Sheet. 1

Charles P. Leavitt

Impt. in Apparatus for Making Ice

PATENTED JUL 18 1871

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Fig. 2

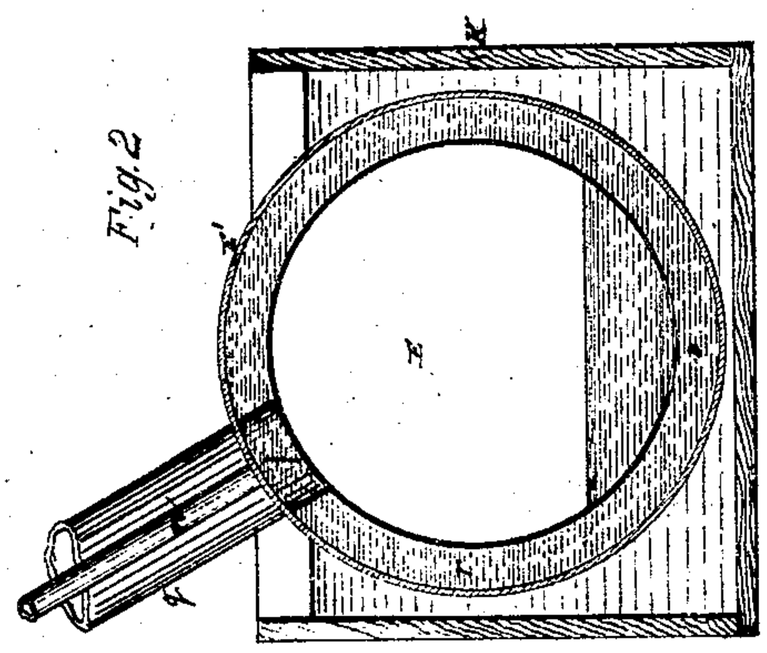
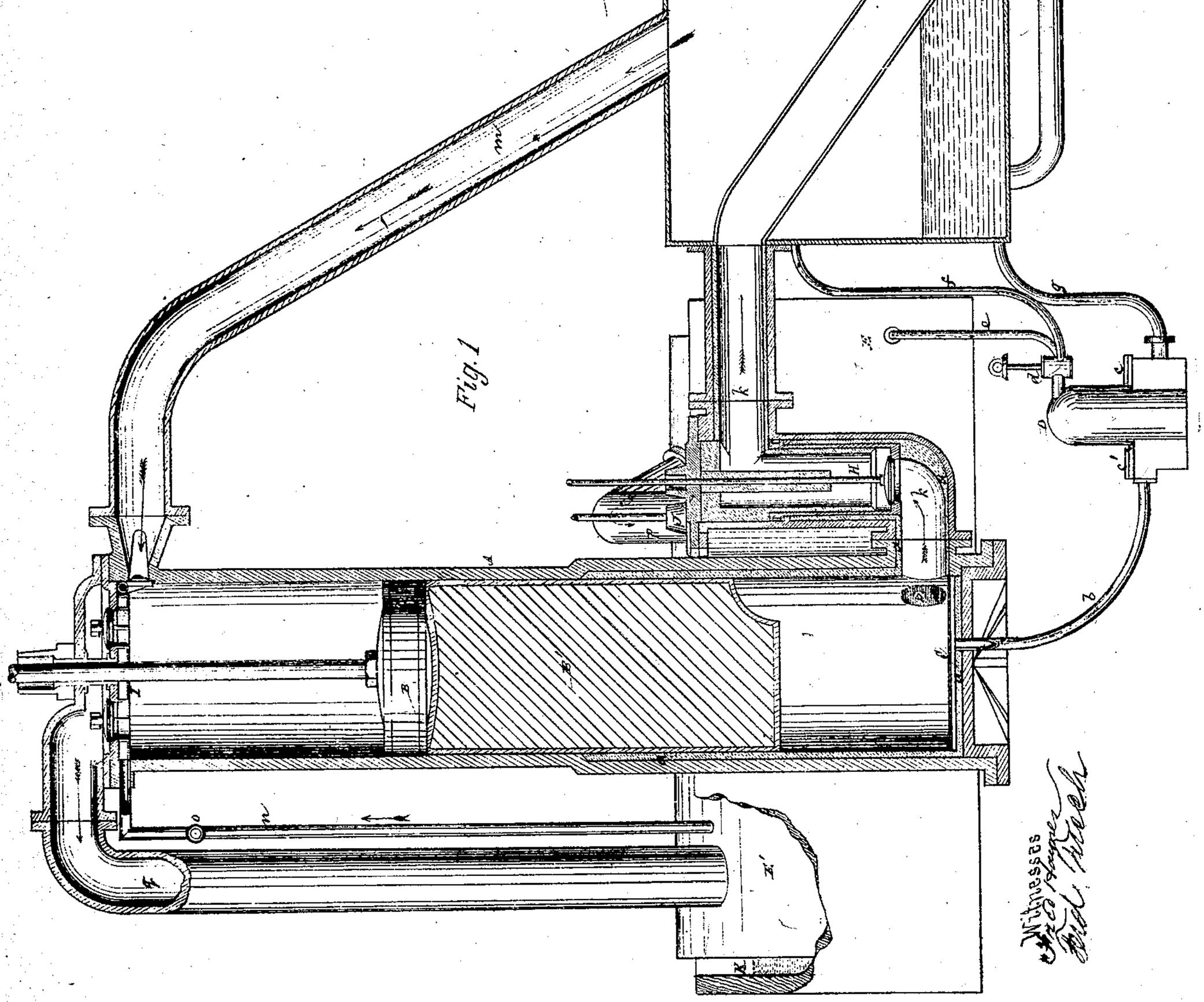


Fig. 1



Witnesses

Charles P. Leavitt

Impt. in Apparatus for Making Ice

Fig 3

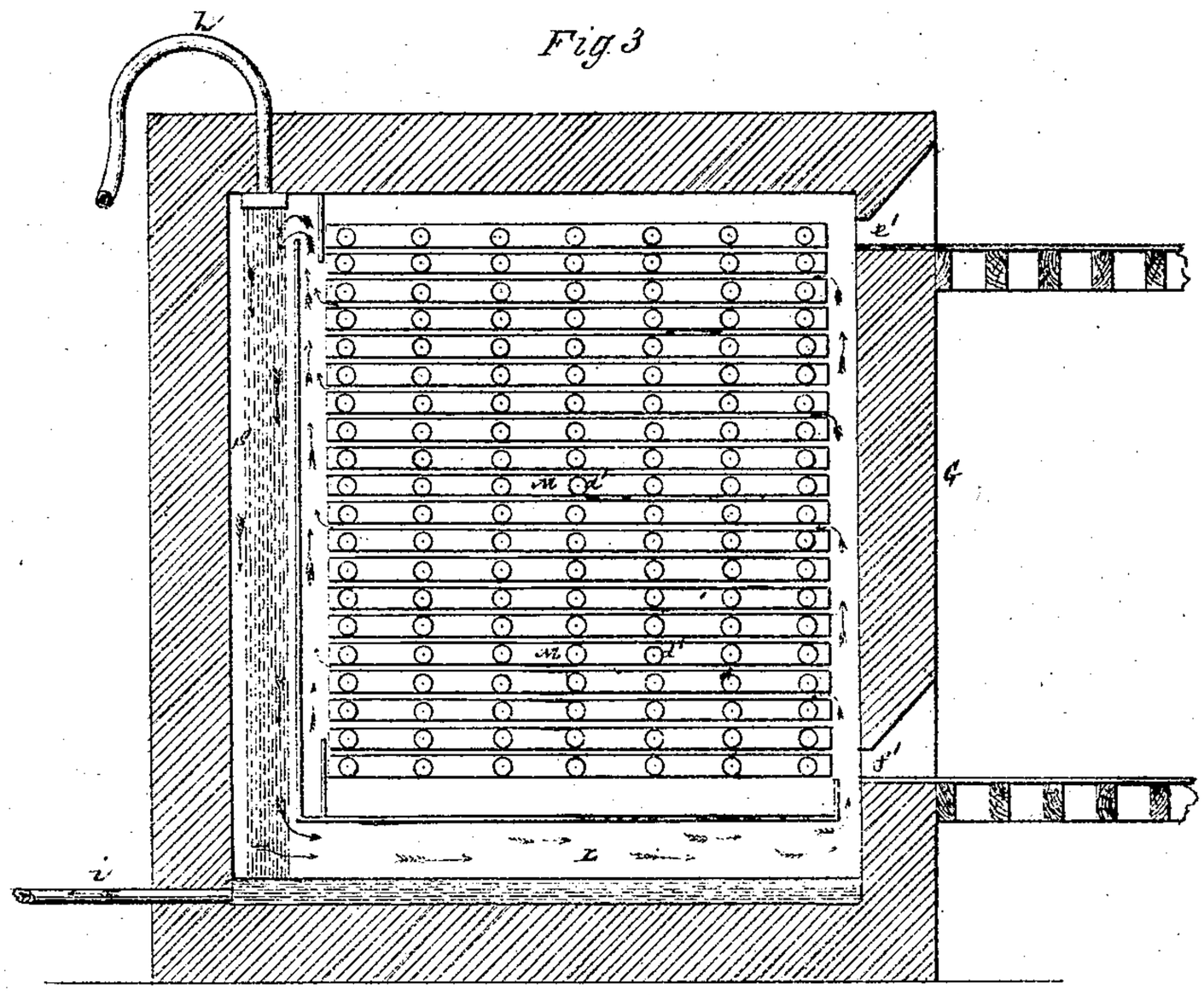
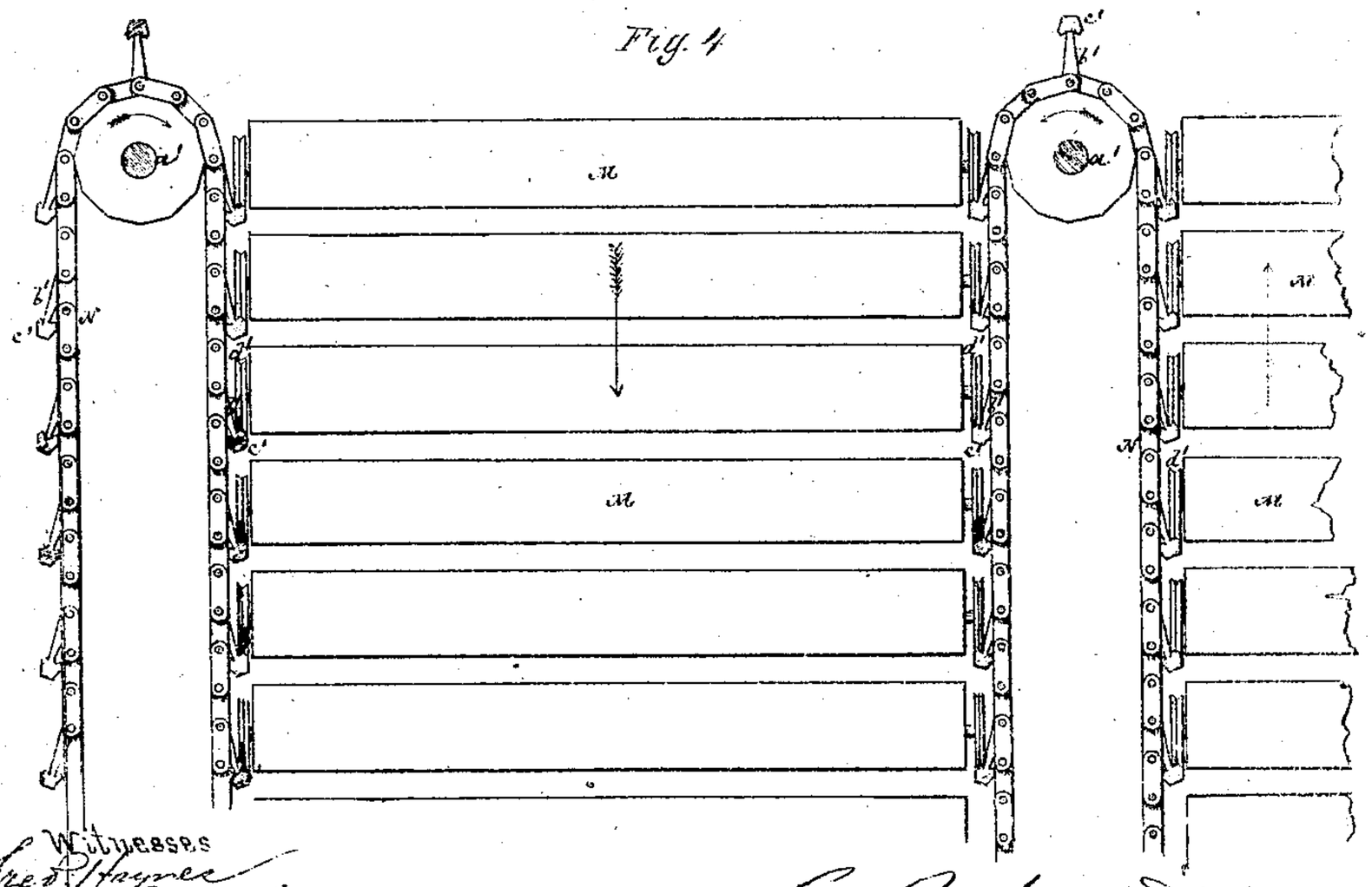


Fig. 4



Witnesses
Fred. Haynes
Fred Fischer

C. P. Leavitt

UNITED STATES PATENT OFFICE.

CHARLES P. LEAVITT, OF NEW YORK, N. Y.

IMPROVEMENT IN APPARATUS FOR MAKING ICE.

Specification forming part of Letters Patent No. 117,087, dated July 18, 1871; antedated July 7, 1871.

To all whom it may concern:

Be it known that I, CHARLES P. LEAVITT, of the city, county, and State of New York, have invented a new and useful Improvement in Apparatus for Making Ice, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing forming part of this specification, and in which—

Figure 1 represents a sectional elevation of a pneumatic ice-making machine or brine-cooler, forming a portion of the invention; and Fig. 2, a vertical section at right angles to Fig. 1 through a condensed-air-and-brine receiver forming part of said machine. Fig. 3 is a partly-sectional front elevation of the freezing-house portion of the apparatus, omitting certain details, including the devices by which ice-pans used therein are carried and operated; and Fig. 4, a sectional view, on a larger scale, at right angles to Fig. 3, showing said pans and the means of carrying and operating them.

Similar letters of reference indicate corresponding parts.

This invention relates to the manfacture of ice on what is known as the pneumatic principle. In this invention atmospheric air is first condensed to a moderately-high pressure, and during such condensation the heat developed thereby abstracted by a shower of cold liquid introduced within the pump, by which the condensation is effected. Said air is then expanded within a cylinder or chamber, coated on the inside with a suitable non-conducting material. The force exerted by such expansion of the air is utilized for the partial condensation of another body of air. The air, during a part of the expansion, has a shower of brine injected into it, from which the heat absorbed by the mechanical power given out is taken. This brine, by keeping the air at a higher temperature than it would otherwise have, causes a greater amount of force to be given out, which is accompanied by a greater absorption of heat corresponding to the mean higher temperature of the expanding air, so that while the efficiency of the machine is increased, the power to drive it is proportionally diminished. The injection of the brine into the cylinder or chamber in which the air is expanded only during the latter part of the expansion forms a novel feature of this part of the invention, and the lining of said cylinder or chamber with a non-conductor is also a feature. The air, when expanded, is returned to the pump to be condensed, while the cold brine goes to a freezing-house and falls in a shower, to cool and keep in circulation a body of air which absorbs heat from water contained in pans, and soon converts said water into ice. The brine then returns to be injected again into the cylinder or chamber in which the air is expanded. This operation takes place continually. Said freezing-house comprises various novel features, including apparatus for traversing and balancing the pans, which are mounted on wheels, and for circulating the air which abstracts heat from the water contained in the pans, to convert the water into ice.

Referring to the accompanying drawing, A is a cylinder, fitted with a piston, B, and plunger B′, which is in length over twice the stroke of said piston that has its travel restricted to the upper portion of the cylinder. The lower portion of said cylinder is of greater diameter than the upper part, and is lined with a non-conducting material, *a*, on its sides and bottom. The exhaust-passages from said cylinder A form the condensing-chamber or barrel of a condensing-pump, while its lower part, as the piston B rises, constitutes a chamber for the expansion of the air. Attached to the lower side of the piston B is a non-conducting plunger, B′, equal in length to the stroke of the piston, and working loosely within the cylinder A. At the bottom of the cylinder A is a perforated plate or sprinkler, C, through which brine is injected into the cylinder A, to commingle with the expanding air in said cylinder, the injection being made by a force-pump or by an air-pressure apparatus, D, in connection with the cylinder by a pipe, *b*. Said air-pressure apparatus is simply a chamber fitted with induction and eduction-valves *c c′*, like a pump, and provided at its top with a three-way cock or valve, *d*, worked by the engine, so as to admit high-pressure air by a pipe, *e*, deriving its supply from a compressed-air receiver, E, at the beginning of the upward stroke of the piston B, and thereby driving out the liquid in the cylinder or chamber of the injector D into the lower portion of the cylinder A. On the downward stroke of the piston B the air is discharged, by the operation of the cock *d*, through a pipe, *f*, into a low-pressure receiver, F, while a fresh supply of brine fills the apparatus D by a pipe, *g*, from

the same receiver, F. A dipper or any other suitable means than that here described for supplying the chamber in which the air is expanded with brine may be used.

It will be observed that the brine is not forced into the cylinder until the pressure falls in it below that of the air in the receiver D, so that in no case can there be a shower of brine in the cylinder while it has the same pressure as the receiver E′. The valve *d* that regulates the admission of air to the chamber D can be adjusted so as to force the brine into the cylinder at any time after the expansion begins—*i. e.*, any time after the pressure in the cylinder is less than that of the receiver—and this valve is so placed that the air in the cylinder shall receive the shower, when, by its expansion, it has fallen to a temperature equal to that of the brine. The receiver F may be made of wood, as it has no pressure to sustain greater than that of the atmosphere. In the bottom of it is a mass of brine, which is made to circulate between it and a freezing-house, G, by pipes *h* and *i*. The exhaust air from the engine enters this receiver F by a pipe, *k*, the same passing through the brine by means of a distributer or perforations, *l*, in said pipe. H is the induction-valve, which, on being opened, allows of the exhaust air being thus passed from the cylinder A to the receiver F. Having remained in this receiver long enough to be free of spray, said air passes, by a pipe, *m*, to the upper or compression side of the piston B. This air may, by its reduced temperature, be used to cool the water that is to be frozen. Said air, after it enters the upper portion of the cylinder A, is here condensed by a shower of brine falling from a shower-pan or sprinkler, I, which is supplied by a pipe, *n*, that is fitted with a valve, *o*. This valve is worked automatically by the engine so as to inject the brine through the sprinkler I only after the heat developed by condensation has brought the air to its natural temperature, say 60° Fahrenheit, more or less. The object of using brine instead of water to remove the heat developed by the condensation of the air is to prevent waste of brine. It is evident that there must be more or less exchange of watery particles between the receiver F and the upper part of the cylinder; also, that the air, having a greater capacity for moisture in the warm receiver E than it has in the cold receiver F, the tendency of the solution in E is to become stronger, and in F weaker. By using brine above the piston, as well as below, this action can be productive of no loss, since the brine in one receiver can be exchanged for the brine in the other, as the exigency of the case requires. The air is first admitted to the cylinder A through a pipe, *p*, from the compressed-air receiver E by means of an induction-valve, J. Upon the condensation of the air by the upward stroke of the piston B it is thrown back, along with the injected brine, by a pipe, *q*, into the receiver E. This receiver is constructed of a thin inner shell, open at its bottom, and arranged within an outer shell or jacket, E′, leaving an annular space, *r*, between them. The pipe *u* communicates with this annular space near its top, while the pipe *q* connects with the receiver E. The supply of brine being limited, it fills the annular space *r* upon communication being opened with the cylinder when the pressure is low, thus preventing leakage of air from the receiver, and the whole being immersed in a tank, K, constantly supplied with cold water, which keeps the brine cool. Any device may be used to force the brine to travel over the entire surface of the jacket E′ before being returned to the cylinder, the simplest arrangement for which purpose is to make the opening in the bottom of the receiver E at one end of the latter, and to connect the pipe *n* with the jacket near the opposite end.

In this pneumatic ice-machine, which, in operating as described, finally reduces the temperature of the brine in the receiver F to the requisite temperature to effect the freezing of water in the freezing-house G, it will be observed that the brine is first employed in the lower portion of the cylinder A to impart heat to the expanding air, thus reducing its own temperature and imparting additional force to said air, and that it afterward is used in the upper portion of the cylinder to lower the temperature produced by condensation of the air. A small auxiliary pump is used in connection with the machine to neutralize the slight additional heat which is given to the air after leaving the cylinder, before being condensed. The cooled brine, leaving the tank or receiver F by the pipe *h*, is caused to fall in a shower within a compartment, S, of the freezing-house G, said compartment being open at its top. From thence the brine is made to circulate through or over the bottom of a lower compartment, L, and from here returned by the pipe *i* to the receiver F. The showering of the brine, as represented in Fig. 3, produces a rapid current of air, which, taking the direction of the arrows in said figure, flows down with and is cooled by the shower, afterward passing into the compartment L, where it deposits its spray, and then passes over and around freezing-pans M, and subsequently down with the shower again, and so on continually, thus keeping up a circulation of cold air around the pans. These pans which contain the water to be frozen are arranged in side tiers or rows, one pan above another, and with a dividing space between them for the circulation of the cold air around them. The structure and mode of operating these pans will be best understood by reference to Fig. 4. Through the top of the freezing-house is arranged a series of horizontal shafts, *a′ a′*, at distances of four feet apart, more or less. Directly below these shafts, near the bottom of the house, are similar shafts. The upper set of shafts is geared together so as to revolve simultaneously, and is provided, as well as the lower shafts, at distances of a few feet apart, with chain-pulleys, over which endless chains N N are passed. Attached to these chains are arms *b′ b′*, which carry double V-shaped rails *c′ c′*, that extend nearly across the house in a horizontal direction. The pans M M, which are provided with wheels *d′ d′* that run upon these rails, are equal in length to the freezing-house, or there-

about, and about twelve inches deep, more or less. They are lined on the sides and bottom with wood, so that the water they contain will only be frozen from the top.

The operation is as follows: Supposing the chain-pulleys to rotate as indicated by arrows in Fig. 4, it will be seen that the pans M M of the one tier or row are descending, while the other row of pans is ascending, as indicated by the respective arrows, and that the rails *c' c'*, being double, are capable, both on the ascending and descending sides of the chains, of receiving and sustaining the pans by their wheels *d' d'*. By this arrangement the rails are carried slowly around with the chains, and as each rail is turned into its place at the top a corresponding rail is turned over on the other side, and upon these rails a pan of water is run in. This continuing, the pans slowly descend, supported one above the other. By the time a pan reaches the bottom its contents are frozen, when it is drawn out, the ice removed, and the pan refilled with water and run in on the ascending side of the chains. Upon arriving at the top the ice is again taken out, and the pan, being refilled with water, goes down upon the same side as at first. *e'* and *f'*, in Fig. 3, are top and bottom openings, through which the pans are entered and removed in passing them onto and from off the rails.

By the arrangement of the pans on the chains in side tiers or rows, as described, the one tier or set of pans is made to balance the other, which reduces the labor of operating them and the chains which carry them. The handling of the pans, too, is greatly facilitated by providing them with wheels, and running them on and off rails to and from their places, as specified.

What is here claimed, and desired to be secured by Letters Patent, is—

1. The arrangement and combination of the injector D, its ingress and egress-pipes *e g* and *f b*, and valves *c c'* and *d*, with sprinklers C in the bottom of the expansion-chamber A, substantially as and for the purpose set forth.

2. The non-conducting lining *a*, of wood, within the cylinder A, substantially as shown and described.

3. The arrangement of a sprinkler, I, above the piston, and its supply-pipe *n* for injecting brine from the annular chamber *r*, substantially as and for the purposes herein set forth.

4. The combination of the low-pressure receiver F, the compressed-air receiver E with its brine-jacket E', the cylinder A with its lining *a*, the piston B with its attached plunger B', the sprinklers C I, and the injector D, for operation essentially as specified.

5. The freezing-house G, constructed with compartments S and L, and attached brine linlet-and-outlet pipes *h* and *i*, arranged and operating substantially as specified.

6. The endless chains N, constructed or provided with double reversible rails *c'*, for operation as described.

7. The ice-pans M, provided with side-wheels *d'*, in combination with the double rails *c'* of the chains N, substantially as specified.

8. The combination and arrangement of the ice-pans M having side wheels *d'* with the double reversible rails *c'* of the endless chains N and the freezing-house G with its compartments S L and attached brine-pipes *h* and *i*, all for operation together as herein shown and described.

C. P. LEAVITT.

Witnesses:
FRED. HAYNES,
FERD TUSCH.