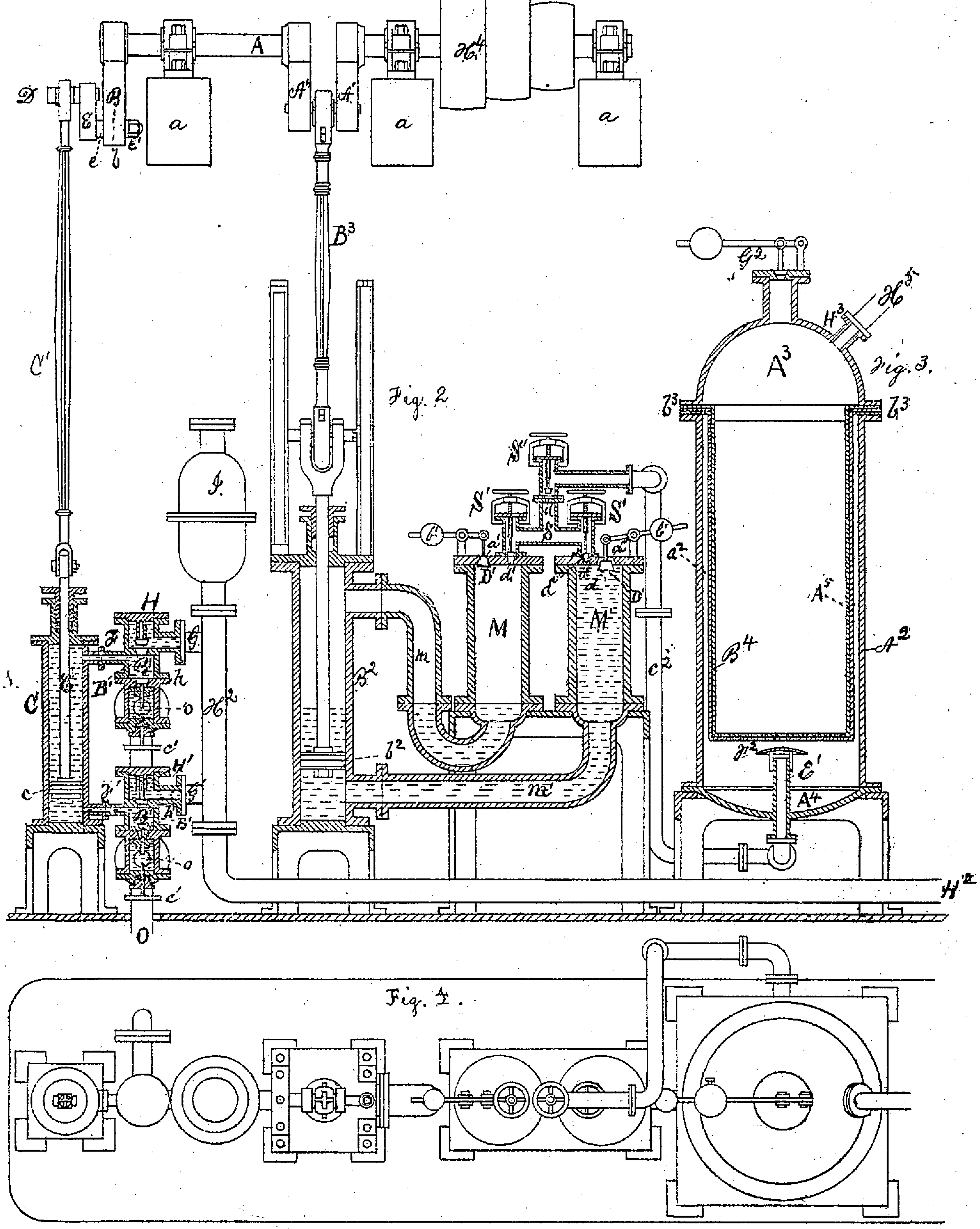
# H. NORMAN & C. F. DIETRICH.

## Ice-Machines.

No. 135,576. Patented Feb. 4, 1873.




WITNESSES.

H. N. Jenkins
James C. Kiddell.

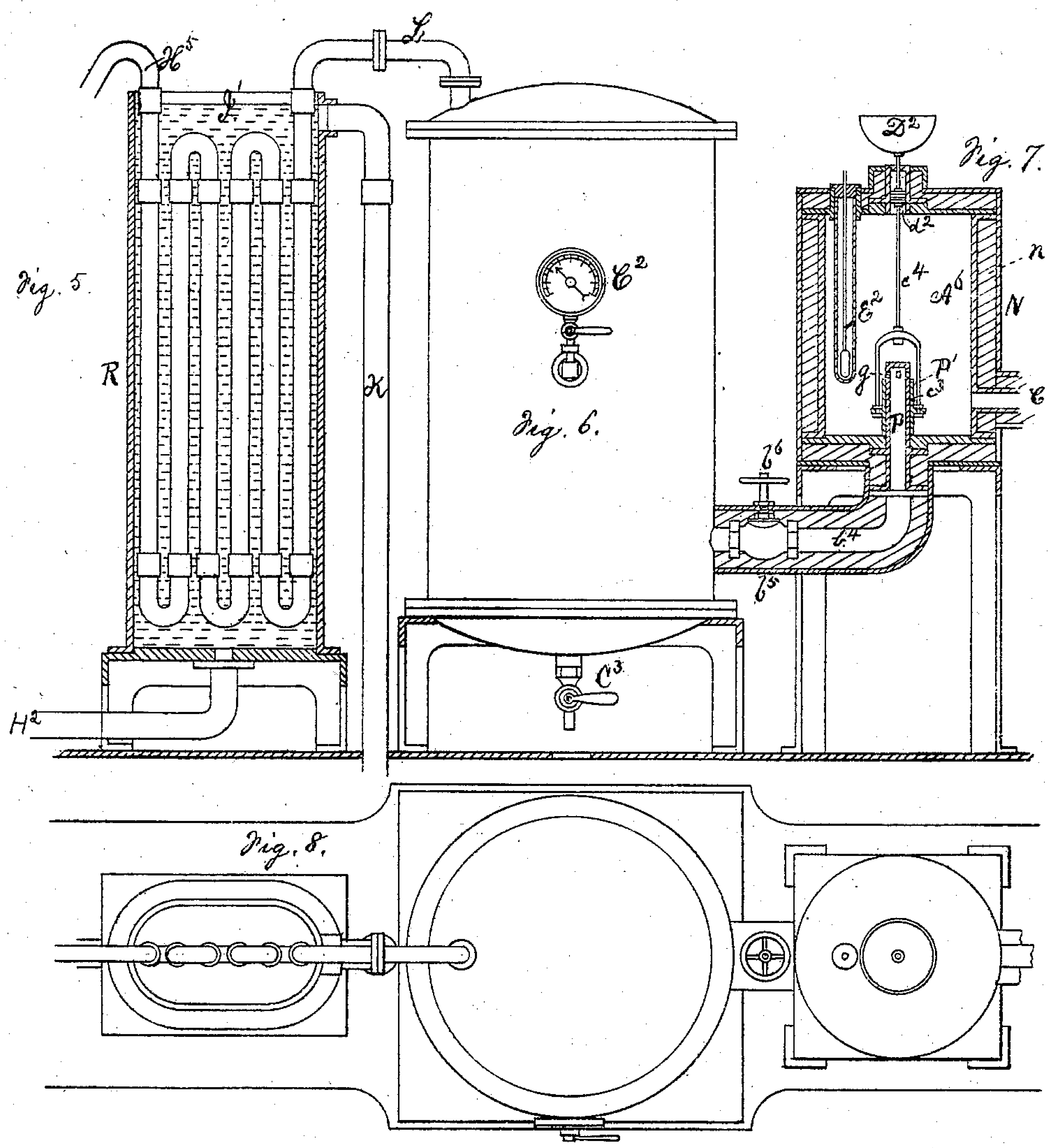
INVENTORS.

Henry Norman
Charles F Dietrich.

# H. NORMAN & C. F. DIETRICH.

## Ice-Machines.

No. 135,576. Patented Feb. 4, 1873.




WITNESSES.

H. N. Jenkins
Samuel C. Kiddell.

INVENTORS.

Henry Norman
Charles F. Dietrich.

3 Sheets--Sheet 3.

# H. NORMAN & C. F. DIETRICH.

## Ice-Machines.

No. 135,576. Patented Feb. 4, 1873.

Fig. 9.

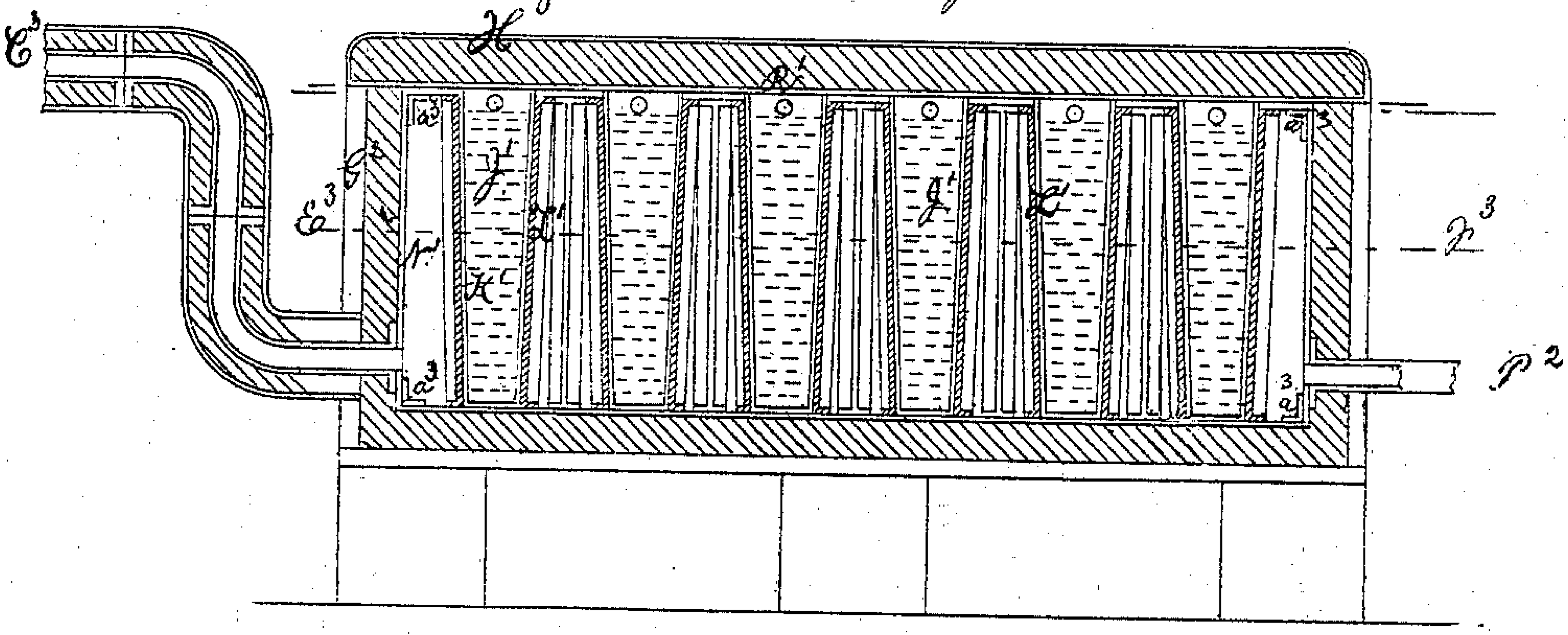
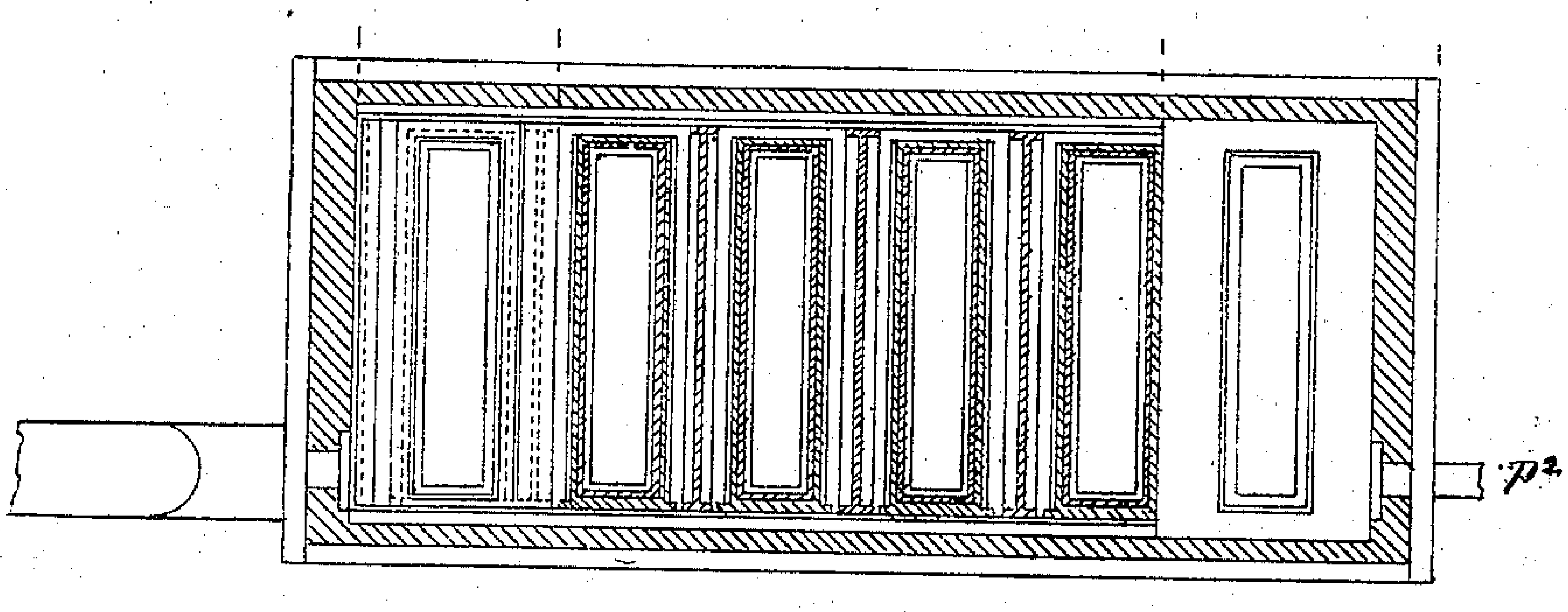


Fig. 10.



WITNESSES.

H. N. Jenkins
James C. Middell.

INVENTORS.

Henry Norman
Charles J Dietrich.

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS)

# UNITED STATES PATENT OFFICE.

HENRY NORMAN AND CHARLES F. DIETRICH, OF NEW ORLEANS, LA.

## IMPROVEMENT IN ICE-MACHINES.

Specification forming part of Letters Patent No. **135,576**, dated February 4, 1873.

*To all whom it may concern:*

Be it known that we, HENRY NORMAN and CHARLES F. DIETRICH, of New Orleans, in the parish of Orleans and State of Louisiana, have invented an Improved Refrigerating Apparatus for Animal, Vegetable, and Liquid Substances, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing and the letters of reference marked thereon making part of this specification, in which—

Figure 1 is a front elevation, partly in section, of the water-supply pump. Fig. 2 is a front elevation, partly in section, of the air-compressing engine. Fig. 3 is a front elevation, partly in section, of the air-drying apparatus. Fig. 4 is a top-plan view of Figs. 1, 2, and 3. Fig. 5 is a front elevation, partly in section, of the cooler. Fig. 6 is a front elevation, partly in section, of the reservoir. Fig. 7 is a front elevation, partly in section, of the combined air-pressure regulator and air-discharging device. Fig. 8 is a top-plan view of Figs. 5, 6, and 7. Fig. 9 is a front elevation, partly in section, of the refrigerator. Fig. 10 is a top-plan view of the refrigerator.

The nature of our invention consists in so constructing the drier that contains the oxide or chloride of calcium that it can be rendered perfectly air-tight, and so arranged that the compressed air to be dried shall enter at its base and be forced to pass up through the calcium, so permeating the same in its passage and before it is discharged from the drier as to be entirely freed from all dampness and moisture. Our drier consists of three cylinders—an outer jacket-cylinder and two interior cylinders, the latter being of such diameters that one shall fit snugly in the other, while the relative dimensions of the inner cylinders and the outer cylinder shall be such that when the interior cylinders are in position between the outer and intermediate one there shall be left a narrow annular passage, the upper section of which is closed and all egress of the air through the same prevented by the flanged bearings of the intermediate cylinders. The base-plates of the intermediate cylinders are perforated in such manner that when the one is inserted in the other their perforations shall register. These perforations communicate directly with the air-chamber at the base of the outer cylinder, and into which the compressed air is introduced. The inner cylinder is filled with calcium, and the compressed air enters through the perforations and arises up through the material to the dome of the drier, and in which passage all particles of humidity which the compressed air may have contained are absorbed. From the dome the air is conveyed to a cooler, and thence to the reservoir. Our invention also consists in a novel arrangement of the air-pressure receptacle or regulator, and from which the air which supplies the refrigerator is fed. This discharge or feeder is air-tight, and is to be so surrounded by a jacket-cylinder as to permit of its being incased with some suitable non-conducting material, as is also the tube which conveys the compressed, dried, and refrigerated air from the reservoir to its discharge-chamber. This air-tube enters the discharge pressure-chamber at the base thereof, and protrudes some distance above the same so as to furnish, as it were, a neck-seat for a sleeve-valve. This sleeve-valve is connected, by a forked arm, with a piston-rod, and to which is secured a piston and weight-cup. These are relatively so arranged that when in their normal condition the valve-sleeve shall be held or rest at such position on the neck of the inlet-pipe as to leave its discharge-orifices open and entirely unobstructed; and, of course, through the weight-cup, the degree of pressure that the piston will resist without being elevated can be regulated at pleasure; but the instant the pressure exceeds the given or desired quantity the piston is set to resist, the same is elevated, carrying with it the piston-rod, and so drawing up the sleeve-valve as to close the discharge-orifices of the tube, and thus, for the time, effectually cut off all further ingress of air from the reservoir; but the moment the refrigerator has exhausted the air from the chamber, so as to reduce the pressure to the desired point, the piston automatically drops, and, carrying with it the valve-sleeve, opens again the inlet-orifices of the tube. Thus it will be seen that the action of the valve is controlled and graduated by the action of the pressure of the air on the piston.

The supply-pump and air-engine which we propose to use, and which are hereinafter described, we have not mentioned in the above recital, although they are believed to be new and useful, as we desire to make each the distinctive subject-matter of independent applications.

The construction and operation of our invention are as follows: A is the main driving-shaft, and through which motion is communicated to the operating mechanism of the apparatus. When driven through an endless belt the belt is secured over the pulley $H^4$. This shaft A is journaled in suitable bearings *a a*, as clearly shown in Figs. 1 and 2. $A^1$, $A^1$, and B are crank-shafts, and drive respectively the jointed piston-rod $B^2$ $C^1$ of the air engine and pump. The piston-rod $C^1$ is not connected directly with the crank-shaft or eccentric B, but is secured to a wrist-pin, D, attached to a crank, E, whose bearing-bolt *e* is secured in the slotted face *b* of the crank-shaft, and is fastened and held at any desired point therein by means of a jam-nut, *c'*. This means of adjustment permits the stroke of the piston-rod $C^1$ being regulated at pleasure. C is the chamber of the pump, and in it works the piston *c* attached to the rod $C^1$, and operates in the usual manner. The chamber C is connected with the valve-chests $B^1$ $B^1$ by means of connecting-pipes F $F^1$ entering the chamber C at such relative positions that, while the connection with the pipe F shall be always above the stroke of the piston *c*, the other pipe $F^1$ enters the chamber at such section thereof as always to be below the stroke of the same, and which insures always a supply of water to the chamber C through one or the other of the pipes F and $F^1$, and from their respective valve-chests. The valve-chests $B^1$ $B^1$ are connected with an ordinary suction-pipe, O, by means of short lateral pipes *o o*. In each valve-chest, and at their upper sections, are arranged automatically-acting pressure-valves H and $H^1$, and also in each chest are suction-valves *h h'*. These latter are provided with valve-stems, and are so arranged as to be controlled, when desired, by thumb-screws $c^1$ $c^1$, so by turning one of the screws $c^1$ the valve *h'*, in connection with which it operates, can be so driven out of its seat as to be kept permanently open, and consequently inoperative.

To illustrate the action of the pump, as the arrangement of the chests $B^1$ $B^1$ and valves H $H^1$ and *h h'* are mere duplications of each other, we will describe its operation in connection with the upper chest $B^1$: The lower thumb-screw $c^1$ has been so driven against the stem of the valve *h'* as to drive it out of its seat, and which renders it inoperative, and the other thumb-screw $c^1$ is in such position as to leave the valve *h* free to act. Power is now applied to the piston-rod $C^1$, and the water is drawn by suction through the upper lateral pipe *o* into the valve-chest $B^1$, and the pressure lifts the valve *h*, and the water passes through the same, and by means of the pipe F into the chamber C. Now, as the piston *c* is elevated, the water is forced back into the chest, its weight or pressure closing the valve *h* and opening the valve H, and allowing of its passage or of its being discharged into the pipe G.

As described, the pump is of course a single-acting pump, and it is made a double-acting pump by leaving the valves *h h'* both free to act, and which is done by screwing the thumb-screws out so as to be entirely free from all contact with the stems of the valves *h h'*; or, on the other hand, the pump is rendered inoperative simply by turning both screws in so as to lift the valves *h h'*. The water thus elevated and discharged is conveyed from one or both of the valve-chests $B^1$ $B^1$, as the case may be, by lateral pipes G $G^1$, into a discharge-tube, $H^2$, and which is closed at its upper section by an ordinary air-chamber, I. This tube extends to the base of the cooler, Fig. 5, and discharges its contents in and around the coil secured therein.

In Fig. 2 is shown the air-engine or compression-pump with which we propose to compress the air and thence supply the same to our improved drier, Fig. 3. This air-engine consists of three cylinders, $B^2$ and M M'. The cylinders M M' are connected with the cylinder $B^2$ by means of pipes *m m'* extending from the base of their respective cylinders, and connected with the cylinder $B^2$ at such sections thereof that one shall enter above the highest stroke of its piston $b^2$, and the other beneath its lowest stroke. The piston $b^2$ is connected to the jointed rod $B^3$, and acts in the chamber or cylinder $B^2$ on the well-known principle of the ordinary pump. To the upper section of the cylinder $B^2$ may be attached slotted upright guides, and which will aid to insure the proper and direct action of the jointed piston-rod $B^3$. These cylinders are all seated on suitable bearings. In the heads or lids of the cylinders M M' are placed the inward-opening suction-valves $D^1$ $D^1$, and which are counterbalanced by the rods $a^1$ $a^1$ and weights $b^1$ $b^1$. These cylinders M M' are connected with a tube, S, and which is provided with three valves, *d* $d^1$ $d^1$. The valve *d* closes its discharge-orifice, and the valves $d^1$ $d^1$ its connections with the cylinders M M'. Each valve is rendered perfectly air-tight by means of a lid and clamp, S'. The upper section of this tube S is connected with the tube $c^2$, which conveys the compressed air to the drying apparatus, Fig. 3.

The operation of this air-engine or compression-pump is as follows: By any convenient means the cylinder $B^2$ is filled with water both above and below its piston $b^2$, and the piston is then elevated to its highest point, which drives the water through the pipe *m* into the cylinder M, partially filling the same. The valve $D^1$ is then opened, and, through any convenient means, the cylinder M is completely filled with water. The downward stroke of the piston $b^2$ then, through the pipe *m'*, partially fills the cylinder M′, which is then, also through its valve $D^1$, also completely filled with water. Now, the next downward stroke of the piston necessarily lowers the column of water in the cylinder M, the water flowing through the pipe *m* into the chamber $B^2$. This leaves a vacuum in the cylinder M above its water-column, and which vacuum opens the valve $B^1$, and the air rushes in and fills the cylinder; and as the piston $b^2$ again rises, so does the water-column in the cylinder M, and which, through the pressure of the air, closes the valve $D^1$, and the same pressure opens the valve $d^1$, allowing the compressed air to escape into the tube S and elevate the valve *d*, and thence to pass by the pipe $c^2$ to the drier. The cylinder M′ has its water-column elevated and lowered through the action of the piston precisely as does the cylinder M, although they are acted on alternately, as the stroke of the piston $b^2$ which elevates the column of water in one cylinder depresses it in the other, and vice versa. The air thus compressed by hydraulic pressure is, of course, moist and damp, and, to prevent its freezing before the completion of its action as a refrigerating agent, should be dried. Therefore the pipe $c^2$ which receives the air from the compressing apparatus is made to discharge the same at the base of the drier. This apparatus is clearly illustrated in Fig. 3, and consists of an outer cylinder, $A^2$, having a removable dome-shaped top, $A^3$, and a convex base, $A^4$. This cylinder $A^2$ is to be perfectly air-tight when in operation, and has arranged in its dome an ordinary safety-valve, $G^2$, and an air-discharge nozzle, $H^3$, and to which is attached the pipe $H^5$ that conveys the dried compressed air to the cooler, while through the convex bottom of this cylinder $A^2$ enters and is secured in an air-tight bearing the pipe $c^2$ that conveys the air from the compressing apparatus. The neck of this pipe or tube $E^1$ projects some distance above its bearing, and is provided with a deflecting-cap, $F^2$, so arranged that, while it leaves a free inlet for the air, prevents the escape of all moisture or particles of the drying material through the tube $E^1$ to the pipe $c^2$. Within this chamber $A^2$ are secured two interior cylinders, $A^5$ and $B^4$, and which last are to be of such diameters that one will fit closely in the other, while the relative dimensions of the cylinders $A^2$ and $A^5$ are to be such that when the cylinder $A^5$ is inserted there shall be left a narrow annular passage, $a^2$, between the cylinders, but which passage $a^2$ is closed at its upper section, so as to effectually prevent the escape of air by means of the flanged bearings $b^3$ $b^3$ of the interior cylinders. The base-plate of each of these interior cylinders $A^5$ and $B^4$ are perforated, and in such manner that when the cylinder $B^4$ is inserted in the cylinder $A^5$ these perforations shall register. The inner cylinder $B^4$ is to be constructed of either lead, gutta-percha, or other non-corrosive material, and is to be filled with either dry oxide of calcium or dried chloride of calcium. Thus it will be seen that the air that enters through the pipe in order to reach the dome of the cylinder $A^2$ is compelled to pass through the perforations in the base of the cylinders $A^5$ $B^4$, and to ascend through the mass of calcium. Now, in this ascent, it entirely permeates the mass, and which permeation deprives the air of every particle of its humidity or moisture, and causes it to enter the dome $A^3$ of the cylinder $A^2$ in a dried state, and from which it is fed to the cooler, Fig. 5. By means of the removable dome of the cylinder $A^2$ ready access can be had to the interior cylinder $B^4$ to fill the same or replace the calcium, as occasion requires. The dried compressed air is now carried by the pipe $H^5$, which is attached to the nozzle $H^3$ of the dome of the cylinder $A^2$, Fig. 3, to the cooler, Fig. 5, and discharged and caused to pass through the coiled pipes I′ arranged therein, as illustrated in the drawing. This coil of pipe I′ is inclosed in a water box or cylinder, R, and which is supplied by the pump, Fig. 1, through the pipe $H^2$. The dimensions of this box or case are to be such that the coil through which the air passes shall be completely embedded in water. The water is finally discharged by the pipe K, and the compressed air, after being subjected to the cooling action of the submerged coil, is conveyed by the pipe L to the reservoir, Fig. 6, and enters through the dome thereof. While the arrangement of cooler herein described, consisting of a submerged coil, and which subjects the dried and compressed air, in its passage, to the action of a constantly-flowing current, produced by the pump, Fig. 1, is admirably adapted for the purposes designed, we desire it distinctly understood that there is nothing arbitrary about this arrangement, as the coil, when not incased and exposed to the direct action of the atmosphere, acts in a similar manner, and with nearly the same effect. The reservoir, Fig. 6, which receives the air from the cooler, Fig. 5, by means of the pipe L, is an air-tight vessel, and is furnished with a manometer, $C^2$, and which measures the density of the air, and a faucet, $C^3$, at its base, by which the accumulating moisture, if there be any, may be drawn off. The discharge-tube $b^4$ of the reservoir communicates directly with the apparatus, Fig. 7, that supplies the dried compressed air to the refrigerator. The tube $b^4$ is inclosed in a jacket-tube, $b^5$, so as to permit of its being incased or surrounded by some suitable non-conducting material, and this tube may be provided with a valve or cut-off faucet, $b^6$. This tube $b^4$ communicates with a projecting tube, P, at the base of the chamber $A^6$ of the air-distributer, and which constitutes, as it were, a neck-valve for the sliding or traveling sleeve-valve $P^1$, Fig. 7. The mouth of this tube is closed, but around the upper section of its neck are perforations *g g*, through which the air is discharged into the chamber $A^6$ of the distributer, and which consists of the chamber or cylinder $A^6$. This chamber or cylinder is surrounded by some suitable non-conducting material $n$, and which is incased in an outer cylinder or jacket, N, of wood, cloth, &c. The exterior surface of the tube or neck-valve P and the inner face of the circular or sleeve valve $P^1$ are ground, polished, and finished with great care, so as to insure of the one working in the other with the greatest nicety. To this sleeve-valve $P^1$ is secured the forked arm $c^3$, and to which the piston-rod $c^4$ is attached, and to which is secured the piston $d^2$ and the weight-cup $D^2$. This piston-rod, of course, is so arranged as to work in a stuffing-box, and which is to be perfectly air-tight. This chamber $A^6$ is also provided with a thermometer, $E^2$, which indicates the degree of temperature in the cylinder. The air is discharged and fed to the refrigerator, Fig. 9, by means of the tube $C^3$, which is also jacketed so as to be incased with some suitable heat non-conducting material.

The operation of this air-distributing apparatus and regulator is readily explained. The features, as shown in Fig. 7, are all in their normal position, and the sleeve-valve $P^1$ is at such position on the tube P as to leave its orifices $g$ $g$ perfectly unobstructed for the admission and discharge of air from the reservoir. The quantity of air that it is designed to supply to the chamber $A^6$, and thence to be distributed to the refrigerator, being ascertained, the cup $D^2$ is weighted accordingly. The air entering will, of course, owing to its tendency to ascend, press against the piston $d^2$, but the same remains fixed so long as the pressure does not exceed the counterbalancing pressure of the weight in the cup. But the instant the pressure is greater than is desired or the cup is set to resist, this piston $d^2$ is elevated, and which, through the piston-rod $c^4$ and forked arm $c^3$, so elevates the sleeve-valve $P^1$ as to close the orifices $g$ $g$, and which consequently cuts off all further admission of air, and the orifices $g$ $g$ of the inlet-valve remain closed until, through the discharge-pipe $C^3$ leading to the refrigerator, the pressure and density of the air within the chamber are reduced to a point at or below that which the cup $D^2$ was weighted to resist, when the piston instantly drops, and, through the piston-rod $c^4$ and forked arm $c^3$, so drives down the valve $P^1$ as to leave the orifices $g$ $g$ again open for the admission of air. Thus it will be seen that the action of the sleeve-valve $P^1$ is automatically controlled, and, through the weight-cup, piston, and piston-rod, the pressure which causes the valve to act can be graduated and regulated at pleasure. The jacketed tube $C^3$ conveys the air from the discharge-regulator to the refrigerator, Figs. 9 and 10, and in which the animal or vegetable substances, water, or other liquids which it is desired to cool or freeze, are to be placed. This refrigerator consists of the box or case $G^2$, which may be closed by the cover $H^6$. Within the box $G^2$ there is introduced another box, N′, in such manner as to leave an intervening space between the sides of said box N′ and the outer box $G^2$, and this space, as well as that included within the double cover $H^6$, is completely filled with some suitable non-conducting material, such as charcoal, sawdust, &c. The pipe $C^3$ passes through the side of the box $G^2$ and connects the box N′ with the air pressure and discharging apparatus, shown in Fig. 7. At the end of the box N′ is shown the escape-pipe $P^2$. N′ represents a square box or case, made of iron, other metal, or wood, hermetically secured in its joints by the angles $a^3$ $a^3$. Within this box are placed the boxes J′ J′ and the partitions I′ I′, in such manner that they are hermetically joined to the bottom and one side of the box N′, and also to the cover $H^6$, shown in Fig. 9. Between one side of the box I′ and one side of the box N′ a vacant space is left, as shown in Fig. 9. In the same manner a vacant space is left between the partitions L′ L′ and the box N′, but opposite the vacant space between I′ and N′. After hermetically fastening to the case N′ the boxes I′ I′ and the partitions L′ L′, as above described, the whole is closed hermetically by the lid or plate R′, Fig. 9. Thus a series of open boxes is formed, slightly tapering toward the bottom, in which the boxes K′ K′, made of metal, earthenware, porcelain, &c., are placed. The upper ends of the two smaller sides of these boxes K′ K′ are provided with an opening to serve the purpose of affixing a handle for lifting out and replacing the boxes. The boxes K′ K′ are filled with the objects or substances to be refrigerated or frozen and then covered with the lid $H^6$. The air now rushing in through the pipe $C^3$ is forced to pass around three sides of the boxes I′ I′.

It is clearly evident that any other form of refrigerative boxes other than those described may be substituted, and that vessels of any kind filled with liquids and placed in the box is sufficient to refrigerate such liquids to the point of freezing, provided such vessels are surrounded by the cold air generated in the above-described machine. The air escaping through the tube $P^2$, Figs. 9 and 10, can be allowed to pass freely into the atmosphere, or may be made to return to the compressing apparatus, as may be desired.

What we claim as new, and desire to secure by Letters Patent of the United States, is—

1. The drier, Fig. 3, consisting of the outer cylinder $A^2$ and interior cylinders $A^5$ and $B^4$, and which latter have their bottoms perforated, as stated, tube $E^1$, and cap $F^2$, the whole being so combined and arranged as to compel the air introduced into the outer cylinder to ascend through the drying material contained in the inner cylinder $B^4$, substantially as described.

2. The air-regulator, Fig. 7, consisting of the chamber $A^6$, perforated tube P, valve $P^1$,

piston-rod $c^4$, piston $d^2$, and cup D', the whole being so combined and arranged as to operate substantially as described.

3. A refrigerating apparatus consisting of the pump, air-compressing engine, cooler, reservoir, and distributer, when the same are constructed as described, and so combined and arranged as to operate substantially as specified.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HENRY NORMAN.
CHARLES F. DIETRICH.

Witnesses:
JAMES C. KIDDELL,
H. N. JENKINS.