No. 676,666. Patented June 18, 1901.

J. PATTEN.

ICE MACHINE.

(Application filed Oct. 10, 1900.)

(No Model.) 5 Sheets—Sheet 1.

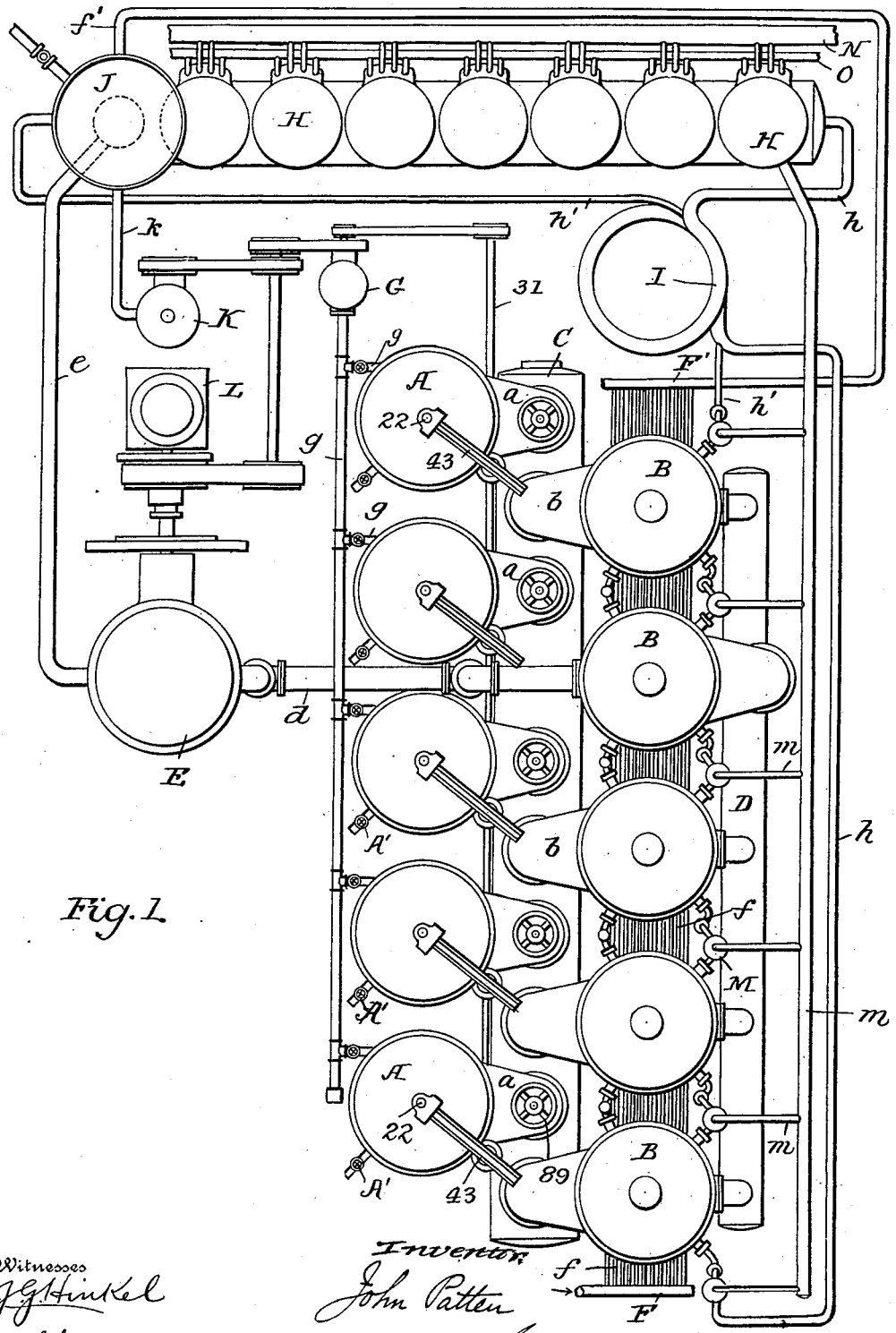


Fig. 1.

Witnesses
J. J. Hinkel
C. W. Clement.

Inventor
John Patten
By Watson & Watson Attorneys

No. 676,666. Patented June 18, 1901.

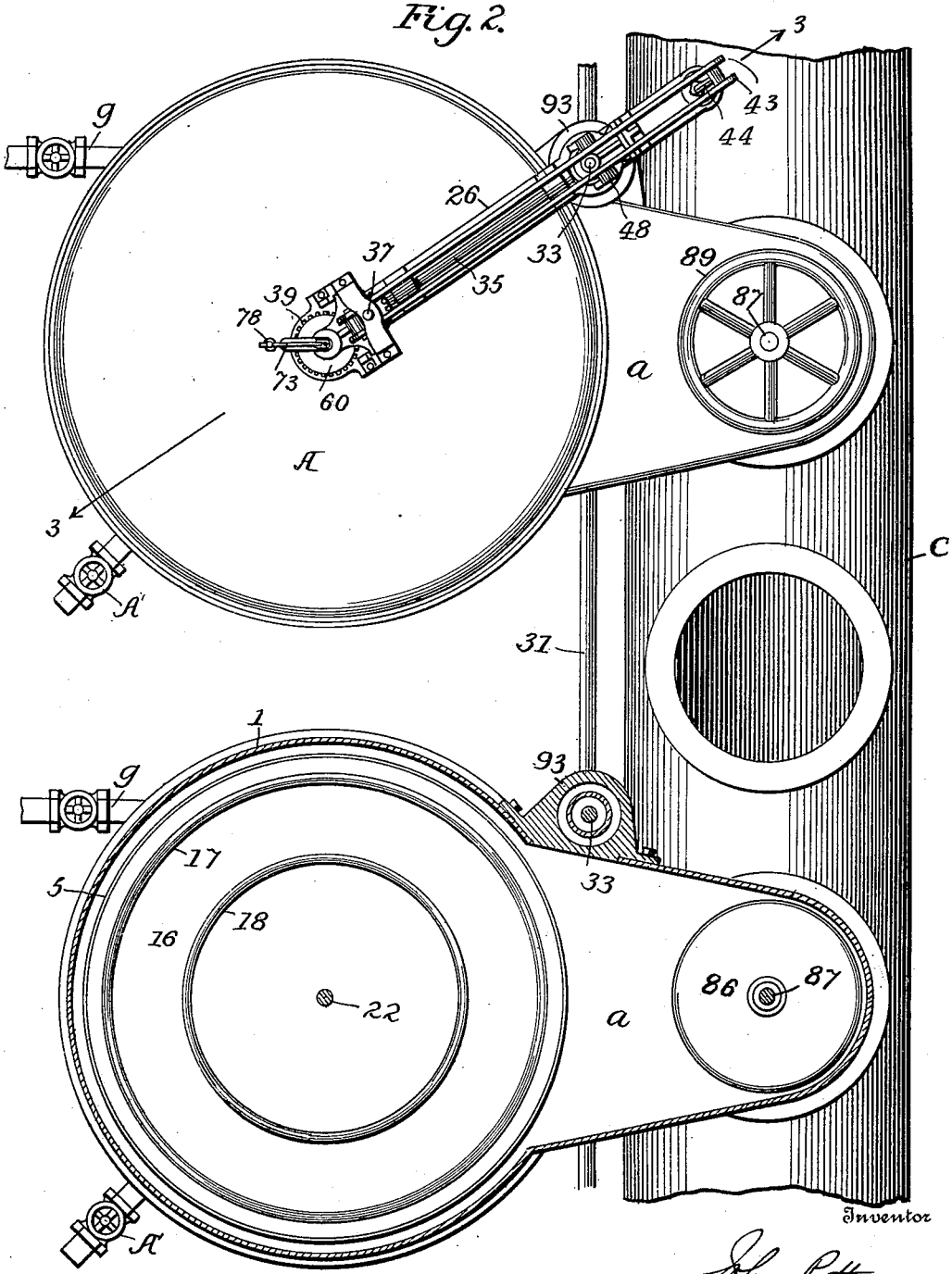
J. PATTEN.

ICE MACHINE.

(Application filed Oct. 10, 1900.)

(No Model.) 5 Sheets—Sheet 2.

Fig. 2.



Witnesses
J. J. Finkel
C. W. Clement

Inventor
John Patten

By Watson & Watson Attorneys

No. 676,666. Patented June 18, 1901.

J. PATTEN.

ICE MACHINE.

(Application filed Oct. 10, 1900.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 10.

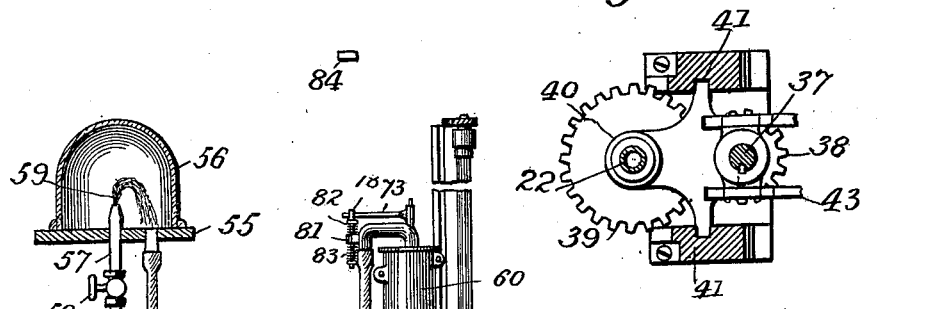


Fig. 11.

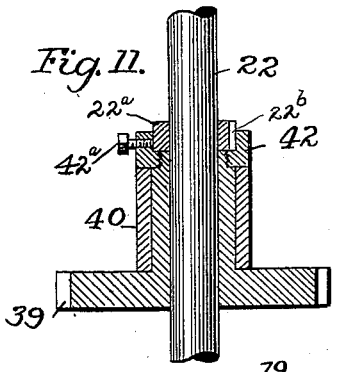
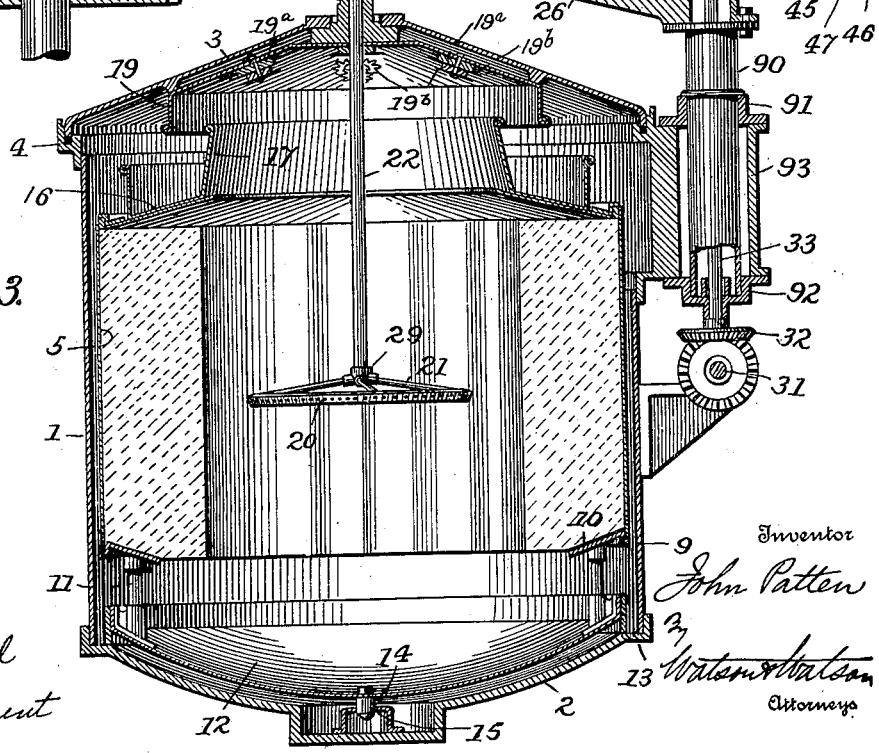


Fig. 3.



Witnesses
J. J. Hinkel
C. W. Clement

Inventor
John Patten
By Watson & Watson
Attorneys

No. 676,666. Patented June 18, 1901.

J. PATTEN.

ICE MACHINE.

(Application filed Oct. 10, 1900.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 4.

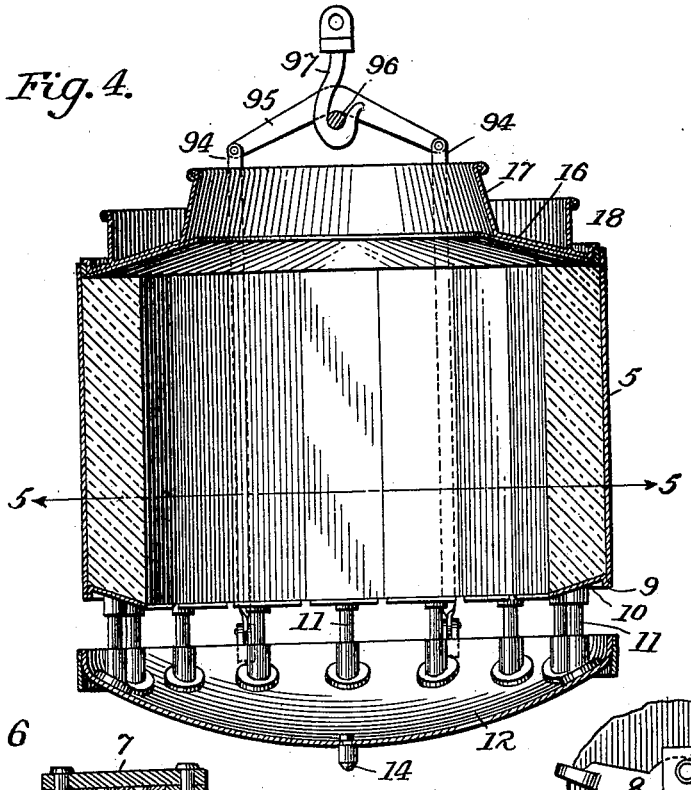


Fig. 6

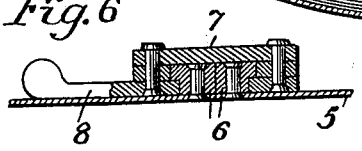


Fig. 7

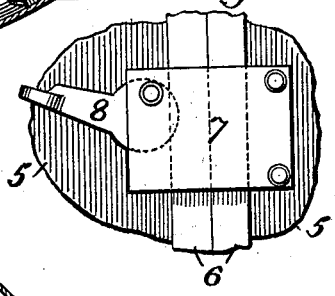
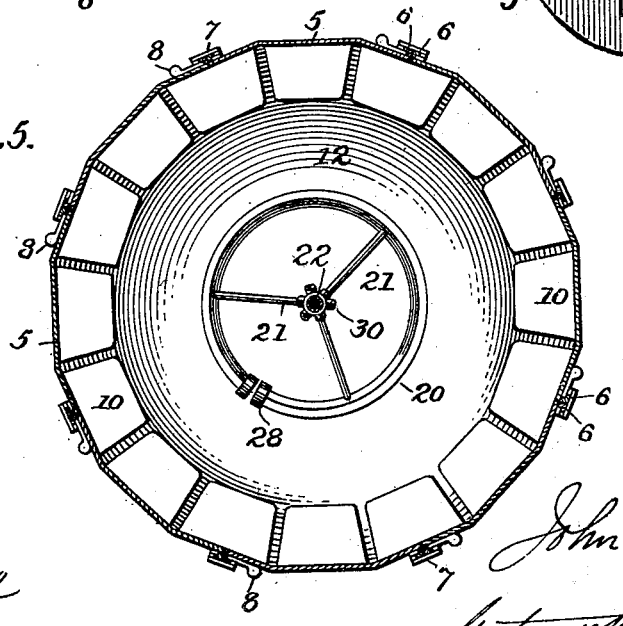


Fig. 5.



Witnesses

F. G. Hinkel

C. W. Clement.

Inventor

John Patten

By Watson & Watson Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 676,666. Patented June 18, 1901.

J. PATTEN.

ICE MACHINE.

(Application filed Oct. 10, 1900.)

(No Model.) 5 Sheets—Sheet 5.

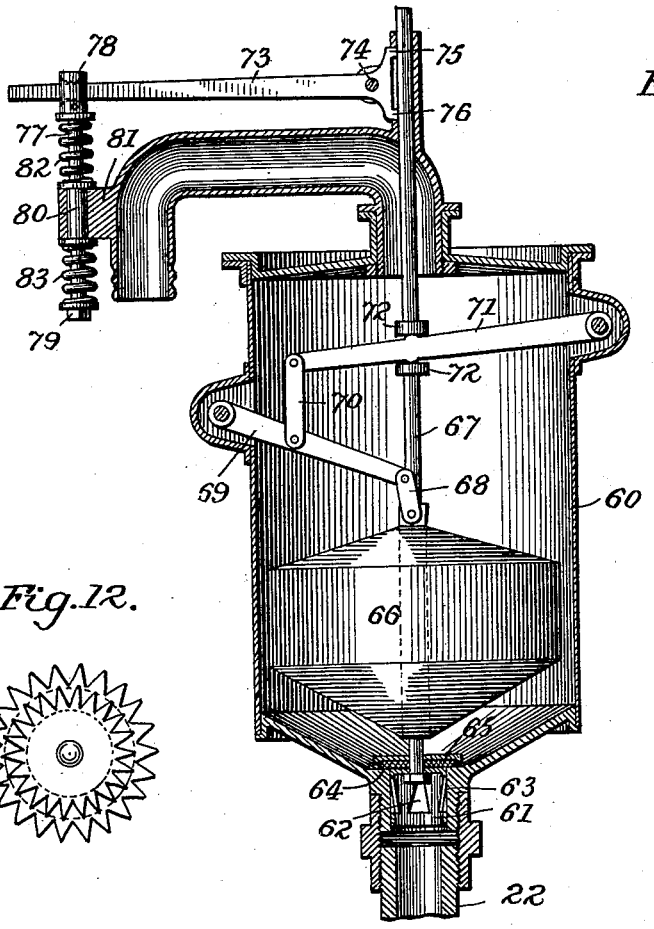
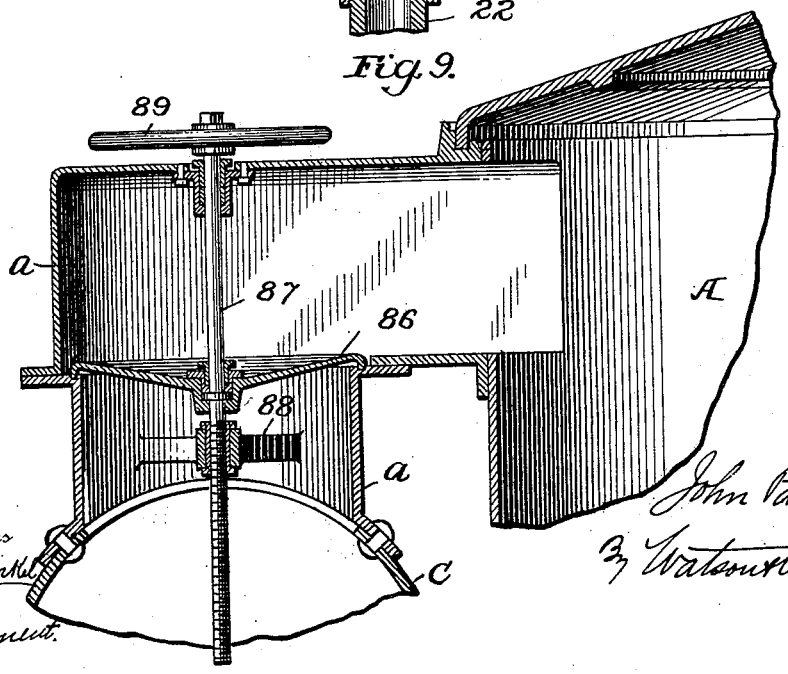


Fig. 8.

Fig. 12.

Fig. 9.



Witnesses
J. G. Hinkel
C. W. Clement.

Inventor
John Patten
By Watson & Watson
Attorneys

UNITED STATES PATENT OFFICE.

JOHN PATTEN, OF BALTIMORE, MARYLAND, ASSIGNOR TO THE PATTEN VACUUM ICE MACHINE COMPANY, OF SAME PLACE.

ICE-MACHINE.

SPECIFICATION forming part of Letters Patent No. 676,666, dated June 18, 1901.

Application filed October 10, 1900. Serial No. 32,560. (No model.)

To all whom it may concern:

Be it known that I, JOHN PATTEN, a citizen of the United States, residing in the city of Baltimore, State of Maryland, have invented certain new and useful Improvements in Ice-Machines, of which the following is a specification.

This invention comprises various improvements in that class of ice-making apparatus in which water is frozen by subjecting it to the influence of a high vacuum. The rapid evaporation thus produced deprives the water of its heat and converts it into ice.

The present application relates more particularly to the vessel in which the ice is formed, which will be termed the "freezing-chamber," and the apparatus associated therewith; and it consists in various improvements upon apparatus previously invented by me and forming the subject-matter of application, Serial No. 604,271, filed August 29, 1896. Patentable features disclosed in this application and not claimed herein are claimed in said prior application.

In the accompanying drawings, Figure 1 is a plan view illustrating the relation and arrangement of a complete refrigerating plant embodying the present invention. Fig. 2 shows an enlarged plan view of one of the freezing-chambers and a sectional plan view of another. Fig. 3 is a vertical section of the freezing-chamber about on the line 3 3 of Fig. 2. Fig. 4 is a vertical sectional view illustrating the manner of removing the ice from the freezing-chamber. Fig. 5 is a sectional plan on the line 5 5 of Fig. 4. Figs. 6 and 7 are details of the locking device illustrated in Fig. 5. Fig. 8 is a vertical sectional view illustrating the device for feeding water to the freezing-chamber. Fig. 9 is a vertical section illustrating the connection between the freezing-chamber and the vapor-exhaust pipe. Fig. 10 is a section on the line 10 10 of Fig. 3. Fig. 11 is a detail view of part of the gearing connected with the rotatable spray-pipe, and Fig. 12 is a detail view of an ice-retaining attachment for a baffle-plate in the freezing-chamber.

Referring to Fig. 1 of the drawings, A A indicate the freezing-chambers, five being shown in the plant illustrated, and B B indicate absorbers. All of the freezing-chambers, and preferably all but one of the absorbers, communicate with a common tank or tube C through connecting-pipes *a* and *b*, respectively. In the embodiment of my invention herein illustrated all but one of the absorbers communicate with a common exhaust-pipe D, which pipe is exhausted by a vapor-exhauster or vacuum-pump E through a connecting-pipe *d*, one of the absorbers being interposed between said exhaust-duct and vacuum-pump, so that the vapor exhausted from all of the other absorbers of the series passes finally through this one absorber, which is directly connected to the pipe *d*. The acid in the absorbers is kept constantly cooled by a series of pipes or coils, (not shown,) which are supplied by a corresponding series of pipes *f f*. The water enters the pipes *f* through a header F, and after passing through the series of absorbers it leaves through a second header F'. It is conveyed away by a pipe *f'*.

Sulfuric acid or other suitable material is circulated through the absorbers B to take up a large proportion of the vapor from the freezing-chambers, and thus relieve the pumps and produce a higher vacuum than could be obtained by the use of pumps alone. For the purpose of this application we will assume that acid is the absorbent material used. This acid is circulated continuously between the absorbers B and a series of concentrators H. Steam is supplied to coils in the concentrators from steam-pipe N and the exhaust-steam escapes through the pipe O. The hot concentrated acid flows from the concentrators through a pipe *h* to the end absorber of the series, and it is then caused to flow successively through the several absorbers, and it leaves the absorber at the other end of the series through a pipe *h'* and returns to the concentrators. The incoming and return acid pipes are arranged so that the hot acid from the concentrator is cooled by the cooler acid flowing from the absorbers, and the heat thus returned to the concentrators. As shown, this is accomplished by inclosing a portion of the return-pipe *h'* in a portion of the supply-pipe *h*, this device I being termed a "heat-exchanger." The exhaust from the pump E

is discharged through a pipe *e* into a condenser J, in which the vapors from the concentrators are condensed. The water flowing from the pipe *f'* may be directed into this condenser and utilized for condensing purposes. The air, gases, and vapor are exhausted from the condenser J and the concentrators H through a pipe *k* by vacuum-pump K. The several pumps are driven by a suitable engine L. The acid is pumped from one absorber to the next by means of pumps M M. These pumps M are preferably connected with exhaust apparatus to clear the acid of any entrained air or gases. As shown, they are connected with one of the concentrators through the pipes *m m*.

A supplemental pump G is used to pump air out of each freezing-chamber after the ice formed therein has been removed and the chamber closed again for forming another block. This pump may be used in connection with the pump E to pump the air out of the entire system in first starting the plant; but after the vacuum is once established the pump E maintains it, and the pump G, as aforesaid, is employed to remove air from the freezing-chambers which is admitted while removing ice therefrom. Air is admitted to the freezing-chamber and the vacuum therein broken when ice is to be removed through a valve A'.

I shall now proceed to describe one of the freezing-chambers A, it being understood that they are all alike in construction and operation.

The chamber preferably has a cylindrical wall 1, an arched bottom plate 2, and an arched top or cover 3. The cover has a flange bearing upon a packing-ring 4, supported on the upper end of the wall 1. The ice is formed on an inner removable wall composed of a series a vertical plates 5, Figs. 4 and 6. Each of these plates is bent, as shown, on two lines and the series of plates form a polygonal wall extending around the freezing-chamber just within the outer wall 1. The plates 5 are provided with undercut or L-shaped ribs 6 on their vertical edges, and the ribs of adjoining plates are clamped together in such manner that they may be readily separated. As shown, the clamps each consist of a plate 7, attached to one of the plates 5, and an eccentric or cam 8, pivoted to said plate 7 and adapted to engage the rib or flange 6 of the adjoining plate 5. (See Figs. 6 and 7.) The polygonal wall 5 rests upon steps or flanges 9 at the outer edge of a series of tables 10, which tables are supported by a series of pedestals 11, extending upward from a pan 12, which normally rests on a ring 13, supported at the margin of the bottom 2. The pin 14, extending downward from the center of the pan 12, serves to center the pan by entering the step 15, centrally located on the bottom 2.

Resting on the upper edge of the polygonal wall 5 is an annular cover 16, upon which is supported two baffle-plates 17 18. Depending from the outer cover 3 and intermediate the annular baffle-plates 17 18 is a third baffle-plate 19. These plates prevent particles of water or snow from being drawn out with the vapor and falling between the walls 1 and 5. Should water fall between these walls, the polygonal ice-chamber could not be readily removed, as hereinafter described.

The water to be frozen is sprayed against the polygonal wall 5 by an annular spray-pipe 20, connected by hollow arms 21 to a vertically-arranged supply-pipe 22. Pipe 22 extends upward through a stuffing-box 23, formed in the upper end of a screw 24, which is centrally and rigidly connected to the cover 3. The screw 24 is engaged by a nut 25, which is rotatably supported in the arm 26 of a crane to be hereinafter described. Nut 25 can be turned by inserting a suitable lever or handle in sockets 27. The spray-pipe 20 is not a complete circle, but its ends adjoin each other and are closed by removable caps 28. By removing the caps 28 a flexible rod or brush may be inserted and passed entirely through the pipe 20 to clean it should it become choked. Opposite each of the spoke-pipes 21 there is an opening in the hub 29 closed by a cap 30. By removing the caps 30 a brush or rod may be inserted to clean out the spoke-pipes. The perforations in the pipe 20 are necessarily small and they may be easily clogged.

The spray-pipe is reciprocated vertically to form a sheet or cylinder of ice of the same thickness throughout the depth of the polygonal wall 5, and it is rotated at the same time to prevent the ice from being formed in ridges within said wall. Under the high vacuum which I use in producing ice in this apparatus the water freezes at the moment it strikes the wall 5 or the ice formed on said wall, and if the spray-pipe 20 were not kept constantly moving the inner surface of the ice would be very irregular.

The spray-pipe is rotated continuously by means of a power-shaft 31, bevel-gears 32, vertical shaft 33, bevel-gears 34, horizontal shaft 35, bevel-gears 36, vertical shaft 37, gear 38, splined on said shaft and adapted to slide upon and rotate with it, and an intermeshing gear 39, carried by the supply-pipe 22. The gear 38 rotates in a sliding head 40, which slides vertically upon guides 41. Gear 39 is also carried by said head 40, and a collar 42 sustains the pipe 22 upon the head 40.

The spray-pipe 20 and supply-pipe 22 are reciprocated vertically by means of a lever 43, one end of which is pivotally connected to the head 40, while the other end is connected by a link 44 to a bracket 45, forming a rearward extension of the crane-arm 26. The link 44 is connected to the bracket 45 with a limited degree of flexibility by means of a pair of flexible washers 46, which engage opposite sides of the bracket and are held in place by nuts 47. The lever 43 is rocked by means of links 48, which connect an intermediate part of the lever pivotally

with opposite sides of a ring 49. On the inner surface of this ring is a guide-piece which engages a continuous spiral guide-groove 50 in a drum or enlargement 51 on the upper end of shaft 33. The ring 49 has also a rearward projection 52, which engages a fixed guide 53 to prevent the ring from turning. It will be seen that the means described are adapted to continuously rotate the spray-pipe 20 and at the same time to reciprocate it vertically from the upper to the lower extremes of the polygonal wall 5.

Water is supplied to the pipe 22 through a flexible hose 54, Fig. 3, which connects with the upper end of the supply-pipe 22.

To readily gage the amount of water supplied to the freezing-chamber, I first permit the water to flow in a vertical jet into a closed vessel provided with a transparent wall, through which the jet may be seen. As shown, the water first enters through the bottom of a vessel 55, the body of which is composed of a glass bell 56. The water flows upward vertically from the nozzle of a pipe 57, controlled by a valve 58. The amount of water entering the vessel 55 can be determined quite accurately by the height of the jet 59, which height can be gaged by the valve 58. From the vessel 55 the water flows through the flexible pipe 54.

Referring to Figs. 3 and 8, it will be seen that the water from the pipe 54 first enters a regulating-chamber 60, supported on the upper end of the pipe 22. The outflow from this chamber to the pipe 22 is controlled by a valve 61, having a series of V-shaped openings 62, which are closed by the valve-casing 63. At the upper end of the casing 63 is a valve-seat 64, upon which sits an annular washer 65, adapted to close the entrance to pipe 22 entirely. As the valve 61 is raised the openings 62 are gradually uncovered. During the operation of the machine these openings are always more or less uncovered the amount depending upon the position of a float 66. The float 66 is not directly connected with the stem 67 of the valve 61, but is provided with a central opening through which said stem loosely passes. The stem extends up through the top of the vessel 60 and forms a guide for the float. The movement of the float 66 is communicated to the stem 67 by means of link 68, lever 69, link 70, and lever 71, the lever 71 passing between two fixed collars 72 on the stem 67. By means of this system of leverage the movements and fluctuations of the valve 61 are very much less than those of the float 66, while the power of the float to move the valve is increased. If the water were supplied directly from the flexible pipe 64 to the freezing-chamber, the head of water would vary as the spray-pipe moved up and down and more water would be discharged while it was in its lowest position than when it was in its highest position. By the use of the equalizing-chamber 60 on the supply-pipe the water is supplied to the spray-pipe under constant head and practically uniform in quantity for any given opening of the valve 58. Of course the total amount supplied can be varied by means of the valve 58.

As the spray-pipe reaches its highest and lowest points the reversal of its vertical movement would tend to momentarily displace the float 60—that is, the float would be carried up or down relatively to the chamber 60 by its inertia. To prevent this, I have provided a clamping device which holds the valve-stem 67 and prevents it moving longitudinally for a moment at each extreme of the movement of the spray-pipe. As shown in Fig. 8, this device comprises a lever 73, pivoted at 74 and having two projections 75 76, adapted to bear alternately upon the valve-stem 67 as the outer end of the lever is moved up and down. The outer end of lever 73 passes through an opening in a rod 77. Rod 77 has heads 78 79 on its ends, and its middle part slides freely in a sleeve 80, which is confined in a fixed bracket 81. Springs 82 83 surround the rod on opposite sides of the bracket and hold it normally in a given position with reference to said bracket, in which position the bearing-points 75 76 of the lever 73 are both free from the valve-stem 67. As the spray-pipe reaches its highest position rod 77 engages a fixed bracket 84, Fig. 3, and is depressed thereby, causing the lever 73 for a moment to clamp the valve-stem 67 and prevent the float 66 from rising above its proper position by reason of its inertia. In the same manner the lower end of rod 77 strikes a fixed abutment 85, and as the spray-pipe reaches its lowest position the valve-stem is temporarily clamped.

In the connecting-pipe *a*, between the freezing-chamber A and the vapor pipe or trunk C, there is a valve 86, by means of which the freezing-chamber may be shut off from the vapor-pipe when it is desired to open it for the purpose of removing the ice. As shown, this valve is operated by a valve-stem 87, which is threaded into the central hub 88 of a spider supported by a vertical portion of the connecting-pipe *a*. The valve 86 is operated by a handle 89 on the shaft or stem 87.

The operation of the freezing-chamber is as follows: Assuming that the chamber is closed air-tight and exhausted to a sufficient degree, the machinery is started and the valve 58 opened until the height of the jet of water 59 indicates that a proper supply is flowing to the spray-pipe. The spray-pipe is reciprocated vertically and simultaneously rotated, in consequence of which the water is sprayed evenly over the polygonal inner wall. The length of its vertical reciprocation is practically equal to the depth of the polygonal wall, and as the ice cylinder is formed its lower end rests upon the tables 10. Should any of the water drop, it will be caught in the pan 12. I have found, however, that when the apparatus is in proper working condition all

of the water will freeze immediately as it strikes the surface of the ice, and practically none of it will fall below the point of its first contact, so that the ice cylinder may be built out, as illustrated in Fig. 3 of the drawings. After the ice has been formed to the desired thickness, which can be readily determined by passing the water through a meter, the water is shut off and the valve 86 is closed tightly. The mechanism for rotating and reciprocating the spray-pipe is then stopped with the spray-pipe in its highest position. The nut 25 is then turned, which raises the screw 24 and the cover 3, after which the crane 26 is swung to one side, carrying the cover and spray-pipe with it. The crane is mounted upon a hollow shaft 90, which has a bearing 91 and a seat 92 on a fixed bracket 93, Fig. 3. It will be seen that the vertical shaft 33 passes through the axis of the crane-spindle 90 and that the crane can be rotated on the shaft 90 without disarranging the mechanism which it carries.

Two pairs of straps 94 are connected to the pan 12, Fig. 4, and the upper ends of each pair are connected by a bail 95. Through these two bails a rod 96 is passed, and said rod is engaged by one or more hooks 97, connected to an elevator or overhead traveling crane. (Not shown.) By this means the pan 12 and the parts supported by it, together with the cylinder of ice, as shown in Fig. 4, are lifted out of the freezing-chamber and transported to any convenient place for cutting the ice into blocks. The annular cover 16 is then removed and the polygonal side plates 5 are removed by loosening the clamps 8. Should these plates adhere to the ice, they may be warmed by any suitable means to detach them. The cylinder of ice is thus exposed, and it is then sawed vertically into strips. The tables 10, upon which it rests, are separated, so that a saw can be passed between them and completely sever the ice. As soon as the ice is removed the polygonal plates and the annular cover 16 can be replaced and the parts restored to the freezing-chamber, when the operation of forming a new cylinder of ice can be immediately commenced. By having a series of freezing-chambers all but one can be kept in constant operation and the manufacture of ice thus carried on continuously.

By leaving a space between the outer surface of baffle-plate 19 and the inner surface of the cover to the freezing-chamber I prevent the surface of said baffle-plate from becoming heated enough to loosen the ice which forms on the under surface. If such ice should become loosened and fall, damage would probably result to the sprinkler. As a further means for holding any ice that may form on this lower surface of the baffle-plate 19, I may provide such plate with a series of retaining devices, such as are illustrated in detail in Fig. 12. A suitable number of small wooden blocks or plugs 19^a are secured to and project downwardly from the inclined surface of the baffle-plate, and to each of said blocks are secured metallic plates 19^b, provided with peripheral teeth or projections. The ice forming on the baffle-plate is retained by these toothed plates, and as the wooden blocks or plugs are non-conductors the ice is held securely against the plate. After the block of ice has been formed within the freezing-chamber and the cover has been removed the operator breaks or otherwise removes the ice from said plate.

In Fig. 11 I have illustrated in detail, on an enlarged scale, the connection between the supply-pipe 22 and gear 39. A collar 22^a is brazed or otherwise suitably secured to said supply-pipe and is provided with a key or spline 22^b, that enters a corresponding groove or seat in the collar 42, which collar is engaged by threads with the upwardly-extending hub or gear 39. A set-screw 42^a normally holds the collars 42 and 22^a together, so that the pipe 22 is rotated by the gear 39. When, however, the tank is open and ice to be removed, the set-screw is loosened, and the supply-pipe and spray devices connected therewith can then be lifted vertically by hand to points above the upper end of the tank and freezing-chamber, so as to offer no obstruction to the lateral swinging of arm 26.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In refrigerating apparatus, the combination with a freezing-chamber, and means for maintaining a vacuum therein, of a pan removably sustained in said chamber, a vertical wall supported by the pan and upon which the ice is formed, and means for spraying water upon said wall.

2. In refrigerating apparatus, the combination with a freezing-chamber, of means for forming a cylindrical wall of ice therein, and a series of supports for said ice arranged below the ice and so separated that a saw may pass between them.

3. In refrigerating apparatus, the combination with a freezing-chamber, of a separable polygonal wall, means for forming ice thereon, and a series of separated supports for said ice.

4. In refrigerating apparatus, the combination with a freezing-chamber, of a removable inner apparatus upon which the ice is formed comprising a pan, a series of separated supports carried by the pan, a separable polygonal wall carried by said supports, and means for removing all of said parts from the freezing-chamber.

5. In refrigerating apparatus, the combination with a cylindrical freezing-chamber, and means for maintaining a vacuum therein, of a circular spray-pipe, means for rotating said spray-pipe, and means for reciprocating the same in the direction of its axis.

6. In refrigerating apparatus, the combination with a freezing-chamber, of a vertically-

reciprocating spray-pipe therein, and a tank connected to and reciprocating with said spray-pipe, whereby the head of water in the spray-pipe is rendered substantially uniform.

7. In refrigerating apparatus, the combination with the freezing-chamber, of a vertically-reciprocating spray-pipe, a tank carried by said pipe, means for supplying water continuously to the tank, and a float in said tank arranged to govern the flow of water from the tank to the spray-pipe.

8. In refrigerating apparatus, the combination with the freezing-chamber, of a vertically-reciprocating spray-pipe, a tank movable with said spray-pipe, a valve controlling communication from the tank to the spray-pipe, the float in said tank, and the levers connecting said float with said valve.

9. In refrigerating apparatus, the combination with the freezing-chamber, the vertically-reciprocating spray-pipe, the tank movable with said pipe, the valve, and the float governing said valve, of means for locking the valve at the extremes of the reciprocating movement of the spray-pipe.

10. In refrigerating apparatus, the combination with the reciprocating spray-pipe, a tank movable therewith, the valve controlling communication between the tank and spray-pipe, and a float for controlling the valve, of the stem connected to the valve, the lever adapted to clamp said stem when moved from its normal position, the spring device for holding the lever in normal position, and the fixed abutments for moving said lever out of normal position each time the movement of the spray-pipe is reversed.

11. In refrigerating apparatus, the combination with the freezing-chamber, of a vertically-reciprocating spray-pipe, and means for reciprocating said spray-pipe comprising a lever, a rotating shaft, a reverse spiral guide upon said shaft, a part reciprocated by said guide, and a connection between said part and said lever.

12. In a refrigerating apparatus, the combination with the freezing-chamber having a removable cover, of a rotating and reciprocating spray-pipe passing vertically through said cover, the crane arranged to rock about a vertical axis, means carried by an arm of the crane for elevating the cover, a power-shaft extending through the vertical axis of the crane, and mechanism carried by the crane and operated by said shaft for rotating and reciprocating said spray-pipe.

13. In refrigerating apparatus, the combination with a freezing-chamber, and means for maintaining a vacuum therein, of a spray-pipe within the chamber, and means for gaging the supply of water to said pipe comprising a vertically-arranged nozzle, and a valve controlling the flow of water therethrough, the supply of water being determined by the height of the jet from said nozzle.

14. In refrigerating apparatus, the combination with the freezing-chamber, and means for maintaining a vacuum therein, of a movable spray-pipe extending through the wall of the chamber, a tank carried by said spray-pipe for maintaining a constant head of water therein, a flexible pipe for supplying said tank, and means for gaging the amount of water admitted to said flexible pipe.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN PATTEN.

Witnesses:
FELIX R. SULLIVAN,
LOUIS A. KATZENBERGER.