

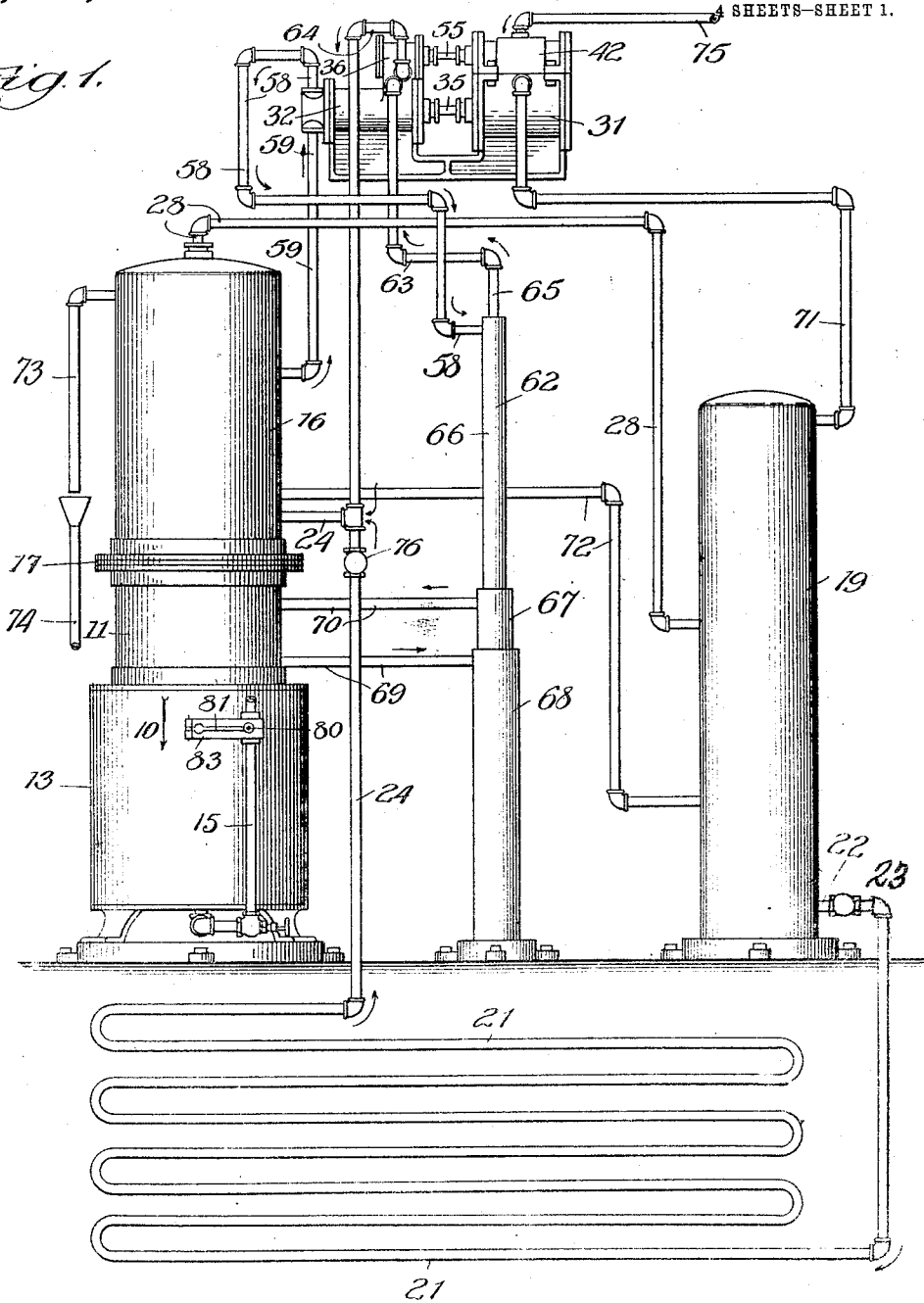
J. ZANDER & J. LEVEY.
REFRIGERATING APPARATUS.
APPLICATION FILED APR. 14, 1913.

1,105,171.

Patented July 28, 1914.

SHEETS-SHEET 1.

Fig. 1.



Witnesses:
C. E. Gaylord,
Chas. H. Buell

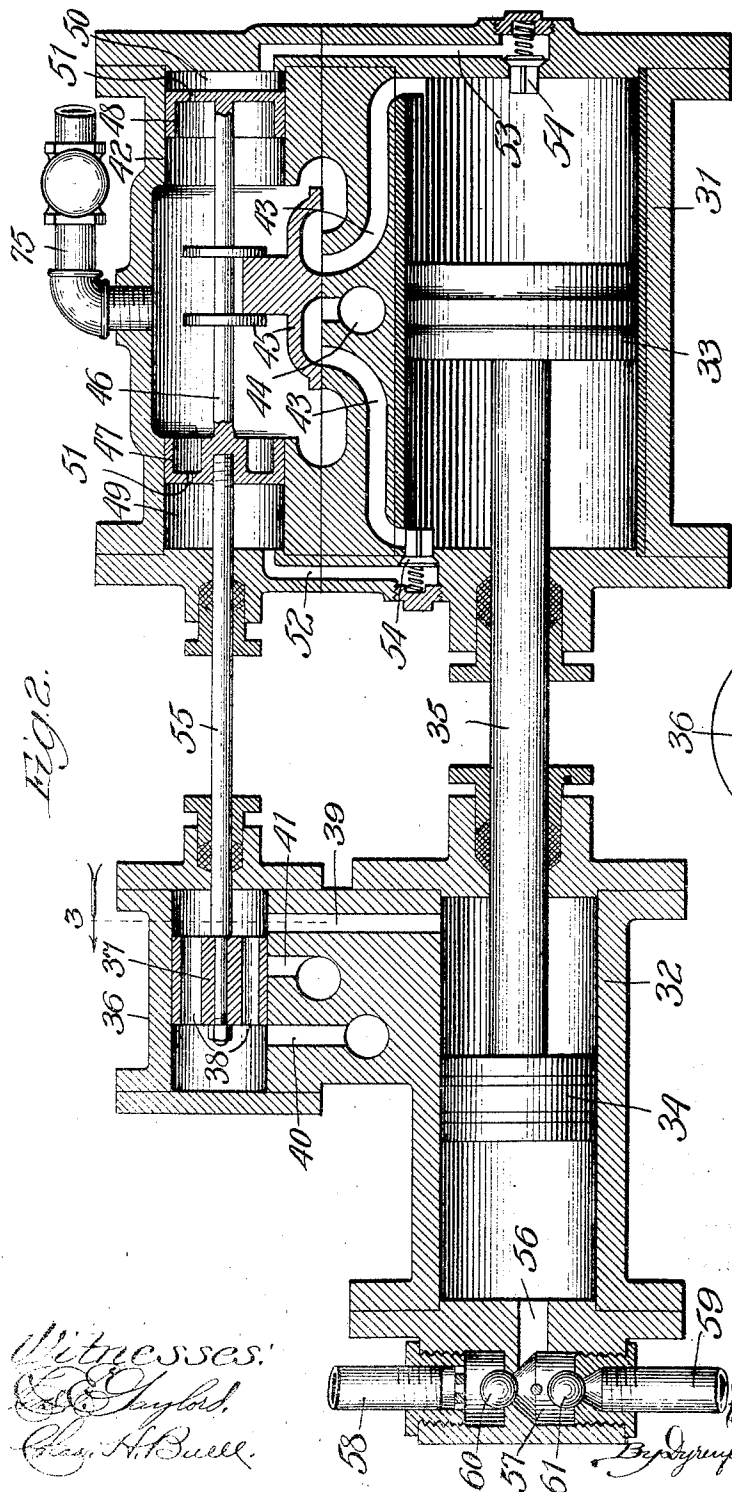
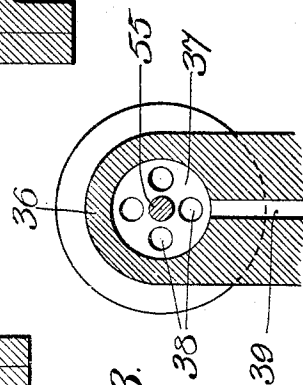
Inventors:
John Zander,
John Levey,
Prof. Dyrenfeller, Secy, Christian & Miller,
Attys.

J. ZANDER & J. LEVEY.
REFRIGERATING APPARATUS.
APPLICATION FILED APR. 14, 1913.

1,105,171.

Patented July 28, 1914.

4 SHEETS—SHEET 2.



Witnesses:
C. C. Lyford,
Chas. H. Buell.

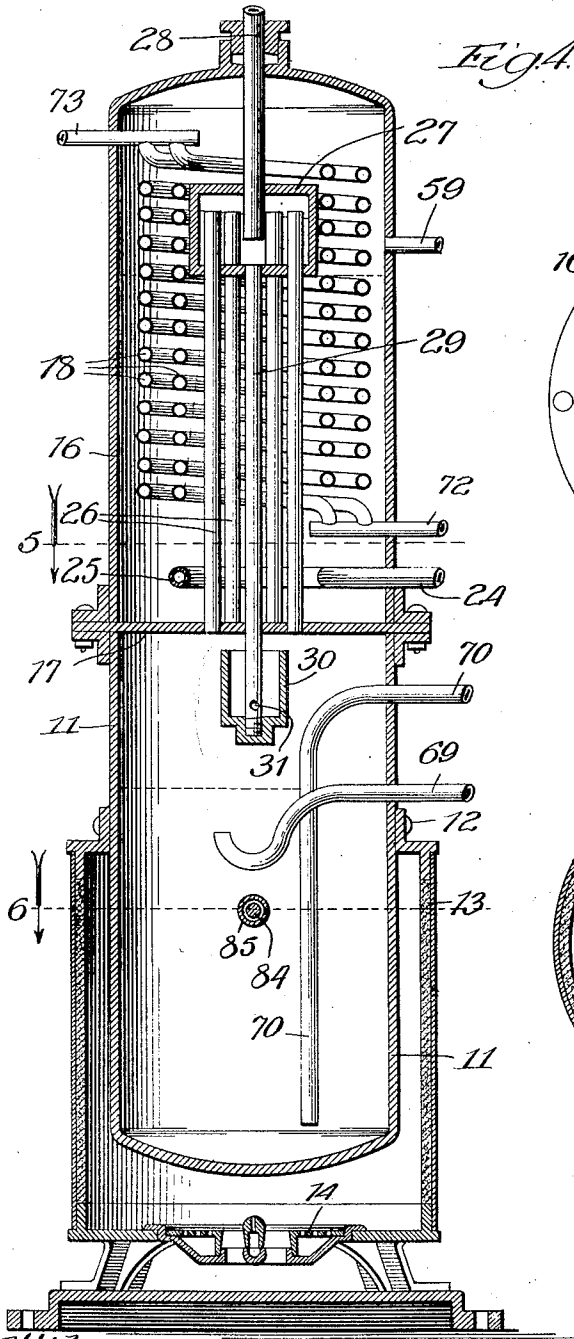
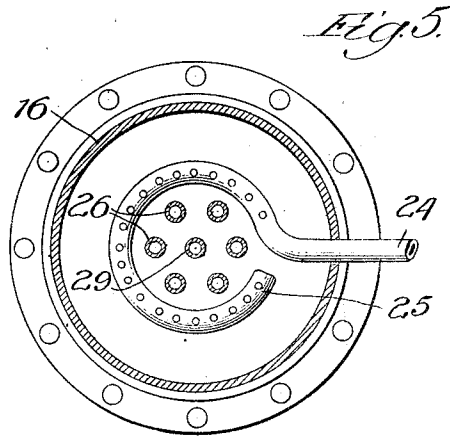
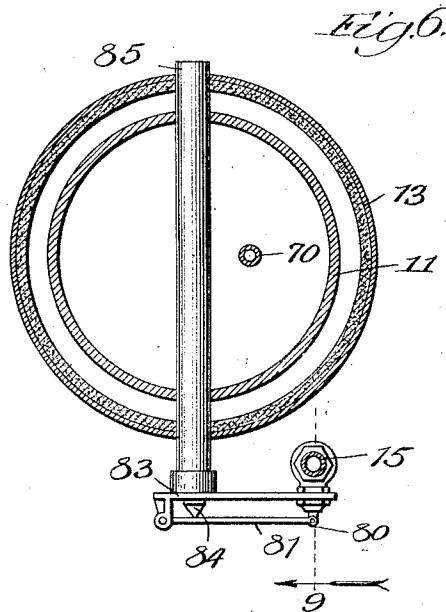
Inventors:
John Zander,
John Levey,
By George F. Smith, Charles E. Wells,
Attys...

J. ZANDER & J. LEVEY.
REFRIGERATING APPARATUS.
APPLICATION FILED APR. 14, 1913.

1,105,171.

Patented July 28, 1914.

4 SHEETS—SHEET 3.



Witnesses:

E. C. Lyford,
Chas. H. Buell

Inventors:

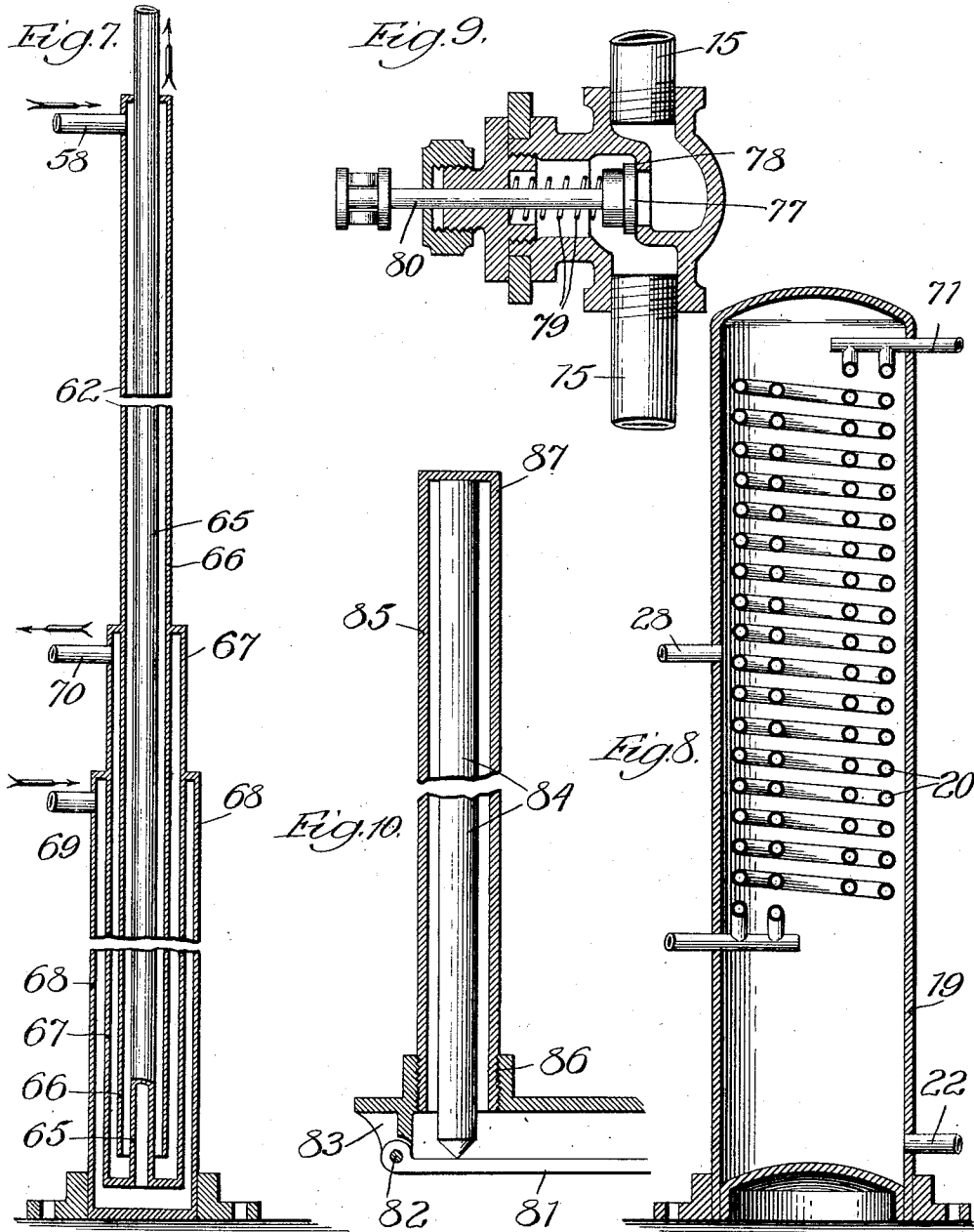
John Zander & J. Levey,
By Depuefort, Sec., Chittam Mills,
Attys.

J. ZANDER & J. LEVEY.
REFRIGERATING APPARATUS.
APPLICATION FILED APR. 14, 1913.

1,105,171.

Patented July 28, 1914.

4 SHEETS-SHEET 4.



Witnesses:
C. Taylor,
Chas. H. Buell.

Inventors:
{ John Zander,
John Levey,
By George H. Levey, Charles H. Buell,
Attys.

UNITED STATES PATENT OFFICE.

JOHN ZANDER AND JOHN LEVEY, OF CHICAGO, ILLINOIS; SAID LEVEY ASSIGNOR TO SAID ZANDER.

REFRIGERATING APPARATUS.

1,105,171.

Specification of Letters Patent.

Patented July 28, 1914.

Application filed April 14, 1913. Serial No. 781,021.

To all whom it may concern:

Be it known that we, JOHN ZANDER and JOHN LEVEY, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Refrigerating Apparatus, of which the following is a specification.

Our invention relates more particularly to improvements in anhydrous ammonia refrigerating apparatus. In apparatus of this type it is common to provide a generating chamber for generating the ammonia-gas, an absorbing chamber containing water and into which the ammonia-gas after passage through the refrigerating coils is discharged for mixture therewith, with means in said absorbing chamber for cooling the ammonia liquor therein, and a condensing-chamber into which the ammonia-gas produced in the generator is discharged and reduced to liquid condition preparatory to its introduction into the refrigerating coils. It is also common practice to repeatedly use the original charge of ammonia, and as the ammonia-gas after passing through the refrigerating coils is discharged into the absorbing chamber, it thus becomes necessary to replenish the supply of ammonia in the generator as it is withdrawn therefrom during the operation of the apparatus, with ammonia from the absorbing chamber. This is commonly done by pumping the liquor from the absorbing chamber into the generating chamber and providing for a corresponding flow of liquor from the latter to the absorbing chamber, thus producing a circulation between these chambers which causes the liquor in both to be maintained of approximately equal strength. The pressure in the generating chamber, however, is relatively high, usually about one hundred pounds to the square inch, as compared with substantially atmospheric pressure in the absorbing-chamber, and in constructions as hitherto provided it is necessary to pump the liquor from the absorbing-chamber into the generating chamber, against the relatively high pressure in the latter, thus rendering necessary the use of comparatively high-power pumps, the installation and operation of which is attendant with relatively great expense. Furthermore in operating apparatus as hitherto provided careful attention on the part of the operator is re-

quired, and the conditions in general attending its operation are such that the cost of installation and operation render the use of such types of apparatus, where a relatively small capacity only is needed, prohibitive.

One of our objects, generally stated, is to provide improvements in apparatus of this type wherein the cost of installation and operation thereof will be greatly reduced and be sufficiently low, as compared with apparatus as hitherto constructed, that apparatus of relatively small capacity may be installed and operated with economy.

Another object is to provide improvements in the heat-interchanger commonly employed for causing the liquor during its discharge from the generating chamber into the absorbing chamber, to be cooled by the counter-flow of liquor from the absorbing chamber to the generating-chamber, in order that the interchanged liquor shall more nearly approach in temperature the temperature of the liquor into which it is discharged.

Still another object is to provide an improved construction of dehydrater which shall be of simple form, economical of manufacture, and which shall operate positively to separate the water vapor from the ammonia vapor generated in the generating chamber, for preventing water vapor from passing into the condenser; and still another object is to so improve upon apparatus of the type above referred to as to cause it to be better adapted for the performance of its work in a positive manner, with economy, and with the minimum amount of attention.

Referring to the accompanying drawings: Figure 1 is a view in elevation, partly diagrammatic, of an apparatus constructed in accordance with our invention. Fig. 2 is a longitudinal sectional view of the pumping means employed for effecting the interchanging of liquid in the absorbing and generating-chambers. Fig. 3 is a section taken at the line 3 on Fig. 2 and viewed in the direction of the arrow. Fig. 4 is a view in vertical sectional elevation of the generating chamber, the absorbing chamber superposed thereon, and our improved dehydrating means, the latter being shown in full elevation. Fig. 5 is a section taken at the line 5 on Fig. 4 and viewed in the direction of the arrow. Fig. 6 is a section taken

at the line 6 on Fig. 4 and viewed in the direction of the arrow, showing the thermostatic means employed for regulating the heat in the generating chamber. Fig. 7 is a view in vertical sectional elevation of our improved heat-interchanging device. Fig. 8 is a view in vertical sectional elevation of the ammonia condenser employed. Fig. 9 is a sectional view of the valve-means operated by the thermostat shown in Fig. 6 for controlling the flow of gas to the burner of the generating chamber; and Fig. 10, an enlarged section taken at the line 10 on Fig. 1 and viewed in the direction of the arrow.

The generating-chamber, represented at 11, is shown as surrounded at its lower end, and supported, as indicated at 12, from a casing 13 which contains the means for heating the chamber 11, these means in the construction illustrated comprising a gas-burner 14 supplied with gas from a suitable source thereof, not shown, through a pipe 15.

The absorbing chamber is represented at 16 and in the construction illustrated surmounts the generating chamber 11, the bottom plate 17 of the former forming the top of the chamber 11. The cooling coil of the absorbing chamber 16 is represented at 18 and is preferably connected with a supply of cold water, as hereinafter explained.

The ammonia-gas condensing chamber is represented at 19 and contains a cooling coil 20 through which cold water is circulated, as hereinafter described, the condensing chamber 19 being connected with the refrigerating coils represented at 21, through the medium of a pipe 22 containing an expansion-valve represented diagrammatically at 23, and which may be of any suitable construction, the discharge-end of the coil 21 being connected with a pipe 24 which opens into the chamber 16 and preferably terminates in an annular spray-head 25 located in the latter, the expansion-valve 23 being preferably so adjusted in practice as to reduce the pressure in the coil 21 to a degree slightly greater than the pressure in the chamber 16.

In accordance with the preferred illustrated embodiment of our invention, we provide a dehydrater in the absorbing chamber 16 which operates to remove all water vapors from the ammonia vapors generated in the chamber 13 before they pass into the condenser 19, the following being a description of our improved construction for this purpose: Extending upwardly in the chamber 16, and located within the convolutions of the coil 18, is a series of pipes 26 which open at their lower ends through the plate 17 and into the chamber 11 and at their upper ends into a gas-tight box 27, above the bottom of the latter, the box 27 communicating with the condensing chamber 20 through the medium of a pipe 28 open at

its opposite ends and which opens at one end into the chamber 20 and at its opposite end passes through the top of the chamber 16 and the top of the box 27 and terminates below the tops of the pipes 26 and preferably centrally of the series thereof. A pipe 29 opens at its upper end into the box 27, through the bottom of the latter, and at its lower end extends through the plate 17 into the chamber 11, this pipe carrying on its lower end a cup 30 which communicates with the interior of the pipe 29 through openings 31 in the side of the latter and thus forms a water seal, as hereinafter described, for preventing ammonia-gas from passing from the chamber 11 through the pipe 29.

In the operation of the apparatus, the ammonia-gas generated in the chamber 11 passes therefrom through the tubes 26 into the box 27, thence into the pipe 28 and into the condensing chamber 19 where it is reduced to liquid form, any water vapor generated in the chamber 11 being condensed either on the plate 17, which is relatively cool, or in the tubes 26, or in the box 27, in the latter case the condensed water vapors flowing from the box 27 and thence into the cup 30, through the pipe 29, from which cup they overflow into the chamber 11. The liquid ammonia in the condenser 19 in passing through the expansion valve 23 expands into gaseous condition, thence passing through the coil 21, where it performs the refrigerating function in accordance with common practice, and then by way of the pipe 24 enters the absorbing chamber 16 where it is mixed with the ammonia liquor therein and the heat thus developed removed by the cooling effect of the water in the coil 18.

As the ammonia-gas is generated for supplying the coil 21, from the ammonia liquor in the chamber 11, and as the discharge from the coil 21 is into the absorbing chamber 16, it is necessary that the liquid in these chambers be interchanged, and this is accomplished in the construction illustrated by my improved circulating means, a description of which is as follows: As a preface to the following description it may be said that it is well understood in the art that the pressure in the chamber 11 under normal operating conditions is about one hundred pounds to the square inch, as compared with substantially atmospheric pressure in the chamber 16, and thus the interchange of liquid just referred to involves the passage of liquid into a chamber wherein the liquid is under relatively high pressure, from a chamber wherein the liquid is under substantially no pressure.

The pumping means for producing circulation of the liquid is represented in Fig. 2, and in the preferred form illustrated comprises: a pair of alining cylinders 31 and 32

containing pistons 33 and 34, respectively, connected together by a rod 35, the cylinder 32 and piston 34 constituting the pump-proper and the cylinder 31 and piston 33 the driving means therefor. The pump-casing contains a supplemental cylinder 36 containing a piston-valve 37 having openings 38 extending longitudinally therethrough, the interior of the cylinder 36 being connected at one end with the corresponding end of the cylinder 32 by a passage 39 and having ports 40 and 41 opening into it, as illustrated in Fig. 2, the ports 40 and 41 and passage 39 being so disposed as to cause the port 40 and passage 39 to be in communication with each other through the openings 38 in the piston-valve 37 when the latter is in one position, and open the port 41 to the passage 39 and close to the latter the port 40, when the piston-valve 37 is shifted to another position, as hereinafter described. The valve-means for controlling the flow of fluid-pressure into the cylinder 31 to operate the piston 33 are of well-known construction, and comprise a casing 42 with inlet and outlet ports 43 and 44 respectively, the former opening into the cylinder 31 at the opposite ends of the latter, a slide-valve 45 for controlling the ports 43 and 44, connected with a rod 46 carrying pistons 47 and 48 operating in cylinders 49 and 50, respectively, which communicate behind the pistons therein, with the fluid pressure supplied through relatively small apertures 51 in the pistons 47 and 48, these cylinders opening into the respective ends of the cylinder 31 through the medium of passages 52 and 53, respectively, equipped with outwardly opening check-valves 54 extending into the path of movement of the piston 33. The piston-valve 37 is reciprocated in the cylinder 36 for the purpose hereinafter stated, at the end of each strike of the piston 34, and in the construction illustrated is thus operated from the valve mechanism just described, through the medium of a rod 55 which is connected with the pistons 37 and 47.

The end of the cylinder 32 opposite to that equipped with the passage 39 contains a port 56 which opens into a chamber 57 communicating at its upper and lower ends with pipes 58 and 59 respectively, and containing ball-valves 60 and 61, the valve 61 opening toward the port 56 and the valve 60 opening away from the port 56. The pipe 59 opens into the chamber 16 and the pipe 58 opens into my improved heat-interchanging device represented at 62 and hereinafter described. The port 40 is connected with a pipe 63 also opening into the heat-interchanger 62, and the port 41 connects with a pipe 64 which opens into the pipe 24 and thus communicates with the interior of the chamber 16.

Our improved heat-interchanger com-

prises a plurality of concentrically disposed tubes 65, 66, 67, and 68, shown as four in number, the innermost tube 65, which connects with the pipe 63 being open at its bottom and opening into the outermost tube 68 which is connected near its upper end with a pipe 69 which extends into the chamber 11 near the upper end thereof. The tube 66, which is closed at its upper end, communicates with the pipe 58, the lower end of this tube being open and reaching short of the bottom of the tube 67, this last-referred to tube being closed at its upper and lower ends as represented and connected near its upper end with a pipe 70 which opens into the chamber 11 and terminates at its lower, open end a slight distance above the bottom of this chamber.

The coil 20 is connected at its upper end with a pipe 71 which is connected with the exhaust-port 44 of the pump, and at its lower end with a pipe 72 which opens into the lower end of the coil 18, the latter at its upper end discharging into a pipe 73 which exhausts into a pipe 74 which would lead to a sewer. It will thus be noted that the coils 18 and 20 are in series, and to render the operation of the apparatus as economical as possible, provision is thus made not only for using the water pressure which would be supplied from a suitable source thereof through a pipe 75 to the pump, as a means for producing the desired cooling action in the condenser and absorbing chamber, but also as the motive power for driving the pump.

The operation of the apparatus in so far as described is as follows: Assuming the apparatus to be empty, the operator would first charge the generating-chamber and absorbing chamber 11 and 16, respectively, with a solution of ammonia of about 28 per cent. strength, as is commonly used. The burner 14 would then be lighted and the pumping mechanism hereinbefore described started by allowing water pressure to flow into the valve-casing of the motor, the spent water therefrom flowing through the coils 18 and 20 of the condensing and absorbing chambers. Under the action of the heat applied to the chamber 11 the ammonia in the solution therein gasifies and passes upwardly through the pipes 26 into the box 27 and thence into the pipe 28 from which it flows into the condensing chamber 19. The ammonia-gas thus produced liquefies at about one hundred pounds pressure when subjected to the cooling effect of the water in the coil 20, when the water supplied to this coil is of substantially the same temperature as water furnished by street-mains, and thus the liquid in the tank 11 in the operation of the apparatus is under about one-hundred pounds pressure. The liquid ammonia in the condensing chamber 20

escapes past the expansion-valve 23 permitting it to expand and become gas which in passing through the coil 21 produces the desired refrigerating action, the spent ammonia-gas passing thence through the pipe 24 past a check-valve 76 therein into the spray-head 25 from which it discharges into the liquor in the absorbing chamber 16, the cooling effect produced by the coils 18 operating to absorb the heat produced by the mixture of the ammonia-gas with the liquor in the chamber 16.

The operation of the pumping mechanism is as follows: Assuming the pump to be in the position illustrated in Fig. 2, in which case the pistons 33 and 34 are moving to the left in Fig. 2 and the piston-valve 37 occupies the position therein illustrated, in which position the ports 39 and 40 are in communication with each other through the medium of the openings 38 in the piston-valve 37, the piston 34 drives the liquor in the left-hand end of the cylinder 32 through the passage 56 and past the ball 60 into the pipe 58 and thence into the tube 66 from which it discharges into the tube 67 and thence into the generating chamber 11. The piston 37 being in the position just illustrated, the right-hand end of the cylinder 32 is in communication with the generating chamber 11 through the medium of the passage 39, the openings 38 in the piston-valve 37, the port 40, and pipes 65, 68, and 69, and thus the piston 34, in driving the contents in the left-hand end of the cylinder 32 into the chamber 11, is aided by the exertion of the pressure from the same chamber introduced into the right-hand end of the cylinder, and thus the piston 34 may be driven by relatively low power. As the piston 33 nears the limit of its stroke to the left in Fig. 2, it opens the check-valve 54 at the left-hand end of the cylinder 31, thus permitting the fluid pressure in the cylinder 49 to escape through the passage 52, port 43 and exhaust-port 44, with the result of causing the fluid pressure in the valve-casing to shift the pistons 47 and 48, and consequently the slide-valve 45, to the left in Fig. 2 to cause the left-hand end of the cylinder 31 to communicate with the fluid pressure supply and the other end of this cylinder to be open to the exhaust 44, whereupon the pistons 33 and 34 move to the right in Fig. 2, the shifting of the pistons 47 and 48 to the left in Fig. 2 causing the piston-valve 37 to shift in the same direction, thus closing the port 40 and opening the port 41 to the port 39. In the movement of the piston 34 to the right in Fig. 2, the suction produced in the left-hand end of the cylinder 32 causes a low-pressure charge of liquor to be sucked from the chamber 16 into the left-hand end of the cylinder 32 through the pipe 59 and past the valve 61, the liquor which in the operation of the

piston 34 to the left in Fig. 2 enters the right-hand end of the cylinder 32, exhausting from the latter through the passage 39 and port 41 and thence into the pipes 64 and 24 to the absorbing chamber 16. Upon the next reversal of the movement of the piston 34 the low-pressure charge sucked into the left-hand end of the cylinder 32 in the operation just stated is forced into the generating chamber 11 as hereinbefore stated, these operations continuing so long as the pump actuates. It will be understood from the description just given that upon each movement of the piston 34 to the right in Fig. 2 a charge of low pressure liquor is sucked from the low pressure chamber 16 into the cylinder 32 and that the charge introduced into the right-hand end of the cylinder 32 from the high pressure chamber 11 in the preceding movement of the piston, is discharged into the low pressure chamber 16; and that upon each movement of the piston 34 to the left in Fig. 2, the low pressure charge sucked into the cylinder in the previous operation of the piston, will be forced into the high pressure chamber 11 and during such movement of the piston high pressure liquor will flow from the chamber 11 into the right-hand end of the cylinder 32, and thus the pump is never required to force the liquid against a high pressure, and by circulating the liquor from one of these chambers to the other, the strength of these liquors is maintained substantially constant.

It is preferred that the volume of that portion of the piston-rod 35 which operates in the cylinder 32 be so proportioned relative to the volume of the ammonia vaporized in the chamber 11 that in the operation of the pump it will tend to maintain the water-levels in the chambers 11 and 16 approximately constant. Should the liquor, however, in either chamber 11 or 16 drop below a predetermined level, determined by the ends of the pipes 69 and 59, the pump will discontinue to pump liquid from such chamber, but instead will pump gas, and thus the predetermined liquid-levels in these chambers will be automatically maintained. It will be noted from the foregoing that the liquor discharged from the chamber 11 into chamber 16 through the spray-head 25 is mixed with ammonia gas from the coil 21 before it enters the head 25, thus effecting an admixture of liquid and gas before it leaves the head 25 and upon leaving the latter is sprayed into the liquor in the chamber 16 thus facilitating absorption.

In operating the generator it is necessary that the heat supplied thereto be sufficiently low as to prevent the boiling of the water-content of the liquor in the chamber 11, as the presence of water in the condensing chamber is very apt to impair the operation of the apparatus. To render the operation

of the apparatus automatic in this particular and to prevent the undue heating of the liquor in the chamber 11, we provide thermostatic means, a description of which is as follows: Located in the pipe 15 is a reciprocatory valve 77 adapted to be yieldingly held to its seat 78 for shutting off the burner 14, by means of a spring 79, the outer end of the stem 80 of the valve 77 engaging with a lever 81 fulcrumed, as indicated at 82, on a bracket 83 secured to the pipe 15 and cooperating with a rod 84 loosely confined in a tube 85 extending through the chamber 11 and screwing at its open end into the bracket 83 as represented at 86, its opposite end being closed as indicated at 87, and free to expand and contract.

The rod 84 should be of less co-efficient of expansion than the tube 85, and these parts should be so constructed that the rod 84 may move inwardly in the tube 85 sufficiently far to permit the valve 77 to close under the action of its spring 79 when the temperature of the ammonia liquor in the chamber 11 reaches a predetermined degree, which should be enough lower than the boiling point of water under one-hundred pounds pressure, as to prevent the production of water vapor.

While we have illustrated and described a particular construction embodying our invention, we do not wish to be understood as intending to limit it thereto, as the same may be variously modified and altered without departing from the spirit thereof.

What we claim as new and desire to secure by Letters Patent is:

1. The combination with chambers adapted to contain fluid at different pressures, of a pump for pumping fluid from said low pressure chamber into said high pressure chamber, and vice versa, and means operating when said pump is discharging into either of said chambers to cause the charge next to be pumped to enter the suction end of the pump from the chamber into which the pump is discharging.

2. The combination with chambers adapted to contain fluid at different pressures, of a pump for pumping fluid from said low pressure chamber into said high pressure chamber, and vice versa, and means operating when said pump is discharging into said high pressure chamber to cause fluid from said high-pressure chamber to enter the suction end of the pump, and when said pump is discharging into said low pressure chamber to cause fluid from said low pressure chamber to enter the suction end of the pump.

3. The combination with chambers adapted to contain fluid at different pressures, of a pump for pumping fluid from said low pressure chamber into said high pressure chamber, and vice versa, comprising a cylinder, a piston therein, means for actuating said piston, pipes communicating with said chambers, respectively, and opening into one end of said cylinder, check-valves for controlling said pipes, other pipes communicating with said chambers, respectively, and valve means for alternately opening said last referred to pipes to the other end of said cylinder, constructed and arranged to cause the opposite ends of said cylinder to be in communication with one of said chambers during the operation of the pump, in one direction and in communication with the other of said chambers during its operation in the other direction.

4. The combination with chambers adapted to contain fluid at different pressures, of a pump for pumping fluid from said low pressure chamber into said high pressure chamber, and vice versa, comprising a cylinder, a piston in said cylinder, means for operating said piston, and means operating upon the movement of the piston in one direction to admit fluid from one of said chambers into one end of said cylinder and discharge the fluid in the opposite end of said cylinder into said last referred to chamber, and upon the movement of the piston in the opposite direction to discharge the fluid thus introduced into the cylinder, to the other of said chambers and admit fluid from said last referred to chamber into the opposite end of said cylinder.

5. The combination with chambers adapted to contain fluid at different pressures, of a pump for pumping fluid from said low pressure chamber into said high pressure chamber and vice versa, comprising a cylinder, a piston therein, means for actuating said piston, pipes communicating with said chambers, respectively, and opening into one end of said cylinder, inwardly and outwardly opening check-valves for controlling said respective pipes, a valve-chamber in communication with said cylinder containing ports, pipes communicating with said chambers and ports respectively, a valve in said valve chamber for alternately opening said ports to the interior of said chambers and to said cylinder, and means for actuating said valve timed with relation to the movement of said piston for causing said cylinder to be in communication at opposite ends with one of said chambers during the movement of the piston in one direction and with the other of said chambers upon the movement of the piston in the opposite direction.

6. The combination with chambers adapted to contain fluid at different pressures, of a pump for pumping fluid from said low pressure chamber into said high pressure chamber and vice versa, comprising a cylinder, a piston in said cylinder, means for causing fluid from one of said chambers to

actuating said piston, pipes communicating with said chambers, respectively, and opening into one end of said cylinder, check-valves for controlling said pipes, other pipes communicating with said chambers, respectively, and valve means for alternately opening said last referred to pipes to the other end of said cylinder, constructed and arranged to cause the opposite ends of said cylinder to be in communication with one of said chambers during the operation of the pump, in one direction and in communication with the other of said chambers during its operation in the other direction.

enter one end of said cylinder in the movement of the piston in one direction and force the fluid thus introduced into the cylinder into the other of said chambers when the pump is moved in the opposite direction, and means operating, upon said last referred to movement of the piston to introduce into said cylinder a charge of fluid from the chamber into which the pump is discharging and upon the first referred to movement of the piston to cause said charge to be forced into the other of said chambers.

7. In refrigerating apparatus, the combination of a generating chamber, an absorbing chamber, and dehydrating means in said absorbing chamber and communicating with said generating chamber.

8. In refrigerating apparatus, the combination of a generating chamber, an absorbing chamber, and pipes in said absorbing chamber opening into said generating chamber, but closed to said absorbing chamber for conducting the ammonia vapor from said generating chamber.

9. In refrigerating apparatus, the combination of a generating chamber, and dehydrating means comprising a pipe opening at one end into said chamber, a gas-tight box into which said pipe, at its opposite end, opens, and a gas-outlet pipe for said box.

10. In refrigerating apparatus, the combination of a generating chamber, and dehydrating means comprising a pipe opening at one end into said chamber, a gas-tight box into which said pipe, at its opposite end, opens, a gas-outlet pipe for said box, and a water-outlet pipe for said box.

11. In refrigerating apparatus, the combination of a generating chamber, and dehydrating means comprising a pipe opening at one end into said chamber, a gas-tight box into which said pipe, at its opposite end, opens, a gas-outlet pipe for said box, a water-outlet pipe for said box, and means for preventing the gas from escaping through said water-outlet.

12. In refrigerating apparatus, the combination of a generating chamber, and dehydrating means comprising a pipe opening at one end into said chamber, a gas-tight box into which said pipe, at its opposite end, opens, a gas-outlet pipe for said box, a water-outlet pipe for said box, and a water-seal for said water-outlet for preventing the escape of gas through said water-outlet.

13. In refrigerating apparatus, the combination of a generating chamber, and dehydrating means comprising a pipe opening at one end into said chamber, a gas-tight box into which said pipe, at its opposite end, opens, and a gas-outlet pipe for said box depending into the latter.

14. In refrigerating apparatus, the combination of a generating chamber, and dehydrating means comprising a pipe opening

at one end into said chamber, a gas-tight box into which said pipe, at its opposite end, opens, a gas-outlet pipe for said box extending below the top of the latter, and a water-outlet pipe for said box.

15. In refrigerating apparatus, the combination of a generating chamber, and dehydrating means comprising a pipe opening at one end into said chamber, a gas-tight box into which said pipe, at its opposite end, opens above the bottom of the latter, and a gas-outlet pipe for said box extending below the top of the latter and the top of said first-named pipe.

16. In refrigerating apparatus, the combination of a generating chamber, and dehydrating means comprising a pipe opening at one end into said chamber, a gas-tight box into which said pipe at its opposite end, opens above the bottom of the latter, a gas-outlet pipe for said box extending below the top of the latter and the top of said first-named pipe, and a water-outlet for said box.

17. In refrigerating apparatus, the combination of a generating chamber, and dehydrating means comprising a pipe opening at one end into said chamber, a gas-tight box into which said pipe at its opposite end, opens above the bottom of the latter, a gas-outlet pipe for said box extending below the top of the latter and the top of said first-named pipe, a water-outlet pipe communicating with said box, and a water-seal for said water-outlet pipe.

18. In refrigerating apparatus, the combination of a generating chamber containing a gas-outlet, and an absorbing chamber superposed on said generating chamber, the bottom of said absorbing chamber constituting the top of said generating chamber, whereby the relatively cool top of said generating chamber operates to condense water-vapors contacting therewith.

19. In refrigerating apparatus, the combination of a generating chamber containing a gas-outlet, an absorbing chamber superposed on said generating chamber, the bottom of said absorbing chamber constituting the top of said generating chamber, whereby the relatively cool top of said generating chamber operates to condense water-vapors contacting therewith, and means for conducting the vapors generated in said generating chamber, through said absorbing chamber but out of contact with the fluid contents of the latter.

20. In refrigerating apparatus, the combination of a generating chamber, an absorbing chamber, means for condensing the ammonia gas generated in said first-named chamber, a refrigerating coil connected with the supply of ammonia in said condenser, a spraying device in said absorbing chamber, means for discharging liquor from said generating chamber into said absorbing chamber

ber through said spraying device, and from
said absorbing chamber into said generating
chamber, and means for mixing the liquor
to be supplied to said spraying device with
5 the gas from said coil before their discharge
through said spraying device.

21. In refrigerating apparatus, the com-
bination of a generating chamber, an ab-
sorbing chamber, means for condensing the
10 ammonia gas generated in said first-named
chamber, a refrigerating coil connected with

the supply of ammonia in said condenser, a
spraying device in said absorbing chamber,
a pipe for conducting liquor from said gen-
erating chamber into said spraying device, 15
and a pipe connected with said first-named
pipe and said coil, for the purpose set forth.

JOHN ZANDER.
JOHN LEVEY.

In presence of—

W. B. DEARBORN,
O. C. AVISUS.