2 Sheets--Sheet 1.

J. M. BEATH.
Ice-Machine.

No. 168,706.

Patented Oct. 11, 1875.

Fig. 1

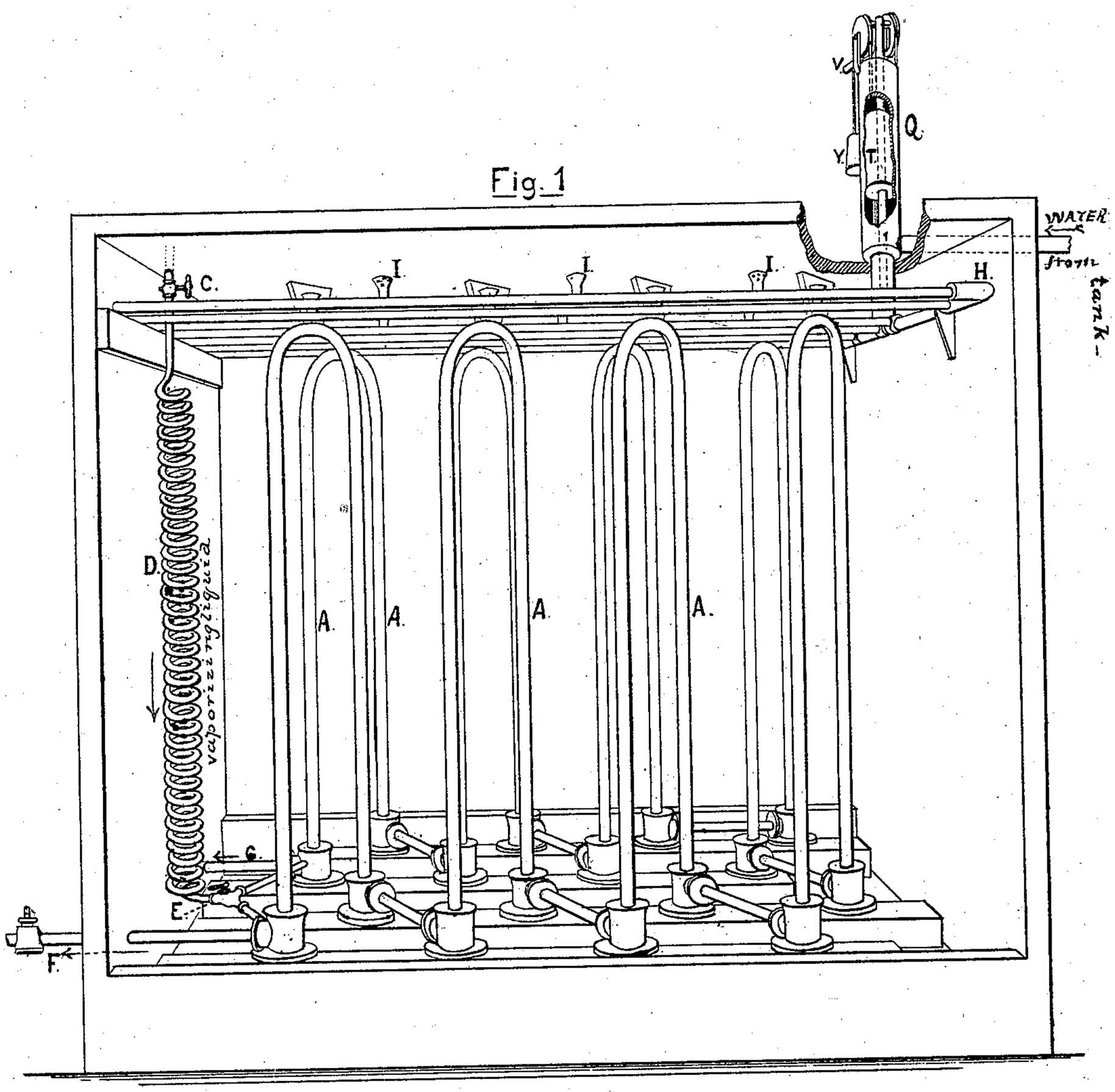


Fig. 2.

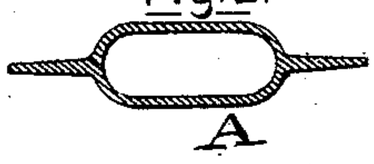


Fig. 3

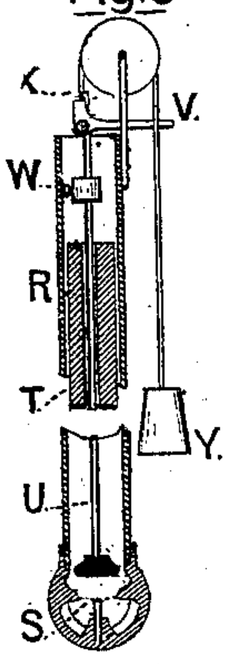
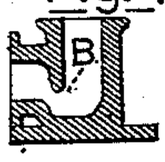


Fig. 4



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Alfred Lix

Inventor:
John M. Beath

2 Sheets--Sheet 2.

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Fig. 5

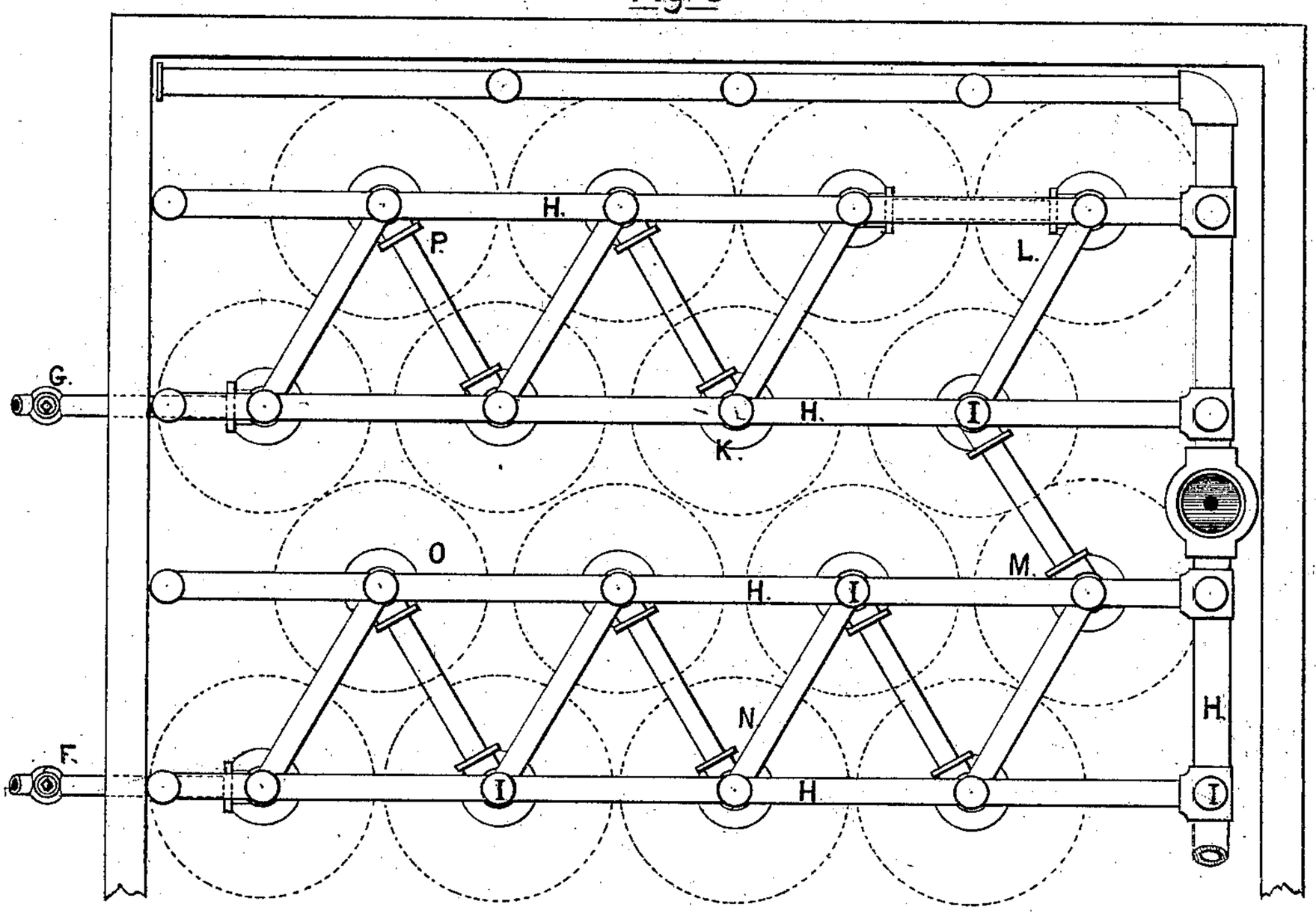
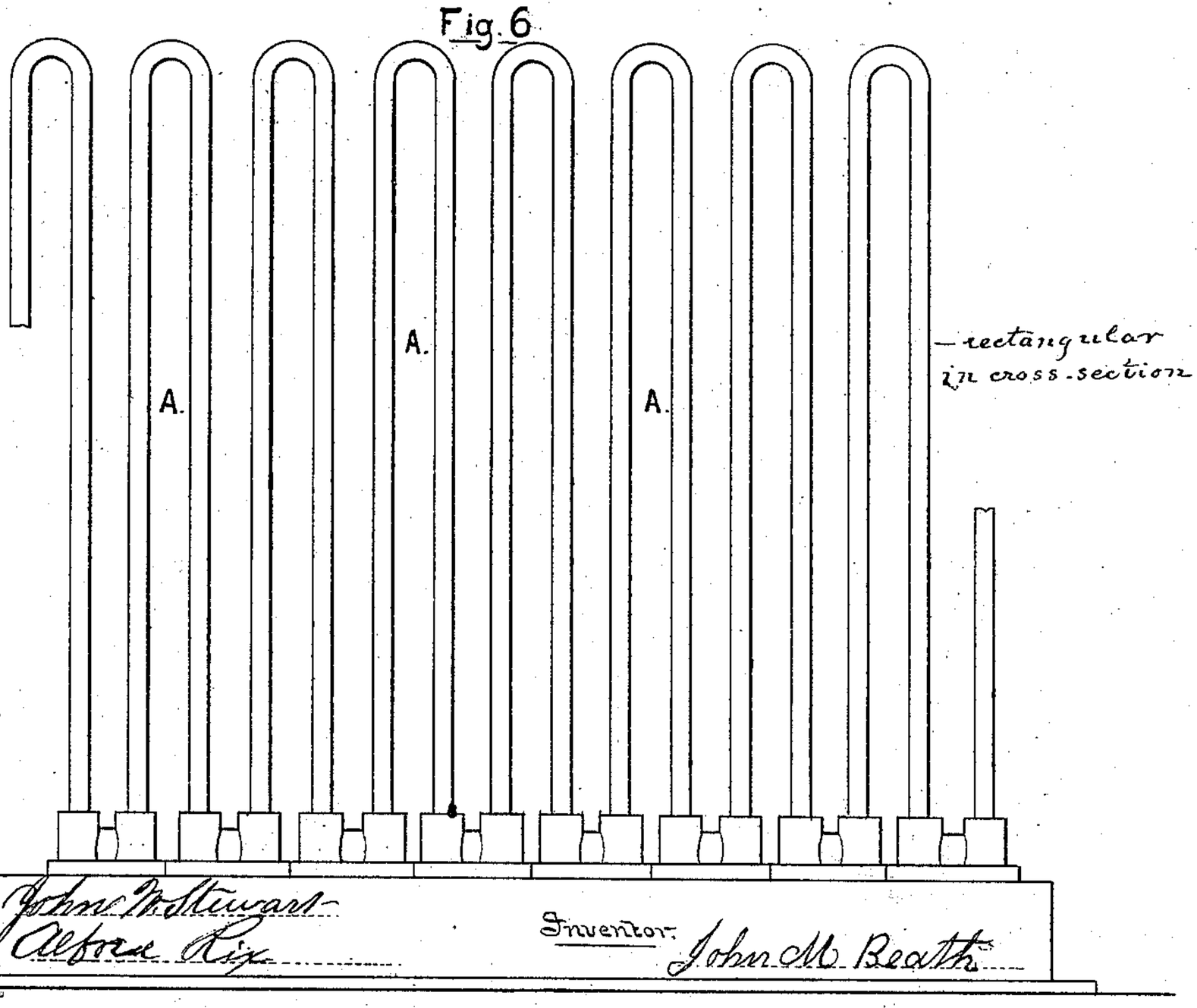


Fig. 6



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UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN ICE-MACHINES.

Specification forming part of Letters Patent No. **168,706,** dated October 11, 1875; application filed January 14, 1874.

To all whom it may concern:

Be it known that I, JOHN MCGOUCH BEATH, of the city and county of San Francisco, in the State of California, have invented certain new and useful Improvements in the Manufacture of Artificial Ice and Apparatus therefor, of which the following is a specification:

My said improvements relate to the process of forming the ice, and to that portion of ice-making apparatus known as the congealer.

One object of my invention is to produce solid ice, and to have it free from such impurities as are liable to exist in the water to be congealed. Another object is to so simplify the congealing apparatus that it may be extensively constructed with comparatively little expense, and, by filling large rooms or buildings therewith, practically admit of the ice remaining upon the congealers, as in a magazine or storehouse, until demand exists therefor.

My invention consists mainly in forming the ice on freezing-surfaces, in the rear of which the refrigerating agent is applied, and through which it operates, by the congelation of water which is applied to and over said surfaces in flowing currents, whereby the surface of the ice as it is formed is constantly washed and kept free from such objectionable matter as is naturally rejected and thrown to the surface of the ice in the process of congelation, and which would, if not removed, render the ice impure and less solid. My invention further consists in a novel process of manufacturing ice around hollow cores containing the refrigerant, by showering or throwing the water upon them in excess of the quantity congealed. Also, in arranging congealing-pipes in a vertical position, whereby they and the ice formed thereon are rendered self-sustaining. Also, in combining with said vertical congealers, a water-delivering apparatus, whereby the water may be discharged upon said congealers at proper points and in proper quantities for the production of ice. Also, in the combination, with each vertical congealer, of a trap for containing a portion of the liquidized refrigerant, through which the gases will pass in their course from one congealer to another.

Referring to the drawings, Figure 1 represents a perspective view of the congealer. Fig. 2 represents a transverse section of one form of congealing-pipe. Fig. 3 represents a vertical central section of the feeder. Fig. 4 represents a like view of an elbow. Fig. 5 represents a plan of the congealer. Fig. 6 represents an elevation of another arrangement of the pipes.

Like letters of reference in the different drawings indicate the same parts.

I will now proceed to describe one form of congealing apparatus embodying my invention, and will afterward mention certain variations.

The congealer is situated in a room having a water-tight floor, and sides also water-tight, and the whole inclosure adapted to exclude heat as much as practicable.

The congealer consists of a system of vertical pipes, A, so connected as to have one continuous channel through them. The connections above are made by bends in the pipe, while below they are made by elbows and horizontal pipes. These elbows have a pedal-flange resting upon and bolted to the supporting-timber. Within the elbow and beneath the vertical bore is a small cavity or trap, B, Fig. 4. The vertical pipes are arranged in rows along the timbers, and also diagonally—that is, each pipe (except the exterior ones) is surrounded by six others, equidistant from it and from each other.

The vaporizing-liquid is introduced from the liquefying apparatus, and its quantity regulated by the cock C into the coil D, whence it is directed by the two-way cock E through the system in either direction, and discharged from either of the outlets F or G. Just above this system of congealing-pipes is the sprinkler—a system of water-pipes, H, with a nozzle, I, over each vertical pipe, and extra ones for outside, and each nozzle having lateral perforations so directed as to throw water in fine streams or spray upon the upright pipes. The water is not thrown upon the pipes nearest to the throwing-nozzle, but upon the next beyond. For example, if we consider the nozzle at K, Fig. 5, it throws water upon the vertical pipes L, M, N, O, and P, and upon all others similarly situated. This insures a better distribution of the water than if it were thrown upon the nearest pipes.

The sprinkler is supplied with water intermittently by the automatic feeder, Fig. 3, and Q, Fig. 1. This consists of a cylinder, R, which communicates with the sprinkler by the valve S, which is operated as follows: Within the cylinder is the float T sliding vertically on the valve-rod U. Outside of the cylinder is the counter-balance Y, suspended by two cords passing over pulleys and attached to the float. The float weighs a little more than the counter-balance. Above the cylinder on the valve-rod is a collar adjusted by a thumb-screw. Through the valve-rod near its top passes a pin, X. This pin on each side of the valve-rod rests on the ends of bent forked lever V, pivoted near the valve-rod, and having the horizontal end the heaviest, so that its forked end shall always press against the pin. As the water is pumped from the floor below into the cylinder, it raises the float T until it strikes the collar W, and carries the rod and valve upward until the pin X rises above the fork, which then drops under the pin and suspends the rod and valve, until, from the discharge of water, the float sinks and the counter-balance rises sufficiently to raise the horizontal end of the lever V, and moves the fork from under the pin, and allows the valve to fall and close, when the water commences to rise as before. The feeder should be protected from external heat.

The operation of the congealer is as follows: The stop-cock C being opened, the volatile liquid passes into the coil D, and thence into the system of upright pipes A, and is driven forward and distributed by the formation of vapor. The traps B in the elbows prevent the passage of gas without carrying more or less of the liquid with it. After passing through the congealer the gas goes into the liquefying apparatus in the usual manner. The original supply-water is allowed to trickle down the coil D, and is thus cooled, and at the same time the gas formed in the coil aids in driving forward the liquid. The feeder, being in operation as already explained, makes its discharges periodically. The frequency of discharge is regulated by changing the speed of the pump, or the length of its stroke. The amount of discharge is adjusted by the collar on the valve-rod. The height at which the feeder is placed above the sprinkler must be varied according to the height of the vaporizing-pipes and their distance from the nozzles. The aim should be to have the jets of water when the discharge commences reach and wet the upper ends of the upright pipes, and, when it ceases, to reach somewhat above their lower ends. The water should be applied either continuously or intermittently, but with such frequency, and in such quantities, as to evenly distribute it over the surface of the pipes, or the ice formed thereon, and thereby to wash away all impurities and objectionable matter, which would otherwise be held in the process of congelation. The excess of water on falling upon the inclined floor flows from thence to a tank beneath, from which it is again supplied to the feeders by means of a pump.

The bottom of the room may be provided with any proper filtering materials, through which the water can drain into the well beneath the pump.

The ice is loosened from the pipes in the ordinary manner by admitting into them gas from the condenser. It can then be removed from the pipes, when desired, by sawing and splitting.

It will be apparent that a proper ice-factory will have several systems of congealing-pipes, respectively connected with the liquefying apparatus, as shown, so that while the ice is being removed from one system of pipes it may be forming on others.

As water in the act of freezing tends to reject all impurities held in suspension or in solution, if the rejected matter is washed away from the freezing-surface as fast as it accumulates thereon the ice will be pure, transparent, and of great density.

This is the operation and effect of my method, and constitutes one of its most valuable features. So marked is this peculiarity that it has produced pure ice from highly-discolored surface-water gathered in a rain-storm. The old methods of freezing the water in a body can never give this result.

Another important feature of my method is that it dispenses with the ordinary costly and cumbrous freezing-tanks, and all the inconveniences incident to conducting the work under water.

If desired, large ice-houses may be cheaply filled with closely-packed ice made on the spot, and removed as required for use.

The congealing-pipes may be of any desired form. A convenient one, when made of cast-iron, is shown by Fig. 2.

The congealing-pipes need not, necessarily, be vertical, although I prefer this position for convenience of wetting and removal of the ice, and especially as the ice is thus made self-supporting.

The location of the upright pipes in relation to each other may be varied to meet special requirements. For example: If it is desired to produce the ice in rectangular blocks, instead of cylindrical ones, the pipes may be placed in separate rows, and those of each row so near together that the ice will unite between them, as shown in Fig. 6.

Of course, changes in the respects above mentioned will require corresponding changes in the water-feeder.

If the pipes are horizontal the water must be thrown upon the under sides; otherwise the formation will be deficient and irregular.

If a single row of nozzles is placed above the row of pipes, and arranged so as, by a valve, to let fall a sudden flood of water upon the pipes, the washing will be sufficiently well done.

It will be readily comprehended that, as the

ice is formed upon the hollow cores, the freezing-surface is gradually increased in area, and although the freezing operation will proceed proportionately slower as the thickness of ice increases, the increase of freezing-area will practically compensate therefor, thereby admitting of the formation of cylinders of ice of any required size. The ice so formed on each isolated congealer (composed, for instance, of a single one and one-half inch iron gas-pipe) will, in practice, when operated on a large scale, weigh from one to three tons, and unless the congealer be relieved of this great weight it will be liable to be racked, strained, and even broken, and for that reason it is essential that the column of ice as it is formed be self-supporting by resting at its lower end upon the hollow base, which also supports the congealer. The water is applied so as to be more or less evenly distributed on the congealer from top to bottom, so that ice is formed thereon, extending from the base upward, and by an endwise support on the base it is rendered self-supporting.

I am aware that vertical congealing-plates have heretofore been employed within freezing-tanks. In such cases the water in the tanks surrounds the plates, and, as all ice will float in water, it is obvious that ice formed on the plates, although adhering thereto, will, in fact, be supported by the water in the tank. Such congealers have been heretofore supported either by the walls or bottom of the tank, and were not mounted on bases, which also afforded an independent support for the body of ice as fast as it was formed.

No such arrangement is at all essential with the congealers employed in tanks in the art of ice-making as heretofore practiced, because the ice could not be formed in great bulk or weight, and because the water in the tank served practically to relieve the congealer wholly from the weight of the ice; and I, therefore, make no specific claim to vertical congealers employed in combination with a freezing-tank, but confine my special claim to isolated vertical congealers, as distinguished from those referred to as located within a tank, and in practice surrounded by water contained in said tank.

I am aware that it has been proposed to form ice on the surface of a revolving drum partially submerged in water contained in a tank, and partially exposed to currents of air at a freezing temperature. With such an apparatus the process involved differs from mine in several important particulars, to wit: The freezing-surface on which the ice is formed is not exposed to the action of a refrigerant applied at the rear of said surface, but it is exposed to the action of the refrigerant in front of its feezing-surface. Under my process the ice is formed and gradually hardened as the operation progresses, and, when ice of proper thickness has been formed, that portion which was next the freezing-surface is more solid and firm even than that which is at the exterior of the layer. With the revolving drum referred to the ice next the drum cannot become harder as the operation continues, but, in fact, must either remain in its normal condition or become more or less softened as its distance from the refrigerating agent increases.

I am also aware that it has been proposed to manufacture ice by means of a drum, similarly arranged and partially submerged, which was filled with a refrigerating agent for the purpose of forming ice on the exterior surface, from which it was removed by scrapers as fast as formed in a more or less granulated condition, and subsequently compressed in molds.

In both cases the revolution of the drums in the water would appear to involve, in a measure, the principle of applying water to the freezing-surface in a flowing stream; but it differs from the method involved in my process in this: the revolution of the drums must, of necessity, in both instances, be maintained at a slow speed. In the first case this would be essential, in order to allow the air sufficient time to operate upon the water carried up on the surface of the drum, and in the latter case, to admit in each partial revolution of the drum of the formation of a sufficient quantity of ice to be removed by the scrapers. In neither case is there any such movement of the water over the freezing-surfaces as will produce the effect sought and attained by me. All objectionable matter contained in the water must, of necessity, by reason of the slow movement of the drums, be collected at or near the surface of the water in the tank, at the point where their peripheries and their coating of ice leave the water in their rotating upward movement, and the ice would therefore be constantly charged with objectionable matter, and thereby defeat one of the prime objects which I seek to obtain.

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

1. The improvement in the manufacture of ice which consists in forming the ice on freezing-surfaces, in the rear of which the refrigerant is applied, and through which it operates by congealing portions of water applied to and traversing said freezing-surfaces in flowing streams, substantially as described, whereby the surface of the ice is freed from objectionable matter, as specified.

2. The herein-described process of manufacturing ice around cores, through which the freezing agent flows, by showering or throwing the water upon them, so that constant currents or films of water shall flow over the surface of the ice during its formation, substantially as specified.

3. In an ice-making apparatus, whereby ice is formed by the congelation, on vertical freezing-surfaces, of water, which traverses the same in flowing streams, an isolated vertical congealer, mounted on a base which not only supports the congealer, but also affords a di-

rect support for the ice formed thereon, substantially as described, whereby the employment of a freezing-tank is obviated, and the ice, in any desired bulk or quantity, may be formed upon the congealer without liability of racking or straining the same, as set forth.

4. The combination, with a congealer composed of pipes for containing the refrigerant, of a water-feeding apparatus, substantially as described, whereby the water to be frozen is delivered on all sides of the congealer.

5. The combination, with a base-pipe and one or more vertical congealers, of a trap at the base of each congealer for containing condensed or liquefied portions of the refrigerant, substantially as described, whereby gaseous portions of the refrigerant will be passed through the liquid in the passage from one congealer to another, as specified.

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