4 Sheets

Sheet 1.

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Ice Machine. PATENTED JAN 24 1871

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Fig. 1.

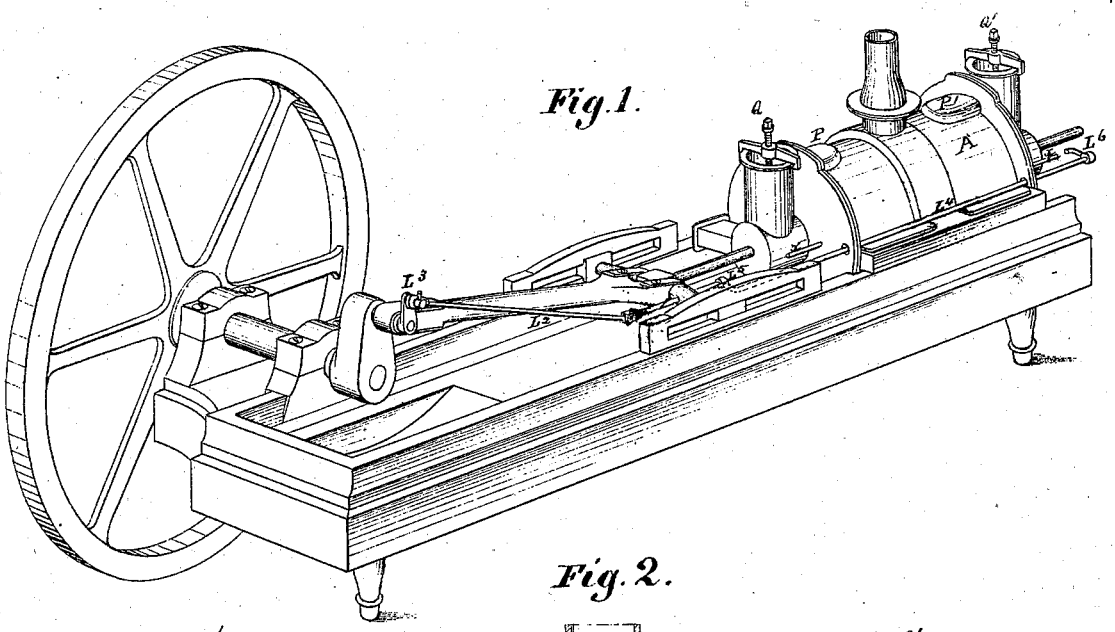
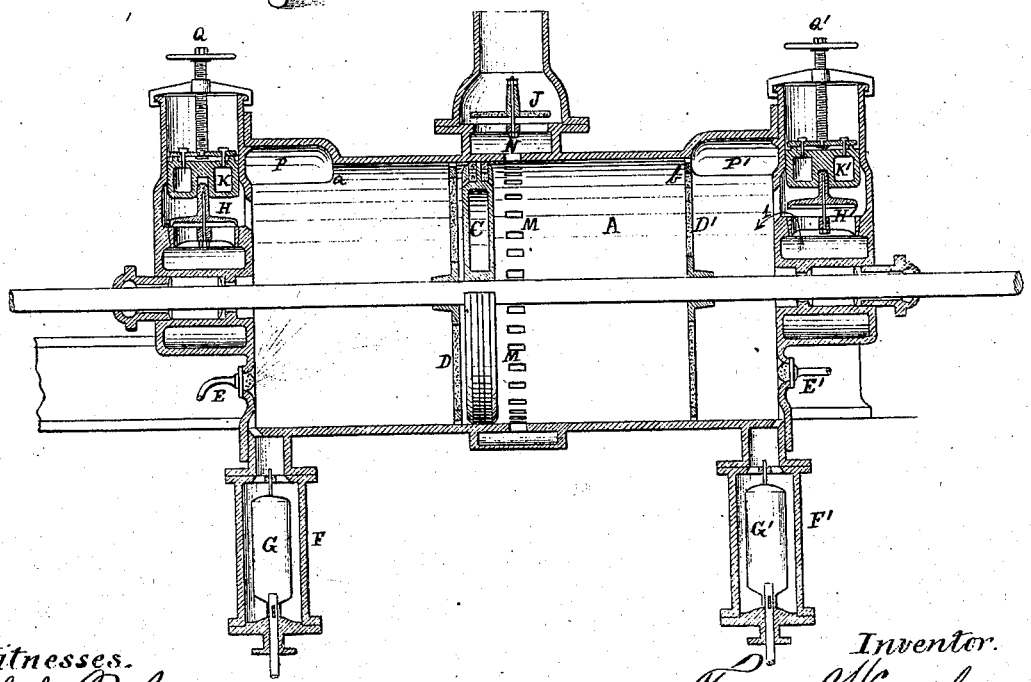


Fig. 2.



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Ice Machine.

Fig. 3.

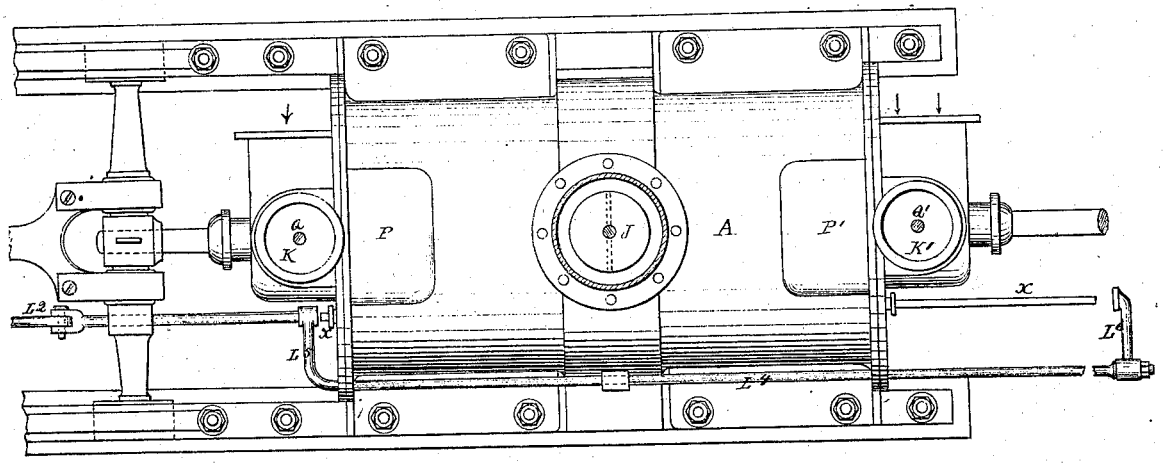

Fig. 4

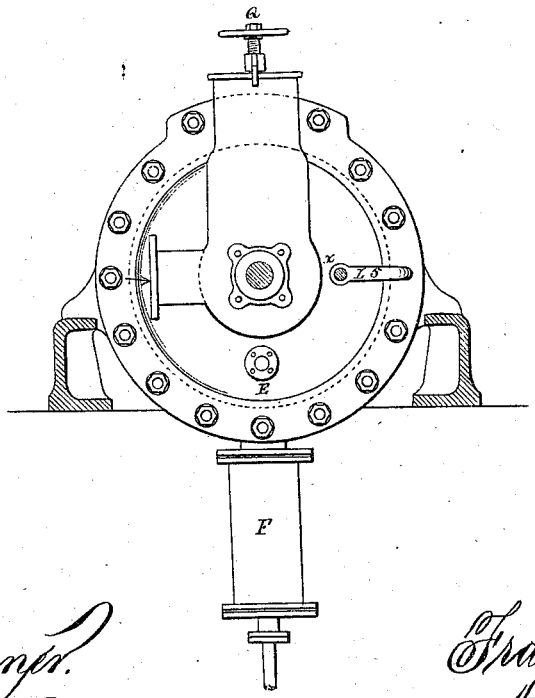

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Fig. 5.

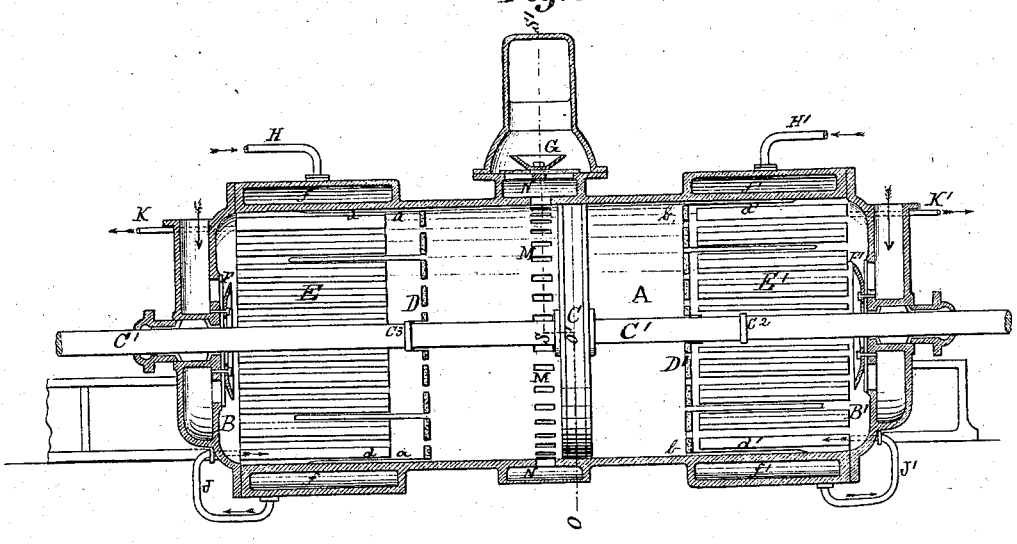

Fig. 6.

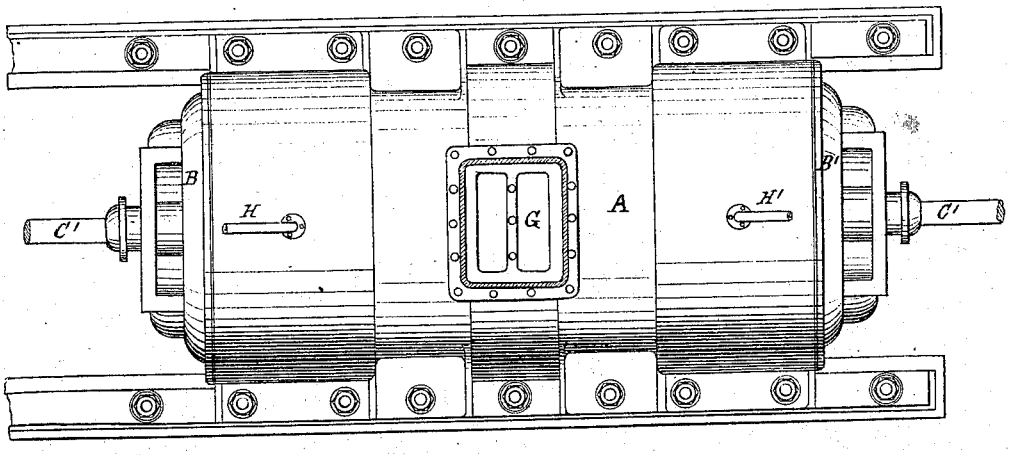

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Fig. 7.

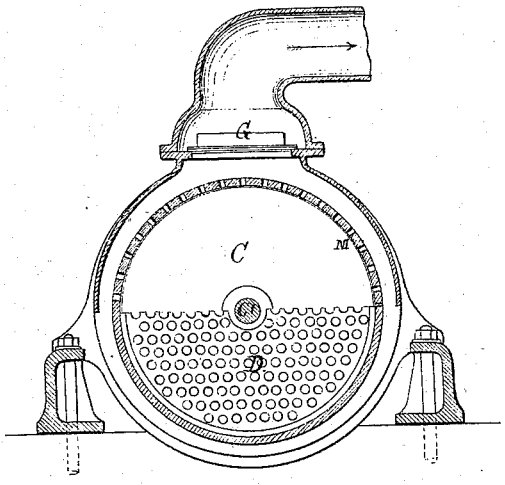
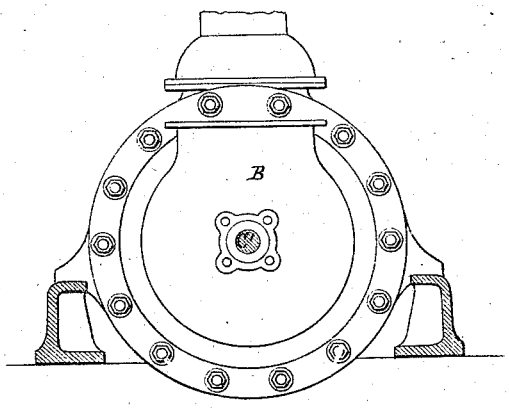


Fig. 8.



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UNITED STATES PATENT OFFICE.

FRANZ WINDHAUSEN, OF BRUNSWICK, GERMANY, ASSIGNOR TO LOUIS SCHNEIDER, C. T. BUDDECKE, AND JOHN A. BLAFFER, OF NEW ORLEANS, LOUISIANA.

IMPROVEMENT IN ICE-MACHINES.

Specification forming part of Letters Patent No. **111,293**, dated January 24, 1871.

To all whom it may concern:

Be it known that I, FRANZ WINDHAUSEN, of the city of Brunswick, Germany, have invented certain new and useful Improvements in Machines for Making Ice, and for General Refrigerating Purposes; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the drawings furnished and forming a part of this specification.

The machine is represented on the accompanying drawings, Sheets Nos. 1 and 2, viz.:

Figure 1, Sheet 1, represents my improved machine in perspective; Fig. 2, Sheet 1, in vertical longitudinal section; Fig. 3, Sheet 2, view from above; Fig. 4, Sheet 2, front view of the machine.

In all the figures the same letters designate like parts.

The machine is composed essentially of the cylinder A, the front and back covers B and B′, connected with the above; the pistons C, D, and D′ inclosed in the cylinder; the pipes E and E′, for the introduction of water; the reservoirs F and F′ below the cylinder, together with the self-acting valves G and G′ therein; the air-sucking valves H and H′; the valve J for emitting air; the two pistons K and K′, arranged so as to be moved by means of screws; the mechanism L, for moving the pistons D and D′.

All the above-mentioned parts are, as will be seen, connected together and fastened on the bed-plate. The connection is such that by turning the crank the piston C in the cylinder A describes a reciprocating movement from *a* to *b*. In the middle, between *a* and *b*, the cylinder is provided with openings M, through which the expanded air can escape in the annular channel N, and thence farther through the valve J. The pistons D and D′ are made as light as possible of thin tin. They are free on the piston-rod C′, movable, and so adapted to the circumference that they push in the reservoirs F and F′, the water injected in front of and behind the piston C through the pipes E and E′. Their movement is limited within both ends of the cylinder and extend to the openings M. It is accomplished on the one side by the piston C, which carries them from the middle toward the end of the cylinder, and on the other side by the counter-crank L^3, which, by means of the rods L^2, the bent rod L^4, and the parts L^5 and L^6, pushes the pistons D and D′ from the end of the cylinder to the middle of the same. These parts L^5 and L^6 come in contact with the ends of the rod X, which extends through the cylinder A, protruding beyond each head. The pistons D and D′, while they are supported by the main piston-rod, and are moved by the piston C from a point near the middle of the cylinder to the points indicated as *a* and *b*, are moved from these points still farther in the same direction by the rod X, by the counter-crank L^3 and its connections. So, also, the pistons D and D′ are moved by this rod from the ends of the cylinder toward the delivery-ports M. This movement of the pistons D and D′ is effected by means of collars fixed upon the rod X at proper intervals, which engage with the pistons at about the time the piston C ceases to advance toward their respective ends. Upon the return movement of the piston C the pistons D and D′ remain at rest until other corresponding collars on the rod X engage therewith and cause them to move toward the middle of the cylinder.

The following is the manner of performing the machine: The machine is set in motion by turning the crank, which moves the piston from *b* to *a*. Thereby air is sucked in through the valve H′ in the direction of arrow 1. On the retrograde motion of the piston from *a* to *b*, the quantity of air in front of the piston from *a* to the opening M escapes through the latter and the valve J. On the farther advance of the piston from the mentioned opening M to *b*, the air in front of the piston is compressed, and at the same time, during that operation, cooled by the water injected at E′. On the back stroke of the piston, the air previously compressed is expanded, and is thus cooled, according to the degree of expansion. After the air has been allowed to expand to a litttle below atmospheric tension, the valve H opens by outside atmospheric pressure, and atmospheric air is admitted in the cylinder until the piston C has reached *b*. On the retrograde motion of the piston, the air, which

has been cooled, is ejected through the valve J, and the fresh air admitted by the valve H is again compressed and expanded in the manner just described. In exactly like manner the above-described acts are performed in the rear of the piston. It is in order that the air sucked by the valves H and H′ should remain separated from the expanded air that the auxiliary pistons D and D′, above described, are placed in front and rear of the piston C, as already described. They perform, also, the following specific functions: First, to push the injected water out of the cylinder into the reservoirs F and F′; second, to guard the piston C from being heated by the compressed air and the injected cool water; third, to effect, by their particular motion, the expulsion of all the expanded air through the valve J. . The relative position of these pistons to the piston C, at the different stages of motion, is as follows: When the piston C moves from *b* to *a*, the piston D remains immediately opposite the opening M until it is reached by the piston C, and then it is carried along to *a*, and thence moved farther on toward the end of the cylinder by means of the continued movement of the counter-crank L^3 and its connecting rods. On the way from *a* to the end of the cylinder, the compressed air escapes, through the channel P, from the space in front of the piston D to the other side of the same. Both channels P and P′ are formed by the bulging out of the upper cylinder wall, as shown. If the piston C moves from *a* to *b*, the piston D maintains its position at the end of the cylinder till C has reached the middle of its line of motion; but now the piston D is pushed in front of the openings M, by means of the piece L^5 attached to the rod L^4, while the crank is performing one-fourth of a revolution. (See Fig. 3.) At the same time atmospheric air is admitted through the valve H, and, as during this movement the piston D describes a larger space than the piston C, a larger quantity of expanded air is accordingly ejected through the valve J. On the back stroke of the piston C, the piston D finds itself again in front of the openings M, and the expanded and highly-cooled air inclosed between these two pistons is expelled through the valve J. Just the same performances as before described take place in the cylinder on the other side of the piston. The cool water is introduced, viz., injected into the cylinder, by means of well-known pumps, through the perforated mouth-pieces E and E′, but only at the moment when the pistons D and D′ are carried out of the middle of the cylinder, by the piston C, toward the end of the same. The water is removed from the reservoirs F and F′ by the self-acting valves G and G′, which are, in fact, floats, and so light that, by a corresponding stage of the water and atmospheric pressure in the interior of the cylinder A, they open by hydrostatic power, which takes place every time when on the respective side in the cylinder the air is expanded to atmospheric pressure. On the other hand, the valves G and G′ remain closed when the air on the respective side is compressed. Finally, the pistons K and K′ are to be mentioned. They are fixed in corresponding cylinders above the valves H and H′, and are movable by means of the adjusting-screws Q and Q′. They serve to regulate the degree of compression of the air, for, by them, the space to which the quantity of air in front and in the rear of the piston C is to be compressed may be enlarged or diminished within certain limits.

As a modification of the machine already described, I include in my application for patent the mechanism exhibited on Sheets 3 and 4 of the drawings, in which independent letters of reference are used.

Fig. 5 represents a vertical section. Fig. 7 represents a cross-section, O O′ S S′. Fig. 6 represents a view from above. Fig. 8 represents a front view of the machine.

The machine is composed of the cylinder A; the piston and piston-rods C and C′; the cylinder-covers B and B′; the tubular apparatus E and E′ on both sides in the interior of the cylinder A; the cloak-pistons D and D′ (mantel kolben;) the aspiration-valves F and F′; the expiration-valve G.

The construction of the cylinder is as follows: In the middle of the cylinder the openings M are employed in the same manner as in the machine before described. At both ends of the cylinder is placed a tubular air-cooling apparatus, E and E′, in connection with the cylinder-covers, so fixed that the former leave open between themselves and the cylinder-wall a free annular concentric space, in which the likewise concentric annular cloaks *d* and *d′* of the pistons D and D′ are easily movable. Further, around the cylinder A are placed, at both ends and cast with it, concentric annular chambers *f* and *f′*, which, filled with water, serve also as cooling apparatus. The cooling water runs in the latter through the tubes H and H′, and afterward through the tubes J and J′ in the inner tubular cooling apparatus, and thence the water flows off again through the tubes K and K′. Between the tubular cooling apparatus is comprised the space in which the piston C is moving, and midway are the openings M, already described above. The piston C is of ordinary construction. The piston-rod traverses both cylinder-covers, and is put in connection with any known mechanical power, so that the to-and-fro motion of the piston, from *a* to *b* and vice versa, is thereby effected. The pistons D and D′ are on both sides of the piston-rods C, and are easily movable on the piston-rods C^1. They are moved along on the one side by the piston C to the limit ascribed to the piston, and on the other side by the knobs C^2 and C^3 on the rod C^1 from the end of the cylinder to the opening at M.

It will be observed that the pistons D and D′ are provided with numerous perforations, through which air, in process of compression, cooling, and expansion, freely passes.

The operation of the machine is as follows: If the piston C be moved from *a* to *b* the piston D′ will remain stationary at *a* until the knob C^2 moves against the latter. At this instant C is before the openings M. It passes the same and takes along the piston D, and compresses the air in the front half of the cylinder. The heat of the air generated by that process is taken up by the cooling apparatus E, while at the same time the direct contact of the heated air with the cylinder-wall and the piston C is prevented by the cloak-wall of the piston D. On the moving back of the piston C from *a* to *b* the previously-compressed air expands and passes through holes in the piston D immediately behind the piston C. When the latter arrives before the openings M the piston D′ is taken along and atmospheric air is sucked in at the same time through the valve F. On the back stroke of the piston C the air in front of it is expelled through the opening M, the channel N and the valve G, and when the piston moves farther on the atmospheric air sucked in is again compressed.

The operations above described are performed in a like manner on the other side of the piston.

I designate as novel in the above-described machine—

1. The eduction-ports M, located in the walls of the cylinder between the ends, and so arranged with relation to the induction-valves that air introduced into the cylinder at either end will be discharged after having been compressed, cooled, and expanded through said openings, as described.

2. In combination with the cylinder A and piston C, the pistons K and K′, with their chambers and connecting passages, the whole being so arranged that by the raising and lowering of the pistons the interior spaces on both sides of the piston C will be increased or lessened, as described.

3. The combination of the main piston C and auxiliary pistons D and D′, arranged within the cylinder, substantially as and for the purposes herein described.

4. In combination with the cylinder of an ice-machine provided with an intermittent water-injecting apparatus, the reservoirs F and float-valves G, the latter being so arranged that their natural buoyancy will open the valves, and the pressure within the cylinder will close them, substantially as described.

5. In combination with the cylinder of an ice-machine, the compression, cooling, expansion, and ejecting apparatus, so arranged that the several processes will be effected within the same cylinder at each and every complete stroke of the piston, substantially as described.

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Witnesses:

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