

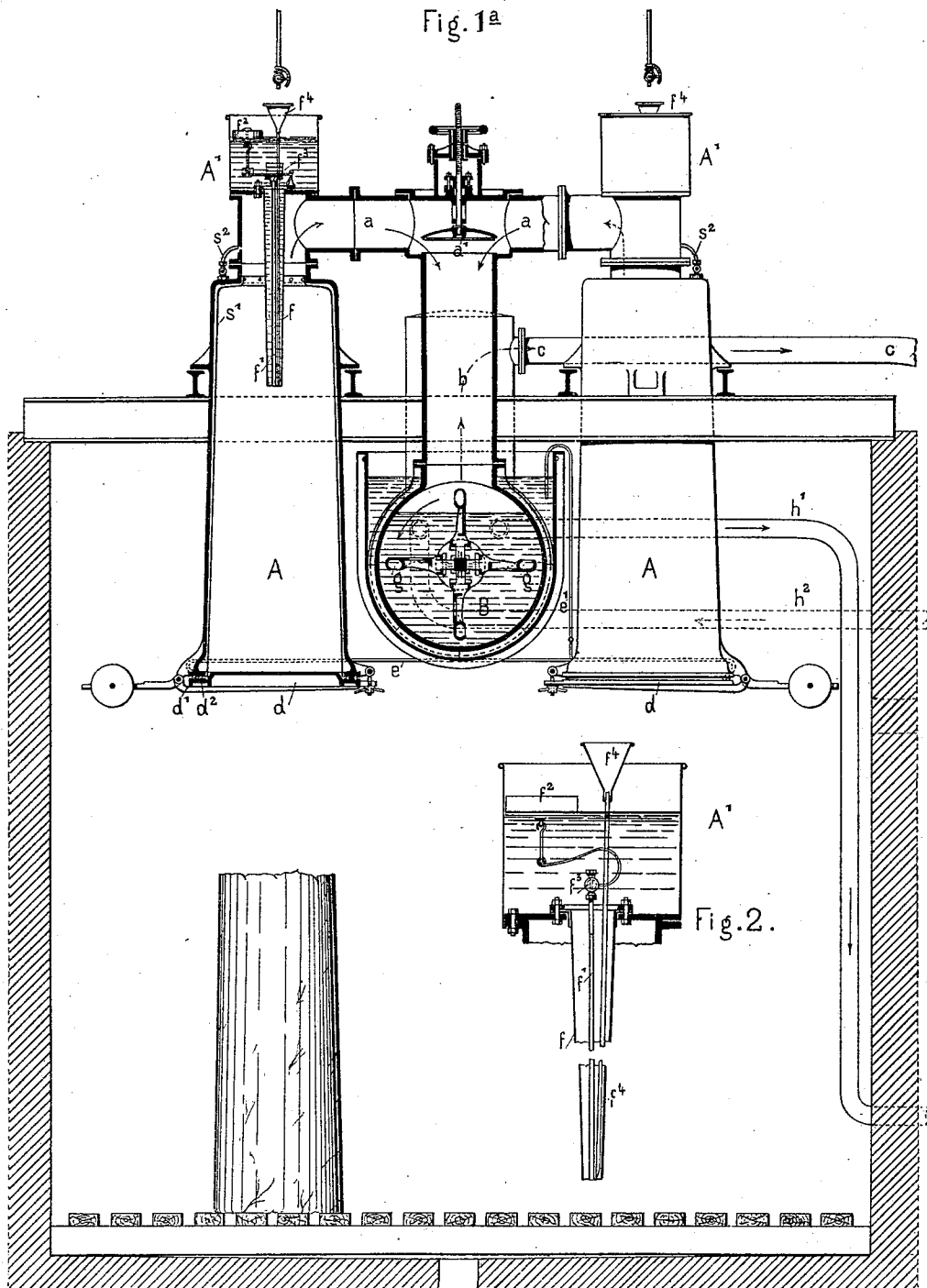
(Model.)

2 Sheets—Sheet 1.

FRANZ WINDHAUSEN.
Ice Making Machine.

No. 236,471.

Patented Jan. 11, 1881.



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Geo. T. Smallwood Jr.
Walter Allen

Inventor

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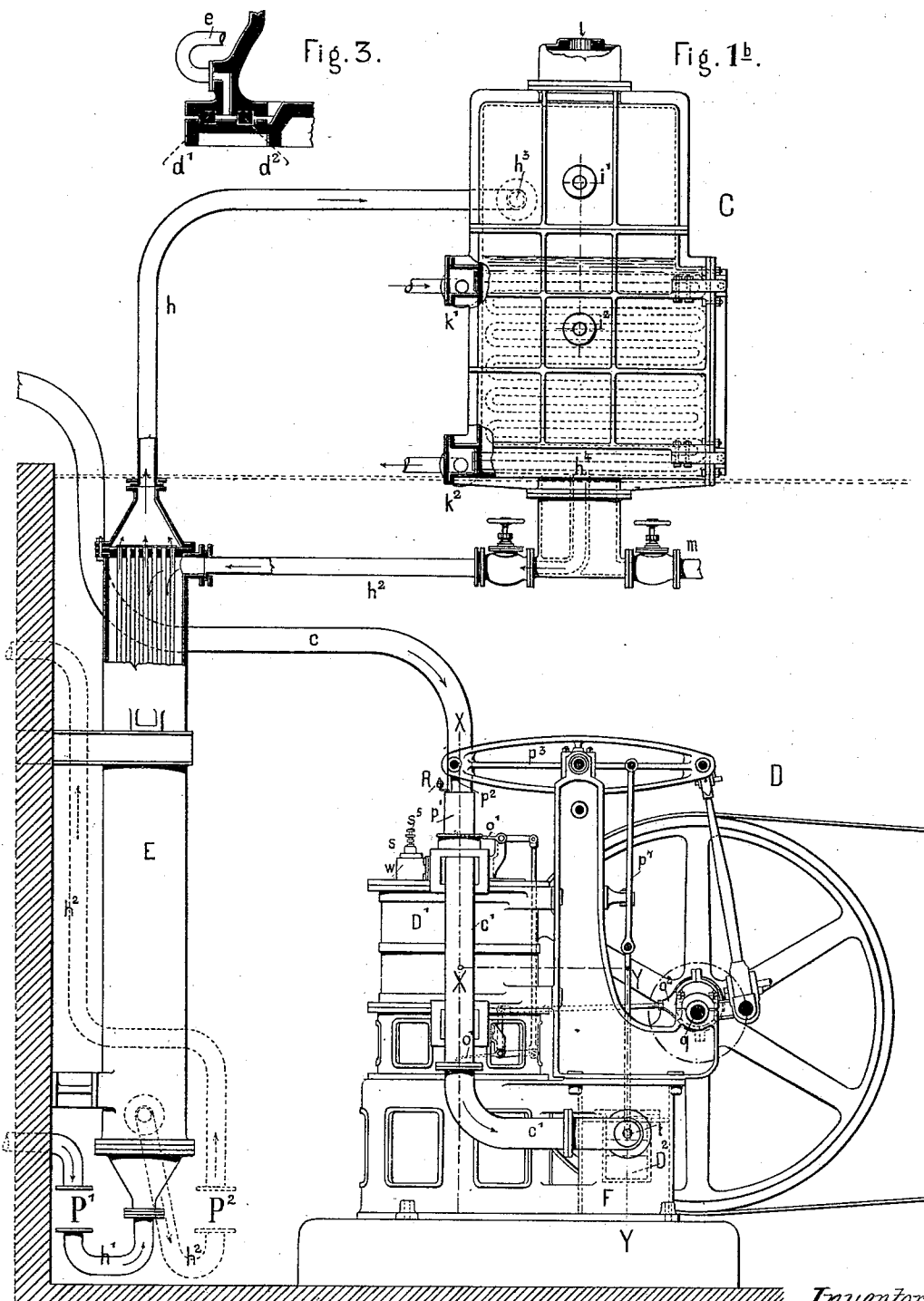
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UNITED STATES PATENT OFFICE.

FRANZ WINDHAUSEN, OF BERLIN, GERMANY, ASSIGNOR TO FRANZ
HERMANN EGELLS, OF SAME PLACE.

ICE-MAKING MACHINE.

SPECIFICATION forming part of Letters Patent No. 236,471, dated January 11, 1881.

Application filed November 4, 1880. (Model.) Patented in England April 25, 1878, in Italy June 30, 1879, in France April 1, 1878, in Austria October 23, 1878, in Germany December 14, 1877, in Spain August 30, 1879, in England May 11, 1880, and in Belgium May 14, 1880.

To all whom it may concern:

Be it known that I, FRANZ WINDHAUSEN, of Berlin, Prussia, Germany, engineer, have invented new and useful Improvements in Ice-Making Machines, of which the following is a specification.

The machine is based on the principle of the generation of cold by the evaporation of water in a vacuum. The same is represented on the annexed two sheets of drawings by Figures 1^a and 1^b, which are to be considered as parts of one figure. Figs. 2 and 3 represent details on a larger scale.

A A are the vessels in which the ice is to be produced; B, an absorbing-vessel containing sulphuric acid; C, an apparatus for reconcentrating the acid as it is becoming diluted by absorption of vapor; D, an air-pump, and E an apparatus for warming the acid on its way from B to C by means of the concentrated and hot acid flowing in the contrary direction from C to B.

The vessels A, or refrigerators, are, by preference, arranged in two rows, one on either side of the absorber B. The refrigerators placed opposite to each other communicate, by means of the pipes *a* and *b*, with the absorber, a valve, *a'*, allowing such communication to be interrupted without disturbing the other refrigerators of the series. The absorber is connected by pipe *c* with the air-pump D, which is, by preference, a compound pump of my invention, consisting of two co-operating pumps of different capacity, and provided with a condenser, as is described in the specification of a special patent application. By means of this pump an almost perfect vacuum is maintained in the refrigerators, and at the same time the greater part of the vapor generated from the water within them is extracted by the said pump and condensed, whereas the residual vapor is absorbed by the sulphuric acid.

The refrigerators A are vessels of cylindrical or other suitable form, slightly tapering toward the top, so that the block of ice formed within them may more easily become loose and fall out. They are closed at the bottom by covers *d*, hinged on one side, and provided

with means for securely fastening them, and with a packing adapted to produce a perfectly air-tight joint. Each vessel has an inside case or lining, *s'*, between which and the wall of the vessel there is a narrow space communicating with a steam-pipe, *s*². The purpose of this arrangement will be explained hereinafter.

The water which is to be converted into ice is introduced into the refrigerator from a vessel, A'. (Shown on a larger scale in Fig. 2.) From this vessel a tube, *f*, closed at its lower end, and by preference conical, extends into A. Through the tube *f* a narrow pipe, *f'*, passes, whose lower open end is fixed in the bottom of *f*, whereas its upper end carries a cock or valve, *f*³, provided with a float, *f*². *f*⁴ is a pipe extending nearly to the bottom of *f*, or cut off slanting at its lower end, so as to provide for a free outlet, whereas its upper end is funnel-shaped, so that it may receive the water running from the supply-pipe. (Shown in Fig. 1.) This water, which will have a temperature varying between about 45° and 75° Fahrenheit, descends through pipe *f*⁴, rises in *f*, and thereupon flows through pipe *f'* in a thin stream into the refrigerator. In consequence of the described arrangement, the water surrounding the pipe *f'* will, on account of its being comparatively warm, prevent the formation of ice in this pipe, whereas if the said pipe were carried directly into the refrigerator it would soon be stopped up by ice. The cock or valve *f*³ is closed by the float *f*² whenever the water-level in A' sinks, whereby this cock is always kept submerged and air prevented from entering by *f'* into the refrigerator. The water flowing into the vessel A spreads out on the bottom *d* and freezes as it loses heat from evaporation. A solid block of ice is thus gradually formed, filling out the whole vessel to the height which may be considered desirable, or to its very top. The cover *d* being thereupon opened, the ice drops out of the vessel, or, in case it should adhere to the wall of the same, steam is admitted by the above-mentioned steam-pipe *s*² into the space between the inside lining, *s'*, of the ves-

sel and its outer wall, whereby the block is quickly caused to become detached.

As an important part of the refrigerator is to be considered the packing of the cover d . (Shown in detail in Fig. 3.) The same consists of two undivided rings or strips, d' and d'' , of india-rubber or other suitable packing material, partly sunk into grooves wrought into the bottom flange of the vessel A, or into the cover d , or otherwise attached to the same. The space between the rings d' and d'' communicates, by means of a pipe, e , with a water-reservoir, in this case by the branch pipe e' with the water-reservoir surrounding the absorber B. Whenever there is the slightest lack of tightness of the inside packing-ring, d'' , water will be sucked into the space between the rings or strips d and d'' as soon as the refrigerator is put in communication with the pump. Every possibility of an entrance of air across the packing is by these means excluded.

The absorber B consists, according to the drawings, of a horizontal cylinder partly filled with sulphuric acid, and within which a shaft provided with arms g rotates. These arms serve to stir the acid, and continually to mix the surface portion, as it absorbs moistures, with the more concentrated portion at the bottom. The arms g , especially when made spoon-shaped, as shown by drawings, carry up acid along with them, and thus promote the absorption of vapor. The absorber is provided with a water-jacket, by means of which the acid, which would otherwise become hot by the absorbing process, is kept cool. For the purpose of maintaining the acid at the highest possible degree of concentration it is continuously drawn from the absorber and delivered at h^3 into the concentrating apparatus C by means of a pump arranged at P' , but not shown in the drawings, and by the pipes h' h'' . On its way it passes upward through a series of small pipes inside of the apparatus E, where it is warmed by the hot concentrated acid surrounding the said pipes in E and flowing in the contrary direction. The acid arriving in the concentrating apparatus at h^3 is heated by steam, having, by preference, a tension of two atmospheres or above. This steam enters at h' into a series of serpentine tubes, while the condensed water is allowed to flow off or to be returned to the boiler by a tube attached at h^2 . At i^2 a gage-glass and instruments for indicating the temperature and the degree of concentration of the acid may be fixed. Within the apparatus a vacuum is maintained by the air-pump D, or another similar pump, the connecting-pipe of which is attached at l . By means of such vacuum the acid is caused to boil at the temperature imparted to it by the steam circulating in the heating-tubes, and to evaporate the water which it has absorbed in B, the vapor or steam thus generated being extracted and condensed by the air-pump. The concentrated acid flows off at h^4 , and is conducted by pipe h^2 into the apparatus E, where it fills the spaces between the

tubes, through which the acid from B passes upward. The concentrated and hot acid is thus cooled by giving up its heat to the weaker and cold acid, and is thereupon pumped back into the absorber by a pump placed at P^2 , but also not represented in the drawings, and by the pipe h^2 . (Shown by dotted lines.) The valve m serves to empty the apparatus C when required.

All parts of the apparatuses B, C, and E which are in contact with acid, and the pipes by which they communicate with each other, must be made of or lined or covered with a material incorrodible by the acid. As such material, lead is preferred. It may, however, be observed that cast-iron is also almost incorrodible by sulphuric acid when such acid is concentrated.

Considering that the compound air-pump D, which I have invented, is adapted to extract the vapor from the refrigerators A, even without the aid of the absorber B, the latter may be dispensed with, if desired. The whole process of concentration of the sulphuric acid is in such case also done away with. Certainly a machine of this kind will not be as efficient as when provided with the absorber B, and the cost of producing ice by means of the same will be higher. Nevertheless it may be preferred when simplicity of arrangement is considered an essential feature. On the other hand, an ordinary air-pump may be used instead of my improved compound pump when the absorber is employed; but the efficiency of the machine will in this case also be reduced.

It is obvious that the machine may be used for cooling water without freezing it by admitting a sufficiently large quantity of the same into the refrigerators and drawing it off before it is converted into ice. Also, liquids whose freezing-point lies very low can be cooled by the machine to a temperature below the freezing-point of water, so that they may serve as a freezing medium.

With regard to the refrigerators, it is yet to be mentioned that their shape and the arrangement of their details may be modified without departing from the nature of the invention. They may, for instance, be constructed in the form of rectangular boxes with a door in front, this door being provided with the packing described in the foregoing. Moreover, when thus designed, they may be fitted with shelves on which troughs containing the water to be frozen are placed.

I claim as my invention—

1. In an ice-making machine, the combination of the refrigerator or hermetically-closed vessel A with the compound air-pump D, as and for the purpose described.

2. In combination with the refrigerator A, when operating together with an air-pump, the reservoir A' , the pipes f , f' , and f^4 , a cock or valve, f^3 , and float f^2 , as and for the purpose hereinbefore described.

3. In combination with the refrigerator A, the packing of the door d , consisting of two

rings or continuous strips of india-rubber or other suitable packing material, between which water is admitted, substantially as described.

5 4. The combination with the refrigerator A, operating together with an air-pump, of the absorber B, containing sulphuric acid, and of the concentrating apparatus C, heated by steam-pipes and connected with an air-pump, as described, and for the purpose stated.

5. The combination, with the refrigerator A, 10 a suitable air-pump, the absorber B, and the concentrating apparatus C, of the tubular apparatus E, substantially as and for the purpose specified.

FRANZ WINDHAUSEN.

Witnesses:

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BERTHOLD ROE.