

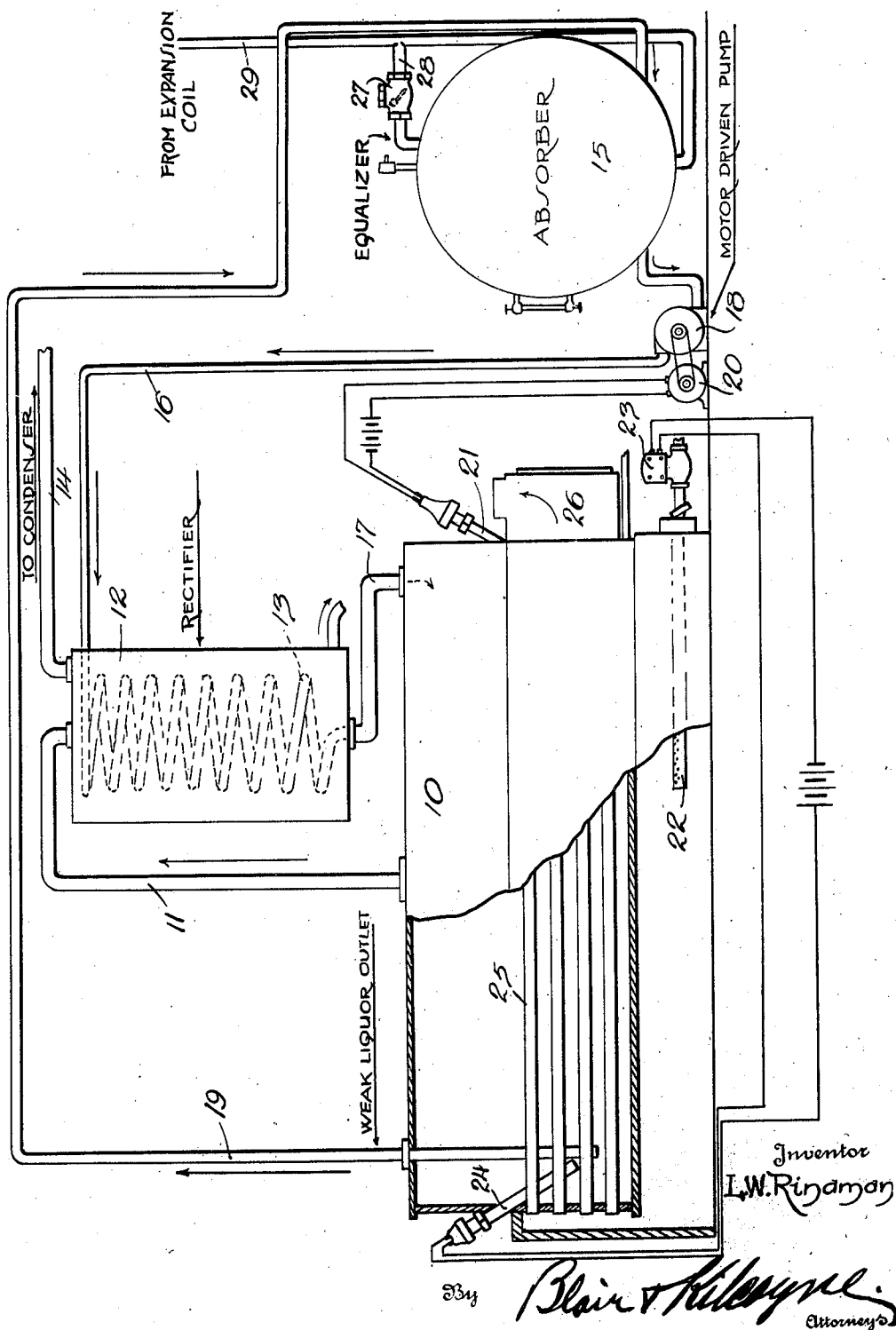
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REFRIGERATION APPARATUS

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REFRIGERATION APPARATUS

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This invention relates to improvements in ammonia absorption refrigerating systems and more particularly has to do with the novel method and construction of the generator rectifier and automatic control of the heat supply by the temperature in the generator and the automatic control of the liquor pump by the generator temperature.

One of the objects of the present invention is to provide a simple and practical apparatus, including a generator or still, for more effectively carrying out the usual ammonia absorption process of refrigeration.

A further object is to provide an apparatus of the above character which will be more reliable and efficient in use and maintain the entire system in a condition of operation whereby temporary loss of ammonia gas and liquor in the generating system is reduced to a minimum.

A further object is to provide a system of the above general character in which the generator will always be in condition and filled to the desired level with liquid ammonia at the desired degree of concentration for effectively carrying on the refrigerating function of the system when the temperature of the generator reaches the proper stage.

A further object is to provide features and means of control for both the generator and the pumping of liquid from the absorber through the rectifier to the generator in proper relation to the temperature of the generator.

Other objects will be in part obvious from the annexed drawing and in part hereinafter indicated in connection with the following analysis of this invention.

This invention accordingly consists in the features of construction, combination of parts and in the unique relation of the members and in the relative proportioning and disposition thereof, all as more completely outlined herein.

To enable others skilled in the art to fully comprehend the underlying features of this invention, that they may embody the same by the numerous modifications in structure and relation contemplated by the invention, a drawing depicting a preferred form of the invention has been annexed as a part of this disclosure, in which is illustrated diagrammatically a flow sheet showing only such parts of the system as are necessary to an understanding of the present invention, certain parts being omitted for the sake of clearness and simplification.

In the drawing, 10 indicates a still containing an aqueous solution of ammonia under pressure which, when heated to a predetermined tempera-

ture, approximately 160°, begins to drive off a certain amount of ammonia gas and water vapor through pipe 11 to a rectifier 12 where essentially all the water vapor is condensed on coming in contact with a cooled coil 13, and the thus dried, anhydrous ammonia gas passes out through pipe 14 to the well known condenser, expansion valve, and refrigerating coils. These parts, all being well known in purpose and construction, further description is unnecessary.

There is indicated at 15 an absorber connected with the coil 13 by pipe 16 for conveying the cooled strong ammonia liquor back to the still emptying at pipe 17. Weak ammonia liquor is drawn by the differential in pressure from the still through pipe 19 to the absorber. Within the circuit of pipe 16 is a pump 18 driven by motor 20, the operation of which is controlled by a thermostat 21 in the still 10. A gas or liquid fuel burner 22 of any well known type is positioned under the lower part of the still and has an electrically controlled valve 23 for supplying fuel to the burner, this electrical valve 23 being under the control of a second thermostat 24 in the still as indicated. It will be noted particularly that the still is of the fire tube type, that is, the products of combustion from the burner pass transversely beneath the still, thence through the fire tubes 25, submerged directly in the ammonia solution, and out through the stack 26.

As above explained, all of these parts per se are well known and a detailed statement of their construction and operation is unnecessary to those skilled in the art. The present invention resides more particularly in the peculiar arrangement, interconnection, and relation of the various parts, each to the other, as will now be pointed out.

The process consists in the heating of a strong solution of aqueous ammonia in the generator or still 10 by means of direct contact fire tubes in which the gases or products of combustion pass through these fire tubes 25 submerged in the aqueous solution, thereby presenting very decided advantages. In the first place, the still is heated at the bottom by direct fire, and the hot gases from the fire are passed through fire tubes 25 whereby relatively intense heat is applied directly to the aqueous solution of ammonia. This results in a very rapid liberation of ammonia gas but such liberation is accompanied by considerably less water vapor than when heated by previous methods employing low temperature heating means. The intense heat used in my process rapidly raises the temperature of the aqueous

ammonia solution to volatilizing temperature, thus causing the ammonia gas in solution to expand quickly and release itself from the water. The water is relatively slower in vaporizing than the suddenly heated ammonia. This is because the latent heat of vaporization of water is materially greater than that necessary to release the ammonia from solution. For example, using approximate figures, a 37% ammonia solution with a total weight of 6.2 lbs. enters the generator 10 at 200° F. and is heated to approximately 260° F. under 185 lbs. gauge pressure to a concentration of 25%. This liberates about one pound of gaseous ammonia, and approximately 750 B. t. u.'s are required to release it from solution, this being its heat of absorption at these concentrations. The sensible heat required to raise this ammonia from 200° F. to 250° F. is not considered, as the specific heat is about the same as that of water. As the latent heat necessary to vaporize 1 lb. of water at 185 lbs. gauge pressure is 844 B. t. u.'s more heat must be absorbed and consequently more time will be consumed in absorbing this heat by the water than by the ammonia. In the usual gradual heating, much water is evaporated and consequently more fuel is used as the heat, in the usual methods, has time to be conducted to all parts of the solution. With rapid heating, from a high temperature source under my conditions, the above difference in the heat required to expel the ammonia and that required to vaporize the water is accentuated especially on the hot surface exposed to the direct fire. This action is so pronounced in this process that no analyzer is required as in other methods and a simpler and less expensive machine results.

Complete automatic control in my process is accomplished by means of thermostat 24 in still 10 which controls fuel burners 23 and by means of thermostat 21 which controls pump 18. Both of these thermostats, it will be noted, are responsive to changes in the temperature in still 10.

Thermostat 24, the burner thermostat, is advantageously located and adjusted to cut off the burners when the temperature in the still near outlet 19 reaches about 260° F. and to turn the burners on again when the temperature drops to about 240° F. Thermostat 21, the pump thermostat, is advantageously arranged so that pump 18 begins to operate when the temperature in the still near inlet 17 reaches about 160° F. The pump of course continues to operate so long as the temperature is 160° F. or above. It will be understood, however, that these specific temperatures are merely illustrative and my invention is not restricted thereto.

The advantages of providing thermostatic control for both the burner and the pump are numerous, and so far as I am aware I am the first to have provided this dual control. The control is of course entirely automatic. It is to be noted that the pump 18 is started at just about the time when the ammonia in significant quantities is being distilled out of the generator. This means that cold, weak ammonia solution in the absorber is then, by the pump 18, immediately pumped through the rectifier where any water vapor in the ammonia gas being generated is removed. In other words, and in contrast with other processes, I do not wait until the generator temperature has reached 240° F. or 250° F. before beginning the circulation of weak liquor from the absorber to the rectifier. Thus as soon as appreciable quantities of ammonia gas are being liberated, conditions for the proper rectification of the vapor are

established and, from this moment on, the whole system is nicely regulated and controlled.

Assume now that the apparatus has run for the desired length of time, the still temperature being between 240° F. and 250° F. and regulated by thermostat 24. When the apparatus is shut down, the still temperature begins to decrease. In other processes and apparatus, any circulation pump used has been shut off by hand at this time, but in my process and apparatus pump 18 continues to function until the still temperature reaches 160° F. during the cooling down stage. This is important and it means that during the cooling down, strong ammonia liquor is still continuing to be formed in the absorber and is being returned to the generator. Hence, when the system is cold, there is in the generator a strong ammonia solution ready for immediate use when the system is started up again, and, consequently, flooding of the absorber is avoided.

In processes and apparatus heretofore proposed, these objectives are either not realized or are realized at best in a haphazard, uncontrolled way because of the manual operations heretofore used.

Thus it is apparent that the co-joint use of the two thermostats 21 and 24 gives me completely automatic control of the refrigeration process during all its phases and each time there is a shut down the system is automatically restored to its original starting condition.

In the usual methods of absorption refrigeration, hand regulation and careful supervision is necessary in order to prevent flooding of the expansion coils by liquor backing up from the absorber, even after the unit is shut down. In this invention this is prevented during normal operation and shut down by the thermostatically controlled liquor pump on the absorber outlet, in conjunction with the usual float valve or other arrangement to control the liquor inlet flow. However, in the event of a prolonged shut down, or for other reasons, there may occur a greater pressure in the absorber than in the expansion coils, which would cause the liquor in the absorber to be drawn into the expansion coils regardless of check valves between these units to prevent this.

This invention positively prevents this contrary flow at all times, and without dependence on mechanical devices, as connected to the top of the absorber, above its liquid level, is equalizer line 28, containing check valve 27, said line 28 connecting into line 29 as shown. Any suction or syphoning tendency in line 29, which might cause a flow of liquor to the expansion coils, is destroyed, as line 28 equalizes the pressure on the surface of the liquor in the absorber to that in line 29. Check valve 27 is employed to cause the usual flow of ammonia under normal operation to enter the absorber through line 29, by preventing its flow to the absorber through line 28.

It will thus be observed that the present invention provides an improved generator or still together with automatic control devices therefor and results in a system which is highly efficient, and requires far less manual attention than in heretofore proposed systems.

Without further analysis the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various applications without omitting certain features that, from the standpoint of the prior art, fairly constitute essential characteristics of the generic or specific aspects of 75

this invention, and therefore such adaptations should and are intended to be comprehended within the meaning and range of equivalency of the following claims.

5 I claim:

1. A refrigerating apparatus comprising, in combination, a generator still, a rectifier, an absorber and a pump for circulating aqueous solution from the absorber through the rectifier to the generator still, a fluid fuel burner for said generator still, and a plurality of thermostatic means within the still for controlling said burner and said pump in predetermined relationship.

15 2. A refrigerating apparatus including, in combination, a generator still, a rectifier, an absorber and a pump for circulating aqueous solution from the absorber through the rectifier to the generator still, a liquid or gaseous fuel burner for said generator still, thermostatic means within the still for controlling said burner, and a second thermostatic means for controlling said pump, the setting of said second thermostatic means being at a lower point than that of said
20 first-mentioned thermostatic means whereby in starting said still the pump will start operation before vapor leaves the still.

3. A refrigerating apparatus including a still, a rectifier, an absorber and a pump for circulating ammonia solution, said still including a fire tube generator, a fuel burner associated therewith, thermostatic means in the still for controlling said burner, and thermostatic means in said still for controlling said pump, the setting of said second-named thermostat for operating the pump being materially lower than the setting of the thermostat for controlling the burner.
5 10

4. A refrigerating apparatus comprising, in combination, a generator still, heating means associated with said still, a rectifier, an absorber and a pump for circulating aqueous solution from the absorber to the rectifier, a thermostat in said still for controlling the operation of said pump, and a second thermostat associated with the still and adapted to control said heating means, the settings of said thermostats being such that the pump will operate at all times when the generator is above a distilling temperature whereby on shutting down the apparatus the generator will be filled with a strong solution and the system drained of gas.
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