the liquid contents thereof has assumed a normal temperature. As the tanks are completely closed during this period, the cooling and condensation of the contents causes the formation of a partial vacuum in the top of the upper tank and in the pipe leading therefrom to the condenser valve. Upon the appearance of a vacuum, as observed by any suitable means such as an ordinary gage, refrigeration and absorption may be started. At this time I slightly open the valve between the reservoir and the coil and permit the liquid ammonia to expand or gasify therein. At the same time I open the valve between the coil and the lower tank so that the expanded ammonia may pass back into that tank. The ammonia, expanding within the coil, reduces the temperature thereof; accomplishing the refrigeration which is the end and aim of the invention.

When, through absorption, the liquid in the tanks becomes saturated, the further return flow of expanded gas will cease an ac-

cumulation of surplus gas in the tanks and the vacuum will be destroyed. The destruction of the vacuum by the accumulation of gas in the top of the upper tank rarely occurs prior to the substantially complete saturation of the water; and in fact can only take place when the reservoir valve is so widely opened as to permit the gas to rush back to the tanks in such large volume as to induce a high temperature therein and thereby greatly reduce the absorptive capacity of the water. In a practical sense, the destruction of the vacuum normally marks the end of the refrigerating operation, inasmuch as further gas from the refrigerating coil will not thereafter be effectively absorbed. Further, if the return flow of gas were continued, back pressure would quickly build up and limit the expansion of the ammonia gas in the coil. In the case of apparatus of ordinary dimensions, the absorption extends through many hours, whereas distillation may be accomplished in a much shorter time. At the end of the absorption period, I again close all the valves before referred to, and again heat the lower tank to institute a new distillation of the ammonia water.

My invention will be more readily understood by reference to the accompanying drawing, forming part of this specification, and in which I have depicted an apparatus or machine of simple and preferred form.

Figure 1 of the drawings is a plan view of such apparatus. Fig. 2 is a side view thereof, the condenser, the reservoir, the refrigerating coil and the return pipe being shown diagrammatically; it should be understood that in practice the coil is always placed above the liquid tank. Fig. 3 is a vertical transverse section of the lower and upper tanks and the circulation pipes.

The process herein disclosed is not claimed in this application, being fully described and claimed in my co-pending application filed June 8th, 1911, Serial No. 631,933.

In the drawings, 7 represents the lower tank. This is preferably of considerably less diameter than length and occupies a horizontal position. Beneath the tank is a heater, preferably, a gas pipe 5 having burners 6 and a regulating valve 5'. As indicated in the drawings, I may subdivide the upper tank into two or more smaller tanks and thereby relatively increase the radiating surface. In the present case there are three such tanks indicated by the numeral 8. These tanks are also arranged horizontally and are preferably parallel with one another and transverse to the longer lower tank. These tanks 8 collectively constitute the upper tank before referred to, and each thereof is connected with the lower tank by circulating pipes which perform the functions before described. Above the tanks 8 is a

header 15. Pipes 14, 14 extend, preferably, from points about midway of the tank 7, through the top of the tank 7, and at their upper ends join the header 15. The portions
 5 of the pipes 14 which are within the tank 7 contain perforations 14' to facilitate the entrance of liquid thereto and prevent the accumulation of either steam or gas in the upper part of the lower tank. Pipes 16, 16,
 10 16 extend downwardly from the header, through the tops of the tanks 8, and downwardly therein to points near the bottoms thereof. The pipes 14, 15, 16, the inclosing tank 8, and the pipes 21, 12, constitute an
 15 effective siphon, which insures the rapid interchange of cool water from tank 8 for the warmer liquid from tank 7. As clearly shown in Figs. 2 and 3, each pipe 16 has its lower end equipped with a cross pipe 61
 20 which is perforated and constitutes a diffuser. One or more pipes 12 extend downwardly from each tank 8 and are joined to and communicate with the lower part of tank 7. The pipes 12, as shown in Fig. 3,
 25 extend within respective tanks 8 and their inner ends are perforated as shown at 21. The pipes 14, 15, 16, 61, 21 and 12 constitute the circulating pipes or ducts before referred to.

30 18 is the gas exit pipe. It is connected with each tank 8 and the openings 18' leading from the tanks 8 to the pipes 18 are all above the highest level attained by the liquid in the tanks during the operation of the apparatus.
 35 19 is the condenser and 20 is the condenser valve. The condenser may comprise a simple water jacket for flowing water and an ordinary condenser coil 21* indicated by
 40 dotted lines in Fig. 2.

23 is the reservoir, which is joined to the condenser coil by a pipe 22.

11 represents the refrigerating coil, and 24 is the expansion valve which is interposed
 45 between the reservoir and the coil.

9 represents the return pipe and 10 is the valve which is interposed between the refrigerating coil and the lower tank 7. The pipe 9 extends through the end of the tank
 50 7 and to the other end thereof, being disposed near the bottom of the tank 7. The portion of the pipe 9 which lies within the tank 7 contains a large number of small perforations for diffusing the gas. It should
 55 be understood that all joints between the tanks and pipes are tight joints, and that the tanks, coils and reservoir are closed, and constructed to withstand high pressures.

One way in which to prepare the apparatus for use consists in closing the valves 10
 60 and 20, then temporarily opening the header 15 and filling the tanks 7 and 8 and connected pipes with ammonia water, up to a working level in the upper tank. The air
 65 remaining in the upper tank may be then

exhausted and the header closed. When this is accomplished, the apparatus will be found ready for use. All the valves being closed, the gas may be lighted under the tank 7. Obviously, the liquid which is in
 70 contact with the bottom and side walls of the tank 7 will be quickly raised in temperature. This heated liquid having no other escape will rise through the pipes 14 and then descend into the tanks 8 through
 75 pipes 16 and 61. As the hot liquid rises in this manner, it is replaced by the cooler liquid which flows into the tank 7 through the diffusers 21 and the pipes 12. As the temperature of the liquid increases, gas will
 80 be liberated and when the pressure in the tank becomes approximately ninety pounds, which appears to be the minimum condensation pressure, the valve 20 may be opened to permit the gas to escape from the tanks
 85 8 and flow into the condenser. At this time the condenser coil is cooled, and through the action of its low temperature and the pressure of the gas, the latter is condensed and flows into the reservoir 23. It will be ob-
 90 served that the gases evolved in the upper tank or tanks, due to a sufficient rise of temperature therein, may bubble upward through the liquid therein and thence pass directly to the condenser. By reason of heat
 95 radiation, the temperature of the upper tank is never sufficient to generate steam at the pressure existing therein, hence gases initially distilled in the upper tank are substantially free from water. It will be further
 100 observed that all steam and gas which ascend with the water in riser pipes 14 are discharged into the tanks 8 through the subdividing and admixing perforations of the pipes 61 located near the bottoms of the
 105 tanks 8, and hence relatively far below the surface of the liquid therein. By reason of the relatively low temperature in the tanks 8 all steam thus discharged therein is immediately condensed, while the gas thus dis-
 110 charged may find escape at the surface of the liquid. In this manner I insure the effective dehydration of the distilling gases prior to their exit through the pipe 18. The substantially uniform withdrawal of the
 115 liquid from the several portions of the tanks 8 by the perforated pipes 21 insures a substantially uniform temperature throughout said tanks. On completion of distillation the valve 20 is closed, and then, as before
 120 stated, the tanks and contents are either cooled or permitted to cool in order to prepare the weak liquor or residual water for the absorption of or recombination with the ammonia. When the temperature has
 125 dropped sufficiently, the valves 24 and 10 may be opened to permit the gradual return of the ammonia to the tank 7, with the important effect of refrigeration in the coil 11. At this point I call attention to the large
 130

amount of radiating surface presented by the upper and lower tanks and circulating pipes. Circulation obviously continues after the heat is shut off, and the heat is dissipated quickly so that only a short time is required to reduce the weak liquor to a temperature admitting effective absorption of the gas.

As the gas enters the tank 7 through the perforated portion of the pipe 9 it is subdivided into a great number of streams of minute bubbles, and quickly enters into combination with the water. This combination gives off heat, and through the rise of temperature thus occasioned an active-circulation of the liquid is set up in the circulating pipes and tanks. As the liquid which contains the bubbles of gas ascends through the pipes 14 and thence into the upper tanks through the diffusers, the liquid is thoroughly agitated and admixed with the gas and the latter is thoroughly diffused in the liquid contents of the upper tanks. It is to be assumed, therefore, that very little of the gas returns to the lower tanks through the down or fall pipes 21, 12. The perforated pipes or diffusers in the tanks 8 obviously cause the breaking up of the gas bubbles and the absorption of the gas by the water. As best shown in Fig. 3, I prefer that the fall ducts or pipes 12 shall discharge at points immediately adjacent to the region of the admission of gas to the tank 7, for the purpose of keeping down the temperature of the water surrounding the perforated pipe 9. Absorption goes on in this way until the whole body of liquid in the tank is saturated with ammonia, whereupon the valves 24 and 10 may be again closed preparatory to the next heating of the liquid. No danger and no bad results attend any mismanipulation of the valves or of the heat.

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

1. The herein described ammonia absorption refrigerating apparatus, comprising upper and lower closed tanks to contain a requisite quantity of ammonia water, in combination with a valved gas outlet for the upper tank, a valved gas diffusing inlet for the lower tank, means for heating the contents of the lower tank to a higher temperature than the contents of the upper tank and siphonic circulating and diffusing ducts, together establishing a closed liquid circuit within and between said tanks and insuring the diffusion in the cooler liquid contents of the upper tank, of liquid, vapors and gases heated, evolved or diffused in the lower tank, whereby substantially anhydrous ammonia gas may be distilled under pressure and subsequently re-absorbed under a partial vacuum.

2. The herein described ammonia absorp-

tion refrigerating apparatus, comprising upper and lower closed tanks to contain a requisite quantity of ammonia water, in combination with a valved gas outlet at the top of the upper tank, a valved gas diffusing inlet in the lower part of the lower tank, means for heating the contents of the lower tank to a higher temperature than the contents of the upper tank and siphonic circulating and diffusing ducts, together establishing a closed liquid circuit within and between said tanks, limiting initial evolution and diffusion of vapors and gases to the liquid contents of the lower tank, and insuring subsequent diffusion in the cooler liquid contents of the upper tank, of liquid, vapors and gases from the lower tank, whereby substantially anhydrous ammonia gas may be distilled under pressure and substantially re-absorbed under a partial vacuum.

3. The herein described ammonia absorption refrigerating apparatus, comprising a lower closed tank and an upper closed tank, together adapted to contain a requisite quantity of ammonia water, in combination with riser and fall ducts joining said tanks, said riser duct arranged to lead ammonia water, steam and gases from the upper part of said lower tank into the ammonia water in said upper tank, and said fall duct arranged to lead ammonia water from a lower part of said upper tank into said lower tank, a valved gas outlet for said upper tank, a valved gas inlet duct for the lower tank, and a heater associated with said lower tank, whereby substantially anhydrous ammonia gas may be distilled under pressure and subsequently re-absorbed under a partial vacuum.

4. The herein described ammonia absorption refrigerating apparatus, comprising a lower closed tank and an upper closed tank, together adapted to contain a requisite quantity of ammonia water and a free space above the water, in combination with riser and fall ducts joining said tanks, said riser duct arranged to lead ammonia water, steam and gases from the upper part of said lower tank and deliver it only into the ammonia water in said upper tank, and said fall duct arranged to lead and direct ammonia water from the lower part of said upper tank into the lower part of said lower tank, a valved gas outlet for said upper tank, a valved gas inlet for the lower tank, and a heater associated with said lower tank, whereby substantially anhydrous ammonia gas may be distilled under pressure and subsequently re-absorbed under a partial vacuum.

5. The herein described ammonia absorption refrigerating apparatus, comprising a lower closed tank and an upper closed tank, together adapted to contain a requisite quantity of ammonia water, in combination

with riser and fall ducts siphonically joining said tanks, said riser duct arranged to lead ammonia water, steam and gases from the upper part of said lower tank and diffuse the same in the ammonia water in said upper tank, and said fall duct arranged to lead ammonia water from the said upper tank and direct the same into the lower part of said lower tank, a valved gas outlet for said upper tank, a valved gas inlet for the lower tank, and a heater associated with said lower tank, whereby substantially anhydrous ammonia gas may be distilled under pressure and subsequently re-absorbed under a partial vacuum.

6. The herein described ammonia absorption refrigerating apparatus, comprising a closed heat absorbing and radiating ammonia water tank, in combination with a second closed heat radiating and vacuum ammonia water tank, a diffuser arranged in said second tank below the working liquid level therein, a riser duct leading from the first tank to the diffuser within the second tank, a fall duct leading from the second tank and arranged to direct the liquid therefrom into the lower part of the first mentioned tank, a valved ammonia gas outlet for said second tank, a valved ammonia gas inlet for said first tank, and a heater associated with said first tank, whereby substantially anhydrous ammonia gas may be distilled under pressure and subsequently re-absorbed under a partial vacuum.

7. The herein described ammonia absorption refrigerating apparatus, comprising a lower heat absorbing and radiating closed tank, in combination with an upper heat radiating and vacuum closed tank, said tanks together adapted to contain a requisite quantity of ammonia water without completely filling said upper tank, a diffuser arranged in said upper tank below the working liquid level therein, a riser duct leading from the upper part of said lower tank to said diffuser, a fall duct leading from said upper tank and arranged to direct the liquid therefrom into the lower part of the lower tank, a valved ammonia gas outlet for said upper tank, a valved ammonia gas diffuser in the lower part of said lower tank, and a heater associated with said lower tank, whereby substantially anhydrous ammonia gas may be distilled under pressure and subsequently re-absorbed under a partial vacuum.

8. The herein described ammonia absorption refrigerating apparatus, comprising a lower heat absorbing and radiating closed tank, in combination with a plurality of upper heat radiating and vacuum closed tanks, said tanks together adapted to contain a requisite quantity of ammonia water without completely filling said upper tanks, a diffuser arranged in each upper tank be-

low the surface level of the liquid therein, a riser duct or ducts leading from the lower tank to each said diffuser, a fall duct leading from each upper tank and arranged to direct the liquid therefrom into the lower part of the lower tank, a valved ammonia gas outlet common to said upper tanks, a valved ammonia gas diffuser in said lower tank, and a heater associated with said lower tank, whereby substantially anhydrous ammonia gas may be distilled under pressure and subsequently re-absorbed under a partial vacuum.

9. The herein described ammonia absorption refrigerating apparatus, comprising a lower heat absorbing and radiating closed tank, in combination with a plurality of upper heat radiating and vacuum closed tanks, said tanks together adapted to contain a requisite quantity of ammonia water without completely filling said upper tanks, riser ducts leading from the upper part of said lower tank and discharging into said upper tanks below the working liquid level therein, a fall duct leading from the lower part of each upper tank and arranged to direct the liquid therefrom into the lower part of the lower tank, a valved ammonia gas outlet common to said upper tanks, a valved ammonia gas diffuser in said lower part of said lower tank, and a heater associated with said lower tank, whereby substantially anhydrous ammonia gas may be distilled under pressure and subsequently re-absorbed under a partial vacuum.

10. The herein described ammonia absorption refrigerating apparatus, comprising a lower closed tank, a combination with an upper closed tank, diffusing means arranged in said upper tank below the working liquid level therein, siphonic ducts connecting said tanks and co-acting with said diffusing means in the said upper tank, a valved ammonia gas outlet for said upper tank, a valved ammonia gas inlet for said lower tank, and a heater associated with said lower tank.

11. The herein described ammonia absorption refrigerating apparatus, comprising a horizontally elongated closed tank, in combination with a horizontally elongated second closed tank above the same, riser and fall ducts siphonically connecting the lower portion of the second tank with the upper and lower portions, respectively, of the first mentioned tank, a valved gas outlet for said second tank, a valved gas inlet for said first tank, and a heater associated with said first tank.

12. The herein described ammonia absorption refrigerating apparatus, comprising a horizontally elongated closed tank, in combination with a horizontally elongated second closed tank above the same, riser and fall ducts siphonically connecting the lower

portion of the second tank with the upper and lower portions, respectively, of the first mentioned tank, a diffuser in said second tank and co-acting with said riser duct, a 5 valved gas outlet for said second tank, a valved gas diffuser in the lower part of said first tank, and a heater associated with said first tank.

13. The herein described ammonia absorption refrigerating apparatus, comprising a 10 horizontally elongated closed tank, in combination with a plurality of horizontally elongated closed tanks arranged above the same, ducts siphonically connecting the 15 lower portions of the upper tanks with the upper and lower portions, respectively, of the first mentioned tank, diffusers in said upper tanks and co-acting with respective ducts, a valved gas outlet for said upper 20 tanks, a valved gas diffusing inlet pipe disposed in the lower part of said first tank, and a heater associated with the said first tank.

14. The herein described ammonia absorption refrigerating apparatus, comprising a 25 lower horizontally elongated closed tank, in connection with an upper horizontally elongated tank, riser and fall ducts extending between and siphonically connecting the two 30 tanks, a horizontally disposed diffuser or distributor at the discharge end of the riser duct in the upper tank and below the working liquid level therein, a valved gas outlet for the upper tank, a valved gas diffusing 35 inlet duct in the lower tank, and heating means associated with said lower tank.

15. In an ammonia absorption refrigerating apparatus, juxtapositioned closed tanks 40 to contain a requisite quantity of ammonia water, in combination with a valved ammonia gas inlet for one said tank, a valved gas outlet for the other, means for heating

the tank having the gas inlet, ducts establishing circulatory communication between said tanks, and so disposed as to restrict circulation to and within the water therein, and 45 means diffusing the flow of water to and from said ducts.

16. The herein described ammonia distilling apparatus, comprising upper and 50 lower closed tanks to contain a requisite quantity of ammonia water, means for heating the contents of the lower tank to a higher temperature than the contents of the upper tank, and a valved gas outlet at the 55 top of the upper tank, in combination with siphonic circulating and diffusing ducts completing a closed liquid circuit within and between said tanks and insuring the diffusion in the cooler liquid contents of the 60 upper tank, of liquid, vapors and gases heated and evolved in the lower tank, whereby substantially anhydrous ammonia gas may be distilled under pressure.

17. The herein described ammonia absorption refrigerating apparatus, comprising 65 upper and lower closed tanks to contain a requisite quantity of water, in combination with a gas diffusing inlet in the lower part of the lower tank and siphonic circulating 70 and diffusing ducts, together establishing a closed liquid circuit within and between said tanks and insuring diffusion in the cooler liquid contents of the upper tank, of gases not absorbed in the lower tank, whereby 75 ammonia gas may be absorbed under a partial vacuum.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

DANIEL C. SMITH.

Witnesses:

L. M. DORMAN,
JOHN MURTAGH.