(No Model.)

W. S. BREWER.

METHOD OF AND APPARATUS FOR REFRIGERATING LIQUIDS.

No. 310,025. Patented Dec. 30, 1884.

Fig. 1.

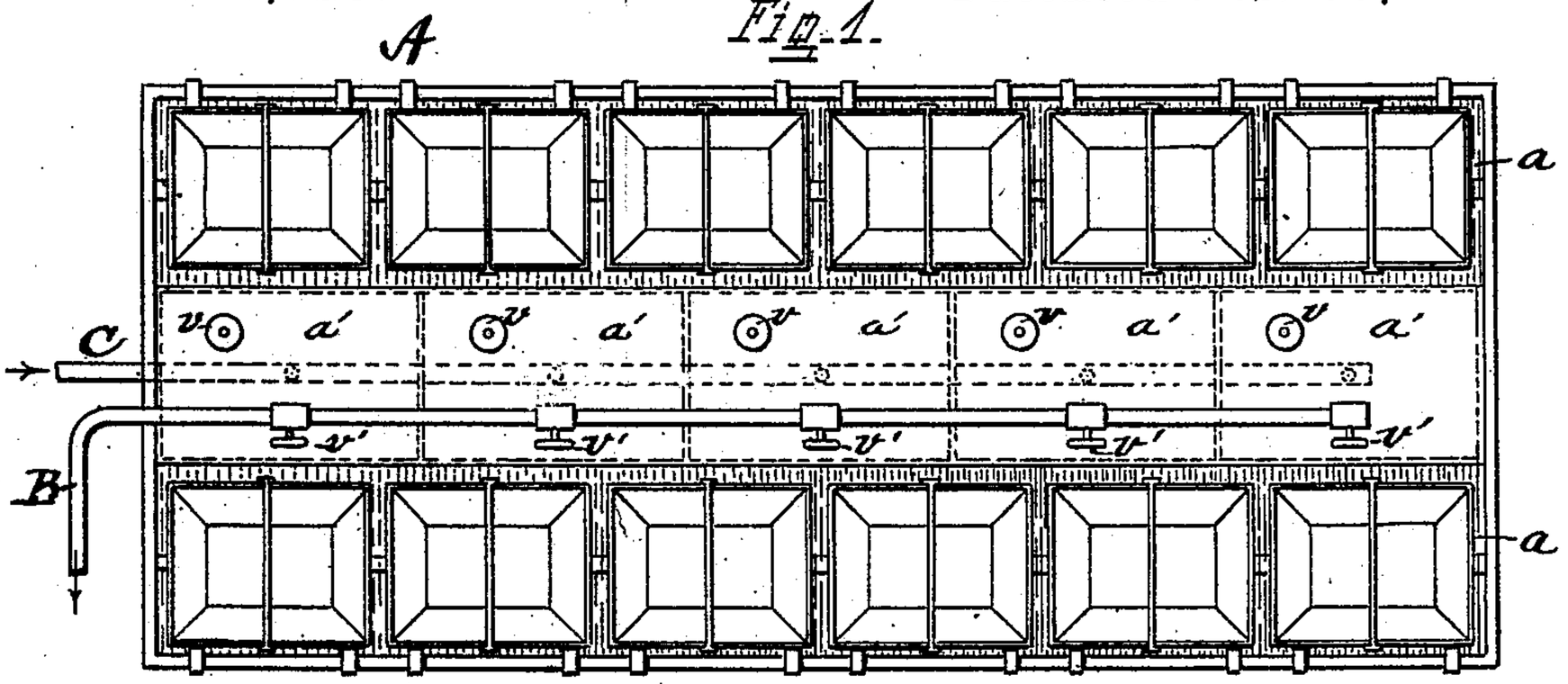


Fig. 2.

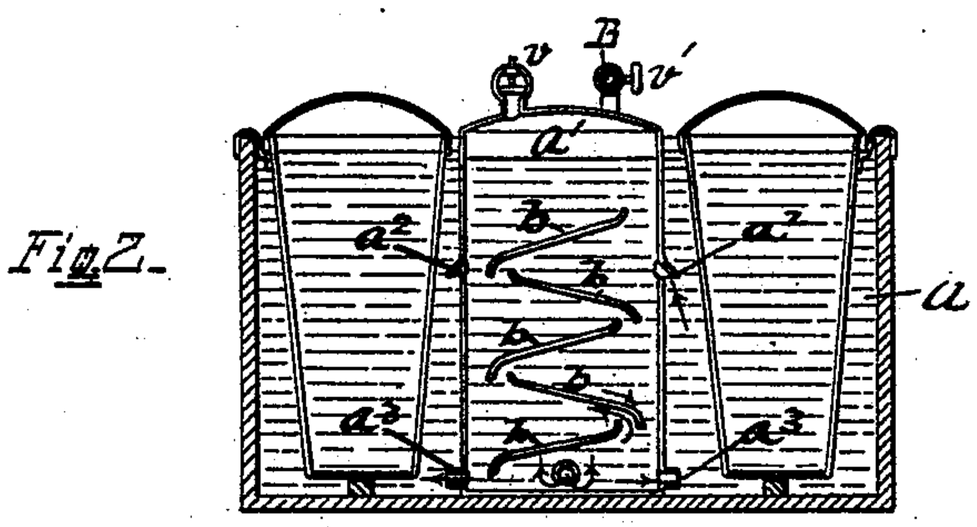
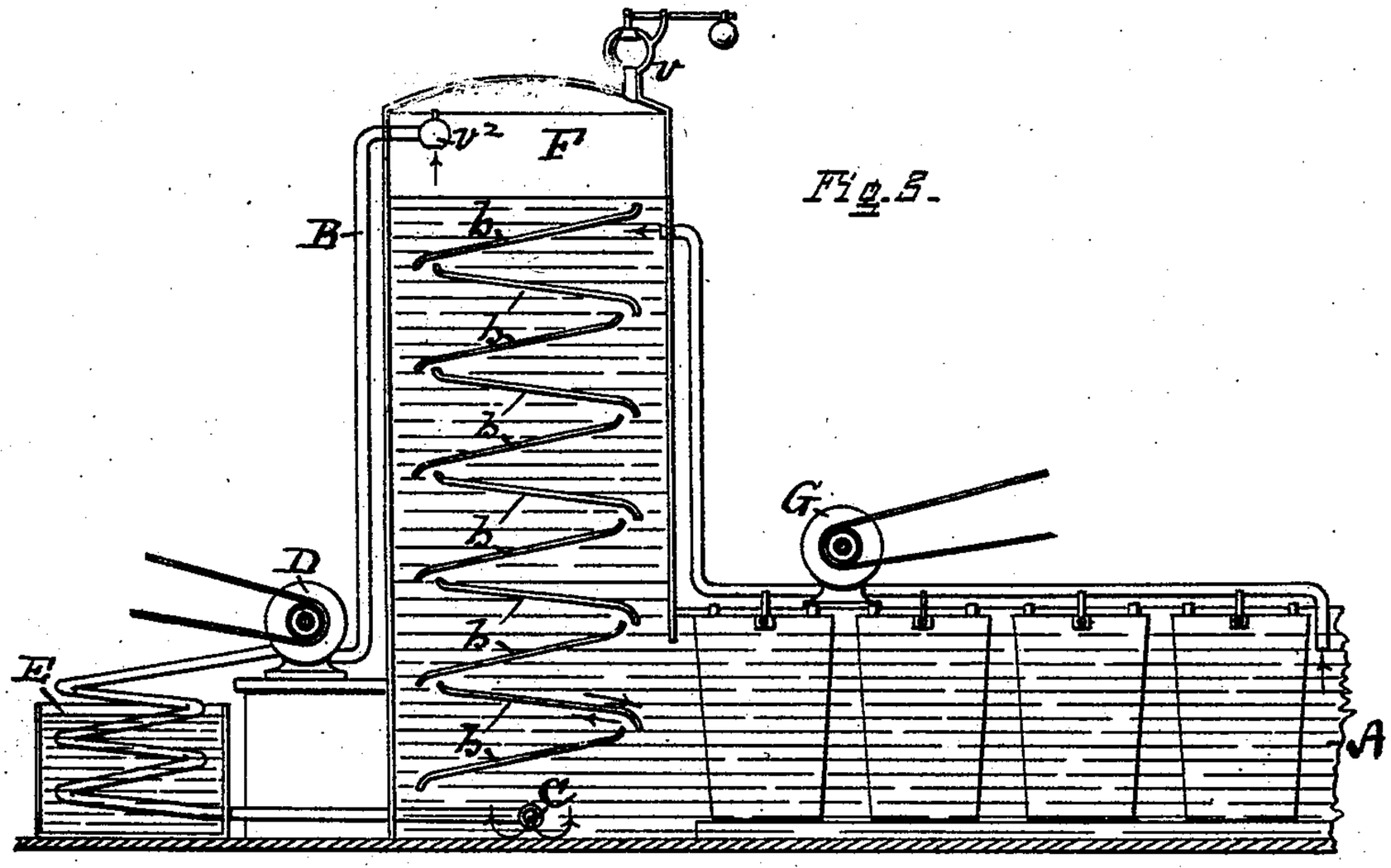


Fig. 3.



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METHOD OF AND APPARATUS FOR REFRIGERATING LIQUIDS.

SPECIFICATION forming part of Letters Patent No. 310,025, dated December 30, 1884.

Application filed February 7, 1883. Renewed August 9, 1884. (No model.)

To all whom it may concern:

Be it known that I, WESLEY S. BREWER, a citizen of the United States, residing at Richmond, Wayne County, Indiana, have invented new and useful Improvements in Methods of and Apparatus for Refrigerating Liquids, of which the following is a specification.

My invention relates to methods and apparatus for the refrigeration of liquids by means of the expansion and absorption of heat by atmospheric air released from compression, its object being to simplify and render the same more efficient and less expensive in cost and operation.

To this end my invention consists, primarily, in releasing and expanding the compressed air in direct contact with the refrigerating-liquid; secondly, in decreasing the density of the liquid, thereby increasing the expansive capacity of the air exhausted therein; and, lastly, in the construction and arrangement of apparatus for the continuous refrigeration of the liquid medium employed in artificial ice-making by the methods above indicated.

Apparatus for carrying out my invention is illustrated in the accompanying drawings, in which Figures 1 and 2 are a plan view and cross-section, respectively, of a refrigerating-tank for ice-making, in which the principle employed is the exhaustion of compressed air in direct contact with the brine used as the refrigerating medium; and Fig. 3, a longitudinal vertical section of the apparatus provided with means for decreasing the density of the liquid, the said means being in this case a vertical tank or column provided with an air-exhauster for maintaining the column of liquid normally above the general level by air-pressure acting against a vacuum.

Referring to the drawings, in which the parts described herein are indicated by the letters of reference, A designates the refrigerating-tank, which may be conveniently divided into three compartments longitudinally, of which the outside compartments, *a a*, are simply open portions of the main tank, designed for the reception of the congealing-vessels, of the usual character, and the central compartment is closed at the top, and preferably divided by cross-partitions into a number of sub-compartments, *a'*. Each of the sub-compartments *a'* is provided with a vacuum-valve, *v*, opening inward, and has a branch connection with the air-exhausting pipe B. The compartments *a'* are also perforated at the sides and bottom, as at a^2 a^3, to assist the circulation of the liquid contents of the general tank, as hereinafter described.

Longitudinally at or near the bottom of the central compartment extends an air-delivery pipe, C, passing through the entire series of sub-compartments *a'*, and provided with one or more openings at each sub-compartment, preferably at the under side of the pipe C. Regulating-valves may be used at such openings, if deemed necessary; but generally regulating-valves *v'* in the branch connections with the air-exhausting pipe B will be sufficient, in connection with the vacuum-valves *v*, (the latter being provided with means for due regulation,) to equalize the outflow of air to correspond with the inflow in the several sub-compartments *a'*. Each sub-compartment is further provided with a series of inclined partitions or deflectors, *b*, arranged one above another, as shown, to catch and retard the ascending air and guide it from side to side in a zigzag course through the surrounding liquid. These deflectors are independent of each other, and terminate at each side wholly within the sub-compartments *a'*, but may be soldered or otherwise attached at opposite ends to the cross-partitions separating the sub-compartments.

The parts thus described constitute my improved apparatus in its simplest form, it being premised that suitable mechanism, D, of any approved form, be provided for exhausting the air from the sub-compartments *a'* and compressing the same and forcing it back again through the delivery-pipe C, and also suitable provision—such as a coil, E—be added for cooling down the air when compressed.

The apparatus so constructed is operative to a practicable degree for ordinary refrigerating purposes—for example, the refrigeration of a liquid designed to circulate in pipes through an apartment where a low temperature is desired. It is also operative for ice manufacture, but involves a considerable compression of the air by powerful compressors,

the operation in either case being the compression and cooling of the air, then allowing it to escape into the sub-compartments through the delivery-pipe C and pass upward beneath the deflecting-partitions through the contained liquid, thence being exhausted from the compartments through the pipe B. I prefer, however, to construct the tank A with one or more columns, F, which are simply vertical extensions of the sub-compartments a', and may be considered the practical equivalent of a series of such sub-compartments, with the additional function presently to be described. The column F may be of any convenient height within the limit of the hydrostatic law of the vacuum, and provided with the perforated delivery-pipe C, deflecting-partitions b, and vacuum-valve v, as before described for the sub-compartments a'. The exhaust-pipe B is, however, in this instance provided with a valve, v^2, opening outwardly from the chamber. The exhauster D and coil E, of any approved construction, I have before referred to. I have shown the exhauster D as a rotary air-pump for convenience of representation; but it will be understood that piston-pumps for exhausting and compressing the air, either in the same or different machines, with all the necessary apparatus, may be employed driven from any convenient source of power.

The general operation is the same as that before described; but it will be obvious that to maintain the column of liquid at a considerable height above the general level of the open tank A a vacuum must be wholly or partially maintained in the upper portion of the column F, and the density of the column of liquid maintained therein will uniformly decrease toward the top, thus enabling the ascending air to attain a much higher expansion than otherwise, and thus absorb more heat from the surrounding liquid and produce a lower degree of refrigeration of the latter.

I find it desirable, in connection with the apparatus in this form, to employ an independent circulating-pump G, with its receiving-pipe extended to a point remote from the column, and its delivery-pipe extended upward to discharge into the column near the top, but preferably below the general level of the liquid therein. The ordinary gages are to be attached to the column to ascertain the height of the liquid therein, and the ordinary regulating-cocks to the supply, exhaust, and circulating pipes to regulate the flow of liquid and of air, so as to maintain the proper relations of the same.

It will be obvious that the function of the partitions b is to retard the ascending air and pass it in a lengthened course through the refrigerating-liquid, and that a series of screens of fine mesh would also serve the purpose by subdividing the air-bubbles, and thus practically lengthening the course of the air through the liquid.

I am aware that the expansion of air has been before utilized for similar purposes; but in such operations the air has been expanded in pipes and receivers submerged in the refrigerating medium, whereby much of the efficiency is lost.

I claim and desire to secure by Letters Patent—

1. As an improvement in the art of refrigerating or congealing liquids immersed in a liquid-refrigerating medium, the process of injecting compressed air directly into the body of said liquid-refrigerating medium to expand therein and absorb heat therefrom, substantially as before set forth.

2. As an improvement in the art of refrigerating or congealing liquids by the expansion of compressed air in a liquid-refrigerating medium, the introduction of compressed air directly into and its expansion in direct contact with a refrigerating medium held *in vacuo*, substantially as set forth.

3. In an apparatus for the manufacture of ice by expanding compressed air in a liquid-refrigerating medium, an aerating-chamber, a' or F, (one or more,) connected with an air-compressing apparatus provided with deflecting-partitions b, substantially as set forth.

4. In an ice-making apparatus, in combination with the refrigerating-tank A, one or more chambers, a' or F, communicating therewith, and provided with the perforated air-admission pipe C and exhaust-pipe B, connected with a single air-forcing apparatus, substantially as and for the purpose specified.

5. The improved ice-making apparatus, embodying a refrigerating-tank A, aerating-column F, communicating therewith, air exhausting and compressing apparatus D, cooler E, and pipes B and C, substantially as and for the purpose set forth.

6. In an ice-making apparatus of the character described, the combination, with the refrigerating-tank A and column F, having open communication with each other, of the circulating-pump G, communicating with the tank and column, substantially in the manner and for the purpose specified.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WESLEY S. BREWER.

Witnesses:
L. M. HOSEA,
JOSEPH A. KLAYOR.