# T. S. C. Lowe.

## Ice Machine.

No. 63,405. Patented Apr. 2, 1867.

Fig. 1.

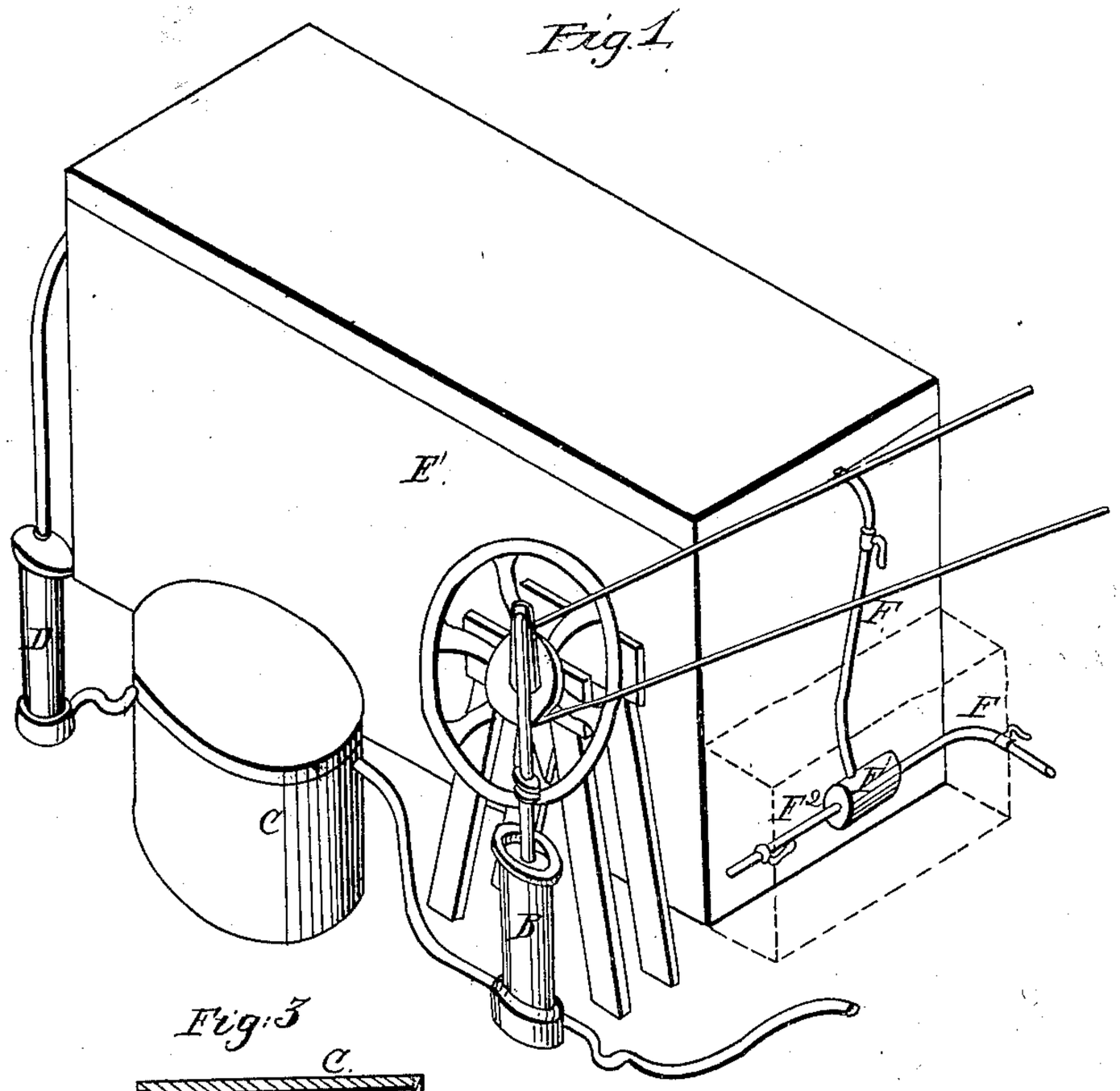



Fig: 3

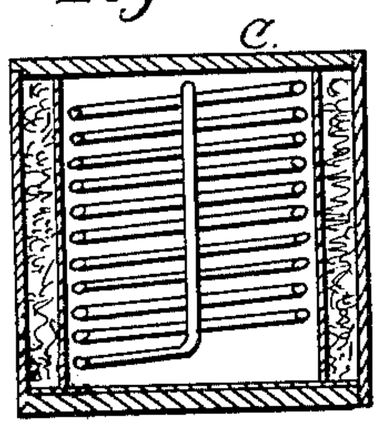
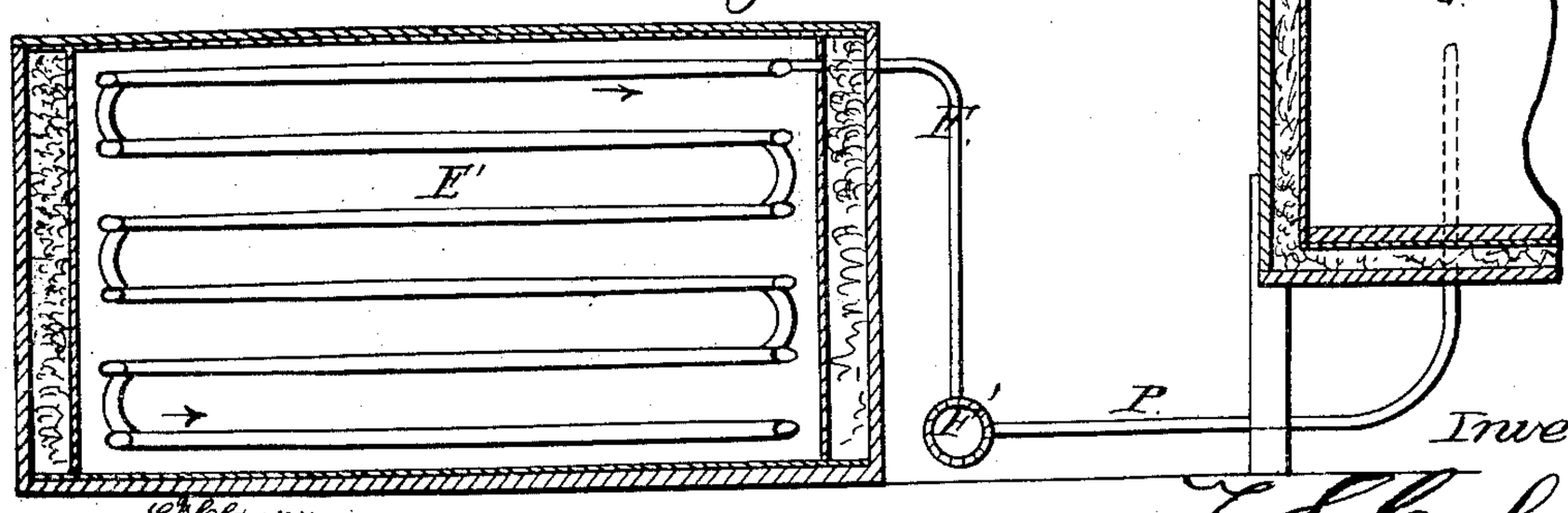



Fig: 2.




Witnesses:
C. F. Clausen.
L. A. Murphy

Inventor:
T. S. C. Lowe.
D. P. Holloway, Jr. Atty

# United States Patent Office.

THADDEUS S. C. LOWE, OF NEW YORK, N. Y.

*Letters Patent No.* 63,405, *dated April* 2, 1867.

## IMPROVED APPARATUS FOR CONDENSING CARBONIC ACID, AND FOR DRAWING OFF AND APPLYING THE SAME FOR COOLING AND FREEZING.

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

TO ALL WHOM IT MAY CONCERN:

Be it known that I, THADDEUS S. C. LOWE, of the city, county, and State of New York, have invented a new and useful Process and Apparatus for Condensing Carbonic Acid Gas into a Liquid, and retaining the same under pressure, and for drawing the same off in the liquid form for expansion in a freezing apparatus; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the annexed drawings, making part of this specification, in which—

Figure 1 is a perspective view.

Figure 2 is a vertical longitudinal section of the condenser, a transverse section of the gauge, and shows the end of the expansion-chamber; and

Figure 3 is a vertical section of the cooler.

The same letters are employed in all the figures in the indication of identical parts.

In an application for Letters Patent filed in the United States Patent Office on the fifteenth day of December, 1866, I set forth in full my new and improved process for manufacturing ice, in which the frigorific effects of the expansion of carbonic acid gas which has first been reduced by mechanical pressure to a fluid state are utilized by means of a complete apparatus therein described. This application is intended to apply to so much of said process and apparatus only as is employed in the condensation and preservation under pressure of the carbonic acid, and the withdrawal of the fluid from the receiver in proper quantities for filling the expansion-chamber.

I will proceed to describe the same, so that a person skilled in the art may manufacture and operate the same.

Two modes are known for the condensation of carbonic acid gas—one by positive pressure applied mechanically, the other by the process of Thelovier, (1835,) in which the generation of the gas in a close vessel is made to furnish the force by which it is condensed. As it is essential to the economical operation of the process that the carbonic acid should be used over and over again, the process of condensation introduced by Thelovier is not applicable. I therefore make use of a pneumatic pump, B, which must be so constructed and driven as to be capable of producing a pressure of about forty atmospheres. This pump must have an induction pipe with a valve opening inwardly, and an eduction pipe opening outwardly. For its more economical working, I propose to so construct the piston-rod that the piston may be carried to and against the bottom of the cylinder; but this will be more fully set forth in another application to be made on the pump. I have experimented with many gases, but find that they are destructive to the pump. Carbonic acid seems to act as a lubricator, so that the cylinder is not injured in its use. I use a single-action pump, the cylinder being open above. On this should pour a stream of cold water. The pump should be placed in a tub, to be kept filled with water. As a considerable amount of heat is evolved in the compression of the gas, in order to its economical condensation the gas must be cooled. To this end I pass the eduction pipe, formed in a coil, through the tank C, through which passes a constant stream of cold water with which the tank is filled. This water takes up the caloric from the gas. It is also important that there should be no water in the gas, as this, by freezing, would close the pipes. I therefore place a water-trap in the pipe after it leaves the cooler, so that the water can be drawn from the pipe. When the gas has once become perfectly dry, as it is repeatedly used in the circuit, it cannot acquire moisture. D is a cylindrical vessel used as a dryer, through which the gas passes, the water or moisture being taken up by chloride of sodium or other suitable absorbent, with which the dryer is filled. The pipe then leads into the condensing coil E′, placed within the case E. As this coil is subjected constantly to a pressure of nearly forty atmospheres, or six hundred pounds to the square inch, and may be required to sustain a greater pressure, it should be tested to bear a pressure much greater than that, say three times as much. This pipe may be provided with a safety-valve, and should have a pressure-gauge for indicating the actual pressure. The gas will liquefy at the point where it is the most reduced in temperature. It is therefore necessary that the coil should be kept colder than that in the cooler; to this end the condensing coil is placed in a case, E, (which should be made double and properly protected against external heat,) and kept constantly covered by ice. In this coil the carbonic acid is gradually condensed into a liquid, having about one six hundred and fiftieth part of the bulk of the gas under the ordinary pressure of the atmosphere. From the condenser-coil the

liquid is to be drawn into the expansion-chamber, or, for other use. It must be carefully measured into this chamber, for if allowed to escape by merely opening the communication, if too much entered the chamber it would be liable to be destroyed by the pressure of the expanding gas, which is very great, and if not carefully regulated would prove very dangerous. The pressure of the condensed and liquefied carbonic acid increases very rapidly with the increase of the temperature. It would therefore be impossible to induce the liquid to flow from the coil in the gauge $F^1$ if the latter were warm. To induce the flow of gas into the gauge, I enclose it in a box, and pack it in a mixture of ice and salt. The pipe leading into the gauge, as also that leading from it, is closed by a stop-cock. If the liquid were permitted to flow into the gauge by simply opening the stop-cock in the induction pipe thereof, it would, on entering, be expanded and freeze itself, thus filling the gauge with frozen crystals resembling snow, and preventing further action. To avoid this difficulty, a pipe leads from the upper part of the condensing-coil E′ into the gauge, which, being first opened, will fill the gauge with gas at the pressure requisite for condensation. Then opening the stop-cock in the induction pipe $F^2$, and closing the one in the eduction pipe, the liquid will flow from the condensing-coil into and will fill the gauge, which is colder than the coil. Then, by closing the cock in the induction pipe, and opening the eduction pipe leading into the expansion-chamber, the fluid being relieved from pressure will resume the form of a gas, which, filling the chamber, will there produce its frigorific effect. In the same manner, when the liquid is to be drawn off for other uses, it may be done in the same manner by substituting a proper receiver for the gauge. This receiver being placed in the cold receptacle, and reduced below the temperature of the coil, will be filled by the fluid in the same manner, when it may be closed and detached by ordinary devices. I make either a bifurcated pipe, F, or two pipes, leading from the condensing-coil into the freezing-chamber. These pipes are connected, one with the top, the other with the bottom of the coil; the upper one will admit gas to the chamber, the lower one will admit the fluid. By this means very different degrees of temperature may be produced in the freezing-chamber, as the gas only expands to about forty times its own bulk, while the fluid expands nearly six hundred and fifty times.

Having fully explained so much of the process and apparatus as relates to the condensation of the gas, its retention as a fluid under pressure, and the manner by which the fluid may be drawn from the receiver, what I claim as new therein, and as of my invention, and desire to secure by Letters Patent, is—

1. So arranging and operating an apparatus for condensing and retaining under pressure, in the form of a liquid, substances which in their normal state are gases, that the heat generated in condensation shall be taken up by the water in a cooler, C, and the liquid be condensed in a condenser, E′, which is maintained at a temperature below that of the cooler.

2. In such an apparatus the combination of a condensing-pump B, cooler C, dryer D, and the condenser E′, substantially as set forth.

3. The mode, substantially as set forth, of inducing the flow of the liquefied product of condensation from the condenser E′ into a gauge, $F^1$, or other receiver.

4. The mode, substantially as set forth, of regulating the temperature of the expansion-chamber by pipes F, leading thereto, connected respectively with the upper and lower parts of the condenser E′.

5. The combination of the condenser E′, pipe F, gauge $F^1$, and expansion-chamber G, substantially as and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

T. S. C. LOWE.

Witnesses:

R. MASON,

C. F. CLAUSEN.