(No Model.)

# E. DE STOPPANI.

## ICE RINK.

No. 515,979 Patented Mar. 6, 1894.

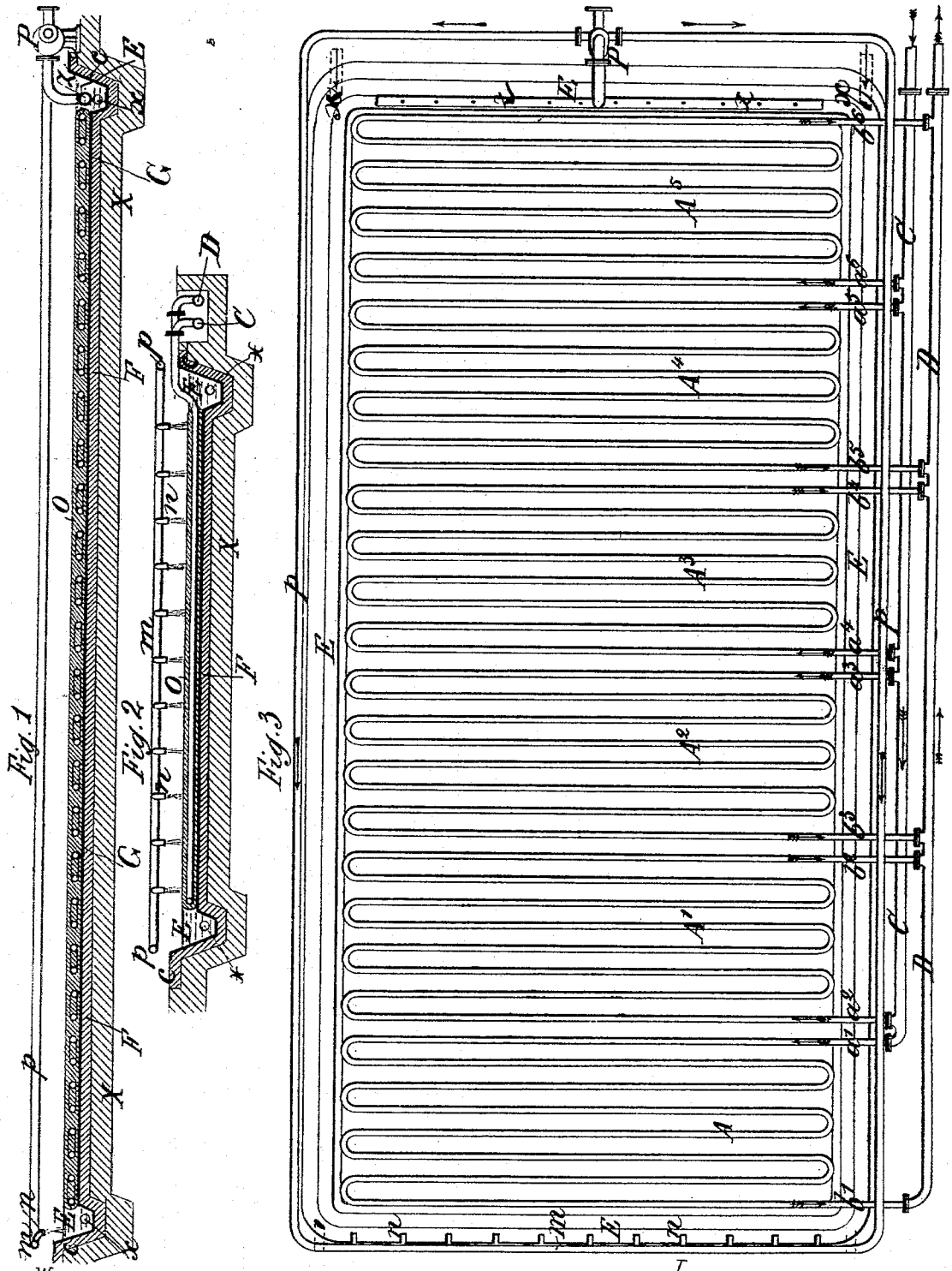

Fig. 1

Fig. 2

Fig. 3

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# UNITED STATES PATENT OFFICE.

EDOUARD DE STOPPANI, OF PARIS, FRANCE.

## ICE-RINK.

SPECIFICATION forming part of Letters Patent No. 515,979, dated March 6, 1894.

Application filed May 12, 1893. Serial No. 473,908. (No model.) Patented in France April 14, 1892, No. 220,933; in England July 1, 1892, No. 12,256, and in Belgium July 2, 1892, No. 100,357.

*To all whom it may concern:*

Be it known that I, EDOUARD DE STOPPANI, a citizen of the Republic of France, residing at Paris, France, have invented a certain new and useful Improved Ice-Rink, (for some parts of which I have been granted patents as follows: in France, No. 220,933, dated April 14, 1892; in Belgium, No. 100,357, dated July 2, 1892, and in England, No. 12,256, dated July 1, 1892,) of which the following is a specification.

My invention relates to an apparatus designed for freezing bodies of water of comparatively extended area and limited depth, and it has the following distinctive characteristics in construction and operation: First. The sheet of ice is frozen on an elevated platform forming the bottom of a shallow, lead-lined tank, and is surrounded by a channel with sloping sides, filled with open water which intervenes between it and the sides of the tank all around. Second. The water is uniformly circulated or caused to flow while being frozen, in order to maintain a nearly uniform temperature. Third. The pipes through which the refrigerant liquid circulates are arranged in flat, serpentine coils, raised a little above the surface of the tank-bottom, and the sheet of ice, which embeds them, rests upon the bottom of the tank. Fourth. The outlets and inlets of the several coils are so arranged that the outlets of adjacent coils will be side by side and the inlets of adjacent coils will be also side by side, the object being to avoid abrupt differences in temperature in adjacent pipes of the coils.

The invention will be fully described hereinafter and its novel features carefully defined in the claims.

In the accompanying drawings which serve to illustrate the invention—Figure 1 is a longitudinal section, Fig. 2 a transverse section, and Fig. 3 a plan of an apparatus embodying my improvements.

In carrying out my invention, a shallow, level tank or basin, of the proper area, is constructed as follows: A bed of concrete, X, is laid on the ground and over this is built a covering, F, of wood, bricks of agglomerated materials, or the like. Over the covering F, and forming an inner lining for the tank, is a continuous covering of sheet lead, G. This covering or lining may be made of sheets carefully soldered together at their edges to guard against leaks. About the margin of the tank is a channel E, which extends entirely around the thus elevated central portion of the bottom of the tank on which the bed of ice is to be formed, and has sloping sides; exterior to this channel, the margin, *c*, of the tank is raised above the level of the said elevated central portion of the tank-bottom. Supported on the bottom of the tank, but elevated a little above its general surface, are the flat coils through which the liquid refrigerant flows. To allow free expansion and contraction of the tubes during congelation, whatever may be the temperature of the liquid in them, the container for the refrigerant is divided up into independent coils, A, A′, $A^2$, $A^3$, $A^4$ and $A^5$, the number of the coils depending somewhat on the extent of the surface to be frozen. Each coil consists of a metal pipe or tube so bent that it consists of straight parts lying side by side and connected in series by circular bends, so that, when seen in plan, the coil is serpentine. These coils lie side by side in the same horizontal plane and extend transversely of the oblong tank as herein shown in such a manner as to be equally distributed over the elevated portion of the bottom. The liquid refrigerant, of any known kind, which circulates through the coils, enters the latter at the several extremities, $a'$, $a^2$, $a^3$, $a^4$, $a^5$, and passes out of the same at the respective opposite extremities thereof, $b'$, $b^2$, $b^3$, $b^4$ and $b^5$. The inlets connect with a main supply pipe, C, and the outlets connect with a main discharge pipe D. With this construction it will be readily understood that each coil is perfectly free to elongate or bend during the congelation, and that whatever may be the temperature of the refrigerant, the pipes C and D are free to expand and contract lengthwise, as they extend at right angles to the straight portion of the coils.

In order to obtain a perfectly level and uniform sheet of ice, the inlets and outlets of the coils are arranged symmetrically in such a manner that, as far as possible, the inlets of adjacent coils, as $a'$ and $a^2$, shall be side by side, and the outlets of adjacent coils, as $b^2$

and $b^3$, shall be side by side, the pairs of inlets and outlets thus alternating, as seen in Fig. 3. This arrangement of the coil-inlets and outlets avoids the necessity of reversing the flow of the liquid through the coils, as between any two contiguous pipes of the coils there will be no material difference of temperature. The liquid entering each coil will be at its lowest temperature and its temperature will gradually rise as the liquid flows through the coil, being slightly higher at the outlet; so, by placing inlets side by side and outlets side by side, abrupt differences of temperature at points near together are avoided. I prefer to employ a serpentine coil with several U-shaped elements or parts, as shown in Fig. 3, but the number of bends in the coil is not essential to the attainment of good results. The pipes or tubes C and D are situated exterior to the tank, and the inlet and outlet pipes of the coils are bent, as seen in Fig. 2, so as to pass over the elevated margin, *c*, thereof and do not pass through said margin. This is done to avoid leaks. The pipes C and D may be placed in a sort of trough of concrete so that they can be covered with or embedded in non-conducting material. The area covered by the coils is limited to the elevated bottom of the tank, and the water in the deep channel E is not frozen, whereby the sheet of ice, O, seen in Figs. 1 and 2, is left free at its edges, all around and detached from the margin of the tank. The strains on the tank from expansion of the ice are thus avoided. The ice embeds the coils, as shown in these figures and rests on the tank-bottom; there will be no water under it.

There will be one or more inlets, *x*, for supplying water to the tank. I have herein shown four of these inlets, one at each corner of the tank and opening into the channel E. Four inlets are not essential, but are convenient when the tank covers a considerable area. When the surface of the sheet of ice has become roughened or cut up, the water may be admitted at the inlets *x* and allowed to rise high enough to flood it and renew its surface.

The arrangement which provides a channel of open water about the sheet or block of ice prevents the formation of cracks in the latter, avoids injury to the pipes of the coils and reduces to a minimum all liability to deformation either of the tank, the sheet of ice, or the surface of the latter.

In order to obtain a sheet of ice with a perfectly plane surface it is important not only to be able to regulate the temperature of the liquid refrigerant circulating through the coils, as explained, but also to be able to maintain near approach to uniformity in the temperature of the water in which the coils are submerged. To attain this end I freeze the water while it is flowing; that is to say, in place of submerging the coils in a tranquil body of water, I impart to the water which envelops the coils a methodical circulation or flow, similar to that in a river, the flow being transversely to the straight pipes of the coils, by preference. This circulation of the water is effected by means of a pump, P, placed at one end or side of the tank and having its suction or inlet connected with a perforated pipe, *z*, which is submerged in the water in the channel E. The discharge or delivery of the pump is connected by pipes *p*, with a pipe *m*, at the end or side of the tank opposite to the pump, and this pipe *m* is provided with numerous ajutages, *n*. These regularly spaced ajutages, taken in connection with the transversely extending, perforated pipe *z*, provide a substantially equal circulation and flow of the water throughout the entire width of the sheet of ice. The circulation of the water should be kept up until the ice is of the desired thickness.

Having thus described my invention, I claim—

1. In an apparatus for forming a bed of ice with a smooth, uniform surface, the combination with a shallow tank, of a series of flat coils of pipe arranged on the bottom of the tank for the liquid refrigerant, to flow through, and the pipes C and D, connected therewith, the inlets of the adjacent coils being arranged side by side and the outlets of adjacent coils also arranged side by side, substantially as and for the purpose set forth.

2. In an apparatus for the purpose specified, the combination with a shallow tank, of a series of flat coils arranged side by side in the bottom of the tank and each formed of a single pipe with a U-shaped bend or bends; and the pipes C and D, to which the terminals of the coils are connected as described, the inlets of the adjacent coils being side by side and the outlets of adjacent coils being also side by side, as and for the purpose set forth.

3. In an apparatus for the purpose specified, the combination with a shallow tank having a deep channel E, for water extending entirely around it, as set forth, of the coils for the liquid refrigerant arranged entirely within the space surrounded by said channel, whereby the bed or sheet of ice formed about and embedding said coils is wholly disconnected from the margin of the tank and rests upon the bottom of the latter, as and for the purposes set forth.

4. In an apparatus for the purpose set forth, a shallow tank with a deep channel E, extending entirely around it at the sides and ends, said tank comprising a concrete bed, X, a covering, F, on said bed, and a continuous lining, G, of sheet lead, as set forth.

5. In an apparatus for the purpose set forth, the combination with the shallow tank, having a margin *c*, which rises above its bottom, and a deep channel E, for water extending around it within the margin, whereby the tank-bottom is elevated above the bottom of the said channel, of the flat coils for the liquid refrigerant, supported on the bottom within the space surrounded by the channel, said

coils being elevated slightly above the tank-bottom so that they will be wholly encompassed by the bed of ice formed in the tank, and means for supplying water to the tank.

6. The combination with the shallow tank having the deep channel E, and the coils for the liquid refrigerant arranged within the space surrounded by said channel, as described, of the pump P, arranged at one end of the tank, the discharge pipe *m* at the opposite end of the tank, and the pipes, connecting the pump with said pipes *m*, whereby a uniform circulation from one end to the other of the tank is effected, as set forth.

7. An apparatus for forming a bed of ice with a smooth, uniform surface, comprising a shallow tank having a deep channel about its margin, flat coils of pipe arranged on the bottom of the tank within the space surrounded by said channel, means for maintaining a continuous flow of a refrigerant liquid through said coils, and means for causing water to flow in a continuous, uniform sheet over and among said coils, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

EDOUARD DE STOPPANI.

Witnesses:
ROBT. M. HOOPER,
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