J. KYLE.

Process and Apparatus for Making Ice.

No. 208,019. Patented Sept. 17, 1878.

Fig. 1

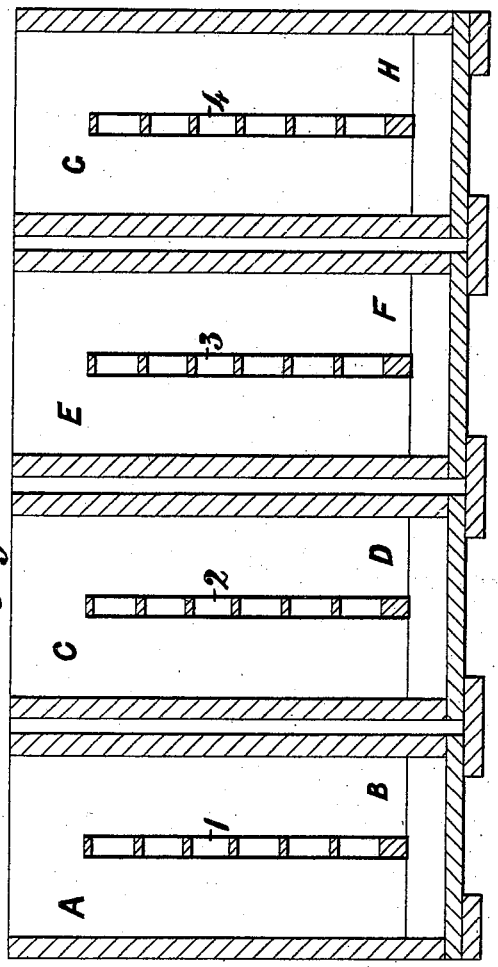



Fig. 2

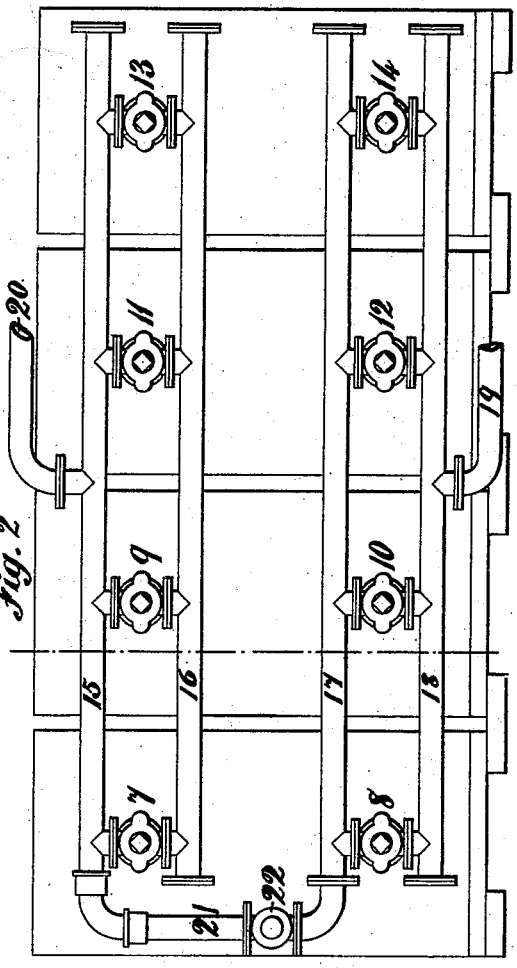
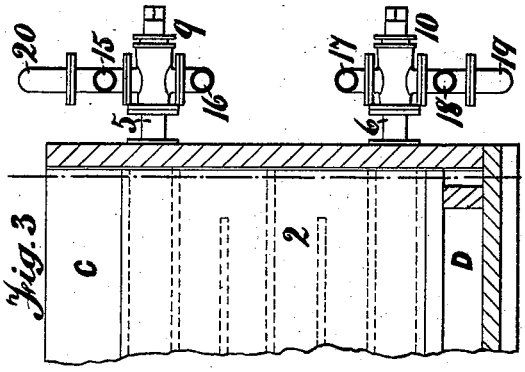



Fig. 3




Witnesses

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# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN PROCESSES AND APPARATUS FOR MAKING ICE.

Specification forming part of Letters Patent No. **208,019**, dated September 17, 1878; application filed May 20, 1878; patented in England, September 22, 1874.

*To all whom it may concern:*

Be it known that I, JOHN KYLE, of Glasgow, in the county of Lanark, North Britain, have invented a new and useful Improvement in and applicable to Ice-Making Apparatus or Appliances, for which English Patent No. 3,241, of 1874, was granted to me, and of which the following is a specification:

My said invention relates to the now well-known process of making ice artificially by means of brine or other suitable salt solution or liquid cooled in any of the various known ways to a temperature below that at which water freezes.

In the process referred to the brine or other heat-abstracting liquid passes from the apparatus by means of which its temperature is lowered to a suitable point to ice-boxes containing the water to be frozen, and having in such ice-boxes traversed hollow metallic partitions, or equivalent apparatus, upon the surface of which the ice is formed, and returns again to the cooling apparatus for the removal from it of the heat abstracted from the water.

In the modes hitherto in use for applying the heat-abstracting liquid, (which, for convenience, will be hereinafter referred to simply as the liquid,) an inconvenience has arisen from the gradually-diminishing rate of freezing action as the slabs of ice increase in thickness, in consequence of which the liquid returns to the cooling apparatus (the same rate of flow being maintained) in a gradually less heated state until a condition is reached such that its return temperature becomes too low for the proper economical working of the cooling apparatus.

In order to overcome this difficulty, I cause the liquid to pass through separate sections or parts of the ice-boxes in a special order, which is changed at intervals in a regular manner, and in such a way as that the liquid, on proceeding from the cooling apparatus, first acts in parts of the ice-boxes in which the slabs of ice have attained nearly their full thickness, next where the ice is not so thick, and so on until it finally acts on water altogether unfrozen. In this way the freshly-cooled liquid, not abstracting much heat where the ice slabs are already of considerable thickness, is still cool enough to abstract heat where the ice slabs are thinner, and if by the time it reaches the last part or section of the ice-boxes it has become too heated to actually freeze the water, it can at least cool the water to near the freezing-point.

It will be obvious that in conducting the process in this way there will be a maximum difference between the temperature of the liquid on its leaving and that on its returning to the cooling apparatus, and as this difference of temperature is prevented from varying much by the regular changes in the order of passage of the liquid through the several parts or sections of the ice-boxes, the cooling apparatus can be arranged to develop a constant maximum duty with convenience and economy.

My improvements are economically and otherwise advantageous in the production of slabs or blocks of ice of the thickness of three or four inches, as hitherto made in freezing-machines; but a most important advantage of the improvements consists in their admitting of the ice being made in blocks of eight inches thickness, or even thicker, quite as economically as the thinner slabs hitherto made, the advantage of having the blocks of an extra thickness being well understood by those practically conversant with the artificial production of ice.

My invention consists, first, in causing the refrigerant to pass alternately in reverse directions through the cell or cells of the ice box or boxes of the series; second, in making each cell of the series the first or receiving cell and reversing the current in each cell of the series alternately; and, lastly, in the construction and arrangement of apparatus by which I carry the same into effect.

In order that my said invention and the manner of performing the same may be properly understood, I hereunto append a sheet of explanatory drawings to be hereinafter referred to, and showing a set of ice-boxes as arranged and fitted for carrying out my improved system of working. In these drawings the same reference letters and numerals are used to mark the same or like parts wherever they are repeated.

Figure 1 is a transverse vertical section of a

set of four simple ice-boxes, A B, C D, E F, G H, each with a single hollow partition or cell, 1 2 3 4, in it. Each box or section may have in it two or more of the hollow partitions or cells for the passage of the liquid. Fig. 2 is an end elevation of the ice-boxes, and Fig. 3 is a vertical section as at right angles to Fig. 2.

The hollow partitions or cells 1 2 3 4 are, by preference, of one of the kinds described in the specification of Letters Patent granted to me and dated the 12th July, 1873, No. 2,410, and at one end of the boxes the top and bottom of each partition or cell are connected by short pipes 5 6 to three-way stop-cocks 7 8 9 10 11 12 13 14. Each stop-cock has a conical plug, the smaller end of which is bored to communicate with the pipe 5 or 6 leading to the partition or cell, and a single port is formed through the side of the plug to communicate, according to the position into which the plug is turned, with one or other of two diametrically-opposite branch pipes, while any plug may be set in a position to stop all passage through it. The several stop-cocks communicate by the branch pipes just referred to with transverse horizontal pipes 15 16 17 18 above and below them. The liquid coming from the cooling apparatus by a pipe, 19, can have access by the bottom horizontal pipe, 18, to the several lower stop-cocks, 8 10 12 14; and supposing the ice to be thickest in box or section A B, thinner in C D, and thinnest in E F, while G H is just filled up with fresh water, the liquid will be first entering the bottom of the partition or cell 1 in A B, the stop-cock 8 being suitably set for that purpose. The other stop-cocks will be set so that the liquid leaving the top of A B will proceed by the pipe 16 to the top of C D, and passing through the partition or cell 2 therein will proceed from the bottom thereof by the pipe 17 to the bottom of E F. The liquid, after passing through the partition or cell 3 in E F, will proceed by the pipe 15 to the return-pipe 20, leading it back to the cooling apparatus. In short, the liquid passes through the boxes in the order and in the upward and downward direction in each box, which may be simply indicated by the arrangement of the reference-letters—thus B A, C D, F E. As soon as the ice in box A B is thick enough, the several stop-cocks are turned in such a way that the liquid may pass in the course D C, E F, H G, and in a similar way the third course will be F E, G H, B A, and the fourth will be H G, A B, D C. The four courses will then be repeated in the order already given.

It will be noticed that at each change the upward or downward direction in each box is reversed, which will correct the tendency to form ice of different thicknesses in the upper and lower parts of each box.

The horizontal pipes 15 and 17 are connected by a branch, 21, having a stop-cock, 22, to admit of the boxes being worked singly or in pairs, if wished, at any time; but the stop-cock 22 is closed when working on the triple system hereinbefore described, and which I believe to be the best as regards quantity of ice produced for the power employed, although the advantage gained by it may be obtained in a less degree by working with two boxes in each course, and at each change causing the liquid to pass first through the box in which ice has been partly formed, and then through the box freshly filled up with water.

When working according to the triple system hereinbefore described, with three boxes or sections in each course, and with a fourth box, from which the ice is being removed and in which fresh water is being filled, the ice may be loosened from the partitions in the ordinary way by pumping comparatively warm water or liquid through the partitions, such water or liquid being separate from the liquid by means of which the freezing is effected. My improved arrangement, however, admits of a more convenient and economical mode of loosening the ice being adopted. Supposing the ice to be thick enough in box A B, then, before setting the stop-cocks for the second of the four courses hereinbefore described, they are set so that the course of the liquid may be D C, G H, B A. The heat of the freshly-supplied water in G H will raise the liquid some degrees above the freezing-point, so that on passing through the partition in A B it will have a thawing effect on the ice attached; then the stop-cocks are set for the second course, D C, E F, H G, as hereinbefore described.

To obtain a similar action when the ice is to be removed from the other boxes, C D, E F, G H, the stop-cocks are to be arranged for the following courses, respectively, namely: second, F E, A B, D C; third, H G, C D, F E; and, fourth, B A, E F, H G.

If considered desirable, additional branch pipes and stop-cocks may be fitted in connection with the ice-boxes, to admit of the liquid passing in succession through all four sections when being used for detaching finished ice, so that its temperature may be still higher on passing through the fourth box; or, even with pipes and stop-cocks fitted as herein described and delineated, the stop-cocks may be set so that, instead of missing a box or section, as hereinbefore described, the liquid may pass downward through two adjacent boxes or sections instead of one, the current being divided between the two.

I am aware that it has been heretofore proposed to shift the freezing-liquid to different parts of the vat, so that all the vessels of liquid to be frozen should be subjected in turn to the freezing-liquid when at its lowest temperature, or, as the process has been termed, subjecting the liquid to "progressive circuits of cold currents," and do not herein claim such subject-matter; but

What I claim is—

1. The method herein described for forming slabs of ice of uniform thickness, which consists in causing the refrigerant to pass through

a box or series of boxes, and alternately reversing the current in said box or each box of the series, substantially as specified.

2. The method herein described for forming slabs of ice of uniform thickness, which consists in making each cell of a series the first or receiving cell successively, and reversing the current in each cell of the series alternately, substantially as specified.

3. The combination, with a series of ice-boxes, of a series of cells, each cell connected at top and bottom to a series of pipes and provided with a three-way stop-cock, and the two series of pipes connected by a cross-branch provided with a stop-cock, whereby the refrigerant may be passed alternately from cell to cell and its direction alternately reversed in each cell, substantially as described.

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Witnesses:

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