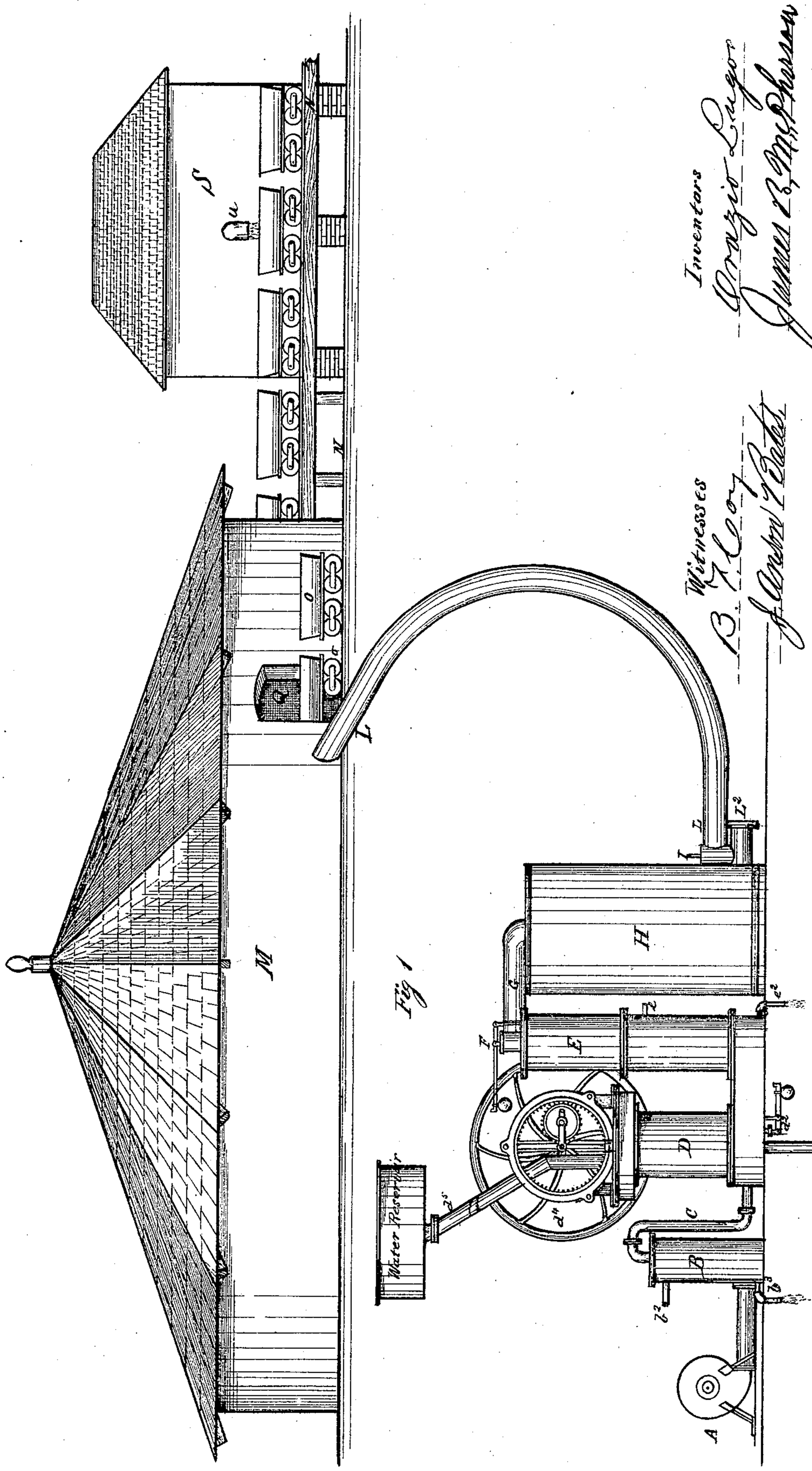
3 Sheets—Sheet 1.

O. LUGO & J. B. McPHERSON.

COOLING AIR IN THE MANUFACTURE OF ICE.

No. 112,726. Patented Mar. 14, 1871.

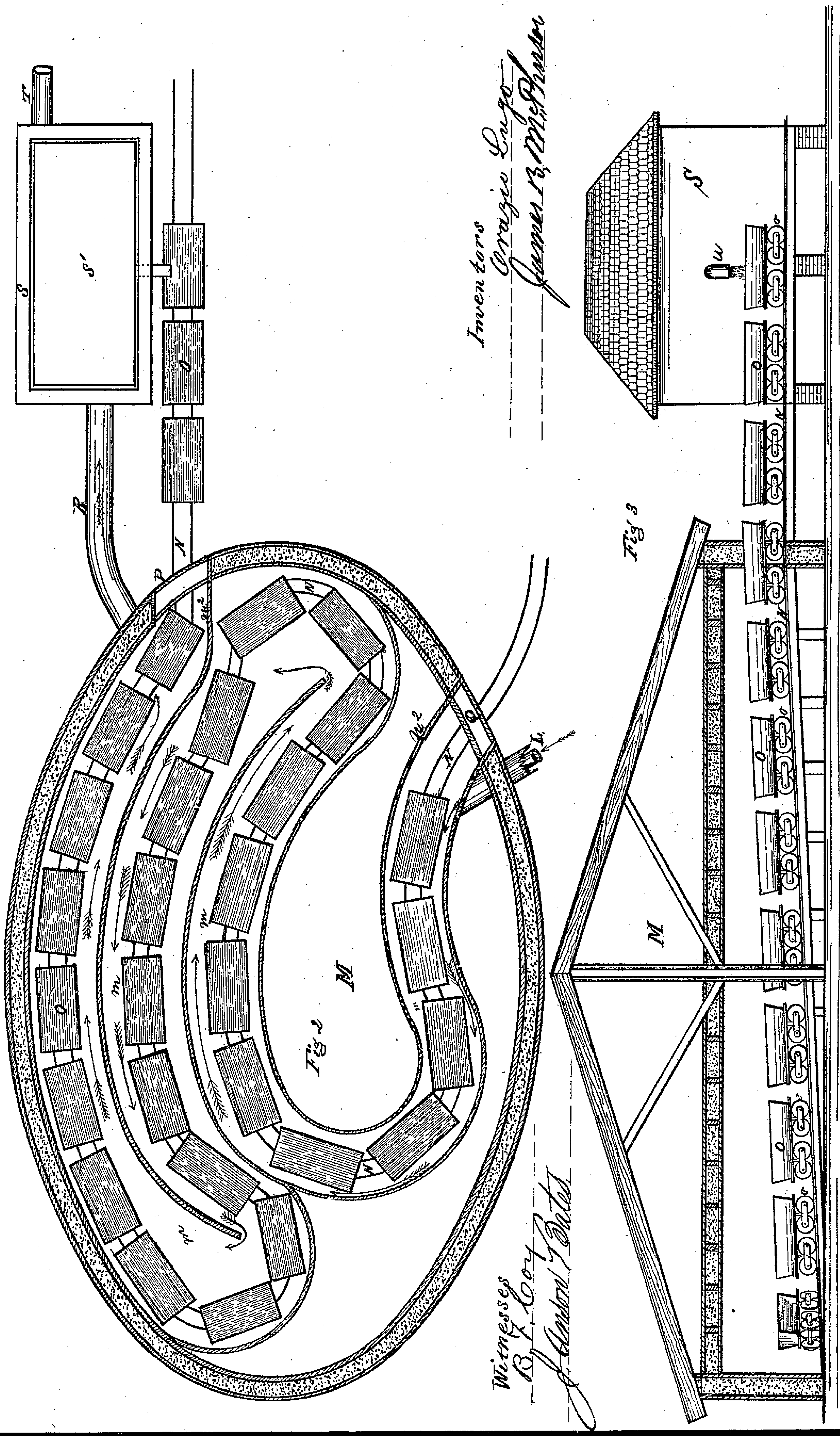


3 Sheets—Sheet 2.

O. LUGO & J. B. McPHERSON.

COOLING AIR IN THE MANUFACTURE OF ICE.

No. 112,726. Patented Mar. 14, 1871.



3 Sheets—Sheet 3.

O. LUGO & J. B. McPHERSON.

COOLING AIR IN THE MANUFACTURE OF ICE.

No. 112,726. Patented Mar. 14, 1871.

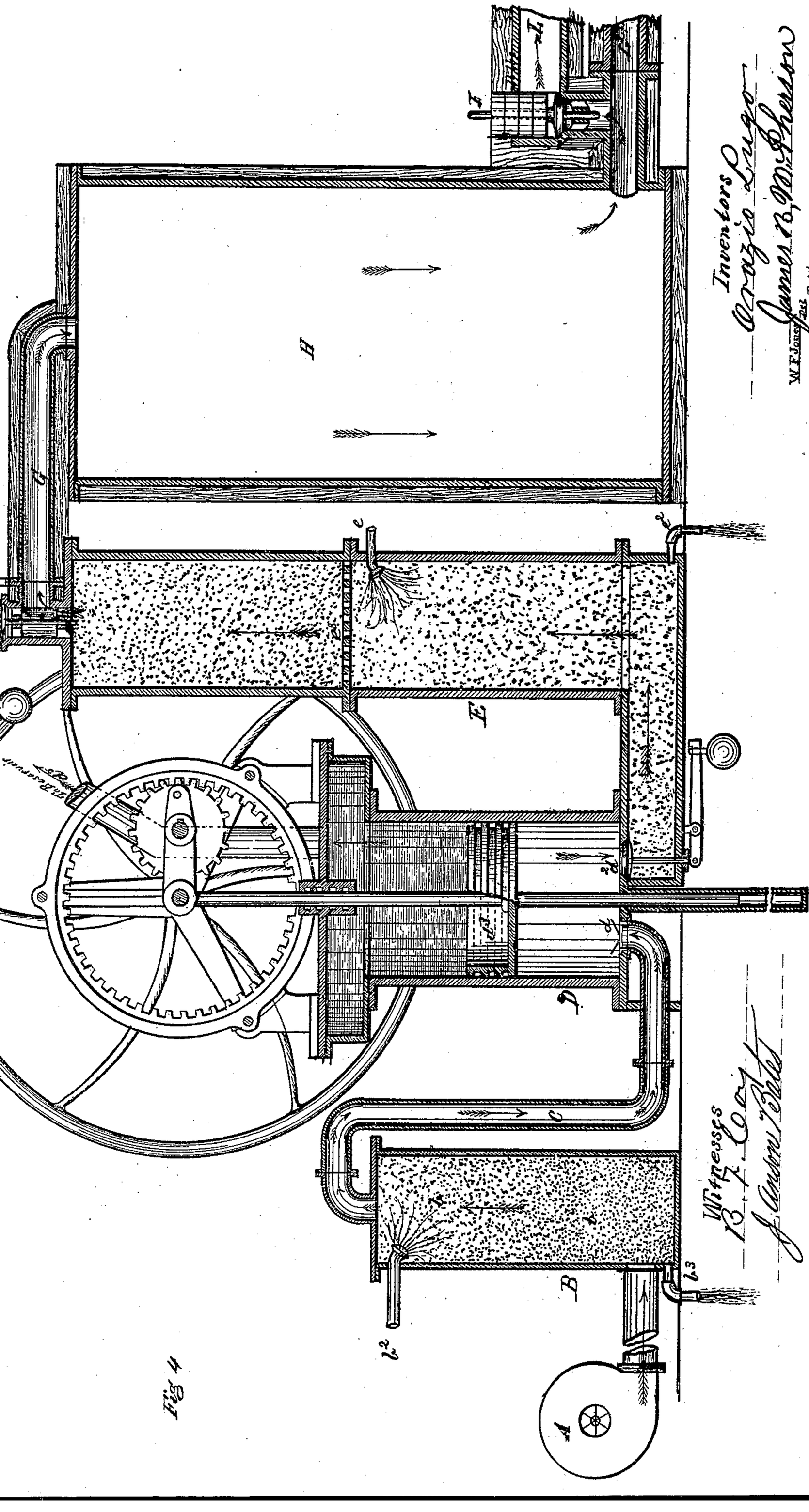


Fig 4

United States Patent Office.

ORAZIO LUGO AND JAMES B. McPHERSON, OF BALTIMORE, MARYLAND.

Letters Patent No. 112,726, dated March 14, 1871.

IMPROVEMENT IN COOLING AIR AND IN THE MANUFACTURE OF ICE.

The Schedule referred to in these Letters Patent and making part of the same.

Be it known that we, ORAZIO LUGO and JAMES B. MCPHERSON, of the city and county of Baltimore, in the State of Maryland, have invented certain useful Improvements in Machine and Process for Making Ice, and for general cooling purposes.

Our invention consists—

First, in a peculiar mode of constructing the pump for the compression of air;

Second, in the novelty of cooling and introducing the air into the pump;

Third, in the new manner of extracting the heat developed by the compression of the air while under pressure, and in contact with cold water made to trickle over porous materials;

Fourth, in letting the cooled compressed air expand in a comparatively-large chamber before using said air for the purpose of making ice or cooling; and

Fifth, in the novelty of construction of a chamber or ice-house in which water is congealed in large quantities, employing, however, purposely, a longer time than has hitherto been customary.

By these combinations, or a part of them, we are enabled to put into successful operation the manufacture of ice on a large scale, if it be desirable, with a comparatively small amount of manual labor, and the production of large blocks of clear ice at a very small cost, similar to that produced by nature in cold climates; we, therefore, do hereby declare that the following specification, in connection with the accompanying drawing, is a clear, true, and exact description thereof.

Three sheets of drawing are given, of which—

Sheet 1, Figure, 1, shows an external view of the machine, ice-house, and cooling-house.

Sheet 2, Figure 2, represents the ice and cooling-houses in cross horizontal section.

Sheet 2, Figure 3, represents the ice-house in cross vertical section, showing trucks carrying pans filled with water to be frozen.

Sheet 3, Figure 4, represents a cross vertical section of the ice-machine proper.

Similar letters of reference are used in the several figures.

In sheet 3, fig. 4—

A represents a pressure-blower or air-pump.

B is a cooler, consisting of a rectangular or circular vessel, filled with a porous material, *b*.

The pipe b^2 carries cold water over the porous material in B. The same water is discharged at the lower part of B at b^3.

C is a supply-pipe or conduit connecting the cooler B with the interior of the pump D

D is a single-acting free-working piston air-pump.

d is an induction-valve, of ordinary construction, through which atmospheric air is partially forced into the pump D by the blower or pump A.

d^2 is an eduction-valve, which can be weighed externally.

The piston d^3 works out of contact with the cylinder, and it has not a continuous cylindrical surface. It is cut by grooves of slight depth and about three-fourths of an inch apart.

The piston is driven by means of the epicycloidal combination of La Hire, operated by a crank and fly-wheel, d^4. It is guided by a rod extending entirely through the cylinder at the top as well as the bottom.

d^5 is a pipe, connecting the upper part of the pump D with a water-reservoir.

E is a cooler, consisting of a strong rectangular or cylindrical vessel, a part of which forms the bed-plate of the pump. The cooler E is also filled with porous material, as shown by the dots.

The pipe *e* carries cool water over the porous mass in the lower compartment of the cooler, and is discharged at the lower part at e^2. The cooler E is divided by a diaphragm, e^3; the upper compartment is also filled with a porous mass, as shown, which is kept dry, for the purpose of extracting any moisture that may be carried with the air from the lower compartment of the cooler E. A glass gauge may be affixed near to the discharge-pipe e^2, to ascertain the height of the water in the cooler.

F is a valve, provided with means of regulation, by which it may open at any given pressure.

G is a pipe, enveloped with non-conducting casing, connecting the cooler E with the chamber H.

H is a proportionally-large chamber or vessel, (as shown in proportion to the rest of the machine,) made of strong material and cased, in order to prevent as much as possible any radiation.

I is a valve, provided with means of adjustment.

L is a pipe, through which the cold air passes to the ice-chamber, or to any apartment to be cooled or refrigerated.

L^2 is an opening provided for the removal of any accumulation of snow in the chamber H.

In sheet 2, fig. 2, the pipe L is intended to connect the chamber H with the ice-house M.

M M is the ice-house, divided into galleries, *m m m*, by partitions or walls, m^2 m^2.

N N is a railroad-track running through the whole length of the galleries *m m m*.

O O are pans, holding the water to be frozen, and carried by trucks, *o o*.

P is the inlet-door for the railway to the galleries.

Q is the outlet-door of the railway from the galleries.

R is an air-pipe or conduit connecting M with S.

S is a house in which there are tanks, *s'*, containing water intended to be cooled by the air coming from the ice-house M.

T is an outlet-pipe for the air.

U is a pipe connecting with the water-tanks in the house S.

Similar letters of reference indicate the several parts of the machine in fig. 1, sheet 1.

In order to enable those skilled in the art to apply our invention, we will proceed to describe the operation of the machine.

We will suppose that means are provided for the introduction and discharge of water in the coolers B and E through the pipes b^2 b^3 and e e^2, as seen in fig. 4, sheet 3; and, also, that the necessary power to drive the machine is at hand; that the upper part of the pump D is filled with water up through the pipe d^5 to the water-reservoir, placed as high as practicable, (ninety feet high, if convenient.)

The eduction-valve d^2 of the pump D is weighed (by way of illustration) to five pounds to the square inch; the valve F is weighted at forty-five pounds to the square inch, and the valve I is adjusted to five pounds outward pressure; the pipe L being connected with the ice-house M; the pans O O and the tanks S' filled with water; the trucks *o o* carrying the pans O O, being in the galleries of the ice-house M, as shown in fig. 2, sheet 2; and, finally, the doors P and Q of the ice-house M are closed.

The operation is conducted as follows:

Water is turned on at b^2, fig. 4, sheet 3, and the discharge of the same is regulated at b^3. The pump A is set in motion, by which air is forced into the cooler B through the wet porous mass. The air in B is cooled by the water introduced at b^2, and also saturated with moisture.

The pump D is also set in motion by turning the center-shaft at d^1, which communicates motion to the free-working piston d^3. During the upward stroke of the piston d^3 air is partially forced into the cylinder, by the pump A, through the induction-valve d, so that, by the time the piston reaches its highest point, the pump will be filled with air already partially compressed and saturated with moisture.

While the lower part of the pump D is being filled with air, as described, the piston d^3 lifts water contained in the upper part of the pump up through the large pipe d^5 to the water-reservoir above.

The pipe d^5 is made sufficiently large, so that the water in the cylinder may freely pass upward and downward.

On the first downward stroke of the piston the air underneath it is compressed until the resistance of the valve d^2 is overcome, when said valve d^2 will open and the air be ejected into the cooler E.

After a few strokes of the piston the resistance offered by the valve d^2 will amount to about fifty-five pounds to the square inch; therefore the air will be compressed in D to a volume corresponding to that pressure.

The power used in lifting the water in the upper part of the pump to the water-reservoir is again returned on the downward stroke of the piston, when said power is most needed, to compress the volume of air underneath the piston.

The water in the pump D serves also for other very useful purposes: as for keeping cool the pump, and for partially forming, as it were, a packing for the piston

The space between the cylinder of the piston and the walls of the cylinder of the pump is very small, so that the film of air and water between will practically be confined there, and form, as it were, a frictionless packing.

The air is made to enter the pump D saturated with moisture, for the purpose of imparting to the watery vapors the heat developed by the compression of the air.

Any condensation of the water in the pump D, or leakage during the upward stroke of the piston, will be discharged with the compressed air through the valve d^2.

From the valve d^2 the compressed air passes into the cooler E, where it is cooled by the water introduced at e over the porous mass. Then, moving into the upper compartment of the cooler E, the compressed air passes again through porous materials, and there gives up any moisture that it may have carried from the lower section of the cooler.

On reaching the weighed valve F the compressed air raises said valve and passes through the pipe G into the large chamber H.

In the chamber H the air expands and in a minute or two becomes very cold. The cold and partially expanded air finally raises the weighed valve I and passes through the pipe L.

The pipe L may now be connected with any chamber or room in which substances such as meats, lard, oils, fruit, or water are placed to be cooled or frozen.

In fig. 2, sheet 2, the pipe L is intended to connect with the chamber H, in order to carry the cold air to the ice-house M.

The cold air travels in the galleries *m m* in the direction of the arrows, then passes through the pipe or conduit R into the house S, and finally escapes through the pipe T.

Ice will be formed first in the pans O O, nearest to the door Q of the ice-house M.

When any of the pans containing ice are taken out of the ice-house at the door Q, an equal number of pans (on trucks, as seen) is pushed into the ice-house at the door P.

When the cold air enters the ice-house at L it absorbs the heat of the water in the pans O O, and as the air moves in the galleries toward the outlet-pipe R it slowly reduces the temperature of the water in the pans O O, so that by the time a truck has traveled from the door P through the whole length of the galleries to the door Q, the water in the pans will be converted into clear and hard ice.

The cold air is brought in direct contact with the water to be frozen in the ice-house M, as described and claimed in Letters Patent No. 111,280, dated January 24, 1871, (allowed July 8, 1870,) and granted to David K. Tuttle and Orazio Lugo for improvements in ice-machines.

When it is desirable to manufacture ice on a large scale, several machines (as shown in fig. 4, sheet 3) can be connected with the ice-house M; or the number of pumps D can be increased and the same connected with coolers similar to B and E.

The ice-house M can be modified by running the trucks *o o* into straight galleries. The pump D can also be modified by inverting it, *i. e.*, by connecting with the lower end of the pump D the water-pipe d^5 and the water-reservoir, and placing the induction and eduction-valves d and d^2 on the top of the pump, &c.

The water in the pump D can be replaced by mercury or any other suitable liquid, either with or without a head-pressure, (as shown at d^5;) or the water or other liquids in the pump D can be dispensed with entirely, and one or more double or single-acting free-working piston air-pumps could replace the pump D; and finally, any ordinary air-pump may have one of its compartments filled with water, mercury, or any other suitable liquid, with a head-pressure, if desirable.

Having described our invention,

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

1. The free-working piston-pump, substantially such

as herein described, in combination with suitable devices for cooling the air compressed by the pump, and subsequently expanding the same so as to cool or refrigerate air for making ice, cooling, and refrigerating, as set forth.

2. The process of cooling and saturating with watery vapors or moisture the air before compressing the same, as and for the purpose herein described.

3. The process herein described of cooling compressed air by passing said air through coolers filled with a porous material saturated with cold water.

4. The method of cooling air by letting it expand in comparatively large chambers before using it for making ice or cooling purposes, substantially for the purpose herein set forth.

5. The railway N N and trucks *o o*, carrying pans O O, and the ice-house M, substantially as herein described and shown, when used in combination with currents of cold air for the purpose of making ice.

6. The pressure-blower A, in combination with the cooler B and the pump D, substantially as and for the purpose set forth.

7. The cooler E, in combination with the pump D and the chamber H, substantially as shown and described.

8. The chamber H and pipe L, in combination with the galleries *m m* of the ice-house M, substantially for the purpose set forth.

9. The pipe or conduit R, in combination with the ice-house M and the interior of the cooling-house S, for the purpose set forth.

10. A house for forming ice, having non-conducting walls, and tracks for trucks or cars suitable for introducing water and removing ice when formed.

ORAZIO LUGO.
JAMES B. McPHERSON.

Witnesses:
B. F. COY,
J. ANSON BATES.