E. F. FISHER.

REFRIGERATING APPARATUS.

APPLICATION FILED OCT. 8, 1919.

1,415,828. Patented May 9, 1922.

Fig. 1.

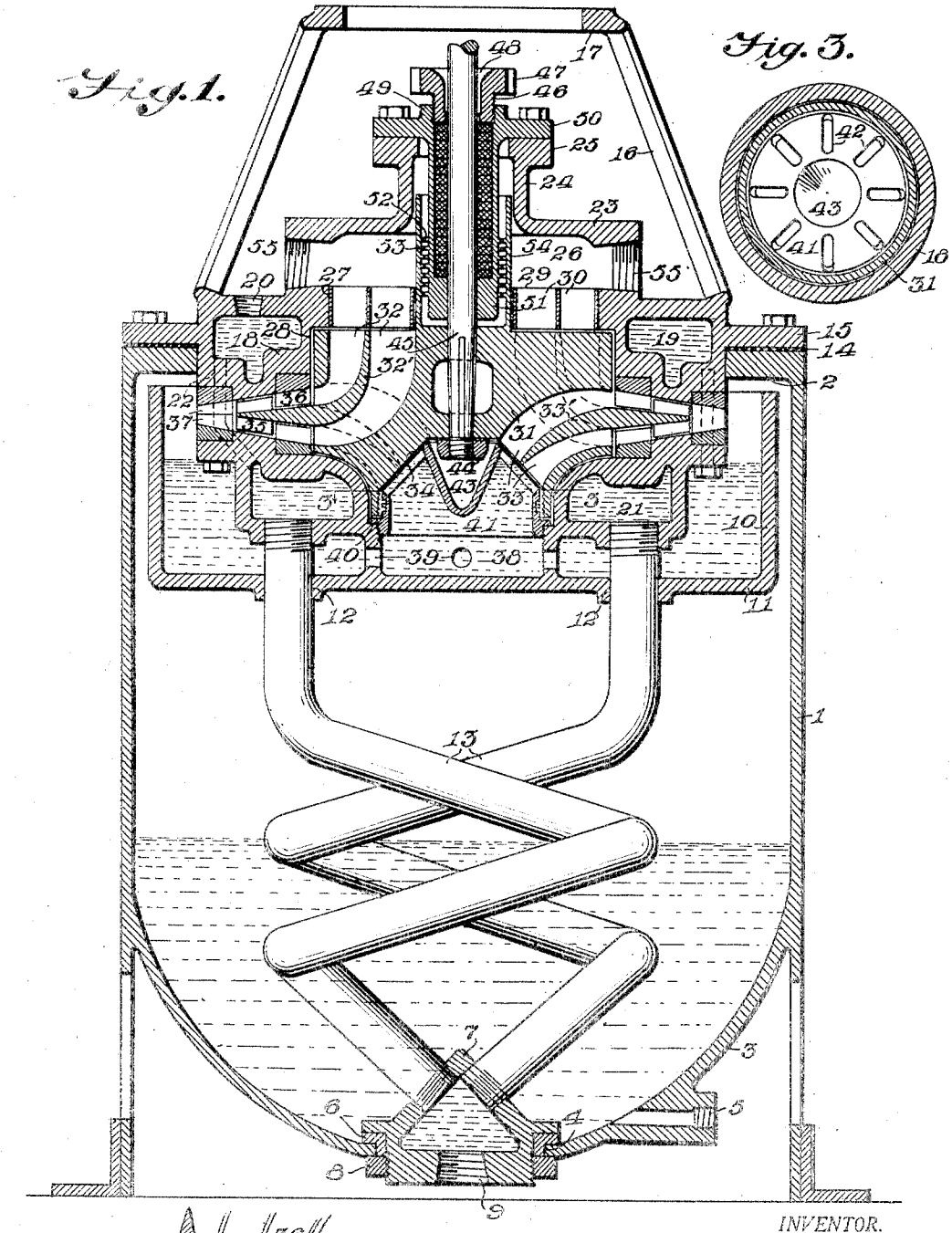
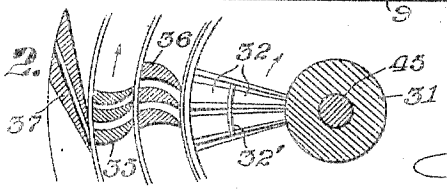


Fig. 3.

Fig. 2.



INVENTOR.
Ernest F. Fisher,
BY
J. Stuart Freeman,
ATTORNEY.

UNITED STATES PATENT OFFICE.

ERNEST F. FISHER, OF ESSINGTON, PENNSYLVANIA.

REFRIGERATING APPARATUS.

1,415,828. Specification of Letters Patent. Patented May 9, 1922.

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To all whom it may concern:

Be it known that I, ERNEST F. FISHER, a citizen of the United States, residing at Essington, in the county of Delaware and State of Pennsylvania, have invented certain new and useful Improvements in Refrigerating Apparatus, of which the following is a specification.

The object of this invention is to provide an improved refrigerating apparatus, which can be made and used in units of widely varying sizes, from that required for small compact domestic installations, to those designed to satisfy the requirements of hotels, restaurants, and cold-storage plants.

In this invention the cooling temperatures are obtained by rapidly evaporating a suitable readily volatilized liquid, such as ammonia, ethyl-chlorid, sulfur-dioxid, or the like, after which the generated vapor, having accomplished its heat-absorbing function, is thereupon liquefied by subjecting to its critical pressure at the available temperature.

This alternative vaporization and liquefaction, continuing in regular and infinitely repeated cycles, effects a system of refrigeration which is noted for its high efficiency in operation and extremely low cost of maintenance, as there is to all intents and purposes no deteriorization in the cooling agent, and therefore substantially the only cost is in providing motive power to operate the apparatus.

Another object of the invention is to provide an improved centrifugal compressor unit, comprising revolvable concentric circular series of nozzles stepped in diminishing cross-sectional areas as they progress radially outwardly, said series having interposed between them a similar concentric series of stationary blades, and a stationary concentric series of compression nozzles through which the outermost series of said revolving blades discharges the vaporized refrigerant into an annular surrounding compression chamber.

And a further object is to provide a compressor unit of the foregoing characteristics, and in addition thereto the combination of a series of conduits comprising a centrifugal fan and leading from the upper portion of the central hub portion of the said unit downwardly and thence radially outwardly to the point where they discharge at spaced intervals in a plane quantities of the vaporized refrigerant, with a second series of spaced channels in said hub portion comprising a centrifugal pump and leading from the lower portion upwardly and thence radially outwardly between said first channels and to the point where these latter channels discharge quantities of a suitable sealing liquid in a plane common with said first plane and both vapor and liquid being thence projected into a concentric series of adjacent relatively stationary nozzles.

This sealing liquid which effects a sealing of the gaps between the adjacent portions of the relatively movable elements of the device, and which possessing a higher specific gravity than the cooling vapor, operates as a series of liquid pistons under the centrifugal force imparted to it by the compressor unit to accelerate the passage of said vapor through the same, quite similar to the manner in which the spaced bodies of mercury in a Sprengel gas-pump in falling convey between them quantities of gas otherwise difficult to draw from a chamber being vacuated against the atmospheric pressure outside.

With these and other objects in mind, the improved apparatus comprises numerous details of construction and operation fully brought out in the following description when read in conjunction with the accompanying drawings, in which Fig. 1 is a vertical diametrical section of one embodiment of the invention; Fig. 2 is an enlarged diagrammatic sectional view showing the relation between the movable and stationary blades; and Fig. 3 is a section on the line 3—3 of Fig. 1.

Referring to the drawings, a container 1 is provided at its uppermost periphery with an inwardly directed flange 2, and at its bottom closed by a cup-like bottom wall 3, having a centrally positioned aperture 4 and a laterally directed internally threaded aperture 5 extending from one side of the lower portion of said bottom wall. Secured within said first aperture is a gasket 6, having a central bore and through which is made to extend a hollow union 7, having a downwardly projecting threaded end portion secured firmly in position by means of a nut 8 and provided with a threaded centrally positioned aperture 9.

Suspended within the upper portion of said container in a manner hereinafter described is a cylindrical baffle-wall 10 in spaced relation with the sides of said container, and closed at the bottom by a horizontally extending wall 11 provided with spaced apertures 12, through which extend the upper end portions of a pair of tubular coils 13 secured at their lower ends with the union 7. The upper surface of the flange 2 is covered by a gasket 14, upon which is secured a flanged portion 15 of an upwardly extending open frame 16, provided at the top with horizontally extending members 17, upon or above which an electric motor (not shown) or other source of power may be positioned.

The flanges 15 extend radially outwardly from a member 18, having an annular water-cooling chamber 19 in its upper portion with an outlet 20 leading therefrom, and in its lower portion with an annular water-cooling chamber 21 into which the coils 13 lead, and said chambers being connected by means of one or more circulating channels 22. The member 18 is provided with an upwardly extending portion 23 surrounded by a neck 24, in turn ending in upwardly and outwardly extending flanges 25, while the portion 23 is provided with an annular channel 26 opening downwardly through an enlarged aperture 27 into the hollow chamber portion 28 of the member 18.

The aperture 27 is partially closed by means of a suitable spider 29, having peripherally and radially spaced apertures 30, which may be said to act as a series of stationary nozzles for a purpose hereinafter described. Revolvably mounted within the chamber 28 is a rotor 31, comprising a centrifugal fan and a hydraulic pump, and having spaced channels 32 extending from immediately below and in alignment with the nozzles 30 downwardly, and thence radially outwardly in a general horizontal plane, while said rotor is also provided between said first channels with similarly shaped spaced channels 33, extending upwardly through a concaved recess 34 in the bottom of the rotor, and thence radially outwardly in a horizontal plane coincident with said first plane, so that these two series of channels form a continuous set of nozzles, adapted when the device is in operation to discharge fluids therefrom radially in a horizontal direction.

Separating the channels 32 of each pair, and also separating each of the channels of the lower pairs 33, are walls 32′ and 33′, which extend beyond the radially outer surface of said rotor to form a continuous outwardly tapering disc-like projection, which carries upon its outermost periphery a series of upwardly and downwardly extending blades 35, forming between them nozzles of less cross-sectional area than the cross sections of the nozzles formed by the termination of the channels 32 and 33. The member 18 then is provided with oppositely positioned blades 36, immediately above and below the mid-sections of the outer portions of the extensions of the partitions 32′ and 33′, and said last-named partitions are positioned in direct alignment with and between the outer end portions of said channels 32 and 33 on the inner side, and the blades 35 on the outer side, and the nozzles formed between consecutive blades being in cross-sectional area midway between those of the blades 35 and the said outlets of the said channels.

Finally, the member 18 has secured in the outer periphery thereof, and centrally disposed in alignment with the disc-like extension of the partitions 32′—33′, a series of stationary nozzles 37, into which the nozzles between the blades 35 discharge directly, and are of such cross-section that together with the cross-sectional areas of the nozzles hereinbefore described, a continuously narrowing peripheral annular series of nozzle-channels is provided, which constantly decrease in size as they progress outwardly.

That portion of the member 18 inclosing a water-cooling chamber 21 is connected with the wall 11 by means of an annular wall 38 provided with spaced apertures 39, and terminating upwardly in a shoulder 40, upon which rests an upwardly tapering member 41 provided with upwardly extending spaced elongated apertures 42 opening directly into the channels 33, said member at its uppermost portion being provided centrally with a downwardly and inwardly positioned cup-shaped section 43 secured in the member 41 and within which is positioned a nut 44 secured upon the tapered end portion of the shaft 45.

Said shaft at its uppermost end portion extends through a gland nut 46, having an upper radially directed flange 47, and centrally hollowed out to provide a recess 48 to receive and hold a lubricant. Said plug is adjustably screwed into a cylinder 49, which by means of an annular flange 50 is secured to the flange 25 formed upon the member 18, while said cylinder is provided with downwardly extending relatively thin walls, closed at their lowermost end portion by a relatively deep wall 51, centrally apertured to provide a journal bearing for the shaft 45, while the walls of said cylinder inclose suitable packing adjustably secured in position by the said plug 46.

The walls of the lower portion of the cylinder 49 are also provided with spaced annular radially extending flanges 52, which are in alignment with and but slightly spaced from similar flanges 53 formed upon

the inner surface of the relatively cylindrical portion 54 extending upwardly from and forming an integral part of the rotor 31.

In the operation of this device, a fresh cold-water connection is made to the aperture 9 in the bottom of the container 1, and means is provided to drain said water from the aperture 20 after the same has performed its function of cooling the interior of the device. A tube is connected to the aperture 5 also in the lower portion of said container, and extends to an expansion valve (not shown) and thence to the cooling coils within the particular chamber which the device is arranged to cool, said cooling coils (also not shown) terminating at their opposite ends in the intake apertures 55 in the upper portion of the member 18.

The container 10—11 is then filled with a suitable sealing fluid substantially to the point indicated, and a condensed refrigerant is entered to any desired height within the container 1 and surrounding the cooling coils 13 upon which the refrigerant after being vaporized and compressed again condenses. The motor or other driving means is then set into motion, revolving the shaft 45 and parts directly secured thereto, including the rotor 31 and blades 35. The sealing fluid, before starting the motor, having extended upwardly into the channels 33, is flung upwardly and outwardly therefrom by means of centrifugal force through the nozzles formed between the stationary blades 36, then again caught by the rapidly rotating blades 35 and with constantly increased energy projected through the nozzles 37, where said fluid is caught by the baffle-wall 10 and drops by gravity again towards the bottom wall 11 of the container therefor.

As the spaced bodies of the sealing fluid progress outwardly through the constantly tapering channel of nozzles, they create a suction by decreasing the pressure within the channels 32, 26 and the cooling coils connected thereto, thus vaporizing the condensed refrigerant which passes from the bottom of the container 1 at a predetermined relatively slow speed through the aperture 5 and expansion valve connected thereto. The vaporized refrigerant being caught between the spaced bodies of the sealing fluid is drawn outwardly through the channel of nozzles, and, separating from the said fluid adjacent to the baffle-wall 11, passes upwardly and over the same at greatly increased pressure, which causes the vapor to condense upon the coils 13 and return by gravity to the bottom of the container 1.

With the increased pressure of the vapor and likewise the pressure upon the condensed liquid refrigerant, there is obviously a generation of heat both in the container 1 and also in and about the parts of the member 18, this heat, however, being dispelled by virtue of the cooling water passing through the coils 13 and water-cooling channels 21 and 19. And before the vaporized refrigerant enters the rotor channels 32, it is first drawn into the stationary nozzles 30 from the distributing channel 26 and by said first channels conveyed in separate streams towards and in substantial alignment with the said rotor channels. Then it is readily obvious how the centrifugal pump channels draw the sealing fluid from below, whence both gas and fluid are discharged from the rotor in a common plane into the adjacent concentric series of stationary nozzles.

Having thus described my invention, what I claim and desire to protect by Letters Patent of the United States is:—

1. In a refrigerating apparatus, a vessel provided centrally with a chamber formed between apertured walls rising from the bottom of said vessel, a portion of said walls spreading laterally and enlarged and hollow to form a peripheral chamber for a cooling liquid, a member having an inlet and secured to the peripheral portion of said walls and hollow to provide a chamber for a cooling liquid and connecting with the chamber in said walls, a member provided with outwardly tapering nozzles interposed between said walls and said member, and a unit revolvable in alignment with said nozzles and positioned between said walls and said member, and having alternately positioned channels adapted to convey a gas from the inlet in said member, and to convey a liquid from said first chamber, and to discharge said gas and liquid in alternately positioned quantities into the respective nozzles of said interposed member.

2. In a refrigerating apparatus, a vessel provided centrally with an upstanding cylindrical apertured wall forming a chamber, said wall being provided with an annular shoulder to form a seat, a hollow member resting upon said seat and provided with a centrally positioned cup-shaped portion surrounded by spaced apertures, said wall being directed outwardly and enlarged to form an annular hollow chamber to contain cooling liquid, an annular member having an inlet and enlarged to form a hollow chamber to contain cooling liquid in communication with said last-named chamber, an annular member interposed between the adjacent portions of said wall and said member and provided with spaced apertures forming nozzles, and a revolvable unit positioned between said first wall and said first annular member and provided with alternately positioned channels discharging in a common plane into said nozzles, and operative to con-

vey respectively a gas from the said inlet and a liquid from said first chamber through the spaced apertures in said first member.

3. In a refrigerating apparatus, a vessel, a centrally positioned apertured cylindrical wall internally threaded and having an annular shoulder forming a seat within said vessel, a hollow member in threaded engagement with said wall and resting upon said seat, and having an apertured conical surface, a second apertured member fixed with respect to said first member, and a rotary member also within said vessel provided with channels alternately co-operating with the apertures in said member and in the conical surface of said first member and movable in close proximity to said surface as a bearing.

In testimony whereof I have affixed my signature.

ERNEST F. FISHER.