No. 706,625. Patented Aug. 12, 1902.

W. J. WOODCOCK.

REFRIGERATING MACHINE.

(Application filed Feb. 28, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

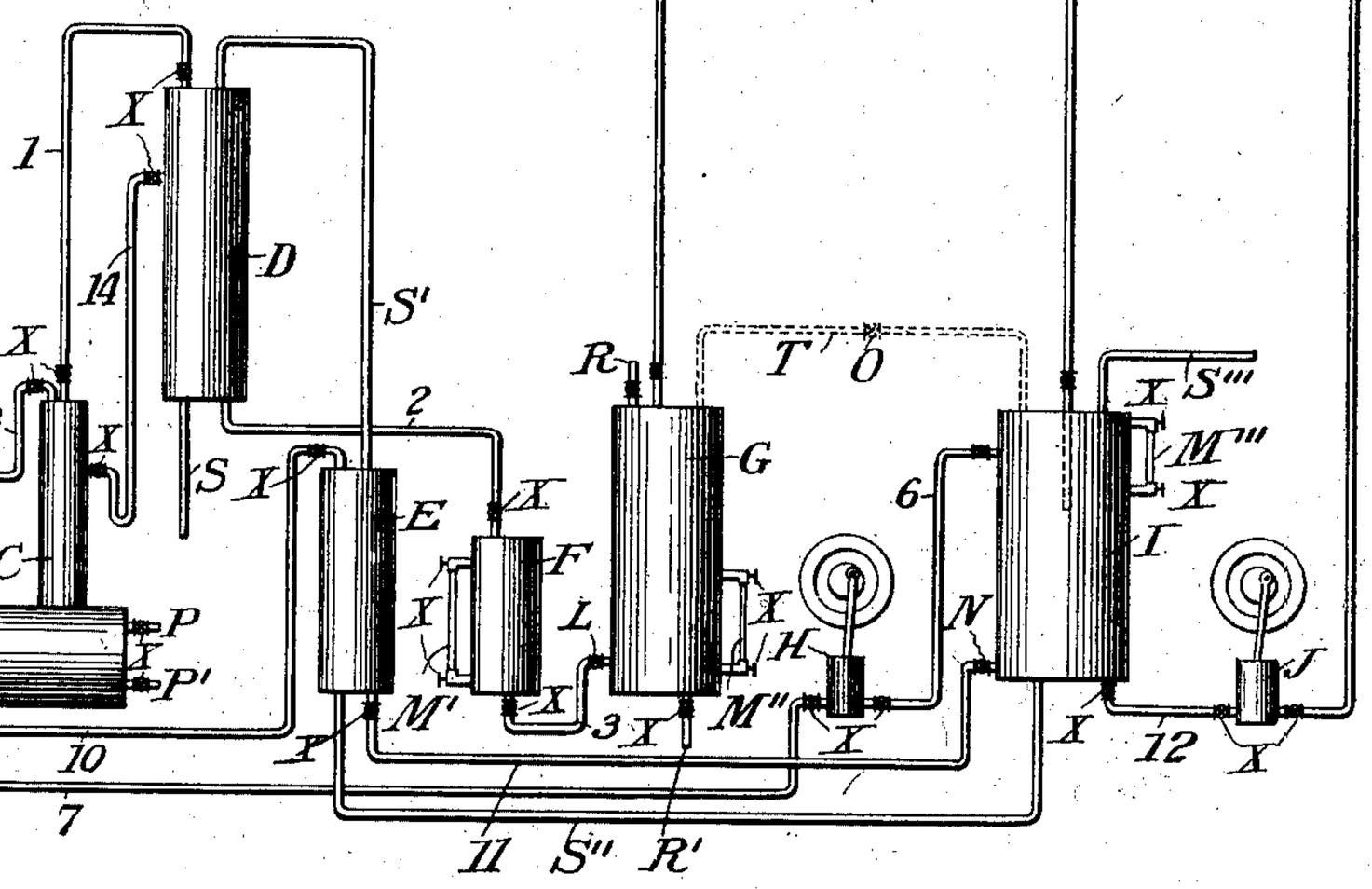

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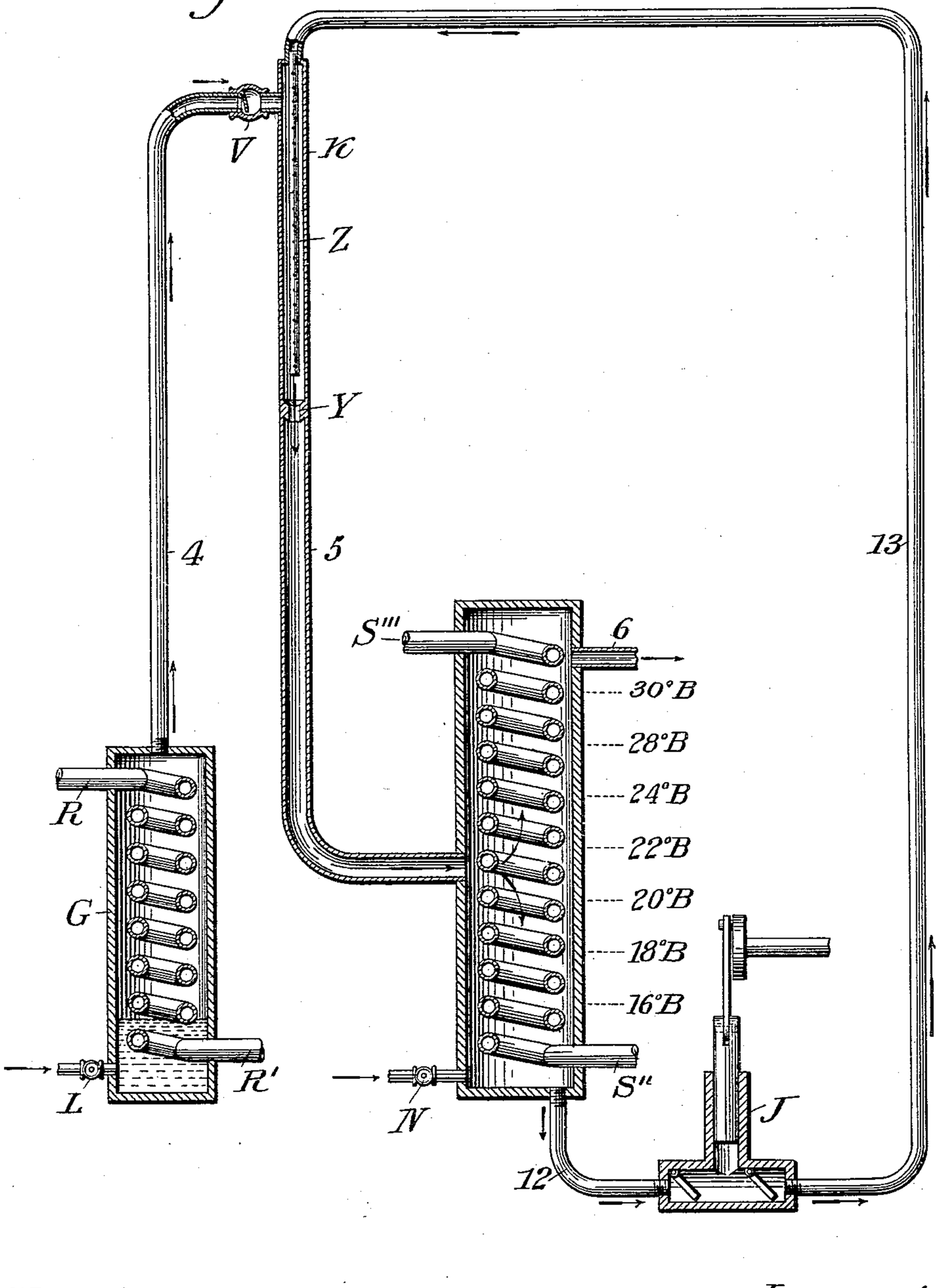
Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLARD J. WOODCOCK, OF BROOKLYN, NEW YORK.

REFRIGERATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 706,625, dated August 12, 1902.

Application filed February 28, 1901. Serial No. 49,293. (No model.)

To all whom it may concern:

Be it known that I, WILLARD J. WOODCOCK, a citizen of the United States, and a resident of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Refrigerating-Machines, of which the following is a specification.

This invention relates to producing low temperatures by the ammonia-absorption process with little or no additional expense over the present temperatures now obtained.

Very low temperatures can be utilized in the manufacture of "plate-ice" if economically produced.

In order to clearly set forth my improvements, I will here describe the ammonia-absorption system as it is generally used and then show the effect of my improvements on the same.

Figure 1 is a diagram of a complete absorption-machine embodying my improvements. Fig. 2 is sectional elevation through the cooler, absorber, reception vessel, and the circulating-pump J and connections.

Referring to the accompanying drawings, Sheet 1, A is the still, where a solution of water and ammonia is distilled by applying heat to the coil P P′, preferably utilizing the exhaust-steam from the power plant. The ammonia-gas rising through the analyzer C passes through pipe 1 to the rectifying and condensing coils in vessel D, where the aqueous vapor is returned as a liquid through pipe 14 to the still A, while the dry ammonia-gas is condensed to an anhydrous liquid and enters the receiver F through pipe 2. The pipes S S′ S″ S‴ conduct the cooling-water to and from the several vessels.

X indicates the location of the various valves used in the system.

M M′ M″ M‴ represent gage-glasses on the several vessels, respectively.

The liquid anhydrous ammonia leaves the receiver F under high pressure through pipe 3 and expansion-valve L to the cooler G, where it expands and produces a temperature due to the pressure in the cooler G and cools the brine circulating through the coils R R′. The ammonia-gas leaves the cooler G through pipe T (shown by dotted lines, because my improvements conduct it differently at this point) and valve O to the absorber I, where it is absorbed by the weak or spent solution of water and ammonia coming from the still A through pipe 9, exchanger B, pipe 10, weak-liquor cooler E, pipe 11, and controlling-valve N to the absorber I, whence, having absorbed the ammonia-gas coming from the cooler G, flows off as a rich or strong solution of water and ammonia through pipe 6 to the pump H and is forced through pipe 7, exchanger B, and pipe 8 into the analyzer C, where it falls into the still A to be redistilled having passed through a closed cycle. In this system the pressure in the cooler G, which determines the temperature produced, is dependent on the pressure in the absorber I.

It is desirable from an economical point of view to have the solution of water and ammonia enter the absorber I as weak as conditions will permit and leave as rich or strong as possible to be redistilled; but increased strength of the solution of water and ammonia tends to cause a higher pressure in the absorber I, and consequently higher pressure in the cooler G, producing temperatures which while low enough for refrigerating purposes are not low enough to freeze plate-ice to desirable thickness in less than from six to eight days, requiring a large investment in freezing-tanks and necessary fittings.

My improvements consist in conducting the ammonia-gas from the cooler G through pipe 4 to the absorber K, which is placed at such an altitude above the reception vessel I that the enriched liquor falling therefrom through pipe 5, terminating in the reception vessel I, will tend to maintain a low pressure in the cooler G. The absorbing process is not instantaneous under all conditions, and one contact of the ammonia-gas and weak solution of water and ammonia from the still A in the absorber K will not sufficiently enrich it to redistill economically. Therefore I provide for a volume of the working fluid to be circulated from the bottom of vessel I, which was used as an absorber in the ordinary system, through pipe 12, pump J, pipe 13 to the absorber K, where it absorbs the incoming ammonia-gas from the cooler G and falls as an enriched solution of water and ammonia through pipe 5 into the reception vessel I, thereby reducing the pressure in the cooler

G and producing a corresponding lower temperature. After the enriched solution of water and ammonia enters the reception vessel I at some distance from the top (pipe 5 ending as shown by dotted lines) the weaker portion of the solution of water and ammonia settles to the bottom and is returned again to the absorber K to be further enriched, while the stronger portion rises to the top of the reception vessel I and flows off through pipe 6 and is returned to the still A, as in the ordinary manner before described, sufficiently enriched to be economically redistilled.

Reference being made to Sheet 2, which shows my improvement more in detail, K represents an exhaust-head or elevated absorber. This absorber utilizes the energy of a volume of the absorbent liquid, which is circulated to operate it to relieve the pressure on the expanding liquid in the cooler G. This circulation of the absorbent liquid is effected by means of pump J elevating the liquid from the bottom of reception vessel I to the absorber K through pipe 13 and spray-pipe Z, where it unites with the gas raising from the cooler G through pipe 4 and check-valve V and, falling from an elevation through throat Y and pipe 5 into the reception vessel I, tends to relieve the pressure on the expanding liquid in cooler G, causing it to vaporize at a lower degree of temperature and cool the brine circulating through the coil R R′. The richer portion of this liquor when discharged in reception vessel I tends to rise to the top and the weaker portion settles to the bottom, as shown in principle by the indications Baumé—viz., 16° B. to 30° B., inclusive. The rich liquor after attaining sufficient strength to distill economically flows off through pipe 6 and is returned to the still at the same rate that the weak or spent liquor is supplied to the reception vessel I through valve N. The incoming weak liquor, together with the weaker portion of the liquor in reception vessel I, is used to supply the absorber K by means of pump J, as described. The heat of association or absorption is removed by means of the cooling-coil S″ S‴.

L represents the expansion-valve on the cooler G.

The effect of my improvements over the ordinary methods are, reference being made to Sheet 1, first, causing the pressure in the cooler G to be independent of the pressure in the absorber; second, admitting of maintaining a lower pressure in the cooler G, and consequently producing a lower temperature; third, obtaining a low temperature, which may be utilized to shorten the process of manufacturing plate-ice; fourth, as the pressure in the reception vessel I no longer determines the temperatures produced a stronger solution of water and ammonia may be returned from the reception vessel I to the still A to be redistilled, greatly increasing the efficiency of the refrigerating-plant, as it is evident that the greater the range between the strong and weak solutions of water and ammonia entering and leaving the still A the greater will be the economy.

My improvements herein described are applicable to any refrigerating apparatus using a soluble gas as a refrigerating agent, and the mechanism admits of various modifications.

What I claim as new is—

1. In combination, an absorber having an entrance for gas, a reception vessel having an entrance for weak liquor, and an exit for strong liquor, means for withdrawing weak liquor from the reception vessel and delivering it to the absorber, means for returning enriched liquor from the absorber to the reception vessel adapted to maintain a low pressure in the absorber, substantially as specified.

2. In combination, an absorber having an entrance for gas, a reception vessel having an entrance for weak liquor, and an exit for strong liquor, means provided to cool the liquor circulated, means for withdrawing weak liquor from the reception vessel and delivering it to the absorber, means for returning enriched liquor from the absorber to the reception vessel adapted to maintain a low pressure in the absorber, substantially as specified.

3. In combination, an expansion-chamber having an entrance for liquid and exit for gas, connections to conduct the gas to an absorber having an entrance to receive it, a reception vessel having an entrance for weak liquor and exit for strong liquor, means for withdrawing weak liquor from the reception vessel and delivering it to the absorber, means for returning enriched liquor from the absorber to the reception vessel adapted to maintain a low pressure in the expansion-chamber, substantially as specified.

4. In combination, an expansion-chamber having an entrance for liquid and exit for gas, connections to conduct the gas to an absorber having an entrance to receive it, a check-valve placed in said connection, a reception vessel having an entrance for weak liquor, and an exit for strong liquor, means for withdrawing weak liquor from the reception vessel, and delivering it to the absorber, means for returning enriched liquor from the absorber to the reception vessel adapted to maintain a low pressure in the absorber, substantially as specified.

Signed at Brooklyn, in the county of Kings and State of New York, this 23d day of February, A. D. 1901.

WILLARD J. WOODCOCK.

Witnesses:

ALLAN F. COOK,

CHAS. J. HACKETT.