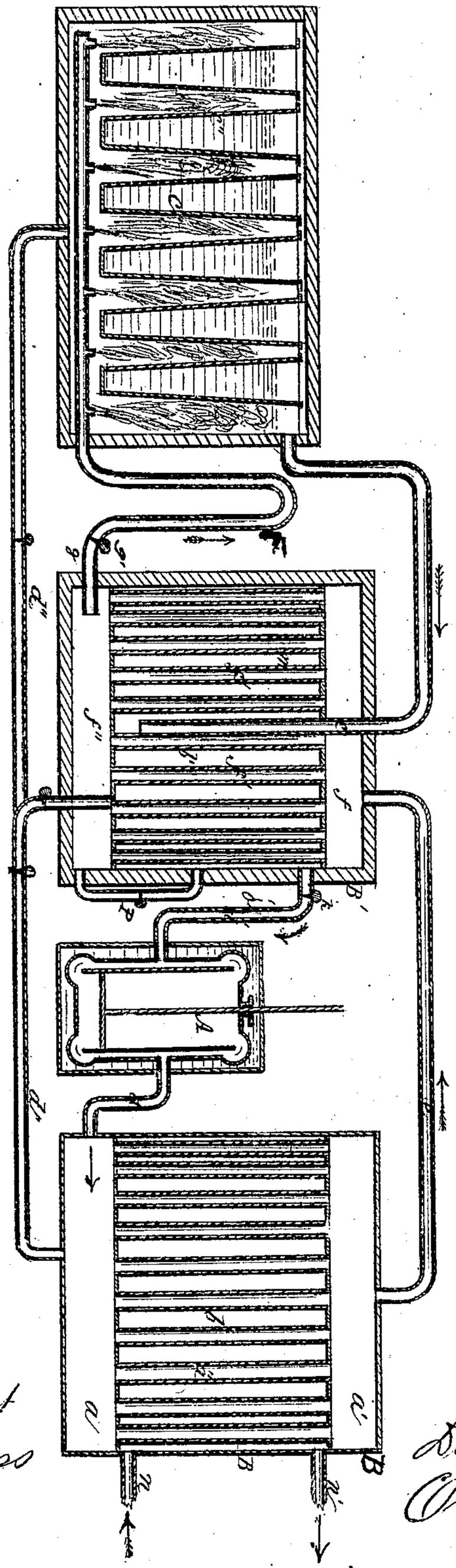
No. 101,682. PATENTED APR. 5, 1870

D. K. TUTTLE & O. LUGO.

ICE MACHINE.



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DAVID K. TUTTLE AND ORAZIO LUGO, OF BALTIMORE, MARYLAND.

IMPROVEMENT IN ICE-MACHINES.

Specification forming part of Letters Patent No. **101,682**, dated April 5, 1870.

To all whom it may concern:

Be it known that we, DAVID K. TUTTLE and ORAZIO LUGO, of the city and county of Baltimore, State of Maryland, have invented certain new and useful Improvements in Ice-Machines, of which the following is a specification:

This invention relates to an ice-producing machine, in which the refrigerating effects of an expanding cooled current of compressed air, and of the vaporization of a volatile liquid, are so combined as to intensify the action of each.

It is well known that ice may be produced either by the vaporization of a volatile liquid or by the rarefaction of compressed gases, when the operation is conducted in apparatus suitable for the purpose. But the results of our invention prove that when currents of cooled compressed air are caused to rarefy in immediate contact with a non-congealing liquid more volatile than water, such as alcohols, ethers, bisulphide of carbon, light hydrocarbons, ammonia, &c., we obtain not only the combined refrigerating effects due to the expansion of the compressed air, and to the amount of the vaporization from the volatile liquid proper to its temperature and pressure, but it will be found that the vaporization is greatly accelerated, and the refrigerative action correspondingly intensified, by the currents of air passing in contact with the volatile liquid.

Another feature of this invention is the further cooling of the compressed air after it leaves the water-cooler, and before rarefaction, by causing it to pass through pipes or chambers which are surrounded by or in contact with a volatile liquid, through which the return current of cold rarefied atmosphere from the refrigerator is caused to pass.

In order that the manner in which these results are accomplished may be the more readily understood, reference is made to the accompanying drawings.

Figure 1 is a vertical longitudinal section through the apparatus.

A is a double-acting air-pump. B is a cooler, consisting of a rectangular or circular vessel, strongly constructed and divided into compartments *a*, *a'*, and *b*. *a* and *a'* are connected by the tubes *a''* for the passage of the compressed air. The space *b* is kept filled with cold water. B' is a cooler of similar general construction to B. A portion of the central tubes is omitted to allow the introduction of the tube *c*. This tube passes through the external shell of the cooler, and through the upper crown-sheet, into the cavity *b'*, where it terminates in an open end. C is the refrigerator, which is a rectangular vessel suitably protected from the absorption of external heat. In C are placed the vessels *c'' c''* containing the water or other liquid to be cooled or frozen.

The pipe *d* communicates with the egress valve-chamber of the pump, and conveys the compressed air into the cavity *a* of B. *e* is a pipe connecting *a'* with *f*. *g* is a pipe passing into the refrigerator C, and having a number of small outlets for the escape of the now rarefied air. *c* is a tube communicating, from the upper portion of C, with the cavity *b* of the cooler B'. The pipe *d'* opens from the top of the cavity *b'* and passes to the induction-valve chamber of the pump.

The operation of the machine is as follows: The cavity *b* of B is filled with cold water, which is allowed to pass freely in at *n* and escape at *n'*. The cavity *b'* of B' is nearly filled with a liquid more volatile than water, such as alcohol, whisky, ether, bisulphide of carbon, light hydrocarbon, or mixtures of the same, or other equivalent volatile liquid. The vessel C is also nearly filled with the same or similar volatile fluid, into which the vessels *c'' c''* are placed and filled with water. The pump being set in motion the air is compressed in *a*, and passes into *a'* through *a''*, where it is partially cooled. From *a'* it passes through *e* to *f*, thence down through the tubes *f' f'* to *f''*, thence to the valve *g'*, from which point it expands. It is caused to bubble through the volatile liquid in *c*, and pass off through *c*, and come in contact with the liquid in B'. Here it abstracts heat from that liquid, and passes through *d'* back to the pump.

The expansion of the cooled compressed current of air, and the evaporation caused by its passage through the liquid in C, rapidly absorbs the heat of that fluid, and soon brings its temperature below the freezing-point of water. The suspended vessels with the water contained therein transmit their heat to the surrounding medium, and ice is formed. The

air leaving the chamber C, being still very cold, may be either passed through a duplicate chamber to reduce the temperature of water preparatory to its being frozen, or the cold atmosphere, may be passed directly into the cooler B′, and thence to the pump. This atmosphere being saturated with the vapors of the volatile liquid taken up in its passage through C and B′, condensation of such vapors will result from the recompression of the air. The condensed liquid is thrown back into B′ and C by means of the pipe *d″*, when desired to return it to C, and through P when desired to return to B′. This latter pipe also serves to discharge a small proportion of the compressed air directly into *b′*, and thus still further depress the temperature of liquid therein contained.

The ice is removed by opening the chamber C, and by the methods ordinarily employed in similar machines.

Having described our invention, what we claim, and desire to secure by Letters Patent of the United States, is—

1. The process herein described of producing ice, by the expansion of cooled compressed air in direct contact with a volatile liquid or liquids placed in the chamber C, as described.

2. The process described for cooling air while under pressure, the same consisting in surrounding the vessels or pipes containing the condensed air with a non-congealing volatile liquid, which is cooled as well as vaporized by the returning current of air from the refrigerator C, either alone or with the aid of a portion of the condensed air previously cooled, as described.

3. The combination of the expanding air, after compression and cooling, with the volatile liquid, as described, and the vessels *c″* containing water or other liquid to be frozen or cooled.

4. The combination of the vessels B and C, as described.

5. The combination of the vessels B′ and C, as described.

6. The combination of the vessels B, B′, and C′, with their equivalents, as described.

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Witnesses:
H. R. HELPER,
JNO D. PATTEN.