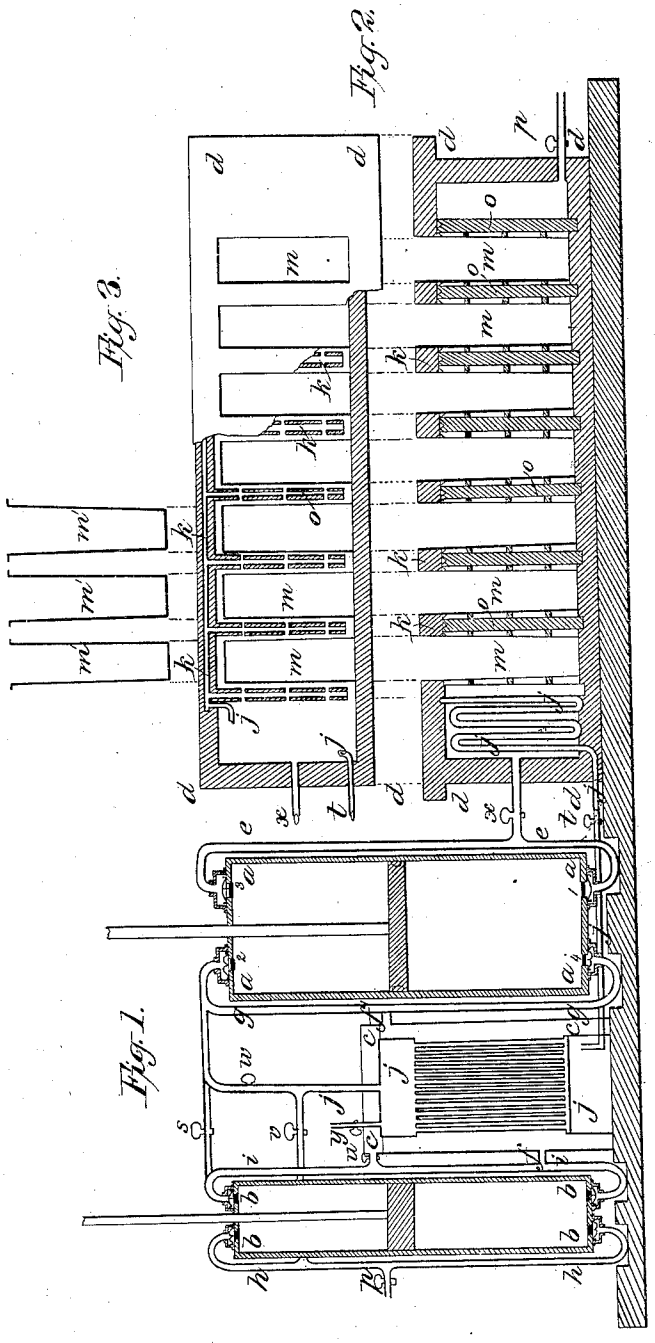
A. C. TWINING.

Manufacture of Ice.

No. 10,221. Patented Nov. 8, 1853.



UNITED STATES PATENT OFFICE.

ALEX. C. TWINING, OF MIDDLEBURY, VERMONT.

MANUFACTURING ICE.

Specification of Letters Patent No. 10,221, dated November 8, 1853.

To all whom it may concern:

Be it known that I, ALEXANDER C. TWINING, of Middlebury, Vermont, have invented an improved refrigerating process and apparatus for making ice and like purposes by evaporation and restoration of liquids, of which the following is a specification.

By reference to the accompanying drawing the nature of the invention and the plan and arrangement of the apparatus will be readily apprehended.

(*a a a a*) is the cylinder of a pump whose piston and piston-rod are seen in the figure, with valves so arranged that when worked by a steam engine or other power, exhaustion will take place on one side of the piston and condensation on the other. The lower valve (1) of the induction pipe (*e e*) rises with the piston, and any vapor or other fluid contents may be drawn into the cylinder through (*e e*). At the same time whatever is above the piston is compressed and forced along the eduction pipe (*g g*) through its upper valve (2), which opens to give exit. On the descent of the piston similar action through the same pipes take place in the opposite spaces of the cylinder and through the opposite valves (3, 4) of the pipes. It is plain how any vessel opening into and through (*e e*) would be exhausted and the vapor or other contents transferred into any other vessel opening into or through (*g g*).

The exhaust vessel in Figure 1 is (*d d d d*), and the reception vessel is the tubular or coiled receptacle (*j j j j*) surrounded by an exterior vessel (*c c c c*) and the water therein, the water being constantly supplied at one part, as (*f*), and running off at another, as (*f'*), or other cooling applications made to the external surfaces. To this form of receptacle there are, of course, an indefinite number of equivalents, as for example, by thin vessels or by plates in near proximity. Also the exhaust vessel (*d d d d*) may be a mere tube or any tight cavity whatever. In whatever form, I call it the cistern. This coiled or otherwise formed receptacle is made to enter the exhaust vessel, and, after exposure within it by coiling or otherwise to the current passing out into (*e e*), see (*k k k*, Figs. 1 and 2), lies along the vessel, in or near one of its upper angles, or may reach to any parts desired. This continuation of the receptacle has certain perforations or perforated branches or channels opening into the exhaust vessel. It is obvious that when the cock (*t*) is fully or partially open the vapor or other contents that had been drawn from (*a d d d*) will reënter it, after having been forced into and through (*j j j j*).

The secondary, or smaller pump (*b b b b*), in Fig. 1, is not always essential. It will, however, in some cases, be an important auxiliary. Being worked simultaneously with (*a a a a*), it will be seen that, if the cocks (*u*, *w*, *r*) are closed and (*v*, *s*) open, the exit from (*a a a a*) is made through (*i i*) into (*b b b b*), and the contents thus received are again discharged through (*h h*) into (*j j j j*), as before; but if the above condition of the cocks is reversed while the first pump acts, as first described, from (*d d d d*) into (*j j j j*), the second pump will exhaust the vessel (*c c c c*), if that be tight, through (*i i*), and discharge its contents into the atmosphere through (*h h*) and (*r*), or into any space into which (*r*) opens or its tube conducts. There are, also, uses of (*b b b b*) which will be explained hereafter.

Now, for the purpose of refrigeration, I employ the above combination—leaving (*l l l l*) out of consideration for the present, as described below. But, inasmuch as the conversion of water into ice is a main purpose of the invention, and inasmuch as a knowledge of the means of doing this implies the ability, with ordinary skill and ingenuity, to apply the process to the other useful purposes above mentioned, I shall herein take the freezing of water as a type of them all; and the apparatus, or combination, or means of doing this, will embrace the elements of the necessary modifications and applications. To freeze water one construction of the exhaust vessel (*d d d d*) may be as shown in Figs. 1 and 2, Fig. 1 being a section of the apparatus and Fig. 2 a plan of (*d d d d*). These show a box divided into compartments by partitions (*v*, *v*, &c) that extend from bottom to top, but unite with the bottom and one side only, leaving a space between themselves and the opposite side—Fig. 2—while the top is formed separate. Each of these equal compartments is intended to receive a water chamber (*m*, *m*, &c) set down into it reaching the bottom, or nearly so, and touching that side which the partitions do not touch, but not touching the side opposite nor the partitions. The top, when on, is tight with the chambers, or re-

ceives them tight into openings in itself, or is of a piece with them, and with the box also if desirable, and as nearly tight upon the partitions as practicable. It is obvious that by this arrangement the only open way through the vessel from end to end traverses back and forward between and around the partitions and water-chambers. Trace in its course a vapor or a liquid entering at the cock (*p*) and drawn out at (*e*). From (*p*) it strikes the first partition (*o*). It finds no opening at top or bottom, but on one side only, Fig. 2. Leaving this opening it is obstructed by the first water-chamber (*m*) which there fits against the side, as well as the top and bottom, Fig. 2. It must, therefore, turn the partition and flow in the narrow space between it and the chamber to the opposite side, which that chamber does not meet. Flowing through the opening there it encounters the second partition (*o*) and can find vent only at its opposite extremity, and this flow from side to side is repeated quite to the exit (*e*). It is obvious that if these chambers were made to touch opposite sides alternately the same result would arise without the partitions, or that the water-chambers might be centrally arranged and admit the current of vapor on every side and beneath, through an opening or openings in the partitions, or even through the chambers themselves if made sufficient in size for more than one water-vessel (not yet described) to each chamber. There are many equivalents, and among them a vertical arrangement may be used. It is obvious, also, that if the temperature of the vapor or liquid were low it must cool the water-chambers, and if the temperature were sufficiently low water in the chambers would be frozen. I may now connect with the pipe (*p*) a tight vessel of any kind, not necessary to be shown in the drawing, containing a volatile liquid, as alcohol, ether, sulfuret of carbon, &c., of which, at present, I find ether the most available, and by working the pump (*a a a a*) to exhaust (*d d d d*)—or the cistern, as I henceforth call it—and its connected vessel the liquid will expand into vapor, which will perform the cooling or freezing office before described. Or ether may be in the cistern itself, enveloping the water-chambers, in part at least, and acting by its own cold, as well as its vapor. But this vapor it is necessary to restore to its liquid form, else the process will be too expensive. Therefore the vessel (*j j j j*) is provided, into which the vapor will be compressed at an elevated temperature and by means of cold water flowing or pumped into (*c c c c*) or by other cooling means united with compression it will be condensed and restored to its liquid condition, from which function of this article I name it, henceforth, the restorer. If the restorer is prolonged into the cistern or into the ether vessel connected with it, and if the cock (*t*) is opened just to the degree to give a proper tension in the restorer, the restored liquid will be forced back to its first place within the cistern or ether vessel. If, in any part, the pump, valves, &c., are exposed to be overheated water cavities should be made in the contiguous metal and kept full. It will be understood that the cistern and all parts whatever of the apparatus or combinations exposed to injurious conduction or radiation of heat are to be protected by non-conductors and other means that may be expedient and known. If air collects in the restorer it may be discharged by the cock (*y*). In this form of process the element of evaporation of ether is taken as a type of all volatile liquids. The combination is that of an exhausting and condensing apparatus or pump with a protected cistern, as above, of any shape or size containing ether or opening to ether inclosed in the tight vessel, as above, and a restorer or vessel into which the vapor, after having been drawn by the exhaust through the cistern and pump, has been forced by the latter and restored to its liquid form by pressure and external cooling. However, to obtain the advantage, in full, of the cold ether, as well as of its vapor, employing latent heat, still more than specific heat, and to obtain important advantages also in manipulation, I have invented an arrangement as follows: First, the water-chambers are made of a piece with the cover, or inserted therein, or connected closely and firmly, so that, when the cover is in place or of a piece with the box, these chambers will have substantially the positions and relations to other parts already described. When latent heat, however, is almost exclusively the effective principle or agency the fit of the chambers to one side is not essential, neither are the partitions, except to sustain by frequent projecting knobs or pins the sides of the chambers against collapsing. Second, these chambers may be coated within the cistern, by cloth or some absorbent or diffusing substance in contact or in very close approximation with their surfaces. Third, I construct branching tubes or channels (*k*, *k*, &c., Figs. 1 and 2) girdling, on every exposed side, the top of each water-chamber and made with minute orifices to inject the ether in jets, or drops, or films upon or between its exposed surface and coating, to keep the latter saturated, in condition to favor evaporation. This congeries of tubes, channels, branches and orifices, of whatever shape, whether tubular, flat or otherwise, and to whatever parts applied, I name, from its office, the percolator. In some forms of process and some other processes it may be used advantageously to introduce water that is to be frozen into the freezing cistern or chamber. This last named specific function of the per-

colator, although valuable, I do not intend to claim here, but hereafter to apply for a patent embracing this part of my invention. Fourth, I provide separate water-vessels (m', m', Fig. 3) fitting, or nearly so, the water-chambers, and to contain the water and ice. Their material may be thin metal india rubber, gutta percha, oiled cloth or other fabrics. Alcohol mixed with water or some other liquid not congealable at the temperatures employed may be held between the water-vessels and chambers to complete contact and equalize refrigeration. Cocks may be provided to shut the percolator in parts, allowing only vapor to act on some of the chambers and for other objects.

I now explain the purposes and operations of the second pump ($b\ b\ b\ b$). First, in case of an extreme exhaustion, leaving but slight tension of vapor within the cistern, the compressing and restoring operation will be more complete by admitting through (s) and ($i\ i$), as before explained, the discharge of ($a\ a\ a\ a$) into ($b\ b\ b\ b$). Again, if the liquid in ($c\ c\ c\ c$) of the restorer is deficient in quantity or naturally not cold enough for the best action, it may be shut off from the atmosphere and cooled by exhaustion, its vapor being drawn through (u) and ($i\ i$), as before explained, and forced through ($h\ h$) and (r). Or this second pump may be small and become a mere suction and force pump to draw or throw the water of the restorer into the boiler or to any other part or point where useful. Yet another use may be ascribed to ($b\ b\ b\ b$). I have spoken already of the employment of some alcoholic or other mixture or liquid to be cooled in the water-chambers and around the movable water-vessels. As a modification or extension of the same idea, there may be an auxiliary cistern of a tubular, or coiled, or other convenient form which may hold or be open to ether and be surrounded by the alcoholic or other suitable mixture or liquid to be cooled by contact with the auxiliary cistern and by the exhaust of ($a\ a\ a\ a$) coöperating ether within the latter. The liquid thus cooled may flow or be drawn out of its containing vessel into or through ($d\ d\ d\ d$) and there perform the freezing office ascribed heretofore to the ether. In this mode of operation this second pump, being made small, may be used to draw the liquid out of its containing vessel into the main cistern ($d\ d\ d\ d$) and return or force it thence into the same containing vessel. This second pump should admit of being disconnected from the driving power or engine in a way to be used only when wanted for the foregoing or special purposes. If by an open passage the space in one side of the piston of ($a\ a\ a\ a$) is connected with ($d\ d\ d\ d$) and the space on the other side with ($j\ j\ j\ j$) or ($c\ c\ c\ c$), the main pump may sometimes perform the offices above ascribed to both in combination. The restorer water, after standing to cool, can be employed anew.

I am aware that it has been proposed to cool and freeze liquids by immersing therein vessels containing volatile liquids to be exhausted by a pump and returned, after condensation; but my arrangements differ essentially from this in many important particulars, especially, 1st, the liquid cooled by exhaustion, or its vapor, is made to flow in a current, or thin sheet, along the surfaces of the water-chambers, thereby quickening the absorption of heat and reducing the necessary quantity of volatile liquid; 2nd, by the use of an exhaust vessel separate from the freezing vessel from which the liquid cooled by exhaustion, or its vapor, may be made to pass into the freezing vessel or cistern, and there perform its refrigerating office, the cold liquid or vapor will be applied to surfaces and in vessels much greater than the same of the evaporating or exhaust vessel, thereby facilitating the exclusion of air from the vacuum and the amount and rate of freezing or refrigeration. The same is true of the arrangement in which an alcoholic or other liquid uncongealable at the temperatures employed is cooled by contact with the separate vessel or its component parts, and then made to pass into the freezing cistern and there perform its refrigerating function. 3rd, by introducing the ether into the freezing cistern (when that is used as the exhaust vessel) through the percolator and its orifices, in minute jets or drops, I present a great surface for coöperation by the exhaust of the pump, and also apply the liquid very economically and directly to the surfaces of the water-chambers. Or, if a separate exhaust vessel is used, as above, the prolongation of the restorer into it may be made to effect the same division into jets and drops, by the percolator being situated there, or otherwise. 4th, by the recesses in the tight freezing cistern (or the water-chambers) into which separate vessels may be set, which contain water or any substance to be cooled, I dispense with a contact of these water-vessels with the freezing liquid and inclose the latter in a cistern kept tight, thus avoiding the loss of the ether by dripping and coöperation to which some other methods would be liable and at the same time allowing the most convenient and economical manipulation and the best shape and dimensions to the cakes or masses frozen. I also avoid the waste and labor of breaking the ice from the freezing vessel.

Among the following I have not claimed specifically the combination of the secondary pump with a freezing cistern containing water-chambers; but, because of the great

advantage of a regulated current for the cooled ether or other liquid which accomplishes the freezing or refrigeration, I reserve that claim for another patent for which I intend hereafter to apply.

The claims.

What I claim and desire to secure by patent is the following:

1. I do not claim the exhaustion of a vessel containing ether and immersed in water, around which the water freezes, and to which the ether is returned after condensation in the restorer; but I claim the combination of an exhausting pump or apparatus that is also condensing or compressing with a restorer and with a freezing cistern having water-chambers, substantially as above.

2. I claim the same pump and restorer in combination with a separate exhaust vessel (the same whose connection is indicated in the drawing, by *p*) in or around which the ether or other liquid uncongealable at the temperature employed is cooled and made to pass into the freezing cistern and there perform its office substantially as above.

3. I claim the percolator, or apparatus introducing into the cistern, or the separate exhaust vessel, the ether or volatile liquid, in jets or drops, as above, in combination with the exhaust pump and retorer.

4. I claim the use of the water-vessels in combination with the water-chambers and the intervening liquid for perfecting contact, as above set forth.

5. I claim, in combination with the restoring apparatus, the cooling of the liquid around the same by exhaustion, using therefor the secondary pump and connections substantially as set forth.

ALEX. C. TWINING.

Witnessed by us:
J. S. SAWYER,
I. HERTZELL.