A. H. TAIT.

Ice-Machine.

No. 163,279. Patented May 11, 1875.

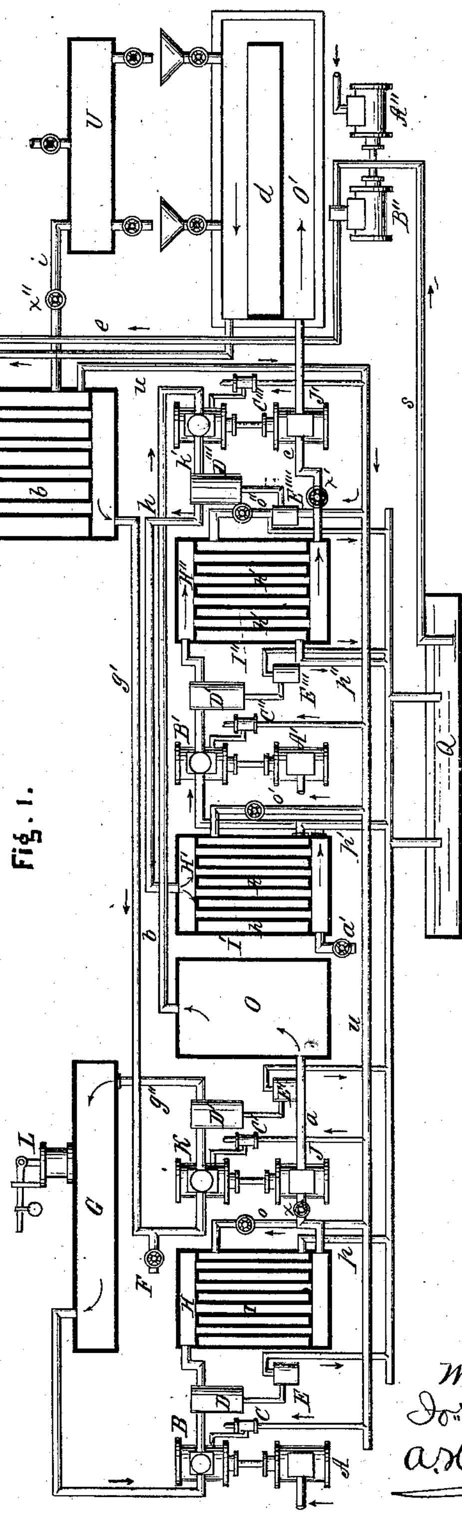

Fig. 1.

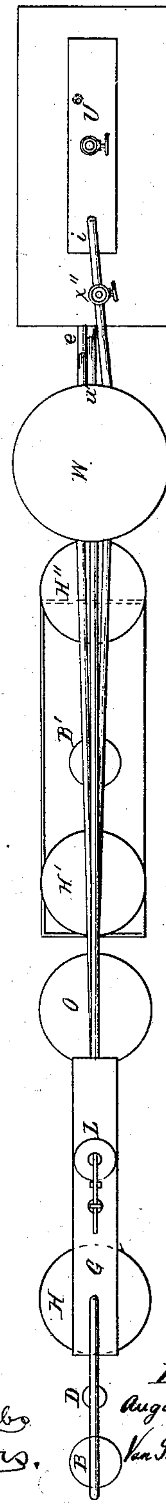

Fig. 2.

Witnesses.
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UNITED STATES PATENT OFFICE.

AUGUSTUS H. TAIT, OF JERSEY CITY, NEW JERSEY.

IMPROVEMENT IN ICE-MACHINES.

Specification forming part of Letters Patent No. 163,279, dated May 11, 1875; application filed October 21, 1874.

To all whom it may concern:

Be it known that I, AUGUSTUS H. TAIT, of Jersey City, in the county of Hudson and State of New Jersey, have invented a certain new and Improved Apparatus for Manufacturing Ice and for Refrigeration, of which the following is a specification:

This invention is illustrated in the accompanying drawing, in which—

Figure 1 represents a longitudinal section. Fig. 2 is a plan or top view.

Similar letters indicate corresponding parts.

This invention relates to that class of ice-machines which freeze water by the expansion of compressed air, and which utilizes the expansive force of the compressed air in the compression of the air. Therefore, to such end my invention consists in the combination of a cool-air reservoir, an air-pump, a condensed-air reservoir, an expanding air-cylinder, and a pump worked by means of the expansion of the air in the expanding air-cylinder, in such a manner that the major portion of the caloric engendered by the compression of the air is converted into power during its expansion, such expanded cold air being subjected to further and repeated compression and expansion, each repetition having the effect of still further reducing the temperature until the air is rendered cold enough for any required purpose.

In the drawing, the letter A designates a steam-cylinder that serves to drive the air force-pump B. With this air force-pump is combined a water-jet pump, C, for the purpose of cooling the air in said force-pump. By means of said jet-pump jets of water may be injected into the air-cylinder; but, if dry air is required, the cylinder of the air force-pump may be surrounded by a jacket, and the cold water injected into or upon said jacket. The jet-water is received in a trap-vessel, D, and a trap-box, E, serves to let out the jet-water. The air force-pump B takes the air from a reservoir, G, which contains air under a pressure of, say, twenty-five pounds to the square inch, such pressure being maintained by an air-pump, K. The pump B forces the air into the space of an upper receiver, H, and the air passes from this upper space through a series of pipes, I, into the lower space of the receiver, where it escapes into the expansive power-cylinder J. The pipes I are surrounded by cold water. The piston, which works in the cylinder J, serves to drive the air force-pump K, which forces the air into the reservoir G, as previously stated. With this air force-pump is combined a water-jet pump, C′, to force water into said pump, or in a jacket surrounding the same, and the jet-water passes off through trap-boxes D′ and E′. The air pewer-cylinder J extends through a pipe, *a*, into a receiver, O, which at first contains air under normal or atmospheric pressure. From this receiver extends a pipe, *b*, to an air force-pump, K′, which is combined with a jet-pump, C″, and jet-water traps D″ E″, and which is operated by an expansion air-cylinder, J′. This cylinder connects, by a pipe, C, controlled by a cock or valve, *x*′, with an air-receiver, H″, containing air under a pressure of, say, eighty pounds to the square inch. The air which exhausts from the expansion-cylinder J′ passes into the lower part of a receiver, O′, which contains a water-pan, *d*, in which the water is frozen, the cold air being made to circulate first beneath, and then above, said pan. This pan is supplied with water from a suitable chamber, V, that receives water through a pipe, *i*, controlled by a valve or cock, *x*″, from the water-space *f* of a cold-air receiver, W, said water-space being charged through a pipe, *e*, by means of a steam-pump, B″, which takes water through a pipe, S, from the water-receiver Q. The air which discharges from the vessel V passes into the receiver W, where it passes through pipes extending through the water-space *f*, so that the water in said space is cooled down to about 35° Fahrenheit. The air from the receiver W passes through a pipe, *g*′, to the air force-pump K, by which it is compressed into air-vessel G, as previously stated. The air force-pump K′ forces the air through pipe *h* into the receiver H′, where it passes through pipes extending through the water-covered pipes I′, so that the compressed air is cooled down. From the receiver H′ the air passes to the pump B′, which pump forces the air into the receiver H″, where it is again compressed to a pressure of eighty pounds to the square inch. The compressed air in the receiver H″ passes through pipes which extend through cold-water-covered pipes I″, so that said compressed air is cooled down. The receivers H H′ H″ are supplied with cold water through pipes *o o′ o″*, which communicate, by means of a pipe, *u*, with the cold-water chamber of the receiver W, which receives air from the ice-box, and in which the water is cooled down to about 35° Fahrenheit, as previously stated.

In starting my apparatus, I pump water, by means of the steam-pump B″, into the water-space of the receiver W, thereby producing a supply of water for the water-spaces of the receivers H H′ H″, and also for the jets and jackets of the air force-pumps. The air force-pump B is then started by admitting steam to the cylinder A, and air is pumped into the receiver H up to a pressure of eighty pounds, more or less, to the square inch. During this operation the pump B is cooled either by the jet C, or by means of a cold-water jacket, or by both, the air being supplied in the beginning through a vacuum-valve, L, or the air-vessel G. As soon as the pressure of the air in the receiver H has reached the desired point, the communication to the expansion-cylinder J is opened, and by the air-driven pump K air is forced into the receiver G, said pump being supplied with air at the beginning through the air-cock F. Steam is now let on to cylinder A′, and the pump B′ draws air from H′, the cock *a′* being temporarily opened to start the supply, forces the air into the receiver H″ to a pressure of eighty pounds, more or less. The expansion-cylinder J′ is now started by opening the cock or valve *x′*, and the pump K′ forces air into the receiver H′ to a pressure of twenty-five or thirty pounds, the cock *a′* being now closed. The expanded air which exhausts from the air-cylinder J passes into the receiver O, whence it is taken by the pump K′, while the expanded air which exhausts from the air-cylinder J′ passes into the ice-chamber V.

My experiments show that when atmospheric air of 85° Fahrenheit is compressed to eighty pounds to the square inch, and the heat of compression is abstracted by the use of water at 70° Fahrenheit, so as to reduce the temperature of the compressed air to 75°, said atmospheric air, upon its expansion through a power-cylinder, to which is attached a force-pump with a resistance of thirty pounds to the square inch, the atmospheric air entering the expansion-cylinder at 75°, will, on its expansion, after performing the work in the pump, have become lowered in temperature to zero of Fahrenheit, showing that the difference between 75° and zero has practically been converted into power in driving the force-pump, and that each time such air is compressed, and then allowed to expand in an expansion-cylinder, 75° of caloric are converted into power, and that power is utilized in compressing air.

In the apparatus which I have above described the compressed air is first expanded into the receiver O, its temperature being reduced to zero, and this air is again compressed and a second time expanded, so that the temperature of the air which exhausts from the second expansion-cylinder J′ is reduced to a temperature of about 60° below zero of Fahrenheit. This air passes into the ice-chamber V, and the water in the pan *d* is rapidly converted into ice. After leaving the ice-chamber the cold air passes through the pipes in the receiver W, to cool the water contained therein, and it is then taken up by the air-pump K and forced into the receiver G, whence it is taken by the pump B and then again forced through the apparatus as before.

It will be readily seen from the above description that, for the purpose of mere refrigeration, the cold air from the receiver O serves to aid directly, but for the purpose of producing clear ice it is requisite that the temperature of the air shall be reduced to a very low degree, and for this reason a second compression and expansion is employed.

I claim—

1. The combination of a cooled-air reservoir, G, air-pump B, condensed-air receiver H, expanding-air cylinder J, pump K, worked by expansion of air in J, pipes *g′ g″*, and expanded-air chamber O, whereby cooled air is subjected to pressure, is condensed, reduced to lower temperature, and expanded, as and for the purpose specified.

2. The combination of condensed-air receiver H′, having inlet *a′*, pump B′, condensed-air receiver H″, air-expansion cylinder J′, pump K′, driven by J′, and expanded-air chambers O and O′, whereby the cooled air in O, which had been cooled by condensation and expansion, is further condensed and expanded, substantially as and for the purpose set forth.

In testimony that I claim the foregoing I have hereunto set my hand and seal this 12th day of October, 1874.

A. H. TAIT. [L. S.]

Witnesses:
W. HAUFF,
E. F. KASTENHUBER.