3 Sheets—Sheet 1.

J. M. BEATH.

ICE-MACHINE.

No. 170,508. Patented Nov. 30, 1875.

Fig. 1.

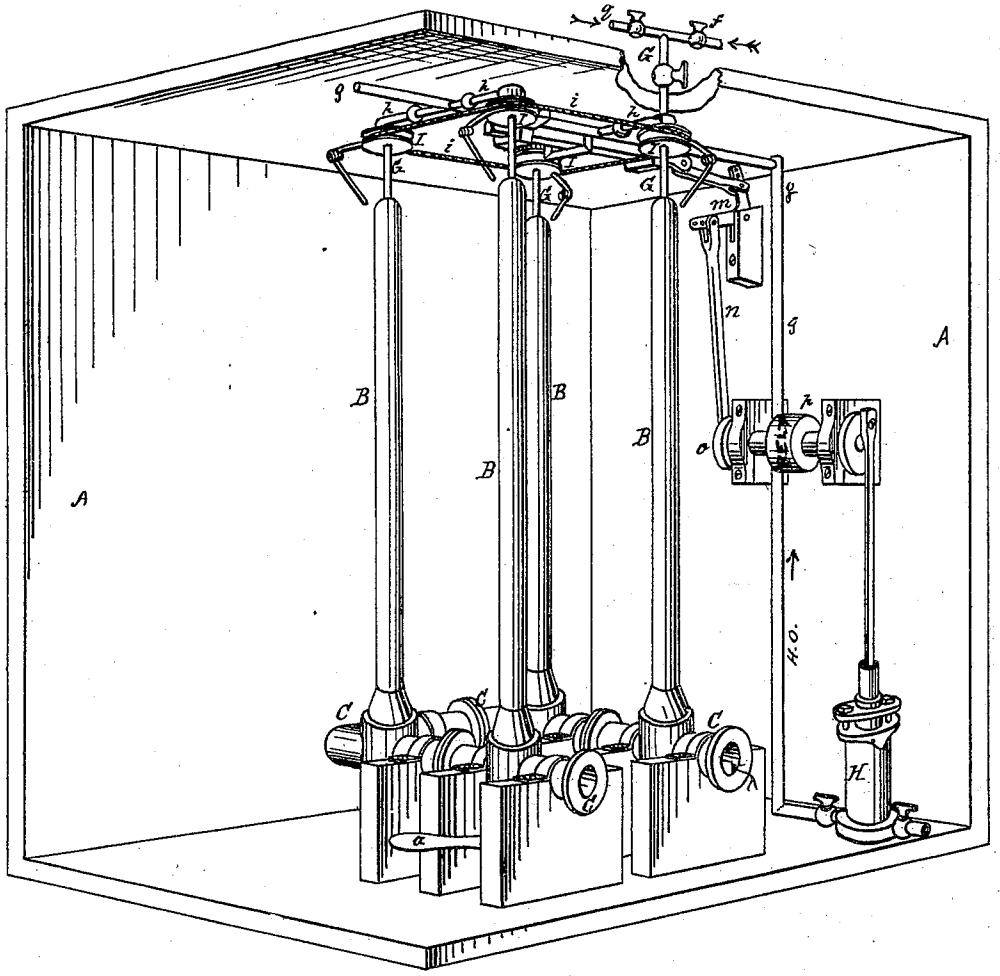
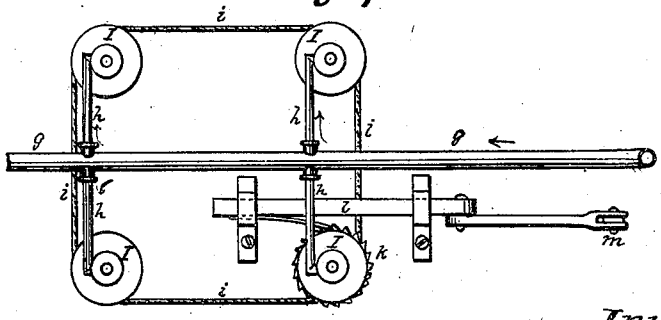


Fig. 7.



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3 Sheets—Sheet 2.

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Fig. 2

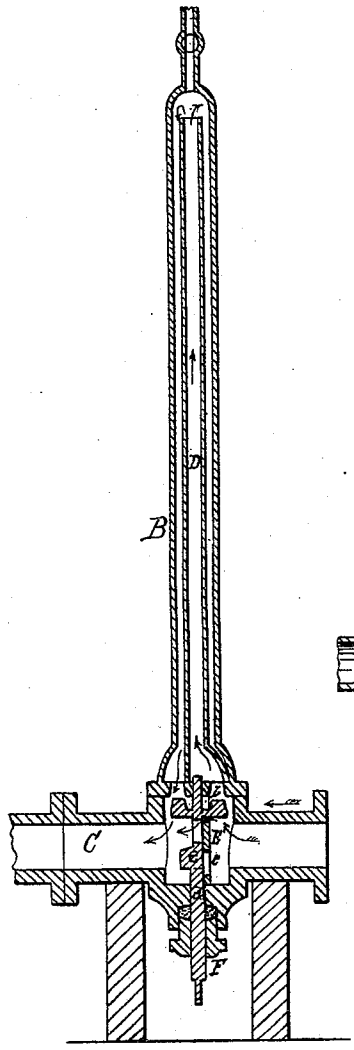

Fig. 4.

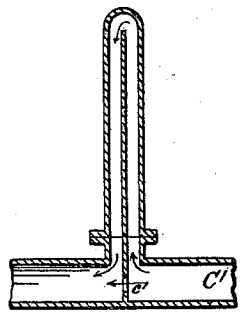

Fig. 5.

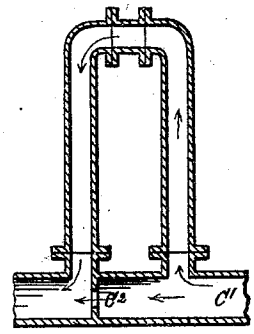

Fig. 3.

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3 Sheets—Sheet 3.

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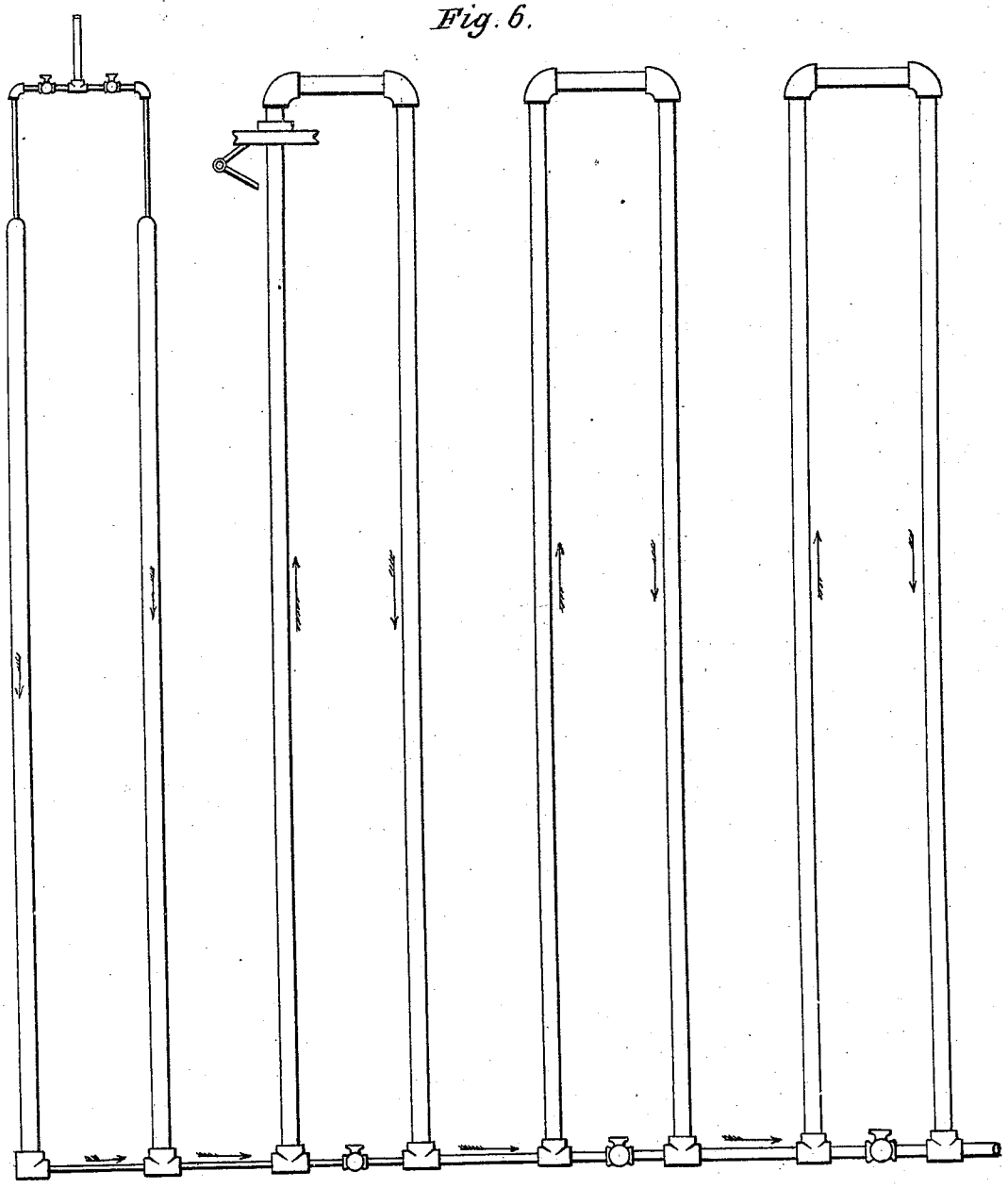
Fig. 6.



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UNITED STATES PATENT OFFICE.

JOHN M. BEATH, OF SAN FRANCISCO, CALIFORNIA.

IMPROVEMENT IN ICE-MACHINES.

Specification forming part of Letters Patent No. **170,508**, dated November 30, 1875; application filed August 5, 1874.

To all whom it may concern:

Be it known that I, JOHN M. BEATH, of the city and county of San Francisco, in the State of California, have invented certain new and useful Improvements in Ice-Machines, of which the following is a specification:

My present invention relates to improvements in congealing apparatus for forming ice by a novel process of my own invention, which constitutes the subject of my separate and distinct prior application for Letters Patent.

This invention has mainly for its object a complete and efficient admixture of the liquid and vapor of volatile refrigerants within the refrigerant-supply pipe, and an efficient circulation of the refrigerant within a series of vertical surface-congealers and a supply-pipe which is common to them all.

I accomplish these results by providing the refrigerant-pipe, from which the congealers are supplied, and which I therefore term the "refrigerant-supply pipe," with partial obstructions, preferably in the form of diaphragms or partitions located within said pipe at intervals, and provided with ports or openings having an area less than the lateral sectional area of the supply-pipe, whereby at each passage through each of said ports or openings the gaseous and liquefied portions of the refrigerant are brought into close and intimate relations with each other, and also by locating adjacent to the junction of each vertical congealer with the supply-pipe one of said diaphragms with a port or opening, whereby a portion of the refrigerant will be diverted into the congealer, and the remaining portion pass through said port or opening, and again merge with that portion of the refrigerant which, after having passed through the congealers, returns into the supply-pipe beyond said diaphragm or partition. By these means the volatile refrigerant may be maintained throughout a series of congealers in good refrigerating condition. I also accomplish closely analogous results by mounting the vertical congealers upon a refrigerant-supply pipe, with which all of them are connected, and in connecting said congealers in pairs by a pipe of proper dimensions at their upper ends, so that the refrigerant may circulate by passing from the supply-pipe upward in one congealer, and downward in the other into the supply-pipe. The circulation referred to in this instance is effected by means of an increased lateral sectional area of the supply-pipe at each point of connection therewith of each of the congealers, through which the return current enters the supply-pipe.

Another feature of my invention consists in providing each vertical congealer with two independent passages, both communicating with the supply-pipe, and arranged to allow the refrigerant to move upward in one passage, and downward in another.

My invention further consists in combining with said vertical congealers and diaphragm a cock so arranged that communication with the congealer may be cut off, and also so arranged that the ports in the diaphragm may be controlled thereby.

My invention still further consists in the combination of a cylindrical vertical congealer, having plane freezing-surfaces, with a revolving water-distributer, whereby the water is delivered for distribution upon the plane freezing-surfaces; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part of the same, is a clear, true, and accurate description of an apparatus fully embodying my said improvements.

Referring to the drawings, of which three sheets are presented, Figure 1 represents, in perspective, a stack of four vertical congealers, with a water-supplying apparatus. Fig. 2 represents, in vertical central section, one of the congealers. Fig. 3 represents, on an enlarged scale, a diametrical section of the refrigerant-supply pipe at its junction with one of the vertical congealers. Figs. 4 and 5 represent in vertical section, and Fig. 6 in elevation, modifications of the vertical congealers, and their combination with the supply-pipe, both with and without the diaphragms and ports. Fig. 7 represents a plan view of the distributers for supplying water to the congealers.

It is to be understood that the congealer is located in a room, the walls of which are partially represented at A in the drawings. This room is so constructed as to serve as a magazine or store-house, in which the ice may remain for any required time upon the congealers un-

til withdrawn for use or for market. In each instance B denotes one form of congealer. It consists of a straight casing, composed of iron pipe, closed at its upper end, and communicates at its base with the refrigerant-supply pipe C. Within this congealer is a pipe, D, of smaller diameter, with its upper end open, and extending to a point adjacent to the upper closed end of the congealer. This interior pipe communicates also with the refrigerant-supply pipe C. Within the supply-pipe C, coincident with the central vertical line of the inner pipe, is a vertical diaphragm or partition, E. The arrows on pipe C indicate the direction taken by the refrigerant therein as it supplies the congealers. For convenience in description the side of the diaphragm toward the heel of the arrow will be termed the front side, and the opposite the rear side. The refrigerant-supply pipe in front of each partition E communicates with the interior pipe D, and on the rear side thereof it communicates with the annular space between the inner pipe and the interior of the congealer, so that when these two passages are open a circulation is effected along the supply-pipe to a partition; thence upward through the inner pipe; thence downward in the congealer into and onward through the supply-pipe C. In order that each congealer may be under perfect control, I guard both passages by means of a valve or cock, a desirable form of which is shown at F. This cock may be manipulated by means of a lever, as at *a*, or by other equally well-known device. Should it be desirable to cut off the refrigerant entirely from the congealer this cock performs that service. For securing desired results it is obvious that the refrigerant must be partially vaporized when it enters the supply-pipe, and as it is introduced to the apparatus in fluid form it is of value that the refrigerating effect resulting from said essential partial gasification be fully utilized. This is accomplished by introducing the liquid refrigerant into the supply-pipe direct from the condenser through one or more of the congealers, in order that, in becoming partially gasified, it shall perform refrigerating service. The branch pipe at *q*, provided with suitable cock, represents a connection with the fluid-containing portion of the condenser.

In the drawings, Fig. 1, a stack of four congealers only is shown. In practice a larger number will be employed, and they will preferably be arranged in parallel rows, so as to properly occupy the space in the room.

In operating upon a row of such congealers it is desirable that only a proper proportion of the refrigerant moving in the supply-pipe should be diverted through each of the congealers. I have discovered, in connection with ammonia, (which is believed by me to be the best refrigerant known in the art,) that when the area of the opening through which the liquid and its vapor is made to flow is such as to admit of considerable velocity of the vapor, it carries the liquid with it, causing both to become intimately mixed somewhat after the manner of foam or froth, for instance—and I have observed in this connection that they will remain in that intimate relation or condition for a considerable length of time, provided said mixture be kept in motion in vertical lines, and the velocity of the mass attained in practice be sufficient to overcome the gravitation of the liquefied particles.

In Fig. 4 the vertical congealer is shown with an interior diaphragm, which extends from the supply-pipe C^1 upward to a point near the top of the interior of the congealer. Near the base of the diaphragm is the port *c'*. As the refrigerant flows toward the left hand the reduced area of the opening of the port causes a portion thereof to be directed upward over the top of the diaphragm, thence downward into the supply-pipe, where it joins that portion which passed through the port, and thence onward to the next congealer.

In Fig. 5 the congealers are arranged in pairs, united at the top, and each connecting at the base with the supply-pipe C^1, as shown. A diaphragm, as at C^2, provided with a port, as before described, is located between the two congealers in the supply-pipe. As the refrigerant flows toward the left hand it is partially obstructed by the diaphragm, and while a portion thereof flows through the port, as before described, a sufficient quantity will be directed into the right-hand congealer, thence upward through the connecting-pipe, then downward through the left-hand congealer into the supply-pipe, as already described in connection with the other two forms of congealer. Although the continuous length of pipe, with the top connection, as shown in Fig. 5, is well adapted to small apparatus, and will produce desirable results with the diaphragm, that form in which each has a double interior passage, whereby both the upward and downward currents are effected in the same congealer, is best adapted for large apparatus.

It is to be understood that, however the vertical congealers may be constructed, it will be advisable to have their openings into the supply-pipe controllable by suitable cocks; also, for convenience in adjusting the area of the openings at the ports in accordance with their location, as before referred to, said ports should in like manner be so controlled.

In order to divert and control in a measure the main body of the refrigerant, I provide in each diaphragm or partition two ports, as at *b* and *c*, the former placed above and the latter below the horizontal diametrical line of the supply-pipe. Attached to the rod *d* of cock F is a gate-plate, *e*, which is in sufficiently close contact with the coincident surface of the partition to close or partially close the port *b*, when the congealer-passages are closed by raising the cock, leaving the lower port *c* wholly unobstructed. Should the passages into the congealer be only partially closed

both the upper and lower ports will be sufficiently open to admit passage of the refrigerant. In order that the ammonia may not be objectionably retarded in its progress through the several ports, said ports will have an increased area of opening at every partition, including the last, in the direction opposite to that whence the supply flows. In order that the area of each port or pair of ports may be accurately adjusted in accordance with requirements dictated by experience, I prefer that the gate-plates *e* be made vertically adjustable on the valve-rod, so that although the area of opening of the ports in all the partitions may be the same, they may, by the relative position of the gate-plates, be varied in capacity to meet requirements in each instance. As the movement of the ammonia is not materially affected by the laws of gravity, it will be obvious that the congealers may be reversed in position, and the refrigerant-supply pipe placed above instead of below, and yet produce desirable results, so far as congealing is concerned, although I consider the arrangement shown as preferable to any other, because, if for no other reason, the supply-pipes being heavy, they are more fittingly so located as to serve as the base or foundation for the congealers. Moreover, the liquidized portion of the refrigerant would be more or less liable to separate from the vapor, and accumulate at the lower ends of the pipe, and such possibility should be avoided as far as practicable in all cases. The passage of the volatile refrigerant through the ports serves in each instance, at each passage, to effect to a valuable degree the readmixture of the liquid and vapor, by bringing them into close and intimate relations with each other. When the refrigerant leaves the congealer, it is more or less vaporized, and on re-entering the supply-pipe it merges with that portion of liquid and gas which passed through the port in the next preceding diaphragm, and becomes incorporated therewith, and well fitted to enter the next congealer, while the passage of a portion thereof through the next port results, as before, in a repeated admixture.

Fig. 6 represents congealers similar to those in Fig. 5, which are connected in like manner with the supply-pipe. Instead, however, of having a uniform diameter, as is possible when the partitions and openings are employed, the supply-pipe is made in lengths or sections which are of gradually-increased diameter, as shown. The refrigerant—ammonia, for instance—entering the supply-pipe at its smallest end (by the way of one or more of the congealers, as shown) under proper pressure, and being not materially affected by gravitation, by reason of its frothy or gasified condition, it readily rises in the first succeeding vertical congealer, and passes over to the next, thence downward. At the point where the supply-pipe is enlarged the pressure of the refrigerant is decreased in consequence of said enlargement, and in proportion thereto, which admits the refrigerant in the congealer in which the current is downward to enter the supply-pipe. The refrigerant so returned unites with that portion thereof which continued in its direct course, and is, by said merging, fitted to supply the next pair of congealers in like manner, and so on through the series, continuously. In practice, I make the sectional area of the supply-pipe between the inlet and outlet of each pair of congealing-pipes such that a small excess of the fluid will be caused to pass through the said congealing-pipes over and above what is requisite to perform the freezing work therein. The volume and density of the fluid may be determined at any given point in its course, from its inlet, in the form of a liquid, into the main supply-pipe, to its outlet therefrom in the form of gas, by calculating the amount of heat it has absorbed in doing its freezing or cooling work before reaching that point, and from this calculation I determine the area of the pipe required to cause the requisite portions of its volume to traverse the upright pipes at that point.

This form of apparatus is well adapted for use on a small scale, and in localities where skillful operators are not available. The ice would be removed from these congealers by sawing and splitting, and it would not be necessary to employ other than mechanical means for detaching it from the congealers.

It will be seen that my invention involves a novel method of distributing ammonia and its vapors, or other volatile liquids and their vapors, in a mixed condition through a series of vertical congealing-pipes, whereby they may be made of uniform size, and possess uniform frigorific power, and, although connected directly with a supply-pipe common to them all, each congealing-pipe may be disconnected therefrom without affecting the operation of others. It is obvious that by connecting the vertical congealing-pipes with the common supply-pipe a more direct route is opened for the main portion of the refrigerant, and renders it practicable to maintain such relations between the frigorific power of the fluids and the pressure under which they are worked as to promote uniform congelation throughout the series of congealing-pipes.

The terms "diaphragm" and "partition" are employed by me herein in their broadest sense, as indicating such a variation in the interior dimensions of the supply-pipe as will admit of the presence of a port or opening having less area than the lateral sectional area of the supply-pipe, for I am well aware that the supply-pipe itself, at points where certain obstruction to the direct flow is required, may be so reduced in diameter as to present an opening of reduced area, thereby producing the same results.

For the purpose of detaching the ice from the surface of the congealers each is connected with the condensing-tank by means of the pipe G, which enters at the upper or closed end,

and is provided with a suitable cock, as at *f*. On closing the cock or valve F gas is admitted from the upper portion of the condenser at a high temperature, which speedily, by melting the ice next the surface of the congealers, effects a disengagement thereof.

While it is essential at all times to keep the freezing-surfaces supplied with an excess of water, as fully set forth in my former application for patent before referred to, to which invention my present improvements particularly relate, it is also of value that the water be discharged upon the congealing-surfaces at intervals, instead of continuously.

The water for congealing is forced by the pump H intermittently, by way of pipe *g* and branches *h*, into the pans I, which are rotatively mounted on the pipes G, which enter the room through the upper ceiling, and connect the condensing-tank with the congealers. A belt-cord, *i*, operatively connects the several pans by engaging therewith after the manner of belt-pulleys. One of the pans has a toothed plate or ratchet-wheel, as at *k*, with which a spring-pawl on slide-rod *l* engages. Longitudinal movement is given to the slide-rod by means of the bell-crank lever at *m*, which is in turn connected by a pitman, *n*, with the pump-shaft at *o*. The pump is driven by a belt over pulley *p*, and during each upward movement of the plunger the sliding rod *l* is made to turn the ratchet-wheel to the extent of one or more teeth, according as it has been adjusted by means of the holes in the lower arm in the bell-crank lever. The movement of the several pans is simultaneous and uniform. The mechanism for producing this intermittent rotation of the pans in their discharge of water upon the freezing-surfaces may be largely varied, the mechanical operations involved being so simple that this may be accomplished in many ways, and I therefore make no claim to the precise details shown, as a revolving water-distributer constitutes, in combination with a congealer having plane freezing-surfaces, a distinctive feature of my invention.

Having thus described my invention, I claim as new, to be secured by Letters Patent—

1. In a congealing apparatus, a series of vertical congealing-pipes, in combination with and connected to a supply-pipe which is common to all of the congealing-pipes, and which delivers the liquid and gaseous ammonia to each of the congealing-pipes, and receives the same after circulating therein, substantially as described.

2. The combination, with a refrigerant-supply pipe, having diaphragms and ports, of vertical congealers, having double connections with the supply-pipe, substantially as described, whereby the refrigerant will be partially diverted from its direct course through the congealers, and return to the supply-pipe.

3. In a volatile refrigerant-supply pipe, one or more diaphragms or partitions, provided with openings of less area than the sectional area of said pipe, substantially as described, whereby the gaseous and fluid portions of the refrigerant may be brought into close relations with each other by their passage through each opening, as specified.

4. The vertical congealers, having independent interior passages for conducting the refrigerant, the supply-pipe, and the diaphragms or partitions with ports, combined to operate substantially as described.

5. A vertical congealer for artificial-ice manufacture, composed of an exterior casing, having a closed end, an interior conductor with an open end, located adjacent to the closed end of the casing, and a refrigerant-supply pipe connected with pipe and casing, substantially as described, whereby the refrigerant will be conducted into the congealer by way of the interior pipe, and from the congealer to the supply-pipe, for the purposes specified.

6. In a congealing apparatus, having vertical congealers immediately supplied from a pipe common to them all, the combination, with the congealers and supply-pipe, of a cock or cocks for controlling the passage of ammonia to each congealer, and a diaphragm in the supply-pipe opposite each congealer, provided with a port or ports, which are also guarded by valves or cocks, substantially as described.

7. The combination of a cylindrical vertical congealer, having plane freezing-surfaces, with a revolving water-distributer, substantially as described.

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