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O. PARKER.

METHOD OF AND APPARATUS FOR MAKING ICE.

No. 255,660. Patented Mar. 28, 1882.

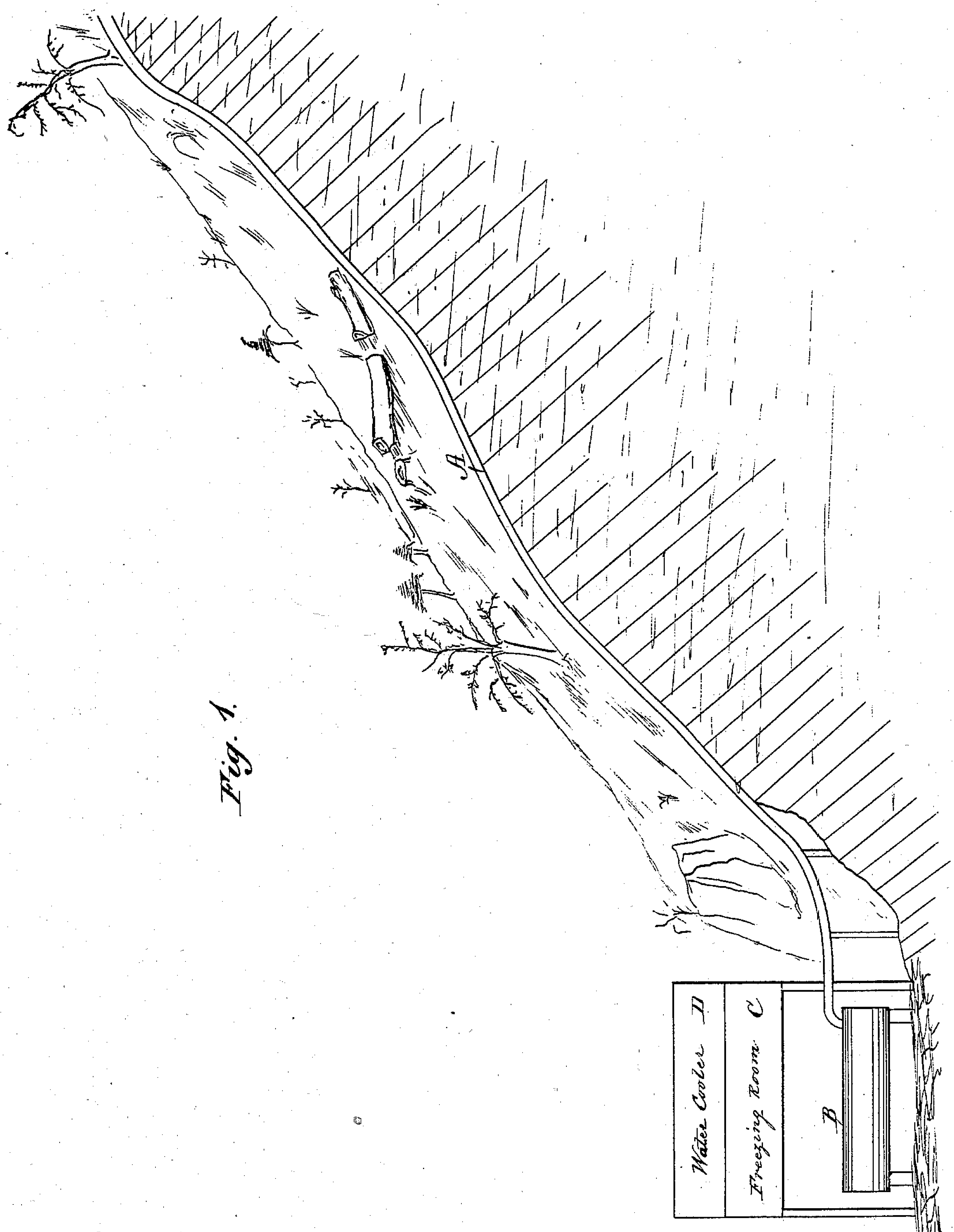

Fig. 1.

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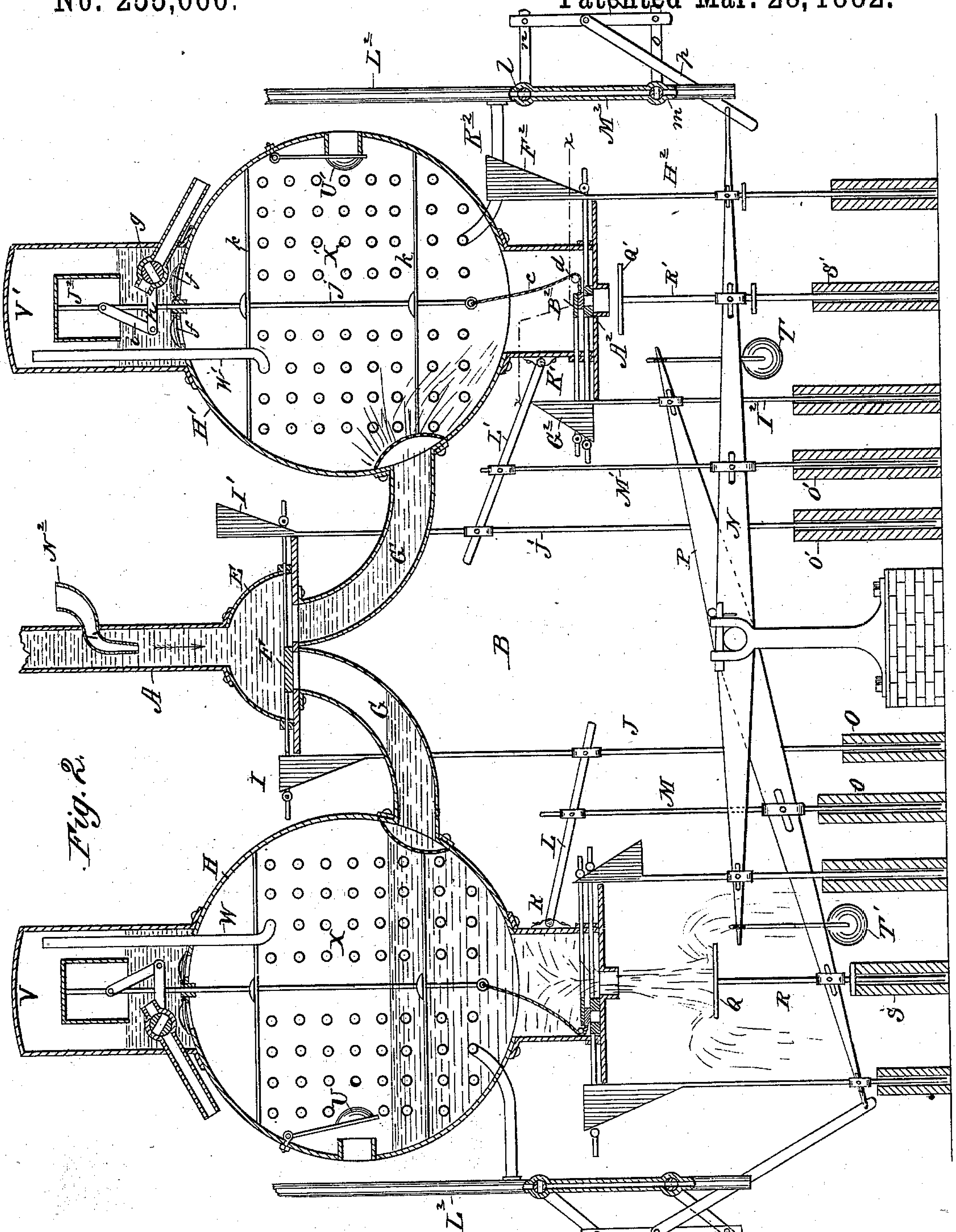

Fig. 2.

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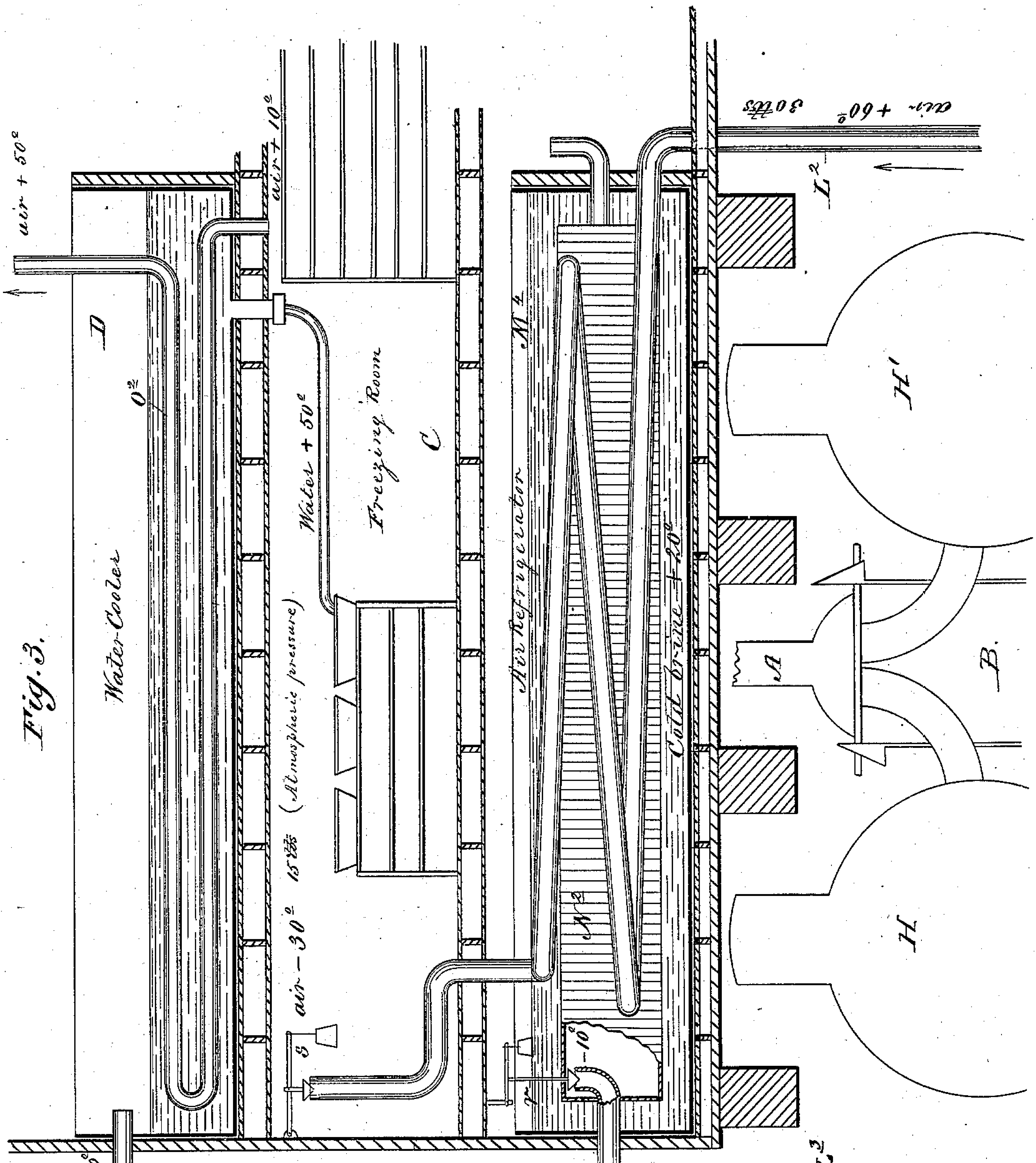

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(No Model.) 5 Sheets—Sheet 4.

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METHOD OF AND APPARATUS FOR MAKING ICE.

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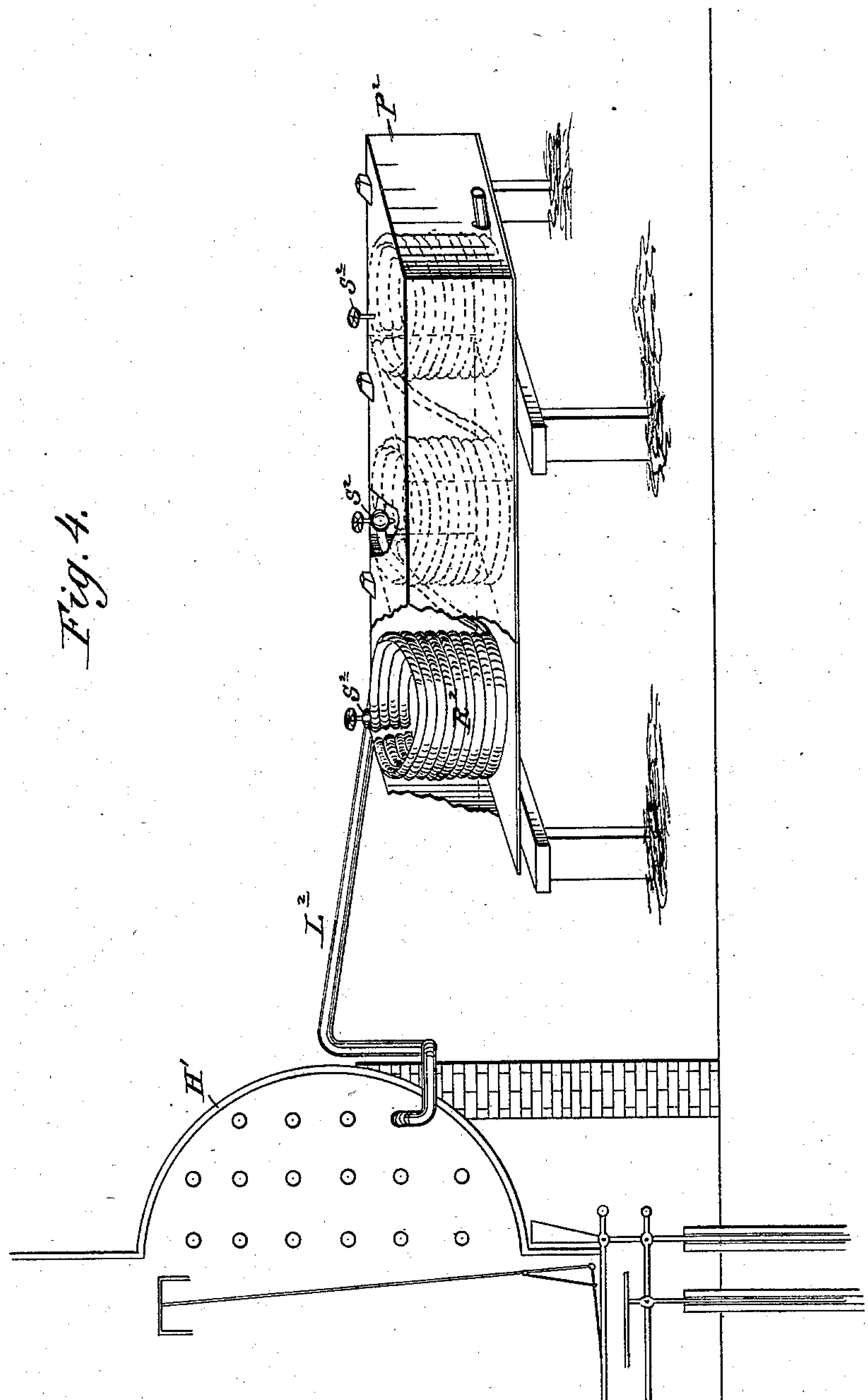
Fig. 4.



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5 Sheets—Sheet 5.

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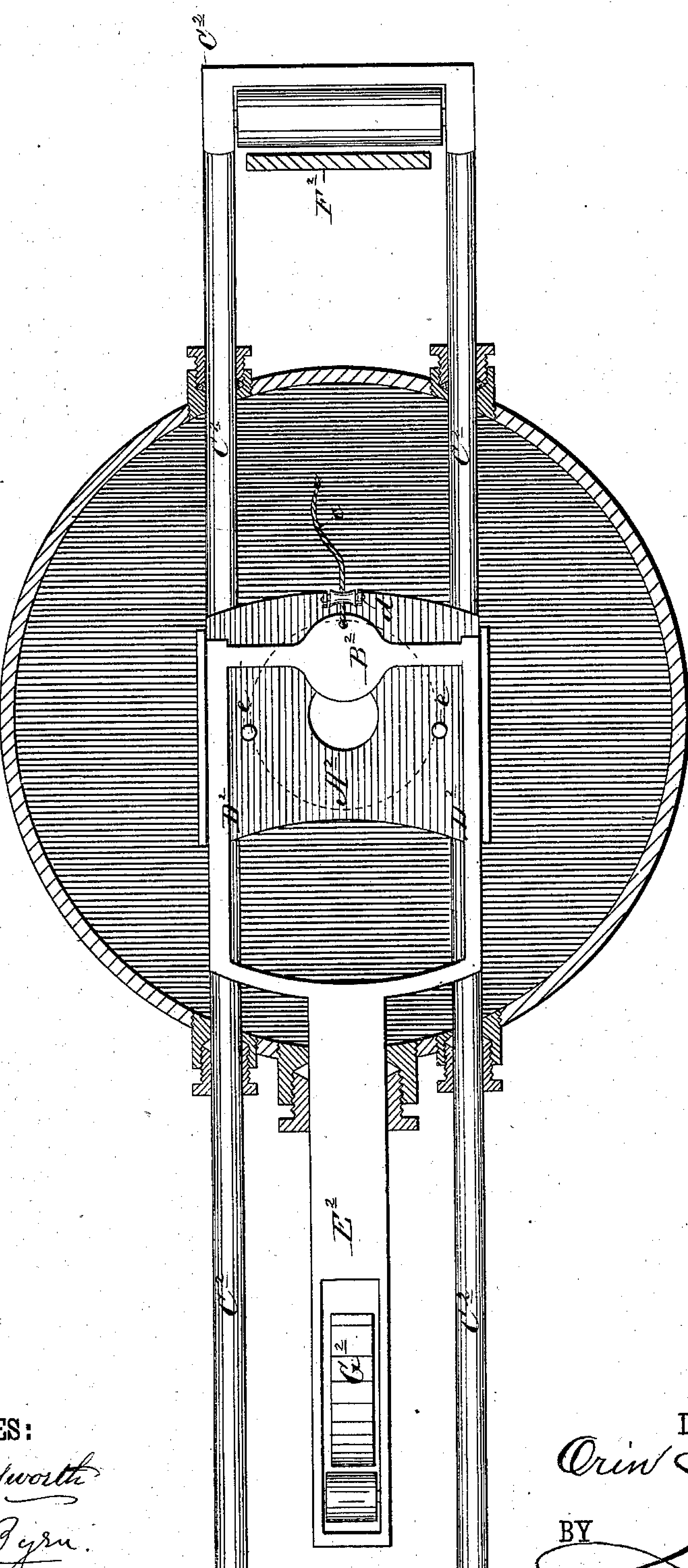

Fig. 5.

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UNITED STATES PATENT OFFICE.

ORIN PARKER, OF WASHINGTON, DISTRICT OF COLUMBIA.

METHOD OF AND APPARATUS FOR MAKING ICE.

SPECIFICATION forming part of Letters Patent No. 255,660, dated March 28, 1882.

Application filed July 30, 1881. (No model.)

To all whom it may concern:

Be it known that I, ORIN PARKER, of Washington city, District of Columbia, have invented a new and Improved Method and Apparatus for Making Ice; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a general view, showing the position of my apparatus at the foot of a hill, to which point a head of water is conducted from a stream at the top. Fig. 2 is an enlarged sectional view, showing the construction and arrangement of the air-compressing and heat-eliminating devices. Fig. 3 is a vertical sectional view through the building in which the ice is made, the said view showing the relation of the air-compressing devices, the air-refrigerating chamber, the freezing-compartment, and the water cooling tank, the one being placed above the other. Fig. 4 is a perspective view, showing a modification of that part of my invention used for refrigerating the compressed air. Fig. 5 is an enlarged detail view of the valve controlling the discharge of water from the compression-chambers, the view being taken on the section-line *x x* of Fig. 2.

My invention relates to certain improvements in the manufacture of ice upon the general plan of compressing atmospheric air, eliminating the heat thus generated, and then allowing the air to expand in a freezing-chamber to produce the required degree of cold, and for this purpose it contemplates the utilization of a hydraulic motor operated by a high head of water for the purpose of compressing the air.

The invention consists principally in compressing the air by the direct contact, dynamic force, and hydrostatic pressure of the head of running water, and simultaneously eliminating the heat thus generated by the same flowing current.

My invention also consists in other adjuncts to this general process, and also, further, in the novel construction of the apparatus for carrying out my invention, as will be hereinafter fully described, and pointed out in the claims.

In the drawings, Fig. 1, A represents an inclined conduit, pipe, or penstock leading from a water-supply at the top of a hill to my apparatus, which is placed at the foot of the hill. This apparatus consists essentially of an air-compressor, B, in which air is compressed by the direct action and dynamic force of the water and the heat of the compressed air simultaneously taken away. Over this is a freezing-room, C, in which the air which has been compressed and cooled is allowed to expand and freeze the pans of water, and above this a water cooler, D, in which the water is contained that is to be introduced into the freezing-room, and which water is preliminarily chilled by the cold currents escaping from the freezing-room. This is all the apparatus that I use when a sufficiently high head of water is available; but when the head is limited, but the supply greater, then I introduce between the air-compressor and the freezing-room an air-refrigerating device for further lowering the temperature of the air before allowing it to expand, as will be explained farther along in its proper connection.

I will first describe the construction, arrangement, and mode of operation of the air-compressor and cooler.

Referring to Fig. 2, the penstock A connects with a valve-chamber, E, which in its bottom has a slide-valve, F, that directs the water alternately through the branched pipes G G′ to the two receivers or air-compressing chambers H H′, the water passing alternately into these two receivers and compressing the air in a cushion above it, and forcing it to the point of utilization, and the water then passing out at the bottom of the receiver by the opening of a valve by a float, and filling the receiver with a fresh charge of air drawn through an inwardly-opening valve preparatory to compressing it by the next inflow of water into this receiver. This arrangement of two receivers filled alternately by a head of water to compress the air and emptied by the alternate working of the valves by floats has heretofore been made use of as an air-compressor, and I do not claim this broadly.

The valve F for directing the current from the penstock alternately to the two receivers I prefer to make of the sliding pattern adapted to cover the transverse area of one of the pipes G G′ and registering alternately with the same. For operating this valve I form yokes or slots in the extensions of the same outside of the valve-chamber and on each side of the same, and place within the yokes triangular rising and falling cams I I′, arranged for alternate operation. The left-hand one of these cams, I, is carried by a rod, J, loosely connected with a lever, L, fulcrumed at K, which latter is connected to a rod, M, geared to the walking-beam P, both the rods M and J being guided in tubular or other form of guides O at their lower ends. The other cam, I′, on the right of valve F is carried by a corresponding rod, J′, connected to a lever, L′, fulcrumed at K′, which latter is connected to a rod, M′, that is geared to another walking-beam, N, arranged beside the first beam, P, and upon the same axis, and these rods also have the same guides at their lower ends. Upon the outer ends of each of these walking-beams N and P is mounted a table, Q Q′, carried by rods R R′, which are loosely connected with the walking-beams, and are guided in tubular guides S S′ below. These tables Q Q′ rest respectively beneath the discharge-orifices from the two receivers H H′, and their function is to receive the impact of the water there discharged for the purpose of tilting the walking-beams and operating the valves, the tables being forced down by the fall of the water upon the same to move the valves, and being raised again when the water is out by the counter-weights T T′. As the water is discharged from the bottom of the receivers the latter are filled with air automatically through valves U U′. These valves are of a peculiar form—*i. e.*, they are hinged at a point remote from the valve-seat and vertically above the same, so that it swings open upon the slightest suction and uncovers the whole of the valve-seat, giving a full ingress for the air. As the air is compressed in the receivers by the direct contact and dynamic force of the water it is forced into the domes V V′, and passes thence down pipes W W′ to coils X X′, which occupy a part of the space in each receiver, and thence passes out to the point where the compressed air is to be utilized. This forcing of the air through a coil immersed in the water by which it was compressed is a prominent feature of my invention, in that it affords at the same time means for compressing the air and eliminating the heat incident to that compression, which latter it is necessary to do in order to get any useful effect from its subsequent expansion, and a meritorious structure of my apparatus in this connection is that these cooling-coils are located in the same receivers where the compression is effected, thus economizing space.

For discharging the water from the receivers a compound valve is used. As these valves and their operating parts are precisely the same in both receivers, it will be sufficient for me to describe one only.

A^2 B^2 (see Fig. 5) are the two parts of the compound valve, one of which, A^2, plays directly above a relatively small opening in B^2, and both of which slide over a large discharge-orifice, (shown in dotted lines,) of one foot diameter, say, in the bottom of the drum of each receiver. A^2 is carried by a yoke-frame, C^2, which extends through stuffing-boxes in the walls of the drums at the bottom of the receivers. B^2 is also carried by a yoke-frame, D^2, which is extended through the opposite wall of the drum in the form of a slotted arm, E^2. The object in constructing this valve of a compound character, as described, is as follows: This valve is primarily operated by a float in the cylinder, which is raised by the water, and, as there is great hydrostatic pressure against the valve A^2 in the bottom of the receiver, it is not possible to move the main valve by any available float. I therefore reduce the work which the float has to do by putting a relatively small valve, B^2, over the opening in valve A^2, and this small valve I connect by a cord, *c*, passing around pulley *d* with the stem of the float, so that the float only has to uncover the opening through valve A^2, which action starts a high-pressure stream of water through the bottom of the receiver upon table Q′, which gives movement to the walking-beam and enables the latter to then open the main valve A^2 and allow the full volume of discharge to take place. Another important function which this supplemental valve B^2 has is to cause the discharge-valve A^2 and inlet-valve F to make a complete and contemporaneous stroke, thus avoiding the half opening of the one and half closing of the other, which would simply allow the water to run through the receiver and render it inoperative.

For operating the main valve two triangular cams, F^2 G^2, (see Fig. 2,) are arranged upon rods H^2 I^2, guided in tubes below and connected respectively with the ends of the two walking-beams N and P. One of these cams, F^2, bears against the yoke-frame C^2 of the main valve (see Fig. 5) to pull it in one direction to open the valve A^2, and the other, G^2, acts both in the slot of the arm E^2 of the small valve B^2 and against the other end of the yoke C^2, to first draw the small valve B^2 over the opening in valve A^2 and then drag the valves A^2 and B^2 together over the large discharge-opening in the bottom of the drum, the said two cams acting thus alternately. In arranging the two valves B^2 and A^2 with respect to cam G^2 the latter may act first in the slotted arm E^2, and then drag the main valve by causing arm E^2 to abut against the frame C^2, as shown in Fig. 5; or cam G^2 may have an independent bearing both in the arm E^2 and against the frame C^2, as shown in Fig. 2, in which case stops *e* (see Fig. 5) are used to define the movement of valve B^2 over A^2.

In arranging the float which opens the valve B^2, I find that if it be placed in the receiver itself, in order to be made of sufficient effective size and to have the requisite movement, it involves an air-cushion in the top of the receiver, which defeats the positive action of the apparatus in compressing the air, for when the water is discharged this air-cushion simply expands again instead of being forced to the point of utilization and allowing a fresh charge to be received through valve U′. To remedy this difficulty I place the float J^2 in the dome V′ at the top of the receiver, (see Fig. 2,) and between the dome and the receiver I place the upwardly-opening valves *f f*, while the pipe W′, which transfers the compressed air to the coil X′, I run to the top of this dome, so as to take off the air at this point. Now, when the water rises in the receiver it forces all the air out of the receiver into the dome, and the water, following into the dome through valves *f*, lifts the float. Then as soon as the water commences to be discharged from the receiver the valves *f f* close and the air in the dome is not allowed to expand into the receiver, but a fresh charge is taken in through inlet-valve U′. It will be seen that in order to lift the float a quantity of water must have passed into the dome V′; and as the valves *f* are immediately closed this water would be trapped in the dome and prevent the float from descending again and giving the requisite slack to cord *c* to permit initial valve B^2 to be drawn back again by cam G^2. To obviate this objection this water in the dome is vented outwardly through a plug valve or cock, *g*, connected through arm *h* and link *i* with the float-stem, which parts are so relatively arranged that just as the float commences to rise the cock or plug-valve *g* is opened, and the water which is subsequently trapped in the lower part of the dome by the closing of valve *f* is expulsively driven out by the tension of the air-cushion above, thus allowing the float to settle to the required position for further action. This ventage of water at this point is so relatively small that it does not affect the other operations; and as the pipe *g* is always below the water-line while open, no air is allowed to escape. The stem *j* of the float J^2 is held in suitable guides, *k*, to keep it in position.

In compressing air in accordance with my invention with a direct contact of water the air will be more or less laden with moisture, and when the air is cooled such moisture will condense. In order to get rid of this condensation before the air is chilled to the freezing-point, this water of condensation is trapped between the outlet-pipe K^2 from the coil X′ and the pipe L^2 leading to the freezing-room. For this purpose I place a leg, M^2, at the bend between pipes K^2 and L^2, in which I place two plug-valves or cocks, *l m*, the openings of which are so relatively arranged that the top one is closed when the lower one is open, and vice versa. These valves have arms *n o*, which are loosely connected with connecting-rods *p* or other equivalent connection with the walking-beam. Now, when the air is being forced out of the coils X′ and up pipe L^2 the upper valve, *l*, is open and the lower one closed, and water of condensation is caught between the two valves *l m*. Then, when the next movement takes place and the water is being discharged from the receivers, the top valve, *l*, is closed by the walking-beam and the lower one, *m*, opened, allowing the trapped water to be discharged. This action being repeated at every stroke, most, if not all, of the objectionable humidity of the air is eliminated.

Of all the apparatus which I have thus described for one of the receivers a duplicate set is provided for the other, working alternately in the same manner.

To increase the effect of the air-compressing devices, I introduce into the penstock A a proportion of air, which is carried into the receivers with the water and is there separated. For this purpose an air-nozzle, N^2, (see Fig. 2,) is carried into the penstock and provided with an inwardly-opening valve, which permits, when a certain velocity is attained by the water in the penstock, air to be drawn in by induction, the valve serving to prevent the water from passing out at this point whenever the flow of water is discontinued. By this means the useful effect of the air-compressor is very materially increased and the air compressed and cooled at the same time that it is taken in. In connection with this principle of the induction of air by a flowing head of water, I would state that I do not claim it broadly, as it is the well-known principle of the tromp. When, however, it is used in connection with my principle of compressing a separate body of air by the direct contact and dynamic force of water it has special value, for that body of air which is being intermittently compressed in the receivers is limited to the capacity of the receivers. By inducing air along with the motive head of water I not only effect at each movement the compression of a volume of air equal to the capacity of that receiver; but this volume is augmented by the air brought in by induction, which, when once in the receiver, separates from the water and mingles with the other body of air taken in through valves U U′.

I will now proceed to describe that part of my apparatus relating to the expansion of the air after it is compressed and cooled, referring more particularly to Fig. 3 of the drawings. Whenever, as before stated, the head of water is sufficiently high to compress the air to a sufficient amount, the air, after it leaves the air-compressors through pipes L^2, is allowed to expand through a pressure-regulator directly into the freezing-room C to produce the cold to freeze the pans of water placed therein. If, however, the head of water is limited, but the quantity unlimited, as is frequently the case, I use a portion of the volume of the weakly-compressed air to cool the other portion preparatory to expanding it in the freezing-chamber. Just beneath the freezing-room I place a tank, M^4, filled with brine or other liquid not congealable at 32°. In this tank and immersed in the brine is an expansion-chamber,

N^2, into which the pipe L^3 from one of the air-compressors enters and opens through a pressure-regulator, *r*. By the expansion of the air from pipe L^3 into this chamber N^2 a considerable degree of cold is produced and the brine also rendered cold. About the chamber and immersed in the brine is a set of pipes, through which the compressed air from the other pipe, L^2, of the other air-compressor is made to pass. By this means only a portion of the air compressed is made available in the freezing-room; but that quantity, being greatly reduced in temperature while in a state of compression, produces a very much lower temperature in the freezing-room when allowed to expand therein through the pressure-regulator *s*.

As a modification of this feature I may arrange, in connection with each one of the pipes L^2 leading from the air-compressor, a tank, P^2, as shown in Fig. 4. In this tank are a series of partitions, forming compartments, in each of which compartments is a coil of pipes, R^2, connected together for a continuous passage through them all. Each of these coils has, however, a vent-orifice and valve, S^2, through which a portion of the compressed air is allowed to escape about the coils, so that a part of the volume of air going into the first coil, in expanding about the coils of the first compartment, chills the coils and reduces the temperature of the compressed air therein, and this compressed air of lower temperature, passing into the next compartment, is further reduced in temperature by the next escape-vent, and so on, so that as in the other case a part of the compressed air is utilized by expansion to cool the remaining quantity, whose effectiveness for ice-making is thereby greatly enhanced.

I am aware that in the Windhausen patent (Reissue No. 4,603) a somewhat analogous principle is made use of. In that case, however, the cold air is expanded in one chamber, (the cylinder,) and then forced mechanically by the reverse movement of the piston to circulate about the pipes through which the compressed air is flowing, and the same body of air is used over and over again. In my case a portion of the cooled and compressed air is expanded in the immediate presence of the remaining portion to further reduce the temperature of the latter, by which method the cold is produced just when it is needed, and the air which is thus expanded, instead of being returned through the machine, is dissipated as waste, my apparatus being adapted to such extensive and economic working as to permit of this waste without materially affecting its general efficiency.

In order that I may economize temperature as far as possible, I conserve the low temperature of the waste air which escapes constantly from the freezing-room by passing it through a coil, O^2, (see Fig, 3,) immersed in a tank above the freezing-room, in which tank is contained the water from which the pans in the freezing-room are filled, thus enabling me to more quickly reduce the temperature of the water in the freezing-room to the freezing-point.

A meritorious feature of the apparatus is that all the valves except that for ingress of air and for egress of trapped water from dome are water-sealed when closed, and the two excepted are so sealed during a part of the time.

In carrying out my invention, also, the air may be expanded in coils in a freezing-bath in freezing-room as well as in open room, and, furthermore, the compressed air may be cooled in coils outside the receiver by same water which effected its compression.

Having thus described my invention, what I claim as new is—

1. The method of making ice which consists in compressing air by the direct contact, hydrostatic pressure, and dynamic force, of running water, and simultaneously eliminating the heat thus generated by the said passing current of water, and subsequently allowing the air to expand to effect the reduction in temperature, substantially as described.

2. The method of reducing the temperature of compressed air which consists in allowing a portion of said compressed air to expand in the immediate presence of the rest of the compressed air, and then be dissipated or allowed to escape as waste, substantially as described.

3. The method of compressing air in a hydraulic ice-machine which consists in introducing a quantity of air with a head of water and utilizing this head of water to displace and compress another body of air in a closed chamber, while the induced portion of air is at the same time being eliminated from the air in said chamber to augment the quantity of compressed air, as described.

4. The method of making ice which consists in expanding a portion of compressed air to reduce the temperature of the remaining compressed air, then using this compressed air of reduced temperature by expansion in a freezing-room to freeze the water, and utilizing the air escaping from the freezing-room to chill the water before being admitted to the pans, as described.

5. A receptacle for compressing air by displacement with water, combined with a conduit or coil for the compressed air, located within the receptacle and opening in the top of the same, whereby the heat is eliminated in the same receptacle in which it was generated, as described.

6. The combination of a receptacle for compressing air by the direct displacement of water, a dome provided with valves opening into the same, and a float arranged in the dome and connected with the water-discharge valve of the main receptacle, as described.

7. The combination, with the dome V′, the receiver H′, and valves *f*, of the float J^2 and rod *j*, and the plug-valve *g*, rod *i*, and arm *h*, as and for the purpose described.

8. The combination, with the receivers H′,

of the air-inlet valve U′, hinged directly above and at a point remote from its seat, as and for the purpose described.

9. The combination, with two receivers, H H′, with floats and valves, and a valve, F, directing the flow alternately to the receiver, as described, of one or more walking-beams provided with tables Q′ to receive the impact of the discharged water and operate the valves, substantially as described.

10. The combination, with the air-eduction pipe from the receivers, of the water-trap composed of leg M^2, having valves *l* and *m*, and a connection with the walking-beam, arranged, as described, to keep one of these valves open and the other shut alternately, as described.

11. The combination, with the receiver, its float, and the walking-beam, of the compound outlet-valve, consisting of a main valve connected to and operated by the walking-beam and a supplemental or initial valve connected with and operated by the float, as described.

12. A tank for cooling compressed air, having several compartments, combined with a series of coils connected for continuous circulation, each of said coils having an escape-vent for successive cooling by expansion of the air in the said coils, as and for the purpose described.

13. The combination of the water-tank D, provided with cooling-coil O^2, opening into the freezing-room, the freezing-room C, placed just beneath it, and a compressed-air-cooling device located beneath the freezing-room, having a compressed-air pipe opening into an expansion-chamber through a pressure-valve, and another compressed-air pipe arranged in proximity to the said expansion-chamber, and then opening through a pressure-valve into the freezing-room, substantially as described.

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